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Deployable Rapid Insertion water Purification and treatment System

For Early Entry and Rapid Insertion

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Deployable Resilient Installation water Purification and treatment System

For Installations Support and Defense Support to Civil Authorities (DSCA)

'DRIPS'

An affordable and easy-to-operate water decontamination system

Background

Following a natural disaster or loss of secondary or tertiary treatment functions at a water treatment facility, DoD Installations and surrounding communities need access to clean water not only for drinking but also for cooking, cleaning, and medical triage. If the water system is contaminated, 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 need to be treated to levels safe for disposal to the wastewater treatment plants 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 on DoD installations.

Most emergency water treatment systems for the Army and the DoD are large and expensive tractor-trailer mounted systems. They can be complicated to operate and maintain (high pressures and concentrated wastes) given their use of reverse osmosis water treatment technology. An emergency water treatment system could be designed and built so the sequence of treatments can be configured on-site to treat 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. Rather than a treatment system, bottled water is typically the first responder's choice when responding to an incident. However, long-term dependence on bottled water creates a large solid waste disposal problem and,

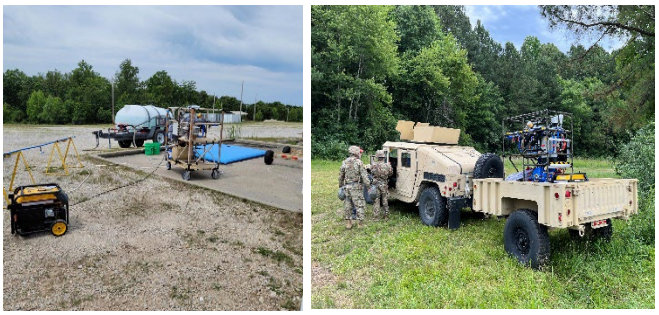

Figure 1. Foreground (left): Final version of the mobile emergency water treatment system cart at the DRIPS Demonstration Ft. Leonard Wood-ERDC CERL Contingency Basing Integration Training, Evaluation Center (CBITEC) Demonstration 2023: (right) FT Barfoot 2024 Quartermaster Liquid Logistics Exercise (QLLEX). Deployable Resilient Installation water Purification and treatment System (DRIPS).

often large vehicles transporting bottled water are unable to get to affected locations because of road debris and damage. In large or extended recoveries, bottled water use for bathing, sanitation, and other non-potable purposes is impractical. However, bottled water could be used in

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EPA INNOVATIVE RESEARCH FOR A SUSTAINABLE FUTURE https://www.epa.gov/emergency-response-research/water-wheels-mobile-water-treatment-system-wow-cart

conjunction with an inexpensive and versatile mobile emergency water treatment system providing water for non-potable water applications such as toilet flushing.

Based on these considerations, through each organization cooperative research agreements from the ERDC and the EPA with industry partners, a list of capabilities needed for a mobile emergency water system was developed. The research and testing that produced the EPA system (Figure 1) is described. The military certification and meeting the MIL 810G Standard for ruggedization is being pursued. Coupling of the ERDC DRIPS would enable water quality reporting, bleach generation, and additional filtration options when coupled with the EPA system.

Capabilities

Treatment Train

- Currently: Up to 10 gallons per minute or 38 liters per minute
- Dual Pre-filtration to reduce turbidity and improve disinfection
- Two by Two media filtration/adsorption tanks for targeted chemical or radiological contaminant removal (e.g. Granular Activated Carbon or Ion Exchange)
- UV LED for additional microbial inactivation
- Reverse Osmosis for Brackish to Freshwater
- On-site chlorine gas & bleach generation for disinfection
- Ability to add or subtract treatment processes in the Field and ability to re-circulate treated water to increase disinfection

Power Supplies

- Dual Fuel Generator (propane, gas); 2KW Generator use
- 110v AC DRIPS 1.0/240v DRIPS 2.0 (2-5kW Generator)
- 12vDC deep cell marine battery w/solar panel recharge DRIPS 1.0

Mobility

- Weighs less than 550 pounds (Ruggedized for the Army will weigh about 750 pounds) Next Gen DRIPS 950 lbs with RO Train.
- Fits in back of pick-up truck or M1102 Army Trailer
- 2–4-person transport/4-8-person transport/Forklift/D-Rings

Communication (adding Telemetry)

- Wired output: Ethernet /USB
- Wireless Output: Bluetooth WIFI (802.11 b/g)-Cellular 5G
- Protocol: Mesh nodes – Dynamic routing –Peer 2 Peer

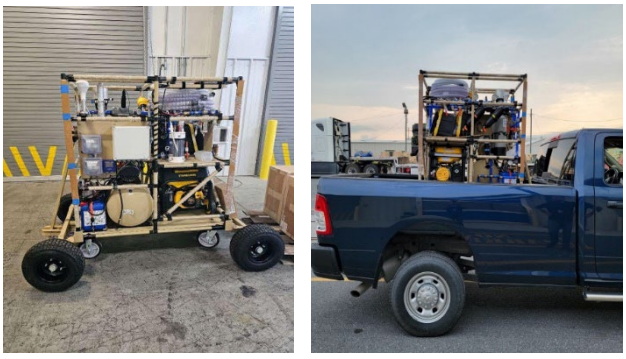

Figure 2: DRIPS 1.0 mobile emergency water treatment system cart Organic Industrial Base 2023.

