



RDECOM



TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Military Field Water Mission

Andrea Oehus

Project Engineer, Water Treatment and Handling Team

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- TARDEC Overview
- Field Water Supply Mission Background
- Producing Safe Water
 - source water selection and protection
 - water treatment
 - disinfection
 - proper operation and maintenance of storage and distribution systems, and
 - operational water quality monitoring
- Questions

TARDEC develops, integrates, and sustains the right technology solutions for all manned and unmanned DOD ground systems and combat support systems to improve Current Force effectiveness and provide superior capabilities for the Future Force.

Accomplished by

- **Leading Systems Integration excellence across the Life Cycle**
- **Continuous pursuit of innovation in our technology focus areas**
- **Living our core and enterprise values**

*TARDEC - Responsible for Research, Development and Engineering Support to **2,800** Army systems and many of the Army's and DOD's top joint warfighter development programs.*

Combat Vehicles

- Heavy Brigade Combat Teams
- Strykers
- MRAPs
- Ground Combat Vehicles (Future)



Force Projection

- Fuel & Water Distribution
- Force Sustainment
- Construction Equipment
- Bridging
- Assured Mobility Systems



Tactical Vehicles

- HMMWVs
- Trailers
- Heavy, Medium and Light Tactical Vehicles



Watercraft

- High Speed Vessel
- Causeways
- Harbor Craft
- Landing Craft



Robotics

- Technology Components
- Demonstrators
- Military Relevant Test & Experimentation
- Transition and Requirements Development



TARDEC Engineers Provide Cradle-To-Grave Engineering Support

Freshwater Test Facility @ SANG B350

- Year Round Water Access
- Approved NPDES discharge permit for 500K GPD
- 6" exterior sanitary drain and interior drains are easily accessible
- 7,500 square feet of heated floor space; 1,500 square feet of loft area over office for storage
- 440V, 240V and 120V power available
- Military water purifiers (TWPS, LWP, ROWPUs) are available for use



Seawater Test Facility – Port Hueneme, CA

- Year-round access to natural seawater
- Approved discharge permit
- Military water purifiers (TWPS, LWP, ROWPUs) are available for use



Water Quality Lab – B210

- organic and inorganic analysis

Water Treatment Test Lab – B210

- Reverse osmosis membrane test stands
- Water and wastewater treatment component testing
- GAC/IX testing

