Pavement Management Guide

October 18, 2021



Prepared by the Pavement and Geotechnical Division of the Office of Materials Technology



ADMINISTRATION

Foreword

The Pavement Management Guide was written to document the procedures followed by the pavement management engineers and technicians of the Maryland Department of Transportation State Highway Administration (MDOT SHA) Pavement Management (PM) Section for pavement data processing and analysis to support MDOT SHA's System Preservation efforts.

All the position titles described throughout this guide are referenced to MDOT SHA positions and roles. As such, a current organizational chart for the PM Section was also included in the <u>MDOT-SHA Organization</u> of this guide to assist the readers with understanding the organizational structure within the PM Section.

A vast majority of the MDOT SHA's pavement management functions are performed by engineers and technician staff in the PM Section of the Pavement and Geotechnical Division (PAGD) of the Office of Materials Technology (OMT). The Team Leaders and Assistant Division Chief are responsible for the quality and timeliness of all the pavement management functions for the Division. Other data collection divisions within OMT also support the pavement management functions of the Comparement functions.

MDOT SHA has adopted a policy of continuous improvement when managing data quality. Infrastructure condition measurements are used to support data-driven decision making which maximizes the return on public investment. As technology advancements are implemented, both current data and historic data are managed to provide both accuracy and consistency by storing and re-processing historic raw data within current protocols, to the extent feasible considering prior technology limitations. Data analysis procedures are continuously updated as and when more data becomes available, thereby facilitating improved decision making. This document is actively managed to reflect the latest pavement data collection, pavement data quality management and pavement data analysis procedures that are followed by MDOT SHA.

Any questions or comments concerning this guide should be directed to:

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1 **OVERVIEW**

1.01 INTRODUCTION

This Maryland Department of Transportation State Highway Administration (MDOT-SHA) Pavement Management (PM) Guide provides a comprehensive set of standard operating procedures (SOPs) designed to assist in conducting different processes involved in the collection, processing, analysis and reporting of PM data. These data directly support MDOT-SHA's pavement asset management program, including all data development, analysis, and any state or federal reporting efforts, including the Highway Performance Monitoring System (HPMS) deliverables, among other applications.

The set of SOPs contained in this guide includes procedures related to the production and submittal of data to the FHWA HPMS as well as other procedures related to the production of pavement management data to support the strategies and goals defined by the MDOT-SHA. This guide is a living document. The contents will be updated and new procedures will be added as they become available.

Each SOP document includes the following five elements: (i) general aspects of the SOP; (ii) frequency of the SOP; (iii) purpose of the SOP; (iv) resources required to perform the SOP; and (v) procedural steps to perform the SOP. The latter SOP element includes the Quality Control (QC) and Quality Assurance (QA) processes performed to check that the data collected and processed at each step have acceptable quality. The definition of QC and QA used in this document follow the definitions used internally by MDOT-SHA staff: QC refers to the quality checks performed by the personnel involved in conducting the process whereas QA refers to the independent quality checks performed by personnel not involved in conducting the process.

The materials contained in the Guide are meant to be useful for both the training of new employees and as a reference to be utilized as needed throughout the course of work. This is a resource document. It is not intended to override or replace the necessary use of good judgment, common sense, and research of current best practices. The audience for whom the Guide was written should have a basic background and general understanding of pavement management, as well as knowledge of the technical skills required for the position and function of the specific SOP.

The following two sections of this Overview chapter provide general information on the Maryland Department of Transportation (MDOT) divisions related to the SOPs included in this Guide, as well as the organization of the document and a description of the relationship among SOPs. The remaining chapters of the document contain the set of PM SOPs grouped by the PM process stage they belong to.

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1.02 MDOT-SHA ORGANIZATION

The MDOT divisions relevant to the SOPs contained in this Guide are shown in Figure 1. The MDOT-SHA and the Maryland Transit Authority (MDTA) are sub-divisions of the MDOT Secretary. The MDTA is responsible for the administration of toll facilities, among other responsibilities. The MDOT-SHA is responsible for the administration of the majority of high volume public highways in Maryland outside Baltimore City. The MDOT-SHA is also responsible for the collection, processing, analysis and reporting of pavement management data on sections administered by other offices, such as the MDTA's toll roads.

The SOPs in this guide relate to both planning and operations work done by respective offices and divisions. The planning efforts which relate to highway inventory management and HPMS reporting are conducted by the Innovative Performance Planning Division (IPP), the Data Services Division (DSD), and the Data Governance Division (DGD). The IPP group is responsible for the submittal of the MDOT data Quality Management Plan to meet requirements from item §490.319(c) of the FHWA's third final rule^{06/12/2019} for national performance management measure regulations. The DSD is responsible for the highway inventory management and the annual submittal of the HPMS data to the FHWA. The DGD is responsible for hosting and managing several of the databases referenced in the SOPs of this document. The Highway Development group is responsible for the development of major projects. Within the Operations branch of MDOT-SHA, the Office of Materials Technology (OMT) is responsible for the field data collection efforts, pavement management, and pavement design. The other offices within the Operations branch provide more tangible components of asset management, including project development, construction and maintenance.





As noted in the organizational breakdown above, the PM section of MDOT-SHA is a subgroup of the Pavement and Geotechnical Division (PAGD), located at the OMT. The PM section of the PAGD, along with the Field Explorations Division (FED), handle many pavement data collection activities, all pavement data processing and analysis responsibilities, and several reporting functions which support MDOT-SHA business plan goals and performance measures.

The Field Explorations Division (FED) is responsible for all pavement field data collection activities. Along with daily data collection, the FED handles equipment calibration, validation, verification, maintenance, and QC/QA of the collected data. The procedures contained in this version of the Guide pertain to data collection activities relating to the Automatic Road Analyzer (ARAN) and skid trailers.

The PM section of the PAGD consists of several teams with defined roles in the pavement management process. Figure 2, shown below, summarizes the various teams and their place in the PM section of the PAGD.



Figure 2: Pavement Management Section Organization

The following list provides a brief description of the roles and responsibilities of the different PM teams, focusing on the processes included in the SOPs of this version of the Guide:

- The Data Processing Team (DPT) is responsible for the processing, updating, managing, developing, and QC/QA of construction data and of the condition data collected in the field by the FED.
- The Data Warehouse Team (DWT) is mainly responsible for the management of PM databases and the integration of data with databases administered by others. It provides support to other PM teams to facilitate the production and processing, quality control, analysis, and reporting of data.
- The Data Analysis Team (DAT) is mainly responsible for the analysis of pavement management data. This includes the projection of the pavement network condition, the optimization of maintenance and rehabilitation strategies, as well as the reporting of pavement management data, including State-wide public reports and state reporting and subsequent federal reporting by planning divisions. The DAT also provides protocol development, outlier review, and any re-processing of historic data as new protocols emerge.

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1.03 MDOT-SHA PM GUIDE ORGANIZATION

The Guide has several sections of interest, representing the many different stages of PM. These include the following:

- The section on <u>Planning</u> provides guidance on the annual planning and updating of inventory information for the list of sections to collect pavement surface condition data with the ARAN survey vans (ARAN Collection List) and skid trailers (Skid Collection List).
- The section on <u>Field Data Collection</u> provides guidance on field testing requirements, equipment calibrations, validation, verification, and maintenance, related to the collection of pavement surface condition data with the ARAN survey vans and skid trailers.
- The section on <u>Construction Data</u> provides guidance on the collection, importing and processing of construction data from various data sources necessary to support PM activities.
- The section on <u>Data Processing</u> provides guidance on the processing and management of the different data elements collected in the field by the ARAN survey vans and skid trailers.
- The section on <u>Data Migration</u> provides guidance on the updating of performance data tables and migration to various data formats.
- The section on <u>HPMS Data Reporting</u> provides guidance on the updating, formatting, and reporting of data to the FHWA's HPMS.
- The section on <u>Trend Analysis</u> provides guidance on the annual updating of pavement condition metric performance models to be used in the optimization of targeted projects, among other applications.
- The section on <u>Optimization</u> provides guidance for the entry of required inputs and generation of the yearly targeted projects list.
- Several <u>Appendices</u> are provided for reference.

Figure 3 and Figure 4 provide a summary of the processes, databases, elements, and procedures which make up the pavement management SOPs described in this document. Figure 3 is an overall summary of database production, beginning with the inventory list received from the DSD and ending with the generation of the optimized targeted projects list. The white trapezoids denote databases; the arrows between the databases indicate the flow of data throughout the PM process; and the colored boxes group the databases together by the stage in which they are produced or utilized (e.g., Planning stage).

Figure 4 is provided to visualize the order and stage of each of the SOPs included in this version of the Guide, as well as the relationship between the different SOPs. Each white circle indicates a stage of pavement management. The rectangles which branch off from the stages are individual SOPs developed for the completion of the particular stage. The dotted lines which surround various stages denote the frequency with which they are performed.

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Figure 4: MDOT-SHA PM Guide SOPs Flowchart

2 **PLANNING**

Click to go to <u>Update of HMIS Tables</u> Click to go to <u>Production of Annual Section Table</u> Click to go to <u>Production of ARAN Collection List</u> Click to go to <u>ARAN Collection List QA</u> Click to go to <u>Production of Skid Collection List</u>



Figure 5: Planning Flowchart

This section describes the set of standard operating procedures (SOP) used by staff from the Data Warehouse Team (DWT) of the Maryland Department of Transportation State Highway Administration's (MDOT-SHA) Office of Materials Technology (OMT) to produce the annual lists of highway segments in the network to be collected by the Field Explorations Division team. The SOPs included in this version of the guide focus on the production of the Automatic Road Analyzer (ARAN) Collection List and the Skid Collection List. The ARAN Collection List consists of the routes on which data are to be collected using the ARAN survey vans for the upcoming year. The Skid Collection List consists of the routes on which data are to be collected using the skid trailers for the upcoming year.

The first step in the planning process is to update the Highway Management Information System (HMIS) tables using the annual inventory data provided by the Data Services Division (DSD). The next stage in the process consists of processing the DSD inventory data to create the ARAN Collection List. This stage includes three SOPs: the production of the Section Table, the production of the Collection List, and, lastly, the QA checks of the annual ARAN Collection List. Following the finalizing of the ARAN Collection List, a procedure is followed to create the Skid Collection List. These tasks are to be completed before the commencement of the data collection season.

2.01 UPDATE OF HMIS TABLES

2.01.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Warehouse Team (DWT) to update the HMIS_UNIVERSE and HMIS_MASTER tables based on the Data Services Division's (DSD) latest inventory data. This section also includes the quality control (QC) processes to check that the updated Highway Management Information System (HMIS) tables are correctly processed and stored. The procedure documented in this section is the first step of the Pavement Management (PM) planning stage.

2.01.02 Frequency

The two HMIS tables in question are updated once a year, after the DSD releases its annual inventory list tables, which generally happens around June.

2.01.03 Purpose

The purpose of this SOP is to populate the HMIS_UNIVERSE and HMIS_MASTER tables with data from the DSD's annual inventory list. The two tables serve as the basis for the Pavement and Geotechnical Division (PAGD) annual inventory update and creation of the collection lists for the upcoming data collection season.

2.01.04 *Resource Requirements*

The updating of HMIS tables involves two people: (1) a DWT member knowledgeable in database management, the two HMIS tables, and the DSD's ARCHIVE tables and, (2) a supervisor who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the updating of the tables and perform the QC checks. These time estimates assume that no issues are detected during the QC checks. The actual level of effort required will increase if the number of issues to address during QC increases.

Position	Function	Resources	Effort Level (man-hrs)
DWT Staff	Database Management	1	2.0
DWT Team Leader (TL)	Supervisor	1	AR ^{06/12/2019}

2.01.05 *Procedure*

The procedure to update the two HMIS tables using the Pavement Data Warehouse (PDW) program and perform QC is comprised of the following two tasks:

- (1) updating of HMIS Tables, and
- (2) performing QC of the updated tables.

1- Updating of HMIS Tables – *performed by DWT member*

Summary: This task uses the PDW program to update the HMIS_UNIVERSE and HMIS_MASTER tables.

Step 1. Start PDW program and click on "Analysis", then "HMIS_Annual_Update." The "HMIS Annual Update" input box will appear on the screen (see below image). The "Year" field in the input box is defaulted to the current year minus one (each year the DSD releases inventory data corresponding to the previous year).

🖳 HMIS Annual Update				
Please Select a Update	Ī	•	Year 2016	T
Function:				
Procedure:				
Schema:				
Table to be Updated	:			
F	Perform Annual Update		Close]

Step 2. From the drop-down menu list in the "Please Select a Update" field, select "HMIS_UNIVERSE/MASTER." The detailed information required for updating the HMIS tables will then appear on the input box. This information includes the "Procedure" name, the appropriate "Schema," and the "Tables to be Updated" (see below image).

🖳 HMIS Annual Update	
Please Select a Update	HMIS_UNIVERSE/MASTER Vear 2016
Function:	To populate master and universe and add them to ALL_YEARS table. Make sure tables ARCHIVE.UNIV2016 and ARCHIVE.MAST2016 exit.
Procedure:	POPULATE_MAST_UNIV (P_YEAR)
Schema:	PAV_CONHIST @ ASSET_NEW
Table to be Updated:	HMIS_UNIVERSE_ALL_YEARS and HMIS_MASTER_ALL_YEARS
Р	erform Annual Update Close

- Step 3. Using Oracle SQL Developer, check whether ARCHIVE.UNIV[YEAR] and ARCHIVE.MASTER[YEAR]^{06/12/2019} exist or not.
 - i. If they do exist, proceed to Step 4.
 - ii. If they do not exist, stop and wait until the DSD is done creating its latest inventory data before updating the HMIS tables.
- Step 4. Click the "Perform Annual Update" button of the input box. The procedure POPULATE_MAST_UNIV will be run automatically in the background.

- i. If no errors occur during the importing of the DSD data, a message will appear on the screen indicating the completion of the procedure once it is done. If so, proceed to Step 6.
- ii. If errors occur during the importing of the DSD data, a message will appear on the screen indicating that the procedure cannot be completed. If so, proceed to Step 5.
- Step 5. If errors occur during the importing of the DSD data in Step 4, then debug the POPULATE_MAST_UNIV procedure using the Oracle SQL Developer to find the location(s) in the code producing the error. Once issue(s) producing errors have been identified, modify the POPULATE_MAST_UNIV code accordingly, until the procedure can be run without errors.

2- Performing QC of Updated Tables – performed by DWT member

Summary: This task performs QC checks of the updated tables to correct any errors that may have occurred during the update.

- Step 6. Once the HMIS tables are created, perform the following QC checks to confirm that the DSD inventory data for the latest year have been correctly populated into the HMIS_UNIVERSE_ALL_YEARS and HMIS_MASTER_ALL_YEARS tables.
 - i. Completeness check Using Oracle SQL Developer, check that the number of records for the updated HMIS_UNIVERSE_ALL_YEARS and HMIS_MASTER_ALL_YEARS tables are similar to the number of records in the same tables for the previous year.
 - ii. Validity check Using Oracle SQL Developer, check that:
 - 1. Values inputted in the updated HMIS tables are within the expected range for the field. For example, lane width values should consist of positive values not greater than 20 feet.
 - 2. Amount of missing values is not excessive.
- Step 7. If the updated HMIS tables pass the QC checks, then the tables are perform inspection acceptable. detailed Otherwise, а of the POPULATE MAST UNIV procedure using Oracle SQL Developer to identify and to resolve the issue(s) preventing successful completion of the QC checks in the previous step. Issues to look for include changes in the field names of the inventory list (with respect to the previous year's list) and missing data elements. Once the cause(s) of the issue(s) has/have been identified, modify POPULATE MAST UNIV procedure accordingly and regenerate the HMIS tables. Repeat Step 6 and Step 7 until the HMIS tables generated pass all QC checks.
- Step 8. Notify other members of the team that the HMIS_UNIVERSE_ALL_YEARS and the HMIS_MASTER_ALL_YEARS tables have been correctly updated.

2.02 PRODUCTION OF ANNUAL SECTION TABLE

2.02.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Warehouse Team (DWT) to produce and to quality control (QC) the annual Section Table. This table contains roadway inventory data for the entire Maryland Department of Transportation State Highway Administration (MDOT-SHA) highway network, which are extracted from the Data Services Division (DSD) inventory data tables in the format and structure required to meet the Pavement and Geotechnical Division (PAGD) needs.

2.02.02 Frequency

The Section Table is generated once per year, after the HMIS_UNIVERSE and HMIS_MASTER tables are updated with the annual DSD inventory data (see <u>Update of HMIS Tables</u>).

2.02.03 Purpose

The purpose of this SOP is to generate the Section Table using the annual DSD inventory data, as contained in the HMIS UNIVERSE and MASTER tables. The Section Table serves as the primary information source for producing the Automatic Road Analyzer (ARAN) Collection List, which contains the complete set of sections to be surveyed in the current year.

2.02.04 *Resource Requirements*

The production and QC of the Section Table involves two people: (1) a DWT member knowledgeable in database management and, (2) a supervisor who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the production of the Section Table and perform the QC checks. These time estimates assume that no issues are detected during the QC checks. The actual level of effort required will increase if the number of issues to address during QC increases.

Position	Function	Resources	Effort Level (man-hrs)
DWT Staff	Database Management	1	40.0
DWT Team Leader (TL)	Supervisor	1	AR ^{06/12/2019}

2.02.05 Procedure

The procedure to produce and QC the Section Table is comprised of the following two tasks:

- (1) producing the Section Table, and
- (2) performing QC of the Section Table.

1- Producing the Section Table – *performed by DWT member*

Summary: This task uses Oracle SQL Developer to produce the Section Table from the updated HMIS Tables.

Step 1. Using the Oracle SQL Developer, verify that the HMIS_UNIVERSE AND HMIS_MASTER tables have been correctly updated with the annual DSD

inventory data for the current year. If not, update the tables following the procedure described in <u>Update of HMIS Tables</u>.

Step 2. Run SECTION_TABLE_PROP_PKG package to produce the initial version of the Section Table.

2- Performing QC of the Section Table – performed by DWT member

Summary: This task performs QC checks of the created Section Table to correct any errors that may have occurred during the production by comparing mileage of the network and mileage of specific sections to the previous year.

- Step 3. Total mileage check: using the Oracle SQL Developer, compare the total mileage of the initial Section Table version to the total mileage of the same table for the previous year.
 - i. If the difference in total mileage is not greater than 100 miles, then the Section Table generated for the current year is acceptable and no further checks are required – proceed to Step 5. The 100 miles allowance is intended to account for the addition of highway sections from one year to the next, minor processing errors, and other factors. This value represents less than 1% of the total highway network managed by the MDOT-SHA.
 - ii. Otherwise, proceed to Step 4.
- Step 4. Individual route mileage check using the Oracle SQL Developer, compare the mileage for the individual routes in the initial version of the Section Table to the mileage for the same individual routes in the Section Table for the previous year. The difference in mileage for each individual route should not exceed 10%. Otherwise, inspect the SECTION_TABLE_PROP_PKG package to identify issue(s) that may explain the large differences in mileage for the individual routes. Possible issues to look for when inspecting the code include the presence of duplicate records and incorrect mainline codes. The mainline code is used to classify the road mileage of the inventoried road into mainline, interchange ramps, service roads, couplet, and others. The two possible outcomes from the inspection are:
 - i. If no issues are detected in the code that explain the large difference in mileage for a specific route, look for additional information that may explain the difference. A possible source of information for this is the "Change Log" published by the DSD as part of their inventory lists. This log contains the differences in DSD's inventory data with respect to the previous year's list.
 - ii. If issues are detected in the code, modify the code as appropriate until the difference in total mileage between the Section Table produced for the current year and the one for the previous year is less than 100 miles.
- Step 5. Once the QC checks have been passed, name the final version of the resulting table as SECTION_TABLE and store it in the PAV_CONHIST user within the ASSET_NEW database.

2.03 PRODUCTION OF ARAN COLLECTION LIST

2.03.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Warehouse Team (DWT) to produce and to quality control (QC) the Automatic Road Analyzer (ARAN) Collection List. This list contains the routes on which data are to be collected using ARAN survey vans, as part of the annual field data collection season. The ARAN Collection List is produced from the current year's Section Table (see <u>Production of Annual Section Table</u>).

2.03.02 Frequency

The ARAN Collection List is produced annually, after the final version of the Section Table for the current year has been generated.

2.03.03 Purpose

The purpose of this standard operating procedure (SOP) is to produce the ARAN Collection List from the current year's Section Table generated using the <u>Production of Annual Section Table</u>. The list is used by the Field Explorations Division (FED) to plan their annual ARAN data collection.

2.03.04 *Resource Requirements*

The production and QC of the ARAN Collection List involves two people: (1) a DWT member knowledgeable in database management and, (2) a supervisor who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the production of the ARAN Collection List and perform the QC checks. These time estimates assume that no issues are detected during the QC checks. The actual level of effort required will increase if the number of issues to address during QC increases.

Position	Function	Resources	Effort Level (man-hrs)
DWT Staff	Database Management	1	40.0
DWT Team Leader (TL)	Supervisor	1	AR ^{06/12/2019}

2.03.05 *Procedure*

The procedure to produce and QC the ARAN Collection List is comprised of the following three tasks:

- (1) producing the Initial ARAN Collection List,
- (2) performing QC of the Initial ARAN Collection List, and
- (1) replacing Initial Section Table GPS Data with ARAN GPS Data.

1- Producing the Initial ARAN Collection List – performed by DWT member

Summary: This task uses Oracle SQL Developer to produce the Initial ARAN Collection List from the Section Table.

Step 1. Using the Oracle SQL Developer, check that the Section Table for the current year exists in the PAV_CONHIST user in the ASSET_NEW database. If it

does not, follow the procedure described in <u>Production of Annual Section Table</u> to produce the Section Table before starting the generation of the ARAN Collection List.

Step 2. Run the ARAN_COLLECTION_LIST_PKG package to produce an initial version of the ARAN Collection List. The procedures contained in this package define the location of the starting and ending mile-points for each network route by aggregating the sections within each route in the Section Table.

2- Performing QC of the Initial ARAN Collection List – performed by DWT member

Summary: This task performs QC checks of the created Initial ARAN Collection List to correct any errors that may have occurred during the production by comparing mileage of the network to the previous year.

- Step 3. Once the initial version of the ARAN Collection List has been created, use the Oracle SQL Developer to compare the resulting total mileage to the mileage from the previous year's ARAN Collection List.
 - i. If the difference in mileage is less than 100 miles, then the initial version of the ARAN Collection List is acceptable proceed to Step 5.
 - ii. Otherwise, proceed to Step 4.
- Step 4. If the difference in total mileage between the current and last year's ARAN greater Collection List is than 100 miles, inspect the ARAN COLLECTION LIST PKG package to identify the issues that are causing the difference in mileage. Once the issues have been identified, modify the package as appropriate and generate another version of the ARAN Collection List. Apply the QC check described in the previous step to the new version of the list. Repeat this process until the resulting ARAN Collection List passes the QC check in Step 3.

3- Replacing Initial Section Table GPS Data with ARAN GPS Data – performed by DWT member

Summary: This task replaces initial Section Table GPS data with GPS data from the ARAN survey vehicles and results in the submittal of the final version of the ARAN Collection List.

Step 5. The inventory data for each highway section in the initial version of the ARAN Collection List are extracted from the Section Table, which, in turn, contains the inventory data released by the Data Services Division (DSD). The GPS data contained in the initial version of the list are replaced with GPS coordinates measured by the Maryland Department of Transportation State Highway Administration (MDOT-SHA) ARAN survey vehicles and reviewed by the Data Processing Team (DPT) staff during the previous year's data collection season^{06/12/2019}. This step is performed by running the UGS_VISION_MATCHED_EXPORT_PKG package from the Oracle SQL Developer. Manual entry of GPS coordinates may also be required in this step

for locations where the GPS data have been obtained through ad-hoc communications with the DPT staff based on the results of their ARAN data processing procedures.

Step 6. Submit the final version of the ARAN Collection List with updated GPS data to the personnel involved in the quality assurance (QA) of the ARAN Collection List.

2.04 ARAN COLLECTION LIST QA

2.04.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Processing Team (DPT) and the Data Warehouse Team (DWT) to perform quality assurance (QA) of the Automatic Road Analyzer (ARAN) Collection List before the list is submitted to the Field Explorations Division (FED). The QA is applied to a version of the ARAN Collection List that incorporates Global Positioning System (GPS) data from the previous year's ARAN data collection.

2.04.02 Frequency

The QA of the ARAN Collection List is performed annually, once a version of the ARAN Collection List with revised GPS data has been produced.

2.04.03 Purpose

The purpose of this SOP is to perform QA of the ARAN Collection List to confirm, prior to actual data collection, that the (1) routes on the list are feasible for data collection and (2) location and inventory information on the list is accurate and complete.

2.04.04 *Resource Requirements*

The QA of the ARAN Collection List involves three people: (1) a DPT member knowledgeable in inventory data collection for the Maryland Department of Transportation State Highway Administration (MDOT-SHA) highway network, (2) a DWT member knowledgeable in database management and, (3) a supervisor who, as required, provides guidance and decision-making. The inventory data expert's (IDE) primary role is to identify possible errors in inventory data and to ensure that routes on the list are feasible for data collection. The database management expert's (DBME) primary role is to produce updated versions of the ARAN Collection List based on the IDE's review. The estimated effort levels in the table below represent the total time, in man-hours, to complete the QA of the ARAN Collection List. These time estimates assume that no issues are detected during the QA checks. The actual level of effort required will increase if the number of issues to address during QA increases.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	Inventory Data Expert	1	4.0
DWT Staff	Database Management	1	8.0
DWT Team Leader (TL)	Supervisor	1	AR ^{06/12/2019}

2.04.05 *Procedure*

The procedure to perform QA of the ARAN Collection List is comprised of two tasks:

- (1) checking feasibility and accuracy of data collection routes, and
 - (2) checking inclusion of revised GPS data.
- 1- Checking Feasibility and Accuracy of Data Collection Routes performed by IDE from the DPT and DBME from the DWT

Summary: This task is performed to confirm that the routes defined by the ARAN Collection List are feasible for data collection and only homogeneous inventory data features are contained within the section limits. Another important element of this first check is confirming that the routes on the list can accommodate multiple collection runs when required^{06/12/2019}.

- Step 1. IDE: open initial version of ARAN Collection List. The list is received by IDE via email as a spreadsheet in MS Excel file format, and it is named "ARAN_Collection_[FISCAL_YEAR]_[DATE]"^{06/12/2019}.
- Step 2. IDE: using initial version of ARAN Collection List spreadsheet, search for systematic errors concerning the feasibility and accuracy of the data collection routes, especially at locations where systematic errors are often identified. If systematic errors are identified, report these errors to DBME for remedial action.
- Step 3. DBME: modify ARAN_COLLECTION_LIST_PKG package to account for the systematic errors detected by the IDE (if any). Re-run the package and inspect the output list until the systematic errors detected by the IDE are no longer present. Re-submit updated version of the ARAN Collection List to the IDE.
- Step 4. Repeat Step 1 to Step 3 until the IDE does not identify further inventory errors on the ARAN Collection List produced by the DBME.
- **2- Checking Inclusion of Revised GPS Data** performed by IDE from the DPT and DBME from the DWT

Summary: This task is performed to confirm that the updates made to the GPS data during last year's processing of ARAN collected data (conducted following <u>Production</u> <u>of ARAN Collection List</u>) are incorporated into the present year's ARAN Collection List.

- Step 5. IDE: locate lists of revised GPS data that resulted from corrections performed to the ARAN Collection List coordinates during last year's data processing.
- Step 6. IDE: randomly select a location with revised GPS data and confirm that GPS coordinates in the initial version of the ARAN Collection List for the selected location match the coordinates on the revised GPS list. Typically, the IDE checks approximately 10 locations with revised GPS data. If the coordinates do not match, report discrepancy to DBME for remedial action.
- Step 7. DBME: inspect UGS_VISION_MATCHED_EXPORT_PKG package and modify accordingly to incorporate revised GPS coordinates, which were not included in the initial version of the ARAN Collection List, as reported by the IDE. Re-run the package and inspect the GPS coordinates in the output list until the reported discrepancies identified by the IDE are no longer present. Re-submit updated version of the ARAN Collection List to the IDE.
- Step 8. Repeat Step 5 to Step 7 until the IDE is able to confirm that the revised GPS data have been incorporated into the ARAN Collection List.

Step 9. Once the checks have been completed and the modifications required by the IDE have been addressed, submit final version of ARAN Collection List to the FED.

2.05 PRODUCTION OF SKID COLLECTION LIST

2.05.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Warehouse Team (DWT) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to produce and to quality control (QC) the "Skid Collection List." This list contains the routes on which skid data are to be collected using the two MDOT-SHA owned skid trailers^{06/12/2019}, as part of the field data collection program. Skid collection is performed on a two-year cycle, and therefore the list of routes is similar on alternating data collection years. The "Skid Collection List" is produced from the current year's "ARAN Collection List" (see <u>Production of Skid Collection List</u>).

2.05.02 Frequency

The "Skid Collection List" is produced annually by the MDOT-SHA DWT staff, after the final version of the ARAN Collection List for the current year has been generated.

2.05.03 Purpose

The purpose of this SOP is to produce the "Skid Collection List" from the current year's "ARAN Collection List" generated using <u>Production of Skid Collection List</u>. The list is used by the Field Explorations Division (FED) of the MDOT-SHA to plan their annual skid data collection program.

2.05.04 *Resource Requirements*

The production and QC of the "Skid Collection List" involves the following two MDOT-SHA staff members: (1) a DWT staff member knowledgeable in database management and, (2) a DWT supervisor – typically the DWT Team Leader (TL) – who, as required, provides guidance and decision-making. The estimated effort levels shown in the table below represent the total time, in man-hours, to complete the production of the "Skid Collection List" and to perform the QC checks. These time estimates assume that no issues are detected during the QC checks. The actual level of effort required will increase if issues are identified during the QC checks.

Position	Function	Resources	Effort Level (man-hrs)
DWT Staff Member	Database Management	1	4.0
DWT TL	Supervisor	1	As Required ^{06/12/2019}

2.05.05 Procedure

The procedure used to produce and to QC the "Skid Collection List" is comprised of the following two tasks:

- (1) production of the "Skid Collection List," and
- (2) QC of the "Skid Collection List."

1- Production of the "Skid Collection List" – *performed by DWT staff member*

Summary: This task uses Oracle SQL Developer to produce the "Skid Collection List" from the "ARAN Collection List."

- Step 1. Using Oracle SQL Developer, check that the "ARAN Collection List" for the current year exists. If it does not, follow the procedure described in <u>Production of ARAN Collection List</u> to produce the "ARAN Collection List" before starting the generation of the "Skid Collection List."
- Step 2. Using Oracle SQL Developer, run the statement provided in <u>Skid Collection</u> <u>List SQL Statement</u> to produce the "Skid Collection List."

2- QC of the "Skid Collection List" – *performed by DWT member*

Summary: Under this task, QC checks of the "Skid Collection List" are performed to correct errors that may have occurred during the production. These checks are done by comparing the network mileage included in the current year's list to the network mileage from two years ago. Since skid data collection is performed on a two-year cycle, the list of routes and hence network mileage is similar on alternating data collection years; i.e., every other year. For example, the mileage included in the "Skid Collection List" created in 2018 should be compared to the mileage included in the "Skid Collection List" created in 2016.

- Step 3. Once the "Skid Collection List" has been created, use Oracle SQL Developer to compare the resulting total network mileage to the total network mileage from the "Skid Collection List" from two years ago.
 - i. If the difference in total mileage is less than 100 miles, then the "Skid Collection List" is acceptable, and the process is complete.
 - ii. Otherwise, proceed to Step 4.
- Step 4. If the difference in total mileage is greater than 100 miles,
 - i. Inspect the SQL statement to identify the issues that are causing the difference in mileage.
 - ii. Once the issues have been identified, modify the statement as appropriate and generate another version of the Skid Collection List.
 - iii. Apply the QC check described in the previous step to the new version of the list.
 - iv. Repeat this process until the resulting Skid Collection List passes the QC check in Step 3.

3 FIELD DATA COLLECTION

Click to go to <u>ARAN Pre-Data Collection Actions</u> Click to go to <u>ARAN Data Collection</u> Click to go to <u>ARAN Data Collection</u> Click to go to <u>ARAN Post-Data Collection Actions</u> Click to go to <u>ARAN Preventive Maintenance</u> Click to go to <u>ARAN Test Loop Data Collection</u> Click to go to <u>ARAN Test Loop Data Collection</u> Click to go to <u>Test Loop Data Analysis</u> Click to go to <u>Skid Pre-Data Collection Actions</u> Click to go to <u>Skid Data Collection Actions</u> Click to go to <u>Skid Post-Data Collection Actions</u> Click to go to <u>Skid Data Collection</u> Click to go to <u>Skid Mater Calibration</u> Click to go to <u>Skid Force Calibration</u> Click to go to <u>Skid Test Loop Data Collection</u>



Figure 6: Field Data Collection Flowchart

This section describes the set of standard operating procedures (SOP) conducted by staff from the Field Explorations Division (FED) of the Maryland Department of Transportation State Highway Administration's (MDOT-SHA) Office of Materials Technology (OMT) to perform field data collection activities and quality control (QC) and quality assurance (QA) of pavement data. The SOPs contained in this version of the guide focus on the calibration, validation and daily data collection activities for the Automatic Road Analyzer (ARAN) survey vans and skid trailers.

The daily data collection activities are divided into six SOPs: ARAN Pre-Data Collection Activities, ARAN Data Collection, ARAN Post-Data Collection Activities, Skid Pre-Collection Activities, Skid Data Collection, and Skid Post-Data Collection Activities. These SOPs describe the tasks required from the beginning of the data collection day to the final shut down of the survey van, and include all quality checks conducted throughout the different daily activities.

This section contains four SOPs related to the calibration and the validation of measurements of the ARAN survey vans. The first is a procedure for calibrating the ARAN's Distance Measuring Instrument (DMI) once a month and involves the adjustment

of the DMI measurements to bring their accuracy and precision to the target standard. The second SOP is a procedure for the activities related to the annual preventive maintenance activities on the ARAN vans. This is typically performed before the start of the data collection season in which all sub-components of the vehicles are checked and corrective actions are taken, if necessary. The third SOP involves the collection of test data with the ARAN survey van along a predetermined "test loop." This is typically performed once every three weeks during the collection season to check that the quality of measurements is within acceptable standards. The fourth SOP outlines the checks performed on data collected on the test loop to validate the measuring equipment before and throughout the data collection season.

In addition, this section contains four SOPs related to the calibration and the validation of measurements of the skid trailers. The first is a procedure for calibrating the skid trailer's Distance Measuring Instrument (DMI) once a month and involves the adjustment of the DMI measurements to bring their accuracy and precision to the target standard. The second and third SOPs are procedures for the calibration of water output and force measurements. The fourth SOP involves the collection of test data with the skid trailer along a predetermined "test loop." This is typically performed once every three weeks during the collection season to check that the quality of measurements is within acceptable standards.

3.01 ARAN PRE-DATA COLLECTION ACTIONS

3.01.01 General

This section describes the standard operating procedure (SOP) followed by the Automatic Road Analyzer (ARAN) crew members of the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Field Explorations Division (FED) to perform preliminary routing, safety, and diagnostic checks prior to daily data collection using an ARAN 9000 survey van with ARAN Collection System (ACS) software Version 2.3^{06/12/2019} (hereafter referred to in this SOP as ARAN). This SOP is one of three to be utilized for daily data collection with the referenced ARAN. It is succeeded by <u>ARAN Data</u> <u>Collection</u> and then <u>ARAN Post-Data Collection Actions</u>. The pre-data collection actions covered in this SOP start from the daily route planning before data collection to the commencement of the first data collection run of the day. This procedure utilizes the ARAN Collection List (see <u>Production of ARAN Collection List</u>) for the current year.

3.01.02 Frequency

This SOP is to be performed each day of ARAN data collection, prior to the first data collection run of the day. The annual ARAN data collection season typically lasts from March to Mid-December.

3.01.03 Purpose

The purpose of this SOP is to develop an efficient routing plan for the data collection and to check the ARAN van is safe to operate and functioning properly for data collection by:

- reducing the effect of environmental factors on the quality of collected data,
- conducting vehicle-related safety checks, and
- validating the functionality of the ARAN sub-components.

3.01.04 *Resource Requirements*

The actions detailed in this SOP are to be performed by the crew of the ARAN van, which is composed of a driver and an operator. The estimated effort levels in the table below represent the total time, in man-hours, required for completion of the daily planning, safety checks, and diagnostics of sub-components. These time estimates assume adequate weather conditions and that the diagnostic checks do not produce results that require additional troubleshooting.

Position	Function	Resources	Effort Level (man-hrs)
ARAN Testing Crew	Driver	1	1.5
ARAN Testing Crew	Operator	1	1.5
FED TL or Coordinator	Supervisor	1	AR ^{06/12/2019}

3.01.05 *Procedure*

The procedure to be followed by the ARAN crew members before starting their data collection runs for the day is comprised of three tasks:

- (1) daily planning of data collection routes,
- (2) vehicle and safety checks, and
- (3) daily diagnostic checks of the ARAN sub-components.
- **1- Route Planning** *performed by driver and operator, with input from Supervisor*

Summary: This task creates a routing outline plan for the daily data collection and assesses conditions to determine whether data collection should proceed or be suspended.

- Step 1. Develop an initial routing plan outline for the day using the selected sections from the ARAN Collection List (see <u>Production of ARAN Collection List</u>) to be collected within the county and a map of the county^{06/12/2019}.
 - i. The route is selected based on several logistic and practical factors such as proximity to office, proximity to ARAN van storage location^{06/12/2019}, proximity to gas stations, and others, with the objective of maximizing the collected mileage for the day.
 - ii. The starting location for the day (first test run) is selected to minimize the impact of sunlight interference with the ARAN's forward facing camera^{06/12/2019}.
- Step 2. Assess weather conditions for the day in order to decide whether to perform or to cancel data collection. Typical weather factors affecting this decision are:
 - i. Fog, rain, snow, or ice ARAN data collection must be cancelled if there is fog, rain, snow, or ice regardless of intensity^{06/12/2019}.
 - ii. Surface wetness or ice If it is not raining or snowing, but the pavement surface is determined to be wet or icy after a visual inspection, data collection is delayed until the surface is dry^{06/12/2019}.
 - iii. Excessive winds If winds are determined to be strong enough to affect measurements^{06/12/2019}, data collection is delayed until conditions subside.

If weather considerations do not result in the cancelation or delay of data collection, proceed to Step 3.

2- Vehicle and Safety Checks – performed by driver and operator

Summary: This task performs vehicle-related safety assessments to check that the ARAN is in proper working order and safe to operate.

- Step 3. Driver: Turn on ARAN van ignition.
- Step 4. Driver: Ensure mirrors (left, right, and rear view) and seat position are properly set for safe driving.
- Step 5. Operator: Clean windshield. Remove dirt or visual obstructions using windshield cleaner so that right-of-way (ROW) images are clear.
- Step 6. Operator: Check tire pressure of all tires, including inner tires from rear axis. If pressure does not read 65 psi, adjust air (release or fill) until 65 psi is achieved on all tires^{06/12/2019}.
- Step 7. Operator: Clean inertial profilers, Laser Crack Measurement Systems' (LCMS), and grade sensors' lenses using a dry, soft rag^{06/12/2019}.
- Step 8. Driver: Check that all ARAN van lights are functioning properly. This includes beacons, hazards, turning signals, and brake lights. If any lights or beacons

are not functioning, communicate issue to Supervisor for further remedial action and suspend data collection until the issue has been resolved.

Step 9. Driver: Test that back-up alarm is functioning properly by placing vehicle in reverse and moving slightly. If the backup alarm is not functioning, communicate issue to Supervisor for further remedial action and suspend data collection until the issue has been resolved.

3- Diagnostic Sub-Component Checks – performed by driver and operator

Summary: This task runs diagnostics on the various ARAN sub-components to check that they are functioning properly for data collection.

- Step 10. Operator: Turn on power inverters using control panel on the center console and check that the inverter reading in the back of the van reads 120 +/- 3 V. If inverter reading is within tolerance, proceed to Step 11. Otherwise, turn inverter off and back on again and check new inverter's reading. If reading is still incorrect, battery level may not be adequate for data collection and further troubleshooting is required. If this occurs, communicate issue to Supervisor and suspend data collection until the issue has been solved. Please refer to the ARAN 9000 Operation Guide for further information regarding this step.
- Step 11. Operator: Power up main computer by turning the system start switch (either front control or on the AC power box) to the third position clockwise and release. Start switch will return to the second position on its own. Wait until all computers have started Windows operating system and login using proper sign-in credentials.
- Step 12. Operator: Open the ACS software by double clicking on the icon "ARAN Collection System" (see image below with icon circled in red) on the ROW desktop^{06/12/2019}.



- Step 13. Operator: Once the ACS software is open, check that the different ARAN subsystems are correctly connected by observing the icon lights on the right column of the window (see image below). If the sub-systems are correctly connected, all of the icon lights should turn green after a few seconds.
 - i. If all icons turn green, proceed to Step 14.
 - ii. If one or more icon lights remain red (as shown in the image below), identify which sub-system is not properly connected and attempt to troubleshoot issue.

For example, operator should reconnect the cables connecting the sub-system equipment to the computer, as a first step. If Operator is not able to solve the issue, he/she should contact Roadware's Technical Service for assistance. If still not able to correct issue, communicate issue to the Supervisor and suspend daily data collection until all sub-systems are properly connected.



Step 14. Operator: Click on the large "Power" button in the upper-left corner of the window (see above image). ACS main screen appears (see below image).



Field Data Collection ARAN Pre-Data Collection Actions



- Step 15. Operator: Login using proper sign-in credentials.
- Step 16. Operator: **Perform Bounce Test**. Make sure the vehicle is on a level, smooth surface (garage floor at MDOT-SHA OMT is acceptable). Click on the "Diagnostics" drop down menu from the main ACS ribbon at the top of the screen. Select "Roughness", then "Bounce Test." The test screen will appear (see below image)^{06/12/2019}.

Field Data Collection ARAN Pre-Data Collection Actions

		R	oughness Diagnostic	5		
	Block Test Bounce Test				DMI Simulation is ON	<u>Turn Off</u>
		Laser	0.000	Accelerome	ter	0.000
		F Bounce Test		<u>_</u> _×	1	
		Bounce Test				
ŧ		Follow the instructions below to p	erform the bounce test			
<u> </u>		Step 1: Park the vehicle on a flat surface	e as level as possible. With the	vehicle motionless press Start		
		Step 2: Keep the vehicle completely mot	tionless during the Static portion	on condenses enclosure vertically by 1-2		
		inches	the bounce section move the	oughness enclosure vertically by 1-2		
		Step 4: Once the Bounce portion is com bar is full	plete stop bouncing and keep	the vehicle motionless until the progress		
F					er	0.000
		Start Cancel				
				Reading static data		
		Static	Bounce	Static		
Rich						
			Can	el Back Next		

- Step 17. Operator: When ready, hit start. The progress bar on the "Bounce Test" window will begin to fill up from left to right.
- Step 18. Operator: When progress bar reaches the beginning of the "Bounce" section, instruct the driver to "start bouncing."
- Step 19. Driver: Apply pressure to the front of the vehicle, causing it to bounce^{06/12/2019}.
- Step 20. Operator: When the progress bar reaches the end of the "Bounce" section, instruct the driver to "stop bouncing."
- Step 21. Driver: Step back from the vehicle and allow the test to complete with the vehicle stationary.
- Step 22. Operator: Wait until the screen indicates that the test is complete. Click "Next." Results screen will appear (see below image). There are four component results (left-static, right-static, left-bounce, right-bounce) that will either show as **PASS** or **FAIL**, then an overall **PASS** or **FAIL** rating will also be displayed.
 - i. If the overall result is **PASS**, click Finish and proceed to Step 23.
 - ii. If the overall result is **FAIL**, click "Cancel" and return to Step 16. Repeat test up to 5 times until a passing result is achieved. If a passing result is still not achieved, communicate issue to the Supervisor and suspend daily data collection until issue is resolved.



Field Data Collection ARAN Pre-Data Collection Actions

~			Roughness Diagnostics			
E	lock Test Bounce Test				DMI Simulation is ON	<u>Turn Off</u>
		Laser	0.000	Accelerome	ter	0.000
Left		Bounce Test Bounce Test Summ The results of the Bounce Overall Bounce Test Res Static Results Left: 1.447 in/mi Pass	ary e Test ult: Pass Right: 0.914 in/mi Pass	Luits In/mi	:	
		Bounce Results Left: 7.964 in/mi Pass View IRI Graph	Right: 5.853 in/mi Pass			
Right		Save Results	e 🔽 IRI Data	Back Finish	er :	0.000

- Step 23. Driver: Drive the van from the bounce test location to an appropriate and safe location such as the parking lot of the OMT building to perform the dynamic diagnostic checks.
- Step 24. Operator: **Perform Grade Diagnostic Check**. Click on the "Diagnostics" drop down menu from the main ACS ribbon at the top of the screen. Select "Grade." Grade diagnostic window will appear.
- Step 25. Driver: Begin driving around the test area.
- Step 26. Operator: Click "Start." Check diagnostic window.
 - i. All 4 grade sensors should be showing readings. Readings should change as ARAN van moves and should be within reasonable values according to the pavement surface being driven.
 - ii. Pitch and roll sensors should also be showing readings. Readings should change as ARAN van moves and should be within reasonable values according to the pavement surface being driven.

RAW Calibrated	Grade Diag	gnostics	fan.
Left Front 10.95 in	Right Front 9.94 in	Left Rear 16.12 in	Right Rear 15.57 in
* Pitch -0.73 %	Pitch Angle -2.14 %		
* Roll 2.53 %	Roll Angle 1.19 %		

Operator: Select "Stop" at bottom of screen after checks are confirmed (should take approximately 1 minute).

- i. If checks in Step 26 are acceptable, proceed to Step 27.
- ii. If checks in Step 26 were not acceptable, stop vehicle. Reconnect the cables connecting the sub-system equipment to the computer and restart test by returning to Step 24. If Operator is not able to resolve the issue, contact Roadware's Technical Service for assistance. If still not able to resolve the issue, communicate issue to the Supervisor and suspend daily data collection until sub-system is functioning properly.
- Step 27. Operator: **Perform DMI Diagnostic Check**. Return to the "Diagnostics" drop down menu from the main ACS ribbon at the top of the screen. Select "DMI." DMI diagnostic window will appear (see below image).
- Step 28. Driver: Continue driving around the same test area.
- Step 29. Operator: Click "Start." Check diagnostic window.
 - i. DMI Count should increase as vehicle moves.
 - ii. Graph should update in real time.
 - iii. Graph should have a positive slope when increasing speed and return to xaxis when vehicle stops.

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Field Data Collection ARAN Pre-Data Collection Actions



Operator: Select "Stop" at bottom of screen after checks are confirmed (should take approximately 1 minute).

- i. If checks in Step 29 are acceptable, proceed to Step 30.
- ii. If checks in Step 29 are not acceptable, stop vehicle. Check DMI connection on wheel. Reconnect cables connecting the sub-system equipment to the computer and restart test by returning to Step 27. If Operator is not able to solve the issue, contact Roadware's Technical Service for assistance. If still not able to resolve issue, communicate issue to the Supervisor and suspend daily data collection until sub-system is functioning properly.
- Step 30. Operator: **Perform LCMS Diagnostic Check**. Return to the "Diagnostics" drop down menu from the main ACS ribbon at the top of the screen. Select "LCMS." LCMS diagnostic window will appear.
- Step 31. Driver: Continue driving around the same test area.
- Step 32. Operator: Click "Start." Check diagnostic window.
 - i. All icon lights should be green.
 - ii. Two images in the center of the window should be updating as the ARAN van moves.
 - iii. Images should be representative of the pavement that is being driven over.
Field Data Collection ARAN Pre-Data Collection Actions



Operator: Select "Stop" at bottom of screen after checks are confirmed (should take approximately 1 minute).

- i. If checks in Step 32 are not acceptable, stop vehicle. Reconnect the cables connecting sub-system equipment to the computer and restart test by returning to Step 30. If Operator is not able to solve the issue, contact Roadware's Technical Service for assistance. If still not able to resolve issue, communicate issue to the Supervisor and suspend daily data collection until sub-system is functioning properly.
- Step 33. Operator: **Perform PS LV Diagnostic Check**. Return to the "Diagnostics" drop down menu from the main ACS ribbon at the top of the screen. Select "POS LV." POS LV diagnostic window will appear.
- Step 34. Driver: Continue driving around the same test area. Ensure no buildings or trees are obstructing the GPS receiver.
- Step 35. Operator: Click "Start." Check diagnostic window.
 - i. Two GPS readings should be reasonable and updating as the vehicle moves. It may take a few moments for the GPS readings to display.

Field Data Collection ARAN Pre-Data Collection Actions

POS LV Diagn	ostics		
Software Version	DMI		
POSLV Version	POSLV Distance	POSLV Distance At Event 1	Scale Factor
LV-420,VER5,5/N7229,HW1.3-12,SW08.53-Apr20/16,ICD07.41,OS6.4.1,IMU7,PGP517,5GP517,DMI2,GIM0,ZVI0	14.925	0.000	18801.9
Primary GPS Version Secondary GPS Version	mi	mi	
BD982 SN:5515C01352, v.00490, channels:388, OMNSN:1010113952			
	Up Counter	Up/Down Counter	
General	0.0	0.0	
GPS Time Stamp POS LV State	Distance Type	DMI Type	DMI Faults
s Signature Sign	DmiDistance	Pulse and Direction	Offline, Failed
IMU	Gams		
Bad IMU Frame Count IMU Faults	Satellite Count	PDOP	Antenna Separation
0 None	14	1.2	5.280
			ft
GPS			
PPS Time PPS Count	GAMS Heading	Head.Accuracy	
390028.000 2298	341.6	0.205699	
s	deg	deg	
GPS Status GPS Faults	GAMS Solution Status	GAMS Faults	
None	Fixed Integer	Heading Rejected	

Operator: Select "Stop" at bottom of screen after checks are confirmed (should take approximately 1 minute).

- i. If checks in Step 35 are acceptable, proceed to Step 36.
- ii. If checks in Step 35 are not acceptable, stop vehicle. Reconnect the cables connecting sub-system equipment to the computer and restart test by returning to Step 33. If Operator is not able to solve the issue, contact Roadware's Technical Service for assistance. If still not able to resolve issue, communicate issue to the Supervisor and suspend daily data collection until sub-system is functioning properly.
- Step 36. Operator: **Perform Roughness Diagnostic Check**. Return to the "Diagnostics" drop down menu from the main ACS ribbon at the top of the screen. Select "Roughness." Roughness diagnostic window will appear.
- Step 37. Driver: Continue driving around the same test area.
- Step 38. Operator: Click "Start." Check diagnostic window.
 - i. Four plots in total (2 laser, 2 accelerometer) should be updating as the ARAN van moves.
 - ii. Laser readings should appear reasonable based on smoothness of test pavement.

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Field Data Collection **ARAN Pre-Data Collection Actions**



Operator: Select "Stop" at bottom of screen after checks are confirmed (should take approximately 1 minute).

- i. If checks in Step 38 are acceptable, proceed to Step 39.
- ii. If checks in Step 38 are not acceptable, stop vehicle. Reconnect the cables connecting sub-system equipment to the computer and restart test by returning to Step 36. If Operator is not able to solve the issue, contact Roadware's Technical Service for assistance. If still not able to resolve issue, communicate issue to the Supervisor and suspend daily data collection until sub-system is functioning properly.
- Step 39. Operator: Perform Video Diagnostic Check. Return to the "Diagnostics" drop down menu from the main ACS ribbon at the top of the screen. Select "Video." Video diagnostic window will appear.
- Driver: Continue driving around the same test area. Step 40.
- Step 41. Operator: Click "Start." Check diagnostic window. There is a tab for each video stream.
 - i. Each image should be clear.
 - Sunlight "wash-out" should be minimal. ii.
 - iii. Image should change as ARAN van moves.



Operator: Select "Stop" at bottom of screen after checks are confirmed (should take approximately 1 minute).

- i. If checks in Step 41 are acceptable, proceed to Step 42.
- ii. If checks in Step 41 are not acceptable, stop vehicle. Reconnect the cables connecting sub-system equipment to the computer and restart test by returning to Step 39. If Operator is not able to solve the issue, contact Roadware's Technical Service for assistance. If still not able to resolve issue, communicate issue to the Supervisor and suspend daily data collection until sub-system is functioning properly.
- Step 42. Operator: **Perform dummy test run**. Select the "Collect" drop down menu from the main ACS ribbon at the top of the screen. Click on "Summary." Data collection window will appear (see below image).

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Field Data Collection ARAN Pre-Data Collection Actions

CARAN Collection Software				
🚁 • 🛞 Collect • 🕎 Status • 🔗 Data Valdation • 🚱 Mission Management •	State Management -	gnastics • 🗳 Configuration •	Colibration -	
Instant VCA Last FAI Constraints Last FAI Constraints	an Dents Deartytion Chainage Exert Begin Segment 0.000 If type Vehicle Speed 5.5 mpls POSLY Oracial System Status Nevigetion Status	U3 9999911 Test Loop I Image: Contract of the second se	Distance 0.761 Me	At Event
Parment	Grade 1.61 5 Messages Show Module Name S Faulting Left Fault Count Right Fau 98	Warring v Clear Izrus Message It Count 96	1000.00 1000.00 0.000 0.500 0.500 0.600 1000.00 1000.00 1000.00 0.500 0.500 0.600 1000.00 0.500 0.000 0.600 1000.00 100	114.41 0.510 416.27 0.649
ystart 🥝 🚞 🗱 🚜 🛹 😪				- 10 10 10 10 10 10 10/0/00

- Step 43. Operator: In the search bar above the map window, type in "DUMMY." Click the magnifying glass to begin the search.
- Step 44. Operator: A list of search results will appear. The section for the dummy test run will read "9999921 DUMMY, AA DUMMY E." Click "Add to List."
- Step 45. Operator: In the queue list of selected sections, click on "DUMMY". Click "Make Current" at the bottom of the map window.
- Step 46. Operator: Confirm the beginning and end of the selected section by the flag icons in the map window.
- Step 47. Operator: Follow <u>ARAN Data Collection</u>, beginning with Step 14, for completing the dummy data collection run.
- Step 48. Operator: If the dummy data collection run does not result in issues, diagnostics are completed^{06/12/2019}. If issues are discovered during dummy test run, troubleshooting of specific sub-component is necessary before beginning data collection.

3.02 ARAN DATA COLLECTION

3.02.01 General

This section describes the standard operating procedure (SOP) followed by the Automatic Road Analyzer (ARAN) crew members of the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Field Explorations Division (FED) to perform data collection using an ARAN 9000 survey van with ARAN Collection System (ACS) software Version 2.3^{06/12/2019} (hereafter referred to in this SOP as ARAN). This SOP is one of three to be utilized for daily data collection with the referenced ARAN. It is preceded by <u>ARAN Pre-Data Collection Actions</u> and succeeded by <u>ARAN Post-Data Collection Actions</u>. The data collection activities covered in this SOP start from the end of the daily diagnostic checks and dummy data collection run (see <u>ARAN Post-Data Collection Actions</u>). This SOP describes the process of completing a full day of data collection. This procedure utilizes the ARAN Collection List (see <u>Production of ARAN Collection List</u>) for the current year. The ACS software should already be initialized from <u>ARAN Pre-Data Collection Actions</u>.

3.02.02 Frequency

This SOP is to be performed daily for each day of ARAN data collection. The annual ARAN data collection season typically lasts from March to Mid-December.

3.02.03 Purpose

The purpose of this SOP is to successfully daily data collection using the ARAN van and to perform quality control (QC) checks of the data while is being collected.

3.02.04 Resource Requirements

The actions detailed in this SOP are to be performed by the crew of the ARAN van, which is composed of a driver and an operator. The estimated effort levels in the table below represent the total time, in man-hours, required for completion data collection. These time estimates assume adequate weather conditions and a typical data collection schedule. Actual time to complete individual runs in the field will vary between routes.

Position	Function	Resources	Effort Level (man-hrs)
ARAN Testing Crew	Driver	1	7.0
ARAN Testing Crew	Operator	1	7.0

3.02.05 *Procedure*

The procedure to be followed by the ARAN crew members for each unique data collection run is comprised of two tasks:

- (1) route selection and
- (2) data collection.

1- Route Selection – *performed by operator*

Summary: This task uses the ACS software to add sections to the data collection queue.

- Step 1. Operator: There are two options for selecting daily routes for data collection based on the routing plan completed in <u>ARAN Pre-Data Collection Actions</u> in the ACS:
 - i. Browsing the populated list under "Mission Management." If this is the preferred method, select the "Mission Management" drop down menu from the main ACS ribbon at the top of the screen. Click on "Routed Segments." The list of sections that have already been imported into the system will appear. Proceed to Step 2.
 - ii. Searching for a specific route in the "Collect" window. If this is the preferred method, skip to Step 3.
- Step 2. Operator: Find the section for which data are to be collected and select it so that the row is highlighted (see below image). Click "Add to List." Multiple sections may be added to queue list, if desired^{06/12/2019}.

Locators						Add to List Collect Section	Add Section	Delete Section
Section ID			2.6	EGRD		T DR		4
100010			0	005				
100020			0	005		5		
100030			0	001		5		
100040			0	005		5		
100050			0	001		5		
100060			Ó	001		6		
100076			0	001		6		
100060			0	100		6		
100090			0	001		6		
Road Name	Direction	Lane	Class					
the second se								
SNORS RD E	Primary	1	ChyPrin	rany				
SNDRS RD E	Frimary	1	Céphin	rary			Add Segment	Delete Segmen
SNDRS RD E Segments Begin Description	Frimary	1 End Description	ChyPrin	Begin Chainage	End Chainage		Add Segment	Delete Segmen
SNDRS RD E Segments Begin Description FOUNDRY STREET	Primary	1 End Description D.8 KM W OF SAND	CityPrin HELLS (T16)	Begin Chainage 9.203	End Chainage 9.81		Add Segment	Delete Segmen

Step 3. Operator: Select the "Collect" drop down menu from the main ACS ribbon at the top of the screen. Click on "Summary." Data collection window appears (see below image). If section(s) was (were) selected using the "Mission Management" window, skip to Step 5. Maryland department of transportation

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Field Data Collection ARAN Data Collection



- Step 4. Operator: In the search bar above the map window (see above image), type in the section identifier of the route to be collected. A list of search results will appear. Select the appropriate section and click "Add to List." Multiple sections may be added to queue list, if desired^{06/12/2019}.
- Step 5. Operator: In the queue list of selected sections, click on the section that is to be collected next. Click "Make Current" at the bottom of the map window (see above image). Confirm the beginning and end of the selected section by the flag icons in the map window. Otherwise, the incorrect section may be selected and the route selection will have to be repeated by returning to Step 1.

2- Data Collection – performed by driver and operator

Summary: This task uses the ACS software to complete a data collection run.

- Step 6. Driver: Navigate vehicle to selected first route and approach beginning of test section. Throughout collection run, adhere to local traffic laws. Attempt to maintain a steady path in the driving lane^{06/12/2019}.
- Step 7. Operator: Click "Start" at the bottom of the screen prior to reaching the beginning of the test section. System will begin to initialize^{06/12/2019}. A green progress bar will begin filling up at the bottom of the screen (see below image). System is initialized and lead-in is complete when bar is completely green.

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Field Data Collection ARAN Data Collection



Step 8. Operator: When van reaches beginning of section, click "Begin Segment." The image below depicts a flowchart for the data collection process.



- Step 9. Operator: **Perform Manual/Visual QC** of data being collected through information displayed in monitor windows during data collection. Visual checks include the following^{06/12/2019}:
 - i. Forward cameras Right-of-way (ROW) camera window and Left camera window. Confirm that the images are crisp, clear and void of obstructions, that there is minimal sunlight interference, and that the images are updating as the vehicle moves down the road.

- ii. LCMS pavement images Confirm that both sets of pavement images are updating as the vehicle moves down the road, and that identifiers on the pavement (such as paint stripes or large cracks) are visible in the image window.
- iii. International Roughness Index (IRI) values Confirm that left and right IRI plots show reasonable numbers based on operator's experience and condition of the pavement being collected.
- iv. Grade Confirm % grade change window shows a reasonable value and it is updating as the vehicle moves down the road.
- v. GPS Confirm Position and Orientation System for Land Vehicles (POS LV) status is green.
- vi. Fault Count Confirm fault count windows shows reasonable values and are updating as the vehicle moves down the road.
- vii. Additional Notes Notes regarding special events during data collection should be added where necessary by typing the appropriate event abbreviation into the dialogue box on the data collection screen. Common events and their abbreviations for data entry are shown in below table.

Description	Event Abbreviation
Lane Exception	L
Milled Surface	Μ
Construction Zone	С
Rumble Strips in Lane	R
Wet Surface	W
Road Closed Ahead	X
Roundabout	0
Traffic Signal Red	Т
New Pavement	Ν
Debris	D

If no issues arise from the checks in this step, proceed to Step 10. If issues do arise, stop the data collection run and attempt to fix problem. For example, operator should reconnect the cables connecting malfunctioning sub-system equipment to the computer, as a first step. If Operator is not able to resolve the issue, contact Roadware's Technical Service for assistance. If still not able to resolve the issue, communicate issue to the Supervisor and suspend daily data collection until all sub-systems are functioning properly. When issue has been corrected, return to Step 5.

- Step 10. Operator: **Observe Automated QC Checks**. Error messages will appear in a window towards the bottom of the data collection screen. Messages highlighted in ORANGE are warnings but do not require the data collection run to be stopped (such as one GPS receiver going out for a moment). Messages highlighted in RED are alerts that require the data collection run to be stopped and the specific error corrected.
 - i. If no issues arise from the checks in this step, proceed to Step 11.

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- ii. If issues do arise, stop the data collection run and attempt to fix problem. For example, operator should reconnect the cables connecting malfunctioning subsystem equipment to the computer, as a first step. If Operator is not able to resolve the issue, contact Roadware's Technical Service for assistance. If still not able to resolve the issue, communicate issue to the Supervisor and suspend daily data collection until all sub-systems are functioning properly. When issue has been corrected, return to Step 1.
- Step 11. Operator: If multiple segments exist along the section, click "Accept" to mark the end of a segment. This will end that segment and begin the next segment automatically. When van reaches the end of the entire section, click "End Segment."
- Step 12. Operator: Click "Stop" at the bottom of the screen once the data collection route is complete. Green status bar will appear and lead-out process will begin. Lead-out is complete when bar is completely green.
- Step 13. Operator: In the queue list of selected sections, click on the section that is to be collected next. Click "Make Current" at the bottom of the map window (see above image). Confirm the beginning and end of the selected section by the flag icons in the map window. Otherwise, an incorrect section may be selected and the route selection will have to be repeated by returning to Step 1.
- Step 14. Driver: Navigate vehicle to next selected route and approach beginning of test section. Return to Step 7 and repeat for all data collection runs for the day^{06/12/2019}.

3.03 ARAN POST-DATA COLLECTION ACTIONS

3.03.01 General

This section describes the standard operating procedure (SOP) followed by the Automatic Road Analyzer (ARAN) crew members of the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Field Explorations Division (FED) to perform data management and validation activities after daily data collection using an ARAN 9000 survey van with ARAN Collection System (ACS) software Version 2.3^{06/12/2019} (hereafter referred to in this SOP as ARAN). This SOP is one of three to be utilized for daily data collection with the referenced ARAN. It is preceded by <u>ARAN Pre-Data</u> <u>Collection Actions</u> and then <u>ARAN Data Collection</u>. The post-data collection actions covered in this SOP start from the completion of the last data collection run of the day (see <u>ARAN Data Collection</u>) to system shut down.

3.03.02 Frequency

This SOP is to be performed each day of ARAN data collection^{06/12/2019}, following the last data collection run of the day.

3.03.03 Purpose

The purpose of this SOP is to perform post-data collection quality control (QC) checks of the ARAN data collected each day (see <u>ARAN Data Collection</u>) and to safely store those data by:

- properly exporting the data,
- checking quality of imaging and roughness data through the review of different runs, and
- documenting the events of the day through a daily report, referred to as the end of day daily report.

3.03.04 Resource Requirements

The actions detailed in this SOP are to be performed by the crew of the ARAN van, which is composed of a driver and an operator. The estimated effort levels in the table below represent the total time, in man-hours, required for completion of all post-data collection activities. These time estimates assume no issues are encountered with exporting and QC of data.

Position	Function	Resources	Effort Level (man-hrs)
ARAN Testing Crew	Driver	1	0.5-1.0
ARAN Testing Crew	Operator	1	0.5-1.0
FED TL or Coordinator	Supervisor	1	AR ^{06/12/2019}

3.03.05 *Procedure*

The procedure to be followed by the ARAN crew members following completion of data collection runs for the day is comprised of five components:

- (1) data export,
- (2) run review,
- (3) end of day daily report,
- (4) pavement image QC, and
- (5) computer shut down and hard drive removal^{06/12/2019}.

1- Data Export – *performed by Operator*

Summary: This task uses the ACS software to export the collected data at the end of the day.

- Step 1. Select the "Data Management" drop down menu from the main ACS ribbon at the top of the screen. Select "Export."
- Step 2. Select today's date from window. Ensure "Entire Day" bubble is filled in at top of window. All runs for the day should appear in the dialogue box (see below image).

Export Data	<u>D</u>	302	2 Pm
Entire Day ODate a	nd Time Range		
	Date:	October-5-2017	
Session Name	Section	Count	
+ 20171005.081923	1		
± 20171005.082910	1		
+ 20171005.085950	1		
± 20171005.092556	1		
Session Total: 4	Section	Total: 4	
	Start	Cancel	

Step 3. Select "Start" (see above image). Progress bar appears as data exports (see below image).

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Field Data Collection ARAN Post-Data Collection Actions

0	Entir	port Data e Day ODate and Time Ra	ange
		Date:	October-5-2017
		Session Name	Section Count
	+	20171005.081923	1
	+	20171005.082910	1
	+	20171005.085950	1
	+	20171005.092556	1
		Carlo Table 6	
		Session Total: 4	Section Total: 4
		Creating Da	atabase
		Start	t Cancel

Step 4. Small notification window will appear that says "Export Completed." Click "OK."

2- Run Review and ROW Imaging QC – performed by Operator

Summary: This task uses the ACS software to review a sample of the collected data and QC the collected images.

Step 5. Select the "Data Validation" drop down menu from the main ACS ribbon at the top of the screen. Select "Review." Review window appears (see below image).

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Field Data Collection ARAN Post-Data Collection Actions

ARAN Collection Software					_ 8 ×
🚁 • 🛞 Colat • 🔄 Statu • 🔗 Deta Vakadon • 🚱 Rangement • 🥪 Deta Reagenent •	Diagnostics • 🦓 Configuration •				
Section: Date Collected: Charge Calindan	Rubberband Chainages Interval	6 mmi K ≪ 🔇	· > »	ж	
Ŧ					
Ē.					
Purfix Bauchases Butthe Cross-Fall					
Toris Religions multiply vicential					_
No series added					
🕼 🔄 🦉 🚜 🖋 🥔				1 10 R	10:59 AM

Step 6. Select "Change Collection" at top left of window (see above image). Window appears with a list of runs completed for the date selected (see below image). Randomly select a specific run to be reviewed by highlighting the row of the corresponding section^{06/12/2019}.

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Field Data Collection ARAN Post-Data Collection Actions

🝻 Browse	For Collection								
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Date	e of Collection	Thursday , October 0!	Show All						
	Cortion ID	Road Nam		Direction	Lano	County	RoutoTD	Dir	
	Section 10	Rudu Ndin	e	Direction	Lane	County	KouterD	Uli	
9999911		Test Loop 1		5	1	AA	TL 1	E	
99999912	2	Test Loop 2		5	1	AA	1L 2	E	
9999913	5	Test Loop 3		5	1	AA	TL 3	E .	
9999921		DOMMIT		5	1	AA	DOMMIT	E	
Index	Beg	in Description	En	d Description					
Run	Description	Date	Begin Chainage	End Chaina	Bagin Di	stance Stamp	End Distance Stamp		
Run	Description	Date	Degin chanage	Cha chaina	ge begin bi	Stance Stamp	End Distance Stamp		
L									
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Step 7. Click "OK" (see above image).

- Step 8. Click "Play." Software will simulate the data collection of the selected section (see below image). Operator should observe the following^{06/12/2019}:
 - i. Route map Confirm by visual check that map in the upper left corner is showing the correct "trace" of the data collection run, which indicates the GPS was working properly.
 - ii. Attribute Table Confirm by visual check that the table in the bottom right corner is populated without gaps^{06/12/2019} and that the values for the corresponding attributes are reasonable^{06/12/2019}.
 - iii. Cameras Confirm via visual check that the camera images in the upper right corner are updating and that they are of acceptable quality. Toggle between the two cameras to perform visual check on both.

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Field Data Collection ARAN Post-Data Collection Actions



Exit the review if the data collection run is complete and the checks have been found to be satisfactory. If issues are noted during the visual checks in Step 8, return to Step 5 and repeat the steps again, but select a different run. If the same issues are identified over multiple runs, communicate issue with Supervisor who will help decide if further action is required, such as recollection of data.

3- End of Day Daily Report – *performed by Operator*

Summary: This task uses the ACS software to produce a daily report.

Step 9. Select the "Data Validation" drop down menu from the main ACS ribbon at the top of the screen. Select "End of Day Daily Report." "Daily Report" window appears (see below image).



ort Date:	Octobe	er-5-2(017	* *			
Session	Section	С	x	R	V Initials		Comments
1005.081923	9999921		\odot	ol		dummy	
1005.082910	9999911	Ŏ	ŏ	ŏ	5	testloop 1	
1005.085950	9999912	۲	\bigcirc	0	D	testloop 2	
1005.092556	9999913	۲	۲	•		testloop 3	
alid Collection, X = ly collected files w	= Not Valid (Fa vill show up as	iiled C C in t	ollect he re	tion, 1 port f	Fest Files), I for tracking	R = Rerun, V = Control or Verific purposes	ation Sites
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- Step 10. Check appropriate bubbles next to section identifiers (see above image). Designations are as follows:
 - i. C = Regular collection
 - ii. X = Eliminated data or dummy file
 - iii. R = Recollected data
 - iv. V = Validation data (test loop)
- Step 11. Add road names under the "Comments" column for each section.
- Step 12. Select "Output Directory" (F Drive).
- Step 13. Confirm all report types have been checked. Click "Generate." Progress bar will appear as report is generated (see below image).



Field Data Collection **ARAN Post-Data Collection Actions**

port Date:	Octobe	r-5-2(017	* *	•			
Session	Section	с	x	R	v	Initials		Comments
1005.081923	9999921	0		0			dummy	
1005.082910	9999911	ŏ	ŏ	ŏ	ŏ		testloop 1	
1005.085950	9999912	۲	Õ	\bigcirc	Õ		testloop 2	
		4						(hats
	(_						
F:\		Outp	ut I	Dire	ector	ry	Browse	Low Speed Threshold 12.427423888888 mph
F:\ ptions Select All	Select None		ut I	Dire	ector	ry	Browse	Low Speed Threshold 12.427423888888 mph
F:\ ptions Select All Daily Re	Select None		ut I	Dire	ctor	ry ⊽ Func	Browse	Low Speed Threshold 12.427423888888 mph Sample Images
F:\ Select All Daily Re	Select None port ort]		Dire	ector F	✓ Func ✓ Secti	Browse tional Class Report	Low Speed Threshold 12.427423888888: mph ✓ Sample Images ✓ QC Video Report
F:\ ptions Select All ☑ Daily Re ☑ PCS Rep ☑ ARAN Se	Select None port ort ettings File]		Dire	F F	 ✓ Func ✓ Secti ✓ Statu 	Browse tional Class Report ions Collected Report us Messages	Low Speed Threshold 12.427423888888i mph ✓ Sample Images ✓ QC Video Report

4- Pavement Image QC – performed by Operator

Summary: This task uses the LCMS Road Inspect software to review and QC collected LCMS pavement images.

- Step 14. On the ROW computer desktop, double click on the "PAVE" computer icon. Monitor will switch to the PAVE computer desktop.
- Step 15. Double-click on the "LCMS Road Inspect" icon (see below image).



Field Data Collection ARAN Post-Data Collection Actions







- Step 17. Select F Drive.
- Step 18. Select "FIS Pavement" icon.
- Step 19. Scroll down to folder with today's data and double click.
- Step 20. Select random image in folder.
- Step 21. Click "Clear All" on right of window.
- Step 22. Click "Process." A new window will appear when image processing is complete (see below image).
- Step 23. Check image for quality. Right and left Laser Crack Measurement System (LCMS) images should line up well, image should be clear and pavement defects/markings should be visible. Otherwise, note the name of the section and communicate issue to Supervisor for further review of collected data and troubleshooting.



- Step 24. Click "Save Result" and a new dialogue box will appear (see below image).
- Step 25. Check all boxes in new dialogue box (see below image). Click "Save."

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Save Analysis Results			8
Save Options Save XML data Save Result Image – Intensity Save Result Image – Range Save Result Image – 3D Save Overlay Image – Intensity Save Overlay Image – Range Save Overlay Image – 3D Save overlay Image – No bkgrd	Overlay Options Image: Overlay Options Imag	 ✓ Dropoff-Curb ✓ Joint Concrete ✓ Sealed Cracks 	
Save Folder Select Folder \\MD85682-ROW\Removable 1	L\paveqc105\LcmsResult_*.*	Save	ancel

- Step 26. Click "Select Folder" (see above image). Navigate to "ROW PC", "Removable."
- Step 27. Create new folder at this location and name it as "pavqc[MMDD]" using today's date at the end (e.g. "pavqc1122").
- Step 28. Click "Open."
- Step 29. Click "Save." Window disappears.
- Step 30. Click "Save" on the "Process Result" window. This window will disappear.
- Step 31. Return to Step 16 and repeat procedure for 2 more images in the same data folder^{06/12/2019}. If one of the images reviewed identifies issues or raises concerns, it may be necessary to inspect additional images.
- Step 32. Close Program.
- Step 33. Click the "ROW" computer icon on desktop to return to ROW computer.
- 5- Computer Shut Down and Hard Drive Removal performed by Operator

Summary: This task completes computer shut down in the ARAN and removes the hard drives from the vehicle for data processing.

- Step 34. While back on the ROW computer, close the ACS.
- Step 35. Click "OK" (see below image).



Field Data Collection ARAN Post-Data Collection Actions



- Step 36. Double-click on the shutdown icon for each computer on the ROW desktop (ROW, PAVE, Server).
- Step 37. Turn off inverter using controls on the center console.
- Step 38. Remove six hard drives from back of van and turn them in to supervisor^{06/12/2019}.
- Step 39. Confirm all computers and inverter have powered down successfully. Turn off van engine and lock doors.

3.04 ARAN DMI CALIBRATION

3.04.01 General

This section describes the standard operating procedure (SOP) followed by the Automatic Road Analyzer (ARAN) crew members from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Field Explorations Divisions (FED) to calibrate the Distance Measuring Instrument (DMI) mounted on the ARAN vans. The steps described in this SOP are based on the ARAN Collection System (ACS) software Version 2.3^{06/12/2019} developed for operating ARAN 9000 vans (hereafter referred to as ARAN). The reference measurements used for the calibrating procedure described in this SOP consist of two one-mile long pavement sections marked on the shoulder lanes along both directions of a road segment on MD Route 100, which have been measured by a state surveyor using thermally compensated steel tape.

3.04.02 Frequency

This SOP should be followed for the calibration of the DMI mounted on ARAN vans once per month during the data collection period^{06/12/2019}.

3.04.03 Purpose

The purpose of this SOP is to check the accuracy of the distance measurements taken by the DMI mounted on ARAN vans and, if necessary, perform corrective actions for recalibration.

3.04.04 *Resource Requirements*

Calibration of the ARAN's DMI is performed by the crew of the ARAN van, composed of a driver and an operator. The estimated effort levels in the table below represent the total time, in man-hours, required for driving from the SHA's Office of Materials Technology (OMT) location to the current calibration sites on MD 100, performing three repeat runs of the test, and driving back to the OMT location.

Position	Function	Resources	Effort Level (man-hrs)
ARAN Testing Crew	Driver	1	1.5
ARAN Testing Crew	Operator	1	1.5

3.04.05 Procedure

The procedure to calibrate the DMI mounted on ARAN 9000 vans using ACS software Version 2.3 is comprised of a single task:

(1) calibrating DMI.

1- Calibrating DMI – *performed by driver and operator*

Summary: This task performs a DMI calibration for the ARAN 9000 van using ACS software at the MDOT-SHA OMT DMI calibration site.

The two calibration sites consist of one-mile long marked sections located near the OMT on the shoulder lanes of MD 100: one in the east-bound direction and the other in the west-bound direction (see map screenshot below).



- Step 1. Driver: Drive the ARAN van to the starting point of the calibration site in the east-bound direction. The starting point can be identified by multiple markings (see below photos):
 - (1) an orange paint mark on a tree to the right of the road,
 - (2) a metal pole just beyond the pavement shoulder,
 - (3) paint markings on the pavement shoulder (line and "ST"), and
 - (4) a survey nail in the pavement shoulder.





Step 2. Operator: Select the "Calibration" drop down menu from the main ACS ribbon at the top of the screen. Select "DMI." This will open the ACS's "DMI Calibration Wizard" application (see below image).

🖉 DMI Calibration		×
TUGRO	DMI Calibration	
	 Locate a straight piece of road of a defined and measured length. Clearly mark the start of the test section. With a tape measure, measure the straight line distance. Using marking tape place the first piece over the start line, making sure to place the edge of the tape exactly on the start line. The edge of the marking tape is your start line; accuracy is very important in this test. Place a second piece of marking tape at the end of the test section, making sure to place the edge of the tape exactly on the stop line. Mark a fixed point on the vehicle frame close to the ground. Align the vehicle so the marking tape is directly over the start line. Click Next to continue. 	
	Cancel Back Next	

Step 3. Driver: Drive the ARAN van until the front bar of van is aligned to the "start" position marking on pavement surface and survey nail as shown in below image^{06/12/2019}.



Step 4. Operator: Enter calibration site length on "DMI Calibration Wizard" (see below image). The length of the current calibration site is 1000 mmi.

🐙 DMI Calibration				×
DMI Calibration				
Enter Calibration Site Length				
DMI Calibration Length 1000	Enter the Calibration Distance. Click Next to START CALIBRATION.			
		Cancel	Back	Next

- Step 5. Operator: Click "Next" on the DMI Calibration Wizard to start calibration.
- Step 6. Driver: Drive forward on shoulder lane from the start mark until a few feet before the end mark. The "DMI Calibration Wizard" should register travelled distance on screen (see below image). Attempt to stay as straight as possible

in the shoulder lane using the white stripe, edge of pavement, and guardrail (where present) as references.



Step 7. Driver: Drive ARAN van until front bar of van is aligned to "end" position marking on pavement surface and survey nail as shown in the below image^{06/12/2019}.



Step 8. Operator: Click "Next" to end the DMI calibration (see below image).

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🌮 DMI 🤇	Calibration	×
DMI (Calibration	
Drive T	est Section	
	Approximate Distance	
	1.001	
	1.001	 Drive the marked test section and drive in a straight line at a consistent speed.
	mi	At the end of the run smoothly stop the vehicle with your reference point directly over the maded and point.
		3. When the run has been completed click Next to continue.
		Cancel Back Next

Step 9. Operator: Click "Finish" on ACS's "DMI Calibration Wizard" and save results (see below image). The ACS's DMI Calibration application will perform the necessary adjustments to the DMI readings to match the measured distance during the calibration procedure to the reference measurement (scale factor).

🍠 DMI Calibration					×
DMI Calibration	1				
Calibration Result					
	Effective Date	DMI Scale Factor			
1	0/5/2017 10:07:45 AM	4795.02			
1	0/3/2017 10:07:45 AM	4705.03			
9	/12/2017 10:40:13 AM	4702.20		=	
9	/12/2017 10:23:33 AM	4701.72			
8	3/16/2017 2:23:40 PM	4695.56			
8	3/16/2017 2:15:16 PM	4703.04			
8	3/16/2017 2:07:30 PM	4737.94			
8	3/16/2017 2:05:28 PM	4694.86			
8	3/16/2017 11:58:07 AM	4988.11			
7	7/12/2017 10:05:34 AM	4703.65		×	
	Current	t Calibration Value	DMI Scale Factor 4706.38		
			Cancel	Bac	k Finish

Step 10. Driver: Drive the ARAN van to starting point of the calibration site in the westbound direction and repeat Step 2 to Step 9 to perform second run of DMI calibration. See photos below for similar markers in the west-bound direction.



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Field Data Collection ARAN DMI Calibration





Step 11. Driver: Drive the ARAN van to starting point of the calibration site in the eastbound direction and repeat Step 2 to Step 9 to perform third run of DMI calibration.

The DMI calibration procedure is completed once the three runs (two at the calibration site in the east-bound direction and one at the calibration site in the west-bound direction) are performed. The calibration factors for the 3 runs must agree within 0.1 percent and preferably within 0.05 percent. If they do not agree, consult Supervisor and discuss next steps for remedial actions.

3.05 PREVENTIVE MAINTENANCE OF ARAN VAN

3.05.01 General

This section describes the standard operating procedure (SOP) followed by the Automatic Road Analyzer (ARAN) crew members from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Field Explorations Divisions (FED) to support and to document the preventive maintenance activities performed annually by Fugro Roadware (Roadware) on the ARAN van and its sub-components.

3.05.02 Frequency

This SOP should be followed for the support and documentation of the annual ARAN preventive maintenance activities. Typically, these preventive maintenance activities are performed in early March, before commencement of the annual data collection season, and takes approximately one week.

3.05.03 Purpose

The purpose of this procedure is to support and to document the preventive maintenance activities performed by Roadware on the ARAN vans, and, if necessary, to perform follow-up actions. Preventive maintenance is done annually to ensure the ARAN vans are functioning properly prior to the start of the data collection season.

3.05.04 *Resource Requirements*

Preventive maintenance work on the ARAN and its documentation on a check-list are performed by a representative from Roadware. Support with the preventive maintenance work and follow-up activities are performed by the crew of the ARAN van, composed of a driver and an operator. The FED team leader is required for oversight and decision-making. The estimated effort levels in the table below represent the total time, in manhours, required for completion and documentation of the annual preventive maintenance activities on the ARAN van and its sub-components. Time estimates assume only minor issues, if any, are encountered during the conduct of the required work.

Position	Function	Resources	Effort Level (man-hrs)
ARAN Testing Crew	Driver	1	40
ARAN Testing Crew	Operator	1	40
FED Team Leader (TL)	Supervisor	1	5

3.05.05 *Procedure*

The procedure to support and document preventive maintenance activities of the ARAN van and its sub-components is comprised of a single task:

(1) supporting and documenting ARAN preventive maintenance.

1- Supporting and Documenting ARAN Preventive Maintenance – performed by driver and operator with support from Supervisor

Summary: This task provides support for ARAN Preventive Maintenance operations, documents results of the maintenance, and makes decisions regarding follow-up actions.

- Step 1. ARAN Testing Crew: Provide technical support as requested by the Roadware technician during the conduct of the preventive maintenance activities.
- Step 2. Supervisor: Obtain preventive maintenance report^{06/12/2019} from the Roadware technician at completion of the work. Refer to the beginning pages of the report for a checklist of preventive maintenance activities. Check the following items on the list to confirm their completion:
 - i. Server computer updates and maintenance.
 - ii. Right-of-way (ROW) computer updates and maintenance.
 - iii. Pavement computer updates and maintenance.
 - iv. Alternating Current (AC) distribution box checks.
 - v. LSDP junction box enclosure checks.
 - vi. Cables, racks, dog house, and miscellaneous checks.
 - vii. Distance Measurement Instrument (DMI) checks.
 - viii. Chassis, generator, inverter, and charger checks.
- Step 3. Supervisor: Refer to the "Recommendations" section of the report. Note suggestions or outstanding issues noted by Roadware and decide if further follow-up actions are required.
- Step 4. Supervisor: Refer to the "System Calibration" section of the report. Review the following calibrations and their results:
 - i. DMI calibration.
 - ii. Roughness Calibration.
 - iii. Static Roughness Test Results.
 - iv. Static Block Test Results.
 - v. Roughness Bounce Test Results.
 - vi. Reverse Runs to Verify Roll, Pitch, and Heading.
 - vii. Frame Angle.
 - viii. Static Grade Test.
 - ix. Static Rock Test.
 - x. Grade Verification.
 - xi. Test Loop 10 Repeat Runs^{06/12/2019} Review metrics including IRI, cross-fall, rutting, etc.

Decide if follow-up remedial actions are required based on the results from the individual checks.

3.06 TEST LOOP ARAN DATA COLLECTION

3.06.01 General

This section describes the standard operating procedure (SOP) followed by the Automatic Road Analyzer (ARAN) crew members from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Field Explorations Division (FED) to perform data collection on a carefully selected designated test loop using an ARAN 9000 survey van with ARAN Collection System (ACS) software Version 2.3^{06/12/2019} (hereafter referred to as ARAN). The data collection route is called the "test loop." The test loop begins and ends near the Office of Materials Technology (OMT) location. It is approximately 13.1 miles in length and is divided into segments of varying length based on surface type, intersection locations, ramp locations, and other common road features. The route was selected specifically because it includes a variety of surface types and road textures. The map^{06/12/2019} below depicts the route for the test loop. The data collected on this test loop are used to validate all ARAN sub-component data.



The required preliminary actions and diagnostic checks outlined in <u>ARAN Pre-Data</u> <u>Collection Actions</u> should be completed prior to the beginning of ARAN data collection runs on the referenced test loop.

3.06.02 Frequency

This SOP requires that three ARAN data collection runs be performed on the test loop once a month throughout the data collection period^{06/12/2019}.

3.06.03 Purpose

The purpose of this SOP is to perform ARAN data collection runs on the test loop^{06/12/2019}.

3.06.04 *Resource Requirements*

The test loop data collection is performed by the crew of the ARAN van, composed of a driver and an operator. The estimated effort levels in the table below represent the total time, in man-hours, required for completion of all test loop activities, including preliminary checks and diagnostics, three data collection runs, and data export and management. These time estimates assume no issues are encountered during the required work.

Position	Function	Resources	Effort Level (man-hrs)
ARAN Testing Crew	Driver	1	2.0
ARAN Testing Crew	Operator	1	2.0
FED Team Leader (TL)	Supervisor	1	AR ^{06/12/2019}

3.06.05 *Procedure*

The procedure to complete data validation on the test loop is comprised of a single task: (1) completing data validation on ARAN Test Loop.

1- Completing Data Validation on ARAN Test Loop – performed by driver and operator

Summary: This task is performed to complete three runs on the ARAN test loop.

- Step 1. Operator: Follow <u>ARAN Pre-Data Collection Actions</u>, beginning with Step 3, for vehicle and diagnostic checks.
 - i. If checks do not identify equipment issues, proceed to Step 2.
 - ii. If checks identify equipment issues, consult <u>ARAN Pre-Data Collection Actions</u> for troubleshooting methods. Communicate issue(s) to the Supervisor and suspend test loop data collection until all sub-systems are functioning properly.
- Step 2. Operator: Select the "Collect" drop down menu from the main ACS ribbon at the top of the screen. Click on "Summary." Data collection window appears (see below image).
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Field Data Collection Test Loop ARAN Data Collection

2 ABAK Calectana Suftware	• State Data Management •	nation - 🖓 Configuration -	Coltratos •	فا_
RCW		82	O Distance	0.761 Next Found
			Distance	0.701 Next Cvent
Activ	e Span Events	9999911 Test Loop 1		
La t	Description Chainage	Image: Construction Construction Construction Construction A And Television A And Television A And Television Construction Construction A And Television A And Television A And Television Construction Construction Construction A And Television A And Television Construction Construction Construction Construction Construction And Television Construction Construction Construction Construction		
Lat	Vehicle Speed 5.5 mph POGLV Oreal System Status Navigation Status	E Cogn Segment Accept	renergie dans renergie dans re	And Davies
Promot	Grade 1.61 56 Messages Show [Module Name Sta Faulting Left Fault Count Right Fault 98	taming v Clear tus Massage Count 96	1000.00 500.00 0.060 0.060 0.060 0.0000 0.0000	Left IRI 114.41 0.800 0.529 0.610 mi Right IRI 416.27 0.009 0.629 0.649 mi
Ysart 🥔 🚞 🎇 雄 🍠 😵				- in is in 10 10 10.2014

- Step 3. Operator: In the search bar above the map window, type in "TL 1". Click the magnifying glass to begin the search.
- Step 4. Operator: A list of search results will appear. The section for the first test loop will read "999911 Test Loop 1, AA TL 1 E". Click "Add to List." Repeat search for "TL 2" and "TL 3". All three test loop runs should now be listed in the section queue to the left of the map (see above image).
- Step 5. Operator: In the queue list of selected sections, click on "Test Loop 1." Click "Make Current" at the bottom of the map window (see above image). Confirm the beginning and end of the selected section by the flag icons in the map window.
- Step 6. Driver and Operator: Follow <u>ARAN Data Collection</u>, beginning with Step 14, for completing the first test loop data collection run.
 - i. If run is completed successfully, proceed to Step 7.
 - ii. If run is not completed successfully or if one or more sub-systems malfunctioned during data collection, attempt to resolve the issue(s). If Operator is not able to resolve the issue(s), contact Roadware's Technical Service for assistance. If still not able to resolve the issue(s), communicate issue(s) to the Supervisor and suspend test loop data collection activities until all sub-systems are again functioning properly. When resolved, return to Step 5 and recollect first test loop run.

- Step 7. Operator: In the queue list of selected sections, click on "Test Loop 2". Click "Make Current" at the bottom of the map window. Confirm the beginning and end of the selected section by the flag icons in the map window.
- Step 8. Driver and Operator: Follow <u>ARAN Data Collection</u>, beginning with Step 14, for completing the second test loop data collection run.
 - i. If is completed successfully, proceed to Step 9.
 - ii. If run is not completed successfully or if one or more sub-systems malfunctioned during data collection, attempt to resolve the issue(s). If Operator is not able to resolve the issue(s), contact Roadware's Technical Service for assistance. If still not able to resolve the issue(s), communicate issue(s) to the Supervisor and suspend test loop data collection activities until all sub-systems are again functioning properly. When resolved, return to Step 7 and recollect second test loop run.
- Step 9. Operator: In the queue list of selected sections, click on "Test Loop 3". Click Make Current at the bottom of the map window. Confirm the beginning and end of the selected section by the flag icons in the map window.
- Step 10. Driver and Operator: Follow <u>ARAN Data Collection</u>, beginning with Step 14, for completing the third test loop data collection run.
 - i. If run is completed successfully, proceed to Step 11.
 - ii. If run is not completed successfully or if one or more sub-systems malfunctioned during data collection, attempt to resolve the issue(s). If Operator is not able to resolve the issue(s), contact Roadware's Technical Service for assistance. If still not able to resolve the issue(s), communicate issue(s) to the Supervisor and suspend test loop data collection activities until all sub-systems are again functioning properly. When resolved, return to Step 9 and recollect third test loop run.
- Step 11. Operator: Follow <u>ARAN Post-Data Collection Actions</u>, beginning with Step 1, for data export and management following the completion of the third test loop run^{06/12/2019}.

3.07 TEST LOOP DATA ANALYSIS

3.07.01 General

This section describes the standard operating procedure (SOP) used by staff from the Field Explorations Division (FED), Data Processing Team (DPT), and Data Analysis Team (DAT) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to help assure the Automatic Road Analyzer (ARAN) quality controlled (QC'd) and quality assured (QA'd) deliverables (pavement data and imagery) are precise, accurate, and consistent throughout the collection season.

The MDOT-SHA test loop is a collection of 45 sections creating an approximately 13.1 miles long run near the Office of Materials Technology (OMT) location. The test loop is divided into 45 segments of varying length according to surface type, construction history, intersection locations, ramp locations, number of lanes, other common road features, and historic ground truth study locations. The route was selected specifically because it includes a variety of pavement structures, surface types, and road textures. The data collected on the test loop are used to validate ARAN sub-component data. Details regarding the test loop ARAN data collection process is described in <u>Test Loop ARAN</u> <u>Data Collection</u>. <u>Test Loop Analysis Details</u> provides further information on the data analysis procedure.

3.07.02 Frequency

This procedure detailed in this SOP is performed by the MDOT-SHA staff once per year as part of the initial data collection program (pre-collection), where the MDOT-SHA operated ARAN vehicles complete 10 runs of the MDOT-SHA test loop prior to the start of the data collection season, and thereafter every 3 weeks throughout the FED collection and delivery season, as part of the 3 week test loop data collection program, where the ARAN vehicle completes 3 runs of the test loop.

3.07.03 Purpose

The purpose of this SOP is to perform analysis on the MDOT-SHA test loop data and imagery collected by the ARAN vehicles order to:

- confirm collected and processed data are precise, accurate, and consistent;
- determine the acceptable range of variance or standard deviation for each performance measure to be used for outlier review; and
- conduct research on topics such pavement data collection and data processing techniques, and pavement performance and deterioration modeling.

3.07.04 *Resource Requirements*

The MDOT-SHA test loop data analysis involves the following three MDOT-SHA staff members: (1) a DPT staff member who is knowledgeable in the Vision software to perform pavement imagery quality control (QC) and lane adjustment, (2) a DAT staff member to perform condition data QC and to generate the test loop QC report, and (3) the DPT Team Leader (TL) to perform quality assurance (QA) functions and who, as required, provides guidance and decision-making. The FED TL and Assistant Division Chief (ADC) may also be required for error resolution and decision-making.

The estimated effort levels shown in the table below represent the total time, in man-hours, required for completion of MDOT-SHA test loop data analysis. These time estimates assume no issues are encountered while performing the required work.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff Member	Imagery QC	1	4.0
DAT Staff Member	Condition Data QC	1	4.0
DPT TL	QA	1	As Required ^{06/12/2019}
FED TL	Error Resolution	1	As Required
ADC	Error Resolution	1	As Required

3.07.05 *Procedure*

The procedure to perform the MDOT-SHA test loop data analysis is comprised of the following four tasks:

- (1) perform pavement imagery QC,
- (2) perform drive-through for lane adjustment and pavement event flagging and generate test loop QC report,
- (3) perform condition data QC and update test loop QC report, and
- (4) submit test loop QC report.

1- **Perform Pavement Imagery QC** – *performed by DPT Staff Member*

Summary: Under this task, the pavement images collected by the ARAN on the MDOT-SHA test loop are checked for correct aspect ratios, correct imaging intervals, and proper quality.

Step 1. After data have been loaded into Vision (see <u>Loading of ARAN Data Vision</u>) and LCMS Global Processor ran (see <u>Running Global LCMS Processor</u>), take measurements using the measurement tools in Vision (see below images).



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- Step 2. Compare measurements taken in Step 1 to the corresponding ground truth measurements to confirm that the images are not distorted (see markings in image below).
 - i. If images are within tolerance of +/- 3% of the actual measured length, proceed to Step 3.
 - ii. Otherwise, refer to <u>Test Loop Data Analysis Details</u> for error resolution guidelines.



- Step 3. Once the LCMS Global Processor has been run and the images created, check to confirm that the chainages have an interval of 0.004 miles (see chainage values in image below).
 - i. If the chainage values are at the correct interval, proceed to Step 4.
 - ii. Otherwise, refer to <u>Test Loop Data Analysis Details</u> for error resolution guidelines.

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Section Explorer Pavement							
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	: V Filter		L		T Filter c	rack types 👻	Tuno Souro
	: [Titter	-			[There	ack types +	Type Seve
40	Frame	Chainage	Crack	Sets (LaneWidt	Offset	Unsealed 0.03
	> 000000302557.fis	-3.046	14	7	141.010	1.288	Sealed 0.075
	000000308994.fis	0.954	80	30	145.122	2.912	crackwidth_1_8 0.12
	> 000000313432.118	8 955	6	3	138 697	12 559	crackwidth_1_4 0.250
	> 000000328306.fis	12.955	10	4	135.202	14.306	crackwidth_3_8 0.37
	> 000000334744.fis	16.955	6	3	132.289	15.763	crackwidth_1_2 0.500
	000000341181.fis	20.955	0	0	131.098	16.358	crackwidth_3_4 U./St
	→ 000000347619.fis	24.955	28	8	130.340	16.737	crackwidth 1 1.50
39	→ 000000354056.fis	28.955	22	11	129.671	17.072	crackwidth_2_in 2.00
		32.900	22	7	129.179	17.318	crackwidth_3_in 3.000
	> 000000373368 fis	40.955	8	4	130.045	16.885	crackwidth_0 >3.0
	> 000000379805.fis	44.955	14	7	130.763	16.526	에 Transverse All
	> 000000386243.fis	48.955	12	5	132.720	15.547	Unsealed 0.03
	→ 000000392680.fis	52.955	10	5	131.305	16.255	sealed 0.07
	- 000000399118.fis	56.955	20	7	133.318	15.248	crackwidth 1 4 0 250
	2 000000405555.fis	60.955	40	10	133.318	15.248	crackwidth 3 8 0.37
38	> 000000411992.fis	64.955	34	8	132.720	15.547	crackwidth_1_2 0.500
	000000418430.fts	72 955	32	10	131./38	15.038	crackwidth_3_4 0.750
	> 000000424887.11s	76 955	22	6	132.421	15.099	crackwidth_1_in 1.00
	> 000000437742.fis	80.955	42	9	133.916	14.949	crackwidth_1 1.500
	> 000000444179.fis	84.955	34	9	136.308	13.753	crackwidth_2_in
	> 000000450617.fis	88.955	20	5	137.205	13.305	crackwidth_3_in 3.00
	➢ 000000457054.fis	92.955	38	9	138.102	12.856	Crackwidth_O 2800
	→ 000000463491.fis	96.955	26	9	138.102	12.856	Unsealed 0.03
27	≥ 000000469929.fis	100.955	38	12	141.092	11.362	Sealed 0.075
	> 000004/6366.fis	104.955	40	12	142.288	10.764	crackwidth_1_8 0.12
	- 000000482804.fls	112 955	14	2	142.087	10.614	crackwidth_1_4 0.250
	> 000000405241.hs	116.955	22	10	143 520	10.403	crackwidth_3_8 0.375
	> 000000502116.fis	120.955	22	9	142.587	10.614	crackwidth_1_2 0.500
	> 000000508553.fis	124.955	28	10	142.288	10.764	crackwidth_3_4_0./5
	→ 000000514990.fis	128.955	16	7	141.690	11.063	crackwidth_1_in
	→ 000000521428.fis	132.955	38	14	141.092	11.362	<
		136.955	16	6	140.793	11.511	🛛 🔊 Summary 💿 Show Cracl
30	000000534303.tis	140.955	24	8	140.494	11.661	
	000000540740.55	144.300	6C 09	19	141.603	9.346	Type
	> 000000553615 fis	152 955	106	32	143.514	8 686	-01- Transverse
	> 000000560052.fis	156.955	84	26	142.019	8.536	
	> 000000566489.fis	160.955	14	6	142.617	8.536	
	> 000000572927.fis	164.955	18	6	143.598	9.027	
	→ 000000579364.fis	168.955	16	7	144.380	9.717	A Longitudinal
	≥ 000000585802.fis	172.955	22	10	143.782	10.016	🐣 Longitudinal
35	> 000000592239.fis	1/6.955	20	8	144.679	9.568	•1 Transverse
	000000598676.118	104 055	108	2/	144.6/9	9.068	A Longitudinal
	> 000000000114.ns	188 955	12	6	144.500	9.032	에 Transverse
	> 000000617988.fis	192.955	32	6	144.272	8.223	A Longitudinal
	> 000000624426.fis	196.955	24	11	145.219	8.065	
	→ 000000630863.fis	200.955	4	2	144.903	6.960	
	→ 000000637301.fis	204.955	36	16	144.272	6.645	
	→ 000000643738.fis	208.955	26	12	144.272	6.013	
34	>> 000000650175.fis	212.955	62	20	143.956	4.593	
	- 000000656673.fis	216.955	66	30	144.588	3.646	
		220.305	64 16	28	144.2/2	2.000	
	> 000000675925 fie	228.955	60	15	143.641	-0.616	
	> 000000682362.fis	232.955	114	34	143.325	-1.090	
	> 000000688800.fis	236.955	32	12	142.694	-2.037	
	→ 000000695237.fis	240.955	20	7	143.641	-1.248	
	→ 000000701674.fis	244.955	20	10	143.578	-2.226	
32	- 000000708112.fis	248.955	12	5	143.956	-1.405	
		767 055	10	0	142 050	N00 C	4

- Step 4. Visually check the pavement images to make sure there is no image distortion or gap/overlap in the middle and along the length of the images (see below image).
 - i. If the images do not have issues, proceed to Step 5.
 - ii. Otherwise, refer to <u>Test Loop Data Analysis Details</u> for error resolution guidelines.

Field Data Collection Test Loop Data Analysis





2- Perform Drive-through for Lane Adjustment and Pavement Event Flagging and **Generate Test Loop QC Report** – *performed by DPT Staff Member*

Summary: Under this task, the Vision software is used to analyze the LCMS output, correct errors in crack or joint detection, and mark events. Additionally, a QC report in MS Excel is created and results of the DPT QC checks are populated prior to submittal to the DAT for the subsequent tasks.

- Step 5. Follow <u>Performing 100% Drive Through</u> for performing drive-through of pavement images and LCMS output. Confirm the accuracy of GPS readings.
- Step 6. Open the "Test Loop Quality Control Summary Report" MS Excel template and create a new file with the following naming scheme: "ARAN#_ COLLECTIONDATETL_QC_REPORT_ANALYSISDATE"^{06/12/2019}. Complete the required fields and submit MS Excel template to the DAT staff member that will perform the subsequent tasks (see below image).

Date: 7/18/2018	Te.		TEST LOOP	QUALITY CONT	ROL SUMMARY REPORT	
Attrib	ute	Checked By	Satisfactory	Unsatisfactory	Comment	Action
Upload / I	mport	VC		N III		
	Image Aspect Ratio	VC	~	_		
Pavement Cracking	Imaging Interval	VC	1		Done by DPT	
mogery	Overlap/Gap	VC	*	¦ 4		-
- 1010000000	GPS Accuracy	VC	· · · · ·	1		
< -lest loop tocators -	DMI	SS	~			
	IRI	SS	~	ļ -		4
	SCD (Crack)	SS	~		Done by DAT	
Performance Measures	FCD (Crack)	SS	1		Bolle by Brit	
	RUT	SS	~			
	Crossfall	SS	1			
List of F	iles:	General Con	nments: The re	port has been uplo	oaded into EDW. A number of sections had	values that fell outside
87I0T4Q2		the expected	range with a v	ery small margin. H	lowever, the measured values were cons	istent for the three runs.
8710U4OM						
8710V4SY						
-						
		2				

- i. Under "List of Files," enter the names of the files being reviewed.
- ii. Next to "Upload/Import," place a check mark under the "Satisfactory" cell heading and enter reviewer initials under the "Checked By" cell heading (see above image). If the upload/import was not successfully completed, resolve issue before continuing.
- iii. Next to "Image Aspect Ratio," place a check mark under the "Satisfactory" or "Unsatisfactory" cell heading based on the review completed in Step 2 and enter reviewer initials under the "Checked By" cell heading. If the review was "Unsatisfactory," provide an explanation under the "Comment" cell heading and the required action under the "Action" cell heading (see above image).
- iv. Next to "Imaging Interval," place a check mark under the "Satisfactory" or "Unsatisfactory" cell heading based on the review completed in Step 3 and enter reviewer initials under the "Checked By" cell heading. If the review was "Unsatisfactory," provide an explanation under the "Comment" cell heading and the required action under the "Action" cell heading (see above image).

- v. Next to "Overlap/Gap," place a check mark under the "Satisfactory" or "Unsatisfactory" cell heading based on the review completed in Step 4 and enter reviewer initials under the "Checked By" cell heading. If the review was "Unsatisfactory", provide an explanation under the "Comment" cell heading and the required action under the "Action" cell heading (see above image).
- vi. Next to "GPS Accuracy," place a check mark under the "Satisfactory" or "Unsatisfactory" cell heading based on the review completed in Step 5 and enter reviewer initials under the "Checked By" cell heading. If the review was "Unsatisfactory," provide an explanation under the "Comment" cell heading and the required action under the "Action" cell heading (see above image).

3- Perform Condition Data QC and Update Test Loop QC Report – *performed by DAT Staff Member*

Summary: Under this task, the various condition data metrics from the MDOT-SHA test loop are reviewed against ground truth measurements. Additionally, the QC report created during the DPT QC checks is updated with the results of the DAT review.

Step 7. Open the "TL Condition QC" MS Excel template and create a new file with the date of the test loop data collection being reviewed^{06/12/2019}.

Step 8.	Paste work	e rav shee	w data et" (see	i froi e be	m the t low ima	est loop age).	colle	ection	effor	t as	dir	ecte	d in	the	"Past	te"

select	MP_SUFFIX	SEC_LENGTH	AVG_IRI	AVG_SCD	AVG_FCD	AVG_RUT	AVG_CROSSFALL
PASTE HERE \rightarrow	1	626.647	215.158	17.16	13.187	0.4381	1.709
	2	911.902	134.894	16.9	23.707	0.2744	1.532
	3	320.485	204.875	20.787	23.74	0.2359	2.561
	4	110.753	244.531	22.983	46.263	0.4208	5.221
	5	218.556	123.35	1.493	5.643	0.1794	1.741
	6	896.532	85.697	0.873	5.073	0.1589	-0.88
	7	225.441	104.589	0.673	3.91	0.3006	1.771
	8	67.728	147.546	0.363	2.28	0.3163	1.733
	9	189.044	169.978	1.45	4.517	0.3483	5.893
	10	107.994	235.688	1.283	2.003	0.3906	1.597
	11	360.513	133.755	0.463	1.49	0.3925	0.605
	12	875.785	68.889	0.883	1.787	0.2471	1.678
	13	103.264	64.892	0.707	2.177	0.0975	1.947
	14	473.894	83.486	1.29	4.183	0.1165	2.782
	15	193.118	161.267	2.933	6.4	0.157	2.977
	16	183.14	153.833	2.357	14.6	0.2918	-2.779
	17	121 8/19	96 504	0 522	0.5	0 1111	-0.516

- Step 9. Click over to the "Main" worksheet. Values for the current test loop data collection will populate in the spreadsheet for the following metrics under the "2018 Measured"^{06/12/2019} column: International Roughness Index (IRI), Rut, Structural Cracking (SC) Density, Functional Cracking (FC) Density, CrossFall, and Distance Measuring Instrument (DMI).
- Step 10. Review DMI data in Columns "AM" and "AN." There is only one section for evaluating DMI. The cell in Column "AN" with a bold box around it should be

populated with "Pass." Further details regarding the comparison criteria can be found in <u>Test Loop Data Analysis Details</u>.

- i. If the bold box reads "Pass," check is complete.
- ii. If the bold box reads "Fail," investigate the magnitude of the range error before continuing.
- Step 11. Review the IRI data in Columns "I" and "J" (see below image). Any cell in Column "J" with a bold box around should be populated with "Pass." Further details regarding the comparison criteria can be found in <u>Test Loop Data</u> <u>Analysis Details</u>.
 - i. If all or most bold boxes read "Pass," check is complete.
 - ii. If there are several bold boxes that read "Fail", investigate the magnitude of the range errors before continuing.

	A	В	C	D	E	F	G	Н		J
1	MD SHEEV	Pouto Namo	SEC LENGTH				IRI			
2	ME_SOLUS	noute Marine	SEC_LENGIN	2017 5th	2017 95th	2018 AVG	2018 Low	2018 High	2018 Measured	Check
3	1	1-MD-176 E - Res 2000 Comp-Sealed Crack - Asphalt	627.34	180.524	227.602	217.18	193.641	240.719	215.158	Pass
4	2	2-MD-176 E - Res 2002 Comp-Asphalt	912.66	125.109	142.635	133.918	125.155	142.681	134.894	Pass
5	3	3-MD-176 E - Transition and Exit Iane Comp-Sealed Crack - Asphalt	317.55	172.159	200.412	199.604	185.4775	213.7305	204.875	Pass
6	4	4-Ramp from MD-176 E to I-97 S Asphalt - Ramp	109.09	206.445	235.993	263.139	248.365	277.913	244.531	Fail
7	5	5-I-97 S Lane Transition JCP	223.47	111.155	124.887	128.004	121.138	134.87	123.35	Pass
8	6	6-I-97 S CRCP	894.89	83.897	88.607	85.656	83.301	88.011	85.697	Pass
9	7	7-I-97 S Lane Transition CRCP/JCP	225.09	96.527	110.45	103.358	96.3965	110.3195	104.589	Pass
10	8	8-I-97 S Decel Lane JCP	67.28	135.568	171.861	160.912	142.7655	179.0585	147.546	Pass
11	9	9-Ramp from I-97 S to MD-174 W Asphalt - Ramp	188.94	150.744	184.739	166.469	149.4715	183.4665	169.978	Pass
12	10	10-MD-174 W RS2004 Asphalt	108.57	226.593	266.458	249.252	229.3195	269.1845	235.688	Pass
13	11	11-MD-174 W 2Lane (Resurfaced 2005) Asphalt	360.28	115.204	127.824	122.249	115.939	128.559	133.755	Fail
14	12	12-MD-174 W 1Lane (Resurfaced 2005) Asphalt	874.9	67.832	76.392	71	66.72	75.28	68.889	Pass
15	13	13-MD-174 W (Rut section # 1) Asphalt	105.4	61.889	72.148	64.858	59.7285	69.9875	64.892	Pass
16	14	14-MD-174 W 1Lane (Resurfaced 2005) Asphalt	472.05	77.496	89.8	79.912	73.76	86.064	83.486	Pass
17	15	15-MD-174 W 2Lane (Resurfaced 2005) Asphalt	192.6	122.032	170.035	149.636	125.6345	173.6375	161.267	Pass
18	16	16-MD-174 W Transition Decel Lane Asphalt	185.22	137.058	166.778	157.105	142.245	171.965	153.833	Pass
19	17	17-MD-170 N 2Lane Asphalt	134.58	68.342	113.095	87.671	65.2945	110.0475	96.504	Pass
20	18	18-MD-170 N 1Lane Asphalt	360.1	91.61	98.978	94.531	90.847	98.215	93.858	Pass
21	19	19-MD-170 N 2Lane Asphalt	170.22	78.378	92.355	88.944	81.9555	95.9325	89.988	Pass
22	20	20-Ramp from MD-170 N to MD 100 E Asphalt	570.03	78.348	84.197	81.219	78.2945	84.1435	82.764	Pass
23	21	21-MD-100 Asphalt	301.94	70.741	76.061	74.139	71.479	76.799	73.679	Pass
24	22	22-MD-100 (one mile survey-dmi) Asphalt	1002.15	75.444	79.212	77.077	75.193	78.961	77.191	Pass
25	23	23-Exit Ramp from MD-100 Asphalt	505.89	92.504	105.392	101.102	94.658	107.546	102.012	Pass
26	24	24-ramp from MD 100 E to I 97 N Asphalt	259.18	122.633	139.993	137.95	129.27	146.63	131.945	Pass
27	25	25-Bridge on the ramp from MD 100 E to I 97 N Concrete Bridge Deck	39.9	136.323	188.265	169.39	143.419	195.361	162.69	Pass
28	26	26-ramp from MD-100 E to I-97 N Asphalt	268.82	119.542	130.877	126.802	121.1345	132.4695	127.37	Pass
29	27	27-I-97 N Accel Lane Transition JCP	263.61	99.211	136.123	115.257	96.801	133.713	124.009	Pass
30	28	28-I-97 N CRCP	108.28	102.022	117.481	106.724	98.9945	114.4535	110.651	Pass
31	29	29-I-97 N - Iane change - exit 15 JCP	249.91	94.16	111.077	101.216	92.7575	109.6745	102.06	Pass
32	30	30-I-97 N CRCP	369.11	106.909	116.477	111.508	106.724	116.292	109.624	Pass
33	31	31-I-97 N Bridge App - IRI Ground Truth Asphalt Approach	50.96	94.463	123.993	110.226	95.461	124.991	105.807	Pass
34	32	32-I-97 N Bridge Concrete Bridge Deck	55.84	139.608	155.853	147.85	139.7275	155.9725	148.225	Pass
35	33	33-I-97 N Asphalt Departure Asphalt	23.42	148.395	227.004	305.895	266.5905	345.1995	264.783	Fail
36	34	34-I-97 N Decel lane - Exit 15 B CRCP (Left)/JCP (Right)	60.43	130.487	153.713	136.647	125.034	148.26	158.697	Fail
37	35	35-Ramp from I-97 N to MD-176 W JCP	60.86	224.325	253.923	239.715	224.916	254.514	231.862	Pass
38	36	36-Ramp from I-97 N to MD-176 W Asphalt	179.49	180.539	203.864	194.402	182.7395	206.0645	195.364	Pass
39	37	37-MD-176 W (Resurfaced 1997) Asphalt	301.12	119.232	130.49	127.648	122.019	133.277	120.43	Fail
40	38	38-MD-176 W (Resurfaced 2002) Asphalt	43.55	124.805	147.586	135.875	124.4845	147.2655	133.81	Pass
41	39	39-MD-176 W (Rut section # 2) Asphalt	53.49	112.84	212.266	143.107	93.394	192.82	128.1	Pass
42	40	40-MD-176 W Asphalt	213.13	111.858	132.384	129.8	119.537	140.063	144.529	Fail
43	41	41-MD-176 W (Rut section # 3) Asphalt	100.41	95.34	116.661	107.294	96.6335	117.9545	107.391	Pass
44	42	42-MD-176 W Asphalt	622.12	114.189	127.987	124.502	117.603	131.401	127.708	Pass
45	43	43-MD-176 W (Rut section # 4) Asphalt	105.37	125.015	143.462	133.825	124.6015	143.0485	142.345	Pass
46	44	44-MD-176 W Asphalt	97.61	128.515	162.132	141.811	125.0025	158.6195	172.747	Fail
47	45	45-MD-176 W Asphalt	627.49	104.348	112.868	107.539	103.279	111.799	113.037	Fail

- Step 12. Review the rutting data in Columns "P" and "Q" (see below image). Any cell in Column "Q" with a bold box around it should be populated with "Pass." Further details regarding the comparison criteria can be found in <u>Test Loop Data Analysis Details</u>.
 - i. If all or most bold boxes read "Pass," check is complete.
 - ii. If there are several bold boxes that read "Fail," investigate the magnitude of the range errors before continuing.

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	A	В	С	К	L	M	N	0	P	Q
1	MD SHEEK	Poute Name	SEC LENGTH				RUT			
2	MI _301117	Howervane	SEC_EENOT	2017 5th	2017 95th	2018 AVG	2018 Low	2018 High	2018 Measured	Check
3	1	1-MD-176 E - Res 2000 Comp-Sealed Crack - Asphalt	627.34	0.4097	0.4435	0.4327	0.4158	0.4496	0.4381	Pass
4	2	2-MD-176 E - Res 2002 Comp-Asphalt	912.66	0.2434	0.2634	0.2718	0.2618	0.2818	0.2744	Pass
5	3	3-MD-176 E - Transition and Exit Iane Comp-Sealed Crack - Asphalt	317.55	0.2051	0.2607	0.2367	0.2089	0.2645	0.2359	Pass
6	4	4-Ramp from MD-176 E to I-97 S Asphalt - Ramp	109.09	0.3682	0.4134	0.4136	0.391	0.4362	0.4208	Pass
7	5	5-I-97 S Lane Transition JCP	223.47	0.1763	0.24	0.1775	0.14565	0.20935	0.1794	Pass
8	6	6-I-97 S CRCP	894.89	0.1378	0.1683	0.1549	0.13965	0.17015	0.1589	Pass
9	7	7-I-97 S Lane Transition CRCP/JCP	225.09	0.2613	0.3748	0.279	0.22225	0.33575	0.3006	Pass
10	8	8-I-97 S Decel Lane JCP	67.28	0.2743	0.3297	0.3106	0.2829	0.3383	0.3163	Pass
11	9	9-Ramp from I-97 S to MD-174 W Asphalt - Ramp	188.94	0.2832	0.3311	0.3236	0.29965	0.34755	0.3483	Fail
12	10	10-MD-174 W RS2004 Asphalt	108.57	0.3602	0.4387	0.3926	0.35335	0.43185	0.3906	Pass
13	11	11-MD-174 W 2Lane (Resurfaced 2005) Asphalt	360.28	0.3426	0.3826	0.3688	0.3488	0.3888	0.3925	Fail
14	12	12-MD-174 W 1Lane (Resurfaced 2005) Asphalt	874.9	0.1996	0.2412	0.2264	0.2056	0.2472	0.2471	Pass
15	13	13-MD-174 W (Rut section # 1) Asphalt	105.4	0.0822	0.1029	0.0984	0.08805	0.10875	0.0975	Pass
16	14	14-MD-174 W 1Lane (Resurfaced 2005) Asphalt	472.05	0.1065	0.1251	0.1098	0.1005	0.1191	0.1165	Pass
17	15	15-MD-174 W 2Lane (Resurfaced 2005) Asphalt	192.6	0.1399	0.1745	0.1517	0.1344	0.169	0.157	Pass
18	16	16-MD-174 W Transition Decel Lane Asphalt	185.22	0.2901	0.3794	0.3186	0.27395	0.36325	0.2918	Pass
19	17	17-MD-170 N 2Lane Asphak	134.58	0.0832	0.1148	0.1005	0.0847	0.1163	0.1111	Pass
20	18	18-MD-170 N 1Lane Asphalt	360.1	0.087	0.1086	0.1091	0.0983	0.1199	0.1245	Fail
21	19	19-MD-170 N 2Lane Asphalt	170.22	0.1316	0.1608	0.1474	0.1328	0.162	0.1849	Fail
22	20	20-Ramp from MD-170 N to MD 100 E Asphalt	570.03	0.1229	0.1437	0.1392	0.1288	0.1496	0.1578	Fail
23	21	21-MD-100 Asphalt	301.94	0.2123	0.2394	0.2201	0.20655	0.23365	0.2259	Pass
24	22	22-MD-100 (one mile survey-dmi) Asphalt	1002.15	0.267	0.2975	0.2843	0.26905	0.29955	0.299	Pass
25	23	23-Exit Ramp from MD-100 Asphalt	505.89	0.2033	0.2275	0.2133	0.2012	0.2254	0.225	Pass
26	24	24-ramp from MD 100 E to I 97 N Asphalt	259.18	0.1572	0.1736	0.1684	0.1602	0.1766	0.1777	Fail
27	25	25-Bridge on the ramp from MD 100 E to I 97 N Concrete Bridge Deck	39.9	0.1226	0.1627	0.1407	0.12065	0.16075	0.1449	Pass
28	26	26-ramp from MD-100 E to I-97 N Asphalt	268.82	0.1268	0.1574	0.136	0.1207	0.1513	0.1466	Pass
29	27	27-I-97 N Accel Lane Transition JCP	263.61	0.2064	0.2804	0.2061	0.1691	0.2431	0.2471	Fail
30	28	28-I-97 N CRCP	108.28	0.1783	0.2331	0.1831	0.1557	0.2105	0.189	Pass
31	29	29-I-97 N - Iane change - exit 15 JCP	249.91	0.2046	0.271	0.2019	0.1687	0.2351	0.2158	Pass
32	30	30-I-97 N CRCP	369.11	0.1079	0.1382	0.1113	0.09615	0.12645	0.1158	Pass
33	31	31-I-97 N Bridge App - IRI Ground Truth Asphalt Approach	50.96	0.1482	0.1897	0.1777	0.15695	0.19845	0.1964	Pass
34	32	32-I-97 N Bridge Concrete Bridge Deck	55.84	0.1201	0.1526	0.1364	0.12015	0.15265	0.1388	Pass
35	33	33-I-97 N Asphalt Departure Asphalt	23.42	0.1119	0.1423	0.122	0.1068	0.1372	0.1237	Pass
36	34	34-I-97 N Decel Iane - Exit 15 B CRCP (Left)/JCP (Right)	60.43	0.199	0.2425	0.214	0.19225	0.23575	0.2252	Pass
37	35	35-Ramp from I-97 N to MD-176 W JCP	60.86	0.1779	0.2297	0.1984	0.1725	0.2243	0.2157	Pass
38	36	36-Ramp from I-97 N to MD-176 W Asphalt	179.49	0.2052	0.2289	0.2232	0.21135	0.23505	0.228	Pass
39	37	37-MD-176 W (Resurfaced 1997) Asphalt	301.12	0.1453	0.1943	0.1617	0.1372	0.1862	0.1573	Pass
40	38	38-MD-176 W (Resurfaced 2002) Asphalt	43.55	0.179	0.2424	0.2039	0.1722	0.2356	0.2069	Pass
41	39	39-MD-176 W (Rut section # 2) Asphalt	53.49	0.2621	0.3772	0.3399	0.28235	0.39745	0.3383	Pass
42	40	40-MD-176 W Asphalt	213.13	0.2424	0.2841	0.2772	0.25635	0.29805	0.2781	Pass
43	41	41-MD-176 W (Rut section # 3) Asphalt	100.41	0.2508	0.2813	0.2702	0.25495	0.28545	0.2838	Pass
44	42	42-MD-176 W Asphalt	622.12	0.3485	0.433	0.4201	0.37785	0.46235	0.4292	Pass
45	43	43-MD-176 W (Rut section # 4) Asphalt	105.37	0.6069	0.7959	0.7365	0.642	0.831	0.757	Pass
46	44	44-MD-176 W Asphalt	97.61	0.4307	0.5033	0.4879	0.4516	0.5242	0.494	Pass
47	45	45-MD-176 W Asphalt	627.49	0.225	0.2571	0.2378	0.22175	0.25385	0.2465	Pass

- Step 13. Review the SC Density data in Columns "W" and "X" (see below image). Any cell in Column "X" with a bold box around it should be populated with "Pass." Further details regarding the comparison criteria can be found in <u>Test Loop</u> <u>Data Analysis Details</u>.
 - i. If all or most bold boxes read "Pass," check is complete.
 - ii. If there are several bold boxes that read "Fail," investigate the magnitude of the range errors before continuing.

STATE HIGHWAY ADMINISTRATION

	A	В	С	R	S	Т	U	V	W	×
1	MD SUFFIX	Boute Name	SEC LENGTH				SC DENS	SITY		
2		Howersame	SEC_EENOIT	2017 5th	2017 95th	2018 AVG	2018 Low	2018 High	2018 Measured	Check
3	1	1-MD-176 E - Res 2000 Comp-Sealed Crack - Asphalt	627.34	9.274	16.466	17.709	14.113	21.305	17.16	Pass
4	2	2-MD-176 E - Res 2002 Comp-Asphalt	912.66	9.494	16.372	16.814	13.375	20.253	16.9	Pass
5	3	3-MD-176 E - Transition and Exit Iane Comp-Sealed Crack - Asphalt	317.55	10.55	19.952	21.555	16.854	26.256	20.787	Pass
6	4	4-Ramp from MD-176 E to I-97 S Asphalt - Ramp	109.09	13.586	23.2	21.718	16.911	26.525	22.983	Pass
7	5	5-I-97 S Lane Transition JCP	223.47	0.85	1.506	1.157	0.829	1.485	1.493	Fail
8	6	6-I-97 S CRCP	894.89	0.402	0.752	0.618	0.443	0.793	0.873	Fail
9	7	7-I-97 S Lane Transition CRCP/JCP	225.09	0.27	0.636	0.579	0.396	0.762	0.673	Pass
10	8	8-I-97 S Decel Lane JCP	67.28	0.116	0.528	0.277	0.071	0.483	0.363	Pass
11	9	9-Ramp from I-97 S to MD-174 W Asphalt - Ramp	188.94	0.576	3.376	2.029	0.629	3.429	1.45	Pass
12	10	10-MD-174 W RS2004 Asphalt	108.57	0.386	1.406	1.113	0.603	1.623	1.283	Pass
13	11	11-MD-174 W 2Lane (Resurfaced 2005) Asphalt	360.28	0.182	0.824	0.828	0.507	1.149	0.463	Fail
14	12	12-MD-174 W 1Lane (Resurfaced 2005) Asphalt	874.9	0.438	1.336	1.275	0.826	1.724	0.883	Pass
15	13	13-MD-174 W (Rut section # 1) Asphalt	105.4	0.21	0.81	0.709	0.409	1.009	0.707	Pass
16	14	14-MD-174 W 1Lane (Resurfaced 2005) Asphalt	472.05	0.548	1.488	1.225	0.755	1.695	1.29	Pass
17	15	15-MD-174 W 2Lane (Resurfaced 2005) Asphalt	192.6	1.552	4.076	2.977	1.715	4.239	2.933	Pass
18	16	16-MD-174 W Transition Decel Lane Asphalt	185.22	1.524	5.224	3.686	1.836	5.536	2.357	Pass
19	17	17-MD-170 N 2Lane Asphalt	134.58	0.144	1.358	0.722	0.115	1.329	0.533	Pass
20	18	18-MD-170 N 1Lane Asphalt	360.1	0.08	0.654	0.474	0.187	0.761	0.237	Pass
21	19	19-MD-170 N 2Lane Asphalt	170.22	0.08	1.48	0.18	-0.52	0.88	0.907	Fail
22	20	20-Ramp from MD-170 N to MD 100 E Asphalt	570.03	0.206	1.098	0.906	0.46	1.352	0.597	Pass
23	21	21-MD-100 Asphalt	301.94	0.112	1	0.506	0.062	0.95	0.44	Pass
24	22	22-MD-100 (one mile survey-dmi) Asphalt	1002.15	0.25	1.088	0.869	0.45	1.288	0.64	Pass
25	23	23-Exit Ramp from MD-100 Asphalt	505.89	3.006	5.578	6.174	4.888	7.46	6.397	Pass
26	24	24-ramp from MD 100 E to I 97 N Asphalt	259.18	0.9	2.727	2.522	1.6085	3.4355	2.147	Pass
27	25	25-Bridge on the ramp from MD 100 E to I 97 N Concrete Bridge Deck	39.9	0.016	0.195	0.103	0.0135	0.1925	0.087	Pass
28	26	26-ramp from MD-100 E to I-97 N Asphalt	268.82	1.19	2.36	1.82	1.235	2.405	2.163	Pass
29	27	27-I-97 N Accel Lane Transition JCP	263.61	0.24	0.65	0.477	0.272	0.682	0.36	Pass
30	28	28-I-97 N CRCP	108.28	0.806	2.266	1.359	0.629	2.089	1.233	Pass
31	29	29-1-97 N - Iane change - exit 15 JCP	249.91	0.776	1.488	1.257	0.901	1.613	1.23	Pass
32	30	30-I-97 N CRCP	369.11	0.92	1.495	1.28	0.9925	1.5675	1.48	Pass
33	31	31-I-97 N Bridge App - IRI Ground Truth Asphalt Approach	50.96	0.21	1.307	0.792	0.2435	1.3405	0.767	Pass
34	32	32-I-97 N Bridge Concrete Bridge Deck	55.84	0.793	2.174	1.946	1.2555	2.6365	1.72	Pass
35	33	33-I-97 N Asphalt Departure Asphalt	23.42	0	0.492	0.117	-0.129	0.363	0.35	Pass
36	34	34-I-97 N Decel Iane - Exit 15 B CRCP (Left)/JCP (Right)	60.43	0.07	0.355	0.191	0.0485	0.3335	0.23	Pass
37	35	35-Ramp from I-97 N to MD-176 W JCP	60.86	0.146	1.061	0.511	0.0535	0.9685	0.487	Pass
38	36	36-Ramp from I-97 N to MD-176 W Asphalt	179.49	11.333	19.761	17.615	13.401	21.829	19.133	Pass
39	37	37-MD-176 W (Resurfaced 1997) Asphalt	301.12	4.055	7.863	7.125	5.221	9.029	7.61	Pass
40	38	38-MD-176 W (Resurfaced 2002) Asphalt	43.55	6.263	14.387	13.465	9.403	17.527	13.207	Pass
41	39	39-MD-176 W (Rut section # 2) Asphalt	53.49	6.15	13.478	11.551	7.887	15.215	13.493	Pass
42	40	40-MD-176 W Asphalt	213.13	12.326	22.864	21.382	16.113	26.651	21.957	Pass
43	41	41-MD-176 W (Rut section # 3) Asphalt	100.41	24.325	41.601	41.024	32.386	49.662	42.847	Pass
44	42	42-MD-176 W Asphalt	622.12	22.314	36.063	35.492	28.6175	42.3665	36.78	Pass
45	43	43-MD-176 W (Rut section # 4) Asphalt	105.37	25.625	43.665	39.845	30.825	48.865	45.56	Pass
46	44	44-MD-176 W Asphalt	97.61	19.599	35.215	32.614	24.806	40.422	34.49	Pass
47	45	45-MD-176 W Asphalt	627.49	5.672	9.858	9.717	7.624	11.81	10.44	Pass

- Step 14. Review the FC Density data in Columns "AD" and "AE" (see below image). Any cell in Column "AE" with a bold box around it should be populated with "Pass." Further details regarding the comparison criteria can be found in <u>Test</u> <u>Loop Data Analysis Details</u>.
 - i. If all or most bold boxes read "Pass," check is complete.
 - ii. If there are several bold boxes that read "Fail," investigate the magnitude of the range errors before continuing.

STATE HIGHWAY ADMINISTRATION

	A	В	С	Y	z	AA	AB	AC	AD	AE
1	MP SLIFFIX	Route Name	SEC LENGTH				FC DENS	TY		
2	ME_0011/A	Houte Name	SEC_EENOT	2017 5th	2017 95th	2018 AVG	2018 Low	2018 High	2018 Measured	Check
3	1	1-MD-176 E - Res 2000 Comp-Sealed Crack - Asphalt	627.34	5.95	12.926	13.256	9.768	16.744	13.187	Pass
4	2	2-MD-176 E - Res 2002 Comp-Asphalt	912.66	11.942	23.212	23.472	17.837	29.107	23.707	Pass
5	3	3-MD-176 E - Transition and Exit Iane Comp-Sealed Crack - Asphalt	317.55	11.088	23.332	22.368	16.246	28.49	23.74	Pass
6	4	4-Ramp from MD-176 E to I-97 S Asphalt - Ramp	109.09	24.834	47.632	46.733	35.334	58.132	46.263	Pass
7	5	5-I-97 S Lane Transition JCP	223.47	2.09	5.528	3.874	2.155	5.593	5.643	Fail
8	6	6-I-97 S CRCP	894.89	4.006	4.878	4.684	4.248	5.12	5.073	Pass
9	7	7-I-97 S Lane Transition CRCP/JCP	225.09	2.69	5.184	4.252	3.005	5.499	3.91	Pass
10	8	8-I-97 S Decel Lane JCP	67.28	1.604	3.61	2.045	1.042	3.048	2.28	Pass
11	9	9-Ramp from I-97 S to MD-174 W Asphalt - Ramp	188.94	1.89	4.568	4.355	3.016	5.694	4.517	Pass
12	10	10-MD-174 W RS2004 Asphalt	108.57	0.92	4.448	1.54	0	3.304	2.003	Pass
13	11	11-MD-174 W 2Lane (Resurfaced 2005) Asphalt	360.28	0.896	3.678	2.927	1.536	4.318	1.49	Fail
14	12	12-MD-174 W 1Lane (Resurfaced 2005) Asphalt	874.9	1.096	2.334	1.881	1.262	2.5	1.787	Pass
15	13	13-MD-174 W (Rut section # 1) Asphalt	105.4	0.972	3.824	1.967	0.541	3.393	2.177	Pass
16	14	14-MD-174 W 1Lane (Resurfaced 2005) Asphalt	472.05	2.262	4.714	3.898	2.672	5.124	4.183	Pass
17	15	15-MD-174 W 2Lane (Resurfaced 2005) Asphalt	192.6	3.42	7.814	6.988	4.791	9.185	6.4	Pass
18	16	16-MD-174 W Transition Decel Lane Asphalt	185.22	9.86	18.496	17.715	13.397	22.033	14.6	Pass
19	17	17-MD-170 N 2Lane Asphalt	134.58	0.136	1.106	0.475	0	0.96	0.5	Pass
20	18	18-MD-170 N 1Lane Asphalt	360.1	0.076	0.566	0.248	0.003	0.493	1.14	Fail
21	19	19-MD-170 N 2Lane Asphalt	170.22	0.07	0.392	0.529	0.368	0.69	1.46	Fail
22	20	20-Ramp from MD-170 N to MD 100 E Asphalt	570.03	0.466	0.994	0.71	0.446	0.974	0.533	Pass
23	21	21-MD-100 Asphalt	301.94	1.338	5.152	3.89	1.983	5.797	2.843	Pass
24	22	22-MD-100 (one mile survey-dmi) Asphalt	1002.15	1.694	4.938	3.984	2.362	5.606	3.127	Pass
25	23	23-Exit Ramp from MD-100 Asphalt	505.89	3.278	6.774	7.446	5.698	9.194	7.957	Pass
26	24	24-ramp from MD 100 E to I 97 N Asphalt	259.18	1.792	3.48	3.306	2.462	4.15	3.18	Pass
27	25	25-Bridge on the ramp from MD 100 E to I 97 N Concrete Bridge Deck	39.9	0.184	1.611	0.862	0.1485	1.5755	0.583	Pass
28	26	26-ramp from MD-100 E to I-97 N Asphalt	268.82	2.303	11.718	5.468	0.7605	10.1755	6.657	Pass
29	27	27-I-97 N Accel Lane Transition JCP	263.61	1.323	2.277	1.9	1.423	2.377	1.753	Pass
30	28	28-I-97 N CRCP	108.28	5.906	9.576	7.758	5.923	9.593	7.16	Pass
31	29	29-I-97 N - Iane change - exit 15 JCP	249.91	1.362	3.581	2.065	0.9555	3.1745	1.58	Pass
32	30	30-I-97 N CRCP	369.11	9.411	12.801	12.099	10.404	13.794	13.137	Pass
33	31	31-I-97 N Bridge App - IRI Ground Truth Asphalt Approach	50.96	0.14	2.034	0.872	0	1.819	0.84	Pass
34	32	32-I-97 N Bridge Concrete Bridge Deck	55.84	0.887	3.215	2.231	1.067	3.395	1.613	Pass
35	33	33-I-97 N Asphalt Departure Asphalt	23.42	0.04	2.378	0.575	0	1.744	0.363	Pass
36	34	34-I-97 N Decel Iane - Exit 15 B CRCP (Left)/JCP (Right)	60.43	1.054	3.392	2.64	1.471	3.809	2.55	Pass
37	35	35-Ramp from I-97 N to MD-176 W JCP	60.86	2.103	7.13	3.29	0.7765	5.8035	4.177	Pass
38	36	36-Ramp from I-97 N to MD-176 W Asphalt	179.49	17.546	46.219	37.216	22.8795	51.5525	43.06	Pass
39	37	37-MD-176 W (Resurfaced 1997) Asphalt	301.12	12.162	24.529	20.263	14.0795	26.4465	22.813	Pass
40	38	38-MD-176 W (Resurfaced 2002) Asphalt	43.55	14.908	29.377	24.105	16.8705	31.3395	28.787	Pass
41	39	39-MD-176 W (Rut section # 2) Asphalt	53.49	10.969	26.912	22.368	14.3965	30.3395	27.02	Pass
42	40	40-MD-176 W Asphalt	213.13	17.225	39.64	34.914	23.7065	46.1215	35.793	Pass
43	41	41-MD-176 W (Rut section # 3) Asphalt	100.41	30.984	59.489	53.81	39.5575	68.0625	59.093	Pass
44	42	42-MD-176 W Asphalt	622.12	38.059	64.137	61.626	48.587	74.665	69.85	Pass
45	43	43-MD-176 W (Rut section # 4) Asphalt	105.37	36.133	67.429	62.116	46.468	77.764	72.957	Pass
46	44	44-MD-176 W Asphalt	97.61	25.011	47.368	42.428	31.2495	53.6065	45.54	Pass
47	45	45-MD-176 W Asphalt	627.49	9.682	18.076	16.426	12.229	20.623	19.89	Pass

- Step 15. Review the crossfall data in Columns "AK" and "AL" (see below image). Any cell in Column "AL" with a bold box around it should be populated with "Pass," Further details regarding the comparison criteria can be found in <u>Test Loop</u> <u>Data Analysis Details</u>.
 - i. If all or most bold boxes read "Pass", check is complete.
 - ii. If there are several bold boxes that read "Fail", investigate the magnitude of the range errors before continuing.

Maryland department of transportation

STATE HIGHWAY ADMINISTRATION

Field Data Collection Test Loop Data Analysis

	A	В	С	AF	AG	AH	AI	AJ	AK	AL
1	MP SHEETY	Route Name	SEC LENGTH				CrossFall			
2		Houte Mame	SEC_EENSIT	2017 5th	2017 95th	2018 AVG	2018 Low	2018 High	2018 Measured	Check
3	1	1-MD-176 E - Res 2000 Comp-Sealed Crack - Asphalt	627.34	1.702	1.867	1.758	1.6755	1.8405	1.709	Pass
4	2	2-MD-176 E - Res 2002 Comp-Asphalt	912.66	1.536	1.686	1.603	1.528	1.678	1.532	Pass
5	3	3-MD-176 E - Transition and Exit Iane Comp-Sealed Crack - Asphalt	317.55	2.256	2.757	2.483	2.2325	2.7335	2.561	Pass
6	4	4-Ramp from MD-176 E to I-97 S Asphalt - Ramp	109.09	5.221	5.424	5.267	5.1655	5.3685	5.221	Pass
7	5	5-I-97 S Lane Transition JCP	223.47	1.593	1.913	1.744	1.584	1.904	1.741	Pass
8	6	6-I-97 S CRCP	894.89	-0.931	-0.696	-0.855	-0.9725	-0.7375	-0.88	Pass
9	7	7-I-97 S Lane Transition CRCP/JCP	225.09	1.787	2.027	1.874	1.754	1.994	1.771	Pass
10	8	8-I-97 S Decel Lane JCP	67.28	1.794	1.971	1.872	1.7835	1.9605	1.733	Fail
11	9	9-Ramp from I-97 S to MD-174 W Asphalt - Ramp	188.94	5.855	6.2	5.983	5.8105	6.1555	5.893	Pass
12	10	10-MD-174 W RS2004 Asphalt	108.57	1.581	2.015	1.719	1.502	1.936	1.597	Pass
13	11	11-MD-174 W 2Lane (Resurfaced 2005) Asphalt	360.28	0.59	0.826	0.693	0.575	0.811	0.605	Pass
14	12	12-MD-174 W 1Lane (Resurfaced 2005) Asphalt	874.9	1.715	1.899	1.803	1.711	1.895	1.678	Fail
15	13	13-MD-174 W (Rut section # 1) Asphalt	105.4	1.99	2.42	2.305	2.09	2.52	1.947	Fail
16	14	14-MD-174 W 1Lane (Resurfaced 2005) Asphalt	472.05	2.715	2.971	2.883	2.755	3.011	2.782	Pass
17	15	15-MD-174 W 2Lane (Resurfaced 2005) Asphalt	192.6	2.622	3.241	2.963	2.6535	3.2725	2.977	Pass
18	16	16-MD-174 W Transition Decel Lane Asphalt	185.22	-2.784	-2.605	-2.716	-2.8055	-2.6265	-2.779	Pass
19	17	17-MD-170 N 2Lane Asphalt	134.58	-1.615	1.12	-0.828	-2.1955	0.5395	-0.516	Pass
20	18	18-MD-170 N 1Lane Asphalt	360.1	-1.633	-1.454	-1.588	-1.6775	-1.4985	-1.613	Pass
21	19	19-MD-170 N 2Lane Asphalt	170.22	1.344	1.52	1.405	1.317	1.493	1.385	Pass
22	20	20-Ramp from MD-170 N to MD 100 E Asphalt	570.03	1.532	2.011	1.829	1.5895	2.0685	1.856	Pass
23	21	21-MD-100 Asphalt	301.94	3.545	3.774	3.579	3.4645	3.6935	3.519	Pass
24	22	22-MD-100 (one mile survey-dmi) Asphalt	1002.15	1.075	1.269	1.097	1	1.194	1.023	Pass
25	23	23-Exit Ramp from MD-100 Asphalt	505.89	4.051	4.202	4.117	4.0415	4.1925	4.072	Pass
26	24	24-ramp from MD 100 E to I 97 N Asphalt	259.18	-4.281	-3.994	-4.118	-4.2615	-3.9745	-4.164	Pass
27	25	25-Bridge on the ramp from MD 100 E to I 97 N Concrete Bridge Deck	39.9	1.833	2.034	1.919	1.8185	2.0195	1.856	Pass
28	26	26-ramp from MD-100 E to I-97 N Asphalt	268.82	7.169	7.472	7.284	7.1325	7.4355	7.232	Pass
29	27	27-I-97 N Accel Lane Transition JCP	263.61	1.839	2.162	1.943	1.7815	2.1045	1.778	Fail
30	28	28-I-97 N CRCP	108.28	3.021	3.226	3.062	2.9595	3.1645	3.037	Pass
31	29	29-I-97 N - Iane change - exit 15 JCP	249.91	3.091	3.779	3.533	3.189	3.877	3.581	Pass
32	30	30-I-97 N CRCP	369.11	2.288	2.482	2.343	2.246	2.44	2.312	Pass
33	31	31-I-97 N Bridge App - IRI Ground Truth Asphalt Approach	50.96	1.466	1.637	1.516	1.4305	1.6015	1.474	Pass
34	32	32-I-97 N Bridge Concrete Bridge Deck	55.84	1.401	1.595	1.462	1.365	1.559	1.415	Pass
35	33	33-I-97 N Asphalt Departure Asphalt	23.42	1.378	1.611	1.451	1.3345	1.5675	1.399	Pass
36	34	34-I-97 N Decel Iane - Exit 15 B CRCP (Left)/JCP (Right)	60.43	1.665	1.806	1.699	1.6285	1.7695	1.624	Fail
37	35	35-Ramp from I-97 N to MD-176 W JCP	60.86	4.568	4.722	4.577	4.5	4.654	4.512	Pass
38	36	36-Ramp from I-97 N to MD-176 W Asphalt	179.49	6.791	6.959	6.829	6.745	6.913	6.787	Pass
39	37	37-MD-176 W (Resurfaced 1997) Asphalt	301.12	1.397	1.775	1.593	1.404	1.782	1.638	Pass
40	38	38-MD-176 W (Resurfaced 2002) Asphalt	43.55	1.945	2.169	2.048	1.936	2.16	1.956	Pass
41	39	39-MD-176 W (Rut section # 2) Asphalt	53.49	1.538	1.793	1.562	1.4345	1.6895	1.465	Pass
42	40	40-MD-176 W Asphalt	213.13	0.534	0.709	0.586	0.4985	0.6735	0.536	Pass
43	41	41-MD-176 W (Rut section # 3) Asphalt	100.41	2.01	2.229	2.1	1.9905	2.2095	2.075	Pass
44	42	42-MD-176 W Asphalt	622.12	2.222	2.397	2.274	2.1865	2.3615	2.202	Pass
45	43	43-MD-176 W (Rut section # 4) Asphalt	105.37	2.525	2.757	2.589	2.473	2.705	2.334	Fail
46	44	44-MD-176 W Asphalt	97.61	2.488	2.738	2.576	2.451	2.701	2.554	Pass
47	45	45-MD-176 W Asphalt	627.49	1.906	2.038	1.968	1.902	2.034	1.898	Fail

Step 16. Open the "Test Loop Quality Control Summary Report" MS Excel file created by the DPT. Complete the fields listed and submit to the DPT, DAT, and FED team leaders for review (see below image).

Date: 7/18/2018			TEST LOOP	QUALITY CONT	ROL SUMMARY REPORT	
Attrib	ute	Checked By	Satisfactory	Unsatisfactory	Comment	Action
Upload / I	mport	VC		N III		
	Image Aspect Ratio	e Aspect Ratio VC 🗸				
Pavement Cracking	Imaging Interval	VC	~		Done by DPT	
magery	Overlap/Gap	VC	*	¦ 4	20110 27 21 1	-
	GPS Accuracy	VC	× .	1		
- Test Loop Locators -	DMI	SS	~			
	IRI	SS	~	!		
	SCD (Crack)	SS	~		Done by DAT	
Performance Measures	FCD (Crack)	SS	~		Done by DAI	1
	RUT	SS	~	T		
	Crossfall	SS	1			
List of F	iles:	General Con	ments: The re	port has been uple	oaded into EDW. A number of sections had	values that fell outside
87I0T4Q2		the expected	range with a v	ery small margin. I	However, the measured values were consi	stent for the three runs.
8710U4OM						
87I0V4SY						
		с.				
-		5				

- i. Place the correct date in the "Date" cell (see above image).
- ii. Next to "DMI,", place a check mark under the "Satisfactory" or "Unsatisfactory" cell heading based on the review completed in Step 10 and enter reviewer initials under the "Checked By" cell heading. If the review was "Unsatisfactory," meaning that the section value failed and the magnitude of the range error was high, provide an explanation under the "Comment" cell heading and the required action under the "Action" cell heading (see above image).
- iii. Next to "IRI," place a check mark under the "Satisfactory" or "Unsatisfactory" cell heading based on the review completed in Step 11 and enter reviewer initials under the "Checked By" cell heading. If the review was "Unsatisfactory," meaning that the number of failed sections was substantial and the magnitude of range errors was high, provide an explanation under the "Comment" cell heading and the required action under the "Action" cell heading (see above image).
- iv. Next to "RUT", place a check mark under the "Satisfactory" or "Unsatisfactory" cell heading based on the review completed in Step 12 and enter reviewer initials under the "Checked By" cell heading. If the review was "Unsatisfactory," meaning that the number of failed sections was substantial and the magnitude of range errors was high, provide an explanation under the "Comment" cell heading and the required action under the "Action" cell heading (see above image).
- v. Next to "SCD (Crack)", place a check mark under the "Satisfactory" or "Unsatisfactory" cell heading based on the review completed in Step 13 and enter reviewer initials under the "Checked By" cell heading If the review was "Unsatisfactory," meaning that the number of failed sections was substantial and the magnitude of range errors was high, provide an explanation under the "Comment" cell heading and the required action under the "Action" cell heading (see above image).
- vi. Next to "FCD (Crack)", place a check mark under the "Satisfactory" or "Unsatisfactory" cell heading based on the review completed in Step 14 and enter reviewer initials under the "Checked By" cell heading. If the review was "Unsatisfactory," meaning that the number of failed sections was substantial and the magnitude of range errors was high, provide an explanation under the "Comment" cell heading and the required action under the "Action" cell heading (see above image).
- vii. Next to "Crossfall", place a check mark under the "Satisfactory" or "Unsatisfactory" cell heading based on the review completed in Step 15 and enter reviewer initials under the "Checked By" cell heading. If the review was "Unsatisfactory," meaning that the number of failed sections was substantial and the magnitude of range errors was high, provide an explanation under the "Comment" cell heading and the required action under the "Action" cell heading (see above image).

4- Submit Test Loop QC Report – performed by DAT Staff Member and Team Leaders

Summary: Under this task, the results of the MDOT-SHA test loop data analysis are documented and reported.

- Step 17. Ensure that MDOT-SHA "Test Loop Quality Control Summary Report" is fully populated (see below image). This is done by a DAT staff member.
 - i. If report is complete, send report to DAT, DPT, and FED TLs.
 - ii. If report is incomplete, fill in missing sections or ask DPT Staff Member to fill in those missing sections, depending on which portion of the report is incomplete.

Date: 7/18/2018	C:					
Attribute		Checked By	Satisfactory	Unsatisfactory	Comment	Action
Upload / Import		VC		N. Contraction		
Pavement Cracking	Image Aspect Ratio	VC	~	l L		
	Imaging Interval	VC	~		Done by DPT	
ininger)	Overlap/Gap	VC	*	։ Կ		
- I state and the state of the	GPS Accuracy	vc	×	1		
- Test coop cocators -	DMI	SS	~			
	IRI	SS	~	ļ		
	SCD (Crack)	SS	~		Done by DAT	
Performance Measures	FCD (Crack)	SS	1		Done by Dru	
	RUT	SS	~			-
	Crossfall	SS	1			
List of F	iles:	General Con	nments: The re	port has been uple	oaded into EDW. A number of sections ha	d values that fell outside
87I0T4Q2		the expected	range with a v	ery small margin. I	However, the measured values were cons	istent for the three runs.
8710U4OM						
8710V4SY						

Step 18. The report resulting from Step 17 is checked by the DAT, DPT, and FED TLs.

- i. If no issues are identified, communicate results to other team leaders and save report to proper location.
- ii. If issues are identified, discuss with relevant parties and determine proper course of action. Once issues have been resolved, save report to proper location.

3.08 SKID PRE-DATA COLLECTION ACTIONS

3.08.01 General

This section describes the standard operating procedure (SOP) used by staff from the Field Explorations Division (FED) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to perform route planning, safety checks, and diagnostic checks prior to the start of skid data collection each day. The steps described in this SOP are based on the ICC MDRPro 2.5^{06/12/2019} software developed for operating Skid Trailers 7 and 8^{06/12/2019}. This SOP is one of three to be utilized for daily data collection with the referenced skid trailers – it is succeeded by <u>Skid Data Collection</u> and then <u>Skid Post-Data Collection Actions</u>. This SOP utilizes the Skid Collection List (see <u>Production of Skid Collection List</u>) for the current year.

<u>Note</u>: due to the frequent changes in skid collection software and the differences between the skid trailers, the main body of this SOP contains general steps to perform the required pre-data collection tasks. The skid user manual for the specific skid trailer should be used as supporting documentation to this SOP. The steps for using the current version of the skid data collection software, ICC MDRPro 2.5, in support of this SOP are provided at the end of this SOP.

3.08.02 Frequency

This SOP is to be performed daily by MDOT-SHA FED staff throughout the skid data collection period^{06/12/2019}, prior to the first data collection run each day.

3.08.03 Purpose

The purposes of this SOP are to develop an efficient route plan for skid data collection and to check the skid trailer to confirm it is safe to operate and functioning properly prior to data collection each day. This is accomplished by:

- Planning of data collection route such that the possible effect of environmental factors on data quality is reduced,
- conducting vehicle-related safety checks, and
- validating the functionality of the skid trailer components.

3.08.04 *Resource Requirements*

The actions detailed in this SOP are performed by the MDOT-SHA FED skid trailer crew, which is comprised of a driver and an operator. The estimated effort levels shown in the table below represent the total time, in man-hours, required for completion of the daily planning, safety checks, and diagnostics checks. These time estimates assume adequate weather conditions and that the diagnostic checks do not produce results that require additional troubleshooting.

Position	Function	Resources	Effort Level (man-hrs)
Skid Testing Crew	Driver	1	1.5
Skid Testing Crew	Operator	1	1.5
FED Team Leader (TL) or Coordinator	Supervisor	1	As Required ^{06/12/2019}

3.08.05 *Procedure*

The procedure required to perform pre-data collection actions on the skid trailer is comprised of the following three tasks:

- (1) planning of data collection routes,
- (2) performing vehicle safety checks, and
- (3) performing daily equipment component diagnostic checks.
- 1- Planning of Data Collection Route *performed by driver and operator, with input from Supervisor*

Summary: Under this task, the planned skid data collection route for the day is created and environmental conditions are assessed to determine whether data collection should proceed or be postponed.

- Step 1. Develop an initial skid data collection route for the day using the selected sections from the Skid Collection List (see <u>Production of Skid Collection List</u>). The route is to be selected based on several logistic and practical factors e.g., proximity to office and to gas stations with the objective of maximizing the collected mileage for the day.
- Step 2. Assess weather conditions for the day in order to decide whether to perform or to cancel skid data collection. Typical weather factors affecting this decision include:
 - i. Fog, snow, or ice skid data collection must be cancelled if there is fog, rain, snow, or ice regardless of intensity^{06/12/2019}.
 - ii. Surface wetness or ice If it is not raining or snowing, but the pavement surface is wet (standing water) or icy after a visual inspection, data collection is to be delayed until the surface is dry^{06/12/2019}.
 - iii. Below freezing if the temperature is below freezing, data collection is delayed until the temperature rises above freezing.

If weather considerations do not result in the cancelation or delay of data collection, proceed Step 3.

2- Performing Vehicle Safety Checks – performed by driver and operator

Summary: This task performs vehicle-related safety assessments to check that the skid trailer is in proper working order and safe to operate.

- Step 3. Driver: Turn on skid vehicle ignition.
- Step 4. Driver: Ensure mirrors (left, right, and rear view) and seat position are properly set for safe driving.
- Step 5. Operator: Check pressure of all tires, including skid trailer test tires. Vehicle tires should have pressure as specified by the vehicle manufacturer for given conditions and skid trailer tires should read 24 psi.
- Step 6. Driver: Make sure water tank is filled.

Step 7. Driver: Check that skid trailer lights are functioning properly. This includes beacons, hazards, turning signals, and brake lights. If any lights or beacons are not functioning, communicate issue to Supervisor for further remedial action and suspend data collection until issue has been resolved.

3- Performing Daily Equipment Component Diagnostic Checks – performed by driver and operator

Summary: This task initiates the skid data collection computer system and runs diagnostic tests on the skid trailer sub-components to check that they are functioning properly for data collection.

- Step 8. Driver: Position the skid trailer on level ground and out of the way of traffic.
- Step 9. Operator: After confirming that engine is running, turn on the "Air" and "Trailer Power." The specific location of these switches may vary between vehicles; consult the user manual of the specific skid trailer for details.
- Step 10. Operator: Turn on computers. The specific location of these switches may vary between vehicles; consult the user manual of the specific skid trailer for details.
- Step 11. Operator: Login to the proper computer user profile with the appropriate user name and password. The specific details of the user profiles may vary between vehicles; consult the user manual of the specific skid trailer for details.
- Step 12. Operator: Login to the current skid data collection software by double-clicking on the MDRPro desktop icon and entering the appropriate sign-in credentials; consult the user manual of the specific skid trailer for details and the end of this SOP for instructions on using the ICC MDRPro 2.5 software.
- Step 13. Operator: Perform pre-data collection diagnostic tests to ensure the skid trailer sub-components are functioning properly; consult the user manual of the specific skid trailer for details and the end of this SOP for instructions on using the ICC MDRPro 2.5 software.
 - i. If the calibration values are within the required tolerance, proceed to <u>Skid Data</u> <u>Collection</u> for commencement of daily skid data collection.
 - ii. If the calibration values are out of range with respect to the required tolerance, contact Supervisor for remedial action and suspend data collection until the issue has been resolved.

ICC MDRPro 2.5 Skid Pre-Data Collection Software Instructions

The following instructions can be followed to supplement Task 3 of this SOP when using the ICC MDRPro 2.5 skid data collection software to perform the required pre-test diagnostic checks.

Double-click on the MDRPro desktop icon (see below image).



In the "Enter Password" dialogue box, type "user" (see below image).



Click on the "Calibration" tab and then select "Pre Test" (see below image).



STATE HIGHWAY ADMINISTRATION

Field Data Collection Skid Pre-Data Collection Actions

🖉 User MDRPro v2.8.6.11 Settings (Log: C:\Data\NETWORK\2018\A	A\20181019\\MDR_Pro2018_10_19_143841.csv) HB	89 USB 8287 72530096 725	21809 [8160]
Main System Options Calib Parameters	Hardware Options Calibration		
System	Profile/Texture Laser	Skid	
		Pre-Test	
Distance Cal	Block Check	Force Ca	ıl
F9 - Collect			F10 - EXIT
Label + Max 15 characters			A USB 43

Observe the values on the screen for "Left Force" and "Left Load" (see below image). Record both numbers in the record book kept in the skid vehicle. If values are out of range, move to more level ground and repeat test.

STATE HIGHWAY ADMINISTRATION

Field Data Collection Skid Pre-Data Collection Actions

Pretest							- 0
Kill - F2 Pull Skid - F	4 Cal R - F5	Save Static - F6 Adj Pa	arams - F7 Whe	eel Sel - F{	Brake Ena	bled - F9 Exit	- F10
Veh Speed Wh	eel ft	Event 0	Water 0.0	Le	eft Speed 0.0	Right Speed	
Ref Post 0.000		Left Force	Left Load	Ri	ght Force	Right Load	
<u>p</u> - Stup Data		Ford	e Static		Load S	Static	
<u>1</u> - CalR On <u>2</u> - CalR Off	<u>Set</u>	-204	-132	RAW	-3818	-3721	
<u>3</u> - Water Arm On		22 For	2 rce Shunt	LB	1082 Loa	1061 d Shunt	
<u>4</u> - Water Arm Off <u>5</u> - Water Pump On		Old Cal -2909	New Cal	RAW	Old Cal -6473	New Cal	
<u>6</u> - Water Pump Off		764		LB	1654		
<u>r</u> - Brake Off		Wheel Se	elected Left		Apply Brake Cal Resistor	e No r Off	
		,				WaterFlowCou 6268154	nt

- i. The "Left Force" value should be close to 0 (less than 10 is acceptable).
- ii. The "Left Load" value should be approximately 1085 (+/- 15 is acceptable). If out-of-range, move the trailer to make sure it is level and take another measurement.
- iii. If values continue to be out of range, contact Supervisor for further remedial action and suspend data collection until the issue has been resolved.

Exit "Pre Test" window by pressing the "F10" key. Pre-data collection actions are now complete.

3.09 SKID DATA COLLECTION

3.09.01 General

This section describes the standard operating procedure (SOP) used by staff from the Field Explorations Division (FED) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to perform daily skid data collection. The steps described in this SOP are based on the ICC MDRPro 2.5^{06/12/2019} software developed for operating Skid Trailers 7 and 8^{06/12/2019}. This SOP is one of three to be utilized for daily data collection with the referenced skid trailers – it is preceded by <u>Skid Pre-Data Collection</u> Actions and succeeded by <u>Skid Post-Data Collection Actions</u>. The data collection activities covered in this SOP start after the end of the daily diagnostic checks (see <u>Skid Pre-Data Collection Actions</u>) and they end prior to commencement of the daily data export (see <u>Skid Post-Data Collection Actions</u>) – i.e., it describes the procedure for completing a full day of skid data collection. This SOP utilizes the Skid Collection List (see <u>Production</u> of Skid Collection List) for the current year.

<u>Note</u>: due to the frequent changes in skid collection software and the differences between the skid trailers, the main body of this SOP contains general steps to perform the required data collection tasks. The skid user manual for the specific skid trailer should be used as a supporting documentation to this SOP. The steps for using the current version of the skid data collection software, ICC MDRPro 2.5, in support of this SOP are provided at the end of this SOP. This software should already be initialized from <u>Skid Pre-Data</u> <u>Collection Actions</u>.

3.09.02 Frequency

This SOP is to be performed daily by MDOT-SHA staff throughout the data collection period^{06/12/2019}.

3.09.03 Purpose

The purposes of this SOP are to perform daily skid data collection and to perform visual quality control (QC) checks on those data while they are being collected.

3.09.04 Resource Requirements

The actions detailed in this SOP are performed by the MDOT-SHA FED skid trailer crew, which is comprised of a driver and an operator. The estimated effort levels shown in the table below represent the total time, in man-hours, required for completion of a full day of skid data collection. These time estimates assume adequate weather conditions and a typical data collection schedule. Actual time to complete individual runs in the field will vary between routes.

Position	Function	Resources	Effort Level (man-hrs)
Skid Testing Crew	Driver	1	6.0
Skid Testing Crew	Operator	1	6.0
FED Team Leader (TL) or Coordinator	Supervisor	1	As Required ^{06/12/2019}

3.09.05 *Procedure*

The procedure required to perform daily skid data collection is comprised of the following single task:

(1) performing daily data collection.

4- **Performing Daily Data Collection** – *performed by driver and operator*

Summary: Under this task, daily skid data collection runs are completed using the skid trailer. The vehicle should be properly functioning and the computer system appropriately initiated after completion of the pre-data collection actions detailed in <u>Skid Pre-Data Collection Actions</u>.

- Step 1. Operator: Navigate to the data collection screen on the current skid collection software; consult the skid user manual of the specific skid trailer for details.
- Step 2. Operator: select the directory where data are to be stored by navigating to the appropriate folder; consult the skid user manual of the specific skid trailer for details.
- Step 3. Operator: Enter the appropriate information for the specific run to be collected; consult the skid user manual of the specific skid trailer for details.
- Step 4. Operator: Copy information from Step 3 into log book kept inside the skid vehicle.
- Step 5. Driver: Once entry of information from Step 3 into the data collection software has been confirmed, drive towards beginning of test segment.
- Step 6. Operator: Initiate the Distance Measuring Instrument (DMI) and data collection at the start of the test segment. Friction tests will occur approximately every 0.1 miles for mainline roads and 0.05 miles for shorter segments and ramps. The wheel will lock at these increments and a skid number will be recorded. If the speed limit is greater than 40 mph, operator should attempt to maintain a speed of 40 mph throughout the test. Otherwise, operator should maintain the posted speed limit. Consult the skid user manual of the specific skid trailer for details.
- Step 7. Operator: Observe data collection screen during test, including: skid numbers, water output, and speed. If data does not seem reasonable, abandon test and restart. If data continues to appear unreasonable, contact Supervisor for further remedial action and suspend data collection until the issue has been resolved.
- Step 8. Operator: At the end of the test segment, end the data collection and save the data; consult the skid user manual of the specific skid trailer for details.
- Step 9. Repeat Step 1 through Step 8 for each data collection run during the day. After completion of the last data collection run, proceed to <u>Skid Post-Data Collection</u> <u>Actions</u> for end-of-day shut-down activities.

ICC MDRPro 2.5 Skid Data Collection Software Instructions

The following instructions can be followed to supplement Task 1 of this SOP when using the ICC MDRPro 2.5 skid data collection software to perform the required data collection.

Click on the "Main" tab. All collection information for a specific run will be entered in this window (see below image).

🚛 User MDRPro v2.8.6.11 Settings (Log: C\Data\NETWORK\2018\AA\20181019\\MDR_Pro_2018_10_19_143841.csv) HB:21 USB 8287 133583216 1335749	929 [8160] 🗖 🗖 🛛
Main System Options Calib Parameters Hardware Options Calibration	
Run Param Sel	
Collection System	Live
System: MDDOT 4	Date 10/19/2018
Collection Type: SkidOnly	Time: 14:46:51
Ref Post Mode: RP_Miles	
Primary DMI Source: Veh	
Primary DCF: 2.099195 in	
	Data Connection
MDR Data Path C:\Data\NETWORK\2018\AA\	
MDR Sub Folder: Auto create	Connected
File Name AA MD 387 Browse	USB Device 0
- Pun Settings	
County CA Reg Port 0.000	
Dictrict Dr.	Save Raw
District D5 C Lare Of Driver ASHIELDS C	Extended Log
Route MD 387 Direction North Ascend	Debug Log
	1
User Ref 1 923011 Weather Condition Sunny Humidity 50.0 %	
User Ref 2 Air Temp 93 ØF	
User Ref 3 Surface Temp 79 ØF	
F9 - Collect	F10 - EXIT
	A USB 43

Select the proper directory under "MDR Data Path"^{06/12/2019} by selecting the "Browse" button next to the dialogue box and navigating to the appropriate folder. Type in the file name in the dialogue box that reads "File Name" following the appropriate format^{06/12/2019}. Fill in all required fields under "Run Settings" (see above image). This includes: County, District, Route Number, Beg Ref Post, Lane, Direction, Ascending/Descending, Operator, and Driver.

Press the "F9" key on the keyboard to open the data collection screen. Ensure the run setting information at the top of the screen is correct, including: Reference Post, Direction, District, County, Route Number, Beginning Mile Post, and Ending Mile Post (see below image). If information is incorrect, return to "Main" tab and update information before continuing with data collection.

Maryland department of transportation Field Data Collection STATE HIGHWAY ADMINISTRATION Skid Data Collection _ MDRPro v2.8.6.11 MDDOT County Route Lane Surf SN Co District nce Pos 0.000 <u>Ig</u>t 0.0 D5 СА MD 387 01 ACP Lane 01 0.000 0000 N + mi Sys = SkidOnly VBat1Curr VBat2Curr WaterLev
0.0 0.0 WaterCnt NextSkid 6268154 -1 AutoModes On Off PPS Hgt (M) Q Age Trk 4852 50.977 2 5.1 359.9
 Trk
 Vel kh HDOP
 GM Time

 359.9
 1.0
 18:41:48.10
 GPS-13Latitude Longitude GM Date Sat 076 40.7234852 10/19/2018 08 39 09 4713861 tEst Mode tYpe Alt W WheelIntr miaUtoGraptWaterArm Pump BrakeCnt Water Load Normal Auto Wet Off Left 0.050 Off Off Up Off Off 0551 0.0 106 Force L Spd R Spd TireTyp 2 0.0 0.0 Ribbed 1061 Conner EVB 🕇 Trip Dist 0.000 Last Trip Dist 75 Surf VTR 12.2 Laser 9.325 0.000 Temp: Air 77 Src RefPost FN Water Wheel Spd Status Cycle Tread Msg Event

Press the "F4" key to initiate the Distance Measuring Instrument (DMI) and data collection.

F8=NR/S

3

-99 Lead: 127 [8160]

F9=RfR

F10=EXIT

278Kb U

F5=GEN

At the end of the data collection run, press the "F3" key on the keyboard to end the test.

Press the "F10" key to exit the data collection screen. Click "Yes" to save data collection run. Click "Yes" again to return to main software screen

F2=KILL AUTO

F3=dmiON

F4=SKID

F1=MSG

3.10 SKID POST-DATA COLLECTION ACTIONS

3.10.01 General

This section describes the standard operating procedure (SOP) used by staff from the Field Explorations Division (FED) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to perform end-of-day data management and shut-down actions following completion of the daily skid data collection. The steps described in this SOP are based on the ICC MDRPro 2.5^{06/12/2019} software developed for operating Skid Trailers 7 and 8^{06/12/2019}. This SOP is one of three to be utilized for daily data collection with the referenced skid trailers – it is preceded by <u>Skid Pre-Data Collection Actions</u> and <u>Skid Data Collection</u>. The post-data collection actions covered in this SOP start from the completion of the last data collection run of the day (see <u>Skid Data Collection</u>) to system shut down.

<u>Note</u>: due to the frequent changes in skid collection software and the differences between the skid trailers, the main body of this SOP contains general steps to perform the required end-of-day data management and shut down tasks. The skid user manual for the specific skid trailer should be used as a supporting documentation to this SOP. The steps for using the current version of the skid collection software, ICC MDRPro 2.5, in support of this SOP are provided at the end of this SOP. The software should already be ready for the post data collection tasks.

3.10.02 Frequency

This SOP is to be performed daily by MDOT-SHA staff throughout the data collection period^{06/12/2019}, following the last data collection run of the day.

3.10.03 Purpose

The purpose of this SOP is perform end-of-day data management and shut-down actions following completion of the daily skid data collection.

3.10.04 *Resource Requirements*

The actions detailed in this SOP are performed by the MDOT-SHA FED skid trailer crew, which is comprised of a driver and an operator. The estimated effort levels shown in the table below represent the total time, in man-hours, required for completion of the post-data collection actions. These time estimates assume no issues are encountered.

Position	Function	Resources	Effort Level (man-hrs)
Skid Testing Crew	Driver	1	0.5
Skid Testing Crew	Operator	1	0.5
FED Team Leader (TL) or Coordinator	Supervisor	1	As Required ^{06/12/2019}

3.10.05 *Procedure*

The procedure required to perform the skid post-data collection actions is comprised of the following tasks:

- (1) transferring collected skid data, and
- (2) shutting down skid trailer system and scanning log book records.

1- Transferring Collected Skid Data – *performed by operator*

Summary: Under this task, the collected skid data is transferred from the on-board computer to a flashdrive for transmittal to the FED TL. This task is only performed at the completion of a county or during the collection of the Test Loop (see <u>Skid Test</u> <u>Loop Data Collection</u>).

- If all segments for the county have been collected, or if the collection effort is on the Skid Test Loop (see <u>Skid Test Loop Data Collection</u>), proceed to Step 2. Otherwise, skip to the system shut-down task that starts in Step 3.
- Step 2. Plug in flashdrive to USB port of on-board computer and navigate to the data storage folder. Copy data and safely eject flashdrive. Consult the skid user manual of the specific skid trailer for details.
- 2- Shutting Down Skid Trailer System and Scanning Log Book Records performed by driver and operator

Summary: Under this task, the on-board computer system and vehicle are shut down.

- Step 3. Operator: Safely shut down all on-board computers; consult the skid user manual of the specific skid trailer for details.
- Step 4. Operator: Turn off "Trailer Power", "Air Compressor", and "Beacon;" consult the skid user manual of the specific skid trailer for details.
- Step 5. Driver: Record vehicle mileage in log book and turn off ignition. Lock all doors.
- Step 6. Once back in the office, scan log book records for the county and deliver flashdrive and scans to FED TL if Task 1 was required.

ICC MDRPro 2.5 Skid Post-Data Collection Software Instructions

The following instructions can be followed to supplement Tasks 1 and 2 of this SOP using ICC MDRPro 2.5 skid data collection software to perform the required post-data collection actions.

To copy data to flashdrive:

- Double-click on the "My Computer" icon on the computer desktop screen.
- Double-click on "C Drive" and then "Data."
- Scroll down to the folder of the county that was just completed. Right-click and select "Copy."
- Navigate to the flashdrive ("Removable Disk (F:)"). Right-click and select "Paste."
- On the bottom right-hand corner of the screen, right-click on the USB icon and select "Eject Flash Disk." A message will appear when it is safe to remove the flashdrive. Unplug flashdrive from computer.

To shut down computers:

- Click on the Windows icon at the bottom left-hand corner of the screen and select "Shut Down."
- Toggle to second computer screen by pressing the black button on the back of the computer monitor.
- On the second computer desktop screen, click on the red power button and select "Shut Down."
- Wait for a message on the screen to read "It is now safe to turn off computer" and then press the red button below the keyboard (hold until it beeps). Confirm that both computers are now off.
- On the middle console, turn off "Trailer Power", "Air Compressor", and "Beacon."

3.11 SKID DMI CALIBRATION

3.11.01 General

This section describes the standard operating procedure (SOP) used by staff from the Field Explorations Division (FED) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to calibrate the Distance Measuring Instrument (DMI) mounted on the skid trailers. The steps described in this SOP are based on the ICC MDRPro 2.5^{06/12/2019} software developed for operating Skid Trailers 7 and 8^{06/12/2019}. The reference measurements used in the DMI calibration procedure described in this SOP are obtained by a state surveyor using thermally compensated steel tape. These reference measurements are obtained along two one-mile long pavement sections, marked on the shoulder lanes in both directions, on a segment of MD Route 100.

<u>Note</u>: due to the frequent changes in skid collection software and the differences between the skid trailers, the main body of this SOP contains general steps to perform the required DMI calibration tasks. The skid user manual for the specific skid trailer should be used as a supporting documentation to this SOP. The steps for using the current version of the skid collection software, ICC MDRPro 2.5, are provided at the end of this SOP.

3.11.02 Frequency

This SOP should be performed monthly by MDOT-SHA FED staff throughout the data collection period^{06/12/2019}.

3.11.03 Purpose

The purpose of this SOP is to check the accuracy of the distance measurements taken by the DMI mounted on Skid Trailers 7 and 8 using the ICC MDRPro 2.5 software and, if deemed necessary, to recalibrate the DMI.

3.11.04 *Resource Requirements*

Calibration of the DMI is performed by the MDOT-SHA FED skid trailer crew, which is comprised of a driver and an operator. The estimated effort levels shown in the table below represent the total time, in man-hours, required for driving from the SHA's Office of Materials Technology (OMT) location to the calibration pavement sections on Route MD 100, performing three data collection runs on these two calibration pavement sections, and driving back to the OMT location.

Position	Function	Resources	Effort Level (man-hrs)
Skid Testing Crew	Driver	1	1.5
Skid Testing Crew	Operator	1	1.5
FED Team Leader (TL) or Coordinator	Supervisor	1	As Required ^{06/12/2019}

3.11.05 *Procedure*

The procedure required to calibrate the DMI mounted on Skid Trailers 7 and 8 using the ICC MDRPro 2.5 software consists of the following two tasks:

- (1) performing repeat calibration runs, and
- (2) saving data and performing data QC.

1- Performing Repeat Calibration Runs – performed by driver and operator

Summary: Under this task, data from three runs are collected along the two calibration pavement sections on Route MD 100 for use in checking the accuracy of the distance measurements taken by the DMI mounted on Skid Trailers 7 and 8 using the ICC MDRPro 2.5 software and, if deemed necessary, for recalibrating the DMI.

The calibration sites consist of two one-mile long pavement sections on Route MD 100, located near the OMT and marked along the shoulder lanes – one in the eastbound direction and the other in the west-bound direction (see map screenshot below). Two runs are performed on the east-bound direction and one run in the west-bound direction, for a total of 3 data collection runs.



- Step 1. Operator: Follow start-up procedures for initiating the computer system and performing standard vehicle checks as described in <u>Skid Pre-Data Collection</u> <u>Actions</u>.
- Step 2. Driver: Drive the skid trailer to the starting point of the calibration site in the east-bound direction. The starting point can be identified by the following markings):
 - i. an orange paint mark on a tree to the right of the road (see first photo that follows this list),
 - ii. a metal pole just beyond the pavement shoulder (see second photo that follows this list),
 - iii. paint markings on the pavement shoulder (line and "ST"; see second photo that follows this list),
 - iv. a survey nail in the pavement shoulder, and
 - v. a yellow sign that reads "DMI Calibration Site."

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Field Data Collection Skid DMI Calibration



- Step 3. Operator: Initiate the skid data collection software and navigate to the "DMI Calibration" window; consult the skid user manual of the specific skid trailer for details
- Step 4. Driver: Drive the skid trailer until the front bumper of the vehicle is aligned with the starting position, as identified by one or more of the earlier referenced markings^{06/12/2019}.
- Step 5. Operator: Begin the first test run in the software; consult the skid user manual of the specific skid trailer for details
- Step 6. Driver: Drive forward on shoulder lane at a safe speed, from the starting position until a few feet before the end mark as identified by metal pole just beyond the pavement shoulder and survey nail shown in the photo below. The calibration interface should display travelled distance on the computer screen.

Attempt to stay as straight as possible in the shoulder lane using the white stripe, edge of pavement, and guardrail (where present) as references.



- Step 7. Driver: Drive skid trailer until front bumper of vehicle is aligned with "ending" position, as identified by metal pole just beyond the pavement shoulder and survey nail shown in the photo above^{06/12/2019}.
- Step 8. Operator: End the first test run; consult the skid user manual of the specific skid trailer for details
- Step 9. Driver: Drive the skid trailer to starting point of the calibration site in the westbound direction and repeat Step 2 to Step 8 to perform second DMI calibration run.
- Step 10. Driver: Drive the skid trailer to starting point of the calibration site in the eastbound direction and repeat Step 2 to Step 8 to perform the third DMI calibration run.

2- Saving Data and Performing Data QC – performed by operator

Summary: Under this task, the DMI calibration results are saved and the resulting calibration factors are evaluated for acceptable accuracy.

- Step 11. Once the third DMI calibration run has been completed, save the data set.
- Step 12. Examine the calibration factors from the results reported in the software; consult the skid user manual of the specific skid trailer for details. The calibration factors for the 3 runs must agree within 0.1 percent and preferably within 0.05 percent.
 - i. If they do not agree, consult TL and discuss next steps for remedial actions.
 - ii. If they do agree, exit the calibration program. Consult the skid user manual of the specific skid trailer for details.

ICC MDRPro 2.5 DMI Calibration Software Instructions

The following instructions can be followed to supplement Task 1 of this SOP when using the ICC MDRPro 2.5 skid data collection software to perform the required DMI calibration.

Click on the "MDRPro 2" icon on the desktop of the computer (see below image).



Login by typing "user" in the "Password" text box (see below image).

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Click on the "Calibration" tab and then the "Distance Cal" button (see below image).
Press the "F6" key to start a new calibration set after the "Distance Calibration" window opens (see below image).

Los Distance Calibration		a factor		×
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Longitude Gps Invalids Air Temp Surface Temp VBat1 75 76 0.0				

Press the "F2" key to start the DMI calibration run.

Press the "F3" key to stop the DMI calibration run.

The following details can be followed to supplement Task 2 of this SOP using ICC MDRPro 2.5 skid data collection software to save the DMI Calibration.

Once third run is complete, press the "F9" key to save the calibration set.

Press the "F10" key to exit the calibration program.

3.12 SKID WATER CALIBRATION

3.12.01 General

This section describes the standard operating procedure (SOP) used by staff from the Field Explorations Division (FED) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to perform the static water calibration of Skid Trailer 7, which is the smaller of the MDOT-SHA friction data collection vehicles. This skid trailer has a 450 gallon water tank and it is typically used in congested areas -- the counties of X1, X2 and X3. Skid Trailer 8, the larger of the MDOT-SHA friction data collection vehicles, uses a different water calibration procedure.

The static water calibration is performed at the Office of Materials Technology (OMT) calibration area.

Note: The user manual for Skid Trailer 7 should be used as supporting documentation to this SOP. The steps for using the current version of the Skid Trailer 7 data collection software, ICC MDRPro 2.5, are provided at the end of this SOP.

3.12.02 Frequency

The static water calibration of Skid Trailer 7 is performed by the MDOT-SHA FED staff once per year, prior to the start of the data collection season^{06/12/2019}.

3.12.03 Purpose

The purpose of this SOP is to check that the quantity of water being released by Skid Trailer 7 is consistent with the on-board equipment readings.

3.12.04 Resource Requirements

The static water calibration of Skid Trailer 7 involves the following MDOT-SHA FED staff members:

- (1) an operator knowledgeable in the data collection software,
- (2) a driver responsible for maintaining a steady speed of 40 mph,
- (3) an assistant to oversee water released into the bucket and,
- (4) a timer to indicate the start and end of the calibration test.

The estimated effort levels shown in the table below represent the total time, in man-hours, to complete the skid water calibration. These time estimates assume no issues are encountered during the calibration.

Position	Function	Resources	Effort Level (man-hrs)
FED Staff	Operator	1	0.5
FED Staff	Assistant	1	0.5
FED Staff	Driver	1	0.5
FED Staff	Timer	1	0.5
FED Team Leader	Supervisor	1	"As required" ^{06/12/2019}

3.12.05 *Procedure*

The procedure required to perform the static calibration of the water being released by Skid 7 is comprised of a single task:

- (1) perform static water calibration.
- **3- Perform Static Water Calibration** performed by driver, operator, assistant, and *timer*

Summary: Under this task, a static water calibration of Skid Trailer 7 is performed at the MDOT-SHA OMT calibration area to check that the quantity of water being released by the referenced skid trailer is consistent with the on-board equipment readings.

- Step 1. Driver: Position the vehicle so that the skid trailer is in the "test pit" in the garage and place wood blocks under the skid trailer tires.
- Step 2. Assistant: Plug power cord from skid trailer in to a power source and initialize equipment.
- Step 3. Assistant: Connect the air supply to the trailer "tongue" and turn on (for water pump).
- Step 4. Assistant: Jack up the vehicle rear tires.
- Step 5. Assistant: Place the splash guard on the water nozzle and place the test bucket underneath the water nozzle.
- Step 6. Operator: Initialize the ICC MDRPro2 skid data collection software and login; see the end of this SOP. Navigate to the water calibration screen (see the end of this SOP); consult the user manual of Skid Trailer 7 for details.
- Step 7. Driver: Turn on the vehicle and begin to "drive" the vehicle to spin the wheels elevated by the jacks. Attempt to maintain a speed of 40 mph.
- Step 8. Operator: When the driver is ready (at a speed of 40 mph), signal "Go" to the timer.
- Step 9. Timer: Start stopwatch.
- Step 10. Operator: Turn on the water pump in the ICC MDRPo 2.5 software interface at the same time as the timer starting the stopwatch. Consult the Skid Trailer 7 user manual for details. Water will begin to fill the bucket.
- Step 11. Timer: Monitor the stopwatch and signal "Stop" to the operator and assistant at the 15 second mark.
- Step 12. Operator: On the timer's "Stop" signal, turn off the water pump in the ICC MDRPro 2.5 software interface. Consult the Skid Trailer 7 user manual for details.
- Step 13. Assistant: On the timer's "Stop" signal, place the pan between the nozzle and bucket to prevent excess drip after the test has ended.
- Step 14. Assistant: Remove the pan once the drip has stopped and dispose of the water in the drip pan.
- Step 15. Assistant: With the help of the operator, remove the filled bucket and place on the scale. Measure the weight of the filled bucket.
- Step 16. Operator: Remove tare (10.2 lbs) from the measured weight and divide the weight of the water (lbs) by 8.33 (lbs/gal) to convert the weight to gallons.

- Step 17. Operator: Multiply the weight in gallons by four (15 second test) to compute a measurement of gallons per minute. The desired range is 27 to 28 gal/min.
- Step 18. Operator: Normally, the first test is thrown out and a second test is run by repeating Step 6 to Step 17. Examine the results of the second test.
 - i. If the flow rate after the second test is in the desired range of 27 to 28 gal/min, the calibration is complete. Save the results of the calibration, power down the software, remove the vehicle from the blocks, remove the bucket and splash guard from the skid trailer, and remove all connections used during the calibration.
 - ii. If the flow rate is still not in the desired range of 27 to 28 gal/min after the second test, troubleshooting is required. Possible solutions include water pump replacement and filter cleaning. Discuss troubleshooting and problem resolution with TL.

ICC MDRPro 2.5 Post-Data Collection Software Instructions

The following instructions can be followed to supplement Task 1 of this SOP when using the ICC MDRPro 2.5 skid data collection software to perform the calibration of the water being released by Skid Trailer 7.

