U. S. Army

Army Environmental Policy Institute

Review of United Nations Environment Programme and Other Post-conflict Environmental Analyses

Abandoned tracked vehicles on the upper part of the British Bala Hissar fortress, south of Kabul, Afghanistan

Executive Summary

Increasing social awareness that human activities have measurable effects on the environment includes the realization that warfare contributes its own cadre of environmental consequences, many of which could be better managed before, during, and after periods of armed conflict. Following recent conflicts, various organizations, including the United Nations (UN) Environmental Programme (UNEP), examined the environmental effects of warfare and offer suggestions about means of minimizing these effects in the post-conflict period. This review of UNEP and other post-conflict environmental assessments offers insight into the following key issues:

- The direct environmental effects from military activities are generally limited in scope and extent, unless the military activity destroys or makes inoperative an industrial facility or critical civil infrastructure (e.g., renders the water supply for a major city unusable).
- The kinds of environmental degradation associated with large-scale human population displacements (e.g., deforestation by refugees needing fuel for cooking) tend to be widespread, complex, and difficult to resolve.
- There is a growing recognition of the importance of environmental, natural resource, and civil infrastructure issues at both the strategic and tactical levels of conflict prevention, prosecution/de-escalation, and post-conflict reconstruction.

As UNEP gained experience and understanding of the environmental consequences of military action, it recognized that larger issues, notably the existence of environmental, natural resource, and civil infrastructure issues across the conflict lifecycle, can affect the course of the conflict and post-conflict periods.

The longstanding approach to managing the footprint of U.S. forces deployed in contingency operations is insufficient to meet the evolving expectations for military cognizance of these issues in the 21st century. Therefore, the Army could benefit from adopting the UN's widening view of environmental, natural resource, and civil infrastructure issues. Doing so requires expanding the view of these issues beyond force protection and compliance to a holistic view of how these issues affect operations in the pre-conflict, conflict, and post-conflict phases. This recognition already exists in a limited way in existing military and doctrinal publications (e.g., Field Manual (FM) 3-100.4, *Environmental Considerations in Military Operations*). Adopting this paradigm requires consideration of these issues across the conflict lifecycle (i.e., pre-conflict—conflict—post-conflict) and in each phase of the lifecycle; therefore, the Army would need to consider new ideas, areas of analysis, and engagement.

The Army has begun, albeit ad hoc, to make this doctrinal shift. This shift has stemmed from the recognition of battlefield commanders in Iraq and Afghanistan that when a population has access to a decent environment in which to live, natural resources to use for livelihoods and consumption, and a basic civil infrastructure, the population has greater positive regard for the U.S. military and will be less likely to engage in insurgent activities. Further expanding the Army's understanding of how these issues shape both the battle and the peace that follows requires not only additional study and analysis but also the will to adapt and overcome these challenges.

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Review of United Nations (UN) Environment Programme (UNEP) and Other Post-conflict Environmental Analyses

1. Introduction

> ***Warfare, by its very nature, is destructive to humans and their natural environment. Environmental damage is a consequence of combat.***
>
> United States (U.S.) Army Field Manual No. 3-100.4, *Environmental Considerations in Military Operations* (15 June 2000)

Increasing social awareness that human activities have measurable effects on the environment includes the realization that warfare contributes its own cadre of environmental consequences, many of which could be better managed or mitigated before, during, and after periods of armed conflict. Following recent conflicts, various organizations, including the United Nations (UN) Environmental Programme (UNEP), examined the environmental effects of warfare and offered suggestions about means of minimizing these effects in the post-conflict period. The Joint Environment Unit (JEU)—a partnership between UNEP and the UN Office for the Coordination for Humanitarian Affairs—has conducted perhaps the most thorough examination through detailed post-conflict environmental assessments (PCEA). These PCEAs identify major environmental risks to health, livelihoods, and security in nations following periods of armed conflict. To date, UNEP has conducted PCEAs in the post-conflict zones of Afghanistan, the Balkans, Iraq, Lebanon, Liberia, the Palestinian territories, Somalia, and Sudan.

The U.S. Army has forces deployed globally in combat and peacekeeping operations. One element of the overall mission specific to operations outside the United States is "… [taking] account of environmental considerations when it acts in the global commons…" and "… [taking] account of environmental considerations when it acts in a foreign nation."[1] Various Department of Defense (DoD) and Service-specific publications define the policies, processes, and procedures for accomplishing this aspect of the military mission outside the United States. Consistent with the mandate to consider environmental issues in the execution of the mission, the U.S. Army is interested in determining if the findings of the UNEP PCEAs apply to U.S. doctrine.

1.1. Project Goal

The Army Environmental Policy Institute (AEPI) assists the Army Secretariat in developing policies and strategies to improve or resolve environmental policy issues that might have significant short- or long-term effects on the U.S. Army. AEPI constantly scans for and assesses future environmental challenges, developing initiatives to help the Army sustain readiness, improve quality of life, strengthen community relationships, and reduce total costs of ownership by suggesting sound environmental investments for force transformation and installation sustainability.

The goal of this AEPI-sponsored study is to examine the body of knowledge on the environmental consequences of recent international military conflicts to identify potential lessons

[1] DoD Directive (DoDD) 6050.7, *Environmental Effects Abroad of Major Department of Defense Actions* (March 31, 1979, Certified Current as of March 5, 2004).

learned for the U.S. Army on how changes in military practice can positively affect the post-conflict physical environment.

1.2. Project Plan

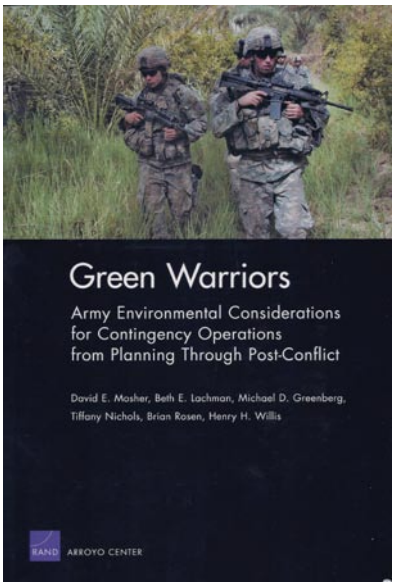
The project had four phases:

- **Phase One:** Develop a work plan and organize and execute a kick-off meeting with key technical stakeholders in the Washington, DC, area. This kickoff meeting was held in August 2009.
- **Phase Two:** Conduct research, collect and evaluate reports of post-conflict environmental consequences, and prepare an initial draft of the study. This phase analyzed the PCEAs that the UNEP and other international agencies produced, evaluating each report's relevance to development of future U.S. Army policy and practices.
- **Phase Three:** Conduct an in-progress review (IPR) to provide feedback on the draft study report.
- **Phase Four:** Submit a final report incorporating feedback from the IPR and from reviews by AEPI-selected experts.

2. Relationship to the *Green Warriors* Report

Over the last two decades, environmental management continues to evolve into a prominent factor in the planning and execution of U.S. military contingency operations. The increasing importance of environmental issues as a component of military success prompted AEPI to contracted with the RAND Corporation to study how the U.S. Army approaches environmental issues during post-conflict and reconstruction phases of overseas contingency operations.

Figure 2-1: *Green Warriors Cover*



The RAND Arroyo Center report *Green Warriors: Army Environmental Considerations for Contingency Operations from Planning Through Post-Conflict*, published in 2008, presents the findings of that study (see Figure 2-1). Although previous publications generally examined environmental management in the context of specific military operations, the *Green Warriors* report provides the first comprehensive assessment of the integration of environmental management into overseas contingency operations by the U.S. military.

In planning the *Review of United Nations (UN) Environment Programme (UNEP) Post-conflict Environmental Analyses* study that is the subject of this report, AEPI directed that the reviews have a relationship to the findings and recommendations of the *Green Warriors* report. Therefore, a brief synopsis of the *Green Warriors* report follows to provide the reader the necessary context for summary of each PCEA.

2.1. Synopsis of the *Green Warriors* Report

The objectives for the *Green Warriors* report included the following:

- Assess how the U.S. Army approaches environmental considerations in overseas contingency operations, including planning, training, and operations
- Determine whether existing policy, doctrine, and guidance adequately addressed environmental activities in post-conflict military operations, including reconstruction
- Propose solutions for filling documented gaps in related policy, doctrine, training, and resourcing to improve the U.S. military's ability to accomplish military and national objectives.

Three principal lines of inquiry formed the basis of the study:

1. Review applicable U.S. and international laws and regulations; DoD and U.S. Army policies, guidance, doctrine, and operational plans; and professional and academic writings found through open source research
2. Conduct interviews with U.S. military and civilian subject matter experts (SME)
3. Review assembly and review case studies in which an environmental issue played a role in an overseas contingency operation.

In the first line of inquiry, the RAND staff collected and analyzed a vast amount of information from a broad array of sources, including the U.S. Army Staff, Army Commands, the Office of the Secretary of Defense (OSD), the Joint Staff, the combatant commands, other federal agencies, other governments, academia, and domestic and international non-governmental organizations (NGO). This information came in many forms, including policy documents, professional publications, interviews, a public opinion survey, and the project staff's personal observations. Some examples of the documents reviewed during this phase are as follows:

- *Basel Convention on the Control or Transboundary Movement of Hazardous Wastes and Their Disposal*
- *National Environmental Policy Act* (NEPA)[2] and the *Foreign Claims Act*[3]
- Executive Order (EO) 12114, *Environmental Effects Abroad of Major Federal Actions*, 4 January 1979
- Office of the Assistant Secretary of the Army for Installations and Environment, *The Army Strategy for the Environment*, 1 October 2004
- DoD Publication 4715.05-G, *Overseas Environmental Baseline Guidance Document* (OEBGD), 1 May 2007.

[2] Sections 4321 to 4370 of Title 42 U.S. Code (USC) (42 USC § 4321 *et seq.*)

[3] 10 USC § 2734 *et seq.*

In the second line of inquiry, the RAND staff interviewed a wide range of SMEs in and outside the U.S. military. The people selected for interviews had either operational or environmental expertise, or they had both

For the third line of inquiry, the RAND staff assembled a database of 111 case studies, analyzing each for effects across the eight dimensions listed in Table 2-1. These dimensions represent ways in which environmental management issues influence the military mission.

Table 2-1: Case Study Dimensions

Evaluation Factors
Health of U.S. Troops or Others
Mission
Financial Costs or Savings for the Army
Community or Diplomatic Relations
Reconstruction Activities
Safety of U.S. Troops
Potential for Additional Environmental Harm
Incurrence of Environmental Liabilities

2.2. Analysis of Case Studies

A review of the 111 case studies in *Green Warriors* found similarities among the environmental issues identified. This review does not distinguish between positive and negative examples; rather, it is merely a counting of the frequency of each topic. Table 2-2 shows the relative frequency of each recommendation and environmental issue.

Table 2-2: Summary of *Green Warriors* Case Studies

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations	39	Improve pre-deployment and field environmental training	95
Encourage an environmental ethic throughout the Army that extends to contingency operations	100	Invest more in environmental resources and good environmental practices for field operations	94
Better incorporate environmental considerations into planning	51	Use a “sustainability” model	39
Environmental Issues Identified			
Asbestos	5	Lack of institutional capacity	12
Cultural resource damage	10	Natural resource damage	17
Deforestation/desertification	2	Petroleum releases	21
Drinking water supply	18	Solid/hazardous wastes	49
Explosive remnants of war	7	Surface water contamination	5
Groundwater contamination	6	Transboundary pollution	7
Human migration	0	Wastewater	14

The top environmental issues were as follows:

- **Solid/hazardous waste management.** Here, the management of solid or hazardous wastes generated by U.S. forces presented some challenge, or U.S. forces helped a host nation resolve a solid or hazardous waste management issue. An example of the former is a case study in which U.S. forces clearing a building encountered leaking and spilled drums of industrial-grade pesticides that affected soldiers’ health. An example of the latter includes several instances in which U.S. forces helped a local government build a new landfill for locally generated wastes.

- **Petroleum releases.** Here, either U.S. forces spilled petroleum products contaminating ground or surface water and soils, or U.S. forces encountered a pre-existing spill of petroleum that affected U.S. operations.
- **Drinking water supply issues.** Here, either U.S. forces encountered an issue with a lack of drinking water supply infrastructure that affected the U.S. forces or the local population, or a release contaminated a drinking water supply.

These results are consistent with the kinds of environmental issues that the UNEP PCEA report identified. The report examined the direct environmental consequences of conflict.

Few of the *Green Warriors* case studies encountered the overriding environmental issue that the UNEP PCEAs identified: the indirect environmental consequences of conflict, primarily the environmental consequences brought on by conflict, drive human population migration. Indirect consequences of conflict include deforestation, desertification, and other natural resource damage (e.g., uncontrolled harvesting of animal species for food). The most probable explanation for this difference is that the RAND team focused on effects or events that U.S. forces reported, but they did not look for the indirect consequences that U.S. forces might have observed, but did not report, considering those conditions to be pre-existing issues.[4]

2.3. Summary of *Green Warriors* Findings and Recommendations

The *Green Warriors* report (Table 2-3 and Appendix B) concludes that integration of environmental considerations into the planning, execution, and follow-up to contingency operations is essential to meeting tactical and strategic objectives in 21st century conflicts. Although a significant body of evidence supports this conclusion, in balancing the factors that contribute to mission success, the little consideration paid to environmental issues as a battle plan component reflects a lack of policy, doctrine, training, and resources.

Table 2-3: Findings and Recommendations of *Green Warriors*

Findings
Environmental issues can have a significant effect on operations.
Environmental considerations can be particularly important for success in the post-conflict phase.
Environmental considerations in contingency operations differ significantly from those experienced in normal operations in the United States.
Environmental issues can have far-reaching effects across operations, across U.S. Army organizations, and around the world.
Inadequate environmental practices in contingency operations can increase risks and costs.
The U.S. Army could improve its understanding of environmental considerations and better incorporate them into plans and operations.
The U.S. Army has no comprehensive approach to environmental considerations in contingencies, especially in the post-conflict phase.
Recommendations
Improve the policy and guidance for environmental considerations in contingency operations.
Encourage an environmental ethic throughout the U.S. Army that extends to contingency operations.

