Street Pavement Assessment for City of Burleson, Texas

Proposal Number: F227047
Date: February 17, 2023

Submitted to:

City of Burleson, Texas
725 SE John Jones Drive
Burleson, TX 76028

Submitted by:

Fugro USA Land, Inc.
8613 Cross Park Drive
Austin, TX 78754

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Mr. Eric Oscarson, P.E.
Director of Public Works

City of Burleson, Texas
725 SE John Jones Drive
Burleson, TX 76028

Subject: Proposal for Street Pavement Assessment for City of Burleson, Texas

Dear Mr. Oscarson,

Fugro USA Land, Inc. (Fugro) is pleased to submit this proposal for the Street Pavement Assessment for the City of Burleson (City). Fugro has over 75 years of experience in pavement and asset data collection, implementing and updating pavement management systems (PMS), and geotechnical and pavement engineering. Fugro understands that maintaining valuable assets, such as roadway infrastructure, has never been more critical and complex due to budget constraints and the growing usage of the infrastructure system.

We offer a wealth of experience with new technologies and methods used by various agencies to monitor existing roadway conditions and prioritize maintenance and capital improvements. Nearly 50% of US DOTs and numerous federal and municipal agencies rely on our automated data collection technology for their roadway asset management needs and we have nearly a quarter of a million miles presently under contract for data collection and analysis services. In the past 25 years, we have collected and processed more than 3,000,000 miles of pavement data collection in North America.

As described in our proposal, Fugro will use our Automatic Road Analyzer (ARAN) equipment for pavement distress and asset data collection at prevailing traffic speeds with no interruption to traffic flow. Fugro's ARAN is designed with high precision measurement systems and relevant safety systems to exceed the expectations of roadway condition data collection. Fugro will collect geo-referenced data with our inertial aided Global Positioning System (GPS). In addition, Right-of-Way (ROW) digital images will be collected using high resolution cameras. These images can be used in the future to develop asset inventories such as pavement markings (linear and point), sidewalks, curbs, traffic signs, and traffic signals.

Fugro will use our Vision software for data processing. The Vision software 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 thus allowing a high-quality data collection and processing.

For this project, Fugro will collect the pavement condition data following ASTM D6433, Standard Practice for Roads and Parking Lots Pavement Condition Index Survey. The data will be formatted for upload into the City's desired Pavement Management System (PMS) software. Fugro is experienced with a variety of pavement management software packages such as Cartegraph, StreetSaver, AgileAssets, Deighton dTIMS, and PAVER. We are a partner with Cartegraph and AgileAssets.

We welcome the opportunity to apply our experience and knowledge to this important project for the City. Please do not hesitate to contact me at 512-977-1851 or by e-mail at salavi@fugro.com if you have questions or need additional information.

Best regards,

Fugro USA Land, Inc.

Sirous Alavi, Ph.D., P.E., PTOE
Director, Pavement Engineering & Infrastructure Management Americas

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1.0 Introduction

Fugro USA Land, Inc. (Fugro) is pleased to submit our proposal to the City of Burleson, Texas (City) for Street Pavement Assessment. The City maintains approximately 241 centerline miles of roads, which equates to approximately 605 lane miles. The roads are approximately 53% concrete and 47% asphalt.

Based on discussions with the City, they are seeking a consultant that can provide pavement inspection solutions for (1) collecting pavement condition data and (2) visualizing each pavement section in a web-based GIS application backed by a geospatial database. This street pavement assessment would then serve as a database used by the City to develop its pavement management strategy and maintenance program. Other items that the City discussed are the development of indices such as the Pavement Condition Index (PCI), Overall Condition Index (OCI), and International Roughness Index (IRI).

Fugro has worked with many agencies in the Dallas-Fort Worth Metroplex and would welcome the opportunity to serve the City for this important project. Fugro has performed hundreds of pavement related projects over the last 75 years—providing innovative solutions. The remainder of this proposal will provide a brief firm profile, our proposed scope of services to successfully complete this project, our means and methods to carry out the work, our team members' qualifications, and relevant references.

2.0 Brief Firm Profile

- **75 years of experience**
- **19 offices across the USA**
- **Over 9,500 employees globally**
- **Federal ID No. 74-2426512**
- **Texas VID No. 1-74-2426512-6**
- **Texas Charter Business Cert. No. 800750681**

Founded in 1947, Fugro offers decades of knowledge and experience to support the diverse needs of our clients. We provide the engineering expertise, state-of-the-art technology, and the necessary resources to ensure each project is delivered on time, within budget, and beyond the quality standards expected by our clients. We understand that the pavement network is an agency's largest and most valuable asset. We work closely with our agency partners to develop strategies to preserve and enhance their roadway networks by optimizing the use of their available resources and funds. Fugro has evolved to become the world's leading Geo-data specialist, collecting, and analyzing comprehensive information about the Earth and the structures built upon it. Figure 1 shows the diversity within Fugro. Besides our Roads' professionals, we can bring in other experts as needed on any project.

Fugro has a proven track record of delivering innovative technical solutions and has consistently been an industry leader in pavement data collection and asset management solutions. We designed and manufactured the ARAN, the world's first automated pavement condition survey vehicle. We are continuously improving our equipment and processes ensuring that we will be the leader in quality pavement data collection and asset management services.

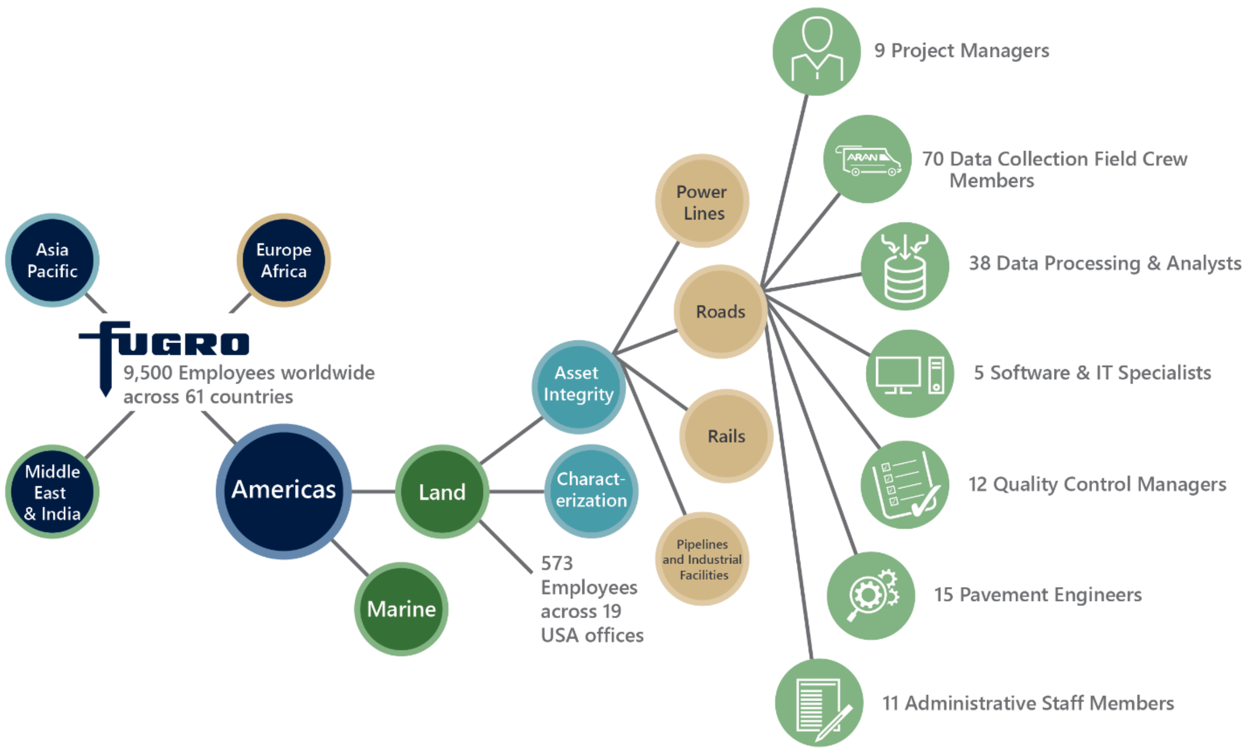

Figure 1: Fugro's Diverse Team Overview

Working around the globe, we employ approximately 9,500 employees in 61 countries. Fugro's North American position is well established with offices spanning the continent including seven offices in Texas.

3.0 Proposed Scope of Services

This section describes our proposed scope of services including those necessary to complete the project.

3.1 Task 1 – Project Initiation

For the project initiation, Fugro recommends a kick-off meeting. Upon receipt of the notice to proceed (NTP), Fugro will work with the City's Project Manager to schedule a project kick-off meeting that will include both key members of Fugro's Project Team and City staff. During the meeting, the draft scope of services or work plan, project schedule, budget, project documents, project goals, and format of deliverables, will be reviewed in detail to ensure that all adhere to the City's specific requirements. Roles and responsibilities will also be covered.

During the kick-off meeting, Fugro will request and/or confirm:

1) Review of project schedule including data collection, processing, and all data delivery milestones and their prioritization.
2) Shapefile of the City's current GIS roadway network.
3) Access to the City's PMS software (e.g., Cartegraph OMS Test or Sandbox environment)
4) Historical M&R activities.

3.2 Task 2 – Review Existing GIS Mapping / Cartegraph OMS

Once Fugro has received the shapefile of the City's GIS roadway network, Fugro will review the shapefile for accuracy and verify the sections that will be collected with the City. All data streams collected with Fugro's ARAN are geotagged and synchronized within 2 milli seconds (msec). This precise synchronization allows Fugro's data to be linked to any GIS system. If needed and with the City's approval, Fugro will modify the database as necessary to sectionalize the roadway network into adequate management sections. For example, arterial streets with 6 lanes or greater (3 lanes in each direction) will be sectionalized to differentiate the direction of travel. This assumption will be discussed and confirmed with City prior to testing.

3.3 Task 3 – Network Referencing

Fugro will develop survey routing maps and ensure the linkage of the road sections to the City's Cartegraph OMS database and GIS. Fugro will also review the sectioning to verify that the pavement management sections align with the City's sectioning practices. We will perform both completeness and logic checks to ensure that all necessary data attributes are available. Prior identification of discrepancies reduces difficulties in identifying roadways during the data collection effort and reduces the amount of time required to process collected data.

