



CASE STUDY

Reality Capture Services Maximize Condition Assessment Value for GLWA Water and Wastewater Facilities

Assessing the condition of infrastructure helps utilities avoid emergencies, prioritize repair and replacement projects, and plan for the future. As the largest water utility in Michigan, the Great Lakes Water Authority (GLWA) provides drinking water distribution and treatment to almost 40% of Michigan's population, and wastewater collection and treatment services to nearly 30% of the state. Regular inspections and condition assessments of their extensive facilities are critical to successful operations.

Wade Trim has a long history of working with GLWA to develop solutions for infrastructure, operational, and regulatory challenges. Facility inspections have been an integral part of our work, helping GLWA assess the condition of their facilities to support near- and long-term decision-making about maintenance, repair, and upgrade needs. As technology continues to evolve, we look for opportunities to bring greater benefits to GLWA through these services. Wade Trim recently developed a hybrid approach to inspection using mobile-scanning technology that allows full reality capture of existing conditions to maximize the value of GLWA's investment.

Formidable Challenges of Traditional Inspection Techniques

Massive tanks used to store different types of water throughout GLWA's system pose unique challenges for inspection—some are very old, some are deep underground, and most are hazardous. GLWA's drinking water treatment plants contain multiple, underground, concrete reservoirs that are about 155,000 square feet and store up to 20 million gallons (MG) of drinking water. On the wastewater side, combined sewer overflow (CSO) facilities used to capture and treat combined sewage are even larger and contain complex features like sloped floors, elevated benches, and confined/narrow spaces.

The traditional inspection process used for GLWA's tanks has been slow and extremely labor intensive. Inspecting a single reservoir could take a team of six people up to three weeks. Unpredictable storm events make inspecting CSO facilities even slower; each facility could take more than a month. During inspection, field workers must spend significant amounts of time in potentially risky situations. They might be up on scaffolding to check

every part of a 40-foot wall in a reservoir. Or, they might be wearing Tyvek suits and waders, working their way through the dark, slippery, and tight spaces of a CSO facility.

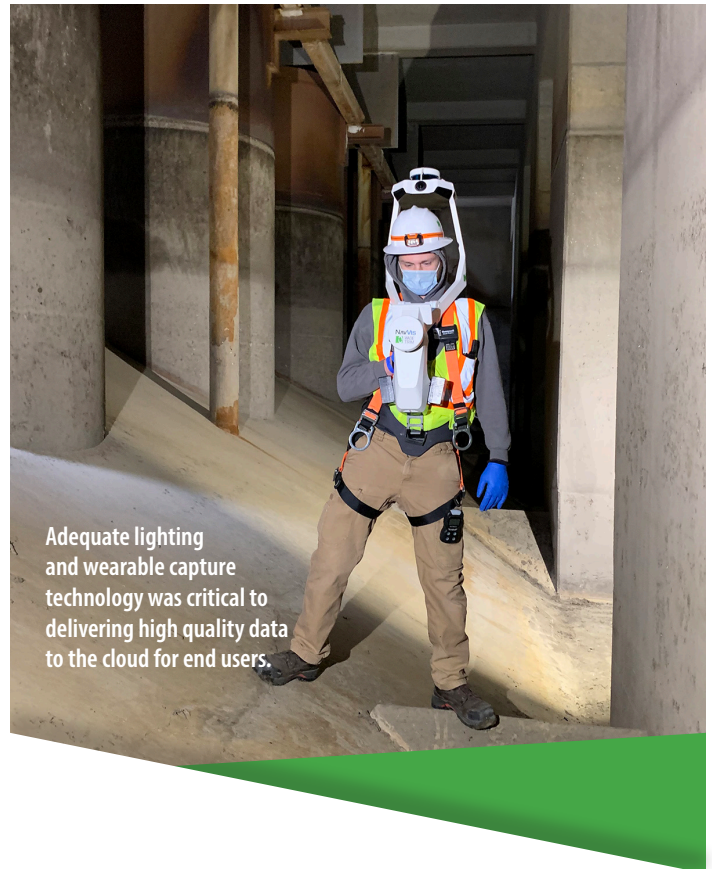
“After a facility was drained and cleaned, we would carry around a set of plans and bang on the surfaces with a hammer and employ different kinds of instruments,” says Brian Gombos, Wade Trim Senior Project Manager. “We’d mark cracks and defects on a plan set as we observed them. Then we’d generate a condition assessment report by re-creating that information in a digital medium.”

