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(see page 10)
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On the cover: Aerial view of the Santan Vista Water Treatment Plant as it neared construction. The plant, jointly owned by the Town of Gilbert and City of Chandler and situated on a 40-acre parcel in southeast Gilbert, was the central piece of a nearly $175M water delivery program and netted the communities seven industry awards. (Photo credit: Sundt Construction Company)
he APWA Board of Directors has identified three primary objectives for the Association: Advocacy of Public Works; Integrated and Comprehensive Professional Development; and Support and Strengthen Chapters. The purpose of these objectives is to focus the efforts of our members and staff in doing the work of the Association. By making our members and staff aware of these objectives, the value and effectiveness of the Association is increased significantly. In this way APWA can truly claim to be the lead organization promoting good public works and the best and most modern infrastructure for the U.S., Canada and our citizens.

When it comes to our various committees and work groups, both at the chapter and national levels, recognizing and taking to heart these objectives means considering them when developing committee work plans and then while working through them. The work of the Technical Committees involves more than keeping up on technical matters; rather, it is to help our members to apply technical information to solve day-to-day problems. The Board’s objectives are intended to help us do just that.

The challenge, then, is to find ways within each Technical Committee’s area of interest to address these objectives. To do this it might be useful to go over just what each of these objectives means.

Let’s start with advocacy: Merriam-Webster’s defines advocacy as “the act or process of supporting a cause or proposal: the act or process of advocating something.” Every professional has a duty and most would agree, an obligation, to promote their profession. We must advocate not for the benefit we might personally receive, but to help the profession as a whole serve our communities and human beings with the technical skills and benefits our profession has to offer.

Public works has brought benefits to humans and their civilizations for thousands of years. We provide two of the basic necessities of life—water, and we are the first line of defense in protecting humans from disease caused by waste and pollution. Our bridges open the world and make commerce possible. The buildings we help build and maintain provide shelter and places for the rest of humanity to develop our civilization and its various cultures. These are the things our profession does and we must make sure people know what we do... we must advocate! By doing so we can gain their support and thus continue our work.

A second priority is to ensure that we invest in the professional development of our members and member agencies. The strides that we have made over the past several years in education of our public works professionals will continue to offer us opportunities to build on new and expanded initiatives in professional
Finally, the Board of Directors is committed to ensure that our **chapters** remain strong and capable of serving their members. Chapters are the strength of the Association and the point of delivery of support and services to our membership. Our members recognize and relate to their own chapters. We want to absolutely be sure that our chapters remain financially and technically healthy, and that we’re delivering good value to our members through them.

The creation of the Council of Chapters—a restructuring and refocusing of the House of Delegates—is a significant step forward to strengthen and support our 63 chapters. The role of the Council of Chapters is to serve the organization as advisors to the Board of Directors, the Executive Director, Technical Committees, and other committees and staff in support of APWA’s mission and strategic initiatives. One of the objectives of the Council is to create chapter-to-chapter links that will strengthen how chapters share information and provide support to one another. The Council and delegates serve as consultants to chapters in support of member engagement and growth.

We must not forget that public works is the field that provides some of the basic necessities for society and all its members to live. We do not build infrastructure for ourselves, but for all the people who inhabit our world. By keeping in mind the three primary objectives the APWA Board of Directors has identified for the Association while we solve the technical problems we face every day, we make ourselves stronger leaders and bring more value to the infrastructure we are responsible for.
Federal Appropriations 101

Josh Reiner
Government Affairs Manager
American Public Works Association
Washington, D.C.

Every spring Congress focuses on funding the federal government for the upcoming fiscal year. The federal fiscal year runs from October 1 to September 30 each year. As you may know, the Constitution gives Congress the power to lay and collect taxes and to appropriate money. It does not specifically state how these powers are to be exercised. Rather, these processes developed over the course of the twentieth century as the federal government increased in complexity.

The first step is for the House of Representatives and Senate to each pass a budget resolution created by their respective budget committees. The budget resolutions set a framework with top-level spending amounts for the federal government. This document includes general funding levels and major policies each chamber wishes to see enacted. The next step is for the respective Appropriations Committee in each chamber to determine the specific fund levels of every federal program. Considering the multitude of agencies, with varying specialized needs, the budget is broken up into twelve parts with an appropriations subcommittee dedicated to each.

The appropriations bills and corresponding committee reports each subcommittee produces include a mixture of spending restrictions, suggestions, and requirements aimed at affecting the behavior of those agencies. A bill may prohibit an agency from issuing a regulation by defunding their ability to work on it, like the Environmental Protection Agency’s pending Waters of the US rule. Another option is to include language in the committee report encouraging an agency to behave in a certain way, unless it wants to risk a drop in funds the following year. Further, under traditional practice, the consideration of these bills on the House and Senate floors allows amendments to the legislation by any Representative or Senator within their respective chamber.

These amendments are only restricted in that they must conform to the budget and cannot create a new program or agency. That is the responsibility of authorizing committees, like the House Transportation and Infrastructure Committee or the Senate Environment and Public Works Committee. Each appropriations bill is then voted on by each chamber and if it differs from the other chamber’s bill, the proposed legislation then goes to a conference committee to iron out those differences.

There are multiple opportunities for constituents to influence the provisions included in each appropriations bill. Until 2011, Representatives and Senators could request funds for specific programs in their districts and states, known as “earmarking.” While earmarking is prohibited, requests for increases on a national program basis can be made by Representatives and Senators. Through their Representative or Senator, constituents can also request specific language in the committee report, which may influence an agency’s behavior.

During this tough budgetary climate, Congress believes strongly in its constitutional responsibility to ensure scarce taxpayer dollars are well spent. Further, the funding power of Congress serves as a check on the Executive Branch. Supporters of federal programs must be prepared to defend those programs from harmful cuts and policy restrictions. The APWA Government Affairs team will continue to monitor for cuts impacting public works, engage lawmakers when needed, and enlist APWA membership to exercise their grassroots muscle when needed.

Josh Reiner can be reached at (202) 218-6734 or jreiner@apwa.net.
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Volvo Construction Equipment
During their April 21-22, 2015 Spring Meeting in Washington, D.C., APWA’s Government Affairs Committee (GAC) members worked diligently to advocate for public works and infrastructure on Capitol Hill. In addition to meeting with key congressional staff from the House Transportation and Infrastructure Committee and the Senate Environment and Public Works Committee, the GAC also met with leaders from the Department of Transportation (DOT), the Federal Emergency Management Agency (FEMA), and the Environmental Protection Agency (EPA). With the APWA strategic emphasis on advocacy, GAC members are redoubling their efforts to increase the awareness of public works with government leaders on Capitol Hill, as well as back home in their local municipalities, regions and states, and with federal departments, agencies, and partner organizations.

“This spring, we in the industry are focused on the urgent need for Congress to reauthorize funding for the Highway Trust Fund, which currently expires at the end of May. GAC has been working with the Government Affairs staff in the D.C. office to meet with important congressional committees. We also met with department leaders from EPA, FEMA and DOT, to discuss the importance of public works and infrastructure topics face-to-face, and have productive conversations about the issues facing our members in their agencies and impacting infrastructure projects across the country,” said GAC Chair, Keith Pugh, P.E., PWLF, Director of Engineering Services, High Point, North Carolina.

**Freshman Congressman**

In addition to meeting with key congressional committee staff, and federal agency and department leaders, the GAC also met with Freshman Congressman, Representative Crescent Hardy, from Nevada’s fourth district. Representative Hardy is a former Director of Public Works himself, and GAC Member Steve Ireland is a...
constituent of the Congressman. The GAC welcomed the opportunity to hear from Representative Hardy about his work on the House Transportation and Infrastructure committee and his views on transportation reauthorization.

The APWA Government Affairs team in D.C. intends to engage with the Congressman and his staff on various public works priorities as well as exploring establishing a Public Works Caucus in the House of Representatives. Andrea Eales, APWA’s new Director of Government Affairs, shared comments about the important work the GAC does on behalf of public works both in D.C. and back home in their communities. “The GAC is motivated to advocate on behalf of APWA’s membership and this most recent meeting was a terrific step in elevating our organization and its priorities at the federal level,” Eales said. “That being said, all APWA members need to engage with their elected officials to educate them about the crucial work public works professionals do to ensure and improve our quality of life in this country.” Andrea urges APWA members who are not yet signed up as APWA Advocates to do so by going to the following link: http://www.apwa.net/be_involved/APWA-Advocates/Sign-Up-For-APWA-Advocates.

Also, in order to stay on top of happenings in D.C. that impact APWA and its priorities, sign up to receive the APWA Washington Report at: http://www.apwa.net/resources/WashingtonReport.

Have questions about APWA Government Affairs? Please contact Andrea at aeales@apwa.net or (202) 218-6730.

In my book, dig and replace has been replaced. This is a much better solution all around.
E&T Committee serves as a resource to chapters and members

Carol S. Estes, P.E.
Professional Development Program Manager
American Public Works Association
Kansas City, Missouri

The Engineering & Technology (E&T) Committee is one of APWA’s broadest Technical Committees. The committee provides education and information to help public works agencies understand and utilize cutting-edge technology and sound engineering principles. The committee sponsors technical sessions at APWA’s annual congress each year, provides informative articles in the June issue of the Reporter and sponsors informative Click, Listen & Learn programs.

At the APWA Congress this year, the E&T Committee recommends several education sessions. In the first, “Taking Flight to the Next Level – Practical Public Works Applications of Unmanned Aerial Vehicles,” attendees will learn about the UAV technology and resources available and what other public works agencies are doing, evaluate how UAVs can benefit the public works mission, and learn what the costs are and the policy issues related to privacy and operation. In the session “From e-Government to m-Government: Public Works on Demand, On the Go” participants will identify new channels and opportunities to deliver public works services, study how to deploy new technology solutions to streamline internal operations and interactions with customers, and how to engage the public and offer outreach to new sectors of the public through innovative technologies. Members attending the “Creating a Culture of Innovation for Your Public Works Agency – With Incredible Results!” session will learn how to establish a culture of innovation in their public works agency; how to encourage the use of cutting-edge technologies and state-of-the-art leadership at every level and astonish their community with the results; and how to coordinate and integrate multiple levels of technologies to reduce costs, enhance services, and promote economic development.

In addition to the educational sessions at Congress, the committee has been writing articles for this edition of the Reporter. Articles submitted or sponsored by the committee include:

• “Managing the Life of Public Works Assets” by Kevin Ford and Andrew Lemer
• “What is the work of today’s Civil Drafters” by Charles D. Upchurch
• “Weather and Public Works” by Dennis Randolph

“Civilizations should be measured by the degree of diversity attained and the degree of unity retained.”

– W. H. Auden (1907-1973), British poet and playwright
“Can We Protect our Electronic Lifelines” by Mike Sutherland, Emergency Management Committee Chair

This year, the E&T Committee revised two of its most requested publications: APWA’s “Red Book,” a discussion of qualifications-based selection (QBS), and “The Roadway Maintenance Guide.” Both publications will be available in the APWA bookstore later this year.

To make new technology more accessible to members, E&T members actively scan emerging new technology that could improve public works practice and to encourage thinking about future best practices, 5 to 10 years hence. Brief items appear in the Reporter in the “Imagination to Innovation” column written by Andrew Lemer, Ph.D.

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, private and education sectors, it is the mission of the committee to serve the needs of members. As always, the committee welcomes any thoughts and comments.

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

- Dennis A. Randolph, P.E. (Chair), Director of Public Works, City of Grandview, Missouri
- Richard M. Balgowan, CPM, CPWM, P.E., PWLF, Robson Forensic, Inc., Hamilton, New Jersey
- Todd A. Blomstrom, Public Works Director, City of Apple Valley, Minnesota
- Andrew Lemer, Ph.D., Senior Program Officer, Transportation Research Board, Washington, D.C.
- Joline McFarlane, Asset Management Specialist, City of Airdrie, Alberta, Canada
- David L. Lawry, P.E. (Board Liaison), Director of Engineering and Public Works, City of Schaumburg, Illinois
- Carol Estes, P.E. (Staff Liaison), Professional Development Program Manager, APWA Kansas City Office

Carol Estes serves as the liaison to three of APWA’s Technical Committees—Engineering & Technology, Transportation, and Utility & Public Right-of-Way—as well as nine subcommittees. She can be reached at (816) 595-5222 or cestes@apwa.net.

