ARMY WATER SECURITY STRATEGY

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PREFACE

This report was prepared under contract for the Army Environmental Policy Institute, by Marstel-Day, LLC. The work was performed under Contract Number: W91278-10-D-0041, TO 0004. The views expressed do not necessarily reflect the official policy or position of the Department of Defense (DoD) or the U.S. Army.

This effort builds a foundation for supporting the water security objective in the draft Army Campaign Plan and updating additional Army strategic documents where water security is likely to be included. The outcome of this effort consists of two documents; a Water Security Strategy and a Water Security Planning Findings Document. The Water Security Strategy is intended to assist the Army in identifying how water affects its ability to successfully accomplish its vital missions in support of U.S. national interests.

The project was led by Dr. Marc Kodack who was a Senior Fellow at AEPI at the start of the project and transitioned to the Office of the Deputy Assistant Secretary of the Army for Energy and Sustainability in June 2011. The project was managed by Juli MacDonald-Wimbush of Marstel-Day, LLC. The project team included Lauren Birney, Richard Engel, Paul Koch, and Sylvia Lam. Other contributors included Lee Halterman, Phil Huber, Rebecca Rubin, Erika Wettergreen, and Harry Zimmerman.

Representatives from a wide range of U.S. Army stakeholders who hold water management responsibilities contributed to the development of the water security strategy. The project team would also like to thank these stakeholders for the time, insights, and feedback that they shared with the project team to inform the strategy development process. In addition, the project team would like to recognize and thank Dr. Marc Kodack for his leadership, vision, and support throughout the project.

EXECUTIVE SUMMARY

The purpose of this effort was to:

1. provide a complete definition for Army water security;
2. conduct the first comprehensive study of water security management in the Army; and
3. identify the key issues on which Army leadership can focus to ensure that the Army has enough water of suitable quality for the foreseeable future.

This effort builds a foundation for supporting the water security objective in the draft Army Comprehensive Plan and updating additional Army strategic documents where water security is likely to be included. The outcome of this effort consists of two documents; a Water Security Strategy and a Water Security Planning Findings Document. The Water Security Strategy is intended to assist the Army in identifying how water affects its ability to successfully accomplish its vital missions in support of U.S. national interests.

The term water security has previously been used in a variety ways—often as a reference to water infrastructure protection, and elsewhere as a reference to the availability of raw water to meet anticipated demands over time. Since this strategy is intended to encompass all issues that might affect the delivery and management of water where the Army needs it, a broad definition of the term is used:

> *Army water security is the assurance that water (potable and non-potable) of suitable quality will be provided at rates sufficient to fully support the Army wherever it has, or anticipates having, a mission in the future.*

The study team implemented a seven-phase approach to develop the water security strategy and companion water security findings document. The study relied heavily on intensive research and primary data gathering through extensive consultation with subject matter experts, both in the Army and Department of Defense (DoD) and outside DoD, to identify and characterize issues to be addressed in the Water Security Strategy. The companion document presenting the findings of the study in further detail will be available through the Army Environmental Policy Institute (AEPI).

Ensuring water security across the Army enterprise will involve addressing a complex interaction of interests and concerns. There is no "one-size-fits-all approach" to water security for Army installations. The short duration of leadership assignments is not conducive to the pursuit of long-term water resources solutions. This posture has resulted in overlooking water security issues—or potential issues—where the Army is in a position to address them appropriately and thereby manage its water security risks.

Identification of future risks to off-base Army water sources and water supplies, and development of action plans to protect them are not yet identified as sustainability goals in current Army guidance. A key to managing potential risks is to have an accurate assessment of those risks. Looking beyond water conservation is important because, although increased water efficiency and conservation measures on-base can reduce the cost of supplying water and contribute to sustaining the regional water supply, those measures cannot replace water that has been contaminated or consumed by other users, or is no longer available due to changes in long-term climate patterns.

Six factors provide a conceptual framework for the types of issues/actions that require attention to achieve Army water security.

- **Sources:** The quantity and quality of natural, raw water (surface and groundwater) available to the region.
- **Supply:** The Army's entitlement and access to the raw water and means of distributing it to Army users.
- **Sustainable Practices:** Net Zero water use efficiency concepts
- **Survivability:** Treating raw water to Federal drinking water standards and preventing and recovering from water supply disruption or contamination.
- **Sponsorship:** Identification and alignment of Army water management responsibilities.
- **Stakeholders:** Constructive engagement of other regional water users.

Due to time and resource constraints, this strategy document has focused on the needs of installations; implementation of the strategy will involve adapting the goals and objectives to the mission and water requirements of the Army Materiel Command (AMC) in support of the critical functions of the Army industrial base. While the Army Reserve and the Army National Guard's (ARNG) state related functions are not part of the scope of this strategy, the water security principles developed here are recognized as being adaptable to their missions.

This Army Water Security strategy is organized under four major goals. Objectives have been identified for each of the goals. The first three goals pertain to the institutional Army (permanent installations) and the fourth goal pertains to the operational Army (expeditionary operations and contingency basing).

Goal #1. Water Resources Sustainability – Preserve Sources, Protect Rights

Objectives for protecting and preserving water sources and rights include:

- Anticipate long-term water requirements
- Anticipate long-term water requirements
- Protect water rights
- Integrate water assessments into strategic decisions
- Influence long-term water management outside the fence line.
- Coordinate, refine, and exercise emergency response plans and preparations
- Eliminate Water planning inefficiencies
- Provide comprehensive water security guidance for installations.

Goal #2 Water Resources Sustainability – Reduce Demand

Objectives for reducing demand include:

- Reduce water withdrawal and consumption rates
- Match water quality to water use
- Sustain a culture of efficiency and conservation.
- Tailor expectations to differences among installations.
- Mitigate adverse consequences of aggressive conservation.

Goal #3 Strategic Investment – Maintain Infrastructure Integrity and Security

Objectives for strategic investment include:

- Develop funding baseline
- Recapitalize: Fund SRM sufficiently to provide for water utilities recapitalization among installations whose water infrastructure assets have not been privatized.
- Anticipate costs: Anticipate the increased costs of water projects resulting from privatization and budget funds accordingly.
- Provide advance planning, contractual flexibility, and adequate staff support to implement and administer Army water privatization contract
- Provide internal/external infrastructure compatibility
- Install robust contamination risk reduction technologies.
- Assess the vulnerability of water and wastewater infrastructure to natural mishaps

Goal #4 Water Security at Contingency Bases – Increase Self-Sufficiency, Reduce Risks

Objectives for water security at contingency bases include:

- Reduce water use
- Engage partner Nations concerning water resources used by the military
- Assist host Nations with civilian water resources sustainability
- Implement Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities (DOTMLPF) solutions identified by the Army Base Camp Capability Based Assessment
- Ensure timely transition to local water sources
- Increase infrastructure adaptability
- Rebuild critical internal organic water supply capabilities
- Implement best practices and policies for distribution of water for personal hydration

ACRONYMS

AAA	Army Audit Agency
ACSIM	Assistant Chief of Staff for Installation Management
ACUB	Army Compatible Use Buffer Program
AEPI	Army Environmental Policy Institute
AEWRS	Army Energy and Water Reporting System
AIPH	Army Institute for Public Health
AMC	Army Materiel Command
AR	Army Regulation
ASA	Assistant Secretary of the Army
ASA (IE&E)	Assistant Secretary of the Army (Installations, Energy and Environment)
ASB	Army Science Board
ATFP	Anti-Terrorism Force Protection
CBA	Capability Based Assessment
CEWMP	Comprehensive Energy and Water Management Plan
CWA	Clean Water Act
CWAA	Clean Water America Alliance
DHS	Department of Homeland Security
DoD	Department of Defense
DOE	Department of Energy
DOI	Department of Interior
DOS	Department of State
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities
EIA	Energy Information Administration
ELD	Environmental Law Division
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
EUCOM	European Command
FM	Field Manual
FY	Fiscal Year
GPD	Gallons Per Day
HQ	Headquarters
IGCC	Integrated Gasification Combined-Cycle
IMCOM	Installation Management Command
ISR	Installation Status Report
IWRM	Integrated Water Resources Management
JLUS	Joint Land Use Study

M	Million
MILCON	Military Construction
MOU	Memorandum of Understanding
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
OCONUS	Outside the Continental United States
OSD	Office of the Secretary of Defense
OSJA	Office of Staff Judge Advocate
OTSJ	Office of the Surgeon General
REC	Regional Environmental Coordinator
REEO	Regional Environmental and Energy Office
SME	Subject-Matter Expert
SRM	Sustainment Restoration and Modernization
UFC	Unified Facilities Criteria
UP	Utilities Privatization
USACE	U.S. Army Corps of Engineers
USAPHC	U.S. Army Public Health Command
USAEC	U.S. Army Environmental Command
USAID	U.S. Agency for International Development
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

INTRODUCTION

PURPOSE OF STUDY

The purpose of this effort was to provide a complete definition for Army water security, conduct the first comprehensive study of water security management in the Army, and identify the key issues on which Army leadership can focus to ensure that the Army has enough water of suitable quality for the foreseeable future. This effort builds a foundation for supporting the water security objective in the draft Army Comprehensive Plan and updating additional Army strategic documents where water security is likely to be included.

The study team implemented a seven-phase approach to develop the water security strategy and companion water security findings document (See Appendix II for details). The study relied heavily on a discovery approach based on intensive research and primary data gathering through extensive consultation with subject matter experts, both in the Army and Department of Defense (DoD) and outside DoD, to identify and characterize issues to be addressed in the Water Security Strategy. A companion document presenting the findings of the study in further detail will be available through the Army Environmental Policy Institute (AEPI).

This strategy document reflects several long-term concerns, including the need to protect sources of surface water and groundwater and maintain access to them; controlling costs and risks associated with delivering fresh water to Army users; increasing regional demands on water by a variety of other users; and the ever-present uncertainties associated with weather and climate. The resulting multifaceted water security strategy is intended to assist the Army in identifying how water affects its ability to successfully accomplish its vital missions in support of U.S. national interests.

Within the framework of Army strategy stated in terms of ends, ways and means, this document emphasizes the ends (goals) and ways (objectives), recognizing that a fuller consideration of the means (resources) will involved more extended deliberation concerning implementation of the strategy in the context of other Army priorities. Due to time and resource constraints, this strategy document has focused on the needs of installations; implementation of the strategy will involve adapting the goals and objectives to the mission and water requirements of the Army Materiel Command (AMC) in support of the critical functions of the Army industrial base. While the state functions of the Army National Guard (ARNG) and Army Reserve are not part of the scope of this strategy, the water security principles developed here are recognized as being adaptable to their missions.

This document contains the water strategy's goals and objectives as well as several appendices, including a list of recommended actions (Appendix I), description of the approach and methods (Appendix II), Conceptual Framework for Achieving Water Security, (Appendix III), Overview of Stakeholders Inside and Outside of Army Enterprise (Appendix IV), Overview of Water Rights (Appendix V), and Summary of Policy Drivers for Army Sustainability (Appendix VI). A companion document presenting the findings of the study in further detail will be available through the Army Environmental Policy Institute (AEPI).

Defining Water Security

The availability of useable water is of strategic importance to all levels of the Army enterprise. Having continued access to adequate water resources and the ability to deliver treated water efficiently is obviously essential for ongoing and future Army missions. But a widely favorable water supply situation cannot be assumed. For example,

- Ongoing population growth and land development trends indicate that pressures on the regional water resources – both surface water and groundwater – that the Army relies upon will continue or increase. Army water conservation alone will not affect these external factors.
- The threat of periodic droughts and persistent climate change indicate that the amount of fresh water available today may not be available tomorrow.
- The Army's use of water has been constrained in some circumstances as a result of endangered species protection.
- Army installations may lack awareness of the status of their water rights and may inadvertently take actions that jeopardize those rights. Army policy concerning water rights has not been updated since 1996.
- Despite the significant achievements of the privatization of water infrastructure and operations for many installations, installation water managers elsewhere express serious concerns about the condition of the remaining Army-owned water infrastructure on which the Army has been relying. For Army-owned utilities awaiting Utilities Privatization (UP) evaluations, half are rated as being in failed or failing condition (Q3 or Q4).
- Water systems are vulnerable to deliberate or accidental contamination; damage to infrastructure resulting from sabotage, accidents, or natural events, including flooding; and cyber attacks. Critical services such as firefighting and healthcare may be affected. Other systems, including energy, transportation, and food supply would also be affected by a denial of water service.
- Outside the Continental United States (OCONUS) installations are especially at risk, as they must rely on the good will of the host nation and local community to continue to support the U.S. installation when providing local municipal water and local national workers.

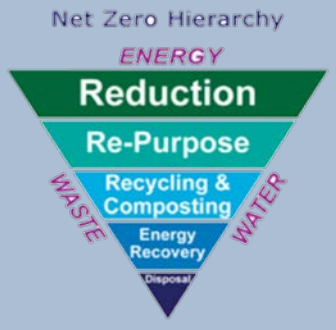
In light of the multiple concerns associated with ensuring that the Army has adequate water, this water strategy has

Net Zero Water Installations

A Net Zero Water Installation limits the consumption of freshwater resources and returns water back to the same watershed so as not to deplete the groundwater and surface water resources of that region in quantity and quality over the course of a year. A Net Zero Water Installation limits the use of potable fresh water and captures, repurposes, or recharges an amount of water equal to, or greater than, the amount of water the installation consumes. The Net Zero Water strategy balances water availability and use to ensure a sustainable water supply for years to come.

To achieve a Net Zero Water installation, efforts begin with conservation, followed by efficiency in use and improved integrity of distribution systems.

Net Zero is an approach that is a force multiplier, enabling the Army to appropriately steward available resources, manage costs, and provide our Soldiers, Families, and Civilians with a sustainable future.



Army Vision for Net Zero White Paper, July 2011

been developed to point the way forward.

The term *water security* has previously been used in a variety ways—often as a reference to water infrastructure protection, and elsewhere as a reference to the availability of raw water to meet anticipated demands over time. Since this strategy is intended to encompass all issues that might affect the delivery and management of water where the Army needs it, a broad definition of the term is used:

Army water security is the assurance that water (potable and non-potable) of suitable quality will be provided at rates sufficient to fully support the Army wherever it has, or anticipates having, a mission in the future.

The scope of concern includes both permanent installations and contingency operations. Key elements to achieve water security include:

- reducing the quantity of fresh water required to perform missions;
- improving water use efficiency;
- minimizing direct costs, including associated energy and transportation costs;
- mitigating health, occupational, and combat-related risks;
- ensuring long-term, sustainable access;
- ensuring survivability of water distribution system from sabotage, attack (including a cyber attack), natural disaster, or accidental contamination;
- minimizing adverse impacts to the environment (at home and in host nations);
- engaging other users of shared water resources to collaborate on future water resources planning; and
- reviewing water priorities in the Army supply chain.

Six factors provide a conceptual framework for the types of issues/actions that require attention to achieve Army water security.

- **Sources:** The quantity and quality of natural, raw water (surface and groundwater) available to the region.
- **Supply:** The Army's entitlement and access to the raw water and means of distributing it to Army users.
- **Sustainable Practices:** Net Zero water use efficiency concepts (see call-out box).
- **Survivability:** Treating raw water to Federal drinking water standards and preventing and recovering from water supply disruption or contamination.
- **Sponsorship:** Identification and alignment of Army water management responsibilities
- **Stakeholders:** Constructive engagement of other regional water users.

More detail on these factors is included in Appendix III.

Complexities of Water Security Management

Ensuring water security across the Army enterprise will involve addressing a complex interaction of interests and concerns. There is no "one-size-fits-all approach" to water security for Army installations. Table 1 characterizes the types of complexities that complicate water security planning and the attendant consequences for installations.

Table 1. Overview of Complexities of Water Security Planning

Complexity	Situation	Consequence
Diverse Missions	Every Army mission is different, some missions are joint, and missions change.	Rational allocation of resources among water security concerns will not simply rely on measures of water use intensity or per capita consumption, but will also consider the value of the military capabilities supported.
Diverse Leadership History Among Installations	The differences in the focus of commanders over time, and changes in the leadership at any one location have led to different results in the present. Some installations have established a tradition of thought leadership in water management and conservation.	The need for information, policy, guidance, and assistance in matters of water security varies greatly, and overall Army progress in this area would improve with wide-ranging leadership and commitments above the installation level. Practical solutions developed at one location may be of benefit at other locations
Multiple Levels and Types of Responsibilities Across the Army Enterprise	Stakeholders across the Army enterprise have responsibility for different aspects of ensuring that water of suitable quality is provided. (See Appendix IV for list of Army stakeholders.) Water security encompasses medical, technical, financial, legal, doctrinal, logistic, managerial, research and community relations concerns among fixed facilities and contingency operations. Having many disparate stakeholders reporting to different commands and bill payers weakens communications, management, and oversight of the overall water mission: Logistics, Public Health, ACSIM/IMCOM, USACE, RDT&E communities, AT/FP community.	A comprehensive approach to ensuring water security will involve coordination among Army offices with diverse and overlapping mandates. Leadership needs to encourage ongoing communication and cooperation among all stakeholders to prevent redundant effort and ensure that all stakeholders share a common goal and align their initiatives in support of that goal.
Multiple Resource Inputs to Army Missions	Water, while absolutely vital, is not the only essential resource that the Army has an interest in securing to meet mission needs.	In the context of ever-pressing funding constraints, proposed investments in water security solutions will always need to be weighed against other investment needs and opportunities.

Complexity	Situation	Consequence
Multiple Water Security Components	Water must typically be obtained from a natural water body, treated, distributed, and, following consumption, discharged. Upstream levels of land development, industrialization, and agriculture affect the quantity and quality of water running off into surface water bodies and percolating down into aquifers. Between the raw water source and consumer, the infrastructure and equipment needed for water treatment, storage, and delivery may lie both inside and outside installation boundaries. Each of these components is vulnerable to accidental and intentional compromise. Computerized control systems are vulnerable to cyber attack. For contingency bases, meeting water requirements presents more complex technical and logistics challenges. The mix of consumptive and non-consumptive uses by the Army determines the availability of water for other users downstream.	Since water security can be affected at multiple points, a robust water security strategy will need to address the vulnerabilities at each of those points. An effective monitoring, surveillance, and protection program must be developed and incorporated into the installation water security plan to protect these components and to allow early detection of problems and rapid response to identified problems. Higher levels of security must be provided for infrastructure designated as critical.
Energy Requirements for Water	Without energy, water systems do not function. From source to tap, every aspect of water collection, transference, treatment, and distribution requires pumps and other equipment that require power. The energy delivery systems may be compromised by overload, natural, accidental, and intentional events, and may be local or widespread in nature.	Robust and redundant or backup energy delivery systems must be considered to be of paramount importance in developing a water security strategy. Employing gravity to the extent possible to move water through the water system can reduce the need for energy, and should be considered when designing new systems.
Differences Among Freshwater Sources	Water sources include surface water and groundwater with different characteristics. Surface water and groundwater are connected. Water may be moved in substantial amounts across watershed boundaries. Watersheds, rivers and aquifers vary in size and water quality. Aquifers exist and different depths. Many aquifers are naturally recharged; others can only be mined for their water. Some installations depend on water infrastructure maintained outside the installation perimeter.	Evaluations of conditions only within a watershed in which an installation lies will not necessarily be sufficient as a basis for identifying factors that influence water availability at an installation. Looking upstream of an installation may lead through external infrastructure to surface water sources and groundwater sources that originate many miles away. From one installation to the next, the scale of this kind of analysis may vary substantially.

