



National Defense Center for
Energy and Environment

Mobile Wastewater Treatment Technology for Contingency Bases

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Outline

- Systems of Systems Approach
- Contingency Base Wastewater Issues
- Wastewater Management Options
- Wastewater Treatment Technology Evaluation
- Selected Technology
- Demonstration
- Preliminary Results
- Next Steps
- Contacts & Questions

Applying a System of Systems Approach

- System is greater than the sum of its parts
- Optimizing individual pieces will not necessarily achieve optimization for the system as a whole
 - Purpose-driven
 - Hierarchical
 - Interdependent
 - Interconnected
 - Complex
 - Dynamic



Wastewater Issues

- Security issues
- Physical space requirements and other site limitations
- Safety and health issues
- Operational and maintenance burdens
- Environmental issues
- Additional demand on existing wastewater treatment infrastructure



Photo credits: Garth Anderson, USACE
Christoph Bangert, New York Times

Contingency Base Wastewater Treatment Options

Option	Advantages	Disadvantages
Tanking and Trucking Offsite	Low Maintenance Expedient Able to Handle Variation in Demand	High Cost Large Footprint Impacts to Host Nation Security Concerns
Septic System and Leach Fields	Low Cost Meets BOD and TSS Removal	Large Footprint for Leach Field Design and Construction Specific to Site Maintenance Inability to Handle Increase in Demand
Burnout and Pit Latrines	Simple and Expedient Low Cost	Groundwater Contamination Impacts to Host Nation Need to Relocate when Full
Portalettes/Porta-Johns	Simple and Expedient Low Cost	Temporary Black Water Disposal Need for Trucking of Waste Security Concerns Waste Contains Blue-Water (Biocide)
Mobile Wastewater Treatment Technology	Exceeds BOD and TSS Removal Mobile Potential Water Reuse	Energy Consumption Cost Complexity Inability to Handle Increase in Demand

Desired Contingency Base Characteristics

- Increased flexibility in contingency base operations
- Decreased construction/de-construction requirements
 - Time, material, equipment, personnel
- Improved operations management
 - Power, water, waste
- Improved design of major utility infrastructure
- Improved Environmental, Safety, and Occupational Health (ESOH) elements

Focus of NDC EE effort: Small- to Mid-size Contingency Bases

Technology Evaluation Criteria

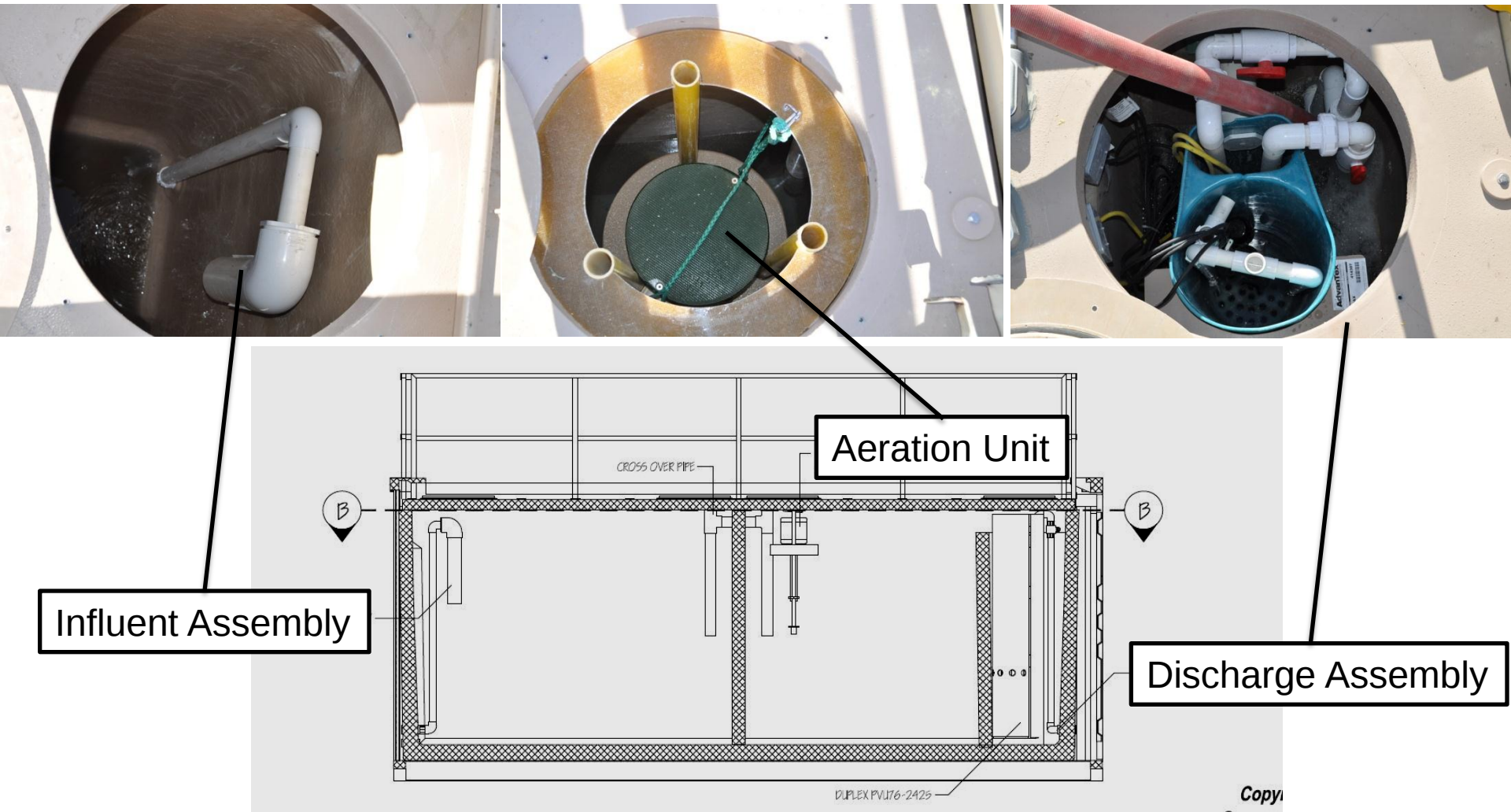
- Power Requirements
- Mobility
- Effluent Quality
- Surge Capacity
- Expansion Possibility
- Disinfection
- Throughput Capacity
- Footprint
- Capital Costs
- Personnel Requirements
- Technical Readiness
- Maintainability/Reliability
- Procurement Lead Time

