The City of Wheaton Illinois has beautified their historic downtown with improvements to underground utilities, roadways, lighting, and signage in this downtown streetscape infrastructure project. Sternberg’s Euro styled lanterns were chosen as a transitional link retaining a historic look with a contemporary touch, well suited to the charm of the downtown area. Sternberg also provided signage, custom poles for traffic light assemblies, and suspension lights.

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A member recently relayed a story to me about a discussion they had with their child who was excited about getting their driver’s license and dreaming about their first car. This brings back fond memories for most of us I am sure. Their son has visions of a classic muscle car. After asking some questions such as, “What do you need this car to do for you?” “How much are you willing to pay to purchase this car?” “How much are you willing to pay for gas?” and “About how your expectation for paying for insurance?” a used classic Honda Civic seemed a bit closer to reality.

I share this story because it illustrates the concept of value that a vehicle owner gets from the vehicle they choose. This is exactly what the management of infrastructure assets is all about. If you look at a general definition of “asset” you are likely to see something like “anything that provides value or potential value.” In the case of infrastructure assets, value is relative to the stakeholders of each community. Let’s take for example the asset that is water. Everyone would agree that safe drinking water is a commonly shared value received from this asset. Beyond that, you are likely to see a wide variety of the values that people also associate with the recre-

ation of water when it is in its storage form. How can a community successfully manage this asset until the value that is desired to be maximized from this asset is understood? This is a key question I encourage each agency that oversees infrastructure assets to determine if you have not defined this value. Because value can be subjective, and different for the same asset across different communities, an agency’s approach to asset management is not likely to be directly transferable and should be focused on the goals of the community.

APWA recognized that many of our international partners had more formalized approaches to asset management than was commonplace in the United States. Therefore, the APWA leadership decided that an improved focus in the area of asset management was desired to assist our membership in making continued strides in this important area. This resulted in the establishment of the Asset Management Task Force, which ultimately led to the creation of the Asset Management Committee. The work of APWA members on both groups has assisted with the development of a strong foundation, and APWA’s focus on this area is a long-term journey.

One of the first areas of focus has been on the definition of an agency’s Asset Management System. A common misperception is that this is an agency’s work order software and/or GIS software tool. This is one component of asset management but is not the full picture. If asset management is

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Engineering & technology and asset management are at the root of today’s public works endeavors. We now live in a world where asset management is an agency’s comprehensive approach to maximizing infrastructure value. As such, it takes a solid examination of not only understanding what this value is, but also understanding each person’s role in maximizing this value.

From work management systems to GIS, 3-D printing, CAD design and electronic permitting, we are using technology in unimaginable ways.

I do not mean to overwhelm you if you are beginning to think of just how broad and deep this subject area can be. You can take comfort in knowing that this is an area that has no jurisdictional boundaries, and great work has occurred. APWA is choosing to shine a light on this important area and work toward developing resources to assist our members with building on their existing Asset Management Systems. This issue of the Reporter has several great articles, and the continued work of the Asset Management Committee is focused on developing additional resources. And when I consider my question to you about the difficulty in identifying any part of your organization that does not have an impact on the value received from infrastructure assets, I recognize that most everything that APWA is working on is connected to asset management in one way or another. If you don’t lose sight of this, you are sure to find opportunities to assist with growing your organization’s approach to asset management.

Similarly, engineering and technology are at the root of today’s public works endeavors.
where we can barely exist without technology to perform even everyday tasks. There is technology involved in every aspect of our lives, and public works is no exception. From work management systems to GIS, 3-D printing, CAD design and electronic permitting, we are using technology in unimaginable ways. This is one of many reasons that APWA has developed our annual Top 5 Trending Technologies in Public Works. This edition of the Reporter includes an article introducing the 2020 technologies, and I think you will be pleased. The Engineering & Technology Committee and the Top Tech Collaboration Workgroup worked tirelessly to whittle down the choices from hundreds of submissions to 16, which were then voted on by the membership. We hope that your agencies can find value in the information that will be presented throughout the year focusing on these very important topics. This year, we will establish the Top 5 Trending Technologies Subcommittee that will help develop the topics each year and provide valuable information on each topic via webinars, Click, Listen & Learns, articles, PWX seminars, and even videos and podcasts. We are excited to be able to provide a more in-depth look at these topics that may be very foreign to a lot of agencies but that are critical as we move forward in the Age of Technology.

In this issue, you will find several articles on engineering and technology topics that will hopefully shed some light on some of the latest items of interest, like drones and innovative pipeline rehabilitation methods. As always, thanks for what you do every day to make the lives of our citizens better. Remember that “the public works because of Public Works.”

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TECHNOLOGY IN 2020:
THE FIVE KEY TRENDS IN
PUBLIC WORKS

Cybersecurity for Critical Infrastructure (pictured) included in this year’s most influential technologies

Thea Voutiritsas, Production Editor, American Public Works Association, Kansas City, Missouri

In an age where technology advances at an exponential pace, public works departments are constantly finding new ways to bring safety, economic stability, sustainability, and service to their communities. To help our members stay in-the-know on which industry-changing endeavors are on the horizon (or in some cases, already here), APWA has conducted the third annual Top Five Trending Technologies survey and report.
Each year, APWA meets with our Technical Committees, Standing Committees, and Council of Chapters to gather suggestions and select 16 trending technologies that will impact public works in the coming year. Those 16 trending technologies then go toe-to-toe in an NCAA-style bracket challenge, where we open the voting up to you. This year, round one received 2,328 votes. The eight remaining topics hit the web for round two, receiving 1,544 votes—resulting in the final four. Finally, a wildcard was selected from the bunch, resulting in the Top Five Trending Technologies for 2020.

According to your responses, these are the top five most influential technologies in public works (in alpha order):

- 3-D Technologies
- Automated/Connected Vehicles
- Cybersecurity for Critical Infrastructure
- Technology for Field Crews
- Waste-to-Resource Technology

Thanks to your votes, we’ll be able to use these trends to develop Click, Listen & Learn programs, APWA Reporter articles, PWX educational sessions, and so much more. Each trend has been selected due to its projected impact on the public sector—across all departments and at all levels. To get a better idea of what’s in store for 2020, we consulted a handful of experienced, knowledgeable public works professionals to share their thoughts and predictions on these trending topics.

### 3-D Technologies

3-D Technologies (such as building information modeling, or BIM) makes the 2020 list, as it is fundamentally changing the way projects are designed. Signed and sealed 3-D deliverables allow project stakeholders to have a greater level of understanding of a design, reducing the possibility of conflict in the final plans, construction, and the expectations of the greater community.

“In a nutshell, working with 3-D makes designing more efficient in reducing conflicts between disciplines. It allows for greater transparency to anyone that’s involved in the project—be it public officials, stakeholders, residents, and the owner and design team,” says Daniel Prokop, Senior Transportation Engineer at HDR, Inc.

Individual team members usually specialize in their own aspect of the design, so in the same way that people outside of the engineering process might have difficulty understanding certain parts of the engineering plans, engineers within a team may not have full cross-disciplinary understanding of each other’s plans and designs, explains Prokop. Lighting or drainage folks may not always be specialized in understanding structural design plans, for example.

“Having this federated model lowers the barrier to understanding detailed engineering designs so that everyone within the team, as well as external stakeholders, can get a much better real-world perspective on the size and location of everything that’s going on,” says Prokop. “It also creates the ability to move into 3-D construction models and then, ultimately, a 3-D asset management tool.”

Certain types of 3-D technology have been around for 30-40 years, often used to automate roadway design. However, the technology was in its infancy and benefits were limited. “Today, we’re moving toward providing highly accurate deliverables that the contractors can directly use to construct horizontal projects, including data for Automated Machine Guidance grading and paving,” says William Sharp, Senior Vice President at HDR.

“Before, it was very much about ‘How do I make a model?’ Now, it’s about ‘How do I attribute a model,’ and ‘How do I use those attributes to do something more powerful?’ And that’s a very different kind of workflow,” says Connor Christian, Transportation BIM Program Manager at HDR, Inc. “It’s very exciting to see that type of evolution, going from people creating models to watching computers make models for you based on a set of criteria.”

As 3-D technology becomes common practice in more states, we will see the impact at every level of stakeholder. “State transportation agencies have been migrating to a software with 3-D modeling capabilities for quite some time, and they have been using it to complete at least some parts of transportation design—specifically roadway elements. But the trend has been moving towards a full comprehensive 3-D design that includes other elements, as well as in some cases going all the way where the 3-D mod-
els are the contractual documents in place of 2-D plans. Municipalities are often stakeholders in large state DOT projects, and there is also a consultant community that’s generally working for both municipalities as well as state DOTs. So, it’s a natural flow that 3-D design is starting to move towards public works,” says Prokop.

Several state DOTs and major transportation agencies are shifting away from traditional 2-D plan sheets and moving towards contractual signed and sealed deliverables. Advances in the technology and its growing popularity have forced DOTs and many major agencies to reevaluate processes. “AASHTO has been very active in this area through the Joint Technical Committee on Electronic Engineering Standards, including level of development standards for 3-D models,” says Sharp. October 2019 at the AASHTO Fall Meeting in St. Louis, the state DOTs adopted the open Industry Foundation Class (IFC) standard data schema as the national standard. “This is a critical step forward for BIM for Infrastructure, providing a standard open 3-D data schema for transportation, which will allow BIM data to be shared seamlessly between design, fabrication, construction, and asset management regardless of the proprietary software packages utilized,” says Sharp.

Prokop urges public works professionals to stay in-the-know and keep moving forward so they can keep up with the transitioning deliverables format from state DOTs and agencies. “Public works organizations must be able to review designs for anything that impacts infrastructure, for which they are a stakeholder or owner. As the DOTs change their deliverable format, public works agencies should be considering changing the way that they review and receive those designs,” says Prokop.

“It’s not a question of whether this change is coming. It’s already here,” says Christian. “The question is, when are clients and owners going to start getting value from it? It depends on the marketplace, but I fully anticipate signed and sealed 3-D deliverables becoming a common reality in transportation within the next five years.”

Automated/Connected Vehicles

Making appearances on both the 2018 and 2019 Top Five Trending Technologies lists, the topic of AV/CV remains a hot topic when it comes to new technology and infrastructure. As of late, developers and manufacturers are talking more and more about making AV/CV both cheaper and safer as the technology evolves.

Rutherford gives the following case: a rolling chassis (with simply wheels and a frame) built the standard way takes over 350 hours, 3,000 parts, and over $49,000 to build. Using additive manufacturing, Local Motors cut those numbers down to 16 hours of assembly, 20 hours of printing, 127 parts, and a cost of $19,000. “In scope, we beat scale quite a bit,” says Rutherford. “It would take a lot of scale to match our cost.”

Now, they have a 10-by-40-foot printer that can put down nearly 500 pounds of material an hour, further reducing production time and costs.

Along with major changes in development of the technology, safety regulation and legislation are becoming a larger—and increasingly necessary—part of the discussion. 2018 and 2019 saw multiple fatal accidents involving autonomous vehicles, which has raised questions about safety, liability, and responsibility. As of November 19, 2019, the National Transportation Safety Board (NTSB) called upon federal regulators to create a review process before allowing automated test vehicles on public roads. “Safety starts at the top,” says NTSB Chairman Robert L. Sumwalt in a press release. It is now more urgent than ever that companies, organizations, and individuals participate in an adequate safety culture surrounding autonomous vehicles.
Rutherford says there are many regulatory factors that need to align, from self-regulation to federal regulation to redundant combinations of safety technologies. “Manufacturers have to take those results into account and do a good job of applying those technologies to make them better,” he says.

In addition to a stronger culture of safety, the topic of AV/CV is requiring more collaboration between vehicle manufacturers and state DOTs. “At some point, the DOTs of the country are going to become the FAAs (Federal Aviation Administration) of the roadway,” says Rutherford. “They’ll need to communicate with the vehicles, monitor them; and the vehicles need infrastructure to predict routes, provide better services, and give us oversight.”

“I think we’re finding new systems of transportation over the years to come... The fun part is we get to figure out what needs to be changed to make it better and how additive manufacturing can allow us to do that faster and for a lesser cost,” says Rutherford.

While the future of AV/CV remains difficult to predict, there are still steps that public works officials can take to prepare infrastructure for the future. Slade Engstrom, Master Professional at TranSystems, suggests investing in options that will benefit existing drivers just as much as future ones. Fiber is one of his first recommendations. “I consider it investing in information,” says Engstrom. “[Fiber] is something that you can gain benefits with the existing technologies that are out there right now, without a connected vehicle (through signal timings and adaptive technologies), so it makes sense to me that’s something that you spend money on and it should help you for information flows in the future, no matter what really comes out of a lot of the other areas.”

Curbside management is another place where Engstrom recommends special attention. “As we go on, curbside management is going to be very important in downtown areas and similar areas because you may not need the parking you have right now,” he says. Down the road, Engstrom predicts some massive changes in land development practices. “Instead of those coveted front door parking spots, you may have a pick-up/drop-off area. So, you’ve got this micro-transit type of attitude where people can figure out different ways to get from point A to point B. And I think it’s a cultural shift that you’re already kind of seeing, but it’s also going to blend in somewhat with what autonomous vehicles will be able to provide.”

Engstrom says similar concerns are soon to rise with truck platooning. “Having an autonomous vehicle run down the freeways is one thing on a platoon, but then having it drive down, say, Main Street in your town, is a whole other idea,” he says. Parking, backing up to loading docks, and similar situations still pose a challenge to automation. “Long story short, I think there are some curbside management practices that are going to happen in conjunction with the changes we’re seeing.”

In addition to fiber and curbside management, Engstrom has noticed some changes in pavement markings on the rise. Contrasting pavement markings (also known as Oreo markings) are becoming more popular. “When you get a sunny day out there and you’re driving along, a lot of times you can’t see—on a really polished concrete surface—that white line. So, contrasting markings do have a huge safety benefit for existing drivers as well,” he says.
Engstrom says the two biggest pieces of the puzzle are getting infrastructure to talk and making a safer roadway (or at least being able to visualize elements out there a little bit better). “If we can do those two things for existing drivers, so much the better is the way I look at it,” he says. “If they benefit autonomous vehicles at the same time, again, so much the better because that’s just going to help us keep pushing this down the road.”

To stay ahead of the game, Engstrom recommends that cities either participate in a pilot, or at least follow them closely. “Participating in a pilot teaches you a lot about how things are actually working, and that’s probably one of the only ways that you’ll truly understand the intricacies of these vehicles. If you can’t participate in those pilots, find out a way to really learn about them and understand them.” The FHWA, ITE, and NOCOE (National Operations Center of Excellence) offer a number of useful materials for staying abreast of the technologies. “Just try to find a way to get involved; try to follow the dialogues that are going on, understand what those issues are,” says Engstrom.

“The neat thing about this type of technology is that it’s not something that we’ve had to do since we went from horse and buggy to vehicles if you start thinking about it. This is that type of change where it’s fundamentally turning things on its ear, so to speak.”

Cybersecurity for Critical Infrastructure

From transportation systems, drinking water, and telecommunication networks to electric power generators and natural gas pipelines, much of critical infrastructure shares a common characteristic: a growing dependence on industrial control systems (ICS). ICS control, monitor, and manage their essential functions—which means they need to be protected. “Considering that much of the equipment public works professionals depend on was or will be connected to the internet, or rely on a computer, the susceptibility for the equipment to be hacked increases in magnitude—requiring a more stringent approach to defend,” says Marty Williams, APWA Government Affairs Manager.

“In order to survive and thrive, it is imperative that public works professionals have a firm grasp or understanding of the tools they are using—this certainly includes the area of cybersecurity,” says Williams. Those who have a sound and complete understanding of their organization’s cybersecurity measures are in the best possible position to not only defend against any intrusions but to proactively use technology to their advantage. Being well-informed means being able to make decisions that will best serve your organization—in the short and long term.

“Cybersecurity is an inescapable problem for public works as potholes are to roads, and both result in public consequences,” says Bradford Willke, Assistant Director (Acting), Stakeholder Engagement at U.S. Cybersecurity and Infrastructure Agency (CISA). With a growing dependency on IT, cybersecurity becomes a key enabler to public works operations and initiatives.

“CISA leads the federal government’s unified effort to work with the ICS community to reduce risk to critical infrastructure by strengthening control systems’ security and resilience. We view the prevention and mitigation of incidents with a potentially significant impact on national security, public health and safety, and economic security as an achievable goal. But as with IT security, ICS security is still going through a cycle where increased awareness of cyber issues is needed,” says Willke.

“Failing to take measures to safeguard your infrastructure can lead to some disastrous consequences,” says Williams. “We have APWA members that either directly or indirectly oversee their Supervisory Control and Data Acquisition (SCADA) systems, or other high-tech control systems, which may run a water source system such as a dam. If they, as overseers, lack knowledge on how to defend their systems, they become a target for a cyber-criminal to potentially inflict damage on that system,” says Williams. “Even the theft of public works data could result in the public’s trust being undermined, and the denied access to data from events like ransomware could drive accreditation, accountability, and even operational disruptions,” explains Willke.

As technology progresses, we will see more and more of the physical and cyber landscapes converging. “As we broaden our public works’ features and capabilities—cyber-ifying the physical environment—we potentially broaden the attack surface,” says Willke. “Public works is moving us to the reality of a connected, interactive environment... and the policy implications are such that we’ll get to the point where we can no longer separate the operations technology from the physical technology.”

Cyber-attacks pose countless (and in some cases, difficult to imagine) real-world implications, reinforcing just how critical it is that agencies, organizations, and individual users share the responsibility of protecting public interest. “As a practical matter, public works operations and planning departments should be actively talking to, leveraging, and collaborating with their internal IT departments to ensure privacy and security considerations are explicit in new and existing projects. Leadership awareness of the cyber-physical risk drives investment to increase cyber capability, resulting in operational resilience. Moreover, incorporating cyber at the policy level in governance structures and processes yields greater cyber maturity,” says Willke.

Willke says one of the main ways to develop a mature and holistic culture of cyber-readiness is to treat it as an operational imperative. CISA’s Cyber Essentials (which can be found at cisa.gov/cyber-essentials) are a great starting point. “We need to understand that the basics—driving investment and...
culture, promoting security awareness and vigilance, protecting assets and applications, backing up data, developing response plans—are not mutually exclusive, that collectively they form a layered defense,” says Willke.

