



2. Project Understanding

Cumberland and Salem counties, along with South Jersey Transportation Planning Organization (SJTPO) constantly strive to improve the safety and condition of the Counties road network. To increase the efficiency in managing assets and pavement, the Counties desire to develop a GIS compatible database system to automate the pavement and asset management processes.

The goals of the project include:

- Develop a County-wide video library with a GIS integrated video log, using 5 or more cameras that clearly show the pavement conditions and all assets for all of the paved roads in the Counties.
- Create asset inventories and condition evaluation for sign, guardrail.
- Provide capability to collect inventory of other roadway assets in the future.
- Complete pavement ratings and follow up with an efficient and cost-effective system to develop repair work plans and manage pavement repairs.
- Provide the data and software to support the County pavement management effort, identification of roadway hazards, and other asset management programs.

EnterInfo's system will include accurate location and orientation information using DGPS, linear referencing, and inertial navigation system. The Counties users will have the ability to retrieve real-world coordinates and measurement information into ODBC compliant database and ESRI GeoDatabase formats. The following technical specifications and attributes will be used:

Extent of Work

- Drive and acquire "smart" images
- Collection of asset features using ESRI compatible software
- Deliver images and asset features in geo-database
- Pavement rating
- Install and configure GIS compatible applications
- Provide software trainings

Technical Details

- 5 camera configuration capturing at 25 feet interval
- Horizontal accuracy – 3'

Asset management

- In office asset collection via GIS
- Collect feature with existing GIS data as reference
- Ability to measure distance
- Customize interface to collect additional features
- Each asset collected has dynamic link to an image

Pavement Management

- In-office windshield survey
- Repair decision tree strategy
- Ability to prioritize and forecast required budget for repairs
- Results linked to GIS

Deliverables:

Image Acquisition and Collection of two assets

1. Images
2. ESRI V9.3 Personal GeoDatabase



3. One License of GIS compatible Asset Collection software
4. One day on-site trainings for the Asset Applications

Pavement Condition Rating

- Pavement Condition rating results
- One License of ArcGIS compatible Pavement Management Applications
- One day of on-site training on Pavement software

Once the Notice to proceed (NTP) is issued:

1. EnterInfo will set up kick-off meeting within two weeks after NTP to provide desired camera angle settings, procedures on image capturing and a pilot roads sampling with images for both pavement and assets
2. Two weeks (10 days) after the Pilot first delivery of data for 50+ miles of assessed pavement ratings and asset captured
3. One week review time by the Counties/ SJTPO
4. Eight weeks (40 days) to complete the remaining 500+ miles for both asset and pavement rating
5. One week review time by Counties/ SJTPO
6. Four Months from NTP, project acceptance / project close out

3. Scope of Work

3.1 eRoadInfo Asset and Pavement Management System

EnterInfo's image based pavement and asset management solution eRoadInfo is proposed for this project. eRoadInfo is an innovative system that has been successfully implemented for many government clients throughout the United States. eRoadInfo is a turn-key system that automates the entire pavement engineering process from survey, analysis, reporting, budgeting, to road condition forecasting. eRoadInfo includes many mobile pavement condition detection components. All of these components are integrated with (and controlled by) the eRoadInfo application. The end product is a high efficiency and cost-effective asset and pavement management system, which operates as an ESRI ArcGIS Extension and outputs data directly into the ESRI geo-database.

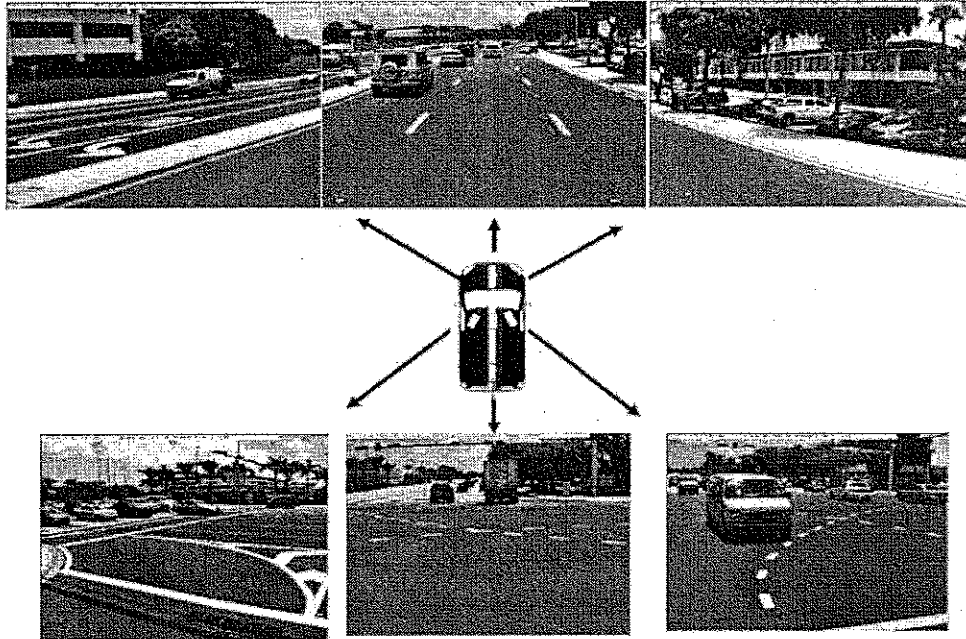
eRoadInfo has three modules – eRoadPavement, eRoadAsset, and eRoadMobile. These modules will be used to complete the project tasks.