Selected Wastewater Treatment Technology

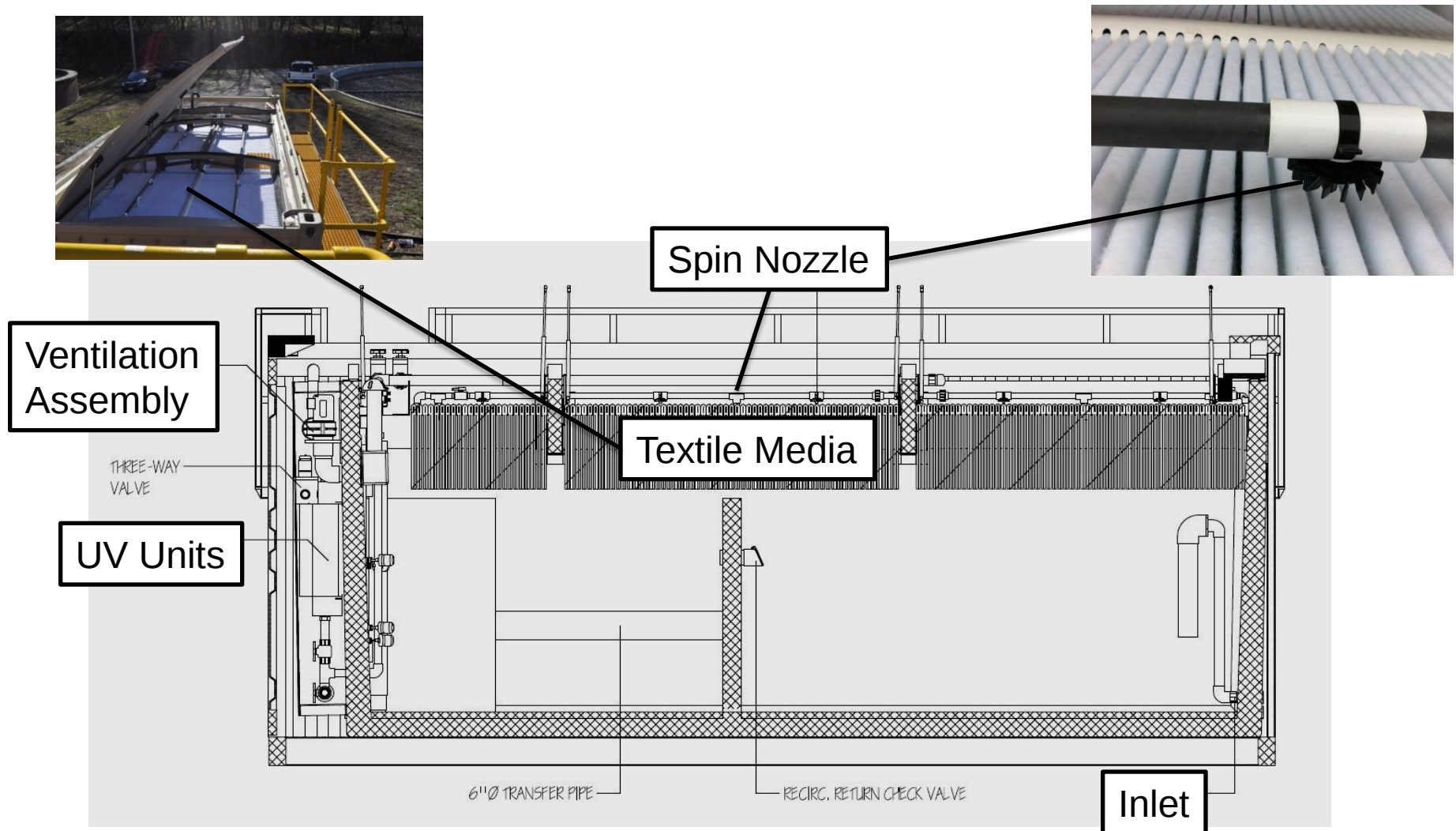
- AX-Mobile by Orenco Systems, Inc.
- Multi pass, packed bed, aerobic wastewater treatment system
- Treat wastewater for up to 200 soldiers/day (40' system); up to 10,000 gallons per day (peak flow)
- Possibility for expansion – comes in standard ISO 20' and 40' containers that weigh 9,500 lbs and 21,000 lbs
- Costs \$135K and \$211K
- Equalization Tank included
- Ultraviolet disinfection
- Control panel and operating software with optional cellular telemetry
- Flexible footprint (side by side or in series)
- Possibility for water reuse (dust control and irrigation)



