Agenda Item No. 9
Request for Town Council Action

TO: The Honorable Mayor and Town Council

FROM: Arosha Jayawickrema, Town Manager

DATE: November 16, 2021

SUBJECT: Requesting a Bid Waiver Authorizing StreetScan® to Conduct a Comprehensive Pavement Conditions Evaluation of Town Roadways

SUMMARY:

Public Works Department Staff feel that an overall Town road evaluation is needed at this time, both to have a third party objectively assess every Town road's pavement condition and to support future road restoration funding requests. (The most recent Town-wide road evaluation was completed in 2011.). StreetScan® (based in Wakefield, MA) has completed multiple assessments for CT municipalities, and has been pre-qualified by the Connecticut Conference of Municipalities (CCM) for these services. At the request of the Public Works Department, StreetScan® gave a presentation to Town Council in May of this year, to give an overview of their inspection technology that includes 360-degree photography and Artificial Intelligence processing of pavement conditions. Staff also requested a proposal from StreetScan® to evaluate every Town road (see attached). StreetScan®'s base services and fees include: data collection, data processing and GIS integration in the amount of $15,262 plus $7,500 for first year setup and licensing of its StreetLogix Asset Management software program for a total of $22,762.00. Staff obtained a second proposal, from Infrastructure Management Services (IMS), for similar services in the amount of $49,020 (attached). In addition, fees for the BETA Group hired in 2011 for road assessments totaled approximately $19,000; however, the technology was not as sophisticated at the time and this fee did not include associated integration into an asset management software program. Staff recommend awarding the project to StreetScan®, as this is in the best interest of the Town. Funds are available from Public Work's Contractual Services Account (#001.20.2036.0.53814.00000).

ACTION NEEDED:

Move to authorize the Town Manager to waive the bidding requirements, and award the contract to StreetScan®, for an amount not to exceed $22,762.00, for a comprehensive assessment of Town roadways, as this is in the best interest of the Town.

ATTACHMENTS:

1) StreetScan® Automated Asset Management Proposal dated October 6, 2021
2) IMS Proposal dated November 5, 2021
3) Sufficiency of Funds

PREPARED BY:
Michael S. Ahern, P.E., Director of Public Works

MSA

Automated Asset Management Proposal

Berlin, CT

October 6th, 2021

Proposal for the Town of Berlin, CT

Prepared for:

Michael Ahern

Director of Public Works

Berlin

240 Kensington Road

Berlin, CT, 06037

860-828-7014

Prepared by:

StreetScan Inc.

603 Salem Street

Wakefield, MA 01880

617.399.8236

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October 6th, 2021

Michael Ahern, Public Works Director
Town of Berlin
Berlin, CT 06037

Thank you for your interest in StreetScan. Municipalities worldwide are faced with aging infrastructure and limited budget resources to repair and maintain them. Having the ability to monitor the health of your street network through an abundance of data collected via multiple vehicle-mounted sensors allows your staff to properly allocate repair and maintenance budgets. This is now made possible in an affordable, objective way utilizing StreetScan's advanced mobile sensing vehicle and online web-based app.

Our service offering includes:

- Data Collection: vehicle survey of paved lane miles.
- Data Processing of pavement condition and assets.
- Data Visualization: pavement monitoring system including StreetScan's Pavement Rating (SPR) Report.
- Pavement Management Plan: maintenance and budget options, suggestions and scenarios; optional cloud-based access with robust interactive planning and budgeting tools.

Also available (see Appendices for more details):

- 360° imagery Viewer
- Optional asset extractions including pavement markings, traffic signs, utility assets, street lighting, sidewalks, curbs, trees, etc.

On behalf of the team at StreetScan, we are pleased to submit this proposal for your review. We strive to be as accurate as possible in our initial projections and cost estimates, and look forward to meeting with you soon to discuss any questions you may have.

Yours truly,

Stan Karlin
Manager, Sales and Marketing

1.ABOUT US

At StreetScan, we come to work each day because we want to solve our clients' biggest problems when it comes to monitoring their street assets. We have a Smart City Mobile Sensing Service Offering targeted at providing clients with an intelligent, objective and affordable way to manage those assets.

Throughout the history of business, people have used data to make more informed decisions. StreetScan enables exactly this for our municipal clients.

Municipalities no longer have to send inspectors into the field for pavement surveys. Now, they can leverage the power of data to improve their decision-making abilities.

This all came about as a result of a 2009 groundbreaking project at Northeastern University that received more than $18 million in funding over a 5-year period. This stamp of approval was due to the power of the project to end localized pavement inspections and enable continuous network-wide health monitoring of roadways.

What kind of technology made this possible? Versatile Onboard Traffic Embedded Roaming Sensors (VOTERS). A framework, prototype and blueprint were successfully designed and developed, and in 2015, StreetScan was launched as a spin-off of the project. It is our comprehensive, advanced hardware and software turn-key solution that distinguishes us from the competition. More importantly, it provides street asset monitoring at a reasonable cost for our clients.

2017 saw the emergence of our current Smart City Service Offering and we have combined this service with our pavement management offering. Clients save time, money and no longer require additional field surveys. Our ScanCars can enable municipalities and other clients to extract and monitor critical assets such as pavement condition, traffic signage, pavement markings, streetlights and other transportation infrastructure assets.

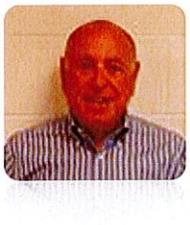
We embrace progress. In 2018, StreetScan launched Streetlogix. This extensively customizable, web-based GIS asset management software has changed the landscape for municipalities. Municipalities can now optimize their budget within a user-friendly GIS environment. The system provides objective information on the current state of their infrastructure and makes maintenance and repair recommendations, including the prioritization of roadway projects. Using unprecedented data visualization and budget optimization tools, our clients have been creating defensible data-driven Capital Improvement Plans while successfully justifying their budgeting requests.

The most important thing you need to know about StreetScan is our data-driven approach. It will change the way you monitor your street assets – for the better and for the future.

StreetScan streetlogix

Powered by AI

2.OUR TEAM



Stanley Karlin – Manager, Sales & Marketing – As the Manager of Sales & Marketing at StreetScan, Stan brings over 25 years of experience in selling & marketing exclusively to the public sector. Stan came to StreetScan after selling his municipal software company where he served as the Chief Marketing Officer, and is eager to promote StreetScan's new technologies and solutions to local governments. He received his M.Ed. From Temple University in Instructional Design & has used this knowledge to help better explain complex solutions in marketing.

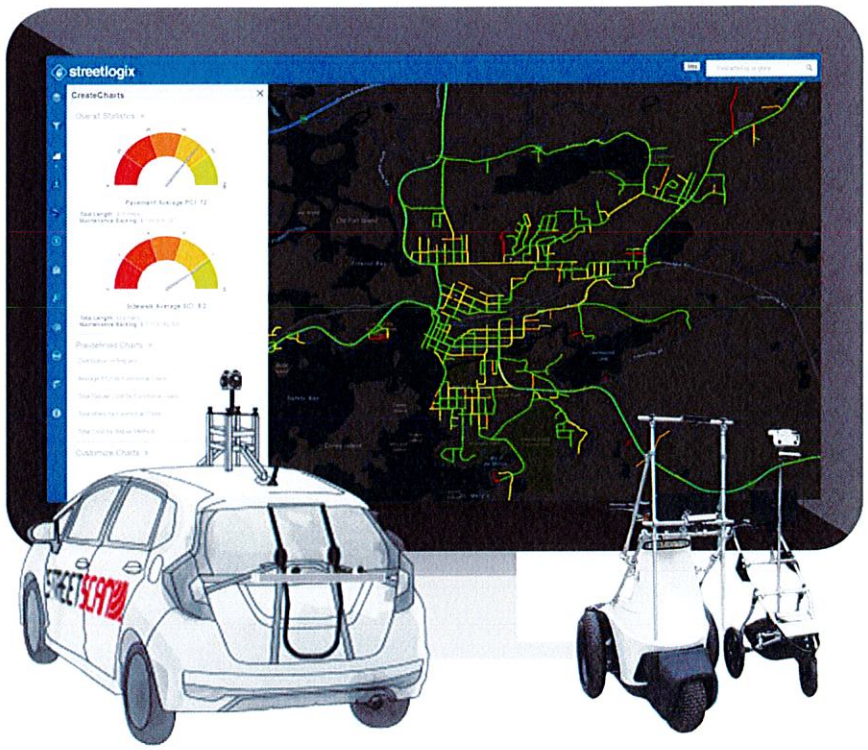
David M. Vines – Sr. Project Manager – David will provide project management leadership for the road condition assessment of the municipal road network. As the primary point of client contact, David will coordinate the project from the kickoff meeting to project delivery. He will provide geotechnical support for route creation, results publishing and end-user training on software functionality. David joined StreetScan as a Research and Development Engineer and was instrumental in the initial setup of the firm. He received his Ph.D. in Civil Engineering and a MS in Structural Engineering from Northeastern University in Boston, MA, as well as a B.S. in Civil Engineering from Valparaiso University in Valparaiso, IN.

Kathy Zarrehparvar – Sr. Implementation Project Manager – Kathy works closely with Streetlogix customers to successfully implement our software products. She manages projects from initiation to delivery and ensures that Streetlogix users are properly onboarded. Kathy brings 15 years' experience in project management, software implementation, and process improvements skills. She is well versed in understanding customers' needs and goals to help tailor solutions that optimize their operations and workflows. A Certified Project Management Professional, Kathy received her B.S. in Civil Engineering from the Eastern Mediterranean University in Northern Cyprus, and an Associate Certificate in Applied Web Development from the British Columbia Institute of Technology.

Ivano Teti – Customer Success Manager, Streetlogix – Ivano provides ongoing support to our customers from their onboarding of Streetlogix through the long term, ensuring they reach their goals for integrating asset management technologies to enhance their daily operations. He brings over 13 years' experience in sales and management, with a strong knowledge of the traffic, transit signal and detection industry. Prior to joining Streetlogix, Ivano managed accounts and inside sales at Electromega Ltd. where he provided adaptable and cost-efficient traffic solutions to Ontario municipalities alongside external partners such as Leotek, Siemens, and others. Ivano has completed management courses at Concordia University's John Molson School of Business in Montreal, QC.

3.THE STREETSCAN SYSTEM

StreetScan's automated data collection and algorithm-based roads prioritization software can help optimize your road budget and provide user-friendly analytics about the status of your roads and sidewalks.



Data Collection

StreetScan's vehicles equipped with multi-sensor systems detect pavement & sidewalk surface distresses without interrupting traffic flow.

Data Processing

Optimized algorithms evaluate and prioritize repairs of assets, including pavement, sidewalks, traffic signs, and more.

GIS Analytics

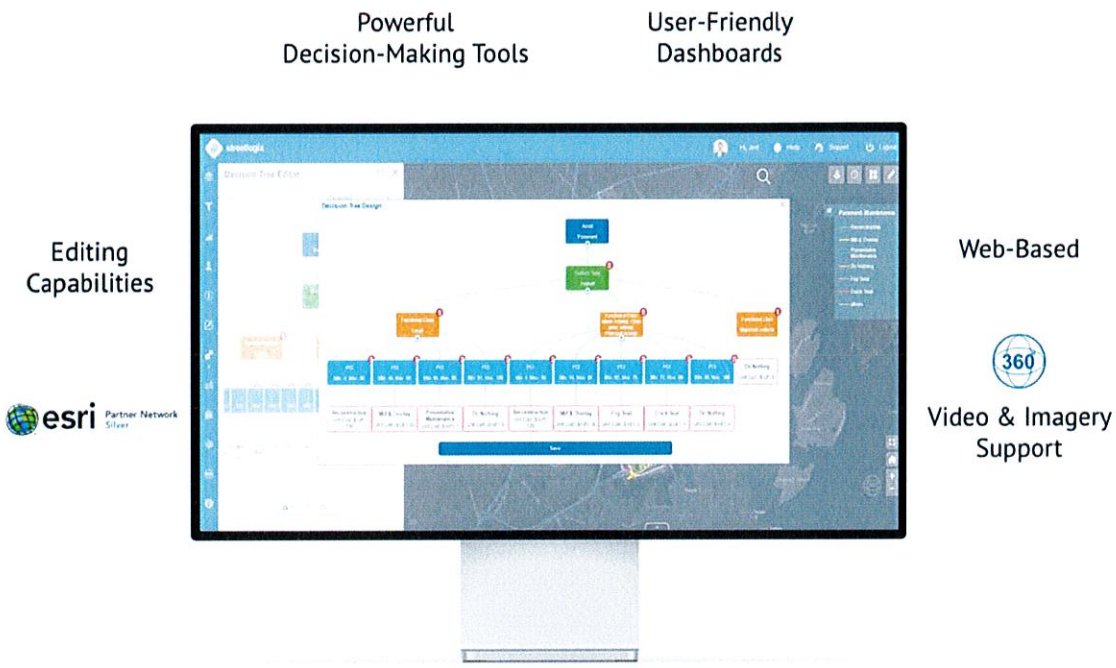
Collected data goes into Streetlogix, our unique **cloud-based application,** allowing municipalities to visualize and manage road assets in order to schedule maintenance within a user-friendly GIS environment.

4. STREETLOGIX SOFTWARE

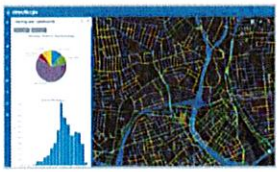
4.1 ASSET MANAGEMENT SOFTWARE

Streetlogix's **Asset Management Module** is a cloud-based mapping, analysis, and decision-making tool for the public sector. Use it to create maps, analyze data and plan road repairs, sidewalk projects, traffic signs and right-of-way budgeting decisions. Your data and maps are stored in a secure and private infrastructure and can be configured to meet your mapping and IT requirements.

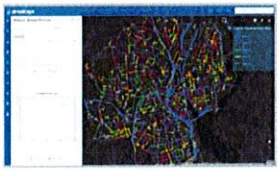
Asset Management Key Features:



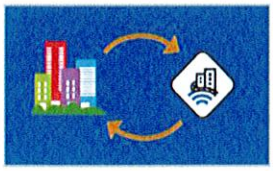
MAPPING & REPORTING



BUDGETING



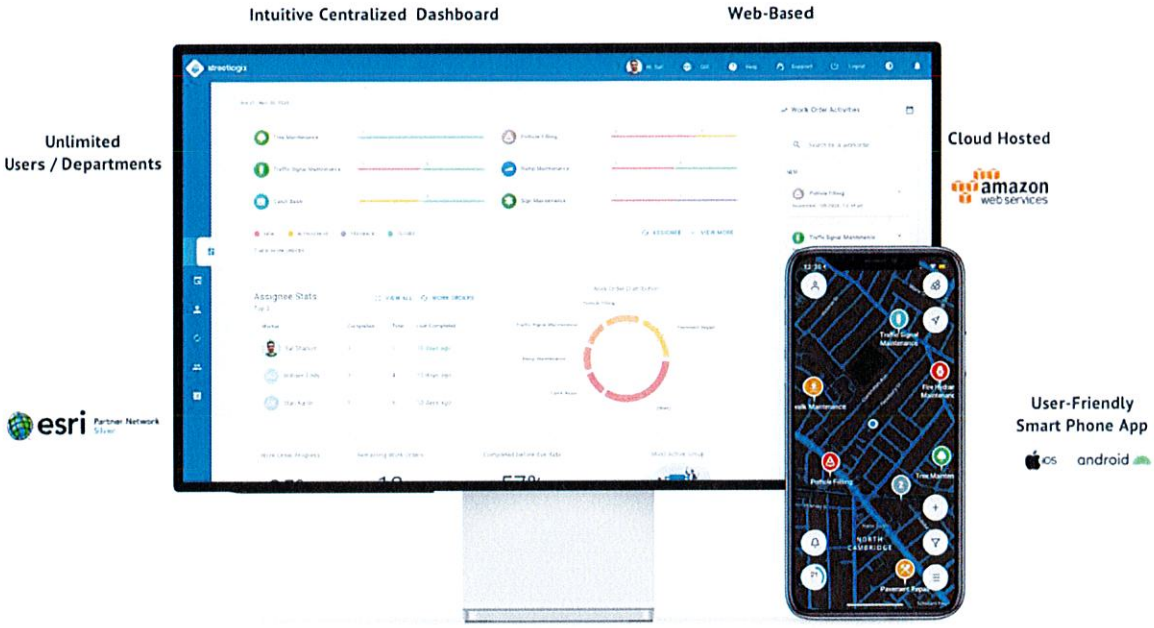
SOFTWARE INTEGRATION

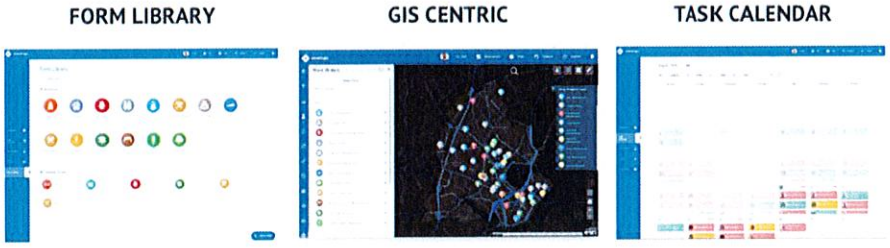


4.2 WORK ORDER MANAGEMENT SYSTEM

Streetlogix's **Work Order Management System** brings greater organization, efficiency, and accountability to your task management planning, allowing you to effectively schedule, track and manage all work orders, as well as monitor work order performance metrics in a centralized dashboard. Plus, you can track and complete work orders in the field using our app on your mobile device.

