

This presentation premiered at WaterSmart Innovations

watersmartinnovations.com



Water Conservation at a National Guard Training Base: Camp Atterbury, IN

Ms. ELISABETH M. JENICEK

Senior Researcher, Energy Branch
U.S. Army ERDC-CERL
Champaign IL USA

Ms. AMY L. VICKERS

President
Amy Vickers & Associates, Inc.
Amherst MA USA

3 October 2012



US Army Corps of Engineers
BUILDING STRONG®



Outline

- Background, objective and impact to Army
- Site description
- Site survey & findings
- Technology retrofits
- Survey and education
- Metering and monitoring
- Lessons learned



Corporate Comparison

The US Army is comparable to a major corporation in terms of funding, assets and global reach. The Army would rank 5th in comparison to Fortune 500 companies based on funding alone.

Army Demographics

Mission: “To fight and win our nation’s wars.”

Operating Locations: worldwide

Funding: **\$245.6 Billion**

Personnel

Active: 547,400

Guard: 358,200

Reserve: 205,000

Civilian: 300,000

TOTAL: **1,410,600**

Top 5 Fortune 500 Companies (2009)

Company	Revenue (\$B)
1. Wal-Mart Stores	421.85
2. Exxon Mobil	354.67
3. Chevron	196.34
4. ConocoPhillips	184.97
5. Fannie Mae	153.83



Current Water Mandates

Federal Mandate	Water Topic	Water Performance Target
Executive Order 13423	Water Consumption	<ul style="list-style-type: none"> Reduce consumption by 2% annually for 16% total by FY2015 (FY2007 baseline)
	Water Audits	<ul style="list-style-type: none"> At least 10% per year every 10 years
	Products and Services	<ul style="list-style-type: none"> Procurement of water efficient products and services; WaterSense
Energy Independence and Security Act of 2007	Covered Facilities (75%)	<ul style="list-style-type: none"> Comprehensive evaluations, project implementation, and follow-up
	Post-Construction Stormwater	<ul style="list-style-type: none"> Restore to pre-development hydrology
Executive Order 13514	Water Consumption	<ul style="list-style-type: none"> Reduce consumption by 2% annually for 26% total by FY2020 (FY2007 baseline)
	Industrial, Landscape, Agricultural	<ul style="list-style-type: none"> Agencies reduce consumption by 2% annually for 20% total by FY2020 (FY2010 baseline)
	Water Reuse	<ul style="list-style-type: none"> Identify, promote, and implement water reuse strategies
	Stormwater Management	<ul style="list-style-type: none"> Implement and achieve objectives from EPA
Army Sustainable Design and Development Policy	New Construction and Renovation	<ul style="list-style-type: none"> Achieve 30% reduction compared to baseline IAW ASHRAE Outdoor use achieve a 50% reduction “ ”



Sustainable Standards, Codes & Programs

ASHRAE Standard 189.1

- Required for new construction and major renovation
- Comprehensive with requirement elements

USGBC Leadership in Energy & Environmental Design (LEED)

- Silver required for new construction and major renovation
- Plumbing and irrigation focus with optional provisions

EPA WaterSense

- Products are required for all Federal agencies per EO 13423
- Plumbing and irrigation

IAPMO Green Plumbing & Mechanical Code Supplement (GPMCS)

- No Army requirement
- Comprehensive with required elements

ICC International Green Construction Code (IGCC)

- No Army requirement
- Comprehensive with required elements



Basic Elements

Element	ASHRAE 189.1-2011	LEED 2009	WaterSense	GPMCS 2012	IGCC 2012
Landscape Design-Adaptive and Native Planting	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>
Irrigation System Design	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Advanced Irrigation Controls	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
High Efficiency Plumbing Fixtures	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
High Efficiency Appliances	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Advanced Sub-Metering	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Cooling Tower Water Management	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
High Efficiency Commercial Food Equipment	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
High Efficiency Medical and Lab Equipment	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Alternative Water Sources	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Technical Objective