3.4 Task 4 – Pavement Condition Data Collection

Fugro will conduct the automated pavement condition surveys on the City's roadway network using our ARAN vehicle(s). Fugro's ARAN collects distress/asset data at prevailing traffic speeds, with no interruption to traffic flow, state-of-the-art safety features, and great accuracy in reported pavement distress data. Unlike manual and windshield surveys data collection, no sampling methods will be used for pavement rating and 100% of ARAN traveled lane will be distress surveyed and reported. Hence, the resulting PCI value will be due to the pavement distresses for the entire traveled lane and not based on some random samples (as is the case with manual surveys). For this project, Fugro will collect data during daylight hours with no adverse weather conditions. The City has approximately 17 centerline miles of arterial roads, 34 centerline miles of collector roads, 173 centerline miles of local roads. Fugro will be collecting 1 lane per direction for arterial and collector roads, and 1 lane for local roads. This will result in approximately 275 test miles of data collection.

3.4.1 Fugro's Automatic Road Analyzer (ARAN)

Developed in 1977, our ARAN was the first automated data collection vehicle available in the market and continued to evolve with the latest technology and equipment. Figure 2 shows our current sixth generation ARAN. The ARAN includes cutting-edge gyroscopes, sensors, cameras, computers, software, and related equipment, all designed to withstand the rigors of collecting seven days a week, 365 days a year in all landscapes and climates. Fugro's experience and industry knowledge have allowed us to be innovative and responsive to the changing economic conditions facing transportation agencies, balancing reduced budgets, and staffing with the demands for maintaining a safe, reliable, and efficient transportation network.

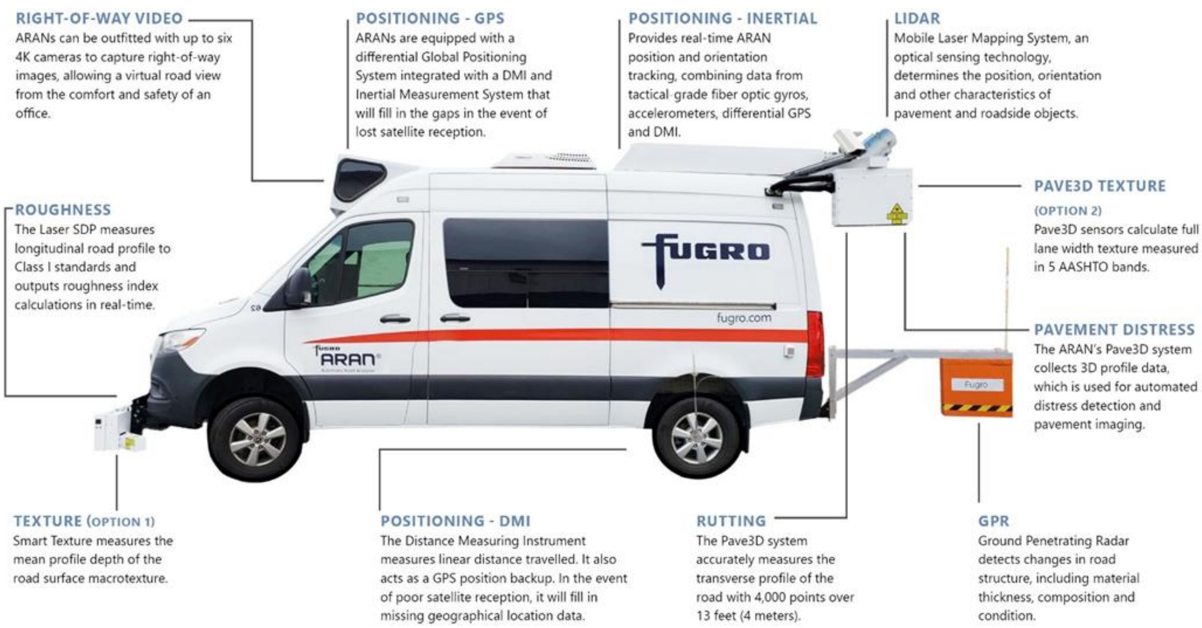

Figure 2: The Automatic Road Analyzer (ARAN)

Currently, we are working with over half the North American DOTs and many municipalities providing a full range of innovative custom roadway management solutions including data collection, PMS services, and M&R work plan development. Client satisfaction and trust are top priorities for us. We have developed many long-standing clients with this sound approach. We are working with over twenty (20) States/Provinces in North America

The following describes some of the specific ARAN subsystems that are pertinent to the project.

Locational Referencing and Positioning

The ARAN is equipped with a Distance Measuring Instrument (DMI) mounted on the driver's-side rear wheel as shown in Figure 3. The DMI is used to provide distance based triggers to the ARAN subsystems and translate wheel revolutions into measurements of velocity and linear distance traveled. The DMI meets the Class 1 requirements per ASTM E950, Standard Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference.

Figure 3: Distance Measuring Instrument (DMI)

The ARAN also incorporates a Differential Global Positioning System (DGPS) using Applanix's POS LV 220. The POS LV is Global Navigation Satellite System (GNSS)-aided inertial technology that mitigates the real-world effects of GPS outage.

The POS LV 220 tracks and reports the position (latitude, longitude, and elevation) and orientation (heading) of the ARAN in real-time using complementary locating technologies. The GPS corrects any drift evident in the inertial sensor over time, while the inertial sensor ensures that accurate positioning will be continuously available, even during periods of GPS outage due to tree canopy, mountainous terrain, tunnels, or urban canyons. Figure 4 is an image of the Applanix POS LV system.

Figure 4: Applanix POS LV

Downward Pavement Image Collection

Fugro's Pave3D uses downward-facing high-speed cameras, custom optics, and laser line projectors to output range and intensity data, which derive a 3D image of the pavement surface as seen in Figure 5. These capabilities improve performance of post-processing techniques resulting in superior accuracy for identifying pavement crack severity. These images facilitate automated and manual crack identification methods.

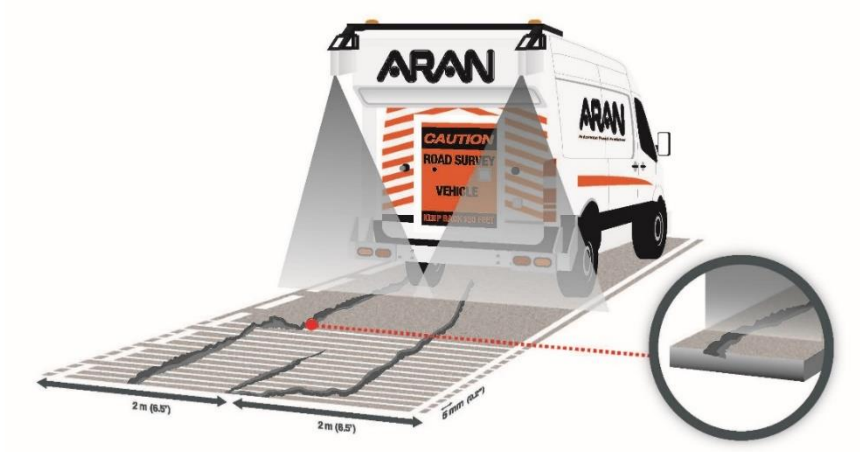

Figure 5: Downward Scanning Capabilities

Figure 6 depicts the range, intensity, and 3D views captured by Fugro's Pave3D system. The range image represents depth in grayscale; lower elevations due to defects like cracks, potholes, corner breaks, etc., appear dark. A range image means only actual pavement distress is detected and no other artifacts on the road like oil, skid marks, or dampness in hairline cracks. The intensity image is a more "traditional" camera image showing the surface as the human eye would see it. An intensity image is essential for the visual verification of non-crack-related distresses like raveling. The 3D view combines the Range and Intensity images to provide an enhanced image of the roadway that is ideal for visual rating and quality control of the cracking detected by the automated distress tool. Using both range and intensity information matched pixel for pixel, we can better determine the exact locations of cracks based on width, depth, texture, color, and other surrounding features.

Some of the advantages of using the Pave3D system over conventional pavement images include:

- Uninterrupted operation in all lighting conditions during the day and at night without the need for artificial pavement illumination.
    - Sun and shadows and various pavement types ranging from dark asphalt to light-colored concrete can be measured at highway survey speeds and on roads reaching 14 feet in width and still achieve the 0.19 inches longitudinal resolution.

- Continuous collection of pavement images along the roadway's length with no interruptions.
    - This feature allows the user to select their desired reproduction interval length of generated pavement images, which align with predetermined right-of-way image intervals. The high-definition images are processed for various condition and distress ratings within Fugro’s Vision software.

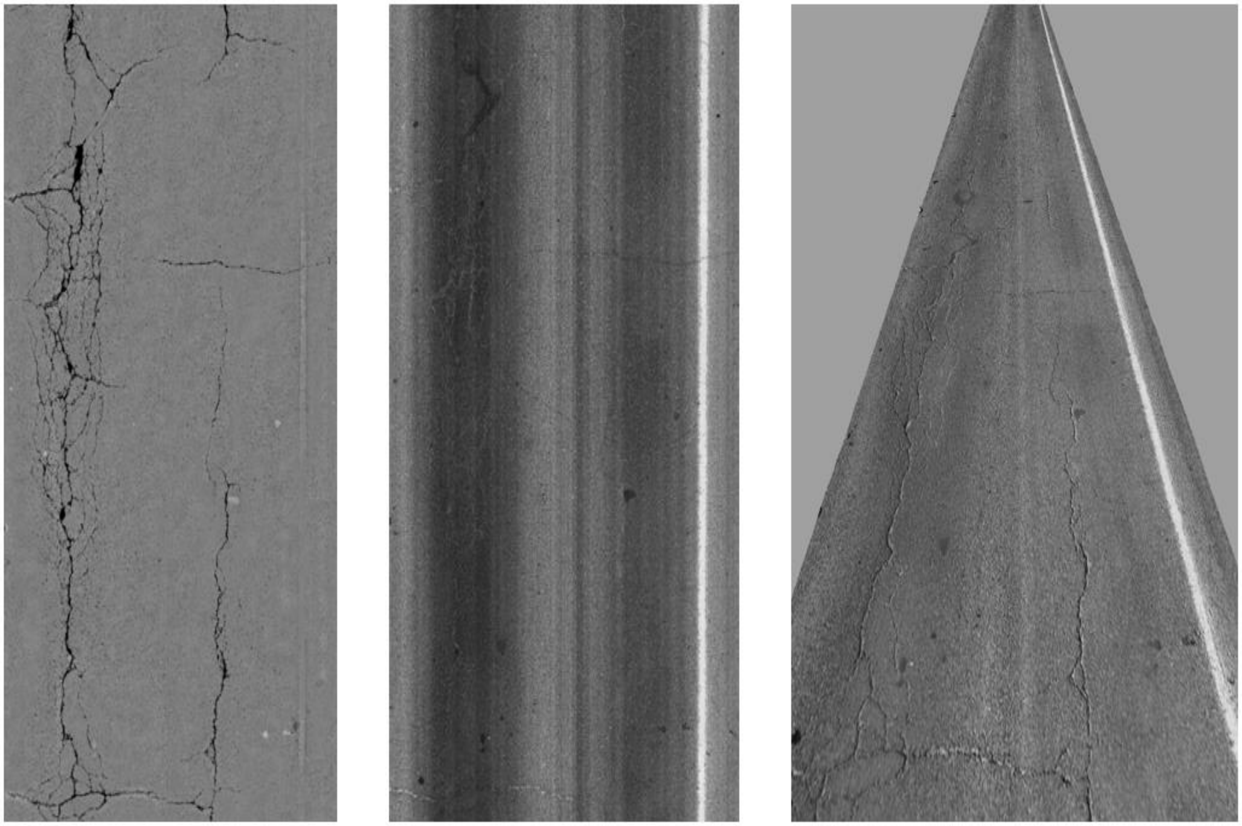

Figure 6: Range View (left), Intensity View (middle), and 3D View (right)

Laser SDP (South Dakota Profiler)

Fugro's Laser SDP (South Dakota Profiler) system shown in Figure 7 is a non-contact Class 1 inertial profiler (per ASTM E950) that uses lasers and accelerometers mounted at the front of the vehicle over each wheel path. The system measures the longitudinal profile for 100% of all lane miles to calculate International Roughness Index (IRI) and Ride Condition Index (RCI) for maximum accuracy. The equipment conforms with AASHTO R 57 "Standard Practice for Operating Inertial Profiling System" and the 2018 Caltrans Standard Specifications.