Work Order Key Features:

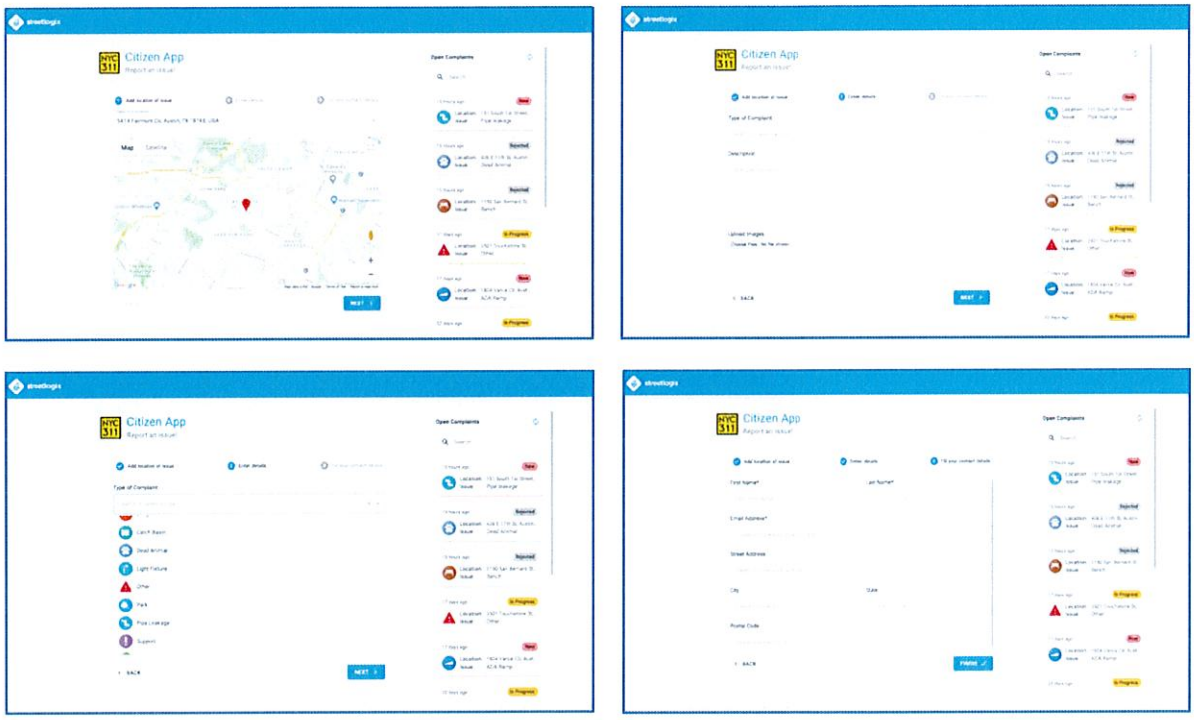




4.3 CITIZEN ENGAGEMENT APP

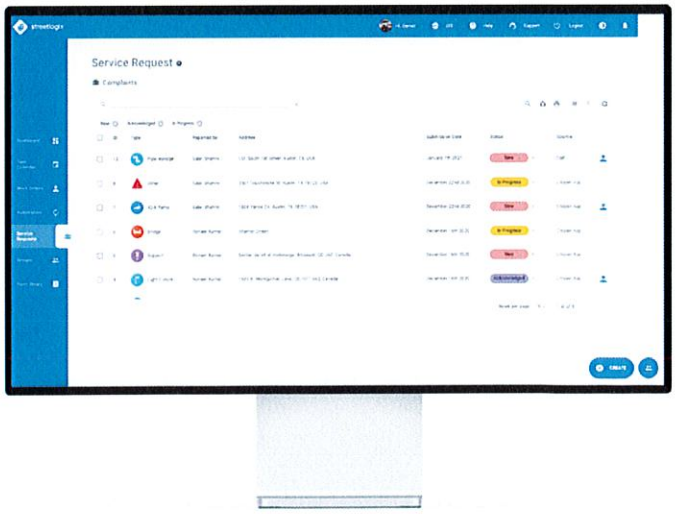
Streetlogix's **Citizen Engagement App** empowers your residents to submit service requests while enabling you to easily monitor the submissions. Our 311 application ensures your residents that each request is heard, acknowledged and tracked. It is simple to use, easy to set up, and allows automatic updates for residents on efforts to keep their community functioning. Streetlogix Citizen Engagement app helps you build a collaborative, transparent and stronger community.

Resident Online Form:



Layout Editor:

Seamless integration with Work Order App



5.PRICING OVERVIEW

5.1 DATA COLLECTION (STREETSCAN)

PAVEMENT MANAGEMENT				
	SERVICES INCLUDED	**CENTERLINE MILES**	**$/CL**	**TOTAL**
StreetScan DATA COLLECTION	ScanCar Data Collection	111 mi	$140	$15,540
	Data Processing			
	Processed Data Results			
Mobilization and Setup Cost				$832
TOTAL				$16,372
DISCOUNT				($1,110)
TOTAL w/ Discount				**$15,262**

5.2 SOFTWARE (STREETLOGIX)

STREETLOGIX SOFTWARE MODULE PRICING					
streetlogix MODULES	POPULATION	ANNUAL LICENSE	ANNUAL DATA	IMPLEMENTATION FEE	TOTALS
ASSET MANAGEMENT	20,436	$5,000	$750	$1,750	$7,500
WORK ORDER		$15,000	$2,750*	$10,000	$27,750
CITIZEN ENGAGEMENT		$5,000	N/A	$5,000	$10,000

* Recommended data package as per the table below

The following Hosting Fees are for the Work Order module:

DATA HOSTING AND MAINTENANCE (AWS CLOUD)*				
	PACKAGE	DATA STORAGE	DATA TRANSACTIONS	ANNUAL COST
amazon web services	10	10 GB/ Year	2 GB / Month	$750*
	25	25 GB / Year	5 GB / Month	$1,500*
	50	**50 GB / Year**	**10 GB / Month**	**$2,750***
	100	100 GB / Year	20 GB / Month	$5,500*
	250	250 GB / Year	50 GB / Month	$12,000*

*Fees are based on data usage. The bolded package above is your municipality's estimated usage (based upon population). The data could also be hosted by the municipality if you have the internal hosting capacity.

5.3 OPTIONAL SERVICES AND ASSETS

One of our unique advantages is the ability for our clients to extract, assess and obtain actionable data from other Municipal assets utilizing the same data collected for the Pavement Management Survey. Below is a list of additional assets we can process from the collected data. This is set up as an a-la-carte menu so you can pick and choose the assets to meet your asset management needs.

Assets	Unit L=Lane CL=Centerline	QTY (est.)	Price ($/Unit)	PRICE ADDER (est.)	
				STANDARD	Work Order Module
Assets Extracted from ScanCar Dataset (Pavement Management Service Required)					
360 Degree Imagery Package	CL-M	111	$25	$2,775	Included
Pavement Markings (2 Attributes)	CL-M	111	$20	$2,220	
Pavement Markings (3 Attributes)			$50	$5,550	
Sidewalk GIS Database	CL-M	111	$30	$3,330	
Curb GIS Database	CL-M	111	$50	$5,550	
Traffic Signage (3 Attributes)	Signs	2,554	$1	$2,554	Included
Traffic Signage (4 Attributes)			$3	$7,662	$5,108
Catch Basins	Catch Basins	2,220	$2	$4,440	Included
Manholes	Manholes	3,330	$1	$3,330	Included
Tree GIS Inventory	Trees	2,220	$3	$6,660	
Street Lighting GIS Database	Lights	2,043	$2	$4,086	Included

Assumptions:

All asset quantities are estimated based on lane or centerline miles except for:

- Traffic Signs are estimated at 1/8 of the municipal population
- Street Lighting which is 1/10 of the municipal population
- Catch Basins which is estimated at CL-M multiplied by 20
- Metal Objects (Manholes & Valve) which is estimated at CL-M multiplied by 30
- Tree Inventory which is estimated at CL-M multiplied by 20

Annex

APPENDIX A – SCOPE OF WORK AND DELIVERABLES

ROAD AND SIDEWALK ASSESSMENT SERVICE

StreetScan offers a technology-based Pavement Management approach for continuous health monitoring of your road network. Combining years of R&D at Northeastern University, StreetScan's vehicles and web-based app Streetlogix save you time and make your repair dollars go further. We have developed a 4-step process to effectively Scan, Process and Manage your road data.

STEP 1: DATA COLLECTION

Roads

Vehicle Deployed: ScanCar

StreetScan utilizes 3D imaging technology to measure road defects, such as cracking and bumps. The 3D imaging cameras provide a 8' (2.4m) of lateral road coverage and seamless road coverage in the direction of travel at speeds up to 65 mph (72kph). A 360 degree camera system provides imagery of the road surface and ROW. An Inertial Measurement Unit (IMU) enabled GNSS position system provides position location, even in the event of intermittent GPS satellite coverage.

Sidewalks

Vehicle Deployed: ScanCarts

StreetScan has developed a technology stroller-based approach which captures all the necessary distress & ADA data. We currently have 5 Carts in our fleet. StreetScan utilizes 2D imaging technology to measure sidewalk defects, such as Uplifts, Bumps, Holes, Cracking & Surface Texture. An IMU mounted on the cart measures tilt, slope & accelerations. A laptop computer is used for controlling data collection. An encoder on each wheel of the ScanCart's rear wheels provides accurate linear displacement along with a GPS, providing position information.

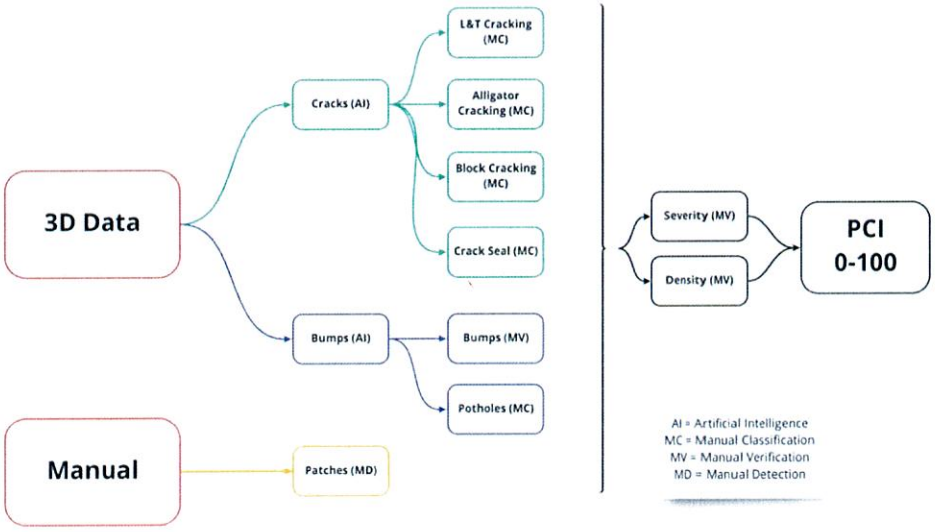
STEP 2: DATA EXTRACTION

Roads

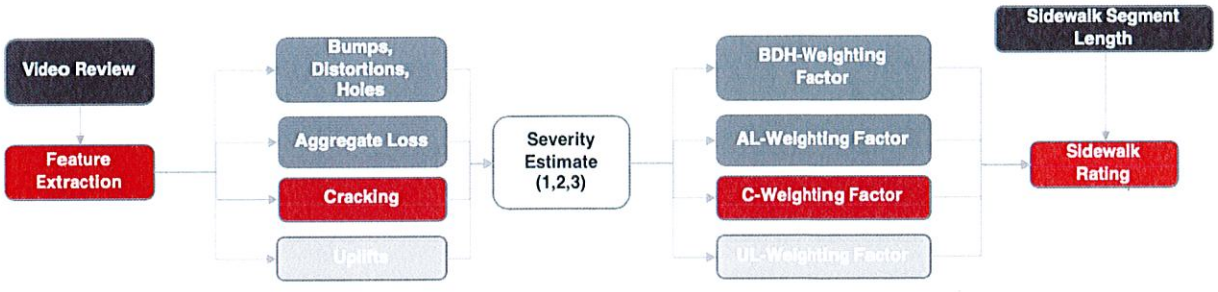
The collected data (TBs/day) is uploaded to the StreetScan server, where automated software processes the raw sensor data. Using advanced processing algorithms, the sensors' raw data is converted into meaningful parameters representing different aspects of pavement condition. Several of our key indicators are fused to determine the **StreetScan Pavement Rating (PCI)** for each road segment. StreetScan's GIS specialists segment the pavement evaluation data from intersection to intersection and populate the database allocated to the segment.

Sidewalks

StreetScan's basic approach uses a weighted failures scheme per linear distance for a given sidewalk segment. Individual failure or feature types are given various weightings depending on their contribution to perceived sidewalk condition. As an example, an uplift is considered to have more impact to the sidewalk quality than aggregate loss, so it is given a greater weighting in the rating formula.



Sidewalk Algorithm



STEP 3: DATA VISUALIZATION AND ANALYTICS

Roads

Municipal staff will be given access to Streetlogix, our GIS web-based application, in order to view and analyze all collected survey data in addition to data from other sources to assist in decision making.