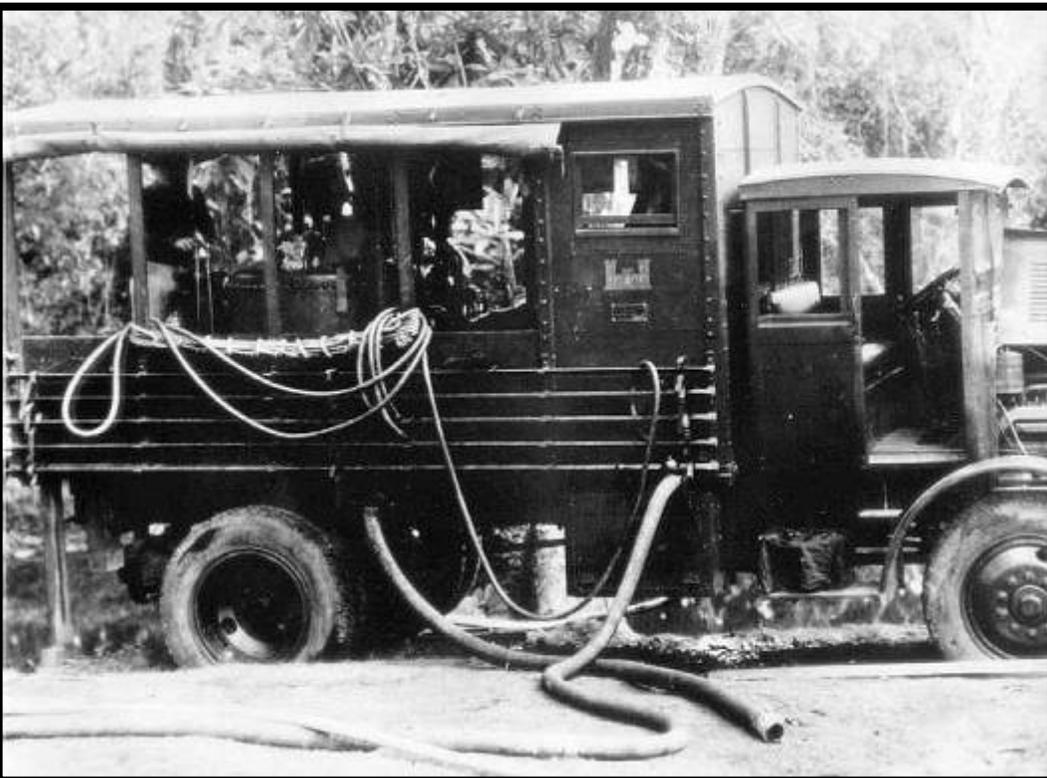


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**THE WORLDS ULTIMATE WEAPON RUNS ON WATER...
EVERYTHING ELSE RUNS ON FUEL.**



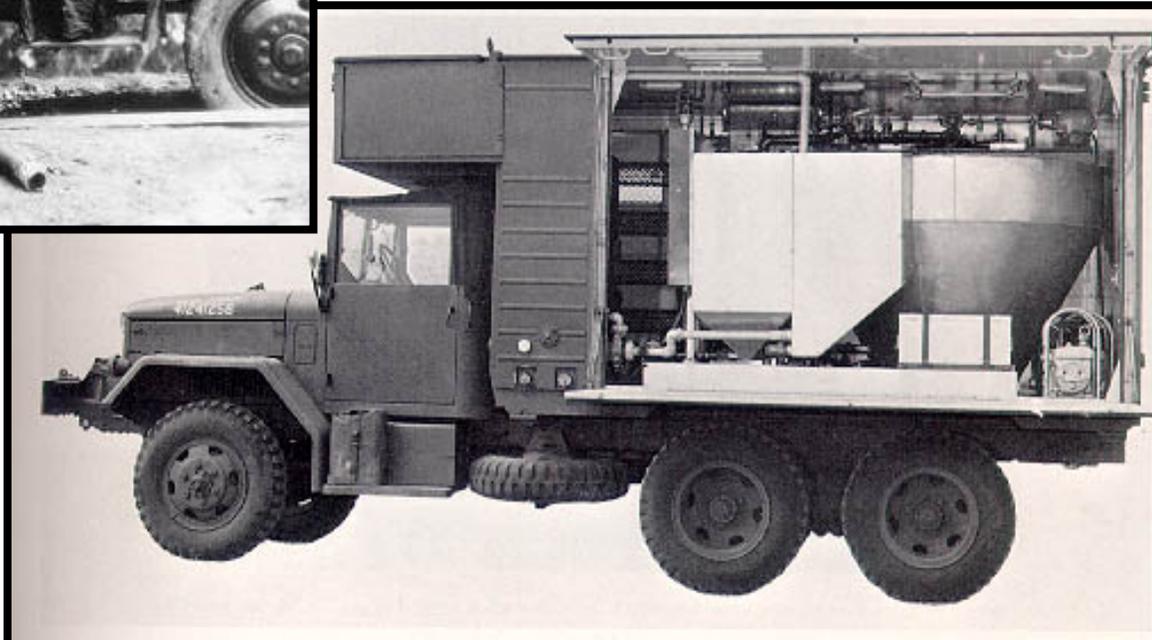
- **Drinking Water Related Health Problems in WWI lead to development of the Mobile Water Purification Unit**
- **The Mobile Water Purification Unit found to be only partially effective during WWII**
- **After WWII, multiple units developed for various types of source water**
 - **Seawater Distillation Unit**
 - **NBC Treatment Unit**
 - **Fresh Water Purifier (ERDLATOR)**
- **Use of multiple units led to logistics and training problems**
- **US Government funded research in Reverse Osmosis led to fielding of Reverse Osmosis Water Purification Units (ROWPUs) in the 1980's**



Army **E**ngineering **R**esearch
and **D**evelopment **L**aboratory

ERDLATOR

Army Mobile Water
Purification System



- 3-4% Water deficit (2-3 quarts) significantly reduces performance (up to 48%)
- 6-8% Water deficit (4-6 quarts) renders a soldier completely ineffective
- Minimum water consumption is 1 gallon/ soldier/ day to 3 gallon/ soldier/ day
- Universal unit level average is 6.6 gallon/ soldier/ day (53 pounds)
- Fully developed theater requires 15.6 gallon/ soldier/ day (129.5 pounds)
- Water is projected to be 30 to 40% of the daily sustainment requirement



