CONCRETE TANK POLYUREA

# Tall Drink of Water: Challenges of Lining a Potable Water Tank

BY **JENNIFER FRAKES**
PHOTOS COURTESY **CREATIVE POLYMERS & ASSOCIATES**

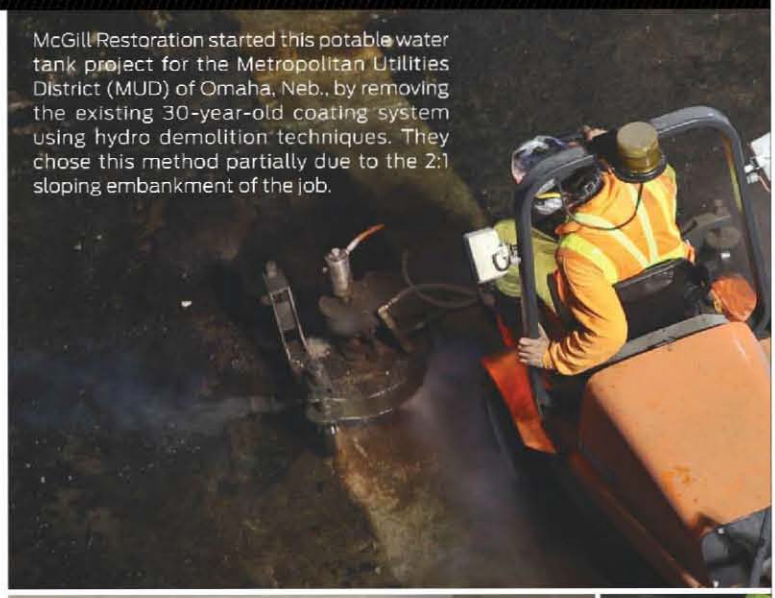
**For Timothy McGill, president of McGill Restoration Inc.,** coating the interior of a 20-million-gallon (75,708,236 L) potable water storage basin for the Metropolitan Utilities District (MUD) of Omaha, Neb., was a great project to be awarded on many levels. "This water tank is only about 1,000 yards [914 m] from our office. It is literally right in our backyard," said McGill.

While the job's water treatment plant location was certainly convenient, the job itself was not without challenges, including the removal of the existing 30-year-old coating system as well as dealing with steep slopes, unexpected moisture issues, and a tight timeline. How did McGill and his crew turn this large — and at times difficult — job into a success to which Omaha residents can raise a glass...of fresh, clean water? Read on to find out!

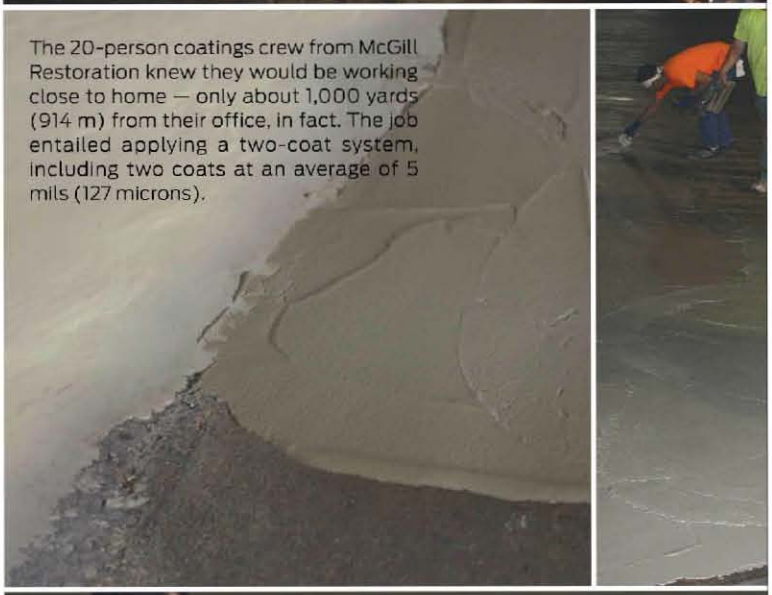
## Scoping the Project

According to McGill, the area to be coated was approximately 127,000 square feet (11,799 $m^2$) and consisted primarily of an 8-inch-thick (20 cm) concrete slab. "The substrate was sound but had significant cracking. On top of the substrate was an old, failing coating system that needed to be completely removed," explained McGill. At the outset of the project, the scope included the removal of the old lining system and the application of a ⅛-inch (0.3 cm) epoxy parge coat, followed by the installation of 80 mils (2,032 microns) of a polyurea polyurethane copolymer coating. (A parge coat is a thin coat of a cementitious or polymeric mortar that is applied to concrete or masonry for refinement of the surface).