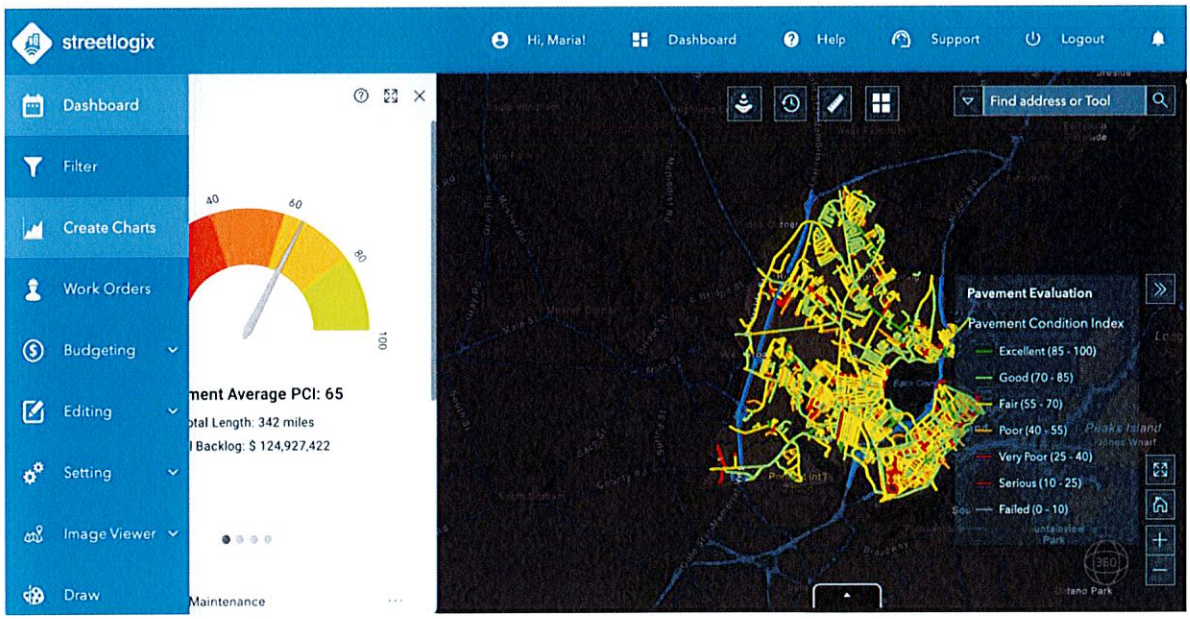
This provides staff an easy-to-use tool to quickly review PCI results, distress data and 360 images along with pavement history and other data that the municipality wants to be integrated. All data is hosted in the cloud, allowing users to login from anywhere on any computer to view the results. Streetlogix has many data import and export features making it compatible with any existing GIS solution concerning asset management. Streetlogix provides powerful data visualization and management tools including 360 viewer and extensive charts and dashboards (example below).

Sidewalks

Municipalities are given access to our GIS web-based application, Streetlogix, in order to view and analyze all collected survey data in addition to data from other sources to assist in decision making.

This provides clients an easy-to-use tool to quickly review sidewalk condition results, distresses and sidewalk images. All data is hosted in the cloud allowing users to login from anywhere on any computer to view the results. Streetlogix has many data import and export features making it compatible with any existing GIS solution. Streetlogix provides powerful data visualization and management tools including 360 viewer and extensive charts and dashboards (example below).

Portal view: Overall stats and available layers



STEP 4: MAINTENANCE PLANNING

Roads

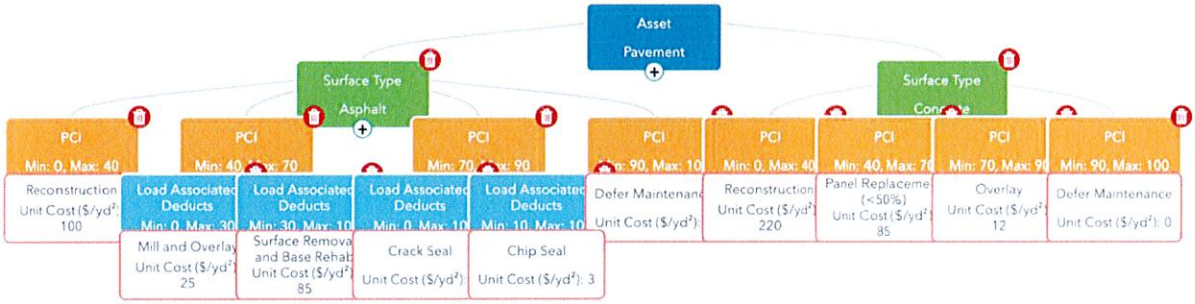
Once the inventory condition database and GIS web-app have been finalized, the work on implementing the pavement management side of the software begins. While pavement condition indicators are concerned with the current condition of the network, the management side of the process concerns itself with the analysis of condition, prediction of future condition, generation of maintenance options and pavement management scenarios. At this stage, the Client's preferred repair methods and associated costs are used to customize our Streetlogix asset management module. The results are compiled and reported to the client in our Streetlogix software and as a digital storymap.

Our decision-trees are highly customizable and we work with staff to tailor it to ensure our AI will provide the neccesarry maintenance and repair suggestions. All decision trees & underlying data will be editable by staff.

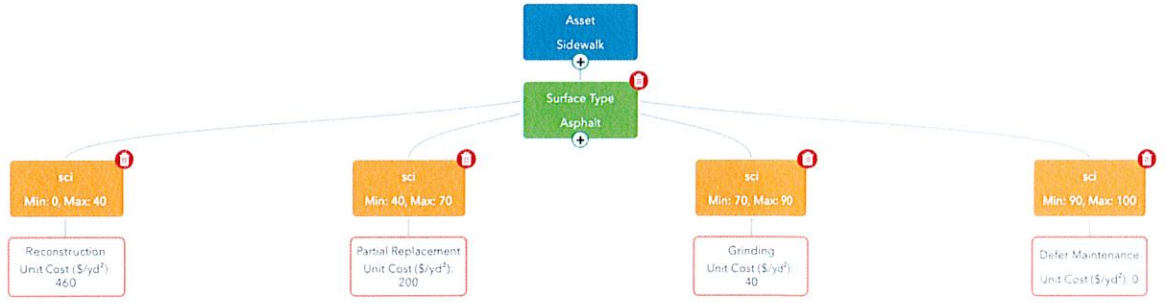
Sidewalks

Once the inventory condition database and GIS web-app have been finalized, the work on implementing the sidewalk management side of the software begins. While sidewalk condition indicators are concerned with the current condition of the network, the management side of the process concerns itself with the analysis of conditions, prediction of future conditions, generation of maintenance options and sidewalk management scenarios. At this stage, the Client's preferred repair methods and associated costs are used to customize our sidewalk management modules. The results are compiled and reported to the client in our Streetlogix software and as a pdf document.

Roads:



Sidewalks:



APPENDIX B – OPTIONAL SERVICES AND ASSET COLLECTION

StreetScan leverages AI with Semantic Segmentation in order to process the attributes which are included as part of the Work Order Module. As a result we guarantee over 80% accuracy of detecting all assets within the right of way but is subject to error due to obstructions or miss classifying the asset. 360 Imagery has the lowest margin of error and therefore is reliant on the imagery processed to obtain the assets.

Paving Markings

Through StreetScan's existing collected data, our geospatial engineering team can extract pavement markings and insert them into a separate GIS layer. All data is accessible through Streetlogix. A visual review of the markings determine their current condition and whether maintenance is required.

Attributes	Description
Category*	Left Turn, Right Turn, Crosswalk, etc.
Location*	Global Positioning System (GPS) location (+/- 5 meters)
Condition	The analysis will be conducted from intersection to intersection and given a rating of either Good, Fair or Critical. If the length of the road is longer than 1,000 ft, the analysis will be broken up into 1,000 ft segments

*Attributes included for the basic Pavement Marking inventory

** Measurement device has a rated accuracy of 0.1 degrees. However, in practice due to variations in ground surface and location where measurement is take, measured value can typically vary +/- 1 degree*

Sidewalk GIS Database

StreetScan provides sidewalk locations, determined from existing data sources (satellite imagery, Google StreetView or ScanCar images) if available. All data is provided as a GIS layer.

Deliverable:

- GIS layer of sidewalk locations

Curb GIS Database

StreetScan provides curb locations, determined from front or side facing imagery. Data is provided as a GIS layer.

Deliverable:

- GIS layer of the linear features where curbs are present

Traffic Signage

StreetScan's traffic sign asset management service provides a simple solution for the Municipality to quickly and efficiently manage its traffic signs. StreetScan utilizes an algorithm to automatically locate traffic signs saving you time and money. Our geospatial engineering team then undergoes a rigorous Q&A process and collects multiple unique attributes. Traffic sign quantities are estimated at 1/8 of municipal population. Charges will be for actual number identified; please inform us if you have more accurate estimates.

Attributes	Description
Sign Category*	Regulatory, Warning, Guide, School, Recreation, Information, General
Sign Name*	Federal or State MUTCD designation or custom designation for specialized signs
GPS Location*	Global Positioning System (GPS) location (+/- 5 meters)
Sign & Post Condition	Good, Fair, Critical rating assessed through review of daytime digital images

*Attributes included for the basic sign inventory

Catch Basins

StreetScan provides catch basin locations, determined from existing data sources (satellite imagery, Google StreetView or ScanCar images) if available. All data is provided as a GIS layer.

Deliverable:

- GIS Layer of catch basin

Manhole

StreetScan provides location of circular Manhole access points which are visible in the road imagery data. All data is provided as a GIS layer.

Deliverable:

- GIS layer of manhole locations

Tree GIS Database

StreetScan provides tree locations which are situated in the right of way, determined from existing data sources satellite imagery, Google StreetView or ScanCar images if available. All data is provided as a GIS Layer.

Deliverable:

- GIS layer of tree location

Streetlight GIS Database

Utilizing the ScanCar's cameras, StreetScan has the ability to review already collected data and extract the necessary street lighting attributes. A new street lighting data layer will be accessible through Streetlogix.

Attributes	Description
GPS Location	Global Positioning System (GPS) location (+/- 5 meter)

ADA Sidewalk Width

StreetScan will manually calculate the sidewalk width from the 3D Data collected as this feature is not automated.

ADA Ramp Compliance Survey

StreetScan will determine the compliance of ADA Ramps, measuring the following attributes: ramp slope & cross slope, road slope & cross slope, flare slopes, ramp width, landing area, tactile pad (present/not present/condition). As part of this service, StreetScan provides imagery of all ramps and a GIS data layer accessible in Streetlogix, showing location of ADA ramps and all measured properties.

Deliverables:

- GIS Layer with ramp location & missing ramps
- Image of ramps/no ramp
- Compliance
- Measured Attributes (shown below)

Attributes	Description
GPS Location	Global Positioning System (GPS) location (typically +/- 1.5 meters)
Image	Image of Ramp
Ramp Slope / Cross Slope	Angle (+/- 1 Degree)*
Road Slope / Cross Slope	Angle (+/- 1 Degree)*
Flare Slopes	Angle (+/- 1 Degree)*
Ramp Width Compliance	Yes/No
Landing Area Compliance	Yes, No/Obstructed
Tactile Pad	Present/Not Present & Condition

APPENDIX C – OUR CLIENTS

REFERENCES & ADDITIONAL INFORMATION

City of New Bedford, MA

Project Objective:

StreetScan was contracted by the City of New Bedford to perform a road assessment survey that would objectively collect pavement condition and ROW data and provide a custom pavement management plan.

Project Description:

In the spring of 2019, StreetScan collected pavement condition, texture and roughness rating for each road segment (intersection to intersection) of 528 centerline miles.

The system utilized 3D imaging technology to measure the severity and extent of road defects including cracking, bumps, surface distortions, surface texture and potholes.

Additionally, the City selected StreetScan's Enhanced visualization package consisting of 360° HD camera that captured optical imagery of the road surface and right-of-way. StreetScan provided curb locations, determined from front or side facing imagery, via a GIS layer.The mandate included the assessment of 268 pavement markings.

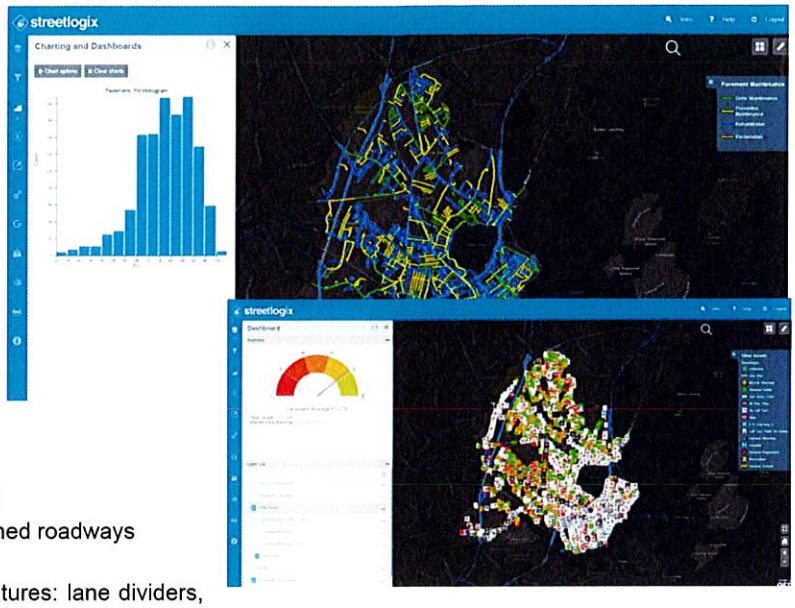
The City added a Sidewalk and Ramp Assessment Survey to be carried out in the spring of 2020.

Project Outcome:

StreetScan delivered a custom pavement management plan and decision-making solutions via Streetlogix, StreetScan's GIS web-based software, whose algorithm utilizes PCI, road usage data and a cost benefit analysis to determine road maintenance, repair costs and prioritization per segment. Budgeting and planning tools allow for editable short- and long-term planning as well as level of service analysis with target PCI.

Project Contacts	
City of New Bedford, MA	Adam Hart, Supervising Civil Engineer (508) 9791550 x 67332 / adam.hart@newbedford-ma.gov
StreetScan	Salar Shahini, Chief Data Officer (617) 399-8236 / salar.shahini.s@streetscan.com

City of Portland, ME



Project Objective:

The City of Portland, ME, selected StreetScan to perform a mobile sensing survey of City's road network and prepare custom Maintenance and Repair suggestions.

The mandate comprised the assessment of traffic signs, pavement markings and Streetlight Lux Levels.

Project Description:

Data collection for the project included:

- 221 centerline miles of city-maintained roadways
- 21,847 traffic signs inventoried
- 2,585 pavement markings (line features: lane dividers, bike lanes, etc.)
- 4,429 pavement markings (point features: left arrow, bicycle marking, etc.)

StreetScan used specialized ScanVan vehicles to assess the condition of roadways in normal traffic flow. During the survey, imagery collected from 2D Camera systems were used to locate pavement markings and traffic sign locations. Consequently, Manual on Uniform Traffic Control Devices (MUTCD) attributes were extracted from the traffic sign images by our technicians.

A Streetlight Lux Level Pilot was also performed. Utilizing a vehicle equipped with light sensors, StreetScan surveyed the Municipality at night to collect light level illumination data and provided a GIS layer also accessible through its web-based software.

Project Outcome:

Data collection was completed in December 2016. Survey results were placed in Streetlogix, a customizable, GIS web-based application, whose algorithm utilizes PCI, road usage data and a cost benefit analysis to determine road maintenance, repair costs and prioritization per segment. Budgeting and planning tools allow for editable short- and long-term planning as well as level of service analysis with target PCI.

A second road data collection was performed in October 2019.

Project Contacts	
City of Portland, ME	Christopher Branch, Public Works Director (207) 874-8801 / cbranch@portlandmaine.gov
StreetScan	Salar Shahini, Chief Data Officer (617) 399-8236 / salar.shahini.s@streetscan.com

City of Lebanon, NH

Project Objective:

Perform a mobile sensing survey of the City's road and sidewalk network to assess its current condition and prepare custom Maintenance and Repair suggestions.

Project Description:

In the summer of 2019, StreetScan utilized specialized ScanVan vehicles to assess the condition of 96 miles of roadway and, using a pavement condition index scale which runs from 0-100, developed a Municipal-wide inventory of road condition. The system utilizes 3D imaging technology to measure the severity and extent of road defects including cracking, bumps, surface distortions, surface texture and potholes.