The ARAN saves raw longitudinal profile data for every one (1) inch of pavement in both wheel paths along with the standard deviations of each. The result is computed IRI values (in inches/mile) for each tenth (0.10) mile segment (528 feet) for both the left and right wheel paths. Highlights of Fugro's Laser SDP system for IRI data collection include:

- Equipped with GoCator dispersion lasers providing a full 100mm (4-inch) line of data across the road surface (like that of a tire footprint). This offers improved consistency, repeatability, and accuracy in the collection of the longitudinal profile.
- Ability to collect at variable testing speeds while maintaining a bias of less than 5%.
- Allowance for testing at low speed and "Stop and Go" conditions.
- High accuracy; measurements within ± 5% of all popular manual profiling techniques.

- High repeatability with standard deviation for repeat runs within ± 5% of the mean. GoCator sensors' use further improves on this consistency, regardless of the testing surface type or condition.
- Real-Time IRI reporting for immediate operator identification of system issues.
- Two standard conformance tests, one static, and the other dynamic, ensure that both the laser and accelerometer components of the system are operating as intended
- Multiple parameters reported, including mean and max IRI and standard deviation by segment.

Figure 7: ARAN Laser SDP

Fugro has developed reliable, speed-sensitive algorithms to improve the accuracy of the longitudinal profile calculated in low speed zones. These algorithms reduce the impact of the unwanted frequencies in the accelerometer signal that affect profile and IRI calculations. Since the low-speed algorithms are non-casual, meaning that they incorporate future data into the calculation, the low speed roughness feature recalculates the longitudinal profile and IRI during the processing stage for maximum accuracy and repeatability.

Right-of-Way (ROW) Images

With our long history of working with States, Counties, and municipalities, we understand the value that transportation agencies receive from high quality digital images that offer a clear, focused view of the roadway and surrounding area. We have taken great care to source, calibrate, and maintain the best cameras in the industry. The image collection for this project will include both continuous ROW and downward facing pavement imaging. Collection will be performed on dry pavement and when weather and light do not inhibit visibility of pavement and ROW.

ROW cameras will capture the lane of travel and ROW. These images shall be captured at a minimum interval (e.g., 25 feet), at typical City speeds, and will provide 100% and continuous coverage of the ROW in full-frame with a high pixel resolution. The ARAN will collect ROW images utilizing Sony FX9 HD cameras that offer a resolution up to 3840 x 2160 pixels at 16:9 aspect ratio. Figure 8 provides an example of Fugro's superior ROW image quality collected for one of our current clients. Each image is tied to a GPS location as well as a linear reference, which allows all images to be tied back to each other. All images can then be used to extract visible assets now or in the future.

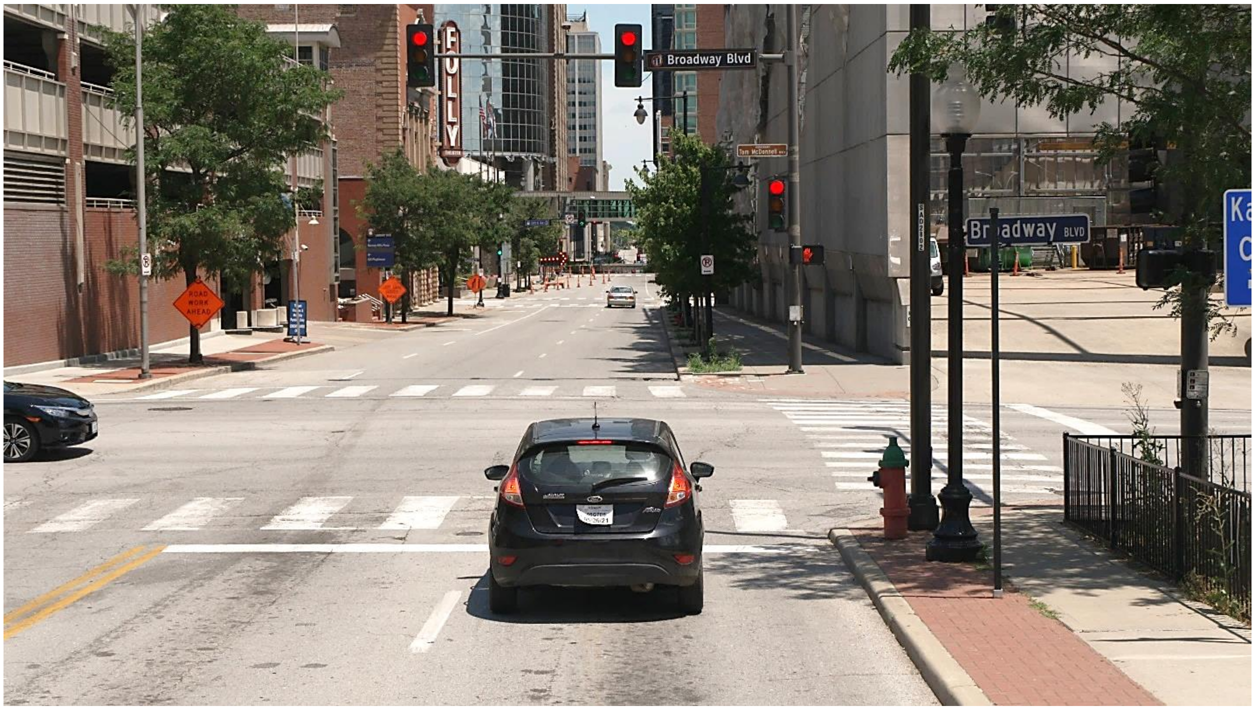

Figure 8: Example of Fugro's Superior ROW Image Quality

3.5 Task 5 – Data Processing and Analysis

Fugro is a pioneer in developing data processing and visualizing software products. Fugro's Vision and iVision software are customized to be used in combination with ARAN for efficient data processing and asset extraction processes. Fugro's engineers have developed sophisticated and proven algorithms to greatly improve the detection, classification, rating, and reporting of data. For this task, we have described the distress standards to be used, the processing software, and our QA/QC protocols.

3.5.1 Distress Standards & Pavement Condition Index (PCI)

The images provide a visual representation of various cracking types, surface defects, patches, and other distresses along the roadway. Fugro will identify the distresses as defined in American Society for Testing and Materials (ASTM) D6433-20, Standard Practice for Roads and Parking Lots Pavement Condition Index Survey. The ASTM D6433 standard is used by many municipalities worldwide to calculate Pavement Condition Index (PCI) for their roadway networks. PCI uses a scale from 0 to 100, where 0 represents a completely failed pavement and 100 represents a pavement in perfect condition. PCI is calculated based on the type, severity, and extent of surface distresses. Each distress type includes a severity level (i.e., low, medium, and high) and has a different impact or "deduct" value for pavement condition depending on its quantity (i.e., extent). Since each distress type has a different impact on pavement performance, deduct values are specific to individual distresses in accordance with the ASTM D6433 standard. High severity distresses and/or high distress quantities result in more reductions in PCI scores. In general, deduct values for fatigue cracking are higher than deduct values of other types of cracking.

Presence of load related fatigue cracking results in lower PCI scores, when compared with similar severities and extents for cracking associated with environmental conditions such as transverse cracking. Table 1 and Table 2 present the asphalt and concrete pavement distresses and their classifications.

Table 1: Asphalt Concrete Pavement Distresses and Classification

ID #	Load Related	ID#	Climate/Durability Related	ID#	Other Related
1	Alligator Cracking	3	Block Cracking	2	Bleeding
7	Edge Cracking	8	Joint Reflection Cracking	4	Bumps & Sags
13	Pothole	10	Longitudinal/Transverse Cracking	5	Corrugation
15	Rutting	19	Raveling	6	Depression
		20	Weathering	9	Lane/Shoulder Drop Off
				11	Patch/Utility Cut
				12	Polished Aggregate
				14	Railroad Crossing
				16	Shoving
				17	Slippage Cracking
				18	Swell

Table 2: Concrete Pavement Distresses and Classifications

ID #	Load Related	ID#	Climate/Durability Related	ID#	Other Related
22	Corner Break	21	Blow Up	25	Faulting
23	Divided Slab	24	Durability Cracking	27	Lane/Shoulder Drop Off
28	Linear Cracking	26	Joint Seal Damage	29	Large Patch/Utility Cut
34	Punchout	37	Shrinkage Cracking	30	Small Patch
		38	Corner Spalling	31	Polished Aggregate
		39	Joint Spalling	32	Popouts
				33	Pumping
				35	Railroad Crossing
				36	Scaling

For this project, Fugro is assuming we will use Cartegraph OMS to calculate the PCI for the pavement sections.

3.5.2 Data Processing Software - Vision

Vision software is considered an integral part of data processing and QC methodology in Fugro's pavement condition assessment approach. Vision was developed by Fugro to ensure a simple and accurate process for analyzing ARAN data. The software facilitates the entire data processing workflow including key modules for data upload, georeferencing and segmentation, video and sensor data quality analysis, and pavement distress analysis. It synchronizes all of the data (imagery along with sensor and map data) allowing the analyst to virtually drive on the road to assess quality, investigate anomalies, and confirm locations and conditions.