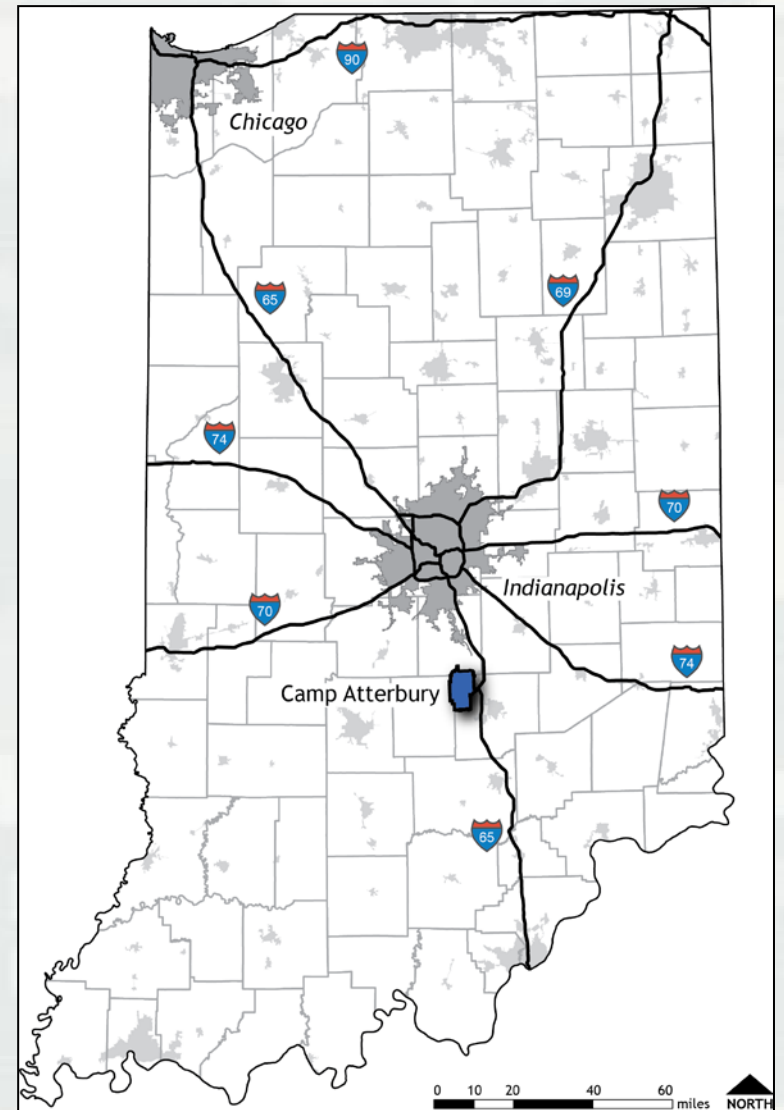
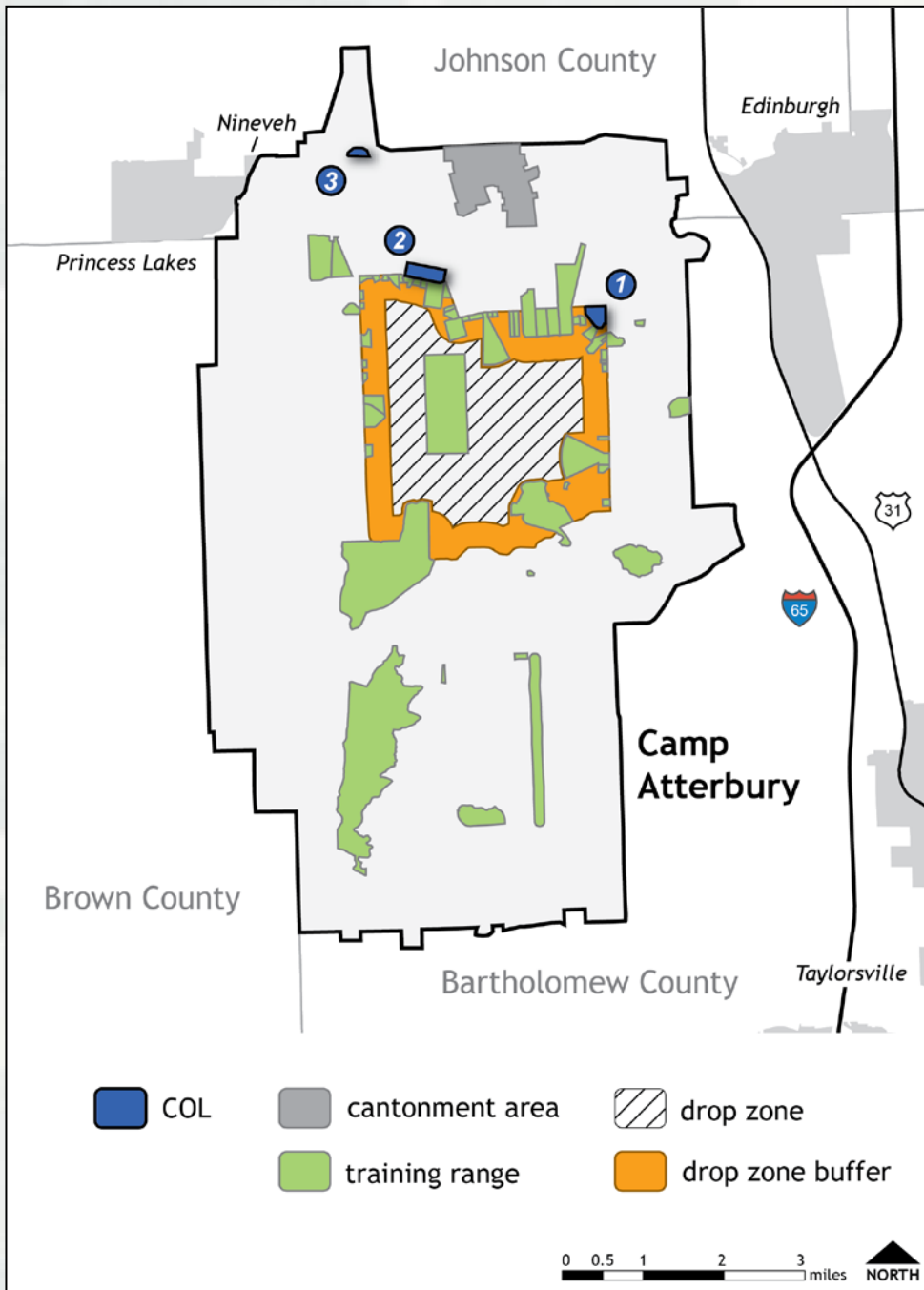
To demonstrate and validate the retrofit of existing facilities with technologies that support reduced potable water consumption through conservation and building gray water reuse.



Impact to the Army

- Reduce water consumption by 30%.
- Document and analyze training area water usage.
- Develop cost/benefit calculations to support wider adoption.
- Decrease wastewater discharge.
- Educate soldiers in training areas about the Army's water ethic.