For sidewalk assessments, StreetScan deployed mobile carts with high definition video capture capability to assess the condition of 30 miles of sidewalk. Through analysis techniques, sidewalk distresses such as cracking, aggregate loss, uplifts and surface distortion were identified, which were then used to calculate sidewalk condition ratings on a scale of 0 to 100–with 0 being the worst and 100 being ideal

Project Outcome:

Results from the survey were placed in Streetlogix, providing an enriched view of the City's street network with color-coded pavement conditions and other assets, along with images for every scanned road and a range of decision-making tools

Project Contacts	
City of Lebanon, NH	James Donison, Director of Public Works (603) 448-3112 / james.donison@lebanonnh.gov
StreetScan	Salar Shahini, Chief Data Officer (617) 399-8236 / salar.shahini.s@streetscan.com

Sample of other Clients:

Town of Amherst, MA

County of Tippecanoe, IN

City of Parma Heights, OH

City of Kilgore, TX

City of Hillsboro, OR

City of Lafayette, IN

City of New Bedford, MA

City of Spokane Valley, WA

Town of Somers, CT

Town of Dover, NJ

City of Portland, ME

City of Sidney, OH

City of Greenwood, AR

City of Castle Pines, CO

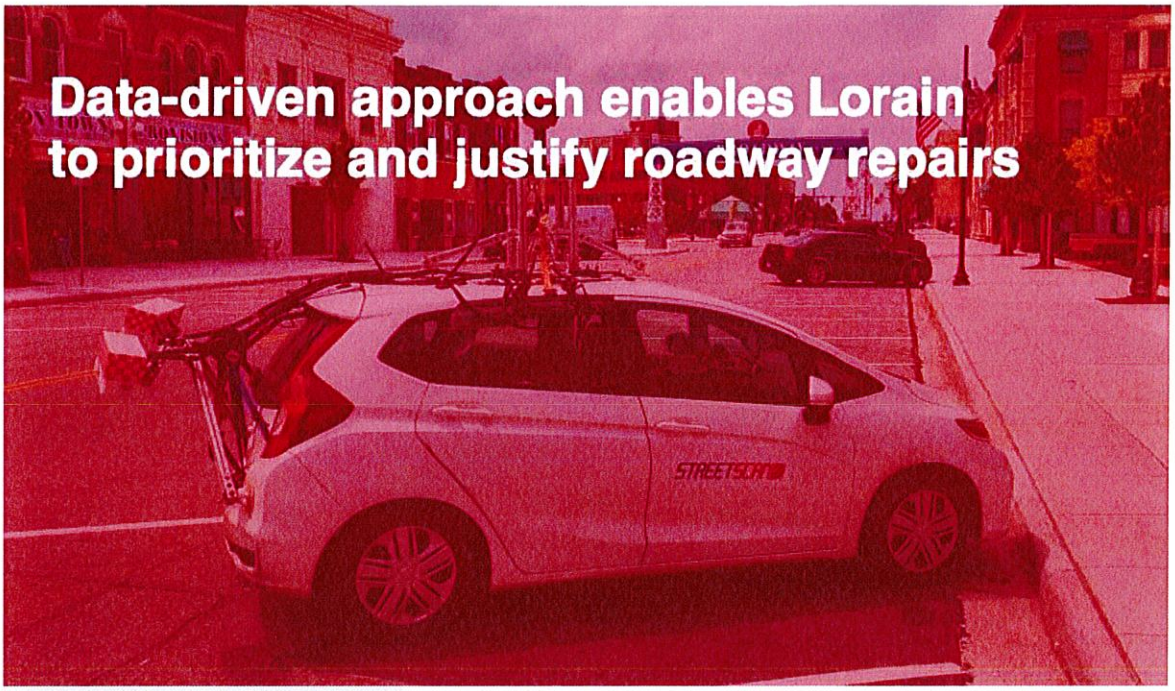
County of Tulsa, OK

City of Barrie, ON

Town of Beverly, MA

Town of Hampstead, QC

CASE STUDY



OVERVIEW

User
City of Lorain, OH

Challenge
To replace a labor-intensive, subjective approach to assess its roads, the City needed a data-driven way to evaluate the condition of its roadway network.

Solution
- StreetScan's mobile sensing vehicle
- Streetlogix street asset management software

Results
The City now has the data and software tools to prioritize road repairs, eliminate outside influences and spend its money more efficiently through better planning.

The City of Lorain is located in northeastern Ohio on Lake Erie, approximately 30 miles west of Cleveland. With over 60,000 residents, Lorain has numerous historical sites and activities to participate in for both residents and visitors and is home to the Charles Berry Bridge, the second-largest bascule bridge in the world.

The Challenge

Like many municipalities in North America, Lorain was utilizing a visual assessment to gather information on the status of its road network. This subjective and labor-intensive method motivated the City to embrace a faster, objective, and transparent way to assess roadway conditions and determine which roads needed repair, along with how and in what order they needed to be repaired. Lorain's small engineering group was also receiving numerous complaints from residents. "Everyone thinks their street is in poor condition and we needed the ability to properly prioritize maintenance and improvements in a data-driven, scientific approach," said Guy Singer, Lorain's Deputy Director of Engineering.

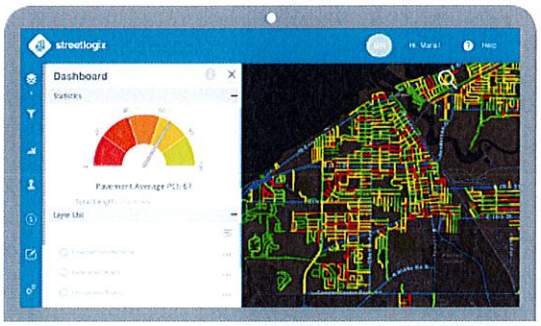
The Solution

Lorain embarked on a rigorous RFP process to select a pavement management provider and proceeded to interview the top three candidates. StreetScan was selected by a committee. "The attribute that the committee believed set StreetScan apart from other vendors was their Streetlogix asset management software," explained Singer.

StreetScan performed a City-wide condition assessment using its Smart City Mobile Sensing Technology. This automated method was developed to provide municipalities with a fast, objective analysis, ensuring that repair and maintenance decisions are based on complete and up-to-date data.

StreetScan's mobile-sensing vehicle travelled 272 centerline miles of roads to assess road conditions in normal traffic flow and, using a pavement condition index scale which runs from 0-100 (with 0 being the worst and 100 being ideal), developed a City-wide inventory of road conditions. The system utilizes 3D imaging technology to aid in the detection of various road defects. The automated detection results, combined with extensive human QA/QC, provided reliable and accurate surface condition estimates.

"The attribute that the committee believed set StreetScan apart from other vendors was their Streetlogix asset management software."
Guy Singer
Deputy Director of Engineering
City of Lorain, OH



The Results

Lorain's overall pavement condition index (PCI) was rated at an average PCI of 66, with 84.4% of the roads above a critical PCI condition of 55. Only 6% of the roads were rated as 'very poor' or 'serious'.

All survey results were placed in the Streetlogix platform, a powerful GIS asset management software that provides the City unprecedented tools to develop capital improvement plans and perform projections on their roadway conditions. Streetlogix AI-engine utilizes PCI, road usage data and a cost benefit analysis to determine road maintenance, repair costs and prioritization per segment. Budgeting and planning tools allow for editable short- and long-term planning as well as level of service analysis with target PCI.

The Benefit

City Staff is now able to interactively share, edit, and view the up-to-date roadway data on a common platform, as well as perform budget planning and develop multi-year capital improvement & maintenance programs. "With Streetlogix, we plan to develop a system that accurately estimates the road maintenance required year to year. This will create an iterative process for us that we believe will improve as we move into the future," concluded Singer.

Quotation for Professional Services

IMS Infrastructure Management Services
8380 S. Kyrene Rd., Suite 101, Tempe, AZ 85284
Phone: (480) 839-4347 Fax: (480) 839-4348
www.imsanalysis.com

To:	Michael Ahern, Director of Public Works	**Date:**	November 5, 2021
From:	Dan White, Manager of Client Services	**Project:**	Town of Berlin
Subject:	Pavement Management Services	**Cc:**	

Thank you for taking the time to review the pavement data collection services offered by IMS Infrastructure Management Services. IMS excels in pavement and asset management solutions and can provide a full suite of data collection and software implementation services.

As we understand, the Town currently maintains approximately **111 centerline miles of streets** and is interested in updating its pavement management program. IMS will survey local streets in a single direction; and **9 miles of major streets** in each direction to capture pavement distress data per the ASTM D6433 survey protocols. IMS utilized the GIS provided by the Town to complete a network review, resulting in an estimated **120 test-miles**. We propose to collect data with our LCMS-2 equipped survey vehicle. Our continuous, linear survey ensures that there will not be any inconsistencies as associated with sampling-based field surveys.

The base scope of work includes the completion of objective pavement distress data collection, GIS linkage, project development, and other value-added services such as an enhanced cost-benefit pavement analysis and five-year report. IMS has also provided pricing for optional services such as deflection testing for structural strength analysis, ROW asset inventories, and the IMSvue data viewer.

Our approach, and key service differentiator, is based on three, time proven fundamentals:

Answer the questions that are being asked – don't over-engineer the system or make it needlessly complicated. Databases and the application of technology are meant to simplify asset management, not make it more difficult.

Service and quality are paramount to success – the right blend of technically correct data, condition rating, and reporting will provide the agency with a long-term, stable solution. Service to the Client remains our top priority.

Local control and communications are key – it is important that all stakeholders understand the impacts of their decisions and have the system outputs react accordingly. We are readily available.

Services we can offer the Town of Berlin include:

- Objective roadway performance data collection including a full suite of surface distresses.
- Subgrade pavement performance analysis with a Dynaflect and/or FWD.
- Right-of-way asset data collection and HD digital image and GPS coordinate data collection.

Project Profiles and Local Experience

IMS has developed long-term partnerships with clients large and small across the United States and Canada. As such, our projects regularly take us across the map to assist clients with updating their pavement management programs. IMS performs approximately 100 pavement management update and implementation projects annually. On all assignments, the IMS team utilized our LCMS-2 equipped survey vehicles to perform a network-wide pavement performance evaluation and digital image surveys. IMS has also performed right-of-way asset inventories for many agencies, including the development of GIS-linked condition assessments of the sidewalks, signs, curb & gutter, pedestrian curb ramps and many other assets. IMS also specializes in comprehensive sidewalk and ramp evaluations to assist agencies with ADA compliance and maintenance programs.

Our philosophy is based on the provision of quality pavement condition data for the implementation of multiyear pavement management plans. As illustrated in the map, our extensive reach throughout the snow belt provides IMS with a unique understanding of the pavement deterioration curves for freeze-thaw climates. IMS utilizes this knowledge in combination with local maintenance practices and capabilities to develop and provide five-year maintenance management programs. IMS is the only pavement management consultant who has enough local, regional, and national expertise to offer such a wide-ranging comparison across multiple software platforms for PCI reporting.

Project Profiles:

Dover and Rochester, NH: CMA Engineering teamed with IMS for the completion of a citywide pavement management program for each municipality. CMA led the project that included pavement distress surveys on approximately 150 miles for each of Dover and Rochester. IMS also supplied digital images at 25-foot intervals and delivered multiple maps based on PCI scores and budget scenarios. The data was formatted and prepped for load to the Dover's newly implemented VUEWorks software, while Rochester received IMS' Easy Street Analysis software.

Stamford, CT: In 2015, Stamford selected IMS to setup a pavement management program. IMS implemented PavePRO Manager for the City's software program and trained the City staff on its functionality and reporting tools. The Laser RST was mobilized to survey 354 miles while a Dynaflect performed structural analysis on all streets as well. The end result was a comprehensive pavement management program that identified weaknesses in the network and causes of subgrade failures. The data was analyzed for the development of budget scenarios and deterioration models for a multi-year report for the CIP program.

Additional regional projects in progress or recently completed by IMS: North Kingstown, RI; Worcester, MA; Westfield, Livingston, and Millburn, NJ; Smithtown, NY.

GIS Integration & Mapping

The role of GIS in asset management cannot be overstated. It is a powerful tool that provides the ability to handle and present vast amounts of data in an efficient manner. Not only does GIS allow an agency to visually plot textural data, it also establishes an easy access portal to the data through an efficient integration with many 3rd party asset and work management software.

IMS kicks off every project by completing a brief review of the client's GIS environment to assess suitability for network referencing, survey map preparation, and pavement management purposes. Our team will consume the Town's existing GIS files and use the GIS as the basis for developing the network segmentation on a logical block-to-block or intersection-to-intersection basis. *IMS will not make changes to GIS unless approved by Town staff.*

The data collected by IMS is linked to the existing GIS environment and is supplied as a personal geodatabase, spatial database engine, Auto CAD files, or a series of shape files. IMS collects XY coordinates for all data elements using GPS technology coupled with inertial navigation and integrates with most 3rd party GIS applications, including ESRI.

At a minimum, the GIS supplied by the Town should have an ownership attribute, functional classifications, contiguous line work, and be in a digital format such as shape files and/or personal/file geodatabases. As a supplemental task, IMS also offers full service "GIS Clean-Up" and "Functional Class Review" activities for agencies that require additional GIS development above and beyond standard network referencing activities. IMS can also compare the existing roadway inventory within any current asset management system to the Town's GIS environment. If they do not match and a one-to-one relationship is required, IMS has the team available to develop the correct referencing information. This remains an optional activity to be conducted at the discretion of Town staff.

For this assignment, GIS will be used in four key areas of work:

1. GIS will be used to verify the streets to be surveyed and to create the routing maps for use during the field surveys.
2. The survey productivity will be tracked through the plotting of the GPS data collected during the field surveys. This will allow IMS to review all streets that have been covered, identify anomalies in the referencing, and spot missed streets.
3. GIS will be used in processing the distress and inventory data. By plotting the data, we can QA the data and identify data exceptions in addition to proofing out the GIS.
4. Personal geodatabases, spatial database engines, shape and/or KML files, can be created for the visual presentation of condition data and analysis results.

LCMS-2 Equipment Description and Pavement Distress Identification

The IMS fleet of pavement performance equipment includes four LMCS-2 Road Surface Testers, each equipped with the LCMS-2 technology, the ***largest such fleet in the US***. IMS also has access to two Dynaflect Devices and mobile LiDAR for ADA compliance surveys. For this survey, we propose to use one LCMS-2 survey vehicle coupled with HD digital imagery and GPS capabilities. The LCMS-2 equipped van, with its 2-sensor arrary is capable of collecting a full suite of ASTM compliant pavement condition data complete with high accuracy GPS coordinates and multiple view HD digital images for both rigid and flexible pavements (in real time). The LCMS-2 equpment provides three demensional high-speed, mm-level scanning and pattern recognition analysis. Specialized data processing, using GIS as its backbone, allows the pavement data to be quickly checked for completeness and quality.

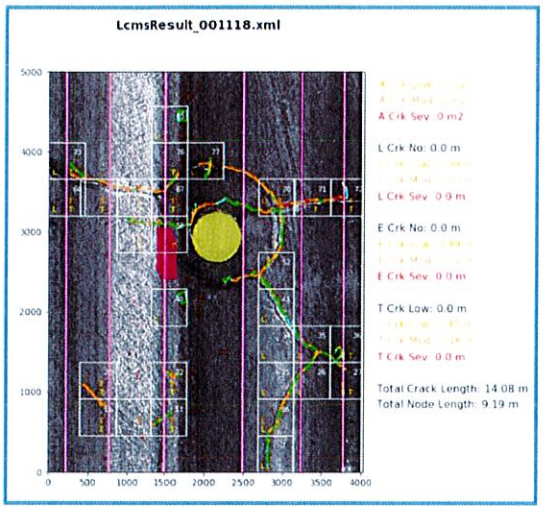
The main components of the LCMS-2 RST are:

- A 2-sensor, 3D LCMS-2 array coupled with 2 IMU's (inertial measurement unit) are utilized to measure pavement roughness, rutting, cracking, potholes, bleeding, geometrics, and many other common ASTM D6433 surface distresses.
- Automated crack profiling and production of extent-severity based pavement distresses through the 3D crack profile software.
- Up to 4 HD digital cameras are mounted for forward, side, rear, and right-of-way views.
- Ability to collect dual wheel path roughness to International Roughness Index (IRI) standards using 3D profile technology.
- High accuracy Global Positioning System (GPS) receiver with OXTS inertial navigation for geo-locating of pavement and asset information with excellent accuracy.
- Dual distance measuring instruments to measure linear distances to within +/- 0.5%.
- Built-in software and on-board processors to develop roadway inventories, time code integration, and system monitors.
- Integrated touchscreen event board used for capturing additional roadway attributes on the fly or even expanding the roadway distress data to be captured. The touchscreen is programmed with a mobile mapping device to ensure navigation and routing is as efficient as possible. All inputs can be programmed for acquisition using a standard extent and severity format.

