CENTRAL TEXAS REGIONAL
MOBILITY AUTHORITY

May 29, 2019
AGENDA ITEM #8

Authorize the Executive Director to contract with Data Transfer Solutions, LLC for pavement condition and asset data collection services on Mobility Authority toll facilities

Strategic Plan Relevance:	Regional Mobility
Department:	Engineering
Contact:	Justin Word, Director of Engineering
Associated Costs:	$117,345.00
Funding Source:	Operations Budget
Action Requested:	Consider and act on draft resolution

Project Description/Background – The Central Texas Regional Mobility Authority recognized the need for a more robust method for organizing, communicating and planning their maintenance needs through formally implementing a Transportation Asset Management Program (TAMP). A web-enabled Integrated GIS, Enterprise Asset Management software, VUEWorks, was implemented to support this program. VUEWorks is capable of establishing a means for monitoring, evaluating and planning for the preservation of its system puts the agency in the best place for mitigating risks. An established TAMP not only better positions the agency to respond to inquiries, litigation, new mandates, and reporting requirements, it can help effectively manage change as the agency transitions from establishing and building out its transportation network to ensuring the cost-effective preservation of that network.

As part of the TAMP implemented by Central Texas Regional Mobility Authority in 2018, pavement condition data was collected to support the pavement management program on their current infrastructure consisting of 290 Toll Phases I & II from US 183 to Parmer, 183A Toll Phases I & II from northwest Austin through Cedar Park and Leander, SH71 Toll from near Presidential Boulevard at ABIA to the east near SH 130 and MoPac Express from Cesar Chavez Street to Parmer Lane. This data is utilized within the web-enabled Integrated GIS, Enterprise Asset Management software, VUEWorks, and is key in evaluation of routine maintenance and restoration and replacement (R&R) needs. Data is collected annually to support on-going decision making for determining the best approach to management of the pavement. This is accomplished through determining

the pavement condition from the data collected, assessing risks, selecting the appropriate work activities and programming the associated costs.

With the opening of the SH45SW Project, a four-lane toll road, stretching 3.6 miles between MoPac and FM 1626, the Mobility Authority will add to their infrastructure, therefore data collection will be needed to add this corridor to their TAMP.

Previous Actions - The Central Texas Regional Mobility Authority approved the Fiscal Year 2018 Operating Budget on June 28, 2017. The approved FY18 Operations budget had identified funds for implementation of an Asset Management Program. As part of this program pavement condition data was collected on the corridors open to traffic, 290 Toll, 183A Toll, SH71 Toll and Mopac Express.

Action Requested/Staff Recommendation – Staff recommends entering into a contract with Data Transfer Solutions, LLC (DTS), the makers of VUEWorks, through the Houston-Galveston Area Council Cooperative Purchasing Program (HGACbuy). Under this proposed agreement, DTS will perform pavement condition data collection services on 290 Toll, 183A Toll, SH71 Toll, Mopac Express, and SH45SW for an amount not to exceed $102,045.00. Staff also recommends establishing a contingency amount for this contract of an amount not to exceed $15,300.00 for a total contract amount of $117,345.00.

We expect the data collection to start and complete in June.

Financing – Operations Budget

Backup Provided: Draft Resolution
Draft Agreement

GENERAL MEETING OF THE BOARD OF DIRECTORS
OF THE
CENTRAL TEXAS REGIONAL MOBILITY AUTHORITY

RESOLUTION NO. 19-0XX

AUTHORIZING THE EXECUTIVE DIRECTOR TO CONTRACT WITH DATA TRANSFER SOLUTIONS, LLC FOR PAVEMENT CONDITION AND ASSET DATA COLLECTION SERVICES ON MOBILITY AUTHORITY TOLL FACILITIES

WHEREAS, the Mobility Authority has established a Transportation Asset Management Program ("TAMP") to create a more robust method for organizing, communicating and planning the maintenance needs for Mobility Authority facilities; and

WHEREAS, the Mobility Authority initiated the implementation of TAMP, by collecting and recording initial inventory data and pavement condition data of Mobility Authority facilities which is maintained in VUEWorks, a web-enabled Integrated Graphic Information System, Enterprise Asset Management software program; and

WHEREAS, it is necessary to collect asset and pavement condition data for new Mobility Authority facilities becoming operational in the near future and to regularly recollect pavement condition data to update in VUEWorks to be utilized in evaluating routine maintenance and restoration and replacement needs; and

WHEREAS, Data Transfer Solutions, LLC, the company that manages and updates VUEWorks, participates in the Houston-Galveston Area Council Cooperative Purchasing Program (HGACbuy); and

WHEREAS, in accordance of with Article 15 of the Mobility Authority Policy Code, purchases made through a cooperative program such as HGACbuy are deemed to have satisfied Mobility Authority procurement requirements; and

WHEREAS, the Executive Director requests authorization to contract with Data Transfer Solutions, LLC in an amount not to exceed $117,345.00 through HGACbuy to collect initial asset and pavement condition data for the SH 45SW corridor and to recollect pavement condition data to update VUEWorks for existing Mobility Authority facilities consisting of 290 Toll Phases I & II, 183A Toll Phases I & II, SH71 Toll and MoPac Express.

NOW THEREFORE BE IT RESOLVED that the Board of Directors hereby authorizes the Executive Director to contract with Data Transfer Solutions, LLC through HGACbuy in an amount not to exceed $117,345.00 to collect initial asset and pavement condition data for new Mobility Authority facilities becoming operational in the near future and to recollect and inventory pavement condition data on existing Mobility Authority facilities

Adopted by the Board of Directors of the Central Texas Regional Mobility Authority on the 29th day of May 2019.

Submitted and reviewed by:

_____
Geoffrey Petrov, General Counsel

Approved:

_____
Ray A. Wilkerson
Chairman, Board of Directors

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dts MAKERS OF VUEWorks.
Member of the SNC-Lavalin Group

Data Transfer Solutions, LLC
3680 Avalon Park Blvd E, Suite 200
Orlando, FL 32828
Tel: +1 407-382-5222
Fax: +1 407-382-5420

dtsgis.com
snclavalin.com

Central Texas Regional Mobility Authority
3300 N. IH 35, Suite 300
Austin, TX 78705

Attn: Lisa Pohlmeyer
Senior Project Manager – Asset Management
Central Texas Regional Mobility Authority

April 12, 2019

Subject: Central Texas Regional Mobility Authority
HGACBuy Contract (No. HP10-17) for Pavement and Asset Data Collection Services and VUEWorks Implementation

Dear Ms. Pohlmeyer:

This is an Agreement between DATA TRANSFER SOLUTIONS, LLC, a Florida corporation, having offices at 3680 Avalon Park Blvd, Suite 200, Orlando, FL 32828 (DTS), and the CENTRAL TEXAS REGIONAL MOBILITY AUTHORITY, having offices at 3300 North IH35, Suite 300, Austin, TX 78705 (Mobility Authority) for 2019 Pavement and Asset Data Collection Services and VUEWorks implementation. DTS shall provide to Client the requested services as described herein the following documents, attached for your information:

Exhibit 1: 2019 Pavement Data Collection Services for 290 Toll Phases I & II, US 183A Toll Phases I & II, SH71 Toll and MoPac Express
Attachment A HGACBuy Contract Pricing Worksheet (No. HP10-17)
Attachment B Contract Scope of Work

Exhibit 2: 2019 Pavement and Asset Data Collection Services for SH45 SW
Attachment A HGACBuy Contract Pricing Worksheet (No. HP10-17)
Attachment B Contract Scope of Work

The Mobility Authority will execute separate purchase orders through the HGACBuy Cooperative Program consistent with the Pricing Worksheet in Attachment A for each referenced Exhibit for the applicable scope of work.

Compensation to be paid based on percentage complete on each task to DTS for providing the requested services shall be in accordance with the Attachments.

DTS requests your signature to execute this Agreement on page 3 of 3 of this document.

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dts MAKERS OF VUEWorks.
Member of the SNC-Lavalin Group

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Orlando, FL 32828
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Fax: +1 407-382-5420

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If you have any questions or need additional information, please contact Allen Ibaugh at (407)382-5222 or email at aibaugh@dtsgis.com.

Sincerely,

Allen Ibaugh, AICP, GISP
Business Unit Director

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dts MAKERS OF VUEWorks.
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HGACBuy Contract (No. HP10-17)
Central Texas Regional Mobility Authority
Member Number 18-6487
VUEWorks Implementation

Data Transfer Solutions, LLC

By: _____ 05.16.19
Name: A.M. "Trey" Fragala III, AICP, PMP Date
Title: Chief Operating Officer

Central Texas Regional Mobility Authority

By: _____ _____
Name: Mike Heiligenstein Date
Title: Executive Director

Exhibit 1: 2019 Pavement Data Collection Services
Corridors: 290 Toll Phases I & II, US 183A Toll Phases I & II, SH71 Toll, and MoPac Express
Central Texas Regional Mobility Authority

Prepared by:
Data Transfer Solutions, LLC
3680 Avalon Park East Blvd., Suite 200
Orlando, FL 32828
www.dtsgis.com

HGACBuy	CONTRACT PRICING WORKSHEET For Catalog & Price Sheet Type Purchases	Contract No.:	HP10-17	Date Prepared:	5/3/2019

This Worksheet is prepared by Contractor and given to End User. If a PO is issued, both documents
MUST be faxed to H-GAC @ 713-993-4548. Therefore please type or print legibly.