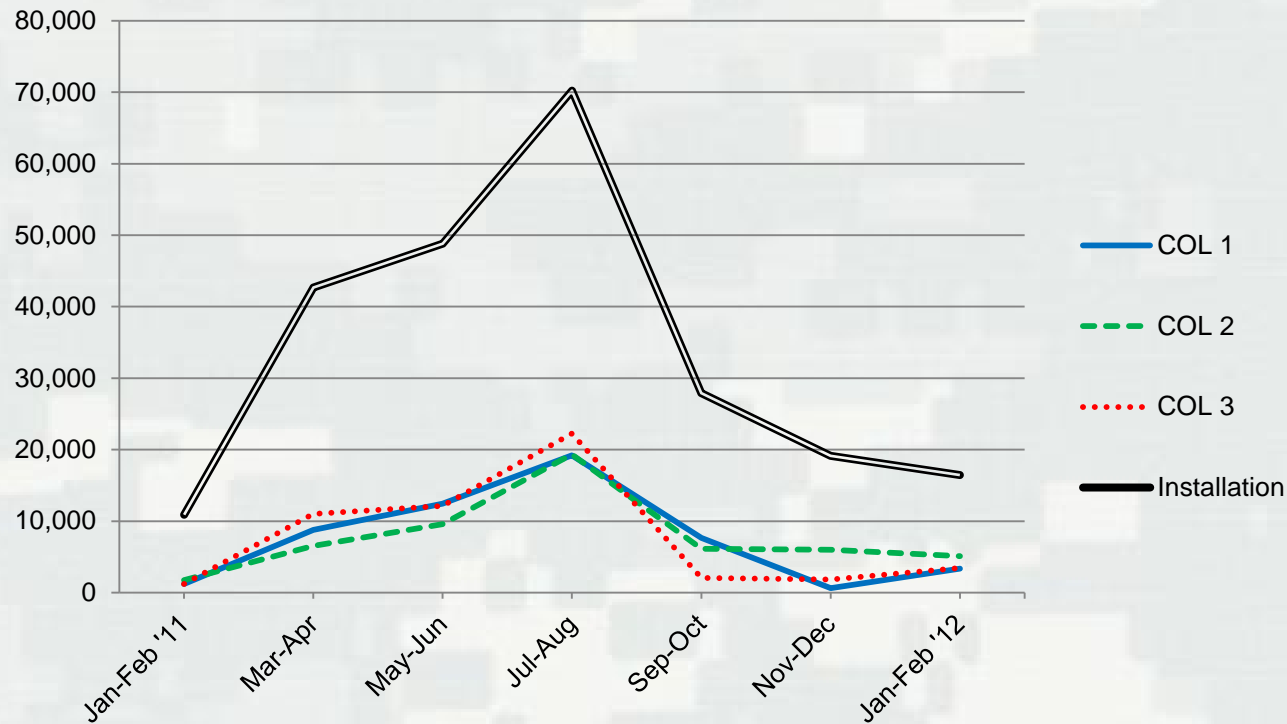




BUILDING STRONG®

Training OPTEMPO in 2011

Training Personnel at Camp Atterbury



Remote Mobile Shower ReMS



- Showers and sinks.
- Utility sink and hot water heater.
- Supplied from self-contained tank or potable water system.
- Configuration used at geographically disparate training areas.



Survey Method

Waste Per Quarter at 60 PSI Water Pressure

Diameter of Stream	Gallons	Cubic Feet	Cubic Meters
1/4"	1,181,500	158,000	4,475
3/16"	666,000	89,031	2,521
1/8"	296,000	39,400	1,115
1/16"	74,000	9,850	280

A continuous leak from a hole this size would, over a three month period, waste water in the amounts shown above.



New Resources Group, Inc.
P.O. Box 320049
Fairfield, CT 06425
Phone: 203-366-1000 Fax: 203-366-1001
www.NRGIDEAS.com

How Much Can You Save?
Save water and energy (energy used to heat your hot water) and money with high efficiency lower flow shower heads and aerators.

Determine the flow at showers and sinks.
Flow is measured as volume per minute. This handy tool will show you the flow in gallons and liters per minute, and help guide you to saving water, energy and money.

Easy instructions on how to test your showers and faucets.

- 1) Turn on the fixture to be tested - shower head, faucet, or hose. Adjust the flow to how you would normally use the fixture.
- 2) Hold the bag open and place under the fixture for exactly FIVE seconds.
- 3) Remove from the flow, hold the bag up and read the flow rate measurement on the bag. Pour water out and repeat. It is important to get the FIVE seconds correct. Practice counting with a watch. Repeat the test to check your results.
- 4) Below we have indicated efficient shower head, kitchen aerator and bathroom aerator guidelines.

NOTE: These are maximum recommendations. You can always go lower if you are comfortable with the performance at the lower flow. The lower the flow, the more water, energy and money you will save.

Showerheads
Compare the water level for your current heads to the efficient one. Look in the Potential Savings column to see how much you can save with a new shower head. The most efficient shower heads are available at www.nrgideas.com.

Faucets
(Bathroom and Kitchen)
Compare the water level for faucet to the efficient one. Look in the Potential Savings column to see how much you can save with a new faucet aerator. The most efficient aerators are available at www.nrgideas.com.

Water Level	Flow Rate	Potential Savings on your utility bills	Water Level	Flow Rate	Potential Savings on your utility bills
Gallons (US)	Liters		Gallons (US)	Liters	
5 GPM	19 LPM	\$207/year	5 GPM	19 LPM	\$16/year
4 GPM	15.2 LPM	\$124/year	4 GPM	15.2 LPM	\$11/year
3 GPM	11.4 LPM	\$41/year	3 GPM	11.4 LPM	\$6/year
2 GPM	7.6 LPM		2 GPM	7.6 LPM	
1.5 GPM	5.7 LPM		1.5 GPM	5.7 LPM	
1 GPM	3.8 LPM		1 GPM	3.8 LPM	
.5 GPM	1.9 LPM		.5 GPM	1.9 LPM	

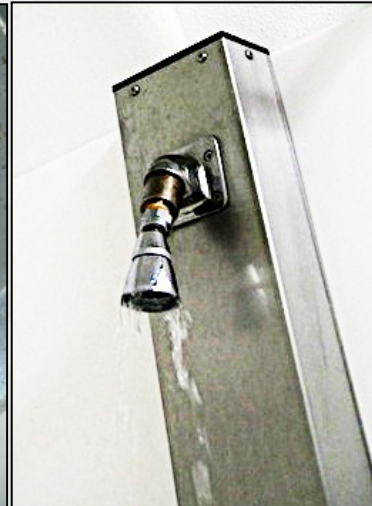
Calculations assume 2 people per household, 2.2 gpm shower head, 8 minutes per shower, 8 showers per person each week. Water, sewer and energy savings are all included.

Calculations assume 2 people per household. Potential savings are for five 2.2 aerators one in the kitchen and one in the bathroom. Water, sewer and energy savings are all included.

EPA WaterSense Flow • Showers: 2.0 gpm, Bath Faucet: 1.5 gpm

Showers

- Clogged fixtures.
- Leaking fixtures.
- Missing showerheads.
- Irregular water pressure conditions.



