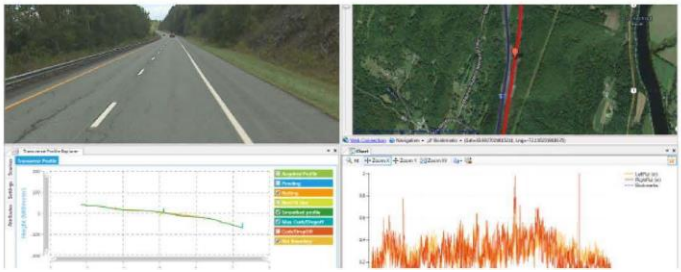
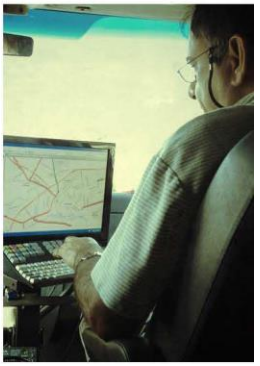
Fugro Roadware





Proposal of Work for Asset Management Services

Coppell, Texas
Attn: Jamie Brierton
255 E. Parkway Blvd.
Coppell, TX 75019

December 1, 2017

Fugro Roadware, Inc.
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December 1, 2017

Coppell, Texas
Attn: Jamie Brierton
255 E. Parkway Blvd.
Coppell, TX 75019

Dear Ms. Brierton,

Fugro Roadware, Inc. is pleased to submit this proposal to perform asset management services for the City of Coppell as a member listed on the North Texas SHARE Buy Board for Pavement Analysis Services (RFQ #NCT-2016-14).

Fugro's Project Team has the experience and resources required to deliver projects on time and to the quality standards expected by the City of Coppell. We have had the privilege of providing asset data collection and condition assessment services to NCTCOG participating agencies for over 20 years, and this offers us a unique understanding of the needs and expectations of the City of Coppell.

Fugro Roadware understands that the City of Coppell is seeking a qualified firm to perform right-of-way data acquisition and analysis for roadways maintained by the City. The firm is to provide all necessary field inspectors, vehicles, tools, and equipment required to perform professional asset management services including, but not limited to:

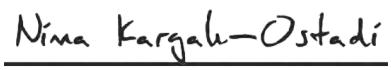
1) Automatic and continuous measurement of pavement cracking, texture, rutting (both wheel path ruts), digital images, and dual-wheel path roughness data to International Roughness Index (IRI) standards.
2) Calculation of Pavement Condition Index (PCI) for each surveyed road segment.
3) Data collection for assets such as sidewalks, ADA ramps, curb, and traffic signs.
4) Delivery of PCI and asset data in a format compatible with the City's Geographic Information System (GIS) database.
5) Estimation of the annual budget required to meet long term goals regarding desired pavement condition levels.
6) Development of five-year and ten-year rehabilitation plans with input from the City.

Fugro has long been a leader in asset data collection and analysis. Based on our experience with other similarly sized projects, we have put together a proposal package that addresses our team's experience and qualifications, our proposed methodology and approach, as well as the tools and equipment necessary to carry out the scope of work as outlined in the North Texas SHARE Buy Board for Pavement Analysis Services (RFQ #NCT-2016-14).

Please do not hesitate to contact Nima Kargah-Ostadi, PhD, P.E. at (512) 977-1883 (nkargah-ostadi@fugro.com), or Thomas Burchett, P.E. at (512) 977-1853 (tburchett@fugro.com) if you have any questions.

Sincerely,

FUGRO ROADWARE, INC.
TBPE Firm Registration No. F-15799



Nima Kargah-Ostadi, PhD, P.E.
Pavement Engineering Manager

SECTION A: DESCRIPTION OF SERVICES

A.1 Introduction to Fugro Roadware, Inc.

Fugro Roadware has over 45 years of experience with pavement and roadway asset data collection and offers a strong record of successfully providing services that are described in the NCTCOG solicitation document (RFQ #NCT-2016-14). Fugro provides services for all aspects of pavement management and evaluation, planning and oversight, developing maintenance and rehabilitation strategies, and optimizing network conditions within available budgets. Our services deliver value by planning, accurately diagnosing, and prioritizing maintenance and rehabilitation activities.

We are active in a number of industry research organizations and committees, such as the Federal Highway Administration (FHWA)'s Long Term Pavement Performance (LTPP) program, the Transportation Research Board (TRB)'s Strategic Highway Research Program (SHRP, SHRP 2), and the National Cooperative Highway Research Program (NCHRP).

The following provides a high-level overview of the services that Fugro can offer to the NCTCOG. *Section A.1.7 Ability to Respond to Stated Objectives* provides additional details as to how we plan to meet the specific objectives as outlined in the solicitation document.

