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Winter 2016
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Implications of Connected and Automated Vehicle Technologies

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Allentown's Historic 8th Street Bridge

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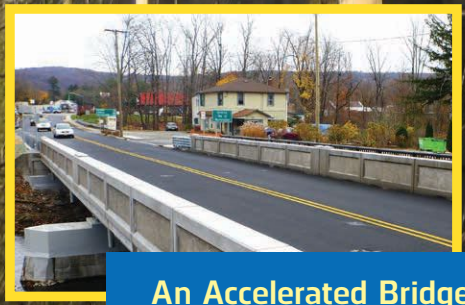

An Accelerated Bridge Reconstruction

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ASHE National President 2015-2016

New Directions

I hope you enjoyed the holiday season and had the opportunity to spend time with family and friends. I wish everyone a fabulous and successful new year! This is the time for optimism and a fresh start, if needed. So let's stay positive and be thankful for all the good things life has to offer.

Good things continue to happen within our organization. We are making great strides in becoming more visible in the highway/transportation industry. I am hearing a lot of positive feedback concerning the new digital *scanner*. Advertising should continue to increase as companies realize the benefits of this interactive magazine and the significant number of industry professionals who are being exposed to their products and services. I am also very pleased about the increasing number of advertisers taking advantage of the Inside Lane. I thank all the companies that are advertising with ASHE. We appreciate and need your support!

The ASHE Branding & Public Relations Guidelines were finalized and distributed to Sections and Regions in the fall. This document will assure consistency in how we present ourselves as a professional organization. A strong, unified identify creates a positive perception of the organization. The guidelines are to be used in advertising, promotional literature, displays, logos, social media, etc. Many thanks to the National PR Committee, led by Amanda Schumacher, for all their hard work and time in creating this important document.

I have had the opportunity to interact with many members of our organization at meetings, seminars and in conference calls since my tenure began as National President in June. This unique opportunity has allowed me to obtain input from many ASHE members and others. The positive attitude and outlook concerning our organization have been refreshing. The amount of time and effort expended by the many officers, directors and committee members throughout the organization is astounding. Good things do not just happen; thank you all for your dedication!

Several individuals have approached me over the last few months inquiring about ASHE. Typically, once they become informed of what ASHE is all about, they ultimately decide to join our organization. They realize that being a member of ASHE can benefit them both professionally and personally, and they can have a positive impact on the highway/transportation industry. I warmly welcome all of our new members and ask everyone to spread the good news about being part of the ASHE organization!

In October the National Board met in Charlotte, NC, home of the Carolina-Piedmont Section. Beautiful weather greeted us, and a lot was accomplished during the two days of meetings. Several National Board members attended the Carolina-Piedmont Section's member luncheon the day before, followed by an informal meeting with the Section officers.

In January, the National Board will meet in Fort Lauderdale, FL. The National Board and Committee members will once again take the opportunity to meet with the local Gold Coast Section's officers and members to answer questions, obtain suggestions and extend support from National. We are also looking forward to warm, sunny weather in January!

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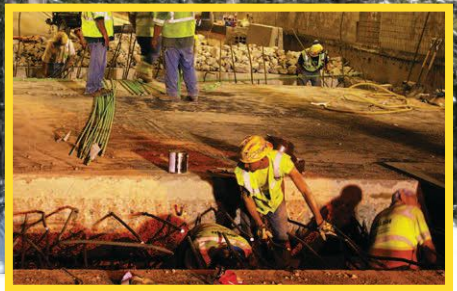
In This Issue

ASHE scanner



on the cover

Upgrade for a Historic Allentown Landmark and Vital Traffic Artery

ASHE East Penn Section

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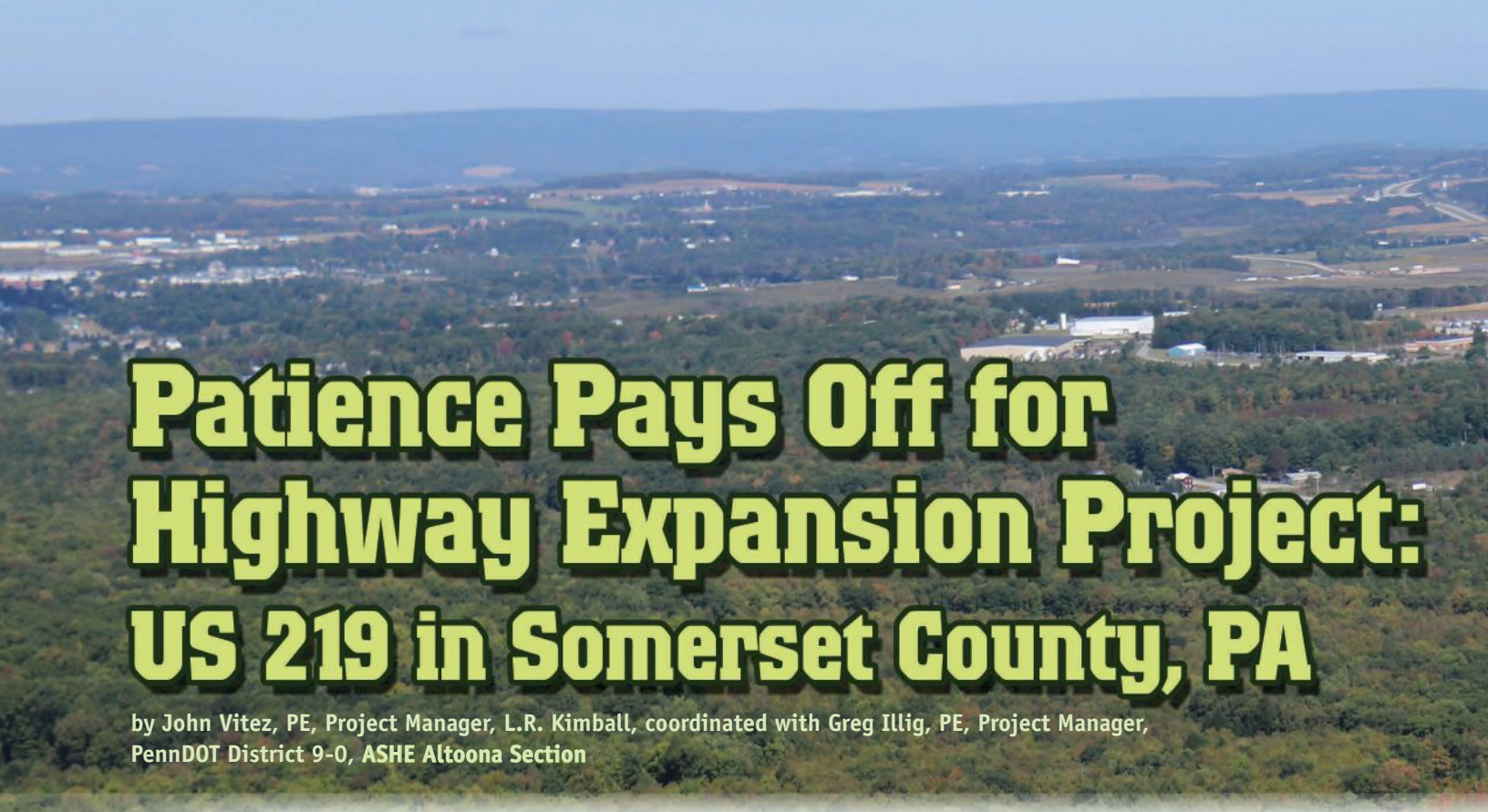
Happy New Year!

Tammy



Patience Pays Off for Highway Expansion Project: US 219 in Somerset County, PA

by John Vitez, PE, Project Manager, L.R. Kimball, coordinated with Greg Illig, PE, Project Manager, PennDOT District 9-0, ASHE Altoona Section

It has been more than 40 years since a rural 11-mile expansion of US 219 connecting Somerset with Meyersdale, PA, was first proposed. In the early 2000s, the project, which stretches across miles of streams, wetlands and natural habitats of endangered species, finally gained the traction it needed to move forward. After years of funding struggles, lawmakers in 2012 passed the Federal Transportation Legislation; Moving Ahead for Progress in the 21st Century (MAP-21). The MAP-21 legislation made it possible for the Pennsylvania Department of Transportation (PennDOT), through coordination with the Federal Highway Administration (FHWA) and Appalachian Regional Commission (ARC), to utilize 100 percent Federal Appalachian Development Funding to finance the project construction. The much-anticipated roadway, which has the potential to spur economic development in the rural region, is now expected to open in early 2018.

On the surface, the $335 million expansion of the four-lane limited access highway resembled similar highway projects. Its highlights include:

- two new interchanges
- one modified interchange
- six sets of new dual structures, including the Buffalo Creek Bridge, the highest bridge in the six-county PennDOT District 9
- one set of modified dual structures (two-span curved girders)
- four new box culverts
- 10 million cubic yards of earthwork
- five million cubic yards of excess material to be removed or recycled or disposed

Before the first shovel of dirt could be moved, PennDOT's final design team, led by prime consultant L.R. Kimball, faced a challenging set of design issues that had the potential to once again derail the much-needed project.