Buying Agency:	Central Texas Regional Mobility Authority	**Contractor:**	Data Transfer Solutions, LLC
Contact Person:	Lisa Pohlmeyer	**Prepared By:**	Bart Williamson
Phone:	(512) 996-9778	**Phone:**	210-837-5249
Fax:	(512) 996-9784	**Fax:**	
Email:	lpohlmeyer@ctrma.org	**Email:**	bwilliamson@dtsgis.com

Catalog / Price Sheet Name:	
General Description of Product:	

A. Catalog / Price Sheet Items being purchased - Itemize Below - Attach Additional Sheet If Necessary

Quan	Description	Unit Pr	Total
1	Centerline Identification	1600	1600
1	Field Set-up & GPS Network Creation	5000	5000
1	Senior Pavement Engineer	4950	4950
1	Project Calibration Site Survey	1,500	1500
112	Mobile Asset Data Collection (Units = Lane Miles)	60	6720
112	Pavement Condition Evaluation (Per TxDOT PMIS) (Units = Lane Miles)	100	11200
1	GIS and Metadata Documentation	10200	10200
1	Pavement Final Report	5000	5000
40	Integration Services (VUEWorks) (units = hours)	250	10000
		Total From Other Sheets, If Any:	
DTS will bill lump sum based on percent complete for each task item.		**Subtotal A:**	56170

B. Unpublished Options, Accessory or Service items - Itemize Below - Attach Additional Sheet If Necessary
(Note: Unpublished Items are any which were not submitted and priced in contractor's bid.)

Quan	Description	Unit Pr	Total
			0
		Total From Other Sheets, If Any:	
DTS will bill lump sum based on percent complete for each task item.		**Subtotal B:**	0

Check: Total cost of Unpublished Options (B) cannot exceed 25% of the total of	**For this transaction the percentage is:**	0%

C. Other Allowances, Discounts, Trade-Ins, Freight, Make Ready or Miscellaneous Charges

Subtotal C:	0

Delivery Date:		**D. Total Purchase Price (A+B+C):**	56170

ATTACHMENT B
Central Texas Regional Mobility Authority (CTRMA)
Pavement Data Collection Services
Contract Scope of Work

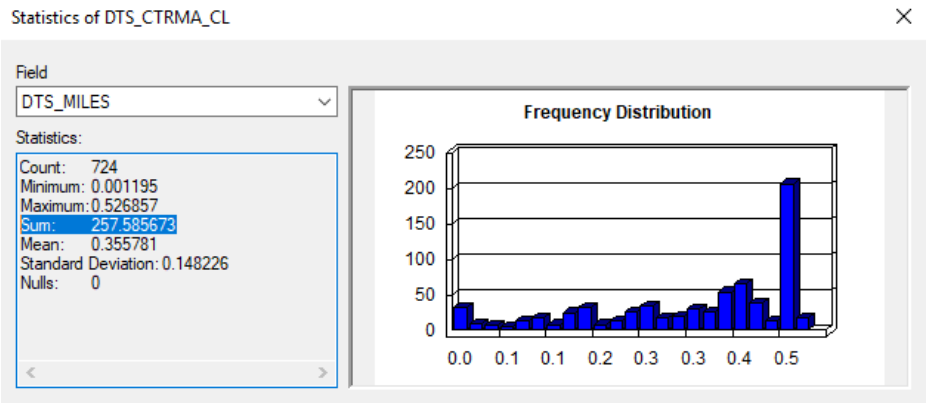
Task 1 - Project Setup

1.1 *Project Initiation*

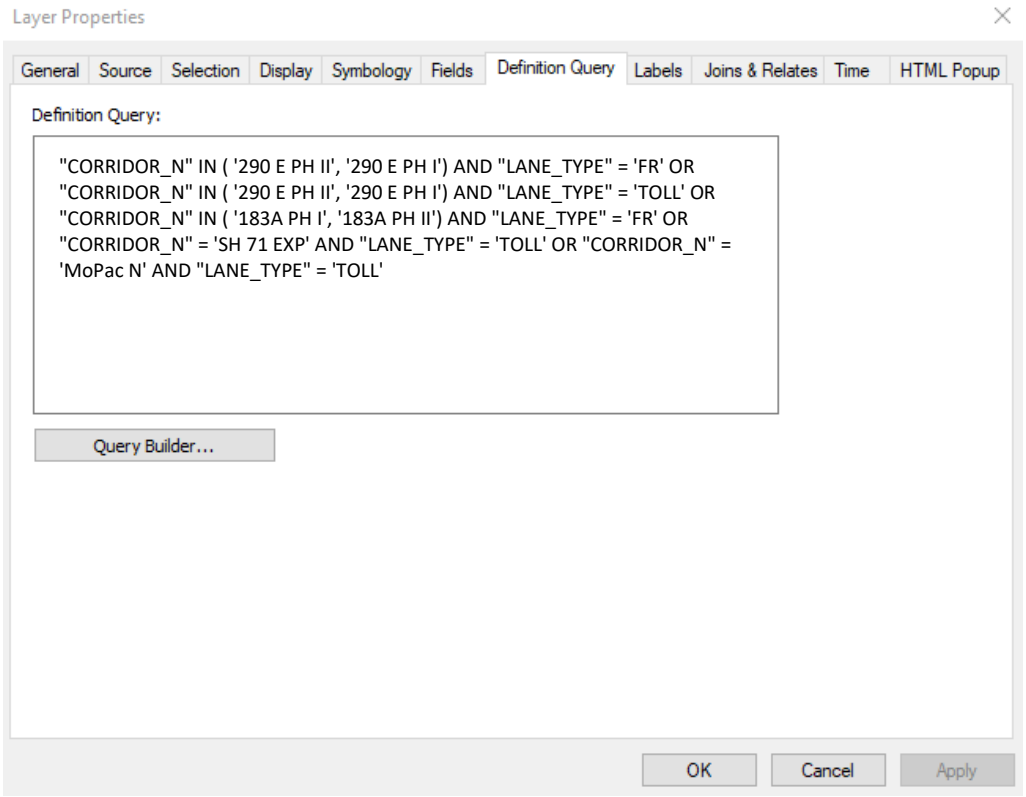
Upon notice to proceed the CONSULTANT will arrange a kick-off meeting to confirm the project requirements and scheduling. The kick-off meeting will include proposed key personnel and the OWNER's project members. During the meeting, CONSULTANT will present the proposed Project Approach, which includes project equipment, software, methodology, schedules and deliverables. The proposed approach will be finalized based on the OWNER requirements and decisions during the meeting. Data collection will be based on the current GIS data, initially provided to CONSULTANT by the OWNER and imported into VUEWorks. Project communication protocol, documentation, accounting methodologies, data format and standards will be confirmed during the meeting. It is essential that the OWNER provide prompt and efficient communication in order that workflow continues as planned in the schedule. Changes to data model may contribute to workflow disruptions and result in a change to the project schedule and cost estimate. Deliverables will be transmitted to CTRMA's Project Manager for review. Pavement management and asset extraction will be managed by Kathy Anamisis. VUEWorks implementation will be managed by Ryan Francoforte.

1.2 *GIS Centerline/Data Import and Data Preparation*

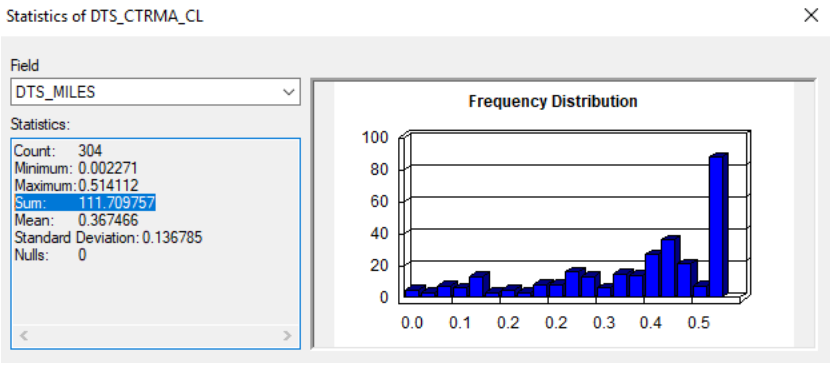
For this centerline assessment, DTS used the half-mile centerline provided by CTRMA (CTRMA_Phase1and2_PaveTesting) geodatabase. This file has 724 records totaling 258 centerline miles.



DTS was instructed that the following segments should be collected: 290E toll lanes and frontage lanes, 183A frontage lanes, SH71 toll lanes, and MoPac toll lanes. The following query was used on the centerline provided by CTRMA: "CORRIDOR_N" IN ('290 E PH II', '290 E PH I') AND "LANE_TYPE" = 'FR' OR "CORRIDOR_N" IN ('290 E PH II', '290 E PH I') AND "LANE_TYPE" = 'TOLL' OR "CORRIDOR_N" IN ('183A PH I', '183A PH II') AND "LANE_TYPE" = 'FR' OR "CORRIDOR_N" = 'SH 71 EXP' AND "LANE_TYPE" = 'TOLL' OR "CORRIDOR_N" = 'MoPac N' AND "LANE_TYPE" = 'TOLL'



After performing the above query on the half-mile centerline provided by CTRMA the centerline now has 304 records and 112 centerline miles.



CONSULTANT will use the previous geodatabase provided by the OWNER to collect data. Once data has been validated through the QC process, it will be published in VUEWorks. Each lane segment record, in the respective layers, will have a corresponding record in the pavement database.

The project schedule and cost estimate may be impacted if a timely response is not received from the OWNER and/or changes are made to the centerline after data collection and processing has been initiated. Cost estimate may also be revised if centerline analysis and mileage calculation changes.

CONSULTANT will utilize the TxDOT Pavement Management Information System (PMIS) methodology for determining the Distress Score which will be combined with the IRI values to determine the Pavement Condition Score (PCS).

CONSULTANT will provide the OWNER with a GPS "breadcrumb" file of data collection routes and image locations containing X, Y, and Z in WGS-84 Coordinates.

1.3 *Project Management*

CONSULTANT will provide project management for the duration of the project, including coordinating and attending meetings via web meetings or in person with OWNER, data research and collection efforts as required, preparing weekly progress reports and schedule updates. CONSULTANT's Asset Management Services Project Manager will review project progress on a weekly basis and be involved with any changes to the daily schedule to increase efficiency and accuracy in data collection. Project management will also oversee implementation of the data and coordination with the OWNER's GIS support.