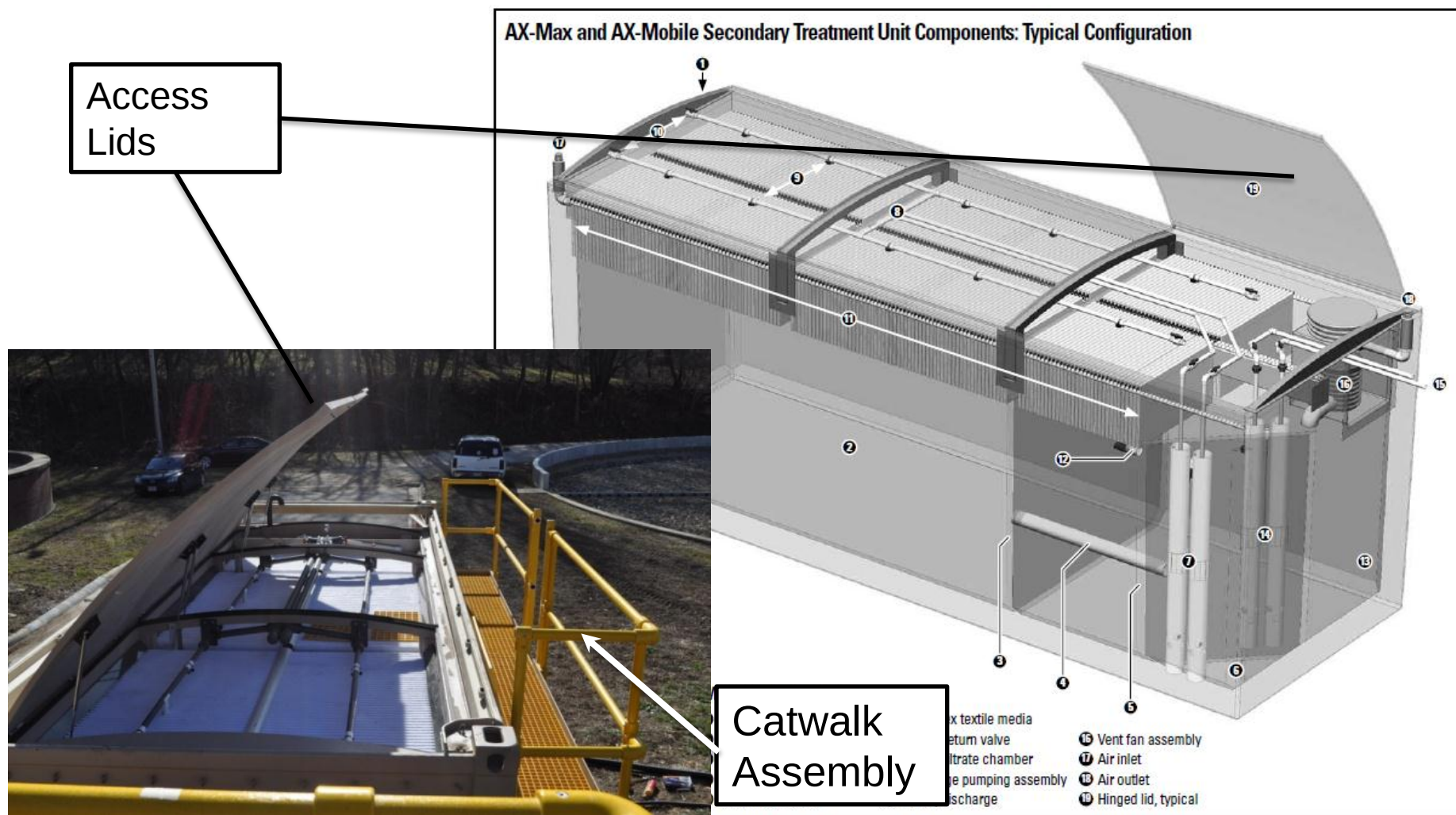
Primary Tank Specifications



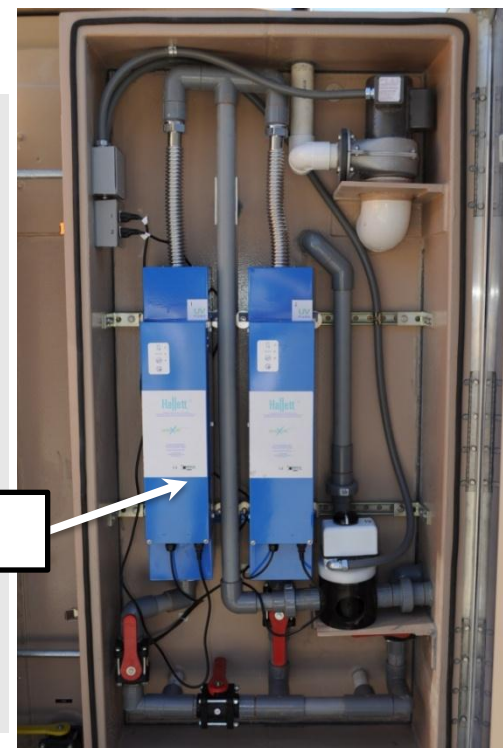