Complicated Right-of-Way Considerations

Although the targeted 11-mile stretch was largely uninhabited, its location in the heart of agricultural and coal-producing Somerset County meant that the team had to work closely with Pennsylvania's Agricultural Lands Condemnation Approval Board to successfully acquire right-of way from several agriculture parcels. They also had to secure mineral rights for every surface property that would be impacted by the project.

To achieve this objective, mineral specialists from L.R. Kimball developed a comprehensive Mineral Appraisal Report for PennDOT that measured the excavation and market value of potential coal production for each parcel, as well as the value of the coal per ton on individual parcels. These analyses were later rolled into the right-of-way claim for each parcel. Based on the thoroughness of this analytical tool, no residential parcels were displaced, and only one commercial property, a rock farm, was required to move across the highway from its previous location.

Protecting Threatened and Endangered (T&E) Species

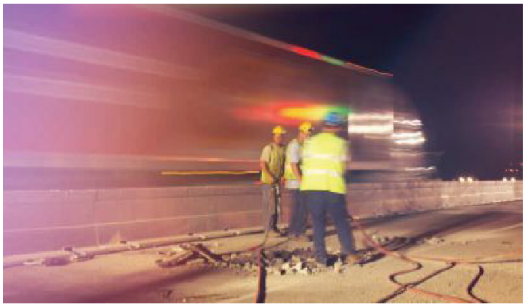
In addition to complex right-of-way issues, the team also had to develop and carry out effective strategies to protect several T&E species, including the Indiana Bat, Eastern Small-Footed Bat, Long Nose Sucker Fish, and Appalachian Blue Violet Plant. Working with several state and federal agencies, including the U.S. Fish and Wildlife Service (USFWS), Pennsylvania Game Commission (PGC) and the Pennsylvania Fish and Boat Commission (PFBC), they conducted intensive surveys to confirm the presence of the species, and developed successful mitigation strategies and avoidance measures.

For example, to safeguard bat habitats, no trees were removed during the months of April through mid-November, blasting was halted in certain areas from mid-November through late March and annual monitoring will continue throughout construction. Similarly, to protect the Long Nose Sucker, in-stream work ceases from mid-March through June, a basin discharge point was relocated from Blue Lick Creek to the much larger Casselman River (which required boring under US 219 and CSX Railroad), the temperature of the Blue Lick Creek is monitored daily and new foliage has been planted to help shade stream channels.

A Permitting Maze

Not surprisingly, the rural and environmental nature of the project generated an abundance of permitting concerns. However, strong organizational capabilities and solid working relationships enabled the team to work

(continued on page 9)



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through permitting challenges and keep the project moving forward.

In addition to USFWS, PGC and PFBC, several other organizations, including the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, Pennsylvania Department of Environmental Protection and Pennsylvania Department of Conservation and Natural Resources, required realistic and cost-effective action plans to address a range of issues related to:

- pollutant discharge elimination systems
- watershed designs
- wetland mitigation planning
- on-site and off-site stream restorations
- dam removals
- wildlife passages, which resulted in a 20x10-foot culvert (equipped with skylights) for large mammals and multiple 18-inch and 36-inch culverts for small mammals and herptiles (reptiles and amphibians)

As each issue was addressed and the proper permitting obtained, the project moved closer to its planned 2013 construction start date.

A Safe and Modern Roadway

By 2018, the long-awaited route between Somerset and Meyersdale will be complete and open to traffic. Already, the majority of the timber has been removed, significant earthwork and drainage milestones have been reached, the modified dual structures and one set of new dual mainline structures are complete and construction is moving forward on the remaining five sets of dual bridge structures. A paving contract will be awarded shortly, with physical construction expected to begin in spring 2016.

The success of the project reflects the efforts of the entire team, including all subconsultants, as well as several federal and state governing and permitting bodies. A detailed project schedule has also helped the team maintain its focus and keep its eye on the prize—the completion of a safe and modern roadway that will help anchor the economic development efforts of the southern Somerset County region.

Transforming University Drive (SR 817): *Completing the Street* along a Suburban Arterial Roadway

by Carlos M. Cejas, PE, **ASHE Gold Coast Section**

Traditional suburban arterial roadways are reaching their useful life limits. Because of this, the Florida Department of Transportation (FDOT) District 4, in collaboration with the Broward County Metropolitan Planning Organization (MPO), has decided to take a new approach to State roadway transportation mobility in southern Florida. The commonly known way of accommodating future travel demand by simply adding more automobile capacity is no longer a viable approach. The new way of thinking in District 4 is to take auto-centric roadway facilities and transform them into "complete" arterial roadways that address identified transportation needs. This new way of thinking will be applied along the 20-mile-long University Drive/SR 817 corridor (extending from the Miami-Dade County line to Sample Road) by implementing cost-effective multimodal transportation solutions.

For this corridor, the transportation goals are to:

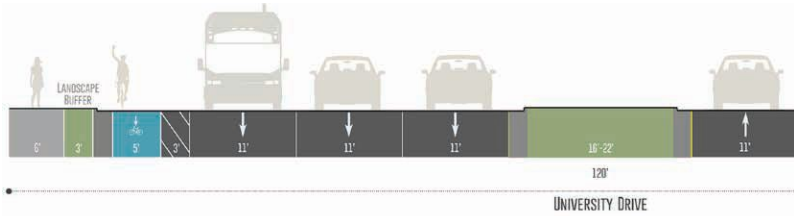
- improve mobility and safety
- improve livability and walkability within and adjacent to the corridor
- encourage new Transit Oriented Development (TOD) at identified transit hubs

In order to achieve these goals and complete the design phase more efficiently and effectively, a one-year feasibility and preliminary engineering design study phase is being conducted. The design study phase will utilize the results of an extensive Broward County MPO Planning Study that concluded with a locally preferred alternative that was approved in September 2014 by the MPO Governing Board. This design study phase will assess a long list of multimodal improvements in collaboration with a relatively large group of project stakeholders. The challenge will be to get through this initial phase within the allocated time frame with a single agreed-upon, corridor-length concept plan.

A series of improvements by travel mode, focused in eight previously identified activity areas, are currently being assessed along the corridor and will be implemented in a way that avoids any major right-of-way acquisitions and minimizes impacts to existing utilities, canals and landscaping, while balancing the needs of all travel modes. Additionally, a significant amount (144 miles) of off-corridor transportation improvements, primarily for pedestrians and bicyclists, is also being assessed. This level of off-corridor transportation improvements is something new for the FDOT and the consultant community.

The types of improvements being proposed by travel mode include:

- *Pedestrian Improvements:* Continuous and buffered six-foot-wide minimum sidewalks, sidewalk connections to bus stops, new pedestrian



THE LOCALLY PREFERRED ALTERNATIVE (LPA) WAS **RECOMMENDED** BY THE **PAC** AND THE **BROWARD MPO TECHNICAL COMMITTEES** IN AUGUST OF 2014. THE LPA WAS **APPROVED** BY THE **BROWARD MPO BOARD** IN SEPTEMBER OF 2014

lighting, landscaping buffers, driveway consolidations, new high-emphasis cross-walks with American Disabilities Act (ADA) compliant curb ramps, pedestrian refuge features, new count-down pedestrian signals, increased pedestrian crossing times at intersections, right turn lane removal at select intersections, reduced curb radii greater than 50 feet and a new shared-use path where space is available.

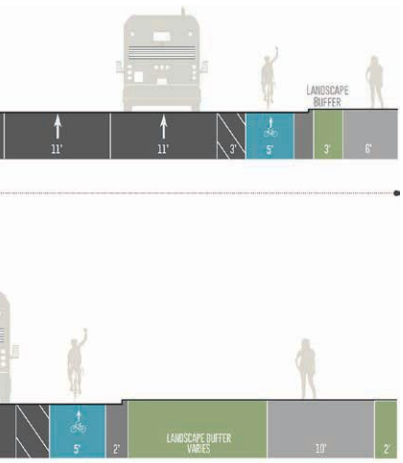
–*Bicyclist Improvements:* On-street buffered and designated bicycle lanes, and new bicycle racks at transit stops.

–*Transit Improvements:* New bus shelters, enhanced bus stops with shelters, queue jump lanes, mobility hubs, increased bus frequency, new transit signal priority and Advanced Traffic Management Systems.

–*Automobile Improvements:* Traffic signal and timing upgrades, and auxiliary left turn lane extensions.

As could be expected, being an innovator with the types of improvements under consideration for implementation requires an extensive amount of coordination with other transportation agencies (including those in Broward and Miami-Dade counties), 10 municipalities and the school district. The coordination efforts will result in approval of the proposed improvements within local agency jurisdictional limits, integration with ongoing and future local and county projects, beginning the process for establishing maintenance agreements and identifying the need for any permanent easements.

When completed, FDOT District 4 will have established a new way of approaching roadway design projects in Broward County and, in turn, will set the stage to transform University Drive and the surrounding communities. Stay tuned for actual results on this transportation corridor as well as others.



SHARED USE PATH DETAIL (WHERE ROW AVAILABLE)

Carlos M. Cejas, PE, is a Vice President and senior project manager with the Miami Office of Gannett Fleming, Inc. The information contained in this article comes from the University Drive/SR 817 Design Project being performed for FDOT District 4.