Shower Flow

COL/FOB NUMBER & NAME, CONNEX/TRAILER#:

Data Collection

Date & time flow tests and pictures taken (appx):

Year fixture installed:

Flow rate marking on showerhead, gallons per minute (gpm):

Flow rate measurement, avg. gpm (avg. of 3 flow tests)

Difference in actual vs. rated flow, gpm:

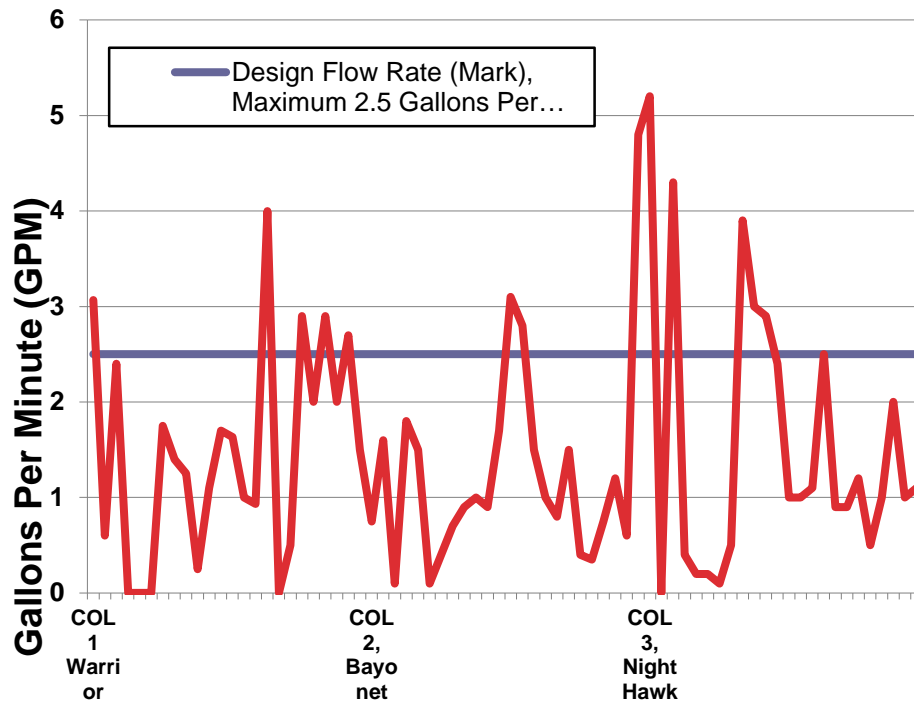
Leakage (yes/no; est. leak gpm):

Condition of fixture

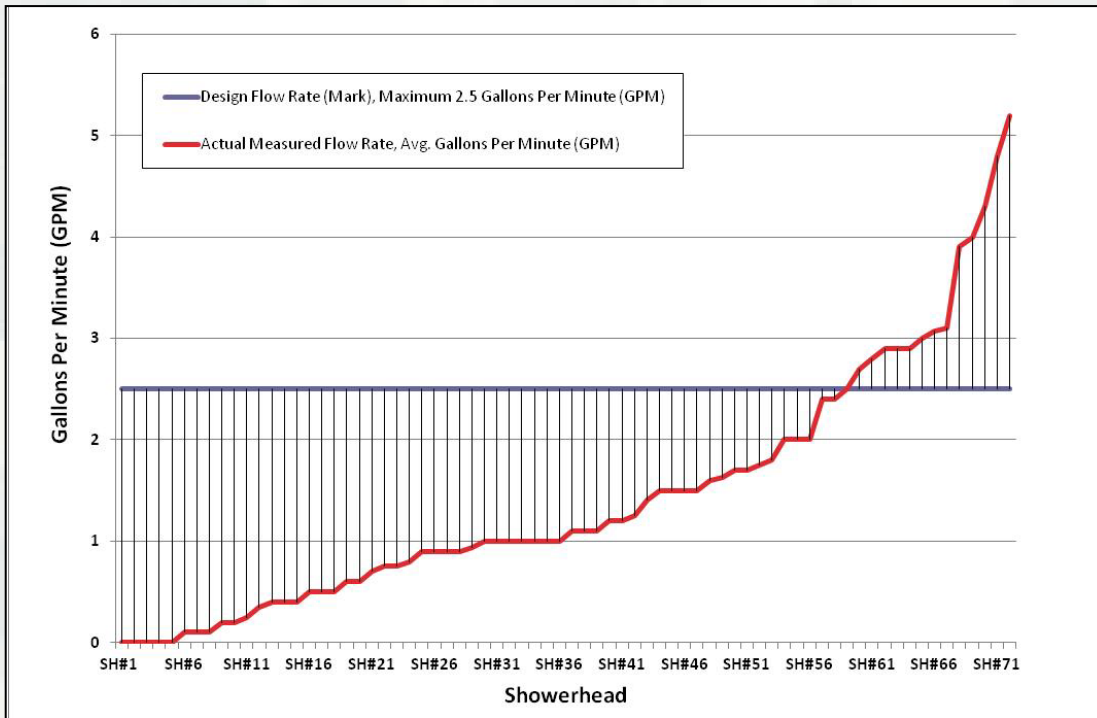
good working order:

poor/broken/clogged:

Additional Notes:



Shower Survey Data



Measured Flow Rate	Showerheads	
	Number	Percent
Flow rate above 2.5 gpm (high)	13	18%
Flow rate between 1.7 gpm and 2.5 gpm (acceptable range for design flow rate)	11	15%
Flow rate below 1.7 gpm (low)	43	60%
No flow or dribble (broken)	5	7%
Total	72	100%

Condition of fixture	COL 1, Warrior		COL 2, Bayonet		COL 3, Night Hawk	
	Number	Percent	Number	Percent	Number	Percent
Good working order	13	54%	3	13%	2	8%
Poor flow, clogged, broken or missing showerhead	11	46%	21	88%	22	92%
Total	24	100%	24	100%	24	100%
Leaking showerheads	0	0%	0	0%	4	17%

Faucets



- Clogged fixtures.
- Faulty metering controls and settings.
- Overspray.
- Missing aerators.
- Irregular water pressure conditions.