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Great projects abound in Arizona – visit one as part of your 2015 Congress experience

Jeffrey A. Kramer, P.E., PWLF, CPM, CCM
Associate Director, Alliance for Construction Excellence
Arizona State University, Tempe, Arizona
Co-chair, 2015 APWA Congress Volunteers Committee

Now that you have decided to come to Congress in Arizona in 2015, your next big decision is what to do with all your time while you are here. Sure, most of it will be spent in educational sessions, on the expo floor, or at one of the many social events, but what about checking out some of Arizona’s fantastic public works project history, including great works such as the Hoover Dam, Marble Canyon Bridge, Roosevelt Dam, and Central Arizona Project (CAP), to name a few.

The Congress Committee has planned several great options for you, including a tour of the CAP headquarters and canal. Other options include the Valley Metro Rail Maintenance Facility, the Sky Harbor International Airport Consolidated Car Rental Facility, Chase Ballpark and its Northwind Facility, and the Tempe Town Lake Dam, among others.

One of the hallmarks of Arizona’s public works industry is collaboration. Our communities often join forces for major public works infrastructure, sharing capital and operating costs to everyone’s benefits. Sure, many other places around the country do this too, but in Arizona we have made it into an award-winning project. One such project that isn’t on the technical tour agenda is the SanTan Vista Water Treatment Plant (STVWP).

On the surface it sounds like a municipal water treatment plant; located in Gilbert, Ariz., a suburb in the southeast Phoenix metro area that was the fastest growing municipality in the country for about a decade. The plant is jointly owned by Gilbert and Chandler, Ariz., another rapidly growing SE Valley suburb. Gilbert staffs and operates the plant, which was funded 50/50 by the two municipalities, and a comprehensive intergovernmental agreement spells out financial responsibilities for operating and maintenance costs.

But dig a little deeper, and what you find is a surface water treatment plant that was one part of a four-project, $200M plus (original program budget) program both communities needed quickly in order to meet rapidly increasing water supply needs in the southeast valley. The projects included the STVWP at a cost of $125M; a 14-mile-long, 48-inch diameter raw water delivery pipeline to bring CAP water to the plant ($50M); eight miles of 16-inch to 36-inch finished water distribution lines ($15.5M); and one mile of new five-lane arterial roadway ($12M). All four projects had different teams and different challenges to meet the demanding schedules, so the owners contracted with ARCADIS as their program manager to oversee all the work. Here are a few highlights of the program as it was implemented with Gilbert as the lead agency on all projects.

SanTan Vista Water Treatment Plant
As Gilbert and Chandler began working together toward developing the SVWTP it was clear there would be several challenges:

Aerial view showing completed treatment plant with new arterial access road. Adjacent vacant land is planned for future residential subdivisions.
• The plant was developed as a 24MGD facility, but included future expansion to a 48MDG facility with minimal throwaway work.

• A demanding schedule of 3.5 years from start to finish operations had to be met.

• Addressing concerns of adjacent neighbors as the plant location is in a growth area with multiple planned developments.

• Funding was fixed by the communities, so there could be no cost growth. There was a strong desire to reduce costs so a lower bond sale could be held.

The owners chose to deliver the plan using the Construction Manager at Risk delivery method, with a team of Sundt as CMAR, Black & Veatch as designer, and Corollo as owner’s onsite resident engineer/inspector.

• The plant was designed with a polymer and micro-sand ballasted flocculation treatment process, a first for Arizona, and a process that allowed a significantly smaller footprint than other processes.

• Chlorination was achieved through onsite sodium hypochlorite generation, eliminating the transport and storage of chlorine.

• Water used during the treatment process is recovered and recirculated back through the plant, giving a 99% efficiency rating.

• Expansion was also addressed, and the plant was constructed with all building facilities completed, and pre-set connections for a mirrored treatment process train in place to simplify, and provide cost efficiency, in the future expansion.

• Delivery time was three years and eight months from design NTP to final completion of construction, with the schedule experiencing only 16 days growth, all weather related.

• Project cost was reduced during design, resulting in a GMP of $88.5M and a total project cost of $110M, a savings of over $15M from the original budget. Cost growth during construction was held to less than one percent.

• The final project received seven awards:

  o Maricopa County Air Quality Department Air Quality During Construction Honor Award
  
  o 2009 ACI AZ Chapter Exposing the Best in Concrete Award
  
  o 2009 ACEC Engineering Excellence Honor Award
  
  o 2009 American City and County Magazine Crown Communities Excellence Award
  
  o 2010 Maricopa Association of Governments Desert Peaks Award – Regional Partnership
  
  o 2010 APWA AZ Chapter Project of the Year – Environment over $75M
  
  o 2010 CMAA National Project Achievement Award – Infrastructures Less Than $150M
CAP Raw Water Delivery Pipeline
Much like the plant itself, getting raw water to the plant so it had something to treat was another major challenge for the communities. The nearest supply source was an existing turnout structure on the CAP canal in Pinal County, requiring a nearly 14-mile gravity pipeline. Challenges included:

- The pipeline had to be in service before the plant was ready to commission, providing only 30 months for project delivery.
- Rights-of-way, easements and/or permits were needed from multiple private landowners, several irrigation districts, the State Land Department, three federal agencies (Central AZ Water Conservation District, BLM and BuRec), two counties (Pinal and Maricopa), and three municipalities (Chandler, Gilbert and Queen Creek)—over 200 agencies and owners total.
- The pipeline alignment crossed the Union Pacific Railroad.
- 14 miles of pipe material had to be procured and delivered on schedule without excessive material storage available.

A design-build team led by Achen-Gardner Construction hit the challenges head on. Coupled with designers Stantec and HDR, and owner’s rep PM/CM Jacobs with Wilson Engineers, the design-build team took on a total project delivery role. Not only did the team perform design and construction, they handled all right-of-way, easement and permit acquisition activities from title reports to negotiations to closings. This approach paid big dividends as the team delivered the project several months early and more than $8M under original budget. Highlights of how the team accomplished this are:

- An initial alignment study for the entire route determined that by increasing the route two miles the project would actually save money through lower R/W costs, and increased productivity reducing installation costs.
- Thorough analysis of pipe type, installation cost and availability, coupled with competitive bids solicited at 30% design, resulted in a decision to use ductile iron pipe, providing a cost savings of over $700,000 (due to lower installation and corrosion protection costs) and more certainty in delivery availability.
- A multiple GMP approach allowed the DB team to begin early construction and long lead procurement, which was critical to meeting the overall schedule requirement.

As with the other projects, this one also had its share of interesting challenges to overcome:

- Lines of four different diameters were needed to serve three different delivery zones in two different municipalities.
- Chandler’s line had to cross an irrigation district main delivery canal as well as a regional flood control channel.
- The restrictive schedule required the GMP to be developed based on 30% complete plans, and the project to be constructed in multiple phases in order to stay ahead of plan finalization.
- Chandler required a full system flush of their line, which required over seven million gallons of water to perform.

For this project a design-build team led by Hunter Contracting, with designer Stantec, and owner’s rep PM/CM Wood-Patel & Associates was selected. The construction GMP of over $13.8M

Ocotillo Road Finished Water Lines
In addition to getting water into the plant and treating it, the program included lines to distribute the treated water into the two municipal systems.
was performed on a Time & Materials basis to satisfy Chandler, who was concerned about the early GMP and cost containment since the project was over 80% theirs. Ultimately the project was completed for only $11.9M, and was two months early, in spite of two significant delays—a collapse of the main irrigation canal which flooded a jacking pit and caused several weeks of delay during repairs, and waiting for the plant to come online to produce 15 million gallons of water to provide for bac-t and scour testing.

**Ocotillo Road**

Getting water to and from the plant wasn’t the only transportation issue the owners faced; getting people there was an issue too as the plant location had no existing roadways servicing it. Gilbert proceeded with their $12M Ocotillo Road project to solve that issue. The one-mile-long, five-lane minor arterial was delivered using a design-build approach, not because it had a series of challenges or issues to overcome, but because it became a vehicle to help the other projects address issues including:

- With the plant located near the mid-mile location, portions of the raw water delivery line and the finished water distribution lines were built with the roadway project to allow the roadway to complete without concern about the pipeline projects disturbing new pavement later.
- A deep 15-inch sewer line to serve new Gilbert and Queen Creek development was included with the project to avoid future impacts to the water lines and pavement during installation.
- The plant required redundant power supply, requiring a significant electrical infrastructure to be placed for Salt River Project from the west end of the project into the plant.
- Coordination was required with adjacent planned developments including two residential subdivisions and a Town of Gilbert Fire Station, as well as existing rural residential properties impacted by the new access.

Constructed by the design-build team of Haydon Building Corporation with designer AZTEC Engineering, and owner’s rep PM/CM Carter-Burgess (now Jacobs), the project was delivered one month early and $700,000 under budget.

The four projects highlighted constitute a significant public works infrastructure undertaking that was superbly delivered, with overall savings of nearly $26M due to the collaborative delivery processes, providing significant benefit to two municipalities and their nearly 500,000 residents. These brief snippets don’t tell the whole story for any of the four projects, but you CAN get an up close and detailed look at the projects on the technical tours. Make sure you register for one soon as they will fill up quickly. We look forward to seeing you this summer in Arizona at the 2015 Congress!

Jeffrey A. Kramer is serving as a Co-chair for the Arizona Chapter’s 2015 Congress Volunteers Committee. An APWA and Arizona Chapter member since 1993, he serves as the Associate Director of the Alliance for Construction Excellence, which is the outreach arm of the Del E. Webb School of Construction at Arizona State University. (Kramer was the senior program manager for ARCADIS during delivery of the projects in the article.) He can be reached at (480) 965-1418 or jeffkramer0813@gmail.com.
The Challenge: To develop and implement a comprehensive stormwater program that would reduce the amount of nutrient concentrations and other pollutants entering the regional stormwater system.

The Purpose: To meet the federally-mandated requirement for stormwater discharges; to improve the quality of water discharged into the Everglades.

The Solution: Wellington Environmental Preserve at the Marjory Stoneman Douglas Everglades Habitat.

The Village of Wellington, Fla., in western Palm Beach County is a unique mixture of urban, rural, equine and agricultural land uses each having varying impacts on stormwater quality. Through regulations controlling animal waste, fertilizer use and application plus specialized development standards, Wellington has demonstrated its commitment to protecting and improving our water resources.

Since 1999 Wellington has played a leadership role in the development and implementation of stormwater quality improvements. To date Wellington has invested over $20 million and has partnered with regional, state and federal agencies towards the mutual goal of improving water quality in South Florida and ultimately in the Everglades. Some of the projects include a complete re-plumbing of its stormwater canal system which eliminated discharges to portions of the Everglades.

In an effort to comply with the Everglades Forever Act, one of the least known but most impressive places to see in Wellington—the Wellington Environmental Preserve at the Marjory Stoneman Douglas Everglades Habitat, or as we call Section 24—was created.

Section 24 is a 365-acre rainwater storage area that removes excess phosphorus from the rainwater before it enters the Everglades. Section 24 is a place where people can enjoy nature trails, a paved pedestrian path and a boardwalk that leads to seven designated learning areas. There is a large decorative trellis and six-story observation tower located at two of these learning areas. Interior uplands and native landscaping provide an exhibition of the beauty of natural Florida. The Preserve is now home to a wealth of flora and fauna.
to a wide variety of Florida wildlife including rare birds, gators, deer, foxes and otters.

The Preserve also includes a 3.6-mile perimeter equestrian trail that is an extension of the approximately 65-mile Wellington bridle trail system. The Preserve has become a great place for folks to visit and observe Florida wildlife, walk the trails and visit the learning centers, climb to the top of the observation tower and enjoy the view, or even plan a wedding at the trellis.

