



## INCIDENT REPORT



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### INCIDENT HIGHLIGHTS

**DATE:**

February 14, 2021

**TIME:**

7:15 AM (approximate)

**VICTIMS:**

57 – year old operator

**INDUSTRY/NAICS CODE:**

Sewage Treatment Facilities / 221320

**EMPLOYER:**

Municipal Wastewater Treatment Plant

**SAFETY & TRAINING:**

Victim had initial and ongoing operator training.

**SCENE:**

Wastewater clarifier

**LOCATION:**

Southern Illinois

**EVENT TYPE:**

Fatality (drowning)

**INSPECTION #:** 1515215    **REPORT DATE:** July 20, 2021

## Wastewater Plant Lead Operator Drowns in Clarifier in Cold Weather

### SUMMARY

On February 14, 2021, the Illinois Department of Labor – Division of Occupational Safety and Health (IL-OSHA) learned of the death of a wastewater plant operator that occurred the same day. IL-OSHA opened an inspection on February 17, 2021 to investigate the circumstances that led to the wastewater plant operator falling into and drowning in an open clarifier.

### CONTRIBUTING FACTORS

**Key contributing factors identified in this investigation include:**

- Victim encountered an unscheduled maintenance condition.
- Victim was working alone.
- Extreme cold weather increased the hazards associated with working over water due to the effects of cold water immersion.
- The actual risk of work was much higher than the perceived risk.

### RECOMMENDATIONS

**To help prevent similar occurrences, employers should:**

- Increase machine resilience to extreme weather.
- Ensure start work controls are in place for non-routine work.
- Ensure additional controls are in place when working alone.
- Recognize the effects of cold water immersion.
- Detailed recommendations on page 10.



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*Figure 1 – Clarifier on 2/14/21, post incident (photo credit: Illinois State Police).*

### BACKGROUND

The victim, age 57, worked in the municipal sewer department at the wastewater treatment plant (WWTP) where he had been an employee for more than twenty-two years. The victim worked full-time, averaging 40 hours per week, Monday – Friday, 7:00 AM to 3:00 PM, with some rotating weekend hours. On the day of the incident, a Sunday, the victim's typical morning routine was to arrive to the WWTP and obtain water samples for EPA regulatory requirements. The victim was hired by the municipality in 1998 and was designated as the WWTP lead man.

The municipal sewer department has thirteen full-time employees led by a superintendent. It operates and maintains the wastewater treatment plant, collection system, twenty pump stations and approximately one hundred fifty private pump stations. The WWTP design capacity is 10.5 million gallons per day (mgd) with an average capacity of 4.95mgd.



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The involved structure is a peripheral drive, rotating bridge, final clarifier. The inside radius of the clarifier is forty-one feet and the depth as measured at the outer weir plate is approximately thirteen feet. The floor of the clarifier gradually slopes downward to the center for the collection of solids. One end of the rotating bridge sits on a center bearing pivot point on a concrete pillar in the middle of the clarifier. The other end of the bridge moves around the outer wall via two ½ horsepower motors that drive neoprene rollers and travel along the top of the outer wall. Sludge scraper blades (bottom) and a scum skimmer plate (surface) are attached to the bridge. One 360-degree rotation of the bridge takes approximately sixty minutes. A fixed, engineered access point with steps aligns with the bridge during rotation (see figure 1, left side of photograph). This allows employees to stop the bridge and safely access the bridge walking surface.

The purpose of a wastewater clarifier is to remove solids, produce cleaner effluent and concentrate solids. A clarifier provides enough retention time to slow water down and allow solids to settle downward. The sludge scraper blades slowly rotate and guide solids to the center of the tank for removal. Clarified water flows over weirs around the outer edge of the clarifier for further treatment. Floating matter known as scum is skimmed from the surface using a plate that directs the matter to a collection point for removal. The clarifier is not aerated and the wastewater present in the clarifier is opaque (low to no visibility).

A review of maintenance records and work orders for the year prior to the incident appear to show that the involved clarifier was maintained in accordance with manufacturer recommendations, specifically lubrication of the center bearing.