Click on the "MDRPro 2" icon on the desktop of the computer (see below image).



Login by typing "user" in the "Password" text box (see below image).

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Click on the "Calibration" tab and then "Water Cal" then "Water Arm On" so that the water pump arm is angled downwards.

Click "Water Pump On" at the same time as the timer starting the stopwatch. Water will begin to fill the bucket.

On the timer's "Stop" signal, click "Water Pump Off".

3.13 SKID FORCE CALIBRATION

3.13.01 General

This section describes the standard operating procedure (SOP) used by staff from the Field Explorations Division (FED) of the Maryland Department of Transportation State Highway Administration's (MDOT-SHA) to perform skid force calibrations on the MDOT-SHA friction data collection vehicles. The procedure described in this document is specific to the MDOT-SHA Skid Trailers 7" and 8 data collection vehicles and to the use of the ICC MDRPro v2.5 skid data collection software. This procedure may not be applicable to other friction data collection vehicles or data collection software.

The skid force calibration is performed at the MDOT-SHA Office of Materials Technology (OMT) calibration area.

Note: The user manuals for Skid Trailers 7 and 8 should be used as supporting documentation to this SOP. The steps for using the current version of the skid collection software, ICC MDRPro 2.5, are provided at the end of this SOP.

3.13.02 Frequency

The skid force calibration of Skid Trailers 7 and 8 is performed by the MDOT-SHA FED staff once per year, prior to the start of the data collection season^{06/12/2019}, or when required.

3.13.03 Purpose

The purpose of this SOP is to check that the load applied to left tire of Skid Trailers 7 and 8 and the traction readings recorded by the force meter are consistent with the on-board equipment readings as well as within the calibration standards; and to make the necessary adjustments when required.

3.13.04 *Resource Requirements*

The skid force calibration involves the following MDOT-SHA FED staff members: (1) an operator knowledgeable in the data collection software, and (2) a load meter assistant responsible for increasing and decreasing load levels and monitoring traction readings. The estimated effort levels shown in the table below represent the total time, in man-hours, to complete the skid force calibration. These time estimates assume no issues encountered during the calibration.

Position	Function	Resources	Effort Level (man-hrs)
FED Staff	Operator	1	1.0
FED Staff	Assistant	1	1.0
FED Team Leader	Supervisor	1	"As required" ^{06/12/2019}

3.13.05 *Procedure*

The procedure required to perform the skid force calibration for Skid Trailers 7 and 8 is comprised of the following two tasks:

- (1) perform Skid Force calibration, and
- (2) evaluate Skid Force calibration results.

1- Perform Skid Force Calibration – performed by operator and assistant

Summary: Under this task, a skid force calibration is performed at the MDOT-SHA OMT calibration area on Skid Trailers 7 and 8. This is accomplished by measuring force readings underneath the left tire of the referenced skid trailers at varying pressure levels.

Step 1. Operator: Position vehicle so that the skid trailer is in the "test pit" in the garage and place wood calibration blocks under the skid trailer right tire. Place load plate under the skid trailer left tire (see below photo^{06/12/2019}).



- Step 2. Operator: Plug skid trailer power cord into power source and initialize equipment.
- Step 3. Operator: Initialize the skid data collection software and login. Navigate to the water calibration screen (see details at the end of this SOP); consult user manual of specific skid trailer for details.
- Step 4. Assistant: Connect air cylinder and chains to load plate (see below photo).

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- Step 5. Assistant: Connect load meter to load plate and to the ports in the vehicle.
- Step 6. Assistant: Connect air supply to trailer "tongue" (see below photo) and turn on water pump.



- Step 7. Allow 15 minutes for the equipment to warm up.
- Step 8. Assistant: Raise left wheel using air jack behind trailer and push the "Zero" button on the force meter. The traction reading should be less than 5 and the load reading should be around 1,085 (see below photo). If not, make sure all components are connected and the software is initialized. Do not proceed to Step 9 until readings are acceptable.

Field Data Collection Skid Force Calibration



- Step 9. Operator: In software interface, turn on the break and check that the readings on the load meter have not changed. If they have changed, do not continue until issue is resolved. Observe that load and traction readings through the software's auto-test function are updating. If they are not, make sure the cable from the load meter is plugged into the correct vehicle serial ports before continuing; consult user manual of specific skid trailer for details
- Step 10. Operator: Begin test; consult user manual of specific skid trailer for details.
- Step 11. Operator: Instruct the load meter assistant to begin increasing the load by turning the pressure switch clockwise.
- Step 12. Assistant: Visually monitor the traction reading and continue to increase the load until the traction reading is near 100. The traction reading can be within +/- 10 of 100, but it is crucial that the load does not decrease. If the traction reading goes slightly above 100, DO NOT decrease the load to reach the desired traction reading.
- Step 13. Assistant: When the traction reading is near 100, signal to the operator.
- Step 14. Operator: Click the test option in the skid data collection software. Repeat Step 11 to Step 13 for traction levels 200, 300, 400, 500, 600, 700, and 750.
- Step 15. Assistant: After completion of testing at traction level 750, begin to decrease the load and repeat the process for traction levels 700, 600, 500, 400, 300, 200, 100, and 0.

2- Evaluate Skid Force Calibration Results – performed by operator

Summary: Under this task, the results of the skid force calibration are evaluated by comparing the force readings as measured by the force meter with the applied load as measured under the skid tire by the data collection software. The steps for using the current version of the skid collection software, ICC MDRPro 2.5, are provided at the end of this SOP.

- Step 16. Operator: Once testing is complete, check the percent error for the force and load. Out of tolerance values will be flagged by the software.
- Step 17. Operator: Check for non-linearity issues.
- Step 18. Operator: Examine a best fit curve of force meter readings to truck readings. Skid Number (SN) values should be within 0.3 points (standard acceptance criteria is within 3 points).
- Step 19. Operator: Exit software, power down the computer, remove connections, and break down the calibration setup.

ICC MDRPro 2.5 Skid Force Calibration Software Instructions

The following instructions can be followed to supplement Task 1 of this SOP when using ICC MDRPro 2.5 skid data collection software to perform the required force calibration on Skid Trailers 7 and 8.

Click on the "MDRPro 2" icon on the desktop of the computer (see below image).



Login by typing "user" in the "Password" text box (see below image).

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F9 - Collect		F1	0 - EXIT
Label + Max 15 characters			A USB 43

Click on the "Calibration" tab and then on "Force Cal" button (see below image).

In the software interface, make sure the first "Calibration Team" field is populated with the name of the operator and assistant.

Click on the "Break On" button.

Click on the "Autotest" button and confirm that load and traction readings are updating.

Click on the "Test" button. The data will populate for the "0" load row under the "M-Force" column in the interface table (see below image).

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Start Dat	S	hunt	-2723.392157	12	500										
Stop Dat	a Lo	, ad Coe	fficients	13	400										
Call De	Pre	eCal B	-4.960784	14	300										
Call Of		Bias	0.000000	15	200										
Water Arm	On e	iain 🗍	-0.281112	16	100										
Water Arm	Off Z	Zero	-86	17	0										
Water Pmp	On S	tatic	-4131.647059									Er	nd Force(Cal Calibr	ation
Water Pmp	Off	hunt	-6836.725490												
Brake O			. 1												
Brake Of		ad Test D	ata												
														_	
k.															

Select the next cell down in the "M-Force" column that corresponds with the "100" "Cal F" row. The cell will turn yellow when selected.

Click the "Test" button when prompted by the Assistant. Data will be populated in the selected yellow cell.

Confirm that the correct cell is selected (colored yellow) in the "M-Force" column before clicking on the "Test" button at each traction level.

The following details can be followed to supplement Task 2 of this SOP using ICC MDRPro 2.5 skid data collection software to save and exit the required force calibration.

Click on the "Calc" button and the software will produce a best fit curve of force meter readings to truck readings.

When finished, click on the "Report", "Break Off", "Exit", "Yes", and "Exit" buttons, in that order.

3.14 SKID TEST LOOP DATA COLLECTION

3.14.01 General

This section describes the standard operating procedure (SOP) used by staff from the Field Explorations Division (FED) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to perform skid data collection on a route specifically selected for this purpose. The steps described in this SOP are based on the ICC MDRPro 2.5^{o6/12/2019} software developed for operating Skid Trailers 7 and 8^{o6/12/2019}. The data collection route is called the "test loop." As depicted in the map^{06/12/2019} below, the test loop begins and ends near the Office of Materials Technology (OMT) location. It is approximately 13.1 miles in length and it is divided into segments of varying length based on surface type, intersection locations, ramp locations, and other common road features. This route was selected because it includes a variety of surface types and textures, which are used to validate the MDOT-SHA skid data.



The preliminary actions and diagnostic checks outlined in <u>Skid Pre-Data Collection Actions</u> must be completed prior to the beginning of skid data collection runs on the referenced test loop.

3.14.02 Frequency

This SOP requires that MDOT-SHA FED staff perform three skid data collection runs on the test loop once per month during the data collection season ^{06/12/2019}.

3.14.03 *Purpose*

The purpose of this SOP is to perform skid data collection runs on the test loop to validate the MDOT-SHA skid data.

3.14.04 *Resource Requirements*

The actions detailed in this SOP are performed by the MDOT-SHA FED skid trailer crew, which is comprised of a driver and an operator. The estimated effort levels shown in the table below represent the total time, in man-hours, required for completion of all test loop activities, including preliminary checks and diagnostics, three data collection runs, and data export and management. These time estimates assume no issues are encountered during the required work.

Position	Function	Resources	Effort Level (man-hrs)
Skid Testing Crew	Driver	1	2.0
Skid Testing Crew	Operator	1	2.0
FED Team Leader (TL) or Coordinator	Supervisor	1	As Required ^{06/12/2019}

3.14.05 *Procedure*

The procedure required to complete skid data validation on the MDOT-SHA test loop is comprised of the following task:

(1) completing skid data collection on MDOT-SHA test loop.

1- Completing Skid Data Collection on MDOT-SHA Test Loop – performed by driver and operator

Summary: Under this task, three runs on the MDOT-SHA skid test loop are completed.

- Step 1. Operator: Follow <u>Skid Pre-Data Collection Actions</u>, Step 3 through Step 16, for vehicle and diagnostic checks and system initialization.
 - i. If checks do not identify equipment issues, proceed to Step 2.
 - ii. If checks identify equipment issues, consult <u>Skid Pre-Data Collection Actions</u> for troubleshooting methods. Communicate issue(s) to the TL or Coordinator and suspend test loop data collection until all systems are functioning properly.
- Step 2. Driver and Operator: Follow <u>Skid Data Collection</u>, Step 1 through Step 10, for completing each test loop data collection run. The file name should be "TESTLOOP[RUN#][DATE]". Three runs are to be completed.
 - i. If runs are successfully completed, proceed to Error! Reference source not found.
 - ii. If a run is not successfully completed or if one or more systems malfunctioned during data collection, attempt to resolve the issue(s). If Operator is not able to resolve the issue(s), communicate issue(s) to the TL or Coordinator and suspend test loop data collection activities until all systems are again functioning properly. When resolved, return to Step 2 and recollect the test loop runs.

Step 20. Driver and Operator: Follow <u>Skid Post-Data Collection Actions</u>, Step 1 through Step 14, for data management and system shut-down following the completion of the third and final test loop run^{06/12/2019}.

STATE HIGHWAY ADMINISTRATION

4 **CONSTRUCTION DATA**

Click to go to Processing Paving & Maintenance History Data Click to go to Processing Access Permit Data Click to go to Processing As Bid Unit Cost Data Click to go to Processing As Built Unit Cost Data Click to go to Reviewing Projects in MCMS Click to go to Running Transport Application Click to go to Looking Up Fund Type Click to go to Making Lane Configuration Changes Click to go to Adding to Project Engineer List Click to go to Viewing Paving & Maintenance History by Route Click to go to Promoting As Bid to Construction History Click to go to Generating As Built Report Click to go to HMA Tonnage Application Construction Data 4.01 Paving and Maintenance Records 4.02 Access Permit Records 4.03 As Bid Unit Cost Records 4.04 As Built Unit Cost Records 4.05 MCMS Records 4.06 Transport Application 4.07 Fund Type Lookup 4.08 Lane Configuration Changes 4.09 Project Engineer List 4.10 History by Route 4.11 Promote from As Bid



4.12 As Built List 4.13 HMA Tonnage

This section describes the set of standard operating procedures (SOP) conducted by staff from the Data Processing Team (DPT) of the Maryland Department of Transportation State Highway Administration's (MDOT-SHA) Office of Materials Technology (OMT) to collect, import, and process construction data from various sources necessary to support PM activities. The information collected, imported, and processed in these SOPs are incorporated into the Business Plan Tables.

The first two construction SOPs involve collecting and importing construction data from various historical sources. The first SOP describes the process required to import construction data from paving and maintenance history data, while the second SOP describes the process required to import construction data from access permit information.

The next two construction SOPs involve collecting and importing construction data from cost data sources. The first SOP describes the process required to import construction data from As Bid unit cost information, while the second SOP describes the process required to import construction data from As Built unit cost information.

The final set of construction SOPs describe supplemental procedures designed to support the SOPs described above. This set includes nine SOPs: reviewing projects in the Maryland Construction Management System, running the Transport application, looking up fund type, making lane configuration changes, adding to the Project Engineer list, viewing paving and maintenance history by route, promoting As Bid to construction history, generating an As Built report, and running the Hot Mix Asphalt Tonnage application.

4.01 PROCESSING PAVING & MAINTENANCE HISTORY DATA

4.01.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to collect and update construction history data in the Engineering Data Warehouse (EDW). Projects are classified as either "Paving" or "Maintenance." Paving projects consist of a continuous treatment applied to the roadway (i.e. mill and overlay, reconstruction, etc.). Maintenance projects consist of spot improvements applied to the roadway (i.e. patching, crack sealing, slurry/micro sealing, etc.). Construction history is used within the Pavement Management System (PMS) to fuel pavement inventory information, assist in the development of performance models, assist the Pavement Design Team, and assist external customers with knowledge concerning the structural history, composition, and traffic information for MDOT-SHA controlled roadways. There are various external and internal data sources for the collection of construction history information.

4.01.02 Frequency

The updating of construction history is a continuous process that occurs year-round.

4.01.03 Purpose

The purpose of this SOP is to collect and update paving and maintenance construction history data, verify and update inventory information associated with the project, perform quality control (QC) of gathered data, and update the data in the EDW.

4.01.04 *Resource Requirements*

Data collection and upload of paving and maintenance information involves two people: (1) a user knowledgeable in collection of construction history data from various sources and the EDW software to perform data collection, QC, and uploading, and (2) a supervisor who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	EDW user and QC	1	1.0-16.0 ^{06/12/2019}
DPT TL	Supervisor	1	AR ^{06/12/2019}

4.01.05 *Procedure*

The procedure to collect and update paving and maintenance history data is comprised of the following three tasks:

- (1) collection of paving and maintenance data,
- (2) input of collected paving data into the EDW, and
- (3) input of collected maintenance data into the EDW.

1- Paving and Maintenance Data Collection – performed by EDW user

Summary: This task collects and reviews paving and maintenance construction data from a variety of sources in order to retrieve the necessary inputs for data entry into the EDW.

	Data Item	Source
Project Information	Contract (and FMIS) #	Project Plans/IFB
	Fund Type	IFB/FMIS Lookup (Internal function)
	State Construction P.E.	Assignment List Database
	Functional Class	HLR/P & G Report
	Project Description	IFB
Location	Code	Contract Number (BA,AA,etc)
	Route	Bid Tab (single Ad)/IFB/HLR/Project
		Plans/P & G Report
	BMP & EMP	IFB/HLR/Project Plans/P&G
		Report/Visidata
	Inventory Direction	HLR/Visidata
Project Rehab Info	Thickness	IFB/Project Plans/P&G Report
	Design Life	IFB/P&G Report
	Construction Type	Project Plans/IFB
	Construction Layers	Project Plans/IFB/P&G Report
	Mix Design	HMA Tonnage Database/IFB/P&G
		Report
	Paving/Patching/Milling Dates	MCMS

- Step 1. For each project where available, review the Right-of-Way (ROW) video collected by the Automated Road Analyzer (ARAN) vehicle, "Visidata.exe." Review the video to determine the limits of work for the project and verify, where possible, the type of construction action.
- Step 2. Check the **Invitation for Bid (IFB)** for relevant pavement history data. IFBs can be received directly from the Office of Maintenance (OOM) and the Office of Highway Design (OHD). They may also come from either the Pavement Design (PD) Team or General Test team.
- Step 3. Obtain pertinent pages of the IFBs that relate to construction history and dispose of remaining pages. The pertinent pages are (but not limited to): Title Page, Project Description, Category 500 Paving –Asphalt Cement Price Index, Paving Typical Sections, Plans Sheet, Soil Boring, Pavement Coring Log, and 2000, 5000 & 6000 series items in Schedule of Prices section (located near end of document).
- Step 4. Retrieve Project **Plan Set** from the source. Review pertinent pages that relate to construction history. Ensure that all the pertinent data is enclosed in the plan set paving typical sections, plan sheets, etc.
- Step 5. Identify the project limits using the **Highway Location Reference (HLR) Guide**. The HLR Guide is categorized by county and route. Verify the mile

points. The HLR also gives the Functional Class and AADT (Refer to Highway Location Referencing Guide).

- Step 6. Access the MCMS database through the EDW application (see <u>Reviewing</u> <u>Projects in MCMS</u>). Export the relevant spreadsheets to Excel. Relevant pages are: Items Report and IDR Detail. For area-wide projects, ensure the appropriate Financial Management Information System (FMIS) number is chosen when exporting the spreadsheet to Excel. In the Items Report, all 2000, 5000 and 6000 series items should be evaluated to determine which items are relevant.
- Step 7. Check Hot Mix Asphalt (HMA) Tonnage production database. Sort the data by "Contract Number" and hide all the unnecessary fields in the database. Keep Paving Location, Mix Number Production Date, and Actual Tonnage. Compare the total project estimated tonnage to the accumulated "actual" tonnage (see HMA Tonnage Application).
 - i. If the values are close, copy both tables (Estimated & Actual) into an Excel spreadsheet. Proceed to Step 8.
 - ii. If the values are not close, further investigation is required before proceeding. Cross reference MCMS report and contact Project Engineer to reconcile any differences.
- Step 8. Access the **Assignment List database** and print a summary with the State Construction P.E. listed.
- Step 9. Check PM records for the **PM 003 form**. This form contains the mile points (or station numbers), location information, mix design, project engineer, and type of construction.
- 2- Paving Data Input into EDW and QC performed by EDW user

Summary: This task inputs collected paving construction data into the EDW.

- Step 10. If the construction history data was paving, proceed to Step 11. If the construction history data was maintenance, skip to Step 26.
- Step 11. Open the EDW application.
- Step 12. On the Main Menu, click on "Data." From the "Data" drop-down menu, choose "Construction Data" (see below image).



Administration	Data	Analysis	Reporting	Help	Exit
2	C	onstruction D	ata		
	A	ran	I		
	W	isecrax	I		
	Vi	sidata			
	Fr	iction	I		
	М	CMS			
	М	aintenance	I		
	Н	MA Tonnage	• •		
	In	ventory			

Step 13. In the "Select an Action" section choose "Add New" and then "Paving History" from the "Source" drop-down menu (see below image).

Qe -	Data Warehouse ·	Connec	ted to Dev	elopment Data	ıbase - [Project Se	election]
	Administration	Data	Analysis	Reporting	Help	Exit	
1							
6	Select an Action: -		Select a	Data Source:		Select	a Criteria
	ction: Add New	~	Source:	PAVING HISTO	► RY	ОВ	y Contract
			Filter by:	MAINTENANCE UC - AS BID UC - AS BUILT ACCESS PERM			
Do	ouble Click a Cont	ract to Se	elect		JECIOI	RUFUSEL	2

Step 14. Enter the required "Contract No" (and FMIS number if applicable). Click "Save" and then "OK" in the dialogue box that appears (see below image).

Source:	PA	VING HIST	ORY	Change	Contract Guide		FMIS:	Promote	MCMS
ConHist	_Main	Location	Construction	n QC/QA Cheo	cklist Supporting	g Documents	S		
Cont	tract								
Co	ontract	Guide		FMIS					
Note	•								
Upd	ate Info	rmation:							
La	st Upda	ite Date	11	Update	ed By				
Add	d New	Delet	e Sa	ve					

Step 15. Click the "Locations" tab. Click "Add New" at bottom of screen (see below image).

MARYLAND DEPARTMENT OF TRANSPORTA		
STATE HIGHWAY ADMINISTRATION	Proc	Construction Data essing Paving & Maintenance Data

e:	PAVING H	IISTORY	Chan	ge Cont	ract Guid	le	FMIS:		Promote		MCMS			Clo
Hist	list_Main Location Construction QC/QA Checklist Supporting Documents													
Dou	ble Click to S	elect											Fit	
	LOC_ID	CONTRACT	FMIS	COUNTY	MUN	PREFIX	ASC_PREFIX	ROUTE	SUFFIX	DIR	BMP	EMP	EXIT_NO	
*														
•		III												Þ
	acation ID -									ſ	Addition	al Data		
		AUTONO	<u> </u>				1.1			l				
Loc	cation	Mun	Drafin	Dauta	Die		Limits		latera e etir					
County Mun Pretix Route Dir.														
									Т.					
	EXIT#	Ramp#										Alph	a	
	•			✓ Confi	rm Nev	w Rte	EMP				T	.		
Cor	nstruction Info	rmation												
Loc	ation Descrip	tion:												
_					_			_			State (on DE:	
Pav	ving Dates: Fi	rom _/_/	_ → Pat	ching Dates:	From/		 Milling Date 	s: From	<u></u>	<u> </u>	State C	onstructi	-	
		To _/_/			To/		•	То _					•	
Sou	urce Informati	on:			Up	date Infor	mation:							
	Data Entry	ENGIN	EERING_V	/AREH(-	Las	t Update	Date //		Updated By					
Note	es								Bridge ?			isidata		
_														
A -1		-1-4- 0-										and the second second		

- Step 16. Enter route information: County, Municipal (if needed), Prefix, Route, and Direction. Click "Confirm." The "BMP" & "EMP" will automatically populate under the "Limits" section. Adjust the mile points to fit the specific project. When entering a ramp, always chose the Main Inventory direction in the "Location" section denoted by the asterisk (*). Click "Confirm" and then proceed by inputting the "Exit #" and "Ramp."
- Step 17. Enter construction information: Location Description, Paving, Patching and Milling Dates, and State Construction P.E. Click "Save" at the bottom of the screen. The locations that were entered will now appear in the location table (see below image). If the State Construction P.E. is not listed in the drop-down menu, then he/she will need to be added to the list before continuing (see <u>Adding to Project Engineer List</u>).

MARYLAND DEPARTMENT OF TRANSPORTATION

Construction Data

STATE HIGHWAY ADMINISTRATION Processing Paving & Maintenance Data

Instruction Construction Construction Country MUN PREFix ASC_PREFix ROUTE Suffix 1002965 Test 123 TE5443 2 0 MD MD 2
LOC_ID CONTRACT FMIS COUNTY MUN PREFIX ASC_PREFIX ROUTE SUFF 1002965 Test 123 TE5443 2 0 MD MD 2 </th
1002965 Test 123 TE5443 2 0 MD MD 2 1002966 Test 123 TE5443 2 0 MD MD 2 * 1002966 Test 123 TE5443 2 0 MD MD 2 * 1002966 Additional Data 1002966 Additional Data Location County Mun Prefix Route Dir. BMP 0 BMP BMP Additional Data
I002966 Test 123 TE5443 2 0 MD MD 2 * Image: Second seco
*
Image: County Imag
Image: County Image: County Mun Prefix Route Dir. AA NONE MD 2 S MD MD Au
Location ID = 1002966 Location County Mun Prefix Route Dir. AA • NONE • MD • 2 • S • BMP 0
Location County Mun Prefix Route Dir. AA • NONE • MD • 2 • S • BMP 0
Location County Mun Prefix Route Dir. AA • NONE • MD • 2 • S • BMP 0
County Mun Prefix Route Dir. AA • NONE • MD • 2 • S • BMP 0
AA • NONE • MD • 2 • S • BMP 0
Exit# Ramp#
Confirm New Rte EMP 41.4 Alpha
Construction Information
Location Description: Patching & Resurfacing - Test
,
Paving Dates: From 04/04/2012 Patching Dates: From /// Milling Dates: From 03/06/2012 State Construction PE:
Paving Dates: From 04/04/2012 Patching Dates: From // Milling Dates: From 03/06/2012 State Construction PE:
Paving Dates: From 04/04/2012 Patching Dates: From Milling Dates: From 03/06/2012 State Construction PE: To 04/05/2012 To To 04/10/2012
Paving Dates: From 04/04/2012 • Patching Dates: From 1/1 • Milling Dates: From 03/06/2012 • State Construction PE: To 04/05/2012 • To 1/1 • To 04/10/2012 • Source Information: Update Information:

- Step 18. Double-click on a location (it will be highlighted in blue when selected), then click on "Additional Data." Select the "Fund Type." To verify the "Fund Type," refer to Looking Up Fund Type. In the "Critical Dates" section, the definitions for each critical date are as follows:
 - i. Received any correspondence received from the Districts or the P.E.
 - ii. Identified project was identified by the PM team.
 - iii. Processed the data entry began for the project.

Fill in the fields and click "Save" (see below image). Repeat this step for each location in the project.



STATE HIGHWAY ADMINISTRATION Processing Paving & Maintenance Data

	Construction	Data
0	Maintonanao	Data

🛃 Administration Data Analysis Reporting Help Exit
Contract briana FMIS Location ID 1009272 Location COUNTY = AL, ROUTE = CO 4 E, EXIT = , RAMP = , BMP = 0, EMP = 0.33 Close
Copy Data From Apply
Contract Information
PCA Fund - ARRA
Critical Dates
Received Identified Processed J_J J_J J_J Mat Clear Ride Memo Ride Memo Add PM 003 J_J J_J J_J J_J
Other inFo
Design Life Paving Patching Need Info
UC MCMS Review Date /_/ UC Notes WMA Notes Save

- Step 19. Double-click on a location (it will be highlighted in blue when selected). Click on the "Construction" tab.
- Click "Add New." Select a "Construction Type" from the drop-down menu. Step 20. Click the "Definition" button for details regarding each type.
- Fill in all the appropriate fields: Layer, Thickness, Material Type, Mix Method, Step 21. Mix Type, Band, and ESAL. Then, select the correct "Material Description."
- Step 22. Click on the boxes above each lane at the bottom of the screen or select the appropriate option from the "Quick Lane Coverage" drop-down menu. Click on "Apply Treatment" to save the treatment for the selected section (see below image).

Construction Data Processing Paving & Maintenance Data

STATE HIGHWAY ADMINISTRATION Proc

ConHist_Main	Location Co	nstruction	QC/QA Checkl	ist Supporting	Documents					
Location:	ounty - AL M		Profix = CO Po	uto = 4 Directio		Domo - PM		- 0.22		
Loodaon. C	Ounty - AL, M	un-none,	Field - CO, NO	ule - 4, Directio	/// - L, LXII - , r	Namp - , Div		- 0.33		
Treatment ID:		For	This Location O	nly Constructi	on Type: RE-	CONSTRUC	TION	▼ Definitio	View Exi	sting ConHist
Seq.	Layer	Thick. "	Material Type	Mix Method	Mix Type	Band	Binder	ESAL	Mat Descrip.	MatCode
- + # 1	ORIGINAL : 👻	0.75 👻	ASPHALT 👻	A- HOT MIX 👻	R- RAP 👻	9.5MM 👻	58-28 👻	LEVEL - 2 👻	355 - 9.5MM, 58-28, L 2 🗸	355
- + # 2		-	-	-	-	•	-	-	-	·
- + # 3	-	-	•	-	•	-	-	-	-	
- + # 4	-	-	•	-	•	-	-	-	-	
- + # 5	-	-	-	-	-	-	-	-	-	
Prev. 5	Next 5	Treatmen	t Date 12/31/20)99 👻 Disp	lay Date		Apply	/ Treatment	Copy Add 1	New Delete
Lane Configu	ration									
		Quick La	ane Coverage:			•	Clear All			
								Special	Pavement	
			8					Par	k & Ride	
Subsection								III We	ich Station	
< <	> >								igh otation	
0 - 0.13	-							Res	stArea	
Replace	Lanes									
	89		8					Modifu	Pofrash	
	00	1 1						woony	rteiresn	

- Step 23. Repeat Step 19 to Step 22 for all locations on the project.
- Step 24. Click on "QC/QA Checklist" tab. Click on the relevant boxes on "QC/QA Check List" (left side of screen) and then click the "Save" button on the bottom of screen. If all data for the project is entered completely, click the "Check" button (see below image). Otherwise, return to incomplete data and input before proceeding.

Maryland department of transportation

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Construction Data Processing Paving & Maintenance Data

Source:	MAINTENANCE	Change CN/FN C	ontract GUIDE	FMIS: EXAM	PLE Promote	MCMS	Close
ConHist_M	ain Location Construc	tion QC/QA Checkli	st Supporting Docume	ents			
	Check List		Value/Comment				
PM-	-001				Check UnCheck	QC Review Completion	
Cor	itract#						
🔽 FMI	S#				Last Check Date: 10/19/2	012 By: BGAMBLE	
🔽 Fun	d Type						
🔽 Οοι	inty						
🔽 Rou	ite						
🔽 Dire	ection						
🔽 Mile	Points				Check UnCheck	QA Review Completion	
Pro	ject Description						
📃 Pav	ring Compl Date				Last DataWarehouse	By:	
E Fro	m Orig PAV_HIST Notes						
Ro	adway Project Type				Saved.		
Ca	pital Paving / Patching	g project Only					
Cra	ck / Joint Sealing						
Pate	ching				C	C Review Completion	
Milli	ing						
Ref	lective Joint Cracking pre	-treatment			Last Check Date: //	By:	
Oth	er						
Ro	adway Project Type						
Ro	utine Maint. PCA Proje	ects Only					
1 of 5	Previous	Next	Sa	ive			

Step 25. Click on "Supporting Documents" tab and upload any supporting documents using the "Upload" button (see below image). After this step, the procedure is complete (next section is for promotion through maintenance history only).

a Warehouse - Connected to Development Database - [Construction Details]	
Administration Data Analysis Reporting Help Exit	Test Version 1.17
Durce: PAVING HISTORY Change CN/FN Contract. Test 123 FMIS: TE5443 Promote	MCMS
ConHist Main Losstian Construction OC/OA Checklist Supporting Documents	
Brow	se Upload
To Open, Double Click; To Delete, Single Click then Press Delete Button.	
Central Location for Supporting Documents: \\hanpmdata\PMDATA\05 Documentation\Engineering Data Warehouse	\Support_Doc\

3- Maintenance Data Input into EDW and QC – *performed by EDW user*

Summary: This task inputs collected maintenance construction data into the EDW.

- Step 26. Open the EDW application.
- Step 27. On the Main Menu, click on "Data." From the "Data" drop-down menu, choose "Construction Data" (see below image).



Step 28. In the "Select an Action" section choose "Add New" and then "Maintenance" from the "Source" drop-down menu (see below image).

<u>()</u>	Data Warehouse -	Connec	ted to Dev	elopment Data	abase - [Project Selection]
•	Administration	Data	Analysis	Reporting	Help	Exit
1						
6	Select an Action: -		_ Select a	Data Source:		Select a Criteria
						O By Contract
			Source:		~	
A	ction: Add New	~		PAVING HISTO	RY	
			Filter by:	UC-AS BID	-	
				UC-AS BUILT	ито	
				SHA/MdTA PR	DJECTS F	PROPOSED
Do	ouble Click a Conti	ract to Se	elect			

Step 29. A dialogue box will appear: "Do you want to import the data from Maintenance spreadsheet?" Click "No" except for the reports from Office of Maintenance (see below image).



Step 30. Enter the required "Contract No" (and FMIS number if applicable). Click "Save" and then "OK" in the dialogue box that appears (see below image).

🛃 Admini	stration	Data	Analysis	Reporting	Help	Exit				
Source:	MA			hange CN/FI	Cor	itract: <mark>Guide</mark>		FMIS: Example	Promote	MCMS
ConHist	t_Main	Location	Construction	n QC/QA Ch	ecklist	Supporting	g Documer	nts		
Cont	tract									
C	ontract	Guide		FMIS	Exam	ple]			
Note	9									
Upd	late Infor	mation:								
La	st Updat	te Date	11	Upda	ated By					
Add	d New	Delet	e Sa	ve						

Step 31. Click the "Locations" tab. Click "Add New" at bottom of screen (see below image).

Durce: MAINTENANCE	Change CN/FN Contract Guide	FMIS: Example Promote	MCMS Close
ConHist_Main Location Constru	ction QC/QA Checklist Supporting Doc	uments	
Double Click to Select			Fit
Location ID =	Measurement ID	View/Add Measurements	Additional Data
Location		Limits	
County Mun	Prefix Route Dir.	Intersection	on By
Evit#			MP ACT.
Kamp#-	Confirm New Rte	EMP	▼ Alpha
Construction Information			
Location Description:			
Paving Dates: From	Patching Dates: From	Milling Dates: From	State Construction PE:
To	To	_ • To _/ •	
Source Information:	Update Inf	ormation:	
Data Entry:	▼ Last Upda	te Date // Updated By	,
Notes		Bridge ?	Visidata
Add New Delete S	Copy Data From		- Apply

- Step 32. Enter route information: County, Prefix, Route, and Direction. Click "Confirm." The "BMP" & "EMP" will automatically populate under the "Limits" section. Adjust the mile points to fit the specific project. When entering a ramp, always chose the Main Inventory direction in the "Location" section denoted by the asterisk (*). Click "Confirm" and then proceed by inputting the "Exit #" and "Ramp."
- Step 33. Enter construction information: Location Description, Paving, Patching and Milling Dates, and State Construction P.E. Click "Save" at the bottom of the screen. The locations that were entered will now appear in the location table (see below image). If the State Construction P.E. is not listed in the drop-down menu, then he/she will need to be added to the list before continuing (<u>Adding</u> to Project Engineer List).

Administra	ation Data	a Analysis	Reporti	ng Help	Exit								Test Versio	n 1.20
ource:	MAINTE	NANCE	Change (N/FN Cont	tract Gui	de	FMIS: Exam	ple	Promote		MCMS]		Close
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	la Cliekte S	oloot		ACHECKIST	Support	ing Docu	intents						F a	_
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Þ	1009273	Guide	Example	2	0	MD	MD	3		N	0	7.11		c
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*														
4														•
Loca A	ation ID = ation County VA v NC	1009273 Mun DNE •	Mea Prefix MD	Route	Dir.		Limits BMP 0	asurement	s Intersect	ion	Additio	By		T
E	Exit#	Ramp #		✓ Confi	irm Ne	w Rte	EMP 7.11				v	MP	ha	Ι.
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Sour	rce Informati Data Entry	on: : ENGIN	EERING_V	/AREH -	Up	odate Info st Update	rmation: Date 10/17/2	D12	Updated B	y B	GAMBLE			
Notes	s								Bridge ?			/isidata		
Add	New D	elete Sa	ive	Сору [)ata Fron	n					•	\pply		

- Step 34. Double-click on a location (it will be highlighted in blue when selected), then click on "Additional Data." Select the "Fund Type." To verify the "Fund Type," refer to <u>Looking Up Fund Type</u>. In the "Critical Dates" section, the definitions for each critical date are as follows:
 - i. Received any correspondence received from the Districts or the P.E.
 - ii. Identified project was identified by the PM team.
 - iii. Processed the data entry began for the project.

Fill in the fields and click "Save" (see below image). Repeat this step for each location in the project.



Construction Data Processing Paving & Maintenance Data

Administration Data Analysis Reporting Help Exit
Contract Guide FMIS Example Location ID 1009273 Location COUNTY = AA BOUTE = MD 3 N* EXIT = BAMP = BMP = 0 EMP = 7.11
Copy Data From Contract Information PCA Fund
Critical Dates Received Identified Processed Mat Clear Ride Memo Ride Memo Add PM 003
Other inFo Design Life Paving Patching Need Info
UC MCMS Review Date _/_/
UC Notes WMA Notes

- Step 35. Double-click on a location (it will be highlighted in blue when selected). Click on the "Construction" tab.
- Step 36. Click "Add New." Select a "Construction Type" from the drop-down menu. Click the "Definition" button for details regarding each type (see below image).

STATE HIGHWAY ADMINISTRATION Construction Data Processing Paving & Maintenance Data

	NEW_CONSTRUCTION	PROJ_DESCRIPTION1	^				
	New Construction	(use existing), original const - subgrade thru original surface					
Reconstruction (use existing)							
	Major (Heavy) Rehabilitation projects where => 4"" milling and HMA or PCC overlay						
	Structural Overlay	overlay and / or mill & overlay increases overall pave thickness >1.5"					
Minor (light) Rehabilitation overlay and / or mill & overlay increases overall pave thickness 0.01*** - 1.5***							
	Preventative Maintenance	overlay and / or mill & overlay pave thickness <=1.5"					
	Preventative Maintenance	asph seal / rejuv, aqq. seals, crack and / or joint seals, grinding and / or milling only projects, capital project patr	-				

- Step 37. Fill in all the appropriate fields: Layer, Thickness, Material Type, Mix Method, Mix Type, Band, and ESAL. Then, select the correct "Material Description."
- Step 38. Click on the boxes above each lane at the bottom of the screen or select the appropriate option from the "Quick Lane Coverage" drop-down menu. Click on "Apply Treatment" to save the treatment for the selected section (see below image).

Administration Data	Analysis Reporting He	lp Exit			Test Version 1.20
iource: MAINTENAN	CE Change CN/FN Construction OC/OA Check	Contract Guide	FMIS: Example	Promote MCMS	Close
Location: County = AA	, Mun =NONE, Prefix = MD, F	toute = 3, Direction = N *, E	Exit = , Ramp = , BMP =	0, EMP = 7.11	
Treatment ID:	▼ For This Location (Only Construction Type:	PLEASE SELECT	✓ Definition	View Existing ConHist
Seq. Layer	Thick." Material Type	Mix Method Mix Typ	e Band Bind	der ESAL Mat	Descrip. MatCode
-+#	• • • • •	-	•	•	•
-+#	• • •		•	•	•
-+#	•		•	• •	_
-+#	• • • •		•	•	•
-+#	• • •	-	-	•	•
Prev. 5 Next 5	5 Treatment Date _/_/	 Display Date 		Apply Treatment Co	py Add New Delete
Lane Configuration	Quick Lana Coverage			or All	
	Quick Lane Coverage				
				Special Pavement-	
Subsection				Park & Ride	
		Weigh Station			
		Rest Area			
0-0.0440 -		I NestAlea			
Replace Lanes					
Add Lanes	1 3 2 1 1	1 2 3 1		Modify	fresh
		1 2 3 1			

Step 39. Repeat Step 19 to Step 22 for all locations on the project.

Step 40. Click on "QC/QA Checklist" tab. Click on the relevant boxes on "QC/QA Check List" (left side of screen) and then click the "Save" button on the bottom of screen. If all data for the project is entered completely, click the "Check" button (see below image). Otherwise, return to incomplete data and input before proceeding.

Source: MAINTENANCE Change CN/FN Co	Intract: GUIDE FMIS: EXAMPLE Promote MCMS	Close
ConHist_Main Location Construction QC/QA Checklis	t Supporting Documents	
QC/QA Check List	Value/Comment Check UnCheck QC Review Completion	
Contract #		
<pre>Image: Image: Imag</pre>	Last Check Date: 10/19/2012 By: BGAMBLE	
V Fund Type		
✓ County		
✓ Route		
☑ Direction		
Mile Points	Check UnCheck QA Review Completion	
Project Description		
Paving Compl Date	Last DataWarehouse By:	
From Orig PAV_HIST Notes		
Roadway Project Type	Saved.	
Capital Paving / Patching project Only		
Crack / Joint Sealing		
Patching	C C Review Completion	
Milling		_
Reflective Joint Cracking pre-treatment	Last Check Date: // By:	
Other		
Roadway Project Type		
Routine Maint. PCA Projects Only		
1 of 5 Previous Next	Save	

Step 41. Click on "Supporting Documents" tab and upload any supporting documents using the "Upload" button (see below image). After this step, the procedure is complete.

ta Warehouse - Connected to Development Database - [Construction Details]	A 1 STOLEN AND A
Administration Data Analysis Reporting Help Exit	Test Version 1.17
ource: PAVING HISTORY Change CN/FN Contract Test 123 FMIS: TE5443 Promote MCMS	Close
Conflict Main Logation Construction OC/OA Checklist Supporting Documents	
conflist_Main Location Construction QC/QA Checklist Supporting Documents	
Browse Uploa	d
To Open, Double Click; To Delete, Single Click then Press Delete Button.	
Central Location for Supporting Documents: \\hanpmdata\PMDATA\05 Documentation\Engineering Data Warehouse\Support_Doc\	

4.02 PROCESSING ACCESS PERMIT DATA

4.02.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to collect and update access permit data in the Engineering Data Warehouse (EDW). Access Permits have limited information available. Relevant inventory information is gathered from a variety of sources including but not limited to: Highway Location Reference (HLR), Plan Sets, Access Permit Contracts, and Material Managements reports.

4.02.02 Frequency

The updating of access permit data is a continuous process that occurs year-round.

4.02.03 Purpose

The purpose of this SOP is to collect access permit data, verify and update inventory information associated with the project, perform quality control (QC) of gathered data, and update the data in the Unit Cost Database of the EDW.

4.02.04 *Resource Requirements*

Data collection and upload of access permit information involves two people: (1) a user knowledgeable in collection of access permit data from various sources and EDW software to perform data collection, QC, and uploading, and (2) a supervisor who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	EDW user and QC	1	1.0-16.0 ^{06/12/2019}
DPT TL	Supervisor	1	AR ^{06/12/2019}

4.02.05 *Procedure*

The procedure to collect and upload access permit data is comprised of the following two tasks:

(1) collection of access permit data

(2) input of collected data into EDW.

1- Access Permit Data Collection – *performed by EDW user*

Summary: This task collects and reviews access permit data from a variety of sources in order to retrieve the necessary inputs for data entry into the EDW.

- Step 1. Retrieve Project **Plan Set** from the source. Extract Permit #, Project Description, Location, and Rehab Information.
- Step 2. Identify the project limits using the Highway Location Reference (HLR) Guide. The HLR guide is categorized by county and route. Verify the mile points. The HLR also gives the Functional Class and AADT (Refer to Highway Location Referencing Guide).

- Step 3. Locate the **Project File** in the Materials Management file room. The files are not in numerical order but in sequential order. Therefore, ensure that the appropriate file folder is acquired.
- Step 4. Scan all **Contracts** in the folder.

2- Access Permit Data Input into EDW and QC – performed by EDW user

Summary: This task inputs collected access permit construction data into the EDW.

Step 5. Refer to <u>Processing Paving & Maintenance History Data</u>, Section 2 for step by step directions. The steps for "Access Permit" projects are the same as "Paving History." Be sure that the **Contract #** is entered in the <u>Access Permit</u> format.
4.03 PROCESSING AS BID UNIT COST DATA

4.03.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to collect and update As Bid unit cost data in the Engineering Data Warehouse (EDW). As Bid projects are single advertised projects. As Bid data is processed and analyzed prior to the commencement of construction. The primary data source for this information is bid tabulations published by the Office of Highway Design, extracted from the MDOT-SHA website. Relevant inventory information to supplement the cost data is gathered from a variety of sources, including, but not limited to: Pavement & Geotechnical Reports (P&G Report), Pavement Management (PM) Base, project plans, Visidata, Vision and the Highway Location Referencing (HLR) System.

4.03.02 Frequency

The updating of As Bid unit costs is a continuous process that occurs year-round.

4.03.03 Purpose

The purpose of this SOP is to collect As Bid unit cost data, verify and update inventory information associated with the project, perform quality control (QC) of gathered data, and update the data in the Unit Cost Database of the EDW.

4.03.04 Resource Requirements

Data collection and upload of As Bid unit cost information involves two people: (1) a user knowledgeable in collection of As Bid unit cost data from various sources and the EDW software to perform data collection, QC, and uploading, and (2) a supervisor who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues were encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff (Fund 77)	EDW user and QC	1	1.5
DPT Staff (Non- Fund 77)	EDW user and QC	1	2.0
DPT TL	Supervisor	1	AR ^{06/12/2019}

4.03.05 Procedure

The procedure to collect and upload As Bid unit cost data is comprised of the following two tasks:

- (1) collection of As Bid unit cost data
- (2) input of collected data into EDW and QC.

1- As Bid Data Collection – *performed by EDW user*

Summary: This task collects and reviews As Bid unit cost data from a variety of sources in order to retrieve the necessary inputs for data entry into the EDW.

Step 1. For each project where available, review the Right-of-Way (ROW) video collected by the Automated Road Analyzer (ARAN) vehicle, "Vision." Review the video to determine the limits of work for the project and verify, where possible, the type of construction action (see image below).



- Step 2. Identify the project limits using the Highway Location Reference (HLR) Guide in conjunction with the Project Description from the Invitation for Bids (IFB). The HLR Guide is categorized by county and route. Verify the mile points. The HLR also gives the Functional Class and AADT (Refer to Highway Location Referencing Guide and Project Description).
- Step 3. Check the IFB for relevant pavement history data. IFBs can be received directly from the Office of Maintenance (OOM) and the Office of Highway Design (OHD). They may also come from either the Pavement Design (PD) Team or General Test team. Maryland eMarketplace is also a location where the IFBs can be found (see below images).

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Search Using:	ALL of the criteria V			
		Find It Clear		
Search Fields:	Bid # Secrete A1655177 Operating A1655177 Operating V Operating V Proclass Kethod V NGP Class Ive V Commodity Code Q	Fired It Clear	Bid Opening Date(MMDDYYYY)	~
Results	<u> </u>			
<u>Bid</u> ≢	Contract/Blanket #	Buyer		Description
MDJ023103516	<u>14</u>	Alex Okeike	QA1695177 - MD 19/19A in Church Hill	
				Exit
			Copyright	2017 Periscope Holdings, Inc All Rights Reserved.



aryland ////////////////////////////////////										
Bid Solicitation: MDJ(0231035164									
Header Information										
Bid Number:	MDJ0231035164		Description:	QA1695177 - MD 19/19A in Church Hill						
Purchaser:	Alex Okeke		Organization:	Maryland State Highway Administration						
Department:	J0206023 - SHA-OFFICE OF HIGHWAY DEVELOPMENT		Location:	06023 - OFFICE OF HIGHWAY DEVELOPMENT						
Fiscal Year:	18		Type Code:	IT - Invitation to Bid (ITB)						
Alternate Id:	QA1695177		Required Date:							
Info Contact:	Alex like Okeke (410) 545-8868		Bid Type:	OPEN						
Purchase Method:	Open Market									
Pre Bid Conference:	See attached "Advertisement Notice"									
Bulletin Desc:	QA1695177 - This project, located in Queen / Symbols; Any necessary Erosion and Sedime	inne?s County, is for safety and resurfacing improvements to MD 19 (nt Controls	Main Street / Walnut Street) and MD 19A (Main S	treet) in Church Hill for a total distance of 1.93 miles. The work will consist	of the following: Grinding Asphalt Pavement; Partial Depth and F					
File Attachments:	707 N. Calvent Street Mal Stop C-102 Ballmore, MD 21202 Email: modelshab:Chgaha state nd us Phone: (410)545-5840 PAX: (410)265-5840 QA1955177 Ad Notice.pdf: QA1955177 Ad IFB.pdf QA191	5177 Ad Plans.pdf - QA1695177.ebax - QA1695177 Addendum No	Lodf . QA1695177 Addendum No. 1 Plans.od	2071 N. Calvert Strett Mall Stor C-102 Usilianitos. No. 21:202 Britanica Marci 2:202 Britanic Monthabiot(Starbash Provin: (410):566-5840 Provin: (410):566-5001 - Cal4595177.0015						
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- Step 4. Remove pertinent pages of the IFBs that relate to construction history and dispose of remaining pages. The pertinent pages are (but not limited to): Title Page, Project Description, Category 500 Paving –Asphalt Cement Price Index, Paving Typical Sections, Plans Sheet, Soil Boring, Pavement Coring Log, and 2000, 5000 & 6000 series items in Schedule of Prices section (located near end of document).
- Step 5. Retrieve Project **Plan Set** from the source. Review pertinent pages that relate to construction history. Ensure that all the pertinent data is enclosed in the plan set paving typical sections, plan sheets, etc. The plan set can be found on the Maryland eMarketplace site (see below image).

MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION Processing

Construction Data Processing As Bid Unit Cost Data

@rketplace 🛰	2				
Bid Solicitation: MDJ	0231035164				
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Bid Number:	MDJ0231035164		Description:	QA1695177 - MD 19/19A in Church Hill	
Purchaser:	Alex Okeke		Organization:	Maryland State Highway Administration	
Department:	J0206023 - SHA-OFFICE OF HIGHWAY DEVELOPME	NT.	Location:	06023 - OFFICE OF HIGHWAY DEVELOPMENT	
Fiscal Year:	18		Type Code:	IT - Invitation to Bid (ITB)	
Alternate Id:	QA1695177		Required Date:		
Info Contact:	Alex like Okeke (410) 545-8868		Bid Type:	OPEN	
Purchase Method:	Open Market				
Pre Bid Conference:	See attached "Advertisement Notice"				
Bulletin Desc:	QA1695177 - This project, located in Qr Symbols; Any necessary Erosion and ?	usen Anne?s County, is for safety and resurfacing improvements to MD 19 (M Sediment Controls	ain Street / Walnut Street) and MD 19A (Main Street)	I) in Church Hill for a total distance of 1.93 miles. The work will consist of th	.e following: Grinding Asphalt Pavement
Ship-to Address:	Angele Smith 707 N. Calvert Street Meil Stop C-102 Baltimore, NU0 21 702 US Email: modoshabkid X@sha.state.md.us Phone: (410)(545-864) FAX: (410)(545-860)		Bill-to Address:	Angels Smith 707 N. Calvert Street Mail Stop C-102 Baltimore, MD 21202 US Email: indosthabid/@gaha.state.md.us Phone: (410)245-8040 FAX: (410)205-3001	
File Attachments:	QA1695177 Ad Notice.pdf . QA1695177 Ad IFB.pdf	QA1695177 Ad Plans.pdf . DA1695177.ebsx . QA1695177 Addendum No.	1.pdf . QA1695177 Addendum No. 1 Plans.pdf . 9	JA1695177.001x	
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- Step 6. Access **Transport** database through the EDW application (see <u>Running</u> <u>Transport Application</u>). Export the spreadsheet to Excel. Identify the paving related items (typically **2000, 5000 & 6000** series items).
- Step 7. Access the **Bid Tabulation** on the SHA homepage. Select the contract number for the project and print. The Bid Tabulation contains the contract number, letting date (date of bid opening) and the completion date (see below image).

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1003	110500	PRICE ADJUSTMENT FOR DIESEL FUEL	EA I	1,000.00000	1.00000	1,000.00000	1.00000	1,000.00000	1.00000	1,000.00000
1005	120610	ARROW PANEL	UD D	25.00000	30.00000	750.00000	50.00000	1,250.00000	2,000.00000	50,000.00000
1006	120625	TEMPORARY TRAFFIC SIGNS HIGH PERFOR	51	108.00000	45.00000	4,860.00000	20.00000	2,160.00000	50.00000	5,400.00000
1007	120717	REFLECTIVE BARRIER MARKERS	EA I	89.00000	20.00000	1,780.00000	20.00000	1,780.00000	25.00000	2,225.00000
1008	120750	TEMPORARY CRASH CUSHION SAND FILLED	BBL	38.00000	320.00000	12,160.00000	300.00000	11,400.00000	350.00000	13,300.00000
1009	120763	VERTICAL PANELS	EA I	3.00000	80.00000	180.00000	80.00000	240.00000	25.00000	75.00000
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1012	120860	PORTABLE VARIABLE MESSAGE SIGN	UD	14.00000	150.00000	2,100.00000	150.00000	2,100.00000	250.00000	3,500.00000
1013	120890	PROTECTION VEHICLE	1 00 1	25.00000	330.00000	8,250.00000	650.00000	16,250.00000	1,000.00000	25,000.00000
1014	121050	TEMPORARY TYPE E TRAFFIC BARRIER EN	EA	1.00000	18,000.00000	18,000.00000	11,500.00000	11,500.00000	18,000.00000	18,000.00000
1015	121150	CONSTRUCTION STAFFORT	1.19	2,130.00000	15.00000	31,950.00000	43 000 00000 1	53,250.00000 I	80.000.00000	117,150.00000
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		GRADING ITEMS TOTAL :		1		1,500.00000		3,000.00000		7,500.00000
DRAINAG	35									
3001	300000-07	(SENDREGS	1.07	7,00000 1	650,00000,1	4 550 00000 1	500,00000,1	3 500 00000 1	1 000 00000 1	7 000 00000 1
3002	301008	STABILIZED CONSTRUCTION ENTRANCE	EA	1.00000	3,500.00000	3,500.00000	4,000.00000	4,000.00000	5,000.00000	5,000.000000
3003	388043	18 INCH PIPE SLOPE DRAIN	LF	66.00000	50.00000	3,300.00000	50.00000	3,300.00000	45.00000	2,970.00000
3004	388059	EROSION AND SEDIMENT CONTROL CLEANO	I CY	114.00000	15.00000	1,710.00000	50.00000	5,700.00000	80.00000	9,120.00000
3005	388151	TEMPORARY ASPHALT BERM	LF	2,007.00000	16.00000	32,112.00000	37.00000	74,259.00000	35.00000	70,245.00000
3007	390525	SILT FENCE	LF	2,177.00000	2.50000	5,442.50000	3.00000	6,531.00000	3.00000	6,531.00000

Step 8. Access the **PMbase** from the Office of Materials Technology (OMT) homepage. Enter the route information required and retrieve the Construction

History for the route. The construction history data includes the last treatment applied to the roadway and the pavement type.

Step 9. Locate the **PAGD Geotechnical Report** on the "OMTOOCShared:\OMT\ Design Projects" drive which is categorized by district. The folders are categorized by the contract number, by route, or by project description (or a combination thereof). Extract from the contract folder the **Pavement Recommendation Memorandum** and an excel spreadsheet entitled "Design Help." The report will indicate the design life (if not, ask the pavement engineer who worked on the project). Use the "Design Help" to compute the ESALs as follows:

ESALs = ADT x 18 Kip Truck Factor x (% Truck ADT/100) x (% Directional Distribution/100).

2- As Bid Data Input into EDW and QC – performed by EDW user

Summary: This task inputs collected As Bid data into the EDW.

- Step 10. Open the EDW application.
- Step 11. On the Main Menu click on "Reporting." From the "Reporting" drop-down menu, choose "Transport" (see below image).

🎯 Data Warehouse - Co	🔉 Data Warehouse - Connected to Production Database										
Administration Da	ata Analysis	Reporting Help Exit									
2		Construction Data									
		Condition									
		MCMS									
		Transport									
		HMA Tonnage									

Step 12. In the "Select a Transport Report" section choose "Report – Contracts Not in Unit Cost" from the drop-down menu (see below image).

MARYLAND DEPARTMENT OF TRANSPORTATION

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Construction Data Processing As Bid Unit Cost Data

ж D	ata Warehouse - Co	onnected to Proc	luction Database - [Transport	Reports				COMPANY OF THE OWNER.	the second second second
•	Administration	Data Anal	ysis Reporting	Help	Exit					Test Version 1.1
~										
S	Select a Transport Report - Contra	Report	<mark>Cost</mark> →					Exp	ort to Excel	Close
Do	ouble Click to Sele	ect a Contract fo	or Detailed Report	ts; Highlig	ht a Conti	ract and then Click	on Remove but	ton to Remove from	the Report.	Remove
	LCONTID	DATELET	COUNTY1	CO	UNTY2	COUNTY3	COUNTY4	CDESCR	CONTAMT	VNAMEL
Þ	WA3255180	03/29/2012	WASHINGTO	N				I-70 BRIDGE NO	13351728.7	CONCRETE GEN
	WA3515130	03/29/2012	WASHINGTO	N				US 40 ALT. AT P	1534793.75	C. WILLIAM HET

- Step 13. Highlight and remove all the projects that are not good candidates such as projects not having pavement related items in the 5000 series (tree teaming, Snow removal, guardrail repairs).
- Step 14. Double-click on a contract for the detailed item report.
- Step 15. Examine and identify all the mainline and shoulder related items include Excavation, GAB, common borrow, HMA, concrete, patching, milling/grinding, rumble strips and topsoil. These items are located in the following codes: 2000 Borrow and Excavation, 5000 Paving, and 6000 Shoulder items.
- Step 16. Check the pavement-related Items and click "Promote to As Bid" button (see below image).

🕫 Data V	Narehouse	e - Connected	d to Production Database - [Transport Report by Contract]	Contraction of the local division of the loc	and the second se	and the second second
🖳 Ad	ministrati	on Data	Analysis Reporting Help Exit		Test Ver	sion 1.18
~						
Contra	act WA3	255180	Promote to As Bid	Export to Ex	cel	Close
	CHECK	PRPITEM	DESC1	LCONTID	DATELET	COUNTY1 *
		459110	FABRICATED STRUCTURAL STEEL	WA3255180	03/29/2012	WASHINGT
		459310	STEEL STUD SHEAR DEVELOPERS	WA3255180	03/29/2012	WASHINGT
		466115	EPOXY PROTECTIVE COATINGS ON ABUTMENTS	WA3255180	03/29/2012	WASHINGT
		488107	CONCRETE SLOPE PROTECTION FOR BRIDGENO. 21106	WA3255180	03/29/2012	WASHINGT
		488111	BOTTOM CUTOFF WALLS FOR CONCRETE SLOPE PROTECTIONFOR BRIDGENO. 21106	WA3255180	03/29/2012	WASHINGT
		492047	BOTTOM CUTOFF WALLS FOR RIPRAP SLOPE PROTECTION FOR BRIDGENO. 21106	WA3255180	03/29/2012	WASHINGT
		492049	SIDE CUTOFF WALLS FOR RIPRAP SLOPE PROTECTION FOR BRIDGENO. 21106	WA3255180	03/29/2012	WASHINGT
	V	504086	HOT MIX ASPHALT SUPERPAVE 9.5MM FOR SURFACE, PG64-22, LEVEL-2	WA3255180	03/29/2012	WASHINGT
		504106	HOT MIX ASPHALT SUPERPAVE 9.5MM FOR WEDGE/LEVEL, PG64-22, LEVEL-4	WA3255180	03/29/2012	WASHINGT
		504264	GAP-GRADED STONE MATRIX ASPHALT 12.5MM, PG76-22	WA3255180	03/29/2012	WASHINGT
		504298	HOT MIX ASPHALT SUPERPAVE 19.0MM FOR BASE, PG64-22, LEVEL-2	WA3255180	03/29/2012	WASHINGT
	~	504310	HOT MIX ASPHALT SUPERPAVE 19.0MM FOR WEDGE/LEVEL, PG64-22, LEVEL-4	WA3255180	03/29/2012	WASHINGT
	~	504328	HOT MIX ASPHALT SUPERPAVE 19.0MM FOR PARTIAL DEPTH PATCH, PG64-22, LEVEL-4	WA3255180	03/29/2012	WASHINGT
	~	504422	HOT MIX ASPHALT SUPERPAVE 25.0MM FOR BASE, PG64-22, LEVEL-2	WA3255180	03/29/2012	WASHINGT
	~	504600	PRICE ADJUSTMENT FOR ASPHALT BINDER	WA3255180	03/29/2012	WASHINGT
	~	504605	PAYMENT ADJUSTMENT FOR PAVEMENT DENSITY	WA3255180	03/29/2012	WASHINGT
	~	504610	PAYMENT ADJUSTMENT FOR HOT MIX ASPHALT MIXTURE	WA3255180	03/29/2012	WASHINGT =
	~	520111	4 INCH GRADED AGGREGATE BASE COURSE	WA3255180	03/29/2012	WASHINGT
	~	520112	5 INCH GRADED AGGREGATE BASE COURSE	WA3255180	03/29/2012	WASHINGT
	1	520113	6 INCH GRADED AGGREGATE BASE COURSE	WA3255180	03/29/2012	WASHINGT
	V	530100	GRINDING HOT MIX ASPHALT PAVEMENT 0 INCH TO 2 INCH	WA3255180	03/29/2012	WASHINGT
1	V	535100	PAVEMENT SURFACE PROFILE PAY ADJUSTMENT	WA3255180	03/29/2012	WASHINGT
		585351	PAVEMENT MARKER REFLECTOR LENSES	WA3255180	03/29/2012	WASHINGT

- Construction Data Processing As Bid Unit Cost Data
- Step 17. A dialogue box will appear: "You will need to enter the location associated with the items selected. Do you want to continue?" Click "Yes" (see below image).

DataWarehouse_New	X
You will need to enter the locations associate want to continue?	ed with the items selected. Do you
	Yes No

Step 18. Click "Add New" at the bottom left hand corner of the screen to add a new location. Fill in the route information: County, Prefix, Route, Direction, From MP, To MP, and Description. Click "Save." Repeat this step until all the locations for the project are entered. When all the locations have been entered and appear in the table, click "OK" (see below image).

dminis	stration	Data	Analysis	Reporti	ng Help E	xit		
ontract \	WA32551	80	F	MIS 0		ОК	Cance	
LOC	C_ID	COU	NTY	MUN	PREFIX	ASC_PREF	K ROUTE	E
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Cour Cour Exi	nty it # cription	"" 	Mun amp #	· · · · · · · · · · · · · · · · · · ·	Prefix From MP	Route	Dir.	•

Step 19. A dialogue box will appear: "A Unit Cost As Bid record has been successfully created for the selected items. Do you want to review the created As Bid record?" Click "Yes" (see below image).



Step 20. Enter data for: **Fund Type, Letting Date, Cement Price, and Binder** (should automatically appear). Click "Save" (see below image).

a Warehouse - Connected to Production Database - [Construction Details]	Test Version 1 18
Surce: UC - AS BID Change CN/FN Contract: WA3255180 FMIS: Promote	Transport
s Built/As Bid_Main Location Construction Item Cost QC/QA Checklist Supporting Documents	
Contract Information	
Contract# WA3255180 FMIS #	
Project Info.	
Fund Type: Letting Date: 03/29/2012	
Project Feature:	
As Built Semi-Final As Built Final Area Wide Verified	
Cement Price: Get Price Select a Price:	
Date From:	
Binder: 64-22 Date To:	
Note	
Update Information:	
AMOURADYAN	

Step 21. Click the "Location" tab to enter the location information. The locations entered for the project during Step 19 will appear in the location table. Click "Save." Double-click on a location in the location table. When it is highlighted in blue, click "View/Add UC Measures" (see below image).

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Construction Data Processing As Bid Unit Cost Data

ce: UC - AS BID	Change CN/FN Contract	FMIS:	Promote	Transport
Built/As Bid_Main Location	Construction Item Cost QC/QA C	Checklist Supporting Docu	iments	
Double Click to Select				Fit
Location ID =	UnitCost ID	View/Add U	C Measures	
Location		Limits		
County Mun	Prefix Route Dir.		Intersection	By
*	*	▼ BMP		O MP ACT.
Exit#Ramp#				Alpha
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Construction Information				
Location Description:				
Source Information:		odate Information:		
Data Entry:			Updated By	
Netes			Eridae 2	Visidata
Notes			Bildge ?	Visidata
Add New Delete	Save Copy Data From	n	•	Apply

Step 22. Enter the required information: Functional Class, Pavement type, Est. Completion Date, Thickness, Design Life, Action, Action Year, and ESALs. The Total Bid should automatically populate if the contract was promoted through the Transport feature. See Step 24 to automatically populate Lane Miles, Pavement Area, and Shoulder Area (see below image).

Contract QA1695177 FMIS ID 18614	COUNTY = QA, MUN = , ROUTH	= MD 19 A N *, EXIT = , RAMP = , I	BMP = 0, EMP
General Information Functional Class: Rural Major Collector	Pavement Type: F	Est. Completion Date:	05/17/2018 -
Project Summary: Lane Miles: 390 OW Pave. Area (sy): 27228.44 OW	Shid Area (sy): 6265.61 OW	Open Worksheet	Total Bid: 683111.54
Project Rehab Info: Existing Payment Info: Thickness: 150 Action: THIN OVERLAY >15 AND <25 Design Life: 10 Action: 2007 Estimated Life? Design Life: 8 Estimated Section:	Pavement Condit PCI: 0 AADT: 0 Friction: 0	on: IR: 0 ESALs: 225	Delete
Edit Locations Associated with Current Unit ID Remove Press Sect Add Press Sect CODE MUN ROUTE RSUFF RNUM Direct 17 0 MD 19 E 17 17 0 N0 19 N1 17 0 MD 19 N1 17 0 MD 19 N1 17 0 MD A 19 N1 17 0 MD A 19 N1 17 0 MD A 19 S1 17 0 MD A 19 S1 S1	Apply Cuck Lane C ECTION BMP 0 0 0 0 1 1 1 1		Calc Lane Mile/Areas

To attain the completion date, go to the SHA Intranet page and click on the Business Tab (see below image).

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Construction Data Processing As Bid Unit Cost Data



Click on the "Contracts, Bids & Proposals" link on the left side and then click on the "Bid Tabulations" link. Search for the contract and click on the "Contract Number" (see below images).



If you would like to download a copy of this file <u>click here</u> For additional information on Contract Number (QA1695177) <u>click here</u>



lank		Name			Total Bid	& Over Low Bid					
1	DAVID	A. BRAMBLE, INC.			683,111.54000	100.00	-				
2	GEORG	E & LYNCH, INC.			735,085.79000	107.61					
3	ALLAN	MYERS MD, INC.			795,777.00000	116.49					
LINE N	O ITEM COD	E ITEM DESCRIPTION	1 000	< 1	QUANTITY	DAVID A. BRAMBLE,	INC.	GEORGE & LYNCE	H, INC.	ALLAN MYERS HD.	INC.
						UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
PRELIM	INARY										
1001	110500	PRICE ADJUSTMENT FOR DIESEL FUEL	EA	1	1,000.00000	1.00000	1,000.00000	1.00000	1,000.00000	1.00000	1,000.0
1002	114006	5 INCH YELLOW PAVEMENT MARKING PAIN	LF	- I	19,205.00000	.25000	4,801.25000	.25000	4,801.25000	.25000	4,801.2
1003	114011	5 INCH WHITE PAVEMENT MARKING PAINT	LF		9,779.00000	.25000	2,444.75000	.25000	2,444.75000	.25000	2,444.7
1004	114021	10 INCH WHITE PAVEMENT MARKING PAIN	LF	1	110.00000	.55000	60.50000	.50000	55.00000	.50000	55.0
1005	114036	12 INCH WHITE PAVEMENT MARKING PAIN	LF	1	288.00000	2.30000	662.40000	2.14000	616.32000	2.20000	633.6
1006	114041	16 INCH WHITE PAVEMENT MARKING PAIN	LF	1	213.00000	3.00000	639.00000	2.70000	575.10000	2.75000	585.7
L007	114216	5 INCH YELLOW REMOVABLE PAVEMENT LI	LF	- I	961.00000	1.50000	1,441.50000	1.82000	1,749.02000	1.85000	1,777.8
1008	114236	12 INCH WHITE REMOVABLE PAVEMENT LI	LF	- I	288.00000	3.20000	921.60000	4.28000	1,232.64000	4.40000	1,267.2
1009	114241	16 INCH WHITE REMOVABLE PAVEMENT LI	LF		213.00000	4.00000	852.00000	5.35000	1,139.55000	5.50000	1,171.5
1010	114276	REMOVAL OF REMOVABLE PAVEMENT MARKI	LF	1	1,461.00000	1.00000	1,461.00000	.42000	613.62000	.40000	584.4
1011	120500	MAINTENANCE OF TRAFFIC	LS	1	1.00000	30,000.00000	30,000.00000	41,100.00000	41,100.00000	41,357.56000	41,357.5
L012	120625	TEMPORARY TRAFFIC SIGNS HIGH PERFOR	SF	- I	350.00000	50.00000	17,500.00000	23.00000	8,050.00000	21.95000	7,682.5
L013	120747	FLAGGER	HR		1,120.00000	35.00000	39,200.00000	28.20000	31,584.00000	28.85000	32,312.0
1014	120773	RELOCATE SIGN	SF		14.00000	50.00000	700.00000	30.15000	422.10000	32.95000	461.3
1015	120820	DRUMS FOR MAINTENANCE OF TRAFFIC	EA	- I	41.00000	60.00000	2,460.00000	84.60000	3,468.60000	27.45000	1,125.4
1016	120860	FORTABLE VARIABLE MESSAGE SIGN	I UD	- I.	114.00000	40.00000	4,560.00000	66.80000	7,615.20000	82.00000	9,348.0
L017	120890	PROTECTION VEHICLE	1 00	1	14.00000	.01000	.14000	237.00000	3,318.00000	.01000	.1
L018	130840	CONSTRUCTION STAKEOUT	LS	1	1.00000	5,000.00000	5,000.00000	5,900.00000	5,900.00000	1,000.00000	1,000.0
1019	130850	MOBILIZATION	LS	1	1.00000	25,000.00000	25,000.00000	39,000.00000	39,000.00000	35,000.00000	35,000.0
		PRELIMINARY ITEMS TOTAL :			1		138,704.14000		154,685.15000		142,608.2

- Step 23. In the "Edit Location Associated with Current Unit ID" section of the screen click on the "Add" pull-down menu and make sure all the locations are added to this unit cost measures. If the As Bid was promoted from the "Transport" feature, the locations will already appear in the table. If the project wasn't promoted from the "Transport" feature, the locations must be enter manually using the aforementioned steps.
- Step 24. Click on the drop-down menu in the "Quick Lane Coverage" section of the screen. Select "All" then press "Calc Lane Miles/Area" and the EDW will automatically generate the quantities for lane miles, pavement area and shoulder area (see image below).

ntract QA1695177 FMIS General Information Functional Class: Rural Major Collector Project Summary: Lane Miles: 390 OW Pave. Project Rehab Info: Thickness: 1.50 Action: TH	ID 18614 COUN Pavement Ty Area (sy): 27228.44 OW Shid Area ment Info:	TY = QA, MUN = , ROUTE = MI ype: F → a (sy): 6265.61 OW	D 19 A N*, EXIT = , RAMP = , BN Est. Completion Date: Open Worksheet	1P = 0, EMP Close 05/17/2018 Total Bid: 683111.54
General Information Functional Class: Rural Major Colector Project Summary: Lane Miles: 390 OW Pave. Project Rehab Info: Thickness: 1.50 Action: TH	Pavement Ty Area (sy): 27228.44 OW Shid Area ment Info:	ype: F →	Est Completion Date: Open Worksheet	05/17/2018
Project Summary: Lane Miles: 3,90 OW Pave. Project Rehab Info: Existing Pav Thickness: 1,50 Action: TH	Area (sy): 27228.44 OW Shid Area	a (sy): 6265.61 OW	Open Worksheet	Total Bid: 683111.54
Project Rehab Info: Thickness: 1.50 Action: TH	ment Info:			
Thickness: 1.50 Action: TH	ment Info:			
Action: TH		Pavement Condition:		
	N OVERLAY >=1.5 AND <2.5	PCI:		Delete
Design Life: 10 Action Year:	2007	AAD 1: 0	ESALS: 225	Save
Estimated Life? Design Life:	8	Friction: 0		Jave
dit Locations Associated with Current Uni	tID	Quick Lane Cover	age	
Please Select			•••	Calc Lane Mile/Areas
Relilove	Apply			
Add Please Select	·		• 2 2	Clear Add Lane Mile/Areas
17 0 MD	19 E C			
17 0 MD	19 W C			
17 0 MD A	19 N C			
17 0 MD A	19 S C			

- Step 25. Verify the accuracy of the quantities that the EDW generated. Click on "Open Worksheet." Fill in the appropriate fields (extracted from the typical section within the Plans Set): Lanes, Lane Mi, L (length), m/I W (width), Shoulder W (width), and Shoulder SY. The total at the bottom of the worksheet should be within 5% of the EDW auto generated quantity (see below image).
 - i. If the total is within 5% of the EDW auto generated quantity, proceed to Step 26.
 - ii. If the total is not within 5% of the EDW, further investigation is required to reconcile any differences. Click on the SY Pavement tab of the spreadsheet and plug in the surface tonnage and the thickness. The SY surface will automatically populate. Compare that result to the worksheet and the EDW result. In addition, if there is any grinding, compare the grinded SY to the result.

Construction Data Processing As Bid Unit Cost Data

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- Step 26. Click "Save" and then "Close." The EDW will automatically return to the "Location" tab.
- Step 27. Double-click on a location in the table while on the "Location" Tab. Make sure the location is highlighted in blue. Click on the "Construction" Tab (see below image).



Construction Data Processing As Bid Unit Cost Data

urce:	UC - A	AS BID	Char	nge CN/FN Co	ontract BRIAN	A F	MIS: TEST		Promote	Transp	ort Clo
s Built/As	s Bid_Main	Location	Constru	ction Item Cost	t QC/QA Che	cklist Supp	orting Docum	ients			
Location	County	= FR, Mun =	NONE.	Prefix = MD, Rou	ute = 17, Direct	ion = N *, Ex	it = , Ramp = ,	BMP = 0, EN	1P = 0.4850		
Treatme	ent ID:	Ŧ	🔽 For T	his Location Onl	ly Constructio	on Type: Pl	EASE SELEC	Г	• Definition	View E	cisting ConHist
	Seq. L	ayer T	hick. "	Material Type	Mix Method	Mix Type	Band	Binder	ESAL	Mat Descrip.	MatCode
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Subsec < 0 - 0.4	ection < >	>		ine Coverage:			•	Clear All	Special Pave Park & F Weigh S	ement Ride Station	
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Subser Contractions Subserved Contractions Subserved Contractions Subserved Contractions Con	ection	> •		ine Coverage:			•	Clear All	Special Pave Park & F Weigh S Rest Are	ement Ride Station	

Step 28. Click on "Add New." Select a "Construction Type" from the drop-down menu. The definition of each "Construction Type" can be viewed by clicking the "Definition" button (see below image).

🚽 Cons	truction Type Definition		. Σ	3
	NEW_CONSTRUCTION	PROJ_DESCRIPTION1	-	
	New Construction	(use existing), original const - subgrade thru original surface		
	Reconstruction	(use existing)	=	
	Major (Heavy) Rehabilitation	projects where => 4"" milling and HMA or PCC overlay		
	Structural Overlay	overlay and / or mill & overlay increases overall pave thickness >1.5"		
	Minor (light) Rehabilitation	overlay and / or mill & overlay increases overall pave thickness 0.01 - 1.5		
	Preventative Maintenance	overlay and / or mill & overlay pave thickness <=1.5"		
•	Preventative Maintenance	asph seal / rejuv, aqq. seals, crack and / or joint seals, grinding and / or milling only projects, capital project pa	ite 🔻	
		Close		

- Step 29. Fill in all the appropriate fields: Layers, Thickness, Material Type, Mix Method, Mix Type, Band, and ESAL. Select the correct "Material Description."
- Step 30. Click on the boxes above each lane on the bottom of the screen or select the appropriate option from the "Quick Lane Coverage" drop-down menu. For all Unit Cost As Bid, the treatment date is the "Completion Date." Click on "Apply Treatment" to save the treatment for the selected section (see below image).



Construction Data Processing As Bid Unit Cost Data

onHist_Main Location	Construction	QC/QA Check	list Supporting	g Documents						
Location: County = Al	., Mun =NONE	E <mark>, Prefix = CO, R</mark> o	oute = 4, Directio	on = E, Exit = , F	Ramp = , BN	/IP = 0, EM	P = 0.33			
Treatment ID:	- V For	This Location O	nly Construct	ion Type: RE-	CONSTRUC	TION	▼ Definitio	on	View Exis	ting ConHist
Seq. Layer	Thick."	Material Type	Mix Method	Mix Type	Band	Binder	ESAL	Mat Desc	rip.	MatCode
- + # 1 ORIGINAL	. • 0.75 •	ASPHALT -	A- HOT MIX 🔹	R- RAP 👻	9.5MM -	58-28	▼ LEVEL - 2 ▼	355 - 9.5MM, 58-28	3, L 2 👻	355
- + # 2	•	•	-	-	-]	• •		-	
- + # 3	-	·	-	-	•		• •		•	
- + # 4	•	•	•	-	•		• •		•	
- + # 5	•	· 🗸	-	-	-		•		•	
Prev. 5 Next	5 Treatme	nt Date 12/31/2	099 👻 Disp	olay Date		Ар	ply Treatment	Сору	Add N	ew Delete
Lane Configuration	Quick I	Lane Coverage:			•	🗖 Clear A	JI			
							Special	Pavement		
							🗖 Par	rk & Ride		
Subsection							m We	aigh Station		
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0-0.13 🗸										
							Re	stArea		
							Re	stArea		
Replace Lanes							Re	stArea		

- Step 31. Repeat Step 27 to Step 30 for all locations of the project. Then, proceed to Step 24.
- Step 32. Click on the "Item Cost" tab. Double-click on each item (highlighting the item in blue) in the table and assign the relevant activity under the "Activity" dropdown menu. Click "Save." Repeat for each item in the table. For Bid Adjustments, the unit must be assigned as "Each" (see below image).

Unit l	D 18614	Loca	ation County = QA	Prefix = MD, Ro	ute = 19 A. Directio	on = N *, Ramp	= , Exit = , BMP =	0, EMP = 0.49	
Cour	UNIT ID	ITEM ID	ACTIVITY DESC	CATEGORY	DESCRIPTION	AS BUILT	UNIT COST	QUANTITY	UNIT
Þ	18614	115988	MILLING	500000	FINE MILLING A	NO	2	34224	SY
	18614	115996	RESURFACING	571205	REMOVAL OF U	NO	90	110	CY
	18614	115990	RESURFACING	504518	SUPERPAVE AS	NO	115	200	TON
	18614	115989	RESURFACING	504500	SUPERPAVE AS	NO	86	3020	TON
	18614	115995	BID ADJUSTME	535100	PAVEMENT SU	NO	1	16200	EACH
	18614	115994	BID ADJUSTME	504615	PAYMENT ADJU	NO	1	12250	EACH
	18614	115993	BID ADJUSTME	504605	PAYMENT ADJU	NO	1	12250	EACH
	18614	115992	BID ADJUSTME	504600	PRICE ADJUST	NO	1	2000	EACH
	18614	115991	PATCHING	504564	SUPERPAVE AS	NO	100	700	TON
rt A C	Activity ategory Code	MILLING MILLING RESURFACING WIDENING NEW CONSTRUC' AS-BUILT ADJUST		escription .FIN	E MILLING ASPHALT	PAVEMENT (1-2.	5" DEPTH)		•
U	Init Cost 2	BID ADJUSTMENT PATCHING	224	U	nit SY	 Item Cos 	st 68448		
	dd New	Delete	Save						

Step 33. Click on "QC/QA Checklist" tab. Click on the relevant boxes on "QC/QA Check List" (left side of screen) and then click the "Save" button on the bottom of screen. If all data for the project is entered completely, click the "Check" button (see below image). Otherwise, return to incomplete data and input before proceeding.

Source: MAINTENANCE Change CN/FN Co	Intract GUIDE FMIS: EXAMPLE Promote MCMS Close
ConHist_Main Location Construction QC/QA Checklis	It Supporting Documents
QC/QA Check List	Value/Comment
PM-001	Check UnCheck QC Review Completion
Contract#	
FMIS #	Last Check Date: 10/19/2012 By: BGAMBLE
Fund Type	
County	
Route	
V Direction	
Mile Points	Check UnCheck QA Review Completion
Project Description	
Paving Compl Date	Last DataWarehouse By:
From Orig PAV_HIST Notes	
Roadway Project Type	Saved.
Capital Paving / Patching project Only	
Crack / Joint Sealing	
Patching	C C C Review Completion
Milling	
Reflective Joint Cracking pre-treatment	Last Check Date: // By:
Other	
Roadway Project Type	
Routine Maint. PCA Projects Only	
1 of 5 Previous Next	Save

- Step 34. Scan, download and save all the supporting documents in a folder (local driver, PRG).
- Step 35. Click on "Supporting Documents" tab and click on the "Browse" button to open the files location, select the file and click "OK" and then click on the "Upload" button (see below image).

2003 1004 LC A100 FPD # AXX000 FX Vessor 107 3 2013 2019 LC A100 FPD # (AXX000 FX Vessor 107 3 2013 2019 LC A100 FPD # (AXX000 FX Vessor 107 3 2014 2019 LC A100 FPD # (AXX000 FX Vessor 107 3 2015 2019 LC A100 FPD # (AXX000 FX Vessor 107 3 2020 2019 LC A100 Baarfie FAXX00 FX Vessor 107 3 2020 2019 LC A100 Baarfie FAXX00 FIX Vessor 107 3 2020 2019 LC A100 Baarfie FAXX00 FIX Vessor 107 3 2020 2019 State FAXX00 FIX Vessor 107 3	200 2008 CC-A100 PECA AXX0017A News 107 3 201 2109 CC-A100 PECA AXX0017A News 107 3 201 2109 CC-A100 PECA MAX0017A News 107 3 201 2109 CC-A100 PECA MAX0017A News 107 3 201 2109 CC-A100 PECA MAX0017A News 107 3 202 2109 CC-A100 Decarlier A4X0017A News 107 3 202 2109 CC-A100 Decarlier A4X0017A News 107 3 202 2109 CC-A100 Decarlier A4X0018C News 107 3 202 2109 Decarlier A4X0018C News 107 3 203 210 Decarlier A4X0018C News 107 3 204 Nontrecarlier Nontrol A4X0018C	C10 20100 C.C. A100 PF/H A102017L News 107 3 2012 20130 C.C. A100 PF/H AV32017L News 107 3 2012 20130 C.C. A100 PF/H AV32017L News 107 3 2012 20130 C.C. A100 PF/H AV32017L News 107 3 2012 20130 C.C. A100 PF/H AV32017L News 107 3 202 20130 C.C. A100 Bearlie AV32017L News 107 3 202 20130 C.C. A100 Bearlie AV32017L News 107 3 202 20130 C.C. A100 Bearlie AV32017L News 107 3 203 Model Model AV32017L News 107 3 203 Model Model Model Model News 107 204 Model Model	Intel UP: All B0 DPM Attact XM, Verws. VP J 4 7005 UP: All B0 PPM Attact XM, Verws. VP J 5 7058 UP: All B0 PPM Attact XM, Verws. VP J 6 7059 UP: All B0 PPM Attact XM, Verws. VP J 6 7059 UP: All B0 PPM Attact XM, Verws. VP J 6 7059 UP: All B0 PPM Attact XM, Verws. VP J 6 7059 UP: All B0 PPM Attact XM, Verws. VP J 7059 UP: All B0 PPM Attact XM, Verws. VP J 7059 UP Attact XM, Verws. VP J J	2005 U.C. Allis D OFF AUX0127A Verage 07 3 2005 U.C. Allis D OFF AUX00127A Verage 107 3 2005 U.C. Allis D OFF AUX00127A Verage 107 3 2005 U.C. Allis D OFF AUX00127A Verage 107 3 2005 U.C. Allis D Decrifts AUX00127A Verage 107 3 2005 U.C. All BD Decrifts AUX00127A Verage 107 3 2005 U.C. All BD Decrifts AUX00127A Verage 107 3 2005 U.C. All BD Decrifts AUX00127A Verage 107 3	DSB UC. A150 PEF 44 A1502 HZ-A Vage. 107 3 DSB UC. A150 PEF 44 A1502 HZ-A Vage. 107 3 DSB UC. A150 PEF 44 A1502 HZ-A Vage. 107 3 DSB UC. A150 PEF 44 A1502 HZ-A Vage. 107 3 DSB UC. A150 PEF 44 A1502 HZ-L Vage. 107 3 DSB UC. A150 PEF 44 A1502 HZ-L Vage. 107 3 DSB UC. A150 PEF 44 A1502 HZ-L Vage. 107 3
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Step 36. The supporting documents should include, but is not limited to:

- i. IFB
- ii. Plans
- iii. Notes and other draft used by the user
- iv. The spreadsheet used to verify the accuracy of the quantities
- v. A screenshot of the first page of the bid tabulation showing the completion date
- vi. The "Design Help" spreadsheet showing the calculation the ESALs
- vii. PAGD Geotechnical Report
- viii. PMBase Report

4.04 PROCESSING AS BUILT UNIT COST DATA

4.04.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to collect and update As Built unit cost data in the Engineering Data Warehouse (EDW). As Built projects are area-wide projects. As Built data is processed and analyzed approximately three months after the completion of construction. The primary data source for this information is bid tabulations published by the Office of Highway Design (OHD), extracted from the MDOT-SHA website. Relevant inventory information to supplement the cost data is gathered from a variety of sources, including, but not limited to: Pavement & Geotechnical Reports (P&G Report), Pavement Management (PM) Base, project plans, Visidata, and the Highway Location Referencing (HLR) System. As Built projects can be promoted either from the Maryland Construction Management System (MCMS) or from paving or maintenance history.

4.04.02 Frequency

The updating of As Built unit costs is a continuous process that occurs year-round.

4.04.03 Purpose

The purpose of this SOP is to collect As Built unit cost data, verify and update inventory information associated with the project, perform quality control (QC) of gathered data, and update the data in the Unit Cost Database of the EDW.

4.04.04 *Resource Requirements*

Data collection and upload of As Built unit cost information involves two people: (1) a user knowledgeable in collection of As Built unit cost data from various sources and the EDW software to perform data collection, QC, and uploading, and (2) a supervisor who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues were encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	EDW user and QC	1	4.0
DPT TL	Supervisor	1	AR ^{06/12/2019}

4.04.05 Procedure

The procedure to collect and upload As Built unit cost data is comprised of the following three tasks:

- (1) collection of As Built unit cost data
- (2) input of collected data into the EDW by promotion from MCMS, and
- (3) input of collected data into the EDW by promotion from paving or maintenance history.

1- As Built Data Collection – *performed by EDW user*

Summary: This task collects and reviews As Built construction data from a variety of sources in order to retrieve the necessary inputs for data entry into the EDW.

- Step 1. For each project where available, review the Right-of-Way (ROW) video collected by the Automated Road Analyzer (ARAN) vehicle, "Visidata.exe." Review the video to determine the limits of work for the project and verify, where possible, the type of construction action.
- Step 2. Identify the project limits using the Highway Location Reference (HLR) Guide. The HLR Guide is categorized by county and route. Verify the mile points. The HLR also gives the Functional Class and AADT (Refer to Highway Location Referencing Guide).
- Step 3. Check the **Invitation for Bid (IFB)** for relevant pavement history data. IFBs can be received directly from the Office of Maintenance (OOM) and the OHD. They may also come from either the Pavement Design (PD) Team or General Test team.
- Step 4. Remove pertinent pages of the IFBs that relate to construction history and dispose of remaining pages. The pertinent pages are (but not limited to): Title Page, Project Description, Category 500 Paving Asphalt Cement Price Index, Paving Typical Sections, Plans Sheet, Soil Boring, Pavement Coring Log, and 2000, 5000 & 6000 series items in Schedule of Prices section (located near end of document).
- Step 5. Retrieve Project **Plan Set** from the source. Review pertinent pages that relate to construction history. Ensure that all the pertinent data is enclosed in the plan set paving typical sections, plan sheets, etc.
- Step 6. Access the MCMS database through the EDW application (see <u>Reviewing</u> <u>Projects in MCMS</u>). Export the relevant spreadsheets to Excel. Relevant pages are: Items Report and IDR Detail. For area-wide projects, ensure the appropriate Financial Management Information System (FMIS) number is chosen when exporting the spreadsheet to excel. In the Items Report, all 2000, 5000 and 6000 series items should be evaluated to determine which items are relevant.
- Step 7. Check Hot Mix Asphalt (HMA) Tonnage production database. Sort the data by "Contract Number" and hide all the unnecessary fields in the database. Keep Paving Location, Mix Number Production Date, and Actual Tonnage. Compare the total project estimated tonnage to the accumulated "actual" tonnage (see HMA Tonnage Application).
 - i. If the values are close, copy both tables (Estimated & Actual) into an Excel spreadsheet. Proceed to Step 8.
 - ii. If the values are not close, further investigation is required before proceeding. Cross reference MCMS report and contact Project Engineer to reconcile any differences.

- Step 8. Access the **Bid Tabulation** on the MDOT-SHA homepage. Select the contract number for the project and print. The Bid Tabulation contains the contract number and letting date (date of bid opening).
- Step 9. Access the **PMbase** from the Office of Materials Technology (OMT) homepage. Enter the route information required and retrieve the Construction History for the route, IRI, and Friction. The construction history data includes the last treatment applied to the roadway and the pavement type.
- Step 10. Locate the **PAGD Geotechnical Report** on the "OMTOOCShared:\ OMT\Design Projects" drive which is categorized by district. The folders are categorized by the contract number, by route, or by project description (or a combination thereof). Extract from the contract folder the **pavement recommendation memorandum** and an excel spreadsheet entitled "Design Help."
- 2- As Built Data Input into EDW and QC (Promotion from MCMS) performed by EDW user

Summary: This task inputs collected As Built data that was promoted from MCMS into the EDW.

- Step 11. If the As Built data was promoted from the MCMS, proceed to Step 11. If the As Built data was promoted from paving or maintenance history, skip to Step 33.
- Step 12. Open the EDW application.
- Step 13. On the Main Menu click on "Reporting." From the "Reporting" drop-down menu, choose "MCMS" (see below image).

🎯 Data Warehouse	- Connec	ted to Produc	tion Database				
Administration	Data	Analysis	Reporting	Help	Exit		
~			Constru	iction Da	ata	•	
			Conditi	on		-	
			MCMS				
			Transp	ort			
			HMA T	onnage			
			Historio	al Note:	s Fields		

Step 14. In the "Select a MCMS Report" section choose "Specify a Contract" from the drop-down menu (see below image).



🕼 D	ata Warehouse - Co	onnected	to Production	Database - [T	ansport	Reports]	and the second second	-	-		the other states
	Administration	Data	Analysis	Reporting	Help	Exit					Test Version 1.20
-	Select a Transpor	t Report ntracts in	n Transport	T						Export to Excel	Close
Do	Report - Contra out Specify a Cont	acts Not tract	in Unit Cost	Reports	Highlig	nt a Con	tract and then Clic	k on Remove bu	utton to Rem	ove from the Report.	Remove

Step 15. Enter the required "Contract No." Click on the "Select a Report" drop-down menu and select "Report – IDR by Job No. Detail" (see below image).

Reporting Help	Exit	Test Version 1.20
Select a Filter for MCMS Items Default	Contract No.	Select a Report Close Fyootto Eyrol
□ 1000s ♥ 2000s □ 3000s ■ 4000s ♥ 5000s ♥ 6000s □ 7000s □ 8000s □ 9000s		

- Step 16. Select the specific "Project Description" from the drop-down menu. Make sure the FMIS matches the specific project needed. Click "Export to Excel" and when promoted, save the document in the desired location.
- Step 17. Repeat Step 14 to Step 15, except in the "Select a Report" drop-down menu, select "Report IDR by Job No. Item Cost."
- Step 18. With the "Report IDR by Job No. Item Cost" open in the EDW window, check the boxes of the items that apply to pavement and then press the "Promote to As Built" button (see below image).

•	Administ	ration Data	Analysis F	Reporting Help	Exit				Test Version 1.2	20
~										
Se	elect a Fil efault	ter for MCMS It	ems		Contract No. XY2215177	Select a Report Report - IDR by Jo	ob No. Iter	n Cost 👻	Close	
	_ 1000s ☑ 6000s	✓ 2000s [□ 7000s [3000s 40	000s 📝 5000s	Select a Job Description Patching MD 632 from I-7	70to MD 68 🗸 FMIS 🛚	A220A57	•	Export to Excel Promote to As Bu	uilt
	CHE	CK ITEM_NO	CATEGORYCOD	E DESCR			UNIT	UNIT_PRICE	FIELD_QUANTITY	ПЕМ_С
	V	5006. 01A	504206	HMA SUPPAV 1	2.5MM SURF PG64-22 LEV 2 FOR	PATCHING 0 INCH TO 3 INCH DEPTH	TON	85.4	1063.67	90837.4
	V	5010. 01A	504600	PRICE ADJUST	ASPH BINDER (DO NOT ALTER)		EA	1	6787.49	6787.49
I	V		504610	PAYM'T ADJUS'	HMA MIXTURE (DO NOT ALTER)				1464.37	1464.37
		5017. 01A	585431	5" YELLOW PAY	/ MARK PAINT LINES		LF	0.13	2189	284.57
		5018. 01A	585433	5" WHITE PAV'T	MARK PAINT LINES		LF	0.13	10945	1422.85

Step 19. A dialogue box will appear: "The Contract/FMIS has been promoted from Paving Hist to As Built." Click "OK." Another dialogue box will appear: "You will need to enter the location associated with the items selected. Do you want to continue?" Click "Yes" (see below images).

ſ	DataWarehouse_New
	The Contract/FMIS has been promoted from Paving Hist to As Built.
	ОК
Data	Warehouse_New
Yo wa	u will need to enter the locations associated with the items selected. Do you nt to continue?
	Yes No

Step 20. The EDW automatically retrieves the paving or maintenance associated with this contract and FMIS number. Therefore, the location should automatically appear in the location tab. Double-click a location in the location table (it will be highlighted in blue when selected). Edit the description and mile points if needed. Click "Save" (see below image). If all the locations are not listed, click "Add New" and enter required information before clicking "Save."

	ST	ATE HIGHW	AY ADM	IINISTRATI	ON	Process	ing As Bu	ilt Unit Cost
Administratio	n Data	Analysis	Reporti	ng Help	Exit			
ntract XX104	15277	FM	IS CA21	I5B59		ОК		Cancel
LOC_ID	СС	UNTY	MUN	PR	EFIX	ASC_PF	EFIX	ROUTE
1009552	4		0	MD		MD		2
	III							Þ
ocation	III							Þ
ocation County	m	Mun		Prefix	_	Route		► Þir.
ocation County		Mun	_	Prefix	•	Route		Þir.
ocation County Exit #	· · · · · · · · · · · · · · · · · · ·	Mun Ramp #	•	Prefix From MP	•	Route To MP		Þir.
coation County Exit#	· · · · · · · · · · · · · · · · · · ·	Mun Ramp #	· · · · · · · · · · · · · · · · · · ·	Prefix From MP	▼	Route To MP		Þir.
county County Exit # Descriptio	•	Mun Ramp #	· · ·	Prefix From MP	•	Route To MP		Þir.
ocation County Exit # Descriptio	• • • • • • • • • • • • • • • • • • •	Mun Ramp #		Prefix From MP	•	Route To MP)ir.
ocation County Exit # Descriptio	•	Mun Ramp #	· · · · · · · · · · · · · · · · · · ·	Prefix From MP		Route To MP)ir.

Maryland department of transportation

A dialogue box will appear: "A Unit Cost As Built record has been successfully Step 21. created for the selected items. Do you want to review the created As Bid record?" Click "Yes" (see below image).

ſ	DataWarehouse_New
	A Unit Cost As Built record has been successfully created for the selected items. Do you want to review the created As Built record?
	Yes No

Enter data for: Fund Type, Letting Date, Cement Price, and Binder (should Step 22. automatically appear). Check the appropriate boxes in the "Project Feature" section and click "Save" (see below image).

Construction Data



Construction Data Processing As Built Unit Cost Data

Administration	Data Analysis Rep	orting Help Exit			
<u> </u>					
Source: U(Chang	e CN/FN Contract: XX10	45277 FMIS: CA21	15B59	MCMS
As Built/As Bid_I	Main Location Construct	on Item Cost QC/QA Cl	necklist Supporting Doc	uments	
Contract Inform	ation		_		
Contract#	XX1045277 FM	MIS # CA215B59			
Project Info.					
Fund Type:	✓ Lettin	ng Date: _/_/ •	•		
Project Feature	9:				
🔲 As Built Ser	ni-Final 📃 As Built F	inal 🔲 Area Wide	Verified		
Other Items:					
Cement Price:	Get	Price Select a Price:	•		
		Date From:	_		
Binder:	64-22	Date To:	_ <u>_</u>		
Note					
Update Information	ation:				
Last Update Da	ite 11/07/2012 Upo	lated By BGAMBLE			
	Delete Save				
· · ·		2			

Step 23. Click the "Location" tab to enter the location information. The locations entered for the project during Step 19 will appear in the location table. Click "Save." Double-click on a location in the location table. When it is highlighted in blue, click "View/Add UC Measures" (see below image).

Maryland department of transportation

STATE HIGHWAY ADMINISTRATION

Construction Data Processing As Built Unit Cost Data

Administration Data	Analysis	Reporting	Help	Exit							Test	Version 1.18
ntract WA3255180	FMIS		ID	6080	COUNTY = \	VA, MUN = , R	OUTE = IS	70 E *, EXIT	= , RAMP =	• . BMP =	= 22.48, EMF	Close
Gernal Information												
Functional Class: Rural	Principal Arterial	- Interstat 🔻		Pav	ement Type:	F	•	Est. Con	npletion D	ate:		¥
Project Summary:												
Lane Miles: 2.96	OW Pav	e. Area (sy):	20838.4	OW S	Shld Area (sy):	11662.96	WO	Open	Workshe	et	Total Bid	: 13351728.7
Project Rehab Info:	Existing P	avment Info:				Pavement Co	ndition:					
Thickness: 2	Action: T	'HIN OVERLAY	(>=1.5 ANE) <2.5	-	PCI:		IR	l: 8	3	_	Delete
Design Life: 12	Action Voc	100	0			AADT	46900	ES	ALs: 6	112	- 1	Delete
Estimated Life?	Design Life	e: 12	D	🔽 Estima	ated Life?	Friction:	45					Save
it Locations Associated	with Current U	lint ID				Quick La	ne Covera	age				
Remove Please Select				•		All Thru +	Aux + Shou	lder Lanes		•	Calc La	ne Mile/Areas
Tremove .					Apply		1				Addla	na Mila/Araga
Add Please Select				•		<u> <</u> <	J	•	<u>></u> >	Clea	r Add La	ne Mile/Areas
CODE MUN	ROUTE	RSUFF	RNUM	DIRECT	ION BMP							
21 0	IS		70	E	22.48							
21 0	10		/0	**	22.50							

Step 24. Enter the required information: Functional Class, Pavement type, Est. Completion Date, Thickness, Design Life, Action, Action year, Design Life, PCI, IRI, AADT, ESALs, Friction. The Total Bid should automatically appear if the contract was promoted through the MCMS feature. The Lane Miles, Pavement Area, and Shoulder can be automatically generated by the EDW application (see below image). Maryland department of transportation

STATE HIGHWAY ADMINISTRATION

Construction Data Processing As Built Unit Cost Data

Administrat	on Data	Analysis	Reporting	Help	Exit							I	est Versi	on 1.18
ontract WA	3255180	FMIS		ID	6080	COUNTY =	VA, MUN = ,	ROUTE = IS	70 E *, E	XIT = , R/	MP=,BM	IP = 22.48,	EMI	Close
Gernal Inform	nation													
Functional C	lass: Rura	l Principal Arteria	al - Interstat 💌		Pav	vement Type:	F	•	Est.	Complet	ion Date:			•
Project Sum	mary:													
_ane Miles:	2.96	OW Pa	ve. Area (sy)	20838.4	WO	Shld Area (sy):	11662.96	WO	0	pen Wor	ksheet	Tota	l Bid: 1335	51728.7
Project Reha	ab Info:	Existing	Pavment Info				Pavement (Condition:						
Thickness:	2	Action:	THIN OVERLA	Y >=1.5 ANI) <2.5	•	PCI:			IRI:	88			alata
Design Life:	12	Action Vo	100	10			AADT	46900	_	ESALs	6012	_		elete
Estima	ted Life?	Design L	ife: 12	10	🔽 Estim	ated Life?	Friction	: 45			0012		S	ave
it Locations	Associated	I with Current	Uint ID				Quick L	ane Cover	age					
Remove	Please Selec	x			•		All Thru	+ Aux + Sho	ulder Lanes	;	•	Cal	c Lane Mi	le/Areas
						Apply						ear Ad	d Lano Mi	
Add	Please Selec	t			•								u Lane Ivi	ie/Aieas
CODE	MUN	ROUTE	RSUFF	RNUM	DIRECT	ION BMP								
21	0	IS		70	W	22.40								
	1-			-										

- Step 25. In the "Edit Location Associated with Current Unit ID" section of the screen, click on the "Add" pull-down menu and make sure all the locations are added to this unit cost measures. If the As Built was promoted from the MCMS feature, the locations will already appear in the table.
- Step 26. Click on the drop-down menu in the "Quick Lane Coverage" section of the screen. Select "All Thru" then press "Calc Lane Miles/Area" and the EDW will automatically generate the quantities for lane miles, pavement area and shoulder area (see below image).

Edit	Locations	Associated	with Current	Unit ID				Quic	k Lan	e Cov	erage									
F	Remove	Please Selec	t			-		Plea	se Spe	cifiy				•	•	C	alc La	ine Mil	le/Are	as
	Add	Please Select	t			- Ap	oply	<	<			•	>	>	Clea	r /	Add La	ane Mi	le/Are	eas
	CODE	MUN	ROUTE	RSUFF	RNUM	DIRECTION	BMP													
•	10	0	MD		17	S	0													
	10	0	MD		17	Ν	0													
												_				_				
								1 1	1	1			1				1		1	· ·
•							Þ.													

Step 27. Verify the quantities that the EDW generated. Click on "Open Worksheet." Fill in the appropriate fields (extracted from the typical section within the Plans Set): Lanes, Lane Mi, L (length), m/l W (width), Shoulder W (width), and

Shoulder SY. The total at the bottom of the worksheet should be within 5% of the EDW auto generated quantity (see below image).

- i. If the total is within 5% of the EDW auto generated quantity, proceed to Step 28.
- ii. If the total is not within 5% of the EDW, further investigation is required to reconcile any differences.



- Step 28. Click "Save" and then "Close." The EDW will automatically return to the "Location" tab.
- Step 29. Double-click on a location in the table while on the "Location" tab. Make sure the location is highlighted in blue. Click on the "Construction" tab. Since the project has been promoted from MCMS and the EDW retrieved the construction history from the paving or maintenance history, the construction layers should already be populated (see below image). Make sure the construction data is correct using the information gathered in the "Data Collection" section. If the data is not accurate, make the necessary adjustments to correct the construction data. However, the "Construction <u>History</u>" must be edited as well. Repeat this step for all locations on the project.



Construction Data Processing As Built Unit Cost Data

	U	IC - AS BUILT	Cha	ange CN/FN	Contract XX104	5277 FI	MIS: CA215	B59		MCMS	Clo
Built/As	Bid_	Main Locatio	on Constri	ltem Co	st QC/QA Che	cklist Suppo	orting Docun	nents			
ocation:	C	ounty = CA, M	un =NONE	, Prefix = MD, R	oute = 2, Directi	on = N *, Exit =	, Ramp = , B	BMP = 21.74	EMP = 25.63		
							•				
reatmer	nt ID:	308088	• 🔽 For	This Location C	only Constructi	on Type: MIN	NOR (LIGHT)	REHABILITA	▼ Definition	View Exis	ting ConHis
	Seq.	Layer	Thick. "	Material Type	Mix Method	Mix Type	Band	Binder	ESAL	Mat Descrip.	MatCode
+#	1	SURFACE 👻	2 🗸	ASPHALT -	A- HOT MIX 🔻	R- RAP 🗸	12.5MM 👻	64-22 🔻	LEVEL - 2 👻	504206 - 12.5MM, 64-22, S 👻	504206 .
+#	2	MILLING -	2 👻	PAVEMENTI -	0- N/A 👻	0- N/A 🗸 🗸	N/A 👻	N/A 🔫	N/A 👻	110 - CARBIDE GRINDING 👻	110 .
+#	3	-	-	-	-	-	-	-	-	-	
+#	4	•	-	-	•	•	-	-	-	-	
• + #	5	-	-	-	-	•	-	-	-	-	
Prev. 5		/I INext5	rreatmen	it Date 08/01/2	1012 🔻 Disp	lav Dale UI-			The start and		
ane Co	nfigu	iration	Quick L:	ane Coverage:			Aug-2012	Appl	y Treatment	Copy	lew Dele
ane Co	nfigu	iration	Quick La	ane Coverage:			Aug-2012 [Clear All	y Treatment	Pavement	lew Dele
ane Co	nfigu	iration	Quick L	ane Coverage:		5 5	₩ug-2012 [Appl	Special	Pavement k & Ride	lew Dele
ane Co Subsec	nfigu	iration	Quick La	ane Coverage:		x	₩ug-2012 [Appl	Special	Pavement k & Ride	lew Dele
ane Co Subsec	nfigu tion	iration	Quick L	ane Coverage:		α	▼ [Clear All	Special	Pavement k & Ride igh Station	lew Dele
Subsec	nfigu ction < 21.8	> > 3380 -	Quick L	ane Coverage:		2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	▼ [Clear All	Special Par We Res	Pavement k & Ride igh Station st Area	lew Dele
Subsec	nfigu ction < 21.8	≥ ≥ ≥ 3380 ▼ è Lanes	Quick L	ane Coverage:			- [Clear All	Special Par We Res	Pavement k & Ride igh Station st Area	lew Dele

- Step 30. Click on the "Item Cost" tab. Double-click on each item (highlighting the item in blue) in the table and assign the relevant activity under the "Activity" dropdown menu. Click "Save." Repeat for each item in the table. For As Built Adjustments, the unit must be assigned as "Each." Make sure the "As Built" box is checked for every item.
- Step 31. Click on "QC/QA Checklist" tab. Click on the relevant boxes on "QC/QA Check List" (left side of screen) and then click the "Save" button on the bottom of screen. If all data for the project is entered completely, click the "Check" button (see below image). Otherwise, return to incomplete data and input before proceeding.

MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

Construction Data Processing As Built Unit Cost Data

Source	MAINTENANCE Chan	Ige CN/FN Contract GUIDE	FMIS: EXAMPLE	Promote MCMS	Close
ConHi	ist_Main Location Construction C	QC/QA Checklist Supporting Docum	nents		
	/QA Check List	Value/Comment			
	PM-001		Check	UnCheck QC Rev	view Completion
V	Contract#				
V	FMIS #		Last Che	eck Date: 10/19/2012	By: BGAMBLE
V	Fund Type				
V	County				
V	Route				
V	Direction				
V	Mile Points		Chec	k UnCheck QAR	eview Completion
	Project Description				
	Paving Compl Date		Last Da	ataWarehouse	By:
	From Orig PAV_HIST Notes				
	Roadway Project Type			Saved.	
	Capital Paving / Patching proje	ect Only			
	Crack / Joint Sealing			ОК	
V	Patching		С	C	Review Completion
	Milling				
	Reflective Joint Cracking pre-treatment	nent	Last Ch	eck Date: //	By:
	Other				
	Roadway Project Type				
	Routine Maint. PCA Projects 0	Inly			
1 of	5 Previous Next		ave		

Step 32. Click on "Supporting Documents" tab and upload any supporting documents using the "Upload" button (see below image). After this step, the procedure is complete (next section is for promotion through paving or maintenance history only).

Warehouse - Connected to Development Database - [Construction Details]	
dministration Data Analysis Reporting Help Exit	Test Version 1.17
JICE: PAVING HISTORY Change CN/FN Contract Test 123 FMIS: TE5443 Promote MCMS	Close
onHist_Main Location Construction QC/QA Checklist Supporting Documents	
Browse	load
To Open. Double Click: To Delete. Single Click then Press Delete Button.	
Central Location for Supporting Documents: \\hanpmdata\PMDATA\05 Documentation\Engineering Data Warehouse\Support_Do	c/

3- As Built Data Input into EDW and QC (Promotion from Paving or Maintenance History) – performed by EDW user

Summary: This task inputs collected As Built data that was promoted from Paving or Maintenance History into the EDW.

- Step 33. Open the EDW application.
- Step 34. On the Main Menu click on "Data." From the "Data" drop-down menu, choose "Construction Data" (see below image).



Step 35. Click on the "Action" drop-down menu and select "View/Edit/Delete" (see below image).

•	Administration	Data	Analysis	Reporting	Help
2					
5	elect an Action:		- Select a [Data Source:	
А	ction:	•	Source:		-
	View/Edit/D Add New	elete	Filter by:		T
Do	ouble Click a Cont	ract to S	elect		

- Step 36. Select either "Paving" or "Maintenance" from the "Source" drop-down menu.
- Step 37. Enter the "Contract No." of the projected to be promoted to Unit Cost As Built (see below image).



Construction Data Processing As Built Unit Cost Data

🛃 A	dministration	Data Ar	alysis R	eporting	Help	Exit							Test Ver	sion 1.20	
Sel	ect an Action:	S	elect a Data	a Source:		Select a Criter	ia:								
						By Contra	act/Permit#	ŧ	By Rou	te (County:		-		
		So	ource: PAV	ING HISTO	RY 🔻						Mun:		-		_
Actio	on: View/Edit/Del	lete 🔻				No.: XX1	105877	•			Prefix:		-	Close	
		Fil	ter by: All R	ecords	-						Route:		-		
Doub	le Click a Contra	act to Selec	t											Fit	
	CONTRACT	FMIS	COUNTY	MUN	PREFIX	ASC_PREFIX	ROUTE	SUFFIX	DIR	BMP	EMP	EXIT_NO	RAMP_NO	LOC_ID	^
Þ	XX1105877	FR385A5G	10	0	MD	MD	904	F	E	0.05	0.19		0	1003923	
	XX1105877	FR385A5G	10	0	MD	MD	904	F	w	0.05	0.19		0	1003924	
	XX1105877	FR385A5H	10	0	MD	MD	806	А	N	0	3.04		0	1005840	
	XX1105877	FR385A5H	10	0	MD	MD	806	A	S	0	3.04		0	1005841	
	XX1105877	FR385B51	10	0	MD	MD	194		N	3.20	3.25		0	31091	

- Step 38. Double-click the Contract & FMIS number of the specific project that will be promoted to Unit Cost As Built. The EDW will open the "Construction" main tab for that specific contract.
- Step 39. Click the "MCMS" button. A MCMS window with the contract number already entered will open. Click "Export to Excel" for the relevant spreadsheets and press Close" (see below image).

Reporting Help	Exit	Test Version 1.20
Select a Filter for MCMS Items Default 1000s 2000s 3000s 4000s 5000s 0000s 7000s 8000s 9000s 9000s	Contract No. Select a Report XY2115177	Close Export to Excel

Step 40. Click the "Promote" button. A dialogue box will appear: "WARNING. You are about to promote Paving History/Maintenance records to As Built records for Contract: _____ and FMIS _____. Are you sure you want to continue?" Click "OK" (see below image).



😼 Data Warehouse - Connected to Production Database - [Construction Details]	
💀 Administration Data Analysis Reporting Help Exit	Test Version 1.18
Source: MAINTENANCE Change CN/FN Contract: XX6275177 ConHist_Main Location Construction QC/QA Checklist Supporting Documer	FMIS: MO266B51 Promote MCMS Close
Contract Contract XX6275177 FMIS MO266B51	
Note	DataWarehouse_New
Update Information:	WARNING: You are about to promote Paving History/Maintenance records to As Built records for Contract: XX6275177 and FMIS: MO266B51. Are you sure you want to continue?
Last Update Date 03/19/2012 Updated By AMOURADYAI Delete Save	OK Cancel

- Step 41. Once the promotion is complete a dialogue box will appear: "Promotion done!" Click "OK." Then close the "Construction History" project.
- Click on "Data." Select the "Construction Data" option from the drop-down Step 42. menu. Click on the "Action" drop-down menu and select "View/Edit/Delete." Select "UC- As Built" from the "Source" drop-down menu
- Step 43. Enter data for: Fund Type, Letting Date, Cement Price, and Binder (should automatically appear). Check the appropriate boxes in the "Project Feature" section. Click "Save" (see below image).



Construction Data Processing As Built Unit Cost Data

Source: UC - AS BUILT Change CN/FN Contract. XX1045277 FMIS: CA215B59 MCMS As Built/AS Bid_Main Location Construction Item Cost QC/QA Checklist Supporting Documents Contract # XX1045277 FMIS # CA215B59 Project Info. Fund Type: Letting Date: ////////////////////////////////////	Administration	Data Analysis Reporting	Help Exit		
Source: UC - AS BUILT Change CN/FN Contract XX1045277 FMIS: CA215B59 MCMS As Built/As Bid_Main Location Construction Item Cost QC/QA Checklist Supporting Documents Contract Information Contract # XX1045277 FMIS # CA215B59 MCMS Project Info. Fund Type: Letting Date: Project Feature: As Built Semi-Final As Built Final Area Wide Verified Other Items: Get Price Select a Price:	<u>~~</u>				
As Built/As Bid_Main Location Construction Item Cost QC/QA Checklist Supporting Documents Contract Information Contract # XX1045277 FMIS # CA215B59 Project Info. Fund Type: Project Feature: As Built Semi-Final As Built Final Area Wide Verified Other Items: Cement Price: Get Price Get Price Binder: Get 2 Update Information: Last Update Date 11/07/2012 Updated By BGAMBLE Delete Save	Source: UC -	AS BUILT Change CN/	FN Contract XX1045277	FMIS: CA215B59	MCMS
Contract Information Contract # XX1045277 FMIS # CA215B59 Project Info. Fund Type: Letting Date: Project Feature: As Built Semi-Final As Built Final Area Wide Verified Other Items: Cement Price: Get Price Select a Price: Date From: Junction: Update Information: Last Update Date 11/07/2012 Updated By BGAMBLE	As Built/As Bid_Ma	ain Location Construction It	em Cost QC/QA Checklist	Supporting Documents	
Contract # XX1045277 FMIS # CA215B59 Project Info. Fund Type: Letting Date: Project Feature: As Built Semi-Final As Built Final Other Items: Cement Price: Get Price Binder: 64-22 Note Update Information: Last Update Date 11/07/2012 Updated By BGAMBLE	Contract Information	tion			
Project Info. Fund Type: Project Feature: As Built Semi-Final As Built Semi-Final As Built Final Area Wide Other Items: Cement Price: Get Price Select a Price: Date From: Junction: Update Information: Last Update Date 11/07/2012 Updated By BGAMBLE	Contract#	X1045277 FMIS #	CA215B59		
Fund Type: Letting Date: Project Feature: As Built Semi-Final Other Items: Cement Price: Binder: 64-22 Date To: Jupdate Information: Last Update Date Internation: Last Update Date Internation: Date To: Delete Save	Project Info.				
Project Feature: As Built Semi-Final As Built Semi-Final As Built Final Area Wide Verified Other Items: Cement Price: Get Price Select a Price: Date From: Jule Date To: Vpdate Information: Last Update Date 11/07/2012 Updated By BGAMBLE	Fund Type:	 Letting Dat 	e: _/_/ 🔻		
As Built Semi-Final As Built Final Other Items: Cement Price: Get Price Select a Price: Date From: Jate To: Note Update Information: Last Update Date 11/07/2012 Updated By BGAMBLE	Project Feature:				
Other Items: Cement Price: Get Price Select a Price: Date From: Jate From: Jate To: Note Update Information: Last Update Date 11/07/2012 Updated By BGAMBLE	🔲 As Built Semi	-Final 📄 As Built Final	🗖 Area Wide 🛛	Verified	
Cement Price: Get Price Select a Price: Date From: Date From: J Date To: J Note Update Information: Last Update Date 11/07/2012 Updated By BGAMBLE	Other Items:				
Binder: 64-22 Date From: Date To: Oute To: Vpdate Information: Last Update Date 11/07/2012 Updated By BGAMBLE Delete	Cement Price:	Get Price	Select a Price:	*	
Binder: 64-22 Note Update Information: Last Update Date 11/07/2012 Delete Save			Date From:		
Note Update Information: Last Update Date 11/07/2012 Updated By BGAMBLE Delete Save	Binder:	64-22	Date To:	▼	
Update Information: Last Update Date 11/07/2012 Updated By BGAMBLE Delete Save	Note				
Update Information: Last Update Date 11/07/2012 Updated By BGAMBLE Delete Save					
Update Information: Last Update Date 11/07/2012 Updated By BGAMBLE Delete Save					
Last Update Date 11/07/2012 Updated By BGAMBLE Delete Save	Update Informati	on:			
Delete Save	Last Update Date	e 11/07/2012 Updated F	BGAMBLE		
Delete Save					
		Delete Save			

Step 44. Click the "Location" tab and make changes if necessary. Click "Save." Doubleclick on a location in the location table. When it is highlighted in blue, click "View/Add UC Measures" (see below image). Maryland department of transportation

STATE HIGHWAY ADMINISTRATION

Construction Data Processing As Built Unit Cost Data

Administration Data	Analysis	Reporting	Help	Exit						Te	st Version 1.18
ontract WA3255180	FMIS		ID	6080	COUNTY = \	VA, MUN = , R	OUTE = IS	70 E *, EXIT •	= , RAMP = , BI	MP = 22.48, E	MF Close
Gernal Information											
Functional Class: Rura	l Principal Arterial	- Interstat 🔻		Pav	ement Type:	F	•	Est. Con	pletion Date:		•
Project Summary:											
Lane Miles: 2.96	OW Pav	e. Area (sy):	20838.4	OW S	Shld Area (sy):	11662.96	WO	Open	Worksheet] Total E	Bid: 13351728.7
Project Rehab Info:	Existing P	avment Info:				Pavement Co	ondition:				
Thickness: 2	Action:	THIN OVERLAY	′>=1.5 ANE	<2.5	•	PCI:		IR	l: 88		Delete
Dosign Life: 12	Action	100				AADT	46900	ES	ALS: 6012		Delete
Estimated Life?	Design Lif	e: 12	•	V Estima	ated Life?	Friction:	45		0012		Save
lit Locations Associated	with Current L	Jint ID				Quick La	ne Covera	age			
Remove Please Selec	t			•		All Thru +	Aux + Shou	Ider Lanes	•	Calc	Lane Mile/Areas
					Apply		1	_			
Add Please Selec	t			•				• •		Aud	Lane Mile/Aleas
CODE MUN	ROUTE	RSUFF	RNUM	DIRECTI	ON BMP						
21 0	15		70	E	22.48						
21 0	10		/0		22.50						

- Step 45. Enter the required information: **Total Bid, Functional Class, Pavement type, Est. Completion Date, Thickness, Design Life, Action, Action year, Design Life, PCI, IRI, AADT, ESALs, Friction**. The Total Bid will not appear automatically because the contract was promoted from Construction History. The Lane Miles, Pavement Area, and Shoulder can be automatically generated by the EDW application.
- Step 46. In the "Edit Location Associated with Current Unit ID" section of the screen, click on the "Add" pull-down menu and make sure all the locations are added to this unit cost measures. The locations will not automatically populate in the location table because the project was promoted from Construction History.
- Step 47. Click on the drop-down menu in the "Quick Lane Coverage" section of the screen. Select "All Thru" then press "Calc Lane Miles/Area" and EDW will automatically generate the quantities for lane miles, pavement area and shoulder area (see below image).

Edi	Locations A	Associated	with Current	Unit ID				Qui	ck La	ne Co	verag	е										h
	Remove	Please Selec	zt			-		Ple	ase Sp	ecifiy						•		Calc	Lane	Mile/	Areas	
	Add	Please Selec	t			- A	pply	<	<]			Ŧ	>	>	Cle	ar	Add	Lane	Mile	Areas]
	CODE	MUN	ROUTE	RSUFF	RNUM	DIRECTION	BMP															
•	10	0	MD		17	S	0															
	10	0	MD		17	N	0															
																			1000	10000		
								1	1	1	1 1	1	1	1	1	1 1	1	1	1	1	1 1	
•		III					Þ															

- Step 48. Verify the quantities that the EDW generated. Click on "Open Worksheet." Fill in the appropriate fields (extracted from the typical section within the Plans Set): Lanes, Lane Mi, L (length), m/l W (width), Shoulder W (width), and Shoulder SY. The total at the bottom of the worksheet should be within 5% of the EDW auto generated quantity (see below image).
 - i. If the total is within 5% of the EDW auto generated quantity, proceed to Step 49.
 - ii. If the total is not within 5% of the EDW, further investigation is required to reconcile any differences.

	D6	•	· (•	f_{∞}				
	Α	В	С	D	E	F	G	H I
1	Lanes	Lane Mi	L	m/I W	m/I SY	shldr W	shldr SY	Source
2		0			0		0	
3		0			0		0	
4		0			0		0	
5		0			0		0	
6		0			0		0	
7		0			0		0	
8		0			0		0	
9		0			0		0	
10		0			0		0	
11		0			0		0	
12		0			0		0	
13		0			0		0	
14		0			0		0	
15		0			0		0	
10		0			0		0	
1/		0			0		0	
10		0			0		0	
19		0			0		0	
20		0			0		0	
21		0			0		0	
22		0			0		0	
24		0			0		0	
25		0			0		0	
26		0			0		0	
27		Ő			0		0	
28		0			0		0	
29		0			0		0	
30		0			0		0	
31		0			0		0	
32		0			0		0	
33		0			0		0	
34		0			0		0	
35	totals	0			0		0	
36								
37					0			

- Step 49. Click "Save" and then "Close." The EDW will automatically return to the "Location" tab.
- Step 50. Double-click on a location in the table while on the "Location" tab. Make sure the location is highlighted in blue. Click on the "Construction" tab. Since the project has been promoted from Construction History, the EDW should have populated the construction layer (see below image). Make sure the construction data is correct using the information gathered in the "Data Collection" section. If the data is not accurate, make the necessary adjustments to correct the construction data. However, the "Construction <u>History</u>" must be edited as well. Repeat this step for all locations on the project.

ource:	UC - AS BU	LT	Cha	ange CN/FN	Contract XX10	45277	FI	MIS: CA215	B59		MCMS			Close
As Built/As B	Bid_Main Lo	atio	n Constru	uction Item Co	st QC/QA Ch	ecklist S	uppo	orting Docur	ments					
Location:	County = C/	A, Mu	in =NONE	, Prefix = MD, R	oute = 2, Direc	tion = N *, I	Exit =	<mark>, Ramp = .</mark>	BMP = 21.74	4, EMP = 25.6	3			
Treatment	ID: 308088	•	For	This Location O	Inly Construc	tion Type:	MIN	NOR (LIGHT)) REHABILIT	A ▼ Definiti	on	View Exis	ting Con	Hist
S	eq. Layer		Thick. "	Material Type	Mix Method	Міх Тур	е	Band	Binder	ESAL	Mat Des	crip.	MatCode	,
- + #	1 SURFACE	•	2 🗸	ASPHALT -	A- HOT MIX 🗸	R-RAP	•	12.5MM 👻	64-22	► LEVEL - 2 ▼	504206 - 12.5MM	, 64-22, S 🔻	504206	
- + #	2 MILLING	-	2 👻	PAVEMENT -	0- N/A 🗸	- 0- N/A	•	N/A 👻	N/A 🗖	• N/A •	110 - CARBIDE G	RINDING 👻	110	
-+#	3	•	•	•	-	•	•	-		• •		•		
- + #	4	•	-	•	-	·	•]				-		
-+#	5	•	-	-	-	·	•]	·	• •		•		
Prev 5	1/1 Next	5	Treatmen	t Date 08/01/2	012 - Dis	plav Date	01-	Aug-2012		olv Treatment	Сору	Add N	ew D	elete
-Long Cori	fouration							-		-				
Lane Com	ilgulation		Quick La	ane Coverage:				-	🔲 Clear Al	I				
											Pavement			
			NNN 888	55 (55555 5 55555 (75755) (rk 8 Dido			
Subsecti	ion										IK & RIUE			
<	: > >									We We	eigh Station			
21.74 - 2	21.8380 -									🔲 Re	st Area			
		9												
@ Deel		ר												
					ANALY MERICAN PROPERTY AND									
Repr	ace Lanes				ette 🗱 🗱 Et									

- Step 51. Click on the "Item Cost" tab. Double-click on each item (highlighting the item in blue) in the table and assign the relevant activity under the "Activity" dropdown menu. Click "Save." Repeat for each item in the table. For As Built Adjustments, the unit must be assigned as "Each." Make sure the "As Built" box is checked for every item.
- Step 52. Click on "QC/QA Checklist" tab. Click on the relevant boxes on "QC/QA Check List" (left side of screen) and then click the "Save" button on the bottom of screen. If all data for the project is entered completely, click the "Check" button (see below image). Otherwise, return to incomplete data and input before proceeding.
STATE HIGHWAY ADMINISTRATION

Construction Data Processing As Built Unit Cost Data

ist_Main Location Construction QC/QA Checklist Supporting Documents	
/QA Check List Value/Comment	
PM-001	Check UnCheck QC Review Completion
Contract#	
] FMIS#	Last Check Date: // By:
] Fund Type	
County	
Route	
Direction	
Mile Points	Check UnCheck QA Review Completion
Project Description	
Paving Compl Date	Last Check Date: // By:
From Orig PAV_HIST Notes	
Roadway Project Type	
Capital Paving / Patching project Only	_
Crack / Joint Sealing	
] Patching	Check UnCheck ADC Review Completion
] Milling	
Reflective Joint Cracking pre-treatment	Last Check Date: // By:
] Other	
Roadway Project Type	
Routine Maint. PCA Projects Only	

Step 53. Click on "Supporting Documents" tab and upload any supporting documents using the "Upload" button (see below image).

Source: PAVING HISTORY Change CN/FN Contract: Test 123 FMIS: TE5443 Promote MCMS C ContHist_Main Location Construction QC/QA Checklist Supporting Documents Browse Upload To Open, Double Click: To Delete, Single Click then Press Delete Button. Delete	Administration Data Analysis Repo	ting Help Exit			Test Version 1.17
Contribut_Main Location Construction QC/QA Checklist Supporting Documents Browse Upload To Open, Double Click, To Delete, Single Click then Press Delete Button. Delete Central Location for Supporting Documents: Whenperdata/PMDATAW5 Documentation/Engineering Data Warehouse/Support Doct	Source: PAVING HISTORY Change	CN/FN Contract Test 123	FMIS: TE5443	Promote MCMS	Clos
Central Location for Supporting Documents: Ubanomdata/PMDATA/05 Documentation/Engineering Data Watebouse/Support Doc/	ConHist_Main Location Construction QC	QA Checklist Supporting Docum	ents		
To Open, Double Click; To Delete, Single Click then Press Delete Button. Delete Central Location for Supporting Documents:				Browse Upload	
Central Location for Supporting Documents: Whatomatal PMDATA/05 Documentation/Engineering Data Watehouse/Support Doc/	To Open, Double Click; To Delete, Single	Click then Press Delete Button.	Delete		
Central Location for Supporting Documents: Whatpendata/PMDATA/05 Documentation/Engineering Data Watehouse/Support Doc/					
Central Location for Supporting Documents: [Nanomdata]PMDATA\05 Documentation\Engineering Data Warehouse\Support Doc\					
Central Location for Supporting Documents: Whatpendata/PMDATA/05 Documentation/Engineering Data Warehouse/Support Doc/					
Central Location for Supporting Documents: [Nanomdata]PMDATA\05 Documentation\Engineering Data Warehouse\Support Doc\					
Central Location for Supporting Documents: [][hanpmdata]PMDATA]05 Documentation]Engineering Data Warehouse][Support_Doc]					
Central Location for Supporting Documents: [Nanomdata]PMDATA\05 Documentation\Engineering Data Warehouse\Support Doc\					
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Central Location for Supporting Documents: \\happmdata\PMDATA\05 Documentation\Engineering Data Warehouse\Support Doc\					
Central Location for Supporting Documents: (hanpmdata)PMDATA\05 Documentation\Engineering Data Warehouse\Support Doc\					
The second	Central Location for Supporting Document	s: \\hanpmdata\PMDATA\05 Doc	umentation\Engineering Dat	a Warehouse\Support_Doc\	

4.05 REVIEWING PROJECTS IN MCMS

4.05.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to review construction information for single-ad and areawide projects using the Maryland Construction Management System (MCMS) within the Engineering Data Warehouse (EDW). MCMS is a standalone application run by the inspection division of MDOT-SHA. The database contains detailed construction projects. MCMS is the primary source for construction information for single-ad and area-wide projects. Three spreadsheets created by MCMS are utilized: an itemized report with quantities and unit cost, a detailed construction report categorized by item, and the job order (applies only to area-wide projects). The EDW has an internal MCMS feature to streamline the data collection process.

4.05.02 Frequency

The use of the MCMS application within the EDW is a continuous process that occurs year-round.

4.05.03 Purpose

The purpose of this SOP is to review construction information using the MCMS application and produce reports of the desired information for use in construction data collection (see <u>Processing Paving & Maintenance History Data</u>, <u>Processing Access Permit Data</u>], and <u>Processing As Built Unit Cost Data</u>.

4.05.04 *Resource Requirements*

The running of the MCMS application involves two people: (1) a user knowledgeable in EDW software to run the application, and (2) a supervisor who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues were encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	EDW user	1	4.0
DPT TL	Supervisor	1	AR ^{06/12/2019}

4.05.05 *Procedure*

The procedure to run the MCMS application for construction information reporting is comprised of a single task:

(1) generating an MCMS report in the EDW.

1- Generating an MCMS Report in the EDW – performed by EDW user

Summary: This task generates a report from the MCMS application within the EDW. The output of this task is an Excel spreadsheet with a list of desired contracts and associated construction information.

- Step 1. Open the EDW application.
- Step 2. Select the "Reporting" button from the main menu and click "MCMS" from the drop-down list (see below image).

0	Data Warehouse	- Connec	ted to Produc	tion Database				
	Administration	Data	Analysis	Reporting	Help	Exit		
	2			Constru	iction Da	ata	•	
Ī				Conditi	on		-	
				MCMS				
				Transp	ort			
				HMA T	onnage			
				Historio	al Note:	s Fields		

Step 3. In the "Select a MCMS Report" drop-down list, click "Specify a Contract" (see below image).

0e D	Data Warehouse - Connected to Production Database - [MCMS Reports]										
•	Administration	Data	Analysis	Reporting	Help	Exit	Test Version 1.20				
8											
	Select a MCMS Specify a Cont Double Click to Se	Report ract	ontract for De	• etailed Repor	ts; Highl	ight a Co	Export to Excel Close Close				

Step 4. Another window will automatically open. Enter the "Contract No" (see below image).

🖷 Administration Data Analysis Reporting Help	Exit		Test Version 1.20
Select a Filter for MCMS Items	Contract No.	Select a Report	
Default -			Close
			Export to Excel
☑ 6000s □ 7000s □ 8000s □ 9000s			

Step 5. On the left side of the window, change the "Select a Filter for MCMS Items" to "User's Pick" and check the boxes for all the desired item series (see below image).

	Administra	ation Da	ta Analy	sis Repo	rting Help
S	elect a Filte	er for MCM	S Items		
l	Jser's Pick	-			
	🔲 1000s	☑ 2000s	🔲 3000s	🗏 4000s	▼ 5000s
	✓ 6000s	7000s	8000s	9000s	

Step 6. On the "Select a Report" drop-down menu, choose the desired option. The first four reports apply to single-ad projects, while the last three reports apply to area-wide projects (see below image).

Select a Report	Class
-	Close
Report - IDR Detail Report - IDR Summary Report - Items Report - IDR INSP Report - IDR by Job No. Detail Report - IDR by Job No. Summary Report - IDR by Job No. Item Cost	Export to Excel

- i. If a single-ad project option is chosen, proceed to Step 8.
- ii. If an area-wide project option is chosen, proceed to Step 7.
- Step 7. Choose the correct description from the "Select a Job Description" drop-down menu and confirm the "FMIS" matches the specific project needed. If it does not match, confirm the correct job description was selected (see below image).

•	Administr	ation Data	Analysis Repo	rting Help	Exit					Test Version 1.	20
2											
S	elect a Filt	er for MCMS Ite	ems		Contract No.	Selecta	Report				
D	efault	•			XY2215177	Report -	IDR by Jo	b No. It	em Cost 🛛 👻	Close	
	🗌 1000s	☑ 2000s	3000s 🗌 4000s	√ 5000s	Select a Job Description					Export to Exce	:
	√ 6000s	7000 s	8000s 🗌 9000s		Patching MD 632 from I-7	'0to MD 68 🗸	FMIS W	A220A5	57	Promote to As B	uilt
	CHEC	K ITEM_NO	CATEGORYCODE	DESCR				UNIT	UNIT_PRICE	FIELD_QUANTITY	ITEM_C
	V	5006. 01A	504206	HMA SUPPAV 12	2.5MM SURF PG64-22 LEV 2 FOR F	PATCHING 0 INCH TO 3 I	NCH DEPTH	TON	85.4	1063.67	90837.4
	V	5010. 01A	504600	PRICE ADJUST A	SPH BINDER (DO NOT ALTER)			EA	1	6787.49	6787.49
J	7	5012. 01A	504610	PAYM'T ADJUST	HMA MIXTURE (DO NOT ALTER)			EA	1	1464.37	1464.37
		5017. 01A	585431	5" YELLOW PAN	/ MARK PAINT LINES			LF	0.13	2189	284.57
		5018. 01A	585433	5" WHITE PAV'T	MARK PAINT LINES			LF	0.13	10945	1422.85

- Step 8. Once the desired contracts are displayed, click the "Export to Excel" button. Name the document in the save prompt window, choose the proper save location, and click "Save." The spreadsheet will automatically open in Excel.
- Step 9. Repeat Step 2 to Step 8 for each desired MCMS report.

4.06 RUNNING TRANSPORT APPLICATION

4.06.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to review bid tabulation information for single-ad projects in the Engineering Data Warehouse (EDW) prior to Unit Cost – As Bid data processing (see <u>Processing As Bid Unit Cost Data</u>). The Transport application within the EDW is used to accomplish this task. It is operated by the Office of Construction within the MDOT-SHA as a means to prompt the DPT when contracts are ready.

4.06.02 Frequency

The use of the Transport application within the EDW is a continuous process that occurs year-round.

4.06.03 Purpose

The purpose of this SOP is to review bid information and determine if the contracts are good candidates for promotion to the Unit Cost - As Bid processing.

4.06.04 *Resource Requirements*

The running of the Transport application involves two people: (1) a user knowledgeable in EDW software to run the application, and (2) a supervisor who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues were encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	EDW user	1	1.0
DPT TL	Supervisor	1	AR ^{06/12/2019}

4.06.05 *Procedure*

The procedure to run the Transport application is comprised of a single task: (1) running Transport application in the EDW.

1- Running Transport Application in the EDW – performed by EDW user

Summary: This task generates a list from the Transport application within the EDW for contracts that are good candidates for Unit Cost – As Bid. This task is completed prior to data processing of Unit Cost – As Bid contracts as outlined in <u>Processing As Bid Unit Cost Data</u>.

- Step 1. Open the EDW application.
- Step 2. Select the "Reporting" button from the main menu and click "Transport" from the drop-down list (see below image).

MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

🎾 Data Warehouse - Connected to Production Database											
Administration	Data	Analysis	Reporting Help Exit								
<u></u>			Construction Data								
			Condition								
			MCMS								
			Transport								
			HMA Tonnage								

Step 3. In the "Select a Transport Report" drop-down list, click "Report – Contracts Not in Unit Cost" (see below image).

🄉 D	ata Warehouse - Co	onnected	to Production	Database - [Ti	ansport	Reports]	_	-	And in case of the local diversion of	-
•	Administration	Data	Analysis	Reporting	Help	Exit				Test Version 1.20
S	elect a Transpor	t Report	n Transport	•					Export to Excel	Close
Do	Report - Contra out Specify a Cont	acts Not tract	in Unit Cost	Reports	Highlig	ht a Con	tract and then Click on Rem	iove button to Remo	ove from the Report.	Remove

Step 4. Double-click on a contract to see the detailed item report (see below image). The EDW will automatically open the detailed item report. Not every project that is displayed in the Transport application qualifies as a good candidate for "Unit Cost – As Bid", the project **must** contain **5000s** series paving items.

dministra	ation Data	Analysis	Reporting	Help						
ect a Tra					EXIT					Test Vers
ect a Tra										
Report-	nsport Report Contracts Not	in Unit Cost	•					Exp	oort to Excel	Close
le Click t	o Select a Co	ntract for Det	ailed Reports; F	-lighlight	a Contrac	t and then Click	on Remove butto	n to Remove from	the Report.	Remov
LCONT		IELEI	COUNTYT	COUN	112	COUNTYS	COUNTY4	CDESCR	CONTAMT	VNAMEL
WA325	5180 03/	29/2012	WASHINGTON					I-70 BRIDGE NO	13351728.7	CONCRETE GE
WA351	5130 03/	29/2012	WASHINGTON					US 40 ALT. AT P	1534793.75	C. WILLIAM HE

- i. If the project is a good candidate for Unit Cost As Bid, continue to <u>Processing</u> <u>As Bid Unit Cost Data</u>.
- ii. If the project is not a good candidate for Unit Cost As Bid, click the "Remove" button. A dialogue box will appear (see below image). "Reviewed contract not a good candidate" will already be populated in the text area. Click "OK."

Inserting into Exclude_MCMS Table	x
Please provide the comment for excluding the current Contract = AX0835127 and FMIS = 0:	OK Cancel
Reviewed contact not a good candidate.	

4.07 LOOKING UP FUND TYPE

4.07.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to look up the fund type for a specific project using an application within the Engineering Data Warehouse (EDW). MDOT-SHA has a numbering convention for projects and the last two digits in the contract number indicate the type of construction project. However, this is not always the case for area-wide projects. The Mother Contract could indicate a rehab project while the Financial Management Information System (FMIS) number could represent an intersection improvement. The FMIS lookup application gives fund type directly from the Office of Finance. Area-wide projects have a contract and FMIS number, whereas single-ad projects are assigned a single contract number. However, using the county and the next five digits, an FMIS can be created and used as the FMIS for lookup purposes (e.g., "AL3805177" is a single-ad contract number, while "AL380(A/B/C)51" is the FMIS number). The list of fund types has been included as an appendix (see Fund Type).

4.07.02 Frequency

The use of the fund type lookup application within the EDW is a continuous process that occurs year-round.

4.07.03 Purpose

The purpose of this SOP is to look up the fund type for a specific construction project.

4.07.04 Resource Requirements

Looking up a construction project fund type involves two people: (1) a user knowledgeable in the EDW software to run the application, and (2) a supervisor who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues were encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	EDW user	1	0.5
DPT TL	Supervisor	1	AR ^{06/12/2019}

4.07.05 *Procedure*

The procedure to look up a construction project fund type is comprised of a single task: (1) running fund type lookup application in the EDW.

1- Running Fund Type Lookup Application in the EDW – performed by EDW user

Summary: This task utilizes the fund type lookup application in the EDW to identify the fund type for a specific contract.

Step 1. Open the EDW application.

Step 2. Select the "Administration" button from the main menu and click "Lookups" from the drop-down list, then "Fund/FMIS" (see below image).

0	Data Warehouse - Connected to Production Database							
	Administration	Data	Analysis	Reporting	Help	Exit		
:	Connection							
	PickList	- • I						
	Lookups	•	Contrac	t/FMIS				
	Exit EDW		Fund/FI	MIS				
			Exclude	ed MCMS/Tra	nsport			
						_		

Step 3. A new window will automatically appear. In the "Select a FMIS" drop-down list, select the appropriate FMIS number (see below image).

Seler AL38	ot a FMIS: 0B51	•						
	FUND	INSERT_DATE	RTI	START_DATE	TITLE	ROUTE_NO	REMARKS	PROJ_NO
•	77	06/22/2012	77U100	20110118	TC-MD55 BR	I-68		AL380B

Step 4. The FMIS information will populate in the window. The first column in the table of the appendix ("Fund") indicates the fund type. Reference <u>Fund Type</u>.

4.08 MAKING LANE CONFIGURATION CHANGES

4.08.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to make changes to lane configurations using an application within the Engineering Data Warehouse (EDW). MDOT-SHA construction projects can modify, extend, or create new lanes and roadways. These changes need to be reflected in the EDW. Lane modification changes (modified lane, new lane or extended lane) in the EDW are only allowed for completed projects. Proposed projects, As-Bid, or incomplete projects are prohibited from making lane modifications.

4.08.02 Frequency

Making changes to lane configurations within the EDW is a continuous process that occurs year-round.

4.08.03 Purpose

The purpose of this SOP is to obtain pertinent data relating to changes in lane configuration and then to modify or extend existing routes or create new routes in the EDW.

4.08.04 *Resource Requirements*

Making changes to lane configurations within the EDW involves two people: (1) a user knowledgeable in the EDW software to run the application, and (2) a supervisor who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues were encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	EDW user	1	4.0
DPT TL	Supervisor	1	AR ^{06/12/2019}

4.08.05 *Procedure*

The procedure to make changes to lane configurations within the EDW is comprised of the following four tasks:

- (1) identifying lane configuration changes,
- (2) viewing or modifying an existing route,
- (3) creating a new route, and
- (4) extending an existing route.

1- Identifying Lane Configuration Changes – performed by EDW user

Summary: This task obtains and verifies several key pieces of construction data in order to determine the extents and type of lane configuration change to be made. Plan sets are required for all lane configuration changes.

- Step 1. Retrieve Project **Plan Set** from the source. Review pertinent pages that relate to construction history. Check that all the pertinent data is enclosed in the plan set (including paving typical sections, plan sheets, etc.). Using the plan set, determine where the lane modification should occur (Beginning Milepost, Ending Milepost, and Lane Width).
- Step 2. Review the **Right-of-Way (ROW)** video collected by the Automated Road Analyzer (ARAN) vehicle (**Visidata.exe**). Use the video to determine the project limits and where the lane configuration changes occurred.
- Step 3. Identify the project limits using the Highway Location Reference (HLR) Guide. The HLR Guide is categorized by county and route. Verify the mile points (Refer to Highway Location Referencing Guide).
- Step 4. Determine the appropriate type of lane configuration change.
 - i. If an existing route needs to be modified, proceed to Step 5.
 - ii. If a new route needs to be created, proceed to Step 14.
 - iii. If an existing route needs to be extended, proceed to Step 22.

2- Viewing or Modifying Existing Route – performed by EDW user

Summary: This task uses the EDW software to modify an existing route based on determined lane configuration changes. The "View/Modify Existing Route" feature within the EDW allows for modifications of the route, such as creation or removal of lanes, construction of turning lanes, etc. When modifying a lane within the EDW system, all of the history associated with that lane is modified as well. Check the accuracy of the changes that will be made to the route prior to completion.

- Step 5. Open the EDW application.
- Step 6. Select the "Data" button from the main menu and click "Inventory" from the drop-down list, then "View/Modify an Existing Route" (see below image).

Administration	Data	Analysis	Reportin	g He	lp Exit	
2	Construction Data					
	Ar	ran	•			
	W	isecrax	•			
	Vi	sidata				
	Fr	iction	+			
	M	CMS				
	М	aintenance	+			
	Н	MA Tonnage	• •			
	In	ventory	•	Vi	iew/Modify an Existing	g Route
	_			A	dd a New Route	
				E	xtend an Existing Rout	te

Step 7. A new window will automatically appear. Enter the required information for the route to be modified: County, Municipal (if needed), Prefix, Route, and Direction. Press "Confirm." In the "Limits" section, enter the Beginning Milepost and the Ending Milepost for the area where the lane modification will

occur. Press "Confirm." The existing lane configuration will be displayed at the bottom of the screen (see below image).



Step 8. In the EDW lane configuration system, roadways have "breaks" which are sections of the roadway. These breaks can occur where turn lanes begin or end, shoulders exist, acceleration or deceleration lanes begin or end, etc. These breaks are displayed in the drop-down menu in the "Configuration Breaks" section. Select the range where the lane configuration will be modified from the drop-down menu. Click the "Modify Lane Config" button (see below image).



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Construction Data Making Lane Configuration Changes

County Mun Prefix Route AA + NONE + MD + 468	Dir. ▼ N/S ▼	Close	
ixut# v Ramp# imits	• Confirm		
MP Intersection From 0 W SHADYSIDE RD (BACK) (0) ~	By @ MP ACT.		
To 1 CENTRAL AVE (11.19)	Confirm		
Infiguration Breaks		Display Option	
0.72 - 0.76 0.76 - 0.83 0.83 - 0.85 1 0.85 - 0.92		Compare GL and PHY Clear Mismatching	
0.92-1		Modify Lane Config	
		Refesh	
1			

Step 9. A new window will automatically appear. In the "Action" drop-down menu, choose "Change Lane Feature." Enter required information for: **From, To Location, Type, Sub Type, Asc. Type, Width, and Lane No.** Click "Preview Change" (see below image).

Location: Subsection 0-0.04	Apply Cancel
Lane Configuration	Applying a lane change (repeat the process till all changes are made) Preview Change Clear Last Change Action: GELANE FEATURE To Loc: Type: Sub Type: Asc Type: Width: Lane No.

Step 10. A dialogue box will appear with a warning regarding the proposed changes. Double-check that the changes are correct and click "OK" (see below image).

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Construction Data Making Lane Configuration Changes

Da	ataWarehouse_New
N	Warning! Please double check the change you would like to make. Click OK if you want to continue, otherwise click Cancel.
	OK Cancel

Step 11. Click "Apply." A dialogue box will appear. Click "OK" (see below image).

DataWarehouse_New	23
Lane Configuration Modified!	
ОК	

Step 12. Another dialogue box will appear indicating that the lane configuration changes have been applied and to refresh the inventory diagram to display the lane configuration changes. Click "OK" (see below image).



- Step 13. Confirm the lane configuration changes were made successfully by running the Route History application as outlined in <u>Viewing Paving & Maintenance History</u> by Route.
- 3- Adding a New Route performed by EDW user

Summary: This task uses the EDW software to create a route that does not currently exist in the EDW. Currently, the "Add a New Route" function is in the draft phases. This feature has not been used in a practical application but only for testing purposes.

- Step 14. Open the EDW application.
- Step 15. Select the "Data" button from the main menu and click "Inventory" from the drop-down list, then "Add a New Route" (see below image).

Administration	Data Analysis Re	porting	Help	Exit
	Construction Data			
	Aran	- F 🖿		
	Wisecrax	- •		
	Visidata	- 81		
	Friction	III		
	MCMS	- 81		
	Maintenance	I I		
	HMA Tonnage	III		
	Inventory	•	View/	Modify an Existing Route
			Add a	a New Route
			Exten	d an Existing Route
		_		

Step 16. A new window will automatically appear. Enter the required information for the route to be added: **County, Municipal (if needed), and Prefix**. Press "Continue" (see below image).

County	Mun	Prefix Rou	te Dir.
	•	▼	•
Exit#	Ramp #	E	MP EMP
· · · · ·			
	Continue	Close	

Step 17. A new window will automatically appear. Enter the required information for the route to be added: **County, Municipal (if needed), Prefix, Route, Suffix, and Mainline**. Click "Create Route" (see below image).

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Construction Data Making Lane Configuration Changes

ntv	Continue			Create Large	Q Long Conferen	CI
n	Sections		Ψ	Create Lanes	& Lane Conligu	rations
efix	Location	Feature Type	Sub Type	Asso Type	No. of Lanes	Width*, ft
oute	LEFT OUTER	SHOULDER	-			0
ffix	LEFT OUTER	LANE	AUX		0	0
ction*	LEFT	LANE	THRU		0	0
	LEFT INNER	LANE	AUX	-	0	0
л	LEFT INNER	SHOULDER	×			0
mp						
inline 👻	CENTER	MEDIAN	Ψ			0
present inventory direction	RIGHT INNER	SHOULDER	-			0
Create Route	RIGHT INNER	LANE	AUX		0	0
	RIGHT	LANE	THRU		0	0
e Segments	RIGHT OUTER	LANE	AUX		0	0
D	RIGHT OUTER	SHOULDER				0
P						
Create Segments le Sections Add a Break Clear All k Points					View	ane Configuration
Create Sections	1 1 1	1 1 1 1 S	ווווו N	1 1 1	1	

Step 18. A dialogue box will appear. Verify that all entered route information is correct and click "Yes" (see below image).

DataWarehouse_New	<u> </u>
Warning! Are you sure you want to create a new route?	
Yes No	

- Step 19. Proceed to the "Define Segments" section of the screen. Enter the **Beginning Milepost and Ending Milepost** and click "Create Segments." In the "Define a Section" section, enter the break points to split the route into different subsections, each with a different lane configuration. Click "Create Sections."
- Step 20. For each lane configuration break, define the lanes. Click the "View Lane Configuration" button to view the lanes graphically and click "Save Lane Configuration" to save the defined the lane configuration.
- Step 21. Once all subsections have been defined (all items in the drop-down list have "defined" next to them), click the "Create Lanes and Lane Configuration" button to finish the entire process of creating a new route.

4- Extending a Route – *performed by EDW user*

Summary: This task uses the EDW software to extend an existing route beyond the current inventory. Currently, the "Extend a Route" function is in the draft phases. This feature has not been used in a practical application but only for testing purposes.

Step 22. Open the EDW application.

Step 23. Select the "Data" button from the main menu and click "Inventory" from the drop-down list, then "Extend an Existing Route" (see below image).

Administration	Data Analysis Report	ing Help Exit
	Construction Data	
	Aran 🕨	
	Wisecrax +	
	Visidata	
	Friction +	
	MCMS	
	Maintenance +	
	HMA Tonnage 🔹 🕨	
	Inventory •	View/Modify an Existing Route
		Add a New Route
		Extend an Existing Route

Step 24. A new window will automatically appear. Enter the required information for the route to be extended: County, Municipal (if needed), Prefix, Route, Direction, Beginning Milepost of Extension, and Ending Milepost of Extension. Press "Continue" (see below image).

🖳 Invento	ory Update					×
Locati	on Information					
	County	Mun	Prefix	Route	Dir.	
		•	•	-	-	
	Exit#	Ramp#		BMP	EMP	
	_		-	1		
		Continue	С	lose		

Step 25. A dialogue box will appear confirming the beginning and ending mileposts for the extending portion of the existing route. Check that the mileposts are correct and click "Yes" (see below image).

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Step 26. A new window will automatically appear. The "Define a Route" section will be grayed out because the extension is for an existing route. Enter the **Beginning Milepost and Ending Milepost** in the "Define Segments" section and click "Create Segments" (see below image).

Administration	Data	Analysis	Reportir	ng Help	p	Exit									TestV	ersion 1.16
Define a Rout	e	_	-Define S	Section La	anes	s & Lane Config	jurations	;		ſ						Class
County	HA			Sections				-			Create La	anes	& Lane Config	urations		Close
Mun Prefix	IS			Location		Feature Type	S	Sub Typ	e		Asso Ty	ype	No. of Lanes	Width*, ft		
Route	95			EFT OUTE	R	SHOULDER								0		
Suffix				EFT OUTE	R	LANE		AUX				-	0	0		
Direction*		-		LEFT		LANE		THRU					0	0		
Exit				LEFT INNER		LANE		AUX				-	0	0	_	
Ramp				LEFT INNEP	3	SHOULDER			*					0		
Mainline		-		CENTER		MEDIAN								0		
* represent	inventory d	irection		UCUT INNE			[_				
Crea	ate Boute							ALIV	Y						-	
						LANE		TUDII				-	0			
Define Segme	∋nts	_			B	LANE						-	0			
BMP	18.39		B	ант онт	B	SHOULDER		AUA				-				
EMP	56					ONOOLDEN									_	
Create	Segments															
Define Sectio	ns												View	/Lene Configu	ration	
	Add a Br	eak												r conie coniiga		
	Clear A	All											Save	e Lane Configu	uration	
Break Points																
Creat	e Sections			1 1	1	1 1 1 1	1 1	1	1 1	1	1 1	1	1			

- Step 27. In the "Define a Section" section, enter the break points to split the route into different subsections, each with a different lane configuration. Click "Create Sections."
- Step 28. For each lane configuration break, define the lanes. Click the "View Lane Configuration" button to view the lanes graphically and click "Save Lane Configuration" to save the defined the lane configuration.
- Step 29. Once all subsections have been defined (all items in the drop-down list have "defined" next to them), click the "Create Lanes and Lane Configuration" button to finish the entire process of extending an existing route.

4.09 ADDING TO PROJECT ENGINEER LIST

4.09.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to add the name of a Project Engineer (PE) to the MDOT-SHA PE list within the Engineering Data Warehouse (EDW). The EDW tracks the Project Engineer for construction projects. In the event of a discrepancy in provided information or a question on the project the, PE is listed. During the data entry process, the name of the PE may not appear in the drop-down menu on the "Location" tab and requires an addition to the PE list. The list is an internal feature in the EDW system that can be modified to add additional names to the drop-down menu.

4.09.02 Frequency

Adding the name of a PE to the MDOT-SHA PE list within the EDW is a continuous process that occurs year-round.

4.09.03 Purpose

The purpose of this SOP is to add the name of a PE to the MDOT-SHA PE list.

4.09.04 *Resource Requirements*

Adding the name of a PE to the MDOT-SHA PE list within the EDW involves two people: (1) a user knowledgeable in the EDW software to run the application, and (2) a supervisor who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues were encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	EDW user	1	0.5
DPT TL	Supervisor	1	AR ^{06/12/2019}

4.09.05 *Procedure*

The procedure to add the name of a PE to the MDOT-SHA PE list within the EDW is comprised of a single task:

(1) adding PE name to the MDOT-SHA PE list in the EDW.

1- Adding PE name to the MDOT-SHA PE list in the EDW – performed by EDW user

Summary: This task adds the name of a PE to the MDOT-SHA PE list within the EDW so that it will appear in the drop-down menu of the "Location" tab.

- Step 1. Open the EDW application.
- Step 2. Select the "Administration" button from the main menu and click "PickList" from the drop-down list, then "Users", then "SHA PE" (see below image).

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🞾 Data Warehouse - Connected to Production Database									
Administration [Data	Analysis	Repo	rting	Help	Exit			
Connection									
PickList	•	Materia	ls	•					
Lookups	•	Proced	ures	•					
Exit EDW		Constru	ction	•					
_		Location	n	•					
		Users		•	PAG	D Users			
					PAG	D Team	- 1		
					SHA	PE			
							_		

Step 3. A new window will automatically appear. Scroll to the bottom of the list in the window and in the blank spot add the next number in sequential order, P.E. First & Last Name, and a 1. The 1 indicates that the PE is still active while a 0 indicates that the PE has retired (see below image).

	141	Wally Clever	1		
	142	Mike Kelly	1		
	143	Bill Truax	1		
	144	Francis Robeson	1		
	145	Roger Campbell	1		
	146	Dave Felker	1		
*					
* To	retire a re	ecord, simply set its	status to 0.	Save	Close

Step 4. Click "Save." Close any open tabs and close the EDW. Reopen the EDW application and confirm that the entered name appears in the drop-down menu on the "Location" tab.

4.10 VIEWING PAVING & MAINTENANCE HISTORY BY ROUTE

4.10.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to view paving and maintenance history by route within the Engineering Data Warehouse (EDW). The EDW application imported thousands of records from the old Access Database and new records are being created on a daily basis. Most projects fit together like puzzle pieces along the roadway; where project "A" stops, project "B" begins. The EDW has a feature that enables you to see all the construction history for a segment of roadway.

4.10.02 Frequency

Viewing paving and maintenance history by route within the EDW is a continuous process that occurs year-round.

4.10.03 Purpose

The purpose of this SOP is to view paving and maintenance history by route within the EDW. It should be utilized when lane configuration changes are made to a route in the EDW as outlined in <u>Making Lane Configuration Changes</u>.

4.10.04 *Resource Requirements*

Viewing paving and maintenance history by route within the EDW involves two people: (1) a user knowledgeable in the EDW software to run the application, and (2) a supervisor who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues were encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	EDW user	1	0.5
DPT TL	Supervisor	1	AR ^{06/12/2019}

4.10.05 *Procedure*

The procedure to view paving and maintenance history by route within the EDW is comprised of a single task:

(1) viewing construction data by route in the EDW.

1- Viewing Construction Data by Route in the EDW – performed by EDW user

Summary: This task generates a report that displays all construction history (paving and maintenance) for a specified route.

- Step 1. Open the EDW application.
- Step 2. Select the "Reporting" button from the main menu and click "Construction Data" from the drop-down list, then "By Route" (see below image).



Administration	Data	Analysis	Reporting	Help	Exit			
~			Constru	uction Da	ata	•	By Route	
			Conditi	on		•	By Contract	
			MCMS				Summary (By Date)	
			Transp	ort				·
			HMA T	onnage				
			Historio	cal Notes	s Fields			

Step 3. A new window will automatically appear. Enter the required location information: **County, Municipal, Prefix, Route, and Direction**. Click "Confirm" (see below image).

Locatio	on					
	County	Mun		Prefix	Route	Dir.
[•		•	-	-	-
Exit#	•	Ramp #			•	Confirm

Step 4. Choose the **Beginning Milepost and Ending Milepost** for the section for which the construction history is needed. This information can be manually entered, or the closest reference point can be selected from the drop-down menu. Click "Confirm" (see below image).



Step 5. A lane configuration diagram will appear on the left-hand side of the screen. Select the "Source" drop-down menu and choose "Paving Only" (or "Paving & Maintenance" if desired). Click "New Report by Route" and a dialogue box will appear. Click "OK" (see below image).

1	DataWarehouse_New
	A report by route is created for Global_Route_ID =20024, Sub_Route_ID = 0, BMP = 0, EMP = 1.5, Data Source Code = 1.
	ОК

Step 6. Click "Larger View" to display the entire report. Click "Add Format" to make the window easier to read (see below image).

									_	
LAYER	LAYER_GROUP	THICK	MAT_CODE	DESCRIPTION	MIX_METHOD	CONTRACT_REPOI	CONTRACT_ENTR'	FMIS	^	
Baltimore	MD 150	w	THRU LANE 1	BMP 0	EMP .45					Add Format
1034387	65774	38466	504250	12.5mm, 76-22,	A- HOT MIX	BA2225183	BA2225183	0	=	Close
1034387	65774	38466	110	Carbide Grinding	0- N/A	BA2225183	BA2225183	0	-	
1034387	65786	38467	10	Band SN	A- HOT MIX	M403	M403	0		
1034387	26108	38468	1	Surface	A- HOT MIX	MAINTENANCE	99-5759	0		
1034387	58016	38469	1	Surface	A- HOT MIX	B -655-000-415	B -655-000-415	0		
1034387	10040	38470	1	Surface	A- HOT MIX	B -333-001-466	B -333-001-466	0		
1034387	10040	38470	28	Base	A- HOT MIX	B -333-001-466	B -333-001-466	0		
1034387	10040	38470	48	Penetration Mac	0- N/A	B -333-001-466	B -333-001-466	0		
1034387	10040	38470	47	Macadam - Stone	0- N/A	B -333-001-466	B -333-001-466	0		
1034387	10040	38470	49	Screenings (scr	0- N/A	B -333-001-466	B -333-001-466	0		
Baltimore	MD 150	w	THRU LANE 1	BMP .45	EMP .85					
1034387	50135	38636	504250	12.5mm, 76-22,	A- HOT MIX	BA2225183	BA2225183	0		
1034387	50135	38636	110	Carbide Grinding	0- N/A	BA2225183	BA2225183	0		

4.11 PROMOTING AS BID TO CONSTRUCTION HISTORY

4.11.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to promote As Bid projects to Construction History within the Engineering Data Warehouse (EDW). Unit Cost – As Bid information is processed prior to construction; several pieces of data used for Unit Cost – As Bid are also needed in Construction History. The EDW application has a feature to easily promote these items.

4.11.02 Frequency

Promoting As Bid projects to Construction History within the EDW is a continuous process that occurs year-round.

4.11.03 Purpose

The purpose of this SOP is to promote As Bid projects to Construction History within the EDW.

4.11.04 *Resource Requirements*

Promoting As Bid projects to Construction History within the EDW involves two people: (1) a user knowledgeable in the EDW software to run the application, and (2) a supervisor who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues were encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	EDW user	1	0.5
DPT TL	Supervisor	1	AR ^{06/12/2019}

4.11.05 *Procedure*

The procedure to promote As Bid projects to Construction History within the EDW is comprised of a single task:

(1) promoting As Bid project to construction history in the EDW.

1- Promoting As Bid Project to Construction History in the EDW – performed by EDW user

Summary: This task promotes As Bid contracts to Construction History in the EDW.

- Step 1. Open the EDW application.
- Step 2. Find the specific contract under "Unit Cost As Bid."
- Step 3. Open the contract and click on the "As Bid_Main" tab (see below image).

Construction Data

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Contract Inform	Main Location C	onstruction Item	Cost QC/QA Check	list Supporting Documer	nts	
Contract#	User	FMIS #	Guide		Import Data from Transport]
Project Info.						
Fund Type:	77 👻	Letting Date:	11/07/2011 -			
Project Featur	e:					
🔲 As Built Se	mi-Final 🔲 A	s Built Final	🔲 Area Wide	Verified		
Other Items:						
Cement Price:	560.55	Get Price	Select a Price:	•		
Binder:	64-22		Date From:	✓ ▼		
Note						

Click the green "Promote" button at the top of the screen. A dialogue box will Step 4. appear with a warning about the promotion to construction history. Click "OK" (see below image).

DataWarehouse_New	x
WARNING: You are about to promote As Bid reco Contract: User and FMIS: Guide. Once promoted, Bid MUST be re-visited in Paving History. Are you	ords to Paving History records for , the treatments coming from As u sure you want to continue?
	OK Cancel

- Step 5. Another dialogue box will appear that reads "Promotion Done!" Click "OK."
- Step 6. Close the As-Bid screen and proceed to the specific contract in Paving History.

4.12 GENERATING AS BUILT REPORT

4.12.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to generate an As Built report within the Engineering Data Warehouse (EDW). The Maryland Construction Management System (MCMS) internal application has several different reports that it can generate. For Unit Cost – As Built, a report by month in which paving was completed is essential to the data processing of Unit Cost – As Built information. This feature is helpful with the three-month rule used by the Pavement Management (PM) team with Unit Cost – As Built.

4.12.02 Frequency

Generating an As Built report within the EDW is a continuous process that occurs yearround.

4.12.03 Purpose

The purpose of this SOP is to generate an As Built report within the EDW.

4.12.04 Resource Requirements

Generating an As Built report within the EDW involves two people: (1) a user knowledgeable in the EDW software to run the application, and (2) a supervisor who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues were encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	EDW user	1	0.5
DPT TL	Supervisor	1	AR ^{06/12/2019}

4.12.05 *Procedure*

The procedure to generate an As Built report within the EDW is comprised of a single task: (1) generating As Built report in the EDW

1- Generating As Built Report in the EDW – performed by EDW user

Summary: This task generates a report for As Built contracts in the EDW. The output of this task is an Excel spreadsheet with the desired As Built data.

- Step 1. Open the EDW application.
- Step 2. Select the "Reporting" button from the main menu and click "MCMS" from the drop-down list.
- Step 3. In the "Select a MCMS Report" box, select "UC Report Contract Not in UC Month" (see below image).

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Select a MCMS Report	
CH Report - Last Charge Date CH Report - Days Past Award Date Do CH Report - Contract Not In Hist CH Report - Contract Not In Hist XXXY UC Report - Contract Not In UC All UC Report - Contract Not In UC Month Specify a Contract	Reports; Hi

Step 4. In the "Select Year and Month" box, indicate the **Year** and **Month** desired (see below image).

Select	Year and	d Month		
Year	2012	•	Month 03	•

Step 5. The contracts that are not currently in the Unit Cost database for that month will automatically appear. Review the contracts and remove any that are not good candidates for Unit Cost by highlighting the contract row and clicking "Remove" (see below image).

Select a MCMS Report UC Report - Contract Not In UC Month		th ▼ Ye	lect Year and Mo ear 2012	nth ▼ Month 03	•		Export	to Excel	Close	
Doub	ble Click to Select	a Contract for De	etailed Reports; H	Highlight a Contra	ct and then Click	on Remove butto	n to Remove from	the Report	5X75 11111050	Remove
	CONTRACT_PERMI	FMIS	TO_CHAR(LM.PAV	FUND	ARKA	ID_PREFIX	ID_RIE_NO	MP_SUFFIX	EXII_NUMBER	RAMP_NUM
Þ	XX8155377				False					
	XX8155377	MO267B56	20120329	77	False	MD	109			0

Step 6. When only the desired contracts remain in the window, click "Export to Excel." Name the document in the save prompt window, chose the proper save location, and click "Save."

4.13 HMA TONNAGE APPLICATION

4.13.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to validate asphalt tonnage values in construction records. This procedure uses the HMA_Tonnage dataset provided by the Office of Materials Technology's (OMT) Asphalt Technology Division and the submitted As-Built PM-003 forms to compare asphalt properties and tonnage values for all construction records entered into the Engineering Data Warehouse (EDW). The HMA_Tonnage dataset includes two tables that are reviewed by the DPT: "Actual" and "Estimated." The "Actual" table is used for the data validation, while the "Estimated" table provides supporting data (such as routing number). Important comparisons taken from this procedure include the mix design and tonnage values.

4.13.02 Frequency

The validation of asphalt tonnage values occurs quarterly as a minimum but can also occur as-requested.

4.13.03 Purpose

The purpose of this SOP is to validate asphalt tonnage values in construction records by comparing the dataset provided by the OMT Asphalt Technology Division with the As-Built PM-003 forms.

4.13.04 *Resource Requirements*

The validation of asphalt tonnage values involves one person: (1) a user, typically the DPT Team Leader (TL), knowledgeable in Microsoft Access and Excel, to validate the construction records and perform quality control (QC) checks. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues were encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DPT TL	Access user and QC	1	1.0

4.13.05 Procedure

The procedure to validate asphalt tonnage values in construction records is comprised of two components:

- (1) validating asphalt tonnage in Microsoft Access, and
- (2) performing QC of validated tables.

1- Validating Asphalt Tonnage in Microsoft Access – *performed by DPT TL*

Summary: This task validates asphalt tonnage values in construction records by comparing the dataset provided by the OMT Asphalt Technology Division with the As-Built PM-003 forms.

Step 1. Open Microsoft Access and select "Get External Data." Browse and select the file at the following path: S:\SHA\OMT\PLT_PROD\2009\HMA-2009.accdb. Make sure "Import tables…" is selected and click "OK" (see below image)^{06/12/2019}.

Get External Data - Access Database	? 🗙
Select the source and destination of the data	
Specify the source of the data.	
Eile name: S:\SHA\OMT\PLT_PROD\2009\HMA-2009.accdb Browse	
 Specify how and where you want to store the data in the current database. Import tables, queries, forms, reports, macros, and modules into the current database. If the specified object does not exist, Access will create it. If the specified object already exists, Access will append a number to name of the imported object. Changes made to source objects (including data in tables) will not be reflected in the current data Link to the data source by creating a linked table. Access will create a table that will maintain a link to the source data. Changes made to the data in Access will be reflected in the source and vice versa. NOTE: If the source database requires a password, the password will be stored with the linked table. 	o the base.
OK Can	cel

Step 2. Select the "Tables" tab and highlight "Actual" and "Estimated", then click "OK" (see below image).

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Tables Queries Forms Reports Modules 2005 Plant Update OK 2005 Plants OK Cancel Estimated Select All Select All Deselect All Plants 2009 Deselect All Deselect All	nport Objects	? 🛛
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Plants-Merged Producers050509 xActual xEstimated	Tables Queries Forms Reports Macros Modules 2005 Plant Update 2005 Plants Actual Estimated Estimated	OK Cancel Select All Deselect All Options >>

Step 3. Select the working directory: PMtestData\Construction History\HMA Tonnage\ 2009\2009 4Q (year & quarter).

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😂 0:\Construction History\HMA Tonnage\2009		
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 PMtestData on 'Pavement Data (Hanpmdata)' (O:) Aran - current year Aran Condition Data Processing Archive Condition Data Construction History Access Permits As-Built Efforts Balto City Bid Tabs Clearance Letters Complete Contacts Contacts Data Processing Consign and Geotech Rec Design and Geotech Rec Design Life Form 42 Forms Form 42 Form 42 GIS HISD 		 2009 3Q 2009 4Q MA 09 4Q.accdb
Image → HMA Tonnage Image → 2005		
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Step 4. Add new fields in "Actual" table for "FMIS", "Fund", and "District" (see below image).



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(1) - (1) - (1)) =	Table Too	Is 09 Q3 : Databa	ase (Access 2007) - Micros	soft Access	_ = ×
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Actual - Table	1756 N010	3019R2C01F AT9815	176	02/13/2009 76	19.84 4	
Actual : Table	1757 N010	3012R2C01F AT 9815	176	02/13/2009 76	35.61 4	
	1773 N011	5019R2C01F AT9815	176	03/17/2009 76	98.20 4	
	1758 N116	D9R4C35T BA4045	176	02/13/2009 76	44.38 4	
	1844 N116	19R2C01F BA4045	176	03/31/2009 76	596.73 4	
	1763 N020	5119R4C02F BA8275	177	03/09/2009 77	62.59 4	
	1765 N020	5119R4C02F BA8275	177	03/10/2009 77	62.23 4	
	1768 N020	5119R4C02F BA8275	177	03/11/2009 77	63.30 4	
	1770 N020	5119R4C02F BA8275	177	03/12/2009 77	72.93 4	
	1777 N020	5119R4C02F BA8275	177	03/18/2009 77	82.21 4	
	1826 N020	5119R4C02F BA8275	177	03/30/2009 77	82.93 4	
	1832 N020	5119R4C02F BA8275	177	03/31/2009 77	84.89 4	
	1760 N010	5125R4C01F BA9775	iA72	03/06/2009 72	126.02 4	
	1761 N010	5125R4C01F BA9775	iA72	03/09/2009 72	103.92 4	
	1762 N051	D9R2C03F BA9775	A72	03/09/2009 72	105.03 4	
	1764 N010	5125R4C01F BA9775	A72	03/10/2009 72	127.46 4	
	1767 N051	D9R2C03F BA9775	iA72	03/11/2009 72	41.78 4	
	1766 N010	5125R4C01F BA9775	A72	03/11/2009 72	151.58 4	
	1769 N051	09R2C03F BA9775	A72	03/12/2009 72	115.58 4	
	1798 N010	5125R4C01F BA9775	A72	03/23/2009 72	127.41 4	
	1810 N020	5119R4C02F BA9775	A72	03/25/2009 72	87.56 4	
	1815 N051	12R2C04F BA9775	A72	03/29/2009 72	260.94 4	
	2 N040	19S2C02F CL6955	184R	01/05/2009 84	726.98 7	
	1 N040	19S2C02F CL6955	184R	01/06/2009 84	593.64 7	
	4 N040	19S2C02F CL6955	184R	01/08/2009 84	528.82 7	
	1809 W169	19R4C02F FR3255	176	03/25/2009 76	1014.82 7	
	5 W169	19R2C01F FR3825	280	01/22/2009 80	675.71 7	
	6 W169	19R2C01F FR3825	280	01/26/2009 80	90.19 7	
	10 W169	12R2C01F FR3825	280	02/08/2009 80	340.43 7	
	7 W169	19R2C01F FR3825	280	02/08/2009 80	769.81 7	
	11 W169	19R2C01F FR3825	280	02/09/2009 80	73.41 7	
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Step 5. Select Data Type for new fields by clicking on the "Design" tab along the top ribbon and changing the "Data Type" column to the appropriate type for each new field (see below image).

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_	Plant Number	Text	t	Enter Plant Number		
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	Mix Number	Text	t	Enter Mix Number		
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	Contract Number	Text	t	Enter Contract Number		
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	Production Date	Date	e/Time	Enter Production Date		
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					can set is 255. Press F1 for neip on field size	

- Step 6. Return to Access table and hide all fields except: Mix Number, Contract Number, FMIS, Production Date, Fund, Tonnage/Actual, District (see below image).
- Step 7. Sort table by Contract and Production Date (see below image).

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	1994 W17619V2C02T	AL3095180	04/24/200	9 80	13.97 6	
Iable1 : Table	2004 W17619V2C02T	AL3095180	04/27/200	9 80	20.88 6	
Actual 🌣	2284 W17619V2C02F	AL3095180	05/28/200	9 80	164.56 6	
Actual : Table	2279 W17612V2C02F	AL3095180	05/29/200	9 80	129.16 6	
	2112 W13319V4C01F	AL4145176	05/05/200	9 76	233.21 6	
Estimated	2135 W13319V4C01F	AL4145176	05/13/200	9 76	233.21 6	
Estimated : Table	2278 W13309V4C0TF	AL4145176	05/14/200	9 /6	125.85 6	
Original Actual	2277 W13319V4CUTF	AL4143176	05/14/200	3 /6	336.84 b	
	1959 W00113V2C01F	ALS73ASB ALE79AED	04/21/200	9	21.00 6	
Uriginal Actual : Table	1967 W08119V2C03F	AL573A5B	04/21/200	9	147.61.6	
	2131 W08112V2C03F	AL 57945B	04/27/200	9	147.45.6	
	2007 W08112V2C03F	AL 57945B	04/27/200	9	168.39.6	
	2305 W08112V2C03F	AL579B5C	06/01/200	9	778.67 6	
	1976 W08112V2C03F	AL579B5H	04/23/200	9	168.88 6	
	2639 W17619V2C02F	AL8795184	06/26/200	9 84	10.02 6	
	2703 W17612V2C02F	AL8795184	06/26/200	9 84	5.00 6	
	2704 W17319V2C02F	AL8795184	06/30/200	9 84	11.51 6	
	2267 W08109V2C03F	AL8815184	05/20/200	9 84	10.00 6	
	2027 N0113812R2C01F	AT9815176	04/23/200	9 76	303.71	
	2029 N0113812R2C01F	AT9815176	04/26/200	9 76	156.66	
	2473 N0213819R2C03F	AT9815176	06/15/200	9 76	199.53	
	2560 N0213819R2C03F	AT9815176	06/16/200	9 76	110.19	
	2262 N08312R2C08F	AX232B51	05/27/200	9	127.77	
	2272 S12009H4F03F	AX4805176	05/27/200	9 76	1090.75	
	2322 S12009H4F03F	AX4805176	06/01/200	9 76	1124.65	
	2354 S12009H4F03F	AX4805176	06/02/200	9 76	747.71	
	2432 S12009H4F06F	AX4805176	06/12/200	9 76	1308.08	
	2490 \$10909H4F03F	AX4805176	06/15/200	9 76	588.70	
	2506 512009H4F03F	AX4805176	06/16/200	9 76	277.14	
	2623 512009H4F03F	AX4805176	06/16/200	3 /b 9 70	2/7.14	
	2505 512003H4F03F	AV600176	06/08/200	a /o	167.11	
	2555 W17612V2C02F	AX504A76	06/21/200	9	310.23	
	2300 W 11012 V20021	A1004870	00/22/200	-	310.23	•
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Step 8. Populate Fund Type (currently manual – see below image). In the future, could be automated with OOF supplied FMIS Data # spreadsheet.

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	2496 N05112V4F01F	BA5645177	06/16/200	9 77	561.65
Table1 : Table	2523 N05112V4F01F	BA5645177	06/18/200	9 77	555.46
Actual 🏾 🕆	2545 N05112V4F01F	BA5645177	06/21/200	9 77	573.63
Actual : Table	2607 N05112V4F01F	BA5645177	06/24/200	9 77	542.04
Tell-stall and	2638 N05112V4F01F	BA5645177	06/25/200	9 77	620.58
Estimated	2631 N05112V4F01F	BA5545177	06/26/200	9 //	482.11
Estimated : Table	2026 N021301302C03F	DA0700177	04/22/200	9 77	52.72
Original Actual	2028 N0213819B2C03F	BA6765177	04/23/200	9 77	63.73
Original Actual : Table	2155 N13812G4E04E	BA6765177	05/13/200	9 77	1393.06
- Original Actual : Table	2249 N13812G4F04F	BA6765177	05/18/200	9 77	1173.28
	2250 N13812G4F04F	BA6765177	05/19/200	9 77	1459.32
	2248 N13812G4F04F	BA6765177	05/20/200	9 77	698.53
	2301 N13812G4F04F	BA6765177	05/21/200	9 77	373.89
	2024 N12719R2C02F	BA6835184	04/28/200	9 84	54.93
	2111 N12719R2C02F	BA6835184	05/11/200	9 84	59.54
	2145 N12719R2C02F	BA6835184	05/12/200	9 84	60.25
	2196 N05119R2C02F	BA6835184	05/18/200	9 84	210.98
	2212 N05119R2C02F	BA6835184	05/19/200	9 84	162.77
	2547 N05119R2C02F	BA6835184	06/16/200	9 84	350.63
	2214 SU1219R2C50	BA6885184	05/19/200	9 84	0.00
	2628 N12709R2C02F	BA7065171	06/24/200	9 71	104.29
	2660 NT2709H2C02F	BA7065171	06/26/200	9 /1	43.51
	1840 N0205119R4C02F	BA62/01/7 DA0075177	04/01/200	9 77	53.32
	1970 N05119D4C02F	DA0270177	04/06/200	9 77	92.40
	1992 N05119D4C02F	DA0275177	04/07/200	9 77	111 20
	1895 N05119B4C02F	BA8275177	04/00/200	9 77	110.12
	1934 N05119B4C02E	BA8275177	04/16/200	9 77	70.02
	1946 N05112/4E01E	B48275177	04/18/200	9 77	636.21
	1945 N05119B4C02E	BA8275177	04/18/200	9 77	1454.29
	1955 N12719B4C02F	BA8275177	04/21/200	9 77	82.56
	1975 N12719B4C02F	BA8275177	04/22/200	9 77	105.40
	2046 N12719R4C02F	BA8275177	04/29/200	9 77	103.85
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Step 9. Clean up Contract and FMIS fields (see below image).

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lable1 *	2690 H15809B2C04F	W0310K51	06/29/200	9 11	34.75
Table1 : Table	2720 H15809A2C05F	W0310K51	06/30/200	9 13	95.82
Actual 🌣	2275 E15819R2C51T	W0634B51	05/28/200	9 4	30.83
Actual : Table	2552 E15819R2C51T	W0634B51	06/22/200	9 5	53.74
	2595 E15819R2C51F	W0634B51	06/23/200	9 7	11.11
Estimated	2269 E15819R2C51T	W0638B51	05/27/200	9 4	38.07
Estimated : Table	2101 E18109H2C04F	W0781B57	05/11/200	9 4	88.91
Original Actual	2117 E18109H2C04F	WU/81857	05/12/200	9 /	00.00
	2158 E18109H2L04F	WU/81857	05/13/200	9 11	00.00
Original Actual : Table	2177 E18109H2C04F	WU781857	05/14/200	9 12	00.00
	2104 E10103H2C04F	WU/01007	05/16/200	a 0	00.00
	2200 E10103H2C04F	1/(0701D57	05/13/200	a o	00.00
	2259 E19109H2C04E	×/1235177	W0791857 05/27/200	9 5	00.00
	1968 H18109B2C01T	XX1095268	04/22/200	9 4	43.91
	1970 H18109B2C01T	>>>1095268	04/23/200	9 12	00.00
	2057 W14412V4E01E	>>>>1105177	04/30/200	9 9	00.39
	2183 W14412V4F01F	×1105177	05/17/200	9 5	91.27
	1898 W14412B2C05F	××1105777	04/08/200	9 3	98.80
	1899 W14412B2C05F	××1105777	04/09/200	9 2	69.50
	1937 W14412V4F01F	××1105777	04/16/200	9 4	93.16
	1950 W14412V2F01F	××1105777	04/17/200	9 6	38.02
	2037 W14404V2C03F	××1105777	04/28/200	9 4	58.40
	2094 W14412V4F01F	XX1105777	05/10/200	9 9	84.43
	2152 W14412V4F04F	XX1105777	05/13/200	9 12	.07.16
	2231 W14419R2C03F	₩1105777	05/20/200	9	63.33
	2242 W13512V4F01F	XX1105777	05/21/200	9 2	31.33
	2293 W14412V4F01F	₩1105777	05/31/200	9 6	58.27
	2445 W14412R4C04F	XX1105777	06/14/200	9	84.68
	2366 W14412R2C05F	₩1135877	06/02/200	9 3	18.30
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Step 10. Populate District field (currently manual – see below image). In the future, could be automated with OOF supplied FMIS Data # spreadsheet.

		Table Tools HIV	A 09 4Q : Database (A	ccess 2007) - Microsoft A	ccess	- 7
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umated ×	AL4145176	05/	14/2009 76	233.21 b		
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riginal Actual	AL4143176	00/	21/2009	330.04 0		
	ALS73ASB ALE79AED	04/	21/2003	21.00 6		
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	AL 579850	04/	01/2009	778.67.6		
	AL 579B5H	04/	23/2009	168.88.6		
	AL 8795184	04/	26/2009 84	10.02.6		
	AI 8795184	06/	26/2009 84	5.00 6		
	AL8795184	06/	30/2009 84	11.51.6		
	AL8815184	05/	20/2009 84	10.00 6		
	AT9815176	04/	23/2009 76	303.71		
	AT9815176	04/	26/2009 76	156.66		
	AT9815176	06/	15/2009 76	199.53		
	AT9815176	06/	16/2009 76	110.19		
	AX232B51	05/	27/2009	127.77		
	AX4805176	05/	27/2009 76	1090.75		
	AX4805176	06/	01/2009 76	1124.65		
	AX4805176	06/	02/2009 76	747.71		
	AX4805176	06/	12/2009 76	1308.08		
	AX4805176	06/	15/2009 76	588.70		
	AX4805176	06/	16/2009 76	277.14		
	AX4805176	06/	16/2009 76	277.14		
	AX4805176	06/	08/2009 76	0.00		
	AX504A76	06/	21/2009	167.11		
	AX504A76	06/	22/2009	310.23		

2- Performing QC of Validated Tables – performed by DPT TL

Summary: This task performs QC checks on the validated tonnage tables.