This beautiful Preserve was built through a partnership between South Florida Water Management District (SFWMD) and Wellington. In compliance with the 1994 Everglades Forever Act, rainwater from Wellington must be cleansed of phosphorus before it enters the Florida Everglades. The southern half of Wellington (Basin B) has 9,230 acres of stormwater runoff (rainwater) that is now west to Section 24 via the C-1 canal heading north to the C-51 canal that runs along State Road 80 before finally entering the Everglades.

In order to accomplish this, seven stormwater pump stations were constructed or renovated along with the widening of nearby canals. Approximately one inch of rainwater from Basin B was also rerouted to reach Section 24. It is naturally cleansed as it flows through over two miles of combined wetland/marsh area, littoral shelves and deep water sediment traps. Phase II of Wellington’s Best Management Practices and Mitigation Project is designed to further enhance flood attenuation, improve water quality and provide additional storage of the surface water.

The project’s goal is to further reduce nutrient concentrations and other pollutants that potentially may enter the regional stormwater systems. Wellington has proactively and independently proposed new BMP regulations and operational protocols designed to further reduce nutrients in our stormwater systems. This goal is consistent and complimentary to other state and federal efforts to improve water quality in South Florida and the Florida Everglades.

We recently got the chance to share the beauty of the Wellington Preserve with Ann Daniels, APWA Director of Accreditation; Shawn Hartness, Assistant Service Director at Union Township, Ohio; and Catlin Gard,
Assistant to the Public Works Director in Shawnee, Kans., during our Accreditation Site Visit in January.

Since 1994, the State of Florida has invested $1.8 billion toward lowering phosphorus levels in the Everglades-bound waters through a combination of nutrient source controls and construction projects. Farming Best Management Practices (BMPs) prevent or reduce phosphorus in discharges at the source, and Stormwater Treatment Areas (STAs) use “green technology” to remove excess phosphorus.

Five Everglades STAs are operational in Florida with an effective treatment area of 57,000 acres, including 12,000 acres completed in 2012. In 2014 these constructed wetlands treated more than 14.7 million acre-feet of water and have retained approximately 1,874 metric tons of phosphorus.

Farming BMPs under the SFWMD regulatory source control program on 47,000 acres of agricultural lands south of Lake Okeechobee have resulted in annual average phosphorus reductions greater than 50 percent, more than twice the amount required by state law. To date, BMPs at the source and regional STAs together have prevented approximately 4,582 metric tons of phosphorus from entering the Everglades.

While reading this you may have asked yourself, “Who is Marjory Stoneman Douglas?” She was born on April 7, 1890 in Minneapolis and became a reporter for the Miami Herald in 1915. In 1917 she was the first Florida woman to enlist in the Naval Reserve. After she was discharged she focused on several causes, including feminism, racial equality, and conservation. She dedicated the rest of her life to protecting and restoring Florida’s natural ecosystems.

Ms. Douglas was also an author and in 1947 her book The Everglades: River of Grass was published and it was the same year that Everglades National Park was dedicated. In 1969, Ms. Douglas created the Friends of the Everglades, a nonprofit organization devoted to raising awareness about Florida’s fragile wetlands.

Ms. Douglas was an author and in 1947 her book The Everglades: River of Grass was published and it was the same year that Everglades National Park was dedicated. In 1969, Ms. Douglas created the Friends of the Everglades, a nonprofit organization devoted to raising awareness about Florida’s fragile wetlands.

In 1993, at the age of 103, Ms. Douglas was awarded the Presidential Medal of Freedom, the highest honor for American civilians.

Ms. Douglas personifies passionate commitment. Her crusade to preserve and restore the Everglades has enhanced our nation’s respect for our precious environment. She has been called the “Grandmother of the Glades” and her splendid example in safeguarding America’s beauty and splendor should be followed by generations to come.

Marjory Stoneman Douglas died in 1998 at the age of 108. Her legacy will be our preservation of her dream—to protect and restore her beloved River of Grass.

The Wellington Environmental Preserve at the Marjory Stoneman Douglas Everglades Habitat was named the “Project of the Year” by the Palm Beach County Chapter of the American Society of Civil Engineers and is located at 3491 Flying Cow Road, Wellington, Florida.

“There are no other Everglades in the world. They are, they have always been, one of the unique regions of the earth; remote, never wholly known.” – Marjory Stoneman Douglas

Jesse Wright can be reached at (561) 791-4078 or jwright@wellingtonfl.gov.
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My background in the public works industry has not been what I would call typical. I started in the industry roughly 14 years ago at the age of 16 as an intern through a regional transportation program. The program is designed to get high school students incorporated in the transportation side of public works. Following my internship I worked as a part-time temporary employee in the maintenance department of a local municipality while in college studying civil engineering. As a member of the maintenance crew I learned the construction side of public works while building and installing all different forms of typical public works improvements. Later I took the position of Engineering Technician where I learned the administrative side of a public works department. Following my role as technician I obtained my Public Works Inspector position in which I have applied both my construction and administrative background in the public works industry.

I pursued the APWA Certified Public Infrastructure Inspector certification in order to improve myself as an inspector and test my knowledge. Prior to applying for the CPII certification I had performed extensive research to find the best overall inspector certification in the industry. Although I was able to find other certifications specific to all forms of construction, I felt the APWA CPII certification was the best all-encompassing certification for a Public Works Inspector.

When preparing for the exam I read a few of the books recommended in the reading list; however, I relied mostly on experience. The books I chose to read generally pertained to areas I felt I was weaker in, which helped me learn things I probably would not have learned otherwise. Based on APWA’s reading list it is clear that the exam covers generally anything you can expect to see in construction. Although I would recommend reading as much as possible prior to the exam, experience is certainly required to pass it.

Obtaining the CPII certification provides a backbone when performing...
Monitor production in real time with the Walz Payload Scanner. This new technology provides accurate carried payload values on haulage assets all from a laser scanner & App. This new development in production monitoring is poised to revolutionize how operations monitor production without disruptions to daily work.

**System Deliverables**
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- Optimize loading practices
- Interface to existing site monitoring systems
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- Portable trailer operation

*For more information, visit: Walz Laser Scanner & Payload Scanner App*

Sanitary Sewer Capacity Assurance Phase 1 Project (2014)

Inspections and enforcement of public works contracts. Contractors and project managers typically feel more comfortable knowing the inspector has at least a general understanding of construction. The CPII certification provides proof of that understanding and more. Even preparation for the exam made me a better inspector. Our Director of Public Works stated the following:

“As a long-time Public Works Director and APWA member, I recognize the importance of technical and professional competence in employees that work for local government. The APWA certification program is rigorous and thorough for a reason, so that Inspectors can do the very best job ensuring that taxpayer dollars are spent in the best way possible. Having Anthony certified as a CPII gives me confidence that we will have a consistent and complete inspection process for city projects and private development projects within the right-of-way, getting the best quality from a wide array of contractors.”

– Jay Walter, Director of Public Works

The community benefits whenever it has trained, certified professionals working for it. As an inspector it is imperative that I ensure the best quality of construction on every project, so tax dollars are spent most efficiently.

My advice to individuals who apply to take the CPII exam would be to get involved with as much construction as possible. Infrastructure inspectors may have one of the most stressful roles on any project; however, we also have one of the most exciting. For us every project is different in terms of constructability and process. While project managers may be issuing contract change orders, and reviewing requests for information on every project, we as inspectors get to see each unique project get built from the ground up daily. By getting involved with different types of construction it will make it easier to prepare for the CPII exam. In addition, by getting involved with different types of construction, it will make it easier to understand the reading material APWA recommends.

*Anthony Riddell can be reached at (650) 802-4212 or ariddell@cityofsancarlos.org.*
Attracting and retaining young professionals

Karen Mondora, P.E.
Assistant to the Director of Public Services
City of Farmington Hills, Michigan
Member, APWA Diversity Committee

Picture this: You’ve hired a promising new employee who is just beginning their career. This employee is excited to join your organization, digs into the work, absorbs training and spits out tasks like a champ. As they grow and develop their skills, new opportunities become available to them and they are lured away from your organization by the private sector who promises a higher salary, profit sharing, bonuses, and rapid advancement. Due to budget limitations, union structure, or institutional road blocks, you are handcuffed by your agency’s policies and cannot compete. This costs your department and organization lost productivity, excessive administrative time in finding replacements, and creates a strain on those left standing.

How can you break this trend? How can you compete with the private sector? Why should you bother?

Why bother? Young professionals are an integral part of the future of any organization. Without YPs, succession planning fails and the “brain drain” threatens continuity of service.

• Research shows that the cost of replacing an entry level employee is between 30-50% of their annual salary.¹
• The cost of hiring a new employee includes advertising, interviewing, screening and hiring.
• Cost of on-the-job training. It takes a new employee 1-2 years to reach the full productivity needed for their classification. It also takes time away from experienced staff in order to develop skills in junior staff.
• Loss of morale. Other staff notice turnover and tend to disengage or become disillusioned. They question if the grass is in fact greener somewhere else.

How can you compete with the private sector? As demand for talent increases, we must become proactive and nimble in our retention efforts. Create a great workplace and offer as many intangibles as your budgets and policies allow.

How can you break the YP turnover trend? It’s not just about money. Find out what else motivates people and use it to your advantage. Work-life balance and flexible work arrangements are vastly important to younger generations. YPs value their social lives. They also value experiences oftentimes more than possessions. Providing an environment supportive of these interests will go a long way in your retention efforts.

Strategies for retention:
• Foster high-quality relationships. Encourage them to become involved in professional organizations. Take them with you to your APWA local branch meetings.
• Map out five- and ten-year career paths for new employees and revisit regularly. YPs are always on the lookout for career opportunities. Keep them focused on your organization.
• Diversify workload. It is very tempting to continue to assign similar work to the same person for the sake of efficiency. However, this desire for efficiency must be tempered with an eye on the needs of the employee. Few people like to do the same thing day after day. Repetition can foster boredom. Boredom fosters negativity. Unchecked negativity can fester within a person and spread like a cancer to those around them. A diverse workload is an investment in the professional experience of your employee.
• Provide opportunities to learn and develop new skills. Use cross training to your advantage! It may take twice as long to mentor a young professional through the process, but it is a worthwhile investment of time. Young professionals will likely bring a new perspective and possible innovation to past practices. Win-win!!
• Be open to new ideas and integrating technology in daily work.
• Effective recognition. I’m not talking financial rewards here, either. Salary is certainly a key factor, but people are motivated by more than money. The feeling of being appreciated and providing meaningful work are just as vital to long-term career
happiness. Catch your people “in the moment” doing exemplary work.

- Work-life balance. Maybe you can’t give them more vacation time due to policies, but can you offer flex time, comp time, alternate schedules, or telecommuting? Is there opportunity to partner with local transit authorities for free bus passes, golf and parks perks, municipal recreation program discounts?

- Invest in the “whole employee.” Encourage your employer to provide a wellness program. How about assistance with investments or legal matters?

- Consider offsite meeting opportunities and team-building exercises.

- Technical folks have the reputation for being quieter and more introverted than their peers. Does your workplace provide opportunities for social engagement such as book clubs, potlucks, or golf leagues? YPs value their social lives. Many like to have friends in their workplace and have opportunities to do things outside of work with those people. Having a friendly work atmosphere and a good mix of seniority can help foster that kind of environment.

- Conduct exit interviews. Whenever possible, pinpoint the reasons for a YP’s departure so you can adjust your retention efforts. Be sure to leave on good terms as you will likely be working with them again in some future capacity.

YPs bring energy to your group, keep the mood buoyant, and inspire everyone to stay invested. Learning what their needs are and showing YPs that you competitively fulfill those needs will help attract and retain them.

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Special Reminder: Please make sure you update your personal membership profile, including answering the optional questions 13-16 (see page 10, November 2013 Reporter). Please refer to APWA’s 2013 Diversity Resource Guide 2nd Edition and the Diversity Toolbox for more ideas in celebrating the diversity in your chapter.
The following questions are intended to be used by someone interviewing or collecting information for an individual that they would like to nominate for APWA’s Recognize Your Leaders series printed monthly in the APWA Reporter.