[4] There is one example in which the *Green Warriors* report examined a large, historical issue: the development of a water management model for the Mesopotamian Marshlands. This model was developed as a joint effort of the U.S. Agency for International Development (USAID), U.S. Army Corps of Engineers (USACE), and Iraqi Ministry of Water Resources. The model focuses on reconstruction of this natural resource and reestablishing water flow in Iraq's system of canals.

Table 2-3: Findings and Recommendations of *Green Warriors*

Findings
Better incorporate environmental considerations into planning.
Improve pre-deployment and field environmental training.
Invest more in environmental resources and good environmental practices for field operations.
Use a "sustainability" model for contingency operations.

3. Documents Reviewed as Part of Study

Section 3.0 examines 18 PCEAs or similar documents for environmental issues related to sustainability, effects to health or livelihood, and security in nations following periods of armed conflict. Each review presents the following:

- **Background**—a summary of the background of the conflict or document
- **Assessment Method**—a summary of the assessment methodology
- **Summary of Findings**—a summary of findings from the review
- **Relevance to the U.S. Army**—an assessment of the relevance to the Army.

Each reviewed document also is analyzed using the findings and recommendations in the *Green Warriors* report (summarized in Section 2.0 as a guide).

3.1. U.S. Army, Center for Army Lessons Learned (CALL), Newsletter, *Integrating Environmental Protection: Techniques and Procedures for Military Environmental Protection*, 1999

3.1.1. Background

This CALL newsletter seeks to familiarize unit commanders with applying and integrating all aspects of environmental considerations as they apply to the conduct of military operations (i.e., "Military Environmental Protection"). Instead of focusing on the two extremes of peacetime and war, this publication seeks to articulate a set of standards applicable in military operations other than war (MOOTW). This "gray" area poses many challenges in determining how to execute environmental stewardship because each situation is unique and, more importantly, changes over time.

The document describes military environmental protection as "… a practice that leaders and soldiers are quickly accepting as they begin to understand the relationship between military environmental protection and success on the battlefield." The article describes the "battlefield" in a broad sense, including in that term home station training, rotations to a combat training center (CTC), and deployment in support of an ongoing operation. It asserts that military environmental protection is important because—

- It is good for the leader and the troops under that leader's command
- Environmental stewardship is gaining recognition as a fundamental part of the U.S. Army's ethics and business practices
- A growing body of laws and regulations compel responsible action
- Failure to apply properly environmental considerations has fiscal and operational costs.

Finally, the article concludes that inaction creates a "... risk that our soldiers will be unprepared for the missions they will face."

Based in part on the lessons learned in the U.S. Army's deployment in support of the Bosnian peacekeeping mission, this article expands beyond the administrative aspects of environmental management and addresses integration into the tactical and operational realms. The article advocates including environmental appendices in training simulations with operation plans (OPLAN) and operation orders (OPORD) at all organizational levels, from the overall commander to the maneuver brigade and task force (TF) commanders, including this appendix in their respective OPLAN or OPORD.

3.1.2. Assessment Method

There was no assessment method per se; the document is a compilation of actual techniques and procedures used by units supporting or taking part in the operations in Bosnia-Herzegovina during OPERATION JOINT ENDEAVOR (OJE), OPERATION JOINT GUARD (OJG), and the ongoing OPERATION JOINT FORGE (OJF). The information is grouped by the phases of force projection (i.e., training, pre-deployment, mobilization, deployment, operations, redeployment, post-deployment). A majority of the techniques and procedures focus on application of environmental stewardship during contingency operations.

3.1.3. Summary of Findings

The document presents information about numerous topical areas, with a discussion of the associated issues and tactics and the techniques that the unit commander can use to address those issues. Table 3-1 lists the topics addressed by phase of force projection.

For example, the discussion "Integrate Environmental Considerations at the Earliest Possible Opportunity" references the requirement in Army FM 101-5 for *Appendix 2 (Environmental Considerations)* in *Annex F (ENGINEER)* of an Army OPLAN or OPORD, or the inclusion of Annex L on environmental considerations in a joint OPLAN or OPORD. The discussion makes the argument that although it is usually an engineer's responsibility to write this section of the OPLAN or OPORD, the engineer is only one of several staff officers with responsibility for integrating

Table 3-1: Topics Addressed in *Integrating Environmental Protection: Techniques and Procedures for Military Environmental Protection*

Phase	Topics
Training	Tactical Application of Military Environmental Protection
	The Cost of Hazardous Waste Removal
Pre-Deployment	Environmental Authority (Environmental Stewardship Starts at the Top)
	Integrate Environmental Considerations at the Earliest Possible Opportunity
	Standard Operating Procedures
	Staff Knowledge of the Area of Operations
	Environmental Training/Awareness
Mobilization	Environmental Stewardship
	Site Selection
	Spill Response Contracts and Plans
Deployment	Initial Environmental Baseline Surveys
	Base Camp Design/Positioning
	Lack of Spill Materials
Operations	Field Sanitation
	Base Camp Assistance/Assessment Team
	Hazardous Waste Removal
	Soldier Safety
Redeployment	Base Camp Transfer and Closure
Post-Deployment	Closure Environmental Baseline Survey

environmental protection into the plan. Further, it is incumbent on the engineer to act in a primary integrating role throughout the plan development process. In the discussion of tactics and techniques, the document details the roles of various staff officers in preparing the environmental aspects of the plan. For example, it describes the role of S1/G1, S3/G3, S4/G4, S5/G5, the surgeon, the chemical officer, the safety officer, the public affairs officers, and the staff judge advocate as containing an inherent requirement to include environmental considerations in their analysis and plan development. Doing so as early in the process as possible ensures inclusion in the OPLAN or OPORD. This discussion also cites a specific lesson—this one from OJE—in which medical intelligence did not include non-medical environmental or health threats in their analysis. This exclusion limited the ability of preventive medicine personnel and medical planners to anticipate and address potential health threats of concern specific to the area of operations. Another example was the failure to include information about industrial facilities in Bosnia in time to allow consideration of the health effects of U.S. forces of these pollution sources.

3.1.4. Relevance to the U.S. Army

This document, already a U.S. Army publication, is relevant in that it provides fact-based examples of the need for environmental and natural resources intelligence at the operational level. Doing so allows operational planners to incorporate those factors into the OPLAN or OPORD.

The document also is relevant in that it is a training tool that gives unit leaders of various levels information and insights into the need for incorporating environmental information into operational plans, including suggested tactics and techniques for accomplishing this task.

Finally, this document is relevant to the U.S. Army in that it identified the importance of attaching consideration of environmental and natural resource issues to planning military operations. Table 3-2 presents a summary scorecard.

Table 3-2: Summary Scorecard *Integrating Environmental Protection: Techniques and Procedures for Military Environmental Protection*

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations	✓	Improve pre-deployment and field environmental training	✓
Encourage an environmental ethic throughout the Army that extends to contingency operations	✓	Invest more in environmental resources and good environmental practices for field operations	
Better incorporate environmental considerations into planning	✓	Use a “sustainability” model	
Environmental Issues Identified			
Asbestos		Lack of institutional capacity	
Cultural resource damage		Natural resource damage	✓
Deforestation/desertification		Petroleum releases	✓
Drinking water supply	✓	Solid/hazardous wastes	✓
Explosive remnants of war		Surface water contamination	✓
Groundwater contamination	✓	Transboundary pollution	
Human migration		Wastewater	✓

3.2. UNEP, *UNEP Final Report: Post-Conflict Environmental Assessment—FYR of Macedonia,* 2000

3.2.1. Background

The Former Yugoslav Republic (FYR) of Macedonia is located in the central part of the Balkan Peninsula (see Figure 3-1). The country's mainly mountainous territory covers a total area of 25,713 square kilometers. The population is roughly 2 million people, of which about 1.2 million, or 60 percent, live in urban areas.

Figure 3-1: FYR of Macedonia

Macedonia was primarily an agrarian economy before World War II. Following the war, dramatic industrial growth and urbanization occurred. State-owned industries consumed raw materials and exploited energy sources at great expense to the nation's environment and natural resources. With little or no effective regulation, industrialists cleared forests; emitted pollutants into the air, soil, and water; and dumped waste into nearby water bodies or onto open land. In summary, short-term economic growth took precedence over long-term sustainable development.

In 1991 and 1992, several Yugoslav republics declared their independence. The disintegration of the Yugoslav common market aggravated economic conditions in the region. Industries began to reduce output, thereby lowering some environmental stress. Unfortunately, highly polluting industrial processes were not altered measurably, and growing urbanization reduced air quality, increased pressure on water supplies, and further exacerbated waste treatment and disposal problems.

3.2.2. Assessment Method

Assessments involved extensive analyses of relevant environmental issues, meetings with key stakeholders, field missions, publication of reports, and efforts to catalyze concrete environmental remediation action. The assessment process began with a systematic review of the available literature and data. The UNEP investigation team comprised specialists in chemical and technological processes, solid waste management, biodiversity, drinking water, wastewater, air quality, soil, land use planning, law, government, humanitarian assistance, emergency management, environmental economics, environmental information, and communications. They then held meetings with environmental leaders from the Government of the Former Yugoslav Republic of Macedonia, the non-governmental community, and academia.

UNEP identified three core areas of concern:

- **Sites of urgent environmental concern (i.e., "hot spots").** This investigation focused on 10 identified "hot spots" considered most likely to pose immediate risks to the environment and human health. At each site, with the exception of Lojane, the team met with plant representatives or local officials, conducted visual inspections of the facilities, and, when appropriate, took samples of soil, water, or air. Team experts also met with

government and municipal officials, as well as representatives of non-governmental organizations.

- **Refugee effects on Macedonia's environment.** The team specializing in the potential environmental effects of refugees met with 14 agencies and organizations that were directly or indirectly involved with the refugee influx.
- **Macedonia's institutional capacity for environmental protection.** The institutional capacity team met with government representatives from environmental, health, agriculture, forestry and water management, energy, and urban planning entities, as well as donors and representatives of non-governmental organizations.

At several of the locations and institutions, the available technical information was limited or outdated. The UNEP team followed up by obtaining and reviewing additional data after the mission and by analyzing the results of samples that mission experts took in the field.

3.2.3. Summary of Findings

UNEP identified environmental hot spot conditions in 5 of the 10 sites investigated. These sites required urgent attention in order to halt serious risks to public health and the natural environment. The remaining five industrial sites that the hot spot team visited had serious environmental problems. These problems require investigation, implementation of remediation measures, and long-term monitoring to mitigate further risks to human health and the environment. Two key areas that need improvement emerged from the hot spot investigation:

- Implement environmentally acceptable industrial processes, including measures for adequately controlling the use of chemicals
- Provide adequate handling, storage, treatment, and disposal of waste, whether solid or liquid, hazardous or non-hazardous, municipal or industrial.

The long-term environmental effects of refugee influxes to Macedonia are considered minimal. Environmental considerations were integrated successfully into most aspects of refugee operations and camp management. The team identified minor instances of refugee-related environmental degradation that might have been avoided with greater environmental planning, management, and integration with other sectors and government agencies.

In terms of institutional capacity for environmental protection, the government of Macedonia has taken significant strides toward developing its environmental protection capacities. To improve, government offices need better coordination of responsibilities and funding. Environmental monitoring is insufficient and not adequately linked to public health. Enforcement of regulations is weak and could be strengthened by creating a permitting system.

Political and economic destabilization of the Balkans region has made environmental degradation difficult to undertake. The Kosovo conflict placed an additional burden on the already over-stretched Macedonian resources . As stated earlier, however, the direct environmental effects of refugees were found to be minimal, especially compared with the chronic lack of investment in environmental protection.

3.2.4. Relevance to the U.S. Army

The Kosovo conflict led to 261,000 refugees fleeing to Macedonia. This assessment (*Macedonia*, 2000*)* determined that the refugee population imposed some detrimental effects on the

environment, but early planning and coordination greatly minimized these effects. When engaging in conflict or contingency operations, the U.S. military should work with surrounding countries to help minimize the effects of potential refugee populations on the environment. Table 3-3 presents a summary scorecard for Macedonia.

Table 3-3: Summary Scorecard *UNEP Final Report: Post-Conflict Environmental Assessment—FYR of Macedonia*

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations	✓	Improve pre-deployment and field environmental training	
Encourage an environmental ethic throughout the Army that extends to contingency operations		Invest more in environmental resources and good environmental practices for field operations	
Better incorporate environmental considerations into planning	✓	Use a "sustainability" model	✓
Environmental Issues Identified			
Asbestos		Lack of institutional capacity	✓
Cultural resource damage		Natural resource damage	✓
Deforestation/desertification	✓	Petroleum releases	✓
Drinking water supply	✓	Solid/hazardous wastes	✓
Explosive remnants of war		Surface water contamination	✓
Groundwater contamination	✓	Transboundary pollution	✓
Human migration	✓	Wastewater	✓

3.3. UNEP, *UNEP Final Report: Post-Conflict Environmental Assessment—Albania*, 2000

3.3.1. Background

Albania is located in the western part of the Balkan Peninsula (see Figure 3-2). Its western coast faces the Adriatic and Ionian Seas. Much of Albania's 28,748 square kilometers is mountainous. The country has approximately 3.5 million inhabitants, 46 percent of whom live in urban areas.

Figure 3-2: Albania

Between 1944 and 1991, Albania's government was controlled by the Communist Party, known most of that time as the Albanian Party of Labor (APL). During this period, emission controls and wastewater treatment were not incorporated into most factory designs. About half of Albania's labor force worked in agricultural collectives, and substantial resources were invested in reclaiming, irrigating, and fertilizing farms; however, environmental criteria were not incorporated into these processes.

In March 1992, Albania began transitioning to a free market economy, but the lack of environmental criteria from the communist era remained in effect. Continued political instability and civil unrest, mixed with persistent economic failures, caused most industries to shut down. During spring 1999, thousands of refugees escaped conflict in Kosovo by entering Albania, further weakening an already deteriorating environmental infrastructure.

Albanians face high unemployment, widespread poverty, population migration, and profound environmental degradation. The water supply and solid waste systems are strained beyond capacity. Cases exist in which families, lacking alternatives, created homes on extremely hazardous industrial sites.