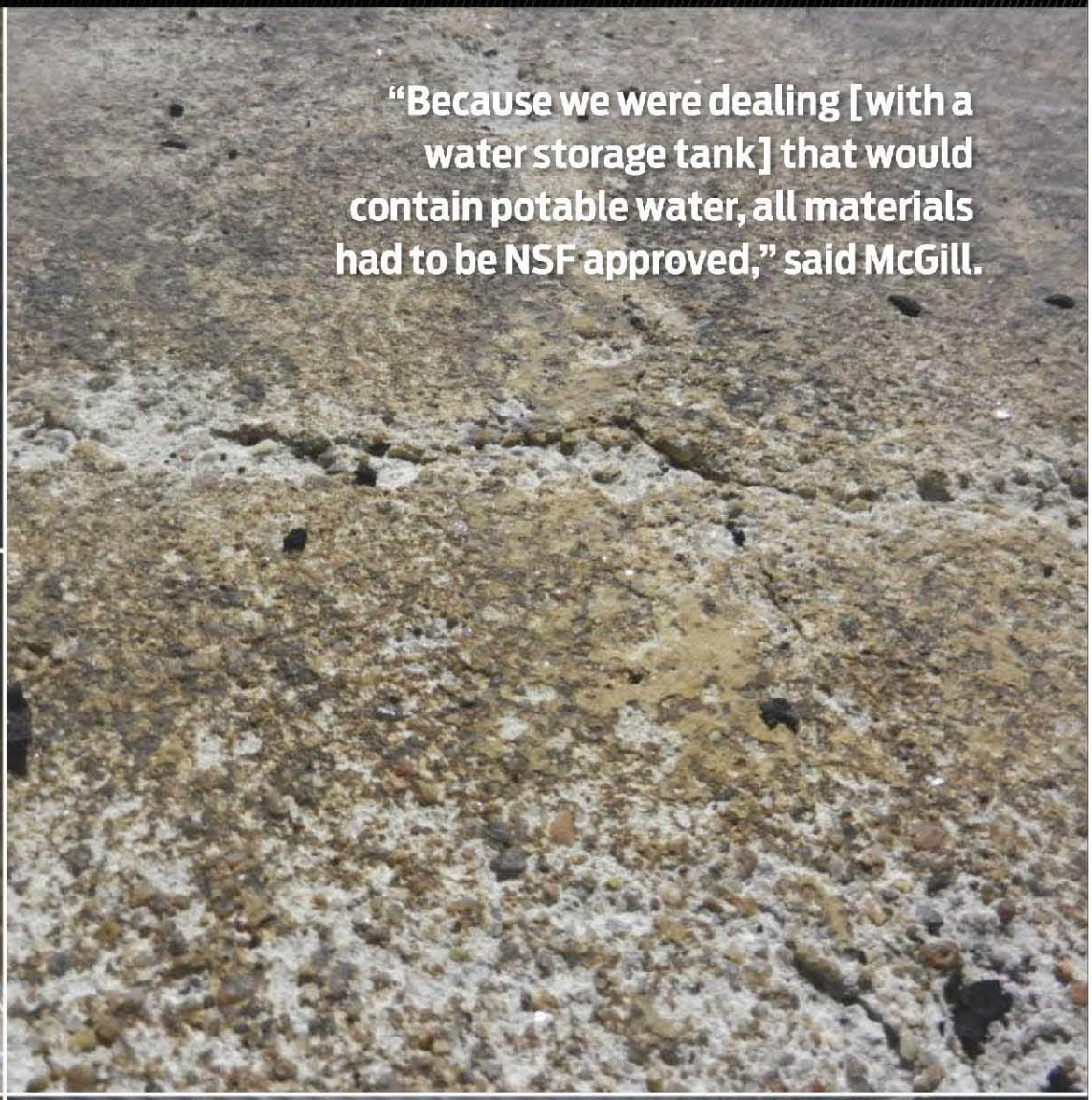
"Because we were dealing [with a water storage tank] that would contain potable water, all materials had to be NSF approved," said McGill. NSF International is an independent, accredited organization that develops public health standards and certification programs that help protect the world's food, water, consumer products, and the environment. NSF/American



