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Students at Woodgate Elementary School (Village of Matteson, Ill.) (above) learn about engineering and the waterworks industry when they visit the jobsite where the sphere of a water tank is cut from the existing stem, lifted off, and moved laterally away (right). Photos courtesy of Robinson Engineering Ltd. (South Holland, Ill.) and Woodgate Elementary School. Used with permission.



Reaching New Heights With Community Involvement

WHEN PROFESSIONAL ENGINEERS OFFER HANDS-ON, PROJECT-BASED LEARNING TO STUDENTS, THE COLLABORATION IS BENEFICIAL FOR BOTH GROUPS, AS WELL AS THE COMMUNITY IN WHICH THEY LIVE. THE CONNECTION IS ESPECIALLY VALUABLE TO STUDENTS WHO ARE MADE AWARE OF THE DIVERSE OPPORTUNITIES IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM) CAREERS THROUGH THIS PROCESS.

Waterworks professionals spend extended periods on specifications, bids, project management, and more, and it's easy to lose sight of the ultimate goal of every project—improving people's lives. Too often, professionals plan and complete a project and then simply move on, knowing the public good is served and people's day-to-day lives are improved.

Robinson Engineering Ltd. of South Holland, Ill., recently completed a project in which it flipped that template inside out. The firm brought the community into the project from the beginning and worked closely with its municipal client to prioritize education and public involvement alongside design, budget, and schedule.

In doing so, Robinson created a model for future projects and, more important, found a way to bring added value to the community beyond the project itself. It's a model Robinson believes can be adopted for many public works projects and one that not only shines a more favorable light on the work and the waterworks profession but also builds confidence in local government, educates the public, and results in a more fulfilling vocation.

THE PROBLEM, A SOLUTION, AND A SPARK

Located approximately 30 mi south of Chicago, Ill., the Village of Matteson has a water system that spans two independent pressure zones, with each zone serviced by an elevated tank at a different overflow elevation. The west tank was built in 1971, and the east tank, about 5 mi away, was built in 1975, each by Chicago Bridge & Iron Co. The old plans and shop drawings showed a substantial elevation differential between the tanks. Surveyors used GPS satellites to lock in the elevation data, and field elevations showed

the differential to be 18.97 ft. Multiple pressure-reducing valves had compensated for the differential over the years. Like all mechanical valves, however, they require maintenance. When valves fail, it results in costly upkeep, water main breaks, and tank overflows that frequently degrade and interrupt service.

Robinson proposed to address the problem by adding 19 ft to the stem of the elevated tank at the lower grade by lifting the entire sphere section of the tank with three large cranes and inserting a 19-ft riser stem below the sphere to bring both tanks to the same hydraulic grade line (overflow elevation).

With the elevation differential established and a resolution proposed, the other determining factor was whether the soil had sufficient compressive strength around the tank. To assess soil strength, two angled soil borings were taken 180 degrees apart. The borings confirmed that the soil did have sufficient strength, leaving the final question of whether the steel thickness on the cone and riser could handle the additional weight and turning moment of the additional 19 ft. All deciding factors were checked, rechecked, and confirmed. The plans and specifications were then submitted to the Federal Aviation Authority (because of the additional height of the tower) and the Illinois Environmental Protection Agency for permits.

The final two construction factors were the crane delivery and the weather. The weight of the sphere was 240,000 lb, requiring specialized cranes. The two selected cranes had a 550-ton capacity each. A third 240-ton-capacity crane was used to install the riser pipe.

The project had to be completed on a very small plot of land relative to the size of the equipment involved. All the work was done on a site no larger than 150 ft by 150 ft. The contractor strategically positioned the three stationary cranes and one mobile crane to lift the sphere, remove the existing riser, install the

new riser, and reinstall the sphere. The contractor also used a 100-ft-tall “cherry picker” to cut the riser, attach the lifting lugs, attach the lifting straps, and reweld the sections.

The project comprised relatively routine work, with some interesting challenges, and the usual focus on

this is a no-brainer,” said Brian Mitchell, administrator for the Village of Matteson. “We see spending on infrastructure and on education both as community investments. This was a chance to combine them in one project and to impact kids’ lives at the same time.”