3.3.2. Assessment Methodology

This UNEP PCEA analyzed environmental conditions with a view toward emergency prevention and preparedness as much as emergency mitigation and response. The assessment was conducted in cooperation with Albania's National Environment Agency (NEA). The assessment process began with a systematic review of available literature and data concerning Albania's environment. The assessment continued with a preliminary UNEP field mission to meet with environmental leaders from government, the non-governmental community, and academia.

The investigation team comprised specialists in chemical and technological processes, solid waste management, biodiversity, drinking water, wastewater, air quality, soil, land use planning, law, government, humanitarian assistance, emergency management, environmental economics, environmental information, and communications.

UNEP focused the assessment on three core areas of concern:

- **Sites of urgent environmental concern (i.e., hot spots).** This investigation focused on nine identified hot spots considered most likely to pose immediate risks to the environment and human health. At each site, the team met with plant representatives or local officials; conducted visual inspections of the facilities; and, when appropriate, took samples of soil, water, or air.
- **Refugee effects on Albania's environment.** The team specializing in the potential environmental effect of refugees met with seven agencies and organizations that were directly or indirectly involved with the refugee influx. The team then inspected 12 refugee-affected areas.
- **Albania's institutional capacity for environmental protection**. The institutional capacity team met with government representatives from the environmental, health, transportation, public works, agriculture and food, forestry and pastures, water council, and public economy and privatization entities, as well as donors and representatives of non-governmental organizations.

3.3.3. Summary of Findings

During its field mission, UNEP identified hot spot environmental conditions at five of the nine identified sites. These sites require urgent attention in order to halt dangerous risks to human health and the surrounding environment. The remaining four sites that UNEP investigated have serious environmental problems requiring investigation, remediation measures, and long-term monitoring to avoid further risks to human health and the environment. Environmental hazards include groundwater contamination, surface water contamination, water supply contamination, air pollution, solid waste, medical waste, untreated wastewater, and deforestation.

The long-term environmental effect of refugee influxes into Albania were determined to be minimal. UNEP, however, observed areas of minor environmental degradation that might have been avoided with a greater degree of environmental planning, management, and agency cooperation. In addition, a majority of the camps were not rehabilitated adequately.

The government has made significant strides, through legislation and programs, toward developing its environmental protection capacities. A challenge Albania faces is that environmental responsibilities are widely dispersed and often overlapping, resulting in uncoordinated policies, slow implementation, inadequate monitoring, and weak enforcement. The creation of a strong, adequately financed Ministry of Environment (MoEN) would help clarify environmental responsibilities, strengthen policy and enforcement efforts, and increase environmental awareness in Albania.

3.3.4. Relevance to the U.S. Army

Unlike many post-conflict environmental assessments, the assessment of Albania is as much a story about the effect of past practices as it is about the effect of a specific conflict on the environment. From this assessment, the detrimental effect of civil unrest, regional instability, and refugee populations fleeing to Albania is apparent. What is more apparent, though, is that a country with a failing environmental infrastructure cannot withstand the additional stresses of conflict.

It is important for the U.S. military to consider not only the current environmental infrastructure of a region when entering conflict and contingency operations but also the mission's potential effect on that infrastructure. Early coordination with governments regarding the status of a failing environmental infrastructure can prevent further environmental degradation and lead to greater economic and political stability. Table 3-4 presents a summary scorecard for Albania.

Table 3-4: Summary Scorecard *UNEP Final Report: Post-Conflict Environmental Assessment—Albania*

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations	✓	Improve pre-deployment and field environmental training	
Encourage an environmental ethic throughout the Army that extends to contingency operations		Invest more in environmental resources and good environmental practices for field operations	
Better incorporate environmental considerations into planning	✓	Use a "sustainability" model	✓
Environmental Issues Identified			
Asbestos		Lack of institutional capacity	✓
Cultural resource damage		Natural resource damage	✓
Deforestation/desertification	✓	Petroleum releases	✓
Drinking water supply	✓	Solid/hazardous wastes	✓
Explosive remnants of war		Surface water contamination	✓
Groundwater contamination	✓	Transboundary pollution	✓
Human migration	✓	Wastewater	✓

3.4. UNEP, *Afghanistan Post-Conflict Environmental Assessment*, 2003

3.4.1. Background

Before the Soviet invasion in 1979, Afghanistan saw a long-standing process of land degradation, evidence of which is apparent throughout much of the country. Since then, through the period of Soviet occupation and the civil war that followed, the country's natural resource

base further declined and the environment deteriorated. Every aspect of the environment experienced degradation, from agriculture to waste management. In some cases, irreparable harm resulted; in others, a remedy to the problems created will take decades and will require a tremendous investment of resources.

In September 2002, following a request by the government of Afghanistan, a month-long UNEP team of 20 Afghan and international scientists and experts visited 38 urban sites in four cities and 35 different rural locations. The mission was to not only perform a comprehensive assessment of the environmental issues facing the Afghan government but also offer recommendations for priority actions to halt degradation and restore some measure of sustainable resource management.

The mission was a veritable "who's who" of environmental organizations, with assistance provided by the Afghan government (e.g., Afghan Assistance Coordination Agency, Ministries of Irrigation, Water Resources and Environment, Public Health, and Agriculture and Animal Husbandry), the Asian Development Bank, numerous NGOs (e.g., the Agency for Rehabilitation and Energy Conservation in Afghanistan, the Afghan Relief Committee, Madera, and Save the Environment Afghanistan), and the governments of Canada, Finland, Luxembourg, and Switzerland. UNEP was impressed by the highly skilled Afghans met during the mission and by the Afghan peoples' commitment to improving the environment, even in the face of extraordinary material and financial handicaps.

This assessment provided the foundation of the longest running, most complex engagement in UNEP's history. The 2009 report *UNEP in Afghanistan: Laying the Foundations for Sustainable Development* provides information about the efforts of UNEP, the Afghan government, and the international community to address the issues identified by this assessment.

3.4.2. Assessment Method

UNEP's previous PCEA efforts focused on damages tied directly to military operations and the environmental effects of chemicals released from damaged or destroy targets. In Afghanistan, however, UNEP realized from the outset that even though war-related damage was severe (e.g., Afghanistan had the distinction of possessing the most landmines in the world), of greater significance was the long-term environmental degradation that had resulted, in part, by a complete collapse of local and national forms of governance. Still, this PCEA followed the basic model used in the Balkans and elsewhere.

First, a detailed analysis of existing data was coupled with a careful analysis of satellite data to identify locations of interest and assess land use trends over time. The land use analysis, which covered a 25-year period, provided key information about wetland degradation, desertification, and deforestation.

Next, a team of Afghan and international experts was assembled and deployed in country. The team had a list of locations to visit, either to gain firsthand knowledge of conditions through visual observation or to collect samples, or both. Because of security risks—ongoing conflict and dangers of mines and other unexploded ordnance—the UNEP mission was unable to cover all parts of Afghanistan. For example, safe access to the Ajar Valley or the cedar forests of Kunar and Nuristan provinces was not possible because of ongoing local fighting.

The teams traveled about the country, interviewing various representatives of the Afghan government, business, and academia, as well as citizens, taking photographs, conducting onsite inspections of various facilities, and collecting samples for laboratory analysis.

The effort concluded with the preparation of the subject report.

3.4.3. Summary of Findings

The PCEA determined that Afghanistan's environment was badly damaged, a humanitarian crisis created by decades of conflict. The absence of government control and rule of law had resulted in the degradation and loss of valuable natural resources. With the dependence of the Afghan people on the land and its biological and ecological processes as the foundation for existence, the UNEP report summarizes conditions as being in such a fragile state that effective natural resource management and rehabilitation must be a national priority if Afghanistan is to achieve long-term social stability and prosperity.

For example, despite low levels of consumption and production, weak management of solid waste is already one of the country's most glaring environmental problems. In urban areas, UNEP determined that poor waste management practices and lack of proper sanitation posed serious risks to human health. UNEP found evidence of only a few industrial activities operating without regard for protection of worker health of prevention of environmental degradation, but none of the solid waste dumpsites visited had any measures in place to prevent groundwater contamination or toxic air pollution from burning wastes. Conditions at or near hospitals were of particular concern, with the report referencing use of contaminated groundwater in patient care and poor human and medical waste management practices occurring within the hospital complex itself. Population growth stemming from decreased mortality rates and refugee and internally displaced persons returns are predicted to overstress an already inadequate solid waste management system, suggesting that conditions will only worsen.

Figure 3-3: Open Sewer, Kabul, Afghanistan

Dust and vehicle emissions in Afghanistan's urban areas are the principal sources of air pollution. Vehicle density is growing rapidly, with most running on low-grade diesel fuel, the primary cause of the air pollution evident in urban areas. During cold periods, air quality is further degraded by the use of coal and wood-fired ovens, stoves, and open fires for cooking and heating.

Being an arid country, water is essential to Afghanistan's prosperity and survivability. UNEP found that both surface and groundwater resources had been affected severely by drought, contamination from waste dumps, chemicals and open sewers, and uncoordinated and unmanaged extraction. Only a tiny fraction of Afghanistan's population, and that being in urban centers, has access to adequate sanitation. As shown in Figure 3-3, even in Kabul, wastewater collection is via open gutters and canals, and wastewater treatment is nearly non-existent. As a result, urban drinking water supplies are cross-contaminated with coliform bacteria (e.g., *Escherichia coli*), posing a considerable risk to public health. UNEP estimated that less than a

quarter of the urban population and less than 15 percent of the total population has access to safe drinking water. Many of the country's wetlands are completely dry and no longer support wildlife populations or provide agricultural inputs (e.g., the Sistan wetland, a critically important haven for waterfowl, was completely dry). Wind-blown sediments are filling irrigation canals and reservoirs, covering roads, fields, and villages, with an overall effect of increasing local vulnerability to drought. In many regions, improved water resource management is an essential first step in rebuilding rural communities and improving human health. Maintaining water quality and quantity should be the overriding goal of all land-use planning activities in Afghanistan as is implementation of an integrated water basin planning program.

The forests and woodlands of Afghanistan —sources of fuel wood and construction materials—and foodstuffs (e.g., pistachio and almond) are badly depleted by long-term illegal harvesting and widespread uncontrolled grazing, preventing regeneration. For example, UNEP's satellite analyses revealed a 50-percent decline in the conifer forests of three provinces, while pistachio woodlands in two others provinces (an important source of food and an economic engine) are so degraded as to be nearly unproductive. Moreover, the loss of forests and vegetation and excessive grazing and dry land cultivation are contributing to wind and surface water erosion of the topsoil making restoration of these woodlands slow and likely ineffective. This erosion in agricultural productivity is driving people from rural to urban areas in search of food and employment.

Figure 3-4: Ibex and Marco Polo Sheep Horns

Afghanistan's wildlife also is badly harmed by the aggregate injury inflicted on its natural resources. Many species are either on the brink of extinction or already extinct. For example, flamingos have not bred successfully in Afghanistan for 4 years, and other endangered species such as the Marco Polo sheep are illegally hunted for sport, for meat, or to supply the illicit fur trade (see Figure 3-4). With less than 1 percent of the land base classified as protected areas—none of which cover the dwindling conifer forests of the east—no coordinated management activity protects and conserves ecological integrity and wildlife.

The last finding of UNEP was the complete collapse of environmental governance. Before the Soviet invasion in 1979, Afghanistan had started to address some of the nation's environmental problems in water supply, deforestation, and wildlife conservation. After the Soviet invasion and subsequent periods of civil war and Taliban rule, environmental governance ceased to exist in any meaningful way. This was thought to be a contributing factor in the overall decline in environmental conditions; however, more likely the real cause was the collapse of governance generally (i.e., not specific to environment). This UNEP report examines in detail the organizational structure and mission of the various ministries involved in environmental management; however, this structure has grown and changed over the last 6 years, making this discussion of historical value only.

UNEP offers 163 recommendations, many with five or more subcomponents. These recommendations are aimed at three different kinds of environmental issues:

- *Supply* of environmental goods and services is decreasing as a result of degradation, overuse, and mismanagement.
- *Demand* for environmental goods and services is increasing with high levels of population growth and millions of returning refugees.
- *Access* to environmental goods and services is unequal owing to ongoing civil disorder and power imbalances.

Table 3-5: UNEP Recommendation Categories

Cross-cutting recommendations
Environmental legislation and enforcement
Capacity building for environmental management
Environment and job creation
Environmental planning
Environmental impact assessment procedures
Industry and trade
Public participation, training, and environmental education
Sectoral recommendations
Water supply
Waste management
Hazardous wastes and chemicals
Open woodlands
Eastern conifer forests
Energy
Air Quality
Protected areas network and wildlife conservation
Desertification
Plant resources for food and agriculture
International environmental conventions
Site-specific recommendations
Address waste and other management concerns at specific locations throughout the country

As shown in Table 3-5, the UNEP recommendations were divided into cross-cutting, sector-based, and site-specific recommendations, and where possible, into immediate actions to reduce risks to human health or to arrest environmental degradation, and longer term actions related to planning, capacity building, and institutional development.

Responsibility for implementing these recommendations lies with the government and people of Afghanistan, but UNEP suggested three features critical for success: (1) full cooperation among the ministries responsible for these issues; (2) development of a regulatory structure and enforcement mechanisms at the central, regional, and local levels; and (3) sustained technical and financial assistance from the international community.

3.4.4. Relevance to the U.S. Army

The PCEA on Afghanistan provides insight into the environmental challenges that exist in Afghanistan. The exact role of the U.S. Army in resolving these issues is unknown; however, it is reasonable to assume that with the surge in U.S. forces and the accompanying expansion of the U.S. Army's mission, there will be a need for engagement on at least some of the UNEP recommendations. Therefore, U.S. Army operational planners and those within the military environmental community should carefully examine this report to identify, prioritize, and harmonize the recommendations with the U.S. Army's plan for engagement in Afghanistan.