The Laser Crack Measuring System 2 (LCMS) also automatically collects transverse cracking, block cracking, alligator cracking, longitudinal cracking, rutting, potholes, faulting, roughness, geometrics, and texture. The LCMS-2 technology automatically detects cracks and minute variances in the pavement surface using a horizontal resolution of 1mm. **Thus, the LCMS-2 greatly diminishes the subjective nature of PCI data collection performed by image-based surveys or manual surveys.**

Collecting Objective Condition Data

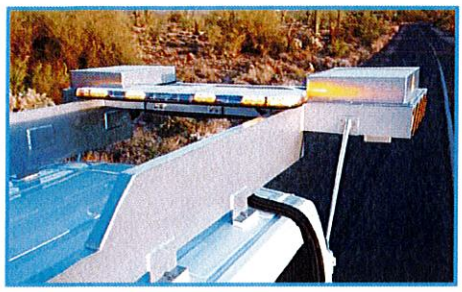
The IMS Laser Crack Measurement System (LCMS-2) is one of the most technologically advanced devices available for pavement performance assessments. The two-sensor array completes a 3D millimeter level scanning of the pavement surfaces that pass below the laser array. With a high speed one-millimeter resolution, this means the LCMS-2 device deploys a continuous scan of laser points (approximately 4,000) across 13-foot of pavement, making it one of the most high-resolution pavement laser scanners available. The onboard processing software then takes it a step further by analyzing pavement elevation (range & intensity) and automatically identifying cracking, rutting, roughness in the form of IRI, potholes, and bleeding.



While any engineering firm could deploy the LCMS-2 equipment for data collection, processing the information for distress quantification requires a complete understanding of automated technologies, GIS mapping, and distress measurement protocols found in standards such as ASTM D6433. Simply reviewing the LCMS-2 cracking vectors (colored cracks) with the human eyeball dilutes the objectivity of the equipment. *(This image represents an internal QA tool, and is not available as a deliverable,)*

IMS engineers and technologists have developed a computerized processing application that automatically applies an 18"x18" grid to the LCMS-2 downward images (FIS files) and uses pre-programmed geometric algorithms to classify and quantity distresses by type. These automated processing routines result in an unparalleled level of objectivity and efficiency in distress pattern recognition analysis. The image above illustrates the quantity of several distresses as well as the presence of a manhole, which was automatically scrubbed from the dataset.

In addition to the auto quantification and classification of ASTM D6433 distresses, the LCMS-2 device also operates as a Class I profile device that collects longitudinal profile (in the form of the International Roughness Index) and transverse profile (rutting) using advanced 3D profile laser scanning technology. The system is not subject to vehicle wander like other automated technologies and compensates for variation in driver ability. The processing software can calculate rutting width and depth following the ASHTO Taut Wire methodology. The white solid lines indicate there was no rutting in the left wheel path and that rutting was detected and measured in the right wheel path. Filters can also be applied to account for rehabilitation activity overlap, which can be as much as a ¼ inch depending on the application.



Cracking, Faulting, Texture, Bleeding, & Potholes: The RST allows IMS to conduct an objective crack survey, thus increasing the accuracy of an otherwise subjective manual survey. High-speed lasers and an on-board processing computer, accurately measure the surface profile of the road. Included in this profile are all cracks and faults as small as 1/8" (2 mm) wide that pass beneath the lasers. Processing software then reduces and filters this information to determine the *total number of cracks, crack width/depth, as well as the crack interval*, plus faulting information. From this information, quantified crack data can be determined at both the sample and summary intervals. Crack identification includes all cracking such as alligator, transverse, longitudinal, map, and edge cracking (where applicable).

Rutting: The LCMS-2 device collects continuous transverse profile data at 1-millimeter resolution at highway speed. This configuration is far superior to other types of vehicles that utilize three lasers or sonic transducers to calculate "relative rutting". Even five sensor units are extremely sensitive to driver error since it is essential in this case that the driver keep the data collection vehicle's wheel exactly in the rutted wheel tracks (assuming that they fit).

The Taut wire method is used to calculate the rut depth in both the right and left wheel track on a continuous basis. Either the right or deeper of the two-wheel path ruts may be used for rut depth calculations with the average rut depth for that wheel path reported for each section. *Rut depth results, quantified by 3 - 4 severity thresholds (with break points at user-defined levels such as 0.25, 0.50 and 0.65 inches) and percentage of section will be provided for every segment.*

Roughness: International Roughness Index (IRI) data is calculated in real time from continuous longitudinal profile data collected by the van's 3D profile device. Data is simultaneously obtained from three devices to determine the road profile: a pulse transducer-based distance-measuring instrument (DMI), high speed 3D laser sensors operating at 112 MHz, and an accelerometer in conformance with ASTM E 950. The RST unit conforms to a Class I profiling device, and it can also "pause" over non-valid roadway sections such as localized maintenance activities, railroad crossings, or brick inlays and not affect the overall IRI value.

Distortions, Raveling, Patching, & Other Custom Attributes: While the LCMS-2 automatically collects the majority of ASTM D6433 distresses, the RST platform can be configured to collect the remaining distresses (raveling, distortions, and patching) using the integrated DDCRS. By means of a touch screen-based tablet computer, highly trained IMS technicians input changes in observed distress severities and extents or identify specific roadway assets or attributes such as curb reveal or lip of gutter information. The DDCRS is integrated into the data flow through time code, GPS, DMI distance and inventory control. The data is then post processed in the office to generate extent quantities for each observed distress severity level throughout every surveyed road section.

PCI Development, Analysis Configuration & Multi-Year Rehabilitation Plans

Immediately following the completion of the field surveys, IMS will begin processing the pavement distress extent and severity scores to develop a Pavement Condition Index (PCI) for each roadway segment (utilizing the Town's existing sections). The condition results are analyzed by a team of IMS engineers, who then develop the Town's multi-year pavement management plan. This section provides a brief summary of the functionality of the IMS pavement analysis in order to emphasize our implementation expertise as well as the abilities and constraints within a pavement analysis.

The purpose of pavement management is to produce cost effective maintenance programs that maximize available resources and roadway life. By incorporating key components of a cost benefit analysis into the analysis operating parameters, we can develop a game plan that is optimized to meet the needs of the Town staff. In addition, the analysis operating parameters described within this section will be delivered in an easy-to-use interactive Excel spreadsheet including the segment PCI data, pavement deterioration curves, triggers (priority weighting factors), and the prioritized multi-year rehabilitation plan. Everything is linked to GIS in the form of simple shape files or a personal geodatabase.

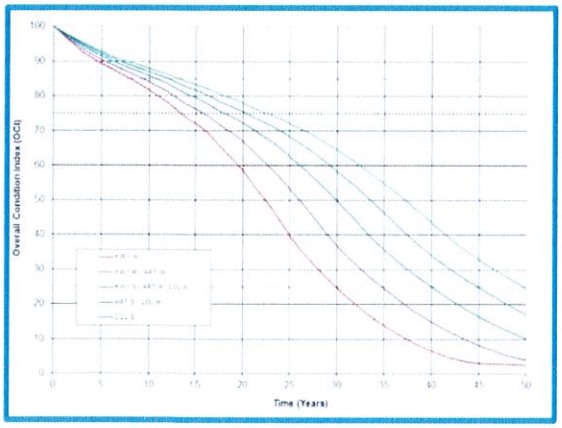
Field Inspection Data and Pavement Condition Index (PCI)

The IMS analysis allows you to store information regarding your pavements, including surface types, number of lanes, patching estimates, cross slopes, and sidewalk & curb types with replacement estimates. Pavement condition data including surface distress, roughness, and deflection results can be stored and analyzed. Using an in-house Pavement Manager Setup module, we can develop customized condition elements, distress types (load & non-load), Indices (SDI, RI, & SI), weightings, and PCI score.

In addition to the yearly programs, the net impact each budget scenario has on the expected condition of the road network over time can be determined. This budget impact can be illustrated both in terms of the yearly increase or decrease in the average network PCI score, PCI distribution, or % Backlog of roads that were not selected by the budgets. IMS converts the difficult to understand FHWA and ASTM D6433 data to a 0-10 distress rating scale with distress weighted factors (DWF).

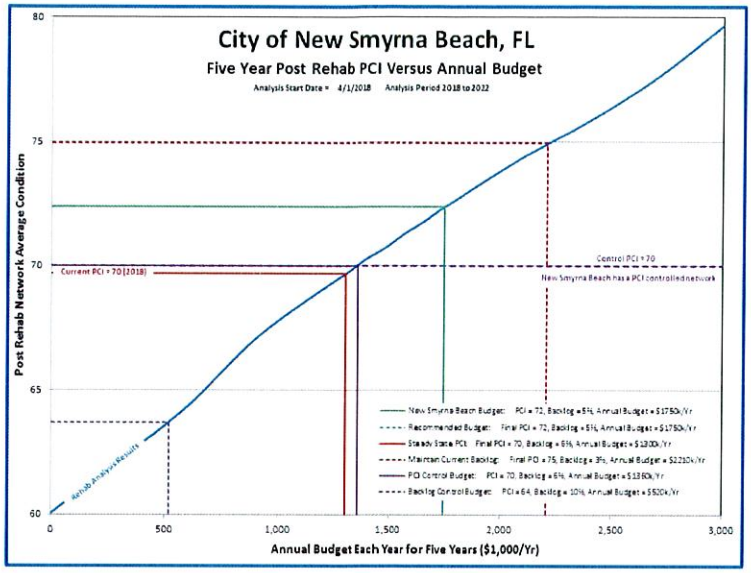
Modeling and Performance Curves

With the IMS analysis, you can forecast various budget scenarios to help you determine your ideal maintenance and rehabilitation schedule. This approach will help you decide what rehab activities should be performed, when and where to perform them, and an ideal budget for your system to maintain it at a specific level of service.



IMS engineers use pavement deterioration models that can be customized to reflect the climatic conditions and structural characteristics of the Berlin Road network. As a result, performance curves can be developed on factors such as functional class, pavement type and sub-grade strength.

Rehabilitation Analysis



An unlimited number of pavement maintenance and rehabilitation strategies can be defined with the IMS approach to pavement management. An analysis is then run, incorporating the performance curves, set points, filter criteria and rehab alternatives to identify the overall need in terms of rehab strategies and costs for the Town's street network, for today as well as year on year for the next 3, 5, or 10 years.

The IMS approach allows you to input any number of "what if" budget scenarios and produce prioritized yearly rehab programs based on those funding levels over a 10-year analysis period. Typical budget scenarios include Budget $/Year, Unlimited Budget $, "Do Nothing" Budget, and a Target PCI Budget.

What is included in an IMS analysis & report?

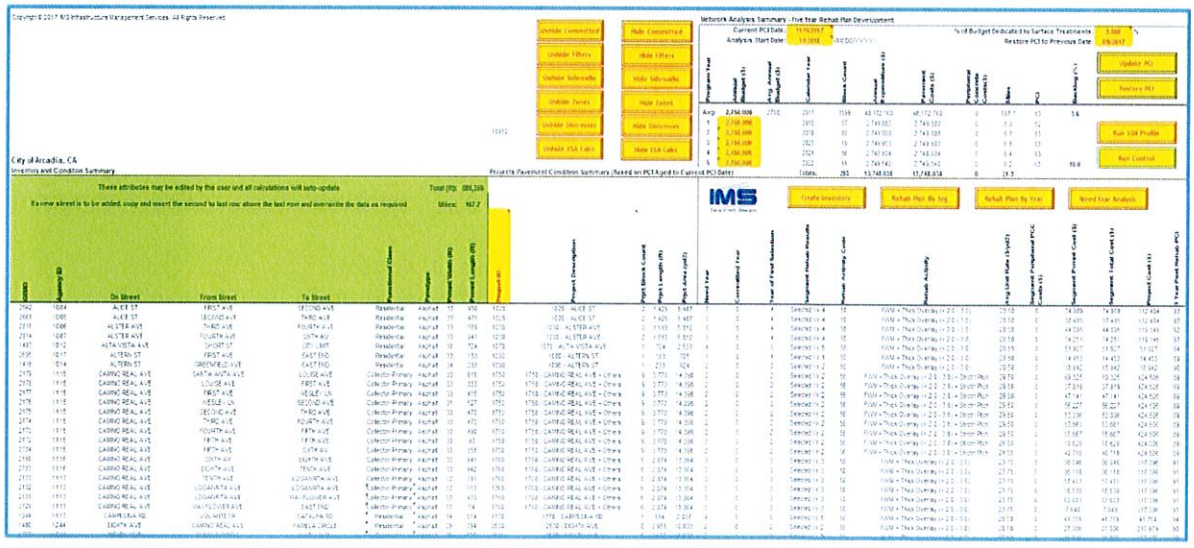
- *Street ownership and inventory/attribute report*
- *Present condition ranking* – detailed and summary condition data including Good/Fair/Poor, Load Associated Distresses (LAD), Non-LAD, and Project reviews of each street in the network, as well as the network as a whole.
- *Fix all budget analysis* – this identifies the upper limit of spending by rehabilitating all streets assuming unlimited funding.
- *Do nothing analysis* – this identifies the effects of not performing roadway rehabilitation projects.
- *Steady state rehabilitation life cycle analysis* – this identifies the minimum amount of rehabilitation that must be completed in order to maintain the existing level of service over 3, 5, or 10 years.
- *PCI & funding levels* – what funding will be necessary to maintain a PCI of 70, 75 & 80.
- *Plus or minus 50% and other additional runs* – additional budget runs are completed at rates of +50% and -50% of the suggested steady state analysis. Up to 10 budget scenarios will be run.
- *Integration of capital projects and Master Plans* – ongoing and proposed projects that affect roadway rehabilitation planning will be incorporated into the analysis.
- *Draft multi-year rehabilitation and prioritized paving plans* – based on need, available budget and level of service constraints; a minimum of three budget runs will be completed.
- *Final prioritized paving plan* – incorporating feedback from stakeholder departments and utilities, complete with budget and level of service constraints.

Pavement Management Spreadsheet: Easy Street Analysis (ESA)

It is imperative that the Town staff have direct access to the pavement condition and analysis results without having to become software experts. While the results of the survey will certainly be documented and bound into a final report that illustrates the findings of the survey, those results will remain static. To provide interactive results that enhance our final report, we have engineered a simple and easy-to-use Excel spreadsheet called Easy Street Analysis (ESA). ESA utilizes the core metrics of any great pavement management system, such as the ability to prioritize and optimize the multi-year plans, and ESA can be consulted independently or integrated into third-party pavement management applications like PAVER. With ESA, we can introduce IRI, structural integrity, logical projects, custom Priority Weighting Factors (PWF), and cost-benefit techniques.

ESA will be programmed to develop a multi-year maintenance and rehabilitation plan using "cost of deferral" as a rehabilitation candidate selection constraint in an effort to introduce cost-benefit techniques into the Town's Pavement Management Plan. In addition, ESA will have referenced deterioration curves for each functional classification, pavement type, and even pavement strength rating. Storing the data in this open architecture empowers the Town to utilize third-party software in the future if desired. ESA will also contain a full suite of maintenance and rehabilitation techniques, unit rates, and associated PCI resets. The parameters of the analysis (Priority Weighting Factors) can also be modified and reprioritized whenever required. This flexibility will allow the Berlin data to evolve with the priorities of elected officials and department staff. Programmed Priority Weighting Factors include functional classification, pavement type, and pavement strength, while actual candidate selection is based on the incremental cost of deferral.

As demonstrated in the image below, the analysis data in the spreadsheet is supplemented with many cells highlighted in yellow. The yellow highlighted cells indicate that they are "HOT" and can be modified by the end user. Two of the yellow cells shown below represent the Annual Budget and the Project ID. The Annual Budget cell can be modified with a new budget, and the five-year plan will automatically re-prioritize. Although IMS will have already aggregated the Town's segments (intersection-to-intersection) into viable projects (multiple segments strung together to form a logical project), the user has the ability to aggregate additional segments into a project or even remove a segment from a project.



ESA also allows an agency to refresh the five-year plan by entering the maintenance and rehabilitation work completed. As seen in the image below, ESA contains "PCI Override" functionality. When work has been completed on a particular segment, the user inserts the override PCI value along with a date. ESA then removes the segment from the five-year plan and updates all referenced network PCI averages.