That day in the school assembly, while soaking up the students’ enthusiasm for their work, the project team understood the project outcome would now include changing lives. And the students were not the only ones who would benefit.



safety, budget, and timeline. The combination of several aspects of the job, however, sparked a brand-new approach: the project’s relative simplicity, its visibility, and the location next to Matteson’s Woodgate Elementary School, a PreK-5 school with 374 students.

BRINGING IN STUDENTS

Engineers love to talk about what they do and how they do it. But to the layperson, many municipal water works projects are complex and involve impenetrable jargon, design theory, and complex computations. The typical resident is less interested in the process than in the result and the cost, and rightly so. Despite the underlying complexities, this job was straightforward. It appeared the idea of lifting a tank with giant cranes, inserting a riser, and setting the tank down again was one even a child could grasp.

Back on the jobsite, eyeing nearby Woodgate, the engineers, village officials, and contractors considered a new idea. What if they could involve the students in the project? Would that be worth doing?

It helped that the Village of Matteson takes a holistic view of community involvement. “For us

As it happened, Bart Gilliam, Matteson Public Works director, had been familiarizing the children with the water tower and water system in the form of a field trip to the tower each autumn for the preceding eight years. His description of the students’ interest and the many questions asked on those trips got the team’s wheels spinning. They put together some ideas, and the team set up a brainstorming meeting with Woodgate’s principal, Nina King. “To be honest, I’m juggling a lot of appointments every day,” Principal King recalled. “Very few are with municipal engineers and water tank contractors.” She nearly put them off, she said, chuckling. “But the team’s love of their work and their interest in sharing it with the kids came through so clearly—sometimes you just have to have faith and get out of the way. The impact can be profound.”

The project team showed up for the meeting with aerial photographs, drawings, plans and, most important, a passion for giving back to the community. Team members quickly won over the educators and all agreed to the following objectives:

- Expose the students to a world that’s fresh and new to them.
- Convey the project team’s passion and excitement for their work.

- Offer hands-on experience, involve the students, and make them feel like part of the project.
- Give the students a once-in-a-lifetime experience.
- Get the students out of the classroom and into the field.
- Make learning come alive.
- Make a difference in the children's lives.

THE PRESENTATION

In a first for the consultant, the project team included elementary school science and math teachers working alongside engineers, surveyors, contractors, village elected officials, village administrators, and public works professionals. Together they decided to introduce the project to the students with a 30-minute, age-appropriate, interactive presentation. The team covered topics including the following:

- Matteson's objectives
- The role of the Public Works Department
- The purpose of the project
- Basic hydraulics

- Basic measurements, including global positioning
- Contractor safety
- A demonstration of robotic survey equipment to be used

In addition, all students received commemorative shirts and workbook activities (Figure 1), and they were shown the hardhats that would go to the class that scored the highest on the worksheets during the presentation. The students were so energized and had so many questions that the presentation stretched to 90 minutes. "Every good teacher knows that when you have a teachable moment, you don't stop," Principal King said. And it didn't stop. The questions kept rolling in, and the professionals kept answering.

That day in the school assembly, while soaking up the students' enthusiasm for their work, the project team understood the project outcome would now include changing lives. And the students were not the only ones who would benefit.

"I was blessed to be part of this," remarked one presenter. Another called that day the highlight of his

professional career. "We saw lights go on, and I knew that because of our involvement, their world was going to get a little bigger. That's a good day's work."

"We were all humbled by the opportunity to work alongside such dedicated school officials," Gilliam said. "The commitment of the principal and teachers to a new idea truly touched our hearts. We all have so much respect for educators and what they do for our kids. To think we would be working alongside them, and they with us, was very exciting."