- Multiple Barrier Approach
 - source water selection and protection
 - water treatment
 - disinfection
 - proper operation and maintenance of storage and distribution systems, and
 - operational water quality monitoring

- Sources
 - Surface
 - Ground
 - Host Nation Municipal
- Criteria
 - Quality / Quantity
 - Pollution Sources
 - Vulnerability



*RAW WATER IS CONSIDERED NON-POTABLE
UNTIL TREATED AND CERTIFIED TO MEET THE
Tri Service Field Water Standards*

- Multiple Barrier Approach
 - source water selection and protection
 - **water treatment**
 - disinfection
 - proper operation and maintenance of storage and distribution systems, and
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600 ROWPU – Fielded 1981



3000 GPH ROWPU - Fielded 1989

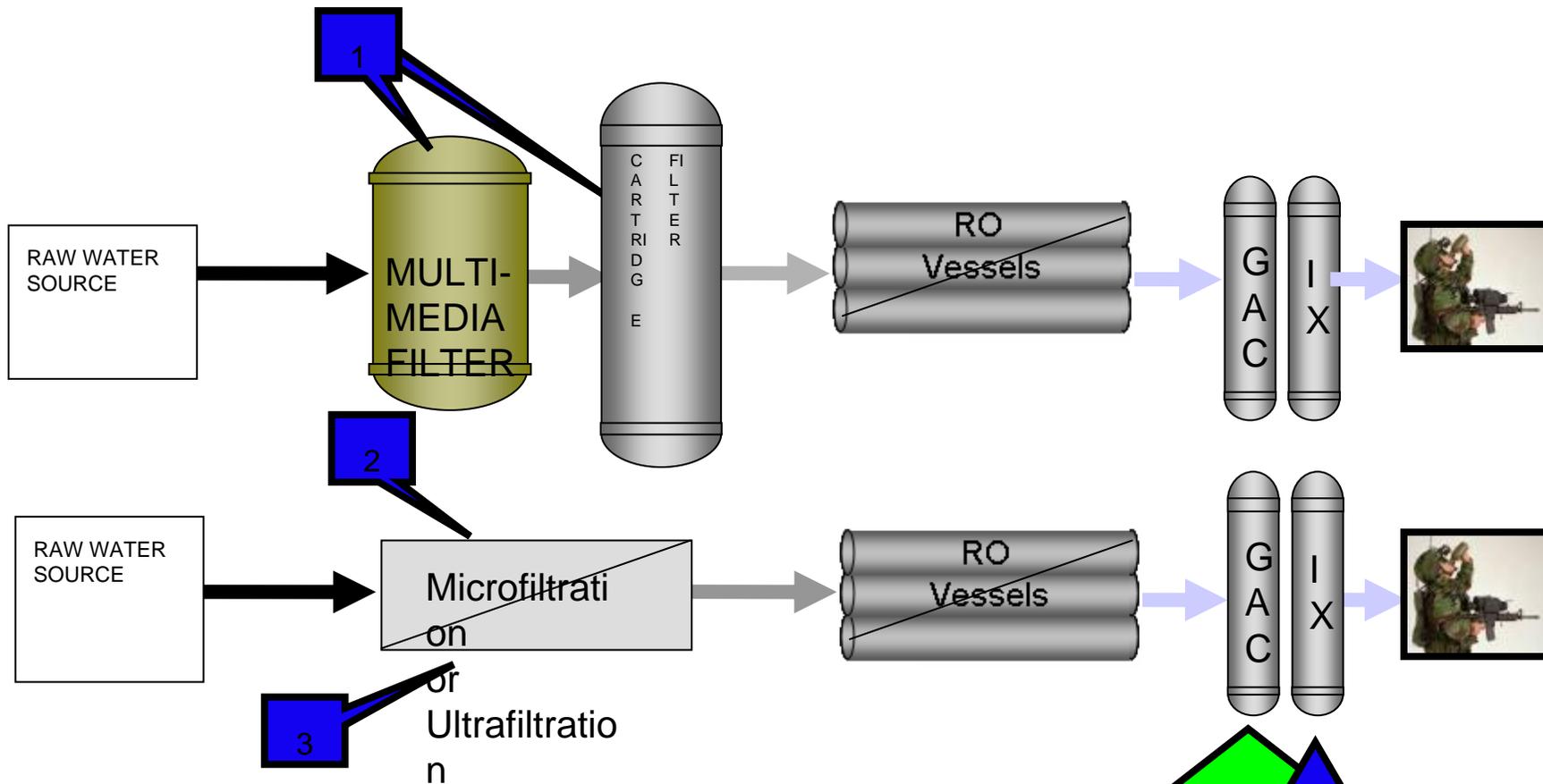


1500 GPH Tactical Water Purification System (TWPS) - Fielded 2004



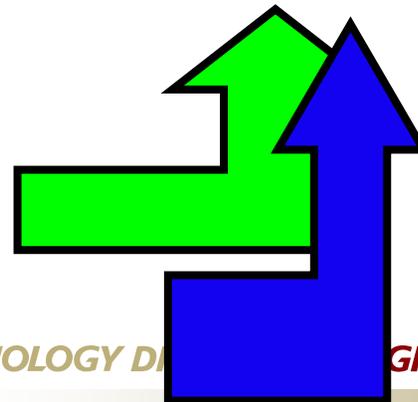
**Lightweight Water Purifier (LWP)
Fielded 2005**

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Activated carbon cartridge

Ion exchange cartridge



- Produce potable water that meets Tri-Service Standards from any available source