Human error is, and will perhaps continue to be, one of the greatest hurdles in cybersecurity. Human error generally falls into one of two broad areas: error without malicious intent (or by accident), and error through active human intrusion with an expressed goal of causing a disruption, explains Williams. “For example, you have one or more of your city hall building control systems hacked into, thereby producing erroneous information or interfering in a system being able to complete an assigned task, such as controlling the building’s electronic door locks. Alternatively, let’s say a human operator, without malicious intent, introduces a corrupted USB which infects one computer; however, through contact with other systems infects all computers that are connected via a bad link. Unfortunately, the repercussions are potentially endless.”

Both Williams and Willke agree that awareness—on an individual and organizational level—is integral to protecting our critical infrastructure. Cybersecurity requires a cultural attitude adjustment and implementation, as it’s the under-educated users, lack of management participation, under-investment in training and procedures, avoiding peer and partnership cooperation, among other issues, that make us vulnerable.

“We need to take a page from public works to increase public awareness as a key to advance a culture of cybersecurity and align our desired outcomes,” says Willke. “To build a sustainable security culture, the greater citizenry needs to be not only literate on the risks they pose but seen as participatory in outcomes.” Willke says that cybersecurity and privacy should be part of the conversation from the start, allowing new and existing solutions to be built into our processes, with involvement from all corners of public works personnel. “It’s not an IT, IT shop, IT hero problem. It’s a business and operational requirement,” says Willke.

“It is anticipated that by 2020 there will be almost 20.5 billion (with a B) devices connected to the internet. It goes without saying that you can expect that almost every aspect of critical infrastructure will be connected... so keep this in mind, just one infected device can cause a great deal of problems, so do what you can to keep the internet as safe as possible—practice smart cyber hygiene,” says Williams.

**Technology for Field Crews**

A wider array of technology for field crews is now available—empowering field-centric public works teams to be more efficient and connected. Real-time GIS connectivity, drones, operations dashboards, along with lightweight equipment are changing the way operators work in the field.

The biggest game-changer in technology for field crews has been the increase in network accessibility. “Broad network connectivity helps workers become more efficient and no longer need to bring separate devices into the field. At the same time, networks have expanded to provide greater coverage where it wasn’t available before. This enables crews to have connected, real-time access even while in remote.
areas,” says Becky Tamashasky, Executive Vice President of Vision and Product Engineering at Cityworks.

Field mobility solutions have saved a significant amount of time, money, and energy on the part of both field crew and office staff, as workers can return to the office less and communicate with office staff more easily.

Greater connectivity means that software can be taken directly into the field, creating a space for mobile native apps designed with field mobility in mind. “These apps are designed to be easy for users to interact with the functionality, with larger buttons and simplified forms designed for easier touch input,” says Tamashasky. “Native apps also have the ability to go offline in situations where network access is poor or limited and then to sync data when reconnected to the office or cellular network.”

Field mobility solutions have saved a significant amount of time, money, and energy on the part of both field crew and office staff, as workers can return to the office less and communicate with office staff more easily. Operations dashboards can now provide location-aware data visualization and analytics in real-time to an entire team, helping key players and decision-makers stay on the same page and update each other all at once.

“In addition to recording routine activities, frontline professionals can electronically capture asset information, GIS updates, and other pertinent data. This allows agencies to track work performed, augment their registries, and keep their GIS current as part of a paperless process on an enterprise level,” says Kirstin Runberg Platt, Asset Management Administrator for the City of Newport News.

Going paperless adds a new level of efficiency and accuracy to processes as well. “Inevitably, the paper documents need to be reviewed and then entered into a system once delivered to the main office,” says Tamashasky. “This generally has several potential issues as there could inherently be a backlog for entry, meaning that if data was identified as missing during the review, by the time this identification takes place, crews have moved on and the information is lost.” Tasks that previously required several steps and a paper record can now be streamlined into a single process.
In addition to major breakthroughs in field mobility and real-time updates, field crews can expect a number of innovative tools (and ways to use them) on the horizon, including advancements in GIS, drones, artificial intelligence (AI) and machine learning, and virtual and augmented reality (VR and AR).

“GIS remains a staple tool of empowering public works operations, but the scale of operations the technology supports has grown considerably,” says Chris Thomas, Director of Government Markets at ESRI. “GIS now does not stop at the front door. It now goes through the door to support activities such as indoor mapping, facilities management, space planning, navigation, disaster response, and much more.”

Sensors can now be used to provide constant information through the Internet of Things (IoT). “Sensors now take many forms, from air quality and stream gauges to consumer data such as WAZE to autonomous vehicles,” says Thomas. Because these data feeds are location-based, GIS helps to make sense of the information that flows in.

Drones are being combined with high-end mapping and imagery solutions to make data collection and inspections safer, easier, and more affordable. “The data is being used for inspections such as water tanks, roads, and bridges with amazing return on investment,” says Thomas.

Further down the line, public works can expect to see VR and AR used to enhance field data. “As 3-D modeling and indoor mapping continue to evolve, so too will virtual reality,” says Thomas. “It’s anticipated that the future of apps for public works will start to branch into virtual reality,” says Tamashasky. “With apps that are displaying virtual reality scenes, public works crews will have visualization of underground infrastructure before breaking ground. This will likewise enable visualization with systems such as lift stations, pump stations, and transformers where there is a dense collection of assets in a contained area.”

With so many new technologies taking hold, Platt believes that communication between developers and those in the field is more important than ever. “Working closely with the frontline professionals within the various disciplines to understand their needs is critical,” she says. “Communication and collaboration are required and play a major part in the brainstorming process. As a result, apps can be developed, tested, and implemented with buy-in in place.”

**Waste-to-Resource Technology**

For most of the early 21st century, China was the main destination for U.S. recyclables. In 2018, the Chinese government announced the National Sword that banned many scrap materials and stopped accepting others unless they met a contamination rate of 0.5 percent. “To put it in perspective, contamination rates of U.S. recyclables before processing can reach 25 percent or higher,” explains Karen M. Luken, CEO at Economic Environmental Solutions International (EESI).

Many U.S. cities have gone from receiving revenue from their recyclables to paying recycling companies more than $100 per ton. According to the U.S. EPA, the average daily per capita recycling rate in the U.S. is 1.51 pounds per year. Thus, recycling fees for a city with a population of 100,000 could cost almost $2.8 million. “A lot of communities are concerned with the cost of recycling because the markets have disappeared over the last few years,” says Marc Rogoff, Senior Consultant at Geosyntec.

Recently closed Asian recycling markets combined with climbing landfill costs have forced public works officials to look at new and efficient ways of dealing with solid waste domestically. While some technologies are quite familiar, like material recovery facilities, composting sites, and mass burn thermal energy plants, others have been more recently developed, like anaerobic digestion, pyrolysis, gasification, plastic-to-fuel, and other creative ideas.

One creative idea comes from the U.K.-based company, MacRebur. Also known as The Plastic Road Company, MacRebur has developed a way to use waste plastic in asphalt pavements. When CEO Toby McCartney was working in southern India, he noticed people placing waste plastic into potholes and lighting it on fire to fill the hole. While
or incinerator bound) that melt at a temperature lower than 120 degrees Celsius so that it homogenizes properly without creating microplastics or releasing toxins.

Because the plastic additive turns one man’s trash into another man’s treasure, the mix is relatively affordable. “We’re taking a waste and using it to replace an expensive oil,” says McCartney. “And then there’s the obvious maintenance cost savings. From a financial perspective, the roads outperform regular asphalt and therefore don’t require as much maintenance... it’s also environmentally saving. For every ton of bitumen that we replace, we save a ton of carbon emissions. So, there’s this huge savings there with carbon taxes and with carbon footprint that we’re all trying to reduce.”

Since its inception in 2016, MacRebur has helped to produce plastic roads not just in the UK, but internationally. MacRebur has been helping cities close the loop, so to speak, on their waste plastics. Their first U.S. project was on the University of California San Diego campus (after which cities in Texas, Alabama, Florida, and North Carolina soon followed). Manufacturers in the U.S. and across the world now have an MLA (manufacturing license agreement), which allows them to process their local waste and use it in their own roads. MacRebur has completed 14 licenses this year and hopes for 20 next year.

“I think there’s really only one way for businesses to succeed in the future, and that’s to combine purpose with profit,” says McCartney. “I like the businesses that look at taking something from nothing—like a waste—and then use it or recycle it into something that helps clean up the planet or helps do something for other people, but also combine that with profit. I think it’s the way forward really.”

Another solution communities are now looking towards is Waste-to-Energy (WTE) plants. WTE facilities are something Marc Rogoff, Senior Consultant at GeoSyntec, is more than familiar with. He started his career as deputy director for Hillsborough County, Florida, where the county was running out of landfill space. “We were originally trying to implement a new disposal option for the county, and ultimately after three years, we were able to construct a mass-burn waste energy facility in 1985,” says Rogoff.

“Advanced waste-to-resource technologies have the capacity to create high quality commodities that can offset much of the development and operating costs.”
~ Karen Luken, EESI.
over that hump,” says Rogoff. However, the capital costs often pay off in the long run, as landfills require operating costs and long-term care even 30 years after closure. “With WTE plants, you don’t have that. The only difference is you have a lot of capital to build the plant,” says Rogoff. “But they’re relatively efficient and then you’re providing long-term capacity (perhaps over 50 years solution) to the community.”

Rogoff believes the future looks bright for WTE and its possible applications. “I personally think you’re going to see facilities being developed that provide multiple solutions to the community, not only in developing micro-grids that can provide energy for other land uses nearby such as water resources, providing energy supplies for desalination applications,” says Rogoff. “I see the future becoming kind of like an energy park, where WTE can provide the capacity for material that cannot find a home.”

While the model for WTE plants is fairly well established, many waste-to-resource technologies are still in their infancy. “Advanced waste-to-resource technologies have the capacity to create high quality commodities that can offset much of the development and operating costs,” says Karen Luken from EESI. Luken says the four advanced technologies showing the greatest potential for converting municipal waste into a resource are anaerobic digestion, gasification/pyrolysis, plasma arc, and plastics to fuel.

Anaerobic digestion (AD) is a biochemical process that breaks down organic waste (like livestock manure, municipal wastewater solids, food waste, etc.) to produce biogas and digestate. The biogas can be used to generate energy, while the digestate (the undigested solids and liquids that remain) can be land applied or composted to produce a high-quality soil amendment.

Gasification and pyrolysis turn carbon-based waste (like paper, petroleum-based waste plastics, and organic materials) into energy fuels through thermal processes. Gasification breaks down hydrocarbons into a syngas by controlling the amount of oxygen present. Pyrolysis is the thermal degradation of waste in the absence of air to produce char, pyrolysis oil, and syngas. Plasma arc or plasma gasification uses high electrical energy and high temperatures created by an electrical arc gasifier to convert waste into syngas. Plasma arc systems typically use gasification to break down waste, then pass the syngas and ash through a plasma gasifier, which helps achieve maximum conversion efficiency of waste. The resulting syngas can be converted into electricity, thermal energy for direct use, or ethanol as fuel.

Plastics-to-fuel (PTF) processes plastics #2-7 to produce crude oil using variations of gasification or pyrolysis technologies. The plastic is heated in an oxygen-free environment, melted, and vaporized into gas. The gas is then pulled into a central condensing system where it is cooled and condensed into synthetic crude oil. Feedstock impurities are separated out into a char and the synthetic crude oil is transferred to an exterior tank ready for transport to a refinery.

“Some of these technologies require large volumes to be economically viable,” says Luken. “For example, Brightmark Energy has begun constructing the nation’s first commercial-scale plastics-to-fuel plant, which will be located in Ashley, Indiana.” The plant will accept all plastic waste generated for the entire state. “While this concept will definitely present some legal challenges with respect to executing inter-local agreements, it also means that just one facility has the potential to virtually eliminate plastic waste in Indiana,” says Luken.

Luken warns public works officials to carefully vet new technologies before selecting one to replace their traditional recycling program, as the vast majority of them require a homogenous waste stream. “Many of the marketing presentations being delivered to public works directors claim their technology can accept all waste and no separate collection is required. In addition, some presentations claim that the value of the commodity they produce exceeds processing costs and therefore, there will be no cost to the city,” says Luken. “Upon closer review, many of these technologies can only accept a commingled, multi-material waste stream if partnered with a pre-processing facility—a cost that cannot typically be recovered through commodity sales. In addition, some of the commodities produced by these technologies need to compete with the petroleum industry, which is highly volatile.” She recommends that municipalities determine if technology vendors have long-term, off-take agreements that demonstrate guaranteed revenue regardless of the market for fossil fuels.

“The Chinese National Sword has provided an opportunity for U.S. waste to be domestically repurposed into new products and renewable energy rather than contributing to our carbon footprint by shipping our recyclables halfway around the world. This is exciting from both an economic and environmental perspective,” says Karen Luken. This policy decision may be a pivotal moment in our journey to convert waste into a resource. Many experts in the field see it as an opportunity to build better domestic infrastructure of technologies, and to give municipalities greater control over their waste-to-resource destiny.

**What’s next?**

APWA’s Engineering and Technology Committee has created a Trending Technologies Subcommittee. As we head into 2020, the subcommittee will work with APWA’s Technical Committees, Standing Committees, the Council of Chapters, and industry experts to produce new educational programs addressing these trending technologies, including March’s “Talking Top Tech: Starting an AV/CV Pilot Edition.” Be sure to keep an eye out for updates on this and future programs through our website (at www.apwa.net/events), social media channels, and via email.

*Thea Voutiritsas can be reached at (816) 595-5258 or tvoutiritsas@apwa.net.*
Asset Management Committee: Focusing efforts on educational initiatives

Dan Sailer, P.E., Assistant Public Works Director, Town of Castle Rock, Colorado; Chair, APWA Asset Management Committee

The mission of the Asset Management Committee is to support APWA members who operate, improve and maintain public works and infrastructure through advocacy, education, resource development, and member engagement in the field of asset management.

The committee is new to APWA and was developed in order to increase focus in this important area. The committee is in its second year of existence. Prior to committee status, an Asset Management Task Force existed for close to three years. In both forms, volunteer members have been working diligently to begin setting the foundation for advancing the committee’s current mission.

At its core, an asset is anything that provides value, or potential value. In the context of physical infrastructure assets, the value that community stakeholders receive from public works assets can be variable. As such, an organization’s approach to managing these assets to maximize this value with available resources needs to be tailored to their community’s needs. As you learn more about the committee’s activities, this is a central theme that you will continue to see. The activities of an organization that connect to maximizing an asset’s value is the definition of their Asset Management System. When you think more about this definition, nearly everything a public works agency does is part of this system.

The committee is currently focusing efforts on educational initiatives in the area of asset management to begin spreading a common asset management vernacular for all members. Some recent resources that exist on the committee’s web page include:

- Guide to Successful Asset Management System Development
- Infrastructure Report Card templates
- Asset Management Presentation (uploading soon)
- Links to other valuable asset management resources

The committee has developed a Strategic Plan, aligned with APWA’s Strategic Plan, that looks a little further down the road. This plan is in final draft form and is soon to be uploaded to the committee’s web page. Initiatives that are currently active this year include:

- Asset Management Road Map
- Asset Management Dictionary
- Educational video on the fundamentals of Asset Management

For the 2019-2020 year, the Asset Management Committee is chaired by Dan Sailer, P.E., who serves as the Public Works Assistant Director for the Town of Castle Rock, Colorado. Mr. Sailer is joined by the following committee members:

- Toby Rickman, P.E., PWLF, Deputy Director, Pierce County Public Works, Tacoma, Washington
- Russ Barton, Director of Logistics/Asset Management, City of Tuscaloosa, Alabama
- Becky Bonebrake, Senior Civil Engineer, City of Overland Park, Kansas
- Kirstin Platt, Asset Management Administrator, City of Newport News, Virginia
- Greg Chartier, P.Eng., MSC, Infrastructure Management Consultant, Greg Chartier Consulting, Saskatoon, Saskatchewan
- Matt Harper, APWA Education Manager, serves as the committee’s APWA liaison.
- Jim Neal, P.E., PWLF, Public Works Director (retired), Summerville, South Carolina, serves as the APWA Director-at-Large for Asset Management.

Dan Sailer can be reached at (720) 733-2470 or dsailer@crgov.com.
Tools for Engineers

Hesha N. Gamble, P.E., PTOE, County Engineer, County of Greenville, South Carolina, and Chair, APWA Engineering & Technology Committee

With the increase in the use of technology in all areas of public works, the Engineering & Technology (E&T) Committee is committed to encouraging the sharing and application of knowledge about engineering and technology and advancing these practices in public works, pursuing APWA’s mission to develop and support those who plan, build, maintain and improve our communities. The committee sponsors technical sessions at PWX and the Snow Conference each year, provides informative articles in the January issue of the APWA Reporter, sponsors Click, Listen & Learns and webinars, and produces other useful material dedicated to these topics.

The E&T Committee has officially established the Trending Technologies Subcommittee, which will help select and produce content related to the five chosen topics each year. This newly created subcommittee will consist of one representative from each Technical Committee, as well as the International Affairs Committee, Center for Sustainability, Small Cities/Rural Communities Committee, Young Professionals Committee, and Professional Development Committee. This will allow for more information to be provided to agencies on these very important topics each year.

This year, the Engineering & Technology Committee is working on a Toolbox for Engineers!

This year, the committee has officially established the Engineering & Technology Knowledge Team! This will allow for those who are interested in and have expertise in various engineering and technology topics to contribute their knowledge in the development of materials to benefit our members. If you are interested in joining the Knowledge Team, check out the expectations here: http://bit.ly/ET-Knowledge-Team-Expectations and please contact Rita Cassida at rcassida@apwa.net to express your interest.

This year, the Engineering & Technology Committee is working on a Toolbox for Engineers that is introduced in this issue of the Reporter. We hope that this information will help young engineers and technicians, or those who are new to their position in the field or in the office. We plan to develop and begin to roll out this toolbox in the coming months, so stay tuned, and send us your topic ideas!
As the committee looks to the future, it is their hope to serve as a resource to chapters and members. With a diverse committee makeup which includes representation from the public and private sectors, it is the mission of the committee to serve the needs of members.

The current members of the Engineering & Technology Technical Committee are:

- Ms. Hesha Gamble, P.E., PTOE, County Engineer, County of Greenville, SC
- Mr. Robert Valenzuela, P.E., CFM, Director of Public Works, City of Sugar Land, TX
- Mr. Gregory M. Baird, MPA, President, Water Finance Research Foundation, Provo, UT
- Mr. Michael Holder, VP Transportation Services, Gannett Fleming, Inc, Raleigh, NC
- Dr. Saidur Rahman, P.Eng., Ph.D., Senior Engineer, Bridges, Structures and Expressways, Engineering & Construction Services, City of Toronto, Ontario

- Mr. Gary Strack, P.E., Vice President, Anderson Engineering, Kansas City, MO
- Mr. James R. Neal, P.E., PWLF, Summerville, SC, APWA Technical Director
- Ms. Rita Cassida, P.E., Education Manager, APWA Kansas City Office, Staff Liaison

Hesha Gamble can be reached at (864) 467-4612 or hgamble@greenvillecounty.org.