Complexity	Situation	Consequence
Geographic Variability	The geographic conditions affecting water security vary vastly among Army locations. Climate differences are well known. The quality of raw water can be variously influenced by natural chemicals, agriculture, industry, and urbanization. Regional growth rates and patterns are different from one location to the next. Legal constraints on water rights vary across the United States and internationally.	An enterprise-wide Army water security strategy must encompass diverse solutions that are tailored to the specific conditions in and around the installation or contingency base. Programmatic goals and objectives that are tailored to regional and installation-specific circumstances will assure Army of maximum benefit for dollars invested.
Vagaries of Weather and Climate	Weather will always vary naturally. The effects of climate change cannot be precisely predicted.	The consequences of Army action (or inaction) cannot be determined precisely. Addressing water security issues will necessarily require some judgment concerning the probability that adverse situations develop.
Multiple Water Users	The Army is one water user among many. The amount of raw water available from regional water sources is influenced by the behavior not only of the Army, but also of many other water users. Water is also needed to support ecosystem services.	Unilateral Army action with regard to its own water use may or may not have a significant effect on the sustainability of the supplies upon which the Army is relying. Army water conservation efforts alone will not necessarily result in substantial increases to water security.
Size and Extent of Army Water Systems	Individuals or groups who have issues with the government or the military, be they terrorists, disgruntled or former employees, angry people or students recognize that threats and actions against military facilities or personnel get great press and lots of attention, and it is comparatively easy to disrupt water systems' service.	Surveillance and vigilance, including education programs, detection equipment, and water system vulnerability assessments, need to be improved and increased to deter, delay, and respond rapidly to water system attacks of any kind.
Multiple Levels of Government Interest	States administer water rights and federal interests participate in state water rights adjudications. Army water use may involve government interests as close as the local public water utility, as broad as interstate water commissions, and as distant as host nations overseas. Host nation agreements would further involve allied/friendly governments.	Judicious interaction with other levels of government will concern resource levels, nature of Army representation, and diplomacy.
Multiple Drivers for Water Conservation	Beyond the mandates of Executive Order (EO) 13514*, conservation action may be more substantially driven by legal constraints due to legislation such as the Endangered Species Act, by applicable state water law, and by limitations on the quantity and quality of raw	A robust evaluation of the success of conservation efforts will examine more than progress toward consumption reduction goals relative to a baseline consumption rate. At any given allocation, a variety of factors will affect how much water use intensity can be

Complexity	Situation	Consequence
	water supply.	reduced from prior years.
Differences in Arrangements involving Non-Military Organizations	Water and wastewater utilities may be Army owned and operated, Army owned and privately operated, or privately owned and privately operated. External public utilities may supply all or part of the water needed.	Policies and procedures encompassing Army water and wastewater infrastructure will have implications for commercial and public organizations supplying these services.

*EO 13514 prescribes water consumption reduction goals in terms of water use per unit of building area relative to a 2007 baseline.

CHARACTERIZING WHAT IS AT STAKE: HAZARDS AND RISKS

CHARACTERIZING WATER SECURITY HAZARDS AND RISKS

Army installations and operations are subject to water-related hazards and risks. Since the terms *hazard* and *risk* are often confused, clarification has been provided. Immediately following is a discussion of the Army's posture toward these issues.

- *FM 5-19 defines a hazard as "a condition with the potential to cause injury, illness, or death of personnel; damage to or loss of equipment or property; or mission degradation."*[1]
- *Risk* refers to the combination of the probability that harm will result from a hazard and the severity of the harm resulting from it. Risks exist because of the *probability* associated with the occurrence of the adverse event and the *severity* of the impact to the system if the event occurs. Risk management involves developing controls to reduce either the probability or the severity of harm. Controls may involve modifying human behavior, hardening the system against the risk or avoiding the risk altogether. The risk of a water main breaking can be reduced by adequate maintenance (an example of hardening). The risk of depleting a groundwater source at one location can be reduced by locating a mission where water is more plentiful (an example of avoidance/elimination control).
- *Probability* is the likelihood of an event. There are natural probabilities, for example, associated with rainfall, drought, and climate change impacts. The probability of impacts from land development patterns, water use, and the regulatory climate affecting water resources governance may vary from one jurisdiction or administration to the next.
- *Severity* is expressed in terms of the degree to which an incident will affect combat power, mission capability, or readiness. The availability of an emergency water supply can reduce the severity of an installation's vulnerability to water infrastructure disruptions. Robust antiterrorism measures can reduce the severity of impact to water infrastructure from tampering attempts by increasing the systems resilience.

[1] U.S. Army. *FM 5-19 Composite Risk Assessment* (2006), 1-3.

Table 2 presents water security vulnerabilities identified during this study. These examples were collected during the interviews with stakeholders across the Army and at several installations across the country, and according to their effect along the water supply pathway.[2]

WATER-RELATED PERCEPTIONS, HAZARDS, AND RISKS: GAPS IN ARMY SUSTAINABILITY PLANNING

A key to managing risk is to have an accurate assessment of it. The tendency for some Army leaders, however—from garrison commanders up through the Secretariat level—has been to operate under the unspoken assumption that raw water will always be available in the quantities that Army activities require or that investments can always be deferred for another year. The short duration of leadership assignments is not conducive to the pursuit of long-term water resources solutions. This posture has resulted in overlooking water security issues—or potential issues—where the Army is in a position to address them appropriately and thereby manage its water security risks.

The Army's conventional water management focus, understandably, lies inside the fence line, where Anti-Terrorism Force Protection (ATFP) and essential concerns about infrastructure integrity and regulatory compliance necessarily place a high demand on scarce resources. Installations are required to maintain up-to-date Water System Vulnerability Assessments and Emergency Response Plans. Much energy has been directed to installation water conservation measures, with notable successes.

Nevertheless, *outside the fence line* significant water security issues may exist or arise that can directly affect the ability of the installation to perform its mission. Consequently, a more robust approach to water security requires situational awareness and effective action beyond the perimeter.

Identification of future risks to off-base Army water sources and water supplies, and development of action plans to protect them are not yet identified as sustainability goals in current Army guidance. This is important because, although increased water efficiency and conservation measures on-base can reduce the cost of supplying water and contribute to sustaining the regional water supply, those measures cannot replace water that has been contaminated or consumed by other users, or is no longer available due to changes in long-term climate patterns.

A lack of water availability has already begun to limit the scope of Army operations in water-short regions, and threatens to curtail Army operations in the future as regional water supplies are drawn down at unsustainable rates. Increased competition for water supplies, legal challenges to Army water uses, degradation of surface and subsurface waters, and long-term droughts will exacerbate this problem.

Army collaboration with external stakeholders is essential to protect water sources and address these water challenges. Collaborating to address mutual interests in external natural resources is not a new idea; the Army Compatible Use Buffer program (ACUB), which has been operating since 2003, creates partnerships to protect off-base habitat and prevent incompatible land uses that could affect Army readiness. However, the study team—through its literature survey and interviews with a sample of stakeholder across the Army—found little evidence of collaborative long-range water planning with state and regional officials or the Army-managed Regional Environmental and Energy Offices (REEOs) to address external water hazards and risks.

[2] The water supply pathway provides a framework for organizing the multi-faceted aspects to the water security issues. The water supply pathway covers water sources, production, distribution, use/reuse, and disposal.

Table 2. Water Security Hazards and Examples of Local Effects on the Army

Water Supply Pathway	Type of Hazard	Example of Hazard
Sources	**Water rights**	Appropriations of water for users outside Army installations may constrain access to regional water resources and, consequently, limit mission expansion in those areas.
	Water Availability	Reduction, degradation, or loss of raw water sources could force installations to reduce their operations, increase capital and operating costs for water conservation and recycling, and/or require the Army to relocate missions elsewhere.
	Climate Change	Climate change could alter or accelerate weather patterns, leaving installations unprepared for droughts and increasing competition with local communities for dwindling water resources. The increase likelihood of more severe weather events which could potentially lead to flash flooding or interruption in the collection and treatment of water.
	Water Quality	Declining water quality could require Army installations to invest in expensive water treatment systems.
	Dependency on Outside Parties	External suppliers could limit or terminate water supplied to Army installations or increase water rates with little notice. Suppliers' water security vulnerabilities extend to Army clients, but the Army has little leverage to force suppliers to improve their water security programs, particularly when these suppliers do not see a rate of return that offsets the investments they would be asked to implement.
	Water Contracting Risks	Failure of water contractors, e.g., due to bankruptcy, could leave Army installations without staff to operate water supply and wastewater treatment systems.
Water Supply Infrastructure (Treatment and Distribution)	**Infrastructure Integrity**	Deteriorated water infrastructure presents greater risk of water supply disruption as a consequence of component failure or intentional or accidental damage. Infrastructure connections with other public utilities expose installations to any vulnerability in those systems.
	Access	States are increasingly regulating and restricting the Army's access to surface and groundwater supplies as a means of protecting sensitive habitat and conserving water sources for public use, both in riparian rights states and in prior appropriation (water rights) states. Lack of participation by the Army in state planning processes may restrict its access to water supplies during droughts, and Army water rights are subject to state abandonment procedures. (For example, Maryland officials have deferred action on a Fort Meade, 2-million (M)-gallons-per-day (GPD) groundwater withdrawal request due to lack of comprehensive regional water demand forecasts.)

Water Supply Pathway	Type of Hazard	Example of Hazard
	ATFP	Keeping an aquifer free from contamination and bioterrorism at wellheads; the security of the wells is a concern, particularly if they are near an international border. Keeping surface water containment areas free from contamination due to bioterrorism; the issue of security of surface water is a concern.
	Extreme Weather and Natural Disturbances	Long-term drought conditions are drying up surface waters on base, including lakes and ponds used for training, range water sources, aquatic training, and recreation. These activities may have to be curtailed or relocated elsewhere. Flooding events may take components of the water supply system offline.
	System Redundancy	See comment for "Dependency on outside parties."
	Lack of Resources	Water privatization projects have been executed to recapitalize and modernize Army water systems. Given the Army's resource constraints, UP increases flexibility to handle potential situations that may arise, such as urgent or unplanned water projects. Infrastructure funding for systems not selected for privatization remains less secure.
Gray Water Supply Infrastructure (Production/ Distribution)	**Installation and Maintenance**	Failure to understand the physical and operational limitations on gray water systems may lead Army decision makers to overestimate their capacities and under-budget their construction and operating costs.
	Cross-Contamination	Gray water may enter the potable water supply where the systems are located in close proximity.
	System Failure	Black and gray water may contaminate drinking water distribution systems as a result of infrastructure damage resulting in leaks.
Wastewater Infrastructure (Disposal)	**Accidental Exposure of Potable Water to Wastewater**	Army personnel and dependents may be exposed to public health risks; Army may incur fines and penalties; future water projects may be delayed due to increased scrutiny by regulators.
	Conservation-Caused Discharge Chemical Issues	Highly effective water conservation efforts may result in wastewater having nitrate concentrations so high that installations may need to implement additional treatment of wastewater before it enters their waste treatment plants to ensure that the effluent meets National Pollutant Discharge Elimination system (NPDES) standards.
	Operational Issues	Systems unable to operate at design parameters due to low flow, e.g., within pump design curves
Use	**Health Issues due to**	Lack of public health personnel to inspect ice machines, water buffaloes, and range water storage facilities on recommended schedules increases waterborne illness risks to Army personnel. The level of health risk is

Water Supply Pathway	Type of Hazard	Example of Hazard
	Contamination	further affected by the degree of protection provided against accidental or intentional insertion of contaminants into water distribution systems.
	Stagnation in Water Distribution Systems	Very low flow rates in portions of the water distribution system – due to low demand resulting from water conservation, for example – may reduce residual chlorine levels and thereby increase the risk of contamination of the supply. Low flows can also result in increased chemical dosing and/or increased flushing of lines—a problem that is already evident on Army posts with vacant barracks.
	Peak Demand Charges	Peak demand charges for water use create an unfunded cost obligation that must be paid by diverting funds from other intended uses.

These hazards leave the Army with several overarching risks that will affect the Army's ability to perform its mission. Table 3 includes five major types of risks and descriptions of the potential mission impacts.

Table 3. Types of Water Security Risks Posed

Type of Risks	Description of Effect
Costs	Army installation water costs are increasing substantially, especially with aging water infrastructure. Operations and Maintenance (O&M) budgets are not keeping pace with these increases. This causes funds to be diverted from maintenance and repair projects, increasing deferred maintenance problems.
Mission Performance Degradation/Continuity	Restricted water availability due to droughts, habitat protection requirements, and competition from other users can constrain or prevent future mission growth.
Health	Testing and inspection of ice machines, water storage tanks, and water buffaloes at less than recommended intervals due to staffing constraints can increase the risk of transmitting water-borne diseases to Army troops, employees, and dependents. Lack of timely maintenance of water distribution and storage systems also can increase health risks by allowing contaminants to enter the potable water supply through cracks and deterioration of system components.
Public Relations	Army installation water requirements are not systematically shared with the general public or with state officials. This limits effective water requirements planning and can contribute to disagreements over future water use. State officials are unaware of critical Army water requirements and do not include them in drought contingency plans.

Type of Risks	Description of Effect
Inefficient Use of Scarce Resources	Uniform, Army-wide water reduction requirements can force installations that have already achieved major reductions to invest disproportionate amounts of funds to achieve further water savings. This diverts funds from projects with greater potential water savings or higher returns on investment at other installations.

Intersection with Other Resources

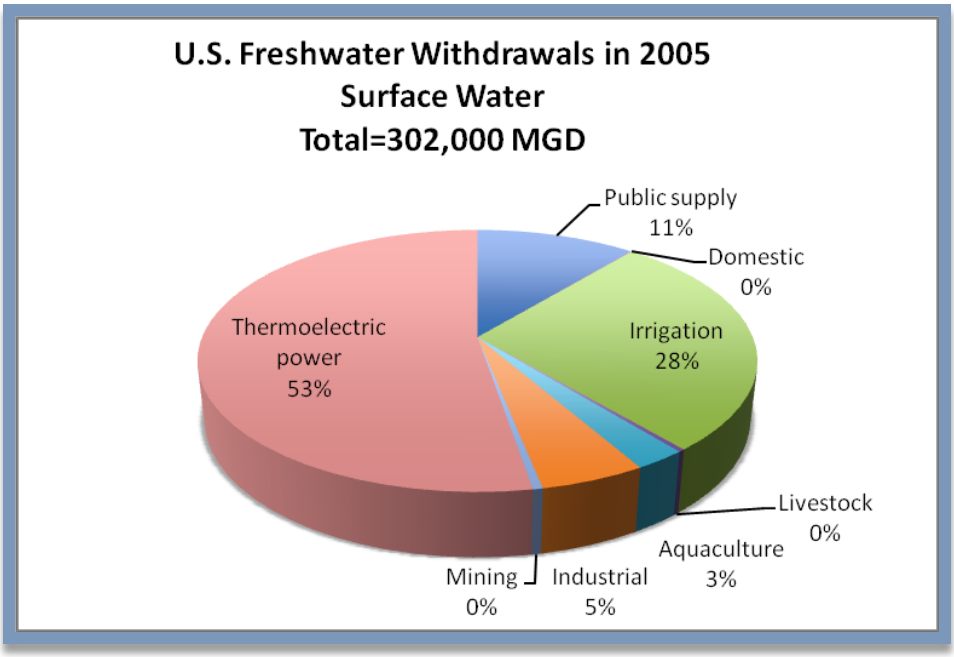
In the vicinity of Army installations, water availability and water quality will be influenced by regional water uses in other economic sectors such as energy production, agriculture, and industrial manufacturing. Different sectors rely on different sources of water. For example, most surface water is withdrawn for thermoelectric power in the energy sector; whereas most groundwater is withdrawn for irrigation in the agriculture sector. Figure 1 illustrates the distribution of water withdrawals for surface water and ground water among eight categories. On a national scale, much more surface water than groundwater is used; the total amount of fresh groundwater withdrawn is 26 percent of the total amount of fresh surface water withdrawn. From state to state, however, the ratio of groundwater withdrawals to surface water withdrawals can vary substantially.

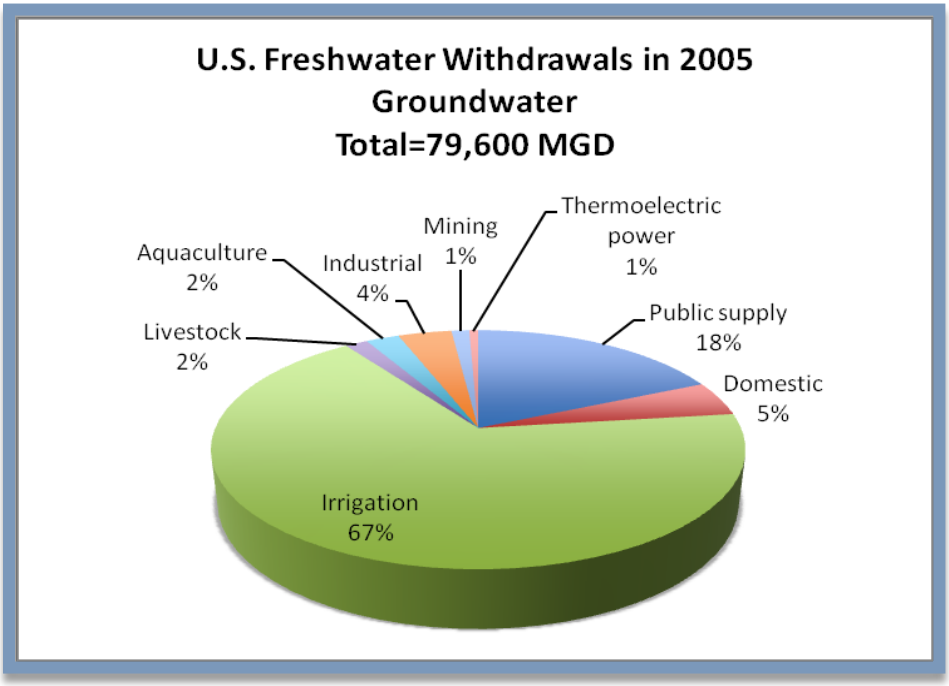
It is worth noting that withdrawal rates are not the rates at which the resource is being consumed. The net effect on regional water availability also depends on the rates of return flow, which vary among the sectors of use as well as within each sector.