Nominator’s Name: ____________________________________________________________

Candidate’s Name: ____________________________________________________________

Candidate’s Title: _____________________________________________________________

Candidate’s Agency/Organization: ______________________________________________

Candidate’s City/State: _________________________________________________________

How long has the candidate been involved in the public works industry? __________

How long has the candidate worked in their current position? ______________________

Please describe the reason that the candidate is being considered for recognition.

How was the candidate’s leadership ideas/actions brought to the forefront?

Who did the candidate work with to help bring this idea/action forward?

Did the candidate experience any challenges when trying to implement this?

Are there steps/processes that, when looking back, the candidate could have done differently to make this idea/action even more successful (lessons learned)?

Email submissions to bstein@apwa.net
EDUCATION CALENDAR

For more information about these programs or to register online, visit www2.apwa.net/Events. Program information will be updated as it becomes available. Questions? Call the Professional Development Department at 1-800-848-APWA.

2015

- **June 18**: Best Practices for GPS Fleet Management Solutions
- **July 13-17**: CSM, CPII and CPFP Certification Exams (computer-based testing)
- **August 30 - September 2**: 2015 International Public Works Congress & Exposition, Phoenix Convention Center, Phoenix, AZ
- **September 21-25**: CSM, CPII and CPFP Certification Exams (computer-based testing)
- **November 16-20**: CSM, CPII and CPFP Certification Exams (computer-based testing)

2016

- **May 22-25**: 2016 North American Snow Conference, Hartford, CT
- **August 28-31**: 2016 International Public Works Congress & Exposition, Minneapolis, MN

- = Click, Listen & Learn program (Free to Members)
- = Live Conference (Paid Registration)
- = Certification Exam
- = Web-based training

APWA members may access past Click, Listen & Learn programs from the Members’ Library at no cost. Programs can be streamed to your computer via the link found in the library. If you have expertise that you would like to share, please use the online Call for Presentations form to describe your expertise and perspective on the topic. www.apwa.net/callforpresentations/
Dying for a charge

Andrew C. Lemer, Ph.D.
Senior Program Officer
The National Academies of the United States, Washington, D.C.
Member, APWA Engineering & Technology Committee

Dennis Gabor, awarded the 1971 Nobel Prize in Physics for his discoveries underpinning the development of holography, once wrote, “The future cannot be predicted, but futures can be invented.” Imagination to Innovation is a periodic look at new technology and scientific discovery that we could be using to invent the future of public works.

It is not difficult to understand why relying completely on solar energy is a worthy goal, but how to capture and store sunlight and convert it into a form we can use—not necessarily in that order—remains challenging. Living plants do a reasonably good job, using photosynthesis to convert water, nutrients from soil, and sunlight into biomass that can be harvested and burned or processed into alcohol. The biomass (chopped firewood, for example) and alcohol (in a tank car to be added to gasoline, perhaps) is stored solar energy, ready to use, but so far the production processes we have developed are not particularly efficient and have unfortunate side effects, air pollution, soil depletion, and high costs, to name a few.

Researchers searching for ways to emulate and improve on natural photosynthesis have explored ways to create dye-sensitized solar cells (DSSC). Some are working on replacing chlorophyll and the related compounds that plants use with more easily fabricated and controlled chemicals. One line of experimentation relies on porphyrins. While synthesized versions are the objects of these studies, many porphyrins are found in nature; one of the best-known gives color to the hemoglobin in red blood cells that carries oxygen to the far-flung cells of our bodies.

The porphyrins can have a role in sensitizing other compounds to the influence of light. Porphyrin photosensitizers have shown promise in cancer treatment; the drugs are activated by light when they have reached their cancer-cell target and minimize collateral damage to healthy surrounding tissue.

Solar cell researchers have had some success working with photosensitizing compounds containing metallic elements such as ruthenium and iridium to boost the speed and efficiencies of the chemical reactions to convert sunlight to usable energy in what are referred to as water-splitting dye-sensitized photoelectrochemical cells (WS-DSPECs). “Water-splitting” in this case means decomposition of water into oxygen and hydrogen. (Perhaps you remember the high school chemistry class electrolysis experiment where aluminum-foil electrodes and a battery were hooked up to pass electricity through a glass of water, producing bubbles of hydrogen on one electrode and oxygen on the other.)

Scientists figure this approach could convert as much as 20 percent of light to electricity, in the range of what commercially available (and capital intensive) photovoltaic cells can do. The big problem is that the metals involved are not particularly abundant on Earth. Large-scale application of these metal-based WS-DSPECs would be problematic. However, researchers at Pennsylvania State University and Arizona State University recently published their demonstration of a functional metal-free WS-DSPEC. With further research, dye-sensitized photochemical cells could enable direct harvesting of sunlight on a scale to meet the energy demands of a home, office or community. There certainly seems to be growth potential.

Andrew Lemer, Ph.D., is currently a Senior Program Officer with the National Academy of Sciences of the United States of America. In addition to technical papers and occasional articles for the Reporter, he writes on civil infrastructure and human settlement at www.andrewlemer.com.

Correction
The listings for EJ and GovHR USA were inadvertently listed incorrectly in the April Buyer’s Guide. Their correct information, including categories, is included below:

EJ
(800) 874-4100
301 Spring Street
East Jordan, MI 49727
www.ejco.com
Construction Equipment & Supplies, Detectable Warning
Water/Sewers, Manhole Risers
Water/Sewers, Manholes
Water/Sewers, Sanitary Sewer

GovHR USA
(847) 380-3240
650 Dundee Rd Ste 270
Northbrook, IL 60062-2767
www.govhrusa.com
Business Services, Consulting
Thank You!

Every year National Public Works Week gets bigger and better. The number of participating municipalities continues to grow, which means the number of citizens who are exposed to the value of public works grows.

At APWA one of our main goals is to educate the general public about the value and necessities of public works projects throughout North America, and public works professionals like you are our best ambassadors.

Public Works Professionals don’t stop after National Public Works Week is over, neither should the celebration. Keep the recognition in your area going by finding additional ways to celebrate the men and women of public works!

Visit our website at apwa.net/npww for more information about National Public Works Week. Be sure to share your experiences on social media using the hashtag #NPWW.

If you have any questions about NPWW, contact Jon Dilley at jdilley@apwa.net or call 816-595-5251.
Customer Service – Don’t groan, no eye rolling. Yes, I know you’ve heard it and some of you are thinking, “I don’t have time for that, because I have to get my real work done.” Well your real work, your real career and your real customers need you to know how critical customer service is.

Who are your customers? What is your role? How do you keep them? How do you lose them? Keep reading to find out why this topic needs to be kept current in your mind and current with your staff. The information is based on a presentation in the SoCal Public Works Institute Module 1 by Natalie Meeks, Public Works Director, City of Anaheim and Jeffrey Cooper, VP Engineering, Penco.

Everyone at work with whom you interact are our customers. Everyone who purchases or uses your activities, events, products and services are our customers. Your supervisor, manager and all of your employees are customers, too. You help achieve extraordinary customer service when you make each interaction one that is positive, effective, efficient, courteous, competent, thorough, and professional. This is our job! What does it look like to be effective? It means that we satisfy our customer’s needs, in a way that considers and respects the customer’s priorities. Serving every customer well helps you, your program, and your organization stand out. It’s essential to your job security, future job/career opportunities and contributes to how you feel about what you do.

Good customer service means we communicate clearly, we’re open and genuinely attentive; knowing your services and products, using positive language, following up on feedback, looking for way to improve service and knowing what your customer expects/needs.

Find out what your customers need with informal interviews. Ask what they want, ask what results are important to them and about their priorities. Don’t take complaints personally. Look and act like a professional. Keep learning, keep teaching, smile genuinely.
**Customer Service Basics**

1. Be professional. Maintain a neat appearance and keep your workspace organized.

2. Make every customer feel welcome. Forget the problem you may have just dealt with—focus your energies on serving the current customer.

3. Always be courteous—manners matter. Treat customers the way they wish to be treated.

4. Take each customer problem seriously. When customers have a concern or a complaint, listen attentively and try to solve their problem yourself...and as quickly as possible.

5. Follow through! Do what you must to solve the problem within the boundaries of your organization.

6. Understand your customers’ needs and match those needs with correct solutions.

7. Know your organization and your activities, events, products and services. You will be better able to serve your customer, resolve problems, and direct them to another department, when needed.

8. Learn your lines. Take the time to master the technical and procedural ins and outs of your job.

9. Be a team player. Help those you work with. When a coworker is trying to help three people at once, pitch in.

10. Enjoy your work! Customer service is a demanding job. Find joy in the fact that you are helping people meet their needs.

**Customer Service DON’TS**

- Make them wait
- Give them the “run-around”
- Answer with, “That’s not my job,” “I just do what they tell me,” “We can’t do that” and “our policy...”
- Bad-mouth your program, the organization or the competition
- Demonstrate your lack of product or service knowledge
- Be an “uncaring” customer service person
- Fail to follow-up
- Use the voice tone that says you don’t care
- Confuse them with inconsistent body language

**Loyalty Facts – Don’t drive your customers away or give yourself bad press**

- Only 4% of customers who have had a problem will ever complain to management; but 91% will never come back.
- Most customers just go away because they believe their complaints will not do any good.
- News of poor customer service reaches twice as many people than news of good customer service—think of that next time you choose not to give good customer service to your staff.
- Online reviews make negative feedback easily accessible to current and potential customers.
- 56%-70% of the customers who complain to you will do business with you again if you resolve their problem. If they feel you acted quickly and to their satisfaction, up to 96% will do business with you again.
- A dissatisfied customer will tell 9-15 people about it and approximately 13% of your dissatisfied customers will tell more than 20 people about their problem.
- Rule of 10’s: It costs up to $10,000 to get a new customer; 10 seconds to lose him/her; and up to 10 years for the customer to get over whatever made him/her leave you (almost like a bad college boyfriend).
- Long-term customers are usually more profitable. A 5% increase in customer retention can boost profits by 25% to 125%.

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**So remember these acronyms:**

**Customer Service Model**

S – Smile
E – Eye contact and body language
R – Respect and welcoming
V – Value the needs of the customer
I – Initiate the assessment of needs
C – Create solutions
E – End with thank you

**When things go wrong**

L – Listen
A – Apologize
S – Solve
T – Thank

“We hope for a certain stability without destructive change. We hope for a future that is at least as good as the present. We hope to reside in cities that are resilient. Are sustainable. And above all, livable. We deserve, and with the right choices, can have all three.”

– David Maddox, Founder & Editor, *The Nature of Cities*
Tasmanian council creates remote-controlled car equipped to inspect stormwater pipes

Jill Park
Editor, Public Works Professional Magazine
Institute of Public Works Engineering Australasia (IPWEA)
Sydney, Australia

In 2003 NASA’s Mars Exploration Rover Mission sent two robots out into space in search of water on the red planet. George Town Council (GTC) in Tasmania took a similarly novel approach when faced with the task of inspecting stormwater pipes by creating their own “Rover.”

GTC is a small port town 50km north of Launceston that services 5,000 residents so asset management budgets are tight. Therefore, GTC Civil Engineer James Lio had few options available to him when collecting stormwater asset information.

“Stormwater pipes are not evaluated yearly due to the cost of inspection,” Lio says. “One of my tasks as a project engineer is to update the GTC asset register while keeping the cost under control.”

Choices, choices
The first option considered was to hire external contractors at a cost of $300 per hour. The distance and cost meant that it would be unfeasible to call out the contractors for ad-hoc work, such as blockages after heavy rainfall, so this option was ruled out.

Secondly, Lio considered purchasing CCTV equipment. His research showed that a “bare-bone” pipe inspection apparatus would have set the council back $10,000, an unjustifiable cost for GTC in light of the fact that the equipment would only be used once a year or during a callout.

That only left one option: to build an inspection tool himself. Lio was confident that he could build his own “Rover” inspection machine at a competitive price using off-the-shelf equipment.

Lio turned to IPWEA’s Ask Your Mates forum for advice from members about how best to approach the project. His questions sparked one of the most popular comment streams on the forum last year.