McGill Restoration started this potable water tank project for the Metropolitan Utilities District (MUD) of Omaha, Neb., by removing the existing 30-year-old coating system using hydro demolition techniques. They chose this method partially due to the 2:1 sloping embankment of the job.



The 20-person coatings crew from McGill Restoration knew they would be working close to home — only about 1,000 yards (914 m) from their office, in fact. The job entailed applying a two-coat system, including two coats at an average of 5 mils (127 microns).



**"Because we were dealing [with a water storage tank] that would contain potable water, all materials had to be NSF approved," said McGill.**

Using hand trowels, the crew applied a parge coat of Polyprime 21 mixed with a filler material. This was applied in one pass at an average thickness of 125 mils (3,175 microns).

Wearing 3M respirators with isocynanide cartridges, safety glasses, and gloves, the crew spray-applied an additional coat of Polyprime 21 after the parge coat at an average thickness of 5 mils (127 microns). They then applied a 100 percent solids polyurea polyurethane copolymer on top.

National Standards Institute (ANSI) Standard 61: Drinking Water System Components — Health Effects establishes minimum health effect requirements for materials, components, products, or systems that come into direct contact with drinking water, drinking water treatment chemicals, or both. All of the coatings used on the water tank are manufactured by Polycoat Products and are NSF approved.

## The Pressure's On

To completely remove the old, cold tar urethane coating, McGill and his team decided to use hydro demolition. "We chose this method for two reasons: First, we could remove the existing coatings and profile the concrete in one pass. Second, about two-thirds of the substrate was a 2:1 sloping embankment. With the hydro demolition method, we were able to use a specialized hydraulic robot that climbed the embankment on a cable-driven system. The robot is manufactured by Blasters, Inc., and the hydro demolition pump is manufactured by Jetstream," explained McGill.

The 19-inch (48 cm) hydro demolition head that was attached to the robot operated at 20,000 psi (138 MPa), allowing for complete coating removal and creation of a 5–6 surface profile per the International Concrete Repair Institute (ICRI) surface preparation guidelines. According to McGill, this profile was exactly right for the application of the epoxy parge coat. The crew also used hand-held lances manufactured by Jetstream. The lances operated at 20,000 psi (138 MPa) to remove any residual coating and debris.

Hundreds of relative humidity tests were conducted by a third-party testing service on the concrete substrate. These moisture tests revealed extremely high levels of vapor drive within the substrate, which resulted in applying two coats of the primer to the entire substrate.

For the horizontal floor of the tank, McGill and his crew used a Kubota tractor with a 19-inch (48 cm) hydro demolition

head. "The tractor operated at about 60 gallons per minute [227 L/m]. We also used the hand-held lances and firehoses to remove any coating or debris that was left behind on the floor," said McGill.

Keeping to the schedule was an important part of the surface preparation aspect of the job as well as the project as a whole. According to McGill, other trades were relying on him and his crew to remain on schedule. "Coating the interior of the water storage basin is only one portion of the job. Nothing else could start until we were finished with our part," stated McGill.

As a result, McGill decided to run double shifts to stay on top of the tight timeline. "We had 8 guys on site at a time — 16 per day. The hydro demolition machine can only run the one robot, or two lances, so we needed to keep the machine running on two shifts," said McGill. He also pointed out that the project started in early March, usually a slow time of year for coatings applicators in colder climates, so double shifts put more of his employees back to work while simultaneously jump-starting the water tank coating schedule. "Even with double shifts, the hydro demolition process and cleaning of the entire tank area took about one month from start to finish," said McGill. In other words, the removal and prep work took up approximately one-third of the three-month project schedule.