We hope that the Toolbox will help young engineers and technicians, or those who are new to their position in the field or in the office.
Who We Are
The Public Works Department in Atoka, Tennessee, prides itself on our customer service. In fact, we strive to be so good at what we do that our citizens are a bit spoiled. Here in Atoka, we do everything with a “Making Life Flow” mentality. Much like water flows, sewer flows, stormwater flows, and even traffic flows, we want the lives of our citizens and visitors to flow seamlessly. Often, public works employees and the jobs we do are taken for granted by the people we serve. I choose to see it as a good thing. If we are doing our jobs correctly, the people we serve can go without any inconvenience to their daily lives. With all the different directions that families are pulled in, worrying about clean water, functioning sewer, and smooth streets should be the least of their worries. In January 2019, USA Today recognized Atoka as the best place to live in Tennessee.

For many years, the town operated out of a building that was built to serve a population of 1,000. In just a few short years, we grew to around 10,000 and it was time to look at the present and future needs. We learned that FEMA was funding safe rooms in the region, so we decided to seize the opportunity. We brought an idea to FEMA to combine daily functions with a safe room, and that is how it started. We were approved for a grant of $1.1 million and, with help from the Fisher and Arnold firm, we designed the large complex here which cost roughly $5 million.

What We’ve Designed
The front admin suite is a normal steel constructed building with special energy-saving designs. The front admin
suite ties into our board room and police station. We had to consider the number of people that the safe room had to accommodate during a weather emergency. The board room and most of the police station will accommodate 1,200 people during a weather event. The Atoka elementary school down the road also has a safe room. The roof is eight inches of solid concrete and steel with walls that are two feet thick composed of the same materials. Every doorway is recessed and has solid walls protecting them, and the few windows in the building are made to withstand an F5 tornado. This facility is smart and energy efficient. It knows when someone is in the room and it turns the lights on. It also brings the room to a preset temperature comfortable to the occupant. All the lighting is LED.

We moved the public works shop to a location south of here in an industrial-zoned area. The new public works building has 13,000 square feet of climate-controlled shop and office space and roughly two acres of fenced-in yard.

When we built this complex, we wanted to be able to use all the new technologies available to make work more efficient. Having only seven employees in the field for public works to handle operations of water, sewer, stormwater, and streets in a town this size, we need all the help we can get. Every field employee has an iPad equipped with all troubleshooting documents and our GIS database. We use an electronic work order system to efficiently track and appropriate all our work. The employees can take pictures of issues they see and the work done. On top of this, all our vehicles and equipment have GPS tracking, which allows us to see the movements of our assets and keep track of mechanical and service issues. It alerts us to any mechanical problems before the driver even knows. It also lets us know when it’s time to service the asset.

Where We’re Heading
All our water meters, water tower, master meters, and sewer lift stations have radio read or SCADA capabilities. I can control our water and sewer with the phone in my hand. This is password protected and only accessible to certain people. We have also developed an app for the citizens to download. They can do nearly anything on the app that they could do at town hall. By using these technologies, it helps Atoka to have one of the lowest tax rates around, which allows us to plan larger projects. We are in the final design stages of one of the first rural roundabouts in the region. We are also in the planning phase of a new water treatment facility for the town.

Daniel Lovett is the Director of Public Works, Director of the Atoka Utility Department, and GIS Manager for the Town of Atoka, Tennessee. He can be reached at (901) 837-5327 or DLovett@TownofAtoka.com.

International Perspective
Finland has undertaken a major municipal technology service digitalization project. The project aims at streamlining service processes and providing residents with information openly. The fact that each of the roughly 320 municipalities in Finland is developing applications for themselves poses a social challenge, when we could pool our resources together and possibly make better applications for less money. This is a global issue, and the bill for this inefficiency is footed by the taxpayers.

Cities in the Helsinki region have been adding their data to the open interface since 2011. The interface is available at www.hri.fi. Thus far, the open data has been used to collectively build 244 applications to help residents, and there will be more. I hope that you the readers are able to take the time to learn more about the finished applications!

– contributed by Ville Alatypio, M.Sc., eMBA, D.Sc. Cand., Lean Six Sigma, Director, Street & Park Maintenance Unit, Helsinki City Construction Services Stara, City of Helsinki, Finland; Chair, Finnish Association of Municipal Engineering
Does this quote sound familiar? “[...] Plans are an essential management tool which bring together all related business processes and stakeholders, internal and external, to achieve a common understanding and commitment to improve performance. It is a tactical-level document which focuses its analysis, options development, programs, delivery mechanisms, and reporting mechanisms on ensuring that strategic objectives are achieved.” (emphasis added)

You may recognize this from federal language taken from the U.S. Department of Transportation Federal Highway Administration Asset Management website for Transportation Asset Management Plans (TAMP) (https://www.fhwa.dot.gov/asset/plans.cfm). This requirement for each state to develop a risk-based TAMP for the National Highway System is intended to improve or preserve the system’s physical assets’ condition. Each state’s TAMP plan establishes a method to manage physical infrastructure assets over time to achieve agreed levels of service and performance targets in a planned and cost-effective way.

Here’s a thought to ponder though... Why wouldn’t our most important assets—employees who deliver the products and services to program, scope, design, construct, maintain, operate and manage the infrastructure assets and their workplaces—deserve such a thoughtful and thorough approach? Pursued with a clear and structured plan to ensure that we achieve inclusive workplaces with skilled and productive employees who reflect the diversity of our communities?

You often hear well-respected professionals in our industry refer to employees as critical assets. Do we actively treat employees and the environments that they work within as critical assets in a planned and focused manner? Are you developing both yourself and your employees as the keys to current and future success? The presence and application of a comprehensive documented plan with goals, measures, and targets would be the true test of commitment to our employees’ success.
most critical assets. Such an approach would also be the most effective method to attract and retain a diverse workforce working within engaging and inclusive work environments. The methods of infrastructure asset management have worked well for our public works assets, so apply some of those concepts to our critical employee and work environment assets.

There are distinct components to a complete asset management plan. Each can be viewed through a diversity and inclusivity lens with the goal to attract, develop and retain a skilled diverse workforce which works within a productive, safe, and inclusive work environment that fully engages them. Listed below are questions for you to consider for your workplace and employees as you consider how you might develop an employee and workplace asset management plan.

**Inventory and Condition**
- Instead of quantifying the physical characteristics of bridges and roads, can you identify the diversity of your workforce?
- Have you completed any workplace environment surveys or culture studies to understand how employees judge workplace culture, environment, supervision/management, programs, etc.?

**Objectives and Measures**
- Have you discussed within your organization what objectives you wish to pursue for diversity across the organization? Do you wish to reflect your community?
- If you do not have climate study data for your work environments, what other methods can you pursue to identify and quantify the attributes of your desired work environment? How would you then set an improvement objective with measures and a target? Establish an improvement plan?

**Performance Gap Identification**
- This gap between what we know we have and what we wish to achieve would show up as identifying, for example, the gap between the diversity of a current workforce as compared to the diversity of the community in which they exist. Can you identify this?
- Can you identify the gap between the cultural competency your business needs to be successful with what levels of cultural competency your employees have? Do you have any plan for cultural competency improvement? Unconscious bias awareness?
Lifecycle Cost and Planning

• Instead of identifying the refurbishment cycle for an infrastructure asset, can you identify the career path opportunities for positions within your organization such that employees understand possible options and the knowledge, skills, abilities and experiences needed to achieve progression?

• Does your organization have a continuing education reimbursement program or a technical/professional organization membership policy to support employees’ development? Are decisions made surrounding these transparent and equitable?

• Are you identifying the skills—both technical and leadership—needed when key employees retire? When frontline employees retire? Do you have a good idea of when a wave of retirements may occur such that you can adequately plan for long-term recruitment?

Risk Management Analysis

• One of the most cost-effective risk mitigation methods for physical assets is a good inspection program, so have you reviewed your performance evaluation processes and ensured that they are equitable, completed in a regular cycle, completed in a transparent manner, and that substantive evaluation discussions occur with all employees that include discussion of development opportunities?

• What risks would your company or agency experience with the loss of talent and diverse perspectives and experiences? Do you have a plan to address any of those consequences?

• What risks would your workplace have from a productivity or legal standpoint if you do not have well-established and consistently-applied methods for workplace conflict resolution? How about identification and resolution of behaviors intended to exclude employees or be overtly or covertly hostile toward them?

Financial Plan

• Instead of forecasting the financial needs of maintaining an infrastructure asset, given what you gather and analyze regarding anticipated retirements and desired recruitment, can you forecast recruitment costs and new employee training costs?

Investment Strategies

• What other agencies or nonprofits could you partner with to expand your reach and resources into communities under-represented in your workforce to create a path for employment?

Work through what you know, what you can pursue and what you hope to accomplish.

• Have you considered mentorship programs for potential future employees to connect them with your jobs and support their development?

• Can you manage some of the recruitment and new employee training costs through integrated internal train-the-trainer development that also provides current employees development opportunities?

Improvement Plans

• How are you ensuring that equitable opportunities exist across all employees for training and experiences? How do you develop a diverse group of potential applicants for promotions and transfers?

• Have you reviewed your hiring practices to ensure that inequity is eliminated in processes or requirements and unnecessary barriers are eliminated?

• Do you ensure that interview panels include diverse perspectives and have transparent methods for evaluation?

• What support systems do you have in place, such as employee resource networks, to support employees who are not in the majority or who are non-traditional?

There are many more plan strategies than can be contained in this article and they need to be developed specific to your community, your workplace, and your individual situation.

Most importantly, just as with infrastructure asset management, make and document a plan. Work through what you know, what you can pursue and what you hope to accomplish. Ensure you document collection of the basic data, developing your options, planning efforts and programs, how you will deliver those efforts and programs and how, when, and to whom you will report on them. Clearly articulate your goals, measures and targets so you can hold yourself accountable and keep focused.

Remember, as identified by Sue Desmond-Hellmann, head of the Bill & Melinda Gates Foundation, “Most people overestimate what they accomplish in one year, but underestimate what they can accomplish in 10 years.” Developing and following a plan—even one that is not perfect in every way and requires adjustments for realities encountered—is the best method to reach goals that otherwise seem too large to conquer. The goals for our employees and our workplaces are critically important and deserve the best we have to offer.

Beverly A.B. Farraher can be reached at (651) 266-9820 or beverly.farraher@ci.stpaul.mn.us.
On November 14-15, the Executive Leadership Group (ELG) for Traffic Incident Management (TIM), of which APWA is a member, held its third Transportation and Public Safety Summit in Washington, D.C. Representing APWA were ELG TIM members Harry Weed, APWA New York Metro Chapter member and former APWA National Board Member, and APWA Director of Government and Public Affairs Andrea Eales. APWA Executive Director Scott Grayson also participated on behalf of APWA to show executive support for the efforts of the ELG TIM.

The summit focused on expanding partnerships in TIM to continue improving coordination among national responder groups representing emergency professionals (police, fire, EMS, towing, and public works) who are responsible for responding to traffic crashes. The ELG TIM is supported by the Federal Highway Administration (FHWA).

TIM is defined by FHWA as “the planned and coordinated multi-disciplinary process to detect, respond to, and clear traffic incidents so that traffic flow may be restored as safely and quickly as possible.” In January 2015, APWA joined the ELG for TIM and since has provided trainings for APWA members during PWX and Snow Conferences.

During the summit, several members of U.S. Department of Transportation (DOT) leadership stopped by to show their support for TIM efforts, including U.S. DOT Secretary Elaine Chao and FHWA Administrator Nicole Nason. U.S. Representative John Rutherford (R-FL), who served as a Sheriff prior to being elected to Congress, was the keynote speaker for the summit luncheon. During the summit, Andrea Eales moderated a discussion panel of local elected officials and policy experts titled, “Partnership Opportunities Closer to Home,” and Harry Weed spoke on behalf of APWA’s membership during a rapid-fire panel to kick off the summit.

The event closed with the signing of a proclamation recognizing National Traffic Incident Response Awareness Week, which was November 10-16.

For questions specific to APWA’s involvement in TIM, please contact Andrea Eales at aeales@apwa.net.
Listed in this index are all articles published in the 12 issues of the APWA Reporter during 2019. They are categorized by subject, with subject headings in alphabetical order. All of the articles can be found on the APWA Reporter web page at www.apwa.net/Resources/Reporter.

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A Blended Solution.

The new KWSA80K and KWSA50K push-to-talk over cellular phones expand and enhance the capabilities of KENWOOD’s family of land mobile radios, taking your communications network to the next level. Built on our legacy of quality engineering and innovation, these ruggedized phones feature renowned audio quality, 3G/4G LTE and Wi-Fi. Connectivity and durability, where and when you need it the most.
While the news coverage of Washington has been dominated by multiple non-legislative issues, there are still rumbles of work being done in the Capitol City. Work that will have an impact on public works across the country.

Both Congress and federal agencies have been diligently toiling to put in place laws and regulations related to water resources. APWA has been tracking these movements and working with the appropriate agencies and Congressional offices to ensure that the perspective of public works is heard loud and clear.

To that end, in November, APWA, along with the House Public Works and Infrastructure Caucus, held a briefing on Capitol Hill entitled, “Water Issues and Public Works: A Discussion on Water Infrastructure, Regulatory Issues, and Emerging Contaminants.” The briefing was held in the Rayburn House Office Building, and attended by roughly 40 Congressional staffers, Agency employees, and private sector representatives.

The event was headlined by a panel of APWA experts, including APWA President Bill Spearman, APWA Water Resources Management Committee Chair Barry Sheff, and APWA Water Resources Management Committee member Evan Pratt. APWA Executive Director Scott Grayson moderated the event.

As readers were not present for the briefing, I’ll provide a summary of the issues covered that day and try to provide some outlook on where they will go in the coming months.

Clean Water SRF Reauthorization

In late October, the House Transportation and Infrastructure Committee unanimously passed H.R. 1497, the Water Quality Protection and Job Creation Act of 2019. The bipartisan legislation would increase the Clean Water State Revolving Fund (CWSRF) program’s authorization level to $14 billion over the next five years, giving communities greater ability to meet their needs to protect public health and the environment.

In addition to the increased funding, the legislation would allow for extended permitting for certain municipal dis-
chargers under the National Pollutant Discharge Elimination Program (NPDES), include funding set-asides for rural and small communities, water workforce development programs, and programs related to water affordability. Funding to help communities with combined sewer systems deal with releases of sewage during heavy rain events would also be included.

All these elements are beneficial to public works and would provide valuable federal resources to communities across the country. As such, APWA issued a letter of support for the legislation in October and is working with Congressional staff to get the bill to the House floor for a vote.

Such action might not take place soon. The most likely path forward for this legislation is in the Water Resources Development Act (WRDA) legislation that both the House and Senate are working on. WRDA is legislation passed every two years to authorize U.S. Army Corps of Engineers projects related to water resources. In recent years the bill has served as the vehicle for legislation related to drinking water, wastewater, and stormwater.

Due to the bipartisan support for H.R. 1497, it is likely that the language from that bill will be included in the larger WRDA package, which will likely be considered by the House in the summer.

Waters of the United States
In October, the Trump Administration issued the final rule repealing the 2015 “Waters of the United States” (WOTUS) rule; that rule is expected to be in effect by the time you read this article.

The 2015 rule was implemented by the Obama Administration and had been blocked by courts in 27 states, while being in effect in 22 states. The new rule will put all 50 states back under regulations that had been in place since 1986 which was interpreted by guidance written by the Bush Administration in 2008.

The Trump Administration has been working to align federal water regulations with the views of late Supreme Court Justice Antonin Scalia. Scalia argued that the Clean Water Act (CWA) only applied to waterways with “relatively permanent” surface water connections to navigable waters. The two previous administrations based their regulations on an opinion from former Justice Anthony Kennedy, stating that CWA regulations apply to waters with a “significant nexus” to navigable waters. Such a nexus could include chemical, biological, or hydrological connections. The final rule will eliminate protections for streams that flow only after rainfall or snowmelt, and protections for wetlands without surface water connections to larger waterways will also be removed.

Like the 2015 rule, the new final rule will end up in the courts. The day the new final rule was announced 11 groups, including the National Wildlife Federation and the Natural Resources Defense Council, filed a suit in the U.S. District Court for the District of South Carolina. In a separate case a lawsuit was filed on behalf of the New Mexico Cattle Growers’ Association.

While no comments are being accepted on the new final rule, APWA did submit comments during the comment period for the previous iteration of the rule, which are still valid. In three key areas, the new proposed rule could do serious harm to public works professionals and programs:

- Continued permitting uncertainty (what are the obligations of the water provider);
- Assumptions regarding cooperative federalism (will states have the will and the way to provide protections for now unprotected waters?); and
- Additional costs for water providers and water customers (what are the financial burdens that unprotected waters will have on the system?).

With the courts now involved, it is likely that a resolution to the regulation will be a long time coming. And with 2020 being an election year, there could very well be a new administration that issues a completely new WOTUS rule. Stay tuned.

Lead and Copper Rule Revisions
An additional regulatory development is the release of the Environmental Protection Agency’s (EPA) revised Lead and Copper Rule (LCR). The revisions are the first major overhaul to the LCR since its inception in 1991.

After the lead contamination crises in Flint, Mich., and more recent events in Newark, N.J., EPA released the LCR revisions and focused on six key areas. First, communities are now required to prepare and update a publicly available inventory of lead service lines in order to identify the areas most impacted by lead. Second, community water systems are now required to use corrosion control treatment to prevent spikes in lead levels. Third, water systems will now be required to replace the public portion of a lead service line when a customer chooses to replace their portion of
the same line. Fourth, water systems will be following new sampling procedures to better target locations with high lead levels and get more accurate samples. Fifth, customers will receive clearer communications from water providers, which will be required to notify customers within 24 hours if a sample collected in their home is above the lead action level. Finally, water systems will be required to take drinking water samples from schools and childcare facilities served by the system.

While all of these are laudable goals, and all of them were part of the comments submitted by APWA in developing the new rule, there is a legitimate question of how to pay for these additional requirements. Community water systems, like all public works providers, work on tight budgets, and meeting these requirements might mean those systems have to choose between additional lead remediation or other treatments and infrastructure investment.