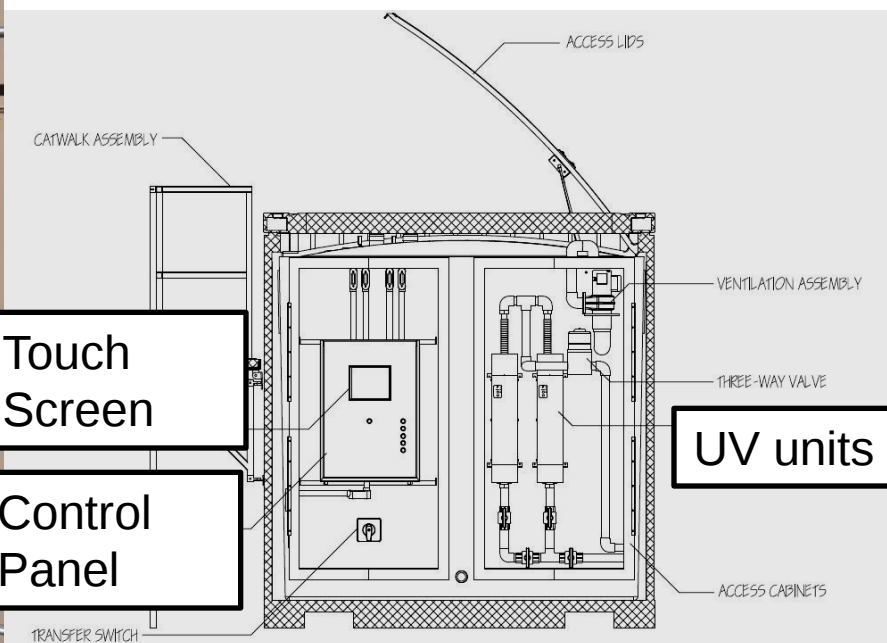
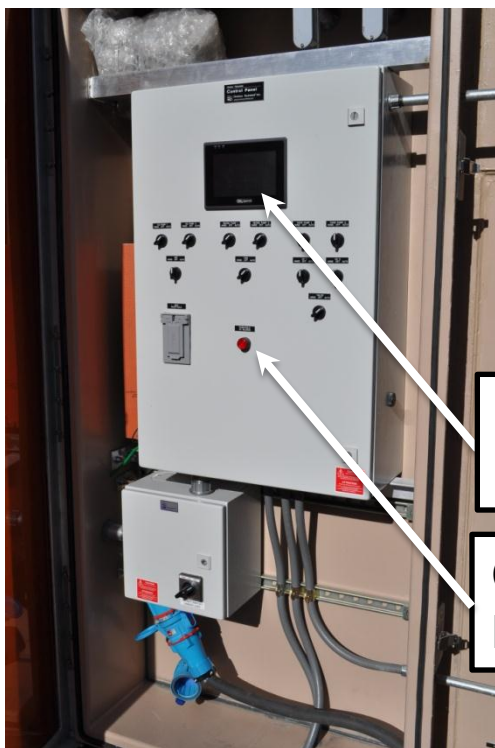
Secondary Tank Specifications