Task 1 Deliverables:

- Meeting minutes and project schedule.
- Weekly progress reports and schedule updates.

Task 2 - Pavement Data and Image Capture

The CONSULTANT will collect roadway data and images for the OWNER's 81 centerline miles of roadway using a Mobile Asset Collection (MAC) data collection vehicle.

2.1 *System Setup, Mobilization and Pilot Project*

CONSULTANT will set up the data collection system and pavement management system so that all GIS and database system data are integrated and properly configured.

CONSULTANT will mobilize one or more Mobile Asset Collection (MAC) Laser Road Imaging Systems (LRIS) vehicles to OWNER site.

2.2 *Field Data and Image Capture*

The DTS team consists of a driver and operator (CONSULTANT) who will systematically drive the MAC LRIS vehicle on the road segment listings provided by the OWNER. The CONSULTANT will collect pavement data by driving our MAC vehicle in each mainline lane of the specified 33-lane mile project area. CONSULTANT proposes to use its MAC LRIS vehicle line scan camera with laser illumination and four right-of-way cameras to capture pavement and ROW images to be used during the pavement rating process. Unpaved roads will not be surveyed.

Mobile Asset Collection (MAC) Vehicle

The CONSULTANT Mobile Asset Collection vehicle is equipped with:

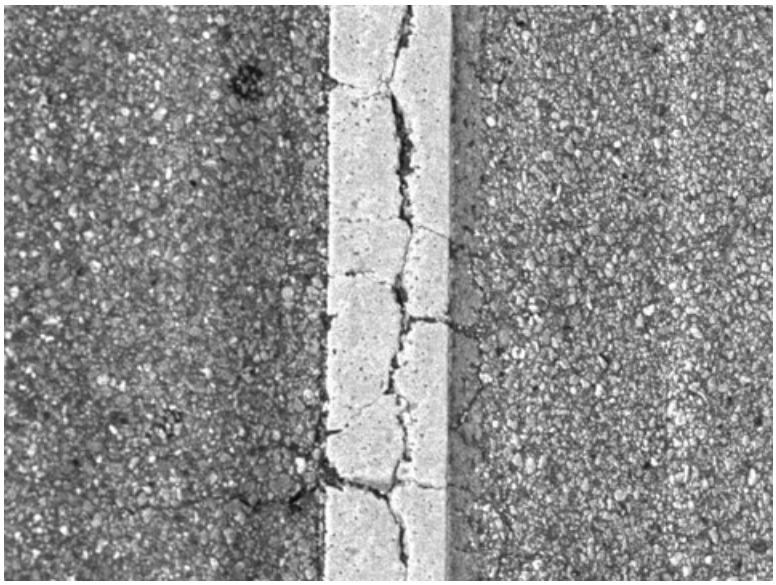
- High-resolution right-of-way digital cameras – Allied Vision Prosilica GX1920C GigE, frame rate of 15 images per second and 1936 x 1456 color resolution
- Laser Road Imaging System (LRIS) pavement imaging system – collects high-definition pavement images used to extract distress type severity and extent measurements. 4096 pixel/line, 28,000 lines/sec, 1mm resolution
- ApplanixPOS220V inertial measuring unit (IMU) – centimeter-level positioning of MAC van during collection
- DMI equipment – distance measuring instrument used for system integration
- GPS equipment – used for mapping level positioning of the vehicle, heading information and positional tagging of images. 2 positional units, 1 differential unit
- Servers – on board servers for storing data, processing images and storing profiler, GPS, DMI and IMU data
- Surface (road) profiler – used for precise pavement ride and rut measurement

The MAC system collects all pavement and right-of-way images, IMU, DMI and profiler data concurrently.

2.3 *Pavement Surface Imaging Rating*

CONSULTANT MAC LRIS vehicle pavement imaging sensors are oriented from nadir (straight-down) to achieve the best perspective, laser-illuminated to ensure uniform image contrast and GIS-integrated to provide geospatial distress vectors (points, lines and polygons) that can be loaded and verified using GIS.

- CONSULTANT will utilize a downward-facing, progressive line scan camera that provides high-resolution images (1mm pixel, 4,000 pixels wide, and ~12 feet width) of the pavement surface to clearly detect and quantify distresses.
- pavement surface imaging (JPEG format) will span, at a minimum, the data collection lane from left lane stripe to right lane stripe, and will provide 100% continuous pavement coverage
- image resolution will be such that all visual cracking distresses can be accurately identified and quantified
- images will have a minimum horizontal resolution of 4,000 pixels or better
- images will be synchronized with OWNER'S centerline file
- CONSULTANT will collect longitudinal profile and roughness data (IRI) to provide a ride condition index for each segment



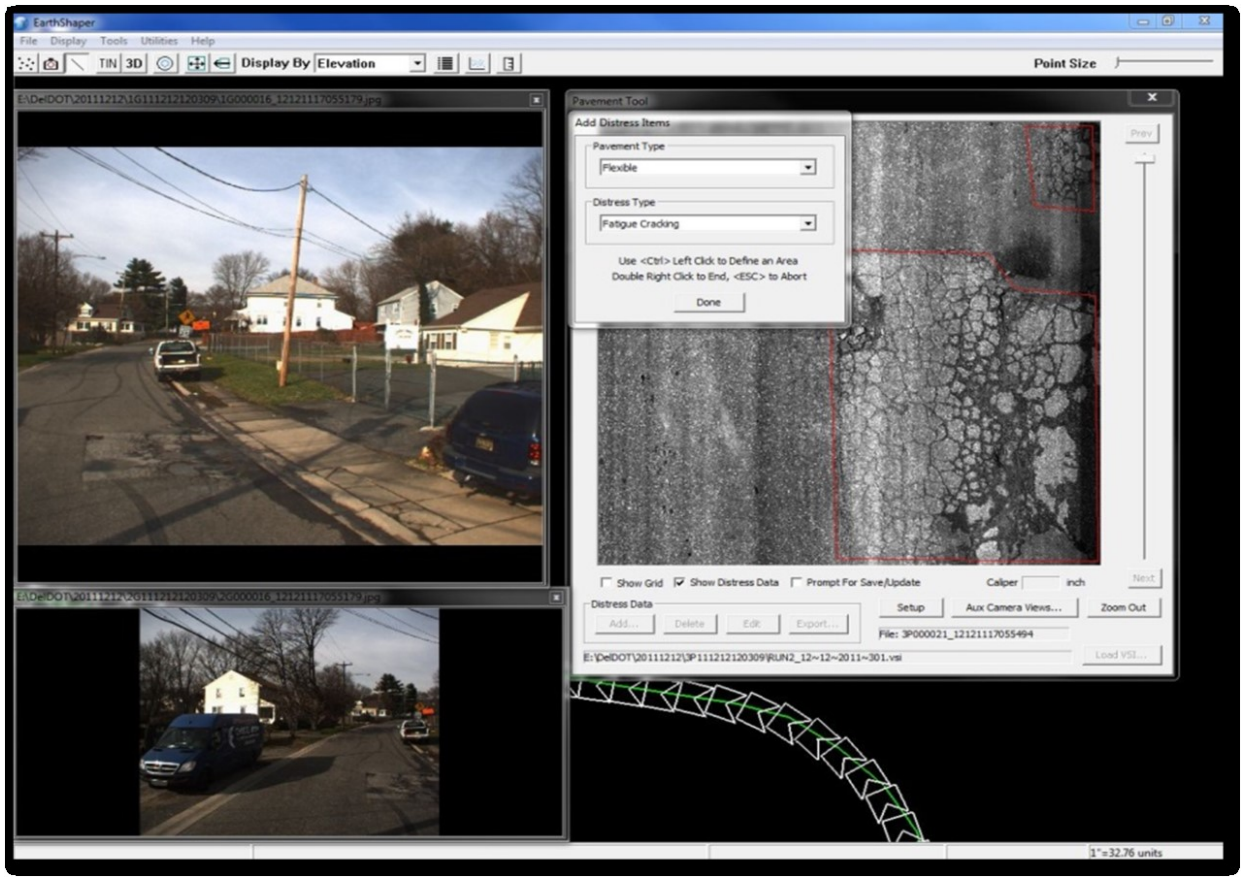
Pavement Image Captured with the 4K Laser Road Imaging System

2.4 Pavement Condition Evaluation

With the pavement image collection started, CONSULTANT will begin processing pavement images. This allows CONSULTANT to begin the pavement distress rating process concurrent with

the image collection.

Once pavement images and distress mapping processing is complete for each collection day, CONSULTANT'S experienced pavement evaluators will review each street segment's images for a complete and thorough evaluation of the existing pavement condition per the TxDOT pavement distress rating process. The EarthShaper™ software allows distress vectors to be viewed and edited through this workflow. The CONSULTANT has designed the EarthShaper asset data extraction software by optimizing the performance of visualization/QC of the roadway condition and inventory data. To improve accuracy to desired 97%, CONSULTANT will perform field validations of select segments to identify anomalies in the data and provide guidance in distress evaluations. A meeting will be conducted with the OWNER to review data. CONSULTANT's QA methodology is outlined in Task 5.



Pavement Condition Evaluation within EarthShaper™ software

IRI (International Roughness Index) will be collected using profiler equipment that meets TxDOT standards. CONSULTANT utilizes a surface profiling system manufactured by International Cybernetics Corporation (ICC) for evaluating the smoothness of pavement.

Task 2 Deliverables:

- CONSULTANT will provide right-of-way imagery for all segments collected in a JPEG format.
- CONSULTANT will provide downward-facing pavement imagery for all segments collected.
- CONSULTANT shall provide geodatabase of distresses containing the Type, Severity and Extent of distresses along the road segment as defined by the TxDOT PMIS methodology for 100% of the roadway for all lane types.
- CONSULTANT shall provide IRI data in accordance ASTM E950.
- CONSULTANT will format the database of pavement results 0.1 segmentation for IRI data and a 0.5-mile segmentation aligning with developed audible sections, for pavement distress and rutting data.