Pavement Condition Summary										Condition Details										
Surface Distress Index (SDI)	Roughness Index (RI)	Structural Index (SI)	Pavement Cndtn Index (PCI)	Strength Rating	Condition Rating	Load Assoc Distress Deducts (LADD)	Non-Load Distress Deducts (NLAD)	PCI Override (OPCI)	OPCI Date	Current Segment PCI (CPCI)	Segment IRI (mm/m)	Deflection Results	Rutting (ACP Only)	L&T Cracking / Linear Crk	Alligator Cracking Divided Slab / Blow Up	Map Crk / Crnr Brk / D Crk	Edge Cracking Joint Spall / Joint Sealant	Distortions / Faulting	Bleeding / Polished Agg	Raveling / Scaling / CAL	Patches / Potholes
74	63	60	**70**	Mod	V Good	24	3			**70**	3.9	0	10.0	10.0	8.9	10.0	10.0	9.1	10.0	9.4	9.2
79	53	60	**70**	Mod	V Good	7	14			**70**	6.6	0	10.0	8.9	10.0	10.0	10.0	10.0	10.0	9.1	9.1
60	58	60	**59**	Mod	Fair	34	7			**59**	4.4	0	10.0	9.6	7.0	10.0	10.0	10.0	10.0	9.3	9.5
57	66	30	**60**	Weak	Good	41	2			**60**	3.5	0	10.0	10.0	6.1	10.0	10.0	9.7	10.0	9.7	10.0
70	59	80	**66**	Strng	Good	6	24			**66**	4.3	0	10.0	7.2	9.5	10.0	10.0	9.9	10.0	9.8	9.9
81	60	80	**74**	Strng	V Good	0	19			**74**	4.2	0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	6.5	10.0
91	98	60	**93**	Mod	Excellent	4	6			**93**	1.4	0	10.0	10.0	9.6	10.0	10.0	10.0	10.0	9.0	10.0
83	71	60	**79**	Mod	V Good	8	10			**79**	3.1	0	10.0	10.0	10.0	10.0	8.8	9.7	9.8	8.4	10.0
80	85	60	**82**	Mod	V Good	0	20			**82**	2.1	0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	6.3	10.0
83	88	60	**85**	Mod	V Good	6	12			**84**	1.9	0	10.0	10.0	10.0	10.0	10.0	10.0	9.8	8.0	9.3
86	67	60	**80**	Mod	V Good	4	11			**79**	3.7	0	10.0	10.0	9.7	10.0	10.0	9.9	10.0	8.0	10.0

Additional Features of the IMS Easy Street Analysis Spreadsheet

- Red triangle tips that trigger a dialogue box explaining cell contents
- Ability to spontaneously add new road segments and attributes
- Modifiable distress indices for Town field inspections
- Input work completed and override segment level PCI scores
- Prioritize by neighborhoods, zones, or districts
- Ability to modify project lengths – includes aggregating and splits
- Commit projects and force "Must Do's" or "Must Never Do"
- Program-varying annual budgets over a five-year horizon
- Commit a percentage of the budget to surface treatments if desired
- Automated rehabilitation plan prioritization and optimization
- Macros that automatically sort and filter simple rehabilitation and inventory lists
- Ability to sync the spreadsheet with the Data Viewer though a .CSV file export

While the ESA spreadsheet is not meant to replace pavement management systems, it is an alternative for agencies that do not have the resources or staff to maintain a dedicated application or for agencies that run an application that is unable to prioritize and optimize projects to meet their needs. For the Town of Berlin, ESA will be a useful tool that has analytical capabilities on-par or exceeding many third-party software solutions.

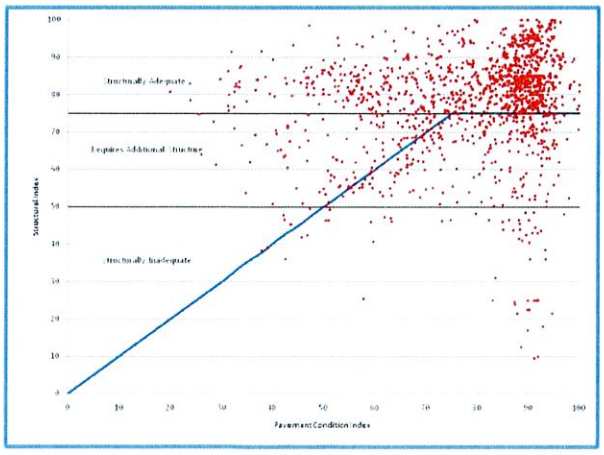
Deflection Testing (Optional)

Subsurface distress investigations are a valuable tool to assess the sub grade condition of a roadway. As a part of a sound pavement management program, IMS can integrate the Structural Index (SI) as a component of each roadways final PCI score. To assess the subgrade strength of a roadway, a Dynaflect is utilized for Asphalt and Concrete roadways.

Structural Strength Assessment & Analysis:

Deflection testing is performed using a Dynaflect, in accordance with ASTM standards. The IMS team is capable of conducting a structural assessment of all designated roadways but is typically performed on roads that carry regular heavy loading. Deflection testing is completed at least once in each direction in every street segment (every 300 - 500 feet) along the outside lanes of the roadway. Testing shall be altered to an inside lane when it appears to be in a worse condition than the outside lane of the segment based on site observations. IMS records readings in 5 geophones for inclusion in the overall pavement condition index. These readings are used to determine the pavement strength, load transfer capabilities, and identify properties of the base and sub-grade.

Upon completion of the deflection survey a structural analysis is performed. Dynaflect's apply a known load to the pavement and measure the pavement response to the load. The structural adequacy of a road is expressed as a 0 to 100 score with several key ranges: roadways with a Structural Index greater than 75 are deemed to be structurally adequate for the loading and may be treated with lightweight surface treatments or thin overlays; those between 50 and 75 typically reflect roads that require additional pavement thickness; and scores below 50 typically require reconstruction and increased base and pavement thickness.



The adjacent graph presents a sample structural adequacy plot of a recent client's roadway network against its average pavement condition.

The diagonal blue line separates roadways that are performing above expectations (above the line), from those that are not, (below the line). The small number of roadways falling below the diagonal line indicates this particular Agency has a high percentage of roadways that are structurally inadequate for their design load. This is typically the result of insufficient base and structural materials during the original construction, or the application of overlays that were too thin during the lifetime of the roadway.

Proposed Project Budget

The detailed budget presented below is based on the scope of work described in this proposal. We can provide a detailed scope of work if requested to accompany this document. It represents a realistic budget to complete the work, and we are confident we can maintain an on-time, on-budget approach to the assignment. Based on the current seasonal conditions, IMS projects mobilization to occur in the Spring of 2022, if selected for this project.

Task	Activity	Quant	Units	Unit Rate	Total
	Project Initiation				
1	Project Initiation & Kickoff	1	LS	$3,000.00	$3,000.00
2	Network Referencing & GIS Linkage	120	T-Mi	$20.00	$2,400.00
3	Network Inventory Checks & Survey Map Development	120	T-Mi	$10.00	$1,200.00
	Field Surveys				
4	LCMS-2 Survey Vehicle Mobilization/Calibration	1	LS	$4,500.00	$4,500.00
5	LCMS-2 Pavement Data Collection	120	T-Mi	$165.00	$19,800.00
	Data Management				
6	Pavement Data QA/QC, Processing & Format	120	T-Mi	$35.00	$4,200.00
7	Pavement Management Report and Updated Geodatabase	1	LS	$6,500.00	$6,500.00
8	Optimized Cost-Benefit Analysis: Project Planning, Budget Scenarios and Model Runs for 5-year Budget Recommendations *i. Report Additions to Include Multi-Year Recommendations* *ii. Easy Street Analysis (ESA) Spreadsheet Pavement Management Tool includes training and support for 1-Year*	1	LS	$4,000.00	$4,000.00
9	Project Management & Meetings	1	LS	$3,420.00	$3,420.00
	Berlin Pavement Management Project Total:				**$49,020.00**
	Optional Project Activities:				
10	Council Meeting/Workshop/Presentation	1	EA	$3,500.00	$3,500.00
11	IMSvue Web-hosted Viewer **(includes 2-Years Tech Support)**	1	LS	$7,500.00	$7,500.00
12	Delivery of HD Digital Images at 15-Foot Intervals	120	T-MI	$20.00	$2,400.00
13	Dynaflect Mobilization	1	LS	$3,250.00	$3,250.00
	a. Deflection Testing & Structural Analysis	120	T-Mi	$170.00	$20,400.00
14	Right-of-Way Asset Inventory Data Collection (GPS & Image QC/QA)	120	T-MI	$15.00	$1,800.00
	a. Asset Inventory & Condition Assessment - Curb Ramps	120	T-Mi	$84.00	$10,080.00
	b. Asset Inventory & Condition Assessment - Sidewalks	120	T-Mi	$70.00	$8,400.00
	c. Asset Inventory & Condition Assessment - Curb & Gutter	120	T-Mi	$70.00	$8,400.00
	d. Asset Inventory & Condition Assessment - Signs & Supports	120	T-Mi	$140.00	$16,800.00
	e. Asset Inventory & Condition Assessment - Street Lights	120	T-Mi	$70.00	$8,400.00
	f. Asset Inventory & Condition Assessment - Street Furniture	120	T-Mi	$56.00	$6,720.00
	g. Asset Inventory & Condition Assessment - Markings & Striping	120	T-Mi	$91.00	$10,920.00
	h. Asset Inventory & Condition Assessment - Traffic Signals/Cabinets	120	T-Mi	$56.00	$6,720.00

Thank you for considering IMS as a viable solution to your pavement management needs and we will strive to become an asset and extension of the Town of Berlin staff and team. If any questions arise, please do not hesitate to contact me at (847) 481-6322 or dwhite@imsanalysis.com.

Regards,
IMS Infrastructure Management Services

Dan White, MBA
Manager of Client Services

TOWN OF BERLIN

CERTIFICATION OF SUFFICIENCY OF FUNDS

(Sec. 6-10-2 of the Town Charter)

DATE	11-Nov-21

Purchase Item or Contract: Comprehensive roadway assessment Requested by: Mike Ahern

QUANTITY	DESCRIPTION	PRICE PER UNIT	$ AMOUNT
1.00	Comprehensive roadway assessment	$22,762.00	$22,762.00
			-
			-
			-
			-
		TOTAL	$22,762.00

Account No. 001.20.2036.0.53814.00000 Contractual Services

Budgeted Amount.....	$49,500.00	Available balance.....	$38,100.00
Encumbrances to Date.....	$9,374.68	Amount Needed for This Package.....	$22,762.00
Expenditures to Date.....	$2,025.32	Available Balance After Purchase.....	$15,338.00

Is a budget change needed? ☐ Yes ☒ No

If so, has a budget change been prepared? ☐ Yes ☐ No

☒ I certify that there ARE sufficient funds available to support the purchase of the items described above.

Finance Director or Assist.Finance Director

or:

☐ I certify that a budget change in the amount of $_____ must be processed concurrently with this certification to support this commitment.

Finance Director or Assist.Finance Director

Quotation for Professional Services

IMS Infrastructure Management Services
8380 S. Kyrene Rd., Suite 101, Tempe, AZ 85284
Phone: (480) 839-4347 Fax: (480) 839-4348
www.imsanalysis.com

To:	Michael Ahern, Director of Public Works	**Date:**	November 5, 2021
From:	Dan White, Manager of Client Services	**Project:**	Town of Berlin
Subject:	Pavement Management Services	**Cc:**	

Thank you for taking the time to review the pavement data collection services offered by IMS Infrastructure Management Services. IMS excels in pavement and asset management solutions and can provide a full suite of data collection and software implementation services.

As we understand, the Town currently maintains approximately **111 centerline miles of streets** and is interested in updating its pavement management program. IMS will survey local streets in a single direction; and **9 miles of major streets** in each direction to capture pavement distress data per the ASTM D6433 survey protocols. IMS utilized the GIS provided by the Town to complete a network review, resulting in an estimated **120 test-miles**. We propose to collect data with our LCMS-2 equipped survey vehicle. Our continuous, linear survey ensures that there will not be any inconsistencies as associated with sampling-based field surveys.

The base scope of work includes the completion of objective pavement distress data collection, GIS linkage, project development, and other value-added services such as an enhanced cost-benefit pavement analysis and five-year report. IMS has also provided pricing for optional services such as deflection testing for structural strength analysis, ROW asset inventories, and the IMSvue data viewer.

Our approach, and key service differentiator, is based on three, time proven fundamentals:

Answer the questions that are being asked – don't over-engineer the system or make it needlessly complicated. Databases and the application of technology are meant to simplify asset management, not make it more difficult.

Service and quality are paramount to success – the right blend of technically correct data, condition rating, and reporting will provide the agency with a long-term, stable solution. Service to the Client remains our top priority.

Local control and communications are key – it is important that all stakeholders understand the impacts of their decisions and have the system outputs react accordingly. We are readily available.

Services we can offer the Town of Berlin include:

Objective roadway performance data collection including a full suite of surface distresses.
Subgrade pavement performance analysis with a Dynaflect and/or FWD.
Right-of-way asset data collection and HD digital image and GPS coordinate data collection.

Project Profiles and Local Experience

IMS has developed long-term partnerships with clients large and small across the United States and Canada. As such, our projects regularly take us across the map to assist clients with updating their pavement management programs. IMS performs approximately 100 pavement management update and implementation projects annually. On all assignments, the IMS team utilized our LCMS-2 equipped survey vehicles to perform a network-wide pavement performance evaluation and digital image surveys. IMS has also performed right-of-way asset inventories for many agencies, including the development of GIS-linked condition assessments of the sidewalks, signs, curb & gutter, pedestrian curb ramps and many other assets. IMS also specializes in comprehensive sidewalk and ramp evaluations to assist agencies with ADA compliance and maintenance programs.

Our philosophy is based on the provision of quality pavement condition data for the implementation of multiyear pavement management plans. As illustrated in the map, our extensive reach throughout the snow belt provides IMS with a unique understanding of the pavement deterioration curves for freeze-thaw climates. IMS utilizes this knowledge in combination with local maintenance practices and capabilities to develop and provide five-year maintenance management programs. IMS is the only pavement management consultant who has enough local, regional, and national expertise to offer such a wide-ranging comparison across multiple software platforms for PCI reporting.

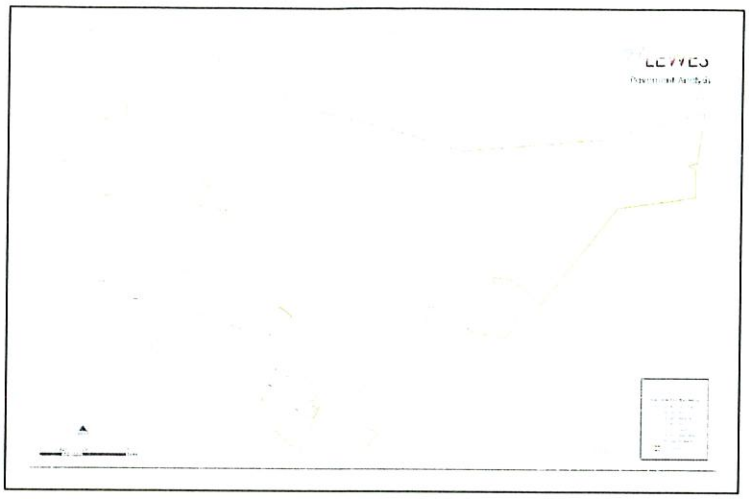
Project Profiles:

Dover and Rochester, NH: CMA Engineering teamed with IMS for the completion of a citywide pavement management program for each municipality. CMA led the project that included pavement distress surveys on approximately 150 miles for each of Dover and Rochester. IMS also supplied digital images at 25-foot intervals and delivered multiple maps based on PCI scores and budget scenarios. The data was formatted and prepped for load to the Dover's newly implemented VUEWorks software, while Rochester received IMS' Easy Street Analysis software.

