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Green Warriors

Army Environmental Considerations for Contingency Operations from Planning Through Post-Conflict

David E. Mosher, Beth E. Lachman, Michael D. Greenberg, Tiffany Nichols, Brian Rosen, Henry H. Willis

Prepared for the United States Army

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Preface

Environmental issues have become increasingly important in contingency operations the U.S. Army conducts overseas. Countries in which the Army conducts operations tend to have environmental problems caused by industrialization, lack of environmental protection, long-running conflict, and natural conditions. This situation creates health and safety risks for soldiers, can affect missions, and can increase the importance of life-sustaining environmental infrastructures for such things as clean water, sewage disposal, and agriculture to provide food for the local populace.

Prompted by the growing importance of environmental considerations in military operations, the Army Environmental Policy Institute (AEPI) asked RAND to examine how the Army approaches this issue in overseas contingency operations, particularly during the post-conflict and reconstruction phases. It also asked RAND to identify existing problems and gaps in policy, doctrine, and guidance and to propose solutions the Army could adopt to address them. This report should be of interest to the environmental community within the Army, the Office of the Secretary of Defense (OSD), and the other Services, as well as to other military planners, operators, trainers, and policymakers.

The report concludes that environmental considerations—including clean water, sanitation, hazardous-waste management—can be important for achieving overall U.S. objectives during reconstruction and post-conflict operations, including both short- and long-term stability. If not properly addressed in planning or operations, environmen-

tal considerations can increase the costs of an operation and make it more difficult for the Army to sustain the mission. Yet, environmental considerations are not well incorporated into Army planning or operations in any phase of an operation. To address these shortcomings, the Army should take additional steps to ensure that environmental considerations (from strategic to tactical) are appropriately incorporated into planning, operations, training, and research.

The research was carried out in RAND Arroyo Center's Strategy, Doctrine, and Resources Program. RAND Arroyo Center, part of the RAND Corporation, is a federally funded research and development center sponsored by the U.S. Army.

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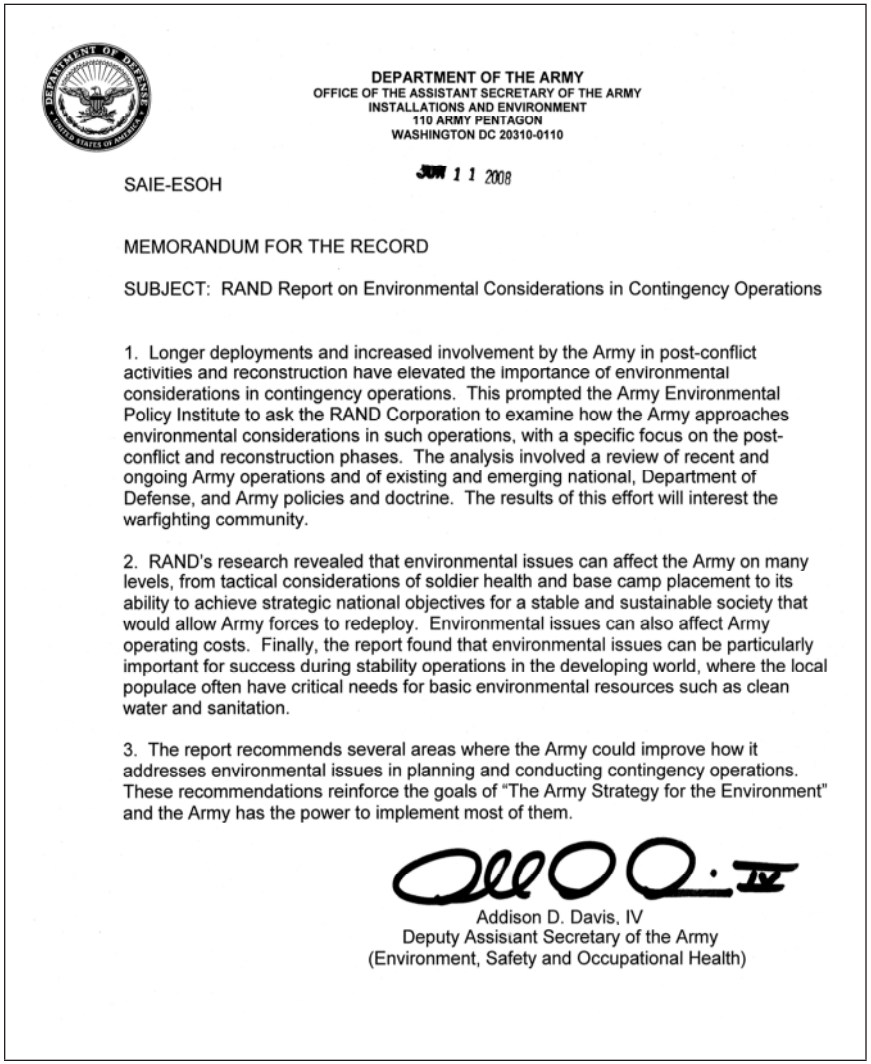

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MEMORANDUM FOR THE RECORD

SUBJECT: RAND Report on Environmental Considerations in Contingency Operations

1. Longer deployments and increased involvement by the Army in post-conflict activities and reconstruction have elevated the importance of environmental considerations in contingency operations. This prompted the Army Environmental Policy Institute to ask the RAND Corporation to examine how the Army approaches environmental considerations in such operations, with a specific focus on the post-conflict and reconstruction phases. The analysis involved a review of recent and ongoing Army operations and of existing and emerging national, Department of Defense, and Army policies and doctrine. The results of this effort will interest the warfighting community.

2. RAND's research revealed that environmental issues can affect the Army on many levels, from tactical considerations of soldier health and base camp placement to its ability to achieve strategic national objectives for a stable and sustainable society that would allow Army forces to redeploy. Environmental issues can also affect Army operating costs. Finally, the report found that environmental issues can be particularly important for success during stability operations in the developing world, where the local populace often have critical needs for basic environmental resources such as clean water and sanitation.

3. The report recommends several areas where the Army could improve how it addresses environmental issues in planning and conducting contingency operations. These recommendations reinforce the goals of "The Army Strategy for the Environment" and the Army has the power to implement most of them.

Addison D. Davis, IV
Deputy Assistant Secretary of the Army
(Environment, Safety and Occupational Health)

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Summary

Background and Purpose

Since 1991, the United States has engaged in military operations in the Middle East, Central Asia, Africa, Europe, the Pacific Basin, and the Caribbean. In many instances, U.S. forces have remained in these areas far longer than was initially anticipated. As a result, U.S. forces have become closely involved in such activities as stability operations, reconstruction, and nation-building. Frequently, these activities are as important to accomplishing the long-term U.S. goals as the combat operations that may have preceded them.

The longer stays and involvement in post-conflict activities have elevated the importance of environmental considerations in U.S. military operations, for a variety of reasons. First, conflicts often occur in countries where the environment poses risks to U.S. forces. Disease, polluted air or water, or toxic substances may present a high risk when the troops remain in the country for only a short time, but a long-term presence greatly increases it. Second, the actions of U.S. forces with respect to the environment become more important because of their effect on the local populace and its support for U.S. goals, including return to local governance. Therefore, U.S. forces need to ensure that they do not contribute to environmental problems by disposing of waste improperly, failing to address environmental problems they create (e.g., fuel spills), or damaging important natural or cultural resources such as farmland and water supplies. Third, reconstruction projects and other activities that improve local environmental conditions can foster a positive attitude toward the United States and the

host-nation government that it is supporting. This goodwill can have tangible benefits for U.S. national objectives: It can aid the economic and social developments necessary for long-term stability and improve cooperation with locals, which in turn can improve intelligence, lower security risks, and speed construction and transition to civilian government. Finally, environmental effects can easily transcend national borders, spilling over into neighboring or even distant countries. Given the importance of other countries to U.S. global military activities, it is important to maintain good relations with them, and poor environmental practices can hinder that process.

The growing importance of environmental considerations in military operations prompted the Army Environmental Policy Institute (AEPI) to ask the RAND Arroyo Center to assess how the Army approaches environmental considerations in overseas contingency operations, including planning, training, and operations. The aim of this assessment was to determine whether existing policy, doctrine, and guidance adequately address environmental activities in post-conflict military operations and, increasingly, in reconstruction. Where we found gaps and problems, we proposed changes the Army might adopt to improve its ability to accomplish military and national objectives. Because environmental issues can affect mission and national objectives, the study results are important not only to the Army's environmental community, but also to operators, planners, trainers, and policymakers within the Army and the other Services.

Sources of Information

We drew information from a broad range of sources, including regulatory and doctrinal publications published by the Department of Defense (DoD), the Joint Staff, and the Army. We also reviewed U.S. and international statutes pertaining to environmental issues. Additionally, we interviewed a wide range of people with environmental responsibilities or experience both inside and outside the Army. We also scoured the open literature for examples of environmental effects and best practices. Finally, we compiled a database of operational expe-

rience with environmental issues from a variety of contingency operations where actions by the Army or other entities had either a positive or a negative effect on mission objectives. The database contains 111 cases.

Findings and Recommendations

Our analysis produced seven major findings:

- Environmental issues can have a significant impact on operations.
- Environmental considerations can be particularly important for success in the post-conflict phase of operations.
- Environmental considerations in contingency operations differ significantly from those in normal operations in the United States.
- Environmental issues can have far-reaching impacts across operations, Army organizations, and the world.
- Inadequate environmental practices in contingency operations can increase current and future costs, liabilities, diplomatic problems, and risks to soldier health.
- The Army could improve its understanding of environmental considerations and could incorporate them more effectively into plans and operations.
- The Army has no comprehensive approach to environmental considerations in contingencies, especially in the post-conflict phase.

In light of these findings, we recommend the following:

- The Army needs to improve its policy and guidance for environmental considerations in contingency operations. It should work with DoD to develop guidance that applies irrespective of location.
- The Army needs to bring about a cultural change regarding the ways environmental issues are viewed and handled in contingen-

cies. Such change is difficult and will require a broad-based effort that includes changes in doctrine, training, and equipment.

- The Army needs to improve the incorporation of environmental considerations into planning. This would help foster the cultural change referred to above.
- The Army needs to improve pre-deployment and field environmental training.
- The Army needs to invest more in environmental resources and good environmental practices in field operations.
- The concept of sustaining the mission as defined in *The Army Strategy for the Environment*[1] provides a useful model for approaching environmental considerations in contingency operations, particularly during the post-conflict phase. The concept uses an integrated approach to planning and operations that recognizes the interrelationships of mission, environment, and the community (which includes the local population, host nations, and U.S. troops). This approach has already been adopted by parts of the Army. Employing it more widely would reinforce our other recommendations.

Most of these recommendations are within the Army's power to execute. The recent DoD directive on stability and reconstruction could provide a powerful tool for implementing them.[2] However, we recognize that some will not be easy to implement, particularly effecting a cultural change. Nevertheless, a substantial body of operational experience underscores the importance of environmental issues in achieving the nation's strategic goals for launching a contingency operation in the first place. It does no good to win the war only to forfeit the peace.

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[1] United States Army, 2004 (http://www.asaie.army.mil/Public/IE/default.html).

[2] Department of Defense, DODD 3000.05, 2005.

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Needless to say, any errors and oversights are those of the authors alone.

Acronyms

AFMIC	Armed Forces Medical Intelligence Center
AOR	area of responsibility
AR	Army Regulation
ARNG	Army National Guard
CA	civil affairs
CALL	Center for Army Lessons Learned
CENTCOM	Central Command
CFLCC	combined force land-component commander
CHPPM	Army Center for Health Promotion and Preventive Medicine
CONUS	continental United States
CSIS	Center for Strategic and International Studies
CWC	Chemical Weapons Convention
DoD	Department of Defense
DODD	Department of Defense directive
DODI	Department of Defense instruction
DOTMLPF	doctrine, organizations, training, materiel, leadership, personnel, and facilities
DRMS	Defense Reutilization and Marketing Service
EBS	environmental baseline survey

EHSA	environmental health site assessment
ENMOD	Environmental Modification
EO	Executive Order
EOD	explosive ordnance disposal
ESOH	environment, safety, and occupational health
EUCOM	U.S. European Command
FCA	Foreign Claims Act of 1982
FGS	final governing standards
FM	Army field manual
FTCA	Federal Tort Claims Act
HAZMAT	hazardous materials
HN	host nation
ICC	International Criminal Court
ICJ	International Court of Justice
IED	improvised explosive device
IRI	International Republican Institute
JAG	Army Judge Advocate General
JEMB	Joint Environmental Management Board
JFC	joint force commander
JFE	joint force engineer
JP	Joint Publication
JTF	joint task force
MANSCEN	Maneuver Support Center
MCRP	Marine Corps Reference Publication
MEJA	Military Extraterritorial Jurisdiction Act of 2000
NCO	non-commissioned officer
NEPA	National Environmental Policy Act
NGO	non-governmental organization

O&M	operations and maintenance
OCONUS	outside the continental United States
OEBGD	Overseas Environmental Baseline Guidance Document
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OJE	Operation Joint Endeavor
OPLAN	operation plan
OPORD	operation order
ORI	Oxford Research International
OSH	occupational safety and health
OSHA	Occupational Safety and Health Administration
PM-10	particulate matter up to 10 microns in size
POL	petroleum, oil, and lubricants
R&D	research and development
RCA	riot-control agent
RCRA	Resource Conservation and Recovery Act of 1976
RDT&E	research, development, test, and evaluation
SOFA	status-of-forces agreement
SOP	standard operating procedure
SSTR	stability, security, transition, and reconstruction
SWET	sewage, water, electrical, and trash
UN	United Nations
UNEP	United Nations Environment Programme
UNSC	United Nations Security Council
USACE	U.S. Army Corps of Engineers
USAID	U.S. Agency for International Development
USAREUR	U.S. Army in Europe

U.S. EPA	U.S. Environmental Protection Agency
USMC	U.S. Marine Corps
UXO	unexploded ordnance

CHAPTER ONE

Introduction

Background

In the past few decades, the United States has been involved in contingency operations throughout the world. Since the end of the Cold War, U.S. combat forces have deployed to the Persian Gulf region to oust Iraqi forces from Kuwait in 1990–1991; Somalia to provide humanitarian assistance amid the chaos in 1992–1993; Bosnia in 1996 and Kosovo in 1999 to enforce peace agreements; Haiti to provide stability in 1997; Afghanistan to remove the Taliban from power in 2001; and Iraq to end the Saddam Hussein regime in 2003. Not only have U.S. forces been involved in more contingency operations[1] in recent years, they have remained in many of those theaters for years longer than initially expected. As a result, Army forces have become increasingly

[1] Joint Publication 1-02, *DOD Dictionary of Military and Associated Terms*, defines a contingency operation as "a military operation that is either designated by the Secretary of Defense as a contingency operation or becomes a contingency operation as a matter of law (10 United States code (USC) 101[a][13]). It is a military operation that: a. is designated by the Secretary of Defense as an operation in which members of the Armed Forces are or may become involved in military actions, operations, or hostilities against an enemy of the United States or against an opposing force; or b. is created by definition of law. Under 10 USC 101 (a)(13)(B), a contingency operation exists if a military operation results in the (1) callup to (or retention on) active duty of members of the uniformed Services under certain enumerated statutes (10 USC Sections 688, 12301(a), 12302, 12304, 12305, 12406, or 331-335); and (2) the callup to (or retention on) active duty of members of the uniformed Services under other (non-enumerated) statutes during war or national emergency declared by the President or Congress" (Joint Chiefs of Staff, 2006).

involved in the post-conflict phase of the operations, which includes stabilizing the country, reconstruction, and nation-building.[2] Environmental issues have become an important part of these operations,[3] particularly when U.S. forces remain in the region for long periods or the political goals include winning support of the local population for U.S. forces and newly formed governments.

Every time U.S. forces deploy overseas in a contingency operation, they affect and are affected by the environment in their area of operations in many different ways, as illustrated in Figure 1.1. First, geographic circumstances (climate, geography, weather) can directly affect Army operations, and environmental problems (disease, exposure to toxic substances) can affect soldier health. Soldier ill health can, in turn, consume resources and can affect combat effectiveness.

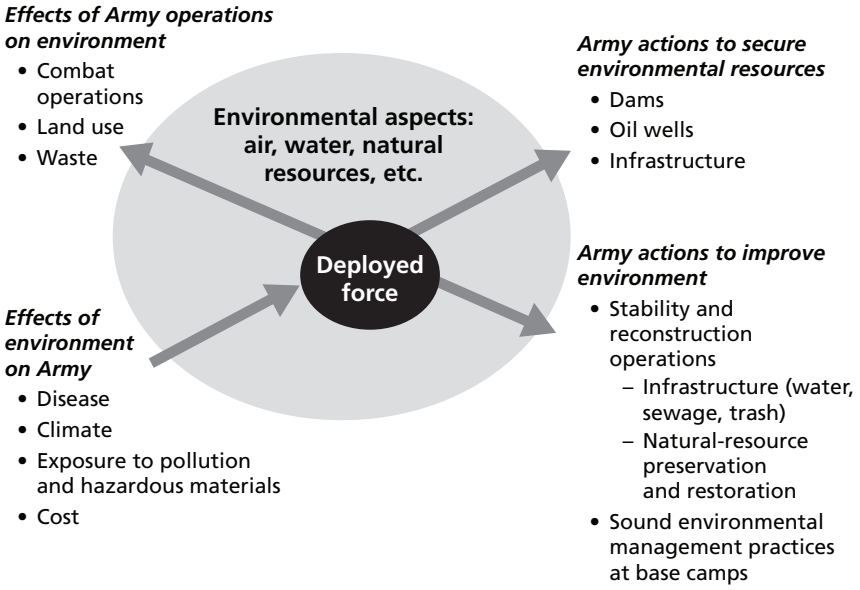
Second, the Army's effect on the environment begins as soon as soldiers arrive in the theater of operations, either in the country that is the focus of the operation or in neighboring countries that are supporting U.S. operations in the region. In addition, Army forces can affect the environment through the normal course of combat operations.

---

[2] For years, the Army and the Department of Defense (DoD) have considered contingency operations to have four phases: deter/engage; seize the initiative; decisive operations; and transition, which is often called post-conflict (see Joint Publication 3-0, 2001, pp. IV-22 through IV-24). Based on its experiences in Afghanistan and Iraq, the military changed the definition in its 2006 update of Joint Publication 3-0 to include six phases, splitting the transition phase into two phases—stabilize and enable civilian authorities—and adding a pre-conflict phase (see Box 2.1 on p. 19).

[3] Technically, the term "environment" refers to the sum of all external conditions affecting the life, development, and survival of an organism (U.S. EPA, http://www.epa.gov/OCEPAterms/eterms.html). The term "environmental issues" refers to issues such as air quality, water quality and supply, hazardous materials, solid and hazardous wastes, chemical and toxic substances, noise pollution, and land and natural-resource concerns (species, ecosystems, habitats, soil quality, arable lands, wetlands, watersheds, etc.). Another important environmental issue is management of environmental infrastructures, such as wastewater treatment plants and landfills. In addition, for the Army, cultural resources are considered an environmental issue, even though they are not in the traditional definition. These and other environmental terms are defined in footnotes where they first appear and also in the glossary of selected environmental terms at the end of this report.

Figure 1.1.
The Interaction Between Deployed Forces and the Environment



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Third, the deployed force may take deliberate actions to secure environmental resources such as dams, oil wells, and water supplies, either to ensure that military operations are not affected by their destruction or to secure them for more-strategic purposes such as nation-building.

Fourth, the Army may take deliberate steps to limit the environmental effects of its presence or to improve legacy environmental conditions, such as helping to rebuild drinking-water and sewage-treatment infrastructure, as part of an overall post-conflict strategy to contribute directly to establishing stability or nation-building or to leave a positive legacy in the region. The Army may also implement sound environmental management practices, such as good housekeeping of hazardous materials, because it makes good business sense and can reduce support costs and political and financial liabilities for the operation. For all these reasons, environmental issues can have a significant effect on different aspects of Army contingency operations.

The extent to which the environment can directly affect military operations or to which the Army should take environmental considerations into account in its plans and operations depends on the specifics of the operation, including the situation on the ground, the military objectives, and the ultimate goals of the operation. However, scant policy, doctrinal, or training support exists to help commanders make informed decisions about environmental issues during a contingency operation.

This gap reflects the fact that the common perception in many parts of the operational Army is that environmental considerations are all about complying with the United States' complex system of laws and regulations at home installations or training facilities in the United States. These laws and regulations include procedures for reporting and managing hazardous materials and wastes, protecting threatened and endangered species, and long-term management of training lands and installations. Units stationed at permanent bases overseas must comply with established final governing standards that respect local host-nation laws. The Army already expends significant effort and resources addressing these environmental concerns at installations and training facilities. *The Army Strategy for the Environment*[4] takes those efforts one step further by approaching environmental issues from the perspective of sustaining Army operations far into the future and strategically addressing the interrelationships of mission, environmental, and community concerns. However, regulatory compliance and installation environmental management may not seem relevant in many contingency operations, where U.S. laws do not apply, host-nation laws may be minimal or nonexistent, and local environmental conditions may be severely degraded.

As a result, in contingency operations, environmental issues are not given the same priority as force protection and safety, and they are generally relegated to base-camp managers, many of whom are Army engineers. Little attention is paid to the strategic implications of the environment on the desired outcome of a contingency. In many instances, this may be appropriate, particularly during combat—com-

[4] U.S. Army, 2004.

manders are rightly more concerned about the immediate military threats to their soldiers than about the long-term consequences of exposure to a pollutant that might increase cancer risks[5] in 30 years. But in other circumstances, paying attention to environmental considerations may be more appropriate, particularly for post-conflict operations, peacekeeping, and nation-building, where mission success may depend on it.

Why Should Commanders Care About Environmental Issues in Contingency Operations?

We approached this question from the perspective of accomplishing Army missions in contingency operations, not from the normative perspective of the greater environmental or social good that results from protecting the environment. Using this approach, we arrived at a two-fold answer: First, the environment can affect the health and safety of soldiers. Second, the environment can affect the ability of commanders to accomplish their mission and achieve U.S. national objectives. We also found that the longer Army forces must remain in the theater of operations, the more important environmental issues can become.

Indeed, in the war on terrorism, the nature of contingency operations may be changing. Recent experience suggests that ongoing and future contingencies will feature large stability, security, transition, and reconstruction (SSTR) components, will involve longer stays in-theater, and will require the Army to perform functions that have historically been managed by other U.S. government agencies, international organizations, or non-governmental organizations (NGOs). These factors elevate the importance of treating environmental issues more explicitly and systematically in planning, operations, and training.

Environmental Issues Can Affect Soldier Health and Safety

Often the most direct effect of the environment is on soldiers. Endemic diseases can significantly affect unit readiness if soldiers are not prop-

[5] Joint Publication 1-02 defines risk as the probability and severity of loss linked to hazards (www.dtic.mil/doctrine/jel/doddict).

erly vaccinated, taught how to protect themselves or control animal or insect vectors for those diseases, or advised on how to avoid high-risk areas.[6] Legacy environmental contamination can sicken soldiers, particularly when base camps are located improperly or soldiers are not taught how to handle the potentially hazardous materials they encounter. Poor sanitation practices can cause soldiers to fall ill, as can poor management of hazardous materials that Army forces generate.

A hazardous environment can also raise force-protection issues. For example, bedding down or locating a base camp near an industrial facility increases the threat that toxic industrial chemicals and materials stored or produced in the facility could be used against soldiers. In one case, the Tamil Tigers, an insurgent group in Sri Lanka, used chlorine gas to injure soldiers.[7] The 1984 accident at the Union Carbide plant in Bhopal, India, where thousands of people died from a leak of methyl isocyanide and hydrogen cyanide gas, suggests the dangers of locating soldiers in potentially hazardous areas. Hazardous wastes[8] or materials stored at base camps can also be used against soldiers.

Environmental Issues Can Affect Mission Success

Commanders are concerned about achieving desired tactical outcomes and mission objectives, and the environment can be an important factor in each of them. It can also be a factor in achieving national objectives for an operation.

Tactical outcomes can be adversely affected by weather, geography, and geology, which can enable or limit tactical operations. Threats from natural resources such as water (e.g., water stored in dams) and oil fields can also affect operations. Dams can be destroyed by the

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[6] The Army takes what it calls "disease and non-battle injuries" very seriously and works hard to minimize them. As a result, rates of disease and non-battle injuries have been steadily improving over the years. The discussion of health risks in this study does not imply otherwise.

[7] See Parachini, 2003.

[8] The U.S. Environmental Protection Agency (U.S. EPA) defines hazardous wastes as by-products of society that can pose a substantial or potential hazard to human health or the environment when improperly managed. They possess at least one of four characteristics—ignitability, corrosiveness, reactivity, or toxicity—or appear on special EPA lists.

enemy to impair the Army's ability to advance. Oil wells can be set on fire—Iraqi forces did this in 1991 to cause economic and environmental damage to Kuwait.

The environment may also be important during the post-conflict phase of an operation,[9] or even before combat operations end. Providing clean water, managing sewage, or providing irrigation water can be important for convincing the local populace to support the U.S. mission and not an insurgency, according to some commanders.[10] Although these are not traditional Army missions, they can have an important effect on the outcome of an operation, from both a military and a political perspective. Addressing legacy problems can also help a new government develop legitimacy and can enable U.S. forces to withdraw from the country sooner. Indeed, many of the goals of stability operations defined in the 2006 edition of JP 3.0, *Joint Operations*, can have environmental components.

Operational effectiveness can be hampered by poor environmental practices or helped by good ones. Logistics requirements and costs can be reduced by good practices, for instance, applying technologies to reduce operational requirements for petroleum, oil, and lubricants (POL) or field water treatment systems, or reducing acute threats to soldier health. Good environmental practices can also reduce the resources that must be diverted to address environmental issues.

Commanders may also want to reduce or prevent liabilities, either financial or diplomatic. Good environmental awareness and practices during contingency operations can reduce the financial liabilities the Army and the United States may face. On more than one occasion in recent operations, contractors have removed hazardous wastes from base camps and, without Army knowledge, dumped them along the side of a road or in other inappropriate locations, sometimes to avoid

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[9] Post-conflict operations are conceptually easy to separate from combat operations, but as experience in Iraq has shown, the line is not always clean in practice—stabilization and reconstruction operations can be under way even though combat operations are taking place. Indeed, Joint doctrine now emphasizes that the different phases of combat may overlap and that stabilization and reconstruction activities may be occurring simultaneously with other phases (JP 3-0, 2006, p. IV-25).

[10] See Major General Chiarelli's comments in Jaffe, 2004.

disposing of them properly or to sell the drums that hold the wastes. These actions have created cleanup costs for the Army that are many times higher than the original price of the contract. In other cases, the Army has had to spend large sums to remediate serious preexisting environmental contamination at base camps, expenses that could have been avoided if the base camps had been located elsewhere.

Financial liabilities can also arise from claims brought by U.S. soldiers who believe they were exposed to hazardous substances, as the Army's past experiences with Agent Orange and Gulf War Illness illustrate.[11] Members of the local populace may also bring claims against the Army for environmentally related damage, draining funds that could be more effectively used for reconstruction or stabilization activities.

Inadequate attention to environmental issues can also create diplomatic liabilities. Illegal dumping by contractors and poor waste-management practices by soldiers have caused immediate diplomatic problems with host nations whose support has been critical. Long-term diplomatic problems from environmental problems can also emerge years after an operation is over.

Perhaps most important are the environmental issues that can affect U.S. national objectives, those strategic political and economic objectives that U.S. leaders established when they committed forces to the contingency operation in the first place. One such national objective may be winning and maintaining support of the local populace. Although environmental conditions may be poor and national environmental laws may be weak or nonexistent, our research indicates that locals often care deeply about the environment, which can be critical to their survival, livelihood, and well-being. Vital environmental issues can include access to clean drinking water, effective sewage systems, and viable farmland (see Box 1.1). Restoring or building these basic infrastructures is often essential for the economic and social development necessary for stability. To the extent that such projects improve cooperation with locals, they can lower security risks, improve intel-

[11] See, for example, *A Review of the Scientific Literature as It Pertains to Gulf War Illnesses*, Volumes 1–8, RAND MR-1018/1-OSD through MR-1018/8-OSD2001; and U.S. Department of Veterans Affairs (http://permanent.access.gpo.gov/lps49045/agentorangefs.htm).

ligence, and speed reconstruction. National objectives that have environmental components also include preserving natural resources that have important economic value (such as oil fields or fisheries) and even preserving cultural resources that are a matter of national, regional, religious, or cultural pride. If long-term stability of a country is a mission objective, sustainability and the long-term health of natural systems, including watersheds, forests, ecosystems, biodiversity, and farmlands, are also important. Local customs and practices can take the place of laws, and therefore military leaders, when designing plans and

Box 1.1
Water Issues Are Often a Key Concern During Post-Conflict and Reconstruction

Water issues are a major concern in post-conflict operations and reconstruction activities. Clean drinking water is essential for U.S. soldiers and the local population. Given the degraded environmental conditions in many of the countries of conflict, access to clean drinking water and managing sewage can be major concerns, especially in the prevention of waterborne infections. For instance, during summer 2004, diseases such as typhoid and hepatitis were rampant in Baghdad. Supplying clean drinking water is therefore a key reconstruction priority in such areas.

Repairing and building wells and wastewater treatment facilities are often key post-conflict and reconstruction tasks that the Army has been performing in place of the civilian organizations and NGOs that have historically taken on such responsibilities. Many of these projects are conducted to reduce health risks to soldiers, but they also meet reconstruction needs and can help win and maintain support of the local people.

Watershed management, river and canal flows, and wetlands are also important concerns for stability and reconstruction. By 1999, the Mesopotamian Marshlands in Iraq had been reduced to 7 percent of their original size through years of unstainable water-management practices. The United Nations called the destruction of Iraq's wetlands "one of the world's great environmental disasters" because of the significance of this marshland to both regional species and migratory bird species. These wetlands also play an important role in the local economy. The U.S. Agency for International Development (USAID), the Iraqi Ministry of Water Resources, and the U.S. Army Corps of Engineers (USACE) are developing a water-management model that will aid efforts to reconstruct Iraq's historic water flow and help restore the wetlands. USACE developed a reservoir-system simulation model for use in both day-to-day operational decisions and long-term water-resource-management studies. The model will help manage the country's system of dams and canals. The United Nations Environment Programme (UNEP) and other nations, such as Japan, are also collaborating to help restore the wetlands. With U.S. help and international attention, some initial successes have been realized in restoring parts of the Mesopotamian Marshlands.

conducting operations, should understand how the local people interact with their environment.

The environmental components of national objectives are often seen as falling outside the normal conception of the military mission. Because they have little to do with combat operations or military objectives, they are often not taken into consideration during the Army's planning, training, or operations. Yet ignoring these broader political objectives can lead to failure, as Prussian military writer Carl von Clausewitz warned.[12] Thus, the environmental dimensions of national objectives should be carefully considered. The manner in which the military conducts its operations can affect environmental outcomes upon which the success of the overall mission may depend. There is some evidence that national objectives such as stabilizing societies after conflict are now being emphasized at the Army's combat training centers, but the degree to which environmental considerations are included is unclear.

U.S. efforts to address water, sewage, and trash issues are now widespread in Iraq, and many are being conducted by the Army and its contractors, sometimes with very good results. But the Army started these efforts later than it would have if U.S. civilian and military planners had fully appreciated their significance before the conflict began. Indeed, policy promulgated by DoD in late 2005 now recognizes the importance of stability and reconstruction in contingency operations, stating that they are just as important as combat operations and should be included in planning at all levels.[13] The extent to which this policy will affect the military's planning and conduct of operations is unknown at this time.

Long-Term Deployments Amplify the Importance of Environmental Issues

The longer U.S. forces remain in-theater, the more important environmental issues become to mission success and soldier health. As U.S. experiences in Bosnia, Kosovo, Afghanistan, and Iraq illustrate, quick

[12] von Clausewitz, 1956.

[13] See Department of Defense, DODD 3000.05, 2005.

exits are rare even after quick military victories. Moreover, civilian organizations (U.S. government, international agencies, and NGOs) may not arrive as quickly as expected, often because of concerns about security.

The effect of these delays is twofold: First, commanders must protect their soldiers from longer-term exposures to hazardous wastes, pollution, and diseases, whether those exposures are from conditions in the base camps or endemic to the area of operations. Consequently, more-comprehensive solutions to base-camp wastes, disease vectors, and health protection become necessary. Second, delays in the arrival of civilian organizations during the stabilization or nation-building phase have resulted in the Army having to undertake important infrastructure projects and other projects that address concerns of the local populace. Many of these projects, such as providing clean water or sewage treatment plants, providing water for irrigation, and controlling disease, involve environmental issues.

The Army's intensive involvement in stabilization and reconstruction is arguably one of the most compelling reasons for commanders to focus on environmental issues during planning and operations, in part because many more months can be spent in this phase of the operation than earlier phases and, in part, because success in this phase is key to the overall success of the mission.

The Importance of "Doing the Right Thing"

Although "doing the right thing" does not apply to the direct effects on mission and health discussed above, many in the Army believe in its importance. In our discussions with soldiers, so many of them talked about the importance of doing the right thing that we felt it was important to mention. Soldiers have come to expect the United States to treat the environment with respect. We have identified many examples of Army units doing things to protect or restore the environment, not because they had to, but because they believed it was the right thing to do. We also found a few cases where failure to protect the environment has hurt soldier morale.

Doing the right thing is an important part of the Army's values, as described in an Army field manual, FM 1, *The Army*.[14] It is noteworthy that this can and does extend to environmental considerations.

The Challenge of Incorporating Environmental Considerations into Contingency Operations

Despite the importance of environmental considerations to soldier health, stability and reconstruction, and mission success, environmental issues are often not adequately accounted for in the planning for and conduct of contingency operations. This shortfall ranges from mundane issues at base camps to high-level political goals for an operation. Our research suggests that the principal reason for the shortfall is the lack of emphasis in doctrine, training, and leadership. There are many environmental policies, doctrines, and regulations in place for installations and operations in the United States and at permanent facilities overseas, but virtually none of them apply to contingency operations. Training captures some elements: Anecdotal evidence suggests that soldiers arrive in the theater looking for the recycling bin for their water bottles or the oil recycling facility. But sound environmental practices are not emphasized in-theater, and soldiers quickly adapt to the more permissive atmosphere. Not only does training fail to emphasize environmental factors in planning, to advance either the military or national objectives in an operation, it does not seem to capture or exercise the steps required to appropriately site, establish, and operate base camps, particularly camps that are likely to remain in operation for more than a few months. Leadership education on environmental considerations in contingency operations also appears to be very thin, particularly regarding the need to ensure that environmentally related national-level objectives are captured in plans, that units are aware of the importance of environmental issues, and that they have standard operating procedures (SOPs) for environmental protection in the field.

[14] FM 1, paragraph 1-61 and Figure 1-2.

In addition, little institutional learning appears to be taking place within the Army, despite the fact that the Army ends up dealing with environmental issues time and again. U.S. forces in Iraq seem to be relearning many of the same base-camp lessons that had been learned in the Balkans in the 1990s. Nor does there appear to be much research and development (R&D) under way to help reduce the tightly linked logistical, financial, and environmental burdens of base camps.

Purpose and Methodology of This Report

This report attempts to assess whether existing policy, doctrine, and guidance adequately address environmental considerations in post-conflict military operations and, increasingly, in reconstruction.[15] It also proposes changes to policy, doctrine, training, and resourcing that might improve the Army's ability to accomplish military and national objectives.

Our definition of environment is relatively broad, but it is consistent with the Joint Staff's definition: "The spectrum of environmental media, resources, or programs that may impact on, or are affected by, the planning and execution of military operations. Factors may include, but are not limited to, environmental compliance, pollution prevention, conservation, protection of historical and cultural sites, and protection of flora and fauna."[16]

We have examined the problem from both the top down and the bottom up to find gaps in policy, training, leadership, capabilities, and implementation. From the top, we surveyed the policies and doctrine that DoD and the Army have in place that relate to the environment in contingency operations. We also examined the domestic and international legal context within which the Army conducts contingency

[15] Safety was not a major focus for this study because so much emphasis has been placed on safety issues in U.S. operations in Iraq and Afghanistan. However, safety issues that were identified as important and relevant are mentioned here, since some are closely linked to certain environmental concerns, such as dealing with toxic materials that are highly flammable.

[16] Joint Publication 1-02, 2006.

operations. From the bottom, we examined how environmental considerations have been incorporated into Army planning and operations, from base camps to combat operations to reconstruction activities.

Our methodology for the bottom-up analysis consisted of extensive interviews with a wide range of soldiers and other staff involved in contingency operations and a literature review of environmental considerations in Army operational experience. A good portion of our data comes from Iraq, because the operation there is so large and is ongoing, but we also collected data from Afghanistan, Bosnia, Kosovo, and Haiti.

In our interviews, we focused not only on the primary countries involved in each contingency operation, but also on the neighboring countries that permitted the United States to base forces on their territory. We conducted phone and in-person interviews lasting from 20 minutes to 2 hours with more than 50 people from organizations including USACE, field engineering units deployed in recent operations, the Armed Forces Medical Intelligence Center, the Army Center for Health Promotion and Preventive Medicine (CHPPM), and key combat units. We also interviewed a few representatives from organizations outside the Army, including staff from the Department of State Office of the Coordinator for Stabilization and Reconstruction, other Services, and Army contractors.

We reviewed literature about operations from a variety of sources, including newspapers, professional publications such as *Engineer* and *The Journal of Strategic Studies*, and lessons-learned documents. We also assessed some of the broader reconstruction literature in an attempt to understand better the Army's role and environmental considerations in post-conflict operations.

From all of these sources, we developed a database of 111 cases that illustrate environmental issues in contingency operations. We analyzed the data and discovered that environmental issues can have a wide range of effects (both positive and negative) on the Army, its missions, and national objectives. We also assessed trends and developed insights from the cases, interviews, and a review of the available literature on contingency operations.

Finally, to get a better understanding of the environmental concerns of the local populace, we collected and analyzed public-opinion data from Iraq.

Structure of This Report

Chapter Two describes the environmental policy, legal, and operational context within which the Army conducts contingency operations. Chapter Three presents a wide range of operational Army experiences that relate to the environment, including the 111 case studies that were collected during the course of our research. It then analyzes these case studies along a variety of dimensions, including impacts on mission, health effects on soldiers, financial costs to the Army, diplomatic costs, and effects on safety and community relations. Chapter Four presents our analysis of the Army's operational experience of environmental considerations in contingency operations, based on the case studies, data collected from extensive interviews, and the broader literature. Chapter Five presents our findings about environmental considerations in contingency operations and gaps in Army policy and practices and makes several recommendations that could help address those gaps. Appendix A reviews domestic and international law related to environmental considerations in Army contingency operations. Appendix B summarizes the findings from public-opinion surveys of the local populace in Iraq. Finally, the case studies are listed in detail in Appendix C.

CHAPTER TWO

The Context for Environmental Considerations in Contingency Operations

Any consideration of the environment in a contingency operation must take account of the legal, policy, operational, and environmental context in which the operation occurs.

Principal Areas of Interaction with the Environment

Army forces interact with the environment in five principal arenas: achieving strategic objectives, conducting tactical operations, sustaining forces, providing humanitarian assistance, and conducting stabilization and reconstruction operations. The environmental considerations can differ in each arena.

Achieving Strategic Objectives

Strategic objectives are driven by the nation's overall purposes in engaging in an operation. Those purposes are often much broader than simply winning military battles. They may include political, economic, social, and diplomatic outcomes. At a minimum, most successful operations require establishing stability as soon as possible. The manner in which the military conducts its combat and post-conflict activities can either enable or hinder achievement of these outcomes. Strategic objectives should be reflected in the Secretary of Defense's direction to the joint force commander (JFC) and through him to the land-component commander and subordinate commands. Strategic objec-

tives with environmental components include preserving natural resources from harm to permit future economic growth; reducing the chances for environmental damage from attacks on industrial targets and nuclear, biological, and chemical weapons facilities; preserving cultural assets for their importance to national identity; providing basic life-supporting infrastructure to help stabilize the country and gain the support of the citizens; and imparting a sustainability ethic in economic, natural-resource, and agricultural matters so that economic development and quality of life can be sustained over the long term. To the extent that strategic objectives for a contingency operation have direct or indirect environmental components, they will condition the activity of U.S. forces in the other four arenas.

Conducting Tactical Operations

During tactical operations, Army forces must work to minimize the impact of the environment on soldier health, e.g., from pollution or disease. They must also try to provide safety from nearby man-made assets such as dams or stocks of industrial chemicals that can be used against U.S. forces, and they must work to preserve lines of communication and to limit the effect of climate and terrain on combat operations. Most Army operating practices aimed at achieving tactical objectives and protecting soldiers address these environmental issues, albeit indirectly.

Sustaining Forces

Deployed forces must be supported and sustained during all phases of an operation. (See Box 2.1 for a description of the phases of contingency operations.) During combat operations, the environmental aspects of force sustainment center on provision of potable water and expedient handling of hazardous materials and wastes but also include reducing unnecessary exposure to disease and hazardous and toxic materials. As the combat phase of an operation winds down across the theater or in specific areas, force-sustainment activities focus on base camps and include providing clean water, sanitation, and a disease-free environment for soldiers while managing waste streams in a manner that does not create additional health, safety, or force-protection hazards.

Box 2.1
The Phases of Contingency Operations

Traditionally, joint doctrine has considered contingency operations to have four phases (see the 2001 version of Joint Publication 3-0):

- Deter/engage, where the crisis is defined and U.S. forces may take action if threats cannot be deterred.
- Seize the initiative, where U.S. forces seek to seize the initiative in combat or non-combat situations through the application of appropriate joint-force capabilities.
- Decisive operations, where the focus is on dominating the situation to establish the conditions for an early, favorable conclusion in combat or non-combat situations. This phase also sets the conditions for the transition phase.
- Transition, often called post-conflict, where commanders work to bring the situation to a successful conclusion, "typically characterized by self-sustaining peace and the establishment of the rule of law," and bring their forces home. According to doctrine, "the outcome of military operations should not conflict with the long-term solution to the crisis."

This construct was doctrine at the start of the operations in Iraq and Afghanistan.

To provide greater emphasis on operations after combat, the Joint Staff has developed a new six-phase construct that essentially breaks the post-conflict phase into two phases—stabilization and enable civilian authorities. It also adds a pre-conflict phase. According to the latest version of Joint Publication 3-0 (September 2006) on joint operations, the focus during the stabilization phase is on establishing security, providing initial humanitarian assistance, restoring essential public services, providing reconstruction assistance, and setting the conditions for the transition back to legitimate civil governance. This phase clearly has important environmental aspects. The military commander has the lead during stabilization. During the enable-civil-authorities phase, the military commander supports the civil authorities with significant interagency, multinational, and NGO coordination. The goal of this phase is to establish the conditions that will allow U.S. forces to leave the theater. A key feature of the new construct is that it recognizes that phases can overlap and that different phases can be going on in different parts of the host country simultaneously.

Base-camp operations are also the focus of force sustainment in nearby countries that are used as staging and support areas for an operation.

Almost every contingency operation involves building and operating base camps, yet the Army does not have SOPs for these tasks, which are generally undertaken by engineers and logisticians, with substantial support from contractors.[1] Base camps can range in size

[1] FM 3-34.250, *General Engineering*, provides doctrinal guidelines for creating and operating base camps.

from several hundred inhabitants to tens of thousands, on the scale of a small city. The longer a base camp is occupied and the larger its population, the more it must be sustainable, both environmentally and logistically. The Army spends significant resources on base camps during contingency operations. Managing waste streams alone can entail sizable costs given the need for proper management of hazardous, medical, and solid wastes. Any steps the Army can take to be more efficient, either by shrinking the volume of wastes or by reducing the cost of processing them, will reduce the operating costs of base camps. Some combatant commands have developed their own procedures after being engaged in a contingency operation for a while, but those lessons and procedures are not incorporated as best practices into other commands or the Army training establishment,[2] nor do they include proven methods for reducing the cost and logistical impact of base camps. (This issue is discussed in more detail in Chapter Three.)

Providing Humanitarian Assistance

During combat operations and immediately after cessation of high-intensity combat, Army forces are often involved in providing humanitarian assistance to refugees and those civilians who remain in their homes but are unable to meet their basic needs. Environmental considerations, including finding sources of potable water and managing waste streams from refugee camps, loom large in these activities.

Conducting Stabilization and Reconstruction Operations

During stabilization and reconstruction operations, Army forces often encounter environmental issues in their efforts to restore basic services so that civilian authorities can take over running the country. These activities can include rebuilding (or building anew) water and sanitation systems, agricultural infrastructure such as irrigation systems, and landfill facilities for civilian streams of solid and hazardous waste.

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[2] For example, the European Command developed a guide for building and running base camps called the Red Book, based on its experience in Bosnia. However, the U.S. Central Command (CENTCOM) did not take advantage of the Red Book in Afghanistan or Iraq. Only after several years in those countries did it develop its own guide, called the Sand Book.

They can also include protecting and preserving cultural, historical, and natural resources that are symbolically or economically important to the local populace, as well as helping to control disease vectors. As discussed later in this chapter, the environment and life-sustaining infrastructures are often severely stressed in countries where contingency operations occur, making restoration a high-priority activity for U.S. forces.

The environment's effect on the Army and its missions and the Army's impact on the environment differ in these five arenas. Moreover, the doctrinal and policy context can also differ for each. In the following discussion of the legal, policy, operational, and environmental contexts, we identify issues unique to each arena, where appropriate.