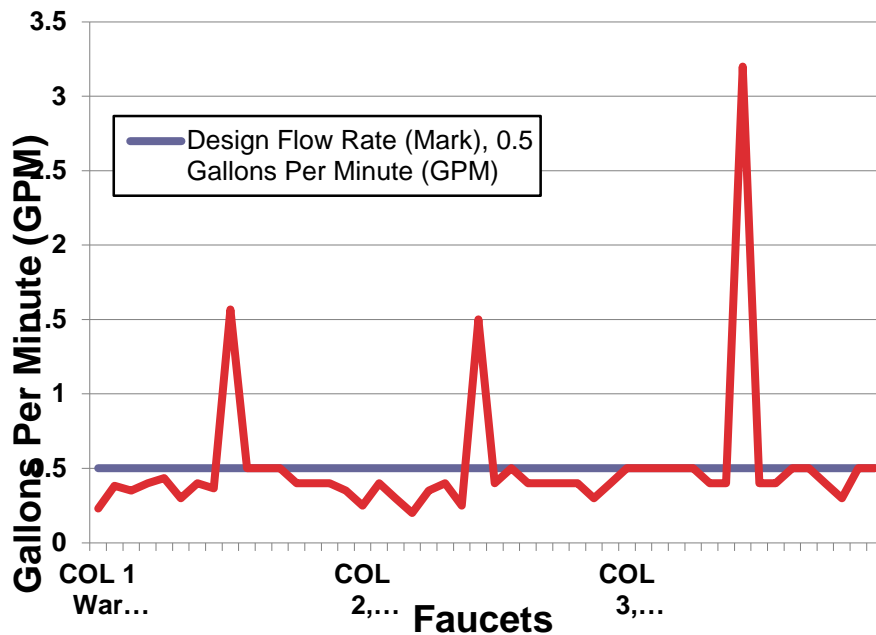


BUILDING STRONG®

Faucet Flow

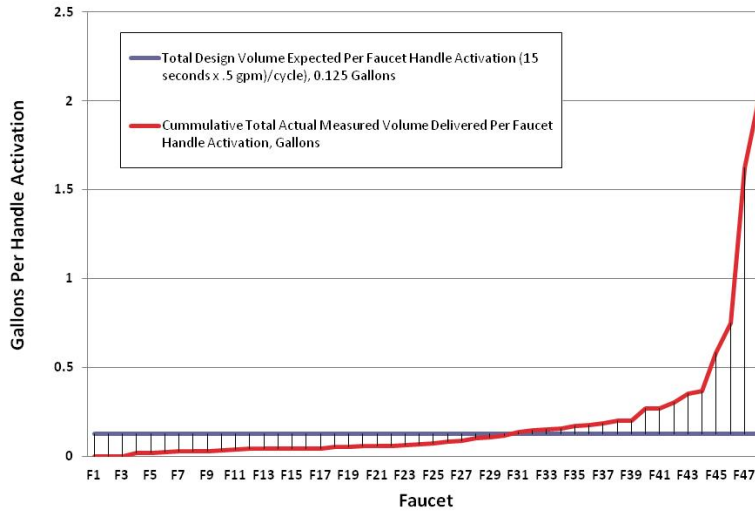
COL/FOB NUMBER & NAME, ReMS#:

Data Collection	FAUCET # 1	FAUCET # 2	FAUCET # 3
Date & time flow tests and pictures taken (appx):			
Year fixture installed:			
Aerator installed?			
Flow rate marking on faucet, gallons per minute (gpm):			
Flow rate measurement, avg. gpm (avg. of 3 flow tests)			
Difference in actual vs. rated flow, gpm:			
Faucet metering cycle, seconds:			
Est. volume per cycle, gallons:			
Leakage (yes/no; est. leak gpm):			
Condition of fixture			
good working order:			
poor/broken/clogged:			
Additional Notes:			



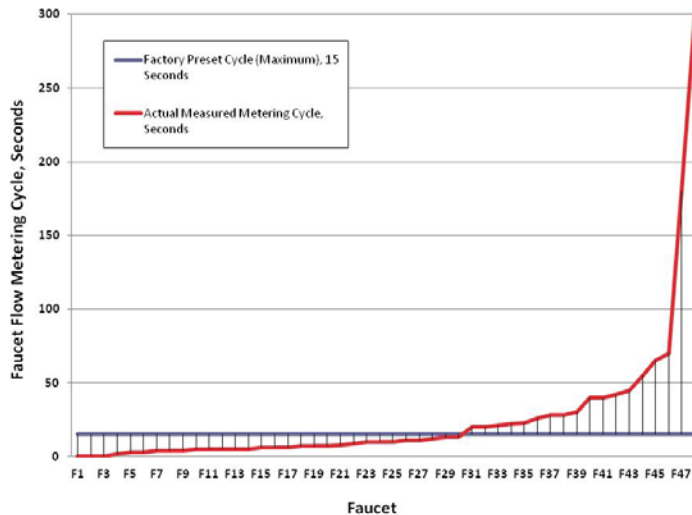
BUILDING STRONG®

Faucet Survey Data



Measured Flow Rate	Faucets	
	Number	Percent
Flow rate above 0.5 gpm (high)	3	6%
Flow rate between 0.35 gpm and 0.5 gpm (acceptable range for design flow rate)	3	6%
Flow rate below 0.35 gpm (low)	25	52%
No flow or dribble (broken)	17	35%
Total	48	100%

Condition of fixture	COL 1, Warrior		COL 2, Bayonet		COL 3, Night Hawk	
	Number	Percent	Number	Percent	Number	Percent
Good working order	13	81%	10	63%	12	75%
Poor flow, clogged, broken or missing aerator	3	19%	6	38%	4	25%
Total	16	100%	16	100%	16	100%
Leaking faucets	1	8%	4	33%	1	8%



BUILDING STRONG®

Shower and Faucet Retrofits



- Pre-retrofit flow tests “do over” (to account for softened water).
 - Fixture flow rates improved-closer to design (rated) flows.
 - Fewer missing fixtures and leakage problems.



Shower and Faucet Retrofits

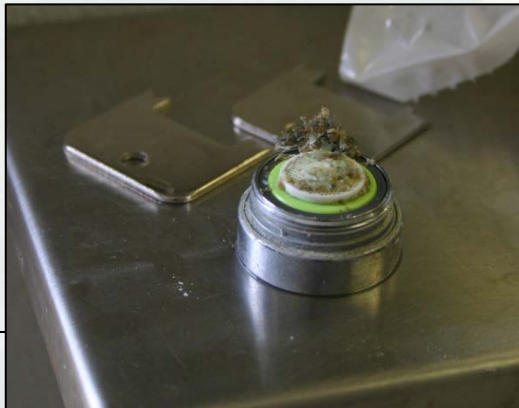


- Retrofits installed
 - 0.35 gpm aerators.
 - 1.5 gpm showerheads.
- Post-flow tests
 - Measured flows lower than design flows.
 - Water pressure conditions vary.
 - Residual lime scale in fixture units?