Strategic Considerations

Wildlife Requirements. Although water needed to support aquatic wildlife is not included among the freshwater withdrawals presented in Figure 1, this need may nevertheless represent a significant issue for water security on Army installations. To achieve the objectives of the CWA, states establish limits on water withdrawals so that, among other things, sufficient water of adequate quality is available to maintain the ecological health of aquatic environments. The ESA constrains federal agencies from actions that would jeopardize the viability of endangered species, including species found in aquatic environments. The national interest in ensuring adequate water to support endangered species has resulted in significant constraints in water use at Fort Huachuca. A natural reduction in in-stream flows due to climate change may further aggravate competition for water between wildlife requirements and other beneficial uses.

Figure 1. Estimated U.S. Freshwater Withdrawals in 20053



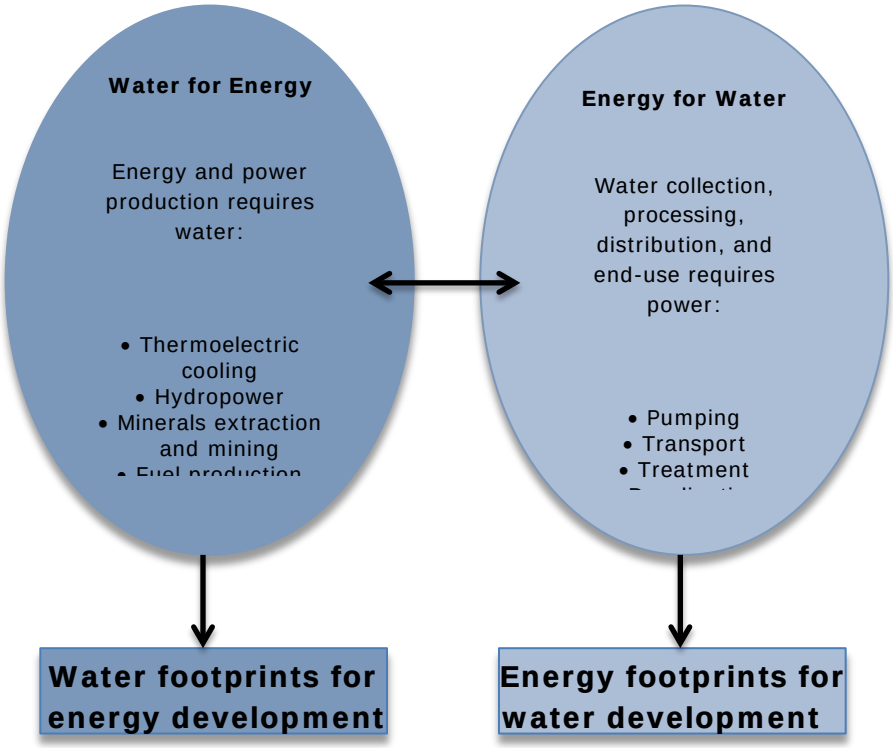


[3] United States Geological Survey (USGS), *Estimated Use of Water in the United States in 2005* (2009), 5.

ENERGY/WATER NEXUS

The use of water and energy are fundamentally linked in this way: water is needed for energy production, and energy is needed to treat and transport water (Figure 2).

Figure 2. Interlinkages between Energy and Water[4]



Energy for Water Resources Development. Energy is needed for treating, transporting, and heating water before it is used, and after the water is used energy is needed for transporting, treating, and possibly recycling wastewater. Within the water utility industry, energy accounts for 60-80 percent of water transportation and treatment costs, and 14 percent of total water utility costs.[5] Since energy use is significant part of water cost, saving water saves energy. Energy as a proportion of total cost of water resource development is significant and growing in all phases of the water supply pathway. For example:

- Energy as a percent of operating costs for drinking water systems can reach as high as 40 percent and is expected to increase 20 percent in the next 15 years due to population growth and tightening drinking water regulations.[6]
- A study conducted in California concluded that the energy consumption associated with water usage is actually greater than the energy needed for supply and treatment. Activities such as

[4] United Nations Educational, Scientific and Cultural Organization (UNESCO), *UN World Water Development Report 3: Water in a Changing World, (*2009), 117.

[5] Ibid.

[6] United States Environmental Protection, *Energy Efficiency for Water and Wastewater Utilities*, http://water.epa.gov/infrastructure/sustain/energyefficiency.cfm (accessed on December 12, 2011).

water heating and clothes washing require 14 percent of California's electricity consumption and 31 percent of its natural gas consumption.[7]

- Energy costs represent approximately 28 percent of wastewater costs.[8]

Water for Energy Development. Because water is needed for electric energy generation, projected increases in energy demands indicate that water demands associated with electric power will likewise increase. The Energy Information Administration (EIA), a unit of the Department of Energy (DOE), forecast a nearly 50 percent increase in the demand for electricity between 2005 and 2030. A portion of the demand will be met with wind power and solar photovoltaics, which use virtually no water. But most of the rest of the demand will be met with new thermoelectric plants.[9]

Because the amount of water used in electric energy generation varies across a wide range of technologies (Table 4), the effect of new energy development on regional water resources will likewise vary depending on the types of energy production technologies that are brought on line. The choice of cooling systems used in new energy facilities will also make a significant difference, because some systems are much more efficient than others in their use of water.[10]

Table 4. Water Intensity of Electricity Generation by Fuel Source and Generation Technology[11]

Generation Technology	Wet Cooling Water Consumption (gal/MWh)	Other Water Consumption (gal/MWh)
Solar Trough	760-920	8
Solar Tower	750	8
Photovoltaic Solar	0	5
Wind	0	0
Fossil	300-480	35-104
Biomass	300-480	Highly variable, depending on whether biomass is irrigated
Nuclear	400-720	75-180
Geothermal	1400	N/A
Natural Gas Combined Cycle	180	18-21
Coal Integrated Gasification Combined-Cycle (IGCC)	200	140
Hydroelectric		Highly variable, avg. 4,500 due to evaporation

Hydroelectric power generation can be directly affected by water availability because it requires that specified water levels be adequately maintained in the reservoirs behind the dams that have been built to

[7] United States Department of Energy (DOE), *Energy Demands on Water Resources: Report to Congress on the Interdependency of Energy and Water* (2006), 26.

[8] McGuire Environmental Consultants, *Water and Wastewater Industry Energy* Efficiency*: A Research Roadmap*, sponsored by California Energy Commission and American Water Works Association Research Foundation (2003), 16.

[9] United States Department of Energy (DOE), *Energy Demands on Water Resources: Report to Congress on the Interdependency of Energy and Water* (2006), 24.

[10] Sandia National Laboratories, *Overview of Energy-Water Interdependencies and the Emerging Energy Demands on Water Resources* (2007), 7.

[11] Office of Senator Jon Kyl, *Deploying Solar Power in the State of Arizona: A Brief Overview of the Solar Water Nexus - May 2010* (2010), 7.

provide electrical power. The consequences of inadequate water for hydropower are already being felt in the United States. Behind Hoover Dam, for example, Lake Mead has not been full in over 10 years,[12] and in 2010, the decline of Lake Mead reduced the peak capacity of its turbines from 130 megawatts to 100 megawatts.

Alternative Transportation Fuels. The production of alternative transportation fuels from biomass may also have a significant effect on regional water demand. "[V]irtually every alternative transportation fuel being considered will require more water than current petroleum refining. A major national scale-up of production capacity and use of nonconventional alternative transportation fuels to meet future domestic fuel demands could significantly increase water demands and effects."[13]

Water Quality Impacts. The development of resources may also have an effect on the quality of the natural waters on which the Army depends. In brief:

- Agricultural runoff may contain sediment, pesticides, herbicides, and fertilizers. The Environmental Protection Agency (EPA) has declared that "agriculture is the leading source of impairment in the Nation's rivers and lakes."[14]
- Fossil fuel extraction, transportation, storage and processing can each affect water quality if adequate measures are not taken to guard against the release of chemicals into the environment.[15] Extraction of natural gas by hydraulic fracturing (or "fracking") is a particular concern, not only because of the chemicals included in the mixture that is injected into natural rock,[16] but also because of the risk of natural gas's contaminating aquifers that provide potable water.[17]
- Independent of their fuel source, thermoelectric power plants may discharge waters warm enough to diminish water quality in receiving waters.[18]

WATER/LAND NEXUS

Army water security will continue to be influenced by how land is developed both upstream of Army installations that depend on surface water and above the aquifers that Army installations depend upon for groundwater. Since land development covers open ground with structures and pavement, it generally causes floods to be higher and aquifer recharge rates to be lower. Lower recharge rates, in turn, not only

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[12] United States Army Corps of Engineers (USACE), Engineer Research and Development Center (ERDC), Construction Engineering Research Laboratory (CERL), *Technical Report 11-5 Water Sustainability Assessment for Ten Army Installations* (2011), 8.

[13] Sandia National Laboratories, *Overview of Energy-Water Interdependencies and the Emerging Energy Demands on Water Resources* (2007), 15.

[14] United Nations Food and Agriculture Organization (FAO), *Control of Water Pollution from Agriculture* (1996), http://www.fao.org/docrep/W2598E/w2598e04.htm#chapter 1: introduction to agricultural water pollution (accessed 18 July 2011).

[15] United States Department of Energy (DOE), *Energy Demands on Water Resources: Report to Congress on the Interdependency of Energy and Water*, 2006, 23.

[16] J. D. Arthur,."Hydraulic Fracturing Considerations for Natural Gas Wells of the Marcellus Shale," *Ground Water Protection Council Annual Forum*, Cincinnati, 2008.

[17] S. G. Osburn,. "Methane Contamination of Drinking Water Accompanying Gas-Well Drilling and Hydraulic Fracturing," *Proceedings of the National Academy of Sciences*, 2011.

[18] United States Department of Energy (DOE), *Energy Demands on Water Resources: Report to Congress on the Interdependency of Energy and Water*, 2006, 17.

reduce the sustainability of groundwater resources, but diminish the availability of water in rivers and streams between storm events. Green infrastructure, a term that refers to the intentional preservation and planting of vegetation along tracts of land in an otherwise developed region, helps reduce the effect of land development on water quality and quantity.

CONCLUSION

Because of the intersection of water with other resources, the Army's water interests can be served by influencing the development and use of those resources. Regional economic activities in several areas—particularly energy production, agricultural practices, and land development—can influence the quantity and quality of water available to the Army. Consequently, it is in the Army's interest to promote a selection of alternatives in each area that best protects regional water resources.

ARMY WATER SECURITY STRATEGY

INTRODUCTION

This Army Water Security strategy is organized under four major goals. Three of the goals pertain to the institutional Army (permanent installations):

1. Water Resources Sustainability – Preserve Sources, Protect Rights
2. Water Resources Sustainability – Reduce Demand
3. Strategic Investment – Maintain Infrastructure Integrity and Security

The fourth goal pertains to the operational Army (expeditionary operations and contingency basing):

4. Water Security at Contingency Bases – Increase Self-Sufficiency, Reduce Risks

This section describes the objectives associated with each goal and concludes with crosscutting recommendations for Army leadership. A brief rationale is provided for each goal and objective. Recommended actions for each objective are compiled in a matrix provided in Appendix I.

GOAL #1: WATER RESOURCES SUSTAINABILITY– PROTECT AND PRESERVE SOURCES AND RIGHTS

Regional population growth and land development reduce the quantity of raw water available and increase the competition for it, increase the variability in surface water flows, decrease water quality, and decrease groundwater recharge rates. These consequences present a threat to the availability of water to support current and future Army mission requirements, and may increase Army water treatment costs. Long-term droughts, extreme weather events, and variations in precipitation patterns can exacerbate these problems. Further, legal and administrative challenges to Army water rights highlight the importance of developing strategies and allocating personnel resources to protecting these rights.

Objectives for protecting and preserving water sources and rights include:

1.1 Anticipate Long-Term Water Requirements. Maintain up-to-date assessments of an installation's current and projected water needs in the context of regional water availability. Verify in advance that adequate water resources are available for future mission requirements as part of the real property master planning process and as part of the basing decision process for new or realigned functions.

- *Sustain support for use of water demand forecast tools.* Since computer technologies are constantly changing and methods evolving, sustained support is necessary to ensure that software tools are adequately maintained and modified over time. This action will involve evaluating the cost effectiveness of alternative approaches, from simple rules of thumb, such as 150-gallon per day (GPD)/person estimate, to more complex forecast tools such as the Installation Water Resource Analysis and Planning System (which has not been updated in recent years), and the more recent methods reported in U. S. Army Corps of Engineers (USACE) Public Works

Technical Bulletin 200-1-85. Tools for assessment of regional water situations, such as the Water Evaluation and Planning system, should also be explored.

- *Develop a long-term forecast period for water requirements at each installation that includes a regional water supply and demand analysis.* A water demand forecast based on a number of conceivable scenarios provides a useful basis for discussing risks and the consequences of future action taken by the Army as well as other regional water users.
- *Designate a cycle or set of triggers for revising installation and regional forecasts.* Include the requirement to perform long-term water forecasting and water supply sustainability assessments for Army installations as integral components of the Army Energy Security Implementation Strategy (AESIS), the Army Sustainability Campaign Plan (ASCP) for Installations and in future installation Comprehensive Energy and Water Management Plans (CEWMPs). Diligence in refreshing forecasts will not only ensure that recent information is available to decision makers, but also provide valuable periodic feedback concerning the forecast method.

1.2 Protect Water Rights. Develop a proactive policy to identify and protect Army water rights nationwide.

Legal concerns pertaining to water rights encompass a variety of complex issues, including water rights associated with federal lands reserved out of the public domain, water rights associated with land transactions, benefits and consequences of participating in state permitting programs, and opportunities for banking and monetizing water rights. Issues are further complicated by the differences in water law among the states. (See Appendix IV) Given that the frequency and intensity of water rights issues will likely increase in the foreseeable future, Army water security will benefit from substantial diligence concerning the management of water rights among all Army installations.

1.3 Integrate Water Assessments into Strategic Decisions. Evaluate water resource requirements and effects early in all strategic planning actions, including base closure and realignment actions and designs, program basing, renewable energy siting, and procurement and acquisition decisions.

The availability of ample water resources can no longer be assumed. An early assessment of the availability of water to support each of several alternative courses of action being considered will shed light on any water security concerns that may affect the cost and consequences associated with each option. Water availability is best evaluated ahead of basing decisions and the associated NEPA processes. The time frame for Military Construction (MILCON) decisions is too slow to adapt to changing water needs and constraints. The requirements of large amounts of water for cooling data centers makes this issue more critical as the Army's needs for cyber infrastructure increase.

- *Use water footprints analysis to make resource and mission decisions for different types of installation activity.* Based on known measures, including recent metering, establish reasonable ranges of water use for different missions and specialized sectors, such as renewable energy projects.
- *Amend Army facilities management and real property planning guidance.* Include mission-based water planning requirements and community participation in water source protection and water supply planning activities [e.g., similar to the Joint Land Use Study (JLUS) process]

- *Assess and track embedded water* risks for critical items in the Army supply chain. This requires: compiling a master list of all the Army's suppliers, determining which supplies are critical; where criticality is based on the importance of what a supplier produces to a final product or service that cannot be obtained by any other suppliers; ranking all the critical supplies against one another with respect to the amount of risk of these suppliers' not being able to produce their product or service; using geo-spatial tools to physically locate the manufacturing location of each critical supplier; and then determining what the current and future water availability is for that supplier. Alternatively, suppliers of critical equipment could be required to report on the sustainability of the water supplies on which they to support their processing as a contract requirement. The supply chain contains an unassessed amount of risk that cannot be determined and addressed in the absence of such data and analysis.

1.4 Influence Long-Term Water Management outside the Fence Line. Proactively and systematically engage public and private external stakeholders who have a role in the protection, use, and long-term availability of water in the watersheds and aquifers on which the Army installations depend. Participate in water planning activities conducted by external water stakeholders.

Population growth, the establishment of in-stream flow requirements for wildlife, and the effect of land development on regional hydrology can influence the long-term availability of water for the Army. Consequently, the Army will benefit from proactive engagement that provides (1) situational awareness of trends that may affect regional water resources; (2) opportunities to make the Army's water resources interests better known and work collaboratively to address water issues that affect all the communities relying on a shared water source; and (3) occasions for exploring applications of the Army Compatible Use Buffer (ACUB) program to expand relationships with conservation and public sector organizations to protect water sources on an ecosystem scale.

1.5 Coordinate, Refine, and Exercise Emergency Response Plans and Preparations. Ensure robust planning and preparation for extreme events and supply disruptions that may affect water availability. Investigate feasibility of creating back-up wells, expanding storage, strategies for sourcing, pre-placement and rotation of contingency drinking water drinking and material stockpiles and establishing procurement relationships with other sources that can be activated in times of acute shortage. Review and update installation and community Water System Emergency Response Plans (WSERP) and installation contingency water rationing plans.

Only a few states have established priorities concerning defense requirements for water during times of drought. (This study found that Utah and Hawaii have done so.) Among local communities, Emergency Response Plans that address disruptions to water supply are not necessarily updated regularly with sufficiently detailed community information. Even where long-term water availability of water is adequate, short-term disruptions may constrain Army activity. The feasibility of implementing water contingency operations plans under actual emergency scenarios should be clear. Privatization contracts should provide contractual flexibility to make facility adjustments and investments in a timely manner in an emergency or contingency response situation.

1.6 Eliminate Water Planning Inefficiencies. Consolidate water planning information requirements and incorporate water planning into installation master plans (e.g., area development plans).

In a Lean Six Sigma study, the U.S. Army Environmental Command (USAEC) found that a number of plans that are required from Army installations and pertain to water management contain redundant requests for information, and the guidance provided for producing the plans is not very detailed.[19] Consequently, among the plans developed by different contractors at different times, the information provided is inconsistent.

1.7 Provide Comprehensive Water Security Guidance for Installations. Ensure that installations have up-to-date guidance for ongoing implementation of a comprehensive approach to sustainable water resources planning and management.

Army water security guidance materials should include sections focused on water rights protection, water security responsibilities for garrison command and staff, stakeholder engagement considerations regarding water, water demand forecast methods, investment priorities and water management support resources within the Army, Department of Defense (DoD), and other branches of government. The USACE approach to Integrated Water Resources Management (IWRM) can be further adapted to this end.[20]

[19] Briefing materials provided by USAEC encompassed 65 plans, including 12 related to drinking water alone. A full list of the plans evaluated is provided with further discussion in the Findings Document provided as a companion to this strategy.

[20] U.S. Army Corps of Engineers, *National Report: Responding to National Water Resources Challenges* (2010), 27-31.

GOAL #2: WATER RESOURCES SUSTAINABILITY – REDUCE DEMAND

Water conservation is a recurring emphasis among policy drivers pertaining to Army sustainability over the past several years. (See Appendix V) Pursuing opportunities to manage demand should continue as a key water security goal and it will be of particular importance where unilateral Army water management decisions can have a major influence on the sustainability of the Army's water supply.