Automated & semi-automated algorithms are incorporated in Vision for pavement distress detection, classification, and rating. Digital pavement images collected by the ARAN serve as input to the distress rating process. ROW images are also used to enhance the distress-rating accuracy. Each distress can be identified in terms of location, severity, exact dimensions, and other characteristics. The software also allows for customized distress rating protocol. Moreover, Vision's Report Generator module facilitates the creation of custom reports and data deliveries using post-processed collection of all pavement performance parameters. This module allows Fugro staff to modify and apply reporting templates to ensure that data conforms to client requirements. Figure 9 provides a screenshot of Fugro's Vision software.

Crack Detection - WiseCrax

Accurate and consistent crack measuring starts with a good foundation. In this case, the good foundation is our ARANs equipped with LCMS, supplying a superior laser-based image for the identification of true cracking. This allows for easy determination of cracking versus other elements such as texture in the pavement. Fugro builds upon its superior hardware used to collect the raw data with our world leading Vision software. WiseCrax offers a customizable surface distress setup for classification and severity rating, continuous full-lane or zone rating, zone detection, and crack maps for quality control of the distress rating. Our distress technicians use this module to easily quantify each pavement crack by the software's automatic determination of a crack's beginning, end, width, depth, and orientation. Measuring cracks is conducted using a three phase process. The following provides an overview of each phase as shown in Figure 10:

- 3D Laser Image – The Foundation for Proper Crack Measurement: The 3D laser image provides the ability to easily distinguish cracking from anomalies on the road surface by using depth.
- Detection: Extraction of crack maps on 3D pavement imagery. Depth is used in the detection of cracks on the 3D image.
- Classification: Analysis of the crack map. For some projects, Fugro would place detected cracks into various categories such as longitudinal, transverse, or alligator. Fugro could also detect crack lengths and widths and place them in five zones per ASTM E3303.
- Rating: Fugro would report the various metrics based on ASTM Standard D6433-20 and data dictionary requirements such as length of cracking, width of cracking, and crack density.

The WiseCrax editor allows our technicians to easily input specific distress severity and extent criteria such as:

- Number of cracks and their respective severity per cracking type (e.g., Alligator, Block, Edge, Longitudinal, Transverse, etc.).
- Location and orientation of the cracking across the lane width.
- The total length of a given crack and its orientation.
- Total crack lengths per distress type and severity summarized on a pavement image and segment/network basis.

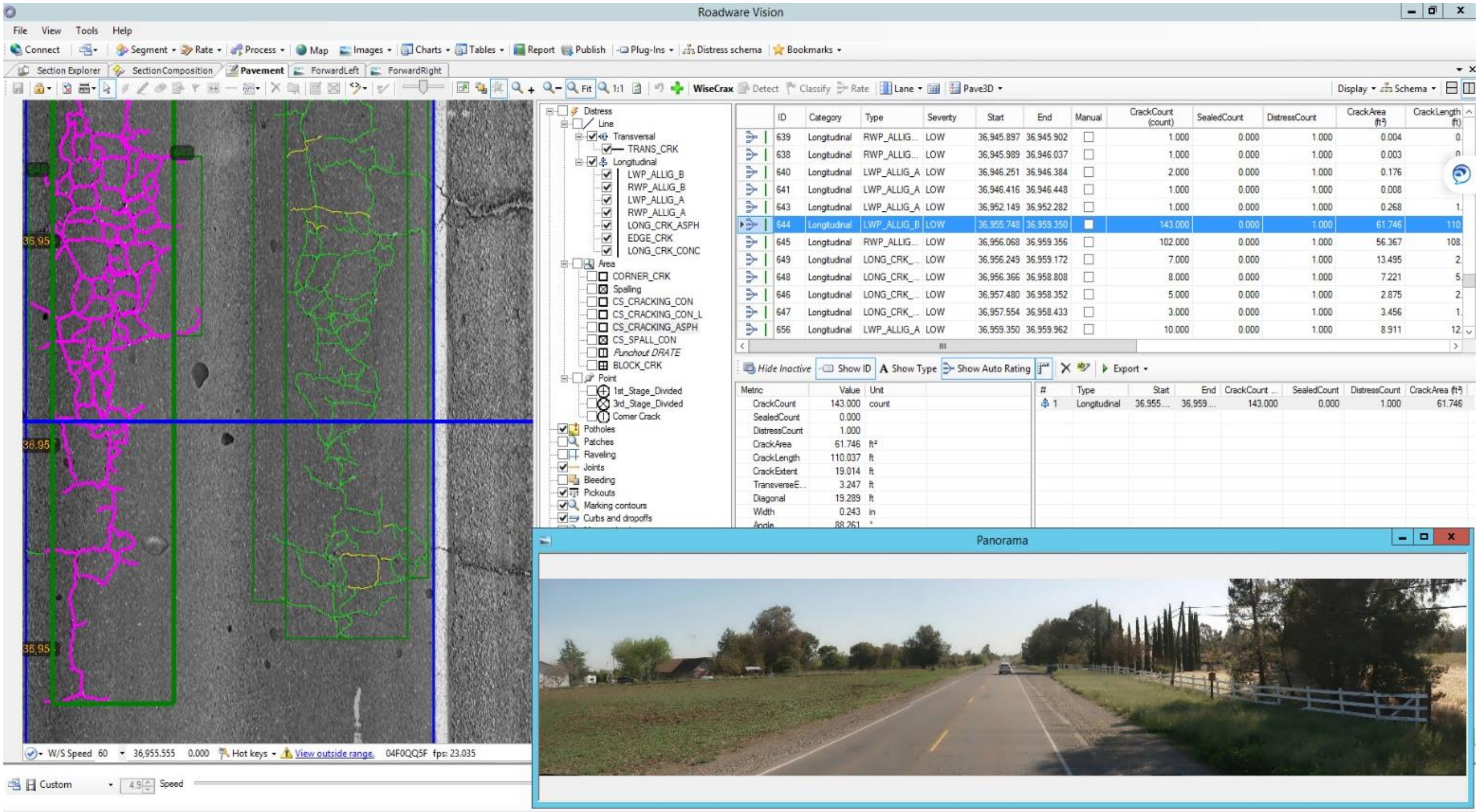

Figure 9: Fugro's Vision Processing Software

- Visual representation of pavement crack location on a given pavement image; color-coded according to its allocated severity state. (Cracks can be manually overwritten or deleted by the distress technicians.)
- Automated determination of pavement line markings, which can be used to restrict and classify pavement cracking.
- Automated statistic reports displaying summary graphs and tables of the entire collection (network) or defined section.

The distress information in WiseCrax is visually overlaid on the pavement imagery to facilitate the manual validation of the automated distress rating and to add in any distresses that require manual intervention.

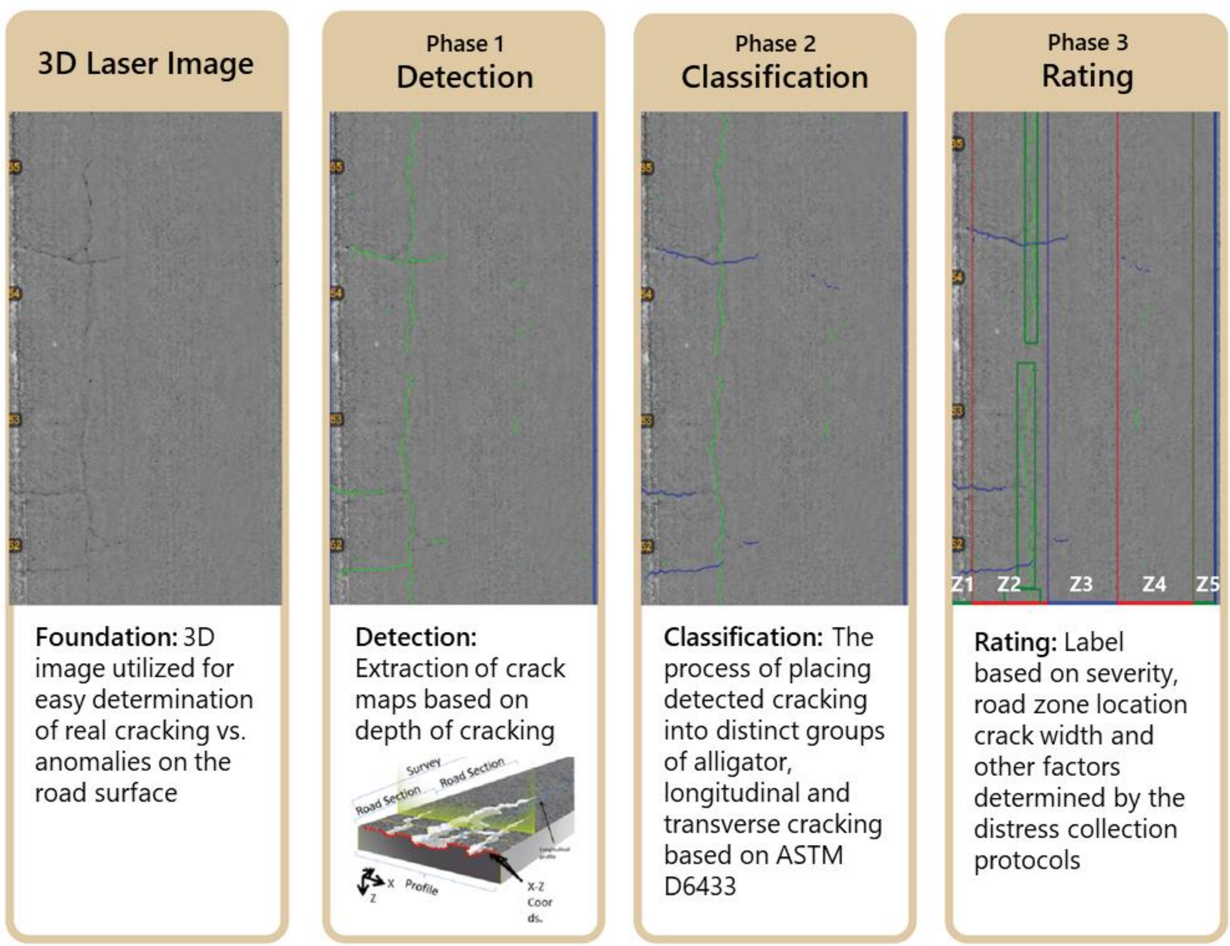

Figure 10: Fugro's Three Phase Approach for Measuring Cracks & Reporting

3.5.3 Data Viewing Software - iVision

Fugro's iVision5 viewing software provides the agency with a powerful tool to review collected images and asset data in a synchronized, GIS-based environment. iVision5 is hosted by Fugro and available on any device with access to the internet, this meets a remotely positioned workforce's needs. Fugro will upload all raw images and data to our Vision processing software, data will be processed by our team, and post processed data will be synchronized with iVision5.

iVision5 contains a user-friendly interface that seamlessly integrates the collected data and imagery, GPS, distress and asset calculation tools, and mapping layers. The software's dashboard is fully customizable to meet the unique needs of each DOT's requirements. iVision5 offers open data schemas that enable customized data querying, extraction, and linking with other systems to provide maximum flexibility and data-synchronization capabilities. These advanced data sharing and integration mechanisms allow the application to be launched and linked to multiple different asset management applications.