Domestic and International Legal Context

U.S. military actions during overseas contingency operations are regulated by applicable domestic and international laws. Actions that affect the environment are no different. However, our review of relevant U.S. and international law found that few regulations apply to the environment; even fewer constrain or guide the actions of U.S. forces beyond setting very high thresholds for impermissible conduct.[3] Domestic laws and regulations almost universally stop at the water's edge.[4] International laws, including conventions or customs to which the United States does not consider itself to be a party, also have little to say about the environment during conflict, war being an explicit exception in many of them. (See Appendix A for a full treatment of the domestic and international legal context.) Bilateral agreements between the

[3] Note that this is an analysis of *legal issues*, not *legal advice*. Legal advice can be provided only by Army counsel.

[4] One domestic law that has received attention in recent years is the Military Extraterritorial Jurisdiction Act of 2000, which makes it possible for Service members to be prosecuted in U.S. courts for actions committed outside the United States that would have been considered felonious had they been committed within the United States. This statute is unlikely to apply to environmental cases, however, in part, because violations of environmental regulations usually carry civil penalties in the United States.

United States and countries with which it has permanent basing rights tend to constrain U.S. activities in those countries, much like U.S. laws and regulations tend to do at installations in the United States. But such host-nation agreements rarely exist between the United States and countries that are the focus of contingency operations. Moreover, in cases where the government falls before or during an operation, there is no governing authority to promulgate or enforce laws.

There are two primary exceptions to the absence of legal constraints in contingency operations: The 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal and a U.S. law, the Foreign Claims Act. The Basel Convention has caused Army engineers and logisticians difficulties in many contingency operations because it severely limits their ability to export hazardous waste and materials from the country in which they were generated. The convention was created to limit and control the international shipment of hazardous wastes and to protect less-developed countries from becoming unwitting dumping grounds for the developed world's hazardous wastes, but it has had a series of unanticipated effects on U.S. forces deployed in contingency operations. The convention requires notice and consent from transit and destination countries for all shipments of waste across international boundaries. Although the United States is not a party to the convention, U.S. forces overseas are still constrained by it, for two reasons.[5] First, many of the states that are the focus of contingency operations or that support U.S. forces in the region do not have the capacity to dispose of hazardous wastes in an environmentally sound manner. As a result, the wastes must be transferred to other states that do have appropriate facilities. Second, although the states in which the wastes originate are often not parties to the convention, the states that have the capacity to accept the wastes usually are parties. The convention requires member states to refuse shipments unless the state of origin is a member of the treaty or has

[5] The United States signed the treaty in 1990, and the Senate ratified it in 1991. The Bush administration submitted implementing legislation that same year, but the Congress never acted upon it. As a result, the United States is not considered a party to the treaty.

negotiated a bilateral agreement for transshipment that meets the criteria of the convention. Since these agreements do not usually exist, they must be negotiated. This process has usually started only after U.S. forces have arrived.

It often takes a year or more to reach agreements with a host country and surrounding countries to permit the Army to export its wastes.[6] Moreover, exporting hazardous wastes is expensive. Until Basel Convention issues are resolved, wastes build up rapidly at base camps and logistics hubs in many contingency operations and can create hazards for U.S. forces and friction with the local population and government. (See Box 2.2 for a discussion of military hazardous-waste problems.) In recent operations, several fires and other incidents have resulted from overloaded storage facilities. Large collections of hazardous wastes also present force-protection challenges, because they can become the targets of enemy attacks.

The second legal constraint, the Foreign Claims Act, creates an opening for future financial liabilities against the Army and the U.S. government. The act is a U.S. law that allows foreigners to receive compensation for claims for personal injury, death, or property loss or damage arising from non-combat activities involving negligent or wrongful acts, which could include actions related to the environment.

In addition to these two constraints, a few legal wild cards loom that might cover the environmental consequences of future actions by Army forces in overseas contingencies. Foremost among them is the newly formed International Criminal Court (ICC), which can try a citizen of any country for any of four types of crimes: war crimes, genocide, crimes against humanity, and aggression. It does not seem likely that wartime actions that affect the local environment will fall under the ICC's jurisdiction, but the court is new and there is some concern that it could evolve in unanticipated ways in the future.

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[6] According to a briefing by the Defense Logistics Agency, it has taken 24 months to negotiate the bilateral agreements with Uzbekistan, 18 months for those with Afghanistan and Pakistan, 11 months for those with Kosovo, and 9 months for those with Bosnia and Macedonia (McCullough, 2005).

Box 2.2
Military Hazardous Wastes

Hazardous wastes are a fact of life in modern military operations. They are always present and can pose real dangers to soldiers and local inhabitants unless they are handled and disposed of properly. Typical hazardous wastes in contingency operations include soil contaminated by fuel or oil spills, batteries, used contaminated metal and plastic containers, waste grease, used oil, and antifreeze. The volumes of waste that can be generated in military operations can be staggering. In one year during Operation Joint Endeavor (OJE) in Bosnia-Herzegovina, a U.S. force with a few tens of thousands of soldiers generated more than 1.8 million kilograms of hazardous waste during peacekeeping. Combat operations would have generated even more wastes.*

One of the most common environmental incidents in contingency operations is spillage or improper disposal of hazardous wastes. In one case in Iraq, soldiers mixed incompatible hazardous wastes, creating serious risks to health and safety. Similar problems occurred in the Balkans and Afghanistan. Improper handling of hazardous wastes can also create significant costs and liabilities for the Army.

Army logisticians, aided by contractors and the Defense Reutilization and Marketing Service (DRMS), are responsible for managing and transporting the hazardous wastes generated in contingency operations. DoD policy requires that hazardous wastes generated by the military be disposed of "in an environmentally sound manner."** Properly disposing of hazardous wastes can be very expensive, so there is an incentive to reduce their use and to recycle as much as possible.

As a result of the lack of capacity in the country of origin and the Basel Convention–related difficulties for shipping wastes across borders, hazardous wastes from an operation often build up in storage areas for many months. Recent operations illustrate the risks that such buildups can create. In Afghanistan, two lithium-battery fires that released hazardous fumes occurred because the batteries were stored improperly. In a case in Iraq, commanders used expedient accumulation points for their hazardous wastes; the accumulation points were located so close to the perimeter of their camp that the hazardous materials risked becoming targets for attack by insurgents.

Proper oversight of contractors who dispose of hazardous wastes is also essential. In several incidents in the past few years, local contractors have dumped wastes in unapproved facilities or along the sides of roads, forcing the Army to pay for expensive cleanups. In some cases, the local contractor was hired by a U.S. contractor charged with managing the camp, creating further oversight challenges for the Army.

*Center for Army Lessons Learned, Appendix A, 1999.
**Joint Publication 4-04, p. VI-2.

Because there are few legal or regulatory constraints on the actions of U.S. forces or individual Service members with respect to the environment, the U.S. government, DoD, and the Army have had no strong motivation to develop policies, regulations, or training programs to address this issue. It is often left up to commanders to develop

policies for each contingency. This provides operational flexibility but makes it difficult to develop a coherent Army-wide approach to training and doctrine.[7] This differs sharply from the situation in the United States, where laws and regulations have profound effects on the way installations are run, training ranges are used, and soldiers are trained. The same is true in many host nations where U.S. forces are permanently based. The ad hoc approach to environmental considerations in contingency operations also differs from force-protection considerations, for which there are clear policies and guidance for both peacetime and contingencies.

Policy Context

In the United States, laws and regulations designed to protect the environment have motivated DoD and the Services to develop detailed environmental policies and SOPs that embody sound environmental practices. In the Army, these policies relate primarily to installations and training facilities (see Box 2.3).[8] In host nations where U.S. forces have basing rights, DoD, through designated executive agents, generally develops country-specific environmental guidance, which includes the final governing standards (FGS). By policy, DoD compares host-nation standards with the broad set of standards for environmental management on installations contained in its Overseas Environmental Baseline Guidance Document (OEBGD) and picks the more protective standard in each category. In a few cases, environmental issues are also addressed in agreements that have been negotiated with the host country and may impose additional requirements. In cases where those agreements and standards are not specific about the environment, commanders are required to comply with the OEBGD.[9]

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[7] It is often a mistake to assume that the lack of host-nation environmental laws means that the environment is completely unregulated. Local customs and practices that regulate environmental use often evolve, and these should be understood by commanders for their area of operations.

[8] See, for example, Department of the Army, AR 200-1.

[9] Department of Defense, DoD 4715.5-G.

Box 2.3
U.S. Environmental Policy Context

There is a stark contrast between the policy context in contingency operations and that at permanent bases and training facilities in the United States and overseas. Permanent Army bases have clear environmental policies and procedures. In the United States, the Army is subject to comprehensive environmental laws, including the Clean Water Act; the Clean Air Act; the National Environmental Policy Act (NEPA); the Comprehensive Environmental Response, Compensation, and Liability Act; the Resource Conservation and Recovery Act; and the Endangered Species Act. Similarly, in host nations such as Germany and Japan in which the United States has permanent bases, the Army must comply with the FGS that generally respect host-nation environmental standards. As a result, for permanent bases in the United States and overseas, the Army has developed clear environmental policies and procedures that are followed.

At permanent bases and training locations, the Army also focuses on the business and strategic value of implementing pollution prevention and strategic natural-resource and environmental management. Army engineers are developing and implementing new pollution-prevention procedures to save cleanup costs, and bases are addressing encroachment and natural-resource pressures on training lands by trying to more effectively manage natural resources, including the land. For example, environmental managers at Fort Benning are implementing ecosystem management to manage and sustain the land for long-term training needs and to protect key species, such as the red-cockaded woodpecker.

In the United States and other permanent base locations, the focus has been on four environmental pillars:

- *Prevention*. Focus efforts on pollution prevention to reduce or eliminate pollution at the source.
- *Conservation*. Conserve and protect natural and cultural resources so that they will be available for present and future generations to use.
- *Compliance*. Give immediate priority to sustained compliance with all environmental laws.
- *Restoration*. Simultaneously continue to restore previously contaminated sites as quickly as funds permit.*

In principle, the Army likes to abide by these pillars everywhere, but they really do not apply in overseas contingency operations.

This focus on the four pillars is in the process of being replaced by a new emphasis on sustainability of the mission, the environment, and the community, which is at the core of the October 2004 *Army Strategy for the Environment*.**

* See, for example, TC 3-34.489, *The Soldier and the Environment*.
** U.S. Army, 2004.

By contrast, in contingency operations, it is left to presidential directives, executive orders, DoD, Joint Staff, and Army policies, regulations, and doctrine to motivate and guide behavior.

We conducted a thorough assessment of all the presidential, DoD, and Army directives, regulations, and guidance that relate to the environment and found that very few apply to contingency operations. Those that relate to U.S. environmental laws explicitly exclude activities outside of the United States. Most of those that deal with military activities overseas focus on basing and training in countries with which the United States has bilateral agreements that address environmental considerations, and they explicitly exclude contingency operations. The very few that address environmental considerations in contingency operations do not focus on post-conflict operations at all, except for procedures for leaving the country. Table 2.1 surveys the major regulations and publications, arranged in order of document number, and shows their relevance to environmental considerations in contingency operations. The numbers of the most relevant documents for contingency operations are highlighted in boldface. We discuss a few of those documents below.

Presidential Orders and DoD Directives and Regulations

There is a wide range of presidential orders and DoD directives and instructions that relate to the military and the environment. Virtually all of them apply to actions within the United States. The primary presidential guidance that relates to environmental issues for U.S. actions overseas is EO 12114, "Environmental Effects Abroad of Major Federal Actions." The stated purpose of EO 12114 is to "further the purpose of the National Environmental Policy Act (NEPA) and the Marine Protection Research and Sanctuaries Act and the Deepwater Port Act consistent with the foreign policy and national security policy of the United States."[10] To that end, it requires that NEPA-like impact assessments, environmental studies, or environmental reviews be conducted before federal actions can be taken. However, the Executive Order and the DoD directive that implements it (DODD 6050.7) exclude actions taken "when the national security or interest is involved or when the action occurs in the course of an armed conflict." This exception does not automatically apply to all peacekeeping and support operations,

[10] Executive Order 12114, Section 1-1.

Table 2.1
Relevance of Selected Regulations and Publications to Environmental Considerations in Contingency Operations

Document Number (Date)	Title	Purpose	Relevance to Contingency Operations	Comments
AR 200.1 (2007)	Environmental Protection and Enhancement	Addresses environmental responsibilities for all Army organizations and agencies.	Excludes training, off-installation deployments, and contingency operations.	
AR 200.2 (1988)	Environmental Effects of Army Actions	Establishes policy, procedures, and responsibilities for assessing the environmental effects of Army actions. It implements the National Environmental Policy Act (NEPA), EO 12114, DoD Directive 6050.1, and DoD Directive 6050.7.	Does not apply "to combat or combat-related activities in a combat zone." May apply to certain stability and support operations.	
DODD 3000.05 (2005)	Military Support for Stability, Security, Transition, and Reconstruction (SSTR) Operations	Establishes that stability operations are of comparable importance to combat operations and defines DoD and Service roles for integrating stability operations throughout DoD.	Extremely relevant to contingency operations but does not address environmental considerations directly.	This newly issued directive has the potential to be an important foundation for developing environmental policy for contingency operations.

Table 2.1 (continued)

Document Number (Date)	Title	Purpose	Relevance to Contingency Operations	Comments
DODD 4715.5-G (2000)	Overseas Environmental Baseline Guidance Document (OEBGD)	Provides criteria and management practices aimed at protecting human health and the environment in determining the FGS for environmental compliance at DoD installations located outside the United States. Reportedly reflects generally accepted environmental standards applicable to DoD in the United States. Is the de facto standard for DoD installations in host nations where FGS have not been established.	Exempts "off-installation operational deployments including cases of hostilities, contingency operations in hazardous areas, and when United States forces are operating as part of a multi-national force not under full control of the United States."	Other publications, including JP 4-04 and FM 3-100.4, suggest that the OEBGD be used as a resource for establishing standards for contingency operations. A new version of this document may be released soon.
DODD 6050.7 (1979)	Environmental Effects Abroad of Major Department of Defense Actions	Implements EO 12114 and requires impact assessments prior to taking action.	Exempts actions that involve national security or interest or that occur in the course of armed conflict.	May not exempt all stability and support operations.
DODI 4715.5 (1996)	Management of Environmental Compliance at Overseas Installations	Establishes environmental compliance standards for protection of human health and the environment at DoD installations in foreign countries. Requires development and maintenance of an OEBGD.	Exempts contingency operations and training that occur away from the installation.	

Table 2.1 (continued)

Document Number (Date)	Title	Purpose	Relevance to Contingency Operations	Comments
DODI 4715.8 (1998)	Environmental Remediation Policy for DOD Activities Overseas	Establishes responsibilities and procedures for remediation of environmental contamination on or away from DoD installations or facilities that was caused by DoD operations outside the United States.	Does not apply to contingency operations.	
EO 12114 (1979)	Environmental Effects Abroad of Major Federal Actions	Mandates impact assessments before federal actions are taken.	Exempts actions that involve national security or interest or that occur in the course of armed conflict.	May not exempt all stability and support operations.
EO 13112 (1999)	Invasive Species	Directs all federal agencies to prevent the introduction of exotic species into the natural ecosystems of the United States. (Supersedes EO 11987, "Exotic Organisms.")	Very relevant.	All equipment must be thoroughly cleaned before customs officials will allow it to be returned to the United States.
FM 3-34.500 (Final draft form, May 2006)	Environmental Considerations	Establishes and explains the principles of environmental support across the spectrum of operations and the ways in which commanders develop and implement command environmental programs.	Very relevant.	Will replace FM 3-100.4 when it is adopted. Does the best job of raising strategic, operational, and tactical issues.

Table 2.1 (continued)

Document Number (Date)	Title	Purpose	Relevance to Contingency Operations	Comments
FM 3-100.4, MCRP 4-11 (2000)	Environmental Considerations in Military Operations	Provides guidance in applying appropriate environmental-protection procedures during military operations, including contingency operations.	Very relevant, but being replaced by FM 3-34.500.	Introduction raises some strategic and tactical issues, but the focus is heavily on force sustainment.
FM 41-10 (2000)	Civil Affairs Operations	Presents doctrine for civil affairs (CA) operations.	Very relevant.	Includes environmental management as a CA mission and capability. New efforts to establish a base camp proponent may leave all environmental efforts outside the camps to civil affairs.
JP 3-34 (2000)	Engineer Doctrine for Joint Operations	Establishes doctrine to govern activities and performance of engineers in joint operations.	Relevant.	Limited, but explicit. Focused on force sustainment. Being combined with JP 4-04.
JP 3-34 (2007)	Joint Engineer Operations	Combines JP 3-34 (2000) and JP 4-04	Very relevant.	Similar environmental focus as JP 4-04, but with increased focus on environmental considerations.

Table 2.1 (continued)

Document Number (Date)	Title	Purpose	Relevance to Contingency Operations	Comments
JP 4-04 (2001)	Joint Doctrine for Civil Engineering Support	Establishes doctrine to govern activities and performance of civil engineers in support of joint operations.	Relevant.	Has a chapter on environmental considerations. Focused on force sustainment and limiting liabilities. Being combined with JP 3-34.

but it easily can if it is certified by the secretary of defense or the president. As a result, EO 12114 has little practical effect on the conduct of contingency operations. Other DoD instructions, including DODI 4715.5, "Management of Environmental Compliance at Overseas Installations," and DODI 4715.8, "Environmental Remediation Policy for DOD Activities Overseas," also exclude contingency operations.

A second executive order of note has nothing to do with the conduct of contingency operations but has a significant effect on forces that are in the process of returning to the United States. EO 13112, "Invasive Species," is intended to help stanch the introduction of invasive species into the United States. Because of this order, soldiers must thoroughly wash their equipment and vehicles to remove any organisms or seeds they may have picked up. Inspectors from customs and the Department of Agriculture inspect and must approve the equipment before it can be transported back to the United States.

A DoD directive issued in 2005, DODD 3000.05, has the potential to increase the degree to which environmental considerations are addressed in contingency operations, although it does not address the environment directly. The directive establishes that "stability operations are a core U.S. military mission that the Department of Defense shall be prepared to conduct and support"[11] and that they should be given priority comparable to that of combat operations. The immediate goals for stability operations listed in the directive include restoring essential services and meeting humanitarian needs, both of which have important environmental components. The list of long-term goals includes developing the indigenous capacity for securing essential services, which also has important environmental components, including rebuilding or establishing water and sewage infrastructures, public health systems, and food supplies. Because the directive is relatively new and the environmental components of these tasks are not explicitly stated, it is unclear what significance it will have for shaping U.S. policy for environmental considerations in contingency operations. However, the strong position the directive takes on stability operations and the measures it establishes to ensure that DoD and the Services

[11] Department of Defense, DODD 3000.05, paragraph 4.1.

incorporate these operations "across all DoD activities including doctrine, organizations, training, education, exercises, materiel, leadership, personnel, facilities, and planning" could make it an important document.

Joint Staff and Army Regulations and Guidance

The only Army doctrinal document that focuses directly on the environmental aspects of contingency operations is field manual FM 3-100.4, *Environmental Considerations in Military Operations*, a relatively low-level document in the Army's doctrinal hierarchy. Several joint publications for engineers, including JP 3-34, *Engineer Doctrine for Joint Operations*, and JP 4-04, *Joint Doctrine for Civil Engineering Support*,[12] also address environmental considerations as part of the engineer mission. A few Army-engineer and civil-affairs publications also mention environmental considerations but do not adequately address them.

In brief, these regulations and guidance documents assign responsibilities for environmental planning and execution (JP 4-04 and FM 3-100.4), mandate that combatant commanders and land-component commanders include environmental considerations in operation plans and operation orders (JP 4-04, CJCSM 3122.03A, and FM 101-5), discuss the need for levels of environmental protection that vary based on the combat threat (JP 4-04, FM 3-100.4), highlight the importance for the combatant commander of providing well-considered environmental guidance to subordinate commanders (FM 3-100.4), and provide guidance for unit planning, training, and developing SOPs (FM 3-100.4). Although these documents focus on the environment, none directly addresses the post-conflict phase of operations or emphasizes the important role that environmental considerations can play in mission success.

In a joint operation, joint doctrine leads Service doctrine. Since very few contingency operations are likely to be conducted by the Army alone, joint doctrine is very important. In its absence, however, Army

[12] The Joint Staff has combined these two publications in the 2007 edition of JP 3-34, *Joint Engineer Operations.*

forces default to Army doctrine, as long as it does not contradict specific guidance from the combatant commander or JFC. Furthermore, Army planners on the JFC's staff can use Army guidance and their experience with Army doctrine to ensure that relevant environmental issues are raised to the commander for his consideration and to ensure that they are properly considered in developing courses of action, operation plans (OPLANs), and operation orders (OPORDs).

Environmental Responsibilities in Contingency Operations. One of the most important contributions of the joint and Army doctrines is that they assign clear environmental responsibilities. They make it clear that everyone throughout the Army and the joint force, from the combatant commander to the newest soldier or sailor, is responsible for the environment. Combatant commanders and JFCs must protect the environment as much as possible within operational constraints, instill an environmental ethic and awareness in their soldiers, and ensure that environmental considerations are incorporated in the planning and decisionmaking process.[13] Their staffs, including the component engineer, component environmental engineer, component staff judge advocate, component commander safety officer, and component director of logistics, are responsible for providing the inputs and guidance on environmental considerations into the decisionmaking processes. They are also responsible for assisting in the implementation of decisions and plans. (See Box 2.4 for a list of environmental responsibilities spelled out in JP 4-04.)

These responsibilities are mirrored in Army units, according to Army doctrine (FM 3-100.4). In addition to executing the environmental guidance provided by higher commands, unit commanders are responsible for training their soldiers so that they can implement good environmental practices during contingency operations. Soldiers are responsible for understanding and supporting the Army's environmental program and complying with environmental policies established by the combatant commander and unit SOPs.[14] They are also charged

[13] JP 4-04, pp. VI-1 to VI-3.

[14] FM 3-100.4, pp. 1-9 to 1-18.

Box 2.4
Environmental Responsibilities Specified in Joint Doctrine

Combatant Commander and Subordinate Joint Force Commander (JFC)

- Protect the environment to the greatest extent possible consistent with operational requirements.
- Demonstrate proactive environmental leadership during all phases of joint operations across the range of military operations.
- Instill an environmental ethic in subordinate commands and promote environmental awareness throughout the joint force.
- Ensure that environmental considerations are an integral part in the planning and decisionmaking processes.
- Ensure compliance, as far as practicable within the confines of mission accomplishment, with all applicable domestic environmental laws, country-specific FGS, and the DoD OEBGDs, as well as relevant international agreements, "Environmental Considerations" annexes to relevant OPLAN, OPORDs, and/or other operational directives, and other environmental requirements that apply to the operation.
- Minimize potential adverse impacts on human health and the environment while maximizing readiness and operational effectiveness.

Combatant Command Engineer and Subordinate Joint Force Engineer (JFE)

- Provide guidance to the combatant commander and/or subordinate JFE on environmental considerations in planning and executing joint operations.
- Develop and assist in the implementation of policies, procedures, and practices of the "Environmental Considerations" annex to an OPLAN and/or OPORD.

Combatant Command Staff Judge Advocate and Subordinate Joint Force Staff Judge Advocate

- Advise the commander and staff on compliance with environmental laws, regulations, treaties, conventions, and status-of-forces agreements (SOFAs) and their potential impact.
- Assist in negotiating transit agreements in advance of actual deployment to permit the transit of regulated (hazardous) wastes to effect their disposal in an environmentally sound manner.
- Determine baseline environmental-survey requirements.
- Process civilian claims resulting from environmental damage.

Combatant Command Surgeon and Subordinate Joint Force Surgeon

- Provide preventive medicine and occupational-health support to the joint force, with priorities on water and wastewater, including water vulnerability-assessment support, sanitation, waste disposal, health-risk assessment (e.g., base-camp site selection), environmental health sampling and surveillance, and vector control.

Joint Force J-4 (Logistics)

- Ensure that wastes and effluents from operations and Service functions are appropriately controlled.
- Include all aspects of hazardous materials (HAZMAT) and regulated (hazardous) waste management to minimize use, storage, transportation, disposition, and return to home station of excess materials.

Box 2.4 (continued)

Unit Commanders

- Comply with the applicable environmental requirements established by the JFC in the "Environmental Considerations" annex of the OPLAN and/or OPORD.
- Keep the JFC and staff informed of conditions that may result in noncompliance or the potential for noncompliance with the annex.
- Establish a unit-level point of contact for communication of environmental information with the JFE and/or Joint Environmental Management Board (JEMB), as required.

SOURCE: Joint Publication 4-04, pp. VI-1 to VI-3.

with reporting any spills, identifying environmental risks to themselves and their team, and recommending actions to the chain of command that help reduce those risks.

Several leaders within a unit have special environmental responsibilities. The assistant chief of staff for logistics oversees many functions that have a potential for generating hazardous waste. Therefore, he is responsible for establishing procedures for reducing and controlling hazardous materials, recommending command policies for disposing of solid and hazardous waste, and preventing pollution. In coordination with the assistant chief of staff for operations, he oversees the preparation of spill-prevention and response plans. The engineer coordinator advises the commander on environmental issues, determines the impact of operations on the environment, and integrates environmental considerations into the decisionmaking process. He also assists in performing site assessments for installations and facilities. He and the staff judge advocate advise the commander on the necessity for environmental assessments.

Joint Doctrine JP 4-04 and JP 3-34. Two joint publications (both for engineers) have provided the most guidance on environmental considerations in joint operations: JP 4-04, *Joint Doctrine for Civil Engineering Support (2001)*, and JP 3-34, *Engineer Doctrine for Joint Operations (2000)*. These two publications have just been combined and released as a single publication in 2007, as discussed below. The earlier two publications are important, however, because they reflect the joint doctrine that was in effect during all but the past year of operations in Afghanistan and Iraq.

JP 4-04 and JP 3-34 touch on environmental issues, listing responsibilities, but they provide little guidance or instruction and fall far short of the specificity in FM 3-100.4. Their most concrete contribution to environmental considerations is establishing the requirements and responsibilities for providing guidance on the environment and developing the environmental annex to the OPLANs and OPORDs. For example, JP 4-04 states:

> The combatant command and subordinate joint force engineer are responsible for providing guidance to the combatant commander and/or subordinate JFC on environmental considerations in planning and executing joint operations. The combatant command and subordinate joint force engineer and staff develop and assist in the implementation of policies, procedures, and practices of the "Environmental Considerations" annex to an OPLAN and/or OPORD.[15]

JP 3-34 states, "Engineers are responsible for preparing . . . Annex L, 'Environmental Considerations.'"[16] According to JP 4-04, the combatant commander can establish a JEMB, which can provide "guidance on the development of Annex L, 'Environmental Considerations,' to an OPLAN or OPORD and, if appropriate, assumes responsibility for preparation of this annex."[17] The requirement for the combatant commander to develop Annex L is spelled out as one of many tasks in the Joint Operation Planning and Execution System.[18]

The planning section of JP 3-34 contains a section on environmental considerations, one of 15 planning considerations for joint operations:

> Successful planning and execution of joint engineering operations and exercises requires ever-increasing attention to environmental considerations. Environmental considerations extend far

[15] JP 4-04, p. VI-2.

[16] JP 3-34, 2000, p. III-5.

[17] JP 4-04, p. II-13.

[18] CJCSM 3122.03A.

> beyond the engineer and logistic communities. Operators, intelligence staffs, medical representatives, legal counsel, and other members of a JFC's staff have a shared responsibility to ensure that environmental considerations are incorporated into operations and exercise planning. An environmental site survey should be conducted prior to deployment whenever possible to document current environmental conditions. Coordination with preventive medicine functions assessing environmental health risks to deployed personnel is essential.[19]

JP 3-34 also urges JFEs to coordinate, as appropriate, with "other staff elements, to include medical, logistic, operations, intelligence, legal, civil affairs, and other Joint Staff members," with other DoD and U.S. government agencies, and "with appropriate allied and coalition partner counterpart staff agencies" when conducting coalition operations.

Nevertheless, although both joint publications mention environmental considerations and give engineers responsibility for developing Annex L and some responsibility for helping combatant commanders account for environmental issues in planning, their focus is primarily on the environmental aspects of force sustainment. They do not encourage engineers to focus on tactical or strategic considerations in planning or operations, nor do they tell them how they should do so. For example, in its discussion of strategic planning, JP 3-34 says, "The combatant commander's engineer planning concepts focus on the relationship of geography and force-projection infrastructure to the concept of operations,"[20] which omits most of the environmental considerations that would relate to the success of a contingency operation that had a stabilization or reconstruction component.

Similarly, in the "Environmental Considerations" section of JP 3-34's planning chapter, it is clear that the reasons for focusing on the environment are soldier health and compliance with regulations and laws. That section provides a list of "requirements related to environmental considerations," which include

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[19] JP 3-34, 2000, p. III-15

[20] JP 3-34, 2000, p. III-2.

- Provisions of U.S. environmental law applicable overseas
- Executive orders
- DoD directives (DODDs), regulations, and policies
- Host-nation laws
- SOFAs
- International treaties, protocols, and conventions.[21]

The discussion of the legal context earlier in this chapter indicates that, with the exception of the Basel Convention, current standards and regulations have little, if any, practical effect on contingency operations. Moreover, they do not provide any guidance about how the Army or the joint force should approach the strategic and tactical environmental considerations for a contingency operation.

JP 4-04 goes the farthest of any joint publication in its effort to make environmental considerations a part of the planning and training process. It includes a chapter on environmental considerations, which says:

> The aim of this chapter is to make environmental considerations part of a commander's planning process. Environmental considerations include the spectrum of environmental media, resources, or programs that may impact on, or are affected by, the planning and execution of military operations. Factors may include, but are not limited to: environmental compliance, pollution prevention, and conservation; health of personnel and protection of historical and cultural sites; and protection of flora and fauna.[22]

The chapter lays out specific responsibilities for key individuals, including JFCs, engineers, judge advocates, surgeons, public affairs officers, and unit commanders. It vests the JFCs with a wide range of responsibilities. For example:

> In the absence of definitive environmental guidance within applicable international agreements, geographic combatant com-

[21] JP 3-34, 2000, p. III-15.

[22] JP 4-04, p. VI-1.

> manders and subordinate JFCs should establish guidance in the OPLAN and/or OPORD that will protect force health, limit adverse public health impacts, consider the U.S. liability, and be consistent with mission goals.[23]

The chapter also addresses environmental roles and responsibilities, environmental requirements, environmental planning for operations, and environmental contingencies that may arise during an operation. It establishes a list of activities associated with what it calls "environmental support operations," which include the following:

- Baseline environmental surveys
- Site surveys to determine environmental and cultural conditions
- Integration of environmental considerations into plans
- Recommendations for non-toxic, environmentally benign material substitution
- Emergency-response plans and training
- Establishment of solid- and liquid-waste disposal systems
- Establishment of hazardous-materials distribution centers
- Establishment of hazardous-waste collection and shipment centers
- Sampling of water sources for contaminates
- Site-closure surveys and removal of wastes and excess supplies.[24]

The importance of environmental considerations in the post-conflict phase is largely absent from both joint publications. JP 3-34 briefly addresses so-called "post-hostilities operations," which involve a number of important environmental issues, but they are not identified as such:

> During redeployment of the force, engineers undertake preparation of facilities for retrograde, including close out of construction projects, refurbishment and turnover of property and real estate to the HN [host nation], construction of wash racks and

[23] JP 4-04, p. VI-4.

[24] JP 4-04, p. IV-19.

> other redeployment facilities, and preparation of collection points for disposal of hazardous waste. Environmental related support operations may be required during PHO [post-hostilities operations]. In addition, engineers may be tasked to provide support to the HN such as infrastructure repair and improvement to support a more rapid transition to civilian control. The magnitude of engineer support to foreign governments is determined by U.S. interests and objectives in the stabilization of the region.[25]

In addition to the obvious environmental activities listed (refurbishment of property, preparation of collection points for hazardous waste), several other activities have important environmental components. Infrastructure repair may include repair of drinking water, sanitation, or irrigation systems. Wash-rack activities are driven by U.S. government concerns about invasive species that could be brought back to the United States on vehicles and equipment. (Invasive species are discussed further in Chapter Three.) Customs and Department of Agriculture officials, empowered by Executive Order 13112, inspect equipment carefully before they permit it to be loaded onto ships or aircraft. They worry about the introduction of even a few seeds, so if the equipment does not meet their standards, it must be washed again. In our interviews, soldiers complained that the inspectors insist that every speck of dirt be removed. Properly used, wash racks have an added benefit of controlling POL from vehicles, thereby limiting pollution of surface streams and aquifers in the host nation. But the lack of adequate racks can often delay redeployment of units from the theater, so units work hard to get access to racks or fabricate their own. This raises another environmental issue: ensuring that the runoff from racks fabricated in the field is adequately contained so that it does not pollute nearby areas. The wash-rack issue has become an increasingly pressing problem over the years as sensitivity to invasive species has grown.

JP 4-04 includes a short paragraph on "military operations other than war" in its long list of planning considerations, and JP 3-34

[25] JP 3-34, 2000, p. IV-17.

advises that engineering liaison with all involved military units and civilian agencies is essential to success in these types of operations.[26]

The 2007 Update to JP 3-34, Joint Engineer Operations. An updated version of JP 3-34 was released in February 2007. It combines the previous versions of JP 3-34 and JP 4-04 into a single volume. While there are some changes to the content of the new doctrine in other areas, the changes with respect to environmental considerations are relatively small. The environmental considerations chapter from JP 4-04 is now an appendix in JP 3-34, expanded to emphasize the importance of the JFC including environmental considerations in training and operations in addition to planning, and the importance of continuous updates to environmental plans as the operation evolves. The appendix also includes some useful additions to the lists of responsibilities reflecting these themes and other issues. Most important is the inclusion of the Joint Force J-3 (deputy commander for operations) and vesting him with considerable responsibility for environmental considerations:

> It is the J-3's responsibility to ensure that any significant collateral environmental damage caused by command-directed operations is understood and approved by the commander during the decision-making process. Geopolitical concerns that include architectural and cultural issues, and force health protection issues, must be integrated into OPLANs/OPORDs and CONPLANs. The J-3 establishes and supervises the command training programs to include environmental skill and awareness training that supports the unit mission. The J-3 also ensures that the unit protects and maintains training areas. As the overall ground manager and planner of troop movements, bivouacking, and quartering, the J-3 understands and considers environmental vulnerabilities and the associated force health protection during operations. Placement of base camps and other such sites is of critical concern to the J-3 and some environmental considerations may be as important as the considerations of force protection. The J-3 may assign special missions to tactical units to secure and

[26] JP 3-34, 2000, p. III-17.

> safeguard critical environmental resources, such as wastewater treatment plants in urban areas in order to mitigate risks to and from the environment, or cultural locations such as museums/sacred sites. When appropriate, the J-3 prepares counterterrorism and security plans to combat possible environmental sabotage. The J-3 exercises coordination staff responsibility over the staff engineer (if it is not a separate staff element) in the preparation and implementation of an EBS for each base camp or similar site. The J-3 ensures that the data has been recorded for future review and potential remediation consideration.[27]

Finally, while the 2007 edition of JP 3-34 continues to focus primarily on the environmental aspects of sustaining the force, it introduces, but does not dwell on, the strategic importance of environmental considerations.

> Environmental issues can have strategic implications and affect mission success and end states if not recognized early and incorporated into planning and operations. Natural resources protection can be a key strategic mission objective, important to HN reconstruction. Failure to recognize environmental threats can result in significant health risks to the JTF [joint task force], adversely impacting readiness. If not appropriately addressed, environmental issues have the potential to negatively impact local community relations, affect insurgent activities, and create diplomatic problems for the JTF.[28]

Taken together, the changes in the 2007 edition represent an evolutionary improvement in environmental doctrine, establishing the importance of environmental considerations in contingency operations and the need to plan and train for them.

FM 3-100.4, Environmental Considerations in Military Operations. FM 3-100.4 is the document that deals most directly with environmental considerations in contingency operations, and it does a very good job in most respects. It also addresses other military operations.

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[27] JP 3-34, 2007, p. D-5.

[28] JP 3-34, 2007, p. III-2.

FM 3-100.4 was published jointly with the Marine Corps, so it is a multi-Service document, rather than a true joint publication. The Army Engineer School is the proponent for the document, and its emphasis reflects that proponency.[29]

The field manual covers a broad range of issues. It introduces the concept of military environmental protection ("the application and integration of all aspects of natural environmental considerations, as they apply to the conduct of military operations") and provides guidance to units about how to achieve it. Because it focuses on units at the brigade level and below, FM 3-100.4 does not address strategic considerations in detail, but it notes that they may be articulated in the instructions or plans from higher echelons (joint force, land-component commander, corps, or division):

> The higher commander's guidance is essential and is rarely initiated by commanders at the operational or tactical levels without initial guidance from the strategic level. Given the linkage between political and military considerations at the commander in chief (CINC) level, this will likely be the vital echelon for initiating and defining the driving guidance on military environmental protection for any given operation.[30]

The manual also warns commanders of new environmental considerations that have not been part of their previous experience, including conducting humanitarian (stability or support) operations after environmental disasters, integrating force health-protection considerations in densely populated areas that lack operational public health measures, responding to environmental terrorism or sabotage, working within the limitations brought about by environmental considerations, and remedying adverse environmental impacts as a part of the exit strategy.

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[29] In the Army, every regulation or field manual has a proponent, a branch of the Army (infantry, engineers, civil affairs) or a specific office with the Service or the Army secretariat, that is responsible for the publication, modification, and dissemination of the document and its guidance to the relevant parts of the Army.

[30] FM 3-100.4, p. 4-1.

Strategic considerations aside, FM 3-100.4 suggests the range of issues that should be addressed by unit staff, including

- Topography and soils
- Vegetation, including crops
- Air quality
- Wildlife and livestock
- Archaeological and historical sites
- Safety and public health
- Land and facility use, occupation, and return
- Water quality, including surface water, groundwater, storm water, and wetlands
- Hazardous-materials and hazardous-waste disposal and potential cleanup requirements
- Socioeconomic and political condition sensitivities and desired end states pertaining to or functions of environmental conditions.[31]

The manual also illustrates how commanders should strike a balance between operational and environmental imperatives. For example:

> As the commander prioritizes and analyzes the risks associated with an operation he may rank some environmental considerations as less important or more critical than other considerations. Protection of the environment may very well have to take a backseat to other tactical considerations as the commander weighs matters of force protection. However, protecting soldiers and Marines will always be high on the commander's list and environmental considerations that impact force protection and the health and safety of his personnel will cause them to become one of his highest priorities.[32]

One of the strengths of the field manual is that it provides concrete guidance on how to incorporate environmental protection into plans and operations. It stresses the use of standard Army risk-

[31] FM 3-100.4, p. 2-11.

[32] FM 3-100.4, p. 4-1.

assessment techniques and the military decisionmaking process and provides templates and examples for applying these techniques to environmental risks.[33] The manual also provides guidance on how to develop unit SOPs and assess training. In addition, it provides templates for Army environmental annexes, forms, and instructions for conducting initial and final environmental baseline surveys (EBSs) and reporting spills. It emphasizes the importance of documenting the initial environmental conditions for protecting soldier health and for closing facilities at the end of the mission. The manual urges units to use environmental-protection levels, where activities to protect the environment such as waste management, hazardous-materials management, protection of natural resources, and protection of cultural and historical resources are tied to risk: higher levels of environmental protection when combat risks are low, and more basic levels when units are engaged in combat. Finally, the manual provides lists of environmental equipment that units should take on deployments.

Despite its strengths, FM 3-100.4 has some limitations. For example, its discussion of risk focuses only on environmental hazards to the force, which are clearly the most pressing environmental concern to a unit. This is appropriate in the sense that strategic concerns are not the main focus of units at the brigade level and below. But it is still shortsighted, as it may cause a unit to overlook other environmental considerations in planning and execution, such as desired end-states for the mission and efforts to win and maintain support from the local populace. Addressing this issue may require that units use a broader definition of their mission when conducting risk assessments and planning activities. In other words, units may need to consider the environmental dimensions of the implied tasks for the mission in their execution of the specified tasks they are asked to perform. If the focus is largely the pre-combat and combat phases of the mission, the risk-assessment process will result in answers appropriate only for tactical and force-sustaining dimensions of an operation. If the mission is construed to extend through the post-conflict phase, strategic considerations and end states are more likely to be adequately addressed.

[33] See FM 3-100.12.

Another issue left unresolved by the manual is that of ensuring that strategic environmental considerations are articulated by the combatant commander and communicated to lower echelons; without such guidance, a unit's process for including environmental considerations in plans will not normally focus on these issues. However, the manual appears to provide enough guidance on planning and training so that if those strategic considerations are spelled out in the OPLANs and OPORDs from higher commands, unit leaders can incorporate them into their plans.

One critique of this manual—and, in fact, of any Service publication—is that Services rarely operate outside the joint or even multilateral framework in contingency operations, so the doctrine has limited utility. While it is certainly preferable to have joint-level doctrine, its absence does not make Army-specific doctrine irrelevant. Many of the engineers who staff combatant command headquarters are from the Army, and they can approach issues based on established Army doctrine, setting the tone for an entire operation.

Another shortcoming of FM 3-100.4 is that it does not adequately address the relationship between U.S. forces and contractors; guidance on that relationship is essential given the extent to which the Army relies on contractors to run its base camps and manage its waste streams. The manual deserves credit for raising the issue by stating up front that its guidance applies to support provided by the Army's Logistics Civil Augmentation Program (LOGCAP) contractor (it is the only doctrinal document we found that suggests this link other than the Army Judge Advocate General's *Operational Law Handbook*), but it does not explore the issue further. In particular, it does not establish guidance or provide templates for standard contracts that specify conduct with respect to the environment. Our interviews suggest that this is an important oversight, because contracting officers at many base camps do not have training in the environmental aspects of contracting. The absence of guidance on contracting may be due to the fact that the manual is aimed toward combat units, not the support units (primarily engineers and logisticians) that are more likely to deal with contractors. Unfortunately, the manuals that relate to engineers also overlook this important topic.

Perhaps the most serious shortcoming of FM 3-100.4 is that it contains no discussion of planning for and execution during the post-conflict phase. Other than mentioning that post-conflict operations may have environmental components, the manual is silent on this issue.

A final limitation of FM 3-100.4 is its apparent lack of use within the Army, perhaps because no Army regulations or DoD policies motivate such use. Field manuals provide guidance, but following them is not required. Army regulations, DoD directives and instructions, and presidential directives must be obeyed, yet none of them address environmental considerations in contingency operations directly, particularly with respect to the post-conflict phase. So FM 3-100.4 is essentially an orphan—guidance without a requirement to follow it.

FM 3-34.500, Environmental Considerations. FM 3-100.4 is currently in the final stage of being updated and revised. The revision (FM 3-34.500, *Environmental Considerations*) focuses more specifically on the contingency aspects of military operations. Like its predecessor, it will be a dual-Service publication, also published by the Marine Corps as MCWP 4-11B. The final draft was issued in May 2006, and final publication is expected in 2008.

The new field manual addresses several issues the old one did not. It provides guidance on how to incorporate environmental considerations into joint planning for an operation, along with extensive direction to units at the brigade level and below on how to incorporate environmental considerations into all phases of the operational cycle, including unit training before deployment and preparation for deployment to a specific area of operation. The new manual also lists the many annexes of the joint plan (in addition to Annex L) that will have significant environmental considerations, including the requirements for medical intelligence and geospatial information. And it emphasizes the importance of having the highest-echelon commander provide appropriate environmental guidance to subordinate commanders.

Reflecting the focus on contingency operations, the new manual includes an appendix on the environmental considerations for designing and building base camps to support forces engaged in contingency operations. It also adds guidelines for operational planning and man-

agement of hazardous wastes and materials during contingency operations. It does not, however, emphasize guidance for combatant commanders and JFCs on how to ensure that environmental considerations are included in the planning process. This is to be expected, since it is explicitly aimed at brigades and lower-level units, but it leaves an important gap in guidance.

The Army Strategy for the Environment

The Army regulations and doctrine reviewed above were not coordinated as part of an overarching strategy for the environment. The Army released a new environmental strategy in October 2004[34] that has the potential to change the current situation, but whether it will or not depends on how it is implemented over the next few years. The new strategy presents a vision and goals that should help provide context and motivation for future Army publications, doctrine, and training.[35] It defines the Army's leadership commitment and philosophy for meeting present and future mission requirements that can be affected by or can affect the environment. It marks the beginning of a process that the Army is undertaking to establish detailed Army-wide goals. Because the strategy is still fairly new, it will take some time before its implementation percolates down through the Army's doctrinal process.

According to the strategy, the Army's environmental mission is to "sustain the environment to enable the Army mission and secure the future," or more succinctly, "sustain the mission, secure the future." The vision articulated in the strategy, "sustainable operations, installations, systems, and communities enabling the Army mission" provides a useful approach for thinking about the environment that recognizes "the interdependence between our mission, the community, and the environment." This interdependence is the key to the strategy's definition of sustainability: "A sustainable Army simultaneously meets current as well as future mission requirements worldwide, safeguards human health, improves quality of life, and enhances the natural envi-

[34] U.S. Army, 2004.

[35] Ibid.

ronment." The interrelationships of mission, environment, and the community are viewed as the "triple bottom line of sustainability."