The inspection process was also expensive for GLWA. Every day one of their facilities is inactive reduces their capacity to serve the surrounding area with drinking water, or to handle wastewater. Since it costs around \$100,000 on average to shut down a tank for isolation and cleaning, the opportunity to capture a tank’s condition assessment information and imagery only comes once every 5 years.

Mobilizing a New Process

Everything changed when GLWA needed to expedite a comprehensive inspection and condition assessment of 10 large, finished water reservoirs at four water treatment plants. Full documentation of the existing condition of “every square foot” and job orders delivered to the repair contractor were required. Knowing how difficult and time-intensive this project would be to accomplish using traditional methods, Wade Trim considered how state-of-the-art scanning technology could be used during inspection. The main goals were to facilitate speed of capture, minimize tank shutdown time, and capture 100% of the existing conditions in a digital twin environment.

Our initial approach combined the use of aerial inspection drones and terrestrial laser scanning. We had used these technologies extensively to capture outdoor areas but weren’t sure how effective they would be in a confined, indoor space. A concept drone flight completed along one wall inside a reservoir revealed it would still take significant time to create a 3D model from the aerial images captured. It was clear that laser scanning would also be difficult to complete quickly given the structure’s complexity and height, as well as the need to work around concrete columns spaced every 20 square feet.



Adequate lighting and wearable capture technology was critical to delivering high quality data to the cloud for end users.

Looking beyond our known technology, Wade Trim turned to NavVis, a young company focused on reality capture solutions for indoor facilities. Their mobile mapping technology was intended to supplement traditional surveying devices to capture comprehensive data with high speed and accuracy. Point cloud and 1 sigma accuracy, 360-degree panoramic imagery, and quality media could be delivered in a single, cloud-based platform called “NavVis IVION”, capturing the built environment as a photorealistic digital twin. Though NavVis was primarily digitalizing manufacturing facilities, it was exciting to imagine how their technology could be applied to GLWA’s large, underground facilities.

After much due diligence, we selected NavVis mobile M6 and VLX scanning equipment and invested in a full-scale proof of concept at one of the reservoirs, at no cost to the project. The results were impressive - allowing us to quickly evaluate conditions, develop repair documents, and issue job orders to the contractor that had already mobilized to the site and was waiting for direction. We soon purchased the M6, that operates on wheels, and VLX, that is wearable, and began using the new equipment to inspect GLWA’s reservoirs.

New Application Creates Unique Learning Curve

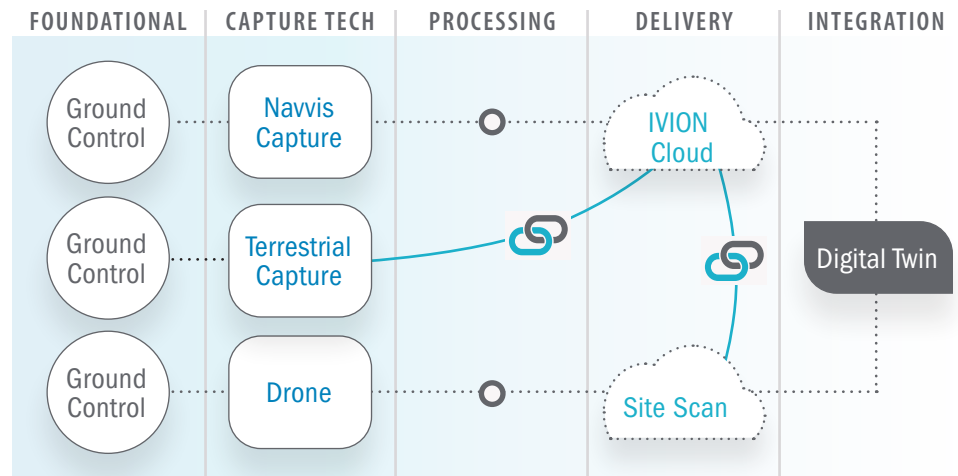
Using the NavVis scanning equipment effectively on GLWA's reservoirs required a learning curve for both Wade Trim and NavVis. Initially, Wade Trim had to learn how to operate the equipment and integrate the data with our drone and terrestrial laser scanning technologies used on the project. NavVis had to respond to new challenges encountered using their equipment in dark, underground environments. A working partnership between the two firms quickly developed to refine the inspection approach, share feedback on equipment performance, and improve deliverables.