eRoadMobile consists of a mobile van and all of the components equipped in the van. The standard components include computers, high-resolution cameras, GPS, and inertial navigation device. Optional devices include IRI roughness laser, pavement crack detection device, and rutting sensors.

eRoadAsset allows the users to create geo-referenced database records and pavement condition assessments using video and images captured by eRoadMobile. eRoadAsset is the ideal tool for creating new asset inventories or for verifying the correctness of existing databases. Because every eRoadAsset record is visible and verifiable in the video, it significantly reduces the need for field verification and ultimately reduces the maintenance cost. Multiple video datasets can be associated with the road to document asset conditions at different times.

3.2 Collect Roadway Images

EnterInfo will capture forward perspective and right of way images using a six-camera system for the entire network of roads maintained by the Client:



Above is a diagram showing the proposed right-of-way camera system with 3 cameras pointing forward and 3 cameras pointing backward:

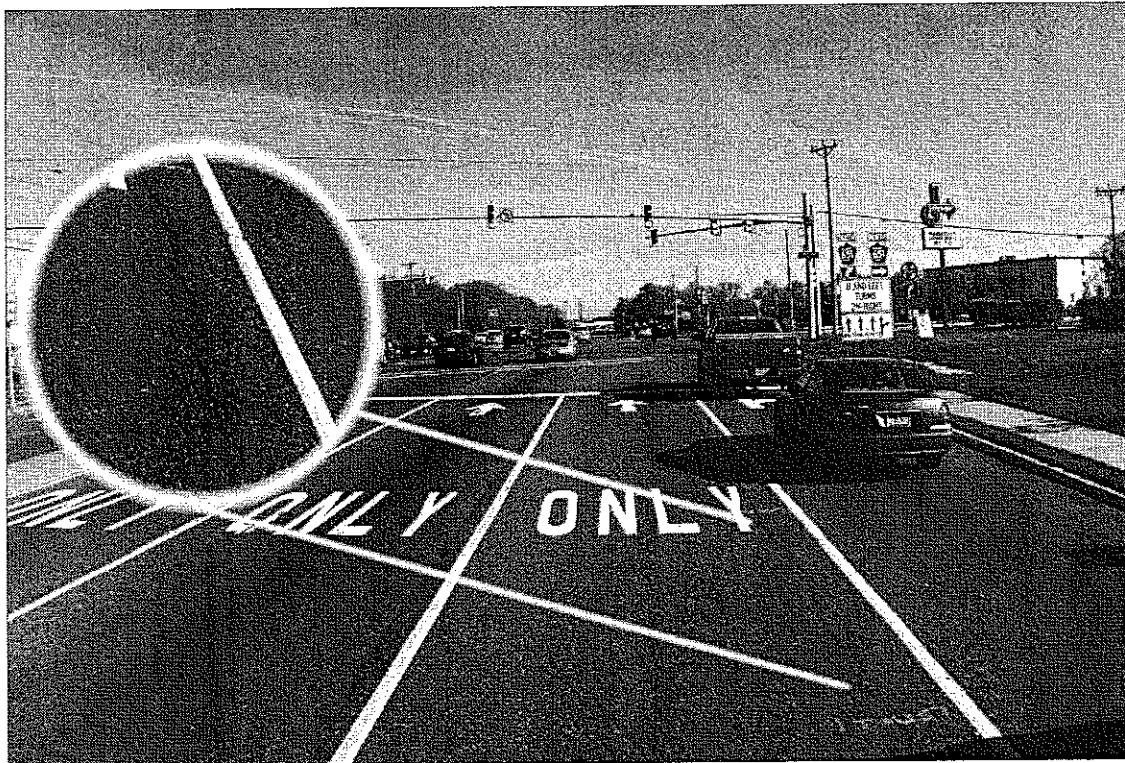
1. The primary forward camera is a 11 mega pixel 4000x2600 HD camera taking front view picture at 25-ft interval
2. Five additional cameras (three in the front view and two rear view) at 1280x960 will supplement the front view camera also capturing at 25-ft interval.
3. Downward scanning of the traveled lane as 11.5 ft by 11.5 ft images. Crack Scanning and automated crack detection data including density of longitudinal and transverse cracking categorized into low, medium and high severity levels.
4. The Rut Bar will capture to produce transverse profile data for measuring pavement deformation.
5. Longitudinal profile data along both wheel paths in IRI (International Roughness Index) format.