The strategy adopts a new approach for the Army: recognizing that the Army mission, the community, and the environment are connected and taking environmental actions because they will allow the Army to continue to operate and train its forces well into the future, in contrast to the old approach, which focused mostly on environmental compliance. This vision is already evident at Army installations, where installation staff has been working proactively to establish buffer zones around training areas so that Army activities will not be constrained in future years by sprawling communities and natural-resource concerns. The Army has become a leader within the military by adopting this sustainability approach.

To achieve its vision, the new strategy advances six goals:

1. **Foster a sustainability ethic.** Foster an ethic within the Army that takes us beyond compliance to sustainability.
2. **Strengthen Army operations.** Strengthen Army operational capability by reducing our environmental footprint.
3. **Meet test, training, and mission requirements.** Meet current and future training, testing, and other mission requirements by sustaining land, air, and water resources.
4. **Minimize impacts and total ownership costs.** Minimize impacts and total ownership costs of Army systems, materiel, facilities, and operations by integrating the principles and practices of sustainability.
5. **Enhance well-being.** Enhance the well-being of our soldiers, civilians, families, neighbors, and communities through leadership in sustainability.
6. **Drive innovation.** Use innovative technology and the principles of sustainability to meet user needs and anticipate future Army challenges.

The strategy is broad and is intended to cover all Army operations at home and overseas, in peacetime and during contingency operations. Although it does not specifically call out contingency operations

and only briefly mentions deployment, it clearly applies to contingency operations as well as other Army operations. For example, Goal 2, "Strengthen Army operations," is being interpreted in the implementation process as being focused on contingency operations. "Sustaining the mission" through sound environmental practices can be important in these operations, particularly when Army forces end up staying in the region for more than a few months. In those cases, base camps must have effective and sustainable sewage and waste management practices to provide a healthy environment for soldiers. Minimizing the environmental impacts of base camps can also sustain or even enhance the support of the local population. Furthermore, a primary emphasis during the post-conflict phase for many contingency operations is getting the host nation to be able to sustain itself (including life-supporting infrastructures such as water, sewage, and agriculture) so that local civil authorities can take control of the country and U.S. forces can return home.

Attention to environmental issues during planning and execution can strengthen Army operations during all phases of a contingency, because commanders and soldiers will be aware of critical environmental issues that could affect overall mission success. Similarly, attention to environmental considerations during planning will allow commanders to identify and address special training requirements. Minimizing the Army's impact on the environment during contingencies will reduce the volume of wastes that must be managed, thereby reducing logistical burdens and costs. Similarly, innovations that reduce the Army's impact can reduce the costs of an operation. Moreover, innovations that reduce the Army's consumption of resources (POL, water, hazardous materials, etc.) can reduce the logistical burden of supporting the deployed force.

All these examples are what Goal 4, "Minimize impacts and total ownership costs," is about, since it means the Army "will more effectively and efficiently manage by integrating sustainable practices into . . . systems, materiel, facilities, and operations" to reduce impacts on the environment, operations, and "the true cost of doing business."

Other strategy goals also apply to contingency operations, such as Goal 6, "Drive innovation." This goal emphasizes applying innova-

tive technologies and sustainability principles to how the Army operates, and this also includes contingency operations.

As the new strategy is implemented throughout the Army, it can help address some of the gaps in Army doctrine and training. Current implementation plans for strengthening the Army's operational capability by reducing its environmental footprint are a good start toward addressing these gaps.

Summary of the Policy Context

Current policy regarding environmental issues has a limited effect on the Army in contingency operations. There are no executive orders, DoD directives or instructions, or Army regulations that require compliance. Joint publications assign responsibilities for environmental issues within the joint force command, and the Joint Staff has established a requirement for the combatant command and each of the component commands to develop an annex on environmental considerations for operational plans and orders, but the guidance is vague on what should be included and largely omits the strategic considerations that may be critical during the post-conflict phase, despite their potential importance to overall mission success. Army field manual FM 3-100.4 does a good job of providing units at the brigade level and below with the tools needed to incorporate military environmental protection into their planning and operations, but it does not apply to the higher-level echelons where some of the broader environmental considerations must be raised and addressed, nor does it address the post-conflict phase. It also does not seem to be widely known or used.

Operational Context

The operational context in which Army forces find themselves during a contingency operation is as important for environmental considerations as the legal and policy context. Many factors, including the duration of the operation, its objectives and nature, and the involvement of other stakeholders, have made environmental considerations

more prominent in recent operations than they have been in the past. There is no indication that this trend will reverse any time soon.

Duration of the Operation

While the combat phase of operations seems to have gotten shorter, the length of Army involvement has not. After winning the high-intensity combat phase quickly, U.S. forces often have to remain for months or years to establish and secure the peace. This is also true in some peace enforcement and peacekeeping operations where U.S. forces have not been involved in combat.

In recent missions, the transition, or post-conflict, phase of contingency operations[36] has often involved far more than shutting down base camps and cleaning equipment for return to the United States. It has required efforts to reconstruct security, justice, governance, social, infrastructure, or economic systems so that the country is able to function without continued conflict or the need for external help and intervention. U.S. forces have been deployed on the Sinai Peninsula since 1982 to enforce the Camp David peace accords between Egypt and Israel (see Table 2.2). They have been in Haiti for 13 years, although the current U.S. contingent is significantly smaller than the original force. While the bulk of U.S. forces finally left Bosnia in December 2004 after nine years, a small force remains to support the European Union force operating there today. The number of U.S. troops in Kosovo has also been reduced, but some still remain there. Afghanistan and Iraq are also likely to require long deployments. Only in Somalia did U.S. forces leave in less than a year, and that was due to political pressure in Washington, not the resolution of the conflict, which persists to this day. In all of the operations except that on the Sinai Peninsula, stability and reconstruction were an important part of the military mission, even in countries such as Bosnia and Kosovo, where civil organizations provided the majority of the reconstruction effort.

Objectives and Nature of the Operation

The objectives and nature of an operation can have profound effects on the operational context in which environmental issues are consid-

[36] See Box 2.1.

Table 2.2
Recent Contingency Operations

Location	Operation	Start Date	End Date	Duration as of March 2008 (years)
Sinai Peninsula	Multinationalforce and observers	1982	Ongoing	26
Somalia	Operation Restore Hope	December 1992	May 1993	0.5
Haiti	Operation Uphold Democracy/Maintain Democracy and subsequent operations	September 1994	Ongoing	13
Bosnia	Operation Joint Endeavor	December 1995	December 2004	9
Kosovo	Operation Task Force Eagle	June 1999	Ongoing	8
Afghanistan	Enduring Freedom	October 2001	Ongoing	6
Iraq	Operation Iraqi Freedom	March 2003	Ongoing	5

SOURCES: Pirnie and Francisco, 1998; "Where Are the Legions [SPQR]" (www.globalsecurity.org/military/ops/global-deployments.htm) ; United Nations Stabilization Mission in Haiti (www.un.org/Depts/dpko/missions/minustah/facts.html); KFOR Guardian Online (www.tffalcon.hqusareur.army.mil).

ered and acted upon. An emphasis on achieving and preserving stability can make environmental issues much more important to mission success than traditional military planning, training, and execution would consider them to be, particularly during the post-conflict phase. Army units in Iraq and Afghanistan have found themselves focusing their efforts on providing clean water, managing sewage, and collecting trash in an effort to convince locals of their good intentions and to provide fewer reasons for them to resist the U.S. presence or join an insurgency.

The nature of an operation can also affect the importance of environmental considerations and the manner in which they are addressed. A critical factor affecting environmental considerations is the level of security, or permissiveness. In operations such as the one in Bosnia, civil organizations have been able to shoulder much of the burden of reconstruction, including the environmental aspects. In these situations, the Army can play a supporting role, filling gaps or providing unique capabilities. If the security situation is bad enough that civilian organizations cannot function, however, as is the case in Iraq and

parts of Afghanistan, the Army must take a more prominent or even a leadership role. As the security situation improves, civilians from U.S. government agencies, international organizations, and NGOs can play a more prominent role. Security and the level of combat can also vary across a country, creating zones that allow Army forces to concentrate on environmental considerations and zones where soldiers can address only basic force-protection and health-protection activities.

Part of the reason the Army is spending more time in reconstruction activities is that the nature of conflicts and reconstruction has changed. Major conventional wars, including World War I and World War II, had a fairly clear end to hostilities, after which reconstruction activities could be conducted in a fairly secure environment, without the threat of significant insurgencies. This is not the case in operations where insurgency activities may occur at different time periods in different parts of the country and where insurgents deliberately target such reconstruction activities as road-building and electrical-system repair. In Afghanistan and Iraq, Army troops have had to remain after the end of the initial combat phase to help provide security and to battle insurgents while humanitarian assistance and reconstruction activities are under way. Indeed, the Army has had to assume much more of the reconstruction mission in Iraq than it anticipated, because the insurgents targeted the NGOs providing assistance, and many of them, including the United Nations, left shortly after they arrived. According to some reconstruction experts, "the temporal coincidence of combat operations and assistance (including that provided by military forces) may become a new paradigm."[37] U.S. ground forces can be fighting insurgents in one part of the country while implementing reconstruction activities in another.[38] Sometimes the Army must do both at the same time in the same place, as they are doing in Iraq. Experience with recent contingency operations indicates that reconstruction activities need to start before the conflict is completely over. Because insurgency activities can go on for years or even decades, there is a critical need to start restoring key economic, governance, and social systems

[37] Oliker et al., 2004, p.2.

[38] See, for example, Boot, 2006.

in the host countries as soon as possible. This suggests the importance of including reconstruction and nation-building activities very early in the overall planning process for a contingency. Although that process is usually a joint or coalition effort, the Army is often deeply involved and is frequently the Service that ends up being responsible for executing the military's portion of the reconstruction plan.

Involvement of Other Stakeholders

The Army must also account for other stakeholders and actors in planning for and addressing environmental considerations in contingency operations. In joint operations, Army forces take direction from the joint commander. Other U.S. military Services will most likely be involved, along with military forces from coalition partners. Plans usually call for post-conflict humanitarian and reconstruction activities to be conducted by civilian organizations, including U.S. agencies (State Department and USAID), United Nations (UN) organizations, and NGOs. Since the goal is usually to transition to civilian-run operations and local civilian government as soon as possible, coordination of planning and execution is important during all phases of the operation to ensure that U.S. forces support the desired environmental end states.

The exact form these relationships take, who takes charge of the reconstruction, and the extent of support or leadership expected from the Army depends on the specifics of the operation, including who the United States' partners are, whether the operation is conducted under UN auspices, and the security situation. In Bosnia, the United Nations led the reconstruction effort, and civilian organizations were prominent in the stabilization and reconstruction phase, although U.S. forces also played an important role. In Iraq, the coalition led by the United States has been responsible for the post-conflict phase, and the Army has played a leadership role, because the invasion was not conducted under UN auspices and most NGOs have stayed away because of the poor security situation.

The experience in Afghanistan illustrates some of the challenges of coordinating humanitarian and reconstruction activities between

many different organizations.[39] Because the conflict started within a month of the September 11, 2001, attacks, there was little time for planning for the post-conflict phase, particularly the role that humanitarian assistance and reconstruction should play in achieving the military and political goals of the operation. In addition, concern about the Afghanis' historical hatred of foreign invaders led military planners to circumscribe the military's mission, limiting its primary goals to "the elimination of al Qaeda elements in Afghanistan and the concomitant destruction of the Taliban regime that harbored them."[40] Broader military or political objectives, including reconstruction, were to be determined later. As a result, much of the early humanitarian assistance activity was conducted in a fairly ad hoc fashion. CENTCOM had included representatives from USAID and the State Department at its headquarters to help support the assistance effort, but challenges to providing assistance during the early days and pressure from U.S. agencies and NGOs convinced CENTCOM leaders to include NGO representatives as well. This helped with information exchange and the sharing of perspectives, but post-conflict coordination within Afghanistan was still difficult. Part of the problem was that the international organizations and NGOs were fundamentally uncomfortable working with a military force in an operation that had not been sanctioned by the United Nations, because they believed that their neutrality would be questioned by the Afghanis. Nevertheless, CENTCOM coordination with USAID worked well, and establishing liaisons with NGOs and international organizations led to unprecedented communication between the two communities.

Host-nation governments are also important stakeholders that must be taken into account in planning for and executing contingency operations. Interactions with these governments on a broad range of issues, including the environment, are an enduring feature of contingency operations. Establishing and maintaining good relations with neighboring countries that support U.S. operations in a region can also be critical for the achievement of U.S. long-term objectives. In

[39] Oliker et al., 2004.

[40] Ibid., p. 38.

some situations, environmental issues are important in this regard. For example, Kuwait, whose support is central to operations in Iraq, has established high standards for U.S. environmental behavior. By contrast, Qatar seems less concerned about environmental issues related to U.S. activities there.

The Environmental Context

The environmental context in recent operations has made environmental considerations more prominent than they have been in the past. Factors affecting the environmental context include severe degradation of the local environment, the degree to which local communities view environmental issues as important, and the fact that environmental issues in contingency operations vary significantly from those issues at the Army's permanent installations. The international community can also exert pressure on U.S. forces to address local environmental issues in contingency operations.

Severe Degradation of the Local Environment

Recent experiences in Somalia, Iraq, Afghanistan, and even the Balkans indicate that environmental conditions are often significantly degraded in the countries where contingency operations occur. Because of the strong environmental policy, regulatory, and management practices that have been implemented in the United States in the past 30 to 40 years, Americans enjoy healthy environmental conditions with relatively clean air, clean water, and, in general, sound management of natural resources, agriculture, and ecosystems. Americans often take their good environmental conditions for granted and do not realize how bad conditions can be in other countries or what the consequences can be for soldiers and the local population in those countries.

Three primary factors contribute to degraded environmental conditions, particularly in poor countries. First, many countries do not have environmental laws and regulations, and in those that do, the regulations are often not enforced. These countries can face enormous pressures on their air, water, and land from poor industrial and

natural-resource practices and overpopulation. Pollution from industry can also be significant, because of the lack of constraints on such practices. Pollution from ongoing and past activities can create human health risks for anyone exposed to the high level of toxic chemicals and hazardous wastes. In many places, the toxic and hazardous-waste pollution has been building up in the water and land for decades, creating significant health risks throughout the country. These long-term pollution problems can be significant even in relatively well-developed countries such as those in Eastern Europe, where decades of industrial pollution have left natural systems seriously contaminated. Governments themselves, by not considering the long-term impact or human health impact of policies and practices and by not investing enough in community infrastructure, may contribute to environmental problems, especially regarding key environmental infrastructure issues, such as waste disposal and provision of clean water.

Environmental degradation is not limited to the countries in which contingency operations occur; nations that support U.S. forces in the region can also have high levels of environmental pollution. The Ash Shuaiba Port in Kuwait presents a well-known health threat because of serious regional industrial air pollution generated by a local cement factory, oil refineries, a fertilizer plant, and other factories (see Box 2.5).

The second factor contributing to environmental degradation in many cases is pressure on natural resources caused by overpopulation, extraction industries, overgrazing, deforestation, and other unsustainable agricultural practices. Somalia is a classic case where overgrazing, overpopulation, and drought have contributed to significant ecosystem loss, desertification problems, and famine.

Iraq and Afghanistan illustrate the third factor that contributes to poor environmental conditions—years of war and political instability. War can contribute directly to environmental problems: Countries with years and even decades of fighting often have significant problems with land mines, unexploded ordnance (UXO), oil wastes, and other toxic and hazardous wastes. Conflicts may also directly damage key water, agricultural, and natural-resource infrastructures. In Afghanistan, the UNEP Post-Conflict Environmental Assessment found that much of

Box 2.5
Ash Shuaiba Port: The Health Risk for U.S. Troops from Industrial Pollution

Ash Shuaiba Port in Kuwait has been critical for U.S. operations in Iraq because it is one of the few nearby deep-water ports, which are needed to offload equipment from vessels the military uses for sealift. The area has known health threats arising from serious regional industrial air pollution caused by a local cement factory, oil refineries, a fertilizer plant, and other factories. The U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM) monitors the air and assesses the health risks for U.S. troops in the region, especially the risk from high levels of particulate matter (PM-10). The U.S. military has implemented procedures to minimize the risks, including putting gravel in the life-support area to help suppress dust, minimizing outdoor activity, and minimizing the time troops spend at the port. Despite these efforts, U.S. troops have gotten ill from the high level of pollution and the unpredictability of the chemical releases. Some Service members were treated for exposure to an unexpected ammonia release in April 2004, and others got sick from a sulfur dioxide release. According to CHPPM, this ongoing problem has the potential to affect the mission: "A release of similar concentrations [of sulfur dioxide] could result in a portion of individuals experiencing respiratory irritation and mild health effects ultimately resulting in reduced mission capability." Given such risk, CHPPM continues to extensively monitor and assess the problem, and the U.S. military continues to implement mitigation procedures.

SOURCES: U.S. Army, Center for Health Promotion and Preventive Medicine, 2004, 2005.

the country's environment has been degraded to an alarming extent, with potentially serious implications for human health. Decades of conflict and violence, coupled with drought, poverty, and population growth, have placed significant pressures on fresh water, soils, forests, wildlife, and other natural resources.[41] A conflict can also contribute indirectly to environmental degradation through the economic pressures that it creates. Key infrastructures can suffer from neglect and underinvestment, and inhabitants may adopt unsustainable practices in order to survive.

Severe environmental degradation can create health risks for U.S. forces that are serious enough to affect operations or mission readiness, and it can make environmental issues important to the local populace

[41] United Nations Environment Programme, 2003a.

and, by extension, to mission success. Operating and living in locations with high levels of toxins and hazardous pollution means U.S. forces can face far greater health risks from environmental conditions than they are typically exposed to in the United States or other developed countries. For example, in Operation Joint Endeavor (OJE), the Army located a base camp between a caustic soda plant and a cement plant, both of which emitted significant air pollution. When an atmospheric inversion layer occurred, the pollution turned into caustic ash that peeled paint off vehicles and sent some soldiers to the clinic. The Army then had to take emergency actions to relocate the base camp to a safer location.

The combination of environmental degradation and unsustainable population levels can create situations in which basic human environmental needs become central to human health and survival and therefore become important concerns to the local inhabitants. In these situations, basic public services, such as clean drinking water, electricity, sewage treatment, and trash pickup become immediate, first-order concerns and prerequisites for restoring a functioning economy and society. The ability to produce enough food, including access to healthy land for grazing and growing crops and adequate irrigation infrastructure, often is another key concern. Such issues are central to the post-conflict and reconstruction process, as the United Nations has documented in Afghanistan.[42]

The Importance of Environmental Conditions to the Local Populace

U.S. troops and others often assume that the local people in a country of conflict or nearby host nations do not care about environmental issues, because they see people dumping trash in the streets, fishing in polluted rivers, and living with other significant pollution problems. However, this pollution may reflect the lack of environmental protection, lack of basic investments in community infrastructure, and historical practices, rather than a lack of concern about environmental conditions. Similar scenes were common in many areas of the United States 50 to 75 years ago, especially in rural areas, before the current environmental laws and basic infrastructures were fully in place and

[42] Ibid.

community practices had changed. Just because a country is polluted does not mean that people are not concerned about pollution issues. In fact, people living in severely degraded environmental conditions may be especially concerned about environmental issues.

We have collected some evidence that Iraqis care deeply about environmental issues. Polling data collected in Iraq from 2003 to 2005 indicate that Iraqis are very concerned about critical aspects of the environment and suggest that those aspects should be central to the reconstruction effort. Although Iraq has extensive oil wealth and at one time had developed good infrastructures, three wars over the past 20 years, 12 years of international sanctions, and insufficient investments in public infrastructure have severely degraded critical systems and the environment.

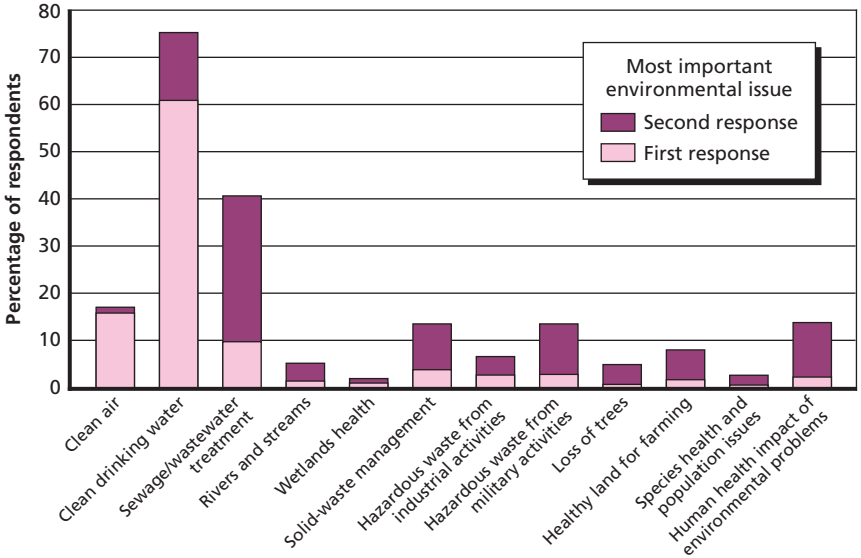
We examined a wide range of public-opinion data obtained in Iraq between fall 2003 and February 2005 and also commissioned a poll seeking Iraqis' environmental views in February 2005.[43] (The full results and analysis of Iraqi survey data are given in Appendix B.) The public-opinion data indicate that Iraqis from all provinces at that time worried about rebuilding infrastructure, including water and sewage facilities, more than any other issue except security (and sometimes the economy). In fact, in one opinion poll from early 2005,[44] when Iraqis were asked, "Which of the following approaches to social issues would make you most likely to support a party or candidate were they offered?" 23.1 percent of the respondents gave "Access to clean water" as their first or second response.

The data from the February 2005 survey indicate that among environmental issues, Iraqis are most concerned about clean drinking water, then sewage and wastewater treatment, followed by clean air (see Figure 2.1). When respondents were asked to name the most important environmental problem facing them and their family today, 60.4 per-

[43] Environmental questions were added to an Iraqi monthly opinion poll in February 2005 courtesy of Dr. David Jodice, President, and Matthew Warshaw, Senior Research Manager, D3 Systems, Inc. (Phone: 703-255-0884; FAX: 703-255-6465; Web: www.d3systems.com).

[44] International Republican Institute, 2005a.

Figure 2.1
Most Important Environmental Issue Cited by Iraqis



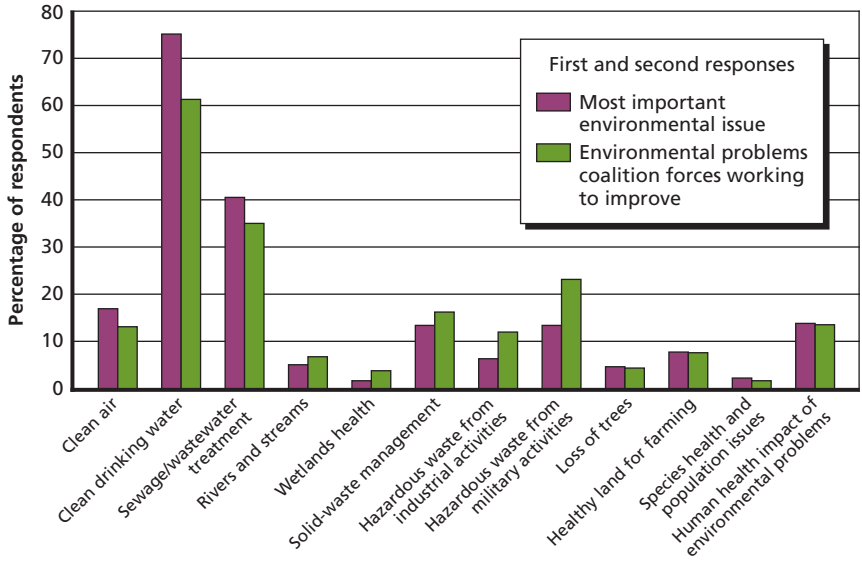
SOURCE: Data courtesy of D3 Systems.

RAND *MG632-2.1*

cent mentioned clean drinking water first, and 74.8 percent mentioned it as their first or second response. Sewage and wastewater treatment was the second highest issue for first and second response for 40.3 percent of the respondents, but only 9.4 percent of respondents mentioned it as their first response. Clean air was next highest for first response at 15.4 percent, but it was only 16.8 percent for first and second responses combined. Solid-waste management, hazardous waste from military activities, and the effects of environmental problems on human health were also viewed as most important by some of the respondents.

These results suggest the importance that environmentally related reconstruction projects can have in stabilizing the country and winning the support of the populace for coalition forces and the new Iraqi government. In fact, these polling data suggest that U.S. reconstruction activities match well with Iraqis' priorities. Figure 2.2 compares the answers to two questions: What do you think the coalition forces are working to improve? and What do you believe are the most important

Figure 2.2
Comparison of Iraqi Views of the Most Important Environmental Problems to Iraqi Views of What Coalition Forces Are Working to Improve



SOURCE: Data courtesy of D3 Systems.
RAND *MG632-2.2*

environmental issues? The answers regarding what the coalition forces were working to improve were largely consistent with what respondents stated were the most important environmental issues—good news for U.S. forces. Clean drinking water and sewage/wastewater treatment were ranked high for both importance and what the coalition forces are working to improve. However, it is important to note that respondents were asked what they think coalition forces *are* working to improve, not what coalition forces *should be* working to improve.

In sum, in countries with severe environmental degradation, the local population often cares deeply about environmental issues that directly affect their health and even survival. In the most degraded areas, such issues can become a significant factor in reconstruction activities and efforts to win over the populace.

Environmental Issues in Contingency Operations Significantly Different from Issues in the United States

The Army's environmental considerations are very different in contingency operations than for Army operations in the United States. As discussed in the policy-context section, the practices and procedures required to meet U.S. environmental regulations do not usually apply. The countries involved in a conflict often have few, if any, environmental laws, and there is little Army guidance from doctrine or policy. Also, the significant environmental degradation that often exists creates health risks that soldiers are unfamiliar with at home and heightens the importance of basic environmental considerations for sustaining the force and winning the support of the local populace. Finally, Army units in contingency operations must take a great deal more responsibility themselves for considering and protecting the environment than they are accustomed to. In an actual operation, they cannot rely on the extensive environmental support assets that they have at home installations and training facilities, including Department of Public Works staff, contractors, and well-established environmental practices and infrastructures. The Army's push over the last two decades to divest Army units of these responsibilities and give them to civilians and contractors has amplified this difference between peacetime and wartime operations for combat units. It has also amplified the difference for the support units that are tasked with building and operating base camps and conducting many of the reconstruction activities but that often have little experience or training in these areas when they arrive in-theater.

CHAPTER THREE

Experience with Environmental Considerations in Contingency Operations

This chapter catalogs a wide range of Army and joint-force environmental experiences in contingency operations and assesses what those experiences may mean for future operations. First, we discuss how environmental considerations have been incorporated into planning for contingency operations, Army activities in the field, and training for field operations. Next, we present some of the key findings from a database of 111 case studies that we assembled from interviews and literature reviews. Chapter Four presents insights gained from our analysis of the operational experience, based on the case studies, interviews, and the broader literature.

Planning and Guidance in the Field

How have the Army, the joint force, and coalition forces incorporated into their operations planning the wide range of environmental considerations that could affect Army operations and mission success? As discussed in Chapter Two, joint and Army doctrine ask the JFC and the land-component commander to develop an annex to their respective OPLANs that addresses environmental considerations. This is usually the only explicit high-level treatment of such considerations in the OPLAN, although some regional commands have gone further by developing guidance for specific environmental considerations in their areas of responsibility. Our research indicates that the annexes to

OPLANS focus primarily on the force-sustainment aspects of the environment and say little, if anything, about strategic aspects of environmental considerations or their importance in the post-conflict phases of an operation. The same is largely true for the environmentally related guidance issued by regional commands.

The rules of engagement for an operation could also reflect the high-level environmental concerns of commanders, including orders to preserve water supplies, dams, or culturally important landmarks. But again, our research suggests that rules of engagement typically do not focus on the desired end states for the post-conflict phase.

Environmental Considerations in Operation Planning: Annex L

The requirement for combatant commanders to develop an environmental annex for each contingency comes from the Joint Operation Planning and Execution System.[1] Responsibilities are spelled out in more detail in JP 3-34 (2007) and JP 4-04.[2] The annexes will be tailored for each contingency, but the U.S. European Command (EUCOM) developed a general Annex L in 2003 that combatant commanders in EUCOM and other theaters have used as a template. CENTCOM planners appear to have adopted large sections of EUCOM's template to create Annex L to the Operation Iraqi Freedom (OIF) OPLAN (1003 V), adding or modifying where necessary to fit their particular situation. Annex L was not intended to address post-conflict or strategic goals but could be adapted to do so.

Annex L spells out the overall environmental mission for the operation and the responsibilities of each key actor in executing that mission. According to the initial OIF annex:

> USCENTCOM, its components, and JTFs will consider environmental consequences while preparing and executing orders based upon this plan. Upon deployment, U.S. forces must actively prevent pollution, respect the natural resources of host nations, comply with U.S. and host nation environmental regulations (to the extent applicable during periods of conflict), and clean-up

[1] Joint Chiefs of Staff, CJCSM 3122.03A.

[2] JP 4-04, pp. VI-1 to VI-3.

> hazardous and POL spills and other environmental contamination that directly endanger the health and safety of U.S. Forces, Allied Forces, and non-combatants.[3]

Both the EUCOM and OIF environmental annexes focus primarily on force sustainment: how wastes should be collected, cleaned up, and accounted for; what the acceptable sources of potable water are; and how to manage hazardous materials. In operations (either combat or support) that occur in countries with which FGS have been established, the Annex Ls call for standards that are consistent with the FGS. In all other cases, the annexes provide minimum standards and urge commanders to use the OEBGD to guide the development of environmental standards for the operation (although the OEBGD does not technically apply to operational deployments that are not on overseas U.S. installations).

The OIF Annex L also discusses the degree to which each activity should be conducted during each phase of the operation—less compliance is demanded when bullets are flying, and more compliance is required before and after the combat phases of the operation. The annex addresses the tension between environmental compliance and military expediency in the following manner: "In the combat arena, environmental considerations will always be subordinated to the preservation of human life and force protection. However, this does not mean that the preservation of the natural environment may be ignored in the execution of orders generated from this Plan or in the development of branch, sequel, or subordinate plans."[4]

Unfortunately, neither the EUCOM nor the initial OIF annexes provide guidance on the tactical or strategic goals that commanders should be concerned with during planning or operations. Indeed, the goals presented in Annex L for OIF are relatively narrow in scope: "U.S. Forces will include environmental considerations in all aspects of operations to minimize actions which might expose U.S. Forces

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[3] Annex L to USCENTCOM OPLAN 1003V, September 18, 2002, unclassified portions, p. L-3.

[4] Ibid., p. L-1.

to unnecessary health risks, cause unnecessary harm to the environment, or subject the U.S. to unfavorable publicity and future claims for damages."[5] The Annex Ls call for component commanders to develop their own guidance for their forces in their component-specific operation plans, but the land-component plan for OIF provides little additional detail on environmentally related tactical goals.

The annexes do not focus on the unique environmental considerations that may apply during the post-conflict phase of an operation, where stabilization and reconstruction activities can be important. Instead, what is expected of U.S. forces is simply full compliance, and environmental activities are focused on cleaning up facilities so that they can be turned over to the host nation and documenting final conditions for any future claims or legal challenges.

Moreover, it is not clear how much of the guidance provided in Annex L gets down to the Army units on the ground. Many soldiers and engineers we interviewed who were deployed in Iraq were unaware of the contents of Annex L (and the CFLCC (combined-force land-component commander) analog, Appendix 2 to Annex F (Engineer) of COBRA II). Those who were aware of them did not feel that the annex provided much guidance that was useful to them. Several felt that it did not represent a serious effort by CENTCOM planners to address environmental issues but was merely an exercise in checking the box.

Regional Guidance

In addition to developing an environmental annex before an operation, individual combatant commands can create their own policies and publications on implementation, informed by their geographic situation and their experiences in contingency operations. Although a number of regional commands have issued environmental guidance for their areas of responsibility, the European theater seems to have been the most active. EUCOM has published a number of environmental guidelines, including the aforementioned Annex L template, which it created based on experience in the Balkans. The U.S. Army in Europe

[5] Ibid., p. L-3.

(USAREUR) also developed a detailed guidebook that outlines standards for base camps in contingency operations, commonly known as the Red Book.[6] Another example is the booklet "You Spill, You Dig" that USACE in Europe developed to help soldiers prevent environmental accidents during operations, including contingency operations.[7] This practical guide educates and reminds soldiers about field spill prevention and response practices, such as at vehicle fueling and maintenance areas, for hazardous-materials storage and hazardous-waste management. An important aspect of these guidance documents is that they are ready to be used in future contingencies. Sometimes the policies presented in these documents are picked up by other combatant commands, but often they are not. For example, CENTCOM and other commands did not adopt USAREUR's Red Book and adapt it to its area of responsibility (AOR). In fact, they had nothing similar before OIF started. As a result, they had to develop their own Sand Book after OIF was under way, which meant that the development of base camps was more ad hoc than it should have been. It is not clear how extensively CENTCOM relied on the Red Book in drafting its guide.

Army Activities in the Field

In contingency operations, Army units spend their time in combat operations moving from place to place, living in base camps, and conducting stability, support, and reconstruction activities. Different functional operations within these activities have diverse environmental considerations. As discussed earlier, the primary environmental considerations during combat are force health protection and tactical considerations, and they are conditioned by mission objectives. Given the importance placed on military expedience during combat, a unit's environmental responsibilities are fairly limited. Experience in recent contingency operations has shown that environmental considerations

[6] United States Army, Europe, 2004.

[7] U.S. Army Corps of Engineers, 2000. Another guidance document is United States Army, Europe, 2005.

are significantly more important in other areas, including base camps, stability and reconstruction, and the movement of forces and materiel. Each of these areas is discussed briefly below.

Base Camps

Base camps have become a central feature of contingency operations. They are usually established in states surrounding the conflict zone before operations begin and are established quickly within the conflict zone as conditions become more permissive. As soon as a base camp is established, it becomes the center of a unit's life and the focus of a massive logistical effort. The base camp also becomes the primary medium through which soldiers and the environment interact. As homes to up to many thousands of soldiers and nearly as many vehicles, base camps generate large streams of wastes and effluents. Base camps require large sources of energy and clean water, as well as an environment that has clean air and is largely free of disease and disease vectors. Failure to meet these requirements can affect soldier health and reduce mission readiness. Failure to manage wastes properly can also affect mission readiness and relations with the local populace.

Establishing and running base camps consumes a significant share of the available resources during an operation. The task of establishing the camps usually falls to the engineers, with significant support from logisticians and other branches. One of the first steps that should be performed when selecting a location for a base camp is an initial environmental baseline survey (EBS)[8] to make sure that the environmental, safety, and force-protection conditions are acceptable. The first EBSs at a potential site are often done quickly by the unit's junior officers, who are not specifically trained for that task. Sometimes an EBS is conducted by an engineer or chemical officer, but even they are not specifically trained. At this time, there is no curriculum at the engineer or chemical officer schools for training soldiers in how to conduct an EBS. The units and engineers are often focused on establishing

[8] The EBS is a multidiscipline site survey conducted during the initial stage of deployment. A closeout EBS is conducted when joint forces depart the site. An EBS should be performed by an environmental professional, such as an engineer or medical officer (FM 3-34.500).

a field-expedient camp, rather than a facility for long-term occupation. As such, they have different standards and requirements. Therefore, the preliminary EBSs should be followed by a more thorough assessment by trained assessors before a base camp is established. In addition, trained personnel from the medical corps should conduct an environmental health site assessment (EHSA)[9] before a base camp is established or expanded.

Unfortunately, data from the field indicate that these assessments are not always performed prior to siting a camp, and the results of this omission can be costly or even dangerous.

The operations at a base camp may be run by engineers and logisticians, but they may also fall to any available officer, regardless of training. The camps usually receive significant support from contractors, who provide many services, including removal or disposal of wastes, including food wastes, gray water, black water, and hazardous wastes.

One central issue for base camps is the length of time they are likely to be in operation. The longer a camp is likely to be occupied, the more investment must be made in infrastructure to handle wastes and provide healthy, sanitary conditions for the soldiers who live there. Conditions that will suffice for a few weeks or months can become unacceptable hazards to health and safety if a camp is used for longer periods. Decisions about how much to invest in a base camp are complicated by uncertainty about how many Army forces will remain in the region and how long they will remain, which often leads decisionmakers to consider base camps as "temporary" even after they have been occupied for years.

Although considering the camps to be temporary may be easier for decisionmakers, it has an effect on the resources available to address environmental issues, because vastly more funding is available for construction at facilities that have been declared "enduring." Temporary camps often have trouble getting the equipment they need for environmental support, such as incinerators to burn solid, hazardous, and med-

[9] An EHSA is conducted to determine if environmental contaminants from current or prior land use, disease vectors, or other environmental conditions exist at deployment sites that could pose a health risk to deployed personnel (FM 3-34.500).

ical wastes. Temporary camps also have difficultly getting resources to address acute environmental problems. A further complication is organizational: The Army organizations charged with managing permanent installations in the United States and overseas have not considered base camps as part of their mission, which means that the commanders in a contingency cannot benefit from the expertise of those organizations in planning or running base camps.[10]

Base camps also face a significant challenge from surges in the number of residents, particularly during the rotation of units. In the overlap between rotations, camp population can double, which can stress the ability of the wastewater systems to handle the load. Also, our research suggests that new residents often do not follow the camp's established environmental operating procedures, dump hazardous wastes on the ground, or do not clean up spills.

Although engineers play a prominent role in establishing, running, and closing base camps, many are not trained in construction engineering and other key skills because of the Army's focus on developing combat engineers. The Army has recently recognized the perennial problems it has with base camps, so it has decided to formally establish a proponent for base camps and has assigned the part of the Maneuver Support Center (MANSCEN) that was the Army Engineer School to that role. The hope is that a proponent will help establish SOPs for designing, building, and operating base camps in future operations. In fact, MANSCEN is standing up an integrated concept development team to conduct an assessment of what is needed.

The process of closing a camp and returning it to the host nation raises another set of environmental issues. The Army's goal is to return the camp and the surrounding environment to the same state that existed when it began operating the camp. But this does not always happen, and it is not even possible in some cases. Depending on the mission requirements and pullout deadlines, the United States may decide to document the environmental contamination, fence it in, and inform the host nation, rather than pursue further remediation. In

[10] This may change if the Army's Installation Management Command is given responsibility for base camps.

other cases, the United States may remove and clean up any remaining wastes, hazardous materials, and ordnance. A closure plan that involves a final EBS is an important part of this process. By comparing it to the initial EBS that was conducted when the camp was built, the Army can ensure that remediation is conducted, if appropriate, and can account for any damage, wastes, or pollution that existed at the camp before the Army arrived.

Stability and Reconstruction

In recent operations, the Army has been involved in a wide range of reconstruction activities, including construction of roads, bridges, and railroads, and repairing, improving, or building electrical infrastructure, wells, water and sewage treatment facilities, irrigation systems, schools, hospitals, clinics, and museums. The Army has even helped collect municipal refuse (garbage and trash). As will be discussed in detail later, many of these activities can involve environmental issues, from addressing a pressing environmental concern for the local populace, such as drilling a well for water, to raising some environmental concern about a reconstruction project, such as the effect of water runoff or loss of farmland from building a new major road. Reconstruction activities can involve soldiers with a range of skills, particularly engineers, civil affairs officers, USACE, and Army combat and combat support units, as well as contracted assets.

Movement of Forces and Materiel

The movement of forces and materiel throughout the theater is a daily fact of life in contingency operations. These transportation activities can involve significant environmental considerations. For example, during recent contingency operations, force movements have often resulted in easily preventable litter problems and spills of fuel and oil. In addition, impacts on natural systems, such as agricultural lands, watersheds, and fragile ecosystems, can be an issue with vehicle, equipment, supplies, and troop movements.

Different Field Activities Have Different Environmental Considerations

Environmental considerations can vary significantly among the many activities the Army undertakes in the field. Environmental concerns occur across a wide range of areas, including air, water, hazardous materials and waste, solid waste, natural resources, and cultural resources. In its operations, the Army needs to consider such diverse issues as protecting drinking water, addressing sanitation and sewage concerns, disposing of hazardous waste, properly managing and storing hazardous materials, and minimizing harm to natural and cultural resources. Since there are many different environmental media and issues to consider in contingency operations, the Army needs to consider the potential effects of many environmental impacts on operations and achievement of desired end states. This complicates analysis, planning, and training. It also means that the Army needs environmental understanding and expertise to fully incorporate and analyze potential impacts and actions for implementation.

Environmental considerations also vary by the type of activity or process in which soldiers are engaged. For example, a maintenance shop or refueling station raises different environmental considerations from those in troop sleeping areas or mess halls. Hazardous-waste management and spill prevention and response are primary concerns at maintenance shops and refueling stations, while sanitation and water quality are key concerns at military housing sites and mess halls. A military hospital, by contrast, must concern itself with sanitation and biomedical and hazardous waste.

Training for Field Operations

Although Army field manuals make clear that soldiers should be trained and units should have appropriate SOPs to protect the environment, the data we obtained from interviews and case studies of recent contingency operations indicate that these instructions are not always followed. There may be several reasons for this. First, there may be a

lack of appreciation for the importance of the environmental aspects of contingency operations and consequently a lack of attention to them.

Second, peacetime training does not adequately reflect the activities that combat units and support units are likely to engage in. Units rotating through Army combat training centers such as the National Training Center are not rated on their ability to build and use field-expedient sanitation facilities or to manage trash or other wastes. Concerned about the impact of so many soldiers on their own facilities, the training centers provide portable chemical toilets, trash cans, and collection points for hazardous wastes instead.

Similarly, engineers do not get training or experience in building and running base camps. In fact, engineers are often thrown into base-camp site selection, development, and management with little experience or training in environmental considerations or environmental tasks, such as performing EBSs. Nor are engineers trained to write and oversee contracts to ensure that environmental standards for an operation are being met. These important skills are not emphasized at home installations, where the Department of Public Works takes care of many activities.

Third, training does not take place in the environmental conditions soldiers are likely to encounter in contingency operations. The environmental conditions in U.S. and most overseas installations and training facilities are quite good, but avoiding illness and disease may require special precautions in a contingency operation.

Fourth, because of rotation and scheduling, units are not strongly inclined to take ownership of environmental issues. For instance, units that are just passing through a base camp may not feel any environmental responsibility for their actions at that camp.

Environmental Issues in Operational Experience: Case Studies

In addition to understanding how environmental considerations have been incorporated into planning and guidance, it is important to look at what has actually happened in the field. Because experiences in

earlier phases of an operation can have a significant impact on later phases, particularly on stabilization and reconstruction, all phases of actual contingency operations need to be examined.

To understand how environmental considerations played out in all phases of actual contingency operations, we conducted an extensive literature review and interviews of personnel involved in contingency operations in Iraq, Afghanistan, the Balkans, Somalia, and Haiti, and in the first Persian Gulf War. Information from these sources was used to develop a case study database to help us analyze the range of effects that environmental issues could have on contingency operations. In the next chapter, we draw on the case studies and other information, such as the broader field, environmental, and reconstruction literature, to analyze the effects of environmental considerations on operational experiences.

Case Studies of Contingency-Operation Activities with Environmental Concerns

Given the breadth of environmental considerations and the depth of available information on how they are handled during contingency operations, we developed a database of 111 cases to understand what types of environmentally related issues occur and what consequences they have or might have. The goal of this analysis was to illustrate the range of issues in a contingency operation where the environment can be a factor and should be considered in planning and the conduct of combat operations and stability, support, transition, and reconstruction operations. To that end, we included cases from actual contingency operations that raised or illustrated an environmental issue. In some cases, considering or not considering an issue in planning or operations had a direct, measurable effect. In other cases, the effect was more indirect or diffuse. In still other cases, there was no effect, but there easily could have been and may be in similar future cases if environmental issues are not taken into consideration.

Most of the cases in our database were extracted from Army lessons-learned documents, such as reports from the Center for Army Lessons Learned (CALL); field operational documentation, such as EBSs; technical journals, such as the Army's *Engineer* and other engi-

neering journals; and interviews. All cases raise or illustrate an environmental issue and come from an authoritative source, such as a published journal article, or have been confirmed by multiple sources (e.g., another interview, the literature, or operational documentation). Mainstream news sources, such as *The New York Times* and *The Wall Street Journal*, were sometimes used to corroborate information from other sources. In many cases, we heard the same "story" from multiple interviewees or had it verified by another source, such as an environmental engineer who had recently returned from the field or an actual EBS.[11]

Almost 40 percent of the cases in the database are from the current operation in Iraq, more than 30 percent are from the Balkans, and more than 20 percent are from Afghanistan. The rest are from other known contingency operations (such as Haiti and the first Gulf War) or from unknown contingency operations. (The case studies in the database are listed in Appendix C.) Most of the cases are Army experiences, but a few significant and useful cases from other Services are also included. Some cases came from joint operations, where it was difficult to distinguish which Service was involved. More than 60 percent of the cases reflect the post-conflict stage of the operation. However, in some cases, it was difficult to determine the stage of the operation during which the experience occurred. In addition, the Army is often directly involved in a large number of reconstruction projects that focus on environmental concerns. About 20 percent of our cases were actual reconstruction activities, many of them related to water projects.[12]

The database is not a statistical sample, since the cases were not randomly selected. Initially, we included any case that raised an environmental issue. However, after we found several examples of a certain type, we did not add similar cases unless they were different in some

[11] Our interviews were not for attribution, so we do not identify or reference individual sources. Unpublished sources, such as individual trip notes, are also not listed here. However, we do reference other sources in this section as much as possible. For additional sources, see the Bibliography.