Figure 11 provides an example of one display option for iVision5's rich dashboard layout. This dashboard is customizable to the user's preferences and needs. All displayed data is playing in a synchronized view as the user navigates along the roadway on the GIS-based map. The agency will be then provided with multiple licenses to use the software for one year at no additional cost. After one year, licenses can be renewed annually for an additional cost.

Figure 11: iVision5 Dashboard Example

3.5.4 Data Quality Management Plan (DQMP)

Fugro understands that the quality of collected pavement distress data is the key to the successful implementation and maintenance of any asset management system. Fugro will develop a formal Data Quality Management Plan (DQMP). Figure 12 shows an example quality checks from start up to data delivery. The DQMP will use reasonable quality control and manage the data collection and delivery process to effectively provide data that meets or exceeds the City's expectations. Fugro understands that data quality is imperative for all transportation agencies. Fugro's

International Standards Organization (ISO) 9001:2008 Quality Management System (QMS) includes Standard Operating Procedures (SOPs) with proven calibration and quality control processes and principles. Fugro has developed SOPs for controlling quality both in the field and office. These SOPs ensure each task is performed with consistency and discipline resulting in high quality work. The following are some of Fugro's Standard Operating Procedures and Plans:

- Location-Referencing Standard Operating Procedure
- Adverse Weather Standard Operating Procedure
- Initial Data Screening Standard Operating Procedure
- International Roughness Index Standard Operating Procedure
- Rut Depth Standard Operating Procedure
- Pavement Imagery Standard Operating Procedure
- Distress Data Reduction Standard Operating Procedure
- Roadway Photo Imagery Standard Operating Procedure
- Roadway Characteristics and Asset Data Standard Operating Procedure.
- Roadway Pavement Structural Composition/ Thickness Data Standard Operating Procedure

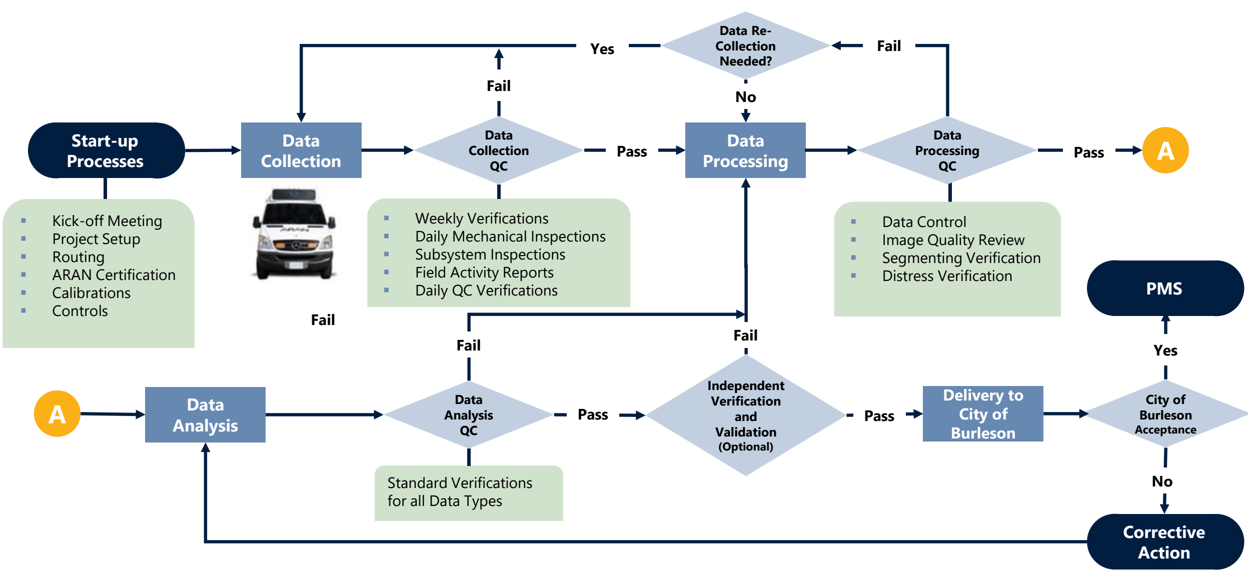

Figure 12: Example of Quality Checks for the City

3.6 Task 6 – Data Formatting and Loading

As per discussions with the City, the data needs to be formatted for loading into their PMS software, Cartegraph OMS. Fugro is currently a Data Partner with Cartegraph. We have been utilizing Cartegraph with our clients for many years. The following is a brief discussion on how we load new pavement data into Cartegraph OMS.

3.6.1 Create Import Files

Fugro will transform our distress delivery file into import files for the Cartegraph OMS upload. The import files include an inventory file (e.g., section, sample, IRI) and inspection files for asphalt distresses and concrete distresses. The inventory file will need to have task and inspection levels. Some important items to note before importation. A pavement record should exist for the data that is being loaded. Values such as pavement type in Cartegraph should be reviewed and should match with the inventory file. Before importing the inspection, a task must be defined.

For the inspection files with distresses, the extent of the distress needs to be determined. For asphalt distresses, it is the quantity of the distress divided by the area. For concrete distresses, it will be the number of slabs.

3.6.2 Importing Data into City's PMS

The following tasks are the typical approach to loading the pavement inspection data directly into Cartegraph OMS:

- **Step 1: Import Tasks (Open Status) –** Fugro will create import tasks by creating a format file. We will check "Include Field Names" in properties and confirm the fields status as "Planned" or "In Progress."
- **Step 2: Open Inspection –** Fugro will create the inspections, where the samples will be imported.
- **Step 3: Import Samples –** Fugro will create the samples, where the distress will be imported.
- **Step 4: Import Distresses –** Fugro will import the distresses into the samples. The distresses will be in terms of extent.
- **Step 5: No Distress Import –** Fugro will create samples where no distresses were recorded. We have to mark sections without distress otherwise there may be errors after importation.
- **Step 6: Close Inspection –** Fugro will then close the inspections by creating a close the inspection item for all inspections.
- **Step 7: Close Task –** Fugro will create a close task for the import process. In properties, we would check "Include Field Names" and save records without errors. The fields status should be changed to "Completed."

Please note that we will need access to the City's Cartegraph OMS system. Typically, an agency will have a test environment, where we would enter the new data. The City would be able to review and approve before it is entered directly into the production environment. Fugro will coordinate all activities with the City and Cartegraph.

3.6.3 Deliverables

After our data processing and analysis, Fugro will provide the following deliverables:

- **Geodatabase Delivery –** Fugro will deliver ESRI compatible geodatabase with distress data, PCI, IRI, and other attribute data. The geodatabase will be compatible to City's GIS system including street, from and to, functional class, pavement type, length, width, and area. Fugro is highly experienced in providing similar information to its clients as part of its pavement and asset data collection projects.
- **Data Delivery Files –** Fugro will provide electronic files (e.g., Excel or CSV) with segment information.
- **PMS Electronic Files –** Fugro will deliver the Cartegraph import files that will be uploaded into Cartegraph OMS.
- **Updated Cartegraph OMS Database –** Fugro will update the City's Cartegraph OMS database with the inspected data. The City will review and provide approval before data is entered into the production environment.
- **Image Delivery –** Fugro will deliver all the collected images (ROW) to the City on a hard drive. These will be linked to the geodatabase delivery.
- **iVision5 access -** Images will be available on Fugro's iVision5 dashboard.

3.7 Task 7 – Asset Extraction

Agencies are increasingly seeking to inventory and assess the condition of in-road and roadside assets. We offer asset inventories using the ARAN digital images as well as mobile LiDAR. The advantage of digital image or LiDAR based asset extractions is the safety of employees versus traditional manual field-based inventories. Digital images and mobile LiDAR used for asset inventory and other analytics are dependent upon "line-of-sight" measurements, which means obstructions such as buses, parked vehicles, garbage canisters, and vegetation can impact the "line-of-sight" measurements and image collection. Fugro 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'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. Assets can be provided to clients via geodatabases for incorporation into the client's GIS system. Figure 13 shows a screen capture of Surveyor's Asset Attribute Editor. Fugro staff use a triangulation method with two successive images to determine an asset's location. Field assessment crews will only be deployed if additional condition assessment is required (e.g., ADA ramps), saving both time and money.

The items the City has discussed have been made **bold** (street sign, traffic signal, pavement markings) in the list. For example, all existing traffic control signs including location, relative location, post type, MUTCD/local sign code, and picture could be extracted. An asset data dictionary would be developed with the City to ensure assets are extracted per the City's requested definitions.

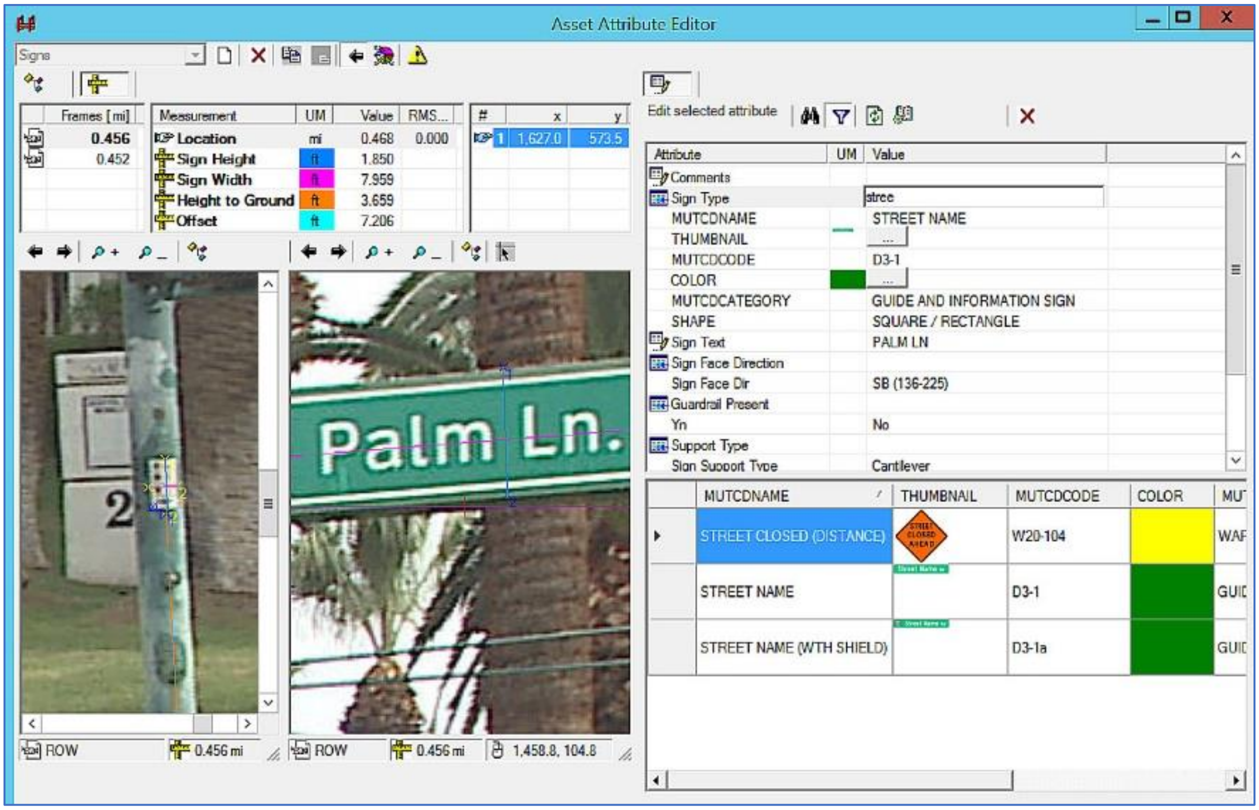

Figure 13: Screen Capture of Surveyor

The following is a list of point and linear assets that Fugro can extract using photogrammetry:

- Bicycle Lanes
- Bridges
- Brush & Tree Control
- Cable Barriers
- Cattle Guards
- Cemetery
- Church
- Concrete Barriers
- Curbs
- Driveways & Access Points
- Drop Inlets / Catch Basins
- Emergency Call Boxes
- Fences
- Fire Hydrants
- Fire Station
- Gates
- Guard Walls
- Guardrails
- Lighting
- Hospital
- HOV Lanes
- Intersections
- ITS Devices
- Lane Widths
- Linear Pavement Markings
- Low Water Crossings
- Manholes
- Median Openings
- Medians
- Meters
- Mile Markers
- **Traffic Signals**
- Number of Lanes
- On Route Parking
- Overpasses
- Paved Ditch
- **Pavement Markings**
- Plowable Markers
- Point Pavement Markings
- Police Station
- Post Office
- Railroad Crossings
- Raised Pavement Markings
- Red Light Cameras
- Retaining Walls
- **Roadway Signs**
- Rock Slide Protections
- Rumble Strips
- School Zones
- Schools
- Shoulder Widths
- Shoulders
- Sidewalk Ramps
- Sidewalks
- Sight Distance (Passing Lanes)
- Sign Supports
- Slopes
- Snow Fences
- Sound Barriers
- Speed Cameras
- Toll Plazas
- Traffic Count Stations
- Traffic Lights
- Trees
- Tunnels
- Turf Condition
- Turn Lanes
- Unpaved Ditches
- Utility Poles
- Water Valves

A GDB file will be provided to the City with the various assets and will be compatible with the City's GIS system. Figure 14 shows a screen capture of ArcGIS of an agency where we extracted traffic sign poles, traffic sign heads, point pavement markings like arrows or legends, linear pavement markings like striping, curbs, and curb ramps.

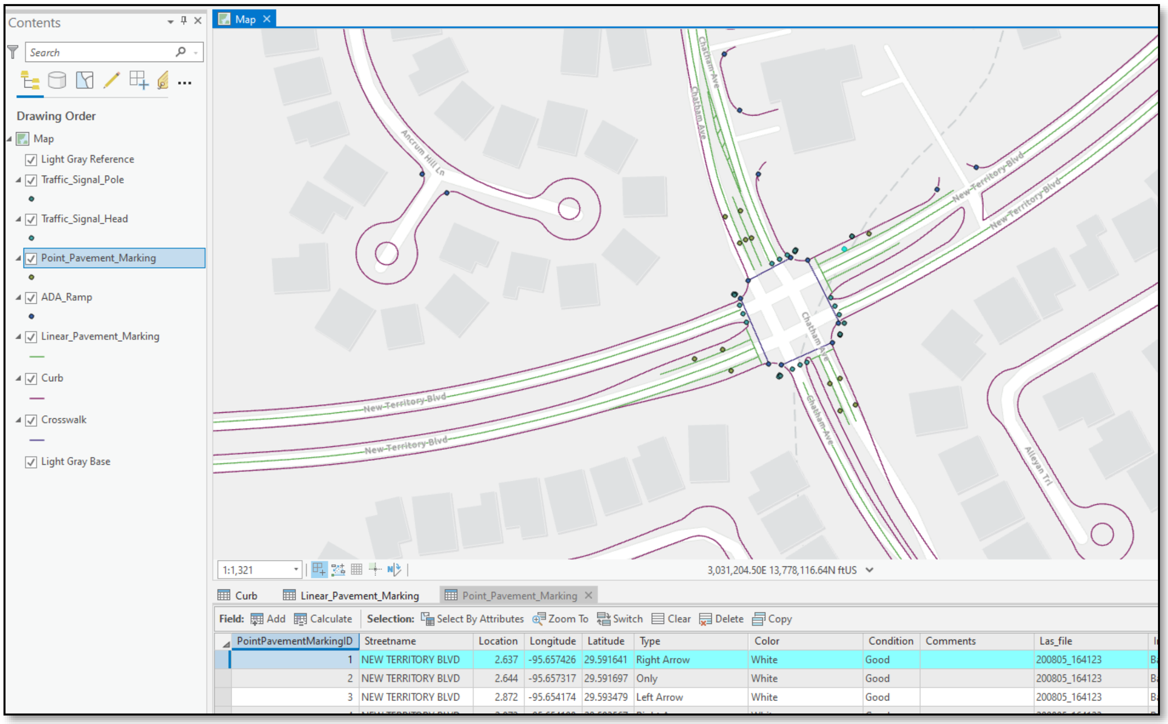

Figure 14: Screen Capture of ArcGIS with Extracted Assets

4.0 Means and Methods

Per discussions with the City, Fugro is providing information on the means and methods that we will employ to complete the project.

The equipment that will be used on the project will be the following:

- ARAN based out of Texas and used on many municipal projects. ARAN has been detailed in Section 3.4.1.

Regarding methodologies to be used, Fugro will adhere to the following standards:

- ASTM D6433, Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys, for identifying pavement distresses and calculating PCI for the pavement sections.
- ASTM E1926, Standard Practice for Computing IRI of Roads from Longitudinal Profile Measurements, for calculating IRI for the pavement sections.

- Vision Software for identifying and reporting distresses.

Please refer to Section 3.0 Proposed Scope of Services for detailed descriptions of equipment and methodologies.

5.0 Project Management Plan

Fugro believes successful projects are dependent upon clear and open communication with our clients, a strong professional team and project manager, and the utilization of a detailed project management plan. Our consistent record of delivering PMS projects exceeds the expectations of even our most complex clients' projects, both in terms of time and budget. Our proposed team has extensive experience in developing and following project management plans. We create a customized management plan to be presented during our client kick-off meeting that describes the data collection technology, collection and analysis procedures, and reporting capabilities. Figure 15 shows high-level items in our typical project management plan including the following:

- Start-up activities such as a kick-off meeting, review of GIS shapefile, review of the communication plan, review of a customized quality control plan, and review of pavement and asset data dictionary.
- Data collection and delivery schedules.
- List of data collection vehicles, equipment, personnel, and equipment calibrations and certifications.
- Access to our field and data analysis tracking systems to ensure that data is delivered on or ahead of schedule.

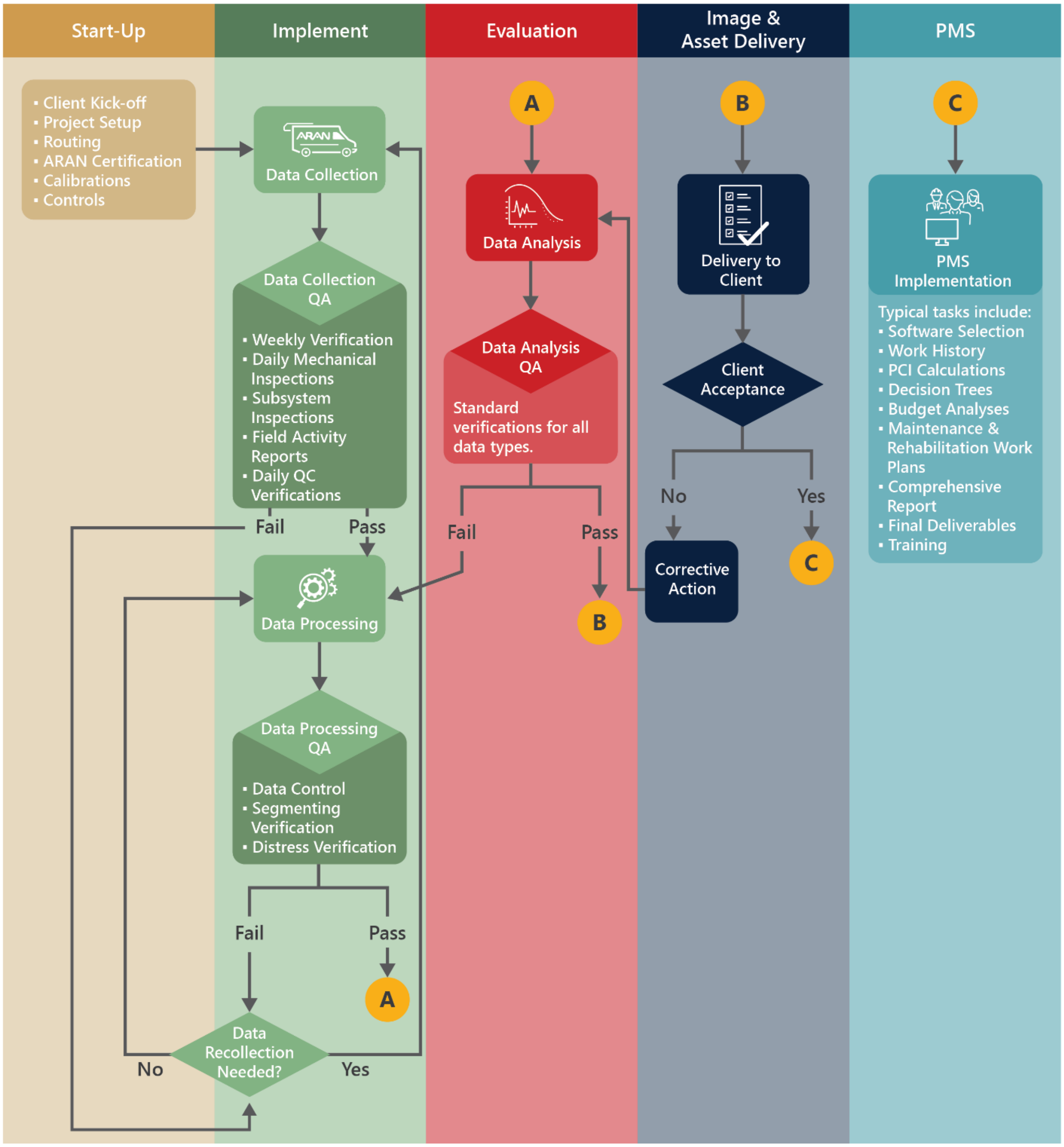

Figure 15: Project Management Plan

5.1 Project Team

In the following pages, a bio has been provided for key personnel including a brief overview of professional career, professional background highlighting relevant projects or services that have been completed and role(s) in each project or services, educational background, relevant professional activities and certifications, and years with the firm. Full resumes can be provided if requested.

