2026 Pavement Management System Update for Humboldt County Association of Governments (HCAOG)

FUGRO | STATEMENT OF QUALIFICATIONS

16 January 2026

Humboldt County Association of Governments

Submitted by:

Fugro USA Land, INC.
1777 Botelho Dr. Suite 262
Walnut Creek CA 94596

A-Cover Letter

FUGRO USA Land, INC.
1777 Botelho Dr. Suite 262
Walnut Creek CA 94596

2026 Pavement Management System Update
Attention: Amy Eberwein, Administrative Services Officer
611 I Street, Suite B, Eureka, CA 95501
amy.eberwein@hcaog.net

January 16, 2026
RE: Proposal for 2026 Pavement Management System Update

Dear Ms. Eberwein,

Fugro USA Land, Inc. (Fugro) is pleased to submit our proposal for the 2026 Pavement Management System Update for Humboldt County Association of Governments (HCAOG). Fugro understands that HCAOG is requesting consultant services to assist designated jurisdictions and tribal lands within the Humboldt County Region better manage and maintain their streets and roadways using the StreetSaver Pavement Management System (PMS). Fugro understands the goal for this project is to help educate policy makers about the current condition of their pavement network and the impact of various funding scenarios on future network conditions. This contract focuses on maintaining existing databases, while providing jurisdictions with the information to advocate for additional funds when needed for pavement maintenance and engineering design. Our team is prepared to execute the following tasks for this project in accordance to specifications within the provided Attachment B of the solicitation package:

- Project management and reporting.
- Data collection and reporting.
- Reviewing maintenance and rehabilitation strategies.
- Preparing Final Reports.
- Presenting completed Pavement Management System update.
- Facilitating training.

Fugro has over 75 years of experience in pavement and transportation 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. In the past 25 years, we have collected and processed more than 3,000,000 miles of pavement data collection in North America. In California, Fugro has a multiyear contract with Caltrans to collect data for the entire Caltrans Highway System which includes over 58,000 miles of pavement distress and right-of-way asset data per year. Because of this active project, Fugro has multiple Automated Road Analyzer (ARAN) data collection vehicles in California year-round. In addition to our Caltrans project, Fugro collected over 9,000 miles of automated pavement data for the update of the City of San Jose's StreetSaver database between the years 2017 and 2025. Fugro has years of experience with StreetSaver and was a consultant in the MTC Pavement Management Technical Assistance Program (P-TAP) program for five years. Fugro has provided PMP updates to over 20 agencies in the Bay Area.

I, Keith Owens, am authorized to negotiate contracts for Fugro. Our assigned point of contact is Benjamin Ong and his contact information is below:

Contact Person:	Benjamin Ong Business Development Professional
Phone Number:	416-629-2697
Email Address:	bong@fugro.com

Fugro does not see any conflict of interest, actual or apparent, that would limit our ability to provide the requested services. We acknowledge the receipt of this RFP and all addenda. Fugro stipulates herein that this proposal is a firm offer to enter into a contract to perform work specified by the HCAOG in the RFP and will remain valid for a period of at least a sixty (60) days from the date of submittal.

We welcome the opportunity to apply our experience and knowledge to this important project for the HCAOG. Please do not hesitate to contact Benjamin if you have questions or need additional information.

Yours faithfully,

Keith Owens
Commercial Director, Land - North America

B-Technical Proposal

RFP Subject: 2026 Pavement Management System Update for Humboldt County Association of Governments (HCAOG)
Name of the Proposer's Firm: Fugro USA Land, INC.
Address: 1777 Botelho Dr. Suite 262 Walnut Creek CA 94596
Telephone Number: 416-629-2697
Name of Contact Person: Benjamin Ong
Contact Person's Email Address: bong@fugro.com
Date: January 06, 2026

1. Table of Contents

Figures in the Main Text

2. Understanding of Project

With over a thousand miles of roads serving over 130,000 residents in Humboldt County, HCAOG jurisdictions require accurate pavement condition and asset inventory data to make targeted and proactive decisions. Our fleet of 26 Automated Road Analyzers (ARANs), Professional Engineers, dedicated project managers, and expert data analysts are trusted by agencies including, Caltrans and the City of San Jose, to provide the necessary support for optimal data collection and pavement management programming.

2.1 Project Purpose

Fugro understands that the Humboldt County Association of Governments (HCAOG) is seeking a consultant that possesses expertise in pavement management to provide professional and technical services in developing and implementing a Pavement Management Program (PMP) update utilizing StreetSaver. **Our team is confident in our abilities to meet the requirements of this solicitation.** The update will assess pavement conditions of the road network as well as additional pavement management program update services as requested by the HCAOG.

The HCAOG depends on quality pavement condition data for its public street maintenance and rehabilitation programs. Fugro understands the importance of this information in the continuity of the of each jurisdiction's work and is fully prepared to collect and provide the data to meet the ongoing needs and provide our pavement management services to update each PMP.

2.2 High-level Approach

Fugro's technical approach for all required tasks is detailed in **Section 4**. Our team is comprised of experienced pavement management Engineers and a large data collection and processing team with access to industry leading equipment. Pavement condition data collection will be conducted using our in-house designed and built **Automated Road Analyzer (ARAN) which has completed the requirements of the MTC StreetSaver Automated Rating Vendor Certification Program** with the skills and knowledge on pavement condition assessment based on the MTC's modified ASTM D6433.

Fugro offers a long history of successfully managing automated pavement condition survey projects based upon our proven professional project management plan shown in **Figure 2.1**. Mr. Michael Tavares will be the assigned Project Manager responsible for all communication with the county and jurisdiction representatives, and the various internal project and processing meetings and reports held or delivered each week.

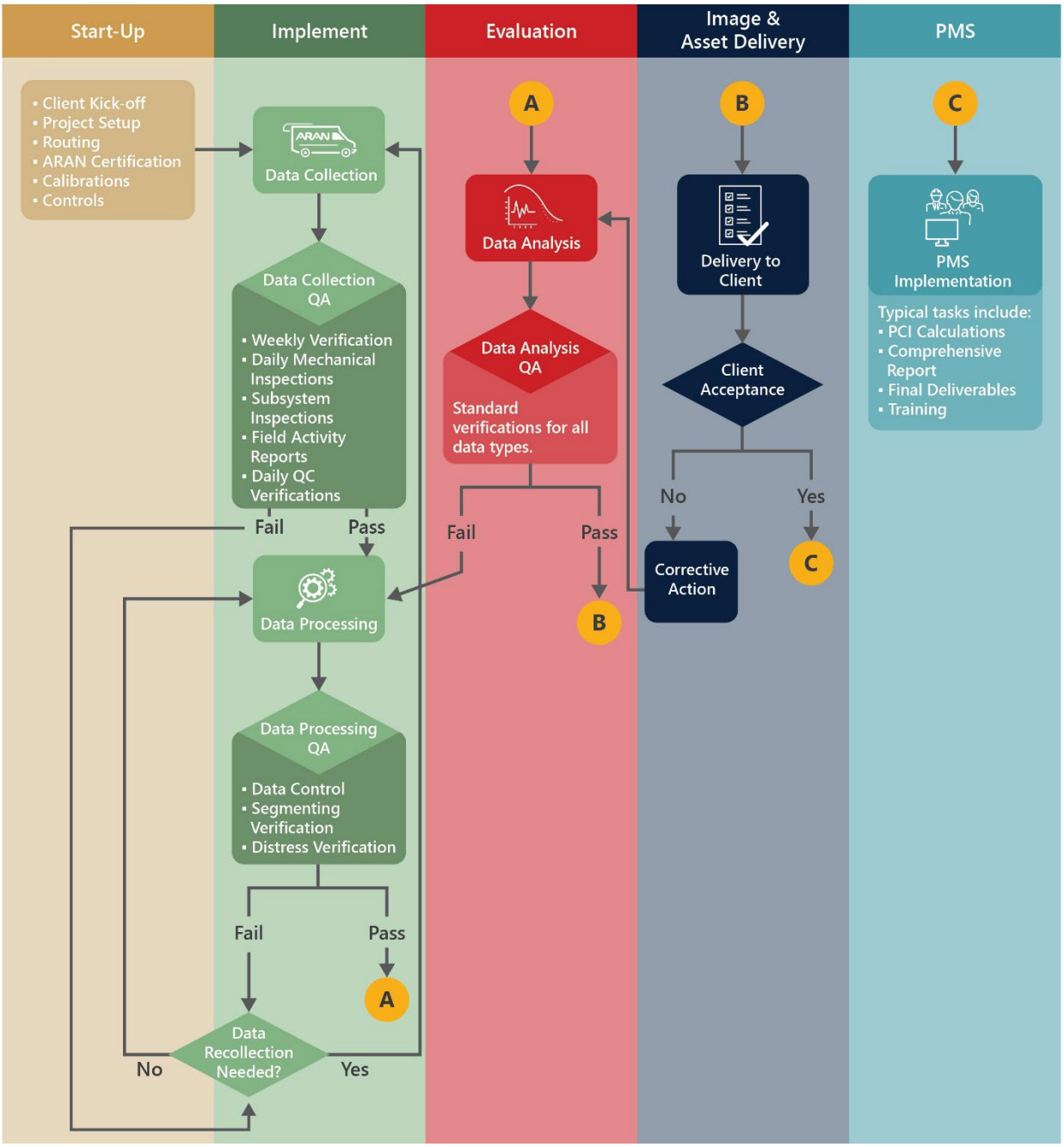

Figure 2.1: Our high-level project approach. Setup, daily, weekly, monthly, and project completion equipment controls occur as part of our standard operating procedures and project data quality management plan.

Fugro is prepared to:

- Collect pavement condition data with our ARAN vehicle(s).
- Process and analyze the pavement distresses per the Metropolitan Transportation Commission (MTC) published documents for "Pavement Condition Index Distress Identification Manual for Flexible Pavements" and "Pavement Condition Index Distress Identification Manual for Rigid Pavements."

- Prepare and load the data into StreetSaver asset management system.
- Review of maintenance and rehabilitation strategies.
- Develop a final multi-year M&R work plan and final report for each jurisdiction.
- Presentation of completed PMP to TAC and HCAOG board.
- StreetSaver training.

3. Consultant Qualifications and Experience

3.1 A- Firm

Fugro has over 55 years of experience with pavement condition and data collection services and offers a strong record of successfully providing services that are described in this solicitation. We offer a wealth of experience in new technologies and methods for the collection of roadway condition data for use by transportation agencies for monitoring existing roadway conditions, identification of deficiencies, and the prioritizing of road work.

Fugro USA Land, INC. Profile:

- Federal ID No. 74-2426512.
- California SOS No. C2972980.
- OSHA 18001:2007 certification.
- ISO 9001 certified.
- North American Industry Classification System (NAICS): 541330 - Engineering Services.
- Standard Industrial Classification (SIC): 8711 - Engineering Services.

Fugro is the world's leading automated pavement condition survey provider and geo-data specialist, collecting and analyzing comprehensive information to help our clients operate their assets safely, sustainably, and efficiently. **Fugro researched, developed and manufactured the first high speed road profiler vehicle; the ARAN (Automatic Road Analyzer).** The ARAN utilizes industry-leading mobile mapping and laser-scanning components and is able to collect the full spectrum of infrastructure information in a single pass at highway speeds. We continue to improve the ARAN and to invest in innovative software solutions for data processing, analysis and viewing. Some of the many benefits to choosing Fugro can be seen in **Figure 3.1**. Fugro's current fleet of 26 ARAN vehicles survey over 330,000 miles of roadway inventory performance and condition data each year and has collected in excess of 3,000,000 miles in North American in the past 25 years. We build on average 10 new ARANs a year, both for our own fleet and for our government clients around the world.

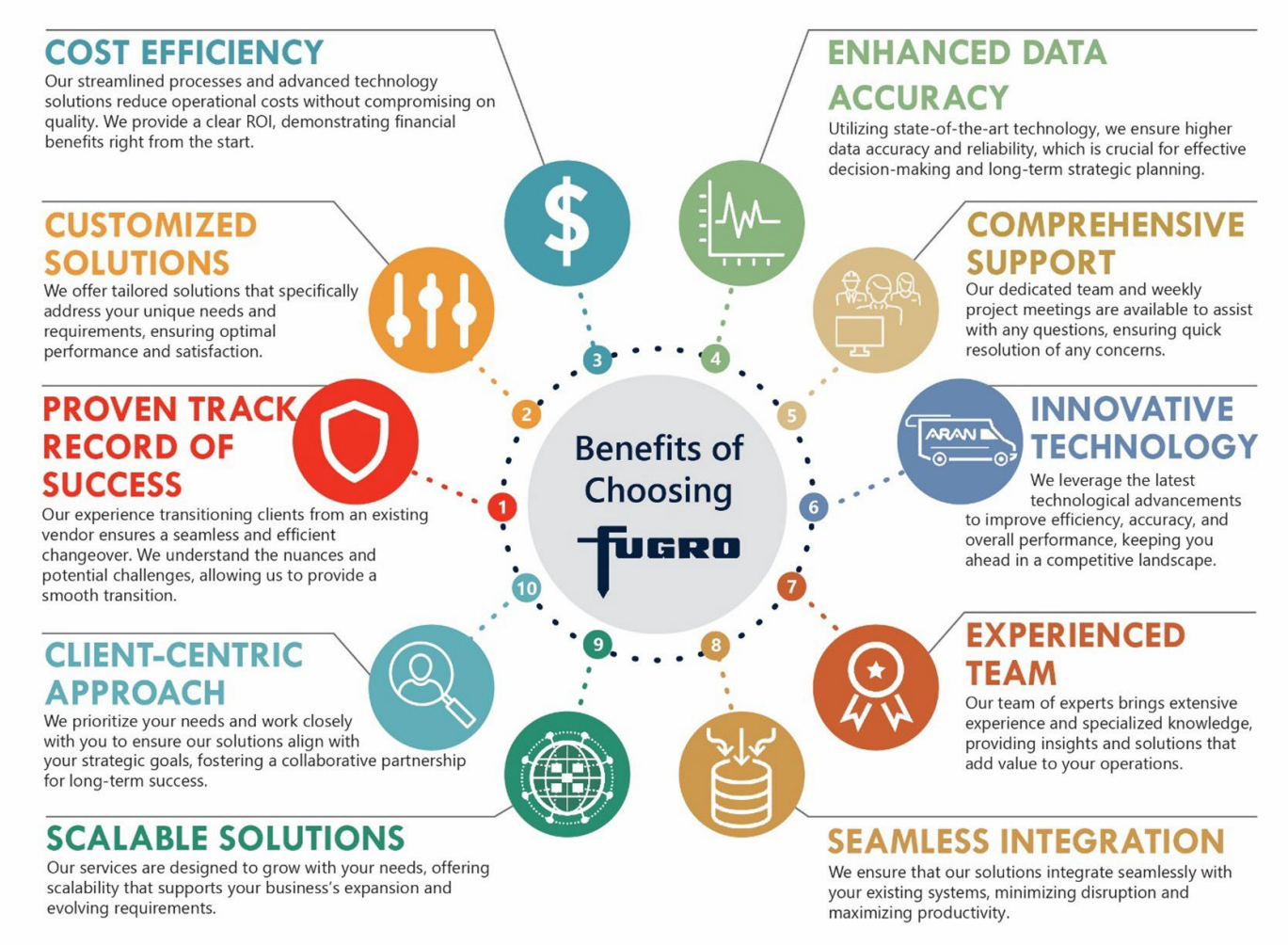

Figure 3.1: Our benefit. Fugro's current fleet of 26 high speed profiler vehicles survey over 330,000 miles of roadway inventory performance and condition data each year, including over 58,000 miles of Caltrans state-maintained highway.