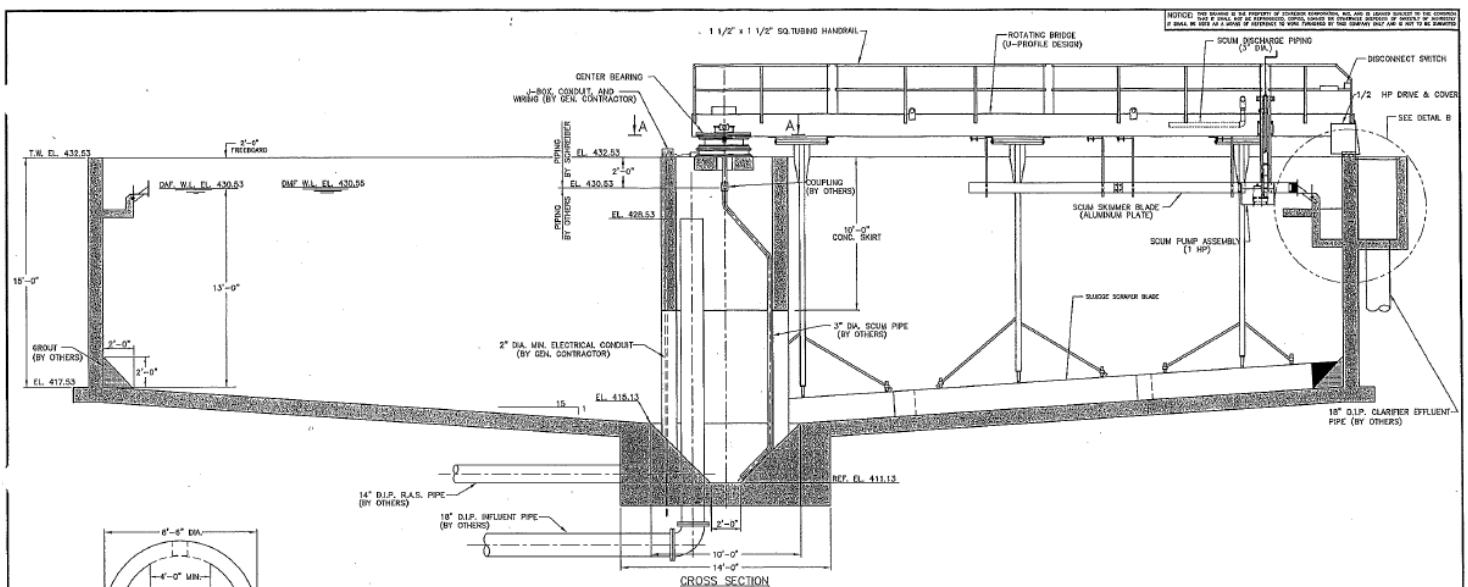
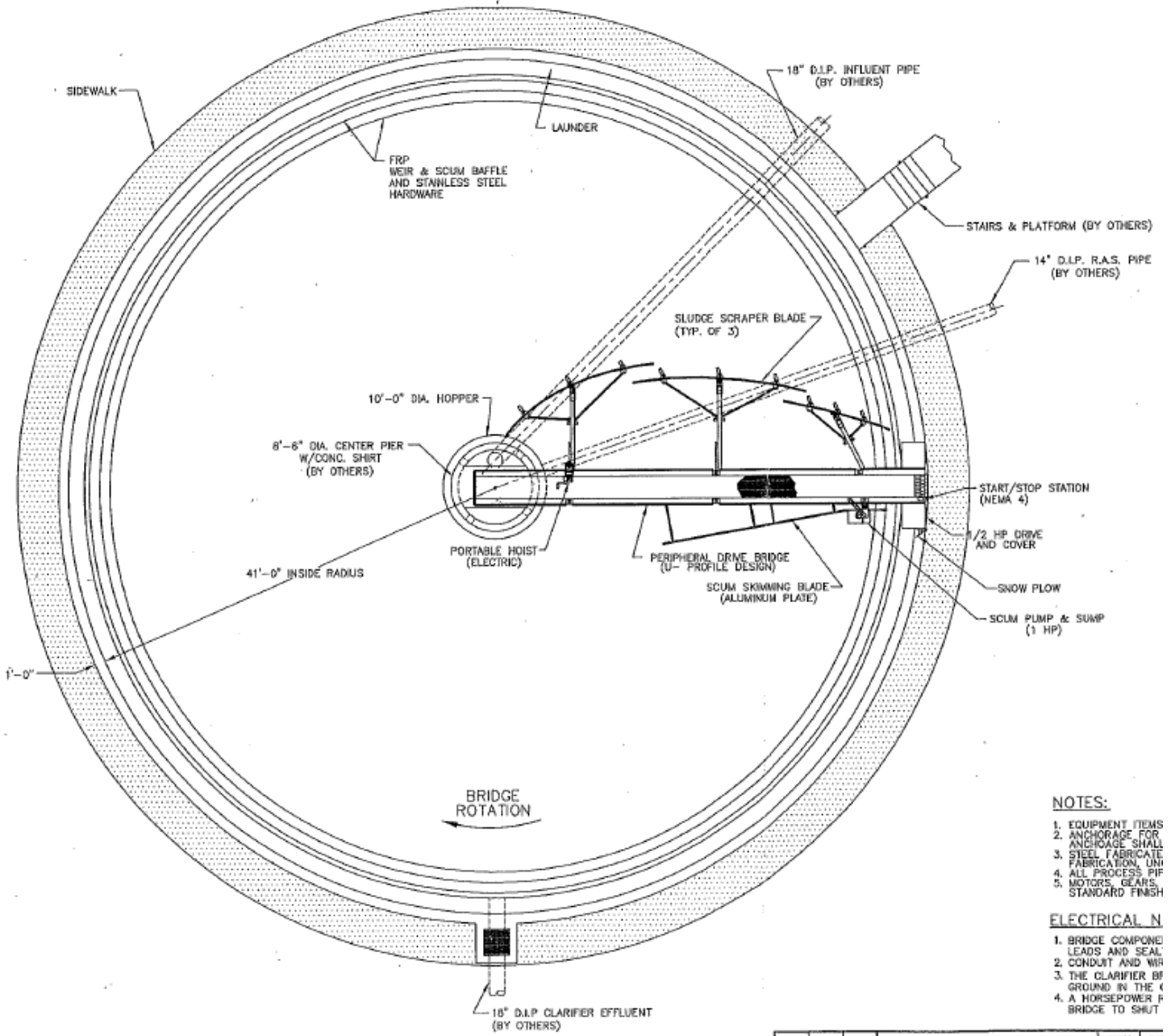


