

# Water Savings Opportunity Survey (WSOS) Fort Belvoir, Virginia

## *Executive Summary*

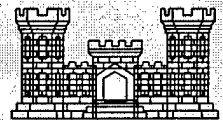
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CONTRACT #DACA01-94-D-0034  
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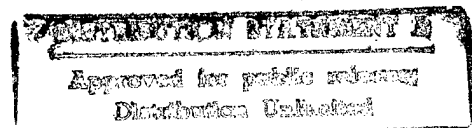
July 30, 1996

**SYSTEMS***corp*

SYSTEMS ENGINEERING AND MANAGEMENT CORPORATION



Baltimore District-  
US Army Corps  
of Engineers



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DEPARTMENT OF THE ARMY  
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS  
P.O. BOX 9005  
CHAMPAIGN, ILLINOIS 61826-9005

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## 1.0 EXECUTIVE SUMMARY

FY95S WATER CONSERVATION STUDY (WATER AND ENERGY), FT. BELVOIR, VA

### 1.1 SYNOPSIS

Systems Corp surveyed and completed water and energy analyses for 250 representative buildings at Fort Belvoir, categorized as unaccompanied personnel housing, community facilities, administrative facilities, maintenance facilities, training facilities, family housing, hospital, heating plants, cooling towers, and water distribution systems. The water conservation opportunities (WCOs) evaluated are listed in *Table 1.1*.

Fort Belvoir's water distribution system is served by the Fairfax County Water Authority. The current rate charged to the post by Fairfax County Water Authority is \$0.67/kgal or \$0.117/kliter. Fort Belvoir's sanitary sewer discharges into a sewage treatment plant which is operated by the Department of Public Works. The current rate charged to the post is \$2.14/kgal or \$0.565/kliter. *Section 2, par. 2.2.1, page 2-37* discusses in detail the baseline water and energy consumption at Fort Belvoir.

Cost estimates were prepared using MeansData for Windows Spreadsheets, Version 3.12. Life-cycle cost analyses were performed using the Life-Cycle Cost in Design (LCCID) computer program. Project descriptions and DD1391 forms were prepared for one Energy Conservation Investment Program (ECIP) projects. The total of the eight projects that were developed represents \$471.2K in annual water and energy savings and a total discounted savings of \$5.97M in the twenty year life of the projects. The simple paybacks average 2.95 years and the savings to investment (SIR) for the one ECIP project is 2.06. Seven Federal Energy Management Program (FEMP) Projects were developed. Each project is listed in *Table 1.1* with initial construction cost, energy savings, simple payback period, savings to investment ratio, and water and maintenance savings.

### 1.2 INTRODUCTION

Systems Engineering and Management Corporation (Systems/Corp) was contracted by the Baltimore District of the United States Army Corps of Engineers to perform a water conservation study of Fort Belvoir, Virginia.

#### 1.2.1 Scope of Work

1. Evaluate selected water conservation opportunities (WCOs) to determine their water savings potential and economic feasibility.

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Table 1.1  
SUMMARY OF RECOMMENDED PROJECTS

PROJECT	INITIAL COST (\$)	ENERGY SAVINGS (MWH/YR)	SIMPLE PAYBACK PERIOD (YRS)	SIR	WATER AND MAINTENANCE SAVINGS (\$)
ECIP-1: Implementation of WCO-1: Spring Loaded Faucets in Non-Family Housing Buildings	\$698,465	1,241	7.12	2.21	\$40,620
FEMP 1 Implementation of WCO-2: Faucet Aerators In Non-Family Housing Buildings	\$3,289	159	0.24	66.55	\$11,104
FEMP-2 Implementation of WCO-3: Flush Valve Retrofits for Water Closets In Non-Family Housing Buildings	\$155,072	—	8.86	1.68	\$19,592
FEMP-3: Implementation of WCO-4: Flush Valve in Retrofits for Urinals In Non-Family Housing Buildings	\$9,146	—	3.84	3.87	\$2,379
FEMP-4: Implementation of WCO-2FH: Faucet Aerators in Family Housing Buildings	\$70,632	956	0.54	27.88	\$86,518
FEMP-5: Implementation of WCO-3FH: Water Closet Retrofits in Family Housing Buildings	\$97,746		1.13	13.18	\$96,218
FEMP-6: Implementation of WCO-13: Water Efficient Equipment Upgrades	\$38,469	5,174	0.38	17.84	\$7,260
FEMP-7: Implementation of WCO-14: Repair Leaks in Water Distribution System	\$81,167		0.95	15.69	\$85,566

FORT BELVOIR WSOS SUMMARY SHEET					
PROJECT	ENERGY SAVINGS	ENERGY SAVINGS	WATER SAVINGS	WATER SAVINGS	1st YR \$ SAVINGS
	MWH/YR	MBTU/YR	L/YR	MGAL/YR	K\$
ECIP-1	1,241	4,236	116,933,579	30.89	98.11
FEMP-1	159	543	14,965,144	3.95	13.99
FEMP-2	-	-	26,404,429	6.98	19.59
FEMP-3	-	-	3,206,681	0.85	2.38
FEMP-4	956	3,263	116,604,937	30.81	131.74
FEMP-5	-	-	140,670,171	37.17	86.44
FEMP-6	5,174	17,659	32,711,430	8.64	101.38
FEMP-7	-	-	483,424,678	127.72	85.57
TOTALS	7,530	25,700	934,921,049	247.01	539.20

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2. Conduct a limited site survey of selected buildings, family housing, heating plants, cooling towers and water distribution systems to insure any methods of water conservation which are practical and have not been evaluated in any previous study have been considered and the results documented
3. Determine efficiency of existing systems. Determine the replacement options with the highest SIR.
4. Provide complete programming or implementation documentation for all recommended WCOs.
5. Prepare a comprehensive report to document the work performed, the results, and the recommendations.