Fugro's staff of over 11,000 professionals across 57 countries includes a diverse group of highly experienced and technical specialists, as seen within **Figure 3.2**. With offices across the US, including five based in California (Sacramento, Walnut Creek, Los Angeles, Ventura, and Newport Beach), our position in North America is well established. A diverse range of services and state-of-the-art technology enable us to help governments and industries meet their commercial objectives and environmental responsibilities.

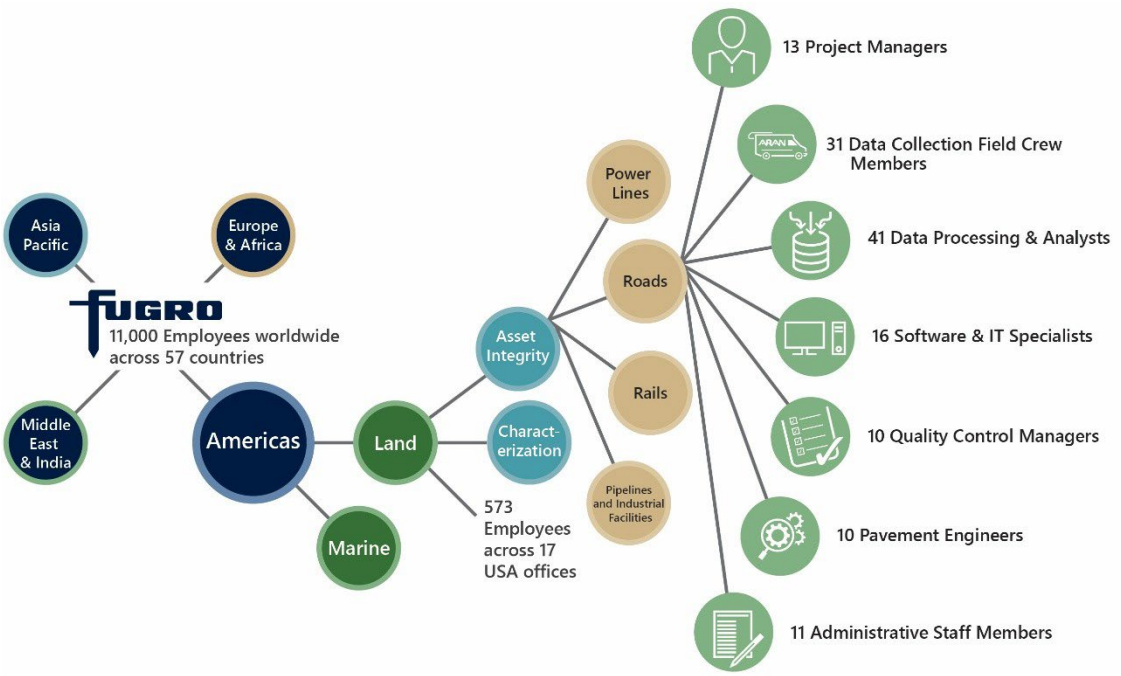

Figure 3.2: Our team. All of our service lines have access to shared engineering and research resources to proactively adopt the latest best practices and be at the forefront of technology.

3.1.1 MTC Certification

Fugro is a Metropolitan Transportation Commission (MTC) certified consultant with widespread experience providing StreetSaver PMP updates Fugro's Project Manager, Michael Tavares, is verified in MTC's rater certification program (**Figure 3.3**) and served as the Certified Rater and Supervisor for over 30 PMP updates using the StreetSaver program.

Figure 3.3: Automated rating vendor certificates. As part of our recent San Jose project, Fugro has also completed vendor certification requirements based on the MTC's modified ASTM D6433.

3.1.2 Litigation Regarding The Provision Of Services Equivalent To Those Set Forth In This RFP That Have Been Brought By Or Against The Proposer, Including The Nature And Result Of Such Litigation, If Applicable

N/A

3.1.3 Detailed Description Of Any Fraud Convictions Related To Public Contracts, If Applicable

N/A

3.1.4 Detailed Description Of Any Current Or Prior Debarments, Suspensions Or Other Humboldt County Association Of Governments Ineligibility To Participate In Public Contracts, If Applicable

N/A

3.1.5 Detailed Description Of Any Violations Of Local, State And/Or Federal Industry Or Regulatory Requirements, If Applicable

N/A

3.1.6 Detailed Description Of Any Controlling Or Financial Interest The Proposer Has In Any Other Firms Or Organizations, Or Whether The Proposer's Firm Is Owned Or Controlled By Any Other Firm Or Organization

Fugro USA Land, Inc. is a wholly owned subsidiary of Fugro USA Inc. with the ultimate parent Fugro NV (www.fugro.com).

Shareholder	Ownership	Date Notification
NN Groep N.V.	14.67 %	2 November 2023
ASR Nederland N.V.	7.63 %	30 November 2020
H.M. van Heijst	3.03%	4 April 2025
Fugro N.V.	3.00%	9 December 2024

3.2 B- Key Personnel

In this section, Fugro describes the qualifications of all key personnel, who will be responsible for conducting the work and their years of experience. This team has performed similar work for numerous other agencies in North America.

3.2.1 Organizational Chart

The organizational chart within **Figure 3.4** outlines Fugro's key personnel for this project and their lines of authority. The HCAOG will have access to the most experienced staff in the industry, offering unmatched service and solutions. Our team members are Certified Lean Six Sigma Green Belts who are well versed in the elements of continuous improvement. Our team understands and practices this philosophy under the supervision of the Service Line Director, Mr. Denis Charland, who holds a Certified Black Belt in Lean Six Sigma Methodology.

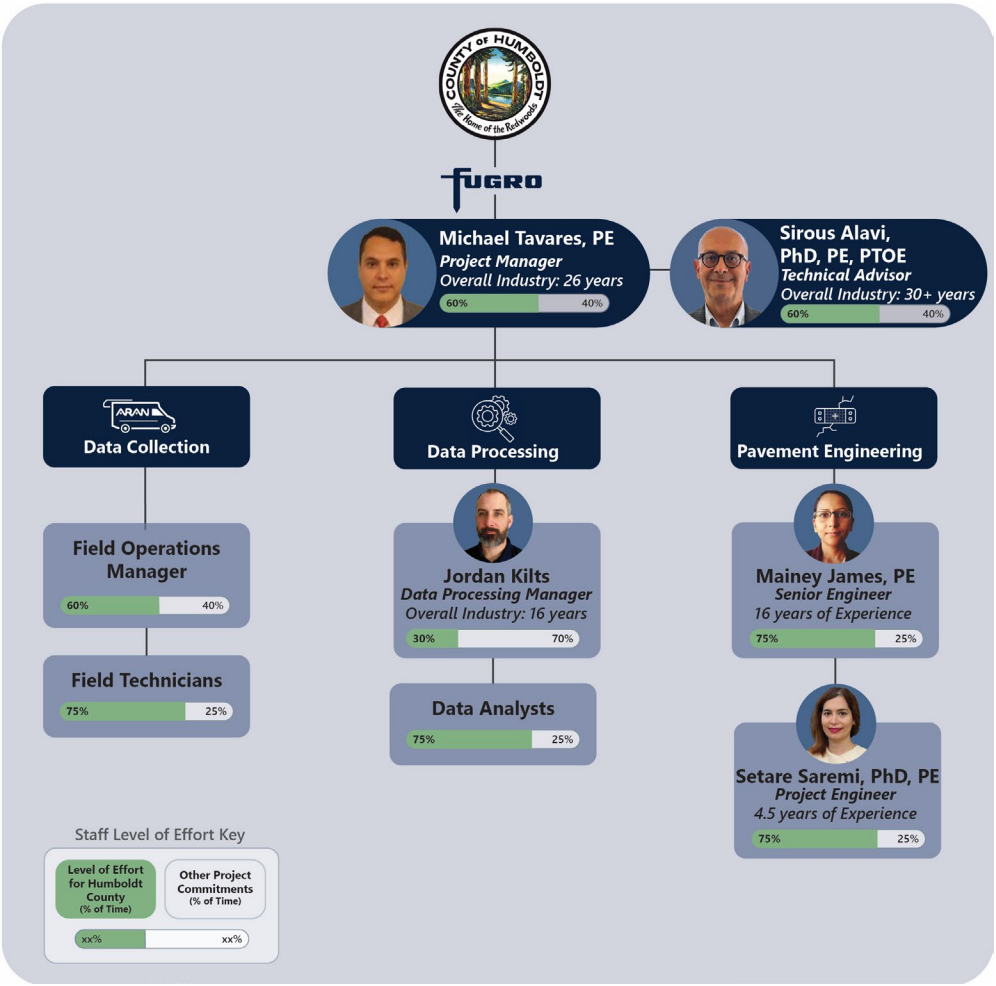

Figure 3.4: Organizational chart. Our team consists of California-licensed Professional Engineers and technicians with expertise in network-level automated pavement data collection.

3.2.2 Team Bios

This section provided a brief bio of our proposed project team that summarizes our professional background, past work experiences, skills, and significant accomplishments.

3.2.2.1 Project Manager – Michael P. Tavares, P.E.

Mr. Michael P. Tavares, P.E. is the proposed Project Manager and is the person responsible for day-to-day management of the project. He is currently a Principal Engineer for Fugro. He has a Master of Science Degree in Civil Engineering from The University of Texas at El Paso with over 26 years of experience in pavement engineering. He is a licensed professional engineer in California and Nevada. In the past, Mr. Tavares has been accredited at the Federal Highway Administration (FHWA) Pavement Distress Accreditation Workshops, and Orange County Transportation Authority (OCTA) Rater Certification Program. He is currently certified by the Metropolitan Transportation Commission (MTC) StreetSaver Pavement Distress Rater Certification Program. He is currently certified by AgileAssets Partner's Program to carry out pavement analysis through the Pavement Analyst Module of the software. He is also certified by Cartegraph for Cartegraph OMS. He has extensive experience using both PAVER and StreetSaver. The work included updating PMS inventories, adding pavement condition surveys, updating any work history, updating performance modeling, developing various budget scenarios, and performing Pavement Management Plan (PMP) analyses and reporting. Mr. Tavares performed this work for over twenty cities in the Bay Area for the HCAOG Pavement Management Technical Assistance Program (P-TAP) contract from 2017 to 2021.

3.2.2.2 Technical Advisor – Sirous Alavi, Ph.D., P.E., PTOE

Dr. Sirous Alavi, P.E., PTOE is the proposed Technical Advisor, who is a representative authorized to sign an agreement for the firm. He is the Director of Pavement Engineering and Infrastructure Management Americas for Fugro. 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 32 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 of San Francisco Bay Area 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 100 pavement and asset management projects and routinely oversees many of Fugro's projects including many projects related to StreetSaver updates. Lastly, his experience includes serving as the Principal Investigator for a number of national and state agency pavement engineering & research

projects including the NCHRP Synthesis on Falling Weight Deflectometer (FWD) Usage, FHWA LTPP, and FHWA Next Generation Pavement Performance Measures and Asset Management Protocols.

3.2.2.3 Data Processing Manager – Jordan Kilts

Mr. Jordan Kilts offers 15 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 New Mexico, Colorado, Louisiana, New York State, and Virginia. Mr. Kilts works avidly to keep his team's focus on network level asset inventories; quickly, safely, and on-time 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 the 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 has an effective communicator and is able to collaborate with multiple teams and departments.

3.2.2.4 Senior Engineer – Mainey James, P.E.

Ms. Mainey James, P.E. is a Senior Engineer for Fugro. She has a Master of Science Degree in Civil Engineering from the University of Arkansas with over 16 years of experience in pavement engineering including pavement evaluation, design, management, and research. Her research experience includes the FHWA 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 worked on 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 Abilene, Burleson, and McKinney, Texas.

3.2.2.5 Project Engineer – Setare Saremi, Ph.D., P.E.

Dr. Setare Saremi is a Project Engineer for Fugro. She 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 for over three years, 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 PMS updates for the Cities of Abilene, McKinney, San Diego, and Waco.

3.2.2.6 Field Operations

Over 70 field data collection crew members are available for this project. All of our field crews have extensive experience performing automated pavement condition surveys for state DOTs, counties, and local agencies. Our field crews are trained and certified for project requirements and conduct daily quality reviews. Fugro's field crew members have in-depth experience with equipment operations, troubleshooting, software diagnostics, and data collection best practices (e.g., best time and directions to collect data).

3.2.2.7 Additional Staff

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

3.2.3 Full Resumes

Resumes are provided within **Section 7**.

3.2.4 Staffing Plan Per Task

Task	Subtask	Job Title	Staff Member
1) Kick-Off Meeting, Project Management, And Reporting	Project Kick-Off Meeting	Project Manager	Michael Tavares, PE
		Technical Advisor	Dr. Sirous Alavi, PhD, PE
		Project Engineer	Michael Tavares, PE
		Project Engineer	Mainey James, PE
	Preparation of Work Scope, Schedule, and Budget	Project Manager	Michael Tavares, PE
		Technical Advisor	Dr. Sirous Alavi, PhD, PE
		Project Engineer	Mainey James, PE
2) Risk Management	Review Existing GIS Mapping	Data Processing Manager	Jordan Kilts

	Network Referencing Routing	Data Processing Manager	Jordan Kilts
	Automated Data Collection	Field Supervisor	Adon Gaitan
	MTC Modified ASTM D6433	Project Engineer	Michael Tavares, PE
3) Data Collection and Reporting	Pavement Data Reporting	Data Processing Manager	Jordan Kilts
	StreetSaver Setup, Review, and Update	Project Engineer	Michael Tavares, PE
		Project Engineer	Mainey James, PE
		Project Engineer	Setare Saremi, PhD, PE
		Project Engineer	Setare Saremi, PhD, PE
4) Review Maintenance and Rehabilitation Strategies	Pavement Management System Projects	Project Engineer	Mainey James
5) Final Reports		Project Engineer	Mainey James, PE
6) Presentation of Completed Pavement Management System Update		Project Engineer	Michael Tavares, PE
7) Training		Project Engineer	Mainey James, PE

3.2.5 Approach to Managing Resources

Fugro has the equipment and staffing capacity to meet the project requirements and simultaneous work in California. We currently have a **fleet of 26 vehicles available with slack capacity** to accommodate emergencies and new requirements. Fugro has over 30 field collection operators that live and work across North America. For every ARAN Fugro assigns a team of ARAN field operations crew that rotate on a staggered schedule. Our production capabilities are also scalable to support larger data collection ranging from 500 miles 5,000 miles. Data processing and collection work in parallel, with data quality,

checked daily to reduce costly reruns early in the process. Fugro routinely achieves on-time delivery rates of above 95%.

Our progressive tools deploy a proactive and integrated system for monitoring activities and managing subcontractor performance, specifically designed to minimize change orders, reducing costs and improving scheduled time to completion. We apply subcontractor accountability via clear KPIs and regular performance reviews, while employing transparent communication and a formal early warning system to collaboratively identify and resolve potential deviations before they escalate. This end-to-end approach ensures strict adherence to scope, controlling costs and schedule by preventing the conditions that typically necessitate change requests.

3.2.6 Equal Employment Opportunity

3.2.6.1 Fugro's Affirmative Action Policy

Fugro is committed to equal employment opportunity, and it is Fugro's policy to take affirmative action to employ and advance in employment protected veterans and individuals with disabilities.