EnterInfo will capture roadway data in the following manner:

- Drive on the worst pavement condition lane of the road, most likely the right-most lane.
- Two lane non-divided roads will be driven in one direction.
- Non-divided roads with four lanes or more, and roads that are divided will be driven in both directions.
- EnterInfo will not survey unpaved roads

Deliverables:

1. Roadway images in JPEG format.
2. Downward scan images in JPEG format
3. Point dataset with crack density information and GPS coordinates.
4. Longitudinal Profile data in IRI (International Roughness Index) format
5. Transverse profile data as Driver and passenger rut depth data.



Above is a sample of the images from the 11 Megapixel camera magnified to different levels to show the overall picture as well as the details captured from this camera: The right-of-way images are clear enough to identify 1/8 inch cracks and collect various assets such as guardrails, guardrail terminals, signs, pavement markings and unpaved shoulders.

3.3 Roadway Asset Inventory Service

eRoadInfo provides an innovative and cost effective approach to complete the asset inventory projects. eRoadInfo allows the users to create geo-referenced asset records using the captured photos. Users click on asset objects in the photo to create GIS records. When a cursor is positioned in the photo, eRoadInfo interactively synchronizes the cursor location in the map view. This ability allows an efficient asset inventory creation as well as the ability to validate any data records. The same image set will be used to create inventories for signs and guardrails.

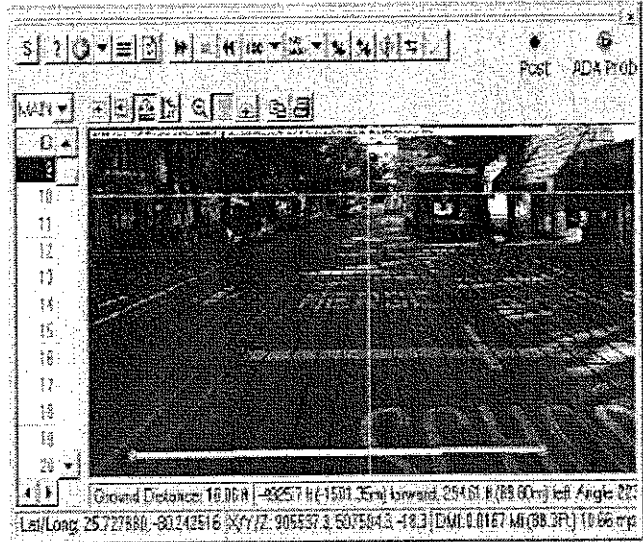
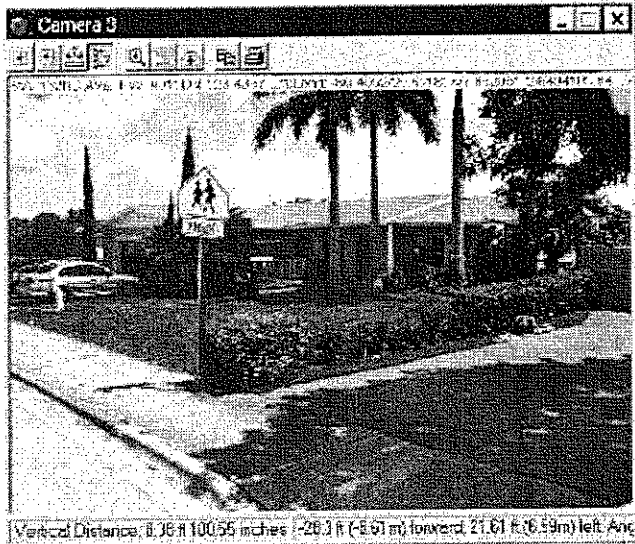
The right-of-way imaging system is integrated with an Applanix POSLV-220 Inertial Navigation System that provides 0.3-meter accuracy at real time and 0.02-meter accuracy after post processing. The roadside asset can be inventoried at sub-meter accuracy using the images. The eRoadAsset module can collect point and linear features in fully GIS compatible formats.

When reviewing the images, assets visible on the image can be captured from the office desk by simply clicking on the location of the asset in the image. The EnterInfo operators will collect the asset data using the photogrammetric measurement based on the images' location and orientation information recorded during the survey.

EnterInfo will configure the collection interface to suit the Client specific database structure and attribute needs. The data can be stored directly into a central GIS database for data sharing and editing.



Using the forward right-of-way camera, the eRoadInfo system can measure any horizontal distances using the camera optical parameters and mounting orientation information.