EPA has said that they encourage states and cities to leverage existing federal resources to meet the new proposed LCR mandates, including the Drinking Water State Revolving Fund (DWSRF) program, grant programs created in the Water Infrastructure Improvements for the Nation Act in 2016, the Water Infrastructure Finance and Innovation Act (WIFIA) program, and the Department of Housing and Urban Development’s Community Development Block Grant (CDBG) program.

While all these programs are effective tools at investing in water infrastructure, they do not provide nearly enough resources to communities to meet the existing need. As such, APWA has submitted additional comments to EPA. These comments focus not only on how to fund and finance communities to meet the new requirements, but also on how to craft the regulation to ensure that communities are best able to stay in compliance and meet their obligations to consumers.

The final proposed rule is to be expected sometime in 2020. As always, APWA will continue working with all parties to represent the interests of public works.

Overall, the fall of 2019 was a busy season for the water sector. The items you just read about are just the things on the surface, and, like an iceberg, there is always more underneath.

Sean Garcia can be reached at (202) 218-6734 or sgarcia@apwa.net.
APWA's DIY-Public WorksShop Kits provide our chapters and agencies with high-quality, professional, and comprehensive materials for face-to-face education programs. DIY Kits provide you with everything you need to host a program, minus the facilitator.

DIY-Public WorksShop Kits Include:
- Facilitator Guide
- Participant Guide
- PowerPoint Slides*
- Information on how to offer CEUs for the program
- CEU Workshop Forms
- Marketing Resources
- Session Evaluation Template

* Program materials vary by Kit.

Current DIY-Public WorksShop Kits Available:

**DIY Ethics for Professionals**
This course is designed for individuals interested in exploring ethics, as it applies personally and professionally. This course provides practical advice on ethics and emphasizes the importance of ethical behavior in personal and professional interactions. It provides real-world examples, as well as advice in dealing with the non-technical aspects of our profession.

**DIY Math 101: Calculating Concrete & Asphalt**
This course is designed for individuals looking to brush up on their math skills. It provides in-depth instruction and hands-on training for calculating volume and area as needed to determine the amount of concrete or asphalt needed to pave a given area (such as a driveway or parking lot).

For more information, visit [www.apwa.net/DIYKits](http://www.apwa.net/DIYKits) or email lms@apwa.net
Welcome to 2020, the start of a new decade that will bring about even more technological change for all of us in public works. The pace of technological discovery and improvement seems to increase daily; with it comes amazing new ways for us to work, but also great expectations from our customers.

Consider the iPhone. The 3G’s, released in 2009, had a screen size of 3.5 inches (89 mm), weighed 4.8 ounces (135 g), and had a 3 Megapixel camera that shot VGA (480p) video at 30 frames per second. It didn’t have Touch ID, let alone Face ID. The iPhone 11 pro, released in 2019, has a screen size of 5.85 inches (149 mm), weighs 6.6 ounces (188 g), three 12 Megapixel lenses capable of shooting video in 4k, and uses Face ID for log-in. In the span of 10 years, a simple hand-held device has transformed from a phone with a small camera to a biometric-enabled computer capable of shooting full-length movies.

The smart phone in general is one example of the drastic technological change that has come to public works in the past decade, and it will continue to shape our future. In 2009, few public works agencies were just beginning to see the potential of data and how smart phone users could impact customer service and interaction. Now, as we start the 2020s, smart phone users can use apps to send data requests, comments, and complaints directly to public works customer service representatives, enabling near real-time responses to issues small and large.

Unfortunately, the same technology that helps us can also hamper us. The same customers that know how to submit real-time comments to public works agencies also know how to track their submissions and they are constantly vigilant about their concerns.

Data-based Advocacy

Paul Ryckbost, AICP, P.E., Senior Consultant, Guernsey, Oklahoma City, Oklahoma, and member, APWA Government Affairs Committee

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Unfortunately, the same technology that helps us can also hamper us. The same customers that know how to submit real-time comments to public works agencies also know how to track their submissions and they are constantly vigilant about their concerns.
Potholes that aren’t filled immediately, broken streetlights that aren’t fixed, and hidden or missing traffic signs that aren’t replaced are noted by the public. This all creates additional headaches for leadership and can diminish the positive value that technology brings with it. Public works leaders can be disheartened by the constant barrage of complaints, even when they, and their staff, are working diligently, day-in and day-out, on items across their jurisdictions.

Disheartening as these data-driven customers may be, solutions exist that may satiate them! The use of data dashboards can be a powerful way to advocate for public works, telling winning stories—those of need, and those of future improvement. Data dashboards take critical databases and information and present them in visual formats that make the sometimes mind-boggling size of public works operations easier to understand, and also make people aware that their one concern is part of a holistic operation that is there to support the quality of life for all customers.

Let’s look at a couple of great examples from public works agencies in the U.S.

The Virginia Department of Transportation operates a clean, visually engrossing dashboard that highlights various traffic metrics, including safety, road surface condition, and finance. Befitting a transportation agency, each metric is displayed as though they were on a literal vehicle dashboard. The metrics are updated daily, and each category is available for download if anyone wants to investigate the details. (See dashboard image on p. 36.)

A different kind of dashboard is related to real-time mapping, something many snowfighting agencies are taking to heart. The Michigan Department of Transportation uses real-time mapping to highlight where its plows are, and often the plows are equipped with cameras, able to show Michiganders and visitors real-time road conditions and note that plows are working hard. The Mi Drive mapping also provides updates on real-time road conditions (green to red), construction projects, and access to its numerous traffic cameras, among other items. These types of real-time transportation maps are great tools for advocacy in that they provide visual confirmation that public works agencies are actively working for the public. (See dashboard image at top of page.)

Data dashboards aren’t just for state agencies—while states may have bigger budgets, smaller public works agencies can still capture and present data effectively. The City of Johns Creek, Georgia, houses a large variety of city-wide data on its website, and its public works-specific dashboard tells its customers all about the work being done in the city. The data is presented in multiple formats, highlighting areas of the city where work has been common and noting the amount of work via charts. (See dashboard image at right.)

Creating a dashboard takes two important things: metrics and data. If you’re interested in creating a dashboard for use in reporting to your customers and advocating for public works, you’ll need to start with an understanding of what you want to report and use for advocacy. If you have a strategic plan for your agency, you likely have metrics, goals, and/or objectives which would be a good starting point. Do you want to measure safety? Do you want to measure potholes? Do you want to measure water system breaks (or lack thereof)?

Once you understand the items you want to present and the metrics you’ll be measuring against, you’ll need the data. Multiple methods exist for compiling and presenting data, so you and your agency will have many options if you proceed down this road.

Data and the data revolution are powerful tools for advocacy if we take the time and effort to present them. Data can highlight where budgets need to be adjusted, data can indicate the effectiveness of programs, and data can provide customers with real-time information about conditions in their area.

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Imagine you’ve just exited a rough meeting detailing all the issues that arose with a new project, when suddenly you receive an email requesting an interview. What should you, a public works professional inexperienced in media relations, do?

This scenario is a common one, and unfortunately many public works professionals may feel unprepared or uncomfortable to some degree when faced with an interview request. Some may be nervous and view it as a potential smear against their work, but this line of thinking can ultimately be harmful to you and your organization. It is important to see interviews as an opportunity to enlighten the community on a particular issue and about public works. Engaging in interviews requires extensive forethought and planning, but a quality interview can increase public awareness and understanding of the issues that affect your work and your community.

The following is an introductory guide to ensuring you are never unprepared for an unexpected interview or request for comment.

**Step One: Before the Request**

Prior to responding to an interview request, first consider the following tips for a successful interview. These measures are the most fundamental: knowing yourself and your message to the very last detail. As a public works professional, it is assumed that you have a thorough understanding of the project or work you are being interviewed about; but applying that knowledge in an interview setting necessitates a unique use of your expertise.
I would recommend, if possible, that you only agree to an interview request if you truly want to participate in it, know what you want to say, know what you wish to accomplish, and know what you stand to benefit by accepting. I would also suggest that PW professionals in departments with a Public Affairs Officer (PAO) or Public Information Officer (PIO) consult with them, and that the PW professional get to know their department’s communications team.

Try not to accept “cold calls” as more often than not this can lead to uncertain or unsatisfactory results that will render all your preparation for a moment like this useless. If a reporter attempts to conduct a cold call interview with you, respectfully request their questions in writing and provide them with a deadline of when you will respond. Of course, this is not always possible, but is certainly preferred.

You should also consider getting to know your local reporters before a disaster or problem arises. This builds a foundation of trust, and they are more likely to consider your viewpoint if they know you and know that you provide them with facts.

Before moving on to the pre-screening, it is arguably most important to remember that absolutely nothing is “off the record.” Just because you or the interviewer said those words does not mean they hold any weight. You must be prepared for anything you say to a journalist to be used in their publications, and as such should only speak to them about issues you and your organization are 100% sure are correct and should be in the public domain. Now, building trust and rapport with your local reporters is a good way to circumvent “on the record” vs. “off the record,” but you should never rely on it to shield you from the repercussions of divulging information unrelated to the agreed-upon topic.

**Step Two: Pre-screening**

To best prepare for the type of information you may need to give or questions an interviewer may ask, consume publications from news organizations which you believe may one day contact you for an interview. Even if those specific organizations never do come calling, it is good practice to be knowledgeable of industry-related publications, and it may even aid you in future interviews.

You may not always be able to receive the interviewer’s questions prior to the actual interview. Instead, the interviewer will inform you of the general topic or issue they would like to discuss, thereby allowing you to help carve the story into one you design. The blueprint for any successful interview is to analyze, communicate, and adhere to your message through three to five elements that you incorporate into your answers.

**Step Three: The Interview**

After successfully completing the first two steps, participating in the interview itself should be the easiest part. Much like planning for a public works project, the amount of time and care that go into your preparations have a direct effect on the quality of the product. If you have successfully prepared for the interview, you will be able to stay on track and clearly state your key talking points.

If the interviewer attempts to steer the questions toward an area that you believe to be outside your realm of expertise (or may compromise you or your organization in any way), it is perfectly acceptable (even encouraged) to answer with a simple “I don’t know.” It is ALWAYS better to not answer, rather than offer information that may land you in hot water if it were to be deemed incorrect or not appropriate for public knowledge.

Lastly, you must confirm that you are explaining and highlighting all your points in a clear, easily digestible manner. It does not benefit you nor the interviewer to go through an entire interview process only to discover in the official released publication that the interviewer incorrectly described one or more of your elements. To prevent this, you may request the interviewer read your statements back to you or to receive a draft copy of the publication prior to the official release, but you should always be conscious of the fact that not all interviewers will grant this request.

**Step 4: After the Interview**

Often, interviews will come to a natural close once an interviewer has asked all their questions. However, this is not the end of your interview process. There is still one crucial last step to complete before mentally moving on: the follow-up. This can be done at any time, whether it be immediately after the interview, a week later, or even right before the article is published (though I wouldn’t recommend this). Examining an interview is comprised of two distinct parts, a self-evaluation and an interview-evaluation.

When conducting a self-evaluation, it is important to always remember to record the interviewer’s contact information. This procedure will enable you to quickly and efficiently contact the interviewer should an issue arise. To evaluate an interview, consider the aspects that affect you and your organization most, such as confirming the accuracy of quotes or clarifying your organization’s position. Lastly, it is good practice to ask an interviewer if you will be able to read a copy of the publication before it is released.

As a PW professional, you are the source of the knowledge that interviewers are attempting to disseminate, and as such it will always be your decision on what, when, and how to communicate it to them. It is my hope that through this road map, fielding an unexpected request for an interview will not be approached as a daunting task, but rather as an opportunity to promote your work and community.

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As an agent of public works who oversees the road projects in my municipality, I am constantly faced with questions from residents and elected officials regarding a lot of the decisions that I have to make regarding our roads. Why did we fix this road, when their road is in much worse shape? Why can’t we fix more roads? Where are my tax dollars going to in the city? What will the roads look like in 5 or 10 years? I would like to do a project in my area, so what can you do to help me with that?

It got overwhelming at times, and I was taking time away from managing projects to address these issues (many times it was the same questions being asked by multiple residents). So, I began to look at different ways that we could address the situation. One of the ways that I found to be very promising was the concept of a City Pavement Manual. It is a document that explains the rationale behind decisions that are made each year. It could be a way for the city staff to increase transparency behind our decisions for the residents and elected officials, while also serving to answer many of the common questions that come up during projects. If we could pull it off, it seemed like a win for everyone.

So, like any good academic, I followed the mantra of “stealing from one is plagiarism, stealing from many is research,” and began to look for any example of something even remotely close to this concept that I could find. I looked at what other municipalities had done which was similar to what I was trying to do and took the best practices that I thought would be applicable to my situation. I gathered the potential sources of information that the City had available and determined the areas of focus for the document. In the end, I decided on six specific areas for the Pavement Manual:

- **Pavement Management System Strategy:** A general overview and description of pavement management and the benefits of implementing a system for this task.
- **Pavement Management Process:** An overview of the three steps we take with our PMP, which includes System Configuration, Field Data Collection, and Data Analysis, Reporting and Planning.
- **Municipal Pavement Summary:** An overview of the municipal pavement and relevant characteristics, like age distribution, total number of lane miles, concrete vs. asphalt percentage, etc.
- **Annual Maintenance Program Summary:** An overview of the accomplishments in the Annual Maintenance Programs which were conducted during the past calendar year.
- **Future Considerations for Pavement Management:** An overview of street ratings for the entire city, and explains the rationale behind decisions that are made each year.
of the projected future funds for Annual Maintenance Programs, upcoming capital projects, projections for the estimated costs to meet strategic goals, etc.

• **Street Ratings:** An alphabetical list of every street section in the city, by ward, and the corresponding PCI rating for that street section.

Once this document was finalized, I made a presentation to the City Council regarding how to use the document when dealing with residents, and it was placed on the City website so that any resident could use it as a reference. Typically, when we would receive calls about road or road-related decisions, we refer the residents to the Pavement Manual listed on the website as the information contained therein would answer their questions.

Updating and maintenance of the document is performed by simply scheduling a week of time each year towards the task. Obviously, the creation of a 100+ page document, from scratch, is a pretty daunting task, and it did take a significant amount of time to generate the initial Pavement Manual. However, in the succeeding years, producing an update is typically done with some small tweaks and project data updates. Efficiency in updating will increase each year. In addition, by updating the Manual through several iterations, forms have been developed so that information can be easily parsed and inserted into the Manual from different departments. This makes things much easier and consistent.

Lastly, a typical timeline for the Pavement Manual has been established, so in general, personnel know what data is needed and when it should be provided. As always, communication is paramount.


Ultimately, the time spent in the creation and updating/maintenance of this document has been a success for the City and the Engineering Department. We have seen reductions in the number of calls from both residents and elected officials, and we feel that has become a resource for individuals in the community. It allows us to be more transparent and more efficient with our time and resources. It can take any shape that would be beneficial to your community, and there are always new things to add each year, if so inclined. I would recommend this practice to any public works or engineering departments that may be experiencing similar issues.

**Dr. Anthony Friedman was a member of Class XII Emerging Leaders Academy, graduating in 2019. He can be reached at (636) 379-5492 or tfriedman@ofallon.mo.us.**

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Operating a plow during a winter storm is a difficult and sometimes dangerous task. The plow driver has to be out on the roads when visibility is poor and road conditions are bad, so that he or she can make those road conditions safe. And if that were not enough of a challenge to face, the working conditions in a snowplow are less than ideal.

It is becoming clear that a sedentary workspace is not a particularly healthy one, but a snowplow cab is of necessity sedentary. The operator is sat behind the wheel, often for many hours. Additionally, they are beset by the noise and vibration of the snowplow itself, which can be substantial and is certainly fatiguing. When they take a break, they may well grab the nearest available food that is unlikely to be noted for its healthiness, which of course may also negatively impact their health over time.

But wait, there’s more! Operators often have to work unusual shift patterns (a couple of night shifts, then two day shifts, and so on), and in the last few winters we have had areas of the country where the winter has been remorseless, requiring operators to work 30, 40, or even 50 or more days in a row, with no rest and recovery period in sight.

So, it is reasonable to ask if there are any practices out there that minimize the impacts of unusual shift patterns, a tough work environment, and less than ideal food. And while there is not going to be a simple cure to this, there are a number of ideas and approaches in use that can help in this regard.

One example of dealing with the issue of shift difficulties has been developed in Alaska, where Dan Schacher (our Winter Maintenance Subcommittee chair) has worked with his crews (he is based out of Fairbanks, Alaska, so they have long winters to deal with) to create a shift process that minimizes the negative impacts of night shifts.

Up in Alaska for the most part they have to provide winter maintenance on a 24/7 basis, which means all their operations staff are going to be doing some night shift work. Their first step was to split the winter into two—and their staff as well. Half of the staff works nights in the first half of the winter, and then works days. The other half starts the winter working days, then works nights. This avoids (or at least

Staying healthy during winter operations

Wilfrid Nixon, Ph.D., P.E., PWLF, President, Professional Snowfighters Association, Iowa City, Iowa; member, APWA Winter Maintenance Subcommittee
minimizes) the difficult event of doing nights twice in a row then having to go back to days and be bright and chipper when you do that (not really possible!).

They have gone further though. They have changed their working practices so that in any 14-day period each person works seven straight days (or nights) for 12 hours per day (or night) giving them 84 hours total work over the two-week period. The extra four hours (above 80 hours) are counted as overtime, as are any additional hours for which they might be called in. The real benefit of this approach is that at the end of their week of night work, each member of the operating staff has seven days to recover (which is apparently of great value for people working the night shift). This may not be feasible for every agency that has to provide 24/7 service, but it is clear that it works very well for the folks up in Alaska. By the way, this was very much a “bottom up” idea, and the operators who made this suggestion won an Alaska Department of Transportation and Public Facilities Regional Award for the Best Suggestion in the past 12 months.

With regard to the sedentary nature of the plow operator job, the same advice applies here as to those of us who drive desks rather than plow trucks—get up and walk from time to time! In a plow truck, that means whenever you stop for whatever reason, take the chance to get down from the truck and walk around it even just once. Again, this may not be a perfect solution, but it is certainly better than not doing it.