Task 3 - Pavement Final Report

Once the Pavement Condition Score (PCS) has been calculated, CONSULTANT will provide the following:

Task 3 Deliverables:

- Technical Memorandum compiling the results of the project.
- Final GIS file geodatabase containing collected pavement data and publish in VUEWorks, as applicable. CONSULTANT will use domains included in geodatabase where provided for the extraction attributes defined in the lists below.
- Assistance to OWNER to develop constraints and guidelines for development of budget scenarios and analysis for maintenance plan development to be performed by the OWNER.
- Assistance to OWNER to configure deterioration curves for the corridor.
- Pavement Condition forms.

Task 4 – Pavement Inventory & Condition

The vehicles will capture images at an interval of approximately 10 to 15 feet for both forward and side-facing directions and geo-referenced to the pavement inventory by segment. CONSULTANT will collect pavement with the following attributes:

Pavement Condition Attributes (Line Feature) Per CTRMA Domain Model

- CORRIDOR_NAME
- TRAVEL_DIRECTION
- LANE_TYPE
- PVMT_TYPE
- LANE_ID

- PVMT_COND_SCORE
- PVMT_VIS_DISTRESS
- PVMT_RD_QUALITY
- INSTALL_YEAR
- DATE_COLLECTED
- SRUT
- DRUT
- PATCH
- PCPATCH
- FAIL
- BLOCK
- ALG
- LONG_CRACK
- TCRACK
- SPALL
- PUNCH
- ACPATC
- FLJ
- SSLAB
- RAVELING
- FLUSHING
- CONCRETE_PATCHES
- AVG_TR_CRK_SPAC

Pavement IRI Attributes (Line Feature) per CTRMA Domain Model

- CORRIDOR_NAME
- TRAVEL_DIRECTION
- LANE_TYPE
- PVMT_TYPE
- LANE_ID
- IRI_SCORE
- DATE_COLLECTED

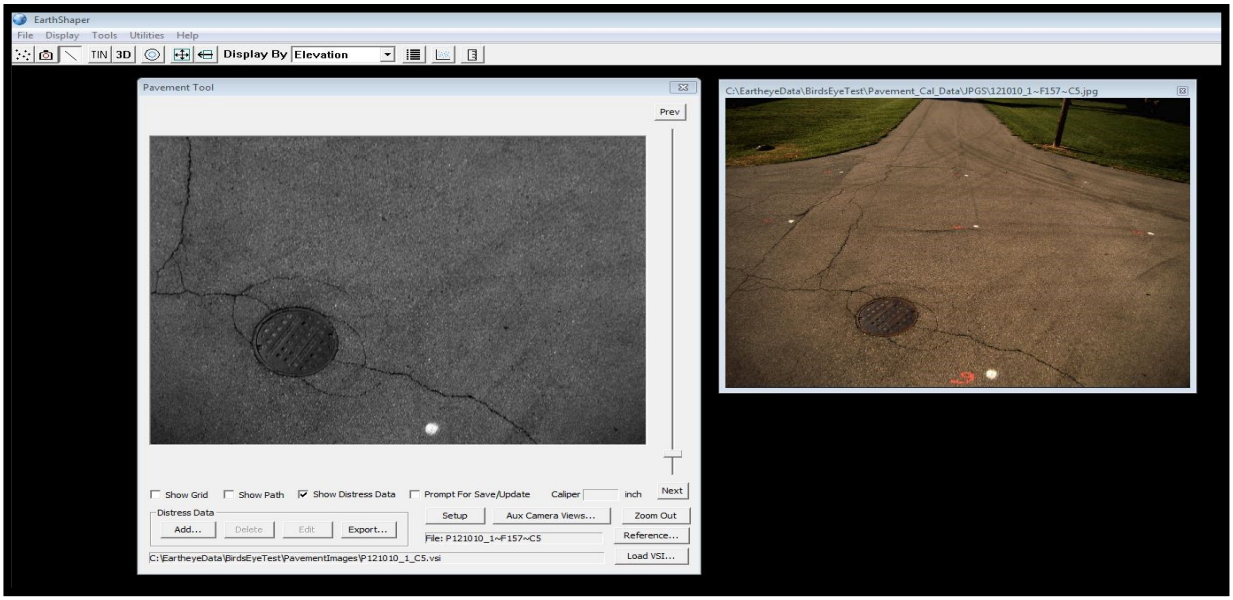
Task 4 Deliverables:

- CONSULTANT will deliver a pavement inventory with attributes identified above in a GIS file geodatabase and publish in VUEWorks.

Task 5-Quality Assurance and Quality Control

The CONSULTANT will perform quality assurance and quality control on all data collected.

CONSULTANT has a proven Quality Assurance (QA)/Quality Control (QC) procedure for all MAC image collection projects. CONSULTANT'S QC procedures begin with MAC vehicle collection process. For the OWNER, a MAC calibration site(s) will be established that consists of up to ten point locations nailed, painted and surveyed in a location easily accessible to the MAC LRIS vehicle. This calibration site will be recorded in at least two perpendicular directions at the beginning and end of each collection day.



Calibration Site Checked Daily to Ensure the Accuracy of Collection

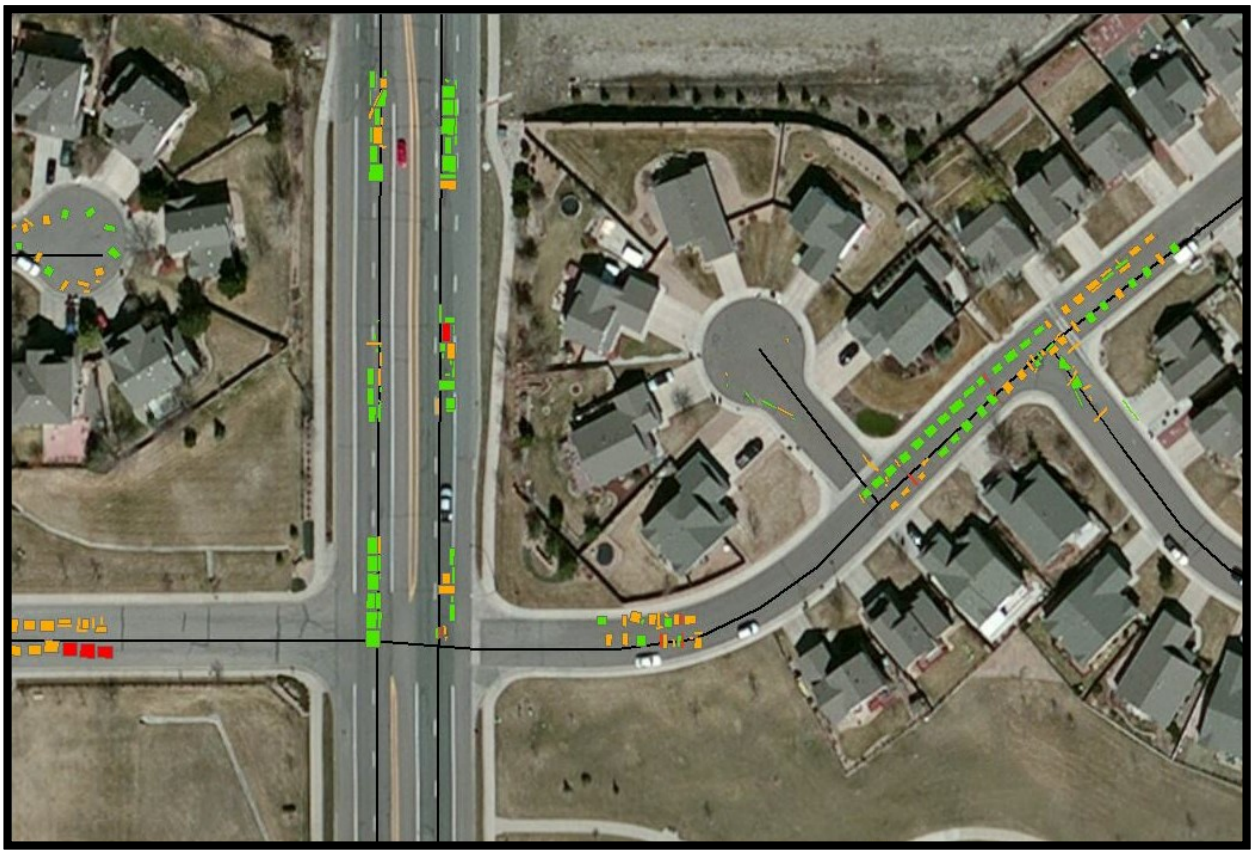
The MAC technician will check each camera's exposure rate, image quality and GPS and IMU operation to ensure the MAC system is recording the image, GPS, DMI and IMU data and that the GPS location is within the stated project tolerance. Each collection day's calibration collection will be documented in the MAC collection log book. The MAC collection log book also contains information such as date, location, technician, driver, any issue that developed during the collection day and DMI calibration runs. CONSULTANT will maintain a Microsoft Access database of any collection or other project issues. All project team personnel including OWNER personnel will have access to the database to log comments, check the status of issues and have one central repository to track project issues and resolutions.

During image collection, the MAC technician reviews the images collected on-screen as they are collected and any issue with image clarity requires the collection run to end and the image quality issue to be resolved. Once resolved, the collection run begins from the beginning for the road segment collected. The MAC technician also monitors GPS reception during collection. If GPS reception is lost (measured using PDOP – positional dilution of precision), the MAC technician stops the collection and resolves the GPS reception issue. Collection begins again once the GPS reception issue is resolved. All issues resulting in the collection run being stopped will be recorded in the MAC collection log book along with the resolution.

With a completed collection drive delivered to CONSULTANT headquarters in Orlando, images

are post processed and provided to the image QC Officer who will perform quality control checks on each delivery provided. The QC Officer will visually review the collection routes for image quality. All collection runs that are considered of low quality will be marked for recollection before the MAC vehicle(s) is allowed to leave the CTRMA.