It is our policy to recruit, hire, train, and promote persons in all job titles, and ensure that all other personnel actions are administered, without regard to race, color, religion, national origin, sex, sexual orientation, gender identity, veteran status and disability, or other legally protected status, and we will ensure that all employment decisions are based only on valid job requirements.

Fugro will also provide reasonable accommodation to known physical or mental limitations of an otherwise qualified employee or applicant for employment, unless the accommodation would impose undue hardship on the operation of our business.

Fugro's EEO policy and affirmative action program has the full support of its Group Director.

Employees and applicants shall not be subjected to harassment, intimidation, threats, coercion or discrimination because they have engaged in or may engage in any of the following activities: (1) filing a complaint; (2) assisting or participating in an investigation, compliance evaluation, hearing, or any other activity related to the administration of the affirmative action provisions of section 503, VEVRAA, or any other federal, state, or local law requiring equal opportunity for individuals with disabilities or protected veterans; (3) opposing any act of practice made unlawful by section 503, VEVRAA, or their implementing regulations in this part, or any other federal, state, or local law requiring equal opportunity for individuals with disabilities or protected veterans; or (4) exercising any other right protected by section 503, VEVRAA or their implementing regulations.

Fugro's affirmative action program contains an audit and reporting system which enables us to measure the effectiveness of our program, indicate any need for remedial action, determine the degree to which our objectives have been attained, determine whether protected veterans and individuals with disabilities

had had the opportunity to participate in company-sponsored activities, measure our compliance with the program's specific obligations, and document actions taken to comply with these obligations.

Responsibility for implementing Fugro's affirmative action program has been delegated to Erin Kessler, North America Human Resources Manager.

3.2.6.2 DBE Inclusion

Fugro actively searches local and statewide small-business directories to build diverse subcontracting teams. We regularly work with a variety of DBEs across the country to complete our contracts. For projects similar in scope to HCAOG's Pavement Management System Update project, we have utilized DBE in important roles such as Independent Verification and Validation of data and field equipment operators.

For projects with specific DBE goals, Fugro will strategically identify area where a partnering with a DBE firm will not only fulfil requirements, but provide added value and success to the prime, subcontractor, and client. These cases require a Good Faith Effort which may involve advertising, soliciting bids, and contacting firms directly.

3.3 C- References

Fugro has provided the following select references from projects with similar types of work.

City of San Jose – Pavement Management Program Update

Contact: Frank Farshidi
Title: Division Manager
Address: 200 E. Santa Clara Street, San José, California, 95113
Email: frank.farshidi@sanjoseca.gov
Phone: 408-277-5516
Software Used: StreetSaver
Dates of Service: Multiple contracts 2017-present
Scope of Work: Fugro provided automated pavement data collection in 2017, 2019, 2022, and 2025 across City of San Jose's entire road network. Fugro provided PCI values for street segments according to the City's data segmentation and uploaded these to StreetSaver database. A manual inventory of 26,800 ramps was collected in 2017 and in 2022 an automated roadside asset extraction via photogrammetry across 5 assets: Curb, Sidewalk, Pavement Marking, Manhole and Signs was conducted. The pavement condition data collected by Fugro has helped the City secure funding for their proactive pavement maintenance program that recently crossed the 1,000-mile mark (since 2020) and raised their network pavement condition index from 66 (2019) to 73 (2024). Between 2019 and 2024, the program has also installed 13,148 curb ramps compliant with the Americans with Disabilities Act.

City of Simi Valley – Pavement Management Program Update

Contact: Ashique Khandaker, P.E.
Title: Senior Engineer

Address: 2929 Tapo Canyon Road, Simi Valley, CA 93063
Email: akhandaker@simivalley.org
Phone: 805-583-6971
Software Used: StreetSaver
Dates of Service: 2025-Ongoing
Scope of Work: Fugro is currently contracted with the City of Simi Valley to conduct a pavement condition survey and report the pavement condition score for approximately 424 test miles using our ARAN technology. The work includes StreetSaver database review, the addition/subtraction of streets, updated GIS layer, updated decision tree, budget analyses, and 10-year work plan.

City of San Diego – Pavement Condition Assessment

Contact: Aida Vance, P.E.
Title: Project Manager
Address: 1200 Third Avenue, Suite 200, San Diego, CA 92101
Email: avance@sandiego.gov
Phone: 619-527-8074
Dates of Service: 2022-2023
Software Used: Cartegraph OMS
Scope of Work: Fugro was contracted by the City of San Diego to assess the pavement conditions of their roadway network (approximately 2,756 centerline miles of roadways and 235 miles of alleys) using our ARAN technology. Additionally, Fugro collected the pavement condition of the City's bike paths (71 miles) using our mobile golf cart-sized vehicle technology. The pavement condition assessment provided updated pavement condition data for the City's PMS. Fugro provided Pavement Condition Index (PCI) and Ride Condition Index (RCI) scores, uploaded the data into the City's Cartegraph OMS, and published the results on the City's public webpage.

California Department of Transportation

Contact: Mr. Haiping Zhou
Title: Project Manager
Address: 1120 N Street Sacramento, CA 95814
Email: haiping.zhou@dot.ca.gov
Phone: 916-639-5634
Dates of Service: 2020-2026
Software Used: PaveM
Scope of Work: Annual collection, processing and delivery of global referencing data, longitudinal profile and IRI, rutting, surface distress, pavement and HD ROW images, and asset extraction for approximately 120,000 miles. During the project, Fugro worked with Caltrans to develop a new project-specific distress manual, and in the transition to the use of 3D technology for surface distress. Data was formatted for use within Caltrans' PaveM Pavement Management System (PMS), and PaveM was integrated with Fugro's web-based iVision software.

4. Approach

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 work plan. **Our consistent record of delivering data collection and pavement engineering projects exceeds the expectations of even our most complex clients' projects, both in terms of time and budget.**

4.1 Task 1 – Kick-Off Meeting, Project Management, And Reporting

4.1.1 Project Coordination and Kick-off Meeting

As part of our project initiation, Fugro recommends a kick-off meeting. Upon receipt of the notice to proceed (NTP), Fugro will work with the jurisdiction's Project Manager to schedule a project kick-off meeting that will include both key members of Fugro's Project Team and jurisdiction 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 jurisdiction's specific requirements. Roles and responsibilities will also be covered.

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

1. Scope of work and budget.
2. Schedule including data collection, processing, and all data delivery milestones and their prioritization.
3. Shapefile of the jurisdiction's current GIS roadway network.
4. Existing spreadsheets and database of roadway segments.
5. Software options and integration with GIS software products.
6. Previous maintenance projects and practices.
7. Historical M&R activities.

4.1.2 Project Management

Fugro will manage the project and coordinate the work with the jurisdiction's Project Manager. We will have monthly project update meetings with the jurisdiction for the duration of the project. The Project Manager will be available through emails, office phones, mobile phones, via the web with MS Teams meetings, and in person meetings as needed. Fugro will coordinate the monthly project progress meetings with written agendas, meeting minutes, and maintain a list of action items during the course of the project work. Fugro will also be available for any meetings in addition to the monthly project meetings to discuss significant milestones or critical path items.

After the kick-off meeting and project initiation, Fugro will finalize our progress schedule (e.g., Microsoft Project or Gantt format) for the project. The progress schedule will help us monitor the status of the

project throughout the entirety of the project from startup to acceptance of the final report to project close out. Fugro will be responsible for notifying the jurisdiction of any delays in major or minor tasks and will provide a detailed explanation for any time extension requests.

4.1.3 Schedule and Coordination

As part of this proposal, a detailed schedule and Gantt chart is provided in **Section 5**. The Gantt chart will include all required subtasks within each functional category, such as project management, setup, data collection, data processing, reporting, QA/QC, and any planned meetings. After the kick-off meeting has occurred, the schedule will be updated based on the jurisdiction-specific requirements and scope of work.

4.2 Task 2 - Risk Management and Quality Assurance

4.2.1 Quality Control Plan

Quality Assurance and Control (QA/QC) is a crucial aspect of every successful project. All data that is collected and processed becomes a critical component for any management system it is uploaded to and will ultimately contribute to important and critical decisions that each jurisdiction will make. The establishment and practice of a quality program for data collection, processing and delivery is necessary in ensuring that dependable, accurate and complete data is collected. Just as crucial are the documented processes for how to address situations when data quality is an issue. Fugro's quality program includes all data collection protocols with established quality standards and acceptance criteria, identifies responsibilities, defines quality control tasks and provides guidelines for monitoring data collection activity including immediate and appropriate corrective actions and provision for reporting throughout the entire process.

Having a robust quality program will improve the ability for each jurisdiction to provide reasonable, timely and reliable preservation and rehabilitation recommendations across their entire asset ownership and provides the following:

- Better compliance with external data requirements.
- Better credibility within the organization.
- Better integration with other internal agency data.
- Cost savings.
- Improved accuracy and consistency of the data.
- Improved decision support for managers.
- Increased accuracy in reporting deficiencies.
- Increased accuracy of budget need determinations.

4.2.1.1 Data Quality Management/Control

Fugro has invested significantly in gaining and maintaining ISO certification. **Fugro's ISO 9001:2015 registered Quality Management System (QMS) includes our enhanced quality control program**

which has been developed from lessons learned through our years of industry experience and best practices from other transportation agencies. Earning the ISO standard requires a very significant investment as well as a commitment by senior management to ensure that the certification is fully implemented on all projects.

Included in this QMS is a comprehensive set of Standard Operating Procedures (SOPs) for controlling quality, both in the field and in-office. These SOPs ensure each task is performed with consistency and discipline. SOPs include data quality requirements that define the level of resolution, accuracy and repeatability of the data elements. Resolution refers to the level of detail (controlled by technology) and accuracy refers to the closeness of a measurement to some ground truth. Repeatability refers to the analytical comparison of output data after repeated measurements on the same highway segment given similar conditions

Figure 4.1 is a diagram highlighting Fugro's quality workflow and highlights how quality assurance/quality control is incorporated into every process, ensuring that any exceptions are caught as early as possible and handled according to pre-defined rules and procedures.

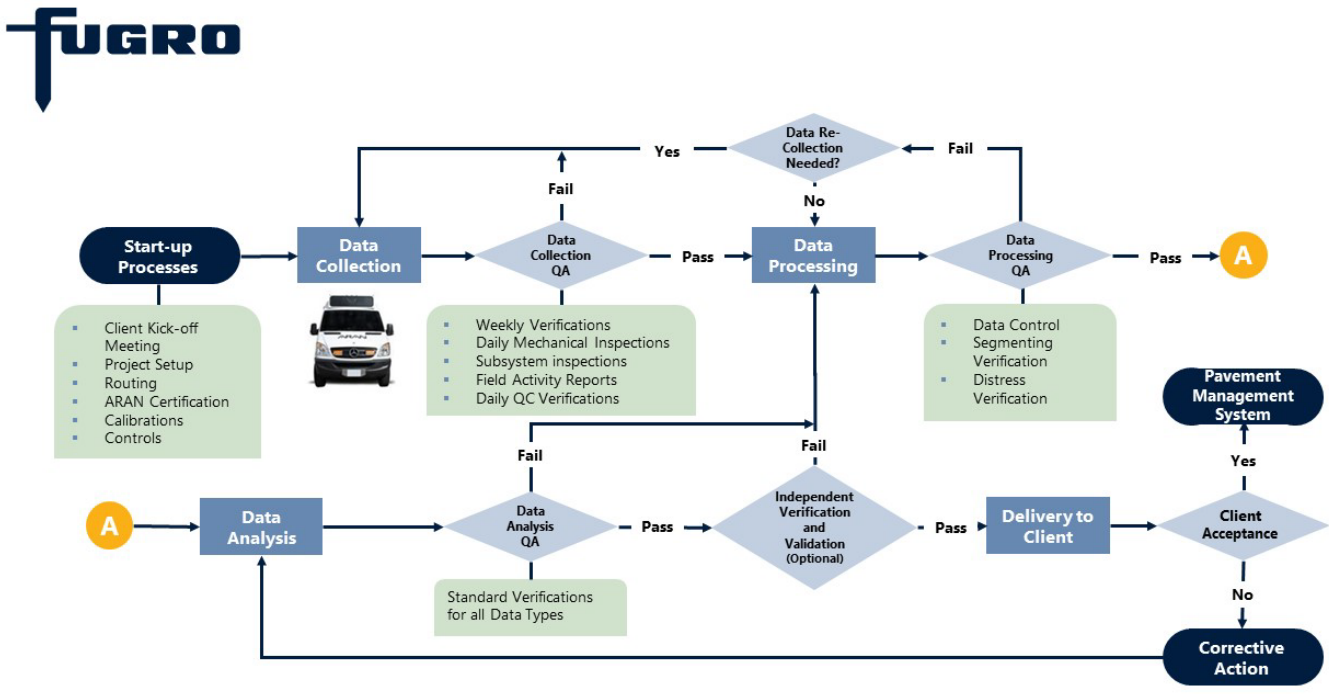

Figure 4.1: Example of QC/QA procedures and checks. This workflow ensures all appropriate action is taken within multiple task levels to ensure all data imported into a Pavement Management System is correct.

4.2.1.2 Standard Operating Procedures (SOPs)

The following outlines the Fugro's standard SOPs for pavement condition and data collection projects that are included in our Quality Control Plans.

Automatic Road Analyzer (ARAN) Certification

The ARAN Certification process ensures that data collection vehicle settings and data collected are within project guidelines. ARAN field operators (drivers) will be trained on the unique aspects of each jurisdiction's project. All field operators have also received Smith System driver training and certification.

Real-time Quality Monitoring on the ARAN

Quality control subsystems are built into each ARAN vehicle. If a sensor is recording out-of-range or does not register a change for a predetermined length of time, the system alerts the operator to the potential malfunction and the need to take action. Real-time health monitoring and live remote access into any ARAN by Fugro's technical support team ensures that only good quality data is collected.

Verification/Control

The ARAN Collection Software (ACS) interface controls all ARAN subsystems independently to ensure maximum flexibility and robustness during testing / collection. These systems allow operators to perform daily verification that ensures every vehicle delivers optimum data accuracy and repeatability, using features such as user-specified data ranges to establish out of range or non-functioning subsystems. A data subset is uploaded daily and examined by trained data analysis staff in the office.

Daily Quality Assurance Cycle

A quality assurance cycle is performed daily on all subsystems to ensure each is operating properly. The data collected at the end of the day is also checked for completeness against log sheets and routing schedules. Samples from each system are then uploaded to be evaluated by Data Services personnel to ensure settings and results are within project guidelines.

Data Handling

The data handling SOP covers the control of all data collected and ensures that all original ARAN files are copied from the ARAN to removable hard drives creating the redundancy necessary to safeguard the original field data. The data will then be shipped to Fugro's processing team.

Applying Jurisdiction-Specific Requirements

Fugro's SOP is to fully understand and implement its clients' data acceptance criteria. Before delivery, all data will undergo exactly the same quality checks as requested by each jurisdiction. Data that fail to meet the acceptance requirements will be scheduled for rework.

Data Audits and Spot Checks

Fugro ensures that accuracy is maintained by performing audits and spot checks on a continuous and random basis all throughout the overall data process flow.