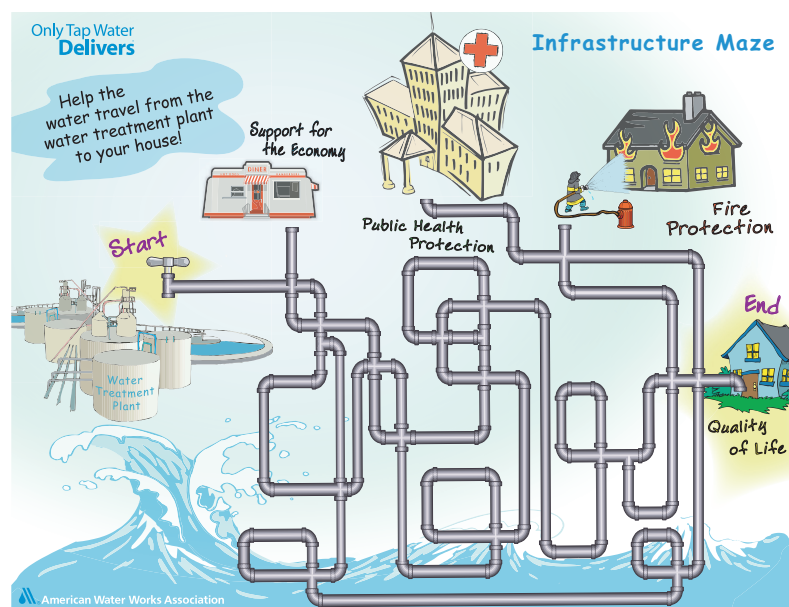
YOUTH ON THE JOB

The presentation was just the beginning. As the project commenced, the team set up a mock "command center" near the jobsite equipped not only with doughnut holes and candy but also with multiple computers, a three-dimensional model of the tank, plans, scales, and other items that would be typical in a site trailer. The children were allowed to wear hardhats while in the command center and to try on safety climbing harnesses. They also participated in a "question scavenger hunt," collecting answers from the professionals to questions such as "What type of education do you have," "Why did you go into this field," and "What do you like best about your job?"

The professionals worked with the children on their workbook assignments as well, getting down on the ground with them to help them complete the field measurements and explain the tools they used to design, build, and maintain the project. The world of complex engineering problems seemed far away to the project team members as they brought the children into their world and were gratified to see their own excitement reflected back to them by the students. A few days after the school presentation and before the scheduled lift, the contractor and the engineer had a conversation they'll long remember.

On the jobsite as they discussed the schedule for the lift, they were approached by a little girl, walking

FIGURE 1 Workbook activity used to teach children about the tools that public works employees and engineers used to design, build, and maintain the water tank project in Village of Matteson, Ill.



Source: Only Tap Water Delivers, © American Water Works Association

home past the site, who looked to be in second or third grade. “She was about 3½ feet tall, and probably all of 40 pounds soaking wet,” the contractor recalled. “Her backpack looked like it weighed as much as she did.” She kind of reminded us of a Sherpa going up Mount Everest. She called out, “Hey Mister, I know how much that tank weighs!” Teasingly, they pretended not to believe her. “Oh yeah?” they responded, laughing. “How much does it weigh?” She replied, “240,000 pounds!” They were delighted not only by the correct answer, but more so by the fact that they were actually reaching the students. They high-fived her, congratulated her on her brilliance, and then encouraged her to study engineering when she goes to college.

TANK RAISING DAY

On a cold November day with snow on the ground and temperatures hovering around 20°F, the project team and its young protégés gathered at the jobsite. Months of surveying, designing, gathering soil borings, permitting, and conducting educational activities finally culminated in the big event. With wind speeds predicted to be less than 18 mph and clear skies in the forecast, conditions were perfect for raising the tank. The perfect conditions were captured on video by Robinson Engineering and posted to YouTube (<http://youtu.be/Zu3-dcMPUxA>).

The main event began unfolding at 4:00 a.m. when the command center was brought to the jobsite. Because wind speeds are typically calmest in the morning, the team’s goal was to get the tank lifted and placed on the new stem starting at 6:00 a.m. and to wrap up by 3:00 p.m.

Around 5:00 a.m., the workers began arriving to warm up the cranes and prepare the equipment for the lift. As is customary on hazardous jobs in the community, the actual lift started with a prayer, led by Public Works Superintendent Hardin, who is also an ordained minister. Hardin asked that the men

and women working on the job be granted the wisdom to work safely and that no harm or danger befall the workers, with all returning safely to their families at the end of the day.