As far as food and what to eat while on a long shift, things get a lot more complicated and there is no clear consensus on what would be best for both individual health and operator performance. Three things do seem to have some degree of agreement though. First, if you rely on sugary drinks or sugary food for energy, you will have to deal with the inevitable sugar crash, and that is not ideal if you are doing a long night shift. Second, if you use caffeine to help you keep awake that is not in general a problem (although as with all things, too much caffeine may be!). And third, if you can stick with your regular mealtimes even when you are doing shift work, that does appear to help your body deal with the rigors of shift work. Staying away from unhealthy snacks is also a good idea, but of course just like your truck needs refueling so do you.

So, yes, it is a hard job driving a plow, and having to deal with the challenges of shift work, a tough work location, and the difficulty of eating healthy when dealing with those factors makes it even harder. There are some ideas out there that may help, but these are not a magic wand that makes it all better. Nonetheless, some of these ideas (and there are no doubt others out there) may be of use to you and your operations team.

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When I was about 13 years old, my mother blew out the engine to our car because she did not replace the oil. My father had passed away the year before and was the one who took care of maintaining the family’s vehicles. Routine oil changes were not on my mother’s radar, and to her credit, she was more focused on the visible issue at hand, raising three teenagers and managing a career on her own. However, the importance of paying attention to your engine to keep your car running smoothly and not leave you stranded was a lesson she learned well and passed along to us.

This story reminded me of how often we get busy with everyday life, and that sometimes we do not remember or even know how to pay attention to our engines in the workplace, our people. The public works industry is about People Serving People. Before we can effectively serve our communities, we must first focus on the people in our organizations.

So, how well is your workplace engine running? Do you need new parts? How and where do you find new parts? How do you keep old parts tuned?

The Leadership and Management Committee and the Knowledge Team will devote the 2020 articles series to “People, the Engine of Public Works.” While at PWX in Seattle, many conversations revolved around the challenges that agencies are having with hiring, onboarding, and retaining engaged people. The Rocky Mountain Public Works Institute even asked for this topic to be specifically addressed in the last session this fall. There is good reason to prioritize this topic. Engaged employees outperform disengaged employees on average by almost 28%, according to a 2006 study. Additionally, a trickle-down effect results from energized employees who go beyond just meeting expectations of their job to giving their best and supporting a culture of serving the public.

The challenge we are experiencing is two-fold. The first is attracting talent to our agencies, and the second part is to then create a positive and supportive work environment. We are such a diverse association; there is not a single solution that meets everyone’s needs related to attracting and retaining talent. For example, public works departments in resort areas do not have as much of a problem with hiring good people as retaining them due to the high cost of living. On the other hand, in less populated areas finding qualified people is a difficult task. The series of articles will provide insights from several different perspectives to help inspire innovative approaches.

Regarding the second part of the equation, creating a positive and supportive work environment, factors like the size and location of an agency do not make a significant difference in leadership and management techniques. As managers and supervisors, there are common things we should all do to keep our engines running smoothly. Even further, there are not any new revelations or theories on how best
to engage employees; mostly it comes
down to putting what we know into
actions. Below is a list of how to engage
employees from the article “How to
Engage Employees – a Complete Guide
for Managers” by nut cache.

- Get to know your people
- Provide people with the tools for
  success
- Let people know how your agen-
cies are doing
- Allow your people to grow
- Support your people and the
  authority you have granted
- Recognize your team and their
  hard work
- Encourage teamwork among your
  people
- Find people that care about the
  public
- Listen to and act on feedback
- Create a workplace environment
  free of fear
- Motivate, inspire and coach your
  people
- Let people show you how well they
  can lead
- Encourage personal development

The second part of the 2020 series will
focus on the actions we can take to
better engage our people. One com-
mon factor that engaged employees’
reference as an essential element to
satisfaction is involvement in mean-
ingful work. As public works agencies,
we have a leg up on other organizations
because we inherently provide work
that directly affects the quality of life
in our community. It is up to us to help
our people see and feel that connection
to public service.

For me personally, I can often find
other things I would rather be doing
than taking my car in for an oil change,
but I know that it is important for the
health and longevity of my engine, so I
make the time for it. Our people, as the
engines of our organization, also need
that same commitment and routine
attention. It starts by devoting time to
hiring the right people, then help-
ing employees find their place in the
overall mission and vision, and finally
investing in the time and support to
perform regular check-ups. When
our actions demonstrate we value our
people, it results in people giving their
best in return, which benefits our com-
unities and the vision to advance the
quality of life for all.

To put it simply, People Serving People
starts with keeping our engines tuned.

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Engagement through celebrations

Recognize your people
his article will explain how I ended up in “Oz,” what my Study Tour entailed, some of what I learned, and why you should consider a study tour abroad. While attending PWX 2018 in Kansas City, Municipal Engineering Foundation Victoria (MEFV) representative Claude Cullino asked to meet with the Chicago Metro Chapter (chapter) leaders and members of the chapter’s International Affairs Committee. MEFV challenged the chapter, due to a long-standing treasured relationship, to allocate funding matched by MEFV to support one chapter member on an inaugural 2019 Study Tour in Victoria, Australia. We decided the chapter should create a program to offer a public works study tour for a chapter member. I asked Claude “if they could host two” and he replied, “we can host twelve, we’re only paying for one.” So, I decided to go self-funded. The planning of my study tour occurred from August 2018 to July 2019. I received amazing help planning my Oz study tour from Michael Plant. Michael was crucial to my study tour planning as he and I worked together in Chicago for Baxter & Woodman. He returned to his homeland a couple of years ago and served as my first host (I spent the first two nights in his home), navigator and mate. Warren Roberts, MEFV Chair, Claude, and too many others to name also took care of me in Oz. I was told to tell you and all I encounter in public works: “consider a study tour to Oz and my mates will give you the incredible hospitality they offered me.”

I visited a number of Councils (Local Municipalities) across Victoria and attended the Institute of Public Works Engineering Australasia (IPWEA) Conference in Tasmania via support from Chris Champion, another great mate. My employer accommodated my being away from work for three-plus weeks (August 13-September 2; though uncommon in the U.S., MEFV Study Tour awardees conduct four- to six-week public works
study tours for learning objectives). While scheduling visits, I also helped the Chicago Metro Chapter/MEFV first Study Tour awardee, Karen Kase, plan her visit. MEFV gave me considerable advice, allowing me to focus my time and enjoy a land I never could have imagined visiting.

My study tour topics evolved from the roles I am part of in Chicago, as trusted advisor to Chicago clients, twenty-plus years as an elected official on a local high school board, and work with elected officials across Illinois. I chose Amalgamation (Government Unit Consolidation) as Australia has halved their units of government over the past 40 years, and Illinois has twice as many as any U.S. state; shared services/joint tendering (many local agencies we serve use practice and my research showed that Oz public works agencies do as well); and women in public works leadership as I believe we have a lot of work to do for equity and women having their equal place everywhere. MEFV guides agreed with my management topics and Council representatives could trade ideas on any or all topics.

My itinerary, based on how I live my life, tried to smash 38 days into 19 days. On my second Thursday, after visiting two Councils and speaking at an evening ITE meeting in downtown Melbourne, Michael Plant asked Warren Roberts and I to dinner. While at dinner, Warren announced he had heard from Emma Dalton (who had previously visited Chicago on a MEFV study tour), who wanted to connect with us early the next morning (three hours from Melbourne). I organized my travel to have the first day for orientation; and my first Friday included an MEFV luncheon to salute their study tour team, and a footie (Oz rules football) game. The first Saturday, Michael drove me along the Great Ocean Road to meet David Moloney and family who hosted me the first weekend, and I visited his Council on my first Monday. The first week in Melbourne I was hosted by Warren Roberts and his wife, where I visited over ten Councils, attended a dinner hosted by the MEFV Board, and spoke at an ITE event. The second weekend was spent with Emma Dalton’s family, then back to Melbourne via another mate, Matt Varcoe, to fly to Tasmania for my second week. The third Friday, Karen Kase and I flew back to Melbourne, hosted by Warren and his wife at their ocean house on Philip Island. My third Sunday was spent traveling back to Melbourne, and then scant hours with Michael Plant visiting more of the city before a delightful dinner to say goodbye (like Dorothy in the Wizard’s basket I was crying) and salute Karen Kase who was starting her study tour. In Victoria I slept in five homes owned by four families, was driven over 1,600 miles, and was graciously hosted at many meals by MEFV mates.

I have given presentations about my study tour and remain available for more as this article is a very brief summary. A few highlights of what I learned on my study tour:

**Amalgamation**

Australia’s population is 27 million with 670 governments or one unit of government per 40,000 people; the U.S. population is 330 million with 88,000 governments or one unit of government per 4,000 people. The Victoria local government was reduced from 210 to 78 Councils, which required 1,600 Councilors (Aldermen) offices being eliminated and a struggle through a mandatory 20% reduction in tax revenues. Some benefits of amalgamation included: implementation of asset management; reduction in cost of government by over 10%; Councils were reinforced as the first layer of public service, with only federal and state level governments for other responsibilities; and integrated infrastructure planning.
Shared Services
This practice allows two or more government agencies to jointly retain consultants, contractors, or purchase commodities together to potentially save time and money. Local governments in Chicago are using Shared Services regularly. One example of cost savings consisted of three Councils working together on building security staff which resulted in savings of over $2 million in the first year. The use of Shared Services provides better financial forecasting, and in some cases job training/employment for disadvantaged populations. The three basic ways Shared Services can work include a staff working for multiple agencies, projects by two or more agencies being jointly bid for construction, and defined multi-agency organization that buys services or commodities while allowing local agencies’ members to opt in or out of different purchases.

Women in Public Works Leadership
Women and men have different attributes that sometimes seem to set them apart. I heard in my Oz interviews that women are good communicators and better listeners, more collaborative, empathetic, multi-task work and home because of societal pressure, are caring, ethical, and the collective view that women are less valuable than men. Some ideas I learned include: “Imposter Syndrome”—feeling of inadequacy persisting despite evidence of success; women feel they have to know more than men when applying for a job; concept of “Lean In” or women forcing themselves to be seen and/or heard in meetings; and recognizing they must seek challenges and pursue career goals without fear. Some ideas for improvement for all involved in public works to promote equity for women include: maintain women leadership teams and ongoing leadership training; include training for flexible work schedule options; promote more women role models; and mentoring opportunities. Other potential ideas include when women are seeking employment, that résumés have names removed during the interview, that job descriptions be written with more gender neutrality, hiring panels should be composed of women and men, create diversity at all levels of the organization, and acknowledge that leadership requires diversity, range of styles and perspectives.

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4. Identify the terminology and formulas that are used when calculating area and volume.

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Applications of Unmanned Aerial Systems in engineering

Sean Burke  
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In just a few short years, Unmanned Aerial Systems (UAS) or drones have gone from a fascinating new way to take videos and photos to a powerful data collection tool for a variety of industries. Since the popularity boom of the mid-2010s, the UAS industry has evolved rapidly as tools were developed and the technology around drones evolved at a rapid pace. Higher camera capabilities and higher accuracy data are creating more detailed models, and software automatically processes metadata from drone photos to create detailed geospatial product. All the while internet technologies continued to advance and platforms for quick, easy sharing of products developed rapidly.

In engineering, drones allow field workers to collect high-resolution imagery and geospatial products in
a timely and efficient manner. Users were previously limited to the NAIP imagery updates every few years, Google Earth, or the costly method of flying the project with an aircraft. With a UAS, a pilot can quickly plan a flight plan, fly a project site, and process the data into a variety of 2-D imagery and surface analysis products or 3-D elevation models and photo realistic models with a minimal level of effort. The ability to process or integrate with software providers such as ESRI and their ArcGIS Online platform allows the ability to get data from the field to online in a single day depending on the project size.

The products derived from drone flights have been utilized in several aspects of the industry:

- **Geographic Information Systems (GIS)** – Every photograph or product derived from the drone contains a spatial component that allows the products to be mapped. Several applications allow for project footprint input to develop autonomous flight plans and data capture. Photogrammetric processing geo locates the image to a surface and captures elevation data that can be used to create 3-D models and elevation data for use in analysis.

- **Change Detection or Site Monitoring** – The UAS can fly a preprogrammed flight at regular intervals to take regular photos or create aerial imagery or models that can be compared over time.

- **High Resolution Aerial Imagery** – Users can easily capture updated aerial imagery that previously was collected only by satellite and manned aerial vehicles. Imagery is often of higher resolution than what was previously available. Previously, users were often relegated to using imagery that was several years old depending on imagery acquisition cycle.

- **3-D – Reality Mesh** – Software innovations have made the generation of realistic 3-D models. Using preprogrammed flight grids engineers can create models that can be uploaded and viewed on the internet. Clients/Supervisors can monitor build progress from a distance.
Site Inspections – UAS have been used to reduce field time and decrease safety risk in assessing certain objects. High resolution cameras make it possible to zoom in to features and make judgments from computer. Current inspection methods also often include human access to dangerous/unstable locations and/or expensive equipment rentals. Methods can be used on bridges, dams, retaining walls, and roofs among other features.

Thermal Imaging/Infrared Cameras – Additional sensors or cameras can be added to the drone to make items visible that are not usually visible to the human eye such as temperature or gas emission. These techniques can be useful in the inspection process to identify abnormalities in construction, such as gas emitting from a pipe, or an electrical component running hotter than normal, signifying an underlying electrical issue.

Digital Surface Models – Topographic Mapping products such as contours, Digital Elevation Models (DEM), and Digital Surface Models (DSM) can be derived from data collected through aerial surveys. These products can be used to calculate earthwork quantities and be incorporated into GIS applications. It’s important to note that UAS is not a one-to-one replacement for traditional survey techniques, as survey techniques must be used in conjunction with the UAS to achieve necessary accuracy.

Volumetric Analysis – Using surface models and elevation data collected, volume calculations can be run to determine volume of stockpile or amount of matter removed from an area. Cut/fill analysis is frequently performed in road or building construction and can also be used to assess slope stability.

LIDAR (Light Detection and Ranging) – LIDAR is a remote sensing technique that uses pulsed lasers to measure variable distances to the earth. This technique combines the high-resolution distance measurement with a high accuracy GPS device to create a point cloud that can be used to create detailed 3-D models of objects or physical environments that can be very useful in inspections and other assessments.

Business Marketing Materials – One of the largest and most popular uses for UAS remains the ability to capture project videography and photography. Increased altitude allows the ability to capture large projects in their entirety where not previously possible without manned aircraft. The adage of “a picture says a thousand words” applies to the business development process where a picture can convey scale or complexity of a project where words cannot do justice.

Gradually, the FAA has begun to loosen restrictions on flight, and innovation continues in the drone industry. The FAA has created workflows for obtaining flight clearance by obtaining waivers for flight operations to take place at night or near an airport. In 2018, several airports began participating in Low Altitude Authorization and Notification Capability (LAANC) which allow pilots to electronically request airspace authorizations from airports and receive instant approval. In 2019, the FAA announced plans to remove the flight restrictions on nighttime and over people. Machine learning technologies will allow software to auto classify point clouds to identify features and detect deficiencies in inspections. Integration of UAS into 5G cellular network will assist in faster data transfer and better drone connectivity over a distance. The realm of possibility continues to expand as companies begin to experiment with drone delivery services and flights beyond visual line of sight. Increased capabilities of the drone and processing software combined with longer, safer, and more efficient flights will be catalysts for the next wave of drone innovation.

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When hiring an individual with a nationally-recognized APWA certification, you have confidence that those individuals will:

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Learn more about the CPII, CPWP-S, CPFP, CSM, and CPWP-M certifications at the certification tab on the www.apwa.net website or by contacting certification@apwa.net
We have data, now what?

Abby Owens, Public Works Compliance Analyst, City of Plano, Texas; member, APWA Asset Management Knowledge Team and Connected & Automated Vehicles Subcommittee

Plano is a mid-size city in Texas just north of Dallas; it is well known across the country for its quality of life and strong job market. From 1980 through 2000, the city experienced tremendous growth in population, increasing 75 percent across each decade. As a result, the majority of the city’s infrastructure was installed during this 20-year period. Today, the 72-square-mile city has a population of nearly 290,000 and thousands of miles of aging infrastructure needing maintenance and attention.

In 2016, the Public Works Department and Parks and Recreation Department collaborated to invest in a work and asset management system from Cartegraph. City leadership supported this new software and the ideas behind asset management. This software would assist in improving operational efficiencies, providing reliable data, and launching our asset management program.

Three years into our computerized maintenance management system (CMMS), we had collected nearly 40 asset types and over 550,000 assets. We already had the location of our water, sewer and stormwater assets, as well as screening walls, pavement, sidewalks, signs, supports, and bridges. Field crews worked to complete inventories of traffic assets, pavement markings, and guardrails. Using our CMMS, we were cataloging over 1,500 tasks a week and collecting a rich maintenance history of our infrastructure. We could even track the 400 requests received each week and what work was performed in response. We felt like we were ahead of most cities and making real strides in asset management.

After this three-year process, we realized that having the data is only part of the process. Like many cities, we started with inventory and data collection without having a vision or strategic plan in place. We had all this data, but now what? How do we know what to do next? How do we know the condition of each asset? Which assets need to be replaced first? What level of service do we want from each asset? What metrics should we track and report?

After joining the APWA Asset Management Committee, we discovered APWA’s Guide to Successful Asset Management System Development. This simple guide helped outline the basics of what an asset management program should include—and we were lacking in many of the foundational elements. We looked at our department and realized that frameworks existed for pavement and water and sewer assets, but the documentation didn’t equal a complete plan and common information didn’t exist to tie back to an overall strategic asset management plan (SAMP). For pavement, we were using pavement condition index scores to help determine priority streets for repair and replacement, but level of service hadn’t yet been identified. Our sewer collection system recently had a capacity management operation and maintenance (CMOM) plan developed that provided goals, objectives and metrics, but the condition of the
system and prioritization for repair and replacement didn’t exist. Through the requirements of the American Water Infrastructure Act of 2018, we were completing a condition assessment of our water distribution system and would have necessary pieces to then develop a water infrastructure asset management plan. Each of these efforts were all great starts towards asset management, but none of them were actual asset management plans. The road to asset management is like a web; and we were missing the strands to connect these efforts and establish a direction.

We are embarking on the development of a strategic asset management plan this year to identify the threads that will guide our asset management programs. We will develop the needed foundation through cross-departmental discussion, difficult decisions, and answering important questions. Our SAMP will involve key stakeholders and be informed by other city strategic plans (comprehensive master plan, capital investment plan, etc.). It will provide a vision for the organization related to asset management and include guiding policies, principles, and objectives. With a solid foundation for asset management, we can then revisit our existing approaches to assemble more informed and thorough asset management plans for pavement, water distribution, and sewer collection, while also developing approaches for other asset classes.