- **Incoming Data** – Standard quality checks performed at this stage include:

    - Automated flagging of incoming data to eliminate the possibility that any results are outside of pre-defined limits. This includes data collection completeness.
    - Investigating data outside these pre-defined parameters to determine whether or not the results are within the data acceptance criteria.
    - Image quality control checks for quality, completeness and integrity of the images.
- **Processing** – Standard quality checks performed at this stage include:
    - Queries and analysis to ensure high accuracy is met on pavement data.
    - Noting and correcting any errors resulting from processing.
- **Reporting** – Standard quality checks performed during this stage of data reduction include:
    - Ensuring all final processed data matches the acceptance criteria.
    - Ensuring that reporting requirements are met where events such as bridge decks, railroad crossings, and construction zones are present.

Data Specific SOPs

Specific SOPs based upon the data type to be processed and delivered including:

- International Roughness Index Standard Operating Procedure (SOP).
- Rut Depth Standard Operating Procedure (SOP).
- Pavement Imagery Standard Operating Procedure (SOP).
- Distress Data Reduction Standard Operating Procedure (SOP).
- Roadway Photo Imagery Standard Operating Procedure (SOP).
- Roadway Characteristics Standard Operating Procedure (SOP).

Data Acceptance SOPs

Fugro SOPs are to fully understand and implement each client's data acceptance criteria. A few highlights of the SOP are identified as follows:

- **Run A Mile** – just one mile of data (or small sample) is processed end to end for HCAOG signoff.
- **Pilot Delivery** – a larger representative data set is delivered for approval.
- 1st Full Production Delivery – This delivery is the final catch, before other full production deliveries are made.
- **Final Delivery** – In some cases a full delivery of the entire project is made.
- **Sign Off** – In a project or cycle close out meeting a full review is made of the data delivered.

Post-Delivery SOPs

Standard operating procedures have been put in place to ensure:

- Concerns, when raised, are put through Fugro's Corrective Action process.
    - This ensures timely resolution of any issues; with full traceability and traceability.

- Analysis of issues for ongoing improvement through Fugro's preventive action system.

4.2.2 Weather and Equipment Downtime

One of the common challenges associated with the pavement data collection is operational and weather delays. Our large fleet enables us to mitigate risks by having multiple ARAN vehicles local and available in case unexpected challenges arise. Each jurisdiction will receive weekly updates on all task execution, how it compared to the plan, and an updated plan for the upcoming week. If it is determined that schedule slippage has occurred, our Project Manager will escalate the issue to Fugro's management and keep the jurisdiction informed of any decision. With a fleet of 26 ARAN vehicles and a large team of field operators and data technicians, Fugro has the ability to deploy extra equipment or increase project staff if necessary. The decision will be made in coordination with our full Project Management Office and Operations Managers who meet weekly.

4.2.3 Traffic and Safety

Fugro anticipates and has prepared for road-related challenges such as traffic, ongoing construction, roadside parking and no-stopping zones, transit facilities, school zones, and many more. These variables influence both public safety and the planning and execution of the project. Some location-specific preparations Fugro has implemented for a jurisdiction's project include (but are not limited to):

- Smith System Driver Training and refresher course for all field technicians, supervisors, and managers.
- Data-based scope definition and pricing based on road AATD, equipment run-rate comparison, and local weather trends.
- Secondary data processing QC protocols to properly identify pavement distress and limiting false positives caused by utility cuts or other surface phenomena.

4.3 Task 3 – Data Collection and Reporting

4.3.1 Data Collection Methodology

4.3.1.1 Project Data Collection Test Miles

Our recommendation for the number of test miles is the following:

- For residential streets, collect only one lane. Given our ARAN coverage of 100% of a lane, this will result in 50% surface area coverage on 2-lane local streets and an even higher percentage on alleys and bike paths. ASTM recommends at least 10% surface area coverage.
- For arterial and collector streets, collect one in each direction. If roads are already divided by median or other structures, Fugro would also recommend collection on each direction. Our proposed coverage will be more than the minimum ASTM recommendation of 10% coverage.

Using this methodology and the breakdown of functional classes provided by the HCAOG, the total number of test miles is estimated to be 1,643.43 miles. The test mileage is broken down by jurisdiction below.

Jurisdiction	Functional Class	ARAN Passes	Centerline Miles	Test Miles
Arcata	Arterials	2	14.20	28.40
Arcata	Collectors	2	14.20	28.40
Arcata	Residential	1	35.60	35.60
Blue Lake	Arterials	2	0.70	1.40
Blue Lake	Residential	1	6.40	6.40
Eureka	Arterials	2	11.80	23.60
Eureka	Collectors	2	24.10	48.20
Eureka	Residential	1	79.00	79.00
Ferndale	Rural Major Collector	2	2.30	4.60
Ferndale	Residential	1	7.00	7.00
Fortuna	Arterials	2	7.90	15.80
Fortuna	Collectors	2	6.30	12.60
Fortuna	Residential	1	33.00	33.00
Rio Dell	Rural Major Collector	2	1.00	2.00
Rio Dell	Residential	1	13.30	13.30
Trinidad	Major Collector	2	0.70	1.40
Trinidad	Minor Collector	2	0.60	1.20
Trinidad	Residential	1	1.60	1.60
Humboldt County	Arterials	2	346.40	692.80
Humboldt County	Collectors	2	99.60	199.20
Humboldt County	Residential	1	407.93	407.93
Total				**1643.43**

4.3.1.2 Automated Data Collection Equipment

Fugro will conduct the automated pavement condition surveys on the HCAOG's roadway network using our ARAN vehicle. 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 the 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.

Developed in 1977, Fugro's ARAN was the first automated data collection vehicle available in the market and continued to evolve with the latest technology and equipment. **Figure 4.2** 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.

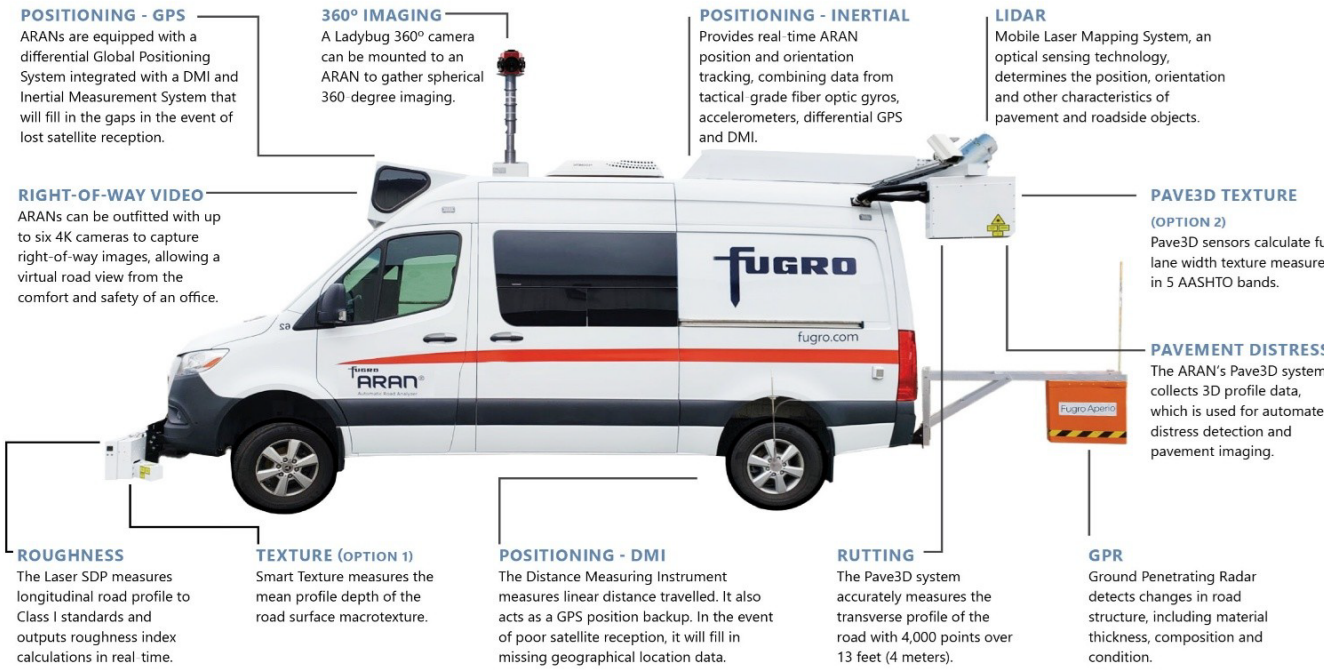

Figure 4.2: Automated Road Analyzer (ARAN). Setup, daily, weekly, monthly, and project completion equipment controls testing occur as part of our standard operating procedures and project data quality management plan.

4.3.1.3 Locational Referencing and Positioning

The ARAN is equipped with a Distance Measuring Instrument (DMI) mounted on the driver's side rear wheel. 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.

The ARAN also incorporates a Differential Global Positioning System (DGPS) using Applanix's POS LV 220. The POS LV is a 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.

4.3.1.4 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 4.3**. These capabilities improve the performance of post-processing techniques resulting in superior accuracy for identifying pavement crack severity. These images facilitate automated and manual crack identification methods.

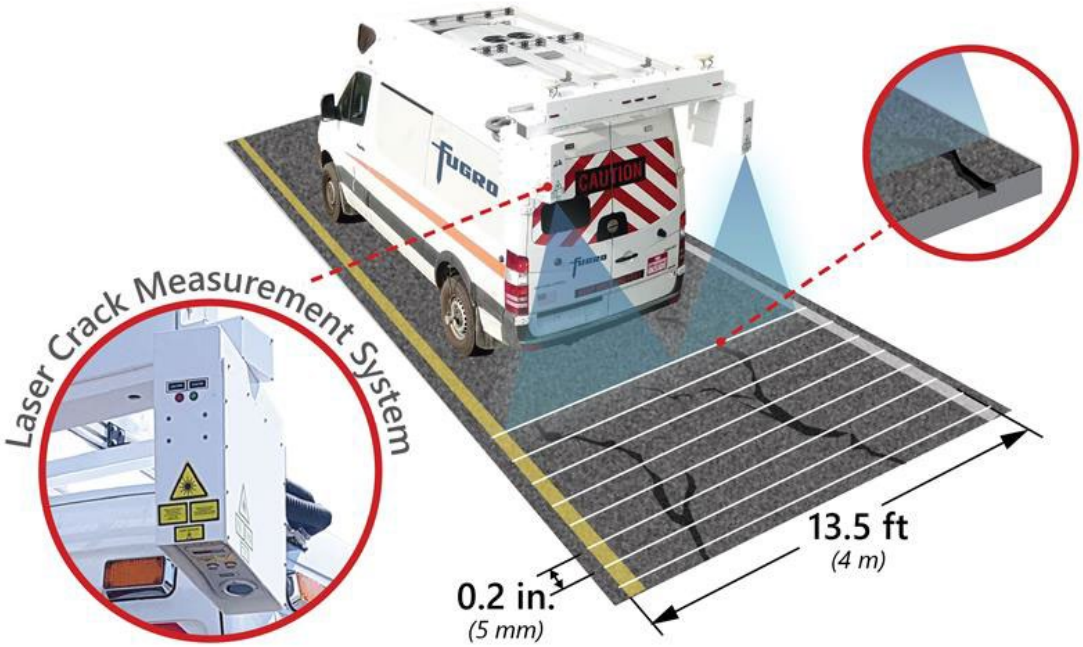

Figure 4.3: Pave3D system. Our system utilizes second generation Laser Crack Measurement System (LCMS2) sensors to collect detailed pavement image and crack depths, widths, and lengths.

Figure 4.4 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.

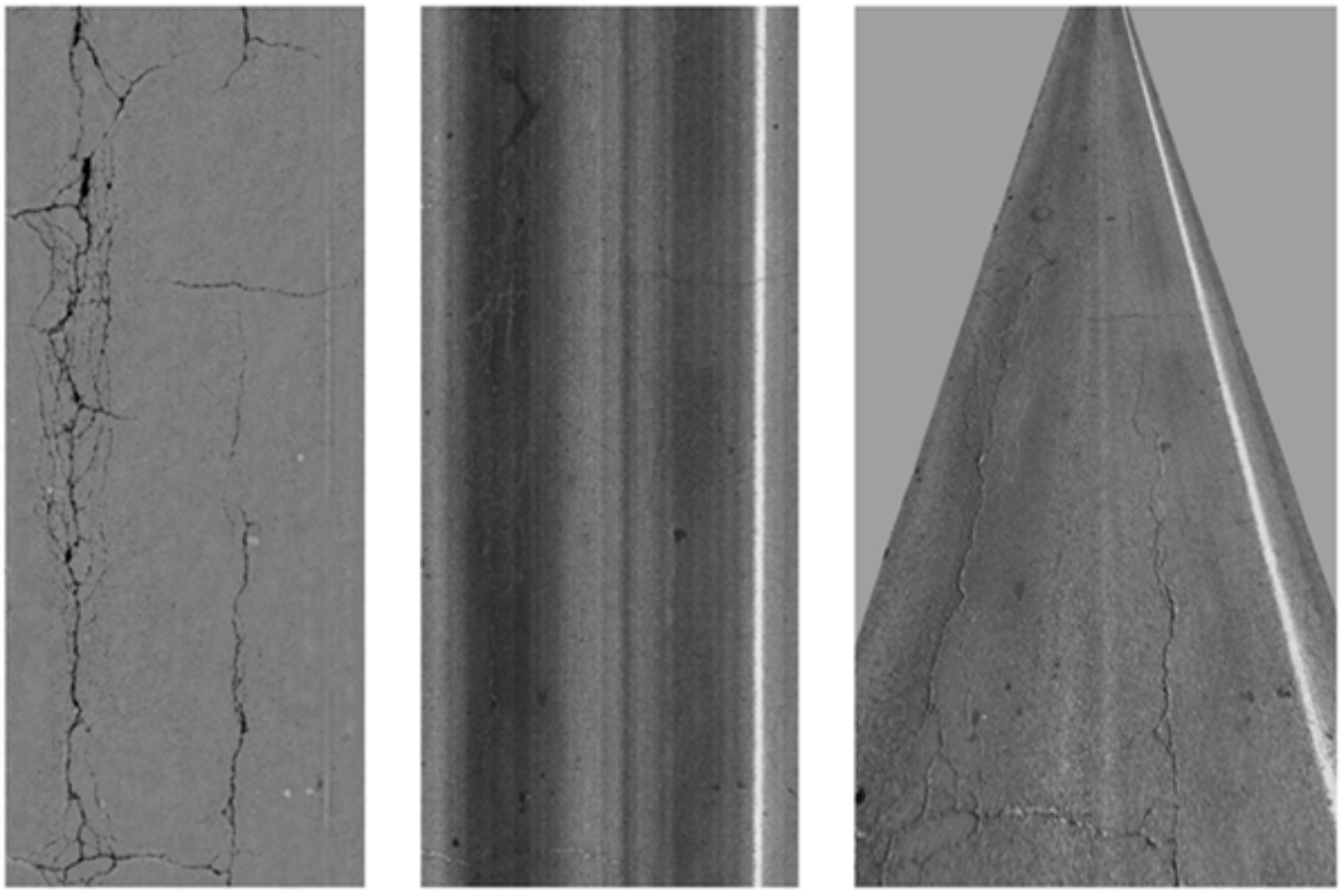

Figure 4.4: Pavement images. The 3D image on the far right combines the intensity (visual characteristics – center image) and range (cracking only - far left image) sources.

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 conditions and distress ratings within Fugro's Vision software.