Additionally, CONSULTANT will provide independent quality checks via field verification to confirm accuracy of automated data collection. CONSULTANT utilizes walk-out maps that display pavement distress data for field confirmation and acceptance. CONSULTANT's QA methodology is outlined in Task 5.



CONSULTANT field Maps utilized for field verification of pavement distress data

TASK 5 Deliverables:

- CONSULTANT will perform field verification of pavement condition scores with CTRMA staff to answer questions and resolve discrepancies in data and field observations.

ACCEPTANCE CRITERIA

The results of the data collection shall be quality checked for rating consistency by CONSULTANT to ensure the accuracy and quality of deliverables. Notes from field validations will be implemented into the distress evaluations to make any corrections for deficiencies in distress identification. Additionally, deliverables will be checked for missing and/or duplicate assets and

anomalies. A 97% accuracy rate is expected and Quality Control checks will be based on the batch/sample size of the delivery (see Table A below to determine sample size for the appropriate accuracy rate).

For any measurement that is needed, it must be accurate to the nearest foot. If the data has more errors than allowable the set of data will be corrected. This process will be repeated until each set of data is within the allowable limits.

Method of measurement of acceptable quality level (AQL)

Each attribute captured for an asset counts as one unit of measure. Each physical measurement required for an asset location counts as one attribute or unit of measure. The following location information also counts as an attribute or unit of measure for each asset: Physical presence (when captured as per source = correct, not captured or missed = incorrect) In the event of a duplicate capture of an asset, the total number of attributes or units of measure for the duplicate asset(s) will be deducted from the total units of the sample set, and one error or unit of measure (incorrect physical presence) is charged.

TABLE A

Batch size			Sample Size (Normal)	Acceptance Rate (%)				
				99.0	98.5	97.5	96.0	93.5
2	to	8	2	≤ 0	≤ 0	≤ 0	≤ 0	≤ 0
9	to	15	3	≤ 0	≤ 0	≤ 0	≤ 0	≤ 0
16	to	25	5	≤ 0	≤ 0	≤ 0	≤ 0	≤ 1
26	to	50	8	≤ 0	≤ 0	≤ 0	≤ 1	≤ 1
51	to	90	13	≤ 0	≤ 0	≤ 1	≤ 1	≤ 2
91	to	150	20	≤ 0	≤ 1	≤ 1	≤ 2	≤ 3
151	to	280	32	≤ 1	≤ 1	≤ 2	≤ 3	≤ 5
281	to	500	50	≤ 1	≤ 2	≤ 3	≤ 5	≤ 7
501	to	1,200	80	≤ 2	≤ 3	≤ 5	≤ 7	≤ 10
1,201	to	3,200	125	≤ 3	≤ 5	≤ 7	≤ 10	≤ 14
3,201	to	10,000	200	≤ 5	≤ 7	≤ 10	≤ 14	≤ 21
10,001	to	35,000	315	≤ 7	≤ 10	≤ 14	≤ 21	≤ 21
35,001	to	150,000	500	≤ 10	≤ 14	≤ 21	≤ 21	≤ 21
150,001	to	500,000	800	≤ 14	≤ 21	≤ 21	≤ 21	≤ 21
500,001	and over		1250	≤ 21	≤ 21	≤ 21	≤ 21	≤ 21

Example: a delivery results in 100 assets – each asset has been determined to have 10 attributes to be captured (including the physical presence “attribute” for each asset) – thus total units of measure for the Batch size = 1,000 (100 x 10). Based on Table A, a Quality Control using a sample size of 80 units should be assessed for quality. With an expected accuracy of 97%, the allowable

number of errors ≤ 5.

Exhibit 2: 2019 Pavement and Asset Data Collection Services
Corridor: SH45 SW
Central Texas Regional Mobility Authority

Prepared by:
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HGACBuy	CONTRACT PRICING WORKSHEET For Catalog & Price Sheet Type Purchases	Contract No.:	HP10-17	Date Prepared:	5/3/2019

This Worksheet is prepared by Contractor and given to End User. If a PO is issued, both documents MUST be faxed to H-GAC @ 713-993-4548. Therefore please type or print legibly.

Buying Agency:	Central Texas Regional Mobility Authority	**Contractor:**	Data Transfer Solutions, LLC
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Catalog / Price Sheet Name:	**ATTACHMENT A**
General Description of Product:	

A. Catalog / Price Sheet Items being purchased - Itemize Below - Attach Additional Sheet If Necessary

Quan	Description	Unit Pr	Total
1	Centerline Identification	1600	1600
1	Field Set-up & GPS Network Creation	5000	5000
1	Senior Pavement Engineer	4950	4950
1	Project Calibration Site Survey	1500	1500
26	Mobile Asset Data Collection (Units = Lane Miles)	60	1560
26	Pavement Condition Evaluation (Per TxDOT PMIS) (Units = Lane Miles)	100	2600
9	Bridge Inventory (Units = Lane Miles)	40	360
9	Barrier Inventory (Units = Lane Miles)	40	360
9	Street Signs Inventory (Units = Lane Miles)	40	360
9	Pavement Markings and Striping Inventory (Units = Lane Miles)	70	630
9	Street Lights Inventory (Units = Lane Miles)	30	270
1	GIS and Metadata Documentation	10200	10200
9	ADA Ramps and Signals (Units = Lane Miles)	30	270
9	Signals (Units = Lane Miles)	30	270
1	Pavement Final Report	5000	5000
40	Integration Services (VUEWorks) (units = hours)	250	10000
		Total From Other Sheets, If Any:	
DTS will bill lump sum based on percent complete for each task item.		**Subtotal A:**	44930

B. Unpublished Options, Accessory or Service items - Itemize Below - Attach Additional Sheet If Necessary
(Note: Unpublished Items are any which were not submitted and priced in contractor's bid.)

Quan	Description	Unit Pr	Total
9	Stand-Alone Attenuator (Units = Lane Miles)	25	225
9	Overhead and Ground Sign Structures (Units = Lane Miles)	80	720
		Total From Other Sheets, If Any:	
DTS will bill lump sum based on percent complete for each task item.		**Subtotal B:**	945

Check: Total cost of Unpublished Options (B) cannot exceed 25% of the total of	**For this transaction the percentage is:**	2%

C. Other Allowances, Discounts, Trade-Ins, Freight, Make Ready or Miscellaneous Charges

Subtotal C:	0

Delivery Date:	**D. Total Purchase Price (A+B+C):**	45875

ATTACHMENT B
Central Texas Regional Mobility Authority (CTRMA)
Pavement and Asset Data Collection Services
Contract Scope of Work

Task 1 - Project Setup

1.1 *Project Initiation*

Upon notice to proceed the CONSULTANT will arrange a kick-off meeting to confirm the project requirements and scheduling. The kick-off meeting will include proposed key personnel and the OWNER's project members. During the meeting, CONSULTANT will present the proposed Project Approach, which includes project equipment, software, methodology, schedules and deliverables. The proposed approach will be finalized based on the OWNER requirements and decisions during the meeting. CONSULTANT will request that the OWNER provide any existing database, roadbeds, centerlines, Linear Referencing System (LRS) for project use, Geographic Information System (GIS) layers as currently configured in VUEWorks® and aerial imagery for project use. Project communication protocol, documentation, accounting methodologies, data format and standards will be confirmed during the meeting. It is essential that the OWNER provide prompt and efficient communication in order that workflow continues as planned in the schedule. Changes to data model may contribute to workflow disruptions and result in a change to the project schedule and cost estimate. Deliverables will be transmitted to CTRMA's Project Manager for review. Pavement management and asset extraction will be managed by Kathy Anamisis. VUEWorks implementation will be managed by Ryan Francoforte.

1.2 *GIS Centerline/Data Import and Data Preparation*

OWNER will provide three file geodatabases 1) roadbed centerline, 2) lane lines for pavement testing in 0.5-mile segmentation and 3) lane lines for IRI testing in 0.1-mile segmentation. CONSULTANT will use the geodatabases provided by the OWNER to collect data. Once data has been validated through the QC process, it will be published in VUEWorks. Each lane segment record, in the respective layers, will have a corresponding record in the pavement database.

The project schedule and cost estimate may be impacted if a timely response is not received from the OWNER and/or changes are made to the centerline after data collection and processing has been initiated.

CONSULTANT will utilize the TxDOT Pavement Management Information System (PMIS) methodology for determining the Distress Score which will be combined with the IRI values to determine the Pavement Condition Score (PCS).

CONSULTANT will provide the OWNER with a GPS "breadcrumb" file of data collection routes and image locations containing X, Y, and Z in WGS-84 Coordinates.

1.3 *Project Management*

CONSULTANT will provide project management for the duration of the project, including coordinating and attending meetings via web meetings or in person with OWNER, data research and collection efforts as required, preparing weekly progress reports and schedule updates. CONSULTANT's Asset Management Services Project Manager will review project progress on a weekly basis and be involved with any changes to the daily schedule to increase efficiency and accuracy in data collection. Project management will also oversee implementation of the data and coordination with the OWNER's GIS support.

Task 1 Deliverables:

- Meeting minutes and project schedule.
- Weekly progress reports and schedule updates.

Task 2 - Pavement Data and Image Capture

The CONSULTANT will collect roadway data and images for the OWNER's 33 lane miles of roadway using a Mobile Asset Collection (MAC) data collection vehicle.

2.1 *System Setup, Mobilization and Pilot Project*

CONSULTANT will set up the data collection system and pavement management system so that all GIS and database system data are integrated and properly configured.

CONSULTANT will mobilize one or more Mobile Asset Collection (MAC) Laser Road Imaging Systems (LRIS) vehicles to OWNER site.

CONSULTANT will work with the OWNER to set up a pilot project area so initial sample data can be collected and verified. CONSULTANT will collect data on the pilot project area and review the result with the OWNER and acquire approval for full size project implementation. CONSULTANT's QA methodology is outlined in Task 14 at the end of this document.