MileMarkers

News From Across ASHE-Miles

ASHE Albany Turns Five

October 8 marked the fifth anniversary of the Albany Section's chartering with ASHE. The Section began with 62 members and has grown over the past five years to 107 members, a 73% increase. Over these past years the Section has offered regular PDH breakfast/lunch/dinner meetings, construction site tours, golf outings and other social events, often partnering with other professional organizations in shared meetings. Through members' efforts and generosity, support to the Capital District Future City Competition (over $11,500 raised so far) and U.S. Marine Corps Reserve Toys for Tots Program, a yearly college scholarship fund and participation in student mentoring programs have been iniciated. The Section co-hosted the 2013 ASHE National Conference in Lake Placid, giving lasting ASHE memories to those attending.

The new President, Rob Cartwright, has put together a robust event calendar for this coming year, providing a variety of meetings and events for member participation. It is hoped that ASHE Albany members will take every advantage of what the Section offers this year, and members wish the best of luck to Rob in his efforts to continue to keep ASHE Albany the premier professional organization in the New York Capital District.

Legislative Committee

ASHE—Funding PowerPoint and Decal Distribution: *LinkedIn*

ASHE introduced the transportation funding decal and presentation template in the Winter 2015 *scanner*. As a reminder, these tools are available for all ASHE members and other organizations to raise awareness of the need for a long-term transportation funding solution.

The first tool is the "Funding. Fix It Now!" windshield decal (shown at left). Decals are available for purchase in the ASHE Store for a nominal cost depending on the quantity (e.g., $3.90 per 100). Orders can be placed at http://www.ashe-store.cathyrossner.com/product/449295.

The second tool is a presentation template loaded with relevant and timely data that can be used by ASHE members and constituents to advance the message for an improved highway funding solution. The presentation is available for download from the ASHE National website at ashe.pro under the Information>Downloads section. Understanding that each state has certain preferences, this tool is available in an editable format so that members can customize as necessary to fit a particular situation and need. The presentation is updated periodically in an effort to be as current as possible. Forward suggested revisions/updates to Brad Winkler, Legislative Committee Chair at winklerbs@pbworld.com.

(MileMarkers continued on page 25)

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New Directions *(continued from page 3)*

If you have not done so already, now is the time to put the National Conference on your calendar! It will be held May 19 to 22, in downtown Pittsburgh, Pennsylvania! You can obtain information from the Conference website, http://2016conference.ashe.pro. On-line registration will be available in early February, so take advantage of the early-bird rates and assure your room reservation. Additionally, information and a registration form will also be included in the next edition of the scanner in April. The Pittsburgh Section has hosted several successful ASHE National Conferences in the past, so you can be assured of an enjoyable and educational experience. We will also be celebrating the Pittsburgh Section's 50th anniversary at the conference, so it will truly be a special event.

I continue to look forward to meeting and talking with you, the members of ASHE. Your suggestions and comments are always welcome. Let's Keep the Momentum Going!

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50th

The Pittsburgh Section invites you to celebrate our 50th Anniversary as an ASHE Section during the 2016 National Conference, May 19th-22nd. The Conference is being held at the iconic Wyndham Grand Hotel, located on the point of the Three Rivers of Pittsburgh.

Conference Co-Chair Kevin Duris welcomes your attendance: "The Pittsburgh Section, the largest with 551 members, is proud to host our sixth National Conference during our 50th year of existence. We are planning to have enjoyable, educational and exciting activities."

There's an endless list of things to do and see in Pittsburgh: The Andy Warhol Museum, Carnegie Science Center, National Aviary, Kennywood Park, Senator John Heinz History Center, and Benedum Center, to name a few. We'll take you out to a ball game Friday night at the scenic PNC Park Stadium. Conference attendees will enjoy the luxurious World-Series Suites, as we watch the Pittsburgh Pirates take on the Colorado Rockies.

In addition to the wide variety of tours and city-excursions, technical sessions will feature some of the region's most prominent and influential speakers in the transportation industry. Earn up to 4.5 PDH's during technical sessions focusing on connecting the next 50 years in transportation.

Bring your golf clubs, because we'll be teeing off at Quicksilver Golf Club on Saturday morning. Tucked among western Pennsylvania's rolling hills, these fairways are lush, and the greens are fast and true.

We'll see you May 19th-22nd in Pittsburgh, where transportation is connecting the next 50 years.

"The ASHE Pittsburgh Section is excited to welcome ASHE national conference attendees to the Steel City in 2016. We invite you to come celebrate with us the 50th anniversary of our Section and enjoy the many amenities our city has to offer."

- Pat Kane, Conference Co-Chair

Mobile Mapping Technologies Lead to Safer, More Accurate and More Cost-Effective Roads

by Nathan Fischer, PE, Woolpert, **ASHE Triko Valley Section**

In an era when transportation budgets are tight for most state and local government agencies, multifaceted technology options are required to get the most out of limited project funding.

The use of mobile mapping system (MMS) technology provides engineers with 3D lidar point cloud data, survey-grade surface data and imagery to assist in developing infrastructure improvement and replacement design solutions. MMS data provides many benefits beyond traditional field survey methods, while meeting accuracy, reducing cost and schedule, and providing more information.

When MMS technology is combined with new or existing aerial imagery and new lidar data or other data sources, it is considered a data fusion approach. This kind of coordinated effort with multiple uses is applicable to all modes of transportation and all forms of transportation projects.

Practical Application of Data Fusion

Some transportation projects are complex, such as the intersection of multiple highways and surface streets; others are simpler, like a rural, single-lane road.

A recent project undertaken by Project Manager Brad Fugate, a certified photogrammetrist, was a little of both. A majority of the project was a rural, two-lane road but it also had the complexities of highway ramps, dangerous sharp curves, heavy truck traffic and steep surrounding terrain.

"Any type of road that we're doing has its own inherent complexity to it, but for this project there were lots of pieces to the puzzle," Fugate said.

The project focused on the road that began with a four-lane highway ramp and followed a creek up a steep valley. The road had blind curves, no shoulder on either side, and was bracketed by a mountainside and a drop-off into a valley and creek.

Mobile mapping systems technologies were used to improve and enhance the challenges of a rural, two-lane road. The road had blind curves, no shoulder and tight navigation, and was home to a heavy industry processing plant, a manufacturing plant and a power substation.

Compounding the hazards of the already-tight navigation, the roughly five-mile road was home to a heavy industry processing plant with infrastructure that bridged the road. Also on the road were a manufacturing plant and a power substation. These industrial sites greatly increased the number of heavy trucks that traversed the road daily. Also, immediately north of the road was a strip mine with runoff that flowed toward the creek on the south side.

"They wanted to take this road and straighten it out, maybe widen it and get rid of some of the dangerous curves, keep personnel safe and off the roadway, obtain 3D horizontal and vertical information for infrastructure. They also wanted to produce one-inch equals 40-foot scale, planimetric and topographic base mapping with one-foot contours and half-foot contours on roadway, and most importantly provide an efficient cost-effective solution," Fugate said. "For this request, typically, we would use photogrammetry to produce the base mapping and send surveyors out to cross sections of the road every 25 or 50 feet."

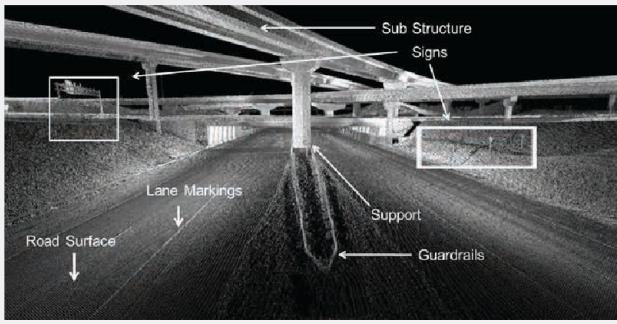
Fugate said the special requirements of this road led Woolpert to develop an alternate strategy. "If we had used traditional methods, it would've taken several weeks and caused multiple lane closures," he said. "That would have disrupted the production at both the manufacturing and processing plant, and would have presented even more of a safety hazard to the surveyors than already existed." Fugate said a data fusion approach was recommended by combining multiple mapping disciplines: surveying, MMS, new aerial imagery and existing aerial lidar data.

"We used new aerial imagery and existing aerial lidar data to produce the planimetric and topographic base mapping beyond the roadway," Fugate said. "For the roadway, MMS was used to obtain survey-grade surface information, keeping our surveyors safe and out of the roadway. The MMS also provided a digital terrain model and 3D point cloud, allowing designers to take cross sections and profiles of the roadway wherever needed. With the MMS point cloud data and oblique imagery data, the design process will be greatly enhanced.

By employing a data fusion approach, the designer's requested information and the data collected by the photogrammetrist and surveyor are combined.

Not only is the process of data fusion with MMS as a component less expensive, offering multiple uses; but it also provides a more comprehensive and accurate product. "You can measure the hard surface of the road, the height of a pole and the guardrail, the ground clearance of electrical wires and bridges, the positioning of transformers, not to mention the infrastructure particular to this road—it's all available in the data," he said. "It's a way to save money on both ends, also there is a savings in using existing data at the outset combined with new data. It is less expensive and has multiple uses."