4.3.1.5 Internation Roughness Index (Value Add)

Fugro's Laser SDP (South Dakota Profiler) system 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 the International Roughness Index (IRI) for maximum accuracy. The equipment conforms with AASHTO R 57 "Standard Practice for Operating Inertial Profiling System".

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 segment 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.

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.

4.3.1.6 Right-of-Way Images (Value Add)

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. The collection will be performed on dry pavement and when weather and light do not inhibit the 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) and will provide 100% and continuous coverage of the ROW in full-frame with a high pixel resolution (near 360 degree HD imagery). The ARAN will collect ROW images utilizing Sony FX9 HD cameras that offer a resolution of up to 3840 x 2160 pixels at a 16:9 aspect ratio. **Figure 4.5** 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.

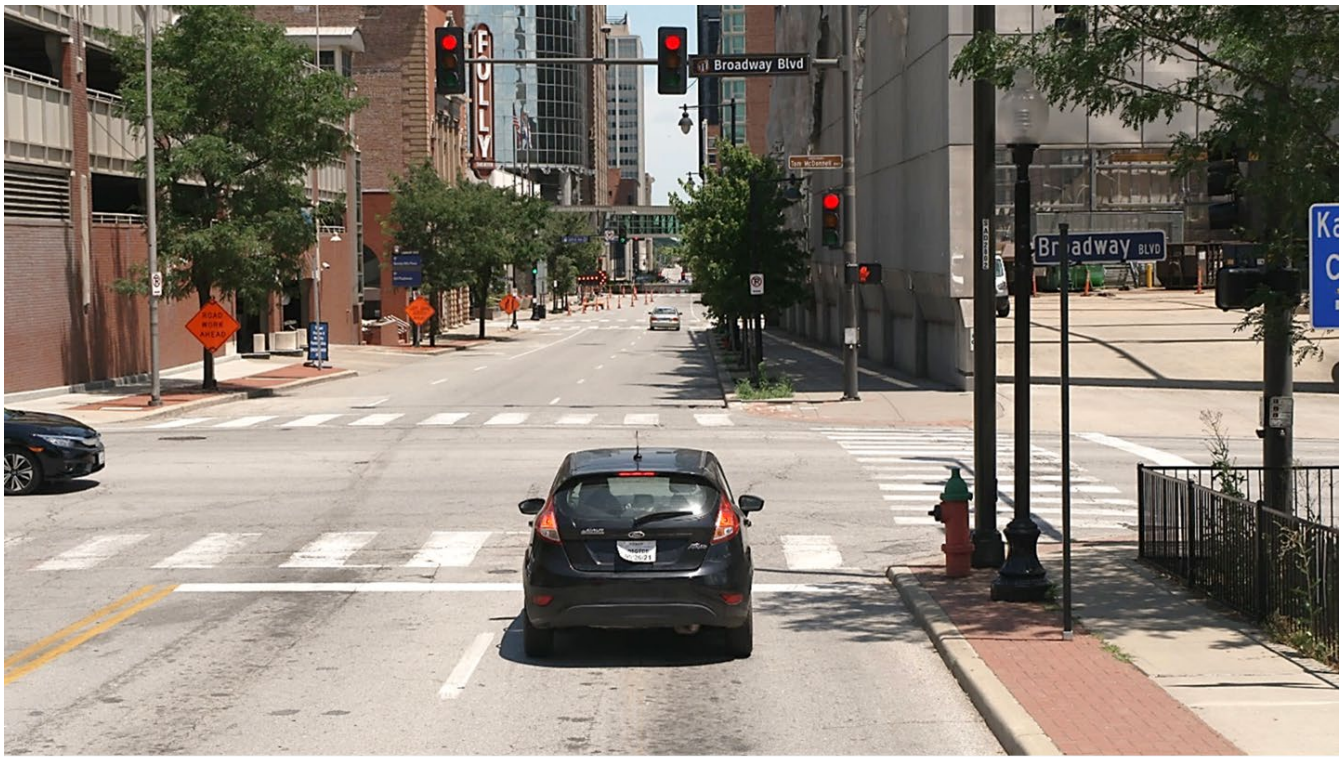

Figure 4.5: Right of Way (ROW) images. The ARAN can be set up with up to 6 cameras providing a 360 view. All cameras are calibrated and ready for photogrametric asset extraction.

4.3.1.7 ARAN Data Processing

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. **Figure 4.6** provides a screenshot of Fugro's Vision software.

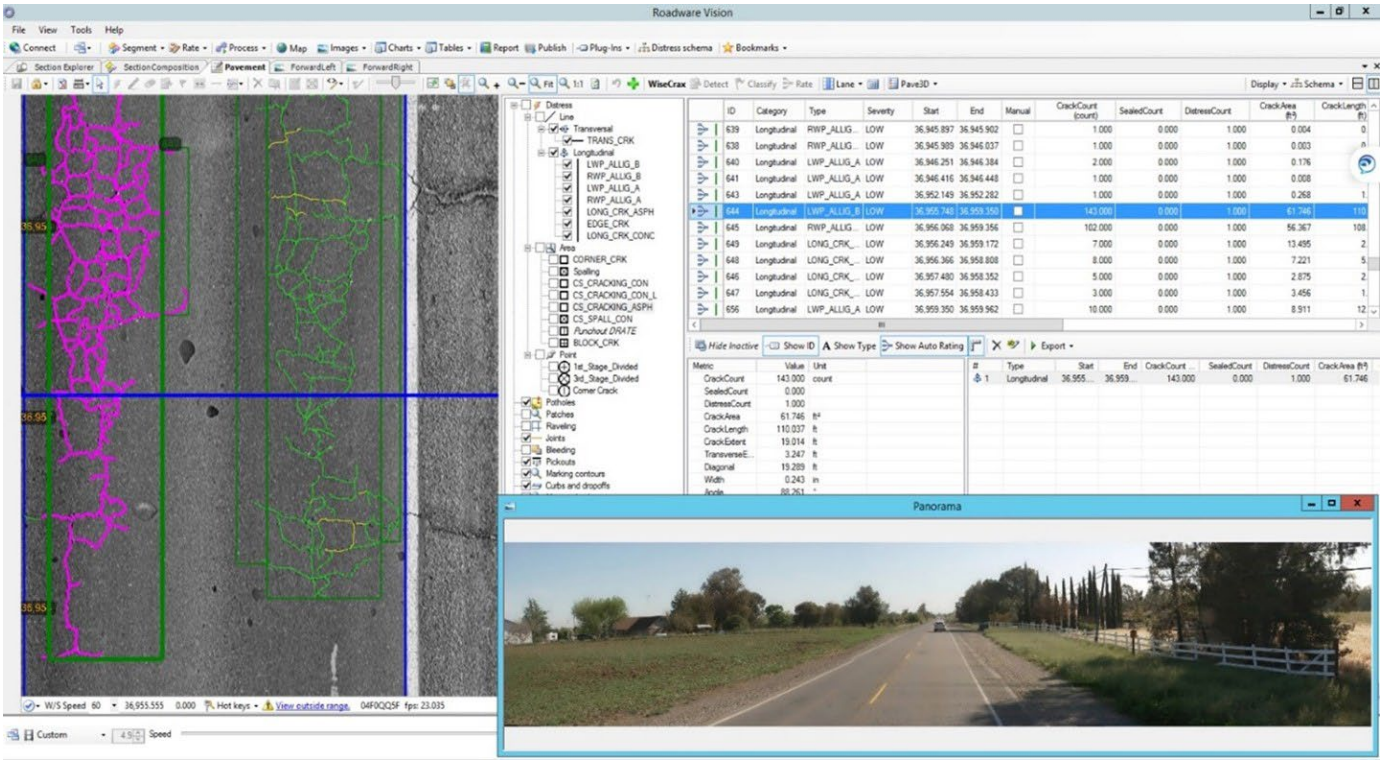

Figure 4.6: Vision Processing Software. Our Vision software is used to translate cracking data into pavement distress values used to calculate Pavement Condition Scores (PCI) using MTC's modifiifed ASTM D6433 standard.

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 Vision processing 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 multi-stage process. The following provides an overview of each phase:

- **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 MTC's modified ASTM D6433 standard and data dictionary requirements such as length of cracking, width of cracking, and crack density.

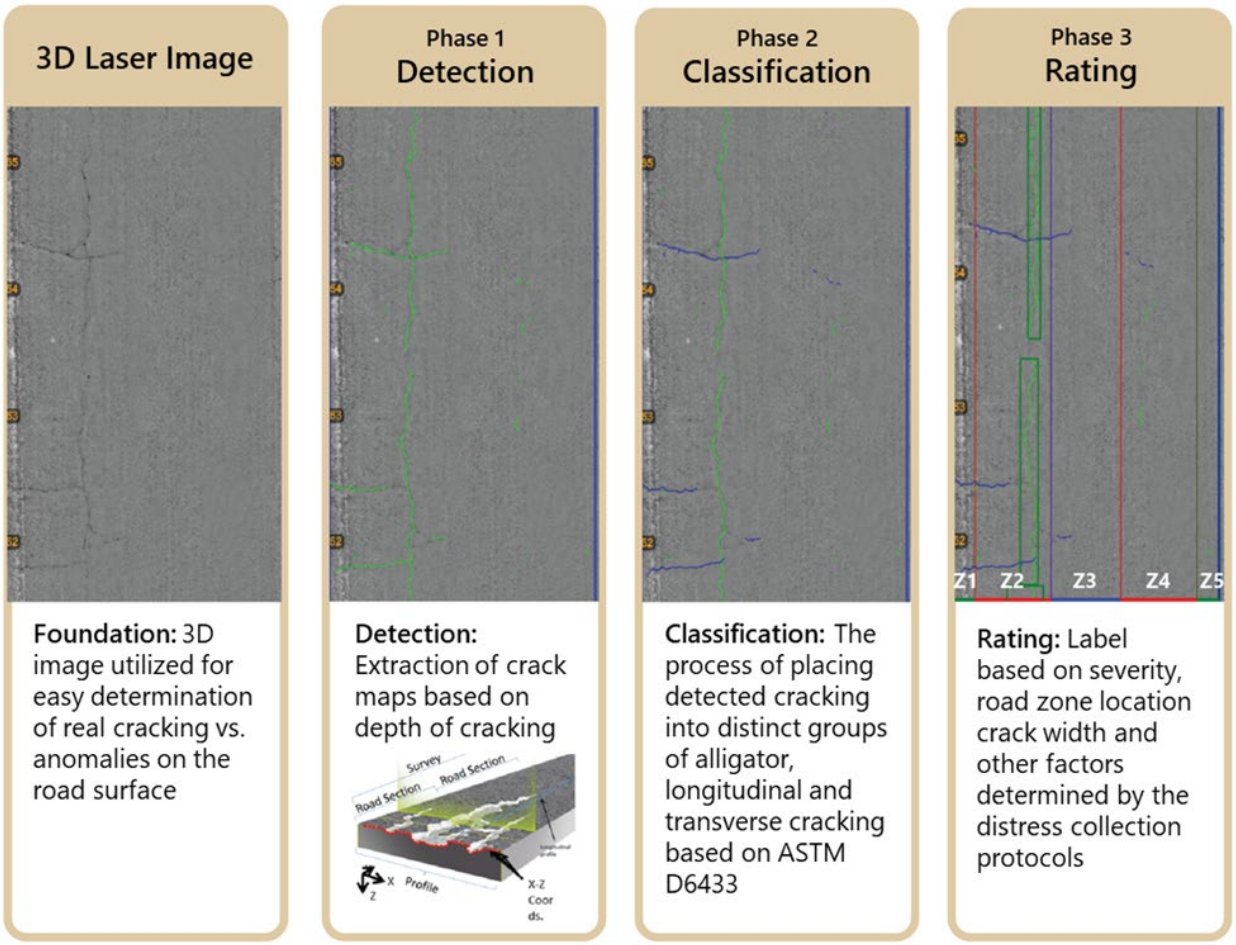

Figure 4.7: Measuring cracks and reporting distress. Using detailed 3D crack information is used to identify ASTM D6433 distress type, severity, and extent, enables our ARAN system to be more consistent, accurate, and objective than manual inspections.

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 are summarized on a pavement image and segment/network basis.
- 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.

4.3.1.8 MTC Modified ASTM D6433

The ROW and pavement facing images collected by our ARAN provide a visual representation of various cracking types, surface defects, patches, and other distresses along the roadway. These are the distresses in the modified ASTM D6433, Standard Practice for Roads and Parking Lots Pavement Condition Index Survey used by MTC. Fugro is well-versed in identifying pavement distresses defined in ASTM D6433 and the modified version. The tables that follow present the asphalt concrete (flexible) and concrete (rigid) pavement distresses and their classifications. The IDs in the tables represent the identification number in the most recent MTC Pavement Condition Index Distress Identification Manual (AC 5th Edition/PCC 4th Edition).

Table 4.2: MTC Asphalt Concrete (AC) (Flexible) Pavement Distresses and Classification

ID #	Load Related	ID#	Climate/Durability Related	ID#	Other Related
1	Alligator Cracking	**2**	Block Cracking	**3**	Distortions
6	Rutting & Depressions	**4**	Longitudinal/Transverse Cracking	**5**	Patch/Utility Cut
		7	Raveling		
		8	Weathering		

Table 4.3: MTC Concrete (Rigid) Pavement Distresses and Classifications

ID #	Load Related	ID#	Climate/Durability Related	ID#	Other Related
1	Corner Break	**7**	Spalling	**3**	Faulting
2	Divided Slab			**5**	Patching and Utility Cuts
4	Linear Cracking			**6**	Scaling/Map Cracking/Crazing

4.4 Task 4 - Review Maintenance and Rehabilitation Strategies

Fugro is experienced with a variety of PMS/AMS software packages such as StreetSaver, Cartegraph NAV, Cartegraph OMS, AgileAssets Pavement Analyst, and PAVER. Our experience with these software packages includes developing condition listings, condition maps, work plans, budget optimization, and maintenance and rehabilitation alternatives for many agencies.

4.4.1 Determine Pavement Condition Index (PCI)

StreerSaver will use the modified ASTM D6433-20 standard (i.e., HCAOG standard) to calculate PCI for all inspection units in each section. 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 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 for 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.

An example of a typical PCI rating scale is shown in **Figure 4.8** which shows pavement condition categories and PCI breakpoints, which are critical decision points for maintenance and rehabilitation treatments.

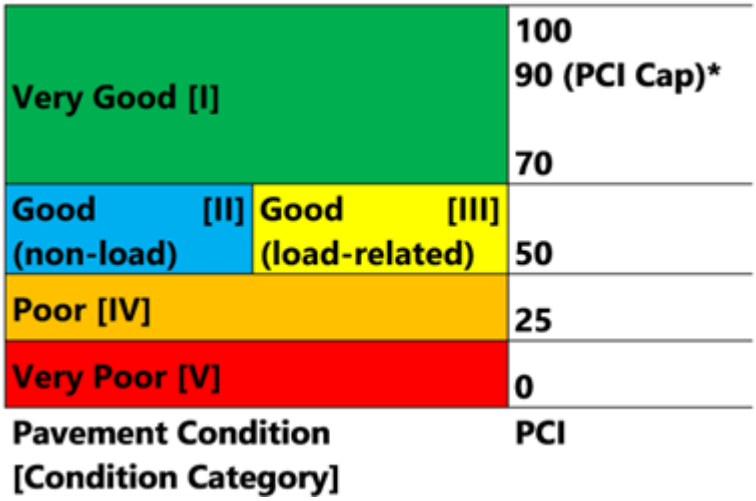

Figure 4.8: Example of pavement condition categories by PCI in StreetSaver. While accurate PCI information captures current conditions and identifies treatment and budget needs, multi-year comparison helps analyze usage-based deterioration and effectiveness of treatments.