A.1.1 Pavement Data Collection and Processing

Fugro Roadware operates a fleet of 22 Automatic Road Analyzer (ARAN) vehicles that automatically and continuously measure over 15 different data types simultaneously on arterial and collector streets, streets with concrete, asphalt, and/or dirt/gravel, and alleyways. Data types include:

- Roughness, smoothness, ride and International Roughness Index (IRI)
- Rutting and Transverse Profile
- Pavement Distress
- Road Geometrics (Grade, Curve, Cross Fall, Slide Slope, Edge Drop Off)
- Pavement and Right-of-Way (ROW) Images
- Faulting
- Texture

Fugro has developed our Vision software for the processing and analysis of pavement condition data. Vision is a customized digital condition rating system that can be configured for user defined severity/extent based upon pavement distresses and pertinent roadway attributes. Data can be exported to pavement management system (PMS) or asset management system (AMS), and it can be easily customized for industry standard reporting.

A.1.2 Asset Inventory

Fugro Roadware has extensive experience collecting roadway assets and has extracted and delivered over 70 different asset types totaling 5.1 million unique assets over 216,000 miles of road for municipal and State agencies since 2008. Fugro Roadware's Surveyor software uses the calibrated geo-referenced images collected by the ARAN to capture, extract, measure, and store data on client's visible roadside assets. Surveyor will be used to meet NCTCOG requirements for asset data collection for sidewalks (location, length, width and condition), ADA ramps (location, configuration, presence of truncated domes or other detectable warning features, condition), and roadway signs (type, location). Assets can be provided to NCTCOG Participants via Geodatabases for incorporation into the Participant's GIS system, if applicable.

A.1.3 Data Viewing and Managed Hosting

Fugro Roadware's iVision is a web-based software that offers the ability to review the collected data and images. NCTCOG Participants will benefit from the functionality of Fugro Roadware's iVision software completely ***free of charge*** for one year for up to 5 users per Participant on our hosting service. With over 1 Petabyte (1 billion Megabytes) of data storage, we currently provide such managed services for numerous State and municipal agencies within the U.S.

A.1.4 Pavement Management System (PMS) Services

Fugro is experienced with a variety of pavement management software packages such as Cartegraph, StreetSaver, AgileAssets, Deighton dTIMS and MicroPAVER. Our experience with these software packages includes developing condition listings, condition maps, work plans, budget optimization, and maintenance and rehabilitation alternatives for agencies.

Fugro Roadware can provide tailored pavement management solutions to NCTCOG Participants based upon their specific requirements. Fugro has provided pavement management services for all different sized agencies with a wide variety of needs:

- Data migration from legacy systems
- Loading of Pavement Management Data
- Pavement Management Implementation
- Pavement Management Update
- Geographic Information System services
- Work plans, budget analysis, and network condition reporting
- Performance Modeling
- Computer Hardware and PMS/Asset Software
- Presentations to City Councils and Commissioners Courts

A.1.5 Training

Fugro's certified professionals have years of experience providing clients and engineering professionals with a variety of training and continuing education courses pertaining to pavement design, materials, pavement management, and pavement preservation.

A.1.6 Data Collection Vehicles and Equipment

Fugro manufactures ARAN data collection vehicles, including the ARAN 9000, ARAN 8000 and ARAN 7000 RoadProfiler, to client specifications.

A.1.7 Ability to Respond to Stated Objectives

The Fugro Roadware Project Team has the ability to meet the objectives laid out in Section 1.02 of the solicitation document. Fugro's experience in pavement asset data collection in Central Texas puts us in a unique position to add value to our clients during each phase of the asset management process.

1. **Automated pavement surface cracking, including rutting and roughness.**

   Fugro has state-of-the-art equipment and data control procedures to ensure that data collection efforts are conducted comprehensively, and with pinpoint accuracy. A full description of the equipment Fugro uses to perform these surveys is outlined in *Section A.2 Overview of Automated Equipment.*

2. **Pavement surface distress and structural condition information through automated means for all participant owned roadways.**

   Fugro rates surface distress using a combination of manual and automated means using our Vision software. Key personnel are trained in a variety of pavement distress identification methodologies including Federal Highway Administration (FHWA) Long-Term Pavement Performance (LTPP) Distress Identification Manual, Pavement Condition Index ASTM D6433, Texas Department of Transportation (TxDOT) Pavement Management Information Systems (PMIS), and Metropolitan Transit Authority (MTS) StreetSaver. Experienced personnel, along with specially developed crack detection and rut processing software ensure that surface distress information is reported with a high level of precision.

3. **Provide a customized digital condition rating system to collect user-defined severity/extent based pavement distress and pertinent roadway attributes.**

   A unique aspect of each pavement management software (PMS) system available on the market today is the ability to create customized condition rating systems for project prioritization and project planning. The Fugro Project Team's experience with the full spectrum of products available on the market today means that we can tailor a software implementation based on the needs of the participating agency. Whether that means using a Pavement Condition Index (PCI) based approach, Ride Condition Index (RCI), Traffic Condition Index (TCI), or a combination of these rating systems, Fugro has the knowledge to create a classification system that fits the needs of any size agency.