Shower and Faucet Retrofits

- Faucet timers set for 15-seconds.
- Shower heads.
- Delta in-kind donation.



Composting Toilet: survey



Composting Toilet: retrofit



BUILDING STRONG®

Composting Toilet Results

- Cost effectiveness:
 - ▶ \$175/year savings per unit.
 - ▶ Replacement of Porta Potties of 2:1.
 - ▶ Cost effectiveness increases with usage.
- User acceptance:
 - ▶ Less maintenance.
 - ▶ No odor.



Bulk Water Point: survey



Bulk Water Point: retrofit

- Solar powered.
- SmartVend Terminal
- Card activated.

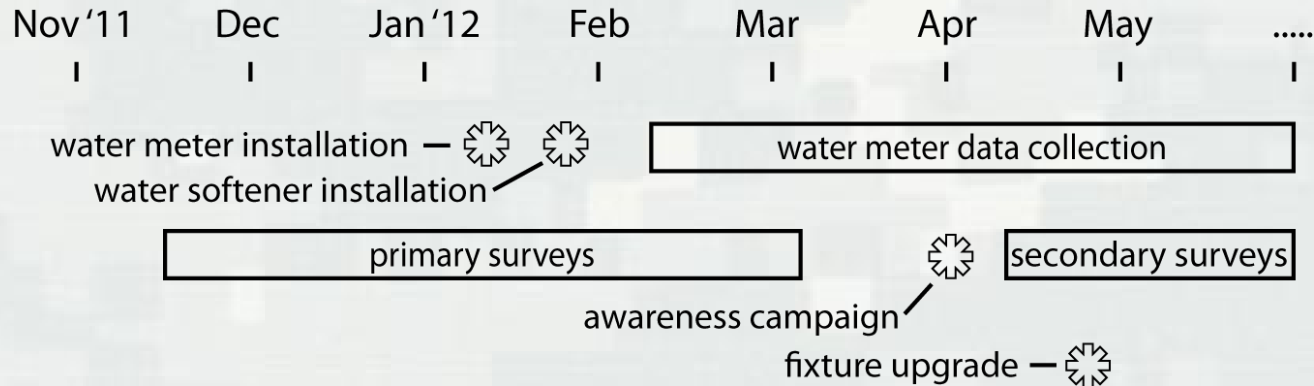


Metering and Monitoring



Period End Date	FOB2 Bayonet			FOB3 Nighthawk		
	West Conne x	East Connex	Overnight Strength	South Connex	North Connex	Overnight Strength
	water used (gal)	water used (gal)	(personnel)	water used (gal)	water used (gal)	(personnel)
19-Dec-11	meter installation					
4-Jan-12	0	110	-	10	-	-
1-Feb	75	25	-	50	-	-
10-Feb	0	0	0	0	-	0
24-Feb	85	75	0	7,260	2,310	2,526
5-Mar	580	200	847	5,820	2,090	2,526
1-Apr	4,690	7,920	4,150	1,650	9,060	1,955
3- Apr	awareness campaign installation					
3-May	2,780	4,160	2,075	10,140	9,200	2,004

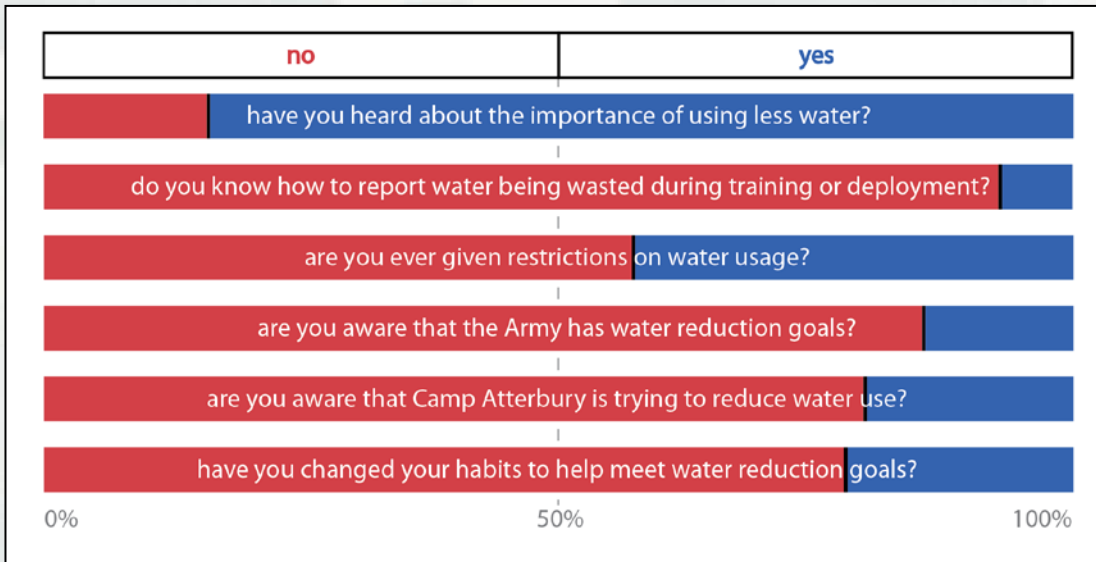
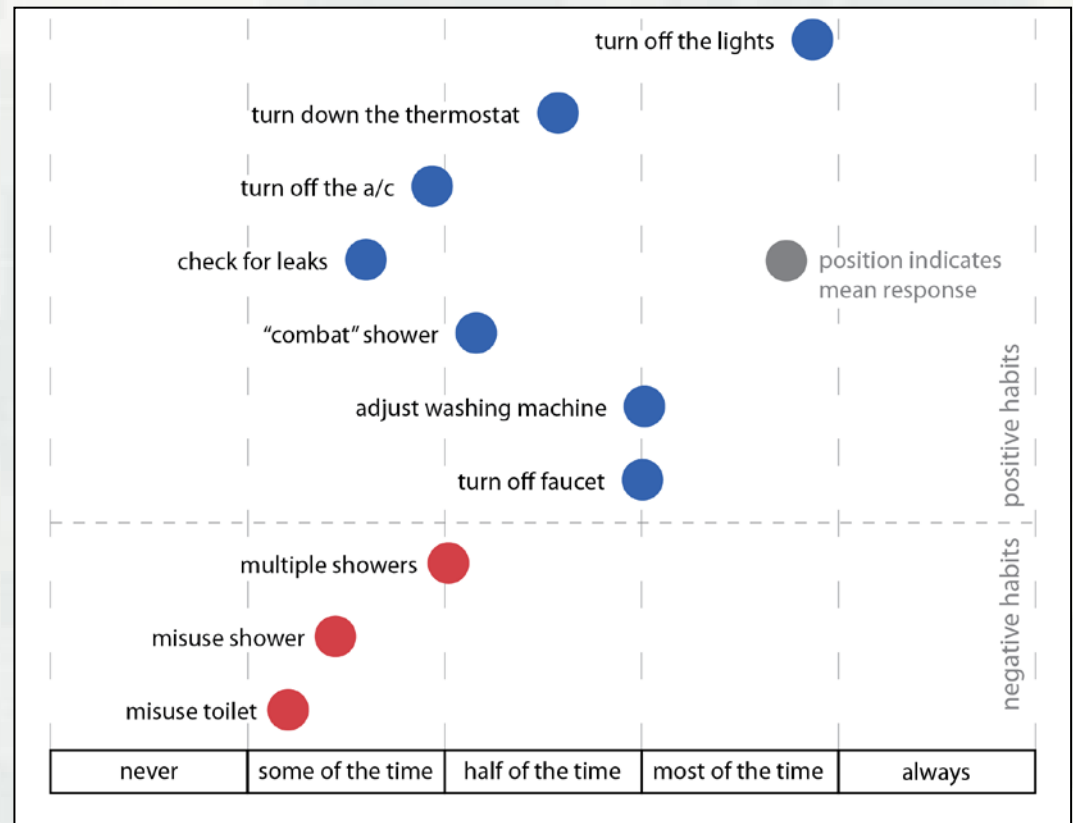
Survey and Education