3.3.1 Sign Inventory and Rating

The project team will use eRoadInfo to define interfaces and database structures for the Counties. Database structure and all of the tables will be customized according to the County standards and specifications. The eRoadInfo application will be provided to the Counties to validate all of the collected asset records. The captured road video and the existing Counties sign database will be used to collect sign inventory. Using eRoadInfo, the project team will click on the base of each sign post to locate the sign and create a MUTCD sign symbol in the ArcGIS sign layer. If an existing record in the database is matched with a sign in the video, the attributes will be kept and the Source field will be marked accordingly. The attributes for the sign feature will include; Road name, Direction, Mile Point, (x,y), MUTCD Code, Material, Condition (Critical, Poor, Fair, Good, Excellent), Post Material, Post Condition (Critical, Poor, Fair, Good, Excellent), and Note.

3.3.2 Guardrail Inventory and Rating

The captured road video will be used to inventory guardrails in the Counties. Using eRoadInfo, the project team will click on the starting and ending point plus any needed intermediate points to create the linear shape of each guardrail in the ArcGIS guardrail layer. The attributes for the curb feature will include Road name; Direction; Starting Mile Point; Starting (x,y); Starting Device Type; Ending Mile Point; Ending (x,y); Length; Ending Device Type; Condition (Critical, Poor, Fair, Good, Excellent); and Note.

The eRoadInfo asset inventory application runs as an ArcGIS Extension. It puts the power of the Data Collection Workbench into the ESRI

ArcGIS/ArcMap desktops: Using the ERoadInfo ArcGIS Extension, users can combine the data collection capability of eRoadInfo with the power of the ArcGIS map data productivity tools

All images are identified by a combination of a unique "SessionID" and an image sequence number. The image information is stored in Microsoft Access database containing various fields including latitude/longitude and State Plane coordinate, speed, mile point and route identification information and inertial measurement



data. Here is a sample of the top part of the image data:

Field Name	Data Type	Description
SessionID	Text	Session ID
ImageSequence	Number	Image sequence 1-x
TimeCaptured	Date/Time	Date time the image was captured
TimeFromSessionStart	Number	Time elapsed since the session started
Longitude	Number	Longitude of the vehicle
Latitude	Number	Latitude of the vehicle
Speed	Number	Speed of the vehicle
GPSQuality	Number	GPS quality
GPSTime	Number	GPS Time
DMIMilePoint	Number	Mile Point
Comments	Text	Comments
RoadAttributeID	Text	Road attribute data ID
VoiceSequence	Number	Voice record sequence
Bearing	Number	Heading, 0 due east, 90 due north
Roll	Number	Roll of the vehicle
Slope	Number	Slope of the vehicle
X	Number	X
Y	Number	Y
Altitude	Number	Z

All images are located to the nearest one-thousandth mile. The location information of the image is also "burned-in" to the image JPEG file as well.

3.4 Pavement Analysis and Pavement Software

eRoadPavement is a complete pavement repair decision support system that automates the workflow of the entire pavement management process from inspection, rating, and analysis to the creation of repair and maintenance budgets. eRoadInfo provides strong data verification capability. From the ArcGIS application, a user can click on a road to view pavement data. Thematic maps can be produced to reflect repair methods, priorities, costs, etc...

EnterInfo will work with the Clients to customize eRoadInfo Pavement software that can display the images collected, with the associated pavement database record and the distress rating result. The software will allow user to increment ahead and/or back one frame at a time or playing forward or backward like a VCR. The eRoadInfo software is Windows XP/Vista compatible software that can run as a stand-alone system or as an ArcGIS extension. It is a user-friendly point and click system that allows the easy review of all the data collected easily.

3.4.1 Pavement Database Preparation

EnterInfo will use the existing centerline data provided by the Counties and will create a pavement database based on the centerline layer. Each road segment record in the centerline layer will have a corresponding record in the pavement database. EnterInfo will work with the Counties to maintain the unique identifier of each of the road segments on the Counties road network so that the pavement database can maintain a persistent link to the GIS data.

Deliverables:

1. Pavement database based on the Client's road centerline layer.
2. Pavement distress rating manual.

3.4.2 Distress Standardization

EnterInfo will provide sample photos and descriptions for each of the distress types. These standards will be



included in the project Distress Identification Manual and will be distributed to all of the project members. We believe this is important preparation work for creating consistent and accurate results.

To ensure rating consistency, eRoadInfo's process always starts with the development of a Distress Identification Manual (DIM) followed by a training session open to all of the involved members. EnterInfo will communicate with The Counties Project Team to gather required information to define all of the distress types and treatment selections. Based on this information, a PCI rating and treatment selection manual will be created to identify and define each distress type and its severity, extent and treatment selection.