5.1.1 Project Manager – Dr. Sirous Alavi, P.E., PTOE

Dr. Sirous Alavi, P.E., PTOE is the proposed Project Manager and is designated as a Pavement Engineer for this project. He is the Director of Pavement Engineering and Infrastructure Management for Fugro Americas. He is a graduate of the University of California at Berkeley with a Ph.D. in Civil Engineering, specializing in Pavement Engineering. He is a licensed professional engineer in several states including California. Dr. Alavi has over 29 years of experience in the U.S. pavement engineering community. Dr. Alavi served three full terms as a member on the National Academy of Science Transportation Research Board (TRB) Committee AFD60 on Flexible Pavement Design and Committee ABJ35 on Highway Traffic Monitoring. His experience includes serving as the Principal Investigator for a number of national and state agency pavement engineering & research projects including the FHWA Long Term Pavement Performance Program (LTPP), and FHWA Next Generation Pavement Performance Measures and -Asset Management Protocols. He was the project manager for the MTC P-TAP StreetSaver projects for Rounds 18-21. He has also served as the project manager for the State of Alaska PMS update and the Government of Manitoba PMS replacement projects. He has managed over 50 pavement and asset management projects and routinely oversees many of Fugro's projects including several projects related to Cartegraph PMS updates (e.g., Cities of Abilene, Missouri City).

5.1.2 Pavement Engineering

Senior Engineer – Mr. Michael P. Tavares, P.E.

Mr. Michael P. Tavares, P.E. is a Senior Engineer and was designated as a Pavement Engineer for this project. He has a Master of Science Degree in Civil Engineering from The University of Texas at El Paso with over 20 years of experience in pavement engineering. He is a licensed professional engineer in California, Nevada, and Guam. Mr. Tavares has been accredited at the FHWA Pavement Distress Accreditation Workshops, Orange County Transportation Authority (OCTA) Rater Certification Program, and the San Francisco Bay Area Metropolitan Transportation Commission (MTC) StreetSaver Pavement Distress Rater Certification Program. He is also certified by AgileAssets Partner's Program to carry out pavement analysis through Pavement Analyst Module of the software. He has extensive experience with PAVER, StreetSaver, Cartegraph, and AgileAssets PMS inventory, update, and PMP analysis and reporting working on a similar scope of services for over twenty cities in the US.

Pavement Engineer – Dr. Farhang Jalali

Dr. Farhang Jalali is a graduate of the National Center for Asphalt Technology (NCAT) at Auburn University with a Ph.D. in Civil Engineering, specializing in Pavement Technology. His research at NCAT involved establishing stochastic performance models for preventive treatments and quantifying the life-extending benefits. During his professional career, Dr. Jalali has worked developing and updating Pavement Management Programs (PMP's) for various agencies using StreetSaver and PAVER. His work involved developing pavement rehabilitation designs, linking street inventory to GIS shapefiles, creating PCI and PMP related maps using Esri ArcGIS, updating pavement distress data into PMS software, performing field data collection, performing quality control of inspections, and producing M&R work plans. Most recently, he has worked on the PMS replacement project for the Government of Manitoba, which includes developing a PMS using AgileAssets' Pavement Analyst. Dr. Jalali is also our resident GIS Expert with extensive experience with PMS database applications. He also is experienced with various coding languages (e.g., Python).

Project Engineer – Dr. Setare Saremi

Dr. Setare Saremi has a Ph.D. in Civil Engineering (Geotechnical and Pavement) from the University of Maryland. Dr. Saremi has extensive research in pavement engineering, development of prediction models, structural evaluation, and non-destructive testing methods. As a project engineer at Fugro, her expertise in examining concrete strength by a combination of destructive and non-destructive testing methods is a major contributor to our pavement engineering group. She is also knowledgeable in civil engineering materials testing and data analysis. Throughout her academic career, she was awarded several research fellowships from the University of Maryland. Her most recent experience includes working on Cartegraph PMS updates for the Cities of Abilene, McKinney, and Schertz.

Pavement Engineer – Ms. Mainey James, P.E.

Ms. Mainey James, P.E. has a Master of Science Degree in Civil Engineering from the University of Arkansas with over twelve years of experience in pavement engineering including pavement evaluation, design, management, and research. Her research experience includes FHWA Long-Term Pavement Performance (LTPP) study evaluating the influence of materials, climate, traffic, and pavement distresses on the long-term performance of pavements, the National Cooperative Highway Research Program (NCHRP) projects for performance based specification for pavement construction, sensitivity analysis of AASHTOWare Pavement ME Design software for materials characterization, deflection back-calculation analysis, analysis of seasonal impacts on pavement evaluation, and pavement forensic investigation. She also assisted the City of Dallas network level structural capacity testing and evaluation using FWD, remaining life analysis, and life-cycle cost analysis. She worked on the PMS update projects for the Cities of McKinney and Abilene, Texas.

5.1.3 Field Operations

Over 70 field data collection crew are available for the project. All crew offer extensive experience with automated pavement condition surveys for State DOT and City clients. Field crew are trained and certified for project requirements and conduct daily quality reviews. Fugro’s field crew have in-depth experience with equipment operations, trouble-shooting, software diagnostics, and data collection best practices (e.g., best time and directions to collect data).

5.1.4 Data Processing

Distress Processing Manager – Mr. David Hunter

Mr. David Hunter has over 10 years of industry experience to our team offering an exceptionally diverse set of skills that are focused on the successful delivery of data. He possesses expert-level programming skills and is responsible for our quality assurance routines. He is very knowledgeable on setting in-place analysis, quality verification, and trend tools to ensure the delivered data will stand the reasonableness test. Mr. Hunter’s software training and experience is comprised of ArcGIS (including such extensions as Spatial Analyst, Geostatistical Analyst, 3D

Analyst), AutoCAD, ER Mapper, Map Info Professional, and Microsoft Office Suite. Mr. Hunter represents one of our data scientist and database experts.

Distress Rating Supervisor – Ms. Suha Bsharat

Ms. Suha Bsharat has over 5 years of experience with data processing, data analysis, computer engineering, and database management. She has extensive technical, software application, and Information Technology (IT) skills including SQL Server and Oracle, MS Access, ArcGIS, UNIX, and web design. Additionally, she has a proven ability with data and process modeling and resolving data integrity issues while analyzing data using multiple databases.

As a Data Analyst, Ms. Bharat is responsible for analyzing and processing roadway condition data including surface distress and sensor data, as well as pavement and roadway imagery. She well-versed in Fugro's Vision data processing software, Vision batch processors, and SQL scripts. Ms. Bharat performs quality control on the data and delivers data to clients in a variety of formats including Access databases, ArcGIS geodatabases and shapefiles, CVS files, and Fugro's iVision web-based software. Ms. Bsharat represents one of our data scientist and database experts.

Data Analyst – Ms. Jaime Mann

Ms. Jaime Mann has over 14 years of experience with the processing, analysis, and delivery of roadway condition data. She offers superior analytical and problem-solving skills with the ability to quickly assess data integrity. She is a very knowledgeable team player, who constantly strives to ensure that tasks are completed correctly the first time. She monitors incoming data for quality and consistency, performs data processing, and creates output formats and formatting for client delivery. She works with Fugro's Project Management and Data Services teams to contribute to project setup and execution. Ms. Mann has been involved in numerous statewide data collection projects such as Colorado, South Carolina, and Pennsylvania.

5.1.5 Asset Extraction

Asset Inventory Supervisor – Mr. Jordan Kilts

Mr. Jordan Kilts offers 10 years of experience with roadway asset inventory processing and feature extraction. He has a degree in Geographic Analysis and have been involved with all of Fugro's State DOT asset inventory projects such as Colorado, Louisiana, New York State, and Virginia. Mr. Kilts focuses his team to provide network level asset inventories quickly, safely, and on-time delivery with high quality output. He has been responsible for delivering over 6.7 million assets from over 70 unique asset types. He is involved in on-going research and development, as well as testing of Fugro's Surveyor software, and is responsible for overseeing his team's resources. He offers a strong dedication and commitment to process improvement initiatives, quality assurance, and compliance. Mr. Kilts is an effective communicator and is able to collaborate with multiple teams and departments. Mr. Kilts is also part of Fugro's Joint Health and Safety Committee.

5.1.6 IT & Business Systems

Database Manager – Yaoming Gu

Mr. Yaoming Gu has extensive experience in working with State DOTs and currently serves as Fugro's Database Manager. He is responsible for monitoring database systems and maintenance of database servers, as well as performing complex database troubleshooting performance analysis. He designs and provides tools to assist in the management of the database environments and designs and implements redundant systems including policies and procedures for disaster recovery and data archiving. He provides training and technical support to operations staff to better utilize data processing databases and installs and configures Microsoft SQL Server software and related products. Mr. Gu has been working with databases for over 20 years, and currently manages more than 1,000 databases for Fugro data collection projects. He has served as Senior Data Analyst for several state-level projects including Louisiana, Mississippi, and Iowa. Mr. Gu represents one of our data scientists and database experts.

Geo-Data Specialist – Yifei Chen

Ms. Yifei Chen has extensive knowledge of roadway asset extraction and processing, and currently serves as Fugro's Geo-data Specialist. She has a Master of Environmental Studies, Geography from the University of Waterloo. She is responsible for spatial data processing, quality control, and GIS automation in both pavement and asset projects. Ms. Chen is keen on process optimization and continuously creates solutions for automating processes and improving data quality. She is a certified FME professional and provides technical support for spatial data manipulation and analysis for pavement and roadway assets data. She also is experienced with various coding languages (e.g., SQL, Python, JavaScript). Ms. Chen is experienced in working with mobile LiDAR data in post-processing and feature extraction. Her recent work experience includes state and city level projects in California and Virginia providing support to process improvements including data automation and quality control.

iVision Specialist – Michael Slack

Mr. Michael Slack offers more than 10 years of experience working with transportation agencies in the use of Fugro's data collection equipment, processing roadway condition data, and information technology (IT). He offers a thorough understanding of data and image processing, analysis and client delivery, helping to develop plans and procedures as necessary for each project. He has the ability to identify and resolve complex problems, conduct diagnostic investigations and troubleshoot software and database related issues. Additionally, he has in-depth knowledge and extensive hands-on experience with software setup, database permissions, query and analysis tools, and SQL and web services. In his current role, he works with other Fugro Data Processing and Analysis teams to create customized data deliveries if needed, as well as Fugro's software engineers to make recommended changes to software processing tools as needed. He is responsible for analyzing client's business and technology needs, developing and conducting end-user training, creating training and learning materials, and attending client meetings as required.