Objectives for reducing demand include:

2.1 Reduce Water Withdrawal and Consumption Rates. Minimize the net effect of Army water use on local water resources.

By minimizing the amount of fresh water that it withdraws, the Army will limit its effect on regional surface water and ground water resources. It will also reduce the costs associated with water treatment, storage, distribution, and heating; and wastewater collection and treatment. By setting the standard for conservation and responsible water use, Army installations can serve as a model for surrounding communities to follow their lead in preserving and protecting shared water sources. The Army's Net Zero Water program will help to reduce water use, increase installation security, and increase the Army's sustainability of regional water sources of supply.

2.2 Match Water Quality to Water Use. Where feasible, replace potable water with lower quality rain water, groundwater, or gray water.

Given the expense of treating water to meet fresh water standards, those costs can be saved where fresh water can be replaced by alternative sources for such uses as irrigation and toilet flushing. Some water security advantages, such as the use of gray water and treated wastewater, however, will come at the cost of constructing and maintaining dual systems, which may not be affordable or feasible to operate in some locations.

2.3 Sustain a Culture of Efficiency and Conservation. Establish water efficiency and conservation as continuously reinforced standard operating procedures.

The Army's success in using water efficiently will be influenced by the choices made by individuals at all levels across the organization. Perpetuating an awareness of the importance of using water efficiently will encourage choices that collectively make a difference in how water is used across the enterprise. Sustaining a culture of efficiency and conservation will encourage the adoption of building standards, best management practices, procurement decisions, training practices, and individual behaviors that result in water savings. Where possible, programs that highlight and return benefits of efficiencies at the points of consumption and apply negative consequences of waste at the points of waste generation should be instituted as incentives to advance beyond awareness to higher levels of unit and individual commitment.

2.4 Tailor Expectations to Differences Among Installations. Adapt water conservation targets and conservation strategies among installations to recognize variations in geographic settings and in water consumption reductions already achieved.

The Executive Order (EO) 13514 water use intensity targets, for example, use a 2007 baseline. Using a 2007 baseline for setting individual installation goals in CEWMPs creates challenges for installations whose 2007 water use intensity was already low because of sizable deployments that year, or water

consumption reductions already achieved. An additional enterprise-wide approach to achieving water conservation targets will identify where the greatest additional decreases in water use intensity can be achieved among all facilities. A higher percentage reduction in consumption since 2007 would be reasonably expected from installations where the greater potentials for reduction still exist. Using water-use-per-person versus the current reliance on building square footage to calculate water intensity is an alternative method that should be seriously considered.

2.5 Mitigate Adverse Consequences of Aggressive Conservation. Adapt infrastructure design and operation to ensure that substantially reduced flows do not pose health hazards.

Since chlorine levels in treated water diminish over time, low flow rates in water distribution systems can result in increased health risk at points of consumption. Low flow rates in pipes that carry wastewater can result in insufficient movement of waste through the system and high concentrations of bio-solids/bio-liquids and contaminants. High concentrations of waste material may diminish the effectiveness of treatment plant operations, resulting in National Pollutant Discharge Elimination System (NPDES) violations.

GOAL #3: STRATEGIC INVESTMENT – IMPROVE AND MAINTAIN INFRASTRUCTURE INTEGRITY AND SECURITY

Army installations across the country work to ensure the integrity of the water and wastewater systems to ensure an uninterrupted water supply and comply with applicable health standards and environmental regulations. However, water security requires robust funding to ensure that systems do not deteriorate or become obsolete. With the annual Sustainment Restoration and Modernization (SRM) and Military Construction (MILCON) funding routinely at only approximately 80 percent of the amount required to fully revitalize these utilities, there is a systematic underfunding of the Army-owned water and wastewater systems.

> Based on an FY09 analysis of Army Installation Status Report (ISR) quality ratings, 50 percent of the Army utility systems pending Utility Privatization evaluations – electric, water, wastewater, and natural gas – are severely deteriorated or failing.

Utilities privatization (UP) projects, where implemented, have largely been successful in recapitalizing and upgrading Army water systems. UP provides a stabilized utility rate platform by amortization of project costs and the accumulation of Repair and Restoration (R&R) reinvestment funds. As of July 2011, 32 water and 34 wastewater systems had been privatized.[21] The Army Energy and Water Campaign Plan cites UP as the Army's preferred strategy for upgrading identified deficiencies in existing utility infrastructure. The Army UP Program was reviewed and reauthorized on 28 Jan 2011 by the 3-star Budget, Requirements, and Programs Board and was subsequently validated for funding.

Privatizing infrastructure assets has raised questions about how to ensure that those assets are protected from accidents and malicious tampering. Relying on connections to external utilities exposes the installation to the vulnerabilities associated with those utilities and introduces concerns about how an installation will function in a situation that requires it to be self-sufficient for an extended length of time.

Army research and development (R&D) has a significant ongoing role ensuring that the Army uses the most efficient and effective water infrastructure technology. In November 2011, the US Army Engineering Research and Development Center (ERDC) Construction Engineering Research Laboratory (CERL) convened an "Integrated Water Security Summit" to examine critical issues in water infrastructure security. R&D in the areas of contaminant sensing, control systems, water purification, and water quality analysis results in tools, techniques and internal knowledge specifically suited to Army water security concerns.

Objectives for strategic investment include:

3.1 Develop Funding Baseline: Develop a baseline of all water system funding requirements for retained and privatized water systems.

A baseline of funding requirements will indicate where the greatest water security needs and risks are, not only in terms of infrastructure condition, but also in terms of the criticality of the missions that the infrastructure supports.

[21] https://secureweb2.hqda.pentagon.mil/VDAS_ArmyPostureStatement/2011/information_papers/PostedDocument.asp?id=130.

3.2 Recapitalize: Fund SRM sufficiently to provide for water utilities recapitalization among installations whose water infrastructure assets have not been privatized.

Chronic underfunding of Army-owned infrastructure perpetuates inefficiencies that exacerbate the scarcity of funds and introduces unnecessary risks to Army missions. Funding with a long-term view of costs and benefits will reduce waste and mitigate risk of failure of infrastructure components.

3.3 Anticipate Costs: Anticipate the increased costs of water projects resulting from privatization and budget funds accordingly.

Under privatization contracts, addressing years of previously deferred infrastructure maintenance can result in substantial increases in the cost of water.

3.4 Provide Advance Planning, Contractual Flexibility, and Adequate Staff Support to Implement and Administer Army Water Privatization Contracts: Ensure that all Army water privatization contracts include advance planning to identify and prioritize initial water system improvement projects and to accommodate future increases in installation missions and water consumption. Further ensure that all contracts grant access to the entire water system to Army ATFP and Public Health officials to inspect the entire water system, review operational logs and laboratory procedures, collect and test water samples, ensure compliance with the National Primary Drinking Water Regulations, and make recommendations where improvements are noted to be needed. Provide contractual flexibility to accommodate unforeseen capital improvement costs, to amortize them in water rates, and to redesign or reschedule water system repair and replacement projects to minimize the cost and time they require. Ensure that contractual language is perfectly clear concerning responsibilities for water infrastructure security. Security concerns should include how well a contractor will respond to crisis situation and the degree to which installations have the flexibility and means to operate self-sufficiently, and for how long.

The period of performance for privatization contracts may extend over several decades. Including planning services in these contracts, providing contractual flexibility, and maintaining robust staff support will help ensure that long-term privatization commitments deliver the greatest value to the Army and ensure the greatest level of security.

3.5 Provide Internal/External Infrastructure Compatibility: Ensure that Army installation infrastructure and external, privately owned infrastructure function together with a high degree of effectiveness and efficiency.

Water and wastewater systems that were designed to serve separate communities face different performance requirements when they are expected to function together. Resolving these differences will increase operational efficiency and security.

3.6 Install Robust Contamination Risk Reduction Technologies. Upgrade Army installation infrastructure with appropriate USACERL Water Integrated Security Program (WISP) Off-The-Shelf Technologies.

The American Water Works Association, the USEPA, and the Department of Homeland Security (DHS) concluded that water supplies contained within critical infrastructure pipelines are vulnerable to deliberate and accidental contamination. The economic cost of deliberate contamination can quickly rise to $26 billion for an attack on a community of about 10,000 people (comparable to the size of a military

installation.)[22] These figures do not include costs associate with risk to mission. Cities have begun investing in contaminant sensing technologies for their own systems.

3.7 Assess the Vulnerability of Water and Wastewater Infrastructure to Natural Mishaps

The Installation Status Report – Infrastructure component (ISR-I) does not include an assessment of the vulnerability of water and wastewater infrastructure to natural mishaps. Flooding events in particular may disrupt the function of pumping stations and treatment plants. Climate change is widely expected to increase the severity of flooding inland and result in sea level rise along coastlines. EPA Climate Ready Water Utilities initiative offers tools that may be adapted to the assessment of flood risk.

[22] Porco, John W. "Municipal Water Distribution System Security Study: Recommendations for Science and Technology Investments. "American Water Works Association Journal; April, 2010; pp 30-32.

Goal #4: Water Security at Contingency Bases – Increase

Self-Sufficiency, Reduce Risks

Ensuring a secure water supply for expeditionary operations involves consideration of multiple water needs. Basic water consumption requirements identified in JP4-03 are (with asterisks indicating a need for potable water):

- Drinking*
- Heat Treatment
- Personal Hygiene*
- Food Preparation*
- Laundering
- Centralized Hygiene*
- Force Provider

Additional water requirements identified by JP4-03 are:

- Hospitals*
- Nuclear, Biological, and Chemical Decontamination*
- Vehicle Maintenance
- Mortuary Affairs
- Engineer Construction
- Aircraft Washing
- Tactical Ice Plant
- Refugee and Enemy Prisoner of War Camps*
- Firefighting

Water security solutions inevitably involve tradeoffs among multiple objectives (see text box). The overarching concern is the sustainment of Army operations, and water security is one component of that concern.

Currently, about 20 percent of the load carried by supply convoys in theaters of operation is drinking water. The transportation of this water involves direct costs, personnel hazards, heavy fuel consumption, use of scarce cargo space, and—for plastic bottles—solid waste. Although Soldiers have, for some time, shown a preference for the convenience and taste of water shipped in plastic bottles, the ideal solution is to draw, treat, and package locally available water close to the point of consumption. Having a well inside

the base perimeter and minimizing freshwater withdrawals in favor of reuse substantially reduce cost, security and logistical concerns.

Water resource needs can change substantially over time. Consequently, a key challenge in selecting and developing water supply solutions for contingency operations is uncertainty in the size and duration of the Army presence.

Objectives for water security at contingency bases include:

4.1 Reduce Water Use. Practice Low Impact Operations, using as little water as possible in order to minimize the effect of the Army's presence on local water supplies. Transfer best practices gathered from the Net Zero water initiative to contingency basing operations.

Increasing water efficiency and conservation is advantageous not only in arid climates, but would deliver benefits wherever the Army operates.

4.2 Engage Partner Nations Concerning Water Resources Used by the Military. In support of Combatant Commander's plans, cooperate on sharing best practices and appropriate technologies to increase the resiliency of water management on U.S. contingency bases as well as the management of Partner Nation infrastructure.

For example, since Paraguay is a water-stressed country, a military-to-military effort focused on well drilling skills would help both militaries train in this critical skill set, tap water resources that could support military operations (particularly humanitarian assistance/disaster relief), and possibly improve the water supply infrastructure that would benefit local populations. (Initiatives in this area will need to be coordinated with a fiscal attorney to ensure that the Army can use funds for this purpose.)

Enhancing resiliency of water management systems in theater should include evaluating technologies that are already in by Partner Nations in theater. For example, German forces are using conex-based water and wastewater treatment systems in Afghanistan. Adopting proven technologies used by

Competing Water Security Objectives for Expeditionary Operations

Warfighter Needs

- Provide fully for all water consumption requirements identified in JP4-03.
- As a priority, maximize wholesomeness and palatability of water used for personal hydration.

Transportation and Storage

- Minimize potential for supply disruption.
- Minimize volume and duration of water storage.
- Minimize financial costs.
- Minimize risks to transportation personnel.
- Minimize use of cargo space.
- Minimize fuel consumption.
- Minimize opportunities for tampering.
- Minimize risk of accidental contamination.

Local Source Water Utilization

- Minimize source water detection time.
- Minimize water testing time.
- Minimize distance and handling between source and consumer.

Host Nation Relationship

- Minimize solid waste generation.
- Minimize reductions to water resource availability for host nation communities.
- Maximize generation of goodwill through water resources development.
- Minimize environmental effect of wastewater disposal.

Equipment

- Maximize ease of equipment assembly, operation, and maintenance.
- Maximize equipment operator skill.
- Maximize equipment durability.
- Maximize equipment portability.
- Minimize exposure of high-value resources to hostilities.
- Maximize effectiveness of treatment for widest array of potential contaminants.
- Minimize energy consumption.
- Minimize time required for testing treated water.
- Minimize time and effort needed for the development and delivery of new solutions.

Infrastructure Planning and Design

- Maximize suitability of water security solutions selected for each situation.
- Minimize administrative complexity and overhead.
- Minimize costs and level of effort associated with modifications of water systems as needs change.

others in U.S. contingency bases could reduce costs and increase interoperability of systems if necessary.

4.3 Assist Host Nations with Civilian Water Resources Sustainability. Improve local water resources in support of Combatant Commander's plans and in coordination with local stakeholders and other U.S. Federal agencies [e.g., Department of State (DOS), U.S. Agency for International Development (USAID), and USACE].

Although the Army and other Services seek to avoid interfering with host nation water sources by drilling into deep aquifers, they may also have opportunities to have a positive effect on local water sources. This can occur through the development of water management systems that help recharge aquifers, such as building reservoirs that capture storm runoff. By building infrastructure that helps improve the sustainability of the water supply for the local population, the Army, and particularly USAID and USACE, could help create good will among the local communities and partner nations. Undertaking these kinds of efforts through military-to-military cooperation could further enhance the benefit. Systematic coordination with other U.S. government agencies—DOS, USAID, and USACE—will increase the effect of U.S. water resource projects and reduce the number overlapping or competing projects in a Host Nation. The USACE maintains ongoing efforts to provide technical assistance for infrastructure development. (Initiatives in this area will need to be coordinated with a fiscal attorney to ensure that the Army can use funds for this purpose.) Efforts could include conducting studies, where appropriate, in addition to construction projects. The USACE development of Kandahar water supply master plan, for example includes water supply (groundwater) and water distribution modeling.

4.4 Implement Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities (DOTMLPF) solutions identified by the Army Base Camp Capability Based Assessment. Address the current trend towards distributed water operations (DWO), where small commercial off the shelf (COTS) water treatment units are purchased to support small unit operations for periods of days to weeks out of reach of practical resupply of water from a forward operating base (FOB). Issues include determining the water production rate and level of treatment required as well as testing and evaluation of the commercial-off-the-shelf (COTS) units by the Army Test and Evaluation Command (ATEC), getting a safety release for them, and having the Army Institute of Public Health perform a health risk assessment of the COTS units. Further, doctrine and policy need to be developed concerning who will operate the COTS units, the training required for non-MOS qualified operators to operate them, and to establish water quality monitoring and Public Health/Preventive Medicine oversight requirements, and who will provide that oversight.

The Base Camp Capabilities-Based Assessment (CBA), begun in 2008, examined base camp management and identified actions that would achieve improvements in a number of areas, including water supply management. Over 50 solutions that improve efficiencies in water security-related areas were identified. Furthermore, as this strategy was being prepared, a Sustainment CBA launched in 2010 has produced a draft list of water security solutions. These two CBAs collectively identify a multifaceted way forward that has been vetted and approved by the Army Capability Integration Center. (See References for a complete list of the CBA reference documents.)

4.5 Ensure Timely Transition to Local Water Sources. Reduce transportation of bottled and bulk water.

Transitioning quickly to water supply systems that safely draw water from local water resources and deliver a wholesome and palatable product will eliminate the costs and risks otherwise associated with

transporting water. Key to the effectiveness of this transition is weighing the availability of water as an important siting factor for contingency bases.

4.6 Increase Infrastructure Adaptability. Plan for alternative scenarios of water and wastewater infrastructure development over the life cycle of contingency bases.

A major challenge for water infrastructure development is the uncertainties associated with the size and duration of the Army presence. Planning that results in flexible designs and positioning of assets for several conceivable scenarios will ease infrastructure transitions and reduce waste as situations change.

4.7 Rebuild Critical Internal Organic Water Supply Capabilities. These capabilities should include deep well drilling and construction, master planning, and infrastructure management.

Due to a loss of internal technical capabilities, overreliance on contractors in a deployment environment has emerged as a significant concern. Joint operations further increase the challenges of managing contingency bases effectively.

4.8 Implement Best Practices and Policies for Distribution of Water for Personal Hydration. Ensure the most cost-effective modes of distribution and prepare the warfighter for using them.

Bottled water is a convenient means of personal hydration that has become familiar and popular in Army operations over the past two decades. But the costs, risks to transportation personnel, and packaging waste associated with providing bottled water exclusively over extended periods argue for greater use of alternative means of personal hydration. Articulating the alternatives and providing sufficient guidance to ensure that they can be used effectively and consistently will increase the likelihood that optimal solutions will be selected in theater.

WATER SECURITY LEADERSHIP

An effective Army water security program requires a comprehensive strategy that covers all phases of the water supply pathway, describes the risks and challenges associated with them, and identifies the Army leadership roles and responsibilities required to address them. Currently, significant gaps exist in Army water security policy, guidance, oversight, and funding decisions with respect to protecting off-base Army water sources, collaborating with external water suppliers and users to ensure continued water availability, coordinating future mission siting decisions with installations' water supplies and water program funding, defending Army water rights, and advocating with state and federal officials to support Army's water requirements. Army institutional water policy historically has had an implicit "inside the fenceline" focus that neglects to address critical water source issues such as protection of watersheds and aquifers, growing regional demand for limited water sources, collaboration with regional and state water planning organizations, legal challenges to Army water rights, and state regulatory restrictions on Army water withdrawals. Consequently, Army leadership opportunities exist with respect to these issues, and policy changes are needed to address them.

The pursuit of a complex set of water security goals and objectives across the Army clearly requires effective leadership to ensure that:

- Water security roles and responsibilities are clearly defined across the Army enterprise to ensure that appropriate Army organizations and offices are assigned to manage all phases of the water supply pathway, including water sources, supplies, distribution, use, and disposal.
- Water security issues are given the level of attention that is consistent with their importance.
- Water security is understood to be more than water conservation.
- Protection and sustainment of off-base Army water sources is identified as an essential water security objective and it is assigned to appropriate Army organizations as a defined responsibility within their functional and geographic areas of responsibility.
- Roles and responsibilities for engaging water stakeholders and protecting off-base water sources and supplies are clear.
- Water planning and water source protection are adequately addressed in policy, planning, and guidance documents.
- Appropriate and timely action is taken in response to water security findings and recommendations provided by Army authorities, such as the Army Science Board (ASB), the Army Audit Agency (AAA), USACE, and the USAEC.

In light of the common threads among the water security goals identified above, these leadership objectives and actions are recommended.

Align Responsibilities. Establish and align Army organizational responsibilities to implement the water security strategy.