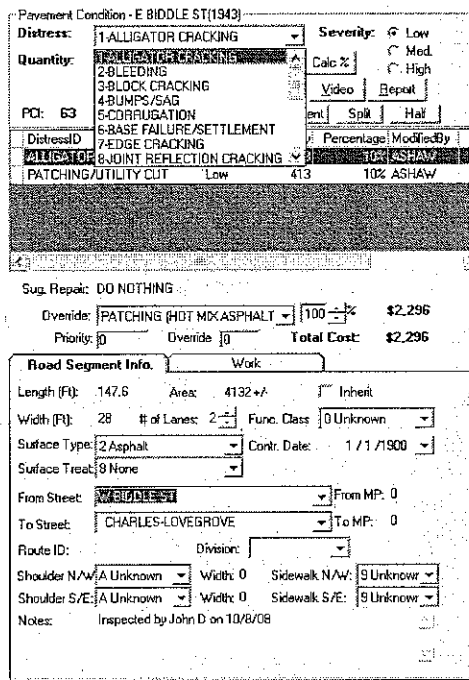
The eRoadInfo application provides the flexibility for users to define repair methods for each distress condition. The eRoadInfo project team will communicate the County current and long-term pavement management goals so that the Counties and the eRoadInfo team can jointly confirm the best treatment solution for each distress type and severity level. The ultimate goal is to maximize pavement performance at minimum cost.

3.4.3 Pavement Distress Condition Rating

eRoadPavement provides an efficient interface for pavement survey data entry. eRoadPavement allows the surveyors to enter distress conditions for asphalt and concrete surfaces. The standard surface distress types and the eRoadInfo application interface are shown in the following table:

eRoadInfo Distress Types (3 Severities, 1-100 Extents)

Asphalt	Concrete
Alligator Cracking	Blow-up/Shatter
Base Failure/Settlement	Corner Breaker
Bleeding	Divided Slab
Block cracking	Durability Cracking
Bumps/Sag	Faulting
Corrugation	Joint Seal Damage
Edge Cracking	Lane/Shoulder Drop
Joint reflection cracking	Linear Cracking
Lane Shoulder drop	Large Patch / Util Cut
Long. Cracking	Small Patch
Patching/Utility Cut	Polished Aggregate
Polished Aggregate	Popouts
Pothole	Pumping
Trans/Thermal Cracking	Punchout
Rutting	Railroad Crossing
Raveling	Scaling / Cracking
Shoving	Shrinkage Cracking
Slippage Cracking	Corner Spalling
Wheel Path Cracking	Joint Spalling
Drainage	Drainage



eRoadInfo creates pavement and asset databases using photos, and optional pavement sensors, and downward pavement imaging. The eRoadInfo project approach allows pavement ratings and asset inventory tasks to be performed either in the field or in the office. eRoadInfo's project approach minimizes fieldwork and project cost while allowing all of the work to be verified in the office while viewing captured images using ArcGIS applications.

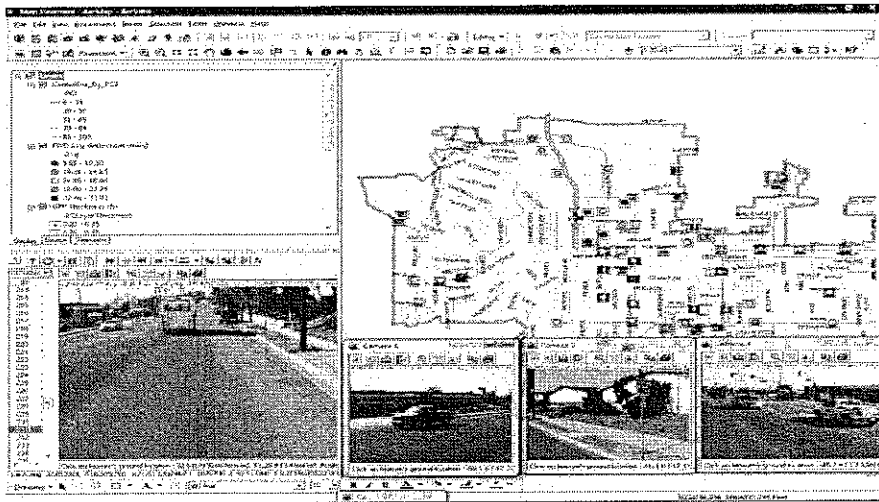
The eRoadInfo Team follows the PCI standard to perform distress survey. All of the paved roads that are maintained by the Counties will be surveyed. The distress rating typically is assessed on road segments from block to block. The typical image capturing interval is 25 feet. This interval can be configured based on the



County preference.

Following the distress standard approved by the Counties, ratings will be assessed by viewing of the captured road video. Using the eRoadPavement interface, the pavement rating is completed in the office while viewing road video, and/or all of the supplemental indexes. eRoadInfo GIS/ IT expert staff will work with the Counties staff to seamlessly merge the pavement and asset data into the Counties GIS system.

Here following is a screenshot of the eRoadInfo software (ArcGIS Extension) that shows a fully GIS integrated data viewing environment where PCI values are used to color-code all the roadway segments.