This report also is relevant to the U.S. Army in that it documents the kinds of conditions that can be expected in most of the locations where the U.S. Army may be asked to intervene, either in a military or humanitarian role. Looking back at the last two decades, the U.S. Army has been deployed primarily to countries deeply in crisis (e.g., Somalia, Afghanistan, Iraq). All these

crises have had an environmental component from either direct military action or other causes (e.g., population displacement). This UNEP report provides insight into a worst-case scenario that U.S. troops might encounter; therefore, it provides excellent information for development of war game scenarios for testing environmental doctrine. Table 3-6 presents a summary scorecard for Afghanistan.

Table 3-6: Summary Scorecard *Afghanistan Post-Conflict Environmental Assessment*

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations	✓	Improve pre-deployment and field environmental training	✓
Encourage an environmental ethic throughout the Army that extends to contingency operations	✓	Invest more in environmental resources and good environmental practices for field operations	✓
Better incorporate environmental considerations into planning	✓	Use a "sustainability" model	✓
Environmental Issues Identified			
Asbestos		Lack of institutional capacity	✓
Cultural resource damage	✓	Natural resource damage	✓
Deforestation/desertification	✓	Petroleum releases	✓
Drinking water supply	✓	Solid/hazardous wastes	✓
Explosive remnants of war	✓	Surface water contamination	✓
Groundwater contamination	✓	Transboundary pollution	✓
Human migration	✓	Wastewater	✓

3.5. UNEP, *From Conflict to Sustainable Development: Assessment and Clean-up in Serbia and Montenegro*, 2004

3.5.1. Background

The State Union of Serbia and Montenegro is located in the Western Balkans region of southeast Europe (see Figure 3-5). Most of these countries lie within the Danube drainage basin. In terms of natural diversity, Serbia and Montenegro is one of the most important areas in Europe, supporting a wealth of plant and animal species matched by few other European nations. Protected areas cover more than 338,000 hectares, including 10 national parks. In 2002, the population of Serbia and Montenegro was roughly 8 million.

The 1999 armed conflict in the Balkans was triggered by the collapse of efforts to find a diplomatic solution to the Kosovo crisis. The Rambouillet peace negotiations failed, and some of the member states of the North Atlantic Treaty Organization (NATO) initiated air strikes on targets within the then Federal Republic of Yugoslavia (FRY) a few days later on 24 March 1999. Although the conflict was relatively short lived, with NATO suspending its campaign on 10 June 1999, severe damage was inflicted on strategic infrastructure in the Republics of Serbia and Montenegro.

The intensity of the air strikes, targeting industrial and military facilities, and dramatic television pictures combined to fuel claims of an environmental disaster. An example, shown as Figure 3-6, was the destruction of an oil refinery and storage area at Novi Sad. When hit, the tanks and pipelines released more than 70,000 tons of crude oil and oil products, causing contamination of groundwater and soil. Simultaneously, NATO was underlining its policy of selective, precision targeting and rejecting reports of environmental crisis. UNEP and the UN Centre for Human Settlements (UNCHS) initiated a neutral, independent, scientific assessment of the environmental situation in Serbia and Montenegro.

Figure 3-5: Serbia and Montenegro

Figure 3-6: Destroyed Tanks and Pipelines at Novi Sad Oil Refinery

3.5.2. Assessment Methodology

The assessment, conducted between July and October 1999, consisted of both field missions and desk study components. The sites visited were selected after systematic review of information from a wide range of sources, including the findings of a preliminary field assessment conducted in June 1999. UNEP saw these sites as being the locations most likely to have suffered environmental effects because of the conflict.

The UNEP assessment teams visited industrial areas at Pancevo, Novi Sad, Kragujevac, Bor, Pristina, Nis, Novi Beograd, Obrenovac, Kraljevo, and Prahovo. The teams analyzed soil, air, and groundwater samples on the spot, using mobile laboratory facilities, or sent the samples to laboratories in Denmark and Germany. Environmental effects also were examined along the Danube River. The scientific work focused mainly on sampling river water, bank and bottom sediments, and freshwater mussels and other invertebrate fauna. For comparison, samples were taken upstream and downstream of industrial sites damaged during the conflict. Another investigation focused on the consequences of the conflict for biodiversity, especially in protected areas, and the team(s) visited Fruska Gora National Park, Kopaonik National Park, Zlatibor in Serbia, and Lake Skadar in Montenegro.

3.5.3. Summary of Findings

The assessment team determined that there had been no generalized environmental effects resulting from the conflict. Instead, there were more localized effects and in some cases a long-term legacy of poor environmental management. The team identified four hot spot locations in Serbia:

- **Pancevo.** Spills of ethylene dichloride and mercury at Pancevo petrochemical plant contaminated soil, groundwater, and the complex's wastewater canal, which leads to the Danube River. The wastewater treatment plant, although not directly hit during the air strikes, also was damaged, causing untreated wastewater from various units of the petrochemical plant and oil refinery to flow into the canal. At the heavily targeted oil refinery, about 80,000 tons of oil products and crude oil burned, releasing sulfur dioxide and other noxious gases. An estimated 5,000 tons of oil and oil products also leaked into the soil and the sewer system, aggravating pre-existing soil and groundwater contamination at the refinery. At the fertilizer plant, the nitrogen-phosphorous-potassium plant and fuel-oil tanks were destroyed, and the ammonia plant was damaged. Large quantities of hazardous substances from the whole complex reached the wastewater canal and the Danube River.
- **Novi Sad.** During the conflict, several storage tanks and pipelines at Novi Sad oil refinery were damaged, and in excess of 70,000 tons of crude oil and oil products reportedly burned or leaked into the wastewater collection system and the ground, causing contamination of soil and groundwater.
- **Kragujevac.** The key concerns identified at the Zastava industrial complex, heavily damaged by bombing, were the high concentrations of polychlorinated biphenyls (PCB) and dioxins detected on the paint hall floor, in the power plant's transformer station, and in the sediments of the Lepenica River. An estimated 2,500 kilograms (kg) of PCB oil had leaked from damaged transformers.

- **Bor.** At the Bor mining and smelting complex, which air strikes had targeted, the assessment team identified localized PCB contamination at the site of a destroyed transformer station, but also raised concerns about severe and chronic air pollution in the Bor region because of the plant's long-term operations.

3.5.4. Relevance to the U.S. Army

The armed conflict in the Balkans was relatively short, lasting less than 3 months. Within this timeframe though, significant effects occurred to the surrounding environment. Whether it is a long-term engagement or short-term contingency operation, the effect of conflict on natural infrastructure can be devastating. To minimize the effect of conflict on human health and the environment, after the conflict has ended, the U.S. military assisted in assessment and clean-up activities by quickly providing information about specific targets and the kinds of weapons that were used on them. Sharing information leads to a quicker response and reduces the risk of continued effects to the surrounding environment. Table 3-7 presents a summary scorecard for Serbia and Montenegro.

Table 3-7: Summary Scorecard *From Conflict to Sustainable Development: Assessment and Clean-up in Serbia and Montenegro*

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations	✓	Improve pre-deployment and field environmental training	✓
Encourage an environmental ethic throughout the Army that extends to contingency operations		Invest more in environmental resources and good environmental practices for field operations	
Better incorporate environmental considerations into planning	✓	Use a "sustainability" model	
Environmental Issues Identified			
Asbestos		Lack of institutional capacity	
Cultural resource damage		Natural resource damage	✓
Deforestation/desertification		Petroleum releases	✓
Drinking water supply	✓	Solid/hazardous wastes	✓
Explosive remnants of war	✓	Surface water contamination	✓
Groundwater contamination	✓	Transboundary pollution	✓
Human migration		Wastewater	✓

3.6. UNEP, *The State of the Environment in Somalia: A Desk Study*, 2005

3.6.1. Background

Somalia, shown in Figure 3-7, is Africa's easternmost country and is bordered by Kenya to the south, Ethiopia to the west, Djibouti to the northwest, the Gulf of Aden to the north, and the Indian Ocean to the east. It is a large, relatively flat country, with an arid or semi-arid climate and prone to severe droughts and floods. Somalia's estimated 10 million people mostly support themselves through nomadic pastoralism and agriculture. They are among the poorest in the world, largely the result of internal conflict, which began in the late 1980s and intensified following the fall of the Siyad Barre government in 1991. This collapse led to one of the fastest and largest population displacements ever recorded on the African continent. At the peak of this crisis, more than 800,000 Somalis were thought to have fled to neighboring countries.

No functioning national government has operated since 1991, leaving the country open to fragmentation among competing local interest groups and its natural resources vulnerable to theft by foreign interests and over-exploitation by local ones. Somalia's rich fishery resources are looted systematically by unlicensed foreign-flagged fishing boats, and its forests stripped for export-oriented charcoal production.

Figure 3-7: Somalia

Steps toward repairing Somalia began with a National Reconciliation Conference, hosted by the Government of Kenya in 2002 under the auspices of the Inter-governmental Authority on Development. These steps resulted in the selection of a 275-member parliament, which elected a speaker in September 2004 and President Abdullahi Yusuf Ahmed in mid-October 2004 to lead a new Transitional Federal Government (TFG). Poor security delayed the TFG's entry to Somalia until June 2005 when the TFG established a base at Jowhar, north of Mogadishu. Meanwhile, the Indian Ocean tsunami of 26 December 2004 killed about 300 people and affected the livelihoods of some 44,000 people along the northeastern coastline areas. UNEP stepped in to review the state of the environment in Somalia after the 2004 tsunami and so many years of conflict.

3.6.2. Assessment Method

As part of an overall response to the tsunami, UNEP prepared a desk study assessment of the tsunami's effects on Somalia in early 2005. Following the release of the preliminary findings, the Somalia TFG requested that UNEP send a fact-finding mission to the country to not only investigate the alleged existence of tsunami-related hazardous waste but also conduct a more detailed and extensive desk study about the state of the environment in Somalia.

This effort resulted in a UN inter-agency technical fact-finding mission, led by the United Nations Development Programme Humanitarian/Resident Coordinator and composed of experts from UNEP, the Food and Agricultural Organization of the United Nations, and the World Health Organization. The mission visited three key populated coastal locations—Hafun, Bandarbeyla and Eyl—stretching more than 500 kilometers during 25–29 May 2005 period. The immediate objective was to establish whether hazardous waste and/or damages from the tsunami posed risks to human health and the environment.

3.6.3. Summary of Findings

Findings of the desk study indicate that little information related to natural resources management is available, although there is still sufficient evidence to highlight numerous concerns over recent and current patterns of natural resources use. Not only is Somalia experiencing significant environmental problems (e.g., deforestation, over-fishing, overgrazing, and soil erosion) but also it lacks human and financial resources, a political structure, and stability sufficient to allow these issues to be addressed at even the most basic level.

These problems have been compounded by a series of droughts over much of the country. Large numbers of people have died resulting from drought and starvation, and livelihoods have faltered

as livestock herds also succumbed to drought and food shortages. Heavy rains and flooding typically follow periods of drought, only adding to the population's burden.

The study makes three key overall recommendations:

- Strengthen environmental governance to ensure sustainable management of the country's natural resource base. This recommendation includes developing and enhancing conservation programs for strategic natural resources, promoting equity in resource use, and conducting resource assessments to establish the health of resources and their sustainable levels of use, as well as the participation of all stakeholders in making decisions about resource management actions that affect them.
- Carry out environmental assessments to guide the setting of priorities for environmental recovery, resource management, and development planning.
- Revitalize environmental cooperation with neighboring countries and within the region, to support peace building, enhance important environmental initiatives, and share information and knowledge.

The study also recommends the following specific interventions for immediate action:

- Proper management of waste, including effective containment and/or clean-up of all remaining stocks of pesticides in the country
- Institutional development and strengthening
- Soil erosion control
- Fisheries management, including taking measures against illegal fishing by foreign vessels
- Improved and controlled charcoal production
- Conducting field-based environmental assessments to inform future decision making
- Improving national disaster preparedness and response capacity.

The following are recommended interventions for medium-term action:

- Reclaiming the protected area network
- Protecting marine resources
- Sustaining management of forest and woodland resources
- Developing an adequate policy and legal framework for environmental management.

Rebuilding Somalia will require time and a huge, concerted, and sustained effort by the international community and the country itself. Equally important, for many of these recommendations to be put into effect, good relations need to be forged with neighboring countries. The key priorities in Somalia's nation-building process include deepening the peace process, increasing stability, broadening reconciliation, deepening reconstruction and development efforts, and beginning to resume progress toward the Millennium Development Goals. Immediate steps also must be taken to ensure more sustainable management of Somalia's environmental assets.

3.6.4. Relevance to the U.S. Army

The situation in Somalia highlights the inherent link between a country's political stability and the environment. Without a functioning government to oversee and control natural resources, these resources can succumb easily to misuse and exploitation. Further, continued exploitation of natural resources often exacerbates political instability, leading to more conflict. The *Green Warriors* report focuses on actions to address environmental issues that can be taken post-conflict and during planning and contingency operations.

When engaging in post-conflict activities, the U.S. military should consider assisting countries in addressing their institutional capability to deal with environmental issues. The military also can show the country ways in which natural resources sustainability positively effects political stability. Ultimately, this action not only benefits the struggling country but also decreases the need for international intervention attributed to continued conflict. Table 3-8 presents a summary scorecard for Somalia.