Figure 4.9 illustrates the relation between PCI scores and asphalt pavement distresses. From the pictures shown in the figure, an increase in distress quantities and severity levels results in a decrease in the PCI.

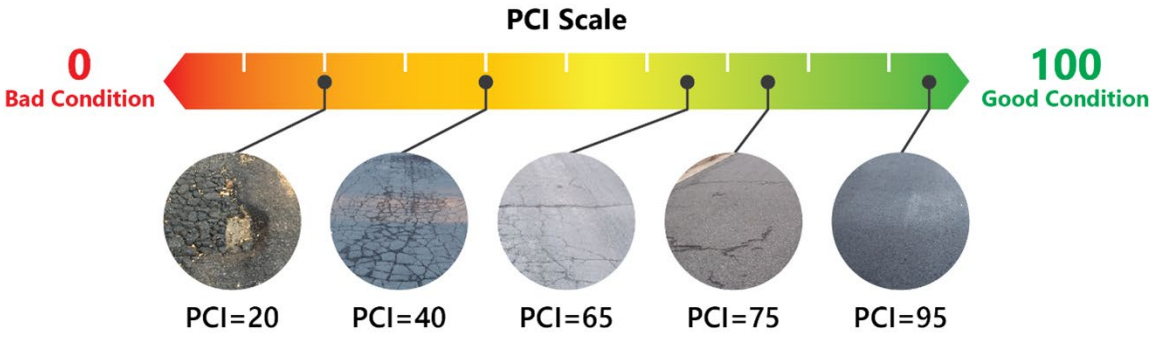

Figure 4.9: Schematic illustration of the relationship between PCI and pavement distresses for flexible pavement. Our laser-based ARAN system accurately measures and determines average and maximum crack widths essential for determining distress severity.

4.4.1.1 Review M&R Strategies

To facilitate the development of M&R recommendations, Fugro will first work with the jurisdiction staff to create the M&R decision strategy tree. M&R decision strategies would be based on the PCI values. Other factors such as the agency's past experience with various M&R strategies and also types and severity of distresses (i.e., load related distresses, weather related distresses, and materials & construction related distress) contributing to a PCI value will also impact the M&R decision strategies.

Fugro will develop the M&R decision strategy tree based on practices that have worked well for the jurisdiction. Fugro personnel have national and local experience with typical life expectancies of various maintenance/rehabilitation strategies. Fugro would discuss with the jurisdiction staff to establish treatment types for use in the M&R decision strategy tree. All existing and desired treatments will be considered. **Figure 4.10** is an example of a typical decision tree for a Northern California agency.

Fugro will provide recommendations to the jurisdiction with regard to current maintenance activities, which may include pavement preservation techniques such as slurry seals, micro-surfacing, chip-seals, overlays, pulverization, or even total pavement replacement.

For example, StreetSaver is equipped with a standard format for structuring the decision tree. Fugro will work with the jurisdiction to fine-tune the StreetSaver decision tree with their own preferred practices, which are appropriate based on local conditions such as roadway functional classification, climatic and soil conditions. Fugro will work closely with the jurisdiction to gather unit cost information for the preferred strategies and input those values into the StreetSaver program. Utilizing the StreetSaver program, the rules from the jurisdiction's decision tree are applied to each road section in the StreetSaver database to identify the applicable treatment. The program then calculates the PCI that would result from that treatment. Asphalt overlays and full reconstruction would return the PCI to 100, while seal treatments would make an incremental increase (5 to 10 points, typically) depending on what kind of distresses were present in the inspection. The program would then apply the deterioration curves and estimate the PCI one year into the future. This process is repeated for each year of a five-year cycle: (1)

based on forecast PCI, apply treatment as determined by the decision tree; (2) calculate PCI resulting from treatment; (3) project PCI ahead another year.

Functional Class	Surface	Condition Category	Treatment Type	Treatment	Cost/Sq Yd, except Seal Cracks in LF:	Yrs Between Crack Seals	Yrs Between Surface Seals	# of Surface Seals before Overlay
Arterial	AC	I - Very Good	Crack Treatment	SEAL CRACKS	$1.00	5		
			Surface Treatment	SLURRY SEAL	$8.00		8	
			Restoration Treatment	THIN AC OVERLAY(1.5 INCHES)	$30.00			3
		II - Good, Non-Load Related		CAPE SEAL	$9.00		8	
		III - Good, Load Related		AC OVERLAY (2")	$35.00			
		IV - Poor		AC OVERLAY (3")	$52.00			
		V - Very Poor		RECONSTRUCT SURFACE (AC)	$82.00			
	AC/AC	I - Very Good	Crack Treatment	SEAL CRACKS	$1.00	5		
			Surface Treatment	SLURRY SEAL	$8.00		8	
			Restoration Treatment	THIN AC OVERLAY(1.5 INCHES)	$30.00			3
		II - Good, Non-Load Related		CAPE SEAL	$9.00		8	
		III - Good, Load Related		AC OVERLAY (2")	$35.00			
		IV - Poor		AC OVERLAY (3")	$52.00			
		V - Very Poor		RECONSTRUCT SURFACE (AC)	$82.00			
	AC/PCC	I - Very Good	Crack Treatment	SEAL CRACKS	$1.00	3		
			Surface Treatment	SLURRY SEAL	$5.00		6	
			Restoration Treatment	THIN AC OVERLAY(1.5 INCHES)	$30.00			3
		II - Good, Non-Load Related		AC OVERLAY (2")	$25.00			
		III - Good, Load Related		AC OVERLAY (2")	$50.00			
		IV - Poor		AC OVERLAY (2")	$60.00			
		V - Very Poor		RECONSTRUCT SURFACE (AC)	$70.00			
	PCC	I - Very Good	Crack Treatment	SEAL CRACKS	$1.00	3		
			Surface Treatment	DO NOTHING	$0.00		99	
			Restoration Treatment	DO NOTHING	$0.00			100
		II - Good, Non-Load Related		DO NOTHING	$0.00			
		III - Good, Load Related		DO NOTHING	$0.00			
		IV - Poor		DO NOTHING	$0.00			
		V - Very Poor		DO NOTHING	$0.00			

Functional Class and Surface combination not used

Selected Treatment is not a Surface Seal

Figure 4.10: Typical M&R decision tree for California agency. Our project team relies upon California-licensed Profreesional Engineers with experince and knowledge of applying commonly used M&R treatments.

4.4.1.2 Budget Analysis and Finding Scenarios

Budget analyses will be performed to understand the funding necessary to address certain pavement conditions. Fugro is very experienced at performing various budget analyses for agencies. Fugro would first compute the "Budget Needs" analysis for the jurisdiction. The budget needs analysis represents the "ideal world" or unconstrained funding levels. Based on the jurisdiction's M&R strategies and the condition indices of the sections, the PMS program would select a maintenance or rehabilitation action and compute the total costs over a period of time (e.g., 5 year M&R work plan). The results of the budget needs analysis can then be compared with several "what-if" budget analyses.

Based on discussions with the jurisdiction, Fugro will prepare several budget scenarios that are either "budget" driven or "target" driven. Under a "budget" driven scenario, Fugro will utilize the PMS program to evaluate the impact of a given (predetermined) annual "existing budget" for the M&R program on the overall network PCI value with time. Under a "target" driven scenario, Fugro will utilize the PMS program

to determine the annual M&R budget needed for maintaining (or improving) the overall network PCI value by a predetermined target value. **Figure 4.11** shows an example of the effect of various funding levels on the network PCI. Typical scenarios that could be included are the following:

- Budget Needs Assessment.
- Existing Budget.
- Maintain Current PCI.
- Improve Network PCI (by 5 pts).
- Improve Network to Regional Target PCI.

Each budget scenario studied will show future pavement maintenance needs and future rehabilitation needs. Fugro will show the deferred maintenance cost (unfunded backlog) for each budget scenario. Based on the budget analyses, the jurisdiction would then select a scenario that best fits its current and upcoming funds.

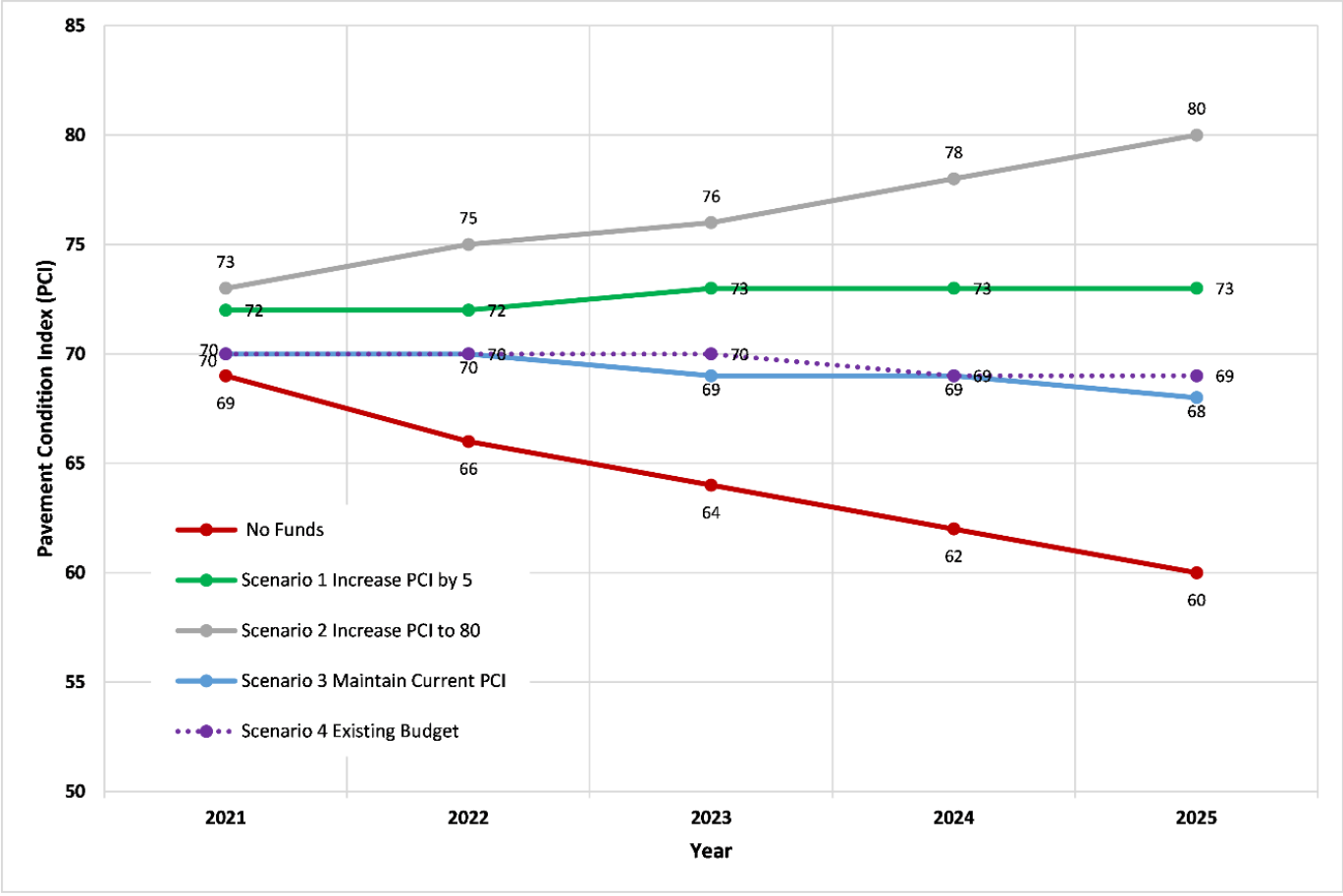

Figure 4.11: Example of different funding levels on Network PCI. Budget scenario analysis allows asset owners to identify funding gaps, quantify risk, and advocate for appropriate funding.

4.4.1.3 Draft Pavement Management Report

Fugro will prepare a draft Fixed Asset Management System Report discussing the outcomes of rehabilitation strategies, recommendations, and budgeting requirements for jurisdiction review and input before preparing the final report. The draft report shall include the following items for jurisdiction review and approval.

- Current PCI in tabular form.
- Current curb and gutter, sidewalk, and ADA ramps conditions in tabular form.
- Condition distribution by functional classification.
- Exhibit showing proposed annual work to be performed based upon available funding over a 5-year period.
- Clear and legible colored map exhibits including street names and pavement conditions. Maps showing attribute information, PCI with limits, length, lanes, and type of pavement, and other applicable items.

4.5 Task 5 - Final Reports

4.5.1.1 Pavement Management System Projects

The final report shall be presented in a single comprehensive document, containing all items in the draft report and the following items:

- **Executive Summary** – Fugro will provide a summary outlining the completed project that would be suitable for stakeholders to review.
- **Relevant Background Information** – This will include the purposes of the project and background on PMS.
- **Methodology for Field Survey** – Fugro will describe the equipment used for the field survey. We will also discuss the data processing and analysis used to report the data.
- **Description of work history or completed M&R** – Fugro will provide a description of the completed M&R that the jurisdiction has recently performed. Most of this information will have been provided by the jurisdiction prior to our data collection.
- **Methodology for Budget Analysis** – Fugro will provide a thorough discussion of the budget analysis performed for the jurisdiction. This will include showing the costs of deferred maintenance, the multi-year budget and/or target driven scenario analysis.
- **Multi-year M&R Work Plan** – Based on the budget analyses and in consultation with the jurisdiction, a scenario would be selected that best fits the jurisdiction's current and upcoming funds. The work plan (e.g., 5 years) would indicate which treatments would be applied to each pavement section based on the M&R decision tree and the associated costs.
- **Draft Pavement Management Program Certification Status letter** to the jurisdiction and to HCAOG.

4.5.1.2 Image Access on Automated Collected Data (ARAN)

Another deliverable we will provide the jurisdiction is all collected images (i.e., ROW images, downward facing pavement images) on a hard drive. This ensures that the jurisdiction has a copy of its data and acts as a backup to our data collection activities. Fugro provides images typically every 25 ft. The images will be related to our GDB delivery.

Fugro also provides access to our iVision5 viewing software for a year. It will provide the jurisdiction with a powerful tool to review collected images in a synchronized, GIS-based environment. iVision5 can be accessed by any device with internet access and is shown in **Figure 4.12**. It has a user-friendly interface that jurisdiction personnel can utilize. In addition, the user does not have to have ArcGIS expertise or have ArcGIS installed on their computer. If needed, Fugro will provide training on the usage of iVision5. Our iVision5 application offers:

- Ability to create and customize tables, charts, graphs for data analysis and synchronized viewing.
- User options to view any combination of roadway and pavement image views.
- Year-to-year comparisons of all data in all views in one session or multiple sessions.
- GIS-type map showing the location of current view including Google Maps, Microsoft Virtual Earth (Bing Maps), or state-owned mapping/ ortho photos.
- "U-turn" function for viewing the opposite direction at the same location without having to re-input location coordinates.
- Capability to overlay distresses on the pavement image.
- Query capabilities for all attributes in the databases (e.g., Route, year, distress levels, pavement types).

Figure 4.12: iVision5 viewing software. This platform allows all agency staff to virtually drive and inspect any ARAN collected road using any computer or mobile device.