Figure 2 – Clarifier cross section.



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Figure 3 – Clarifier top view.

**INCIDENT**

On Sunday February 14, 2021, at approximately 7:00 AM the victim started his shift at the wastewater treatment plant. He was the only employee scheduled at the plant that day and was expected to work until 3:00 PM. The weather was extremely cold that morning and reported to be approximately 2F at 7:00 AM with a wind chill of -10 to -15F. The victim’s primary work tasks were to collect the daily water samples from



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various process locations for testing as required by the Illinois EPA, and to monitor the overall wastewater treatment process. Due to the size of the plant, the victim used a Ford F-150 truck to drive to the various sampling points. Upon reaching the involved clarifier, the victim noticed that the bridge was bound up and not rotating as it should. At 7:04 AM the victim contacted the WWTP lead maintenance employee from his work cell phone. The victim relayed that the bridge for the involved clarifier was bound up, not moving, and that he needed assistance. The call lasted approximately one minute. This is the last time that anyone communicated with the victim.

NOTE: Since the victim was working alone, the following course of events are presumed based on observations and evidence obtained during the investigation. The last phone call from the victim ended at approximately 7:05 AM and the maintenance employee that was contacted by the victim arrived at the plant at approximately 7:20 AM. The maintenance employee called his manager at 7:31 AM to report that the victim was missing.

After ending the phone call at approximately 7:05 AM, it is presumed that the victim got on the clarifier bridge and attempted to troubleshoot the malfunction. It is likely that the bridge was bound up due to extremely cold weather and precipitation that froze the center bearing. Since the two peripheral drive motors are only rated at  $\frac{1}{2}$  hp each, they could not overcome a frozen center bearing and the bridge ceased to rotate. Photographs from the day of the incident show calcium chloride (ice melt) was present on the concrete pillar that houses the center bearing and the center bearing itself (see figure 4). It is highly likely that the victim applied the calcium chloride. The center bearing is located under the bridge walking platform and is not easily accessible from the platform. It is unknown, but possible that the victim was attempting to apply calcium chloride to the center bearing while leaning over the top rail or mid rail of the bridge guardrail and fell into the clarifier. The actual cause of the victim falling into the clarifier may never be known.



Figure 4 – Calcium chloride on the center bearing (photo credit: Illinois State Police).



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Due to the extremely cold temperatures that morning and in the days leading up to the incident, the victim would have experienced one or more phases of cold water immersion upon entering the water. Cold water immersion is a series of physiological events that occur when humans quickly enter in cold water.