Table 3-8: Summary Scorecard *The State of the Environment in Somalia: A Desk Study*

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations		Improve pre-deployment and field environmental training	
Encourage an environmental ethic throughout the Army that extends to contingency operations		Invest more in environmental resources and good environmental practices for field operations	
Better incorporate environmental considerations into planning	✓	Use a "sustainability" model	✓
Environmental Issues Identified			
Asbestos		Lack of institutional capacity	✓
Cultural resource damage		Natural resource damage	✓
Deforestation/desertification	✓	Petroleum releases	
Drinking water supply	✓	Solid/hazardous wastes	✓
Explosive remnants of war		Surface water contamination	✓
Groundwater contamination	✓	Transboundary pollution	✓
Human migration	✓	Wastewater	✓

3.7. UNEP, *Environmental Consideration of Human Displacement in Liberia: A Guide for Decision-Makers and Practitioners,* 2006

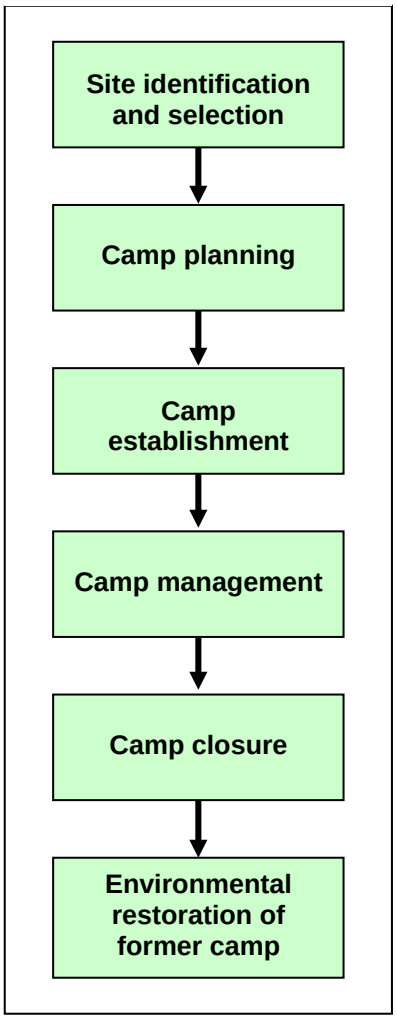
3.7.1. Background

The UN has a primary mission of providing humanitarian assistance to displaced populations, including refugees and internally displaced persons (IDP). Displaced populations can be a result of conflict or natural disaster, but they share common elements in terms of their needs, environmental effects, and actions needed to minimize human, economic, and environmental costs.

This UNEP publication addresses environmental management in the context of mass human migration and displacement. This guide outlines the process for integrating environmental considerations into the planning, management, and closure of camps to house refugee and IDP populations. The guide also examines integrating environmental considerations into planning and executing actions to return these people to their homes and reintegrating or reestablishing their local social structures.

Using the humanitarian displacement of refugees and internally IDPs in Liberia as a backdrop, the report presented examples of the kinds of issued faced in managing a human population displacement. The guide offers checklists and best practices developed based on experience obtained via the management of refugee and IDP camps in Liberia and the eventual reintegration of the displaced persons into Liberia and neighboring countries, notably Sierra Leone.

Figure 3-8: Camp Management Lifecycle



3.7.2. Assessment Method

This guide uses a series of case studies, primarily in Liberia, to demonstrate lessons learned in managing camps for refugees and IDPs. Based on the direct experience of UN and other NGOs that established and/or operated these camps, this guide is a useful handbook for planning, establishing, operating, and decommissioning such camps.

3.7.3. Summary of Findings

Using the camp management lifecycle shown in Figure 3-8, the guide examines environment issues from the initial identification of a potential site for a camp, through its planning, establishment and management, to eventual closure and post-closure land and environmental restoration. In doing so, the guide takes a holistic view of environmental issues, looking beyond immediate issues such as preventing deforestation or restoring deforested areas to the myriad of issues essential to building and reestablishing people's livelihoods and their personal security (e.g., helping create income-generating opportunities).

The guide also examines environmental and infrastructure issues in resettlement of displaced populations, with a focus on preventing environmental degradation or destruction from taking place during when preparing for the return of displaced people. Here, the keys to success appear to be early planning, knowledge of existing conditions in the anticipated area of return, and the kinds of livelihood options available to people when they resettle. Instead of providing only minimal reintegration and return assistance, preventing depletion of natural resources or the impairment or destruction of environmental goods and services, for example, enhances the likelihood of successful resettlement.

Figure 3-9: Crowded Conditions at Salala Camp, Liberia

Using direct references to the situation in Liberia following that nation's decades long civil war where UNEP camps and other humanitarian organization camps hosted some 800,000 refuges and IDPs for nearly 15 years, the guide also speaks to the challenges associated with resettling and reintegrating this population in the post-conflict period. A series of case studies outlines the various environmental issues encountered in the management of refugee and IDP camps in Liberia, such as the Salala Camp, near Monrovia (see Figure 3-9). Table 3-9 summarizes several of these case studies.

Table 3-9: Summary of Example Case Studies

Title	Summary
Location and proximity of IDP and refugee camps as an indicator of environmental vulnerability	In Liberia's civil war, a majority of IDP camps were located in and around Monrovia (the capitol) and spread out to the northeast. Nine camps were located within a radius of only 4 km, whereas others were spread evenly along a northeast-southwest primary road, spaced 4–10 km apart. Given the population density in this area, the crowded living conditions, and the need to obtain basic items such as fuel wood, building poles, and thatching materials, a range of environmental effects existed throughout a zone that stretched from the coast to almost 120 km inland.
From abundance to scarcity—addressing needs and protecting the environment	This case study examines the social effects associated with the arrival of a refugee or IDP population on the residents of a given area. Some 15,000 Sierra Leonean refugees fleeing into Liberia created an unprecedented demand for fuel wood and thatching, changing the pre-crisis abundance into a shortage. The UN High Commission for Refugees, through the Environmental Foundation for Africa, trained refugees and people from the host communities to produce and use energy-efficient cooking stoves, reducing the demand for fuel wood and reducing the pressure on the dwindling vegetation cover.
Protecting vegetation cover despite high population density	This study evaluated the positive benefit of maintaining vegetative cover inside a camp. The camp studied was the largest refugee camp in Liberia, with more than 20,000 Sierra Leonean refugees. Planting fast-growing trees within the camp, along with preserving indigenous trees, allowed the site to be quickly restored to its pre-camp state.
Tumutu camp: site assessment aids planning	The Norwegian Refugee Council considered environmental conditions when establishing the Tumutu IDP camp. The camp followed the site selection and layout criteria specified in various guides on the subject. Criteria considered included the year-round availability of water, year-round accessibility, access to other local settlements, availability of vegetation and fuel wood, and avoidance

Table 3-9: Summary of Example Case Studies

Title	Summary
	of ecologically sensitive areas like national parks. The camp layout also considered the needs of individual households, especially space for gardening. As a result, this camp had a lower overall environmental effect than camps not properly sited.
Environmentally conscious site preparation	Environmentally friendly construction practices and adoption of traditional building practices were used in building several camps. Examples include preserving topsoil by clearing land using machetes; minimizing heavy equipment use to limit soil compaction; protecting existing trees by marking and education; and using raditional mud daubing to protect wood from decay, thus extending the lifespan of the construction material.

3.7.4. Relevance to the U.S. Army

This guide is relevant to U.S. Army support of humanitarian missions (e.g., support of populations displaced by natural disasters) and to operational planning where there is a potential for a population of refugees or IDPs to turn to the U.S. military for support during and following a period of conflict.

To a lesser degree, the U.S. Army could benefit from evaluating the relevance of the checklists on camp planning, operation, and closure to U.S. Army doctrinal publications related to establishing and operating enduring, but impermanent, facilities supporting contingency operations. These checklists address the following:

- Addressing camp closure
- Restoring forest landscapes
- Identifying sites for return and reintegration
- Promoting energy-saving practices
- Promoting sound water and sanitation practices
- Promoting sound construction
- Promoting sound agricultural practices
- Promoting sound livestock management
- Promoting sound waste management practices
- Promoting sound income-generating practices.

Table 3-10: Example Checklist

Identifying sites for return and reintegration	
Checklists	Assess the community's needs in terms of domestic energy (and preferences for fuel/cooking types)
	Promote the use of improved cooking stoves
	Ensure that people are using and maintaining them correctly
	Demonstrate and promote improved cooking practices
	If conditions allow, encourage shared cooking; this action also should be considered during camp layout
	Examine options for promoting alternative fuels
	Monitor household needs and fuel consumption rates
	If possible, expand technical support to local communities as well

Table 3-10 is an example of the checklists contained in the guide. This checklist addressed the promotion of energy-saving practices. Often, refugee and IDP populations rely on woodcutting for their cooking fuel, resulting in deforestation, loss of topsoil, and reduction in agricultural productivity. Table 3-11 presents a summary scorecard for Liberia.

Table 3-11: Summary Scorecard *Environmental Consideration of Human Displacement in Liberia: A Guide for Decision-Makers and Practitioners*

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations	✓	Improve pre-deployment and field environmental training	✓
Encourage an environmental ethic throughout the Army that extends to contingency operations	✓	Invest more in environmental resources and good environmental practices for field operations	
Better incorporate environmental considerations into planning	✓	Use a "sustainability" model	✓
Environmental Issues Identified			
Asbestos		Lack of institutional capacity	
Cultural resource damage		Natural resource damage	✓
Deforestation/desertification	✓	Petroleum releases	
Drinking water supply	✓	Solid/hazardous wastes	✓
Explosive remnants of war		Surface water contamination	✓
Groundwater contamination		Transboundary pollution	
Human migration	✓	Wastewater	✓

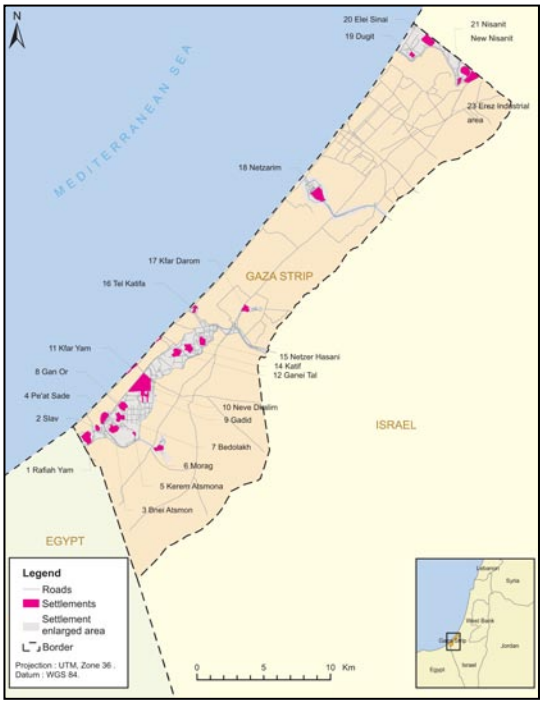
3.8. UNEP, *Environmental Assessment of the Areas Disengaged by Israel in the Gaza Strip*, 2006

3.8.1. Background

In the decades following the Arab-Israeli conflicts in 1967, Israel established numerous settlements in the area known as the Gaza Strip (see Figure 3-10). These settlements, located throughout the Gaza Strip, varied from small hamlets to large tracts used for agricultural, industrial, and residential purposes. In the years following 1967, Gaza was the site of continual low-intensity insurgency warfare, marked by periods of higher intensity insurgency warfare (e.g., the first [1987–1993] and second [2000–2006] *Infitada*).

In 2005, following years of dialog over control of the Gaza Strip, Israel implemented a unilateral disengagement plan. Under this plan, Israel dismantled 21 settlements in the Gaza Strip and in the joint Israeli-Palestinian Erez Industrial Zone (EIZ) (see Table 3-12). As part of disengagement, Israeli destroyed most of the Israeli-related residential structures and some of the associated infrastructure (e.g., electrical service, sewerage).

Figure 3-10: Map of the Gaza Strip



Following the Israeli withdrawal, the Palestinian National Authority (PNA) assumed full administrative authority in the Gaza Strip. As part of the PNA response to the Israeli disengagement plan, the Palestinian Environment Quality Authority (PEQA) requested UNEP assistance with a systematic assessment of the environmental conditions at the vacated settlements. UNEP responded with a comprehensive assessment plan, conduct of historical research, and remote sensing analyses, followed by an on-the-ground assessment by an international team of UN personnel.

Table 3-12: Israeli Settlements in Gaza Before the 2005 Withdrawal

Bedolah,	Bnei Atzmon (Atzmona)	Dugit
Elei Sinai	Gadid	Gan Or
Ganei Tal	Katif	Kfar Darom
Kfar Yam	Kerem Atzmona	Morag
Neveh Dekalim	Netzarim	Netzer Hazani
Nisanit	Pe'at Sade	Rafiah Yam
Slav	Shirat Hayam	

3.8.2. Assessment Methodology

The UNEP objectives for this post-disengagement environmental assessment were:

- Establish a baseline of conditions at the disengaged settlements
- Identify areas where environmental conditions presented a concern in resettlement.

The subject area included 21 former Israeli settlements in the Gaza Strip, including several beaches associated with these settlements.

The assessment procedures used by the UNEP team are similar in organization and scope to that used by DoD or other federal agencies in performing environmental assessments domestically. Within each of the settlements assessed, the assessment involved:

- Using historical research and remote sensing analyses to identify areas of interest
- Visiting the former settlements and where appropriate, performing in-the-field analyses or collecting samples of environmental media (e.g., soil, water) for subsequent quantitative analysis
- Identifying areas (e.g., hazardous waste disposal, presence of friable asbestos) or issues of immediate public health concern (e.g., contaminated water)
- Preparing a report summarizing the assessment findings, offering recommendations for subsequent actions (e.g., resolving immediate public health hazards), and making the collected information available for later use (in this case by the Palestinian Authority).
- The first phase involves collection and analysis of existing information about conditions at the site. This historical research accompanied an assessment of remotely sensed information (in this case, recent commercially obtained satellite imagery) of the Gaza Strip. The satellite imagery allowed careful planning of fieldwork, ensuring maximum efficiency of the deployed personnel.

As is the case with environmental assessments elsewhere (e.g., Australia, Europe, United States), this UNEP study used health-based comparison values for chemical concentrations and radioactivity to determine the significance of detected contaminants. Table 3-13 summarizes the sources of these values.

3.8.3. Summary of Findings

Similar conditions occurred across the 21 former settlements, with the assessment finding:

- Nearly all residential structures were razed without benefit of a coordinated plan for demolition debris management; therefore, collection, removal, and recycling or proper disposal of this debris is needed before resettlement.
- Some non-residential structures (e.g., warehouses, administrative and public structures) were razed, whereas others remained standing in various states of disrepair.