2.2 *Field Data and Image Capture*

The DTS team consists of a driver and operator (CONSULTANT) who will systematically drive the MAC LRIS vehicle on the road segment listings provided by the OWNER. The CONSULTANT will collect pavement data by driving our MAC vehicle in each mainline lane of the specified 33-lane mile project area. CONSULTANT proposes to use its MAC LRIS vehicle line scan camera with laser illumination and four right-of-way cameras to capture pavement and ROW images to be used during the pavement rating process. Unpaved roads will not be surveyed.

Mobile Asset Collection (MAC) Vehicle

The CONSULTANT Mobile Asset Collection vehicle is equipped with:

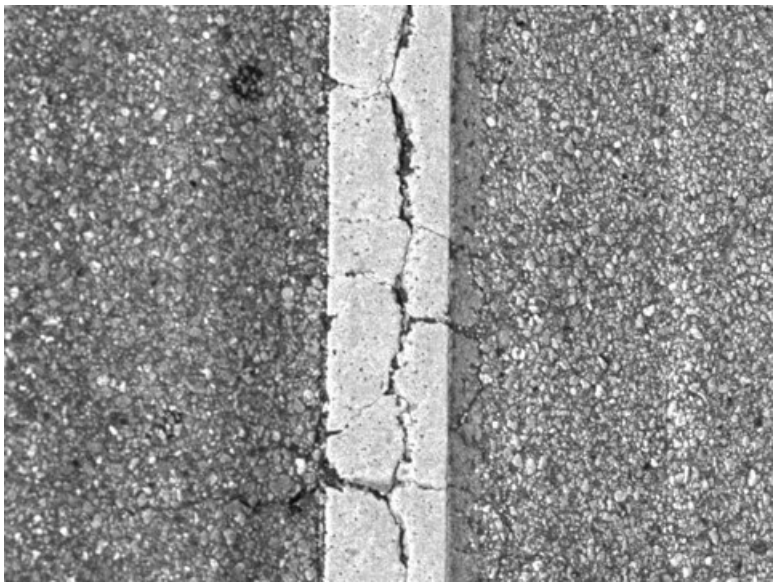
- High-resolution right-of-way digital cameras – Allied Vision Prosilica GX1920C GigE, frame rate of 15 images per second and 1936 x 1456 color resolution
- Laser Road Imaging System (LRIS) pavement imaging system – collects high-definition pavement images used to extract distress type severity and extent measurements. 4096 pixel/line, 28,000 lines/sec, 1mm resolution
- ApplanixPOS220V inertial measuring unit (IMU) – centimeter-level positioning of MAC van during collection
- DMI equipment – distance measuring instrument used for system integration
- GPS equipment – used for mapping level positioning of the vehicle, heading information and positional tagging of images. 2 positional units, 1 differential unit
- Servers – on board servers for storing data, processing images and storing profiler, GPS, DMI and IMU data
- Surface (road) profiler – used for precise pavement ride and rut measurement

The MAC system collects all pavement and right-of-way images, IMU, DMI and profiler data concurrently. The CONSULTANT'S MAC LRIS vehicles will collect imagery for roadway assets including: barriers, stand-alone attenuators, pavement striping, pavement markings(graphics), sign panels and structures, sign overhead structure, ADA ramps, traffic signals, and street lights (illumination structures). NOTE: Bridge information shall be collected by the OWNER. Once developed, CONSULTANT shall assign a unique Bride ID in VUEWorks for the OWNER-specified Bridges.

2.3 *Pavement Surface Imaging Rating*

CONSULTANT MAC LRIS vehicle pavement imaging sensors are oriented from nadir (straight-down) to achieve the best perspective, laser-illuminated to ensure uniform image contrast and GIS-integrated to provide geospatial distress vectors (points, lines and polygons) that can be loaded and verified using GIS.

- CONSULTANT will utilize a downward-facing, progressive line scan camera that provides high-resolution images (1mm pixel, 4,000 pixels wide, and ~12 feet width) of the pavement surface to clearly detect and quantify distresses.
- pavement surface imaging (JPEG format) will span, at a minimum, the data collection lane from left lane stripe to right lane stripe, and will provide 100% continuous pavement coverage
- image resolution will be such that all visual cracking distresses can be accurately identified and quantified
- images will have a minimum horizontal resolution of 4,000 pixels or better
- images will be synchronized with OWNER'S centerline file
- CONSULTANT will collect longitudinal profile and roughness data (IRI) to provide a ride condition index for each segment



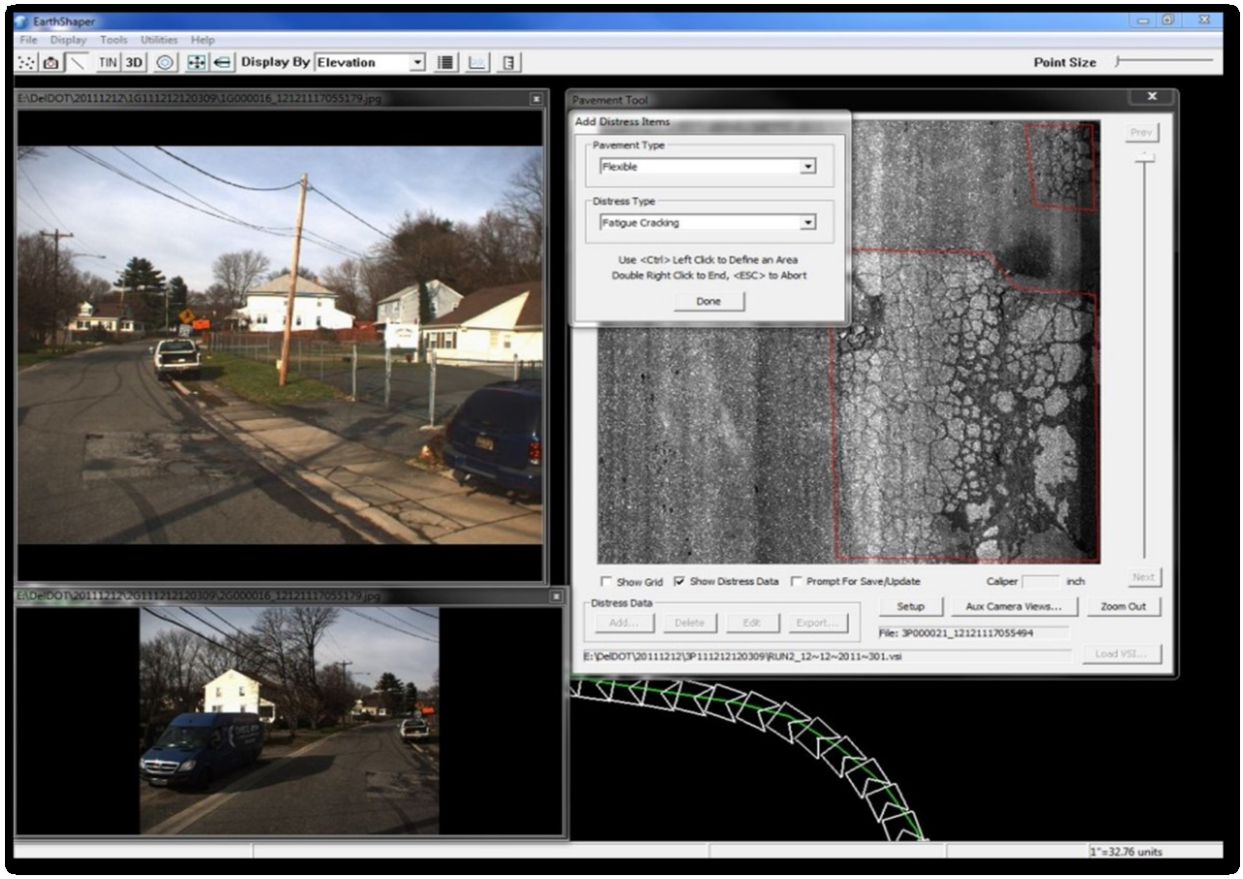
Pavement Image Captured with the 4K Laser Road Imaging System

2.4 Pavement Condition Evaluation

With the pavement image collection started, CONSULTANT will begin processing pavement images. This allows CONSULTANT to begin the pavement distress rating process concurrent with the image collection.

Once pavement images and distress mapping processing is complete for each collection day,

CONSULTANT'S experienced pavement evaluators will review each street segment's images for a complete and thorough evaluation of the existing pavement condition per the TxDOT pavement distress rating process. The EarthShaper™ software allows distress vectors to be viewed and edited through this workflow. The CONSULTANT has designed the EarthShaper asset data extraction software by optimizing the performance of visualization/QC of the roadway condition and inventory data. To improve accuracy to desired 97%, CONSULTANT will perform field validations of select segments to identify anomalies in the data and provide guidance in distress evaluations. A meeting will be conducted with the OWNER to review data. CONSULTANT's QA methodology is outlined in Task 14 at the end of this document.



Pavement Condition Evaluation within EarthShaper™ software

IRI (International Roughness Index) will be collected using profiler equipment that meets TxDOT standards. CONSULTANT utilizes a surface profiling system manufactured by International Cybernetics Corporation (ICC) for evaluating the smoothness of pavement.

Task 2 Deliverables:

- CONSULTANT will provide right-of-way imagery for all segments collected in a JPEG format.
- CONSULTANT will provide downward-facing pavement imagery for all segments collected.

- CONSULTANT shall provide geodatabase of distresses containing the Type, Severity and Extent of distresses along the road segment as defined by the TxDOT PMIS methodology for 100% of the roadway for all lane types.
- CONSULTANT shall provide IRI data in accordance ASTM E950.
- CONSULTANT will format the database of pavement results 0.1 segmentation for IRI data and a 0.5-mile segmentation aligning with developed audible sections, for pavement distress and rutting data.