4. **Collect dual-wheel path roughness data to International Roughness Index Standards.**

   Fugro performs roughness data collection for a number of local and state agencies, and the Federal Government as part of the FHWA LTPP program. Our experience collecting and delivering roughness data is unmatched in the industry and this allows us to collect, process and deliver roughness data quickly, efficiently, and tailored to the needs of our clients. More information can be found in *Section A.2.5 Roughness Data (International Roughness Index)*.

5. **Collect and provide roadway information to the client, containing at a minimum: street name, endpoints, inventory date, pavement type, functional class, pavement condition score, roughness, surface distress and pavement age.**

   Each PMS software package has different requirements for network inventory information. Fugro's experience with the full spectrum of products provides us with the

insight to know, well in advance, what inventory items are necessary for the collection, management, and improvement of an agency's pavement network, and the experience to integrate this information with the agency's currently available Geographic Information System (GIS) or database systems. The Fugro project team will use this experience to ensure that either a comprehensive inventory is created, or an existing inventory is optimized to the degree necessary for implementation into the participating agency's desired PMS software.

6. **Collect Digital Images at 25-foot intervals of the road surface condition and link to a geodatabase.**

   Fugro standard practice is to collect Right-of-Way (ROW) images at 25-foot intervals, and a continuous image of the pavement surface. Images are used for surface distress detection and specifically, ROW images, are used for roadway asset assessment. What sets Fugro apart from our competitors is the ability for us to host these geo-referenced images in our cloud-based iVision software. This software allows instant access to the entire roadway network from any internet-enabled device. A full description of these capabilities can be found in *Section A.3 iVision Hosting Services.*

7. **Collect Additional and/or missing roadway attribute data and create shape (.shp) files for roadway data for incorporation in the Participant's GIS system.**

   All of the data Fugro collects is comprehensively georeferenced. This means that data can be migrated into the Participant's current GIS systems without a significant level of effort. Fugro takes extra steps to ensure that this georeferenced information is maintained throughout the collection, implementation and delivery process, to ensure that even if a client is not currently using a GIS-based system, the information is available should they choose to implement one at a later date. (future-proofing)

8. **Load assessment data (imagery, measurements, condition data) for all Participant-maintained pavements into a PMS system, as specified by the client.**

   The Fugro Project team has extensive experience in each of the industry standard Pavement Management System (PMS) software packages currently available, including: MicroPAVER, Cartegraph, AgileAssets, Deighton, StreetSaver, Lucity, etc. Our unbiased approach to implementation means that Fugro will recommend a software package with the needs of each individual Participant in mind. For example, a Participant with a network of 700 miles will have significantly different budget, software and maintenance needs than one with 100 miles of pavement. The Fugro Project Team has the experience needed to ensure that each Participant is getting a customized recommendation based on their particular circumstances.

9. **Implement map module so that pavement condition and other data can be integrated, displayed and accessed through the map interface in a format consistent with the Participant's preferred referencing system.**

   Each PMS software package has different mapping functionality built-in, Fugro has experience with each system and performs comprehensive software testing and training with each client. This ensures that not only does each module of the PMS software function properly, but that the Participating Agency is trained and competent in its use.

10. **Provide to the participant the pavement condition data in a pavement management system database approved by Participant. Coordinate with IT**

department to ensure the format is compatible with current software practices, including ESRI ArcGIS.

As mentioned in objective #5, all of the data that Fugro collects is georeferenced for integration with industry standard GIS software including the ESRI suite. Fugro's diverse client-base uses a variety of geo-referencing software and this gives our team valuable experience on the methods of integrating asset collection data with each of these software packages.

11. **Calculate a Pavement Condition Index (PCI) score for each road segment using an approved pavement management system and in accordance with ASTM D6433. Provide results compatible with Participant's GIS database.**

    Each PMS software package calculates PCI in a slightly different way. As part of each data collection and implementation project, Fugro conducts extensive field surveys of pavement surface distress to guarantee the accuracy of PCI score calculations. As an additional benefit, Fugro will invite the Participating Agency staff along for these field surveys, to help clarify the differences in PCI scores, and how each distress factors into the overall condition rating.

12. **Calculate the International Roughness Index for each road segment in accordance with ASTM E1926, and provide results compatible with GIS databases.**

    Fugro performs roughness data collection for a number of local and state agencies, and the Federal Government as part of the FHWA LTPP program. Our experience collecting and delivering roughness data is unmatched in the industry, and this allows us to collect, process and deliver roughness data quickly, efficiently, and tailored to the needs of our clients. More information can be found in *Section A.2.5 Roughness Data (International Roughness Index).*

13. **With input from Participant's Staff, devise a weighing system taking into account PCI, IRI, ADT, public safety and apply to roadway information.**

    Each PMS software package has different capabilities for ranking or prioritizing streets for maintenance and rehabilitation treatments. Based on the Participant's needs, Fugro will determine the level of software sophistication necessary to meet the needs of the Participant, in the most efficient manner. This could be a small municipality ranking solely on PCI, or a large City that needs to consider emergency evacuation routes, ride quality, disaster evacuation routes, etc. This 0-100 numeric index will be applied to the roadway information collected for the entire jurisdiction and is used by the software in determining appropriate maintenance and rehabilitation treatments.