Table 3-13: Environmental Comparison Values Used in Gaza Study

Media	Standards Used
Soil	United Kingdom Contaminated Land Exposure Assessment (CLEA) standards, using the most restrictive exposure scenario (i.e., domestic gardens with vegetable root uptake)
Soil	Dutch (2000) standards for soil remediation (i.e., concentrations above which remediation is required)
Water	Dutch intervention values (i.e., the concentration triggering requirements for remediation)

- A portion of the industrial infrastructure was razed (e.g., power and water infrastructure remained in some places, but was absent in others).
- Roads were generally well maintained and usable but sidewalks and pedestrian walkways were extensively damaged by removal of subsurface infrastructure (e.g., subsurface electrical transmission lines).
- The residential settlements had localized areas of petroleum hydrocarbon contamination (primarily from spilled fuel), but this contamination did not present an immediate or significant risk to public health or the environment.
- Roof and wall sheeting and other asbestos-containing debris were identified in 12 settlements and the EIZ; therefore, this material must be collected for proper disposal
- The EIZ has several areas (e.g., the demolished power generation station) with significant contamination by petroleum and other chemicals.
- Eight of the settlements had associated solid waste disposal areas requiring land use restrictions and a follow-up action plan (e.g., further assessment to determine the need for remediation).
- There is a widespread solid waste management problem attributed to numerous low-technology disposal sites at which large volumes (> 50 percent) of reclaimable biodegradable material are being disposed rather than recycled, thereby contributing to uncontrolled scavenging and reduction in total disposal capacity.
- Small quantities of hazardous wastes (e.g., lead-acid batteries, solvents, agricultural chemicals) are widely present and require collection for proper disposal.
- Water quality was generally good, with no contamination detected at concentrations requiring intervention.[5]
- There is no evidence of anthropogenic radioactive materials.

[5] The samples from two wells indicated trace concentrations of hydrocarbons; UNEP recommended continued monitoring before initiating a detailed investigation.

- There is a need for a Gaza Strip-wide comprehensive solid and hazardous waste management program and a comprehensive coastal zone management program addressing coastal zone construction, effluent disposal, and dune disturbance.

3.8.4. Relevance to the U.S. Army

Some of the findings of this PCEA are consistent with the experience of the U.S. Army when exiting from a forward operating base or more enduring facility or installation. For example, the most common contaminant found by the UNEP team was petroleum products. The U.S. military often encounters petroleum contamination at facilities where there was long-term operation of fueling points for vehicles or above- or underground storage tanks containing petroleum products. In contrast, the other findings—for example, the presence of vast quantities of residential building rubble—are typically not seen when U.S. forces vacate a base, save when U.S. forces relocate during ongoing combat operations.

When viewed compared with the findings of the *Green Warriors* report and against the experience to date under various domestic and international force realignments and redeployments, this PCEA points out that the direct environmental consequences from the disengagement and withdrawal of forces not engaged in combat operations are limited in scope and effect and similar to the conditions following any departure of the military from a facility where it was based for an extended period. The effects that occur most often are releases of petroleum products and the creation of large quantities of building rubble that must be disposed of as part of reconstruction. Table 3-14 presents a summary scorecard for Israel in the Gaza Strip.

Table 3-14: Summary Scorecard *Environmental Assessment of the Areas Disengaged by Israel in the Gaza Strip*

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations		Improve pre-deployment and field environmental training	
Encourage an environmental ethic throughout the Army that extends to contingency operations		Invest more in environmental resources and good environmental practices for field operations	
Better incorporate environmental considerations into planning	✓	Use a “sustainability” model	
Environmental Issues Identified			
Asbestos	✓	Lack of institutional capacity	
Cultural resource damage		Natural resource damage	✓
Deforestation/desertification		Petroleum releases	✓
Drinking water supply	✓	Solid/hazardous wastes	✓
Explosive remnants of war		Surface water contamination	
Groundwater contamination		Transboundary pollution	✓
Human migration	✓	Wastewater	✓

3.9. UNEP, *Ground Contamination Assessment Report: Military Waste Storage Site, Astana, Afghanistan,* 2006

3.9.1. Background

In November 2005, the Afghanistan New Beginnings Programme (ANBP) approached UNEP to undertake a preliminary assessment of a military storage site located near Astana, a small village in the Panjshir Valley. The subject site is an open and undeveloped parcel of land in the Parwan Province of Afghanistan. The site extends north from the base of the Hindu Kush mountain range toward the Panjshir River (see Figure 3-10).

Figure 3-10: Astana, Afghanistan

The Russian army used the site as a helicopter base during the 1980s. Traces of this activity (e.g., helicopter engines, armory components, and instrument panels) are still visible onsite. The Russian army evacuated Astana in the late 1980s.

During the period of Taliban governance in the 1990s, the Afghan Northern Alliance—the Taliban's main opponents—stockpiled military hardware throughout the Panjshir Valley. Anecdotal evidence shows that rocket components were transported from various areas in the country to form an arsenal that could be used against the Taliban, though it is unclear whether any rockets were actually fueled and launched from the site during that period.

The site is used regularly as grazing land for goat and cattle herds. It also is apparent that crops have been cultivated in some areas in the past. Local guardsmen indicated that part of the site had been used to grow vegetables, but that this practice had been stopped because of odors emanating from the materials stored nearby.

3.9.2. Assessment Methodology

UNEP representatives based in Kabul managed this project, and the UNEP Post-Conflict Branch in Geneva oversaw it. The project included the following:

- The investigation and characterization of hazardous substances stored on the subject site
- The assessment of potential environmental and health risks associated with the storage of hazardous wastes, and the communication of these risks to the relevant stakeholders
- The development of pragmatic recommendations for remedial action.

Assessment of the site involved historical research, interviews, and on-the-ground site visits, photographs, soil sampling, water sampling, air monitoring, and radioactivity testing.

3.9.3. Summary of Findings

The site assessment team identified military equipment in several stockpiles (see Figure 3-11). The stockpiles were divided into four main sites:

- Site 1: Missile and warhead storage site

- Site 2: Rocket fuel storage site
- Site 3: Warhead cover storage site
- Site 4: Missile casing and nitric acid storage site.

In its current state, the Astana site represents high risks for numerous environmental and human receptors. The principal risks identified relate to the storage of hazardous substances and, to a lesser extent, to the locally affected soil conditions recorded on site. Table 3-15 summarizes the UNEP assessment findings.

Figure 3-11: SCUD Warhead Canisters

Table 3-15: Astana SCUD Site Findings

Substance	Presence at Astana
Unsymmetrical dimethylhydrazine (UDMH)	UDMH is a conventional rocket propellant commonly used in Russian SCUD missiles. It is estimated that up to 45 m^3 of UDMH currently remain on site. Anecdotal evidence indicates that looters are removing UDMH container lids to sell as scrap metal. UDMH is a probable human carcinogen. Hydrazine compounds were recorded in soil and in water samples recovered from two locations onsite.
Nitric acid	Nitric acid is a strong oxidizing agent that is mixed with UDMH fuel in the launching process of SCUD missiles. About 10 m^3 of nitric acid remain on site. Additional nitric acid containers may still be buried. Although relatively neutral pH values were recorded in soil surrounding the nitric acid storage area, elevated concentrations of nitrates were detected in specific locations, which is potentially indicative of past spills or leaks of nitric acid.
Radioactive materials	Elevated levels of radiation were recorded in damaged helicopter instruments found on site. It is expected that the source of radiation is radium or tritium within the instruments themselves. It is estimated that between 100 and 300 instrument panels remain on site. Radiation above laboratory detectable limits was not recorded in any soil or water samples recovered from the site.
Unexploded ordnance	It is estimated that up to 4,800 kg of unexploded ordnance remain on site in the form of 32 missile warheads. The majority of these warheads are stored in protective casings or cradles, but a few remain exposed (see **Error! Reference ource not found.**). Analysis of the soil surrounding the warheads revealed significantly high levels of the explosive compounds RDX and TNT.

3.9.4. Relevance to the U.S. Army

Hazardous chemicals and other miscellaneous materials associated with the fueling, arming, and firing of SCUD missiles remain onsite and present serious risks to the human and animal populations that live and work in the Panjshir Valley. These risks affect the local people's ability to use the land for agricultural purposes, requiring them to identify other, perhaps less beneficial means to survive. Local residents also have pilfered through the abandoned site, dismantling metal containers containing hazardous substances and removing from the site to be recycled for

profit. This practice has further exposed the people to the hazards that are present at the site and made the remaining hazards less stable.

This situation highlights the need for a military to be cognizant of what they bring in and leave behind after combat operations. A military should be equipped to remove or neutralize hazards that are brought in during combat operations so that neither the military nor the residents will be exposed to such hazards. Without this awareness and capability, continued exposure will lead to environmental degradation and present a long-term danger to local residents. Table 3-16 presents a summary scorecard for Astana, Afghanistan.

Table 3-16: Summary Scorecard *Ground Contamination Assessment Report: Military Waste Storage Site, Astana, Afghanistan*

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations		Improve pre-deployment and field environmental training	✓
Encourage an environmental ethic throughout the Army that extends to contingency operations	✓	Invest more in environmental resources and good environmental practices for field operations	✓
Better incorporate environmental considerations into planning	✓	Use a "sustainability" model	✓
Environmental Issues Identified			
Asbestos		Lack of institutional capacity	
Cultural resource damage		Natural resource damage	✓
Deforestation/desertification		Petroleum releases	✓
Drinking water supply	✓	Solid/hazardous wastes	✓
Explosive remnants of war	✓	Surface water contamination	✓
Groundwater contamination	✓	Transboundary pollution	
Human migration		Wastewater	

3.10. UNEP, *UNEP in Iraq—Post-Conflict Assessment, Clean-up and Reconstruction*, 2007

3.10.1. Background

The UN experienced years of challenges dealing with the Saddam regime—from the controversial use of chemical weapons during the Iran-Iraq war of the 1980s, to Iraq's invasion of and forcible expulsion from Kuwait, to the decade of arms inspections, oil-for-food programs, and eventually, the invasion of Iraq and toppling of the Saddam regime. The UN expended significant effort in missions within Iraq, developing a large body of knowledge about a host of issues, including environmental and natural resource management issues.

UNEP was in Iraq performing environmental work before the 2003 conflict and continued to work after the fall of the Saddam regime. The focus of this UNEP mission was assessing the environmental situation before and during OPERATION IRAQI FREEDOM (OIF) and into the ensuing reconstruction period. UNEP worked to help establish the MoEN, a key counterpart institution needed to lead environmental capacity-building efforts. UNEP's interventions with MoEN had nine key objectives:

- Assess the existing environmental issues in Iraq that require focused attention from MoEN and support from the international community

- Assess the existing capacity within MoEN and other ministries to address those environmental priorities
- Undertake field-based assessments of environmental contamination caused by conflict and by industrial activities
- Support the sustainable management of the Iraqi marshlands
- Re-link Iraq to regional and multilateral institutions dealing with environmental issues
- Reestablish cooperation between Iraq and its neighbors on issues relating to the environment
- Strengthen the institutional capacity of the MoEN for environmental monitoring and information management
- Strengthen the institutional capacity in Iraq for responding to environmental emergencies
- Incorporate environmental concerns into other activities undertaken by the United Nations in Iraq.

All UNEP engagement activities sought to help Iraq not only recover from damage to its environment caused by conflict but also create a plan for future sustainable development. Table 3-17 lists some of the UNEP actions between 2003 and 2007.

A significant element of each UNEP project was providing adequate training and equipment to Iraqi government ministry representatives. Substantial efforts also went into on-the-ground implementation of pilot projects with teams of Iraqis and international contractors working together on projects such as hardware installation activities. Capacity-building activities were undertaken from neighboring countries such as Jordan, Syria, Egypt, and Bahrain, and when required, from Switzerland, Kenya, and Japan. For the marshlands project, training activities inside Iraq were carried out in cooperation with relevant ministries and local universities. To facilitate constant dialog and domestic implementation, UNEP appointed a national coordinator for the marshlands project and established a coordination mechanism with national, provincial, and local institutions.

Table 3-17: UNEP Key Objectives in Cooperative Efforts with the Iraqi MoEN, 2003–2008

Effort	Timeframe
Desk study on the environment in Iraq	Feb–Apr 03
Post-conflict needs assessment	Jun–Oct 03
Capacity-building activities	Mar 04–Sep 06
Environmental site assessments	Jul 04–Nov 05
Institutional capacity assessment	Jan–Dec 05
Clean-up of contaminated sites	Nov 05–Dec 06
Environmental mainstreaming within the UN Programme for Iraq	Jan 05–Dec 06
Support to environmental management of the Iraqi marshlands including: strategy development and coordination; baseline data collection and analysis; capacity-building; pilot project implementation in drinking water provision, sanitation and wetland restoration; and awareness-raising	Jul 04–Jul 07
Activities related to depleted uranium	Jun 05–Jul 07

UNEP began working in Iraq under the assumption that the security situation would gradually improve. Instead, the deterioration of the security situation in Iraq, especially the bombing of the

UN compounds in August and September 2003, was a significant constraint on the ability of the UNEP to execute its missions. UNEP experienced many issues, including those below:

- Loss of key personnel (e.g., having been killed or injured in the attacks or having resigned because of personal security concerns)
- Field activities that incurred severe delays because of security problems, shortened working hours border closings, curfews, and movement restrictions
- Projects that were adapted in design and delivery to minimize time and efforts inside Iraq (e.g., greater use of prefabricated, container-loaded system)
- Inability of UNEP experts to travel to Iraq to work with Iraqi nationals undertaking various projects.

Nonetheless, UNEP found solutions to these issues and was able to successfully complete and transition many projects to the Iraqi government.

3.10.2. Assessment Methodology

UNEP carried out a wide range of activities in Iraq between 2003 and 2006, primarily through the UN Post-Conflict and Disaster Management Branch (PCDMB) and the International Environmental Technology Centre (IETC). Many activities continued into 2007 and beyond. The UNEP decided to prepare an up-to-date compilation of information about these activities, drawing from earlier publications detailing specific projects. UNEP objectives in developing this report were as follows:

- Provide a complete description of the various activities undertaken by UNEP in Iraq between 2003 and 2006
- Make an objective assessment of the effects of UNEP's intervention
- Document the lessons learned by UNEP in implementing activities in a complex situation such as Iraq.

The report that was issued not only met UNEP's overall objectives, demonstrating the success of many of the interventions undertaken between 2003 and 2007, but also provides significant insight into the overall success of UNEP's intervention in Iraq.