This customized Software will be used for the specific practice and procedures used by the Counties. The customization will reflect the Client's road repair and maintenance program's policies and practices. The subtasks will include:

1. Configure the system to reflect the rehabilitation alternatives and repair methods used by the Counties.
2. Configure the system to reflect the current and local costs for the repair methods.
3. Configure the system to reflect the preferred repair method and critical PCI thresholds.
4. Acquire estimated multi-year budget information from Counties staff and provide a draft multi-year rehabilitation program for review by Counties staff.
5. Run the automated repair recommendation program and produce a list of repair/rehabilitation candidates.
6. Work with Counties staff to review the rehabilitation program and modify analysis parameters iteratively to produce the final repair program required.
7. Provide Counties staff textual and map reports of the repair program.

Deliverables:

1. Pavement database with localized decision tree and repair method configuration.
2. Textual report listing for various repair program candidates.
3. GIS map showing the various repair program candidates.

The team will collect surface distress for flexible/composite pavement and for concrete pavement using the same methodology as US Army Corps of Engineer's MicroPAVER.

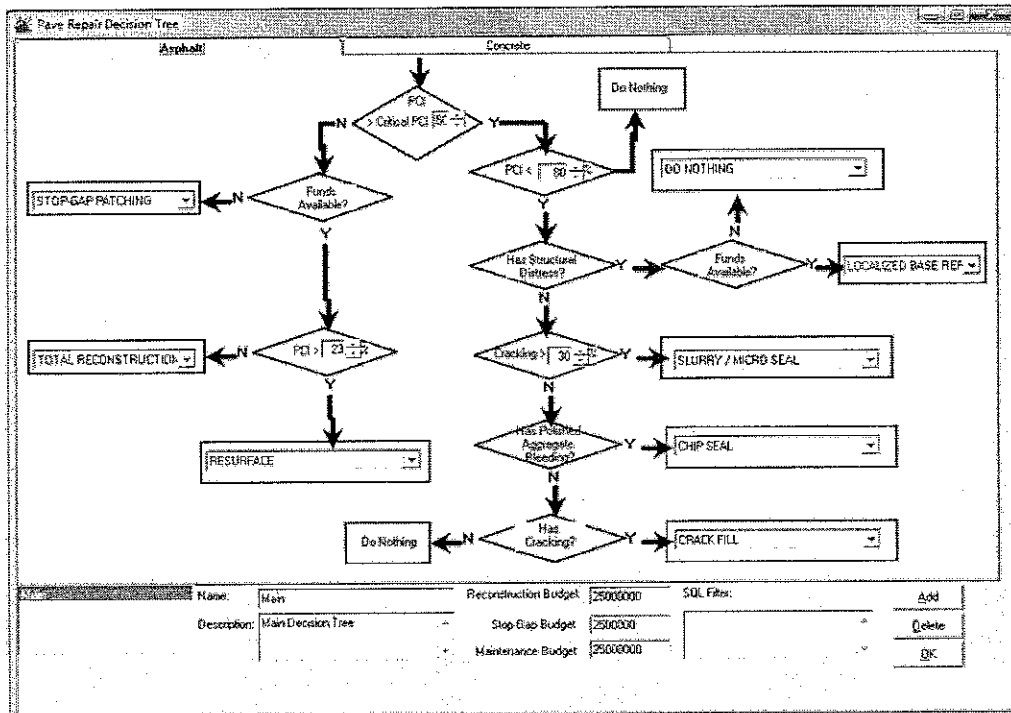


1. The road distress types include 20 different types for asphalt pavement and 20 types for concrete pavement.
2. The road distress severity will be assessed at 3 severity levels (low, medium and high).
3. The distress extent levels will be estimated from 1 to 100% extents (by 1% increment).
4. The PCI (Pavement Condition Index) will be calculated based on ASTM and MicroPAVER deduction curves to calculate a 1-100 PCI index for each road segment based on the distress extent and severity. 100 will be a newly constructed road and 1 being a very poor condition.
5. The distress rating typically is assessed on road segments from block to block. If a road is very long and there is a significant change of road condition in the middle of the road, the road will be split as needed and separate conditions assigned for each segment.

All of the paved roads that are maintained by the Counties will be surveyed.

3.4.4 Pavement Repair Decision Tree Configuration

EnterInfo will configure a pavement repair decision tree to best suit the Client's pavement preservation approach.



3.4.5 Data Analysis, Priority Setting, Repair Strategies, and Forecasting

eRoadInfo's comprehensive pavement management capability will be used to address the County needs in analysis, priority setting, reporting, budgeting, project history tracking, and road condition forecasting. The eRoadPavement application provides the flexibility for users to define repair methods for each distress condition. The EnterInfo project team will discuss the Client's current and long-term pavement management goals so that the Counties and the EnterInfo team can jointly confirm the best treatment solution for each distress type and severity level. The ultimate goal is to maximize pavement performance at a least cost.