[12] Safety was not a major focus for this study, since so much emphasis has been placed on safety issues in U.S. operations in Iraq and Afghanistan. However, safety issues that were relevant are mentioned, since some of them, such as dealing with highly flammable toxic materials, are closely linked to environmental concerns.

way, e.g., they occurred in a different contingency operation or were handled a different way. For example, there were examples of looting of museums throughout Iraq, but only a few were entered in the database, namely, the looting of the Iraq Museum and the Natural History Museum in Baghdad and the small museums in Babylon. The looting of the Iraq Museum was highly publicized and had a large impact on community relations. The Babylon museums did not get as much visibility. Most other examples of museum looting were similar enough to the Babylon case that they were not included in the database.

Clearly, the database has some potential biases. As it was being developed, we noticed that a large number of the cases involved hazardous waste, hazardous materials and chemical incidents; human health effects; and water concerns. These concerns have a more immediate impact on soldiers and operations than other environmental factors, and they are often better documented and addressed by Army engineers. Very few of the cases involved natural-resource issues, such as habitat and species concerns. Because these areas were underrepresented, we conducted special literature searches and added interview questions to elicit more natural-resource experiences, but we found few examples. Because impacts on habitat and species are longer-term strategic issues that usually do not directly affect soldiers or operations, there is not much documentation on them. However, they are important concerns.

Another initial bias was the nature of the cases. Many of the examples we initially collected were about environmental problems—troops getting sick or improper disposal of hazardous waste—rather than about positive environmental actions. We addressed this bias by searching the literature for more positive examples, which we found, for example, in Army activities directly focused on reconstruction projects. As a result of this effort, almost half of the cases in the database are incidents that had a positive or beneficial effect on the environment.

In this chapter and the next, we refer to many different cases to provide concrete illustrations of our findings. Some of these examples are referenced more than once, because they are useful to illustrate dif-

ferent points. In other cases, examples may seem the same, but they actually reflect different cases because they occurred in a different operation or under different circumstances.

Impact Analysis

With these caveats about the database in mind, we analyzed each case to determine whether the issue or issues it raised had or could have had an impact in one or more of eight key dimensions:

1. Affecting the health of U.S. troops or others
2. Affecting the military mission
3. Incurring financial costs or savings for the Army
4. Affecting community or diplomatic relations
5. Affecting reconstruction activities
6. Affecting the safety of U.S. troops
7. Causing additional environmental harm
8. Incurring environmental liability.

These dimensions were chosen because they represent the diverse ways that environmental issues can affect the Army, positively or negatively. We also assessed whether the environmental issues in each case were the result of a condition that existed in the country before U.S. forces arrived, were newly created by U.S. operations, or were a combination of both. About half of the cases involved an environmental concern that existed before U.S. forces even entered the country. In some cases, the Army was conducting an activity specifically to help address an environmental problem, such as repairing a water treatment facility or developing a state-of-the-art waste-disposal system; therefore, we also recorded whether the case was a positive or beneficial action.

Table 3.1 presents two examples from the database and their actual or potential impacts on each dimension. The table also includes basic contextual information about the case, including its title, a brief description, the contingency operation and the specific location, if known, and sources of information.

Table 3.1
Case Study Database Examples

	Unreported fuel spill affects base-camp expansion	Repaired city main water supply
Summary	A 300-gallon fuel tanker overturned at a U.S. forces base camp. The spill was not officially reported and the site was not properly marked. Base-camp planners planned to construct sleeping areas at the site. "As first tents went up," base-camp officials learned of the spill, "leaving the camp planners with two options: remediate the site or re-site the troop sleeping areas. Either option would cost the unit additional time and resources. . . . During the time of inaction, the size of the plume increased and required a more costly remediation effort."	Civil affairs personnel of the U.S. Army Reserve in a civil-military task force were helping rebuild the country. Part of this task force helped repair one of a city's main water supply lines. Army members on the task force designed the repair, supervised local workers, and helped provide security. The International Committee of the Red Cross financed the repairs. The UN helped de-mine the area.
Contingency operation	OIF	OJE
Location	Iraq	Sarajevo
Actual or Potential Impact[a]		
Affects the health of U.S. troops or others	*Could have contaminated the water supply for friendly forces and civilians causing contaminated-water-related illnesses.*	Provided safe drinking water to the city so less risk of waterborne illnesses developing.
Affects the military mission	Impact to readiness because additional time needed to expand the base camp.	N/A
Incurs financial costs or savings to the Army	Costly remediation effort to clean up the plume.	Minimal cost to the Army; Army staff involvement in the reconstruction project.
Affects community or diplomatic relations	*If it had contaminated the water supply, it could have incurred a diplomatic cost with local community and broader public.*	Good local public relations and *perhaps some positive international visibility.*
Affects reconstruction activities	N/A	Restored water supply line for a major city.
Affects the safety of U.S. troops	*Soldiers might have used contaminated dirt to fill sandbags around their living facilities.*	N/A
Causes additional environmental harm	Contaminated the ground. *Also, it could have seeped into the ground water.*	N/A
Incurs environmental liability	*If it had affected the water supply, potential long-term liability associated with contaminating the water supply.*	N/A
Source	Center for Army Lessons Learned, 2004, p. 25.	Leverinton, 1998, p. 57.

[a] Potential impacts indicated by italics.

To illustrate the range of cases and their diverse effects, we will discuss each of the impact dimensions and provide examples from the database. This discussion also tries to capture the complexity and diversity of the impacts and includes positive and negative impacts, stakeholders that are affected, and different environmental media. It also shows that the impacts are not unique to any one contingency operation, and in many cases, effects cross more than one dimension. We indicate the portion of cases in the database that raised issues in each dimension in order to characterize the data; the numbers are not intended to attach any statistical significance to the findings.

Effects on the Health of U.S. Troops or Others. One of the most significant impacts of environmental considerations is that on the health of U.S. troops, allies, local populations, or other populations. About two-thirds of the cases we collected had or could have had a human-health impact. Some cases involved a direct or potential effect on U.S. troops; in others, the environmental issue could or did affect local communities or it could have affected both U.S. troops and locals. The case mentioned earlier from OJE, in which air pollution at a base camp from a caustic soda and cement plant made soldiers sick, illustrates an immediate threat to soldier health. U.S. operations at the Ash Shuaiba Port in Kuwait posed a similar risk (see Box 2.5). Other cases involved longer-term health risks, such as exposure to cancer-causing chemicals. In Afghanistan, U.S. and coalition forces occupied a former Soviet base, where they discovered a stockpile of leaking transformers that contained PCBs, a known carcinogen. Quick action minimized any potential exposure of U.S. troops,[13] but a longer-term and more-significant exposure would have put soldiers at more risk for developing cancer later on.

In many cases, the health impact affects both U.S. troops and the surrounding community, as occurred in Haiti when the U.S. Marines located a guard post on top of a building storing one ton of cyanide that was left over from an old cigar factory. The cyanide was stored in untapped metal barrels, the integrity of which worried military health officials, particularly in the humid Haitian environment. Fortunately,

[13] For more details on this case study, see Center for Army Lessons Learned, 2004, p. 22.

this incident was addressed before it had a health effect, but had the cyanide been released into the environment, it could have significantly injured Marines and the population in neighboring communities.

Effects on the Military Mission. In a surprising number of cases (more than one-third of those in our non-random database), environmental considerations had a direct or potential effect on the military's warfighting mission. Some of these case studies concerned clear tactical or strategic objectives that the U.S. military sought to secure during the conflict. For example, during OIF, the U.S. forces secured a dam and oil wells.[14] Securing the dam had a tactical objective: to prevent Iraqi forces from blowing it up and slowing the U.S. approach to Baghdad. Securing the oil wells had a strategic objective: to prevent the enemy from blowing them up and causing economic disruption and environmental problems, as occurred during the first Gulf War. These examples illustrate the positive effects that considering environmental consequences can have on operations.

In other cases, failure to consider the environmental consequences could have affected—or did affect—the military mission by reducing readiness, degrading visibility, delaying a mission objective, or reducing force-protection capabilities. Relocating a poorly sited base camp, as the Army had to do in OJE, affects readiness, since troops have to divert their energies to dismantling and relocating the camp. A poorly sited camp can also affect mission capability if troops become ill. Troop visibility was affected in OIF when U.S. units leveled large desert tracts with heavy construction equipment to construct troop bed-down facilities and motor parks. These actions removed the "top layer of hardpan soil[15] that acts as a crust and minimizes sand movement. Consequently, the movement of construction and military vehicles created

[14] Before the war began, Special Operations forces entered Iraq and secured the southern oil fields to avoid an ecological disaster like the Kuwait oil fires of the first Gulf War, which "would have affected combat and diplomatic support during and after the war" (Drechsler, 2005, p. 15).

[15] The technical term for rocky surfaces that form in some deserts is "desert pavement." The reaction of these surfaces to military operations is more complicated than is indicated here. Hurley et al., undated (gis.esri.com/library/userconf/proc04/docs/pap1744.pdf).

large volumes of airborne sand and dust particles."[16] Visibility was limited, vehicle maintenance was interrupted, and soldiers' breathing was affected, resulting in a negative impact on the military mission.

Force-protection risks can also be increased by environmental issues, as illustrated in a case from Iraq. Because of the hostile environment there, commanders set up their own hazardous-waste accumulation points inside their base camps. These field-expedient satellite accumulation points were located too close to camp perimeters, creating potential targets for hand grenades and improvised explosive devices (IEDs).[17]

Environmental issues can affect the military mission in yet another way. Poor U.S. environmental practices in host nations in the region that support U.S. forces can cause diplomatic problems that affect operations. In OIF, a contractor in a host nation dumped waste antifreeze from a U.S. base camp and sold the drums. This incident caused a major diplomatic problem that is still being negotiated. Although it has not reached the level where it is affecting operations in this case, host nations have restricted U.S. activities in several non-contingency operations in other parts of the world because of environmental concerns. For example, restrictions were imposed on Army training in Germany, and an Army training range was closed in Okinawa.

Finally, military operations can be affected by the ability of the logistical systems to support them. If base camps and military equipment have large requirements for resources, the logistics system must supply them for military operations to continue. By taking steps such as developing local water sources and reusing engine oil to reduce logistical needs, the Army can reduce the logistical burdens of an operation, either by providing more logistics capacity for warfighting or by reducing the size of the logistical tail needed for an operation.

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[16] Center for Army Lessons Learned, 2004, pp. 24–26.

[17] To avoid this problem, they could have used the hazardous-waste accumulation and feeder sites in Iraq that had been established by the Defense Reutilization Marketing Services Forward Support Team, Europe, and that had the proper procedures for storing hazardous waste. For more details see Center for Army Lessons Learned, 2004, p. 29.

Incurring Financial Costs or Savings for the Army. More than two-thirds of the cases we collected had some sort of tangible financial impact on the Army, DoD, or the United States. This suggests that a broad range of cases raise financial issues. In many cases, the costs were incurred or increased because environmental issues were not sufficiently considered or addressed. In one country supporting U.S. operations in the war on terrorism, "the U.S. hired a local national contractor to haul waste oil from U.S. forces' positions. The contractor dumped the oil in a local landfill and sold the barrels. Lack of direct oversight of the contractor resulted in a claim by the host nation for cleanup compensation of $1.25 million."[18] We found many more examples of spills and improper disposal of hazardous waste that have incurred large cleanup costs, especially in host nations. In other cases, costs have been incurred in unexpected areas, such as additional training and contractor expenses. For instance, at a major Army installation in the United States, the Army National Guard (ARNG) troops that backfilled for the deployed unit did not have environmental training. The installation environmental manager had to hire trainers to train the ARNG replacements and extra contractors to handle base hazardous-waste issues that the active Army unit normally handled.

In some cases, a small investment can save the Army money in the long run. In Bosnia, engineers conducted a pilot project to compost petroleum-contaminated soil with sewage-treatment sludge so the Army would not have to ship the soil out of the country as hazardous waste. This project generated a significant cost savings: Shipping the hazardous waste would have cost an estimated $1 million.

Effects on Community or Diplomatic Relations. Environmental issues can affect relations with any stakeholder group, from local communities, to host nations, to international opinion, to the U.S. public. In about three-quarters of the cases we collected, U.S. military actions affected or had the potential to affect community or diplomatic relations. When U.S. troops cut down the date palms in Baghdad and spilled oil near a hospital in Croatia, they hurt relations with the local

[18] Ibid., p. 28.

community. Conversely, addressing environmental issues can have a positive impact on community relationships and can even contribute to winning hearts and minds. Well-repairing activities in both Afghanistan and Iraq have helped to promote local good will. Many other environmentally related projects in Iraq, including repairing sewers, instituting garbage-collection service, building a city landfill, and fixing water treatment plants, have helped improve community relations and may even reduce insurgency problems, as will be discussed later.

Environmental issues can also cause diplomatic difficulties with host nations and allies, especially issues of waste management and base-camp cleanups. In one host nation supporting U.S. operations in Iraq, soldiers were dumping trash from U.S. airfield operations into a landfill. An Army colonel agreed to clean up the landfill, but the agreement implied that the landfill would be cleaned to U.S. standards, which would cost millions of dollars. This incident caused a diplomatic problem, and the Army had to negotiate a settlement with the host nation.[19] In Bosnia, similar diplomatic problems arose because of country concerns about transporting hazardous waste and conformance with the Basel Convention (see Box 2.2).[20]

Some local issues have had international impacts as well. A world-renowned Iraqi museum was looted by Iraqis in Baghdad during OIF, and the Army was criticized in the press throughout the world for not protecting it better. The public outcry created a significant diplomatic problem for garnering international and local public support for U.S.

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[19] This incident could have been avoided if environmental staff had been involved. Environmental staff would have made a more appropriate agreement.

[20] Hazardous wastes were an important diplomatic problem in OJE. Normally, they are transported from a central point to remediation sites, but in one case, host-nation officials refused permits to the Division Resource Management Office's contractor to transport wastes into Germany, which bottled up the disposal system. Implementation Force vehicles then had to transport the hazardous wastes. The problem was elevated to the highest level of the command structure, but no satisfactory solution was reached ("Environmental Actions in the Former Republic of Yugoslavia," 1997, p. 16). In other cases in OJE, diplomatic issues regarding environmental cleanup responsibilities and costs arose because troops from different countries in the UN force worked and generated hazardous waste together, and it was not always clear who was responsible or would pay for the cleanup.

efforts in Iraq, and the incident "prompted a wave of anti-American anger" in Baghdad.[21]

A positive example of environmental considerations occurred in Iraq when U.S. forces worked to help restore water flow to the Mesopotamian Marshlands. By 1999, large portions of the marshlands had been drained, and they were reduced to 7 percent their original size. The decline of these important wetlands is recognized by the international community as a significant environmental problem for regional species, such as migratory birds. USAID, the Iraqi Ministry of Water Resources, and USACE are collaborating to help restore the wetlands by developing a water-management model that will aid efforts to reconstruct Iraqi's historic water flow.[22] In fact, after the fall of the Hussein regime, the international press and environmental magazines published optimistic articles about how U.S. efforts might help restore such wetlands, thereby helping both the environment and the local economy.[23]

Some cases even had the potential to affect public relations in the United States. In one case, non-native spiders and other insects were discovered at a U.S. installation in crates returning from Iraq. Installation environmental staff were alerted, and the insects were eradicated. However, the introduction of a non-native species could have caused significant economic, environmental, and public relations problems in the United States (see Box 3.1).

Finally, in some cases, by paying a small amount of attention to environmental issues that have a large potential for diplomatic concerns, diplomatic problems can be avoided altogether. This is especially true for cultural-resource concerns. In Afghanistan, commanders placed the world-famous Blue Mosque off-limits to U.S. troops to avoid problems with cultural sensitivities. One of Islam's most important religious sites, it is located near a U.S. base camp.

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[21] Trofimov, 2003. Some of the thefts were an Iraqi inside job, and many, but not all, of the artifacts were recovered. However, the diplomatic damage had been done both in Iraq and in the worldwide popular press.

[22] For more details on the model see Gould, 2004; Gould and Hanbali, 2004.

[23] See, for example, Gray, 2005.

Box 3.1
Invasive Species and Prevention Practices

An invasive species is defined as a species that is non-native (or alien) to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112). Plants, animals, and other organisms (e.g., microbes) can all be invasive species. Human actions, such as transportation between nations, are the primary means of invasive-species introductions. Invasive species cost billions of dollars each year through their impact on agriculture, forestry, and public health.

One study estimates that the total costs of invasive species in the United States are more than $137 billion per year.* Each invasive species can have significant economic consequences. The direct and secondary economic costs of spotted knapweed on wildlife-associated benefits in Montana are estimated to be $2.64 million per year.** The zebra and quagga mussels in U.S. lakes are estimated to incur costs of $1 billion per year and have had a significant impact on the aquatic ecosystems and public infrastructure. The zebra mussel attaches to hard surfaces, such as water intake structures like those used for power and municipal water-treatment plants. In areas with extensive zebra-mussel colonization, the effect has been reductions in pumping capabilities and occasional shutdowns.

The military, like U.S. civil agencies, is very much aware of potentially significant effects from invasive species to civil society and military activities because of the experience with the brown tree snake on Guam. Shortly after World War II, the brown tree snake was accidentally transported from its native range in the South Pacific to Guam, probably as a stowaway in military ship cargo. As a result of abnormally abundant prey resources on Guam and the absence of natural predators and other population controls, brown tree snake populations reached unprecedented numbers, with densities as high as 12,000 per square mile. Snakes have caused the extirpation of most of the native forest vertebrate species; thousands of power outages affecting private, commercial, and military activities; widespread loss of domestic birds and pets; and considerable emotional trauma to residents and visitors alike when snakes invaded human habitats where they could cause severe envenomation of small children. Approximately every third day, there is a snake-caused power outage somewhere on Guam, with costs estimated at from $1 million to $4 million each year from direct damages and lost productivity. Effects on the U.S. military include time delays in routine military traffic, the potential accidental dispersal of the snakes to other military locations, the need for special practices in military training in the Western Pacific region, and the need for additional procedures for the management of wildlife on military lands on Guam.

The risks of such invasive species being unintentionally introduced in the United States is a concern in contingency operations, which result in a great many troops, supplies, and vehicles returning to the United States. At one installation in the United States, soldiers noticed non-native spiders and other creatures coming out of crates returning from Iraq. They called an exterminator to address the problem. Although this is the only such incident that has been reported, the

Box 3.1 (continued)

base environmental staff was concerned that other non-native species may have gone undetected. If that happened, whether the invader was a seed or insect or some other species, the risks for problems are potentially high.

Because of such risks, especially to U.S. agriculture, customs officials require that all military vehicles be thoroughly cleaned before returning to the United States. For example, in operations in Iraq, Bosnia, and Afghanistan, all military vehicles must be thoroughly washed on wash racks before being shipped home. U.S. customs officials strictly enforce this requirement even when there are long lines of vehicles waiting to be treated. In one case, Army redeployments were delayed because of long lines of vehicles waiting for cleaning.

For more information see http://www.invasivespeciesinfo.gov/, http://invasivespecies.nbii.gov/index.html, and Westbrook and Ramos, 2005.

*Pimentel et al., 2000, pp. 53–65.
**Kulla, 1998.

Effects on Reconstruction Activities. Environmental issues can also have the potential to affect reconstruction activities, as was the case for more than 40 percent of the cases we examined. This impact occurs both in actual reconstruction projects and in activities that may affect reconstruction efforts. The Army works on reconstruction projects that improve environmental conditions, especially water and waste projects. Army staff helped assess water, wastewater, and solid-waste systems in 14 municipalities in Bosnia during OJE,[24] and the Army's 1st Cavalry Division helped build a new city landfill and clean and repair sewer lines in Sadr City, Iraq.[25] The Army has also helped with cultural-resource projects. The 16th Engineer Battalion ran a project to help restore and reopen the Iraq Museum of Natural History, which had been badly damaged by looters.[26]

Army activities that are being conducted for other reasons may indirectly help with reconstruction. For example, in Bosnia, the U.S. military constructed wastewater treatment facilities at two different base camps because the existing facilities posed a threat to soldier

[24] This effort involved Army engineers and ARNG civil affairs personnel in a civil-military task force. For more details, see Leverinton, 1998, p. 58.

[25] Jaffe, 2004.

[26] College, 2004, p. 19.

health.[27] The new facilities were then used by local communities after the U.S. military left. In a similar case, U.S. forces repaired a well at a base camp in Afghanistan that will be available to the local community after the United States closes the base camp.

Army actions that do not address environmental concerns can slow down reconstruction projects or increase the effort required. When U.S. forces cut down date palms in Iraq, they increased the reconstruction burden, because the trees will have to be replanted, and the people who depended on those trees for their livelihood will have to find other jobs. Similarly, because they did not protect the Iraq Museum in Baghdad, U.S. forces had to spend time later trying to track down stolen artifacts and helping to restore the facility. Failure by Army units to consider the remediation of land and habitats that must be done before base camps can be closed unnecessarily increases the costs and time required to do so.[28]

Effects on the Safety of U.S. Troops. In about one-third of the cases we collected, environmental considerations had an actual or potential impact on safety. An environmental and safety information board for newcomers at a base camp in Operation Enduring Freedom (OEF) provided information about fire safety, vehicle safety, unexploded ordnance, wildlife, and environmental-protection procedures, which enhanced soldier knowledge about safety practices.[29] Conversely, in another case, soldiers may have created a safety risk when they used dirt contaminated with fuel to fill sandbags around their living facilities (see Table 3.1).

Causing Additional Environmental Harm. Even though the Army encounters legacy environmental problems in contingency operations, its activities can still cause additional environmental harm. In more than half of the cases that we collected, U.S. military actions directly or indirectly caused or had the potential to cause such harm, either in the country of conflict, a host nation, or the United States. Polluting

[27] Dale and Zettersten, 2001.

[28] For more details see "Environmental Actions in the Former Republic of Yugoslavia," 1997, p. 15.

[29] "Environmental Issues Associated with Operation Enduring Freedom," 2003, p. 27.

the country of conflict with hazardous wastes and UXO has been a common problem; oil spills and contractors dumping hazardous wastes inappropriately are particularly troublesome. In one case, soldiers in Iraq accidentally spilled high-grade diesel fuel (JP-8) in a lake, causing damage to the aquatic system. Similar incidents have occurred in host nations. A base camp in Albania during Task Force Hawk did not have an operational wastewater treatment facility, so raw wastewater was discharged into a local river. The Army can improve environmental conditions, and it has done so by helping to restore the Mesopotamian Marshlands and clearing UXO so that local people can use farmlands again.[30]

As noted above, ecosystems in the United States could be damaged by invasive species from faraway conflicts, and, conversely, U.S. concerns about invasive species have caused environmental damage in the theater, where runoff from wash racks has polluted streams.[31]

Incurring Environmental Liability. A long-term concern in contingency operations is the possibility that the Army might face environmental liability claims in the future. Almost half of the cases we analyzed had the potential for some sort of future claim. Claims could involve lawsuits, political fallout, and expenses associated with long-term environmental consequences, including remediation and long-term health-care costs. The political consequences of dealing with issues associated with environmental exposure could also be unpleasant for the Army, as they were in the case of Agent Orange exposure in Vietnam and Gulf War Illness. A fuel spill at a base camp in Croatia during OJE illustrates a more common example of potential liabil-

[30] U.S. Army engineers and explosive ordnance disposal (EOD) teams removed 150 cluster-bomb munitions from road craters in a highway in Iraq to enhance the safety of the local population. They also removed 51 cluster bombs from a local community, enabling the residents to use the land for farming again. For more details, see Vosler et al., 2003.

[31] In one example from OJE, vehicle wash racks were built near creeks because of expediency concerns and the lack of real estate. Some discharge ran directly into some streams. Environmental damage resulted from the vehicle runoff sludge, which included heavy metals (cadmium). This problem could have been avoided by implementing environmental controls to prevent the runoff. See "Environmental Actions in the Former Republic of Yugoslavia," 1997, p. 15.

ity. The spill contaminated the ground and possibly the groundwater and a nearby well. The Army performed site characterization studies to assess the damage and cleanup needs, but the extent of the remediation requirements was unclear. This uncertainty creates the potential for future liabilities associated with the cleanup.

Liability concerns related to soldier health are also common. In one case, a 50-pound bag of asbestos was found at a machine shop at a base camp in Afghanistan, and roof tiles were confirmed to contain 10 percent friable asbestos. The roof tiles were installed on housing used by U.S. personnel. A contractor replaced the roofs, but U.S. troops could have been exposed to asbestos fibers. Because prolonged exposure to asbestos fibers can cause certain forms of lung cancer known as mesothelioma, these types of incidents raise the risk that liability claims could result in the future.

CHAPTER FOUR

Analysis of Army Operational Experience

On the basis of our analysis of the case study database and data collected from interviews and the literature, we developed a number of insights. In this chapter, we discuss nine insights that we believe are central to understanding and ultimately improving the Army's policy, doctrine, training, and operations as they apply to environmental considerations in contingency operations:

- Environmental considerations have a broad range of far-reaching impacts.
- The Army is involved in many diverse reconstruction activities with environmental components.
- Insufficient resources are available to fully address environmental issues.
- Contractors must be carefully selected and managed.
- Collaboration with stakeholders is beneficial and critical.
- Proactive environmental practices and lessons in some parts of the Army are not being transferred to other parts.
- Country-specific conditions and needs should be considered.
- Short- and long-term considerations need to be balanced.
- Environmental problems may contribute to problems of insurgency.

Environmental Considerations Have a Broad Range of Far-Reaching Impacts

Environmental considerations can have far-reaching and broad impacts across many impact dimensions, across many organizations inside and outside the Army, and in many geographic areas, not just in the country of conflict.

Impacts Across Many Dimensions

An environmental issue can affect many of the eight impact areas discussed in the previous chapter—soldier health, the military mission, the environment, cost, community and diplomatic relations, safety, liability, and reconstruction activities. Nearly all of the case studies we examined affected or had the potential to affect three or more of these areas. The case in Table 3.1 titled "Unreported fuel spill affects base-camp expansion" affected or had the potential to affect all of the areas except reconstruction activities. These multiple effects tend to be seen mostly in cases of negative impacts on the environment, especially where the initial problem was not properly identified, managed, or addressed early on. In fact, where problems were not properly handled initially, the effects often got worse and were more far-reaching. In the case of the fuel spill, soldiers might have filled sandbags with the oil-contaminated soil and created a secondary safety risk. Improper dumping by soldiers and contractors has frequently caused multiple problems—environmental damage, diplomatic costs, financial costs, and even liability risks.[1]

The effects of such environmental problems can multiply, partly because many environmental considerations are associated with high risks, such as the health and safety risks from the uncontrolled release of or exposure to certain hazardous materials, hazardous wastes, and chemicals. The case in Haiti where the USMC located a guard post

[1] As discussed earlier, a lack of contractor oversight on a local contractor hired to haul waste oil from U.S. forces' positions resulted in the improper dumping of the oil and a claim by the host nation for cleanup compensation of $1.25 million. In this case, the environmental damage, the diplomatic costs, the liability risks, and the financial costs all could have been avoided by having contractor oversight and proper disposal procedures.

on top of a building where cyanide was stored is a good example of high environmental risk. For toxic chemicals and hazardous wastes, pollution prevention, early detection, and proper response are critical to avoiding more-serious problems. Industry, the military, regulators, and policymakers in the United States and other developed countries understand this, which is why so many of the environmental policies and activities in those countries are now focused on preventing pollution, avoiding environmental harm, and promoting sound environmental management and sustainable practices.[2] This approach is also used in Army and OSD policies and activities.

Environmental concerns can also have effects in an unanticipated area—morale. One Army National Guardsman stationed in Iraq created an "Iraq bird blog," an online journal documenting his bird-watching in the war zone,[3] which improved the morale of some U.S. troops and families. Proper treatment of environmental concerns such as hazardous-waste disposal can also give soldiers a sense of confidence that their own health and safety are being protected by commanders to the maximum extent practicable. On the other hand, morale was hurt at the U.S. base camp in Albania during Task Force Eagle, where there was no operational wastewater treatment facility and the camp discharged raw wastewater into the nearby river. Open discharge of untreated waste into an already heavily contaminated river "caused significant concern on the part of U.S. soldiers" who believed this violated U.S. "environmental ethics." They even expressed concern to the chain of command.[4] At other times, the effect of an environmental issue on morale has been mixed. For instance, in OJE, a U.S. Army environ-

[2] In fact, the whole environmental field has evolved over the last 15 years to focus more on improved environmental management to prevent costly environmental damage. For examples, see Lachman, Camm, and Resetar, 2001.

[3] He also added information about sightings of other species in Iraq and reports from other U.S. military personnel throughout the country. See "Dispatches from the Warble Zone," 2005, and http://birdingbabylon.blogspot.com/.

[4] The United States analyzed various options, health risks, and host-nation practices, and conferred with host-nation officials to examine the problem. It was learned that the host nation had issued a permit for the discharge. For more details, see Zettersten and Dale, undated.

mental sanitation team helped a mountain town that had sewage running in the streets. Given the town's circumstances and an inexperienced public works staff, the team's recommendations were to build ditches to control the sewage and obtain a pump truck to maintain the many cesspools in the area. The engineers felt good about helping, but they also regretted that they were not able to do more.[5] Finally, morale may be improved if soldiers know that leaders are doing as much as possible to provide a safe workplace for them.

Impacts Across Many Organizations Inside and Outside the Army

Many different organizations inside and outside the Army affect environmental considerations and are affected by them. As was touched upon earlier in the discussion of Army environmental responsibilities, many different organizations within the Army have special responsibilities regarding environmental concerns. For example, CHPPM and Army medical staff are responsible for monitoring environmental health concerns, and medical staff also have to treat troops when they become ill. Staff who work at fuel-storage and refueling sites need to take special measures to minimize the potential for spills and to respond appropriately if a spill occurs. Different Army organizations often work together on environmental issues. In one case, environmental health professionals in Djibouti found that bulk food and water supplies were being stored outside, where they were exposed to excessive dust and possibly to insects and other disease vectors. They worked with the camp mess-hall staff to address the problem. Army planners, commanders, and engineers and soldiers in the field may also work together to secure dams and key water infrastructure plants during a conflict.

Even more Army organizations may need to become involved if environmental issues are not properly handled. Cases involving improper dumping of hazardous wastes in host nations often require the involvement of not only environmental staff and camp commanders, but also the legal and public affairs staff to deal with the diplomatic, political, and legal implications. As discussed earlier, when engineers

[5] Leverinton, 1998, p. 58.

began to expand a base camp over a site that had been contaminated by an unreported fuel spill, environmental specialists and base-camp officers, planners, and construction workers were all affected when the spill was discovered. Some became involved in analyzing and addressing the problem.[6]

Organizations outside the Army, including coalition partners, host-nation governments, the Department of State, USAID, contractors, and NGOs, also are often affected by or involved with environmental issues. When political issues arise from cases of improper hazardous-waste disposal, host-nation officials become involved, and if the problem becomes big enough, so does the Department of State. Reconstruction activities often involve diverse organizations outside of the Army. When Army civil-affairs staff and engineers worked to repair the main water supply in Sarajevo, the International Committee of the Red Cross, local workers, and the United Nations were also involved (see Table 3.1). Even the International Police Task Force participated by escorting the workers to the site through hostile territory. In another case in Bosnia, German, Italian, Hungarian, Romanian, and U.S. military engineering units worked together to rebuild the east-west railroad line, performing extensive de-mining in the process.[7] The International Management Group (IMG), the World Bank, and USAID provided money and resources for the project.

Impacts in Many Geographic Areas

Military environmental considerations impact many different geographic areas, not just the country of conflict. Environmental media issues, such as air quality, water, and species concerns, do not follow political and jurisdictional boundaries. Watersheds also do not follow political boundaries. In Iraq, for example, two major rivers, the Tigris and the Euphrates, both rise in the eastern mountains of Turkey. The Euphrates basin embraces parts of Iraq, Turkey, Syria, and Saudi Arabia; the Tigris basin covers parts of Iran, Iraq, Turkey, and Syria. In their lower courses, the rivers create a vast network of wetlands—the

[6] See "Unreported fuel spill affects base-camp expansion" in Table 3.1.

[7] Tooney, 1998, p. 3.

Mesopotamian Marshlands—which cover about 20,000 square kilometers, part of which is in Iran.[8] The Iraqi portion of the watersheds is affected by what happens upstream and downstream. For example, the marshlands are affected by dams upstream in Turkey. Similarly, the migrating birds that visit these wetlands travel from many other countries.

The disposition of hazardous wastes can also raise transnational issues. Countries in the theater of operations are often unable to dispose of these wastes in an environmentally sound manner, as required by U.S. policy.[9] Therefore, they must be shipped out, which raises Basel Convention issues and concerns in nations that would be involved in the transportation or would be transited.

Countries that host U.S. forces during a contingency operation may also be affected by environmental issues caused by their presence. At one multiyear "temporary" base camp near Iraq (designated as a temporary base camp, it has evolved into a semi-permanent camp), soldiers did not report numerous spills, especially near motor pools. As a result, significant pollution problems built up and will need to be addressed before the camp can be closed.

Contingency operations can even cause environmental issues in the United States, particularly the introduction of non-native species that could create significant economic, environmental, and public relations problems. In addition, rear-detachment personnel have not been prepared to comply with U.S. environmental requirements at the installations they are assigned to support, which increases environmental and safety risks and decreases an installation's ability to meet U.S. environmental requirements.[10]

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[8] United Nations Environment Programme (UNEP), 2003d.

[9] See, for example, JP 4-04, p. VI-2.

[10] "Many deploying units fail to realize the importance of maintaining environmentally trained personnel as part of their rear detachment. The rear detachment is responsible for the continued maintenance of existing facilities and hazardous materials (HM) storage areas and complying with installation and state environmental requirements" (Center for Army Lessons Learned, 2004, p. 5).

The Army Is Involved in Many Diverse Reconstruction Activities with Environmental Components

Given the uncertain security situation in many post-conflict operations and the importance of reconstruction in U.S. goals, the Army often ends up being involved in reconstruction activities, many of which have environmental considerations. Some of these are projects to help local communities, and some are more strategic, addressing wider or longer-term strategic infrastructure or environmental concerns.

Many local reconstruction projects help surrounding communities, which can create positive views of the Army and its goals and can contribute to winning the support of the populace. Army and USMC units in Iraq have discovered the importance of conducting local sewage, water, electrical, and trash (SWET) operations,[11] many examples of which are included in our case-study database.

Strategic analyses and assessments address longer-term regional and national concerns. Many of them focus on water systems and infrastructure. As discussed earlier, Army staff helped assess water, wastewater, and solid-waste disposal systems in 14 different municipalities in Bosnia, and in Iraq, the 14th Engineer Battalion assessed the condition of water and other infrastructure, including power, oil, and gas facilities.[12] Very few of the strategic activities actually address ecosystem and habitat concerns, however. One strategic watershed project that actually does address some ecosystem concerns is a USACE project that developed a reservoir-system simulation model for use in both day-to-day operational decisions and long-term water-resource-management studies in Iraq. This model is being used to help develop a strategy for managing the country's system of dams and canals. The Army is using its experience from modeling in the Everglades and other U.S. watersheds to help develop the model, which will help restore key

[11] Since our definition of *environmental* did not include electrical issues, we did not include them in our case-study database, although we found them in the literature. The database does not include many of the USACE reconstruction projects, since it is focused primarily on mainstream Army activities.

[12] Red, amber, and green ratings were used to prioritize future reconstruction work, with the help of local laborers. See Vosler, 2003.

water flows throughout Iraq, along with the Mesopotamian Marshlands. Using this same approach in Afghanistan, the USACE engineers and the Afghanistan Engineer District have teamed up to develop a reservoir simulation model of the Kajaki Reservoir and other projects in nearby valleys.[13]

It is important to note that many reconstruction projects that at first glance do not appear to have environmental considerations actually do have them, and environmental issues need to be considered in their design and construction. Water issues have come up in highway and other road-building activities, including one case where the 14th Engineer Battalion replaced culverts during a highway project to restore water flow beneath the road, addressing a storm-water-runoff issue. One way to ensure that environmental issues are considered during reconstruction is to institute a basic environmental assessment as part of the planning process for the operation. The intent would not be to create a rigid regulatory system, but to ensure that important environmental issues are raised to commanders so that they can consider them when they are making decisions about planning and executing an operation.

Insufficient Resources Are Available to Fully Address Environmental Issues

Our analysis also showed that the lack of sufficient resources is a primary reason for the failure to fully address environmental considerations in contingency operations. Shortages of manpower and funding appear to be the most acute. There are often not enough environmental staff available where and when needed, including during the planning process, and not enough personnel sufficiently trained, knowledgeable, and attentive to environmental issues. Good-quality information about local conditions is also often insufficient or not readily available to decisionmakers.

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[13] For more details on these modeling efforts, see Gould, 2004, and Gould and Hanbali, 2004.

First, there is a lack of attention to and consideration for environmental issues in contingency operations throughout much of the Army. Many Army personnel assume environmental considerations are someone else's responsibility. Often commanders do not know much about environmental issues and do not adequately consider them in their planning and other decisionmaking processes. At several base camps in host nations for OIF, unit commanders placed little, if any, emphasis on environmental considerations associated with their stays. Their attitude was that it was not their responsibility; it was the responsibility of the permanent staff, just as it is at installations in the CONUS. However, bases in contingency operations do not have the same level of environmental support and resources that CONUS installations have; therefore, commanders need to take a more active role in dealing with their units' actions and their impact on the environment while in base camps. Many soldiers have similar attitudes. At one base camp in a host nation for OIF, soldiers were dumping their wastes, both solid and hazardous, instead of following proper disposal procedures. Their attitude was either, "We are in the desert, what does it matter?" "The locals don't care, so why should we?" or "We are just passing through and don't have the time." These soldiers seemed to have little, if any, environmental awareness, training, or accountability. In another example from OJE, basic environmental materials were not a priority; materials for dealing with spills were often an afterthought and were the last item to be shipped in.

Second, throughout much of the Army, there is a lack of appropriate experience in, training for, and knowledge about dealing with environmental considerations in contingency operations. Commanders and other Army staff have many responsibilities and often do not have time for environmental training. In OIF, many base-camp commanders and their staffs had little, if any, pre-deployment training in running a base camp or about the environmental concerns that may arise. Many engineers (both active and reserve) are not prepared to support base-camp operations. They have no experience designing, planning, building, or maintaining base-camp utility systems, which include water, sanitation, and solid-waste field-expedient systems for short- and long-term durations. Similarly, soldiers do not appear to be

adequately trained in environmental responsibilities during deployed operations. For example, soldiers are given the task of performing EBSs without any training in how to perform them. Improperly completing or not completing an EBS can cause serious problems. In Afghanistan, a U.S. military unit occupied a former-Soviet hardened aircraft hangar with limited ventilation. Within a few weeks, soldiers living and working in this structure developed short-term respiratory illnesses. It was found that space heaters had "caused the aircraft oil, lubricants, and cleaning substances embedded in the joints and cracks of the concrete hangar to vaporize and form noxious vapors," to which the soldiers were subjected on a daily basis. This situation could have been prevented if a proper EBS had been performed.[14] According to one Army colonel at a base camp in OIF, Army training for environmental issues is "woefully inadequate" for officers and non-commissioned officers (NCOs), in terms of both action and awareness. Similarly, logistics planners do not seem to be sufficiently aware of environmental considerations in deployment situations or their implications for logistics support. Options that minimize wastes would reduce logistics burdens, but they do not appear to get sufficient attention.

The soldiers at the aircraft hangar in Afghanistan may not have known they were supposed to conduct an EBS before occupying the hangar. Similarly, in one case in Bosnia, base-camp leaders were unaware of solutions for maneuver damage at their camps; they had no experience in dismantling hesco bastions (prefabricated metal/cardboard shells filled with soil), disposing of gravel, or clearing firing ranges and burn pits. As a result, they left landscape damage at their bases. If commanders had been better informed, they could have asked Army environmental staff to visit the camp to recommend and help with appropriate remediation procedures before closure.[15]

Third, there are often too few qualified environmental staff to handle environmental responsibilities in contingency operations. Not all Army units in the field even have environmental officers in their organizational structures. In addition, the environmental officer is

[14] Center for Army Lessons Learned, 2004, p. 24.

[15] "Environmental Actions in the Former Republic of Yugoslavia," 1997, p. 15.

often an extra duty assigned to a junior officer or an NCO who does not have the time, training, or experience to do the job properly. During the planning phase, combatant commanders usually rely on their engineers to develop Annex L, the environmental annex to the joint war plan. But these engineers may not have the training or experience to identify the most important environmental issues for the commander or to develop the most effective guidance, particularly for post-conflict operations and for achieving desired end states. The Army has many environmental experts, both civilian and military, in USACE and elsewhere who could be brought in to help.

Manpower shortages in contingency operations can be illustrated by the experience at a base camp in Kuwait, a host nation for OIF. Many different Army units pass through the camp on their way to Iraq, causing sudden influxes of as many as 20,000 soldiers and their associated equipment. Only two staff members have been available at the camp to deal with environmental issues that arise during surges, which has proven to be insufficient to handle the waste-management and other environmental issues that emerge. As discussed earlier, many of the transient soldiers are not trained about or do not follow proper waste and spill procedures. As a result of this shortage of environmental experts, the waste and other problems from each surge accumulate, creating bigger problems that are more expensive to remediate when the camp is closed.

Fourth, in addition to training and manpower shortages, there is often insufficient funding for environmental programs, equipment, and staff. The shortage of environmental manpower partly reflects that fact, as does the unavailability of environmental supplies and equipment such as proper waste-storage facilities. Specific funding for environmental programs often does not exist at base camps, so environmental programs must compete with everyday base-camp operations for operating funds. In some cases, environmental programs get some support from operations and maintenance (O&M) funds, but such funds appear to be declining.

If the Army had devoted more resources to staff, awareness, training, equipment, and programs for environmental issues, it could have avoided many of the problems that we found in our case studies,

thereby reducing health risks to soldiers, improving relations with the local populace, and saving money. Since prevention and early detection of environmental problems is critical to minimizing their effects, devoting more resources to these initial efforts can prevent larger problems from occurring later.

Finally, information for commanders about local environmental conditions and infrastructures is often insufficient, not readily available, or not accessed by the decisionmakers when it is available, in stark contrast to the quantity and quality of information available at U.S. installations. Had commanders known the true state of infrastructure in Iraq, they could have made sure that appropriate expertise was in Baghdad and other cities as soon as the regime fell. During the highly compressed timelines typical of contingency operations, good information is even more critical. CHPPM and other organizations provide important information for commanders, but more resources could help these organizations provide even higher-quality information. It also is important that commanders be fully aware of the information that such organizations provide and that they see it.

Contractors Must Be Carefully Selected and Managed

The Army relies on contractors for many central functions in contingency operations. Two functions with significant contracting and environmental components are base-operation support and reconstruction. Contracts for supporting base-camp operations can include preventive maintenance, custodial services, utilities, roads, and grounds. Contractors are also often used to haul away solid, food, gray-water, black-water, and hazardous wastes. Reconstruction projects may involve contractor assistance with the design, oversight, and actual conduct of reconstruction projects, and local physical labor is often used for the actual construction tasks.

Experience from many contingency operations has shown that contractors must be carefully selected, monitored, and managed to ensure that environmental considerations are properly addressed. Our research of field experience indicates that environmental considerations

are not being addressed sufficiently at any step in the contracting process. First, they are not being sufficiently spelled out when the contracts are written, especially for base-camp support. Contractors generally comply only with environmental requirements that are specified in the contracts, so statements of work for contracts must specify environmental responsibilities and liabilities. There are no standard contracts for base camps, so each camp creates its own, and many of the engineering officers and base-camp staff that help write the contracts do not have sufficient knowledge or training in contracting or in the environmental aspects of contracting, so the contracts are not written properly.

Second, there is insufficient oversight after the contracts are awarded. Proper oversight requires enough staff who have the right skills and training and who can devote enough time to do the job properly. Our research identified numerous examples where local contractors improperly dumped wastes that they were hired to dispose of properly. In OIF, for example, as discussed earlier, a contractor in a host nation dumped antifreeze from a base camp and sold the drums. In Iraq, a local contractor was hired to build a landfill and then remove dining-hall wastes to it. Instead, the contractor dumped the wastes at the back of the base camp. Base-camp officials learned of the problem only when they were tipped off about it.

There is also a lack of incentives for including reuse and recycling provisions in base-camp contracts, even though these activities can have budget, environmental, and even security benefits for the Army, particularly in the case of hazardous wastes. At one base camp in a host nation for OIF, local contractors are handling all the hazardous, solid, black-water, and medical wastes.[16] The U.S. military is investigating recycling programs to reduce costs and also to reduce the risks posed by contractors having extensive access to installations. Creating incentives for base-camp managers to consider the full cost of acquiring

[16] Recycling is not always cost-effective, even after accounting for the full costs of purchasing and transporting the materials to the theater and of storing and removing wastes or dealing with them locally. In those cases, other approaches may be more appropriate.

materials and dealing with the wastes would encourage them to make more cost-effective decisions in the design and operation of the camp.