Step 11. Locate, analyze, and eliminate duplicates (look at Contract, FMIS, and Tonnage/Actual fields – see below image).



STATE HIGHWAY ADMINISTRATION

Construction Data HMA Tonnage Application

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Step 12. Complete Validation spreadsheet (see below image).

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12	Contract check / revisions	Х										
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Step 13. Post completed files to the following location: Pmdata\01 Report Data\KPA Report (see below image).



Step 14. Notify Assistant Division Chief (ADC) and Data Analysis Team (DAT) via email with Validation spreadsheet attached (see below image).

Maryland department of transportation

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HMA Tonnage database - FYO9 Q3 - Message (HTML)		
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From: Mark Chapman	Sent: Mon 04/13/2009 1:01 PM	
To: Weixian Xiong		
Cc: Wen Huang; Roger Leung; Wenbing Song; Bo Yang Subject: HMA Tonnage database - FY09 O3		
Attachments: MIHMA Ton validation 2009 03.vls (36 KB)		
Weixian,		
FY2009 Q3 HMA tonnage data is now available for your review. Attached is our Validation / Checklist spreadsheet.		
Hanpmdata \ 01 Report Data \ KPA Report \ 2009Q3 \ DPT Databases		
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⊞ 🛅 2007Q1		
II 🛅 2007Q2		~

2- Performing QC of Validated Tables – performed by DPT TL

Summary: This task preforms QC checks on the HMA tonnage validated tables.

Step 15. Check the final HMA tonnage validated tables for accuracy and completeness.

STATE HIGHWAY ADMINISTRATION

DATA PROCESSING 5

Click to go to Loading of ARAN Data into Vision
Click to go to ARAN Submittal QA
Click to go to Post-Processing of ARAN GPS Data
Click to go to Running Global LCMS Processor
Click to go to Running Roughness Processor
Click to go to Route Matching
Click to go to Performing 100% Drive Through
Click to go to Running Rut Processor
Click to go to Running Classification and Rating Processors
Click to go to <u>Running Vibing Processor</u>
Click to go to <u>Running Thumbnail Creator</u>
Click to go to Running Curve Fit Batch Processor
Click to go to Reporting and Uploading to Oracle
Click to go to Reformatting ARAN Hard Drives
Click to go to Creating PAGDQC Report
Click to go to Running Routing Importer
Click to go to Changing Latitude/Longitude
Click to go to Accessing Electronic ARAN Logs
Click to go to Using eGIS
Click to go to <u>Changing Image Banner or Logo</u>
Click to go to Year-End ARAN Data Closeout
Click to go to Route Matching - Transfers

Click to go to Loading Pavement Surface Friction Data Click to go to Skid Submittal QC



Figure 8: Data Processing SOPs Flowchart

This section describes the set of standard operating procedures (SOP) conducted mainly by staff from the Data Processing Team (DPT) of the Maryland Department of Transportation State Highway Administration's (MDOT-SHA) Office of Materials Technology (OMT) to process and manage data elements collected in the field with the ARAN survey vans and skid trailers by the Field Explorations Division (FED). The SOPs contained in this section begin with the loading of data into the Vision database. The subsequent processes are nearly all completed using the Vision program and involve running various "processors" and performing QC/QA checks on the data. The processing is completed with the transfer of the Vision database into Oracle.

The various processors run in the Vision program include: GPS (in conjunction with the POSPac program), Laser Crack Measurement System (LCMS), Roughness, Rut, Classification and Rating, Vibing, and Curve Fit. These processors are run for batches of data as they are delivered by the FED throughout the data collection season. The data processing is also supplemented by other manual procedures, including the matching of routes and performing a drive through of LCMS data by a user in Vision.

This section also describes supplemental procedures designed to support the SOPs described above. This set includes eight SOPs: creating a Pavement and Geotechnical Division Quality Control (PAGDQC) report, running the routing importer, accessing electronic ARAN logs, changing latitude/longitude, using eGIS, modifying the image banner or logo on the collected images, performing the year-end ARAN data closeout, and performing transfers during route matching.

The final two SOPs in this chapter describe the loading and QC of collected skid data. Once the skid data is loaded into the EDW, it is ready to be used for trend analysis. No further processing is performed on skid data.

5.01 LOADING OF ARAN DATA INTO VISION

5.01.01 General

This section describes the standard operating procedure (SOP) followed by the Maryland State Highway Administration's (MD SHA's) Data Processing Team (DPT) to load final deliverable submittals from Office of Materials Technology's (OMT) Field Explorations Division (FED) as acquired from their Automatic Road Analyzer (ARAN) pavement survey data and imagery collection program. Using vendor supplied DCS loading software, routines are performed to load the deliveries into a network imagery (Videolog) server and SQL database(s). Quality control (QC) and quality assurance (QA) routines are then performed on the loading process . The loading of the deliverables is performed in batches usually every 4 - 5 workdays throughout the annual data collection season and anytime year-round. This SOP applies to the data loading and QC/QA of each individual deliverable batch.

Each submittal consists of a survey data SQL database, Right-of-Way and Pavement imagery files, daily field QC files, and orientation (GPS) files. They are delivered by FED members to DPT members in six (or more) 1-terabyte (TB) external hard-disks. These disks are delivered to the DPT as-extracted from the ARAN van computers without any further processing. Each submittal consists of an original and a duplicate disk for the three different types of data and imagery sets. The three data elements are named (1) "ROW", which contains Right-of-Way (ROW) images and FED quality control information, (2) "PVT", which contains Laser Crack Measurement System (LCMS) images, and (3) "SVR", which contains left ROW camera images and all other measurements taken by other sensors (i.e., data measured by grade sensors, longitudinal profilers, inertial measurement unit, and global positioning system). More disks may be introduced into a batch when the amount of collected data of a particular dataset for the batch is larger than 1-TB.

Once the field survey data database is uploaded into the Vision software database(s) and imagery links are established with DCS loading software, Vision post-processing and analysis routines are performed. The results are then imported into the MD SHA Pavement Management System (PMS).

5.01.02 Frequency

The loading of FED ARAN submittals into the Videolog server and Vision database is completed every time a delivery is received by the DPT, which typically occurs every 4 to 5 days. Assuming an average of 60 lane miles collected per day, each batch contains, on average, between 240 and 300 miles of ARAN data and imagery. The actual frequency varies according to the proximity of the collected routes to OMT's Hanover, MD office and it ranges from 1 day (when collected near the OMT office) to 2 weeks (when collected far from the OMT office). Shorter turn-around periods are preferred to minimize the amount of mileage requiring potential recollection. FED's annual ARAN collection season typically runs from April to October but deliveries sometimes occur year-round.

5.01.03 Purpose

The purpose of this SOP is to :

- record received disks with ARAN collected data and imagery and upload daily log sheets into the Engineering Data Warehouse (EDW),
- upload the measurements and imagery data collected by the ARAN equipment in the field to the Vision database using the Roadware Data Control Software (DCS),
- load the "Pavement and Geotechnical Division Quality Control" (PAGDQC) report^{06/12/2019} to the EDW, and
- confirm that the ARAN collected data is successfully loaded into the Vision database and, if necessary, perform corrective actions.

5.01.04 *Resource Requirements*

The loading of ARAN data involves two people: (1) a user knowledgeable in Roadware DCS software to load the ARAN data batch and perform QC, and (2) a supervisor to perform QA of the loading process. The estimated effort levels in the table below represent the total time, in man-hours, to complete the data loading and QC/QA processes. These time estimates assume average batch quantities and that no issues need to be addressed during the QC and QA.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	DCS user and QC	1	4.0
DPT Team Leader (TL)	Supervisor - QA checks	1	0.5

5.01.05 *Procedure*

The procedure followed by the DPT staff for loading the ARAN data and performing QC/QA is comprised of five tasks:

- (1) scanning of daily log sheets,
- (2) recording of received ARAN drives,
- (3) loading of ARAN Data,
- (4) final data loading QC,
- (5) creating PAGDQC report,
- (6) DPT TL notification, and
- (7) data loading QA.

1- Scanning of Daily Log Sheets – to be completed by DPT Staff

Summary: This task creates digital copies of the daily log sheets completed by the FED during data collection.

- Step 1. Scan the paper copies of the field daily log sheets delivered by the FED along with the 1-TB hard disks.
- Step 2. Name each of the scanned files as "Rec[arrival date][ARAN Number]" (e.g., "Rec050517A3.pdf").
- Step 3. Save each of the scanned sheets as a PDF in the server folder for the corresponding data collection year: \\shahanartico2\shaomtvideolog\ [YEAR]\Data\Field Logs (e.g., "\\shahanartico2\shaomtvideolog\2017\Data\ Field Logs").

2- Recording of Received ARAN Drives – to be completed by DPT Staff

Summary: This task records the disks with ARAN collected data received from the FED into the EDW.

Step 4. Open the "Data Warehouse" program and click on "Data", "Aran", "Record Drive and First Image" (see below image).

🎉 Data Warehouse	- Connected to Pr	oduction Databa	ase				
Administration	Data Analys	sis Design	Reporting	Help	Exit		
2	Constructi	on Data					
	Aran	Data Up	load				
	Wisecrax	Record	Drive ar	nd First Image			
	Visidata		Data Tra	ansfer fro	om SQL to Orac	le	
	Friction	•	View/Ed	View/Edit Unique Run Status			
	MCMS		Upload	FED Fie	ld Log		
	Maintenan	ice +	Collectio	n List E	dit		
	HMA Ton	nage 🔸	Collectio	n List va	s. Base Report		
	Inventory	•	ARAN In	nagery (Checks		
	Curve	•	Route M	atching	QC		
	WIM	•				_	
	Videolog						

"ARAN Drive Info" window will appear. The only two boxes in the window to be completed are "Record Drive Info" and "Daily Log File" (see below image).

STATE HIGHWAY ADMINISTRATION

Record Drive Info Olar ARAN 3/4 Please Locate the Drive: Please Input Drive # For Original Field Drive Prove Data Test Date Drive No Collection Year:	ARAN Drive Info		
View Existing Drive Info Collection Year File Name Drive_No Dup_Drive_No Test_Date View View Modify Drive No. Drive_No Dup_Drive_No Current No. • New No. Modify Drive No Report Prive No Report Parkan 3/4 Test Date From Test Date To Report Data_Type View Modify Prive No Report Collection Year: • Report	Record Drive Info ARAN 3/4 Collection Year: 2017 DVD?	Please Locate the Drive: Please Input Drive #: For Original Field Drive Browse For Duplicate Drive	Record
Collection Year File Name Drive_No Dup_Drive_No Test_Date Data_Type Modify Drive No. O Drive_No Dup_Drive_No Current No. New No. Modify Drive No Report Image: Collection Year: Image: Collection Year: Image: Collection Year: Image: Collection Year: Prive No Collection Year: Image: Collection Year: Image: Collection Year: Image: Collection Year: Collection Year:	View Existing Drive Info		
Modify Drive_No Dup_Drive_No Current No. New No. Modify Drive_No Report	Collection Year	File Name Drive_No Dup_Drive_No Test_Date Data_Type	View
O Drive_No Dup_Drive_No Current No. ✓ New No. Modify Drive No Report Image: Collection Year: Image: Collection Year: Image: Collection Year: Image: Collection Year: Test Date From Test Date To Image: Collection Year: Image: Collection Year: Image: Collection Year: Image: Collection Year:	Modify Drive No.		
Drive No Report Test Date From Test Date To Report Daily Log File Collection Year: ▼ Report Repor	○ Drive_No ○ Dup_Drive_No	Current No. Vew No.	Modify
ARAN 3/4 Daily Log File Collection Year: Report	Drive No Report	Test Date From Test Date To	
Daily Log File Collection Year: Report	✓ ARAN 3/4		Report
Collection Year:	Daily Log File		
	Collection Year:	▼	Report

Step 5. Obtain labels of the received disks from the daily log sheets. Each disk with the ARAN data collected in the field is labeled using two numbers separated with a dash mark (e.g., "173-17"). The first number refers to the order at which the disk was used while the second number refers to the year the disk was purchased (some years the year of purchase is on the left while in other years it's on the right). The labels of the disks (original(s) and duplicate(s)) for each of the three sets of data elements, referred to by the FED as "server" (SVR), "pavement" (PVT), and "right-of-way" (ROW), are reported in columns 4 to 9, as shown in the image below. In some cases, the ARAN operators omit to write down the year of purchase part of the label (as is the case in the daily log sheet shown as example). The labels to be recorded into the Data Warehouse program must contain both the disk number and the purchase year (e.g., the labels of the hard disk from the daily log sheet in the image are 33-17 and 35-17 for SVR, 126-17 and 127-17 for PVT, and 48-17 and 46-17 for ROW).

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		MU	,										-010010 -7	u.	

Step 6. Insert one of the "original" SVR disks into the external drive docking station.

Step 7. Identify what drive the disk was connected to. This information can be found in the "Windows Explorer" (see below image). If no new disk appears in the computer ("New Volume" does not appear), try to re-insert the disk into docking

station until it is detected. If the disk is still not detected, contact MDOT-SHA Information Technology (IT) staff for assistance.

🖳 Computer
🛛 🚢 Local Disk (C:)
DATADRIVE1 (D:)
🖻 🧫 New Volume (F:)

Step 8. In the Data Warehouse program, click the "Browse" button under the "Record Drive Info" box (see below image).

Record Drive Info						
🔽 ARAN 3/4		Please Locate the Drive:	Plea	ase Input Drive #:	For Original Field Drive	
Collection Year:	2017	•	Browse		For Duplicate Drive	Record
DVD?						

- Step 9. Select the computer drive to which the disk with the ARAN collected data was connected to (computer drive "F:/" in the image shown as example).
- Step 10. Type the complete label of the connected disk (i.e., including both the disk number and the purchase year) into the "Please Input Drive #" field of the "Record Drive Info" box (see below image).

🖳 ARAN Drive Info					- • •
Record Drive Info	2017	Please Locate the Drive:	Please Input Drive #: 150-17	For Original Field Drive	Record
DVD?	2017			For Duplicate Drive	

Step 11. Click on the "Record" button. The "ARAN Drive Info" application will automatically populate the "Daily Log File". Once the following message window appears, click on the "OK" button (see below image).

DataWa	rehouse 🗙
Done.	
	ОК

- Step 12. Repeat Step 8 to Step 11 for recording the label of the corresponding "duplicate" disk of the dataset being recorded (i.e., SVR data in first iteration). The label of the duplicate disk is recorded with the original disk of the corresponding dataset connected so the same information will be inputted into the "Please locate the driver" - only the label inputted into the "Please input Drive #" will be different.
- Step 13. Unplug disk from external docking station.
- Step 14. If more than one "original" disk with the analyzed dataset was received (e.g., SVR), repeat Step 6 to Step 13 until the labels of all the original and duplicates disks are recorded.

Step 15. Repeat Step 6 to Step 13 twice; one time for recording the labels of the original and duplicate disks with the PVT data and the second time for the disks with the ROW data.

3- Loading of ARAN data – to be completed by DPT Staff

Summary: This task uploads the measurements and imagery data collected by the ARAN equipment in the field to the Vision database using the Roadware DCS and identifies any errors which may occur during the data upload.

- Step 16. Connect the original (or duplicate, these will produce the same result) 1-TB hard disks with each of the three sets of data elements produced by the ARAN survey vans to the docking station of the computer with the Roadware DCS software. All three drives must be connected.
- Step 17. Navigate to: \\shahanartico2\shaomtvideolog\2017\Data. Open the appropriate ARAN folder (named as "[YY]_A[#ARAN]"; e.g., "17_A3" for ARAN 3 and "17_A4" for ARAN 4. Right click and make a new folder. Name the folder "Rec [datereceived]" (see below image).

Network shahanartico2	▶ shaomtvideolog ▶ 2017 ▶ Data ♪	17_A4 ►
Burn New folder		
	Name	Date modified Type
	퉬 Rec030817A4	03/09/2017 12:58 File folder
ls	퉬 Rec050117	05/01/2017 3:15 PM File folder
ices	퉬 Rec050517	05/10/2017 9:17 AM File folder
	퉬 Rec051617	05/23/2017 12:14 File folder
	퉬 Rec051917	06/02/2017 3:03 PM File folder
	퉬 Rec053117	06/21/2017 3:01 PM File folder
: (C:)	퉬 Rec060217	06/21/2017 3:36 PM File folder
/E1 (D:)	퉬 Rec060917	06/13/2017 11:10 File folder
me <mark>(F:)</mark>	퉬 Rec061517	06/21/2017 1:04 PM File folder
me <mark>(</mark> G:)	퉬 Rec062117	07/31/2017 10:23 File folder
me <mark>(H:)</mark>	퉬 Rec071017	07/11/2017 8:29 AM File folder
me <mark>(</mark> I:)	퉬 Rec071217	07/13/2017 2:11 PM File folder
;hahanfs1\omtoocusers) (M:)	퉬 Rec072417	07/26/2017 11:17 File folder
ared (\\shahanfs1) (N:)	퉬 Rec082117	08/24/2017 7:55 AM File folder
ams (\\shahanfs1) (P:)		

Step 18. Copy the folder named "Posdata" from the "SVR" hard disk drive to the "Rec" folder that was just created (see below image).

Maryland department of transportation	Data Daaraaina
STATE HIGHWAY ADMINISTRATION	Loading of ARAN Data into Vision
📔 ExportBakFiles	08/2
🐌 ExportDataFiles	08/2
🌗 ExportLogs	08/2
🌗 Images	08/2
🔰 Posdata	08/2
📗 RenamedImages	08/2
🌗 RenameLog	08/2
🌗 Thumbnails	08/2
📡 ResetRenamedVideo.exe	05/2

Step 19. Copy the log and Pavement QC folders from the "ROW" hard disk drive to the "Rec" folder that was just created (see below image).

20170817	08/17/2017 2:50 PM	File folder
20170818	08/18/2017 2:51 PM	File folder
20170820	08/20/2017 8:36 AM	File folder
20170823	08/23/2017 2:22 PM	File folder
20170824	08/24/2017 1:50 PM	File folder
20170825	08/25/2017 1:28 PM	File folder
20170828	08/28/2017 2:34 PM	File folder
ExportLogs	08/28/2017 1:52 PM	File folder
퉬 Images	08/28/2017 1:45 PM	File folder
퉬 paveqc817	08/17/2017 2:51 PM	File folder
퉬 paveqc818	08/18/2017 2:21 PM	File folder
퉬 paveqc820	08/20/2017 8:39 AM	File folder
퉬 paveqc823	08/23/2017 1:58 PM	File folder
퉬 paveqc824	08/24/2017 1:53 PM	File folder
퉬 paveqc825	08/25/2017 1:24 PM	File folder
havenc828	08/28/2017 2·36 PM	File folder
paveqeozo	00/20/2017 2:001101	The folder

Step 20. Open the Roadware DCS.exe program. The default location of the Roadware DCS software is "C:\Program Files (x86)\Fugro Roadware\Data Control Software\Roadware.DCS.exe". A desktop shortcut of the software may also have been created, however, confirm that the shortcut directs to the Roadware.DCS.exe file as it is sometimes linked to an incorrect file. Click the "Cancel" button when the dialogue box appears (see below image).

Da	Fugro Roadware Data Control Software
20 20	Please wait while Windows configures Fugro Roadware Data Control
20	Curt
20	Cancel

Step 21. The program will open. The "Select a Project" window should have project "SHA_MD_VISION_PROJECT1" listed under the "Project Name" column, as shown in the image below. If project "SHA_MD_VISION_PROJECT1" is not listed, contact the MDOT-SHA IT staff for assistance. Otherwise, click on the "OK" button to proceed (see below image).

📡 Data Control Software	August 10.4		states and a state	
File View Tools Help				
Current Project: No Project	Selected Change Project			
	<i>(</i>			
	Select a Project			
	Search	C c	reate a New Project 🔊 Filter 🔹	
	Project Name	Last Accessed	Date Created	
	SHA_MD_VISION_PROJECT1	10/5/2017 12:18:58 PM	4/18/2016 10:32:51 AM	
			OK Cancel	
	<u></u>			

Step 22. Confirm that all connected 1-TB disks with ARAN data are detected by the DCS software. For this, check if all the disks are listed after the "Drives to scan" message (see below image). The name of the computer drives to which the disks are connected ("F:/", "G:/" and "I:/" in the image) are variable. They will be randomly assigned to a letter from "E:/" to "Z:/". Also, the plug to which they are connected is not relevant.

📡 Data Control Software	Strephone State			Sugar States and States	-	_ <u>_</u> X
File View Tools Help						
Current Project: SHA_M	ID_VISION_PROJECT1	Change Project				
Upload and Import Wizard Vi	deo QC Import SBET					
Scan for Drives	Click here to scan for con Drives to Scan: F: G: I:\ Sci	nnected ARAN Har anning Options	d drives			

i. If one or more of the disks are not listed in the "Drives to scan" line, click on the "Scanning Options" link (appears in bold, blue text after the list of connected disks). Select all computer drives to which the disks with ARAN data are connected to and click on "OK" (see below image). If one, or more, of the connected disks are not detected by the computer, reconnect the disk to a different slot of the docking station and confirm that it was detected by the computer. If the disk is still not detected by the computer connect the duplicate

disk to the docking station. If neither the original nor the duplicate disks are detectable by the computer after repeated trials, suspend the procedure and communicate issue with Supervisor and FED TL for remedial actions (e.g., recollection of data).

Select the	Drives to Scar	for ARAN Da	ata	
Driv	e Labe	el		*
D:\	DA	TADRIVE1		
J F:∖	Nev	v Volume		=
✓ G:\	Nev	v Volume		
✓ H:\	Nev	v Volume		
✓ I:\	Nev	v Volume		-

Step 23. Once all the drives with connected ARAN disks are listed on the "Drives to Scan" line, click on the "Scan for Drives" button. Next, the DCS software will perform QC checks to confirm that all the data elements collected by the ARAN survey vans are present in the connected disks (see below image).

Current Project: SHA_M	ID_VISION_PROJECT1 Change Project
Upload and Import Wizard Vi	ideo QC Import SBET
Scan for Drives	4 Drives Found <u>View Drive Details</u> Drives to Scan: F: G: H: I:\ <u>Scanning Options</u>

Step 24. The DCS software will finish scanning the connected drives (see below image).

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Data Processing Loading of ARAN Data into Vision

📡 Data Control Softw	are		Sec. 100		Tax weather				
File View Tools	Help								
Current Project	: SHA_MD_VISION	PROJECT1 Chan	ge Project						
Upload and Import	Wizard Video QC Imp	oort SBET							
Scan f Drive QC Results	or Drives 4 Drives Four Drives to Sca	nd <u>View Drive Details</u> n: F: G: H: I:\ <u>Scar</u>	ning Options					Save Q	C Results
Drive ARAN N	ame Data Type	Message		Deta	ls				*
I:\ MD8568	6 BAK File	Image folder found b	out no BAK file	2017	70726				
MD8568	2 Data Drive	Missing Hard Drive		1					-
MD8568	2 Images Drive	Missing Hard Drive		FISP	avement				
MD0560	DCS Data	Missing Data Folder							*
Upload Data Files	and Images							<u>Upload</u>	Options
Upload Path: \\s	nahanartico2\shaomtvideol	og\2017\Video		Browse	🔲 Skip Uploading				
Import Data									
Select All	🕤 Select None 🔞 Invert	t Selection						Import	Options
Import Filename		Date	Length	Size	Destination Database		Filter I	No Lead In/Out	*
MD8568	6_Export_20170725141143	.bak 2017/07/25	1119.174	1437 MB	OMT_ARAN_PROD_2017_1	1			
MD8568	6_Export_20170727142827	bak 2017/07/27	1044.094	1083 MB	OMT_ARAN_PROD_2017_1				
MD8568	6_Export_20170728123535	bak 2017/07/28	1009.266	278 MB	OMT_ARAN_PROD_2017_1				
MD8568	6_Export_20170801110805	.bak 2017/08/01	15984	352 MB	OMT_ARAN_PROD_2017_1				
✓ MD8568	6_Export_20170802141054	.bak 2017/08/02	2010.61	462 MB	OMT_ARAN_PROD_2017_1	•			-
If collection alrea	dy exists in the database	Skip Over	write	Create group	(s) for this data Grouping Options				
	,			2. Jule g. Jup					
🖌 Start Video	QС								
									Start

- i. First, read the information provided in the "Drive QC Results" box. If all data elements collected by the ARAN survey vans were contained in the connected disks, then the "Drive QC Results" box would be empty. Otherwise, a list of error messages listing the data elements missing in the connected disks will appear (as shown in the image above. For example, the error messages listed from the "Drive QC Results" box shown in the image indicate that the data elements in the SVR and Pavement drives are missing). If one or more data elements were listed as missing, reconnect the corresponding disks to the docking station and repeat Steps 19 and 20. If data elements are still reported as missing in the "Drive QC Results" box, connect the duplicate of the corresponding disks. If it is not possible to detect the missing data elements from either the original or the duplicate disks, report the need for recollecting the routes contained in the affected disks.
- ii. Once no missing elements are listed in the "Drive QC Results" box, check that the default upload path in the "Upload Data Files and Images" box is \\shahanartico2\shaomtvideolog\[YEAR]\Video. Otherwise, type in that upload path.
- iii. Next compare the scanned copy of the daily log data to the filter in the imported data. For this, click on the "Filter" icon of the first row (see below image).

Import	Filename	Date	Length	Size	Destination Database	Filter	
1	MD85686_Export_20170725141143.bak	2017/07/25	1119.174	1437 MB	OMT_ARAN_PROD_2017_1	• 🎤	$\langle -$

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Data Processing Loading of ARAN Data into Vision

The following	window	will	appear.
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📡 Filter	Filter Sessions - MD85686_Export_20170725141143.bak											
Se Se	Select All Select None Selection											
Import	Session	Section Name	Begin Distance Stamp	End Distance Stamp	Begin Chainage	End Chainage						
1	[20170725.073236]	9999921	200.873128443164	1182.29028491068	0	999						
1	[20170725.081543]	916722	321.520253272818	34123.9743764487	20.4	41.107						
1	[20170725.085358]	916711	283.903403297195	28319.5226518444	0	16.19						
1	[20170725.093236]	922121	335.967463832508	2731.58882056195	0	1.34						
1	[20170725.094836]	563311	288.118570834665	974.766307135566	0	0.277						
1	[20170725.095600]	566811	174.999431381026	738.816070256313	0	0.25						
1	[20170725.100347]	924121	387.27426002186	18527.2455139394	0	11.19						
1	[20170725.102947]	577511	203.453895590605	1707.513984	0	0.97						
1	[20170725.104122]	924111	267.544869494098	5237.38359262725	0	11.19						
1	[20170725.105048]	922321	366.781968871984	9050.50444610379	0	5.28						
1	[20170725.112812]	922311	328.742042314813	4775.4948629235	0	5.28						
1	[20170725.113431]	584211	197.258174096384	1518.1156548408	0	0.58						
1	[20170725.113933]	922311	174.296654170566	4342.90375914185	0	5.28						
-	[20170725.121104]	924111	166.193669258721	13506.9205067751	0	11.19						
1	[20170725.122536]	922111	324.753797671081	2640.48611632697	0	1.34						
1	[20170725.123711]	569111	542.786313971706	3551.05803083911	0	1.73						
1	[20170725.124334]	924211	193.882108445649	178.637184	0	0.01						
1	[20170725.125331]	916711	170.791528794955	7558.79133405207	0	16.19						
1	[20170725.130858]	918021	255.857272091321	8625.71739585137	0	1.97						
1	[20170725.134312]	917711	456.429759751537	19652.8240924939	0	9.21						
						OK Cancel						

With the previous window open, access the electronic daily logs (see below image). To access the scanned daily logs, navigate to ("\\shahanartico2\ shaomtvideolog\[YEAR]\Data\[YY]_A[ARAN Number]\Rec[MMDDYYY]"). Compare the information in both windows. The "Session" column in Vision and the "FILENAME" column in Excel are the same (YYYMMDD.24hrTime). Deselect any files with an "X" in the "Status" column in Excel. "DUMMY" files will always have an "X" in the "Status" column and "999921" in the "HEADER" column.

A	L * : ×	· 🗸 J	fx FILEN	NAME											
	А	В	С	D	Е	F	G	н	I	J	к	L	м	N	[
1	FILENAME	ARAN	HEADER	Direction	Lane	From	То	Length	CollLengt	Functiona	Comment	Initials	Status	District	Pav
2															
3	[20171004.083309]	85686	9999921	5	1	0	999	999	0.04974	2-Primary	DUMMY		х		
4	[20171004.084724]	85686	9999921	5	1	0	999	999	0.89146	2-Primary	DUMMY		х		
5	[20171004.085450]	85686	1064811	5	1	0	0.48	0.48	0.74726	2-Primary	M10 E7 R4		С		
6	[20171004.085806]	85686	920121	6	1	0	0.05	0.05	0.20554	2-Primary	M172		С		
7	[20171004.090057]	85686	920111	5	1	0	0.05	0.05	0.1767	2-Primary	M172		С		
8	[20171004.092446]	85686	1066411	5	1	0	0.39	0.39	0.63054	2-Primary	M10 E7 R7		С		
9	[20171004 094208]	85686	1066311	5	1	0	0.45	0.45	0 762	2-Primary	M10 F7 R2		C		

Step 25. Once you have the correct files selected, click the "Start" button in Vision. The "Upload and Import Wizard Progress" window will open (see below image). Click the "Details button" to see what step the program has completed.

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Data Processing Loading of ARAN Data into Vision

Upload and Import Wizard Progress	
Progress	
	0%
🔶 Details	
Current Step Progress	
Copying BAK file to Shared Folder	
	Cancel

Step 26. After the program is complete, click the "View Results" button (see below image).

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Upload and Import Wizard Progress	
Progress	100%
Oetails Current Step Progress	
Finished	
	View Results

Click the "Details" tab on the left-hand window to view the results of the import. Check window for errors (see below images for examples).

- i. If there are no errors, proceed to Step 27.
- ii. If there are some errors, but not errors with every run, reimport the runs with errors by returning to Step 25.
- iii. If every run received an error (such as all runs saying, "no images found in database," suspend data import and inform FED that recollection may be necessary.

Import Result – Summary with no errors

Kesults				
Summary	Summany		Edit	ave
Details	Summary		Lun	uve
Exceptions	File Name	Comment	Database	
Logging				
	F			
	Errors		5	ave
	Application Task	File Name Message Details		
1				
				OK

Import Result – Detail with no errors

Summary	Details			Show: Information	Warning Error Sa	ave
Details						
Exceptions	Application	Task	File Name	Message	Details	<u>^</u>
Logging	🛆 DCS	Import Data		Importing skipped by Filtering.	[20170822.094735]	
	A DCS	Import Data		Collection already exists. Importing skipped.	[20170822.095547]	-
	🔥 DCS	Import Data		Collection already exists. Importing skipped.	[20170822.101452]	
	🛕 DCS	Import Data		Collection already exists. Importing skipped.	[20170822.102801]	
	🛕 DCS	Import Data		Collection already exists. Importing skipped.	[20170822.104126]	
	🛕 DCS	Import Data		Collection already exists. Importing skipped.	[20170822.105308]	
	\Lambda DCS	Import Data		Collection already exists. Importing skipped.	[20170822.110558]	
	🔥 DCS	Import Data		Collection already exists. Importing skipped.	[20170822.110948]	
	🔥 DCS	Import Data		Collection already exists. Importing skipped.	[20170822.113920]	
	🔥 DCS	Import Data		Collection already exists. Importing skipped.	[20170822.114532]	
	🛕 DCS	Import Data		Collection already exists. Importing skipped.	[20170822.120003]	
	🔥 DCS	Import Data		Collection already exists. Importing skipped.	[20170822.131354]	
	🛆 DCS	Import Data		Collection already exists. Importing skipped.	[20170822.132745]	
	🔥 DCS	Rename Video		Rename Video - Create folder and move files	Could not find file 'F:\FISPavement\'	
	🛆 DCS	Rename Video		Rename Video - Create folder and move files	Could not find file 'F:\FISPavement\'	
	🔥 DCS	Rename Video		Rename Video - Create folder and move files	Could not find file 'F:\FISPavement\'	
	DCS	Upload Data		Uploading Files Complete	FISPavement	
	DCS	Upload Data		Uploading Files Complete	Data	
	DCS	Upload Data		Uploading Files Complete	Left	
	DCS	Upload Data		Uploading Files Complete	Posdata	
	DCS	Upload Data		Uploading Files Complete	ROW	
	DCS	Rename Video	78L0S40C	Rename Successful - FIS	78L0S40C	
	DCS	Rename Video	78L0S40C	Rename Successful - Left	78L0S40C	
	DCS	Rename Video	78L0S40C	Rename Successful - ROW	78L0S40C	
	DCS	Rename Video	78L0S4K8	Rename Successful - FIS	78L0S4K8	
	DCS	Rename Video	78L0S4K8	Rename Successful - Left	78L0S4K8	
	000	Rename Fraco	102004100	Rename Succession - Eere	102004100	

Details		Show: Information Warn	hing Error
Application	ask File Name	Message	Details
💥 DCS Rename	/ideo No LCMS FisFrame	s found in database 78I0Q3	30K
💢 DCS Rename	/ideo No Left Images for	und in database 78I0Q3	30K
💥 DCS Rename	/ideo No ROW Images f	ound in database 78I0Q3	30K
🗙 DCS Rename	/ideo No ROW Images f	ound in database 78I0Q3	30K
🗶 DCS Rename	/ideo No LCMS FisFrame	s found in database 780103	3TS
🗶 DCS Rename	/ideo No Left Images for	und in database 78O103	3TS
🗶 DCS Rename	/ideo No ROW Images f	ound in database 780103	3TS
🗙 DCS Rename	/ideo No ROW Images f	ound in database 780103	3TS
🗙 DCS Rename	/ideo No LCMS FisFrame	s found in database 78P0Z3	365
💥 DCS Rename	/ideo No Left Images for	und in database 78P0Z3	365
🗙 DCS Rename	/ideo No ROW Images f	ound in database 78P0Z3	365
💥 DCS Rename	/ideo No ROW Images f	ound in database 78S0N3	3ZL
💥 DCS Rename	/ideo No ROW Images f	ound in database 78P0Z3	365
💥 DCS Rename	/ideo No LCMS FisFrame	s found in database 78S0N3	3ZL
🗶 DCS Rename	/ideo No Left Images for	und in database 78S0N3	3ZL
💥 DCS Rename	/ideo No ROW Images f	ound in database 78S0N3	3ZL
💥 DCS Rename	/ideo No LCMS FisFrame	s found in database 78S0R3	3N5
💥 DCS Rename	/ideo No Left Images for	und in database 78S0R3	3N5
💥 DCS Rename	/ideo No ROW Images f	ound in database 78S0R3	3N5
💥 DCS Rename	/ideo No ROW Images f	ound in database 78S0R3	3N5
💥 DCS Rename	/ideo No LCMS FisFrame	s found in database 78S0R3	3N6
💥 DCS Rename	/ideo No Left Images for	und in database 78S0R3	3N6
💥 DCS Rename	/ideo No ROW Images f	ound in database 78S0R3	3N6
DCS Rename	/ideo No ROW Images f	ound in database 78SOR3	3N6
🔀 DCS Rename	/ideo No LCMS FisFrame	s found in database 78S0X3	3QD
🔀 DCS Rename	/ideo No Left Images for	und in database 78S0X3	3QD
🛛 💢 DCS 🛛 Rename	/ideo No ROW Images f	ound in database 78S0X3	3QD

Import Result - Detail "no images found" errors (recollection may be necessary)

4- Final Data Loading QC – to be completed by DPT Staff

Summary: This task ensures that the collected "ROW" and "Left" images collected with the ARAN equipment in the field are acceptable and flags image data sets which may be incomplete or of unacceptable quality.

Step 27. Open Vision. Select the "Images" drop-down menu and select "Left". "Left" viewer tab will appear (see below image). Images will only be displayed if a file is selected. If the window opens and there is no image, make sure a file is selected in the Section Explorer window.

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Step 28. Select the "Images" drop-down menu and select "ROW". "ROW" viewer tab will appear (see below image). Images will only be displayed if a file is selected. If the window opens and there is no image, make sure a file is selected in the Section Explorer window



Step 29. Arrange "Section Explorer", "ROW", and "Left" windows so that they can be viewed simultaneously on the screen. Right-click on the "Section Explorer" tab and select "New Horizontal Tab Group" (see below image). The "Section Explorer" window will move to the bottom of the Vision display.

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Step 30. Right-click on the "ROW" tab and select "New Vertical Tab Group." The "ROW" window will move to the right of the Vision display, next to the "Left" window (see below image).

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File View 1	fools Help										
Connect	🖷 - 🛛 🏇 Se	egment 🕶 🐲	Rate 👻 💣 Pro	ocess 🔹 🎯 Map 🛛 🚞 Images 🔹 🏲	🛿 Panoramic View 🛛 🐻 Charts 👻 🚳	Tables 👻 📕 🖬 Repo	ert 📑 Publish 🛛 🛥 Plu	g-Ins 🔹 👬 Distress schem	a 🙀 Bookmarks 👻		
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Step 31. Select one of the imported files in the "Section Explorer" window. The first image for both cameras will appear in the "Left" and "ROW" windows. Check the image for quality. Click the "skip to last" button to view the last image (see below image). Check the image for quality. Check at least one file for each day of data collection.



- i. If images are of acceptable, proceed to Step 32.
- ii. If images are missing (more than half) or otherwise not of acceptable quality, return to Step 25 and reimport the files.

5- Creating and Importing PAGDQC Report – to be completed by DPT Staff

Summary: This task creates and populates a PAGD_QC_CSV file for all collection runs imported into the Vision database for each FED submission. The file is then imported into the EDW to update the Edit/View Unique Run Status program to allow tracking, status, and notes of each collection run (FED QC/QA, Route Matching QC/QA, etc.).

Step 32. Refer to <u>Creating PAGDQC Report</u> for creation and uploading of the PAGD_QC Report. This step is essential for FED QC/QA staff can provide their feedback for each collection run as part of their QC/QA review. The FED review will determine if a collection run requires recollection and if it's ready for office post-processing.

6- DPT TL Notification – to be completed by DPT Staff

Summary: This task notifies the DPT TL of completion of data loading and results from QC.

- Step 33. Notify DPT TL of completion of data loading and results from QC.
 - i. Compose an email to the DPT TL (cc the Assistant Division Chief for Pavement Management in the email).
 - ii. Indicate that the received data has been loaded into the Vision database.
 - iii. Attach the PAGD_QG Report and the PDF with the scanned ARAN Collection Daily Logs.
 - iv. Use the following email subject: "New Aran [ARAN NUMBER] Submission" (e.g., "New ARAN 3 Submission").
 - v. Include all problems or concerns with the received data found while performing the previous steps.

7- Data Loading QA and FED Notification – to be completed by DPT TL

Summary: This task confirms the completeness of the data loading and ensures the correct attachments were included in the notification email from DPT staff. This task also uploads the data via ProjectWise and alerts the FED TL when complete.

- Step 34. Open the notification email sent from DPT Staff. Make sure the following files are provided as an attachment to the email:
 - i. FED QC Spreadsheet (PAGDQC Report renamed)
 - ii. ARAN Field Log

If one or both of these files were not attached to the email, contact the DPT Staff that submitted the notification and request to resubmit email with correct files.

Step 35. Navigate to folder location of the FED daily QC folders on the network: \\shahanartico2\shaomtvideolog\[YEAR]\Data\[YY]_A[ARANNumber]\Rec[MM DDYYYY]. Confirm that one folder per data collection date in the batch (use the ARAN Field Log to get the list of data collection days in the batch) has been created and that they have the necessary files. See image below for the list of files expected to be populated in each daily collection folder.

Name	Date modified	Туре	Size
PAVQC725	9/5/2017 5:06 PM	File folder	
🔊 Collected_Length_By_Func_Class.csv	7/25/2017 5:07 PM	Microsoft Excel C	1 KB
🗟 Daily_MD85686_20170725.csv	7/25/2017 5:06 PM	Microsoft Excel C	6 KB
🏜 left1.jpg	7/25/2017 3:57 PM	JPEG Image	1,573 KB
🛃 left2.jpg	7/25/2017 3:58 PM	JPEG Image	1,550 KB
🏜 left3.jpg	7/25/2017 3:58 PM	JPEG Image	1,567 KB
B MD85686_Export_20170725141143_log.csv	7/25/2017 5:15 PM	Microsoft Excel C	2 KB
MD85686_Settings_20170725.xml	7/25/2017 5:07 PM	XML File	60 KB
🚯 MD85686_StatusMessages_20170725.csv	7/25/2017 5:07 PM	Microsoft Excel C	13 KB
QC_Pcs_Files.csv	7/25/2017 5:06 PM	Microsoft Excel C	4 KB
QC_Video.csv	7/25/2017 5:06 PM	Microsoft Excel C	4 KB
🛃 row1.jpg	7/25/2017 3:58 PM	JPEG Image	1,056 KB
🛃 row2.jpg	7/25/2017 3:58 PM	JPEG Image	1,006 KB
🛃 row3.jpg	7/25/2017 3:58 PM	JPEG Image	1,014 KB
Sections_Collected_List.csv	7/25/2017 5:06 PM	Microsoft Excel C	1 KB
Sections_Not_Collected_List.csv	7/25/2017 5:06 PM	Microsoft Excel C	70 KB
🛃 thumbnail_left1.jpg	7/25/2017 3:57 PM	JPEG Image	74 KB
🛂 thumbnail_left2.jpg	7/25/2017 3:58 PM	JPEG Image	72 KB
🏜 thumbnail_left3.jpg	7/25/2017 3:58 PM	JPEG Image	73 KB
🛃 thumbnail_row1.jpg	7/25/2017 3:58 PM	JPEG Image	65 KB
🛂 thumbnail_row2.jpg	7/25/2017 3:58 PM	JPEG Image	63 KB
🛂 thumbnail_row3.jpg	7/25/2017 3:58 PM	JPEG Image	64 KB

Step 36. Use ProjectWise Explorer V8i to create folder in the corresponding data collection year within the FED's ARAN ProjectWise directory with the following name "[ARANNUMBER][YYYYMMDD (for last day of collection in batch)]" (e.g., "A3_20170725"). Import all items into the created folder including the FED QC Spreadsheet, the ARAN Field Log, and the folders for each data collection date with the corresponding files.

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Office of Maintenance	20171011		Preliminary	
Ornice of Materials Technology	20171013		Preliminary	
Engineering Geology Division	20171017		Preliminary	
Det ADAM	20171018		Preliminary	
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⊕ 201 A3_20170816_TL ⊕ 201 A3_20170828 ⊕ 201 A3_20170912 ⊕ 201 A3_20170912_TL	View. (Default>	Property value Property value	Property name	Property value
⊕ [27 A 3, 20170816, TL ⊕ [27 A 3, 20170828 ⊕ [27 A 3, 20170828 ⊕ [27 A 3, 20170912] ⊕ [27 A 3, 20170912] TL ⊕ [27 A 3, 20170912]	Mew: CDefault> Property name Name Enders Name	Property value Rec101817A3.pdf A 2 30121018	Property name Description Exclusion Exclusion	Property value Rec101817A3
(a) (b) (c) (c) (c) (c) (c) (c) (c) (c) (c) (c	Verw: <default> Property name Name Folder Name</default>	Property value Rec101817A3.pdf A3_20171018 Classifier	Property name Description Folder Description	Property value Rec101817A3
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Step 37. Send email to FED TL to communicate completion of data loading into the Vision Database as well as completion of uploading FED daily field QC files and sample imagery. Include the ProjectWise link of the uploaded folder in the email. This allows the FED TL to start their QA review (<u>ARAN Submittal QA</u>) to determine if any collection is invalid and/or requires recollection prior to the post-processing procedures.

5.02 ARAN SUBMITTAL QA

5.02.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Field Explorations Division (FED) to perform quality assurance (QA) of the data collected using the Automatic Road Analyzer (ARAN) survey vans before those data are submitted to the Data Processing Team (DPT). The ARAN collected data are subject to additional quality checks by other teams of the MDOT-SHA Office of Materials Technology (OMT) in subsequent stages of their Pavement Management System (PMS)^{06/12/2019}.

5.02.02 Frequency

The QA of an ARAN data submittal starts every time a batch of ARAN collected data is uploaded to a Vision Database by the DPT, which typically occurs every 4 to 5 days. Assuming an average of 60 miles collected per day, each batch contains, on average, between 240 and 300 miles of ARAN data. The actual frequency varies according to the proximity of the routes on which data were collected for the data batch to the OMT office and it ranges from 1 day (when collected near the OMT office) to 2 weeks (when collected far from the OMT office). Shorter turn-around periods are preferred to minimize the amount of mileage requiring data recollection. The annual ARAN data collection season typically lasts from March to Mid-December.

5.02.03 Purpose

The purpose of this SOP is for the FED staff to assure that the data collected using the ARAN survey vans are of acceptable quality before they are delivered to other OMT teams and SHA offices for their use in various PMS applications. For example, Right-of-Way (ROW) images are submitted by the FED to SHA offices other than the OMT.

5.02.04 *Resource Requirements*

The QA of the ARAN data submittal involves two people: (1) a reviewer of ARAN data who performs the QA checks and (2) a supervisor who, as required, makes decisions based on the QA results on whether or not to recollect data on one or more routes where data have already been collected. The estimated effort levels in the table below represent the total time, in man-hours, to perform the QA of the ARAN data submittal.

Position	Function	Resources	Effort Level (man-hrs)
FED Staff	Reviewer	1	1.0-24.0 ^{06/12/2019}
FED TL	Supervisor	1	AR ^{06/12/2019}

5.02.05 *Procedure*

The procedure to perform QA of the ARAN data submittal is comprised of the following six tasks:

- (1) preliminary actions,
- (2) QA of International Roughness Index (IRI) data,
- (3) QA of ARAN daily settings,
- (4) QA of images,
- (5) reporting of QA results, and
- (6) decision to recollect.

The ARAN data elements inspected during the quality checks in this SOP are IRI measurements, settings used during data collection, and the different images produced by the system: Right-of-Way (ROW), Left Camera (Left), and laser crack measurement system range (LCMSRange) and intensity (LCMS3D) images. The QA of IRI data checks for completeness and validity of testing conditions. The QA of ARAN daily settings is performed to verify that the setting used during each data collection day were the ones intended. The QA of images checks for their completeness and fidelity.

The following steps describe the process conducted by members of the FED to QA the ARAN data submittal:

1- Preliminary Actions - performed by Reviewer

Summary: This task identifies the ARAN submittal to be checked, removes previously reviewed runs from QA list and initializes a new submission spreadsheet.

- Step 1. Open the server folder containing the ARAN submittal data. A link to the ARAN submittal's folder is provided in the email sent by the DPT to notify completion of the data loading into the Vision database (see Loading of ARAN Data into Vision). Clicking the link will automatically navigate to the submittal folder. If the link is not included in the completion notification, then contact the DPT TL to request information on the location of the server folder with the ARAN submittal data.
- Step 2. Identify previously collected routes Print a copy of the scanned field daily log and compare it with the log from the submittal immediately prior to the one in question for the corresponding ARAN survey van to detect if any of reported runs have already been reviewed. Duplicate runs are sometimes collected by the ARAN crew due to routing strategies and other reasons. Cross off the duplicate runs, if any.
- Step 3. Initialize sheet for new submission in yearly spreadsheet (see image below). Run MS Excel and open the "QA yearly spreadsheet" corresponding to the specific ARAN survey van associated with the submittal under review. The QA yearly spreadsheet is named as "[YYYY]_Aran[VanNumber] [ReviewerInitials]" (e.g., "2017_Aran4_BE") and it is stored in the reviewer's computer. Create a new sheet and name it as "[ARAN_Number] [YYYYMMDD]" (e.g., "A3_20170807"). Once the new sheet has been named, copy the columns and sections for "FED QC Report," "Settings", and "Images" from the sheet with the last ARAN submittal information, paste them into the new sheet, and clear out each of the sections.

	А	В	С	D	E	F	G	Н
1	FED QC Report	County	Route	Direction	Error (s)			
2								
3								
4	Settings							
5								
6								
7	Images	County	Route	Direction	Error (s)			
8								
9								
10								

2- QA of IRI Data - performed by Reviewer

Summary: This task creates and populates a spreadsheet which evaluates the fidelity of the collected IRI data. The spreadsheet checks both completeness of IRI data and the speed at which the measurements were taken.

- Step 4. Open the following two files using MS Excel:
 - i. "FED_QC_100000.csv," located in the submittal's folder (see Step 1), and
 - ii. "IRI Review" spreadsheet, located on the Reviewer's computer. This spreadsheet has the IRI QA checks pre-loaded.
- Step 5. Copy all the data from the "FED_QC_1000000" spreadsheet (do not copy the column headers) and paste it into the "IRI Review" spreadsheet at cell "J3" (see image below). The IRI QA results for each run are reported on columns "Right IRI Check," "Left IRI Check" and "Avg Speed." The values in these three columns will refresh automatically once the new values are pasted. Flagged values are marked with a red cell background, as illustrated in the image below.

	A	В	C	F	I	J	K	L	М	N	0	P	
1						Paste Data							
2	Unique Run	Right IRI Check	Left IRI Check	Avg Speed		IDLocator	L_Cou	L_Routel	L_D	UniqueRun	CollectionVehicle	DCSTimeStamp	IDS
3	7700S307	101%	101%	31.72905089		4333	MO	MD 117	W	7700S307	1723	7/24/2017 10:19	
4	7700T3KT	100%	100%	31.3110018		4340	MO	MD 121	Ν	7700T3KT	1723	7/24/2017 10:38	
5	7700U3D0	103%	103%	28.21060558		4342	MO	MD 121 A	Ν	7700U3D0	1723	7/24/2017 10:55	
6	7700U3KO	102%	101%	25.05675947		4343	MO	MD 121 A	S	7700U3KO	1723	7/24/2017 11:00	
7	7700W3TT	100%	100%	32.37654446		4341	MO	MD 121	S	7700W3TT	1723	7/24/2017 11:49	
8	7700X3BM	101%	100%	35.29115523		4333	MO	MD 117	W	7700X3BM	1723	7/24/2017 11:59	
9	7700X3XT	100%	100%	33.86766013		4332	MO	MD 117	E	7700X3XT	1723	7/24/2017 12:13	
10	7700Z3JB	102%	102%	23.84680658		4335	MO	MD 117 A	W	7700Z3JB	1723	7/24/2017 12:47	
11	7700Z3N9	106%	105%	24.91380385		4334	мо	MD 117 A	E	7700Z3N9	1723	7/24/2017 12:49	
12	770103HI	101%	101%	40.45615741		4338	MO	MD 119	N	770103HI	1723	7/24/2017 13:08	
13	770113WA	100%	100%	41.82077466		4339	MO	MD 119	S	770113WA	1723	7/24/2017 13:38	
14	77P0X3FX	106%	105%	23.17114576		4458	MO	MD 594 A	E	77POX3FX	1723	7/25/2017 12:02	
15	77P0Y38A	106%	105%	21.5523209		4459	MO	MD 594 A	W	77P0Y38A	1723	7/25/2017 12:19	
16	77P0Y38B	131%	116%	13.19156374		4462	MO	MD 594 C	E	77P0Y38B	1723	7/25/2017 12:19	
17	77POY3TE	154%	135%	10.62384887		4463	MO	MD 594 C	W	77POY3TE	1723	7/25/2017 12:32	
18	77P0Z331	115%	113%	12.46492211		4460	MO	MD 594 B	E	77P0Z331	1723	7/25/2017 12:37	
19	77P0Z330	116%	114%	12.14573228		4461	MO	MD 594 B	W	77P0Z330	1723	7/25/2017 12:37	
20	77P1031D	102%	102%	22.21893811		4376	мо	MD 195	N	77P1031D	1723	7/25/2017 12:58	
21	77P103PZ	105%	109%	17.86084131		4378	MO	MD 195 A	N	77P103PZ	1723	7/25/2017 13:13	

Step 6. Report every flagged run from the IRI completeness check or the IRI measuring speed check into the "FED QC Report" section of the "QA submittal review" spreadsheet by copying their "Unique Run" number and commenting on with the "Unique Run" number and the text "Bad IRI" (see below image). The IRI completeness check consists of reviewing the percentage of IRI values (either from the left or right sensor) missing for the run. Flagged values in the "Right IRI Check" and "Left IRI Check" columns indicate that 25% or more of the IRI measured data for the run are missing. The IRI measuring speed check is performed to detect if the speed at which the ARAN van collected the IRI values was under the acceptable threshold of 35 miles per hour. Flagged values in the "Avg Speed" column indicate the testing speed for the run was lower than acceptable. Once reporting of all flagged runs has been completed, save the "IRI Review" spreadsheet under the name "Aran [ARAN Number] [MMDD] IRI Fidelity" using the MS Excel file extension.

FED QC Report			
7970X4PX	Bad IRI		
797164NW	Bad IRI		
79B0P4JH	Bad IRI		

3- QA of ARAN Daily Settings - performed by Reviewer

Summary: This task creates and populates a spreadsheet which evaluates the accuracy of ARAN settings. The spreadsheet performs a side by side comparison of setting values for the data submittal and the pre-loaded functions. Conflicts with setting inputs are reported as errors.

- Step 7. Open the ARAN daily settings file corresponding to the first data collection day of the submittal using a text editor software. The ARAN settings file for each data collection day is located in the sub-folder for the corresponding day within the server submittal's folder (see Step 1). The ARAN settings files are named as "MD[Number]_Settings_[YYYYMMDD].xml" (e.g., "MD854682_Settings_ 20170713.xml).
- Step 8. Open the ARAN settings review spreadsheet in MS Excel and select the sheet corresponding to the ARAN associated with the submittal data (e.g., ARAN 3). This spreadsheet contains the ideal setting values for each of the ARAN survey vans and it is used as the reference to check if the ARAN daily settings used in the field were the correct ones. The ARAN settings may differ between ARAN vans.
- Step 9. Copy everything from the ARAN daily settings file, and paste it into the settings review spreadsheet in cell "A2" (see below image).

1	A B	C D	E	F	G	н	I	J.	K	L	M	N 0	PQRSTUVVWZAA AB
1	PASTE ARAN 3 DATA	INTO BLUE CELL										Difference	6/2/2017
2	xml version="1.0"</td <td>encoding="utf-8</td> <td>?></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>0</td> <td><?xml version="1.0" encoding="utf-8"?></td>	encoding="utf-8	?>									0	xml version="1.0" encoding="utf-8"?
3	<aransettings></aransettings>											0	<aransettings></aransettings>
4	<misc></misc>											0	<misc> Error Count 15</misc>
5	<acs_version></acs_version>											0	<acs_version></acs_version>
6	<version>2.3.1.45</version>											0	<version>2.3.1.45</version>
7	<platform>x64<td>latform></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td><platform>x64</platform></td></platform>	latform>										0	<platform>x64</platform>
8												0	
9	<aran_name></aran_name>											0	<aran_name></aran_name>
10	<name>MD85682</name>											0	<name>MD85682</name>
11												0	
12												0	
13	<calibrations></calibrations>											0	<calibrations></calibrations>
14	<areascancalibrat< td=""><td>ion></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td><areascancalibration></areascancalibration></td></areascancalibrat<>	ion>										0	<areascancalibration></areascancalibration>
15	<strobedelay dat<="" td=""><td>aType="float">0.</td><td>055337<td>beDelay></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td><strobedelay datatype="float">0.055337</strobedelay></td></td></strobedelay>	aType="float">0.	055337 <td>beDelay></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>0</td> <td><strobedelay datatype="float">0.055337</strobedelay></td>	beDelay>								0	<strobedelay datatype="float">0.055337</strobedelay>
16	<transoverlap da<="" td=""><td>taType="int">0<!--</td--><td>TransOverlap</td><td>></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td><transoverlap datatype="Int">0</transoverlap></td></td></transoverlap>	taType="int">0 </td <td>TransOverlap</td> <td>></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>0</td> <td><transoverlap datatype="Int">0</transoverlap></td>	TransOverlap	>								0	<transoverlap datatype="Int">0</transoverlap>
17	<topmargin data<="" td=""><td>[ype="int">0<td>pMargin></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td><topmargin datatype="int">0</topmargin></td></td></topmargin>	[ype="int">0 <td>pMargin></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>0</td> <td><topmargin datatype="int">0</topmargin></td>	pMargin>									0	<topmargin datatype="int">0</topmargin>
18	<leftmargin data<="" td=""><td>Type="int">0<td>ftMargin></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td><leftmargin datatype="int">0</leftmargin></td></td></leftmargin>	Type="int">0 <td>ftMargin></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>0</td> <td><leftmargin datatype="int">0</leftmargin></td>	ftMargin>									0	<leftmargin datatype="int">0</leftmargin>
19	<rightmargin data<="" td=""><td>aType="int">0<td>ightMargin></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td><rightmargin datatype="int">0</rightmargin></td></td></rightmargin>	aType="int">0 <td>ightMargin></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>0</td> <td><rightmargin datatype="int">0</rightmargin></td>	ightMargin>									0	<rightmargin datatype="int">0</rightmargin>
20	<bottommargin d<="" td=""><td>ataType="int">0•</td><td>/BottomMan</td><td>gin></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td><bottommargin datatype="int">0</bottommargin></td></bottommargin>	ataType="int">0•	/BottomMan	gin>								0	<bottommargin datatype="int">0</bottommargin>
21	<ydistperpixel da<="" td=""><td>taType="float">0</td><td>.00154<td>tPerPixel></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td><ydistperpixel datatype="float">0.00154</ydistperpixel></td></td></ydistperpixel>	taType="float">0	.00154 <td>tPerPixel></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>0</td> <td><ydistperpixel datatype="float">0.00154</ydistperpixel></td>	tPerPixel>								0	<ydistperpixel datatype="float">0.00154</ydistperpixel>
22	<xdistperpixel da<="" td=""><td>itaType="float"></td><td>.00154<td>stPerPixel></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td><xdistperpixel datatype="float">0.00154</xdistperpixel></td></td></xdistperpixel>	itaType="float">	.00154 <td>stPerPixel></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>0</td> <td><xdistperpixel datatype="float">0.00154</xdistperpixel></td>	stPerPixel>								0	<xdistperpixel datatype="float">0.00154</xdistperpixel>
23	<imageoffset dat<="" td=""><td>aType="int">0<td>mageOffset></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td><imageoffset datatype="int">0</imageoffset></td></td></imageoffset>	aType="int">0 <td>mageOffset></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>0</td> <td><imageoffset datatype="int">0</imageoffset></td>	mageOffset>									0	<imageoffset datatype="int">0</imageoffset>
24	<effectivedate da<="" td=""><td>taType="datetim</td><td>ie">May 5 20</td><td>16 11:12AM</td><td><td>Date></td><td></td><td></td><td></td><td></td><td></td><td></td><td><effectivedate datatype="datetime">May 5 2016 11:12AM</effectivedate></td></td></effectivedate>	taType="datetim	ie">May 5 20	16 11:12AM	<td>Date></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td><effectivedate datatype="datetime">May 5 2016 11:12AM</effectivedate></td>	Date>							<effectivedate datatype="datetime">May 5 2016 11:12AM</effectivedate>
25	<td>tion></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>0</td> <td></td>	tion>										0	
26	<bridgeclearancec< td=""><td>alibration></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td><bridgeclearancecalibration></bridgeclearancecalibration></td></bridgeclearancec<>	alibration>										0	<bridgeclearancecalibration></bridgeclearancecalibration>
27	<leftoffset datat<="" td=""><td>ype="float">0<td>eftOffset></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td><leftoffset datatype="float">0</leftoffset></td></td></leftoffset>	ype="float">0 <td>eftOffset></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>0</td> <td><leftoffset datatype="float">0</leftoffset></td>	eftOffset>									0	<leftoffset datatype="float">0</leftoffset>
28	<centeroffset da<="" td=""><td>taType="float">0</td><td><td>et></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td><centeroffset datatype="float">0</centeroffset></td></td></centeroffset>	taType="float">0	<td>et></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>0</td> <td><centeroffset datatype="float">0</centeroffset></td>	et>								0	<centeroffset datatype="float">0</centeroffset>

Step 10. Once the ARAN daily settings values have been pasted into the settings review spreadsheet, the spreadsheet will automatically perform a line-by-line comparison between setting values through its pre-loaded functions. The output from this comparison consists of the count of lines with differences in the settings, referred to as "Error Count" (as presented in the top right corner

of the above image where 15 differences were found). Each line of the ARAN daily settings in conflict with the reference setting values is flagged in red color.

Step 11. Report the "Error Count" for the ARAN daily settings, as well as each of the line numbers in conflict with the reference settings, into the "Settings" section of the yearly spreadsheet separating by data collection date (as shown in the image below).

	Α	В	С	D	E	F	G	Н	I	J	К	L	м	N	0
1	FED QC Re	County	Route	Direction	Error (s)										
2	No Flags														
3															
4															
5	Settings														
6															
7	07/24/201	7 22 setti	ngs conflict	s detected	Lines 33,	279, 374, 4:	12, 426, 56	99, 593, 617	, 641, 665,	689, 713, 7	37, 761, 79	0, 819, 848	, 877, 906, 1	935, 964, 99	93
8	07/25/201	7 22 setti	ngs conflict	s detected	Lines 33,	279, 374, 4:	12, 426, 56	99, 593, 617	, 641, 665,	689, 713, 7	37, 761, 79	0, 819, 848	, 877, 906,	935, 964, 99	93
9	07/26/201	7 22 setti	ngs conflict	s detected	Lines 33,	279, 374, 4:	12, 426, 56	99, 593, 617	7, 641, 665,	689, 713, 7	37, 761, 79	0, 819, 848	, 877, 906,	935, 964, 99	93
10	07/28/201	7 23 setti	ngs conflict	s detected	: Lines 33,	279, 338, 34	47, 412, 42	6, 5699, 593	3, 617, 641,	665, 689, 7	13, 737, 76	1, 790, 819	, 848, 877,	906, 935, 96	64, 993
11	07/30/201	7 23 setti	ngs conflict	s detected	Lines 33,	279, 338, 34	47, 412, 42	6, 5699, 593	8, 617, 641,	665, 689, 7	13, 737, 76	1, 790, 819	, 848, 877,	906, 935, 90	64, 993
12	07/31/201	7 23 setti	ngs conflict	s detected	Lines 33,	279, 338, 34	47, 412, 42	6, 5699, 593	3, 617, 641,	665, 689, 7	13, 737, 76	1, 790, 819	, 848, 877,	906, 935, 96	64, 993
13	08/01/201	7 22 setti	ngs conflict	s detected	Lines 33,	279, 374, 4:	12, 426, 56	99, 593, 617	7, 641, 665,	689, 713, 7	37, 761, 79	0, 819, 848	, 877, 906,	935, 964, 99	93
14	08/02/201	7 22 setti	ngs conflict	s detected	Lines 33,	279, 374, 4:	12, 426, 56	99, 593, 617	7, 641, 665,	689, 713, 7	37, 761, 79	0, 819, 848	, 877, 906,	935, 964, 99	93
10															

Step 12. Repeat Step 7 to Step 11 for each data collection day in the ARAN submittal data.

4- QA of Images - performed by Reviewer

Summary: This task uses Vision software to check for abnormalities in the collected images from the ARAN data submittal and reports any issues found in the "Submittal Review Spreadsheet."

Step 13. Open Roadware Vision software^{06/12/2019}. A screen with a list of projects will appear (see below image). Select project "OMT_ARAN_PROD_2017_1" and click on the "OK" button. If the project is not listed, Reviewer should contact MDOT-SHA Information Technology (IT) staff for assistance with connecting the correct project folder to Reviewer's account.

Section Explorer						• >
Groups 79Q0R4D	D(1/1)				5	egments 🔿 — Intervals 🔿 —
				Drag a column h	re to group by this column.	
D						
County	RouteID	Dir	Collection	Vehicle	Length	
Contains:	T Contains:	T Contains:	τ Contains: τ	iquals: T Equals		τ
AA	15 97 E15 R3	N	79Q0R4DO	1724	202.712	
AA	15.97 E15 R4	N	79Q0U46J	1724	435.926	
AA	15 97 E15 R5	N	79Q0T4Q8	1724	147.009	
AA	15 97 E15 R6	E	79TOR4Q5	1724	304.567	
AA	15 97 E15 R7	s	7A20Q4GD	1724	180.353	
AA	15.97 E15 R8	N	79Q0R41Q	1724	408.510	
AA	15 97 E15 R9	N	795054L7	1724	399.441	
AA	15.97 E16 R1	E	79Q0R4G1	1724	554.989	
AA	15.97 E16 R2	N	79Q0549E	1724	432.442	
Ø AA	15 97 E16 R3	N				
AA	15 97 E16 R4	s	79Q0U484	1724	169.342	
AA	15.97 E16 R5	s	79Q054Q3	1724	305.262	
AA	15 97 E16 R6	N	79Q0T42T	1724	144.079	
Ø AA	15 97 E16 R7	N				
AA	15 97 E16 R8	s	79Q054Z9	1724	369.973	
AA	15 97 E17 R1	N	7A40V4X6	1724	1,277.711	
AA	15 97 E17 R4	E	7A30T48E	1724	1,029.365	
AA	15.97 E17 R6	s	7A40\/4PG	1724	950.678	
Ø AA	15.97 E17 R7	s				
Ø AA	15.97 E5 R2	E				
AA	15 97 E5 R2	w	7A20W40K	1724	1,120.143	
AA	15.97 E5 R5	s	7A20V446	1724	1,979,917	
AA	MD 10	N	7540W410	1724	7,626.871	
AA	MD 10	s	7540V40N	1724	7,374.705	
**	UD 10 73 73		-	1954	400 870	

Step 14. Load or set up Vision workspace. If no workspace in Vision is saved, or if the workspace is to be changed, set up the workspace as preferred containing, as a minimum, the Section Explorer, the ROW, Left, LCMS3D, and LCMSRange images, and the map window. The various image windows are opened using the "Images" button on the menu ribbon. With the map window open, click on the "Main Menu", "Base Maps" button within the "Map" window and add the basemap of choice (e.g., "Google Map"). Once workspace set up is finalized, save it using "File", "Save Workspace" to make it available for future QA of Images. If a workspace in Vision is available, load it from "File", "Select Workspace".



- Step 15. The "Section Explorer" will show the list of all runs collected for the project. Double click on the first (see above image).
- Step 16. Find runs to review from the list of runs marked in the printed daily logs reported by the ARAN crew members. Ignore duplicate runs previously checked as a part of the previous submittal (crossed out runs in the daily log, as described in Step 2). For this:
 - i. Right click anywhere at the top bar in the "Section Explorer" window in Roadware Vision. Double click on time to reveal the data collection date for each unique run. Scroll up or down to the point at which the ARAN submittal begins, as indicated in the field daily log.
 - ii. Type in code "1723"—if submittal data is from ARAN 3—or code "1724" —if submittal data is from ARAN 4—under the "Vehicle" column to filter out runs collected by ARAN vans other than the one corresponding to the submittal under review.
- Step 17. Select the run to review and click on the "Play" button at the bottom of Roadware Vision to begin reviewing the images in the submittal. Set the image rate to 8 (every 1/8 frame of the submittal) and speed to ~80% (moderate percent). This should be done based on personal preference.

Step 18. Look for abnormalities during the visual inspection, such as:

- i. Missing images,
- ii. Improper lighting (images too bright or too dark),
- iii. Presence of spots blocking the vision—such as water drops, and
- iv. Other abnormalities in the images.

Hit the "Stop" button every time an abnormality is detected and report the issue in the "Image QC" section of the Submittal Review Spreadsheet annotating the collection name and the frame at which the issue occurred (as shown in the image below).

FED QC Report				
No Flags				
Settings			<u>.</u>	
8-				
09/26/2017 5 setting	gs conflicts detecte	ed: Lines 33, 338, 3	47, 509, 543	
09/28/2017 5 setting	gs conflicts detecte	ed: Lines 33, 338, 3	47, 509, 543	
09/29/2017 4 setting	gs conflicts detecte	ed: Lines 33, 347, 5	09, 543	
10/02/2017 4 setting	gs conflicts detecte	ed: Lines 33, 347, 5	09, 543	
10/03/2017 5 setting	gs conflicts detecte	ed: Lines 33, 338, 3	47, 509, 543	
10/04/2017 4 setting	gs conflicts detecte	ed: Lines 33, 347, 5	09, 543	
Images	County	Route	Direction	Error (s)
79Q0R4RE	AA	IS 97 E15 R 2	w	No left images after frame 316
79Q0S49E	AA	IS 97 E16 R2	N	No left images 288-320, 328-376, 392-432
79Q0S4J5	AA	IS 895 B E3B R2	E	No left image at 1,160
7A30S45G	AA	MD 3 E7 R7	N	ROW No input signal 96-290

Step 19. Repeat Step 17 and Step 18 for each run in the submittal until all issues for every run have been reported in the Submittal Review Spreadsheet.

5- Reporting of QA Results - performed by Reviewer

Summary: This task uses the Engineering Data Warehouse software to input the results of the previous checks for each run collected in the ARAN data submittal. This task also results in an email submission indicating the reviewer's portion of the data submittal QA is complete.

- Step 20. Open the Engineering Data Warehouse (EDW) software and navigate to "Data", "ARAN", "View/Edit Unique Run Status."
- Step 21. The Engineering Data Warehouse will populate with list of runs completed (see below image). Complete the QA information for each data collection run of the submittal. (generally each run has one route)

MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

Data Processing ARAN Submittal QA

ear	County	Route	e TestDa	ate File Nar	ne Drive No.		Filter			Aran		200	
17 -	All 👻		• 09/26/201	7 -	•	•		Showin	g Recollected A	Vie Vie	w	Dup QC	Close
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2017	7	900R4G1	3205	229	09/26/2017	2	44	0	IS	97		F	16
2017	7	7900R4I0	3206	227	09/26/2017	2	AA	0	IS	97		N	15
2017	7	9Q0R4RE	3207	221	09/26/2017	2	AA	0	IS	97		w	15
2017	7	900S35Z	3071	2984	09/26/2017	10	FR	0	MD	26		E	
2017	7	79Q0S49E	3208	230	09/26/2017	2	AA	0	IS	97		N	16
2017	7	79Q0S4J5	3209	182	09/26/2017	2	AA	0	IS	895	в	E	3B
2017	7	9005403	3210	233	09/26/2017	2	AA	0	IS	97		s	16
2017	7	79Q0S4Z9	3211	236	09/26/2017	2	AA	0	IS	97		s	16 =
2017	7	9Q0T3GM	3072	2985	09/26/2017	10	FR	0	MD	26		w	
2017	7	9Q0T3YK	3073	2990	09/26/2017	10	FR	0	MD	31		E	
2017	7	900T42T	3212	234	09/26/2017	2	AA	0	IS	97		N	16
2017	7	9Q0T460	3213	220	09/26/2017	2	AA	0	IS	97		N	15
2017	7	9Q0T4QB	3214	224	09/26/2017	2	AA	0	IS	97		N	15
2017	7	79Q0T4U3	3215	218	09/26/2017	2	AA	0	IS	97		W	14
2017	7	9Q0T4XU	3216	294	09/26/2017	2	AA	0	MD	100		N	11
2017	7	79QOU3IT	3074	2991	09/26/2017	10	FR	0	MD	31		W	
2017	7	9000434	3217	213	09/26/2017	2	AA	0	IS	97		s	14
2017	7	79Q0U46J	3218	223	09/26/2017	2	AA	0	IS	97		N	15
2017	7	79Q0U4B4	3219	232	09/26/2017	2	AA	0	IS	97		S	16
2017	7	900V31R	3075	2985	09/26/2017	10	FR	0	MD	26		W	
2017	7	9Q0Z323	3076	2872	09/26/2017	10	FR	0	co	457		N	
2017	7	79Q0Z3W8	3077	2978	09/26/2017	10	FR	0	MD	194		N	
2017	7	79Q103VC	3078	2979	09/26/2017	10	FR	0	MD	194		s	
2017	7	79Q113YG	3079	3006	09/26/2017	10	FR	0	MD	550		N	-

- i. Select "Year", "County", and "Test Date" to find the corresponding runs for each submittal (see above image).
 - ii. Double click on the reviewed runs, type in relevant notes (add a "Standard Note" using drop-down list or a custom note in the "Add Note" field), press Save, and check off the "QC reviewed" button in the next window that opens (see below image).

PLEAR FLEMANE DESIGN Device note constant Device note Device note <thdevice note<="" th=""> <thd< th=""><th>ar Cou</th><th>rty Route</th><th>Tes • 07/24</th><th>t Date File Nam 2017 ↓</th><th>e Drive No.</th><th>Filter</th><th>Showing Rec</th><th>Aran ollected All 👻</th><th>View</th><th>Dup QC Ck</th><th>DSe</th></thd<></thdevice>	ar Cou	rty Route	Tes • 07/24	t Date File Nam 2017 ↓	e Drive No.	Filter	Showing Rec	Aran ollected All 👻	View	Dup QC Ck	DSe
Instruction	YEAR	FILENAME 7700P30D	IDSESSION	ARAN Unique Rur	Status Update	COUNTY	MIN	поште пиши	DellEE	DIRECTION EVEL	
2017 7700130L 1017 2017 7700130L 1578 2017 7700130L 1579 2017 7700130L 1579 2017 7700130L 1579 2017 7700130L 1579 2017 7700130L 1581 2017 770023L8 1581 2017 770023L8 1582 2017 770023L8 1583 2017 770023L8 1583 2017 770023L8 1584 2017 770023M8 1584 2017 770013ML 1586 2017 770013ML 1586 2017 77013ML 1586 2017 77013ML 1586 2017 77013ML 1586	2017	77005307	1576								
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Z017 77023J8 1583 Z017 77002398 1584 Z017 77002398 1584 Z017 7701394 1585 Z017 7701394 1585 Z017 7701394 1585 PED Note BELLISON 08/15/2017 PAGD DPT Wisecrax @ QC Checked/Uploaded QA Checked @ QC Checked/Uploaded QA Checked	2017	7700Z3JB	1583		00/15/2017	By. DELLISON		20011	001112	on by. on ton	
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Repeat Step 21 until the QA information for each run in the ARAN data submittal is inputted into the Engineering Data Warehouse^{06/12/2019}.

- Step 22. Reply to the original notification email from the DPT (see Step 1) communicating that the QA of the submittal has been completed (see below image).
 - i. Post a link to the submittal's server folder in reviewer's email by copying the link that was provided in the original email.
 - ii. Attach Reviewer's Submittal Review Spreadsheet.
 - iii. Attach Reviewer's IRI Fidelity spreadsheet.
 - iv. Include list of major issues detected during conduct of QA review checks, if any, performed on the ARAN data submittal that Reviewer considers important to highlight.
 - v. Submit email to Supervisor and copy to DPT Team Leader and DWT Team Leader.

tonule		10
8501	🔹 🔹 RE: Aran field collection uploaded for FED evaluation and review - Aran4 Oct 5 and test loops - Message (HTML)	
File Message	Insert Options Format Text Review Help Q Tell me what you want to do	
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To	Mark Chapman	
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C for Aran 4 subi atuses have bee • 79Q0R4Rf • 79Q0S49E • 7A20S45G s always, I've att tto the same she rian	omittals <u>A4 20171004</u> and <u>A4 20171005 11</u> have been completed. All runs have been reviewed, daily settings have been checked, IRI Filtrations have been compiled, and Unique Run en updated with Engineering Data Warehouse. On the whole, this submittal looks good but it is not without some flaws. EE AA IS 97 E15 R2 W: No left images after frame 316 of 372. Recollect IE AA IS 97 E16 R2 N: No left images after frames 288-320, 328-376, and 392-432. Recollect IE AA IS 97 E16 R2 N: No left images at frames 288-320, 328-376, and 392-432. Recollect IE AA IS 97 E16 R2 N: No left images at frames 288-320, 328-376, and 392-432. Recollect IE AA IS 97 E16 R2 N: No left images at frames 288-320, 328-376, and 392-432. Recollect IE AA IS 97 E16 R2 N: No left images at frames 288-320, 328-376, and 392-432. Recollect IE AA IS 97 E16 R2 N: No left images at frames 288-320, 328-376, and 392-432. Recollect It ached the 2017 Aran 4 Submittal Review spreadsheet and these submittals IRI Filtration Review spreadsheet as well. Please note, I have combined the info and notes for both submittals eet in the 2017 Aran 4 review spreadsheet and the same IRI Filtration review spreadsheet. If you have any further concerns or questions please feel free to reach out,	
om: Mark Chapr ent: Thursday. O	man Dictober 12. 2017 11:37 AM	
Ralph Smith <	<rsmith3@sha.state.md.us></rsmith3@sha.state.md.us>	
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6- Decision To Recollect - performed by Supervisor

Summary: This task performs necessary checks of the reviewer's tasks for the review of an ARAN data submittal.

- Step 23. Upon receipt of QA submittal email, Supervisor should review errors reported and decide if data should be recollected. The decision to recollect is based on several factors:
 - i. Data type and completeness.
 - Settings some setting errors are expected, such as DMI calibration factor (would be different if vehicle was calibrated recently), others are unexpected and could have a more critical influence on data.

- 2. IRI check the percentage of incomplete data. If it is determined that a large quantity of data is missing, recollection may be necessary.
- Video completeness is an essential component of the deliverable. Decision to recollect is based on percentage of data that is missing or of poor quality. Some cloudiness or minor visual obstructions may be allowable whereas a large amount of light (washed out) images may be a candidate for recollection.
- ii. Extent to which the data quality is affected by errors.
- iii. Length and type of road where errors occur.
 - 1. Interstate or HPMS sections always get recollected (important to State).
 - 2. Smaller local roads recollection is typically based on the earlier stated factors, but sometimes decision is made that recollection is not necessary.
- iv. Extent of error Determine if errors are of a localized nature or if they exist across a large amount of data.

When decisions are made to recollect, communicate list of sections where data should be recollected to the ARAN crew.
5.03 POST-PROCESSING OF ARAN GPS DATA

5.03.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to process the Global Positioning System (GPS) data collected by the Automatic Road Analyzer (ARAN) survey vans in the field by Field Explorations Division (FED) staff. The post-processing of ARAN GPS data is performed in batches throughout the annual data collection season. This SOP applies to the GPS post-processing of each individual ARAN data batch. The post-processing of ARAN GPS data is performed after completion of loading the ARAN data into Vision as outlined in Loading of ARAN Data into Vision. This process results in the generation of ARAN GPS location data for import into the Vision database.

5.03.02 Frequency

The post-processing of GPS data is completed every time a batch of ARAN collected data is received by the DPT, which typically occurs every 4 to 5 days. Assuming an average of 60 miles collected per day, each batch contains, on average, between 240 and 300 miles of ARAN data. The actual frequency varies according to the proximity of the routes on which data were collected for the data batch to the Office of Materials Technology (OMT) office and it ranges from 1 day (when collected near the OMT office) to 2 weeks (when collected far from the OMT office). Shorter turn-around periods are preferred to minimize the amount of mileage requiring data recollection. The annual ARAN data collection season typically lasts from March to Mid-December.

5.03.03 Purpose

The purpose of this SOP is to process the ARAN GPS data and perform quality control (QC) and quality assurance (QA) checks.

5.03.04 *Resource Requirements*

The processing of GPS data involves two people: (1) a user knowledgeable in Roadware Vision and POSPac MMS 6.2^{06/12/2019} software to process the GPS data and perform QC, and (2) a supervisor who, as required, provides guidance and decision-making and performs QA. The estimated effort levels in the table below represent the total time, in man-hours, to complete the GPS processing and QC/QA checks. These time estimates assume average batch quantities and no issues encountered during processing.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	POSPac/DCS user and QC	1	4.0
DPT TL	Supervisor and QA	1	AR ^{06/12/2019}

5.03.05 *Procedure*

The POSPac computer on the ARAN van starts collecting data as soon as it is powered on. The data files are around 8 MB in size – whenever a file reaches that general file size, a new file is automatically created. If the POSPac computer is running for the entire data collection day, there would be approximately 160 to 180 daily files. During a typical data collection day, the computer is shut down at least once, resulting in two sets of files (or more depending on the number of shut downs). The image below shows an example set of daily files.

LV201706220717.000	LV201706220842.000
LV201706220717.001	LV201706220842.001
LV201706220717.002	LV201706220842.002
LV201706220717.003	LV201706220842.003
LV201706220717.004	LV201706220842.004
LV201706220717.005	LV201706220842.005
LV201706220717.006	LV201706220842.006
LV201706220717.007	LV201706220842.007
LV201706220717.008	LV201706220842.008
LV201706220717.009	LV201706220842.009

Each set needs to be processed and imported separately. If the wrong POSPac data is imported into the wrong set of files, the GPS mapping for those days will be incorrect and will need reprocessing. The MS Excel Macro code for sorting the list of POSPac file names has been included as an appendix (see <u>POSPac List Files Macro</u>).

The procedure to process ARAN GPS data and perform QC/QA is comprised of the following three tasks:

- (1) processing GPS data,
- (2) performing QC of the processed GPS data, and
- (3) performing QA of the processed GPS data.
- 1- Processing GPS Data performed by POSPac and DCS user

Summary: This task uses the POSPac software to process GPS files from the ARAN data submittal and Roadware DCS to import the results into Vision.

Step 1. Open a blank document in MS Excel. Click on the "Developer" tab. If the tab is not shown, consult the help tool within Excel for directions on how to enable it. Click the "Visual Basic" button (see below image).

File	Ho	ome In	sert Pag	e Layout	Formulas	Data	Review	View	Developer	♀ Tell	me what you	ı want to do		
Visual Basic	Macros	E Record Use Re Macro Code	Macro ative Referer Security	nces Add ins	Excel Add-ins Add-ins	COM Add-ins	Insert Design Mode	C Prope	erties Code Dialog	urce Expa	Properties Insion Packs esh Data XML	Import 🗟 Export		
A1		•	× ✓	f _x										
	А	В	с	D	E	F	G	н	I	J	к	L	м	N
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Step 2. Copy the MS Excel Macro code provided in <u>POSPac List Files Macro</u> and paste it into the dialogue window in Excel. Click "Run" (see below image).



Step 3. A "Browse" window will pop-up requesting the location of the POSPac files (see below image). The POSPac files should be located in the "Videolog" server folder for the corresponding ARAN data batch, named as "[YYYY]\Data\[YY]_A[ARAN#]\Rec[MMDDYY]\Posdata" (e.g., "2017\Data\ 17_A3\Rec062217\Posdata").

K Browse				x
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Organize 🔻 New folder				0
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🕞 Libraries 👘 🐌 170622	06/22/2017 12:22	File folder		
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🚽 Music 🗧				
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Videos				
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🕌 Local Disk (C:)				
DATADRIVE1 (D:) 🗸 🖌 👘				Þ
Folder name:				
	Tools 🔻	ок	Cance	!

If the POSPac files are not on the "Videolog" server, they need to be copied from the hard drive. Roadware DCS copies the files to the video folder, but they are not separated by ARAN number.

Once the POSPac files are located, select the "Posdata" folder at the above location and click "OK."

Step 4. Sort the Excel results into different sections.

- i. Select the column or highlight the cells that have files listed.
- ii. Hit the "Alt" key, followed by the "D" key, followed by the "S" key (do not hold all keys down at once).
- iii. The "Sort" window will appear (see below image). Click "OK."

1	Sort							? ×
	<mark>⁺</mark> A <u>A</u> dd	Level X Dele	te Level	Copy Level	Option	ns	My dat	a has <u>h</u> eaders
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Step 5. Organize the entries by cutting and pasting file sets into separate columns. A file set is defined as a collection of files with the same characters prior to the ".XXX" extension. For example, an entry in Excel that reads "LV201706220717.001" belongs to the file set "LV201706220717" and should be included in the same column as all entries with that pre-extension name. Each file name should have its own column (see below image). The number of file sets is dependent upon the number of computer restarts performed throughout the day. Typically, there will be at least 2 different file sets, but it is not unusual to have more.

LV201706210751.000	LV201706220717.000	LV201706220842.000
	LV201706220717.001	LV201706220842.001
	LV201706220717.002	LV201706220842.002
	LV201706220717.003	LV201706220842.003
	LV201706220717.004	LV201706220842.004
	LV201706220717.005	LV201706220842.005
	LV201706220717.006	LV201706220842.006
	LV201706220717.007	LV201706220842.007
	LV201706220717.008	LV201706220842.008
	LV201706220717.009	LV201706220842.009
	LV201706220717.010	LV201706220842.010

Step 6. Open the POSPac MMS 6.2 program by clicking on the "POSPac" icon (see below image) located on the Desktop. Start-up screen once program is opened may appear different depending on user's computer settings and previous experience with POSPac. Search for the POSPac MMS 6.2 file using the windows explorer if the desktop shortcut is not available.



Step 7. Click on the "Tools" drop-down menu and select *Options* (see below image).



Confirm that the "Project management folder" location, under the "File Locations" menu (see below image), is pointed to the correct "Videolog" server folder location: "\\shahanartico2\shaomtvideolog\[YEAR]\Data\POS Export\". Otherwise, click the "..." button and browse to that location. Click "OK." If this is the beginning of the data collection season, the folders for "Data" and "POS Export" will need to be created before this step.

Options		
General File Locations Startup and Display	Project Management Project management folder:	
Update Options Reference Stations External Application	\\shahanartico2\shaomtvideolog\2017\Data\POS Export\ Export folder:	
Import Options	\\shahanartico2\shaomtvideolog\2017\Data\POS Export\ Download and import folder:	
	\\shahanartico2\shaomtvideolog\2017\Data\POS Export\	
	Copy imported files to import folder Templates Template folder: C:\Users\jmask\AppData\Roaming\Applanix\POSPac MMS\6.2\]

Step 8. If desired, the starting state may also be changed under the "Startup and Display" menu (see below image). In most cases, the most convenient setting is "Open new default project." Click "OK" to exit the "Options" window and save setting changes.

Options		
General File Locations ♦ Startup and Display Internet Download Update Options Reference Stations External Application Import Options	Startup Options Starting state: No project Last project Qpen project command Display of start page Open new default project Recently-used file list: 4 Image: Start page Open new default project Recently-used file list: 4 Image: Start page Open new default project Recently-used file list: 4 Image: Start page Open new default project Recently-used file list: 4 Image: Start page Graphics Window Options Image: Display data tips Background color: Image: Display data tips Back Image: White Pick aperture: 5 Image: pixels Application Display Option Window display mode: Tabbed views (SDI)	
		OK Cancel

Step 9. A new project should now be created in POSPac MMS (see below image). If not, click the "New Default Project" button. Then, click the "Import" button.

Λ				ARTMEN	T OF T	RANSPORT	ATION			
			STATE HIC	SHWAY A	DMINI	STRATION	Pos	st-Processing	Data Pro of ARAN G	ocessing PS Data
Pn	DOCD-	- MMS	Unnamor	4						-
P	PUSPa	C IVIIVIS -	Unnamed							
Ei	le <u>E</u> di	t <u>V</u> iew	<u>P</u> roject	<u>S</u> elect	Ru <u>n</u>	<u>R</u> eports	<u>T</u> ools	<u>W</u> indow	<u>H</u> elp	
1	L 🧭	🖬 🛛 🖻	🛯 🖓	🏨 i 🖪	, ∎	•	1 A .	心会。	Q	🌯 🛤
	Plan	View								
Projec	10000)								
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lorer										
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	5000									

An import window will appear on the right-hand side of the program. If the program has been used before, the window will display the last files that were imported. Otherwise, it will be blank.

Step 10. Using "Windows Explorer", navigate to the file location of the POSPac files. Copy the address displayed at the top of the window. Paste the address in the "Import Folder" dialogue box in the POSPac Import window (see images below).

	10.00	1002				 x
🕞 💭 🗢 🚺 🛝 shahanartico2\shaomtvide	eolog\2017\Data\17_A3\Re	c062217\Posdata\170622		✓ 4 Search 1	70622	Q
Organize 🔻 📄 Open Burn M	New folder				= -	0
☆ Favorites	▲ Name	Date modified	Туре	Size		-
🧮 Desktop	LV201706220717	.000 06/22/2017 7:20 AI	VI 000 File	8,195 KB		Ξ
🐌 Downloads	LV201706220717	.001 06/22/2017 7:23 AI	VI 001 File	8,193 KB		
📃 Recent Places	E LV201706220717	.002 06/22/2017 7:26 AI	VI 002 File	8,194 KB		
🝊 OneDrive	LV201706220717	.003 06/22/2017 7:29 AI	VI 003 File	8,193 KB		
	LV201706220717	.004 06/22/2017 7:32 AI	VI 004 File	8,194 KB		
🖳 Computer	LV201706220717	.005 06/22/2017 7:36 AI	VI 005 File	8,193 KB		
🚢 Local Disk (C:)	LV201706220717	.006 06/22/2017 7:39 AI	VI 006 File	8,194 KB		
👝 DATADRIVE1 (D:)	LV201706220717	.007 06/22/2017 7:43 AI	VI 007 File	8,196 KB		
🚽 JMask (\\shahanfs1\omtoocusers) (I	LV201706220717	.008 06/22/2017 7:46 AI	VI 008 File	8,193 KB		
🖵 omtoocshared (\\shahanfs1) (N:)	- LV201706220717	.009 06/22/2017 7:50 AI	√I 009 File	8,195 KB		-
LV201706220717.001 Date mo 001 File	odified: 06/22/2017 7:23 Al Size: 8.00 MB	M Date created: 06/22/2017 12:22 PM				

×	lmport		φ×
	🗢 🗖 🗄 🖶 🎉		
	Import Folder		
	\2017\Data\17_A3\Rec062	217\Posdata\170622	
	Select File(s)		
	File Name	File Type	*
	LV201706220842.016	POS Data	
	LV201706220842.028	POS Data	
	11/00/200007/2010	500 D -	

After pasting the address, do not hit enter. The program will automatically show the POSPac files after pasting the address.

Step 11. Import the first file set. Click the "File Name" column. This will sort the file names (see below image). Compare the sorted list in the POSPac Import window to the Excel sheet with the sorted columns created in Step 1 to Step 5. All file sets will be displayed in the POSPac Import window. However, each set must be processed individually. Using the Excel sheet as a guide, select only the first set of files in the POSPac Import window. Make sure all files begin with a capital "LV." The case of the "L" and "V" at the beginning of the file names must match for a given set. If some of the files in the set begin with "lv", change them to "LV" in the data folder before importing into POSPac.

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Data Processing Post-Processing of ARAN GPS Data

- Import		Ϋ ヘ
🗢 🚍 🔂 隆		
Transact Coldon		
Import roider		
\\shahanartico2\shaomtvid	leolog\201\1706	22 💌
Select File(s)		
Die News		
LV20170020717.000		- i
LV201706220717.000		
11/201706220717.001		
LV201706220717.002	POS Data	
LV201706220717.003	POS Data	
LV201706220717.005	POS Data	
LV201706220717.006	POS Data	
LV201706220717.007	POS Data	
LV201706220717.008	POS Data	
LV201706220717.009	POS Data	E
LV201706220717.010	POS Data	
LV201706220717.011	POS Data	
LV201706220717.012	POS Data	
LV201706220717.013	POS Data	
LV201706220717.014	POS Data	
LV201706220717.015	POS Data	
LV201706220717.016	POS Data	
LV201706220717.017	POS Data	
LV201706220717.018	POS Data	
LV201706220717.019	POS Data	
LV201706220717.020	POS Data	
LV201706220717.021	POS Data	
LV201706220717.022	POS Data	
LV201706220842.000	POS Data	
LV201706220842.001	POS Data	
LV201706220842.002	POS Data	
LV201706220842.003	POS Data	
LV201706220842.004	POS Data	
LV201706220842.005	POS Data	
LV201/06220842.006	POS Data	
LV201/06220842.00/	POS Data	
LV201706220842.008	POS Data	
LV201706220842.009	POS Data	
LV201/00220042.010	POS Data	Ψ.
22 files esterted		
20 1103 30100100.		
Close command after im	port	
	port	
Settings		*
Extraction Start Tim 0		
Downsampling Fact 1		
Extraction End Tim 9999	99	
	Import	Close
PS 0 🛱 50010.425 m,	39425.152 m	

Click "Import" once all the files in a set are selected (see above image). Several boxes will open and close as the program takes a few minutes to process the

files. Do nothing until the "Raw Data Check In" window appears (see below image). Click "OK."

Ra	Raw Data Check In							
				F	Point View			
	Import	Point ID	File Name	Start Time	End Time	Duration	Feature Code	
+	V	Start	LV201706220717	06/22/2017 11:26:44 AM	06/22/2017 11:26:44 AM	00:00:00	(None)	
		Roving Segment	LV201706220717	06/22/2017 11:26:52 AM	06/22/2017 12:44:28 PM	01:17:36	(None)	
F	Point	Antenna Receiver						
1		'			ſ			
					l	<u>H</u> eset		

"Project Definition" window will appear (see below image). Click "OK."

Projection Definition							
The project's projection will be automatically updated based on the global point 'Start'. Enter the best known grid coordinates known for point 'Start'. These values will become the projection's false origin.							
Easting:	Origin longitude:						
0.000 m	W76°40'43.34179"						
Northing:	Origin latitude:						
0.000 m	N39°09'28.43100"						
	OK						
	UK						

If the following error message appears, it's due to an error in the file name (some files in the set have "LV" while others have "lv"). Click "OK" and return to Step 10 once all the files in a set have matching cases (see below image).



Step 12. Review map display of processed data in POSPac. The program will show a plot of the ARAN path for the processed file set (see typical image below). The map size will depend upon the size of the file set. If the map shows too many straight lines or strange overlaps are visible (indicating the road path may not have been followed and the GPS readings are incorrect), the data may need to be examined for validity (see abnormal image below).



Data Processing Post-Processing of ARAN GPS Data



Step 13. Save the file. Select "Save As" from the main ribbon. The format for saving files is [MMDDYY][ARAN#]_pt[#FILEFORTHEDAY] (see below image). The "pt" in the filename is used to distinguish different sets of files in the same day. Repeat Step 11 to Step 13 for all file sets in the batch.

Data Processing Post-Processing of ARAN GPS Data

Pp Save As				×
Save in:	POS Export	•	G 🤌 📂 🛄 -	
æ	Name	*	Date modified	Туре
Recent Places	062217A3p1		09/22/2017 10:47	File folder
	lidData		07/31/2017 11:11	File folder
Desktop	Unnamed		08/29/2017 9:58 AM 09/22/2017 1:08 PM	File folder File folder
	Unnamed(2)		09/25/2017 9:07 AM	File folder
Libraries	Pp 062217A3p1.	pospac pospac	09/22/2017 10:47	POSPac p POSPac p
Computer				
	•			P.
Network	File name:	062517A3_pt1		Save
	Save as type:	Project Files (*.pospac)	-	Cancel
				Help

- Step 14. Rename POSPac files so they may be loaded into Vision. Open two "Windows Explorer" windows.
 - i. In the first "Explorer" window, navigate to the "POS Export" folder (see below image).

		-		12244	1.00	2.00		×
🕞 🕞 🗢 🕌 🕨 Network 🕨 shahanartico	o2 🕨	shaomtvideolog + 2017 + Da	ita ▶ POS Export ▶	• 4 ₇	Search POS I	xport		٩
Organize 🔻 Burn New folder							•	0
☆ Favorites	^	Name	Date modified	Туре	Size			
🥅 Desktop		🐌 062517A3_pt1	09/25/2017 9:14 AM	File folder				
🚺 Downloads) 062517A3_pt2	09/25/2017 9:46 AM	File folder				
🔛 Recent Places	Ξ	퉬 OldData	07/31/2017 11:11	File folder				
Computer								
Local Disk (C:)								
DATADRIVE1 (D:)								
👳 JMask (\\shahanfs1\omtoocusers) (f								
🚽 omtoocshared (\\shahanfs1) (N:)	-							
3 items								

Select the first file set folder. Navigate to "Mission 1", then "Extract." Find the files named **vnav_Mission1.out** and **vrms_Mission1.out** (they will be listed last). Copy these files (see below image).

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Data Processing Post-Processing of ARAN GPS Data

				12000		als also		- 0	X	-
😋 🔵 🗢 🔰 🕨 Network 🕨 shahanarti	ico2 I	• shaomtvideolog → 2017 → Data	POS Export > 062517A3_pt1 >	Mission 1 Extract	t	✓ 4 Search Extract		_		p
Organize 🔻 📄 Open Burn	Organize 🔻 🗋 Open Burn New folder 📳 👻 🗍 🔞									
🔆 Favorites	^	Name	Date modified	Туре	Size					^
🧮 Desktop		gps_iono_Mission 1.dat	09/25/2017 9:08 AM	DAT File	1 KB					
🚺 Downloads		hdg_Mission 1.dat	09/25/2017 9:08 AM	DAT File	15 KB					
🔚 Recent Places		hwconfig_Mission 1.out	09/25/2017 9:08 AM	OUT File	2 KB					
🝊 OneDrive	Ξ	idx_Mission 1.txt	09/25/2017 9:08 AM	TXT File	1 KB					
		imu_Mission 1.dat	09/25/2017 9:08 AM	DAT File	3,897 KB					
🖳 Computer		imudt_Mission 1.log	09/25/2017 9:08 AM	Text Document	1 KB					_
🏭 Local Disk (C:)		mgps_Mission 1.gps	09/25/2017 9:08 AM	GPS File	6,072 KB					
DATADRIVE1 (D:)		mgpsconv_Mission 1.log	09/25/2017 9:08 AM	Text Document	3 KB					
🚽 JMask (\\shahanfs1\omtoocusers)	0	obs_pri_Mission 1.dat	09/25/2017 9:08 AM	DAT File	730 KB					Ε
🚽 omtoocshared (\\shahanfs1) (N:)		tm_Mission 1.dat	09/25/2017 9:08 AM	DAT File	1,949 KB					
🚽 hanprograms (\\shahanfs1) (P:)		vnav_Mission 1.out	09/25/2017 9:08 AM	OUT File	4,070 KB					
雬 sharedprograms (\\shahqfs3) (S:)	-	vrms_Mission 1.out	09/25/2017 9:08 AM	OUT File	48 KB					-
2 items selected Date mod	2 items selected Date modified: 09/25/2017 9:08 AM Date created: 09/25/2017 9:08 AM Size: 4.02 MB									

ii. In the second "Explorer" window, navigate to the ARAN Submission file (see below image).

🔶 Favorites	Name	Date modified	Туре	Size			
Contraction Contra	20170625	07/05/2017 8:17 AM	File folder				
😺 Downloads	20170626	07/05/2017 8:17 AM	File folder				
🔚 Recent Places	30170627	07/05/2017 8:17 AM	File folder				
🐔 OneDrive	20170628	07/05/2017 8:17 AM	File folder				
	June 20170629	07/05/2017 8:17 AM	File folder				
🖳 Computer	PAVEQC625	07/05/2017 9:30 AM	File folder				
🖀 Local Disk (C:)	퉬 paveqc626	07/05/2017 8:17 AM	File folder				
DATADRIVE1 (D:)	퉬 paveqc627	07/05/2017 8:17 AM	File folder				
🖵 JMask (\\shahanfs1\omtoocusers) (M:)	퉬 paveqc628	07/05/2017 8:17 AM	File folder				
雬 omtoocshared (\\shahanfs1) (N:)	퉬 paveqc629	07/05/2017 8:17 AM	File folder				
🖵 hanprograms (\\shahanfs1) (P:)	퉬 posdata	07/05/2017 8:20 AM	7/05/2017 8:20 AM File folder				
雬 sharedprograms (\\shahqfs3) (S:)	PAGD_QC_1000000.csv	07/05/2017 7:54 AM	Microsoft Excel C	soft Excel C 26 KB			
🚽 PmdataPRG (\\shahanpmdata1) (Z:)	vrms_Mission 1.out	09/25/2017 9:08 AM	OUT File	48 KB			
	vnav_Mission 1.out	09/25/2017 9:08 AM	OUT File	4,070 KB			
🗣 Network							

Paste the copied files into this folder. The "Mission 1" part of the copied files must be renamed. To do this, open the "PAGD_QC_1000000" spreadsheet located in the same folder. Find a "UniqueRun" from the corresponding date of the POSPac file set. Replace "Mission 1" in both copied files with that "UniqueRun" value. Repeat this step for all file sets in the batch (see images below).

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Data Processing Post-Processing of ARAN GPS Data

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	Clipboar	d 15	i	Font	Г	5	Alignment		ra l	Number
A	L	• : :	×	<i>f</i> ∗ IDL	ocator					
	А	В	с	D	E	F	G	н	I	J
1	IDLocator	L_County	L_RouteID	L_Dir	UniqueRun	Collection	DCSTimeStamp	IDSession	BeginDist	EndDistan B
2	1384	BA	IS 83	S	76P0K3UV	1723	06/25/2017 7:3	0 994	0	5298.772
3	1384	BA	IS 83	S	76P0L3OI	1723	06/25/2017 7:4	8 995	0	4281.384
4	1599	BA	MD 25 A	S	76P0L3OH	1723	06/25/2017 7:4	8 996	0	2323.87
5	1383	BA	IS 83	N	76P0L3ZG	1723	06/25/2017 7:5	4 997	0	5924.981
6	1598	BA	MD 25 A	N	76P0L3ZH	1723	06/25/2017 7:5	4 998	0	841.0202
7	1383	BA	IS 83	N	76P0M3GP	1723	06/25/2017 8:0	5 999	0	39969.39
8	1626	BA	MD 45	S	76P0O3SI	1723	06/25/2017 8:5	5 1000	0	41762.84
				P/	AVEQC625 aveqc626					
				📗 pa	aveqc627					
				🌗 pa	aveqc628					
				🕛 pa	aveqc629					
				ili po	osdata					
				🔊 P/	AGD_QC_10	00000.csv				
					ms_76P0L3	OH <mark>.out</mark>				
				📄 vr	nav_Mission	1.out				

- Step 15. Open the Data Control Software. Click "OK."
- Step 16. Click the "Import SBET" tab. The "Import SBET" window will appear (see below image). SBET is a type of GPS file, which does not exist in the ARAN data output. However, this import also works for vnav and vrms files.



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Data Processing Post-Processing of ARAN GPS Data

👔 Data Control Software	- nap
File View Tools Help	
Current Project: SHA_MD_VISION_PROJECT1 Change Project	
Upload and Import Wizard Video QC Import SBET	
Import to Database: OMT_ARAN_PROD_2017_1	
SBET Location: Browse Limit frequency of POS Data	to: 50 Hz
Select Group	
Select All Select None 🔞 Invert Selection	Save to CSV
Import Filename Time Span Chainage Length Dual CAD Diff Single Other	
	Start

Browse for the file location. The file location is the ARAN submission folder in Step 17. which the vnav and vrms files were just copied and renamed in Step 14. Once the location is set, click the "Select Group" button (see above image). The "Group Selector" window will open (see below image).

Group Selector] Group Selector							
🖻 Refresh								
Group	Description	Video Path	Expre 🔺					
🖃 🔲 Al								
- 🚺 74S0V3R7			[D					
- 🚺 74S0X4A6			[D					
- 🚺 74S154I2			[D					
- 🚺 74S1637M			[D					
- 📒 74S164MR			[D					
- 🔲 7540N437			[D					
- 📒 79F0L3R7			[DC					
- 📒 A3			[D					
- 📒 A4			[D					
😐 🗐 Al	All		[dc					
- 📒 All the TL			[Locat					
- 📕 Base Report			[DCSe:					
🕀 📒 Batch 01	ARAN 1724 - Apr 18 to Apr 18	\\shahanartico2\shaomtvideolog\2017\Video	[DC					
Batch 02	ARAN 1723 - Apr 18 to Apr 18	\\shahanartico2\shaomtvideolog\2017\Video	[DC					
- 📒 Batch 03	ARAN 1724 - Apr 28 to Apr 28	\\shahanartico2\shaomtvideolog\2017\Video	[DC					
- 📒 Batch 04	ARAN 1724 - Apr 28 to Apr 28	\\shahanartico2\shaomtvideolog\2017\Video	[DC					
🕀 📒 Batch 05	ARAN 1723 - Apr 28 to Apr 28	\\shahanartico2\shaomtvideolog\2017\Video	[DC					
Batch 06	ARAN 1723 - May 02 to May 03	\\shahanartico2\shaomtvideolog\2017\Video	[DC					
Batch 07	ARAN 1724 - May 02 to May 04	\\shahanartico2\shaomtvideolog\2017\Video	[DC					
- 📒 Batch 09	ARAN 1723 - May 08 to May 14	\\shahanartico2\shaomtvideolog\2017\Video	[DC					
Batch 10	ARAN 1724 - May 08 to May 15	\\shahanartico2\shaomtvideolog\2017\Video	[DC					
- 📒 Batch 11	ARAN 1724 - May 16 to May 18	\\shahanartico2\shaomtvideolog\2017\Video	[DC					
- 📕 Batch 12	ARAN 1724 - May 16 to May 18	\\shahanartico2\shaomtvideolog\2017\Video	[DC					
Batch 13	ARAN 1723 - May 15 to May 18	\\shahanartico2\shaomtvideolog\2017\Video	IDC					

Step 18. Select the correct data batch in the window (corresponds to the proper ARAN number and collection date). Click "OK." The DCS will display all files in the selected batch. This may take a few minutes to process (see below image).

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Data Processing Post-Processing of ARAN GPS Data

Data Control Software								
File Vie	w Tools Hel	р						
Current	t Project: <i>Sh</i>	A_MD_VISION	PROJECT1 Cha	ange Project				
Upload a	ind Import Wizard	d Video QC Impo	ort SBET					
Import	Import to Database: OMT_ARAN_PROD_2017_1							
SBET LO	SBET Location: ico2\shaomtvideolog\2017\Data\17 A4\Rec092617 Browse Limit frequency of POS Data to: 50 Hz							
Sel	Select Group Batch 47 X							
🖌 Se	lect All	elect None 🔞 Inve	rt Selection	estore Origin	al GPS		Reference Save to CS	iv.
Import	Filename	Time Span	Chainage Length	Dual	CAD Diff	Single Oth	er	
	79J0L46T	2853.59607122606	29591.1621392887	0	142573	0		
	79J0O40J	3219.60327537218	39117.9169237004	0	160864	0		
	79J0R4M8	2501.63085687661	31300.8926051041	0	124978	0		
-	79J0T4N2	46.003976963897	226.464056399323	0	2360	0		E
	79J0T4TD	51.3153251508775	233.687776491023	0	2733	0		
	79J0U45L	701.764868050028	10041.9447122847	0	35067	47		
	79J0U4R2	129.021396066848	1238.60781964878	0	6508	0		
v	79J0U4WG	161.02432563412	1237.35573472158	0	8197	0		
v	79J0V488	153.615660781186	1412.65758278831	0	7687	0		
v	79J0V4O3	41.8475684165605	158.99765755225	0	2143	0		
V	79J0V4SD	40.4562823666492	128.454486380954	0	2292	0		
1	79J0V4W9	95.5206751512596	455.625074520961	0	0	0		
	79J0W41M	87.2172018511337	433.801353738821	0	4393	0		
1	79J0W47P	92.4690521931916	698.222437733671	0	0	0		
1	79J0W4OU	126.092617355054	1158.99125691535	0	6328	0		
1	79J0W4Y9	1788.89580619492	21011.1689162149	0	81474	0		
v	79J0Y4YT	709.654818281706	9551.79887293768	0	35479	0		
v	79J0Z4M6	19.85857768805	230.996789723291	0	1012	0		
v	79J124H5	986.909137967858	13337.4765881363	0	49316	0		
	79J134CS	589.857904247998	6337.91422036535	0	29488	0		
	79J134V6	198.540678483725	369.005892367434	0	4848	0		
V	79J14454	110.16986523688	374.199853998665	0	5517	0		
	79J144I9	48.3432970432041	572.82420701067	0	2431	0		
	79J144Z3	50.1050461421255	264.031118625686	0	2542	0		
v	79J1542S	62.3141883408825	296.147960057561	0	3128	0		
	79J154AI	582.272528145026	6193.41325467992	0	29104	0		
	79J1642V	67.9515190602397	373.311842970758	0	0	0		-
							Start	

Step 19. Click the "Start" button. An import progress window will appear. You can click the drop-down arrow next to "Details" to see the import status. When the program is done, the import progress window will show 100% (see below image).

Import SBET Progress	
Progress	100%
Oetails Current Step Progress	
Finished	
	View Results

2- Performing QC of Processed GPS Data – performed by DCS user

Summary: This task reviews errors encountered when importing and performs a visual check of the results in Vision's mapping window prior to completion.

Step 20. Click the "View Results" button.

i. If there are no errors, open Vision's mapping window to visually inspect the routes. Ensure the vehicle's routing (red line) is in close proximity to the green pins (see below image). When this is finished, the process is complete.

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Data Processing Post-Processing of ARAN GPS Data



ii. If there are errors, they will appear in the bottom window (see below image). Proceed to Step 21.

	ummary				Edit			
	File Name Comment Data							
II								
	rrors							
	rrors Applicatio	n Task	File Name	Message	Details			
	Applicatio	n Task Import SBET	File Name	Message Import SBET Exception - 7850M3Z1	Details Coverage: No Coverage was found for this session			
	rrors Applicatio CS CS CS	n Task Import SBET Import SBET	File Name	Message Import SBET Exception - 7850M3Z1 Import SBET Exception - 7850P306	Details Coverage: No Coverage was found for this session Coverage: No Coverage was found for this session			
	Applicatio CCS CCS CCS CCS CCS	n Task Import SBET Import SBET Import SBET	File Name	Message Import SBET Exception - 7850M3Z1 Import SBET Exception - 7850P306 Import SBET Exception - 7850P33H	Details Coverage: No Coverage was found for this session Coverage: No Coverage was found for this session Coverage: No Coverage was found for this session			
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Step 21. Check to make sure the files receiving errors are valid. Go to the Vision "Section Explorer" and filter for the "Collection ID" associated with the error. The Collection ID can be found in the "Message" column of the error window.

- i. If the files which received errors are marked as "DUMMY", they are not valid, and the errors do not need to be corrected (process is complete).
- ii. If the files are valid, their GPS files were not imported properly, and they will need to be found and imported. Proceed to Step 22.
- In the Vision window, first note the collection date and time. Then, navigate to Step 22. the GPS files and find the corresponding files of that date and time. Run POSPac for those files by completing Step 6 to Step 14.
- Import revised files into Vision. Complete Step 15 to Step 19. When importing, Step 23. make sure to deselect files that were already correctly imported.
 - i. If the files import this time with no error messages, the process is complete.
 - ii. If the files still do not import, contact Supervisor to discuss next steps.

3- Performing QA of Processed GPS Data – performed by Supervisor

Summary: This task performs QA checks on the processed GPS data.

- Step 24. TL review of QC staff notification of recollection.
- Review of production status receive weekly update from QC staff (last ARAN Step 25. collection data fully processed).
- Verify ARAN collection path matches the route overlay in the Vision map. Step 26.

5.04 RUNNING GLOBAL LCMS PROCESSOR

5.04.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to process the Laser Crack Measurement System (LCMS) data collected by the Automatic Road Analyzer (ARAN) survey vans in the field by Field Explorations Division (FED) staff. The processing of LCMS data is performed in batches throughout the annual data collection season. This SOP applies to the LCMS processing, quality control (QC), and quality assurance (QA) of each individual ARAN data batch. The processing of LCMS data is performed after completion of loading the ARAN data into Vision as outlined in Loading of ARAN Data into Vision and post-processing of GPS data as outlined in <u>Post-Processing of ARAN GPS Data</u>. This process results in the generation of ARAN pavement imagery, transverse profiles, and population of cracking and lane width data on images.

5.04.02 Frequency

The LCMS Global Processor is run every time a batch of ARAN collected data is received by the DPT, which typically occurs every 4 to 5 days. Assuming an average of 60 miles collected per day, each batch contains, on average, between 240 and 300 miles of ARAN data. The actual frequency varies according to the proximity of the routes on which data were collected for the data batch to the Office of Materials Technology (OMT) office and it ranges from 1 day (when collected near the OMT office) to 2 weeks (when collected far from the OMT office). Shorter turn-around periods are preferred to minimize the amount of mileage requiring data recollection. The annual ARAN data collection season typically lasts from April through October but deliveries sometimes can occur year-round.

5.04.03 Purpose

The purpose of this SOP is to process the LCMS data and perform QC/QA of the results.

5.04.04 Resource Requirements

The running of the LCMS Global Processor involves two people: (1) a user knowledgeable in Roadware Vision software to run the LCMS Global Processor and perform QC, and (2) a supervisor who, as required, provides guidance and decision-making and performs QA. The estimated effort levels in the table below represent the total time, in man-hours, to complete the LCMS processing and QC/QA checks. These time estimates assume average batch quantities and no issues encountered during processing.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	Vision user and QC	1	4.0
DPT TL	Supervisor and QA	1	AR ^{06/12/2019}

5.04.05 *Procedure*

The procedure to run the LCMS Global Processor and perform QC/QA is comprised of the following three tasks:

- (1) running LCMS Global Processor in Vision,
- (2) performing QC of the processed LCMS data, and
- (3) performing QA of the processed LCMS data.

1- Running LCMS Global Processor in Vision – performed by Vision user

Summary: This task uses Vision software to process LCMS image files from the ARAN data submittal.

- Step 1. Open Vision.
 - i. If the LCSM Global Processor has not been run on any of the files in the database, proceed to Step 2.
 - ii. If the LCSM Global Processor has been run on any of the files in the database, proceed to Step 17.
- Step 2. Click the "Process" drop-down menu. Select "New Batch Processor." The "Batch Processor" window will open (see below image).

af Batch Processor			x				
🛃 Tasks 🗈 Options 📅 Data							
00		Batch Processor					
😥 Add 📸 New 📖 Delete	Task	Description	Ve				
Add New Delete	Task Auto Segmentation Processor Avi encoder Classifications Processor Curve Fit Batch Processor ExD Processor ExD Processor Fall Processor Maine Processor Maine Processor Maine Processor Maine Detection Processor JPEG Cracks Detection Processor JPEG Lanes Detection Processor Point Area Distress Processor Repot Generator Processor Ruphness Processor Ruphness Processor Sampled QC Events Rating Processor Segmentation Rubberbanding Segmention Ruberts Shapefile Exporter Thumbnal Creator Vehicle Positions Processor	Description Automatically matches the collected sessions with the routed data. Encode collected JPEG files to AVI. Classifies the existing detected cracks. Uses the curve fit functionality to process data inside batch processing. ERD files exporter. Provides support for geo-tagging images with gps data. Detect and filter Faults Copies original images to a given output folder Measures the brightness of images and compares against acceptable range for quality. Runs the iVison publisher on the current database. Detect and filter is a session of images Detects cracks from JPEG files. Detects lanes from JPEG files. Batch processes Ladybug collected data. Collection of LCMS functions for images conversion, cracks detection and classification an Pavement exporter based on a template file. Point-o-Area Distress Processor. Generate reports. Calculates and stores improved longitudinal profiles and roughness indices Rut processor for Transverse Profile data. Calculates and stores improved longitudinal profiles and roughness indices Rut processor. Seports SHP and KML files. Cereates humbnalis from original images in a given output folder Creates levels of detail for Vehicle Positions. Encode collected JPEG files to WMV.	Ve 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)				
	•	III	•				
ask 💻 SHAHQVISIONPRD,1438 🖳 OMT_4 🧶	ARAN_PROD_2017_1 🛃 0 🗊 13,522,482 🤕	9,008,448	.::				

- Step 3. Select "Crack Processing" from the window on the left. Click the box next to "LCMS Global Processor" in the window on the right. Then click the "Options" tab (see above image).
- Step 4. Instead of changing settings manually, search for preset schemas. Click the "Load" button (see below image).

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Data Processing Running Global LCMS Processor

a b	Batch Pro	ocessor					n de la companya de l
	Tasks	🗈 Options 🚏 Data 🐺	Process				
	🚽 Save	🚰 Load					🚰 Show Properties 🗄 👌 🕡 🍠 Reset 🗸 🏀
t t		Task	On Error	Retries	Retry delay	Log	Save LCMS Image Streams False
	1	LCMS Global Processor	Skin	0	00.00.00	False	Scale factor 0.5
	· •		onip		00.00.00	10,00	⊿ Joints/faults extraction
							Delete Joints False
							Do extract joints and faults False
							Memory/Performance
							Allow parallelization at session level True
							Use ideal cpu count Irue
							a Misc
							EventsMapper Roadware.DataMapper.Distress.EventsI
							Pavement Distress Manager Roadware. Data Mapper. Distress. Paveme
							Overnde FIS Folder
							A Pavement events
							Allow parallelization at session level
							 a set to table, while sessions are processed in parallel, in raise some processors spin each session and process parts of it in parallel.
							🗄 Simple
							⊿ Options
							Error handling Skip
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							Log results False
							Retries count 0
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. 是	Mask 💻	SHAHQVISIONPRD,1438 👤 OMT	_ARAN_PROD_2	2017_1 Ž 1	13,522,482	2 🥑 9,00	

Navigate to the location: "\\shahanpmdata1\pmdata\05 Documentation\PM Manuals\Vision\Schemas\[YEAR]." In this folder, look for an XML file named "LCMS_GLOBAL_PROCESSOR_[MOST RECENTDATE]." Select the file and click "Open" (see below image).

Coad processor settings fro	om file			×
🖉 🗸 🗸 mdata	▶ 05 Documentation ▶ PM Manuals ▶ Vision ▶ Schemas ▶ 2017 ▶	▼ 4 ₂	Search 2017	م
Organize 👻 New folde	er		:	- 🗌 🔞
☆ Favorites	Name	Date modified	Туре	Size
🧮 Desktop	🐌 OLD	10/17/2017 3:10 PM	File folder	
\rm Downloads	\mu OLD 2016 ARAN3 for rebuilding for 2017	06/13/2017 10:47	File folder	
🔚 Recent Places	🜗 Rut Protocol-Not Finalized	09/11/2017 1:33 PM	File folder	
🝊 OneDrive	🌗 Send to Fugro	10/05/2017 1:28 PM	File folder	
	🌗 Thumbnail	09/18/2017 10:07	File folder	
💻 Computer	🌗 Trial	10/17/2017 2:18 PM	File folder	
🚢 Local Disk (C:)	鷆 Vibing	07/25/2017 10:32	File folder	=
👝 DATADRIVE1 (D:)	Base_Report_9_29_2017.xml	09/29/2017 9:28 AM	XML Document	1 KI
🖵 JMask (\\shahanfs1\	CLASSIFICATION_PROFILE_6-13-2017.xml	06/13/2017 11:25	XML Document	1 KI
🚽 omtoocshared (\\sh	CurveFit2017_Protocol_6-13-2017.xml	06/13/2017 1:18 PM	XML Document	3 KI
🚽 hanprograms (\\sha	LCMS_GLOBAL_PROCESSOR_9-19-2017.xml	09/20/2017 9:54 AM	XML Document	3 KI
🚽 sharedprograms (\\s	LCMS_GLOBAL_PROCESSOR_LANE_DETECTION_ONLY-10-17-17.xml	10/17/2017 2:57 PM	XML Document	2 KI
🚽 PmdataPRG (\\shah	LCMS_Maryland_2017_06_14_2017.xml	06/14/2017 1:03 PM	XML Document	8 KI
	matched.xml	08/10/2017 12:12	XML Document	1,560 KI
👊 Network	RATING_PROCESSOR_6-13-2017.xml	06/13/2017 11:28	XML Document	1 KI
	Roughness_Processor_7-12-2017.xml	07/12/2017 8:59 AM	XML Document	1 KI
	RUT_Processor_ARAN3_9-11-2017.xml	09/11/2017 2:02 PM	XML Document	3 KI
	RUT Processor ARAN4 After June 20 9-11-2017.xml	09/11/2017 2:02 PM	XML Document	3 KI *
				,
File na	ame: LCMS_GLOBAL_PROCESSOR_9-19-2017.xml	-	XML (*.xml)	•
			Open	Cancel

- Step 5. Click "Data" from the top menu bar. Every file in the database will appear in the window. The list must be filtered to only include the sections from the current batch. This can be accomplished through two different methods:
 - i. Removing unwanted files, or
 - ii. Removing all files and selecting a batch to re-add.

- Step 6. Choose removal method. If removing all files and selecting a batch to re-add is preferred, skip to Step 7. Otherwise, use a combination of the Shift and Ctrl keys to highlight all unwanted files in the window. Click "Remove." Proceed to Step 8.
- Step 7. To remove all files, click the "Check" drop-down menu and select "All." Click "Remove." Then, click the "Reload" (first blue arrow) button. The "Group Partitions" window will open (see below image).

Group Partitions Explorer	
P Enter search criteria	
Show All	
🛈 🗸 Ali	
Batch 01	
Batch 02	
Batch 03	
Batch 04	
Batch 05	
7540N437	
more than one file	
74S0X4A6	
Batch 06	
Batch 07	
July 14 To July 18	
IS 695	
Batch 09	
Batch 10	-
OK	

Select the current batch by clicking the checkbox next to the appropriate batch name. Click the "OK."

Step 8. Once only the desired files appear in the "Batch Processor" window, they may be processed. Click "Process", then "Start." The files will begin to appear under the session window (see below image). The LCMS Global Processor will take anywhere from 1-3 hours to run. It will depend on the number of lane miles, the number of files, the number of cores in the computer, and database traffic.

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Data Processing Running Global LCMS Processor

	Task	Statue	Start	ور	Duration	Art	ual Duration	Bun Pate	Fet Remaining	Fet Finish
Å 1	LCMS Global Processor	Busy	10:46:07 AN	1 7.41	00.00:13:08	Adit	00.00:13:08	21.61	00.02:44:22 11/0	01/2017 1:43:38 PM
Tasł	LCMS Global Proce	ssor								
	Session	Length	Matched	Start	%	Duration	Run Rate			
	7AA0P4IH	1,371	0	10:46:07 AM	11.28	00.00:13:09	0.71			
2	7AA0P4RL	633	0	10:46:07 AM	13.10	00.00:13:09	0.38			
3	7AA0Q4BS	818	0	10:46:07 AM	5.71	00.00:13:08	0.21			
	7AA0P4YF	765	0	10:46:07 AM	19.69	00.00:13:08	0.69			
)	/AA0P4WB	616	0	10:46:07 AM	16.36	00.00:13:08	0.46			
) -	7AA0R403	408	0	10:46:07 AM	26.73	00.00:13:08	0.50			
•	74401430	461	0	10:46:07 AM	22.70	00.00:13:08	0.48			
, 1	74408413	690	0	10:46:07 AM	12.00	00.00.13.08	0.38			
0	7AA0R4PX	582	0	10:46:07 AM	19.11	00.00.13.08	0.55			
1	7AA0S4HD	515	0	10:46:07 AM	15.47	00.00:13:08	0.36			
2	7AA0W4R8	1.543	0	10:46:07 AM	3.73	00.00:13:08	0.26			
13	7AA0Q4OP	542	0	10:46:07 AM	30.67	00.00:13:08	0.76			
14	7AA0R428	762	0	10:46:07 AM	21.79	00.00:13:08	0.76			
15	7AA0Q4GJ	1,106	0	10:46:07 AM	11.70	00.00:13:08	0.59			
16	7AA0U4IC	258	0	10:46:07 AM	36.56	00.00:13:08	0.43			
7	7AA0U4VE	254	0	10:46:07 AM	24.29	00.00:13:08	0.28			
8	7AA0R4CN	834	0	10:46:07 AM	16.01	00.00:13:08	0.61			
9	7AA0V4ZA	711	0	10:46:07 AM	16.27	00.00:13:08	0.53			
20	7AA0U4A0	435	0	10:46:07 AM	12.39	00.00:13:08	0.25			
21	7AA0X446	1,369	0	10:46:07 AM	11.32	00.00:13:08	0.71			
22	7AA1048I	797	0	10:46:08 AM	17.64	00.00:13:08	0.64			
23	7AA0Z4YR	109	0	10:46:08 AM	100.00	00.00:07:24	88.0			
.4 vr	7AAUW45R	/42	0	10:46:07 AM	12.16	00.00:13:08	0.41			
20	74HUM42W	30	0	10:46:08 AM	30.00	00.00.12:00	0.43			
20	7AH0M475	326	0	10:46:09 AM	54.01	00.00.13.00	0.04			
28	7AA074GH	579	0	10:46:08 AM	23.75	00.00.13.08	0.63			
9	7AH0M4BP	147	0	10:46:09 AM	75.41	00.00:13:06	0.51			
0	7AH0M4FA	413	0	10:46:10 AM	10.49	00.00:13:05	0.20			
1	7AH0M4TK	717	0	10:46:11 AM	7.04	00.00:13:05	0.23			
2	7AH0N48D	351	0	10:46:11 AM	19.66	00.00:13:05	0.32			
13	7AH0N4S2	283	0	10:46:11 AM	41.83	00.00:13:05	0.54			
34	7AH0N4J6	306	0	10:46:11 AM	46.18	00.00:13:05	0.65			
5	7AH0O40U	235	0	10:46:11 AM	46.55	00.00:13:04	0.50			
36	7AH0O4BL	220	0	10:46:11 AM	19.64	00.00:13:04	0.20			
37	7AH0Q41E	132	0	10:46:11 AM	59.06	00.00:13:04	0.36			
38	7AH0O4JB	109	0	10:46:11 AM	100.00	00.00:09:53	0.66			
19	/AH0P4VW	331	0	10:46:11 AM	41.20	00.00:13:04	0.63			
10	7AHUP4ZU	259	0	10:46:11 AM	18.00	00.00:13:04	0.21			
1	7AHUP408	/19	0	10:46:11 AM	13.58	00.00.13:04	0.45			
12	74H00400	143	0	10:46:11 AM	6.22	00.00:13:04	0.39			
14	7AH00400	321	0	10:46:11 AM	24.75	00.00.13.04	0.22			
15	7AH0Q478	80	0	10:46:12 AM	66.32	00.00.13.03	0.30			
6	7AH0Q49P	789	0	10:46:12 AM	9.14	00.00:13:03	0.33			
17	7AH0Q4DO	313	0	10:46:12 AM	19.62	00.00:13:03	0.28			
18	7AH0Q4QO	605	0	10:53:32 AM	4.17	00.00:05:43	0.26			
9	7AH0R47P	542	0	10:56:04 AM	0.00	00:00:00:00				
0										
51										
52										

Step 9. A dialogue box will appear when processing is complete.

- i. If the box says, "Batch processing has completed", proceed to Step 11.
- ii. If the box says, "Batch processing has completed with errors", proceed to Step 10.
- Step 10. View the errors. Click the "*Exceptions*" drop-down menu and select "*View Exceptions*."
 - i. If the error is "Missing Images", this is acceptable. Proceed to Step 11.

ii. If any other errors are present, reprocessing is required. Click the "Exceptions" drop-down menu and select "Reprocess Exceptions." This will remove all the files from the data screen except for the files that had exceptions. Next, click the "Start" button to reprocess.

2- Performing QC of Processed LCMS Data – performed by Vision user

Summary: This task checks the quality of processed LCMS data through visual inspection of images and reasonableness of crack length values, as well as runs the "Process Monitor" application.

Step 11. Close the processor and restart Vision. In the "Section Explorer", select a file that was just run in the processor. Click the "Rate" drop-down menu and then click "Pavement Distress" (see below image).

F	ile	View Tools	He	elp						
	Co	nnect 🛛 📲 -	8) Segment 🝷 狄 I	Rate	- 🗸 💏 Process 🕶 🛛 🍯	🕽 Map 🛛 🛋 Images 🕶 🖿	Panoramic Vi	ew 🛛 🛜 Cha	irts 👻 🗊 Tables 👻 📔 Repo
2	<u>و ر</u>	ection Explorer								
	Gro	ups 7AI104EO	(1/	1)						
ρ						A T				
		County		RouteID		Dir	Time	Collection	Vehicle	
	¥	Contains:	T	Contains:	т	Contains: T	Equals: T	NotNull: T	Equals: T	Equals:
		AA		IS 595 E23 R4		Ν	10/18/2017 1:27:42 PM	7AI114E6	1724	
		AA		US 50 E28 R2		w	10/18/2017 1:16:13 PM	7AI104V1	1724	
		AA		US 50 E29 R7		w	10/18/2017 1:13:59 PM	7AI104RB	1724	
		AA		US 50 E32 R2		E	10/18/2017 1:10:25 PM	7AI104LD	1724	
►		AA		US 50 E32 R4		w	10/18/2017 1:06:24 PM	7AI104EO	1724	
		AA		US 50 E32 R5		s	10/18/2017 1:03:46 PM	7AI104AA	1724	
		AA		US 50 E30 R4		N	10/18/2017 12:59:04	7AI1042G	1724	
		AA		US 50 E30 R5		s	10/18/2017 12:57:32	7AI0Z4ZW	1724	
		AA		US 50 E29 R2		W	10/18/2017 12:51:43	7AI0Z4Q7	1724	

Step 12. A "Pavement" window will appear (could take a few minutes). At the bottom right of the screen, select the "Cracks" tab. In the window on the right, a list of all the files, their chainage, number of cracks, and other information will be displayed (see below image).

Data Processing Running Global LCMS Processor



- Step 13. Check the "Crack" and "LaneWidth" columns for zeroes. There should be a minimal amount of zeroes in the "Crack" column and no zeroes in the "LaneWidth" column. If all zeroes are showing for both columns, the LCMS Global Processor was not processed successfully on the selected file.
 - i. If the file was not processed correctly, return to Step 1.
 - ii. If the file was processed correctly, but the wrong file was selected for the QC, return to Step 11 and select the correct file.
 - iii. If this check did not result in any issues, proceed to Step 14.
- Step 14. Check the LCMS3D Images. Select a file that was processed and click on the "Images" drop-down menu. Click on "LCMS3D." The image will appear in the window (see below image). At a minimum, check the first and last images.
 - i. If the images are displayed correctly, proceed to Step 15.
 - ii. If the images are not displayed correctly, the data will need to be reprocessed. Return to Step 2.

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- Step 15. Check the LCMSRange Images. Select a file that was processed and click on the "Images" drop-down menu. Click on "LCMSRange." The image will appear in the window (see below image). At a minimum, check the first and last images.
 - i. If the images are displayed correctly, proceed to Step 16.
 - ii. If the images are not displayed correctly, the data will need to be reprocessed. Return to Step 2.

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Data Processing Running Global LCMS Processor



- Step 16. Repeat Step 14 and Step 15 for at least 3 files from the batch.
- Step 17. Perform the Process Monitor Check. Click the "Process" drop-down menu and select "Process Monitor." The "Process Monitor" window will appear (see below image).

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Section Explo	rer 🏼 Pavem	ent 🚉 LCMS3D	🕿 LCMSRange	Process Monitor]					
💏 Get Status 💣				: 🕑 Matched Only	96 🖤 Exception → 🌱	Rut 👻 🕎 Roi	ughness 👻 🖓 Crac	kDetection 👻 🍸	CrackClassification +	
🛃 Up 📑 Down	Color 🗹 🗸			UniqueRun	Collection Time	County	RouteID	Dir	Length	Matched
Process	Color	Method		74I0S3NZ	04/18/2017 10:19:11 AM				686.164	
				74I0S3TF	04/18/2017 10:22:27 AM				600.356	
7 But				74I0T41Z	04/18/2017 10:27:35 AM				1,342.957	
A suchness				74I0T36C	04/18/2017 10:30:12 AM				1,536.765	
Crack Detection	20			74I0T4K8	04/18/2017 10:38:32 AM				1,397.927	
I ar Crack Classific	ation			74I0T3OC	04/18/2017 10:41:00 AM				1,501.127	
Z A Distress Bating	1			74I0T4YA	04/18/2017 10:46:58 AM				802.542	
	,			74I0U4IA	04/18/2017 10:58:58 AM				1,315.185	
Curve Fit Horizo	ontal			74I0U4SK	04/18/2017 11:05:08 AM				1,005.624	
CurveFitVertic	al			74S0U3LB	04/28/2017 11:00:47 AM				13,067.643	
	0			74S0U4MQ	04/28/2017 11:01:38 AM				397.758	
Transverse Pro	ofile			74S0V40L	04/28/2017 11:09:57 AM				13,070.617	
	onic			74S0V3R7	04/28/2017 11:25:55 AM				13,054.209	
				74S0W46B	04/28/2017 11:34:59 AM				13,021.856	
				74S0W3V1	04/28/2017 11:49:49 AM				13,043.166	
				74S0X4A6	04/28/2017 11:58:54 AM				13,024.639	
				74S0X3YG	04/28/2017 12:13:28 PM				13,047.466	
				74S0Y4DL	04/28/2017 12:22:33 PM				13,028.031	
				74S0Z3N6	04/28/2017 12:49:54 PM				13,050.819	
				74S1042I	04/28/2017 12:59:06 PM				13,035.816	
				74S103QO	04/28/2017 1:13:36 PM				13,056.942	
				74S1145A	04/28/2017 1:22:22 PM				13,028.374	
				74S12383	04/28/2017 1:45:39 PM				13,046.835	
		Total	Matched	74S124MC	04/28/2017 1:54:12 PM				13,030.461	
Collected S	Consigna	2 274		740400100	0.4 /00 /004 7 0 04 00 D14				40.050.504	

- Step 18. Click on the "Checkbox" drop-down menu and select Clear. This will uncheck all the checked processes. Running the status check for all processes will take several hours to complete.
- Step 19. Recheck the box next to "Crack Detection". Click the "Get Status" button. The process will take a few minutes. A status bar at the top of the screen will estimate the remaining time to complete. When it is finished, the status bar will show all green and the "Crack Detection" field in the right window will show crack lengths in milimiles (see below image). Lane Detection is also done during the LCMS Global Processor, but it will be run in a later step.

💏 Get Status 🧃				· Matched Only	r %						
💽 Up 🥃 Dowr	n 👪 Color 🗹 •	•		UniqueRun	Collection Time	County	RouteID	Dir	Length	Matched	CrackDetection
Process	Color	Method		74I0S3NZ	04/18/2017 10:19:11 AM	AA	DUMMY	E	686.164		
				57410S3TF	04/18/2017 10:22:27 AM	AA	DUMMY	E	600.356		
Dut				74I0T41Z	04/18/2017 10:27:35 AM	AA	DUMMY	E	1,342.957		
Revelances				74I0T36C	04/18/2017 10:30:12 AM	AA	TL 1	E	1.536.765		
Roughness				74I0T4K8	04/18/2017 10:38:32 AM	AA	TL 1	E	1.397.927		
Crack Detect	ention			74I0T3OC	04/18/2017 10:41:00 AM	AA	MD 176	E	1.501.127		
Distance Datio	Calion			🔶 7410T4YA	04/18/2017 10:46:58 AM	AA	TL 2	E	802.542		
Distressmattr	ig .			À 74I0U4IA	04/18/2017 10:58:58 AM	AA	TL 3	E	1.315.185		
Event Rating				7410U4SK	04/18/2017 11:05:08 AM	AA	TL 4	F	1 005 624		
	zontal			74S0U3LB	04/28/2017 11:00:47 AM	AA	TL 1	F	13 067 643		
	cal	_		74S0U4MQ	04/28/2017 11:01:38 AM	AA	DUMMY	F	397 758		
LaneDetectio	on	-		A 7450V40	04/28/2017 11:09:57 AM	AA	TI 2017 11	F	13 002 252	13 002 252	13,002.252
Iransverser	rofile			23 74S0V40	04/28/2017 11:09:57 AM	AA	TL 1	F	68 364		
				~ 74S0V3B7	04/28/2017 11:25:55 AM	AA	TL 2017 1	F	12 950 856	12 950 856	12,950.856
				3 74S0V3B7	04/28/2017 11:25:55 AM	AA	TL 2	F	103 353		
				74S0W46B	04/28/2017 11:34:59 AM	AA	TL 2017 12	F	12 990 914	12 990 914	12,990,914
				A3 7450W/46B	04/28/2017 11:34:59 AM	ΔΔ	TL 2	F	30.942	12,000.011	
				~ 74S0W3V1	04/28/2017 11:49:49 AM	AA	TL 2017 3	F	12 946 795	12 946 795	12,946,795
				23 74S0W3V1	04/28/2017 11:49:49 AM	AA	TL 3	F	96.370	12,010.700	
				74S0X4A6	04/28/2017 11:58:54 AM	AA	TL 2017 13	F	12 988 751	12 988 751	12.988.751
				A 7450X4A6	04/28/2017 11:58:54 AM	AA	TL 3	F	35 887	12,000.701	
				~ 7450X3YG	04/28/2017 12:13:28 PM	AA	TL 2017.4	F	12 946 391	12 946 391	12.946.391
				A3 7450X3YG	04/28/2017 12:13:28 PM	AA	TI 4	F	101.075	12,010.001	
		Total	Matched	7450Y4DI	04/28/2017 12:22:33 PM	ΔΔ	TL 2017 14	F	12 989 405	12 989 405	12,989,405
Locator	Total Count	6.469		2 7450Y4DL	04/28/2017 12:22:33 PM	44	TL 4	E	38.626	12,303.403	
	Total Length	13,134,924		7450740E	04/28/2017 12:49:54 PM	44	TL 5	F	13 050 819		
	Selected Count	2,910		74510421	04/28/2017 12:59:06 PM	ΔΔ	TL 2017 15	F	12 995 382	12 995 382	12 995 382
	Selected Length	11,493,937		2 74510421	04/28/2017 12:53:00 FM	44	TL 5	5	40.424	12,000.002	
Group	Al			74510421	04/20/2017 12:33:00 FM	AA	TL 2017 6	C	12 949 201	12 949 261	12 948 261
Sessions	Count	3.274	2.089	2 745103QO	04/20/2017 1:13:30 PM	44	TL 2017 0	E	109 691	12,340.201	12,010.201
	Length	13 522 482	9 029 652	74010300	04/20/2017 1:13:30 FM	AA	TL 2017 16	C	12 000 700	12 000 700	12 990 769
Transfers	Count	262		03 7401145A	04/20/2017 1.22.22 FM	AA	TL 2017 10	E	27 605	12,330.703	12,000.700
				AC1000	04/20/2017 1.45.20 PM	AA	TL 0017 7	-	12 047 227	12 047 227	12 947 227
		12 618 155	8 988 091	374512303	04/20/2017 1.45.30 PM	AA	TL 2017 7		12,347.227	12,347.227	12,541.221
			-,,	AC124MC	04/20/2017 1.43.33 FM	AA	TL 2017 17	E .	10 000 151	12 000 151	12 988 151
				3 745124MC	04/20/2017 1:54:12 PM	AA	TL 201/1/	E	12,368,101	12,300.101	12,300.131
					04/20/2017 1:04:12 PM	AA	1L / TL 2017 9	C	42.311	12 045 022	12 945 622
				3745133V2	04/20/2017 2:21:02 PM	AA	TL 2017 8	E	12,343.623	12,343.623	12,040.020
					04/20/2017 2:21:02 PM	AA	TL 0017.10	E	104.898	10.007.701	12 997 701
				37 745 144/4G	04/28/2017 2:30:16 PM	AVA	TL 0	C	12,387.701	12,387.701	12,307.701
				/45144AG	04/28/2017 2:30:16 PM	AA	1L 8	E	49.803	10.044.000	12 044 200
					04/28/201/2:4/:11 PM	AA	TE 2017 9	E	12,944.299	12,944.299	12,944.299

- Step 20. On the toolbar above the right window, deselect the "Matched Only" button. Find the first file that was part of the batch that was processed. Scroll through the other files in the batch. Make sure the values for "Crack Detection" are similar to the values for "Length." They will never be exact. The "Crack Detection" value should never be less than half of the "Length" value.
 - i. If all the files in the batch show reasonable values for "Crack Detection," proceed to Step 21.
 - ii. If one or more of the files in the batch show unreasonable values for "Crack Detection," the data will need to be reprocessed. Return to Step 2.
- Step 21. Repeat Step 2 to Step 10. This time, however, in Step 4, select the schema file titled "LCMS_GLOBAL_PROCESSOR_LANE_DETECTION_ONLY-[MOST RECENTDATE]." Never run this schema without first running the "LCMS_GLOBAL_PROCESSOR_[MOST RECENTDATE]" schema. Once these steps are repeated, process is complete (images do not need to be checked twice).

3- Performing QA of Processed LCMS Data – *performed by Supervisor*

Summary: This task performs QA checks on the processed LCMS data.

- Step 22. TL review of QC staff notification of recollection.
- Step 23. Review of production status receive weekly update from QC staff (last ARAN collection data fully processed).

5.05 RUNNING ROUGHNESS PROCESSOR

5.05.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to run the Roughness Processor in the Roadware Vision software using data collected by the Automatic Road Analyzer (ARAN) survey vans in the field by Field Explorations Division (FED) staff. The Roughness Processor is run in batches throughout the annual data collection season. This SOP applies to the processing of an ARAN data batch (or batches). The Roughness Processor is run after running the LCMS Global Processor (see <u>Running Global LCMS Processor</u>). This process results in the generation of ARAN pavement roughness profile data in the form of the International Roughness Index (IRI).

5.05.02 Frequency

The Roughness Processor is run on batches of ARAN collected data as they are received by the DPT. The frequency and timing varies according to schedule, available resources, and quantity of data received. The batches are processed in a continuous flow throughout the data collection season.

Each ARAN data batch is typically delivered to the DPT every 4 to 5 days. Assuming an average of 60 miles collected per day, each batch contains, on average, between 240 and 300 miles of ARAN data. The actual frequency varies according to the proximity of the routes on which data were collected for the data batch to the Office of Materials Technology (OMT) office and it ranges from 1 day (when collected near the OMT office) to 2 weeks (when collected far from the OMT office). Shorter turn-around periods are preferred to minimize the amount of mileage requiring data recollection. The annual ARAN data collection season typically lasts from March to Mid-December.

5.05.03 Purpose

The purpose of this SOP is to run the Roughness Processor for collected ARAN data and perform quality control (QC) and quality assurance (QA) checks.

5.05.04 *Resource Requirements*

The running of the Roughness Processor involves two people: (1) a user knowledgeable in Roadware Vision software to run the processors and perform QC, and (2) a supervisor who, as required, provides guidance and decision-making and performs QA. The estimated effort levels in the table below represent the total time, in man-hours, to complete the processing and QC/QA checks. These time estimates assume average batch quantities and no issues encountered during processing.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	Vision user and QC	1	3.0
DPT TL	Supervisor and QA	1	AR ^{06/12/2019}

5.05.05 Procedure

The procedure to run the Roughness Processor and perform QC/QA is comprised of the following three tasks:

- (1) running Roughness Processor in Vision,
- (2) performing QC of the processed data, and
- (3) performing QA of the processed data

1- Running Roughness Processor in Vision – performed by Vision user

Summary: This task uses Vision software to process IRI data from the ARAN data submittal.

- Step 1. Open Vision.
- Step 2. Click the "Process" drop-down menu. Select "New Batch Processor." The "Batch Processor" window will open (see below image).

40	👔 🗄 🚧 Offline	Batch Processor
😥 Add 🎬 New 💷 Delete	Task	Description
Processors	Exif Geo-Tagging & Vibing Processor	Provides support for geo-tagging images with gps data.
Complex Data Extraction	Fault Processor	Detect and filter Faults
	🔲 📖 Image Copier Processor	Copies original images to a given output folder
ERD Processor	Image QC Processor	Measures the brightness of images and compares against acceptable range for quality.
Image Processing	🔲 📖 iVision publisher batch processor.	Runs the iVison publisher on the current database.
QC	Joint Detection Processor	Detect joints in a session of images
Reporting	JPEG Cracks Detection Processor	Detects cracks from JPEG files.
Sensor Data Processing	JPEG Lanes Detection Processor	Detects lanes from JPEG files.
	🔲 📖 Ladybug processor	Batch processes Ladybug collected data.
	LCMS Global Processor	Collection of LCMS functions for images conversion, cracks detection and classification an.
	PavementExport Processor	Pavement exporter based on a template file.
	Point-to-Area Distress Processor	Point-to-Area Distress Processor.
	Rating Processor	Distress rating processor.
	Report Generator Processor	Generate reports.
	🔽 📖 Roughness Processor	Calculates and stores improved longitudinal profiles and roughness indices
	Rut Processor	Rut processor for Transverse Profile data.
	Sampled QC Events Rating Processor	Sampled QC events for manual rating processor.
	Segmentation Rubberbanding	Reverts all landmarks to original chainages and revert rechained matches to rubberbanded
	Segmenting QC Processor	Generates bookmarks for segmenting quality checks.
	Shapefile Exporter	Exports SHP and KML files.
	🔲 🖳 Thumbnail Creator	Creates thumbnails from original images in a given output folder
	Vehicle Positions Processor	Creates levels of detail for Vehicle Positions.
	•	III
	X 🗢 🔺	
	# Task	Description
	1 Roughness Processor	Calculates and stores improved longitudinal profiles and roughness indices

- Step 3. Click the box next to "Roughness Processor" in the window on the right.
- Step 4. Click the "Options" tab. Instead of changing settings manually, search for preset schemas. Click the "Load" button. Navigate to the folder where schema files are stored^{06/12/2019}. In this folder, look for an XML file named "Roughness_Processor_[MOST RECENTDATE]." Select the file and click "Open" (see below image).

Data Processing Running Roughness Processor

STATE HIGHWAY	ADMINISTRATION
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💏 Batch Processor	en i hante	-										_ 0	23
🛃 Tasks 🔛 Options 🚏 Data	Process												
Save Coad					😭 Show Prop	perties	Ž	🗼 🞯 🏼 🌱 Reset 🕶				🐁 Simpl	le 👩
# Task	On Error	Retries	Retry delay	Log			۵	General					
1 Roughness Processor	Skip	0	00:00:00	False				Batch Size Overwrite Mode	1	0000 ne			
								Process Algorithm	S	tandard			
							4	IRI					
								Sample IRI	T	rue			
							4	Longitudinal Profile					
Load processor settings from file								Profile Comple Interval (m	<u> </u>				23
Computer	(\\shahanpmdata1)		05 Documenta	ation\PM	/anuals\Vision) (T:) ▶ 2017	7 .		Concession in succession in the	- -	Search 20	17		p
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Organize New folder					· ·						8== •		
🔆 Favorites			Â	Name				Date modified	Туре		Size		
🧮 Desktop				퉬 OL	D			06/29/2017 11:10	File fold	er			
🚺 Downloads				🐌 OL	D 2016 ARAN3 for rebuilding	g for 2017	7	06/13/2017 10:47	File fold	er			
🔚 Recent Places				🐌 Ru	t Protocol-Not Finalized			07/12/2017 9:48 AM	File fold	er			
				🔰 Vil	ing			07/25/2017 10:32	File fold	er			
👰 Computer				🗋 CL	ASSIFICATION_PROFILE_6-1	3-2017.xr	ml	06/13/2017 11:25	XML Do	cument		1 KB	
🚽 shaomtvideolog (\\shahanartico2) (B:)			🗋 Cu	rveFit2017_Protocol_6-13-20	17.xml		06/13/2017 1:18 PM	XML Do	cument		3 KB	
🏭 Local Disk (C:)				🗋 LC	MS_GLOBAL_PROCESSOR_6	-13-2017	.x	06/13/2017 10:14	XML Do	cument		3 KB	
👝 New Volume (E:)				LC	MS_Maryland_2017_06_14_20	017.xml		06/14/2017 1:03 PM	XML Do	cument		8 KB	
🚽 VCoulibaly (\\SHAVMHANFS1\OMT	FOOCUsers) (M:)		=	📄 ma	tched.xml			08/10/2017 12:12	XML Do	cument	1,5	60 KB	
🚽 omtoocshared (\\shahanfs1) (N:)				📄 RA	TING_PROCESSOR_6-13-201	7.xml		06/13/2017 11:28	XML Do	cument		1 KB	
🚽 PMtestData (\\hanpmdata) (O:)				C Ro	ughness_Processor_7-12-201	L7.xml		07/12/2017 8:59 AM	XML Do	cument		1 KB	
🚽 hanprograms (\\shahanfs1) (P:)				TE	TURE_CRACK_ONLY_LCMS	GLOBA	L	06/13/2017 11:35	XML Do	cument		2 KB	
👾 Wx_Processing (\\HANPMDATA\PM	/workingData) (Q:)			TE	XTURE_ONLY_LCMS_GLOBA	L_PROCE	ES	06/13/2017 10:17	XML Do	cument		2 KB	
🖵 PMDATA (\\shahanpmdata1) (R:)													
👾 sharedprograms (\\shahqfs3) (S:)													
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2 7712		167					_					_	

- Step 5. Click "Data" from the top menu bar. Every file in the database will appear in the window. The list must be filtered to only include the sections from the current batch. This can be accomplished through two different methods:
 - i. Removing unwanted files, or
 - ii. Removing all files and selecting a batch to re-add.
- Step 6. Choose removal method. If removing all files and selecting a batch to re-add is preferred, skip to Step 7. Otherwise, use a combination of the Shift and Ctrl keys to highlight all unwanted files in the window. Click "Remove." Proceed to Step 8 (see below image).

Tasks	Dptions 🚏	Data 🐺 Process							
າ 🗹	🗙 Remove 🗢 🔶	🖷 🕨 Go	😥 Search	1					
	Session	> Date	Vehicle	Collected	Matched	%	County	RouteID	Dir
3 1	7521039K	2017-05-02 01:03	1723	3,891	3,722	96	BA	US 1	N
2	752104HV	2017-05-02 01:08	1724	457	266	58	AA	MD 713 B	E
5 4	752104PZ	2017-05-02 01:13	1724	502	268	53	AA	MD 713 B	W
5 3	752103Q7	2017-05-02 01:13	1723	4,091	3,701	90	BA	US 1	S
5	752104YS	2017-05-02 01:18	1724	630	275	44	AA	MD 713 C	N
5 6	7521134L	2017-05-02 01:21	1723	3,070	2,692	88	BA	US 1 AL	N
5 7	7521149D	2017-05-02 01:24	1724	3,792	3,564	94	AA	CO 582	N
5 8	752113QM	2017-05-02 01:35	1723	3,088	2,642	86	BA	US 1 AL	S
5 9	7521244K	2017-05-02 01:43	1724	1,511	553	37	AA	CO 4527	N
S 10	7521237V	2017-05-02 01:45	1723	3,784	2,706	72	BA	MD 166	N
🗐 11	752123QP	2017-05-02 01:56	1723	3,745	2,721	73	BA	MD 166	S
12	752124RG	2017-05-02 01:57	1724	5,926	5,631	95	AA	MD 176	E
5 13	752134OX	2017-05-02 02:17	1724	2,627	2,323	88	AA	MD 162	N
5 14	7520S36U	2017-05-02 10:08	1723	3,017	2,155	71	AA	IS 195	N
🗐 15	7520S4B9	2017-05-02 10:11	1724	1,513	1,383	91	AA	MD 652	S
5 16	7520S3FR	2017-05-02 10:14	1723	2,676	2,169	81	AA	IS 195	S
5 17	7520S3NC	2017-05-02 10:18	1723	3,598	1,408	39	BA	MD 295	N
5 18	7520S4TD	2017-05-02 10:22	1724	2,525	2,304	91	AA	MD 162	S
5 19	7520T33L	2017-05-02 10:28	1723	2,310	1,405	61	BA	MD 295	S
21	7520T3BN	2017-05-02 10:33	1723	13,852	13,167	95	BA	MD 695	N
20	7520T3BM	2017-05-02 10:33	1723	30,002	28,029	93	AA	IS 695	N
5 22	7520T4EG	2017-05-02 10:35	1724	5,877	5,627	96	AA	MD 176	W
23	7520U4ER	2017-05-02 10:56	1724	319	193	60	AA	MD 100 N	S
2 4	7520U4HZ	2017-05-02 10:58	1724	103	41	40	AA	MD 100 O	N
5 25	7520U4O8	2017-05-02 11:02	1724	103	42	41	AA	MD 100 O	S
26	7520U4QU	2017-05-02 11:04	1724	321	192	60	AA	MD 100 N	N
27	7520V4FO	2017-05-02 11:19	1724	3,176	3,036	96	AA	MD 713	S
28	7520W41M	2017-05-02 11:32	1724	3,426	3,038	89	AA	MD 713	N
5 30	7520X37Z	2017-05-02 11:57	1723	15,557	14,909	96	BA	MD 695	S
5 29	7520X380	2017-05-02 11:57	1723	28,616	27,069	95	BA	IS 695	S
5 31	7520X495	2017-05-02 11:58	1724	981	781	80	AA	CO 575	W
5 32	7520X4QA	2017-05-02 12:08	1724	371	264	71	AA	MD 713 D	S
33	7520X4WI	2017-05-02 12:12	1724	1 489	1 128	76	AA	CO 6203	W

Step 7. To remove all files, click the "Check" drop-down menu and select "All." Click "Remove." Then, click the "Reload" (first blue arrow) button. The "Group Partitions" window will open (see below image).

Group Partitions Explorer
P Enter search criteria
Show All
🕥 🔄 Batch 01
Batch 02
Batch 03
Batch 04
Batch 05
7540N437
more than one file
74S0X4A6
Batch 06
Batch 07
July 14 To July 18
Batch 09
I Batch IU
OK

Select the current batch by clicking the checkbox next to the appropriate batch name. Click the "OK."
Step 8. Once only the desired files appear in the "Batch Processor" window, they may be processed. Click "Process", then "Start." The files will begin to appear under the session window (see below image).

	Task 🧹	Status	Start	%	Duration	Actual Duration	Run Rate	Est. Remaining	Est. Finish	
71	Roughness Processor	Waiting								

Note: if a red "X" appears next to the name of the run during processing, the Roughness Processor has already been ran for that file (see below image).

	Task	Status	Start	%	Duration	Actual Durati	on Run Rate	Est. Remaining	Est. Finis
0 1	Roughness Processor	Completed	10:30:16 AM	100.00	00.00:00:00	00.00:00	0 25,295.13	00.00:00:00	08/15/2017 10:30:1.
								_	
Task	Roughness Processor								
	Session	Length	Matched	Start	%	Duration Run Ra	te		
	77V0R3UA	505	274	10:30:16 AM	100.00	00.00:00:00 4,160	14		
	77V0P3WV	804	570	10:30:17 AM	100.00	00.00:00:00 11.597	49		

2- Performing QC of Processed IRI Data – performed by Vision user

Summary: This task checks the quality of processed IRI data through an inspection of errors reported by Vision during processing.

Step 9. A dialogue box will appear when processing is complete.

- i. If the box says "Batch processing has completed", proceed to Step 11.
- ii. If the box says "Batch processing has completed with errors", proceed to Step 10.

g sche	edule + #} start #II Pau									
	Task	Status	Start	%	Duration	n Acti	ual Duration	Run Rate	Est. Remaining	Est. Fini
0 1	Roughness Processor	Completed	7:37:02 AM	1 100.00	00.00:00:02	2	00.00:00:02	60,285.73	00.00:00:00	12/01/2017 7:37:0
Tas	sk Roughness Processor									
Таз	sk Roughness Processor	Length	Matched	Start	%	Duration	Run Rate			
Tas 1	sk Roughness Processor Session 78E1030J	- Length 10,999	Matched 10,438	Start 7:37:02 AM	%	Duration 00.00:00:00	Run Rate 76,434.59			
Tas 1 2	sk Roughness Processor Session 78E1030J 78B0W3IM	- Length 10.999 9,356	Matched 10,438 9,155	Start 7:37:02 AM 7:37:02 AM	% 100.00 100.00	Duration 00.00:00:00 00.00:00:00	Run Rate 76,434.59 67,896.37			
Tas 1 2 3	k Roughness Processor Session 78E1003J 78B0V3D3 78B0V3D3	Length 10,999 9,356 10,534	Matched 10,438 9,155 10,271	Start 7:37:02 AM 7:37:02 AM 7:37:03 AM	% 100.00 100.00 100.00	Duration 00.00:00:00 00.00:00:00 00.00:00:00	Run Rate 76,434.59 67,896.37 71,813.18			
Tas 1 2 3 4 5	sk Roughness Processor Session 78E1030J 78B0W3IM 78B0W303 78B0U39Q	Length 10,999 9,356 10,534 3,160	Matched 10,438 9,155 10,271 909	Start 7:37:02 AM 7:37:02 AM 7:37:03 AM 7:37:03 AM	% 100.00 100.00 100.00 100.00	Duration 00.00:00:00 00.00:00:00 00.00:00:00 00.00:00:00	Run Rate 76,434.59 67,896.37 71,813.18 23,164.61			
Tas 1 2 3 4 5 6 7	k Roughness Processor Session 78E1030J 78B0V3D3 78B0V3D3 78B0U39Q	Length 10,999 9,356 10,534 3,160 Done	Matched 10.438 9.155 10.271 909	Start 7:37:02 AM 7:37:02 AM 7:37:03 AM 7:37:03 AM	% 100.00 100.00 100.00 100.00	Duration 00.00:00:00 00.00:00:00 00.00:00:00 00.00:00:00	Run Rate 76,434.59 67,896.37 71,813.18 23,164.61			
Ta: 1 2 3 4 5 6 7 8 9 10	Roughness Processor Session 78E1030J 78B0W3IM 78B0U303 78B0U39Q	Length 10,999 9,356 10,534 3,160	Matched 10,438 9,155 10,271 909 Batch proc	Start 7:37:02 AM 7:37:02 AM 7:37:03 AM 7:37:03 AM 7:37:03 AM	% 100.00 100.00 100.00 100.00 eted with errors.	Duration 00.00:00:00 00.00:00:00 00.00:00:00 22	Run Rate 76,434.59 67,896.37 71,813.18 23,164.61			
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- Step 10. View the errors. Click the "Exceptions" drop-down menu and select "View Exceptions."
 - i. If the error is "Missing Images", this is acceptable. Proceed to Step 11.
 - ii. If any other errors are present, reprocessing is required. Click the "Exceptions" drop-down menu and select "Reprocess Exceptions." This will remove all the files from the data screen except for the files that had exceptions. Next, click the "Start" button to reprocess.

Data Processing Running Roughness Processor

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3- Performing QA of Processed IRI Data – performed by Supervisor

Summary: This task performs QA checks on the processed IRI data.

- Step 11. TL review of QC staff notification of recollection.
- Step 12. Review of production status receive weekly update from QC staff (last ARAN collection data fully processed).

5.06 ROUTE MATCHING

5.06.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to match the inventory data with the data collected by the Automatic Road Analyzer (ARAN) survey vans in the field by Field Explorations Division (FED) staff. This SOP is performed after the running of the Roughness Processor (see Running Roughness Processor). Performing route matching may require the user to reference several additional SOPs developed to supplement the route matching procedure, including Accessing the Electronic ARAN Logs (Accessing Electronic ARAN Logs), Changing Lat/Long (Changing Latitude/Longitude), Using eGIS (Using eGIS), and Importing Inventory Changes (Running Routing Importer). For further information regarding route matching, including troubleshooting and common examples, refer to the "Vision Matching 2015" guide.

5.06.02 Frequency

Route matching is completed on batches of ARAN collected data as they are received by the DPT. The frequency and timing varies according to schedule, available resources, and quantity of data received. The batches are processed in a continuous flow throughout the data collection season.

Each ARAN data batch is typically delivered to the DPT every 4 to 5 days. Assuming an average of 60 miles collected per day, each batch contains, on average, between 240 and 300 miles of ARAN data. The actual frequency varies according to the proximity of the routes on which data were collected for the data batch to the Office of Materials Technology (OMT) office and it ranges from 1 day (when collected near the OMT office) to 2 weeks (when collected far from the OMT office). Shorter turn-around periods are preferred to minimize the amount of mileage requiring data recollection. The annual ARAN data collection season typically lasts from March to Mid-December.

5.06.03 Purpose

The purpose of this SOP is to compare and match the expected set of routing inventory data with the ARAN data collected in the field and to perform quality control (QC) and quality assurance (QA) checks. It is also referred to as "segmenting.

5.06.04 *Resource Requirements*

Route matching involves two people: (1) a user knowledgeable in Vision software and the Engineering Data Warehouse (EDW) application to perform the route matching and QC, (2) a supervisor who, as required, provides guidance and decision-making and performs QA. The estimated effort levels in the table below represent the total time, in man-hours, to complete route matching and QA. These time estimates assume average batch quantities and no issues were encountered during the process.

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Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	Vision/EDW user and QC	1	40.0
DPT Team Leader (TL)	Supervisor and QA	1	AR ^{06/12/2019}

5.06.05 *Procedure*

The procedure to compare and match the inventory data with the ARAN data collected in the field is comprised of the following five components:

- (1) changing workspaces in Vision,
- (2) route matching,
- (3) updating table in the EDW,
- (4) performing QC of matched routes, and
- (5) performing overall QA of the process.

1- Changing Workspaces in Vision – performed by Vision user

Summary: This task opens the appropriate windows in Vision and arranges them so that route matching can be performed efficiently.

- Step 19. Open Vision.
- Step 20. The "Section Explorer" window will appear when the program opens. All routes that were imported via the Routing Importer (<u>Running Routing Importer</u>) are listed. If data has been collected for a specific route, the "Collection" and "Vehicle" fields will be populated (see below image).

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Þ		FR	MU 1625 M57	w	79R1334N	1723	
		FR	MU 290 M103	N	79T0Q3PL	1723	
		FR	MU 30 M158	W	79S0W36M	1723	
		FR	MU 30 M158	w	79SOW3FP	1723	
		FR	MU 30 M158	w	79S0W3NP	1723	
		FR	MU 30 M158	w	79S0X35F	1723	
		FR	MU 300 M17	s	76D1538A	1723	
		FR	MU 350 M17	E	76D143NI	1723	
		FR	MU 351 M17	E	76D143NJ	1723	
		CD	MIL200 M57	c	70501200	1700	

Step 21. Filter out routes that have not been collected. Select the "Filter" icon under the "Collection" column and select "Is not null" from the drop-down menu (see below image). Maryland department of transportation

Data Processing Route Matching





Step 22. Add Date/Time to the columns. Right-click on the header bar and select "Column Chooser" (see below image). Drag the "Time" column into the "Column Chooser" window, or double-click it in the list.

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Step 23. Open "Process Monitor" window. Click the "Process" drop-down menu and then select "Process Monitor." The "Process Monitor" window will appear as a new tab with "Section Explorer", which was already open (see below image).

Maryland department of transportation

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Data Processing Route Matching

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Step 24. Open "Section Composition" window. Click the "Segment" drop-down menu and then select "Section Composition." The "Section Composition" window will appear as a new tab (see below image).



Step 25. Open image windows. Click the "Images" drop-down menu and then select "Left.". Repeat the sequence for the "ROW" image window. Both image windows will appear as new tabs (see below image).

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Step 26. Open the "Map" window. Click the "Map" button. The "Map" window will appear as a new tab (see below image).

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Step 27. Undock the map. Right-click on the "Map" tab and select "Undock" from the drop-down menu (see below image). The map will undock. Drag the new map window to the second monitor (the one without the Vision program). Maximize the map screen on the second monitor.

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Step 28. Click the button with the horizontal lines on the top left of the map window. Click the "Layers" option. The default layer settings will appear. Uncheck the following: "Collected Sessions" and "Station Data" from the list (see below image).

Layers	We are sorry, but we don't have imagery at this zoom level for this region.	We are sorry, but we don't have imagery at this zoom level for this region.
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Step 29. Click on the "Base Maps" option. The typical preferred map is selected by clicking the "Google" tab and then checking "GoogleMap" in the map list. When the map selection is complete, click the two left-facing arrows at the top of the options window to close the tab (see below image).

STATE HIGHWAY ADMINISTRATION

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Step 30. At the bottom left corner of the window, select the "Measure Distance" icon. This will prevent the program from jumping to different routes during route matching (see below image). While this setting prevents the map from jumping to a different route, the "Measure Distance" setting will also draw a line on the map whenever it is clicked. To remove measurements from the screen when it gets cluttered, select the icon with the horizontal lines at the top left of the screen, select the "Measurements" option and click the large "X."



Step 31. Return to the remaining windows still docked in the Vision program. Right-click on the "Section Composition" tab header and select "New Horizontal Tab Group" (see below image).

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Step 32. Repeat Step 31 for the "Left" and "ROW" image windows (see below image).

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Step 33. In the "Section Composition" window, select the "Custom" drop-down menu and choose "Section Composition" (see below image). This will move the vehicle location on the map and the sensor bar in the "Section Composition" window twice for every single movement in the image windows.

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Step 34. Resize the images. Click the "Maximize" button in the upper right hand corner of the Vision program. Hover the mouse over the top of each image window. A toolbar will appear. Click the "Fit" button (see below image).



Step 35. In the "Process Monitor" tab, click the "Check" drop-down menu and select "Clear" (see below image). This will remove the checks beside the items listed in the process table.

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Step 36. In the "Process Monitor" window, click the "Get Status" button. The status of the task will be shown in a progress bar beside the "Get Status" button (see below image).

Section Explorer								
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Step 37. Move the vertical bar which separates the two windows in the "Process Monitor" tab to the left so that the table with "Unique Run" as the first column can be seen on the right (see below image). It may be necessary to resize the image windows to accomplish the optimal view.

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	🍌 74I0T41Z	04/18/2017 10:27:35 AM	AA	DUMMY	E		The second se	e da la
<	> 74I0T36C	04/18/2017 10:30:12 AM	AA	TL 1	E			
	🧇 74ІОТ4К8	04/18/2017 10:38:32 AM	AA	TL 1	E		44	
	🍌 74I0ТЗОС	04/18/2017 10:41:00 AM	AA	MD 176	E			
	🚸 74I0T4YA	04/18/2017 10:46:58 AM	AA	TL 2	E			A Stand Stand Stand Stand
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	74SOU3LB	04/28/2017 11:00:47 AM	AA	TL 1	E	1		Contraction of the second s
	74S0U4MQ	04/28/2017 11:01:38 AM	AA	DUMMY	E			
	74S0V40L	04/28/2017 11:09:57 AM	AA	TL 2017 11	Е	1		
	23 74S0V40L	04/28/2017 11:09:57 AM	AA	TL 1	E			
	🚸 74S0V3R7	04/28/2017 11:25:55 AM	AA	TL 2017 1	E	1		
	24S0V3R7	04/28/2017 11:25:55 AM	AA	TL 2	Е			and the second s
	🚸 74SOW46B	04/28/2017 11:34:59 AM	AA	TL 2017 12	E	1.		
	24SOW46B	04/28/2017 11:34:59 AM	AA	TL 2	E			
	74S0W3V1	04/28/2017 11:49:49 AM	AA	TL 2017 3	E	1		4
	14S0W3V1	04/28/2017 11:49:49 AM	AA	TL 3	E			A CONTRACTOR OF
	🚸 74S0X4A6	04/28/2017 11:58:54 AM	AA	TL 2017 13	E	1	n a sa na sa kantang iton 24 ng taon 26 ng taon 19 ng taon 20 ng ta	
	👌 74S0X4A6	04/28/2017 11:58:54 AM	AA	TL 3	E	-		
	Â	III				•		

Step 38. Continue arranging windows until the "Matched" column can be seen in the "Process Monitor" window. If a file has already been matched, a distance value will appear in the "Matched" column. Otherwise, the column will be blank (if it has not been matched or if it was transferred to another route). Check that the Vision program windows and the map window look similar to the images below before continuing with route matching.

Vision window (Process Monitor, ROW, Left, Section Composition)

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Configuration	Astory 🏭 Monitor										
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B 9 740T41Z	04/18/2017 10:27:35 AM AA DU	IMMY E	1,342.957							and the second se	State of the state of the
B. \$740T39C	04/18/2017 10:30:12 AM AA TL	1 E	1.536.765		- 11			-	Million and Million	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	and the second
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Q 740130C	04/18/2017 10:41:00 AM AA MS	0175 E	1,501.127		- 11	and the second	4.4			A T	State of the second
D P / NUL 4TA	04/18/2017 10:46:58 AM AA TL	2 6	802.542		- 11	States		and the second second		A DECK DECK DECK DECK DECK DECK DECK DECK	and the state of the second state of the
E ZADUATY	04/10/2017 12:00:00 AM AA TO	4 5	1,015,105		- 11		and the second second	And Post Property in the local distance			Contraction of the second s
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7450/40	04/28/2017 11:09:57 AM AA TL	2017 11 E	13.002.252	13.002.252	- 111			and the second			
227450/40L	04/28/2017 11:09:57 AM AA TL	1 E	68.364		_	Contraction of Contra					
7450/3R7	04/28/2017 11:25:55 AM AA TL	2017 1 E	12,950.056	12,950.056	_						
237490V3R7	04/28/2017 11:25:55 AM AA TL	2 E	103.353						A COLUMN AND A COLUMN		
 7450W46E 	04/28/2017 11:34:59 AM AA TL	2017 12 E	12,990,914	12,990.914	_						
27450W46E	04/28/2017 11:34:59 AM AA TL	2 E	30.942		_						
74S0W3V1	04/28/2017 11:49:49 AM AA TL	20173 E	12.546.795	12.946.795						and the second second	
Local 1450W3V1	04/25/2017 11/49/49 AM AA TL	3 6	96.370		- 11						
274505446	04/28/2017 11:58:54 AM AA IL	201713 E	12,588.751	12,388./51	- 11						
74500040	04/20/2017 10:00:04 AM TO	3 E	12 545 351	12 546 391	_						
General 20 7450C015	04/28/2017 12:13:28 PM AA TI	4 5	101 075	14,049,001	- 11						
Seesi Seesi	04/28/2017 12:22:33 PM AA TL	2017 14 E	12,505,405	12,589,405	_						
2 7450Y40L	04/28/2017 12:22:33 PM AA TL	4 E	38 626		_						
Trane 🐓 74S0Z3N6	04/28/2017 12:49:54 PM AA TL	5 E	13.050.819				endorario de la contrata de				
%74510428	04/28/2017 12:59:06 PM AA TL	2017 15 E	12,995.382	12,995.382							
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Map window

2- Route Matching – performed by Vision user

Summary: This task uses Vision software to compare and match a collected ARAN file to the appropriate inventory section. This task utilizes many Vision tools (see below image).

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Data Processing Route Matching

Line			Sessi	on		Mate	h	
1	Cursor			Unmatched			Nomal	
	Alignment			Rejected		ī	Compressed	
Zoor	n			Transferred			Stretched	
	Selection		•	Collapsed			Compressed	Excess
Land	mark			Unused			Stretched	Excess
\diamond	Routed			Collected				
\mathbf{x}	Routed	GPS		Exception	Error			
\diamond	Virtual			Exception	Warning			
☆	Virtual	GPS		Exception	Info			
•	Edited		Anch	or				
*	Edited	GPS	\frown	Candidate				
	Split		¥.	Candidate	Could			
Secti	on		7	GPS	G000			
	Unmatched		x	GPS	Poor			
	Gap		Δ	Manual	Good			
	Exception	Error	\triangle	Manual	Poor			
	Exception	Comment	\bigcirc	Fill	Good			
			\bigcirc	Fill	Poor			
			\diamond	LinearReference	Good			
			\wedge	LinearDeference	Deer			

Step 39. In the "Process Monitor" window, select a file by clicking on the appropriate row in the table. The candidates for route matching will have blanks in the "Matched" column of the table (see below image).

/10	Sec	tion Explorer	Process Monitor [100	% do	ne]				→ ×
🗈 C	onfig	uration 🧐 His	tory 🛍 Monitor						
1	Ŧ	Matched O	inly %						
<u> </u>	Ŧ	UniqueRun	Collection Time	C	RouteID	Dir	Length	Matched	-
Proc	ess	78H0O4TY	08/17/2017 8:56:22 AM	CL	MD 851	N	1,122.958	1,029.264	
	Б	78H0P4OC	08/17/2017 9:14:36 AM	CL	CO 733	S	301.554	119.453	
	B	🚸 78H0P4W9	08/17/2017 9:19:21 AM	CL	CO 758	S	2,099.645	1,989.860	
	R	🚸 78H0Q3QR	08/17/2017 9:37:39 AM	BA	CO 5212	W	1,605.958	1,463.418	
	G	< 78H0R45V	08/17/2017 9:46:43 AM	CL	CO 713	N	771.237	560.369	
	Cr	< 78HOR4AM	08/17/2017 9:49:34 AM	CL	CO 640	W	1,293.209	1,063.003	
	Di	🧇 78H0R4O0	08/17/2017 9:57:36 AM	CL	MD 850 H	W	1,878.048	1,742.870	
	E1	🗇 78H0R3QT	08/17/2017 9:59:17 AM	AA	IS 895	S	9,565.759		
	G	🧇 78H0S443	08/17/2017 10:07:15 AM	CL	MD 850 J	W	1,228.258	1,228.258	
	C	🧇 78H0S4AB	08/17/2017 10:10:59 AM	CL	MD 850 J	E	1,227.085	1,219.584	
	La	🧇 78H0S3ES	08/17/2017 10:13:40 AM	BA	IS 895	N	9,728.781		
	Tr	🧇 78H0S4LR	08/17/2017 10:17:51 AM	CL	MD 854 A	N	2,687.436		
		78H0S4YM	08/17/2017 10:25:34 AM	CL	MD 854 A	S	2,658.679		
		🧇 78H0T4AZ	08/17/2017 10:32:59 AM	CL	MD 850 H	E	1,786.321		
		🧇 78H0T3UF	08/17/2017 10:44:39 AM	BA	MD 151	S	8,087.246		
	•	🧇 78H0T4UU	08/17/2017 10:44:54 AM	CL	CO 1611	S	286.979		

Step 40. Using the "Section Composition" window, click the "Auto-Match" button (see below image).

			Data Processing Route Matching		
Sect	n Composition	🛛 🖬 🖉 🔍 + 🔍 - 🔍 Fit 🔍 1:1	0 💁 🖻 📽 Landmark Editing 🔹 🍡 🗔 🔯 🚖		- > 8 🖬 🗄
County RouteID Dir	CL MD 854 A S		<u>ĝ</u>	2.000	2,859
Date Time Vehicle ►:	78H0S4YM - 08/17/2017 - 10:25 AM - 1724 -				

- Step 41. A "Check Out" window will open (see below image). In order to perform route matching on a file, it must first be checked out.
 - v. If the "OK" button on the "Check Out" window is grayed out and a user is listed under the "User" column, that user must check the file back in and save before continuing.
 - vi. Otherwise, click "OK."

🔒 Check Out		100	
Session	User	LogTime	Comment
▶ # 78H0S4YM			
Comment			
Silent checko	ut 🔲		OK Cancel

- Step 42. The "Automatic Section Matching" window will appear. Click the "Run" button. Results will appear in the "Matching Results" dialogue box.
 - i. If there are no errors, a route will appear with a green arrow and a globe icon next to the session name. Click "OK" (see below image).

Data Processing Route Matching

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Actions	V 🐝 A	utofill using	ection 🔲 💅	Create partial		o intermediary			
245) 🙆 🙆		uente	M	Begin E	Begin				
C C C	000	Venus	1	Iccept 7	Accept				
📄 🚢 Snap match	es		- N	End E	End				
Tolerated discrepancy Value Matched length									
C)istance 🍥 Ai	nd 🚔	50.00	250.00	(maximum)				
Percent	age (%) 💿 🔿)r	5.00	200.00	(minimum)				
Matching Candidatos									
Session		Begin	End	Collect	ted length		••••		
V 912 78H0S4YM	2	540 000	2 674 140	CONCO	34 140		Ŷ		
			2,07				•		
Matching Results									
Session	Begin	End	Length	Begin + /	End + /	%			
🗞 78H0S4YM	0.000	2,640.000	2,640.000	0.000	0.000	99.41			

ii. If there are errors for a single route, a route will appear with an exclamation point icon next to the session name and the "OK" button will be grayed out. Investigate the possible causes and resolve issue with the specific file before continuing. The most common solution is using the snapping procedure to bypass auto-matching (see Step 71 and Step 72).

Data Processing Route Matching

STATE HIGHWAY ADMINISTRATION

Actions		utofill uning		Country and int	D	ron intormodion	,
🔽 🎡 Automatch	V 🐝 C	ontinuous colle	ection 📃 🆠	matches		sults	/
💿 🍓 GPS	🔘 🍠 E	vents	M	Begin E	Begin		1
			1	Accept /	Accept		
📄 🚔 Snap match	es		-	End E	End		
✓ Tolerated d	iscrepancy		Value M	latched length			
C)istance 🍥 A	nd 🚔	50.00	250.00	(maximum)		
Percent	ane (%)	0r 🖾	5.00	200.00	(minimum)		
1 ciccii	.uge ()	v	9.00 V	200.00	(minimum Girn)		
Matching Candidates							
Session		Begin	End	Collect	ed length		
🔽 🔩 78N0P4MF		0.000	16,511.733	10	6,511.733		
📝 🍕 78N0R4ZX		0.000	3,669.500	: :	3,669.500		
Matching Results							
Session	Begin	End	Length	Begin + /	End + /	%	
1 78N0R4ZX	0.000	19,370.000) 19,370	15,301.617			

- iii. If there are errors for multiple routes, the routes will appear with exclamation point icons next to the session name and the "OK" button will be grayed out. This typically indicates that there are multiple files for the same route. Investigate the possible causes and resolve issue with the specific files before continuing. Possible solutions include removing one of the files by: transferring one file to another route or rejecting an older route if the routes are duplicates.
- Step 43. A dialogue box will appear.
 - i. If no errors or irregularities are present, click "Yes" (see below image). Proceed to Step 48.

Automatic Section Matching					
Do you want to keep the 1	match(es) created?				
Yes	No				

- ii. If errors or irregularities are present, manual segmentation is required. Proceed to Step 44.
- Step 44. In the "Section Composition" window, click the "Landmark Editing" drop-down menu and select "Insert Landmark" (see below image).



- Step 45. Locate the appropriate reference location on the sensor bar and align the pink line with that location.
- Step 46. Snap the appropriate marker to the location reference. Right-click on the marker, click "Snap" and then "Snap right" or "Snap left" depending on which way the marker needs to move (see below image).



- Step 47. Apply the "Add Match" function and select "All." If any segments of the match require removal, tag the individual segment and select "Delete Match" to remove.
- Step 48. Repeat Step 44 to Step 47 for all landmarks and segments.

Step 49. Check the starting point of the file. Click the sensor bar in the "Section Composition" window somewhere close to the starting landmark (green star before blue bar – see below image).



- Step 50. In the "Map" window, zoom in to at least 16 feet. Make sure the vehicle position (yellow triangle) is close enough to the starting marker (green balloon). Use the measuring tool in the "Map" window if the distance cannot be determined visually.
 - i. If the starting marker is greater than 4.2 mmi (approximately 22.176 feet) from the vehicle position, proceed to Step 51 to place a "gap" in the Section Composition.
 - ii. Otherwise, proceed to Step 61.
- Step 51. In the "Map" window, use the measuring tool to draw a line from the base of the starting marker to the beginning vehicle position (see below image). Do not draw the line at an angle, which would add distance to the measurement.

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Step 52. View the distance of the line in the "Measurement" window of the map (see below image).

Мар		*
Layers		*
Measurements		•
		×
Distance	T	
5.67698447073843	·	Delete

- Step 53. Using the distance, calculate the gap needed (for the above distance, a gap would need to be placed from 0.0 to 0.05).
- Step 54. Click the "Landmark Editing" drop-down menu and select "Insert Landmark" (see below image).

🔶 Secti	on Compositio	n								
1	🖻 🐣 👴	9	🚽 🖉 I	Ø 🔍 🕇	🔍 – 🔍 Fit	Q 1:1	0 🗹 🕶	📝 L	andmark Editing 🝷 🏊	
								Z	Edit Landmark	
County	CL		- de					Ì	Insert Landmark	
RouteID	MD 854 A							•	Match Landmark	
Dir	S		T					i	Create Gap Merge Segments	
								_		_

Step 55. The "Insert Landmark" window will appear. Enter the correct chainage into the "Chainage" box (see below image).



- Step 56. Click "OK" and the sensor bar should move to the specified location.
- Step 57. Right-click inside the dotted box which contains the sensor bar for the route in the "Section Composition" window (see below image).



Step 58. Select "Align", then "Shift Begin." This will move the start of the file to the location of the sensor bar.

Step 59. Right-click inside the dotted box which contains the sensor bar for the route in the "Section Composition" window. Select "Add Match", then "From current" (see below image). This will match from the location of the sensor bar to the end.



Step 60. The "Match Editor" window will open. Change "Rubber-band" to "Re-chain" and click "OK" (see below image).

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Data Processing Route Matching

Match Editor								
Match coverage								
	Chainage adjustment							
Complete	R	Rubber-band						
	R	le-chain						
	Direc	tion						
	@ E	onward Rackward						
	V P	ropagate re-chaining						
	L S	plit landmarks with same chainage						
	Ancho	r						
Partial	@ B	egin 🔘 End						
Comments								
Other								
Summary								
Jan Begin	5	Matched to routed data						
⇒ End	2,640	Modifies the routed landmark's chainage						
Routed len	2,635	Given by the collected length						
Actual len	2,635	Given by the collected length						
Length %	100	Exact match						
Difference	0	Expected length achieved						
Dense viewstra								
Range visualizer								
💌 🖪 Begin 🕠		End 🎽 📃						
		OK Cancel						

- Step 61. Navigate to the end of the run (there should be a yellow triangle near the end). Place the sensor bar close to the yellow triangle.
- Step 62. Look at the "Map" window. Move the sensor bar in the "Section Composition" window and the yellow vehicle position in the "Map" window to a location close to the green balloon using the navigation controls (see below image).

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- Step 63. Check the distance between the yellow vehicle position marker and the ending marker (green balloon) using the measurement method as described in Step 51.
 - i. If the ending marker is greater than 4.2 mmi (approximately 22.176 feet) from the vehicle position, place a gap at the end of the run.
 - ii. Otherwise, right-click inside the dotted box which contains the sensor bar for the route in the "Section Composition" window. Select "Snap", then "Snap Left" (see below image). This will move the ending point to the correct spot and the triangle on the sensor bar should turn green.