- Identify a water security champion to lead the pursuit of excellence in water resources planning and management across the Army at the Secretariat [Assistant Secretary of the Army

(Installations, Energy, and Environment) (ASA (IE&E))] level and maintain water security expertise at ACSIM, Installation Management Command (IMCOM) Headquarters, and IMCOM regions.

- Clarify water security responsibilities:
  - Identify a lead in ASA/Civil Works and USACE/Civil Works to promote regional water resource management and increase collaboration with civil agencies [e.g., Department of Interior (DOI), National Oceanic and Atmospheric Administration (NOAA), and U.S. Department of Agriculture (USDA)][23]
  - Define a water security role for IMCOM and IMCOM regions; coordinate with USAEC, Environmental Law Division (ELD), and USACE Civil Works.
  - As per AR 40-5, DA PAM 40-11, TB MED 576, and TB MED 577, designate the Office of the Surgeon General (OTSG) and US Army Public Health Command (USAPHC)/Army Institute of Public Health (AIPH) as required consultants on all aspects of health- and health risk- related aspects water systems, water quality, water use, recycle, and reuse, and other water security requirements where the potential for human consumption or human water contact exists.
  - Define specific water security responsibilities for Army REEOs and DoD Regional Environmental Coordinators (RECs), including coordination of cross-service water issues, communications with state and federal agencies on issues affecting military water use, participation in state and regional strategic water planning initiatives and regulatory monitoring and convening of water managers at the regional level to discuss landscape-scale water source sustainability issues.
  - Align water security responsibilities among headquarters, regions, and installations.
  - Coordinate operational water strategy goals through the Army G-4 and counterparts on the Joint and Combatant Command staffs.

Secure Accurate and Actionable Information. Ensure that standard water reporting processes provide the right kind of information accurately, and for a reasonable cost.

- In collaboration with personnel supplying water data, review and update all water reporting mechanisms [including the Installation Status Reports (ISRs) and Army Energy and Water Reporting System (AEWRS)] to capture the critical information that the water security champion needs to track to ensure water sustainability.
- Develop an installation water balance to determine water sources and distributions.

Incorporate Accountability Clauses. Where future issuances of Army doctrine [such as Army Regulation (AR) 420-1] and guidance specify courses of action concerning water security, indicate how

[23] U. S. Army Corps of Engineers (USACE); U. S. Army; U. S. Geological Survey (USGS); U. S. Department of the Interior (DOI); National Oceanic and Atmospheric Administration (NOAA), *Memorandum of Understanding (MOU): Collaborative Science, Services and Tools to Support Integrated and Adaptive Water Resources Management*, 2011.

and when progress will be evaluated. This will encourage evaluation of barriers and guide redirection if warranted.

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APPENDIX I: PROPOSED IMPLEMENTATION PLAN

Goal 1. Water Resources Sustainability – Preserve Sources, Protect Rights	Recommended Action
Objective: **Anticipate Long-Term Water Requirements.**	Sustain support for use of water demand forecast tools.
Objective: **Anticipate Long-Term Water Requirements.**	Develop a long-term forecast period for water requirements at each installation that includes a regional water supply and demand analysis
Objective: **Anticipate Long-Term Water Requirements.**	Designate a cycle or set of triggers for revising installation and regional forecasts.
Objective: **Integrate Water Considerations into Strategic Decisions.**	Determine typical water footprints for different types of installation activity.
Objective: **Integrate Water Considerations into Strategic Decisions.**	Amend Army facilities management and real property planning guidance.
Objective: **Integrate Water Considerations into Strategic Decisions.**	Assess and track embedded water risks for critical items in the Army supply chain.
Objective: **Influence Long-Term Water Management outside the Fence Line.**	Each installation or group of installations, if they are located in the same region, should participate in regional Integrated Watershed Resources Planning efforts.
Objective: **Influence Long-Term Water Management outside the Fence Line.**	Assign installations and their headquarters responsibilities to coordinate with local and state-level elected officials, their professional planning staffs, state environmental and water planning agencies, public water supply authorities, conservation organizations, and citizens' groups, to identify and support shared water resource protection and demand management goals.
Objective: **Influence Long-Term Water Management outside the Fence Line.**	Provide guidance to installations concerning best practices for engaging external stakeholders concerning water resource issues.
Objective: **Influence Long-Term Water Management outside the Fence Line.**	Establish the extent of the water supply area both above and below ground for each installation. This fundamental initial step will demonstrate the extent of the region that influences the amount of water available to each installation and inform an engagement strategy.

Objective: **Influence Long-Term Water Management outside the Fence Line.**	Leverage tools developed by Assistant Secretary of the Army (ASA)/Civil Works as part of its Integrated and Adaptive Water Resources Management, and its activities with National Oceanic and Atmospheric Administration (NOAA) and U. S. Geological Survey (USGS) to develop strategies to protect water resources at Army installations.[24]
Objective: **Influence Long-Term Water Management outside the Fence Line.**	Share USACE water forecasting data with public officials.
Objective: **Influence Long-Term Water Management outside the Fence Line.**	Establish a regular calendar for participating in regional or watershed-level forums that bring together Army (other DoD installations) with other federal and state officials concerning water source protection strategies. Establish these forums where there are none that address Army water interests. The convener of the forums could be the REEO/REC or a USACE regional office.
Objective: **Influence Long-Term Water Management outside the Fence Line.**	Take action to address water security as an encroachment issue by developing and implementing engagement strategies to protect the regional freshwater resources on which Army installations depend, with an initial focus on the installations that are most constrained—or most likely to be constrained – by water availability.
Objective: **Influence Long-Term Water Management outside the Fence Line.**	Expand conservation partnering programs [e.g., Readiness and Environmental Protection Initiative (REPI)/Army Compatible Use Buffer (ACUB) program] to protect at-risk water sources identified by USACE as critical for Army missions.
Objective: **Protect Water Rights.**	Include water rights management duties as part of positions at IMCOM regions and specialized OSJA legal staff. Create procedures to assess the need to maintain existing water rights and to acquire new ones at individual Army installations to meet current and future mission requirements. As applicable, expand the concept of water rights protection to include protection and access to riparian water rights.
Objective: **Protect Water Rights.**	Assign and partition clearly-defined water rights roles and responsibilities among the Secretariat, Environmental Law Division (ELD), IMCOM, REEOs, and installations.
Objective: **Protect Water Rights.**	Ensure that IMCOM HQ can provide expertise to installation staff on water rights and water access matters.
Objective: **Protect Water Rights.**	Coordinate water rights and water access actions with the Army Regional Energy and Environmental Offices.
Objective: **Protect Water Rights.**	Review Army policy on water rights, update and edit as appropriate, and implement communication strategy to disseminate the guidance to all installations.
Objective: **Protect Water Rights.**	Establish a baseline of the water rights status at Army installations nationwide to identify risks and opportunities across the Army enterprise.
Objective: **Protect Water Rights.**	For at-risk installations, develop a water rights strategy to maximize water rights protection for not only current missions, but also for conceivable growth and mission expansion scenarios.
Objective: **Protect Water Rights.**	Develop an accessible, shareable database with current water rights information for all Army owned-land, water-purchasing agreements, and thresholds.

[24] U. S. Army Corps of Engineers (USACE); U. S. Army (DA); U S. Geological Survey (USGS); Department of the Interior (DOI); National Oceanic and Atmospheric Administration (NOAA), *Memorandum of Understanding (MOU): Collaborative Science, Services and Tools to Support Integrated and Adaptive Water Resources Management*, 2011.

Objective: **Protect Water Rights.**	Develop a training module on water rights issues that could be offered to installation leadership and personnel.
Objective: **Coordinate Emergency Preparation.**	Establish nationwide coordination with states on policies that could affect Army water access during drought or inundation/flooding
Objective: **Coordinate Emergency Preparation.**	Develop protocols for assessing the quality of water contingency operations plans, which is not being done in conjunction with Environmental Performance Assessment System
Objective: **Coordinate Emergency Preparation.**	As part of emergency response planning, develop emergency water procurement plans (e.g., tanked or bottled water) for use in the event of water supply disruptions.
Objective: **Coordinate Emergency Preparation.**	Evaluate emergency water distribution plans to determine the appropriate priority for providing water to military dependents living on base in Army-owned and privatized housing. Incorporate water requirements for family housing into emergency response planning.
Objective: **Eliminate Water Planning Inefficiencies**.	As per the USAEC's recommendations, aggregate water planning requirements to eliminate redundant and unnecessary effort and avoid the submittal of inconsistent information among the plans provided. Provide clear planning templates and clear examples.
Objective: **Provide Comprehensive Water Security Guidance for Installations.**	Publish updated comprehensive water security guidance. The guidance may parallel *How the Army Runs* or DoD literature that is already available for engaging communities on other encroachment concerns.
Objective: **Provide Comprehensive Water Security Guidance for Installations.**	Recognize water security as an encroachment issue, incorporate water-related stakeholder engagement and compatible land use planning actions as responsibilities for IMCOM regions and Army installations.
Objective: **Provide Comprehensive Water Security Guidance for Installations.**	Adapt AR 420-1 and Installation Management Community Leaders Handbook to reflect new guidance, incorporating by reference where appropriate. Provide consistent, detailed guidance for garrison commanders and their staffs to use to engage public officials and other external stakeholders in collaborative water planning. Integrate water planning policies and procedures with real property master planning processes.
Goal 2. Water Resources Sustainability – Reduce Demand	**Recommended Actions**
Objective: **Match Water Quality to Water Use.**	Publish technical advisories for emerging technologies and new approaches such as direct reuse of treated wastewater.
Objective: **Sustain a Culture of Efficiency and Conservation.**	Use integrated watershed resources management (IWRM) for community engagement on regional resource issues, including water efficiency and conservation
Objective: **Sustain a Culture of Efficiency and Conservation.**	Conduct water balance assessments to determine how water is being used and by whom, to establish a baseline of water use. This can then be used to assess how more efficient systems or upgrades can be integrated into new construction or maintenance activities.
Objective: **Sustain a Culture of Efficiency and Conservation.**	Strengthen water conservation incentives such as mock billing and award programs.
Objective: **Sustain a Culture of Efficiency and Conservation.**	Identify water conservation in Army policy and doctrine as a vital "mission sustainability factor" and obligation for all Army troops and employees.

Objective: **Sustain a Culture of Efficiency and Conservation.**	Design and engineer water-using systems (e.g., showers and irrigation systems) to maximize water efficiency with a minimum of user input.
Objective: **Sustain a Culture of Efficiency and Conservation.**	With direct input from water managers, develop and promulgate water conservation training and sharing of best practices across installations.
Objective: **Sustain a Culture of Efficiency and Conservation.**	Update United Facilities Criteria documents to reflect methods of designing for water efficiency including use of neighborhood sized water treatment facilities.
Objective: **Sustain a Culture of Efficiency and Conservation.**	Annually revise plans and funding for installing water meters in new construction and retrofitted buildings. Prioritize installation facilities or complexes with the greatest opportunity for water savings and changes in water-using processes and behaviors.
Objective: **Sustain a Culture of Efficiency and Conservation.**	Tailor retrofit installation of water-efficient fixtures in existing buildings to the specific water system operations and conditions of individual Army installations.
Objective: **Tailor Expectations to Differences among Installations.**	Evaluate installation water consumption by type of facility (e.g., office, barracks) and target reductions according to updated benchmarks and best practices for each facility type.
Objective: **Mitigate Adverse Consequences of Aggressive Conservation**	Establish partnerships with code organizations to research and develop strategies to mitigate all system impacts of low flows. (Code groups have requested input of the effects of low flows; any changes to plumbing codes will affect new Army construction.)
Goal #3: Strategic Investment – Improve and Maintain Infrastructure Integrity and Security	**Recommended Action**
Objective: **Develop Funding Baseline**	Develop a baseline of water system funding requirements.
Objective: **Recapitalize**	Establish effective policy for funding non-privatized systems.
Objective: **Anticipate Costs; Privatization Contracts**	Based on Army privatization experience to date, document best practices and lessons learned and provide training to convey the acquired knowledge. Include examples of robust language pertaining to responsibility for infrastructure security.
Objective: **Maximize Compatibility**	Conduct engineering studies to (1) determine technological incompatibilities between Army installation infrastructure and external, privately owned infrastructure and (2) develop a roadmap to maximize the compatibility of internal and external infrastructure.
Objective: **Install Robust Contamination Risk Reduction Technologies**	Identify and test techniques for estimating costs and benefits of upgrading Army installations with off-the-shelf technologies that facilitate physical protection, detection of a deliberate or accidental contamination, isolation/ treatment/rehabilitation/recovery of the Army installation's critical water supply and associated water infrastructure network.
Objective: **Evaluate Vulnerability to Natural Mishaps**	Adapt the Installation Status Report – Infrastructure component (ISR-I) to include an indication of vulnerability of water supply to flooding. Evaluate the feasibility of applying EPA Climate Read Water Utilities assessment tools.
Goal #4: Water Security at Contingency Bases – Increase Self-Sufficiency, Reduce Risk	**Recommended Action**
Objective: **Reduce Water Use.**	Determine metrics for assessing the water use at contingency bases.

Objective: **Engage Partner Nations Concerning Water Resources Used by the Military.**	Establish a partner nation engagement strategy for water security.
Objective: **Assist Host Nations With Civilian Water Resources Sustainability.**	Develop doctrine and guidance pertaining to host nation water interests, including: o Coordinating with the DOS and USAID regarding near-term community relations and long-term community stability o Engaging nationals constructively regarding the effect of Army presence on water resources o Managing discharge to prevent adverse health and ecological effects of wastewater, and bringing online appropriate technology for safely processing wastewater to produce a useful agricultural resource o Ensuring the long-term effectiveness of water resource planning for contingency operations
Objective: **Assist Host Nations With Civilian Water Resources Sustainability.**	Establish a trained cadre of engineers who can work closely with USAID in support of host nation stabilization and reconstruction.
Objective: **Ensure Timely Transition to Local Water Sources**.	Update guidance [Field Manual (FM) 5-484, dated 1994] for raw water source acquisition so that it includes surface water as well as ground water. The updated guidance should indicate how water testing will be coordinated with water detection and acquisition activities.
Objective: **Ensure Timely Transition to Local Water Sources**.	Develop doctrine and guidance for integrating raw water source availability into contingency base siting.
Objective: **Ensure Timely Transition to Local Water Sources**	Establish protocols for rapid assessment of contaminant risk in natural water bodies.
Objective: **Ensure Timely Transition to Local Water Sources**.	Reactivate engineering technical support for well drilling to ensure that best practices are incorporated.
Objective: **Ensure Timely Transition to Local Water Sources.**	Establish a clear policy for maintaining equipment and skills in peacetime.
Objective: **Rebuild Internal Capabilities**	Articulate a strategy for fully rebuilding and maintaining core internal capabilities for designing, building and managing semi-permanent and permanent water supply systems.
Objective: **Rebuild Internal Capabilities**	Develop appropriate training and doctrine suitable for move to distribute water operation.
Objective: **Implement Best Practices and Policies for Personal Hydration.**	Establish and implement a metric for bottled water use intensity (e.g. gallons per person per day) that would provide a comparison among contingency bases.
Objective: **Implement Best Practices and Policies for Personal Hydration.**	Establish a clear doctrine concerning modes of water packaging, storage, and transportation for personal hydration.
Objective: **Implement Best Practices and Policies for Personal Hydration.**	Establish a detailed policy concerning where and when to use different systems for hydration, depending on type and duration of a soldier's situation, size of unit, and contingency operations phase.

Objective: **Implement Best Practices and Policies for Personal Hydration.**	Provide guidance on best practices for developing a recycling economy in the host nation.
Objective: **Implement Best Practices and Policies for Personal Hydration.**	Evaluate the latest technologies for biodegradable bottles.
Objective: **Implement Best Practices and Policies for Personal Hydration.**	Specify training experiences that are best matched to the variety of water supply constraints encountered in theater.

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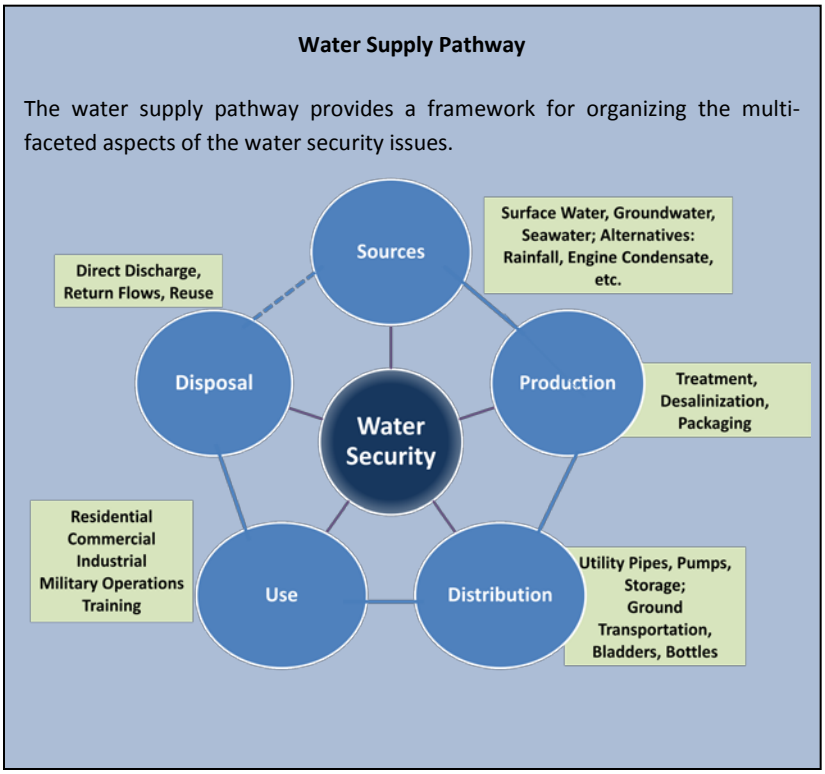
APPENDIX II: STUDY APPROACH AND METHODS

The study team implemented a seven-phase approach to develop the water security strategy, companion findings document, and strategic communications plan. (Figure A-1) The study relied heavily on a discovery approach based on intensive research and primary data gathering through extensive consultation with subject matter experts, both in the Army and Department of Defense (DoD) and outside DoD, to identify and characterize issues to be addressed in the Water Security Strategy.

Figure A-1. Water Supply Pathway



For the purposes of the study, water security management issues are divided into three mission areas: institutional, operations, and supply chain.

- **Institutional:** The term 'institutional' includes all installations managed by the Army's Installation Management Command (IMCOM), which will soon also include all Army Materiel Command (AMC)-run depots. The term encompasses training activities.
- **Operations:** The term 'operations' encompasses the Army's expeditionary operations and contingency basing in an overseas theater.
- **Supply Chain:** The term 'supply chain' refers to the acquisition process, with a focus on the water security-related risks embedded in the supply chain and the role water security issues play in the acquisition decisions.