There should also be incentives for contractors to minimize logistics burdens. The resources needed to operate base camps and the generation of wastes could both be minimized. For example, proper incentives could reduce the use of items such as single-use water bottles, which create huge streams of solid waste.

The choice of local or foreign contractors must also be carefully considered before contracts are issued. The advantages and disadvantages of each need to be considered, especially in infrastructure and reconstruction projects. Local contractors have local knowledge and tend to be less expensive, but they often have different standards and skill levels. However, hiring them can help improve relations with the local population and can provide local jobs, both of which can be important parts of the stabilization and reconstruction process. In Iraq, Task Force Neighborhood hired locals to fix the water pumps and generators at a treatment plant supplying water to northern Tikrit and an airfield that houses thousands of U.S. soldiers.[17] This effort and many other SWET projects in Iraq helped provide jobs and promote good will and were often cost-effective because salaries were lower. At the same time, the lack of appropriate skills of local contractors can hurt a project, as happened when a local contractor without sufficient knowledge dumped food waste into a wastewater treatment plant that was under construction at a base camp in Bosnia, delaying its startup.

Contractors from the United States and other developed nations often have more-sophisticated technological approaches, which can be useful. In Bosnia, a USACE contractor designed and built field-expedient structures for hazardous-waste storage that met the Army's need for low-cost, effective, and legally compliant systems. Many of these systems exceeded country and host-nation standards.[18]

Foreign contractors may not know local conditions, and the jobs on their projects do not necessarily go to locals. In addition, they tend

[17] Vosler et al., 2003.

[18] These structures were implemented at multiple base camps, which saved the Army money (Zettersten and Dale, undated).

to be more expensive and may alienate the locals by bringing more "foreigners" into the country. In Iraq, some U.S. firms hired as contractors on reconstruction projects were criticized for being significantly more expensive, which created unfavorable press in the United States. Western contractors in Iraq tend to hire large numbers of private security guards, travel in heavily guarded convoys, have elaborate base camps, pay high insurance premiums, pay higher salaries, and have extensive administrative support, all of which adds an average of 25 percent to the contract price.[19] Much of this extra expense is related to security required because of the insurgency problems. Another problem with using foreign contractors is that locals may not be able to maintain Western-designed systems after the contractors leave. In Afghanistan, a U.S. contractor built a water infrastructure system as a local reconstruction project and then left, but the locals did not have sufficient knowledge or skills to maintain it.

Collaboration with Stakeholders Is Beneficial and Critical

Collaboration in environmental activities, especially reconstruction activities, provides significant benefits, and such collaboration can be critical to success for a variety of reasons. First, it is important to work with partners and stakeholders that are affected by the activities. Local populations and governments are more likely to accept and view projects positively if they are involved in them. In addition, when local experts are involved, local and cultural conditions are more likely to be addressed appropriately. When the Army was helping restore the Iraq Museum of Natural History, it worked with Iraqi government officials, museum and natural-resource experts, and Iraqi contractors. Local expertise and support were needed for the project to succeed.[20] To support operations in Bosnia, the Army and USACE developed a working relationship with regulatory authorities in Hungary. Bases in Hungary were critical to U.S. operations, but the public and the government

[19] Glanz, 2004a.

[20] College, 2004.

were extremely concerned about pollution because they were living with the environmental legacy of the Soviet Army. An environmental operative committee was established to discuss environmentally related issues and upcoming activities that could have environmental impacts, to monitor environmental-protection activities, and to work out solutions that were acceptable to all.[21] Collaboration was key to securing and maintaining Hungary's support.

Second, partners may be helpful if activities are too large to address alone or outside expertise is needed to complete a project more efficiently and quickly. The Army consulted British museum experts while restoring Iraq's Museum of Natural History. In Bosnia, collaboration was key to repairing Sarajevo's main water supply, where the Army environmental sanitation team designed the repair, supervised local workers, and helped provide security. The International Committee of the Red Cross financed the repairs, the United Nations helped de-mine the area, and the International Police Task Force escorted workers to the site through hostile territory.[22] Collaboration also can help in fielding innovative technologies. In Afghanistan, the U.S. military coordinated with German engineers on the use of a new German "Minebreaker" vehicle to more effectively clear land mines and UXO at the base airfield and a highway near Army units. They also collaborated with the Afghan government in the testing and implementation of the new vehicle.[23]

Third, pooling resources saves the United States money, and it is more cost-efficient for coalition partners and other stakeholders to share the financial burden with the United States.

Fourth, it may be important to collaborate with the local population or the international community for political or diplomatic reasons.

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[21] Zettersten and Dale, undated.

[22] Leverinton, 1998, p. 57.

[23] Sponfeldner, 2003.

Fifth, evidence from the environmental literature suggests that collaboration can be critical to success when addressing significant environmental concerns.[24]

Finally, problems can arise in the absence of sufficient coordination and collaboration. As some have argued, the interagency collaboration process for the invasion of Iraq "did not adequately address many interdepartmental concerns for pre- and postwar planning contingencies. As a result, some U.S. reconstruction activities seemed ill-considered and ineffective."[25] This can be contrasted to the civil-military planning for Kosovo, which benefited from lessons learned in Bosnia, Haiti, and Somalia, and a resulting presidential decision directive, PDD 56.[26]

The Afghanistan experience illustrates the challenges of coordinating among many different organizations. Including representatives from USAID and the State Department led to improved coordination in the interagency process, according to a RAND study on the early efforts there.[27] Including representatives from international organizations and NGOs at CENTCOM headquarters created an unprecedented exchange of information and views. Despite these positive steps, coordination within Afghanistan after hostilities were over was still difficult, in part due to the diverse interests and missions of the many organizations. The lack of security outside the major cities also limited the ability of civilian agencies to conduct reconstruction operations, which meant that the military had to shoulder much of the burden. To improve coordination in future contingency operations, the RAND study recommended that relationships between the military and other U.S. government agencies become better institutionalized, something that clearly had not happened by the start of the invasion of Iraq. It also recommended that NGOs and international organizations develop a

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[24] For examples about how common and important collaboration is in U.S. ecosystem management activities see Yaffee et al., 1996.

[25] Drechsler, 2005 (p. 22), offers an extensive critique of post-conflict planning in Iraq.

[26] Ibid., pp. 4–5.

[27] Oliker et al., 2004.

joint doctrine for future civil-military operations that would improve coordination with the U.S. and other militaries.

The Office of the Coordinator for Reconstruction and Stabilization, created within the State Department in August 2004, has the potential to be an important vehicle for formalizing relationships between civilian government organizations and NGOs and the military on stabilization and reconstruction projects, including the environmental aspects of those projects. The organization has proposed several innovations that could improve planning and operations, including developing a common civil-military planning framework, deploying humanitarian reconstruction teams to the combatant commands for planning, standing up advance civil teams that would embed with the military at the brigade or division level in combat environments to provide immediate civilian leadership for stabilization and reconstruction efforts, and establishing relationships with international organizations to help planning and coordination.[28] The success of these innovations will hinge in part on how the office evolves, how much funding it receives, and how well it can integrate with the military during peacetime and stability operations.

Proactive Environmental Practices and Lessons Are Not Being Transferred to Other Parts of the Army

Through the literature, interviews, and case studies, we found that many lessons and good field environmental practices are not being integrated throughout the Army. A large number of lessons from the Balkans and other contingency operations have been documented by Army organizations; for example, the Center for Army Lessons Learned has published documented lessons.[29] Army engineers have held at least three workshops on lessons from base-camp experience that included discussions of environmental issues, including the 3rd Base Camp Workshop,

[28] Ambassador Carlos Pascual, presentation delivered to the Eisenhower National Security Conference, September 28, 2005.

[29] Center for Army Lessons Learned, 2004.

"Experienced Leaders and Current Practices Involved in Base Camps of Today," held at West Point in May 2005. Despite those efforts, the lessons are not being integrated into Army doctrine, guidance, training, and practices. Environmental staff and engineers with experience in the Balkans have been dismayed that the Army is making the same mistakes in OIF and OEF that EUCOM and USAEUR learned how to avoid years earlier.

We found energetic Army individuals in the field developing and implementing innovative environmental practices and technological approaches, but these activities were not being transferred to other parts of the theater of operations or other parts of the Army. For example, in OJE, an Army engineer who organized the environmental-management program at a Bosnian base camp also set up an environmental training program. Squadron soldiers were trained in such topics as spill response and proper waste-handling. The engineer used borrowed videotapes and 35mm slides, as well as training aids that he created himself. He also developed a booklet that includes maps, lists, and the information soldiers need to ensure they leave the land in the same condition in which they found it.[30] Another recent example from Iraq was the application of an on-site sludge treatment that saved disposal costs and effort. At another base camp in Iraq, Army engineers created a dry bed for sewage waste. In this creative application of a well-known technology, the sludge was tilled in with the soil to dry out and was then retilled so that it was properly returned to the soil and did not have to be disposed of elsewhere. At a base camp in Kuwait, a recycling program has been started to re-use pallets and serviceable wood. Soldiers use what they need, and the rest is sold to local contractors to take off-post. Similarly, a base camp in Afghanistan has a wood-recycling program that has generated significant savings because wood is such an expensive resource there. Yet recycling efforts have not been institutionalized in the Army as standard base-camp procedures, even though they can reduce costs, waste streams, disposal problems, and logistics tails.

[30] Shipley, 1997.

A number of existing industry environmental technology procedures and practices could be tested and used at base camps to help address waste issues and other environmental concerns. Examples include waste-to-energy systems, black-water to gray-water systems, recycling wash-rack water, and more-modularized and standardized infrastructure design. These technologies and practices could help reduce the logistic tail and waste issues of Army operations. However, like the innovations in the field, they have not been tested and evaluated or transferred into Army doctrine and practices. In some cases, additional R&D, testing, and evaluation are needed, but these investments are not being made. In other cases, the innovative practices have already been tested in the field, but they have not been fully documented and are not being incorporated into the appropriate operational guidance, training, and procedures.

Country-Specific Conditions and Needs Should Be Considered

Each contingency operation faces unique local and country-specific needs based on environmental conditions, culture, local laws and practices, and the level of the existing technological infrastructure. Understanding local conditions is particularly important for reconstruction and infrastructure projects, where systems need to be maintained after the U.S. forces leave. For example, in Tuzla during OJE, the existing wastewater treatment plants posed a threat to soldier health. The U.S. military addressed the problem by building two batch reactor-activated-sludge facilities. Although they were not up to U.S. standards, they were appropriate for the situation because they met country standards and were compatible with the technological infrastructure.[31] In another example from Bosnia, Army engineers hired a local contractor to drill a well for a base camp, since the existing well could not produce enough water. Because of other jobs and the fact that their older equipment required frequent maintenance, the job took two and one-half

[31] Center for Army Lessons Learned, 2004, p. 28.

months instead of the expected seven days. Army engineers were concerned that the project took so long, but the work was satisfactory, and a viable well was dug without mishap.[32] This example shows how local knowledge can be important, but local work-schedule and technology standards differ from those in the United States.

Similarly, as discussed earlier, the 14th Engineer Battalion assessed the condition of water and other infrastructure in Iraq. Local needs and conditions were considered in prioritizing future reconstruction work. Given that infrastructure projects need to be maintained by local people after the U.S. forces leave, it was important to understand the local capabilities.

Another example of the importance of local environmental conditions, described earlier, concerned the relationship between damaging the fragile topsoil (technically called desert pavement) in Iraq and minimizing dust. U.S. units using heavy construction equipment leveled large desert tracts during base-camp construction, which destroyed the desert pavement and created dust storms, causing visibility, breathing, and vehicle-maintenance problems. These problems might have been avoided by performing an appropriate environmental assessment and factoring the local soil and other environmental conditions into the base-camp design.

Cultural issues are also important, because actions that are not acceptable in the local culture can cause diplomatic problems. For example, the Blue Mosque—a key Moslem religious site—was placed off-limits to U.S. troops stationed in Afghanistan. The commander realized that an incident involving U.S. troops at this important cultural site could affect community relations, reconstruction activities, and even military operations.

The Defense Science Board has highlighted the importance of understanding local and cultural issues, even recommending that the military include units comprising experts in the culture and other aspects of a country and region. This is expertise that would take years of language study and living in a region to develop.[33] Access to high-

[32] Akins, 1998.

[33] Defense Science Board, 2004, pp. vii and xii–xv.

quality information about the country where U.S. forces are located is important for understanding local conditions and cultures.

Short- and Long-Term Considerations Need to Be Balanced

From an environmental perspective, having forces stationed in a country for a few weeks is very different from having them there for a few years. The length of stay is an important factor in crucial decisions about issues such as base-camp infrastructure. There are four main areas in which the Army needs to balance short- and long-term environmental issues in contingency operations: base camps, health exposures, reconstruction projects, and natural systems.

Procedures for temporary facilities are different from those needed for more-permanent base camps and other contingency-operation facilities. If the Army is going to be at a camp for several years, investing in longer-term infrastructure to address environmental issues becomes more important. After the Army had been in Afghanistan for more than a few months, it realized that it needed to invest in a longer-term state-of-the-art waste-disposal system at Kandahar International Airport. By spring 2002, the airport presented human-health and environmental threats because of the large amounts of waste from U.S. troops and the destroyed equipment, trash, and hazardous waste left by the Taliban. At first, the disposal area was just a shallow burn pit. In spring 2002, Army engineers designed and implemented a "one-stop-shopping" waste-disposal system. The facility consisted of recycling areas, hazardous-waste storage cells, a medical-waste incinerator, and a large burn pit with controlled access. Hazardous waste was effectively segregated and contained away from troop areas.[34] The U.S. military also realized it needed to develop better solutions for long-term runway repair, including methods of dust control. Because of the initial airport conditions, intensive U.S. military use, and extremes of hot and cold weather, frequent runway repair was needed. New techniques were developed to patch the runway, including dust control to prevent

[34] Anderson and Wolf, 2004.

brownout conditions that limit visibility. After the repair is completed, a commercial dust-control agent is spread over the soil patches, which helps prevent dust and increases the durability of the patches.[35]

Whether a base camp is categorized as temporary or enduring makes a big difference in the investments that the Army makes in environmental infrastructures—camps that are classified as temporary receive less funding than enduring or permanent camps do. This would be appropriate if temporary camps that were operated for more than a few months were recategorized as enduring. But for political reasons, such as not wanting to be seen by the locals or the U.S. Congress as having a long-term presence in a host nation, many bases remain classified as temporary even if they are used for years. Temporary bases receive little funding for infrastructure improvements and often no funding for environmental programs. Predictably, many temporary camps that operate for a long time have serious environmental problems.

Concerns about troop exposures to environmental health risks also vary based on the length of stay in an area. Many environmental exposures are not as significant if the amount and duration of exposure to the high-risk chemical or pollutant are low. As the length of exposure time to high-risk chemicals or pollutants increases, so does the risk. If the U.S. military operates in a polluted area for years, rather than a few days or weeks, more mitigation procedures may be needed. The industrial-pollution health risk for U.S. troops at the Ash Shuaiba Port provides a good example of the need to consider long-term issues (see Box 2.5). This port has been critical for U.S. operations in Iraq, but continuous exposure to the significant industrial air pollution in the area increases human-health risks. Therefore, to minimize exposure risks the U.S. military has implemented such procedures as spreading gravel in the life-support area to help suppress dust, minimizing outdoor activity, and minimizing the time troops spend at the port. In addition, CHPPM continues to extensively monitor and assess the problem, and the U.S. military continues to implement mitigation procedures. Experiences with Agent Orange and Gulf War Illness have

[35] Baker, 2003.

made the military increasingly aware of the impact of long-term illnesses and exposure risks during combat. Military medical organizations such as CHPPM are tasked with monitoring and assessing those risks and exposures.

Short- and long-term issues also need to be balanced in reconstruction projects, such as water-infrastructure projects that serve troops or the local population. Wastewater treatment facilities built by the U.S. military at two base camps in Bosnia were not up to U.S. standards for long-term facilities, but they were sufficient for the few years that the base camps were likely to be in operation, given country conditions. In fact, at the time, they were the only two fully functional wastewater treatment facilities in the country.[36] Long-term considerations also played a role in the Army's investment of time to help restore the Iraq Museum of Natural History.

The long-term health of natural systems, including ecosystems and species, are another consideration that has not received much attention. Although they have not been a central concern for reconstruction, longer-term impacts on the health of ecosystems, watersheds, biodiversity, species, and farming systems are important for stability and sustainability, particularly in poor countries with high levels of environmental degradation. The military needs to better understand these systems and the impact of its actions on them, especially in reconstruction activities. The Army's efforts to help restore the Mesopotamian Marshlands and develop watershed-management tools in Iraq are good examples of current activities that are addressing an ecosystem concern that is important both ecologically and to local populations. Such ecosystem and watershed issues are likely to become more important in future contingencies, because they tend to occur in countries and regions that have systemic environmental problems and because more worldwide attention is being placed on ecosystem degradation, as well as habitat and biodiversity loss.

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[36] Dale and Zettersten, undated.

Environmental Problems May Contribute to Insurgency Problems

Counterinsurgency experts have long argued that winning hearts and minds is critical to establishing peace.[37] Force is often not enough to stop insurgency activities; winning the basic trust and support of local populations is needed. The inability to gain the support of local populations contributes to insurgency, warlordism, and an unstable security situation, as has been demonstrated in Iraq and Somalia. Addressing key economic and social issues, including health and environmental concerns, can be an important part of winning hearts and minds.[38] For example, after the Army helped repair a well in Iraq, an Iraqi citizen said, "When this well is done, each time somebody takes a drink of water they will say the Americans did something good."[39] Our research uncovered many other examples of the importance of environmental issues in gaining local support.

Evidence from operational experience in Iraq suggests that environmental problems may contribute to insurgency problems. From fall 2003 throughout 2004, the 1st Cavalry Division, under the command of Major General Chiarelli, developed, managed, and worked on numerous SWET projects in Baghdad, including cleaning and repairing clogged sewer lines, collecting trash, and building a new landfill. Using Geographic Information System (GIS)[40] databases and tools to analyze geospatial patterns, General Chiarelli's intelligence officers determined that the insurgency was strongest in areas with little or no sewer service, faltering electricity, and high unemployment. Addressing sewer, trash, drinking-water, and electricity issues was important for the "fence sitters" who had not yet decided whether to support the

[37] For example, see Beckett, 2001; Callwell, 1906; Kitson, 1971.

[38] For a good discussion of the importance of environmental health issues related to drinking water, sewage, and infectious diseases to winning hearts and minds, see Jones et al., 2006.

[39] Glanz, 2004b.

[40] GIS is a class of software for managing, storing, manipulating, analyzing, visualizing, and using digital geospatial data.

new government or the insurgency.[41] These poor or barely middle-class Iraqis who often do not have jobs are prime recruitment pools for the insurgents. General Chiarelli contends that by giving them jobs and helping to address SWET problems, they will see that the Americans are helping and may decide not to join the insurgency. In fact, the 1st Cavalry Division found that where services were restored, insurgent attacks fell sharply.[42] However, the extent to which the Army is, or should be, advertising U.S. involvement in such projects is unclear.

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[41] Jaffe, 2004.

[42] For more information about the 1st Cavalry and the experiences of other Army units in Iraq to help win the hearts and minds, see Jaffe, 2004; Glanz, 2004b; Wilson, 2004; Graham, 2005; Murphy, 2004; Shanker, 2004; Vosler et al., 2003.

CHAPTER FIVE

Findings and Recommendations

Environmental considerations for the Army range from strategic concerns about desired end states to mundane issues of managing sewage at base camps. In this report, we have identified the effects of environmental considerations on the Army in contingency operations and the lack of policy and doctrinal support in this area. Although environmental considerations are integral to the Army's ability to meet national objectives and desired end states in contingency operations, they are often underrepresented in the competition for attention, investments, and manpower. Balancing environmental considerations with other factors that contribute to mission success is a constant undertaking and requires better awareness, training, information, doctrine, and guidelines. In this chapter, we summarize our main findings and suggest ways in which the Army could address the issues that we identified.

Findings

Our examination of the Army's experience in contingency operations and the legal and policy context in which those operations occur resulted in seven principal findings:

1. Environmental issues can have a significant impact on operations.
2. Environmental considerations can be particularly important for success in the post-conflict phase.

3. Environmental considerations in contingency operations differ significantly from those experienced during normal operations in the United States.
4. Environmental issues can have far-reaching impacts across operations, Army organizations, and the world.
5. Inadequate environmental practices in contingency operations can increase risks and costs.
6. The Army could improve its understanding of environmental considerations and better incorporate them into plans and operations.
7. The Army has no comprehensive approach to environmental considerations in contingencies, especially in the post-conflict phase.

1. Environmental Issues Can Have a Significant Impact on Operations

Environmental issues can have a significant impact on all phases of contingency operations, from warfighting to reconstruction. They can be a key strategic consideration because they have the potential to influence operations and end states; they can pose a health risk to soldiers; they can directly disrupt Army operations; and they can indirectly affect Army operations by creating diplomatic problems.

Threats from natural resources such as oil wells or water stored in dams can affect operations or be a key strategic objective for a mission. Dams can be destroyed and oil wells can be set on fire by the enemy to impair the Army's ability to advance. Thus, the Army may take deliberate actions to secure them, either to ensure that operations are not affected by their destruction or to secure them for more-strategic purposes such as nation-building.

Environmental problems can also pose significant health risks to soldiers. If enough soldiers become ill or die because of an environmental health risk, such as pollution exposure or disease vectors, the mission can be adversely affected. In addition, since so many of the countries in which contingency operations occur have significant pollution problems and environmental degradation, the potential for

adverse health effects on soldiers can be much higher than it is in the United States.

Environmental problems can degrade, delay, or disrupt mission operations by affecting unit and equipment readiness, efficiency, effectiveness, and force protection. They have disrupted operations at base camps and have even forced some camps to be relocated entirely. Dust can affect vehicles, maintenance activities, and troop movement. Poor environmental management at base camps can put significant and unnecessary burdens on the logistics system that should be available to support combat operations or stability, support, transition, and reconstruction operations.

Environmental issues can indirectly affect Army operations by creating problems with key stakeholders, such as local communities, allies, and host nations. Pollution from Army activities has created diplomatic problems in several host nations and could affect the Army's ability to operate in those nations. Similarly, environmental concerns can affect community relationships, either positively or negatively, which can, in turn, affect reconstruction activities and even insurgent activities.

2. Environmental Considerations Can Be Particularly Important for Success in the Post-Conflict Phase

Environmental issues can be especially important during the post-conflict phase, which includes SSTR operations. The Army gets involved in many reconstruction activities that seek to provide basic services to the local populace or to develop the necessary infrastructures for eventual economic and social stability and viability of a host nation. Although these activities usually have large environmental components, the environment is often not the driving factor. Projects can be aimed at addressing either local issues or more-strategic issues that affect a wider area or long-term concerns. Environmental considerations are very important during the post-conflict phase, because basic environmental issues such as clean drinking water and sewage treatment can be very important to the local populace, particularly in poor countries that have legacy environmental problems. We found that Army reconstruction activities such as building water infrastructure,

rebuilding cultural resources, and landfill projects can help improve local attitudes about the presence of U.S. forces. There is even evidence from Iraq that problems with clean water, trash, and sewage can contribute to the insurgency. To the extent that reconstruction projects improve cooperation and build trust with local people, they can lower security risks, improve intelligence, and speed reconstruction.

More-strategic environmental projects, such as addressing regional and national water flow and infrastructure concerns, can be important for broader national reconstruction. The health of agricultural systems is also an important long-term environmental consideration. Addressing such basic societal concerns can be critical for the country's ability to function and sustain itself, possibly allowing U.S. forces to leave.

Base camps are a major environmental concern for the Army in the post-conflict phase. Camps must be properly managed to minimize pollution, hazardous-waste spills, and damage to natural resources. Left unchecked, base-camp problems can affect soldier health and unit readiness. They can also affect community, regional, and national relations in the country of conflict or nearby countries that support U.S. operations. Pollution and other environmental damage can incur financial costs to the Army when it closes a camp because it often has to pay to clean up the damage.

3. Environmental Considerations in Contingency Operations Are Significantly Different from Those in Normal Operations in the United States

Another significant finding is that environmental issues and conditions are very different in contingency operations from what soldiers are accustomed to in the United States. First, soldiers may face significantly higher environmental-exposure risks in contingency operations. Countries where the Army is involved in operations may have serious environmental degradation, including the presence of toxic wastes, air and water pollution, disease, and degraded natural ecosystems.

Second, many basic community services and infrastructures have been damaged by conflict or not maintained or developed sufficiently to begin with. Thus the practical realities of providing clean drinking water, treating wastewater, disposing of solid and hazardous waste, and

avoiding illness from exposures to toxins and disease become common major environmental concerns for the Army in contingency operations. Moreover, deployed forces must handle these issues themselves, because they do not have the support from the public works staff and contractors that they rely on at installations in the United States.

Third, compliance requirements are often different in contingency operations. U.S. and international laws usually do not apply, and the countries of conflict often do not have many environmental laws. Without strict legal regulations and compliance concerns to compel action, some parts of the Army find it difficult to consider environmental issues as a serious concern.

4. Environmental Issues Can Have Far-Reaching Impacts Across Operations, Army Organizations, and the World

Environmental issues can affect contingency operations across many dimensions, including the military mission, soldier health, safety, cost, diplomatic and community relations, and reconstruction activities. Many organizations within and outside the Army can be affected by and can affect environmental considerations in contingency operations. Army organizations, including engineers; CHPPM; medical staff; logisticians; transporters; maintenance-shop workers; lawyers; ordnance staff; environment, safety, and occupational health (ESOH) staff; and civil and public affairs personnel, have special environmental responsibilities. Organizations outside the Army, such as allies, host-nation governments, the Department of State, USAID, contractors, and NGOs, can also be affected by or become involved in environmental issues, particularly during reconstruction.

Finally, environmental issues can affect geographic areas outside the country of conflict. Air-quality, water, and species concerns do not follow political or jurisdictional boundaries. In addition, environmental issues can arise in the countries near the conflict that are supporting U.S. forces and even at installations in the United States if, for example, invasive species are inadvertently brought home by returning units.

5. Inadequate Environmental Practices in Contingency Operations Can Increase Risks and Costs

When environmental issues are improperly identified, managed, or addressed, they can turn into bigger problems that have higher costs and risks to health, safety, and the mission. In fact, if they are not properly handled, the effects often get worse and can cross over into other media. A fuel spill contaminates the soil, but left unchecked, it can pollute water sources. It is usually more costly to clean up spills than to prevent them; cleaning up a spill that has had time to leach into the soil is even more expensive. It is also more costly to address exposure-related health concerns than to avoid the exposure. And it is usually more expensive and difficult to reassure locals after an environmental incident than it is to avoid the incident. The effects can multiply, partly because many environmental problems can have high risks, such as the health and safety risks associated with the uncontrolled release of or exposure to hazardous materials, hazardous wastes, and chemicals.

6. The Army Could Improve Its Understanding of Environmental Considerations and Better Incorporate Them into Plans and Operations

Many parts of the Army do not fully appreciate the important role that environmental issues can play in contingency operations, particularly in the post-conflict and reconstruction phases. As a result, they do not incorporate environmental considerations into their plans and operations as well as they could. In particular, the strategic aspects of environmental considerations, including desired end states for the operation, are not being sufficiently addressed in planning. For example, experience in Iraq suggests that establishing clean-water and sewage infrastructures is important for achieving stability. Yet planners did not understand the importance of these systems or the poor shape they were in before major combat operations ended. This points to the need for high-quality information about environmental conditions and infrastructure before an operation is initiated.

There is a lack of attention to or consideration of environmental issues in contingency operations throughout much of the Army. Many Army personnel assume that environmental considerations are some-

one else's responsibility. Commanders often do not know much about such considerations and do not adequately consider them in their planning and other decisionmaking processes. Many soldiers have similar attitudes.

Each contingency operation faces unique country-specific needs based on the environmental and ecosystem conditions, culture, local laws and practices, and the technological level of the existing infrastructure. Information about local health conditions is provided by CHPPM and the Armed Forces Medical Intelligence Center (AFMIC), but commanders do not necessarily incorporate this information into their plans. In many cases, the extent and locations of specific legacy pollution problems and unique ecosystem conditions are not known by Army decisionmakers. Understanding and planning for such conditions can be important for protecting soldier health and also for infrastructure and reconstruction projects that meet the local population's needs and that can be maintained after U.S. forces leave. Cultural issues are also important, because it is important to know what practices are acceptable and sustainable in the culture of the country.

At the joint-force level, environmental annexes to operations plans take a narrow approach to environmental considerations, focusing on such things as how much attention units should pay to environmental protection in each phase of the operation or when they should collect trash or just mark it for other units to collect. The annexes do not cover strategic issues or end states, and they neglect important environmental considerations in the post-conflict phase.

In addition, the Army generally focuses more on short-term issues than on long-term environmental considerations. Although longer-term issues are typically the responsibility of the JFC, the fact that the Army often ends up staying in contingency operations for much longer than it originally planned argues for more attention being paid to longer-term environmental implications in base-camp infrastructure, health exposure, reconstruction projects, and natural-systems concerns. Issues such as the health of ecosystems, watersheds, biodiversity, species, and agricultural systems may warrant additional attention because of their importance for reconstruction and long-term natural-system sustainability. Better understanding of these concerns

and the impact of the Army's actions on them could improve success in reconstruction and nation-building activities.

7. The Army Has No Comprehensive Approach to Environmental Considerations in Contingencies, Especially in the Post-Conflict Phase

The Army does not have a comprehensive approach to considering and addressing environmental issues in contingencies, particularly those relating to the post-conflict phase. Evidence can be found of deficiencies in policy and guidance; planning; training; base camps; contracting; research, development, test, and evaluation (RDT&E); absorbing lessons; and resource allocation.

There is little policy or doctrine. Although numerous presidential directives, DoD policies, and Army regulations and doctrine address environmental issues at installations in the United States and permanent facilities overseas, they almost universally exclude contingency operations explicitly. Few Army doctrinal documents address environmental considerations in contingency operations even in passing. Only one Army field manual is dedicated to environmental considerations in military operations, and it is not widely used. Only a few joint publications discuss environmental issues in contingency operations.

Ground-component commanders and JFCs are required to have an environmental annex in their war plans, but there is little guidance about what to include there. In addition, none of the joint or Army publications say much about the post-conflict phase or how to achieve desired end states. Finally, there are no DoD instructions or Army regulations to motivate the Army or the Joint Staff to address these gaps.

Operational planning also does not comprehensively incorporate environmental issues, as discussed above. Environmental annexes in the joint force OPLANs focus on day-to-day issues, not on how to achieve end states. Unit planning appears to incorporate environmental issues even less. Although units are not expected to determine the environmental components of end states desired by the national leaders or the JFC, their plans should incorporate them where appropriate. Moreover, units often do not have standard environmental procedures for field

operations and sometimes leave their equipment for spill response and other environmental emergencies at home when they deploy.

There is a chronic lack of training and awareness across much of the Army about environmental considerations, even among those who are supposed to be responsible for environmental issues. Most units receive little training about how to operate in an environmentally appropriate way in the field and are therefore often unaware of the proper environmental procedures. Nor are operating forces adequately trained to take on the environmental functions that are provided at home by installation staff, contractors, and well-developed infrastructures or those functions that are unique to contingency operations. For example, soldiers are often given the task of performing EBSs without any training in how to do so, particularly during the early days of an operation. Many engineers are not prepared to perform base-camp support operations, and few have any experience in designing, planning, building, or maintaining base-camp utility systems for water, sanitation, and solid wastes. Similarly, logistics staff are not sufficiently aware of environmental considerations in deployment situations.

Heretofore, there has been no coherent approach to base camps and the many environmental issues they raise. Base camps are an ever-present feature of contingency operations, yet the Army seems to have approached them in an ad hoc fashion that is characterized by a focus on short-sighted, expedient solutions that are often inadequate and, in the end, more expensive than long-term solutions. Camps are sometimes improperly located because an adequate baseline survey was not conducted. Waste management is a chronic issue and a burden on the logistics system, but little effort seems to be devoted to developing methods for reducing and recycling wastes. The Army has, however, taken some recent steps that could improve the way it handles base camps (see the discussion of resources and proponency below).

Environmental considerations are also not being addressed sufficiently in contracting. This is an important loophole, because contracting is now fundamental to Army operations in contingencies, particularly for the construction and operation of base camps. Contracts for base-camp construction and support are usually written from scratch at each base camp by engineers and base-camp staff who have little

knowledge or training in environmental contracting. As a result, the environmental aspects of the contract are often poorly written, and statements of work often do not specify the contractor's environmental responsibilities and liabilities. Moreover, the contracts usually do not include incentives for contractors to minimize wastes. Finally, there is often insufficient oversight when the contracts are implemented, because there are not enough trained people to devote the needed attention and time to the task.

Many of the lessons and good field practices developed during a contingency operation do not get disseminated throughout the Army. Lessons from the Balkans and other contingency operations have been documented by Army organizations but have not been incorporated into doctrine, guidance, training, and practice. In addition, innovative practices and technological approaches have been developed and implemented by people in the field, but these are often not transferred throughout the theater or to other parts of the Army.

Existing technologies and practices that could help reduce the logistics tail, waste, and costs are not being widely used. Some practices, such as using waste-to-energy systems and recycling runoff from wash racks, are not being tested, evaluated, or used in the field, while others that have already been tested in the field have not been fully documented and so are not being incorporated into the appropriate doctrine, training, and procedures.

Finally, available resources are not sufficient to cover environmental programs and activities in the field, including programs, equipment, and staff. For example, base camps do not have the funds or the staff to address environmental problems before they get worse or to obtain such environmental supplies and equipment as proper waste-storage facilities.

Recommendations

The Army could develop a more comprehensive approach to environmental considerations in contingency operations, one that moves environmental considerations from being addressed on an ad hoc basis to

being infused throughout the Army's culture, policy, and doctrine. To create such an approach, we recommend the following:

1. Improve the policy and guidance for environmental considerations in contingency operations.
2. Encourage an environmental ethic throughout the Army that extends to contingency operations.
3. Better incorporate environmental considerations into planning.
4. Improve pre-deployment and field environmental training.
5. Invest more in environmental resources and good environmental practices for field operations.
6. Use a "sustainability" model for contingency operations.

1. Improve the Policy and Guidance for Environmental Considerations in Contingency Operations

Our analysis of DoD, joint, and Army policy and doctrine revealed that there is no comprehensive approach to environmental considerations in contingency operations. The only way to remedy this situation is for DoD to issue or update directives that create a standard policy for environmental considerations. A DoD-wide policy is necessary because environmental issues can affect all Services and must be addressed cooperatively. The Army should issue or modify Army regulations, field manuals, and pamphlets to implement such a directive.

The goal of the policy would be to ensure that overseas contingency operations do not occur in a policy vacuum, so that issues ranging from strategic considerations in planning to base-camp management are handled by standard rather than ad hoc practices. It should also ensure that environmental issues get proper consideration in planning, training, and operations, including stabilization and reconstruction activities. The policy and related regulations and doctrine should apply everywhere but should allow flexibility for military imperatives, commanders' prerogatives, and regionally appropriate variations.

Explicit DoD and Army policies concerning environmental issues would allow doctrine, training, SOPs, and force concepts to be developed. They would also establish responsibilities for commanders and clear expectations and standards to which units can train. Updating

the doctrine embodied in FM 3-100.4 and its likely replacement, FM 3-34.500, would be a start, but the Army should also address environmental considerations in the field manuals for other important actors, such as combat units, the medical corps, logisticians, and Army leaders. Without such policies and regulations, our recommendations will be difficult to achieve.

The Army strategy for the environment and its implementation process could provide a powerful mechanism for more effectively integrating environmental considerations in contingency operations into the Army. Its vision for sustaining the Army's mission and strategically addressing the interrelationships of mission, environment, and community could provide the basis for developing policy and guidance.

Our analysis revealed that base camps have significant gaps in environmental policy and doctrine. Base camps are a fact of life in contingency operations, required almost invariably. Badly designed or operated camps can pose risks to soldier health and the local environment, create unnecessary problems for managing hazardous waste, and impose high logistical burdens. These shortfalls could be addressed by implementing policies and doctrine explicitly for base camps that include standardizing camp design and environmental practices and establishing basic contracts for base-camp construction and operations, waste haulers, and management. At present, those contracts are usually developed at each camp and often do not include appropriate environmental provisions or incentives for contractors to minimize waste streams, logistical burdens, and costs. Base-camp design and operations should also incorporate environmental best practices, such as containment around refueling points and proper storage facilities and procedures for hazardous wastes. Our research suggests that policies and guidance should also account for the different phases of an operation, including the initial combat or entry phase; the second phase, where contractors provide much of the support; and the final phase, where U.S. forces redeploy and facilities are closed.

2. Encourage an Environmental Ethic Throughout the Army That Extends to Contingency Operations

The Army encourages soldiers and leaders to behave in an environmentally responsible manner at permanent bases and training facilities. That ethic should carry over to contingency operations and should not be left behind in the United States when units deploy. It is important for commanders and soldiers alike to understand the importance of environmental protection and good environmental practices for their health, force protection, and gaining and maintaining the support of the local populace. Good environmental behavior by U.S. forces can also be important for preserving access to bases in other countries. The United States often needs these bases for years, as was the case in Saudi Arabia and Kuwait after the Persian Gulf War and in Hungary during operations in the Balkans. Soldiers should also understand that environmental issues can be important to locals, even in countries that suffer from high levels of pollution and environmental degradation. In fact, environmental issues can be as important to communities in other countries as they are to communities in the United States. Soldiers and commanders should understand that good environmental practices in contingency operations can make good business sense, as they often do at U.S. installations. Using fewer resources during combat and base-camp operations can reduce costs, waste streams, and logistical burdens. The Army strategy for the environment, if fully implemented, could provide a good first step in establishing an Army culture of environmental stewardship in contingency operations.[1]

3. Better Incorporate Environmental Considerations into Planning

Environmental considerations could be better incorporated into planning for contingency operations throughout the Army. At present, they are included only in a very limited way. The focus in annexes to campaign plans is primarily on how wastes should be collected, cleaned up, and accounted for; the acceptable sources of potable water; how

[1] Past experience with implementing environmental policy within the military could help with the implementation of environmental stewardship into contingency operations. The need for organizational change to integrate environmental management systems within DoD is a good example (see Camm et al., 2001).

to manage hazardous materials in the field; and the degree to which each activity should be conducted during each phase of an operation. Although such guidance is useful for lower-level units, there are other important environmental issues that are not addressed, such as those that are specific to the region. Current plans omit the strategic aspects of the environment and whether specific environmental considerations might be important for achieving desired end states such as stability and transition to a self-sustaining state. As Major General Chiarelli discovered first-hand when he led the 1st Cavalry in Baghdad, water, sewage, trash, and electricity can play an important role in achieving stability. His soldiers were much less likely to encounter resistance in the parts of Sadr City where these utilities were available. Possibly in reaction to the lack of attention post-conflict activities received in planning and operations in Iraq and Afghanistan, DoD subsequently issued a directive (DoDD 3000.05) that emphasizes the importance of reconstruction and stability to overall mission success and directs the Services to incorporate it into plans and training.

Particular environmental considerations may or may not be important in a given operation. The goal of DoD and Army policy and doctrine should be to ensure that the commander receives the best possible information and analysis about environmental considerations so that he can make informed decisions. To provide such information, it is necessary to fully assess and consider the implications, costs, and benefits of environmental issues, including effects on soldier health, tactical objectives, stabilization, and reconstruction. For instance, OPLANs and other planning documents should incorporate more information about specific environmental, cultural, and technological issues in the region and their potential impact on Army operations. Long-term environmental sustainability, such as the health of natural systems, should be addressed during planning for reconstruction and nation-building operations. Environmental considerations should be considered on a par with force protection and safety, since they can be equally important to protecting soldiers and, in some cases, more important for mission success. The focus and nature of planning vary by type of organization. If the recent DoD directive on military support for SSTR operations (DODD 3000.05) is successful in improving

the military's focus on strategic goals and desired end states in planning for contingency operations, planning for environmental considerations should improve. But modifying the SSTR directive to address environmental considerations explicitly rather than only indirectly as it does today would be more effective.

We next present some suggestions for three types of organization within the Army: combatant commanders, combat units, and support units.

Combatant Commanders. JTFs and ground-component commanders, command staff, and specialists should incorporate strategic considerations, national objectives, and desired end states into OPLANs and OPORDs so that subordinate commanders will be aware of high-priority environmental considerations and can incorporate them into their planning and operations. In some cases, those considerations may be important enough or may apply to a broad enough range of units that they should be listed more prominently in war plans rather than being addressed only in the environmental annex. OPLANs and OPORDs should also incorporate relevant references to international agreements and stationing agreements that are specific to the contingency.

Combatant commanders need staff with the necessary expertise to address the full range of environmental considerations. They often task their engineering staff, who may have limited relevant experience, but the Army has many environmental experts in USACE and elsewhere that commanders could draw on when formulating plans. All phases of an operation should be addressed fully, including post-conflict phases and support operations in nearby countries. Environmental annexes and appendices should provide more regional specifics about environmental conditions and desired end states. They should also better incorporate intelligence about regional environmental conditions, local sensitivities, and cultural issues, and they should be as clear and accurate as possible about the likely duration of the U.S. presence in the region after the conflict ends so that base camps can be appropriately designed, sized, and developed. Because no pre-contingency plan can predict the phases with accuracy, however, a phased approach should be developed that outlines the important goals of each possible phase in which the joint force may have to participate if the operation

continues for longer than anticipated. Finally, environmental annexes should include more specifics about long-term considerations for post-conflict operations so that combat units and leaders can design combat-operation plans with those long-term goals in mind.

Combat Units. Combat units should also better incorporate environmental considerations into their planning. Commanders and staff should recognize the important role that environmental issues can play in tactical operations, protecting soldier health, and the overall success of mission. The plans and orders from higher headquarters should spell out high-priority considerations, but units must also consider whether additional environmental issues have the potential to affect their mission or the end states established for the operation. Standard Army risk-assessment techniques can be used to address environmental considerations, and some units already use them. But implementation of these techniques is very uneven across the Army. Sound environmental SOPs for field operations should be available, and units should be appropriately trained and equipped when they deploy.

Support Units. Because certain types of combat-support and combat-service-support units have special environmental responsibilities, environmental considerations should be a central part of their planning. Engineering units should build environmental considerations into their plans and contracts for base-camp construction, management, and support. Logistics units should also keep environmental issues in mind when supplying contingency operations, for example, by incorporating more waste-minimization practices and technologies into the supply chain. Cooperation between camp planners and logisticians in addressing base-camp environmental issues during the planning phase can result in better environmental practices and smaller logistical burdens and costs (e.g., by reducing waste disposal costs and the amount of supplies that need to shipped into the theater). Such cooperation can also assure that the necessary equipment to reduce the environmental impact of base camps is deployed to the field.

The logistics community can also lead by including environmental considerations and sustainability into decisions about what materiel and equipment to purchase and how to do contracting. It can also

encourage the Army to consider environmental factors and sustainability in its decisions about how to equip the force.

Staff judge advocates should also be active in the planning phase so that they can advise commanders about legal and regulatory issues. They should strive to negotiate Basel Convention agreements for hazardous-waste transshipment as early as possible to avoid the months-long buildups of hazardous wastes in theater that have plagued recent operations.

4. Improve Pre-Deployment and Field Environmental Training

Training for environmental issues could be improved across the board. Improving doctrine, planning, and SOPs is important, but the approved practices also need to be exercised through training. Lessons from field experience should be incorporated into training at all levels, and recent experience indicates that this is not happening. Predeployment training is also crucial to ensuring good environmental practices in contingency operations. The training should emphasize specific regional issues, including environmental conditions, the local culture, and prominent local environmental concerns.

Environmental considerations can be infused into unit planning and operations by emphasizing environmental considerations at training centers. Facing attrition due to simulated pollution, enemy attacks on poorly secured collection points for hazardous wastes, or disease spread by insufficient sanitation practices would focus units' attention on these issues. Training that emphasizes the post-conflict phase should also factor in the local populations' environmental concerns and cultural symbols.

More environmental education and training could also be given in the field. Soldiers and engineers are obviously busy with many duties, but quick and simple environmental training guides could be supplied to help them. More regionally specific, easy-to-use field guides, like "You Spill, You Dig," should be developed and given to units upon deployment—for example, playing cards or pamphlets could be developed that show animal and plant species or cultural icons of concern in the country of operation to educate U.S. troops about such concerns. Checklists and educational posters for key environmental concerns,

such as checklists on how to do an EBS at a base camp or posters about appropriate environmental procedures at fueling stations, should also be available in the field. Even commanders could be given checklists about strategic environmental concerns for the operation.

The following are suggestions for training at particular levels.

Commanders. Commanders should receive more than an hour or two of training on the importance of environmental considerations in contingency operations. They should know that environmental responsibilities do not end when they leave their home installation but follow them as they mobilize, deploy, pass through base camps, and engage in combat operations. Understanding the longer-term and more-strategic issues, especially the potential impact of environmental issues on reconstruction and stabilization efforts, should be part of this education. They also should be made aware of DoD and Army policies, doctrine, and resources that relate to the environment in contingency operations. Commanders should be given training before deployment to increase their awareness of the importance of environmental considerations and to emphasize their responsibilities.