14. **Estimate the annual budget required to meet the long-term goals regarding desired pavement condition levels.**

    Each PMS software allows for the creation of an infinite number of budget funding scenarios. Fugro will work with the client to determine the budget necessary to accomplish the agency's asset management goals; whether this means maximizing conditions based on limited resources, or determining the needs for maintaining or achieving a particular condition. Fugro has helped many different clients achieve higher network condition scores, secure additional funding as needed for maintenance, and maintain their network without requiring an increase in budget.

15. **Create a Five-year and ten-year pavement rehabilitation plan with input from Participant's Staff.**

    The Fugro project team includes personnel with extensive backgrounds in cost-benefit analysis, maintenance and rehabilitation techniques, budget optimization, and project level work plan development. With input from the Participating Agency and based on the current and projected levels of funding, Fugro will generate a number of multi-year budget funding scenarios to ensure that the Participating Agency's long-term pavement preservation needs are met. Scenarios can be generated based on PCI or condition score goals, separated maintenance and capital improvement budgets, multi-year bond cycles, and a variety of other factors.

16. **Recommend the computer hardware and software needed for successful implementation, potentially including licenses and other software as needed.**

    Based on the size of the Participating Agency, the available budget, the performance requirements of the software, and many other factors, Fugro will develop a customized software recommendation for maintaining a comprehensive asset management database. In most circumstances, all that is required is training to develop familiarity with current software capabilities. The Fugro Project Team's relationship with each of the leading PMS software manufacturers means that software licensing, implementation and maintenance can be performed entirely in-house.

17. **Train Participant staff and provide assistance to the Public Works and IT Department as needed for the use of data collected.**

    Fugro believes that software training should include more than just training the client on how to use the software, but on the role each pavement management component plays in achieving proper results, year after year. Fugro employs a large staff of database management personnel, customer support staff, and software developers to ensure that our products and services are used to their fullest potential, and provide the Participating Agency with significant value for years to come.

A.2 Overview of Automated Equipment

The ARAN is the world's most reliable and trusted fully integrated pavement surveying vehicle. Today's sixth generation ARAN technology collects more miles per day than any other platform and experiences the lowest electrical and mechanical downtime in the industry.

Each ARAN has the ability to collect and measure all the data types requested in the solicitation document in a single pass at posted speeds. Its modular design enables us to quickly configure any ARAN vehicle in our fleet to the NCTCOG Participant's needs. Operators are trained in the use of the ARAN's quality assurance systems in order to quickly identify errors that may impact the integrity of collected data. In addition, each day, a data subset is uploaded and examined by Fugro's project manager and data analysis department.

Fugro Roadware's Automatic Road Analyzer (ARAN) data collection vehicle (see *Figure 1*) offers the ability to automatically and synchronously collect the following data types:

- Transverse profile and Rutting
- Pavement images and Surface distress
- Texture data, mean profile depth (MPD) from our laser-based system
- Roadway Geometry (POS LV)
- Longitudinal profile and Roughness (IRI)
- Right of Way (ROW) digital images
- Linear reference data with the use of a Distance Measurement Instrument (DMI)
- Geo-referenced data with the use of an inertial aided Global Positioning System (GPS)
- LiDAR
- Ground Penetrating Radar

Figure 1 – The Automatic Road Analyzer (ARAN)

A.2.1 Positioning

The ARAN is equipped with a Distance Measuring Instrument (DMI) that measures chainage, and linear distance traveled, and a Global Positioning System (GPS). However, if the satellite signal is lost, the ARAN's Inertial Reference System (POS LV) will fill in the gaps. POS LV is a state-of-the-art inertial aided navigation system that provides precise roll, pitch, heading, velocity, and position information to other onboard subsystems.

A.2.2 Pavement Imaging

The pavement surface condition will be documented by the equipment as a series of high-definition images. Planar-view digital images (JPEG format) are recorded to removable hard drives for 100% of the width (up to 14 feet) and length of the traveled lane using two high-resolution monochrome digital cameras. The high-definition images clearly show the types of distresses encountered along the road.

A.2.3 Surface Distress

Automated distress data collection will be performed in accordance with ASTM D6433 Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys using Fugro's Vision software. Vision facilitates the entire data processing workflow from the ARAN to the final deliverable formats including key modules for Data Upload, Linear Referencing/Segmentation, Video Quality Analysis, Sensor Data Quality Analysis and Pavement Distress, and Report Generation. The Report Generator Wizard of Vision facilitates the creation of custom reports and for data upload to Pavement Management System (PMS) or Asset Management System (AMS) applications. *Figure 2* provides a screenshot of Fugro Roadware's Vision software.