Task 3 - Pavement Final Report

Once the Pavement Condition Score (PCS) has been calculated, CONSULTANT will provide the following:

Task 3 Deliverables:

- Technical Memorandum compiling the results of the project.
- Final GIS file geodatabase containing collected pavement data and publish in VUEWorks, as applicable. CONSULTANT will use domains included in geodatabase where provided for the extraction attributes defined in the lists below.
- Assistance to OWNER to develop constraints and guidelines for development of budget scenarios and analysis for maintenance plan development to be performed by the OWNER.
- Pavement Condition forms.

Task 4 – Pavement Inventory & Condition

CONSULTANT's Mobile Asset Collection (MAC) vehicles will collect right-of-way asset inventories at the same time that data is collected for the pavement management system. The vehicles will capture images at an interval of approximately 10 to 15 feet for both forward and side-facing directions and geo-referenced to the pavement inventory by segment. CONSULTANT will collect pavement with the following attributes:

Pavement Condition Attributes (Line Feature) Per CTRMA Domain Model

- CORRIDOR_NAME
- TRAVEL_DIRECTION
- LANE_TYPE
- PVMT_TYPE
- LANE_ID
- PVMT_COND_SCORE
- PVMT_VIS_DISTRESS
- PVMT_RD_QUALITY
- DATE_COLLECTED

- SRUT
- DRUT
- PATCH
- PCPATCH
- FAIL
- BLOCK
- ALG
- LONG_CRACK
- TCRACK
- SPALL
- PUNCH
- ACPATC
- FLJ
- SSLAB
- RAVELING
- FLUSHING
- CONCRETE_PATCHES
- AVG_TR_CRK_SPAC

Pavement IRI Attributes (Line Feature) per CTRMA Domain Model

- CORRIDOR_NAME
- TRAVEL_DIRECTION
- LANE_TYPE
- PVMT_TYPE
- LANE_ID
- IRI_SCORE
- DATE_COLLECTED

Task 4 Deliverables:

- CONSULTANT will deliver a pavement inventory with attributes identified above in a GIS file geodatabase and publish in VUEWorks.

Task 5 – Barrier Inventory Guardrail, Concrete Barrier, Cable Barrier, Attenuators

CONSULTANT's Mobile Asset Collection (MAC) vehicles will collect right-of-way asset inventories at the same time that data is collected for the pavement management system. The vehicles will capture images at an interval of approximately 10 to 15 feet for both forward and side-facing directions and geo-referenced to the pavement inventory by segment. CONSULTANT will collect a barrier inventory with the following attributes:

Barrier Attributes (Line Feature) Per CTRMA Domain Model

- CORRIDOR_NAME
- CROSS_ST_NAME
- TRAVEL_DIRECTION
- LANE_TYPE
- BARRIER_TYPE
- RMA_ID

Task 5 Deliverables:

- CONSULTANT will deliver a barrier inventory with attributes identified above in a GIS file geodatabase and publish in VUEWorks.

Task 6 – Stand-Alone Attenuator (crash cushion) Inventory (point feature) Per CTRMA Domain Model

CONSULTANT's Mobile Asset Collection (MAC) vehicles will collect right-of-way asset inventories at the same time that data is collected for the pavement management system. The vehicles will capture images at an interval of approximately 10 to 15 feet for both forward and side-facing directions and geo-referenced to the pavement inventory by segment. CONSULTANT will collect a stand-alone attenuator (crash cushion) inventory with the following attributes:

Attenuators Attributes (Point Feature) Per CTRMA Domain Model

- CORRIDOR_NAME
- CROSS_ST_NAME
- TRAVEL_DIRECTION
- LANE_TYPE
- ATTENUATOR_TYPE

- RM
- RMA_ID
- ATTENUATOR_PHOTO

Task 6 Deliverables:

- CONSULTANT will deliver a stand-alone attenuator inventory with attributes identified above in a GIS file geodatabase and publish in VUEWorks.

Task 7-Pavement Striping and Reflective Markers Inventory (line feature) Per CTRMA Domain Model

CONSULTANT's Mobile Asset Collection (MAC) vehicles will collect right-of-way asset inventories at the same time that data is collected for the pavement management system. The vehicles will capture images at an interval of approximately 10 to 15 feet for both forward and side-facing directions and geo-referenced to the pavement inventory by segment. Data will be categorized by color (yellow or white). CONSULTANT will collect pavement striping with the following attributes:

Pavement Striping Attributes (Line Feature) Per CTRMA Domain Model

- CORRIDOR_NAME
- CROSS_ST_NAME
- TRAVEL_DIRECTION
- LANE_TYPE
- STRIPING_TYPE
- STRIPING_COLOR
- STRIPING_WIDTH
- RPM_TYPE
- RMA_ID

Sample image of pavement striping collected with MAC LRIS system

Task 7 Deliverables:

- CONSULTANT will deliver a pavement striping inventory with attributes identified above in a GIS file geodatabase and publish in VUEWorks.

Task 8-Pavement Markings & Graphics

CONSULTANT's Mobile Asset Collection (MAC) vehicles will collect right-of-way asset inventories at the same time that data is collected for the pavement management system. The vehicles will capture images at an interval of approximately 10 to 15 feet for both forward and side-facing directions and geo-referenced to the pavement inventory by segment. CONSULTANT will collect pavement markings with the following attributes:

Pavement Markings & Graphics Attributes (Point Feature) Per CTRMA Domain Model

- CORRIDOR_NAME
- CROSS_ST_NAME
- TRAVEL_DIRECTION
- LANE_TYPE
- GRAPHIC_TYPE

- GRAPHIC_COLOR
- RM
- RMA_ID

Sample image of pavement markings & graphics collected with MAC LRIS system

Task 8 Deliverables:

- CONSULTANT will deliver a pavement marking inventory with attributes identified above in a GIS file geodatabase and publish in VUEWorks.

Task 9 – Traffic Sign and Support Inventory

CONSULTANT's Mobile Asset Collection (MAC) vehicles will collect right-of-way asset inventories at the same time that data is collected for the pavement management system. The vehicles will capture images at an interval of approximately 10 to 15 feet for both forward and side-facing directions and geo-referenced to the pavement inventory by segment. OWNER will provide updated geodatabase for this feature class prior to extraction.
CONSULTANT will collect traffic signs with the following attributes:

Traffic Sign and Support Attributes (Point Feature) Per CTRMA Domain Model

- CORRIDOR_NAME
- CROSS_ST_NAME
- TRAVEL_DIRECTION
- LANE_TYPE
- PANEL_MUTCD_CAT
- PANEL_MUTCD_CODE
- PANEL_SUPPORT_STRUCT
- PANEL_ORIENTATION
- PANEL_TEXT
- PANEL_PHOTO
- RM
- RMA_ID

FeatureClassName – GndSignStructure (Point Feature)

- CORRIDOR_NAME
- CROSS_ST_NAME
- TRAVEL_DIRECTION
- LANE_TYPE
- POST_QTY
- RM
- RMA_ID

Task 9 Deliverables:

- CONSULTANT will deliver a sign and sign support inventory with attributes identified above in a GIS file geodatabase along with corresponding extracted asset image and publish in VUEWorks

Sample MAC LRIS van imagery of signs

Task 10 – Traffic Sign Overhead Sign Structure (OSS) Support Inventory

CONSULTANT's Mobile Asset Collection (MAC) vehicles will collect right-of-way asset inventories at the same time that data is collected for the pavement management system. The vehicles will capture images at an interval of approximately 10 to 15 feet for both forward and side-facing directions and geo-referenced to the pavement inventory by segment. OWNER will provide updated geodatabase for this feature class prior to extraction.
CONSULTANT will collect traffic signs with the following attributes:

Traffic Sign OSS Support (Line Feature) Per CTRMA Domain Model

- CORRIDOR_NAME
- CROSS_ST_NAME
- TRAVEL_DIRECTION
- LANE_TYPE
- OSS_TYPE
- RMA_ID
- OSS_PHOTO_1

Task 10 Deliverables:

- CONSULTANT will deliver an overhead sign support inventory with attributes identified above in a GIS file geodatabase along with corresponding extracted asset image and publish in VUEWorks.

Task 11-Street Light (illumination structure) Inventory

CONSULTANT's Mobile Asset Collection (MAC) vehicles will collect right-of-way asset inventories at the same time that data is collected for the pavement management system. The vehicles will capture images at an interval of approximately 10 to 15 feet for both forward and side-facing directions and geo-referenced to the pavement inventory by segment. OWNER will provide updated geodatabase for this feature class prior to extraction. NOTE: traffic signals with lighting, are not marked as illumination. It is a signal that happens to have a street light mounted. In these cases the asset will be specified as a 'signal'. CONSULTANT will collect street lighting with the following attributes:

Street Lights Attributes (Point Feature) Per CTRMA Domain Model

- CORRIDOR_NAME
- CROSS_ST_NAME
- TRAVEL_DIRECTION
- LANE_TYPE
- I_POST_TYPE
- RM
- RMA_ID
- I_POST_PHOTO

Sample image of street lighting collected with MAC LRIS system

Task 11 Deliverables:

- CONSULTANT will deliver a street light inventory with attributes identified above in a GIS file geodatabase along with corresponding extracted asset image and publish in VUEWorks.

Task 12 – ADA Ramp Inventory

The CONSULTANT's MAC vehicles will collect right-of-way asset inventories simultaneously with data that are collected for the pavement management system. The vehicles will capture images at an interval of approximately 10 to 15 feet for both forward and side-facing directions and geo-referenced to the pavement inventory by segment. The CONSULTANT will collect ADA ramps (point feature) with the following attributes:

- CORRIDOR_NAME
- CROSS_ST_NAME
- TRAVEL_DIRECTION
- RM
- ADA_PHOTO

Sample image of ramps collected with MAC system

Task 12 Deliverables:

- The CONSULTANT will deliver a ramp inventory with attributes identified above in a GIS file geodatabase along with corresponding extracted asset images and publish in VUEWorks.