Additional Details of Secondary Treatment



Secondary Tank Specifications (con't)



Telemetry, Remote Monitoring and Operation

- Airlink Raven X 3G Wireless Data Communication Platform
- Used for remote operation and monitoring of unit
- Provides online monitoring of flows and alarms
- Device is complex and needs significant number of hours for technical setup



POWERED BY: ALEOS

Demonstration Site: Fort Leonard Wood, MO



Demonstration Site: Fort Leonard Wood, MO



Critical Support Provided

- Installation Management Command (IMCOM)/ Fort Leonard Wood Garrison Command

- Directorate of Logistics
- Directorate of Emergency Services-Fire Department
- Directorate of Public Works
 - Environmental Division
 - Engineering Division
 - Operations Division, WWTP Operating Contractor - TFW



- The Maneuver Support Center of Excellence (MSCoE)

- Headquarters and Headquarters Detachment (HHD), Alpha (A) Company, Bravo (B) Company and the 94th Signal Company of the 193rd Brigade Support Battalion (BSB) of the 4th Maneuver Enhancement Brigade (MEB)



- US Army Engineer School

- Directorate of Environmental Integration
- The 1st Engineer Brigade



Demonstration Objectives

- Treatment Capability
 - Does effluent meet contingency guidelines (less than 30 mg/L of BOD and TSS)?
- Mobility
 - What are the transportation, set up and decommissioning requirements?
- Manpower
 - What are the operator training, capabilities and time requirements?
- Energy Consumption
 - How much energy is used per gallon of treated wastewater?
 - What are power source options?
- Treatment Capacity
 - How do changes in flow (average, high and low) impact effluent water quality?
 - How do low ambient air temperatures impact effluent water quality?
- Treatment of Wastewater Containing Blue-Water
 - How does blue-water contamination impact effluent water quality?
- Operations and Maintenance Requirements

Demonstration Setup

- Site and wastewater source – Fort Leonard Wood Wastewater Treatment Facility
- Raw wastewater flow diverted prior to primary clarifier
- Effluent waste - treated water diverted back to treatment facility
- Additional pumps, control panel and plumbing needed for lift station to divert wastewater to treatment technology
- Panel enables user to specify flow to technology to test average, high and low flow conditions



Equipment Delivery, Off Loading and Placement

The AX-Mobile unit was delivered to FLW on February 21, 2012



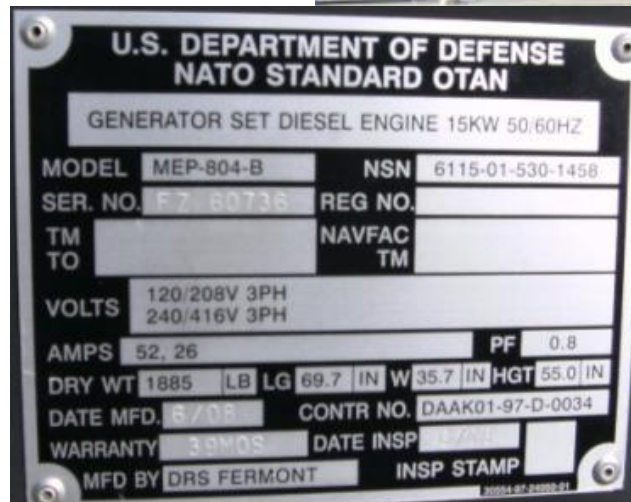
Equipment and operators for off loading and placement provided by FLW