EnterInfo will provide applications and transfer all of the needed knowledge for the Counties personnel to produce:

- Plan to Improve condition of the overall road network to an acceptable level
- Plan to maintain the road network at its current condition
- Projection of future roadway condition based on historical, current and other funding levels
- Cost estimates for specific projects
- Various repair options based on repair strategies and funding constraints
- Cost estimates for various repair types and funding scenarios
- Comparisons of repair scenarios and the projected road network conditions
- Multiple year Capital Improvement Plan

eRoadInfo calculates a PCI rating for each road segment based on the severity and extent for each of the distresses identified on the road. The repair priority is determined using the calculated PCI and the road classification. Weighted factors such as traffic volume, drainage condition, or user preference can be included in the priority analysis. The final repair decision is determined following the budget and PCI criteria defined in the eRoadInfo Repair Decision Tree, which uses an interactive programming interface and advanced algorithms to complete the repair analysis. The end result is a fully customizable high efficiency pavement management system that meets every government's specific local requirements.

Using the eRoadInfo decision tree configuration capability, users can configure repair and maintenance activities. Examples of this function are:

- Define the Desired Repair Method based on Road Conditions
- Determine Repair method by PCI using the Critical PCI Range, Condition and Budget
- Apply the Repair Logic to the Road Network Analysis
- Specify Fund Sources, Distribution, and Filter

Once the ratings and analysis are completed and the repair unit costs have been entered into the system, eRoadInfo will analyze and suggest repair methods and calculate maintenance costs for the Counties roads. eRoadInfo will sort, analyze, and model the pavement information to optimize resources and prioritize treatment selections.

3.4.6 Development and Implementation of Budget Optimization

EnterInfo will work with the Counties to create a series of alternative pavement repair strategies and execute a "what-if" analysis to identify the advantage and disadvantages of each strategy. EnterInfo will train the Counties staff to perform these "what-if" analyses for future needs. The sub-tasks will include:

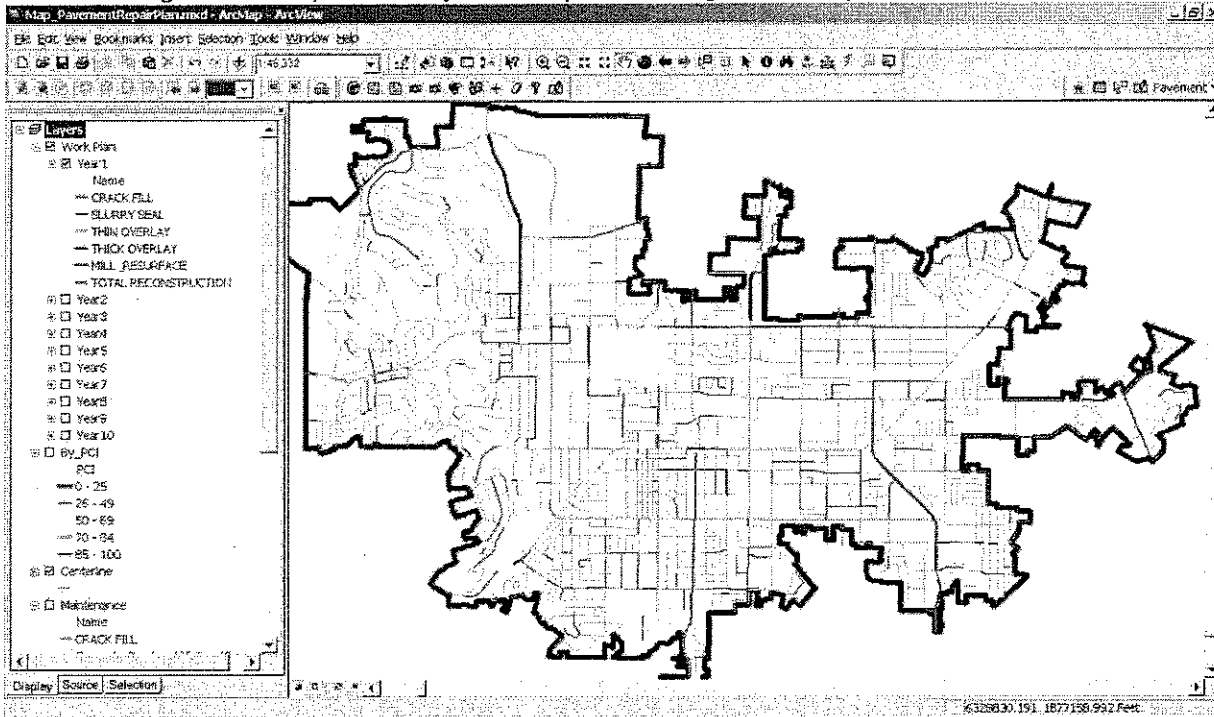
1. Setup a few repair strategies based on the eRoadPavement template.
2. Execute the "what-if" analysis to produce condition projections.
3. Work iteratively with the Counties to modify the various strategy settings to derive different "What-If" scenarios to identify the optimum scenario.
4. Produce 3-year pavement repair work plans based on a selected optimal repair strategy.
5. Review the computer generated 3-year pavement repair work plan to make necessary adjustments.