The benefit to the designer who then receives this data fusion is that it helps reduce the ambiguity and error associated with traditional data acquisition. "Inevitably, when you collect data, you may miss something, You often wish you had turned the camera in another direction or shot a utility structure in the field from another angle." He added that data fusion bridges the chasm between the designer's requested information, and the data collected by the photogrammetrist or surveyor. "With the point cloud from the MMS, you can put yourself there from your desk and see in all directions," Fugate said. "And all that data is extractable."



New aerial imagery and existing aerial lidar data were combined to produce planimetric and topographic base mapping for a road project.

Data can also be used for applications beyond design, such as asset management. "Many firms stop at a single MMS collect for a single purpose, but that's where we're taking it further, by not only producing the base mapping from multiple sources and then designing using that data, but then using that for asset management and other applications," he said.

Greater Efficiencies, Lower Costs and Reduced Risk

The evolving technology associated with mobile mapping has been consistently driving more efficient and cost-effective strategies to municipalities. Additionally, the MMS takes surveyors out of harm's way in particularly dangerous situations, such as this one.

Through the increased application of data generated by this technology, more infrastructure will be addressed more accurately. This will lead to more thoroughly updated infrastructure and safer roads.

Paris Avenue/Easton Street Roundabout Boosts Safety in Stark County, Ohio

by David Torrence, PE, PS, Chief Deputy Engineer, Stark County;
ASHE Cuyahoga Valley Section

The Stark County Engineer's Office (SCEO) in northeast Ohio has upgraded dozens of intersections in the last several years to improve safety and traffic capacity. These intersections were chosen for upgrade based on a history of high crash rates, using data provided from the Stark County Area Transportation Study (SCATS).

One intersection on the yearly SCATS crash rate list was the intersection of Paris Avenue and Easton Street in Nimishillen Township. With an approximate total Average Daily Traffic (ADT) of 4,000, the total number of crashes was relatively low, but the severity of those accidents was high. This intersection features speed limits of 45 mph on Easton Street and 55 mph on Paris Avenue. Paris Avenue, which runs north and south, was the through movement; it connects to US 62 approximately one mile to the north. Easton Street runs east-west and was the stop condition at the intersection.

The intersection is on a skew, which makes sight lines somewhat difficult and, without proper driver caution, dangerou In the years prior to construction, there were two fatal accidents, both the result of a failure to stop at the eastbound appro on Easton Street During this time, there were also several injury accidents involving all legs of the intersection.

A crest in the vertical curvature to the north of the intersection further complicated the sight lines at the intersection spite meeting current design criteria. In addition, a church is on the northwest corner, with an accompanying cemetery locat the southwest corner of the intersection. Biery Cheese, a locally owned company with approximately 50 to 60 semi trucks mo and out of its site on a daily basis, is located just to the south of the project location.

With all of those factors taken into consideration, many traditional intersection improvement alternatives were not ad beyond the conceptual stage. Full signalization, along with the addition of turn lanes, was not warranted. The SCEO had insta warning beacon that helped eliminate fatal accidents due to failure of motorists to stop. However, accidents still occurred in tion, and the SCEO decided this intersection was a good location for a modern roundabout because it could accomplish the f

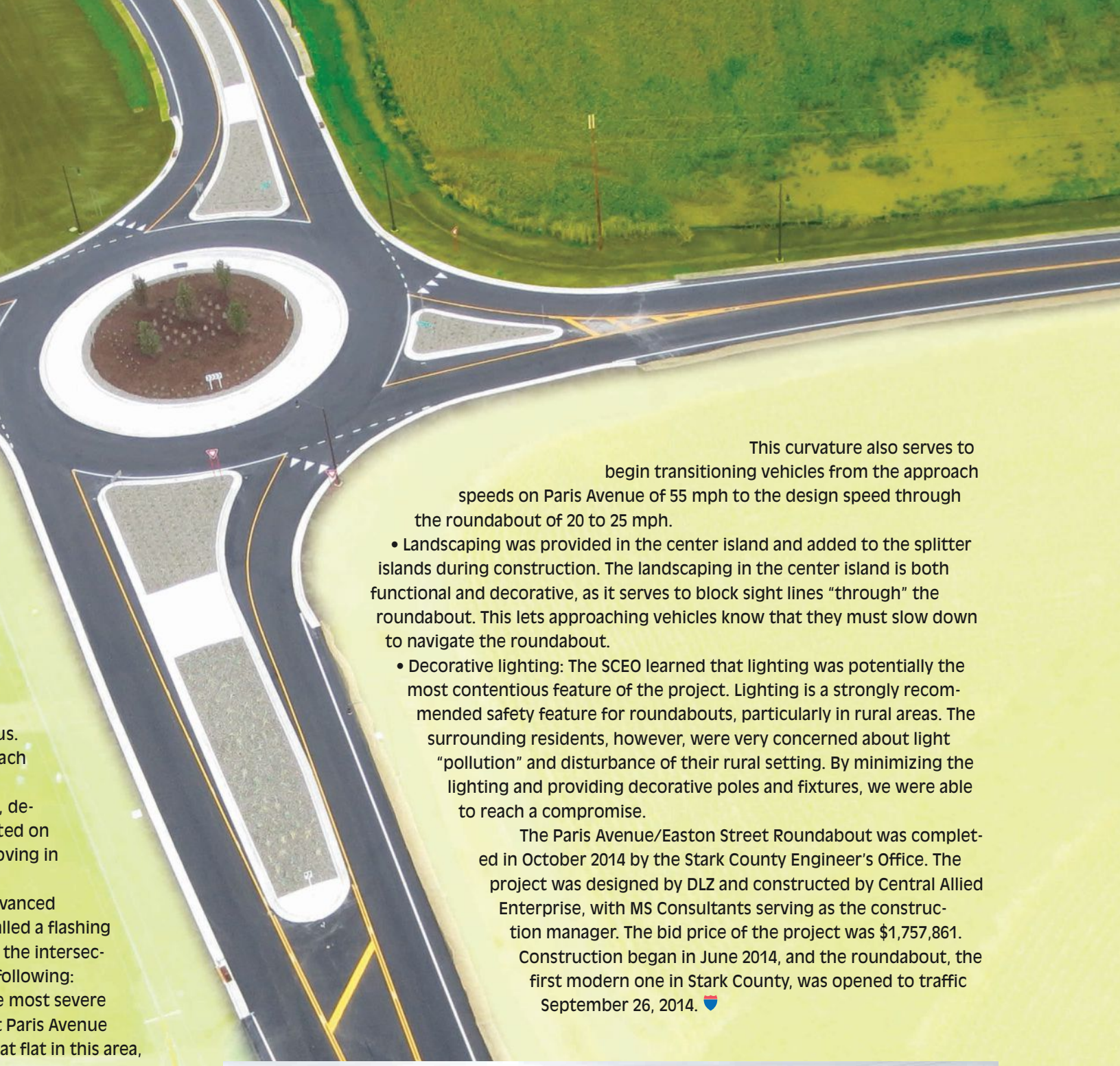
1. Eliminate "failure to stop" accidents, especially those with a high severity (injury/fatality), which was the cause of the accidents at this location. Traveling westbound toward the intersection on Easton Street, the prior existing stop condition at was the first stop condition that drivers encounter for a distance of nearly three miles. Easton Street is straight and somewh through rural sections of the county, and from the accident data it appeared that drivers were potentially "lulled to sleep" ar stop sign due to inattention.

2. Slow traffic to between 20 and 25 mph, making any collisions that could occur at this intersection much less severe.

3. Allow for a more efficient movement of trucks through the intersection. The roundabout was designed with a 170-fo diameter, which is fairly large for a single lane roundabout. The roundabout was designed so that 53-foot trailers, the size of from Biery Cheese, would only need to utilize the interior truck apron while making a left turn movement through the round trucks to move through the roundabout efficiently.

Other features of the project include:

• Alignment to avoid the cemetery and accommodate trucks; the cemetery in the southwest quadrant of the project had to No permanent or even temporary right of way was permitted on this parcel due to the Federal funds allocated to the project the skew of the intersecting roadways, approach curvature had to be added to the north and south legs approaching the rou



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This curvature also serves to begin transitioning vehicles from the approach speeds on Paris Avenue of 55 mph to the design speed through the roundabout of 20 to 25 mph.

- Landscaping was provided in the center island and added to the splitter islands during construction. The landscaping in the center island is both functional and decorative, as it serves to block sight lines "through" the roundabout. This lets approaching vehicles know that they must slow down to navigate the roundabout.
- Decorative lighting: The SCEO learned that lighting was potentially the most contentious feature of the project. Lighting is a strongly recommended safety feature for roundabouts, particularly in rural areas. The surrounding residents, however, were very concerned about light "pollution" and disturbance of their rural setting. By minimizing the lighting and providing decorative poles and fixtures, we were able to reach a compromise.

The Paris Avenue/Easton Street Roundabout was completed in October 2014 by the Stark County Engineer's Office. The project was designed by DLZ and constructed by Central Allied Enterprise, with MS Consultants serving as the construction manager. The bid price of the project was $1,757,861. Construction began in June 2014, and the roundabout, the first modern one in Stark County, was opened to traffic September 26, 2014.