- Pre-retrofit survey.
- Educational material.
- Retrofit of ReMS.
- Post-retrofit survey.

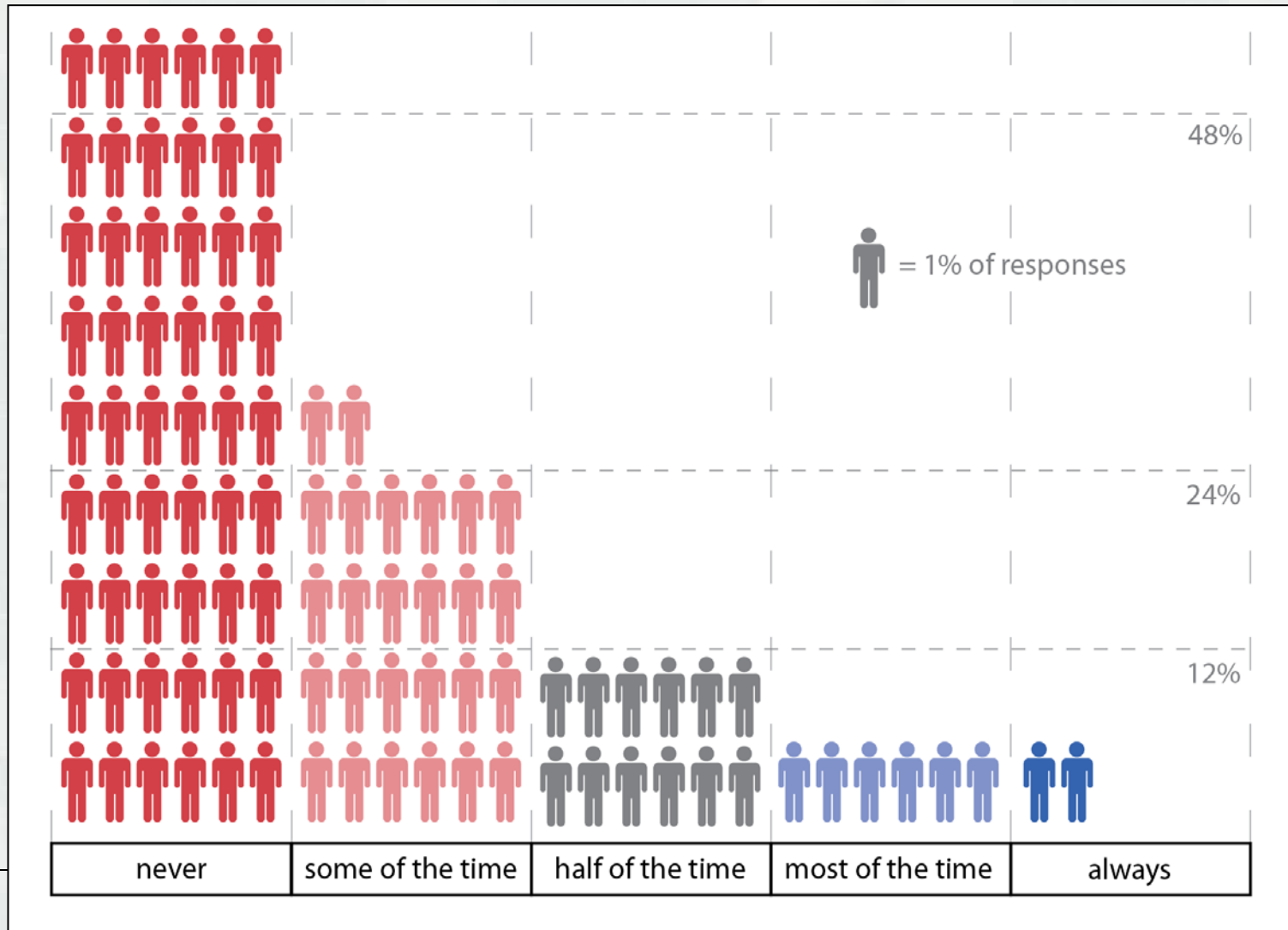


How often do you . . .