4.6 Task 6 - Presentation Of Completed Pavement Management System Update

Fugro will prepare a presentation tailored to the TAC and HCAOG Council, management staff, and other stakeholders. The presentation will provide a summary of the pavement network (including results of the pavement condition update), as well as budget and planning recommendations.

4.7 Task 7 – Training

Fugro is thoroughly experienced with StreetSaver and will be able to provide training to the HCAOG and member jurisdictions. The software training will include hands-on software training. The training will include all aspects of the PMS including data entry and editing, performing PCI calculations and budget and analysis, generating reports, and use of the GIS toolbox. Each participant will need to provide computers with internet access (Wi-Fi). Mr. Tavares, the proposed project manager, will lead the Fugro team training activities. He has over two decades of pavement management experience and has conducted numerous training programs related to the field of pavement engineering and management. By the end of the training seminar, the agency staff will be able to implement, update, and maintain their PMS software to provide decision makers with accurate pavement condition data and corresponding analyses.

5. Work Plan & Schedule

Fugro is prepared to deliver all necessary resources and experience to you're the HCAOG. Fugro is confident in our abilities to deliver projects that will increase any jurisdiction's economic growth, opportunity, and quality of life for all transportation system users. We currently have a fleet of 26 vehicles in North America with multiple already in the state for our Caltrans project, and a slack capacity to accommodate emergencies and new requirements. Our large ARAN fleet ensures schedules are easily met. The ARAN fleet is serviced and calibrated in-house at our Richmond, Virginia office.

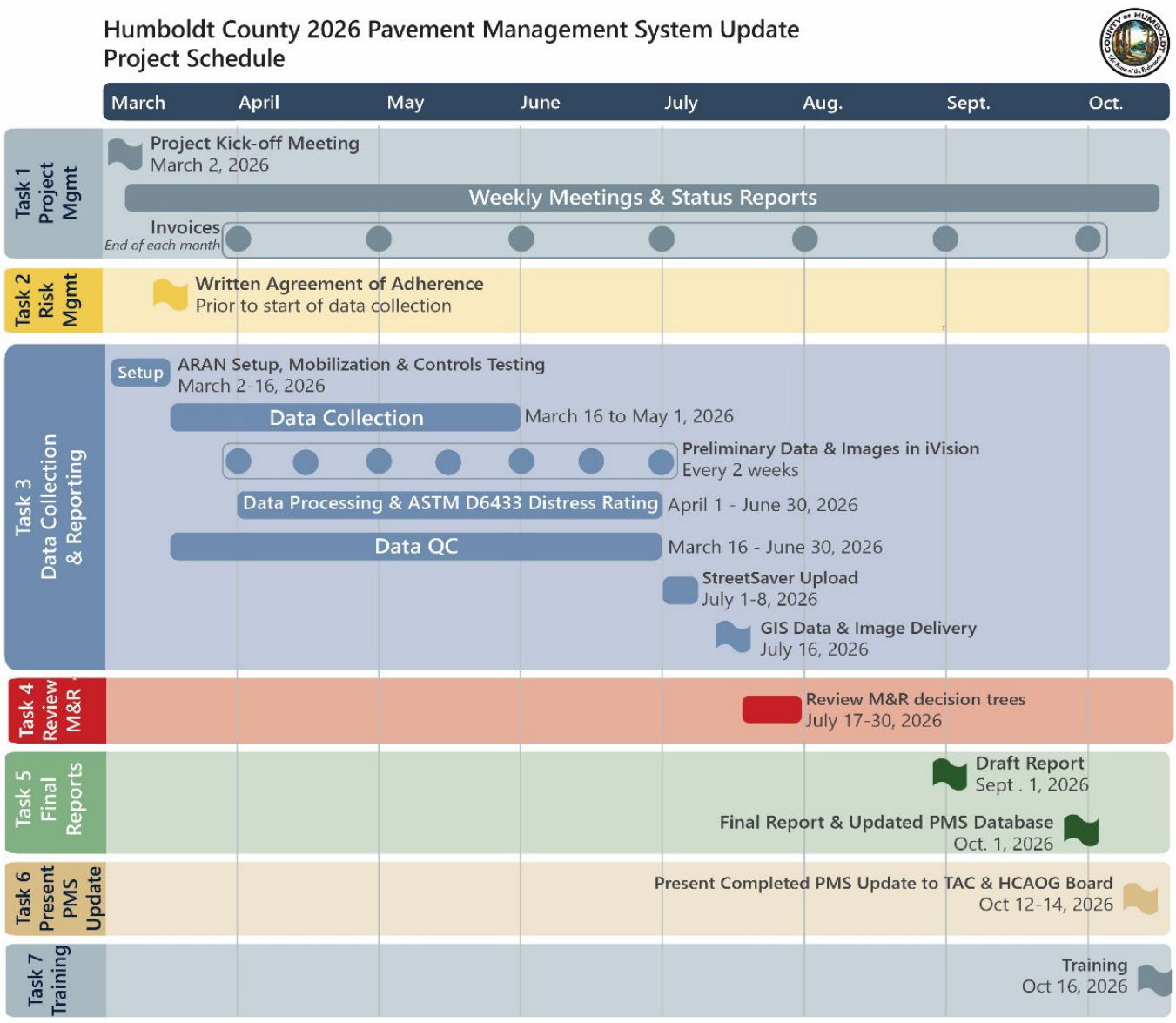

Figure 5.1: Project Schedule. Field data collection has the largest effect on our schedule. Our large ARAN fleet and in-State presence for the Caltrans project will help mitigate any equipment-related risks.

6. Cost Proposal

Fugro has provided the level of effort per task as shown in **Table 6.1**.

Table 6.1: Pricing Table

Staff	Position	Rate ($/Hr)	Hours Per Task							Total Hours	Total Labor
			1	2	3	4	5	6	7		
Michael Tavares, PE	Project Manager	$230.00	20		15	25	30	16	16	122	$28,060.00
Dr. Sirous Alavi, PhD, PE	Technical Advisor	$280.00	5			5	10	5		25	$7,000.00
Mainey James, PE	Project Engineer	$200.00	2		10	10	20			42	$8,400.00
Setare Saremi, PhD, PE	Project Engineer	$180.00	2		40	50	30	20	10	152	$27,360.00

Other Direct Costs	Task	Total Direct
ARAN Collection and Processing (1163.03 Centerline Miles - Estimated 1692.83 Test Miles) *	3	$144,180

Total Fee	**$215,000.00**

* Test milage was estimated using the following assumption:

- For residential streets, collect only one lane.
- For arterial and collector streets, collect one in each direction.

7. Required Attachments (Resumes)

Michael P. Tavares, P.E.

Project Manager, Principal Engineer

Years of Experience: 26 years **Length of Time with the Company:** 9 years

Project Responsibilities & Role:

Mr. Michael P. Tavares, P.E. is the proposed Project Manager. Mr. Tavares has over 26 years of experience in transportation engineering including pavement evaluation, pavement design, and pavement & asset management working on projects for Federal, State, and Local Agencies. Mr. Tavares is a registered professional engineer in California and Nevada. Mr. Tavares serves as a principal engineer and project manager for pavement engineering and management projects and provides support to business development activities. He has been the lead engineer on over 100 transportation engineering projects including transportation research, pavement designs, pavement rehabilitations, pavement management systems, asset management systems, traffic impact studies, corridor studies, pedestrian studies, circulation studies, signal warrant studies, and traffic & pavement data collection studies. Mr. Tavares is an expert in life-cycle cost analysis, pavement data collection, quality control & quality assurance (QC/QA), and pavement data analysis.

Education Background/Professional Certifications

1995 – The University of Texas at El Paso, BSc Civil Engineering

1998 – The University of Texas at El Paso, MSc Civil Engineering

Professional Engineering Licenses

Professional Engineer: California (#C68608), Nevada (#20411)

Professional Affiliations

ASCE, APWA, Alpha Chi, CalAPA, Chi Epsilon, Golden Key National Honor Society, ITS Nevada, Tau Beta Pi, Transportation Research Board (Past Young Member) on Committee AFD Highway Traffic Monitoring

Training/Skills

Metropolitan Transportation Commission (MTC) StreetSaver Certified Rater (Current)
Trimble/AgileAssets Pavement Analyst Certification
Cartegraph OMS Certification
Orange County Transportation Authority (OCTA) Prequalified Pavement Inspector (Past)

Trimble/AgileAssets Pavement Analyst, PAVER, StreetSaver, AASHTOWare Pavement ME Design, AASHTO 93, FPS21 (Pavement design software). ELMOD, Modulus 6.0, ProVAL, AutoCAD, FHWA Realcost (Life-Cycle Cost Analysis Software), ArcGIS, Microsoft Office

Project-Related Experience

- NMDOT Aviation HWD Testing and PCR Reporting 2024 – For the NMDOT Aviation Division, Fugro performed network level HWD testing and International Civil Aviation Organization (ICAO)'s Pavement Classification Rating (PCR) reporting for 9 airports. As the project task lead, Ms. James oversees the pavement data collection, data analysis and reporting for the project.
- MTC of San Francisco Bay Area Pavement Technical Assistant Contract (P-TAP) – Mr. Tavares served as Senior Engineer, Certified Rater, and Supervisor of all field data collection tasks. The contract was a multi-year project to provide PMS data collection and analysis including developing pavement

management maintenance & rehabilitation (M&R) plans for various jurisdictions within the San Francisco Bay Area Region utilizing StreetSaver. The program objectives included providing information with regards to the collected pavement distress data quality management, network level pavement repair options, budget analysis with annual and multi-year programming, impact of varying levels of budgets, and cost-effective pavement repair recommendations. Mr. Tavares served 20 agencies under this contract.

- Government of Manitoba PMS Replacement Project (2021-2022) – Mr. Tavares served as Senior Engineer and certified Pavement Analyst user. Fugro replaced Manitoba's legacy PMS software with AgileAssets' Pavement Analyst. Work included review of past data, conversion of data to new LRM, and development of network-level performance models.
- City of Sugar Land, Texas Street Pavement Assessment – Served as the Project Manager responsible for all project related activities, communication, quality, and client deliverables. Fugro collected pavement, asset, and lidar data for over 1,000 test miles of City streets. Assets included curb type, curb ramps, traffic signals, linear pavement markings, point pavement markings, etc. Lidar included .LAS point cloud with calibrated 360-degree ladybug imagery.
- Federal Highway Administration (FHWA) Identification of Effective Next Generation Pavement Performance Measures and Asset Management Methodologies to Support MAP-21 Performance Management Requirements – The objective of this study was to identify effective next generation pavement performance measures and asset management methodologies to support "The Moving Ahead for Progress in the 21st Century Act (MAP-21)." Mr. Tavares served as a Project Engineer providing a literature review and co-authored the final report.
- FHWA – Long-Term Pavement Performance Southern Regional Support Contract - Served as the pavement traffic data coordinator on FHWA LTPP Southern Regional Support Contract (SRSC). In 1987, the LTPP program began an ongoing study consisting of rigorous long-term field experiments monitoring of more than 2,400 asphalt and Portland-cement concrete pavement test sections across the U.S. and Canada. Mr. Tavares oversaw traffic data QC/QA and analysis for over 600 test sections in eleven southern states and Puerto Rico.

Selected Publications, Reports, and Presentations:

- Alavi, S., N. Kargah-Ostadi, M. Tavares, J. Daleiden, "Pavement Performance Measures and Asset Management Methodologies to Support MAP-21 Performance Management Requirements," prepared for FHWA Contract Number: DTFH6115C00046, September, 2016.
- Alavi, S., M. Tavares, "'Highway Project Cost Estimating and Management", Report #FHWA/MT-08-007/8189, prepared for the Montana Department of Transportation in cooperation with FHWA, February, 2009.
- Alavi, S., J. Le Cates, M. Tavares, "Falling Weight Deflectometer Usage", NCHRP Synthesis 381, 2008.
- Alavi, S., M. Tavares, "Ride Specification Review for the Montana Department of Transportation," Final Report to MDT, FHWA/MT-004-8179, June 2006.
- Alavi, S., M. Tavares, Nadarajah Suthahar, "Flexible Pavement Design Manual", Regional Transportation Commission of Washoe County, February 2007.
- Alavi, S., M. Tavares, "Guidelines for Traffic Calming", prepared for the City of Sparks, Nevada, December 2005.

Sirous Alavi, Ph.D., P.E., PTOE

Director, Pavement Engineering & Infrastructure Management Americas

Years of Experience: 33 years **Length of Time with the Company:** 9 years

Project Responsibilities and Role:

Dr. Sirous Alavi, P.E., PTOE is the proposed Project Manager. Dr. Alavi has over 33 years of experience in the U.S. transportation community and in the areas of transportation engineering, traffic engineering, pavement design & rehabilitation, and pavement & infrastructure asset management. In his professional career so far, he has managed over 200 transportation engineering consulting projects for federal, state, and local agencies. Throughout his career, he has served various engineering consulting firms as senior engineer, chief engineer, senior consultant, department manager, division manager, member of the board of directors, and president. He is a professional engineer in several states including California.

Dr. Alavi's transportation engineering projects include transportation research, pavement designs, pavement rehabilitations, pavement and asset management systems, traffic impact studies, corridor studies, pedestrian studies, circulation studies, signal warrant studies, and traffic & pavement data collection studies for cities, counties, and state agencies. Dr. Alavi has authored numerous publications, reports, and technical briefs and has made presentations at conferences, seminars, and various agencies. He routinely serves as a reviewer and a technical committee member for scientific journals.

Education Background/Professional Certifications

1992 – Ph.D. Civil Engineering, Transportation Engineering, (Ph.D. Thesis in Pavement Engineering, Minors: Construction Management, City & Regional Planning), University of California at Berkeley

1988 – M. Eng. in Civil Engineering, Transportation Engineering, University of California at Berkeley

1985 - MSc. Civil Engineering, Structural Engineering, The George Washington University

1983 – BSc. Civil Engineering, The George Washington University

Professional Traffic Operation Engineer (PTOE # 3930)

Professional Engineering Licenses

California (#84641), Florida (#PE93921), Virginia (#0402029560), Texas (#134692), Nevada (#14157), Arizona (#62404), New Hampshire (#15264), Tennessee (#123476), Delaware (#25837), Utah (#13099901-2202), Wyoming (#18140), Maryland (#62768)

Professional Affiliations

American Society of Civil Engineers (Past Board Member: Orange County Transportation & Development Institute), Institute of Transportation Engineers, Association of Asphalt Paving Technologists, Transportation Research Board [Past Committee Member ABJ35 Highway Traffic Monitoring (9 Years), Past Committee Member AFD60 Flexible Pavement Design (9 Years)], Transportation Research Board (Current Committee Member AKP50 Pavement Surface Properties and Vehicle Interaction)

Project Management Experience

- Served as the Project Manager for over 50 PMS Update Projects in the Past 5 Years
  - New Mexico DOT Airport Pavement Management System Update (2022-2026)
  - Province of Manitoba Pavement Management System Replacement (2021-2025)
  - City of Hampton Pavement Data Collection (2024-2025)

- City of Burleson Street Pavement Assessment (2023)
- City of Jacksonville Pavement Management System Update (2022-2023)
- City of DeSoto Pavement Management System Update (2022-2023)
- City of Manvel Pavement Management System Update (2021-2023)
- City of Hampton Pavement Data Collection Services (2022)
- City of Steinbach Pavement Management System Update (2022)
- City of Dallas Pavement Condition Survey (2022)
- City of Schertz Pavement Management System Update (2021)
- City of Richardson Pavement Management System Update (2020-2021)
- City of Bulverde Pavement Assessment and Evaluation (2020)
- City of Corinth Pavement Management System Update (2020)
- City of Buda Pavement Management System Update (2020)
- City of Dallas Pavement Condition Assessment Asset Collection, FWD, and GPR (2018-2019)
- City of Abilene Pavement Condition Assessment (2021-2022)
- City of Missouri City Pavement Condition Assessment (2019-2020)

- FHWA Next Generation Pavement Performance and Asset Management System Development Government of Manitoba PMS Replacement Project (with Trimble/AgileAssets Pavement Analyst) 2021-2022
- Alaska DOT&PF Trimble/AgileAssets Pavement Analyst and Pavement Engineering Support 2022-2023
- MTC of San Francisco Bay Area Pavement Technical Assistant Contract (MTC P-TAP) - Agency StreetSaver PMS Updates 2017-2020
- NCHRP Synthesis 381 Falling Weight Deflectometer (FWD) Usage
- FHWA Long-Term Pavement Performance Western Regional Support Contract
- Montana Department of Transportation (MDT) Highway Project Cost Estimating and Management
- FHWA/NCHRP Accelerated Field Test of Performance-Related Specifications for Hot-Mix Asphalt Construction (WesTrack) Project
- State of Montana Project on Ride Specification Review for Flexible Pavements
- Nevada Department of Transportation (NDOT) Project Cost Estimation for Planning
- Montana Department of Transportation (MDT) Highway Project Cost Estimating and Management
- State of Arizona Development of New Pavement Design Equivalent Single Axle Load (ESAL) Project
- Vehicle Miles Traveled Fee Study, Phase I, for Nevada DOT
- American Society of Civil Engineering Research Foundation (CERF) Weigh-In-Motion (WIM) Evaluation

Mainey James, P.E.