Once the coating was water-blasted off the concrete substrate and all surfaces were pressure-washed clean, the crew hauled all the old coating debris to the landfill. Luckily, the old lining system was not toxic and did not require special handling or disposal.

## All Wet

Before the crew could begin applying the new coating system, there were two items that needed to be completed: Sealing up any existing cracks in the concrete and performing moisture tests to ensure that the substrate was dry enough to receive the parge coat and ultimately the polyurea polyurethane copolymer topcoat. "We performed over 1,000 lineal feet [305 m] of hydrophilic urethane grout injection to seal up actively leaking cracks prior to beginning the coatings operation. In other words, we filled the cracks with the same material as we used for the parge coat — Polycoat Products Polyprime 21 mixed with a filler material," stated McGill.

And then there was the issue of moisture — lots of moisture. The original specifications called for the parge coat to be laid down on the concrete at this point in the project, but that's not exactly what ended up happening. According to McGill, the crew performed hundreds of calcium chloride moisture tests, all of which came back much too high for coating application.

The calcium chloride tests are manufactured by Vaprecision Inc., and each professional vapor emission testing system is its own kit. The test creates a vacuum-sealed environment and contains a canister full of granules that absorb the moisture from the substrate. "It seems that the area where the tank is located had some apparent ground water, possibly spring-fed water, or possibly just water that was being lost during

# JOB AT **A GLANCE**

**PROJECT:**
Rehabilitating a 20-million-gallon (75,708,236 L) potable water tank, which required removing an existing 30-year-old coating system using hydro demolition techniques and applying a copolymer plural component coating system

**COATINGS CONTRACTOR:**
McGill Restoration Inc.
2821 Grebe St.
Omaha, NE 68112
(402) 320-7137
www.mcgillrestoration.com

**SIZE OF CONTRACTOR:**
65 employees

**SIZE OF CREW:**
20 workers

**PRIME CLIENT:**
Metropolitan Utilities District (MUD) of Omaha, Nebraska
1723 Harney St.
Omaha, NE 68102-1960
(800) 732-5864
www.mudomaha.com

**SUBSTRATE:**
Concrete

**CONDITION OF SUBSTRATE:**
Mostly sound but had some significant cracking

**SIZE OF JOB:**
127,000 sq. ft. (11,799 m²)

**DURATION:**
3 months

**UNUSUAL FACTORS/CHALLENGES:**
- Because the tank is used to store potable water, all products had to be NSF-approved.
- All crewmembers had to pass extensive background checks before they were allowed on the premises of the water treatment plant.
- The water storage basin is only 1,000 yards (914 m) from the office of McGill Restoration Inc.
- A hydraulic robot on a cable-mounted system was used on the steep embankments of the tank during the hydro demolition phase of the job.
- To keep on schedule, McGill had double shifts running during the surface prep portion of the project.
- Extremely high moisture infiltration in the concrete substrate resulted in the application of two additional primer coats to provide a vapor block.

**MATERIALS/PROCESSES:**
- Utilized a hydro demolition with hydraulic robot mounted on a cable to remove the cold tar urethane coating from the 2:1 sloping embankments of the tank
- Removed the old coating system on the tank floor using a Kubota tractor with a 19-inch (48 cm) hydro demolition head
- Performed over 1,000 lineal feet (305 m) of hydrophilic urethane grout injection using Polyprime 21 mixed with a filler to seal up actively leaking cracks prior to beginning the coatings operation

- Applied 2 average 5-mil (127 microns) coats of Poly Products PolyPrime 21 using Graco Ultra Max II 1095 airless sprayer with a .035 tip when moisture tests revealed extremely high levels of vapor drive within the substrate
- Applied a parge coat of Polyprime 21 mixed with a filler material using hand-trowels at an average thickness of 125 mils (3,175 microns) in one pass
- Applied an additional coat of Polyprime 21 to the entire water tank area at an average thickness of 5 mils (127 microns) once the parge coat was in place
- Applied Polycoat Products' Polyeuro 1050H to the substrate using a Graco XP-50 plural component pump; Polyeuro 1050H is a 100 percent solids polyurea polyurethane copolymer