5.1.7 Additional Staff

In addition to the Fugro team members listed, there are over 150 Fugro experienced professionals including pavement engineering experts with graduate degrees (M.S. & Ph.D.), ARAN operators, data handling and processing units, administrative support, and corporate support that work closely together as one Fugro team to ensure the successful, on-time, and within-budget delivery of our project deliverables.

5.2 Organizational Chart

The proposed team (Figure 16) has worked together on many statewide and municipal data collection and PMS projects in the past.

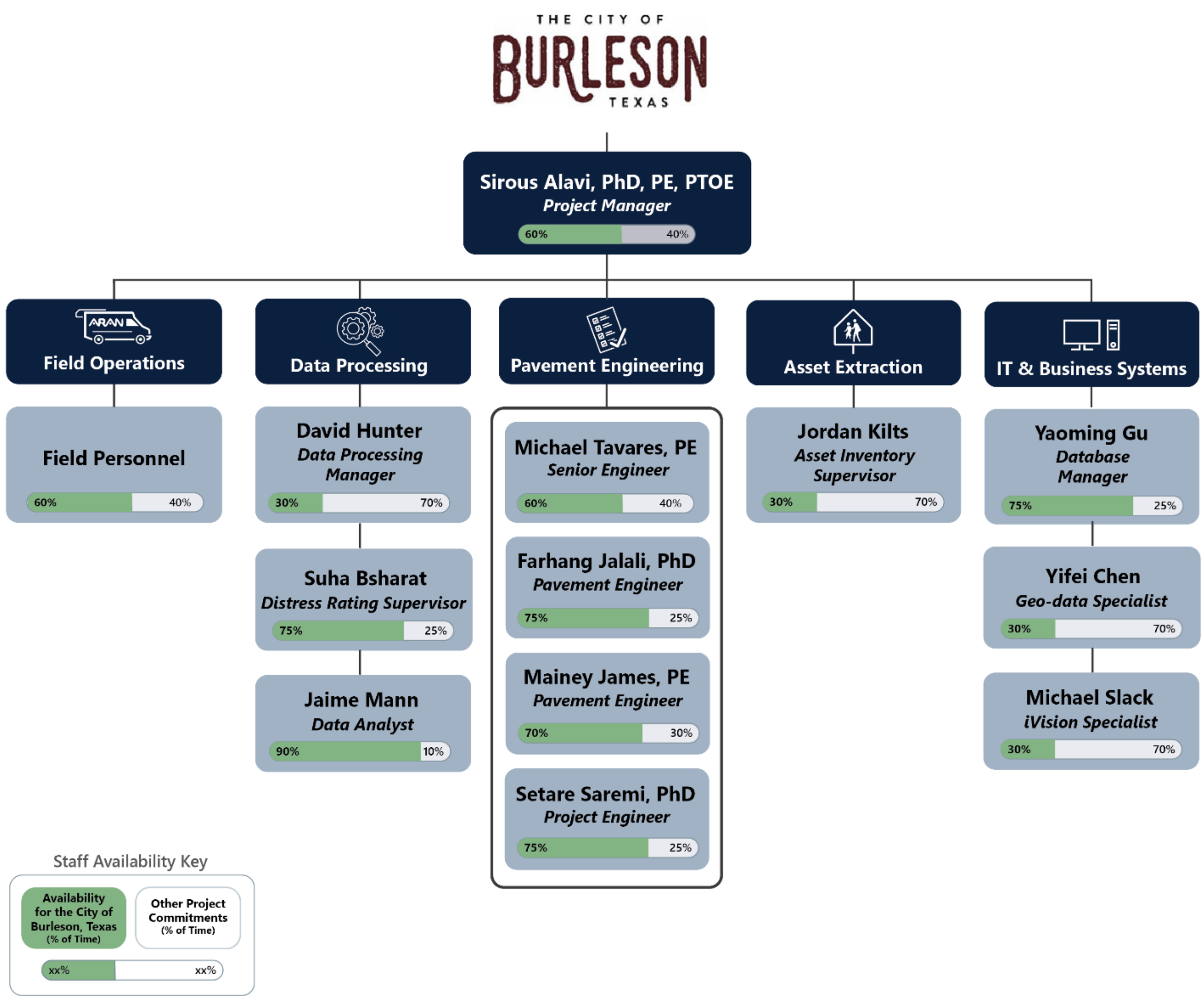

Figure 16: Organizational Chart

6.0 Experience with Similar Projects/Texas Projects

Fugro has a wealth of experience performing pavement condition assessment and pavement management services for government agencies across Texas, within the United States, and around the world. Figure 17 is a partial list of recent clients in Texas for which Fugro has provided pavement distress inventory, pavement management system updates, and multi-year M&R plan updates.

Abilene, TX	Dallas, TX	Missouri City, TX
Addison, TX	Pflugerville, TX	North Richland Hills, TX
Baytown, TX	Irving, TX	Richardson, TX
Bedford, TX	Kerville, TX	Rowlett, TX
Buda, TX	Lancaster, TX	San Angelo, TX
Bulverde, TX	Mansfield, TX	Schertz, TX
Coppell, TX	McKinney, TX	Sugar Land, TX
Corinth, TX	Midlothian, TX	Waco, TX

Figure 17: Recent Clients in Texas

6.1 Selected Reference Projects

The following are three (3) selected reference projects conducted by Fugro with similar scopes of work. Contact information has also been provided including name, phone number, and email address.

6.1.1 City of Abilene – Pavement Condition Survey and Management Services

Contact: Max E. Johnson
Title: Director of Public Works
Address: 555 Walnut Street, Room 201-A, Abilene, Texas 79601
Email: max.johnson@abilenetx.gov
Phone: 325-676-6283
Project Status: 2021-2022
Project Cost: $182,490
Scope of Work: Fugro performed an automated pavement inspection for Abilene's roadway network (approximately 650 centerline miles). Fugro previously collected their network in 2015-2016. The condition survey was conducted in accordance with ASTM D6433, and condition data was imported into Cartegraph to update the pavement management database. Fugro updated their PCI scores and IRI. Fugro also developed a 10 year M&R work plan for the City based on a new decision tree. We evaluated five different budget scenarios and made recommendations. Another part of the contract included collecting FWD data for approximately 59 centerline miles of arterials to develop a Structural Strength Index (SSI) parameter for the City. Fugro prepared a comprehensive final report.

6.1.2 City of Missouri City – Pavement Condition Survey and Management Services

Contact: Cliff Brouhard, P.E., PTOE
Title: Assistant Director of Public Works
Address: 1522 Texas Parkway, Missouri City, Texas 77489
Email: clifford.brouhard@missouricitytx.gov
Phone: 281-403-8555
Project Status: 2019-2020
Project Cost: $285,100

Scope of Work: Fugro performed an automated pavement inspection for Missouri City's 600 lane miles of street network. Fugro performed a similar inspection for the City in 2013. The condition survey was conducted in accordance with ASTM D6433, and condition data was imported into the City' Cartegraph system to update the pavement management database. Fugro also conducted a manual sidewalk assessment survey for Missouri City. Fugro utilized a GPS data collection system capable of sub-meter accuracy to record locations of sidewalk, localized failures, and vegetation in accordance with the City's sidewalk policy. The collected sidewalk data was delivered in file formats compatible with Missouri City's GIS and Cartegraph databases. This project highlights our ability to conduct manual field surveys of assets such as sidewalk or curb ramps for ADA compliance measurements.

6.1.3 City of Sugar Land – Street Pavement Assessment & Asset Data Collection

Contact: Mathew Douglas
Title: Operations Manager
Address: 111 Gillingham Drive, Sugar Land, Texas 77478
Email: mdouglas@sugarlandtx.gov
Phone: 281-275-2577
Project Status: 2019-2020
Project Cost: $310,640

Scope of Work: Fugro was contracted to collect right-of-way (ROW) images and pavement condition data for approximately 1,172 lane miles of streets. Data deliverables included pavement cracking, texture, rutting, forward and rear ROW digital images, and dual-wheel path roughness data to International Roughness Index (IRI) standards. In addition, Fugro extracted assets from our Lidar data collection, which included curb ramps, traffic signals, linear pavement markings, and point pavement markings. Fugro provided the results that were compatible with the City's Geographic Information System (GIS) database as well as their PMS software, Assetic.

7.0 Pricing Proposal

Fugro has prepared the following pricing proposal that has all the costs for which compensation is expected. Table 3 presents the costs using North Central Texas Council of Governments (NCTCOG) items. The Pricing Proposal is based on 275 test miles of data collection.

Table 3: Pricing Proposal

Item	Description	Unit	Base Cost ($)	Unit Cost ($)	Quantity	Item Total ($)
1	Automatically and continuously measure pavement cracking, texture, rutting, width, and pavement type	Test Mile	5,000	100	275	32,500
2	Collect pavement surface distress through automated means	Test Mile	5,000	60	275	21,500
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	2,000		1	2,000
4	Collect dual-wheel path roughness data to International Roughness Index standards	Test Mile		10	275	2,750
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		20	275	5,500
6	Collect digital images at 25-foot intervals of the road surface condition and link to a geodatabase (minimum forward facing imagery)	Test Mile		10	275	2,750
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.	Test Mile		80	275	22,000
10	Collect photos of sidewalks, ADA ramps, and/or roadway signs inventoried under items, 8, 9, and 12.	Test Mile		0	275	0
12	Collect location and type of visible pavement markings and provide georeferenced data.	Test Mile		80	275	22,000

Item	Description	Unit	Base Cost ($)	Unit Cost ($)	Quantity	Item Total ($)
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	5,000	5	275	6,375
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	5,000	5	275	6,375
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		15	275	4,125
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		5	275	1,375
26	Additional miscellaneous services, selected by Participant, not to exceed 15% of total bid. - collect traffic signals, and provide georeferenced data.	Test Mile		80	275	22,000
					Grand Total	**151,250**

A proposed schedule will be provided after discussions with the City. Based on similar sized projects, we believe the project can be completed successfully in 6 to 8 months.

Bryan Langley - City Manager

FUGRO