**COLD WATER KILLS  
ARE YOU NEXT?**

Cold water causes an involuntary gasp (or torso) reflex

Cold Water Shock - 1 Min  
Cold Incapacitation - 10 mins  
Hypothermia - 1 Hour

Falls are involved in 19% of all water-related fatalities

It takes less than ½ cup of water in your lungs to drown

Life Jackets Save Lives Please Wear It

US Army Corps of Engineers  
[www.CorpsLakes.us/watersafety](http://www.CorpsLakes.us/watersafety)

Figure 5 – Cold water awareness poster (Credit: U.S. Army Corps of Engineers).

Phase 1, Cold Shock: This phase lasts up to two minutes, but usually lasts approximately one minute. Upon entering cold water, a person will gasp involuntarily and uncontrollably. If a person enters the water headfirst, this gasp can allow water to enter the lungs and lead to drowning where the person never surfaces. The human response to this phase is proportional to the rate at which one enters the water. If entry is slow and controlled the response will be lessened, if the entry is immediate or unplanned, the response is greater. The shock severity is also proportional to the water temperature, the colder the water, the greater the response. This phase also places a great amount of stress on the cardiovascular system and can lead to cardiac arrest.



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Phase 2, Cold Incapacitation: If a person survives phase 1 and remains in the water, they will enter a phase of cold incapacitation that will last between approximately two and fifteen minutes. During this time, the person's nerves and muscle fibers will get colder and colder which leads to more rapid muscle exhaustion. This can progress to muscle failure where the person can no longer keep their head above the water, and they drown.

Phase 3, Hypothermia: If a person survives phase 2 and remains in the water, they will enter a phase of hypothermia approximately thirty minutes after entry. Surviving to this phase is usually due to a floatation device. Death in this phase is likely due to cardiac arrest.

Phase 4, Circum Rescue Collapse: If a person is rescued after an hour or more, a person can experience fainting, incapacitation, or even death. This is a function of the human "fight or flight" response. When rescue is imminent, the body can relax, resulting in a sudden drop in blood pressure.

The official cause of death for the wastewater operator as listed on the autopsy report is drowning. It is likely that the victim succumbed during phase 1 or phase 2 of cold water immersion. The timeline between the victim's last call and the maintenance employee's arrival excludes the possibility of phase 3. Phase 4 is excluded since the victim was not rescued.

If the victim survived the initial entry into the water, it is possible that he would have attempted to grab onto or climb onto the concrete pillar at the center of the clarifier. Based on the victim's height, and the distance from the waterline to the top of the concrete pillar (approximately 2 feet), it is highly unlikely that the victim, even in normal temperatures, would have been able to grab the top of the pillar, and even less likely that he could have pulled himself out of the water.

NOTE: The victim was wearing bulky winter clothes due to cold temperatures. While the clothes may have limited the ease of movement, they did not contribute to drowning due to weight. Wet clothes only weigh a person down when exiting water.

NOTE: Based on interviews, the victim could swim and was considered a good swimmer.

### INCIDENT TIMELINE

7:04 AM: Victim calls maintenance employee to report malfunctioning clarifier.

7:05 AM – 7:20 AM: Victim falls into clarifier.

7:20 AM: Maintenance employee arrives and looks around plant for victim.

7:31 AM: Maintenance employee calls field manager to report that he cannot locate victim and that victim



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may have fallen into clarifier since victim's hat is floating on the surface. Victim's truck is near the clarifier and is still running.

7:42 AM: Field manager calls public works superintendent to report an employee missing.

7:47 AM: Field manager calls public works superintendent again and is instructed to call 911.

7:48 AM: 911 call from field manager received.

7:52 AM: Municipal fire and police units dispatched to wastewater treatment plant.

7:54 AM: First fire apparatus arrives on scene.

7:56 AM: Fire department incident commander requests regional dive team.

7:59 AM: Ambulance arrives on scene.

10:04 AM: Victim recovered.



*Figure 6 – View from bridge looking at center pillar and bearing. Red object in water is a coffee can presumably used to spread calcium chloride. Note: the clarifier had been drained below the operating level during search and rescue operations (Photo credit: Illinois State Police).*





### INVESTIGATION BY IL-OSHA

IL-OSHA inspectors arrived at the municipality on February 22nd, 2021 to investigate the incident. Subsequent visits were made to gather additional information and conduct interviews. IL-OSHA gathered information from public and private sources to build a timeline and determine if any violations of the Illinois Occupational Safety and Health Act occurred.

### FINDINGS

Direct Cause: Exposure to a respiratory hazard of wastewater effluent leading to drowning.