Kennedy Connector Project Transforms Cincinnati

by John Brazina, PE, CDOTE; Jeff Koehn, PE, IBI Group; and Mike Prus, Prus Construction; **ASHE Triko Valley Section**

Through thoughtful planning, effective stakeholder involvement, innovative design and high-quality construction, the City of Cincinnati's Department of Transportation and Engineering's (CDOTE) Kennedy Connector Project has been completed. With financial support from the Federal Highway Administration, the Ohio Department of Transportation, the Ohio-Kentucky-Indiana Council of Governments and the City of Cincinnati, along with help from critical stakeholders, this $35 million project (including right of way) addressed a legacy transportation issue. The initial construction of I-71 and SR 562 in the 1960's had an unintended and significant impact on the local transportation network in the Oakley neighborhood of Cincinnati, Ohio. The access point to I-71 NB was isolated from the rest of the I-71/SR 562 interchange. Vehicles heading to the I-71 NB ramp had to pass through several intersections in retail and commercial areas that—by the early 2000's—were performing at Level of Service D or worse at peak hour, and reducing air quality in a region with air quality issues.

Further exacerbating the traffic demand, several brownfield sites had been redeveloped into retail, and the restoration of a 75-acre, Cold War-era factory site was imminent. As part of a comprehensive neighborhood planning effort initiated by the City of Cincinnati, a transportation solution was identified that would solve the existing traffic problems and provide the necessary capacity for the brownfield developments. The complex solution involved constructing 7,100 feet of new and upgraded roadways that would cross over a creek and a railroad track; miss several high-voltage electric towers; cross over a 20-inch diameter, high-pressure gas main and impact other electric, gas and fiber lines as well as combined sanitary and storm sewers. Property acquisition was also required, including that of a large operational industrial facility. The new roadway section is composed of five lanes with dedicated bike lanes.

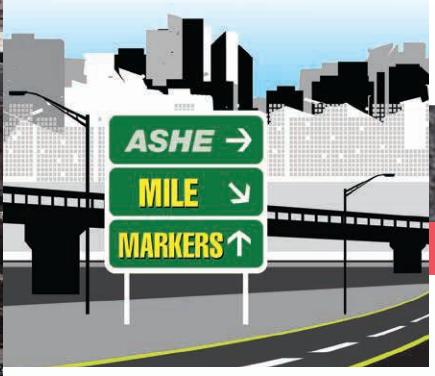
Because of the scale, complexity of the project and impact to the surrounding community, it received the 2013 American Society of Highway Engineers (ASHE) Triko Valley Project of the Year Award. Firms involved in the delivery of this project included IBI Group, CDS Associates, Thelen and the ASC Group providing engineering design and environmental services, and Prus Construction as the general contractor leading the construction team.

Stakeholder communication was a major part of the project success. The design team conducted and attended numerous public meetings to keep the public informed during design, and CDOTE retained a public relations firm during construction to provide weekly updates to the local press via press releases and Facebook. The project had its own Facebook page.

Because the area was already developed, the utility impacts were significant. The extensive utility coordination included the relocation of the 20-inch diameter, high-pressure gas main; the relocation and consolidation of two electric lines over the railroad tracks to one line over the tracks; the jack and bore of new water mains, sanitary sewer and storm sewer (four locations, ranging from 16-inch to 48-inch diameter carrier pipes); and new water mains along the Kennedy Connector (completed by IBI, under contract with Greater Cincinnati Water Works). The 48-inch water main crossed Duck Creek, with a self-supporting steel pipe bridge. CDOTE partnered with the Metropolitan Sewer District of Cincinnati to separate the project, and 20 acres adjacent to the project, from the combined sewer, reducing the annual combined sewer overflow volume and frequency.

The project included new lighting, the modification of seven traffic signals and the interconnection of the new signals to the existing City systems. The intersection of Duck Creek Road and Kennedy was raised nine feet to accommodate a U.S. Army Corps of Engineers flood control project. The construction of the new bridge over the railroad track utilized a two-piece precast concrete arch with a

(continued on page 26)



MileMarkers

News From Across ASHE-Miles

For the Love of the Road

by Michael D. Hurtt, PE
ASHE Albany Section

The Dynamic Motorcycle Duo of Mike Hurtt and Joe Foglietta (both of the Albany Section) took to the road once again this past September for another epic journey. Past trips included an 8,600-mile cross-country adventure in 2012 and a 3,500-mile ride to the 2014 ASHE National Conference in Bismarck, ND. This year's rather short 2,500-mile trip wasn't about a specific destination, but rather about the road itself—the Blue Ridge Parkway.

Constructed in the 1930's as a Public Works Program, the Blue Ridge Parkway connects the Shenandoah National Park in Virginia with the Great Smokey Mountains at the North Carolina/Tennessee border. The Parkway rides the crest of the Appalachians, meandering from peak to peak and gap to gap, with nary a tangent section between the 469 miles of endless and exhilarating curves, sweepers and switchbacks. Combine this with 26 tunnels, 168 bridges, six viaducts, hundreds of scenic overlooks and pull-offs and over a mile of elevation difference (highest elevation at 6,053 feet), and it's a ride worth the undertaking. It's also a slow road (for some—wink, wink) with a 45-mph speed limit, narrow lanes, minimal shoulders and limited sight distance, seemingly designed with the motorcycle enthusiast in mind.

Many of our ASHE members became highway engineers for one reason—we love the road. The Blue Ridge Parkway is the embodiment of the perfect road. It ebbs and flows through the scenic landscape, designed "as if Mother Nature placed it there herself." For those highway engineers of the 1930's, this project must have been an absolute joy to work on, blending the horizontal and vertical alignments into the topography, developing endless superelevation transitions, siting the scenic overlooks and making the bold decisions to tunnel versus going around. With the environmental regulations of today, this project wouldn't have gone a mile, let alone hundreds. Regardless of how one feels about environmental protection, travelers of the Blue Ridge Parkway are extremely thankful that this road was built, opening the wonderment of the Appalachians for all those adventurous enough to ride the road.

ASHE East Penn Section Celebrates 50th Anniversary of Charter

On October 12, 1965, the East Penn Section became the seventh Section to join the American Society of Highway Engineers with 25 Charter members. The Section was formed to represent ASHE in the Lehigh Valley region of Pennsylvania. Since 1965, the Section membership has increased to nearly 100 members and continues to grow. Events to celebrate this milestone included a 50th Anniversary Happy Hour on October 15 at The Hamilton Restaurant in Allentown, and a dinner celebration on December 1 at the Sands Bethlehem. The dinner event honored past Presidents of the East Penn Section, and the Section received a certificate from ASHE National represented by Sam Mody, Past National President. For more information about the ASHE East Penn Section, please visit their website at www.eastpenn.ashe.pro.

72-foot clear span. IBI worked closely with the Indiana-Ohio Railway to secure the approval of the design and to complete the permitting.

Construction began in May 2012 and was completed in December 2013. The all-concrete project includes concrete pavement and sidewalks, a cast-in-place concrete wall, a two-span, pre-cast concrete bridge and a 72-foot span, two-piece precast concrete arch. The two-piece arch structure was more cost effective than the curved steel girder bridge contemplated in the initial design phase and has lower life-cycle costs. A significant portion of the cost savings came from the elimination of deep foundations and the use of spread footings. To reduce total and differential settlements, the location of the abutment footings were pre-loaded with 30 feet of soil for 120 days.

The Kennedy Connector project, conceived more than 10 years prior to construction completion, has had a positive impact on the community and environment, through the reduction of combined sewer overflows, lessening of traffic congestion, improvement of air quality, increased traffic network efficiency and construction of bike lanes. It has also served as a catalyst to create as many as 3,000 new jobs.

Implications of Connected and Automated Vehicle (C/AV) Technologies on Transportation System Management and Operations

Jia Li, PhD, and Meredith Cebelak, PhD, PE, **ASHE Tampa Bay Section**

Several challenges and uncertainties are anticipated with the harnessing of smart driving technologies. Primarily, the development and adoption of vehicle automation and communication technologies involve the complex interplay of different interested parties, including technology companies, car manufacturers, public agencies at the federal, state and local levels and consumers. Significant uncertainty surrounds public acceptance due to the technology costs, reliability concerns and other factors. In addition, with high levels of automation and wireless communication, cyber-security will become a significant concern. Social equity is also of concern with early adoptees of smart driving technologies potentially benefiting more from the system, and the impact can be twofold. For example, dedicated lanes for C/AVs may provide safer and more reliable service for early C/AV adopters who are presumably people with higher income. Meanwhile, C/AV-based transit and shared service can also enhance access to transportation for those mobility-constrained groups, e.g., elders, teenagers and people who cannot afford a car.

In light of these challenges and uncertainties, smart driving technologies alone will not solve all of the transportation system's problems. To best harness smart driving technologies and achieve important system benefits under limited budgets and other constraints, a comprehensive understanding of the impacts of these technologies is essential. In particular, one central task is to understand how the automation and connectivity technologies, given varying levels of market penetration, will shape Transportation System Management and Operations (TSM&O) strategies, as well as associated benefits and costs.