Building the spec
Armed with his feedback from Ask Your Mates, Lio and his team created a list of key requirements for the Rover. The machine would have to be able to inspect pipe diameter of 300mm and above; capture video in the dark or equipped with an LED torch light; reverse and steer remotely; be compact and easily maintained; be water resistant, if not waterproof; record video footage within the pipe; and cost less than $5,000, and therefore not be recorded as a capital purchase.

“Armed with these specifications, I scouted for parts from major electronic stores while putting them together mentally,” says Lio.

Iteration one used an off-the-shelf remote-controlled car with a Pan Tilt Zoom-mounted camera. Upon testing, the remote-controlled car did not have enough torque to drag a CAT5 cable. The wireless signal also proved unable to penetrate through stormwater pipes.

Iteration two – Timber chassis, hard plastic tire, front-wheel drive. Pros: easy and cheaper to build. Cons: insufficient traction due to both weight and two-wheel drive
Next Lio and his team decided to custom build a remote-controlled car with a mounted camera. He had tried to avoid this option as the steering mechanism of a remote-controlled car can be hard to reproduce. However, a “Eureka” moment while watching a TV program about kayaking made it feasible—he could control the vehicle by manipulating which side of the motor got turned on.

“After going through some test runs, the four high-torque motors held up beautifully well, but the Rover stopped moving due to loss of traction.” Mark two taught Lio that he would have to replace the plywood chassis for a heavier one and change the hard plastic wheels.

And so mark three was created: a custom-made steel chassis car with a PTZ-mounted camera. The third iteration is the same configuration as the previous, but with the addition of a 16mm steel plate chassis and four rubber wheels. Assemblage of the pieces is slightly more technical to construct—a normal drill bit doesn’t cut it—but the resulting machine has proved robust.

“Two switches control the Rover: when two buttons are pushed it moves forward, pressing the left button will steer the car left and vice versa,” says Lio. “Reverse can be done by reversing voltage polarity and throttling can be done by increasing and decreasing voltage.”

Measuring how far the Rover has travelled along the pipe was discussed at length on the Ask Your Mates forum. Lio followed his peers’ advice. “Travel distance is measured by reading tags installed onto the cabling,” he says. “The operator is required to key in distance onto a notepad, which is captured by the video recorder.”

Rover mark three is only partly water resistant, so the equipment has to be handled (and operated) with care. Regardless, spare parts are readily available and cheap to purchase so the GTC does not have to bear the full brunt of the cost of replacing the Rover.

GTC is in the process of testing mark three, but the Rover has proven to be an efficient and cost-effective way for a small council on a tight budget to inspect stormwater pipes. NASA would be proud.

This article was originally posted on February 12, 2015 on the “In the pipeline” section of IPWEA’s website. It is reprinted here with permission. Jill Park can be reached at jill@mahlabmedia.com.au.

The Rover

The Rover system has been designed and built by James Lio at George Town Council in Tasmania from items that can be bought off the shelf and easily fitted together. These items include:

1. A Laptop Computer
2. Wireless Router
3. Tenvis PTZ camera with infrared vision that is capable of night vision and is able to capture 640x480 resolution video
4. 12 volt reversible gearhead electric motors (12kgcm torque)
5. A hose wheel for cable management
6. 100m CAT 5 cable
7. 4xD cell holder powering the camera
8. 4x100m high amperage cable (two pairs of cable to control each side of the car allowing it to turn right and left)
9. 16mm steel plate measuring 300x400mm (depending on the pipe diameter)
10. 12 Volt inverter
11. Switch mode laboratory power supply (1–36 volt)
12. Hot glue, cable tie, electric connector, switches and electric drill

Please note: The machine featured is not associated with the Rovver, manufactured by iPEK and marketed by SECA in Australia and New Zealand.
Managing the life of public works assets

Kevin M. Ford, Ph.D., Solutions Engineer, Decision Lens, Arlington, Virginia; Andrew Lemer, Ph.D., Senior Program Officer, Transportation Research Board, Washington, D.C., and member, APWA Engineering & Technology Committee

Public works professionals have been doing their jobs for many generations, stretching back long before the ancient civilizations of China, Egypt, Rome, and the Aztecs built their legacies. Over the centuries, we have learned a thing or two about how to develop and operate systems to serve our enterprises and improve our quality of life, but we still face the same problems: Things break or wear out. People’s expectations increase. Technology evolves. There’s never enough money.

What is different now is the colossal increase in our ability to capture, keep, and use information to increase our knowledge and support management decisions. It is not exactly news that we are living in an age of information, and it is turning out to be a game-changer for public works.

Consider the matter of service life of a traffic sign, culvert, water pipe, or bridge deck—really, any public works asset. The life expectancy of that asset is a crucial factor when deciding about the asset’s design or purchase, its maintenance or rehabilitation, or its replacement. Public works assets face the end of life—as do we all—when wear and tear deteriorate their ability to perform at the level we require or our expectations change to render the asset obsolete. The actual end may come sooner if the resources are available to make a change, or may be deferred by “limping along” until the necessity for change becomes inescapable.

On one hand, people understand that complete failure of a public works asset—think bridge collapse or dam washout—can be disastrous. On the other hand, the work of maintaining the asset or replacing parts is expensive and often disruptive. Thinking ahead about when assets and their constituent parts are likely to reach the ends of their useful lives, actions that might be taken to extend the life or not, and the consequences of action or inaction is where information comes in. We are gradually replacing rules of thumb and guesswork with evidence-based information as a basis for estimating asset service life.

The National Cooperative Highway Research Program (NCHRP) has sponsored work that can help public works managers make better estimates and collect data to make their estimates even better. NCHRP Report 713 Estimating Life Expectancies of Highway Assets, published in two volumes in 2012, describes methods and available data that may be used for several types of highway assets. Some of these asset types are used in other areas of public works practice, and the tools and techniques are often transferrable. Volume 1 of the report is a how-to-do-it guidebook; Volume 2 describes technical issues and data needs associated with estimating asset life expectancies and the practices used in a number of other fields—such as the energy and financial industries—to make such estimates.

Pay me now or pay me later!
Waiting until an asset fails can be expensive. Think about your car. Regular oil and filter changes are low-cost ways to significantly extend the life of a vehicle and hence delay the cost of replacement. Public works assets are not much different. Regular maintenance can effectively extend infrastructure life but at what point are we throwing good money after bad? Reliable life estimates are critical when evaluating preservation strategies to see which yields the biggest bang for the buck. Furthermore, life estimates can be used to compare the cost effectiveness of design and material alternatives, synchronize work packages, support project prioritization, allocate funds, and carry out asset valuation.

To come up with an estimate for infrastructure life, data-driven models can and have been developed to identify not only the typical lifespan of public works assets but also the most critical factors affecting that lifespan. Public works assets deteriorate with age due to accumulated effects of system usage and environmental conditions as influenced by their material, structural design, and repair history, among other factors. By knowing the likely culprits, public works officials can proactively mitigate risk and plan ahead for replacements under dynamically changing conditions.

Life is inherently uncertain
Recognizing that some assets will reach the end of their useful life
quicker than others and conversely some assets will perform beyond expectations, asset managers must be prepared for anything. Rather than setting fixed replacement intervals, significant cost savings can be realized from a performance-based approach to decision-making triggering costly activities only when necessary. So how can we plan for the unknown?

The benefit of having data-driven models is that we can quickly assess the critical “what ifs?” What if assets deteriorate more quickly than normal? What if projects cost more than expected? What if we had more or less funding to maintain our infrastructure? By using even simple models to explore such uncertainties, public works managers can make decisions with greater confidence and develop contingency plans based on the likelihood of different events outside of our control. Having a good sense of what an asset’s service life will be can mean having the ability to say with some confidence that we will need, say, at least a certain amount of dollars to maintain an acceptable state-of-repair or level-of-service for the next five years.

Mining your own data
The tools and methods of service-life estimation are really only as good as the data upon which they rely. Data can be considered “good” in this case when it reflects all of the uncertainties and idiosyncrasies of a particular place and its public works infrastructure. By being able to explain why a public works asset is behaving the way it is, decision-makers can update predictive models to inform planning scenarios. As more information becomes available, the service-life estimates can become more robust, and that leads to more efficient business processes.

Blending economic evaluations with predictive models and expert judgments, public works officials have multiple tools they can use to strategically manage a wide range of physical assets. Having a data-driven decision process helps not only to identify the “right” projects but also helps bring all stakeholders into a productive conversation about what a community wants from its public works and what it can afford to do (or can’t afford not to!).


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The importance of weather to public works

*Weather as technical subject matter*

Dennis Randolph, P.E., PTOE, PWLF
Director of Public Works
City of Grandview, Missouri
Chair, APWA Engineering and Technology Committee

Most of us in the public works profession understate all we do to make the world a better place for people to live. Without the infrastructure we build and take care of, much of the good that takes place in the world would not be possible. Because we don’t spend enough time telling people what we do, they do not know the nature of the problems we deal with every day.

For example, one element we don’t often bring to the attention of those outside the profession is our relationship with weather. For nearly every type and piece of infrastructure we build and maintain, we must deal with the challenges of climate and weather. For us in public works weather is every day.

For most folks, especially at their workplace, bad weather means staying inside. There is usually little impact. But for the public works professional, we simply cannot and do not “hunker-down” when the weather is other than ideal. There are times when it is simply too dangerous to be out in a blizzard or a storm. Most often any work we try to do in extreme conditions will simply be overwhelmed by heavy snowfall or hurricane winds. However, except for these extremes, the public works professional must be out battling with the elements, because it is our job to keep the infrastructure working for all those others who must and do take shelter.

There are no “snow days” in public works. Neither are there flood days, tornado days, or hurricane days. When such disasters come, public works must be out there first, clearing roads, building dikes, and helping other first responders get to where people need help. So to keep our infrastructure working and serving it is appropriate that we take a lead when it comes to planning and dealing with weather.

Recent emphasis on planning and building infrastructure to deal with sea level rising has brought some attention to the public works field. But again, these large-scale events overshadow the fact that nearly everything we do is in some way impacted by weather and weather events.

The range of weather impacts

If we stop for a moment and think about the technical areas that APWA members are involved with (refer to Table 1), we can get a grasp of all the considerations that are given to weather events. Each of the Technical
Committees has weather-related matters to deal with—whether it is specifying equipment that can function in below-freezing blizzards, developing stormwater handling systems that can protect neighborhoods from floods, or disposing of debris after a tornado or hurricane has come through our community.

Some of the weather impacts we deal with are obvious. We know it becomes problematic when it is raining, whether we can continue with many of our construction activities. We also know it is not possible to do excavation or mass grading, or place concrete, or asphalt unless weather is dry and temperatures are within specific ranges.

During some types of weather it is difficult to build, and sometimes, even after a condition stops, lingering effects make work difficult if not impossible for us. We must wait for ground to dry out before we can go ahead with excavation or mass grading. If the air and soil temperatures are too cold some work can be delayed because concrete does not cure fast enough, or we need to spend more money on additives or insulated blankets. Even when we can manage to get our paving and earthwork done, we often need special timing provisions for our projects to be able to establish ground cover and turf, or to plant trees and other materials that are an integral part of so many projects.

Knowing about weather
Clearly because public works infrastructure and weather are so closely tied a successful public works professional needs a formal background in climate and weather. We need to have enough knowledge of climate and weather to make the best decisions possible, whether it is when to call out a winter maintenance crew, or when to call a seasonal halt to placing concrete for sidewalks, or if trees should be planted to complete a project.

That knowledge needs to transcend the “old wives tales” most of us have known about or have heard. We need as a profession to have a background in climate and weather that recognizes the science in the topic as well as the science in public works.

Sustainability
More and more, we work to plan, build, and preserve sustainable infrastructure. This means in its most basic form, to build in a way that acknowledges the earth, its climate and weather, as well as its soils and resources. It also means using them in a way that preserves the integrity of the entire system in which they reside.

Much like planting crops, we must build infrastructure by working in harmony with nature. To do otherwise means to fight climate and weather, and when we try to fight climate and weather it means increased costs. We must learn to nurture and maintain our infrastructure so that it can serve the community, not unlike how farmers nurture and renew the soil and the environment in which they work so that it can produce crops and goods for many years.