After the four cranes completed their prelift testing and warmup, the

the ownership they felt for the project. As the work got underway, the students called out to the team with a chorus of “thank you” and “good luck” going out to their new pals, many of whom the youngsters now addressed by name. At 8:00 a.m., the

For the first time but not the last, the lessons learned were not just among the team members but among members of the community as well.



first harness was attached to the tank at approximately 7:00 a.m. The students began arriving at school around 8:00 a.m. (see the photograph on this page and the left photograph on page 28), and their excitement quickly became palpable. For many students, this event was the high point of all the time they had spent learning about the project. Even the students in grades not involved in the program were full of questions, which the other students answered, proudly showing off their new knowledge of engineering and

last lifting strap was attached and the process of cutting away the tank began. The weather window seemed to be holding, and it was “go time.”

The sphere was cut from the existing stem, lifted off, and moved laterally away from the existing stem and pedestal (see the right-hand photograph on page 28). The sphere hung suspended by two 550-ton Mega Wing cranes for approximately five hours until the old stem was removed and the new stem was installed. A 240-ton Mega Wing crane was then used to remove the



Students at Woodgate Elementary School in Village of Matteson, Ill., learn about an engineering public works and contracting project to add 19 ft to the stem of an elevated water tank near their school. Photo courtesy of Robinson Engineering Ltd. (South Holland, Ill.) and Woodgate Elementary School. Used with permission.

existing stem and install the new stem. At approximately 8:40 a.m. the existing stem was cut and removed by the 240-ton crane. The new, taller stem was then put into place. As the sphere hovered over the new stem, most of the Woodgate students came out into the parking

community educational partnership were the norm, many more children would likely grow up with the ambition to become engineers or public servants, enriching their communities immeasurably.

Every major municipal engineering project ends with a final team meeting

Brian D. Mitchell, Village administrator, and Village Trustees of the Village of Matteson; Bart Gilliam, public works director; Gordon Hardin, public works superintendent; Dr. Nina Gregory-King, principal, and all of the educators, students, and community leaders at Woodgate; Robert Clouse and his team at Phoenix Fabricators; and the dedicated staff at Robinson Engineering.

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lot or peered out of school windows to witness the setting of the sphere.

The engineer, contractor, and village worked closely with Principal King to make sure the students were outside and ready to celebrate the moment they had all worked toward—placing the tank's sphere on its new stem. As it finally touched down, the crane operators blew their air horns simultaneously. The children in the parking lot and the school, armed with noisemakers and hard hats, went wild with excitement to see this once-in-a-lifetime event.

The welding process continued for another four hours on that day to secure the tank so the cranes could be dismantled and removed. After three to four additional days of welding; X-raying; reattaching ladders; and installing fill pipe, overflow pipes, conduits, etc., the job was done. It was clear, however, the project's impact was just beginning.

THE PAYOFF

At a village board meeting, Village Administrator Mitchell commented that "the true payoff of the project will occur 10 to 12 years from now when Woodgate students graduate from college with science or engineering degrees." Mayor André Ashmore remarked that if this kind of

to discuss the outcome and any lessons learned. For the first time but not the last, the lessons learned were not just among the team members but among members of the community as well. What's more, the team's sense of accomplishment included the unique and rewarding element of integrating its work into the educational mission of a school. The Village of Matteson, the engineer, and the contractor had challenged each other as professionals not only to complete the project on time, within budget, and without incident, but also to educate the public on the importance of the public works, engineering, and contracting professions. As a result of their experience in Matteson, they believe this is an objective that can and will be included in future projects.

Not every job lends itself to this kind of engagement, and there's a certain investment of effort, time, and money required to pull it off. But we all saw this as an investment well worth making—in our community, in our profession, and in our own job satisfaction.

ACKNOWLEDGMENT

The author thanks everyone who made the project described in this article a success for their dedication and professionalism, including André B. Ashmore, Village president,

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Thomas E. Nagle is a professional engineer with 28 years of diversified engineering experience, with particular

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<http://dx.doi.org/10.5942/jawwa.2015.107.0116>

AWWA RESOURCES

- Bridging the Engineering Workforce Gap Through Community Outreach (PDF). Kekelis, L. & Gomes, L., 2009. *Journal AWWA*, 101:8:52. Product No. JAW 0070537.
- Education and Training: High School Students Gain Early Exposure to the Water Industry (PDF). Starling, D.H. & Canady, D.C., 2010. *Opflow*, 36:9:10. Product No. OPF_0072509.

These resources have been supplied by *Journal AWWA* staff. For information on these and other AWWA resources, visit www.awwa.org.