Units. Commanders should establish for their units SOPs for environmental protection in contingency operations and should train to them. In many cases, these procedures will be the same as those at their home installations, but contingency operations are likely to demand more, because units will not have the support and infrastructure that they are accustomed to at home.

Soldiers. Commanders should make soldiers aware of the importance of environmental protection and of how to incorporate environmental-protection measures into field operations without support from permanent installation staff, infrastructure, or contractors. Soldiers should also know how to respond to spills and other environmental incidents. Before deployment, leaders should make soldiers aware of how different the environment will be in the contingency operation from that in the United States, which environmental issues the locals consider important, and what is expected of the soldiers with respect to the environment in the operation. This training should be reinforced in the field with easy-to-understand environmental field guides and education pamphlets.

Engineers. Engineering staff supporting the JTF, ground-component commander, and combat units should know how to site, establish, and run base camps, and their knowledge should include the relevant environmental considerations. Although the USACE Field Engineering Teams can provide some assistance, staff responsible for base camps cannot rely solely on them, because of their limited size. To develop these skills, engineers should train as they fight, either running actual base camps or using a base-camp training facility that stresses key skills, including those related to the environment. Such a training facility does not exist at this time. To ensure that base camps are not located in hazardous areas, all engineers, regardless of their specialty, should be trained in how to conduct an initial site EBS.

Because contactors provide many essential services at base camps, camp managers should be trained in how to write and oversee contracts so that environmental considerations are fully integrated. Recent experience indicates that contracts are often poorly written, provide inadequate environmental protections, and do not create incentives for reducing waste streams, logistical requirements, and cost. Developing a standard base-camp contract that addresses basic environmental issues would be an important step toward solving this problem.

Medical Community. The medical community has a central role to play in protecting soldier health by reducing exposure to preexisting environmental hazards and ensuring that practices at base camps and other facilities do not increase health risks. Medical intelligence and analysis provided by AFMIC and CHPPM are critical for operational planning. Environmental-health site assessments are also critical for deciding where to locate base camps and other facilities. Commanders are not required to use either of these assets, but they should use them more fully to protect soldier health. The medical community could also be directed to support post-conflict planning, both for supporting U.S. forces and for supporting the mission to establish the end state desired by the U.S. government, although it appears that it has not been asked to do so in recent operations.

Staff Judge Advocates. Staff judge advocates should be trained to recognize environmental issues and either to understand the implications of environmental laws and regulations themselves or to get expert

help so that they can advise commanders. They could also be trained to help write contracts that implement Army and command environmental policy and guidelines and to address the legal and international treaty issues associated with hazardous-waste transshipment.

5. Invest More in Environmental Resources and Good Environmental Practices for Field Operations

Even if all the planning is done correctly and soldiers and commanders are properly trained, environmental issues still will not be fully addressed in contingency operations without some investment in resources and in developing and implementing good practices and new approaches. With sufficient investment in proper environmental-management practices, personnel, R&D, environmental information and intelligence systems, technology, and implementation, many core environmental issues such as fuel spills, solid-waste management, toxic and hazardous-waste disposal, sewage disposal, provision of clean water, and disposal of waste motor oils can be addressed.

Manning and Personnel Management. Given the centrality of base camps to contingency operations, the Army should seriously consider standardizing its approach to them. For example, it could develop teams of specialists who know how to site, design, build, operate, and close a base camp. Engineers with construction, environmental, and construction management skills would be essential, as would logisticians who know how to run and supply a camp and people who know how to write and oversee contracts. Each base camp should have an experienced hazardous- and solid-waste manager. In camps that are established and run by contractors, the contractors could assume some of the planning and management functions, but they would still need oversight. Base-camp units could be a good way to use the reserve component and would be consistent with the Army's modularization effort.

One of the common themes heard in our interviews was that there are not enough staff with the right skills to follow through on environmental issues. One solution would be to put more environmental staff in the field. The Army plans to increase the number of environmental officers and put one in every brigade, but they need specific training for

contingency operations. Furthermore, they can be effective only if they are deployed to the theater; in some cases, the environmental officer is left behind to make room for other priorities. The Army also should make sure that it has enough people with the right skills to oversee contractors. Inappropriate dumping of hazardous wastes by contractors is a common environmental problem the Army has encountered at base camps in recent operations.

Research and Development. Given the cost of operating base camps and the environmental problems they can create, the Army should consider funding the development, application, and evaluation of innovative concepts that could reduce the environmental impacts of base camps, manage waste streams (including hazardous wastes) more efficiently, reduce logistical support requirements, and increase the sustainability of the force. For example, funds could be used to evaluate technologies for reusing waste motor oil as a fuel source—e.g., to run vehicles, heat water, and cool buildings—and to assess their feasibility for widespread adoption into the force.

An important component of an R&D strategy would be more field experiments at existing base camps. An experiment conducted at a base camp in Bosnia demonstrated that soil from a fuel spill could be composted for a few months and end up clean enough to be used for growing food. This finding saved thousands of dollars in hazardous-waste transport and disposal. Another component of an R&D strategy would be the rapid incorporation of emerging best practices from R&D and field experiments into doctrine so that they could proliferate throughout the Army. Finally, the Army should encourage and reward innovative practices in the field that address environmental problems.

Resources and Proponency. In addition to changes in manning and R&D, the Army should create Army-wide resources for addressing environmental considerations in contingency operations and should ensure that they are appropriately incorporated into joint and component operational plans. Although this is nominally a DoD function for joint operations, the Army will need to develop its own resources and proponency because it is the Service that is most likely to run base camps and lead the military's SSTR operations. As a first step, the Army should fully establish a base-camp proponent who can develop

doctrine, SOPs based on best practices, and training programs, all of which would address environmental considerations. The proponent also could develop standard modular designs for base camps, including structures and infrastructure systems that can be adapted to each base camp's situation and can account for variations in camp size and surges in camp population. Finally, the proponent should develop standard contract templates that cover environmental issues for base camps. That contract template should assign responsibility and liability to the contractor and should include minimizing waste volumes as a goal to encourage sound practices and to reduce overall Army costs and logistical burdens.

In 2008, the Army created an integrated capabilities development team led by its Maneuver Support Center (MANSCEN) to address base-camp issues. The team is developing a concept capabilities plan for how to address the doctrine, organizations, training, materiel, leadership, personnel, and facilities (DOTMLPF) requirements for base camps. That analysis will guide a subsequent capabilities-based assessment. One of the team's key tasks is to identify a base-camp proponent. It is essential for the Army to name a proponent for this critical area and to provide it the resources and authority necessary to undertake its responsibilities. It is not clear whether the proponent's mandate will extend to environmental issues beyond base camps or providing host nations with expertise, but a broad mandate could help the Army get a better handle on these issues.

One of the most effective steps the proponent could take would be to establish an online community of practice for base-camp designers, builders, and managers that would allow them to access the latest resources and best practices developed by the proponent and share the latest tactics, techniques, and procedures (TTPs) that they have developed in the field during operations. Similar web sites, such as companycommander.com and platoonleader.org emerged during OIF and are considered very successful. First Corps has also developed a community of practice for Stryker brigades throughout the Army. Ideally, the site would go beyond base camps and serve as a resource to everyone who is involved in environmental considerations in contingency operations.

To support this environmental community of practice, the Army could establish a central permanent repository of environmental information and resources in the United States that would be accessible from deployed locations. Such a repository should link into all relevant organizations' existing information and resources, such as CHPPM databases.

Accessible Funds. Base-camp personnel expressed frustration over the lack of money for cleaning up spills and addressing other environmental problems. They have had to raid their operating accounts to obtain funds to do anything. As a result, spills are sometimes ignored, with the result that they will be bigger and more expensive to clean up when the camp is closed. To keep costs down, protect soldier health, and avoid alienating local populations, the Army should find a way to provide base-camp managers with separate funds for cleaning up spills and addressing other time-urgent environmental issues.

A bigger frustration expressed by managers of "temporary" base camps was the difficulty they had getting funds to build needed environmental infrastructures, particularly for managing wastes. These "temporary" camps are often occupied for several years, but without proper infrastructure, they have to hire contractors to remove and dispose of brown-water and gray-water wastes—a very expensive process. They also cannot build adequate collection facilities for hazardous-waste storage, which creates a potential hazard for soldier health. Investing in appropriate infrastructure at the start could have saved money, but it cannot be done for camps that are labeled "temporary." The Army should investigate ways to resolve this issue.

Getting More from Existing Assets. The Army has a wide variety of expertise in USACE that deployed units and camp managers could take advantage of. For example, the Hazardous, Toxic, and Radioactive Waste Center of Expertise has been providing support to deployed troops through the USACE Engineering Infrastructure & Intelligence Reachback Center. This center uses environmental experts to find solutions to environmental problems that deployed troops are experiencing. However, these resources do not appear to be used as much as they could be.

6. Use a "Sustainability" Model for Contingency Operations

The Army strategy for the environment emphasizes sustaining the Army's mission by adopting a systems approach that considers the interrelationships of mission, environment, and the community, the "triple bottom line of sustainability." Assessing, understanding, considering, and addressing these relationships of mission, environment, and the community (including the local population, host nations, U.S. troops, and the U.S. public) are key to our recommendations. Sustainability could be a useful way to approach contingency operations, particularly during the post-conflict phase, and would reinforce our other recommendations. Keeping sustainability in mind, commanders would be able to make better decisions about environmental issues and better support the mission.

Most recent contingency operations have involved long stabilization and reconstruction phases, which require U.S. forces to remain in the country or the region for years. During this phase, sound environmental practices can be essential for sustaining U.S. forces at base camps, providing a healthy and safe environment for them, while at the same time minimizing wastes and managing waste streams to keep costs and logistics demands low. Sound environmental practices can also sustain good relations with the local people who live near base camps and can be important for preserving access to basing rights in nearby countries. Finally, sustainability can be central to the end state that the United States wants to achieve in a contingency operation—a country that will remain sustainable after U.S. forces leave. Healthy natural systems that are sustainable over the long term are important to achieving this goal. Therefore, Army forces should encourage sustainable environmental practices in the host nation through reconstruction projects and advice to local authorities and by providing a good example.

Conclusion

The information and experiences documented in this study demonstrate that environmental considerations are integral to the Army's

ability to meet national objectives and desired end states in contingency operations. Yet they are often underrepresented when they compete for attention, investments, and manpower with other warfighting considerations. Balancing environmental considerations with other factors that contribute to mission success is a constant undertaking and requires better awareness, training, information, doctrine, and guidelines. The recommendations presented in this study will require changes in policy, planning, training, soldier attitudes, resource allocation, and overall awareness. Moreover, the proposed changes work in parallel—the Army will not likely be able to implement one without the others.

Implementation of the recommendations should be carefully planned and executed. It will require leadership at the highest levels of the Army, the Joint Staff, and the Office of the Secretary of Defense. It will also require resources. The implementation process for the Army strategy for the environment provides a means for incorporating environmental considerations into contingency operations and instituting some of the recommendations of this study.

Taking steps to improve the Army's consideration of environmental issues is important because it can affect mission success and operational effectiveness in contingency operations. Properly accounting for environmental considerations in planning, combat operations, and stability, support, and reconstruction operations can help the United States achieve strategic and tactical goals, as well as desired end states. This study has focused on the Army, but the analysis applies to other actors in contingency operations, including other U.S. government agencies and military Services and the militaries of coalition partners.

APPENDIX A

Domestic and International Law in Army Contingency Operations

Army operations overseas may be constrained or influenced by more than DoD and Army guidance documents or regulatory pronouncements on environment, safety, and occupational health (ESOH). Various sorts of legal restrictions relating to ESOH might also apply to Army post-conflict operations in Iraq and elsewhere. A number of American laws and regulations could conceivably impose limits on Army operations or standards for government liability in connection with illnesses suffered by soldiers or veterans as a consequence of time spent on the battlefield. On a very different note, Army contingency operations could also involve international ESOH effects, particularly to the extent that Army activities affect foreign nationals, property, and governments. These sorts of international ESOH effects could include the toxic consequences of unexploded Army ordnance, for example, but could also relate to broader Army efforts (or failures) in connection with building or maintaining critical environmental and/or public health infrastructure (e.g., electrical and water facilities in Iraq). To the extent that international laws establish relevant environmental standards and enforcement mechanisms, Army operations could be influenced or restricted by those laws as well.

In this appendix, we present a brief analysis of the application of domestic and international laws to the environmental impact of Army operations overseas. This analysis is not intended as a comprehensive review of all relevant legal issues, nor should it be construed as provid-

ing legal advice.[1] Rather, we offer a basic summary of the application of U.S. and international ESOH laws as they are likely to apply to American military operations. This is the legal framework with which policymakers must contend in developing new ESOH policies for the Army.

Although this framework includes areas of significant ambiguity, our findings generally suggest that the Army faces only limited legal restrictions and ESOH liability risk in connection with overseas operations. Moreover, in the international legal arena, the thresholds for violating the law are high, and there is little ability for other states to enforce their laws against the United States, so even if the United States were accused of violations, it is unlikely that any international or national forum would be able to adjudicate and enforce the claim. Even where they are not legally binding, however, environmental laws establish an aspirational standard that the U.S. military may want to meet, for a host of operational and diplomatic reasons.[2]

The Applicability of Domestic U.S. Law

U.S. laws currently include a number of statutes that regulate the environment and/or occupational safety and health. These statutes impose limits on the conduct of private actors in the United States (e.g., American citizens and corporations) and in some instances establish criminal or civil sanctions for violations. With regard to Army operations overseas, however, the threshold question is whether *any* of these rules apply to the Army when it operates outside the United States in the unique context of its military missions.

There are three distinct ways in which U.S. substantive laws potentially could apply. First, they might establish binding ESOH standards or requirements for Army operations. Second, they could establish criminal penalties for ESOH-related misconduct in Army operations.

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[1] As noted in the text of this report, this is an analysis of the legal issues, not legal advice. Such advice can be provided only by Army counsel.

[2] See the discussion in Berger, Grimes, and Jensen (2004), at 184, 189.

And third, they might create tort liability for ESOH-related injuries that result from Army operations. We examine each of these aspects of U.S. law below.

Domestic Environmental Laws as Binding Regulatory Authority

U.S. laws currently include more than a dozen major environmental statutes, which collectively regulate pollution, toxic emissions, dumping, the protection of endangered species, and many other aspects of environmental policy within the United States.[3] In general, however, U.S. environmental statutes do not have formal application to military operations outside the country.[4] Common-law doctrine has long established that extraterritorial application of U.S. statutes occurs only where there is clear congressional intent to achieve that end.[5] For this reason, other legal commentators, including the Army Judge Advocate General (JAG) Corps, have generally downplayed the details of U.S. environmental statutes in regard to planning for Army operations overseas.[6]

Instead, commentators have focused attention on Executive Order 12114 (1979), which imposes on DoD a requirement to evaluate the environmental impact of its overseas operations.[7] This executive order is implemented by DODD 6050.7, which provides a more detailed set of rules for when and how the military is required to undertake environmental study or review in connection with proposed operations.[8] For current purposes, it suffices to point out that many Army operations are likely to be exempt from the formal requirements of Execu-

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[3] For a descriptive listing of many of these statutes, see *Operational Law Handbook (2004)*, at 197–198.

[4] See Berger, Grimes, and Jensen (2004), at 184; Whitaker, 1997, 1995.

[5] See *Foley Bros. v. Filardo*, 336 US 281, 1949.

[6] Again, see Berger, Grimes, and Jensen (2004); Whitaker, 1997, 1995.

[7] The requirements of Executive Order 12114 parallel, in some respects, those of the National Environmental Policy Act of 1969 (NEPA), which requires environmental-impact statements by federal agency decisionmakers in connection with proposed federal actions.

[8] The JAG Corps offers a detailed analysis of these rules in *Operational Law Handbook (2004)*, at 184–189.

tive Order 12114. The order includes several major exceptions from its own environmental study requirements, most notably in connection with cabinet-authorized national-security actions and armed conflicts, disaster and emergency relief activities, and intelligence activities.[9] Despite the fact that most overseas military operations arguably fall within these exemptions, the JAG Corps nevertheless observes that it is U.S. policy always to conduct a good-faith environmental audit and that domestic environmental standards should be adhered to, provided there is no interference with the accomplishment of [an operational] mission.[10] However, this view of U.S. policy is not universally shared within the DoD and Army environmental community.

A somewhat different question is posed by whether U.S. occupational safety and health (OSH) laws have any application to overseas Army operations. Whereas environmental laws protect land and natural resources, OSH laws ultimately protect employees (i.e., Army soldiers). Under the Occupational Safety and Health Act of 1970,[11] federal agencies (including DoD) are required to implement comprehensive OSH programs that are consistent with Occupational Safety and Health Administration (OSHA) regulatory standards.[12] DoD Instruction 6055.1 describes the military's comprehensive OSH program and establishes that in the context of "military-unique workplaces and operations" (e.g., combat and peacekeeping operations), OSHA standards will apply only "insofar as practicable." To the extent that military deployments render compliance with OSHA infeasible or inappropriate, DoD reserves authority to develop and apply its own OSH rules.[13] The implication appears to be that OSHA standards are not generally binding on Army operations overseas, except to the extent that DoD chooses to adopt and enforce them.

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[9] See § 2-5 (a),(c) of Executive Order 12114 (1979).

[10] See *Operational Law Handbook (2004)*, at 189.

[11] Occupational Safety and Health Act of 1970, Public Law 91-596, 84 Stat. 1590.

[12] See 29 USC 668 (2005).

[13] See Department of Defense Instruction 6055.1, August 19, 1998, at E3.4.2.

Domestic Criminal Sanctions for Environmental Misconduct

Many U.S. environmental statutes include criminal penalties for violation of pertinent environmental standards or regulations.[14] Application of these criminal laws to overseas military operations, however, raises complicated issues. Under the Military Extraterritorial Jurisdiction Act of 2000 (MEJA),[15] conduct by members of the armed forces outside the United States that would have been felonious if it occurred within U.S. jurisdiction is punishable as provided by U.S. law for that offense.[16] One of the basic effects of MEJA is to give extraterritorial reach to U.S. criminal-felony laws (e.g., by defining offenses such as rape and murder).[17]

But the manner in which this MEJA provision would interact with U.S. environmental laws is ambiguous. Most U.S. environmental statutes are primarily regulatory, rather than criminal, in nature. Moreover, most of the criminal penalties that are embedded in U.S. environmental laws are tied to violations of regulatory standards. Thus, consider the example of one such criminal provision, the disposal of hazardous waste without a required federal permit under the Resource Conservation and Recovery Act of 1976 (RCRA). It is plausible that, under some circumstances, the dumping of hazardous waste by Army personnel in the United States might involve a risk of criminal liability pursuant to RCRA.

It is far less clear that this RCRA provision, when combined with MEJA, would result in similar criminal liability for actions taken by Army personnel outside the United States in connection with overseas operations. For example, soldiers on the battlefield may expend depleted-uranium rounds while in combat. It is hard to imagine that

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[14] Examples of criminal provisions in U.S. environmental statutes include the Endangered Species Act of 1973, at 16 USC 1540, and the Resource Conservation and Recovery Act of 1976, at 42 USC 6928.

[15] Military Extraterritorial Jurisdiction Act of 2000, Pub L. No. 106-523, 114 Stat. 2488.

[16] See 18 USC 3261(a) (2005).

[17] According to one commentator, MEJA was inspired by a case of child molestation in which the offender, the spouse of a soldier, was beyond prosecution because of a lack of extraterritorial jurisdiction over the crime. See the discussion in Schmitt (2000).

RCRA and MEJA would be interpreted to imply that U.S. environmental permits are required to fight on foreign battlefields or that RCRA criminal liability would apply to Army soldiers in the absence of such permits. Once again, it is generally accepted as doctrine that most U.S. environmental statutes (and regulatory standards) do not have extraterritorial application to overseas military operations.

In sum, MEJA creates a sphere of ambiguity about whether and to what extent U.S. criminal environmental laws might ever have extraterritorial application in connection with overseas operations. The complexities of the legal questions involved are beyond our ability to address in detail and may be appropriate for formal study by Army counsel. From a policy perspective, the threat of criminal liability, however remote, may create another incentive for compliance by operational commanders with U.S. environmental standards.

Domestic Tort Liability for Environmental Misconduct

Under domestic law, individuals and businesses can often be held liable for injuries and damages caused by their environmental misconduct (e.g., toxic dumping), whether that misconduct takes the form of negligence or an intentional tort. By contrast, Army operations overseas are largely protected from U.S. tort liability under the doctrine of sovereign immunity, which generally precludes tort suits against the federal government without the government's consent.[18] The Federal Tort Claims Act (FTCA) establishes a limited waiver of the federal government's immunity in some instances, particularly when government officials or employees are negligent. The FTCA nevertheless preserves sovereign immunity from tort claims that arise (1) in a foreign country or (2) from combatant activities of the military during time of war.[19] These exceptions under the FTCA would probably cover most Army operations overseas. On a related note, the Supreme Court has interpreted sovereign immunity broadly to preclude members of the armed Services from bringing tort suits against the military.[20] Consequently,

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[18] See generally 28 USC 2671–2680.

[19] See 28 USC 2680.

[20] *Feres v. U.S.*, 340 U.S. 135 (1950). See the discussion in Turley (2003).

it appears unlikely that the Army or its personnel would face U.S. tort liability in connection with overseas operations.

The above notwithstanding, a separate question is posed by whether Army operations might ever result in tort-style civil liability under international law. We address this question in our analysis of international law issues below.

The Foreign Claims Act

The primary source of U.S. legal authority that creates civil liability for the U.S. Army in connection with its overseas operations is the Foreign Claims Act of 1982 (FCA).[21] The FCA provides the Secretary of Defense with the authority to compensate the inhabitants of foreign countries for claims involving personal injury, death, or property damage caused by non-combat activities of U.S. military personnel overseas. Each claim brought under the FCA can be settled in an amount up to $100,000, and the stated purpose of the statute is "to promote and maintain friendly [international] relations through prompt settlement of meritorious claims."[22] The FCA establishes an elaborate procedural mechanism for adjudicating and resolving such claims, and the JAG Corps has summarized the relevant procedures in its operations manual.[23] For current purposes, it suffices to emphasize two points: First, the existence of the FCA means that the Army can face significant liability from harms inflicted on foreign nationals in connection with overseas operations, at least to the extent that such harms do not derive from U.S. combat activities during a time of war. Second, the FCA does not specifically establish any substantive environmental standards for liability in connection with U.S. operations. Nevertheless, claims for losses associated with negative environmental impacts are plausible under the FCA, and any such claims would be resolved based on the environmental laws of the country within which they arise.

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[21] Codified at 10 USC 2734–2736.

[22] Bracketed text added; see 10 USC 2734(a).

[23] See *Operational Law Handbook (2004)*, at 124–125.

We discuss in greater detail below the relationship between the FCA and other sources of international law, which potentially give rise to mechanisms for adjudication of foreign tort claims against the U.S. Army in relation to its operations overseas.

The Applicability and Requirements of International and Foreign Law

Two types of law apply outside of the United States: international law and the law of the nation in which the U.S. military operates, which we refer to as the host nation.

Host-Nation Law

The host nation may regulate the environment, and the general rule is that all parties present, including U.S. forces, must respect the host nation's laws. The general rule has exceptions, however: U.S. forces will be immune from host-nation law when (1) immunity is conferred on U.S. forces by agreement, (2) U.S. forces enter the host nation by force (possibly only if they enter to combat the host nation's forces), and (3) U.S. forces enter on a UN-sanctioned security-enforcement mission.

Immunity Conferred by Agreement. U.S. forces are immune from a host nation's laws when the host nation agrees to the immunity. The simplicity of this rule belies a hidden complexity. The type of immunity at issue here is more rare, conceptually different, and broader than the type of immunity granted in status-of-forces agreements (SOFAs) and stationing agreements. Under the former, the laws of the host nation do not apply to and may be disregarded by U.S. forces. In comparison, under many SOFAs and stationing agreements, the host nation's law applies to the members of the force, and they are bound by that law, but they are immune from the host nation exerting criminal or civil jurisdiction over them for violations of the law.

U.S. Forces Enter by Force (Traditionally, to Combat National Forces). If U.S. forces enter the host nation by force, they are immune from host-nation law, although this rule may apply only when U.S. forces enter to combat national forces. The rule has its genesis in the

Law of the Flag. Originally, immunity based on the Law of the Flag had two prongs: A foreign military force is immune from the laws of the host nation when it enters the nation (1) by force or (2) with the nation's consent.

Focusing on the first prong, traditionally, when a nation's military entered another nation by force, it was to engage in combat with national forces. Today, the reasons and purposes for which a military may forcefully enter another nation are broader and include peacekeeping and peace enforcement, but it is unclear whether the rule has similarly broadened or applies only in the narrower context in which it originated.

The second prong—immunity when entering a nation with its consent—no longer has the universal acceptance it once had and has probably fallen into disfavor. It appears that states do not recognize immunity in these situations, for if a nation's forces were always immune from host-nation law when in that nation with the consent of the host, there would be no need to include immunity provisions in SOFAs and stationing agreements. Yet states routinely include such provisions in these agreements. The second prong, however, may maintain some vitality through a merging with the first prong. If a nation's military enters another nation upon its invitation, or possibly merely with its consent, for purposes of using force (for example, to combat third-party forces such as terrorist groups or rebels) or to forcefully keep the peace, host-nation law may not apply.

U.S. Forces Enter on a UN-Sanctioned Security Enforcement Mission. When the United Nations Security Council authorizes a nation's forces to perform security operations in another nation, it also authorizes the forces to take actions necessary to fulfill the mission and thereby, explicitly or implicitly, immunizes them from the host nation's law that the mission requires it to violate. Unlike the situations discussed above, this situation does not confer blanket immunity. Here, the extent of the immunity depends on the mission mandate. If the mission mandate requires the forces to perform tasks that are inconsistent with host-nation law, the forces are immune to the extent of the inconsistency. Because UN security-enforcement missions could fall on a broad spectrum, so too could the extent of the forces' immunity.

At one end of the spectrum is entering the host nation to wage war against national forces, as occurred in the Persian Gulf War. Here, the third category of immunity merges with the surviving portion of the Law of the Flag (the second category of immunity), and immunity is at its broadest. At the other end of the spectrum is entering the host nation at its request to maintain peace and security. Here, immunity is at its narrowest; there may be little or no immunity. Entering on a UN-sanctioned security-enforcement mission could place forces at any point along the spectrum, but the basic rule is the same nonetheless: Immunity extends to those actions that are required by the mission.

International Law

There are two types of international law: conventional law and customary law (typically referred to as customary international law). Conventional law is formed through treaties. Generally, only nations that ratify a treaty are bound by it. A treaty, or some of its provisions if not the whole treaty, can nonetheless apply to nations that do not ratify it if the treaty (or some of its provisions) becomes customary international law.

Customary international law, as the name suggests, is a custom that takes on the character of law. The formation of customary international law has two requirements. First, there is a custom or general practice of states. Second, states follow this custom in the belief that the law obliges them to do so.[24] That is, as the general practice emerges and becomes more widespread, it carries with it a sense of legal obligation. Customary international law does not affect all states equally. Specifically, it will not bind states that steadfastly reject the emerging custom.

The requirements for the formation of customary international law raise several questions: What constitutes state practice? How much practice is required? How many states are required? Are the practices of every state given the same weight or do they differ in their importance? What type of dissent from the custom is required such that the custom will not bind a dissenting state? While some authoritative writ-

[24] This requirement is known as *opinio juris*.

ings shed light on these issues,[25] there are few concrete answers. Thus, the particular law formed from the several actions of several states is often ambiguous and subject to conflicting interpretation.

Despite customary international law's ambiguities, it is clear that conventional law and customary international law share an important characteristic. Both are based on consent, and thus so is international law more generally. Nations, with few exceptions,[26] are bound only by those laws to which they consent, either expressly through treaty ratification or impliedly through a general practice of acceding to an emerging or established custom.

Conventional law has the benefit of being codified and thus unambiguously consented to; however, it too inflicts ambiguity as to what the law is. Often, the precise interpretation of a provision in a

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[25] For example:

> "Practice of states" . . . includes diplomatic acts and instructions as well as public measures and other governmental acts and official statements of policy, whether they are unilateral or undertaken in cooperation with other states. . . . Inaction may constitute state practice, as when a state acquiesces in acts of another state that affect its legal rights. The practice necessary to create customary law may be of comparatively short duration, but . . . it must be "general and consistent." A practice can be general even if it is not universally followed; there is no precise formula to indicate how widespread a practice must be, but it should reflect wide acceptance among the states particularly involved in the relevant activity. Failure of a significant number of important states to adopt a practice can prevent a principle from becoming general customary law though it might become "particular customary law" for the participating states. A principle of customary law is not binding on a state that declares its dissent from the principle during its development.

Restatement (Third) of Foreign Relations of the United States § 102, cmt. b. See also Michael Byers, *The Shifting Foundations of International Law: A Decade of Forceful Measures Against Iraq*, 13 Eur. J. Int'l L. 21 (2002); Anthony D'Amato, *Appraisals of the ICJ's Decision: Nicaragua v. United States (Merits)*, 81 Am. J. Int'l L. 101 (1987) (explaining the formation of customary international law, particularly how treaties contribute to custom, in critiquing the International Court of Justice's decision in *Nicaragua v. United States*).

[26] All nations are bound by *jus cogens*, which are peremptory norms of international law from which no state may derogate. The Vienna Convention on the Law of Treaties, 1969, 1155 UNTS 331, Art. 53. Examples of *jus cogens* are the prohibitions against genocide, slavery, and piracy.

convention and thus the obligations of states are as subject to differing opinions as is customary international law.

Conventions Relevant to the Environment. Several international conventions have provisions that limit, either directly or indirectly, effects on the environment. The conventions are listed below, along with relevant provisions and commentary.

Hague IV: *Convention (IV) Respecting the Laws and Customs of War on Land* and its annex, *Regulations Concerning the Laws and Customs of War on Land*, October 18, 1907.[27]

- Article 22 codified the customary law that methods of warfare are not unlimited, which established the general principle that some actions are forbidden. Subsequent articles set forth some specific prohibitions.
- Article 23(e) forbids the use of weapons or material calculated to cause unnecessary suffering.
- Article 23(g) forbids the destruction or seizure of property unless demanded by military necessity.[28]

The Gas Protocol: *1925 Geneva Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare*, June 17, 1925.[29]

- The protocol bans the use of "asphyxiating, poisonous or other gases, and of all analogous liquids, materials or devices."
- The United States reserved the right to use herbicides and riot-control agents (RCAs), under the belief that neither was a proscribed agent under international law.

The Chemical Weapons Convention (CWC): *Convention on the Prohibition of the Development, Production, Stockpiling and*

[27] 6 Stat. 2277, 205 Consol. T.S. 277.

[28] Necessity will be discussed in the relevant section on customary international law, p. 163.

[29] 26 U.S.T. 571, T.I.A.S. No. 8061

Use of Chemical Weapons and on Their Destruction, January 13, 1993.[30]

- The CWC complements the Gas Protocol, often setting forth more rigorous standards.
- Essentially, the CWC bans chemical weapons.
- Article 1(5) bans RCAs as a "method of warfare." Executive Order 11850 interprets this provision and sets forth U.S. policy regarding the use of RCAs (and herbicides).
- With regard to RCAs, the United States renounces their first use except defensively to save lives such as for controlling riots in areas under U.S. military control, dispersing civilians where the enemy uses civilians to mask or screen an attack, or protecting convoys from civil disturbances, terrorists, and paramilitary attack.
- With regard to herbicides, the United States renounces first use except to control vegetation around defensive areas.

Conventional Weapons Convention: *Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Excessively Injurious or Have Indiscriminate Effects*, October 10, 1980.[31]

- Article 8 of Amended Protocol II bans the indiscriminate use of mines, booby traps, and other devices.
- Indiscriminate is defined, in part, as use (a) that is not directed against a military objective, (b) that employs a method or means of delivery that cannot be directed at a specific military objective, or (c) (i) that may be expected to cause incidental loss of civilian life or injury to civilian objects (including the environment) and (ii) that would be excessive in relation to the concrete and direct military advantage to be gained.
- Article 4 of Amended Protocol II stringently limits the use of anti-personnel mines.

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[30] 32 I.L.M. 800.

[31] 19 I.L.M. 1525. The United States ratified only Protocols I and II of the treaty's three optional protocols.

- U.S. policy is to not employ anti-personnel mines that do not self-destruct except in Korea and for training purposes.
- Protocol III, which the United States has not ratified and thus by which it is not bound, bans incendiaries such as napalm, flame-throwers, and thermite weapons.

Fourth Geneva Convention: *The Geneva Convention Relative to the Protection of Civilian Persons in Time of War*, August 12, 1949.[32]

- Article 53 prohibits the destruction of property, including real or personal property owned individually, collectively, or by the state, in occupied territory "unless absolutely necessary by military operations."
- The prohibition applies only to occupied territory.
- The term "destruction" likely includes merely damaging.
- Destruction that is extensive is a war crime.

ENMOD Convention: *The Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques*, May 18, 1977.[33]

- Whereas other conventions regulate the effect weapons have on the environment, ENMOD bans using or manipulating the environment as a weapon.
- Article 1 prohibits the use or manipulation of the environment that is (1) widespread, (2) long-lasting, or (3) severe, and these terms are subject to various interpretations.
- ENMOD has limited effect, because it bans only significant manipulations that probably require extremely advanced technology. According to the United States' interpretation, to violate ENMOD requires changing the dynamics, composition, or structure of the earth by manipulating its natural processes. Examples include weather-pattern alterations, earthquake modification, and ocean-current modification to cause, for exam-

[32] 6 U.S.T. 3316, 75 U.N.T.S. 135.

[33] 31 U.S.T. 333. 1108 U.N.T.S. 151.

ple, tsunamis. Diversion of a river, destruction of a dam, release of millions of barrels of oil, and destruction of water supplies do not violate ENMOD. Other nations, however, argue that ENMOD applies more broadly.
- ENMOD is further limited in that it prohibits only uses or modifications that harm another ENMOD party state.

Additional Protocol I: *Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts*, June 8, 1977.[34]

- Additional Protocol I is more specific to environmental protection than the other treaties discussed herein.
- The United States has not ratified Additional Protocol I. As such, it is not bound by Protocol I as a matter of conventional law, but, in part because 162 nations have ratified the protocol, some of its provisions may have become customary international law.
- Additional Protocol I sets a threshold level of impermissible harm; it does not balance the level of harm against military necessity as customary international law and other treaties do.
- Article 35 prohibits any method of warfare that may be expected to cause widespread, long-term, and severe damage to the environment. The harm must have all three of these characteristics, and their meaning is fiercely debated. The United States interprets them to set a very high threshold, but other states disagree.
- Mere foreseeability of this type of harm resulting, but not the intent to cause that harm, is required for an action to constitute a violation of the prohibition.
- The protocol bans reprisals against the environment and other civilian objects.
- Article 54 prohibits targeting objects such as foodstuffs, agricultural areas for the production of foodstuffs, crops, livestock,

[34] 16 I.L.M. 1391, 1125 U.N.T.S. 3.

and drinking-water installations that are indispensable for the survival of civilians, even if the objects are used to support opposing military forces.[35]

- Article 56 bans targeting installations housing dangerous forces (e.g., dams, dikes, nuclear plants) if their destruction would cause severe loss to civilians, including the loss of property. These bans are subject to exceptions for installations being used in regular, significant, and direct support of military operations.

Rome Statute: *Rome Statute of the International Criminal Court*, July 17, 1998.[36]

- Relevant provisions will be discussed in the section on determinations and consequences of a violation (and sometimes a non-violation) of the law.

Basel Convention: *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal*, March 22, 1989.[37]

- The Basel Convention has 166 party states.[38] The United States, which has signed but not ratified the convention, is not among them. As a signatory, the United States is obliged to act in accordance with the convention's purposes but is not formally bound by it.
- Generally, the Basel Convention requires prior notification and consent for shipment of hazardous waste across the national borders of party states.

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[35] The prohibition contains an exception that permits the destruction of these objects if they are used as sustenance solely for the members of enemy armed forces or in direct support of military action, but the exception does not apply if it would result in the civilian population having such inadequate food or water as to cause it to starve or to move, which would be the likely result if an object indispensable for its survival were destroyed. The exception thus seems to have little effect, since it does not alter Article 54's prohibition.

[36] U.N. Doc. A/CONF.183/9.

[37] 28 I.L.M. 649 (1989).

[38] Parties to the Basel Convention, online at http://www.basel.int/ratif/convention.htm.

- Before shipment can commence, all states involved in export, transit, or import must be notified of the proposed shipment and consent in writing.
- Party states may not allow the import or transit of hazardous waste from states not party to the convention unless there is a bilateral agreement between the states that provides for environmentally sound management and disposal of the waste.
- The only shipments to which the Basel Convention does not apply are those in which all states involved are not party to the convention.
- The Defense Logistics Agency takes the lead in handling Basel issues.

Relevant Customary International Law. Customary international law regarding military operations that could cause harm to civilians or civilian objects rests on two basic concepts: necessity, under which some actions are impermissible regardless of the degree of harm that results, and proportionality, which requires a balancing of benefit and harm.

The principle of necessity forbids the damage or seizure of property unless demanded by military necessity. Military necessity requires that an act be taken to further a valid military objective, i.e., one that would make an effective contribution to a military action.

Under the principle of proportionality, which requires a balancing of benefit and harm, expected civilian loss must not be excessive in relation to the concrete and direct military advantage anticipated. This balancing can be done on a tactical, individual-act basis or on the basis of a broader mission of which each act is a part.

Determinations and Consequences of a Violation (and Sometimes a Non-Violation) of the Law

Important Classifications

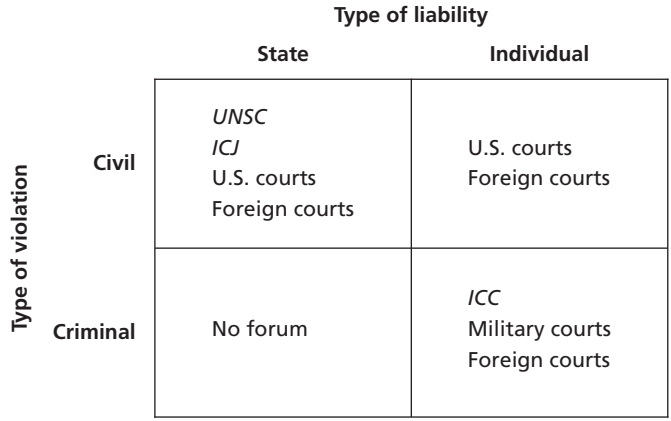
Two important classifications play a large role in determining the forum that rules on whether a law was violated and the consequences

if it was. First, a violation can be civil or criminal. Typically, civil violations result in money damages (including sanctions), whereas criminal violations can result in incarceration. Second, the state or an individual can be liable for the action. These two classifications are summarized in Figure A.1, where each cell of the matrix lists the forums that have jurisdiction of a matter, given the type of violation and the type of liability. The forums are discussed individually below.

Forums for State Liability of Civil Violations

United Nations Security Council. The United Nations Security Council (UNSC) has the authority to judge as illegal certain military actions that violate the UN Charter. Such a finding requires an affirmative vote of the UNSC; i.e., at least nine of the 15 members must vote for the resolution, and no permanent member may veto it. Because the United States may exercise a veto, it is practically impossible for the UNSC to render such an adverse ruling against the United States.

Figure A.1
Type of Liability



NOTE: Plain text indicates state tribunals. *Italic* text indicates international tribunals.

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International Court of Justice. The International Court of Justice (ICJ), also known as the World Court, is the judicial arm of the United Nations; although it has the authority to rule on many types of international disputes between states,[39] it is unlikely that it could obtain jurisdiction of a claim against the United States that involved U.S. military operations. The ICJ gains jurisdiction of a controversy only if the states that are parties to the controversy accept that jurisdiction, and this can be done in any of three ways: The states can conclude a special agreement whereby they submit the particular controversy to the court; the states can be parties to a treaty that provides for the court to resolve disputes under it; or both states can accept the "optional clause," which declares that a state accepts the jurisdiction of the court as compulsory for a dispute with another state that has accepted the optional clause.

It is unlikely that any of the three ways to gain jurisdiction will enable the ICJ to rule on the legality of U.S. military action. First, it is unlikely that the United States would consent to the ICJ adjudicating a matter that would subject the country to the potential of an adverse ruling. Second, the United States is not party to any treaty that would compel it to submit a dispute involving post-conflict operations to the ICJ. Third, the United States does not accept jurisdiction under the optional clause, and after the Nicaragua case, it is unlikely to do so in the near future.[40]

Even if the ICJ somehow held that it had jurisdiction over a dispute involving the United States' conduct of post-conflict operations, the United States could refuse to comply with the court's ruling. The sole enforcement mechanism against a state that refuses to comply with

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[39] Only states and not individuals may be parties to a case in the ICJ.

[40] At the ICJ's inception, the United States filed with the court its declaration that it accepted the court's jurisdiction under the optional clause. On April 6, 1984, the United States attempted to exclude from this acceptance "disputes with any Central American State or arising out of or related to events in Central America." Days later, Nicaragua brought to the court an action against the United States. The ICJ, against the objection of the United States, ruled that it had jurisdiction. The United States withdrew from the litigation and revoked its acceptance of the court's jurisdiction under the optional clause. Despite this, the ICJ ruled on the merits and imposed judgment against the United States (*Book Review: The International Court of Justice at a Crossroads*, 87 Mich. L. Rev. 1712 (1989)).

a judgment of the ICJ is through the UNSC, and the United States could veto any attempt to enforce an ICJ ruling against itself.

U.S. and Foreign Courts. A suit could proceed in a court in the host nation of a conflict or in the United States, but this would be rare. As discussed in the section below on paying claims, the United States makes a concerted effort to administratively review all claims and pay those that are valid. While it is possible that a claim the United States has denied could result in litigation, such a suit would face several barriers. If the suit were commenced in a host-nation court, the primary barrier is that states generally forbid allowing civil suits against foreign governments for non-commercial activities;[41] states prefer to handle disputes between their citizens and a foreign government diplomatically. Even if a host nation were to permit such a suit and the court entered a judgment against the United States, the plaintiffs might not be able to collect on that judgment absent the United States consenting to it.

Suits against the United States in a U.S. court are even more unlikely. The United States is immune from suit for claims arising in a foreign country[42] and for claims arising out of the combatant activities of the military during times of armed conflict.[43] U.S. courts have also dismissed claims against the United States arising out of military activity by relying on the principle that such claims call into question the military's decisions and actions, which the Constitution commits to the president and his subordinates and, as such, are nonjusticiable.[44]

Forums for State Liability of Criminal Violations

There is no forum exclusively dedicated to reviewing criminal claims against states.[45] To the extent that a state violates international law

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[41] A nation other than the host nation, and thus further removed from the matter, would be more likely to follow this general principle and thus less likely to permit a suit against the United States.

[42] 28 U.S.C. § 2680(k).

[43] 28 U.S.C. § 2680(j).

[44] *Nejad v. United States*, 724 F. Supp. 753(C.D. Cal. 1989).

[45] It is conceivable that some acts of state might be considered by certain individuals to be criminal violations of international law. In this case, the only forum for such claims would

by committing crimes such as genocide, the international community views these as crimes committed by individuals and attempts to hold the individuals responsible. To the extent that a state violates international law by committing acts that may be viewed as a crime for which it is more difficult to hold an individual responsible, such as unlawfully breaching the peace by invading a neighboring country or sponsoring terrorism, the only appropriate forums are the UNSC and perhaps the ICJ, in which case the discussion in the preceding section applies here as well.

Forums for Individual Liability of Civil Violations

Suits against individuals in the U.S. military for civil wrongdoing could be brought in U.S. or foreign courts, but such suits would be rare. Most Service members have few assets, making a plaintiff's potential recovery not worth the costs of litigation.

Forums for Individual Liability of Criminal Violations

Individuals could be tried for national or international crimes emanating from military activities, and specifically those relating to post-conflict reconstruction, in the International Criminal Court (ICC), military courts, or foreign courts.

It should be noted that the field of international criminal law is layered with ambiguity, beginning with the ambiguity involving the mere existence of international crimes.[46] The traditional, and now minority, view is that "international criminal law in any true sense does not exist."[47] Under this view, crimes with an international flavor are national crimes, and the issues posed by international law are whether a state can claim jurisdiction over the act and apply its criminal law when the act occurred outside the state's territorial jurisdiction. Although there are still some proponents of this view, the existence of international criminal tribunals for the former Yugoslavia and Rwanda

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be the ICJ or the UNSC, so the discussion of those forums in the preceding section applies here as well.

[46] Murphy, 1999.

[47] Schwarzenberger, 1950.

and the ICC have essentially removed this ambiguity. The determination of what acts constitute international crimes, however, remains ambiguous. Whereas there is an obvious consensus that the crimes over which the international criminal tribunals have jurisdiction are international crimes, there is no such consensus about the specific conduct that constitutes criminal activity. For example, there is little debate about whether war crimes are international crimes, but there is considerable debate about what specific conduct should constitute a war crime. The effect of states' different interpretations of the law is that a foreign state may attempt to try a U.S. Service member for an act that the United States considers legal. In any event, environmental damage would likely have to be quite severe and perhaps the acts resulting in it would have to be committed wantonly to be criminal.