Yet nearly every act of nurturing in public works is based on the rhythms established by climate and weather:

- We plow snow and salt streets from November to March
- We sweep streets from April to October
- We crack fill when pavement temperatures make cracks open to an optimal width
- We plant trees and turf in the spring and fall
- We dig sewer trenches in the dry season, and
- Chip and seal in the warmest season

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Everyone who wants to be successful in the public works profession needs to learn the rhythms of the seasons. The rhythms of our work are set to a great extent by nature and at many levels:

- Cosmic level rhythms bring cycles of hundreds, thousands, tens of thousands or even more years.
- Solar cycles, for example related to sunspots, bring cycles with multiyear lengths that build or dampen annual/seasonal events.
- Annual cycles, as the earth rotates around the sun, bring the seasons and set some of our major schedules for us, and
- Daily cycles, that bring temperatures up and down as the Earth turns, drive pressure patterns and make weather that we must deal with on a local basis every day.

Together, drivers at all these levels make weather different every day, and this is what makes public works so unique, because we must deal with this change every day.

As we work on our streets and sewers, parking lots, treatment operations, and other infrastructure we are responsible for, we need to keep in mind how important a relationship we have with climate and weather. More important we need to understand that our relationship with climate and weather is not restricted to growing seasons, but is a 24-hour, 365-day-a-year relationship.

Using weather knowledge
We need to know more about climate and weather than has been handed down to us through old wives tales and memories of the “big one in ’57.” We need to incorporate modern science of climate and weather into our planning and operations. By doing so we can take weather information that is given to us by forecasters and translate it into practices that make our work more efficient and timely.

We also need to make use of weather information as it becomes available to us, not only during severe conditions, but every day. How weather affects our workers and equipment makes a difference in their productivity and well-being. It also makes a difference to the quality of the work that we produce.

We need to be active users of weather data and information, so we can manage our infrastructure in the way that is most beneficial to our communities and the people in our communities.

Dennis Randolph was selected as one of APWA’s 2015 Top Ten Public Works Leaders of the Year. He can be reached at (816) 316-4855 or drand77201@att.net.
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What is the work of today’s Civil Drafters?

Charles D. Upchurch
Senior O*NET Occupation Expert Research Liaison
Research Triangle Institute
Research Triangle Park, North Carolina

Drafting work has changed, significantly, in the last 25 years. You might say that drafting tables and drafting machines are now just symbols for drafting, rather than basic tools of the trade. Drafting now involves a lot more computer work, and today's drafters produce “plans” instead of “blueprints.”

The Dictionary of Occupational Titles (DOT), from what is now the U.S. Department of Labor, was published

n the 1970s or '80s, most drafters would have used equipment like this:
1938-1999. There may still be some copies in reference sections of some public and academic libraries. Although the DOT is no longer available (from the U.S. Government Printing Office),¹ in its time this book was considered the ultimate authority on occupational descriptions. After originally introducing drafting work under the title *Draughtsman*, the last complete update (1991) hinted that the work of Drafters might change with computerization. A Drafter, it said:

“Prepares working plans and detail drawings from rough or detailed sketches...using standard drafting techniques and devices, such as drawing board, T-square, protractor, and drafting machine, or using computer-assisted design/drafting equipment.”²

Since APWA is interested in public works and civil engineering, let’s look at the specialty area of Civil Drafters. APWA members depend on someone performing the work of Civil Drafters, enabling them to plan and conduct the vital work of rebuilding America’s infrastructure. Some APWA members may contract out this work; some do this type of work, themselves; others have prior civil drafting experience, and supervise Civil Drafters as part of their current civil engineering, project management, or other roles.


- Make “detailed construction drawings, topographical profiles, and related maps and specifications used in planning and construction of civil engineering projects, such as highways, river and harbor improvements, flood control, and drainage.”
- Review “rough sketches, drawings, specifications, and other engineering data received from [Civil Engineers].”
- Make “detailed drawings of structures and installations, such as roads, culverts, fresh water supply, sewage disposal systems, dikes, wharfs, and breakwaters.”
- Sometimes “compute volume of tonnage of excavations and fills and prepare graphs and hauling diagrams used in earthmoving operations” and some might “accompany survey crew in field to locate grading markers or to collect data required for revision of construction drawings.”

As with the general Drafters description, the Dictionary of Occupational Titles only briefly mentioned the use of computer-based technologies by Civil Drafters, saying only that [Civil Drafters]:

- May “use computer-assisted drafting (CAD) equipment and software.”³

Fast forward to the twenty-first century
In 2001, the Occupational Information Network (O*NET) superseded the 70-year-old Dictionary of Occupational Titles. Searchable workforce information describing worker characteristics and work attributes for most of the work performed in the U.S. workforce can be accessed easily, now (using an internet browser, with no registration) and it is totally free of charge. The URL is www.OnetOnline.org.

“Maintenance of the O*NET database by the U.S. Department of Labor and the National Center for O*NET Development plays an integral role in assuring the vitality of the American workforce.”⁴ To this end, Research Triangle Institute (RTI International), a well-known and respected nonprofit research organization, collects occupational data from occupation experts and incumbents (people with experience performing the work themselves). The O*NET Data Collection Program uses voluntary, standardized occupational questionnaires to collect information about generalized work activities, work context, the types of knowledge needed, and other aspects of work. The aggregated information is used by the National Center for O*NET Development to regularly update over 970 occupational categories.

The O*NET Data Collection Program’s goal is to provide the most complete, accurate, and up-to-date information possible about occupations for use by the American public. This information is provided free of charge through several DOL-sponsored websites, including: Occupational Information Network (O*NET) Center, O*NET Online, My Next Move (also translated as Mi Proximo Paso), My Next Move – for Veterans; and also through the American Job Center network (which uses O*NET information).

The occupation of Civil Drafters was last updated in 2008, based largely on input from experienced drafters. Today’s short description says: “Prepare drawings and topographical and relief maps used in civil engineering projects, such as highways, bridges, pipelines, flood control projects, and water and sewerage control systems.”
In O*NET, the work of Civil Drafters is described separately from other drafting occupations (like architectural, electrical, electronic, and mechanical drafters). Civil Drafters are also described separately from occupations with a different work focus even if they might involve some civil drafting (such as Mapping Technicians, and Civil Engineering Technicians).

Tasks which may be performed by Civil Drafters include:

- Draft plans and detailed drawings for structures, installations, and construction projects such as highways, sewage disposal systems, and dikes, working from sketches or notes.
- Produce drawings using computer-assisted drafting systems (CAD) or drafting machines, or by hand using compasses, dividers, protractors, triangles and other drafting devices.
- Correlate, interpret, and modify data obtained from topographical surveys, well logs, and geophysical prospecting reports.
- Determine quality, cost, strength and quantity of required materials, and enter figures on materials lists.

The O*NET program recently added the following Task for data collection:

- Plot characteristics of boreholes for oil and gas wells from photographic subsurface survey recordings and other data, representing depth, degree and direction of inclination.

**Developing tomorrow's workforce, today**

As the current batch of highly skilled workers begins to retire, it is time to start getting the next generation interested in the work of Civil Drafters.

**If you are interested in helping with the 2015 update of Civil Drafters:**

RTI and the O*NET Data Collection Program are asking APWA members to share their civil drafting experience to help students, educators, and the general public to learn about this work. The program will collect information about types of knowledge required, how the work is performed and typical work settings. Each of the related tasks will be rated for frequency and importance so the next generation can find out what they will be doing as Civil Drafters.

**How does this benefit APWA?**

All of the O*NET tools are available online, without login, and the entire database can be downloaded free of charge. The summary and details of each occupation are maintained as an accurate and up-to-date snapshot of the occupation, using aggregated data collected from occupational experts from all regions of the U.S. APWA members can use O*NET free of charge to write job descriptions, develop training programs, implement workforce development programs, and help students learn more about what is involved in this work.

APWA has helped O*NET in past years with updates of other occupational categories. This time, we are looking for volunteers who have worked at some point during their careers as Civil Drafters to self-identify as potential experts.

**Could you be an Occupation Expert?**

Looking at your overall career, do you have all three of the following criteria?

1. a minimum of one year of hands-on experience performing the work described in the Civil Drafters occupation (regardless of your job title) AND

2. a combination of five years of experience (including any combination of years performing, supervising, training others to do civil drafting work, or writing instructional materials for Civil Drafters) AND

3. any recent experience with the work of Civil Drafters (performing, supervising, training others to do civil drafting work, or writing instructional materials for Civil Drafters) within the last six months.

If you have all three of these, then please contact the author of this article (contact information below) so your name can be added as a potential Occupation Expert for the work of Civil Drafters. If selected as an Occupation Expert, you will be contacted later this year by phone, to confirm your interest. Then, you will receive an information package by Priority Mail before you consent to receive a standardized occupational questionnaire.

This voluntary data collection, conducted by Research Triangle Institute, is sponsored and funded by the U.S. Department of Labor, as approved by the Office of Management & Budget (OMB # 1205-0421, expires 6/30/2015, see https://onet.rti.org/survey.cfm).
CONTACT: Charles D. Upchurch, O*NET Occupation Expert Research Liaison, Research Triangle Institute, 877-233-7348 Ext.113, Cupchuch@onet.rti.org

Thank you again for your assistance. Please let me know if you have any questions.

1 The Dictionary of Occupational Titles (DOT), a book published from 1939-1991, is archived for historic research at http://www.oolj.dot.gov/libdot.htm with the following disclaimer: “The DOT, however, has been replaced by the O*NET.”

2 “DRAFTER (profess. & kin.) Prepares working plans and detail drawings from rough or detailed sketches and notes for engineering or manufacturing purposes according to dimensional specifications. Calculates and lays out dimensions, angles, curvature of parts, materials to be used, relationship of one part to another, and relationship of various parts to entire structure or project, utilizing knowledge of engineering practices, mathematics, building materials, manufacturing technology, and related physical sciences. Creates preliminary or final sketch of proposed drawing, using standard drafting techniques and devices, such as drawing board, t-square, protractor, and drafting machine, or using computer-assisted design/drafting equipment. Modifies drawings as directed by engineer or architect. Classifications are made according to type of drafting, such as electrical, electronic, aeronautical, civil, mechanical, or architectural.” (Source: see endnote 1, above.)

3 “DRAFTER, CIVIL (profess. & kin.) Alternate titles: drafter, civil engineering; drafter, construction; drafter, engineering. Drafts detailed construction drawings, topographical profiles, and related maps and specifications used in planning and construction of civil engineering projects, such as highways, river and harbor improvements, flood control, and drainage; Reviews rough sketches, drawings, specifications, and other engineering data received from CIVIL ENGINEER (profess. & kin.) 005.061-014. Plots maps and charts showing profiles and cross-sections, indicating relation of topographical contours and elevations to buildings, retaining walls, tunnels, overhead power lines, and other structures. Drafts detailed drawings of structures and installations, such as roads, culverts, fresh water supply, sewage disposal systems, dikes, wharfs, and breakwaters. Computes volume of tonnage of excavations and fills and prepares graphs and hauling diagrams used in earthmoving operations. Performs other duties as described under DRAFTER (profess. & kin.) Master Title. May accompany survey crew in field to locate grading markers or to collect data required for revision of construction drawings. May specialize in drafting and modifying topographical maps from surveying notes and aerial photographs and be designated Drafter, Topographical (profess. & kin.). May use computer-assisted drafting (CAD) equipment and software and be designated Drafter, Civil (CAD) (profess. & kin.). GOE: 05.03.02 STRENGTH: 877-233-7348 Ext.113, Cupchuch@onet.rti.org

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This article was a collaborative effort between Carol Estes, P.E., APWA Professional Development Program Manager and staff liaison to the Engineering and Technology Technical Committee, who suggested the criteria for APWA members to self-identify as Occupation Experts, and Charles Upchurch, who for 10 years has worked as contracted co-employee of Research Triangle Institute (RTI) on the O*NET Data Collection project for the National Center for O*NET Development (NCOD), sponsored and funded through the U.S. Department of Labor/Employment & Training Administration (US DOL/ETA), Workforce Information office.