- System produces 600 gallons per hour on seawater (35,000 ppm) and 900 gallons per hour on freshwater
- Raw water intake system – strainer and raw water pump
- Clarification system – multi-media filter, cartridge filter, chemical injection pumps
- Purification system – high pressure pump, 8 6-inch reverse osmosis elements
- NBC decontamination system – activated carbon, mixed-bed ion exchange
- Disinfection by Chlorination





600 GPH ROWPU Characteristics



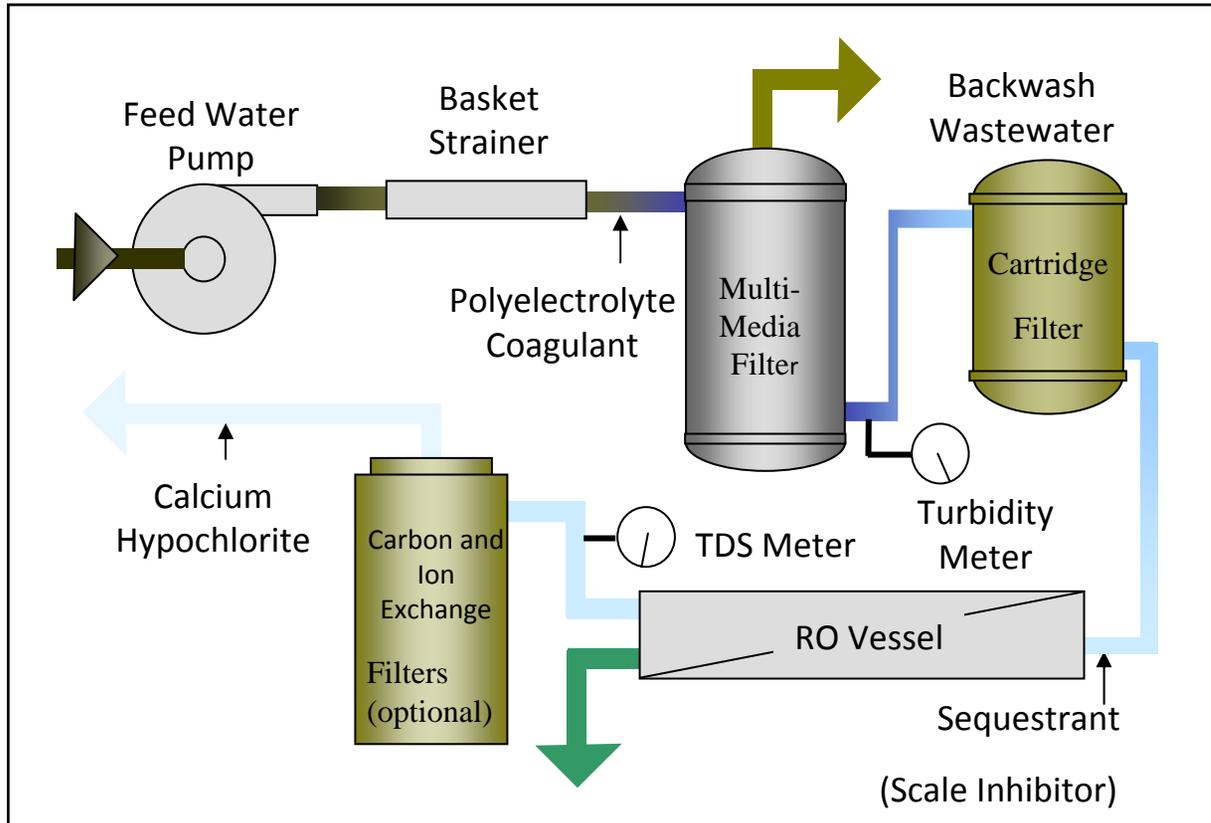
- 30 kW Generator (Army only)
2850 lb
- 5 ton Trailer (Army only)
5595 lb
- Skid mounted (USMC and AF)
 - 9.5 L x 7 W x 5.7 H ft
 - 7300 lb
- Trailer Mounted with 30Kw generator
 - 19 L x 8 W x 8 H ft
 - 16,975 lb
- Three - 3K onion tanks packed w/ROWPU
- GAC, IX and chlorination post treatment for NBC removal
- Chlorination to 2 ppm
- Feed flow – 30 gpm
- Multi-media filtration
6-7 gal/min/sq. ft
- 5um cartridge filtration
8 ea - 2.5 inch dia x 40 inch long filters
String wound, polypropylene
- Reverse osmosis
8 ea – 6 inch dia. X 40 inch long polyamide RO elements
Avg salt rejection – 99.4%
All elements in series
50% recovery on freshwater and 33% on seawater