Understanding C/AV's Impact on TSM&O Strategies

Smart driving technologies can influence every phase of a driver's trip, from pre-trip planning (mode and departure time choice), in-trip navigating (route choice) and maneuvering decisions (car-following and lane changing), to post-trip activities (e.g., parking). Advanced driver assistance systems can help drivers choose less congested routes and automate repetitive functions, which make driving safer, more comfortable and decrease anxiety overall (e.g., auto-valet parking in downtown areas).

While smart driving technologies alone provide many benefits directly to drivers, TSM&O strategies can be crucial in utilizing the C/AV technologies to maximize benefits. As an example, C/AV signal operations would be greatly enhanced and become more intelligent, given accurate

information on vehicle speed, acceleration, lane and vehicle type. With increasing market penetration of C/AVs, traffic signal control operations may see benefits in two ways. First, through Dedicated Short Range Communications (DSRC), the smart vehicles entering the system may have advanced knowledge of signal phase and timing (SPaT) information and can adjust their speed accordingly, reducing idling time and number of stops. Second, C/AV technologies also allow real-time guidance for advisory information to be more effectively transmitted (timely and personalized) to drivers through wireless communication between roadside units and in-vehicle devices, which would enable more seamless, cost-effective and personalized system-wide dynamic route guidance.

Table 1: TSM&O Strategies and Primary Benefits

TSM&O Strategies	Coverage	Execution	Major Benefits		
			Mobility	Safety	Environment
C/AV Signal Control	Arterial	Control	X	X	O
Road Weather Management	Arterial & Freeway	Information, Advice	X	X	O
Traffic Flow Smoothing	Freeway	Advice	X	X	O
Intelligent Ramp Metering	Freeway	Control	X	X	O
Dynamic Route Guidance	Arterial & Freeway	Information, Advice	X	O	O
AV Managed Lanes	Freeway	Pricing	X	O	O
Intersection Collision Avoidance	Arterial	Information	O	X	O
Shared AVs	Arterial & Freeway	Information, Demand	O	X	O
Note: X=significant & direct impact; O= secondary benefit					

Table 1 left, identifies a list of TSM&O strategies that are commonly used in today's transportation environment that have the potential to provide major congestion relief, and increase safety and/or environmental benefits.

Benefit and Cost Analysis

The benefits and costs of TSM&O strategies can be estimated on a corridor or regional level. The former will require fewer assumptions and can capture more specific features of the project under consideration than the latter. The Benefit-Cost (B/C) analysis is uncertain due to the unpredictable nature of the technology's evolution and the complexities that influence the vehicle market. Such analysis aims to provide a starting point for grasping the magnitude of benefits and costs of primary TSM&O strategies once C/AVs are in place. Using B/C analysis as a preliminary baseline, more in-depth data analysis, simulation modeling and field tests can be conducted in a more purposeful and effective fashion.

Table 2: Key Values in Estimates

Parameter	Value
Value of Travel Time (VOTT)	$12 / hour
Comprehensive cost of crashes	$6,000,000 / fatality
	$126,000 / injury
	$3,200 / crash
Annual interest rate	5%

Table 3: Potential Performance Metrics to Consider

Benefit	Performance Measure	Unit
Mobility	Capacity increase	Vehicles / hour / lane
	Delay reduction	Total system time in hours
Safety	Reduction of crashes	Number of crashes
Environment	Fuel consumption	Ton
	Emissions	Ton

Tables 2 and 3 summarize the United States Department of Transportation (USDOT1) and National Highway Traffic Safety Administration (NHTSA2) recommendations for the key parameter values, for a typical B/C analysis of TSM&O strategies (Table 2), as well as applicable performance metrics (Table 3).

The mobility benefit estimate is based on the traffic flow and capacity analysis of the concerned strategies, as well as empirical and simulation results of similar strategies in the past. As an illustrative example, the perception-reaction time (PRT) with the use of cruise-adaptive cruise control (CACC) is reduced from the standard range of 0.5 to 1.5 seconds to 0.25 seconds due to increased driver situational awareness. For this case, as market penetration of CACC vehicles

rises, the effective capacity of each lane has the potential to be at least doubled, since the traffic traveling at the same speed can be made denser. The Bureau of Public Roads (BPR) function may be applied in order to convert these effective capacity improvements to travel time savings, across different volume-capacity (V/C) ratios. Subsequently, the monetary value of the congestion savings per year can be calculated by multiplying the assumed valuation of travel time (VOTT) by the delay reduction from the capacity increase.

The costs of typical Intelligent Transportation Systems (ITS) projects are available from USDOT's ITS benefit database (http://www.itsbenefits.its.dot.gov/). With these values as a reference, the costs included in a B/C analysis should consist of the deployed devices, infrastructure and staffing. An important uncertain factor in the cost estimate is the cost of technology components, such as roadside communication devices and more intelligent controllers. The initial prices of these products are usually high, but they have the potential to reduce quickly when entering the phase of mass production. Thus, there should be a unit price drop realized as the market penetration of C/AV increases.

Concluding Remarks

To best understand the impact of C/AVs on TSM&O strategies through B/C analysis, several issues are worth noting. First, B/C analysis of emerging technologies and pertaining influences usually involves extensive assumptions on the effectiveness of TSM&O strategies and their cost. While the approximations were based on information presented in past cases, the estimates are intrinsically uncertain. As a result, the calculated B/C ratio values should be interpreted in terms of their order of magnitude and relative values, rather than the absolute value. These B/C ratio estimates can be improved when more empirical/experimental data or simulation results (e.g., percentage reduction in travel delay) are available. Second, this B/C analysis of TSM&O strategies did not take into consideration some significant benefits, such as driver comfort and value of reduced driving burden. If the benefits and cost from drivers' perspective are of concern, these should be included in the analysis. Finally, for B/C analysis of TSM&O strategies, we typically consider short-term impacts of C/AVs. For the long-term impacts of C/AVs, one should factor in the change in travel demand, lane use and other policy decisions.

Upgrade for a Historic Allentown Landmark and Vital Traffic Artery

by Ralph Eberhardt, PE, MBA, **ASHE East Penn Section**

The 8th Street Bridge, an iconic part of the skyline in Allentown, Pennsylvania, is a vital transportation link. To extend its life, the Pennsylvania Department of Transportation (PennDOT) selected a design team led by Michael Baker International to undertake an $18 million rehabilitation of the 2,700-foot-long, 17-span, concrete spandrel arch viaduct. The design challenges of this project centered on enhancing the long-term durability and functionality of the bridge while respecting its historic significance.

Part of the National Register of Historic Places, the 8th Street Bridge was built in 1913 and spans Little Lehigh Creek, Martin Luther King Jr. Drive, Harrison Street, a former railroad line and a portion of Fountain Park at heights of 80 to 100 feet. This reinforced concrete bridge consists of nine open spandrel arch spans and eight arched "T" beam spans. The original structure was built to carry two trolley lines and one toll lane for motor vehicles. Later, the structure was converted to carry two 10-foot-wide northbound motor vehicle lanes, one 10-foot-wide southbound lane and two sidewalks. Michael Baker coordinated closely with the Pennsylvania Historic and Museum Commission, PennDOT Environmental Unit and the City of Allentown Historic Architecture Review Board throughout the design process to protect the bridge's historical integrity and address the character-defining elements of the bridge. Distinctive elements of this structure include the open-spandrel arches, arched T-beams, arched floor beams, obelisk-style light poles, ornate alcoves, decorative railings and ornamental features on the piers.

The project began with comprehensive inspections of the structure to determine the condition of the numerous bridge elements and to assist with a load rating. Michael Baker employed a three-dimensional LiDAR survey to confirm and supplement the bridge arch geometry found in existing plans and a 1913 *Engineering News* article. Due to the complexity of the open-spandrel arch structure, it was recommended that a three-dimensional finite element model of the structure be created to complete the load rating analysis. In addition, the team obtained several concrete core samples from the existing bridge and conducted testing to determine a realistic compressive strength of the concrete elements. The comprehensive strengths of the structure varied from a low of 4,980 pounds per square inch (psi) to a high of 9,510 psi and significantly affected the structure's ability to carry current-day design loads. Due to the extensive deterioration of the existing T-beams spans and their limited service lives, the team determined it would need to replace all T-beam spans in the superstructure.

To meet current design requirements and provide a functional structure, the team expanded the outside width of the superstructure from 46 feet to 48 feet, 10 inches. The new cross section includes two 11-foot outside lanes, one 12-foot center lane, outside parapet walls and two sidewalks with safety barriers separating the roadway and sidewalk.

To maintain the road's current grade and ensure that the bridge could accommodate future needs, the team installed lightweight geofoam blocks to support the new deck system. Geofoam is an expanded polystyrene material that has been used as a lightweight fill material in transportation projects all over the world for more than 30 years. It has the weight of approximately one percent of

Workers make concrete repairs to arched floor beams and spandrel columns.

typical soil or stone materials, has little or no compression, provides predictable support characteristics and is easy to install. Crews added concrete floor beam extensions to support the new concrete deck and installed geofoam between floor beam extensions to minimize the weight of the structure so it could be used without any load restrictions.