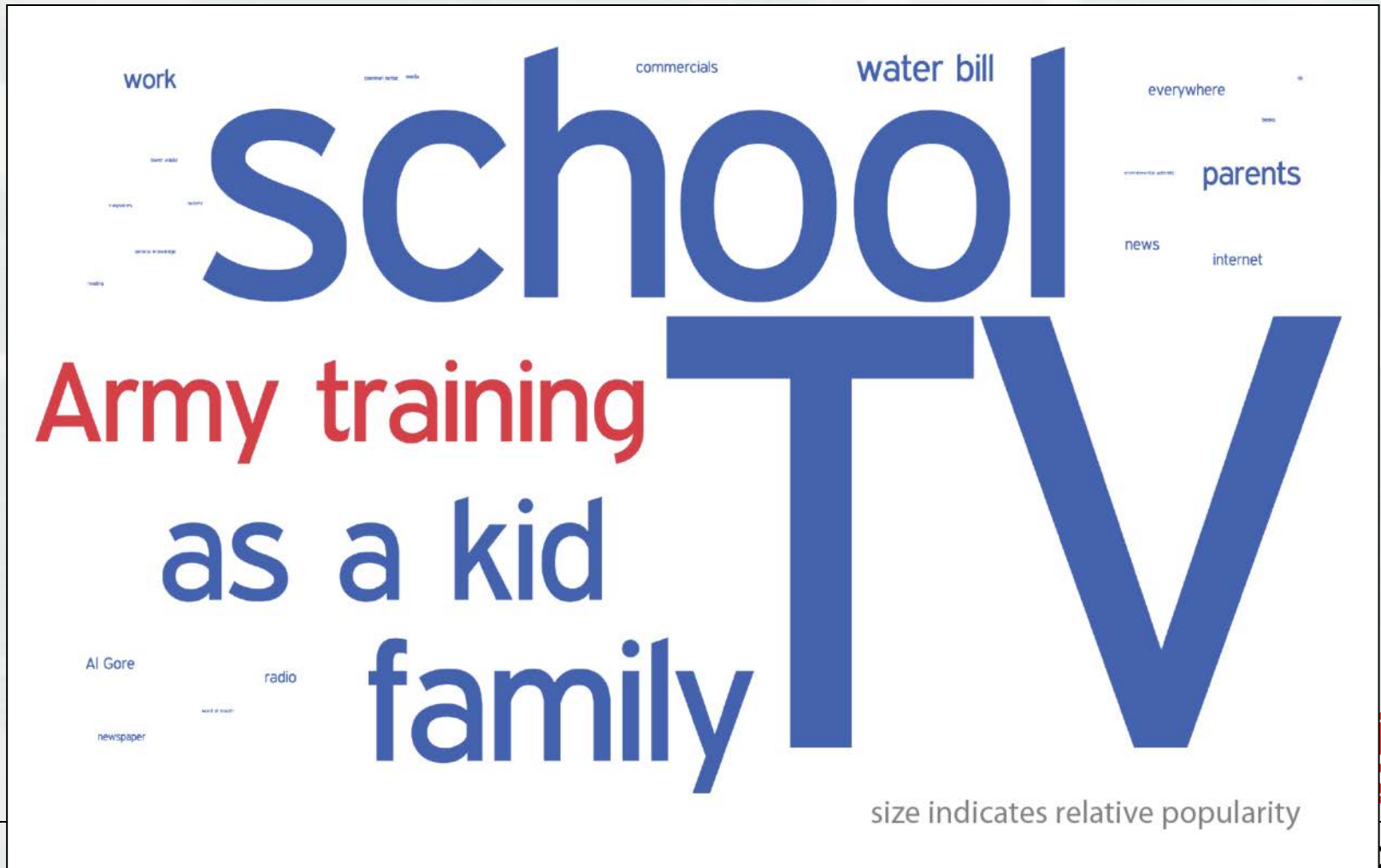


BUILDING STRONG®

How often do you think about how much water is used during daily training tasks?



Have you ever heard about the importance of using less water? If so, how?



Lessons Learned

1. Hard water can have a significant impact on fixture flow rates, leakage, and operability.
 - ▶ Fixture removal, reduced number of working showers, and additional cleaning time and cost incurred if water softeners are not installed.
 - ▶ Residual lime inside fixtures impacting post-retrofit flows?
2. Irregular water pressure conditions in shower connexes affects fixture flow rates.
 - ▶ All fixtures “on” sometimes diminishes flows.



Lessons Learned

3. Soldier acceptance of reduced flow 1.5 gpm showerheads and 0.35 gpm faucets appears to be good.
 - ▶ Survey results.
 - ▶ Direct feedback from COL/FOB mayors only.
 - ▶ Baseline pre-softener fixtures not the best comparison.



Lessons Learned

4. Measured fixture water savings:

Showerhead retrofits: 45% water savings*	
Showerhead pre-and post retrofit	Measured flow rate, gpm
Pre-retrofit flow (mfr rated 2.5 gpm), average	2.2
Post-retrofit flow (mfr rated 1.5 gpm), average	1.2
Water savings, average	1.0

Faucet aerator retrofits: 43% water savings*	
Faucet aerator pre-and post retrofit	Measured flow rate, gpm
Pre-retrofit flow (mfr rated 0.5 gpm), average	0.51
Post-retrofit flow (mfr rated 0.35 gpm), average	0.29
Water savings, average	0.22

* With water softeners installed
gpm—gallons per minute



BUILDING STRONG®

Lessons Learned

5. Water saving unknowns:

► Showerheads:

- Do reduced flow rates affect length of showering time, e.g., shampoo and body soap removal?

► Faucet aerators:

- Do reduced flow rates affect length of time soldiers use the faucet, e.g., hand soap removal, shaving?
- Changes in utility sink (high flow) usage?

6. Data logger and software limitations: can't pull out individual fixture use and flow rates.



Lessons Learned

7. Long-term challenges to fixture retrofit water savings at Camp Atterbury:

- ▶ Future replacement fixtures may be specified to higher flow ASHRAE standards or available stock.
- ▶ Retrofit fixture performance could degrade quickly if water softener maintenance is not continued; fixture removal could result.
- ▶ Water losses from broken and leaking fixtures is a continuing problem, negates some retrofit savings.



Thank-you!