Upchurch says of his own work experience, “I didn’t really have a career plan when I graduated, just a variety of interesting options. To find out what I liked, I just picked a type of work, and tried doing it for a while. I had a series of mini-careers, a method of career exploration which was always interesting, but it has taken quite a while for me to get where I am today. Early on, I used mostly physical tools, to get tangible, physical results. Needing more of a human connection, I explored educational facilitation and counseling, consultative sales, telecom network troubleshooting, and—now—assisting with the O*NET occupational research to help people understand more about ALL of the different kinds of work that are out there.

“My work on the O*NET project empowers me to help people and organizations be happy and successful, both now and in the generations that follow. Thanks to the free online resources provided by O*NET, today’s high school and college graduates have access to information from people with years of hands-on experience in literally hundreds of different types of work. Having these tools means today’s students can maximize their future success while they are still in school; by learning to assess their own skills and interests, and exploring a broad range of careers, they inform their career choices and learn how to focus their education to achieve their goals.

“When contacting professional associations, industry groups, government officials, unions, employers, or occupation experts themselves, I am always proud when my fellow Americans help me with this voluntary project. In my experience, people are very quick to provide assistance when they realize that doing so might help their friends and families, their neighbors, and the general public. People, organizations, and companies all prefer to be helpful, if they can do so in a way that doesn’t take too much of their time, and doesn’t put themselves or their employers at any risk, and this occupational research program gives them the perfect opportunity to do so.”
Can we protect our electronic lifelines?

Mike Sutherland, AAE, TLO
Director of Public Works & EOC
Town of Parker, Colorado
Chair, APWA Emergency Management Committee

On September 1, 1859, amateur astronomer Richard Carrington, in his private observatory outside of London, watched “two patches of intensely bright and white light” erupting from the sunspots. Five minutes later the fireballs vanished, and within hours their impact would be felt across the globe.

Later, telegraph communications began to fail with sparks showering from telegraph machines, shocking operators and setting papers ablaze. Colorful auroras illuminated the nighttime skies from a massive solar flare with the energy of 10 billion atomic bombs. Electrified gases and subatomic particles raced toward Earth and the resulting geomagnetic storm—dubbed the “Carrington Event”—was the largest on record to have struck the planet.

Ice core samples have determined that the Carrington Event was twice as big as any other solar storm in the last 500 years. The impact of a similar storm today? Due to its bearing on power grids, satellite communications, and navigational systems...between $1 trillion and $2 trillion.

Can it happen again?
On July 31, 2013, speaking on a panel with experts Henry Cooper and Peter Vincent Pry, former CIA Director James Woolsey stated, “The earth barely missed a massive solar punch in the teeth two weeks ago.” Scientists had reported that if the Earth had been about two weeks farther along in its annual journey around the Sun it would have been blasted by a solar storm at least as powerful as the Carrington Event one hundred fifty-four years earlier.

Solar storms aimed at Earth arrive in three stages, not all of which occur in any given storm.

- First, high-energy sunlight—mostly x-rays and ultraviolet light—ionizes Earth’s upper atmosphere, interfering with radio communications.
- Next comes a radiation storm, potentially dangerous to unprotected astronauts.
- Finally, there’s a coronal mass ejection, or CME, a slower moving cloud of charged particles that can take several days to reach Earth’s atmosphere. When a CME hits, the solar particles can interact with Earth’s magnetic field to produce powerful electromagnetic fluctuations.

Disruptions to global positioning systems (GPS) in cell phones, airplanes, ships and automobiles (the GPS industry is predicted to grow to nearly $1 trillion by 2017) plus satellite communications—also essential to many daily activities—would be at risk from solar storms.

The greatest vulnerability may be to the electrical grid, since power surges caused by solar particles could blow out giant transformers. Such transformers can take a long time to replace, especially if hundreds are destroyed at once; most are manufactured in countries other than the United States.

- A coronal mass ejection (CME) is an ejection from the Sun’s corona—a large bubble of plasma escaping the sun’s gravitational field, blasting through space to the Earth at high speeds over the course of several hours.

Solutions: One is to rebuild the aging power grid to be less vulnerable to solar disruptions; another is better forecasting. Solar Dynamics Observatory spacecraft are hoping to get a better understanding of how the sun behaves as it moves away from, then toward its next maximum, and begins generating bigger storms.

- Studies may help scientists predict when and where solar flares might appear and whether a given storm is pointed at Earth. Improved predictions will provide more accurate forecasts, so officials can take mitigating actions.
- Damaging emissions from big storms travel slowly enough to be detected by sun-watching satellites well before the particles strike Earth, which gives us about 20 hours to determine what actions must be taken.
- Electric utilities could protect valuable transformers by taking them offline before the storm strikes. That would produce local blackouts for a couple of hours.
The ejected plasma consists primarily of electrons and protons, plus the intense coronal magnetic field.

When a CME impacts the Earth’s magnetosphere, it deforms the Earth’s magnetic field, changing the direction of compass needles and inducing large electrical currents in Earth itself; this is called a geomagnetic storm.

CME impacts can induce magnetic reconnection in Earth’s magnetotail (the midnight side of the magnetosphere); this launches protons and electrons downward toward Earth’s atmosphere, where they form the aurora.

A geomagnetic storm is caused by a solar wind shock wave which typically strikes the Earth’s magnetic field 24 to 36 hours after the event. This only happens if the shock wave travels in a direction toward Earth.

Eleven-year solar cycle
The sun undergoes a “stormy” period of activity called the “solar maximum,” followed by a period of quiet called the “solar minimum.” During the solar maximum there are many sunspots, solar flares and coronal mass ejections.

- The solar wind and space plasma storms induce massive electrical currents that can affect power systems on the ground, especially in the north.
- A large storm in 1989 induced currents in the American northeast that caused a failure in the Hydro-Quebec power system that deprived six million people of power for over nine hours in Canada and the United States.
- While the solar maximum cycle is nearly ended—in early 2015 it is near the peak of Solar Cycle 24—past significant events have occurred near solar minimums.

- Space Weather can change the orbits of satellites and shorten mission lifetimes, and the excess radiation can physically damage satellites and pose a threat to astronauts.
- Movements of the Earth’s magnetic field can also cause current surges in power lines that destroy equipment and knock out power over large areas.
- Storms can set up currents that corrode the metal structure of petroleum pipelines, disrupt satellite and land-based communications, short-circuit satellite electronics, and interfere with navigation on ships and aircraft.

Space Weather can change the orbits of satellites and shorten mission lifetimes, and the excess radiation can physically damage satellites and pose a threat to astronauts.

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Electromagnetic Pulse (EMP) Events (sometimes called High-altitude EMP, or HEMP)

In 1962, during the depths of the Cold War, the U.S. military exploded a nuclear weapon high above the Pacific Ocean. Dubbed Operation Starfish Prime, this exercise was part of a larger project to evaluate the impacts of nuclear explosions in space. The missile, launched from Johnson Island, 900 miles from Hawaii, was armed with a 1.4 megaton warhead, programmed to explode at 250 miles above the earth. It detonated as expected. What was not entirely expected was the magnitude of the resulting electromagnetic pulse (EMP).

The worst effects of a Soviet high-altitude test occurred on 22 October 1962, in the Soviet Project K nuclear tests when a 300 kiloton missile-warhead detonated near Dzhezkazgan at 290-km (180 miles) altitude. The EMP fused 570 km (354 miles) of overhead telephone line with a measured current of 2,500 A, started a fire that burned down the Karaganda power plant, and shut down 1,000-km (621 miles) of shallow-buried power cables between Akmola and Almaty.

EMP is a high-intensity burst of electromagnetic energy caused by rapid acceleration of charged particles. Nuclear weapons, non-nuclear weapons and geomagnetic storms can power an EMP, and the resultant change in the Earth’s magnetic field can disrupt wired systems. An EMP has three main elements, defined as E1, E2 and E3—that arrive in sequence and have measurably different effects that can be cumulatively damaging to electronic equipment.

The effects and components of Electromagnetic Pulse

E1: An electromagnetic shock disrupts electronics, such as communication systems.

- This initial shock wave lasts about one microsecond, and is similar to very intense static electricity that can overload circuitry of every device in its line of sight.

E2: An effect similar to lightning rapidly follows and compounds the first component.

- By itself, this second component might not be a problem if anti-lightning protection is in place. However, the E1 energy may destroy protective measures allowing E2 to further damage electronics.

E3: The pulse flows through electricity transmission lines, overloading and damaging transmission distribution centers, fuses, and power lines.

- This is a longer duration magnetic energy—about one microsecond to a full second—and creates a localized geomagnetic impulse that is damaging primarily to long-lines. This builds up throughout the length of the transmission lines then quickly collapses, causing power surges that overload any equipment connected to utility and telecommunication systems.

- High-altitude nuclear detonations, as well as electromagnetic bombs (a.k.a. eBombs), can destroy every electronic device within line-of-sight. The true impact can’t accurately be determined as tests simply are seldom undertaken.

- Gamma rays generated via the explosion add impact that may disable computers and vehicle electric systems, above and beyond the expected influences of geomagnetic storms.

What else is out to harm key systems?

Additional technology that could prove to be very damaging to electronics of all types is known as “Radio Frequency Devices” or “High-Powered Microwave Devices” (RF and HPM). It is widely known that many governments—including our own—have developed and tested many variants of these devices. Oddly enough, most of the necessary components can be easily purchased (legally) at electronics supply stores, and on the Internet.

These devices, used as weapons, can be created in the form of “guns” that can...
be aimed fairly accurately, or could be transported and fired as “bombs” in vans or trucks. Imagine the results if directed at aircraft, power substations, banks or communications centers. RF devices would have no discernable effect on people or animals standing nearby, but a HPM would cause a painful, burning sensation and may be fatal.

Can our critical infrastructure be hardened?
Various protections have been developed to prevent or mitigate the harmful effects of geomagnetic, EMP and RF/HMP blasts but it is generally unknown how well these might work outside of laboratories and test programs.

The most common is known as the Faraday cage. It can be created as a complete enclosure using multiple layers of alternating copper or aluminum window screen, layered with plastic in between. Aluminum foil is also believed to be an adequate substitute for screen, as long as several layers are used. Some electrical experts suggest that a new, steel trash can be used as the final container, with multiple electronic devices individually caged, then stored within—so long as the can has a tight-fitting lid that is sealed well with metal tape.

That all sounds simple enough, but what about protecting large transformers, aircraft or vehicles from electromagnetic impulses, to name only a few important assets? Not so simple, but we can assume that interested industries, many governments and various trade associations are hard at work trying to find solutions to those challenges.

It would be easy to feel rather helpless in the face of these natural and man-made threats to our way of life now so dependent on electronic technology. Solace needs to come in knowing that our engineers and scientists are working as hard at creating defenses to these attacks as their predecessors did at creating them, or discovering the natural sources from millions of miles away.

This is one more very good reason to support science, technology, engineering and math studies in our schools. Go STEM!

Mike Sutherland can be reached at (303) 805-3205 or msutherland@parkeronline.org.
Q “Our city is asking us to find ways to save costs and provide better energy efficiency projects in our community. We’ve already upgraded our lighting to LEDs and have tried to find more efficient mechanical systems. None of this has really provided great savings. What are other cities doing to create a bigger impact on their energy costs?”

A While the items you have mentioned are beneficial, major cost savings will result from changes made to water and wastewater treatment systems. These systems typically account for 30-40 percent of a city’s total energy demand. Did you realize that? The Tennessee Water and Wastewater Energy Efficiency Partnership has helped many wastewater treatment plants in Tennessee to operate more efficiently. Their projects have shown that low-cost changes to water and wastewater treatment plants can have big energy and cost savings. The program was formed in 2011 as a collaborative effort between local utility districts, the U.S. EPA Region 4, the Tennessee Department of Environment and Conservation, the Tennessee Valley Authority, the University of Memphis and the University of Tennessee’s Municipal Technical Advisory Service. This first statewide effort of its kind has drawn 16 communities to participate so far in a series of workshops and facility energy assessments. Each utility identified low- or no-cost operations changes and earmarks larger energy efficiency investments that are incorporated when planned capital improvements occur. The focus of the program is to determine how to best reduce energy usage at plants without the financial burden of expensive capital projects, with many participants seeing almost immediate benefits.