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

- Produce potable water that meets Tri-Service Standards from any available source
- System produces 2000 gallons per hour on seawater (35,000 ppm) and 3000 gallons per hour on freshwater
- Raw water intake system – strainer, raw water pump, and cyclone separator
- Clarification system – multi-media filter, cartridge filter, chemical injection pumps
- Purification system – high pressure pump, 12 8-inch reverse osmosis elements
- NBC decontamination system – activated carbon, mixed-bed ion exchange
- Disinfection by Chlorination



- Contained in a special ISO container with skid mounted external components
 - Mounted on a standard 30ft M871 military trailer
 - Powered by a 60kw diesel generator also mounted on the trailer
 - Dimension & Weight: 20'L x 8'H x 8'W, 15,100lbs (fully packed container/ROWPU only)
 - Dimension & Weight: 30'L x 13'H x 8'W, 37,960lbs (fully packed and mounted on trailer w/generator)
 - Three - 3K onion tanks packed w/ROWPU, seven additional tanks come with the system for a total of ten at 135lbs each
- Feed flow – 100 gpm
 - Multi-media filtration
12-13 gal/min/sq. ft
 - 3um cartridge filtration
12 ea - 2.5 inch dia x 40 inch long filters
String wound, polypropylene
 - Reverse osmosis
2 ea – 8 inch dia. X 40 inch long polyamide RO elements
Avg salt rejection – 99.4%
2x1x1 array
50% recovery on freshwater and 33% on seawater
 - GAC, IX and chlorination post treatment for NBC removal
 - Chlorination to 2 ppm



600-gph and 3,000-gph ROWPUs water flow diagram

1500 GPH Tactical Water Purification System (TWPS)

- 1200 gallons per hour on seawater (45,000 ppm)
- 1500 gallons per hour on freshwater
- 0.2 micron microfiltration
- Ten reverse osmosis elements
- Energy recovery device
- Compressed Air valves, controls, and MF back flushing every 15 minutes
- Sodium bisulfite, anti-scalant, and chlorine addition
- 6000 gallon storage, one 125 gpm pump
- Carbon and ion exchange cartridges





1500 GPH TWPS Characteristics



- USMC and Army version have the same base skid-mounted system
- Army system is mounted in a ISO flatrack and includes a 60kW TQG and the following kits:
 - Cold Weather
 - Chemical Cleaning Wastewater Storage
 - NBC Water Treatment
 - NBC Survivability
 - Ocean Intake Structure
- USMC orders the kits separately as required
- Dimensions and Weight
 - Army: 8'H X 8'W X 20'L, 23,300 lbs
 - USMC: 6'H X 7.16' X 13.75' L
10,000 lbs
- Transportability
 - Army – HEMTT LHS or PLS
 - USMC - MTRV
- Feed flow – 50 gpm
- Product Flow
 - Freshwater – 1800 GPH
 - Brackish/seawater 1500 GPH
- Strainer - 60 micron
- Microfiltration
 - MEMCOR system – 0.2 micron hollow fibers
 - 12 MF modules/outside-in filtration
 - Backflushes every 15 mins for approx 1 min
- Reverse osmosis
 - 10 ea – 8 inch dia. X 40 inch long polyamide RO elements
 - Avg salt rejection – 99.4%
 - 50% recovery on freshwater and 40% on seawater
- GAC, IX and chlorination post treatment for NBC removal
- Chlorination to 2 ppm