Time to off load and place both containers approximately 30 minutes

Generator Setup

- MEP-804B Generator Set, Skid Mounted, Tactical Quiet, 15 kW 50/60 Hz
- Generators and maintenance provided by HHC, 94th, A, and B COs, 193rd BSB, 4th MEB
- Delivery and off loading (1 hour, 2 persons)
- Connection to generator and testing (2 hours, 2 persons)



Unit Setup and Commissioning

- AX-Mobile setup
- Influent and effluent lines and sampling ports (approximately 1 hour, 1 person)
- Installation of ladder and barrier on both containers (approximately 4 hours, 2 persons)



Unit Setup and Commissioning (con't)

- Water tight and leak test (4 hours)
- Water from wet well used to fill primary tank
- Fire hydrant used to fill secondary container
- Fire hose and equipment provided by FLW fire department



Completed Commissioning



Data Collection and Results

- Influent Flows
 - Conducted flows associated with 0, 75, 100 and 150 soldiers.
 - System designed for flows associated with 100 soldiers
- Influent and Effluent BOD, TSS, pH and temperature*

	Influent		Effluent			
	BOD5	TSS	BOD5	TSS	pH	Temp
Count	144	152	61	61	38	38
Average	199.74	308	21.9	21.8	7.2	68.9

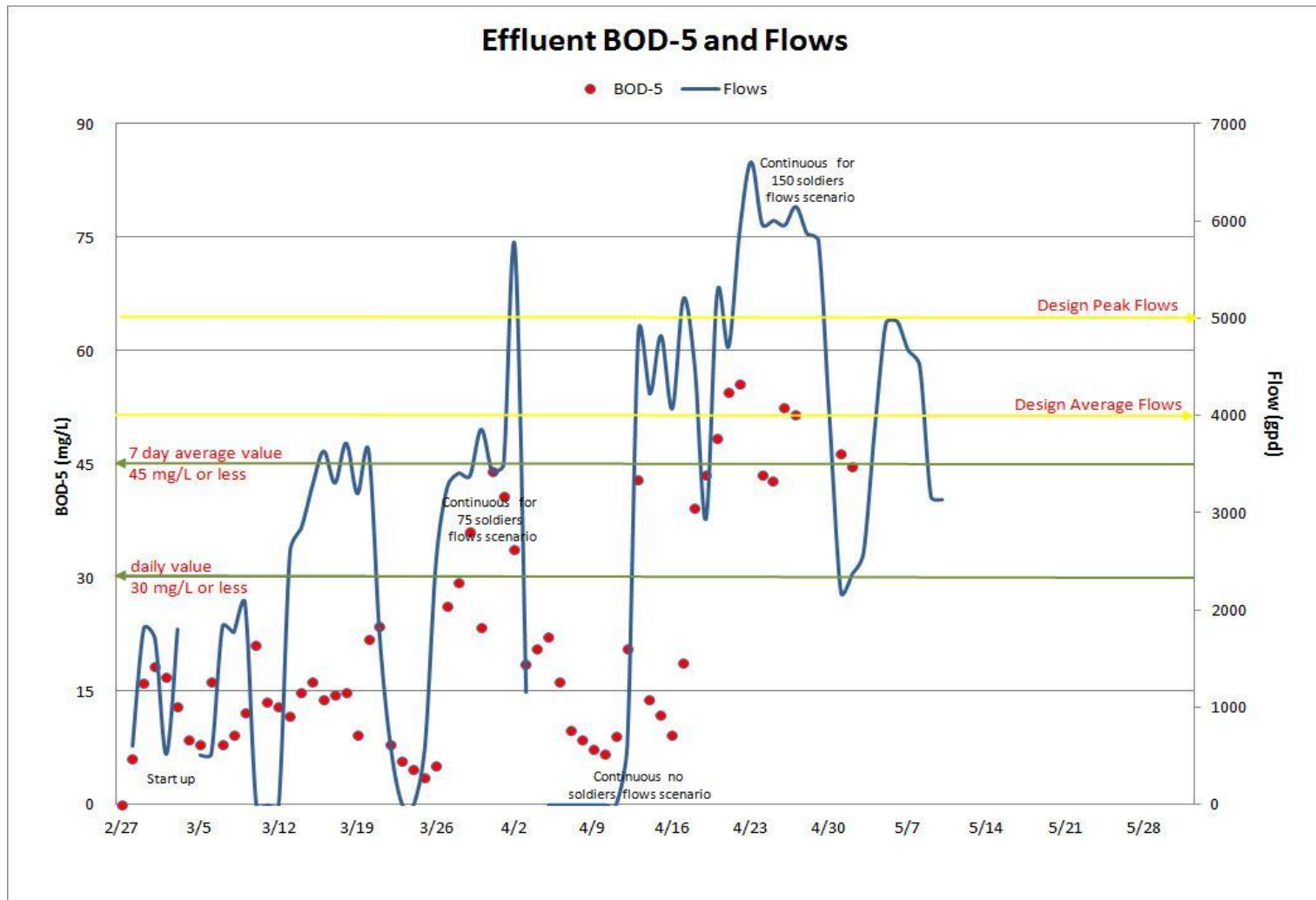
*(all flow scenarios)