Maryland department of transportation Data Processing STATE HIGHWAY ADMINISTRATION Route Matching No action Q Magnify mode Frozen Ð Navigation ۲ Auto match Ctrl+A V Add match × Delete match ۲ 8 Snap ۲ Ē Ctrl+Left Snap left Align Þ 4 Snap right Ctrl+Right ŧΞ Order ۶ Snap back Ctrl+Back i t 1 Ctrl+M Comment • Drag left ≥ Drag right Reject Ctrl+J 23 Transfer Ctrl+T Ctrl+L Recall Exception Editor Ctrl+X 2 Delete Current Session

- Step 64. With the starting location still selected, check the "ROW Image" and "Left Image" to confirm that there are images present.
 - i. If there is no image present for one or both of the image windows, investigate missing image issue and resolve before continuing (may require reimporting of image files).
 - ii. Otherwise, proceed to Step 65.
- Step 65. Check the stopping point of the file. Click the sensor bar in the "Section Composition" window somewhere close to the ending landmark (green star before blue bar).
- Step 66. In the "Map" window, zoom in to at least 16 feet. Make sure the vehicle position (yellow triangle) is close enough to the ending marker (green balloon). Since the sensor bar is only placing the vehicle position close to the end of the route, it may be necessary to use the arrow keys to move the vehicle to the exact end of the route. Use the measuring tool in the "Map" window if the distance cannot be determined visually.
 - i. If the ending marker is greater than 4.2 mmi (approximately 22.176 feet) from the vehicle position, repeat Step 51 to Step 63 for placing a "gap" in the Section Composition.
 - ii. Otherwise, proceed to Step 67.
- Step 67. With the ending location still selected, check the "ROW Image" and "Left Image" to confirm that there are images present.

- i. If there is no image present for one or both of the image windows, investigate missing image issue and resolve before continuing (may require reimporting of image files).
- ii. Otherwise, proceed to Step 68.
- Step 68. Using the "Section Composition" window, click the "Rechain" button (see below image).

Sect	ion omposition				• ×
1 🖬 🔒 🕯	🖉 🖻 ا 🍝 🤞		🖉 🥥 🔍 🕂 🔍 – 🔍 Fit 🔍 1:1 🛛 🕛 🜌 🐨 🐨 🖓 Landmark Editing 🔹 🔚	۱ 😣 😒	🙆 🗄
۵.					-
County	CL	4	8	8	53
RouteID	MD 854 A		2	50	2,6
Dir	S	11			
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⊳ - M	4 Þ M				2
	78H0S4YM				
Date	08/17/2017				
Time	10:25 AM				
Vehicle	1724				
►0					\bigcirc
🗟 - 🛛 🚺	4 🕨 🕅 🔁				2

Step 69. Click "OK" in the "Rechain Section" window (see below image).

Rechain Section								
Range of rechaining (all matches contained within)								
Optimized in the section	etitic section							
○ I Starting from current p	osition (to the end of the section)							
이 릐 Ending at current posi	tion (from the start of the section)							
Direction of rechaining								
Forward (left to right)								
🔘 🔄 Backward (right to left)							
Change rechained matches of	comments							
🔲 🌌 Apply this comment	 Overwrite Merge 							
	OK Cancel							

The blue bar for the route will now show a grid of white lines.

- Step 70. Check that the starting and ending markers are green.
 - i. If markers remain yellow, proceed to Step 71.
 - ii. Otherwise, skip to Step 74.

Step 71. If one or both of the markers remain yellow, snapping must occur to move the markers to the proper location. Move the cursor close to the correct location in the "Section Composition" window. Right-click and select "Snap", then "Snap left" or "Snap right", depending on which direction the marker needs to move (see below image).



Step 72. In the "Match Snap" window, select "Re-chain" and click "OK" (see below image).

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🔥 Match Snap	— X	
Snapping direction 릐 This action will snap the matched point from le This will change the neighboring match(es).	eft to the current collected position.	
Chainage adjustment		
Re-chain		
	OK Cancel	

- Step 73. Repeat Step 71 and Step 72 for other markers if necessary.
 - i. If markers are now both green, proceed to Step 74.
 - ii. Otherwise, investigate other possible solutions to resolve the issue before continuing.
- Step 74. Check that the beginning milepost (BMP) is correct.
 - i. If the BMP is less than zero or between 0.0 and 0.1, it is incorrect and needs to be updated. Proceed to Step 75.
 - ii. If the BMP is 0.0 or greater than 0.1, no changes are required. Proceed to Step 76.
- Step 75. Click on the starting marker in the "Section Composition" window, click "Landmark Editing", and then "Edit Landmark." Enter the correct BMP in the "Chainage" box and click "OK" (see below image). Correct BMP can be looked up in the routing inventory in the "Section Explorer" window.

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🔋 Edit Landmark					
i 🔊 Original 🍋	Current				
Chainage	0.000 🖨 0.000				
Event type					
Description	OLD NATIONAL PIKE (AHEAD)				
Rechaining effect within current section ○ ◇ None (rechain only current landmark) ○ ⇒ Propagate forward (rechain next landmarks within section)					
🔘 🧊 Propagat	e forward and backward (rechain whole section)				
	OK Cancel				

Step 76. Check if multiple routes exist in same file.

- i. If multiple routes exist, refer to <u>Accessing Electronic ARAN Logs</u> for accessing electronic ARAN logs.
- ii. If multiple routes do not exist, proceed to Step 77.
- Step 77. Return to the "Section Composition" window and click the "Complete" button (see helow image).

🔶 Sect	ion Composition				- ×
1 🛗 🍰 🐐	🕫 🖻 🌲 👽	🤊 🛃 🖉 🔍 🕂 🔍 – 🔍 Fit 🔍 1:1	0 🛃 🖻 📝 Landmark Editing 🝷 🎍	. 🗆 🕹 🗙	🤶 💼 🗄
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County	CL	a	B	8	8
RouteID	MD 854 A		10	50	2,6
Dir	S				
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	78H0S4YM				
Date	08/17/2017				
Time	10:25 AM				
Vehicle	1724				
(3)					
8 - I N	4 🕨 M 🔁	Ţ			

Step 78. Click the "OK" button on the dialogue box that appears (see below image). Place any pertinent notes in the "Comment" field. Comments may include: adjusted GPS landmarks, stopped 100' early, started 100' late, adjusted mile points, or gap due to road closure.



Data Processing Route Matching

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0	Comple	ete	x				
Sec	tion Co	mpositio	Show Current Show All				
		Current Status	Next Status	L_CO	L_ROUTE	L_D	
	V	H	0	WO	MD 90 E4 R8	S	
-							
1	Comment						
ad	justed st	art GPS lar	ndmark, er	nded early			
						OK Cancel	

Step 79. In the "Section Composition" window, click the "Check In" button (see below image).

/ 🍫 Secti	on Composition				→ ×
1 🛗 🔒 🔮	🕫 😂 🍣 🕯	🚽 🚑 🧭 🔍 🕂 🔍 🗖	it 🔍 1:1 🛛 🔹 🥶 🐨 Landmark Editing 👻 🔚 🕅	*	😣 🖻 🗄
County	CL	d	8	8	g
RouteID	MD 854 A		Ê	50	2,6
Dir	S				
la • M →	A M A M				<i></i>
	78H0S4YM -				
Date	08/17/2017				
Time	10:25 AM				
Vehicle	1724				
► 0		Bannanan			
⊳ - M ·	4 🕨 🖌 💽				
		1 B			

Step 80. Click the "OK" button on the dialogue box that appears (see below image).

Data Processing Route Matching

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Ð	Check !	ín					. 🗆 🗙
Sec	tion Co	mpositio	n			Show Cur	rent Show All
		Current Status	Next Status	L_County	L_RouteID	L_Dir	
	V	2		CL	MD 854 A	S	
	8 -						
	Comm	enil					
						ОК	Cancel

Step 81. In the "Section Composition" window, click the "Save" button (see below image).

Sect	ion Composition				- ×
1 🛗 🏦 🕯	🔊 😒 🌲 😥) 🛃 🖉 🥝 🔍 🕂 🔍 – 🔍 Fit 🔍 1:1	0 🗹 🛛 🐨 🕼 Landmark Editing 🔹 ⊾ 🗆	1 🗐 🖈	۱
				0	
County	CL	4	8		- 83
RouteID	MD 854 A		2	50	26
Dir	S				
🗟 - 📕	4) M				
	78H0S4YM -				
Date	08/17/2017				
Time	10:25 AM				
Vehicle	1724				
3					
⊳ - 	< > N 🔁				

Step 82. Click the "OK" button on the dialogue box that appears (see below image).

	Save					
Sec	tion Co	mpositio	n			Show Current Show All
		Current Status	Next Status	L_County	L_RouteID	L_Dir
		4		CL	MD 854 A	S
	Comm	ent				
						OK Cancel

3- Updating Table in the EDW – *performed by EDW user*

Summary: This task updates the "View/Edit Unique Run Status" table in the EDW with the matched route and includes any notes for the run.

- Step 83. Open the EDW application.
- Step 84. Select "Data" and then click "ARAN" and "View/Edit Unique Run Status" from the drop-down menu (see below image).

🍻 Data Warehouse	Data Warehouse - Connected to Production Database							
Administration	Data Analysis		Design	Re	eporting	Help	Exit	
	Co	nstruction D	ata					
	Aran		•		Data Up	oload		
	Wis	secrax	•		Record	Drive an	nd First Image	
	Vis	idata			Data Tr	ansfer fro	om SQL to Oracle	
	Friction		•		View/Edit Unique Run Status		e Run Status	
	MCMS				Upload FED Field Log		ld Log	
	Ma	intenance	•		Collecti	on List E	dit	
	HN	1A Tonnage	• •		Collection List vs. Base Report		s. Base Report	
	Inv	entory	•		ARAN I	magery (Checks	
	Curve		•		Route N	Natching	QC	
	WI	M	•					
	Vid	leolog						
	X_Fund76_77		+					
	Cra	ash	•					

Step 85. In the table that opens, select the current year and "All" in the "County" field. The table will populate based on the above query (see below image).

Y 201	ear Coun 7 • All	ty Route	e TestDa ▼	ate File Nar ▼	me Drive No	•	Filter	•
	YEAR	FILENAME	IDSESSION	IDLOCATOR	COLLECT_DATE	CODE	COUNTY	M
Þ	2017	7410S3NZ	6	1	04/18/2017	2	AA	
	2017	7410S3TF	7	1	04/18/2017	2	AA	
	2017	74107360	8	2	04/18/2017	2	A A	

Step 86. Double click one of the records in the table. It does not matter which record is selected. In the window that opens, click the arrow next to the "File Name" drop-down list and select the file name that was just matched (see below image).

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Nan onique nun status o	puate			
ile Name 7410U41A	🚽 Lo	Cation AA TL 9 E M E R MP:0-1.315	Length	1.315 Drive No NA Usecrax Required
ED 7410U4IA 7410U4SK 74S0U3LB			Collection Match	
74S0U4MQ		QA Checked Recollect	🗖 Ma	atch QC 🔲 Recollect 🛛 Not To Use 🔲 GPS Revised
La: 74S0V3IV/ 74S0V40L 74S0W3V1 74S0W46P		By:	LastR	Review Date: By:
74S0X3YG 74S0X3YG 74S0X4A6			QA	A Review (Team Leader Only)
Standard 74S0Y4DL 74S0Z3N6 74S10200		→ Add. Note	Standard Note	✓ Add. Note
ED Note 74S103Q0 74S103Q0 74S103Q0 74S103Q0			Match Note	jm ignore
GD DPT 74S12383 Wisecra 74S124MC Wisecra 74S133V2			PAGD DAT	
74S144AG QC CI 74S1532N 74S1532N 74S154I2	(QA Checked 🔲 Wx_Impossible	Recollect	QC Checked QA Checked
74S1637M 74S164MR DPT Nc 7520S36U 7520S3FB			DAT Note	
7520S3NC 7520S4B9 7520S4TD				
7520T33L View FEL 7520T3BM	-	5	ave Close	Confirm Recollection Done

Step 87. Check the box next to "Match QC" once the correct file is selected. The program will add the user name and date. If any notes need to be added, select a common note from the "Standard Note" drop-down menu or type a manual note in the "Add. Note" field (see below image).

Collection Match			
☑ Ma Last R	atch QC 🔲 Recollect 📄 Review Date: 11/14/2017	Not To Use GPS Revised By: JMASK	
QA	Review (Team Leader Only	у)	
Standard Note		Add. Note	
Match Note	Portion of Collection Missing Late Start Early Ending Late Start and Early Ending		
PAGD DAT	Road Closures Added Route to Vision Inventory Wrong Tum Collection Gaps Run Corrupted Test Run Only	QA Checked	
DAT Note			

Step 88. Add text in the "Match Note" field, which should include user initials, date, and any notes from Step 78.

Step 89. Click the "Save" button.

Step 90. If closing out a District, complete the status table and submit to the DPT TL via email (see below image).

Step	Reviewed	Complete?	worksheet archived?
1			
2			
3			
4			
5			
6			
7			

4- Performing QC of Matched Routes – performed by Vision and EDW user

Summary: This task performs route and systemic level reviews of matched routes to check for accuracy and completeness. Vision and EDW application tools are utilized to determine if data is ready for production to further processing routines can occur.

- Step 91. Perform route level QC inspection by opening a matched route in Vision. Check for the following key items:
 - i. Check that all sections in the run are matched, including ramps. Match any remaining sections, if necessary. Use Vision Map, Layers, Routed Nodes feature to assist in process (see image below).

Matched as collected (1), but now needs the ramp match (2)



ii. Check landmark accuracy. If landmark needs adjustment, update the year's inventory spreadsheet with new GPS and load into Vision. Maintain spreadsheet for reference by others.

Example of a bad landmark that requires adjustment



iii. Check the section beginning and ending landmark mileage. Correct if necessary.

Example of false landmark mile point (158 should read 0)



iv. Accommodate gaps in collection (missing collection, late start, early end, road closures, etc.). Determine if a gap (or gaps) exists. Accommodate in the matching process where necessary and place a note in the Vision run upon check out as well as in the EDW for others' reference.
Example of collection missing (and match accommodated) at the start of a route



40 WB TO MD 151 NB 🖉 Landmarks 👻



v. Verify collection run joins. Revisit start and end of each run to verify the joins are correct. Use keyboard left or right buttons to navigate to beginning or end of a run after it has been tagged.



vi. Determine if transfers are required and complete transfers where necessary. Use Vision Map, Layers, Routed Nodes feature to help identify routes needing transfer.

Example: Section 1 was the original collection and Sections 2 and 3 require transfer to their respective ramps.



vii. Check that all collection runs are either matched, transferred, or rejected. Determine if all sections within a collection session are identified and match, transfer, or reject accordingly. Rejecting routes should only be utilized when a collection run has been determined to be unsalvageable due to data or imagery issues (recollection is needed) or a substantial portion of a run is not useful (except where it can be matched to another route). viii. Enter and apply pertinent notes (QC and review notes) for each collection run in Vision. Notes should be entered after selecting the "Complete" button (see below images).

🔒 Check Out	_		
Session	User	LogTime	Comment
6600S200	mchapman	09/08/2016 11:16:29 AM	ended 70' early due to dead en
Comment			
🚫 Silent checko	ut 🔳		OK Cancel

Note examples include:

0.15 mi gap due to bridge closure @ MP 0.09 977' short due to early ending (salvaged part of IS 83 south collection) added route to Vision inventory adjusted GPS landmarks adjusted GPS landmarks, ended 410' early due to wrong turn ended 175' early due to dead end and parked vehicles ended early due to dead end started 0.05 mi late due to blocked roadway (farm equip storage) started 21' late and ended 0.04 mi early due to impassable road - overgrowth started 25' late due to dead end, gap between 0.32 - 0.44 due to road detour. started 52' late due to dead end

ix. Enter and apply pertinent notes (QC and review notes) for each collection run in the EDW application (see below images).

🏇 Data Warehouse	- Connec	ted to Produc	tion Databa	ise		-		
Administration	Data	Analysis	Design	Repo	orting	Help	Exit	
	Co	onstruction D)ata					
	Ar	an	•	D)ata Up	load		
	W	isecrax	•	R	Record	Drive ar	nd First Image	
	Vi	sidata		D)ata Tra	ansfer fro	om SQL to Ora	acle
	Fr	iction	•	V	/iew/Ed	lit Uniqu	e Run Status	
	M	CMS		U				
	M	aintenance	•	С	ollectio	on List E	dit	
	H	MA Tonnage	ə 🕨	С	ollectio	on List ve	s. Base Repo	rt
	In	ventory	•	A	RAN Ir	nagery	Checks	
	Cu	Irve	+	R	loute M	latching	QC	
	W	IM	•					

Yea 2016	ar •	County All 🗸	Route	Test Date ▼	e File Name ▼	Drive No.	-	Filter •	Showing R	ecollected All	an ▼	
	YEAR		FILENAME	IDSESSION	IDLOCATOR	COLLECT_DATE	CODE	COUNTY	MUN	ROUTE	RN	
•	2016		65903200	8	6	05/09/2016	13	НО	0	MD	100	
	2016		65903200	8	3500	05/09/2016	13	но	0	MD	100	
	2016		65904200	9	7	05/09/2016	13	но	0	MD	100	
	2016		65905200	10	8	05/09/2016	13	но	0	MD	100	
	2016		65906200	11	9	05/09/2016	13	но	0	MD	100	
	2016		65907200	12	10	05/09/2016	13	но	0	MD	100	
	2016		65908200	13	11	05/09/2016	13	но	0	MD	100	
File FEI	File Name 6Al0L200 Location CL MD 852 H W M0 E R MP-0-0228 Length 0228 Drive No NA Wisecrax Required? FED OPPE OPPE Matched Recollect OPPE Image: Comparison of the c											
	Noute Data QC Checked QA Checked Wx 100 Percent QC Checked QC Checked/Uploaded QA Checked Wx_Impossible Recollect DPT Note DAT Note											
	iew FED) Field Log				Save	Close	Confirm Recolled	tion Done			

Step 92. Perform systemic level QC inspection by opening Vision once per week. Click "Segment" and select "Match Discrepancy Finder" from the drop-down menu (see below image).



i. In the "Group Partition Selector", select "All", enter "4" in the "Discrepancy Threshold" box, and click "OK" (see below image).

ect 🗙 Remove 📓	Refresh				Discrepa	ncy Threshold		4 🔚
ROUTE D	Session	Start	End Match	nes Discrepancies	Maximum			
) Group Partition Se	lector							23
🗈 Refresh 🔍 Disp	lay							
Group	Description	Video Path			Expression			
🕀 📑 Al 🗾								
	~ 2							
		L_CO	L_ROUTE	L_D	CollectionVehicle	DCSTimeStamp	UniqueRun	
🗈 🛄 Al		AA	MD 162	N	1721	05/09/2016 10:	6590T16W	
		AA	MD 162	S	1721	05/09/2016 10:	6590T16X	
		AA	MD 176	E	1721	05/09/2016 10:	6590T16R	
		AA	MD 176	E	1721	05/09/2016 10:	6590T16S	
		AA	MD 176	E	1721	05/09/2016 10:	6590T16T	
		AA	MD 176	E	1721	06/06/2016 9:1	6660P1RD	
		AA	MD 176	E	1721	06/06/2016 9:1	6660P1RE	
		AA	MD 176	E	1721	06/06/2016 9:1	6660P1RF	
		AA	MD 176	E	1721	06/06/2016 9:2	6660Q103	
		AA	MD 176	E	1721	06/06/2016 9:2	6660Q104	
		AA	MD 176	E	1721	06/06/2016 10:	6660T195	
		AA	MD 270	N	1721	05/09/2016 10:	6590T16V	
		AA	MD 270	S	1721	05/09/2016 10:	6590T16U	
		НО	MD 100 E7 R2	N	5513	05/09/2016 7:3	65903200	
		HO	MD 100 E6 R2	N	5513	05/09/2016 7:4	65904200	

ii. Review results. A yellow triangle in the "CO" column indicates a failed QC (requires review), while a blue check mark indicates a passed QC (see below image). Review each failed QC and determine if discrepancy is reasonable and that QC notes exist within Vision and the EDW. Address the issue by populating notes where needed and making appropriate correct actions.

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Data Processing Route Matching

Select 🗙	Remove 🔄 Refresh						Discrepancy Thresh	bld	4 🔚 Show
CO	ROUTE	D	Session	Start	End	Matches	Discrepancies	Maximum	
A HO	MD 103 A	S	6590K200	0.000	194.000	1	1	4.358	
🖄 HA	US 1	N	69S0P1E2	15,690.000	27,540.918	1	1	4.085	
🔥 GA	US 219 B	E	66910200	0.000	187.000	1	1	4.039	
🔔 DO	MU 1470 M19	w	65G03200	0.000	399.000	1	1	4.799	
🔔 DO	MD 343 B	w	65G0I200	0.000	257.000	1	1	4.061	
🔔 CO	MD 776 A	N	65I0Q200	0.000	161.000	1	1	4.113	
🔔 CO	MD 485 A	W	65I0L200	0.000	198.000	1	1	4.023	
🖄 BA	US 40 E18 R6	E	6AF0L1UC	0.000	2,588.766	1	1	11.985	
🐴 AL	MD 135 E	S	6691S200	0.000	87.000	1	1	5.975	
🐴 AL	MD 935 A	W	66A05200	0.000	176.000	1	1	4.472	
⊘wo	US 50 WC	S	65Q15200	0.000	87.000	1	0	0.000	
⊘wo	US 50 WC	N	65Q11200	0.000	350.000	1	0	0.000	
⊘wo	US 50 WB	S	65Q11200	0.000	350.000	1	0	0.000	
⊘wo	US 50 WB	N	65Q14200	0.000	140.000	1	0	0.000	

iii. Click "View" and select "SQL Queries", then "Segmenting QC" to determine what routes require further review of accuracy and completeness (see below image). Take corrective actions where necessary.



For each of the above items, run the SQL procedure to attain collection run(s) with issues that require review to determine accuracy and completeness. Evaluate and address any issues and make sure QC notes are placed in the EDW Unique Run status program for each run. Before selecting "Execute," Short Matches requires "4" value entry, GPS Matching Discrepancies require "4" value entry, and Continuous Match Gaps requires "0.1" value entry where Values are null.

Example of results

🕼 Sections 🖗 Section Composition 🚯 Find Match Discrepancies	SQL Q	ueries								
Process Merge_EDO_Rut			- 🛄	Group (Not selec	ted) 🕨 Run					
📧 Export 🔄 Show/Hide 🔯 Refresh 🕨 Execute 🕁 Save 📝 Update 🕻	K Delete									
SP Queries 7	Query S	P Parameters								
or vulnes	User Queries F F F F F F F F F F F F F F F F F F F	r rainettes Paraneter Elangh Tireahold Percent Tireahold Percent Tireahold Percent Tireahold Percent Tireahold Percent Toreahold Percent T	Type L Type L Toat foat foat foat foat foat foat foat f	angth	Value 10 12 est 25 25 25 25 25 25 25 25 25 25	do. DC Sessions Unique cestamp as distancestar EndDistanceStamp 153.41355541222 233.72442220144 238.7324762 124.3973284486135	Run. wf.Transi np_fis, speed*2 IDLocator 279 4657 4656 1162 1317	L_CO AL PG BA BA	LROUTE (5.6) E34 R3 M0 210 E34 R3 M0 210 E38 R2 M0 210 E38 R2 (5.83 E16 R7	name, stationd W W W W W N

Step 93. Communicate results of QC review to DPT TL and discuss any lingering issues that may need to be resolved.

5- Performing QA of Overall Process – performed by Supervisor

Summary: This task performs QA checks on route matching process.

Step 94. See existing QA guide.

5.07 PERFORMING 100% DRIVE THROUGH

5.07.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to perform quality control (QC) and quality assurance (QA) checks of the Laser Crack Measurement System (LCMS) pavement image output using data collected by the Automatic Road Analyzer (ARAN) survey vans in the field by Field Explorations Division (FED) staff. This SOP is performed after completion of route matching (see <u>Route Matching</u>).

5.07.02 Frequency

The 100% drive through of pavement images is performed every time a batch of ARAN collected data is received by the DPT. Each ARAN data batch is typically delivered to the DPT every 4 to 5 days. Assuming an average of 60 miles collected per day, each batch contains, on average, between 240 and 300 miles of ARAN data. The actual frequency varies according to the proximity of the routes on which data were collected for the data batch to the Office of Materials Technology (OMT) office and it ranges from 1 day (when collected near the OMT office) to 2 weeks (when collected far from the OMT office). Shorter turn-around periods are preferred to minimize the amount of mileage requiring data recollection. The annual ARAN data collection season typically lasts from March to Mid-December.

5.07.03 Purpose

The purpose of this SOP is to perform a thorough check of the LCMS pavement image output, correct any errors in crack or joint detection, and perform QC and QA checks.

5.07.04 *Resource Requirements*

Performing the 100% drive through involves three people: (1) a user knowledgeable in Vision software to perform QC on the pavement images, (2) a user knowledgeable in Vision software to perform QA on the analyzed images, and (3) a supervisor who, as required, provides guidance and decision-making and performs QA. The estimated effort levels in the table below represent the total time, in man-hours, to complete the drive through QC/QA. These time estimates assume average batch quantities and no issues were encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	Vision user and QC	1	336.0
DPT Staff	QA	1	25.0
DPT TL	Supervisor and QA	1	AR ^{06/12/2019}

5.07.05 *Procedure*

The procedure to perform the 100% drive through and perform QC/QA is comprised of the following three tasks:

- (1) performing 100% drive through QC,
- (2) performing QA of the analyzed images, and
- (3) performing overall QA of the process.

1- Performing 100% Drive Through QC – performed by Vision user

Summary: This task uses Vision software to analyze the LCMS output, correct errors in crack or joint detection, and mark events.

Step 1. Open Vision software. Select the target database and click "OK" (see below image)

3 Select Project			×
🗞 New 🗙 Delete 🥂 Clear	🕑 Test		
Project	Server	Last accessed	<u>^</u>
OMT_ARAN_PROD_2017_1	SHAHQVISIONPRD, 1438	12/05/2017 06:39:01	=
OMT_ARAN_CRACK_2012	SHAHQDBCLSPROD	05/30/2017 21:17:47	
OMT_ARAN_CRACK_2013	SHAHQDBCLSPROD	05/30/2017 20:26:03	
OMT_ARAN_CRACK_2014	SHAHQDBCLSPROD	05/30/2017 20:26:03	
OMT_ARAN_CRACK_2015	SHAHQDBCLSPROD	05/30/2017 20:26:03	
<pre>OMT_ARAN_PROD_1995_A</pre>	SHAHQDBCLSPROD	05/30/2017 20:26:03	
OMT_ARAN_PROD_1996_A	SHAHQDBCLSPROD	05/30/2017 20:26:03	
<pre>OMT_ARAN_PROD_1997_A</pre>	SHAHQDBCLSPROD	05/30/2017 20:26:03	
OMT_ARAN_PROD_1998_A	SHAHQDBCLSPROD	05/30/2017 20:26:03	
I OMT_ARAN_PROD_1999_A	SHAHQDBCLSPROD	05/30/2017 20:26:03	-
		OK Can	cel

Step 2. Click on "Rate" and select "Pavement Distress" from the drop-down menu (see below image).

تررية	коа	aware vision	_					1 (1) (1) (1) (1) (1) (1) (1) (1) (1) (1				
	File	View Tools	Hel	р								
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	و 😰	ection Explore	er		🛷 Eve	nts						
	Gro	ups 78E0O3\	/1 (1 / 1	L)	Pav	ement Distress						
					🔰 Sch	Schema Tag Editor						
۶						▲ ▼						
		County	/	Rout	teID	Dir		Collection	Vehicle			
	×	Contains:	т	Contains:	T	Contains:	Ŧ	Contains: T	Equals: T	Equals:		
		BA		MD 140		N		78E0O3V1	1723			
		BA		MD 140		S		78E0Q3U3	1723			
		BA		MD 140		S		78E0S3V5	1723			
	Ø	BA		MD 140 E5	R1	E						
	Ø	BA		MD 140 E5	R2	N						
	Ø	BA		MD 140 E5	R6	s						
	Ø	BA		MD 140 E5	R7	W						
	Ø	BA		MD 140 E5	R8	E						
		BA		MD 144		E		7620R3K2	1723			

Step 3. From the menu on the right side of the window, deselect: **Potholes, Raveling, Bleeding, Pickouts, and Curbs & Drop-offs** (see below image).



Step 4. Click on "Images" and select "ROW" from the drop-down menu (see below image).

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🖏 Connect 📲 - 🟇 Segment 🗸	🐉 Rate 🔹 🐗 Process 👻 🎯 Map	Images 👻 🎽 Panora	amic View	🔂 Charts 🝷 🔂 T	Tables -	Report 🦷	Publish	- Plug-Ins 👻 🚠 Distress sche	ma 🙀 Bo	okmarks •
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Step 5. Adjust the "ROW" window by clicking on the "ROW" tab and selecting "New Vertical Tab Group" (see below image).



Step 6. Start driving through using the "Play button (see below image).

STATE HIGHWAY ADMINISTRATION

Data Processing Performing 100% Drive Through

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	00001/3809.fts	9.428	10	0	
	0000180247.fis	13.428	6	0	
	0000186684.fis	17.428	6	0	
	00001005504	21.428	5	0	
	JUUU 133559.fis	25.428	16	0	
	UUUU2U0396.fts	29.428	8	0	
	JUUU212434.fts	33.428	6	0	
	0000218871.fis	37.428	10	0	
	0000225308.fts	41.428	14	0	
	0000231746.fis	45.428	9	0	
	0000238183.fts	49.428	23	0	
	0000244620.fts	53.428	13	0	
	0000251058.tis	57.428	15	0	
	JUUU257495.fis	61.428	14	0	
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	0000315432.fts	97.428	10	0	
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• W/S Speed 60 • 🔡 🔍 Ma	agnify 🛷 Distres	ses 🥖 Cra	acks 🥔	Statistics	~

Step 7. Identify pavement type.

- i. If the section is Jointed Concrete Pavement (JCP), proceed to Step 8.
- ii. If the section is Continuously Reinforced Concrete Pavement (CRCP), proceed to Step 10.
- iii. If the section is Flexible (Asphalt) Pavement, proceed to Step 12.
- Step 8. Navigate to beginning of section. Draw a "JCP Distress Event" line from the beginning to the end of the JCP concrete section (see below images).

10 Piler Piler Piler cektype Piler cektype 10 Piler Piler cektype Piler cektype Piler cektype 11 Piler cektype Piler cektype Piler cektype Piler cektype 12 Piler cektype Piler cektype Piler cektype Piler cektype 12 Piler cektype Piler cektype Piler cektype Piler cektype 13 Piler cektype Piler cektype Piler cektype Piler cektype 14 Piler cektype Piler cektype Piler cektype Piler cektype 14 Piler cektype Piler cektype Piler cektype Piler cektype 14 Piler cektype Piler cektype Piler cektype Piler cektype 14 Piler cektype Piler cektype Piler cektype Piler cektype 14 Piler cektype Piler cektype Piler cektype Piler cektype 14 Piler cektype Piler cektype Piler cektype Piler cektype 14 Piler cektype Piler cektype Piler cektype Piler cektype 15 Piler cektype Pil	Section Explorer						-		
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12 •••••••••••••••••••••••••••••		🕒 00000154497.fis	3	-2.572	22	0	154.370	0.000 =	Unsealer
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12 00000173895/n: 9.4.28 0000016864/n: 17.42 0000016864/n: 17.42 0000016864/n: 17.42 0000016864/n: 17.42 00000016864/n: 17.42 00000016864/n: 17.42 00000021867/n: 24.42 0100002187/n: 24.42 0100002187/n: 24.42 0100002187/n: 74.42 0100002187/n: 74.42 0100002187/n: 74.42 10 14.4554 8.460 14.267 5.464 000000218656 74.22 10 14.267 5.464 listergand_cracking endot not not not not not not not not not n		000000167372.fis	3	5.428	3	0	154.370	0.000	crackwic
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32		000000180247.fis	3	13.428	6	0	154.370	0.000	crackwic
12 142 5 0 12.543 17.400 10 1000001595595 24.28 16 0 12.544 26.151 11 10000012124348 33.42 6 0 132.644 15605 11 14.286 14.423 5.332 0 144.524 5.342 12 0000002174745 45.422 23 0 144.226 5.43 13 0000002174745 45.422 23 0 144.226 5.43 14 0000002174745 45.422 13 0 148.207 5.43 14 0000002170584 7.422 14 0 17.705 6.78 15 0000002170584 7.422 11 14.6140 6.475 0.78 15 Event_Bad_Image 14.226 13.784 10.4057 0.78 0.7428 16 Event_Song_Bar 5.2428 11 10.5390 13.18 0.77428 11.3390 12.313 16.22 11.43 13.201 11.44514 14.205 0.77428 14.4657 0.		🕒 00000186684.fis	3	17.428	6	0	144.930	5.901	crackwic
11 10 11 12 14 12 14 13 14 <td< td=""><td>142</td><td>000000193121.fis</td><td>3</td><td>21.428</td><td>5</td><td>0</td><td>126.493</td><td>17.480</td><td>crackwic</td></td<>	142	000000193121.fis	3	21.428	5	0	126.493	17.480	crackwic
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11 00000223136/a 41.428 14 146.207 5.353 10 000002231766/a 45.428 9 0 146.207 5.423 10 00000023103/a 49.428 2.3 0 146.207 5.423 11 000000225105/a 5.7428 15 0 147.556 5.748 11 000000225105/a 61.428 1 0 146.167 5.663 0000002251455/a 61.428 1 0 147.556 5.748 16.476 69.428 5 0 147.575 15.438 14.4457 6.5428 11 0 16.575 17.438 14.4457 6.5428 11 0.4578 13.3897 13.3897 13.3897 13.3277 13.342 13.3277 13.343 13.3277 13.343 13.445077 10.33728 13.342 13.3277 13.342 14.4334 5.041 17.7428 14.46307 10.378 17.340 5.576 17.464 13.483 5.376 17.428 14.46307 6.031 11.746 14.6336 6.374 17.746 17.746		🕒 00000218871.fis	3	37.428	10	0	144.534	8.460	crackwic
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13		🕒 00000231746.fis	3	45.428	9	0	148.246	5.423	W Iransverse
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140 0000002734955s 61428 14 0 147025 6.033 140 14 14 0 147025 6.033 crackwic 140 14 14 0 147025 6.033 crackwic 140 14 14 0 14725 10.438 crackwic 140 14 14 0 135724 14.045 crackwic crackwic 140 14 0 135780 13.118 crackwic crackwic <td>CARLES AND AND AND AND AND AND AND AND AND AND</td> <td>00000251058.fis</td> <td>3</td> <td>57.428</td> <td>15</td> <td>0</td> <td>147.596</td> <td>5.748</td> <td>crackwic</td>	CARLES AND	00000251058.fis	3	57.428	15	0	147.596	5.748	crackwic
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137 Event_Disregard_Cracking + 69.428 5 0 140.578 10.438 140 Event_Bad_Image - 73.428 28 0 135.724 14.045 140 Event_Stop_Bar 81.428 10 0 135.500 13.118 crackwic 159 Event_Crosswalk 83.428 10 0 135.500 13.927 crackwic crackwic 159 Event_Crosswalk 83.428 6 0 139.198 12.313 crackwic crackwic </td <td></td> <td>1 EQ. 00000000000000000000000000000000000</td> <td></td> <td>65.428</td> <td>11</td> <td>0</td> <td>146.140</td> <td>6.476</td> <td>crackwic</td>		1 EQ. 00000000000000000000000000000000000		65.428	11	0	146.140	6.476	crackwic
100 T 4.28 2.8 0 135.724 14.045 crackwic 100 Event_Sealed_Cracking_Exists 1 10 135.80 13.118 crackwic 110 Event_Stop_Bar 98.428 10 0 135.300 14.227 110 Event_Crosswalk 98.428 4 0 137.328 12.818 111 Event_Bridge 99.428 4 0 137.328 12.818 111 Event_Bairoad 101.428 16 0 143.057 10.379 111 101.428 16 0 143.057 10.379 Wareaction 111 101.428 10 146.522 7.465.244 6.394 6.394 117.428 10 146.326 6.344 crackwic crackwic crackwic 117.428 10 146.326 6.344 crackwic crackwic crackwic 117.428 10 146.326 6.344 crackwic crackwic crackwic 117.428 10 146.326 6.344 corackwic <t< td=""><td></td><td>Event_Disregard_Cracking</td><td>•</td><td>69.428</td><td>5</td><td>0</td><td>140.578</td><td>10.438</td><td>crackwic</td></t<>		Event_Disregard_Cracking	•	69.428	5	0	140.578	10.438	crackwic
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139 Event_Crosswalk + 85.428 11 0 135.560 13.227 139 Event_Bridge + 89.428 4 0 137.328 13.133.183 12.43 139 Event_Lane_Deviation + 99.428 6 0 141.413 11.201 Uneselie 139 Event_Miled_Pavement + 101.428 10 146.395 5.349 130 Event_Miled_Pavement + 113.428 9 0 147.340 5.876 117.428 11 0 146.395 6.344 crackwic crackwic 117.428 11 0 146.405 6.344 crackwic crackwic 117.428 137.861 117.766 11.796 6.344 crackwic crackwic 129.428 30 146.336 6.378 crackwic crackwic crackwic 141.428 30 127.2731 15.291 1.46.405 6.344 crackwic crackwic 141.428 30 127.2731 15.291 1.46.366 6.378 crackwic<		Event Step Par		81.428	10	0	135.360	14.227	crackwic
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139 Event_Railroad 101.428 16 0 143.057 103.79 Event_Railroad 105.428 11 0 146.522 7.466 Event_Wet_Surface 105.428 12 0 147.340 5.879 Event_Brick_Pavement 113.428 9 0 147.340 5.879 Event_Milled_Pavement 121.428 0 146.405 6.334 Event_CRCP_Exists 129.428 0 146.405 6.344 Event_JCP_Exists 129.428 0 146.405 6.344 ICP_Event_Exists 137.861 11.766 145.244 6.924 ICP_Event_Exists 137.861 11.766 145.242 6.924 ICongitudinal Crack (LE) 141.428 0 128.29 2.73 Longitudinal Crack (LE) 141.428 129.822 9.27.231 13.981 Longitudinal Crack (RWP) 157.428 120.2607 4.623 Longitudinal Crack (RWP) 157.428 122.607 4.623 Longitudinal Sealed Crack (LE) 165.428 122.2607 4.623 Longitudinal S		Event Lane Deviation		97.428	6	0	141.413	11.201	Lineasley
133 Event_Kaiiroad 105.428 11 0 146.522 7.466 Event_Wet_Surface 109.428 12 0 148.394 5.349 Event_Brick_Pavement 117.428 11 0 146.572 7.466 Event_Milled_Pavement 117.428 11 0 146.474 6.309 Event_CRCP_Exists 125.428 7 0 146.405 6.344 Event_CRCP_Exists 129.428 3 0 146.336 6.378 Icongitudinal Crack (LE) 141.428 3 0 125.424 6.924 Longitudinal Crack (LE) 141.428 3 0 127.231 15.291 Longitudinal Crack (LE) 141.428 3 0 126.522 9.273 Longitudinal Crack (LWP) 145.428 10 129.822 9.273 Longitudinal Crack (CTR) 153.428 10 125.391 13.997 Longitudinal Crack (RE) 161.428 0 126.07 4.623 Longitudinal Sealed Crack (RE) 164.428 0 143.384 7.530 Longitudina				101.428	16	0	143.057	10.379	Sealed
138 Event_Wet_Surface 109.428 12 0 148.334 5.349 Event_Brick_Pavement 117.428 9 0 147.340 5.876 Event_Milled_Pavement 121.428 40 0 146.474 6.309 Event_Debris 125.428 7 0 146.436 6.378 Event_CRCP_Exists 129.428 3 0 146.336 6.378 Event_JCP_Exists 120.428 3 0 127.231 15.291 Longitudinal Crack (LE) 141.428 3 0 127.231 15.291 Longitudinal Crack (RWP) 153.428 10 125.491 100 143.319 -1.489 Longitudinal Crack (RWP) 153.428 10 125.391 13.997 @ Unclassfied	139	Event_Kailroad	•	105.428	11	0	146.522	7.466	crackwir
138 Event_Brick_Pavement 113.428 9 0 147.340 5.876 Event_Milled_Pavement 117.428 11 0 146.097 6.093 Event_Debris 121.428 40 0 146.474 6.309 Event_CRCP_Exists 129.428 3 0 146.436 6.378 Event_JCP_Exists 129.428 3 0 145.244 6.924 I Longitudinal Crack (LE) 141.428 3 0 127.231 15.291 Longitudinal Crack (LWP) 145.428 10 143.219 -1.489 Longitudinal Crack (RWP) 153.428 10 143.219 -1.489 Longitudinal Crack (RE) 161.428 0 126.007 4.623 Unclassified Unclassified 0 Unclassified 0 Unclassified 165.428 1 0 125.391 13.997 Longitudinal Sealed Crack (RE) 169.428 0 144.334 7.530 Longitudinal Sealed Crack (RE) 181.428 0 145.446 6.994 Unclassified 0 Uncl		Event_Wet_Surface	•	109.428	12	0	148.394	5.349	crackwic
138 Event_Milled_Pavement 117.428 11 0 146.907 6.093 Event_Debris 121.428 40 0 146.405 6.344 Event_CRCP_Exists 129.428 3 0 146.405 6.344 Event_CRCP_Exists 129.428 3 0 146.405 6.344 Event_JCP_Exists 120.9282 3.0 146.405 6.344 Longitudinal Crack (LE) 141.428 3 0 127.231 15.291 Longitudinal Crack (LE) 141.428 3 0 127.231 15.291 Longitudinal Crack (CTR) 153.428 17 0 145.624 6.924 Longitudinal Crack (RE) 161.428 3 0 122.607 4.623 Longitudinal Sealed Crack (LE) 165.428 1 0 125.391 13.997 Longitudinal Sealed Crack (CTR) 177.428 0 144.403 7.530 Longitudinal Sealed Crack (RWP) 181.428 0 146.433 7.530 Longitudinal Sealed Crack (RWP) 181.428 0 146.434 6.299 <t< td=""><td>4</td><td>Event Brick Pavement</td><td>•</td><td>113.428</td><td>9</td><td>0</td><td>147.340</td><td>5.876</td><td>crackwic</td></t<>	4	Event Brick Pavement	•	113.428	9	0	147.340	5.876	crackwic
138 Event_Debris 121.428 40 0 146.474 6.309 Event_Debris 125.428 7 0 146.405 6.344 Event_CRCP_Exists 129.428 3 0 146.336 6.378 Isongitudinal Crack (LE) 141.428 3 0 127.231 15.291 Longitudinal Crack (LWP) 145.428 314 0 129.822 9.273 Longitudinal Crack (CTR) 149.428 201 0 143.219 -1.489 Longitudinal Crack (RWP) 157.428 42 0 133.681 6.592 Longitudinal Crack (RE) 161.428 0 125.391 13.997 Longitudinal Sealed Crack (LE) 169.428 0 145.264 6.914 Longitudinal Sealed Crack (RE) 181.428 0 145.264 6.914 Wolclassfied 0 146.494 6.299 193.428 19 0 148.108 5.492 Longitudinal Sealed Crack (RE) 181.428 0 145.264 6.914 0 0 0 10 0 0 0 <		Event Milled Bavement		117.428	11	0	146.907	6.093	crackwic
138 Event_Debris 125.428 7 0 146.405 6.344 129.428 3 0 146.336 6.378 145.244 6.924 137 Event_JCP_Exists 129.428 3 0 146.336 6.378 145.244 6.924 137.861 11.796 145.244 6.924 137 Longitudinal Crack (LE) 141.428 3 0 127.231 15.291 153.428 17 0 145.856 8.979 153.428 17 0 145.856 8.979 100gitudinal Crack (RWP) 157.428 42 0 133.681 6.592 0 <td< td=""><td></td><td>Event_wined_Pavement</td><td></td><td>121.428</td><td>40</td><td>0</td><td>146.474</td><td>6.309</td><td>crackwic</td></td<>		Event_wined_Pavement		121.428	40	0	146.474	6.309	crackwic
138 Event_CRCP_Exists 129.428 3 0 146.336 6.378 Event_JCP_Exists Id.2P_Event_Exists 145.244 6.924 137.861 11.796 Longitudinal Crack (LE) 141.428 3 0 129.822 9.273 Longitudinal Crack (LWP) 145.428 314 0 129.822 9.273 Longitudinal Crack (CTR) 149.428 201 0 143.219 -1.489 Longitudinal Crack (RWP) 157.428 42 0 133.681 6.592 Longitudinal Crack (RE) 161.428 0 125.391 13.997 Longitudinal Sealed Crack (LWP) 165.428 0 146.438 7.530 Longitudinal Sealed Crack (LWP) 177.428 6 0 144.033 7.530 Longitudinal Sealed Crack (RE) 181.428 30 0 145.264 6.914 Worklassfied Worklassfied Worklassfied Worklassfied Worklassfied Longitudinal Sealed Crack (RE) 181.428 30 0 145.264 6.914 Longitudinal Sealed Crack (RE) 189.428 1	the second second second	Event_Debris	•	125.428	7	0	146.405	6.344	crackwic
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137 153.428 17 0 145.356 -8.979 137 Longitudinal Crack (RP) 157.428 42 0 133.681 -6.592 Longitudinal Crack (RE) 165.428 1 0 122.607 4.623 Longitudinal Sealed Crack (LE) 165.428 1 0 125.391 13.997 Longitudinal Sealed Crack (LE) 169.428 3 0 136.818 12.318 Longitudinal Sealed Crack (CTR) 177.428 6 0 144.033 7.530 Longitudinal Sealed Crack (RE) 181.428 30 0 145.264 6.914 Longitudinal Sealed Crack (RE) 189.428 19 0 148.108 5.492 Ocea 193.428 19 0 149.722 4.685		Longitudinal Crack (CTR)	•	149.428	201	0	143.219	-1.489	Ounclassified
137 Longitudinal Crack (RE) 157.428 42 0 133.881 -6.592 Image: Constraint of the constraint		Longitudinal Crack (RWP)	•	153.428	1/	0	145.856	-8.9/9	Ounclassified
137 Longitudinal Crack (RE) 161.428 3 0 122.507 4.623 Longitudinal Sealed Crack (LE) 165.428 1 0 125.391 13.997 Longitudinal Sealed Crack (LWP) 169.428 3 0 143.384 7.854 Longitudinal Sealed Crack (CTR) 177.428 6 0 144.033 7.530 Longitudinal Sealed Crack (RWP) 181.428 30 0 145.264 6.914 Longitudinal Sealed Crack (RE) 189.428 15 0 146.494 6.299 Longitudinal Sealed Crack (RE) 189.428 19 0 149.722 4.685 Close 193.428 19 0 149.554 4.749				157.428	42	0	133.681	-6.592	Ounclassified
136 Longitudinal Sealed Crack (LE) 165,428 1 0 125,391 13,397 169,428 3 0 136,818 12,318 13,397 12,318	137	Longitudinal Crack (RE)	•	161.428	3	0	122.607	4.623	Ounclassified
Longitudinal Sealed Crack (LWP) 169.428 3 0 136.818 12.318 Longitudinal Sealed Crack (CTR) 173.428 4 0 143.384 7.854 Longitudinal Sealed Crack (CTR) 177.428 6 0 144.033 7.530 Longitudinal Sealed Crack (RWP) 181.428 30 0 145.264 6.914 Longitudinal Sealed Crack (RE) 189.428 15 0 146.494 6.299 189.428 19 0 148.108 5.492 Close 193.428 9 0 149.722 4.685		Longitudinal Sealed Crack (LE)	•	165.428	1	0	125.391	13.997	🕜 Unclassified
136 Longitudinal Sealed Crack (CTR) 173.428 4 0 143.384 7.894 Longitudinal Sealed Crack (CTR) 177.428 6 0 144.033 7.530 Longitudinal Sealed Crack (RWP) 181.428 30 0 145.264 6.914 Longitudinal Sealed Crack (RE) 189.428 15 0 146.494 6.299 189.428 19 0 148.108 5.492 Ociose 193.428 9 0 149.722 4.685	s s s s s s s s s s s s s s s s s s s	Longitudinal Sealed Crack (LWP)	•	109.428	3	0	140.004	7.054	🕜 Unclassified
Longitudinal Scaled Crack (RW) 177,428 6 0 144,033 7,530 Longitudinal Scaled Crack (RW) 181,428 30 0 145,264 6,914 Longitudinal Scaled Crack (RE) 181,428 15 0 146,494 6,299 Na 189,428 19 0 148,108 5,492 Close 193,428 9 0 149,722 4,685		Longitudinal Sealed Crack (CTP)		177.420	4	0	143.384	7.604	0 Unclassified
Longitudinal Sealed Crack (RW) 181.428 30 0 149.264 6.914 Longitudinal Sealed Crack (RE) 185.428 15 0 146.494 6.299 No Close 189.428 19 0 148.108 5.492 193.428 9 0 149.722 4.685 197.428 19 0 149.544 4.794		Longitudinal Scaled Clack (CTR)	,	101 420	20	0	144.033	7.03U	🕜 Unclassified
Longitudinal Sealed Crack (RE) 169.420 13 0 140.494 6.239 136 Close 189.428 19 0 148.108 5.492 191.428 9 0 149.722 4.685 197.428 19 0 149.544 4.794		Longitudinal Sealed Crack (RWP)	•	101.428	30	0	140.204	6.200	
Ios.420 Ios.420 <t< td=""><td>128</td><td>Longitudinal Sealed Crack (RE)</td><td>•</td><td>100.428</td><td>10</td><td>0</td><td>140.434</td><td>5.492</td><td> </td></t<>	128	Longitudinal Sealed Crack (RE)	•	100.428	10	0	140.434	5.492	
Close 133.420 3 U 143.722 4.003		Class		192.428	13	0	1/10 722	1 605	
	4	Close		197 / 20	10	0	143.722	4.000	

Maryland DEPARTMENT OF TRANSPORTATION

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	Filter				🐺 Filter c	rack types 👻	Туре	Severity (in)	
143	Frame	Chainage	Crack	Sets (LaneWidt	Offset ^	🛎 Longitudinal	All	
	000000154497.fis	-2.572	22	0	154.370	0.000	Unsealed	0.039	
	000000160935.fis	1.428	10	0	154.370	0.000	Sealed	0.079	
	000000167372.fis	5.428	3	0	154.370	0.000	crackwidth_1_8	0.125	
	🕞 000000173809.fis	9.428	10	0	154.370	0.000	crackwidth_1_4	0.250	
	000000180247.fis	13.428	6	0	154.370	0.000	crackwidth_3_0	0.575	
	000000186684.fis	17.428	6	0	144.930	5.901	crackwidth_1_2	0.500	
42	000000193121.fis	21.428	5	0	126.493	17.480	crackwidth 1 in	1.000	
	000000199559.fis	25.428	16	0	122.584	20.615	crackwidth_1	1.500	
	200000205996.fis	29.428	8	0	132.604	15.605	crackwidth 2 in	2.000	
	000000212434.fis	33.428	6	0	139.002	12.406	crackwidth_3_in	3.000	
	0000002188/1.fis	37.428	10	0	144.534	8.460	crackwidth_0	>3.000	
	000000225308.fis	41.428	14	0	148.423	5.335	I Transverse	All	
1		40.428	3	0	148.246	5.443	Unsealed	0.039	
	00000230103.115	43.420 53.429	13	0	148.167	5 463	Sealed	0.079	
	000000251058 fis	57 428	15	0	147 596	5 748	crackwidth_1_8	0.125	
12	00000257495 fis	61 428	14	0	147.025	6.033	crackwidth_1_4	0.250	
	00000263933 fis	65.428	11	0	146.140	6 476	crackwidth_3_8	0.375	
	000000270370.fis	69.428	5	0	140.578	10.438	crackwidth_1_2	0.500	
	000000276807.fis	73.428	28	0	135.724	14.045	crackwidth_3_4	0.750	
	00000283245.fis	77.428	14	0	137.580	13.118	crackwidth_1_in	1.000	
	000000289682.fis	81.428	10	0	135.360	14.227	crackwidth_1	1.500	
	🔒 000000296119.fis	85.428	11	0	135.960	13.927	crackwidth_2_in	2.000	
	vent_Pave_Change	•	Pave C	hange	137.328	13.243	crackwidth 0	>3.000	
	CP_Cracked_Slab	• 28	6	0	139.189	12.313	# Alligator	All	
	ntact ICP Slab	▶ 28	16	0	143.057	10.379	Unsealed	0.039	
		28	11	0	146.522	7.466	Sealed	0.079	
S (lose	28	12	0	148.394	5.349	crackwidth_1_8	0.125	
	000000341181.fis	113.428	9	0	147.340	5.876	crackwidth_1_4	0.250	
	🕞 000000347619.fis	117.428	11	0	146.907	6.093	crackwidth_3_8	0.3/5	
	000000354056.fis	121.428	40	0	146.474	6.309	crackwidth_1_2	0.500	
· · ·	000000360493.fis	125.428	7	0	146.405	6.344	crackwidth_1_in	1.000	
	000000366931.fis	129.428	3	0	146.336	6.378	crackwidth_1	1.500	
	000000373368.fis	133.428	8	0	145.244	6.924		0.000	
	2000000379805.fis	137.428	15	0	137.861	11.796	🗄 ∑ Summary 🞯 Show	Crack List 🔏 W	/idth
	2000000386243.fis	141.428	3	0	127.231	15.291			
	000000392680.fis	145.428	314	0	129.822	9.2/3	Туре	Chainage	Of
		149.428	201	0	143.219	-1.489	Ounclassified	133.440	
	00000405555.18	103.428	17	0	140.806	-0.3/3	O Unclassified	134.360	
	00000411992.18	107.420	42	0	122 607	-0.002	O Unclassified	134.984	
	000000410430.118	165.428	3	0	125.007	13 997	Unclassified	135.012	
	000000424307.lls	169 428	3	0	136 818	12.318	W Unclassified	135.960	
	000000437742 fie	173 428	4	0	143 384	7.854	Unclassified	136.038	
	000000444179 fis	177.428	6	0	144.033	7.530	Unclassified	136.053	
	000000450617.fis	181.428	30	0	145.264	6.914		136.510	
	00000457054.fis	185.428	15	0	146.494	6.299			
6	000000463491.fis	189.428	19	0	148.108	5.492			
	000000469929.fis	193.428	9	0	149.722	4.685			
	000000476366.fis	197.428	19	0	149.594	4.749			
	000000482804.fis	201.428	10	0	146.690	7.382			
	000000489241.fis	205.428	8	0	143.657	10.079			
	000000495678.fis	209.428	16	0	144.149	9.833			
	000000502116.fis	213.428	8	0	145.537	9.139			
5	00000508553.fis	217.428	6	0	146.078	8.868			
	00000514990 fie	221 / 20	1	0	145 724	9.045			

Step 9. Analyze first slab. Examine slab for cracking. If a crack (or cracks) exists, draw a point distress labeled "JCP_Cracked_Slab" in the middle of the slab. Otherwise, draw a point distress labeled "Intact_JCP_Slab" in the middle of the slab. Ensure the slab joint was detected (as indicated by a horizontal blue line at the joint). If it was not detected, draw the joint line in manually. To identify a slab as cracked or intact, select the "Distress" button, double-click on the slab, and select the event. Repeat slab analysis for all slabs in section (see below images).

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Step 10. Navigate to beginning of section. Draw a "CRCP Distress Event" line from the beginning to the end of the CRCP section (see below image).



Step 11. Analyze the pavement, moving from beginning to end of the section. Adjust blue line with the "Lane Mark" tool if pavement lane is not lined up properly. Draw area distress markers over top of any observed distresses in the images: "CRCP_Punchout" for punchouts, "CRCP_Long" for longitudinal cracks, "CRCP_Patch_Asphalt" for asphalt patches, or "CRCP_Patch_Concrete" for concrete patches. Follow the HPMS Field Manual (FHWA, December 2016) for drawing distress areas. To add a distress, select the "Distress" button, double-click on the pavement, and select the event. Continue to end of pavement section (see below image).



- Step 12. Navigate to beginning of section. Virtually drive the pavement section. Make the following adjustments where necessary:
 - i. If the blue line is not aligned with the marked line (either inside or outside), then adjust it manually (see below image).

 ✓ Section Explorer / ✓ Pavement ✓ Section Explorer / ✓ 	?- ⊻ ■ ─()— 2	ب	Q + Q	- 🔍 Fit 🕻	1:1
	Filter				🐺 Filter c	rack
	Frame	Chainage	Crack	Sets (LaneWidt	Off:
<mark>84</mark> - 10 - 10 - 10 - 10 - 10 - 10 - 10 - 1	A 00000154497.fis	-2.572	22	0	154.370	0
	00000160935.fis	1.428	10	0	154.370	0
	900000167372.fis	5.428	3	0	154.370	0
	00000173809.fis	9.428	10	0	154.370	0
	A 000000180247.fis	13.428	6	0	154.370	0
	🔒 000000186684.fis	17.428	6	0	144.930	5
	🔒 000000193121.fis	21.428	5	0	126.493	17
	Phillippe 000000199559.fis	25.428	16	0	122.584	20
	A 00000205996.fis	29.428	8	0	132.604	15
83	200000212434.fis	33.428	6	0	139.002	12
	200000218871.fis	37.428	10	0	144.534	8
	200000225308.fis	41.428	14	0	148.423	5
	200000231746.fis	45.428	9	0	148.246	5
	200000238183.fis	49.428	23	0	148.207	5
	200000244620.fis	53.428	13	0	148.167	5
	2000000251058.fis	57.428	15	0	147.596	5
	0000025/495.tis	61.428	14	0	147.025	6
	00000263933.fis	65.428	11	0	146.140	6
	0000002/03/0.fis	69.428	5	0	140.578	10
82 · · · · · · · · · · · · · · · · · · ·	0000002/680/.fis	/3.428	28	0	135./24	14
		//.428	14	0	107.367	3
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		03.420	4	0	120 100	12
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	000000321869 fis	101 428	16	0	143.057	10
	> 000000328306 fis	105 428	11	0	146 522	7
	000000334744 fis	109 428	12	0	148.394	5
81	000000341181.fis	113,428	9	0	147.340	5
	000000347619.fis	117.428	11	0	146.907	6
	A 00000354056.fis	121.428	40	0	146.474	6
	900000360493.fis	125.428	7	0	146.405	6
	A 00000366931.fis	129.428	3	0	146.336	6
	🔒 000000373368.fis	133.428	8	0	145.244	6
	🔒 000000379805.fis	137.428	15	0	137.861	11
	🔒 000000386243.fis	141.428	3	0	127.231	15
	A 00000392680.fis	145.428	314	0	129.822	9
	A 000000399118.fis	149.428	201	0	143.219	-1
	200000405555.fis	153.428	17	0	145.856	-8
	200000411992.fis	157.428	42	0	133.681	-6
	200000418430.fis	161.428	3	0	122.607	4
	200000424867.fis	165.428	1	0	125.391	13
	200000431304.fis	169.428	3	0	136.818	12
	000000437742.fis	1/3.428	4	0	143.384	7
	000004441/9.fis	1//.428	6	0	144.033	
		105.420	30	0	145.264	6
	000000407004.fts	100.420	10	0	140.434	6
79	00000463431.lls	103.420	13	0	140.100	3
	00000403323.lls	107 / 20	10	0	149.722	-
	- 000000470300.lls	201 / 28	10	0	146 690	7
	- 000000402004.iis	205.428	8	0	143.657	10
	000000495678 fis	209 428	16	0	144 149	
	000000502116 fis	213 428	8	0	145 537	9
	A 00000508553 fis	217.428	6	0	146.078	8
	A 000000514990 fis	221.428	1	0	145.724	9
	A 00000521428.fis	225.428	2	0	145.321	9
	A 00000527865.fis	229.428	5	0	144.248	9
	A 00000534303.fis	233.428	12	0	145.597	7
	🔒 000000540740.fis	237.428	8	0	145.924	4
	🔒 000000547177.fis	241.428	1	0	138.927	6
	🕞 000000553615.fis	245.428	4	0	134.144	8
	200000560052.fis	249.428	6	0	136.062	9

- ii. Delete false positive crack detections (can be due to manhole covers, inlets, gutter pans, rumble strips, etc.).
- iii. Draw distress event lines for noted items, including bridges, railroads, crosswalks, stop bars, bad images, disregarded cracks, wet pavement, lane deviations, debris, brick pavement, crack seals, etc. Draw a point event for any pavement change. To draw a distress event, click on the "Distress" button and right-click at the start of the event, right-click where the event should end, and choose the event. Continue to end of pavement section (see below images).