Indirect Causes:

1. The peripheral drive for the rotating bridge style clarifier malfunctioned due to a frozen center bearing as a result of extreme cold weather and precipitation. The clarifier manufacturer's winter maintenance procedures do not provide guidance on frozen center bearings. The municipality had experienced frozen center bearings in the past. Maintenance employees stated that they had previously used a wand propane torch to thaw a frozen center bearing.
2. The victim was likely engaged in troubleshooting a non-routine, unscheduled maintenance event. Non-routine events are a common source of fatalities and severe injuries.
3. The victim was working alone on a weekend. Working alone does not change the hazards encountered by workers, however, there is a greater risk of hazards causing harm since no one is available to aid or rescue a lone worker.
4. The victim was working in extreme cold weather that increased the risk of working over water. The effects and phases of cold water immersion were likely not recognized by the victim and thus the perceived risk was much lower than the actual risk.
5. Once in the water, the victim was likely unaware of involuntary physiological responses to cold water immersion. This may have reduced the chance of survival past phase 1 of cold water immersion.
6. The victim was not wearing a personal floatation device (PFD). While PFDs are not typically worn by wastewater operators, it must be recognized that had the victim been wearing a PFD it is possible that he would have been found in a survivable state by the maintenance employee that arrived at the plant at approximately 7:20 AM.
7. If the victim survived the initial phase of cold water immersion, it would have been extremely difficult if not impossible to self-rescue using the center concrete pillar.



## CONCLUSION

This incident illustrates the hazards of working alone, non-routine work, cold water immersion, and work where the actual risk is much greater than the perceived risk.

## RECOMMENDATIONS

- Attempt to increase resilience/reliability of plant equipment that may be subject to extreme environmental conditions. Reduce the potential for unscheduled maintenance.
- Ensure proper start work controls are in place when non-routine events occur.
- Apply additional controls for lone worker operations. Such controls may include but are not limited to lone worker phone apps, video surveillance, and prohibitions on certain work when alone.
- Train wastewater employees on the hazards of cold water immersion.
- Consider the use of personal floatation devices when workers are operating near water, especially when operating alone, and especially when operating in cold weather.
- Consider providing a method for self-rescue if a worker enters the water.

## CITATION(S)

NOTE: The citations issued to the employer were the result of “plain-sight” observations during the on-site inspection. They are not directly related to the incident.

- ***Serious - 29 CFR 1910.22(c): Access and egress. The employer must provide, and ensure each employee uses, a safe means of access and egress to and from walking-working surfaces.***

On 2/22/21, an incident investigation at the employer's wastewater treatment plant was conducted. While interviewing the employer representatives and employees, it was discovered that employees mount the rotating bridge of the peripheral drive clarifiers without using the engineered access point. Employees stated that due to the slow speed of the rotating bridge it takes approximately one hour for the bridge to align with the access point.



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- ***Serious - 29 CFR 1910.28(b)(1)(i): Unprotected sides and edges. (i) Except as provided elsewhere in this section, the employer must ensure that each employee on a walking-working surface with an unprotected side or edge that is 4 feet (1.2m) or more above a lower level is protected from falling by one or more of the following:***
  - \*Guardrail systems;***
  - \*Safety net systems;***
  - \*or Personal fall protection systems, such as personal fall arrest, travel restraint, or positioning systems.***

On 2/22/21, an incident investigation at the employer's wastewater treatment plant was conducted. A fall hazard was observed when the rotating bridge(s) on the peripheral drive clarifier(s) is occupied while the bridge is not aligned with the engineered access point. Employees working from the elevated surface of the rotating bridge are exposed to a fall of approximately 60" with no means of fall protection that complies with the standard.

- ***Serious - 29 CFR 1910.22(d)(1): Walking-working surfaces are inspected, regularly and as necessary, and maintained in a safe condition;***
  - \*Hazardous conditions on walking working surfaces are corrected or repaired before an employee uses the walking-working surface again. If the correction or repair cannot be made immediately, the hazard must be guarded to prevent employees from using the walking-working surface until the hazard is corrected or repaired; and***
  - \* When any correction or repair involves the structural integrity of the walking-working surface, a qualified person performs or supervises the correction or repair.***

On 2/22/21, an incident investigation at the employer's wastewater treatment plant was conducted. It was discovered that several clips used to secure the grates that make up the walking surface of the south clarifier rotating bridge were missing. 18 of 45 clips were observed as missing or not installed. These clips secure the walking surface to the frame of the rotating bridge. No inspection of the clarifier bridge could be produced when requested.