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Lightweight Water Purifier (LWP)



Support ground, amphibious, Special Operation Forces, air mobile and airborne units operating autonomously

Purifies up to 125 gph from a fresh water source, 75 gph from salt water and NBC-contaminated sources.

Ultrafiltration pretreatment



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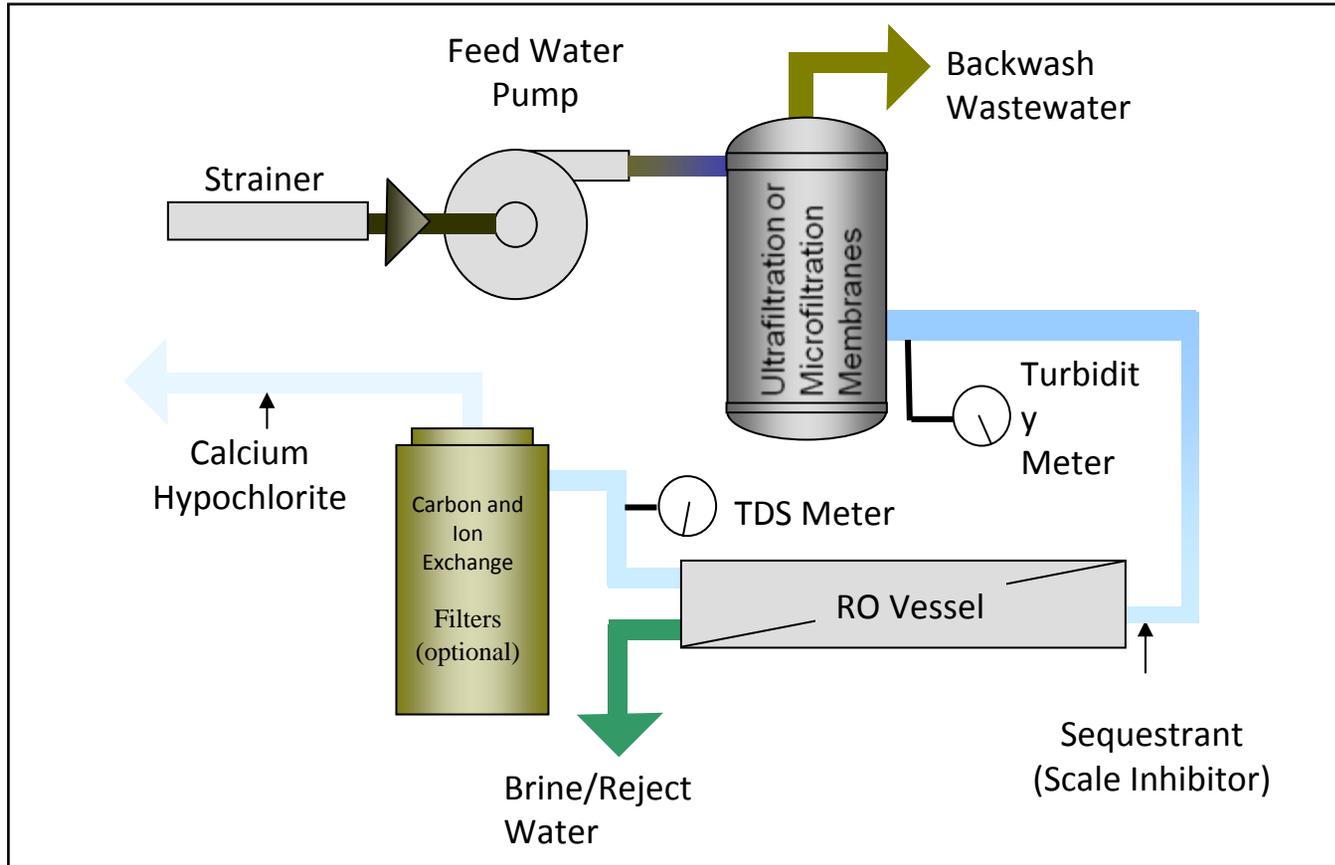