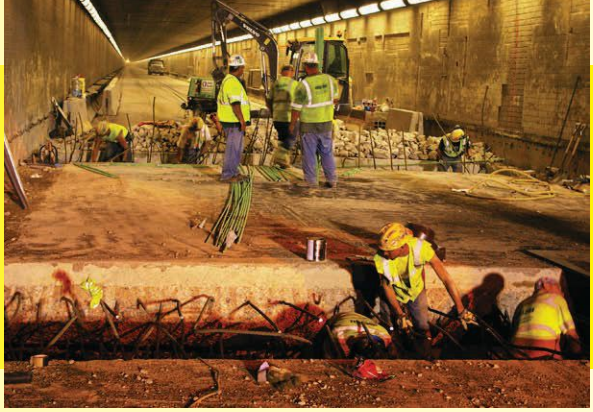
In addition to maintaining the historical structural significance of the bridge, several project-specific specifications were developed to aid in this effort, including period-style acorn lighting fixtures, power washing of the entire structure, tinting of all concrete to match the existing bridge color and metalizing/painting of fabricated steel to blend the new bridge enhancements as seamlessly as was feasible with the existing structure. The team also developed several custom designs to mimic the existing historic features, including pre-cast arch fascia panels, pre-cast decorative alcoves, pier jacketing and pre-cast obelisk light poles. At the request of community stakeholders, the team added a pedestrian safety fence to the top of the decorative railing.

Approach span construction at the north end of the bridge

As part of the environmental clearance, the team determined that a pair of Peregrine Falcons had been nesting on the bridge. There are only 29 known nesting pairs of this protected bird in Pennsylvania. Since the birds are an endangered species, PennDOT coordinates with the Pennsylvania Game Commission to mitigate the potential impact any project might have on the falcons. The commission determined that the falcons had nested for several years on the nearby PPL building prior to nesting on the bridge. The commission directed PennDOT to construct screening on the underside of each of the nine open arches on the bridge to deter the falcons from nesting on the bridge. In addition, the commission directed PennDOT and Michael Baker to build a nest box with an Internet-accessible camera on the PPL building. This provided the falcons with an alternate nesting location during the two-year construction project. The web camera enabled the public and the commission to monitor the birds.

The Michael Baker team determined early on that a full closure of the bridge was not feasible during the projected two-year construction period. To stage the construction, crews kept one motor vehicle lane open into the city and one sidewalk open at all times. With the removal of southbound traffic across the bridge, the team established a detour route. The Michael Baker team also modified four existing traffic signals and created a temporary traffic signal to deal with significant increased traffic volumes from the detoured traffic.

Construction of this vital project is set to be completed in fall 2016. Through collaboration and careful planning, PennDOT and the Michael Baker team engineered a solution that preserves the past, protects the environment and provides for the growing needs of the residents and businesses of Allentown.



Enhanced Tunnel Vision: Rehabilitating Pittsburgh's Gateway from the East

by Jonathan McHugh, PE, Gannett Fleming, **ASHE Pittsburgh Section**

The tunnels in and around Pittsburgh, Pennsylvania, may not be as prominent as the city's many bridges, but they are just as important to its infrastructure. The Squirrel Hill Tunnel, a fixture on Interstate 376 since 1953, is a crucial component to the primary travel corridor from regions east of the city. The average daily traffic (ADT) through the tunnel totals more than 102,000 vehicles.

Although the 4,225-foot, rock-bored tunnel held up well during the past 60 years, the Pennsylvania Department of Transportation (PennDOT) and prime engineer, Gannett Fleming, determined that many of the structural, electrical, ventilation, control and fire and life safety systems were in need of repair or replacement.

Bringing Down the Ceiling

The most visually apparent component of the Squirrel Hill Tunnel Rehabilitation project was the removal of the ceiling. The existing ceiling had nearly 18,000 square feet of severe deterioration. Preliminary design cost estimates revealed that it was less costly to remove the ceiling than it was to replace the deteriorated areas. The removal would save approximately $3 million and provide a higher vertical clearance inside the tunnel.

The ceiling removal also gives the tunnel a less constricted feel. This allows traffic to flow more freely by reducing the "black hole effect"—the tendency for drivers to slow down while entering a darker space. This effect compounded already existing congestion issues.

In addition to raising vertical clearance, removing the ceiling allowed for the relocation of the tunnel lighting system. Removal of the ceiling and installation of the new lighting system effectively utilized the existing constraints of the tunnel to provide improved operation and maintenance of both the tunnel ventilation and lighting systems.

Another key driver of the cost effectiveness of the ceiling removal was the ability to retain the existing ventilation system. Tunnel ventilation testing and analysis revealed that for normal and emergency situations, the ventilation system performed adequately without the ceiling, as it was converted from a partially transverse to a full longitudinal configuration. A special provision was included in the contract to test the longitudinal configuration, with funds set aside to design and install vane axial fans, if needed, to assist the air flow under normal or emergency conditions. This testing, performed during a tunnel weekend closure, showed that additional fans were not needed.

Up to Code

The entire project proved to be a juggling act of balancing the multiple and varying design criteria that governed the transportation, structural, electrical, mechanical, fire life safety and environmental aspects of the project. Nearly a dozen design codes, including American Association of State and Highway Transportation Officials (AASHTO), National Fire Protection Association (NFPA), National Electric Code (NEC), Institute of Education Sciences (IES), International Building Code (IBC), Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), PennDOT design standards and local best practices, were employed through the duration of the upgrades.

These criteria, at times, offered competing requirements—forcing the design team to make judgments as to which were more stringent and, therefore, controlling. In the end, many items were harmonized. For instance, the structural braces supporting the steel ventilation duct work also supported the new tunnel lighting.

Complex Location

Rehabilitating a highway tunnel with all of its components is exceedingly complex and was compounded by having to maintain the high levels of traffic during construction within the restricted confines of the tunnel.

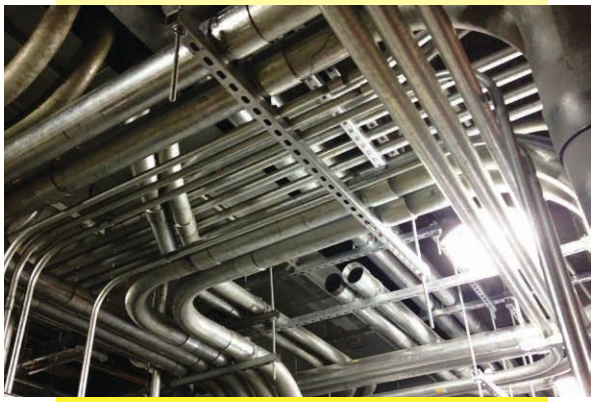
The project required balancing the many often conflicting needs of multiple tunnel systems and integrating them into one comprehensive project. The project site constraints created numerous challenges that affected both the design and construction of the project, including:

- The project's electrical, plumbing and systems integration work pushed many of the construction items out of the scope of the typical transportation project.
- The West Portal Building basement, which supports the I-376 travel lanes in each direction, required complicated structure repairs.
- The project employed a complicated urban detour that affected Pittsburgh's densely populated Regent Square, Squirrel Hill and Oakland neighborhoods.
- Many of the tunnel life safety systems were obsolete and required full rehabilitation and new Supervisory Control and Data Acquisition (SCADA) interface.
- With the tunnel located in a historic corridor, Parkway East, the rehabilitation included cultural resources and historic preservation processes.
- Late in design, the project team combined two adjacent bridge rehabilitations into the tunnel rehabilitation project.
- The contractor "value engineered" the relining of the deteriorated tunnel water line, which supplied the fire hydrants within the tunnel, into a manual dry standpipe system.

The construction work time restrictions proved to be one of the biggest challenges. Because the tunnel is situated on a main artery in Pittsburgh, serving more than 100,000 vehicles daily, there were limited construction times. While some construction activities could be completed during normal working times without disrupting traffic, most of the work occurred during single-lane, nighttime closures from 10 p.m. to 6 a.m. This limited shift included the time to set up and take down the traffic control for the closures. In addition, 14 weekend full closures were provided for the contractor in order to complete certain demolition and roadway repair work that could only occur with no traffic in the tunnel.

An Improved Gateway

With I-376 traffic into Pittsburgh from the east steadily increasing and the National Tunnel Inspection Standards nearing activation, the Squirrel Hill Tunnel was in desperate need of rehabilitation. By overcoming challenges presented by the existing tunnel and developing an innovative approach to removing the ceiling, the goals of PennDOT were met and the project was completed within budget.



(facing page, top left):
Photo 1—At the west portal entrance, crews work to repair a severely deteriorated slab that serves as a roadway for motorists and a ceiling for the basement beneath it. In a race against the clock, crews completed the full demolition and total rehabilitation in one weekend closure.

Photo 2—Removing 18,000 square feet of severely deteriorated ceiling was a design innovation that increased vertical clearance for over-height trucks; improved visibility, which allowed motorists to maintain more consistent speeds; and yielded a $3 million savings to PennDOT.

Photo 3—The project featured many integrated design elements. These steel struts support the concrete against the lateral earth pressure on the tunnel. They additionally served as lighting brackets and as supports for ventilation ductwork.

(at right):
Photo 4—The Squirrel Hill Tunnel is flanked by portal buildings on each end. These Art Deco-styled buildings serve as control centers for the various systems in the tunnel. They also house ventilation fans, maintenance facilities and equipment garages.