Data Collection and Results (con't)

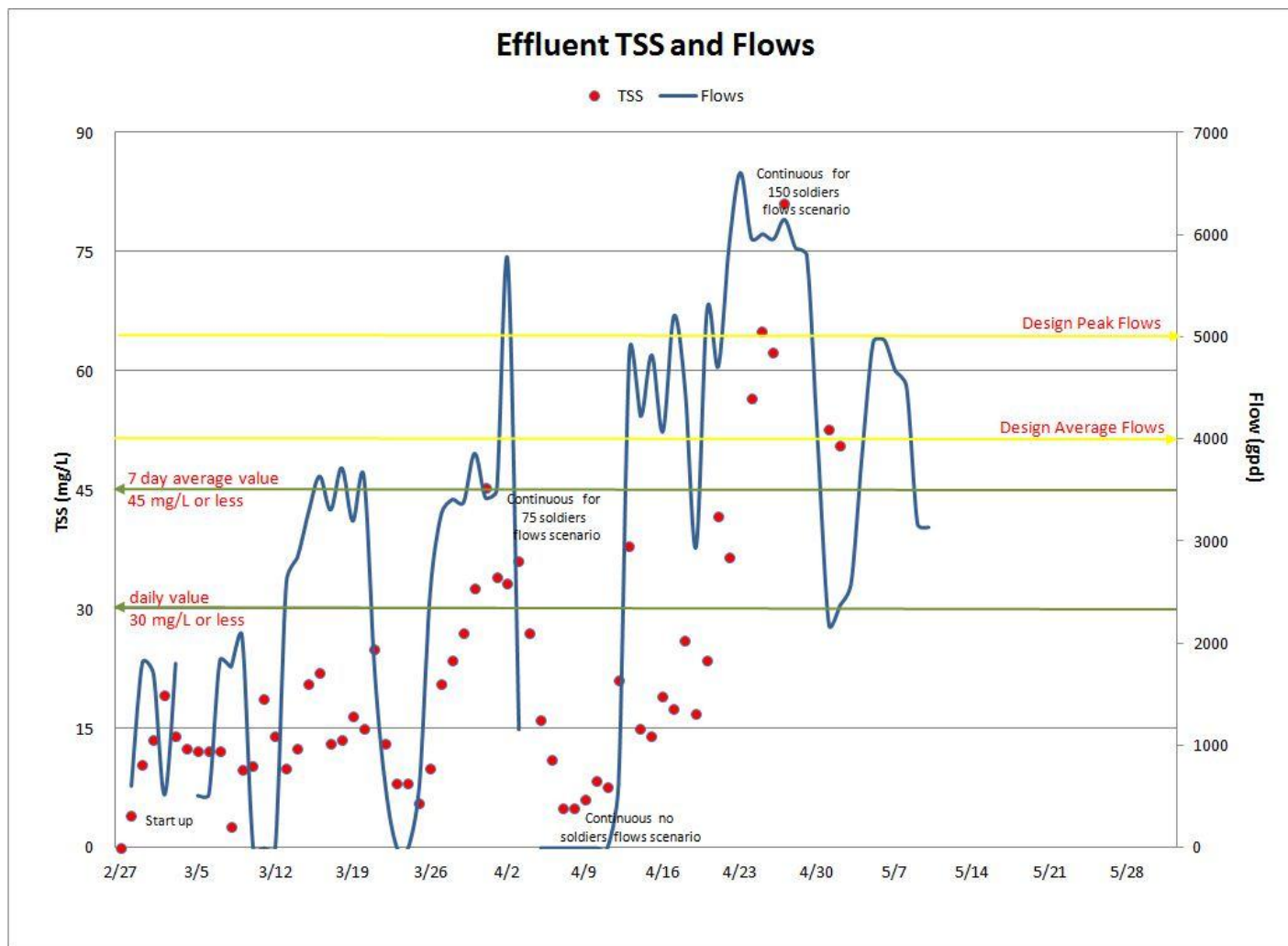
- Originally the unit was running on 15 kW generator. On average the diesel consumption is approximately ½ gallon per hour. On April 5th, the generator was switched to a 5 kW unit.
- Electricity meter installed to measure energy usage during various flow scenarios.