The City of Columbia, utilizing the energy management team, found that it was not necessary to operate a second 450 horsepower blower more than 12 hours a day which resulted in an immediate annual energy savings of 1.9 million kilowatts per year, or $160,000 for an energy reduction of 24 percent. The City of Fayetteville made a similar but even more significant discovery. The energy management team determined that the best opportunity for savings was the aerobic digesters for the plant’s holding tank. They were able to reduce the run time on three 125-horsepower aerator motors which results in reducing the annual operations costs of 30 percent for a savings of more than $50,000. For more information, contact Mark Williams, Wastewater Director, Columbia, TN.

Q “It’s that time of year again! Our favorite issue to deal with is alleys! We have lots of them and they seem to be a bigger nuisance each year. Any suggestions as to how we might find some use for them?”

A There are several cities that are finding more potential in these once dangerous and usually underused spaces. San Francisco has transformed hundreds of alleys into “living alleys” where people can hang out. Nashville is one of a dozen U.S. cities that have turned to alley greening projects in the past decade as part of a larger effort to create green infrastructure and promote sustainability. Other cities include Austin; Baltimore; Chicago; Dubuque, Iowa; Los Angeles; and Seattle, among others. Chicago was one of the first to pioneer a green alley program back in 2006. Its 1,900 miles of alleys were experiencing periodic flooding. They launched an environmental and beautification campaign that mandated that infrastructure be retrofitted, when possible, in a sustainable way. The Chicago Green Alley program’s goal was to resurface its alleys with porous material that could absorb water into the ground rather than having it spill into Lake Michigan. So far, they have outfitted more than 100 alleys. Nashville wants to make its alleys more walkable and safe. It’s a new vision for an old design that is increasingly shared by other cities.

Cities no longer want alleys to be simply green. They want to create...
“living” spaces—places that not only implement sustainable best practices but also encourage community activities and active uses like walking and bicycling. San Francisco has helped transform Linden Alley in the Market and Octavia neighborhood from an unremarkable backstreet into a bustling “living alley” where people can hang out. They created a 100-foot, curb-free stretch of concrete, blurring the line between sidewalk and street. The actual roadway was narrowed with granite benches and pockets of green and lavender so that the space could be shared by cars and pedestrians alike. It’s a perfect place for living alleys. Their ultimate goal was to find ways to make the alleys more usable in an area heavily congested with traffic on the main streets and it has been wildly successful. They have also developed a Living Alleys Toolkit which serves as a how-to guide for transforming more alleyways. The Toolkit is based on the assumption that the bulk of the improvements would be spearheaded by community groups. The program continues to grow and Los Angeles is working to add permeable pavement to its alleys to soak up rainwater, add gardens that line the alleyways and create mini parks, and add streetlights and crosswalks that will keep pedestrians safe. Sounds like some great ideas. Hopefully, one of them might work for you.

Ask Ann...

Please address all inquiries to:
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E-mail: adaniels@apwa.net
Public works departments are under the proverbial microscope when abiding by budgets and attempting to maintain optimal performance. They are increasingly adapting in order to keep street sweepers on our roads, snow off streets and other work trucks moving to complete various municipal service tasks. In some cases, this municipal equipment includes the various fire trucks used in front-line duty to protect the citizens and their property.

Stainless steel was introduced over a century ago, but the metals industry is finally taking advantage of advances in chemical composition and new manufacturing processes to reduce its cost, increase its strength and durability in harsh conditions and push the material into the twenty-first century. As challenges of budgeting, appropriating, operating and maintaining stability in public works assets become increasingly challenging, municipal equipment manufacturers have begun viewing material choice and engineering design as equally important decisions in the overall production process.

Until recently, public works departments have not utilized these metallurgical developments and were instead combining new technological advancements with twentieth century materials, essentially taking one step forward and two steps back. Now is the time to understand how to take huge forward leaps.

For years, engineers have been seeking an answer to the question of “How?” How do we save fuel? How do we reduce weight? How to we increase the life of public works vehicles and assets? How do we routinely meet higher performance demands with less or stagnant funding?

Engineers and materials suppliers have been working hand in hand to answer these questions—and they now exist. Specialty stainless steels and solutions are now ready and able to change the public works landscape. “Next-generation” materials have been engineered to keep public works assets on the roads, out of maintenance shops and performing taxpayer duties on a consistent basis.

Engineers and metallurgists have zeroed in on these industries, researched and then developed these materials with low maintenance requirements, cost-stability and a strong resistance to challenging elements in mind. Crompion International, a Baton Rouge, Louisiana-based specialty stainless solutions provider for the public works industry, is one of several companies utilizing a suite of next generation metals to modernize the way street and truck-mounted vacuum sweepers, fire apparatus, snowplows, salt spreaders and dump body vehicles are fabricated, purchased and operated.

These next-generation materials, the Cromgard specialty stainless steel family for example, have been used successfully by established sweeper companies. Their cab and subassembly construction, hopper and fender applications highlight the durability of the material when installed.

Given their unique mechanical and chemical properties, these specialty stainless steels are enabling end users to realize cost savings through a reduced need for consistent upkeep, all without compromising crew safety. In service,
they require virtually no maintenance, which generates savings, improved productivity and longer service life.

In addition, music to the ears of any department who has ever had to stick round budgets into square results, Cromgard stainless steels are not subject to erratic price fluctuations due to the low content of price volatile nickel and are considered a budget saver.

New, modern grades of stainless steel are stronger than traditional carbon steels traditionally fabricated for vehicle components. Surprisingly for many, these new high-strength stainless steel materials are also an option to heavier gauge aluminum, allowing greater energy-efficiency in public works vehicles.

With a lower-weight design option now available, the ability to specify thinner gauge supports the public works department bottom line. Once fabricated into end-user products, these low-cost materials provide strength, corrosion and abrasion resistance, durability, as well as good weldability and formability for conventional fabrication capabilities.

Low-cost, next-generation materials are well-suited to stand up to even the most challenging elements for public works vehicles—corrosion and abrasion. Take for example next-generation grades within the Cromgard family of stainless steels—Cromgard C12 and Cromgard C20-1.

These materials were designed to greatly prolong the service lives of public works and commercial maintenance vehicles, including notable performance in truck-mounted vacuum and street sweepers. The modernization of the way these sweepers are fabricated is fully underway with specialty stainless solutions like the Cromgard C12 and Cromgard C20-1 grades.

This has already been proven as some of the most established sweeper companies are now successfully fabricating with these next-generation materials. Constantly searching for methods to reduce the thickness of hopper assemblies, some companies are turning to these types of specialty stainless steels due to their many advantages including increased strength and toughness, which greatly helps to battle the abrasion of debris and rocks on interior hopper surfaces.

The number of applications is continuously growing with current uses in subassembly and cab construction as well as fenders and hoppers.

With an added aesthetic appeal due to 20% chromium content, this next-generation grade shows good pitting and crevice corrosion and is unequalled by virtually all other uncoated engineering materials. It is also ideal for tank applications. The sweeper body and/or chassis are best suited for this grade because of the aesthetic appeal and chrome content.

Next-generation stainless steels with 12% chromium content, Cromgard C12 for example, are over 85% stronger than 304LSS, and stronger and more corrosion resistant than aluminum. With increased strength, low-weight design options are now more attainable.

Throughout various applications, Cromgard C12 has been tremendously successful in displacing aluminum, coated carbon steel and even traditional stainless steels. Subsequently, this helps to demonstrate an economical advantage and a realistic performance, especially in wear cost over time.

While Cromgard C12’s properties will perform best for application in panels of sweeper bodies, additional applications of this next-generation material include battery mounts, debris hoppers, brackets and framing, water and fuel tanks as well as wheel wells.

There are also applications where next-generation materials are performing life-saving duties, for example, the fire apparatus industry. American firefighters respond to an emergency call every twenty seconds and, in some years unfortunately, more perish in rollovers than were killed or injured on scene.

Most apparatus manufacturers still use aluminum to build their cab or truck bodies, but some now lead the way in building the next generation of safer, stronger and more corrosion-resistant fire apparatus. These new stainless steel cab and body designs incorporate cost-effective, advanced high-strength stainless steels and provide industry-leading protection for the engineer, officer and other crew. The improved corrosion resistance allows for a very long service life with very low maintenance costs.

As this grade is exponentially stronger than traditional stainless steel and 250 times more corrosion and abrasion resistant than uncoated mild steel, the apparatus will protect our firefighting heroes and stand the test of time through long winters, salty roads and rainy summers, many of the same conditions weathered by street sweepers and work trucks.

Crompion International, metallurgists and engineers across the world have one goal in mind when developing the public works industry’s next generation solutions—support the customer’s bottom line. Whether a public works department, fire department or commercial usage, modern specialty stainless steels are advancing a next-generation approach to budgeting purchasing, fabrication and operation.

Ken Grantham can be reached at (225) 343-4219 or KGrantham@crompion.com
Products in the News

Tippmann Post Driving Equipment introduces side mount adapter for driving u-channel posts

Tippmann Side Mount Adapter fastens quickly to all u-channel posts ranging in size from 2 lb. per foot all the way up to a 4 lb. per foot post. Whether you are driving an 8 ft. post or a 14 ft. post, this adapter will allow you to drive from a height you are comfortable with and your feet on the ground. This adapter is equipped with 11 sturdy attachment pins, which fit all major manufacturer u-channel hole patterns. The side mount adapter is then held in place by a long retaining pin and clevis. Learn more about this adapter as well as view online video demonstrations by visiting propanehammer.com. Or call toll free for a free brochure: (866) 286-8046.

ClearSpan™ is the industry leader for sand and salt storage

ClearSpan™ Fabric Structures, the preferred choice for sand and salt storage, provides design-build and energy-efficient solutions for material, equipment and other storage needs. Just recently, the Township of Wayne Department of Public Works in Wayne, N.J., installed a 65’ wide by 100’ long ClearSpan Hercules Truss Arch building for their salt supply. The ClearSpan buildings feature abundant natural light and spacious interiors without support posts. With minimal foundation requirements, the structures can be permanent or temporary, and are easy to relocate. Made in the USA, they can be built to any length and up to 300’ wide. According to George Holzapfel, Wayne’s public works director, “[The building] is well received. Material stored is safe from the elements and access for trucks and equipment is excellent.” For more information, call 1-866-643-1010 or visit www.clearspan.com/ADAPWA.

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Collective Data launches new web-based version of fleet and asset management software

Collective Data, Inc., a leading provider of fleet and asset management software systems, has officially launched a new web-based version of their collectiveFleet™ solution. The new version brings a new level of accessibility and ease of use, while maintaining Collective Data’s core goal of being able to easily configure the software to meet different requirements among organizations. The new web-based version is a mobile-responsive application that allows the software to be accessed through a web browser. The user interface was designed from the ground up to be easy to use on computers, tablets, and phones while being similar enough to the Windows version to make the transition to the new platform easier. For more information, visit http://www.collectivedata.com.

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Cree introduces the RUL Series, the first of Cree’s innovative outdoor LED luminaires to address the more than 600,000 rural street and area light fixtures installed. Featuring elements of Cree’s groundbreaking SCS Technology™ Platform, the Cree LED Rural Utility Light solution lasts up to 100K hours to L70 (70 percent light output), compared to High Pressure Sodium lamps which have a 50 percent mortality rate after 24K hours of service, providing less maintenance and increased energy savings. The Series provides industry leading efficacy of greater than 110 lumens per watt. For more information, visit 866-924-3645 or http://cree.com.

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2015  Aug. 30-Sept. 2  Phoenix, AZ
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For more information, contact Dana Priddy at (800) 848-APWA or send e-mail to dpriddy@apwa.net.

**JUNE 2015**

7-10  American Water Works Association’s ACE15, Anaheim, CA, www.awwa.org


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