3.10.3. Summary of Findings

Although the report addresses many projects, one UNEP project is of particular importance: *Desk Study on the Environment in Iraq* (2003). With the escalation of issues between the international community and Iraq in late 2002 and early 2003, UNEP brought together a team of experts to monitor environmental effects related to the conflict.

The team began to compile the information about conditions in Iraq as a preparatory action to what it saw as an inevitable engagement, helping resolve environmental and infrastructure issues in Iraq. The team conducted regular surveillance of conflict-related news feeds and, placing this against the backdrop of the environmental situation in Iraq, prepared a series of situation reports on environmental issues associated with the conflict.

The UNEP team documented this information in its publication *Desk Study on the Environment in Iraq* (2003) and the companion document *Environment in Iraq UNEP Progress Report* (2003). Both reports outlined the key chronic environmental problems that the country faced, as well as

the environmental threats posed by the military conflicts. The *Desk Study* proved to be an important baseline for planning the post-conflict reconstruction efforts undertaken after the fall of the Saddam regime. Table 3-18 presents some key findings of the *Desk Study*.

Table 3-18: Key Findings in the UNEP *Desk Study on the Environment in Iraq* (2003)

Finding Area	Summary
Pollution Associated With Disruption of Power Supply	Targeting of the power grid caused Baghdad, Basra, and other cities to experience extended periods without electricity, resulting in serious effects to already inadequate water distribution and sanitation systems. As a result, millions of civilians were deprived of basic services, the risk of disease was elevated, and the pollution burden of the Tigris River increased.
Oil Well Fires in Southern Iraq and Oil-Filled Trenches Around Baghdad	There were instances of oil fires, either from destroyed oil wellheads or Iraqi forces setting fire to oil-filled trenches in an attempt to reduce visibility and impede coalition weapons. Of these, the trenches had a greater effect on human health and the environment, generated large quantities of dense black smoke containing a range of toxic substances, contaminating soil, and polluting groundwater bodies used as drinking water supplies.
Targeting of Industrial Sites	The study documents several cases in which coalition air bombardment targeted industrial sites, especially those with potential dual uses, such as fertilizer and pharmaceutical facilities. These sites were potential sources of air, soil, and water pollution, with possible risks for human health. There also was a documented case of a coalition air strike on a missile factory damaging buildings within the Al-Rasheed water treatment plant.
Targeting of Military Sites	As should be expected, coalition forces hit military sites especially hard. Many of these attacks achieved the military objective of denying the Iraqi military arms and other support; however, these attacks also were associated with releases into the environment. The Al-Kindi rocket and missile development site located at Mosul, near the Tigris River some 400 km north of Baghdad, was targeted by a coalition air strike on 30 March 2003. IAEA and UNMOVIC inspectors had visited the site on four occasions between December 2002 and February 2003. On 3 April, the Pentagon reported dropping a precision-guided bomb on a surface-to-air missile factory in the southwestern outskirts of Baghdad.
Physical Degradation of Ecosystems	The study documented the widespread degradation of the fragile ecosystems of the Iraqi desert. The movement of thousands of military vehicles over open ground, intensive fighting, and air bombardments had effects that will take many decades for nature to erase.
Effects Due to Looting and Other Acts of Vandalism	Following the collapse of the Saddam regime, widespread and often indiscriminate looting resulted in environmental damage. One case cited in the *Desk Study* was the Al-Mishraq Sulfur State Company near Mosul. For unknown reasons, the plant was burned, emitting a huge visible plume containing sulfur dioxide, sulfuric acid, and other oxidized sulfur by-products. It was reported that molten elemental sulfur affected the Tigris River. In another case, the Al-Doura refinery warehouses near Abu Ghraib were ransacked, causing a major environmental disaster. More than 5,000 tons of chemicals were used, and highly hazardous materials (e.g., tetraethylene lead, furfural) were spilled, burnt, or stolen. Burning of the chemicals generated toxic fumes affecting a radius of 2 to 3 km around the storage facility. Consequently, the entire area is assumed to be heavily contaminated with a high potential for groundwater pollution.

Table 3-18: Key Findings in the UNEP *Desk Study on the Environment in Iraq* (2003)

Finding Area	Summary
Sabotage of Oil Pipelines	The sabotage of oil pipelines across Iraq temporarily halted oil exports (limiting income needed for reconstruction), resulting in significant, albeit localized, environmental damage.
Uncontrolled Dumping of Municipal Waste	The vacuum created by the sudden collapse of the Saddam regime, coupled with the limited control asserted by the coalition in the days immediately following, led to uncontrolled dumping of municipal waste into the streets. Conflict-generated demolition waste from bomb-damaged buildings and military hardware (e.g., vehicles, unexploded ordnance) also presented a massive solid and hazardous waste management challenge. The Coalition Provisional Authority (CPA) initiated an emergency waste collection program that ran for 6 months, removing more than 1 million m^3 of waste from the streets and neighborhoods of Baghdad. The CPA opened three new temporary landfills to handle the excessive amount of waste generated. At one point, one of these temporary landfills (Awarisch in southwestern Baghdad) contained more than 10,000 damaged or destroyed military vehicles.

The balance of the document addresses the condition of the Iraqi environmental governance structure and natural resources, and the success of various UNEP projects to improve governance and site conditions.

3.10.4. Relevance to the U.S. Army

This document is relevant to the U.S. Army in that it highlights the strategic and tactical importance assigned to environmental and natural resource management issues and the value of a comprehensive environmental and natural resources assessment to conflict prevention, military operations, and post-conflict reconstruction efforts.

Historically, during contingency operations, the U.S. Army considered environmental issues primarily at the tactical level, with a primary focus on our forces achieving some designated minimum standard of environmental stewardship. There are notable exceptions, such as the deployment of forces to protect Iraqi oilfields from a repeat of the environmental terrorism Saddam's forces inflicted on Kuwait in the waning days of OPERATION DESERT STORM, but these are more often exceptions to the rule than the standard operational practice. It is comparatively recently that the Army began to consider the broader strategic implications of environmental management during contingency operations.

In contract, the *Desk Study* is an example of the kind of strategic and tactical environmental and natural resource assessment that the Army should be able to undertake as part of the operational planning process and to review and update in the period following cessation of hostilities. This information can be used to assist operational planners in preparing operational orders that minimize direct environmental effects (i.e., avoiding damaging chemical plants) where militarily possible. Such a study also has strategic value in informing planning for operations during the immediate period after cessation of hostilities, in the post-conflict transition period when the defeated forces undergo disarmament and demobilization, and the post-conflict reconstruction period. During these phases, a comprehensive environmental assessment will enable U.S. forces to target actions intended to restore key pieces of environmental infrastructure such as water and wastewater treatment facilities as quickly as possible. Such actions can greatly reduce the

potential for disease outbreaks and promote a return to a sense of normalcy and increased confidence in the government's ability to provide positive benefits to the citizenry.

In addition to informing strategic decision-making, a comprehensive environmental and natural resources assessment has tactical value in helping commanders on the battlefield understand and prepare for the kinds of environmental conditions that U.S. forces will encounter (e.g., lack of sewage systems, uncollected solid waste). As is seen from the CPA's need to establish an emergency solid waste management system and to open new landfills to provide capacity for disposal of building rubble, destroyed vehicles, and other detritus of war, our forces, accustomed to environmental support at their home stations, may encounter conditions so far removed from their experience to date that they likely will face difficulty in preparing effective responses. A comprehensive environmental assessment ensures that field commanders are aware of and understand the conditions they will encounter and have considered options for responding to those conditions. Table 3-19 presents a summary scorecard for the post-conflict assessment, clean-up, and reconstruction.

Table 3-19: Summary Scorecard *UNEP in Iraq—Post-Conflict Assessment, Clean-up, and Reconstruction*

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations	✓	Improve pre-deployment and field environmental training	✓
Encourage an environmental ethic throughout the Army that extends to contingency operations		Invest more in environmental resources and good environmental practices for field operations	✓
Better incorporate environmental considerations into planning	✓	Use a "sustainability" model	✓
Environmental Issues Identified			
Asbestos		Lack of institutional capacity	✓
Cultural resource damage		Natural resource damage	✓
Deforestation/desertification	✓	Petroleum releases	✓
Drinking water supply	✓	Solid/hazardous wastes	✓
Explosive remnants of war	✓	Surface water contamination	✓
Groundwater contamination	✓	Transboundary pollution	✓
Human migration	✓	Wastewater	✓

3.11. UNEP, *Lebanon Post-Conflict Environmental Assessment*, 2007

3.11.1. Background

Lebanon is a small, largely mountainous country located on the eastern shore of the Mediterranean Sea (see Figure 3-12). It is bordered by Syria to the north and east, and by Israel to the south. Conflict between Lebanon and Israel erupted on 12 July 2006, ending 34 days later with a ceasefire on 14 August.

This conflict caused severe damage to infrastructure with widespread destruction of arterial roads and more than 100 bridges or overpasses. Beirut airport and sea ports were bombed, and roughly 30,000 housing units were destroyed or badly damaged. The bombing of fuel storage tanks at the Jiyeh thermal power plant resulted in some 10,000–15,000 tons of heavy fuel oil spilling into the sea, affecting about 150 km of Lebanese coastline, as well as part of Syria's coast.

The 1975–1990 civil war seriously damaged Lebanon's economic infrastructure, but the economy witnessed its strongest period of sustained growth since 1995 in the first half of 2006, before the July–August war. Based largely on the tourism sector, the growth was reversed by the conflict, which damaged infrastructure and trade. With concerns regarding the extent of environmental damage caused by the conflict, the Lebanese Minister of Environment requested UNEP to conduct a post-conflict environmental assessment of Lebanon. UNEP sent a team of 12 international environmental experts to Lebanon to conduct a field assessment.

Figure 3-12: Lebanon

3.11.2. Assessment Methodology

The assessment team included experts in solid and hazardous waste management, freshwater resources, land-based contamination, marine and coastal management, and military operations. The team visited more than 100 sites nationwide and took roughly 200 samples of soil, surface water, groundwater, dust, ash, seawater, sediment, and marine animals. The assessment team used the Dutch Intervention Values and Environmental Screening or Target Values for soil and water samples.

The assessment team divided the assessment into five distinct categories of concern:

- Industrial and urban contamination
- Solid and hazardous waste
- Water resources
- Coastal and marine environment
- Weapons.

The findings, detailed laboratory test results, and recommendations were documented for further monitoring and to assist the government in developing environmental management policies and remediation priorities.

3.11.3. Summary of Findings

Although lasting only 34 days, the summer 2006 conflict inflicted serious environmental damage on Lebanon. The most visible environmental effect was the oil spill from the bombing of the Jiyeh power plant. Further, the Lebanese people were unable to handle the vast quantities of rubble resulting from the bombings. Finally, the risk associated with unexploded cluster bombs throughout Lebanon was severe and extensive.

The spill from the Jiyeh power plant released 10,000–15,000 tons of oil along the coastline of Lebanon, severely affecting coastal communities. The ongoing conflict impaired local and international capacities to respond to the spill (see Figure 3-13). An ongoing containment and clean-up operation was launched in the weeks following the conflict. A substantial amount of the oil sank to the sea bottom in the immediate vicinity of the power plant, most likely smothering the biota in the sediment. The risk of remobilization remains unless the oil is fully extracted. As

a result of prevailing wind conditions and sea currents, most of the oil that did not sink was pushed against the coast and northwards, affecting marinas, wharfs, beaches, property, and archeologically important sites.

Figure 3-13: Oily Waste From Clean-up

Management of solid waste is one of the key environmental issues Lebanon faces. Existing dumpsites have become overloaded with conflict-related demolition rubble, exacerbating existing problems with solid waste management. Numerous additional dumpsites were created hastily and in inappropriate locations to cope with the excess debris. A sharp increase in hazardous healthcare waste resulted from conflict-related deaths and injuries. This waste has mixed into the normal waste stream, ending up in routine dumpsites where it constitutes a serious risk to the health and safety of site workers and the public. Oil-contaminated waste materials collected during clean-up operations require appropriate disposal. Hydrocarbon-contaminated soil at many sites, such as petrol stations and industrial facilities, potentially require treatment and/or appropriate disposal.

It is estimated that up to 1 million unexploded cluster bomblets may be on the ground in Lebanon. Between the end of the conflict and 11 November 2006, cluster bomblets killed 23 people and injured 136 people. These munitions pose a grave risk to the Lebanese population and are a serious impediment to post-conflict recovery and reconstruction efforts. Agricultural fields also are heavily contaminated with unexploded ordnance, affecting the livelihoods of populations in those areas.

3.11.4. Relevance to the U.S. Army

Although a power plant is a logical military target during conflict operations, consideration of the consequences (e.g., release of 10,000–15,000 tons of oil into a transboundary coastal environment) could change the decision to target that structure. The U.S. military should reflect on this event and consider how targets might be eliminated, as well as ways to minimize the effect on the environment. Two key actions, quick response and shared institutional knowledge, could have minimized the extent of environmental damage in Lebanon and can be applied to future conflict or contingency operations. Table 3-20 presents a summary scorecard for Lebanon.

Table 3-20: Summary Scorecard *Lebanon Post-Conflict Environmental Assessment*

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations	✓	Improve pre-deployment and field environmental training	✓
Encourage an environmental ethic throughout the Army that extends to contingency operations		Invest more in environmental resources and good environmental practices for field operations	✓
Better incorporate environmental considerations into planning	✓	Use a “sustainability” model	✓

Table 3-20: Summary Scorecard *Lebanon Post-Conflict Environmental Assessment*

Environmental Issues Identified			
Asbestos	✓	Lack of institutional capacity	✓
Cultural resource damage	✓	Natural resource damage	✓
Deforestation/desertification	✓	Petroleum releases	✓
Drinking water supply	✓	Solid/hazardous wastes	✓
Explosive remnants of war	✓	Surface water contamination	✓
Groundwater contamination	✓	Transboundary pollution	✓
Human migration	✓	Wastewater	✓

3.12. *Sudan Post-Conflict Environmental Assessment*, 2007

3.12.1. Background

Sudan's 22 years of continuous civil war ended in January 2005. These years of conflict directly affected more than 60 percent of Sudan's land area. Tribal and small-scale conflicts over cattle theft, access to water and grazing, and local politics fought with small arms are a main theme throughout Sudan's history. A majority of large-scale, long-term conflicts in Sudan were confrontations between the central government and an array of anti-government forces. Government forces were largely composed of conventional army and air forces, and allied local militias, whereas the opposition was local insurgents or militias that evolved into a united resistance army with a parallel governance and administration structure. Most actions were fought with small arms and light weapons, but occasional battles occurred with the use of tanks, artillery, and other assets (e.g., aircraft). All sides widely used landmines throughout Sudan; consequently, an estimated 32 percent of the country is affected by abandoned minefields without clear markings of hazardous areas.