Research Approach

Cooperative Research and Development Agreements

Utilizing a Cooperative Research and Development Agreement (CRADA) with the non-profit humanitarian relief organization WaterStep, a prototype mobile emergency water treatment system was first fabricated and evaluated at the Environmental Protection Agency (EPA) Test & Evaluation Facility located in Cincinnati, Ohio. The mobile emergency water treatment system was then challenged at the EPA Water Security Test Bed, located near Idaho Falls, Idaho, replicating a field scale emergency response. Components of the mobile system were then deployed to Puerto Rico in response to Hurricane Maria. The mobile emergency water treatment system was modified and expanded based upon the field results and challenged once again at the Water Security Test Bed. The ERDC's WaterDOG was tested with the Army Quartermaster Liquid Logistics Exercise (QLLEX), Effective Energy for Expeditionary Operations-Limited Objective Experiment (EX2-LOE), Networked Integration Exercise (NIE) 16.1, & the Army Expeditionary Warrior Experiments (AEWE) Ft. Benning, GA. The ERDC formed a CRADA with Newcomer Arms LLC to develop the earlier version of the DRIPS that were sent to Africa for conservation efforts. New CRADAs in 2025 with WaterStep for further coordination.

Prototype Test Evaluations

Pilot testing at the Test & Evaluation Facility for the WOW Cart confirmed the ability of multiple water treatment process to be quickly configured to treat sufficient quantities of contaminated water. Initial full-scale testing at the Water Security Test Bed demonstrated greater than 7 log reduction of Bacillus globigii, an anthrax surrogate, recirculating in batch mode. Field deployment also demonstrated that the mobile framework was capable of being easily transported via pick-up truck and rolled into position by two people.

Hurricane Maria Deployment

Shortly thereafter, Hurricane Maria made landfall in Puerto Rico on Wednesday, September 20, 2017.

Within just three weeks, WaterStep's team was on the ground training emergency workers and distributing kits with components of the 2nd generation WOW Cart. In addition to providing drinking water, in parallel, an added feature to the kits were 1-liter containers that produced a 1% solution of liquid bleach, to be used for general cleaning and for support of medical triage by medical personnel. Over 100 kits were deployed, and hundreds of people trained in the proper use of the equipment. Though some kits are still being used there, many are now positioned and poised to be used during the next disaster.

Evaluations to Date

Learning from both the field challenge and Hurricane Maria experience, the final version of the WOW Cart was challenged at the Test & Evaluation Facility with secondary wastewater and subsequently tested again at the Water Security Test Bed against lagoon water contaminated with diesel fuel and *Escherichia coli*. The WOW Cart successfully removed 4 to 6 logs of *E. coli* and total coliforms, respectively, to non-detection levels from the contaminated lagoon simultaneously with diesel fuel components. Diesel fuel components were removed to below detection levels, which made the water safe to drink. Results did reveal that

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extremely dirty water (turbidity >120 NTU) could foul the chemical water treatment process prematurely and prevent adequate supplies of treated water from being available.

Future Research Activities

This research is driven by requirements under the federal Safe Drinking Water Act and Clean Water Act. For DoD Installations TB-MED 576-Surveillance of Water Supplies at Fixed Installations; TB-MED 577 Sanitary Control and Surveillance of Field Water Supplies, and meeting MIL 810G Standard will be pursued. Other supporting documentation includes ASA(IE&E) Strategy 2025. Tri-Service publications include the TB MED 530/ NAVMED P-5010-1/AFMAN 48-147_IP and Joint Publication 4-02 for related Joint Health Services. It also responds to part of the National Response Framework developed by the Federal Emergency Management Agency (FEMA). The EPA will continue to partner with drinking water and storm water utilities, disaster relief organizations, FEMA and other state and federal agencies, such as USACE ERDC, as well as private companies to protect public health and the environment. Technology development and integration will continue including:

- Additional pre-filtration technologies to treat extremely contaminated water
- Evaluation/integration of innovative future treatment technologies
- Real-time and remote operating and reporting capabilities
- Applications to medical triage in the field and at forward operating bases
- Case study field evaluations
- Industry CRADA: DRIPS scale up: 100,000GPD/17HRS
- National Lilly Pad: WOW Carts/ DRIPS deployed to strategically designated locations: ERDC, Districts, Installations, Civil Affairs Emergency Response-NG&R
- GLADIATOR: Graywater Logistics Assured Defense Installation Advance Technology for Operational Resilience system (ERDCs GRTS+ DRIPS)
- Arctic DRIPS w/ modular force sustainment unit Alaska