Figure A-2. Overview Seven-phase Approach

Figure A-2 depicts the seven-phase approach. The phases included:

Phase 1 and 2: Issue identification and Stakeholder Identification. Literature reviewed for this study includes Army and DoD guidance, policy, planning documents, and regulations; U.S. Army Corps of Engineers (USACE) water and sustainability related studies; and non-DoD water-related studies with national and international scopes. Over 150 documents were reviewed. The literature survey was used to establish the current state of Army water security management policy, guidance, doctrine, and water-related initiatives; to identify the key issues for each of the mission areas; and to develop a list of the key stakeholders that needed to be engaged in each mission area.

Phase 3 and 4: Taxonomy Development and Stakeholder Outreach. The issues identified in the literature survey for each mission area were organized in a taxonomy framework based on the water supply pathway (See call-out box), and by mission area.

Subsequently, the research team conducted over 65 interviews with Army stakeholders who have responsibility for water security management and planning. Interviewees included several stakeholders in USACE.

Many interviews were conducted with individuals either in-person or over the phone; however, some interviews were conducted in group sessions of two to eight experts who work on different aspects of water management issues. Approximately half of the Army stakeholder interviews were conducted at the installation level during research trips to Fort Bragg, Fort Carson, Fort Huachuca, and Fort Meade. At each installation, the research team conducted interviews with a number of key personnel who have water management responsibilities, including the director of Public Works, Chief of Environment Division, Natural Resources Program Manager, Chief of Operations and Maintenance (O&M), Antiterrorism/Force Protection (ATFP) Officer, and Installation Master Planner.

These interviews took place between January and June 2011. In advance of each interview, interviewees were provided with a general set of questions (see call-out box) that were augmented with tailored questions addressing each stakeholder's specific responsibilities. Individual interviews varied in duration from 45 minutes to 90 minutes and typically lasted one hour. Group interviews with four people or more lasted 90 minutes or longer to ensure that all views were heard. These interviews were conducted on a not-for-attribution basis and key insights from each interview were captured in interview notes.

General Interview Questions

- How do you define water security?
- How do you characterize your organization's role as it relates to achieving water security?
- What do you see as the most pressing issues for Army water security?
- Which issues are being addressed well?
- What gaps remain to be filled? Which represent the greatest potential for return on investment?
- What do you see as the most effective drivers of change? What are the most significant deterrents?
- What elements of a draft Army water security strategy would be of greatest interest to your organization(s)?

The Army interviews were augmented by discussions with other stakeholders in DoD and other federal agencies who work closely with DoD to support the Operations mission area. In addition, the research team had discussions with several subject matter experts (SMEs) in the water management and ecosystem services field and representatives from non-governmental organizations, such as the Clean Water America Alliance (CWAA).

Table A-1 provides an overview of the stakeholders interviewed by general category.

Table A-1: Overview of Army and Non-Army Stakeholders

Category of Organization	# of Interviews	# of Interviewees
Army (All Excluding Installation Visits)	21	48
Army (Installation Visits)	40	46
USACE	8	13
Other DoD [e.g., Office of the Secretary of Defense (OSD), Joint Staff, Other Services)	2	2
Other Federal Agencies [e.g., Department of State (DOS), U.S. Agency for International Development (USAID)]	4	8
Non-Governmental (non-profit, private sector)	6	9
Total Stakeholder Interviews	81	126

The insights gathered through this extensive interview process that inform both the Water Security Findings document and the Water Security Strategy represent the informed views and impressions of a cross-section of stakeholders who were generous with their time and insights. These impressions do not represent views from all critical stakeholders. Gaps in the data collection exist due to time constraints, resources, and scheduling constraints.

Phase 5: Risk and Intersection Analysis. The impressions gathered in the stakeholder engagement process were used as an input to identify critical vulnerabilities and risks; to understand the dimension of water's intersection with other resources; and to inform the characterizations of issues, gaps, and

opportunities that are presented in the Water Security Findings document, and to shape the goals and objectives presented in the draft Water Security Strategy.

Phases 6 and 7. Strategy Review and Finalization. The draft strategy was circulated to a number of the key stakeholders for their comments, and a group of stakeholders participated in a Water Security Strategy Review tele-conference to provided comments and recommendations to inform the final water security strategy document.

Communications and Outreach. A communication and engagement strategy was developed to inform a roll out strategy for the Water Security Strategy. As part of the stakeholder engagement process, the stakeholders were placed into four tiers. These tiers are described in Table A-2. The strategy includes a prioritization of relationships and leadership based on the stakeholder analysis to develop a recommended briefing schedule and approach. In addition, the communication strategy recommended the messages to highlight in the strategy document.

Table A-2: Overview of Army and Non-Army Stakeholders

Tier	Percentage	Influence
First Tier – Strategic Stakeholder	1-5 percent	They exercise very significant influence over, or control, planning, legislative, regulatory, or other processes, perhaps singlehandedly preventing or assuring outcomes.
Second Tier – Strategic Stakeholder	10-20 percent	They exercise substantial influence over processes and First Tier Stakeholders.
Third – Strategic Stakeholder	70 percent	They are meaningful and have an equity in the outcome but no significant influence on the outcome.
Fourth – Information Source	10 percent	They provide useful information for strategy development.

APPENDIX III: CONCEPTUAL FRAMEWORK FOR ACHIEVING WATER SECURITY

Six factors provide a conceptual framework for the types of issues/actions that require attention to achieve Army water security—Sources, Supply, Survivability, Sustainable Practices, Survivability and Sponsorship (Table A-3).

- **Sources:** Monitoring and protecting the quantity and quality of natural, raw water available to the region in cooperation with state and local officials and with private conservation organizations.
- **Supply:** Identifying Army's current and future water requirements; working with water suppliers to ensure that shared water resources can meet the needs of the Army and other consumers; sizing Army water systems to meet future demands.
- **Sustainable Practices:** Implementing sustainable water programs such as Net Zero water use efficiency concepts (see call-out box); implementing water conservation, recycling, and reuse programs tailored to the specific conditions and capabilities of individual Army installations.
- **Survivability:** Preventing and recovering from water supply disruption or contamination; preparing water supply contingency plans for droughts or power failures; establishing backup water supply sources and agreements; timely budgeting of Sustainment, Restoration and Modernization (SRM) and Military Construction (MILCON) funds to repair or replace deteriorated water systems.
- **Sponsorship:** Identification and alignment of Army water management responsibilities; ensuring that specific organizations are assigned clearly-defined roles for managing all aspects of Army water programs including water source protection, planning future water requirements, timely funding of new water projects, defense of Army water rights, physical security and contingency planning, utility privatization and procurement issues, and stakeholder engagement programs.
- **Stakeholders:** Constructive, ongoing engagement with local, regional, and state-level public and private water stakeholders; promoting collaborative efforts to protect water sources and to use shared water supplies on a sustainable basis; informing public decision makers and regulators of Army's current and future water requirements; working to publicize Army's water requirements.

Table A-3. Summary of Six Factors of Army Water Security

Factor	Basic Considerations	Fundamental Objectives
Sources	1. Regional population growth and land development 2. Water demands of various sectors, including renewable energy 3. Opportunities for ecosystem-based source protection 4. Potential for water reuse to reduce demand for raw water	**Physical/Chemical**: Protect watersheds, groundwater and surface water sources, and their water quality. **Biological**: Preserve aquatic ecological functions, safety, and usefulness of natural waters. **Economic**: Prevent increases in treatment costs due to avoidable declines in raw water quality. Plan and prepare for drought.

Supply	1. Water rights 2. Water treatment effectiveness 3. Capacity of infrastructure to deliver quantity and quality of potable water required 4. Costs and pricing	**Physical/Chemical**: Determine quantities of water needed to support current and anticipated mission. Protect rights to those quantities of water. **Biological**: Protect quality of the water supply. **Economic**: Avoid unnecessary costs, such as distribution system leaks. Price to recover costs and provide incentive for efficient use.
Survivability	1. Infrastructure protection 2. Damage mitigation 3. Recovery from disruption	**Physical/Chemical**: Protect water production and distribution systems to ensure stable operation. **Biological**: Prevent contamination. **Economic**: Ensure that contingency plans are in place to coordinate response to disruption effectively.
Sustainable Practices	Conservation; reuse and repurposing; water system BMPs; Net Zero water program; ecosystem-based source protection;	Put Army water use in balance with water sources/supplies; maximize conservation with low-flow fixtures, water system revitalization and water use education; benchmark water management practices with public and commercial water suppliers; reuse and recycle water; recharge water sources; partı with stakeholders to protect water sources and ecosystems; minimize disposable water bottle use in theatre.
Sponsorship	Clarity of roles and responsibilities concerning all water security issues	Clearly define Army roles and responsibilities for water supply planning and design, management and maintenance, security, programming and budgeting, procurement, and host nation agreements. Ensure adequate attention to source protection, partnering opportunities, anticipating future needs, and contingency planni
Stakeholders	Water utilities Surface water users Groundwater users	Acquire situational awareness concerning trends in regional wat demand, supply, and quality that may affect the Army. Influence regional water management to the benefit of the Army mission. Prevent misunderstandings concerning Army water use in politically sensitive areas, particularly among host nations.

APPENDIX IV: OVERVIEW OF STAKEHOLDERS INSIDE AND OUTSIDE ARMY ENTERPRISE

Recognizing that execution of a comprehensive water security strategy would involve a variety of offices inside and outside the Army. There were specific tasks completed under this study to identify the suite of stakeholders. Water-related roles and responsibilities of the key stakeholders in the institutional Army are summarized in Table A-4. Developed from reviewing responsibilities in Army regulations, Table A-4 categorizes stakeholders by their role in policy; compliance, oversight, and resourcing; and installation management.

Table A-4: Army Institutional Water Security Management Stakeholders

Agency/Office	Water Related Responsibilities
POLICY	
Office of the Assistant Secretary (Installations, Energy & Environment (OASA[IE&E])	Implements the Net Zero Water Program. Submits the Army Annual Energy Management Report to Deputy Undersecretary of Defense (DUSD [I&E][AR 420-1]). Serves as proponent for Army Energy & Water Management Awards at Secretariat level (AR 420-1).
Office of the Deputy Assistant Secretary (Energy & Sustainability) (ODASA[E&S])	Provides strategic leadership, policy guidance, program oversight and outreach for energy and sustainability. This responsibility encompasses utilities privatization; energy policy review; and energy partnerships. Identifies successful water management practices and demonstration installations for the Net Zero program.
Office of the Deputy Assistant Secretary (Environment, Safety, & Occupational Health) (ODASA[ESOH])	Restoration (active/ Formerly Used Defense Sites (FUDS)/compliance); sustainability, compliance, conservation, pollution prevention, historic properties, international; safety and occupational health; explosive, chemical safety, munitions response, chemical warfare response.
Office of the Deputy Assistant Secretary (Installations, Housing & Partnerships (ODASA [IH&P])	Military Construction (MILCON) Engineering Housing Base Realignment and Closure (BRAC) Partnerships.
Office of the Deputy Assistant Secretary (Strategic Integration) (ODASA[SI])	Conducts research and analysis to enhance infrastructure support to the Army for stationing efforts, future infrastructure requirements, transformational strategies and performance metrics. Administers a research program to address tomorrow's infrastructure challenges and to continually develop improvements for soldiers, civilians, families, and the Joint team.
Army Regional Energy and Environmental Offices (REEOs)	Four offices engage state, federal, non-governmental, and other organizations on water issues that can affect installation operation and training.
DoD Regional Environmental Coordinators (RECs)	Ten coordinators monitor environmental regulatory developments and convey the interests of the military to state and federal regulators.
Office of the Surgeon General (TSG)	Sets water quality standards and ensures compliance. Provides guidance concerning health aspects of the AEWMP (AR 420-1).

Agency/Office	Water Related Responsibilities
Office of the Chief of Engineers (COE)	The COE Plans Branch works with Army and Joint Staff in long-range planning. Functions as the primary Army Staff contact concerning utilities acquisition and sales administration, engineering, and legal issues (AR 420-1). Perform responsibilities stated in the Army Federal Acquisition Regulation Supplement (AFARS) 5141 and AR 420–41.
OVERSIGHT, COMPLIANCE, and RESOURCING	
Office of the Assistant Chief of Staff for Installation Management (OACSIM)	Serves as proponent for utilities privatization, evaluates privatization candidates. Provides policy, programming, and oversight for environmental programs. Produces the Army Annual Energy and Water Management Report and Implementation Plan (AR 420-1). Provides guidance for complying with laws and executive orders concerning water management. Reviews AEWMP for deficiencies that can be eliminated. Formulates and coordinates Army policy concerning water resources for installations. Advises Assistant Secretary of the Army (Installations, Energy and Environment) (ASA [IE&E]) on water matters. Provides advisers on water to principal DA witnesses. Serves as primary Army staff (ARSTAF) contact and advisor for energy and water management issues Army-wide (AR 420-1). Maintains the water information management system. Provides guidance concerning Army Energy and Water Reporting System (AEWRS). Participate in the planning, programming, and budget process for all Army water matters. Review Joint and Army strategic plans to ensure appropriate consideration of water issues. Ensure compatibility between the AEWMP and the Army Environmental Program (described in AR 200–1). Exchange ideas with agencies and organizations outside the Army. Provide guidance and support for research and development (R&D) concerning water efficiency.
Installation Management Command (IMCOM) Headquarters	Ensures that regions develop and submit to the Assistant Chief of Staff for Installation Management (ACSIM) an annual report that includes significant garrison energy and water management accomplishments during that fiscal year (AR 420-1).
IMCOM Commander	Establish and maintain an active Energy and Water Management Program (EWMP) at all agency/command levels. Promote regional and garrison water conservation/awareness activities. Ensure each region and garrison has an Energy Manager appointed in writing and trained as required by pertinent laws and Executive Orders (EOs). Ensure that water conservation responsibilities are included in position descriptions of those critical to execution of laws and EOs. Ensure Directors of IMCOM Regions are actively supporting progress toward water conservation goals at the garrison level. Promote and recognize energy and water conservation through the

Agency/Office	Water Related Responsibilities
	incentive/suggestion awards program. Develop and maintain water conservation information programs. Ensure that water consumption data provided through AEWRS are accurate. Consolidate and recommend candidate energy and water projects to include Energy Conservation Improvement Program (ECIP) projects. Establish regionally conducted on-site reviews of installation Energy and Water Management Programs. Provide Region Annual Energy Reports and Implementation Plans for submission to OACSIM. Submit Secretary of the Army and Federal Energy and Water Management Award nominations to OACSIM. Provide engineer liaison to Army Commands (ACOMs), Army Service. Component Commands (ASCCs), and Direct Reporting Unites (DRUs). Ensure that garrisons have adequate water management plans to include strategies for continuing essential garrison missions during emergencies.
Army Environmental Command (AEC)	Assists the Army in compliance activities for drinking water management, wastewater management, watershed and storm water management, conservation of resources, and pollution prevention. AEC supports installations directly when requested.
Commanders of Army Commands (ACOMs), Army Service Component Commands (ASCCs), and Direct Reporting Units (DRUs)	Infuse energy and water efficiencies into the development of Army operations, processes, procedures, acquisition strategies, and other mission-related functions (AR 420-1). Support efforts to give priority to funding for R&D and materiel acquisition that improves energy and water efficiency (AR 420-1). Include energy and water conservation responsibilities in position descriptions of subordinate commanders to the extent practical to ensure appropriate compliance with the AEWMP. Include emphasis on compliance during all training exercises. Include successful implementation of energy efficiency, water conservation, renewable energy, and alternative energy projects in performance evaluations (AR 420-1).
Army Medical Command (MEDCOM) Public Health Command (PHC)	In addition to responsibilities as an ACOM, MEDCOM PHC sets standards for water quality to ensure health of Soldiers, Families, and Civilians on military installations.
Judge Advocate General (JAG) Environmental Law Division (ELD)	Interprets water-related legislation and represents the Army's interests in regulatory initiatives. Serves as a liaison between the U.S. Army and the U.S. Department of Justice (DOJ) on legal matters dealing with water rights issues particularly in the Western United States.
Deputy Chief of Staff G-4 (Logistics)	Recommends Army policy for management of Army tactical & mobility energy & water (AR 420-1). Supports R&D funding & material acquisition that improves energy & water efficiency (AR 420-1).
Deputy Chief of Staff G-3/5/7	Ensures recognition of AR 420-1 in development of Army regulations, role, and missions (AR 420-1). Develops guidance to ACOM, ASCC, and DRU commanders emphasizing AEWMP compliance (AR 420-1).
INSTALLATION OPERATIONS	

Agency/Office	Water Related Responsibilities
Directorate of Public Works (DPW) – Master Planning	Oversees implementation of water conservation at the installation level through infrastructure planning.
DPW – Operations & Maintenance	Funds infrastructure upgrades and performs maintenance on water infrastructure at installations. Responsible for water and wastewater services. Disinfects water infrastructure components following construction, repairs, installation of taps, or contamination situations (AR 420-1).
DPW – Engineering Division	Coordinates with utility privatization firms and external public utilities. The Contracting Officer Representative coordinates directly with the utility privatization firms.
DPW – Environmental/Natural Resources Division	Manages natural resources (including water resources) on the installation. Reports energy and water consumption and cost data through AEWRS (AR 420-1). Ensure compliance with the Safe Drinking Water Act (SDWA) and the Clean Water Act (CWA).
Directorate of Emergency Services – Anti-Terrorism/Force Protection (ATFP)	Roles and responsibilities include antiterrorism measures to protect water infrastructure.
Public Affairs Office (PAO)	Prepares a Public Notification Plan (required SDWA) to outline process for alerting personnel and organizations connected to the installation of noncompliance with water quality standards (AR 420-1).
Preventative Medicine Department	Prepares a Public Notification Plan (required by SDWA) to outline process for alerting personnel and organizations connected to the installation of noncompliance with water quality standards (AR 420-1). Works closely with DPW on drinking water quality and quality of water for recreational uses.
Staff Judge Advocate (SJA)	Roles and responsibilities include maintaining water rights documentation and protecting the interests of the installation in water rights adjudication. Prepares a Public Notification Plan (required by SDWA) to outline the process for alerting personnel and organizations connected to the installation of noncompliance with water quality standards (AR 420-1).

Working closely with the Army stakeholders, USACE brings an enormous amount of water management analysis, planning and construction expertise to water management challenges facing Army installations across the country (Table A-5).

Table A-5. U.S. Army Corps of Engineers Water Security Management Stakeholders

Agency/Office	Water Related Responsibilities
USACE	The Institute for Water Resources (IWR) provides forward-looking analysis and research in developing planning methodologies to aid the Civil Works program in the following areas: (a) analysis of emerging water resources trends and issues; (b) state-of-the-art planning and hydrologic engineering methods, models, and training; and (c) national data management of results-oriented program and project information across Civil Works business lines. The IWR houses the International Center for Integrated Water Resources Management (ICIWaRM), a source of expertise concerning global water resource issues.