**SAFETY CONSIDERATIONS:**

- The crewmembers wore neoprene rain gear, protective face shields, respirators when necessary, and gloves for the hydro demolition work.
- For the coating portion of the job, the spray crew wore Tyvek suits to keep any materials off their clothes and skin. They also used 3M respirators with isocynanide cartridges for respiratory protection. Safety glasses, hard hats, and gloves were also worn throughout the duration of the job.
- Although the tank was not considered a confined space, a hoist was in place so that personnel could be lifted to the top of the tank if necessary.
- All vents in the tank were opened, and half a dozen large fans were used to keep the air circulating in the tank.

the filtration process of the water treatment plant," said McGill. The fact that the storage basin is 35–40 feet (11–12 m) underground wasn't helping things when it came to moisture infiltration; the areas of high moisture content were mostly in the bottom 12 feet (4 m) of elevation within the water tank.

Hundreds of relative humidity tests were also conducted by Terracon, a third-party testing service, and were uniformly coming back much too high for coating application to commence. The moisture issues in the tank's interior needed to be addressed quickly so that the project could remain on schedule. As stated by McGill, this adjustment to the project specifications received buy-in from both MUD, as the asset owner, and HDR Engineering, the design consultant on the job. They also conferred with Polycoat Products to determine the right product that would help to block the vapor drive within the substrate.

Although the crew found that the water basin was mostly sound, it did have some significant cracking. To mitigate those problems, the crew used a hydrophilic urethane grout injection to seal up actively leaking cracks, which were handled prior to the beginning of the coatings operation.

"Working with Polycoat Products, we decided to apply two coats of Polyprime 21 primer, a 90 percent solids NSF-approved epoxy, to some areas in the tank," said McGill. The crew once again conducted moisture tests, and this time the results were exactly what McGill had hoped for — no outgassing or bubbles occurred. Since the primer performed so well as a vapor block in these areas, the crew then installed two coats of Polyprime 21 throughout the entire water storage basin. Using a Graco Ultra Max II 1095 airless sprayer with a .035 tip, the crew laid down the primer at an average dry mil thickness of 5 mils (127 microns) per coat.

## Back in Business

With the moisture issues taken care of, the crew could finally get down to the business of installing the parge coat. "The parge coat is the same epoxy as the primer [Polyprime 21] with a filler material that is mixed in at 2.5 parts powder to 1 part epoxy. This makes the material have a mortar-like consistency," explained McGill. The crew hand-troweled the epoxy coating at a thickness of 125 mils (3,175 microns) in one pass. According to McGill, he and his crew were able to trowel approximately 6,000 square feet (557 $m^2$) per working day, so the parge coat took a little over 20 days to apply.

Once the parge coat was in place, an additional coat of Polyprime 21 was applied to the entire water tank area at an average thickness of 5 mils (127 microns). At that point, it was finally time to apply Polycoat Products' Polyeuro 1050H to the substrate using a Graco XP-50 plural component pump. Polyeuro 1050H is a 100 percent solids polyurea polyurethane copolymer that is NSF-approved for direct contact with potable water. "We applied the Polyeuro 1050H in 2 average 40-mil [1,016 microns] coats for a total average thickness of 80 mils [2,032 microns] when finished. When we first tried to spray the coating at the full 80 mils [2,032 microns] in one coat, the steep embankment caused the coating to run on us. By spraying in two equal passes, the Polyeuro 1050H stayed exactly where we sprayed it, and we had no issues with sagging or running," said McGill.

McGill also revealed that the coating was applied all the way to the top of the concrete water storage basin. "There's a concrete curb on the top of the tank with about two feet [0.6 m] of space between the curb and the metal covering on the tank. There's an asphalt ring around the top of the tank, so we coated all the way down the face of concrete curb. Once we were finished with our part of the job, the asphalt was going to be redone, giving the area a good overlap [of coverage]," said McGill.

## Not More Moisture?

Water is a recurring theme on this job; even after the moisture issues within the substrate were fixed, there was one more moisture challenge the crew had to endure. The project started in the early spring, and in Nebraska that means that the weather can be less than optimal. "Cold and wet conditions

did slow down the coating process at certain times during the job. We needed temperatures above 50° F [10° C], less than 80 percent humidity in the air, and the temperature had to be at least 5° F [3° C] above the dew point," explained McGill. Given the cold and damp weather of the season, the crew had to stop coating operations at times during the project to allow conditions to stabilize. Luckily, the weather delays did not keep the crew down for long, and they were able to keep on schedule.