Significant interoperability issues had to be addressed to support dataset accuracy. NavVis works on the metric system, further refined by use of truncated numbers. The survey work to establish ground control points (GCP) in the structure relies on the imperial numbering system that includes decimals. Wade Trim pioneered a process to convert the GCP information to metric after scanning, accounting for the difference in decimal use, before the data could be input and processed. In addition, aerial photogrammetry point cloud information captured with drones had to be converted to a different file format to be compatible with NavVis IVION's online viewer.

Other challenges focused on ease of use for end users. Extra lighting was needed to capture imagery with high enough quality to support NavVis IVION. We affixed our own lighting onto the NavVis equipment and additional static lighting was secured with the contractor. In addition, the NavVis system required a unique URL, or web address, for each facility scanned to store and access the data. To facilitate GLWA's ability to access and view their facility data, it was important to provide access to information about multiple facilities using a single URL address. Wade Trim demonstrated that additional datasets could be added to a single URL address and worked with NavVis to add multiple facility capability in NavVis IVION.

Hybrid Mobile-Scanning Workflow Delivers Cost and Safety Benefits

The hybrid mobile-scanning workflow that emerged combined the strengths of drones, terrestrial laser scan-



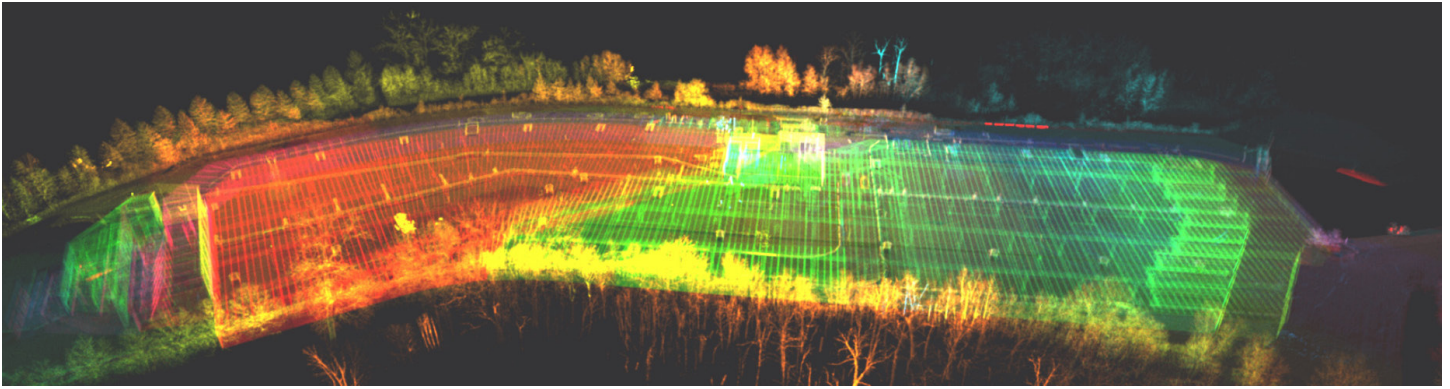
The hybrid mobile scanning workflow integrates multiple technologies to maximize value via cloud-based data delivery.

ners, and mobile capture equipment to deliver more value to GLWA. The workflow began with laser scanning the facility exterior to establish ground control points, flying the site with drones to capture high resolution exterior imagery, and then walking the interior with the NavVis equipment to capture all interior data. All data was then placed into a "digital twin" environment made available through the cloud-based software platform "NavVis IVION" made available from any connected device, allowing all project stakeholders to collaborate in an immersive and navigable virtual project environment.