Agency/Office	Water Related Responsibilities
	Installation Support Offices are available on a reimbursable basis to consult with installations directly concerning water policy implementation.
	Civil Works programs include water resource development business lines including flood control, navigation, recreation, and infrastructure and environmental stewardship.
	The Defense Critical Infrastructure Program (DCIP) is a Department of Defense (DoD) risk-management program that seeks to ensure the availability of networked assets critical to DoD mission-fulfillment.
	The Engineer Research and Development Center (ERDC)/Construction Engineering Research Laboratory (CERL) focuses on acquisition, planning, and design for facilities, installation operations, military ranges, and lands.
	As per AR 420-1, the USACE is responsible for creating water efficiency design standards, offering technical support and guidance, and reporting metering data through AEWRS.

Finally, Army stakeholders must work with a range of external stakeholders, including Federal agencies, regional organizations, state and local government officials, and non-governmental organizations, to ensure water security at Army installations around the country (Table A-6).

Table A-6. Major External Stakeholders

Agency/Office	Water Related Responsibilities
LAND-HOLDING	
Department of the Interior (DOI) Bureau of Land Management BLM)	Administers public lands in 12 Western states, including Alaska, as well as sub-surface mineral estates throughout the nation. The BLM Water Resources Program aims to ensure sufficient quality and quantity of water for the successful management of the National System of Public Lands.
DOI Bureau of Reclamation (BOR)	BOR is the largest wholesaler of water in the country. It also has instituted numerous programs, initiatives, and activities to help Western States, Native American Tribes, and others meet new water needs and balance competing uses. The WaterSMART program helps support water resource planners and managers with decision making. The program identifies strategies for water conservation and adaptive measures to address climate change impacts on future water demands. The program also coordinates with the DOI Task Force on Energy and Climate Change Response Council.
DOI Fish & Wildlife Service (FWS)	Manages the National Wildlife Refuge System. Participates in Landscape Conservation Cooperatives (LCCs). LCCs are public-private partnerships that approach conservation on a landscape-scale basis to ensure sustainability of land, water, wildlife and cultural resources. The principal federal partner responsible for administering the Endangered Species Act (ESA) and water issues affecting enforcement of the ESA.

Agency/Office	Water Related Responsibilities
REGULATORY	
Environmental Protection Agency (EPA)	Administers the Clean Water Act (CWA), SDWA, the Public Health Security and Bioterrorism Preparedness and Response Act, and other regulations pertaining to public water quality and safety. Works with the Department of Homeland Security (DHS) as the Sector-Specific Agency (SSA) for water security under the National Infrastructure Protection Plan (NIPP). Through the Water Security Division, provides tools for assessing the vulnerability of community water systems to natural and malicious disruption. Research and development of field-deployable water treatment technologies and other security technologies to protect public water supply (EPA 2009, *Award-Winning Ultrafiltration Device*, http://www.epa.gov/nhsrc/news/news081409.html).
Food and Drug Administration (FDA)	Regulates the quality and safety of bottled drinking water.
SECURITY	
Department of Homeland Security (DHS)	The Office of Infrastructure Protection executes the NIPP, which assigns federal agencies to lead a collaborative process for critical infrastructure protection within 18 sectors. The Defense Industrial Base (DIB) is a sector under the NIPP that includes DoD, government, and the private sector worldwide industrial complex, with the capabilities of performing research and development, design, production, delivery, and maintenance of military weapons systems, subsystems, components, or parts to meet military requirements. Right now, the DIB does not include the commercial infrastructure of providers of services such as power, communications, transportation, or utilities that DoD uses to meet military operational requirements, but some at Fort Bragg would like to see that changed.[25]
INFORMATION SERVICES	
DOI U.S. Geological Survey (USGS)	Collects information about the nation's water resources and provides access to water data, publications, and maps, as well as to recent water projects and events.
National Science Foundation (NSF)	Funds research in engineering, environment, geosciences, and more.
WATER MANAGEMENT	
American Water Works Association (AWWA)	Maintains water and wastewater infrastructure standards and guidance (including AWWA Manual 19, *Emergency Planning for Water Utilities*, which is incorporated into AR 420-1 by reference).
Nature Conservancy	Partners with Army installations to purchase easements or properties from landowners under the Army Compatible Use Buffer (ACUB) program. The purchase of properties can constrain the amount of water that would otherwise be withdrawn by property owners.
State and Regional Water Commissions	Coordinate governance and policy concerning water resources.

Table A-7 lists key military organizations that are involved in supplying water for the operational Army. The roles and responsibilities of many of these organizations are specified in AR 700-136 Tactical Land-

[25] See the section on Fort Bragg, page 66.

Based Water Resources Management. In addition, military stakeholders must work with a range of external organizations to ensure water security within the operational context.

Table A-7. Army Operational Water Security Management Stakeholders

Agency/Office	Water Related Responsibilities
POLICY	
Deputy Under Secretary of Defense for Strategy, Plans, and Forces (DUSD SPF)	Coordinates and issues the Defense Planning and Programming Guidance (DPPG), which is primarily for planning military operations.
Deputy Assistant Secretary of Defense for Strategy	Provides guidance and funding to engage partner nations on water security issues through the Defense Environmental International Cooperation (DEIC) program.
Office of the Deputy Assistant Secretary of the Army for Energy and Sustainability	Leads Contingency Basing and Operational Energy Strategies for OASA (IE&E).
Deputy Chief of Staff G-4 (Logistics)	Serves as ARSTAF proponent for land-based water resource matters in support of contingency operations (AR 700-136). Acts on behalf of the Secretary of the Army for any or all of DoD Executive Agent responsibilities, functions, and authorities (AR 700-136). Coordinates requirements relating to logistics, research, development, and acquisition with the Assistant Secretary of the Army (Acquisition, Logistics and Technology) [ASA(ALT)] (AR 700-136). Ensures consistency with other Services and joint staff doctrine and procedures (AR 700-136). Establishes and chairs annual meetings of the Joint Water Resources Management Action Group (JWRMAG) (AR 700-136). Manages a database of land-based water resources (AR 700-136).
The Surgeon General (TSG)	Establishes potable and nonpotable water quality standards, monitoring and surveillance requirements, and conducts testing (AR 700-136). Develops protocols for the use of tactical water purification systems; guides the selection and use of commercial-off-the-shelf water purifiers and water treatment systems (AR 700-136). Establishes procedures for executing field water vulnerability assessments (AR 700-136). Participates in JWRMAG.
Office of the Chief of Engineers (COE)	Formulates policies, procedures, and equipment requirements to locate and develop raw water sources (AR 700-136). Develops and maintains an automated database for rapid retrieval of water related data (AR 700-136). Establishes and assists in the operation of the water utility and waste water systems associated with “Force Provider” support sites. Specific COE requirements are determined by the Force Provider commander (AR 700-136).
U.S. Army Training and Doctrine	The Center for Army Lessons Learned (CALL) collects and analyzes operational

Agency/Office	Water Related Responsibilities
Command (TRADOC)	data and reports lessons learned for military commanders, staff, and students. The U.S. Army Engineering School (USAES) Combat Engineers School Directorate of Environmental Integration (DEI) at the Concepts, Organization, Doctrine, and Development Directorate (CODDD) within the Maneuver Support Center Excellence (MSCoE) works with other organizations that define processes and procedures used by policy and planning organizations and staff sections to provide efficient Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities (DOTMLPF) solutions for complex issues. The Army Capabilities Integration Center (ARCIC) develops Army Soldier and Civilian leaders, and designs, develops, and integrates capabilities, concepts, and doctrine in order to build an Army that is a versatile mix of tailorable, adaptable, and networked organizations operating on a rotational cycle for Full Spectrum Operations. The CODDD develops all tactical water support doctrine on the use of commercial bottled water and water packaging systems (AR 700-136). Validates DoD and Army water consumption planning factors (AR 700-136).
U.S. Army Quartermaster Center & School (USAQMC&S)	Provides entry level training as well as functional support training for officers. The Petroleum and Water Department provides advanced individual training in water treatment distribution. This includes the training of Army logisticians to meet combatant commander specified needs for water.
Combined Arms Support Command (CASCOM)	Commands the Sustainment Center of Excellence (SCoE); trains and educates Soldiers and Civilians, develops and integrates capabilities, concepts and doctrine, and executes functional proponency to enable the Army's Sustainment Warfighting Function.
Army Research Laboratory-Army Research Office (ARL-ARO)	Serves as the Army's premier extramural basic research agency in the engineering, physical, information, and life sciences; developing and exploiting innovative advances to insure the nation's technological superiority.
OVERSIGHT, COMPLIANCE, and RESOURCING	
Deputy Chief of Staff G-3/5/7	Oversees water-related troop organization, force structure, operations, plans, and readiness (AR 700-136). Ensures that resources are programmed to support the requirements of the combatant commands and the DCS, G-4 through the program objective memorandum (POM) submissions (AR 700-136). Participates in JWRMAG (AR 700-136).
Assistant Secretary of the Army for Acquisition, Logistics and Technology (ASA(ALT))	Coordinates with DCS, G-3/5/7 on planning and preparing the modernization portion of the POM (AR 700-136). Reviews and validates the research, development, and acquisition (RDA) program with DCS, G-3/5/7 and the Assistant Secretary of the Army, Financial Management and Comptroller (ASA(FM&C)), and oversees the program execution (AR 700-136). Oversees the product manager, Petroleum and Water Systems (AR 700-136).
Army Materiel Command (AMC)	Oversees the Research Development and Engineering Center, which, through Tank Automotive Research Development Center (TARDEC) will employ science and technology, research and development, engineering support, quality assurance and

Agency/Office	Water Related Responsibilities
	related work to develop technologies for field water treatment and consumption (AR 700-136). Oversees the Integrated Logistics Support Center (AR 700-136). Oversees the Army Field Support Command (AR 700-136). Participates in the JWRMAG (AR 700-136).
Tank Automotive Research Development Center (TARDEC)	Develops and tests the technologies needed to provide water to troops in the field. Water Quality and Water Test Cell Laboratories develop, test, and evaluate experimental and bench-scale water purification and treatment technology.
U.S. Army Forces Command (FORSCOM)	Provides tactical water support planning (AR 700-136). Minimizes dependency on commercial bottled water (AR 700-136). Establishes a basic-days-of-supply level for water consumption (packaged) during the initial stages of combat operations. Synchronizes arrival of water units in such a way that the water distribution system will expand from commercial packaged water distribution early on to water production and distribution as the theater matures (AR 700-136). Establishes and maintains a collective (unit level) tactical water training facility (AR 700-136). Responds to operational requirements for tactical water purification equipment (AR 700-136). Participates in JWRMAG (AR 700-136).
Army Medical Command (MEDCOM) Public Health Command (PHC)	Sets standards for water quality and testing. Ensures compliance with water testing.
CONTINGENCY BASE OPERATIONS	
Commanders of quartermaster units	Ensure proper testing, treatment, storage, and distribution of potable water (AR 700-136). Establish and operate water points for direct support/general support of units (AR 700-136). Participate in FORSCOM unit-level tactical water support training (AR 700-136). Identify and ensure compliance with local environmental requirements at sites where water treatment equipment is used (AR 700-136). Employ unit field sanitation teams in accordance with Field Manual (FM 21-10 to conduct routine inspection of unit water containers and trailers, conduct daily checks of unit water supplies for chlorine residual, and disinfect (chlorinate) unit water supplies as required (AR 700-136).
Commanders of engineer units	Locate and develop water resources (AR 700-136). Provide construction support necessary to establish water well sites and construct, maintain, and operate permanent and semi permanent water utility systems in the theater of operations (AR 700-136).
Commanders of transportation units	Provide line haul transportation of water between bulk storage facilities (AR 700-136).

Agency/Office	Water Related Responsibilities
Commanders at all levels	Protect water inventories, ensuring adequate supply for all base needs, executing sanitation procedures, surveillance, and other general oversight duties (AR 700-136).
GENERAL CONTINGENCY BASE SUPPORT	
U.S. Army Corps of Engineers (USACE)	The Installation Operations thrust area of the Construction Engineering Research Laboratory (CERL) responds to the directives of AR 200-1, Environmental Protection and Enhancement, Pollution Prevention. This thrust area provides for the development of new technologies and applications of existing technology to address Army user requirements for facilities pollution prevention, industrial operations, and environmental compliance.

TTable A-8 describes the roles of several critical external stakeholder groups, including host nation governments and agencies, U.S. federal agencies, regional organizations, state and local government officials, and non-governmental organizations.

Table A-8. External Operational Water Security Management Stakeholders

Agency/Office	Water Related Responsibilities
DoD/MILITARY ENGAGEMENT	
Joint Chiefs of Staff, Logistics Directorate (J-4)	Coordinates across organizations in the logistics Community of Interest (COI) including the Office of the Secretary of Defense, the Services, the Combatant Commands, the industrial base, and multinational and interagency partners. Addresses water supply, transportation, and distribution issues.
Office of the Secretary of Defense (OSD)	Coordinates policy development, planning, resource management, fiscal, and program evaluation responsibilities for DoD. Policy Office, through Defense Policy and Planning Guidance (DPPG), has the authority to establish policy concerning water security measures for Army operations.
Unified Combatant Commands (COCOMs)	As regional commands with ongoing missions, COCOMs have a vested interest in helping to sustain regional water security for the benefit of U.S. interests and maintaining good relations with countries in a particular region.
INTELLIGENCE COMMUNITY	
Central Intelligence Agency (CIA)	Has the capability to collect and share secret information about water resources in operating environments.
Defense Intelligence Agency (DIA)	This organization supports military intelligence needs specifically to support missions.
DIPLOMATIC	
Department of State (DOS) U.S. embassies	Establish and maintain points of contact in host country to provide diplomatic support to U.S. military operations and assist in dialog and negotiations concerning water resource issues.

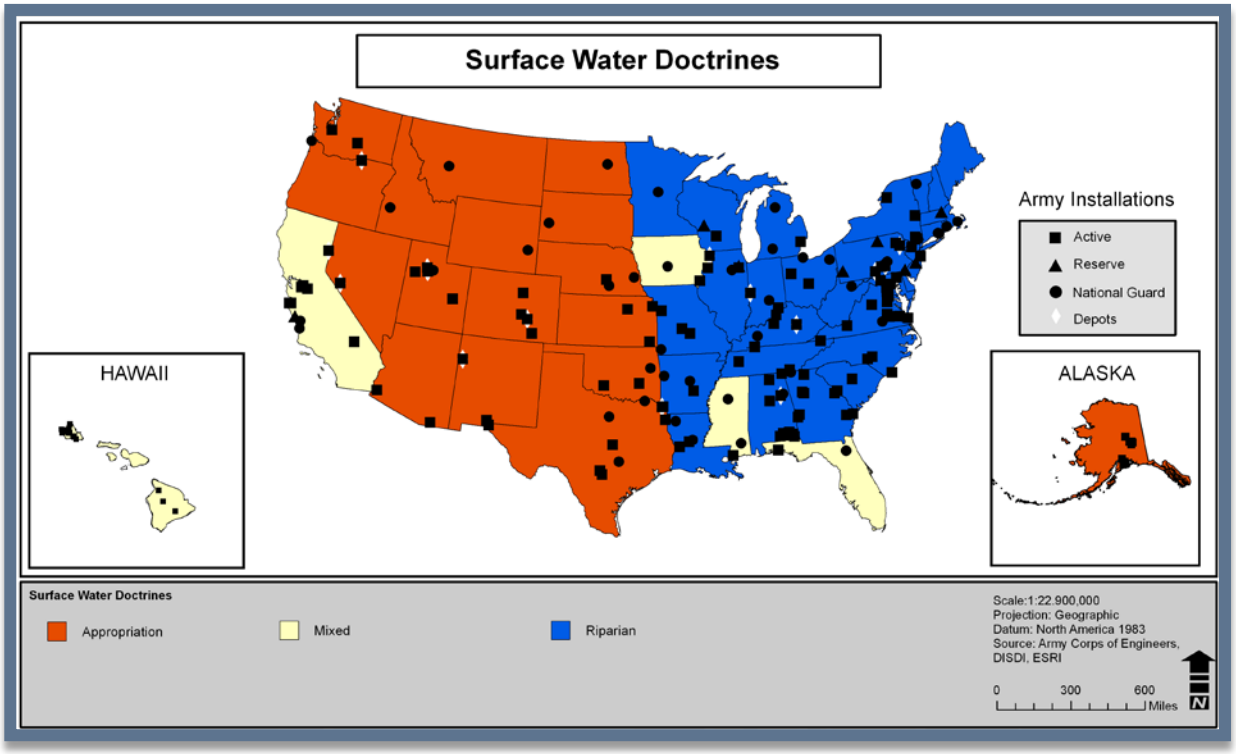
Agency/Office	Water Related Responsibilities
DEVELOPMENT	
U.S. Agency for International Development (USAID)	Provide assistance with drinking water, sanitation, and hygiene, water productivity and efficiency, water governance and regulation, water and natural resources management, natural disasters and climate change.
U.S. Army Corps of Engineers (USACE) Institute of Water Resources (IWR)	Supports international collaboration on water resources issues through its International Center for Integrated Water Resources Management (ICIWaRM).
USACE Districts (OCONUS)	Supports infrastructure development needs in country (particularly Afghanistan and the Middle East).

APPENDIX V: OVERVIEW OF WATER RIGHTS

SURFACE WATER RIGHTS

Among different states, surface water law may be based on the doctrine of riparian rights, the doctrine of prior appropriation, or hybrid ("mixed") water rights systems that incorporate elements of both riparian rights and prior appropriation. Historically, eastern states have used the riparian system; western states tend to adhere to the prior appropriation doctrine (Figure A-3).[26]

Figure A-3. Surface Water Doctrines[27]



- **Riparian Rights.** The doctrine of riparian rights is based on the common law water allocation systems used throughout the eastern United States. In a riparian system, landowners are allowed to draw water from a source that passes through or adjacent to his or her property, within reason. Non-riparian landowners do not possess this right. However, some states have chosen to establish permit programs for riparian and non-riparian water users. Military installations in the eastern states have generally had few issues with accessing adequate water supplies, but with increasing

[26] U. S. Army, *Army Water Rights and the Judge Advocate*, 1992, 4-5.

[27] U. S. Army Corps of Engineers (USACE), *Technical Report 09-38: Army Installations Water Sustainability Assessment*, 2009, 25-27.

competition and dwindling supplies, ensuring installation water rights may become more controversial in the future.