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			10000154497.tis	-2.5/2	22	0	154.370	0.000	
	Contract Street Street Providence		10000160333.lls	5.428	3	0	154.370	0.000	
151		- 00	10000173809 fis	9 428	10	0	154.370	0.000	
		- OC	0000180247 fis	13 428	6	0	154.370	0.000	
		00	0000186684.fis	17.428	6	0	144.930	5.901	
		00	00000193121.fis	21.428	5	0	126.493	17.480	
		P 00	0000199559.fis	25.428	16	0	122.584	20.615	
		P 00	00000205996.fis	29.428	8	0	132.604	15.605	
	1 Alexandream Alexandream Alexandream Alexandream Alexandream Alexandream Alexandream Alexandream Alexandream A	P 00)0000212434.fis	33.428	6	0	139.002	12.406	
AND DESCRIPTION OF TAXABLE PARTY OF TAXABLE PARTY.		■ 00)0000218871.fis	37.428	10	0	144.534	8.460	
		00	0000225308.fis	41.428	14	0	148.423	5.335	-0[
150	- Jus L	00	00000231746.fis	45.428	9	0	148.246	5.423	
			JUUUU238183.fis	49.428	23	0	148.207	5.443	
			0000244620.05	53.420	15	0	140.107	0.403 E 740	
	~~~~		10000251056.lls	57.420	1/	0	147.036	6.033	
		- 00	10000257455.lis	65 428	11	0	146 140	6.476	
	and an and a second second second	- OC	0000270370 fis	69 428	5	0	140.578	10 438	
the set of		<b>00</b>	0000276807.fis	73.428	28	0	135.724	14.045	
many and the second sec		00	00000283245.fis	77.428	14	0	137.580	13.118	
		00	0000289682.fis	81.428	10	0	135.360	14.227	
	TIC TO TE	P 00	0000296119.fis	85.428	11	0	135.960	13.927	
		P 00	00000302557.fis	89.428	4	0	137.328	13.243	
		P 00	00000308994.fis	93.428	6	0	139.189	12.313	1
	v lan	<b>₩ 00</b>	00000315432.fis	97.428	6	0	141.413	11.201	
		00	0000321869.fis	101.428	16	0	143.057	10.379	
			00000328306.fis	105.428	11	0	146.522	7.466	
			JUUUU334/44.fis	112.428	12	0	148.394	5.349	
			10000341161.1IS	113.420	11	0	147.340	6.093	
The second s			10000347615.lls	121 428	40	0	146.307	6 309	
	A CONTRACTOR OF		10000360493 fis	125 428	7	0	146 405	6.344	
148		00	0000366931.fis	129.428	3	0	146.336	6.378	
		00	00000373368.fis	133.428	8	0	145.244	6.924	•
	Front Discoursed Constraints		0000379805.fis	137.428	15	0	137.861	11.796	1 5
	Event_Disregard_Cracking	•	0000386243.fis	141.428	3	0	127.231	15.291	. 4
	Event_Bad_Image	•	0000392680.fis	145.428	314	0	129.822	9.273	Ty
	Event_Sealed_Cracking_Exists	•	0000399118.fis	149.428	201	0	143.219	-1.489	
	Event_Stop_Bar	•	Stop B	ar (3.428	17	0	145.856	-8.979	0
	Event Crosswalk	•		17.428	42	0	133.681	-6.592	
	Event Dridge	,	0000418430.fis	161.428	3	0	122.607	4.623	
147	Event_Bridge	•	0000424867.fis	165.428	1	0	125.391	13.997	
	Event_Lane_Deviation	•	1000431304.118	103.428	3	0	1/2 294	7.95/	
	Event_Railroad	•	0000444179 fie	173.420	4	0	144 022	7.530	
	Event_Wet_Surface	+	0000450617.fis	181.428	30	0	145.264	6,914	
	Event Brick Pavement		0000457054.fis	185.428	15	0	146.494	6.299	
	Event_billed Devenuent	,	0000463491.fis	189.428	19	0	148.108	5.492	
	event_ivilled_Pavement	•	0000469929.fis	193.428	9	0	149.722	4.685	
	Event_Debris	•	0000476366.fis	197.428	19	0	149.594	4.749	
	Event_CRCP_Exists	•	0000482804.fis	201.428	10	0	146.690	7.382	
146	Event_JCP_Exists		0000489241.fis	205.428	8	0	143.657	10.079	
	Longitudinal Crack (LE)		0000495678.fis	209.428	16	0	144.149	9.833	
			0000502116.fis	213.428	8	0	145.537	9.139	
	Longitudinal Crack (LWP)	•	UU00508553.fis	217.428	6	0	146.078	8.868	
	Longitudinal Crack (CTR)	•	UUUU514990.fis	221.428	1	0	145.724	9.045	
Ref State of	Longitudinal Crack (RWP)	+	1000527065 fr-	225.428	2	0	145.321	9.24/	
	Longitudinal Crack (RE)	•	100052/000.1IS	223.428	10	0	144.248	7 929	
	Longitudinal Sealed Crack (LE)		0000540740 fie	233.420	12 8	0	145 924	4.833	
	Congratulinal Sealed Clack (LE)	,	1000547177 fis	237.420	1	0	138 927	6 129	



#### STATE HIGHWAY ADMINISTRATION

Data Processing Performing 100% Drive Through



STATE HIGHWAY ADMINISTRATION

Data Processing Performing 100% Drive Through



### 2- Performing QA of Analyzed Images – performed by Vision user

Summary: This task checks the QC'ed pavement images through a visual inspection.

- Step 13. Open Vision.
- Step 14. Complete Step 2 through Step 12 for two random files for each drive through operator. Ensure that protocol has been followed. Correct any errors and resolve any issues before continuing.
- Step 15. Report findings to supervisor.

### 3- Performing QA of Overall Process – performed by Supervisor

**Summary:** This task performs QA checks on the drive through process.

- Step 16. Perform weekly data QA routines.
- Step 17. TL review of QC staff notification of recollection and QA staff weekly data review.
- Step 18. Review of production status receive weekly update from QA staff (last ARAN collection date and lane miles fully processed).

# 5.08 RUNNING RUT PROCESSOR

# 5.08.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to run the Rut Processor in the Roadware Vision software using data collected by the Automatic Road Analyzer (ARAN) survey vans in the field by Field Explorations Division (FED) staff. The Rut Processor is run in batches throughout the annual data collection season. This SOP applies to the processing of an ARAN data batch (or batches). The Rut Processor is run after completion of the ARAN data drive-through (see <u>Performing 100% Drive Through</u>). This process results in the generation of ARAN pavement transverse profile (rutting) data.

# 5.08.02 Frequency

The Rut Processor is run on batches of ARAN collected data as they are received by the DPT. The frequency and timing varies according to schedule, available resources, and quantity of data received. The batches are processed in a continuous flow throughout the data collection season.

Each ARAN data batch is typically delivered to the DPT every 4 to 5 days. Assuming an average of 60 miles collected per day, each batch contains, on average, between 240 and 300 miles of ARAN data. The actual frequency varies according to the proximity of the routes on which data were collected for the data batch to the Office of Materials Technology (OMT) office and it ranges from 1 day (when collected near the OMT office) to 2 weeks (when collected far from the OMT office). Shorter turn-around periods are preferred to minimize the amount of mileage requiring data recollection. The annual ARAN data collection season typically lasts from March to Mid-December.

# 5.08.03 Purpose

The purpose of this SOP is to run the Rut Processor for collected ARAN data and perform quality control (QC) and quality assurance (QA) checks.

# 5.08.04 *Resource Requirements*

The running of the Rut Processor involves two people: (1) a user knowledgeable in Roadware Vision software to run the processors and perform QC, and (2) a supervisor who, as required, provides guidance and decision-making and performs QA. The estimated effort levels in the table below represent the total time, in man-hours, to complete the processing and QC/QA checks. These time estimates assume average batch quantities and no issues encountered during processing.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	Vision user and QC	1	3.0
DPT TL	Supervisor and QA	1	AR ^{06/12/2019}

# 5.08.05 *Procedure*

The procedure to run the Rut Processor and perform QC/QA is comprised of the following three tasks:

(1) running Rut Processor in Vision,

- (2) performing QC of the processed rut data, and
- (3) performing QA of the processed rut data

#### 1- Running Rut Processor in Vision – performed by Vision user

**Summary:** This task uses Vision software to process rut data from the ARAN data submittal.

- Step 1. Open Vision.
- Step 2. Click the "Process" drop-down menu. Select "New Batch Processor." The "Batch Processor" window will open (see below image).

are Batch Processor			23				
🛃 Tasks 🗈 Options 🍟 Data 📟	Process						
		Batch Processor					
🔁 Add 📸 New 📄 Delete	Task	Description					
	Total	Detection of the Faulty	-				
	I mage Cenier Processor	Cepies and liter radius	-				
Complex Data Extraction	Image Copier Hocesson	Measures the brightness of images and compares against accentable range for quality	-				
EPD Processing	iVision publisher batch processor	Runs the Menn nublisher on the current database	-				
	In Init Detection Processor	Detect joints in a session of images					
	JPEG Cracks Detection Processor	Detects cracks from JPEG files					
Reporting	JPEG Lanes Detection Processor	Detects lanes from JPEG files					
Sensor Data Processing	I advbug processor	Batch processes Ladvbug collected data					
	LCMS Global Processor	Collection of LCMS functions for images conversion, cracks detection and classification and					
	Pavement Export Processor	Pavement exporter based on a template file.					
	Point-to-Area Distress Processor	Point-to-Area Distress Processor.					
	Rating Processor	Distress rating processor.					
	Report Generator Processor	Generate reports.	Ξ				
	Roughness Processor	Calculates and stores improved longitudinal profiles and roughness indices					
	Rut Processor	Rut processor for Transverse Profile data.					
	Sampled QC Events Rating Processo	r Sampled QC events for manual rating processor.					
	E Segmentation Rubberbanding	Reverts all landmarks to original chainages and revert rechained matches to rubberbanded					
	Segmenting QC Processor	Generates bookmarks for segmenting quality checks.					
	Shapefile Exporter	Exports SHP and KML files.					
	🔲 📖 Thumbnail Creator	Creates thumbnails from original images in a given output folder					
	Vehicle Positions Processor	Creates levels of detail for Vehicle Positions.					
	WMV Encoder	Encode collected JPEG files to WMV.	-				
	•	4 III	1				
	X 🕈 🔺						
	# Task	Description					
	1 But Processor	But processor for Transverse Profile data.					
		· · · · · · · · · · · · · · · · · · ·					
😹 vcoulibaly 🔜 SHAHQVISIONPRD,1438 🛄 🤇	OMT_ARAN_PROD_2017_1 🌌 1 🔚 13,593,6	27 🕑 10,700,380					
			-				

- Step 3. Click the box next to "Rut Processor" in the window on the right.
- Step 4. Click the "Options" tab. Instead of changing settings manually, search for preset schemas. Click the "Load" button. Navigate to the folder where schema files are stored^{06/12/2019}. In this folder, look for the one of three rut XML files for the ARAN data to be processed (see below image).
  - i. "RUT_Processor_ARAN3_[MOST RECENTDATE]" for all ARAN 3 data.
  - ii. "RUT_Processor_ARAN4_AfterJune21_[MOST RECENTDATE]" for all ARAN 4 data collected after June 21, 2017.

iii. "RUT_Processor_ARAN4_BeforeJune21_[MOST_RECENTDATE]" for all ARAN 4 data collected before June 21, 2017.

💏 Batch Pr	ocessor									23
谢 Tasks	Doptions 📅 Data	a 🐺 Process								
🔛 Save	💕 Load				🚰 Show	Properties	Ž↓ 🞯 🔊 Reset	•	🎭 Simple	
# 1	Task Rut Processor	On Error Skip	Retries 0	Retry delay 00:00:00	Log False		<ul> <li>1. Profile Validit Maximum height Maximum spacing Minimum length Percent of valid po Validate Profile</li> <li>2. Pacamplo</li> </ul>	y 0.0635 0.11 2 ints 70 True		
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📃 Rece	ent Places				鷆 Rut Prote	ocol-Not Finali	zed	07/12/2017 9:48 AM	File folder	
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🖳 🖳 Wx_F	Processing (\\HANPMDAT	A\PMworkingData) (Q:)			RUT Pro	Cessor ARAN4	AfterJune21 8-15	08/15/2017 3:04 PM	XML Docum	ent
🛛 🖵 PMD	ATA (\\shahanpmdata1) (I	R:)			RUT Pro	cessor ARAN4	BeforeJune21 8	08/15/2017 3:02 PM	XML Docum	ent
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	File name: RUT	Processor_ARAN3 8-15	-2017.xml	*				★ XML (*.xml)	<u> </u>	•
								Open	Canc	el

Select the XML file for the ARAN 3 and click "Open."

- Step 5. Click "Data" from the top menu bar. Every file in the database will appear in the window. The list must be filtered to only include the sections from the current batch and appropriate ARAN vehicle. Under the "Vehicle" column, "1723" is for the ARAN 3 and "1724" is for the ARAN 4. Filtering the list can be accomplished through two different methods:
  - i. Removing unwanted files, or
  - ii. Removing all files and selecting a batch to re-add.
- Step 6. Choose removal method. If removing all files and selecting a batch to re-add is preferred, skip to Step 7. Otherwise, use a combination of the Shift and Ctrl keys to highlight all unwanted files in the window. Click "Remove." Proceed to Step 8 (see below image).

STATE HIGHWAY ADMINISTRATION

<b>•</b>	Remove 🔷	🔺 👜 🕨 Go 🛛	😥 Search						
	Session	> Date	Vehicle	Collected	Matched	%	County	RouteID	Dir
1	7521039K	2017-05-02 01:03	1723	3,891	3,722	96	BA	US 1	N
2	752103Q7	2017-05-02 01:13	1723	4,091	3,701	90	BA	US 1	S
3	7521134L	2017-05-02 01:21	1723	3,070	2,692	88	BA	US 1 AL	N
4	752113QM	2017-05-02 01:35	1723	3,088	2,642	86	BA	US 1 AL	S
5	7521237V	2017-05-02 01:45	1723	3,784	2,706	72	BA	MD 166	N
6	752123QP	2017-05-02 01:56	1723	3,745	2,721	73	BA	MD 166	S
7	7520S36U	2017-05-02 10:08	1723	3,017	2,155	71	AA	IS 195	N
8	7520S3FR	2017-05-02 10:14	1723	2,676	2,169	81	AA	IS 195	S
9	7520S3NC	2017-05-02 10:18	1723	3,598	1,408	39	BA	MD 295	N
3 10	7520T33L	2017-05-02 10:28	1723	2,310	1,405	61	BA	MD 295	S
3 11	7520T3BN	2017-05-02 10:33	1723	13,852	13,167	95	BA	MD 695	N
3 12	7520T3BM	2017-05-02 10:33	1723	30,002	28,029	93	AA	IS 695	N
3 13	7520X37Z	2017-05-02 11:57	1723	15,557	14,909	96	BA	MD 695	S
3 14	7520X380	2017-05-02 11:57	1723	28,616	27,069	95	BA	IS 695	S
3 15	75310361	2017-05-03 01:01	1723	7,885	7,510	95	BA	MD 151	S
3 16	75311396	2017-05-03 01:24	1723	2,797	2,329	83	BA	MD 158	W
3 17	753113P2	2017-05-03 01:34	1723	5,082	4,759	94	BA	MD 157	N
3 18	753123MT	2017-05-03 01:54	1723	5,070	4,764	94	BA	MD 157	S
3 19	753133G8	2017-05-03 02:12	1723	2,667	2,334	88	BA	MD 158	E
3 20	7530N32P	2017-05-03 08:18	1723	2,934	1,935	66	BA	MD 588	N
3 21	7530N3VB	2017-05-03 08:35	723	11,159	10,819	97	BA	US 1	N
22	7530P300	2017-05-03 09:00	723	11,313	10,809	96	BA	US 1	S
23	7530Q324	2017-05-03 09:22	723	3,066	1,930	63	BA	MD 588	S
24	7530R3U8	2017-05-03 10:01	723	11,658	11,495	99	BA	US 40	E
25	7530S3UM	2017-05-03 10:23	723	11,582	11,485	99	BA	US 40	W
3 26	7530U354	2017-05-03 10:51	1723	11,782	11,453	97	BA	MD 7	E
27	7530V3GX	2017-05-03 11:19	1723	11,736	11,464	98	BA	MD 7	W

Step 7. To remove all files, click the "Check" drop-down menu and select "All." Click "Remove." Then, click the "Reload" (first blue arrow) button. The "Group Partitions" window will open (see below image).

Group Partitions Explorer
P Enter search criteria
Show All
🕑 🔄 Batch 01
Batch 02
Batch 03
Batch 04
Batch 05
7540N437
more than one file
7450X4A6
Batch 06
Batch 07
July 14 To July 18
Batch 09
I Batch 10
OK

Select the current batch by clicking the checkbox next to the appropriate batch name. Click the "OK."

Step 8. Once only the desired files appear in the "Batch Processor" window, they may be processed. Click "Process", then "Start." The files will begin to appear under the session window (see below image).

					-					
	Task	Status	Start	%	Duration	Actu	ual Duration	Run Rate	Est. Remaining	Est. Finis
<b>V</b> 1	Rut Processor	Comple	ed 8:44:49 A	M 100.00	00.00:00:36	; (	00.00:00:36	306.31	00.00:00:00	12/01/2017 8:45:26.
👌 Task	k Rut Processor									
	Session	Length	Matched	Start	%	Duration	Run Rate			
	78110379	738	331	8:44:49 AM	100.00	80:00:00:00	300.09			
N 2	70110362	300	20	0.44.30 AM	100.00	00.00.00.04	203.07			
14	7810M3HB	356	200	8:45:10 AM	100.00	00.00.00.04	296.89			
15	7810M3Q4	384	242	8:45:15 AM	100.00	00.00:00:04	297.22			
6	7810O3DJ	196	134	8:45:19 AM	100.00	00.00:00:03	219.57			
7	7810O3DI	150	109	8:45:23 AM	100.00	00.00:00:03	162.88			
8										
9										
10					52					
11		Done								
12										
13		A								
	Nana	Batch	processing has	completed with w	varnings.					

## 2- Performing QC of Processed Rut Data – performed by Vision user

**Summary:** This task checks the quality of processed rut data through an inspection of errors reported by Vision during processing and a visual inspection of the rut depth graph.

Step 9. A dialogue box will appear when processing is complete.

- i. If the box says "Batch processing has completed", proceed to Step 11.
- ii. If the box says "Batch processing has completed with errors", proceed to Step 10.
- Step 10. View the errors. Click the "*Exceptions*" drop-down menu and select "*View Exceptions*."
  - i. If the error is "Missing Images", this is acceptable. Proceed to Step 11.
  - ii. If any other errors are present, reprocessing is required. Click the "Exceptions" drop-down menu and select "Reprocess Exceptions." This will remove all the

files from the data screen except for the files that had exceptions. Next, click the "Start" button to reprocess.

- Step 11. Check the "Batch Processor" window for runs that did not process. The software occasionally skips runs. In the window showing processed results, check the "Run Rate" column. Any runs that have blanks in this column will need to be reprocessed. Select those runs, removing runs already processed, and change the output location to a new temporary folder. Click "Reset."
- Step 12. Click on "Plug-Ins" tab and select "Transverse Profile Explorer" tab (see below image)

Roadware Vision									
File View Tools	Help								
🔍 Connect 🔰 🖏 🚽	🏇 Segment 👻 🎲 Ra	ite 🔹 💣 Process 🔹	🛯 🎯 Map 🛛 🚉 Images 🔹 🎮 Pa	noramic View   🗊 Charts 🕶 🗊 Tables 🕶   🕻	🛾 Report 🖏 Publish 🛛	- Plug-Ins 🔹 🝰 Distress schema	🔆 Bookmarks 👻		
Section Explorer						🤨 Status			
Groups 7810M3HB	(1 / 1)					Change plugins folder			
						Curve Fitting	Drag a column here to group by this column.		
Q		A .				Segmentation Statistics			
County	RouteID	Dir		Collection	Vehicle				
Contains:	▼ Contains:	▼ Contains:	▼ Contains: 7840V3SB	т	Equa T Equals:				
BA	CO 1153	s	7840V3SB		1723				
1									

Select a session and click on the "Go" button to open the profile of the run (see below image).

#### STATE HIGHWAY ADMINISTRATION

	ns 🏻 🍟 Data 🗍 🐺 Pr	ocess	De v	A						
g Schi	Task	Status	Start	s 👻 🐴 Warnings	Duratien	Actu	ual Duration	Run Rate	Est, Remaining	Est. Fir
<b>0</b> 1	Rut Processor	Completed	8:44:49 AM	100.00	00.00:00:36	(	00.00:00:36	306.31	00.00:00:00	12/01/2017 8:45:2
Та	sk But Processor									
	Session	Longth	Matched	Start	•/	Duration	Bun Bate		-	
15		Lengui		Jun	10	Daradon	Tion Thato			
1	78110379	738	331	8:44:49 AM	100.00	00.00:00:08	300.09			
1	78110379 781103BZ	738 380	331 26	8:44:49 AM 8:44:58 AM	100.00	00.00:00:08	300.09 283.67			
1	78110379 781103BZ 781103BZ 781103C0	738 380 892	331 26 200	8:44:49 AM 8:44:58 AM 8:45:03 AM	100.00 100.00 100.00	00.00:00:08 00.00:00:04 00.00:00:07	300.09 283.67 445.79			
1 2 3 4	78110379 781103BZ 781103C0 7810M3HB	738 380 892 356	331 26 200 201	8:44:49 AM 8:44:58 AM 8:45:03 AM 8:45:10 AM	100.00 100.00 100.00 100.00	00.00:00:08 00.00:00:04 00.00:00:07 00.00:00:04	300.09 283.67 445.79 296.89			
1 2 3 4 5	78110379 781103BZ 781103C0 7810M3HB 7810M3Q4	738 380 892 356 384	331 26 200 201 242	8:44:49 AM 8:44:58 AM 8:45:03 AM 8:45:10 AM 8:45:15 AM	7,0 100.00 100.00 100.00 100.00 100.00	00.00:00:08 00.00:00:04 00.00:00:07 00.00:00:04 00.00:00:04	300.09 283.67 445.79 296.89 297.22			
1 2 3 4 5 6	78110379 781103BZ 781103C0 7810M3HB 7810M3Q4 781003DJ	738 380 892 356 384 196	331 26 200 201 242 134	8:44:49 AM 8:44:58 AM 8:45:03 AM 8:45:10 AM 8:45:15 AM 8:45:19 AM	7.000 100.00 100.00 100.00 100.00 100.00 100.00	00.00:00:08 00.00:00:04 00.00:00:07 00.00:00:04 00.00:00:04 00.00:00:04	300.09 283.67 445.79 296.89 297.22 219.57			
1 2 3 4 5 6 7	78110379 78110382 781103C0 7810M3HB 7810M3Q4 781003DJ 781003DJ 781003DJ	738 380 892 356 384 196 150	331 26 200 201 242 134 109	8:44:49 AM 8:44:58 AM 8:45:03 AM 8:45:10 AM 8:45:15 AM 8:45:19 AM 8:45:23 AM	7.0 100.00 100.00 100.00 100.00 100.00 100.00	00.00:00:08 00.00:00:04 00.00:00:07 00.00:00:04 00.00:00:04 00.00:00:03 00.00:00:03	300.09 283.67 445.79 296.89 297.22 219.57 162.88			
1 2 3 4 5 6 7 8	78110379 78110382 7810382 7810030 7810M3HB 7810M3Q4 781003DJ 781003DJ	738 380 892 356 384 196 150	331 26 200 201 242 134 109	8:44:49 AM 8:44:58 AM 8:45:03 AM 8:45:10 AM 8:45:15 AM 8:45:19 AM 8:45:23 AM	20 100.00 100.00 100.00 100.00 100.00 100.00	00.00:00:08 00.00:00:04 00.00:00:07 00.00:00:04 00.00:00:04 00.00:00:03 00.00:00:03	300.09 283.67 445.79 296.89 297.22 219.57 162.88			
1 2 3 4 5 6 7 8 9	78110379 78110362 7810362 78100304 78100304 78100304 7810030J 7810030J	738 380 892 356 384 196 150	331 26 200 201 242 134 109	8:44:49 AM 8:44:58 AM 8:45:03 AM 8:45:10 AM 8:45:15 AM 8:45:19 AM 8:45:23 AM	100.00 100.00 100.00 100.00 100.00 100.00 100.00	00.00:00:08 00.00:00:04 00.00:00:07 00.00:00:04 00.00:00:04 00.00:00:04 00.00:00:03	300.09 283.67 445.79 296.89 297.22 219.57 162.88			
1 2 3 4 5 6 7 8 9 10	78110379 78110382 7810382 7810034 7810034 7810034 7810030J 7810030J	738 380 892 356 384 196 150	331 26 200 201 242 134 109	8:44:58 AM 8:44:58 AM 8:45:03 AM 8:45:10 AM 8:45:15 AM 8:45:19 AM 8:45:23 AM	20000 100.00 100.00 100.00 100.00 100.00 100.00	00.00:00:08 00.00:00:04 00.00:00:07 00.00:00:04 00.00:00:04 00.00:00:03 00.00:00:03	300.09 283.67 445.79 296.89 297.22 219.57 162.88			
1 2 3 4 5 6 7 8 9 10 11	78110379 78110382 78110300 7810034B 7810034B 78100344 7810030J 7810030J	738 380 892 356 384 196 150	331 26 200 201 242 134 109	8:44:49 AM 8:44:58 AM 8:45:03 AM 8:45:10 AM 8:45:15 AM 8:45:19 AM 8:45:23 AM	100.00 100.00 100.00 100.00 100.00 100.00 100.00	00.00:00:08 00.00:00:04 00.00:00:07 00.00:00:00 00.00:00:04 00.00:00:03 00.00:00:03	300.09 283.67 445.79 296.89 297.22 219.57 162.88			
1 2 3 4 5 6 7 8 9 10 11 12	78110379 78110382 7810382 78100384 78100384 78100384 78100384	738 380 892 356 384 196 150	331 26 200 201 242 134 109	8:44:49 AM 8:44:58 AM 8:45:03 AM 8:45:10 AM 8:45:15 AM 8:45:19 AM 8:45:23 AM	2000 100.00 100.00 100.00 100.00 100.00 100.00	00.00:00:08 00.00:00:07 00.00:00:07 00.00:00:07 00.00:00:00 00.00:00:03 00.00:00:03	300.09 283.67 445.79 296.89 297.22 219.57 162.88			
1 2 3 4 5 6 7 8 9 10 11 12 13	78110379 78110382 781103C0 7810M3HB 7810M344 781003DJ 781003DJ 781003DJ	738 380 892 356 384 196 150	331 26 200 201 242 134 109	8:44:49 AM 8:44:58 AM 8:45:03 AM 8:45:10 AM 8:45:15 AM 8:45:15 AM 8:45:19 AM 8:45:23 AM	2 100.00 100.00 100.00 100.00 100.00 100.00	00.00:00:08 00.00:00:04 00.00:00:00 00.00:00:00 00.00:00:00 00.00:00:03 00.00:00:03	300.09 283.67 445.79 296.89 297.22 219.57 162.88			

The transverse profile and the Rut Depth should be showing a graph similar to the graph below (see below image).

- i. If either the "Transverse Profile" or "Rut Depth" graph is blank, the processor will need to be run again by returning to Step 2.
- ii. Otherwise, proceed to Step 13.

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Step 13. Return to Step 2 and repeat the process for both types of ARAN 4 data, selecting the appropriate XML file each time^{06/12/2019}.

## 3- Performing QA of Processed Rut Data – performed by Supervisor

Summary: This task performs QA checks on the processed rut data.

- Step 14. TL review of QC staff notification of recollection.
- Step 15. Review of production status receive weekly update from QC staff (last ARAN collection data fully processed).

# 5.09 RUNNING CLASSIFICATION AND RATING PROCESSORS

## 5.09.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to run the Classification and Rating Processors in the Roadware Vision software using data collected by the Automatic Road Analyzer (ARAN) survey vans in the field by Field Explorations Division (FED) staff. The Classification and Rating Processors are run in batches throughout the annual data collection season. This SOP applies to the processing of an ARAN data batch (or batches). The Classification and Rating Processors are run after completion of the ARAN data drive-through (see <u>Performing 100% Drive Through</u>). This process results in the generation of ARAN cracking data.

## 5.09.02 Frequency

The Classification and Rating Processors are run on batches of ARAN collected data as they are received by the DPT. The frequency and timing varies according to schedule, available resources, and quantity of data received. The batches are processed in a continuous flow throughout the data collection season.

Each ARAN data batch is typically delivered to the DPT every 4 to 5 days. Assuming an average of 60 miles collected per day, each batch contains, on average, between 240 and 300 miles of ARAN data. The actual frequency varies according to the proximity of the routes on which data were collected for the data batch to the Office of Materials Technology (OMT) office and it ranges from 1 day (when collected near the OMT office) to 2 weeks (when collected far from the OMT office). Shorter turn-around periods are preferred to minimize the amount of mileage requiring data recollection. The annual ARAN data collection season typically lasts from March to Mid-December.

## 5.09.03 Purpose

The purpose of this SOP is to run the Classification and Rating Processors for collected ARAN data and perform quality control (QC) and quality assurance (QA) checks.

## 5.09.04 *Resource Requirements*

The running of the Classification and Rating Processors involves two people: (1) a user knowledgeable in Roadware Vision software to run the processors and perform QC, and (2) a supervisor who, as required, provides guidance and decision-making and performs QA. The estimated effort levels in the table below represent the total time, in man-hours, to complete the processing and QC/QA checks. These time estimates assume average batch quantities and no issues encountered during processing.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	Vision user and QC	1	3.0
DPT TL	Supervisor and QA	1	AR ^{06/12/2019}

# 5.09.05 *Procedure*

The procedure to run the Classification and Rating Processors and perform QC/QA is comprised of the following three tasks:

- (1) running Classification and Rating Processors in Vision,
- (2) performing QC of the processed data, and
- (3) performing QA of the processed data.

#### 1- Running Classification & Rating Processors in Vision – performed by Vision User

**Summary:** This task uses Vision software to process cracking data from the ARAN data submittal.

- Step 1. Open Vision.
- Step 2. Click the "Process" drop-down menu. Select "New Batch Processor." The "Batch Processor" window will open (see below image).

	🛝 🛛 🏹 Offline	Batch Processor
🕽 Add 🞬 New 📖 Delete	Task	Description
Processors	Auto Segmentation Processor	Automatically matches the collected sessions with the routed data.
Complex Data Extraction	Avi encoder	Encode collected JPEG files to AVI.
- Cracks Processing	Classifications Processor	Classifies the exising detected cracks.
ERD Processor	Curve Ht Batch Processor	Uses the curve fit functionality to process data inside batch processing.
Image Processing	ERD Processor	ERD files exporter.
<u>C</u>	🔲 🛄 Exif Geo-Tagging & Vibing Processor	Provides support for geo-tagging images with gps data.
Reporting	E Rault Processor	Detect and filter Faults
Emission Data Processing	Image Copier Processor	Copies original images to a given output folder
	Image QC Processor	Measures the brightness of images and compares against acceptable range for quality.
	iVision publisher batch processor.	Runs the iVison publisher on the current database.
	Dint Detection Processor	Detect joints in a session of images
	JPEG Cracks Detection Processor	Detects cracks from JPEG files.
	JPEG Lanes Detection Processor	Detects lanes from JPEG files.
	Ladybug processor	Batch processes Ladybug collected data.
	LCMS Global Processor	Collection of LCMS functions for images conversion, cracks detection and classification an.
	PavementExport Processor	Pavement exporter based on a template file.
	Point-to-Area Distress Processor	Point-to-Area Distress Processor.
	Rating Processor	Distress rating processor.
	Report Generator Processor	Generate reports.
	Roughness Processor	Calculates and stores improved longitudinal profiles and roughness indices
	Rut Processor	Rut processor for Transverse Profile data.
	Sampled QC Events Rating Processor	r Sampled QC events for manual rating processor.
	•	
	1 🗙   🗢 🔺	
	# Task	Description
	🔲 🗋 1 Classifications Processor	Classifies the exising detected cracks.
	2 Rating Processor	Distress rating processor.

- Step 3. Click the box next to "Classification Processor" and "Rating Processor" in the window on the right.
- Step 4. Click the "Options" tab with the "Classification Processor" highlighted. Instead of changing settings manually, search for preset schemas. Click the "Load" button. Navigate to the folder where schema files are stored^{06/12/2019}. In this folder, look for an XML file named "CLASSIFICATION_PROFILE_[MOST RECENTDATE]." Select the file and click "Open" (see below image).
|            |                               | STATE HI         | GHW        | AY AD        | MINISTRATIO                | DN R           | unning Classi                                   | ication/Rati   | ng Proc  | ess |
|------------|-------------------------------|------------------|------------|--------------|----------------------------|----------------|-------------------------------------------------|----------------|----------|-----|
| 😤 Batch Pr | rocessor                      | -                |            | -            |                            |                |                                                 |                |          |     |
| 🔰 Tasks    | Doptions 🚏 Data               |                  |            |              |                            |                |                                                 |                |          |     |
| 🗄 🔛 Save   | 🚰 Load 🐊 Save all             |                  |            |              | Show Properties            | i <u>≵</u> ↓ 🞯 | 🄊 Reset 👻                                       | 🎭 Simple 💈     | 1        |     |
| #          | Task                          | On Error         | Retries    | Retry delay  | Log                        | D Classifi     | ications                                        |                |          |     |
| 1          | Classifications Processor     | Skip             | 0          | 00:00:00     | False                      | Allow pa       | y/Performance<br>arallelization at sessio False |                |          |     |
| 12         | Rating Processor              | Skip             | 0          | 00:00:00     | False                      | Use idea       | al cpu count True                               |                |          |     |
|            |                               |                  |            |              |                            | Proces         | S                                               |                |          |     |
|            |                               |                  |            |              |                            |                |                                                 |                |          |     |
| processor  | settings from file            |                  |            |              |                            |                |                                                 |                |          |     |
| ) - 🚺 🕨    | Computer 🕨 Schemas (\\shał    | hanpmdata1\PMD   | ATA\05 Doc | umentation\P | M Manuals\Vision) (T:) 🕨   | 2017 ►         |                                                 |                | 7        |     |
| ize 🔻      | New folder                    |                  |            |              |                            |                |                                                 |                |          |     |
|            |                               |                  |            | ▲ Na         |                            |                | Date modified                                   | Type           | Size     | -   |
| avorites   |                               |                  |            |              |                            |                | 06 (20 (2017 11 10                              | THE CLU        | Size     |     |
| Download   | e                             |                  |            |              | OLD 2016 ARANZ for rebui   | Iding for 2017 | 06/29/2017 11:10<br>06/13/2017 10:47            | File folder    |          |     |
| Recent Pla | ices                          |                  |            |              | Rut Protocol-Not Finalized | iung 101 2017  | 07/12/2017 9:48 AM                              | File folder    |          |     |
|            |                               |                  |            |              | Vibing                     |                | 07/25/2017 10:32                                | File folder    |          |     |
| omputer    |                               |                  |            |              | CLASSIFICATION_PROFILE     | _6-13-2017.xr  | ml 06/13/2017 11:25                             | XML Document   | 1 KB     |     |
| shaomtvid  | leolog (\\shahanartico2) (B:) |                  |            |              | CurveFit2017_Protocol_6-1  | 3-2017.xml     | 06/13/2017 1:18 PM                              | XML Document   | 3 KB     |     |
| Local Disk | (C:)                          |                  |            |              | LCMS_GLOBAL_PROCESSO       | R_6-13-2017.   | .x 06/13/2017 10:14                             | XML Document   | 3 KB     |     |
| New Volur  | me (E:)                       |                  |            |              | LCMS_Maryland_2017_06_     | 4_2017.xml     | 06/14/2017 1:03 PM                              | XML Document   | 8 KB     |     |
| VCoulibaly | (\\SHAVMHANFS1\OMTOOCL        | Jsers) (M:)      |            |              | matched.xml                |                | 08/10/2017 12:12                                | XML Document   | 1,560 KB |     |
| DMtortD-t  | area (\\snanants1) (N:)       |                  |            |              | RATING_PROCESSOR_6-13      | -2017.xml      | 05/13/2017 11:28                                | XIVIL Document | 1 KB     |     |
| hanprogra  | ums (\\shahanfs1) (0:)        |                  |            |              | TEXTURE CRACK ONLY I       | CMS GLORAL     | 06/13/2017 8:59 AM                              | XML Document   | 2 KB     |     |
| Wx Proces  | ssing (\\HANPMDATA\PMworki    | ngData) (Q:)     |            |              | TEXTURE ONLY LCMS GL       | OBAL PROCE     | ES 06/13/2017 10:17                             | XML Document   | 2 KB     |     |
| PMDATA (   | (\\shahanpmdata1) (R:)        |                  |            |              |                            |                |                                                 |                | 2.10     |     |
| sharedpro  | grams (\\shahqfs3) (S:)       |                  |            |              |                            |                |                                                 |                |          |     |
| Schemas (  | \\shahanpmdata1\PMDATA\05     | Documentation\P  | M Manuals\ | Visi         |                            |                |                                                 |                |          |     |
| Design Pro | ojects (\\SHAHANFS1\OMTOOC    | Shared\OMT) (Y:) |            |              |                            |                |                                                 |                |          |     |
| PmdataPR   | :G (\\hanpmdata) (Z:)         |                  |            |              |                            |                |                                                 |                |          |     |
|            |                               |                  |            |              |                            |                |                                                 |                |          |     |

Step 5. Click the "Options" tab with the "Rating Processor" highlighted. Instead of changing settings manually, search for preset schemas. Click the "Load" button. Navigate to the folder where schema files are stored^{06/12/2019}. In this folder, look for an XML file named "RATING_PROCESSOR_[MOST RECENTDATE]." Select the file and click "Open" (see below image).

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Data Processing

STATE UICUWAY ADMINISTRATION	Data Proceeding
STATE HIGHWAT ADMINISTRATION	Running Classification/Rating Processors

Tasks Dptions								
🚽 Save 💕 Load 🗊 Save all				Show Properties	i <u>≵</u> ↓ 🕜 ⊨⊅ F	Reset 🕶	🏇 Simple	<u>2</u>
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processor settings from file								
)⊽ 🚺 ► Computer ► Schemas (\\shahan;	omdata1\PMD/	ATA\05 Doci	umentation\F	PM Manuals\Vision) (T:) ▶	2017 🕨		✓ ≤ Search 20	17
nize 🔻 New folder								iii 🔹 🔟 🤅
avorites			Na	me		Date modified	Туре	Size
Desktop				OLD		06/29/2017 11:10	File folder	
Downloads				OLD 2016 ARAN3 for rebu	ilding for 2017	06/13/2017 10:47	File folder	
Recent Places				Rut Protocol-Not Finalize	a j	07/12/2017 9:48 AM	File folder	
				Vibing		07/25/2017 10:32	File folder	
omputer				CLASSIFICATION PROFIL	6-13-2017.xml	06/13/2017 11:25	XML Document	1 KB
shaomtvideolog (\\shahanartico2) (B:)				CurveFit2017 Protocol 6-	_ L3-2017.xml	06/13/2017 1:18 PM	XML Document	3 KB
Local Disk (C:)				LCMS GLOBAL PROCESS	OR 6-13-2017.x	06/13/2017 10:14	XML Document	3 KB
New Volume (E:)				LCMS Maryland 2017 06		06/14/2017 1:03 PM	XML Document	8 KB
VCoulibaly (\\SHAVMHANFS1\OMTOOCUsers	s) (M:)			matched.xml	-	08/10/2017 12:12	XML Document	1,560 KB
omtoocshared (\\shahanfs1) (N:)				RATING PROCESSOR 6-1	3-2017.xml	06/13/2017 11:28	XML Document	1 KB
PMtestData (\\hanpmdata) (0:)				Roughness Processor 7-1	2-2017.xml	07/12/2017 8:59 AM	XML Document	1 KB
hanprograms (\\shahanfs1) (P:)			C	TEXTURE_CRACK_ONLY	.CMS_GLOBAL	06/13/2017 11:35	XML Document	2 KB
Wx_Processing (\\HANPMDATA\PMworkingD	ata) (Q:)		C.	TEXTURE ONLY LCMS G	OBAL PROCES	06/13/2017 10:17	XML Document	2 KB
PMDATA (\\shahanpmdata1) (R:)					-			
sharedprograms (\\shahqfs3) (S:)								
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etwork			-					
File name: RATING_PROCESSO	DR_6-13-2017.x	ml					▼ XML (*.xml	I)
	-							

- Step 6. Click "Data" from the top menu bar. Every file in the database will appear in the window. The list must be filtered to only include the sections from the current batch. This can be accomplished through two different methods:
  - i. Removing unwanted files, or
  - ii. Removing all files and selecting a batch to re-add.
- Step 7. Choose removal method. If removing all files and selecting a batch to re-add is preferred, skip to Step 7. Otherwise, use a combination of the Shift and Ctrl keys to highlight all unwanted files in the window. Click "Remove." Proceed to Step 8 (see below image).

Tasks	Dptions	Data 🖉 Process							
ר ₪	🗙 Remove 🔹	🌢	😥 Search						
	Session	> Date	Vehicle	Collected	Matched	%	County	RouteID	Dir
3 1	7521039K	2017-05-02 01:03	1723	3,891	3,722	96	BA	US 1	N
S 🛯	752104HV	2017-05-02 01:08	1724	457	266	58	AA	MD 713 B	E
5 4	752104PZ	2017-05-02 01:13	1724	502	268	53	AA	MD 713 B	W
3	752103Q7	2017-05-02 01:13	1723	4,091	3,701	90	BA	US 1	S
5	752104YS	2017-05-02 01:18	1724	630	275	44	AA	MD 713 C	N
6	7521134L	2017-05-02 01:21	1723	3,070	2,692	88	BA	US 1 AL	N
5 7	7521149D	2017-05-02 01:24	1724	3,792	3,564	94	AA	CO 582	N
5 8	752113QM	2017-05-02 01:35	1723	3,088	2,642	86	BA	US 1 AL	S
S 9	7521244K	2017-05-02 01:43	1724	1,511	553	37	AA	CO 4527	N
iii 10	7521237V	2017-05-02 01:45	1723	3,784	2,706	72	BA	MD 166	N
8 11	752123QP	2017-05-02 01:56	1723	3,745	2,721	73	BA	MD 166	S
12	752124RG	2017-05-02 01:57	1724	5,926	5,631	95	AA	MD 176	E
S 13	752134OX	2017-05-02 02:17	1724	2,627	2,323	88	AA	MD 162	N
<b>14</b>	7520S36U	2017-05-02 10:08	1723	3,017	2,155	71	AA	IS 195	N
15	7520S4B9	2017-05-02 10:11	1724	1,513	1,383	91	AA	MD 652	S
16	7520S3FR	2017-05-02 10:14	1723	2,676	2,169	81	AA	IS 195	S
S 17	7520S3NC	2017-05-02 10:18	1723	3,598	1,408	39	BA	MD 295	N
18	7520S4TD	2017-05-02 10:22	1724	2,525	2,304	91	AA	MD 162	S
S 19	7520T33L	2017-05-02 10:28	1723	2,310	1,405	61	BA	MD 295	S
21	7520T3BN	2017-05-02 10:33	1723	13,852	13,167	95	BA	MD 695	N
20	7520T3BM	2017-05-02 10:33	1723	30,002	28,029	93	AA	IS 695	N
22	7520T4EG	2017-05-02 10:35	1724	5,877	5,627	96	AA	MD 176	W
23	7520U4ER	2017-05-02 10:56	1724	319	193	60	AA	MD 100 N	S
24	7520U4HZ	2017-05-02 10:58	1724	103	41	40	AA	MD 100 O	N
25	7520U4O8	2017-05-02 11:02	1724	103	42	41	AA	MD 100 O	S
26	7520U4QU	2017-05-02 11:04	1724	321	192	60	AA	MD 100 N	N
27	7520V4FO	2017-05-02 11:19	1724	3,176	3,036	96	AA	MD 713	S
28	7520W41M	2017-05-02 11:32	1724	3,426	3,038	89	AA	MD 713	N
30	7520X37Z	2017-05-02 11:57	1723	15,557	14,909	96	BA	MD 695	S
29	7520X380	2017-05-02 11:57	1723	28,616	27,069	95	BA	IS 695	S
31	7520X495	2017-05-02 11:58	1724	981	781	80	AA	CO 575	W
32	7520X4QA	2017-05-02 12:08	1724	371	264	71	AA	MD 713 D	S
32	7520X4WI	2017-05-02 12:12	1724	1 489	1 128	76	ΔΔ	CO 6203	w

Step 8. To remove all files, click the "Check" drop-down menu and select "All." Click "Remove." Then, click the "Reload" (first blue arrow) button. The "Group Partitions" window will open (see below image).

Group Partitions Explorer	
P Enter search criteria	
Show All	
Batch 01	
Batch 02	
Batch 03	
Batch 04	
Batch 05	
7540N437	
more than one file	
74S0X4A6	
Batch 06	
Batch 07	
July 14 To July 18	
IS 695	
Batch 09	
Batch 10	-
OK	

Select the current batch by clicking the checkbox next to the appropriate batch name. Click the "OK."

Step 9. Once only the desired files appear in the "Batch Processor" window, they may be processed. Click "Process", then "Start." The files will begin to appear under the session window (see below image).

Task       Status       Status       %       Duration       Actual Duration       Run Rate       Est. Remaining       Est.         1       Classifications Processor       Wating	3 Schee	dule 👻 🐗 Start 👘 Pause	Stop	Exceptions -	<u> W</u> arnings	Info 🕨 Go				
Image: Status Processor       Wating       Image: Status Processor       Wating       Image: Status Processor       Wating         Rating Processor       Wating       Image: Status Processor       Image: Status Processor       Image: Status Processor       Image: Status Processor         Image: Status Processor       Image: Status Processor       Image: Status Processor       Image: Status Processor       Image: Status Processor         Image: Status Processor       Image: Status Processor       Image: Status Processor       Image: Status Processor       Image: Status Processor         Image: Status Processor       Image: Status Processor       Image: Status Processor       Image: Status Processor       Image: Status Processor         Image: Status Processor       Image: Status Processor       Image: Status Processor       Image: Status Processor       Image: Status Processor         Image: Status Processor       Image: Status Processor       Image: Status Processor       Image: Status Processor       Image: Status Processor         Image: Status Processor       Image: Status Processor       Image: Status Processor       Image: Status Processor       Image: Status Processor         Image: Status Processor       Image: Status Processor       Image: Status Processor       Image: Status Processor       Image: Status Processor         Image: Status Processor       Image: Status Processor       Image: S		Task	Status	Start	%	Duration	Actual Duration	Run Rate	Est. Remaining	Est. Finis
	a 2 a 2	Classifications Processor Rating Processor	Waiting Waiting							

### 2- Performing QC of Processed Data – performed by Vision user

**Summary:** This task checks the quality of processed cracking data through an inspection of errors reported by Vision during processing.

- Step 10. A dialogue box will appear when processing is complete.
  - i. If the box says "Batch processing has completed", proceed to Step 12.
  - ii. If the box says "Batch processing has completed with errors", proceed to Step 10.
- Step 11. View the errors. Click the "Exceptions" drop-down menu and select "View Exceptions."
  - i. If the error is "Missing Images", this is acceptable. Proceed to Step 12.
  - ii. If any other errors are present, reprocessing is required. Click the "Exceptions" drop-down menu and select "Reprocess Exceptions." This will remove all the files from the data screen except for the files that had exceptions. Next, click the "Start" button to reprocess.
- Step 12. Check the "Batch Processor" window for runs that did not process. The software occasionally skips runs. In the window showing processed results, check the "Run Rate" column. Any runs that have blanks in this column will

need to be reprocessed. Select those runs, removing runs already processed, and change the output location to a new temporary folder. Click "Reset."

Step 13. Click on the "Rate" tab and select "Pavement Distress" from the drop-down menu (see below image).

Roadware Vision			
File View Tools Help			
🗄 🗞 Connect 🔰 📑 🗸 🕴 🏇 Segment 🖲	🕶 ờ Rate 👻 💏 Process 🔹 🎯 N	1ap 🛛 🔤 Images 👻 🏲 Panoramic View 🛛 🛅 Charts 👻 🔂 Tables 👻 📔	🖥 Report 🛯 🙀 Publish 🛛 🖃 Plug-Ins 👻 📑 Distress schem
Section Explorer	🖋 Events		
■ Groups 781103BZ (1 / 1)	Pavement Distress		
<u> </u>	🔮 Schema Tag Editor		
Q	<b>A V</b>		
County Rou	uteID Dir	Collection	Vehicle
Contains: T Contains:	T Contains: T	Contains: 7840V3SB	Equa 🔻 Equals:
BA CO 1153	S	7840V3SB	1723

The downward image list will open in the "Pavement" tab. Make sure that all the frames have been classified and rated by observing that the rating sign is in front of all frames. There should also be boxes around all the cracks.

- i. If all rows have the rating sign and the cracks have boxes around them, proceed to Step 11.
- ii. If there are red flags or blank spaces where the rating sign should be, or if there are cracks not surrounded by boxes, those files will need to be re-classified and rated (see below image). Return to Step 2.

1	Section Explore	Pavemer	nt													
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						TO AN A DA			200000167372.fis	5.860	6	2	141.277	8.907		crackwidtł
						🖌 Literal			200000173809.fis	9,860	12	2	145.608	6.742		crackwidth
						<mark>2</mark> - 1957)			2000000180247.fis	13.860	2	1	149.939	4.577		crackwidtł
						(C. S. S. S. S.			200000186684.fis	17.860	0	1	150,776	1.974		crackwidth
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									2000000199559.fis	25.860	2	1	149.213	-5.746		crackwidth
1									00000205996.fis	29.860	0	0	150.610	-6.602		crackwidth
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4						638633			200000218871.fis	37.860	32	9	154.390	-1.171		crackwidth
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3- Performing QA of Processed Rut Data – performed by Supervisor

### Summary: This task performs QA checks on the processed data.

- Step 14. TL review of QC staff notification of recollection.
- Step 15. Review of production status receive weekly update from QC staff (last ARAN collection data fully processed).

# 5.10 RUNNING VIBING PROCESSOR

### 5.10.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to perform vibing routines in the Roadware Vision software using data collected by the Automatic Road Analyzer (ARAN) survey vans in the field by Field Explorations Division (FED) staff. Vibing is the process of adding a status bar and logo to the "Left" and "ROW" images collected with the ARAN van.

The Vibing Processor is run in batches throughout the annual data collection season. The actual name of the processor in Vision is "Exif Geo-Tagging and Vibing Processor," but is commonly referred to as "vibing." This SOP applies to the processing of an ARAN data batch (or batches). The Vibing Processor is run after running the Classification and Rating Processors (see <u>Running Classification and Rating Processors</u>). This process results in the generation of a status bar at the top of the "Left" and "ROW" images and adds latitude/longitude data to the image properties.

### 5.10.02 Frequency

The Vibing Processor is run on batches of ARAN collected data as they are received by the DPT. Vibing can be performed on the same data multiple times. If changes in route mileage occur, the vibing processor will need to be rerun. Performing the rerun on the entire data set will not harm the data output. The frequency and timing varies according to schedule, available resources, and quantity of data received. The batches are processed in a continuous flow throughout the data collection season.

Each ARAN data batch is typically delivered to the DPT every 4 to 5 days. Assuming an average of 60 miles collected per day, each batch contains, on average, between 240 and 300 miles of ARAN data. The actual frequency varies according to the proximity of the routes on which data were collected for the data batch to the Office of Materials Technology (OMT) office and it ranges from 1 day (when collected near the OMT office) to 2 weeks (when collected far from the OMT office). Shorter turn-around periods are preferred to minimize the amount of mileage requiring data recollection. The annual ARAN data collection season typically lasts from March to Mid-December.

# 5.10.03 Purpose

The purpose of this SOP is to run the Vibing Processor for collected ARAN data and perform quality control (QC) and quality assurance (QA) checks.

### 5.10.04 *Resource Requirements*

The running of the Vibing Processor involves two people: (1) a user knowledgeable in Roadware Vision software to run the processor and perform QC, and (2) a supervisor who, as required, provides guidance and decision-making and performs QA. The estimated effort levels in the table below represent the total time, in man-hours, to complete the processing and QC/QA checks. These time estimates assume average batch quantities and no issues encountered during processing.

MOT MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	Vision user and QC	1	40.0
DPT TL	Supervisor and QA	1	AR ^{06/12/2019}

### 5.10.05 *Procedure*

The procedure to run the Vibing Processor and perform QC/QA is comprised of the following five tasks:

- (1) running the Vibing Processor in Vision for "Left" images,
- (2) performing QC of processed "Left" images,
- (3) running the Vibing Processor in Vision for "ROW" images,
- (4) performing QC of processed "ROW" images, and
- (5) performing QA of the processed data.

#### 1- Running Vibing Processor for "Left" Images – performed by Vision user

**Summary:** This task uses Vision software to generate a banner and logo on the "Left" image files from the ARAN data submittal. This task also adds latitude/longitude data to the "Left" image properties.

#### Step 1. Open Vision.

Step 2. Click the "Process" drop-down menu. Select "New Batch Processor." The "Batch Processor" window will open (see below image).

Batch Processor			×
Tasks 🗈 Options 📅 Data			
	M Offline	Batch Processor	
Add New Delete	Task	Description	Ve
			ve
E Processors	Auto Segmentation Processor	Automatically matches the collected sessions with the routed data.	- 12
Complex Data Extraction	Avi encoder	Encode collected JPEG files to AVI.	- 1.
Cracks Processing	Classifications Processor	Uassifies the exising detected cracks.	- 1.
ERD Processor	Curve Ht Batch Processor	Uses the curve fit functionality to process data inside batch processing.	
Image Processing	ERD Processor	ERD files exporter.	
	Exit Geo-Tagging & Vibing Processor	Provides support for geo-tagging images with gps data.	
Senser Data Processing	Fault Processor	Detect and filter Faults	- 12
Jensor Data Processing	I I I Image Copier Processor	Copies original images to a given output folder	1.
	Image QC Processor	Measures the brightness of images and compares against acceptable range for quality.	1.
	Vision publisher batch processor.	Runs the iVison publisher on the current database.	1.
	Joint Detection Processor	Detect joints in a session of images	1.
	JPEG Cracks Detection Processor	Detects cracks from JPEG files.	1.
	JPEG Lanes Detection Processor	Detects lanes from JPEG files.	1.
	Ladybug processor	Batch processes Ladybug collected data.	1.
	LCMS Global Processor	Collection of LCMS functions for images conversion, cracks detection and classification an	1.
	PavementExport Processor	Pavement exporter based on a template file.	1.
	Point-to-Area Distress Processor	Point-to-Area Distress Processor.	1.
	Rating Processor	Distress rating processor.	1.
	Report Generator Processor	Generate reports.	1.
	Roughness Processor	Calculates and stores improved longitudinal profiles and roughness indices	1.
	Rut Processor	Rut processor for Transverse Profile data.	3.
	Sampled QC Events Rating Processor	Sampled QC events for manual rating processor.	1.
	Segmentation Rubberbanding	Reverts all landmarks to original chainages and revert rechained matches to rubberbanded	1.
	Segmenting QC Processor	Generates bookmarks for segmenting quality checks.	1.1
	Shapefile Exporter	Exports SHP and KML files.	1.1
	🔲 📖 Thumbnail Creator	Creates thumbnails from original images in a given output folder	1.
	E Vehicle Positions Processor	Creates levels of detail for Vehicle Positions.	1.1
	Contract Con	Encode collected JPEG files to WMV.	1.1
	4		-
			-
ask 📃 SHAHQVISIONPRD,1438 🛄 OMT	ARAN_PROD_2017_1 🛃 0 🗐 13,522,482 😪	9,008,448	:

Step 3. Click the box next to "Exif Geo-Tagging and Vibing Processor" in the window on the right.

Step 4. Click the "Options" tab^{06/12/2019}. Instead of changing settings manually, search for preset schemas. Click the "Load" button. Navigate to the folder where schema files are stored^{06/12/2019}. In this folder, look for an XML file named "Left." Select the file and click "Open" (see below image).

💣 Batch Pro	ocessor					-				• X
🄰 Tasks	Doptions 📅 Data									
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	Exil Geo-Tagging & vibing Processor	экір	U	00.00.00	Faise			Draw chainages	False	
								Draw cracks	False	
								Draw distresses	False	
								Draw lanes	False	E
								Draw pavement	True	
								Draw pick-outs	False	
								Draw potholes	False	
								Draw raveling	False	
								Draw road zones	False	
							⊿	Exif		
								Geo-Tagging enabled	True	
							⊿	Image Streams		
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							⊿	Selected image streams	String[] Array	
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								[1]	LCMSRange	
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Validation	Error							[3]	ROW	
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息 JMask 💻	SHAHQVISIONPRD,1438 👤 OMT_A	RAN_PROD_	2017_1 葇 1	13,528,38	9,078	3,787				.:

- Step 5. Click "Data" from the top menu bar. Every file in the database will appear in the window. The list must be filtered to only include the sections from the current batch. This can be accomplished through two different methods:
  - i. Removing unwanted files, or
  - ii. Removing all files and selecting a batch to re-add.
- Step 6. Choose removal method. If removing all files and selecting a batch to re-add is preferred, skip to Step 7. Otherwise, use a combination of the Shift and Ctrl keys to highlight all unwanted files in the window. Click "Remove." Proceed to Step 8 (see below image).

#### STATE HIGHWAY ADMINISTRATION

Tasks	Doptions	Data 🖉 Process							
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	Session	> Date	Vehicle	Collected	Matched	%	County	RouteID	Dir
1	7521039K	2017-05-02 01:03	1723	3,891	3,722	96	BA	US 1	N
5 2	752104HV	2017-05-02 01:08	1724	457	266	58	AA	MD 713 B	E
5 4	752104PZ	2017-05-02 01:13	1724	502	268	53	AA	MD 713 B	W
5 3	752103Q7	2017-05-02 01:13	1723	4,091	3,701	90	BA	US 1	S
5	752104YS	2017-05-02 01:18	1724	630	275	44	AA	MD 713 C	N
6	7521134L	2017-05-02 01:21	1723	3,070	2,692	88	BA	US 1 AL	N
5 7	7521149D	2017-05-02 01:24	1724	3,792	3,564	94	AA	CO 582	N
5 8	752113QM	2017-05-02 01:35	1723	3,088	2,642	86	BA	US 1 AL	S
5 9	7521244K	2017-05-02 01:43	1724	1,511	553	37	AA	CO 4527	N
🗐 10	7521237V	2017-05-02 01:45	1723	3,784	2,706	72	BA	MD 166	N
🗐 11	752123QP	2017-05-02 01:56	1723	3,745	2,721	73	BA	MD 166	S
S 12	752124RG	2017-05-02 01:57	1724	5,926	5,631	95	AA	MD 176	E
5 13	752134OX	2017-05-02 02:17	1724	2,627	2,323	88	AA	MD 162	N
🗐 14	7520S36U	2017-05-02 10:08	1723	3,017	2,155	71	AA	IS 195	N
🗐 15	7520S4B9	2017-05-02 10:11	1724	1,513	1,383	91	AA	MD 652	S
S 16	7520S3FR	2017-05-02 10:14	1723	2,676	2,169	81	AA	IS 195	S
🗐 17	7520S3NC	2017-05-02 10:18	1723	3,598	1,408	39	BA	MD 295	N
5 18	7520S4TD	2017-05-02 10:22	1724	2,525	2,304	91	AA	MD 162	S
5 19	7520T33L	2017-05-02 10:28	1723	2,310	1,405	61	BA	MD 295	S
21	7520T3BN	2017-05-02 10:33	1723	13,852	13,167	95	BA	MD 695	N
20	7520T3BM	2017-05-02 10:33	1723	30,002	28,029	93	AA	IS 695	N
22	7520T4EG	2017-05-02 10:35	1724	5,877	5,627	96	AA	MD 176	W
23	7520U4ER	2017-05-02 10:56	1724	319	193	60	AA	MD 100 N	S
24	7520U4HZ	2017-05-02 10:58	1724	103	41	40	AA	MD 100 O	N
25	7520U4O8	2017-05-02 11:02	1724	103	42	41	AA	MD 100 O	S
26	7520U4QU	2017-05-02 11:04	1724	321	192	60	AA	MD 100 N	N
27	7520V4FO	2017-05-02 11:19	1724	3,176	3,036	96	AA	MD 713	S
28	7520W41M	2017-05-02 11:32	1724	3,426	3,038	89	AA	MD 713	N
iii 30	7520X37Z	2017-05-02 11:57	1723	15,557	14,909	96	BA	MD 695	S
5 29	7520X380	2017-05-02 11:57	1723	28,616	27,069	95	BA	IS 695	S
5 31	7520X495	2017-05-02 11:58	1724	981	781	80	AA	CO 575	W
<b>3</b> 2	7520X4QA	2017-05-02 12:08	1724	371	264	71	AA	MD 713 D	S
33	7520X4WI	2017-05-02 12:12	1724	1 489	1 128	76	Δ <b>Δ</b>	CO 6203	W

Step 7. To remove all files, click the "Check" drop-down menu and select "All." Click "Remove." Then, click the "Reload" (first blue arrow) button. The "Group Partitions" window will open (see below image).

Group Partitions Explorer	
P Enter search criteria	
Show All	1
Batch 01	11
Batch 02	4
Batch 03	
Batch 04	
O Batch 05	
7540N437	
more than one file	
74S0X4A6	
Batch 06	
Batch 07	
July 14 To July 18	
IS 695	
Batch 09	ч
L Batch 10	-
OK	

Select the current batch by clicking the checkbox next to the appropriate batch name. Click the "OK."

Step 8. Once only the desired files appear in the "Batch Processor" window, they may be processed. Click "Process", then "Start." The files will begin to appear under the session window (see below image). The Vibing Processor will take anywhere from 1-3 hours to run. It will depend on the number of lane miles, the number of files, the number of cores in the computer, and database traffic. Other batch processors can process multiple files at one time, however, this processor only processes one file at a time

💞 Batch Pro	ocessor									
Doptions	🖓 Data 🖉 Proce	ess								
: 👸 Sched	lule 👻 👘 Start 🛛 🖓 Paus	e and Stop	🛃 Exceptions	🝷 🧥 Warnings	Info 📔 🕨	Go				
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ang 1	7AI0Q44U	856	0	8:39:39 AM	0.00	00.00:00:13	0.00			
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ar 3	7AI0Q4QL	509	0	8:39:39 AM	0.00	00:00:00:00				
4										
5										
6										
7										

Step 9. A dialogue box will appear when processing is complete.

- i. If the box says "Batch processing has completed", proceed to Step 11.
- ii. If the box says "Batch processing has completed with errors", proceed to Step 10.
- Step 10. View the errors. Click the "Exceptions" drop-down menu and select "View Exceptions."
  - i. If the error is "Missing Images", this is acceptable. Proceed to Step 11.
  - ii. If any other errors are present, reprocessing is required. Click the "Exceptions" drop-down menu and select "Reprocess Exceptions." This will remove all the files from the data screen except for the files that had exceptions. Next, click the "Start" button to reprocess.

#### 2- Performing QC of Processed "Left" Images – performed by Vision user

**Summary:** This task checks that the banner and logo were added to the "Left" processed images through visual inspection.

Step 11. Close the processor and restart Vision. In the "Section Explorer" window, select a file that was run in the processor (see below image).

MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

Data Processing Running Vibing Processor

	-						
Fil	e View	Tools	Help				
8	Connect	-	🏇 Segment 👻 🎲 Rate 👻   💏 Process	🛛 🔇 Map	📉 Images 👻 💓 Panoramic View	📋 Charts 👻 🛐 Tables	👻 🔲 Repo
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Q				<b>*</b>				
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		АА	US 50 E28 R2	w	10/18/2017 1:16:13 PM	7AI104V1	1724	
		АА	US 50 E29 R7	w	10/18/2017 1:13:59 PM	7AI104RB	1724	
		АА	US 50 E32 R2	E	10/18/2017 1:10:25 PM	7AI104LD	1724	
►		АА	US 50 E32 R4	w	10/18/2017 1:06:24 PM	7AI104EO	1724	
		АА	US 50 E32 R5	s	10/18/2017 1:03:46 PM	7AI104AA	1724	
		АА	US 50 E30 R4	Ν	10/18/2017 12:59:04	7AI1042G	1724	
		АА	US 50 E30 R5	s	10/18/2017 12:57:32	7AI0Z4ZW	1724	
		АА	US 50 E29 R2	w	10/18/2017 12:51:43	7AI0Z4Q7	1724	

- Step 12. Click the "Images" drop-down menu and select "Left." The first image that appears may not display the banner and logo generated during processing. This is normal. Only the area that is "matched" will display the banner and logo. There are two methods of locating the matched area (choose one and proceed):
  - i. Click the "Play" button at the bottom of the window and wait until the matched area appears (see below image).



ii. Click the "Segment" drop-down menu and select "Section Comparison." The area in the checkered blue is matched. Click somewhere in the checkered section and Vision will move to that location (see below image).



#### Step 13. The "Left" image now should display the blue banner and logo.

- i. If you do see the banner and logo after checking the first and last image, proceed to Step 14.
- ii. If you do not see the banner and logo, first check that the image is fit on the screen. Move the mouse to the top of the image so that a control bar appears. Click the "Fit" button. If the banner and logo are now displayed, proceed to Step 14.
- iii. If the banner and logo are still not displayed, the affected files will need to be reprocessed. Return to Step 2 and perform processing for all affected files. Occasionally, the batch processor will skip files. If a file is found in the QC process which does not have the banner and logo, it will be necessary to check all files for correctness and rerun the processor on all affected files.

#### 3- Running Vibing Processor for "ROW" Images – performed by Vision user

**Summary:** This task uses Vision software to generate a banner and logo on the "ROW" image files from the ARAN data submittal. This task also adds latitude/longitude data to the "ROW" image properties.

Step 14. Run the same processor for the "ROW" images by repeating Step 2 to Step 10. However, this time in Step 4, select the XML file named "ROW."

#### 4- Performing QC of Processed "ROW" Images – performed by Vision user

**Summary:** This task checks that the banner and logo were added to the "ROW" processed images through visual inspection.

Step 15. Perform the same QC steps for the "ROW" images by repeating Step 11 to Step 13. However, this time in Step 12 select "ROW."

#### 5- Performing QA of Processed Data – performed by Supervisor

**Summary:** This task performs QA checks on the processed vibing data.

- Step 16. TL review of QC staff notification of recollection.
- Step 17. Review of production status receive weekly update from QC staff (last ARAN collection date).
- Step 18. Review Vision app's ROW imagery display and check for banner.

# 5.11 RUNNING THUMBNAIL CREATOR

## 5.11.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to run the Thumbnail Creator in the Roadware Vision software using data collected by the Automatic Road Analyzer (ARAN) survey vans in the field by Field Explorations Division (FED) staff. The Thumbnail Creator is run in batches throughout the annual data collection season. This SOP applies to the processing of an ARAN data batch (or batches). The Thumbnail Creator is run after running the Vibing Processor (see <u>Running Vibing Processor</u>). This process results in the generation of reduced file sizes for the "Left", "ROW", and "Pavement" collected images.

### 5.11.02 Frequency

The Thumbnail Creator is run on batches of ARAN collected data as they are received by the DPT. The frequency and timing varies according to schedule, available resources, and quantity of data received. The batches are processed in a continuous flow throughout the data collection season.

Each ARAN data batch is typically delivered to the DPT every 4 to 5 days. Assuming an average of 60 miles collected per day, each batch contains, on average, between 240 and 300 miles of ARAN data. The actual frequency varies according to the proximity of the routes on which data were collected for the data batch to the Office of Materials Technology (OMT) office and it ranges from 1 day (when collected near the OMT office) to 2 weeks (when collected far from the OMT office). Shorter turn-around periods are preferred to minimize the amount of mileage requiring data recollection. The annual ARAN data collection season typically lasts from March to Mid-December.

# 5.11.03 *Purpose*

The purpose of this SOP is to run the Thumbnail Creator for collected ARAN data and perform quality control (QC) and quality assurance (QA) checks.

### 5.11.04 *Resource Requirements*

The running of the Thumbnail Creator involves two people: (1) a user knowledgeable in Roadware Vision software to run the processor and perform QC, and (2) a supervisor who, as required, provides guidance and decision-making and performs QA. The estimated effort levels in the table below represent the total time, in man-hours, to complete the processing and QC/QA checks. These time estimates assume average batch quantities and no issues encountered during processing.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	Vision user and QC	1	40.0
DPT TL	Supervisor and QA	1	AR ^{06/12/2019}

# 5.11.05 Procedure

The procedure to run the Thumbnail Creator and perform QC/QA is comprised of the following three tasks:

(1) running the Thumbnail Creator in Vision,

- (2) performing QC of the processed data, and
- (3) performing QA of the processed data.

#### 1- Running Thumbnail Creator in Vision and QC – performed by Vision user

**Summary:** This task uses Vision software to reduce the file sizes of the "Left", "ROW", and "Pavement" image files from the ARAN data submittal.

- Step 1. Open Vision.
- Step 2. Click the "Process" drop-down menu. Select "New Batch Processor." The "Batch Processor" window will open (see below image).

A Batch Processor	tas concerns.		x
🛃 Tasks 🗈 Options 📅 Data			
	🔧 Offline	Batch Processor	
🖗 Add 🛗 New 📖 Delete	Task	Description	Ve
Add New Delete	Task         Auto Segmentation Processor         Avi encoder         Classifications Processor         Curve Fit Batch Processor         END Processor         Exit Geo-Tagging & Vibing Processor         Fault Processor         Image Copier Processor         Maint Detection Processor         Joint Detection Processor         JPEG Cracks Detection Processor         LCMS Global Processor         Point4o-Area Distress Processor         Repot Generator Processor         Repot Generator Processor         Sampled QC Events Rating Processor         Sampled QC Processor         Segmentation Rubberbanding         Segmenting QC Processor         Shapefile Expoter         Thumbnal Creator         Vehicle Positions Processor	Description Automatically matches the collected sessions with the routed data. Encode collected JPEG files to AVI. Classifies the existing detected cracks. Uses the curve fit functionality to process data inside batch processing. ERD files exporter. Provides support for geo-tagging images with gps data. Detect and filter Faults Copies original images to a given output folder Measures the brightness of images and compares against acceptable range for quality. Runs the iVison publisher on the current database. Detects lanes from JPEG files. Batch processes Ladybug collected data. Collection of LCMS functions for images conversion, cracks detection and classification an Pavement exporter based on a template file. Point-o-Area Distress Processor. Generate reports. Calculates and stores improved longitudinal profiles and roughness indices Rut processor for Transverse Profile data. Gainetas bookmarks to original chainages and revert rechained matches to subberbanded Generates bookmarks for segmenting quality checks. Exports SHP and KML files. Exports SHP and KML files. Exports Orden aging images in a given output folder Creates levels of detal for Vehicle Positions. Encode collected JPEG files to WMV.	V 111111111111111111111111111111111111
	•		•
ask 🔜 SHAHQVISIONPRD,1438 🖳 OMT_4 🔍	ARAN_PROD_2017_1 🍃 0 🗐 13,522,482 🕑	9,008,448	:

- Step 3. Click the box next to "Thumbnail Creator" in the window on the right.
- Step 4. Click the "Options" tab^{06/12/2019}. Instead of changing settings manually, search for preset schemas. Click the "Load" button. Navigate to the folder where schema files are stored^{06/12/2019}. In this folder, look for an XML file named "Thumbnail [MOST RECENT DATE] All images and both Arans." Select the file and click "Open" (see below image).

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A Load processor settings fro	m file						X
🕞 🗢 🖡 « pmdata )	05 Documentation + PM Manuals + Vision + Schemas	▶ 2017 ▶ Thumbnail	<b>- - i i j</b>	Search Thum	bnail		٩
Organize 🔻 New folder	r						?
☆ Favorites	Name	Date modified	Туре	Size			
📃 Desktop	Thumbnail 091817 All images and both Arans.xml	09/18/2017 10:07	XML Document	2 KB	)		
Downloads							
Recent Places							
ConeDrive							
Computer							
Local Disk (C:)							
DATADRIVE1 (D:)							
👝 New Volume (F:)							
👝 New Volume (G:)							
👝 New Volume (H:)							
🚽 JMask (\\shahanfs1\							
🚽 omtoocshared (\\sh							
⋥ hanprograms (\\sha							
sharedprograms (\\s							
🕎 PmdataPRG (\\shah							
A Naturali							
Network							
File na	me: Thumbhail 091817 All images and both Arans yml		•	XML (*.xml)			•
				Open	Ca	ncel	
						_	.11

Make sure the output folder is pointing to the correct location in the window to the right (see below image).

AZ	🗼 🞯 🔊 Reset 👻		🎭 Advanced	
8	Image Streams			
	All	True		
8	Selected image streams	String[] Array		
	[0]	LCMS3D		
	[1]	LCMSRange		
	[2]	Left		
	[3]	ROW		
8	Input parameters			
	Input directory			
8	Memory/Performance			
	Allow parallelization at session level	False		
8	Output			
	Compression Quality	90		
	Create Scale Output Folder	False		
	Create/Group by Date Output Folder	False		
	Output video folder	\\shahanartico2\shaomtvideolog\2017\Vi	deo\Thumbnai	ils
8	Scale factor	Click to edit		
	▲ 0.6000	0.6000		
	Value	0.6		
	Skip Processed Images	False		
	Video subfolders	Parent		
8	Process			
	Matches tolerance	0		
	Process only matches	True		

- Step 5. Click "Data" from the top menu bar. Every file in the database will appear in the window. The list must be filtered to only include the sections from the current batch. This can be accomplished through two different methods:
  - i. Removing unwanted files, or
  - ii. Removing all files and selecting a batch to re-add.
- Step 6. Choose removal method. If removing all files and selecting a batch to re-add is preferred, skip to Step 7. Otherwise, use a combination of the Shift and Ctrl keys to highlight all unwanted files in the window. Click "Remove." Proceed to Step 8 (see below image).

Tasks	B Dptions	Data 😽 Process							
י ₪	🗙 Remove 🔷	🔺 🕶   🕨 Go	😥 Search						
ŧ	Session	> Date	Vehicle	Collected	Matched	%	County	RouteID	Dir
5 1	7521039K	2017-05-02 01:03	1723	3,891	3,722	96	BA	US 1	N
2	752104HV	2017-05-02 01:08	1724	457	266	58	AA	MD 713 B	E
5 4	752104PZ	2017-05-02 01:13	1724	502	268	53	AA	MD 713 B	W
3	752103Q7	2017-05-02 01:13	1723	4,091	3,701	90	BA	US 1	S
5	752104YS	2017-05-02 01:18	1724	630	275	44	AA	MD 713 C	N
5 6	7521134L	2017-05-02 01:21	1723	3,070	2,692	88	BA	US 1 AL	N
5 7	7521149D	2017-05-02 01:24	1724	3,792	3,564	94	AA	CO 582	N
5 8	752113QM	2017-05-02 01:35	1723	3,088	2,642	86	BA	US 1 AL	S
5 9	7521244K	2017-05-02 01:43	1724	1,511	553	37	AA	CO 4527	N
10	7521237V	2017-05-02 01:45	1723	3,784	2,706	72	BA	MD 166	N
🗐 11	752123QP	2017-05-02 01:56	1723	3,745	2,721	73	BA	MD 166	S
12	752124RG	2017-05-02 01:57	1724	5,926	5,631	95	AA	MD 176	E
13	752134OX	2017-05-02 02:17	1724	2,627	2,323	88	AA	MD 162	N
14	7520S36U	2017-05-02 10:08	1723	3,017	2,155	71	AA	IS 195	N
15	7520S4B9	2017-05-02 10:11	1724	1,513	1,383	91	AA	MD 652	S
16	7520S3FR	2017-05-02 10:14	1723	2,676	2,169	81	AA	IS 195	S
17	7520S3NC	2017-05-02 10:18	1723	3,598	1,408	39	BA	MD 295	N
5 18	7520S4TD	2017-05-02 10:22	1724	2,525	2,304	91	AA	MD 162	S
5 19	7520T33L	2017-05-02 10:28	1723	2,310	1,405	61	BA	MD 295	S
21	7520T3BN	2017-05-02 10:33	1723	13,852	13,167	95	BA	MD 695	N
<b>20</b>	7520T3BM	2017-05-02 10:33	1723	30,002	28,029	93	AA	IS 695	N
22	7520T4EG	2017-05-02 10:35	1724	5,877	5,627	96	AA	MD 176	W
23	7520U4ER	2017-05-02 10:56	1724	319	193	60	AA	MD 100 N	S
24	7520U4HZ	2017-05-02 10:58	1724	103	41	40	AA	MD 100 O	N
25	7520U4O8	2017-05-02 11:02	1724	103	42	41	AA	MD 100 O	S
26	7520U4QU	2017-05-02 11:04	1724	321	192	60	AA	MD 100 N	N
27	7520V4FO	2017-05-02 11:19	1724	3,176	3,036	96	AA	MD 713	S
28	7520W41M	2017-05-02 11:32	1724	3,426	3,038	89	AA	MD 713	N
30	7520X37Z	2017-05-02 11:57	1723	15,557	14,909	96	BA	MD 695	S
29	7520X380	2017-05-02 11:57	1723	28,616	27,069	95	BA	IS 695	S
31	7520X495	2017-05-02 11:58	1724	981	781	80	AA	CO 575	W
32	7520X4QA	2017-05-02 12:08	1724	371	264	71	AA	MD 713 D	S
33	7520X4WL	2017-05-02 12:12	1724	1,489	1,128	76	AA	CO 6203	W

Step 7. To remove all files, click the "Check" drop-down menu and select "All." Click "Remove." Then, click the "Reload" (first blue arrow) button. The "Group Partitions" window will open (see below image).

STATE HIGHWAY ADMINISTRATION

Group Partitions Explorer	
P Enter search criteria	
Show All	1
• Batch 01	
Batch 02	
Batch 03	
Batch 04	
Batch 05	
7540N437	
more than one file	
7450X4A6	
Batch 06	
Batch 07	
July 14 To July 18	
IS 695	
Batch 09	
Batch 10 ▼	1
OK	

Select the current batch by clicking the checkbox next to the appropriate batch name. Click the "OK."

Step 8. Once only the desired files appear in the "Batch Processor" window, they may be processed. Click "Process", then "Start." The files will begin to appear under the session window (see below image). The Thumbnail Creator will take anywhere from 1-3 hours to run. It will depend on the number of lane miles, the number of files, the number of cores in the computer, and database traffic. Other batch processors can process multiple files at one time, however, this processor only processes one file at a time

STATE HIGHWAY ADMINISTRATION

	Processor									
Optior	ns 🍟 Data 🛛 🐺 Pr	rocess								
🖏 Sch	edule - 🛛 🚓 Start 🛛 🚓 Pa	ause 🚛 Stop 🛛	Exceptions	👻 <u> A</u> Warnings	Info 📔 🕨 Go					
	Task	Status	Start	%	Duration	Acti	ual Duration	Run Rate	Est. Remaining	Est. Fini
a71	Thumbnail Creator	Busy	2:23:25 PM	0.00	00.00:00:00		00.00:00:00	Infinity	00.00:00:00	11/10/2017 2:23:25
Ta	sk Thumbnail Creator									
Та	sk Thumbnail Creator Session	Length	Matched	Start	%	Duration	Run Rate			
Ta 1 2 3	sk Thumbnail Creator Session 75205489	Length 1,513	Matched 1,383	Start 2:23:25 PM	% 0.00	Duration 00.00:00:00	Run Rate			
Ta 1 2 3 4 5 6	sk <b>Thumbnail Creator</b> Session 75205489	Length 1,513	Matched 1,383	Start 2:23:25 PM	% 0.00	Duration 00.00:00:00	Run Rate			
Ta 1 2 3 4 5 6 7	sk <b>Thumbnail Creator</b> Session 75205489	Length 1,513	Matched 1,383	Start 2:23-25 PM	% 0.00	Duration 00.00:00:00	Run Rate			
Ta 1 2 3 4 5 6 7 8 9	sk Thumbnail Creator Session 75205489	Length 1,513	Matched 1,383	Start 2:23:25 PM	% 0.00	Duration 00.00:00:00	Run Rate			
Ta 1 2 3 4 5 6 7 8 9 10	sk <b>Thumbnail Creator</b> Session 75205489	Length 1,513	Matched 1,383	Start 2:23:25 PM	2.	Duration 00.00:00:00	Run Rate			
Ta 1 2 3 4 5 6 7 8 9 10 11	k Thumbnail Creator Session 75205489	Length 1,513	Matched 1,383	Start 2:23:25 PM	%	Duration 00.00:00:00	Run Rate			
Ta 1 2 3 4 5 5 6 7 8 9 10 11 12 2	k Thumbnail Creator Session 752054B9	Length 1,513	Matched 1,383	Start 2:23:25 PM	%	Duration 00.00:00:00	Run Rate			
Ta 1 2 3 4 5 6 7 8 9 10 11 12 13 	sk Thumbnail Creator Session 75205489	Length 1,513	Matched 1,383	Start 2:23:25 PM	% 0.00	Duration 00.00:00:00	Run Rate			
Ta 1 2 3 4 5 6 7 8 9 10 11 12 13  Sessi	Kore	Length 1.513	Matched 1,383	Start 2:23:25 PM	% 0.00	Duration 00.00:00:00	Run Rate			

Step 9. A dialogue box will appear when processing is complete.

- i. If the box says "Batch processing has completed", proceed to Step 11.
- ii. If the box says "Batch processing has completed with errors", proceed to Step 10.
- Step 10. View the errors. Click the "Exceptions" drop-down menu and select "View Exceptions."
  - i. If the error is "Missing Images", this is acceptable. Proceed to Step 11.
  - ii. If any other errors are present, reprocessing is required. Click the "Exceptions" drop-down menu and select "Reprocess Exceptions." This will remove all the files from the data screen except for the files that had exceptions. Next, click the "Start" button to reprocess.

#### 2- Performing QC of Processed Data – performed by Vision user

**Summary:** This task checks that the folders contain the correct number of processed images and performs visual inspection of a sample of images to look for abnormalities.

Step 11. Navigate to the output folder (see below image).

STATE HIGHWAY ADMINISTRATION

and the second second									
→ → Network → shahanartico2 → shaomtvideolog → 2017 → Video → Thumbnails →									
Organize 🔻 Burn New folder									
🔆 Favorites	Name	Date modified	Туре						
🧮 Desktop	\mu LCMS3D	09/20/2017 6:00 AM	File folder						
鷆 Downloads	퉬 LCMSRange	09/20/2017 6:02 AM	File folder						
🔄 Recent Places	퉬 Left	11/07/2017 9:47 AM	File folder						
🝊 OneDrive	퉬 ROW	11/07/2017 10:23	File folder						

- Step 12. Check the number of files in each folder. There should be the same number of files in each folder type ("Left", "ROW", "LCMSRange", and "LCMS3D").
  - i. If the number of files match in each folder, proceed to Step 13.
  - ii. If there are discrepancies, isolate the files that are missing from certain folders and reprocess those files by returning to Step 2 and repeating the procedure only for the files in question. Proceed to Step 13.
- Step 13. Spot check a few of the images in "Windows Explorer."
  - i. If the images look acceptable, process is complete. However, if there are changes in mileage that cause the Vibing Processor to be rerun, those files will also need to be reprocessed in the Thumbnail Creator.
  - ii. If there are issues with the processed images, isolate the files that are missing or incorrect and reprocess those files by returning to Step 2 and repeating the procedure only for the files in question.

#### 3- Performing QA of Processed Data – performed by Supervisor

Summary: This task performs QA checks on the processed images.

- Step 14. TL review of QC staff notification of recollection.
- Step 15. Review of production status receive weekly update from QC staff (last ARAN collection date).
- Step 16. Review Videlog server to make sure imagery is posted and available.

# 5.12 RUNNING CURVE FIT BATCH PROCESSOR

### 5.12.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to run the Curve Fit Batch Processor in the Roadware Vision software using data collected by the Automatic Road Analyzer (ARAN) survey vans in the field by Field Explorations Division (FED) staff. The Curve Fit Batch Processor is run in batches throughout the annual data collection season. This SOP applies to the processing of an ARAN data batch (or batches). The Curve Fit Batch Processor is run after completion of the ARAN data route matching (see <u>Route Matching</u>). This process results in the generation of ARAN vertical and horizontal roadway (geometric) data.

### 5.12.02 Frequency

The Curve Fit Batch Processor is run on batches of ARAN collected data as they are received by the DPT. The frequency and timing varies according to schedule, available resources, and quantity of data received. The batches are processed in a continuous flow throughout the data collection season.

Each ARAN data batch is typically delivered to the DPT every 4 to 5 days. Assuming an average of 60 miles collected per day, each batch contains, on average, between 240 and 300 miles of ARAN data. The actual frequency varies according to the proximity of the routes on which data were collected for the data batch to the Office of Materials Technology (OMT) office and it ranges from 1 day (when collected near the OMT office) to 2 weeks (when collected far from the OMT office). Shorter turn-around periods are preferred to minimize the amount of mileage requiring data recollection. The annual ARAN data collection season typically lasts from March to Mid-December.

# 5.12.03 Purpose

The purpose of this SOP is to run the Curve Fit Batch Processor for collected ARAN data and perform quality control (QC) and quality assurance (QA) checks.

### 5.12.04 *Resource Requirements*

The running of the Curve Fit Batch Processor involves two people: (1) a user knowledgeable in Roadware Vision software to run the Curve Fit Batch Processor and perform QC, and (2) a supervisor who, as required, provides guidance and decision-making and performs QA. The estimated effort levels in the table below represent the total time, in man-hours, to complete the processing and QC/QA checks. These time estimates assume average batch quantities and no issues encountered during processing.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	Vision user and QC	1	3.0
DPT TL	Supervisor and QA	1	AR ^{06/12/2019}

# 5.12.05 Procedure

The procedure to run the Curve Fit Batch Processor and perform QC/QA is comprised of the following three tasks:

- (1) running Curve Fit Batch Processor in Vision,
- (2) performing QC of the processed curve fit data, and
- (3) performing QA of the processed curve fit data.

#### 1- Running Curve Fit Batch Processor in Vision – performed by Vision User

**Summary:** This task uses Vision software to process curve fit data from the ARAN data submittal.

- Step 1. Open Vision.
- Step 2. Click the "Process" drop-down menu. Select "New Batch Processor." The "Batch Processor" window will open (see below image).

Batch Processor	1708		X				
📝 Tasks 🗈 Options 🍟 Data							
80	👫 Offline	Batch Processor					
🔁 Add 📑 New 📄 Delete	Task	Description					
		Automatically matches the collected sessions with the routed data					
Processors	Avi encoder	Encode collected JPEG files to AVI					
Cracks Processing	Classifications Processor	Classifies the exising detected cracks					
ERD Processor	Curve Fit Batch Processor	Uses the curve fit functionality to process data inside batch processing.					
Image Processing	ERD Processor	ERD files exporter.					
- 🔁 QC	Exif Geo-Tagging & Vibing Processor	Provides support for geo-tagging images with gps data.					
Reporting	E Rault Processor	Detect and filter Faults					
Sensor Data Processing	🔲 📖 Image Copier Processor	Copies original images to a given output folder					
	🔲 📖 Image QC Processor	Measures the brightness of images and compares against acceptable range for quality.					
	🔲 📖 iVision publisher batch processor.	Runs the iVison publisher on the current database.					
	Direction Processor	Detect joints in a session of images					
	I III III JPEG Cracks Detection Processor	Detects cracks from JPEG files.					
	JPEG Lanes Detection Processor	Detects lanes from JPEG files.					
	Ladybug processor	Batch processes Ladybug collected data.					
	LCMS Global Processor	Collection of LCMS functions for images conversion, cracks detection and classification an					
	Pavement Export Processor	Pavement exporter based on a template file.					
	Point-to-Area Distress Processor	Point-to-Area Distress Processor.	_				
	Rating Processor	Distress rating processor.	_				
	Report Generator Processor	Generate reports.	_				
	Roughness Processor	Calculates and stores improved longitudinal profiles and roughness indices	_				
	Rut Processor	Rut processor for Transverse Profile data.					
	Sampled QC Events Rating Processor	Sampled QC events for manual rating processor.					
		····					
	X 🗢 🔺						
	# Task	Description					
	🔲 🗋 1 Curve Fit Batch Processor	Uses the curve fit functionality to process data inside batch processing.					
			_				
			_				
Revealibely SHAHOVISIONPRD 1438	MT ARAN PROD 2017 1 🏂 1 💷 8 806 16	5 🐼 7 437 701					

- Step 3. Click the box next to "Curve Fit Batch Processor" in the window on the right. Then click the "Options" tab (see above image).
- Step 4. Instead of changing settings manually, search for preset schemas. Click the "Load" button. Navigate to the folder where schemas are stored^{06/12/2019}. In this folder, look for an XML file named "CurveFit2017_Protocol_[MOST RECENTDATE]." Select the file and click "Open" (see below image).

STATE HIGHWAY ADMINISTRATION

Data Processing Running Curve Fit Batch Processor

atch Pro	Cessor	1 1/10								00	23
🛃 Tasks 🤇	Doptions Data										
Save	1 Load					Show Properties	14	l 🔞 🌱 Reset -		Simpl	e 🖻
#		On Error	Retries	Retor delay	Log		4	Curve fit parameters -	Horizontal		-
1	Curve Fit Batch Processor	Skin	0	00:00:00	Ealse	-		Arc maximum radius (meters	s) 10000		
		crop		00.00.00	1000			Arc minimum angle	10		- 11
								Arc tolerance (meters)	1		
								Collinear discrepancy perce	ant O		E
								Consider nearby roads	False		- 11
								Control radii lengths (percer	nt) 100		
at Load pro	cessor settings from file						1	the state of the local division of the	-		23
00-	A Computer & Schampe	() chahannmdata	1) PMDATA)	05 Documen	tation\E	M Manuale/Vicion) (Tr) > 2017			- A Search	2017	0
00	Schemas	(((snananprindata	I (PIVIDATA)	oo bocamen	tation (P				• • • • • • • • • • • • • • • • • • •	.017	~
Organize	<ul> <li>New folder</li> </ul>									III • 🗔	0
Travor	rites			-	Na	ne		Date modified	Туре	Size	
Des	ktop					OLD		06/29/2017 11:10	File folder		
Dov	wnloads					OLD 2016 ARAN3 for rebuilding for 20	017	06/13/2017 10:47	File folder		
SE Rec	ent Places					Rut Protocol-Not Finalized		07/12/2017 9:48 AM	File folder		
1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.						Vibing		07/25/2017 10:32	File folder		
Com	puter					CLASSIFICATION PROFILE 6-13-2017.	Jaml	06/13/2017 11:25	XML Document	1 KB	
🖵 sha	omtvideolog (\\shahanartico2)	(B:)				CurveFit2017_Protocol_6-13-2017.xml	D	06/13/2017 1:18 PM	XML Document	3 KB	
🚢 Loo	al Disk (C:)					LCMS_GLOBAL_PROCESSOR_6-13-201	17.x.	06/13/2017 10:14	XML Document	3 KB	
Ca Nev	w Volume (E:)					LCMS_Maryland_2017_06_14_2017.xml	d i	06/14/2017 1:03 PM	XML Document	8 KB	
VC	oulibaly (\\SHAVMHANFS1\OM	TOOCUsers) (M:)		_		matched.xml		08/10/2017 12:12	XML Document	1,560 KB	
🖵 om	toocshared (\\shahanfs1) (N:)			1		RATING_PROCESSOR_6-13-2017.xml		06/13/2017 11:28	XML Document	1 KB	
PM 🔛	ItestData (\\hanpmdata) (O:)					Roughness_Processor_7-12-2017.xml		07/12/2017 8:59 AM	XML Document	1 KB	
😪 har	nprograms (\\shahanfs1) (P:)					TEXTURE_CRACK_ONLY_LCMS_GLOB	BAL_	06/13/2017 11:35	XML Document	2 KB	
🖵 Wx	Processing (\\HANPMDATA\PI	MworkingData) (Q	:)			TEXTURE_ONLY_LCMS_GLOBAL_PRO	CES	06/13/2017 10:17	XML Document	2 KB	
PM	DATA (\\shahanpmdata1) (R:)										
🖵 sha	redprograms (\\shahqfs3) (S:)										
Sch	emas (\\shahanpmdata1\PMDA	ATA\05 Document	ation\PM M	anuals\Visi							
🖵 Des	sign Projects (\\SHAHANFS1\ON	ATOOCShared\ON	AT) (Y:)								
🖵 Pm	dataPRG (\\hanpmdata) (Z:)										
🗣 Netw	ork			-	-						
	File name:								XML (*.se	al)	•
								(			
								(	Ope	Cance	el 🖉

Step 5. Set the output location to the following: \\shahanpmdata1\PMtestData\Archive Condition Data\Data17\Curve Fit Files (see below image).

💏 Batch Processor			
Tasks Dotions 💞 Data	Process		
🚽 Save 💕 Load	Show Prope	ties 🕴 👷 🖤 Reset +	😵 Simple 🔮
# Task	On Error Retries	Enable KML File Export	True
1 Curve Et Batch Processor	Scin (	Export collected road in KML files	True
T Corve ni batch nocesso	Skip (	KML arcs color	Blue
		KML arcs width	0
		KML line width	0
		KML lines color	Black
		KML radius color	Green
		KML radius width	0
		KML road color	Red
		KML road width	0
		# Export Shapefile	
		Enable Shapefile Export	True
		<ul> <li>Output parameters</li> </ul>	
		Export conversion	Feet
		Export only matched data	True
		Output directory	Archive Condition Data\Data17\Curve Fit Files
		Output mode	Extended
		4 Process	
		Crossfal source	RutValuesExtended
		Curve fit process	Eventhing
		Enable horizontal processing	True
		Enable vertical processing	True
		Present and Incodes	

- Step 6. Click "Data" from the top menu bar. Every file in the database will appear in the window. The list must be filtered to only include the sections from the current batch. This can be accomplished through two different methods:
  - i. Removing unwanted files, or
  - ii. Removing all files and selecting a batch to re-add.

- Step 7. Choose removal method. If removing all files and selecting a batch to re-add is preferred, skip to Step 7. Otherwise, use a combination of the Shift and Ctrl keys to highlight all unwanted files in the window. Click "Remove." Proceed to Step 8.
- Step 8. To remove all files, click the "Check" drop-down menu and select "All." Click "Remove." Then, click the "Reload" (first blue arrow) button. The "Group Partitions" window will open (see below image).

Group Partitions Explorer	
P Enter search criteria	
Show All	
Batch 01	
Batch 02	
Batch 03	
Batch 04	
Batch 05	
7540N437	
more than one file	
74S0X4A6	
Batch 06	
Batch 07	
July 14 To July 18	
IS 695	
Batch 09	
Batch 10	
OK	

Select the current batch by clicking the checkbox next to the appropriate batch name. Click the "OK."

Step 9. Once only the desired files appear in the "Batch Processor" window, they may be processed. Click "Process", then "Start." The files will begin to appear under the session window (see below image).

	Task	Status	Start	%	Duration	Actual Duration	Run Rate	Est. Remaining	Est. Finish	
171	Curve Fit Batch Processor	Waiting								

#### 2- Performing QC of Processed Data – performed by Vision user

**Summary:** This task checks the quality of processed curve fit data through an inspection of errors reported by Vision during processing.

- Step 10. A dialogue box will appear when processing is complete.
  - i. If the box says, "Batch processing has completed", proceed to Step 12.
  - ii. If the box says, "Batch processing has completed with errors", proceed to Step 10.
- Step 11. View the errors. Click the "*Exceptions*" drop-down menu and select "*View Exceptions*."
  - i. If the error is "Missing Images", this is acceptable. Proceed to Step 12.
  - ii. If any other errors are present, reprocessing is required. Click the "Exceptions" drop-down menu and select "Reprocess Exceptions." This will remove all the files from the data screen except for the files that had exceptions. Next, click the "Start" button to reprocess.
- Step 12. Check the "Batch Processor" window for runs that did not process. The software occasionally skips runs. In the window showing processed results, check the "Run Rate" column. Any runs that have blanks in this column will need to be reprocessed. Select those runs, removing runs already processed, and change the output location to a new temporary folder. Click "Reset" (see below image).

😤 Batch Pr	rocessor	-							Statistics of the local division of the loca	
Doptions	s 🚏 Data 🐺 Proces	38								
: Ma Sche	dule - A Start A Pause	Reset	Exception	🔹 🔥 Warnings	Info 🕨 Go					
#	Task	Clarker	Grad	• •	Duration	Act	ual Duration	Pup Pate	Est Remaining	Ect. Einich
···	Cores Di Datala Dasaras	Consistent	7.00.07 AM	100.00	00.00.01.10	nua		2 700.05	Cat. Homaning	00 /15 /2017 7-00-20
	Curve Hit Batch Processor	Completed	7:06:07 AM	100.00	00.00.01:12		00.00:01:12	3,/33.35	00.00.00.00	06/15/2017 7:05:20
Tasl	k Curve Fit Batch Process	sor								
#	Session	Length	Matched	Start	%	Duration	Run Rate			
21	76P0Z3C2	24,102	23,226	7:08:07 AM	100.00	00.00:00:00				
2	76P0L301	2,660	2,245	7:08:26 AM	100.00	00.00:00:05	1,810.43			
3	76P0L3ZH	523	441	7:08:32 AM	100.00	00:00:00:00	5,700.93			
Ø4	76P103U9	2,646	1,503	7:08:32 AM	100.00	00:00:00:00				
05	76P0M3GP	24,836	23,148	7:08:34 AM	100.00	00.00:00:22	4,034.70			
6	76Q003PB	589	180	7:08:57 AM	100.00	00.00:00:00	6,837.56			
07	76Q0T3MQ	10,839	10,012	7:09:05 AM	100.00	00.00:00:01	24,697.24			
8 🕥	76Q0Y44E	10,183	9,898	7:09:18 AM	100.00	00.00:00:01	21,190.61			
9										
10										
11										
12										

Step 13. Once reprocessing is complete, navigate to the temporary folder that was created for the reprocessed results. Move all files and move to the main folder

that contains the original processed files. Select "Move and Replace" if there are any duplicate files (see below image).



**3- Performing QA of Processed Rut Data** – *performed by Supervisor* 

Summary: This task performs QA checks on the processed curve fit data.

- Step 14. TL review of QC staff notification of recollection.
- Step 15. Review of production status receive weekly update from QC staff (last ARAN collection data fully processed).

# 5.13 REPORTING AND UPLOADING DATA TO ORACLE

### 5.13.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to upload data collected by the Automatic Road Analyzer (ARAN) survey vans in the field by Field Explorations Division (FED) staff and processed by DPT staff in Roadware Vision software to Oracle using the Engineering Data Warehouse (EDW). This SOP is performed once all other data processing is completed for a specific batch of data. A list of columns required for running the report generator in Vision is included as an appendix (see <u>Base Report</u>. In addition, the methodology behind the International Roughness Index (IRI) speed adjustment is also included as an appendix (see <u>IRI Speed Adjustment</u>).

### 5.13.02 Frequency

The report generation and Oracle upload is performed on batches of ARAN collected data as they are received by the DPT. The frequency and timing varies according to schedule, available resources, and quantity of data received. The batches are processed in a continuous flow throughout the data collection season. Each ARAN data batch is typically delivered to the DPT every 4 to 5 days. Assuming an average of 60 miles collected per day, each batch contains, on average, between 240 and 300 miles of ARAN data. The actual frequency varies according to the proximity of the routes on which data were collected for the data batch to the Office of Materials Technology (OMT) office and it ranges from 1 day (when collected near the OMT office) to 2 weeks (when collected far from the OMT office). Shorter turn-around periods are preferred to minimize the amount of mileage requiring data recollection. The annual ARAN data collection season typically lasts from March to Mid-December.

### 5.13.03 Purpose

The purpose of this SOP is to run the report generator in Vision and then upload the processed data from Vision to Oracle using the EDW. The operations performed in the EDW utilize SQL Developer packages to populate the output tables and perform a speed adjustment for the IRI data. The UPD_VISION_TABLE package populates the Base tables, while the CONDITION_PKG creates new fields in the output tables (LEFTIRI_ADJ and RIGHTIRI_ADJ) and populates them with IRI data adjusted for speed. The output tables will serve as the basis for developing the Business Plan Tables.

### 5.13.04 *Resource Requirements*

Running the report generator and uploading data to Oracle involves four people: (1) a user knowledgeable in Vision and the EDW to run the report generator and upload the data, (2) a database management expert to perform QA in Oracle, (3) a database management expert who, as required, performs code repair and troubleshooting, and (4) a supervisor who, as required, provides guidance and decision-making and performs QA. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume average batch quantities and no issues encountered during uploading.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	Vision/EDW user	1	120.0
DWT Staff	QA	2	0.5
DWT Staff	Code Repair	1	A D 06/12/2019
DPT TL	Supervisor and QA	1	

### 5.13.05 *Procedure*

The procedure to generate the reports and upload data to Oracle is comprised of the following four tasks:

- (1) defining a new report,
- (2) running the report generator,
- (3) uploading data from Vision to Oracle, and
- (4) performing QA of uploaded data.

#### 1- Defining a New Report – performed by Vision user

**Summary:** This task uses Vision software to define a new report to be used in the generation of ARAN data reports. If the report has been previously defined and created in Vision, the user may proceed to the next component (Step 8).

- Step 1. Determine if the desired report has already been defined and created in Vision.
  - i. If the report has been previously defined and created, proceed to the next component by skipping to Step 8.
  - ii. If the report has not been previously defined and created, proceed to Step 2.
- Step 2. Open Vision and connect to the proper database.
- Step 3. Click the "Report" drop-down menu and select "Report Generator." The "Report Generator" window will open with all the reports that have been previously defined (see below image).

Report Generator						
🐂 Report Editor 🔲 Sel	lect source 🛛 💏 Gen	erate 🛛 🔛 Save 📂 Lo	bad			(i) Abo
нероп						
🥝 Validate   🚽 Check						
Template Name	Group by	Break by	Description	Length mode	Reset mode	
BASE_ADDTION	Locator		Vision Base Report at Various Interval	Measured	Interval Multiple	
PAGD_QC	Locator		Count Report for QC (1 Record Per File)	Chainage	IntervalMultiple	-
BASE	Locator		Vision Base Report at Various Interval	Measured	Interval Multiple	
Detail4mmi_BASE	Locator		Detail Report at 4millimile	Chainage	Interval Multiple	
GPS1mmi_BASE	Locator		GPS Report at 1millimile	Chainage	Interval Multiple	
IMAGERY_BASE	Locator		Imagery Table at 4millimile	Chainage	Interval Multiple	
Detail10thmile	Locator		Detail Report at 10th mile	Chainage	Interval Multiple	
Rutting2mmi_PLAY	Locator		Rutting Report at 2millimile	Chainage	Interval Multiple	
Detail4mmi	Locator		Detail Report at 4millimile	Measured	Interval Multiple	
Detail4mmi_Groomed	Locator		Detail Report at 4millimile & 100millimile	Chainage	Interval Multiple	
🗐 Cracking	Locator		Cracking Report at 4millimile	Chainage	Interval Multiple	
GPS1mmi	Locator		GPS Report at 1millimile	Chainage	IntervalMultiple	
Rutting2mmi	Locator		Rutting Report at 2millimile	Chainage	IntervalMultiple	
j						
1.00	L_ROUTE	L_D	CollectionVehicle D0	CSTimeStamp	UniqueRun	Length
L_00						
AA	MD 162	N	1721 05/	/09/2016 10:30 AM	6590T16W	2898.625992147
AA AA AA	MD 162 MD 162	N S	1721 05. 1721 05.	/09/2016 10:30 AM /09/2016 10:30 AM	6590T16W 6590T16X	2898.625992147 2894.4982392844
AA AA AA AA	MD 162 MD 162 MD 176	N S E	1721         05.           1721         05.           1721         05.           1721         05.	/09/2016 10:30 AM /09/2016 10:30 AM /09/2016 10:30 AM	6590T16W 6590T16X 6590T16R	2898.625992147 2894.4982392844 4745.41662248182

Step 4. Click "Report Editor" and the "Report Template Editor" will appear. Click the "New" button, as highlighted in red, to create a new report, click the "Modify" button, as highlighted in blue, to modify an existing report, or click the "Delete" button, as highlighted in black, to delete an existing report.

ipiato Hamo	Group by	Break by	Description	Length mode	Reset mode	
BASE ADDTION	Locator		Vision Base Report at Various Interval	Measured	IntervalMultiple	
PAGD QC	Locator		Count Report for QC (1 Record Per File)	Chainage	IntervalMultiple	
BASE	Locator		Vision Base Report at Various Interval	Measured	IntervalMultiple	
Detail4mmi_BASE	Locator		Detail Report at 4millimile	Chainage	IntervalMultiple	
GPS1mmi_BASE	Locator		GPS Report at 1millimile	Chainage	IntervalMultiple	
MAGERY_BASE	Locator		Imagery Table at 4millimile	Chainage	IntervalMultiple	
Detail10thmile	Locator		Detail Report at 10th mile	Chainage	IntervalMultiple	
Rutting2mmi_PLAY	Locator		Rutting Report at 2millimile	Chainage	IntervalMultiple	
Detail4mmi	Locator		Detail Report at 4millimile	Measured	IntervalMultiple	
Detail4mmi_Groomed	Locator		Detail Report at 4millimile & 100millimile	Chainage	IntervalMultiple	
Cracking	Locator		Cracking Report at 4millimile	Chainage	IntervalMultiple	
GPS1mmi	Locator		GPS Report at 1millimile	Chainage	IntervalMultiple	
Rutting2mmi	Locator		Rutting Report at 2millimile	Chainage	IntervalMultiple	
Collection_Log	Locator		Summary of Collection	Chainage	IntervalMultiple	
FED_4mmi_data	Locator		raw vehicle data (AVG)	Chainage	IntervalMultiple	
FED_2mmi_data	Locator		raw vehicle data (AVG)	Chainage	IntervalMultiple	
GIS4mmi	Locator		GIS Table at 4millimile	Chainage	IntervalMultiple	
MAGERY	Locator		Imagery Table at 4millimile	Chainage	IntervalMultiple	
FED_QC	Locator		Count Report for QC (1 Record Per File)	Chainage	IntervalMultiple	
VISIDATA - DO NOT U	ISE Locator			Chainage	IntervalMultiple	
vals						
000 300 40	00 10	0.000 3 1,000,	000.000			
.000 3 4.0						

Step 5. Click the "New" button and enter the information for: "Name", "Description", "Grouping", "Interval length mode", "Interval reset mode", "Break by", and "Intervals" as shown in the image below. Click "OK." A new report named "Base" will be created in Vision (see below image). MARYLAND DEPARTMENT OF TRANSPORTATION

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Data Processing Reporting and Uploading Data to Oracle

Report Editor [Modify]					- • •
Name					
BASE					
Description					
Vision Base Report at Various Interval of 1, 2, 4,	100, 1000000mm	i			
Interval	Break by				
Grouping	i 🙉   🐰 🗈	E 🔁			
Locator 👻					
Interval length mode					
Measured					
Interval reset mode					
IntervalMultiple 🔹	J				
🔲 Orter tistemediaertable to SOI	Intervals				
	: 🎦 New 🗙	Delete			
	[]  1.000	4.000	g ^{mm} 100.000	g ^{mm} 1,000,000.000	
	ĮL				
				ОК	Cancel

Step 6. After the new "Base" report is created, click the "Columns" tab in the "Report Templates Editor" window to define all columns needed in the new report, one column at a time. Again, click the "New" button to add a new column, click the "Modify" button to modify an existing button, or click the "Delete" button to delete an existing column (see below image).

: 🎦 New 🔄 Modify 🗙	Delete 🛛 🎯 Va	lidate 🛃 Check				
Template Name	Group by	Break by	Description	Length mode	Reset mode	A
BASE_ADDTION	Locator		Vision Base Report at Various Interval	Measured	IntervalMultiple	
PAGD_QC	Locator		Count Report for QC (1 Record Per File)	Chainage	IntervalMultiple	
BASE	Locator		Vision Base Report at Various Interval	Measured	IntervalMultiple	
Detail4mmi_BASE	Locator		Detail Report at 4millimile	Chainage	IntervalMultiple	
GPS1mmi_BASE	Locator		GPS Report at 1millimile	Chainage	IntervalMultiple	=
IMAGERY_BASE	Locator		Imagery Table at 4millimile	Chainage	IntervalMultiple	
Detail 10thmile	Locator		Detail Report at 10th mile	Chainage	IntervalMultiple	
Rutting2mmi_PLAY	Locator		Rutting Report at 2millimile	Chainage	IntervalMultiple	
Detail4mmi	Locator		Detail Report at 4millimile	Measured	IntervalMultiple	
Detail4mmi_Groomed	Locator		Detail Report at 4millimile & 100millimile	Chainage	IntervalMultiple	
Cracking	Locator		Cracking Report at 4millimile	Chainage	IntervalMultiple	
GPS1mmi	Locator		GPS Report at 1millimile	Chainage	IntervalMultiple	
Rutting2mmi	Locator		Rutting Report at 2millimile	Chainage	IntervalMultiple	
Collection_Log	Locator		Summary of Collection	Chainage	IntervalMultiple	
FED_4mmi_data	Locator		raw vehicle data (AVG)	Chainage	IntervalMultiple	
FED_2mmi_data	Locator		raw vehicle data (AVG)	Chainage	IntervalMultiple	
GIS4mmi	Locator		GIS Table at 4millimile	Chainage	IntervalMultiple	
IMAGERY	Locator		Imagery Table at 4millimile	Chainage	IntervalMultiple	
FED_QC	Locator		Count Report for QC (1 Record Per File)	Chainage	IntervalMultiple	
VISIDATA - DO NOT USE	Locator			Chainage	IntervalMultiple	-
Intervals						
1 000	10	0 000	000 000			

Step 7. Click the "New" button and enter the information for: "Name", "Description", "Type" (data type such as TEXT or NUMBER, decimals, aggregation type such

as MAX, MIN, FIRST...), "Conditional Split" and "Transformation" for each column that is needed. The below image gives an example for defining a column named "EVENT_BRICK_OFFICE." The details of each column of the "Base" report can be found in the appendix <u>Base Report</u>. Once all columns are defined, the new report will be ready to be ran by the Report Generator in Vision (see below image).

🛄 Output Column Editor [Modify]				- • ×
Name				
EVENT_BRICK_OFFICE				
Description				
Type NUMBER Decimals 0				
Now Madify X Data			Maya Un	Move Down
			Move op	
Conditional Split	Iransformation	Details		
COMPUTE (manualdistressesvalues, FIRST([Length]),[distresstypename]="Event_Brick_Pavement", 0, 0}>0	1			
	0			
		:		
			ОК	Cancel

### 2- Running Report Generator – performed by Vision user

**Summary:** This task uses Vision software to process report data from the ARAN data submittal.

- Step 8. Open Vision.
- Step 9. Click the "Process" drop-down menu. Select "New Batch Processor." The "Batch Processor" window will open (see below image).

STATE HIGHWAY ADMINISTRATION

	🛝 🕴 👬 Offli	ne	Batch Processor					
🕽 Add 📸 New 📖 Delete	Task		Description	_				
Processor		to Segmentation Processor	Automatically matches the collected sessions with the routed data.					
Complex Data Extraction	Av	i encoder	Encode collected JPEG files to AVI.					
Cracks Processing	🔲 📖 Cla	ssifications Processor	Classifies the exising detected cracks.					
ERD Processor	Cu	rve Fit Batch Processor	Uses the curve fit functionality to process data inside batch processing.					
Image Processing		D Processor	ERD files exporter.					
	Exi	f Geo-Tagging & Vibing Processor	Provides support for geo-tagging images with gps data.					
🛅 Reporting	E 🔍 Fa	ult Processor	Detect and filter Faults					
Sensor Data Processing	🔲 🔍 Ima	age Copier Processor	Copies original images to a given output folder					
	🔲 🔍 Ima	age QC Processor	Measures the brightness of images and compares against acceptable range for quality	y.				
	i 🗖 🔍 i Me	sion publisher batch processor.	Runs the iVison publisher on the current database.					
	📃 🛄 Joi	nt Detection Processor	Detect joints in a session of images					
	📃 🛄 JP	EG Cracks Detection Processor	Detects cracks from JPEG files.					
	📃 🛄 JP	EG Lanes Detection Processor	Detects lanes from JPEG files.					
	📃 🛄 La	dybug processor	Batch processes Ladybug collected data.					
	📃 🛄 LC	MS Global Processor	Collection of LCMS functions for images conversion, cracks detection and classification	on an.				
	📃 🛄 Pa	vementExport Processor	Pavement exporter based on a template file. Point to Area Distress Processor.					
	📃 🛄 Po	int-to-Area Distress Processor						
	Ra	ting Processor	Distress rating processor.					
	(   🛛 🔍 尾	port Generator Processor	Generate reports.					
	Ro	ughness Processor	Calculates and stores improved longitudinal profiles and roughness indices					
	📃 🛄 Ru	t Processor	Rut processor for Transverse Profile data.					
	📃 🛄 Sa	mpled QC Events Rating Processor	Sampled QC events for manual rating processor.					
	•							
	i 🗙   🤜	* 🔺						
	#	Task	Description					
	1 🗌 🗋 🗎	Report Generator Processor	Generate reports.					

- Step 10. Click the box next to "Report Generator Processor" in the window on the right.
- Step 11. Click the "Options" tab. Instead of changing settings manually, search for preset schemas. Click the "Load" button. Navigate to the folder where schema files are stored^{06/12/2019}. In this folder, look for an XML file named "Base_Report_[MOST RECENTDATE]." Select the file and click "Open" (see below image).

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Data Processing Reporting and Uploading Data to Oracle

atch Processor								
Tasks 🛛 🔛 Options 🖓 Data								
Save Load				🚰 Show	Properties	∱↓ 🞯 🔊 Reset 🗸		🐁 Simple
Task	On Error	Retries	Retry delay	Log		⊿ DataToReport		
1 Report Generator Processor	Skip	0	00:00:00	False		Data Type To Report	MatchedOnly	
						Export to .CSV Folder		
						Overwrite existing files	True	
						Matched Only Data Include Incomplete Interv	ala Taua	
						Reset Segment Chainage	False	
						Memory/Performance		
oad processor settings from file						Allow parallelization at ses	sin False	23
						Contract on the local division of the	ine.	
/ ◯ ▽ 🖙 ト Com ト 2017 (\\shahanpmd	lata1\PME	ATA\05 Doc	umentation\P	// Manuals\Vis	ion\S ▶	<ul> <li>✓ </li> <li></li></ul>	(\\shahanpmda	t 🔎
)rganize 🗙 New folder							= -	
	ſ	lame					Date modifi	ed
🔜 Desktop		LCMS_GL	DBAL PROCES	SOR_LANE_DE	TECTION_ONL	Y-10-17-17.xml	10/17/2017 2	2:57 PM
🐌 Downloads		Base_Report_9_29_2017.xml					09/29/2017 9	9:28 AM
🔚 Recent Places		LCMS_GL	DBAL_PROCES	19-2017	.xml		09/20/2017 9	9:54 AM
	[	RUT_Processor_ARAN4_Before_June_209-14-2017.xml					09/14/2017 1	L1:02
🖳 Computer	[	RUT_Processor_ARAN4_After_June_209-11-2017.xml						2:02 PM
雬 shaomtvideolog (\\shahanartico2) (B:)	[	RUT_Proc	essor_ARAN3_	9-11-2017.xml			09/11/2017 2	2:02 PM
🚢 Local Disk (C:)	[	Roughness_Processor_7-12-2017.xml					07/12/2017 8	3:59 AM lel.
👝 New Volume (E:)	[	LCMS_Maryland_2017_06_14_2017.xml					06/14/2017 1	L:03 PM
🖵 VCoulibaly (\\SHAVMHANFS1\OMTOOC	Users	CurveFit2017_Protocol_6-13-2017.xml					06/13/2017 1	L:18 PM 💩 Sir
坖 PMtestData (\\hanpmdata) (O:)	[	TEXTURE_	CRACK_ONLY	LCMS_GLOBA	L_PROCESSOR	_6-13-2017.xml	06/13/2017 1	1:35
🕎 Wx_Processing (\\HANPMDATA\PMwork	cingD	RATING_PROCESSOR_6-13-2017.xml					06/13/2017 1	1:28
坖 PMDATA (\\shahanpmdata1) (R:)	[	CLASSIFICATION_PROFILE_6-13-2017.xml					06/13/2017 1	1:25
🕎 Engineering Data Warehouse (\\shahanpr	ndati	TEXTURE_ONLY_LCMS_GLOBAL_PROCESSOR_6-13-2017.xml					06/13/2017 1	L0:17
🚽 2017 (\\shahanpmdata1\PMDATA\05 Do	cume	📙 OLD					10/17/2017	3:10 PM
🖵 Design Projects (\\SHAHANFS1\OMTOO	CShai	📗 Trial					10/17/2017 2	2:18 PM
🚅 PmdataPRG (\\hanpmdata) (Z:)		📙 Send to Fi	igro				10/05/2017 1	L:28 PM
		📙 Thumbna	il				09/18/2017 1	L0:07
🙀 Network		📙 Rut Proto	ol-Not Finaliz	ed			09/11/2017 1	L:33 PM
		📗 Vibing					07/25/2017 1	L0:32
		📙 OLD 2016	ARAN3 for reb	uilding for 201	7		06/13/2017 1	L0:47
	•							•
File name: Base Report 9	29 2017.)	ml				✓ XML (* xml)		•
- inclusion								
						( Open	Cancel	

- Step 12. Click "Data" from the top menu bar. Every file in the database will appear in the window. The list must be filtered to only include the sections from the current batch. This can be accomplished through two different methods:
  - i. Removing unwanted files, or
  - ii. Removing all files and selecting a batch to re-add.
- Step 13. Choose removal method. If removing all files and selecting a batch to re-add is preferred, skip to Step 7. Otherwise, use a combination of the Shift and Ctrl keys to highlight all unwanted files in the window. Click "Remove." Proceed to Step 8 (see below image).

STATE HIGHWAY ADMINISTRATION

j Tasks	🗈 Options 🗳	Data 🐺 Process							
∽ ⊡ (	🗙 Remove 🗢 4	🕨 🅶   🕨 Go	😥 Search						
¥	Session	> Date	Vehicle	Collected	Matched	%	County	RouteID	Dir
<b>1</b>	7521039K	2017-05-02 01:03	1723	3,891	3,722	96	BA	US 1	N
🗊 2	752104HV	2017-05-02 01:08	1724	457	266	58	AA	MD 713 B	E
5 4	752104PZ	2017-05-02 01:13	1724	502	268	53	AA	MD 713 B	W
iii 3	752103Q7	2017-05-02 01:13	1723	4,091	3,701	90	BA	US 1	S
5	752104YS	2017-05-02 01:18	1724	630	275	44	AA	MD 713 C	N
<b>6</b>	7521134L	2017-05-02 01:21	1723	3,070	2,692	88	BA	US 1 AL	N
5 7	7521149D	2017-05-02 01:24	1724	3,792	3,564	94	AA	CO 582	N
<b>5</b> 8	752113QM	2017-05-02 01:35	1723	3,088	2,642	86	BA	US 1 AL	S
9	7521244K	2017-05-02 01:43	1724	1,511	553	37	AA	CO 4527	N
iii 10	7521237V	2017-05-02 01:45	1723	3,784	2,706	72	BA	MD 166	N
iii 11	752123QP	2017-05-02 01:56	1723	3,745	2,721	73	BA	MD 166	S
12	752124RG	2017-05-02 01:57	1724	5,926	5,631	95	AA	MD 176	E
🗐 13	7521340X	2017-05-02 02:17	1724	2,627	2,323	88	AA	MD 162	N
🗊 14	7520S36U	2017-05-02 10:08	1723	3,017	2,155	71	AA	IS 195	N
🗊 15	7520S4B9	2017-05-02 10:11	1724	1,513	1,383	91	AA	MD 652	S
iii 16	7520S3FR	2017-05-02 10:14	1723	2,676	2,169	81	AA	IS 195	S
<b>1</b> 7	7520S3NC	2017-05-02 10:18	1723	3,598	1,408	39	BA	MD 295	N
18	7520S4TD	2017-05-02 10:22	1724	2,525	2,304	91	AA	MD 162	S
iii 19	7520T33L	2017-05-02 10:28	1723	2,310	1,405	61	BA	MD 295	S
21	7520T3BN	2017-05-02 10:33	1723	13,852	13,167	95	BA	MD 695	N
iii 20	7520T3BM	2017-05-02 10:33	1723	30,002	28,029	93	AA	IS 695	N
22	7520T4EG	2017-05-02 10:35	1724	5,877	5,627	96	AA	MD 176	W
23	7520U4ER	2017-05-02 10:56	1724	319	193	60	AA	MD 100 N	S
24	7520U4HZ	2017-05-02 10:58	1724	103	41	40	AA	MD 100 O	N
25	7520U4O8	2017-05-02 11:02	1724	103	42	41	AA	MD 100 O	S
26	7520U4QU	2017-05-02 11:04	1724	321	192	60	AA	MD 100 N	N
27	7520V4FO	2017-05-02 11:19	1724	3,176	3,036	96	AA	MD 713	S
28	7520W41M	2017-05-02 11:32	1724	3,426	3,038	89	AA	MD 713	N
<b>30</b>	7520X37Z	2017-05-02 11:57	1723	15,557	14,909	96	BA	MD 695	S
29	7520X380	2017-05-02 11:57	1723	28,616	27,069	95	BA	IS 695	S
31	7520X495	2017-05-02 11:58	1724	981	781	80	AA	CO 575	W
32	7520X4QA	2017-05-02 12:08	1724	371	264	71	AA	MD 713 D	S
iii 22	7520X4W/I	2017-05-02 12:12	1724	1 / 99	1 1 2 9	76	ΔΔ	CO 6203	W

#### Step 14. To remove all files, click the "Check" drop-down menu and select "All." Click "Remove." Then, click the "Reload" (first blue arrow) button. The "Group Partitions" window will open (see below image).

Group Partitions Explorer	
P Enter search criteria	
Show All	
Batch 01	
Batch 02	-
Batch 03	
Batch 04	
Batch 05	
7540N437	
more than one file	
74S0X4A6	
Batch 06	
Batch 07	
July 14 To July 18	
IS 695	
Batch 09	_
Batch IU	
OK	Cancel

Select the current batch by clicking the checkbox next to the appropriate batch name. Click the "OK."

Step 15. Once only the desired files appear in the "Batch Processor" window, they may be processed. Click "Process", then "Start." The files will begin to appear under the session window (see below image).

Tasks	Doptions 🙄 Dat	a 🖓 Proc	ess						
Schee	dule 🗸 🎆 Start 🚠 Pau	se 👘 Stop 🛛	Exceptions	🗕 \Lambda Warnings 📗	Info 🕨 Go				
	Task	Status	Start	%	Duration	Actual Duration	Run Rate	Est. Remaining	Est. Fir
# <u>7</u> 1	Report Generator Process	or Waiting							

A dialogue box will appear when processing is complete.

### 3- Uploading Data from Vision to Oracle – performed by EDW user

**Summary:** This task uses the EDW to migrate processed data from Vision to Oracle in the form of "Base_#" tables.

- Step 16. Open the Engineering Data Warehouse application.
- Step 17. Click the "Data" drop-down menu and select "Aran", then "Data Transfer from SQL to Oracle" (see below image).



Data Processing Reporting and Uploading Data to Oracle

🐅 Data Warehouse	- Connected to Production Data	base
Administration	Data Analysis Desigr	Reporting Help Exit
	Construction Data	
	Aran 🕨	Data Upload
	Wisecrax +	Record Drive and First Image
	Visidata	Data Transfer from SQL to Oracle
	Friction +	View/Edit Unique Run Status
	MCMS	Upload FED Field Log
	Maintenance +	Collection List Edit
	HMA Tonnage 🔹 🕨	Collection List vs. Base Report
	Inventory •	ARAN Imagery Checks
	Curve +	Route Matching QC
	WIM +	
	Videolog	
	X_Fund76_77 •	
	Crash +	

- Step 18. The "Data Transfer from Vision to EDW" window will appear. Ensure the following items are selected then click "Transfer" (see below image):
  - i. Reporting Year "[Current Year]"
  - ii. Database "OMT_ARAN_PROD_[CURRENTYEAR]_1"
  - iii. Schema "AGGREGATION"
  - iv. Table "BASE_1_609344"

🖳 Data Transfer from	Vision to EDW	
Reporting Year	2017 -	Check
Select a Table	e to Transfer	
Database	OMT_ARAN_PROD_2017_1 -	Transfer
Schema	AGGREGATION -	
Table	BASE_1_609344 -	
Note: Always trans	fer DCSESSIONS and LOCATOR	S tables before PAGD_QC_1000000 table

Step 19. Click "OK" on the following prompt (see below image).


Step 20. Click "OK" after the DOS prompt disappears (see below image).



Step 21. A window will appear indicating that the records have been transferred. Click "OK" (see below image).

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Data Processing Reporting and Uploading Data to Oracle

Data Transfer from	VISION TO EDVV			
Reporting Year	2017	• [	Check	Close
Select a Table	e to Transfer			
Database	OMT_ARAN_PROD_2017_1	•	Tran	isfer
Schema	AGGREGATION	•		
Table	BASE_1_609344	•		
Note: Always trans	fer DCSESSIONS and LOCATO	RS tab	les before PAGD	QC_1000000 table
DataWarehou	se_New			x
21/015 reco	rds have been transferred from Vision	fortak	A BASE 1 600344	
214313 1600		i i oi tat		
			ОК	

Step 22. Repeat Step 18 to Step 21 three times, changing the "Table" drop-down option in Step 18 to "BASE_4_437376", then "BASE_100_934", and finally "BASE_1000000" in that order. Please note that the EDW program first calls the "TALENT" tool to transfer a base table such as "BASE_1_609344" in Vision to a stage table named "VISION_BASE_1_609344" in Oracle, then a stored procedure named "UPD_VISION_TABLE" in Oracle production database will be called by EDW to move the data from this stage table into the final base table "EDW17_BASE_1" in Oracle using 2017 data collection as example.

#### 4- Performing QA of Uploaded Data – performed by Supervisor

**Summary:** This task performs QA checks on the uploaded data tables.

The completeness check is needed to make sure a) the base tables in Oracle do not contain any invalid runs or "not to use" runs marked in EDIT_CUR_YR table, and b) the base tables in Oracle contain all the valid runs in EDIT_CUR_YR table. This completeness check is currently done by running a SQL query. The base tables after the clean-up will serve as the basis for populating the business plan tables. Then, the speed adjustment fields are checked to ensure they were created and populated correctly. Finally, the data in the tables are checked for reasonableness.

## 5.14 REFORMATTING ARAN HARD DRIVES

#### 5.14.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to consolidate and reformat the hard drives which contain data collected by the Automatic Road Analyzer (ARAN) survey vans in the field by Field Explorations Division (FED) staff. Consolidation and re-formatting may occur any time after the ARAN data has been loaded into the Vision database, as outlined in Loading of <u>ARAN Data into Vision</u>.

#### 5.14.02 Frequency

Consolidation and reformatting of ARAN hard drives occurs sporadically, whenever external hard drive space is low (available hard drives are all full or in use).

#### 5.14.03 Purpose

The purpose of this SOP is to free up space on the ARAN hard drives so that more data can be collected. The drives are consolidated to save space and then reformatted so that they may be used again.

#### 5.14.04 *Resource Requirements*

Consolidation and reformatting of ARAN hard drives involves two people: (1) a user familiar with computer data storage to consolidate and reformat the drives, and (2) a supervisor who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the consolidation and re-formatting. These time estimates assume no issues are encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	Operator	1	4.0
DPT TL	Supervisor	1	AR ^{06/12/2019}

#### 5.14.05 *Procedure*

The procedure to consolidate and reformat ARAN hard drives is comprised of a single task:

(1) consolidating and reformatting ARAN hard drive.

#### 1- Consolidating and Reformatting ARAN Hard Drive – performed by operator

**Summary:** This task consolidates and reformats an ARAN hard drive.

- Step 1. Prior to consolidation, copy all data from the hard drive to another drive and rerecord the drive data.
- Step 2. Place the drive that has been backed up as part of Step 1 into the offline computer. "Admin" rights are needed to reformat drives.
- Step 3. Turn the computer on and log-in using proper credentials.

- Step 4. Once the computer has initialized and user is logged in, press the "Windows Key" and "E" on the keyboard.
- Step 5. The "My Computer" window will open. Right click on "Computers" on the left side of the menu. Select "Manage" (see below image).



Step 6. The "Computer Management" window will open. Find "Storage" on the left side of the menu and select the sub-item "Disk Management" (see below image). The computer may take a few moments to load the disk configuration information.



#### Step 7. Right-click on the drive to be reformatted. Select "Format" (see below image).

Disk 3 Basic 931.51 GB Online	New Volume (G:) 931.51 GB NTFS Healthy (Primary Partition)		
Disk 4 Basic 931.51 GB Online	New Volume (H:) 931.51 GB NTFS Healthy (Primary Partition)	Open Explore	
<b>CD-ROM 0</b> DVD (E:) No Media		Mark Partition as Active Change Drive Letter and Paths Format	
Unallocated	Primary partition	Extend Volume Shrink Volume Add Mirror Delete Volume	

- Step 8. On the next window, click "OK." Reformatting will begin.
- Step 9. Once the reformatting has completed, click "OK."
- Step 10. Place the reformatted drive in a separate location and alert the FED of its location.

# 5.15 CREATING PAGDQC REPORT

#### 5.15.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to create the "Pavement and Geotechnical Division Quality Control" (PAGDQC) report and upload it to the Engineering Data Warehouse (EDW). The report details the Automatic Road Analyzer (ARAN) data collected in the field by Field Explorations Division (FED) staff. The report is utilized within several other post-processing activities by the DPT.

## 5.15.02 Frequency

Creating and importing the PAGDQC Report is conducted in-part with other postprocessing SOPs utilized by the DPT. The DPT processes ARAN collected data in batches upon receipt from the FED. Each ARAN data batch is typically delivered to the DPT every 4 to 5 days. Assuming an average of 60 miles collected per day, each batch contains, on average, between 240 and 300 miles of ARAN data. The actual frequency varies according to the proximity of the routes on which data were collected for the data batch to the Office of Materials Technology (OMT) office and it ranges from 1 day (when collected near the OMT office) to 2 weeks (when collected far from the OMT office). Shorter turn-around periods are preferred to minimize the amount of mileage requiring data recollection. The annual ARAN data collection season typically lasts from March to Mid-December.

#### 5.15.03 Purpose

The purpose of this SOP is to create the PAGD QC Report and upload it to the EDW.

#### 5.15.04 *Resource Requirements*

The creation and import of the PAGDQC Report involves two people: (1) a user knowledgeable in Roadware Vision software to create the PAGDQC Report and upload it to the EDW and (2) a supervisor who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in manhours, to complete the report generation and upload. These time estimates assume average batch quantities and that no issues are to be addressed.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	Vision User	1	1.0
DPT Team Leader (TL)	Supervisor	1	AR ^{06/12/2019}

#### 5.15.05 *Procedure*

The procedure followed by the DPT staff for creation and import of the PAGDQC Report is comprised of a single task:

(1) creating and importing PAGDQC Report.

#### 1- Creating and Importing PAGDQC Report – to be completed by DPT Staff

**Summary:** This task creates and populates a PAGD_QC_CSV file for all collection runs imported into the Vision database for each FED submission. The file is then imported into the EDW to update the Edit/View Unique Run Status program to allow tracking, status, and notes of each collection run (FED QC/QA, Route Matching QC/QA, etc.).

Step 1. Open Roadware Vision program. Click the "Report" drop-down menu and select "Report Generator" and the "Report Generator" window will appear (see below image).

Report Editor 🌆 Selec	:t source 🦛 Gen	erate 🛛 🔛 Save 🛛 🚔 Load	1				0
Validate 🥥 Check							
blate Name	Group by	Break by	Description	Length mode	Reset mode		
ASE ADDITION	Locator		Vision Base Report at Various Interval	Measured	IntervalMultiple		
AGD QC	Locator		Count Report for QC (1 Record Per File)	Chainage	IntervalMultiple		
ASE	Locator		Vision Base Report at Various Interval	Measured	IntervalMultiple		
etail4mmi_BASE	Locator		Detail Report at 4millimile	Chainage	IntervalMultiple		
S1mmi_BASE	Locator		GPS Report at 1millimile	Chainage	IntervalMultiple		
AGERY_BASE	Locator		Imagery Table at 4millimile	Chainage	IntervalMultiple		
tail10thmile	Locator		Detail Report at 10th mile	Chainage	IntervalMultiple		
itting2mmi_PLAY	Locator		Rutting Report at 2millimile	Chainage	IntervalMultiple		
tail4mmi	Locator		Detail Report at 4millimile	Measured	IntervalMultiple		
tail4mmi_Groomed	Locator		Detail Report at 4millimile & 100millimile	Chainage	IntervalMultiple		
acking	Locator		Cracking Report at 4millimile	Chainage	IntervalMultiple		
S1mmi	Locator		GPS Report at 1millimile	Chainage	IntervalMultiple		
tting2mmi	Locator		Rutting Report at 2millimile	Chainage	IntervalMultiple		
llection_Log	Locator		Summary of Collection	Chainage	IntervalMultiple		
D_4mmi_data	Locator		raw vehicle data (AVG)	Chainage	IntervalMultiple		
D_2mmi_data	Locator		raw vehicle data (AVG)	Chainage	IntervalMultiple		
54mmi	Locator		GIS Table at 4millimile	Chainage	IntervalMultiple		
AGERY	Locator		Imagery Table at 4millimile	Chainage	IntervalMultiple		
D_QC	Locator		Count Report for QC (1 Record Per File)	Chainage	IntervalMultiple		
SIDATA - DO NOT USE	Locator			Chainage	IntervalMultiple		
STARANSETTINGS	Segment			Measured	IntervalMultiple		
APSED_TIME	Locator			Chainage	IntervalMultiple		
rticalCurv	Locator			Chainage	IntervalMultiple		
ulting	Locator			Measured	Continuous		
Jasd	Locator		asdasdas	Unainage	IntervalMultiple		
ANEVENTS	Locator	COMPUTE (RatedEve		Measured	IntervalMultiple		
	Locator		Males Ress Reset at 1000000	Measured	IntervalMultiple		
SE CRACK CEAL	Segment		Vision base Report at 1000000mmi	Measured	IntervalMultiple		
SE_CRACK_SEAL	Locator		Vision Base Report at 4mmi for Crack	Measured	IntervalMultiple		
-	L_RouteID	L_Dir	Collection Vehicle	DCS	TimeStamp	UniqueRun	Length
County	DUMMY	E	1724	04/18	3/2017 10:27 AM	74I0T41Z	1342.95709811101
County						74I0S3NZ	
County	DUMMY	E	1723	04/18	3/2017 10:19 AM		686.163683144453
County	DUMMY DUMMY	E	1723 1723	04/18	3/2017 10:19 AM 3/2017 10:22 AM	7410S3TF	686.163683144453 600.35649371412
County		E	1723 1723 1724	04/18 04/18 04/28	3/2017 10:19 AM 3/2017 10:22 AM 3/2017 11:01 AM	7410S3TF 74S0U4MQ	686.163683144453 600.35649371412 397.758117225776
County	DUMMY DUMMY DUMMY	E E E	1723 1723 1724 1724	04/18 04/18 04/28	3/2017 10:19 AM 3/2017 10:22 AM 3/2017 11:01 AM 5/2017 8:06 AM	74I0S3TF 74S0U4MQ 75G0M3I8	686.163683144453 600.35649371412 397.758117225776 357.213206386149
	DUMMY DUMMY DUMMY DUMMY	E	1723 1723 1724 1723 1724	04/18 04/18 04/28 05/16	3/2017 10:19 AM 3/2017 10:22 AM 3/2017 11:01 AM 3/2017 8:06 AM	7410S3TF 74S0U4MQ 75G0M318 79K0M3AL	686.163683144453 600.35649371412 397.758117225776 357.213206386149
	DUMMY DUMMY DUMMY DUMMY DUMMY	E E E E	1723 1723 1724 1723 1723 1723	04/18 04/18 04/28 05/16 09/20	3/2017 10:19 AM 3/2017 10:22 AM 3/2017 11:01 AM 3/2017 8:06 AM 3/2017 8:01 AM	7410S3TF 74S0U4MQ 75G0M3I8 79K0M3AI	686.163683144453 600.35649371412 397.758117225776 357.213206386149 496.425559782362

Step 2. Select "PAGD_QC" from the list of reports. Click "Check." The "Report Structure Explorer" window will open (see below image).

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Report Stru	cture Explorer [PAGD_Q	C]	themes in success	and the second s		x
🛛 🖸 Refresh 🌡	🎦 Synchronize  🛅 Upd	ate				
Interval	Column	Defined Type	Defined Length	Existing Type	Existing Length	-
000000	Uniquerun	TEXT	255	String	255	
000000	SPEED_AVG	NUMBER		Double		
1000000	LeftIRI_Avg	NUMBER		Double		-
1000000	RightIRI_Avg	NUMBER		Double		=
1000000	LeftRut_Avg	NUMBER		Double		
1000000	RightRut_Avg	NUMBER		Double		
1000000	Grade_Avg	NUMBER		Double		
1000000	LeftIRI_0	NUMBER		Double		
1000000	LeftIRI_1_9	NUMBER		Double		
1000000	LeftIRI_10_999	NUMBER		Double		
🥝 1000000	LeftIRI_1000_9998	NUMBER		Double		
🥝 1000000	LeftIRI_9999	NUMBER		Double		
1000000	RightIRI_0	NUMBER		Double		
1000000	RightIRI_1_9	NUMBER		Double		
1000000	RightIRI_10_999	NUMBER		Double		
1000000	RightIRI_1000_9998	NUMBER		Double		
1000000	RightIRI_9999	NUMBER		Double		
🥝 1000000	LeftRut_0	NUMBER		Double		
1000000	LeftRut_001_2	NUMBER		Double		
1000000	LeftRut_201_5	NUMBER		Double		
1000000	LeftRut_501_10	NUMBER		Double		-
New 🚸 Co	nflict 💈 Recycle 🥝 OK					

- Step 3. Click the "Synchronize" button (see above image). When the button unhighlights itself, the process is complete. Now, click "Update" and wait for the button to un-highlight itself as well. Performing these two actions clears the PAGD_QC table in Vision^{06/12/2019}. Close the "Report Structure Explorer" window.
- Step 4. Click the "Select Source" button. The "Group Partitions Explorer" will open (see below image). Choose the batch of data to be reported (or create a batch to select the correct data). Click "OK."

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Group Partitions Explorer		
P Enter search criteria		
O Show All		<b></b>
Batch 01		
Batch 02		
Batch 03		
Batch 04		
Batch 05		
7540N437		
more than one file		
74S0X4A6		
Batch 06		
Batch 07		
Batch 09		
74515412		
74515412		
74S0V3B7		
74S1637M		
Batch 11		
Batch 12		
Batch 13		
TL-IRI-2017		
TL_IRI_NEW_SHAYAN		
Batch 14		
Batch 15		
Batch 16		
Batch 17		
Batch 18		
Ratch 19		

Step 5. The selected files will be shown in the bottom of the "Report Generator" window. Confirm they are correct. If they are incorrect, return to Step 4. Otherwise, click "Generate." The "Report Job" window will open (see below image).

#### MARYLAND DEPARTMENT OF TRANSPORTATION

#### STATE HIGHWAY ADMINISTRATION

📽 की की 🏻			j 🖑 🎝 🖬 •	7- 🜆 🔍							
Session	Started	Duration	J 1	L_County	L_RouteID	L_Dir	IDSection	CollectionVehicle	DCSTimeStamp	Length	EventLog
77G0N3IE				AA	DUMMY	E	6456	1723	07/16/2017 8:2	120.29298058003	
77G0W3J2				AA	DUMMY	E	6456	1723	07/16/2017 11:	127.028310579	
77Q0S3BX				AA	DUMMY	E	6456	1723	07/26/2017 10:	62.4992651706	
7700R3QD				AA	DUMMY	E	6456	1723	07/24/2017 9:5	341.10506441068	
77Q0L3QO				AA	DUMMY	E	6456	1723	07/26/2017 7:4	161.027955219	
77R0M3PL				AA	DUMMY	E	6456	1723	07/27/2017 8:1	552.766029682	
77R0Y3MB				AA	DUMMY	E	6456	1723	07/27/2017 12:	43.400175830621	
77R0Z38T				AA	DUMMY	E	6456	1723	07/27/2017 12:	35.0048251040	
77R0U4RI				AA	CO 2485	W	6428	1724	07/27/2017 11:	582.034872172	
77P0R490				AA	CO 3261	N	6439	1724	07/25/2017 9:4	426.663122552	
77P0R4LC				AA	CO 3299	N	6440	1724	07/25/2017 9:5	350.339417101	
77P0Z41Z				AA	CO 3322	E	6441	1724	07/25/2017 12:	1869.25338328	
77P0T45N				AA	CO 3409	E	6442	1724	07/25/2017 10:	934.579610331	
77P0W45J				AA	CO 3477	E	6443	1724	07/25/2017 11:	820.742787585	
77S0X4LU				AA	CO 4237	E	6445	1724	07/28/2017 12:	1233.05384044	
77R1348E				AA	MD 174	E	6734	1724	07/27/2017 2:0	6089.40196523	
77SOR4PS				AA	MD 174	W	6735	1724	07/28/2017 9:5	6105.67444212	
77R0T4HV				AA	MD 179	E	6750	1724	07/27/2017 10:	3996.45022077	
77R0Y4WH				AA	MD 179	W	6751	1724	07/27/2017 12:	3178.55528021	
77P0O4PY				AA	MD 2	N	6756	1724	07/25/2017 8:5	17420.5261575	
77P0Z4T7				AA	MD 2	N	6756	1724	07/25/2017 12:	4590.69024724	
77P0M4Y7				AA	MD 2	S	6757	1724	07/25/2017 8:1	21003.8712190	
77P0Y4I0				AA	MD 253	N	6774	1724	07/25/2017 12:	1438.92935174	
77P0Q4IC				AA	MD 253	S	6775	1724	07/25/2017 9:3	1488.5700985802	
77P0V4V0				AA	MD 256	E	6778	1724	07/25/2017 11:	2763.08410172	
77P0W4DX				AA	MD 256	E	6778	1724	07/25/2017 11:	2590.25236678	
77P0U44O				AA	MD 256	W	6779	1724	07/25/2017 10:	5395.81498873	
77S0U403				AA	MD 3 C	E	6830	1724	07/28/2017 10:	4463.96182765	
77P12440				AA	MD 32	N	6841	1724	07/25/2017 1:4	11928.0864331	
77R0Z4HM				AA	MD 436	N	6901	1724	07/27/2017 12:	1219.70087639	
77R10412				AA	MD 436	S	6902	1724	07/27/2017 12:	1232.36356133	
77R0P4CG				AA	MD 450	E	6903	1724	07/27/2017 9:0	11744.6443953	
770004GM				AA	MD 450	C	6002	1724	07/27/2017 9-2	ADDA CADDADDADD	

Step 6. Update settings. Click the "Filter "button and select "Unmatched." This will run the report on both Matched and Unmatched files (see below image).

	🥔 Report Job [F	AGD_QC]				-	
	ि 🐗 को को 🎼			d 🖓 🖉	7- 🜆	Q	
1	Session	Started	Duration	<b>1</b>	✓ Mat	ched	▶ telD
	77G0N3IE				Unn	hatched –	TY IT
	77G0W3J2				AA	D	UMMY

Click the "Regenerate" button (see below image, button is highlighted in blue).

Report Job [PAGD_QC]									
i 💏 🖷 🖷 📗			<b>*</b>	-	7• 🜆	۹			
Session	Started	Duration	1	1	L_County	Ļ			
77G0N3IE					AA	D			
77G0W3J2					AA	D			

Click the "Start" button (see below image, button is highlighted in blue).

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Report Job [PAGD_QC]										
i 💏 🖏 📲 📗			💼 🛷 🦛 🖬 - 🏹 - 🜆 🔍							
Ses Start	Started	Duration	<b>1</b>	L_County						
77G0N3IE				AA						
77G0W3J2				AA						
77Q0S3BX				AA						
7700R3QD				AA						
77Q0L3Q0				AA						

Step 7. Files will begin processing. The "Eventlog" column will indicate the status of the processing. A progress bar will also estimate the overall status. When the program is complete, the progress bar will disappear and the "Eventlog" column will say "Processed" for each file (see below image).

🛹 Report Job [	PAGD_QC]				_		_				
i 🚓 🖏 🖏	an a	• 🛃   🔍									
Session	Started	Duration	1	L_County	L_RouteID	L_Dir	IDSection	CollectionVehicle	DCSTimeStamp	Length	EventLog
# 77G0M3LE	9:29:08 AM	00:00:37.7673579	5	MO	IS 495 E39 R9	N	13105	1723	07/16/2017 8:0	1130.94770855	Processed
#77G0R3YJ	9:29:09 AM	00:00:09.5627387	3	MO	IS 495 E41 R1	N	13114	1723	07/16/2017 10:	462.125410431	Processed
#77G0S34G	9:29:10 AM	00:00:28.2202191	3	MO	IS 495 E41 R3	E	13112	1723	07/16/2017 10:	689.089584446	Processed
🚀 77G0R39U	9:29:10 AM	00:00:30.4354049	3	MO	IS 495 E41 R4	N	13115	1723	07/16/2017 9:4	762.369737053	Processed
# 77G0R30Q	9:29:15 AM	00:00:29.4526112	3	MO	IS 495 E41 R6	E	13113	1723	07/16/2017 9:5	767.362745441	Processed
#77G0Q3RV	9:29:15 AM	00:00:47.5952949	3	MO	IS 495 E41 R7	W	13117	1723	07/16/2017 9:3	1358.12840126	Processed
# 77G0P3NL	9:29:16 AM	00:00:15.6622996	3	MO	IS 495 E41 R8	S	13116	1723	07/16/2017 9:1	596.695943147	Processed
🚀 77F153JF	9:29:16 AM	00:00:46.2069038	1	MO	IS 495 X	N	10717	1723	07/15/2017 2:5	1522.92581625	Processed
# 77F16346	9:29:18 AM	00:01:32.8818046	3	MO	IS 495 X	N	10717	1723	07/15/2017 3:0	2879.51018423	Processed
# 77F153JE	9:29:18 AM	00:00:44.6625137	1	MO	IS 495 X	S	10718	1723	07/15/2017 2:5	1480.18840693	Processed
# 77H0Y3YV	9:29:18 AM	00:02:49.5449088	4	MO	MD 115	E	10727	1723	07/17/2017 12:	6003.4257247729	Processed
# 77H0V37C	9:29:19 AM	00:02:43.5545472	2	MO	MD 115	W	10728	1723	07/17/2017 11:	6343.4602356606	Processed
# 7700X3XT	9:29:20 AM	00:05:40.4574132	5	MO	MD 117	E	10729	1723	07/24/2017 12:	12889.752879375	Processed
# 7700S307	9:29:22 AM	00:05:03.2828515	3	MO	MD 117	W	10730	1723	07/24/2017 10:	7559.35696984	Processed
# 7700X3BM	9:29:22 AM	00:02:18.9379050	3	MO	MD 117	W	10730	1723	07/24/2017 11:	5267.87682873	Processed
#7700Z3N9	9:29:27 AM	00:00:14.3519080	3	MO	MD 117 A	E	10731	1723	07/24/2017 12:	436.92931833599	Processed
# 7700Z3JB	9:29:32 AM	00:00:22.4638560	3	MO	MD 117 A	W	10732	1723	07/24/2017 12:	451.434221711	Processed

Step 8. If the PAGD_QC is being run on a submission, it must be exported. Otherwise, proceed to Step 9.

To export, click the drop-down arrow next to the "Save" button and select "Export all" (see below image). Browse for the appropriate folder location and click "OK." Click "Yes" to overwrite existing files. As the program writes the export, a red circle will appear beside each file (see below image). A dialogue box will appear when the export is finished. Click "OK."

#### STATE HIGHWAY ADMINISTRATION

	ें 🚓 👘 👘 🖉 🔂 - 🟹 - 🔯 🔍						
16	Se	ssion	Started	Duration	1		
	٩	77G0M3LE	9:29:08 AM	00:00:37.7673579			
11	۲	77G0R3YJ	9:29:09 AM	00:00:09.5627387			
11	۲	77G0S34G	9:29:10 AM	00:00:28.2202191			
	۲	77G0R39U	9:29:10 AM	00:00:30.4354049			
	۲	77G0R30Q	9:29:15 AM	00:00:29.4526112			
	۲	77G0Q3RV	9:29:15 AM	00:00:47.5952949			
	۲	77G0P3NL	9:29:16 AM	00:00:15.6622996			
	۹	77F153JF	9:29:16 AM	00:00:46.2069038			
	۲	77F16346	9:29:18 AM	00:01:32.8818046			
	۲	77F153JE	9:29:18 AM	00:00:44.6625137			
	۲	77H0Y3YV	9:29:18 AM	00:02:49.5449088			

To confirm the export, navigate to the folder where the export was saved. The file should be called "PAGD_QC_1000000.csv". Open the file and ensure there are no gaps in the data. Below is a table of column headers and a note on whether they should contain data.

Field	Data?	Field	Data?
IDLocator	Data	RightRut_501_10	Blank
L_County	Data	RightRut_1001_99	Blank
L_RouteID	Data	Grade_N_99_1001	Blank
L_Dir	Data	Grade_N_10_501	Blank
UniqueRun	Data	Grade_N_5_001	Blank
CollectionVehicle	Data	Grade_0	Blank
DCSTimeStamp	Data	Grade_001_5	Blank
IDSession	Data	Grade_501_10	Blank
BeginDistanceStamp	Data	Grade_10_99	Blank
EndDistanceStamp	Data	LeftIRI_TotalRecords	Data
BeginChainage	Data	RightIRI_TotalRecords	Data
EndChainage	Data	LeftRut_TotalRecords	Blank
Status	Data	RightRut_TotalRecords	Blank
Uniquerun1	Data	Grade_TotalRecords	Blank
SPEED_AVG	Data	GPSTime_MAX	Data
LeftIRI_Avg	Data	GPSTime_MIN	Data
RightIRI_Avg	Data	GPSTime_COUNT	Data
LeftRut_Avg	Blank	Hertz_Actual	Blank
RightRut_Avg	Blank	SPEED_STDEV	Data
Grade_Avg	Blank	SPEED_CV	Blank
LeftIRI_0	Blank	L_RUT_STDEV	Blank
LeftIRI_1_9	Blank	L_RUT_CV	Blank
LeftIRI_10_999	Data	R_RUT_STDEV	Blank
LeftIRI_1000_9998	Varies	R_RUT_CV	Blank
LeftIRI_9999	Blank	L_IRI_STDEV	Data
RightIRI_0	Blank	L_IRI_CV	Blank

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Field	Data?	Field	Data?
RightIRI_1_9	Blank	R_IRI_STDEV	Data
RightIRI_10_999	Data	R_IRI_CV	Blank
RightIRI_1000_9998	Varies	GRADE_ABS_AVG	Blank
RightIRI_9999	Blank	GRADE_ABS_STDEV	Blank
LeftRut_0	Blank	GRADE_ABS_CV	Blank
LeftRut_001_2	Blank	XFALL_ABS_AVG	Blank
LeftRut_201_5	Blank	XFALL_ABS_STDEV	Blank
LeftRut_501_10	Blank	XFALL_ABS_CV	Blank
LeftRut_1001_99	Blank	COLL_CATEGORY	Data
RightRut_0	Blank	PRIORITY	Data
RightRut_001_2	Blank	RSECTION_COPY	Data
RightRut_201_5	Blank		

Step 9. Import PAGD_QC into the EDW. Open the program icon to the **left below** ("GetLatestVe…"), not the one to the right (see below images).



Step 10. When the program opens, navigate to "Data\ARAN\Data Transfer from SQL to Oracle" (see below image).

🕼 Data Warehouse	<ul> <li>Connected to Production Dat</li> </ul>	tabase
Administration	Data Analysis Desig	n Reporting Help Exit
-	Construction Data	
	Aran	<ul> <li>Data Upload</li> </ul>
	Wisecrax	Record Drive and First Image
	Visidata	Data Transfer from SQL to Oracle
	Friction	<ul> <li>View/Edit Unique Run Status</li> </ul>
	MCMS	Upload FED Field Log
	Maintenance	Collection List Edit
	HMA Tonnage	Collection List vs. Base Report
	Inventory	ARAN Imagery Checks
	Curve	Route Matching QC
	WIM	>
	Videolog	
	X_Fund76_77	•
	Crash	•

- Step 11. The window below will open. Make the following changes to the window (see below image).
  - i. Change the "Reporting Year" to the correct year using the drop-down menu.
  - ii. Select database "OMT_ARAN_PROD_2017_1" using the drop-down menu.
  - iii. Select DB Schema "DBO" using the drop-down menu.
  - iv. Select Table "DCSESSIONS" using the drop-down menu.

🖳 Data Transfer from	Vision to EDW	
Reporting Year	2017 -	Check
Select a Table	e to Transfer	
Database	OMT_ARAN_PROD_2017_1 -	Transfer
Schema	DBO 👻	
Table	DCSESSIONS -	
Note: Always trans	fer DCSESSIONS and LOCATORS	tables before PAGD_QC_1000000 table

Click "Transfer" (see above image). Click "OK" when the next dialogue box opens. The next dialogue box to appear will say "Please wait until DOS Prompt disappear". Click "OK" after the DOS window closes. Click "OK" to return to the "Data Transfer" window.

Step 12. Change the Table to "LOCATORS" and click the "Transfer" button again (see below image). Click "OK" when the next dialogue box opens. The next dialogue box to appear will say "Please wait until DOS Prompt disappear". Click "OK" after the DOS window closes. Click "OK" to return to the "Data Transfer" window.

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Data Processing Creating PAGDQC Report

•	Data Transfer from	Vision to EDW			
	Reporting Year	2017	•	Check	Close
	Select a Table	e to Transfer			
	Database	OMT_ARAN_PROD_2017_1	•	Т	ransfer
	Schema	DBO	•		
	Table	LOCATORS	•		
	Note: Always trans	fer DCSESSIONS and LOCATO	)RS t	ables before PAG	GD_QC_1000000 table

Step 13. Change the Schema to "AGGREGATION" and the Table to "PAGD_QC_1000000" and click the "Transfer" button again (see below image). Click OK when the next dialogue box opens. The next dialogue box to appear will say "Please wait until DOS Prompt disappear". Click "OK" after the DOS window closes. Click "OK" to return to the "Data Transfer" window.

🖳 Data Transfer from	Vision to EDW	
Reporting Year	2017	Check     Close
Select a Table	e to Transfer	
Database	OMT_ARAN_PROD_2017_1	
Schema	AGGREGATION	•
Table	LOCATORS	•
	PAGD_QC_1000000 BASE_1_609344 BASE_6_437376 BASE_160_034	
Note: Always trans	BASE_100_934 BASE_1000000	Stables before PAGD_QC_1000000 table

Step 14. Change the "Schema" to "DBO", then select the "MATCHES" table and click the "Transfer" button (see below image).

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🖳 Data Transfer from	Vision to EDW		
Reporting Year	2017	•	Check
Select a Table	e to Transfer		
Database	OMT_ARAN_PROD_2017_1	•	Transfer
Schema	DBO	•	
Table	[	-	
	DCSESSIONS LOCATORS		
Note: Always trans	MATCHES ROUTE_MATCH_QC COLLECTEDSPANEVENTS		tables before PAGD_QC_1000000 table
	COLLECTEDPOINTEVENTS		

Step 15. Check the EDW's "View/Modify Unique Run Status" table to make sure the data was imported. The EDW's "View/Modify Unique Run Status" table needs to be updated once a week to show which files have been matched.

## 5.16 RUNNING ROUTING IMPORTER

#### 5.16.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to run the Routing Importer in the Roadware Data Control Software (DCS) using the Automatic Road Analyzer (ARAN) Collection List produced in the planning stage of the ARAN data collection process (see <u>Production of ARAN</u> <u>Collection List</u>). This SOP is performed once the ARAN Collection List for the year has been created and quality assurance (QA) has been performed.

## 5.16.02 Frequency

The Routing Importer is run once per year, prior to the start of the annual data collection season, and then rerun as-needed, in the event any routes change throughout the year.

#### 5.16.03 *Purpose*

The purpose of this SOP is to import all routing data into the Vision Database using the Roadware DCS Routing Importer. It is also used to update existing routing data asneeded.

#### 5.16.04 *Resource Requirements*

The running of the Routing Importer involves two people: (1) a user knowledgeable in Roadware DCS software to run the importer, and (2) a supervisor who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the import. These time estimates assume no issues encountered during importing.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	DCS user and QC	1	0.5
DPT TL	Supervisor	1	AR ^{06/12/2019}

#### 5.16.05 *Procedure*

The procedure to run the Routing Importer is comprised of a single task: (1) running Routing Importer.

#### 1- Running Routing Importer – performed by Roadware DCS user

**Summary:** This task uses Roadware DCS to import or update routing files into the Vision Database for ARAN data collection.

- Step 1. Open Roadware DCS.
- Step 2. Click the "Tools" drop-down menu and select "Routing Importer", then select the current database^{06/12/2019}.
- Step 3. Make sure the correct database is displayed in the "Roadware Routing Importer" window. If not, return to Step 2 and select correct database. Once

the database is correct, click "Browse" next to "Input Source File" (see below image).

📔 Roadware Routing Importe	r	
fugeo	Welcome to Roadware Routing Importer	
	This wizard will help you import your routing data	
	Destination Database	
	Server SHAHQVISIONPRD,1438	
	Database OMT_ARAN_PROD_2017_1	
	Change Connection	
	Input Source File	
		Browse
	Template	
		Browse
About		
	Cancel < Back Next >	Finish

Step 4. Select Inventory file^{06/12/2019} (see below image). Click "Open."

El Open							
Network	Shahanartico2 ↓ shaomtvideolog ↓ 201/ ↓ Data ↓ Notes ↓			<b>▼</b>   * <del>j</del>	Search Notes	_	<b>م</b>
Organize 🔻 New folder 🔠 🔻 🗍 🔞							
📃 Desktop 🔷	Name	Date modified	Туре	Size			
🗼 Downloads 📃	2016 Inventory	11/02/2017 1-20 DM	File folder				
🔛 Recent Places	Inventory Changes	09/28/2017 12:45	File folder				
🐔 OneDrive	Inventory Changes	06/26/2017 9:32 AM	File folder				
	2017 BA US 1 South vis	05/15/2017 2:56 PM	Microsoft Excel 97-2003 Worksheet	28 KB			
🥽 Libraries	2017 BA US 1 South also	05/15/2017 2:54 PM	Microsoft Excel Worksheet	10 KB			
Documents	2017 BA US 1 South Report 20170515-145659.csv	05/15/2017 2:57 PM	Microsoft Excel Comma Separated	1 KB			
Music	ARAN Collection 2017 3 31 2017.xls	04/03/2017 2:36 PM	Microsoft Excel 97-2003 Worksheet	7.183 KB			
Pictures	ARAN Collection Routes 2017 4 10 2017.xlsx	05/18/2017 8:24 AM	Microsoft Excel Worksheet	1.691 KB			
Videos	ARAN Collection Routes 2017 4 10 2017 B Desc Fixed.xlsx	05/05/2017 12:56	Microsoft Excel Worksheet	1,691 KB			
	ARAN_Collection_Routes_2017_4_10_2017_B Desc Fixed_Report_2	05/05/2017 1:04 PM	Microsoft Excel Comma Separated	727 KB			
P Computer	ARAN_Collection_Routes_2017_4_10_2017_B Desc Fixed_Report_2	05/05/2017 1:33 PM	Microsoft Excel Comma Separated	731 KB			
Second Disk (C:)	BA CO 798 West.xlsx	10/10/2017 10:41	Microsoft Excel Worksheet	10 KB			
DATADRIVE1 (D:) =	BA CO 798 West_Report_20171010-104239.csv	10/10/2017 10:42	Microsoft Excel Comma Separated	1 KB			
New Volume (F:)	BA IS 895 South.xlsx	10/12/2017 3:14 PM	Microsoft Excel Worksheet	10 KB			
Rew Volume (G:)	BA IS 895 South_Report_20171011-105005.csv	10/11/2017 10:50	Microsoft Excel Comma Separated	1 KB			
New Volume (H:)	BA IS 895 South_Report_20171011-112039.csv	10/11/2017 11:20	Microsoft Excel Comma Separated	1 KB			
JMask (\\shahant	BA IS 895 South_Report_20171012-151520.csv	10/12/2017 3:15 PM	Microsoft Excel Comma Separated	1 KB			
ge omtoocsnared (\	i briansinventorychange.xlsx	11/13/2017 8:56 AM	Microsoft Excel Worksheet	14 KB			
nanprograms (\\	L MU 340 and CO 362.xlsx	09/26/2017 8:46 AM	Microsoft Excel Worksheet	10 KB			
Producto DBG (A) als	OMT_collection_list_inventory_7212017.xlsx	07/21/2017 11:56	Microsoft Excel Worksheet	1,680 KB			
	US 50 West DO & TA current Inventory.xlsx	05/22/2017 12:16	Microsoft Excel Worksheet	10 KB			
St Network	US 50 West DO.xls	05/22/2017 1:00 PM	Microsoft Excel 97-2003 Worksheet	27 KB			
- INELWOIK	ស US 50 West DO_Report_20170522-130115.csv	05/22/2017 1:01 PM	Microsoft Excel Comma Separated	1 KB			
-							
File par	me				Supported Files (* csv	* vic * vic	
The na				•	Supported Files ( 1639,		
					Open	Cancel	
[[						_	

#### Step 5. Select preferred template. There are two options:

- i. Open an existing template. Click "Browse" next to "Template". Select the proper template (XML file) from the same folder as the inventory file. Click "Open" and then "Next" and proceed to Step 8.
- ii. Create a new template. Instead of browsing for a file, click "Next" with the template blank and proceed to Step 6.
- Step 6. "Mappings" window will open. Change settings to the preferred configuration. Click "Next" (see below image).

L	Roadw	vare Routing Importer			
Γ	Mappi	ngs			
	Sele	ct the column from your	input source that matches	s each field	
	Poqui	rod			Search
L	Auto	Field	Manning	Preview	Search
L	Auto	County	CO	AA	ASSOCIATED_ID_PREFIX
L		RouteID	ROUTE	MD 100 M	BEG_LAT REG_LONG
L		Dir	D	S	BEGIN_DESCRIPTION
L	_	Road Name	ROUTE	MD 100 M	BEGIN_DIR_MP
L		Unique ID	RSECTION	918421	BEGIN_GIS_SOURCE_YEAR
L	1	Direction	Primary •		BEGIN SECTION MILE POINT
	1	Lane	Auto		co
L	1	Road Class	Primary •		COLL_CATEGORY
	_	Length	SECTION_LENGTH	0.34	D
L		Begin Chainage	BEGIN_DIR_MP	0	DISTRICT
L		End Chainage	END_DIR_MP	0.34	END_DESCRIPTION
L	Optio	nai	Manaira	Descience	END_GIS_SOURCE_YEAR
L	Auto	Regin Description		STRUC #2170 DEEP RI	END_LAT
L		Begin Longitude	BEG LONG	-76.736783	END_LONG
		Begin Latitude	BEG LAT	39.179842	END_SECTION_MILE_POINT
L		End Description	END_DESCRIPTION	DORSEY RD	EXIT_NUMBER
L		End Longitude	END_LONG	-76.7410838	FDIR GLOBAL BOUTE ID
L		End Latitude	END_LAT	39.1763781	GOVT_CONTROL
L					ID_PREFIX
L					ID_RTE_NO
L					INV_EMP
L					IS_INV_DIR
L					MP_SUFFIX
L					MULTIPLE_END_INT
L					MUNICIPALITY
					NHS_CODE
L					RAMP_NUMBER
L					ROAD_NAME_START
L					ROUTE
L					RSECTION
					RSECTION_COPY
L					RVISIKEY SECTION LENGTH
L					SUB_ROUTE_ID
					TRIMROUTE
$\vdash$					
L				Cancel	< Back Next > Finish

Step 7. "Units and Options" window will open. Ensure the "Chainage Units" are in "Miles" and the "GPS Units" are in "Degrees." In addition, make sure the box next to "Skip importing" is checked for new inventory or "Overwrite" for updated inventory. Click "Next" (see below image).

Roadware Routing Importer									
Units and Options Select the input units and overwrite options									
Chainage Units Miles  GPS Units Degrees									
If the routing already exists in the database:      Skip Importing      Overwrite the existing data, this will delete all related data including any Segmenting									
Cancel < Back Next >	Finish								

Step 8. "Verification" window will appear.

- i. If an existing template was selected in Step 5 and the inventory is new, click "Next."
- ii. If an existing template was selected in Step 5 and the inventory is updated, click "Back" to return to the "Units and Options" window and make sure "Overwrite" is selected. Then, click "Next" and "Next" again.
- iii. If a new template was created in Step 5 click "Next."

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Roadware Routing Importer	
Verification Checking the source file and the mappings for errors	
Progress	100%
Results Type 귟 Unique ID 귟 Road Name 귟 Column 귟 Value 귟 Details	No Errors Found
Cancel < Back	Next > Finish

Step 9. "Summary" window will appear. Click "Next" (see below image).

STATE HIGHWAY ADMINISTRATION

Roadware Routing Impor	ter	
Summary Press next to start impo	orting	
Source		
File Name	\\shahanartico2\shaomtvideolog\2017\Data\Notes\briansinventorychange.xlsx	
Destination		
Database Name	OMT_ARAN_PROD_2017_1	
Mappings		
County RouteID Dir Road Name Unique ID Direction Lane Road Class Length Begin Chainage End Chainage Begin Description Begin Longitude Begin Latitude End Longitude End Latitude	CO ROUTE D ROUTE RSECTION Auto Auto Auto SECTION_LENGTH BEGIN_DIR_MP END_DIR_MP BEGIN_DESCRIPTION BEG_LONG BEG_LAT END_DESCRIPTION END_LONG END_LAT	
<b>Options</b> Chainage Units GPS Units Overwrite sections	Miles Degrees False	
	Cancel < Back Next :	Finish

Step 10. Import progress will be displayed. When the progress bar reaches 100%, import is complete. A summary below the progress bar will list the number of sections imported, overwritten, or skipped. When finished, click "Finish" and the program will close (see below image).



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Roadware Routing Importer		x
Importing Data Please wait while your routing data is being imported		
Import Progress	100%	
Summary O Sections imported Sections overwritten Sections skipped View Detailed Report.		
	Einie	ine in
L Dack IVext >		an

# 5.17 CHANGING LATITUDE/LONGITUDE

## 5.17.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to resolve incorrect route GPS information by changing the latitude and longitude of the beginning or ending point along a route. This SOP is used during route matching (<u>Route Matching</u>) to correct discrepancies between the inventory beginning/ending points and the collected route. Examples of situations where the latitude and longitude should be changed have been included as an appendix (see <u>Examples for Changing Latitude/Longitude</u>).

## 5.17.02 Frequency

Changing the latitude and longitude of the beginning or ending point of a route occurs on an as-needed basis whenever incorrect locations are displayed on the map during route matching.

## 5.17.03 *Purpose*

The purpose of this SOP is to resolve incorrect route GPS information by changing the latitude and longitude of the beginning or ending points along the route.

#### 5.17.04 *Resource Requirements*

Changing the latitude and longitude of the beginning or ending point of a route is performed by a member of the DPT during route matching to resolve incorrect route GPS information. The estimated effort levels in the table below represent the total time, in manhours, to complete the attribute changes. These time estimates assume no issues were encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	Vision user	1	0.5

#### 5.17.05 *Procedure*

The procedure to change the latitude and longitude of the beginning or ending point of a route is comprised a single task:

(1) changing the latitude and longitude of route beginning or ending point.

# 1- Changing the Latitude and Longitude of Route Beginning or Ending Point – *performed by Vision user*

**Summary:** This task identifies incorrect GPS information in the Vision database and resolves it by changing the latitude and longitude of the beginning or ending point of a route. This is a supplemental, corrective task that occurs during route matching (see <u>Route Matching</u>), so the Vision program will already be open, and the user will have decided that a beginning or ending location on the map is incorrect and needs to be updated.

- Step 1. In the "Map" window, click on the "Options" icon (three horizontal lines in the upper left-hand corner of the screen).
- Step 2. Select "Base Maps", then "Google", then "GoogleSatelliteMap" to turn on the satellite view so that the lane configuration of the route in question can be seen.
- Step 3. Before continuing, check the same route in the other direction and confirm the location of the corresponding beginning or ending point (green balloon icon on map).
- Step 4. Open the inventory Excel file for the current year. It will be stored at: \\shahanartico2\shaomtvideolog\(YEAR)\Data\Notes. The name of the file will have the format "ARAN_Collection_Routes_(MostCurrentDate)."
- Step 5. Use the filter button (under "Data," then "Filter") to find the route in question. Filter by Column E, "ID_RTE_N." Make sure both directions of the route are displayed (see below image).

B	• - ്									ARAN_C	olle	ction_2017_3_3	31_2017.xls [Compa	tibility Mode] -	Excel
File	Hom	e Inser	t	Page Layout	Formulas	Data Re	view View	v Developer	Q.	Tell me what	you	want to do			
Paste	Cut Copy	+ t Painter	Calib B	ni I <u>U</u> -	• 11 • A		≫ ·	Wrap Text	•	General \$ • % •		→ Cond	ditional Format as atting ▼ Table ▼	Comma 2 Normal 3 2	Normal 2 Normal
	Clipboard	E.		Fon	t	G.	Alignmer	nt	Es.	Numbe	r	r <u>s</u>		-	ityles
A52	73 👻	: ×		f _x	6922221										
	А	в	с	D	E	F	G	н		1	J	к	L	м	
1	RSECTIO 🔻	DISTRI	C -	ID_PREF -	ID_RTE_N-T	MUNICIPALI 👻	MP_SUFF -	EXIT_NUMB	RAM	_NUMB	-	IS_INV_D -	BEGIN_DIR_N -	END_DIR_N -	ROAD_NAME_S
5272	6922211	5	SM	MD	944	0	F				w	1		0.02	AIRPORT DR
5273	6922221	5	SM	MD	944	0	F				Е	0	0 0	0.02	AIRPORT DR (EI
6737															
6738															

- Step 6. Copy the header row (Row 1) and the route rows and paste them into a blank Excel file.
- Step 7. Copy the beginning latitude (Column X, "BEG_LAT") and longitude (Column Y, "BEG_LONG") for the first route direction into a Google search engine web page (see below image).

Google							
38.3124056		Ļ					
	Google Search	I'm Feeling Lucky					

Step 8. Hit the Enter key. The results of the Google search will appear (see below image).



ASCIImode: data/i/3 # RA = 250 6000 DEC = -38 3540 Radius = 0.1

- Step 9. Click on the map in the search results window to open Google Maps. Zoom in to the red balloon marker. Check that the red balloon is in the identical location as the green balloon in the Vision "Map" window.
  - i. If the two balloons are in the same location, proceed to Step 10.
  - ii. Otherwise, the wrong latitude and longitude have been copied. Check that the route number is correct and that the correct coordinates have been copied into the browser. Resolve before continuing.
- Step 10. In Google Maps, click the location on the map of the corrected beginning location. A dialogue box will open at the bottom of the screen. Click on the coordinates listed (see below image).

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Step 11. The search box will change and the red balloon will move to the new location. Repeat if the new location is not satisfactory. Otherwise, copy the coordinates that are now displayed in the search box (see below image).



- Step 12. Paste the coordinates back into the new Excel file in the appropriate fields. Highlight the updated cells in yellow.
- Step 13. If multiple beginning or ending points require an update, repeat Step 7 to Step 12 for the other locations. When all points have been updated, proceed to Step 14.
- Step 14. Save the Excel file. The name of the file can either be (1) the route name or (2) InventoryChanges(MMDDYY) if more than one route is being updated at once.
- Step 15. Email the Excel file with the updated data to the DPT TL and the database developer.
- Step 16. Import the updated routing information (see <u>Running Routing Importer</u>) before continuing with the matching of that route.

# 5.18 ACCESSING ELECTRONIC ARAN LOGS

## 5.18.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to access the electronic Automatic Road Analyzer (ARAN) logs in order to review data collection information. The electronic logs are created on the ARAN computer by field crew members of the Field Explorations Division (FED). The operator manually adds comments to the electronic log. The log is then added to the Engineering Data Warehouse (EDW) when the drives are recorded. This SOP is used during route matching (Route Matching) to check if multiple routes were collected in a single file.

## 5.18.02 Frequency

Accessing electronic ARAN logs occurs on an as-needed basis whenever it is suspected that multiple routes may have been collected in a single file during route matching (see <u>Route Matching</u>).

## 5.18.03 *Purpose*

The purpose of this SOP is to access information in the electronic ARAN logs to determine if multiple routes were collected in a single file.

#### 5.18.04 Resource Requirements

Accessing electronic ARAN logs is performed by a member of the DPT during route matching (see <u>Route Matching</u>) to determine if multiple routes were collected in a single file using the EDW application. The estimated effort levels in the table below represent the total time, in man-hours, to complete electronic log export and investigation. These time estimates assume no issues were encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	EDW user	1	0.5

#### 5.18.05 *Procedure*

The procedure to access electronic ARAN logs is comprised a single task: (1) accessing electronic ARAN logs.

#### 1- Accessing Electronic ARAN Logs – performed by EDW user

**Summary:** This task accesses information in the electronic ARAN logs to determine if multiple routes were collected in a single file using the EDW.

- Step 1. Open the EDW application.
- Step 2. Click "Data" and select "ARAN", then "Record Drive and First Image" from the drop-down menus (see below image).

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Data Processing Accessing Electronic ARAN Logs

A Data Warehouse - Connected to Production Database											
Administration	Data Analysis	Design	Reporting Help Exit								
	Construction Da	əta									
	Aran	•	Data Upload								
	Wisecrax	•	Record Drive and First Image								
	Visidata		Data Transfer from SQL to Oracle								
	Friction	•	View/Edit Unique Run Status								
	MCMS		Upload FED Field Log								
	Maintenance	•	Collection List Edit								
	HMA Tonnage	•	Collection List vs. Base Report								
	Inventory	•	ARAN Imagery Checks								
	Curve	•	Route Matching QC								
	WIM	•									
	Videolog										

Step 3. The "ARAN Drive Info" window will appear. Select the correct "Collection Year" from the drop-down menu under "Daily Log File" (see below image).

🖳 ARAN Drive Info				
Record Drive Info V ARAN 3/4 Collection Year: 2017 • DVD?	Please Locate the Drive:	Please Input Drive #:	<ul> <li>For Original Field Drive</li> <li>For Duplicate Drive</li> </ul>	Record
View Existing Drive Info				
Collection Year	File Name Drive_No	Dup_Drive_No Test_Date	Data_Type	View
Modify Drive No.				
O Drive_No O Dup_Drive_No	Current No.	New No.		Modify
Drive No Report	Test Data France Test Data Te			
✓ ARAN 3/4				Report
Daily Log File				
Collection Year:		v		Report
Record Count:	Export to Excel Close			

Step 4. In the box next to "Collection Year", select the correct log or choose "All." It is easier to select "All", but the export will take longer (see below image).

Daily Log File					
Collection Year:	2017	•		-	
			All	-	
			Daily_MD85682_20160923.csv		
			Daily_MD85682_20161114.csv		
			Daily_MD85682_20161115.csv	-	
			Daily_MD85682_20161116.csv	=	
			Daily_MD85682_20161117.csv		
			Daily_MD85682_20161118.csv		
			Daily_MD85682_20161119.csv		
			Daily_MD85682_20161120.csv		
			Daily_MD85682_20170405.csv		
			Daily_MD85682_20170406.csv		
			Daily_MD85682_20170418.csv		
			Daily_MD85682_20170428.csv		
			Daily_MD85682_20170502.csv		
			Daily_MD85682_20170503.csv		
		_	Daily_MD85682_20170508.csv		
Beeard Count			Daily_MD85682_20170509.csv		
Record Count.			Daily_MD85682_20170510.csv		
			Daily_MD85682_20170511.csv		
			Daily_MD85682_20170512.csv		

Step 5. Click "Report." The table that populates can be used to view routes and look at the ARAN operator's notes, but they are not searchable (see below image).

Co	ollection Year: 2	2017 🗸	All			•			Repo	ort
	FILENAME	ARAN	HEADER	DIRECTION	LANE	MP_FROM	MP_TO	LENGTH	COLLLENGTH	FUNCT 🔦
÷	[20160923.0802	85682	3499821	6	1	0	0.19	0	1.589260	1-Inters
	[20160923.0807	85682	3499811	5	1	0	0.19	0	1.877630	1-Inters
	[20160923.0844	85682	7261921	6	1	0	3.02	3	3.247250	1-Inters
	[20160923.0948	85682	2589411	5	1	0	1.93	2	1.980240	1-Inters
	[20160923.103511]	85682	3446811	5	1	0	5.69	6	5.789670	1-Inters
	[20160923.1046	85682	3446821	6	1	0	5.69	6	5.859060	1-Inters
	[20160923.110916]	85682	3499612	5	1	12.63	37.85	25	4.947430	1-Inters
	[20160923.111913]	85682	3499621	6	1	0	25.22	25	4.223940	1-Inters
	[20160923.1231	85682	3499921	6	1	0	2.30000000000	2	2.7111	1-Inters *

- Step 6. Click "Export to Excel" and choose a name and location to save the file. Click "Save" and wait for export to complete (if "All" was selected it may take a few minutes). Do not interrupt export by clicking the Excel icon on the taskbar.
- Step 7. When the export is complete, open the Excel file and compare the number of rows to the "Record Count" in the EDW window (see below image).

[20160923.1	1231 85682	3499921	6	1
•				
Record Count	2120	Export to Excel	]	Close

----, --- 5 - ---

Step 8. Examine the Excel spreadsheet. Find the file name in question using the "FILENAME" field, which displays the date and time of the collected route. The file names in Vision will not exactly match the file names from the electronic ARAN log (the time in Vision is in 12-hour format while the time in the log is in 24-hour format). The "HEADER" column will display the name of the route that was collected. Find the route in question and look at the "COMMENTS" column (see below image). If a file contains more than one route, it will be specified in this column (look for a "+" or "and" in the text). Please note that the "HEADER" and "COMMENTS" fields are entered manually in the field and the chance for human error exists.

	А	В	С	D	Е	F	G	н	I	J	к	L
1	FILENAME	ARAN	HEADER	DIRECTION	LANE	MP_FROM	MP_TO	LENGTH	COLLLENGTH	FUNCTIONALCLASS	COMMENTS	INITIAL
2	[20170910.090409]	8 🜗 6	923311	5	1	0	0.42	0	0.950210	2-Primary	M408 A+M408 A EB+M408 B NB+SB	
3	[20170614.143458]	85686	3445621	6	1	0	9.982	10	10.551040	2-Primary	1270	
4	[20170614.144736]	85686	3445611	5	1	0	10.09	10	10.320640	2-Primary	1270	
5												
6												

# 5.19 USING EGIS

## 5.19.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to search for route identifier information using the Maryland Department of Transportation's (MDOT) eGIS system. This SOP is used during route matching (<u>Route Matching</u>) when discrepancies exist which involve checking route information. For further information regarding eGIS, refer to the Vision Matching 2015 guide.

## 5.19.02 Frequency

Using the MDOT eGIS system occurs on an as-needed basis whenever route information must be checked during route matching.

## 5.19.03 Purpose

The purpose of this SOP is to reference routing information using the MDOT eGIS system.

#### 5.19.04 *Resource Requirements*

Using the MDOT eGIS system is performed by a member of the DPT during route matching (see <u>Route Matching</u>) to resolve discrepancies in routing information. The estimated effort levels in the table below represent the total time, in man-hours, to complete the identification of a single route. These time estimates assume no issues were encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	Vision user	1	0.5

#### 5.19.05 *Procedure*

The procedure to identify a route using the MDOT eGIS system is comprised a single task: (1) identifying a route using eGIS.

1- Identifying a Route Using eGIS – performed by Vision user

**Summary:** This task uses the MDOT eGIS system to identify a route.

Step 1. Open a web browser and navigate to: <u>https://onemdot/Pages/default.aspx</u>. The MDOT intranet page will open (see below image).

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	SharePoint	Sites			
		MARY LAND DEPARTMENT OF TRANSPORTATION MY SITE WHO WE ARE	WHAT'S HAPPENING FIND IT C	OFFICES SHAAPPS SHAINTERNET	Search P
še.		Apps Server Business Plan System Consultant Contract Tracking System (CTS) SHA HR App SHA PLC APP User MPEL	Hanover EORS Lane Closure Permits Task Tracking System (TTS) Videolog Viewer	MDOT eGIS Maximo Helpdesk MDOT Intercold Miss Utility Online Ticket Submission Mtrack SHA Online Learning Center Web Trns*port system	Salesforce ADA Reasonable Accommodation Request Form CCDMS CCMS CCMS - Advanced (License Required) e-Snow Book Miss Utility Ticket Tracking System On Site Consultant Tracking System (OSCT) Outdoor Advertising and Junkyard Control Management System VMIPS

Step 2. Click on "SHA APPS" and then select "eGIS." The eGIS page will open (see below image).



Step 3. Uncheck the box beside "Centerline HLR Report" on the right side of the screen, then click the "Route Search" button (see below image).

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- Step 4. Use the drop arrows to select the correct District for the route in question (if the route is in Baltimore City, do not select a District).
- Step 5. Select the correct County (Baltimore City will be an option at the bottom of the list if no District was selected).
- Step 6. Select the correct Municipality if the route is in a city.
- Step 7. Check the circle next to "Route Number."
- Step 8. In the drop-down menus, select the "Route Prefix" and "Route Number" (see below image). If the Route Number is not known, select a known Route Number that is close to the desired route.

Route Search	0 🔊	Route Search
Route S	Search Address Search	
District:	District 2 👻	Book marks
County:	Caroline 👻	
Municipality:		Create Graphic
🔵 RD Name	Route Number Reset	Route Details
Rte Prefix:	···· •	
Rte Number:	•	Measur e Tool

Step 9. The map will populate with the route starting and ending points, as well as intermediate points along the route. The map can be moved by clicking and dragging or zoomed by using the mouse wheel. If the desired route number
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was not known, zoom in to its location. Click the "Identify" button at the bottom of the map screen and then click on the route on the map. The "Identify Features" window will populate with the correct route number and other information (see below image).

dentify Features: Centerline HLR Report 🛞						
Select ID layer: Top Layer	•					
Column	Value					
County	5	•				
Road Name	NOBLE AVE					
Mun Sort	122					
Route Prefix	MU					
Route #	70					
Route Suffix		Ŧ				

If the primary direction is required, change the "Select ID layer" to "Government Control" and view the "ROUTEID" field at the bottom of the window (see below image).

Identify Features: Government Control						
Select ID layer:	Governmen	t Control 🗸				
Column		Value				
EMP		0.22	*			
Exit #						
Ramp #		0				
Govt Control		4	П			
Ownership		Municipal				
ROUTEID		05122MU00070 01NN*****	v			

# 5.20 CHANGING IMAGE BANNER OR LOGO

# 5.20.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Processing Team (DPT) to change the banner or logo on "Left" and "Row" images in the Roadware Vision software using data collected by the Automatic Road Analyzer (ARAN) survey vans in the field by Field Explorations Division (FED) staff. This SOP is used during the running of the Vibing Processor (see <u>Running Vibing Processor</u>) in the event that the banner or logo associated with the schema needs to be updated^{06/12/2019}.

# 5.20.02 Frequency

The changing of the banner or logo for "Left" and "ROW" images is performed as-needed when an alteration to the current format is requested. This is preferably performed prior to the beginning of the ARAN data collection season to ensure continuity in the output image format. The annual ARAN data collection season typically lasts from March to Mid-December.

# 5.20.03 Purpose

The purpose of this SOP is to change the image banner or logo applied to ARAN collected "Left" and "ROW" images.

# 5.20.04 Resource Requirements

Changing the image banner or logo involves two people: (1) a user knowledgeable in Roadware Vision software to update the image format prior to running the Vibing Processor, and (2) a supervisor who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the format changes. These time estimates assume no issues were encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	Vision user and QC	1	0.5
DPT TL	Supervisor	1	AR ^{06/12/2019}

# 5.20.05 *Procedure*

The procedure to change the image banner or logo for "Left" and "ROW" ARAN images is comprised of a single task:

(1) changing the image banner or logo in Vision

# 1- Changing the Image Banner or Logo in Vision – performed by Vision user

**Summary:** This task uses Vision software to change the image banner or logo that is applied to ARAN collected "Left" and "ROW" images.

Step 1. While on the "Options" tab select "Vibe Parameters" and then click the "..." button on the right side of the screen (see below image).



⊿	Vibe		
	JPEG Encoding Quality	100	
⊿	Vibe parameters	Roadware.Processing.ImageExifPlugIn.VibeParametersField	
	IsAnyBannerSelected	True	

Step 2. The "Banner Editor" window will appear. Change the image to either "Left" or "ROW" depending on which banner is to be edited by click the "Camera" dropdown menu and selecting "Left" or "ROW" (see below image).

Banner Editor	The rational	
i 💁 💕 i 🔜 🤊	😽 Banners 🔳 Fields	
Banner 1  Banner 1  Calingel /1000  Calification (Calinagel /1000  Calification (L_Country)  Calification (L_Dur)  Calification (L_Dur)  Calification (L_RouteID)  Calificatio	Banner Name	
<	Associated camera LCMS3D LCMSRange ROW SG Camera - Proview border: SR Ruler	
100		

Step 3. Click the "Fields" tab and the "Expression" window will populate. To make a change, click on one of the expressions. Edit the necessary information in the table to the right (see below image). Make sure the "FieldFont" and "FontColor" fields are the same for each field name.

Maryland department of transportation

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٨	Metadata						
	Field name	MP					
	Field result	MP DIR MP 0.001					
	Field type	PaintOnBanner					
⊿	Misc						
$\triangleright$	AbsoluteCoords	1130, 3					
	EvaluatedMaxSize	18					
	EvaluatedMaxValue	63.934043249130100					
	EvaluatedText	DIR MP 0.001					
	EvaluatorException						
	Expression	{Chainage} /1000					
$\triangleright$	FieldFont	Calibri, 36pt, style=Bold					
	FontColor	White					
	FontOpacityPercent	100					
	Format	DIR MP 0.000					
	FormatException						
	Parent	Roadware.Processing.ImageExifPlugIn.Banner					
	PercentageLeft	56.5656548					
	PercentageTop	2.43902421					
	Table	Locators					
	TextAlignment	Left To Right					

To move the banner to a different location on the image, click and hold on the desired part of the banner and move to new location (see below image).



Step 4. To change the logo, click on the expression "MD_SHA_Logo_RGB_SM.p..." Click the "FilePath" table to the right and select the "…" button. Browse to the location of the new logo and select it (see below image).

⊿	Misc		l
$\triangleright$	AbsoluteCoords	3496, 105	l
	FilePath	\\shahanpmdata1\pmdata\05 Documentation\PM Manuals\Vision\Schemas\2017\Vibin	l
	LogoException		l

- Step 5. When all changes have been made, click the "Save" button on the "Banner Editor" toolbar. Click the "X" to close the "Banner Editor."
- Step 6. Click the "Save" button on the options screen. Change the filename to match its previous name but with the current date at the end.

# 5.21 YEAR-END ARAN DATA CLOSEOUT

# 5.21.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Processing Team (DPT) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to perform the year-end data closeout. The closeout entails copying data from the Vision program and from the Engineering Data Warehouse (EDW) into a Microsoft Excel spreadsheet, then running queries on the spreadsheet to identify missing or incomplete data, and where possible addressing those data issues. The year-end data closeout is performed at the district level – each district will have its own year-end data closeout spreadsheet.

# 5.21.02 Frequency

The year-end data closeout is performed once per year by MDOT-SHA DPT staff, after all routes have been matched (see <u>Route Matching</u>) and the required drive-through checks have been completed (see <u>Performing 100% Drive Through</u>).

# 5.21.03 Purpose

The purpose of this SOP is to complete the data processing activities for the year by identifying missing routes, performing quality control (QC) checks of matched data, and filling in gaps identified in the data set.

# 5.21.04 Resource Requirements

Performing the year-end data closeout involves the following two MDOT-SHA staff members: (1) a DPT staff member knowledgeable in Roadware Vision software and the Engineering Data Warehouse (EDW) to identify missing routes, fill gaps in the data, and perform QC checks, and (2) a supervisor – typically a DPT Team Leader (TL) – who, as required, provides guidance and decision-making and performs quality assurance (QA). The estimated effort levels shown in the table below represent the total time, in man-hours, to complete the closeout and QC/QA checks. These time estimates assume no issues encountered during processing.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff Member	Vision/EDW user and QC	1	20.0
DPT TL	Supervisor and QA	1	As Required ^{06/12/2019}

# 5.21.05 *Procedure*

The procedure to perform the MDOT-SHA year-end data closeout is comprised of the following two tasks:

(1) completion of year-end data closeout spreadsheet, and

(2) QA of year-end data closeout spreadsheet.

# **1- Completion of Year-End Data Closeout Spreadsheet** – performed by DPT staff member knowledgeable in Vision software and EDW

**Summary:** Under this task, missing routes are identified, data gaps are filled, and QC checks are performed by first building a district-level Microsoft Excel spreadsheet using data from Vision and the EDW.

- Step 1. Follow the steps in <u>Creating PAGDQC Report</u> for the creation of the PAGDQC Report in Vision and then updating the PAGDQC Report in the EDW.
- Step 2. In the EDW, navigate to and select "View/Modify Unique Run Status" (see below image).

🎯 Data Warehouse - Connected to Production Database									
Administration	Data	Analysis	Design	Reporting	Help	Exit			
2	C	onstruction D	)ata						
	Aran 🕨			Data Up	pload		i i		
	Wisecrax			Record	Record Drive and First Image				
	Visidata			Data Tr	ansfer fr	om SQL to Ora	acle		
	Friction		•	View/Eo	dit Uniqu	e Run Status			
	MCMS			Upload	Upload FED Field Log				
	Maintenance			Collecti	on List E	dit			
	Н	MA Tonnage	e 🔸	Collecti	Collection List vs. Base Report				
	In	ventory	•	ARANI	ARAN Imagery Checks				
	Ci	urve	•	Route N	/latching	QC			
	WIM •		•						
	Vi	deolog							
	X	_Fund76_77	•						
	Ci	rash	•						

Step 3. Using the drop-down menu, select the appropriate "Year" and set the "County" field to "All" (see below image).

00	Data Ware	ehou	se - Cor	nnected	I to Production	Database -	[View/Modify	Unique R	un Statu:	s (Master List)]
	Admin	istra	ition	Data	Analysis	Design	Reporting	Help	Exit	
	থ									
	Year		Cou	nty	Route	Τe	est Date	File Na	me	Drive No.
	2017	•	All	-		-	•		-	-

Step 4. After the table populates with the corresponding records, select the "Export to Excel" button beneath the table (see below image) and save the Excel file as "AllEditTable.xlsx."

	2017	74S0W3V1	23	4	04/28/2017	
	2017	74S0W3V1	23	15	04/28/2017	
	2017	74S0W46B	12	24	04/28/2017	
	2017	74S0W46B	12	3	04/28/2017	
	2017	74S0X3YG	24	5	04/28/2017	
	2017	74S0X3YG	24	16	04/28/2017	
	2017	74S0X4A6	13	25 4	04/28/2017	
	2017	74S0X4A6	13		04/28/2017	
	2017	74S0Y4DL	14	5	04/28/2017	
	2017	74S0Y4DL	14	26	04/28/2017	
4						

Step 5. In the EDW, navigate to and select "FED" under the "Reporting" tab (see below image).

🎥 Data Warehouse	- Connec	ted to Produc	se					
Administration	Data	Analysis	Design	Reportin	Help	Exit		
2				Con	truction Da	ata	•	
				Con	lition		►	
				MCM	IS			
				Tran	sport			
				Des	gn Life			
				HMA	Tonnage			
				Histe	rical Note	s Fields		
				Mate	rial Unit Co	ost Update	Þ	
				HPN	S Report			
				Miss	ing Constr	uction		
				FED				

Step 6. Using the drop-down tabs, select the appropriate "Year," then select "Pre-Route Matched - Priority 1" under "Report," and then select "All" for "County" (see below image).

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Vear	Papart	County
- Cal	Керок	
2017 -	Route Matched - Priority 1	•
		All
		BA
		BC
		CA
		CH
		CL
		CO
		FR
		GA
		HA
		HU KE
		MO
		PG
		QA
		SO
		TA
		WA
		WO

- Step 7. After the table populates with the corresponding records, select the "Export to Excel" button beneath the table and save the Excel file as "Route Matched Priority 1.xlsx."
- Step 8. Repeat Step 5 through Step 7, except select "Route Matched Priority 2" under "Reports" and save the Excel file as "Route Matched Priority 2.xlsx."
- Step 9. In the EDW, navigate to and select "Route Matching QC" (see below image).

#### STATE HIGHWAY ADMINISTRATION

Data Processing Year-End Closeout

🐲 Data Warehouse - Connected to Production Database											
Administration	Data Analysis Design	Reporting Help Exit									
	Construction Data										
	Aran 🕨	Data Upload									
	Wisecrax >	Record Drive and First Image									
	Visidata	Data Transfer from SQL to Oracle									
	Friction >	View/Edit Unique Run Status									
	MCMS	Upload FED Field Log									
	Maintenance >	Collection List Edit									
	HMA Tonnage 🔹 🕨	Collection List vs. Base Report									
	Inventory >	ARAN Imagery Checks									
	Curve >	Route Matching QC									
	WIM •										
	Videolog										
	X_Fund76_77 +										
	Crash >										
		f									

Step 10. Using the drop-down tabs, select the appropriate "Year" and select "Matched Milepoint Other Than Expected with All Unique Run Status" under "Option" (see below image).

Rout	e Match QC	- Milepoint Zei	ro Discrepancy F	Report					_	_
Ye	ar 2017	•	Option Ma	tched Milepoin	t Other Than Expected	d with All U	Inique Run Si	tatus	•	
	YEAR	FILENAME	IDSESSION	IDLOCATOR	COLLECTION_DATE	CODE	COUNTY	MUN	ROUTE	RNUM
•	2017	78S134BY	2396	346	08/28/2017 2:09 PM	2	AA	0	MD	100
	2017	7A40P41L	3355	364	10/04/2017 9:00 AM	2	AA	0	MD	172
	2017	75N0W4CJ	495	380	05/23/2017 11:38 AM	2	AA	0	MD	177
	2017	75N0W4CI	494	380	05/23/2017 11:38 AM	2	AA	0	MD	177
	2017	76R104HT	1099	390	06/27/2017 1:08 PM	2	AA	0	MD	198

- Step 11. After the table populates with the corresponding records, select the "Export to Excel" beneath the table and save the Excel file as "Matched Milepoint Other Than Expected.xlsx."
- Step 12. Save all exported Microsoft Excel files to a local drive.
- Step 13. Rename the "View/Modify Unique Run Status" Microsoft Excel workbook to the name of the district for which the year-end data closeout is being performed.
- Step 14. Open "View/Modify Unique Run Status" Microsoft Excel sheet. Use a filter on the "County" column of the sheet to select and delete all records that are not associated with the district for which the year-end data close-out is being performed.

Step 15. Rename the sheet tab of the open Microsoft Excel file to the name of the district for which the year-end data close-out is being performed (see below image).

30	2017	76D123PN	937	3018	06/13/2017				
31	2017	76D124MN	834	3113	06/13/2017				
32	2017	76D124MN	834	3233	06/13/2017				
33	2017	76D1332R	938	3019	06/13/2017				
34	2017	76D1439H	939	3003	06/13/2017				
35	2017	76D143NH	940	3002	06/13/2017				
36	2017	76D143NH	940	3090	06/13/2017				
37	2017	76D143NI	941	3091	06/13/2017				
District 7 Edit Table									
REA	READY								

- Step 16. Create seven new sheets in the Microsoft Excel file by clicking on the "+" icon next to the existing sheet names. Name the new sheets as follows:
  - i. Matched priority 1 Diff >-5
  - ii. Matched priority 1&2 >.10mi
  - iii. Milepoints other than expected
  - iv. Match discrepancies
  - v. Rechain
  - vi. Step 6
  - vii. Step 7
- Step 17. Copy the data from the saved (in Step 12) Microsoft Excel files from the EDW into the corresponding new sheets as follows:
  - i. Copy "Route Matched Priority 1" to "Matched priority 1 Diff >-5" sheet
  - ii. Copy "Route Matched Priority 1" and "Route Matched Priority 2" to "Matched priority 1&2 >.10mi" sheet (Note: do not copy routes listed in the "Route Matched Priority 2" file that have a "DIFF_PERC" and "COLLECTED LENGTH" of zero; they are routes that do not need to be collected).
  - iii. Copy "Route Matching QC" to "Milepoints other than expected"
- Step 18. In the three new sheets where data have been copied to, use a filter on the "County" columns to select and delete all records that are not associated with the district for which the year-end data close-out is being performed.
- Step 19. In the main "District" sheet, move the "Route" column and all columns to the right of the "Route" column to Column N. This will leave Column I through M blank (see below image).

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#### STATE HIGHWAY ADMINISTRATION

Data Processing Year-End Closeout

F	ILE H	OME Devel	oper INS	SERT P	AGE LAYOUT FOR	MULAS	DATA	REVIEW	VIEW								
Fre	m From	From From O	ther Exis	sting Re	Connections	s A↓ Z Z↓ A	A Filter	Clear	Te	xt to Fla	ish Remo	ve Da	ata Cor	<b>→</b> □ solidate W	hat-If Relat	ionships	Group Ungrou
Ac	ess Web	Text Source	es • Conn	ections .	All 🗸 🔝 Edit Links	A.A.		🏷 Advanc	ed Col	umns Fi	ill Duplica	ates Valida	ation -	Ana	alysis *		* *
		Get External Da	ata		Connections		Sort & F	ilter				1	Data Tools				
М	16	• : X	√ fx														
	А	В	С	D	E	F	G	н	I	J	К	L	М	N	0	Р	Q
1	YEAR	FILENAME	IDSESSION	IDLOCATO	COLLECT_DATE	CODE	COUNTY	MUN						ROUTE	RNUM	RSUFF	DIRECTIONE
2	2017	7610O4P8	516	3692	06/01/2017	13	но	0						MD	100		E
3	2017	76C133MV	913	3004	06/12/2017	10	FR	0						MD	491		N
4	2017	76C133MW	912	3004	06/12/2017	10	FR	0						MD	491		N
5	2017	76C1735I	921	3005	06/12/2017	10	FR	0						MD	491		S
6	2017	76C1735J	920	3005	06/12/2017	10	FR	0						MD	491		S
7	2017	76D0P3L1	927	3233	06/13/2017	10	FR	0						US	40		E
8	2017	76D0Q3Z2	928	3236	06/13/2017	10	FR	0						US	40	AL	w
9	2017	76D0R440	825	2897	06/13/2017	10	FR	0						IS	70		E
10	2017	76D0R440	825	2486	06/13/2017	6	CL	0						IS	70		E
11	2017	76D0R441	824	2486	06/13/2017	6	CL	0						IS	70		E
12	2017	76D0S33U	929	3235	06/13/2017	10	FR	0						US	40	AL	E
13	2017	76D0S3NH	930	2862	06/13/2017	10	FR	0						со	209		S
14	2017	76D0S4U3	826	2487	06/13/2017	6	CL	0						IS	70		w
15	2017	76D0S4U4	827	2898	06/13/2017	10	FR	0						IS	70		w
16	2017	76D0S4U4	827	2487	06/13/2017	6	CL	0						IS	70		w
17	2017	76D0T3ZG	931	2864	06/13/2017	10	FR	0					L	со	245		s
18	2017	76D0U388	932	3235	06/13/2017	10	FR	0	-					US	40	AL	E
19	2017	76D0V4RP	828	3112	06/13/2017	10	FR	0						US	15		N

Step 20. Rename the blank columns as follows:

Column	Name			
1	Dir+CO+Route			
J Milesage Diff >0.10				
К	'Milesage Diff >0.10 Notes			
L	differences >-5			
М	'differences >-5 notes			

Step 21. In the "Matched priority 1 Diff >-5" sheet, move the "ROUTE" column and all columns to the right of the "ROUTE" column one column to the right. The resulting columns will be as follows (Column B, J, and K will need to be added manually):

Column	Name
А	COUNTY
В	Dir+CO+Route
С	ROUTE
D	DIRECTION
Е	PRIORITY
F	SECTION_LENGTH
G	COLLECTED_LENGTH
Н	DIFF_LENGTH
Ι	DIFF_PERC
J	Collected?
K	Checked

Step 22. In the "Matched priority 1&2 >.10mi" sheet, move the "ROUTE" column and all columns to the right of the "ROUTE" column one column to the right. The resulting columns will be as follows (Column B, J, and K will need to be added manually):

Column	Name
А	COUNTY
В	Dir+CO+Route
С	ROUTE
D	DIRECTION
Е	PRIORITY
F	SECTION_LENGTH
G	COLLECTED_LENGTH
Н	DIFF_LENGTH
1	DIFF_PERC
J	Collected?
К	Checked

Step 23. Enter appropriate formulas into the newly created columns for the three sheets addressed in Step 19 through Step 22. The table below summarizes the appropriate formula to be entered for each new column in the three sheets (see image after table).

Sheet	Column	Formula	Notes
District	Dir+CO+Route	=Q2&" "&G2&" "&N2&" "&O2&""	This is for routes where the "RSUFF" column is blank.
District	Dir+CO+Route (part II)	=Q3&" "&G3&" "&N3&" "&O3&" "&P3&""	Filter the "RSUFF" column hide blank cells, then paste the formula to the remaining records.
District	Milesage Diff >0.10	=IF(COUNTIF('mat ched priority 1&2 >.10mi'!B:B, \$I2)=0, "Distance Okay","> 0.10")	If there are any matching Dir+CO+Route records in the Milesage Diff >0.10 sheet, then the formula will return >0.10. Until you start removing records all the routes listed will show >0.10.
District	differences >-5	=IF(COUNTIF('mat ched priority 1 Diff >-5'!B:B, \$I2)=0, "Distance Okay"," >-5")	If there are any matching Dir+CO+Route records in the Milesage Diff >-5 sheet, then the formula will return >-5. Until you start removing records all the routes listed will show >-5.
Matched priority 1 Diff >-5	Dir+CO+Route	=D2&" "&A2&" "&C2	
Matched priority 1&2 >.10mi	Dir+CO+Route	=D2&" "&A2&" "&C2	

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fx.	: =IF(COUNTIF('matched priority 1&2 >.10mi']B:B, \$i2]=0, "Distance Okay",">0.10")											
	D	Е	F	G	н	I	J	к	L	м	N	0
SI 👻	IDLOCA 👻	COLLECT_DATE	CODE 🔽	COUNT -	MUN 👻	Dir+CO+Route 💌	Milesage Diff >0.10 🔻	Milesage Diff >0.10 Notes 💌	differences >-5 💌	differences >-5 notes 💌	ROUTE 👻	RNUM 👻
	3692	06/01/2017	13	но	0	E HO MD 100	Distance Okay		Distance Okay		MD	100
	3004	06/12/2017	10	FR	0	N FR MD 491	Distance Okay		Distance Okay		MD	491
	3004	06/12/2017	10	FR	0	N FR MD 491	Distance Okay		Distance Okay		MD	491
_	3005	06/12/2017	10	FR	0	S FR MD 491	Distance Okay		Distance Okay		MD	491
	3005	06/12/2017	10	FR	0	S FR MD 491	Distance Okay		Distance Okay		MD	491
	3233	06/13/2017	10	FR	0	E FR US 40	>0.10	construction	Distance Okay		US	40
_	3236	06/13/2017	10	FR	0	W FR US 40 AL	Distance Okay		Distance Okay		US	40
	2897	06/13/2017	10	FR	0	E FR IS 70	Distance Okay		Distance Okay		IS	70
	2486	06/13/2017	6	CL	0	E CL IS 70	Distance Okay		Distance Okay		IS	70
_	2486	06/13/2017	6	CL	0	E CL IS 70	Distance Okay		Distance Okay		IS	70
	3235	06/13/2017	10	FR	0	E FR US 40 AL	Distance Okay		Distance Okay		US	40
	2862	06/13/2017	10	FR	0	S FR CO 209	Distance Okay		Distance Okay		со	209
	2487	06/13/2017	6	CL	0	W CL IS 70	Distance Okay		Distance Okay		IS	70
	2898	06/13/2017	10	FR	0	W FR IS 70	Distance Okay		Distance Okay		IS	70
	2487	06/13/2017	6	CL	0	W CL IS 70	Distance Okay		Distance Okay		IS	70
_	2864	06/13/2017	10	FR	0	S FR CO 245	Distance Okay		Distance Okay		со	245
	3235	06/13/2017	10	FR	0	E FR US 40 AL	Distance Okay		Distance Okay		US	40
	3112	06/13/2017	10	FR	0	N FR US 15	Distance Okay		Distance Okay		US	15
	3234	06/13/2017	10	FR	0	W FR US 40	Distance Okay		Distance Okay		US	40
	3119	06/13/2017	10	FR	0	S FR US 15 BU	Distance Okay		Distance Okay		US	15
	3118	06/13/2017	10	FR	0	N FR US 15 BU	Distance Okay		Distance Okay		US	15
	3053	06/13/2017	10	FR	0	N FR MD 873	>0.10	started late and end early	Distance Okay		MD	873

Step 24.	Using the Filter tool in Excel.	isolate the following	g data and delete the records

Sheet	Data	Notes
Matched priority 1 Diff >-5	DIFF_PERC	Remove any record that has a DIFF PERC of -4 to 100.
Matched priority 1 Diff >-5	DIFF_LENGTH	Remove any record that has a DIFF_LENGTH -0.01 to inf.
Matched priority 1&2 >.10mi	DIFF_LENGTH	Remove any record that has a DIFF_LENGTH -0.1 to inf.

# Step 25. Open Vision. Click the "Segment" drop-down menu and select "Match Discrepancy Finder." The "Find Match Discrepancies" window will appear (see below image).

X Remove	Refresh							
County	RouteID	Dir	Session	Start	End	Matches	Discrepancies	Maximum
⊘ BC	IS 395 A	S	7A30T397	0.000	2,342.591	1	0	0.004
BC 🕑	IS 395 A E1 R4	N	79O0U3A0	0.000	480.016	1	0	0.000
BC 🕑	IS 70	E	79C0Y3MN	0.000	1,618.105	1	0	0.000
🕑 BC	IS 83	N	7BT0X41M	0.000	7,278.190	1	0	0.000
🕑 BC	IS 895	N	7970S3IE	0.000	10,078.612	1	0	0.000
🕑 BC	IS 895	S	797103KU	0.000	10,079.545	1	0	0.000
🕑 BC	IS 895 E10 R4	E	7AH0Y3HQ	0.000	434.696	1	0	0.000
🕑 BC	IS 895 E11A R4	W	7AI0M30U	0.000	421.301	1	0	0.000
🕑 BC	IS 895 E11A R6	S	7AH0Y3TJ	0.000	881.451	1	0	0.001
🖉 BC	IS 895 E11B R1	W	7AI0M3V1	0.000	620.676	1	0	0.000
🖉 BC	IS 895 E11B R7	E	7AI0L3AV	0.000	552.432	1	0	0.000
🕑 BC	IS 895 E12 R1	N	7AI0P3OG	0.000	377.772	1	0	0.000
🖉 BC	IS 895 E12 R2	N	7AH0U377	0.000	1,029.609	1	0	0.000
🖉 BC	IS 895 E12 R4	E	7AI0P30U	0.000	451.152	1	0	0.000
🖉 BC	IS 895 E12 R5	N	7AH0U31A	0.000	659.936	1	0	0.000
🖉 BC	IS 895 E12 R6	E	7AH0U3RX	0.000	381.322	1	0	0.001
🖉 BC	IS 895 E13 R4	N	7AH0U377	0.000	1,029.609	1	0	0.000
🕑 BC	IS 895 E13 R9	E	7AI0Q30Z	0.000	432.545	1	0	0.003
✓ BC	IS 895 E14 R10	S	7AI00300	0.000	1,476.742	1	0	0.000
(Mpr	IC 005 E14 D2	M	TAINTODG	0.000	070 000	1	n	0.000

🕨 Go 🛛 🔄 Start 🍺 End 🔒 Previous 🚇 Next

Step 26. Click on the heading of the "Discrepancies" column so that the records (i.e., rows) on the table are sorted such that those records with data discrepancies are listed at the top of the table.

- Step 27. Double-click on each file with a discrepancy and Vision will navigate to that file. Open the "Section Composition" window to edit the file. Follow the steps in Route Matching <u>Route Matching</u> to correct match discrepancies.
- Step 28. Click the "Refresh" button at the top of the "Find Match Discrepancies" window so that changes made in the "Section Composition" window are reflected in the "Find Match Discrepancies" table.
- Step 29. Repeat Step 27 and Step 28 until no more discrepancies exist.
- Step 30. Right click on the "Find Match Discrepancies" window and select "Copy All with Headers" (see below image).

/ 🧇 Sectio	on Composition 🗡 🔇	Find Match Di	screpancies					
🗙 Remove	🖆 Refresh							
County	RouteID	Dir	Session	Start	End	Matches	Discrepancies	Maximum
⊘wo	US 50 WA	N	758173CX	0.000	924.597	1	0	0.000
	US 50	W	758183MJ	0.000	13,171.368	1	0	0.515
	US 50	W	758123SC	0.000	1,876.202	1	0	0.542
	US 50	E	7580U324	0.000	14,164.181	1	0	0.108
⊘wo	US 50	E	7580U323	19,063.000	31,415.840	1	0	1.474
⊘wo	US 13 BU	S	75B0N30A	0.000	2,656.808	1	0	0.000
	US 13 BU	N	75B0N3CM	0.000	2,652.131	1	0	0.000
	US 13	S	7580U4JJ	0.000	26,324.613	1	0	0.000
	US 13	N	7580W4Y3	0.000	6,888.301	1	0	0.000
⊘wo	US 113 BU	S	75A1432N	0.000	4,277.473	1	0	0.000
⊘wo	US 113 BU	N	75A143IO	Copy Selection	72	1	0	0.000
⊘wo	US 113	S	7590Y3P1	Conv. Colonition with 11		1	0	0.000
	US 113	N	759133VV	Copy Selection with H	eaders 29	1	0	0.000
	MD 90	W	7590R35G	Copy All with Headers	36	1	0	0.000
	MD 90	E	7590P3U5	0.000	11,936.452	1	0	0.000
	MD 818	S	75A0Q3E0	0.000	3,089.082	1	0	0.000
	MD 818	N	75A0P3X2	0.000	2,736.816	1	0	0.000
(Awo	MD 750	AM.		0.000	1 400 005		0	0.000

- Step 31. Paste the records that were copied into the "Match Discrepancies" sheet created in the Microsoft Excel file.
- Step 32. Run the rechain query in Vision (see query at the end of this SOP).
  - i. If all files have been rechained, paste a screenshot of the query results in the "Rechain" sheet created in the Microsoft Excel file.
  - ii. If there are files that have not been rechained, follow the steps in Route Matching <u>Route Matching</u> to rechain. Then, rerun the query and paste a screenshot of the query results in the "Rechain" sheet created in the Microsoft Excel file.
- Step 33. In the "District" sheet, check every route that has a ">0.10" in Column J or a ">-5" in Column L.
  - i. If the matching is correct, enter "Acceptable" in Column K (for notes pertaining to Column J) or Column M (for notes pertaining to Column L).
  - ii. If the matching is incorrect, correct it in Vision and enter "Fixed" in Column K (for notes pertaining to Column J) or Column M (for notes pertaining to Column L). If a file is new or re-matching uncovers a previously non-drive through section, add the filename to the "Step 6" sheet in the Microsoft Excel workbook. If a file only requires re-importing, add file name to the "Step 7" sheet in the Microsoft Excel workbook.
- Step 34. In the "Matched priority 1 Diff >-5" sheet, check all routes that have a "-100" in the "DIFF_PERC" column. Enter "Collected" or "No Collected" in Column J.

All other routes listed in this sheet should be accounted for on the "District" sheet.

- Step 35. In the "Matched priority 1&2 >.10mi" sheet, check all routes that have a "-100" in the "DIFF_PERC" column. Enter "Collected" or "No Collected" in Column J. Compare the filtered list to the one from the "Matched priority 1 Diff >-5" sheet. All other routes listed in this sheet should be accounted for on the "District" sheet.
- Step 36. Email the completed Microsoft Excel file to the DPT TL for review.

# 2- QA of Year-End Data Closeout Spreadsheet – performed by TL

**Summary:** This task performs QA checks on the year-end district-level closeout spreadsheet.

Step 37. Review the transmitted Excel file and discuss any issues with DPT Staff for resolution.

# **Rechain Query**

This query is run to rechain discrepancies that have results from route matching.

select

c.uniquerun. c.idlocator, c.l county, c.l routeid, c.l dir, c.routedlength, c.beginchainage, c.endchainage, c.dmi distance, c.matched_distance, c.distance diff from (select b.uniquerun, b.idlocator, b.l county, b.l_routeid, b.l dir, b.routedlength, b.beginchainage, b.endchainage, b.dmi distance, b.matched distance, (abs(b.dmi distance) - abs(b.matched distance)) distance diff from (select a.uniquerun, a.idsession, a.idlocator, a.l county, a.l routeid, a.l dir, a.routedlength, a.beginchainage, a.endchainage, (a.EndDistanceStamp MMI - a.BeginDistanceStamp MMI) DMI Distance, (a.EndChainage - a.BeginChainage) Matched Distance, a.matchcomment from (SELECT DCSessions.Uniquerun, Matches.IDSession, Matches.BeginChainage, Matches.EndChainage,

Matches.BeginDistanceStamp * 0.621371192237334 BeginDistanceStamp_MMI,

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Locators.IDLocator, Locators.L_County, Locators.L_RouteID, Locators.L_Dir, Matches.MatchComment, abs(Matches.EndChainage - Matches.BeginChainage) RoutedLength FROM dbo.Matches, dbo.DCSessions, dbo.Locators where DCSessions.IDSession = Matches.IDSession and DCSessions.IDLocator = Locators.IDLocator and Locators.L_Routeid not like 'TL%' and UPPER(Locators.L_Routeid) not like 'DUMMY' ) a ) b ) c where distance_diff > 1 or distance diff <-1

# 5.22 ROUTE MATCHING - TRANSFERS

# 5.22.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Processing Team (DPT) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to transfer data collected by the Automatic Road Analyzer (ARAN) survey vans to the appropriate route or section using the vendor supplied Vision post-processing software. Data collection may occur on one or more routes under the same run/file route header to maximize efficiency (e.g., collection on interchange ramps). It is also possible that errors may occur (e.g., route keyed in incorrectly or extra collection on adjacent routes). To accommodate this issue, the ARAN Vision software contains features that enable the user to transfer and re-assign a portion(s) or entire collection run to the appropriate route(s) or sections(s).

# 5.22.02 Frequency

Route matching transfers are a routine part of the MDOT-SHA Route Matching process (<u>Route Matching</u>), which occur upon arrival of the Field Explorations Division's (FED's) ARAN QC/QA'd deliverables. These FED deliverables typically arrive during the April through early October timeframe, but they can also arrive at other times of the year.

# 5.22.03 Purpose

The purpose of this SOP is to document the MDOT-SHA routines and procedures associated with the route matching transfer process. The latest version of the ARAN "Vision Training Guide" should be referenced when addressing issues not covered by this SOP.

# 5.22.04 *Resource Requirements*

The route matching transfer routine involves the following two MDOT-SHA staff members: (1) a DPT staff member who is knowledgeable in the Vision software and the Engineering Data Warehouse (EDW) application to perform the route matching transfers, and (2) the DPT Team Leader (TL) to perform quality assurance (QA) functions and who, as required, provides guidance and decision-making. The Quality Control (QC) and Quality Assurance (QA) routines are incorporated into the Route Matching process (<u>Route Matching</u>). Any issues (and associated recommendations) are discussed with the DPT TL for guidance and decision-making. The estimated effort levels shown in the table below represent the total time, in man-hours, to complete route matching transfers for each FED deliverable. These time estimates assume average batch quantities and that no major issues are encountered during the transfer process.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	Vision/EDW user and QC	1	1.5
DPT Team Leader (TL)	Supervisor and QA	1	0.15

# 5.22.05 *Procedure*

The procedure for transferring a portion(s) or entire ARAN data collection run to the appropriate route(s) or sections(s) is performed, as needed, during the Route Matching process (<u>Route Matching</u>). Once a route or section is identified for transfer, the following three tasks are performed:

- (1) determine the target route or section,
- (2) perform the transfer routine and QC, and
- (3) perform QA.

There are 15 steps associated with these three tasks and the table below summarizes the specific steps associated with each task.

Task	Steps
1	1 - 2
2	3 - 14
3	15

# 1- Determine the Target Route or Section – performed by Vision and EDW user

**Summary:** This task identifies the collection run's destination route or section.

Step 1. Using the EDW's FED ARAN Electronic Daily logs feature (see <u>Accessing</u> <u>Electronic ARAN Logs</u>), review the collection run(s) to determine if the field crew identified additional routes to be assigned to the collection run. Use the "COMMENTS" field to identify comments, as illustrated in the image below.

Record I	Drive Info AN 3/4 tion Year: 2	017	Please	Locate the [	Drive:	Brows	Please Inp	out Drive #:	For Original F	ield Drive	ord
DVI	D?	517							For Duplicate	Drive	
/iew Exi	isting Drive Info										
Collec 2017	ction Year •		File Na	me •	Drive_No	▼ Dup	_Drive_No <del>_</del>	Test_Date ▼	Data_Typ	Vie	ew
Aodify E	Drive No.	up Drive N		Current No		- N	aw No.			Mo	difiy
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nive NC	o nopon		Test Dat	e From	Test Date T	0					
	RAN 3/4		Test Dat	e From	Test Date T	0				Rep	oort
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aily Log	RAN 3/4 g File		Test Dat	e From ▼	Test Date T	•				Rep	oort
Collect	RAN 3/4 g File tion Year: 2	117	Test Dat	e From	Test Date T	•				Rep	port
Daily Log	RAN 3/4 g File tion Year: 2	017	Test Dat	e From	Test Date T	•	·			Rep	port
Daily Log Collect	RAN 3/4 g File tion Year: 2	D17 Ingth F	Test Dat	e From MD85686_20 AS_COMMENT	Test Date T	0 VITIALS	STATUS	DISTRICT	PAVE	Reg Reg LOW_SPD	port
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Collect	RAN 3/4 g File tion Year: 2 0.7860 11.1407 3.03142 0.40545 2.53543 5.31023 8.0940	D17 ENGTH F 2- 40 2- 0 2- 0 2- 0 2- 0 2- 0 2- 0 2- 2 2- 2	Test Dat     _/_/_      Daily_ UNCTIONALCL Primary Primar	E From MD85686_20 AS COMMENT: DUMMY U1 M216 CO416 M216 M216 M216 M216	Test Date T	0 V	STATUS X C C C C C C C C C C C C C C C C C C	DISTRICT	PAVE	Rep Rep 0 26.3 29 15.5 4.5 11.7000000000 9.20000000000	DOIT SPEEI 33.4 27.5 30.7 26.8 33.2 31.1 37.5
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Step 2. If a matched collection run contains an abnormally high (>0.10 mile) lead-in and lead-out, investigate the collection run to determine if the lead-in and lead-out could potentially be on another route that can also be matched. To help identify such cases, use the Vision Map's "Routed Nodes" feature, HLR Guide,

and eGIS's SHA Highway System content feature tools illustrated and described in the following images.



## Vision Routes Nodes feature:

# HLR Guide:

http://www.roads.maryland.gov/index.aspx?PageId=832

			MARYLAND DEPARTM STATE HIGHWA' DATA SERV HIGHWAY LOC	IENT OF TRANS Y ADMINISTRA VICES DIVISION ATION REFERE	PORTATION TION			PAGE	29
ROUTE NUMBER:	MD 51 CONTEN	UED					COUNTY: ALLEO DISTRICT: 6 DATE: 12/31/3	ĴANY 6	
INVENTORY DIRECTION:	EAST								
ROUTE NAME: STATE SYSTEM	INDUSTRIAL BLVD FUNCTIONAL CLASS	MEDIAN TYPE	ACCESS CONTROL	NHS	MILEPOINT	MILEPOINT DESCRIPTION	MARKED LANES	SURFACE WIDTH/TYPE*	AADT
STATE SECONDARY	URB OPA	CURBED	NONE	NOT NHS	00.000 MU1780	HOWARD ST	3	361	14,910
					00.000 MU2371	S MECHANIC ST (BACK)			
					00.040		4	48I	
					00.040	CROSSOVER			
					00.050	TRAFFIC SIGNAL			
					00.050 MU3935	WINSTON ST			
					00.060		5	58I	

# eGIS's SHA Highway System content feature:

# http://shagbegis1/egis/

Using eGIS's Street Map or Imagery Basemap feature, zoom in to the required area.

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- 1. Select SHA Highway System
- 2. Left click "Point"
- 3. Hover pointer over required portion of route and then left click.
- 4. Route number will now be displayed.
- 5. If additional route details are required, see below example display.

14 4	1 of	2 🕨 🕅	\$ 100%	✓		Find   Next	- 🛃 -	۵					
e G	Maryland State Highway Administration Highway Location Reference Report Page 1 of 2 Generated: 4/30/2018												
ROUTE	NUMBER	DIRECTIO	N RO	DAD NAME		DISTRICT	C	O NAME	BEG MILE	POINT	END MILEPO	INT IS IN	VENTORY
MU-	2371	Е	S MECHANIC	ST / S MECHANIC	ST	6	AL	LEGANY	0		0.19		Y
ROUTE	NUMBER	DIRECTIO	N RO	AD NAME		DISTRICT	CO	O NAME	BEG MILE	POINT	END MILEPO	INT IS IN	VENTORY
MU	-2371	E	S MI	ECHANIC ST		6	ALI	LEGANY	0		0.19		Y
BEG MILEPT	BEGSEGID	INT RTES	ADDITIONAL DESC	CLASSIFICATION	FSYSTE	EM ME	DIAN	MAINT SHOP	NHS	AADT	MARKED LANES	SURFACE TYPE	SURFACE WIDTH
0	923237	MU 250	BALTIMORE ST	EVERYTHING ELSE	PRINCIP ARTERIA OTHER	AL NONE IL – R	(UNDIV)	N/A	NOT NHS	9370	2	PAVED	26
0	923237	MU 2370	N MECHANIC ST (BACK)										
0.05	923287	MU 2770	PERSHING ST										
0.12	923357	MU 1640	HARRISON ST										
0.12	923357		TRAFFIC SIGNAL										

# 2- Perform the Transfer Routine and QC – performed by Vision user

**Summary:** This task allows the user to transfer and re-assign a portion or entire collection run to the appropriate route(s) or sections(s). QC is then performed.

Step 3. Open the "Section Composition" window, then right click on the collection run/file. The below window will now appear.



Step 4. Select "Transfer" from the displayed menu. The window below will appear.

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S Transfer	X
Fragment	0 to 13,037
<ul> <li>Start from current position</li> <li>End at current position</li> </ul>	
Transfer location	Select
○ I Not selected	
Comment	
	* *
ОК	Cancel

Step 5. Left click on the "Select" button. The window below will appear.

Field	Criteria			Value				
County	StartsWit	h	-	HA				
RouteID	StartsWit	h	-					
Dir	StartsWit	h	-					
 County		RouteID		Dir		 	 	
County HA		RouteID CO 1738		Dir W		 	 	
County HA HA		RouteID CO 1738 CO 1988		Dir W N		 	 	
County HA HA HA		RouteID CO 1738 CO 1988 CO 2656		Dir W N W		 	 	
County HA HA HA HA		RouteID CO 1738 CO 1988 CO 2656 IS 95		Dir W N W N		 	 	
County HA HA HA HA HA		RoutelD CO 1738 CO 1988 CO 2656 IS 95 IS 95		Dir W N W N S		 	 	
County HA HA HA HA HA HA		RouteID CO 1738 CO 1988 CO 2656 IS 95 IS 95 IS 95 M		Dir W N W N S S N				

Step 6. Locate the route to be assigned by using the route search (AL, BA, etc.), then route prefix (CO, IS, MD, etc.), and then select the appropriate route/direction. Select "OK". The search window will close, and the "Transfer" window illustrated in the image below will be displayed.

S Transfer		
Fragment	0 to 1,444	
Start from current position		
Transfer location	Select	
Pending     HA \ IS 95 M \ N	Jeleut	
Comment		
	-	
ОК	Cancel	

- Step 7. Confirm the destination of the transfer. If not correct, left click on the "Select" button again and search for the correct route.
- Step 8. If an entire collection run requires transfer to a single route, select "Entire fragment" (see red arrow in above image). If transferring only a portion of the collection run/file, use the "Start from current position" or "End at current position" (see black arrow in above image). Note: If file contains two or more routes, user will need to start the transfer from the end working backwards.
- Step 9. Left click on the "OK" button. The collection run's background will appear as shown in the below image.

Step 10. While hovering over the collection run, right click and select the "Go to transfer" button, which is shown in the below image. If there is an inadvertent transfer to the incorrect route, select the "Recall" button, which is also shown in the below image.

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Step 11. The "Section Composition" window will open for the transfer's destination(s) as in the images below. Using <u>Route Matching - Transfers</u> Task 2 (Developing a Route Match Candidate and QC), review and verify the transfer's route destination and that the transferred run is located between the destination's route expected begin and end anchor landmarks.





- Step 12. Complete the transferred run's route match by completing <u>Route Matching -</u> <u>Transfers</u> Tasks 2 and 3.
- Step 13. Once the match is complete, select "Go to source" as shown in the below image to go back to the original route.

	No action		
Q	Magnify mode		
	Frozen		
€	Navigation		۲
٢	Auto match	Ctrl+A	
$\bigcirc$	Add match		•
$\times$	Delete match		F
岛	Snap		۲
車	Align		•
4 <u>2</u> 3≡	Order		۲
	Comment	Ctrl+M	
€	Go to source		
2	Exception Editor	Ctrl+X	
×	Delete Current Se	ssion	

- Step 14. Communicate processing and/or QC issues (including recommendations) to DPT TL so they can be resolved.
- **3- Perform QA** *performed by DPT Team Leader*

Summary: This task performs QA checks on route transfer process.

Step 15. The procedure for completing this step is incorporated in <u>Route Matching -</u> <u>Transfers</u> Task 5 (Performing Quality Assurance (QA), which is performed on a weekly basis.

# 5.23 LOADING PAVEMENT SURFACE FRICTION DATA

# 5.23.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA) Data Processing Team (DPT) to load pavement surface friction data collected by the Field Explorations Division (FED) into the Engineering Data Warehouse (EDW). During this process, the pavement surface friction data are converted to a format consistent with the other MDOT-SHA pavement condition measures.

# 5.23.02 Frequency

The loading of pavement surface friction data into the EDW is completed every time a delivery of such data is received by the DPT. The actual frequency varies according to the proximity of the routes on which data were collected for the delivery. The data collection season typically lasts from April to October, but deliveries may occur year-round.

# 5.23.03 Purpose

The purpose of this SOP is to document the procedure for (1) loading raw pavement surface friction data into the EDW and (2) converting the format of those data to one consistent with that for other pavement condition measures, in preparation for the 4-Phase Study (see <u>Outlier Review</u>), further analysis, and reporting.

# 5.23.04 Resource Requirements

The loading of pavement surface friction data involves two people: (1) a DPT staff member that is knowledgeable of the EDW application for loading the raw friction data and for reassigning route identifiers for invalid records, and (2) the DPT Team Leader (TL) to perform quality assurance (QA) functions and who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues are encountered during loading.

Position	Function	Resources	Effort Level (man-hrs)
DPT Staff	EDW user	1	20.0
DPT TL	Supervisor and QA	1	AR ^{06/12/2019}

# 5.23.05 *Procedure*

The procedure required to load the pavement surface friction data into the EDW and to make the needed format changes to those data is comprised of the following two tasks:

(1) load and validate pavement surface friction data into the EDW, and

(2) convert validated pavement surface friction data from point values to ranges.

# **1- Load and Validate Pavement Surface Friction Data into the EDW** – performed by EDW user

**Summary:** Under this task, the pavement surface friction data files, as delivered by the FED, are first loaded into the EDW and then route identifiers for invalid records are reassigned.

- Step 1. Launch EDW and open the "Friction Data Loader" by clicking "Data," "Friction," and then selecting "Route Data Upload" from the main EDW interface.
- Step 2. In the "Friction Data Loader" window, select a data upload method:
  - i. "By Folder" if loading multiple data files at one time, or
  - ii. "By File Name" if loading a single data file.
- Step 3. Click "Browse" to the right of the selected data upload method and navigate to the location of the friction data file/folder to upload. Friction data files from the FED will be in either text (.txt) or CSV (.csv) format. Use the drop-down menu at the top of the window to select the "Reporting Year" (see image below).

🖳 Friction Data Loader		- • •
Reporting Year	2017	Close
◎ By Folder	<ul> <li>Including all sub-folders</li> </ul>	Browse
By File Name	Z:\Chris\QAFric\Access\2016\FR Ramps Skid7 Report	txt Browse
Upload Data to Temp Accept Temp Data	Route Valid Check	Review Results

Step 4. Click "Upload Data to Temp" to populate the friction data into the "FRICTION_TMP" table in Oracle. Once the upload is complete, the message in the following image will appear:

🖳 Friction Data Loader		
Reporting Year	2017	Close
◎ By Fd DataWar	rehouse_New	
Done!	Friction text data have been loaded into FRICTION_TMP table in ORACLE.	/se
By Fil		) ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
Upload Data to Ter Accept Temp Data	mp Route Valid Check Review	v Results

Step 5. In the "Friction Data Loader" window, click on the "Route Valid Check" button to check that all routes are valid in the friction data file(s). A route would be invalid if the county code, route number, or direction have been assigned incorrectly. Routes that successfully pass the check will have the data fields "global_route_id" and "sub_route_id" assigned to the associated friction data. The message shown in the following image will appear when the route validation process is complete: STATE HIGHWAY ADMINISTRATION Loading Pavement Surface Friction Data

🖳 Friction Data Loader	
Reporting Year	2017
By Folder	DataWarehouse_New     Browse       Includ     Route Valid Check is done!
By File Name	OK Z:\Chris\&
Upload Data to Temp Accept Temp Data	Route Valid Check Review Results

Step 6. Click on the "Review Results" button and the window shown in the image below will appear. Use the "Selection" field at the upper left side of the window to view "Report - Valid Friction Route Passes" or "Report - Invalid Route Passes." The focus of the data review will be on the invalid route records.

arehouse	- Connected 1	o Productio	n Database -	[Valid Route Ch	eck Results]										
inistratio	on Data	Analysis	Design	Reporting	Help Exit										
								_							
n <mark>Rep</mark>	oort - Invalid F	riction Rou	ite Passes	F	Modify	Route Information	Close								
								_							
lify the ro	oute informati	on or chang	ge the MPs.	highlight the re	ecord, then click o	on the button below	Refresh Grid	d Reco	ord Count	913	Expo	rt to Excel			
COUNTY	PREFIX	RNUM	RSUFF	DIRECTION	EXIT_NUMBER	RAMP_NUMBER	GLOBAL_ROUTE_D	SUB_ROUTE_ID	DATE	MILEPOINT	FRICTION	SPEED	BADWATER	TRUCK	FILENAME
2	IS	97		s					08/30/2015	0.22	47	40	0	6	
2	IS	97		s					08/30/2015	0.41	42	39	0	6	
2	IS	97		S					08/30/2015	0.61	48	40	0	6	
2	IS	97		S					08/30/2015	0.81	41	40	0	6	
2	IS	97		S					08/30/2015	1.01	39	40	0	6	
2	IS	97		S					08/30/2015	1.21	44	40	0	6	
2	IS	97		S					08/30/2015	1.41	48	39	0	6	
2	IS	97		S					08/30/2015	1.61	41	40	0	6	
2	IS	97		s					08/30/2015	1.81	47	39	0	6	
	IS	97		S					08/30/2015	2.01	45	40	0	6	
	IS	97		s					08/30/2015	2.21	43	40	0	6	
	IS	97		s					08/30/2015	2.41	39	40	0	6	
	IS	97		S					08/30/2015	2.61	30	40	0	6	
2	IS	97		s					08/30/2015	2.81	43	40	0	6	
	IS	97		S					08/30/2015	3.01	23	40	0	6	
	IS	97		S					08/30/2015	3.21	41	40	0	6	
2	IS	97		S					08/30/2015	3.41	45	40	0	6	
2	IS	97		S					08/30/2015	3.61	46	40	0	6	
2	IS	97		s					08/30/2015	3.81	49	40	0	6	
2	IS	97		S					08/30/2015	4.01	45	40	0	6	
	IS	97		S					08/30/2015	4.21	49	40	0	6	
	IS	97		S					08/30/2015	4.41	40	40	0	6	
	IS	97		S					08/30/2015	4.61	43	40	0	6	
2	IS	97		S					08/30/2015	4.81	36	40	0	6	
	IS	97		S					08/30/2015	5.01	43	40	0	6	
	IS	97		S					08/30/2015	5.21	42	40	0	6	
2	IS	97		S					08/30/2015	5.41	40	40	0	6	
2	IS	97		S					08/30/2015	5.61	36	40	0	6	
2	IS	97		S					08/30/2015	5.81	48	40	0	6	
2	IS	97		S					08/30/2015	6.01	47	40	0	6	

Step 7. View the "Report – Invalid Route Passes" and highlight rows in the table by clicking in the left-most column. After rows are highlighted, click on the "Modify Route Information" button at the bottom of the window. The screen shown in the image below will appear:

ARAN Data - Route Modification										
File Name:	2.MD,980,B.W						Close			
	County	Mun	Prefix	Route	Dir.	Exit#	Ramp #			
Original Route:	2		MD	980 B	W					
New Route:	2 👻	NONE	▼ MD ·	980 B •	- <u>S*</u> -	<b>-</b>	•			
				Apply F	Route Change					

- Step 8. Use the fields to the right of the "New Route" row to re-assign correct route identifiers to the friction data. Click the "Apply Route Change" button to overwrite the original route identifiers with the newly selected ones. The options under "New Route" directly come from the EDW "Global Route Pav" table and therefore are the only valid identifiers. Updated records will also be assigned a "global_route_id" and "sub_route_id."
- Step 9. Repeat Step 7 and Step 8 until there are no more records in the invalid route report table.
- Step 10. In the "Friction Data Loader" window (Step 1) click the "Accept Temp Data" button. The friction data in the "FRICTION_TMP" table will then be uploaded to the "FRICTION" table. The "FRICTION" table is the final table designated for storing friction data.
- 2- Convert Validated Pavement Surface Friction Data from Point Values to Ranges – performed by EDW user

**Summary:** Pavement surface friction is measured at a single point and therefore does not span the full length of a segment or range of pavement segments. To be consistent with other pavement condition measures, this task converts a single mile point to the beginning and ending mile points of every pavement surface friction measurement record.

Step 11. Navigate to the folder located at the following file path:

*N:\OMT\Pavement and Geotechnical\PaveMang\Quality Management Plan\Pavement Management Documentation\Friction Data Adjustments/.* 

The below image shows the contents of the above referenced folder:

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OMT      Pavement and Gentech	nical 🕨 PaveMang 🕨 Quality Management Plan 🕨 Pavement	Management Documen	tation  Friction D	ata Adjustments
Organize  Burn New folder	incer , Foremony , goong management han , Forement	management bocamen		la rajastinenes
★ Favorites	Name	Date modified	Туре	Size
📃 Desktop	1Read me.sql	03/27/2017 12:01	SQL File	1 KB
Recent Places	Friction Update Script.sql	03/27/2017 1:15 PM	SQL File	2 KB
🗼 Downloads	FRICTION_UPDATE_0.83_2016.txt	07/10/2017 3:00 PM	Text Document	2 KB
	Step 1 - FINAL_UPDATE_NON_NULL GlobalIDS.sql	06/22/2016 2:19 PM	SQL File	7 KB
📜 Libraries	Step 2 - FINAL_UPDATE_NULL GlobalIDS.sql	06/22/2016 2:19 PM	SQL File	6 KB
Documents	Step 3 - FlagINV_MILE (NON-Null-Global_Rte_IDs).sql	06/22/2016 1:44 PM	SQL File	2 KB
🖻 🎝 Music	Step 4 - FlagINV_MILE(Null-Global_Rte_IDs).sql	06/22/2016 2:19 PM	SQL File	2 KB
Pictures	Step 5 - Adjust_OutofRange_bmp(Not Null).sql	06/22/2016 2:19 PM	SQL File	2 KB
Videos	Step 6 - Adjust_OutofRange_emp(Not Null).sql	06/22/2016 2:22 PM	SQL File	2 KB
	Step 7 - Adjust_OutofRange_BMP(NULL).sql	06/22/2016 2:19 PM	SQL File	2 KB
🖳 Computer	Step 8 - Adjust_OutofRange_EMP(NULL).sql	06/22/2016 2:19 PM	SQL File	2 KB
Image: State St	Step 9 - CHECK_OutRangeRecs(Not NULL Global).sql	06/22/2016 2:41 PM	SQL File	2 KB
b Local Disk (C:)	Step 10 - CHECK_OutRangeRecs(NULL Global).sql	06/22/2016 2:41 PM	SQL File	2 KB
▷ 坖 PMDATA (\\shahanpmdata1) (E:)				
▷ 坖 UMD Hisoric ROW Imagery Digitization (\\				
▷ 🙀 District7 (\\shavisidata) (H:)				
🛛 🙀 District4 (\\shavisidata) (I:)				
▷ 🙀 District2 (\\shavisidata) (J:)				
▷ 🙀 District8 (\\shavisidata) (K:)				
🖻 🙀 Imagery_Temp (\\shavisidata) (L:)				
▷ 坖 BXu (\\SHAHANFS1\OMTOOCUsers) (M:)				
Image: Second State (\\shahanfs1) (N:)				

Step 12. Click on the SQL script in the folder named "Friction Update Script.sql." The script will call and execute 10 individual SQL files (Steps 1 through Step 10 in the above image) in sequence to process the friction data. After the script finishes processing, the friction data will be ready for the 4-Phase Study (see <u>Outlier Review</u>) to identify potential outliers in the data. Following the outlier study, the data will be populated into the "BUSINESS_PLAN" tables for reporting and for further analysis).

# 5.24 SKID SUBMITTAL QC

# 5.24.01 General

This section describes the standard operating procedure (SOP) used by staff from the Field Explorations Division (FED) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to perform quality control (QC) checks on skid data collected by the agency.

# 5.24.02 Frequency

This SOP requires that QC checks on skid data collected by the MDOT-SHA be performed in batches as they are received from the FED crews throughout the data collection season ^{06/12/2019}. The frequency and timing of the QC checks varies according to data collection schedule, available resources, and quantity of data received. Typically, the QC checks are performed once the skid data for an entire county has been completed.

# 5.24.03 Purpose

The purpose of this SOP is to perform QC checks on the skid data collected by the MDOT-SHA FED in order to identify and eliminate unreasonable data points.

# 5.24.04 *Resource Requirements*

The actions detailed in this SOP are performed by the MDOT-SHA FED Team Leader (TL). The estimated effort level shown in the table below represents the total time, in manhours, required for completion of the QC checks for a given batch of skid data. These time estimates assume no issues are encountered during the checks.

Position	Function	Resources	Effort Level (man-hrs)
FED TL or Coordinator	QC	1	1.0

# 5.24.05 *Procedure*

The procedure required to complete the QC checks for a given batch of skid data is comprised of the following two tasks:

- (1) running skid report, and
- (2) running skid data analyzer.

# 5- Running Skid Report

**Summary:** Under this task, the Skid Report 1.3.2.0 software is used to analyze the skid data contained within a given batch by checking for data completeness and for appropriate use of file naming schemes.

- Step 1. On the desktop, double-click on the "Skid Report 1.3.2.0" icon.
- Step 2. Select "Skid Summary" from the drop-down menu^{06/12/2019}.
- Step 3. Select the desired data set to report.
- Step 4. Select "Run Report." This will create a .csvs file for the data.

- Step 5. Perform required completeness checks on .csvs file as described below. Highlight any issues and alert the appropriate FED personnel if changes to the data must be made.
  - i. The file name is displayed correctly.
  - ii. The collected data is complete when compared to the Skid Collection List.
  - iii. The section numbers are logical for the specific road being collected (R section).
- Step 6. Save .csvs file with QC notes in appropriate location.

# 6- Running Skid Data Analyzer

**Summary:** Under this task, the Skid Data Analyzer 1.1 software is used to analyze the skid data contained within a given batch by checking for unreasonable data points in relation to speed, water output, and skid number (SN).

- Step 7. On the desktop, double-click on the "Skid Data Analyzer 1.1" icon.
- Step 8. Select "Settings" and then "Location Settings."
- Step 9. Under "Save Route Data," navigate to the appropriate collection list file.
- Step 10. Under "Skid Results Data," navigate to the .csvs file for the data collection.
- Step 11. Click "Save."
- Step 12. Click on "Test Criteria Settings."
- Step 13. Accept or adjust thresholds for the various test criteria, including: MPH, Water Average, Lock Friction Value, Slip Friction Value, and Standard Deviation. The current value for each threshold is shown in the table below.

Criteria	Minimum Value	Maximum Value		
Speed	22 mph	42 mph		
Water Average	60% of speed	80% of speed		
Lock Friction Value	10	75		
Slip Friction Value	Not used	Not used		
Standard Deviation	0	12.5		

- Step 14. Click "Save Criteria."
- Step 15. Click on "Test Value Ranges."
- Step 16. Accept or adjust thresholds for the various test criteria, including: MPH, Water Average, Lock Friction Value, Slip Friction Value, and Standard Deviation. These ranges differ from the "Test Criteria Settings" in that the software will eliminate data points identified in these ranges, as opposed to simply flagging them. The current values for "Test Value Ranges" are 90% of the minimum value and 110% of the maximum value in "Test Criteria Settings." The current value for each threshold is shown in the table below.

Criteria	Minimum Value	Maximum Value
----------	---------------	---------------

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Speed	19.8 mph	46.2 mph
Water Average	54% of speed	88% of speed
Lock Friction Value	9	82.5
Slip Friction Value	Not used	Not used
Standard Deviation	0	13.75

- Step 17. Click "Save Parameters" and then "Save Ranges."
- Step 18. Make sure "Lock Test" option is selected.
- Step 19. Select the appropriate county from the drop-down menu.
- Step 20. Click on the "Get Save Data" and "Yes" buttons, and then close the pop-up window that appears.
- Step 21. Click on the "Validate Files" and "Yes" buttons, and then close the pop-up window that appears.
- Step 22. Click on the "Process Skid Data" and "Yes" Buttons.
- Step 23. Click on the "Processed Data" tab. A list of processed files will appear. View plots of the various data runs by double-clicking on a route name. Flagged data points will be identified in both the process data table and the plots.
- Step 24. Click "Show in Excel" and then "Save."

# 6 **DATA MIGRATION**

Click to go to <u>Outlier Review</u> Click to go to <u>Update Final Condition Detail Table</u> Click to go to <u>Update Rut Detailed Table</u> Click to go to <u>Update Cracking Detailed Table</u> Click to go to <u>Update Concrete Detailed Table</u> Click to go to <u>Migrating to Business Plan Tables</u>



Figure 9: Data Migration SOPs Flowchart

This section describes the set of standard operating procedures (SOP) conducted mainly by staff from the Data Warehouse Team (DWT) of the Maryland Department of Transportation State Highway Administration's (MDOT-SHA) Office of Materials Technology (OMT) to integrate the Base Tables to the Business Plan Tables. This set of SOPs includes six procedures.

The first step in the data migration process is to identify and review outliers in performance measure data (IRI, rut, structural crack density, and functional crack density). This helps the DWT to flag questionable data and investigate the possible causes in order to define remedial actions. Following the outlier review, four intermediate databases are created: the Final Condition Detail Table, the Rut Detailed Table, the Cracking Detailed Table, and the Concrete Detailed Table. These intermediate databases prepare the data for migration to the Business Plan Tables, which includes adjusting location information to address potential errors in GPS data, removing outliers, and formatting the data. The final step in the data migration process consists of the production of the Business Plan Tables are performed throughout every step of data migration.
# 6.01 OUTLIER REVIEW

#### 6.01.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Warehouse and Data Analysis Teams (DWT and DAT) to perform the outlier review with data collected by the Automatic Road Analyzer (ARAN) survey vans in the field by Field Explorations Division (FED) staff. This study is performed after the ARAN data have been uploaded from Vision to Oracle and the DWT has been notified by the Data Processing Team (DPT) (see Reporting and Uploading Data to Oracle). The outlier review process identifies data deviating from expected trends and determines possible causes for outlier performance measure values by evaluating historical ARAN data, including speed, construction history, flagged events, pavement imagery, Right-of-Way (ROW) imagery, and comments from the previous year's study. The list of outlier codes is included as an appendix to this SOP (see Outlier Review - Outlier Codes). Outlier identification process identifies and reviews outliers for performance measures such as International Roughness Index (IRI), rut, structural crack density (SC), and functional crack density (FC). The initial study consisted of four phases to identify only IRI outliers and to determine the cause(s) of those anomalies, as illustrated in the figure below.



However, in 2018, a new study was conducted, and the procedures were revised to address the changes and improvements in data collection and processing technologies and to include other performance measures in the process. The new procedure looks at each permornance measure separately and uses unique outlier identification criteria for each measure. Each performance measure requires a unique and customized set of criteria due to the nature of each measure, and different data collection and processing methods and as a result different acceptable ranges of data variation for each measure. The new approach developed for identifying outliers in condition data is referred to as the Hybrid Approach because it combines different outlier identification approaches for

parameters into a unified outlier flagging scheme. With the hybrid approach, a section is only flagged as an outlier if the deviation from the previous year is considered abnormal when previous year's data is valid. The Hybrid approach makes use of parameter trends in the entire network to predict the expected current values and uses data variation in valid test loop sections to define acceptable boundaries for deviation in each parameter. The main assumption with this approach is that the rate of deterioration of a given parameter depends on the current performance level. Deterioration rate versus performance level graghs are developed based on network level data every year and are used for predicting the current year data based on previous year performance levels. Test loop data is carefully monitored and is considered as reliable data which can be used to assess pavement material behavior over time. Data from the test loop were utilized in defining an acceptable window of variation for each parameter. When no maintenance and rehabilitation activity is carried out on a section of test loop over a data collection season, the variation of the collected and processed data in that section can serve as a proxy for acceptable variation of measured pavement condition parameter values.

The following figure is a schematic representation of the Hybrid Approach for flagging outliers for each performance parameter. If a given observation does not fall within the acceptable prediction zone, it is flagged as an outlier. The prediction zone is simply "predicted value ± acceptable range of variation/2".



In the case of rut, it was observed that low rut values are extremely volatile and result in a high percentage of outliers. Thus, based on historic data, a threshold of 0.15" rut in the current year is used for previous year's rut values below 0.07".

## 6.01.02 Frequency

The outlier review is performed multiple times per year, after a set of ARAN data, typically by county or by district, have been uploaded to Oracle and the DWT has been notified by the Data Processing Team (DPT).

## 6.01.03 *Purpose*

The purpose of this SOP is to identify performance measure outliers and to determine the cause(s) of those anomalies.

## 6.01.04 *Resource Requirements*

The outlier review involves two or three people: (1) one or two database management experts from the DWT and DAT to perform the outlier identification and review and quality control (QC) checks, and (2) a supervisor who, as required, provides guidance and decision-making and performs quality assurance (QA) checks. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process every time a new set of data is uploaded to Oracle. These time estimates assume no issues are encountered.

Position	Function	Resources	Effort Level (man-hrs)
DWT/DAT Staff	Database Management and QC	2	24.0
DWT TL	Supervisor and QA	1	AR ¹

## 6.01.05 *Procedure*

The procedure to perform the outlier review is comprised of two tasks:

- (1) performing the outlier review and QC,
- (2) performing QA on the outlier review results.

#### **1- Performing Outlier Review** – *performed by database engineers*

**Summary:** This task identifies causes for outlier performance measure values using historical ARAN data.

- Step 1. Before the start of the outlier review, a new procedure named by current collection year needs to be created and updated in the "EVENTS_DEFAULT" package. For instance, for collection year 2018, the procedure "PHASE4_DEFAULTS_2018" needs to be created by copying the codes from the procedure "PHASE4_DEFAULTS_2017" and updating the table names used in the codes from "EDW17_BASE_4" to "EDW18_BASE_4". The purpose of this procedure is to generate the default outlier codes based on the events identified during DPT's VISION drive through efforts as well as the construction history records entered by the DPT team. Run the procedure to insert the default codes into the "Phase4_Outlier_Detail_Default" table.
- Step 2. Open the DCS RoadCare software from the computer desktop and enter the username and password provided by the RoadCare administrator.
- Step 3. In the RoadCare Explorer window, to the left of the screen, click on "Attributes" and then double-click on the intended performance measure QC attribute ("Performance_Measure_QC"). The procedures should be performed on following attributes: "AVG_IRI_QC", "AVG_RUT_QC", "FC_DENSITY_QC", and "SC_DENSITY_QC".
- Step 4. Check the box next to "Allow Attribute Edit" at the top of the data window (see below image).

¹ "As Required" – Team Leader may be required for decision-making and troubleshooting.

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ADT GE VG_IRI	BIGHTIRI_	Advanced Search:	Allow Abribute Edit			
ODE	POUTES	BEGIN_STATION	END_STATION	DIRECTION	DATE_	RIGHTIRE_QC
ONDITION_IRI	AARD 1476	0.63	0.788	E	06/30/2013	78.17
OUNTY	AA-C0 1476	0.788	0.888	E	06/30/2013	105.44
RACKING	AA-C0 1476	0.888	0.968	E	06/36/2013	82.37
ISTRICT AIDED	AA-CO 1476	0.988	1.088	6	06/36/2013	91.98
RICTION	AA-CO 1476	1.088	1.188	6	06/35/2013	80.77
UNC_CLASS	# AA-C0 1476	1.188	1,288	E	06/30/2013	97.45
OVT_CONTROL	AA-CO 1476	1,200	1.368	E	06/30/2013	118.03
ANE WIDTH	AA-CD 1476	1.388	1.498	E	06/35/2013	102.11
AST_TREATMENT	AA-CO 1476	1,488	1.536	E	06/30/2013	188.48
AST_YEAR	AA-CD 1476	0.63	0.79	6	06/30/2011	72.59
ROJECT DESCRIPTION	AA-CO 1476	0.79	0.09	E	06/30/2011	75.79
EGION	AA-CO 1476	0.89	0.99	E	06/30/2011	82.38
IDE_OC	AA-CO 1476	0.99	1.09	E	06/35/2511	95.54
NUM	AA-CD 1476	1.09	1.19	E	06/30/2011	IIS.00
OAD_CLASS	AA-CO 1478	1.19	1.29	E.	06/30/2011	92.44
OUTE	AA CD 1475	1.25	1.39	6	06/36/2011	92.24
IBI I	AA-C0 1476	1.29	1.49	E	06/30/2011	125.15
CO HOLEDER WIDTH	- 14 4 1 of 1	8 🔰 🔰 🔶 💥 📑 Import from data	source	14 A	lan an anna	1000.00

Step 5. Click the "Advanced Search" button on the far right side of the data window. Next, in the data window shown below, enter the following query: "EXTRACT(YEAR FROM DATE_) = QC YEAR" and then click "OK" (see below image). This step is intended to filter the data that will be replaced with imported data.

Pelds POLITES	1	Attribute Value:
BEGIN STATION END STATION DIRECTION	= <>	2007 2008 2009
ATE_ IGHTIRI_QC	>= >	2010 2011 2012
	<= <	
	ANDOR	2
Check	OK Cance	BI 104341 entries returned.

Step 6. Click on the red icon at the bottom of the data window back on the main RoadCare screen, and then click "Yes" on the dialogue box that appears (see below image). This step deletes the filtered data.

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AADT     AADT     AAGE     AAG, Ri     AAG, Ri     AAG, RUT     CONCITION_RI     CONCITION_RI     CONCITION_RI	RIGHTIRI_QC Sector Pateence Sector Paternoe Adva	Rode: AA-C0 1475 Year: Al - noed Search: BEGIN_STATION	🖉 Alow Atotiscie Edit									
AGE AVG_R01 AVG_R01 CONDITION_R0 CONDITION_R01 CONDITION_R01	Unear Reference     Section Reference     Adva     ROUTES	Year: Al    road Search:  EEGIN_STATION	Alow Abribute Edit.									
G AVG_BUT G CODE CONDITION_RI CONTRACT_NUM	C Section Reference Adva ROUTES	BEGIN_STATION										
CODE CONDITION_RI CONTRACT_NUM	ROUTES	BEGIN_STATION	Section Reference Advanced Search									
CONDITION_RI	ALCO 1475		END_STATION	DIRECTION	DATE_	RIGHTIRE_QC						
CONTRACT_NUM		0.65	0.788	E	05/30/2013	78.17						
COLINITY	AAC0 1476	0.765	0.888	E	06/30/2013	105.44						
- CRACKING	AACO 1475	0.888	0.968	E	06/30/2013	82.37						
- II DISTRICT	A4-C0 1476	0.988	1.000	E	06/30/2013	91.98						
					113	80.77						
- I FUNC CLASS	Delete Raw Att	ribute with Query			23	97.45						
GOVT_CONTROL					112	118.03						
I IRLPER_SCALE	I RI PER SCALE											
LANE_WIDTH	LARE WOLH Delete all any attributes in this table matching the instability of the instabi											
LAST_YEAR	Delete all law	attributes in this tab	e matching the mp	of chiena. Blank query	113	72.65						
- PAVEMENT_TYPE	deletes all ro	ws in Raw Attribute.	les to continue.		111	18.95						
PROJECT_DESCRIPTION					111	10.00						
BIDE OC	-					16-70						
PRIGHTIRI_OC			11	25.54								
BNUM ROAD READ				V		10.00						
BOUTE				Yes No	11	32.44						
- RSUFF					11	32.24	_					
		1.000	1940 C 10		111	125.15						
sco	and the same					1000.00						

- Step 7. After the particular year data is deleted, run the specific attribute query in Oracle SQL Developer from file named: "4Phase Data import queries-QC Year.sql," which is saved in: \\shahanpmdata1\pmdataprg\Shayan\4 Phase Study. This step is intended for checking the query and query results before importing the data.
- Step 8. Double click on the "Import from data source..." button to open the "Data Import" window. Enter the database connection parameters in the left hand top portion of the window and click "Connect" to verify the connection. Paste the SQL statement for the specific QC attribute in the text box and click the "Import" button to import the data. This is the preferred method of data import for large datasets. Alternatively, for smaller datasets, copy and paste the results from the above query by pressing "CTRL+A" in Oracle SQL Developer and "CTRL+C" in RoadCare. Double check that the data is copied by clicking on the year drop-down menu in the main window and selecting that year (see below images).

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DSS Roadcare:			Second Second Second Second Second			(=	
File View Tools Help							
adCare Explorer 👻	# × ST_SIM_BUDGETPERSHOP	1-Analys RIGHTIRI_QC					-
PROGRAM_YEAR_FY12     PROGRAM_YEAR_FY13     PROGRAM_YEAR_FY13     PROGRAM_YEAR_FY14     PROGRAM_YEAR_FY15     PROGRAM_YEAR_FY16	RIGHTIRI_QC Server/Database: Linear Reference Section Reference Add	Route: AA-CO 4645 Year: All  vanced Search:	🖉 Allow Attribu	▼ te Edit			
PROGRAM_YEAR_FY17	ROUTES	BEGIN_STATION	END_STATION	DIRECTION	DATE_	RIGHTIRI_QC	
PROGRAM_YEAR_MDTA	AA-CO 4645	0	0.1	E	06/30/2015	388.03	
PROGIERIS_EXTRA	AA-CO 4645	0.1	0.2	E	06/30/2015	200.75	
UBLIC_MAP_15_BEGLMT	AA-CO 4645	0.2	0.3	E	06/30/2015	299.49	
PUBLIC_MAP_15_ENDLMT	AA-CO 4645	0.3	0.347	E	06/30/2015	391.82	
BEGION	AA-CO 4645	0	0.1	E	06/30/2012	407.39	
- RESECTION	AA-CO 4645	0.1	0.2	E	06/30/2012	222.15	
- RESECTION_2013	AA-CO 4645	0.2	0.3	E	06/30/2012	284.75	
RESECTION_2014	E AA-CO 4645	0.3	0.347	E	06/30/2012	94.94	
RESECTION_FY16	AA-CO 4645	0	0.1	E	06/30/2014	360.61	
RESECTION_FY17	AA-CO 4645	0.1	0.2	E	06/30/2014	194.67	
RESECTION_OCT2014	AA-CO 4645	0.2	0.3	E	06/30/2014	229.69	
RESECTION_PUBLIC_MAP_15	AA-CO 4645	0	0.1	E	06/30/2011	206.47	
	AA-CO 4645	0.1	0.2	E	06/30/2011	201.95	
	AA-CO 4645	0.2	0.3	E	06/30/2011	311.76	
ROAD_NAME	AA-CO 4645	0.3	0.347	E	06/30/2011	279.24	
I ROUTE	AA-CO 4645	0	0.044	E	06/30/2016	418.39	
BSI WORST SUM	AA-CO 4645	0.044	0.144	E	06/30/2016	133.90	
- RSUFF	AA-CO 4645	0.144	0.244	E	06/30/2016	210.03	
🔲 RUT_FY17	AA-CO 4645	0.244	0.343	E	06/30/2016	224.79	
I RUT SEVERITY	▶	🛛 🚽 🗙 🔜 Import from (	lata source 😑				

Import from data source...

🖳 Import Data	-			-	
8≣ 2↓   📼		Database 1	ables	Fields	Field Data
Provider	ORACLE	MCMS_ES	T_EWO		
Connection Type	Network Alias	TMP_3030			
Use Integrated Ser	False	CRASH_V	EHICLE		
Server		FWD1_EO	CATION_LOOKUP		
Database		TMP_EDW	/12_PAGD_QC		
SID		TMP_CRA	SK_100_09		
Network Alias	ASSET_NEW	ALOG CR	K15 FAIL		
Port		Connect ALT_TREN	ID_IRI_CONSEQUENCES		
Login	pav_conhist	MDTA_RO	AD_LIST		
Password	•••••	TMP 444	SECTIONS_TEMP		
		TMĒ_CRA MDWARE MFASURE ∢	ZĀ_100_16 PRODŪNIQUE MENTS Ⅲ ►		
Provider		SQL Statement			
Database Type (MSSQ	IL, ORACLE, MYSQL).	SELECT ROUTES, BEGIN_STATION, END_STATION,			
Database Connections	1	DIRECTION,			
Current Profile		DATA	AR AS DATE		
ASSET NEW	Savo	FROM			
	3876	(SELECT A.REPORTING	YEAR,		
Available Profiles		A.BEGIN STATION.			
ASSET_NEW	Load	A.END_STATION,		- Close	Update Import
ROADCARE DEVISION		I A DIDECTION			
ROADCARE.PROD.SI	HA Remove	Example: SELECT ROAD A DATE_ FROM ROAD_INFO	3 ROUTES, DIR AS DIRECTION, RMATION	BMP AS BEGIN_STATION, EMP	AS END_STATION, ADT AS DATA

Step 9. Following importing of the new data, close the "Performance_Measure_QC" window and perform steps 2-7 for the remaining "Performance_Measure_QC" attributes. Once data import is completed double-click on the "Networks" option in the left hand window followed by "MDSHA_'YEAR'_QC Network" followed by "Dynamic Segmentation" followed by "Rollup" (see below image).



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* Segmentatio	n Rollup - MDSHA	2013_QC NETWORK	
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- Step 10. Click the "Rollup Network" button.
- Step 11. Open Engineering Data Warehouse (EDW) application.
- Step 12. Click on "Analysis" and then select "DAT QC/QA", "ARAN", and "Outlier Review" from the drop-down menus.
- Step 13. Click on "Get List from RoadCare" (see below image). The data will be imported from RoadCare and stored in the "phase4_list_storage" table in Oracle.

		on 2. Gene		e inputs 3. Load In		adcare	4. Get List	from Roade	care 5 Loa		readsheet			
	~ Vi	ew Outlier Su	mmary	Filter			~		Fit					
DISTRICT	FACILITY	SECTION	DIRECTION	GLOBAL_ROUTE_ID	COUNTY	ROUTE	RNUM	RSUFF	BEGIN_STATION	DIR_BMP	DIR_EMP	END_STATION	AREA	DIR_LANE
5	AA-IS 195	1.61-2.56(S)		9161	AA	IS	195		1.61		0.9480	2.56	2.0110	
5	AA-IS 195	1.61-2.56(S)	S	9161	AA	IS	195		1.61	0	0.9480	2.56	2.0110	2
5	AA-IS 195	1.61-2.56(S)	S	9161	AA	IS	195		1.61	0	0.9480	2.56	2.0110	2
5	AA-IS 195	1.61-2.56(S)	S	9161	AA	IS	195		1.61	0	0.9480	2.56	2.0110	2
5	AA-IS 195	0.36-1.04(N)	N	9161	AA	IS	195		0.36	0.36	1.04	1.04	2.2570	3
5	AA-IS 195	0.36-1.04(N)	N	9161	AA	IS	195		0.36	0.36	1.04	1.04	2.2570	3
5	AA-IS 195	0.36-1.04(N)	N	9161	AA	IS	195		0.36	0.36	1.04	1.04	2.2570	3
5	AA-IS 195	0.36-1.04(N)	N	9161	AA	IS	195		0.36	0.36	1.04	1.04	2.2570	3
5	AA-IS 195	1.04-1.61(S)	S	9161	AA	IS	195		1.04	0.9480	1.5080	1.61	1.2430	2
5	AA-IS 195	1.04-1.61(S)	S	9161	AA	IS	195		1.04	0.9480	1.5080	1.61	1.2430	2
5	AA-IS 195	1.04-1.61(S)	S	9161	AA	IS	195		1.04	0.9480	1.5080	1.61	1.2430	2
5	AA-IS 195	1.04-1.61(S)	S	9161	AA	IS	195		1.04	0.9480	1.5080	1.61	1.2430	2
5	AA-IS 195	1.04-1.61(N)	N	9161	AA	IS	195		1.04	1.04	1.61	1.61	1.78	3
5	AA-IS 195	1.04-1.61(N)	N	9161	AA	IS	195		1.04	1.04	1.61	1.61	1.78	3
5	AA-IS 195	1.04-1.61(N)	N	9161	AA	IS	195		1.04	1.04	1.61	1.61	1.78	3
5	AA-IS 195	1.04-1.61(N)	N	9161	AA	IS	195		1.04	1.04	1.61	1.61	1.78	3
5	AA-IS 195	0.36-1.04(S)	S	9161	AA	IS	195		0.36	1.5080	2.4950	1.04	1.7970	3
5	AA-IS 195	0.36-1.04(S)	s	9161	AA	IS	195		0.36	1.5080	2.4950	1.04	1.7970	3
5	AA-IS 195	0.36-1.04(S)	S	9161	AA	IS	195		0.36	1.5080	2.4950	1.04	1.7970	3
5	AA-IS 195	0.36-1.04(S)	S	9161	AA	IS	195		0.36	1.5080	2.4950	1.04	1.7970	3
5	AA-IS 195	1.61-2.56(N)	N	9161	AA	IS	195		1.61	1.61	2.56	2.56	2.22	2
5	AA-IS 195	1.61-2.56(N)	N	9161	AA	IS	195		1.61	1.61	2.56	2.56	2.22	2
5	AA-IS 195	1.61-2.56(N)	N	9161	AA	IS	195		1.61	1.61	2.56	2.56	2.22	2
6	AA-IS 195	1.61-2.56(N)	N	9161	AA	IS	195		1.61	1.61	2.56	2.56	2.22	2

- Step 14. In Oracle SQL Developer, go to the production database and run the following query: "SELECT * FROM PHASE4_LIST_STORAGE". Export the data from "PHASE4_LIST_STORAGE" table to an excel file and save the file as a backup file with date in the corresponding folder. To export the table simply right click on the data, click on the Export option and save the file as a ".xlsx" file format. Then, copy all the data from "phase4_list_storage" table in Oracle SQL Developer using "CTRL+A."
- Step 15. Open the "Outlier_Identifier-Template.xlsm" in Microsoft Excel and paste the copied data in the corresponding columns of the "Data" sheet. The spreadsheet is saved at the following location: \\shahanpmdata1\ pmdataprg\ Shayan\4 Phase Study. Make sure the columns from the Excel output match the Excel template file. After pasting the data make sure the number of records is accurate and "COLLECTION_YEAR" column is populated for all the records.
- Step 16. Select the "RUN OUTLIER IDENTIFICATION" button at the top of "Data" sheet and make sure number of copied rows matches the number of outlier calculation rows at the far right of the spreadsheet. If number of rows do not match, then extend or remove the calculation rows to obtain matching number of rows. Then save the file as "Outlier_Identification_RunX_MM-DD-YY.xlsm" in the corresponding year's outlier review folder.
- Step 17. Copy the values in columns A-AD from "Data" sheet of the latest "Outlier_Identification_RunX_MM-DD-YY.xlsm" file and paste them in the corresponding columns of the "Load_to_Oracle.xls" file saved in \\shahanpmdata1\ pmdataprg\ Shayan\4 Phase Study. Then, save the file as "Load_to_Oracle_MM-DD-YY.xls" in the corresponding year's outlier review folder.
  - i. If the "Phase4_outcome" is 0, then the section is not an outlier and therefore not selected for further investigation.
  - ii. If the "Phase4_outcome" is 1, then the section is an outlier and therefore selected for further investigation.
- Step 18. In Oracle SQL Developer, right-click on the table titled "Phase4_ Outlier_Summary." Remove previously imported data using one of the following methods.
  - i. In Oracle SQL Developer, use the following command: "DELETE PHASE4_ OUTLIER_SUMMARY WHERE COLLECTION_YEAR = [CURRENT YEAR]." The existing year current data will be deleted and replaced with the updated and current data.
  - ii. Click on "Table" followed by "Truncate." This will delete all the data from the table without deleting its properties (see below image). Use of this method should be limited to those cases where the table contains current year data only. This method should be avoided if the table contains data from previous years as it will remove all data.

MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

Data Migration Outlier Review

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I PLANED MA		Generate Table ADI	222	MINNER (1) (1)	Yee	(0)111	16.0milli	

- Step 19. Click "Import Data" in the same table. Select the latest "Load_to_Oracle_MM-DD-YY" file. In the step 4 of the data import select the "Position" option in the "Match by" drop-down menu. Since data import is done based on column positions, check the column positions of both tables before data import.
- Step 20. In the EDW application "Outlier Review" window (see Step 12 if window has closed), click on the year drop-down menu and select the revew year, then click on the View Outlier Summary Button to import the data from Oracle and populate relevant tables and data fields. Afterward, click on the "Filter" drop-down menu and select "Outlier Sections Checks Not Completed" (see below image).

	ndition 2. G			3. Load Inputs into I	Roadcare 4. Get List	from Roadcare	5 Load	Outlier Sprea	dsheet		
~	View Outlier	Summary	Filter O	utlier Sections Only Il Sections	~	Fit					
COLLECTION_YEAR	FACILITY	SECTION	DIRECTION O	utlier Sections Only		SUB_ROUTE_ID	INV_BMP	INV_EMP	DIR_BMP	DIR_EMP	MAX("LANE_CHAN
			N O	utilier Sections Checks	Completed Not Completed						
2018	AA-MD 174	1.76-1.78(E)	E	9204	1	1	1.76	1.78	1.76	1.78	0
2018	AA-MD 175	5.05-6.4(S)	s	9205	1	2	5.05	6.40	3.42	4.77	0
2018	AA-MD 2	12.4-12.44(N)	N	9167	1	1	12.40	12.44	12.40	12.44	0
2018	AA-MD 2	23.87-24.32	s	9167	1	2	23.87	24.32	16.7880	17.23	0
2018	AA-MD 261	5.4-5.41(N)	N	9227	1	1	5.40	5.41	5.40	5.41	0
2018	AA-MD 261	5.4-5.41(S)	s	9227	1	2	5.40	5.41	0	0.01	0
2018	AA-MD 468	11.08-11.19	s	9241	1	2	11.08	11.19	0	0.11	0
2018	AA-MD 648E	0-0.02(N)	N	9254	1	1	0	0.02	0	0.02	0
2018	AA-MD 695	0-0.76(N)	N	9267	1	1	0	0.76	0	0.76	1
2018	AA-MD 695	0.756-0.76(S)	s	9267	1	2	0.7560	0.76	1.6860	1.69	0
2018	AA-US 50	10.62-10.76	E	11021	1	1	10.62	10.76	10.62	10.76	0
2018	AA-US 50	17.05-17.4(E)	E	11021	1	1	17.05	17.40	17.05	17.40	0
2018	AL-IS 68	10.63-11.13	E	805	1	1	10.63	11.13	10.63	11.13	1
2018	AL-MD 144AE	0-2.53(W)	w	825	1	2	0	2.53	0	2.53	0
2018	AL-MD 36	21.77-27.44	N	807	1	1	21.77	27.44	21.77	27.44	0
2018	AL-MD 47	0-0.3(N)	N	810	1	1	0	0.30	0	0.30	0
2018	AL-MD 51	0-0.05(E)	E	812	1	1	0	0.05	0	0.05	0
2018	AL-MD 51	0-0.05(W)	w	812	1	2	0	0.05	25.3810	25.44	0
2018	AL-MD 53	1.18-3.33(N)	N	817	1	2	1.18	3.33	0	2.04	0
2018	AL-MD 53	0-1.18(N)	N	817	1	2	0	1.18	2.04	3.1950	0
2018	AL-MD 61	0-1.94(N)	N	819	1	1	0	1.94	0	1.94	0
2018	AL-MD 61	0-1.883(S)	s	819	1	2	0	1.8830	0	1.8320	0
2018	AL-MD 658	0.0.84(N)	N	833	4	4	0	0.84	0	0.84	0

Step 21. All the outlier sections where the "Outlier_outcome" has been marked as "1" previously will be shown in the window. Click on the "Fit" button to expand the columns.

Investigate each section and enter additional data where necessary. Double-Step 22. click on a section and an additional "Add/Edit Outlier Details" window will appear (see below image). Open the current and previous year Vision database to supplement the investigation. In Vision, check for recent or active construction activities, data collection lane changes, vehicle wander, new distresses or other possible causes for data discrepancy for the section in question. Review the previous year Vision database and historical Vision databases and compare with current year Vision for the same section to determine the reasons for data discrepancy. Use the "Detail Default" and "Year" drop-down menu to explore data populated from existing data tables including construction history data and pavement event data flagged by DPT technicians as a complementary source of data for the review (Note: the current performance parameters are: IRI, structural crack density, functional crack density, rut, and friction. The section will be an outlier if any of these parameters are flagged as outliers).

dd/Edit	Outlier Details							- 0
loadca	re Section Inform	nation			010 01 010			
Coll	ection_Year	Facility	Section	Direction Dir.	BMP Dir_EMP	Global_Route_ID	Sub_Route_ID	
	2018	AA-MD 648E	0-0.02(N)		0 0.02	9254		
	ATTRIBUTE_NAM	IE VALUE_MRYR_MINUS5	VALUE_MRYR_MINUS4	VALUE_MRYR_MINUS3	VALUE_MRYR_MINUS2	VALUE_MRYR_MINUS1	VALUE_MRYR PH	ASE
۰.	AVG_RUT	0.23	0.23	0.21	0.25	0.29	0.21 0	
	FC_DENSITY	12.15	5.76	9.86	32.05	6.07	14.83 1	Close
	SC_DENSITY	6.350000000000005	3.16	5.29	13.39	6.3	6.46 0	
	AVG_IRI	287.79	367.19	306.51	213.68	342.49	288.14 0	View Comments in Edit Table
<								<u>`</u>
oute	AVG_IRI	~						
er Su	mmary		Outlier Dr	tail in Table (	O Detail Default	Year 2018 ~		
0								Performance Parameter: AVG IRI
1	uncer coope	ane Change No						AVG_RUT
3		New Pave No						SC_DENSITY
5	0	Construction No						SPADJ_SKID_NUMBER
6	E	Road Widened No						
11		Lane Change No						Outlier Code:
13	N	New Pave No						
15	c	Construction No						Dir_BMP: Dir_EMP:
16	R	Road Widened No						
18								
	2	Starting and end mile No						
21	R	Starting and end mile No Right IRI > 640 No						Comment
21 22	F	Starting and end mile         No           Right IRI > 640         No           Speed < 15						Comment
21 22 24	F S D	Starting and end mile         No           Right IRI > 640         No           Speed < 15						Comment
21 22 24 25	R S D	Starting and end mile No           Right IRI > 640         No           Speed < 15						Comment
21 22 24 25 27	R S D N	Starting and end mile         No           Right IRI > 640         No           Speed < 15						Comment
21 22 24 25 27 33	5 F 5 0 N 1 6 8	Starting and end mile         No           Right IRI > 640         No           Speed < 15						Comment
21 22 24 25 27 33 34	5 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Starting and end mile         No           Right IRI > 640         No           Speed < 15						Comment
21 22 24 25 27 33 34 35	5 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Starting and end mile         No           Right Ri > 640         No           Speed < 15						Comment
21 22 24 25 27 33 34 35 36	5 8 5 8 8 8 8 8 8 8 8 8 8 7 8 7 8 8 8 8	Starting and end mile         No           Right RI > 640         No           Speed < 15						Comment
21 22 24 25 27 33 34 35 36 37	S R S D L L R R R R R R R R R R R	Starting and mike         No           Right Rip > 640         No           Right Rip > 640         No           Distress         No           Distress         No           Left Rip > 640         No           Raincad Crossing         No           Raundadout         No           Roundadout         No           Runble_Strip         No						Comment Do NoT USE Add New Overwrite Delete

- i. If there is a difference in the Vision data affecting any of the performance parameters, specify the reason for change of affected parameters (IRI, structural crack density, functional crack density, rut, and friction) by highlighting the affected performance parameters and entering the corresponding outlier code in the "Outlier Code" text box in the EDW window. Outlier codes are included as an appendix (see <u>Outlier Review Outlier Codes</u>).
- ii. If no reasons for the discrepancy can be identified after comparing Vision data, then an investigation will need to be conducted comparing current and historic years' condition databases. This investigation should look for any possible reason including errors in data collection, processing, transfer, storage, and analysis. If no reason can be found, outlier code "25 - No Reason" will be selected and an explanation will be added.

- iii. If no explanation for the discrepancy is identified after comparing databases, and data discrepancy is considerable, then the section will go to a recollection list to validate the true value. Currently, outlier review is done gradually along the season on a county by county basis. Once data processing and reporting is complete for a county, outlier identification and review will be performed on the data. If the difference in parameters is not significant and data is marginally outside of the acceptable range, then usually nothing is done about it. However, if the difference is remarkable and such difference is observed in meny sections without any explanation, it is concluded that collected data has issues then source of the issue is investigated and if necessary, recollection is recommended.
- Step 23. Investigate all outlier sections until either explanation has been provided for the outliers or the sections have been moved to the recollection list. Once done, the "Outlier Sections Checks Not Completed" list in the EDW should be empty. Once the "Add/Edit Outlier Details" window is completed and closed for a section, the section automatically moves to the "Outlier Sections Checks Completed" list.
- Step 24. All the outlier codes identified during the outlier review will be populated into the "Phase4_Outlier_Detail" table. All the events identified earlier by ARAN operators, construction history, video review, and available data such as speed less than 15 mph with corresponding codes will be stored in "Phase4_Outlier_Detail_Default" table. The data from those two tables should be exported into the "Condition" table using the procedure: "Imp_OutlierCode_To_cond" followed by "Imp_Default_Events_To_Cond."
- Step 25. After all the outlier codes are populated from the above referenced two tables, run the following SQL query to insert comma at the end of each outlier code: "Update condition set note=note||',' where note is not null and year = YEAR OF QC;"

#### 2- Performing QA on Outlier Review Results – performed by DAT TL

**Summary:** This task performs QA checks on the output from the outlier review in order to identify possible causes of and explanations for the outlier data and to enable discussions with appropriate MDOT-SHA teams in order to pursue possible remedial actions.

Step 26. Perform detailed investigation of outlier review output tables "Phase4_Outlier_ Detail" and "Phase4_Outlier_Detail_Default." Using SQL Developer, run queries to review location of outliers and investigate possible causes or explanations for higher values (e.g., a group of outliers in the same area could be traced back to a problem with the Distance Measuring Instrument (DMI) calibration). This step specifically intends to identify systematic errors or errors that affect a group of data. If an issue is discovered, discuss remedial actions with the appropriate MDOT-SHA team.

# 6.02 UPDATE FINAL CONDITION DETAIL TABLE

## 6.02.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Warehouse Team (DWT) to populate, update and quality control (QC) the annual Final Condition Detail Table. This procedure is performed after the update of the Base 4 Table (see <u>Reporting and Uploading Data to Oracle</u>) and after the completion of the Outlier Review (see <u>Outlier Review</u>). The Final Condition Detail Table is populated and updated with the processed International Roughness Index (IRI) and rut data. The population and updating of this table is one of several intermediate steps performed by the DWT prior to the migration of all intermediate tables to the Business Plan Tables.

## 6.02.02 Frequency

The Final Condition Detail Table is populated and updated once per year.

## 6.02.03 Purpose

The purpose of this SOP is to populate, to update and to QC the Final Condition Detail Table for migration of the processed IRI and rut depth data to the Business Plan Tables. This procedure performs location adjustments to the IRI and rut data to address inconsistencies in GPS data, removes outliers, and organizes the data in preparation for the Business Plan Table migration.

## 6.02.04 *Resource Requirements*

The updating of the Final Condition Detail table involves two people: (1) a database management expert from the DWT to populate and update the table and perform QC, and (2) a supervisor, typically the DWT Team Leader (TL), who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues are encountered.

Position	Function	Resources	Effort Level (man-hrs)
DWT Staff	Database Management and QC	1	40.0
DWT TL	Supervisor	1	AR ^{06/12/2019}

## 6.02.05 Procedure

The procedure to update the Final Condition Detail table is comprised of the following three tasks:

- (1) manually populating initial table,
- (2) applying location adjustments, and
- (3) performing QC of updated table.

#### **1- Manually Populating Initial Table** – *performed by database engineer*

**Summary:** This task manually prepares the initial table using the Base 4 table. SQL Developer is utilized to add rows and to update field names in the table for the current year.

Step 1. Using Oracle SQL Developer, initialize the Final Condition Detail Table by adding rows of data for the current year. Rename fields that may have changed from the previous year.

#### 2- Applying Location Adjustments – performed by database engineer

**Summary:** This task creates new fields in the table for location adjustments through the running of a package in Oracle SQL Developer.

- Step 2. Run the IRI_CLEAN_UP_PKG package to correct inconsistencies in the GPS data. This package compares ARAN data GPS data to historical DSD GPS data and makes corrections where differences may occur. The package compares location data at an interval of every 4 mmi (milli-miles). Two sets of location fields are maintained. The original locators refer to the data collection year and the adjusted locators refer to the inventory year.
  - i. If the ARAN location data matches the historical location data at a data point, no adjustments are made.
  - ii. If the ARAN location data deviates from the inventory year location data at a data point, the ARAN location data is adjusted to match the inventory year location data. All subsequent points along the route are adjusted by this difference.

#### **3- Performing QC of Updated Table** – *performed by database engineer*

**Summary:** This task checks that the updates to the Final Condition Detail Table have been performed correctly.

- Step 3. Using Oracle SQL Developer, check that the new rows have been populated and updated in the Final Condition Detail Table.
  - i. If the table has been updated, proceed to Step 4.
  - ii. If the table has not been updated, confirm that the process has been completed correctly by returning to Step 1.
- Step 4. Using Oracle SQL Developer, check that the location adjustment fields have been created and populated.
  - i. If the new fields have been created and populated, process is complete.
  - ii. If the new fields have not been created and/or populated, confirm that the process has been completed correctly by returning to Step 2.

# 6.03 UPDATE RUT DETAILED TABLE

## 6.03.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Warehouse Team (DWT) to populate, update and quality control (QC) the annual Rut Detailed Table. This process is performed after the update of the Base 4 Table (see <u>Reporting and Uploading Data to Oracle</u>), after the completion of the Outlier Review (see <u>Outlier Review</u>), and after the update of the Final Condition Detail Table (see <u>Update Final Condition Detail Table</u>). The Rut Detailed Table is populated and updated with the processed rut data. The populating and updating of this table is one of several intermediate steps performed by the DWT prior to the migration of all intermediate tables to the Business Plan Tables.

## 6.03.02 Frequency

The Rut Detailed Table is populated and updated once per year.

## 6.03.03 Purpose

The purpose of this SOP is to populate, to update and to QC the Rut Detailed Table for migration of the processed rut data to the Business Plan Tables. This process performs location adjustments to the rut data to address inconsistencies in GPS data, removes outliers, and organizes the data in preparation for the table migration.

#### 6.03.04 *Resource Requirements*

The updating of the Rut Detailed table involves two people: (1) a database management expert from the DWT to populate and update the table and perform QC, and (2) a supervisor, typically the DWT Team Leader (TL), who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues are encountered.

Position	Function	Resources	Effort Level (man-hrs)
DWT Staff	Database Management and QC	1	16.0
DWT TL	Supervisor	1	AR ^{06/12/2019}

## 6.03.05 Procedure

The procedure to populate, to update and to QC the Rut Detailed table is comprised of the following three tasks:

- (1) manually populating initial table,
- (2) running rut package, and
- (3) performing QC of updated table.

#### **1- Manually Populating Initial Table** – *performed by database engineer*

**Summary:** This task manually prepares the initial table using the Base 4 table and the results from the location adjustments made in the Final Condition Detailed Table. SQL Developer is utilized to add rows and update field names in the table for the current year.

- Step 1. Using Oracle SQL Developer, initialize the Rut Detailed Table by adding rows of data for the current year. Rename fields that may have changed from the previous year.
- Step 2. Using Oracle SQL Developer, extract location adjustments from the processed rut data in the Final Condition Detail Table.

#### 2- Running Rut Package – performed by database engineer

**Summary:** This task organizes the processed rut data through the running of a package in Oracle SQL Developer.

Step 3. Run the RUT_DETAILED_PKG package to update the Rut Detailed Table.

#### 3- Performing QC of Updated Table – performed by database engineer

**Summary:** This task checks that the updates to the Rut Detailed Table have been performed correctly.

- Step 4. Using Oracle SQL Developer, check that the new rows have been populated and updated in the Rut Detailed Table.
  - i. If the table has been updated, proceed to Step 4.
  - ii. If the Table has not been updated, confirm that the process has been completed correctly by returning to Step 1.
- Step 5. Using Oracle SQL Developer, check that the location adjustment fields have been created and populated.
  - i. If the new fields have been created and populated, process is complete.
  - ii. If the new fields have not been created and/or populated, confirm that the process has been completed correctly by returning to Step 2.

# 6.04 UPDATE CRACKING DETAILED TABLE

#### 6.04.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Warehouse Team (DWT) to populate, to update and to quality control (QC) the annual Cracking Detailed Table. This process is performed after the update of the Base 4 Table (see <u>Reporting and Uploading Data to Oracle</u>), after the completion of the Outlier Review (see <u>Outlier Review</u>), and after the updates of the Final Condition Detail Table (see <u>Update Final Condition Detail Table</u>) and Rut Detailed Table (see <u>Update Rut Detailed Table</u>). The Cracking Detailed Table is populated with the processed Laser Crack Measurement System (LCMS) data. The populating and updating of this table is one of several intermediate steps performed by the DWT prior to the migration of all intermediate tables to the Business Plan Tables.

#### 6.04.02 Frequency

The Cracking Detailed Table is populated and updated once per year.

## 6.04.03 Purpose

The purpose of this SOP is to populate, to update and to QC the Cracking Detailed Table for migration of the processed cracking data to the Business Plan Tables. This process performs location and density adjustments to the cracking data to address inconsistencies in GPS data and cracking quantities, removes outliers and special event locations, and organizes the data in preparation for table migration.

#### 6.04.04 *Resource Requirements*

The updating of the Cracking Detailed table involves two people: (1) a database management expert from the DWT to populate and update the table and perform QC, and (2) a supervisor, typically the DWT Team Leader (TL), who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues are encountered.

Position	Function	Resources	Effort Level (man-hrs)
DWT Staff	Database Management and QC	1	16.0
DWT TL	Supervisor	1	AR ^{06/12/2019}

#### 6.04.05 *Procedure*

The procedure to populate, to update and to QC the Cracking Detailed Table is comprised of the following three tasks:

- (1) manually populating initial table,
- (2) applying cracking density adjustments, and
- (3) performing QC of updated table.

#### **1- Manually Populating Initial Table** – *performed by database engineer*

**Summary:** This task manually prepares the initial table using the Base 4 table and the results from the location adjustments made in the Final Condition Detailed Table. SQL Developer is utilized to add rows and update field names in the table for the current year and to remove special event locations in the data.

- Step 1. Using Oracle SQL Developer, initialize the Cracking Detailed Table by adding rows of data for the current year. Rename fields that may have changed from the previous year.
- Step 2. Run the CRACKING_TABLES_MP_CORRECTION package to extract location adjustments from the processed data in the Final Condition Detail Table and apply those adjustments to the processed cracking data.
- Step 3. Run the CRACKING_EVENT_LOCATION package to filter out rows marked with a special event. Event markers are placed on images that contain appurtenances, which should be removed from the cracking data, including bridges, railroad crossings, manhole covers, concrete pavement, etc. The placing of these markers is performed as a part of <u>Performing 100% Drive Through</u>.

#### 2- Applying Cracking Density Adjustments – performed by database engineer

**Summary:** This task applies a correction factor for cracking density to the processed cracking data based on manual evaluations performed during data processing.

Step 4. Run the CRACKING_DENSITY_CORRECTION package to apply the required correction factor to the cracking quantities in the Cracking Detailed Table. As a part of the cracking data processing QC, 1% of the network is manually evaluated and the resulting quantities are compared to the automated quantities collected by the ARAN. This comparison results in the development of a correction factor that is applied to the processed data. For sections that did not receive a manual evaluation, an average correction factor is applied based on the county and functional class associated with the specific section. A separate table called CRK_AUTODENSITY_CORR_BINS is created prior to the running of the CRACKING_DENSITY_CORRECTION package, which contains the route-specific correction factors in bins that will be looked up by the density package.

#### **3- Performing QC of Updated Table** – *performed by database engineer*

**Summary:** This task checks that the updates to the Cracking Detailed Table have been performed correctly.

- Step 5. Using Oracle SQL Developer, check that the new rows have been populated and updated in the Rut Detailed Table.
  - i. If the Table has been updated, proceed to Step 4.
  - ii. If the Table has not been updated, confirm that the process has been completed correctly by returning to Step 1.

- Step 6. Using Oracle SQL Developer, check that the location adjustment fields have been created and populated.
  - i. If the new fields have been created and populated, proceed to Step 7.
  - ii. If the new fields have not been created and/or populated, confirm that the process has been completed correctly by returning to Step 2.
- Step 7. Using Oracle SQL Developer, check that the cracking density adjustment fields have been created and populated.
  - i. If the new fields have been created and populated, process is complete.
  - ii. If the new fields have not been created and/or populated, confirm that the process has been completed correctly by returning to Step 4.

# 6.05 UPDATE CONCRETE DETAILED TABLE

## 6.05.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Warehouse Team (DWT) to update and quality control (QC) the annual Concrete Detailed Table. This process is performed after the update of the Base 4 Table (see <u>Reporting and Uploading Data to Oracle</u>), after the completion of the 4 Phase Study (see <u>Outlier Review</u>), and after the updates of the Final Condition Detail Table (see <u>Update Final Condition Detail Table</u>), Rut Detailed Table (see <u>Update Rut Detailed Table</u>), and Cracking Detailed Table (see <u>Update Cracking Detailed Table</u>). The Concrete Detailed Table is populated with all processed data for concrete pavements. The updating of this table is one of several intermediate steps performed by the DWT prior to the migration of all intermediate tables to the Business Plan Tables.

## 6.05.02 Frequency

The Concrete Detailed Table is updated once per year.

## 6.05.03 Purpose

The purpose of this SOP is to populate and update the Concrete Detailed Table for migration to the Business Plan Tables. This process organizes the data for concrete sections only in preparation for the table migration.

#### 6.05.04 Resource Requirements

The updating of the Concrete Detailed table involves two people: (1) a database management expert from the DWT to populate and update the table and perform QC, and (2) a supervisor, typically the DWT Team Leader (TL), who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues are encountered.

Position Function		Resources	Effort Level (man-hrs)
DWT Staff	Database Management and QC	1	4.0
DWT TL	Supervisor	1	AR ^{06/12/2019}

## 6.05.05 Procedure

The procedure to populate, to update and to QC the Concrete Detailed Table is comprised of the following three tasks:

- (1) manually populating initial table,
- (2) running concrete package, and
- (3) performing QC of updated table.

#### 1- Manually Populating Initial Table – performed by database engineer

**Summary:** This task manually prepares the initial table using the Base 4 table. SQL Developer is utilized to add rows and update field names in the table for the current year and to remove special event locations in the data.

Step 1. Using Oracle SQL Developer, initialize the Concrete Detailed Table by adding rows of data for the current year. Rename fields that may have changed from the previous year.

#### 2- Running Concrete Package – performed by database engineer

**Summary:** This task takes the previously processed tables (Final Condition Detail Table, Rut Detailed Table, and Cracking Detailed Table) and extracts the concrete sections into a separate table.

- Step 2. Run the CONCRETE_DETAILED_PKG package to populate the Concrete Detailed Table with data from the concrete sections only.
- **3- Performing QC of Updated Table** *performed by database engineer*

**Summary:** This task checks that the updates to the Concrete Detailed Table have been performed correctly.

Step 3. Using Oracle SQL Developer, check that the new rows have been populated and updated in the Concrete Detailed Table. If the Table has not been updated, confirm the process has been completed correctly by returning to Step 1.

# 6.06 MIGRATING TO BUSINESS PLAN TABLES

## 6.06.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Warehouse Team (DWT) to reformat and to migrate intermediate tables - Final Condition Detail Table (<u>Update Final Condition Detail Table</u>), Rut Detailed Table (<u>Update Final Condition Detail Table</u>), Rut Detailed Table (<u>Update Rut Detailed Table</u>), Cracking Detailed Table (<u>Update Cracking Detailed Table</u>), and Concrete Detailed Table (<u>Update Concrete Detailed Table</u>) - to the Business Plan Tables and to perform quality control (QC) on the migrated tables. This process is performed after the completion of the intermediate tables.

## 6.06.02 Frequency

Reformatting and migration of the referenced intermediate tables to the Business Plan Tables and QC of the migrated tables is performed once per year.

## 6.06.03 Purpose

The purpose of this SOP is to reformat and to migrate the referenced intermediate tables to the Business Plan Tables and to perform QC checks on the migrated tables.

## 6.06.04 *Resource Requirements*

Migration to Business Plan Tables involves two people: (1) a database management expert from the DWT to populate and update the tables and perform QC, and (2) a supervisor, typically the DWT Team Leader (TL), who, as required, provides guidance and decision-making. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues are encountered.

Position	Function	Resources	Effort Level (man-hrs)
DWT Staff	Database Management and QC	1	8.0
DWT TL	Supervisor	1	AR ^{06/12/2019}

## 6.06.05 Procedure

The procedure to reformat and to migrate all intermediate tables to the Business Plan Tables and to perform QC on the migrated tables is comprised of two tasks:

- (1) reformatting and migrating intermediate tables to Business Plan Tables, and
- (2) performing QC of table migration.
- 1- Reformatting and Migrating Intermediate Tables to Business Plan Tables *performed by database engineer*

**Summary:** This task reformats and migrates all intermediate tables to Business Plan Tables.

- Step 1. Discuss possible changes to the Business Plan Tables with TL. Changes could be related to the data structure (new fields added, existing field names changed) or the business plan itself (segmentation changed).
  - i. If changes have occurred from the previous year, modify the packages accordingly before proceeding to Step 2.
  - ii. If no changes have occurred, proceed to Step 2.
- Step 2. Using Oracle SQL Developer or the link provided in the Engineering Data Warehouse (EDW) program, run BUSINESS_PLAN_PKG package. The package will create the BUSINESS_PLAN_1MILE table using condition data from the intermediate tables. To use the EDW program, click "Analysis", then "Business Plan Update", then "Business Plan 1Mile."
- Step 3. Using Oracle SQL Developer or the link provided in the EDW program, run BUSINESS_PLAN_PKG_100MMI package. The package will create the BUSINESS_PLAN_100MMI table using condition data from the intermediate tables. To use the EDW program, click "Analysis", then "Business Plan Update", then "Business Plan 100mmi."
- Step 4. Using Oracle SQL Developer or the link provided in the EDW program, run BUSINESS_PLAN_LMY_PKG package in the Production Database (note: this is an exception as all other Oracle SQL packages are run in development, not production database). This package will create the BUSINESS_PLAN_LMY table, the BUSINESS_PLAN_CONHIST table, and the BUSINESS_PLAN_TREATMENTS table. To use the EDW program, click "Analysis", then "Business Plan Update", then "Business Plan LMY."
- Step 5. Using Oracle SQL Developer or the link provided in the EDW program, run BUSINESS_PLAN_TREND_PKG package. The package will create the BUSINESS_PLAN_TREND table. The trend table is produced by merging the BUSINESS_PLAN_LMY and BUSINESS_PLAN_ 100MMI tables. To use the EDW program, click "Analysis", then "Business Plan Update", then "Business Plan Trend."

#### 2- **Performing QC of Table Migration** – *performed by database engineer*

**Summary:** This task performs QC checks of the migrated tables to identify missing or unreasonable data.

- Step 6. Perform QC of BUSINESS_PLAN_1MILE table and BUSINESS_PLAN_100MMI table. Compare each table with the same table from the previous year and investigate data that meet one of the following criteria:
  - i. Difference in rating category percentage of more than 2 points.
  - ii. Condition element total average greater than 1%.
  - iii. Total lane mileage difference of more than 50 miles.

Using SQL Developer, investigate all instances where one or more of the above criteria are met. Look for missing data and double check that issues are not the result of data processing. Check if year-to-year differences could be

caused by other external factors, such as increased or decreased construction funding. Discuss with ADC and decide if reprocessing must take place or if the packages should be rerun before continuing.

- Step 7. Perform QC of BUSINESS_PLAN_LMY table (intermediate tables Treatments and Con history are not checked). Compare total lane miles of treated sections with the same table from the previous year.
  - i. If there is an unreasonable difference (no specific tolerance since differences are expected, but only within reason), investigate and resolve data processing issues and rerun package.
  - ii. Otherwise, proceed to Step 8.
- Step 8. Perform QC of BUSINESS_PLAN_TREND table. Compare total lane mileage of treated sections in table with the total lane mileage of treated sections in the LMY table. The total lane mileage should be exactly the same.
  - i. If there is a difference between lane mileage totals, investigate difference, debug code if necessary, and rerun package.
  - ii. Otherwise, proceed to Step 9.
- Step 9. Notify TL that the Business Plan Tables are ready for QA.

# 7 FRICTION MANAGEMENT

This section describes the set of standard operating procedures (SOP) to document a systematic approach to addressing pavement friction requirements across the MDOT SHA pavement network. These procedures are conducted mainly by staff from the Data Analysis Team (DAT) and Data Warehouse Team (DWT) to determine site and friction demand categories and corresponding threshold pavement surface friction levels (investigatory and intervention levels), to identify pavement locations that have inadequate friction levels and a higher possibility of wet surface accidents throughout the state. This section is divided into seven SOPs: development/review of friction site and demand categories, network definition and segmentation, site and demand category analysis, data aggregation, section prioritization (under development), report generation, and future improvements to the friction management program. Figure 1 shows the steps of Pavement Friction Management (PFM) program at MDOT SHA for generating annual friction management reports.



Figure 10: MDOT SHA's Pavement Friction Management (PFM) program

# 7.01 DEVELOPMENT/REVIEW OF FRICTION SITE AND DEMAND CATEGORIES

## 7.01.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Analysis Team (DAT) to identify the road features and attributes that play a role in occurrence of wet accidents and to quantify their effect on the road sections' friction demand and investigatory and intervention friction levels. Investigatory and intervention levels are defined, respectively, as levels that prompt the need for a detailed site investigation or the application of a friction restoration treatment. The exact nature of the relationship between pavement friction and wet crashes is site specific, as it is defined not only by pavement friction but by many other factors such as highway alignment, highway features/environment, and highway traffic characteristics. Thus, pavement friction and wet crashes relationships must be developed for the site categories that are typically present in the pavement network. This section describes the steps in development of site and friction demand category criteria that are used to classify network sections based on the effect of various factors on section's friction demand. The goal of this procedure is to manage network friction more efficiently by determining the appropriate level of pavement surface friction for pavement sections within the highway network, based on each section's friction demand. This procedure is intended to ensure the provision of adequate friction levels for a variety of roadway (intersections, approaches to traffic signals, tight curves) and traffic conditions. Pavement sections with measured friction values at or below an assigned investigatory level are subject to a detailed site investigation to determine the need for warning or remedial action, such as erecting warning signs, performing more frequent testing and analysis of friction data and crash data, or applying a short-term restoration treatment. For pavement sections with friction values at or below the intervention level, remedial action may consist of either immediately applying a restoration treatment or programming a treatment into the maintenance or construction work plan and erecting temporary warning signs at the site of interest. Currently, the site categories presented in the following table are being used for assessing the friction adequacy of each section. However, this table might be revised in the future as site category criteria are assessed every year following the steps provided in this SOP.

Site Category	Site Description	Investigatory Skid Number (SN)	Intervention Skid Number (SN)	Demand Category
1	<ul> <li>0.1 mile within approach to Railroad Crossings, Roundabouts, Traffic Lights, Pedestrian Crossings, Stop and Give Way Controlled Intersections, and the prevailing speed is ≥ 55 mph, OR</li> <li>Curves with radius ≤ 750 ft, all speeds, OR</li> <li>Downhill gradients &gt; 10% and &gt; 0.03 miles long, all speeds, OR Freeway/highway off ramps, all speeds.</li> </ul>	55	45	High
2	<ul> <li>0.1 mile within approach to Railroad Crossings, Roundabouts, Traffic Lights, Pedestrian Crossings, Stop and Give Way Controlled Intersections, and the prevailing speed is ≥ 35 mph and &lt; 55 mph, OR</li> <li>0.1 mile within approach to all other intersections ≥ 35 mph, OR</li> <li>Downhill gradients 5 to 10% and</li> <li>0.03 miles long and speed limit is</li> <li>≥ 35 mph, OR</li> <li>Undivided Highways without other geometric constraints which influence frictional demand, the travelling speed is at least 55 mph and average rutting &gt; ¼", OR</li> <li>Curves with radius &gt; 750 ft and ≤ 1,500 ft and speed limit ≥35 mph.</li> </ul>	45	35	Medium
3	All other situations.	40	30	Low

# 7.01.02 Frequency

Development (first year) and review of friction site and demand categories is performed every year, before the end of the data collection season.

# 7.01.03 *Purpose*

The purpose of this SOP is to identify the effect of factors that contribute to wet weather accidents and to develop and/or review criteria for using the section attributes to identify site and demand categories and investigatory and intervention friction levels for each category. The goal is to manage network friction more efficiently by determining the appropriate level of pavement friction for pavement sections within the highway network, based on each section's friction demand.

# 7.01.04 Resource Requirements

Development (first year) and review of friction site and demand categories involves two persons: a DAT staff member knowledgeable of friction performance of pavements, available road and pavement attribute data, and Oracle data tables and DAT team leader.

The estimated effort level in the table below represents the total time, in man-hours, to complete the development and review of friction demand categories. The time estimate assumes no issues are encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DAT Staff	Analyst	1	40.0 (first year) 16.0 (following years)
DAT TL	Supervisor	1	2

#### 7.01.05 *Procedure*

The procedure required to perform the development/update of friction site and demand categories process is comprised of the following three components:

(1) Identifying influential parameters and their data availability,

(2) defining site and demand category criteria based on the identified parameters,

(3) determining the investigatory and intervention friction levels for each site category.

1- Identifying Influential Parameters with Available Reliable Data – performed by DAT staff

**Summary:** Under this task, all the road features and pavement attributes that can affect the occurrence of wet accidents are listed and those with available reliable data are identified.

- Step 1. Prepare a list of factors, road features, and pavement attributes that can affect the occurrence of wet accidents using credible pavement friction and safety documents.
- Step 2. Investigate availability and reliability of data identified in step 1.
  - i. Identify data that are available in data tables and have established quality control procedures.
  - ii. Identify data that are available in data tables or can be obtained internally by means of modifying the data processing procedures but need to be validated before they can be used and plan to establish data validation procedures.
  - iii. Identify data that cannot be obtained through internal data collection and processing procedures but can be obtained from reliable outside sources and plan to acquire the data in a timely manner.
- Step 3. Prepare a list of available factors, road features, and pavement attributes and their data sources. The following table presents the list of factors and their associated data source currently used in friction management program:

Attribute	Source	
ROAD_NAME	HMIS_MASTER_ALL_YEARS	
DISTRICT	HMIS_MASTER_ALL_YEARS, EDW_BASE_1	
COUNTY	HMIS_MASTER_ALL_YEARS, CURVE_H_ALL_YRS, EDW_BASE_1	

Attribute	Source	
ROUTE	HMIS_MASTER_ALL_YEARS, CURVE_H_ALL_YRS, EDW_BASE_1	
DIRECTION	HMIS_MASTER_ALL_YEARS, CURVE_H_ALL_YRS, EDW_BASE_1	
BEGINROWPATH	CURVE_H_ALL_YRS	
ENDROWPATH	CURVE_H_ALL_YRS	
UNIQUERUN	CURVE_H_ALL_YRS	
CURVE_YEAR	CURVE_H_ALL_YRS	
CLASS	CURVE_H_ALL_YRS	
GLOBAL_ROUTE_ID	HMIS_MASTER_ALL_YEARS, CURVE_H_ALL_YRS, EDW_BASE_1	
SUB_ROUTE_ID	HMIS_MASTER_ALL_YEARS, CURVE_H_ALL_YRS, EDW_BASE_1	
ROUTEID	CURVE_H_ALL_YRS	
INV_BMP	HMIS_MASTER_ALL_YEARS, CURVE_H_ALL_YRS, EDW_BASE_1	
INV_EMP	HMIS_MASTER_ALL_YEARS, CURVE_H_ALL_YRS, EDW_BASE_1	
BEGINCHAINAGE	CURVE_H_ALL_YRS, EDW_BASE_1	
ENDCHAINAGE	CURVE_H_ALL_YRS, EDW_BASE_1	
BEGINDISTANCESTAMP	CURVE_H_ALL_YRS, EDW_BASE_1	
ENDDISTANCESTAMP	CURVE_H_ALL_YRS, EDW_BASE_1	
DIR_BMP	CURVE_H_ALL_YRS, EDW_BASE_1	
DIR_EMP	CURVE_H_ALL_YRS, EDW_BASE_1	
BEGIN_LAT	\\shahqhisdfs1\GIS_DATA\TRANSPORTATION\MILE_POINT S\CURRENT\1000TH\SHA_MILEPOINTS_1000TH_MD.gdb	
BEGIN_LONG	\\shahqhisdfs1\GIS_DATA\TRANSPORTATION\MILE_POINT S\CURRENT\1000TH\SHA_MILEPOINTS_1000TH_MD.gdb	
END_LAT	\\shahqhisdfs1\GIS_DATA\TRANSPORTATION\MILE_POINT S\CURRENT\1000TH\SHA_MILEPOINTS_1000TH_MD.gdb	
END_LONG	<u>\\shahqhisdfs1\GIS_DATA\TRANSPORTATION\MILE_POINT</u> S\CURRENT\1000TH\SHA_MILEPOINTS_1000TH_MD.gdb	
LENGTH	HMIS_MASTER_ALL_YEARS, CURVE_H_ALL_YRS, EDW_BASE_1	
BEGINELEVATION	CURVE_H_ALL_YRS	
ENDELEVATION	CURVE_H_ALL_YRS	
TYPE	CURVE_H_ALL_YRS	
RADIUS	CURVE_H_ALL_YRS	
ARCANGLE	CURVE_H_ALL_YRS	
DEFLECTIONANGLE	CURVE_H_ALL_YRS	
CURVATUREDEGREE	CURVE_H_ALL_YRS	
BEGINHEAD	CURVE_H_ALL_YRS	
ENDHEAD	CURVE_H_ALL_YRS	
MEANERR	CURVE_H_ALL_YRS	
MAXERR	CURVE_H_ALL_YRS	
BEGINERR	CURVE_H_ALL_YRS	

Attribute	Source
ENDERR	CURVE_H_ALL_YRS
BEGINX	CURVE_H_ALL_YRS
BEGINY	CURVE_H_ALL_YRS
ENDX	CURVE_H_ALL_YRS
ENDY	CURVE_H_ALL_YRS
CTRX	CURVE_H_ALL_YRS
CTRY	CURVE_H_ALL_YRS
FEATURETYPES	CURVE_H_ALL_YRS
MAXISUPERELEVATION	CURVE_H_ALL_YRS
ANGLEPOINT	CURVE_H_ALL_YRS
STARTSUPERELEVATION	CURVE_H_ALL_YRS
MIDDLESUPERELEVATION	CURVE_H_ALL_YRS
ENDSUPERELEVATION	CURVE_H_ALL_YRS
AVERAGESUPERELEVATION	CURVE_H_ALL_YRS
AVG_LANEWIDTH_FEET	RUT_DETAILED
AVG_PONDING_AREA	RUT_DETAILED
AVG_RUT_DEPTH	RUT_DETAILED
AVG_CROSSFALL_PERCENT	RUT_DETAILED
MIN_CROSSFALL_PERCENT	RUT_DETAILED
MAX_CROSSFALL_PERCENT	RUT_DETAILED
FIRST_CROSSFALLINPERCENT	EDW_BASE_1
LAST_CROSSFALLINPERCENT	EDW_BASE_1
FN_CURRENT	FRICTION
FN_MINUS1	FRICTION
FN_MINUS2	FRICTION
FN_MINUS3	FRICTION
LAST_TREATMENT_YEAR	BUSINESS_PLAN_LMY & LU_TREATMENT
FN_NUMBER	FRICTION, BUSINESS_PLAN_LMY, & LU_TREATMENT
SC_DENSITY	CRACKING_DETAILED
FC_DENSITY	CRACKING_DETAILED
AVG_IRI	EDW18_BASE_4
SURFACE_AGE	BUSINESS_PLAN_LMY & LU_TREATMENT
SURFACE_MATERIAL	BUSINESS_PLAN_TREATMENTS & LU_TREATMENT
SURFACE_TYPE	EDW18_BASE_4 and CONHIST_SURF_TYPE
AVG_GRADE	FINAL_CONDITION_DETAIL
MIN_GRADE	FINAL_CONDITION_DETAIL

Attribute	Source		
MAX_GRADE	FINAL_CONDITION_DETAIL		
MPD_WP_AVG	FRICTION		
FUNC_CL	SECTION_TABLE		
SPEED_LIMIT	SECTION_TABLE, HMIS_MASTER_ALL_YEARS		
AADT	SECTION_TABLE		
ADT	SECTION_TABLE		
TRUCK_PERCENTAGE	Traffic Data (MDOT SHA's Traffic Engineering Division) ⁽¹⁾		
MEDIAN_TYPE	SECTION_TABLE		
WET_CRASH_RATE	Obtained from Office of Traffic and Safety annually		
500'_FROM_CROSS	HMIS_MASTER_ALL_YEARS, EDW18_BASE_4, OOT DATABASE		
SITE CATEGORY	SITE_CATEGORY_TABLE		
INVESTIGATORY_SN	SITE_CATEGORY_TABLE		
INTERVENTION_SN	SITE_CATEGORY_TABLE		
DEMAND_CATEGORY	SITE_CATEGORY_TABLE		
SN_RSL	BUSINESS_PLAN_100MMI		
OVERALL_RSL	BUSINESS_PLAN_100MMI		
SN_DOMINANT	BUSINESS_PLAN_100MMI		

(1): Source: <u>https://www.roads.maryland.gov/Index.aspx?PageId=251</u>

#### 2- Defining Site and Demand Categories Based on the Identified Parameters – performed by DAT staff

**Summary:** Under this task, the effect of identified parameters in step 1 on required friction level of the sections for safe operation of all vehicles will be investigated, and site and demand category criteria (mentioned in Section 7.01.01) will be developed/reviewed accordingly.

- Step 1. Use the most recent friction guidance documents published or recommended by transportation agencies and organizations to identify and establish relationships between the identified parameters and required friction levels. Some of the transportation agencies and organizations that have publications related to pavement friction are:
  - Federal Highway Administration (FHWA)—Office of Safety, Technical Advisories on skid crash reduction, pavement friction courses, and pavement texturing.
  - National Cooperative Highway Research Program (NCHRP)— Syntheses and Reports covering, among other things, safety, friction testing, and surface drainage.
  - American Association of State Highway and Transportation Officials (AASHTO)—Guides, Manuals, and Guide Specifications for highway

geometric design, construction, maintenance, and pavement management.

- State Departments of Transportation (DOT)—Friction management guides and plans.
- Pavement industry groups—Bulletins and Manuals on surface mixture selection and texturing.
- International Agencies (e.g., United Kingdom, Australia, Japan)— Various guides, manuals, and reports on friction testing, design, and safety management.
- Step 2. Update site and demand category criteria based on the identified relationships using the best available guides and practices.
  - i. Identify attributes from step 1 (highway alignment, highway features/environment, and highway traffic characteristics factors) that are available in MDOT SHA data tables and have established quality control procedures.
  - ii. Assess the effect of available attributes on friction demand of network sections using the documents published by organizations listed in step 1 and develop/modify friction site categories accordingly.
  - iii. Check the site category criteria against criteria developed by other agencies with successful friction management programs and investigate any major discrepancy.
  - iv. Correlate the latest wet-weather crash data with the road features and pavement attributes data to validate and quantify the effect of selected attributes and modify the demand category criteria if needed.

# 3- Determining the Investigatory and Intervention Friction Levels for Each Site Category – *performed by DAT staff*

**Summary:** Under this task, the two distinct threshold levels, investigatory and intervention friction levels, are defined/reviewed for assessment of friction adequacy of pavement sections within each site category.

- Step 1. Assess the adequacy of current investigatory and intervention levels by using historical pavement friction data and crash data.
  - i. Plot friction versus pavement age and friction versus wet crash rates for each friction site category as illustrated in the figure below.



- ii. Identify investigatory level as the point corresponding to a large change in friction loss rate.
- iii. Set the friction number corresponding to a significant increase in wet crashes as intervention level.
- iv. Compare the existing and new investigatory and intervention levels and update the thresholds if necessary.

# 7.02 NETWORK DEFINITION AND SEGMENTATION

## 7.02.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Analysis Team (DAT) and Data Warehouse Team (DWT) to define the PFM program network and then divide the network into segments based on factors that influence friction demand. In general, an array of factors comprising the following four broad categories affect the pavement friction demand: highway alignment, highway features/environment, highway traffic characteristics, and driver/vehicle characteristics. The last category, driver/vehicle characteristics, is difficult to assess in terms of friction demand but factors such as location, road geometrics, pavement type, construction history, road and median type, traffic level, road features (intersections, crosswalks, ...), and so forth can be assessed. This section describes network segmentation procedure that is vital to preparation of annual friction management reports.

## 7.02.02 Frequency

Network definition and segmentation is performed annually, after friction site and demand categories and network data tables are finalized. Additionally, selected attribute data are deleted and re-imported whenever changes to the source tables occur. Network definition and segmentation should be repeated every time an updated inventory is provided.

## 7.02.03 Purpose

The purpose of this SOP is to define pavement sections with similar friction demand levels within the network using factors known to affect pavement friction demand.

## 7.02.04 *Resource Requirements*

The network definition and segmentation involve three persons: a DAT staff member knowledgeable of pavement friction performance and pavement management data tables, a DWT staff member knowledgeable of Oracle and source data tables, and and a DAT team leader. The estimated effort level in the table below represents the total time, in man-hours, to complete the network segmentation and data aggregation process. The time estimate assumes no issues are encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DAT Staff	Analyst	1	4.0
DWT Staff	Database Management	1	24.0
DAT TL	Supervisor	1	2

## 7.02.05 Procedure

The procedure required to perform the network definition/segmentation process is comprised of the following three components:

- (1) Updating the network,
- (2) identifying segmentation factors,
- (3) develop/review segmentation logic, and

(4) develop/update segmentation SQL packages based on segmentation logic.

## 1- Updating the Network – performed by DWT staff

**Summary:** Under this task, the network used for the PFM program will be defined/updated to match the current network.

- Step 1. Use the most recent Highway Location Reference (HLR) table as main source to define the network.
- Step 2. Perform manual quality control review of the inventory to identify and address missing data or wrong data. This review will include investigating the completeness of network and the accuracy and consistency of data such as direction, road name, and so on.
- Step 3. Update the PFM network where needed to embrace recent changes in the network.

#### 2- Identifying Segmentation Factors – performed by DAT staff

Summary: Under this task, factors that influence friction demand are identified.

- Step 1. Identify the factors that affect friction demand and are accessible within the pavement management databases.
- Step 2. Identify the best source table or tables with the most reliable and updated data for each factor.

#### 3- Develop/Review Segmentation Logic – performed by DAT staff and Team Leader

**Summary:** Under this task, the network is divided into sections with similar friction demands along each section using a segmentation logic that takes the factors identified in step 1 into account (demand category table in section 7.01.01). Segmentation logic will be reviewed and, if necessary, updated every year. Any change in the segmentation logic should be reviewed and confirmed by a DAT Team Leader (TL).

- Step 1. Apply Category 1 criteria as per the demand category table in section 7.01.01 of this guide. Section length should be at least 0.1 mile for all category 1 sections.
- Step 2. Apply site category extension criteria as follows:

#### Site Category Extension Criteria:

- 1) If any section with a site category is less than 0.1 mile,
  - For stop events such as traffic signal, stop sign, and so on, extend the section backward starting from end milepoint (EMP),
  - For qualifying curves and downhill gradients, compute the mid-point (mid_mp) of the section, mid_mp = (BMP+EMP)/2 and extend on both sides of the mid-point to achieve 0.1 mile.
- If encountering a section with equal or higher site category (lower number represents higher site category), terminate BMP and/or EMP at the edge of that higher site category section and proceed to the next steps (consolidation and merge).

- 3) If Step 2 does not apply, break the mile point at 0.1 mile boundaries and apply the site category to the created 0.1 mile long section (0.1 mile approach to the stop event or between mid_mp - 0.05 and mid_mp + 0.05 in qualifying curves and downhill gradients).
- 4) Go back to Step 1 and repeat until no more sections less than 0.1 mile encountered.

Step 3. Apply site category consolidation criteria as follows:

#### Site Category Consolidation Criteria:

Consolidate adjacent sections with the same site category into one section.

#### Step 4. Apply site category merge criteria as follows:

#### Site Category Merge Criteria:

- 1) Check the gap between any two sections with a site category. If the gap length is less than 0.1 mile:
  - If the gap is between two sections with similar site categories apply the site category to the section/sections in the gap.
  - If the gap is between two sections with different site categories apply the higher of the two site category numbers (e.g. between site categories 1 and 3, assign 3 to the section/sections in the gap)
- 2) If section is <0.1 mile, and the section is the beginning or ending section of a route, then assign the Site Category from the adjacent section to the begin/end section.
- Step 5. At this point, the network is segmented as Category 1 or "Not Categorized". Check whether all Category 1 segments are greater or equal to 0.1 mile in length and proceed to steps 6-9 to determine site category 2 sections.
- Step 6. Apply Category 2 criteria based on the demand category table in section 7.01.01 of this guide for the "Not Categorized" sections of the network without any section length limit consideration.
- Step 7. Apply site category extension criteria (step 2).
- Step 8. Apply site category consolidation criteria (step 3).
- Step 9. Apply site category merge criteria (step 4).
- Step 10. At this point, the "Not Categorized" network is further segmented to Category 2 or "Not Categorized" sections and All Category 1 and Category 2 segments are at least 0.1 mile long. Proceed with Steps 11-14 using the "Not Categorized" sections of the network to assign site category 3.
- Step 11. Apply Category 3 criteria based on the demand category table in section 7.01.01 of this guide for the "Not Categorized" sections of the network without any section length limit consideration.
- Step 12. Apply site category extension criteria (step 2).
- Step 13. Apply site category consolidation criteria (step 3).

- Step 14. Apply site category merge criteria (step 4).
- Step 15. At this point, the entire network should be categorized, and every segment should be at least 0.1 mile long.
- Step 16. No given section should be downgraded from its assigned site category at any point throughout the segmentation steps. Perform a check on the entire segment to verify the network has been categorized correctly.
- Step 17. Add GPS lat and long for each of the segmentation mile markers.

#### 4- Develop/update network segmentation SQL packages – performed by DWT staff

**Summary:** Under this task, the site and demand category criteria and segmentation logics are translated into SQL procedures and packages. Segmentation SQL packages will be reviewed and, if necessary, updated every year.

- Step 1. Review the segmentation logic, and
- Step 2. Develop/update SQL procedures and packages for segmenting the network based on the segmentation logic.

All the SQL procedures and packages currently used for network segmentation are included in Appendix 11.14.
# 7.03 SECTION SITE AND DEMAND CATEGORY ANALYSIS

# 7.03.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Analysis Team (DAT) and Data Warehouse Team (DWT) to check the performance of the developed network segmentation SQL packages and to create a segmented network table with friction site and demand category and investigatory and intervention level information for each section in accordance with the established criteria and logics.

# 7.03.02 Frequency

Demand category analysis is performed annually, after friction demand categories are reviewed, network data tables are finalized, network segmentation logic is established, and network segmentation SQL packages are developed or updated or confirmed. Additionally, if any relevant attribute data is re-imported due to a change to the source tables, or if SQL packages are updated due to a change in the segmentation logic, section site and demand category analysis should be repeated.

# 7.03.03 Purpose

The purpose of this SOP is to segment the network using the established criteria and logic and to identify the friction site and demand category and investigatory and intervention friction levels for each section of the network.

### 7.03.04 Resource Requirements

The section friction site and demand category analysis involves two persons: a DAT staff member knowledgeable of PFM program segmentation demand category criteria and segmentation logics and a DWT staff member knowledgeable of Oracle SQL Developer. The estimated effort level in the table below represents the total time, in man-hours, to complete the site and demand category analysis. The time estimate assumes no issues are encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DAT Staff	Analyst	1	12.0
DWT Staff	Database Management	1	4.0

# 7.03.05 *Procedure*

The procedure required to perform the site and demand category analysis is comprised of the following two components:

(1) check the performance of the developed SQL packages.

(2) execute the segmentation and demand category SQL packages.

### 1- Check the performance of the developed SQL packages – performed by DAT staff

**Summary:** Under this task, the performance of the developed segmentation SQL packages will be examined. The performance/accuracy of the package needs to be examined after each package update.

- Step 1. Select several sample routes with a variety of features and event affecting the friction demand.
- Step 2. Segment the table manually and using the SQL package and compare the results.
- Step 3. If manual and automated (SQL package) segmentation results match for all the sample routes then proceed to the next step (package execution), otherwise report the discrepancy to the DWT staff for troubleshooting.

# **2- Execute the segmentation and demand category SQL package –** *performed by DWT staff*

**Summary:** Under this task, the network is segmented and site and demand category for each section of the network is determined by executing the segmentation and demand category SQL packages.

Step 1. Execute the segmentation and demand category SQL packages annually for the network.

Run the segmentation and demand category SQL packages to segment the network and populate site category, demand category, and investigatory and intervention friction levels for each section of the network. The packages need to be executed at least once every year to account for inventory changes or construction related geometry changes. Moreover, the packages should be executed after every package update.

# 7.04 DATA AGGREGATION

## 7.04.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Analysis Team (DAT) and Data Warehouse Team (DWT) to aggregate data needed for performing friction analysis for each section of the network and prioritization of sections with friction deficiency. This section describes data aggregation logics and procedures to prepare the annual friction management table for friction analysis.

# 7.04.02 Frequency

Network data aggregation for friction management table is performed annually, after friction demand categories are reviewed, network data tables are finalized, network segmentation logic is established, and network segmentation SQL packages are developed, examined, and executed. Additionally, selected attribute data are deleted and re-imported whenever changes to the source tables or segmentation table occur.

### 7.04.03 Purpose

The purpose of this SOP is to prepare the friction management table for performing friction analysis for each section of the network and section prioritization.

# 7.04.04 *Resource Requirements*

The data aggregation involves two persons: a DAT staff knowledgeable of friction table attributes and friction demand categories and a DWT staff member knowledgeable of Oracle and source data tables. The estimated effort level in the table below represents the total time, in man-hours, to complete the data aggregation process. The time estimate assumes no issues are encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DAT Staff	Analyst	1	3.0
DWT Staff	Database Management	1	6.0

### 7.04.05 *Procedure*

The procedure required to perform the data aggregation process is comprised of the following two components:

- (1) identify data aggregation method for each attribute, and
- (2) perform data aggregation.

### 1- Identify Data Aggregation Method – performed by DAT staff

**Summary:** Under this task, the proper data aggregation method for each data field is identified.

- Step 1. Identify/review data fields in the PFM table and update, add, or remove data fields if necessary.
- Step 2. Identify the use and purpose of each data field in the pavement friction program.

Step 3. Based on the identified purpose of each data field, determine the right aggregation method/methods (minimum, maximum, average, dominant, ...).

The following table presents some of the data fields in the pavement friction management program table with their purpose and identified aggregation method:

Attribute	Effect/Purpose	Aggregation Method
CURVE_YEAR	NA	Latest Year Available
TYPE	Curves Have Higher Demand	Dominant
RADIUS	Increases Demand	Maximum
CLASS	A: smooth curve (R>506 m), F: sharp curve (R<61 m)	Minimum
FEATURETYPES	Curve Type	Dominant
MAXISUPERELEVATION	Can Decrease Demand	Maximum
MINISUPERELEVATION	Can Decrease Demand	Minimum
STARTSUPERELEVATION	Can Decrease Demand	Begin
MIDDLESUPERELEVATION	Can Decrease Demand	Middle
ENDSUPERELEVATION	Can Decrease Demand	End
AVERAGESUPERELEVATION	Can Decrease Demand	Weighted Average
AVG_LANEWIDTH_FEET	NA	Weighted Average
PONDING_AREA	Increases Demand	Maximum
AVG_PONDING_AREA	Increases Demand	Weighted Average
RUT_DEPTH	Increases Demand	Maximum
AVG_RUT_DEPTH	Increases Demand	Weighted Average
AVG_CROSSFALL_PERCENT	Can Decrease Demand	Weighted Average
MIN_CROSSFALL_PERCENT	Can Decrease Demand	Minimum
MAX_CROSSFALL_PERCENT	Can Decrease Demand	Maximum
FIRST_CROSSFALLINPERCENT	Can Decrease Demand	First
LAST_CROSSFALLINPERCENT	Can Decrease Demand	Last
SN_CURRENT	SN_NUMBER	Stepped average
SN_MINUS1	SN_NUMBER	NA
SN_MINUS2	SN_NUMBER	NA
SN_MINUS3	SN_NUMBER	NA
LAST_TREATMENT_YEAR	Years Used for Determining SN_NUMBER	Last treatment year
SN_NUMBER	Prioritization and Treatment Decision	Minimum
SC_DENSITY	Treatment Decision	Weighted Average
FC_DENSITY	Treatment Decision	Weighted Average
AVG_IRI	Treatment Decision	Weighted Average

#### STATE HIGHWAY ADMINISTRATION

Attribute	Effect/Purpose	Aggregation Method
SURFACE_AGE	Treatment Decision	Dominant
SURFACE_MATERIAL	Treatment Decision	Dominant
AVG_GRADE	Downhill gradient increases demand	Weighted Average
MIN_GRADE	Downhill gradient increases demand	Minimum
MAX_GRADE	Downhill gradient increases demand	Maximum
MPD_WP_AVG	Higher Mean Profile Depth Accelerates Surface Water Drainage	Weighted Average
FUNC_CL	Treatment Decision	Dominant
AADT	Higher Traffic Increases Demand	Maximum
SPEED	Higher Speed Limits Increase Demand	Maximum
ADT	Higher Traffic Increases Demand	Maximum
Truck Percentage	Higher Truck Percentage Increases Demand	Maximum
MEDIAN_TYPE	Undivided Highways have Higher Demand	Dominant
Wet Crash Rate	Demand Category Verification	Maximum
528'_FROM_CROSS	Road Crossing Features Increase Demand	0 or 1
LATITUDE	Mapping	Closest
LONGITUDE	Mapping	Closest

### 2- Perform Data Aggregation – performed by DWT staff

**Summary:** Under this task, data aggregation for pavement friction management program table data fields is performed.

- Step 1. Compile SQL queries or SQL packages for aggregating data into the segmented PFM table using the determined data aggregation methods for each field.
- Step 2. Execute the queries or packages to populate data into the segmented PFM table.

The SQL package is currently under development by the DWT staff.

# 7.05 SECTION PRIORITIZATION

# 7.05.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Warehouse Team (DWT) to prioritize sections with friction deficiency based on their friction demand, road class, traffic characteristics, and friction level. The current version of PFM only uses site category and friction deficiency for prioritization, but a more comprehensive and robust prioritization procedure will be implemented into the PFM in the future.

# 7.05.02 Frequency

Section prioritization is performed annually, once section site and demand category analysis, and data aggregation are completed. Additionally, if any attribute data is re-imported or network segmentation is updated due to a change to the source tables or a change in the inventory, section prioritization should be repeated.

# 7.05.03 *Purpose*

The purpose of this SOP is to give higher priority to the sections with higher potential for wet weather accidents within each site category.

# 7.05.04 Resource Requirements

The section prioritization involves one person: a DAT staff member knowledgeable of pavement friction performance and PFM. The estimated effort level in the table below represents the total time, in man-hours, to complete the demand category analysis. The time estimate assumes no issues are encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)		
DAT Staff	Analyst	1	4.0		

# 7.05.05 *Procedure*

The procedure required to prioritize the sections is comprised of the following step:

- (1) Give the sections priorities based on site category and friction deficiency,
- (2) Compare the results with the most recent wet crash data, and
- (3) Update the skid data collection list if needed.

# 1- Give the Sections Priorities Based on Site Category and Friction Deficiency – performed by DAT staff

**Summary:** Under this task, sections are prioritized based on their site category and friction deficiency.

- Step 1. Sort the sections based on site category from smallest to largest. Site category 1 has the highest and site category 3 has the lowest friction demand.
- Step 2. Within each site category, order the sections based on friction deficiency by simply sorting them based on friction value from smallest to largest.
- Step 3. If multiple sections have similar friction values, sort them based on traffic volume and speed limit from largest to smallest.

### 2- Compare the results with the most recent wet crash data – performed by DAT staff

**Summary:** Under this task, the most recent wet crash data are obtained and sections with high wet accident rates are further investigated.

- Step 1. Obtain the most recent state wet crash list in cooperation with Office of Traffic and Safety (OOTS).
- Step 2. Identify sections with high numbers of wet crashes.
- Step 3. Investigate the identified sections and update their priority if needed.

### 3- Update the skid data collection list – performed by DAT staff

**Summary:** Under this task, the skid collection list is updated using the updated site categories.

- Step 1. Populate the inventory mileage table based on updated site categories.
- Step 2. Work with Field Explorations Division (FED) staff to determine available skid data collection resources and skid data collection limitations.
- Step 3. Optimize the "% of miles collected per year" and "data collection interval" for each site category with a high emphasis on collecting more mileage and data points from site categories with a higher demand. The goal would be collecting 100% of roads in site category 1 using minimum possible data collection interval and adjusting the "% of miles collected per year" and "data collection interval" for the rest of the network (site categories 2 and 3) based on available data collection resources and feasible skid data points.

The following table is an example skid data collection list. Note that the actual annual list can change based on feedback from FED and data collection limitations.

#### STATE HIGHWAY ADMINISTRATION

				>=1 Mile Roads			< 1 Mile Roads				Total			
Site Category	Investigatory SN	Intervention SN	Demand Category	Total Mileage - SHA Only	Mileage	% of miles collected per year	Collection Interval (mile)	# of tests collected	Mileage	% of miles collected per year	Collection Interval (mile)	# of tests collected	# Miles Tested	# of tests collected
1	55	45	High	1,730	1,428	100%	0.05	28,560	302	100%	0.05	6,040	1,730	34,600
2	45	35	Medium	3,092	2,847	50%	0.2	7,118	245	50%	0.2	613	1,546	7,730
3	40	30	Low	6,192	5,870	33%	0.5	3,909	322	33%	0.5	536	2,062	4,446
Total				11,014	10,145								5,338	46,776
													48%	0.114
													% Collected	Avg Interval

i. This table is only a suggested skid data collection approach and can change based on feedback from FED and data collection limitations.

ii. For site category descriptions, refer to the site category table in section 7.01.01.

# 7.06 GENERATING REPORTS

## 7.06.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Analysis Team (DAT) to generate annual reports and maps for the "Pavement Friction Management Plan". This SOP is performed once the site and demand categories are populated and sections are sorted based on priority.

# 7.06.02 Frequency

The generation of skid reports and maps is performed annually, after the end of the data collection season, and once all data have been processed and migrated into the appropriate tables, network is segmented, data is aggregated into the friction management table, and sections are prioritized. The reports may need to be re-generated if any of the source tables or segmentation change.

# 7.06.03 Purpose

The purpose of this SOP is to generate friction demand category reports and maps to identify sections with friction values below intervention and investigatory levels in each category demand. These reports are complemented with guidance for selecting techniques and treatments that will provide adequate wet pavement friction or lower the chance of wet crash accidents.

# 7.06.04 Resource Requirements

Generating reports and maps involves one person: a DAT staff member familiar with the friction management plan. The estimated effort level shown in the table below represents the total time, in man-hours, to complete the report generation. This time estimate assumes no issues are encountered during the report generation process.

Position	Function	Resources	Effort Level (man-hrs)		
DAT Staff	Analyst	1	4.0		

# 7.06.05 *Procedure*

The procedure to generate reports is comprised of the following two tasks:

- (1) generate statewide report,
- (2) generate district and county reports, and
- (3) generate color coded district and couty maps.

### 1- Generate Statewide Reports – performed by DAT Staff

**Summary:** Under this task, state-wide reports from the site and demand category analysis will be generated for the whole network.

- Step 1. Publish state-wide PFM table and friction deficiency table.
  - i. Open the friction management table
  - ii. List the sections based on site category and priority level.

- iii. Create another list by filtering out the sections that have friction values above investigatory level.
- iv. Publish both lists as state-wide pavement friction management (PFM) program table and state-wide sections with friction deficiency.
- v. Attach the following statement to the report:

"Design engineers should use the latest Maryland State Highway Administration (MDSHA) <u>Pavement & Geotechnical Design Guide</u> to fulfill the requirements of the identified sections with friction deficiency. Section 2.08 of the <u>Design Guide</u> contains guide tables for identifying proper treatments based on pavement type, daily traffic, and pavement performance measures.

Section 2.09 of the <u>Design Guide</u> provides detailed information for each treatment and shows which treatments are intended to improve skid resistance.

Section 6.06.03.02.03.1 of <u>Design Guide</u> describes the pavement preservation and rehabilitation friction design concepts used by MDOT SHA. This section contains guide tables and equations for determining the initial skid numbers and deterioration rates for treatments such as Dense-Graded HMA, Gap-Graded HMA, Micro-Surfacing, High Friction Surface, Surface Abrasion, and Diamond Grinding."

### 2- Generate District and County Reports – performed by DAT Staff

**Summary:** Under this task, district- and county-based reports from the site and demand category analysis will be generated for the whole network.

- Step 1. Open the friction management table.
- Step 2. Use the state-wide table to create individual district tables.
  - i. Filter the state-wide table using the district field.
  - ii. List the sections based on site category and priority level.
  - iii. Create another list by filtering out the sections that have friction values above investigatory level.
  - iv. Publish both lists as district friction management program (PFM) table and district sections with friction deficiency for each district.
  - v. Attach the following statement to each report:

"Design engineers should use the latest Maryland State Highway Administration (MDSHA) <u>Pavement & Geotechnical Design Guide</u> to fulfill the requirements of the identified sections with friction deficiency. Section 2.08 of the <u>Design Guide</u> contains guide tables for identifying proper treatments based on pavement type, daily traffic, and pavement performance measures.

Section 2.09 of the <u>Design Guide</u> provides detailed information for each treatment and shows which treatments are intended to improve skid resistance.

Section 6.06.03.02.03.1 of <u>Design Guide</u> describes the pavement preservation and rehabilitation friction design concepts used by MDSHA. This section contains guide tables and equations for determining the initial skid numbers and deterioration rates for

treatments such as Dense-Graded HMA, Gap-Graded HMA, Micro-Surfacing, High Friction Surface, Surface Abrasion, and Diamond Grinding."

Step 3. Use the state-wide table to create individual county tables.

- i. Filter the state-wide table using the county field.
- ii. List the sections based on site category and priority level.
- iii. Create another list by filtering out the sections that have friction values above investigatory level.
- iv. Publish both lists as county friction management program (PFM) table and county sections with friction deficiency for each district.
- v. Attach the following statement to each report:

"Design engineers should use the latest Maryland State Highway Administration (MDSHA) <u>Pavement & Geotechnical Design Guide</u> to fulfill the requirements of the identified sections with friction deficiency. Section 2.08 of the <u>Design Guide</u> contains guide tables for identifying proper treatments based on pavement type, daily traffic, and pavement performance measures.

Section 2.09 of the <u>Design Guide</u> provides detailed information for each treatment and shows which treatments are intended to improve skid resistance.

Section 6.06.03.02.03.1 of <u>Design Guide</u> describes the pavement preservation and rehabilitation friction design concepts used by MDSHA. This section contains guide tables and equations for determining the initial skid numbers and deterioration rates for treatments such as Dense-Graded HMA, Gap-Graded HMA, Micro-Surfacing, High Friction Surface, Surface Abrasion, and Diamond Grinding."

#### 3- generate color coded district and county maps – performed by DAT Staff

**Summary:** Under this task, district and county reports are used to create color coded skid maps.

- Step 1. Map the data for each district and county using the latest geospatial skid data tables.
- Step 2. Use the friction number, investigatory and intervention level of each section to color code the map as follows:
  - Use red if Skid Number is worse than Intervention Level.
  - Use yellow if Skid Number is between Intervention Level and Investigatory Level.
  - Use green if Skid Number is higher than Investigatory Level.

# 7.07 FUTURE IMPROVEMENTS TO THE PFM PROGRAM

# 7.07.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Analysis Team (DAT) to improve the current procedures of the "Pavement Friction Management Plan". This SOP is performed annually after the publication of PFM reports or once any new relevant type of data with potential for improvement of program becomes available. Implementation of International Friction Index (IFI) into the plan and development of a more robust prioritization procedure for correction of the hazardous skid-prone locations are two expected improvements that MDOT SHA will be undertaking in near future. As more reliable data become available, the PFM procedures may be modified to increase the efficiency of the program.

# 7.07.02 Frequency

The improvement to the PFM is performed annually, after the publication of PFM reports or once new relevant type of data become available.

# 7.07.03 Purpose

The purpose of this SOP is to use the available resources to make the PFM as efficient as possible.

# 7.07.04 *Resource Requirements*

Improving the PFM involves two persons: a DAT staff member familiar with the friction management plan and DAT team leader. The estimated effort level shown in the table below represents the total time, in man-hours, to complete the report generation. This time estimate assumes no issues are encountered during the report generation process.

Position	Function	Resources	Effort Level (man- hrs)		
DAT Staff	Analyst	1	8.0		
DAT TL	Supervision	1	2.0		

# 7.07.05 *Procedure*

The procedure to improve the PFM is comprised of the following two tasks:

- (1) Identify procedures that can be improved by modifying the steps, and
- (2) Investigate if new data sources can be used to improve the procedures.

# **1- Identify Procedures That Can Be Improved by Modifying the Steps** – *performed by DAT Staff*

**Summary:** Under this task, steps within each procedure are assessed and areas where improvements can be made are identified.

- Step 1. Assess the steps within each procedure and look for ways to improve the procedure.
- Step 2. Make a list of suggested improvements and share it with DAT team leader.
- Step 3. Improve the procedures based on the approved list of suggestions.

# 2- Investigate if New Data Sources Can Be Used to Improve the Procedures – performed by DAT Staff

**Summary:** Under this task, availability of new data sources and data fields will be investigated, and procedures will be modified accordingly to allow for incorporation of new resources.

- Step 1. Assess the availability of new resources such as new data fields.
- Step 2. Assess the reliability and accuracy of new data.
- Step 3. Make a list of suggested improvements and share it with DAT team leader.
- Step 4. Improve the procedures based on the approved list of suggestions.

# 8 HPMS DATA REPORTING

Click to go to <u>Production of HPMS Sample Table</u> Click to go to <u>Production of HPMS Full Extent Table</u> Click to go to <u>QA of HPMS Tables</u>



#### Figure 11: HPMS Data Reporting Flowchart

This section describes the set of standard operating procedures (SOP) conducted mainly by staff from the Data Analysis Team (DAT) of the Maryland Department of Transportation State Highway Administration's (MDOT-SHA) Office of Materials Technology (OMT) to update, format, and deliver the Highway Performance Monitoring System (HPMS) tables to the DSD. This section is divided into three SOPs: updating of the HPMS Sample table, updating of the HPMS Full-Extent table, and QA of the tables. The first two cover the production and QC of the HPMS deliverables whereas the third SOPs covers the QA performed to the HPMS deliverables before they are submitted to the DSD.

# 8.01 PRODUCTION OF HPMS SAMPLE TABLE

# 8.01.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Warehouse Team (DWT) and Data Analysis Team (DAT) to produce the Highway Performance Monitoring System (HPMS) Sample Table as required by the Federal Highway Administration (FHWA). The table utilizes the Data Services Division's (DSD) Sample Section table, which is received in Excel format and includes a list of sections for the current year's Sample Table. This process is performed after the completion of Business Plan Tables (BPT) migration, as outlined in <u>Migrating to Business Plan Tables</u> and the production of the HPMS Full Extent table, as outlined in <u>Production of HPMS Full Extent Table</u>.

# 8.01.02 Frequency

The HPMS Sample Table is produced once per year.

# 8.01.03 *Purpose*

The purpose of this SOP is detailed the procedure required to process the DSD Sample Section Table dataset and to populate the HPMS Sample Table with data for the current year for submission to the FHWA.

# 8.01.04 Resource Requirements

The production of the HPMS Sample Table involves two people: (1) the DAT Team Leader (TL) who produces the table and performs quality control (QC), and (2) a DWT member, who, as requested, provides database management support. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues are encountered.

Position	Function	Resources	Effort Level (man-hrs)
DWT Staff	Database Management Support	1	AR ^{06/12/2019}
DAT TL	Data Processing and QA	1	50.0

# 8.01.05 *Procedure*

The procedure to produce the HPMS Sample Table is comprised of four tasks:

- (1) processing DSD Sample Section dataset,
- (2) sending list of changes to DSD,
- (3) producing initial version of HPMS Sample Table, and
- (4) performing QC of HPMS Sample Table.

### **1- Processing DSD Sample Section Dataset** – *performed by DAT TL*

**Summary:** Under this task, HPMS sections that do not have homogenous surface types are split. For instance, if a sample section has a flexible surface type and a concrete surface type, the sample section needs to be split into two distinct sections, one per each surface type. The output is an updated HPMS Sample Section Table with the surface type field populated for all sections. A list of sections that were broken

out in this task based on varying surface types will be sent back to the DSD (see below image for an example of the Sample Section Table).

ROUTEID	COUNTY PREFIX	RTE_NO	SUFFIX	MUN_SORT	BMP	EMP	NEW_BMP	EMP_NEW	BMP_LAT	BMP_LONG	EMP_LAT	EMP_LONG
02000IS00097 01NN**************	2 IS	97		0	11.19	12.1	11.19	12.056	39.11593614	-76.63542651	39.11594939	-76.63543419
02000IS00097 01NN***********************************	2 IS	97		0	11.19	12.1	12.056	12.1	39.12773572	-76.64106639	39.12774939	-76.64107266
03000US00040 01EE**********************************	3 US	40		0	21.84	23.06	21.84	22.977	39.38429794	-76.42215534	39.38430811	-76.422142
03000US00040 01EE**********************************	3 US	40		0	21.84	23.06	22.977	23.06	39.39586443	-76.4069788	39.39587464	-76.40696544
07000MD00213 01NN***********************************	7 MD	213		0	18.85	19.11	18.85	18.937	39.6079611	-75.83400371	39.60797408	-75.834012
07000MD00213 01NN***********************************	7 MD	213		0	18.85	19.11	18.937	19.006	39.60910045	-75.83471296	39.60911346	-75.83472122
07000MD00213 01NN***********************************	7 MD	213		0	18.85	19.11	19.006	19.11	39.60999754	-75.83528331	39.61001048	-75.83529171
08000US00301 01NN*********************************	8 US	301		0	0	2.08	0	1.905	38.35895819	-77.01840715	38.358946	-77.01840244
08000US00301 01NN*********************************	8 US	301		0	0	2.08	1.905	2.08	38.36376154	-76.98072178	38.36376384	-76.98070364
08000US00301 01NN*********************************	8 US	301		0	2.23	3.81	2.23	2.318	38.3644891	-76.97480903	38.36449193	-76.97479089
08000US00301 01NN*********************************	8 US	301		0	2.23	3.81	2.318	3.81	38.36472564	-76.97321318	38.36472812	-76.97319503
15000MD00187 01NN***********************************	15 MD	187		0	0.65	0.91	0.65	0.665	38.99063073	-77.10385837	38.99063966	-77.10387303
15000MD00187 01NN***********************************	15 MD	187		0	0.65	0.91	0.665	0.877	38.99076425	-77.10407855	38.99077316	-77.10409325
15000MD00187 01NN***********************************	15 MD	187		0	0.65	0.91	0.877	0.897	38.99270694	-77.10715414	38.99271692	-77.10716781
15000MD00187 01NN***********************************	15 MD	187		0	0.65	0.91	0.897	0.91	38.99290805	-77.10742568	38.9929183	-77.10743893
15000MD00355 01NN***********************************	15 MD	355		0	5.84	6.38	5.84	5.996	39.04307296	-77.11083085	39.04308673	-77.11083711
15000MD00355 01NN***********************************	15 MD	355		0	5.84	6.38	5.996	6.018	39.04520211	-77.11183852	39.04521583	-77.11184452
15000MD00355 01NN***********************************	15 MD	355		0	5.84	6.38	6.018	6.38	39.04550435	-77.11197444	39.04551801	-77.1119807
15000MD00355 01NN***********************************	15 MD	355		0	18.95	19.7	18.95	19.384	39.19643037	-77.24440993	39.19644468	-77.24441369
15000MD00355 01NN***********************************	15 MD	355		0	18.95	19.7	19.384	19.506	39.19985437	-77.24507808	39.19986878	-77.24508044
15000MD00355 01NN***********************************	15 MD	355		0	18.95	19.7	19.506	19.7	39.20162137	-77.24536508	39.20163591	-77.24536751
16000MD00450 01EE**********************************	16 MD	450		0	3.5	4.19	3.5	4.16	38.95230222	-76.8839262	38.95230687	-76.88390868
16000MD00450 01EE**********************************	16 MD	450		0	3.5	4.19	4.16	4.168	38.95567738	-76.87288021	38.95568595	-76.87286491
16000MD00450 01EE**********************************	16 MD	450		0	3.5	4.19	4.168	4.19	38.95574539	-76.87275808	38.95575401	-76.87274294

- Step 1. Using SQL Developer, run the script^{06/12/2019} "1_Create Surface Type from B_LMY.txt" to create an auxiliary table that will be used to aggregate surface types from the "Business_Plan_LMY" table.
- Step 2. Using SQL Developer, run the script "2_Join Samples with B_LMY Surface Type.txt" to merge the dataset created in Step 1 with the original HMPS Sample Section List. The output of this step will split some sample sections into distinct records based on varying surface types.
- Step 3. Using SQL Developer, run the script "3_ZZ_EDW_SURFACE_BREAKS" to build another intermediate table based on the "EDW_Base_1" table. This will populate surface type information for sections that had missing information from the "Business_Plan_LMY" table.
- Step 4. Using SQL Developer, run the script "POP_SURF_TYPE_HMIS" to populate surface type information that is still missing after Step 1 through Step 3 using the "HMIS_UNIVERSE_ALL_YEARS" table.

### 2- Sending List of Changes to DSD – performed by DAT TL

**Summary:** Under this task, the section modifications identified in the previous task are communicated to the DSD. Also, QC on the table is performed to verify that the new sections have unique identifiers. The DSD produces a new table that accounts for the section changes.

- Step 5. Submit the list of section modifications (only affected locations and in excel csv format) to the DSD via email. The DSD will update and submit a final list of HPMS Sample Sections that includes the additional sections created a result of the surface type section splits back to the DAT.
- Step 6. Inspect and verify that the newly submitted list has the "ORDER_ID" and "Sample_NUMBER" fields populated for all records, including the sections added during the previous task. In addition, verify that there is a unique identifier (ORDER_ID) for each sample record.

- iii. If there are discrepancies encountered during verification, communicate issues to DSD and resolve them before continuing.
- iv. Otherwise, proceed to Step 7.

### **3- Producing HPMS Sample Table** – *performed by DAT TL*

**Summary:** This task uses the updated DSD Sample Section Table to produce the HPMS Section Table by populating, adding, and aggregating data fields.

Step 7. Using Oracle SQL Developer, run a series of packages and scripts to populate the data elements that are part of the submittal for the HPMS Sample locations. The table below shows the data elements that should be populated and the name of the package or script that should be used. Please note that the majority of the data elements are extracted from the HPMS Full-Extent Table already produced for the corresponding year^{06/12/2019}.

HPMS Sample Data Element	Method	Package/Script	Procedure
IRI	SCRIPT	POP_IRI_HPMS_SAMPLE.SQL	N/A
IRI_VALUE_DATE	SCRIPT	POP_IRI_DATE_HPMS_SAMPLE.SQL	N/A
CRACKING_PERCENT	SCRIPT	POP_CRACKING_PERCENT_HPMS_SAMPLE	N/A
CRACKING_VALUE_DATE	SCRIPT	POP_CRACKING_VALUE_DATE_HPMS_SAMPLE.SQL	N/A
RUTTING	SCRIPT	POP_RUTTING_HPMS_SAMPLE.SQL	N/A
RUTTING_VALUE_DATE	SCRIPT	POP_RUTTING_DATE_HPMS_SAMPLE.SQL	N/A
FAULTING	SCRIPT	POP_FAULT_HPMS_SAMPLE.SQL	N/A
FAULTING_VALUE_DATE	SCRIPT	POP_FAULT_VALUE_DATE_HPMS.SQL ^{06/12/2019}	N/A
THICKNESS_RIGID	PACKAGE	BING_HPMS_PAV	N/A
THICKNESS_FLEXIBLE	PACKAGE	BING_HPMS_PAV	N/A
BASE_THICKNESS	PACKAGE	BING_HPMS_PAV	N/A
YEAR_LAST_IMPROV	PACKAGE	BING_HPMS_PAV	N/A
YEAR_LAST_CONSTRUCTION	PACKAGE	BING_HPMS_PAV	N/A
LAST_OVERLAY_THICKNESS	PACKAGE	BING_HPMS_PAV	N/A
CURVE_A	PACKAGE	BING_HPMS_CON	HPMS_CURVE
CURVE_B	PACKAGE	BING_HPMS_CON	HPMS_CURVE
CURVE_C	PACKAGE	BING_HPMS_CON	HPMS_CURVE
CURVE_D	PACKAGE	BING_HPMS_CON	HPMS_CURVE
CURVE_E	PACKAGE	BING_HPMS_CON	HPMS_CURVE
CURVE_F	PACKAGE	BING_HPMS_CON	HPMS_CURVE
GRADE_A	PACKAGE	BING_HPMS_CON	HPMS_GRADE
GRADE_B	PACKAGE	BING_HPMS_CON	HPMS_GRADE
GRADE_C	PACKAGE	BING_HPMS_CON	HPMS_GRADE
GRADE_D	PACKAGE	BING_HPMS_CON	HPMS_GRADE
GRADE_E	PACKAGE	BING_HPMS_CON	HPMS_GRADE
GRADE_F	PACKAGE	BING_HPMS_CON	HPMS_GRADE

### 4- Performing QC of HPMS Sample Table – performed by DAT TL

**Summary:** Under this task, checks on the created HPMS Sample Table are performed in order to ensure that all fields are correct and complete, following the specifications

in the HPMS Field Guide. Please note that the HPMS Field Guide changes regularly and some updates may require an update to the steps in this SOP.

- Step 8. Once the HPMS Sample table is populated, perform quality checks to identify possible missing items or data discrepancies. Check for data that are outside the allowable ranges as specified in the HPMS Field Guide.
  - i. If data are found to be missing or outside the allowable ranges of the HPMS Field Guide specifications, investigate the flagged data to identify the source of the error. If a flagged data value is validated by the investigation, report asis. Otherwise, correct error and revise table. Fixing errors may involve more ad hoc data analysis approaches, such as the usage of more granular data sources (e.g., in Base 1 and Base 4 tables).
  - ii. If no data are found to be missing or outside the allowable ranges of the HPMS Field Guide specifications, process is complete.

# 8.02 PRODUCTION OF HPMS FULL-EXTENT TABLE

### 8.02.01 General

This section describes the standard operating procedure (SOP) used by staff from the Maryland Department of Transportation State Highway Administration's (MDOT-SHA's) Data Warehouse Team (DWT) and Data Analysis Team (DAT) to produce the Highway Performance Monitoring System (HPMS) Full-Extent Table as required by the Federal Highway Administration (FHWA). This process is performed after the completion of Business Plan Tables (BPT) migration, as outlined in <u>Migrating to Business Plan Tables</u>. The HPMS Full-Extent Table is produced for delivery to the Data Services Division (DSD).

### 8.02.02 Frequency

The HPMS Full-Extent Table is produced once per year.

### 8.02.03 Purpose

The purpose of this SOP is to produce the annual HPMS Full-Extent Table, which meets FHWA requirements, and once completed to deliver the table to the DSD.

### 8.02.04 *Resource Requirements*

The production of the HPMS Full-Extent Table involves three people: (1) a DWT member who produces the table and performs quality control (QC), (2) the DAT Team Leader (TL), who provides support and performs quality assurance (QA), and (3) the Assistant Division Chief (ADC), who, as requested, performs further QA. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues are encountered.

Position	Function	Resources	Effort Level (man-hrs)
DWT Staff	Data Processing and QC	1	50.0
DAT TL	Support and QA	1	4.0
ADC	QA	1	AR ^{06/12/2019}

# 8.02.05 *Procedure*

The procedure required to produce the HPMS Full-Extent Table is comprised of the following five tasks:

- (1) producing HPMS_NETWORK_CONDITION_100MMI Table,
- (2) performing QC of HPMS_NETWORK_CONDITION_100MMI Table,
- (3) creating view and notifying TL of completion,
- (4) performing QA of HPMS_NETWORK_CONDITION_100MMI Table, and
- (5) creating final dataset of HPMS Full-Extent Table and notifying ADC for further QA.

# 1- Producing HPMS_NETWORK_CONDITION_100MMI Table – performed by DWT member

**Summary:** Under this task, the four detailed tables (Final Condition Detail Table, Rut Detailed Table, Cracking Detailed Table, and Concrete Detailed Table) developed in accordance with <u>Update Final Condition Detail Table</u>, <u>Update Rut Detailed Table</u>, <u>Update Cracking Detailed Table</u> and <u>Update Concrete Detailed Table</u> are used to

adjust the section extents of the pavements in the network to adapt to FHWA HPMS requirements. The output is the creation of an intermediate table named HPMS_NETWORK_CONDITION_

100MMI that is used to produce the final Full-Extent Table.

- Step 1. Check if there are any changes in HPMS requirements from the previous year.
  - i. If there are no changes, proceed to Step 2.
  - ii. If there are changes, modify code accordingly based on the new requirements. Discuss the HPMS requirement changes with respect to the previous year with the Assistant Division Chief (ADC) to confirm the packages will run properly.
- Step 2. Using the SQL developer, run HPMS_CONDITION_100MMI package. The input will be the four detailed tables (Final Condition Detail Table, Rut Detailed Table, Cracking Detailed Table, and Concrete Detailed Table) developed in accordance with <u>Update Final Condition Detail Table</u>, <u>Update Rut Detailed Table</u>, <u>Update Cracking Detailed Table</u> and <u>Update Concrete Detailed Table</u> and the output will be the intermediate HPMS NETWORK CONDITION 100MMI Table.

### 2- Performing QC of HPMS_NETWORK_CONDITION_100MMI Table – performed by DWT member

**Summary:** Under this task, checks are conducted to confirm that the intermediate HPMS_NETWORK_CONDITION_100MMI Table was correctly populated based on completeness and then compares the data to last year's submission for quality purposes.

- Step 3. Check for completeness.
  - i. Check number of records missing for each of the data elements. No missing records are allowed. Investigate any missing records and attempt to recover. If recovery is not possible, in some cases it is permitted to carry last year's value forward.
- Step 4. Compare to last year's submission.
  - i. Check each rating group (% Poor, Fair, Good) for each condition metric. If the percent change is equal to or less than 1 point, do nothing. If the change is greater than 1 point, investigate the possible causes. Determine if the issue is related to data processing, or if it is a legitimate change in distress rating.
  - ii. Check surface types. Compare lane miles for each surface type. If the percent change is equal to or less than 1 point, do nothing. If the change is greater than 1 point, investigate the possible causes. Determine if the issue is related to data processing, or if it is a legitimate change in surface type amount.

### **3- Creating View and Notifying TL of Completion** – *performed by DWT TL*

**Summary:** Under this task, gaps in the intermediate HPMS_NETWORK_CONDITION_100MMI Table are filled with values from last year's table.

- Step 5. Check if there are changes regarding the data structure of the view. If there are no changes, do nothing. If there are changes, first modify the HPMS[YY]_FULL_EXTENT_COND code accordingly; i.e., to reflect the revised data structure. Then, create the view in the production server called HPMS[YY]_FULL_EXTENT_COND. The view will fill in holes in current year's table using values from the previous year.
- Step 6. Notify DAT Team Leader that the intermediate HPMS_NETWORK_ CONDITION_100MMI Table is ready for QA and that the view, if necessary, has been created.

### 4- QA of HPMS_NETWORK_CONDITION_100MMI Table – performed by DAT TL

**Summary:** Under this task, the updated intermediate HPMS_NETWORK_ CONDITION_100MMI Table resulting from Task 3 is first checked to confirm it has been correctly populated from a completeness viewpoint and then compares the data to table submissions from previous years for quality purposes.

### Step 7. Check for completeness.

- i. Compare total lane mileage from last year's reported HPMS data to the current year's report HPMS data (~ +/- 10 miles of last years). Check mileage by pavement type, last rehabilitation year, last construction date, and by other inventory data types.
  - 1. If checks are acceptable, proceed to Step 8.
  - 2. If checks result in differences greater than the defined tolerance, further investigation is required. For example, if aggregate difference in lane miles by county is positive, this may be to duplicated records or added miles, while if negative may be due to routes on which data were not collected. Use SQL Developer to locate where discrepancies are located. If the cause of the discrepancy is valid, accept as-is. As indicated in the HPMS Field Manual, last year's condition data may be used for a specific missing section (but confirm with HPMS Field Manual that this is allowed for metric in question). Otherwise, report section as missing value. If not valid, ask DWT staff member to fix the issue.
- Step 8. Check for data sanity (i.e., range, acceptable values):
  - i. Using SQL Developer, follow HPMS manual guidelines for doing checks (ad hoc, no code exists). For example, check for International Roughness Index (IRI) values less than 30 in/mi and greater than 400 in/mi. Investigate source of the unacceptable value. If the value is a valid measurement with correct processing, submit it as-is and include a note to the Data Services Division (DSD) justifying the value. Otherwise, contact the TL of the department where the issue originated and request they investigate the issue until it is resolved.
- Step 9. Check for discrepancies in the current year's HPMS data with respect to the last two years of HPMS data submitted.

Check overall mean values of condition metrics at State level to confirm they are within reasonable values. The mean IRI, cracking percent, rutting percent,

and faulting^{06/12/2019} percent change per year should not be more than +-2%. If values are reasonable, do nothing. If one or more checks result in a condition measurement difference outside the listed tolerance, discuss with ADC before continuing.

- Step 10. Check for validity of non-condition data elements (data item numbered 54 through 62 in the HPMS Field Manual) by comparing them with the numbers in last year's HPMS submission.
  - i. Using Oracle SQL Developer, check that the construction year is consistent with last year's submittal.
  - ii. Using SQL Developer, compare surface types between this year and last year. If the surface type has changed, check for construction events. If there are discrepancies that cannot be resolved, discuss them with DPT staff before continuing.

# 5- Creating View of Full-Extent Table and Notifying ADC for further QA – performed by DAT TL

**Summary:** Under this task, a view that will extract data from another view (pav.conhist.HPMS17_FULL_EXTENT_COND) previously created by DWT staff will be created. This view will contain the finalized Full-Extent Table for QA review by the ADC and then submission to the DSD.

- Step 11. Check if there are changes regarding the data structure of the view or the HPMS requirements. If there are no changes, do nothing. If there are changes, modify the HPMS_FULL_EXTENT code accordingly. Then, using Oracle SQL Developer, recreate the HPMS_FULL_EXTENT View within the "Pav_READ" user^{06/12/2019}.
- Step 12. Notify ADC of completion of final data set for final review (see <u>QA of HPMS</u> <u>Tables</u>). Send email with name of the view that will be accessed through "Pav_READ" user.

# 8.03 QA OF HPMS TABLES

## 8.03.01 General

This section describes the standard operating procedure (SOP) used by the Assistant Division Chief (ADC) of the Pavement Management Division of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to perform quality assurance (QA) of the Highway Performance Monitoring System (HPMS) Sample Table and Full-Extent Table before they are submitted to the Data Services Division (DSD). This SOP is performed once the annual HPMS Sample Table and the HPMS Full-Extent Table are produced. It is the last step for the reporting of data to the Federal Highway Administration's (FHWA) HPMS.

# 8.03.02 Frequency

The QA of HPMS Sample Table and Full-Extent Table is performed once per year.

# 8.03.03 Purpose

The purpose of this SOP is:

- check that the HPMS Sample Table and the HPMS Full-Extent Table (1) have been correctly populated, (2) are complete, and (3) present an accurate description of the pavement network condition before the tables are delivered to the DSD;
- investigate, if needed, reasons that explain changes in the pavement network condition with respect to the previous year condition; and
- notify the DSD of delivery of the referenced tables and to have the DSD address data issues identified from their review of the submitted tables.

### 8.03.04 *Resource Requirements*

All the procedural steps for performing QA of the HPMS Sample Table and the HPMS Full-Extent Table are to be carried out by the ADC. However, this SOP may involve the Team Leaders (TL) from other pertinent groups, who as required would provide support and information to resolve data issues encountered during the QA process. The estimated effort levels in the table below represent the total time, in man-hours, to complete the process. These time estimates assume no issues are encountered.

Position	Function	Resources	Effort Level (man-hrs)
ADC	QA checks	1	8.0
FED TL	Issue resolution	1	AR ^{06/12/2019}
DPT TL	Issue resolution	1	AR ¹
DWT TL	Issue resolution	1	AR ¹
DAT TL	Issue resolution	1	AR ¹

# 8.03.05 *Procedure*

The procedure required to perform QA of the HPMS tables is comprised of the following two tasks:

- (1) performing QA of HPMS Sample Table and Full-Extent Table, and
- (2) delivering the above referenced HPMS Tables to DSD.

#### 1- Performing QA of HPMS Sample Table and Full-Extent Table – performed by ADC

**Summary:** Under this task, the final quality checks on the HPMS Sample Table and HPMS Full-Extent Table will be performed before they are delivered to the DSD. The checks in this task serve as a means to confirm the quality of the processed data and, as appropriate, to further investigate the reasons behind the observed changes in the pavement network condition over a one year period of time.

- Step 1. Using SQL Developer, check that the data in both the HPMS Sample Table and HPMS Full-Extent Table are complete.
  - i. Use data from the DSD's annual inventory table for the corresponding collection year to identify sections with missing data from HPMA Full-Extent Table.
  - ii. Use data from the DSD's Sample Section table for the corresponding collection year to identify sections with missing data from HPMA Sample Table.

Review the identified missing data, if any, from each table and discuss with appropriate MDOT-SHA TL whether those data can be recovered through reprocessing of the data. If feasible, then request MDOT-SHA TL to reprocess potentially recoverable data and confirm that these data have been effectively included in the referenced HPMS tables.

- Step 2. Using SQL Developer, check that the data in both the HPMS Sample Table and HPMS Full-Extent Table have been populated correctly. For example, check that the correct data elements are associated with the correct surface type – e.g., faulting data should only be present for jointed concrete pavements and rutting data should only be present for asphalt concrete pavements. Proceed to next step if all data have been correctly populated. Otherwise, communicate data issues identified to the DAT TL for him/her to review these data and to make the appropriate corrections. Review HPMS tables corrected by DAT TL to confirm that the data issues identified have been resolved.
- Step 3. Using SQL Developer and Microsoft Excel, query the HPMS Sample Table and HPMS Full-Extent Table for trends and summary statistics to evaluate the changes in condition of the pavement network over a one year period of time. Example checks performed include:
  - i. Check that data related to pavement condition metrics and HPMS condition ratings (percentage of lane miles in Good, Fair, and Poor condition) in the HPMS Full-Extent Table are reasonable as compared to summary statistics obtained from data collected for the State's Pavement Management System and to the values reported in the HPMS reports from the previous year. Also, check the reasonableness of the statistics relative to the trends over time; e.g., the total lanes miles reported for a given surface type is not expected to differ by more than 1% from the previous year.
  - ii. Check that data related to construction information (e.g., total lanes miles treated) in the HPMS Sample Table is reasonable when compared to the values reported in HPMS reports from the previous year.

Discuss data identified as suspicious (e.g., large changes from one year to the next or large discrepancies with data from other reports for the same data collection year) with pertinent MDOT-SHA TL to evaluate whether the issues

are the result of improper or erroneous data processing or if they are due to changing conditions and circumstances (e.g., a significant reduction in treated miles from previous year may be explained by a decreased budget). Proceed to next step if all data have been correctly populated. Otherwise, request pertinent MDOT-SHA TL to address the data issues that have been identified. Lastly, review HPMS tables corrected by pertinent MDOT-SHA TL to confirm that all data issues have been resolved.

### 2- Reviewing and Finalizing HPMS tables with DSD – performed by ADC

**Summary:** Under this task, the HPMS Sample Table and the HPMS Full-Extent Table are finalized through an iterative process between the ADC and DSD in order to eliminate any remaining issues with the data in the referenced tables.

- Step 4. Notify DSD that the HPMS Sample Table and HPMS Full-Extent Table are ready for their review^{06/12/2019} and that the tables can be accessed through the "Pav_READ" user in the server.
- Step 5. Upon receipt of DSD's review report with the identified HPMS data issues, if any, investigate whether these issues can be resolved through discussion with the pertinent MDOT-SHA TL. If any data can be recovered, take the necessary steps to recover them and update the tables. Identify and note a reason for unrecoverable data. Notify DSD that the tables are ready for re-review, identifying those data issues that were not resolved along with the reason why they could not be resolved.
- Step 6. Repeat Step 5 until all remaining data issues highlighted in the DSD report are considered unrecoverable (e.g., missing data on sections under construction during the data collection season). Communicate to the DSD that the tables have been fully updated and that the work has been finalized.

# 9 TREND ANALYSIS

Click to go to <u>Updating IRI Performance Model</u> Click to go to <u>Updating Cracking Performance Models</u> Click to go to <u>Updating Rutting Performance Model</u> Click to go to <u>Updating Faulting Performance Model</u> Click to go to <u>Updating Friction Performance Model</u>



### Figure 12: Trend Analysis Flowchart

This section describes the set of standard operating procedures (SOP) conducted mainly by staff from the Data Warehouse Team (DWT) and Data Analysis Team (DAT) of the Maryland Department of Transportation State Highway Administration's (MDOT-SHA) Office of Materials Technology (OMT) to perform the annual update the performance models for the pavement condition metrics. This section is divided into five SOPs: updating the IRI performance model, updating the cracking performance models, updating the rutting performance model, updating the faulting performance model, and updating the friction performance model.

# 9.01 UPDATING IRI PERFORMANCE MODEL

# 9.01.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Warehouse Team (DWT) and Data Analysis Team (DAT) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to update the International Roughness Index (IRI) performance model parameters as new IRI data are collected and processed. The IRI performance model follows the exponential function shown in the equation below^{06/12/2019}, which was developed from the analysis of historical MDOT-SHA IRI data.

 $\overline{IRI} = IRI_{in}\,\mu_1 \exp(\mu_1\mu_2 AGE)$ 

Where:

IRI	=	estimated IRI value of pavement at age "AGE", in in/mile;
IRI _{in}	=	Initial pavement IRI value, in in/mile;
AGE	=	age of pavement for which IRI is estimated, in years;
$\mu_1$	=	parameter that captures effect of last treatment; and
$\mu_2$	=	parameter that captures effect of surface type, region, and
		functional class.

The equation parameters  $\mu_1$  and  $\mu_2$  are typically updated yearly to account for possible changes in IRI trends resulting from the most recent IRI data. The current values of  $\mu_1$  and  $\mu_2$  are listed in <u>IRI Performance Model</u>, while a summary of the most recent average yearly IRI percent changes as a function of pavement family are also provided.

# 9.01.02 Frequency

The update of IRI model parameters is typically performed once per year, after the end of the data collection season and once all data have been processed and migrated into the appropriate Business Plan Tables (see <u>Migrating to Buiness Plan Tables</u>).

# 9.01.03 *Purpose*

The purpose of this SOP is to update the IRI performance model parameters to incorporate the most recently collected and processed IRI data.

# 9.01.04 *Resource Requirements*

The updating of the IRI performance models involves the following three MDOT-SHA staff members: (1) a database management expert from the DWT to update model parameters, (2) a database management expert from the DAT to validate the estimated models, and (3) a supervisor – typically the Assistant Division Chief (ADC) – who, as required, provides guidance and decision-making. The estimated effort level shown in the table below represents the total time, in man-hours, to complete the update of the IRI performance model parameters. The estimate assumes no issues are encountered during the update process.

MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

Position	Function	Resources	Effort Level (man-hrs)
DWT Staff	Model Estimation	1	16.0
DAT Staff	Model Validation	1	40.0 or as needed
ADC	Supervisor	1	As required ^{06/12/2019}

### 9.01.05 *Procedure*

The procedure required to update the IRI performance models is comprised of the following two tasks:

- (1) estimation of new IRI model parameters, and
- (2) QA new IRI model parameters.

### 1- Estimation of New IRI Model Parameters – performed by DWT staff

**Summary:** Under this task, the most recently collected and processed IRI data are used to estimate new model parameters.

- Step 1. In Oracle SQL Developer, run package "IRI_MODELS" to estimate new model parameters for each pavement family. Part of this package includes the removal of outliers from the collected IRI data. See <u>Outlier Review Outlier</u> <u>Codes</u> for details regarding the outlier review and methodology for identifying outliers in the IRI data.
- Step 2. Once the IRI model parameters for all families have been updated, inform DAT that parameters are ready for QA.

#### 2- QA of New IRI Model Parameters – performed by DAT Staff

**Summary:** Under this task, QA checks are used to confirm that the newly estimated IRI model parameters produce reasonable trends. The QA checks are performed using an existing MS Excel QA workbook template.

- Step 3. Open the most recent MS Excel QA workbook template^{06/12/2019} (sort by date modified) in the IRI models working folder.
- Step 4. Copy and paste the family slopes from table "trend_iri_family_slopes" (located in Oracle SQL Developer as an output from the previous task) into the "slope" column (E) in the worksheet "Final Groups for IRI".
- Step 5. Plot the IRI model function over 100 years for each pavement family to confirm that the trend looks reasonable. Refer to <u>IRI Performance Model</u> for the most recent average yearly IRI percent change for each pavement family.

IRI values are expected to deteriorate (i.e., increase) at about 2.4% per year on average, with some families deteriorating faster and others slower. Most families should reach an IRI value of 170 in/mile – lowest MDOT-SHA IRI trigger value (IRI_{RSL0}) corresponding to the Interstates functional class – within 100 years assuming an initial IRI value (immediately after last treatment) of 40 in/mile. Exceptions include reinforced concrete pavements and composite pavements with continuously reinforced concrete below the surface layer, which appear to deteriorate at a slower rate. The table below shows the IRI_{RSL0} trigger values for the functional classes.

#### STATE HIGHWAY ADMINISTRATION

FUNC_CL	FC_DESCRIPTION	IRI _{RSL_0, in/mile}
1	Rural Principal Arterial - Interstate	170
11	Urban Principal Arterial - Interstate	170
12	Urban Principal Arterial - Other Freeways	180
14	Urban Principal Arterial - Other	250
16	Urban Minor Arterial	265
17	Urban Major Collector	280
18	Urban Minor Collector	280
19	Urban Local	325
2	Rural Principal Arterial - Other Freeways	180
3	Rural Principal Arterial - Other	180
6	Rural Minor Arterial	250
7	Rural Major Collector	265
8	Rural Minor Collector	280
9	Rural Local	325

It is important to note that ride quality historically controls the condition of the lowest percentage of lane-miles among all five performance measures ranging between only 8-12% of the total lane-miles from 2014-2016. Therefore, it is reasonable to assume that the effect of IRI deterioration on overall pavement condition is somewhat insignificant when compared to the other four performance measures (i.e. rutting, structural and functional cracking, and friction.

- i. If models pass the above referenced QA checks, proceed to Step 6.
- ii. Otherwise, identify issues with the IRI model parameters and discuss remedial actions with appropriate personnel before continuing.
- Step 6. As needed, write/update the IRI model parameters for each pavement family in C#. The existing IRI model parameters can be found in the worksheet "IRI Function," of the MS Excel QA workbook template. The updated parameters, and hence the IRI models, will be used later in the program optimization process (see <u>Defining Network and Importing Data into the RoadCare</u> <u>Optimization Process</u>).

# 9.02 UPDATING CRACKING PERFORMANCE MODELS

# 9.02.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Warehouse Team (DWT) and Data Analysis Team (DAT) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to update the cracking performance model parameters as new cracking data are collected and processed. This SOP covers the cracking performance model parameters used for predicting cracking condition metrics, including those used by the MDOT-SHA pavement management system (PMS) as well as those for submission to the Federal Highway Administration (FHWA) Highway Performance Monitoring System (HPMS). Those metrics are listed in the table below.

Surface Type	MDOT-SHA PMS metrics	FHWA HPMS metrics
Apphalt Congrate (AC)	Structural Cracking Density	Creeking Percent AC
Asphalt Concrete (AC)	Functional Cracking Density	Cracking Percent - AC Cracking Percent - JCP
Jointed Concrete (JCP)	Structural Cracking Density	Cracking Percent - JCP
Continuously Reinforced	Structural Cracking Density	Creaking Dereast CDCD
Concrete (CRCP)	Functional Cracking Density	Tics FHWA HPMS metrics   nsity Cracking Percent - AC   nsity Cracking Percent - JCP   nsity Cracking Percent - CRCP   ensity Cracking Percent - CRCP

The function selected to model Functional and Structural Cracking Density over time is the Gompertz model. This s-shape function is given by the following equation:

$$CD = L \exp(-\exp(ll_int + ll_slp AGE))$$

Where:

CD	=	cracking density (functional or structural) of pavement at age "AGE";
AGE	=	age of pavement since last treatment, in years;
L	=	model parameter (asymptotic cracking density value for large AGEs);
ll_int	=	first model parameter affecting model curvature/deterioration rate;
ll_slp	=	second model parameter affecting model curvature/deterioration rate.

The equation parameters *L*, *II_int* and *II_slp* are typically updated yearly to account for possible changes in cracking trends resulting from the most recent cracking data. The current values of the model parameters are provided in <u>Cracking Performance Models</u> according to pavement family.

# 9.02.02 Frequency

The update of MDOT-SHA cracking modeling parameters is typically performed once per year, after the end of the data collection season and once all data have been processed and migrated into the appropriate Business Plan Tables (see <u>Migrating to Business Plan Tables</u>).

## 9.02.03 *Purpose*

The purpose of this SOP is to update the MDOT-SHA cracking performance model parameters to incorporate the mostly recently collected and processed cracking data.

### 9.02.04 *Resource Requirements*

The updating of the cracking performance models involves the following three MDOT-SHA staff members: (1) a database management expert from the DWT to update model parameters, (2) an analyst from the DAT to validate the estimated models, and (3) a supervisor – typically the Assistant Division Chief (ADC) – who, as required, provides guidance and decision-making. The estimated effort level shown in the table below represents the total time, in man-hours, to complete the update of the cracking performance model parameters. The estimate assumes no issues are encountered during the update process.

Position	Function	Resources	Effort Level (man-hrs)
DWT Staff	Model Estimation	1	8
DAT Staff	Model Validation	1	40 or as needed
ADC	Supervisor	1	As required ^{06/12/2019}

### 9.02.05 *Procedure*

The procedure required to update the MDOT-SHA cracking performance models is comprised of the following two tasks:

- (1) estimation of new model parameters, and
- (2) QA new model parameters.

### 1- Estimation of New Cracking Model Parameters – performed by DWT staff

**Summary:** Under this task, the most recently collected and processed cracking data are used to estimate new model parameters.

- Step 1. In Oracle SQL Developer, run package "CRACKING_MODELS" to estimate new model parameters for each pavement family.
- Step 2. Once the cracking model parameters have been updated, inform DAT that the model parameters are ready to for QA.

### 2- QA of New Model Parameters – performed by DAT Staff

**Summary:** Under this task, QA checks are used to confirm that the newly estimated cracking model parameters produce reasonable trends. The QA checks are performed using an existing MS Excel QA template spreadsheet.

- Step 3. Open the most recent MS Excel QA template spreadsheet in the cracking models working folder^{06/12/2019} and sort by date modified. The QA template spreadsheet is called "Cracking_Density_Models_[MMDDYYYY].xlsx".
- Step 4. Check new estimate parameters for reasonableness and flag those models that exhibit unexpected trends. This is done by plotting the Gompertz curve for 100 years using the graph application in MS Excel to confirm that the trends look reasonable for all pavement families.

It is expected that the cracking density for most pavement families will deteriorate to the RSL0 value of the least important functional class in that family in 100 years, assuming an initial cracking density of 0. The tables below show the cracking density RSL0 values for the various pavement functional classes. This check should be performed before running the optimization and corrections to the pavement family slopes should be made as needed. Analysis of historical data shows that cracking deteriorates the fastest among all performance measures, controlling between 36%-41% of the total lane miles in the MDOT-SHA pavement network from 2015-2017. Therefore, it is reasonable to assume that the effect of cracking deterioration on overall pavement condition is quite significant.

FUNC_CL	FC_DESCRIPTION	FCD _{RSL_0}
1	Rural Principal Arterial - Interstate	25
11	Urban Principal Arterial - Interstate	25
2	Rural Principal Arterial - Other Freeways	35
12	Urban Principal Arterial - Other Freeways	35
3	Rural Principal Arterial - Other	35
14	Urban Principal Arterial - Other	35
6	Rural Minor Arterial	35
16	Urban Minor Arterial	35
7	Rural Major Collector	45
17	Urban Major Collector	45
8	Rural Minor Collector	45
18	Urban Minor Collector	45
9	Rural Local	50
19	Urban Local	50

FUNC_CL	FC_DESCRIPTION	SCD _{RSL_0}
1	Rural Principal Arterial - Interstate	15
11	Urban Principal Arterial - Interstate	15
2	Rural Principal Arterial - Other Freeways	35
12	Urban Principal Arterial - Other Freeways	35
3	Rural Principal Arterial - Other	35
14	Urban Principal Arterial - Other	35
6	Rural Minor Arterial	35
16	Urban Minor Arterial	35
7	Rural Major Collector	35
17	Urban Major Collector	35
8	Rural Minor Collector	35
18	Urban Minor Collector	35
9	Rural Local	40
19	Urban Local	40

The time to "zero RSL" for all pavement families is expected to be between 10 and 50 years and the second model parameter (slope  $ll_slp$ ) should always be negative. Flagged models are subject to further investigation—not immediate rejection.

Step 5. As needed, write/update the cracking model parameters for each pavement family in C#. The existing functions can be found in <u>Cracking Performance</u> <u>Models</u>. The updated parameters and hence cracking models will be used later in the program optimization process.

# 9.03 UPDATING RUTTING PERFORMANCE MODEL

### 9.03.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Warehouse Team (DWT) and Data Analysis Team (DAT) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to update the rutting performance model parameters as new rutting data are collected and processed. The rutting performance model follows the linear function shown in the equation below, which was developed from the analysis of historical MDOT-SHA rutting data.

$$\overline{RD} = RD_{in} + \alpha_1 AGE$$

Where:

 $\overline{RD}$ = estimated rutting value of pavement at age "AGE", in inches; $RD_{in}$ = initial pavement rutting value at time of last treatment, in inches;AGE= age of pavement for which rutting is estimated, in years; $\propto_i$ = parameter (equal to slope of linear regression) that captureseffect of surface type and functional class.

The model, and more specifically the  $\alpha_i$  parameter, is typically updated yearly to incorporate possible changes in rutting trends resulting from the most recent rutting data. The current value of  $\alpha_i$  for the different pavement families are listed in <u>Rutting</u> <u>Performance Model</u>, along with the most recent rutting trend plots by pavement family and the specific C# functions.

### 9.03.02 Frequency

The update of rutting model parameter is typically performed once per year, after the end of the data collection season and once all data have been processed and migrated into the appropriate Business Plan Tables (see <u>Migrating to Business Plan Tables</u>).

### 9.03.03 Purpose

The purpose of this SOP is to update the rutting performance model parameter to incorporate the most recently collected and processed rutting data.

### 9.03.04 *Resource Requirements*

The updating of the rutting performance models involves the following three MDOT-SHA staff members: (1) a database management expert from the DWT to update model parameters, (2) an analyst from the DAT to validate the estimated models, and (3) a supervisor – typically the Assistant Division Chief (ADC) – who, as required, provides guidance and decision-making. The estimated effort level shown in the table below represents the total time, in man-hours, to complete the update of the rutting performance model parameter. The time estimate assumes no issues are encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DWT Staff	Model Estimation	1	8.0
DAT Staff	Model Validation	1	40.0 or as needed
ADC	Supervisor	1	As required ^{06/12/2019}

### 9.03.05 *Procedure*

The procedure required to update the rutting performance model is comprised of the following two tasks:

- (1) estimation of rutting new model parameter, and
- (2) QA new rutting model parameter.

### 1- Estimation of New Rutting Model Parameter – performed by DWT staff

**Summary:** Under this task, the most recently collected and processed rutting data are used to estimate new model parameter.

Step 1. The "business_plan_trend_pkg" must be run in the ASSETDEV environment in Oracle SQL Developer before estimating the new rutting model parameter for each pavement family. This package will update the "business_plan_trend table." Ensure this has been completed prior to moving to Step 3.

#### 2- QA of New Rutting Model Parameter – performed by DAT Staff

**Summary:** Under this task, QA checks are used to confirm that the newly estimated rutting model parameter for each pavement family produces reasonable trends. The QA checks are performed using an existing MS Excel QA workbook template.

- Step 2. Open the most recent MS Excel QA workbook template ^{06/12/2019} (sort by date modified) in the rutting models working folder.
- Step 3. Connect to the ASSETDEV environment in Oracle SQL Developer and run the SQL statement stored in cell "F1" in the worksheet "Data." Paste the output of the SQL statement in the worksheet "Data" from cell A1. The source table in the SQL statement is "business plan trend."
- Step 4. Create a pivot table from the pasted data by selecting "Insert" and then "Pivot Table" from the Excel ribbon. Select the table range of the data that was pasted in Step 3. Select "New Worksheet" and click "OK."
- Step 5. On the new worksheet, filter the pivot table by surface type equal to "F" (Flexible) and organize the fields as shown in the below images.

PAVEMENT_TYPE	F 🖵	]														
Average of RUT_FLEXIBLE		AGE 🖵														
FUNC_CLASS2	FUNC_CLASS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
= 1	. 1	0.098	0.112					0.23	0.231	0.22	0.26	0.211	0.171	0.159	0.186	0.144
Group1	2	0.11	0.123	0.144	0.143	0.145	0.175	0.172	0.171	0.186	0.165	0.167	0.171	0.174	0.203	0.228
	3	0.108	0.16	0.142	0.129	0.13	0.151	0.153	0.153	0.153	0.153	0.137				
≡6	i 6	0.1	0.11	0.106	0.122	0.116	0.128	0.139	0.135	0.144	0.158	0.174	0.185	0.186	0.196	0.19
87	7	0.105	0.11	0.121	0.123	0.139	0.146	0.144	0.151	0.156	0.156	0.137	0.141	0.138	0.145	
8 🗉	8	0.09	0.093	0.098	0.094	0.103	0.107	0.127	0.133	0.141	0.131	0.149	0.141	0.15	0.15	0.167
≡ 9	9	0.081	0.11	0.088	0.098	0.113	0.087		0.145	0.11	0.144	0.137	0.145	0.155	0.101	
⊟11	. 11	0.142	0.131	0.152	0.16	0.157	0.177	0.187	0.201	0.19	0.205	0.196	0.179	0.216		
■12	. 12	0.142	0.147	0.169	0.151	0.135	0.153	0.154	0.156	0.182	0.17	0.19	0.208	0.207	0.271	0.232
■14	14	0.145	0.151	0.158	0.164	0.172	0.185	0.2	0.219	0.21	0.194	0.191	0.225	0.226	0.298	0.298
≡16	i 16	0.133	0.125	0.136	0.135	0.148	0.151	0.168	0.179	0.191	0.206	0.214	0.219	0.221	0.228	0.206
■17	17	0.118	0.112	0.124	0.133	0.155	0.147	0.161	0.163	0.169	0.17	0.191	0.197	0.196	0.188	
∃ Group2		0.1065	0.107	0.097	0.101	0.148				0.21	0.1965	0.1805	0.1785	0.171	0.15	0.12



Step 6. Once the pivot table is organized, copy and paste the data underneath the pivot table in the same worksheet as shown in the below image.

Average of RUT_FLEXII	BLE	Column Labels														
Row Labels		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	0.098	0.112					0.23	0.231	0.22		0.211	0.171			
	2	0.11	0.123	0.144	0.143	0.145	0.175	0.172	0.171	0.186						
	3	0.108	0.16	0.142	0.129	0.13	0.151	0.153	0.153	0.153	0.153	0.137				
	6	0.1	0.11	0.106	0.122	0.116	0.128	0.139	0.135	0.144	0.158	0.174	0.185	0.186	0.196	
	7	0.105	0.11	0.121	0.123	0.139	0.146	0.144	0.151	0.156	0.156					
	8	0.09	0.093	0.098	0.094	0.103	0.107	0.127	0.133	0.141	0.131	0.149	0.141	0.15	0.15	0.167
	9	0.081	0.11	0.088	0.098	0.113			0.145		0.144	0.137	0.145	0.155		
	11	0.142		0.152	0.16	0.157	0.177	0.187	0.201	0.19	0.205	0.196		0.216		
	12	0.142	0.147	0.169	0.151	0.135	0.153	0.154	0.156	0.182	0.17	0.19	0.208	0.207	0.271	0.232
	14	0.145	0.151	0.158	0.164	0.172	0.185	0.2	0.219	0.21	0.194	0.191	0.225	0.226	0.298	0.298
	16	0.133	0.125	0.136	0.135	0.148	0.151	0.168	0.179	0.191	0.206	0.214	0.219	0.221	0.228	
	17	0.118	0.112	0.124	0.133	0.155	0.147	0.161	0.163	0.169	0.17	0.191	0.197	0.196	0.188	
	18	0.092	0.095	0.104							0.18	0.178				
	19	0.121	0.119			0.148				0.21	0.213	0.183	0.216	0.197		
2"  FC=="3		0.109	0.1415	0.143			0.163	0.163	0.162	0.17					0.203	0.228
18"  FC=="19		0.1065	0.107	0.097	0.101	0.148				0.21	0.197					

- Step 7. Perform a visual review of the data and remove any data points believed to be outliers, as illustrated by the yellow highlights in the above image. Previous experience with analyzing rutting data is required to perform this review.
- Step 8. For each pavement family (or group of families), plot the rutting versus time model and obtain the slope by performing a linear regression in Excel. Review the plots for reasonableness and make adjustments to the groupings if necessary. For example, families exhibiting similar trends may be grouped together if the individual plots do not seem reasonable or the amount of data is insufficient. See <u>Rutting Performance Model</u> for the most recent plots by pavement family.
- Step 9. As needed, write/update the rutting model parameter for each pavement family (or group of families) in C#. See <u>Rutting Performance Model</u> for the most recent model functions. The updated parameter for each pavement family, and hence rutting model, will be used later in the program optimization process (see <u>Defining Network and Importing Data into the RoadCare Optimization</u> <u>Process</u>).
Step 10. Repeat Step 4 through Step 9 for surface types "FCJ" (Flexible over JCP) and "FCC" (Flexible over CRCP).

# 9.04 UPDATING FAULTING PERFORMANCE MODEL

## 9.04.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Warehouse Team (DWT) and Data Analysis Team (DAT) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to update the faulting performance model parameters as new faulting data are collected and processed. The faulting performance model follows the linear function shown in the equation below, which was developed from the analysis of historical MDOT-SHA faulting data.

 $\overline{Faulting} = Faulting_{in} + \gamma_1 AGE$ 

Where:	Faulting Faulting _{in} AGE	<ul> <li>= estimated faulting value at age "AGE," in inches;</li> <li>= initial faulting value at time of last treatment, in inches;</li> <li>= age of payement for which faulting is estimated in years:</li> </ul>
	γ _i	= parameter (equal to slope of linear regression) that captures effect of pavement type.

The model, and more specifically the  $\gamma_i$  parameter, is typically updated yearly to incorporate changes in faulting trends resulting from the most recent faulting data. The current values of  $\gamma_i$  for the jointed plain concrete (RJP) and jointed reinforced concrete (RJ) pavement families are provided in the table below. The number of years of historical data available to develop an estimate of the faulting model parameter were limited. Accordingly, improvements in the parameter are expected as additional data are incorporated in the coming years into the model development process.

Pavement Type	Slope (γ _i )
Jointed Plain Concrete (RJP)	0.004
Jointed Reinforced Concrete (RJ)	0.008

## 9.04.02 Frequency

The update of faulting model parameter is typically performed once per year, after the end of the data collection season and once all data have been processed and migrated into the appropriate Business Plan Tables (see <u>Migrating to Business Plan Tables</u>).

## 9.04.03 Purpose

The purpose of this SOP is to update the faulting performance model parameter to incorporate the most recently collected and processed faulting data.

## 9.04.04 *Resource Requirements*

The updating of the faulting performance models involves the following three MDT SHA staff members: (1) a database management expert from the DWT to update model parameters, (2) an analyst from the DAT to validate the estimated models, and (3) a supervisor – typically the Assistant Division Chief (ADC) – who, as required, provides guidance and decision-making. The estimated effort level shown in the table below represents the total time, in man-hours, to complete the update of the faulting performance

model parameter. The time estimate assumes no issues are encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DWT Staff	Model Estimation	1	8.0
DAT Staff	Model Validation	1	20.0 or as needed
ADC	Supervisor	1	As required ^{06/12/2019}

#### 9.04.05 *Procedure*

The procedure required to update the faulting performance model is comprised of the following two tasks:

- (1) estimation of new faulting model parameters, and
- (2) QA new faulting model parameters.

#### 1- Estimation of New Faulting Model Parameter – performed by DWT staff

**Summary:** Under this task, the most recently collected and processed faulting data are used to estimate new model parameters.

Step 1. The "business_plan_trend_pkg" must be run in the ASSETDEV environment in Oracle SQL Developer before estimating new faulting model parameter for each pavement family. This package will update the "business_plan_trend table." Ensure this has been completed prior to moving to Step 3.

#### 2- QA of New Faulting Model Parameter – performed by DAT Staff

**Summary:** Under this task, QA checks are used to confirm that the newly estimated faulting model parameter for each pavement family produces reasonable trends. The QA checks are performed using an existing MS Excel QA workbook template.

- Step 2. Open the most recent MS Excel QA workbook template^{06/12/2019} (sort by date modified) in the faulting models working folder.
- Step 3. Connect to the ASSETDEV environment in Oracle SQL Developer and run the SQL statement stored in cell "M1" in the worksheet "Sheet1." Paste the output of the SQL statement in the Excel sheet. The source table in the SQL statement is "business_plan_trend."
- Step 4. The model parameter for each pavement family is estimated using a linear regression in MS Excel and the data resulting from Step 3, as illustrated in the following two plots.



- Step 5. Examine the faulting versus time plot for each pavement family (jointed plain and jointed reinforced concrete) using the output from the SQL statement in the previous step and check that the equations are showing reasonable results. If the two models pass the QA checks noted above, proceed to Step 6. Otherwise, identify issues and discuss remedial actions with appropriate personnel before continuing
  - i. The check is intended to confirm that faulting reaches a value of 0.15 inches or greater within 100 years from the time of the last treatment, which is assumed to have an initial faulting value of 0. This value of 0.15 inches corresponds to the "Poor" threshold for faulting specified in the final rule.

- ii. It is expected that faulting for reinforced jointed concrete pavements deteriorate at a slower rate than jointed plain concrete pavements.
- Step 6. As needed, write/update the faulting model parameter for each pavement of the two pavement families in C#. The updated parameter for each pavement family, and hence faulting model, will be used later in the program optimization process (see <u>Defining Network and Importing Data into the RoadCare Optimization Process</u>).

# 9.05 UPDATING FRICTION PERFORMANCE MODEL

## 9.05.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Warehouse Team (DWT) and Data Analysis Team (DAT) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to update the friction performance model parameter as new friction data are collected and processed. The friction performance model follows the linear function shown in the equation below, which was developed from the analysis of historical MDOT-SHA friction data.

$$\overline{F} = F_{in} + \alpha_1 AGE$$

Where:

$\overline{F}$	=	estimated friction value of pavement at age "AGE";
F _{in}	=	initial pavement friction value at time of last treatment;
AGE	=	age of pavement for which friction is estimated, in years;
∝ _i	=	parameter (equal to slope of linear regression) that captures effect of
		county and pavement functional class.

The model, and more specifically the  $\propto_i$  parameter, is typically updated yearly to incorporate possible changes in friction trend from the most recent friction data. The current values for the different pavement families are listed in <u>Friction Performance</u> <u>Model</u>, along with the most recent friction trends and models by pavement family.

## 9.05.02 Frequency

The update of the MDOT-SHA friction model parameter is typically performed once per year, after the end of the data collection season and once all data have been processed and migrated into the appropriate Business Plan Tables (see <u>Migrating to Business Plan Tables</u>).

## 9.05.03 Purpose

The purpose of this SOP is to update the MDOT-SHA friction performance model parameter to incorporate the mostly recently collected and processed friction data.

## 9.05.04 *Resource Requirements*

The updating of the friction performance models involves the following three MDOT-SHA staff members: (1) a database management expert from the DWT to update model parameters, (2) an analyst from the DAT to validate the estimated models, and (3) a supervisor – typically the Assistant Division Chief (ADC) – who, as required, provides guidance and decision-making. The estimated effort level shown in the table below represents the total time, in man-hours, to complete the update of the friction performance model parameter. The time estimate assumes no issues are encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DWT Staff	Model Estimation	1	8.0
DAT Staff	Model Validation	1	40.0 or as needed
ADC	Supervisor	1	As required ^{06/12/2019}

#### 9.05.05 *Procedure*

The procedure required to update the MDOT-SHA friction performance model is comprised of the following two tasks:

- (1) estimation of new friction model parameter, and
- (2) QA new friction model parameter.

#### 1- Estimation of New Friction Model Parameter – performed by DWT staff

**Summary:** Under this task, the most recently collected and processed friction data are used to estimate new model parameters.

- Step 1. Open the most recent MS Excel file^{06/12/2019} (sort by date modified) in the friction models working folder.
- Step 2. Connect to the ASSETDEV environment in Oracle SQL Developer and run the SQL statement stored in cell F1 of the worksheet "Data." The source table in the SQL statement is "friction." This will drop the existing table PAV_CONHIST.TREND_FRICTION_12_14_2017 and create a new table PAV_CONHIST.TREND_FRICTION [MM_DD_YYYY] (change date) with the updated data.
- Step 3. While still in Oracle SQL Developer, run the SQL statement stored in cell E1 in the worksheet "Data." Paste the output of the SQL statement in the worksheet "Data" in cell A1.

#### 2- QA of New Friction Model Parameter – performed by DAT Staff

**Summary:** Under this task, QA checks are used to confirm that the newly estimated friction model parameter for each pavement family produces reasonable trends. QA checks are performed using a MS Excel workbook.

- Step 4. Create a pivot table from the pasted data by selecting "Insert" and then "Pivot Table" from the MS Excel ribbon. Select the table range of the data that was pasted in Step 3. Select "Existing Worksheet" and click "OK."
- Step 5. Organize the fields in the pivot table as shown in the below images.

# Maryland department of transportation

STATE HIGHWAY ADMINISTRATION

Trend Analysis Updating Friction Performance Model

Image: Image	Average of SP_ADJ_SKID_NO Column Labels 💌	
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27       423       427       423       427       35       327       453       424       423       333       421       424       423       334       41       423       334       434       424       423       334       444       424       423       334       444       423       334       444       423       334       434       423       334       434       424       423       334       434       423       334       434       423       334       434       423       334       434       434       436       334       434       434       434       434       434       434       434       434       434       434       434       434       434       434       434       434       434       434       434       434       434       434       434       434       434       434       434       434       434       444       444       444       444       444       444       444       444       444       444       444       444       444       444       444       444       444       444       444       444       444       444       444       444       444       44	28 32.5 43.3 44.9 43.3 36 34.9 40.3 34.2 39.8 31.8	30 41.8 40.4 30.4 43.8 50.9 4
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12       49.1       26.5       34       28.85.3       39.7       39.7       39.4       30.4       39.5       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4       39.4	30 35.1 47.7 48.2 41.4 20 35.9 35.9 44.1 31 42.5 42.4 22 34.4 33.4 44.8 44.3	41.1 43.2 35.4 54.1 38.3 4
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AGE   Average of SP	MORE TABLES	$\equiv$ ROWS $\Sigma$ VALUES
		AGE   Average of SP

STATE HIGHWAY ADMINISTRATION

Trend Analysis Updating Friction Performance Model

slope	-0.655	-0.5036	-0.3022		-0.6635	-0.489	-0.2492	-0.2564	-0.4548	-0.3622
AGE	1A	18	1C	1D	2A	2B	2C	2D	3A	3C 3
0	47	52	48	49	48	58	44	45	45	46
1	46.8	51.6	47.4	48.8	47.6	57.4	43.8	44.2	44.7	45.3
2	43.5	51.7	47.9	48.8	47	56.8	41.9	44.2		42
3	41.2	51.4	45.5	45.4	47.4	50.5	43.1	43		45.1
4	44.8	50.8	46.1	44		53.5		43.4		44
5	44	48.8	47.3	44.7		52.5		42.2	43.2	45.7
6	44.5	46.7	47.7	43.8		53.3	42.6	43.5	43.2	45
7	46.2	49.1	48.4	44.4	46	55.3	40.6	43.2	43.1	44.8
8	45.3	50.6	46.7	45.1		52.6	40.9	43.2		44.8
9	43	45.8	45.3	46.1		50.2	41.8	42.3	39.6	
10	44.8		45.7	46.5	41.9	50.2	41	43.4	44	
11		48.9	46.7	48.2	42.6	52.2	41.3	42.1	37.9	
12		47	46.5	48.3	42.9	50.7	41.6	42.2	42.4	42.7
13	41.7	42.8	44.3	47.8	42.1	53	41.4	42.1		42.2
14	42.8	41.3	47.4	47.9	41.5	49.5	40.5	40.6		44.3
15	44	44.8	46	48.9	37.5	53.3	40.6	42.7		41.6
16	36.3	44.7	46.2	48.7	34.3	52	40.3	41.6		40.5
17	36.8			47.8	36	49.9	38.8	42.4	34.7	40.3
18	33.8	44.7		44.9	35.3	50.7	39.6	41.1	35.8	39.9
19	33			46.5	34.1	51.3	40.2			39.6
20	30.1	39.5		50.8	35		42.8		36.4	
21	28	41.9		38.4	33.7	51.9	42.4			
22	28.2	44.4	45.7	33.9	31.2	55.9	42.8			

- Step 6. Once the pivot table is organized, copy and paste the data into a new worksheet.
- Step 7. Perform a visual review of the data and remove any data points believed to be outliers, as illustrated by the yellow highlights in the above image. Previous experience is required to perform this review.
- Step 8. For each pavement family, plot friction versus time data and calculate the slope of the regression line using the graph application in MS Excel. Review plot for reasonableness and make adjustments to the groupings if necessary. See <u>Friction Performance Model</u> for the most recent plots by pavement family.
- Step 9. As needed, write/update the friction model parameter for each pavement family in C#. See <u>Friction Performance Model</u> for the most recent model functions. The updated parameter for each pavement family will be used later in the program optimization process (see <u>Defining Network and Importing Data in the RoadCare Optimization Process</u>).

# 10 **OPTIMIZATION**

Click to go to <u>Network Definition and Data Import</u> Click to go to <u>Network Segmentation and Data Rollup</u> Click to go to <u>Needs Analysis and Running Simulation Engine</u> Click to go to <u>Generating Reports</u>



#### Figure 13: Optimization Flowchart

This section describes the set of standard operating procedures (SOP) conducted mainly by staff from the Data Analysis Team (DAT) of the Maryland Department of Transportation State Highway Administration's (MDOT-SHA) Office of Materials Technology (OMT) to perform the "Conditional RSL/Cost Optimization" in the asset management software, RoadCare, version 3.67. This section is divided into four SOPs: defining the network and importing new data, updating the network segmentation and performing the data rollup, performing a needs analysis and running the simulation engine, and generating reports. These SOPs may require multiple iterations to complete the optimization process.

## 10.01 DEFINING NETWORK AND IMPORTING DATA INTO THE ROADCARE OPTIMIZATION PROCESS

## 10.01.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Analysis Team (DAT) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to define the network of assets and to import the raw data associated with this network for input into the optimization process contained in the asset management software, RoadCare, version 3.67. The SOP described in this document may not be applicable to other versions of RoadCare.

#### 10.01.02 Frequency

The network definition and data import for the RoadCare optimization process is performed once per year, after the end of the data collection season and once all data have been processed and migrated into the appropriate tables. Additionally, selected attribute data are deleted and re-imported whenever changes to the source tables occur, which typically happens several times per year.

## 10.01.03 Purpose

The purpose of this SOP is to prepare the input data required by the RoadCare optimization process by first defining the network of assets and then importing the required network data contained in Oracle tables.

#### 10.01.04 *Resource Requirements*

The network definition and data import process involves one person: a DAT staff member knowledgeable of Oracle and the RoadCare software. The estimated effort level in the table below represents the total time, in man-hours, to complete the network definition and data import process. The time estimate assumes no issues are encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DAT Staff	Analyst	1	20.0

#### 10.01.05 *Procedure*

The procedure required to perform the network definition and data import process is comprised of the following two components:

- (1) define network, and
- (2) import data.

#### 1- **Define Network –** *performed by DAT staff*

**Summary:** Under this task, the RoadCare asset management software's "Route/Section Definition" module and a script run in Oracle SQL Developer are used to define the network of assets from the inventory data contained in the Oracle tables.

Step 1. Open RoadCare software.

Step 2. In RoadCare's "Explorer" panel, expand the "Route/Section Definition" folder and then double-click on "Linear Referenced Routes" to display the contents of the network. Each linear asset is defined by grid columns including name (ROUTES), stations (BEGIN_STATION and END_Station), and direction. Before entering data, select the "Allow Definition Edit" option located at the top of the window as shown in the below image.

	A DSS	RoadCa	re:					
	File	View	Tools	Help				
	RoadC	are Explo	orer JLT			<b>↓</b> ₽	×	
		Rou	ite/Secti Linear R Section F	on Definition eferenced Ro Referenced F	utes acilities			
				Û				
	and the second second				100			
R	Ilup-HPMS_NETWORK Route							• ×
Unea	Linear Route Definer	nition •			Alow Definition Edt	Import Shapefile		
	ROUTES		BEGIN_STATION	N	END_STATION		DIRECTION	*
•	AA-CO 4645		0		0.347		E	1.11

- Step 3. In Oracle SQL Developer, run the first SQL statement labeled "CREATE_INVENTORY" in the "RoadCare Data Import Queries latest.sql" file^{06/12/2019} to update the materialized view called "RC_SECTION_MVIEW." Update the "HMIS_YEAR" field in the SQL statement to retrieve the latest inventory data.
- Step 4. After the materialized view is updated in the SQL Developer, select "pavconhist_assetdev" in the drop-down box next to "Update using:" to replace existing inventory data in RoadCare with the most recent inventory data from the materialized view.
- Step 5. Document changes to the inventory using the Access database and spreadsheet template^{06/12/2019}.
- 2- Perform Data Import performed by DAT Staff

**Summary:** Under this task, raw data from various Oracle tables are validated for input into the RoadCare asset management software. These data represent the attributes that define the pavement network, which was updated in the previous task.

- Step 6. Open RoadCare software.
- Step 7. Double-click on an attribute name from the "Attributes (Raw)" list to show its contents in the display window. Check the box next (to the left) to "Allow Attribute Edit" at the top of the raw attribute data window, as shown in the below image.

TEST_ATTRIBUTE Server/Database Linear Reference Section Reference Adv	Route: All Year: All + anced Search:	V Allow Attribute Edit			
ROUTES	BEGIN_STATION	END_STATION	DIRECTION	DATE_	TEST
CA-MD 2M	0	0.1	N	06/30/2016	0
CA-MD 2M	0	0.1	s	06/30/2016	0
CA-MD 2N	0	0.11	E	06/30/2016	0
CA-MD 2N	0	0.11	W	06/30/2016	0
CAMD 20	0	0.04	E	06/30/2016	0
CA-MD 20	0	0.04	W	05/30/2016	0
CA-MD 2P	0	0.14	E	06/30/2016	0
CA-MD 2P	0	0.14	W	06/30/2016	0
CA-MD 20	0	0.06	E	06/30/2016	0
CAMD 20	0	0.06	W	06/30/2016	0
CAMD 25	0	0.15	N	06/30/2016	0
CAMD 2S	0	0.15	s	06/30/2016	0
CAMD 2T	0	0.28	N	06/30/2016	0
CA-MD 2T	0	0.28	5	06/30/2016	0
CAMD 2V	0	0.03	N	06/30/2016	0
CA-MD 2V	0	0.03	5	06/30/2016	0
CA-MD 2W	0	0.03	E	06/30/2016	0
CAMD 2W	0	0.03	W	05/30/2016	0
CA-MD 2X	0.5	0.53	E	06/30/2016	0
CA-MD 2X	0.5	0.53	W	06/30/2016	0

- Step 8. Click the "Import from Data Source..." button, which is shown at the bottom of the raw attribute data window in the above image, to open the "Data Import" Window.
- Step 9. Enter the database connection parameters in the left hand top portion of the "Data Import" window. The top left section of the window allows the user to select the provider name, server path, database name, to specify if the use of integrated security is active, and to enter login and password information. When placing the cursor on any of the referenced fields, a description of the item is provided at the bottom of the top-left pane, as shown in the below image. For example, when selecting "Database," the area under the information input section reads "Name of the database in which the attribute data resides." These descriptions are intended to aid the user in determining the appropriate input for each field.

Maryland department of transportation

STATE HIGHWAY ADMINISTRATION

Optimization Defining Network and Importing Data

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Care Explorer *	TIST ATTRIBUTE								
- I SCO	Import Data.								-
- SC_DENSITY							_		
SHOLEDED WIDTH	Ph 01 100			Database Tables		Fields		Field Data	
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SKD CATEGORY WAL	Use integrated Sev Fat	laa		ASPR_CRACKING TMP_CODE_DATA	1711				
SKD FY17	Server			TMP_C4					
- SKD RESECTION WAL	Database			EDW12_LOCATORS					
SKD_RUT_FY16	50			TMP_CR_100_BKP					
-II SKID_RUT_FY17	Network Alass AS	GEIDEA	Count	TMP C2					
-B SKD_RUT_UST	Loon na	w conhist	Lorned	FWD1_TMINGS					
SPADJ_SKD_CATEGORY	Paseword ++			HST GISAMM					
- SPADJ_SKID_NUMBER				ADD_GLOBAL_ROUTE_2013					
- SPADJ_SKID_NUMBER_ORG				HIST GPS1MM					
- SURFACE_TYPE				DEBUG QUERY MIKE					
-II SURVEY_SPEED				TMP_2424	2				
-II TEMP_SECTION				TMP CD					
TEST_ATTRIBUTE				1.1	_				
TOLL_PLAZA	Provider		SQL Statement						
TOTAL LANES	Database Type (MSSQL, C	ORACLE, MYSQL)	SELECT ROU	TES, DIRECTION, BEGIN, STATION	END ST	ATION			
TRAVEL DID			DATE_DATA	FROM TEST_ATTRIBUTE					
- TREATMENT LEVEL	Database Connections								
UNIT_COST_PROJECTS_15	Current Profile								
UNIT_COST_PROJECTS_16	pevcorihist_assetdev	Save							
- USE_AS_PRIMARY	Available Parties								
WET_ACCIDENT_LIST	Internetient monthers								
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- Step 10. After introducing the required data into the "Data Import" window, click "Connect" to establish communication with the selected server and access the desired database, as shown in the above image.
- Step 11. When a connection is established, the "Database Tables" section will be populated with the attributes found in selected database. Any value within the "Database Tables" section can be clicked to display the available fields under the "Fields" section. Likewise, clicking any field value displays the data available for that field in the "Field Data" section, as shown in the below image.

			Database Tables	Fields	Field Data
Provider	ORACLE		ROADCARE_FRICTION_5_YEAR_AW	BRIDGE_NUM	010001001
Connection Type	Network Alias		ROADCARE_FRICTION_BY_YEAR	POINT_LOC	010002001
Use integrated Se	False		USION BASE NEW 100	Y COORD	010004001
Server			EDIT_CUR_YR	POINT_X	010005001
Database			MEPDG_BASE_100	POINT Y	010006001
SID			TMP C11	SUB POUTE ID	010010001
Network Alias	ASSET_NEW		MV PAV PHY PAV	DIRECTION	010011001
Port		Connect	SECTION_TABLE_BKP2102015	GLOBAL_SEGMENT_ID	010012001
Login	pav_conhist		TMP_NEW_CRK_12	DIR_MP	010013001
Password			VISION_IMAGERY_4		010014001
		SQL Statement			
tabase Type (MSSC	AL, ORACLE, MYSQL).	WITH A AS			
		FROM BUSI	NESS PLAN_TREATMENTS TRD,		
		WHERE UP	PER(TRD.TREATMENT) = UPPER(TRT.TREAT	ATMENT)	
atabase Connection		AND (TRD.T	REATMENT NOT IN (UNKNOWN', 'SLURRY	SEAL')	
atabase Connection urrent Profile		and OUTER	LANE -1		
atabase Connection urrent Profile SSET_NEW	Save	UNION			
atabase Connection urrent Profile SSET_NEW vallable Profiles	Save	SELECT *	LEGE OF THE TOP IT IS TOP		
atabase Connection urrent Profile SSET_NEW valiable Profiles	Save	SELECT * FROM BUSI	NESS_PLAN_TREATMENTS TRD,		
atabase Connection urrent Profile SSET_NEW vallable Profiles SSET 0 NEW SSETDEV	Save Load	FROM BUSI	NESS_PLAN_TREATMENTS TRD, MENT TRT	+ Cose	Update Import

Step 12. After database connection has been established, navigate to the data import SQL statement titled "RoadCare Data Import Queries latest"^{06/12/2019}. If a

connection cannot be established, discuss the matter with the database administrator before continuing.

- The attribute names in the .sql file will match the attribute names in RoadCare. Step 13. For example, to find the SQL statement for Average IRI, open the .sql file in notepad, press Ctrl+F and search for "begin AVG_IRI." Paste the appropriate SQL statement in the SQL statement text box and click the "Import" button to process the query. The resulting data entries are displayed in the attribute display window, while rejected data entries are displayed in the output window. Clicking the "Update" button will store the SQL statement and connection parameters in the RoadCare database for future data imports. This is the preferred method of import. For small datasets, the user can copy and paste the results from the SQL statement into the RoadCare attribute window data grid. It is important to note that the data import sql statement(s) must be updated to capture any changes to the source tables. For example, if the IRI data in business plan 100mmi table is updated for the past five years, then the criteria filter for the "REPORTING YEAR" field must be updated to include those five years of data. If one or more source tables are dropped or modified extensively, then the relevant data import SQL statements must be updated as well.
- Step 14. After the data import is completed, right click anywhere in the output window and select "Create Log File" to save a copy of the data import log as shown in the below image.

ſ	A Save As		×
	🚱 🕞 🗢 📗 « 2016 Data Import 🕨 log files	✓ ← Search log files	٩
DSS RoadCare:	Organize 🔻 New folder		∷ - (2)
File View Tools Help	^ Name	Date modified Type	Size
RoadCare Explorer     ♥     ♥            → DEFAULT             ⊕ Particle (Raw)             ⊕ Calculated Fields             ⊕ Networks             ⊕ Security	Ecomputer Computer No items m ARamachandran omtoocshared (\ hanprograms (\\ SHAREDProgram Engineering Data PmdataPRG (\\st	latch your search.	
Clear Output Window Copy	Network		
Create Log File	File name: data import log 0/032018		
Close Log File			
<u> </u>	Save as type: Lext tiles (".txt)	Save	Cancel

# 10.02NETWORK SEGMENTATION AND DATA ROLLUP

## 10.02.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Analysis Team (DAT) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to prepare collected data for the "Conditional RSL/Cost Optimization" process in the asset management software, RoadCare, version 3.67. The data preparation requires the creation and segmentation of a new network and the rollup of newly imported data. The SOP described in this document may not be applicable to other versions of RoadCare.

## 10.02.02 Frequency

Network segmentation, segmentation criteria definition and data rollup are performed by the MDOT-SHA once per year, after the end of the data collection season, once the data have been processed and migrated into the appropriate Business Plan Tables (see <u>Migrating to Business Plan Tables</u>). The procedure may need to be repeated multiple times during the iterative "Condition RSL/Cost Optimization" process.

## 10.02.03 Purpose

The purpose of this SOP is to prepare MDOT-SHA collected data for the "Conditional RSL/Cost Optimization" process in RoadCare version 3.67 software by creating a new network, defining the network segmentation criteria, and performing a data rollup.

#### 10.02.04 *Resource Requirements*

Network segmentation, segmentation criteria definition, and data rollup requires one MDOT-SHA staff member: a DAT staff member knowledgeable in Oracle and RoadCare software. The estimated effort levels shown in the table below represents the total time, in man-hours, to complete the network definition, segmentation criteria definition and data rollup. These time estimates assume no issues are encountered during the process.

Position	Function	Resources	Effort Level (man-hrs)
DAT Staff	Analyst	1	AN ^{06/12/2019}

#### 10.02.05 *Procedure*

The procedure to perform the network segmentation, segmentation criteria definition and data rollup is comprised of the following four tasks:

- (1) create new network and define segmentation logic,
- (2) review and update segmentation results,
- (3) rollup data in network, and
- (4) define network specific area.

#### 1- Create New Network and Define Segmentation Logic – performed by DAT Staff

**Summary:** Under this task, the new network is created and the logic for segmentation of the network is determined using the "Segmentation Logic" module in version 3.67 of RoadCare.

- Step 1. Open RoadCare software.
- Step 2. Right-click on the "Networks" module and select "Add New..." as shown in the figure below.



- Step 3. Expand the options inside the "Networks" module by clicking on the "+" icon. Then, expand the options inside the "Dynamic Segmentation" menu that appears by clicking on the "+" icon
- Step 4. Double-click the on "Segmentation Logic" listed under the "Dynamic Segmentation" menu to display the user-interface screen as shown in the below image.

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<u>File View Tools H</u> elp					
RoadCare Explorer 👻 🎚	× /11_BUDGETCAP_TREATMENT-	Analy jic-TEST_NETWORK_SEGMENTA	πı		- ×
	Subset Criteria:	Logic: TEST_NETWC	PRK_SEGMENTAT	ION	Vilow Network Segmentation
	Available Subset: AADT	* New			-
	Ac drienas: Adverse Res GROUP AUALTINI AMY RES RESECTION 2014 AMY RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES RES	Add Root Add Remove	Segment Network		
Dynamic Segmentation	Reason for Break	Shortest(miles)	Longest(miles)	Average(miles)	Count
Segmentation Results     Segmentation Results     Rolling     Wowers     Simulations     DUNT_COST_VETWORK     COOMMITTED_PROJECTS_NETWORK	anyrec RESECTION_FY17	0.004	26.97	1.392000000000001	8685
and occurry	•				
4	.  4 4  1 of1  ▶ ▶	1			
Outout					- I ×

Step 5. Check the box in the top-right corner next to "Allow Network Segmentation" as shown in the above image.

Step 6. To define the segment subset criteria, the user can type the numerical or logic expression in the "Subset Criteria" field or click the 3-dots button in the top-right corner as shown in the above image. The "Edit Segmentation Criteria" window will appear as shown in the below image.

Edit Segmentation Criteria Subset Name: Attribute: RESECTION Fields: ROUTES BEGIN STATION END STATION DIFECTION	Anyrecord Anychange Any Year = <>	Values: ANY REC - PROGRAM YEAR ANY REC-RESECTION:ANY REC - PROGRAM YEAI ANY REC-RESECTION:ANY REC - PROGRAM YEAI ANY REC-RESECTION:ANY REC-RESECTION: Any rec A prog year Any rec A prog year Any rec A prog year: Any rec A prog year: A
DIFIECTION DATE_ YEARS [RESECTION]	>= > <= < AND OR	anyrec prog year 2012;ANY REC-RESECTION bridge-any rec
Check OK	Cancel	

- Step 7. Add a name to the segmentation criteria by typing it under the "Subset Name" field as shown in the above image. As a rule of thumb, the name should be related or self-explain the criteria being used.
- Step 8. Next, select the desired attribute from the pull-down menu under the title "Attribute" as shown in the above image. All raw attributes belonging to the current network are available for selection. Once an attribute is selected, the "Values" pane is populated with the corresponding values for the attribute based on the network's data. In addition, the "Fields" pane located under the "Attribute" list is populated with the information posted under each attribute table. For example, if the raw attribute IRI table contains data fields that include ROUTES, BEGIN_STATION, END_STATION, DIRECTION, DATE, and YEARS, they will all appear listed under Fields. The last entry in the "Fields" window is always the selected attribute, which appears within square brackets.
- Step 9. Double-click on the desired field, then single-click on the numerical or logic expression, and finally double-click on value from the available list under the "Values" pane. As the field, expression, and values are selected, the bottom section of the pane is populated with expression for the segmentation criteria. Changes can be made directly by typing or erasing the expression. Once the criteria is input, the user can click on "Check" to verify how many sections the expression will yield, "OK" to accept the segmentation logic expression, or "Cancel" to return to the previous screen. If there is an error in the syntax of the segmentation expression, a message is displayed in the output window. The numerical and logic expressions available to construct the segmentation criteria are shown in the below image.

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🖳 Edit Segmentation Criteria		
Subset Name: Attribute: RESECTION Fields: ROUTES BEGIN_STATION END_STATION DIRECTION DATE_ YEARS [RESECTION]	Anyrecord Anychange Any Year = <> >= <> <= <> AND OR Numerical and logic expressions	Values: ANY REC - PROGRAM YEAR ANY REC-RESECTION ANY REC-RESECTION;ANY REC - PROGRAM YEAI ANY REC-RESECTION;bridge-any rec Any rec Å prog year; Any rec Å prog year; Any rec Å prog year;ANY REC-RESECTION;bridge-ar Joined Route Begin;ANY REC-RESECTION Route Begin;ANY REC-RESECTION;ANY REC - PRC Route Begin;any change GOVT_CONTROL;ANY RE anyrec prog year 2012;ANY REC-RESECTION bridge-any rec
Check OK	Cancel	

- i. If the expression is correct when "Check" is selected, then click on "OK" to return to the previous screen.
- ii. If the expression is not correct or returns a syntax error, revise the expression before clicking "OK".
- Step 10. The "Segmentation Logic" screen will display the new segmentation expression under the "Subset Criteria" field, and the name of the newly created subset name is displayed under "Available Subset."
  - i. If more subsets need to be added, click on the "New" button located to the right of the "Available Subset" pane as shown in the image below. Repeat Step 7 through Step 9 for each subset that needs to be created. Many segmentation expressions can be input, and every time one is added, it is listed under the "Available Subset" pane.
  - ii. If all subsets have been created, proceed to Step 11.

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BoadCare Explorer         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0	1_BUDGETCAP_TREATMENT-4	analy/jic-test_network_segmenta Logic: TEST_NETWO	™ RK_SEGMENTATI	ON	Allow Network Segmentation
	Available Subset: AADT AC dr Ianes ANREC AGE GROUP_HALFMI ANN EC PESENTION 2012	New	anyrec RESECTION_FY17		
MOTA_0115_016_0     MOTA_013     MOTA_013     MOTA_013_013_0     MOTA_015_UNTAREA_NT2     MOTA_015_NTAREA_NT2     MOTA_015_NTWORK     MOTA_015_NTWORK     MOTA_010_NTWORK     MOTA_010_NTM_00AIS_0.1MI     MOTA_001_S_01MI     MOTA_001_S_01MI	AVY REL RESELTION 2013 AVY REL RESELTION 2014 AVY REL RESETTION 2014 AVYCHANGE SKID_PY17 AVYCHANGE SKID_PY17 AVYCHANGE SKID_PU17 AVYREC SKID_RU1_FY17 AVYREC SKID_RU1_FY17 AVYREC SKID_RU1_FY17 AVYREC PROGRAM AR FUNC CL AVYREC SKID_RU1_FY17 AVYREC PROGRAM AR FUNC CL AVYCHANGE MICH.	Add Root Add Remove			
PUBLIC_MAP_2015_NETWORK     PUBLIC_MAP_2015_NETWORK     TEST_NETWORK_SEGMENTATION     Public Segmentation	Anychange Age_AR (raining Anychange (Roadclass)	*	Segment Network		
Segmentation Logic	Reason for Break anyrec RESECTION_FY17	Shortest(miles) 0.004	Longest(miles) 26.97	Average(miles) 1.392000000000001	Count 8685
< )	4 4  1 of1   ▶ ▶				
Output					▲ ☆ ×

- Step 11. Create the network root for the network segmentation tree. The network segmentation tree is a hierarchical construction that allows for further refinement of the segments. There must be at least one root level entry in the network tree to run the segmentation. After creating the root, the user can add additional levels. To create the network root, select the desired root subset from the "Available Subset" list and click on "Add Root" (make sure the "Allow Network Segmentation" option is checked at the top right corner of the screen as shown in the above image). This will list the selected subset under the right pane of the window. Additional root-level subsets can be added following the same process.
- Step 12. To add additional segmentation tree levels, select a different subset from the "Available Subset" list, select the root subset from the right pane, and click on "Add". This will automatically add the selected subset as a stem or "child node" to the root subset and a "+" icon will appear next to the root subset name. To expand the network tree, click on the "+" icon.
  - i. If a child node is added by error or to a level in the network that it does not correspond to, it can be deleted by selecting the subset name on the right pane of the window and press the "Remove" button.
  - ii. To delete a subset from the "Available Subset" list, click on the subset name and press the "Delete" button. Note that the segmentation criteria "Anychange" and "Anyrecord" buttons cannot be included as child nodes; when this is attempted, the following error message is displayed on the output window: "Error: Cannot have ANYCHANGE, ANYRECORD in a child node."

<u>Note:</u> Also, note that the network segmentation should be as general as possible since further analysis will be based on the segmented network. To split the network and consider parts of it with certain characteristics, a subnetwork should be created first.

Step 13. After the network segmentation tree has been defined, it is time to segment the roadway network. To accomplish his, click on the "Segment Network" button. The entire definition of the roadway is determined using the contents of the network tree. If for any reason the segmentation cannot be done as specified,

the output window will display an error message. If the segmentation is successful, the output window will display the time the segmentation was started and the time when the segmentation was completed. In addition, a summary of the segmentation criteria will be displayed detailing the reason for break (subset name), the Shortest segment distance, the longest segment distance, the average segment length, and the number of segments (i.e., Count). If several root subsets are used, a summary for each one of them is displayed (see below image).

adCare Explorer + 8 X	TEST, SIM, HPMS, 2-Analysis	014 NETWORK JUN2015 2	250M,1			
	Subset Citoria	n Logic: 2014_NE	TWOR	K_JUN2015	5_250M_LMAREA	Alex Network Segmentation
2012_NETWORK_JULY2013_ALL-CONDITIONS	Australia Schutz					
2012_NE_WORK_ONCOLS_ALL_CONDITIONS     2013_NE_WORK_ODT_S.N_EVUT_LIST     2013_NE_WORK_ODT_S.N_EVUT_LIST     2013_NE_WORK_ODT_S.N_E.CONDITIONS     2013_NE_WORK_OCT_2014_ALL_CONDITIONS     2013_NE_WORK_OCT_2014_ALL_CONDITIONS_DM     2013_NE_WORK_OCT_2014_ALL_CONDITIONS_MM     2014_NE_WORK_OCT_2014_ALL_CONDITIONS_MM      2014_NE_WORK_OCT_2014_ALL_CONDITIONS_MM      2014_NE_WORK_OCT_2014_ALL_CONDITIONS_MM      2014_NE_WORK_OCT_2014_ALL_CONDITIONS_MM      2014_NE_WORK_OCT_2014_ALL_CONDITIONS_NE_WORK_OCT_2014_ALL_CONDITIONS_NE_WORK_OCT_2014_ALL_CONDITIONS_NE_WORK_OCT_2014_ALL_CONDITIONS_NE_WORK_OCT_2014_ALL_CONDITIONS_NE_WORK_OCT_2014_ALL_CONDITIONS_NE_WORK_OCT_2014_ALL_CONDITIONS_NE_WORK_OCT_2014_ALL_CONDITIONS_NE_WORK_OCT_2014_ALL_CONDITIONS_NE_WORK_OCT_2014	AUTO AND A STATE A		New dd Root Add Ierrove	HROOL GRED C HYPE PUBLIC, M HYPE CAE, DRO HYPE RESERVO HYPE GOVT, COR Segment Netv	IME M-35 M-25 M-275 M-275 VFHOL	
10 💭 Simulations	Feason for Break	Shotestimies)	Longe	et (miles)	Average(miles)	Court
2014_NETWORK_JUNE2015_PM15_NEWAREA	argrec PUBLIC_NAF_15	0.03	11.52		2.355	262
COMBATTED DOD ECTS NETWORK	ANREC AGE_GROUP_HALPM	0.01	45.230	000000000004	1.472	8218
2 FLIND77 NEEDS ANALYSIS 2014	BRIDGE_GREQ_0 1MI	0.1	1.435		0.253	154
FUND77 NEEDS ANALYSIS 2014 Final	anyrec RESECTION_2015	0.01	12.55		1.3525000000000000	8690
D FUND77_NELDS_NETWORK_2017_SN_UST     D FYS-17_SN0_PROJ_NET     MOSH4_2015_COLETWORK     MOSH4_2015_COLETWORK     MOSH4_2015_COLETWORK     MOSH4_2015_COLETWORK     MOSH4_2015_COLETWORK     MOSH4_2015_COLETWORK	aryrec GOVT_CONTROL	0.01	45.230	0000000004	1 96400000000002	6101

2- Review and Edit Segmentation Results – performed by DAT Staff

**Summary:** Under this task, the segmentation results are reviewed and manually updated using the "Segmentation Results" module in RoadCare.

- Step 14. Double-click on the "Segmentation Results" options located under the "Dynamic Segmentation" menu.
- Step 15. The segmentation results will show the following fields: ROUTES, BEGIN_STATION, END_STATION, DIRECTION, and REASON (the reason for segmenting, in case two root subsets are used, for example) as shown in the below image. Using the "Route" pull-down menu, the user can choose to display all routes or choose a specific one. This is especially convenient when a large number of records exist in the network and the user wants to verify the information for particular ones. The segments can be manually modified by the user using one or more of the tools described below.

The segment length can be modified by changing the BEGIN_STATION and END_STATION limits. The user can type new values under each field for all the affected sections, as shown in the below image.

#### Maryland department of transportation

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Optimization Defining Network and Importing Data

	ROUTES	BEGIN_STATIO	END_STATION	DIRECTION	Reason	^
•	1-IS 68	0.00	1.75	E	Route Begin;ANYCHANGE AGE;Anychange (Roadclass);AnyChange(Func_Class);Anychange(pav_type)	
	1-IS 68	1.75	2.37	Е	Anychange (Roadclass);AnyChange(Func_Class)	
	1-IS 68	2.37	4.76	E	ANYCHANGE AGE	
	1-IS 68	4.76	7.42	E	ANYCHANGE AGE;Anychange (Roadclass);AnyChange(Func_Class)	
	1-IS 68	7.42	8.05	E	Anychange (Roadclass);AnyChange(Func_Class)	
	1-IS 68	8.05	11.43	E	ANYCHANGE AGE;Anychange(pav_type)	

	ROUTES	BEGIN_STATIO	END_STATION	DIRECTION	Reason	^
•	1-IS 68	0.00	1.55	E	Route Begin;ANYCHANGE AGE;Anychange (Roadclass);AnyChange(Func_Class);Anychange(pav_type)	
	1-IS 68	1.55	2.35	E	Anychange (Roadclass):AnyChange(Func_Class)	
	1-IS 68	2.35	4.76	E	ANYCHANGE AGE	
	1-IS 68	4.76	7.42	E	ANYCHANGE AGE;Anychange (Roadclass);AnyChange(Func_Class)	
	1-IS 68	7.42	8.05	E	Anychange (Roadclass);AnyChange(Func_Class)	
	1-IS 68	8.05	11.43	E	ANYCHANGE AGE;Anychange(pav_type)	

The segments can be further manipulated by clicking on "Join" or "Split" button located next to the "Route" pull-down menu. Highlight the records needing to be merged from the results grid and click on the "Join" Button, the segments will be combined in a single record and under the column field "Reason", the legend "Joined" will appear. To split a segment, highlight the records that are to be divided from the results grid, enter the number of sections in the "Number of Split Sections" field, and click the "Split" Button. RoadCare will divide each of the selected segments evenly into the number of selected sections (e.g. if 3 segments are divided into 4 sections the result will be 12 sub-segments). Like the "Join" option, the legend "Split" will appear under the "Reason" column field.

	ROUTES	BEGIN_STATION	END_STATION	DIRECTION	Reason
•	1-IS 68	0	2.37	E	Route Begin;
	1-IS 68	2.37	4.76	E	PVMT_AGE
	1-IS 68	4.76	8.05	E	PVMT_AGE
	1-IS 68	8.05	11.79	E	Joined
	1-IS 68	11.79	12.43	E The value under	PVMT_AGE
	1-IS 68	12.43	13.665	E the Reason field	Split
	1-IS 68	13.665	14.9	E changes to	Split
	1-IS 68	14.9	16.55	E when combining	Split
	1-IS 68	16.55	18.2	E or dividing	Split
	1-IS 68	18.2	20.15	E segments	Split
	1-IS 68	20.15	22.1	E	Split
	1-IS 68	22.1	24.6	E	PVMT_AGE
	1-IS 68	24.6	28.64	E	PVMT_AGE
	1.10.60	20.64	22.65	F	DAME ACC

Additional options to view and manipulate the resulting segments are found in the bottom line toolbar located below the data grid. The toolbar is shown in the below image.

🚺 🖣 10 of 5636 🕨 🔰 Minimum: 0.1 Maximum: 1.0 Increments Even 🔽 Apply To Display 🔝 Apply To All
Takes user to the first record on the list (row 1).
Moves user to the previous record based on the current selected record
If the first record of the list is the one selected, the option is displayed as a gray icon, meaning that it is not available for selection.
10 of 5636 Shows position of the current selected record out of the
total number of records. A specific record number can be selected by typing it in the window and pressing enter.
Moves user to the next record based on the current selected record. If the last record of the list is the one selected, the option is displayed as a gray icon, meaning that it is not available for selection.
Takes user to the last record on the list (last row).
Minimum: 0.1 Defines minimum distance value for the sub-segments
sections
Maximum: 1.0 Defines maximum distance value for the sub-segments
sections
Increments Even   Defines sub-segments gap intervals based on the
section length and the minimum and maximum sub-segment sections values
Apply To Display Limits application of sub-segmentation to only the route
being displayed
Sub-segmentation applied to all segmentation result records
Once the manual segmentation is complete, proceed to the next task.

#### **3- Perform Rollup** – *performed by DAT Staff*

**Summary:** Under this task, the segmented database rollup rules are defined using the "Rollup" module in RoadCare.

Step 16. Rolled-up (or processed) data is the second level of data storage. It is obtained by assigning raw data to the segments created through dynamic segmentation, using appropriate data aggregating methods (average, minimum, maximum, first, last, predominant etc.) to arrive at a representative value for a section. The "Rollup" option allows the user to define the segmented database rollup rules. Two main factors contribute to the rollup rules: "Attribute" and "Method." The attribute information is extracted from the database and cannot be altered. However, the user can specify the rollup method to aggregate and distribute the data for each attribute. To open the "Rollup" interface, double-click on the "Rollup" option under the "Dynamic Segmentation" menu. The "Segmentation Rollup" window interface will appear as shown in the below image.

DSS RoadCare:					
<u>File View Tools H</u> elp					
RoadCare Explorer 🔹 🤻 🗙	Rollup-MDSHA_NETWOR	ĸ			
	Segmentatic Linear Reference Section Section Reference Section	on Rollup - MDS	SHA_NETWORK	ng:	
2015_NETWORK_JUN2016_COMBAF	ATTRIBUTE	METHOD	*		
COMMITTED_PROJECTS_NETWOR	AADT	Average	- =		
FUND77 NEEDS ANALYSIS 2014	AGE	Predominant	-		
FUND77_NEEDS_ANALYSIS_2014_F	AGE_GROUPS	Predominant	-		
FUND77_NEEDS_NETWORK_2017_	AGE_GROUP_HALFMILE	Predominant	<b>•</b>		
HPMS NETWORK	AVG_IRI	Average	•		
DSHA_2015_QC NETWORK	AVG_IRI_QC	Average	•		
DSHA_2016_QC_NETWORK	AVG_REHAB_CYCLE	Predominant	-		
MDSHA_2017_QC_NETWORK	AVG_RUT	Average	-		
Dynamic Segmentation	AVG_RUT_QC	Average	•		
Segmentation Logic	AVG_RUT_SDV	Average	•		
Rollup	BEGIN_LAT_LONG	Predominant	•		
Viewers	BEGIN_LIMIT	First	-		
	BEGIN_MM	First	•		
DTA 2013	BRIDGE	Predominant	-		
mDTA_2015	BRIDGE_LONG	Predominant	-		
MDTA_2015_LMAREA	CI	Average	-		
MDTA 2015_VMTAREA_NT2	CI FAMILY CODE	Predominant	<b>•</b> •		
DTA_2017_NETWORK					
PROP_BUS_PLAN_GOALS_0.1MI     PDOP_BUS_PLAN_COALS_1MI	Rollur	o Network			
III PROP BUS PLAN GOALS IMI					
utput					

- Step 17. Every time an attribute is selected from the "Attribute" list, a list of values is displayed on the pane located to the right of the window. Properly select the "Method" for each "Attribute" by utilizing the table found in <u>Optimization Data</u> <u>Rollup Methods</u>.
- Step 18. Once the appropriate method has been selected for each attribute, press the *Rollup Network* button located under the "Attribute" and "Method" list pane shown in the above image. The output window will show a message stating when the rollup began, the progress of the rollup for each attribute, and when the rollup finished. The user can copy the attribute rollup methods from another network and apply it to the current network by clicking the pull-down menu next to "Update using" and selecting the appropriate network name. See <u>Optimization Data Rollup Methods</u> for further details regarding specific implementation of network segmentation.

#### 4- Define Network Specific Area – performed by DAT Staff

**Summary:** Under this task, the network specific area is defined in RoadCare. MDOT-SHA uses an average of Vehicle Miles Travelled (VMT) and Lane Miles (LM) to calculate the network-specific section area for treatment selection, benefit and remaining life calculations

Step 19. Open the MS Excel spreadsheet with calculations for network specific area^{06/12/2019}.

- Step 20. Copy and paste these data into the attribute "LM_VMT_AREA."
- Step 21. Right-click on the desired network and select "Define Network Specific Area." This opens a pop-up window where user can specify the attribute name that contains the area calculations in the equation box as shown in the below image.



Step 22. Click on "OK" button to save changes.

# **10.03NEEDS ANALYSIS AND RUNNING SIMULATION ENGINE**

## 10.03.01 General

This section describes the standard operating procedure (SOP) used by staff from the Data Analysis Team (DAT) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to prepare collected data for the "Conditional RSL/Cost Optimization" process in the RoadCare version 3.67 asset management software. This is accomplished by performing a needs analysis and running the RoadCare Simulation Engine. This SOP is performed after the data rollup is completed as described in <u>Network Segmentation and Data Rollup</u>. The RoadCare Simulation Engine requires the following five major inputs:

- 1. <u>Analysis</u>: inputs used to manage project selection methodology (optimization & prioritization) and spending rules (i.e., spend within defined budgets or determine required budgets to meet goals);
- 2. <u>Investment</u>: inputs used to manage budget types and annual amounts as well as inflation and discount rates;
- 3. <u>Performance</u>: inputs used to define equations for predicting future attribute values based on current values;
- 4. <u>Treatment</u>: inputs used to manage Maintenance and Rehabilitation (M&R) activities, requirements for feasibility, applicable budget type and unit costs, and consequences resulting from the activity; and
- 5. <u>Committed</u>: inputs used to manage projects that are planned/selected by the user independent of RoadCare's selection methodology and treatment definition constraints.

<u>Note</u>: The SOP described in this document may not be applicable to other versions of RoadCare.

#### 10.03.02 Frequency

Performing a needs analysis and running the Simulation Engine is performed once per year, after the end of the data collection season, once the data have been processed and migrated into the appropriate Business Plan Tables (see <u>Migrating to Business Plan</u> <u>Tables</u>). The procedure may need to be repeated multiple times during the iterative "Condition RSL/Cost Optimization" process.

## 10.03.03 Purpose

The purpose of this SOP is to establish a required budget for the MDOT-SHA network by performing a needs analysis and then optimizing the budget allocation through the Simulation Engine in the RoadCare software.

#### 10.03.04 *Resource Requirements*

Performing needs analysis and running the RoadCare Simulation Engine requires the following three MDOT-SHA staff members: (1) a DAT staff member knowledgeable in Oracle and RoadCare software to perform the needs analysis and run the simulation; (2) the Assistant Division Chief (ADC) to review the reports generated from the simulation and suggest revisions to the inputs where necessary; and (3) the Division Chief (DC) to provide guidance and decision-making during the ADC review. The estimated effort levels

shown in the table below represent the total time, in man-hours, to complete the needs analysis and simulation process. These time estimates assume no issues are encountered during the procedure.

Position	Function	Resources	Effort Level (man-hrs)
DAT Staff	Analyst	1	AN ^{06/12/2019}
ADC	Review	1	AN
DC	Review	1	AN

#### 10.03.05 *Procedure*

The procedure to run the RoadCare Simulation Engine is comprised of the following eight tasks:

- (1) perform a needs analysis
- (2) create a new Simulation,
- (3) input the Analysis parameters,
- (4) input the Investment parameters,
- (5) input the Performance parameters,
- (6) input the Treatment parameters
- (7) input the Committed parameters, and
- (8) run the simulation.

#### **1- Perform a Needs Analysis** – *performed by DAT analyst*

**Summary:** Under this task, a needs analysis is performed to identify the budget requirements for the pavement network. This analysis is performed only as required; i.e., if the simulation budget is not already available. Typically, a needs analysis is performed by running several "Conditional RSL As-Budget Permits" simulations by iteratively increasing the budget in the Investment window (See Task 4 - Total Investment of this SOP) to meet some pre-determined criteria. Simulations are run in a similar manner as explained in the following sections using the same inputs and criteria, and summaries from all sections reports are generated until these criteria are met. Some of these criteria are as follows.

- i. How much money is needed to maintain current conditions?
- ii. How much money is needed to attain MDOT-SHA's business plan goal of RSL=20 in 10 years?
- iii. How much money is needed to achieve a benefit target of X LMY in fiscal year Y?

In order to meet the MDOT-SHA business plan goal of 20 RSL with consistent funding, it has been determined that Fund 77 needs \$260M to \$270M each year overall, with construction remaining steady at \$220M each year. This assumes a system preservation approach with Rehabilitation and Preventive Maintenance. This conclusion can be determined by summarizing various "All Sections" reports. Refer to the files below^{06/12/2019} for more details.

- i. Pavement RSL Predictions 2010-2027 Adjusted with 220M v3.xlsx (Summary sheet)
- ii. All_Sections SW_SIM_BY_TREATMENT DoNothing.xlsm (Do nothing simulation)

- All_Sections SW_SIM_BY_TREATMENT Optimized 220M.xlsm (data for \$220M)
- iv. All_Sections SW_SIM_BY_TREATMENT Optimized.xlsm (data for current budget)

If the simulation budgets has been finalized, then this task can be skipped altogether.

- Step 1. Determine if a needs analysis must be performed based on the criteria described in the summary of Task 1.
  - i. If a needs analysis is required, proceed to Step 2.
  - ii. If a needs analysis is not required, skip to Step 3.
- Step 2. Follow the steps described below for creating a simulation and adjusting the simulation input parameters. Iteratively increase the budget in the Investment window (See Task 4- Total Investment of this SOP) to meet some predetermined criteria. The criteria for the needs analysis should be discussed with the ADC prior to completion of the needs analysis.
- 2- Create a New Simulation performed by DAT analyst

**Summary:** Under this task, a Simulation is created using RoadCare for the desired network.

- Step 3. Open RoadCare software.
- Step 4. Expand the options inside the "Networks" module by clicking on the "+" icon. Then, expand the options inside the "2016_NETWORK_COMBAREA"^{06/12/2019} menu that appears in the list by clicking on the "+" icon.
- Step 5. Right-click the on "Simulations" listed under the "2016_NETWORK_ COMBAREA" menu and select the "Add New" option, as shown in the below image.



Step 6. Type an appropriate simulation name in the text box next to "Simulation Name" and select the appropriate network from the drop-down list next to "Network," as shown in the below image. After the simulation is created, a new folder with the simulation name is listed under the "Simulations" tab.

🖳 Simulation Nan	ne 💌			
Simulation Name:	Demo Simulation			
Network:	MDSHA_NETWORK -			
OK Cancel				

**3-** Analysis Input – *performed by DAT analyst* 

**Summary:** Under this task, the parameters required for the Analysis module are input in RoadCare. The parameters are summarized below.

- Budget: spending rules that are used to limit the allocation of funding to feasible treatments.
- Weighting: input modifies the calculated benefit or remaining life by a userselected parameter. The selected weighting parameter is directly multiplied by the calculated benefit to give a weighted benefit.
- Benefit: input determines which attribute is used in the Incremental benefit/cost calculations. It is recommended to select a benefit variable even when performing a remaining life analysis because the benefit can be calculated and reported, even if not used as a basis for treatment selection.
- Jurisdiction criteria: creates a subset of given network data. For example, if a network contains data for an entire state highway agency, the Jurisdiction input can be used to run a Simulation on only District 1.
- Priority: tab on the analysis window is used to set budget priorities and constraints. The priority column is an integer number greater than 0, with no numbers repeating. The criteria column contains the values that causes this priority to apply; e.g. [SHOP]='CAMBRIDGE' for all sections assigned to the Cambridge Shop. These criteria are applied for every year of the simulation and are based upon the predicted value of the included attributes. The funding levels for rehabilitation, maintenance, and/or construction or other user-defined investment criteria as defined by a positive number between 0 and 100 (i.e. 100% is input as 100). This number represents the maximum cumulative percent of the budget that may be spent on this priority or lower priority levels (priority 1 is the highest priority level). Any money not spent on a higher priority is available to be spent on lower priority treatments/sections. If the criteria field is left blank, the priority applies to all sections.

- Target: tab on the analysis window allows the user to input the network goals which the simulation engine will attempt to satisfy (not applicable for conditional RSL/cost optimization).
- Deficient: tab on the analysis window, allows the user to input the network deficiency targets which the simulation attempts to satisfy (not applicable for conditional RSL/cost optimization).
- Step 7. Expand the options inside the newly created simulation in Step 6 by clicking on the "+" icon. Double-click on the first option, which is "Analysis," to display the main "Analysis" window as shown in the below image.

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<u>Eile View</u> Tools <u>H</u> elp								
RoadCare Explorer 👻 🕂 🗙	Demo Simulation-An	alysis						
						DI/		
	Analysis Methods for Demo Simulation : MDSHA_NETWORK							
	Optimization: Remaining Lif	e/Cost		s Budget Permits	✓ Weighting: 10	TAL_LANES -	Benefit: IRI_PER	_SCALE +
	Description: This is a demo	o simulation.				Be	enefit Limit: 0	
2012_DISTRICT-7	Run Simulation	Jurisdiction Criteria	GOVT_CON	TROL='1' AND SIM	DIV='1' AND (FUNC	_CLASS>'0') AND BF	RIDGE IS NULL AND	ISCONHIST='1' AN
B 2012_NETWORK-2015_SN_RUT_LIST	Priority Target Deficient							
2012_NETWORK-2016_SN_RUT_LIST	Priority	Year Crite	D1	D2	D3	D4	D5	D6
	1	IDI	100	0	0	0	0	0
2012 NETWORK MAY2013 ALL-CONDITION	2	IDI I	0	100	0	0	0	0
2012_NETWORK_MAY2013_IR-IONLY_OLD 1	2	[D1	0	0	100	0	0	0
In 2012_NETWORK_MAY2013_IRI-ONLY_LM_N	3	[DI	0	0	100	0	0	0
2012_NETWORK_MAY2013_IRI-ONLY_VMT_	4	[DI	0	0	0	100	0	0
	5	[DI	0	0	0	0	100	0
MDSHA_2009_QC NETWORK	6	[DI	0	0	0	0	0	100
B DSHA_2010_QC NETWORK	7	[DI	0	0	0	0	0	0
B-     MDSHA_2013_QC NETWORK     E	8	[G	0	0	0	0	0	0
DSHA_NETWORK	*							
Dynamic Segmentation								
□ → Simulations								
Demo Simulation								
- Investment								
- Performance								
Committed								
Results								
Dest_Simulation_for_Network_1								
MDTA T								
			_					
Output								

- Step 8. Enter the required input data. Most inputs required for the simulation engine are conditional in nature. This means that the equation, constraint, or action is entirely dependent upon the current state or condition of each pavement management section. Simulation engine conditional statements are input using standard SQL query syntax. The interface includes a query builder and checker sub-module. For the "Analysis" sub-module, the window contains the following fields:
  - Optimization,
  - Budget,
  - Weighting,
  - Benefit,
  - Description,

- Benefit Limit, and
- Jurisdiction Criteria.

In addition, tabs labeled Priority, Target, and Deficient allow entering additional input data. These inputs vary from one simulation to another. For more details on these inputs, please see RoadCare Help. Listed below are a set of possible inputs to use in a simulation.

Optimization – Conditional RSL/Cost.

Budget – As Budget Permits.

Weighting – None.

Benefit and Benefit Limit – Not applicable for Conditional RSL/Cost optimization.

Jurisdiction Criteria: Varies depending on the simulation; e.g. ISRAMP='0' AND GOVT_CONTROL='1' AND FUNC_CLASS IS NOT NULL AND SIMDIV='1' AND (END_STATION-BEGIN_STATION)>=0.5 AND TOTAL_LANE_MILES >'0' AND (FC_DENSITY>0 OR SC_DENSITY>0 OR AVG_RUT>0 OR AVG_IRI>0 OR SPADJ_SKID_NUMBER>0) AND AGE>=0

Priority – See Steps 10-16.

Target & Deficient – Not applicable for Conditional RSL/Cost Optimization.

- Step 9. When all the data necessary for the simulation are correctly entered, select "Run Simulation" to start the simulation engine. Errors that occur during the compilation or run of the simulation will be displayed in the output window.
- **4- Total Investment** *performed by DAT analyst*

**Summary:** Under this task, the necessary parameters required for the Investment module are input in RoadCare.

- Step 10. In the "Explorer" window, double-click on the second option, "Investment," under the simulations module for the chosen network to display the main "Investment" window, as shown in the below image. Enter the following inputs:
  - **Start year:** field used to define the first year of the simulation. For example, if the RoadCare database contains attribute data from 1999-2017, and a start year of 2020 is entered, RoadCare will roll forward the attributes according to the input performance equations. Usually, the start year is entered as the most recent inventory year plus 1.
  - Analysis period: determines the number of years that a simulation will run. The analysis period should be at least 10 years for the State Optimization. The inflation rate (%) and discount rate (%) fields are used to determine the present value of treatments and committed projects.
  - Inflation rate: 4.2% (most recent).
  - Discount rate: 0%

• **Budget Order:** determines the budget expenditure hierarchy for the "As Budget Permits" and "Unlimited Budget" analyses.

Contact the Chief Engineer's office to get the statewide construction budget for the next several years from the most recent CTP allocation and enter in the "STATEWIDE" budget category in the investment window. Note that committed projects must be in a separate budget category. For the "COMMITTED" category, add the cost of all committed projects by fiscal year to determine the budget. To add budget categories, click the 3 dots (...) button in the Investment window next to Budget order to display the Edit Budget Categories window shown in the image below. Type the name of the budget categories and click "Add". No budget categories names should contain spaces or single quotes. To change the order, select a given category and select "Up" or "Down" based on the desired order of the category in the list. Any category can also be deleted by highlighting the category name and selecting "Delete." Once the budget categories list is complete, select OK.

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RoadCare Explorer 🗸 🕈 🗙		ALL_SEC_SIM-I	investment		<b>~</b> ×
Dynamic Segmentation	1				
Viewers		_ Invest	ment ALL_SEC_S	SIM: TEST_	NETWORK_SEGMENT
Simulations	Sta	rt Year: 2017	Analysis Period: 4	Inflation Rate(%):	4.2 Discount Rate(%): 0
ALL_SEC_SIM	Buc	iget Order: st	TATEWIDE COMMITTED		
-X Investment		3	TATE TO E, COMMITTED		
- Performance		Years	STATEWIDE	COMMITTED	
- Treatment	D.	2017	\$0.00	\$0.00	
- Committed		2018	\$200,000,000.00	\$280,000,000.00	
- Results		2019	\$250,000,000,00	\$210.000.000 00	
B SIM1_BUDGETCAP_TREATME		2020	\$220,000,000,00	\$200,000,000,00	
TEST_SIMULATION_D1		2020	\$230,000,000.00	\$200,000,000.00	
TEST_SIMULATION_D2					
TEST_SIMULATION D4					

STATE HIGHWAY ADMINISTRATION

🖳 Edit Budget Categories	
	Add
D1 D2 D2	Delete
D3 D4 D5	Up
D7 Bonded_PCC_OL	Down
	ОК
	.4

- Step 11. Open the "Budget Per Shop" Excel file^{06/12/2019}. Update all data in the worksheet "2016_SHA_Inventory" by running the SQL statements in cells I1, I21, I42, I69, K97, and P124 in Oracle SQL Developer in the production environment^{06/12/2019}. Calculate \$ MIN (%) and \$ MAX (%) of LM and VMT for each Shop. Use LM if it is the max. This is called "DraftBudgetAlloc" in the Excel file.
- Step 12. Run a "Conditional RSL/Cost - As Budget Permits" simulation with all committed projects and most recent construction budgets from OCE without priorities/budget allocation. The only criteria to use in this simulation is "[GOVT CONTROL] = 1" as shown in the following image. Budget priorities investment provided and inputs are in the simulation "TEST SIM BUDGETPERSHOP 1" in RoadCare. All other inputs remain the same. To access this simulation, expand the options inside the "Networks" module by clicking on the "+" icon. Then, expand the options inside the "2016 NETWORK COMBAREA" menu that appears in the list by clicking on the "+" icon. Then expand the options inside the "Simulations" module by clicking on the "+" icon. This will show the list of simulations under the selected network. Then expand the options inside the selected simulation by clicking on the "+" icon next to the simulation name. See Steps 3 through 7 for screenshots and more details.

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/iT_SIM_BUDGETPERSHOP_1-Analy							
Analysis Methods for TEST_SIM_BUDGETPERSHOP_1 : TEST_NETWORK_SI	EGMENTATION						
Optimization: Conditional RSL/Cost - Budget: As Budget Permits - Weighting: none - Benefit: AVG	_IRI 👻						
Description: Test simulation to determine initial budget per shop and then budget per treatment for districts Benefit Limit: 600							
Run Simulation Jurisdiction Criteria: (GOVT_CONTROL='1' AND FUNC_CLASS IS NOT NULL AND SIMDIV='1' AND (END_ST	ATION-BEGIN_STATION)>=0.5 AND T						
Priority Target Deficient							
Priority Year Criteria	STATEWIDE COMMITTED						
I [GOVT_CONTROL]='1'	100 100						
•							

- Step 13. Once the simulation is complete, generate a "Targets/Suggested Projects Report" (see <u>Generating Reports</u>). Copy the budget allocation by shop from the "Targets" tab in the spreadsheet. These \$ numbers will be called "OptimizResults."
- Step 14. Paste "OptimizResults" in "BudgetPerShop" tab, Column V.
  - i. IF (OptimizResults<DraftBudgetAlloc or OptimizResults>DraftBudgetAlloc) then use DraftBudgetAlloc else use OptimizResults. This is labeled "DRAFT Budgetq" in the Excel file.
- Step 15. Apply the following formula in column H: =*IF(DRAFT Budgetq=\$ MIN (%),"MIN",IF(DRAFT Budgetq=\$ MAX (%),"MAX",""))*
- Step 16. In column K, adjust the budget per shop distributions that are not classified as MAX so that the total adds up to 100%. Note that cumulative budget distributions will be used in RoadCare in the priorities window. These numbers are available in tab "RoadCare BudgetperShop 02202018" in the Excel file. Copy and paste the data in this file (exclude headers) and paste into the "Priority" tab in RoadCare by selecting the first cell under the "Priority" column and pressing Ctrl+V on the keyboard to paste the data (see below image).

1	Priority Le	Year	ATTRIBUTE	STATEWIDE	COMMITTE	D
2	1		[SHOP]='CAMBRIDGE' AND [P	0.80	0	
3	2		[SHOP]='PRINCESS ANNE' AN	1.44	0	
4	3		[SHOP]='SALISBURY' AND [PR	4.57	0	
5	4		[SHOP]='SNOW HILL' AND [PR	6.45	0	

**5- Performance Models** – *performed by DAT analyst* 

**Summary:** Under this task, the necessary parameters required for the performance module are input in RoadCare.

Step 17. In the "Explorer" window, double-click on the third option, "Performance," under the simulations module for the chosen network to display the main "Performance" window as shown in the below image. MARYLAND DEPARTMENT OF TRANSPORTATION

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Double-click on the "AVG_IRI" field in the display window to open the "Edit Step 18. Simulation Equations" window. Make sure "Check this box to enter equation as a function is checked." Paste the updated C# function for IRI from the Excel file into the input window as shown in the image below. Click "OK."

Attributes         AGE_GROUPS         AGE         AGE_GROUPS         ConstructureAL_TYPE         CONTRACT_NIM         CONTRACT_NIM         CONTRACT_NIM         CONTRACT_NIM         CONSTRUCTURAL_ORG         CONSTRUCTURAL_ORG         CONTRACT_NIM         CONSTRUCTURAL_ORG         CONSTRUCTURAL_ORG         CONTRACT_NIM         CONSTRUCTURAL_ORG         CONSTRUCTURAL_ORG         CONSTRUCTURAL_ORG         CONSTRUCTURAL_ORG         CONSTRUCTURAL         Constri	🖳 Edit Simulation Equations		- • •
ABE GROUPS     Athou       ASE GROUP HALFMLE     ABE GROUPS       ASE GROUP HALFMLE     Absol       ANG JRI ORG     Absol       ANG JRI ORG     Absol       ANG JRI ORG     Absol       ANG RUT ORG     Annol       ANG RUT ORG     Annol       ANG RUT ORG     Annol       ANG RUT ORG     Annol       Ansky     Annol       BEGIN LIMIT     Edingol       BEGIN CORE     Cosh()       BRIDGE     Cosh()       Corple OxTEGORY     Cosh()       Corple OxTEGORY     Cosh()       CONTRACT NUM     Sink()       CONTRACT NUM     Sink()       Contract TryPe     Powky)       Conte this box to erter a performance curve as piecewise points	Attributes		
Check OK Cancel	P* Edit Simulation Equations         Attributes         AGE_GROUPS         AGE_GROUP_HALFMILE         AVG_IRI         AVG_REHAB_CYCLE         AVG_RUT_GRG         BEGIN_LIMIT         BEGIN_LIMIT         BEGIN_LIMIT         BEGIN_LIMIT         BEGIN_MM         BRIDGE_LONG         CI_FC_CATEGORY         CI_FC_OTEGORY         CI_FUNCTIONAL_ORG         CI_FUNCTIONAL_ORG         CI_FUNCTIONAL_ORG         CI_FUNCTIONAL_ORG         CI_FUNCTIONAL_ORG         CI_FUNCTIONAL_ORG         CI_STRUCTURAL_ORG         CONTRACT_TYPE         CONTRACT_TYPE         CONTRACT_TYPE         CONTRACT_TYPE         CONTRACT_TYPE         CONTRACT_TYPE         CONTRACT_TYPE         CONTRACT_TYPE         CONTRACT_TYPE         Coheck this box to enter a performance curve as piecewise points.         Equation:         Check this box to enter a performance curve as piecewise points.         Equation:         [FUNC_CLASS]=="1"    [FUNC_CLASS]=="11")         (Answer = 0.012TAGE]}         else {f(FUNC_CLASS]=="1"    [FUNC_CLASS]=="12")         (Answ	<ul> <li>Attribute</li> <li>FUNC_CLASS</li> <li>AGE</li> <li>( Age</li> <li>*</li> </ul>	Value 14 15 Value Value
	Check OK Cancel		

- Step 19. Repeat Step 18 for the other four performance measures (functional cracking density, structural cracking density, rutting, and friction) by copying in the correct C# functions, updated in the Excel file, into the input window.
- Step 20. Run a "Conditional RSL/Cost As Budget Permits" simulation for at least 10 years using the most recent OCE budgets and treatment inputs. Budget priorities and investment inputs are provided in the simulation SIM1_BUDGETCAP_TREATMENT in RoadCare. All other inputs remain the same. To access this simulation, expand the options inside the "Networks" module by clicking on the "+" icon. Then, expand the options inside the "2016_NETWORK_COMBAREA" menu that appears in the list by clicking on the "+" icon. Then expand the options inside the "Simulations" module by clicking on the "+" icon. This will show the list of simulations under the selected network. Then expand the options inside the selected simulation by clicking on the "+" icon next to the simulation name. See Steps 3 through 7 for screenshots and more details.
- Step 21. Once the simulation is complete, generate a "Targets/Suggested Projects Report" (see <u>Generating Reports</u>) for the current optimization year to review the treatment life extension for suggested projects in the optimization year. Compare against the typical treatment life extension ranges specified in the supplemental treatment information section of the MDOT-SHA Pavement Design Guide.
  - i. If the predicted life extension for a specific treatment is outside the recommended range specified in the Design Guide, then the corresponding family of models (usually in cracking or IRI) must be revised to produce more reasonable results.
- 6- Treatments performed by DAT analyst

**Summary:** Under this task, the parameters required for the Treatments module are input in RoadCare.

Step 22. In the "Explorer" window, double-click on the fourth option, "Treatment," under the simulations module for the chosen network to display the main "Treatment" window as shown in the below image.
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 2013, NETWORK, AUG20H, ALL, CONDT
 2013, NETWORK, AUG20H, ALL, CONDT
 2013, NETWORK, OK 2014, ALL, CONDT
 2013, NETWORK, OCT2014, ALL, CONDT
 2013, NETWORK, OKC2014, ALL, CONDT
 2014, NETWORK, OKC2014, ALL, CONDT
 2014, NETWORK, OKC2014, ALL, CONDT
 2014, NETWORK, ALNE2015, PM15, NEW
 2014, NETWORK, ANNE2015, PM15, NEW
 2014, NETWORK, OKC2014, DM15, NEW
 2014, NETWORK, DM162014, DM15, NEW
 2014, NETWORK, DM162014, DM164 2013_NETWORK2017_SN_RUT_LIST Treatments OPTIMIZE_REMA LENGTH + Budget: STATEWO APE AND AD Teatments AD_CLAS DATE . C CATEGOR SSER.E. BONDED PORTLAND CE VG.JR ٠ CONCRETE PAVEMENT TOTAL LANE MILES CONCRETE PAVEMENT NGTH 1 CRACK SEAL OTAL LA DUAMOND GRINDING 2 54 ( Ape ALL_FEASBLE_TREATMENTS FULL-DEPTH RECLAMA ALL_FEASIBLE_TREATMENTS_SI COMMITTED_FUND77_NONFUND D5_OPTIM2ATION RND :-- IN OVERLAY ) GRNDOWERLAY or 1 St FORECASTING REPORTS_SIM GRIND-OVERLAY or 1.51. OPTIMZE_156M_DELIVERABLE_2 MICROSURFACE OPTIMZE REMAINING FUNDS IT O PTMZE, REMAINS, FUNDS, IT O Analysis
 O Reference No Testment OVERLAY (+1.5N ASPH OVERLAY -15N ASPH. OVERLAY >1 SIN ASPHA ANE_MILESI LEN-ILENGTHI TL-(TOTAL_LANESI AN-O.EG. ah Fow(TL*LEN.2)=0 1974ah Pow(TL*LEN.3);) OVERLAY >1 SIN ASPHA RECONSTRUCTION 2 "#1706#T++"1706#K++170(AN+54642*EQ.) 74778*EQ.)) PUBBLIZATION-OVERLA 1000760 2014 NETWORK MAY2015 LIMAREA 2014 NETWORK MAY2015 NEWAREA SURFACE ABRASION THIN OVERLAY ON IN A NBOADED PORTLAND Oveck OK Cancel

Step 23. Open the "Feasibility" tab and ensure the feasibility criteria for each treatment are properly specified. Multiple feasibility conditions can be specified as shown in the below example for a treatment type called "Asphalt Patch Only."

_REMAINING_FUNDS_IT6_NE	EW-Tr	•									
Treatments OP1	Treatments OPTIMIZE_REMAINING_FUNDS_IT6_NEW : 2014_NETWORK_JUNE2015_PM15_NEWAREA										
Treatments 🔺 ^	Budget: STATEWIDE, COMMITTED	Years Before Any Treatment: 2 Years Before Same Treatment: 2									
ASPHALT PATCH ONLY	Description: Treatment# F1										
BONDED PORTLAND CE	Feasibility Cost Consequence										
CONCRETE PAVEMENT	Feasibility										
CONCRETE PAVEMENT	([SURFACE_TYPE]='ASPHALT' AND [AVG_IRI]<=220 AND [CI_STRUC	CTURAL]>65 AND [CI_FUNCTIONAL]>65 AND [AGE]>=2) AND ((([FUNC_CLASS]='1' OR [FUNC_CLAS									
CRACK SEAL	([SURFACE_TYPE]='ASPHALT' AND [AADT]>25000 AND [AVG_IRI]>2	20 AND [CI_STRUCTURAL]>65 AND [CI_FUNCTIONAL]>65 AND [AGE]>=2) AND ((([FUNC_CLASS]='									
DIAMOND GRINDING											

Step 24. Open the "Cost" tab and specify the dollar amount to attach to each treatment. The cost can be defined in terms of an equation or a C# function. Unit cost data for each treatment is obtained using data from past construction projects. Unit cost is averaged for pavements grouped based on District, Road Class, Functional Class Category, and IRI condition and updated annually. The source for these costs is the "Treatment Tree" Excel file^{06/12/2019}. The user must copy and paste the cost functions for each treatment from the "Treatment Tree" Excel file into the text box as shown in the below image. MARYLAND DEPARTMENT OF TRANSPORTATION

Optimization Running Simulation Engine

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are Explorer + 3 X	REMAINING FUNDS (TK, NEW-Tr		📢 Edit Simulation Equations				-00
2013_NETWORK 2017_SN_RUT_UST · 2013_NETWORK_AUG2014_ALL_CONDIT	Treatments OPTIMIZE	REMA	Abritutes LENGTH	(a) [0		Abibule	Value
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				Owk OK Caro			

Step 25. Run the following SQL statement to determine TOTAL_BID, LANE_MILES_RESURFACED, and COST_PER_LANE_MILE by fiscal year:

select fiscal_year, sum(total_bid) total_bid, sum(inv_emp - inv_bmp) lane_ miles_resurfaced, sum(total_bid)/sum(inv_emp - inv_bmp) cost_per_lane_ mile from business_plan_lmy where fund = 77

and treatment in (select treatment from lu_treatment where is_resurfacing = 1) and total_bid >0 and fiscal_year <2100 and max_layer_fy = 1 group by fiscal_year order by fiscal_year;

Step 26. Calculate the inflation rate using the "Solver" tool in Excel as shown in the below image.

2007         2008         2009         2010         2011         2012         2013         2014         2015         2016           0.9775         1.0186         1.0247         1.0635         1.070         1.071         1.070         1.096         1.079         1.044	2017	2018
0.9775 1.0186 1.0247 1.0635 1.070 1.071 1.070 1.096 1.079 1.044		
	1	0.986
\$273,561.10		
\$267,398.51 \$184,569.71		
\$261,374.75 \$187,998.25 <b>\$179,260.82</b>		
\$255,486.69 \$191,490.48 \$183,680.19 <b>\$141,513.98</b>		
\$249,731.27 \$195,047.58 \$188,208.50 \$150,507.00 <b>\$145,178.60</b>		
\$244,105.51 \$198,670.76 \$192,848.46 \$160,071.51 \$155,334.88 \$154,247.45		
\$238,606.48 \$202,361.23 \$197,602.80 \$170,243.84 \$166,201.66 \$165,270.20 \$166,460.13		
\$233,231.32 \$206,120.27 \$202,474.36 \$181,062.60 \$177,828.64 \$177,080.66 \$178,036.02 \$165,416.56		
\$227,977.26 \$209,949.13 \$207,466.01 \$192,568.88 \$190,269.02 \$189,735.10 \$190,416.92 \$181,309.10 <b>\$187,064.06</b>		
\$222,841.55 \$213,849.11 \$212,580.73 \$204,806.37 \$203,579.69 \$203,293.86 \$203,658.80 \$198,728.53 \$201,857.83 \$208,618.42		
\$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,821.54 \$217,8	\$217,821.54	
		\$214,771.41

- Step 27. Use the inflation rates calculated in Step 26 to determine the historical unit cost for various treatments by running the SQL statement in the "Treatment Tree" Excel file (see column AW in worksheet "2007-CurYear Fund77 Projects").
- Step 28. Copy and paste the results of the SQL statement from the previous step into the table "TBL_UNIT_COST_PRJ" in the same worksheet. Exclude outliers by calculating the nth% percentile lower and upper limit for unit cost by treatment (start with 5% for LL and 95% for UL, but these numbers will vary by treatment type). These calculations are stored in the same worksheet in a summary table. If cost data are not available for a specific treatment, then assume a cost based on judgment/experience. The cost data and functions will be automatically updated in the individual treatment worksheets as they are linked to the summary table.
- Step 29. Review the unit cost data for all treatments before the unit cost functions are entered in RoadCare.
- Step 30. Open the "Consequence" tab (see below image) and define what happens after a given treatment is selected. "Consequence" contains the "Attribute" that is affected, the "Change" that is applied, and the "Criteria", which selects the appropriate consequence. An example of consequence definitions for treatment type "Asphalt Patch Only" is shown in the below example. Refer again to "Treatment Tree" Excel file for the most recent treatment consequences.

_REMAINING_FUNDS_IT6_NEW-Tr + X										
Treatments OPT	IMIZE_REMAINING	_FUNDS_	IT6_NEW : 2014_NETWORK_JUNE2	015_PM15_NEWAREA						
Treatments 🔺 ^	Budget: STATEWIDE, COMM	TTED	<ul> <li>Years Before Any T</li> </ul>	reatment: 2 Years Before Same Treatment: 2						
ASPHALT PATCH ONLY Description: Treatment# F1										
BONDED PORTLAND CE	Feasibility Cost Consequer	ce								
CONCRETE PAVEMENT	Attribute	Change	Equation	Criteria						
CONCRETE PAVEMENT	AADT_VMT	▼ +2.5%								
CRACK SEAL	CI_STRUCTURAL	•	([CI_STRUCTURAL]*0.8)+20							
DIAMOND GRINDING	CI_FUNCTIONAL	-	([CI_FUNCTIONAL]*0.8)+20							
FULL-DEPTH RECLAMA	AVG_RUT	✓ -2%								
GRIND >=4IN-OVERLAY	AVG_IRI	•	-0.0000002544*([AVG_IRI]*[AVG_IRI]*[AVG_IRI])+0.00009000							
GRIND-OVERLAY <=1.51	TREATMENT_LEVEL	<ul> <li>MINOR</li> </ul>								
GRIND-OVERLAY <=1.5I	AGE	▼ +1								
MICROSURFACE	CONDITION_IRI	VERY GOOD		[AVG_IRI]>=0 AND [AVG_IRI]<60						
No Treatment	CONDITION_IRI	<ul> <li>GOOD</li> </ul>		[AVG_IRI]>=60 AND [AVG_IRI]<95						
OVERLAY <=1.5IN ASPH	CONDITION_IRI	▼ FAIR		[AVG_IRI]>=95 AND [AVG_IRI]<=170						
OVERLAY <=1.5IN ASPH	CONDITION_IRI	▼ MEDIOCRE		[AVG_IRI]>170 AND [AVG_IRI]<=220						
OVERLAY >1.5IN ASPHA	CONDITION_IRI	<ul> <li>POOR</li> </ul>		[AVG_IRI]>220 AND [AVG_IRI]<=640						
OVERLAY >1.5IN ASPHA	AADT	▼ +2.5%								

## 7- Committed Projects – performed by DAT analyst

**Summary:** Under this task, the parameters required for the "Committed" module are input in RoadCare.

Step 31. In the "Explorer" window, double-click on the fifth option, "Committed," under the simulations module for the chosen network to display the main "Committed"

window as shown in the below image. The available inputs include Facility, Start Year, Analysis Period, Advanced Search, as well as a grid with a list of facilities, sections, and years.

and a	ation Property	• # 3	Demo Sin	ulation Committed	1									
Prop	My .	Value				CTHORY								
	i i i i i i i i i i i i i i i i i i i	AAMD 214		mmitted Mi	DSHA_N	EIWORK	- Demo Sim	ulation				Expot Connibid Projects		
iecte	6	5.64.65(E)	1.2			Facility.	14							
'ear		2015	Stat Year 20	1) · Analysis Per	et 1 +	Advanced Search								
-	ert	D2 Gmd and Overlay	Cashe (Tre	ADDINAL CONTRACTOR	Mark .		. Mark	. March			. Mark			
da		05	TALLUTY	58L10N	2013	2014	2010	205	2017	2018	2/19	2020		
¢		\$503,243,50	ANNU 2	218-28.70	-	-	-	-	-	-	and a second second	-		
an	Before Any	6	10.002	28.722.40(3)		-	-				D2 Umd and OV .			
m	Before Same	1 C	AA180 2	20.45-5201							-	-		
			AANO 2	12-11 25(5)		_	-					-		
			11102	30.25-37.75(5)	-	-	-	-	-	-	-	-		
			AAMD 2	37.75.39.25(5)	-	-	-		-	-	-	-		
			AAMD 2	39,25-40(5)		-			-	_		-		
			AAMD 2	40-41.4(5)		_			_	_		-		
			AAMD 214	0-3.378D		_			_	_				
	Abibute	Change	AAMD 214	3.375 6(E)		_		_	_	_	_	-		
	SPACE SKD_NUMBER	+ 4)	AAMD 214	5.64.65(E)		_	D2 Gest and Ok	<u></u>	_	_				
	LAST_TREATMENT	<ul> <li>T12</li> </ul>	AA-MD 214	6.65-10.177(E)	-	-		-	-	-	-			
	AIG_RUT	- 205	AAMD 214	10.177-11.54(E)										
	CONDITION_IRI	+ FAR	AAMD 214	5.64.65(%)							02 Gend and Ov			
	PR, FER, SCALE	+ 42 53-0 574903811PL_PE	AAMD 253	0-1.34(N)										
	TREATMENT_LEVEL	- MAJOR	AAMD 255	0-3 15(E)	_	_			_	_				
	AGE	+ 0	AAMD 255	3154218			1.1	-						
	CI, FUNCTIONAL	- 100	AA-MD 256	0-1.86(0)			DD Overlay							
	O_STRUCTURAL	• 100	AAMD 256	1.863.31(2)										
			AAMD 256	3.31-5.20(E)										
			AAMD 258	041865										

- Step 32. To prescribe treatments, select a given "Facility" from the pull-down menu or use the "Advanced Search" option. Then, select a "Start Year" and the "Analysis Period;" usually, these two parameters match the investment input values. When the appropriate section is identified, click on the cell that corresponds to the year of interest.
- Step 33. Subsequently, on the pane to the left labeled "Simulation Property," select the treatment type, the budget category that should be used to cover the cost of the treatment, as well as the total cost. Alternatively, committed projects could be imported as a tab delimited text file with the required parameters^{06/12/2019}. The treatments defined under committed are accounted as mandatory activities during the simulation. Click the "Import Committed Projects" button in the top right-hand corner of the Committed Projects window. This will open a dialog box that will allow the user to import the Committed projects file.

## 8- Run Simulation – performed by DAT analyst, ADC, and DC

**Summary:** Under this task, the simulation is run in RoadCare to optimize the budget allocation for the pavement network. The results of this task will then be reviewed, and if revisions are required, another iteration of the entire process will be completed with the discussed implemented changes.

- Step 34. Click "Run Simulation" in the "Analysis" window.
- Step 35. Following <u>Generating Reports</u>, generate the required reports to be reviewed.
- Step 36. Send reports to ADC and DC for review.
  - i. If changes are required, discuss next actions. Make adjustments to the segmentation, data rollup, or simulation inputs as needed. When adjustments are complete, return to Step 34.
  - ii. If no changes are required, the process is complete.

# **10.04GENERATING REPORTS**

# 10.04.01 *General*

This section describes the standard operating procedure (SOP) used by staff from the Data Analysis Team (DAT) of the Maryland Department of Transportation State Highway Administration (MDOT-SHA) to generate reports for the "Conditional RSL/Cost Optimization" process in the RoadCare version 3.67 asset management software. This SOP is performed after the simulation is completed as described in <u>Needs Analysis and Running Simulation Engine</u>.

<u>Note</u>: The SOP described in this document may not be applicable to other versions of RoadCare.

# 10.04.02 Frequency

The generation of reports is performed once per year, after the end of the data collection season, and once all data have been processed and migrated into the appropriate Business Plan Tables (see <u>Migrating to Business Plan Tables</u>). The reports may need to be generated multiple times during the iterative Condition RSL/Cost Optimization process.

# 10.04.03 *Purpose*

The purpose of this SOP is to generate budget reports for the yearly RoadCare simulation, which allocates funding for the needs identified in the pavement network.

# 10.04.04 *Resource Requirements*

Generating reports involves one person: a DAT staff member knowledgeable in RoadCare software. The estimated effort level shown in the table below represents the total time, in man-hours, to complete the report generation. This time estimate assumes no issues are encountered during the report generation process.

Position	Function	Resources	Effort Level (man-hrs)
DAT Staff	Analyst	1	1.0

## 10.04.05 *Procedure*

The procedure to generate reports in RoadCare is comprised of the following two tasks:

- (1) generate standard reports, and
- (2) generate special reports.

## 1- Generate Standard Reports – performed by DAT Staff

**Summary:** Under this task, standard reports from a funding needs simulation can be generated using the RoadCare software.

- Step 4. Open RoadCare software.
  - i. If the report that is to be generated is one of the standard reports, proceed to Step 8.

- ii. If the report that is to be generated is a special report, proceed to Step 8 in Task 2.
- Step 5. Expand the options inside the "Networks" module by clicking on the "+" icon. Then, expand the options inside the "MDSHA_NETWORK" menu that appears in the list by clicking on the "+" icon.
- Step 6. Expand the options inside the "Simulations" module by clicking on the "+" icon.
- Step 7. Right-click on the name of the desired simulation and then click on "Simulation Reports." A menu of all the possible reports will appear. Click on the desired report. All reports will be outputted into a Microsoft Excel 2007 spreadsheet. The types of simulation reports that can be generated are shown in the below image.



## 2- Generate Special Reports – performed by DAT Staff

**Summary:** Under this task, special reports from a funding needs simulation can be generated using the RoadCare software. For the purposes of the Condition RSL/Cost Optimization process, only the following three report types are relevant:

- (1) "FY Targets and Suggested Projects Report",
- (2) "All Sections Shop DM Year & VMT Report", and
- (3) "Attribute View Report."
- Step 8. Select "Tools" from the RoadCare top menu and click on "Special Reports" from the drop-down menu, as shown in the below image.



- Step 9. On the "Special Report Generation" window, select the appropriate "Network,"
   "Simulation," and "Report Type" from the drop-down menus, as shown in the below image.
  - i. If "FY Target & Suggested Projects Report" is selected, proceed to Step 10.
  - ii. If "All Sections Shop DM Year & VMT" is selected, skip to Step 15.
  - iii. If the "Attribute View Report" is required, exit the "Special Report Generation" window and skip to Step 20.

A Special Report Generation		A Special Report Generation	
Network		Network	
2013_NETWORK_OCT2014_ALL_CONDITIONS	-	2013_NETWORK_OCT2014_ALL_CONDITIONS	
Simulation		Simulation	
TEST_SIMUL_VMT	-	Unspecified (for Network Reports )	•
Report Type		Report Type	
Budget & LM per FC per Condition	-	All Sections Shop DM Year & VMT	•
Budget & LM per C per Year Budget Per Condition Report Budget Per Condition Report Budget Per Treatmert Report Detailed Results Report PY Targets & Suggested Projects Report Input Summary Report (Configurable) IRI Condition per FC Lane-Miles Per Condition Report Lane-Miles Per Condition Report Lane-Miles Per Treatment Report Lane-Miles Per Treatment Report Lane-Miles Per Treatment Report Total Budget Report Total Lane-Miles Per Condition Report		Generate Report	

- Step 10. Click "Generate Report."
- Step 11. In the subsequent window, select the appropriate "Fiscal Year" and "Destination Folder" and then click "Finish," as shown in the below image. The user has the option of choosing a custom template file that can be edited if there is a need to modify existing summaries. The user must generate a statewide report for the optimization year and a preliminary report for the subsequent year.

### MARYLAND DEPARTMENT OF TRANSPORTATION

#### STATE HIGHWAY ADMINISTRATION

83	A FY Targets & Sugg	gested Projects Report	<b>E</b>
	Fiscal Year	Prior Fiscal Year	Condition Data Year
	2017 -	2016	2013
	Report Destination Fo	older	
-	C:\Users\ARamachar	ndran\Desktop	Choose Destination
	Custom Template File	. 🗸	
-	C:\Users\ARamachar	ndran\Desktop\Targets & Su	G Choose Template
		Finish	
	×	FY Targets & Sug Fiscal Year 2017 • Report Destination For C:\Users\ARamachai Custom Template File C:\Users\ARamachai	Image: State Projects Report         Fix Targets & Suggested Projects Report         Fiscal Year         2017         2017         2016         Report Destination Folder         C:\Users\ARamachandran\Desktop         Custom Template File         C:\Users\ARamachandran\Desktop\Targets & Su         Finish

Step 12. This "FY Target & Suggested Projects Report" generates a list of suggested projects and a list of pre-defined attribute values for each project in a selected simulation for a given fiscal year. This report also includes a comprehensive summary of budget and treatment distributions, benefit, suggested lane-miles and average life extension categorized by District, Maintenance Shop, Functional Class, Last Treatment, Treatment Type, and RSL Category. Open the Microsoft Excel file generated by the RoadCare software and review both the "Targets" and "Suggested Projects" reports as shown in the below images^{06/12/2019}.

A	В	c	D	E	F	G	н	I	J
	Fund 77 FY20 Targ	et Summary - Statewide							
2 <b>D</b> NH									
4									
5		Targets:	Budget	Benefit (LMY)	Suggested Lane-Miles	Estimated \$/LM	Average Life Extension	\$/LMY	% of Overall \$
6			\$202,023,872	14,552	1,470	\$137,440	10	\$13,882	
7		Preventive Maintenance involving UTBWC	\$9,544,799	757	51	\$185,375	15	\$12,614	4.7%
8		Preventive Maintenance (other)	\$16,582,954	2,671	703	\$23,604	4	\$6,208	8.2%
9		Minor Rehabilitation	\$152,349,252	10,356	672	\$226,694	15	\$14,711	75.4%
10		Structural Overlay	\$11,446,867	768	44	\$261,147	18	\$14,901	5.7%
11		Major Rehabilitation	\$0	0	0	\$0	0	\$0	0%
12		Reconstruction	\$0	0	0	\$0	0	\$0	0%
13		Traffic Barrier / ADA	\$7,100,000	0	0	\$0	0	\$0	3.5%
14		Line Striping	\$5,000,000	0	0	\$0	0	\$0	2.5%
15									
					Suggested		Average Life		
16	Pre	Treatment RSL Categories:	Budget	Benefit (LMY)	LM	\$/LM	Extension	\$/LMY	
17	40 to 50 years		\$0	0	0		0	\$O	
18	30 to <40 years								
19	20 to <30 years	с	\$5,735,688	751	229	\$25,095	3	\$7,639	
20	10 to <20 years	D	\$50,290,411	3,479	441	\$114,083	8	\$14,455	
21	<10 years	E	\$76,849,912	5,486	393	\$195,338	14	\$14,008	
22	0 years		\$54,740,503	4,561	320	\$171,295	14	\$12,002	
23									
					Suggested		Average Life		
24		District	Budget 💌	Benefit (LMY) 💌	LM 👻	\$/LM 💌	Extension 👻	\$/LMY 🔻	
25		1	\$12,950,009	1,069	113	\$114,411	9	\$12,115	
26		2	\$16,500,918	1,512	149	\$110,639	10	\$10,915	
27		3	\$50,775,622	2,696	300	\$169,468	9	\$18,836	
28		4	\$27,880,515	2,110	241	\$115,562	9	\$13,214	
29		5	\$38,030,974	3,110	272	\$139,975	11	\$12,227	
30		6	\$14,055,457	1,426	151	\$92,873	9	\$9,855	
31		7	\$36,830,377	2,630	244	\$151,157	11	\$14,006	
	Targets Suggest	ed Projects Lookup & Notes 🕀			: •				

	Α	В	С	D	E	G	н	I	J	К	L	М	N
1	Detailed	Project	Summary	- FY20 S	Suggested pro	ojects							
2	See "Lookup &	& Notes" work	sheet for notes										
3	Google Maps	VideoLog •	District	County	Shop	Contract Type	Prefix 👻	Route#	Suffix *	Begin MP	End MP	Direction •	Begin Landmark
4	Google Maps	VideoLog	1	DO	Cambridge	Microsurface	US	50		0.61	2.7	EB Only	0.10 mi W of Radiance Dr MU 1120
5	Google Maps	VideoLog	1	DO	Cambridge	Asphalt Paving	MD	313		7.92	8.44	All Dir	
6	Google Maps	VideoLog	1	DO	Cambridge	Asphalt Paving	MD	750		0	0.87	All Dir	Ocean Gateway US 50
7	Google Maps	VideoLog	1	DO	Cambridge	Asphalt Paving	US	50		4.65	6.71	EB Only	Austin Rd CO 181
8	Google Maps	VideoLog	1	SO	Princess Anne	Asphalt Paving	MD	673	A	0	0.53	All Dir	Crisfield Hwy (SB/L) MD 413
9	Google Maps	VideoLog	1	SO	Princess Anne	Asphalt Paving	US	13		6.3	7.1	SB Only	Spur to MD 920d
10	Google Maps	VideoLog	1	SO	Princess Anne	Asphalt Paving	MD	920		0	0.97	All Dir	
11	Google Maps	VideoLog	1	SO	Princess Anne	Asphalt Paving	US	13		19.58	20.17	SB Only	Jones Rd CO 30
12	Google Maps	VideoLog	1	WI	Salisbury	Chip Seal	MD	350		0.18	6.63	All Dir	End Municipal Maintenance
13	Google Maps	VideoLog	1	WI	Salisbury	Crack Seal	US	50		27.06	30.695	WB Only	Worcester Co/L
14	Google Maps	VideoLog	1	WI	Salisbury	Asphalt Paving	US	13	BU	4.17	8.137	All Dir	W College Ave MU 631
15	Google Maps	VideoLog	1	WI	Salisbury	UTBWC	US	13	BU	1.34	3.87	NB Only	0.18 mi S of S Division St MU 110
16	Google Maps	VideoLog	1	WI	Salisbury	Asphalt Paving	MD	346		0.67	1.2	All Dir	Out Corp Lmts Salisbury
17	Google Maps	VideoLog	1	WI	Salisbury	Asphalt Paving	US	50		0	0.75	WB Only	0.75 mi W of Dorchester Co/L
18	Google Maps	VideoLog	1	WI	Salisbury	Asphalt Paving	MD	992		0	0.74	All Dir	
19	Google Maps	VideoLog	1	wo	Snow Hill	Asphalt Patching	MD	378		0	1.49	All Dir	S 1st St MU 9015
20	Google Maps	VideoLog	1	wo	Snow Hill	Crack Seal	MD	374		8.02	8.7	All Dir	0.07 mi W of Prospect Dr MU 388
21	Google Maps	VideoLog	1	WO	Snow Hill	Crack Seal	MD	90		7.78	8.42	WB Only	0.64 mi W of Ocean Pkwy CO 583
22	Google Maps	VideoLog	1	WO	Snow Hill	Crack Seal	MD	575	А	0	0.533	All Dir	Worcester Hwy (SB/L) US 113
23	Google Maps	VideoLog	1	WO	Snow Hill	Crack Seal	MD	12		9.94	11.04	All Dir	Ayres Lane Rd CO 99
24	Google Maps	VideoLog	1	wo	Snow Hill	Crack Seal	US	113		32.86	37.49	SB Only	Delaware St/L
25	Google Maps	VideoLog	1	WO	Snow Hill	Microsurface	MD	90		9.21	9.94	EB Only	0.26 mi W of St Martins Neck Rd CO 220
26	Google Maps	VideoLog	1	wo	Snow Hill	Microsurface	MD	90		9.21	9.94	WB Only	0.47 mi W of St Martins Neck Rd CO 220
27	Google Maps	VideoLog	1	WO	Snow Hill	Asphalt Paving	MD	528		8.51	9.04	All Dir	1st St MD 378
28	Google Maps	VideoLog	1	WO	Snow Hill	Asphalt Paving	US	13		4.11	6.306	SB Only	0.42 mi S of Spur to Winter Quarters Dr
29	Google Maps	VideoLog	1	WO	Snow Hill	Asphalt Paving	US	50		0	4.98	EB Only	Struc #220001031 - Pocomoke River
30	Google Maps	VideoLog	1	WO	Snow Hill	Asphalt Paving	MD	756		0	1.17	All Dir	Linden Ave (Back) MU 340
31	Google Maps	VideoLog	2	QA	Centreville	Chip Seal	MD	18	A	4.59	5.39	All Dir	0.11 mi N of Shopping Center Rd CO 263
32	Google Maps	VideoLog	2	QA	Centreville	Chip Seal	MD	302		6.18	7.65	All Dir	
33	Google Maps	VideoLog	2	QA	Centreville	Crack Seal	US	301		32.39	36.94	NB Only	Sudlersville Rd MD 300
34	Google Maps	VideoLog	2	QA	Centreville	Crack Seal	US	301		11.82	13.52	NB Only	Ocean Gateway (Back) US 50
	4 - >	Targets	Suggested Pro	jects Lo	okup & Notes	+				:	4		

- Step 13. One of the optimization goals is to create realistic overall benefit targets that Districts must meet every year. Towards this end, the following actions must be reviewed^{06/12/2019}:
  - i. Average unit cost for each treatment is compared with historical unit cost data and contractor bid tables for each District.
  - ii. Suggested lane miles (LM) per treatment should be high enough to be contract worthy. The exact number of LM varies by District and treatment.
  - iii. Average life extension should be within the range of expected values for the treatment.
  - iv. Overall benefit (LMY) and \$/LMY Target by District.
- Step 14. If no other reports are required, the procedure is complete. Otherwise, return to Step 9.
- Step 15. Click "Generate Report" to open the "All Sections Shop DM Year & VMT Report" window, which is shown in the below image.

Maryland department of transportation

STATE HIGHWAY ADMINISTRATION

Query Expression	Networkwide Measure	-	Network 2015_NETWORK_JUN2016_COMBAREA
AD_DATE	AD_DATE		Simulation ALL_SECTIONS_PRESERVGUIDE
AGE_GROUPS	AGE_GROUPS		
AGE_GROUP_HALFMILE	AGE_GROUP_HALFMILE		Chanad Banfiles Comment Banfile
AVG_IRI_ORG	AVG_IRI_ORG	-	Stored Profiles Current Profile
<pre></pre>		•	ALLSEC_PGUIDE
L			Delete Load Save As New
Query Expression	Simulation Measure	^	
AADT_VMT	AADT_VMT		Sector States
AGE	AGE		Destination Folder
CI_FC_CATEGORY	CI_FC_CATEGORY		C:\Users\ARamachandran\Desktop Choose Fold
CI_MATERIAL_TYPE	CI_MATERIAL_TYPE	-	Finish
•		۲	1 0 1691
Query Expression	Performance Measure	-	This report supports aliases and query expressions in Oracle
AVG IRI	AVG IRI		syntax for selected measures. Examples
CI FUNCTIONAL	CI FUNCTIONAL	E	CI_FUNCTIONAL AS FCI
CI STRUCTURAL CI STRUCTURAL			CASE WHEN NHS_CODE > 0 THEN 'Yes' ELSE 'No' END
AVG RUT	AVG RUT	-	Query expressions longer than 259 characters must be
			directly typed into the allsec-config-profiles json file located

- Step 16. Load a stored profile if available by selecting the appropriate profile name under "Stored Profiles" and then clicking "Load."
  - i. If a stored profile is loaded, skip to Step 18.
  - ii. Otherwise, proceed to Step 17.
- Step 17. If a profile does not already exist for a simulation, select the appropriate "Networkwide," "Simulation," and "Performance" measures in the three tables to the left of the above image. Check "As New," then enter a profile name in the text box under "Current Profile" and click "Save."
- Step 18. Click "Choose Folder" to select a destination folder and then click "Finish" to start the report generation.
- Step 19. The report will be saved as a Microsoft Excel 2007 macro-enabled workbook (.xlsm) in the folder selected by the user. This report shows performance data for selected sections from the current year, forecasted condition data, feasible treatments with their cost, benefit (LMY) and other relevant information across the entire network for data discovery and reference purposes.

Additionally, the report supports aliases and query expressions in standard Oracle SQL query syntax for selected measures. A couple of examples are shown below^{06/12/2019}:

CI_FUNCTIONAL AS FCI CASE WHEN NHS_CODE > 0 THEN 'Yes' ELSE 'No' END NHS

The report also includes a new interface, shown in the below image, which allows the user to identify potential project candidates by filtering the report based on specific criteria. To use this feature, the user must enable macros in the Microsoft Excel spreadsheet report.

### MARYLAND DEPARTMENT OF TRANSPORTATION

#### STATE HIGHWAY ADMINISTRATION

Optimization Generating Reports

Custom F	ilter											
YEAF	1	COUNTY	SHOP	DIR MILES		LANE MILES	6	AAD	Г	NHS	MAIN_LINE	PAVEMENT_TYPE
>=2018		WI				>2		>1000	<2000			=F
Examples												
>=2018	<=2020	CE	ELKTON	>1		>=2	<5	<100000		Yes	1	*FC*
		<>CE	*ELK*	>1	<2			>1000	<2000	No	<>2	=F
			<> ELKTON					500				⇔F
Filter All	sections											
Identify n	roject can	didates by T	reatment and	\$/I MY								
	ASPHA	LT PATCH ON	ILY	Sho	w Тор	candidates						
YEAF	2	COUNTY	SHOP	DIR MILES		LANE MILES	5	AAD	r	NHS	MAIN_LINE	ASPHALT PATCH ONLY \$/LMY
>=2018	<=2019											<12000
Filter All	sections											

- Step 20. If no other reports are required, the procedure is complete. Otherwise, return to Step 9.
- Step 21. Return to the "RoadCare Explorer" window on the left hand side of the screen. Expand the options inside the "Viewers" module for the appropriate network by clicking on the "+" icon. Then, expand the options inside the "Attribute View" menu that appears in the list by clicking on the "+" icon.
- Step 22. Double-click on an attribute to see its contents on the display window, as illustrated in the below image.

A DSS RoadCare:			-	-	-					
File View Tools Help Viewer Options										
RoadCare Explorer 🚽 🗘 🗙	tribute-2016_	NETWORK_COME	BAR							×
DOUZ_NETWORK_JULY2013_ALL-CONDIT ∧     2012_NETWORK_NOV2013_ALL-CONDIT     2013_FRICTION MAPPING_MAR2014     DOUZ_013_FRICTION MAPPING_MAR2014     DOUZ_013_FRICTION MAPPING_MAR2014	Attri	Attribute View: 2016_NETWORK_COMBAREA								1
2013_NETWORK_AUG2014_ALL_CONDIT	Enable cus	tomhiter		raciity. A		<ul> <li>She</li> </ul>	w Begin/End/Direction			5
2013_NETWORK_JUNE2014_ALL-CONDI	Advanced Search									-
2013_NETWORK_MAR2015_ALL_CONDIT_	FACILITY	SECTION	BEGIN_STATION	END_STATION	DIRECTION	AADT	FC_DENSITY	AVG_RUT		-
2013_NETWORK_OCT2014_ALL_CONDIT	AA-IS 695 RP6-7	0-0.21(S)	0.000	0.210	S	13112	1.4571	0.2460	<b>1</b>	
2013_NETWORK_OCT2014_ALL_CONDIT	AA-IS 695 RP7-5	0-0.02(W)	0.000	0.020	w	1180		0.2400		
2014_NETWORK_JUN2015_250M_LMARE	AA-IS 695 RP7-7	0-0.16(N)	0.000	0.160	N	9302	1.4725	0.3231	1	
2014_NETWORK_JUN2016_COMBAREA	AA-IS 695 RP7-8	0-0.18(E)	0.000	0.180	E	3554	3.2289	0.2422		
2016_NETWORK_COMBAREA	AA-IS 695 RP8-5	0-0.02(E)	0.000	0.020	E	1010	6.2800	0.3150		
Dynamic Segmentation	AA-IS 695 RP8-6	0-0.22(S)	0.000	0.220	S	2762	12.7136	0.2464		
Attribute View	AA-IS 695 RP8-7	0-0.21(W)	0.000	0.210	w	2832	5.3395	0.2743		
🖶 🐄 AADT	AA-IS 695 RP8-8	0-0.11(S)	0.000	0.110	S	5924	3.8764	0.2591	-	
AADT_VMT	AA-IS 895	0-0.8(N)	0.000	0.800	N	28250	7 4563	0.1500	-	
	AA-IS 895	0-0 799(S)	0.000	0 799	S	30658	8 2207	0 1203	-	
AGE_GROUPS	AA-IS 895A	0-0.71(N)	0.000	0.710	N	12341	10 3943	0 1743	-	
🖩 🐄 AVG_IRI	AA-IS 895A	0-0.626(5)	0.000	0.626	s	12341	5.9309	0 1384	-	
B-12 AVG_IRI_QC	44.IS 8958	0.0.91(b)	0.000	0.910	N	10412	15 3952	0.1496	-	
AVG_RUT QC	AAJS 9950	0.91-2.67/M	0.910	2,670	N	11214	4 6495	0.1491	-	
B- AVG_RUT_SDV	AA IC 005D	0.049.2.07(0)	0.049	2.070	6	10545	6.0000	0.1950	- 100 C	
BEGIN_LAT_LONG	AA-IS 0050 DD1	0.046-2.67(3)	0.040	2.670	3 N	7700	0.0050	0.1636		
B BEGIN_LIMIT	AA-15 0358 RF 1	0-0.34(N)	0.000	0.340	N	//63	5.5555	0.2034	-	
BRIDGE	AA-IS 8958 RP2	0-0.3(E)	0.000	0.300	E	1051	10.1433	0.3317	-	
RIDGE LONG	LAA-IS 895B RP6	0-0.35(E)	0.000	0.350	Е.,	9571	3.3871	0.2193		<u> </u>
	lister of the				_					
Output									/¥	×

Step 23. The data grid lists "FACILITY," "SECTION," and the selected attribute values. In addition, the "BEGIN_STATION," "END_STATION," and "DIRECTION" fields can be displayed by checking "Show Begin/End/Direction" at the top of the viewer window. Clicking on any data grid column title sorts all the displayed data in ascending/descending order based on that attribute. Some cells in the data grid may appear empty. This is because the raw database did not have an attribute value for that specific section. For those sections, the default value used when the raw attribute was created is assigned during the analysis/simulation process. At the bottom of the data grid, the line toolbar allows the user to move within records and to display the attribute values that result from running a simulation.

- Step 24. To display attribute values from a desired financial needs simulation, select the simulation name from the "Simulation" drop-down menu.
- Step 25. Right-click on the results grid area and select "Update" to display the corresponding calculated attribute values, as illustrated in the below image.

A DSS RoadCare:			and the second	and the second	and the second second				characterized W	_ 0 <b>_ x</b>
<u>File View Tools Help</u> Viewer Options										
RoadCare Explorer 🗢 👎 🗙	tribute-2016	NETWORK_COMB	AR							<b>-</b> ×
<ul> <li>2013_NETWORK_AUG2014_ALL_CONDIT ^</li> <li>2013_NETWORK_JUNE2014_ALL-CONDIT</li> <li>2013_NETWORK_MAR2015_ALL_CONDIT</li> </ul>	Attri	ibute View	: 2016_NE	TWORK_C	COMBAR	ΞA				
2013_NETWORK_OCT2014_ALL_CONDIT	Enable cu:	Enable custom filter Facility: All								
2013 NETWORK_OCT2014_ALL_CONDIT	Advanced Search	n:								
2014_NETWORK_JUN2015_250M_LMARE										
2014_NETWORK_JUNE2015_PM15_NEW	FACILITY	SECTION	BEGIN_STATION	END_STATION	DIRECTION	AADT	FC_DENSITY	AVG_RUT		-
2015_NETWORK_JUN2016_COMBAREA	CL-IS 70 RP1-68	0-0.18(N)	0.000	0.180	N	2/33	5.1444	0.1839		-
Dynamic Segmentation	CL-IS 70 RP2-68	0-0.25(W)	0.000	0.250	w	6861	6.6960	0.1910	-	
🖨 😥 Viewers	CL-IS 70 RP4-68	0-0.33(N)	0.000	0.330	N	3223	7.1518	0.2332		
Attribute View	CL-MD 31	8.8-9.66(E)	8.800	9.660	E	3216	1.3360	0.1345	-	
AADT	CL-MD 31	9.66-10.35(E)	9.660	10.350	E	5251	10.6051	0.3047		
	CL-MD 140	11.66-11.77(N)	11.660	11.770	N	9921	5.6373	0.1009		
🥥 2010	CL-MD 140	11.77-17.05(N)	11.770	17.050	N	7028	Set Validation Limits	84		
0 2011	CL-MD 26	8.42-9.06(E)	8.420	9.060	E	12985	Set Font	34		
2012	CL-MD 26	9.06-12.97(E)	9.060	12.970	E	11425	Lindata	55		
	CL-MD 27	17.77-20.52(N)	17.770	20.520	N	7572	Conv	51		
🥥 2015	CL-MD 27	20.52-26.42(N)	20.520	26.420	N	6138	Hide Ton	14		
	CL-MD 140	17.05-20.05(N)	17.050	20.050	N	6481	0.4631	0.1002		
	CL-MD 140	20.05-24.93(N)	20.050	24.930	N	3678	0.7799	0.1198	1	
AGE	CL-MD 26	12.97-13.35(E)	12.970	13.350	E	8030	3.6779	0.1972	-	
B * SAGE_GROUP_HALFMILE	CL-MD 26	13 35-13 65(E)	13 350	13 650	F	8030	0.3837	0 1938	-	
B-10 AGE_GROUPS	CL-MD 27	26.42-27.11(N)	26.420	27 110	N	4316	0.3308	0.0998	-	
	CL-MD 27	27 11.27 27(NI)	27.110	27.270	N	4216	1.0156	0.1202	-	
	CL MD 140	0.4.00(0)	0.000	4,000	а С	20004	0.0100	0.1303	-	-
AVG RUT QC		of 947 > >	Simulation ALL	SEC_SIM	3	20004	10.6160	0.1101		
Outout										- 1 ×
output										• • ^
<u> </u>										

Step 26. Right-click on the results grid area and select the "Edit Columns" option to display the "Select Attribute View Columns" window, which is shown in the below image.

MARYLAND DEPARTMENT OF TRANSPORTATION

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Optimization Generating Reports

- Select Attribut	Select Attribute View Columns										
Attibute: AADT Years Available (multiple select) AADT 0 2027 2026 2025 2024 2023 2022 2021 2020 2019 2018 2017 2016 2017 2016 2017 2016 2017 2016 2014 2013 2012 2011 2010 2009 2008	Attribute View Display Column (multiple select) AADT FC_DENSITY AVG_RUT	▼ Up Down Delete									
✓ Order years most recent first.      OK Cancel											

Step 27. From the "Attributes" drop-down menu located at the top of the "Select Attribute View Columns" window, select an attribute to display (e.g. AADT in the above example). If the attribute was included in the simulation criteria, future years will be available from the "Years Available (multiple select)" list. By default, the years are listed in ascending order; to reverse the order, uncheck the option "Order years most recent first." The "Attribute View Display Column (multiple select)" contains the list of attributes that will be displayed. To add attributes to the display, highlight the desired attributes from the "Years Available (multiple select)" list and click the right-facing arrows icon shown in the below image.

Optimization Generating Reports

TION	
IION	Go

🖳 Select Attribut	te View Columns	
Select Attribut Attibute: AADT Years Available (multiple select) AADT 2016 2015 2014 2013 2012 2011 2010 2009 2008	Attribute View Display Column (multiple select) AADT FC_DENSITY AVG_RUT	Up Down Delete
✓ Order years m	ost recent first.	

- Step 28. The highlighted fields are now listed in the pane to the right labeled "Attribute View Display Column (multiple select)." These attribute values will be displayed in the "Attribute" view window. The order of the attributes can be sorted by choosing the "Up" or "Down buttons next to the "Attribute View Display Column (multiple select)" pane. The order in which the attributes are listed on the "Attribute View Display Column (multiple select)" pane. The order in which the attributes are listed on the "Attribute View Display Column (multiple select)" pane is the actual order in which they will be displayed in the attribute view data grid. Attributes can be deleted from that list by highlighting them and pressing "Delete." The selected attributes will disappear from the list and also from the attribute view data grid. When the order is set, click "OK" to accept the selected display columns or click "Cancel" to go back to the previous screen.
- Step 29. The selected attributes can be exported as a report in Microsoft Excel format. To generate the report, right-click on "Attribute View" under the "Viewers" menu on the "RoadCare Explorer Window" and select "Create Attribute View Report," as illustrated in the below image.



Step 30. The report will be displayed in Microsoft Excel format. An example of an attribute report is shown in the below image.

,	AutoSave 💽 Off 📮	5•∂-∓					В	ook1 - Road	lCare			4	- 40
F	ile Home Inse	ert Page Layout	Formulas Da	ata Review	View D	eveloper	Help	Power View f	Report	♀ Tell me v	what you war	nt to do	
Pa	te ✓ Format Painter Clipboard 5	Calibri - B I U - Ent	11 • A A =	- ≪   = = = = = = = = = = = = = AI	🔐 Wrap E E Merg	Text e & Cente	General er - \$ - 9	% ୬ (500 lumber	→ [ .00 Cor .00 Form	ditional For natting + Ta Style	mat as Cell able - Styles	E Insert	Delete F Čells
J7	$17  \mathbf{v}  \vdots  \mathbf{x}  \mathbf{v}  \mathbf{f}_{\mathbf{x}}$												
	А	В	с	D	Е	F	G	н	Ι	J	к	L	м
1 2 2			Attri	bute Vie	w Repo	ort			Prepareo	d By: Aditya	Ramachan	dran	
4			Network:	2016_NETW	ORK_CON	1BARE/	4		Identifie	r: 2016_NE	TWORK_CO	MBAREA	(1771)
5													
6		Pavement attri	bute data for netv	work - 2016_NET	WORK_COM	IBAREA					-		
7	FACILITY	SECTION	BEGIN_STATION	END_STATION	DIRECTION	AADT	FC_DENSITY	AVG_RUT					
8	AA-IS 695 RP6-7	0-0.21(S)	0	0.21	S	13112	1.4571	0.246			Ι		
9	AA-IS 695 RP7-5	0-0.02(W)	0	0.02	W	1180		0.24					
10	AA-IS 695 RP7-7	0-0.16(N)	0	0.16	N	9302	1.4725	0.3231					
11	AA-IS 695 RP7-8	0-0.18(E)	0	0.18	E	3554	3.2289	0.2422					
12	AA-IS 695 RP8-5	0-0.02(E)	0	0.02	E	1010	6.28	0.315					
13	AA-IS 695 RP8-6	0-0.22(S)	0	0.22	S	2762	12.7136	0.2464					
14	AA-IS 695 RP8-7	0-0.21(W)	0	0.21	W	2832	5.3395	0.2743					
15	AA-IS 695 RP8-8	0-0.11(S)	0	0.11	S	5924	3.8764	0.2591					
16	AA-IS 895	0-0.8(N)	0	0.8	N	28250	7.4563	0.15					
17	AA-IS 895	0-0.799(S)	0	0.799	S	30658	8.2207	0.1203					
18	AA-IS 895A	0-0./1(N)	0	0.71	N	12341	10.3943	0.1/43					

Step 31. If no other reports are required, the procedure is complete. Otherwise, return to Step 9.

# 11 **APPENDICES**

# **11.01 SKID COLLECTION LIST SQL STATEMENT**

Use the following statement in Oracle SQL Developer to create the Skid Collection List. Any occurrence of "collection_2016" should be replaced with the current year's date (e.g. for 2019, update to read "collection_2019".

--FROM PAV CONHIST DEVELOPMENT SELECT RSECTION, DISTRICT, CO, ID PREFIX, ID RTE NO, MUNICIPALITY, MP SUFFIX, EXIT NUMBER, RAMP NUMBER, D, IS INV DIR, BEGIN DIR MP, END DIR MP, ROAD NAME START, **BEGIN_DESCRIPTION**, END DESCRIPTION, SECTION LENGTH, COLL CATEGORY, CASE WHEN COLL CATEGORY IN (4,8,9,10) AND DISTRICT IN (1,2,3,4) AND SECTION LENGTH >=0.1 THEN 'D1, D2, D3, D4 SHORT ROADS AND RAMPS' WHEN COLL CATEGORY IN (4,8,9,10) AND DISTRICT IN (5,6,7,8) AND SECTION LENGTH >=0.1

Appendices

THEN 'D5, D6, D7, BC SHORT ROADS AND RAMPS' WHEN COLL CATEGORY IN (3) THEN 'NON-INVENTORY DIRECTION >= 1 MILE ' WHEN COLL CATEGORY IN (5,7) THEN 'INVENTORY DIRECTION >= 1 MILE ' WHEN ID PREFIX IN ('DM','TL') THEN 'QC_TESTING' ELSE NULL END AS FRICTION GROUP, -- PRIORITY ARAN PRIORITY, GOVT_CONTROL, NHS_CODE, INV_BMP, INV EMP, BEG LAT, BEG LONG, END LAT, END LONG, GLOBAL ROUTE ID, SUB_ROUTE_ID, ROUTE, TRIMROUTE, ROUTEID, MULTIPLE BEG INT, MULTIPLE END INT, RVISIKEY, ASSOCIATED_ID_PREFIX, FDIR, BEGIN_SECTION_DESC, **BEGIN_SECTION_MILE_POINT**, END_SECTION_DESC, END SECTION MILE POINT, COLLECTION YEAR FROM

# (

Includes SHA and MDTA Routes in the Inventory Direction >=1 mile								
SELECT *								
FROM collection_list								
WHERE collection_year = 2020								
AND GOVT_CONTROL IN (1,31)								
AND IS_INV_DIR <> 12019 Collection								
AND IS_INV_DIR = 12020 Collection								
AND RAMP_NUMBER IS NULL								
AND coll_category IN (3)2019 Collection Non Inventory Direction								
AND coll_category IN (5,7)2020 Collection - Inventory Direction								
UNION								
Includes Test Loops and Dummy Files								
SELECT *								
FROM collection_list C								
WHERE id_prefix IN ('DM','TL')								
AND collection_year = 2020								
UNION								
Includes Half of SHA and MDTA ramps and short roads >=0.10 (alternating years D1-D4, then D5-D8)								
SELECT *								
FROM collection_list C								
WHERE RAMP_NUMBER IS NOT NULL								
AND DISTRICT IN (1,2,3,4)2019 Collection								
AND DISTRICT IN (5,6,7,8)2020 Collection								
AND collection_year = 2020								
AND GOVT_CONTROL IN (1,31)								
AND COLL_CATEGORY IN (4,8,9,10)								
AND SECTION_LENGTH >=.1								
AND (GLOBAL_ROUTE_ID, SUB_ROUTE_ID) IN								
(SELECT GLOBAL_ROUTE_ID,								
SUB_ROUTE_ID								
FROM								
(SELECT GLOBAL_ROUTE_ID,								