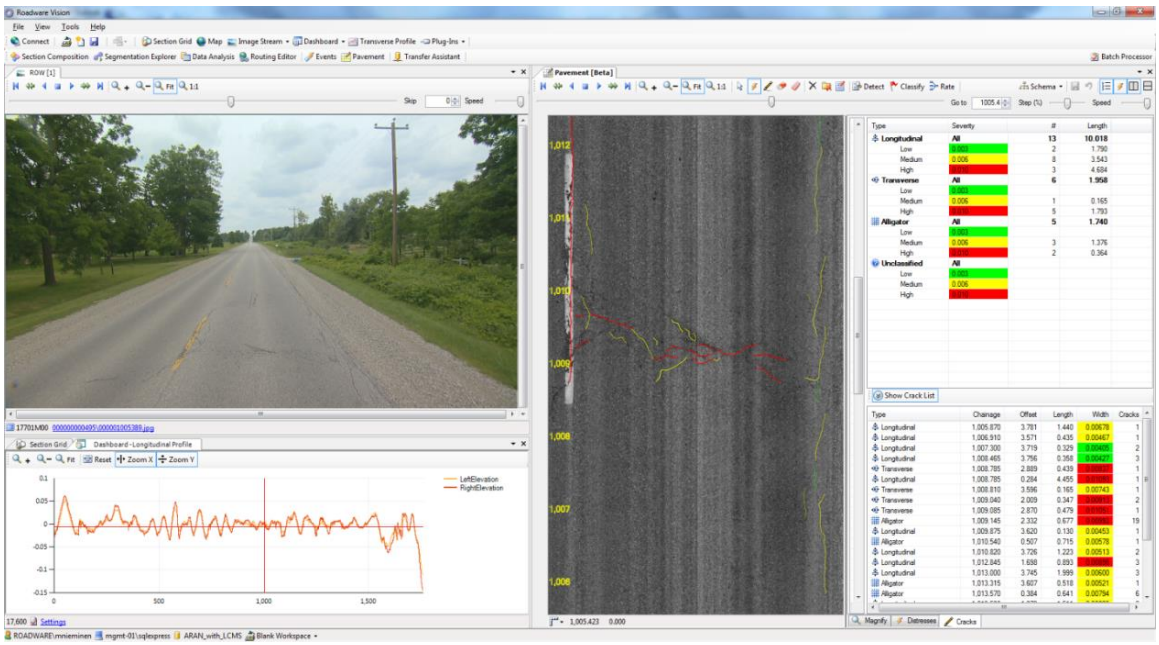


Figure 2 – Vision Screenshot

Digital pavement images collected by the ARAN serve as input to the distress rating process. Right-of-Way (ROW) images (forward-view) are also used to enhance distress-rating accuracy. Each distress can be identified in terms of location, severity, exact dimensions, and other characteristics. This level of detail can provide benefits during planning, performing

maintenance, and detailed pavement design. It is also possible to greatly expand the types of distresses monitored for only a minor increase in effort. This detailed catalog can be used to provide more accurate predictions of future conditions and better recommend and estimate preventative maintenance activities.

A.2.4 Rutting

Transverse profile and rutting data are collected and measured according the NCTCOG Participant's specifications. The Laser XVP produces excellent results on all pavement surfaces. Fugro Roadware's Vision software is used for the review and plotting of transverse profile raw data or data corrected as a result of inputs for vehicle roll. Furthermore, the software can recalculate rut depth using the straight-edge method and detect and measure edge drop-off from stored raw transverse profiles. Edge drop-off can be a critical safety factor for high-speed roadways that have unpaved or soft shoulders.

Rutting will also be categorized based on severity levels can be uploaded into the Participant's pavement management system. The rutting can either be included in the Pavement Condition Index score or reported as its own index. Fugro will confirm with the NCTCOG Participant which procedure is currently in use prior to upload of the rutting data to the Participant's system. Rut measurements will be in accordance with AASHTO R 48.

A.2.5 Roughness Data (International Roughness Index)

The ARAN's Profiler subsystem provides longitudinal profile measurement that will be collected in both wheel paths and used to calculate International Roughness Index (IRI). The Laser SDP is a non-contact Class 1 inertial profiler that uses lasers and accelerometers mounted over each wheel path to determine pavement profile in real-time.

The ARAN will be equipped with the RoLine scan line roughness system. This LMI Selcom RoLine 3 KHz scanning laser system offers improved consistency, reliability, and repeatable and accurate results. It provides a full 100 mm (4-inch) line of data across the road surface (similar to a tire tread). We would be pleased to discuss the benefits of this system with NCTCOG during the project planning stage.

A.2.6 Digital Right-of-Way (ROW) Images

The ARAN will be equipped with 3 Sensor cameras; offering a high 1920 x 1080 image resolution, a standard angle lens (63^0), with a free-running frame rate of 60 frames per second (fps). The additional advantage of using 3 Sensor cameras is the increased color density of images. *Figure 3* provides an example of the ROW image collected by Fugro Roadware's ARAN.