International Criminal Court. The Rome Statute created the ICC, and while the United States is not a party to the statute, the court has the ability to try U.S. nationals.[48] The ICC has jurisdiction over four types of crimes: war crimes, genocide, crimes against humanity, and aggression. War crimes, which can be any of 50 separate criminal acts, is the most relevant category to the environment, particularly the following two provisions: (1) "Extensive destruction . . . of property, not justified by military necessity and carried out unlawfully and wantonly" and "intentionally launching an attack in the knowledge that such attack will cause incidental loss of life or injury to civilians or damage to civilian objects or widespread, long-term and severe damage to the natural environment which would be clearly excessive in relation to the . . . military advantage anticipated." The specific behavior that these provisions proscribe is unclear. The provisions could be exceedingly broad or narrow, depending on, among other things, the court's interpretation of terms such as "extensive destruction," "military neces-

[48] Unlike the other international tribunals discussed above, the ICC tries individuals, not states. The ICC has jurisdiction over individuals if any of three conditions are met: the accused is a national of an ICC party state; the accused committed the alleged crime in an ICC party state; or the accused committed the alleged crime in a non–party state but the non–party state requests the court take jurisdiction of the matter. Because the United States is not a party state, the ICC would not have jurisdiction based on the first condition; however, it could gain jurisdiction based on the second or third condition.

sity," "widespread," "long-term," "severe," "clearly excessive," and "military advantage anticipated."

Military and Foreign Courts. Most crimes, even those having an international dimension, are tried in state tribunals. For Service members, the state tribunal most likely to adjudicate claims of criminal activity is a military court ruling on violations of the Uniform Code of Military Justice.

A host nation that believes a Service member committed a crime within its territory may wish to try him or her in its own courts. In most of the nations in which the U.S. military operates, SOFAs preclude this by mandating that Service members are to be tried in military courts. It is conceivable that a foreign court other than that of the host nation could seek to try a U.S. Service member for an international crime, but such a trial would be unlikely. Although foreign courts have shown an increasing willingness to take jurisdiction over international crimes, they typically do so only in cases where the acts alleged or the damage caused was particularly egregious and no other nation has investigated or prosecuted the matter.

Paying Claims Without Litigation

Property damage, property loss, and personal injuries are common by-products of military operations. They are also the subject of tort claims for which claimants, including local residents, host nations, and allied forces, could recover. Judge advocates investigate, adjudicate, and settle all meritorious claims. Claims against the U.S. military can be separated into three categories: non-combat claims, combat claims, and claims that result in *solatia* payments. Regardless of the category in which the claim falls, the U.S. government makes an effort to pay for the damage it causes, in part, if not primarily, because doing so aids in gaining and keeping the support of the local population.

Non-Combat Claims. A SOFA or other international agreement will often set forth how non-combat claims are to be handled. Generally, SOFAs explicitly provide for the settlement, adjudication, and possibly cost-sharing of all valid non-combat claims. For example, in South Korea, Japan, or any NATO country, claims are managed by a command claims service.

If there is no SOFA or other international agreement that sets forth how claims are to be handled, the FCA controls. Under the FCA, claims for personal injury, death, or property loss or damage arising from non-combat activities involving negligent or wrongful acts are compensable. In adjudicating claims, the host nation's law applies.

Combat Claims. Damage resulting from combat activities is, in principle, not compensable under the terms of the FCA. Combat activities are defined as "activities resulting directly or indirectly from action by the enemy, or the U.S. Armed Forces engaged in, or in immediate preparation for, impending armed conflict."[49] This firm division between compensating for non-combat claims and not compensating for combat claims often requires distinguishing between the types of claims in a combat setting.

Despite the FCA's prohibition against paying combat claims, the U.S. government typically finds a way to legally pay them, because failing to do so hinders the goal of obtaining and maintaining the support of the local populace. For example, in the Vietnam conflict, South Vietnam paid combat claims resulting from U.S. actions. In the Grenada conflict, funds from the U.S. Department of State were used to pay for combat-related death, injury, and property damage. In the Panama conflict, the United States provided funds to Panama, which used them to pay combat claims. The typical result is that although no existing statutory provision authorizes payment and there is no legal obligation to pay, the United States pays combat claims when support of the local population is desired.

Solatia Payments. *Solatia* payments, which are common in some parts of the world, are payments in sympathy or recognition of loss. They are not barred by the principle of not paying combat claims, because they are not claims payments; they are payments in sympathy, not responses to wrongdoing. The primary purpose for making *solatia* payments is to obtain and maintain the goodwill of local populations, particularly those for which *solatia* payments are customary.

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[49] 32 C.F.R. § 536.3(k). See also, AR 27-20, Glossary, sec. II; 10 U.S.C. § 2734(b)(3).

Conclusion

There is little within U.S. domestic, host-nation, or international law that limits the combat activities of U.S. forces in overseas contingency operations. The FCA, a U.S. law, does permit foreign nationals to sue the U.S. government for damages. Many claims processed and paid by Army judge advocates during contingency operations are handled under the provisions of the FCA, although without involving the courts. The only international law relating to the environment that regularly affects U.S. operations is the Basel Convention. Although the United States is not a party to the convention, it often must secure permission from countries that are parties before it attempts to ship wastes out of a conflict zone for proper disposal.

APPENDIX B

The Importance of Environmental Conditions to the Local Populace in Iraq

Polling data collected in Iraq over the past two years show that Iraqis are very concerned about infrastructure and environmental issues and suggest that some environmental issues can be central to the reconstruction effort. We examined a wide range of public-opinion data obtained in Iraq between fall 2003 and February 2005 and also commissioned an environmental poll in February 2005. This appendix analyzes these survey data.

Public-Opinion Surveys in Iraq

Once the combat phase of the war in Iraq ended, numerous organizations conducted public-opinion surveys there. Many of these have been conducted every month or every few months and have focused on political issues, such as the transfer of government to the Iraqis and elections. We acquired and reviewed more than 30 of these surveys to examine views on environmental considerations and found 18 that mention infrastructure and/or environmental issues. They were conducted by several organizations, including the Oxford Research International (ORI), the International Republican Institute (IRI), ABC News, the Iraqi Ministry of Defense, and the U.S. State Department Office of Research. We also examined a CNN/*USA Today*/Gallup poll and some in-depth analyses of survey data in a Center for Strategic and International Studies (CSIS) report and a Physicians for Human Rights

paper. The quality of the surveys varied; however, we found three consistent trends in infrastructure issues across all the polls. These trends are discussed below.

Rebuilding the Infrastructure Is a High Priority

In almost every opinion survey from fall 2003 to February 2005 that asked about the most important issues facing Iraq, security, infrastructure, and economic issues were three top respondent answers. Usually, security was first and infrastructure second. ORI's national surveys in March and June 2004 asked about priorities for the next 12 months. Security was rated most important by 89 percent of the respondents in March 2004 and 87.3 percent in June 2004; 54.4 percent of the respondents named "rebuilding the infrastructure (electricity, water supply, telephone, etc.)" as their first, second, or third response in March 2004, and 59.4 percent did so in June 2004.

Similarly, 55 percent of the respondents in a March 2004 ABC News poll ranked "rebuilding the infrastructure" as their first, second, or third priority (see Figure B.1).

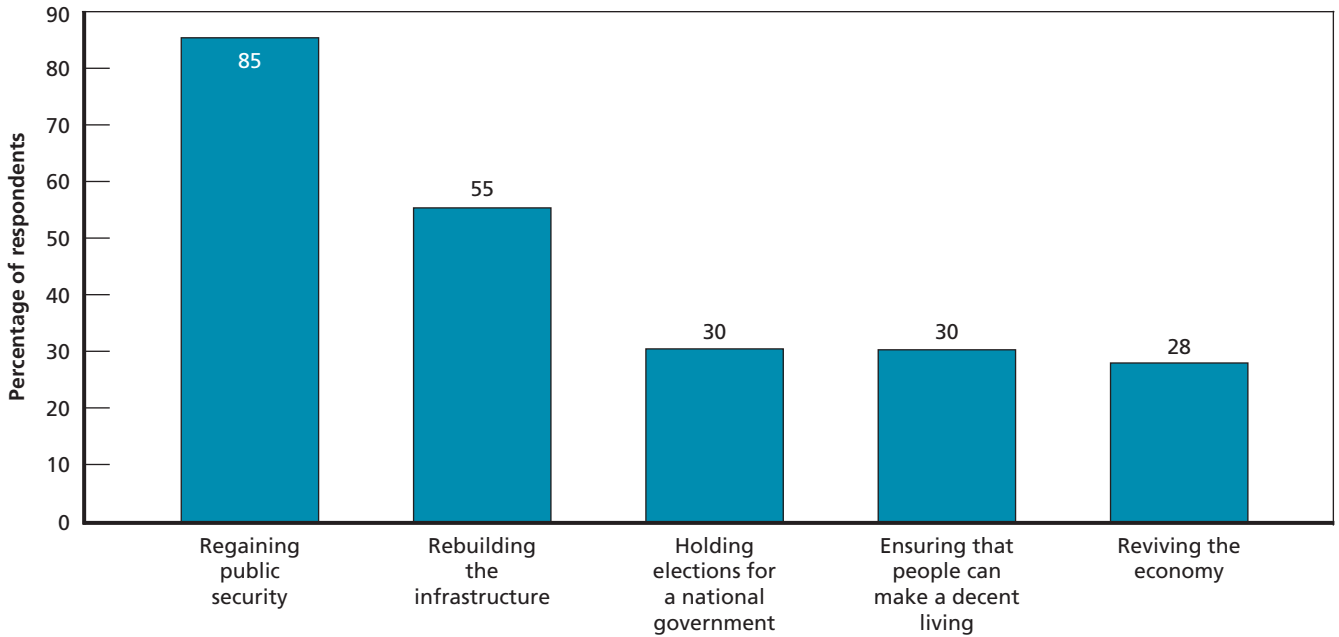
Environmental Issues Are High Infrastructure Priorities

When asked which infrastructure issues were most important, 86.3 percent of the respondents cited "ensuring electricity supply for all without too many interruptions" as their first, second, or third response, and 64.3 percent of respondents cited "ensuring clean water for all." Sewage/sanitation and trash issues were also important concerns for some respondents. For example in an IRI survey that asked what were the most important infrastructure issues in July/August 2004, respondents named as their first, second, or third answers:

- Electricity: 94 percent
- Providing drinking water: 75.8 percent
- Sewage/sanitation: 56.9 percent.

Environmental infrastructure issues, especially clean water, are clearly a high priority for Iraqis. (We have not considered electricity as

Figure B.1
Iraqi Priorities for the Coming Year: Responses to an ABC News Poll, March 2004



SOURCE: ABC News Poll, March 2004.
NOTE: Responses show first, second, or third priority.

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an environmental issue.) In an IRI survey in early 2005,[1] when asked, "Which of the following approaches to social issues would make you most likely to support a party or candidate were they offered?" 23.1 percent of respondents named "access to clean water" as their first or second choice. ("Access to clean water" was the fourth-most-important issue among survey respondents.)

Rebuilding Infrastructure Is a Key Role for the United States

When asked what the U.S. role should be, infrastructure/reconstruction was the top choice; most of the respondents did not consider security a high-priority role for the United States—they wanted Iraqis themselves to provide security. In response to an ORI poll conducted in June 2004 that asked what the role of the U.S. should be in Iraq after the June 2004 handover of power to the Iraqi government, 59.2 percent gave "Help reconstruct the country" as a first response; 84.9 percent said the U.S. should "help reconstruct the country" in their combined first, second, and third responses, while for 45.6 percent, "Help with humanitarian aid" was the next-highest answer. "Restore security in the country" was cited by only 33.8 percent of the respondents.

Survey of Iraqi Views on the Environment

We were able to have three environmental questions included in a monthly opinion poll of the general public throughout Iraq in February 2005. The survey was given to a sample of 2,200 individuals, which was a representative sample of 2,000 adults[2] age 18 and over in all 18 provinces. The interviews were conducted by trained and supervised Iraqi interviewers during February 6–10, 2005.[3]

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[1] "Survey of Iraqi Public Opinion," 2004–2005.

[2] Certain subgroups were oversampled to obtain the right statistical representation for 2,000 individuals.

[3] The environmental questions were added to the poll courtesy of Dr. David Jodice, President, and Matthew Warshaw, Senior Research Manager, D3 Systems, Inc. (Phone: 703-255-0884; FAX: 703-255-6465), Web: www.d3systems.com.

Three environmental questions were asked:

1. What environmental issues are important in Iraq?
2. Which environmental problem is the most important problem facing you and your family today?
3. Which environmental problems are coalition forces working to improve?

Iraqis Think Environmental Issues Are Important

Each respondent was given 12 different environmental issues and asked to indicate whether he or she thought each was very important, somewhat important, somewhat unimportant, or not important in Iraq. The issues were chosen to cover the most likely main issues of environmental concern and to cover all major environmental media:

1. Clean air
2. Clean drinking water
3. Sewage/wastewater treatment
4. Rivers and streams
5. Wetlands health
6. Solid-waste management (trash and landfill issues)
7. Hazardous waste from industrial activities, including toxic chemicals (e.g., oil-industry wastes), nuclear, and biological wastes
8. Hazardous waste from military activities, including toxic chemicals, nuclear waste, munitions, explosives (e.g., unexploded ordnance), and biological wastes
9. Loss of trees, such as date palms
10. Healthy land for farming (issues include desertification, drought, irrigation, salinity, rangeland grazing, and the ability to support date, almonds, wheat, barley, and other grain, vegetable, nut, and fruit crops)
11. Animal and other species (e.g., water buffalo and birds) health and population issues
12. Human-health impacts from environmental problems, including chronic pollution and disease control and prevention issues.

At least 78 percent of the respondents felt that all these issues were at least somewhat important (see Figure B.2). Clean drinking water was considered the most important issue—98.1 percent of the respondents rated it as very important, and 99.9 percent rated it as either very important or somewhat important. Clean air was the next most important, with 86.8 percent stating it was very important and 99.3 percent stating it was either very important or somewhat important. Sewage/wastewater treatment, human-health impacts from environmental problems, and hazardous waste from military activities were also viewed by more than 94 percent of the respondents as very important or somewhat important. Wetlands health was viewed as least important, with only 37.8 percent saying it was very important and 40.8 saying it was somewhat important. However, given that this is a regional issue, such as in the Mesopotamian Marshlands area, 78.6 percent of the total respondents rating it as very important or somewhat important seems fairly high.

Clean Drinking Water Is Considered the Most Important Environmental Issue

The second question ("Which environmental problem is the most important problem facing you and your family today?") was open-ended. After the respondent answered, the interviewer asked, "Anything else?" The first and second problems mentioned were then recorded and answers were categorized by the same 12 environmental areas (see Figure B.3). Again, clean drinking water was mentioned first as the most important problem by 60.4 percent of the respondents; 74.8 percent cited it in their first or second response. Sewage/wastewater treatment was the second most important problem cited in first or second responses by 40.3 percent of the respondents, but it was mentioned first by only 9.4 percent. Clean air was cited in the first response by 15.4 percent, but by only 16.8 percent in first and second responses combined.

Figure B.2
Importance of Environmental Issues to Iraqi Respondents

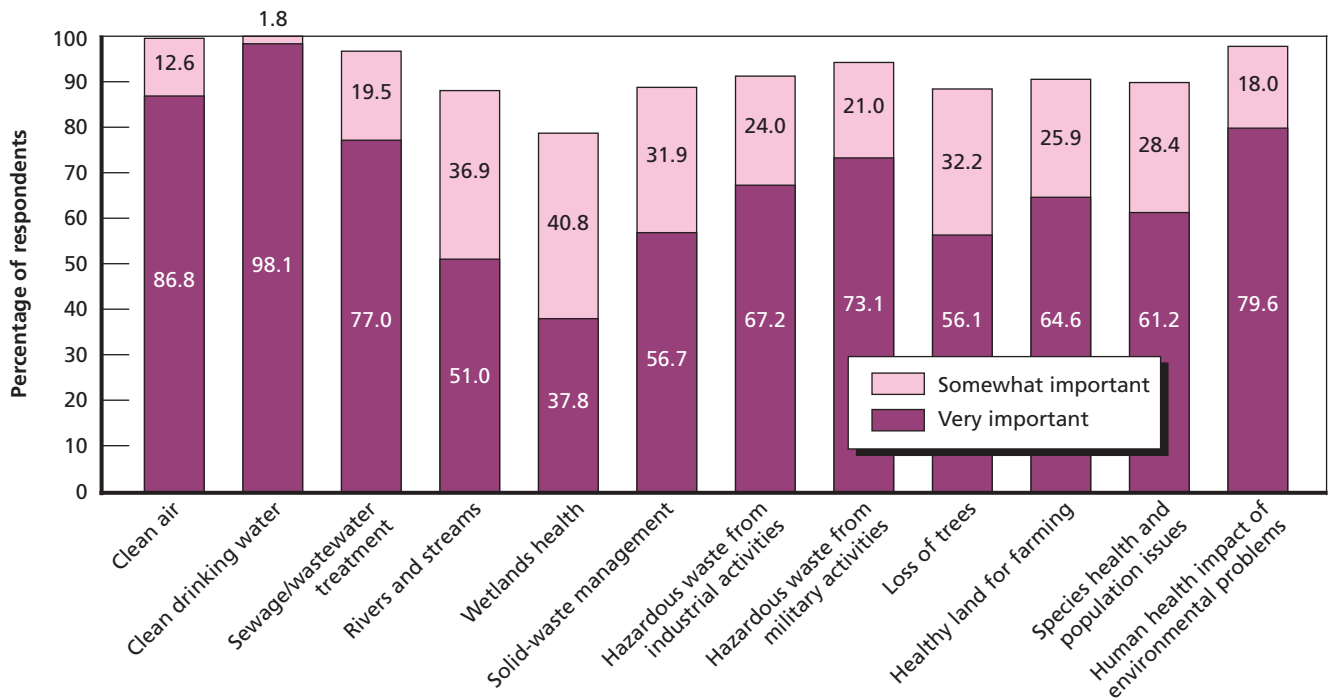

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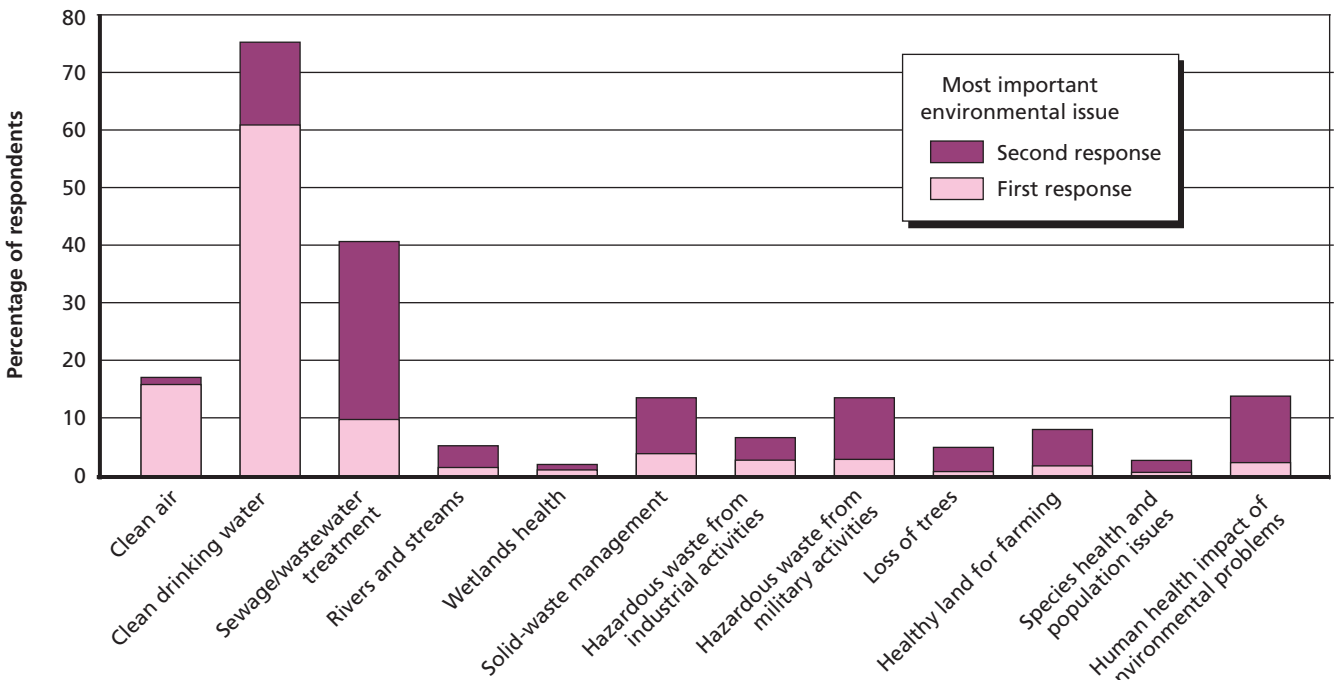
Figure B.3
Environmental Issues Cited as Most Important in First and Second Responses



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Most Iraqis Feel Coalition Forces Are Addressing the Most Important Issues

In response to the next question, "Which environmental problems do you think the coalition forces are working to improve?" which was also open-ended, clean drinking water was again rated highest, with 51 percent of the respondents citing it in their first response and 61 percent citing it in their first or second response (see Figure B.4). The second highest response was for sewage/wastewater treatment, with 12.5 percent of the respondents stating it in their first response and 34.7 percent stating it in their first or second response.

Figure B.5 presents a comparison of the answers to questions 2 and 3, which shows that the responses to the question about what the coalition forces are working to improve were fairly consistent with those about the most important environmental issues. Clean drinking water and sewage/wastewater treatment were ranked high both for importance and for what the coalition forces are working on. However, it is important to note that respondents were asked what they think coalition forces *are* working to improve, not what they *should be* working to improve. The fact that more respondents thought that coalition forces were working to improve the disposal of hazardous wastes from military activities than thought that this was the most important issue may indicate that Iraqis think the forces should work more on hazardous waste from military activities than on some of the other areas they rank as more important.

Other Survey Results. We found there was not much difference in survey results when we analyzed them by such demographic factors as gender, age, and education. However, rural areas placed slightly more importance on healthy land for farming (see Figure B.6). We also noticed some differences by ethnic/religious subgroups (see Figure B.7). Arab Shia respondents care slightly more about clean drinking water and sewage. Kurdish respondents care more about clean air and feel that coalition forces are working to clean the air. For comparison purposes, Figure B.8 shows responses by ethnic/religious subgroup on what coalition forces are working to improve.

There was more variation in responses by province, as shown in Figures B.9 and B.10. Figure B.9 shows a comparison of Baghdad and Diyala provinces' views about the most important environmental issue

Figure B.4
Iraqi Respondent Views of Environmental Problems Coalition Forces Are Working to Improve

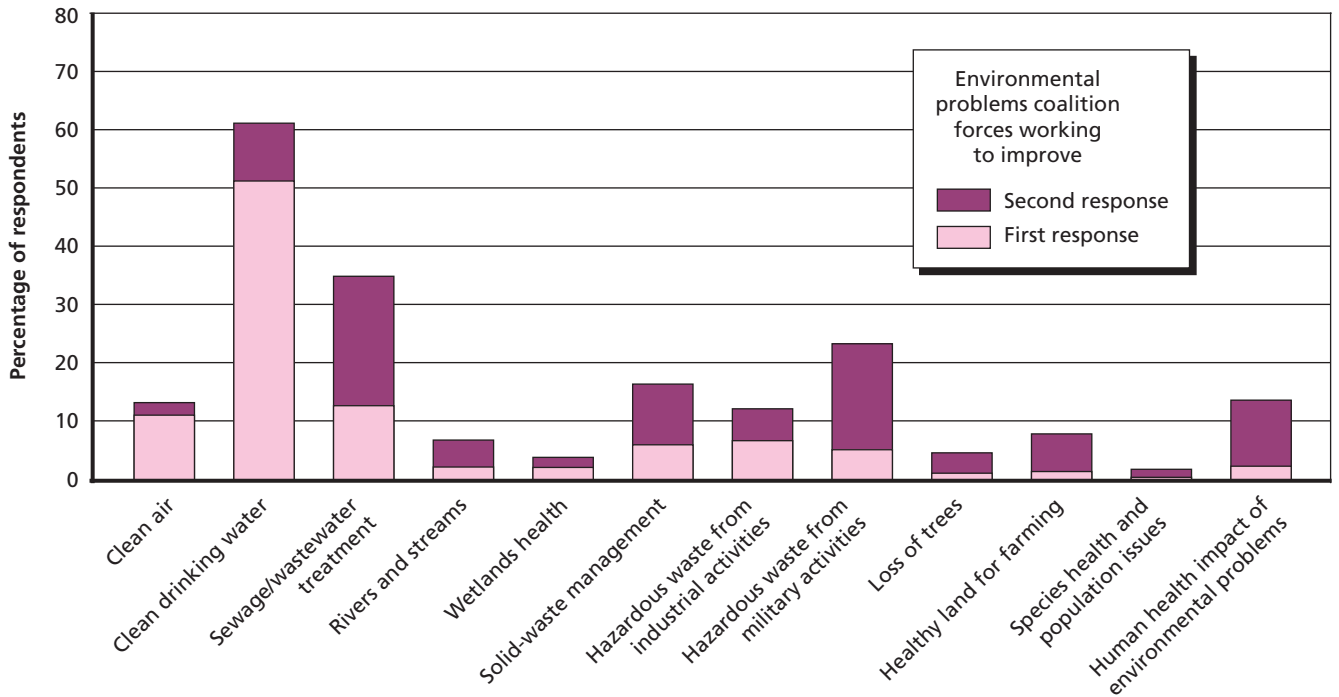

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Figure B.5
Comparison of Iraqi Views of the Most Important Environmental Problems to Iraqi Views of What Coalition Forces Are Working to Improve

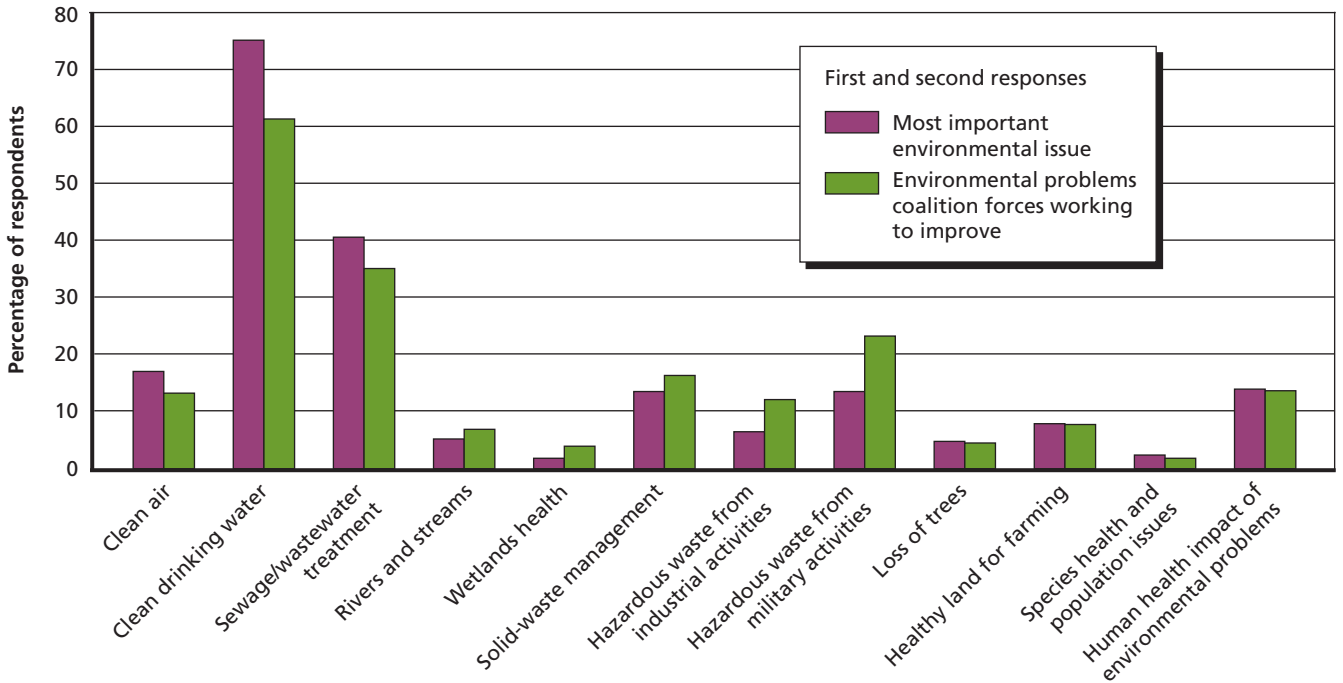

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Figure B.6
Urban and Rural Views of Most Important Environmental Problems

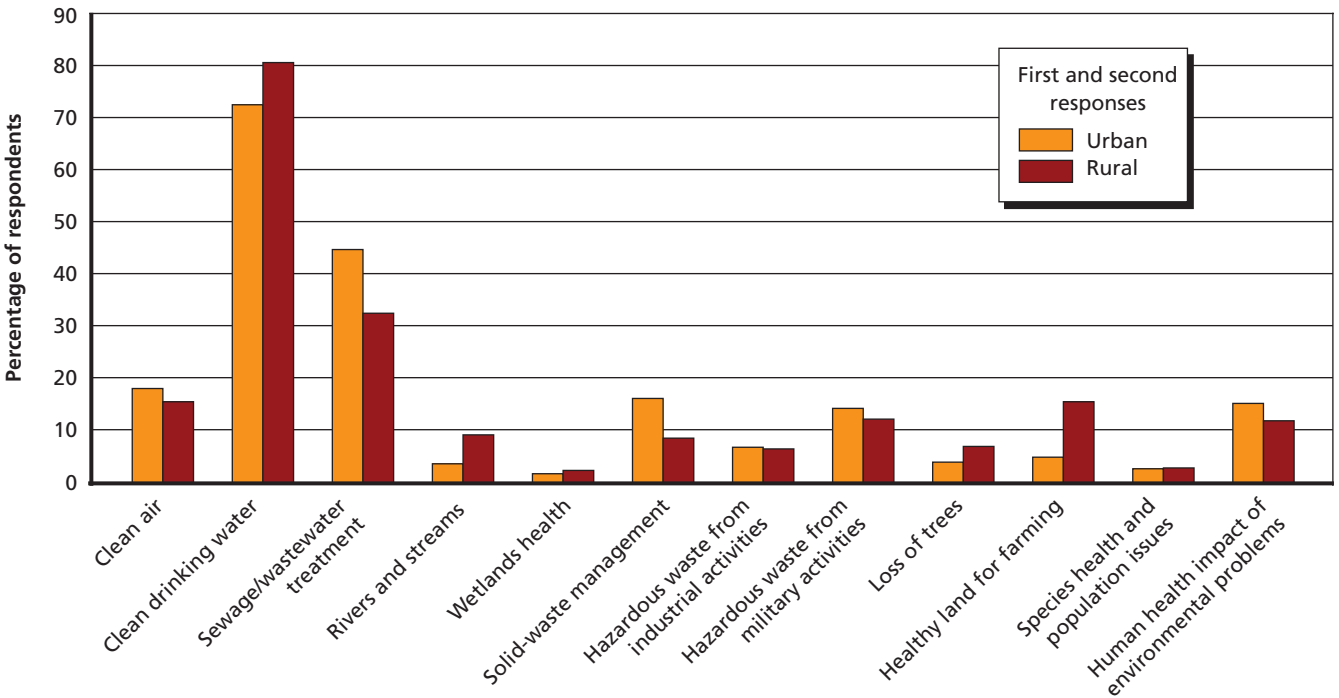

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Figure B.7
Ethnic and Religious Subgroups' Views of Most Important Environmental Problems

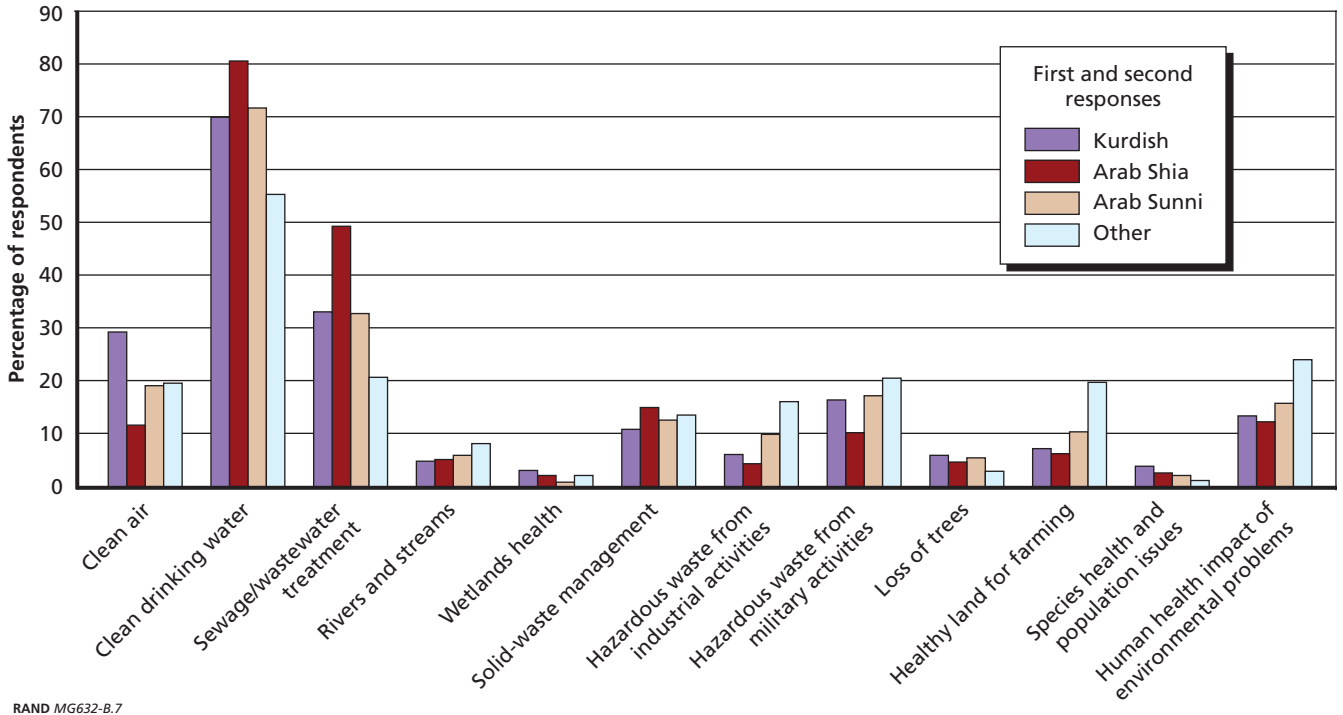

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Figure B.8
Ethnic and Religious Subgroups' Views of Problems Coalition Forces Are Working to Improve

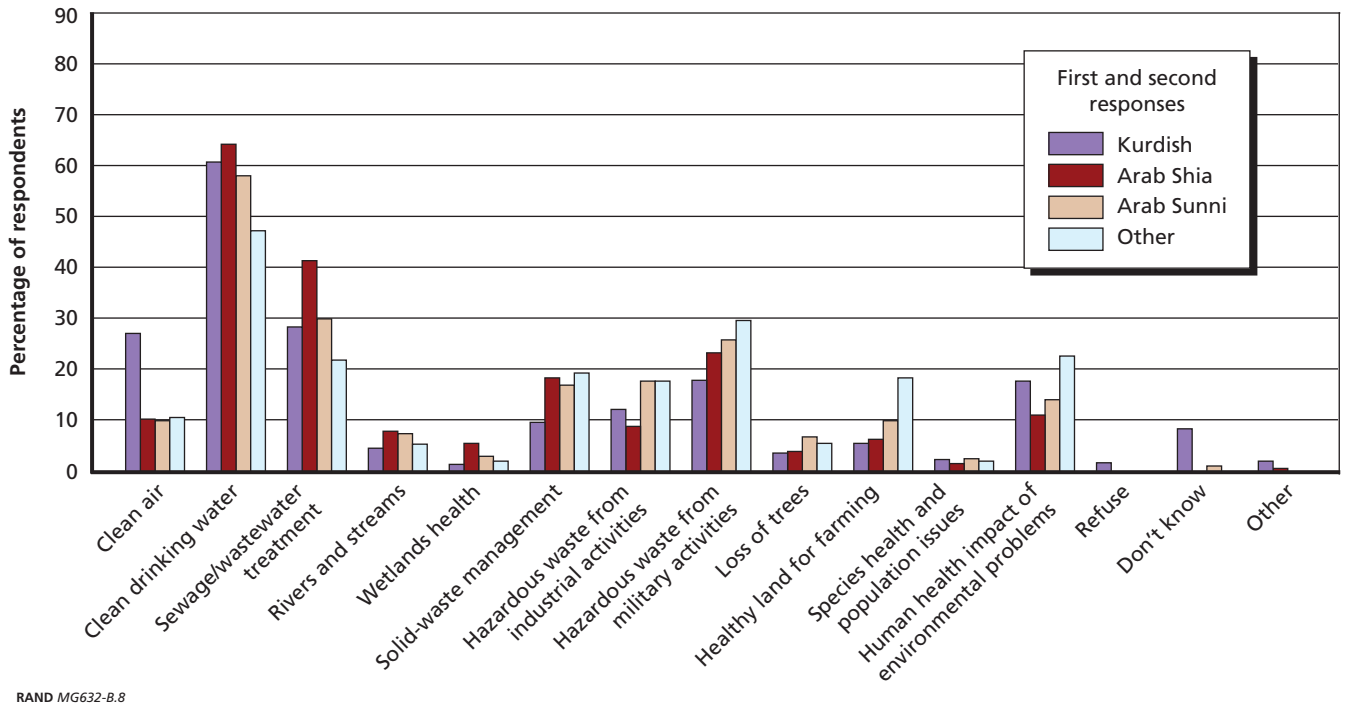

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Figure B.9
Comparison of Iraqi Views in Baghdad and Diyala Provinces (1 and 3)

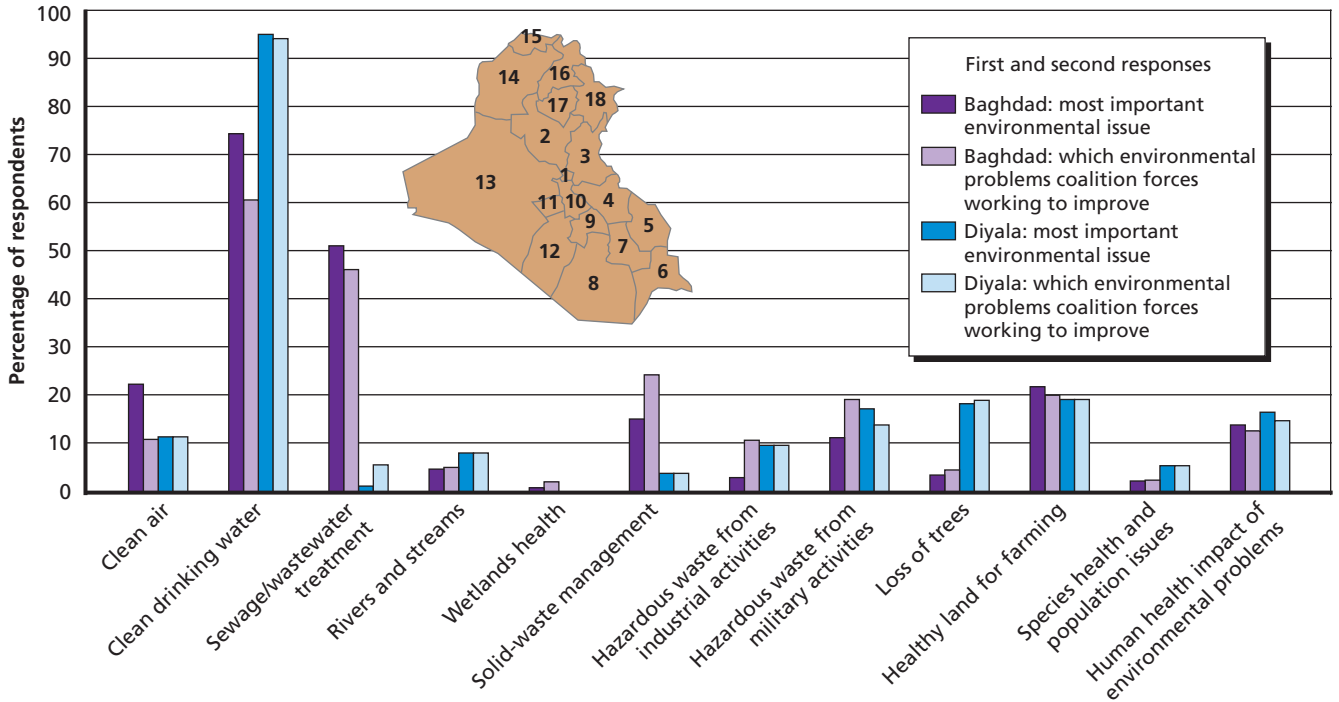

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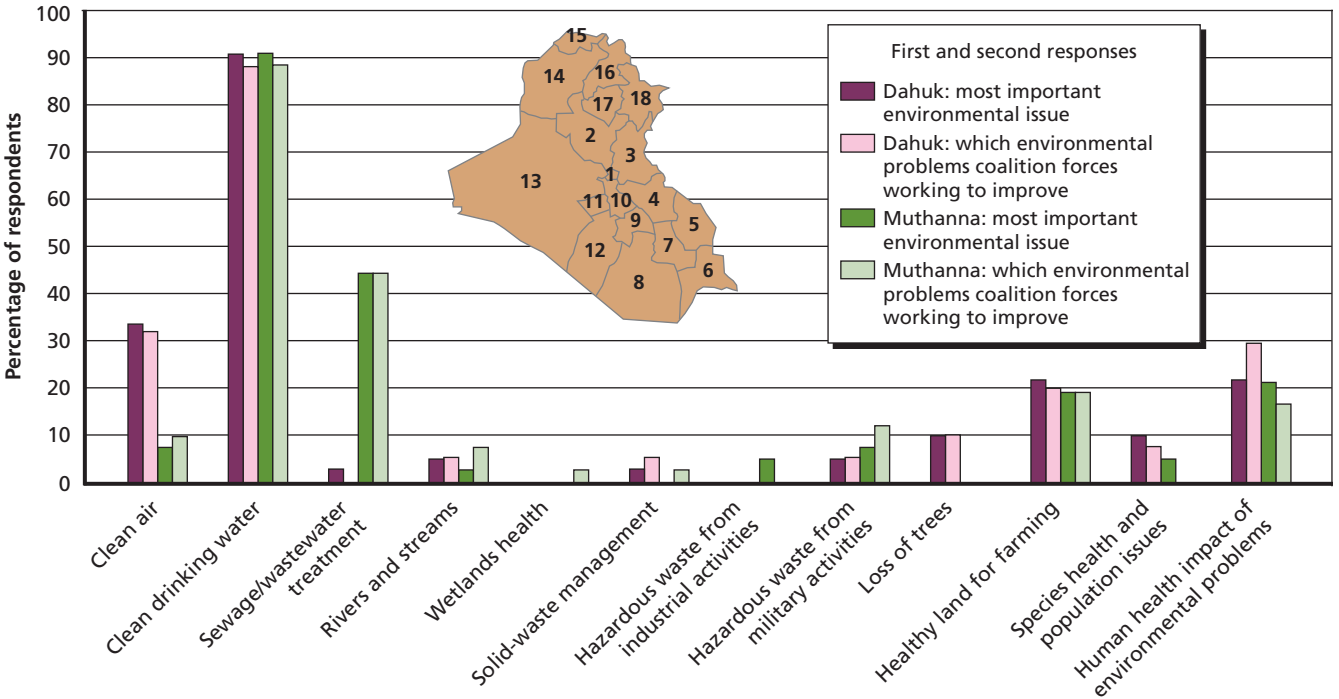
Figure B.10
Comparison of Iraqi Views in Muthanna and Dahuk Provinces (8 and 15)



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and what the coalition forces are working to improve. Baghdad (1 on the map) is the urban country capital, while Diyala (3 on the map) is a rural area to the east of Baghdad where orange-growing and other farming are key concerns. Respondents in both provinces ranked clean drinking water as their highest concern. However, respondents in Baghdad province rated sewage and wastewater treatment issues (which are a problem there) as the second most important issue, while these issues are not very important in Diyala, where respondents are more concerned about the loss of trees and having healthy land.