Task 13-Traffic Signal Inventory

The CONSULTANT's MAC vehicles will collect right-of-way asset inventories simultaneously with data that are collected for the pavement management system. The vehicles will capture images at an interval of approximately 10 to 15 feet for both forward and side-facing directions and geo-referenced to the pavement inventory by segment. The CONSULTANT will collect the traffic signal (point feature) inventory with the following attributes:

- CORRIDOR_NAME
- CROSS_ST_NAME
- TRAVEL_DIRECTION
- LANE_TYPE
- RM
- SIGNAL_PHOTO
- SIGNAL_ILLUMINATION
- RMA_ID

- SIGNAL_ARM

Sample image of signals collected with MAC system

Task 13 Deliverables:

- The CONSULTANT will deliver a traffic signal inventory with attributes identified above in a GIS file geodatabase along with corresponding extracted asset images and publish in VUEWorks.

Task 14-Quality Assurance and Quality Control

The CONSULTANT will perform quality assurance and quality control on all data collected.

CONSULTANT has a proven Quality Assurance (QA)/Quality Control (QC) procedure for all MAC image collection projects. CONSULTANT'S QC procedures begin with MAC vehicle collection process. For the OWNER, a MAC calibration site(s) will be established that consists of up to 10 point locations nailed, painted and surveyed in a location easily accessible to the MAC LRIS vehicle. This calibration site will be recorded in at least two perpendicular directions at the beginning and end of each collection day.

Calibration Site Checked Daily to Ensure the Accuracy of Collection

The MAC technician will check each camera's exposure rate, image quality and GPS and IMU operation to ensure the MAC system is recording the image, GPS, DMI and IMU data and that the GPS location is within the stated project tolerance. Each collection day's calibration collection will be documented in the MAC collection log book. The MAC collection log book also contains information such as date, location, technician, driver, any issue that developed during the collection day and DMI calibration runs. CONSULTANT will maintain a Microsoft Access database of any collection or other project issues. All project team personnel including OWNER personnel will have access to the database to log comments, check the status of issues and have one central repository to track project issues and resolutions.

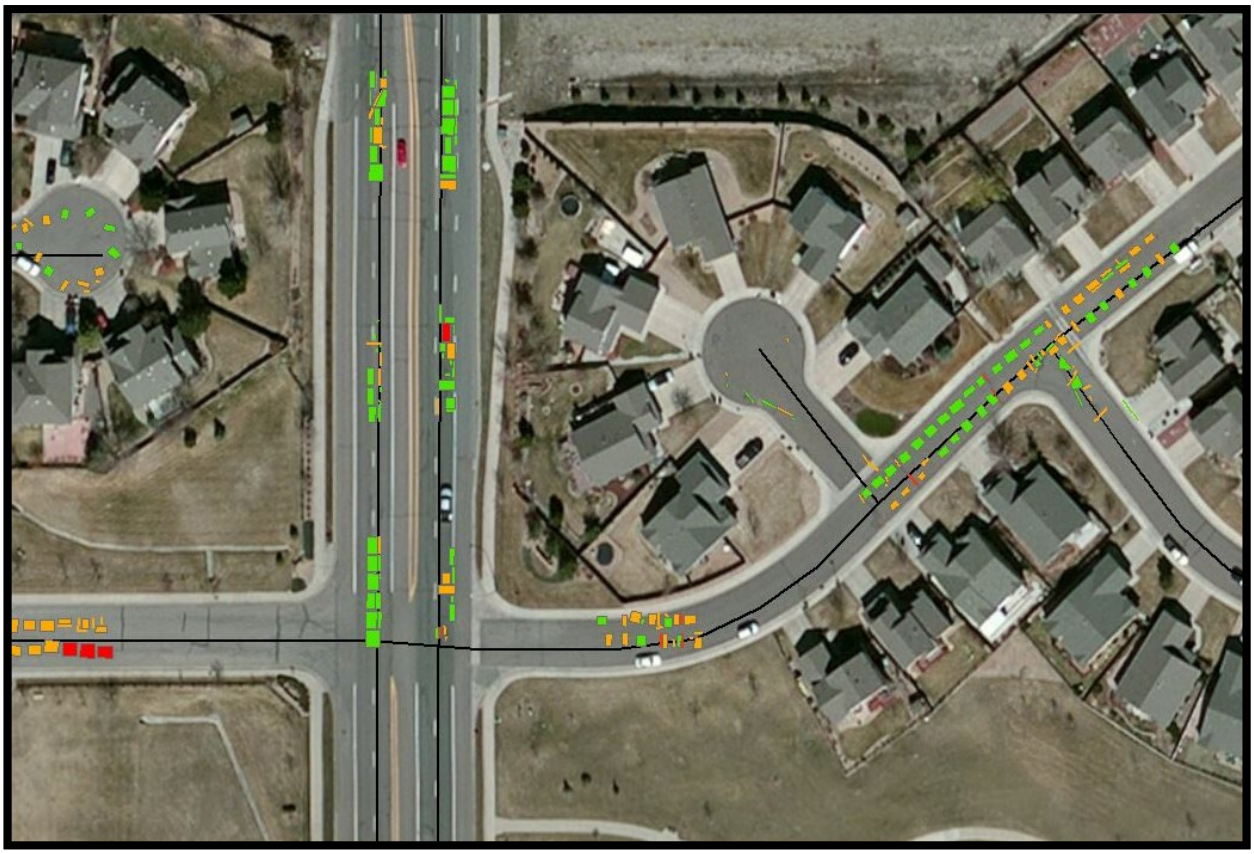
During image collection, the MAC technician reviews the images collected on-screen as they are collected and any issue with image clarity requires the collection run to end and the image quality issue to be resolved. Once resolved, the collection run begins from the beginning for the road segment collected. The MAC technician also monitors GPS reception during collection. If GPS reception is lost (measured using PDOP – positional dilution of precision), the MAC technician stops the collection and resolves the GPS reception issue. Collection begins again once the GPS reception issue is resolved. All issues resulting in the collection run being stopped will be recorded in the MAC collection log book along with the resolution.

With a completed collection drive delivered to CONSULTANT headquarters in Orlando, images are post processed and provided to the image QC Officer who will perform quality control checks on each delivery provided. The QC Officer will visually review the collection routes for image quality. All collection runs that are considered of low quality will be marked for recollection before the MAC vehicle(s) is allowed to leave the CTRMA.

Additionally, CONSULTANT will provide independent quality checks via field verification to

confirm accuracy of automated data collection. CONSULTANT utilizes walk-out maps that display pavement distress data for field confirmation and acceptance. CONSULTANT's QA methodology is outlined in Task 14 at the end of this document.

CONSULTANT will verify use of domains included in CTRMA geodatabase where provided for the extraction attributes.



CONSULTANT field Maps utilized for field verification of pavement distress data

TASK 14 Deliverables:

- CONSULTANT will perform field verification of pavement condition scores with CTRMA staff to answer questions and resolve discrepancies in data and field observations.

ACCEPTANCE CRITERIA

The results of the data collection shall be quality checked for rating consistency by CONSULTANT to ensure the accuracy and quality of deliverables. Notes from field validations will be implemented into the distress evaluations to make any corrections for deficiencies in distress identification. Additionally, deliverables will be checked for missing and/or duplicate assets and anomalies. A 97% accuracy rate is expected and Quality Control checks will be based on the batch/sample size of the delivery (see Table A below to determine sample size for the appropriate

accuracy rate).

For any measurement that is needed, it must be accurate to the nearest foot. If the data has more errors than allowable the set of data will be corrected. This process will be repeated until each set of data is within the allowable limits.

Method of measurement of acceptable quality level (AQL)

Each attribute captured for an asset counts as one unit of measure. Each physical measurement required for an asset location counts as one attribute or unit of measure. The following location information also counts as an attribute or unit of measure for each asset: Physical presence (when captured as per source = correct, not captured or missed = incorrect) In the event of a duplicate capture of an asset, the total number of attributes or units of measure for the duplicate asset(s) will be deducted from the total units of the sample set, and one error or unit of measure (incorrect physical presence) is charged.

TABLE A

Batch size			Sample Size (Normal)	Acceptance Rate (%)				
				99.0	98.5	97.5	96.0	93.5
2	to	8	2	≤ 0	≤ 0	≤ 0	≤ 0	≤ 0
9	to	15	3	≤ 0	≤ 0	≤ 0	≤ 0	≤ 0
16	to	25	5	≤ 0	≤ 0	≤ 0	≤ 0	≤ 1
26	to	50	8	≤ 0	≤ 0	≤ 0	≤ 1	≤ 1
51	to	90	13	≤ 0	≤ 0	≤ 1	≤ 1	≤ 2
91	to	150	20	≤ 0	≤ 1	≤ 1	≤ 2	≤ 3
151	to	280	32	≤ 1	≤ 1	≤ 2	≤ 3	≤ 5
281	to	500	50	≤ 1	≤ 2	≤ 3	≤ 5	≤ 7
501	to	1,200	80	≤ 2	≤ 3	≤ 5	≤ 7	≤ 10
1,201	to	3,200	125	≤ 3	≤ 5	≤ 7	≤ 10	≤ 14
3,201	to	10,000	200	≤ 5	≤ 7	≤ 10	≤ 14	≤ 21
10,001	to	35,000	315	≤ 7	≤ 10	≤ 14	≤ 21	≤ 21
35,001	to	150,000	500	≤ 10	≤ 14	≤ 21	≤ 21	≤ 21
150,001	to	500,000	800	≤ 14	≤ 21	≤ 21	≤ 21	≤ 21
500,001	and over		1250	≤ 21	≤ 21	≤ 21	≤ 21	≤ 21

Example: a delivery results in 100 assets – each asset has been determined to have 10 attributes to be captured (including the physical presence “attribute” for each asset) – thus total units of measure for the Batch size = 1,000 (100 x 10). Based on Table A, a Quality Control using a sample size of 80 units should be assessed for quality. With an expected accuracy of 97%, the allowable number of errors ≤ 5.