Our asset management approach has not followed a natural linear progression and definitely hasn’t been a clear path forward. But with so many wonderful cities to learn from and resources to access, we know we will be moving beyond a “city with data” to a city that’s “doing asset management.”

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APWA WANTS YOU! The Engineering & Technology (E&T) Committee is beginning to create an Engineering & Technology Toolbox for member training that will be housed on the APWA website. The plan is to compile information to help entry-level employees or someone new to the engineering field. The current timeline is to roll this Toolbox out to members gradually over the next few years starting in the summer of 2020. We need members like you to join our Knowledge Team and participate in the development of this Toolbox. If you are interested in joining the Engineering & Technology Knowledge Team to assist with this project, contact Rita Cassida, Staff Liaison, at rcassida@apwa.net or (816) 595-5222.

So, you say to yourself, what kind of training will this be? That is yet to be determined and why we need you to participate. Our goal is to provide everyday knowledge to engineers and those who work with engineers. Some of these topics may be very basic and others may be more advanced to assist our members who have a wide variety of needs. Some of these trainings may be a self-guided tutorial, others may be a PowerPoint™ slideshow for APWA chapters to use in a group session and some may be Click, Listen & Learn.
sessions or APWA eLearning programs. These are just a few methods of sharing the training and there are others which may be included in the future such as podcasts.

Some of the more everyday technology basic topics that the Engineering & Technology Committee believes will be useful for engineers include:

- Ability to prepare clear communications such as email or public notice
- Ability to prepare reports and exhibits in an organized manner
- Managing electronic project documentation such as drawings and photos
- Working with data in a server system
- Creating clear photos with camera or phone

More challenging everyday technology topics for engineers include:

- Creating effective spreadsheets
- Operating project scheduling software
- Basic field surveying and other field instruments
- Using spreadsheets to track projects
- GIS knowledge
- 3D CAD programs
- Operation of specialty design software (such as the U.S. Army Corps of Engineers Hydrologic Engineering Center’s (CEIWR-HEC) River Analysis System (HEC-RAS))

Why should we do this? APWA is well known for its educational offerings and providing value to the membership. This Toolbox will assist with issues that APWA members experience right now. The ongoing retirement of Baby Boomers has created a gap in the workforce. The lack of knowledgeable or experienced workers taking their place in the workforce and the continued under-investment in infrastructure means that this is a critical topic that must be addressed by our organization. The public works staff who remain behind following these retirements will have the Engineering & Technology Toolbox available to them and a broader understanding of what it takes to accomplish some of these tasks.

Why are some of these so basic? Our membership covers a wide demographic of the population and many of our members receive little or no training on how to accomplish these tasks. APWA wants to lend a helping hand to those who start near the bottom of the organization chart yet are eager to better themselves and move up within the organization. Our schools, secondary and post-secondary, are finding it difficult to find time to teach some specialty subjects needed by public works staff.

When are we trying to accomplish this task? We would like to roll out the first training before PWX this year to be able to share with members at that time. If enough members will join the E&T Knowledge Team, it may be possible to prepare two different trainings. So, what are you waiting for?! The beauty of the Knowledge Team is that you can pick and choose what topics interest you and participate as you are available.

The beauty of the Knowledge Team is that you can pick and choose what topics interest you and participate as you are available.

The Toolbox will be available to members only on www.apwa.net.

Where on the APWA website will this Toolbox be housed? The Toolbox will be available on www.apwa.net. It will not be available to non-members, so you will need to log into the APWA website as a member. It will be easily accessible for any member around the world.

For those of you looking for training on everyday technology for engineers, please contact Rita Cassida, Staff Liaison, at rcassida@apwa.net or (816) 595-5222 so she can compile these requests for the committee’s consideration. We look forward to those of you who choose to participate on the E&T Knowledge Team.

Thank you for considering this opportunity.

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The Mighty Brazos River: What we know now, and where do we go from here?

Christopher Steubing, P.E., Assistant City Manager, City of Sugar Land, Texas

The Brazos River basin consumes approximately 44,000 square miles and bisects the state of Texas as it stretches the almost 1,050 miles from the Texas-New Mexico border down to the Gulf of Mexico. Separated into three basins, the lower basin of the river is approximately 10,000 square miles and is largely undeveloped. The lower basin alone consumes several counties and cities ranging from Brazoria County on the Gulf of Mexico to the City of Waco located in McLennan County. The flows within this basin are majority uncontrolled by Army Corps of Engineers reservoirs allowing rainfall to flow unencumbered through many communities, including Sugar Land, before reaching the Gulf. Since 2015 the City of Sugar Land has experienced three major floods on the Brazos River that all registered, or set new records, for flood stage through Fort Bend County and Sugar Land. They have all presented challenges that must be addressed from changes in the base flood elevation for identified rainfall events to scour and erosion that is threatening critical infrastructure and levee improvement districts that protect approximately $9 billion in assessed value in Sugar Land alone.

In 2012 the City began inquiring about river model forecasting and the accuracy for the Brazos River, as our community is located in the bottom third of the lower basin in an area where the watershed narrows as it makes its final approach...
to the Gulf. Although there was not a river event that was creating this interest, the many years of training, preparation and certification of staff through the National Incident Management System (NIMS) had heightened our awareness of the river and helped bring to light that a river basin of this size provides an extreme risk that was relatively unknown with the exception of our updated Fort Bend County Flood Insurance Study from FEMA.

Over the years this interest in the river and conversations with key partners led to the Brazos River Authority (BRA) applying for and receiving a Texas Water Development Board (TWDB) Flood Protection Planning Grant in 2014 for the development of the Lower Brazos Floodplain Protection Planning Study. This was funded partly from a coalition managed by the Brazos River Authority that included the counties of Brazoria, Waller, Washington and Fort Bend, the cities of Lake Jackson, Sandy Point and Sugar Land, and the special districts of Velasco Drainage District and Pecan Grove MUD. The study was performed by Halff Associates. A 220-mile stretch of the river was included in the one-dimensional unsteady hydraulic model (HEC-RAS) that stretched from the Waller/Grimes County line to the gulf. This included multiple overflow streams as well. Discharges generated with the hydrologic model (HEC-HMS) were routed through the HEC-RAS model, and high-level two-dimensional modeling was done on the lower portions of the lower basin to verify overland flow patterns.

All these entities began the journey to try and better understand the lower river basin hydraulics and hydrology in order to better define the flood risk and direction forward as it relates to the Brazos River. Even though the study did not incorporate the entire lower basin, it has advanced our understanding and knowledge on how the basin responds to major events and has prepared us for additional steps moving forward.

The completion of the study and final report came in March 2019. Although delayed due to Hurricane Harvey, the fact that the BRA and TWDB expanded the study to include the results of Harvey provides us with the most accurate information from one of the worst river flood events on record in the past 60 years. The modeling results provided insight on river storage and attenuation within areas outside of identified floodplains, better accuracy of the river model.
for prediction/forecasting purposes, improved coordination of river activities among the communities, and a common knowledge of the impacts within the region. Although it identified a number of significant findings for the bottom half of the lower basin it still leaves the desire to continue this for the remainder of the basin upstream of Washington and Grimes Counties, and ultimately the entire watershed, so all communities can be aware and more knowledgeable about impacts that growth within the watershed and within their region can ultimately have on neighboring communities impacted by the river. See the report at http://www.brazos.org/Lower-Brazos-Floodplain-Protection-Planning-Study.

While the Lower Brazos Floodplain Planning Protection Study was ongoing, the City moved into investigating the issue of erosion that was occurring along portions of the river through the community. An initial study in 2016 was performed by Huitt-Zollars and used historical images and an approach referred to as Time-Sequence-Map-Extrapolation to identify locations where river movement could be evaluated with historical images and the radius points on bends of the river could be identified and the movement traced and evaluated. This allowed Huitt-Zollars to be able to determine the degree of movement at bends in the river and those that were experiencing more drastic changes that might need to be investigated further.

In 2017, with the aftermath of Hurricane Harvey, the erosion study was taken to the next level. The City experienced advanced levels of erosion at several locations along the banks due to the extended high levels and flows that occurred due to the upstream rainfall. Huitt-Zollars brought on Dr. Jean-Louis Briaud, Ph.D., P.E., Geotech professor with Texas A&M University, for his expertise in geotechnical and geomorphological analysis. Together our goal was to better understand and determine the causes of the accelerated erosion, predictability at critical locations and consequences. The team went to work utilizing the modeling information that was developed with the Lower Brazos Floodplain Protection Study and taking soil samples along the corridor in order to run tests to determine erodibility of the soils and the conditions in which the erosion begins to advance at a more rapid rate.

Through this process critical velocities were determined to be between 3.5 to 3.8 ft/s and from the modeling efforts the critical flow rate was identified around 70,000 cfs. With this information determined we were able to review the past 60 years of river flood events and all locations that had experienced significant erosion over the past three years and apply this new information to begin looking at predictability and risk associated with each location. With the highest priority areas identified, these efforts have allowed the City to plan and prepare for the next steps which include looking at regional solutions with our partners along the river including the U.S. Army Corps of Engineers, Fort Bend County and several others in an effort to solve or slow the bank erosion.

By modeling the river to better understand the hydraulics and hydrology of the lower Brazos River basin, along with extensive geotechnical and geomorphologic analysis, we have been able to determine critical flow rates and velocities that advance erosion of the riverbanks during high river events. By identifying these critical thresholds, the City can better plan for high river events, make modifications to our floodplain regulations, city design standards, define critical areas along the river and advocate for improvements in those areas. The information also allowed our team to consider several types of improvements within the identified impacted areas and prioritize these areas in order to seek funding opportunities and resolutions to these issues. Long term we look forward to the continued development of the Texas Flood Plan where we hope that improved understandings of riverine watersheds can provide improved standards for development and floodplain reclamation.

Recognitions: Sam Hinojosa, P.E., Halff Associates; Greg Wine, P.E., Huitt-Zollars; Dr. Jean Louis Briaud, Ph.D., P.E., Professor, Civil Engineering Texas A&M University

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Municipal organizations own, operate, and manage infrastructure systems or capital assets to provide services to communities. Long-term planning of capital assets is central to organizational resilience. To assess capital investment needs, infrastructure organizations use a set of existing frameworks, approaches, and methodologies. These existing frameworks and methodologies are not service-centric and lack the ability to demonstrate an integrated approach to identify, coordinate, and plan capital investment needs. A capital investment planning framework is developed to address these issues. The framework has three components that are governed by the organization structure and policies, as shown in the figure at right.

**Identify Capital Projects**

The capital projects are formally identified through the integration of the following organizational plans:

- **Organization Strategic Plan** – A strategic plan consists of six elements: vision statement, mission statement, core values, goals, objectives and action plans. The strategic plan is developed based on the needs and requirements of the customers. Each business unit in a municipal organization defines objectives in line with the strategic priorities of the organization, including capital investment planning. From the capital investment planning perspective, the following four plans are of particular importance.

- **Comprehensive Plan** – A comprehensive plan is a long-range plan intended to direct the growth and development of a community. As a result of the planning process, a comprehensive plan is developed to regulate public policies on transportation, utilities, land use, recreation, housing, and public facilities.
**Sustainability Plan** – According to the UN, sustainability is defined as fulfilling the community’s environmental, economic, and social needs without compromising those of the future generations. The three-dimensional needs of the community form the three pillars of sustainability—the Triple Bottom Line. Municipal organizations identify and implement capital projects to accomplish sustainability goals.

The comprehensive and sustainability plans guide the development of the infrastructure master plan and asset management plan through the integration and alignment of goals. Municipal organizations create the infrastructure master plan and asset management plan to identify new and rehabilitation/reconstruction capital projects.

**Infrastructure Master Plan** – Supports the comprehensive plan by providing guidance and ensuring there is enough infrastructure capacity at the right service levels to accommodate development and redevelopment. The purpose of this plan is to identify capacity-related new and improvement capital projects to support population and economic growth.

**Asset Management Plan** – Defines the state of the infrastructure, level of service requirements, asset management strategy, and financing strategy. This plan identifies maintenance and rehabilitation/reconstruction capital projects based on the condition, risk, age, etc., at the strategic (10+ years), tactical (4 to 10 years), and operational levels (1-3 years).

Presently, some of these plans are either missing or not well-integrated in small to medium size municipal organizations that result in poor capital investment planning. This framework aligns and integrates these five plans to identify capital projects that have the greatest impacts on service delivery.

**Coordinate Capital Projects**

The capital project coordination is done every time a capital investment plan is developed or updated. The purpose of the coordination process is to develop a well-coordinated plan that involves interacting with stakeholders to identify overlapping capital projects in the same corridor or right-of-way and adjust their schedule to achieve synergies and avoid rework. Capital project coordination is done at four levels.

**Intra-divisional coordination** – At this level, all project managers within all divisions of the public works and utility departments identify and coordinate capital projects. In the *intra-departmental coordination*, all divisional managers interact within a department to coordinate capital projects. Moreover, in the *inter-departmental coordination*, the Public Works and Utility Departments interact and identify capital projects before including them in the capital investment plan for consideration and approval. In the *inter-organizational coordination*, the capital projects are shared with the franchise organizations to assess how the capital investment plan impacts their long- and short-range infrastructure plans.

**Plan and Manage Capital Projects**

At this stage, municipal organizations select the capital projects that have the maximum benefits or returns on investment using the following steps:

**Step 1: Specify service targets** – Identify and define the baseline customer level of service targets based on the organizational level of service framework. The current service performance is benchmarked against the baseline to identify whether a service is to be maintained or enhanced.

**Step 2: Assess investment needs** – Opportunities and risks are used to evaluate investment needs. New opportunities are created because of demographic and economic growth, new regulations, and laws/bylaws. These opportunities create capital projects. Similarly, strategic and asset risks are assessed as high, medium, and low risks. Capital projects are planned to mitigate high risks, while medium and low risks are mitigated through operation and maintenance projects.

**Step 3: Develop, evaluate, and approve business case** – A business case is developed for each candidate capital project, which includes a discussion and assessment of the different alternatives. An alternative with the maximum benefits is selected and approved through a business case approval committee.

**Step 4: Prioritize projects** – Business cases of all capital projects are equally important, but the need is to pick the ones that have significant impacts on the health and safety of communities, service delivery, environment, growth, etc. A level of service-based multi-criteria prioritization model is used to prioritize these business cases. As a result, a prioritized list of capital projects is identified and recommended for inclusion in the capital investment plan.

**Step 5: Develop and approve plans** – Now that a set of capital projects are selected and approved, and included in the strategic, tactical, and operational capital investment plans, the operational capital investment plan feeds into the annual capital budget process.

**Step 6: Implement plans** – Once the annual capital budget is approved, capital projects in the first year of the operational capital investment plan are implemented to ensure services are provided as per the acceptable level of service targets.

**Step 7: Monitor and evaluate the level of service targets** – Level of service targets are continuously monitored to benchmark the current level of service performance. Any gaps in performance will result in either adjusting the acceptable level of service targets or providing more capital projects following the capital investment planning process.

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Time to move from paper to digital work orders: Selecting a GIS-centric CMMS

Many public works and utility departments, especially water and sewer, have seen a drastic increase in both maintenance costs and capital replacement needs as the condition of assets continues to decline. Many times, this asset deterioration is due to under-maintaining an asset and not tracking the condition of an asset. The change in the condition of an asset can trigger a new maintenance activity or a new frequency of the required maintenance. Moving from a paper-based reactive mode to a digital geographic information system (GIS) centric platform advances a department along an asset management path. A Computer Maintenance Management System (CMMS) introduces greater efficiencies and cost savings when it comes to managing our public infrastructure.

Asset Management (AM) is a core business principle and practice that will support everything an organization does. AM decision making requires data collection, data management and analysis. All municipalities and utilities are made up of assets, either linear or buried assets (pipes) or vertical assets (treatment plants). All physical assets, except for land, degrade and lose value over time as the asset ages and deteriorates through use. Ninety percent of these assets are location-based assets requiring GIS in our modern digital world.

To effectively manage the complexity of public infrastructure and water assets, GIS must be at the heart of the data collection solution. GIS is a
standard in the U.S. for federal and local governments including water and sewer utilities and a “Top Tech” for APWA.

The first step in any infrastructure asset management framework is knowing what assets you have and where they are located. Once the asset’s attributes and location are known, the condition of the asset can also be added to the GIS geodatabase.

GIS-centric technology serves as the system of record for risk-based assessments. Basic data identifiers, such as asset attributes, location, age, condition assessments and failure history provide valuable information for calculating asset risk of failure. A GIS-centric CMMS which collects cost (equipment, labor, materials) in work orders assigned to individual assets and inspection asset condition data provides the foundation of making cost-effective decisions through life cycle cost analysis. A GIS-centric CMMS is at the heart of an asset management program’s business process.

Some of the reasons to move from a paper-based to a digital-based CMMS include:

- Reduce the cost of work orders (preventive maintenance over reactive work).
- Adjust maintenance strategies to extend the life of assets.
- Leverage the existing workforce and justify staffing needs.
- Collect and manage asset data more effectively.

Selecting a CMMS as part of an overall asset management program by a public works department or water utility division should take into consideration the following common steps as part of the evaluation process.

Conduct a survey of current practices including:

- Business Processes
- Work Order Process

Without the measurement of asset costs and operational and maintenance activities, an organization’s budget planning process will fail to report whether the allocated funding is sufficient.

- Asset Tracking Process
- Commissioning Process

Document what other systems the CMMS needs to integrate with like GIS, closed circuit TV (CCTV) and other pipe condition inspection software, supervisory control and data acquisition systems (SCADA), financial and electronic document management systems and other data analytics and asset management risk tools. In the U.S. water industry, many of these additional systems already have a history of integration with the Esri ArcGIS platform with their linear pipe assets on GIS shape files.

The basic CMMS functionality includes an asset inventory, service requests and work orders, preventive maintenance tasks and schedules, inventory management and purchasing, condition and risk-criticality analysis, assessment and renewal planning, data analytics and key performance indicator (KPI) metrics, risk visualization, reporting and documentation.

The CMMS software selection process includes developing a shortlist of vendors which provides the assurance of product longevity, training resources, a known pool of references and an existing skilled workforce in the CMMS software. Established CMMS products often have a large resource pool of knowledgeable experts both within and outside of the company. This makes it easier to recruit and hire additional resources when needed to overcome future workforce concerns.