### 1.2.2 Organization of the Pre-Final Report

The submitted material for this report consists of the following: Executive Summary, Methods and Approach, ECIP Project 1, FEMP Projects 1-7, all in one volume.

## 1.3 PRESENT AND HISTORICAL WATER CONSUMPTION

The baseline water and energy consumption and the water and energy conservation opportunities were evaluated using spreadsheets to calculate water and energy consumption. These have been included in *Sections 3 through 10* of this report.

The energy costs and the Fairfax County Water Authority water and sewage costs are used to calculate the savings for the project as follows:

Cost/MBtu	
Electric	= \$0.04730/KWH or \$47.30/MWH
Natural Gas	= \$5.33/MBtu or \$18.19/MWH
Cost/Kgal	
Water	= \$0.67/KGAL or \$0.177/Kliter
Sewage	= \$2.14KGAL or \$0.565/Kliter

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### 1.4 ENERGY CONSERVATION OPPORTUNITIES INVESTIGATED

Systems Corp analyzed nineteen water conservation opportunities (WCOs) at Fort Belvoir, Virginia. The analysis was performed utilizing water models developed by Systems Corp and data collected during the field survey of the facilities at Fort Belvoir. Each WCO was evaluated to determine the potential water savings, dollar savings, implementation costs, simple payback, life-cycle cost, and savings to investment ratio (SIR). The nineteen WCOs that were analyzed are as follows:

WCO-1	Spring-Loaded Faucets
WCO-2	Faucet Aerators
WCO-2FH	Faucet Aerators in Family Housing Units
WCO-3	Flush Valve Retrofits for Water Closets
WCO-3FH	Water Closet Retrofits in Family Housing Units
WCO-3AFH	Water Closet Replacement in Family Housing Units
WCO-4	Flush Valve Retrofits for Urinals
WCO-5	Water Saving Showerheads
WCO-6	Golf Course Irrigation
WCO-7	Water Efficient Appliances
WCO-8	Drinking Fountain Replacement
WCO-9	High Pressure/Hot Water/Low Volume Cleaning Tools
WCO-10	Water Source Removal in Maintenance Areas
WCO-11	Cooling Tower Automatic Blowdown/Chemical Feed
WCO-12	Boiler and Cooling Tower Chemical Treatment Improvements
WCO-13	Water Efficient Equipment Upgrades
WCO-14	Water Distribution System Leak Detection and Repair
WCO-15	Vehicle Wash Stations Centralization
WCO-16	Sensor Controlled Faucets and Flush Valves

Systems Corp's water and energy analysis models were used to determine the savings achieved for implementing each WCO in the facilities evaluated. MeansData for Windows Spreadsheets, Version 3.12 cost estimating software was used to estimate the implementation cost of each WCO in each facility evaluated. The U.S. Army Corps of Engineers' Life-Cycle Cost in Design, Version 1.0, Level 92, software was used to perform life-cycle cost analyses and determine the SIR of each WCO for each facility evaluated.



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### 1.4.1 WCOs Recommended

Systems Corp recommended WCOs evaluated to be implemented, but not in every area surveyed. The following is a list of the WCOs recommended to be implemented for selected buildings listed under each WCO. The criteria for recommendation is a favorable simple payback, and savings to investment ratio (SIR).

WCO-1	Spring-Loaded Faucets
WCO-2	Faucet Aerators
WCO-2FH	Faucet Aerators in Family Housing Units
WCO-3	Flush Valve Retrofits for Water Closets
WCO-3FH	Water Closet Retrofits in Family Housing Units
WCO-3AFH	Water Closet Replacements
WCO-4	Flush Valve Retrofits for Urinals
WCO-13	Water Efficient Equipment Upgrades
WCO-14	Water Distribution System Leak Detection and Repair

### 1.4.2 WCOs Rejected

WCO-3AFH, WCO-6, and WCO-16 were rejected due to the large investment required, the low potential savings, or the existence of a more economically feasible technology. Refer to *Appendix D* for the Life-Cycle Cost Analyses, Cost Estimates and Calculations.

### 1.4.3 ECIP and FEMP Projects Developed

Systems Corp developed one ECIP project and seven FEMP projects (See *Table 1.1*). *ECIP Project 1* consists of the replacement of the existing lavatory faucets in 189 non-family housing buildings with metering type faucets. *FEMP Project 1* consists of replacing the existing deteriorating aerators with new aerators in 106 non-family housing buildings. *FEMP Project 2* consists of retrofitting the existing water closet flush valves in 178 non-family housing buildings with new parts to reduce the volume of water per flush from 17.0 liters per flush to 13.2 liters per flush. *FEMP Project 3* consists of retrofitting the existing urinal flush valves in 33 non-family housing buildings with new parts to reduce the volume of water per use from 11.4 liters per minute to 5.7 liters per minute. *FEMP Project 4* consists of replacing the existing deteriorating aerators in 2,093 family housing units with new aerators. *ECIP Project 5* consists of replacing the flappers in the existing water

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closets in 2,093 family housing units with new early closing flappers with a savings of approximately 7.6 liters per flush (2 gallons per flush) for each water closet. *FEMP Project 6* consists of replacing 111 steam traps with new steam traps with an energy savings of 5,174 MWH/yr. and a savings of 32.0 million liters/yr. (8.64 million gallons/yr.) of water. *FEMP Project 7* consists of repairing 31 leaks in the water distribution system with a savings of 483.4 million liters/yr. (127.7 million gallons/yr.) of water.