"We did the manual inspection – the sounding and so on – at a high level in the field. Then we captured the facility with the VLX," says Neil Wakeman, Advanced Design Technology Manager. "This gave us a full data capture, including imagery, that we could use for additional desk-top evaluation back in the office."

The new workflow sped up the inspection process significantly, reducing overall cost and improving safety by minimizing inspection time for field workers. Using NavVis VLX and manual methods, a team of two could be in and out of a reservoir in only four days. And they used the on-board cameras to capture some "invaluable" 360-degree imagery in areas where they wanted to take a closer look.

The virtual tour environment will allow GLWA and other stakeholders to "revisit" the digital twin of the reservoirs in the future to better understand changing conditions and deterioration over time. In addition, our solution can integrate with other software solutions in the future to provide GLWA with the best opportunity to minimize technology solutions as well as maximize internal resources by limiting investment, training, and support for multiple platforms.



"I was able to completely capture one of the larger CSO facilities in approximately 8 hours of scan time. When we previously grabbed that level of detail and imagery with a terrestrial scanner, it took 300 set ups at 3 minutes each just to finish the roof."

Jason Yoscovits, Drone Fleet Lead and Senior Construction Inspector

Benefits Magnified in Larger Facilities

Recognizing the numerous benefits of the hybrid mobile-scanning workflow, GLWA tasked Wade Trim with assessing the condition of nine remote CSO facilities as part of a long-term maintenance program. The wearable VLX was put to greater use in these larger, more complex facilities enabling capture of data for uneven surfaces, dark conditions, and access to the most difficult corners to reach. The approach dramatically reduced the time needed to complete these structural inspections and delivered more robust as-built data, eliminating the need for follow-up visits.

This extra speed solved several secondary problems, too. It reduced the downtime of the facilities, helping GLWA maintain its capacity and ultimately save money. It also brought significant safety benefits for Wade Trim. "We were able to get in and out of there quickly," says Jason Yoscovits, "We really cut down the time we were exposed to risk. We were also able to reduce our crew – the number of people we exposed to risk – by about half."

With GLWA's 3D data hosted in NavVis IVION, benefits extend beyond the inspection process. The data can be revisited, for instance, to check out a bracket that might have escaped notice when working through the facility. The inspection teams can also use POIs (Points of

Interest) in NavVis IVION to flag potential repairs in the 3D data. This makes it easy to coordinate work with the maintenance contractors.

The 3D data and 360° imagery is also valuable for historical record keeping and training. "When GLWA wants to do an inspection again in 5 years," says Jason, "we can approach it in the same way, and then have the two data sets available for comparison. That's quite valuable from a condition assessment standpoint." He adds, "GLWA can also use 3D data to perform training, and perhaps walk somebody through the lower wet well area of a CSO facility that is rarely visited due to the confined space nature. And you can do it without shutting down the facility."

Lessons Learned

- Since mobile mapping devices, terrestrial laser scanners, and drones all have unique strengths for data capture, the best capture tool is often more than one tool.
- A hybrid mobile-scanning workflow can significantly reduce facility inspection time and cost, and minimize facility downtime.
- Mobile mapping improves safety by limiting the time workers need to be in challenging environments.
- With survey control, the data sets captured from all devices can be combined into a single point cloud—a powerful deliverable that maximizes flexibility and adaptability for all users.

Wade Trim's expertise, growing work experience across the country, and assistance providing NavVis real-world feedback on project performance has led to our designation as one of only 14 NavVis preferred Mapping Partners in the Americas. For more information about our reality capture services, contact Brian Gombos at bgombos@wadetrim.com or 800.482.2864.