Deliverables:

1. Optimizer spreadsheet program showing forecasted road conditions based on funding levels.
2. 3-Year Pavement repair work plan in digital table and map formats.



Here following is an example of a 10 year work plan showing in GIS map format.



3.4.7 Pavement Reports

eRoadInfo will provide a number of the frequently used standard reports designed by the pavement engineers for the pavement management practices. In addition to the standard reports, the Counties users can produce different repair results based on road classifications (traffic volume) and budget constraints. Users can overwrite the eRoadInfo repair decisions if desired. The project team will produce customer reports based on the County specific project needs.

3.5 Project Management

EnterInfo will provide project management for the duration of the project, including coordinating and attending meetings with Counties, data research and collection efforts as required, preparing monthly progress reports, and schedule updates.

Deliverables:

Monthly progress reports and schedule updates.

3.6 QA/QC

Quality is of the highest importance to asset and pavement data. eRoadInfo was designed to provide the most effective quality validation capability. All of the collected pavement distress conditions and asset items can be validated using the eRoadInfo application. By clicking on a road, sign, or sidewalk, the video, scanned image, distress rating, and attributes will be displayed for instant verification. The EnterInfo project team will use the eRoadInfo application capability to thoroughly perform QA/QC on the project data prior to submitting to the Counties for acceptance. Internally, EnterInfo have full time quality assurance personnel that perform a 5% random quality assurance check on all data collected to verify the correctness and completeness of the data. If there is any issue identified the whole sample will be re-evaluated or re-worked to correct the problem.



EnterInfo always provides a 100% quality guarantee on all data that is delivered to the customer that we will correct any issues identified by the customer until full customer satisfaction is achieved.

3.7 Training

EnterInfo proposes to provide a 2-day on-site training for eRoadPavement, eRoadAsset, and eRoadInfo Database Administration. As an ESRI authorized Training Center, EnterInfo has extensive experience in providing training and support services to government clients. Mr. Derege Seifu will be the instructor of the training class. Users' documentation and on-line help will be provided to each student attending the class. EnterInfo also provides software upgrades and phone support services to customers that subscribe to the support services. Phone help desk is provided between 9 a.m. to 5 p.m. EST on business days.

3.8 Project Acceptance

EnterInfo is fully committed to completing all of the project requirements without exception. We propose that the Counties use the same QA/QC process to validate the work produced by the EnterInfo team. eRoadInfo is a unique and efficient tool for the Counties to perform acceptance procedures on the data. The same interface used to create the data is also the ideal tool for performing QA/QC and acceptance tests. As eRoadInfo accesses all of the photos, pavement images, rating tables, maps, and GIS objects using the same interface, all of this information can be used to validate the accuracy of the data in an efficient manner.

Upon submitting the deliverables, the Counties will have 30 days to evaluate, accept or reject the deliverable and EnterInfo will work very closely with the Counties to correct all remaining issues in a timely manner.



Cumberland and Salem Counties , NJ

Proposal Due Date 12/10/2010

RFP – FY 2011 AMDC

Consulting Planning Services For Road Asset Management Data Collection

William Schiavi, manager of Regional Planning
 South Jersey Transportation Planning Organization
 782 S. Brewster Road, Unit 6
 Vineland, NJ 08361

Cost Proposal

Item	Products and Services	Unit	Count	Unit Price	Sub Total
Image Capturing					
1	Image Capture and Image QA/QC	Mile Driven	550	\$158.21	\$87,015.50
2	Travel and Lodging	Man-Days	30	\$200.00	\$6,000.00
Sub-Total					\$93,015.50
Asset Inventory					
3	Sign Inventory	Mile Completed	550	\$50.00	\$27,500.00 *
4	Sign Post Inventory	Mile Completed	550	\$15.00	\$8,250.00 *
5	Guardrail Inventory	Mile Completed	550	\$40.00	\$22,000.00 *
	QA/QC	Mile Completed	550	\$10.00	\$5,500.00
Sub-Total					\$63,250.00
Pavement Rating					
6	Pavement Rating Services "Windshield"	Miles	550	\$50.00	\$27,500.00
Sub-Total					\$27,500.00
Training and Software					
7	eRoadInfo Asset Collection ArcGIS Ext.	License	2	\$5,000.00	\$10,000.00
8	eRoadInfo Pavement Module	License	2	\$3,500.00	\$7,000.00
9	eRoadInfo Asset/Pavement Training	2 Days (at one location)	1	\$5,000.00	\$5,000.00
Sub-Total					\$22,000.00
Total					\$205,765.50

- Note: 1. Additional point feature collected at \$20 to \$40 per mile based on the attributes
 2. EnterInfo is the ESBE
 3. * Performed by Civil Solution - Non DBE firm (Total \$57,750.00)

Authorized Signer: _____

Andy Brown