Photo 5—Eight cross-passages link the eastbound and westbound tunnels and provide a safe evacuation route for motorists in the event of an emergency. Made of photoluminescent material, the entrances will glow in the dark if the tunnel lights go out.

Photo 6—A designed labyrinth of conduit weaves through the tunnel portal building and carries more than 926,000 linear feet, or 175 miles, of circuit to power the tunnel's many operating and communication systems.

Ten Days in August: An Accelerated Bridge Reconstruction

by Ryan J. Adams, PE, SE, **ASHE North Central New Jersey Section**

As the nation's bridges and roadways continue to age, bridge owners are faced with a difficult set of challenges to rehabilitate or replace deteriorating crossings. The challenges become intensified in heavily urbanized areas where mobility impacts due to on-site bridge construction activities can severely reduce a community's quality of travel. In New Jersey's Hackettstown Historic District, Greenman-Pedersen, Inc. (GPI), was able to reduce the mobility impacts arising from the New Jersey Department of Transportation's (NJDOT) reconstruction of Route 46 over the Musconetcong River bridge by utilizing innovative materials and accelerated bridge construction methods. Understanding that reducing on-site construction time was of the utmost importance to the surrounding business and residential communities, a solution was developed that not only minimized social and environmental impacts, but also resulted in an safe and durable structure.

Custom monolithic precast concrete substructure units were attached to the existing concrete while 10 underbridge conduits were temporarily supported.

Connecting the Town of Hackettstown (Warren County) with Mount Olive and Washington Townships (Morris County), the existing crossing was a two-span, 127-foot-long, concrete-encased through-girder bridge. Carrying over 13,200 vehicles per day via one-lane of traffic in each direction, the structure also carried pedestrian traffic by way of a cantilevered sidewalk attached to the southern bridge fascia. Due to the poor condition of the concrete deck and primary members, a superstructure replacement was determined to be the preferred solution for reconstruction of this Class 1 waterway crossing. Complicating the reconstruction, in addition to the relatively high traffic volumes, was the need to provide a design that was sensitive to the remains of a historic grist mill immediately adjacent to one corner of the bridge, while maintaining continuous access to local businesses that bordered the structure on the other three corners. The interrelationship between the traffic, bridge and restrictive site constraints, along with the site's inherent historic value, made the project especially complex to design and construct. Based on input from the project's stakeholders, a decision was reached to avoid severe long-term traffic and right-of-way impacts by performing the reconstruction during a full-road closure over a period of only 10 days.

GPI was able to design the reconstruction to occur over a continuous 10-day, full-road closure by utilizing innovative prefabricated bridge elements and state-of-the-art materials. Constructed under a joint venture between J. Fletcher Creamer & Son and Joseph M. Sanzari, Inc., unique precast concrete substructure and superstructure sections were detailed to be rapidly erected and connected with the State of New Jersey's first application of Ultra-High Performance Concrete (UHPC). The particular UHPC material required for the project had never been used in this type of reconstruction, so calculations, combined with comprehensive specifications, were developed to ensure its proper function and application.

Additionally, a full-depth continuity diaphragm was provided over the pier that served to diminish future maintenance costs by eliminating the deck joint. Due to the accelerated fabrication schedule of the precast concrete superstructure units, the continuity diaphragm was constrained to be designed for unusually high time-dependent forces. This issue was resolved through the application of UHPC material throughout the entire depth of the diaphragm.

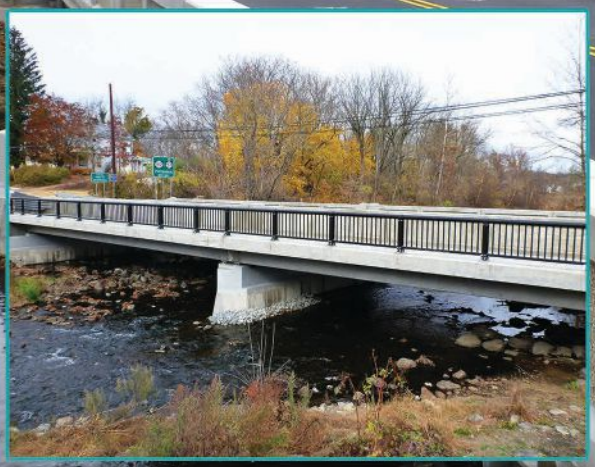
The use of UHPC, combined with custom prefabricated bridge elements designed and detailed to take advantage of UHPC's material characteristics, provided engineers with a solution to minimize travel impacts through accelerated construction techniques. This combination facilitates the rapid construction of bridge components without sacrificing quality, and provides a greater increase in service life over more traditional construction materials and methods.

The selection of prefabricated bridge members also optimized the superstructure depth, increasing the structure's hydraulic opening and improving overall safety by raising the low chord above the 100-year flood elevation. The materials used to construct and connect the prefabricated elements also enhanced the overall durability and maximized the service life of the new structure. The project preserved the integrity of the Musconetcong River and surrounding wetlands, along with the historic remains of the grist mill, even throughout construction. Additionally, architectural treatments were incorporated into the bridge barrier parapets and railing system to preserve the features of the existing structure while also being compatible with the aesthetics of the Hackettstown Historic District.

The project addressed the delicate balance between historic preservation, traffic operations, utility service, environmental impacts and the initial goal of reconstructing the bridge. The narrow time frame during which the reconstruction had to be completed led to the development of prefabricated bridge elements and the use of materials in new applications. The restrictive site conditions and accelerated schedule were further complicated due to the presence of 10 underbridge conduits that were required to be temporarily supported and remain in place throughout construction. Special details and construction operations were built into the contract documents to accommodate the conduits without jeopardizing the overall schedule and final integrity of the structure. Through extensive community outreach led by NJDOT and GPI's design team, the project was able to satisfy multiple project stakeholders, including Mount Olive Township, Washington Township, the Town of Hackettstown, and three local businesses immediately adjacent to the structure.

New Jersey's first application of Ultra-High Performance Concrete was mixed directly on site. The material achieved a compressive strength of over 11,000 psi in less than 20 hours.

After opening the roadway to traffic following the 10-day closure, the remainder of the work was completed behind temporary construction barrier.



An aluminum pedestrian railing that resembled the existing railing was installed along the sidewalk.

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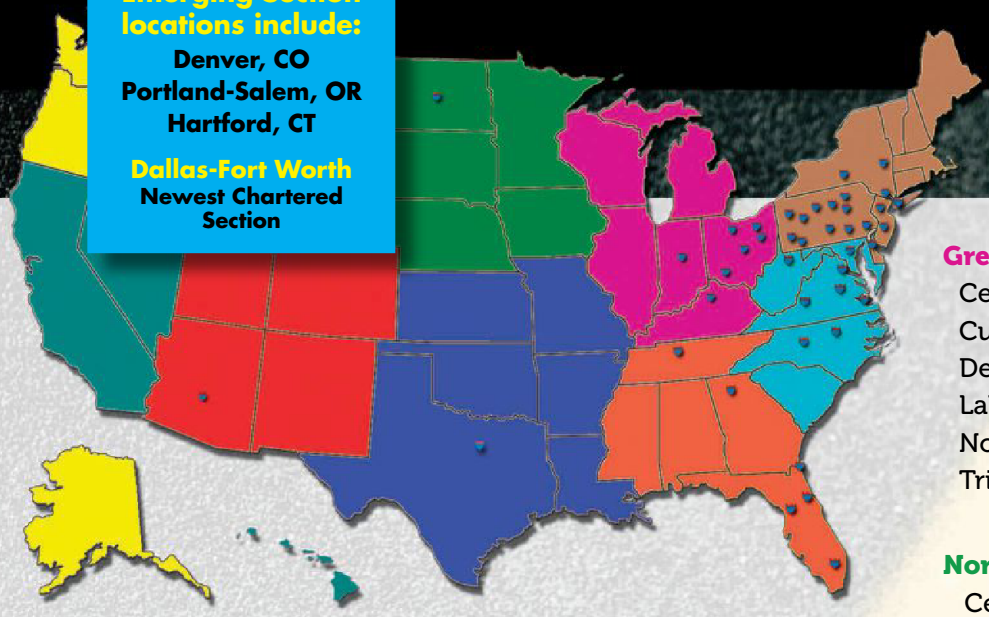

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Altoona	201
Central New York	49
Clearfield	154
Delaware Valley	385
East Penn	67
First State	141
Franklin	139
Harrisburg	356
Long Island	45
Mid-Allegheny	114
New York Metro	87
North Central New Jersey	166
North East Penn	128
Pittsburgh	551
Southern New Jersey	200
Southwest Penn	286
Williamsport	127
Subtotal	**3,311**

Mid-Atlantic Region

Blue Ridge	91
Carolina Piedmont	59
Carolina Triangle	223
Chesapeake	206
Greater Hampton Roads	125
North Central West Virginia	36
Old Dominion	96
Potomac	274
Subtotal	**1,110**

Southeast Region

Central Florida	48
Georgia	334
Gold Coast	10
Middle Tennessee	254
Northeast Florida	197
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Subtotal	**928**

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Central Ohio	182
Cuyahoga Valley	121
Derby City	80
Lake Erie	139
Northwest Ohio	42
Triko Valley	172
Subtotal	**736**

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Subtotal	**123**

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Subtotal	**134**

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