Preliminary Data and Analysis

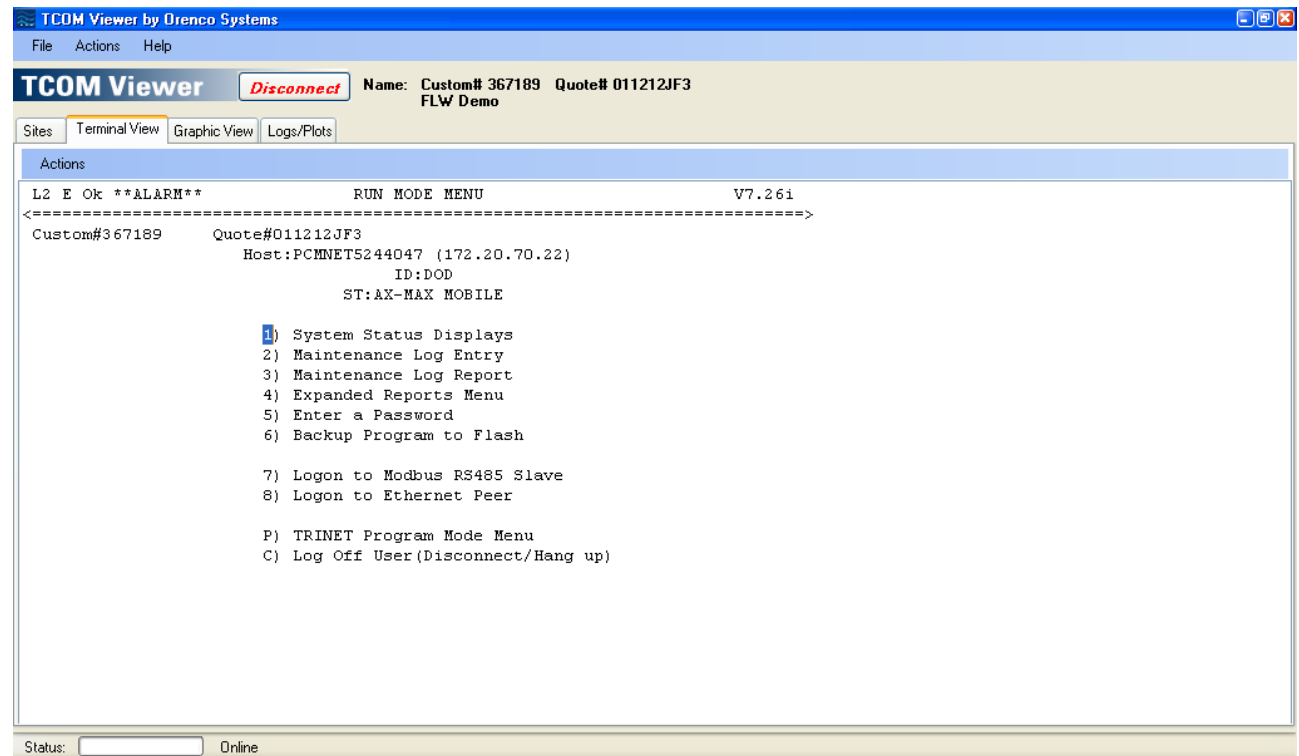


Preliminary Data and Analysis (con't)



Initial Telemetry Results

- Configuration and setup more complex, and not as user friendly as expected
- Setup time and software use complex and would require specialized training and background



Next Steps

Short Term

- Blue-water scenario
- Decommissioning of unit
- Data analysis and final report

Long Term

- Transportation of unit for further field evaluation
- Determine effect of cold weather temperatures on wastewater treatment.



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