## All About Safety

According to McGill, keeping the crew safe was the number one priority on the job. The crewmembers wore neoprene rain gear, protective face shields, respirators when necessary, and gloves for the hydro demolition work. For the coating portion of the job, the spray crew wore Tyvek suits to keep any materials off their clothes and skin. They also used 3M respirators with isocynanide cartridges for respiratory protection. Safety glasses, hard hats, and gloves were also worn throughout the duration of the job.

This 20-million-gallon (75,708,236 L) water basin covered 127,000 sq. ft. (11,799 m²). And the project, which lasted three months, highlighted products that are NSF-approved to meet the needs of potable water — water that this crew has been drinking and will be drinking for years to come!

Although the tank was not considered a confined space, McGill states that the crew had to be aware of how to get a crewmember out of the tank if necessary. "We had a hoist that was used to bring materials in and out of the tank. It could also be used for personnel if they were unable for some reason to walk up the staircase that spanned from the top to the bottom of the tank," explained McGill. He added that for improved ventilation, all vents in the tank were opened, and half a dozen large fans were used to keep the air circulating inside.

Another aspect of safety on the MUD potable water tank job was ensuring that all crewmembers working at the water treatment plant had passed background checks and were cleared to work on site. "Everyone working on the job had to pass a fairly extensive background check in order to have access to the premises. We could only use workers who had been prescreened by the plant to be onsite," stated McGill.

## $H_2O$ Close to Home

McGill is proud of the role McGill Restoration Inc. played in the overall project, not just professionally but also personally as a business owner and resident who drinks water from the water storage basin. "I've been drinking this water my entire life, so it was a unique project from that point of view. Also, it was great that we were able to bid on a job that was so physically close to us. We had very minimal mobilization costs, especially when compared to contractors who were coming from across the country," said McGill.

In addition, McGill and his crew were able to work together with Polycoat Products to come up with ways to mitigate the unexpected moisture issues, deal with some steep slopes, and apply a polyurea polyurethane plural component copolymer coating that will properly protect the concrete substrate for years to come — something that McGill will be able to appreciate personally. **CP**

## VENDOR TEAM

**3M**
*Safety equipment manufacturer*
2350 Minnehaha Ave. East
St. Paul, MN 55144
(800) 364-3577
www.3m.com

**Blasters, Inc.**
*Robot manufacturer*
7813 Professional Pl.
Tampa, FL 33637
(813) 985-4500
www.blasters.net

**Graco Inc.**
*Equipment manufacturer*
88 11th Ave. NE
Minneapolis, MN 55413
(612) 623-6000
www.graco.com

**HDR, Inc.**
*Design consultant*
8404 Indian Hills Dr.
Omaha, NE 68114
(800) 366-4411
www.hdrinc.com

**Jetstream of Houston, LLP**
*Hydro demolition equipment manufacturer*
5905 Thomas Rd.
Houston, TX 77041
(800) 231-8192
www.waterblast.com

**Kubota Tractor Corporation**
*Surface prep equipment manufacturer*
3401 Del Amo Blvd.
Torrance, CA 90503
(888) 458-2682
www.kubota.com

**Polycoat Products**
*Coating manufacturer*
14722 Spring Ave.
Santa Fe Springs, CA 90670
(562) 802-8834
www.polycoatusa.com

**Terracon Consulting Engineers and Scientists**
*Third-party relative humidity testing*
18001 West 160th St., #300
Olathe, KS 66061
(913) 599-6886
www.terracon.com

**Tyvek by DuPont**
*Safety equipment manufacturer*
P.O. Box 80728
Wilmington, DE 19880
(800) 448-9895
www2.dupont.com/Tyvek/en_US

**Vaprecision, Inc.**
*Moisture test manufacturer*
3211 W. MacArthur Blvd.
Santa Ana, CA 92704
(800) 449-6194
www.vaportest.com