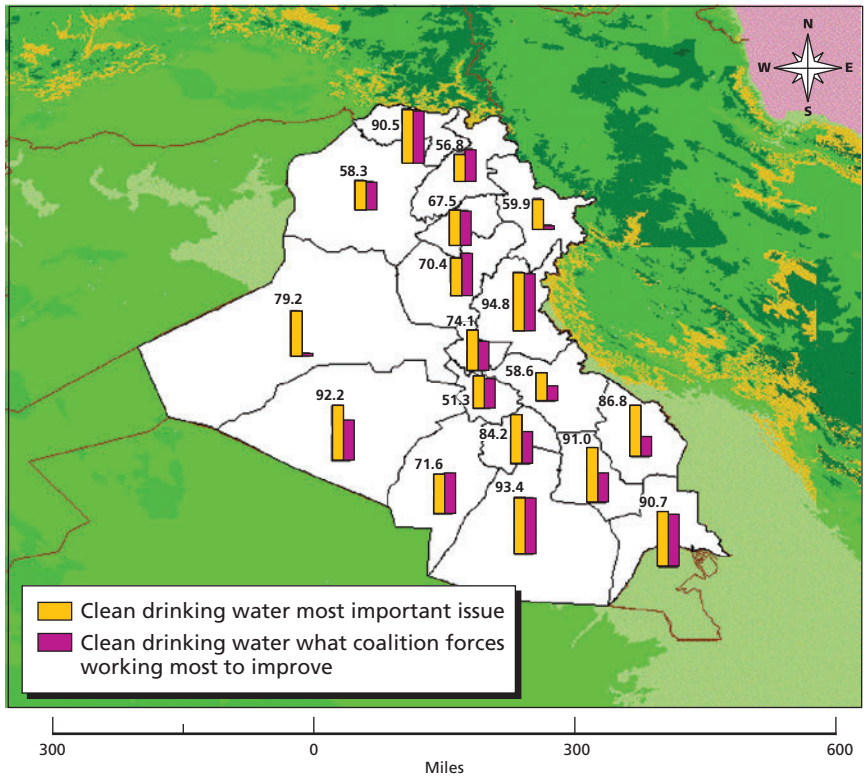
Figure B.10 compares Muthanna and Dahuk provinces' views about the most important environmental issue and what the coalition forces are working to improve. Muthanna (8 on the map) is in the southern part of Iraq, while Dahuk (15 on the map) is in the north. Respondents in both provinces ranked clean drinking water as their highest concern. However, those in Muthanna ranked sewage and wastewater treatment issues as the second most important issue, while those in Dahuk, which has sound wastewater infrastructure but air-quality problems, ranked clean air as the second most important environmental issue.

We also looked at the percentage of respondents who felt clean drinking water was most important and the percentage who felt that the coalition forces were trying to address clean drinking water, by province (see Figure B.11). The left-hand bar in each province shows the percentage of respondents who felt that clean drinking water was the most important issue, and the right-hand bar shows the percentage of respondents who felt that drinking water was what coalition forces were working most to improve.

These province comparisons show some variations by province based on local environmental concerns. However, the overall results are fairly similar to the national averages.

Summary of Environmental Survey Results. Iraqis are very concerned about environmental issues that affect their lives directly. Clean drinking water, sewage/wastewater treatment, and clean air top the list of most-important issues. Solid-waste management, hazardous waste from military activities, and human-health impacts ranked next. Respondents generally felt that coalition forces were working to

Figure B.11
Respondents' Views on the Importance of Clean Drinking Water and Whether Coalition Forces Are Working to Improve the Drinking Water



NOTE: Numbers on the bars are the percent of respondents that cite clean drinking water as the most important environmental issue.

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improve the issues they cared most about. The results are largely consistent across age, gender, and rural/urban locations. However, there are some variations by province and by ethnic/religious group.

APPENDIX C

Case Studies of Operational Experiences

This appendix presents a brief overview of the database of cases in which contingency-operation activities involved some sort of environmental issue. Many of the activities included are normal field activities, because such activities have an effect on or are affected by the environmental conditions and they can be important to overall mission success. Many of these cases also involve environmental health and safety considerations, since they interrelate with the environmental issues. For each case, the summary lists the title, a brief description, and the contingency operation, if known.

The database is not a statistical sample, since we did not randomly select our cases. The goal in creating the database was to collect as wide a range of cases as possible to allow us to analyze the nature of environmental considerations in contingency operations. Initially, we added any case that met our central criterion—i.e., it raised an environmental issue that had either positive or negative environmental aspects, or both.

However, once we found several examples of a certain type, we did not add similar cases to the database unless they were significantly different in some way, such as occurring in a different contingency operation or being handled a different way. We tried to represent the full range of environmental issues that are encountered in contingency operations.

Clearly, the database has some potential biases. As it was being developed, we noticed a large number of the cases involved hazardous waste, hazardous-materials and chemical incidents, human-health

effects, and water concerns. Part of the reason is that these concerns have a more immediate impact on soldiers and on operations, and they are often better documented by Army engineers. Very few of the cases involved natural-resource issues, such as habitat and species concerns. Because these areas were underrepresented, we conducted special literature searches and added interview questions to elicit more natural-resource cases. Nevertheless, our database still has few examples in these areas. Similarly, since the cases found during our preliminary search were almost exclusively incidents where things went wrong or could have gone wrong, we sought out and added cases where U.S. or allied actions had a positive and beneficial effect on the environment, such as environmentally related reconstruction projects. As a result of this effort, almost half of the cases in the database had a positive or beneficial effect on the environment.

The database consists of cases from 1991 to 2006. Some of the case studies may seem dated. However, they have great relevance, since they may easily reoccur if lessons are not learned. Also, we wanted to identify issues that were not unique to one type of contingency operation, so we brought in examples from different contingency operations. The result is that almost 40 percent of the cases are from Iraq, more than 30 percent are from the Balkans, and more than 20 percent are from Afghanistan.[1] The rest are from other contingency operations, such as Haiti and the first Gulf War, or from unknown contingency operations. Most of the cases are Army experiences, but we included a few cases from other Services that provide significant and useful examples. Some cases were joint operations, so it was difficult to distinguish which Service was involved. More than 60 percent of the cases we included in the database occurred during the post-conflict stage of an operation. However, in some cases, it was difficult to determine the stage of the operation during which the case occurred. Finally, the Army is often directly involved in a large number of reconstruction projects that focus on environmental concerns. About 20 percent of our cases were actual reconstruction activities, many of them related to water projects.

[1] These percentages are included to characterize the database, not to suggest that they reflect the relative portion of environmental problems in each of the operations.

Case Number	Case Study Title	Description	Contingency Name/ Location
1	Guard post above cyanide storage	A USMC guard post was on top of a building storing 1 ton of cyanide, which was left over from an old cigar factory. NaCN was stored in metal untapped barrels, raising concerns about container integrity in the humid Haitian environment.	Haiti
2	Lack of contractor oversight results in improper dumping of hazardous wastes	"During operations in support of the war on terrorism, the U.S. hired a local national contractor to haul waste oil from U.S. forces' positions. The contractor dumped the oil in a local landfill and sold the barrels. Lack of direct oversight of the contractor resulted in a claim by the host nation for cleanup compensation of $1.25 million."	Host nation for "war on terrorism"
3	Army engineers develop model to support water management	USACE and the Afghanistan Engineer District teamed up to develop a reservoir simulation model of the Kajaki Reservoir and other projects in nearby valleys.	OEF/ Afghanistan
4	Collaborative effort for UXO cleanup and mine clearing near U.S. troops	The U.S. military coordinated with German engineers to use the new German "Minebreaker" vehicle to more effectively clear landmines and UXO at a base airfield and highway near U.S. Army units. U.S. forces collaborated with the Afghan government in the testing and implementation of the new vehicle.	OEF/ Afghanistan
5	Controlled one-stop waste disposal	In spring 2002, U.S. Army engineers designed and implemented a "one-stop-shopping" waste disposal system at Kandahar International Airport. The facility consisted of recycling areas, hazardous-waste storage cells, a medical-waste incinerator, and a large burn pit with controlled access. Hazardous waste was effectively segregated, contained, and away from troop areas.	OEF/ Afghanistan
6	Drinking-water filtration at base camp	At a base camp, USMC brought a water-filtration system for drinking water, which saves on bottled water. A reverse-osmosis machine takes water pumped from an existing well and filters 12,000 gallons a day of drinking water.	OEF/ Afghanistan

Case Number	Case Study Title	Description	Contingency Name/ Location
7	Dust control in runway repair	Because of initial airport conditions, intensive U.S. military use, and extreme hot and cold weather conditions, Kandahar International Airport requires frequent runway repair. New techniques were developed to patch the runway, and they are now used throughout the area of responsibility and have been incorporated into doctrine for rapid-runway-repair missions. The last step involves dust control to prevent "brownout" conditions that limit visibility. A commercial dust-control agent is spread over the soil patches, which helps prevent dust and increases the durability of the patches.	OEF/ Afghanistan
8	Environmental and safety information board at base camp	An information board at a base camp provides environmental and safety information to newcomers. In simple bullet fashion, the board provides information about fire safety, vehicle safety, UXO, wildlife, and environmental procedures. For example, it says not to harm or kill wildlife and not to dig without a permit.	OEF/ Afghanistan
9	Environmental health-risk communications at base camp	At a U.S. base camp with high levels of legacy pollution, CHPPM implemented risk communication with soldiers, placing educational articles in the base paper and holding Q/A sessions with soldiers.	OEF/ Afghanistan
10	Famous religious site placed off-limits to U.S. troops	The Blue Mosque, the fifth most important religious site in the Moslem world, is located near a U.S. base camp. The building was placed off-limits to U.S. troops by the command.	OEF/ Afghanistan
11	Identified the industrial toxicological and physical hazards throughout a country	U.S. military identified the locations of industrial toxicological and physical hazards throughout Afghanistan to examine troop environmental health concerns.	OEF/ Afghanistan

Case Number	Case Study Title	Description	Contingency Name/ Location
12	Legacy chemical contamination at a base camp threatened soldier health	Severe legacy chemical contamination at a base camp posed a health hazard to troops. In addition, there were no controls over the local landfill. Army engineers constructed a consolidated landfill and provided information to help soldiers avoid potentially contaminated sites.	OEF/ Afghanistan
13	Lithium battery fires	Two lithium battery fires occurred because of improper storage of the batteries as waste.	OEF/ Afghanistan
14	Replacing asbestos roof tiles at a base camp	A 50-pound bag of asbestos was found at a machine shop at a U.S. base camp. Roof tiles on U.S. personnel housing were tested and confirmed to contain 10% friable asbestos. A contractor was replacing these roofs.	OEF/ Afghanistan
15	Solid-waste collection and burning	At a base camp, solid waste (paper, cardboard, plastic, and household wastes) is collected at a temporary site on the base. A local contractor transports the solid waste daily by truck to a burn pit on the base, where it is burned. There is a scrap metal yard on the base.	OEF/ Afghanistan
16	Soldiers attempt improper waste disposal	Soldiers selected a building for occupation and discovered several drums containing unidentified liquids. They buried the drums. A member of higher headquarters noticed these actions. The soldiers had not taken environmental considerations or consequences into account, and it was only matter of time before soil and ground water would be contaminated, because the drums contained hazardous liquids.	OEF/ Afghanistan
17	Soldiers develop respiratory illness after occupying former Soviet structure	A U.S. military unit occupied a former Soviet-hardened aircraft hangar with limited ventilation. The soldiers lived and worked in the structure. Within a few weeks, they developed short-term respiratory illnesses. Space heaters had caused the aircraft oil and other substances embedded in the joints and cracks of the concrete hangar to vaporize and form noxious vapors. Soldiers were subjected to harmful vapors on a daily basis.	OEF/ Afghanistan

Case Number	Case Study Title	Description	Contingency Name/ Location
18	Uncontrolled waste disposal at trash burn pit	By spring 2002, Kandahar International Airport had human-health and environmental threats from huge amounts of waste, both from U.S. troops and from destroyed equipment, trash, and hazardous waste left by the Taliban. At first, the disposal area was just a shallow trash burn pit.	OEF/ Afghanistan
19	U.S. forces occupy former Soviet base with leaking electrical transformers	U.S. and coalition forces occupied a former Soviet base, where they discovered a stockpile of leaking transformers. The commander's risk assessment determined that the transformers were a PCB risk. As a risk-mitigation procedure, the site was marked as a hazardous area and recorded in the EBS. Soldiers then could avoid the contaminated area. "The commander protected his soldiers from an environmental hazard and helped safeguard their health, well-being, and the mission by taking the necessary precautions."	OEF/ Afghanistan
20	U.S. soldiers living with asbestos	At a base camp, U.S. soldiers were living and sweeping the floors in an area with friable asbestos sources.	OEF/ Afghanistan
21	Well repair for base camp	Bottled water is being imported for drinking purposes. U.S. personnel repaired a well at a base camp. UK personnel also repaired a well at the same base. Water is used for shower and washing. Well water is chlorinated prior to use and tested once a month by preventive medical personnel.	OEF/ Afghanistan
22	Encroachment on wildlife in host nation	At a temporary base camp in a host nation, U.S. troops were encroaching on desert foxes, lizards, and other wildlife through their construction and training activities and sewage pollution. The effects on the habitat had an impact on some of the local wildlife.	OEF/host nation
23	Extensive environmental sampling at base camp	Because of high environmental health risks at a very polluted base camp, the U.S. military collected and analyzed more than 200 air, water, and soil samples. They also conducted asbestos and radiation sampling and a health risk assessment.	OEF/host nation

Case Number	Case Study Title	Description	Contingency Name/ Location
24	Hazardous waste stored in open area at base camp	At a base camp, U.S. hazardous waste was collected and stored in an open area with no secondary containment or segregation of items. The area needs to be fenced in, marked, and have proper signs posted, and secondary containment must be constructed for liquid items.	OEF/host nation
25	Improper solid-waste disposal at base camp	Solid waste was collected and consolidated at a base camp 1/2 mile from a U.S. area. Host nation workers are supposed to sort out reusable items and then manage the rest, but they did not burn the waste. Accumulating waste was a potential haven for rats and mice and increased the risk of disease exposure for U.S. forces. The site was unfenced and trash was starting to blow into surrounding vegetation. Solid waste should be removed from the base or properly burned to prevent disease vectors.	OEF/host nation
26	Shooting host-nation wildlife	Hyenas and jackals were seen at a U.S. base camp in a host nation. The host-nation commander requested that U.S. soldiers kill them to ensure that they not wander on the runway. Initially, the troops shot them. The Army environmental engineer did not know if they were threatened or endangered species, so he recommended U.S. forces leave wildlife alone unless they posed an immediate threat to troops.	OEF/host nation
27	Siting of U.S. airfield operations over leaking-fuel-tank site	U.S. forces located an airfield at a site with serious old leaking-fuel-tank problems that emerge when it rains. They had to place a clay cap over the area so that fumes would not affect the soldiers. This delayed construction of the base camp by several days. Major health issues arise whenever it is necessary to dig.	OEF/host nation
28	Buildup of medical waste	A host nation has stopped accepting U.S. medical waste and will not allow the base camp to incinerate it. The waste is being stored in "cool" containers until the issue can be resolved. The U.S. is trying to design an incineration system that is acceptable to the host nation and will not affect troop health.	OEF and OIF/ host nation

Case Number	Case Study Title	Description	Contingency Name/ Location
29	Transient units dumping trash at base camp	At a host-nation base camp, many units are transient troops passing through. Transient units consistently drop and dump hazardous and non-hazardous wastes as they move through the base camp. They dump wastes on-base, off-base, and at an old dump that the host nation had closed.	OEF and OIF/ host nation
30	U.S. tankers losing fluid between base camps	Tankers are supposed to be cleaned before they leave a host nation. Water and cleaner are added to the tanker to clean out fuel/oil residue. This mixture is called *purge fluids*, and it can be disposed of only at a larger base camp. On the way from the smaller base camp to the larger, some U.S. tankers "lose" these purge fluids by dumping the fluid off-base and claiming they had a leaky valve to save travel time.	OEF and OIF/ host nation
31	Improper food and water storage at base camp	Bulk food and water supplies were being stored outside and were exposed to excessive dust and potentially to insects and other vectors.	OIF/host nation
32	Improper procedures in hazardous-waste and HAZMAT storage at base camp	Many drums of HAZMAT were stored in direct sunlight and not properly secured. The hazardous-waste storage facility is located in direct sunlight with temperatures well over 100 degrees Fahrenheit. Elevated temperatures could result in volatilization, which significantly increases the probability of drum rupture, explosion, or fire.	OIF/host nation
33	Inadequate solid-waste incineration at base camp	The solid-waste incineration complex at a base camp is not adequate to dispose of the solid waste at the current waste-production rate. Solid waste remains at the end of the day without the proper facilities to conceal it from small animals, birds, and other vectors in the area.	OIF/host nation

Case Number	Case Study Title	Description	Contingency Name/ Location
34	Industrial pollution health risk for U.S. troops at host-nation port	A deep-water port located in a host nation needed to offload equipment from vessels that require deeper water. The area has known health threats from serious regional industrial air pollution from a local cement factory, oil refineries, a fertilizer plant, and other factories. CHPPM monitors the air and assesses health risks, especially from high levels of PM10 (particulate matter). The U.S. military has implemented procedures to minimize risk, including graveling the life-support area to help suppress dust, minimizing outdoor activity, and minimizing the time troops spend at the port.	OIF/host nation
35	Insufficient mosquito control at base camp	The equipment needed to properly control mosquitoes was not available at a base camp. Potential mosquito breeding sites are present throughout the camp.	OIF/host nation
36	U.S. Army colonel agrees to clean up host-nation landfill	U.S. troops were dumping trash in a host-nation landfill because U.S. airfield operations were being conducted nearby. An Army colonel agreed to clean up the landfill. However, the agreement implied that cleanup should be to U.S. standards, which would cost millions. Environmental staff would have made a more appropriate agreement. The U.S. Army negotiated a settlement with the host nation.	OIF/host nation
37	An incident of cutting down date palms because of snipers	U.S. troops cut down date palms along a major road to halt snipers attacking U.S. troop movements. Century-old trees are important local economic and cultural resources. U.S. troops could have easily been rerouted a few blocks away and would not have had to cut the trees.	OIF/Iraq
38	Army engineers develop model to support water management and to help restore wetlands	By 1999, the Mesopotamian Marshlands were reduced to 7% of their original state. USAID, the Iraqi Ministry of Water Resources, and USACE are developing a water-management model that will aid efforts to reconstruct Iraq's historic water flow and help restore the wetlands. USACE developed a reservoir system simulation model for use in both day-to-day operational decisions and long-term water resource-management studies. The model will help manage the country's system of dams and canals.	OIF/Iraq

Case Number	Case Study Title	Description	Contingency Name/ Location
39	Build new city landfill	A city in Iraq needed a landfill to address its trash problem. The 1st Cavalry Division built a landfill to help the local people. Local workers performed most of the work. The project employed unskilled workers and addressed a core environmental problem in an area where insurgency recruitment was high.	OIF/Iraq
40	Clean and repair sewer lines	City streets were coated with several inches of raw sewage. The 1st Cavalry Division cleaned and repaired sewer lines to help the local people. Local workers performed most of the work. The project employed unskilled workers and addressed a core environmental problem in an area where insurgency recruitment was high.	OIF/Iraq
41	Cluster-bomb clearance	U.S. Army engineers and EOD teams removed 150 cluster-bomb munitions from road craters in a highway to enhance the safety of the local population, and 51 cluster bombs from a local community, enabling the people there to use the land for farming again.	OIF/Iraq
42	Constructed landfill for local community	The 14th Engineer Battalion constructed a city landfill to prevent random dumping of trash in a nearby local community.	OIF/Iraq
43	Culvert built, along with highway repair	While repairing a highway, the 14th Engineer Battalion replaced culverts to restore water flow beneath the route. The culverts help to manage and direct storm-water runoff.	OIF/Iraq
44	Endangered species re-located from base camp	An endangered ibex was roaming around in the Baghdad Airport base-camp area. It was caught by Army environmental personnel and transported to a safe location (either a zoo or the countryside).	OIF/Iraq
45	Engineers fixing water infrastructure at school	Army engineers of the 168th Engineers fixed small problems at local schools, repairing plumbing and electrical systems, to help win hearts and minds.	OIF/Iraq

Case Number	Case Study Title	Description	Contingency Name/ Location
46	Field-expedient satellite accumulation points pose environmental and safety risks	Because of the hostile environment, commanders set up their own hazardous-waste accumulation points inside their base camps instead of using the accumulation and feeder sites established by the Defense Reutilization Marketing Services Forward Support Team, Europe. The new accumulation points have proper storage procedures. The field-expedient satellite accumulation points did not have sufficient environmental procedures, causing health and safety risks. The sites were situated too close to camp perimeters, creating a force-protection issue, since they were potential targets for hand grenades and IEDs.	OIF/Iraq
47	Fixing water treatment plant for local and base populations	Task Force Neighborhood, developed by V Corps, consisted of coalition forces going into neighborhoods and assisting hired Iraqis with projects. The task force hired locals to fix the water pumps and the generator at a water-treatment plant supplying water to northern Tikrit and an airfield that houses thousands of infantry soldiers. Army engineers negotiated for plant parts in the process.	OIF/Iraq
48	Fuel spill in lake	High-grade diesel fuel (JP-8) was spilled in a lake that was used for cleaning and drinking water at a base. The spill was reported, and the Army stopped using the lake water.	OIF/Iraq
49	Hardpan soil disturbance creates safety and health issues for soldiers	U.S. units using heavy construction equipment leveled large desert tracts to construct troop beddown facilities and motor parks. These actions removed the "top layer of hardpan soil that acts as a crust and minimizes sand movement. Consequently, the movement of construction and military vehicles created large volumes of airborne sand and dust particles." This created "limited visibility, soldier breathing problems, and vehicle maintenance issues." It could have been avoided if proper environmental assessment and procedures had been used in base-camp design.	OIF/Iraq

Case Number	Case Study Title	Description	Contingency Name/ Location
50	Improper disposal of hazardous waste at non-forward base camp	U.S. forces at a non-forward base camp failed to properly dispose of their hazardous wastes. Insecticides, used vehicle batteries, POL, and other hazardous wastes were dumped in the same area. Also, fuel and gray-water trucks leaked their contents into the dump. "The unit did not implement spill containment or clean-up procedures to prevent the hazardous fluids from potentially entering the water table. Soldiers jokingly referred to fuel spills as 'replenishing the oil wells.'"	OIF/Iraq
51	Improper movement of industrial waste in building	Troops were clearing out a building that contained industrial-grade pesticides. They did not know what was in some drums, and they started rolling drums that had openings on the side that were not secure. The pesticide spilled, and the fumes made some of the soldiers sick. They should have contacted the environmental officer before acting.	OIF/Iraq
52	Innovative use of on-site sludge treatment	At one base camp, Army engineers created a dry bed for sewage waste. In this innovative application of an existing technology, the sludge was tilled in with the soil to dry out and was then re-tilled so that it was properly returned to the soil. This avoided having to dispose of the sludge.	OIF/Iraq
53	Instituting garbage-collection service for city neighborhoods	An Iraqi city had a problem with trash in its streets. The 1st Cavalry Division placed trash receptacles in streets to help the local people and set up garbage pick-up service. Local workers performed most of the work. The project employs unskilled workers and addresses a core environmental problem in an area where insurgency recruitment was high.	OIF/Iraq
54	Iraq bird blog	An Army National Guardsman stationed in Iraq created an online journal documenting his bird-watching in the war zone. He has also added information about other species sightings in Iraq and sightings by other military personnel there.	OIF/Iraq
55	Iraq monument avoided in coalition-forces attacks	Saddam Hussein's army parked its armor beside the great arch at Ctesiphon, a fragile archeological monument. U.S. troops avoided harming the monument.	OIF/Iraq

Case Number	Case Study Title	Description	Contingency Name/ Location
56	Lack of contractor oversight results in improper dumping of antifreeze wastes	A U.S. contractor in a host nation dumped U.S. antifreeze and sold the drums. This caused a diplomatic issue with the host nation that is still being negotiated. Better contract setup and oversight would have avoided this problem.	OIF/Iraq
57	Local contractor improperly disposing of dining-hall wastes	A local contractor was to build a landfill and then remove dining-hall wastes to it. Instead, his workers dumped the wastes at the back of the base camp. The U.S. was tipped off and followed the contractor, catching his men improperly disposing of wastes.	OIF/Iraq
58	Looting of Babylon museums	During OIF, U.S. troops did not protect the small museums leading to the ancient city of Babylon, and they were stripped to the walls. The U.S. was criticized in the world press for not protecting them.	OIF/Iraq
59	Looting of Iraq Museum	The world-renowned Iraq Museum was looted in Baghdad during OIF. The U.S. Army was criticized for not protecting it. There was a worldwide public outcry and a wave of anti-American anger in Baghdad. Some of the thefts were part of an Iraqi inside job. Much of the treasure was recovered, but not all.	OIF/Iraq
60	Moving of wastes for base-camp building	Before an EBS was conducted, Army troops moved petroleum and solid waste safely from buildings to a cordoned-off area when setting up a base camp. Also, they found a building housing containers that were not intact and chose another building for occupation.	OIF/Iraq
61	Negotiated with government about storage of legacy hazardous wastes	Army engineers were working with the Coalition Provisional Authority and the Iraqi Ministries of Oil, Science, and Environment to figure out where to transport and store a large amount of legacy hazardous wastes found at a base camp. The negotiators could not reach agreement as to where to dispose of them, so they were stored at an isolated location on the base camp.	OIF/Iraq

Case Number	Case Study Title	Description	Contingency Name/ Location
62	Secured dam during conflict	U.S. troops secured a dam during the conflict in Iraq. It was a strategic operation to prevent the enemy from blowing it up and causing flooding.	OIF/Iraq
63	Secured oil wells during conflict	U.S. troops secured oil wells during the conflict in Iraq to prevent the enemy from blowing them up and causing economic disruption and environmental problems like those that occurred in Kuwait during the Gulf War.	OIF/Iraq
64	Soldiers planted gardens at base camps	When Army soldiers went on leave to the U.S., some brought back seeds and planted flower and vegetable gardens at the base camps. This was good for U.S. morale, but it could potentially cause an invasive-species problem in Iraq.	OIF/Iraq
65	Surveyors work around UXO	Once stability operations began in Iraq, Army surveyors conducted geodetic safety surveys of major airfields for V Corps and coalition forces. One airfield was littered with UXO. Surveyors had to coordinate with other engineer forces to obtain UXO information and work around the UXO.	OIF/Iraq
66	Trying to recycle U.S. military oil wastes	Army engineers were working with the Iraqi Ministry of Oil to try to recycle U.S. military oil wastes. The plan was to transport the wastes from various base camps to Iraqi refineries. Agreements were put in place, but there were problems with the logistics related to transporting the waste. The Defense Reutilization and Marketing Service (DMRS) took over this process, but it was unclear if DMRS was able to get it to work given insurgency problems related to transportation.	OIF/Iraq

Case Number	Case Study Title	Description	Contingency Name/ Location
67	Unreported fuel spill affects base-camp expansion	A 300-gallon fuel tanker overturned at a U.S. base camp. The spill was not officially reported, and the site was not properly marked. Base planners planned to construct sleeping areas at the site. As the first tents went up, base-camp officials learned of the spill, leaving the camp planners with two options: remediate the site or re-site the troop sleeping areas. Either option would cost the unit additional time and resources. During the time of inaction, the size of the plume increased and required a more costly remediation effort.	OIF/Iraq
68	U.S. Army helps reopen Natural History Museum	The 16th Engineer Battalion was in charge of a project to help restore and reopen the Iraq Museum of Natural History, which had been badly damaged by looters during the war. The U.S. Army helped supervise Iraqi contractors and provided funding for this and two other projects (building a new Internet cafe and refurbishing a child-care center).	OIF/Iraq
69	U.S. forces digging a well	The U.S. military used equipment to dig a well as part of a civil reconstruction project.	OIF/Iraq
70	U.S. soldiers take souvenir bricks out of temple	U.S. soldiers started taking bricks out of an Iraqi temple for souvenirs. The U.S. placed guards because of its own troops' actions. The U.S. then hired a former curator to give tours so U.S. soldiers could see the temple and be educated about its cultural value. Cultural resources are a diplomatic issue with local people.	OIF/Iraq
71	Vehicle cleaning before returning to the U.S.	All military vehicles (tanks, trucks, etc.) are thoroughly washed on wash racks before being shipped home. Because of agricultural invasive-species concerns, U.S. customs strictly enforces this requirement even when there are long lines of vehicles waiting to be treated.	OIF/Iraq
72	Water-infrastructure assessment	The 14th Engineer Battalion conducted infrastructure assessments to evaluate the condition of water and other infrastructure (power, oil/gas, etc.). Red, amber, and green ratings were used to prioritize future reconstruction work with the help of local laborers.	OIF/Iraq

Case Number	Case Study Title	Description	Contingency Name/ Location
73	Water-infrastructure assistance to fix town drinking-water-quality problem	The 14th Engineer Battalion conducted an infrastructure assessment to evaluate the condition of water infrastructure in a local town. Because of poor water quality, most of the people in the town were suffering from dysentery. The water system consisted of multiple pumps to pump water from the Tigris River to the town. Only one pump was working, and the filtering system was not working. The Army hired and supervised local plumbers to fix the water pumps and filtering system to supply clean water to the town.	OIF/Iraq
74	Assessing local water, wastewater, and solid-waste systems	Civil-affairs personnel of the U.S. Army Reserve in a civil-military task force were helping rebuild the country. The Army environmental sanitation team helped assess water, wastewater, and solid-waste systems in 14 municipalities to collect data for the Ministry of Agriculture, Water Management and Forestry. They developed and administered questionnaires and met with the public-works director to verify answers.	OJE
75	Contractor builds field-expedient structures for hazardous-waste storage	A USACE contractor designed and built field-expedient structures that met the Army's need for low-cost, effective, and legally compliant systems. Many of these systems exceeded country and host-nation standards. They were implemented at numerous base camps.	OJE
76	De-mining for railroad building	In a multinational military-cooperation project, German, Italian, Hungarian, Romanian, and U.S. engineering units worked together on an east-west railroad line. "Extensive de-mining" was performed as part of this reconstruction project. The International Management Group (IMG), the World Bank, and USAID were key players, focusing money and resources on the project.	OJE

Case Number	Case Study Title	Description	Contingency Name/ Location
77	Designing constructed wetlands for town wastewater treatment	Civil-affairs personnel of the U.S. Army Reserve in a civil-military task force were helping rebuild the country. The Army environmental sanitation team assessed a town's water system because of hepatitis and coliform contamination problems. They decided that using a simple clarifier and constructed wetlands was the most feasible solution. They designed the system and helped the town's public-works department request funds. The system would have easy maintenance, which "is critical—especially in Bosnia, where much of the fractured infrastructure is the result of neglect, not of the war."	OJE
78	Emergency movement of base camp because of caustic pollution from nearby factories	A base camp was initially located between caustic soda and cement plants, which emitted air pollution. When an inversion layer occurred, the pollution turned into caustic ash that peeled paint off vehicles and sent some troops to the clinic. There was an emergency action to relocate the base camp.	OJE
79	Environmental training of squadron soldiers	An enthusiastic Army engineer who organized the environmental-management program at a base camp also set up an environmental training program. Squadron soldiers were trained in such topics as spill response and proper waste-handling. The engineer used borrowed videotapes, 35mm slides, and training aids that he created himself. He also developed a booklet that includes maps, lists, and information that soldiers needed to ensure that they left the land in the same condition in which they found it.	OJE
80	Fuel "blivets" leaked into the groundwater	Fuel from fuel "blivets" (nine-bay fuel storage sites) leaked into the groundwater. No secondary containment liner was provided for the site. It was estimated that up to 6,000 gallons were spilled. Local authorities were concerned because the spill site is located about 400 meters up-gradient from a river. A cost-effective remedial approach was proposed.	OJE

Case Number	Case Study Title	Description	Contingency Name/ Location
81	Fuel spill near base-camp well	A fuel spill occurred at a base camp near a well that supplies water to the camp. The spill originated at the site of a former-installation generator and an adjacent fuel storage area consisting of 20,000-gallon bladders within an earthen berm operated by the U.S. Army. The U.S. Army is performing site-characterization studies. The site is operated by the UN, but it was unclear whether the UN would pay remediation costs.	OJE
82	Improperly transporting hazardous wastes	Arriving military-owned demountable containers and container expresses leaked at an intermediate stage base. Some hazardous wastes were improperly transported from Bosnia through Hungary for turn-in in Germany. One shipment contained undrained batteries, which was against OPLAN procedures.	OJE
83	Inadequate secondary containment for potential POL spill	A base camp had utilized berms around and liners under its POL bladders, which would normally prevent spills from entering the soil or groundwater. However, they had lowered a side berm to allow storm water to escape and had not rebuilt the sandbag sidewall to the berm.	OJE
84	Insufficient remediation of maneuver damage at base closure	"Often base camp leaders were unaware of solutions for maneuver damage, such as dismantling hesco bastions (prefabricated metal/cardboard shells filled with soil), disposing of gravel, and clearing firing ranges and burn pits." Environmental personnel should visit a camp six weeks before closure and recommend remediation procedures.	OJE
85	Lack of spill materials	Spill-remediation materials were often afterthoughts and were the last item to be shipped in. Units eventually rushed to order them, but delivery required weeks to months. USACE used a Rapid Response Contract to purchase additional absorbent materials, which were distributed to all base camps. USACE also found some misplaced supplies in-theater.	OJE

Case Number	Case Study Title	Description	Contingency Name/ Location
86	Leaking fuel "blivet" system at base camp	A bladder farm at a base camp experienced several spills of JP-8 fuel. Several thousand gallons were estimated to have spilled during the early part of 1996, causing direct leakage of JP-8 into a small stream and an adjacent wetland. A contractor installed some booms, absorbent pads, checkdams, etc., but their level of mitigation was deemed inadequate. Contamination migrated downstream.	OJE
87	Local contractor drills well for base camp	Army engineers hired a local contractor to drill a well for a base camp because the existing well could not produce enough water for the camp. Because of other jobs and the fact that the contractor's older equipment required frequent maintenance, the job took 2-1/2 months instead of the expected 7 days. Army engineers were concerned that it took so long; however, the work was satisfactory and a viable well was dug without mishap. This shows how local knowledge can be important, but local work schedules and technology standards are different from those in the U.S.	OJE
88	Minimal solution for town sewage problem	Civil-affairs personnel of the U.S. Army Reserve in a civil-military task force were helping rebuild the country. The Army environmental sanitation team helped a mountain town that had sewage running in the streets address this problem. Given the town's circumstances (e.g., it had an inexperienced public-works staff), U.S. Army recommendations were to build ditches to control the sewage and obtain a pump truck to maintain the many cesspools in the area. Army engineers would have liked to do more.	OJE
89	POL spill near hospital	At a base camp near a UN hospital site, U.S. troops reportedly spilled 10 to 15 gallons of POL, while nearby, the Czech Republic spilled a much larger amount. The spill originated from generators and POL storage for them. The U.S. site was covered with plastic to keep rainwater from percolating into the soil and to promote bioremediation. The U.S. Army performed site characterization studies for the spill.	OJE

Case Number	Case Study Title	Description	Contingency Name/ Location
90	Political difficulties in hazardous-waste transportation	Normally, hazardous wastes are transported from a central point to remediation sites. Croatian officials refused permits to DRMS's contractor to transport wastes from Croatia to Germany, which bottled up the disposal system. Implementation-force vehicles therefore had to transport the hazardous wastes. The problem was elevated to the highest level of the command structure, but no satisfactory solution was reached.	OJE
91	Repaired city main water supply	Civil-affairs personnel of the U.S. Army Reserve in a civil-military task force were helping rebuild the country. The Army environmental sanitation team helped repair one of a city's main water supply lines. Army members on this team designed the repair, supervised local workers, and helped provide security. The International Committee of the Red Cross financed the repairs. The UN helped de-mine the area. The International Police Task Force escorted workers to the site through hostile territory.	OJE
92	UN hazardous wastes left at U.S. base camp	Several base camps contained large quantities of used POL products left by previous UN agencies and country tenants. The U.S. left the hazardous wastes in segregated areas in motor pools and away from U.S. forces. The U.S. does not clean up other organizations' waste unless it poses an immediate threat to U.S. soldiers' health.	OJE
93	Using fuel to burn an area to expose land mines	A U.S. contractor deliberately poured an estimated 1,700 gallons of JP-4 onto a sample area of grassy soil in an effort to burn away the top cover in hopes of exposing land mines. None were found, but the JP-4 created high levels of POL content in the soil. U.S. Army environmental staff displeased with the test burn made the contractor till the soil to help accelerate the volatilization and biodegradation of the residual POL.	OJE

Case Number	Case Study Title	Description	Contingency Name/ Location
94	Wash-rack discharge into streams	Because of expediency and a lack of real estate, wash racks were built near creeks, into which some discharge ran directly. Environmental damage included vehicle runoff sludge, including heavy metals (cadmium). Environmental controls could have been implemented to prevent the runoff contamination.	OJE
95	Well replaces bottled water for U.S. troops	A well was developed so U.S. troops would no longer need to use 12,000 bottles of water per day. The bottles constituted 24% of the solid-waste problem at the base.	OJE
96	Contractor builds field-expedient structures for hazardous-waste storage in host nation	A USACE contractor designed and built field-expedient structures that met the Army's need for low-cost, effective, and legally compliant systems. Many of these systems exceeded the host-nation standards. A host-nation base camp had 29 of these structures placed at locations where troop units performed routine maintenance.	OJE/host nation
97	Environmental operative committee formed with host nation	The U.S. Army and USACE developed a working relationship with the host-nation regulatory authorities. An Environmental Operative Committee was established to discuss environmentally related issues and upcoming activities that could have environmental impacts and to monitor environmental protection activities and work out solutions acceptable to all. The committee met quarterly.	OJE/host nation
98	Field wash-water recirculation system	U.S. vehicles had to be washed before being transported into Bosnia or returned to Germany. The host nation, Hungary, required containment of the wash water. U.S. forces built a wash-water recirculation system consisting of two settling basins operating in series. The U.S. also followed proper sludge-disposal methods and monitoring of the system as required by the host nation.	OJE/host nation

Case Number	Case Study Title	Description	Contingency Name/ Location
99	Hazardous-waste management plan in host nation with limited infrastructure	A hazardous-waste management plan was developed for use within the host nation that met host-nation regulations and was reviewed by local regulatory authorities. The plan included all aspects of accumulation, segregation, storage, transportation, and disposal of hazardous wastes generated by the mission. The host nation had limited, developing infrastructure to support the system, which made plan development a challenge.	OJE/host nation
100	Rapid response and fuel cleanup in host nation	A U.S. Army vehicle carrying two 500-gallon portable tanks overturned outside the gates of a base camp on a host-nation highway. Less than 100 gallons spilled, but the spill site was near a storm-water drainage ditch with direct access to surface waters. The contractor was on-site within 1 hour and work was completed within 4 hours. Follow-up activities continued with floating oil-containment booms. To convince local officials that no residual contamination existed, the contractor conducted a spill-site survey and presented it to the host nation officials, who said there was no environmental damage.	OJE/host nation
101	Land farming on petroleum-contaminated soil	A pilot project was implemented to compost petroleum-contaminated soil with sewage-treatment sludge so that there would be no hazardous-waste disposal problem	OJE/Bosnia
102	Construction of wastewater treatment facilities at two base camps	Because of legacy conditions in the country, wastewater treatment plants posed a threat to soldier health. The U.S. built two batch-reactor-activated sludge facilities that were not up to U.S. standards but, given country conditions, were sufficient. In fact, at the time, they were the only two fully functional wastewater treatment facilities in the country. At one plant, a locally hired contractor lacked sufficient knowledge and dumped food waste into the plant, which delayed plant start-up.	OJE-Task Force Eagle/ Bosnia
103	Oil-well fires	Iraqis set more than 500 oil wells on fire in Kuwait as they retreated from the country, causing significant air-pollution and health risks to the local populations and troops.	Operation Desert Storm

Case Number	Case Study Title	Description	Contingency Name/ Location
104	Facultative lagoon constructed for wastewater treatment	The areas around a base camp lacked wastewater treatment. A facultative lagoon was constructed for the purpose.	Operation Nobel Anvil
105	Occupational and environmental health assessment prior to deployment	CHPPM conducted an occupational and environmental health assessment prior to deployment within a small humanitarian-assistance contingency operation in Africa. It assessed the environmental risks of placing U.S. troops in the region from such factors as infectious diseases and industrial pollution.	Small contingency operation/ Africa
106	Secondary containment at refueling facilities in host nation	To prevent pollution, U.S. Army engineers constructed secondary containment refueling facilities at a base camp in a host nation. The decision was made to procure permanent hazardous-waste storage facilities, since the planning period for the base was 3 to 5 years.	Task Force Falcon/host nation
107	EBS identified powdered chlorine, which was removed	An EBS completed within the first 30 days of a mission found powdered chlorine improperly stored in one building. Host-nation soldiers removed the stored hazardous materials.	Task Force Hawk/host nation
108	Raw wastewater discharge into local river because of lack of wastewater infrastructure	A base camp in a host nation had no operational wastewater treatment facility. Given various options, health risks, and host-nation practices, and after discussion with host-nation officials, the solution chosen was to discharge raw wastewater into the nearby river. The host nation issued a permit for the discharge. Open discharge of untreated waste into an already heavily contaminated river "caused significant concern on the part of U.S. soldiers," who believed this violated U.S. "environmental ethics." They expressed concern to the chain of command. As part of a real-estate agreement with the host nation for the camp, the U.S. would clean up any environmental contamination at closure.	Task Force Hawk/host nation

Case Number	Case Study Title	Description	Contingency Name/ Location
109	Non-native insects returning to U.S. base in crates	At a U.S. installation, U.S. troops noticed spiders and other creatures coming out of crates returning from theater. They called an exterminator to address the problem. One incident report was filed, but base environmental staff were concerned that similar incidents may have gone undetected in other cases.	U.S. from OEF or OIF
110	Provided training to ARNG rear detachment and hired contractors to deal with hazardous wastes at base	At a U.S. base, National Guard backfill troops did not have environmental training. The installation environmental manager hired trainers to train them and contractors to handle base hazardous-waste issues that an Army unit normally handles.	U.S. from OEF or OIF
111	Rear-detachment personnel unprepared to comply with U.S. environmental requirements	Many deploying units fail to realize the importance of maintaining environmentally trained personnel as part of their rear detachment. The CONUS rear detachment is responsible for the continued maintenance of existing facilities and hazardous-materials storage areas and for complying with U.S. installation and state environmental requirements. Failure to maintain this capability increases environmental and safety risks and decreases the ability to meet U.S. environmental requirements.	U.S. from OEF or OIF

Glossary of Selected Environmental Terms

biodiversity. In its simplest form, biodiversity can be defined as biological variety. It refers to the number and diversity of species, the genetic material of those species, and the natural communities, ecosystems, and landscapes in which those species live.[1]

black water. Water that has been mixed with waste from the toilet.

cultural resources. Areas, places, buildings, structures, outdoor works of art, natural features, and other objects having a special historical, cultural, archaeological, architectural, community, or aesthetic value.

ecosystem. A group of various species of plants, animals, and microbes interacting with each other and their environment, which includes precipitation, temperature, amount of moisture, and other chemical and physical factors to which organisms are exposed.[2]

environment. The sum of all external conditions affecting the life, development and survival of an organism.[3]

environmental considerations. The spectrum of environmental media, resources, or programs that may impact on, or are affected by, the planning and execution of military operations. Factors may include, but are not limited to, environmental compliance,

[1] Stein, Kutner, and Adams, 2000, pp. 7–8.

[2] Nebel and Wright, 1993.

[3] U.S. EPA (http://www.epa.gov/OCEPAterms/eterms.html).

pollution prevention, conservation, protection of historical and cultural sites, and protection of flora and fauna.[4]

environmental issues. Issues that relate to the environment, such as air quality, water quality and supply, hazardous materials, solid and hazardous wastes, chemical and toxic substances, noise pollution, and land and natural-resource concerns (species, ecosystems, habitats, soil quality, arable land, wetlands, watersheds, etc.); also management of environmental infrastructures, such as wastewater treatment plants and landfills. The Army considers cultural resources to be an environmental issue, even though they are not included in the traditional definition of environmental issues.

environmental media. Term for different environmental categories, and includes water, air, soil, and biota (plants and animals), hazardous materials, solid and hazardous wastes, etc.

gray water. Wastewater from non-toilet plumbing fixtures such as showers, basins, and taps.

habitat. The place where a population (e.g., human, animal, plant, microorganism) lives and its surroundings, both living and non-living.[5]

hazardous material. Any item or agent (biological, chemical, physical) that has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors.[6]

hazardous waste. By-products of society that can pose a substantial or potential hazard to human health or the environment when improperly managed. Hazardous waste possesses at least one of four characteristics—ignitability, corrosivity, reactivity, or toxicity—or appears on special EPA lists.[7]

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[4] Joint Publication 1-02, 2006.

[5] U.S. EPA (http://www.epa.gov/OCEPAterms/hterms.html).

[6] Institute of Hazardous Materials Management (http://www.ihmm.org/dspWhatIsHazMat.cfm).

[7] U.S. EPA (http://www.epa.gov/OCEPAterms/hterms.html).

invasive species. A species that is non-native (or alien) to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health.[8]

legacy environmental conditions. Environmental conditions that exist in a country before U.S. forces arrive.

pollution prevention. Any practice that reduces the amount of hazardous substance, pollutant, or contaminant (including fugitive emissions) entering any waste stream or otherwise released into the environment prior to recycling, treatment, or disposal; any practice that reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants.[9]

stakeholder. Any organization, governmental entity, or individual that has a stake in, interest in, or may be affected by a given activity or action.

sustainable army. An army that simultaneously meets current as well as future mission requirements worldwide, safeguards human health, improves quality of life, and enhances the natural environment.[10]

watershed. A geographic area in which all sources of water, including lakes, rivers, estuaries, wetlands, and streams, as well as ground water, drain to a common surface water body.[11]

wetlands. Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.[12]

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[8] Executive Order 13112.

[9] Pollution Prevention Act of 1990 (http://www.epa.gov/p2/pubs/p2policy/definitions.htm).

[10] U.S. Army, 2004.

[11] EPA (www.epa.gov/owow/watershed/).

[12] U.S. EPA (http://www.epa.gov/owow/wetlands/what/definitions.html).

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