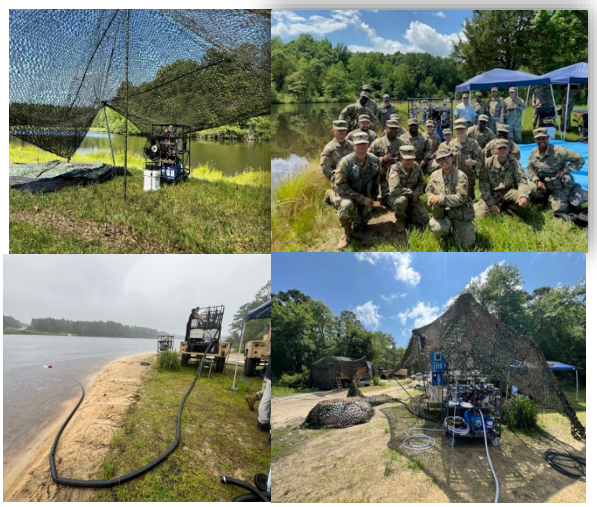
ADDITIONAL DRIPS KNOWLEDGE

The DRIPS has a small footprint (size of a shopping cart that fits through doors-non-ruggedized)-DRIPS 1.0, can be stored with a low profile until needed and can, at a minimum, provide 10 gallons per minute (or 38 liters per minute) or roughly 7,200 gallons over a 12-hour period or above 14,400 GPD in 24 hrs. of potable water for contingency operations, disaster response, training, and austere water supply globally. Next Generation DRIPS 2.0 has doubled pre-filtration, added Reverse Osmosis (RO) for brackish to full ocean water desalinization. Provides 10 gallons per minute (or 38 liters per minute) or roughly 7,200 gallons over a 12-hour period or above 14,400 GPD in 24 hrs with recapture of RO reject. Early Entry support to Phased Operational Water is being assessed with Water Community. Proposed future scale up to 100,000 GPD / (17-hour time frame). The dual fuel 4550W portable generator comes with an electrical start 120V (Firman power equipment) that comes with the DRIPS holds 5 Gallons of gas and last for 14 hours. With a 10 GPM rate, a full tank will generate on average 8,400 gallons over a 14-hour period without having to be refilled. *Assuming a 50% load of the generator for estimate pulls of power from the DRIPS unit.

The DRIPS unit provides an adaptable and flexible option for the DoD in retrieving source water supplies to produce potable water and in tandem bleach generation using table salt in times of need and reduce the need for appropriated fund requests for bottled water by installations. The unit supports the Installation Energy and Water Plan (IEWP) program for requirements: Critical Mission Sustainment and Assured Access measures of the Installation Status Report Mission Capacity (ISR-MC) and is funded from the Installation Technology Transfer Program (ITTP). For Civil Works, the development and demonstration of the RWS Cart Unit is supported by the USACE Flood and Coastal Systems R&D (funded through GI R&D) in response to SoN 1636, to treat biofouling in relief wells.

USE CASE

As a use case scenario from the Lake Charles emergency use response, the use of just one system on the ground could save the military and estimated 20 C-130 flights (man-power, equipment, and fuel consumption savings), 16 tractor trailer truck shipments of bottle water (man-power, equipment, and fuel consumption savings) holding an estimated 800,000 water bottles or 416 pallets with an estimation of $439 per pallet or $182K savings for water and transportation per event. The DRIPS would reduce the logistics of bottled water waste build up and removal as well. The DRIPS aims to improve installation emergency response for water production technology to meet infrastructure readiness needs by providing an estimated over 1.8 million gallons of water treated for potable use over an 18-day period (Future GLADIATOR). Currently, one DRIPS unit has shown a capability to provide 100,000 gallons of water treated for potable use over an 18 day period to over 800 responders on-site, with food preparation and clean-up for 16,000 meals/per day prepared for responders and a community, water for laundry and showers, polished city water when re-distribution starts back up, 50 gallons of bleach solution prepared using 50 lbs of salt, and an ability for ease of training with training hand off with 6 cycles of new trained relief teams/responders. In addition to the ruggedization of the system the team aims to improve with integrating the system with geo-enabled sensors to monitor and report the system production parameters



right: QLLEX24 and 25 DRIPS 1.0 and 2.0 Demonstrations and Training with 810 CO 'WaterDogs'. Next Gen DRIPS (2.0) mobile emergency water treatment system cart ERDC design and build for QLLEX25 Demonstration and Training FT Bragg.

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