Senior Engineer

Years of Experience: 17 years **Length of Time with the Company:** 17 years

Project Responsibilities & Role:

Ms. Mainey James, P.E. is a proposed Senior Engineer. Ms. James has over 17 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 implements the principles of project management to plan and execute projects within the expected schedule and cost. Her pavement engineering and research experience ensures that the deliverables are of high quality and beneficial to the client and their stakeholders. Example projects include assisting the TxDOT State Highway 99 construction team in the quality testing and verification of the pavement layers using Falling Weight Deflectometer (FWD) testing. For the City of Abilene, she led the analysis for the network level structural capacity testing using FWD, and Pavement Management System (PMS) implementation. She recently was the project manager for PMS and asset services for City of Waller, TX; City of Missouri City, TX, and City of Spring Valley Village, TX.

Education Background/Professional Certifications

2007 – M.Sc. Civil Engineering, University of Arkansas

Professional Engineering Licenses

Professional Engineer: Texas (#107425)

Professional Affiliations

Texas Department of Transportation (TxDOT) Pre-Certified (24432)
American Society of Civil Engineers (10748805)

Training/Skills

Project Management, Non-destructive Pavement Evaluation and Analysis, Pavement Distress Survey, Roadway Skid Evaluation, Profile evaluation (PROVAL), Pavement Structural Capacity and Load Limit Analysis using Falling Weight Deflectometer (FWD) non-destructive data analysis (layer moduli backcalculation analysis using MODULUS, ELMOD, BACKFAA), Pavement Design (TxDOT FPS-21, TxCRCP-ME, AASHTO 93, AASHTOWare Pavement ME), Airfield Pavement Design (FAARFIELD, COMFAA), Pavement Remaining Life Analysis (AASHTO), Life-Cycle Cost Analysis (FHWA RealCost), Sidewalk Pavement Survey (Pinpoint GIS software), Pavement Management System (PAVER), geo-spatial data analysis (ArcGIS), and Quality Related Specification Software (QRSS) for Hot-Mix Asphalt Construction

Project-Related Experience

- NMDOT Aviation HWD Testing and PCR Reporting 2024 – For the NMDOT Aviation Division, Fugro performed network level HWD testing and International Civil Aviation Organization (ICAO)'s Pavement Classification Rating (PCR) reporting for 9 airports. As the project task lead, Ms. James oversees the pavement data collection, data analysis and reporting for the project.

- City of Missouri City Pavement Services – 2024 – For the City's Sienna MUD, Fugro performed network level pavement condition and sidewalk assessment. As the project manager, Ms. James is currently performing the project coordination, pavement and sidewalk data analysis and reporting for the project.
- City of Spring Valley Village Pavement Condition Assessment – 2024 – Fugro performed network level pavement data collection and PCI reporting. As the project manager, Ms. James oversees the project coordination, pavement data collection, ARAN demo, data analysis and reporting for the project.
- City of Burleson Pavement Data Collection – 2023 – As a part of the City's pavement management program, Fugro performed network level pavement data collection and asset extraction (pavement markings, signs, and traffic signals). As the project manager, Ms. James oversaw the project coordination, pavement data collection, data analysis and reporting for the project.
- Town of Addison Pavement Data Collection – 2023 – As a part of the City's pavement management program, Fugro performed network level pavement data collection and asset extraction (pavement signs, sidewalk length, sidewalk ramps). As the project manager, Ms. James oversaw the project coordination, pavement data collection, data analysis and reporting for the project.
- City of Abilene Pavement Data Collection and PMS Analysis – 2021 – As a part of the City's pavement management program, Fugro is collecting network level pavement data collection including pavement structural testing using FWD to include structural parameter in treatment selection decision matrix and perform PMS update to develop a 5-year treatment work plan. As the project engineer, Ms. James is currently assisting with the structural capacity testing of the arterial streets in the network.
- City of Waller PMS Services – 2022 – Fugro performed network level pavement data collection and PMS update to develop a 10-year treatment work plan. As the project manager, Ms. James performed the data analysis to develop the recommended 10-year work plan considering their maintenance treatment types, decision matrix, and multiple budget scenarios using Cartegraph software.
- Missouri City Network-Level Sidewalk Survey – 2020 - For the City's network-level PMS update, along with the pavement data collection, manual sidewalk survey and reporting using GIS based pin-point software was performed. As the project engineer, Ms. James performed the survey, data quality review, analysis, and reporting.
- City of Dallas Network-Level Pavement Structural Capacity Evaluation – 2019-2020 – For understanding the network-level structural condition of the City of Dallas arterial streets, a comprehensive pavement structural evaluation using non-destructive techniques such as Ground Penetrating Radar (GPR) and FWD was performed. As the project engineer, Ms. James performed data quality checks, data analysis, and reporting.

Setare Ghahri Saremi, Ph.D., P.E.

Project Engineer

Years of Experience: 3 years **Length of Time with the Company:** 3 years

Project Responsibilities & Role:

Dr. Setare Ghahri Saremi is a proposed Project Engineer. Dr. Saremi has been a project engineer on a number of our recent projects including the City of San Diego, CA and the City of Schertz, TX. Dr. Saremi has extensive experience in pavement engineering, development of prediction models, structural evaluation, and non-destructive testing methods. She is very knowledgeable in data mining and machine learning modeling as well. As an engineer at Fugro, her expertise in examining concrete strength by a combination of destructive and non-destructive testing methods has been a major contribution to the pavement engineering group. Throughout her academic career, she was awarded several research fellowships from the University of Maryland.

Education Background/Professional Certifications

2022 – Ph.D., Civil Engineering (Geotechnical and Pavement), University of Maryland
2018 – M.S., Civil Engineering (Transportation Geotechnics & Infrastructure Materials), University of Texas at El Paso
2014 – B.S., Civil Engineering, Sharif University of Technology

Professional Engineering Licenses

Professional Engineer: Texas (#155237)

Training/Skills

Cartegraph OMS Certification, Proficient in a variety of programming and pavement engineering software, including R, MATLAB, Python, SQL, Java, ArcGIS, PAVER, Cartegraph, MODULUS, KENPAVE, FPS21, AASHTOWare, StreetPave, AutoCAD, and more.

Project-Related Experience

- NMDOT Aviation Airport Pavement Management (2022-2025) – Fugro is performing a four-year pavement condition survey on 48 airports to update the NMDOT Aviation's Airport Pavement Management System (APMS). As a project engineer, Dr. Saremi is assisting with ensuring the quality control standards for the distress rating and pavement network data collection process, calculating the PCIs for collected sections, and developing airport specific work plans.
- City of Steinbach Pavement Management Services (2022) – Fugro collected pavement condition data for 60 miles and provided a PMS update. Dr. Saremi was the Lead Engineer for all project activities including data processing, PCI reporting, providing multiple budget/treatment scenarios analysis, and the City's 10-year network level maintenance and rehabilitation treatment work plan.
- City of Jacksonville Pavement Management Services (2022) – Fugro collected pavement condition data for 165 miles and provided a PMS update. Dr. Saremi was the Lead Engineer for all project activities including data processing, PCI reporting, providing multiple budget/treatment scenarios analysis, and the City's 10-year network level maintenance and rehabilitation treatment work plan.
- City of San Diego Pavement Assessment and Management Services (2023) – Fugro collected pavement condition data and uploaded the data into the City's PMS. The project included pavement distress data collection for over 3,800 test miles, data processing, and network level pavement condition results. Fugro also collected the pavement condition of the City's bike paths using an innovative smaller-sized vehicle. Dr. Saremi was the Lead Engineer for all project activities.

- City of Hempstead Roadway Pavement Assessment (2023) – Fugro collected pavement condition data for 108 miles and updated network level PCI of the City. Dr. Saremi was the Lead Engineer for the project activities including data processing and PCI reporting.
- City of Missouri City Pavement Condition Assessment (2024) – Fugro conducted a pavement condition survey to report pavement distresses for about 26 miles of Sienna MUD's roadway network. Dr. Saremi imported the pavement data into Cartegraph, configured the PMS, and calculated the network PCI.
- City of Spring Valley Pavement Condition Assessment (2024) – Fugro conducted a pavement condition survey to report pavement distresses for about 19 miles. Dr. Saremi imported the pavement data into Cartegraph, configured the PMS, and calculated the network PCI.
- City of Abilene Pavement Management Services (2021) – Fugro collected pavement condition data from approximately 765 miles and provided a PMS update. Dr. Saremi imported the data into Cartegraph, configured the PMS, calculated the network PCI, provided budget analyses and optimization, and developed an updated 10-year M&R work plan.
- City of DeSoto Pavement Condition Surveys, Assets Inventory and Pavement Management Services (2022) – Fugro collected pavement condition data for 270 miles and provided a PMS update. Fugro also collected inventory data for City assets consisting of sidewalks, signs, curb ramps, and curbs & gutters on arterial roads and provided the geo referenced data. Dr. Saremi imported the data into Cartegraph, configured the PMS, calculated the network PCI, provided budget analyses and optimization, and developed an updated 10-year M&R work plan.
- City of Burleson Pavement Condition Surveys, Assets Inventory and Pavement Management Services (2023) – Fugro conducted a pavement condition survey to report pavement distresses for about 252 miles. Fugro also reported assets inventory with available attributes of pavement markings, signs, and traffic signals. Dr. Saremi imported the pavement data into Cartegraph, configured the PMS, and calculated the network PCI.
- Pennsylvania Department of Transportation (PennDOT) District 4 & 5 Ground Penetrating Radar (GPR) Survey (2020-2022) – Fugro is providing project-level GPR surveys, alongside annual collection, processing and delivery of roadway condition data. Fugro provides iVision hosting services for access to the data and images. Dr. Saremi serves as Project Engineer responsible for supporting all project-related activities, communication, quality and client deliverables.
- City of Toronto, Ontario, Canada Ground Penetrating Radar (GPR) Survey and Analysis (2021) – Fugro provided GPR data collection and analysis of about 1,500 lane-miles of city streets for the City of Toronto. The GPR data collection is performed as part of annual Citywide automated distress data collection. The data analysis tasks consisted of establishing the network-level GPR data processing methodology, reviewing construction history and pavement/geotechnical core information, and developing a continuous pavement layer thickness database

Jordan Kilts

Data Analysis Supervisor

Years of Experience: 15 years **Length of Time with the Company:** 15 years

Project Responsibilities & Role:

Mr. Jordan Kilts offers 15 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 works avidly to keep his team's focus on network level asset inventories; quickly, safely, and on-time 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 the 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 has an effective communicator and is able to collaborate with multiple teams and departments.

Mr. Kilts is part of Fugro's Joint Health and Safety Committee.

Education Background/Professional Certifications

2004 – 2008 - Geographic Analysis Degree, Ryerson University

Professional Engineering Licenses

Professional Engineer: Texas (#155237)

Training/Skills

Cartegraph OMS Certification, Proficient in a variety of programming and pavement engineering software, including R, MATLAB, Python, SQL, Java, ArcGIS, PAVER, Cartegraph, MODULUS, KENPAVE, FPS21, AASHTOWare, StreetPave, AutoCAD, and more.

Project-Related Experience

- New Mexico Department of Transportation (NMDOT) – Pavement Condition Data Collection – 2018-2022, 2022-2025 - Annual collection, processing and delivery of roadway condition data including roughness, rutting, surface distress, faulting, GPS and Linear Referencing System (LRS), pavement and HD ROW images for 12,700 miles of highway network.
- Virginia Department of Transportation (VDOT) – Pavement Data & Evaluation Services – 2012-2025 – Annual collection, processing and delivery of roadway condition data including longitudinal profile and International Roughness Index (IRI), transverse profile and rutting, faulting, surface distress, pavement and High Definition (HD) right-of-way (ROW) images for 29,000 miles of highway network. Fugro also delivered 1.2 million roadway assets, as well as Ground Penetrating Radar (GPR) data and analysis.
- City of San Diego Pavement Assessment and Management Services (2023) – Fugro collected pavement condition data and uploaded the data into the City's PMS. The project included pavement distress data collection for over 3,800 test miles, data processing, and network level pavement condition results. Fugro also collected the pavement condition of the City's bike paths using an innovative smaller-sized vehicle. Dr. Saremi was the Lead Engineer for all project activities.
- Louisiana Department of Transportation and Development (LADOTD) – Pavement Distress Data Collection Statewide – 2016-2022, 2023-2028. Annual collection, processing and delivery of roadway condition data including longitudinal profile and IRI,

rutting, surface distress, texture, geometrics, pavement and HD ROW images, Global Positioning System (GPS) and elevation data for 36,000 miles of highway network. Contract also includes GPR data and analysis, coring, friction (skid) testing, and asset inventory for 35,000 miles including Highway Performance Monitoring System (HPMS) data items. Fugro provides iVision hosting services for access to the data and images.

- Pennsylvania Turnpike Commission (PTC) – Automated Data Collection, Inventory, and Analysis of Pavement Distress – 2021-2024 – Annual collection, processing and delivery of roadway condition data including roughness, rutting, surface distress, pavement and High Definition (HD) right-of-way (ROW) images for 1, 400 miles of highway network including 240 miles of ramps. Fugro provides iVision5 hosting services for access to the data and images.
- West Virginia Department of Transportation (WVDOT) – Roadway Acquisition and Analysis – 2012 - 2017 --2023-2027 – Collection, processing and delivery of roadway condition data including IRI, rutting, faulting, surface distress, geometrics, Geographic Information Systems (GIS), pavement and HD ROW images for 19,000 lane miles. Project was expanded to include the delivery of an asset inventory of over 1 million roadway assets.