Figure 3 – HD Camera View

A.2.7 Roadway Asset Data Collection

The calibrated, geo-referenced HD ROW images and be used in combination with our Surveyor software (see *Figure 4)* for asset extraction and inventory. The combination of the forward facing ROW images and Fugro's Surveyor software will be used for the initial assessment of sidewalks, ADA ramps, and sign inventories requested for the NCTCOG project. Field assessment crews will only be deployed if additional condition assessment is required; saving both time and money.

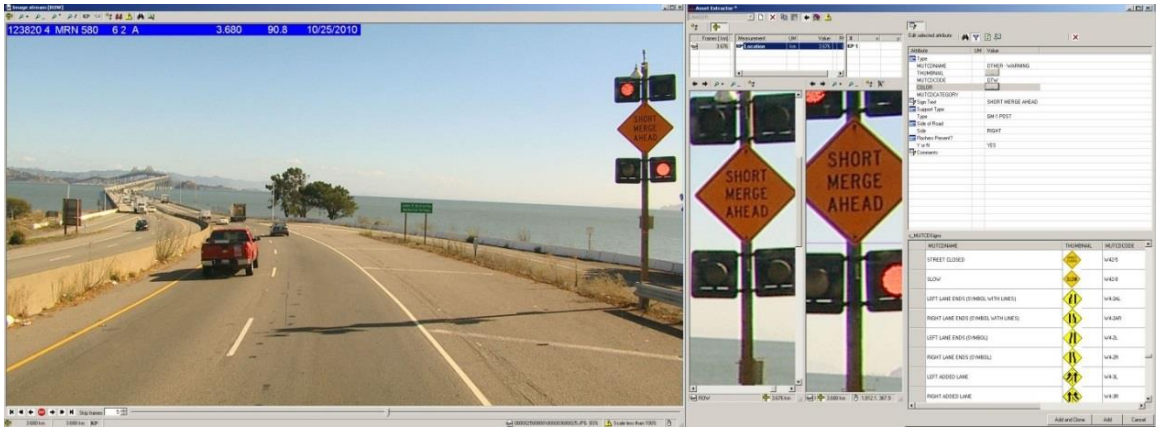


Figure 4 – Surveyor Software Screenshot

A.3 iVision Hosting Services

Highlighted in *Section A.1.3 Data Viewing and Managed Hosting*, NCTCOG Participants will receive the managed hosting services from Fugro Roadware for all of the collected roadway data and images. This will be completely ***free of charge*** for one year for up to 5 users per Participant.

iVision is Fugro Roadware's web-based software that requires only a web browser with internet connectivity (see *Figure 5)*. iVision allows NCTCOG Participant staff to view ROW digital images, pavement images, and a choice of collected pavement management and condition data over the internet.

All of the NCTCOG Participant's data can be displayed in maps, charts, and tables and in the way that the agency wants to display the information. Staff can hide fields, create views, with just a few clicks iVision can present information in the way that best suits their needs.