Lightweight Water Purifier Characteristics



- **Base Unit**
 - Pretreatment Module
 - Pump Module
 - Control Module
 - 3 kW generator
 - High Pressure Pump Module
 - RO Module
 - Chemical Injection/Cleaning Module
 - 2 ea 1000 gal onion tanks
- **Supplemental Cold Weather Kit**
- **Transportability**
 - M1097 HMMWV
 - UH-60 Helicopter
 - C130
 - Air Droppable
- **System Dimensions and Weight**
 - 2000 lbs
 - 4.25'L X 2.25'W X 4' H (HMMWV bed size)
- **Feed flow – 5.0 gpm**
- **Product Flow**
 - Freshwater – 125 GPH
 - Brackish/seawater 75 GPH
- **Ultrafiltration**
 - Koch system – 0.05 micron hollow fibers
 - 3 UF modules/inside-out filtration
 - Backflushes every 15 mins for approx 1 min
- **Reverse osmosis**
 - 7 ea – 2.5 inch dia. X 40 inch long polyamide RO elements
 - Avg salt rejection – 99.4%
 - 50% recovery on freshwater and 30% on seawater
- **GAC, IX and chlorination post treatment for NBC removal**
- **Chlorination to 2 ppm**

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LWP and TWPS water flow diagram



Military Water Purification Equipment Summary



Note: Values presented based on Seawater	LWP	600 ROWPU	3k ROWPU	Army TWPS	EUWP
• Production Rate (gph)	75	600	2,018	1,500	4,170
• Avg RO Flux (gfd)	8.9	12	13.7	7.6	11
• MF/UF Flux (gfd)	25	na	na	25	40
• RO Recovery (%)	30	31	33	40	50
• Weight (gpd/lb.)	1.09	1.40	1.88	1.26	2.62
• Cube (gpd/cu.ft.)	12.9	31.3	28.8	22.5	38.9
• C-130 Lift (gpd)	na	43,200	48,500	28,800	100,000

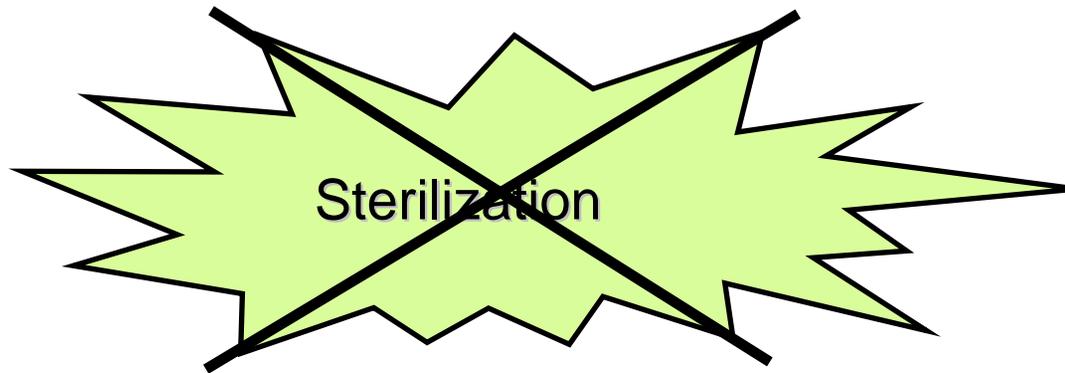
- Able to purify any source - lake, river, ocean, NBC contaminated - in sufficient quantities **BUT**
 - Systems have large energy (fuel) requirements
 - 20 to 50 kW-Hr/ Kgal
 - Systems have a large footprint (size/weight)
 - Systems require operational changes for certain contaminants
 - Systems are a logistics burden - large volume of consumables (filters, membranes, chemicals)

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

- Multiple Barrier Approach
 - source water selection and protection
 - water treatment
 - **disinfection**
 - proper operation and maintenance of storage and distribution systems, and
 - operational water quality monitoring

Primary

“The act of inactivating the larger portion of microorganisms in or on a substance with the probability that all pathogenic organisms are killed by the agent used”