```
SUB_ROUTE_ID,
   SUM(DIR_EMP-DIR_BMP) MILES
  FROM SECTION_TABLE
  WHERE HMIS_YEAR = 2016 -- Most recent inventory year
  GROUP BY GLOBAL_ROUTE_ID,
   SUB_ROUTE_ID
  )
 WHERE MILES >=0.1
ORDER BY district,
routeid,
```

begin_dir_mp;

) )

# 11.02 TEST LOOP DATA ANALYSIS DETAILS Data QC

Data QC checks are performed for data such as the ARAN vehicle's DMI, pavement imagery, IRI, rut, cracking (FCD and SCD), and CrossFall. The MDOT-SHA test loop data collection (and therefore data analysis) is divided into the following two types:

- a. initial data collection program (pre-collection); and
- b. three week MDOT-SHA test loop data collection program (throughout the FED collection and delivery season).

# Pre-Collection Data Quality Acceptance - Initial Data Collection (10 MDOT-SHA test loop runs before data collection)

For each ARAN vehicle and within 30 days of the beginning of FED's ARAN collection season, 10 consecutive MDOT-SHA test loops runs are performed and the resulting data QC'd and QA'd by the FED Pavement Testing Team (PTT) ARAN staff, and the deliverables are provided to the Pavement and Geotechnical Division (PAGD) of the DPT for network uploading and SQL database importing.

DMI values should be within the range of  $1,000 \pm 1$  millimiles for the 1,000 millimiles long DMI section.

For the remaining measures, which include IRI, cross slope, rut, cracking (FCD, SCD, percent cracking for concrete), and friction^{06/12/2019}, the following acceptance criteria is defined as follows:

- Results from each section are compared to the values predicted using the past five years of data for that section.
- Prediction is done using a linear trend line (linear regression) over the past five years of data (average section performance measure values for each year).

If the value for the current year is within the range defined by the equation^{06/12/2019} below, then the data are accepted, and if other QC checks pass then routine MDOT-SHA data collection can start. Otherwise, the accuracy of the data should be investigated and the source of the issue should be addressed.

*Current year's predicted value* ± (*last year's* 95th percentile – *last year's* 5th percentile)/2

Analysis and acceptance of the MDOT-SHA test loop data is conducted within 5 days of data collection. All parties involved are notified of the results.

# Three Week Data Collection Program (3 MDOT-SHA test loop runs every 3 weeks during data collection season)

For each MDOT-SHA operated ARAN vehicle, 3 consecutive data collection runs are performed on 45 test loop sample sections, which provides the pavement management engineers with the opportunity to continuously control the accuracy and consistency of the ARAN data throughout the data collection season. The sample sections vary in length, pavement structure, pavement type, traffic level, number of lanes, distress level, etc. Once the test loop data have been collected and QC'd and QA'd by the FED PTT ARAN staff, the deliverables are then provided to the PAGD DPT for network uploading and SQL database importing.

If the average section performance measure value is within the range of the equation^{06/12/2019} below, then the data are accepted, and if the remaining QC checks pass, then the routine data collection can start for the ARAN vehicle in question. Otherwise, the accuracy of the data should be investigated and the source(s) of issue should be addressed.

Current year's average value from initial collection  $\pm$  (last year's 95th percentile – last year's 5th percentile)/2

Analysis and acceptance of the MDOT-SHA test loop data is conducted within 5 days of data collection. All parties involved are notified of the results.

## **Error Resolution (Corrective Actions)**

- Identifying issue sources:
  - Inquiry from FED for recent change of settings, maintenance activity, or suspicious observations.
  - Inquiry from DPT and DAT to make sure used protocols used are valid and the processing steps have been correctly followed.
  - Exploring other issues not considered above, such as but not limited to data collection equipment calibration, equipment configuration, data processing protocols, and data processing steps.
- Evaluating the data collected after the last acceptable MDOT-SHA test loop runs to determine the affected files.
- Decision-making for addressing issue:
  - Evaluating affected data and all possible solutions for correcting the data.
  - Establishing a course of action for replacing the affected data with acceptable data and, correcting the data if possible or sending a recollection list to FED.
- If the source of error is an ARAN-related change (settings or physical) then:
  - Addressing issue by FED
  - New MDOT-SHA test loop runs
  - MDOT-SHA test loop QC check
  - If QC check, passed then start routine ARAN data collection (and recollection, if needed).

## **Test Loop Section Classifications**

Three defined groups of MDOT-SHA test loop sections are used for data QC purposes. The first group are Ground Truth (GT) sections. These sections have had manual inspection/detection performed along the section (entire or a part of section) by trained raters for one or more condition measures and/or will have manual detections performed in the future when needed. At present, the MDOT-SHA test loop has DMI, IRI, rut, and crack GT sections, which are listed in the below table. However, based on the need for GT studies, additional GT sections can be added to the list in the future.

Cround Truth Costion	TI Sogmont	Pavement Type	Pegin MD		Be	gin	Er	nd	Section Longth (mile)
Ground Truth Section	TL Segment	Pavement Type	begin wiP	Endivip	Latitude	Longitude	Latitude	Longitude	Section Length (mile)
GT DMI section	22	Asphalt	7402.2	8404.35	39.154043759577846	-76.6748144217094	39.157287341389235	-76.65667903466958	1.00
GT IRI Section #1	21 & 22	Asphalt	7209.41383	8408.99091	39.152812	-76.677961	39.15730352	-76.65658391	1199.58
GT IRI Section # 2	31 & 32& 33	AC/Conc. Bridge Deck/AC	10469.42	10595.2878	39.1650835	-76.64232933	39.166778	-76.64149728	125.87
GT Rut Section #1	13	Asphalt	4910.06	5015.46	39.135567361866251	-76.668473234398192	39.135055463892392	-76.67027520991067	0.11
GT Rut Section # 2	39	Asphalt	11244.72	11298.21	39.164966732158682	-76.645302677066439	39.1648256451914	-76.646266099386835	0.05
GT Rut Section #3	41	Asphalt	11511.34	11611.75	39.164371996985857	-76.650187970944373	39.164114971043148	-76.652031687517791	0.10
GT Rut Section #4	43	Asphalt	12233.87	12339.24	39.163100863447191	-76.663443431859193	39.162967030126822	-76.6653228092672	0.11
GT Crack Section #1	4	Asphalt - Ramp	1857.55	1966.64	39.164923054469	-76.644347058998832	39.163782631690708	-76.643579819959172	0.11
GT Crack Section # 2	15	Asphalt	5487.51	5680.11	39.135363166157653	-76.67885812476058	39.136171995324943	-76.682286702714464	0.19
GT Crack Section # 3	39	Asphalt	11244.72	11298.21	39.164966732158682	-76.645302677066439	39.1648256451914	-76.646266099386835	0.05
GT Crack Section #4	43	Asphalt	12233.87	12339.24	39.163100863447191	-76.663443431859193	39.162967030126822	-76.6653228092672	0.11

These GT sections are used as a basis for verification and modification of pavement data collection and data processing techniques, protocols, and procedures for the year in which the GT study is conducted. GT studies are typically performed when a change takes place in the data collection and/or processing procedures and data quality control is needed for validating the data.

**DMI GT section:** The DMI section is exactly one mile long and it is used for controlling the accuracy of the ARAN vehicle's DMI.

**IRI GT sections:** The IRI GT testing was performed in the right wheel path of the IRI GT sections in 2015 using a SurPRO 3500. The results were compared with the ARAN IRI results for validation purposes.

**Rut GT sections:** The rut GT study was performed in 2013. Data were collected using the following four reference approaches:

- a 6-ft straightedge used to collect data in each half of the lane,
- a stringline stretched across the full width of the lane,
- a stringline stretched across 10-ft of the lane, and
- a stringline stretched across 8-ft of the lane.

The manual rut measurement methods were compared with each other and with the automated ARAN rut measurements. The study was performed to establish reference rut values for the rut GT sections and to modify the ARAN rut processing protocol to obtain the most precise and accurate data from ARAN measurements.

**Crack GT sections:** The crack GT sections are four short asphalt pavement sections with different distress levels and crack types. Unsealed and sealed cracks were manually traced on the pavement images along these sections for test loop run 8390S3H4, which was performed on March 9, 2018. These sections will be used as the basis for checking the accuracy and consistency of the automated crack detection by the ARAN data collected vehicle and Vision software.

Cracks on concrete pavements are detected manually. At present there are no concrete crack GT sections in the MDOT-SHA test loop, but since it is a manual process, all the

concrete sections of the first 10 ARAN test loop data collections (pre-collection test loops) can be used as GT sections for controlling the consistency of detectors throughout the collection season.

**GT sections for other measures:** The second group of MDOT-SHA test loop sections are the sections that have 100% reliable data and are ideal for use in run comparisons or for research purposes. These sections are used for the 3-week MDOT-SHA test loop data QC. These sections are relevant to the performance measure being evaluated in terms of pavement type. Since the condition data are affected by ARAN transitioning from one lane to another lane, sections including lane transition zones are not a part of this group of test loop sections. For example, roughness, rutting, and other measures are only compared if the section does not include a lane transition zone or do not have any other event such as debris, damp pavement, or milled pavement that can affect the data quality. These sections are used for performing data QC checks throughout the collection season.

These QC sections are presented in the following table (assuming that the lane transition zones are the only existing event and no other event such as lane change, debris, wet pavement, and so forth exists):

Segment	DMI	IRI	Rut & Cross Slopel	Asphalt Crack Density	Percent Slabs Cracked (JCP)	CRCP ConcreteCracking	Faulting	Friction	Lane Transition
1	×	~	✓	~	×	×	×	~	×
2	×	~	✓	√	×	×	×	~	×
3	×	×	×	×	×	×	×	×	√
4	×	~	✓	✓	×	×	×	✓	×
5	×	×	×	×	×	×	×	×	✓
6	×	~	×	×	*	✓	×	~	×
7	×	×	×	×	×	×	×	×	✓
8	×	×	×	×	~	×	✓	×	×
9	×	~	✓	✓	×	×	×	✓	×
10	×	~	✓	✓	×	×	×	~	×
11	×	~	✓	✓	×	×	×	✓	×
12	×	~	✓	~	×	×	×	~	×
13	×	<	✓	✓	×	×	×	~	×
14	×	~	✓	~	×	×	×	~	×
15	×	~	✓	✓	×	×	×	~	×
16	×	×	×	×	×	×	×	×	✓
17	×	~	✓	✓	×	×	×	~	×
18	×	~	✓	~	×	×	×	~	×
19	×	~	✓	~	×	×	×	~	×
20	×	~	×	~	×	×	×	~	×
21	×	~	✓	√	×	×	×	~	×
22	~	~	✓	√	×	×	×	~	×
23	×	~	✓	√	×	×	×	~	×
24	×	~	✓	~	×	×	×	~	×
25	×	×	×	×	×	×	×	×	×
26	×	~	✓	~	×	×	×	~	×
27	×	×	×	×	✓	×	×	×	✓
28	×	~	×	×	×	√	×	~	×
29	×	×	×	×	~	×	×	×	✓
30	×	~	*	×	×	✓	×	~	×
31	×	×	*	✓	×	×	×	×	×
32	×	×	×	×	×	×	×	×	×
33	×	×	×	✓	×	×	×	×	×
34	×	×	×	×	×	×	×	×	×
35	×	×	×	×	✓	×	✓	×	×
36	×	$\checkmark$	✓	✓	×	×	×	$\checkmark$	×
37	×	×	×	×	×	×	×	×	✓
38	×	×	×	✓	×	×	×	×	×
39	×	×	×	✓	*	×	×	×	×
40	×	$\checkmark$	✓	✓	×	×	×	✓	×
41	×	$\checkmark$	✓	✓	×	×	×	~	×
42	×	$\checkmark$	✓	✓	×	×	×	✓	×
43	×	$\checkmark$	✓	✓	×	×	×	~	×
44	×	×	×	✓	×	×	×	×	×
45	×	$\checkmark$	✓	✓	×	×	×	~	×

The third group of MDOT-SHA test loop QC sections includes those relevant sections for each performance measure excluding the zones with unreliable data such as data from

transition zones, milled sections, damp pavements, and so forth. That is, only data from the flagged milepoints are excluded from calculations.

### Standard Deviation

In the outlier review process, as outlined in <u>Outlier Review</u>, the outliers for each section are determined by means of predicting the current year performance measure using the past 5 years of data and using the standard deviation for that measure to compare the actual current performance measure with the predicted value. The standard deviation used in the outlier review process for each measure is determined using the current year test loop data. Since the sections studied in the outlier review are of different lengths, a single standard deviation for reviewing all the sections cannot be used. The test loop data are used to determine length dependent standard deviations for each measure. That is, for each performance measure, data from different lengths of test loop sections are compared to determine the section length-dependent equation of the standard deviation. The shorter sections. Matching sections with an initial length of 0.1 mile and with incremental length additions of 0.1 mile are compared to build the standard deviation equation based on the section length.

Appendices

# 11.03 FUND TYPE

Each Contract has a fund type and it is standard that the last two digits of the seven digit FMIS number indicate the Fund Type. For Example: "PG6395177," the "77" indicates a resurfacing and rehabilitation project. This Appendix is a complete list of the Capital Program Fund Categories.

### **Major Projects Funding Categories**

- 60 Inter County Connector (ICC)
- 70 Primary
- 71 Secondary
- 72 Interstate
- 73 Woodrow Wilson Bridge

### System Preservation Funding Categories

- 11 Federal/County
- 12 Highway and Safety Operations
- 13 **Operations** A & G Projects
- 14 Maintenance
- 15 General Construction
- 18 High Priority Local Projects
- 23 Truck Weigh
- 24 **Environmental Preservation** Landscaping, wildflower seeding, reforestation and rest areas.
- 25 **Transportation Enhancements** Urban greenways, rail-trail conversions, preservations of certain historic sites, landscaping and pedestrian and bicycle improvements.
- 26 **Noise Barriers** Retrofit noise barriers along existing highways, barrier rehabilitation and noise berms.
- 27 Rest Areas
- 28 Access Controls
- 29 Facilities and Equipment
- 30 Crash Prevention
- 31 Pilot Program Discontinued
- 32 Guardrail End Treatment
- 33 ADA (American Disability Act) Retrofit
- 38 Communications
- 39 Capital Equipment
- 46 Statewide Planning & Research
- 49 Environmental Compliance
- 68 Stimulus Package
- 74 **Drainage Improvements** Areas of recurring flood damage or road closures.
- 75 **Emergencies** Major storm damage, slope failures, sinkholes or other unforeseen roadway or bridge emergency. Must be approved by MDOT.
- 76 **Safety and Spot Improvements** Safety improvements at high accident locations, intersection capacity improvements, slide repairs, roundabouts, ramp modifications and

R/R crossings.

- 77 **Resurfacing and Rehabilitation** Resurfacing, including concrete patching/joint sealing and pavement markings.
- 78 **Pedestrian Access to Transit Stops**
- 79 **Sidewalks** Construction of retrofit sidewalks along State highways and reconstruction of replacement of existing sidewalks if a part of a revitalization effort in an officially designated urban revitalization area.
- 80 **Bridge Replacement & Rehabilitation** Bridge replacement, deck replacements, major rehabilitations, deck overlays, parapet modifications, repainting and spot painting and all structure condition inspections.
- 81 Park and Ride Park and Ride Lots, lot expansions and lighting.
- 82 **TMDL Compliance** Total Maximum Daily Load for stormwater management.
- 83 **Urban Street Reconstruction** Rehabilitation through urban areas that include pavement and drainage reconstruction. Projects may include local participation for sidewalks, street furniture, landscaping and other urban amenity improvements.
- 84 **Community Safety & Enhancements** Improvements where the emphasis is on enhancing the existing infrastructure to promote economic revitalization such as resurfacing, reconstructing drainage, curb and gutter, landscaping, signing, parking bays and lighting. Formerly Neighborhood Conservation.
- 85 **Traffic Management** New signals, signal system construction, signal reconstruction, raised pavement markers, lighting and signing.
- 86 **CHART** Advanced traffic management systems.
- 87 Intersection Capacity
- 88 Bicycle Retrofit
- 89 Not in use.
- 99 Billwork

# **11.04 POSPAC LIST FILES MACRO**

Copy and paste as directed in Step 3 of Post-Processing of ARAN GPS Data.