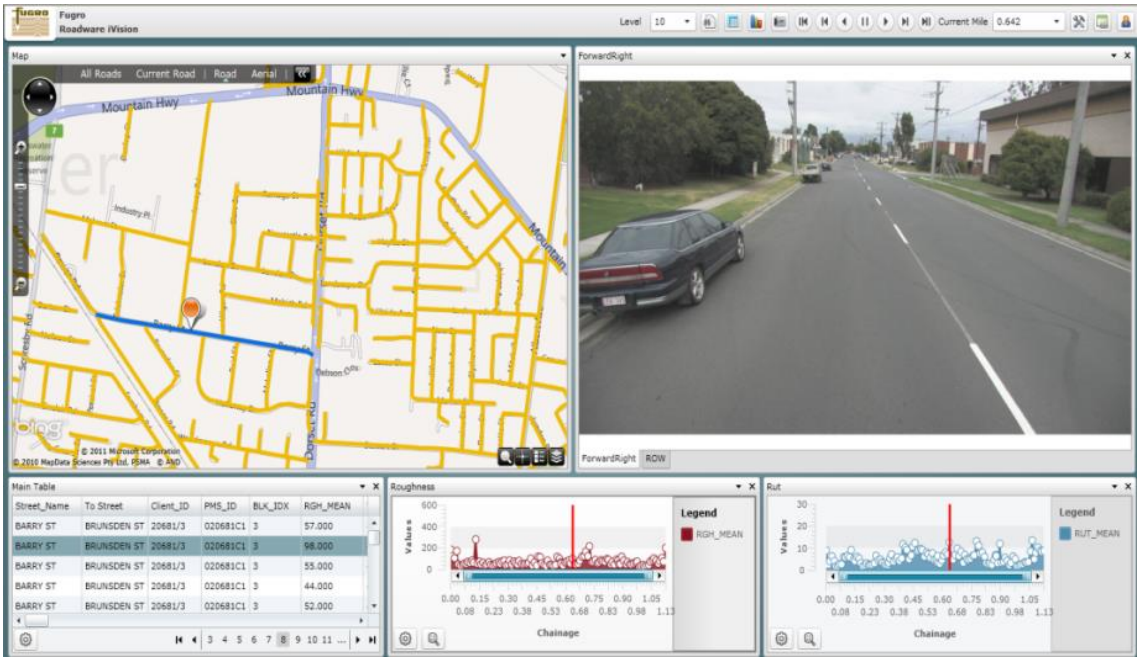


Figure 5 – iVision Screenshot

Pavement and Videolog images can be *exported* and saved directly to a local machine. *Download* tables of data to a CSV or Excel file. *Share* a map or use a chart in a report by taking a snapshot with just one click. Using *Roadware Connect* technology, the NCTCOG Participant staff can work seamlessly with ArcGIS or web services environment.

NCTCOG Participants will benefit from the features now available in the current version of iVision such as:

- Users are now able to scroll through pavement images. Pavement scrolling speed can be controlled by the user.
- Measurement for downward perspective camera images
- Lane Edge Visualization
- Distress Crack Maps display on pavement images (see *Figure 6)*

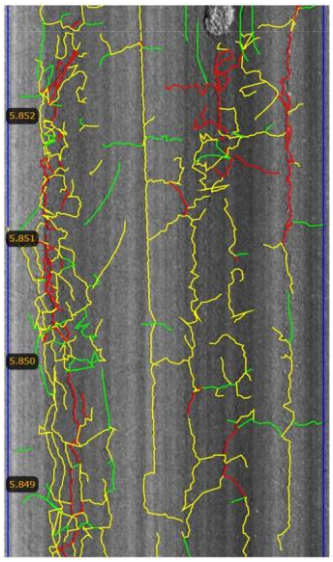


Figure 6 – Distress Crack Maps

- Tooltips have been added to thematic maps. Tooltips show the distress or severity value and display information about the route if a thematic layer has been created (see *Figure 7*).

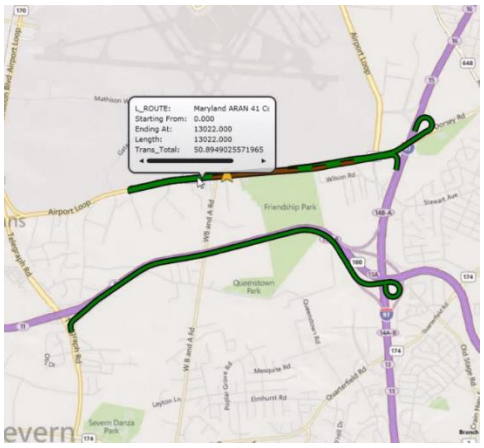


Figure 7 – Tool Tips for Thematic Maps

SECTION B: SCOPE OF WORK

B.1 Overview

The road network in Coppell, Texas is comprised of approximately 393 lane miles of paved roads and 68 miles of paved alleys. Fugro Roadware will collect pavement and asset data along one lane for each two-lane road, one lane in each direction for each four and six-lane road, and one pass for each alley for a total collection length of 256 test miles. Forward-facing and rear-facing right-of-way cameras will be used to collect asset inventories along both sides of the road.

B.2 Right-of-Way (ROW) and Pavement Images

ROW and pavement images will be collected for each lane surveyed using the ARAN. ROW images will be collected at an interval of 25 feet, and pavement images will be collected continuously along the surveyed lane. All images will be delivered to the City of Coppell on external hard drives. Images will also be available to the City for one year via Fugro's iVision viewing software.

B.3 Pavement Data Collection

The following data will be collected and reported to the City of Coppell for each lane surveyed using the ARAN:

- Street Name
- Endpoints
- Segment ID
- Segment Length
- Pavement Width
- Inventory Date
- Pavement Type
- Functional Class (provided by the City)
- Pavement Condition Score
- Rutting
- International Roughness Index (IRI)
- Surface Distress
- Pavement Age (provided by the City)

B.4 Asset Data Collection

The following asset types will be extracted from ROW images using Fugro's Surveyor software:

- Sidewalks
  - Location
  - Length
  - Width
  - Condition
- ADA Ramps (approximately 2,048)
  - Location
  - Configuration
  - Presence of Truncated Domes
  - Condition
  - Image
- Signs (approximately 12,800)
  - Type
  - Location
  - Image
- Curb and Gutter (approximately 2,703,360 linear feet)
  - Type
  - Location
  - Image

"If it can be seen, it can be recorded and measured."

Fugro's Surveyor software is an application that allows operators to locate and measure assets within the right of way. It includes built-in templates for asset type identification, an asset editor, video playback tools, measurement of width, height, length and offset, interactive data tools, pops up asset browser, etc.

If stakeholders within an agency feel that additional or separate data sets are needed, additional asset types can be extracted and inventoried from the collected images at a point in the future.