Maintenance and asset management managers understand that without the measurement of asset costs and operational and maintenance activities, an organization’s budget planning process will fail to report whether the allocated funding is sufficient. When there is no true measurement or analysis, there can be no control process and thus no continuous improvement. Without consistent and accurate projections, an organization will not be able to determine if they are financially sustainable. Furthermore, if the asset is poorly designed, constructed, installed or operated, the maintenance cost curve may not reflect the efforts of the operations and maintenance field crews. Once an asset is designed and installed, the long-term maintenance costs can be locked in for the life of the asset. The U.S. EPA has suggested this can be as high as 65-85% of the total life cycle cost of an asset. For this reason, maintenance and operations should always talk to engineering to close this vital business process loop in asset life cycle management.

Remember, benchmarking and improving record keeping and data accuracy is critical in order to develop a business improvement process to track and report performance goals to management and elected officials.

A CMMS is the core engine of asset data collection, storage, analysis and execution of operational and maintenance strategies and activities. By definition, a GIS-centric CMMS shares the geodatabase as a single asset repository, leveraging it with an architecture web map platform to provide spatial geo-analytical insight into asset criticality proximity, risk mitigation, resilience planning, and multisection asset management analysis and coordination.

A web GIS-centric CMMS enables municipalities and utilities to manage
public assets and community services seamlessly while being responsive to citizen inquiries and concerns in a cost-justified process. GIS-based asset management business processes and software applications and tools connecting field services for public works and utilities to decision makers and the public is at the core of emergency services and disaster recovery efforts building community resilience.

In the event of disaster—natural or man-made—the GIS Web platform and GIS-centric CMMS will turn an asset management program into an efficient disaster preparedness and recovery program including all relevant FEMA cost tracking and reporting. True resilience is embedded in a CMMS’s system of insight which produces operational and risk insights to better manage assets in cost-effective manner. This insight which focuses on asset location and condition can help restore critical systems and services in the most cost effective and timely manner. On average, every dollar spent on improving the condition of your assets can save $6 in the restoration of an asset and services after an emergency.

The GIS platform also provides the basis of integrating the Internet of Things (IoT) to support the “smart” municipality or “smart” utility efforts to enhance and improve the quality of life of citizens.

The public works and utility industry may have had a late start in infrastructure asset management planning, but the adoption of technological best practices and standardization of asset data on a GIS platform can provide for an acceleration of public asset management and infrastructure renewal and replacement planning to achieve cost savings, resource conservation, service level management and taxpayer affordability.

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A web GIS-centric CMMS enables municipalities and utilities to manage public assets and community services seamlessly while being responsive to citizen inquiries and concerns in a cost-justified process.

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Geopolymer mortars are quickly proving to be more effective than the traditional pipe and manhole coating and lining products currently being used to rehabilitate damaged and deteriorated infrastructure. In particular, they are becoming more popular for the structural rehabilitation of large diameter storm and sewer pipe, as well as manholes, wet-wells, junction boxes and other underground structures.

Why have geopolymers become so popular?
The popularity of geopolymers are primarily due to the fact that not only are they proven to be environmentally friendly and possess a reduced carbon footprint, they also provide full structural integrity and extreme corrosion resistance in highly acidic conditions. This is especially important in sewer environments. Geopolymers are a high-strength material providing a fully structural rehabilitation that continues to gain strength over an extended period of time.

Additionally, geopolymers have proven to be extremely versatile in the field, which is where it really counts.

- They can be applied in a single application while other technologies commonly require multiple materials and multiple site visits to achieve similar results.
- They can be spin-cast, spray or trowel applied, allowing them to be effectively used to reline all shapes and sizes of structures.
- Geopolymers pump and flow very readily. This allows the contractor to cover more ground in less time.
- They bond extremely well to a wide variety of construction materials, including concrete, brick, CMP, stone, and others.
- Geopolymers require much less water than cementitious products, creating a material that performs extremely well in freeze/thaw conditions as well as greatly reducing any shrinkage.
- Geopolymers chemical reaction, polycondensation, allows for the material to be installed in both very cold, and very hot conditions.
- It is a certified “Green” product that meets the necessary qualifications for “Reduced Carbon Footprint” classification, when compared to alternative rehab technologies.

By the nature of how the product is mixed, bonds and ultimately applied, the evolution of this spray-applied mortar has led to the design of new and better equipment. The development of these advanced geopolymer lining systems allow for more complex design engineering solutions that traditional mortar applied systems have yet to achieve.

Given all these benefits, geopolymers are being specified to structurally rehabilitate and protect a broad range of infrastructure ranging from very large diameter and completely deteriorated CMP culverts, highly corrosive manholes,
Geopolymers: What is it and how is it best used for infrastructure rehabilitation?

Defining a Geopolymer
Unluckily, a lot of so-called geopolymers “talk the talk, but they don’t “walk the walk.” Until ASTM establishes specific testing and performance standards for geopolymers used for infrastructure rehabilitation, confusion is understandable. So, if you are considering using a geopolymer for a project, it is important to understand the differences between a true geopolymer and other products on the market today that are close, but not the real thing. As the developer and manufacturer of GeoKrete® geopolymer, we have gone to great lengths to clearly define, develop and deliver a true geopolymer for infrastructure rehabilitation and offer the following advice.

There is a common misunderstanding that the bagged, dry mix delivered to a project site is a geopolymer. This is simply not the case. A geopolymer only forms after it has been activated with water. The material in the bag is, in truth, a geopolymer precursor and looks very similar to cementitious products. With the naked eye, they appear to be identical. Since there is no single test that can verify that a bagged product is a geopolymer, third-party verified testing should be conducted.

If a geopolymer mortar has been specified for a project, we recommend the asset owner or its consultant request two non-destructive analytical techniques to determine the elemental composition of materials. These tests are called XRF (X-Ray Fluorescence) and XRD (X-Ray Diffraction). The XRF test determines oxide composition (e.g., wt. % of SiO2, Al2O3, etc.), while the XRD test determines the phase composition of those oxides (e.g., amorphous or crystalline). Geopolymer precursors should consist mainly of amorphous (“reactive”) SiO2 and Al2O3. These tests, along with standard ASTM physical properties tests commonly performed on cementitious products, will help verify the product as a geopolymer.

Having agreed to the benefits of utilizing a geopolymer liner, the next step is to understand geopolymer design parameters. Tunnel engineering design standards, used for the past 100 years, have proven the validity of lining pipes, culverts, and especially tunnels with rigid high strength materials like geopolymer mortars. It is important to consider the right design drivers for each category of lining material and the correlating failure modes. The typical failure mode of a rigid liner type used in the rehabilitation of a properly buried and confined round pipe, is buckling, and thus compressive strength is the appropriate design driver (i.e., flexural strength would be the design driver for a less rigid and more flexible liner material like polyester resin-based CIPP). As compressive strength is the primary design factor, field testing for compressive strength should be performed on a routine basis.

Bottom line? Whether you are rehabilitating damaged waste or stormwater infrastructure or simply protecting it for the future, the lining materials you use will ultimately determine its fate. So, choose carefully and wisely. Make sure the geopolymer you specify meets the requirements of your project and, as promised, by the manufacturer and contractor. Geopolymers are an amazing structural and corrosion protection lining material. They will breathe new life into your aging infrastructure, all the while saving you time and money.

Steve Henning can be reached at (713) 269-2333.

Before shot: 125-foot-deep brick manhole structurally restored with GeoKrete Geopolymer

After shot: 125-foot-deep brick manhole structurally restored with GeoKrete Geopolymer
Water system infrastructure
Layering Risk

How evaluating infrastructure risks by corridor promotes strategic infrastructure investments

Dustin T. Scott, P.E., City Engineer, City of West Fargo, North Dakota; Kellen J. Grubb, Asset Management Coordinator, AE2S, Fargo, North Dakota

Background
The City of West Fargo has been one of the fastest growing communities in North Dakota, climbing from approximately 15,000 residents in 2000 to over 36,000 in 2019. This population growth is accommodated by almost entirely greenfield development, requiring construction of new streets and underground water and sewer systems. The recent surge of expansive growth has shifted focus away from the infrastructure that serves the City’s downtown neighborhood, which contains some infrastructure that has been untouched since the City’s inception in the mid-1920s. Due to concerns with the overall age and condition of the City’s downtown infrastructure and known areas where infrastructure has shown signs of failure, the City embarked on a master planning journey to address their infrastructure needs within their downtown neighborhood. This article will provide insight on how the City of West Fargo combined pavement, water main, sanitary sewer, and storm sewer data to develop a plan for improving their oldest infrastructure in the City’s core area of town. The five-step process used for this project is outlined in Figure 1.

Organize Data
The City maintains geographic information systems (GIS) data of all their infrastructure assets, which was heavily utilized throughout the project. In addition to GIS data, closed-circuit television (CCTV) videos of the City’s sanitary sewer system and pavement condition index (PCI) were leveraged to further enhance the results of the infrastructure evaluation. Data is enormously important when undertaking infrastructure assessment projects because it oftentimes enforces what much of the City staff already believe. However, without the data, how do you prove what you believe is correct?

Establish Assessment Criteria
After the data was collected and organized, it was time to select the criteria to be included in the individual infrastructure risk assessments. The
established criteria were grouped into two categories: Consequence of Failure (COF) and Likelihood of Failure (LOF). COF is defined as the consequence or impact a system would experience during an infrastructure failure and LOF is defined as the likelihood or probability that an infrastructure failure will occur (could be either a structural or performance failure). These two categories form the basis of risk and are important to fully understand prior to making costly infrastructure investments. A simplified equation, where the specific COF and LOF criteria are excluded, for how risk was calculated for each asset type is provided as Figure 2.

Infrastructure was separated into horizontal (pipes and streets) and vertical (sanitary and storm sewer lift stations) asset classes. COF and LOF assessment criteria were then established uniquely for each system to determine the asset risks within each respective system. All assessment criteria were weighted in terms of relative importance, with the most reliable data for each system being weighted the heaviest. For example, when conducting the pavement system and sanitary sewer system risk assessments, PCI and CCTV surveys were weighted heavily because the condition of these respective assets could be seen, rather than calculated or assumed. Figure 3 presents a snapshot of pavement system data and Figure 4 and Figure 5 provide CCTV survey snapshots. As shown, being able to see the condition of the asset is much more impactful (and sometimes more terrifying) than making assumptions of the asset’s condition or operational condition.

Assess System Risk
The next step was to conduct the individual risk assessments for each infrastructure system. In total, there were six risk assessments conducted for this project on the following infrastructure systems: water system, sanitary sewer system, storm sewer system, pavement system, and both the sanitary sewer and storm sewer lift station systems.

![Figure 2: Simplified Infrastructure Risk Equation](image)

![Figure 3: Road in Good Condition (PCI of 97.37)](image)

![Figure 4: Broken Sanitary Sewer](image)

![Figure 5: Toy Obstruction in Sanitary Sewer](image)
By conducting individual system risk assessments, the City was able to understand and consider the replacement needs of individual utilities while also being able to evaluate the overall infrastructure needs within corridors.

**Analyze Corridors**

Determining the optimal time to replace underground infrastructure is challenging. For instance, a water main might be in excellent condition and have decades of service life remaining, but it gets replaced simply because it lies within a corridor that has been targeted for other utility replacement. Performing a corridor analysis provides a comprehensive approach to addressing infrastructure challenges because every asset system within that corridor is being considered. Corridor analyses result in highly feasible recommendations because improvements are grouped into “constructible segments” rather than arbitrary recommendations that are unrealistic and impractical for actual implementation and construction.

For this project, the corridor analysis was performed utilizing the risk assessment results from each respective infrastructure system. The results from the corridor analysis were normalized, and weighting factors (Table 1) were applied to the individual system results to calculate a corridor score and overall risk level as noted in Table 2. The overall risk level then dictated the general improvement recommendation for each corridor ranging from “improve immediately” for Level 5 to just “continue to perform routine monitoring” for Level 1.

**Prioritize Improvements**

The final step was to develop a prioritized list of projects based on the study findings, which were ultimately housed in a 10-year capital improvement plan (CIP). Projects were then prioritized based on the results from the corridor analysis, with considerations for hydraulic modeling recommendations and the individual system risk assessment results. Projects were assigned an associated year based on budgeting information and available funding methods.

This effort resulted in a defensible and prioritized list of infrastructure improvements, as well as a corresponding CIP that will enable key personnel to make informed decisions when improving the state of West Fargo’s downtown infrastructure.

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**Table 1: System Weights for Corridor Analysis**

<table>
<thead>
<tr>
<th>System</th>
<th>System Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement System</td>
<td>35%</td>
</tr>
<tr>
<td>Water Main System</td>
<td>20%</td>
</tr>
<tr>
<td>Sanitary Sewer System</td>
<td>30%</td>
</tr>
<tr>
<td>Storm Sewer System</td>
<td>15%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

**Table 2: Corridor Analysis Levels and General Recommendations**

<table>
<thead>
<tr>
<th>Corridor Score Ranges</th>
<th>Corridor Analysis Level</th>
<th>General Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00 – 0.99</td>
<td>Level 1</td>
<td>No Project Recommended; Routine Monitoring</td>
</tr>
<tr>
<td>1.00 – 1.99</td>
<td>Level 2</td>
<td>No Project Recommended; Routine Monitoring</td>
</tr>
<tr>
<td>2.00 – 2.99</td>
<td>Level 3</td>
<td>No Project Recommended; Increased Monitoring</td>
</tr>
<tr>
<td>3.00 – 3.99</td>
<td>Level 4</td>
<td>Project Recommended in 6-10 Years</td>
</tr>
<tr>
<td>4.00 – 5.00</td>
<td>Level 5</td>
<td>Project Recommended 1-5 Years</td>
</tr>
</tbody>
</table>

A prioritized list of projects was developed based on the study findings, which were ultimately housed in a 10-year capital improvement plan (CIP).
The modernization of state and local government policy through an ideal asset management system

Carlos E. Osterroth, CPFP, Manager of Fleet Services, City of Medicine Hat, Alberta, and member, APWA Asset Management Knowledge Team and Fleet Management Committee

State and Local Government Culture of Excellence and Support for Asset Management Practices

State and local government benefit from well-identified asset management practices as a holistic and sustainable approach to create municipal plans; integrate professional functions within the municipal system; consider a capability delivery framework and process to better identify communities’ levels of service; plan resources; and implement good governance decision-making approaches to create financial plans and budgets. Municipal employees across states and local government units strongly support asset management planning in support of council community engagement and decision-making processes. In the past
few years, municipal employees have worked with a number of asset management associations regionally, nationally, and internationally to improve asset management planning, with the intent to increase the understanding of its role in the municipal sector. Presently, more municipal governments understand that to better serve residents and make the best decisions, the very best data available is needed to create asset management plans. Assets range from linear, horizontal, mobile, IT—and those involving human talent. Basically, assets are all those resources and capabilities associated with a municipal government.

Municipal employees benefit from state and local government assistance to implement corporate planning and regulatory requirements as part of a multi-year phased asset management strategy, including the identification of tasks related to the creation and expansion of tools and resources, where asset management gaps are identified. Some of these gaps relate to the alignment between the public engagement materials, worksheets, templates, and tools and techniques to translate public engagement inputs (data, information, and requirements) into levels of service that drive asset management plans, decision-making processes, and financial budget plans. Alignment between the process to establish demands and needs in community services is necessary for the establishment of foundational levels of service that are the drivers of infrastructure, assets, and other municipal resources and requirements. Therefore, establishing a consistent methodology to determine levels of service will support public engagement requirements—and provide a transparent framework to calibrate the decision-making process based on objective data, essential levels of service, the cost of assets and resources, and budget availability.

Consequently, the municipal asset management approach has the intent to support councils to make informed decisions about what is to be included in their municipal financial reporting plan, considering the integration of public engagement plans; demand and needs analyses; the identification of levels of service; the total cost of assets and resources; a transparent decision-making process that will lead to the establishment of service levels agreements; and their continuous monitoring. As a result of this ongoing support provided by state and local government, the current and emerging asset management needs of municipalities demand the prerequisite of engaging stakeholders and creating enough buy-in to support municipal asset management efforts in a sustainable manner.

**Modernized State and Local Government Policies to Improve and Balance the Status Quo Practice of Tangible Capital Asset Accounting**

After the 2008 world economic crisis, many accounting and financial practices were revealed to have flaws in their various approaches, and these could be easily skewed to portray misleading financial performance, not necessarily portraying the overall health of the corporations, affecting with it all corporation assets, resources, budgets, and funding sources. Also, corporations, government organizations, municipal employees, and councillors acknowledge that municipalities producing financial reports in accordance with traditional accounting requirements do little to ensure municipal performance, ensuring the diligent management, administration, and operation of the organization. This governance gap is also extended to state and local government inspections and audits.

The scope of state and local government inspections and audits anchors itself in what is indicated in the state government requirements, with focus on municipal assessments and financial reporting according to accounting practices. The main assumption that is implied is that maintaining a budget is synonymous with organizational performance, setting a misleading governance and performance expectation for municipal officers and designated employees, where key performance metric is around the belief of maintaining a budget and reporting as the main commitment to the public, in order to meet state government legislation.

Also, some state and local government units would benefit in establishing, monitoring, and enforcing a professional management code of conduct and ethical performance behavior for their administration, management, and operations. While this is an implicit responsibility of municipalities with the public, there are many municipal corporations that lag such a minimum standard in their servant leadership and in the governance of municipal employee behaviors. In order to address these issues and to maximize the effectiveness of state grants and funding for municipalities, a different level of corporate performance and efficiency in the management, administration, and operation of municipalities is required, where employees are accountable for their behavior, actions, and advice in adherence to a profes-
sional code of ethics. Therefore, state and local government guidance and support is needed in the form of passing legislation that requires municipalities to abide by professional management with more effective and responsible results within a more robust asset management framework, process and system.

1. Regulating and Integrating an Asset Management Approach in State Government Regulations

Asset management has been recognized as a professional approach to help communities manage municipal infrastructure and assets to make better funding and investment decisions. Asset management also helps reduce risks, so municipalities can provide reliable and affordable services and a sustainable quality of life to local residents by integrating and balancing data, professional practices, processes and methodologies, as well as levels of service criteria. So far, there are a number of asset management initiatives spearheaded by various organizations in the country. Hence, providing asset management legislation within the state and local government will ensure that historical status quo tangible capital asset accounting practices are complemented with asset management plans for an effective implementation strategy. The intent is to provide elected council members with the total cost of assets ownership and levels of service in conjunction with the risks of not providing minimum levels of service and the impact to the assets, infrastructure, and funding sources in the long term.