Stamford, CT: In 2015, Stamford selected IMS to setup a pavement management program. IMS implemented PavePRO Manager for the City's software program and trained the City staff on its functionality and reporting tools. The Laser RST was mobilized to survey 354 miles while a Dynaflect performed structural analysis on all streets as well. The end result was a comprehensive pavement management program that identified weaknesses in the network and causes of subgrade failures. The data was analyzed for the development of budget scenarios and deterioration models for a multi-year report for the CIP program.

Additional regional projects in progress or recently completed by IMS: North Kingstown, RI; Worcester, MA; Westfield, Livingston, and Millburn, NJ; Smithtown, NY.

GIS Integration & Mapping



The role of GIS in asset management cannot be overstated. It is a powerful tool that provides the ability to handle and present vast amounts of data in an efficient manner. Not only does GIS allow an agency to visually plot textural data, it also establishes an easy access portal to the data through an efficient integration with many 3rd party asset and work management software.

IMS kicks off every project by completing a brief review of the client's GIS environment to assess suitability for network referencing, survey map preparation, and pavement management purposes. Our team will consume the Town's existing GIS files and use the GIS as the basis for developing the network segmentation on a logical block-to-block or intersection-to-intersection basis. *IMS will not make changes to GIS unless approved by Town staff.*

The data collected by IMS is linked to the existing GIS environment and is supplied as a personal geodatabase, spatial database engine, Auto CAD files, or a series of shape files. IMS collects XY coordinates for all data elements using GPS technology coupled with inertial navigation and integrates with most 3rd party GIS applications, including ESRI.

At a minimum, the GIS supplied by the Town should have an ownership attribute, functional classifications, contiguous line work, and be in a digital format such as shape files and/or personal/file geodatabases. As a supplemental task, IMS also offers full service "GIS Clean-Up" and "Functional Class Review" activities for agencies that require additional GIS development above and beyond standard network referencing activities. IMS can also compare the existing roadway inventory within any current asset management system to the Town's GIS environment. If they do not match and a one-to-one relationship is required, IMS has the team available to develop the correct referencing information. This remains an optional activity to be conducted at the discretion of Town staff.

For this assignment, GIS will be used in four key areas of work:

1. GIS will be used to verify the streets to be surveyed and to create the routing maps for use during the field surveys.
2. The survey productivity will be tracked through the plotting of the GPS data collected during the field surveys. This will allow IMS to review all streets that have been covered, identify anomalies in the referencing, and spot missed streets.
3. GIS will be used in processing the distress and inventory data. By plotting the data, we can QA the data and identify data exceptions in addition to proofing out the GIS.
4. Personal geodatabases, spatial database engines, shape and/or KML files, can be created for the visual presentation of condition data and analysis results.

LCMS-2 Equipment Description and Pavement Distress Identification

The IMS fleet of pavement performance equipment includes four LMCS-2 Road Surface Testers, each equipped with the LCMS-2 technology, the ***largest such fleet in the US***. IMS also has access to two Dynaflect Devices and mobile LiDAR for ADA compliance surveys. For this survey, we propose to use one LCMS-2 survey vehicle coupled with HD digital imagery and GPS capabilities. The LCMS-2 equipped van, with its 2-sensor arrary is capable of collecting a full suite of ASTM compliant pavement condition data complete with high accuracy GPS coordinates and multiple view HD digital images for both rigid and flexible pavements (in real time). The LCMS-2 equpment provides three demensional high-speed, mm-level scanning and pattern recognition analysis. Specialized data processing, using GIS as its backbone, allows the pavement data to be quickly checked for completeness and quality.

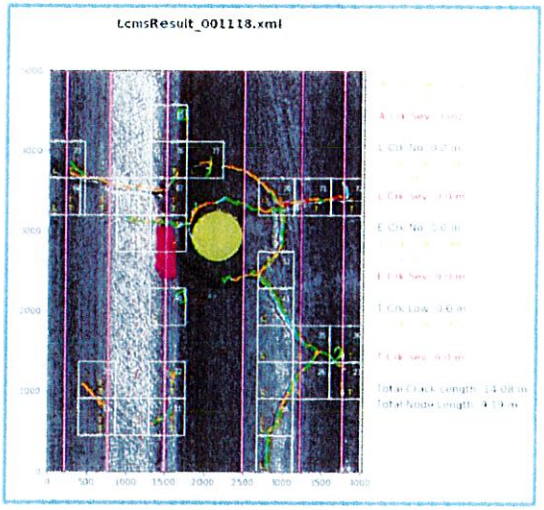
The main components of the LCMS-2 RST are:

- A 2-sensor, 3D LCMS-2 array coupled with 2 IMU's (inertial measurement unit) are utilized to measure pavement roughness, rutting, cracking, potholes, bleeding, geometrics, and many other common ASTM D6433 surface distresses.
- Automated crack profiling and production of extent-severity based pavement distresses through the 3D crack profile software.
- Up to 4 HD digital cameras are mounted for forward, side, rear, and right-of-way views.
- Ability to collect dual wheel path roughness to International Roughness Index (IRI) standards using 3D profile technology.
- High accuracy Global Positioning System (GPS) receiver with OXTS inertial navigation for geo-locating of pavement and asset information with excellent accuracy.
- Dual distance measuring instruments to measure linear distances to within +/- 0.5%.
- Built-in software and on-board processors to develop roadway inventories, time code integration, and system monitors.
- Integrated touchscreen event board used for capturing additional roadway attributes on the fly or even expanding the roadway distress data to be captured. The touchscreen is programmed with a mobile mapping device to ensure navigation and routing is as efficient as possible. All inputs can be programmed for acquisition using a standard extent and severity format.

The Laser Crack Measuring System 2 (LCMS) also automatically collects transverse cracking, block cracking, alligator cracking, longitudinal cracking, rutting, potholes, faulting, roughness, geometrics, and texture. The LCMS-2 technology automatically detects cracks and minute variances in the pavement surface using a horizontal resolution of 1mm. **Thus, the LCMS-2 greatly diminishes the subjective nature of PCI data collection performed by image-based surveys or manual surveys.**

Collecting Objective Condition Data

The IMS Laser Crack Measurement System (LCMS-2) is one of the most technologically advanced devices available for pavement performance assessments. The two-sensor array completes a 3D millimeter level scanning of the pavement surfaces that pass below the laser array. With a high speed one-millimeter resolution, this means the LCMS-2 device deploys a continuous scan of laser points (approximately 4,000) across 13-foot of pavement, making it one of the most high-resolution pavement laser scanners available. The onboard processing software then takes it a step further by analyzing pavement elevation (range & intensity) and automatically identifying cracking, rutting, roughness in the form of IRI, potholes, and bleeding.



While any engineering firm could deploy the LCMS-2 equipment for data collection, processing the information for distress quantification requires a complete understanding of automated technologies, GIS mapping, and distress measurement protocols found in standards such as ASTM D6433. Simply reviewing the LCMS-2 cracking vectors (colored cracks) with the human eyeball dilutes the objectivity of the equipment. *(This image represents an internal QA tool, and is not available as a deliverable,)*

IMS engineers and technologists have developed a computerized processing application that automatically applies an 18"x18" grid to the LCMS-2 downward images (FIS files) and uses pre-programmed geometric algorithms to classify and quantity distresses by type. These automated processing routines result in an unparalleled level of objectivity and efficiency in distress pattern recognition analysis. The image above illustrates the quantity of several distresses as well as the presence of a manhole, which was automatically scrubbed from the dataset.

In addition to the auto quantification and classification of ASTM D6433 distresses, the LCMS-2 device also operates as a Class I profile device that collects longitudinal profile (in the form of the International Roughness Index) and transverse profile (rutting) using advanced 3D profile laser scanning technology. The system is not subject to vehicle wander like other automated technologies and compensates for variation in driver ability. The processing software can calculate rutting width and depth following the ASHTO Taut Wire methodology. The white solid lines indicate there was no rutting in the left wheel path and that rutting was detected and measured in the right wheel path. Filters can also be applied to account for rehabilitation activity overlap, which can be as much as a ¼ inch depending on the application.

Cracking, Faulting, Texture, Bleeding, & Potholes: The RST allows IMS to conduct an objective crack survey, thus increasing the accuracy of an otherwise subjective manual survey. High-speed lasers and an on-board processing computer, accurately measure the surface profile of the road. Included in this profile are all cracks and faults as small as 1/8" (2 mm) wide that pass beneath the lasers. Processing software then reduces and filters this information to determine the *total number of cracks, crack width/depth, as well as the crack interval*, plus faulting information. From this information, quantified crack data can be determined at both the sample and summary intervals. Crack identification includes all cracking such as alligator, transverse, longitudinal, map, and edge cracking (where applicable).

Rutting: The LCMS-2 device collects continuous transverse profile data at 1-millimeter resolution at highway speed. This configuration is far superior to other types of vehicles that utilize three lasers or sonic transducers to calculate "relative rutting". Even five sensor units are extremely sensitive to driver error since it is essential in this case that the driver keep the data collection vehicle's wheel exactly in the rutted wheel tracks (assuming that they fit).

The Taut wire method is used to calculate the rut depth in both the right and left wheel track on a continuous basis. Either the right or deeper of the two-wheel path ruts may be used for rut depth calculations with the average rut depth for that wheel path reported for each section. *Rut depth results, quantified by 3 - 4 severity thresholds (with break points at user-defined levels such as 0.25, 0.50 and 0.65 inches) and percentage of section will be provided for every segment.*

Roughness: International Roughness Index (IRI) data is calculated in real time from continuous longitudinal profile data collected by the van's 3D profile device. Data is simultaneously obtained from three devices to determine the road profile: a pulse transducer-based distance-measuring instrument (DMI), high speed 3D laser sensors operating at 112 MHz, and an accelerometer in conformance with ASTM E 950. The RST unit conforms to a Class I profiling device, and it can also "pause" over non-valid roadway sections such as localized maintenance activities, railroad crossings, or brick inlays and not affect the overall IRI value.

Distortions, Raveling, Patching, & Other Custom Attributes: While the LCMS-2 automatically collects the majority of ASTM D6433 distresses, the RST platform can be configured to collect the remaining distresses (raveling, distortions, and patching) using the integrated DDCRS. By means of a touch screen-based tablet computer, highly trained IMS technicians input changes in observed distress severities and extents or identify specific roadway assets or attributes such as curb reveal or lip of gutter information. The DDCRS is integrated into the data flow through time code, GPS, DMI distance and inventory control. The data is then post processed in the office to generate extent quantities for each observed distress severity level throughout every surveyed road section.

PCI Development, Analysis Configuration & Multi-Year Rehabilitation Plans

Immediately following the completion of the field surveys, IMS will begin processing the pavement distress extent and severity scores to develop a Pavement Condition Index (PCI) for each roadway segment (utilizing the Town's existing sections). The condition results are analyzed by a team of IMS engineers, who then develop the Town's multi-year pavement management plan. This section provides a brief summary of the functionality of the IMS pavement analysis in order to emphasize our implementation expertise as well as the abilities and constraints within a pavement analysis.

The purpose of pavement management is to produce cost effective maintenance programs that maximize available resources and roadway life. By incorporating key components of a cost benefit analysis into the analysis operating parameters, we can develop a game plan that is optimized to meet the needs of the Town staff. In addition, the analysis operating parameters described within this section will be delivered in an easy-to-use interactive Excel spreadsheet including the segment PCI data, pavement deterioration curves, triggers (priority weighting factors), and the prioritized multi-year rehabilitation plan. Everything is linked to GIS in the form of simple shape files or a personal geodatabase.

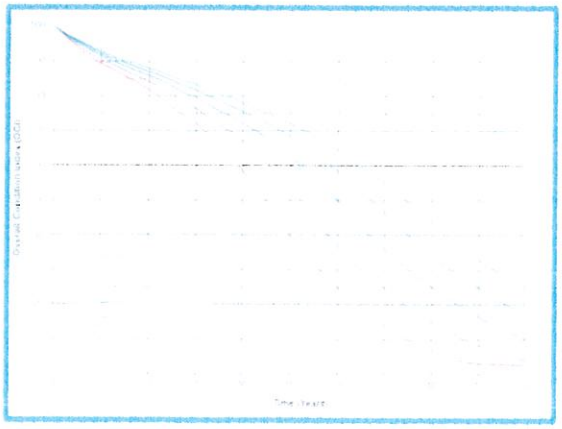
Field Inspection Data and Pavement Condition Index (PCI)

The IMS analysis allows you to store information regarding your pavements, including surface types, number of lanes, patching estimates, cross slopes, and sidewalk & curb types with replacement estimates. Pavement condition data including surface distress, roughness, and deflection results can be stored and analyzed. Using an in-house Pavement Manager Setup module, we can develop customized condition elements, distress types (load & non-load), Indices (SDI, RI, & SI), weightings, and PCI score.

In addition to the yearly programs, the net impact each budget scenario has on the expected condition of the road network over time can be determined. This budget impact can be illustrated both in terms of the yearly increase or decrease in the average network PCI score, PCI distribution, or % Backlog of roads that were not selected by the budgets. IMS converts the difficult to understand FHWA and ASTM D6433 data to a 0-10 distress rating scale with distress weighted factors (DWF).

Modeling and Performance Curves

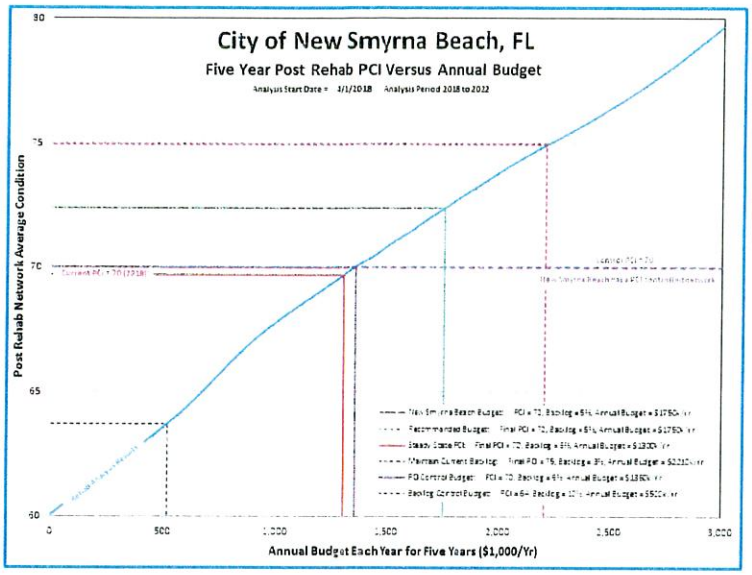
With the IMS analysis, you can forecast various budget scenarios to help you determine your ideal maintenance and rehabilitation schedule. This approach will help you decide what rehab activities should be performed, when and where to perform them, and an ideal budget for your system to maintain it at a specific level of service.



IMS engineers use pavement deterioration models that can be customized to reflect the climatic conditions and structural characteristics of the Berlin Road network. As a result, performance curves can be developed on factors such as functional class, pavement type and sub-grade strength.

Rehabilitation Analysis

An unlimited number of pavement maintenance and rehabilitation strategies can be defined with the IMS approach to pavement management. An analysis is then run, incorporating the performance curves, set points, filter criteria and rehab alternatives to identify the overall need in terms of rehab strategies and costs for the Town's street network, for today as well as year on year for the next 3, 5, or 10 years.



The IMS approach allows you to input any number of "what if" budget scenarios and produce prioritized yearly rehab programs based on those funding levels over a 10-year analysis period. Typical budget scenarios include Budget $/Year, Unlimited Budget $, "Do Nothing" Budget, and a Target PCI Budget.

What is included in an IMS analysis & report?

