

## Water on Wheels (WOW) Mobile Emergency Water Treatment System Cart

*An affordable and easy-to-operate mobile water decontamination system*

### Background

Following a natural disaster, communities need access to clean water not only for drinking but also for cooking, cleaning, showers, and medical triage. If the water system is contaminated or inoperable, decentralized water treatment will be needed. Similarly, mitigation and recovery following a man-made incident, or an accident could require water treatment.

Not all the water being treated needs to be drinking water quality. In some longer-term recovery efforts, contaminated stormwater or wash water from building decontamination activities only needs to be treated to levels safe for disposal to a wastewater treatment plant or back to the environment. Mobile treatment of the highly contaminated water can significantly reduce the volume of water to be transported and reduce the liability and cost of transporting and disposing of a hazardous waste.

Most emergency water treatment systems are large and expensive tractor-trailer mounted systems. They may be unable to reach affected locations because of road debris and damage or are simply unavailable. They can be complicated to operate and maintain (high pressures and concentrated wastes) given their use of reverse osmosis and chemical coagulation water treatment technologies. The WOW Cart could be designed and built so the treatment train is configured on-site to address a broad spectrum of contaminants without using unnecessary and costly unit processes, and without producing large amounts of contaminated waste. The broad spectrum of potential contaminants includes chemical, biological, and radionuclide contaminants.

The typical emergency response distributes bottled water in affected areas rather than relying on a water treatment system. However, long-term dependence on



*WOW cart at the EPA's Water Security Test Bed in Idaho Falls, ID.*

bottled water creates a large solid waste disposal problem. In large or extended recoveries, bottled water uses for bathing, sanitation, as well as non-potable purposes is impractical. However, bottled water could be used in conjunction with an inexpensive and versatile mobile emergency water treatment system providing water for non-potable water applications.

Based on these considerations, a list of capabilities needed for a mobile emergency water system (listed below) was developed through a cooperative research agreement.

### Capabilities

#### **Treatment Train**

- Up to 10 gallons per minute of treated water
- Pre-filtration to reduce turbidity and improve disinfection
- Two media filtration/adsorption tanks for targeted chemical or radiological contaminant removal (e.g. Granular Activated Carbon (GAC) or Ion Exchange)
- UV-C LED for additional microbial inactivation

- On-site chlorine gas generation using table salt and electricity
- In parallel, a 0.5% sodium hypochlorite bleach solution can be produced for general disinfection

### **Power Supplies**

- Dual Fuel Generator (gasoline, propane) or
- 110v, 15A household outlet
- 12v DC deep cell marine battery with solar panel recharge for chlorine gas generation

### **Mobility**

- Weighs less than 500 pounds
- Fits in the back of a pick-up truck
- 2-person transport
- Two foldable 1,250-gallon bladder tanks provided

### **Cooperative Research and Development Agreement**

Utilized a Cooperative Research and Development Agreement with the Louisville, KY non-profit humanitarian relief organization WaterStep. A prototype mobile emergency water treatment system was first fabricated and evaluated at the EPA's Test & Evaluation (T&E) Facility located in Cincinnati, OH. Pilot testing confirmed the quick configuration of multiple water treatment processes to treat sufficient quantities of contaminated water.

### **Prototype and Field Evaluations**

Initial full-scale testing was conducted at the EPA's Water Security Test Bed (WSTB), located near Idaho Falls, ID, replicating a field scale emergency response. The WSTB lagoon was spiked with *Bacillus globigii*, an anthrax surrogate, and successfully inactivated to below detectable levels. The WOW Cart was then successfully challenged against secondary wastewater at the T&E Facility in one-pass flow-through mode.

Subsequently, the WSTB lagoon water was contaminated with diesel fuel and *Escherichia coli* (*E. coli*) simultaneously. The WOW Cart successfully removed *E. coli* and total coliforms to non-detection levels. Diesel fuel was removed from the lagoon to below detection levels as well. Testing found that extremely dirty water (turbidity greater than 120 Nephelometric Turbidity Units) could foul the GAC media within a couple of hours.

### **Deployments**

During prototype testing, Hurricane Maria made landfall in Puerto Rico in September 2017. Within just three weeks, WaterStep's team was on the ground training emergency workers and distributing kits with components of the WOW Cart. In addition to providing drinking water, the sodium hypochlorite bleach solution that can be produced in parallel, was widely used for general cleaning and support of medical triage by medical personnel. Over 100 kits were deployed and hundreds of people trained in the proper use of the equipment.

Hurricane Laura devastated Lake Charles, LA in October 2020. A WOW Cart was in operation for nearly three weeks being seamlessly operated by six different NGOs. Over 100,000 gallons of water was treated, serving upwards of 16,000 meals per day to over 800 first responders and residents. The treated water essentially replaced 800,000 water bottles that would have required over 400 pallets and caused a solid waste disposal problem. This resulted in an estimated savings of \$182,000, not including the transportation costs of either 20 C-130 flights or 16 tractor trailers to deliver the bottled water.

In December 2021, tornadoes struck several communities in Western Kentucky. Kentucky emergency response agencies worked in conjunction with WaterStep to operate multiple WOW Carts that provided water for impacted residents, mobile showers, and kitchens for over a week. A few months later in August 2022, a rainstorm of historical proportions caused widespread flooding in multiple counties in Eastern Kentucky. Thousands of people depended on the four WOW Carts strategically deployed across the counties for several weeks. The Kentucky Division of Water conducted water quality testing and approved the treated water for consumption.

### **Ongoing Research Activities**

This research is driven by requirements under the federal Safe Drinking Water Act and Clean Water Act. It also responds to part of the National Response Framework developed by the Federal Emergency Management Agency (FEMA). The EPA is partnering with the U.S. Army Corps of Engineers (USACE) to further adapt and modify the WOW Cart for both civil and military applications.

The WOW Cart has been integrated into the USACE mobile dam and levee pressure relief well decontamination trailer, thus reducing the expense and hazard of using oxalic acid to improve flows in relief wells. The WOW Cart has also been modified per military specifications to support mobile forces in arctic and desert environments as well as provide 14-day sustainability at fixed military installations.

The Deployable Resilient Installation water Purification and treatment System (DRIPS), a militarized version of the WOW Cart, has been evaluated at Ft. Leonard Wood, MO, Ft. Wainwright, AK, and participated in the Quartermaster Liquid Logistics Exercise at Ft. Barfoot, VA.

Technology research, development, and integration will continue in collaboration between the EPA, USACE, FEMA, and U.S. Forest Service including:

- Additional pre-filtration technologies to treat extremely turbid water
- Evaluation and integration of innovative electro-oxidation treatment technologies
- Treatment technology evaluations to address heavy metals and brackish water
- Applications for firefighter camps
- EPA Regional and State deployment case studies



*The DRIPS with GPS, remote telemetry, chemical resistant coating, and all-terrain wheels.*

## Contacts

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## Additional Information

### WOW Cart website



[www.epa.gov/emergency-response-research/water-wheels-mobile-water-treatment-system-wow-cart](http://www.epa.gov/emergency-response-research/water-wheels-mobile-water-treatment-system-wow-cart)