B.5 Pavement Management

Fugro will utilize an industry standard pavement management software to perform pavement management analyses using the collected data. Fugro will work with City personnel to optimize maintenance and rehabilitation strategies for use during analysis. The results of the pavement management analyses will be summarized in a report which will include budget analyses as well as 5-year and 10-year rehabilitation plans. Additionally, Fugro will provide three days of training to City personnel regarding pavement management and how to use an industry standard pavement management software.

B.6 GIS Data Delivery

The following data will be delivered to the City in GIS format:

- Pavement Condition Score
- International Roughness Index (IRI)
- Asset Data
- 5-year and 10-year rehabilitation plan

SECTION C: FEE SCHEDULE

Item Number	Description	Unit	Base Cost ($)	Unit Cost ($)	Quantity	Item Cost ($)
1	Automatically and continuously measure pavement cracking, texture, rutting, width, and pavement type	Test Mile		50	256	12,800
2	Collect pavement surface distress through automated means	Test Mile		35	256	8,960
3	Provide a digital condition rating system to collect user-defined severity/extent based pavement distresses and pertinent roadway attributes to accommodate a standardized approach to collecting data	Lump Sum	1,500			1,500
4	Collect dual-wheel path roughness data to International Roughness Index standards	Test Mile		5	256	1,280
5	Roadway information that shall be collected and provided to the Participant at a minimum includes street name, endpoints, segment ID, segment length, pavement width, inventory date, pavement type, functional class, pavement condition score, rutting, surface distress, and pavement age.	Test Mile		10	256	2,560
6	Collect digital images at 25-foot intervals of the road surface condition and link to a geodatabase (minimum forward facing imagery)	Test Mile		5	256	1,280
7	Collect sidewalk data to include location, length, width and condition and create shape (.shp) files for incorporation into the Participant's GIS system, if applicable	Test Mile		15	256	3,840
8	Collect sidewalk ADA ramp data to include location, configuration, the presence of truncated domes or other detectable warning feature, and condition and create shape (.shp) files for incorporation into the Participant's GIS system, if applicable.	Each		0.50	2,048	1,024
9	Collect roadway sign data to include type and location and create shape (.shp) files for incorporation into the Participant's GIS system, if applicable	Each		0.50	12,800	6,400
10	Collect photos of sidewalks, ADA ramps, and/or roadway signs inventoried under items 8, 9, and 12.	Each		1	14,848	14,848
11	Collect location of curb and gutter and create shape (.shp) files for incorporation into the Participant's GIS system, if applicable	Linear Feet		0.005	2,703,360	13,517
12	Collect location and type of visible in-pavement features such as valves, manhole covers, etc. and create shape (.shp) files for incorporation into the Participant's GIS system, if applicable	Each		1	0	0
13	Load assessment data for all Participant-maintained pavements into a pavement management software system required by local government Participant(s), if applicable. Cost includes base cost plus lane mile unit cost.	Each Participant	3,500	2	256	4,012
14	Implement map module so that pavement condition and other data can be integrated, displayed, and accessed through the map interface in a format consistent with the Participant's horizontal and vertical control network system, if applicable. Cost includes base cost plus lane mile unit cost.	Each Participant	3,000	2	256	3,512

Item Number	Description	Unit	Base Cost ($)	Unit Cost ($)	Quantity	Item Cost ($)
15	Provide to the Participant the pavement condition data in a pavement management system database approved by Participant. Coordinate with the Participant's IT department to provide pavement condition data in a format compatible with the Participant's Environmental Systems Research Institute (ESRI) GIS database, if applicable. Cost includes base cost plus lane mile unit cost.	Each Participant	3,000	2	256	3,512
16	Calculate a Pavement Condition Index (PCI) score for each road segment using an approved pavement management system and in accordance with ASTM D6433. Provide results compatible with the Participant's GIS database, if applicable	Test Mile		7	256	1,792
17	Calculate the International Roughness Index for each road segment in accordance with ASTM E1926. Provide results compatible with the Participant's GIS database, if applicable	Test Mile		3	256	768
18	With input from Participant's staff, devise a weighing system taking into account PCI, IRI, average daily traffic for thoroughfares (traffic count raw data provided by Participant), and public safety emergency routes; and apply this 0-100 numeric index to the roadway information collected for the entire jurisdiction. Cost includes base cost plus lane mile unit cost.	Test Mile	3,500	5	256	4,780
19	Estimate the annual budget required to meet the long-term goals regarding desired pavement condition levels. Cost includes base cost plus lane mile unit cost.	Each Participant	5,000	5	256	6,280
20	Create a five year and ten-year pavement rehabilitation plan with input from Participant's staff. Cost includes base cost plus lane mile unit cost.	Each Participant	5,000	5	256	6,280
21	Recommend the computer hardware and software needed for successful implementation, potentially including recommendations for licenses of pavement management system software and other geodatabase software as needed	Each Participant	3,000			0
22	Train Participant staff and provide assistance to the Public Works and IT Department as needed for the use of data collected through the fully automated system (20 person maximum per class)	Day		2,000	3	6,000
					Grand Total ($)	**104,945**