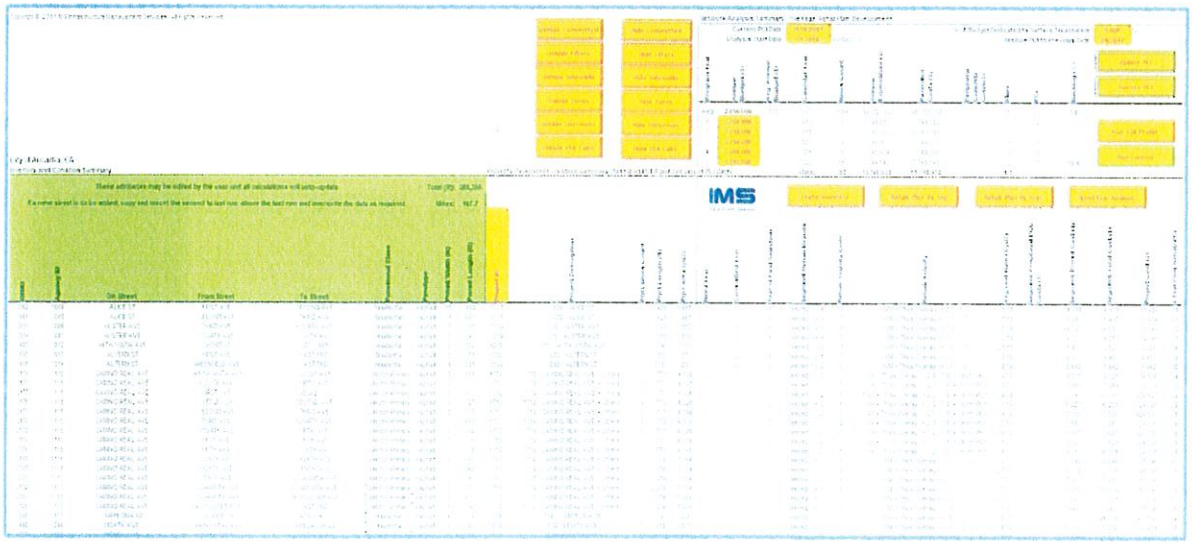
- *Street ownership and inventory/attribute report*
- *Present condition ranking* – detailed and summary condition data including Good/Fair/Poor, Load Associated Distresses (LAD), Non-LAD, and Project reviews of each street in the network, as well as the network as a whole.
- *Fix all budget analysis* – this identifies the upper limit of spending by rehabilitating all streets assuming unlimited funding.
- *Do nothing analysis* – this identifies the effects of not performing roadway rehabilitation projects.
- *Steady state rehabilitation life cycle analysis* – this identifies the minimum amount of rehabilitation that must be completed in order to maintain the existing level of service over 3, 5, or 10 years.
- *PCI & funding levels* – what funding will be necessary to maintain a PCI of 70, 75 & 80.
- *Plus or minus 50% and other additional runs* – additional budget runs are completed at rates of +50% and -50% of the suggested steady state analysis. Up to 10 budget scenarios will be run.
- *Integration of capital projects and Master Plans* – ongoing and proposed projects that affect roadway rehabilitation planning will be incorporated into the analysis.
- *Draft multi-year rehabilitation and prioritized paving plans* – based on need, available budget and level of service constraints; a minimum of three budget runs will be completed.
- *Final prioritized paving plan* – incorporating feedback from stakeholder departments and utilities, complete with budget and level of service constraints.

Pavement Management Spreadsheet: Easy Street Analysis (ESA)

It is imperative that the Town staff have direct access to the pavement condition and analysis results without having to become software experts. While the results of the survey will certainly be documented and bound into a final report that illustrates the findings of the survey, those results will remain static. To provide interactive results that enhance our final report, we have engineered a simple and easy-to-use Excel spreadsheet called Easy Street Analysis (ESA). ESA utilizes the core metrics of any great pavement management system, such as the ability to prioritize and optimize the multi-year plans, and ESA can be consulted independently or integrated into third-party pavement management applications like PAVER. With ESA, we can introduce IRI, structural integrity, logical projects, custom Priority Weighting Factors (PWF), and cost-benefit techniques.

ESA will be programmed to develop a multi-year maintenance and rehabilitation plan using "cost of deferral" as a rehabilitation candidate selection constraint in an effort to introduce cost-benefit techniques into the Town's Pavement Management Plan. In addition, ESA will have referenced deterioration curves for each functional classification, pavement type, and even pavement strength rating. Storing the data in this open architecture empowers the Town to utilize third-party software in the future if desired. ESA will also contain a full suite of maintenance and rehabilitation techniques, unit rates, and associated PCI resets. The parameters of the analysis (Priority Weighting Factors) can also be modified and reprioritized whenever required. This flexibility will allow the Berlin data to evolve with the priorities of elected officials and department staff. Programmed Priority Weighting Factors include functional classification, pavement type, and pavement strength, while actual candidate selection is based on the incremental cost of deferral.

As demonstrated in the image below, the analysis data in the spreadsheet is supplemented with many cells highlighted in yellow. The yellow highlighted cells indicate that they are "HOT" and can be modified by the end user. Two of the yellow cells shown below represent the Annual Budget and the Project ID. The Annual Budget cell can be modified with a new budget, and the five-year plan will automatically re-prioritize. Although IMS will have already aggregated the Town's segments (intersection-to-intersection) into viable projects (multiple segments strung together to form a logical project), the user has the ability to aggregate additional segments into a project or even remove a segment from a project.



ESA also allows an agency to refresh the five-year plan by entering the maintenance and rehabilitation work completed. As seen in the image below, ESA contains "PCI Override" functionality. When work has been completed on a particular segment, the user inserts the override PCI value along with a date. ESA then removes the segment from the five-year plan and updates all referenced network PCI averages.

Pavement Condition Summary										Condition Details										
Surface Distress Index (SDI)	Roughness Index (RI)	Structural Index (SI)	Pavement Cndtn Index (PCI)	Strength Rating	Condition Rating	Load Assoc Distress Deducts (LADD)	Non-Load Distress Deducts (NLAD)	PCI Override (OPCI) / OPCI Date	Current Segment PCI (CPCI)	Segment IRI (mm/m)	Deflection Results	Rutting (ACP Only)	L&T Cracking / Linear Crk	Alligator Cracking / Divided Slab / Blow Up	Map Crk / Crnr Brk / D Crk	Edge Cracking / Joint Spall / Joint Sealant	Distortions / Faulting	Bleeding / Polished Agg	Raveling / Scaling / CAL	Patches / Potholes
74	63	60	**70**	Mod	V Good	24	3		**70**	3.9	0	10.0	10.0	8.9	10.0	10.0	9.1	10.0	9.4	9.2
79	53	60	**70**	Mod	V Good	7	14		**70**	6.6	0	10.0	8.9	10.0	10.0	10.0	10.0	10.0	9.1	9.1
60	58	60	**59**	Mod	Fair	34	7		**59**	4.4	0	10.0	9.6	7.0	10.0	10.0	10.0	10.0	9.3	9.5
57	66	30	**60**	Weak	Good	41	2		**60**	3.5	0	10.0	10.0	6.1	10.0	10.0	9.7	10.0	9.7	10.0
70	59	80	**66**	Strng	Good	6	24		**66**	4.3	0	10.0	7.2	9.5	10.0	10.0	9.9	10.0	9.8	9.9
81	60	80	**74**	Strng	V Good	0	19		**74**	4.2	0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	6.5	10.0
91	98	60	**93**	Mod	Excellent	4	6		**93**	1.4	0	10.0	10.0	9.6	10.0	10.0	10.0	10.0	9.0	10.0
83	71	60	**79**	Mod	V Good	8	10		**79**	3.1	0	10.0	10.0	10.0	10.0	8.8	9.7	9.8	8.4	10.0
80	85	60	**82**	Mod	V Good	0	20		**82**	2.1	0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	6.3	10.0
83	88	60	**85**	Mod	V Good	6	12		**84**	1.9	0	10.0	10.0	10.0	10.0	10.0	10.0	9.8	8.0	9.3
86	67	60	**80**	Mod	V Good	4	11		**79**	3.7	0	10.0	10.0	9.7	10.0	10.0	9.9	10.0	8.0	10.0

Additional Features of the IMS Easy Street Analysis Spreadsheet

- Red triangle tips that trigger a dialogue box explaining cell contents
- Ability to spontaneously add new road segments and attributes
- Modifiable distress indices for Town field inspections
- Input work completed and override segment level PCI scores
- Prioritize by neighborhoods, zones, or districts
- Ability to modify project lengths – includes aggregating and splits
- Commit projects and force "Must Do's" or "Must Never Do"
- Program-varying annual budgets over a five-year horizon
- Commit a percentage of the budget to surface treatments if desired
- Automated rehabilitation plan prioritization and optimization
- Macros that automatically sort and filter simple rehabilitation and inventory lists
- Ability to sync the spreadsheet with the Data Viewer though a .CSV file export

While the ESA spreadsheet is not meant to replace pavement management systems, it is an alternative for agencies that do not have the resources or staff to maintain a dedicated application or for agencies that run an application that is unable to prioritize and optimize projects to meet their needs. For the Town of Berlin, ESA will be a useful tool that has analytical capabilities on-par or exceeding many third-party software solutions.

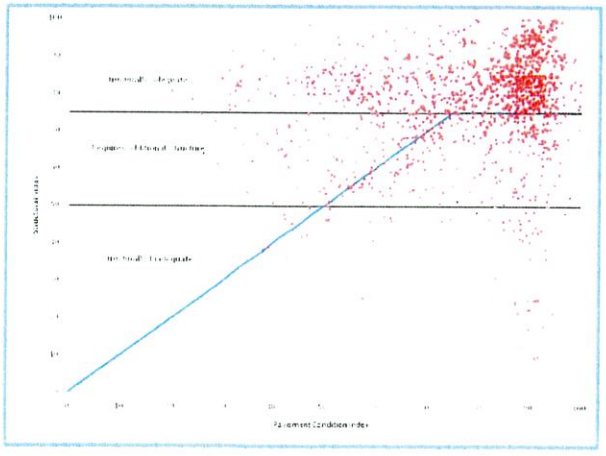
Deflection Testing (Optional)

Subsurface distress investigations are a valuable tool to assess the sub grade condition of a roadway. As a part of a sound pavement management program, IMS can integrate the Structural Index (SI) as a component of each roadways final PCI score. To assess the subgrade strength of a roadway, a Dynaflect is utilized for Asphalt and Concrete roadways.

Structural Strength Assessment & Analysis:

Deflection testing is performed using a Dynaflect, in accordance with ASTM standards. The IMS team is capable of conducting a structural assessment of all designated roadways but is typically performed on roads that carry regular heavy loading. Deflection testing is completed at least once in each direction in every street segment (every 300 - 500 feet) along the outside lanes of the roadway. Testing shall be altered to an inside lane when it appears to be in a worse condition than the outside lane of the segment based on site observations. IMS records readings in 5 geophones for inclusion in the overall pavement condition index. These readings are used to determine the pavement strength, load transfer capabilities, and identify properties of the base and sub-grade.

Upon completion of the deflection survey a structural analysis is performed. Dynaflect's apply a known load to the pavement and measure the pavement response to the load. The structural adequacy of a road is expressed as a 0 to 100 score with several key ranges: roadways with a Structural Index greater than 75 are deemed to be structurally adequate for the loading and may be treated with lightweight surface treatments or thin overlays; those between 50 and 75 typically reflect roads that require additional pavement thickness; and scores below 50 typically require reconstruction and increased base and pavement thickness.



The adjacent graph presents a sample structural adequacy plot of a recent client's roadway network against its average pavement condition.

The diagonal blue line separates roadways that are performing above expectations (above the line), from those that are not, (below the line). The small number of roadways falling below the diagonal line indicates this particular Agency has a high percentage of roadways that are structurally inadequate for their design load. This is typically the result of insufficient base and structural materials during the original construction, or the application of overlays that were too thin during the lifetime of the roadway.

Proposed Project Budget

The detailed budget presented below is based on the scope of work described in this proposal. We can provide a detailed scope of work if requested to accompany this document. It represents a realistic budget to complete the work, and we are confident we can maintain an on-time, on-budget approach to the assignment. Based on the current seasonal conditions, IMS projects mobilization to occur in the Spring of 2022, if selected for this project.

Task	Activity	Quant	Units	Unit Rate	Total
	Project Initiation				
1	Project Initiation & Kickoff	1	LS	$3,000.00	$3,000.00
2	Network Referencing & GIS Linkage	120	T-Mi	$20.00	$2,400.00
3	Network Inventory Checks & Survey Map Development	120	T-Mi	$10.00	$1,200.00
	Field Surveys				
4	LCMS-2 Survey Vehicle Mobilization/Calibration	1	LS	$4,500.00	$4,500.00
5	LCMS-2 Pavement Data Collection	120	T-Mi	$165.00	$19,800.00
	Data Management				
6	Pavement Data QA/QC, Processing & Format	120	T-Mi	$35.00	$4,200.00
7	Pavement Management Report and Updated Geodatabase	1	LS	$6,500.00	$6,500.00
8	Optimized Cost-Benefit Analysis: Project Planning, Budget Scenarios and Model Runs for 5-year Budget Recommendations *i. Report Additions to Include Multi-Year Recommendations* *ii. Easy Street Analysis (ESA) Spreadsheet Pavement Management Tool includes training and support for 1-Year*	1	LS	$4,000.00	$4,000.00
9	Project Management & Meetings	1	LS	$3,420.00	$3,420.00
	Berlin Pavement Management Project Total:				**$49,020.00**
	Optional Project Activities:				
10	Council Meeting/Workshop/Presentation	1	EA	$3,500.00	$3,500.00
11	IMSvue Web-hosted Viewer **(includes 2-Years Tech Support)**	1	LS	$7,500.00	$7,500.00
12	Delivery of HD Digital Images at 15-Foot Intervals	120	T-MI	$20.00	$2,400.00
13	Dynaflect Mobilization	1	LS	$3,250.00	$3,250.00
	a. Deflection Testing & Structural Analysis	120	T-Mi	$170.00	$20,400.00
14	Right-of-Way Asset Inventory Data Collection (GPS & Image QC/QA)	120	T-MI	$15.00	$1,800.00
	a. Asset Inventory & Condition Assessment - Curb Ramps	120	T-Mi	$84.00	$10,080.00
	b. Asset Inventory & Condition Assessment - Sidewalks	120	T-Mi	$70.00	$8,400.00
	c. Asset Inventory & Condition Assessment - Curb & Gutter	120	T-Mi	$70.00	$8,400.00
	d. Asset Inventory & Condition Assessment - Signs & Supports	120	T-Mi	$140.00	$16,800.00
	e. Asset Inventory & Condition Assessment - Street Lights	120	T-Mi	$70.00	$8,400.00
	f. Asset Inventory & Condition Assessment - Street Furniture	120	T-Mi	$56.00	$6,720.00
	g. Asset Inventory & Condition Assessment - Markings & Striping	120	T-Mi	$91.00	$10,920.00
	h. Asset Inventory & Condition Assessment - Traffic Signals/Cabinets	120	T-Mi	$56.00	$6,720.00

Thank you for considering IMS as a viable solution to your pavement management needs and we will strive to become an asset and extension of the Town of Berlin staff and team. If any questions arise, please do not hesitate to contact me at (847) 481-6322 or dwhite@imsanalysis.com.

Regards,
IMS Infrastructure Management Services

Dan White, MBA
Manager of Client Services

TOWN OF BERLIN

CERTIFICATION OF SUFFICIENCY OF FUNDS

(Sec. 6-10-2 of the Town Charter)

DATE	11-Nov-21

Purchase Item or Contract: Comprehensive roadway assessment Requested by: Mike Ahern

QUANTITY	DESCRIPTION	PRICE PER UNIT	$ AMOUNT
1.00	Comprehensive roadway assessment	$22,762.00	$22,762.00
			-
			-
			-
			-
		TOTAL	$22,762.00

Account No. 001.20.2036.0.53814.00000 Contractual Services

Budgeted Amount.....	$49,500.00	Available balance.....	$38,100.00
Encumbrances to Date.....	$9,374.68	Amount Needed for This Package.....	$22,762.00
Expenditures to Date.....	$2,025.32	Available Balance After Purchase.....	$15,338.00

Is a budget change needed? ☐ Yes ☒ No

If so, has a budget change been prepared? ☐ Yes ☐ No

☒ I certify that there ARE sufficient funds available to support the purchase of the items described above.

Finance Director or Assist.Finance Director

or:

☐ I certify that a budget change in the amount of $_____ must be processed concurrently with this certification to support this commitment.

Finance Director or Assist.Finance Director