```
Sub MainList()
'Updateby20150706
Set folder = Application.FileDialog(msoFileDialogFolderPicker)
If folder.Show <> -1 Then Exit Sub
xDir = folder.SelectedItems(1)
Call ListFilesInFolder(xDir, True)
End Sub
Sub ListFilesInFolder(ByVal xFolderName As String, ByVal xIsSubfolders As
Boolean)
Dim xFileSystemObject As Object
Dim xFolder As Object
Dim xSubFolder As Object
Dim xFile As Object
Dim rowIndex As Long
Set xFileSystemObject = CreateObject("Scripting.FileSystemObject")
Set xFolder = xFileSystemObject.GetFolder(xFolderName)
rowIndex = Application.ActiveSheet.Range("A65536").End(xlUp).Row + 1
For Each xFile In xFolder.Files
 Application.ActiveSheet.Cells(rowIndex, 1).Formula = xFile.Name
  rowIndex = rowIndex + 1
Next xFile
If xIsSubfolders Then
  For Each xSubFolder In xFolder.SubFolders
    ListFilesInFolder xSubFolder.Path, True
  Next xSubFolder
End If
Set xFile = Nothing
Set xFolder = Nothing
Set xFileSystemObject = Nothing
End Sub
Function GetFileOwner(ByVal xPath As String, ByVal xName As String)
Dim xFolder As Object
Dim xFolderItem As Object
Dim xShell As Object
xName = StrConv(xName, vbUnicode)
xPath = StrConv(xPath, vbUnicode)
Set xShell = CreateObject("Shell.Application")
Set xFolder = xShell.Namespace(StrConv(xPath, vbFromUnicode))
If Not xFolder Is Nothing Then
  Set xFolderItem = xFolder.ParseName(StrConv(xName, vbFromUnicode))
End If
If Not xFolderItem Is Nothing Then
  GetFileOwner = xFolder.GetDetailsOf(xFolderItem, 8)
Else
  GetFileOwner = ""
End If
Set xShell = Nothing
Set xFolder = Nothing
Set xFolderItem = Nothing
End Function
```

Appendices

# 11.05 BASE REPORT

The table below indicates the parameters required to generate the base report for collected ARAN data.

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
IDLocator	-	-	-	-	-
IDSession	-	-	-	-	-
BeginDistanceSt amp	-	-	-	-	-
EndDistanceSta mp	-	-	-	-	-
BeginChainage	-	-	-	-	-
EndChainage	-	-	-	-	-
Status	-	-	-	-	-
REPORTING_YE AR	FIRST		'2017'		Text
COLLECT_DATE	FIRST		[DCSessions].[DCSTimeStamp]		Text
COUNTY	FIRST		[Locators].[L_County]		Text
MUNICIPALITY	FIRST		[RoutedSegments].[MUNICIPALIT Y]		Text
ID_PREFIX	FIRST		[RoutedSegments].[ID_PREFIX]		Text
ID_ROUTE_NO	FIRST		[RoutedSegments].[ID_RTE_NO]		Text
MP_SUFFIX	FIRST		[RoutedSegments].[MP_SUFFIX]		Text
DIRECTION	FIRST		[Locators].[L_Dir]		Text
EXIT_NUMBER	FIRST		[RoutedSegments].[EXIT_NUMBE R]		Text
RAMP_NUMBER	FIRST		[RoutedSegments].[RAMP_NUMB ER]		Text
ASSOCIATED_I D_PREFIX	FIRST		[RoutedSegments].[ASSOCIATED _ID_PREFIX]		Text
GLOBAL_ROUT E_ID	FIRST		[RoutedSegments].[GLOBAL_ROU TE_ID]		NUMBER
SUB_ROUTE_ID	FIRST		[RoutedSegments].[SUB_ROUTE_ ID]		NUMBER
ROUTEID	FIRST		COMPUTE {RoutedSegments, FIRST([ROUTEID]), , 0, 0}	HMIS ROUTEID, AS INPUT IN THE EFS	Text
DIR_BMP	FIRST			Will be populated in Oracle. Beginchaina ge/1000 for "matched" records	NUMBER
DIR_EMP	FIRST			Will be populated in Oracle. Enddistance stamp/1000 for "matched" records	NUMBER
INV_BMP	FIRST			vviii be populated in Oracle.	NUMBER

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
INV_EMP	FIRST			Will be populated in Oracle	NUMBER
UNIQUERUN	FIRST		COMPUTE {DCSessions, FIRST([UniqueRun]), , 0, 0}		Text
COLLECTION_V EHICLE	FIRST		[DCSessions].[CollectionVehicle]		NUMBER
VERSION	FIRST		[DCSessions].[ARANVersion]		Text
SAT_NUMBER	AVG		COMPUTE {VehiclePositions, SUM([Satellites]), , 0, 0}		NUMBER
STATION_TIME	AVG		COMPUTE {StationData, AVG([StationTime]), , 0, 0}		NUMBER
ELAPSED_TIME	AVG		COMPUTE {StationData, AVG([ElapsedTime]), , 0, 0}		NUMBER
SPEED	AVG		COMPUTE {StationData, AVG([Speed]), , 0, 0}*2.23694	M/H	NUMBER
SPEED_FIRSTR AW	FIRST		[StationData].[Speed]*2.23694	M/H	NUMBER
GPS_LAT_BEGI N	FIRST		COMPUTE {VehiclePositions, FIRST([Latitude]), , 0, 0}*57.2958		NUMBER
GPS_LONG_BE GIN	FIRST		COMPUTE {VehiclePositions, FIRST([Longitude]), , 0, 0}*57.2958		NUMBER
GPS_LAT_END	LAST		COMPUTE {VehiclePositions, LAST([Latitude]), , 0, 0}*57.2958		NUMBER
GPS_LONG_EN D	LAST		COMPUTE {VehiclePositions, LAST([Longitude]), , 0, 0}*57.2958		NUMBER
ELEV_AVG	AVG		COMPUTE {VehiclePositions, AVG([Elevation]), , 0, 0}*3.2808399	FT	NUMBER
GRADE_AVG	AVG		COMPUTE {VehicleOrientations, AVG([Grade]), , 0, 0}*100		NUMBER
L_FAULTING_C OUNT	COUNT		COMPUTE {ConcreteFaults, AVG([Height]), [location]='LeftFault', 0, 0}	COUNT	NUMBER
L_FAULTING_H EIGHT	FIRST		COMPUTE {ConcreteFaults, FIRST([Height]),[location]='LeftFaul t' , 0, 0}*39.3701	IN	NUMBER
R_FAULTING_C OUNT	COUNT		COMPUTE {ConcreteFaults, AVG([Height]),[location]='RightFaul t' , 0, 0}	COUNT	NUMBER
R_FAULTING_H EIGHT	FIRST		COMPUTE {ConcreteFaults, FIRST([Height]),[location]='RightFa ult' , 0, 0}*39.3701	IN	NUMBER
FAULTING_LCM S_ABS_AVG_IN	AVG		COMPUTE {Faults, AVG([ABS_AvgFault]), , 0, 0}	Absolute Value Faulting, IN	NUMBER
FAULTING_LCM S_MIN_IN	MIN		COMPUTE {FaultsReport, MIN([FaultMeasurement*1000 / 25.4]), , 0, 0}	Minimum Fault Value. Not the absolute value, just the minimum raw value, which can be negative., IN	NUMBER

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
FAULTING_LCM S_MAX_IN	МАХ		COMPUTE {FaultsReport, MAX([FaultMeasurement*1000 / 25.4]), , 0, 0}	Maximum faulting value, IN	NUMBER
ROLL	AVG		COMPUTE {TransverseData, AVG([Roll]), , 0, 0}*100		NUMBER
РІТСН	AVG		COMPUTE {AttitudeData, AVG([Pitch]), , 0, 0}*100		NUMBER
ELEV_BEGIN	FIRST		COMPUTE {VehiclePositions, FIRST([Elevation]), , 0, 0}*3.2808399	FT	NUMBER
ELEV_END	LAST		COMPUTE {VehiclePositions, LAST([Elevation]), , 0, 0}*3.2808399	FT	NUMBER
L_IRI_FIRSTRA W	FIRST		[StationData].[LeftIRI]*63.36	IN/MILE	NUMBER
R_IRI_FIRSTRA	FIRST		[StationData].[RightIRI]*63.36	IN/MILE	NUMBER
L_RUT_FIRSTR	FIRST		[RutData].[LeftRut]*1000/25.4	IN	NUMBER
R_RUT_FIRSTR AW	FIRST		[RutData].[RightRut]*1000/25.4	IN	NUMBER
EVENT_DEBRIS _OFFICE	MAX	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Debris', 0, 0}>0;	1; 0		NUMBER
EVENT_STOPB AR_OFFICE	MAX	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Stop_Bar', 0, 0}>0;	1;0		NUMBER
EVENT_LANE_D EVIATION_OFFI CE	MAX	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Lane_Deviation', 0, 0}>0;	1;0		NUMBER
EVENT_MILLED _SURFACE_OF FICE	MAX	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Milled_Pavement', 0, 0}>0;	1;0		NUMBER
EVENT_BRIDGE _OFFICE	MAX	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Bridge', 0, 0}>0;	1;0		NUMBER
EVENT_CRACK _SEAL_OFFICE	MAX	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Sealed_Cracking_Exis ts', 0, 0}>0;	1;0		NUMBER

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
EVENT_CROSS WALK_OFFICE	MAX	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Crosswalk', 0, 0}>0;	1;0		NUMBER
EVENT_RAILRO AD_OFFICE	MAX	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Railroad', 0, 0}>0;	1;0		NUMBER
EVENT_DISREG ARD_CRACK_O FFICE	MAX	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Disregard_Cracking', 0, 0}>0;	1;0		NUMBER
EVENT_BRICK_ OFFICE	MAX	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Brick_Pavement', 0, 0}>0;	1;0		NUMBER
EVENT_BAD_IM AGE_OFFICE	MAX	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Bad_Image', 0, 0}>0;	1;0		NUMBER
EVENT_CRCP_ OFFICE	MAX	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ CRCP_Exists', 0, 0}>0;	1;0		NUMBER
EVENT_JCP_OF FICE	MAX	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ JCP_Exists', 0, 0}>0;	1;0		NUMBER
EVENT_WET_S URFACE_OFFIC E	MAX	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Wet_Surface', 0, 0}>0;	1;0		NUMBER
EVENT_PAVE_C HANGE_OFFICE	MAX	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Pave_Change', 0, 0}>=0;	1;0		NUMBER

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
JCP_CRACKED _SLAB	SUM		COMPUTE {ManualDistressesValues, COUNT([DistressTypeName]),[Dist ressTypeName]='JCP_Cracked_SI ab', 0, 0}	COUNT	NUMBER
JCP_INTACT_SL AB	SUM		COMPUTE {ManualDistressesValues, COUNT([DistressTypeName]),[Dist ressTypeName]='Intact_JCP_Slab', 0, 0}	COUNT	NUMBER
CRCP_PATCH_ CONCRETE	SUM	COMPUTE {ManualDistressesVal ues, SUM([Area*10.7639]), [DistressTypeName]=' CRCP_Patch_Concret e', 0, 0}>0;	COMPUTE {ManualDistressesValues, SUM([Area*10.7639]), [DistressTypeName]='CRCP_Patc h_Concrete', 0, 0};0	SQFT	NUMBER
CRCP_PATCH_ ASPHALT	SUM	COMPUTE {ManualDistressesVal ues, SUM([Area * 10.7639]), [DistressTypeName]=' CRCP_Patch_Asphalt' , 0, 0}>0;	COMPUTE {ManualDistressesValues, SUM([Area * 10.7639]), [DistressTypeName]='CRCP_Patc h_Asphalt', 0, 0};0	SQFT	NUMBER
CRCP_PUNCHO UT	SUM	COMPUTE {ManualDistressesVal ues, SUM([Area * 10.7639]), [DistressTypeName] = 'CRCP_Punchout', 0, 0}>0;	COMPUTE {ManualDistressesValues, SUM([Area * 10.7639]), [DistressTypeName] = 'CRCP_Punchout', 0, 0};0	SQFT	NUMBER
CRCP_LONG	SUM	COMPUTE {ManualDistressesVal ues, SUM([Area * 10.7639]), [DistressTypeName] = 'CRCP_Long', 0, 0}>0;	COMPUTE {ManualDistressesValues, SUM([Area * 10.7639]), [DistressTypeName] = 'CRCP_Long', 0, 0};0	SQFT	NUMBER
EVENT_LANE_D EVIATION_FIEL D	MAX	COMPUTE {CollectedSpanEvents , FIRST([Length]),[Even tName]='Lane', 0, 0}>0;	1;0		NUMBER
EVENT_CONST RUCTION_FIEL D	MAX	COMPUTE {CollectedSpanEvents , FIRST([Length]),[Even tName]='Construction', 0, 0}>0;	1;0		NUMBER
EVENT_NEW_P AVEMENT_FIEL D	MAX	COMPUTE {CollectedSpanEvents , FIRST([Length]),[Even tName]='New', 0, 0}>0;	1;0		NUMBER
EVENT_MILLED _FIELD	MAX	COMPUTE {CollectedSpanEvents , FIRST([Length]),[Even tName]='Milled', 0, 0}>0:	1;0		NUMBER

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
EVENT_ROUND ABOUT_FIELD	MAX	COMPUTE {CollectedSpanEvents , FIRST([Length]),[Even tName]='Roundabout', 0, 0}>0;	1;0		NUMBER
EVENT_WET_FI ELD	МАХ	COMPUTE {CollectedSpanEvents , FIRST([Length]),[Even tName]='Wet', 0, 0}>0;	1;0		NUMBER
EVENT_DEBRIS _FIELD	MAX	COMPUTE {CollectedSpanEvents , FIRST([Length]),[Even tName]='Desbris', 0, 0}>0;	1;0		NUMBER
EVENT_ROAD_ CLOSED_FIELD	МАХ	COMPUTE {CollectedPointEvents, FIRST([MaxSeparatio n]),[EventName]='Clos ed', 0, 0}>0;	1;0		NUMBER
EVENT_RUMBL E_STRIP_FIELD	МАХ	COMPUTE {CollectedPointEvents, FIRST([MaxSeparatio n]),[EventName]='Strip s', 0, 0}>0;	1;0		NUMBER
EVENT_TRAFFI C_FIELD	МАХ	COMPUTE {CollectedPointEvents, FIRST([MaxSeparatio n]),[EventName]='Traff ic', 0, 0}>0;	1;0		NUMBER
ImageROW	FIRST		COMPUTE {Image, LASTKNOWN([JPEGNAME]), [Name] = 'ROW', 1, 1}		TEXT
ImageLeft	FIRST		COMPUTE {Image, LASTKNOWN([JPEGNAME]), [Name] = 'Left', 1, 1}		TEXT
ImagePavement_ Optical	FIRST		COMPUTE {Image, LASTKNOWN([JPEGNAME]), [Name] = 'Pavement', 0, 0}		TEXT
ImagePavement_ Depth	FIRST		COMPUTE {Image, LASTKNOWN([JPEGNAME]), [Name] = 'LCMSRange', 0, 0}		TEXT
ImagePavement_ 3D	FIRST		COMPUTE {Image, LASTKNOWN([JPEGNAME]), [Name] = 'LCMS3D', 0, 0}		TEXT
IMAGEPATH_R OW	FIRST		COMPUTE {Image, LASTKNOWN([imagepath]), [Name] = 'ROW' , 0, 0}		TEXT
IMAGEPATH_LE FT	FIRST		COMPUTE {Image, LASTKNOWN([imagepath]), [Name] = 'LEFT', 0, 0}		TEXT
IMAGEPATH_PA VEMENT_OPTIC AL	FIRST		COMPUTE {Image, LASTKNOWN([imagepath]), [Name] = 'Pavement', 0, 0}		TEXT
IMAGEPATH_PA VEMENT_DEPT H	FIRST		COMPUTE {Image, LASTKNOWN([imagepath]), [Name] = 'LCMSRange', 0, 0}		TEXT
IMAGEPATH_PA VEMENT_3D	FIRST		COMPUTE {Image, LASTKNOWN([imagepath]), [Name] = 'LCMS3D', 0, 0}		TEXT

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
IMAGENAME_R OW	FIRST		COMPUTE {Image, LASTKNOWN([IMAGENAME]), [Name] = 'ROW' , 0, 0}		TEXT
IMAGENAME_L EFT	FIRST		COMPUTE {Image, LASTKNOWN([imagename]), [Name] = 'LEFT', 0, 0}		TEXT
IMAGENAME_P AVEMENT_OPTI CAL	FIRST		COMPUTE {Image, LASTKNOWN([imagename]), [Name] = 'PAVEMENT', 0, 0}		TEXT
IMAGENAME_P AVEMENT_DEP TH	FIRST		COMPUTE {Image, LASTKNOWN([imagename]), [Name] = 'LCMSRange', 0, 0}		TEXT
IMAGENAME_P AVEMENT_3D	FIRST		COMPUTE {Image, LASTKNOWN([imagename]), [Name] = 'LCMS3D', 0, 0}		TEXT
IMAGEFRAME	FIRST		COMPUTE {Image, FIRST([imageframe]), , 0, 0}		TEXT
LANEWIDTH_AV G	AVG		COMPUTE {Lanewidth, AVG([Lanewidth]), [lanewidth]>0, 0, 0}*3.280839895	FT	NUMBER
LANEWIDTH_FI RST	FIRST		COMPUTE {Lanewidth, FIRST([Lanewidth]), [lanewidth]>0, 0, 0}*3.280839895	FT	NUMBER
LeftOffset	AVG		COMPUTE {CalculatedRutValues, AVG([LeftOffset]),[IsValid] = 1 and [RutCalculationMethod] = 'Wire', 0, 0}*3.280839895	FT	NUMBER
RightOffset	AVG		COMPUTE {CalculatedRutValues, AVG([RightOffset]),[IsValid] = 1 and [RutCalculationMethod] = 'Wire', 0, 0}*3.280839895	FT	NUMBER
CrossFallinPerce nt	AVG		COMPUTE {CalculatedRutValues, AVG([CrossFallInPercent]),[IsValid] =1 and [RutCalculationMethod] = 'Wire', 0, 0}		NUMBER
CrossFallinRadia ns	AVG		COMPUTE {CalculatedRutValues, AVG([CrossfallInRadians]),[IsValid] =1 and [RutCalculationMethod] = 'Wire', 0, 0}		NUMBER
LeftPondDepth	AVG		COMPUTE {CalculatedRutValues, FIRST([LeftPondDepth]), [LeftPondIsValid]=1 and [IsValid]=1 and [RutCalculationMethod] = 'Wire', 0, 0}*1000/25.4	IN	NUMBER
RightPondDepth	AVG		COMPUTE {CalculatedRutValues, AVG([RightPondArea]), [RightPondlsValid]=1 and [IsValid]=1 and [RutCalculationMethod] = 'Wire', 0, 0}*1000/25.4	IN	NUMBER
LeftPondArea	AVG		COMPUTE {CalculatedRutValues, AVG([LeftPondArea]),[LeftPondIsV alid]=1 and [IsValid]=1 and [RutCalculationMethod] = 'Wire', 0, 0}*(1000/25.4)*(1000/25.4)	SQIN	NUMBER
RightPondArea	AVG		COMPUTE {CalculatedRutValues, AVG([RightPondArea]),[RightPondI sValid]=1 and [IsValid] = 1 and [RutCalculationMethod] = 'Wire', 0, 0}*(1000/25.4)*(1000/25.4)	SQIN	NUMBER



Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
LaneOffset	AVG		COMPUTE {CalculatedRutValues, AVG([LaneOffset]), [IsValid] = 1 and [RutCalculationMethod] = 'Wire', 0, 0}*3.280839895	FT	NUMBER
RutCalculationM ethod	FIRST		COMPUTE {CalculatedRutValues, FIRST([RutCalculationMethod]), , 0, 0}		TEXT
LeftEdgeType	FIRST		COMPUTE {CalculatedRutValues, FIRST([LeftEdgeType]),[IsValid] = 1 and [LeftEdgeIsValid] =1 and [RutCalculationMethod] = 'Wire', 0, 0}		TEXT
RightEdgeType	FIRST		COMPUTE {CalculatedRutValues, FIRST([RightEdgeType]),[IsValid] = 1 and [RightEdgeIsValid] = 1 and [RutCalculationMethod] = 'Wire', 0, 0}		TEXT
L_RUT_WIRE	AVG		COMPUTE {CalculatedRutValues, AVG([LeftRut]), [LeftRutIsValid] =1 and [IsValid] = 1 and [RutCalculationMethod] = 'Wire', 0, 0}*1000/25.4	IN	NUMBER
R_RUT_WIRE	AVG		COMPUTE {CalculatedRutValues, AVG([RightRut]), [RightRutIsValid]=1 and [IsValid]=1 and [RutCalculationMethod] = 'Wire', 0, 0}*1000/25.4	IN	NUMBER
AVG_WIRE_RU T	AVG		((COMPUTE {CalculatedRutValues, AVG([LeftRut]), [LeftRutIsValid]=1 and [IsValid]=1 and [RutCalculationMethod] = 'Wire', 0, 0}*1000/25.4)+(COMPUTE {CalculatedRutValues, AVG([RightRut]), [RightRutIsValid]=1 and [IsValid]=1 and [RutCalculationMethod] = 'Wire', 0, 0}*1000/25.4))/2	IN	NUMBER
L_RUT_RAW	AVG		COMPUTE {RutData, AVG([LeftRut]), , 0, 0}*1000/25.4	IN	NUMBER
R_RUT_RAW	AVG		COMPUTE {RutData, AVG([RightRut]), , 0, 0}*1000/25.4	IN	NUMBER
AVG_RUT_RAW	AVG		(COMPUTE {RutData, AVG([LeftRut]), , 0, 0}*1000/25.4 + COMPUTE {RutData, AVG([RightRut]), , 0, 0}*1000/25.4)/2	IN	NUMBER


# Maryland department of transportation

#### STATE HIGHWAY ADMINISTRATION

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
L_IRI_ADJ_SP_ CH	AVG			This field is intentionally left blank when reported out of Vision. It will be populated with adjusted left IRI values to consider the change in travel speed of the vehicle during collection., IN/MILE	NUMBER
R_IRI_ADJ_SP_ CH	AVG			This field is intentionally left blank when reported out of Vision. It will be populated with adjusted right IRI values to consider the change in travel speed of the vehicle during collection., IN/MIL E	NUMBER
PERC_IRI_FRO M_SP_CH	AVG			This field is intentionally left blank when reported out of Vision. It will be populated with a code indicating the extent and type of vehicle acceleration during collection., IN/MLE	NUMBER
L_IRI	AVG		COMPUTE {PProcRoughness, AVG([LeftIRI]), , 0, 0}*63.36	IN/MILE	NUMBER
R_IRI	AVG		COMPUTE {PProcRoughness, AVG([RightIRI]), , 0, 0}*63.36	IN/MILE	NUMBER
L_IRI_STATION DATA	AVG		COMPUTE {StationData, AVG([LeftIRI]), , 0, 0}*63.36	IN/MILE	NUMBER

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
R_IRI_STATION DATA	AVG		COMPUTE {StationData, AVG([RightIRI]), , 0, 0}*63.36	IN/MILE	NUMBER
L_IRI_PROCESS ED	AVG		COMPUTE {PProcRoughness, AVG([LeftIRI]), , 0, 0}*63.36	IN/MILE	NUMBER
R_IRI_PROCES SED	AVG		COMPUTE {PProcRoughness, AVG([RightIRI]), , 0, 0}*63.36	IN/MILE	NUMBER
RAVELING_AFF ECTED_PERC	AVG		COMPUTE {RavelingReport, AVG([AffectedPercentage]), , 0, 0}		NUMBER
RAVELING_MEA N_RI_CM3M2	AVG		COMPUTE {RavelingReport, AVG([MeanRI]), , 0, 0}		NUMBER
RAVELING_MEA N_EXIST_RI_CM 3M2	AVG		COMPUTE {RavelingReport, AVG([MeanExistingRI]), , 0, 0}		NUMBER
RAVELING_MEA N_RPI_CM3M2	AVG		COMPUTE {RavelingReport, AVG([MeanRPI]), , 0, 0}		NUMBER
RAVELING_MEA N_AVC_CM3M2	AVG		COMPUTE {RavelingReport, AVG([MeanAVC]), , 0, 0}		NUMBER
JOINT_LENGTH _TRANS_FT	SUM		COMPUTE {JointsReport, SUM([Length]),[Transverse]=1 , 0, 0}*3.28084	FT	NUMBER
JOINT_HEIGHT_ TRANS_IN	AVG		COMPUTE {JointsReport, AVG([Height]), [Transverse]=1, 0, 0}*39.37008	IN	NUMBER
JOINT_LENGTH _LONG_FT	SUM		COMPUTE {JointsReport, SUM([Length]),[Transverse]=0, 0, 0}*3.28084	FT	NUMBER
JOINT_HEIGHT_ LONG_IN	AVG		COMPUTE {JointsReport, AVG([Height]), [Transverse]=0, 0, 0}*39.37008	IN	NUMBER
POTHOLE_ARE A_L_SQIN	SUM		COMPUTE {POTHOLESREPORT, SUM([AREA]), [SEVERITY] = 'Low', 0, 0}*1000/25.4*1000/25.4	SQIN	NUMBER
POTHOLE_MAX _DEPTH_L_IN	МАХ		COMPUTE {POTHOLESREPORT, MAX([MAXIMUMDEPTH]), [SEVERITY] = 'Low', 0, 0}*1000/25.4	IN	NUMBER
POTHOLE_ARE A_M_SQIN	SUM		COMPUTE {POTHOLESREPORT, SUM([AREA]), [SEVERITY] = 'Moderate', 0, 0}*1000/25.4*1000/25.4	SQIN	NUMBER
POTHOLE_MAX _DEPTH_M_IN	MAX		COMPUTE {POTHOLESREPORT, MAX([MAXIMUMDEPTH]), [SEVERITY] = 'Moderate', 0, 0}*1000/25.4	IN	NUMBER
POTHOLE_ARE A_H_SQIN	SUM		COMPUTE {POTHOLESREPORT, SUM([AREA]), [SEVERITY] = 'High', 0, 0)*1000/25.4*1000/25.4	SQIN	NUMBER
POTHOLE_MAX _DEPTH_H_IN	MAX		COMPUTE {POTHOLESREPORT, MAX([MAXIMUMDEPTH]), [SEVERITY] = 'High', 0, 0}*1000/25.4	IN	NUMBER
POTHOLE_DEP TH_AREA_INSQ IN	SUM		COMPUTE {POTHOLESREPORT, SUM([MAXIMUMDEPTH*AREA]), , 0, 0}*1000/25.4*1000/25.4*1000/25.4	CUBIC IN	NUMBER
MPD_LE_IN	AVG	COMPUTE {PProcTexture, AVG([MPD ^(Inch)]), [wheelpath] = 1, 0, 0}	COMPUTE {PProcTexture, AVG([MPD ^(Inch)]), [wheelpath] = 1, 0, 0}	IN	NUMBER

# MOT MARYLAND DEPARTMENT OF TRANSPORTATION

#### STATE HIGHWAY ADMINISTRATION

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
MPD_LWP_IN	AVG	COMPUTE {PProcTexture, AVG([MPD ^(Inch)]), [wheelpath] = 2, 0, 0}>0	COMPUTE {PProcTexture, AVG([MPD ^(Inch)]), [wheelpath] = 2, 0, 0}	IN	NUMBER
MPD_CTR_IN	AVG	COMPUTE {PProcTexture, AVG([MPD ^(Inch)]), [wheelpath] = 3, 0, 0} >0	COMPUTE {PProcTexture, AVG([MPD ^(Inch)]), [wheelpath] = 3, 0, 0}	IN	NUMBER
MPD_RE_IN	AVG	COMPUTE {PProcTexture, AVG([MPD ^(Inch)]), [wheelpath] = 5, 0, 0} > 0	COMPUTE {PProcTexture, AVG([MPD ^(Inch)]), [wheelpath] = 5, 0, 0}	IN	NUMBER
MPD_RWP_IN	AVG	COMPUTE {PProcTexture, AVG([MPD ^(Inch)]), [wheelpath] = 4, 0, 0} > 0	COMPUTE {PProcTexture, AVG([MPD ^(Inch)]), [wheelpath] = 4, 0, 0}	IN	NUMBER
PVT_TY_ASPHA LT_FT	SUM		COMPUTE {RatedEvents, SUM([Length]),[eventtypename] = 'LCMS' and [Eventscorename] ='Asphalt' , 0, 0}*3.28084	FT	NUMBER
PVT_TY_CONC RETE_FT	SUM		COMPUTE {RatedEvents, SUM([Length]),[eventtypename] = 'LCMS' and [Eventscorename] ='Concrete' , 0, 0}*3.28084	FT	NUMBER
PVT_TY_GROO VED_CONC_LO NG_FT	SUM		COMPUTE {RatedEvents, SUM([Length]),[eventtypename] = 'LCMS' and [Eventscorename] ='Grooved Concrete - Longitudinal' , 0, 0}*3.28084	FT	NUMBER
PVT_TY_GROO VED_CONC_TR ANS_FT	SUM		COMPUTE {RatedEvents, SUM([Length]),[eventtypename] = 'LCMS' and [Eventscorename] ='Grooved Concrete - Transversal' , 0, 0}*3.28084	FT	NUMBER
PVT_TY_LEFT_J OINT_CT	SUM		COMPUTE {RatedEvents, COUNT([Eventscorename]),[Event TypeName]='LCMS' and [Eventscorename] ='Left Joint', 0, 0}	COUNT	NUMBER
PVT_TY_RIGHT _JOINT_CT	SUM		COMPUTE {RatedEvents, COUNT([Eventscorename]),[Event TypeName]='LCMS' and [Eventscorename] ='Right Joint', 0, 0}	COUNT	NUMBER



Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
EXCLUDED_FR OM_CRACK_DA TA	MAX	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Milled_Pavement', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Bridge', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Railroad', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Disregard_Cracking', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Brick_Pavement', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Brick_Pavement', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Bad_Image', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ CRCP_Exists', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ CRCP_Exists', 0, 0}>0	1;1;1;1;1;1;1;0		NUMBER



Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
LONGITUDINAL LWP_MAP21E XTENT	SUM	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Milled_Pavement', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Bridge', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Disregard_Cracking', 0,0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Disregard_Cracking', 0,0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Brick_Pavement', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Brick_Pavement', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Bad_Image', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ CRCP_Exists', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ CRCP_Exists', 0, 0}>0	NULL:NULL;NULL:NULL;NULL:NU LL:NULL:NULL;COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] in ('Longitudinal Crack (LWP)','Longitudinal Sealed Crack (LWP)') and [MetricName] = 'CrackExtent' and [Length]>0, 0, 0}*3.280839895	FT	NUMBER



Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
LONGITUDINAL RWP_MAP21E XTENT	SUM	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Milled_Pavement', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Bridge', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Disregard_Cracking', 0,0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Disregard_Cracking', 0,0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Brick_Pavement', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Bad_Image', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ CRCP_Exists', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ CRCP_Exists', 0, 0}>0	NULL:NULL;NULL:NULL;NULL:NU LL:NULL:NULL;COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] in ('Longitudinal Crack (RWP)','Longitudinal Sealed Crack (RWP)') and [MetricName] = 'CrackExtent' and [Length]>0, 0, 0}*3.280839895	FT	NUMBER



Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
SC_CRACK_AR EA	SUM	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Milled_Pavement', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Bridge', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Disregard_Cracking', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Disregard_Cracking', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Brick_Pavement', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Brick_Pavement', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Bad_Image', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ CRCP_Exists', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ CRCP_Exists', 0, 0}>0	NULL:NULL;NULL:NULL;NULL:NU LL:NULL:NULL;COMPUTE {PIVOT_Distress, SUM([CrackLength * Width]), [DistressTypeName] in ('Longitudinal Crack (LWP)', 'Longitudinal Crack (RWP)') and [Length]>0,0, 0}*3.280839895*3.280839895	SQFT	NUMBER



Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
FC_CRACK_AR EA	SUM	COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Milled_Pavement', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Bridge', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Disregard_Cracking', 0,0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Disregard_Cracking', 0,0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Brick_Pavement', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Brick_Pavement', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ Bad_Image', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ CRCP_Exists', 0, 0}>0;COMPUTE {manualdistressesvalu es, FIRST([Length]),[distr esstypename]='Event_ CRCP_Exists', 0, 0}>0	NULL:NULL;NULL:NULL;NULL:NU LL:NULL:NULL;COMPUTE {PIVOT_Distress, SUM([CrackLength * Width]), [DistressTypeName] in ('Longitudinal Crack (CTR)', 'Longitudinal Crack (LE)', 'Longitudinal Crack (LE)', 'Longitudinal Crack (RE)', 'Transverse Crack') and [Length]>0,0, 0}*3.280839895*3.280839895	SQFT	NUMBER
LONGITUDINAL _LE_SEALED	SUM		{RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Sealed Crack (LE)' and [SeverityName] = 'SEALED' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0)*3.280839895	FT	NUMBER

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
LONGITUDINAL _LWP_SEALED	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Sealed Crack (LWP)' and [SeverityName] = 'SEALED' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONGITUDINAL _CTR_SEALED	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Sealed Crack (CTR)' and [SeverityName] = 'SEALED' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONGITUDINAL _RWP_SEALED	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Sealed Crack (RWP)' and [SeverityName] = 'SEALED' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0)*3.280839895	FT	NUMBER
LONGITUDINAL _RE_SEALED	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Sealed Crack (RE)' and [SeverityName] = 'SEALED' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
TRANSVERSE_ ALL_SEALED	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Transverse Sealed Crack' and [SeverityName] = 'SEALED' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_LE_CW_ 1_16	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LE)' and [SeverityName] = 'crackwidth_1_16' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_LE_CW_ 1_8	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LE)' and [SeverityName] = 'crackwidth_1_8' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
LONG_LE_CW_ 1_4	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LE)' and [SeverityName] = 'crackwidth_1_4 ' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_LE_CW_ 3_8	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LE)' and [SeverityName] = 'crackwidth_3_8' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_LE_CW_ 1_2	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LE)' and [SeverityName] = 'crackwidth_1_2' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_LE_CW_ 3_4	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LE)' and [SeverityName] = 'crackwidth_3_4' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0)*3.280839895	FT	NUMBER
LONG_LE_CW_ 1_IN	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LE)' and [SeverityName] = 'crackwidth_1_in' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_LE_CW_ 1_1_2	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LE)' and [SeverityName] = 'crackwidth_1_1_2' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_LE_CW_ 2_IN	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LE)' and [SeverityName] = 'crackwidth_2_in' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0)*3.280839895	FT	NUMBER

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
LONG_LE_CW_ 3_IN	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LE)' and [SeverityName] = 'crackwidth_3_in' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_LE_CW_ OVER3	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LE)' and [SeverityName] = 'crackwidth_Over3' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_LWP_CW _1_16	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LWP)' and [SeverityName] = 'crackwidth_1_16' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_LWP_CW _1_8	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LWP)' and [SeverityName] = 'crackwidth_1_8' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0)*3 280839895	FT	NUMBER
LONG_LWP_CW _1_4	SUM		COMPUTE [RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LWP)' and [SeverityName] = 'crackwidth_1_4 ' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_LWP_CW _3_8	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LWP)' and [SeverityName] = 'crackwidth_3_8' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_LWP_CW _1_2	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LWP)' and [SeverityName] = 'crackwidth_1_2' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
LONG_LWP_CW _3_4	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LWP)' and [SeverityName] = 'crackwidth_3_4' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_LWP_CW _1_IN	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LWP)' and [SeverityName] = 'crackwidth_1_in' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_LWP_CW _1_1_2	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LWP)' and [SeverityName] = 'crackwidth_1_1_2' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_LWP_CW _2_IN	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LWP)' and [SeverityName] = 'crackwidth_2_in' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0)*3.280830895	FT	NUMBER
LONG_LWP_CW _3_IN	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LWP)' and [SeverityName] = 'crackwidth_3_in' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_LWP_CW _OVER3	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (LWP)' and [SeverityName] = 'crackwidth_Over3' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_CTR_CW _1_16	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (CTR)' and [SeverityName] = 'crackwidth_1_16' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0)*3.280839895	FT	NUMBER

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
LONG_CTR_CW _1_8	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (CTR)' and [SeverityName] = 'crackwidth_1_8' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_CTR_CW _1_4	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (CTR)' and [SeverityName] = 'crackwidth_1_4 ' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_CTR_CW _3_8	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (CTR)' and [SeverityName] = 'crackwidth_3_8' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_CTR_CW _1_2	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (CTR)' and [SeverityName] = 'crackwidth_1_2' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0)*3 280839895	FT	NUMBER
LONG_CTR_CW _3_4	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (CTR)' and [SeverityName] = 'crackwidth_3_4' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_CTR_CW _1_IN	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (CTR)' and [SeverityName] = 'crackwidth_1_in' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_CTR_CW _1_1_2	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (CTR)' and [SeverityName] = 'crackwidth_1_1_2' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
LONG_CTR_CW _2_IN	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (CTR)' and [SeverityName] = 'crackwidth_2_in' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_CTR_CW _3_IN	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (CTR)' and [SeverityName] = 'crackwidth_3_in' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_CTR_CW _OVER3	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (CTR)' and [SeverityName] = 'crackwidth_Over3' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_RWP_C W_1_16	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RWP)' and [SeverityName] = 'crackwidth_1_16' and [MetricName] = 'CrackLength' AND [Length]>0_0_01*3_280839895	FT	NUMBER
LONG_RWP_C W_1_8	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RWP)' and [SeverityName] = 'crackwidth_1_8' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_RWP_C W_1_4	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RWP)' and [SeverityName] = 'crackwidth_1_4 ' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_RWP_C W_3_8	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RWP)' and [SeverityName] = 'crackwidth_3_8' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
LONG_RWP_C W_1_2	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RWP)' and [SeverityName] = 'crackwidth_1_2' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_RWP_C W_3_4	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RWP)' and [SeverityName] = 'crackwidth_3_4' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_RWP_C W_1_IN	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RWP)' and [SeverityName] = 'crackwidth_1_in' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_RWP_C W_1_1_2	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RWP)' and [SeverityName] = 'crackwidth_1_1_2' and [MetricName] = 'CrackLength' AND [Length]>0. 0. 0)*3.280839895	FT	NUMBER
LONG_RWP_C W_2_IN	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RWP)' and [SeverityName] = 'crackwidth_2_in' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_RWP_C W_3_IN	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RWP)' and [SeverityName] = 'crackwidth_3_in' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_RWP_C W_OVER3	SUM		0}*3.280839895 COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RWP)' and [SeverityName] = 'crackwidth_Over3' and [MetricName] = 'CrackLength' AND [Length]>0.001*3.280839895		NUMBER

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
LONG_RE_CW_ 1_16	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RE)' and [SeverityName] = 'crackwidth_1_16' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_RE_CW_ 1_8	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RE)' and [SeverityName] = 'crackwidth_1_8' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_RE_CW_ 1_4	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RE)' and [SeverityName] = 'crackwidth_1_4 ' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_RE_CW_ 3_8	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RE)' and [SeverityName] = 'crackwidth_3_8' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0)*3 280839895	FT	NUMBER
LONG_RE_CW_ 1_2	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RE)' and [SeverityName] = 'crackwidth_1_2' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_RE_CW_ 3_4	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RE)' and [SeverityName] = 'crackwidth_3_4' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_RE_CW_ 1_IN	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RE)' and [SeverityName] = 'crackwidth_1_in' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
LONG_RE_CW_ 1_1_2	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RE)' and [SeverityName] = 'crackwidth_1_1_2' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_RE_CW_ 2_IN	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RE)' and [SeverityName] = 'crackwidth_2_in' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_RE_CW_ 3_IN	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RE)' and [SeverityName] = 'crackwidth_3_in' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
LONG_RE_CW_ OVER3	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Longitudinal Crack (RE)' and [SeverityName] = 'crackwidth_Over3' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
TRANS_CW_1_1 6	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Transverse Crack' and [SeverityName] = 'crackwidth_1_16' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
TRANS_CW_1_8	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Transverse Crack' and [SeverityName] = 'crackwidth_1_8' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
TRANS_CW_1_4	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Transverse Crack' and [SeverityName] = 'crackwidth_1_4 ' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0)*3,280839895	FT	NUMBER

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
TRANS_CW_3_8	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Transverse Crack' and [SeverityName] = 'crackwidth_3_8' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
TRANS_CW_1_2	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Transverse Crack' and [SeverityName] = 'crackwidth_1_2' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
TRANS_CW_3_4	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Transverse Crack' and [SeverityName] = 'crackwidth_3_4' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
TRANS_CW_1_I N	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Transverse Crack' and [SeverityName] = 'crackwidth_1_in' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
TRANS_CW_1_1 _2	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Transverse Crack' and [SeverityName] = 'crackwidth_1_1_2' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
TRANS_CW_2_I N	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Transverse Crack' and [SeverityName] = 'crackwidth_2_in' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
TRANS_CW_3_I N	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Transverse Crack' and [SeverityName] = 'crackwidth_3_in' and [MetricName] = 'CrackLength' AND [Length]>0, 0, 0}*3.280839895	FT	NUMBER
TRANS_CW_OV ER3	SUM		COMPUTE {RatedDistressesValues, SUM([MetricValue]), [DistressTypeName] = 'Transverse Crack' and [SeverityName] = 'crackwidth_Over3' and [MetricName] = 'CrackLength' AND [I enoth]>0_0_01*3_280839895	FT	NUMBER

Maryland department of transportation

#### STATE HIGHWAY ADMINISTRATION

Column Name	Aggregation	Conditional Split	Transformation	Description	Туре
BLEEDING_PER CENT_LWP	AVG		COMPUTE {Bleedings, AVG([Percentage]), [WheelPath]='Left', 0, 0}		NUMBER
BLEEDING_IND EX_LWP	AVG		COMPUTE {Bleedings, AVG([INDEX]), [WheelPath]='Left', 0, 0}		NUMBER
BLEEDING_SEV ERITY_LWP	AVG		COMPUTE {Bleedings, AVG([SEVERITY]), [WheelPath]='Left', 0, 0}		NUMBER
BLEEDING_PER CENT_RWP	AVG		COMPUTE {Bleedings, AVG([Percentage]), [WheelPath]='Right', 0, 0}		NUMBER
BLEEDING_IND EX_RWP	AVG		COMPUTE {Bleedings, AVG([INDEX]), [WheelPath]='Right', 0, 0}		NUMBER
BLEEDING_SEV ERITY_RWP	AVG		COMPUTE {Bleedings, AVG([SEVERITY]), [WheelPath]='Right', 0, 0}		NUMBER
PICKOUT_AREA _SQFT	SUM		COMPUTE {PickoutReport, SUM([Area]), , 0, 0}*3.280839895*3.280839895	SQFT	NUMBER
PICKOUT_RADI US_FT	AVG		COMPUTE {PickoutReport, AVG([Radius]), , 0, 0}*3.280839895	FT	NUMBER
PICKOUT_COU NT	COUNT		COMPUTE {PickoutReport, COUNT([Distancestamp]), , 0, 0}	COUNT	NUMBER

# 11.06 IRI SPEED ADJUSTMENT

Below are the steps followed to establish the equations for the IRI adjustment based on change in speed (updated January 26, 2018).

Step 1. Calculate the change in speed (current record speed – previous record speed) between consecutive data stations and average IRI values (only valid if less than 9999) for a specific number of previous and next records depending on the data collection year (see table below for historical data).

YEAR	Data Collection Interval Miles (Feet)	Previous Records (from current record) for Analysis (Distance in feet)	Next Records (from current record) for Analysis (Distance in feet)
1995	0.02 (105.6)	6 (633.6)	6 (633.6)
1996	0.02 (105.6)	6 (633.6)	6 (633.6)
1997	0.02 (105.6)	6 (633.6)	6 (633.6)
1998	0.02 (105.6)	6 (633.6)	6 (633.6)
1999	0.02 (105.6)	6 (633.6)	6 (633.6)
2000	0.02 (105.6)	6 (633.6)	6 (633.6)
2001	0.01 (52.8)	12 (633.6)	12 (633.6)
2002	0.01 (52.8)	12 (633.6)	12 (633.6)
2003	0.01 (52.8)	12 (633.6)	12 (633.6)
2004	0.01 (52.8)	12 (633.6)	12 (633.6)
2005	0.01 (52.8)	12 (633.6)	12 (633.6)
2006	0.01 (52.8)	12 (633.6)	12 (633.6)
2007	0.01 (52.8)	12 (633.6)	12 (633.6)
2008	0.01 (52.8)	12 (633.6)	12 (633.6)
2009	0.01 (52.8)	12 (633.6)	12 (633.6)
2010	0.01 (52.8)	12 (633.6)	12 (633.6)
2011	0.01 (52.8)	12 (633.6)	12 (633.6)
2012	0.005 (26.4)	24 (633.6)	24 (633.6)
2013	0.004 (21.1)	30 (633)	30 (633)
2014	0.004 (21.1)	30 (633)	30 (633)
2015	0.004 (21.1)	30 (633)	30 (633)

Step 2. Plot the graphs for each year with previous and next record numbers (-5 to +5) in the x-axis and IRI values at each speed change (acceleration and deceleration) on the y-axis. Speed change occurs at the current station and only speed change values between -5 and 5 are selected for analysis since more than 95% of the data have the speed change values within this range (see sample graph shown below).

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As seen from the above graph, for deceleration, some of the "next records" are significantly higher than the "previous records". In the case of acceleration, some of the "previous records" are higher than the "next records". Based on the shape of graphs a decision will be made on number of previous and next records that are affected by speed change and need to be adjusted using the curve's baseline. Since station intervals are different between years, the number of affected stations are different.

Step 3. In order to adjust the IRI values, the adjustment baseline should be determined. In the case of deceleration, the flat part of the curve right before the jump in IRI graph, and in the case of acceleration, the flat part of the graph right after the IRI curve flattens after the hump were chosen for calculating the baseline. The points selected for calculating the baseline (average IRI of selected stations) and adjustment for different years are shown in the table below.

Year (s)	Baseline		Adjust		
rear (s)	Deceleration	Acceleration	Deceleration	Acceleration	
1995-2000	Prev. 3 to prev. 6	Next 2 to next 6	Prev. 1 to next 4	Prev. 4 to next 1	
2001-2005	Prev. 6 to prev. 10	Next 3 to next 8	Prev. 2 to next 6	Prev. 6 to next 1	
2006-2011	Prev. 6 to prev. 10	Next 3 to next 8	Prev. 1 to next 5	Prev. 5 to next 1	
2012	Prev. 9 to prev. 18	Next 5 to next 14	Prev. 1 to next 10	Prev. 8 to next 1	
2013-2015	Prev. 9 to Prev. 14	Next 8 to next 13	Prev. 5 to next 12	Prev. 12 to next 5	

- Step 4. Calculate the percent change in IRI (compared to the baseline) of each speed change (separately for deceleration and acceleration) at each station included in the study.
- Step 5. Establish third degree polynomial equations for deceleration and acceleration at each affected station (previous, current, and next stations) based on the percent change IRI values for the affected station and speed changes at the current location. The third-degree polynomial equations are developed after

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several iterations (i.e. the percent change between baseline IRI value and to be adjusted IRI value should not be significantly high) to make sure the equation is only used for the adjustable ranges of speed change. The threshold speed changes are established beyond which either the IRI values are excluded from reporting or the original IRI value retained without any adjustment. The records with speed changes below the threshold value will be adjusted. The equation used for fitting is:  $y = (C_3 * X^3) + (C_2 * X^2) + (C_1 * X^1) + b$ .

Step 6. Evaluate the shape of the curve after each iteration. A typical curve should be in the shape of a semi-circle i.e., it should start at zero (no change in speed and so no change in IRI), increase, then decrease, and at some point, cross the zero and become negative (percent change in IRI value is negative). The curve not only should have the right shape but also should follow the percent IRI change curve closely before crossing the zero line. For each station, percent IRI changes follow a trend up to a certain speed change (threshold) and beyond that speed change become scattered and difficult to adjust using an equation. Thus, the IRI values are adjusted where the equation matches the percent IRI changes closely and beyond the threshold the IRI values are either excluded from reports or the original IRI values are retained (see below graph for illustration).



Step 7. If the curve deviates from the "Typical" curve, then the equation should be adjusted by changing the data range. Performed iterations until the best fit is reached and the curve looks like a described typical shape. If even after

several iterations, the curve keeps on going upward instead of going downward and crossing the zero after some point, then the engineer should determine the threshold value of speed change/percent change in IRI value beyond which the IRI value will be either "excluded/not reported" or retained as original.

- Step 8. For the curves that go downward and cross zero, the threshold speed change/ percent change in IRI value will be the zero crossing point of the curve and IRI values beyond this point are retained and reported as they are (original values). However, if beyond the threshold, the percent IRI change curve continues to have an upward or downward trend (not scattered around the line y=0), then the IRI values are excluded from reporting for speed changes beyond the threshold.
- Step 9. Once the coefficients (C₃, C₂, C₁ and b) are determined for deceleration and acceleration for each affected station (previous or next from current record), these numbers are exported to Oracle to be used for calculating the adjusted IRI values. If a station has multiple adjustment factors (the current station moves along the road and thus each station can have different adjustment factors), the maximum adjustment will be considered.
- Step 10. If the percent adjustment is ≤8% then the original IRI value will be reported as is and no adjustment will be made. If the percent adjustment is >8% then the original IRI value will be adjusted and the adjusted value will be reported.
- Step 11. If the speed is <15 mph, the IRI value will be excluded and will not be reported. If the speed is ≥15 mph, the IRI value will be either adjusted or the original value be reported in accordance with the requirements stated above.

Year(s)	Station	Name	m ₃	m ₂	m ₁	b	Beyond Adj Threshold (Exclude Or original)	Adj between 0 and
1995-2000 DECEL	-1	PERC_AVG_PREV_IRI_Change	-0.00116	-0.02198	-0.11711	-0.08318	0	-14
DEGEE	0	PERC_AVG_CUR_IRI_CHANGE	-0.00217	-0.03130	-0.20593	-0.12910	E	-14
	1	PERC_AVG_NEXT_IRI_CHANGE	-0.00002	0.00216	-0.10718	-0.05477	E	-14
	2	PERC_AVG_NEXT_2_IRI_CHANGE	-0.00154	-0.03338	-0.22732	-0.13379	E	-14
	3	PERC_AVG_NEXT_3_IRI_CHANGE	-0.00013	-0.00686	-0.07670	-0.00289	0	-14
	4	PERC_AVG_NEXT_4_IRI_CHANGE	-0.00061	-0.01301	-0.08209	-0.00458	0	-14
1995-2000 ACCEI	-4	PERC_AVG_PREV_4_IRI_Change	0.00075	-0.01877	0.12645	-0.03976	0	10
AUGEL	-3	PERC_AVG_PREV_3_IRI_CHANGE	-0.00017	-0.00351	0.09993	-0.03005	0	10
	-2	PERC_AVG_PREV_2_IRI_CHANGE	-0.00268	0.03324	0.01137	0.00422	Е	5
	-1	PERC_AVG_PREV_IRI_CHANGE	-0.00163	0.02206	0.01614	-0.00156	E	10
	0	PERC_AVG_CUR_IRI_CHANGE	0.00002	-0.00216	0.03358	-0.01246	0	10
	1	PERC_AVG_NEXT_IRI_CHANGE	0.00008	-0.00079	0.01173	-0.00815	0	10
2001-2005	-2	PERC_PREVIOUS_2_IRI_CHANGE	0.00072	0.00721	-0.02428	-0.01603	0	-12

The final results of the "effect of speed change on IRI" study for years 1995 to 2015 are presented in the following table:

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Year(s)	Station	Name	m ₃	m ₂	m ₁	b	Beyond Adj Threshold (Exclude Or original)	Adj between 0 and
DECEL	-1	PERC_PREVIOUS_IRI_CHANGE	0.01869	0.08010	0.01197	-0.00069	0	-11
	0	PERC_CUR_IRI_CHANGE	0.00053	-0.01307	-0.34568	-0.31056	E	-8
	1	PERC_NEXT_IRI_CHANGE	0.00214	0.03017	-0.12731	-0.02076	E	-7.3
	2	PERC_NEXT_2_IRI_CHANGE	0.00356	0.01917	-0.17969	-0.04994	0	-11
	3	PERC_NEXT_3_IRI_CHANGE	-0.00038	-0.02186	-0.22645	-0.05445	0	-12
	4	PERC_NEXT_4_IRI_CHANGE	0.02454	0.09335	-0.04579	0.00320	0	-8.2
	5	PERC_NEXT_5_IRI_CHANGE	0.01512	0.04367	-0.07957	-0.00087	0	-7
	6	PERC_NEXT_6_IRI_CHANGE	0.00273	-0.01361	-0.12185	-0.00197	0	-5
2001-2005	-6	PERC_PREVIOUS_6_IRI_CHANGE	0.00317	-0.04867	0.18700	-0.02473	0	7
ACCEL	-5	PERC_PREVIOUS_5_IRI_CHANGE	0.00305	-0.04734	0.20904	-0.02855	0	11
	-4	PERC_PREVIOUS_4_IRI_CHANGE	0.00126	-0.03899	0.27189	-0.08652	0	11
	-3	PERC_PREVIOUS_3_IRI_CHANGE	0.00112	-0.04209	0.35558	-0.14980	0	11
	-2	PERC_PREVIOUS_2_IRI_CHANGE	-0.00611	0.05319	0.11003	-0.04261	E	10.2
	-1	PERC_PREVIOUS_IRI_CHANGE	-0.00276	0.02538	0.08636	-0.01779	E	7.5
	0	PERC_CUR_IRI_CHANGE	-0.00204	0.00761	0.05302	-0.00244	0	7
	1	PERC_NEXT_IRI_CHANGE	0.00091	-0.01042	0.04497	-0.00673	0	7
2006-2011	-1	PERC_PREVIOUS_IRI_CHANGE	-0.01714	-0.06903	-0.12196	-0.00228	0	-2
DECEL	0	PERC_CUR_IRI_CHANGE	0.00102	0.00119	-0.09409	-0.00276	E	-6.5
	1	PERC_NEXT_IRI_CHANGE	0.00183	0.00535	-0.14952	-0.04700	E	-6.5
	2	PERC_NEXT_2_IRI_CHANGE	0.00511	0.02864	-0.08809	-0.00936	0	-8
	3	PERC_NEXT_3_IRI_CHANGE	0.00007	-0.01187	-0.13590	-0.01302	0	-11
	4	PERC_NEXT_4_IRI_CHANGE	0.00580	0.01847	-0.07835	-0.00080	0	-5.6
	5	PERC_NEXT_5_IRI_CHANGE	0.00978	0.02161	-0.07577	-0.00002	0	-6
2006-2011	-5	PERC_PREVIOUS_5_IRI_CHANGE	0.00499	-0.08172	0.27239	-0.05097	0	4.4
ACCEL	-4	PERC_PREVIOUS_4_IRI_CHANGE	-0.00603	0.01800	0.10471	0.00239	0	6.2
	-3	PERC_PREVIOUS_3_IRI_CHANGE	0.00376	-0.08346	0.40320	-0.15034	0	6.5
	-2	PERC_PREVIOUS_2_IRI_CHANGE	0.00117	-0.03477	0.22926	-0.04137	E	9.4
	-1	PERC_PREVIOUS_IRI_CHANGE	-0.01225	0.05972	0.06044	-0.04615	E	5.7
	0	PERC_CUR_IRI_CHANGE	-0.01112	0.05732	-0.02522	-0.00104	0	4.7
	1	PERC_NEXT_IRI_CHANGE	-0.00483	0.02905	-0.01443	-0.00262	0	5.6
2012	-1	PERC_PREVIOUS_IRI_CHANGE	0.01729	-0.05790	-0.20439	-0.00951	0	-2.1
DECEL	0	PERC_CUR_IRI_CHANGE	0.13573	0.26871	-0.01729	-0.00034	0	-2.1
	1	PERC_NEXT_IRI_CHANGE	0.10029	0.22843	-0.03596	-0.00114	E	-2.5
	2	PERC_NEXT_2_IRI_CHANGE	0.12142	0.29474	-0.00907	-0.00287	E	-2.5
	3	PERC_NEXT_3_IRI_CHANGE	0.08226	0.28588	0.03517	-0.00212	E	-3.4

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Year(s)	Station	Name	m ₃	m ₂	m ₁	b	Beyond Adj Threshold (Exclude Or original)	Adj between 0 and
	4	PERC_NEXT_4_IRI_CHANGE	0.06541	0.18791	-0.06089	-0.00140	E	-3
	5	PERC_NEXT_5_IRI_CHANGE	0.06089	0.16298	-0.07247	-0.00195	E	-3.2
	6	PERC_NEXT_6_IRI_CHANGE	0.07148	0.16349	-0.07148	-0.00166	0	-2.7
	7	PERC_NEXT_7_IRI_CHANGE	0.03793	0.06310	-0.12112	-0.00143	0	-2.9
	8	PERC_NEXT_8_IRI_CHANGE	-0.01378	-0.05821	-0.16589	-0.00251	0	-2.2
	9	PERC_NEXT_9_IRI_CHANGE	0.04063	0.08397	-0.07354	-0.00065	0	-2.8
	10	PERC_NEXT_10_IRI_CHANGE	0.01092	-0.03087	-0.15878	-0.00691	0	-2.7
2012	-8	PERC_PREVIOUS_8_IRI_CHANGE	-0.19276	0.34384	0.04407	-0.00199	0	2
ACCEL	-7	PERC_PREVIOUS_7_IRI_CHANGE	-0.33409	0.75262	-0.18066	-0.00018	0	2
	-6	PERC_PREVIOUS_6_IRI_CHANGE	-0.36747	0.94653	-0.31198	-0.00294	0	2.2
	-5	PERC_PREVIOUS_5_IRI_CHANGE	-0.49045	1.23441	-0.44638	-0.00193	0	2.1
	-4	PERC_PREVIOUS_4_IRI_CHANGE	-0.40732	1.07071	-0.38984	-0.00176	0	2.2
	-3	PERC_PREVIOUS_3_IRI_CHANGE	-0.35207	0.96729	-0.38855	-0.00139	0	2.3
	-2	PERC_PREVIOUS_2_IRI_CHANGE	-0.27263	0.68402	-0.23191	-0.00373	0	2.2
	-1	PERC_PREVIOUS_IRI_CHANGE	-0.24323	0.59040	-0.20703	-0.00389	0	2.1
	0	PERC_CUR_IRI_CHANGE	-0.19633	0.45747	-0.15961	-0.00428	0	2
	1	PERC_NEXT_IRI_CHANGE	-0.14449	0.33082	-0.13090	-0.00129	0	1.8
2013-2015	-5	PERC_PREVIOUS_5_IRI_CHANGE_Formula	0.00229	-0.03412	-0.07052	-0.00462	0	-1.5
DECEL	-4	PERC_PREVIOUS_4_IRI_CHANGE_Formula	-0.00594	-0.04018	-0.06889	0.00321	0	-2.4
	-3	PERC_PREVIOUS_3_IRI_CHANGE_Formula	-0.01200	-0.11101	-0.15129	-0.00442	0	-1.6
	-2	PERC_PREVIOUS_2_IRI_CHANGE_Formula	-0.06664	-0.28180	-0.30174	-0.02083	0	-1.8
	-1	PERC_PREVIOUS_IRI_CHANGE_Formula	-0.07625	-0.29471	-0.33336	-0.01863	E	-2.4
	0	PERC_CUR_IRI_CHANGE_Formula	-0.04436	-0.18910	-0.27884	-0.01440	E	-2.5
	1	PERC_NEXT_IRI_CHANGE_Formula	-0.01298	-0.04557	-0.17321	0.00481	E	-2.5
	2	PERC_NEXT_2_IRI_CHANGE_Formula	-0.01246	-0.04168	-0.20861	-0.00495	E	-3
	3	PERC_NEXT_3_IRI_CHANGE_Formula	0.00972	0.01461	-0.18929	-0.00051	0	-5.2
	4	PERC_NEXT_4_IRI_CHANGE_Formula	0.01914	0.02410	-0.21317	-0.01063	0	-4
	5	PERC_NEXT_5_IRI_CHANGE_Formula	0.00351	-0.05990	-0.30682	-0.02718	0	-4
	6	PERC_NEXT_6_IRI_CHANGE_Formula	-0.00333	-0.09431	-0.33125	-0.02870	0	-3.8
	7	PERC_NEXT_7_IRI_CHANGE_Formula	0.05887	0.09816	-0.16763	-0.00385	0	-2.7
	8	PERC_NEXT_8_IRI_CHANGE_Formula	0.03904	0.02926	-0.21036	-0.00841	0	-2.7
	9	PERC_NEXT_9_IRI_CHANGE_Formula	-0.00520	-0.11336	-0.30998	-0.02030	0	-3.1
	10	PERC_NEXT_10_IRI_CHANGE_Formula	0.00178	-0.09249	-0.27703	-0.01406	0	-2.3
	11	PERC_NEXT_11_IRI_CHANGE_Formula	0.02047	-0.04249	-0.22880	-0.00690	0	-2.4
	12	PERC_NEXT_12_IRI_CHANGE_Formula	-0.00293	-0.11079	-0.26417	-0.00984	0	-2.4
2013-2015	-12	PERC_PREVIOUS_12_IRI_CHANGE_Formula	0.02778	-0.26908	0.40049	-0.01831	0	1.7

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Year(s)	Station	Name	m ₃	m ₂	m ₁	b	Beyond Adj Threshold (Exclude Or original)	Adj between 0 and
ACCEL	-11	PERC_PREVIOUS_11_IRI_CHANGE_Formula	0.05413	-0.32881	0.44995	-0.02393	0	2
	-10	PERC_PREVIOUS_10_IRI_CHANGE_Formula	0.05342	-0.33693	0.47913	-0.02945	0	2.1
	-9	PERC_PREVIOUS_9_IRI_CHANGE_Formula	0.03102	-0.28365	0.46888	-0.03069	0	2
	-8	PERC_PREVIOUS_8_IRI_CHANGE_Formula	0.00534	-0.22313	0.45779	-0.03330	0	2.1
	-7	PERC_PREVIOUS_7_IRI_CHANGE_Formula	-0.03595	-0.12353	0.42416	-0.03423	0	2
	-6	PERC_PREVIOUS_6_IRI_CHANGE_Formula	-0.09425	0.02266	0.36036	-0.03329	0	2
	-5	PERC_PREVIOUS_5_IRI_CHANGE_Formula	-0.19830	0.31719	0.18291	-0.01922	0	2.1
	-4	PERC_PREVIOUS_4_IRI_CHANGE_Formula	-0.24017	0.49000	0.05472	-0.00837	0	2.1
	-3	PERC_PREVIOUS_3_IRI_CHANGE_Formula	-0.19014	0.42620	0.06539	-0.01249	0	2.3
	-2	PERC_PREVIOUS_2_IRI_CHANGE_Formula	-0.13620	0.41526	-0.03116	0.00587	E	2.9
	-1 PERC_PREVIOUS_IRI_CHANGE_Formula		-0.01119	0.14443	0.09402	-0.00972	Е	2
	0	PERC_CUR_IRI_CHANGE_Formula	-0.04055	0.17229	0.03630	-0.00232	E	2
	1	PERC_NEXT_IRI_CHANGE_Formula	-0.00325	0.07170	0.03694	-0.00100	E	2.5
	2	PERC_NEXT_2_IRI_CHANGE_Formula	0.02206	-0.04167	0.10236	-0.01325	E	2.4
	3	PERC_NEXT_3_IRI_CHANGE_Formula	0.03593	-0.09168	0.11552	-0.01510	E	2.4
	4	PERC_NEXT_4_IRI_CHANGE_Formula	-0.09615	0.22503	-0.09393	0.00748	0	1.8
	5	PERC_NEXT_5_IRI_CHANGE_Formula	-0.07561	0.18395	-0.08516	0.00662	0	1.8

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# 11.07 EXAMPLES FOR CHANGING LATITUDE/LONGITUDE

Below is an example of a latitude and longitude that needs to be changed. The green balloon should be at the gore (the place where the two solid white lines meet). Since the balloon is more than 4.2 millimiles from the gore, a change is required.



Below is another example of a balloon that is not at the gore but is within the 4.2 millimiles tolerance distance. Therefore, the latitude and longitude do not need to be changed.



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Below is an example of the collection stopping before the balloon (displayed in Vision in this case as a pink triangle). Since the ending location is correct, and the problem is that the collection did not continue to the end of the route, a gap should be placed instead of changing the latitude and longitude (see <u>Route Matching</u>).



## **11.08 OUTLIER REVIEW - OUTLIER CODES**

The table below is a list of active outlier codes (as of 2017).

The "ID" field is displayed as "OUTLIER_ID" in Oracle and represents the corresponding outlier code number of a specific outlier explanation.

The "DESCRIPTION" field is displayed as "OUTLIER_DESCRIP" in Oracle and provides a brief description of the type of outlier code.

The "YEAR" field is displayed as "CUR_OR_PREV_YEAR" in Oracle and describes what year's data the outlier code applies to. For example, the "CUR" codes in this table are applied to the current year's collection data (in this case, 2017), while the "PREV" codes in the table are applied to previous years' collection data (in this case, 2013 through 2016).

The "COMMENTS" field provides more context regarding the nature and definition of the outlier code.

ID	DESCRIP	YEAR	COMMENTS
1	Lane Change	CUR	Lane change observed, during current season's data collection. If
			2017 data are in question, the current season refers to 2017 data
			collection.
3	New Pave	CUR	New pavement surface observed.
5	Construction	CUR	Construction activities observed.
6	Road Widened	CUR	Road widening observed.
11	Lane Change	PREV	Lane change observed, during previous seasons' data collections.
			If current season is 2017, the previous seasons refer to 2013 to
			2016 data collection.
13	New Pave	PREV	New pavement surface observed, during previous seasons' data
			collection.
15	Construction	PREV	Construction activities observed, during pervious seasons' data
			collection.
16	Road Widened	PREV	Road widening observed during previous seasons' data collection.
18	Start/end mile point are different	PREV	Location differences in starting or ending mile points being
			greater than 100 ft between different data collection.
21	Right IRI > 640	CUR	Right IRI greater than 640 in/mile.
22	Speed < 15	CUR	Speed less than 15 miles/hour.
24	Distress	PREV	Distresses observed, during previous season's data collection.
25	No Reason	CUR	No clear explanations on why outliers occur.
27	Left IRI > 640	CUR	Left IRI greater than 640 in/mile.
33	Bridge/Structure	CUR	Bridge/structure observed.
34	Railroad Crossing	CUR	Railroad crossing observed.
35	Roundabout	CUR	Roundabout observed.
36	Concrete	CUR	Concrete pavement observed.
37	Rumble_Strip	CUR	Rumble strip observed.
38	OFFICE_STOPBAR	CUR	Code automatically created for stop-bar flagged by data
			processing team.
39	OFFICE_CROSSWALK	CUR	Code automatically created for crosswalk flagged by data
			processing team.
40	OFFICE_CRCP	CUR	Code automatically created for CRCP flagged by data processing
			team.

ID	DESCRIP	YEAR	COMMENTS
41			Code automatically created for ICP flagged by data processing
71		con	team
12		CLIR	Code automatically created for brick flagged by data processing
42	OTTICE_BRICK	CON	team
42		CUP	Code automatically created for debris flagged by data processing
45	OFFICE_DEBRIS	CUR	toom
4.4		CUD	Code outomatically avaited for every cost floared by date
44	OFFICE_CRACK_SEAL	CUR	Code automatically created for crack seal flagged by data
45		CUID	processing team.
45	OFFICE_LANE_DEVIATION	CUR	Code automatically created for lane deviation flagged by data
		<u></u>	processing team.
46	OFFICE_MILLED_SURFACE	CUR	Code automatically created for milled surface flagged by data
		-	processing team.
47	OFFICE_BRIDGE	CUR	Code automatically created for bridge flagged by data processing
			team.
48	OFFICE_RAILROAD	CUR	Code automatically created for railroad flagged by data processing
			team.
49	OFFICE_DISREGARD_CRACK	CUR	Code automatically created for disregarded crack flagged by data
			processing team.
50	OFFICE_BAD_IMAGE	CUR	Code automatically created for bad image flagged by data
			processing team.
51	ARAN_Lane Deviation	CUR	Code automatically created for lane deviation flagged by ARAN
			operator.
52	ARAN New Pavement	CUR	Code automatically created for new pavement flagged by ARAN
	_		operator.
53	ARAN_Bridge	CUR	Code automatically created for bridge flagged by ARAN operator.
54	ARAN Bailroad	CUR	Code automatically created for railroad crossing flagged by ARAN
<b>.</b>			operator.
55	ARAN Crack Seal	CUR	Code automatically created for crack seal flagged by ARAN
			operator
56	ARAN Concrete	CUR	Code automatically created for concrete flagged by ARAN
50		con	operator
57	ARAN Rumble Strip	CLIR	Code automatically created for rumble strip flagged by ARAN
57	ARAN_Rumble_Sup	CON	code automatically created for fumble strip hagged by ARAN
го	ADAN Construction	CLIP	Code automatically areated for construction flagged by ADAN
58	ARAN_CONstruction	COR	code automatically created for construction hagged by ARAN
50	ADAN, Dahata	CLID	Operator.
59	ARAN_DEDRS	CUR	Code automatically created for debris flagged by ARAN operator.
60	Raised_Crosswalk_ Historic_Data	PREV	Raised crosswalk observed, during previous seasons' data
			collection.
61	ARAN_Damp_Pavement	CUR	Code automatically created for damp or wet pavement flagged by
			ARAN operator.
62	NEW_PAVEMENT_CONST_HISTORY	CUR	New pavement based on construction history records.
63	Minor Location Difference	CUR	Minor (shorter than 100 ft) location differences observed from
			one year to another, most at the beginning or ending mileposts.
64	Lane Configuration Change	CUR	Lane configuration change observed.
99		CLIR	Other reasons
	O THEN	2011	

## 11.09 IRI PERFORMANCE MODEL

The following tables provide current information for IRI model parameters.

### Current IRI $\mu_1$ Values by Last Treatment

Last Treatment	$\mu_1$
Mill and Overlay with >1.5" Grade Increase – Gap	0.800
Mill >4" Overlay with Asphalt	0.810
Cold-in-place Recycling Overlay	0.810
Break Crack Seat Overlay	0.810
Rubbilization Overlay	0.810
Reconstruction	0.810
Mill and Overlay with <1.5" Grade Increase – Gap	0.820
Overlay with >1.5" Grade Increase – Gap	0.820
Bonded Portland Cement Concrete Overlay	0.830
Mill and Overlay with >1.5" Grade Increase	0.850
Micro Surfacing	0.900
High Friction Surface	0.900
Mill and Overlay with <1.5" Grade Increase	0.978
Mill Ultrathin Bonded Wearing Course	0.978
Other	1.000
Overlay <1.5" Asphalt	1.023
Thin Overlay <1" Asphalt	1.065

Appendices

Pavement Type	Region	Functional Class	Family	$\mu_2$
Flexible	Mountain	2, 3	1	0.0322
Flexible	Mountain	7, 14, 17	2	0.0255
Flexible	Mountain	16, 18, 19	3	0.0255
Flexible	Central	2, 3, 7, 17	4	0.0219
Flexible	Central	12, 14, 16	5	0.0181
Flexible	Central	18, 19	6	0.0212
Flexible	Coastal	2, 7, 14, 17, 18	7	0.0219
Flexible	Coastal	3, 12, 16	8	0.0180
Flexible	Coastal	19	9	0.0214
Flexible	All	1,11	10	0.0178
Flexible	Mountain and Central	6, 8	11	0.0239
Flexible	Mountain and Central	9	12	0.0242
Flexible	Coastal	6, 8	13	0.0219
Flexible	Coastal	9	14	0.0191
Flexible over JCP	Mountain	8, 9, 18, 19	15	0.0171
Flexible over JCP	Mountain	1, 2, 11, 12, 14, 17	16	0.0267
Flexible over JCP	Central	8, 9, 17	17	0.0269
Flexible over JCP	Central	14	18	0.0279
Flexible over JCP	Central	2, 12, 19	19	0.0241
Flexible over JCP	Central	18	20	0.0516
Flexible over JCP	Central	1,11	21	0.0184
Flexible over JCP	Coastal	6, 8, 9, 12, 14, 17, 18, 19	22	0.0306
Flexible over JCP	Coastal	1, 2, 11	23	0.0377
Flexible over JCP	Mountain and Central	6	24	0.0260
Flexible over JCP ^{06/12/2019}	Mountain	7	25	4
Flexible over JCP ⁴	Mountain	16	26	4
Flexible over JCP	Central	7	27	0.0321
Flexible over JCP	Central	16	28	0.0261
Flexible over JCP	Coastal	7	29	0.0328
Flexible over JCP	Coastal	16	30	0.0176
Flexible over JCP	All	3	31	0.0265
Flexible over CRCP	All	All	32	0.0095
Rigid Jointed	All	All	33	0.0120
Rigid Jointed Plain	All	All	34	0.0220
Rigid Continuous	All	All	35	0.0114
Other	-	-	-	0.0239

## Current IRI $\mu_2$ Values by Family

# IRI Table "trend_iri_family_slopes" with Most Recent Percent Change and Mileage by Family

IRI_FAMILY ^{06/12/2019}	WT_AVG_PCT_IRI_CHANGE, %	MILES_INCLUDED, miles
1	0.03215	603.6
2	0.02553	1551.8
3	0.02545	588.3
4	0.02192	4198.4
5	0.01806	9521.5
6	0.01254	327
7	0.02193	10051.7
8	0.01798	1752.5
9	0.02143	149.1
10	0.01784	3933.8
11	0.02391	6647.6
12	0.02422	562.1
13	0.02188	5155.7
14	0.01907	762
15	0.01713	357.1
16	0.02665	677.1
17	0.02687	675.1
18	0.02793	2648
19	0.02412	1160.3
20	0.05163	105.4
21	0.01835	1466.5
22	0.03061	6566.2
23	0.03768	1309.1
24	0.026	1918.5
25	N/A	0
26	N/A	0
27	0.03213	2123
28	0.02605	2406.3
29	0.03283	4935.3
30	0.01762	594.7
31	0.02647	123.6
32	0.00945	510
33	0.01195	91.4
34	0.02199	63.7
35	0.01135	322.1

## **11.10 CRACKING PERFORMANCE MODELS**

The following tables and scripts provide current information for cracking model parameters.

Treatment Group	Pavement type	Region	Func. Class	L_tilde (Ld)	ll_int (li)	ll_slp (ls)
1	All	All	1	90637719.44	2.8083	-0.0046
С	All	1	14	266.3311	1.4455	-0.0255
2	Composite	1	14	1787.4858	1.948	-0.0111
2	Flexible	1	14	6.03267E+20	3.8714	-0.0029
3	All	2	14	1.06942E+39	4.4886	-0.0009
С	All	2	14	86.8394	1.6175	-0.0618
2	Composite	2	14	150.0416	1.3954	-0.05
2	Flexible	2	14	275.4735	1.6585	-0.0442
3	All	3	14	4103.2955	2.2241	-0.0275
4	All	3	14	55.5406	1.0076	-0.1419
С	All	3	14	41969.4996	2.3521	-0.0217
2	Composite	3	14	117.5573	1.4525	-0.0749
2	Flexible	3	14	125.2176	1.5761	-0.0606
4	All	1 or 2	14	76.2935	1.0401	-0.0643
1	All	All	14	1.00288E+18	3.6796	-0.0019
А	All	All	14	2.15601E+18	3.7308	-0.0031
1	Composite	All	2-3-6	584.7963	1.464	-0.0102
1	Flexible	All	2-3-6	138.1563	1.1843	-0.0417
С	All	1	7-8-9	305.5609	1.7251	-0.031
3	All	2	7-8-9	1956.3351	2.0539	-0.0189
С	All	2	7-8-9	599.4863	1.8873	-0.0317
С	All	3	7-8-9	21079742451	3.1608	-0.0081
3	Composite	3	7-8-9	6.21395E+15	3.5844	-0.0067
3	Flexible	3	7-8-9	1361.205	1.941	-0.0285
1	Composite	All	7-8-9	215.1996	1.3605	-0.0575
2	Composite	All	7-8-9	341.6614	1.7043	-0.0338
4	Composite	All	7-8-9	6.04754E+22	3.9402	-0.0045
6	Composite	All	7-8-9	50.5424	1.0538	-0.0821
10	Composite	All	7-8-9	Ld1=50.5424;li1=1.0538;ls1=- 0.0821;Ld2=573.153;li2=1.5699;ls2=-0.0145;		
1	Flexible	All	7-8-9	109.2627	1.248	-0.0402
2	Flexible	All	7-8-9	6966.2944	2.1961	-0.0176
4	Flexible	All	7-8-9	145528821.1	2.8511	-0.0076
6	Flexible	All	7-8-9	60.3093	1.4039	-0.1222

#### Table 1: FC Density Model parameters

# MaryLand DEPARTMENT OF TRANSPORTATION

#### STATE HIGHWAY ADMINISTRATION

Treatment Group	Pavement type	Region	Func. Class	L_tilde (Ld)	ll_int (li)	ll_slp (ls)	
7	Flexible	All	7-8-9	10471052.58	2.7114	-0.0162	
10	Flexible	All	7-8-9	Ld1=60.3093;li1=1.4039;ls1=- 0.1222;Ld2=10471052.5813;li2=2.7114;ls2=- 0.0162;			
6	Composite	All	11-12-14	76.9602	1.2325	-0.073	
10	Composite	All	11-12-14	Ld1=76.9602;li1=1.2325;ls1=- 0.073;Ld2=573.153;li2=1.5699;ls2=-0.0145;			
6	Flexible	All	11-12-14	9.89737E+30	4.2652	-0.0023	
7	Flexible	All	11-12-14	1882.4205	1.9344	-0.0382	
10	Flexible	All	11-12-14	Ld1=98973660234.9642*Math.Pow(10,20);li1=4 .2652;ls1=- 0.0023;Ld2=1882.4205;li2=1.9344;ls2=-0.0382;			
3	All	2	11-12	89359137.61	2.9464	-0.015	
5	All	2	11-12	1662.1596	1.9936	-0.0288	
3	All	3	11-12	3794.5556	1.951	-0.0064	
5	All	1 or 3	11-12	50.4719	1.1323	-0.0834	
1	All	All	11-12	2.27747E+16	3.5918	-0.0025	
4	All	All	11-12	50.3632	0.8305	-0.0947	
Α	All	All	11-12	2683.6544	2.0435	-0.0171	
С	All	All	11-12	2492522027	3.0629	-0.009	
2	Composite	All	11-12	111.6238	1.2991	-0.053	
2	Flexible	All	11-12	2516.3924	2.013	-0.0291	
В	All	2	11-12-14-16- 17-18-19	600	1.9327	-0.0345	
С	All	1	1-2-3-6	106.2486	1.5597	-0.0593	
2	Composite	1	1-2-3-6	97.2449	1.3891	-0.0457	
3	All	2	1-2-3-6	431.2878	1.7957	-0.0347	
С	All	2	1-2-3-6	7.16067E+17	3.7176	-0.0039	
2	Composite	2	1-2-3-6	4709385.613	2.7561	-0.0194	
3	All	3	1-2-3-6	1789.58	1.9201	-0.0212	
4	All	3	1-2-3-6	78.314	1.1183	-0.1146	
2	Composite	3	1-2-3-6	28894462.16	2.8285	-0.0165	
С	Composite	3	1-2-3-6	170.3627	1.499	-0.0455	
С	Flexible	3	1-2-3-6	397.2458	1.7853	-0.0385	
4	All	1 or 2	1-2-3-6	13659.7542	2.1062	-0.0159	
6	Composite	All	1-2-3-6	6073.429	2.1367	-0.0255	
10	Composite	All	1-2-3-6	Ld1=6073.429;li1=2.1367;ls1=- 0.0255;Ld2=573.153;li2=1.5699;ls2=-0.0145;			
2	Flexible	All	1-2-3-6	367611295.6	2.9757	-0.0088	
6	Flexible	All	1-2-3-6	951.8987	1.9191	-0.0352	
7	Flexible	All	1-2-3-6	201234894.5	2.9441	-0.0166	
# MARYLAND DEPARTMENT OF TRANSPORTATION

#### STATE HIGHWAY ADMINISTRATION

Treatment Group	Pavement type	Region	Func. Class	L_tilde (Ld)	ll_int (li)	ll_slp (ls)
10	Flexible	All	1-2-3-6	Ld1=951. 0.0352;Ld2=201	8987;li1=1.919 234894.491;li2 0.0166;	91;ls1=- 2=2.9441;ls2=-
В	All	2	1-2-3-6-7-8-9	9.38799E+14	3.5453	-0.005
2	Composite	1	16-17-18-19	1032.0372	1.8994	-0.025
2	Flexible	1	16-17-18-19	5437.0356	2.1001	-0.0225
3	All	2	16-17-18-19	860.3014	1.938	-0.0366
2	Composite	2	16-17-18-19	437.9597	1.735	-0.0345
2	Flexible	2	16-17-18-19	720.4722	1.8432	-0.0266
3	All	3	16-17-18-19	573.903	1.7447	-0.0175
4	All	3	16-17-18-19	1382900.394	2.5519	-0.0148
2	Composite	3	16-17-18-19	404.1978	1.6935	-0.0352
2	Flexible	3	16-17-18-19	130.2758	1.7928	-0.0733
4	Composite	1 or 2	16-17-18-19	1.43697E+27	4.1141	-0.0035
4	Flexible	1 or 2	16-17-18-19	58.1315	1.0264	-0.0862
А	All	All	16-17-18-19	19646019564	3.1712	-0.009
1	Composite	All	16-17-18-19	511.7243	1.5606	-0.029
6	Composite	All	16-17-18-19	1.04014E+36	4.402	-0.0008
10	Composite	All	16-17-18-19	Ld1=10401445555430400*Math.Pow(10,20);li1 =4.402;ls1=- 0.0008;Ld2=573.153;li2=1.5699;ls2=-0.0145;		
С	Composite	All	16-17-18-19	2704.5306	2.0572	-0.0246
1	Flexible	All	16-17-18-19	1.27334E+24	3.9863	-0.0011
6	Flexible	All	16-17-18-19	2.21779E+35	4.384	-0.0012
7	Flexible	All	16-17-18-19	73.0759	1.4134	-0.151
10	Flexible	All	16-17-18-19	Ld1=221778.7663 .384;ls1=-0.0012;	348933*Math.P Ld2=73.0759;li 0.151;	ow(10,30);li1=4 i2=1.4134;ls2=-
С	Flexible	All	16-17-18-19	44859729.16	2.8931	-0.0125
5	All	All	16-17-18-19- 14	398.49	1.7958	-0.0324
5	All	All	1-7-8-9-2-3-6	2701.4546	2.077	-0.0293
А	All	All	1-7-8-9-2-3-6	62120662.97	2.8845	-0.0138
3	All	1	All	122962.0574	2.4522	-0.0095
В	All	1	All	2013.4766	2.079	-0.0346
В	All	3	All	1709.5229	1.9365	-0.0165
8	All	All	All	1.71116E+11	3.2614	-0.0093
7	Composite	All	All	573.153	1.5699	-0.0145
N/A	N/A	1	1	3.99E+22	3.93	-0.01
N/A	N/A	2	1	280	1.75	-0.04
N/A	N/A	3	1	280	1.75	-0.04

# Maryland department of transportation

#### STATE HIGHWAY ADMINISTRATION

Treatment Group	Pavement type	Region	Func. Class	L_tilde (Ld)	ll_int (li)	ll_slp (ls)
N/A	N/A	1	2-3-6	763	1.72	-0.01
N/A	N/A	2	2-3-6	108	1.34	-0.04
N/A	N/A	3	2-3-6	29300	2.28	-0.02
N/A	N/A	1	7-8-9	220	1.58	-0.03
N/A	N/A	2	7-8-9	1170	1.88	-0.02
N/A	N/A	3	7-8-9	582	1.77	-0.04
N/A	N/A	1	11-12	593	1.61	-0.02
N/A	N/A	2	11-12	718	1.82	-0.03
N/A	N/A	3	11-12	378	1.67	-0.03
N/A	N/A	1	14	104	1.42	-0.03
N/A	N/A	2	14	238	1.52	-0.04
N/A	N/A	3	14	631	1.82	-0.04
N/A	N/A	1	16-17-18-19	325	1.63	-0.02
N/A	N/A	2	16-17-18-19	104	1.35	-0.04
N/A	N/A	3	16-17-18-19	153	1.5	-0.04

Appendices

Treatment Group	Pavement type	Region	Func. Class	L_tilde (Ld)	ll_int (li)	ll_slp (ls)
1	All	All	1	75.4278	1.8473	-0.1143
С	All	1	14	4.75248E+25	4.0944	-0.0029
2	Composite	1	14	3.47062E+22	3.9847	-0.0035
2	Flexible	1	14	298.7579	2.0722	-0.0526
3	All	2	14	3.81056E+35	4.4145	-0.002
С	All	2	14	93.7206	1.9854	-0.0693
2	Composite	2	14	232006421	3.024	-0.0152
2	Flexible	2	14	4.89637E+16	3.6892	-0.0084
3	All	3	14	3.35974E+33	4.384	-0.0036
4	All	3	14	262.8322	1.4992	-0.0224
С	All	3	14	6.52682E+22	3.9954	-0.0047
2	Composite	3	14	18265317.62	2.9518	-0.0297
2	Flexible	3	14	5.14982E+22	3.9923	-0.0055
4	All	1 or 2	14	289.443	1.5248	-0.0211
1	All	All	14	792.3727	1.8366	-0.0405
А	All	All	14	4.18279E+13	3.5095	-0.0099
1	Composite	All	2-3-6	112.2041	1.3241	-0.042
1	Flexible	All	2-3-6	510.6388	1.729	-0.0364
С	All	1	7-8-9	8.50373E+13	3.534	-0.0097
3	All	2	7-8-9	6218479.458	2.8513	-0.0153
С	All	2	7-8-9	1.26984E+14	3.537	-0.0092
С	All	3	7-8-9	80144088.86	2.9847	-0.0161
3	Composite	3	7-8-9	5.64932E+22	3.9899	-0.008
3	Flexible	3	7-8-9	7.27463E+16	3.6944	-0.0097
1	Composite	All	7-8-9	213.0146	1.5618	-0.0778
2	Composite	All	7-8-9	7762591.691	2.8461	-0.0167
4	Composite	All	7-8-9	620288.2706	2.4844	-0.0038
6	Composite	All	7-8-9	76.1753	1.5778	-0.0364
10	Composite	All	7-8-9	Ld1=76. ² 0.0364;Ld2=467.	1753;li1=1.5778; 7251;li2=1.9154	s1=- ;ls2=-0.0684;
1	Flexible	All	7-8-9	4657209.606	2.7342	-0.022
2	Flexible	All	7-8-9	9.59826E+13	3.5271	-0.0089
4	Flexible	All	7-8-9	1532.5528	1.7333	-0.0123
6	Flexible	All	7-8-9	4.00975E+11	3.3658	-0.0228
7	Flexible	All	7-8-9	645.599	1.9055	-0.073
10	Flexible	All	7-8-9	Ld1=400975145472.392;li1=3.3658;ls1=- 0.0228;Ld2=645.599;li2=1.9055;ls2=-0.073;		
6	Composite	All	11-12-14	56.1012	1.6191	-0.0758

### Table 2: SC Density Model parameters

# Maryland department of transportation

#### STATE HIGHWAY ADMINISTRATION

Treatment Group	Pavement type	Region	Func. Class	L_tilde (Ld)	ll_int (li)	ll_slp (ls)
10	Composite	All	11-12-14	Ld1=56. 0.0758;Ld2=467.	1012;li1=1.6191; 7251;li2=1.9154	ls1=- ;ls2=-0.0684;
6	Flexible	All	11-12-14	252636546.4	3.0582	-0.0175
7	Flexible	All	11-12-14	109.6255	1.7694	-0.0889
10	Flexible	All	11-12-14	Ld1=2526365 0.0175;Ld2=109.	546.4457;li1=3.0 .6255;li2=1.7694	582;ls1=- ;ls2=-0.0889;
3	All	2	11-12	4.5551E+39	4.5402	-0.0019
5	All	2	11-12	3.12277E+28	4.2252	-0.0032
3	All	3	11-12	37964958115	3.2774	-0.0123
5	All	1 or 3	11-12	76695580.37	3.0379	-0.0123
1	All	All	11-12	7.28212E+25	4.1089	-0.0019
4	All	All	11-12	1.19669E+11	3.2652	-0.0123
А	All	All	11-12	257.2113	2.2446	-0.0478
С	All	All	11-12	1.08028E+19	3.8394	-0.0081
2	Composite	All	11-12	2.84956E+12	3.415	-0.0068
2	Flexible	All	11-12	5.08808E+20	3.9143	-0.0074
В	All	2	11-12-14- 16-17-18- 19	1.26807E+14	3.576	-0.0063
С	All	1	1-2-3-6	4.18041E+21	3.9646	-0.0064
2	Composite	1	1-2-3-6	1052792.426	2.7573	-0.0252
3	All	2	1-2-3-6	1.83458E+28	4.2083	-0.005
С	All	2	1-2-3-6	228005.7859	2.6686	-0.0206
2	Composite	2	1-2-3-6	1.06513E+11	3.3238	-0.0154
3	All	3	1-2-3-6	442.6717	2.0893	-0.052
4	All	3	1-2-3-6	84.7338	1.3176	-0.0884
2	Composite	3	1-2-3-6	2599368.844	2.8142	-0.018
С	Composite	3	1-2-3-6	14868.0287	2.4005	-0.0265
С	Flexible	3	1-2-3-6	1.29154E+16	3.6623	-0.0064
4	All	1 or 2	1-2-3-6	2716.8385	1.9974	-0.0138
6	Composite	All	1-2-3-6	22015.125	2.5034	-0.0316
10	Composite	All	1-2-3-6	Ld1=2201 0.0316;Ld2=467.	5.125;li1=2.5034 7251;li2=1.9154	l;ls1=- ;ls2=-0.0684;
2	Flexible	All	1-2-3-6	1.47011E+17	3.7223	-0.0052
6	Flexible	All	1-2-3-6	1.21619E+22	3.9576	-0.0054
7	Flexible	All	1-2-3-6	12702.3337	2.4296	-0.0567
10	Flexible	All	1-2-3-6	Ld1=121.619407 0.0054;Ld2=12	645123*Math.Po 3.9576;Is1=- 2702.3337;Ii2=2. 0.0567;	w(10,20);li1= 4296;ls2=-

# MaryLand DEPARTMENT OF TRANSPORTATION

#### STATE HIGHWAY ADMINISTRATION

Treatment Group	Pavement type	Region	Func. Class	L_tilde (Ld)	ll_int (li)	ll_slp (ls)
В	All	2	1-2-3-6-7- 8-9	582.5478	2.2089	-0.0197
2	Composite	1	16-17-18- 19	1.94491E+17	3.7262	-0.0082
2	Flexible	1	16-17-18- 19	7809.8883	2.3498	-0.0355
3	All	2	16-17-18- 19	207.9771	1.9912	-0.0568
2	Composite	2	16-17-18- 19	1721605.631	2.7579	-0.0209
2	Flexible	2	16-17-18- 19	4.72506E+21	3.9406	-0.0059
3	All	3	16-17-18- 19	2.61569E+17	3.7161	-0.0061
4	All	3	16-17-18- 19	560.9015	1.555	-0.0141
2	Composite	3	16-17-18- 19	69.4426	1.7037	-0.0774
2	Flexible	3	16-17-18- 19	671.6257	2.2066	-0.0565
4	Composite	1 or 2	16-17-18- 19	372.3782	1.5649	-0.0217
4	Flexible	1 or 2	16-17-18- 19	2067.2575	1.7989	-0.0119
А	All	All	16-17-18- 19	739.2838	2.0345	-0.0385
1	Composite	All	16-17-18- 19	2.38079E+17	3.6591	-0.0027
6	Composite	All	16-17-18- 19	1958.3861	2.0325	-0.0116
10	Composite	All	16-17-18- 19	Ld1=1958 0.0116:Ld2=467	.3861;li1=2.0325 .7251:li2=1.9154	; s1=- ; s2=-0.0684:
С	Composite	All	16-17-18- 19	726334947.4	3.0971	-0.0132
1	Flexible	All	16-17-18- 19	3.72605E+11	3.2569	-0.0065
6	Flexible	All	16-17-18- 19	128076.7042	2.5111	-0.0236
7	Flexible	All	16-17-18- 19	51.1047	1.7873	-0.2267
10	Flexible	All	16-17-18- 19	Ld1=12807 0.0236;Ld2=51.	6.7042;li1=2.511 1047;li2=1.7873;	1;ls1=- ls2=-0.2267;
С	Flexible	All	16-17-18- 19	4730810253	3.1961	-0.0152
5	All	All	16-17-18- 19-14	45.6078	1.8813	-0.1221
5	All	All	1-7-8-9-2- 3-6	3.24984E+33	4.3845	-0.0021
A	All	All	1-7-8-9-2- 3-6	54.3291	1.9695	-0.1039
3	All	1	All	32864163.85	2.9756	-0.0152
В	All	1	All	32864163.85	2.9756	-0.0152
В	All	3	All	32864163.85	2.9756	-0.0152
8	All	All	All	32864163.85	2.9756	-0.0152
7	Composite	All	All	467.7251	1.9154	-0.0684

# MaryLand DEPARTMENT OF TRANSPORTATION

#### STATE HIGHWAY ADMINISTRATION

Appendices

Treatment Group	Pavement type	Region	Func. Class	L_tilde (Ld)	ll_int (li)	ll_slp (ls)
N/A	N/A	1	1	1920	2.32	-0.02
N/A	N/A	2	1	1500	2.27	-0.01
N/A	N/A	3	1	1500	2.27	-0.01
N/A	N/A	1	2-3-6	8.08E+11	3.35	-0.01
N/A	N/A	2	2-3-6	31300	2.4	-0.02
N/A	N/A	3	2-3-6	8.38E+17	3.76	-0.01
N/A	N/A	1	7-8-9	658	2.01	-0.05
N/A	N/A	2	7-8-9	746	1.97	-0.03
N/A	N/A	3	7-8-9	420	1.99	-0.06
N/A	N/A	1	11-12	1.12E+24	4.04	-0.01
N/A	N/A	2	11-12	6.65E+19	3.87	-0.01
N/A	N/A	3	11-12	3.05E+12	3.42	-0.01
N/A	N/A	1	14	4.06E+17	3.74	-0.01
N/A	N/A	2	14	586	1.96	-0.04
N/A	N/A	3	14	8.92E+12	3.44	-0.01
N/A	N/A	1	16-17-18- 19	727	2.03	-0.04
N/A	N/A	2	16-17-18- 19	654	1.93	-0.03
N/A	N/A	3	1 <del>6-17-18-</del> 19	656	1.98	-0.04

### Table 3: Treatment Group definitions

#	Last applied treatment
1	ASPHALT PATCH ONLY, POTHOLE PATCHING
2	MILL-OVERLAY <=1.5IN GRADE INCREASE
3	OVERLAY <=1.5IN ASPHALT, MILL-ULTRATHIN BONDED WEARING COURSE
4	CRACK SEAL, JOINT RESEALING
5	MILL-OVERLAY <=1.5IN GRADE INCREASE - GAP
6	THIN OVERLAY <=1IN ASPHALT, HOT-IN-PLACE RECYCLING
7	MICRO SURFACING, CAPE SEAL, HIGH FRICTION SURFACE
8	OVERLAY <=1.5IN ASPHALT - GAP, ULTRATHIN BONDED WEARING COURSE
9	SURFACE ABRASION
10	FOG SEAL, REJUVANATOR, CHIP SEAL, SAND SEAL
А	RECONSTRUCTION, MILL >=4IN-OVERLAY WITH ASPHALT, RUBBILIZATION-OVERLAY, COLD-IN-PLACE RECYCLING-OVERLAY, BREAK-CRACK-SEAT-OVERLAY, FULL-DEPTH RECLAMATION-OVERLAY
В	OVERLAY >1.5IN ASPHALT - GAP, MILL-OVERLAY >1.5IN GRADE INCREASE - GAP
С	OVERLAY >1.5IN ASPHALT, MILL-OVERLAY >1.5IN GRADE INCREASE

Appendices

Functional Class	Description
1	Rural Principal Arterial - Interstate
2	Rural Principal Arterial - Other Freeways
3	Rural Principal Arterial - Other
6	Rural Minor Arterial
7	Rural Major Collector
8	Rural Minor Collector
9	Rural Local
11	Urban Principal Arterial - Interstate
12	Urban Principal Arterial - Other Freeways
14	Urban Principal Arterial - Other
16	Urban Minor Arterial
17	Urban Major Collector
18	Urban Minor Collector
19	Urban Local

### Table 4: Highway Functional Classes

### Table 5: Region Definitions

1 = Mountain 2 = Central 3 = Coastal
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#### **FC Density Function**

doublo	
atring	FC0,FCage,FCDMR=[FC_DENSITY_MR],age=[AGE],Ld=0,li=0,ls=0, gt=0,Ld1=0,li1=0,ls1=0,Ld2=0,li2=0,ls2=0;
string	PT=[PAVEMENT_TYPE],RG=[REGION],LT=[LAST_TREATMENT],F C=[FUNC_CLASS];
if((FC=="1	")&&(gt==0)){if((LT=="ASPHALT PATCH ONLY"  LT=="POTHOLE PATCHING")){Ld=90637719.4409;li=2.8083;ls=-0.0046;gt=1;}}
if((FC=="1	4")&&(gt==0)){if(RG=="1"&&(LT=="OVERLAY >1.5IN ASPHALT"  LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=266.3311;li=1.4455;ls=-0.0255;gt=1;}
else	if(RG=="1"&&(PT=="FCC"  PT=="FCJ"  PT=="COMPOSITE")&&(LT= ="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=1787.4858;li=1.948;ls=-0.0111;gt=1;}
else if(RG	=="1"&&(PT=="F"  PT=="FLEXIBLE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=6.03267467669406*Math.Pow(10,20);li=3.8714;ls= -0.0029;gt=1;}
else if(RG	=="2"&&(LT=="OVERLAY <=1.5IN ASPHALT"  LT=="MILL- ULTRATHIN BONDED WEARING COURSE")){Ld=10694218632770800000*Math.Pow(10,20);li=4.488 6;ls=-0.0009;gt=1;}
else if(RG	=="2"&&(LT=="OVERLAY >1.5IN ASPHALT"  LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=86.8394;li=1.6175;ls=- 0.0618;gt=1;}
else	if(RG=="2"&&(PT=="FCC"  PT=="FCJ"  PT=="COMPOSITE")&&(LT= ="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=150.0416;li=1.3954;ls=-0.05;gt=1;}
else if(RG	=="2"&&(PT=="F"  PT=="FLEXIBLE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=275.4735;li=1.6585;ls=- 0.0442;gt=1;}
else if(RG	=="3"&&(LT=="OVERLAY <=1.5IN ASPHALT"  LT=="MILL- ULTRATHIN BONDED WEARING COURSE")){Ld=4103.2955;li=2.2241;ls=-0.0275;gt=1;}
else if(RG	=="3"&&(LT=="CRACK SEAL"  LT=="JOINT RESEALING")){Ld=55.5406;li=1.0076;ls=-0.1419;gt=1;}
else if(RG	=="3"&&(LT=="OVERLAY >1.5IN ASPHALT"  LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=41969.4996;li=2.3521;ls=- 0.0217;gt=1;}

else	
	if(RG=="3"&&(PT=="FCC"  PT=="FCJ"  PT=="COMPOSITE")&&(LT= ="MILL-OVERLAY <=1.5IN GRADE
	INCREASE")){Ld=117.5573;li=1.4525;ls=-0.0749;gt=1;}
else if(RG=	:="3"&&(PT=="F"  PT=="FLEXIBLE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=125.2176;li=1.5761;ls=- 0.0606;gt=1;}
else if(RG=	:="1"  RG=="2"&&(LT=="CRACK SEAL"  LT=="JOINT RESEALING")){Ld=76.2935;Ii=1.0401;Is=-0.0643;gt=1;}
else if((LT=	="ASPHALT PATCH ONLY"  LT=="POTHOLE PATCHING")){Ld=1002.87617756533*Math.Pow(10,15);li=3.6796;ls =-0.0019;gt=1;}
else if((LT=	="RECONSTRUCTION"  LT=="MILL >=4IN-OVERLAY WITH ASPHALT"  LT=="RUBBILIZATION-OVERLAY"  LT=="COLD-IN- PLACE RECYCLING-OVERLAY"  LT=="BREAK-CRACK-SEAT- OVERLAY"  LT=="FULL-DEPTH RECLAMATION- OVERLAY")){Ld=215600901.711267*Math.Pow(10,10);li=3.7308;ls=- 0.0031;gt=1;}}
if((FC=="2"	FC=="3"  FC=="6")&&(gt==0)){if((PT=="FCC"  PT=="FCJ"  PT=="CO MPOSITE")&&(LT=="ASPHALT PATCH ONLY"  LT=="POTHOLE PATCHING")){Ld=584.7963;li=1.464;ls=-0.0102;gt=1;}
else if((PT=	=="F"  PT=="FLEXIBLE")&&(LT=="ASPHALT PATCH ONLY"  LT=="POTHOLE PATCHING")){Ld=138.1563;li=1.1843;ls=- 0.0417;gt=1;}}
if((FC=="7"	FC=="8"  FC=="9")&&(gt==0)){if(RG=="1"&&(LT=="OVERLAY >1.5IN ASPHALT"  LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=305.5609;li=1.7251;ls=-0.031;gt=1;}
else if(RG=	:="2"&&(LT=="OVERLAY <=1.5IN ASPHALT"  LT=="MILL- ULTRATHIN BONDED WEARING COURSE")){Ld=1956.3351;li=2.0539;ls=-0.0189;gt=1;}
else if(RG=	="2"&&(LT=="OVERLAY >1.5IN ASPHALT"  LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=599.4863;li=1.8873;ls=- 0.0317;gt=1;}
else if(RG=	="3"&&(LT=="OVERLAY >1.5IN ASPHALT"  LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=2.10797424508439*Math.Pow(10,10);Ii=3.1608;Is= -0.0081;gt=1;}
else	
	if(RG=="3"&&(PT=="FCC"  PT=="FCJ"  PT=="COMPOSITE")&&(LT= ="OVERLAY <=1.5IN ASPHALT"  LT=="MILL-ULTRATHIN BONDED WEARING COURSE")){Ld=621395.355961961*Math.Pow(10.10);li=3.5844;ls=-
	0.0067;gt=1;}

else if(RG	G=="3"&&(PT=="F"  PT=="FLEXIBLE")&&(LT=="OVERLAY <=1.5IN ASPHALT"  LT=="MILL-ULTRATHIN BONDED WEARING COURSE")){Ld=1361.205;li=1.941;ls=-0.0285;gt=1;}
else if((P	T=="FCC"  PT=="FCJ"  PT=="COMPOSITE")&&(LT=="ASPHALT PATCH ONLY"  LT=="POTHOLE PATCHING")){Ld=215.1996;li=1.3605;ls=-0.0575;gt=1;}
else if((P	T=="FCC"  PT=="FCJ"  PT=="COMPOSITE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=341.6614;Ii=1.7043;Is=- 0.0338;gt=1;}
else if((P	T=="FCC"  PT=="FCJ"  PT=="COMPOSITE")&&(LT=="CRACK SEAL"  LT=="JOINT RESEALING")){Ld=604.754119009586*Math.Pow(10,20);li=3.9402;l s=-0.0045;gt=1;}
else if((P	T=="FCC"  PT=="FCJ"  PT=="COMPOSITE")&&(LT=="THIN OVERLAY <=1IN ASPHALT"  LT=="HOT-IN-PLACE RECYCLING")){Ld=50.5424;li=1.0538;ls=-0.0821;gt=1;}
else if((P	T=="FCC"  PT=="FCJ"  PT=="COMPOSITE")&&(LT=="FOG SEAL"  LT=="REJUVANATOR"  LT=="CHIP SEAL"  LT=="SAND SEAL")){Ld1=50.5424;li1=1.0538;ls1=- 0.0821;Ld2=573.153;li2=1.5699;ls2=-0.0145;gt=1;}
else if((P	T=="F"  PT=="FLEXIBLE")&&(LT=="ASPHALT PATCH ONLY"  LT=="POTHOLE PATCHING")){Ld=109.2627;li=1.248;ls=- 0.0402;gt=1;}
else if((P	T=="F"  PT=="FLEXIBLE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=6966.2944;li=2.1961;ls=-0.0176;gt=1;}
else if((P	T=="F"  PT=="FLEXIBLE")&&(LT=="CRACK SEAL"  LT=="JOINT RESEALING")){Ld=145528821.0712;li=2.8511;ls=-0.0076;gt=1;}
else if((P	T=="F"  PT=="FLEXIBLE")&&(LT=="THIN OVERLAY <=1IN ASPHALT"  LT=="HOT-IN-PLACE RECYCLING")){Ld=60.3093;li=1.4039;ls=-0.1222;gt=1;}
else if((P	T=="F"  PT=="FLEXIBLE")&&(LT=="MICRO SURFACING"  LT=="CAPE SEAL"  LT=="HIGH FRICTION SURFACE")){Ld=10471052.5813;li=2.7114;ls=-0.0162;gt=1;}
else if((P	T=="F"  PT=="FLEXIBLE")&&(LT=="FOG SEAL"  LT=="REJUVANATOR"  LT=="CHIP SEAL"  LT=="SAND SEAL")){Ld1=60.3093;li1=1.4039;ls1=- 0.1222;Ld2=10471052.5813;li2=2.7114;ls2=-0.0162;gt=1;}}
if((FC=="	11"  FC=="12"  FC=="14")&&(gt==0)){if((PT=="FCC"  PT=="FCJ"  PT==" COMPOSITE")&&(LT=="THIN OVERLAY <=1IN ASPHALT"  LT=="HOT-IN-PLACE RECYCLING")){Ld=76.9602;Ii=1.2325;Is=-0.073;gt=1;}
else if((P	T=="FCC"  PT=="FCJ"  PT=="COMPOSITE")&&(LT=="FOG SEAL"  LT=="REJUVANATOR"  LT=="CHIP SEAL"  LT=="SAND

SEAL")){Ld1=76.9602;li1=1.2325;ls1=- 0.073;Ld2=573.153;li2=1.5699;ls2=-0.0145;gt=1;}
else if((PT=="F"  PT=="FLEXIBLE")&&(LT=="THIN OVERLAY <=1IN ASPHALT"  LT=="HOT-IN-PLACE RECYCLING")){Ld=98973660234.9642*Math.Pow(10,20);li=4.2652;l s=-0.0023;gt=1;}
else if((PT=="F"  PT=="FLEXIBLE")&&(LT=="MICRO SURFACING"  LT=="CAPE SEAL"  LT=="HIGH FRICTION SURFACE")){Ld=1882.4205;li=1.9344;ls=-0.0382;gt=1;}
else if((PT=="F"  PT=="FLEXIBLE")&&(LT=="FOG SEAL"  LT=="REJUVANATOR"  LT=="CHIP SEAL"  LT=="SAND SEAL")){Ld1=98973660234.9642*Math.Pow(10,20);li1=4.2652;ls1=- 0.0023;Ld2=1882.4205;li2=1.9344;ls2=-0.0382;gt=1;}}
if((FC=="11"  FC=="12")&&(gt==0)){if(RG=="2"&&(LT=="OVERLAY <=1.5IN ASPHALT"  LT=="MILL-ULTRATHIN BONDED WEARING COURSE")){Ld=89359137.6056;li=2.9464;ls=-0.015;gt=1;}
else if(RG=="2"&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE - GAP")){Ld=1662.1596;Ii=1.9936;Is=-0.0288;gt=1;}
else if(RG=="3"&&(LT=="OVERLAY <=1.5IN ASPHALT"  LT=="MILL- ULTRATHIN BONDED WEARING COURSE")){Ld=3794.5556;Ii=1.951;Is=-0.0064;gt=1;}
else if(RG=="1"  RG=="3"&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE - GAP")){Ld=50.4719;li=1.1323;ls=-0.0834;gt=1;}
else if((LT=="ASPHALT PATCH ONLY"  LT=="POTHOLE PATCHING")){Ld=22.7746814420507*Math.Pow(10,15);li=3.5918;ls =-0.0025;gt=1;}
else if((LT=="CRACK SEAL"  LT=="JOINT RESEALING")){Ld=50.3632;li=0.8305;ls=-0.0947;gt=1;}
else if((LT=="RECONSTRUCTION"  LT=="MILL >=4IN-OVERLAY WITH ASPHALT"  LT=="RUBBILIZATION-OVERLAY"  LT=="COLD-IN- PLACE RECYCLING-OVERLAY"  LT=="BREAK-CRACK-SEAT- OVERLAY"  LT=="FULL-DEPTH RECLAMATION- OVERLAY")){Ld=2683.6544;Ii=2.0435;Is=-0.0171;gt=1;}
else if((LT=="OVERLAY >1.5IN ASPHALT"  LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=2492522026.8003;Ii=3.0629;Is=- 0.009;gt=1;}
else if((PT=="FCC"  PT=="FCJ"  PT=="COMPOSITE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=111.6238;Ii=1.2991;Is=- 0.053;gt=1;}
else if((PT=="F"  PT=="FLEXIBLE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=2516.3924;li=2.013;ls=-0.0291;gt=1;}}
if((FC=="11"  FC=="12"  FC=="14"  FC=="16"  FC=="17"  FC=="18"  FC=="19")& &(gt==0)){if(RG=="2"&&(LT=="OVERLAY >1.5IN ASPHALT -

	GAP"  LT=="MILL-OVERLAY >1.5IN GRADE INCREASE - GAP")){Ld=600;li=1.9327;ls=-0.0345;gt=1;}}
if((FC=="1"	'  FC=="2"  FC=="3"  FC=="6")&&(gt==0)){if(RG=="1"&&(LT=="OVERL AY >1.5IN ASPHALT"  LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=106.2486;li=1.5597;ls=-0.0593;gt=1;}
else	
	if(RG=="1"&&(PT=="FCC"  PT=="FCJ"  PT=="COMPOSITE")&&(LT= ="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=97.2449;li=1.3891;ls=-0.0457;qt=1;}
alaa if/PC-	$= -2^{2} \times 2^{2} \times 2^{-1} \times $
eise II(RG-	ULTRATHIN BONDED WEARING COURSE")){Ld=431.2878;li=1.7957;ls=-0.0347;gt=1;}
else if(RG=	=="2"&&(LT=="OVERLAY >1.5IN ASPHALT"IILT=="MILL-OVERLAY
<b>X</b> -	>1.5IN GRADE INCREASE")){Ld=71606660.6601704*Math.Pow(10,10);li=3.7176;ls= -0.0039;gt=1;}
else	
	if(RG=="2"&&(PT=="FCC"  PT=="FCJ"  PT=="COMPOSITE")&&(LT= ="MILL-OVERLAY <=1.5IN GRADE INCREASE")\// d=4709385 6133:li=2 7561:ls=_0 0194:at=1:\
else if(RG=	=="3"&&(LT=="OVERLAY <=1.5IN ASPHALT"  LT=="MILL- ULTRATHIN BONDED WEARING COURSE")){Ld=1789.58;li=1.9201;ls=-0.0212;qt=1;}
alaa if/PC-	
	$RESEALING")){Ld=78.314; li=1.1183; ls=-0.1146; gt=1;}$
else	
	If(RG=="3"&&(PT=="FCC"  PT=="FCJ"  PT=="COMPOSITE")&&(LT= ="MILL-OVERLAY <=1.5IN GRADE
	INCREASE )){Ld=28894462.1571;II=2.8285;IS=-0.0165;gt=1;}
else	
	if(RG=="3"&&(PT=="FCC"  PT=="FCJ"  PT=="COMPOSITE")&&(LT= ="OVERLAY >1.5IN ASPHALT"  LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=170.3627;Ii=1.499;Is=-0.0455;gt=1;}
else if(RG=	=="3"&&(PT=="F"  PT=="FLEXIBLE")&&(LT=="OVERLAY >1.5IN ASPHALT"  LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=397.2458;li=1.7853;ls=-0.0385;gt=1;}
else if(RG=	=="1"  RG=="2"&&(LT=="CRACK SEAL"  LT=="JOINT RESEALING")){Ld=13659.7542;li=2.1062;ls=-0.0159;gt=1;}
else if((PT=	=="FCC"  PT=="FCJ"  PT=="COMPOSITE")&&(LT=="THIN OVERLAY <=1IN ASPHALT"  LT=="HOT-IN-PLACE RECYCLING")){Ld=6073.429;li=2.1367;ls=-0.0255;gt=1;}
else if((PT=	=="FCC"  PT=="FCJ"  PT=="COMPOSITE")&&(LT=="FOG
~~~	SEAL"  ÏLT=="REJUÜANATOR"  LT=="CHÍP SEAL"  LT=="SAND

	SEAL")){Ld1=6073.429;li1=2.1367;ls1=- 0.0255;Ld2=573.153;li2=1.5699;ls2=-0.0145;gt=1;}
else if((PT=	:="F" PT=="FLEXIBLE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=367611295.5788;Ii=2.9757;Is=-0.0088;gt=1;}
else if((PT=	:="F" PT=="FLEXIBLE")&&(LT=="THIN OVERLAY <=1IN ASPHALT" LT=="HOT-IN-PLACE RECYCLING")){Ld=951.8987;li=1.9191;ls=-0.0352;gt=1;}
else if((PT=	="F" PT=="FLEXIBLE")&&(LT=="MICRO SURFACING" LT=="CAPE SEAL" LT=="HIGH FRICTION SURFACE")){Ld=201234894.491;li=2.9441;ls=-0.0166;gt=1;}
else if((PT=	:="F" PT=="FLEXIBLE")&&(LT=="FOG SEAL" LT=="REJUVANATOR" LT=="CHIP SEAL" LT=="SAND SEAL")){Ld1=951.8987;li1=1.9191;ls1=- 0.0352;Ld2=201234894.491;li2=2.9441;ls2=-0.0166;gt=1;}}
if((FC=="1"	FC=="2" FC=="3" FC=="6" FC=="7" FC=="8" FC=="9")&&(gt==0)) {if(RG=="2"&&(LT=="OVERLAY >1.5IN ASPHALT - GAP" LT=="MILL-OVERLAY >1.5IN GRADE INCREASE - GAP")){Ld=93879.8842929807*Math.Pow(10,10);II=3.5453;Is=- 0.005;gt=1;}}
if((FC=="16	" FC=="17" FC=="18" FC=="19")&&(gt==0)){if(RG=="1"&&(PT=="F CC" PT=="FCJ" PT=="COMPOSITE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=1032.0372;li=1.8994;ls=- 0.025;gt=1;}
else if(RG=	="1"&&(PT=="F" PT=="FLEXIBLE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=5437.0356;li=2.1001;ls=- 0.0225;gt=1;}
else if(RG=	="2"&&(LT=="OVERLAY <=1.5IN ASPHALT" LT=="MILL- ULTRATHIN BONDED WEARING COURSE")){Ld=860.3014;Ii=1.938;Is=-0.0366;gt=1;}
else	
	if(RG=="2"&&(PT=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT= ="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=437.9597;li=1.735;ls=-0.0345;gt=1;}
else if(RG=	="2"&&(PT=="F" PT=="FLEXIBLE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=720.4722;li=1.8432;ls=- 0.0266;gt=1;}
else if(RG=	="3"&&(LT=="OVERLAY <=1.5IN ASPHALT" LT=="MILL- ULTRATHIN BONDED WEARING COURSE")){Ld=573.903;li=1.7447;ls=-0.0175;gt=1;}
else if(RG=	="3"&&(LT=="CRACK SEAL" LT=="JOINT RESEALING")){Ld=1382900.3943;li=2.5519;ls=-0.0148;gt=1;}
else	if(RG=="3"&&(PT=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT=

	="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=404.1978;li=1.6935;ls=-0.0352;gt=1;}
else if(RG=	=="3"&&(PT=="F" PT=="FLEXIBLE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=130.2758;li=1.7928;ls=- 0.0733;gt=1;}
else	
	if(RG=="1" RG=="2"&&(PT=="FCC" PT=="FCJ" PT=="COMPOSIT E")&&(LT=="CRACK SEAL" LT=="JOINT RESEALING")){Ld=14369723.9977432*Math.Pow(10,20);Ii=4.1141;I s=-0.0035;gt=1;}
else if(RG=	=="1" RG=="2"&&(PT=="F" PT=="FLEXIBLE")&&(LT=="CRACK SEAL" LT=="JOINT RESEALING")){Ld=58.1315;li=1.0264;ls=- 0.0862;gt=1;}
else if((LT=	=="RECONSTRUCTION" LT=="MILL >=4IN-OVERLAY WITH ASPHALT" LT=="RUBBILIZATION-OVERLAY" LT=="COLD-IN- PLACE RECYCLING-OVERLAY" LT=="BREAK-CRACK-SEAT- OVERLAY" LT=="FULL-DEPTH RECLAMATION- OVERLAY")){Ld=19646019564.2089;li=3.1712;ls=-0.009;gt=1;}
else if((PT:	=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT=="ASPHALT PATCH ONLY" LT=="POTHOLE PATCHING")){Ld=511.7243;li=1.5606;ls=-0.029;gt=1;}
else if((PT:	=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT=="THIN OVERLAY <=1IN ASPHALT" LT=="HOT-IN-PLACE RECYCLING")){Ld=10401445555430400*Math.Pow(10,20);li=4.402;l s=-0.0008;gt=1;}
else if((PT	=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT=="FOG SEAL" LT=="REJUVANATOR" LT=="CHIP SEAL" LT=="SAND SEAL")){Ld1=10401445555430400*Math.Pow(10,20);li1=4.402;ls1=- 0.0008;Ld2=573.153;li2=1.5699;ls2=-0.0145;gt=1;}
else if((PT:	=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT=="OVERLAY >1.5IN ASPHALT" LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=2704.5306;Ii=2.0572;Is=-0.0246;gt=1;}
else if((PT	=="F" PT=="FLEXIBLE")&&(LT=="ASPHALT PATCH ONLY" LT=="POTHOLE PATCHING")){Ld=12733.4191692852*Math.Pow(10,20);li=3.9863;ls =-0.0011;gt=1;}
else if((PT:	=="F" PT=="FLEXIBLE")&&(LT=="THIN OVERLAY <=1IN ASPHALT" LT=="HOT-IN-PLACE RECYCLING")){Ld=221778.766348933*Math.Pow(10,30);li=4.384;ls =-0.0012;gt=1;}
else if((PT	=="F" PT=="FLEXIBLE")&&(LT=="MICRO SURFACING" LT=="CAPE SEAL" LT=="HIGH FRICTION SURFACE")){Ld=73.0759;li=1.4134;ls=-0.151;gt=1;}

else if((PT=="F" PT=="FLEXIBLE")&&(LT=="FOG SEAL" LT=="REJUVANATOR" LT=="CHIP SEAL" LT=="SAND SEAL")){Ld1=221778.766348933*Math.Pow(10,30);li1=4.384;ls1=- 0.0012;Ld2=73.0759;li2=1.4134;ls2=-0.151;gt=1;}
else if((PT=="F" PT=="FLEXIBLE")&&(LT=="OVERLAY >1.5IN ASPHALT" LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=44859729.159;li=2.8931;ls=-0.0125;gt=1;}}
if((FC=="16" FC=="17" FC=="18" FC=="19" FC=="14")&&(gt==0)){if((LT=="MIL L-OVERLAY <=1.5IN GRADE INCREASE - GAP")){Ld=398.49;Ii=1.7958;Is=-0.0324;gt=1;}}
$\label{eq:figure} \begin{array}{l} \mbox{if}((FC=="1" FC=="7" FC=="8" FC=="9" FC=="2" FC=="3" FC=="6")\&\&(gt==0)) \\ & \{\mbox{if}((LT=="MILL-OVERLAY <=1.5IN \mbox{ GRADE } INCREASE - $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
else if((LT=="RECONSTRUCTION" LT=="MILL >=4IN-OVERLAY WITH ASPHALT" LT=="RUBBILIZATION-OVERLAY" LT=="COLD-IN- PLACE RECYCLING-OVERLAY" LT=="BREAK-CRACK-SEAT- OVERLAY" LT=="FULL-DEPTH RECLAMATION- OVERLAY")){Ld=62120662.968;li=2.8845;ls=-0.0138;gt=1;}}
if(gt==0){if(RG=="1"&&(LT=="OVERLAY <=1.5IN ASPHALT" LT=="MILL- ULTRATHIN BONDED WEARING COURSE")){Ld=122962.0574;li=2.4522;ls=-0.0095;gt=1;}
else if(RG=="1"&&(LT=="OVERLAY >1.5IN ASPHALT - GAP" LT=="MILL- OVERLAY >1.5IN GRADE INCREASE - GAP")){Ld=2013.4766;li=2.079;ls=-0.0346;gt=1;}
else if(RG=="3"&&(LT=="OVERLAY >1.5IN ASPHALT - GAP" LT=="MILL- OVERLAY >1.5IN GRADE INCREASE - GAP")){Ld=1709.5229;li=1.9365;ls=-0.0165;gt=1;}
else if((LT=="OVERLAY <=1.5IN ASPHALT - GAP" LT=="ULTRATHIN BONDED WEARING COURSE")){Ld=171115888500.86;li=3.2614;ls=-0.0093;gt=1;}
else if((PT=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT=="MICRO SURFACING" LT=="CAPE SEAL" LT=="HIGH FRICTION SURFACE")){Ld=573.153;li=1.5699;ls=-0.0145;gt=1;}}
if((FC=="1")&&(gt==0)){if(RG=="1"){Ld=399*Math.Pow(10,20);li=3.93;ls=- 0.01;gt=1;}
else if(RG=="2"){Ld=280;li=1.75;ls=-0.04;gt=1;}
else if(RG=="3"){Ld=280;li=1.75;ls=-0.04;gt=1;}}
if((FC=="2" FC=="3" FC=="6")&&(gt==0)){if(RG=="1"){Ld=763;li=1.72;ls=- 0.01;gt=1;}
else if(RG=="2"){Ld=108;li=1.34;ls=-0.04;gt=1;}
else if(RG=="3"){Ld=29300;li=2.28;ls=-0.02;gt=1;}}

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Appendices

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if((FC=="7"||FC=="8"||FC=="9")&&(qt==0)){if(RG=="1"){Ld=220;li=1.58;ls=-
           0.03;gt=1;}
else if(RG=="2"){Ld=1170;li=1.88;ls=-0.02;gt=1;}
else if(RG=="3"){Ld=582;li=1.77;ls=-0.04;gt=1;}}
if((FC=="11"||FC=="12")&&(gt==0)){if(RG=="1"){Ld=593;li=1.61;ls=-0.02;gt=1;}
else if(RG=="2"){Ld=718;li=1.82;ls=-0.03;gt=1;}
else if(RG=="3"){Ld=378;li=1.67;ls=-0.03;gt=1;}}
if((FC=="14")&&(gt==0)){if(RG=="1"){Ld=104;li=1.42;ls=-0.03;gt=1;}
else if(RG=="2"){Ld=238;li=1.52;ls=-0.04;gt=1;}
else if(RG=="3"){Ld=631;li=1.82;ls=-0.04;gt=1;}}
if((FC=="16"||FC=="17"||FC=="18"||FC=="19")&&(gt==0)){if(RG=="1"){Ld=325;li=
           1.63;ls=-0.02;qt=1;}
else if(RG=="2"){Ld=104;li=1.35;ls=-0.04;gt=1;}
else if(RG=="3"){Ld=153;li=1.5;ls=-0.04;gt=1;}}
if(FCDMR==0){FCDMR=0.01;}
if(LT=="MILL-ULTRATHIN BONDED WEARING COURSE"||LT=="ULTRATHIN
           BONDED WEARING COURSE"){
FCage=Ld*Math.Exp(-Math.Exp(li+ls*age))*4;
FC0=Ld*Math.Exp(-Math.Exp(li+ls*0))*4;
}
else if(LT=="FOG SEAL"||LT=="REJUVANATOR"||LT=="CHIP
           SEAL"||LT=="SAND SEAL"){
FCage=Ld1*Math.Exp(-Math.Exp(li1+ls1*age))*0.4+Ld2*Math.Exp(-
           Math.Exp(li2+ls2*age))*0.6;
FC0=Ld1*Math.Exp(-Math.Exp(li1+ls1*0))*0.4+Ld2*Math.Exp(-
           Math.Exp(li2+ls2*0))*0.6;
}
else{
FCage=Ld*Math.Exp(-Math.Exp(li+ls*age));
FC0=Ld*Math.Exp(-Math.Exp(li+ls*0));}
if(FCDMR<=FC0){Answer=FCage-FC0;}
else{Answer=FCage;}
```

return Answer;

SC Density Function

•	
double	SC0,SCage,SCDMR=[SC_DENSITY_MR],age=[AGE],Ld=0,li=0,ls=0 ,gt=0,Ld1=0,li1=0,ls1=0,Ld2=0,li2=0,ls2=0;
string	PT=[PAVEMENT_TYPE],RG=[REGION],LT=[LAST_TREATMENT],F C=[FUNC_CLASS];
if((FC=="1"	')&&(gt==0)){if((LT=="ASPHALT PATCH ONLY" LT=="POTHOLE PATCHING")){Ld=75.4278;li=1.8473;ls=-0.1143;gt=1;}}
if((FC=="14	4")&&(gt==0)){if(RG=="1"&&(LT=="OVERLAY >1.5IN ASPHALT" LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=475248.294659273*Math.Pow(10,20);li=4.0944;ls= -0.0029;gt=1;}
else	
	if(RG=="1"&&(PT=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT= ="MILL-OVERLAY <=1.5IN GRADE INCREASE")){I d=347 061977009049*Math Pow(10 20)·li=3 9847·ls=
	-0.0035;qt=1;}
else if(RG=	=="1"&&(PT=="F" PT=="FLEXIBLE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=298.7579;li=2.0722;ls=- 0.0526;gt=1;}
else if(RG=	=="2"&&(LT=="OVERLAY <=1.5IN ASPHALT" LT=="MILL- ULTRATHIN BONDED WEARING COURSE")){Ld=381056.048639361*Math.Pow(10,30);li=4.4145;ls=- 0.002;gt=1;}
else if(RG=	="2"&&(LT=="OVERLAY >1.5IN ASPHALT" LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=93.7206;li=1.9854;ls=- 0.0693;gt=1;}
else	
	if(RG=="2"&&(PT=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT= ="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=232006421.0355;li=3.024;ls=-0.0152;qt=1;}
alaa if(PC-	"?"% % /DT"E" EVIDI E"\% % /I T"NIII I O\/EDI AV
	<pre><= 2 &&(F1=- F) F1=- FLEXIBLE)&&(L1=- MILL-OVERLAT <=1.5IN GRADE INCREASE")){Ld=4896371.86214469*Math.Pow(10,10);li=3.6892;ls= -0.0084;gt=1;}</pre>
else if(RG=	="3"&&(LT=="OVERLAY <=1.5IN ASPHALT" LT=="MILL- ULTRATHIN BONDED WEARING COURSE")){Ld=335974272.41171*Math.Pow(10,25);li=4.384;ls=- 0.0036;gt=1;}
else if(RG=	=="3"&&(LT=="CRACK SEAL" LT=="JOINT RESEALING")){Ld=262.8322;li=1.4992;ls=-0.0224;gt=1;}
else if(RG=	="3"&&(LT=="OVERLAY >1.5IN ASPHALT" LT=="MILL-OVERLAY >1.5IN GRADE

	INCREASE")){Ld=652.682102347311*Math.Pow(10,20);li=3.9954;ls= -0.0047;gt=1;}
else	
	if(RG=="3"&&(PT=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT= ="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=18265317.6231;li=2.9518;ls=-0.0297;gt=1;}
else if(RG=	="3"&&(PT=="F" PT=="FLEXIBLE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE
	INCREASE")){Ld=514.982069631293*Math.Pow(10,20);li=3.9923;ls= -0.0055;gt=1;}
else if(RG=	:="1" RG=="2"&&(LT=="CRACK SEAL" LT=="JOINT RESEALING")){Ld=289.443;li=1.5248;ls=-0.0211;gt=1;}
else if((LT=	="ASPHALT PATCH ONLY" LT=="POTHOLE PATCHING")){Ld=792.3727;li=1.8366;ls=-0.0405;gt=1;}
else if((LT=	<pre>"RECONSTRUCTION" LT=="MILL >=4IN-OVERLAY WITH ASPHALT" LT=="RUBBILIZATION-OVERLAY" LT=="COLD-IN- PLACE RECYCLING-OVERLAY" LT=="BREAK-CRACK-SEAT- OVERLAY" LT=="FULL-DEPTH RECLAMATION- OVERLAY")){Ld=4182.78688673652*Math.Pow(10,10);li=3.5095;ls=- 0.0099;gt=1;}}</pre>
if((FC=="2"	FC=="3" FC=="6")&&(gt==0)){if((PT=="FCC" PT=="FCJ" PT=="CO MPOSITE")&&(LT=="ASPHALT PATCH ONLY" LT=="POTHOLE PATCHING")){Ld=112.2041;li=1.3241;ls=-0.042;gt=1;}
else if((PT=	=="F" PT=="FLEXIBLE")&&(LT=="ASPHALT PATCH ONLY" LT=="POTHOLE PATCHING")){Ld=510.6388;li=1.729;ls=- 0.0364;gt=1;}}
if((FC=="7"	FC=="8" FC=="9")&&(gt==0)){if(RG=="1"&&(LT=="OVERLAY >1.5IN ASPHALT" LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=85037347834966;li=3.534;ls=-0.0097;gt=1;}
else if(RG=	:="2"&&(LT=="OVERLAY <=1.5IN ASPHALT" LT=="MILL- ULTRATHIN BONDED WEARING COURSE")){Ld=6218479.4581;li=2.8513;ls=-0.0153;gt=1;}
else if(RG=	="2"&&(LT=="OVERLAY >1.5IN ASPHALT" LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=126984274512314;li=3.537;ls=- 0.0092;gt=1;}
else if(RG=	="3"&&(LT=="OVERLAY >1.5IN ASPHALT" LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=80144088.8551;li=2.9847;ls=- 0.0161;gt=1;}
else	
	if(RG=="3"&&(PT=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT= ="OVERLAY <=1.5IN ASPHALT" LT=="MILL-ULTRATHIN BONDED WEARING
	COURSE")){Ld=564.932399692712*Math.Pow(10,20);li=3.9899;ls=-

0.008;gt=1;}

else if((PT=="FCC"||PT=="FCJ"||PT=="COMPOSITE")&&(LT=="ASPHALT PATCH ONLY"||LT=="POTHOLE

0.0097;gt=1;}

PATCHING")){Ld=213.0146;li=1.5618;ls=-0.0778;gt=1;}

else if(RG=="3"&&(PT=="F"||PT=="FLEXIBLE")&&(LT=="OVERLAY <=1.5IN ASPHALT"||LT=="MILL-ULTRATHIN BONDED WEARING

COURSE")){Ld=7274634.69497847*Math.Pow(10,10);li=3.6944;ls=-

else if((PT=="FCC"||PT=="FCJ"||PT=="COMPOSITE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=7762591.6914;li=2.8461;ls=-0.0167;gt=1;}

else if((PT=="FCC"||PT=="FCJ"||PT=="COMPOSITE")&&(LT=="CRACK SEAL"||LT=="JOINT RESEALING")){Ld=620288.2706;li=2.4844;ls=-0.0038;gt=1;}

- else if((PT=="FCC"||PT=="FCJ"||PT=="COMPOSITE")&&(LT=="THIN OVERLAY <=1IN ASPHALT"||LT=="HOT-IN-PLACE RECYCLING")){Ld=76.1753;li=1.5778;ls=-0.0364;gt=1;}
- else if((PT=="FCC"||PT=="FCJ"||PT=="COMPOSITE")&&(LT=="FOG SEAL"||LT=="REJUVANATOR"||LT=="CHIP SEAL"||LT=="SAND SEAL")){Ld1=76.1753;li1=1.5778;ls1=-

PATCHING")){Ld=4657209.6055;li=2.7342;ls=-0.022;gt=1;}

RESEALING")){Ld=1532.5528;li=1.7333;ls=-0.0123;gt=1;}

else if((PT=="F"||PT=="FLEXIBLE")&&(LT=="MICRO SURFACING"||LT=="CAPE

if((FC=="11"||FC=="12"||FC=="14")&&(gt==0)){if((PT=="FCC"||PT=="FCJ"||PT=="

RECYCLING")){Ld=56.1012;li=1.6191;ls=-0.0758;gt=1;}

SURFACE")){Ld=645.599;li=1.9055;ls=-0.073;gt=1;}

SEAL")){Ld1=400975145472.392;li1=3.3658;ls1=-0.0228;Ld2=645.599;li2=1.9055;ls2=-0.073;gt=1;}

COMPOSITE")&&(LT=="THIN OVERLAY <=1IN

else if((PT=="FCC"||PT=="FCJ"||PT=="COMPOSITE")&&(LT=="FOG

INCREASE")){Ld=95982573657203;li=3.5271;ls=-0.0089;gt=1;}

RECYCLING")){Ld=400975145472.392;li=3.3658;ls=-0.0228;gt=1;}

SEAL"||LT=="REJUVANATOR"||LT=="CHIP SEAL"||LT=="SAND

else if((PT=="F"||PT=="FLEXIBLE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE

else if((PT=="F"||PT=="FLEXIBLE")&&(LT=="CRACK SEAL"||LT=="JOINT

else if((PT=="F"||PT=="FLEXIBLE")&&(LT=="THIN OVERLAY <=1IN

ASPHALT"||LT=="HOT-IN-PLACE

SEAL"IILT=="HIGH FRICTION

ASPHALT"||LT=="HOT-IN-PLACE

else if((PT=="F"||PT=="FLEXIBLE")&&(LT=="FOG

- 0.0364;Ld2=467.7251;li2=1.9154;ls2=-0.0684;qt=1;}

- else if((PT=="F"||PT=="FLEXIBLE")&&(LT=="ASPHALT PATCH ONLY"||LT=="POTHOLE

SEA	L" LT=="REJUVANATOR" LT=="CHIP SEAL" LT=="SAN	1D
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SEAL")){Ld1=56.1012;li1=1.6191;ls1=- 0.0758;Ld2=467.7251;li2=1.9154;ls2=-0.0684;gt=1;}
else if((PT=="F" PT=="FLEXIBLE")&&(LT=="THIN OVERLAY <=1IN ASPHALT" LT=="HOT-IN-PLACE RECYCLING")){Ld=252636546.4457;li=3.0582;ls=-0.0175;gt=1;}
else if((PT=="F" PT=="FLEXIBLE")&&(LT=="MICRO SURFACING" LT=="CAPE SEAL" LT=="HIGH FRICTION SURFACE")){Ld=109.6255;li=1.7694;ls=-0.0889;gt=1;}
else if((PT=="F" PT=="FLEXIBLE")&&(LT=="FOG SEAL" LT=="REJUVANATOR" LT=="CHIP SEAL" LT=="SAND SEAL")){Ld1=252636546.4457;li1=3.0582;ls1=- 0.0175;Ld2=109.6255;li2=1.7694;ls2=-0.0889;gt=1;}}
if((FC=="11" FC=="12")&&(gt==0)){if(RG=="2"&&(LT=="OVERLAY <=1.5IN ASPHALT" LT=="MILL-ULTRATHIN BONDED WEARING COURSE")){Ld=4555096024.28126*Math.Pow(10,30);Ii=4.5402;Is=- 0.0019;gt=1;}
else if(RG=="2"&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE - GAP")){Ld=312277401.799835*Math.Pow(10,20);li=4.2252;ls=- 0.0032;gt=1;}
else if(RG=="3"&&(LT=="OVERLAY <=1.5IN ASPHALT" LT=="MILL- ULTRATHIN BONDED WEARING COURSE")){Ld=37964958115.2038;li=3.2774;ls=-0.0123;gt=1;}
else if(RG=="1" RG=="3"&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE - GAP")){Ld=76695580.3749;li=3.0379;ls=-0.0123;gt=1;}
else if((LT=="ASPHALT PATCH ONLY" LT=="POTHOLE PATCHING")){Ld=728211.849279491*Math.Pow(10,20);li=4.1089;ls =-0.0019;gt=1;}
else if((LT=="CRACK SEAL" LT=="JOINT RESEALING")){Ld=119668831116.782;li=3.2652;ls=-0.0123;gt=1;}
else if((LT=="RECONSTRUCTION" LT=="MILL >=4IN-OVERLAY WITH ASPHALT" LT=="RUBBILIZATION-OVERLAY" LT=="COLD-IN- PLACE RECYCLING-OVERLAY" LT=="BREAK-CRACK-SEAT- OVERLAY" LT=="FULL-DEPTH RECLAMATION- OVERLAY")){Ld=257.2113;li=2.2446;ls=-0.0478;gt=1;}
else if((LT=="OVERLAY >1.5IN ASPHALT" LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=1080282746.3041*Math.Pow(10,10);li=3.8394;ls=- 0.0081;gt=1;}
else if((PT=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=2849556354718;Ii=3.415;Is=- 0.0068;gt=1;}
else if((PT=="F" PT=="FLEXIBLE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=5.08808444115597*Math.Pow(10,20);li=3.9143;ls= -0.0074;gt=1;}}

if((FC=="1	1" FC=="12" FC=="14" FC=="16" FC=="17" FC=="18" FC=="19")& &(gt==0)){if(RG=="2"&&(LT=="OVERLAY >1.5IN ASPHALT - GAP" LT=="MILL-OVERLAY >1.5IN GRADE INCREASE - GAP")){Ld=126806671084707;li=3.576;ls=-0.0063;gt=1;}}
if((FC=="1"	' FC=="2" FC=="3" FC=="6")&&(gt==0)){if(RG=="1"&&(LT=="OVERL AY >1.5IN ASPHALT" LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=41.8040558403263*Math.Pow(10,20);Ii=3.9646;Is= -0.0064;gt=1;}
else	
	if(RG=="1"&&(PT=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT= ="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=1052792.4264;li=2.7573;ls=-0.0252;gt=1;}
else if(RG=	="2"&&(LT=="OVERLAY <=1.5IN ASPHALT" LT=="MILL-
·	ULTRATHIN BONDED WEARING COURSE")){Ld=183457661.715306*Math.Pow(10,20);li=4.2083;ls=- 0.005;gt=1;}
else if(RG=	="2"&&(LT=="OVERLAY >1.5IN ASPHALT" LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=228005.7859;li=2.6686;ls=- 0.0206;gt=1;}
else	
	if(RG=="2"&&(PT=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT= ="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=106513001677.249;li=3.3238;ls=-0.0154;gt=1;}
else if(RG=	=="3"&&(LT=="OVERLAY <=1.5IN ASPHALT" LT=="MILL-
X	ULTRATHIN BONDED WEARING COURSE")){Ld=442.6717;li=2.0893;ls=-0.052;gt=1;}
else if(RG=	=="3"&&(LT=="CRACK SEAL" LT=="JOINT RESEALING")){Ld=84.7338;Ii=1.3176;Is=-0.0884;gt=1;}
else	
	if(RG=="3"&&(PT=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT= -"MILL_OVERLAX <=1.5IN_CRADE
	INCREASE")){Ld=2599368.8437;li=2.8142;ls=-0.018;gt=1;}
else	
	if(RG=="3"&&(PT=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT= ="OVERLAY >1.5IN ASPHALT" LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=14868.0287;li=2.4005;ls=-0.0265;gt=1;}
else if(RG=	=="3"&&(PT=="F" PT=="FLEXIBLE")&&(LT=="OVERLAY >1.5IN ASPHALT" LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=12915430597549900;li=3.6623;ls=-0.0064;gt=1;}
else if(RG=	=="1" RG=="2"&&(LT=="CRACK SEAL" LT=="JOINT RESEALING")){Ld=2716.8385;li=1.9974;ls=-0.0138;gt=1;}
else if((PT=	=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT=="THIN OVERLAY <=1IN ASPHALT" LT=="HOT-IN-PLACE RECYCLING")){Ld=22015.125;li=2.5034;ls=-0.0316;gt=1;}

else if((PT=	=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT=="FOG SEAL" LT=="REJUVANATOR" LT=="CHIP SEAL" LT=="SAND SEAL")){Ld1=22015.125;li1=2.5034;ls1=- 0.0316;Ld2=467.7251;li2=1.9154;ls2=-0.0684;gt=1;}
else if((PT=	=="F" PT=="FLEXIBLE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=14701100.3697198*Math.Pow(10,10);li=3.7223;ls= -0.0052;gt=1;}
else if((PT=	=="F" PT=="FLEXIBLE")&&(LT=="THIN OVERLAY <=1IN ASPHALT" LT=="HOT-IN-PLACE RECYCLING")){Ld=121.619407645123*Math.Pow(10,20);Ii=3.9576;I s=-0.0054;gt=1;}
else if((PT=	=="F" PT=="FLEXIBLE")&&(LT=="MICRO SURFACING" LT=="CAPE SEAL" LT=="HIGH FRICTION SURFACE")){Ld=12702.3337;li=2.4296;ls=-0.0567;gt=1;}
else if((PT=	=="F" PT=="FLEXIBLE")&&(LT=="FOG SEAL" LT=="REJUVANATOR" LT=="CHIP SEAL" LT=="SAND SEAL")){Ld1=121.619407645123*Math.Pow(10,20);li1=3.9576;ls1=- 0.0054;Ld2=12702.3337;li2=2.4296;ls2=-0.0567;gt=1;}}
if((FC=="1"	' FC=="2" FC=="3" FC=="6" FC=="7" FC=="8" FC=="9")&&(gt==0)) {if(RG=="2"&&(LT=="OVERLAY >1.5IN ASPHALT - GAP" LT=="MILL-OVERLAY >1.5IN GRADE INCREASE - GAP")){Ld=582.5478;Ii=2.2089;Is=-0.0197;gt=1;}}
if((FC=="16	6" FC=="17" FC=="18" FC=="19")&&(gt==0)){if(RG=="1"&&(PT=="F CC" PT=="FCJ" PT=="COMPOSITE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=19449091.0508668*Math.Pow(10,10);li=3.7262;ls= -0.0082;gt=1;}
else if(RG=	=="1"&&(PT=="F" PT=="FLEXIBLE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=7809.8883;li=2.3498;ls=- 0.0355;gt=1;}
else if(RG=	="2"&&(LT=="OVERLAY <=1.5IN ASPHALT" LT=="MILL- ULTRATHIN BONDED WEARING COURSE")){Ld=207.9771;li=1.9912;ls=-0.0568;gt=1;}
else	
	if(RG=="2"&&(PT=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT= ="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=1721605.6314;li=2.7579;ls=-0.0209;gt=1;}
else if(RG=	="2"&&(PT=="F" PT=="FLEXIBLE")&&(LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE")){Ld=47.2506007250682*Math.Pow(10,20);li=3.9406;ls= -0.0059;at=1;}
else if(RG=	=="3"&&(LT=="OVERLAY <=1.5IN ASPHALT" LT=="MILL- ULTRATHIN BONDED WEARING COURSE")){Ld=26156886.9283831*Math.Pow(10,10);li=3.7161;ls=- 0.0061;gt=1;}

else if(RG==' F	"3"&&(LT=="CRACK SEAL" LT=="JOINT RESEALING")){Ld=560.9015:li=1.555:ls=-0.0141:at=1:}
else	
if = 	(RG=="3"&&(PT=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT= "MILL-OVERLAY <=1.5IN GRADE NCREASE")){Ld=69.4426;li=1.7037;ls=-0.0774;gt=1;}
else if(RG== < 0	"3"&&(PT=="F" PT=="FLEXIBLE")&&(LT=="MILL-OVERLAY =1.5IN GRADE INCREASE")){Ld=671.6257;Ii=2.2066;Is=- .0565;gt=1;}
else	
if E F	(RG=="1" RG=="2"&&(PT=="FCC" PT=="FCJ" PT=="COMPOSIT :")&&(LT=="CRACK SEAL" LT=="JOINT RESEALING")){Ld=372.3782;li=1.5649;ls=-0.0217;gt=1;}
else if(RG== S 0	"1" RG=="2"&&(PT=="F" PT=="FLEXIBLE")&&(LT=="CRACK EAL" LT=="JOINT RESEALING")){Ld=2067.2575;li=1.7989;ls=- .0119;gt=1;}
else if((LT==' A F C	'RECONSTRUCTION" LT=="MILL >=4IN-OVERLAY WITH SPHALT" LT=="RUBBILIZATION-OVERLAY" LT=="COLD-IN- PLACE RECYCLING-OVERLAY" LT=="BREAK-CRACK-SEAT- OVERLAY" LT=="FULL-DEPTH RECLAMATION- OVERLAY")){Ld=739.2838;li=2.0345;ls=-0.0385;gt=1;}
else if((PT== F F =	"FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT=="ASPHALT PATCH ONLY" LT=="POTHOLE PATCHING")){Ld=238.079002878799*Math.Pow(10,15);li=3.6591;ls -0.0027;gt=1;}
else if((PT== < F	"FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT=="THIN OVERLAY =1IN ASPHALT" LT=="HOT-IN-PLACE &ECYCLING")){Ld=1958.3861;li=2.0325;ls=-0.0116;gt=1;}
else if((PT== S S 0	"FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT=="FOG EAL" LT=="REJUVANATOR" LT=="CHIP SEAL" LT=="SAND EAL")){Ld1=1958.3861;Ii1=2.0325;Is1=- .0116;Ld2=467.7251;Ii2=1.9154;Is2=-0.0684;gt=1;}
else if((PT== > II	"FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT=="OVERLAY 1.5IN ASPHALT" LT=="MILL-OVERLAY >1.5IN GRADE NCREASE")){Ld=726334947.4193;Ii=3.0971;Is=-0.0132;gt=1;}
else if((PT== C F	"F" PT=="FLEXIBLE")&&(LT=="ASPHALT PATCH DNLY" LT=="POTHOLE PATCHING")){Ld=372604640857.231;li=3.2569;ls=-0.0065;gt=1;}
else if((PT== A F	"F" PT=="FLEXIBLE")&&(LT=="THIN OVERLAY <=1IN SPHALT" LT=="HOT-IN-PLACE RECYCLING")){Ld=128076.7042;li=2.5111;ls=-0.0236;gt=1;}
else if((PT== S	"F" PT=="FLEXIBLE")&&(LT=="MICRO SURFACING" LT=="CAPE SEAL" LT=="HIGH FRICTION SURFACE")){Ld=51.1047;li=1.7873;ls=-0.2267;gt=1;}

else if((PT=="F" PT=="FLEXIBLE")&&(LT=="FOG SEAL" LT=="REJUVANATOR" LT=="CHIP SEAL" LT=="SAND SEAL")){Ld1=128076.7042;li1=2.5111;ls1=- 0.0236;Ld2=51.1047;li2=1.7873;ls2=-0.2267;gt=1;}
else if((PT=="F" PT=="FLEXIBLE")&&(LT=="OVERLAY >1.5IN ASPHALT" LT=="MILL-OVERLAY >1.5IN GRADE INCREASE")){Ld=4730810253.4084;li=3.1961;ls=-0.0152;gt=1;}}
if((FC=="16" FC=="17" FC=="18" FC=="19" FC=="14")&&(gt==0)){if((LT=="MIL L-OVERLAY <=1.5IN GRADE INCREASE - GAP")){Ld=45.6078;Ii=1.8813;Is=-0.1221;gt=1;}}
if((FC=="1" FC=="7" FC=="8" FC=="2" FC=="3" FC=="6")&&(gt==0)) {if((LT=="MILL-OVERLAY <=1.5IN GRADE INCREASE - GAP")){Ld=324983517.00409*Math.Pow(10,25);li=4.3845;ls=- 0.0021;gt=1;}
else if((LT=="RECONSTRUCTION" LT=="MILL >=4IN-OVERLAY WITH ASPHALT" LT=="RUBBILIZATION-OVERLAY" LT=="COLD-IN- PLACE RECYCLING-OVERLAY" LT=="BREAK-CRACK-SEAT- OVERLAY" LT=="FULL-DEPTH RECLAMATION- OVERLAY")){Ld=54.3291;li=1.9695;ls=-0.1039;gt=1;}}
if(gt==0){if(RG=="1"&&(LT=="OVERLAY <=1.5IN ASPHALT" LT=="MILL- ULTRATHIN BONDED WEARING COURSE")){Ld=32864163.8456;li=2.9756;ls=-0.0152;gt=1;}
else if(RG=="1"&&(LT=="OVERLAY >1.5IN ASPHALT - GAP" LT=="MILL- OVERLAY >1.5IN GRADE INCREASE - GAP")){Ld=32864163.8456;li=2.9756;ls=-0.0152;gt=1;}
else if(RG=="3"&&(LT=="OVERLAY >1.5IN ASPHALT - GAP" LT=="MILL- OVERLAY >1.5IN GRADE INCREASE - GAP")){Ld=32864163.8456;Ii=2.9756;Is=-0.0152;gt=1;}
else if((LT=="OVERLAY <=1.5IN ASPHALT - GAP" LT=="ULTRATHIN BONDED WEARING COURSE")){Ld=32864163.8456;Ii=2.9756;Is=- 0.0152;gt=1;}
else if((PT=="FCC" PT=="FCJ" PT=="COMPOSITE")&&(LT=="MICRO SURFACING" LT=="CAPE SEAL" LT=="HIGH FRICTION SURFACE")){Ld=467.7251;li=1.9154;ls=-0.0684;gt=1;}}
if((FC=="1")&&(gt==0)){if(RG=="1"){Ld=1920;li=2.32;ls=-0.02;gt=1;}
else if(RG=="2"){Ld=1500;li=2.27;ls=-0.01;gt=1;}
else if(RG=="3"){Ld=1500;li=2.27;ls=-0.01;gt=1;}}
if((FC=="2" FC=="3" FC=="6")&&(gt==0)){if(RG=="1"){Ld=80800000000;li=3.3 5;ls=-0.01;gt=1;}
else if(RG=="2"){Ld=31300;li=2.4;ls=-0.02;gt=1;}
else if(RG=="3"){Ld=83800000*Math.Pow(10,10);li=3.76;ls=-0.01;gt=1;}}

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if((FC=="7"||FC=="8"||FC=="9")&&(qt==0)){if(RG=="1"){Ld=658;li=2.01;ls=-
           0.05;gt=1;}
else if(RG=="2"){Ld=746;li=1.97;ls=-0.03;gt=1;}
else if(RG=="3"){Ld=420;li=1.99;ls=-0.06;gt=1;}}
if((FC=="11"||FC=="12")&&(gt==0)){if(RG=="1"){Ld=11200*Math.Pow(10,20);li=4.
           04;ls=-0.01;gt=1;}
else if(RG=="2"){Ld=6650000000*Math.Pow(10,10);li=3.87;ls=-0.01;gt=1;}
else if(RG=="3"){Ld=305*Math.Pow(10,10);li=3.42;ls=-0.01;gt=1;}}
if((FC=="14")&&(gt==0)){if(RG=="1"){Ld=40600000*Math.Pow(10,10);li=3.74;ls=-
           0.01;gt=1;
else if(RG=="2"){Ld=586;li=1.96;ls=-0.04;gt=1;}
else if(RG=="3"){Ld=892*Math.Pow(10,10);li=3.44;ls=-0.01;gt=1;}}
if((FC=="16"||FC=="17"||FC=="18"||FC=="19")&&(gt==0)){if(RG=="1"){Ld=727;li=
           2.03;ls=-0.04;gt=1;}
else if(RG=="2"){Ld=654;li=1.93;ls=-0.03;gt=1;}
else if(RG=="3"){Ld=656;li=1.98;ls=-0.04;gt=1;}}
if(SCDMR==0){SCDMR=0.01;}
if(LT=="MILL-ULTRATHIN BONDED WEARING COURSE"||LT=="ULTRATHIN
           BONDED WEARING COURSE"){
SCage=Ld*Math.Exp(-Math.Exp(li+ls*age))*4;
SC0=Ld*Math.Exp(-Math.Exp(li+ls*0))*4;
}
if(LT=="FOG SEAL"||LT=="REJUVANATOR"||LT=="CHIP SEAL"||LT=="SAND
           SEAL"){
SCage=Ld1*Math.Exp(-Math.Exp(li1+ls1*age))*0.4+Ld2*Math.Exp(-
           Math.Exp(li2+ls2*age))*0.6;
SC0=Ld1*Math.Exp(-Math.Exp(li1+ls1*0))*0.4+Ld2*Math.Exp(-
           Math.Exp(li2+ls2*0))*0.6;
}
else{
SCage=Ld*Math.Exp(-Math.Exp(li+ls*age));
SC0=Ld*Math.Exp(-Math.Exp(li+ls*0));}
if(SCDMR<=SC0){Answer=SCage-SC0;}
else{Answer=SCage;}
```

return Answer;

Appendices

11.11 RUTTING PERFORMANCE MODEL

The following tables and scripts provide current information for rutting model parameters.