Therefore, is for the state government regulations to incorporate specific statutes and regulations into the implementation of municipal asset management plans in order to set
state funding priorities when formulating its infrastructure plan. It is necessary that the state and local government support the introduction of a bill to regulate the “form and content” of municipal asset management plans and processes in support of financial report accounting practices. As state and local government recognize, conducting tangible capital asset accounting does not result in the proper planning of assets and resources, as it does not consider assets total lifecycle costs based on Levels of Service (LOS). What is currently happening is that many municipalities only are focusing on tangible capital asset accounting, as this is the main understanding and expectation set by the state and local government in the mind of many chief administrative officers (city managers) and designated officers. Consequently, the implied message is translated in a misleading expectation that does not take into account a balanced administrative, operational, management and financial level of performance, resulting in long-term operational and administrative inefficiencies that will not be resolved by simply continuing to fund municipalities with grants and other funding programs.

The regulation of asset management practices may also have some benefits to the sector, if municipal governments are able to meet the required criteria, given increased financial, capacity and time resources. Service level analyses and better condition data will lead to better decision making by councils and a better understanding by residents and businesses of priorities and managing expectations around the questions of the cost of the LOS and the capacity of municipal corporations to afford them. Better data should also lead, over time, to fewer application-based infrastructure funding programs offered by federal and state governments. If the point of asset management is to take a long-term view to priority setting for investments, then more formula-based programs that allow municipal governments to count on stable funding should result.

**Defining the Elements of an Integrated Municipal Asset Management Plan.** An integrated municipal asset management approach beyond accounting financial reporting practices (“Element viii”), includes as a minimum, the following elements:

i. Identification of all corporate assets and infrastructure as part of a comprehensive asset portfolio and inventory list. Assets definition has to be agreed, although it includes linear, vertical, mobile, information technology—and human talent assets.

ii. Community public participation sessions to establish demand and to conduct needs analyses

iii. Identification of principal and incidental LOS

iv. Creation of Asset Management Plans to include total cost of assets and resources associated with the LOS. A risk management plan and a change management plan shall be included

v. Establishment of a robust decision-making process to determine the right LOS in alignment with what the community can afford. Criteria to be set by council, municipal employees and community members. This to balance community revenues and state grants and funding availability

vi. Creation of a budget plan in alignment with the agreed LOS and funding sources

vii. LOS delivery to be monitored and controlled in accordance with service level agreements (SLAs)

viii. Financial reporting accounting to be conducted as per state government regulations and requirements

ix. Element viii to be complemented with a balanced scorecard that reports on the administration, operations, and management health and performance

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*It is important to consider the potential asset management planning regulation to be embedded into the existing regulatory state government framework, rather than added as a new layer.*

It would be important to consider the potential asset management planning regulation to be embedded into the existing regulatory state government framework, rather than added as a new layer. Therefore, state and local government units to conduct a comprehensive consultation on the potential municipal asset management planning regulation to improve and standardize integrated municipal asset management plans across the states and regions.

Therefore, a regulatory proposal will increase asset management criteria for municipal corporations. This will be in alignment with the state and local government support on building municipal governments’ resilience to implement asset management practices as a foundational cornerstone to change the planning culture in municipal organizations, where tangible capital asset accounting has reigned for many decades and has caused significant budget variances by setting inadequate expectations for the administration, operation and management of municipal corporations.

*Carlos Osterroth can be reached at (403) 529-8217 or osterwin@gmail.com.*
Applying fiber optic technology to active water pipes.

Fred Buckenmeyer, Public Works Director, City of Anacortes, Washington

When the City of Anacortes, a community of approximately 18,000 people on Fidalgo Island in western Washington, wanted to upgrade its radio frequency communications between its water and wastewater facilities system, it turned to fiber optics.

Not only would the fiber optic technology bring advanced communication capabilities to its public works facilities, it would build a backbone for its businesses and residents to latch on to.

Getting the city connected with fiber optics was not the final obstacle; we had to connect that fiber from the city to our water plant 15 miles away alongside the Skagit River in another part of the county.

The cable would have to cross private and public properties, county roads, state highways, and over (or under) at least two major water crossings.

“At first it seemed impossible, I had no idea how to do it,” said city Public Works Director Fred Buckenmeyer.
But after making a few phone calls and learning that a British company, Craley, was putting fiber optic communication cables in messenger lines and then feeding those into water pipes, the nearly impossible task turned into a simple one. 

**QUESTION:** How this was possible with simple phone calls? It needs extensive coordination and time.

**ANSWER:** Refer to the paragraph on p. 78 about Craley traveling to America as well as me traveling to Spain for research purposes.

Moreover, the technology to run fiber lines through water pipes developed by the British-based Craley Group had never been done before in North America. The largest pipes this had been installed, in Spain, was about 10 inches in diameter. Anacortes was the first to install the technology in 36-inch pipes.

There were obstacles, but as Water Maintenance Lead Brent Christensen said, they typically come with utility work.

**QUESTION:** Let me explain more about these “obstacles.” While having a protective cover and chlorinating has been done with other pipe monitoring technologies, what did we do about valves, PRV, etc.? There may be a limit on the distance depending on how we overcame these issues.

**ANSWER:** The obstacles encountered were being the first to do such work; we were in uncharted territory and that involves risk. However, our risk paid off and we were very successful.

**QUESTION:** Also, how would the fiber in the pipe change the acoustics when doing leak detection?

**ANSWER:** Too much speculation on our part.

**QUESTION:** Also, what kind of pipe material and diameter was it?

**ANSWER:** Pipe is 36’ welded steel.

**QUESTION:** What will the SOP be when there is a water main pipe break and what would the repair look like in additional time and costs?

**ANSWER:** SOP on this pipe is welded exterior repairs. Most of the damaged pipe can be repaired in place by welding a repair patch, but in the case of a catastrophic failure (severed pipe) we run a new messenger pipe if needed and use the slack and storage in the nearest handholds to re-splice the fiber.
QUESTION: Installation was done keeping the pipe operational?

ANSWER: For installation, there was a temporary shutdown of the waterline.

“We are on the cutting edge of brand-new technology, and it is exciting,” Christensen said.

The innovative approach meant no digging trenches and no piggybacking on power poles, which in turn meant no need to acquire dozens of easements and permits. Plus, it would use infrastructure the city already owned and controlled.

Buckenmeyer broached the idea to Mayor Laurie Gere and public works committee members who were excited about it.

“I was thrilled that we might have an opportunity to bring fiber to our community,” Gere said. “Before that point it was beyond our financial capabilities.”

Craley representatives flew out with examples of their fittings and assemblies used to thread micro duct conduit and, in turn, fiber into water pipes. And then Buckenmeyer traveled to Spain to see it firsthand, out of his own pocket.

“It was as simple as I thought it was,” Buckenmeyer said.

Next came getting the city water distribution crew to take on the work, considering nobody in North America had ever heard of the technology let alone knew how to install it.

And though the concept may have been simple, putting it into operation was at first easier said than done.

The installation technique involves inserting a draw cable into the water line with a parachute device attached to the front. Water pressure then deploys the parachute and moves the draw cable to an extraction device at the other end. The draw cable is then used to pull in the micro duct and then fiber is blown into the micro duct.

Water Distribution Supervisor Terry Nemeth worked with Craley and a local steel fabricator to modify the PFMs to accommodate large diameter pipes. “Then we worked with Craley to develop a pull rather push method for insertion,” Nemeth said. “This was the most extensive modification. Again, the problem was our large diameter pipes that enable the messenger pipe to roll onto itself.”

“It was just a matter of looking at what needed to be done,” Nemeth said. “I think everybody was working outside of the box.”

Upon permission from the Washington State Department of Health, we installed the pipe-in-pipe method in our water system and trained our talented public works staff to do the installation of the project earning the Most Innovative Award from the Department of Health in March 2019 for this unique approach.

QUESTION: Innovation in which approach?

ANSWER: Just the install of fiber. Innovative in that it’s never been done in the United States and the first in the world in a 36” pipe.

QUESTION: Just installation of the fiber optic cables?

ANSWER: Installing fiber into a conduit is done every day but installing micro-duct into an active water pipe is innovative.

QUESTION: Data measurements and also findings?

ANSWER: The crew constantly monitored the chlorine residuals during the deploy and took samples for bacteria after each deploy.
To better access and transport all the equipment necessary to install the 40 breakouts throughout the water system, the crew built “a deployment trailer” with everything from a chlorinator, which hyper chlorinates the conduit before sending it into the water pipe, to the spools of draw line and conduit.

**QUESTION:** Is the fiber optic able to control chlorination chamber?

**ANSWER:** Fiber can be used to control a number of SCADA components.

One of the last steps of the project has been to feed the fiber cable through the conduit with a fiber blowing machine. Nemeth said they’ve reached speeds of 200 feet per minute and average of 100 feet per minute.

When it got trying, Christensen said Buckenmeyer would remind him that no one in the U.S. had ever done anything resembling the work they were doing and to have faith.

The project has required that faith along with patience, prep and delicate work, said Christensen, who recently was sitting in a van fusing fiber strands together one at a time.

Businesses have already begun to get connected to the city’s fiber with the expectation that household connections will start in early 2020, using the same pipe-in-pipe technology though with smaller breakouts, feeding fiber from water meters to individual homes.

**QUESTION:** You can use pilot-based before connecting to the house to house because it will go through laterals?

**ANSWER:** These smaller breakouts allow us to install fiber from the water meter to the structure (house or building) without tearing up sidewalks, landscape or driveways because the very small micro-duct is in the 1” HDPE service line.

The goal from the beginning was to not only bring in fiber for city facilities, but to build an infrastructure to improve education, health care and quality of life for all community members, Gere said.

The city is also looking at helping others connect including a Naval Air Station on Whidbey Island, which lies across a water strait to the south. The base as well as other communities on the island fortunately get their treated water from the Anacortes system, thus their pipes link to the city’s pipes.

Being the first in North America to tackle pipe-in-pipe installation prompted a visit by Governor Jay Inslee and a visit by Representative Rick Larsen from Washington’s 2nd Congressional District. Anacortes has become the go-to entity in the U.S. for information on the technology.

“People have been contacting us from all over the U.S. asking about our project,” Buckenmeyer said. “It seems like there will be a race to be second going on.”

Craley has also incorporated many of the crew’s ideas and modifications, building on its technology for communities around the world.

**QUESTION:** City to water plant is 15 miles in length. What other parameters does the fiber optics measures like as water quality, any water loss due to leaking and flow levels etc.? What is the cost for instrumentation of the 15 miles?

**ANSWER:** The fiber will be used for telemetry to the booster stations and reservoirs which will give us real time information to monitor instruments for water quality. Craley has also developed a system to monitor leak detection throughout the wet pipe connection. In the near future, it will be used for dark and lit fiber leases.

**QUESTION:** What were the pre-requirements for the installation of fiber optic cables?

**ANSWER:** From Craley the only requirement was a flowing water pipe and a crew with a positive attitude to succeed. DOH required constant monitoring of the chlorine residual as well as successful Bac-T samples on all deployed sections. DOE required de-chlorination of all discharged water.

“The City of Anacortes is served by the most phenomenal professionals in the Northwest who have taken on this challenge, this new technology and done it with excitement and enthusiasm,” Gere said. “I could not be prouder.”

Fred Buckenmeyer can be reached at (360) 588-8330 or fredb@cityofanacortes.org.
For more information about these programs or to register online, visit www.apwa.net/Events. Program information will be updated as it becomes available.

Questions? Call the Professional Development Department at 1-800-848-APWA.

### EDUCATION CALENDAR

<table>
<thead>
<tr>
<th>Year</th>
<th>Event Details</th>
</tr>
</thead>
</table>
| 2020 | January 14-16: Certification Exam Dates (CSM, CPII, CPFP, CPWP-S, CPWP-M)  
February 11-13: Certification Exam Dates (CSM, CPII, CPFP, CPWP-S, CPWP-M)  
February 18-20: Certification Exam Dates (CSM, CPII, CPFP, CPWP-S, CPWP-M)  
April 16: Government Facility Security Programs & Technology  
April 19-22: North American Snow Conference, Cleveland, Ohio  
August 30-September 2: PWX 2020, New Orleans, Louisiana |
| 2021 | April 11-14: North American Snow Conference, Grand Rapids, Michigan  
August 29-September 1: PWX 2021, St. Louis, Missouri |

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Bonnell announces expansion of manufacturing facility

Bonnell Industries Inc. has announced the expansion of their manufacturing facility with the opening of a new building at the company’s headquarters in Dixon, Illinois. At 8,500 square feet and five acres, the addition consists of a large shop floor, parts-mezzanine, office space and worker amenities, with a paved lot for ample parking. Dedicated to Bonnell’s truck install division, the much-needed new building will free up space for other manufacturing lines as the company continues to see growth. For more information on Bonnell and to keep up to date with their latest news, visit www.bonnell.com or follow them on Facebook, LinkedIn and Instagram.

CT Group the exclusive distributor for Miovision TrafficLink in 31 U.S. states

The CT Group, a trusted provider of solutions for the traffic signal control and ITS markets, is now the exclusive distributor of Miovision TrafficLink in 31 states. TrafficLink is a turnkey solution for remote traffic signal management and smart city solutions, providing the entire range of solutions needed for a traffic team to collect, monitor, and understand their traffic signals. This includes a managed cellular connection, and tools for signal monitoring, video streaming, maintenance alerts, as well as traffic data insights. Details at www.cttraffic.com.
Hands-free accessibility from Hyperlight Systems

Our cities are full of barriers, such as faregates and doors. For people with disabilities, physical barriers prevent access to independent and equitable mobility. For everyone else, barriers are a major inconvenience. Using smart wireless technology, Hyperlight Systems is transforming these common barriers into seamless, hands-free experiences for everyone. Hyperlight Systems has developed the world’s first unified platform for hands-free accessibility that has been successfully deployed on the longest autonomous rapid transit system in the world.

Hyperlight Systems has won numerous innovation awards for improving accessibility in public transit. For more information, contact Ashish Sachdeva, CEO & Founder, at (604) 354-4532 or ashish@hyperlightsystems.ca.

Brigade Electronics enhances radar detection range with two new products

Global leaders and experts in vehicle safety Brigade Electronics have added two new products to its radar obstacle detection range: the IP69K Programmable Backsense® Object Detection System and the Backsense® On-Screen Display Kit (OSD). Brigade Electronics’ radar obstacle detection systems work to minimize damage and prevent injuries caused by collisions by informing the driver of the distance between vehicles and obstacles, whether moving or stationary. More information can be found at https://brigade-electronics.com/en-us/.
New sweeper delivers significant fuel savings, quieter operation, and reduced emissions without sacrificing power, performance, or productivity

Elgin Sweeper Company, a leading manufacturer of street sweepers in North America, has initiated customer evaluations of a plug-in, hybrid electric version of its popular Broom Bear mechanical sweeper. The hybrid Broom Bear is another example of Elgin Sweeper’s ongoing commitment to help municipal customers reduce their carbon footprint, improve air quality, and mitigate climate change. The hybrid Broom Bear uses a high-capacity battery to power the sweeper. The battery can be recharged while driving or when plugged into an electrical outlet. For more information, visit www.elginsweeper.com.

RoadBotics: Fast, objective road assessments

RoadBotics empowers cities to assess roads using artificial intelligence. We automate inspections and generate objective, actionable data about road networks. Our detailed maps, unbiased ratings, and practical tools save time and taxpayer dollars for over 160 communities across the country and around the world. For more information, visit www.roadbotics.com, send email to info@roadbotics.com, or call (412) 345-3398.

Rolling Compactor reduces waste volume by up to 80%

The ROPAX Jumbo Rolling Compactor from Epax Systems uses a rolling drum with sharp metal teeth to crush, macerate, tear, rip and compress waste in large open top containers/dumpsters. The rolling drum, which weighs over two tons to aid in compaction, is attached to an articulating boom which moves it from one end of the container to the other and back again crushing and compacting waste all along the way. The ROPAX Jumbo provides effective compaction of a wide variety of items including cardboard and other packaging, wood pallets and crates, cable reels, paper, film and foil, green waste, encapsulated polystyrene, household goods, light metals and other bulky items. For more information, visit www.epaxsystems.com.

Stake Center Locating: The smart choice for utility locating

Stake Center Locating, a leading provider of utility and fiber optic network locating services, has completed the recapitalization of its capital structure. The new capital structure will provide significant liquidity to accelerate Stake Center’s strong growth with current and new customers who desire the company’s unique specialty locating and damage prevention services. With this increase in financial flexibility, Stake Center Locating will also explore alternative avenues to growth, including acquisitions and new service lines. For more information, call 1-336-992-5420 or Toll Free at 1-800-483-4962, or send email to inquiries@stakecenter.com.

New 400,000-pound capacity Universal Testing Machine able to test 12-foot-long samples

CTL|Thompson can now perform high-capacity compression and tension testing on samples of up to 12 feet long at a capacity of 400,000 pounds, thanks to its new Universal Testing Machine and expanded lab. As Acceptance Criteria requirements become more complex, CTL found and refurbished an older machine, then raised its lab roof to accommodate the 28-foot height. The machine’s test frame incorporates state-of-the-industry hydraulics and sensing systems and surpasses nearly all other testing providers in its ability to test large samples. No longer limited by the lack of large test frames, clients can produce longer products that support their design. For more information, visit www ctlthompson.com. (Photo credit: CTL|Thompson)
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2021 Aug. 29-Sept. 1 St. Louis, MO
For more information, contact David Dancy at (800) 848-APWA or send e-mail to ddancy@apwa.net.

National Public Works Week: May 17 – 23, 2020
Always the third full week in May. For more information, contact David Dancy at (800) 848-APWA or send e-mail to ddancy@apwa.net.

North American Snow Conference
2020 April 19-22 Cleveland, OH
For more information, contact Brenda Shaver at (800) 848-APWA or send e-mail to bshaver@apwa.net.

JANUARY 2020

10-11 American Society of Civil Engineers, Regions 3, 6 & 7 Multi-Region Leadership Conference, Detroit, MI, www.asce.org
14-16 APWA Certification Exam Dates (CSM, CPII, CPFP, CPWP-S, CPWP-M)
31-2/1 American Society of Civil Engineers, Regions 1, 2, 4 & 5 Multi-Region Leadership Conference, Philadelphia, PA, www.asce.org

FEBRUARY 2020

11-13 APWA Certification Exam Dates (CSM, CPII, CPFP, CPWP-S, CPWP-M)
16-22 Engineers Week, www.nspe.org
18-20 APWA Certification Exam Dates (CSM, CPII, CPFP, CPWP-S, CPWP-M)
25-29 American Society of Civil Engineers, Geo-Congress 2020, Minneapolis, MN, www.asce.org

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