Prevent re-growth

Protect against potential contamination

Secondary

➤ Disinfectants -

- Chlorine, Iodine, Chlorine Dioxide, UV, Ozone

- Sodium Hypochlorite – bleach (Clorox, 5-10%)
- Calcium Hypochlorite – HTH (70%)
 - Readily Available
 - Relatively safe
 - Effective

➤ Target Disinfectant Residuals (TBMED 577)

- Point of Production
 - ✓ RO Based treatment – 2 mg/L after 30 min
 - ✓ Non-RO Based treatment – 5 mg/L after 30 min
- Point of Consumption – 1 mg/L
- After transport – 1 mg/L
- < 1 mg/L increase to 2 mg/L – available immediately
- Non-detect, increase to 2 mg/L – wait 30 min

- Multiple Barrier Approach
 - source water selection and protection
 - water treatment
 - disinfection
 - proper operation and maintenance of storage and distribution systems, and
 - operational water quality monitoring

Distribution

TWDS - Tactical Water Distro System (10 mi hoseline sets)

SMFT - Semi-Trailer Mounted Fabric Tank (3k and 5k sizes)

FAWPSS - Forward Area Water Point Supply System

400 Gallon Water Trailer

M149A2 Water Trailer

Camel

800 Gallon Water Trailer

Hippo

2000 Gallon Tank Rack



The **HIPPO**



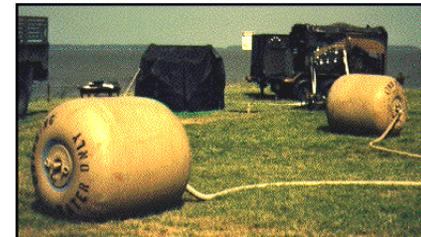
TWDS--10 miles of hoseline;
six 600 GPM pumps;
two 20K storage tanks;
two 125 gpm pumps



The **CAMEL**



400 Gallon Water Trailer
(400 Gal)



FAWPSS

Six 500 gallon drums,
one 125 GPM pump,
and hoses



SMFTs two sizes (3K & 5K)

Storage Systems

SDS - Storage & Distro Systems consist of 50K and 20K bags

Onion Bag - 3,000 gal thin skinned bag for temp storage



SDS come in 800K, 300K, 40K and 20K sizes complete with bags, hoses, & pumps.



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- Multiple Barrier Approach
 - source water selection and protection
 - water treatment
 - disinfection
 - proper operation and maintenance of storage and distribution systems, and
 - **operational water quality monitoring**

- **Basic Characterization Testing (BCT)**
 - Tri-Service Field Water Standards (TSFWS)
 - Water Point Reconnaissance
 - *Untreated Source*

- **Basic Potability Testing (BPT)**
 - Tri-Service Field Water Standards (TSFWS)-Must Meet!
 - after the ROWPU is fully operational and before water is dispensed for consumption
 - *Treated Product*

- **Advanced Water Surveillance and Testing**
 - When a water point remains in operation for greater than 7 days
 - Partial Onsite
 - Partial Sampling for Remote Analysis

Table C-2. Long-term field water quality standards (less than 1 year)

CONSUMPTION RATE	U.S. Tri Service (June 1996)		QSTAG 245 (Sep 1985)	STANAG 2136 (Sep 1995)
	5 L/Day	15 L/Day	5 L/Day	5 L/Day
<u>Physical Properties</u>				
Color (Color Unit)	15	15	15	15
Odor (TON)	3	3	--	3
pH	5 - 9	5 - 9	5 - 9.2	5 - 9
Temperature (Degrees C)	15 - 22	15 - 22	15 - 22	15 - 22
TDS (mg/L)	1000	1000	1500	1000
Turbidity (NTU)	1	1	1	1
<u>Chemical Properties</u>				
Arsenic (mg/L)	0.06	0.02	0.05	0.06
Cyanide (mg/L)	6	2	0.5	6
Chloride (mg/L)	600	600	600	600
Lindane (mg/L)	0.6	0.2	--	--
Magnesium (mg/L)	100	30	150	100
Sulfate (mg/L)	300	100	400	300
<u>Microbiological</u>				
Coliform (#/100 mL)	0	0	1	1
Virus (#/100 mL)	--	--	1	1
Spores/Cysts (#/100 mL)	--	--	1	1
<u>Radiological</u> (μ Ci/L)	0.1	0.05	0.06	2.2 Bq/mL

Current EPA Std was reduced to .01 mg/L in Jan. 2006



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Questions?

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