Pavement Type	Functional Class	Family	Slope
Flexible	1	1	0.009734
Flexible	2, 3	2	0.006751
Flexible	6	3	0.007501
Flexible	7	4	0.006067
Flexible	8	5	0.005461
Flexible	9	6	0.005617
Flexible	11	7	0.006402
Flexible	12	8	0.007211
Flexible	14	9	0.009364
Flexible	16	10	0.008818
Flexible	17	11	0.006681
Flexible	18, 19	12	0.012963
Flexible over JCP	1	13	0.005547
Flexible over JCP	2, 3	14	0.007607
Flexible over JCP	6	15	0.003558
Flexible over JCP	7	16	0.005257
Flexible over JCP	8	17	0.003640
Flexible over JCP	9	18	0.007894
Flexible over JCP	11	19	0.010929
Flexible over JCP	12	20	0.004071
Flexible over JCP	14	21	0.005700
Flexible over JCP	16	22	0.007545
Flexible over JCP	17	23	0.006164
Flexible over JCP	18, 19	24	0.005736
Flexible over CRCP	1	25	0.003421
Flexible over CRCP	11	26	0.017038

Rutting Families by Functional Class and Surface Type

Most Recent Plots by Family

<u>"F" (Flexible)</u>











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"FCJ" (Flexible over JCP)



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"FCC" (Flexible over CRCP)



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Most Recent Model Functions

double age=[AGE], SL, avg_rut = [AVG_RUT]; string FC=[FUNC_CLASS], PT=[PAVEMENT_TYPE];

```
\label{eq:spectral_states} \begin{split} & \text{if}(\mathsf{PT}{==}\mathsf{"F}||\mathsf{PT}{==}\mathsf{"FLEXIBLE"}\} \\ & \text{if}(\mathsf{FC}{==}\mathsf{"1"})\{\mathsf{SL}{=}0.009734;\} \\ & \text{else if}(\mathsf{FC}{==}\mathsf{"6"})\{\mathsf{SL}{=}0.007501;\} \\ & \text{else if}(\mathsf{FC}{==}\mathsf{"7"})\{\mathsf{SL}{=}0.005461;\} \\ & \text{else if}(\mathsf{FC}{==}\mathsf{"8"})\{\mathsf{SL}{=}0.005617;\} \\ & \text{else if}(\mathsf{FC}{==}\mathsf{"11"})\{\mathsf{SL}{=}0.006402;\} \\ & \text{else if}(\mathsf{FC}{==}\mathsf{"12"})\{\mathsf{SL}{=}0.009364;\} \\ & \text{else if}(\mathsf{FC}{==}\mathsf{"14"})\{\mathsf{SL}{=}0.008818;\} \\ & \text{else if}(\mathsf{FC}{==}\mathsf{"2"}||\mathsf{FC}{==}\mathsf{"3"})\{\mathsf{SL}{=}0.006751;\} \\ & \text{else if}(\mathsf{FC}{==}\mathsf{"18"}||\mathsf{FC}{==}\mathsf{"19"})\{\mathsf{SL}{=}0.012963;\} \end{split}
```

```
else if(PT=="FCJ"||PT=="COMPOSITE"){
if(FC=="1"){SL=0.005547;}
else if(FC=="6"){SL=0.003558;}
else if(FC=="7"){SL=0.00364;}
else if(FC=="8"){SL=0.007894;}
else if(FC=="11"){SL=0.010929;}
else if(FC=="11"){SL=0.004071;}
else if(FC=="14"){SL=0.004071;}
else if(FC=="14"){SL=0.0057;}
else if(FC=="16"){SL=0.007545;}
else if(FC=="2"||FC=="3"){SL=0.007607;}
else if(FC=="18"||FC=="19"){SL=0.005736;}
```

else if(PT=="FCC"){ if(FC=="1"){SL=0.003421;} else if(FC=="11"){SL=0.017038;}}

Answer = SL*age + avg_rut; return Answer; STATE HIGHWAY ADMINISTRATION

11.12 FRICTION PERFORMANCE MODEL

The following tables and scripts provide current information for friction model parameters.

County	Functional Class	Family	Slope
CA, QA	1, 2, 11	1A	-0.6550
CA, QA	9, 18, 19	1B	-0.5036
CA, QA	7, 12, 17	1C	-0.3022
CA, QA	3, 6, 8, 14, 16	1D	-0.3906
CH, HO, WA	1, 2, 11	2A	-0.6635
CH, HO, WA	9, 18, 19	2B	-0.4890
CH, HO, WA	7, 12, 17	2C	-0.2492
CH, HO, WA	3, 6, 8, 14, 16	2D	-0.2564
BA	1, 2, 11	3A	-0.4548
BA	7, 12, 17	3C	-0.3622
BA	3, 6, 8, 14, 16	3D	-0.2978
MO, AA	1, 2, 11	4A	-0.5653
MO, AA	9, 18, 19	4B	-0.5048
MO, AA	7, 12, 17	4C	-0.2890
MO, AA	3, 6, 8, 14, 16	4D	-0.3314
SM, FR, CL	1, 2, 11	5A	-0.5805
SM, FR, CL	9, 18, 19	5B	-0.2526
SM, FR, CL	7, 12, 17	5C	-0.2141
SM, FR, CL	3, 6, 8, 14, 16	5D	-0.2038
PG, AL	1, 2, 11	6A	-0.3108
PG, AL	9, 18, 19	6B	-0.6394
PG, AL	7, 12, 17	6C	-0.5430
PG, AL	3, 6, 8, 14, 16	6D	-0.2319
CE, KE, TA, CO, WI	1, 2, 11	7A	-0.2021
CE, KE, TA, CO, WI	9, 18, 19	7B	-0.2807
CE, KE, TA, CO, WI	7, 12, 17	7C	-0.3189
CE, KE, TA, CO, WI	3, 6, 8, 14, 16	7D	-0.3444
SO, DO	1, 2, 11	8A	-0.3635
SO, DO	9, 18, 19	8B	-0.2526
SO, DO	7, 12, 17	8C	-0.2457
SO, DO	3, 6, 8, 14, 16	8D	-0.1868
HA, WO	1, 2, 11	9A	-0.3064
HA, WO	9, 18, 19	9B	-0.2730
HA, WO	7, 12, 17	9C	-0.3906
HA, WO	3, 6, 8, 14, 16	9D	-0.2420
GA	1, 2, 11	10A	-0.4593
GA	7, 12, 17	10C	-0.7543
GA	3, 6, 8, 14, 16	10D	-0.4686

Friction Families by County and Functional Class

Most Recent Plots by Family

Titles are Family Names

X-axis is age in years

Y-axis is friction value







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Most Recent Model Functions

```
// C# Function for friction models updated 12-15-2017
string CTY=[COUNTY].FC=[FUNC CLASS];
double SL=0, SKID=[SPADJ SKID NUMBER],age=[AGE];
if((CTY=="CA"||CTY=="QA") && (FC=="1"||FC=="2"||FC=="11")){SL=-0.655;}
else if((CTY=="CA"||CTY=="QA") && (FC=="9"||FC=="18"||FC=="19")){SL=-0.5036;}
else if((CTY=="CA"||CTY=="QA") && (FC=="7"||FC=="12"||FC=="17")){SL=-0.3022;}
else if((CTY=="CA"||CTY=="QA") &&
(FC=="3"||FC=="6"||FC=="8"||FC=="16"||FC=="14")){SL=-0.3906;}
else if((CTY=="CH"||CTY=="HO"||CTY=="WA") && (FC=="1"||FC=="2"||FC=="1")){SL=-
0.6635:
else if((CTY=="CH"||CTY=="HO"||CTY=="WA") &&
(FC=="9"||FC=="18"||FC=="19")){SL=-0.489;}
else if((CTY=="CH"||CTY=="HO"||CTY=="WA") &&
(FC=="7"||FC=="12"||FC=="17")){SL=-0.2492;}
else if((CTY=="CH"||CTY=="HO"||CTY=="WA") &&
(FC=="3"||FC=="6"||FC=="8"||FC=="16"||FC=="14")){SL=-0.2564;}
else if((CTY=="BA") && (FC=="1"||FC=="2"||FC=="11")){SL=-0.4548;}
else if((CTY=="BA") && (FC=="7"||FC=="12"||FC=="17")){SL=-0.3622;}
else if((CTY=="BA") && (FC=="3"||FC=="6"||FC=="8"||FC=="16"||FC=="14")){SL=-
0.2978;}
else if((CTY=="MO"||CTY=="AA") && (FC=="1"||FC=="2"||FC=="11")){SL=-0.5653;}
else if((CTY=="MO"||CTY=="AA") && (FC=="9"||FC=="18"||FC=="19")){SL=-0.5048;}
else if((CTY=="MO"||CTY=="AA") && (FC=="7"||FC=="12"||FC=="17")){SL=-0.289;}
else if((CTY=="MO"||CTY=="AA") &&
(FC=="3"||FC=="6"||FC=="8"||FC=="16"||FC=="14")){SL=-0.3314;}
else if((CTY=="SM"||CTY=="FR"||CTY=="CL") && (FC=="1"||FC=="2"||FC=="1")){SL=-
0.5805;
else if((CTY=="SM"||CTY=="FR"||CTY=="CL") && (FC=="9"||FC=="18"||FC=="19")){SL=-
0.2526;
else if((CTY=="SM"||CTY=="FR"||CTY=="CL") && (FC=="7"||FC=="12"||FC=="17")){SL=-
0.2141;
else if((CTY=="SM"||CTY=="FR"||CTY=="CL") &&
(FC=="3"||FC=="6"||FC=="8"||FC=="16"||FC=="14")){SL=-0.2038;}
else if((CTY=="PG"||CTY=="AL") && (FC=="1"||FC=="2"||FC=="11")){SL=-0.3108;}
else if((CTY=="PG"||CTY=="AL") && (FC=="9"||FC=="18"||FC=="19")){SL=-0.6394;}
else if((CTY=="PG"||CTY=="AL") && (FC=="7"||FC=="12"||FC=="17")){SL=-0.543;}
else if((CTY=="PG"||CTY=="AL") &&
(FC=="3"||FC=="6"||FC=="8"||FC=="16"||FC=="14")){SL=-0.2319;}
else if((CTY=="CE"||CTY=="KE"||CTY=="TA"||CTY=="CO"||CTY=="WI") &&
(FC=="1"||FC=="2"||FC=="11")){SL=-0.2021;}
else if((CTY=="CE"||CTY=="KE"||CTY=="TA"||CTY=="CO"||CTY=="WI") &&
(FC=="9"||FC=="18"||FC=="19")){SL=-0.2807;}
else if((CTY=="CE"||CTY=="KE"||CTY=="TA"||CTY=="CO"||CTY=="WI") &&
(FC=="7"||FC=="12"||FC=="17")){SL=-0.3189;}
```

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```
else if((CTY=="CE"||CTY=="KE"||CTY=="TA"||CTY=="CO"||CTY=="WI") &&
(FC=="3"||FC=="6"||FC=="8"||FC=="16"||FC=="14")){SL=-0.3444;}
else if((CTY=="SO"||CTY=="DO") && (FC=="1"||FC=="2"||FC=="11")){SL=-0.3635;}
else if((CTY=="SO"||CTY=="DO") && (FC=="9"||FC=="18"||FC=="19")){SL=-0.2526;}
else if((CTY=="SO"||CTY=="DO") && (FC=="7"||FC=="12"||FC=="17")){SL=-0.2457;}
else if((CTY=="SO"||CTY=="DO") &&
(FC=="3"||FC=="6"||FC=="8"||FC=="16"||FC=="14")){SL=-0.1868;}
else if((CTY=="HA"||CTY=="WO") && (FC=="1"||FC=="2"||FC=="11")){SL=-0.3064;}
else if((CTY=="HA"||CTY=="WO") && (FC=="9"||FC=="18"||FC=="19")){SL=-0.273;}
else if((CTY=="HA"||CTY=="WO") && (FC=="7"||FC=="12"||FC=="17")){SL=-0.3906;}
else if((CTY=="HA"||CTY=="WO") &&
(FC=="3"||FC=="6"||FC=="8"||FC=="16"||FC=="14")){SL=-0.242;}
else if((CTY=="GA") && (FC=="1"||FC=="2"||FC=="11")){SL=-0.4593;}
else if((CTY=="GA") && (FC=="7"||FC=="12"||FC=="17")){SL=-0.7543;}
else if((CTY=="GA") && (FC=="3"||FC=="6"||FC=="8"||FC=="16"||FC=="14")){SL=-
0.4686;}
else {SL = -0.3906;}
Answer = SL * age + SKID;
```

return Answer;

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11.13 OPTIMIZATION DATA ROLLUP METHODS

The following table and supporting information relate to the data rollup process in RoadCare.

Rollup Methods by Attribute

To accomplish the stated objective, use the following data rollup methods for each specified attribute using RoadCare:

Attribute	Avg	First	Last	Max	None	Predominant	Std. Dev	Sum
AADT	*							
AGE						*		
AGE_GROUP_HALFMILE						*		
AGE_GROUPS						*		
AVG_IRI	*							
AVG_IRI_QC	*							
AVG_REHAB_CYCLE					*			
AVG_RUT	*							
AVG_RUT_QC	*							
AVG_RUT_SDV							*	
BEGIN_LAT_LONG		*						
BEGIN_LIMIT		*						
BEGIN_MM		*						
BRIDGE						*		
BRIDGE_LONG						*		
СІ	*							
CI_FAMILY_CODE					*			
CI_FC_CATEGORY						*		
CI_FUNCTIONAL	*							
CI_MATERIAL_TYPE						*		
CI_STRUCTURAL	*							
CODE						*		
CONDITION_IRI						*		
COUNTY						*		
CRACK_SEAL_EXISTS						*		
CRACKING_SEG_GROUP						*		
CURB						*		
CY17_PMT_PROJECTS					*			
D3_CS_CANDIDATES					*			
D3_EXCLUSIONS						*		
D3_MICRO_FY18					*			
DENSITY_AVG					*			

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Attribute	Avg	First	Last	Max	None	Predominant	Std. Dev	Sum
DIR BMP		*						
			*					
DIR LANES	*							
DIR MILES								*
DISTRICT						*		
DIVIDED						*		
END LAT LONG			*					
END LIMIT			*					
END MM			*					
EVENT PAVE CHANGE						*		
EXIT NUMBER						*		
FC CATEGORY						*		
FC DENSITY	*							
FC DENSITY MR	*							
FC DENSITY QC	*							
FC DENSITY SDV							*	
FRICTION_RUT_13					*			
FRICTION_RUT_14					*			
FUNC_CLASS						*		
FUND_RTE_LIST_LMR						*		
FY16_17_SUG_PRJ						*		
GLOBAL_ROUTE_ID						*		
GOVT_CONTROL						*		
HMIS_ROUTEID						*		
HPMS_AVG_IRI					*			
HPMS_AVG_RUT					*			
HPMS_CRK_PCT_ASP					*			
HPMS_CRK_PCT_CRC					*			
HPMS_CRK_PCT_JCP					*			
HPMS_FAULTING					*			
HPMS_SEGMENTATION						*		
HPMS_SURFACE_TYPE					*			
INITIAL_SKID_NUMBER					*			
INV_CHANGE					*			
IRI_PER_SCALE					*			
IRI_PHASE4_SEG_GAPS					*			
ISCONHIST						*		
ISRAMP						*		
LANE WIDTH					*			

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Attribute	Avg	First	Last	Max	None	Predominant	Std. Dev	Sum
LAST MAINT TREATMENT						*		
LAST_MAINT_YEAR						*		
LAST_PMAINT_TREATMENT						*		
LAST_PMAINT_YEAR						*		
LAST_REHAB_TREATMENT						*		
LAST_REHAB_YEAR						*		
LAST_TREATMENT						*		
LAST_YEAR						*		
LM_DM_VMT_AREA_16					*			
LM_DM_VMT_AREA_17					*			
LM_DM_VMT_AREA_PM15					*			
LM_VMT_AREA	*							
LM_VMT_AREA_15					*			
MAIN_LINE						*		
MAPPING_AGE					*			
MAPPING_LAST_YEAR					*			
MDTA_FACILITY					*			
MDTA_SEG					*			
NHS_CODE						*		
ONE_MILE_OR_MORE						*		
PAVED_AREA_SY								*
PAVEMENT_TYPE						*		
PCC_SEGMENTS						*		
PRIMARY_DIRECTION						*		
PROGRAM					*			
PROGRAM_COST					*			
PROGRAM_COST_FY12					*			
PROGRAM_FY12					*			
PROGRAM_FY13					*			
PROGRAM_YEAR					*			
PROGRAM_YEAR_FY12					*			
PROGRAM_YEAR_FY13					*			
PROGRAM_YEAR_FY14					*			
PROGRAM_YEAR_FY15					*			
PROGRAM_YEAR_FY16						*		
PROGRAM_YEAR_FY17						*		
PROGRAM_YEAR_MDTA						*		
PROGYEAR13_EXTRA					*			
PROPOSED						*		7

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Attribute	Avg	First	Last	Max	None	Predominant	Std. Dev	Sum
PUBLIC MAP 15						*		
PUBLIC MAP 15 BEGLMT						*		
PUBLIC MAP 15 ENDLMT						*		
R IRI	*							
RAMP NUMBER						*		
REGION						*		
RESECTION					*			
RESECTION_2013					*			
RESECTION_2014					*			
RESECTION_2015					*			
RESECTION_FY16					*			
RESECTION_FY17						*		
RESECTION_OCT2014					*			
RESECTION_OPT2015					*			
RESECTION_PUBLIC_MAP_15						*		
RIGHTIRI_QC	*							
RNUM						*		
ROAD_CLASS						*		
ROAD_NAME						*		
ROUTE						*		
ROUTEID						*		
RSL_WORST_SUM	*							
RSUFF						*		
RUT_FY17					*			
RUT_SEVERITY				*				
SC_DENSITY	*							
SC_DENSITY_MR	*							
SC_DENSITY_QC	*							
SC_DENSITY_SDV							*	
SECTIONS_WO_AGE					*			
SHOP						*		
SHOULDER_WIDTH					*			
SIMDIV						*		
SKID_CATEGORY					*			
SKID_CATEGORY_WAL					*			
SKID_FY17					*			
SKID_RESECTION_WAL					*			
SKID_RUT_FY16					*			
SKID RUT FY17					*			

A 44 mile u 4 m	A	First	Leet	May	Name	Duedeminent	Ctal Davi	C
Attribute	Avg	FIrst	Last	wax	None	Predominant	Sta. Dev	Sum
SKID_RUT_LIST					*			
SPADJ_SKID_CATEGORY						*		
SPADJ_SKID_NUMBER	*							
SPADJ_SKID_NUMBER_QC	*							
SPEED_ARAN	*							
SPEED_LIMIT						*		
SPEED_SKID	*							
SUB_ROUTE_ID	*							
SURFACE_TYPE						*		
SURVEY_SPEED					*			
TEST_ATTRIBUTE					*			
TOLL_PLAZA					*			
TOTAL_LANES	*							
TREATMENT_LEVEL						*		
UNIT_COST_PROJECTS_15					*			
UNIT_COST_PROJECTS_16					*			
USE_AS_PRIMARY						*		
WET_ACCIDENT_LIST					*			
WET_ACCIDENT_LIST_15					*			
WET_ACCIDENT_LIST_16					*			

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Network Segmentation Implementation Details

To accomplish the stated objective, perform segmentation on the newly created network using the following segmentation logic using RoadCare:

- 1. split: any change GOVT_CONTROL
- 2. split: any record PROGRAM_YEAR_FY18 committed projects from PMT, non Fund77 projects, and construction history.
- 3. split: any record PCC (concrete)
- 4. split: any record long bridge (bridge >= 0.25 mile)
- 5. split: any record EVENT_PAVE_CHANGE (source vision base report)

In "Segmentation Results," set minimum = 0.5, set maximum = 6, increments = Exact. Click on "Apply to all sections" button. This will set the minimum and maximum section length to 0.5 miles and 6 miles, respectively, unless they are split due to the five reasons listed above.

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Once done, rollup network and then create an "Attribute View Report" by selecting the following attributes: BRIDGE_LONG, EVENT_PAVE_CHANGE, **CRACKING_SEG_GROUP**, FC_DENSITY, SC_DENSITY, GOVT_CONTROL, PCC_SEGMENTS, PROGRAM_YEAR_FY17, AGE_GROUPS, SIMDIV, USE_AS_PRIMARY, and BEGIN_LIMIT.

Next, create a spreadsheet template for segmentation using the resulting "attribute view report."

CRACKING_SEG_GROUP is a formula field in the spreadsheet. It is defined as CASE

WHEN SC DENSITY<5 and FC DENSITY<4 THEN 1

WHEN SC_DENSITY<5 and FC_DENSITY>=4 AND FC_DENSITY<10 THEN 2 WHEN SC_DENSITY<5 and FC_DENSITY>=10 THEN 3

WHEN SC_DENSITY>=5 AND SC_DENSITY<25 and FC_DENSITY<10 THEN 4 WHEN SC_DENSITY>=5 AND SC_DENSITY<25 and FC_DENSITY>=10 THEN 5 WHEN SC_DENSITY>=25 THEN 6 END CRACKING_SEG_GROUP

If there is a pavement change recorded for any part of the route (i.e. count EVENT_PAVE_CHANGE >0), then make the following changes in the spreadsheet:

- join adjacent sections that belong to the same cracking group, and
- if there is no cracking data available, then just use the "event_pave_change" field for segmentation.

If there is no recorded pavement change for any part of the route (i.e. count EVENT_PAVE_CHANGE =0) then make the following change in the spreadsheet:

- join adjacent sections that belong to the same cracking group, or
- else split the section where the difference in pavement age is greater than five years.

Next, update committed project limits so that there are no small sections adjacent to the committed project, as illustrated in the example below.

ROUTE	BMP_ORG	EMP_ORG	BMP_NEW	EMP_NEW	DIR	YEAR	TREATMENT
WO-MD 707E	0.07	0.82	0.07	0.827	W	2017	CRACK SEAL

ROUTE	SECTION	Original segmentation	Updated segmentation
WO-MD 707E	0.07-0.1(W)	Route Begin - committed project	Route Begin - committed project
WO-MD 707E	0.1-0.82(W)	join: with previous section - committed project	join: with previous section - committed project
WO-MD 707E	0.82-0.827(W)	split: committed project end	join: with previous section - committed project

Once done, review the remaining long/short sections and make changes as needed. Next, copy and paste these sections into a new attribute called "RESECTION_FY18" (see Data Import). Lastly, segment the network using the segmentation logic "Anyrecord" RESECTION FY18 and rollup the network.

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11.14 PAVEMENT FRICTION MANAGEMENT PROGRAM SQL PACKAGES

The following SQL package is used to break the network at every road feature or event that effects friction demand:

--- PACKAGE SPEC CREATE OR REPLACE PACKAGE FRICTION_GUIDE_PKG AS -- 4HRS TO RUN

--EXECUTE FRICTION_GUIDE_PKG.FMG_MAIN(2016,2019,NULL);

PROCEDURE P_SKID_INVENTORY (INV_YEAR NUMBER);-- 1 MINUTE PROCEDURE FMG_MAIN (INV_YEAR NUMBER, COND_YEAR NUMBER, COUNTY_IN VARCHAR2); PROCEDURE P_DH_GRADE (P_YEAR NUMBER); PROCEDURE P_CURVE_RUT(P_YEAR NUMBER); PROCEDURE P_FMG_BASE_SEGMENTATION(INV_YEAR NUMBER, COND_YEAR NUMBER, COUNTY_IN VARCHAR2); -- 3HRS PROCEDURE P_FMG_INTERMED_SEGMENTATION; --1MIN PROCEDURE P_FMG_FINAL_SEGMENTATION; PROCEDURE P_FMG_FINAL_SEGMENTATION;

END FRICTION_GUIDE_PKG;

---PACKAGE BODY CREATE OR REPLACE PACKAGE BODY FRICTION_GUIDE_PKG -- 4HRS TO RUN AS PROCEDURE P SKID INVENTORY(**INV YEAR NUMBER)** AS CURSOR C1-- CURSOR TO DECLARE TAB1 IS SELECT HMIS YEAR, GLOBAL_ROUTE ID, SUB ROUTE ID, ROUTEID, HMIS ROUTEID, DIRECTION, DIR BMP, DIR_EMP, INV_BMP, INV EMP GOVT CONTROL FROM SECTION TABLE WHERE 1=0; **TYPE TYP1** IS TABLE OF C1%ROWTYPE; TAB1 TYP1; V DIRBMP NUMBER; V DIREMP NUMBER; V INVBMP NUMBER; V INVEMP NUMBER: V INV DIR NUMBER; BEGIN EXECUTE IMMEDIATE 'TRUNCATE TABLE SKID INVENTORY'; FOR SEC TABLE IN -- FOR LOOP COLLECTING AND LOOPING DISTINCT GRID, SRID IN A GIVEN YEAR (SELECT DISTINCT HMIS_YEAR, GLOBAL ROUTE ID, SUB ROUTE ID,

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GOVT CONTROL, ROUTEID. HMIS ROUTEID, DIRECTION FROM SECTION TABLE WHERE HMIS YEAR = INV YEAR --AND GOVT CONTROL =1 ---CHANGED BY RG ON 4/11/2020 AND GOVT_CONTROL IN (1,31) --- CHANGED BY RG ON 4/11/2020 -- AND GLOBAL_ROUTE_ID IN(75307,75315,24004, 9212, 805,37037) ORDER BY GLOBAL ROUTE ID, SUB ROUTE ID LOOP V INV DIR := NULL; -- RESETTING THE VARIABLE SELECT HMIS YEAR, GLOBAL ROUTE ID, SUB ROUTE ID, ROUTEID, HMIS ROUTEID, DIRECTION, DIR BMP, DIR EMP, INV BMP, INV EMP, GOVT CONTROL BULK COLLECT INTO TAB1 FROM SECTION TABLE WHERE HMIS YEAR = SEC TABLE.HMIS YEAR AND GLOBAL ROUTE ID =SEC TABLE.GLOBAL ROUTE ID AND DIRECTION = SEC TABLE.DIRECTION AND HMIS ROUTEID =SEC_TABLE.HMIS_ROUTEID AND GOVT CONTROL = SEC TABLE.GOVT CONTROL ORDER BY HMIS_YEAR, GLOBAL_ROUTE_ID, SUB ROUTE ID, DIR BMP, DIR EMP; BEGIN -- THIS BLOCK IS FIND OUT THE INVENTORY DIRECTION OF A ROUTE. IF NO MATCHES ARE FOUND IN THE GLOBAL TABLES. ITS WRITTEN OUT IN THE EXCEPTION PART. SELECT DISTINCT USE AS PRIMARY INTO V INV DIR FROM SECTION TABLE WHERE GLOBAL_ROUTE_ID =SEC_TABLE.GLOBAL_ROUTE_ID AND SUB_ROUTE_ID = SEC_TABLE.SUB_ROUTE_ID AND HMIS YEAR =INV YEAR; EXCEPTION WHEN NO DATA_FOUND THEN DBMS OUTPUT.PUT LINE('NO RECORDS FOUND IN SECTION TABLE FOR '||SEC_TABLE.GLOBAL_ROUTE_ID||' - '||SEC_TABLE.SUB_ROUTE_ID||' - '||SEC_TABLE.DIRECTION); END: --DBMS OUTPUT.PUT LINE(V INV DIR); V DIRBMP := NULL; V_DIREMP := NULL; V INVBMP := NULL: V INVEMP := NULL: IF V INV DIR IS NOT NULL THEN FOR I IN 1.. TAB1.COUNT LOOP IF TAB1.COUNT = 1 THEN -- IF ONLY ONE RECORD EXISTS FOR THE ROUTE INSERT INTO SKID INVENTORY

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INV YEAR, GLOBAL ROUTE ID, SUB ROUTE ID, ROUTEID. HMIS ROUTEID, DIRECTION, DIR_BMP, DIR_EMP, INV_BMP, INV EMP, GOVT CONTROL VALUES TAB1(I).HMIS YEAR, TAB1(I).GLOBAL ROUTE ID, TAB1(I).SUB_ROUTE_ID, TAB1(I).ROUTEID, TAB1(I).HMIS_ROUTEID, TAB1(I).DIRECTION, TAB1(I).DIR BMP, TAB1(I).DIR EMP, TAB1(I).INV BMP, TAB1(I).INV EMP, TAB1(I).GOVT_CONTROL); ELSIF TAB1.COUNT > 1 THEN = 1 THEN IF I V_DIRBMP := TAB1(I).DIR_BMP; V DIREMP := TAB1(I).DIR EMP; V INVBMP := TAB1(I).INV BMP; V INVEMP := TAB1(I).INV_EMP; --DBMS_OUTPUT_PUT_LINE('1ST-'||V_DIRBMP||'-'||V_DIREMP); ELSIF I >1 THEN -- IF THE ROUTE HAS MULTIPLE RECORDS IF TAB1(I).DIR BMP <= TAB1(I-1).DIR EMP THEN -- IF THE CURRENT RECORD IS LESS THAN .04 MILES AWAY FROM THE PREVIOUS RECORD, THE RECORDS ARE ASSUMED CONTINOUS--TAKEN OUT ON 5/23/2017 DUE TO CASES LIKE GRID 1461 V DIREMP := TAB1(I).DIR EMP; IF V INV DIR =1 THEN V INVEMP := TAB1(I).INV EMP; ELSE V INVBMP := TAB1(I).INV_BMP; END IF; ELSIF TAB1(I).DIR BMP > TAB1(I-1).DIR_EMP THEN -- IF THE CURRENT RECORD IS MORE THAN .04 MILES AWAY FROM THE PREVIOUS RECORD, THE RECORDS ARE ASSUMED NON-CONTINOUS AND A BREAK IS INTRODUCED -- TAKEN OUT ON 5/23/2017 DUE TO CASES LIKE GRID 1461 -- DBMS_OUTPUT.PUT_LINE('2ND-'||V_DIRBMP||'-'||V_DIREMP); INSERT INTO SKID INVENTORY INV YEAR, GLOBAL ROUTE ID, SUB ROUTE ID, ROUTEID. HMIS ROUTEID, DIRECTION, DIR_BMP, DIR_EMP INV BMP,

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INV EMP, GOVT CONTROL VALUES TAB1(I).HMIS YEAR, TAB1(I).GLOBAL ROUTE ID, TAB1(I).SUB_ROUTE_ID, TAB1(I).ROUTEID, TAB1(I).HMIS_ROUTEID, TAB1(I).DIRECTION, V_DIRBMP, V_DIREMP, V INVBMP, V INVEMP TAB1(I).GOVT_CONTROL); V_DIRBMP := TAB1(I).DIR_BMP; V_DIREMP := TAB1(I).DIR_EMP; --IF V_INV_DIR =1 THEN V INVEMP := TAB1(I).INV EMP; -- ELSE V INVBMP := TAB1(I).INV_BMP; -- END IF; END IF; END IF; IF I =TAB1.COUNT THEN -- ONE FINAL INSERT IS DONE AT THE LAST RECORD. INSERT INTO SKID INVENTORY (INV YEAR, GLOBAL ROUTE ID, SUB_ROUTE_ID, ROUTEID, HMIS_ROUTEID, DIRECTION, DIR BMP, DIR EMP, INV_BMP, INV EMP. GOVT CONTROL VALUES (TAB1(I).HMIS_YEAR, TAB1(I).GLOBAL ROUTE ID, TAB1(I).SUB ROUTE ID, TAB1(I).ROUTEID, TAB1(I).HMIS_ROUTEID, TAB1(I).DIRECTION, V DIRBMP, V DIREMP, V INVBMP, V INVEMP, TAB1(I).GOVT CONTROL); --DBMS OUTPUT.PUT LINE('3RD-'||V DIRBMP||'-'||V DIREMP); END IF; END IF; END LOOP; COMMIT;

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END IF; END LOOP; MERGE INTO SKID INVENTORY A USING (SELECT DISTINCT LU.DISTRICT, -- SEC.GOVT CONTROL SEC.COUNTY, SEC.MUNICIPALITY, SEC.ROUTE, SEC.RNUM, SEC.RSUFF, SEC.ASSOCIATED ID PREFIX, SEC.EXIT_NUMBER, SEC.RAMP_NUMBER, SEC.GLOBAL ROUTE ID. SEC.SUB ROUTE ID FROM SECTION TABLE SEC, SKID INVENTORY BUS PAVCORE.LU_COUNTY LU WHERE SEC.HMIS_YEAR = INV_YEAR AND SEC.GLOBAL ROUTE ID = BUS.GLOBAL ROUTE ID AND SEC.SUB ROUTE ID = BUS.SUB ROUTE ID AND LU.COUNTY CODE = SEC.COUNTY B ON (A.GLOBAL_ROUTE_ID = B.GLOBAL_ROUTE_ID AND A.SUB_ROUTE_ID = B.SUB_ROUTE_ID) WHEN MATCHED THEN UPDATE SET A.DISTRICT = B.DISTRICT, A.COUNTY = B.COUNTY, A.MUNICIPALITY = B.MUNICIPALITY, = B.ROUTE, A.ROUTE = B.RNUM, A.RNUM A.RSUFF = B.RSUFF, A.ASSOCIATED_ID_PREFIX= B.ASSOCIATED_ID_PREFIX, A.EXIT NUMBER = B.EXIT_NUMBER, A.RAMP_NUMBER = B.RAMP_NUMBER; --- ADDRESS THE ROUTES WITH MAIN LINE CODE 9 WHICH WE DIDNT USE IN SECTION TABLE DUE TO MISSING ATTRIBUTES MERGE INTO SKID INVENTORY A USING (SELECT DISTINCT ROUTEID FROM HMIS UNIVERSE ALL YEARS WHERE MAIN LINE =9 =INV YEAR AND YEAR) B ON (SUBSTR(A.ROUTEID, 1, 14) = SUBSTR(B.ROUTEID, 1, 14)) WHEN MATCHED THEN UPDATE SET A.HMIS_ROUTEID = B.ROUTEID WHERE A.SUB_ROUTE_ID =2; COMMIT: -- ADDEDON 9/21/2021 TO ADDRESS CASES WHEN NON INVENTORY DIR BMP IS NOT ZERO LIKE 75315 UPDATE SKID INVENTORY SET DIR BMP=ROUND(DIR BMP,2), INV BMP = ROUND(INV BMP,2); -- FOR I IN -- (SELECT * FROM SKID INVENTORY -- WHERE (GLOBAL ROUTE ID, SUB ROUTE ID) IN -- (SELECT GLOBAL ROUTE ID, SUB ROUTE ID --FROM (SELECT GLOBAL ROUTE ID, SUB ROUTE ID, ---COUNT(*) ---FROM SKID_INVENTORY ---WHERE SUB_ROUTE_ID = 2 -----AND SUBSTR(HMIS ROUTEID, 16, 1) <> 9
GROUP BY GLOBAL ROUTE ID,

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SUB ROUTE ID ------HAVING COUNT(*)=1 ---) ---) -- AND DIR BMP>0 -- ORDER BY 1,2 --) -- LOOP -- IF I.INV_BMP = 0 THEN --UPDATE SKID INVENTORY ---SET DIR BMP =INV BMP, DIR EMP = INV EMP ---WHERE GLOBAL_ROUTE_ID = I.GLOBAL_ROUTE_ID ---AND SUB ROUTE ID = I.SUB ROUTE ID; -----ELSE UPDATE SKID INVENTORY SET DIR BMP ---=0, DIR EMP = DIR EMP-DIR BMP ___ ---WHERE GLOBAL ROUTE ID = I.GLOBAL ROUTE ID AND SUB ROUTE ID = I.SUB ROUTE ID; ---- END IF: -- END LOOP; END P_SKID_INVENTORY; PROCEDURE FMG MAIN(INV YEAR NUMBER, COND YEAR NUMBER. COUNTY IN VARCHAR2) AS INDEX CHECK NUMBER; BEGIN -- DBMS SQLTUNE.ACCEPT SQL PROFILE(TASK NAME => 'STANAME7943', TASK OWNER => 'PAV_CONHIST', REPLACE => TRUE); --DBMS_SQLTUNE.ACCEPT_SQL_PROFILE(TASK_NAME => 'STANAME88142', TASK_OWNER => 'PAV_CONHIST', REPLACE => TRUE); DBMS_PROFILER.START_PROFILER(SYSDATE); SHA OPTIMIZE2; -- P DH GRADE (COND YEAR);-- RUN ONCE FOR THE WHOLE NETWORK -- P CURVE RUT (COND YEAR);-- RUN ONCE FOR THE WHOLE NETWORK -- INSERT -- INTO PROC PKG RUN LOG VALUES --('BEGIN P_SKID_INVENTORY', --SYSTIMESTAMP ----); -- COMMIT; -- P SKID INVENTORY(INV YEAR); SELECT COUNT(*) INTO INDEX CHECK -- CHECKS FOR INDEX INDX1 BUSSPLAN 1MILE AND DROPS IT IF IT EXITS FROM USER INDEXES WHERE INDEX NAME= 'FMG BASE IDX1'; IF INDEX CHECK =1 THEN EXECUTE IMMEDIATE 'DROP INDEX FMG BASE IDX1'; END IF: SELECT COUNT(*) INTO INDEX_CHECK -- CHECKS FOR INDEX INDX1_BUSSPLAN 1MILE AND DROPS IT IF IT EXITS FROM USER INDEXES WHERE INDEX_NAME= 'FMG_BASE_IDX2'; IF INDEX_CHECK =1 THEN EXECUTE IMMEDIATE 'DROP INDEX FMG_BASE_IDX2'; END IF;

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INSERT INTO PROC PKG RUN LOG VALUES 'BEGIN P FMG_BASE_SEGMENTATION', SYSTIMESTAMP); COMMIT; P_FMG_BASE_SEGMENTATION(INV_YEAR, COND_YEAR, COUNTY_IN); SELECT COUNT(*) INTO INDEX_CHECK -- CHECKS FOR INDEX INDX1_BUSSPLAN_1MILE AND DROPS IT IF IT EXITS FROM USER_INDEXES WHERE INDEX NAME= 'FMG BASE IDX1'; IF INDEX CHECK =0 THEN EXECUTE IMMEDIATE 'CREATE INDEX FMG BASE IDX1 ON FMG_BASE_SEGMENTS(COLLECT_YEAR, GLOBAL ROUTE ID, SUB ROUTE ID, BMP, EMP) ۰. END IF; SELECT COUNT(*) INTO INDEX CHECK -- CHECKS FOR INDEX INDX1 BUSSPLAN 1MILE AND DROPS IT IF IT EXITS FROM USER INDEXES WHERE INDEX NAME= 'FMG_BASE_IDX2'; IF INDEX CHECK =0 THEN EXECUTE IMMEDIATE 'CREATE INDEX FMG BASE IDX2 ON FMG BASE SEGMENTS(COLLECT YEAR, HMIS ROUTEID, EMP. GLOBAL ROUTE ID, SUB ROUTE ID) END IF; INSERT INTO PROC PKG RUN LOG VALUES ('BEGIN P FMG_INTERMED_SEGMENTATION', SYSTIMESTAMP); COMMIT; P_FMG_INTERMED_SEGMENTATION; INSERT INTO PROC_PKG_RUN_LOG VALUES ('BEGIN P_FMG_FINAL_SEGMENTATION', SYSTIMESTAMP); COMMIT: P_FMG_FINAL_SEGMENTATION; INSERT INTO PROC PKG RUN LOG VALUES 'BEGIN P_FMG_ATTRIBUTE_UPDATE', SYSTIMESTAMP COMMIT; P_FMG_ATTRIBUTE_UPDATE; INSERT INTO PROC_PKG_RUN_LOG VALUES

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'END P FMG ATTRIBUTE UPDATE', SYSTIMESTAMP): COMMIT; DBMS PROFILER.STOP PROFILER; END FMG MAIN ; PROCEDURE P_DH_GRADE P_YEAR NUMBER) AS CURSOR CO IS SELECT DISTINCT S.GLOBAL ROUTE ID, S.SUB ROUTE ID FROM FINAL CONDITION DETAIL SKID S WHERE COLLECT_YEAR = P_YEAR -- AND GLOBAL_ROUTE_ID = 1400 --AND SUB ROUTE ID =1 -- AND COUNTY ='AL' -- AND EXISTS (SELECT NULL ---FROM FMG_MANUAL_ROUTES M ---WHERE S.GLOBAL_ROUTE_ID= M.GLOBAL_ROUTE_ID ---AND S.SUB_ROUTE_ID = M.SUB_ROUTE_ID --ORDER BY 1,2; TYPE TYP0 IS TABLE OF C0%ROWTYPE; TAB0 TYP0; CURSOR C1 IS SELECT * FROM DH_GRADE_SKID ; TYPE TYP1 IS TABLE OF C1%ROWTYPE: TAB1 TYP1: V BMP NUMBER; V EMP NUMBER; BEGIN EXECUTE IMMEDIATE ' TRUNCATE TABLE DH_GRADE_SKID'; OPEN C0; LOOP FETCH C0 BULK COLLECT INTO TAB0 LIMIT 100; EXIT WHEN TAB0.COUNT =0; FOR N IN 1.. TAB0. COUNT LOOP SELECT * BULK COLLECT INTO TAB1 FROM (SELECT P YEAR, TAB0(N).GLOBAL ROUTE ID, TABO(N).SUB ROUTE ID, BMP DIR BMP, EMP DIR_EMP, EMP-BMP SEC_LENGTH, SEC_ATTRIBUTE FROM

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(SELECT MIN(DIR BMP) BMP, MAX(DIR EMP) EMP, SEC ATTRIBUTE, SEC RN FROM (SELECT DIR BMP, DIR EMP, SEC_ATTRIBUTE, RN_, ROW_NUMBER() OVER(ORDER BY RN_) -ROW_NUMBER() OVER(PARTITION BY SEC ATTRIBUTE ORDER BY RN) AS SEC RN FROM (SELECT TT.*. ROWNUM RN -- THIS SUBQUERY SORTS THE INCOMING ATTRIBUTE AND SUPPLIES THE RN FIELD. FROM (SELECT DISTINCT DIR BMP, DIR EMP, CASE WHEN GRADE>-5 THEN 'NO DH GRADE' WHEN GRADE >= -10 AND GRADE <= -5 THEN 'DH GRADE_5_TO_10' WHEN GRADE < -10 THEN 'DH GRADE 10' END SEC ATTRIBUTE FROM FINAL CONDITION DETAIL SKID WHERE COLLECT YEAR = P YEAR AND GLOBAL ROUTE ID = TABO(N).GLOBAL ROUTE ID AND SUB ROUTE ID = TAB0(N).SUB_ROUTE_ID ORDER BY 1) TT)) **GROUP BY SEC_ATTRIBUTE**, SEC_RN) -- WHERE SEC ATTRIBUTE IN ('DH GRADE 10','DH GRADE 5 TO 10')) WHERE SEC ATTRIBUTE ='DH GRADE 5 TO 10' ORDER BY 1,2,3,4 ; V_BMP := NULL; V EMP := NULL; FOR I IN 1.. TAB1. COUNT LOOP = 1 THEN IF I V BMP := TAB1(I).DIR BMP; := TAB1(I).DIR EMP; V EMP ELSIF I > 1 THEN IF TAB1(I).DIR_BMP <= TAB1(I - 1).DIR_EMP+.01 THEN V EMP := TAB1(I).DIR EMP; ELSIF TAB1(I).DIR BMP > TAB1(I - 1).DIR EMP+.01 THEN INSERT INTO DH GRADE SKID VALUES TAB1(I).COLLECT YEAR, TAB1(I).GLOBAL_ROUTE_ID, TAB1(I).SUB_ROUTE_ID, V_BMP. V_EMP,

NULL, TAB1(I).SEC ATTRIBUTE); V BMP := TAB1(I).DIR BMP; V_EMP := TAB1(I).DIR_EMP; END IF; END IF; IF I = TAB1.COUNT THEN INSERT INTO DH GRADE SKID VALUES (TAB1(I).COLLECT_YEAR, TAB1(I).GLOBAL_ROUTE_ID, TAB1(I).SUB_ROUTE_ID, V BMP, V EMP, NULL, TAB1(I).SEC_ATTRIBUTE); END IF; END LOOP; END LOOP: END LOOP; CLOSE C0; -- DH_GRADE_10 LOOP OPEN C0; LOOP FETCH C0 BULK COLLECT INTO TAB0 LIMIT 100; EXIT WHEN TAB0.COUNT =0; FOR N IN 1.. TAB0. COUNT LOOP SELECT * BULK COLLECT INTO TAB1 FROM (SELECT P_YEAR, TAB0(N).GLOBAL ROUTE ID, TAB0(N).SUB_ROUTE_ID, BMP DIR BMP, EMP DIR EMP. EMP-BMP SEC LENGTH, SEC ATTRIBUTE FROM (SELECT MIN(DIR_BMP) BMP, MAX(DIR_EMP) EMP, SEC_ATTRIBUTE, SEC_RN FROM (SELECT DIR BMP, DIR EMP, SEC ATTRIBUTE, RN . ROW NUMBER() OVER(ORDER BY RN) - ROW NUMBER() OVER(PARTITION BY SEC ATTRIBUTE ORDER BY RN) AS SEC RN FROM (SELECT TT.*, ROWNUM RN -- THIS SUBQUERY SORTS THE INCOMING ATTRIBUTE AND SUPPLIES THE RN FIELD. FROM (SELECT DISTINCT DIR_BMP, DIR_EMP,

```
CASE
      WHEN GRADE>-5
      THEN 'NO DH GRADE'
      WHEN GRADE >= -10
      AND GRADE <= -5
      THEN 'DH GRADE 5 TO 10'
      WHEN GRADE < -10
      THEN 'DH_GRADE_10'
      END SEC_ATTRIBUTE
     FROM FINAL_CONDITION_DETAIL_SKID
    WHERE COLLECT_YEAR = P_YEAR
    AND GLOBAL_ROUTE_ID = TAB0(N).GLOBAL_ROUTE_ID
    AND SUB_ROUTE_ID = TAB0(N).SUB_ROUTE_ID
     ORDER BY 1
    ) TT
   )
   )
 GROUP BY SEC_ATTRIBUTE,
  SEC_RN
 )
 -- WHERE SEC ATTRIBUTE IN ('DH GRADE 10','DH GRADE 5 TO 10')
 )
WHERE SEC ATTRIBUTE ='DH GRADE 10'
ORDER BY 1,2,3,4 ;
V BMP := NULL;
V EMP := NULL;
FOR I IN 1.. TAB1. COUNT
LOOP
 IF I
             = 1 THEN
 V BMP
              := TAB1(I).DIR BMP;
 V EMP
               := TAB1(I).DIR EMP;
 ELSIF I
              > 1 THEN
 IF TAB1(I).DIR_BMP <= TAB1(I - 1).DIR_EMP+.01 THEN
  V EMP
               := TAB1(I).DIR_EMP;
 ELSIF TAB1(I).DIR_BMP > TAB1(I - 1).DIR_EMP+.01 THEN
   INSERT
   INTO DH GRADE SKID VALUES
    (
     TAB1(I).COLLECT_YEAR,
    TAB1(I).GLOBAL ROUTE ID,
    TAB1(I).SUB ROUTE ID,
    V BMP,
    V EMP,
    NULL,
    TAB1(I).SEC_ATTRIBUTE
    );
  V BMP := TAB1(I).DIR BMP;
  V EMP := TAB1(I).DIR EMP;
 END IF;
 END IF:
 IF I = TAB1.COUNT THEN
 INSERT
 INTO DH GRADE SKID VALUES
   (
   TAB1(I).COLLECT_YEAR,
   TAB1(I).GLOBAL_ROUTE ID,
    TAB1(I).SUB ROUTE ID,
    V_BMP,
    V_EMP,
    NULL,
    TAB1(I).SEC_ATTRIBUTE
```

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): END IF; END LOOP; END LOOP; END LOOP; CLOSE CO: UPDATE DH GRADE SKID SET SEC_LENGTH = DIR_EMP- DIR_BMP; END P_DH_GRADE; PROCEDURE P_CURVE_RUT(P_YEAR NUMBER) AS CNT NUMBER: YEAR LOOP NUMBER ; BEGIN EXECUTE IMMEDIATE 'TRUNCATE TABLE FINAL CONDITION DETAIL SKID'; FOR I IN (SELECT DISTINCT GLOBAL_ROUTE_ID, SUB_ROUTE_ID FROM SKID_INVENTORY -- WHERE GLOBAL ROUTE ID =809 -- AND SUB ROUTE ID =1 ORDER BY 1,2 LOOP YEAR LOOP := P YEAR; WHILE YEAR LOOP>=P YEAR-10 LOOP SELECT COUNT(*) INTO CNT FROM FINAL CONDITION DETAIL WHERE GLOBAL ROUTE ID = I.GLOBAL ROUTE ID AND SUB_ROUTE_ID = I.SUB_ROUTE_ID AND COLLECT_YEAR = YEAR_LOOP; -- DBMS_OUTPUT.PUT_LINE(YEAR_LOOP||'-'||38||'-'||CNT); IF CNT >0 THEN INSERT INTO FINAL_CONDITION_DETAIL_SKID SELECT P_YEAR COLLECT_YEAR, COLLECT_YEAR SOURCE_YEAR, GLOBAL ROUTE ID, SUB ROUTE ID, DIR BMP, DIR EMP INV_BMP, INV EMP, L RUT, R RUT, GRADE FROM FINAL_CONDITION_DETAIL WHERE GLOBAL_ROUTE_ID = I.GLOBAL_ROUTE_ID AND SUB ROUTE ID = I.SUB ROUTE ID AND COLLECT YEAR = YEAR LOOP ORDER BY DIR BMP; --DBMS OUTPUT.PUT LINE(56); EXIT; ELSE SELECT COUNT(*) INTO CNT FROM FINAL_CONDITION_DETAIL WHERE GLOBAL_ROUTE_ID_ORG = I.GLOBAL_ROUTE_ID AND SUB_ROUTE_ID_ORG = I.SUB_ROUTE_ID

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AND COLLECT_YEAR = YEAR LOOP; IF CNT >0 THEN INSERT INTO FINAL CONDITION DETAIL SKID SELECT P YEAR COLLECT YEAR, COLLECT YEAR SOURCE YEAR, GLOBAL ROUTE ID ORG, SUB ROUTE ID ORG, DIR_BMP_ORG, DIR_EMP_ORG, INV_BMP_ORG, INV_EMP_ORG, L RUT, R RUT, GRADE FROM FINAL CONDITION DETAIL WHERE GLOBAL_ROUTE_ID_ORG = I.GLOBAL_ROUTE_ID AND SUB ROUTE_ID_ORG = I.SUB_ROUTE_ID AND COLLECT_YEAR = YEAR_LOOP ORDER BY DIR BMP; DBMS_OUTPUT.PUT_LINE(85); EXIT; ELSE YEAR LOOP:=YEAR LOOP-1; -- DBMS_OUTPUT.PUT_LINE(YEAR_LOOP||'-'||59||'-'||CNT); END IF: END IF; END LOOP: END LOOP; END P CURVE RUT; PROCEDURE P FMG BASE SEGMENTATION(INV YEAR NUMBER, COND YEAR NUMBER. COUNTY_IN VARCHAR2) AS CURSOR C1 IS SELECT BMP, EMP FROM FMG BASE SEGMENTS; TYPE TYP1 IS TABLE OF C1%ROWTYPE; TAB1 TYP1; MAX_MP NUMBER; MIN MP NUMBER; ROUTE CNT NUMBER; DIR MAX MP NUMBER; DIR MIN MP NUMBER; BEGIN EXECUTE IMMEDIATE 'TRUNCATE TABLE FMG_BASE_SEGMENTS'; FOR ROUTE LIST IN (SELECT DISTINCT S.GLOBAL ROUTE ID, S.SUB ROUTE ID, S.GOVT CONTROL, S.HMIS ROUTEID, S.DIR BMP, S.DIR_EMP, S.INV_BMP, S.INV_EMP FROM SKID_INVENTORY S WHERE COUNTY =

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CASE WHEN COUNTY IN IS NOT NULL THEN COUNTY IN ELSE COUNTY END -- WHERE EXISTS -- (SELECT NULL -- FROM FMG_MANUAL_ROUTES M -- WHERE S.GLOBAL_ROUTE_ID= M.GLOBAL_ROUTE_ID -- AND S.SUB_ROUTE_ID = M.SUB_ROUTE_ID --) -- AND GLOBAL_ROUTE_ID IN(37037, 805) -- AND SUB ROUTE ID =2 ORDER BY 1.2.5 LOOP IF ROUTE LIST.SUB ROUTE ID =1 OR (ROUTE LIST.SUB ROUTE ID =2 AND SUBSTR(ROUTE_LIST.HMIS_ROUTEID,16,1)=9) THEN --- NON INV DIRECTION IN UNIVERSE TABLE INSERT INTO FMG_BASE_SEGMENTS (COLLECT YEAR, GOVT_CONTROL, HMIS ROUTEID, GLOBAL ROUTE_ID, SUB ROUTE ID, BMP, EMP) -- SPEED LIMIT CRITERIA WITH SPEED LIMIT AS (SELECT DISTINCT ROUTEID, ID MP BMP, ID_MP+SECTION_LENGTH EMP, CASE WHEN H.SPEED LIMIT>=55-- CHANGED ON 9/17/2021 BASED ON EMAIL FROM PD THEN 'ABOVE 55' WHEN H.SPEED LIMIT>=35 AND H.SPEED LIMIT <55 THEN 'BELOW 55' ELSE 'BELOW 35' END SEC ATTRIBUTE FROM HMIS_UNIVERSE_ALL_YEARS H WHERE YEAR = INV_YEAR AND ROUTEID = ROUTE LIST.HMIS ROUTEID --AND MEDIAN TY IN (4,5) ORDER BY ID MP), WITH SPEED_LIMIT AS ---(SELECT MIN(DIR BMP) BMP, ---MAX(DIR EMP) EMP, --SEC ATTRIBUTE, ___ --SEC RN ---FROM (SELECT DIR BMP, ---DIR EMP, ___ SEC ATTRIBUTE, ___ RN_, ---ROW_NUMBER() OVER(ORDER BY RN_) -ROW_NUMBER() OVER(PARTITION BY SEC_ATTRIBUTE ORDER BY RN_) AS SEC_RN FROM

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(SELECT TT.*, ROWNUM RN -- THIS SUBQUERY SORTS THE INCOMING ATTRIBUTE AND SUPPLIES THE RN FIELD. FROM (SELECT DISTINCT ROUTEID, ___ ID MP DIR BMP. --ID_MP+SECTION_LENGTH DIR_EMP, ___ CASE --WHEN SPEED_LIMIT>=55 ___ THEN 'ABOVE 55' ___ --ELSE 'BELOW 55' END SEC_ATTRIBUTE --FROM HMIS UNIVERSE ALL YEARS --WHERE YEAR = INV YEAR --AND ROUTEID = ROUTE LIST.HMIS ROUTEID ----AND MEDIAN_TY IN (4,5) --ORDER BY ID MP ----) TT --) --) GROUP BY SEC ATTRIBUTE, ___ SEC RN ___ --), -- DIVIDED VS UNDIVIDED CRITERIA DIVIDED AS (SELECT DISTINCT ROUTEID, ID MP BMP, ID MP+SECTION LENGTH EMP, CASE WHEN MEDIAN TY IN (4,5) THEN 'UNDIVIDED' ELSE 'DIVIDED' END SEC_ATTRIBUTE FROM HMIS_UNIVERSE_ALL_YEARS WHERE YEAR = INV_YEAR AND ROUTEID = ROUTE LIST.HMIS ROUTEID --AND MEDIAN TY IN (4,5) ORDER BY ID MP), DIVIDED AS ----(SELECT MIN(DIR BMP) BMP, MAX(DIR EMP) EMP, --SEC_ATTRIBUTE, --SEC_RN --FROM --(SELECT DIR BMP, ___ DIR EMP, --SEC ATTRIBUTE, --RN --ROW_NUMBER() OVER(ORDER BY RN_) -ROW_NUMBER() OVER(PARTITION BY SEC_ATTRIBUTE ORDER BY RN_) AS SEC_RN FROM ----(SELECT TT.*, ROWNUM RN -- THIS SUBQUERY SORTS THE INCOMING ATTRIBUTE AND SUPPLIES THE RN FIELD. FROM (SELECT DISTINCT ROUTEID, --ID MP DIR_BMP, --ID_MP+SECTION_LENGTH DIR_EMP, --CASE ___ WHEN MEDIAN_TY IN (4,5)

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THEN 'UNDIVIDED' ELSE 'DIVIDED' ___ --END SEC ATTRIBUTE FROM HMIS UNIVERSE ALL YEARS --WHERE YEAR = INV YEAR --AND ROUTEID = ROUTE LIST.HMIS ROUTEID ----AND MEDIAN TY IN (4,5) --ORDER BY ID_MP --) TT -----) --) GROUP BY SEC_ATTRIBUTE, ___ SEC RN --**ORDER BY 1** ------ RUT>.25 CRITERIA RUT AS (SELECT * FROM (SELECT DISTINCT DIR_BMP BMP, DIR EMP EMP, CASE WHEN (L_RUT+R_RUT)/2 >0.25 THEN 'HIGH RUT' ELSE 'LOW RUT' END SEC ATTRIBUTE FROM FINAL CONDITION DETAIL SKID WHERE COLLECT YEAR = COND YEAR AND GLOBAL_ROUTE_ID = ROUTE_LIST.GLOBAL_ROUTE ID AND SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID -- AND (L RUT+R RUT)/2 >0.25 -- AND DIR BMP >=0 -- AND DIR_EMP < 1 ORDER BY 1) TT WHERE SEC ATTRIBUTE ='HIGH RUT'), RUT AS ___ (SELECT * --FROM ----(SELECT MIN(DIR BMP) BMP, MAX(DIR EMP) EMP, --SEC_ATTRIBUTE, --DISTANCE --FROM ----(SELECT DIR BMP, ---DIR EMP, ---SEC ATTRIBUTE, RN --ROW_NUMBER() OVER(ORDER BY RN_) -ROW_NUMBER() OVER(PARTITION BY SEC_ATTRIBUTE ORDER BY RN_) AS DISTANCE FROM ----(SELECT TT.*, ROWNUM RN -- THIS SUBQUERY SORTS THE INCOMING ATTRIBUTE AND SUPPLIES THE RN FIELD. FROM (SELECT DISTINCT DIR_BMP DIR BMP, --DIR_EMP DIR_EMP, --CASE --WHEN (L_RUT+R_RUT)/2 >0.25 ___ THEN 'HIGH RUT' ___

MaryLand DEPARTMENT OF TRANSPORTATION

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ELSE 'LOW_RUT' END SEC_ATTRIBUTE FROM FINAL_CONDITION_DETAIL_SKID WHERE COLLECT_YEAR = COND_YEAR AND GLOBAL_ROUTE_ID = ROUTE_LIST.GLOBAL_ROUTE_ID AND SUB_ROUTE_ID = ROUTE_LIST.SUB_ROUTE_ID AND (L_RUT+R_RUT)/2 >0.25 AND DIR_BMP >=0 AND DIR_EMP <1 ORDER BY 1) GROUP BY SEC_ATTRIBUTE, DISTANCE	
) WHERE SEC_ATTRIBUTE ='HIGH_RUT'	
), – – – – CURVE > 250 CRITERIA CURVE AS	
(SELECT CASE	
WHEN ADJ_BMP <route_list.dir_bmp THEN ROUTE_LIST.DIR_BMP ELSE ADJ_BMP END DIR_BMP, CASE</route_list.dir_bmp 	
WHEN ADJ_EMP>ROUTE_LIST.DIR_EMP THEN ROUTE_LIST.DIR_EMP ELSE ADJ_EMP END DIR_EMP, SEC_ATTRIBUTE	
FROM (SELECT BMP , EMP, SEC_LENGTH,	
CASE WHEN SEC_LENGTH<.1 THEN ROUND(BMP-((.1-SEC_LENGTH)/2),3) ELSE BMP END ADJ_BMP,	
CASE WHEN SEC_LENGTH<.1 THEN ROUND(EMP+((.1-SEC_LENGTH)/2),3) ELSE EMP	
SEC_ATTRIBUTE FROM (SELECT DIR BMR BMR	
DIR_EMP EMP, DIR_EMP-DIR_BMP SEC_LENGTH,	
WHEN RADIUS <=25000 AND RADIUS > 0 THEN 'CURVE 750'	
ELSE 'CURVE_NOT750' END SEC_ATTRIBUTE FROM CURVE_H_SHA_NETWORK@PAV_CONHIST_ASSET	
WHERE YEAR = COND_YEAR AND GLOBAL_ROUTE_ID = ROUTE_LIST.GLOBAL_ROUTE_ID AND SUB_ROUTE_ID = ROUTE_LIST.SUB_ROUTE_ID	

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```
)
  ___
      )
  -- WHERE SEC ATTRIBUTE = 'CURVE 750'
  -- ),
  CURVE AS
  (SELECT BMP DIR BMP,
   EMP DIR EMP,
   SEC_ATTRIBUTE
  FROM
   (SELECT DIR BMP BMP,
    DIR EMP EMP,
    DIR EMP-DIR_BMP SEC_LENGTH,
    CASE
             WHEN RADIUS <=250*3.28 --CHANGED ON 12/16/2020 BASED ON THE EMAIL FROM
ΒX
     WHEN RADIUS <= 250*3 -- CHANGED ON 09/17/2021 BASED ON THE EMAIL FROM PD
     AND RADIUS > 0
     THEN 'CURVE 750'
     WHEN RADIUS <= 250 *6 -- CHANGED ON 10/07/2021 BASED ON THE EMAIL FROM KM
     AND RADIUS > 250*3
     THEN 'CURVE 1500'
     ELSE 'CURVE_NOT750'
    END SEC ATTRIBUTE
    FROM CURVE_H_SHA_NETWORK@PAV_CONHIST_ASSET
                   = COND YEAR
   WHERE YEAR
   AND GLOBAL ROUTE ID = ROUTE LIST.GLOBAL ROUTE ID
   AND SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID
   )
    --WHERE SEC ATTRIBUTE = 'CURVE 750'
  WHERE SEC ATTRIBUTE <> 'CURVE NOT750'--CHANGED ON 10/07/2021 BASED ON THE EMAIL
FROM KM
  ),
  -- INTERSECTIONS
  INTERSECTIONS AS
  (SELECT
   CASE
    WHEN ID MP-.1>=0
    THEN ID MP-.1
    ELSE 0
   END BMP
   ID MP EMP
   MP INT RTE NAME SEC ATTRIBUTE
  FROM HMIS_MASTER_ALL_YEARS
  WHERE YEAR
                    = INV_YEAR
                    = ROUTE LIST.HMIS ROUTEID
  AND ROUTEID
  AND MP_LOCATION_TYPE <> 2
  AND (MP INT TYPE
                    > 0
  AND MP INT TYPE
                     < 100
  AND MP INT TYPE NOT IN (7,10,14))
  ),
  -- DOWN HILL GRADE CRITERIA
     DH GRADE AS
  --
     (SELECT
  --
       CASE
       WHEN ADJ BMP<ROUTE LIST.DIR BMP
   --
       THEN ROUTE_LIST.DIR_BMP
   ___
       ELSE ADJ BMP
   --
      END BMP,
  ___
      CASE
  --
       WHEN ADJ_EMP>ROUTE_LIST.DIR_EMP
  --
       THEN ROUTE_LIST.DIR_EMP
```

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- -- ELSE ADJ_EMP
- -- END EMP,
- -- SEC_ATTRIBUTE
- -- FROM
- -- (SELECT BMP ORG_BMP,
- EMP ORG_EMP,
- SEC_LENGTH,
- -- CASE
- -- WHEN SEC_LENGTH<.1
- -- THEN ROUND(BMP-((.1-SEC_LENGTH)/2),3)
- -- ELSE BMP
- -- END ADJ_BMP,
- -- CASE
- -- WHEN SEC_LENGTH<.1
- -- THEN ROUND(EMP+((.1-SEC_LENGTH)/2),3)
- -- ELSE EMP
- -- END ADJ_EMP,
- -- SEC_ATTRIBUTE
- -- FROM
- -- (SELECT BMP,
- -- ÈEMP,
- -- EMP-BMP SEC_LENGTH,
- -- SEC ATTRIBUTE
- -- FROM
- -- (SELECT MIN(DIR_BMP) BMP,
- -- MAX(DIR_EMP) EMP,
- -- SEC_ATTRIBUTE,
- -- SEC_RN
- -- FROM
- -- (SELECT DIR_BMP,
- -- DIR_EMP,
- -- SEC_ATTRIBUTE,
- -- RN_,
- -- ROW_NUMBER() OVER(ORDER BY RN_) -ROW_NUMBER() OVER(PARTITION BY
- SEC_ATTRIBUTE ORDER BY RN_) AS SEC_RN
 - -- FROM
 - -- (SELECT TT.*,
- -- ROWNUM RN_ -- THIS SUBQUERY SORTS THE INCOMING ATTRIBUTE AND SUPPLIES THE RN FIELD.
 - -- FROM
 - -- (SELECT DISTINCT DIR BMP,
 - -- DIR EMP,
 - -- CASE
 - -- WHEN GRADE>-5
 - -- THEN 'NO DH GRADE'
 - -- WHEN GRADE >= -6
 - -- AND GRADE <= -5
 - -- THEN 'DH GRADE 5 TO 10'
 - -- WHEN GRADE < -6
 - -- THEN 'DH GRADE 10'
 - -- END SEC ATTRIBUTE
 - -- FROM FINAL CONDITION DETAIL SKID
 - -- WHERE COLLECT YEAR = COND YEAR
 - -- AND GLOBAL ROUTE ID = ROUTE LIST.GLOBAL ROUTE ID
 - -- AND SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID
 - -- ORDER BY 1
 -) TT
 - --)

--

- --)
- -- GROUP BY SEC_ATTRIBUTE,
- -- SEC_RN

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```
WHERE SEC_ATTRIBUTE IN ('DH_GRADE_10','DH_GRADE_5_TO_10')
__
--
      -- AND EMP
                    -BMP >=.1
--
     )
--
   )
-- ),
DH GRADE AS
(SELECT *
FROM DH_GRADE_SKID
WHERE SEC_LENGTH >=.03
AND COLLECT_YEAR = COND_YEAR
AND GLOBAL_ROUTE_ID = ROUTE_LIST.GLOBAL_ROUTE_ID
AND SUB_ROUTE_ID = ROUTE_LIST.SUB_ROUTE_ID
),
-- ON AND OFF RAMP
RAMP AS
(SELECT
 CASE
 WHEN ID_MP-.1>=0
 THEN ID_MP-.1
 ELSE 0
 END BMP.
ID MP EMP,
'RAMP' SEC_ATTRIBUTE
FROM HMIS_MASTER_ALL_YEARS
WHERE YEAR
                 = INV YEAR
AND ROUTEID
                = ROUTE LIST.HMIS ROUTEID
AND MP_LOCATION_TYPE = 2
AND ID PREFIX
               <>'RP'
AND (MP INT RTE NAME LIKE '%TO '
 ||ID PREFIX
 ï' '
 ∥ID_RTE_NO
 ITRIM(MP_SUFFIX)
 ï' '
 ||MP_DIRECTION
 ||'%'
OR MP INT RTE NAME LIKE '%FR '
 ||ID PREFIX
 ΪĽ '
 ID RTE NO
 ||TRIM(MP_SUFFIX)
 <u>||' '</u>
 ||MP_DIRECTION
 ||'%')
UNION
SELECT
 CASE
 WHEN ID MP-.1>=0
 THEN ID_MP-.1
 ELSE 0
 END BMP
 ID MP EMP,
'RAMP' SEC ATTRIBUTE
FROM HMIS MASTER ALL YEARS
                 = INV YEAR
WHERE YEAR
AND ROUTEID
                = ROUTE_LIST.HMIS_ROUTEID
AND MP_LOCATION_TYPE = \overline{2}
AND ID_PREFIX
                <>'RP'
AND (MP_INT_RTE_NAME LIKE '%TO '
IID PREFIX
```

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II' ' IID RTE NO ||TRIM(MP_SUFFIX) 11' ' Ш CASE WHEN MP_DIRECTION ='E' THEN 'N' WHEN MP_DIRECTION ='W' THEN 'S' WHEN MP_DIRECTION ='N' THEN 'E' WHEN MP_DIRECTION ='S' THEN 'W' END ||'%' OR MP INT RTE NAME LIKE '%FR ' ||ID_PREFIX Ï'' ID RTE NO jjTRIM(MP_SUFFIX) ÎĽ ' CASE WHEN MP_DIRECTION ='E' THEN 'N' WHEN MP_DIRECTION ='W' THEN 'S' WHEN MP_DIRECTION ='N' THEN 'E' WHEN MP DIRECTION ='S' THEN 'W' END ||'%') UNION SELECT CASE WHEN ID MP-.1>=0 THEN ID MP-.1 ELSE 0 END BMP ID MP EMP 'RAMP' SEC_ATTRIBUTE FROM HMIS_MASTER_ALL_YEARS = INV_YEAR WHERE YEAR = ROUTE LIST.HMIS ROUTEID AND ROUTEID AND MP LOCATION TYPE = $\overline{2}$ AND ID PREFIX ='RP' AND (MP INT RTE NAME LIKE '% ' || TRIM(SUBSTR(ROAD_NAME,1,7)) || '%') ORDER BY BMP), --TRAFFIC LIGHTS, STOP SIGN, ROUNDABOUT, RAIL ROAD CROSSINGS SITE CAT 1 AS (SELECT CASE WHEN ID_MP-.1>=0 THEN ID_MP-.1 ELSE 0 END BMP,

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ID MP EMP, -- MP INT RTE NAME, --MP INT TYPE, CASE WHEN MP INT RTE NAME LIKE '%TRAFFIC SIGNAL%' THEN 'TRAFFIC SIGNAL' WHEN MP INT RTE NAME LIKE '%STOP SIGN%' THEN 'STOP_SIGN' WHEN (MP_INT_RTE_NAME LIKE '%ROUNDABOUT%' AND MP INT RTE NAME NOT LIKE '% END ROUNDABOUT%') THEN 'ROUND ABOUT' WHEN MP INT RTE NAME LIKE '%SPUR TO%' THEN 'GIVE WAY' WHEN MP INT RTE NAME LIKE '% RAILROAD CROSSING%' THEN 'RAIL ROAD' --WHEN (MP INT TYPE > 0 AND MP INT TYPE < 100 AND MP INT TYPE NOT IN (7,10,14)) THEN 'INERSECTION' END SEC_ATTRIBUTE FROM HMIS MASTER ALL YEARS WHERE YEAR = INV YEAR AND ROUTEID = ROUTE LIST.HMIS ROUTEID AND (MP INT RTE NAME LIKE '%TRAFFIC SIGNAL%' OR MP INT RTE NAME LIKE '%STOP SIGN%' OR (MP_INT_RTE_NAME LIKE '%ROUNDABOUT%' AND MP INT RTE NAME NOT LIKE '% END ROUNDABOUT%') OR MP INT RTE NAME LIKE '%SPUR TO%' OR MP INT RTE NAME LIKE '%RAILROADC ROSSING%' -- OR (MP_INT_TYPE > 0 AND MP_INT_TYPE < 100 AND MP_INT_TYPE NOT IN (7,10,14)) UNION --PEDESTRIAN CROSSING SELECT CASE WHEN DIR_EMP-.1>=0 THEN DIR_EMP-.1 ELSE 0 END BMP. DIR EMP EMP, --NULL, 'PEDESTRIAN CROSSING' PEDESTRIAN CROSSING FROM EDW18_BASE_4@PAV_CONHIST_ASSET WHERE GLOBAL_ROUTE_ID = ROUTE_LIST.GLOBAL_ROUTE_ID AND SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID AND STATUS = 'MATCHED' AND EVENT_CROSSWALK_OFFICE = 1 FINAL SEG AS (SELECT BMP FROM SPEED LIMIT UNION SELECT EMP FROM SPEED LIMIT UNION SELECT BMP FROM DIVIDED UNION SELECT EMP FROM DIVIDED UNION SELECT BMP FROM RUT UNION SELECT EMP FROM RUT UNION SELECT BMP FROM INTERSECTIONS UNION SELECT EMP FROM INTERSECTIONS

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UNION SELECT DIR BMP FROM CURVE UNION SELECT DIR EMP FROM CURVE UNION SELECT DIR BMP FROM DH GRADE UNION SELECT DIR_EMP FROM DH_GRADE UNION SELECT BMP FROM RAMP UNION SELECT EMP FROM RAMP UNION SELECT BMP FROM SITE CAT 1 UNION SELECT EMP FROM SITE CAT 1 ORDER BY 1 SELECT COND_YEAR, ROUTE_LIST.GOVT_CONTROL, ROUTE LIST.HMIS ROUTEID, ROUTE LIST.GLOBAL ROUTE ID, ROUTE LIST.SUB ROUTE ID, BMP, EMP FROM (SELECT BMP, LEAD (BMP) OVER (ORDER BY BMP) EMP FROM FINAL SEG WHERE EMP IS NOT NULL AND BMP >=0 AND BMP <> EMP AND BMP >=ROUTE_LIST.DIR BMP AND EMP <=ROUTE_LIST.DIR_EMP ORDER BY BMP; UPDATE FMG_BASE_SEGMENTS SET INV BMP = BMP. INV EMP = EMP WHERE SUB ROUTE ID =1 AND GLOBAL ROUTE ID = ROUTE LIST.GLOBAL ROUTE ID; MERGE INTO FMG BASE SEGMENTS A USING (SELECT F.ROWID ROW ID, G.REVERSE MILEPOINT INV BMP FROM FMG BASE SEGMENTS F, GLOBAL_SEGMENT_PAV G WHERE F.GLOBAL_ROUTE_ID= G.GLOBAL_ROUTE_ID AND F.SUB_ROUTE_ID = G.SUB_ROUTE_ID AND F.EMP = G.BEGINNING MILEPOINT AND F.SUB ROUTE ID =2 AND G.GLOBAL ROUTE ID = ROUTE LIST.GLOBAL ROUTE ID AND G.RETIRE DATE IS NULL) B ON (A.ROWID = B.ROW ID) WHEN MATCHED THEN UPDATE SET A.INV BMP = B.INV BMP; MERGE INTO FMG BASE SEGMENTS A USING (SELECT F.ROWID ROW ID, G.REVERSE MILEPOINT INV EMP FROM FMG BASE SEGMENTS F. GLOBAL_SEGMENT_PAV G WHERE F.GLOBAL_ROUTE_ID= G.GLOBAL_ROUTE_ID AND F.SUB_ROUTE_ID = G.SUB_ROUTE_ID AND F.BMP = G.BEGINNING MILEPOINT

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AND F.SUB ROUTE ID =2 AND G.GLOBAL ROUTE_ID = ROUTE_LIST.GLOBAL_ROUTE_ID AND G.RETIRE DATE IS NULL) B ON (A.ROWID = B.ROW ID) WHEN MATCHED THEN UPDATE SET A.INV EMP = B.INV EMP; -- DIVIDED UPDATE MERGE INTO FMG_BASE_SEGMENTS A USING (SELECT DISTINCT F.ROWID ROW ID, F.BMP, F.EMP,-- H.MEDIAN TY, CASE WHEN MEDIAN TY IN (4.5) THEN 'UNDIVIDED' ELSE 'DIVIDED' END SEC ATTRIBUTE FROM HMIS_UNIVERSE_ALL_YEARS H, FMG BASE SEGMENTS F WHERE H.YEAR = INV YEAR AND F.COLLECT YEAR = COND YEAR -- AND H.ROUTEID = ROUTE LIST.HMIS ROUTEID AND F.GLOBAL_ROUTE_ID= ROUTE_LIST.GLOBAL_ROUTE_ID AND F.SUB_ROUTE_ID = ROUTE_LIST.SUB_ROUTE_ID >= ROUTE LIST.DIR BMP AND F.BMP AND F.EMP <= ROUTE LIST.DIR EMP AND F.HMIS ROUTEID = H.ROUTEID AND ((ID MP >= F.BMP <F.EMP) AND ID MP >= ID MP OR (F.BMP AND F.EMP <= ID MP+SECTION LENGTH))) B ON (A.ROWID = B.ROW ID) WHEN MATCHED THEN UPDATE SET A.DIVIDED = B.SEC_ATTRIBUTE; -- SPEED LIMIT UPDATE MERGE INTO FMG BASE SEGMENTS A USING (SELECT DISTINCT F.ROWID ROW ID, F.BMP. F.EMP,-- H.MEDIAN TY, CASE WHEN H.SPEED LIMIT>=55-- CHANGED ON 9/17/2021 BASED ON EMAIL FROM PD THEN 'ABOVE 55' WHEN H.SPEED LIMIT>=35 AND H.SPEED LIMIT <55 THEN 'BELOW 55' ELSE 'BELOW 35' END SEC ATTRIBUTE FROM HMIS UNIVERSE ALL_YEARS H, FMG_BASE_SEGMENTS F = INV YEAR WHERE H.YEAR AND F.COLLECT YEAR = COND YEAR -- AND H.ROUTEID = ROUTE LIST.HMIS ROUTEID AND F.GLOBAL ROUTE ID= ROUTE LIST.GLOBAL ROUTE ID AND F.SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID AND F.BMP >= ROUTE LIST.DIR BMP AND F.EMP <= ROUTE LIST.DIR EMP AND F.HMIS_ROUTEID = H.ROUTEID AND ($(ID_MP \rightarrow F.BMP)$ AND ID MP <F.EMP) OR (F.BMP >= ID MP

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<= ID MP+SECTION LENGTH)) AND F.EMP) B ON (A.ROWID = B.ROW ID) WHEN MATCHED THEN UPDATE SET A.SPEED LIMIT = B.SEC ATTRIBUTE; -- RUT MERGE INTO FMG BASE SEGMENTS A USING (SELECT /*+ INDEX(H FINAL_COND_NEW_LOCATOR_IDX2) */ DISTINCT F.ROWID ROW ID, F.BMP, F.EMP, -- H.MEDIAN_TY, --H.DIR_BMP, H.DIR_EMP 'HIGH RUT' SEC ATTRIBUTE FROM FINAL CONDITION DETAIL SKIDH, FMG_BASE_SEGMENTS F WHERE H.COLLECT_YEAR = COND_YEAR AND F.COLLECT_YEAR = H.COLLECT_YEAR -- AND H.ROUTEID = ROUTE_LIST.HMIS_ROUTEID AND F.GLOBAL_ROUTE_ID = ROUTE_LIST.GLOBAL_ROUTE_ID AND F.SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID AND F.BMP >= ROUTE LIST.DIR BMP AND F.EMP <= ROUTE LIST.DIR EMP AND F.GLOBAL_ROUTE_ID = H.GLOBAL_ROUTE_ID AND F.SUB_ROUTE_ID = H.SUB_ROUTE_ID AND (L RUT+R RUT)/2 >0.25 -- AND ((H.DIR BMP >=F.BMP -- AND H.DIR EMP <=F.EMP) <F.BMP -- OR (H.DIR BMP -- AND H.DIR EMP >F.EMP) -- OR (H.DIR BMP <=F.BMP -- AND H.DIR EMP >F.BMP)) AND (H.DIR_BMP <= F.BMP AND H.DIR_EMP >=F.EMP) -- ORDER BY 2) B ON (A.ROWID = B.ROW_ID) WHEN MATCHED THEN UPDATE SET A.RUT = B.SEC_ATTRIBUTE; -- CURVE MERGE INTO FMG BASE SEGMENTS A USING (SELECT * FROM (SELECT DISTINCT F.ROWID ROW_ID, F.BMP, F.EMP, SEC ATTRIBUTE FROM FMG BASE SEGMENTS F, (SELECT * FROM (SELECT DIR BMP, DIR EMP DIR EMP-DIR BMP SEC LENGTH, CASE -- WHEN RADIUS <=250*3.28 -- CHANGED ON 12/16/2020 BASED ON THE EMAIL FROM BX WHEN RADIUS <=250*3 --CHANGED ON 09/17/2021 BASED ON THE EMAIL FROM PD AND RADIUS > 0 THEN 'CURVE_750' WHEN RADIUS <= 250 *6 -- CHANGED ON 10/07/2021 BASED ON THE EMAIL FROM KM AND RADIUS > 250*3 THEN 'CURVE 1500'

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ELSE 'CURVE NOT750' END SEC ATTRIBUTE FROM CURVE H SHA NETWORK@PAV CONHIST ASSET = COND YEAR WHERE YEAR AND GLOBAL_ROUTE_ID = ROUTE_LIST.GLOBAL_ROUTE_ID AND SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID) --WHERE SEC_ATTRIBUTE = 'CURVE_750' WHERE SEC_ATTRIBUTE <> 'CURVE_NOT750'--CHANGED ON 10/07/2021 BASED ON THE EMAIL FROM KM) H WHERE F.COLLECT_YEAR = COND_YEAR AND F.BMP >= ROUTE LIST.DIR BMP AND F.EMP <= ROUTE LIST.DIR EMP AND F.GLOBAL ROUTE ID = ROUTE LIST.GLOBAL ROUTE ID AND F.SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID AND ((H.DIR_BMP >=F.BMP AND H.DIR EMP -- $\langle =F.EMP \rangle$ OR (H.DIR BMP <F.BMP ---AND H.DIR EMP >F.EMP) ---<=F.BMP OR (H.DIR BMP ---AND H.DIR EMP >F.BMP)) AND (H.DIR BMP <= F.BMP AND H.DIR EMP >=F.EMP) ORDER BY 2) --WHERE SEC ATTRIBUTE = 'CURVE 750' WHERE SEC_ATTRIBUTE <> 'CURVE_NOT750'--CHANGED ON 10/07/2021 BASED ON THE EMAIL FROM KM) B ON (A.ROWID = B.ROW ID) WHEN MATCHED THEN UPDATE SET A.CURVE = B.SEC_ATTRIBUTE; -- INTERSECTIONS MERGE INTO FMG_BASE_SEGMENTS A USING (SELECT * FROM (SELECT DISTINCT F.ROWID ROW ID, F.BMP. F.EMP H.ID MP MP INT RTE NAME SEC ATTRIBUTE, ROW_NUMBER() OVER (PARTITION BY F.ROWID ORDER BY ID_MP,MP INT RTE NAME) RN FROM HMIS_MASTER_ALL_YEARS H , FMG BASE SEGMENTS F = INV YEAR WHERE H.YEAR AND F.COLLECT YEAR = COND YEAR -- AND H.ROUTEID = ROUTE LIST.HMIS ROUTEID AND F.GLOBAL ROUTE ID= ROUTE LIST.GLOBAL ROUTE ID AND F.SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID >= ROUTE LIST.DIR BMP AND F.BMP AND F.EMP <= ROUTE LIST.DIR EMP AND F.HMIS ROUTEID = H.ROUTEID AND (F.BMP >= ID MP -.1 AND F.EMP $\leq ID MP$ AND (MP INT TYPE > 0 AND MP_INT_TYPE < 100 AND MP_INT_TYPE NOT IN (7,10,14)) WHERE RN =1) B ON (A.ROWID = B.ROW ID)

```
WHEN MATCHED THEN
UPDATE
SET A.INTERSECTIONS = B.SEC ATTRIBUTE;
-- DOWNHILL GRAD
--DH GRADE 5 TO 10
MERGE INTO FMG BASE SEGMENTS A USING
( SELECT DISTINCT F.ROWID ROW ID,
 H.SEC_ATTRIBUTE
FROM FMG_BASE_SEGMENTS F,
 (SELECT *
 FROM DH_GRADE_SKID
 WHERE SEC LENGTH >=.03
 AND SEC ATTRIBUTE IN ('DH GRADE 5 TO 10')
 )H
WHERE F.COLLECT YEAR = COND YEAR
 -- AND H.ROUTEID = ROUTE LIST.HMIS ROUTEID
AND F.GLOBAL ROUTE ID = ROUTE LIST.GLOBAL ROUTE ID
AND F.SUB_ROUTE_ID = ROUTE_LIST.SUB_ROUTE_ID
AND F.BMP
               >= ROUTE LIST.DIR BMP
AND F.EMP
               <= ROUTE LIST.DIR EMP
AND F.GLOBAL ROUTE ID = H.GLOBAL ROUTE ID
AND F.SUB ROUTE ID = H.SUB ROUTE ID
AND F.COLLECT YEAR = H.COLLECT YEAR
AND ( (H.DIR_BMP >=F.BMP
AND H.DIR EMP
                 <=F.EMP)
OR (H.DIR BMP
                 <F.BMP
AND H.DIR EMP
                 >F.EMP)
OR (H.DIR BMP
                 <=F.BMP
AND H.DIR_EMP
                 >F.BMP))
)B ON (A.ROWID
                 = B.ROW ID)
WHEN MATCHED THEN
UPDATE
SET A.DOWNHILL_GRADE = B.SEC_ATTRIBUTE;
--DH_GRADE_10
MERGE INTO FMG_BASE_SEGMENTS A USING
(SELECT DISTINCT F.ROWID ROW ID,
 H.SEC ATTRIBUTE
FROM FMG_BASE_SEGMENTS F,
 (SELECT *
 FROM DH GRADE SKID
 WHERE SEC LENGTH>=.03
 AND SEC ATTRIBUTE= ('DH GRADE 10')
 )H
WHERE F.COLLECT_YEAR = COND_YEAR
 -- AND H.ROUTEID = ROUTE LIST.HMIS ROUTEID
AND F.GLOBAL ROUTE ID = ROUTE LIST.GLOBAL ROUTE ID
AND F.SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID
AND F.BMP
              >= ROUTE LIST.DIR BMP
               <= ROUTE LIST.DIR EMP
AND F.EMP
AND F.GLOBAL ROUTE ID = H.GLOBAL ROUTE ID
AND F.SUB ROUTE ID = H.SUB ROUTE ID
AND F.COLLECT YEAR = H.COLLECT YEAR
AND ( (H.DIR BMP >= F.BMP
AND H.DIR EMP
                 <=F.EMP)
                 <F.BMP
OR (H.DIR BMP
AND H.DIR EMP
                 >F.EMP)
OR (H.DIR_ BMP
                 <=F.BMP
AND H.DIR_EMP
                 >F.BMP))
)B ON (A.ROWID
                 = B.ROW_ID)
WHEN MATCHED THEN
UPDATE
```

```
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SET A.DOWNHILL GRADE = B.SEC ATTRIBUTE; -- RAMP -- ROUTE IS NOT A RAMP - DIRECTION CHANGE MERGE INTO FMG BASE SEGMENTS A USING (SELECT * FROM (SELECT DISTINCT F.ROWID ROW ID, F.BMP, F.EMP. H.ID MP. MP_INT_RTE_NAME SEC_ATTRIBUTE, ROW NUMBER() OVER (PARTITION BY F.ROWID ORDER BY ID MP,MP INT RTE NAME) RN FROM HMIS_MASTER_ALL_YEARS H , FMG_BASE_SEGMENTS F WHERE H.YEAR = INV_YEAR AND F.COLLECT_YEAR = COND YEAR -- AND H.ROUTEID = ROUTE LIST.HMIS ROUTEID AND F.GLOBAL_ROUTE_ID= ROUTE_LIST.GLOBAL_ROUTE_ID AND F.SUB_ROUTE_ID = ROUTE_LIST.SUB_ROUTE_ID AND F.BMP >= ROUTE LIST.DIR BMP AND F.EMP <= ROUTE LIST.DIR EMP AND F.HMIS ROUTEID = H.ROUTEID AND (F.BMP >= ID MP -.1 <= ID_MP) AND F.EMP AND MP_LOCATION_TYPE = 2 AND ID PREFIX <>'RP' AND (MP INT RTE NAME LIKE '%TO ' ||ID_PREFIX II' ' IID RTE NO ||TRIM(MP_SUFFIX) <u>||' '</u> **||MP_DIRECTION** jj'%' OR MP_INT_RTE_NAME LIKE '%FR ' ||ID_PREFIX 11' ' IID RTE NO ||TRIM(MP_SUFFIX) II' ' ||MP DIRECTION ||'%')) WHERE RN =1) B ON (A.ROWID = B.ROW_ID) WHEN MATCHED THEN UPDATE SET A.RAMP = B.SEC ATTRIBUTE; -- ROUTE IS NOT A RAMP - DIRECTION CHANGE MERGE INTO FMG_BASE_SEGMENTS A USING (SELECT * FROM (SELECT DISTINCT F.ROWID ROW ID, F.BMP. F.EMP. H.ID MP. MP_INT_RTE_NAME SEC_ATTRIBUTE, ROW_NUMBER() OVER (PARTITION BY F.ROWID ORDER BY ID_MP,MP_INT_RTE_NAME) RN FROM HMIS_MASTER_ALL_YEARS H , FMG_BASE_SEGMENTS F WHERE H.YEAR = INV YEAR

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AND F.COLLECT YEAR = COND YEAR -- AND H.ROUTEID = ROUTE LIST.HMIS ROUTEID AND F.GLOBAL_ROUTE_ID= ROUTE_LIST.GLOBAL_ROUTE_ID AND F.SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID AND F.BMP >= ROUTE LIST.DIR BMP AND F.EMP <= ROUTE LIST.DIR EMP AND F.HMIS ROUTEID = H.ROUTEID AND (F.BMP >= ID_MP -.1 AND F.EMP <= ID_MP) AND MP_LOCATION_TYPE = 2 AND ID PREFIX <>'RP' AND (MP_INT_RTE_NAME LIKE '%TO ' **||ID PREFIX** 11' ' ||ID RTE NO ||TRIM(MP_SUFFIX) 11' ' Î CASE WHEN MP_DIRECTION ='E' THEN 'N' WHEN MP_DIRECTION ='W' THEN 'S' WHEN MP_DIRECTION ='N' THEN 'E' WHEN MP_DIRECTION ='S' THEN 'W' END ||'%' OR MP INT RTE NAME LIKE '%FR ' ||ID PREFIX ij' ' ∥ID_RTE_NO ITRIM(MP_SUFFIX) ï' ' CASE WHEN MP_DIRECTION ='E' THEN 'N' WHEN MP_DIRECTION ='W' THEN 'S' WHEN MP_DIRECTION ='N' THEN 'E' WHEN MP_DIRECTION ='S' THEN 'W' END ||'%')) WHERE RN =1) B ON (A.ROWID = B.ROW_ID) WHEN MATCHED THEN UPDATE SET A.RAMP = B.SEC ATTRIBUTE; -- ROUTE IS A RAMP MERGE INTO FMG BASE SEGMENTS A USING (SELECT * FROM (SELECT DISTINCT F.ROWID ROW_ID, F.BMP, F.EMP H.ID_MP,

```
MP INT RTE NAME SEC ATTRIBUTE,
  ROW NUMBER() OVER ( PARTITION BY F.ROWID ORDER BY ID MP,MP INT RTE NAME) RN
 FROM HMIS MASTER ALL YEARS H,
  FMG BASE SEGMENTS F
 WHERE H.YEAR
                  = INV YEAR
 AND F.COLLECT YEAR = COND YEAR
  -- AND H.ROUTEID = ROUTE LIST.HMIS ROUTEID
 AND F.GLOBAL_ROUTE_ID= ROUTE_LIST.GLOBAL_ROUTE_ID
 AND F.SUB_ROUTE_ID = ROUTE_LIST.SUB_ROUTE_ID
 AND F.BMP
               >= ROUTE_LIST.DIR_BMP
                <= ROUTE_LIST.DIR_EMP
 AND F.EMP
 AND F.HMIS ROUTEID = H.ROUTEID
 AND (F.BMP
                >= ID MP -.1
 AND F.EMP
                <= ID MP)
 AND MP LOCATION TYPE = 2
 AND ID PREFIX
                  ='RP'
 AND (MP INT RTE NAME LIKE '% '
  || TRIM(SUBSTR(ROAD_NAME,1,7))
  || '%')
 )
WHERE RN
             =1
) B ON (A.ROWID = B.ROW ID)
WHEN MATCHED THEN
UPDATE
SET A.RAMP = B.SEC_ATTRIBUTE;
-- CAT ONE FEATURES
MERGE INTO FMG BASE SEGMENTS A USING
(SELECT *
FROM
 (SELECT DISTINCT F.ROWID ROW ID,
  F.BMP,
  F.EMP
  H.ID MP,
  CASE
   WHEN MP_INT_RTE_NAME LIKE '%TRAFFIC SIGNAL%'
   THEN 'TRAFFIC_SIGNAL'
   WHEN MP_INT_RTE_NAME LIKE '%STOP SIGN%'
   THEN 'STOP SIGN'
   WHEN (MP INT RTE NAME LIKE '%ROUNDABOUT%'
   AND MP INT RTE NAME NOT LIKE '% END ROUNDABOUT%')
   THEN 'ROUND ABOUT'
   WHEN MP INT RTE NAME LIKE '%SPUR TO%'
   THEN 'GIVE WAY
   WHEN MP_INT_RTE_NAME LIKE '%RAILROAD CROSSING%'
   THEN 'RAIL ROAD'
  END SEC ATTRIBUTE,
  ROW NUMBER() OVER ( PARTITION BY F.ROWID ORDER BY ID MP,MP INT RTE NAME) RN
 FROM HMIS MASTER ALL YEARS H,
  FMG BASE SEGMENTS F
 WHERE H.YEAR
                  = INV YEAR
 AND F.COLLECT YEAR = COND YEAR
  -- AND H.ROUTEID = ROUTE LIST.HMIS ROUTEID
 AND F.GLOBAL ROUTE ID= ROUTE LIST.GLOBAL ROUTE ID
 AND F.SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID
 AND F.BMP
                >= ROUTE LIST.DIR BMP
 AND F.EMP
                <= ROUTE LIST.DIR EMP
 AND F.HMIS ROUTEID = H.ROUTEID
               >= ID_MP -.1
 AND (F.BMP
 AND F.EMP
                <= ID_MP)
 AND (MP_INT_RTE_NAME LIKE '%TRAFFIC SIGNAL%'
 OR MP INT RTE NAME LIKE '%STOP SIGN%'
```

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OR (MP INT RTE NAME LIKE '% ROUNDABOUT%' AND MP INT RTE NAME NOT LIKE '% END ROUNDABOUT%') OR MP INT_RTE_NAME LIKE '%SPUR TO%' OR MP INT RTE NAME LIKE '%RAILROADC ROSSING%') WHERE RN =1) B ON (A.ROWID = B.ROW ID) WHEN MATCHED THEN UPDATE SET A.CAT_ONE_FEATURES = B.SEC_ATTRIBUTE; -- PEDESTRIAN CROSSING MERGE INTO FMG BASE SEGMENTS A USING (SELECT DISTINCT F.ROWID ROW ID, F.BMP. F.EMP,-- H.MEDIAN TY, --H.DIR BMP, H.DIR EMP 'PEDESTRIAN CROSSING' SEC ATTRIBUTE FROM EDW18_BASE_4@PAV_CONHIST_ASSET H, FMG BASE SEGMENTS F WHERE F.COLLECT YEAR = COND YEAR AND H.ROUTEID = ROUTE LIST.HMIS ROUTEID AND F.GLOBAL ROUTE ID= ROUTE LIST.GLOBAL ROUTE ID AND F.SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID >= ROUTE LIST.DIR BMP AND F.BMP AND F.EMP <= ROUTE LIST.DIR EMP AND F.GLOBAL ROUTE ID = H.GLOBAL ROUTE ID AND F.SUB_ROUTE_ID = H.SUB ROUTE ID = 'MATCHED' AND STATUS AND EVENT CROSSWALK OFFICE = 1 AND ((H.DIR_EMP-.1 >=F.BMP AND H.DIR EMP $\leq F.EMP$ OR (H.DIR_EMP-.1 <F.BMP AND H.DIR_EMP >F.EMP) OR (H.DIR_EMP-.1 <=F.BMP AND H.DIR EMP >F.BMP)) --ORDER BY 2) B ON (A.ROWID = B.ROW ID) WHEN MATCHED THEN UPDATE SET A.CAT ONE FEATURES = B.SEC ATTRIBUTE; -- SITE CATEGORY UPDATE -- UPDATE FMG BASE SEGMENTS -- SET SITE CATEGORY = 1 -- WHERE (CAT_ONE_FEATURES IS NOT NULL-- CHANGED ON 9/17/2021 BASED ON EMAIL FROM PD -- AND SPEED LIMIT ='ABOVE 55') -- AND SITE CATEGORY IS NULL -- AND GLOBAL ROUTE ID = ROUTE LIST.GLOBAL ROUTE ID -- AND SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID; -- UPDATE FMG BASE SEGMENTS -- SET SITE CATEGORY = 2 -- WHERE (CURVE IS NOT NULL -- OR DOWNHILL_GRADE ='DH_GRADE 10' -- OR RAMP IS NOT NULL) -- AND SITE CATEGORY IS NULL -- AND GLOBAL ROUTE ID = ROUTE LIST.GLOBAL ROUTE ID -- AND SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID; -- UPDATE FMG_BASE_SEGMENTS -- SET SITE CATEGORY = 3 -- WHERE ((CAT_ONE_FEATURES IS NOT NULL -- AND SPEED LIMIT ='BELOW 55')-- CHANGED ON 9/17/2021 BASED ON EMAIL FROM PD

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-- OR ((INTERSECTIONS IS NOT NULL -- OR DOWNHILL GRADE ='DH GRADE 5 TO 10') -- AND SPEED LIMIT IN ('ABOVE 55', 'BELOW 55')) ='UNDIVIDED' -- OR (DIVIDED -- AND SPEED LIMIT ='ABOVE 55' -- AND RUT ='HIGH RUT')) -- AND SITE CATEGORY IS NULL -- AND GLOBAL_ROUTE_ID = ROUTE_LIST.GLOBAL_ROUTE_ID -- AND SUB_ROUTE_ID = ROUTE_LIST.SUB_ROUTE_ID; -- UPDATE FMG BASE SEGMENTS -- SET SITE_CATEGORY = 4 -- WHERE ((CAT_ONE_FEATURES IS NOT NULL -- AND SPEED LIMIT ='BELOW 35')-- CHANGED ON 9/17/2021 BASED ON EMAIL FROM PD -- OR (DIVIDED ='UNDIVIDED' -- AND (SPEED LIMIT IN ('BELOW 55', 'BELOW 35')-- CHANGED ON 9/17/2021 BASED ON EMAIL FROM PD -- OR RUT IS NULL)) IS NOT NULL -- OR ((INTERSECTIONS -- OR DOWNHILL GRADE ='DH GRADE_5_TO_10') -- AND SPEED LIMIT IN ('BELOW_35')) -- OR (DIVIDED ='DIVIDED' -- AND SPEED_LIMIT ='ABOVE_55' -- AND RUT ='HIGH RUT')) -- AND SITE CATEGORY IS NULL -- AND GLOBAL_ROUTE_ID = ROUTE LIST.GLOBAL ROUTE ID -- AND SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID; -- UPDATE FMG BASE SEGMENTS -- SET SITE CATEGORY = 5 -- WHERE (DIVIDED ='DIVIDED' -- AND (SPEED LIMIT IN ('BELOW 55', 'BELOW 35')-- CHANGED ON 9/17/2021 BASED ON EMAIL FROM PD -- OR RUT IS NULL)) -- AND SITE CATEGORY IS NULL -- AND GLOBAL_ROUTE_ID = ROUTE_LIST.GLOBAL_ROUTE_ID -- AND SUB_ROUTE_ID = ROUTE_LIST.SUB_ROUTE_ID; COMMIT: ELSE --- NON-INV DIRECTION NOT IN UNIVERSE MASTER TABLES SELECT MAX(DIR_EMP), MIN(DIR BMP) INTO MAX MP, MIN MP FROM SKID INVENTORY WHERE GLOBAL_ROUTE_ID= ROUTE_LIST.GLOBAL_ROUTE_ID AND SUB ROUTE ID = 1; SELECT MAX(DIR EMP), MIN(DIR BMP)-- TO ADRESS CASES LIKE 24004 INTO DIR MAX MP, DIR MIN MP FROM SKID INVENTORY WHERE GLOBAL_ROUTE_ID= ROUTE_LIST.GLOBAL_ROUTE_ID AND SUB_ROUTE ID = 2; SELECT COUNT(*)-- TO CHECK IF A ROUTE HAS MORE THAN ONE ROW IN THE SKID INVENTORY INTO ROUTE CNT FROM SKID INVENTORY WHERE GLOBAL ROUTE ID= ROUTE LIST.GLOBAL ROUTE ID AND SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID; INSERT INTO FMG_BASE_SEGMENTS COLLECT_YEAR, GOVT CONTROL,

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HMIS ROUTEID, GLOBAL ROUTE ID, SUB ROUTE ID, BMP. EMP) -- SPEED LIMIT CRITERIA WITH SPEED_LIMIT AS (SELECT DISTINCT ROUTEID, ID MP BMP, ID MP+SECTION_LENGTH EMP, CASE WHEN H.SPEED LIMIT>=55-- CHANGED ON 9/17/2021 BASED ON EMAIL FROM PD THEN 'ABOVE 55' WHEN H.SPEED LIMIT>=35 AND H.SPEED LIMIT <55 THEN 'BELOW 55' ELSE 'BELOW 35' END SEC_ATTRIBUTE FROM HMIS_UNIVERSE_ALL_YEARS H WHERE YEAR = INV YEAR AND ROUTEID = ROUTE LIST.HMIS ROUTEID --AND MEDIAN TY IN (4,5) ORDER BY ID_MP), -- WITH SPEED LIMIT AS -- (SELECT MIN(DIR BMP) BMP, ---MAX(DIR EMP) EMP, --SEC ATTRIBUTE, SEC RN ---- FROM (SELECT DIR BMP, ---DIR_EMP, ---SEC_ATTRIBUTE, ---RN_, ---ROW_NUMBER() OVER(ORDER BY RN_) -ROW_NUMBER() OVER(PARTITION BY SEC ATTRIBUTE ORDER BY RN) AS SEC RN FROM ---(SELECT TT.*. ---ROWNUM RN -- THIS SUBQUERY SORTS THE INCOMING ATTRIBUTE AND SUPPLIES THE RN FIELD. FROM (SELECT DISTINCT ROUTEID, ---ID MP DIR BMP, ----ID_MP+SECTION_LENGTH DIR_EMP, CASE --WHEN SPEED LIMIT>=55 --THEN 'ABOVE 55' --ELSE 'BELOW 55' ---END SEC ATTRIBUTE --FROM HMIS UNIVERSE ALL YEARS WHERE YEAR = INV YEAR __ AND ROUTEID = ROUTE LIST.HMIS ROUTEID ----AND MEDIAN TY IN (4,5) ORDER BY ID MP ------) TT) ------GROUP BY SEC_ATTRIBUTE, ---SEC_RN ---

--),

-- DIVIDED VS UNDIVIDED CRITERIA -- DIVIDED AS -- (SELECT MIN(DIR BMP) BMP, ---MAX(DIR EMP) EMP, SEC ATTRIBUTE, --SEC_RN ----- FROM (SELECT DIR_BMP, ---DIR_EMP, ---SEC_ATTRIBUTE, ---RN_, ---ROW_NUMBER() OVER(ORDER BY RN_) -ROW_NUMBER() OVER(PARTITION BY SEC ATTRIBUTE ORDER BY RN) AS SEC RN FROM ---(SELECT TT.*, --ROWNUM RN -- THIS SUBQUERY SORTS THE INCOMING ATTRIBUTE AND SUPPLIES THE RN FIELD. FROM (SELECT DISTINCT ROUTEID, ---ID_MP DIR_BMP, --ID_MP+SECTION_LENGTH DIR_EMP, --CASE ---WHEN MEDIAN TY IN (4,5) ---THEN 'UNDIVIDED' ---ELSE 'DIVIDED' --END SEC ATTRIBUTE FROM HMIS UNIVERSE ALL YEARS __ WHERE YEAR = INV YEAR AND ROUTEID = ROUTE LIST.HMIS ROUTEID ----AND MEDIAN TY IN (4,5) ---ORDER BY ID MP ---) TT -----)) ---GROUP BY SEC_ATTRIBUTE, ---SEC_RN --ORDER BY 1 -----), **DIVIDED AS** (SELECT DISTINCT ROUTEID, ID MP BMP, ID MP+SECTION LENGTH EMP, CASE WHEN MEDIAN_TY IN (4,5) THEN 'UNDIVIDED' ELSE 'DIVIDED' END SEC ATTRIBUTE FROM HMIS UNIVERSE ALL YEARS WHERE YEAR = INV_YEAR AND ROUTEID = ROUTE_LIST.HMIS_ROUTEID --AND MEDIAN TY IN (4,5) ORDER BY ID MP). **RUT AS** (SELECT * FROM (SELECT DISTINCT DIR BMP BMP, DIR_EMP EMP, CASE WHEN (L_RUT+R_RUT)/2 >0.25

Updated 10/18/2021

THEN 'HIGH RUT'

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ELSE 'LOW RUT' END SEC ATTRIBUTE FROM FINAL CONDITION DETAIL SKID WHERE COLLECT YEAR = COND YEAR AND GLOBAL ROUTE ID = ROUTE LIST.GLOBAL ROUTE ID AND SUB_ROUTE_ID = ROUTE_LIST.SUB_ROUTE_ID -- AND (L_RUT+R_RUT)/2 >0.25 -- AND DIR_BMP >=0 -- AND DIR_EMP < 1 ORDER BY 1) TT WHERE SEC_ATTRIBUTE ='HIGH_RUT'), -- RUT>.25 CRITERIA -- RUT AS (SELECT * --FROM (SELECT MIN(DIR_BMP) BMP, ---MAX(DIR_EMP) EMP, -----SEC ATTRIBUTE, DISTANCE --FROM --(SELECT DIR BMP, --DIR EMP, ---SEC_ATTRIBUTE, ---RN, ROW NUMBER() OVER(ORDER BY RN) - ROW NUMBER() OVER(PARTITION BY SEC ATTRIBUTE ORDER BY RN_) AS DISTANCE --FROM (SELECT TT.*, ---ROWNUM RN_ -- THIS SUBQUERY SORTS THE INCOMING ATTRIBUTE AND SUPPLIES ---THE RN FIELD. FROM ---(SELECT DISTINCT DIR_BMP DIR_BMP, ---DIR_EMP DIR_EMP, ---CASE ---WHEN (L RUT+R RUT)/2 >0.25 --THEN 'HIGH RUT' ---ELSE 'LOW RUT' ---END SEC ATTRIBUTE ---FROM FINAL CONDITION DETAIL SKID WHERE COLLECT_YEAR = COND_YEAR AND GLOBAL_ROUTE_ID = ROUTE_LIST.GLOBAL_ROUTE_ID ---AND SUB_ROUTE_ID = ROUTE_LIST.SUB_ROUTE_ID ----- AND (L_RUT+R_RUT)/2 >0.25 ---- AND DIR BMP >=0 ---- AND DIR EMP < 1 --ORDER BY 1 ----) TT) ---) ---GROUP BY SEC ATTRIBUTE, --DISTANCE ---- WHERE SEC ATTRIBUTE ='HIGH RUT' --), **CURVE AS** (SELECT BMP DIR_BMP, EMP DIR_EMP, SEC_ATTRIBUTE FROM

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(SELECT DIR BMP BMP, DIR EMP EMP, DIR EMP-DIR BMP SEC LENGTH, CASE -- WHEN RADIUS <=250*3.28 -- CHANGED ON 12/16/2020 BASED ON THE EMAIL FROM BX WHEN RADIUS <= 250*3 -- CHANGED ON 09/17/2021 BASED ON THE EMAIL FROM PD AND RADIUS > 0 THEN 'CURVE_750' WHEN RADIUS <= 250 *6 -- CHANGED ON 10/07/2021 BASED ON THE EMAIL FROM KM AND RADIUS > 250*3 THEN 'CURVE_1500' ELSE 'CURVE NOT750' END SEC_ATTRIBUTE FROM CURVE_H_SHA_NETWORK@PAV_CONHIST_ASSET WHERE YEAR = COND YEAR AND GLOBAL ROUTE ID = ROUTE LIST.GLOBAL ROUTE ID AND SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID) --WHERE SEC ATTRIBUTE = 'CURVE 750' WHERE SEC ATTRIBUTE <> 'CURVE NOT750'--CHANGED ON 10/07/2021 BASED ON THE EMAIL FROM KM), -- INTERSECTIONS INTERSECTIONS AS (SELECT CASE WHEN ID MP+.1>=MAX MP THEN MAX MP ELSE ID MP+.1 END EMP. ID MP BMP. MP INT RTE NAME SEC ATTRIBUTE FROM HMIS_MASTER_ALL_YEARS WHERE YEAR = INV_YEAR AND ROUTEID = ROUTE LIST.HMIS ROUTEID AND MP_LOCATION_TYPE <> 2 AND (MP_INT_TYPE > 0 AND MP_INT_TYPE < 10 < 100 AND MP_INT_TYPE NOT IN (7,10,14))). DH GRADE AS (SELECT * FROM DH GRADE SKID WHERE SEC LENGTH >=.03 AND COLLECT YEAR = COND YEAR AND GLOBAL ROUTE ID = ROUTE LIST.GLOBAL ROUTE ID AND SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID), -- ON AND OFF RAMP RAMP AS (SELECT CASE WHEN ID MP+.1>=MAX MP THEN MAX MP ELSE ID MP+.1 END EMP. ID MP BMP, 'RAMP' SEC_ATTRIBUTE FROM HMIS_MASTER_ALL_YEARS WHERE YEAR = INV_YEAR AND ROUTEID = ROUTE LIST.HMIS ROUTEID

AND MP LOCATION TYPE = 2 AND ID PREFIX <>'RP' AND (MP INT RTE NAME LIKE '%TO ' ||ID_PREFIX ||' ' IID RTE NO ||TRIM(MP SUFFIX) ij' ' ||MP_DIRECTION jj'%' OR MP_INT_RTE_NAME LIKE '%FR ' ||ID_PREFIX ÌÌ' ' ID RTE NO ||TRIM(MP_SUFFIX) II' ' ||MP DIRECTION ||'%') UNION SELECT CASE WHEN ID MP+.1>=MAX MP THEN MAX_MP ELSE ID_MP+.1 END EMP, ID MP BMP, 'RAMP' SEC_ATTRIBUTE FROM HMIS_MASTER_ALL_YEARS WHERE YEAR = INV YEAR AND ROUTEID = ROUTE LIST.HMIS ROUTEID AND MP_LOCATION_TYPE = 2 AND ID PREFIX <>'RP' AND (MP_INT_RTE_NAME LIKE '%TO ' ||ID_PREFIX Ϊ'' ID RTE NO ||TRIM(MP_SUFFIX) Îľ' ' $\|$ CASE WHEN MP DIRECTION ='E' THEN 'N' WHEN MP_DIRECTION ='W' THEN 'S' WHEN MP_DIRECTION ='N' THEN 'E' WHEN MP_DIRECTION ='S' THEN 'W' END ||'%' OR MP_INT_RTE_NAME LIKE '%FR ' ||ID_PREFIX II' ' ||ID RTE NO ||TRIM(MP_SUFFIX) 11' ' ĊASE WHEN MP_DIRECTION ='E' THEN 'N' WHEN MP_DIRECTION ='W'

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THEN 'S' WHEN MP DIRECTION ='N' THEN 'E' WHEN MP DIRECTION ='S' THEN 'W' END ||'%') UNIÓN SELECT CASE WHEN ID MP+.1>=MAX MP THEN MAX MP ELSE ID MP+.1 END EMP. ID_MP BMP. 'RAMP' SEC ATTRIBUTE FROM HMIS MASTER ALL YEARS = INV YEAR WHERE YEAR AND ROUTEID = ROUTE LIST.HMIS ROUTEID AND MP_LOCATION_TYPE = 2 AND ID PREFIX __'RP' AND (MP_INT_RTE_NAME LIKE '% ' || TRIM(SUBSTR(ROAD_NAME,1,7)) || '%') ORDER BY BMP), --TRAFFIC LIGHTS, STOP SIGN, ROUNDABOUT, RAIL ROAD CROSSINGS SITE CAT 1 AS (SELECT CASE WHEN ID MP+.1>=MAX MP THEN MAX MP ELSE ID_MP+.1 END EMP, ID MP BMP, -- MP_INT_RTE_NAME, --MP_INT_TYPE, CASE WHEN MP INT RTE NAME LIKE '%TRAFFIC SIGNAL%' THEN 'TRAFFIC_SIGNAL' WHEN MP INT RTE NAME LIKE '%STOP SIGN%' THEN 'STOP SIGN' WHEN (MP_INT_RTE_NAME LIKE '%ROUNDABOUT%' AND MP_INT_RTE_NAME NOT LIKE '% END ROUNDABOUT%') THEN 'ROUND ABOUT' WHEN MP INT RTE NAME LIKE '%SPUR TO%' THEN 'GIVE_WAY' WHEN MP INT RTE NAME LIKE '% RAILROAD CROSSING%' THEN 'RAIL ROAD' --WHEN (MP_INT_TYPE > 0 AND MP_INT_TYPE < 100 AND MP_INT_TYPE NOT IN (7,10,14)) THEN 'INERSECTION' END SEC ATTRIBUTE FROM HMIS MASTER ALL YEARS WHERE YEAR = INV YEAR AND ROUTEID = ROUTE LIST.HMIS ROUTEID AND (MP INT RTE NAME LIKE '%TRAFFIC SIGNAL%' OR MP INT RTE NAME LIKE '%STOP SIGN%' OR (MP_INT_RTE_NAME LIKE '%ROUNDABOUT%' AND MP_INT_RTE_NAME NOT LIKE '% END ROUNDABOUT%') OR MP_INT_RTE_NAME LIKE '%SPUR TO%' OR MP_INT_RTE_NAME LIKE '%RAILROADC ROSSING%'

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-- OR (MP_INT_TYPE > 0 AND MP_INT_TYPE < 100 AND MP_INT_TYPE NOT IN (7,10,14)) UNION --PEDESTRIAN CROSSING SELECT CASE WHEN DIR EMP-.1>=0 THEN DIR_EMP-.1 ELSE 0 END BMP, DIR_EMP EMP, --NULL, 'PEDESTRIAN_CROSSING' PEDESTRIAN_CROSSING FROM EDW18_BASE_4@PAV_CONHIST_ASSET WHERE GLOBAL_ROUTE_ID = ROUTE_LIST.GLOBAL_ROUTE ID AND SUB ROUTE ID = ROUTE_LIST.SUB_ROUTE_ID AND STATUS = 'MATCHED' AND EVENT CROSSWALK OFFICE = 1), FINAL SEG AS -----(SELECT MAX_MP- EMP BMP FROM SPEED_LIMIT S UNION ---- SELECT MAX MP- BMP EMP FROM SPEED LIMIT S -- UNION -- SELECT MAX_MP- EMP BMP FROM DIVIDED S -- UNION -- SELECT MAX MP- BMP EMP FROM DIVIDED S -- UNION -- SELECT BMP FROM RUT -- UNION -- SELECT EMP FROM RUT -- UNION -- SELECT MAX MP- EMP BMP FROM INTERSECTIONS S -- UNION -- SELECT MAX_MP- BMP EMP FROM INTERSECTIONS S -- UNION -- SELECT DIR BMP FROM CURVE --UNION -- SELECT DIR EMP FROM CURVE UNION ---- SELECT DIR BMP FROM DH GRADE UNION -- SELECT DIR EMP FROM DH GRADE -- UNION -- SELECT MAX_MP- EMP BMP FROM RAMP S -- UNION -- SELECT MAX MP- BMP EMP FROM RAMP S -- UNION -- SELECT MAX MP- EMP BMP FROM SITE CAT 1 S -- UNION -- SELECT MAX_MP- BMP EMP FROM SITE_CAT_1 S ORDER BY 1 --) FINAL SEG AS (SELECT MAX MP- EMP+DIR MIN MP BMP FROM SPEED LIMIT S UNION SELECT MAX MP- BMP+DIR MIN MP EMP FROM SPEED LIMIT S UNION SELECT MAX_MP- EMP+DIR_MIN_MP BMP FROM DIVIDED S UNION SELECT MAX_MP- BMP+DIR_MIN_MP EMP FROM DIVIDED S UNION SELECT BMP FROM RUT

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UNION SELECT EMP FROM RUT UNION SELECT MAX MP- EMP+DIR MIN MP BMP FROM INTERSECTIONS S UNION SELECT MAX MP- BMP+DIR MIN MP EMP FROM INTERSECTIONS S UNION SELECT DIR_BMP FROM CURVE UNION SELECT DIR EMP FROM CURVE UNION SELECT DIR BMP FROM DH GRADE UNION SELECT DIR EMP FROM DH GRADE UNION SELECT MAX MP- EMP+DIR MIN MP BMP FROM RAMP S UNION SELECT MAX_MP- BMP+DIR_MIN_MP EMP FROM RAMP S UNION SELECT MAX_MP- EMP+DIR_MIN_MP BMP FROM SITE_CAT_1 S UNION SELECT MAX MP-BMP+DIR MIN MP EMP FROM SITE CAT 1 S ORDER BY 1 SELECT COND YEAR, ROUTE LIST. GOVT CONTROL, ROUTE LIST.HMIS ROUTEID, ROUTE LIST.GLOBAL ROUTE ID, ROUTE LIST.SUB ROUTE ID, BMP. EMP FROM (SELECT BMP, LEAD (BMP) OVER (ORDER BY BMP) EMP FROM FINAL SEG WHERE EMP IS NOT NULL AND BMP >=0 AND BMP <> EMP AND BMP >= -- CHANGED ON 9/17/21 BASED ON EMAIL FROM PD CASE WHEN ROUTE CNT> 1 THEN ROUTE LIST.DIR BMP ELSE DIR MIN MP END-- TO ADDRESS ROUTES WITH MULTIPLE ROWS. AND EMP <= CASE WHEN ROUTE CNT> 1 THEN ROUTE LIST.DIR EMP ELSE DIR MAX MP END ORDER BY BMP; --- UPDATING INV MILEPOINTS -- CHANGED ON 9/17/21 BASED ON EMAIL FROM PD -- IF MIN MP> 0 AND DIR MIN MP=0 THEN--- TO ADDRESS CASES LIKE 24004 -- UPDATE FMG BASE SEGMENTS F -- SET INV_BMP = MAX MP- EMP, = MAX MP- BMP INV EMP ----- WHERE F.GLOBAL ROUTE ID= ROUTE LIST.GLOBAL ROUTE ID -- AND F.SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID; -- ELSE -- UPDATE FMG_BASE_SEGMENTS F -- SET INV_BMP = MAX_MP- EMP+MIN_MP, INV EMP = MAX MP- BMP+MIN MP --

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-- WHERE F.GLOBAL ROUTE ID= ROUTE LIST.GLOBAL ROUTE ID -- AND F.SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID; -- END IF: UPDATE FMG BASE SEGMENTS F SET INV BMP = MAX MP- EMP+DIR MIN MP, = MAX MP- BMP+DIR MIN MP INV EMP WHERE F.GLOBAL ROUTE ID= ROUTE LIST.GLOBAL ROUTE ID AND F.SUB_ROUTE_ID = ROUTE_LIST.SUB_ROUTE_ID; DELETE FROM FMG_BASE_SEGMENTS F WHERE F.GLOBAL_ROUTE_ID= ROUTE_LIST.GLOBAL_ROUTE_ID AND F.SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID AND (INV BMP <MIN MP OR INV EMP >MAX MP): COMMIT; -- DIVIDED UPDATE BEGIN MERGE INTO FMG BASE SEGMENTS A USING (SELECT DISTINCT F.ROWID ROW ID, F.INV BMP, F.INV EMP, -- H.MEDIAN TY, CASE WHEN MEDIAN TY IN (4,5) THEN 'UNDIVIDED' ELSE 'DIVIDED' END SEC ATTRIBUTE FROM HMIS UNIVERSE ALL YEARS H, FMG BASE SEGMENTS F WHERE H.YEAR = INV YEAR AND F.COLLECT YEAR = COND YEAR -- AND H.ROUTEID = ROUTE LIST.HMIS ROUTEID AND F.GLOBAL ROUTE ID= ROUTE LIST.GLOBAL ROUTE ID AND F.SUB_ROUTE_ID = ROUTE_LIST.SUB_ROUTE_ID -- AND F.INV_BMP >= ROUTE_LIST.INV_BMP --CHANGED FROM ROUTE_LIST.DIR_BMP TO INV BMP OM 11/8 BY RG -- AND F.INV EMP <= ROUTE LIST.INV EMP -- CHANGED FROM ROUTE LIST.DIR EMP TO INV EMP OM 11/8 BY RG AND F.HMIS ROUTEID = H.ROUTEID AND ((ID MP >= F.INV BMP AND ID MP <F.INV EMP) OR (F.INV BMP >= ID MP AND F.INV EMP <= ID MP+SECTION LENGTH))) B ON (A.ROWID = $B.ROW_{ID}$) WHEN MATCHED THEN UPDATE SET A.DIVIDED = B.SEC ATTRIBUTE; EXCEPTION WHEN OTHERS THEN DBMS OUTPUT.PUT LINE('LINE2043- '||ROUTE LIST.HMIS ROUTEID); END: -- SPEED LIMIT UPDATE MERGE INTO FMG BASE SEGMENTS A USING (SELECT DISTINCT F.ROWID ROW ID, F.INV BMP, F.INV EMP, -- H.MEDIAN_TY, CASE WHEN H.SPEED LIMIT>=55-- CHANGED ON 9/17/2021 BASED ON EMAIL FROM PD THEN 'ABOVE 55' WHEN H.SPEED_LIMIT>=35 AND H.SPEED_LIMIT <55 THEN 'BELOW 55'
ELSE 'BELOW 35' END SEC ATTRIBUTE FROM HMIS UNIVERSE ALL YEARS H, FMG BASE SEGMENTS F WHERE H.YEAR = INV YEAR AND F.COLLECT YEAR = COND YEAR -- AND H.ROUTEID = ROUTE LIST.HMIS ROUTEID AND F.GLOBAL_ROUTE_ID= ROUTE_LIST.GLOBAL_ROUTE_ID AND F.SUB_ROUTE_ID = ROUTE_LIST.SUB_ROUTE_ID -- AND F.INV BMP >= ROUTE LIST.INV BMP --CHANGED FROM ROUTE LIST.DIR BMP TO INV BMP OM 11/8 BY RG -- AND F.INV EMP <= ROUTE LIST.INV EMP -- CHANGED FROM ROUTE LIST.DIR EMP TO INV EMP OM 11/8 BY RG AND F.HMIS ROUTEID = H.ROUTEID AND ((ID MP >= F.INV BMP <F.INV EMP) AND ID MP OR (F.INV BMP >= ID MP AND F.INV_EMP <= ID_MP+SECTION_LENGTH))) B ON (A.ROWID = B.ROW ID) WHEN MATCHED THEN UPDATE SET A.SPEED LIMIT = B.SEC ATTRIBUTE; -- RUT MERGE INTO FMG BASE SEGMENTS A USING (SELECT DISTINCT F.ROWID ROW_ID, F.BMP, F.EMP,-- H.MEDIAN TY, --H.DIR BMP, H.DIR EMP, 'HIGH RUT' SEC ATTRIBUTE FROM FINAL CONDITION DETAIL SKIDH, FMG BASE SEGMENTS F WHERE H.COLLECT YEAR = COND YEAR AND F.COLLECT_YEAR = H.COLLECT_YEAR -- AND H.ROUTEID = ROUTE_LIST.HMIS_ROUTEID AND F.GLOBAL_ROUTE_ID = ROUTE_LIST.GLOBAL_ROUTE_ID AND F.SUB_ROUTE_ID = ROUTE_LIST.SUB_ROUTE_ID >= MIN MP AND F.BMP AND F.EMP <= MAX MP AND F.GLOBAL ROUTE ID = H.GLOBAL ROUTE ID AND F.SUB_ROUTE_ID = H.SUB_ROUTE_ID AND (L RUT+R RUT)/2 >0.25 -- AND ((H.DIR BMP >= F.BMP -- AND H.DIR_EMP <=F.EMP) -- OR (H.DIR_BMP <F.BMP -- AND H.DIR EMP >F.EMP) -- OR (H.DIR BMP <=F.BMP -- AND H.DIR_EMP >F.BMP)) AND (H.DIR BMP <= F.BMP AND H.DIR_EMP >=F.EMP) -- ORDER BY 2) B ON (A.ROWID = B.ROW ID) WHEN MATCHED THEN UPDATE SET A.RUT = B.SEC ATTRIBUTE; -- CURVE MERGE INTO FMG BASE SEGMENTS A USING (SELECT * FROM (SELECT DISTINCT F.ROWID ROW_ID, F.BMP, F.EMP,

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SEC ATTRIBUTE
 FROM FMG BASE SEGMENTS F,
  (SELECT *
  FROM
   (SELECT DIR BMP,
    DIR EMP,
    DIR EMP-DIR BMP SEC LENGTH,
    CASE
      -- WHEN RADIUS <=250*3.28 -- CHANGED ON 12/16/2020 BASED ON THE EMAIL FROM BX
     WHEN RADIUS <= 250*3 -- CHANGED ON 09/17/2021 BASED ON THE EMAIL FROM PD
     AND RADIUS > 0
     THEN 'CURVE_750'
     WHEN RADIUS <= 250 *6 -- CHANGED ON 10/07/2021 BASED ON THE EMAIL FROM KM
     AND RADIUS > 250*3
     THEN 'CURVE_1500'
     ELSE 'CURVE NOT750'
    END SEC ATTRIBUTE
   FROM CURVE_H_SHA_NETWORK@PAV_CONHIST_ASSET
                   = COND YEAR
   WHERE YEAR
   AND GLOBAL ROUTE ID = ROUTE LIST.GLOBAL ROUTE ID
   AND SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID
   --WHERE SEC ATTRIBUTE = 'CURVE 750'
  WHERE SEC_ATTRIBUTE <> 'CURVE_NOT750'--CHANGED ON 10/07/2021 BASED ON THE EMAIL
FROM KM
  ) H
 WHERE F.COLLECT YEAR = COND YEAR
 AND F.BMP
                >= MIN MP
 AND F.EMP
                <= MAX MP
 AND F.GLOBAL_ROUTE_ID = ROUTE_LIST.GLOBAL ROUTE ID
 AND F.SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID
 AND (H.DIR BMP
                  <=F.BMP
 AND H.DIR EMP
                  >=F.EMP)
 ORDER BY 2
 )
 --WHERE SEC ATTRIBUTE = 'CURVE 750'
WHERE SEC ATTRIBUTE <> 'CURVE NOT750'--CHANGED ON 10/07/2021 BASED ON THE EMAIL
FROM KM
                = B.ROW_ID)
) B ON (A.ROWID
WHEN MATCHED THEN
UPDATE
SET A.CURVE = B.SEC ATTRIBUTE;
-- INTERSECTIONS
MERGE INTO FMG_BASE_SEGMENTS A USING
(SELECT *
FROM
 (SELECT DISTINCT F.ROWID ROW ID,
  F.INV BMP,
  F.INV EMP,
  H.ID MP,
  MP INT RTE NAME SEC ATTRIBUTE,
  ROW NUMBER() OVER ( PARTITION BY F.ROWID ORDER BY ID MP, MP INT RTE NAME) RN
 FROM HMIS MASTER ALL YEARS H,
  FMG BASE SEGMENTS F
 WHERE H.YEAR
                  = INV YEAR
 AND F.COLLECT YEAR = COND YEAR
  -- AND H.ROUTEID = ROUTE LIST.HMIS ROUTEID
 AND F.GLOBAL_ROUTE_ID= ROUTE_LIST.GLOBAL_ROUTE_ID
 AND F.SUB_ROUTE_ID = ROUTE_LIST.SUB_ROUTE_ID
  -- AND F.INV_BMP >= ROUTE_LIST.INV_BMP --CHANGED FROM ROUTE_LIST.DIR_BMP TO
INV BMP OM 11/8 BY RG
```

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```
-- AND F.INV EMP
                    <= ROUTE LIST.INV EMP -- CHANGED FROM ROUTE LIST.DIR EMP TO
INV EMP OM 11/8 BY RG
 AND F.HMIS ROUTEID = H.ROUTEID
 AND (F.INV BMP
                 >= ID MP
 AND F.INV EMP
                  <= ID MP+.1)
 AND (MP INT TYPE > 0
 AND MP_INT_TYPE < 100
 AND MP_INT_TYPE NOT IN (7,10,14))
WHERE RN
             =1
) B ON (A.ROWID = B.ROW ID)
WHEN MATCHED THEN
UPDATE
SET A.INTERSECTIONS = B.SEC ATTRIBUTE;
-- DOWNHILL GRAD
--DH_GRADE_5_TO_10
MERGE INTO FMG BASE SEGMENTS A USING
( SELECT DISTINCT F.ROWID ROW_ID,
 H.SEC ATTRIBUTE
FROM FMG_BASE_SEGMENTS F,
 (SELECT *
 FROM DH GRADE SKID
 WHERE SEC LENGTH >=.03
 AND SEC_ATTRIBUTE IN ('DH_GRADE_5_TO_10')
 )H
WHERE F.COLLECT YEAR = COND YEAR
 -- AND H.ROUTEID = ROUTE LIST.HMIS ROUTEID
AND F.GLOBAL ROUTE ID = ROUTE LIST.GLOBAL ROUTE ID
AND F.SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID
AND F.BMP
               >= MIN MP
AND F.EMP
               <= MAX MP
AND F.GLOBAL ROUTE ID = H.GLOBAL ROUTE ID
AND F.SUB_ROUTE_ID = H.SUB_ROUTE_ID
AND F.COLLECT_YEAR = H.COLLECT_YEAR
AND ( (H.DIR_BMP
                >=F.BMP
AND H.DIR EMP
                  \leq F.EMP
OR (H.DIR_BMP
                  <F.BMP
AND H.DIR EMP
                  >F.EMP)
OR (H.DIR BMP
                 <=F.BMP
AND H.DIR EMP
                  >F.BMP))
)B ON (A.ROWID
                 = B.ROW ID)
WHEN MATCHED THEN
UPDATE
SET A.DOWNHILL_GRADE = B.SEC_ATTRIBUTE;
--DH GRADE 10
MERGE INTO FMG BASE SEGMENTS A USING
( SELECT DISTINCT F.ROWID ROW ID,
 H.SEC ATTRIBUTE
FROM FMG BASE SEGMENTS F,
 (SELECT *
 FROM DH GRADE SKID
 WHERE SEC LENGTH>=.03
 AND SEC ATTRIBUTE= ('DH GRADE 10')
 )H
WHERE F.COLLECT YEAR = COND YEAR
 -- AND H.ROUTEID = ROUTE LIST.HMIS ROUTEID
AND F.GLOBAL ROUTE ID = ROUTE LIST.GLOBAL ROUTE ID
AND F.SUB_ROUTE_ID = ROUTE_LIST.SUB_ROUTE_ID
               >= MIN MP
AND F.BMP
AND F.EMP
                <= MAX_MP
AND F.GLOBAL_ROUTE_ID = H.GLOBAL_ROUTE_ID
```

AND F.SUB ROUTE ID = H.SUB ROUTE ID AND F.COLLECT YEAR = H.COLLECT YEAR AND ((H.DIR BMP >= F.BMP AND H.DIR EMP $\leq F.EMP$ OR (H.DIR BMP <F.BMP AND H.DIR EMP >F.EMP) OR (H.DIR BMP <=F.BMP AND H.DIR_EMP >F.BMP)))B ON (A.ROWID = B.ROW_ID) WHEN MATCHED THEN UPDATE SET A.DOWNHILL GRADE = B.SEC ATTRIBUTE; -- RAMP -- ROUTE IS NOT A RAMP MERGE INTO FMG BASE SEGMENTS A USING (SELECT * FROM (SELECT DISTINCT F.ROWID ROW_ID, F.INV BMP, F.INV EMP, H.ID MP, MP INT RTE NAME SEC ATTRIBUTE, ROW_NUMBER() OVER (PARTITION BY F.ROWID ORDER BY ID_MP,MP_INT_RTE_NAME) RN FROM HMIS_MASTER_ALL_YEARS H , FMG BASE SEGMENTS F WHERE H.YEAR = INV YEAR AND F.COLLECT YEAR = COND YEAR -- AND H.ROUTEID = ROUTE LIST.HMIS ROUTEID AND F.GLOBAL ROUTE ID= ROUTE LIST.GLOBAL ROUTE ID AND F.SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID -- AND F.INV_BMP >= ROUTE_LIST.INV_BMP --CHANGED FROM ROUTE_LIST.DIR_BMP TO INV BMP OM 11/8 BY RG --AND F.INV_EMP <= ROUTE_LIST.INV_EMP --CHANGED FROM ROUTE_LIST.DIR_EMP TO INV EMP OM 11/8 BY RG AND F.HMIS ROUTEID = H.ROUTEID AND (F.INV_BMP >= ID MP AND F.INV_EMP <= ID MP +.1) AND MP LOCATION TYPE = 2 AND ID PREFIX <>'RP' AND (MP_INT_RTE_NAME LIKE '%TO ' ||ID PREFIX <u>||' '</u> IID RTE NO ||TRIM(MP_SUFFIX) ||' ' ||MP DIRECTION ||'%' OR MP INT RTE NAME LIKE '%FR ' ||ID_PREFIX <u>||' '</u> ID RTE NO ||TRIM(MP_SUFFIX) II' ' ||MP DIRECTION ||'%') WHERE RN =1) B ON (A.ROWID = B.ROW_ID) WHEN MATCHED THEN UPDATE SET A.RAMP = B.SEC_ATTRIBUTE;

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```

```
-- ROUTE IS NOT A RAMP - DIRECTION CHANGE
MERGE INTO FMG BASE SEGMENTS A USING
(SELECT *
FROM
 (SELECT DISTINCT F.ROWID ROW ID,
  F.INV BMP,
  F.INV EMP,
  H.ID MP,
  MP_INT_RTE_NAME SEC_ATTRIBUTE,
  ROW_NUMBER() OVER ( PARTITION BY F.ROWID ORDER BY ID_MP,MP_INT_RTE_NAME) RN
 FROM HMIS_MASTER_ALL_YEARS H ,
  FMG_BASE_SEGMENTS F
 WHERE H.YEAR
                  = INV_YEAR
 AND F.COLLECT_YEAR = COND_YEAR
  -- AND H.ROUTEID = ROUTE LIST.HMIS ROUTEID
 AND F.GLOBAL ROUTE ID= ROUTE LIST.GLOBAL ROUTE ID
 AND F.SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID
  -- AND F.INV_BMP >= ROUTE_LIST.INV_BMP --CHANGED FROM ROUTE_LIST.DIR_BMP TO
INV BMP OM 11/8 BY RG
  --AND F.INV_EMP <= ROUTE_LIST.INV_EMP --CHANGED FROM ROUTE_LIST.DIR_EMP TO
INV EMP OM 11/8 BY RG
 AND F.HMIS ROUTEID = H.ROUTEID
 AND (F.INV BMP
                 >= ID MP
                 <= ID MP +.1)
 AND F.INV_EMP
 AND MP_LOCATION_TYPE = 2
 AND ID PREFIX
                  <>'RP'
 AND (MP INT RTE NAME LIKE '%TO '
  ||ID_PREFIX
  II' '
   IID RTE NO
   ||TRIM(MP_SUFFIX)
   Îľ' '
   CASE
   WHEN MP_DIRECTION ='E'
   THEN 'N'
   WHEN MP_DIRECTION ='W'
   THEN 'S'
   WHEN MP_DIRECTION ='N'
   THEN 'E'
   WHEN MP DIRECTION ='S'
   THEN 'W'
  END
  ||'%'
 OR MP_INT_RTE_NAME LIKE '%FR '
  ||ID_PREFIX
  <u>ا''ا</u>
  IID RTE NO
  ITRIM(MP SUFFIX)
  Ï''
  Ш
  CASE
   WHEN MP DIRECTION ='E'
   THEN 'N'
   WHEN MP DIRECTION ='W'
   THEN 'S'
   WHEN MP DIRECTION ='N'
   THEN 'E'
   WHEN MP_DIRECTION ='S'
   THEN 'W'
  END
```

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||'%') WHERE RN =1) B ON (A.ROWID = B.ROW ID) WHEN MATCHED THEN UPDATE SET A.RAMP = B.SEC ATTRIBUTE; -- ROUTE IS A RAMP MERGE INTO FMG_BASE_SEGMENTS A USING (SELECT * FROM (SELECT DISTINCT F.ROWID ROW ID, F.INV_BMP, F.INV EMP, H.ID MP, MP INT RTE NAME SEC ATTRIBUTE, ROW NUMBER() OVER (PARTITION BY F.ROWID ORDER BY ID MP, MP INT RTE NAME) RN FROM HMIS_MASTER_ALL_YEARS H , FMG BASE SEGMENTS F WHERE H.YEAR = INV YEAR AND F.COLLECT YEAR = COND YEAR -- AND H.ROUTEID = ROUTE LIST.HMIS ROUTEID AND F.GLOBAL ROUTE ID= ROUTE LIST.GLOBAL ROUTE ID AND F.SUB_ROUTE_ID = ROUTE_LIST.SUB_ROUTE_ID -- AND F.INV_BMP >= ROUTE_LIST.INV_BMP --CHANGED FROM ROUTE_LIST.DIR_BMP TO INV BMP OM 11/8 BY RG -- AND F.INV EMP <= ROUTE LIST.INV EMP -- CHANGED FROM ROUTE LIST.DIR EMP TO INV EMP OM 11/8 BY RG AND F.HMIS_ROUTEID = H.ROUTEID AND (F.INV BMP >= ID MP AND F.INV EMP <= ID MP +.1) AND MP LOCATION TYPE = 2 AND ID_PREFIX ='RP' AND (MP_INT_RTE_NAME LIKE '% ' || TRIM(SUBSTR(ROAD_NAME,1,7)) || '%')) WHERE RN =1) B ON (A.ROWID = B.ROW ID) WHEN MATCHED THEN UPDATE SET A.RAMP = B.SEC ATTRIBUTE; -- CAT ONE FEATURES MERGE INTO FMG_BASE_SEGMENTS A USING (SELECT * FROM (SELECT DISTINCT F.ROWID ROW ID, F.INV BMP, F.INV EMP, H.ID MP, CASE WHEN MP INT RTE NAME LIKE '%TRAFFIC SIGNAL%' THEN 'TRAFFIC SIGNAL' WHEN MP INT RTE NAME LIKE '%STOP SIGN%' THEN 'STOP SIGN' WHEN (MP_INT_RTE_NAME LIKE '%ROUNDABOUT%' AND MP INT RTE NAME NOT LIKE '% END ROUNDABOUT%') THEN 'ROUND_ABOUT' WHEN MP_INT_RTE_NAME LIKE '%SPUR TO%' THEN 'GIVE WAY' WHEN MP INT RTE NAME LIKE '% RAILROAD CROSSING%'

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THEN 'RAIL ROAD' END SEC ATTRIBUTE. ROW NUMBER() OVER (PARTITION BY F.ROWID ORDER BY ID MP, MP INT RTE NAME) RN FROM HMIS MASTER ALL YEARS H, FMG BASE SEGMENTS F WHERE H.YEAR = INV YEAR AND F.COLLECT YEAR = COND YEAR -- AND H.ROUTEID = ROUTE_LIST.HMIS_ROUTEID AND F.GLOBAL_ROUTE_ID= ROUTE_LIST.GLOBAL_ROUTE_ID AND F.SUB_ROUTE_ID = ROUTE_LIST.SUB_ROUTE_ID -- AND F.INV BMP >= ROUTE_LIST.INV_BMP --CHANGED FROM ROUTE_LIST.DIR_BMP TO INV BMP OM 11/8 BY RG --AND F.INV EMP <= ROUTE LIST.INV EMP --CHANGED FROM ROUTE LIST.DIR EMP TO INV EMP OM 11/8 BY RG AND F.HMIS ROUTEID = H.ROUTEID AND (F.INV_BMP >= ID_MP AND F.INV_EMP <= ID_MP +.1) AND (MP INT RTE NAME LIKE '% TRAFFIC SIGNAL%' OR MP INT RTE NAME LIKE '%STOP SIGN%' OR (MP INT RTE NAME LIKE '%ROUNDABOUT%' AND MP_INT_RTE_NAME NOT LIKE '%END ROUNDABOUT%') OR MP INT RTE NAME LIKE '%SPUR TO%' OR MP INT RTE NAME LIKE '% RAILROADC ROSSING%') WHERE RN =1) B ON (A.ROWID = B.ROW ID) WHEN MATCHED THEN UPDATE SET A.CAT ONE FEATURES = B.SEC ATTRIBUTE; -- PEDESTRIAN CROSSING MERGE INTO FMG BASE SEGMENTS A USING (SELECT DISTINCT F.ROWID ROW_ID, F.INV_BMP, F.INV_EMP,-- H.MEDIAN_TY, --H.DIR BMP, H.DIR EMP 'PEDESTRIAN CROSSING' SEC ATTRIBUTE FROM EDW18_BASE_4@PAV_CONHIST_ASSET H , FMG BASE SEGMENTS F WHERE F.COLLECT_YEAR = COND_YEAR -- AND H.ROUTEID = ROUTE LIST.HMIS ROUTEID AND F.GLOBAL ROUTE ID= ROUTE LIST.GLOBAL ROUTE ID AND F.SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID -- AND F.INV BMP >= ROUTE LIST.DIR BMP -- AND F.INV_EMP <= ROUTE_LIST.DIR_EMP >= MIN MP AND F.BMP <= MAX MP AND F.EMP AND F.GLOBAL ROUTE ID = H.GLOBAL ROUTE ID AND F.SUB ROUTE ID = H.SUB ROUTE ID = 'MATCHED' AND STATUS AND EVENT CROSSWALK OFFICE = 1 AND ((H.DIR EMP-.1 >=F.INV BMP AND H.DIR EMP <=F.INV EMP) <F.INV BMP OR (H.DIR EMP-.1 AND H.DIR EMP >F.INV EMP) <=F.INV BMP OR (H.DIR EMP-.1 AND H.DIR EMP >F.INV BMP)) ORDER BY 2) B ON (A.ROWID = B.ROW_ID) WHEN MATCHED THEN UPDATE SET A.CAT ONE FEATURES = B.SEC ATTRIBUTE;

```
-- SITE CATEGORY UPDATE
-- UPDATE FMG BASE SEGMENTS
-- SET SITE CATEGORY
                         = 1
-- WHERE (CAT ONE FEATURES IS NOT NULL-- CHANGED ON 9/17/2021 BASED ON EMAIL
FROM PD
-- AND SPEED LIMIT
                       ='ABOVE 55')
-- AND SITE_CATEGORY
                         IS NULL
-- AND GLOBAL_ROUTE_ID = ROUTE_LIST.GLOBAL_ROUTE_ID
                         = ROUTE_LIST.SUB_ROUTE ID;
-- AND SUB_ROUTE_ID
   UPDATE FMG_BASE_SEGMENTS
--
   SET SITE_CATEGORY = 2
--
   WHERE (CURVE
--
                   IS NOT NULL
   OR DOWNHILL GRADE ='DH GRADE 10'
---
   OR RAMP
                 IS NOT NULL)
--
   AND SITE CATEGORY IS NULL
---
   AND GLOBAL ROUTE ID = ROUTE LIST.GLOBAL ROUTE ID
   AND SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID;
   UPDATE FMG_BASE_SEGMENTS
---
   SET SITE CATEGORY
--
                          = 3
   WHERE ( CAT ONE FEATURES IS NOT NULL
--
   AND SPEED LIMIT
                        ='BELOW 55')-- CHANGED ON 9/17/2021 BASED ON EMAIL FROM PD
--
   OR ((INTERSECTIONS
                         IS NOT NULL
--
   OR DOWNHILL GRADE
                           ='DH GRADE 5 TO 10')
---
                        IN ('ABOVE_55', 'BELOW_55') )
--
   AND SPEED LIMIT
                      ='UNDIVIDED'
   OR (DIVIDED
--
   AND SPEED_LIMIT
                         ='ABOVE 55'
--
   AND RUT
                     ='HIGH RUT'))
--
--
   AND SITE CATEGORY
                          IS NULL
   AND GLOBAL ROUTE ID
--
                          = ROUTE LIST.GLOBAL ROUTE ID
---
   AND SUB ROUTE ID
                          = ROUTE LIST.SUB ROUTE ID;
-- UPDATE FMG BASE SEGMENTS
   SET SITE CATEGORY
                          = 4
---
-- WHERE ( CAT_ONE_FEATURES IS NOT NULL
                        ='BELOW_35')-- CHANGED ON 9/17/2021 BASED ON EMAIL FROM PD
   AND SPEED_LIMIT
--
   OR ( DIVIDED
                      ='UNDIVIDED'
--
   AND (SPEED LIMIT
                        IN ('BELOW 55', 'BELOW 35')-- CHANGED ON 9/17/2021 BASED ON
EMAIL FROM PD
-- OR RUT
                    IS NULL))
   OR ( (INTERSECTIONS
                         IS NOT NULL
   OR DOWNHILL GRADE
                           ='DH_GRADE_5_TO_10')
--
   AND SPEED LIMIT
                        IN ('BELOW 35'))
   OR (DIVIDED
                      ='DIVIDED'
   AND SPEED_LIMIT
                        ='ABOVE 55'
--
   AND RUT
                     ='HIGH RUT'))
--
   AND SITE CATEGORY
---
                          IS NULL
-- AND GLOBAL ROUTE ID
                            = ROUTE LIST.GLOBAL ROUTE ID
-- AND SUB ROUTE ID
                          = ROUTE LIST.SUB ROUTE ID;
-- UPDATE FMG BASE SEGMENTS
   SET SITE CATEGORY = 5
--
-- WHERE ( DIVIDED ='DIVIDED'
-- AND (SPEED LIMIT IN ('BELOW 55', 'BELOW 35')-- CHANGED ON 9/17/2021 BASED ON EMAIL
FROM PD
-- OR RUT
                IS NULL))
-- AND SITE CATEGORY IS NULL
-- AND GLOBAL ROUTE ID = ROUTE LIST.GLOBAL ROUTE ID
-- AND SUB ROUTE ID = ROUTE LIST.SUB ROUTE ID;
END IF;
COMMIT;
END LOOP:
UPDATE FMG_BASE_SEGMENTS
                     = 1
SET SITE CATEGORY
```

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WHERE (CAT ONE FEATURES IS NOT NULL-- CHANGED ON 9/17/2021 BASED ON EMAIL FROM PD
AND SPEED LIMIT
                    ='ABOVE 55')
AND SITE_CATEGORY
                      IS NULL :
UPDATE FMG BASE SEGMENTS
SET SITE CATEGORY = 2
                = 'CURVE 750'-- CHANGED ON 10/07 BASED ON EMAIL FROM KM
WHERE (CURVE
OR DOWNHILL GRADE ='DH GRADE 10'
             IS NOT NULL
OR RAMP
AND SITE_CATEGORY IS NULL ;
UPDATE FMG_BASE_SEGMENTS
SET SITE_CATEGORY
                       = 3
WHERE ( (CAT_ONE_FEATURES IS NOT NULL
AND SPEED LIMIT
                     ='BELOW 55')-- CHANGED ON 9/17/2021 BASED ON EMAIL FROM PD
OR (INTERSECTIONS
                     IS NOT NULL
                     IN ('ABOVE_55', 'BELOW_55') )
AND SPEED LIMIT
                         ='DH GRADE_5_TO_10'
OR (DOWNHILL GRADE
                     IN ('ABOVE 55', 'BELOW 55') )
AND SPEED LIMIT
OR (DIVIDED
                  ='UNDIVIDED'
AND SPEED LIMIT
                     ='ABOVE 55'
AND RUT
                 ='HIGH RUT')
                  = 'CURVE 1500' -- CHANGED ON 10/07 BASED ON EMAIL FROM KM
OR (CURVE
AND SPEED LIMIT
                     IN ('ABOVE 55', 'BELOW 55') ))
AND SITE CATEGORY
                       IS NULL;
UPDATE FMG BASE SEGMENTS
SET SITE CATEGORY
                       = 4
WHERE ( (CAT_ONE_FEATURES IS NOT NULL
AND SPEED LIMIT
                     ='BELOW 35')-- CHANGED ON 9/17/2021 BASED ON EMAIL FROM PD
OR ( DIVIDED
                  ='UNDIVIDED'
AND (SPEED LIMIT
                     IN ('BELOW 55', 'BELOW 35')-- CHANGED ON 9/17/2021 BASED ON EMAIL
FROM PD
OR RUT
                IS NULL))
OR (INTERSECTIONS
                     IS NOT NULL
AND SPEED_LIMIT
                     IN ('BELOW_35'))
OR ( DOWNHILL_GRADE
                         ='DH_GRADE_5_TO_10'
AND SPEED LIMIT
                    IN ('BELOW_35'))
OR (DIVIDED
                  ='DIVIDED'
AND SPEED LIMIT
                     ='ABOVE 55'
AND RUT
                 ='HIGH RUT')
OR (CURVE
                  = 'CURVE 1500' -- CHANGED ON 10/07 BASED ON EMAIL FROM KM
AND SPEED LIMIT
                     IN ('BELOW 35'))
)
AND SITE CATEGORY
                       IS NULL;
UPDATE FMG_BASE_SEGMENTS
SET SITE CATEGORY = 5
WHERE ( DIVIDED ='DIVIDED'
AND (SPEED LIMIT IN ('BELOW 55', 'BELOW 35')-- CHANGED ON 9/17/2021 BASED ON EMAIL FROM
PD
OR RUT
            IS NULL)
)
AND SITE CATEGORY IS NULL;
UPDATE FMG BASE SEGMENTS
SET SITE CATEGORY =
 CASE
 WHEN SITE CATEGORY IN (1,2)
 THEN 1
 WHEN SITE CATEGORY IN (3)
 THEN 2
 WHEN SITE_CATEGORY IN (4,5)
 THEN 3
 END:
COMMIT:
```

END P FMG BASE SEGMENTATION;

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PROCEDURE P FMG INTERMED SEGMENTATION AS CURSOR C0 IS SELECT SITE CATEGORY FROM FMG BASE SEGMENTS; TYPE TYP0 TABLE OF C0% ROWTYPE; TAB0 TYP0; CURSOR C1 IS SELECT BMP. EMP FROM FMG BASE SEGMENTS; TYPE TYP1 TABLE OF C1% ROWTYPE; TAB1 TYP1; V BMP NUMBER; V EMP NUMBER; BEGIN EXECUTE IMMEDIATE' TRUNCATE TABLE FMG FINAL SEGMENTS'; FOR SEG IN (SELECT DISTINCT COLLECT_YEAR, HMIS ROUTEID, GLOBAL ROUTE ID, SUB ROUTE ID, GOVT CONTROL FROM FMG BASE SEGMENTS LOOP SELECT DISTINCT SITE_CATEGORY BULK COLLECT INTO TAB0 FROM FMG_BASE_SEGMENTS WHERE COLLECT_YEAR = SEG.COLLECT_YEAR AND GLOBAL_ROUTE_ID = SEG.GLOBAL_ROUTE_ID AND SUB_ROUTE_ID = SEG.SUB_ROUTE_ID AND GOVT_CONTROL =SEG.GOVT_CONTROL ORDER BY SITE CATEGORY ; FOR N IN 1.. TAB0. COUNT LOOP SELECT BMP, EMP BULK COLLECT INTO TAB1 FROM FMG BASE SEGMENTS WHERE COLLECT YEAR = SEG.COLLECT YEAR AND GLOBAL ROUTE ID = SEG.GLOBAL ROUTE ID AND SUB_ROUTE_ID = SEG.SUB_ROUTE_ID AND GOVT CONTROL =SEG.GOVT CONTROL AND SITE CATEGORY = TAB0(N).SITE CATEGORY ORDER BY BMP; V BMP := NULL; V EMP := NULL; FOR I IN 1.. TAB1. COUNT LOOP IF I = 1 THEN V_BMP := TAB1(I).BMP; V_EMP := TAB1(I).EMP; ELSIF I > 1 THEN IF TAB1(I).BMP = TAB1(I - 1).EMP THEN

V EMP := TAB1(I).EMP; ELSIF TAB1(I).BMP <> TAB1(I - 1).EMP THEN INSERT INTO FMG FINAL SEGMENTS (COLLECT YEAR, HMIS ROUTEID, GLOBAL_ROUTE_ID, SUB_ROUTE_ID, GOVT_CONTROL, BMP. EMP. SITE CATEGORY ORG VALUES (SEG.COLLECT YEAR, SEG.HMIS_ROUTEID, SEG.GLOBAL_ROUTE_ID, SEG.SUB_ROUTE_ID, SEG.GOVT_CONTROL, V BMP, V EMP, TAB0(N).SITE_CATEGORY); V BMP := TAB1(I).BMP; V EMP := TAB1(I).EMP; END IF; END IF; IF I = TAB1.COUNT THEN INSERT INTO FMG FINAL SEGMENTS (COLLECT_YEAR, HMIS_ROUTEID, GLOBAL_ROUTE_ID, SUB ROUTE_ID, GOVT_CONTROL, BMP. EMP, SITE CATEGORY ORG VALUES (SEG.COLLECT_YEAR, SEG.HMIS_ROUTEID, SEG.GLOBAL ROUTE ID, SEG.SUB ROUTE ID, SEG.GOVT_CONTROL, V BMP, V EMP. TAB0(N).SITE_CATEGORY); END IF; END LOOP; END LOOP: END LOOP; UPDATE FMG_FINAL_SEGMENTS SET SEC_LENGTH = EMP-BMP; COMMIT; END P_FMG_INTERMED_SEGMENTATION; PROCEDURE P_FMG_FINAL_SEGMENTATION

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```
AS
CURSOR C0
IS
 SELECT SITE CATEGORY FROM FMG BASE SEGMENTS;
TYPE TYP0
IS
TABLE OF C0% ROWTYPE;
TAB0 TYP0;
CURSOR C1
IS
 SELECT BMP,
  FMP
 FROM FMG BASE SEGMENTS;
TYPE TYP1
IS
TABLE OF C1% ROWTYPE;
TAB1 TYP1;
V BMP NUMBER;
V EMP NUMBER;
BEGIN
EXECUTE IMMEDIATE' TRUNCATE TABLE FMG SITE CATEGORY';
FOR SEG IN
(SELECT DISTINCT COLLECT_YEAR,
 HMIS_ROUTEID,
 GLOBAL ROUTE_ID,
 SUB ROUTE ID.
 GOVT CONTROL
FROM FMG BASE SEGMENTS
 --WHERE COUNTY ='AL'
)
LOOP
 SELECT DISTINCT SITE CATEGORY BULK COLLECT
 INTO TAB0
 FROM FMG_BASE_SEGMENTS
 WHERE COLLECT_YEAR = SEG.COLLECT_YEAR
 AND GLOBAL_ROUTE_ID = SEG.GLOBAL_ROUTE_ID
 AND SUB_ROUTE_ID = SEG.SUB_ROUTE_ID
AND GOVT_CONTROL = SEG.GOVT_CONTROL
 ORDER BY SITE CATEGORY ;
 FOR N IN 1.. TAB0. COUNT
 LOOP
  SELECT BMP,
   EMP BULK COLLECT
  INTO TAB1
  FROM FMG_BASE_SEGMENTS
  WHERE COLLECT YEAR = SEG.COLLECT YEAR
  AND GLOBAL ROUTE ID = SEG.GLOBAL ROUTE ID
  AND SUB_ROUTE_ID = SEG.SUB_ROUTE_ID
  AND GOVT CONTROL = SEG.GOVT CONTROL
  AND SITE_CATEGORY = TAB0(N).SITE_CATEGORY
  ORDER BY BMP;
  V BMP := NULL;
  V EMP := NULL;
  FOR I IN 1.. TAB1. COUNT
  LOOP
   IF I
              = 1 THEN
    V BMP
                := TAB1(I).BMP;
    V_EMP
                := TAB1(I).EMP;
   ELSIF I
                > 1 THEN
    IF TAB1(I).BMP = TAB1(I - 1).EMP THEN
     V EMP
                := TAB1(I).EMP;
```

ELSIF TAB1(I).BMP <> TAB1(I - 1).EMP THEN INSERT INTO FMG SITE CATEGORY COLLECT YEAR, HMIS ROUTEID, GLOBAL ROUTE ID, SUB_ROUTE_ID, GOVT_CONTROL, BMP, EMP. SITE_CATEGORY VALUES SEG.COLLECT YEAR, SEG.HMIS ROUTEID, SEG.GLOBAL_ROUTE_ID, SEG.SUB_ROUTE_ID, SEG.GOVT_CONTROL, V BMP, V_EMP, TAB0(N).SITE_CATEGORY); V BMP := TAB1(I).BMP; V EMP := TAB1(I).EMP; END IF; END IF; IF I = TAB1.COUNT THEN INSERT INTO FMG SITE CATEGORY (COLLECT_YEAR, HMIS_ROUTEID, GLOBAL_ROUTE_ID, SUB ROUTE_ID, GOVT_CONTROL, BMP. EMP. SITE CATEGORY) VALUES (SEG.COLLECT_YEAR, SEG.HMIS_ROUTEID, SEG.GLOBAL_ROUTE_ID, SEG.SUB ROUTE ID, SEG.GOVT_CONTROL, V_BMP. V EMP, TAB0(N).SITE_CATEGORY): END IF; END LOOP; END LOOP; END LOOP; COMMIT: END P_FMG_FINAL_SEGMENTATION; PROCEDURE P_FMG_ATTRIBUTE_UPDATE **TYPE TYPE1**

AS

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IS **TABLE OF VARCHAR2** (4000) TAB1 TYPE1; SEC_ATTRIBUTE VARCHAR2(4000); BEGIN FOR SEG IN (SELECT COLLECT_YEAR, GLOBAL ROUTE ID, SUB ROUTE ID, BMP. EMP FROM FMG SITE CATEGORY --WHERE GLOBAL ROUTE ID =805 ORDER BY COLLECT_YEAR, GLOBAL_ROUTE_ID, SUB_ROUTE_ID, BMP LOOP /*** DIVIDED ***/ SELECT DISTINCT DIVIDED BULK COLLECT INTO TAB1 FROM FMG BASE SEGMENTS WHERE COLLECT YEAR = SEG.COLLECT YEAR AND GLOBAL_ROUTE_ID = SEG.GLOBAL_ROUTE_ID AND SUB ROUTE_ID = SEG.SUB_ROUTE_ID AND BMP >= SEG.BMP <= SEG.EMP AND EMP -- AND DIVIDED IS NOT NULL SEC ATTRIBUTE := NULL; FOR I IN 1.. TAB1.COUNT LOOP IF I =1 THEN SEC ATTRIBUTE:= TAB1(I): -- DBMS OUTPUT.PUT LINE('LINE 1'||'-'||SEG.BMP||'-'||SEC ATTRIBUTE); END IF; IF | >1 --AND | <TAB1.COUNT THEN SEC_ATTRIBUTE:= SEC_ATTRIBUTE||','||TAB1(I); -- DBMS_OUTPUT.PUT_LINE('LINE 2'||'-'||SEG.BMP||'-'||SEC_ATTRIBUTE); END IF; IF I =TAB1.COUNT THEN -- DBMS_OUTPUT.PUT_LINE('LINE 3'||'-'||SEG.BMP||'-'||SEC_ATTRIBUTE); UPDATE FMG SITE CATEGORY = SEC_ATTRIBUTE SET DIVIDED WHERE COLLECT YEAR = SEG.COLLECT YEAR AND GLOBAL ROUTE ID = SEG.GLOBAL ROUTE ID AND SUB ROUTE ID = SEG.SUB ROUTE ID AND BMP = SEG.BMP AND EMP = SEG.EMP; END IF; END LOOP: /*** SPEED LIMIT ****/ SELECT DISTINCT SPEED_LIMIT BULK COLLECT INTO TAB1 FROM FMG_BASE_SEGMENTS

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WHERE COLLECT YEAR = SEG.COLLECT YEAR AND GLOBAL ROUTE ID = SEG.GLOBAL ROUTE ID AND SUB ROUTE ID = SEG.SUB ROUTE ID AND BMP >= SEG.BMP AND EMP <= SEG.EMP --AND SPEED LIMIT IS NOT NULL SEC_ATTRIBUTE :=NULL; FOR I IN 1.. TAB1.COUNT LOOP IF I =1 THEN SEC ATTRIBUTE:= TAB1(I); END IF; IF | >1 -- AND | <TAB1.COUNT THEN SEC ATTRIBUTE:= SEC ATTRIBUTE||','||TAB1(I); END IF; IF I =TAB1.COUNT THEN UPDATE FMG_SITE_CATEGORY SET SPEED_LIMIT = SEC_ATTRIBUTE WHERE COLLECT YEAR = SEG.COLLECT YEAR AND GLOBAL ROUTE ID = SEG.GLOBAL ROUTE ID AND SUB ROUTE ID = SEG.SUB ROUTE ID AND BMP = SEG.BMP AND EMP = SEG.EMP; END IF; END LOOP: /*** RUT ***/ SELECT DISTINCT CASE WHEN RUT IS NULL THEN 'LOW_RUT' ELSE RUT END BULK COLLECT INTO TAB1 FROM FMG_BASE_SEGMENTS WHERE COLLECT_YEAR = SEG.COLLECT_YEAR AND GLOBAL_ROUTE_ID = SEG.GLOBAL_ROUTE_ID AND SUB ROUTE ID = SEG.SUB ROUTE ID AND BMP >= SEG.BMP AND EMP <= SEG.EMP -- AND RUT IS NOT NULL SEC ATTRIBUTE := NULL; FOR I IN 1.. TAB1. COUNT LOOP IF I =1 THEN SEC ATTRIBUTE:= TAB1(I); -- DBMS OUTPUT.PUT LINE('LINE 1'||'-'||SEG.BMP||'-'||SEC ATTRIBUTE); END IF: <TAB1.COUNT IF | >1 --AND | THEN SEC ATTRIBUTE:= SEC ATTRIBUTE||','||TAB1(I); -- DBMS_OUTPUT.PUT_LINE('LINE 2'||'-'||SEG.BMP||'-'||SEC_ATTRIBUTE); END IF: IF I =TAB1.COUNT THEN UPDATE FMG SITE CATEGORY = SEC_ATTRIBUTE SET RUT WHERE COLLECT_YEAR = SEG.COLLECT_YEAR AND GLOBAL_ROUTE_ID = SEG.GLOBAL_ROUTE_ID AND SUB_ROUTE_ID = SEG.SUB_ROUTE_ID

AND BMP = SEG.BMP AND EMP = SEG.EMP; END IF; END LOOP: /*** INTERSECTIONS ***/ SELECT DISTINCT INTERSECTIONS BULK COLLECT INTO TAB1 FROM FMG_BASE_SEGMENTS WHERE COLLECT_YEAR = SEG.COLLECT_YEAR AND GLOBAL_ROUTE_ID = SEG.GLOBAL_ROUTE_ID AND SUB_ROUTE_ID = SEG.SUB_ROUTE_ID AND BMP >= SEG.BMP AND EMP <= SEG.EMP AND INTERSECTIONS IS NOT NULL : SEC ATTRIBUTE :=NULL; FOR I IN 1.. TAB1. COUNT LOOP IF I =1 THEN SEC ATTRIBUTE:= TAB1(I); -- DBMS_OUTPUT.PUT_LINE('LINE 1'||'-'||SEG.BMP||'-'||SEC_ATTRIBUTE); END IF; IF | >1 --AND | <TAB1.COUNT THEN SEC_ATTRIBUTE:= SEC_ATTRIBUTE||','||TAB1(I); -- DBMS_OUTPUT.PUT_LINE('LINE 2'||'-'||SEG.BMP||'-'||SEC_ATTRIBUTE); END IF; IF I =TAB1.COUNT THEN -- DBMS_OUTPUT.PUT_LINE('LINE 3'||'-'||SEG.BMP||'-'||SEC_ATTRIBUTE); UPDATE FMG SITE CATEGORY SET INTERSECTIONS = SEC ATTRIBUTE WHERE COLLECT YEAR = SEG.COLLECT YEAR AND GLOBAL ROUTE ID = SEG.GLOBAL ROUTE ID AND SUB_ROUTE_ID = SEG.SUB_ROUTE_ID AND BMP = SEG.BMP AND EMP = SEG.EMP; END IF: END LOOP: /*** DOWNHILL GRADE ***/ SELECT DISTINCT CASE WHEN DOWNHILL GRADE IS NULL THEN 'NO GRADE' ELSE DOWNHILL GRADE END BULK COLLECT INTO TAB1 FROM FMG BASE SEGMENTS WHERE COLLECT YEAR = SEG.COLLECT YEAR AND GLOBAL_ROUTE_ID = SEG.GLOBAL_ROUTE_ID AND SUB ROUTE ID = SEG.SUB_ROUTE_ID AND BMP >= SEG.BMP AND EMP <= SEG.EMP -- AND DOWNHILL GRADE IS NOT NULL SEC ATTRIBUTE := NULL; FOR I IN 1.. TAB1.COUNT LOOP IF I =1 THEN SEC_ATTRIBUTE:= TAB1(I); -- DBMS_OUTPUT.PUT_LINE('LINE 1'||'-'||SEG.BMP||'-'||SEC_ATTRIBUTE); END IF; IF I >1 -- AND I <TAB1.COUNT

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THEN SEC ATTRIBUTE:= SEC ATTRIBUTE||','||TAB1(I); -- DBMS OUTPUT.PUT LINE('LINE 2'||'-'||SEG.BMP||'-'||SEC ATTRIBUTE); END IF: IF I =TAB1.COUNT THEN UPDATE FMG SITE CATEGORY SET DOWNHILL GRADE = SEC_ATTRIBUTE WHERE COLLECT_YEAR = SEG.COLLECT_YEAR AND GLOBAL_ROUTE_ID = SEG.GLOBAL_ROUTE_ID AND SUB_ROUTE_ID = SEG.SUB_ROUTE_ID AND BMP = SEG.BMP AND EMP = SEG.EMP: END IF: END LOOP: /*** RAMP ***/ SELECT DISTINCT RAMP BULK COLLECT INTO TAB1 FROM FMG BASE SEGMENTS WHERE COLLECT_YEAR = SEG.COLLECT_YEAR AND GLOBAL ROUTE ID = SEG.GLOBAL ROUTE ID AND SUB ROUTE ID = SEG.SUB ROUTE ID AND BMP >= SEG.BMP AND EMP <= SEG.EMP AND RAMP IS NOT NULL ; SEC ATTRIBUTE :=NULL; FOR I IN 1.. TAB1.COUNT LOOP IF I =1 THEN SEC ATTRIBUTE:= TAB1(I); -- DBMS OUTPUT.PUT LINE('LINE 1'||'-'||SEG.BMP||'-'||SEC ATTRIBUTE); END IF; IF I >1 --AND I <TAB1.COUNT THEN SEC_ATTRIBUTE:= SEC_ATTRIBUTE||','||TAB1(I); -- DBMS_OUTPUT.PUT_LINE('LINE 2'||'-'||SEG.BMP||'-'||SEC_ATTRIBUTE); END IF: IF I =TAB1.COUNT THEN -- DBMS_OUTPUT.PUT_LINE('LINE 3'||'-'||SEG.BMP||'-'||SEC_ATTRIBUTE); UPDATE FMG SITE CATEGORY SET RAMP = SEC ATTRIBUTE WHERE COLLECT YEAR = SEG.COLLECT YEAR AND GLOBAL ROUTE ID = SEG.GLOBAL ROUTE ID AND SUB_ROUTE_ID = SEG.SUB_ROUTE_ID AND BMP = SEG.BMP AND EMP = SEG.EMP; END IF; END LOOP: /*** CURVE ***/ SELECT DISTINCT CASE WHEN CURVE IS NULL THEN 'NO CURVE' ELSE CURVE END BULK COLLECT INTO TAB1 FROM FMG BASE SEGMENTS WHERE COLLECT YEAR = SEG.COLLECT YEAR AND GLOBAL_ROUTE_ID = SEG.GLOBAL_ROUTE_ID AND SUB_ROUTE_ID = SEG.SUB_ROUTE_ID AND BMP >= SEG.BMP AND EMP <= SEG.EMP

IS NOT NULL

<TAB1.COUNT

-- AND CURVE

LOOP IF I

> END IF: IF | >1 --AND |

SEC ATTRIBUTE := NULL; FOR I IN 1.. TAB1.COUNT

=1 THEN SEC ATTRIBUTE:= TAB1(I);

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-- DBMS_OUTPUT.PUT_LINE('LINE 1'||'-'||SEG.BMP||'-'||SEC_ATTRIBUTE);

THEN SEC_ATTRIBUTE:= SEC_ATTRIBUTE||','||TAB1(I); -- DBMS OUTPUT.PUT LINE('LINE 2'||'-'||SEG.BMP||'-'||SEC ATTRIBUTE); END IF: IF I =TAB1.COUNT THEN UPDATE FMG SITE CATEGORY SET CURVE = SEC ATTRIBUTE WHERE COLLECT_YEAR = SEG.COLLECT_YEAR AND GLOBAL_ROUTE_ID = SEG.GLOBAL_ROUTE_ID AND SUB ROUTE ID = SEG.SUB ROUTE ID = SEG.BMP AND BMP AND EMP = SEG.EMP: END IF: END LOOP: /*** CAT ONE FEATURES ***/ SELECT DISTINCT CAT ONE FEATURES BULK COLLECT INTO TAB1 FROM FMG BASE SEGMENTS WHERE COLLECT YEAR = SEG.COLLECT YEAR AND GLOBAL ROUTE ID = SEG.GLOBAL ROUTE ID AND SUB_ROUTE_ID = SEG.SUB ROUTE ID AND BMP >= SEG.BMP <= SEG.EMP AND EMP AND CAT_ONE_FEATURES IS NOT NULL ; SEC_ATTRIBUTE :=NULL; FOR I IN 1.. TAB1.COUNT LOOP IF I =1 THEN SEC ATTRIBUTE:= TAB1(I): -- DBMS OUTPUT.PUT LINE('LINE 1'||'-'||SEG.BMP||'-'||SEC ATTRIBUTE); END IF; IF | >1 --AND | <TAB1.COUNT THEN SEC_ATTRIBUTE:= SEC_ATTRIBUTE||','||TAB1(I); -- DBMS_OUTPUT.PUT_LINE('LINE 2'||'-'||SEG.BMP||'-'||SEC_ATTRIBUTE); END IF; IF I =TAB1.COUNT THEN -- DBMS OUTPUT.PUT LINE('LINE 3'||'-'||SEG.BMP||'-'||SEC ATTRIBUTE); UPDATE FMG_SITE_CATEGORY SET CAT ONE FEATURES = SEC ATTRIBUTE WHERE COLLECT YEAR = SEG.COLLECT YEAR AND GLOBAL ROUTE ID = SEG.GLOBAL ROUTE ID AND SUB ROUTE ID = SEG.SUB ROUTE ID AND BMP = SEG.BMP AND EMP = SEG.EMP: END IF; END LOOP: COMMIT; END LOOP; END P_FMG_ATTRIBUTE_UPDATE; END FRICTION_GUIDE_PKG;

11.15 CHANGE LOG

The following lists the changes made since the previous version of this Guide was published on-line.

Last Publish Date:

Date	Section	Change
10/18/2021	7.01.01	Site Categories were reduced from 5 to 3 and, consequently, Site Category descriptions, Investigatory Skid Numbers, and Intervention Skid Numbers were revised. The Site Category table was updated accordingly.
10/18/2021	7.02.05	The procedures were updated to reflect the changes made to the Site Category table.
10/18/2021	7.05.05	The procedures, the update of skid data collection list steps and the example skid data collection list table were revised to reflect the changes made to the Site Category table.
10/18/2021	11.14	Friction SQL package was updated to reflect the changes in the Site Categories