- **Prior Appropriation.** The doctrine of prior appropriations adheres to a "first in time, first in right" principle and requires that the water diverted by the appropriator be put to a beneficial use. To protect a water right from other claimants, an appropriator must establish a priority date. This date could be determined as the date of the "intent to divert," or the date on which the appropriator first took steps to divert water. Water rights holders can be forced to relinquish their rights if the state determines that the water allocation is not being put toward a beneficial use, such as agricultural irrigation. In a water shortage situation, a senior appropriator is allowed to use his full allocation before a junior appropriator may use any water.
- **Hybrid Doctrine.** States following the hybrid doctrine at one time recognized riparian rights, but later converted to a system of appropriation while preserving existing riparian rights.[28] [29]

GROUNDWATER LAW

Four legal doctrines concerning groundwater are being applied among the states:

- **Absolute Ownership.** This rule allows a landowner to freely pump water, for any purpose, from sources underlying his or her property.
- **Reasonable Use**. Groundwater use is considered a property right, but the groundwater must be put toward a beneficial use.
- **Correlative Rights.** This rule allows landowners to use a reasonable amount of a connected groundwater supply, typically based on the proportion of land overlying the water source. Correlative rights doctrine also permits landowners whose properties do not overlie a groundwater source to pump from any existing surplus if the annual yield is regulated to ensure that the supply is not exhausted**.**
- **Appropriation.** As with surface water rights, appropriation doctrine for groundwater is based on the principal of "first in time, first in right." Water rights are not necessarily connected to property and may be bought or sold. In times of water shortage, senior users have priority.[30][31]

FEDERAL WATER RIGHTS

The analysis of the status of water rights is specific to each installation, highly specialized, and dependent on a careful legal review by the installation attorney. The following is a general discussion of federal water rights that may arise on Army installations.

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[28] U.S. Army, *Army Water Rights and the Judge Advocate*, 1992, 4-5.

[29] U. S. Army Corps of Engineers (USACE), *Army Installation Water Assessment*, 2009, 22-23.

[30] U. S. Army, *Army Water Rights and the Judge Advocate*, 1992, 4-5.

[31] U. S. Army Corps of Engineers (USACE), *Army Installation Water Assessment*, 2009, 23-25.

Federal installations own and can obtain water rights in support of their mission. The following list describes the primary ways installations can obtain water rights:

- **Federal Reserved Water Rights.** The doctrine of reserved rights recognizes that when the federal government withdraws land from the public domain to establish a reservation or installation, the federal government also has the "implied intent" to reserve un-appropriated water to fulfill the established purpose of the reservation, presently and in the future. Although federal law governs the administration of reserved water rights the "McCarran Amendment"[32] provides a limited waiver of sovereign immunity for "general stream adjudications"; in this situation, states can require the U.S. to quantify, assert, and define its federal water rights.
- **Cession.** On ceded lands, the cession authorization must be examined to determine whether the water rights were ceded with the land.
- **Preemption.** On non-reserved lands, when Congress has clearly and specifically exercised, either expressly or by necessary implication, its authority to preempt state water law, the federal installation will have the paramount water right. In the absence of such preemption, the presumption is that prior appropriation states retain control over allocation of un-appropriated water.[33]
- **Acquisition.** A federal installation may acquire an existing water right, either by purchase or eminent domain.
- **Legislation.** Congress may pass legislation to supersede state law to provide access to water rights for federal lands.

[32] 43 U.S.C. §666

[33] 6 U.S. Op. Off. Legal Counsel 328, 1982

APPENDIX VI: SUMMARY OF POLICY DRIVERS FOR WATER MANAGEMENT

The need for increased diligence in protecting water rights was recognized over two decades ago by an Army Science Board study [Army Science Board, 1988, *Report of the Ad Hoc Subgroup on Water Supply and Management on Army Installations in the Western United States*], and within several years roles and responsibilities associated with Army water rights protection were clarified, and policy and guidance for installations was issued. Table A-9 provides a summary of the key policy and guidance drivers for Army water rights and access.

Table A-9. Policy Drivers and Guidance for Water Management at Installations

Type	Publishing Office or Agency	Title	Year	Key Content Pertaining to Army Water Security
Federal	Congress	Clean Water Act (CWA)	1972	Regulates discharge of pollutants into water of the United States (Amended since 1972)
Federal	Congress	Endangered Species Act (ESA)	1973	May constrain water use to support species habitats
Federal	Congress	Safe Drinking Water Act (SDWA)	1974	Sets national drinking water standards (Amended since 1974)
Federal	Congress	Public Health Security and Bioterrorism Response Act	2002	Requires community water systems serving more than 3,300 people to develop Water System Vulnerability Assessments
Federal	Congress	Energy Independence and Security Act (EISA)	2007	Section 432 requires water evaluations of 25% of covered federal facilities each year. Section 438 defines stormwater control approaches for new federal construction projects
Federal	Congress	Title 10, US Code Chapter 169, Section 2866: Water conservation at military installations (http://uscode.house.gov/download/pls/10C169.txt)	na*	As amended, provides for receipt and use of incentives and water cost savings from utilities for water conservation
Federal	Federal Energy Management Program	Federal Water Efficiency Best Management Practices (http://www1.eere.energy.gov/femp/program/waterefficiency_bmp.html)	na*	Descriptions of 14 water efficiency approaches

Type	Publishing Office or Agency	Title	Year	Key Content Pertaining to Army Water Security
Federal	Executive Office of the President	Executive Order 13423 Strengthening Federal Environmental, Energy, and Transportation Management	2007	Establishes water use reduction goals for federal buildings
Federal	Executive Office of the President	Executive Order 13514 Federal Leadership in Environmental Energy and Economic Performance	2009	Water use reduction goals for federal agencies
Federal	Executive Office of the President: Climate Change Adaptation Task Force	Federal Agency Climate Change Adaptation Planning: Implementing Instructions	2011	Requires agencies to establish responses to climate and participate in interagency efforts
Doctrine and Policy	Department of Defense (DoD)	DoD Financial Management Regulation 7000.14	2009	Volume 12, Chapter 12. Identification, Retention and Use of Energy and Water Savings
Doctrine and Policy	DoD	DoD Instruction (DoDI) 4715.02 Regional Environmental Coordination	2009	Implements policy, assigns responsibilities, and prescribes procedures for coordination with state governments
Doctrine and Policy	DoD	DoD Instruction (DoDI) 4705.1 Management of Land-Based Water Resources in Support of Contingency Operations	2003	Updates policy, responsibilities, and procedures for management of land-based water resources in support of contingency operations to ensure inter-Service compatibility and interoperability of water support equipment.
Doctrine and Policy	Army	Army Regulation (AR) 210-20 Real Property Master Planning for Army Installations	2005	Describes use of Army Compatible Use Buffer (ACUB) for acquiring water rights
Doctrine and Policy	Army	AR 200-1 Environmental Protection and Enhancement	2007	Establishes policy concerning protection and management of natural water resources
Doctrine and Policy	Army	AR 210-14 Army Installation Status Report Program	2007	Establishes policy, roles and responsibilities concerning the ISR, which requires information concerning installation water resources
Doctrine and Policy	Army	AR 420-1 Army Facilities Management	2009	Chapter 22, Army Energy and Water Management Program, and Section 23-20. Water Resource Management Plans
Doctrine and Policy	Army	Army Posture Statement	2011	Reaffirms commitment to environmental stewardship

Type	Publishing Office or Agency	Title	Year	Key Content Pertaining to Army Water Security
Doctrine and Policy	Army	AR 525-13 Antiterrorism	2008	Prescribes policy and identifies standards for physical security
Doctrine and Policy	Army Installation Management (IMCOM)	Policy Memorandum 11-32-1 Operationalizing Sustainability	2011	Specifies sustainability roles and responsibilities and commits to institutionalizing Integrated Strategic Sustainability and Planning (ISSP)
Strategies and Plans	DoD	Defense Installations Strategic Plan	2007	Commitment to sustain water resources needed to support current and future missions
Strategies and Plans	DoD	Strategic Sustainability Performance Plan	2010	Measurement of water consumption against EO 13514 goals. Commitment to stormwater requirements of EISA, Section 438
Strategies and Plans	Army	The Army Strategy for the Environment	2004	Commitment to water conservation, safeguarding natural systems and coordinating with external stakeholders
Strategies and Plans	Army	The U.S. Army Energy Strategy for Installations	2005	Commitment to water conservation, collaboration with external stakeholders, and innovation
Strategies and Plans	Army	Memorandum: Army Metering Implementation Plan	2006	Plan developed for energy is offered as model for other utilities
Strategies and Plans	Army	The U.S. Army Energy and Water Campaign Plan (AEWMP)	2007	One of five major initiatives is water conservation, with eight associated actions explained in detail
Strategies and Plans	Army	Army Sustainability Campaign Plan	2010	Commitment to water conservation, protection of water resources, water security. Annex A indicates how water issues cut across multiple tasks
Strategies and Plans	Army IMCOM	Installation Management Community Campaign Plan 2010-2017	2010	Specifies installation-level actions, roles and responsibilities to increase water efficiency
Guidance	DoD	Military Handbook: Water Conservation	1997	Elements of water conservation planning and optional conservation methods
Guidance	DoD	Energy Managers Handbook	2005	Chapter 13, Water Conservation, calls for water management plans and water audits, describes conservation methods
Guidance	DoD	DoDI 4170.11 Installation Energy Management	2009	Provides guidance, describes roles and responsibilities, and prescribes procedures that encompass water conservation

Type	Publishing Office or Agency	Title	Year	Key Content Pertaining to Army Water Security
Guidance	DoD	DODI 2000.18 Department of Defense Installation Chemical, Biological, Radiological, Nuclear and High-Yield Explosive Response Guidelines	2002	Requires emergency response planning for threats to infrastructure, including water supply.
Guidance	DoD	Unified Facilities Criteria (UFC) 2-000-02AN Installation Master Planning	2005	Indicates need to evaluate hydrology and links to external water systems
Guidance	DoD	UFC 3-230-07A Water Supply: Sources and General Considerations	2004** (1987)	Broad guidance concerning water supply planning and development
Guidance	DoD	UFC 3-230-08A Water Supply: Water Treatment	2004** (1985)	Discusses water quality standards and water treatment design criteria
Guidance	DoD	UFC 3-230-09A Water Supply: Water Storage	2004** (1985)	Presents water storage design criteria and siting considerations
Guidance	DoD	UFC 3-230-10A Water Supply: Water Distribution	2004** (1986)	Provides water distribution design criteria
Guidance	DoD	UFC 3-230-11A Water Supply: Special Projects	2004** (1986)	Establishes minimum requirements for fire protection and potable water for small military projects
Guidance	DoD	UFC 3-230-12A Water Desalination	2004** (1986)	Provides guidance for desalination process design
Guidance	DoD	UFC 3-230-13A Water Supply: Pumping Stations	2004** (1992)	Provides guidance for pumping station design in water distribution systems
Guidance	DoD	UFC 3-230-19N Water Supply Systems	2005	Provides guidance for designing water supply systems
Guidance	DoD	UFC 3-600-1 Fire Protection Engineering for Facilities	2009	Prescribes water requirements for fire suppression
Guidance	Army	Technical Bulletin (Medical) (TB MED) 576 Sanitary Control and Surveillance of Water Supplies at Fixed Installations	1982	Guidance for ensuring water quality
Guidance	Army	Army Pamphlet (PAM) 200-1 Environmental Protection and Enhancement	2002	Chapter 2. Water Resources Management Program

Type	Publishing Office or Agency	Title	Year	Key Content Pertaining to Army Water Security
Guidance	Army	Installation Sustainability Planning Guide	2005	Development of installation sustainability plans, which include sustaining natural water bodies
Guidance	Army	Water efficiency web page (http://army-energy.hqda.pentagon.mil/policies/water_con.asp)	2011	Links to selected regulations, policies, and guidance documents
Guidance	USAPHC	TG 188 Army Food and Water Vulnerability Assessment Guide	2008	Provides a Water System Vulnerability Assessment (WSVA) protocol.
Guidance	Army Assistant Chief of Staff for Installation Management (ACSIM)	Water Quality Programs Guidance Document	2010	Introductory information about the Safe Drinking Water Program and the Clean Water Program
Guidance	Army Assistant Secretary of the Army (Installations, Energy and Environment) [ASA(IE&E)]	Installation Management Water Portfolio 2011-2017	2011	Provides Army examples of Federal water efficiency best management practices
Guidance	Army IMCOM	Installation Management Community Leader Handbook	2010	Support for Line of Effort 6 (Energy and Water) from IMCOM Campaign Plan. Description of Installation Status Reports
Guidance	Army Public Health Command	Technical Guide (TG) 297 Emergency Response Planning for Military Water Systems	2005	Guidance for Emergency Response Plan development
Guidance	United States (U.S.) Army Corps of Engineers (USACE)	Water Supply Handbook	1998	Comprehensive discussion of water supply concepts, policies and planning tools

*Not applicable as the source is a webpage.
** The content of this UFC is taken verbatim from a technical manual published in the year indicated in parentheses.

The Army's vital interest in ensuring adequate water for the warfighter has resulted in numerous regulatory, doctrinal, policy, and guidance documents pertaining to water supply and wastewater for contingency operations. Key documents and recent studies are listed in Appendix Table A-10.

Table A-10. Policy Drivers and Guidance for Water Management at Contingency Bases

Type	Publishing Office or Agency	Title	Year	Key content pertaining to Army water security
Federal	Executive Office of the President	EO 12114 Environmental Effects Abroad of Major Federal Actions	1979	Directs agencies to establish policies and procedures concerning consideration of environmental effects abroad
Doctrine and Policy	DoD	DoD Instruction (DoDI) 4705.1 Management of Land-Based Water Resources in Support of Contingency Operations	2003	Updates policy, responsibilities, and procedures for management of land-based water resources in support of contingency operations to ensure inter-Service compatibility and interoperability of water support equipment.
Doctrine and Policy	DoD	DoD Directive (DoDD) 6050.7 Environmental Effects Abroad of Major Department of Defense Actions	1979 (Cert. 2004)	Establishes policies procedures concerning consideration of environmental effects, including water resources impacts
Doctrine and Policy	DoD	DoDD 6050.16 DoD Policy for Establishing and Implementing Environmental Standards at Overseas Installations	1991	Directs that environmental standards at overseas installations be established
Doctrine and Policy	DoD	DoDD 4705.1 Management of Land-Based Water Resources in Support of Contingency Operations	1992 (Cert. 2003)	"Designates the Secretary of the Army as the DoD Executive Agent for land-based water resources"
Doctrine and Policy	DoD Joint Chiefs	Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3170.01G Joint Capabilities Integration and Development System	2009	Establishes policies and procedures for Joint Capabilities Integration and Development System (JCIDS), including Capability Based Assessments (CBAs)
Doctrine and Policy	DoD Joint Chiefs	Joint Publication (JP) 4-03 Joint Bulk Petroleum and Water Doctrine	2003	Establishes doctrine for bulk water support
Doctrine and Policy	DoD Joint Chiefs	JP 3-34 Joint Engineer Operations	2007	Provides doctrine concerning water supply

Type	Publishing Office or Agency	Title	Year	Key content pertaining to Army water security
				and sanitation engineering
Doctrine and Policy	Army	AR 700-136 Tactical Land-Based Water Resources Management	2009	"[E]stablishes policy and assigns responsibilities for the management of water resources in support of tactical operations"
Guidance	Army	Field Manual (FM) 10-52 Water Supply in Theaters of Operations	1990	Presents concepts and doctrine designing a water purification, storage, and distribution system
Guidance	Army	FM 10-52-1 Water Supply Point Equipment and Operations	1991	Provides doctrine for establishment of a water supply point and operation of equipment
Guidance	Army	FM 5-484 Multiservice Procedures for Well Drilling Operations	1994	Guidance for siting, planning, designing, drilling and constructing wells
Guidance	Army	FM 3-34-400 General Engineering	2008	Chapter 16. Water Supply and Well Drilling (3 pages)
Guidance	Army	FM-3-34 Engineer Operations	2009	Discusses engineer functions that include development of water supply and sanitation systems
Guidance	Army	TB MED 577 Sanitary Control and Surveillance of Field Water supplies	2010	Provides instructions for ensuring potable water quality
Guidance	Army Combined Arms Support Command (CASCOM)	Water Planning Guide	2008	Provides water consumption rates for different uses and climates
Guidance	Army Central Command (CENTCOM)	Regulation 415-1 Construction and Base Camp Development in the USCENTCOM Area of Responsibility "The Sand Book"	2007	Requires environmental reports, provides Environmental Baselines Survey Template, with queries about available raw water and infrastructure
Guidance	Army Force Management School	Capabilities Development and System Acquisition Management: Executive Primer	2011	Describes Integrated Capabilities Development Team (ICDT) function and Capabilities Based Assessment (CBA) process in the context of

Type	Publishing Office or Agency	Title	Year	Key content pertaining to Army water security
				Joint Capabilities Integration and Development System (JCIDS)
Authorized Studies	Booz Allen Hamilton	Water Security as a Strategic Risk to Sustained Military Operations	2010	Presents an analysis of policies and practices associated with the use of bottled drinking water
Authorized Studies	DoD Inspector General	Report D-2008-060 Audit of Potable and Nonpotable Water in Iraq	2008	Assessment of the adequacy of water supply for forces in Iraq
Authorized Studies	Army	Functional Solution Analysis (FSA) for Base Camps For Full Spectrum Operations (2015–2024)	2011	Identifies needs and alternative solutions concerning water and wastewater
Authorized Studies	Army/RAND	Green Warriors: Army Environmental Considerations for Contingency Operations from Planning Through Post-Conflict	2008	Describes how water issues are a key concern in post-conflict and reconstruction phases
Authorized Studies	Army Audit Agency (AAA)	Army Strategy for Establishing, Sustaining, and Transitioning Non-Traditional Installations	2010	Highlighted need for overall strategy to manage
Authorized Studies	Army Science Board (ASB)	Strengthening Sustainability and Resiliency of an Expeditionary Force (in progress)	TBD***	Provides “an overarching architecture of a Brigade Combat Team’s requirements for external support, including water”
Authorized Studies	Army Sustainment Center of Excellence (SCoE)	Sustainment FSA (Draft)	2011	Identifies needs and alternative solutions concerning water and wastewater.
Authorized Studies	Army Training and Doctrine Command (TRADOC)	TRADOC PAM 525-7-7 The United States Army Concept Capability Plan for Army Base Camps in Full Spectrum Operation for the Future Modular Force 2015-2024	2009	Discusses “planning and design, construction and deconstruction, and operations and management of base camps” to provide foundational information for a CBA.
Authorized Studies	U.S. Army Corps of Engineers (USACE) Engineer Research and Development	Technical Report (TR) 08- Draft Sustainable, Full Spectrum Contingency Operations (CONOPS) Gap	2008	Discusses gaps, current practice, and alternative solutions concerning water and wastewater

Type	Publishing Office or Agency	Title	Year	Key content pertaining to Army water security
	Center (ERDC) / Construction Engineering Research Laboratory (CERL)	Assessment		
Authorized Studies	USACE ERDC/CERL	Analysis of Policy and Guidance Regarding Sustainability and Environmental Considerations in Overseas Contingency Operations in the Joint, Interagency, Intergovernmental, and Multinational (JIIM) Environment	2011	Identifies key documents concerning sustainability and the environment and recommends changes to Annex L of Operation Plans (OPLANs)
Authorized Studies	Army Environmental Policy Institute (AEPI)	Sustain the Mission Project: Energy and Water Costing Methodology and Decision Support Tool	2008	Offers a tool for calculating fully burdened costs of water
Authorized Studies	AEPI	Sustain the Mission Project: Casualty Factors for Fuel and Water Resupply Convoys	2009	Evaluates risk of casualties for water supply convoys

***To be determined as draft has not been released.