The outbreak of peace, coupled with the economic effects of a rapidly expanding oil and gas industry, provided the Sudanese government with an opportunity to assess the challenges of recovery and development. To accomplish this task, the Government of National Unity (GONU) and Government of Southern Sudan (GOSS) requested UNEP to conduct a PCEA aimed at establishing a sound technical basis for medium-term actions in the fields of environmental protection and sustainable development.

3.12.2. Assessment Methodology

This UNEP PCEA is one of the most comprehensive assessments of environmental issues in a developing nation that has undergone a protracted period of armed conflict, with more than 150 participants on the UNEP team, hundreds of Sudanese government representatives, and thousands of others in academia, business, and society. It not only provides information about the conditions encountered in an emerging nation but also documents many of the day-to-day operational challenges faced in performing a nationwide environmental assessment.

The UNEP PCEA began in late 2005 and continued through 2006, with 10 separate field missions, each lasting 1 to 4 weeks. The geographical scope included all states of the Republic of Sudan, the coastline, and adjacent territorial seas.

The assessment was conducted in two stages—an initial broad scan followed by a targeted study of 12 identified themes and six crosscutting topics, shown in Table 3-21.

Table 3-21: Key Themes Investigated by UNEP in Sudan

Theme		Cross Cutting Topic
Agriculture	International aid	Aid effectiveness
Conflict and peacebuilding	Marine environments/resources	Capacity-building
Environmental governance and awareness	Natural disasters and desertification	Engagement with local partners
Forest resources	Population displacement	Gender
Freshwater resources	Urban environment and environmental health	Livelihoods and food security
Industry	Wildlife and protected area management	Peacebuilding

The following were major components of this process:

- An initial appraisal and scoping study
- Consultation
- Desk studies
- Fieldwork
- Remote sensing
- Analysis
- Development of the recommendations and reporting.

Teams spent 150 days in the field, covering about 12,000 km. The major constraints encountered during the assessment were (1) security risks posed by ongoing military action, (2) field team support logistics, (3) explosive remnants of war issues (e.g., landmines), and (4) lack of environmental data attributed to extended periods of conflict.

Consultation with local and international stakeholders formed a large part of the assessment, with more than 2,000 interviewees, including representatives of federal, state, and local governments, nongovernmental agencies, academic institutions, international agencies, local residents, agriculturists, pastoralists, foresters, and business people. While the assessment of conflict-related indirect and secondary effects (i.e., credible effects sourced in whole or in part to the conflict and the associated war economy, such as environmental effects related to population displacement), natural resource looting, and war economy resource extraction were the focus of the UNEP's efforts. UNEP carried out numerous specific field activities examining the direct consequences of conflict, including the following:

- Inspections of destroyed military equipment
- Viewing areas littered with unexploded ordnance and landmines
- Inspecting burnt and destroyed villages and forests
- Flyovers in conflict-affected parts of Darfur
- Viewing weaponry held by various armed parties throughout Sudan
- Interviews with demining and military experts within Sudan

- Interviews with conflict-affected communities in Darfur, Southern Kordofan, and Southern Sudan.

3.12.3. Summary of Findings

Perhaps the most relevant section of this UNEP report (*Sudan*, 2007) to the questions of environmental consequences of conflict is Chapter 4, *Conflict and the Environment.* UNEP's assessment determined that connections between conflict and environment in Sudan are complex, pervasive, and a paradox, where conflict erupts over the use of shared natural resources, but that same conflict damages these same resources. UNEP acknowledged many factors have contributed to conflict in Sudan that have little or no link to the environment or natural resources (e.g., political, religious, ethnic, tribal and clan divisions, economic factors, historical feuds). In addition, where environment and natural resource management issues are important, they are generally contributing factors only, not the sole cause for tension.

This PCEA identified the following environmental issues that should be of concern to the government of Sudan:

- **Human population displacement**. The most significant effect of conflict on the population of Sudan has been displacement—people fleeing conflict zones seeking security and displacement attributed to drought and economic factors. An estimated 5 million people, around 10 percent of Sudan's population, were displaced and the number of displaced is rising because of the situation in Darfur. Fewer than a million IDPs returned to their homes following the cessation of widespread hostilities. The severe and complex environmental consequences of displacement include deforestation, devegetation, fallow area regeneration, and invasive weed expansion in camp areas; unsustainable groundwater extraction and water pollution in camp areas; uncontrolled urban slum growth; and development of a "relief economy" that exacerbates demand for natural resources.
- **Desertification and regional climate change**. Since the 1930s when records were first kept, there has been as much as a 200-km southward shift of the boundary between the southern semi-desert and the northern desert regions, a trend expected to continue due to declining precipitation. The remaining semi-desert and savannah represent about 25 percent of the arable land in Sudan, and the forecast of continued desertification could claim as much as 20 percent of Sudan's domestic food production.
- **Deforestation**. Between 1990 and 2005, the country lost 11.6 percent of its forest cover, and forests continue disappearing at a rate of 1 to 2 percent per year largely because of domestic energy needs and the clearance of land for agriculture. Two-thirds of the forests in north, central, and eastern Sudan

Figure 3-14: Devegetated Zone Bordering IDP Camp, Darfur

disappeared between 1972 and 2001, whereas southern Sudan is estimated to have lost 40 percent of its forests. Deforestation rates are particularly high near IDP camps (see Figure 3-14).

- **Unconstrained agriculture**. Severe land degradation attributed to demographic pressure and poorly managed agricultural development represent a pressing environmental problem. Land degradation in its various forms, large-scale forest clearance, riverbank erosion, invasive species, pesticide mismanagement, and agricultural water pollution are compromising Sudan's ability to feed its population.
- **Urban issues and environmental health**. Rapid, chaotic urbanization, chronic solid waste management problems, and the lack of effective water and wastewater treatment are the leading environmental problems facing Sudan's urban centers. Cities are growing at unprecedented rates (e.g., Khartoum alone is home to 64 percent of the country's urban population), fueled by the return of formerly displaced persons. In Darfur, urban centers saw population increases of more than 200 percent in 3 years. Wastewater treatment is grossly inadequate across Sudan. Likewise, solid waste management throughout the country is uniformly poor. Both contribute to an elevated incidence of waterborne disease, potentially placing large populations at risk from epidemic outbreaks.
- **Dams and water projects.** Access to freshwater is the most important environmental issue in Sudan. The construction of 20 large dams for hydroelectric power contributed to loss of agricultural land dependent on continuous water flow, whereas severe riverbank erosion occurs as a result of intense releases within short time periods. Dams cause major degradation of downstream habitats, particularly the Blue Nile and lower Atbara River wetlands. Dams and other water projects also are known to contribute to internal conflict. The Jonglei Canal engineering megaproject (see Figure 3-15), initiated in the 1970s, was linked to the start of the north-south civil war. Never completed, the unfinished canal bed hinders wildlife migration, whereas the excavation equipment provides nest habitat for birds and hive locations for bee colonies.

Figure 3-15: Wreckage of the Jonglei Canal Excavator, Testimony to the Risks Associated With Large-Scale Projects in Sensitive Areas

- **Industrial pollution.** Industrial pollution is growing along with Sudan's emerging oil industry. Decades of poor regulation or control over industrial pollution is clearly visible, albeit moderate in terms of scope and effect. As Sudan expands its oil and gas industry,[6] the release of produced waters and wastewaters is a particular concern because of an insufficient number of industrial wastewater treatment

[6] Oil already plays a major role in the Sudanese economy, providing 95 percent of export revenues and 60 percent of government revenues. Conflict and conflict-related international sanctions are hindering further development of Sudan's oil and natural gas resources.

facilities and the limited ability of domestic sewage systems (where such systems exist) to deal with these streams. Air emissions and hazardous and solid waste management are also largely uncontrolled, but occasional examples of responsible environmental stewardship are encountered at some oil, sugar, and cement facilities.

- **Wildlife and protected areas.** Decades of conflict caused significant damage to Sudan's wildlife and habitat. Throughout Sudan, farming, deforestation, subsistence hunting, and poaching are contributing factors. In some areas, species such as elephant, rhino, buffalo, giraffe, eland, and zebra are all but eradicated despite laws seeking to protect the animals and their habitat.
- **Natural disasters.** Numerous long and devastating droughts in past decades undermined food security and are strongly linked to human displacement and related conflicts. Damaging floods also are common, particularly on the Blue Nile, and are a direct result of deforestation and overgrazing. One of the main effects of flooding is severe riverbank erosion in the narrow, but fertile Nile riverine strip.
- **Marine environment.** Although land-based ecosystems in Sudan are a disaster, UNEP found that Sudan's marine and coastal environment is in relatively good condition. UNEP did note concern for this good condition to worsen because shipping from Port Sudan is on the increase, with the associated potential for catastrophic oil spills.
- **Environmental governance.** At the national level, Sudan is challenged to meet its international treaty and convention commitments. Although the technical skill and level of knowledge in the environmental sector are high, regulatory authorities face critical structural and resource problems. Moreover, UNEP's analysis indicates that although most aid projects in Sudan do not cause significant harm to the environment, a few clearly do. For example, a highly complex issue is the environmental effect of the provision of food and other emergency aid to some 15 percent of the population and the projected effect of limited options for shifting these people from aid dependence to autonomous and sustainable livelihoods. As the report states:

  > *Indeed, the country is presently caught in a vicious circle of food aid dependence, agricultural under development, and environmental degradation. Under current circumstances, if aid were reduced to encourage a return to agriculture, the result in some areas would be food insecurity and an intensification of land degradation, leading to the high likelihood of failure and secondary displacement.*

UNEP also claimed to find linkages between environment and conflict with indirect and direct effects:

- **Indirect effects.** These effects are routinely associated with periods of armed conflict and include the effects of population displacement, lack of governance, conflict-related resource exploitation, and underinvestment in sustainable development.
- **Direct effects, where environmental issues are a contributing cause of conflict.** Examples cited include fighting over possession or rights to agricultural lands, freshwater, oil and gas reserves, and timber.

Of particular concern is the link between land degradation, desertification, and conflict in Darfur. Northern Darfur—where exponential population growth and related environmental stress create

conditions for conflicts to be triggered and sustained by political, tribal or ethnic differences—can be considered a tragic example of the social breakdown that can result from ecological collapse. UNEP posits that long-term peace in the region will not be possible unless these underlying and closely linked environmental and livelihood issues are resolved. Table 3-22 summarizes the environmental effects of conflict in Sudan.

UNEP offers 85 recommendations for addressing these complex, widespread, and interwoven environmental issues. These recommendations fall into four principal categories.

- Invest in environmental management to support lasting peace in Darfur and to avoid local conflict over natural resources elsewhere in Sudan.
- Build capacity at all government levels, and improve legislation to ensure that reconstruction and economic development neither intensify environmental pressures nor threaten the livelihoods of present and future generations.

Table 3-22: Summary of Environmental Effects of Conflict in Sudan

Type of Effect	Scale
Direct Effects	**Minor**
Landmines and explosive remnants of war	Significant
Destroyed target-related effects	Not significant
Defensive works	Not significant
Targeted natural resource destruction	Significant in Darfur, not quantifiable
Indirect Effects	**Major**
Environmental effects related to population displacement	Very significant
Looting of natural resources	Significant
Environmental governance and information vacuum	Significant

- National and regional governments should assume increasing responsibility for investment in the environment and sustainable development.
- All UN relief and development projects in Sudan should integrate environmental considerations into their planning and execution to improve the effectiveness of the UN program. Better coordination and environmental mainstreaming are necessary to ensure that international assistance "does no harm" to Sudan's environment.

3.12.4. Relevance to the U.S. Army

This PCEA on Sudan is relevant to the U.S. Army in three ways.

First, this PCEA provides detailed information about the nature of environmental issues likely to be encountered in a country that has endured a protracted period of traditional and low-intensity or insurgent conflict. The U.S. Army should not only consider assessment of the environmental issues associated with U.S. force operations but also assess whether pre-existing environmental degradation could be a post-conflict operational challenge for U.S. forces. The key areas identified in this PCEA are a starting point for future consideration. For example, if natural resource looting was used to fund the conflict, the U.S. Army should consider conducting an assessment that examines whether interdiction of this trade is necessary for post-conflict stability, and if so, where in the looting process (e.g., point of harvest, transport to market, sale, or exportation) that interdiction would best be accomplished.

Second, this PCEA and the others on protracted conflicts (e.g., Afghanistan) highlight the effect of human population displacement on the environment. A large-scale population displacement not only will inevitably require immediate humanitarian assistance but also may have long-term

environmental consequences (e.g., deforestation) and long-term societal problems (e.g., challenges of shifting people from aid dependence to an autonomous, sustainable status). The U.S. Army today faces the public and media expectation that it can resolve conflict-related population displacement issues concurrent with its operational responsibilities. The information contained in this PCEA can be used to develop a strategy for assessing the nature of human population displacement issues and the kind and level of associated support requirements.

Finally, if the U.S. Army undertakes development of doctrine or guidance on performing PCEAs, the discussion of logistical issues in the UNEP report provides insight on the kinds of issues that will be encountered when performing a nationwide environmental assessment in a post-conflict zone. The methods used also can become a standardized technical approach to such assessments. Of particular interest is the collaboration and engagement with host government representatives, industry, and the citizenry. Table 2-23 presents a summary scorecard for Sudan.

Table 3-23: Summary Scorecard *Sudan Post-Conflict Environmental Assessment*

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations	✓	Improve pre-deployment and field environmental training	
Encourage an environmental ethic throughout the Army that extends to contingency operations		Invest more in environmental resources and good environmental practices for field operations	✓
Better incorporate environmental considerations into planning	✓	Use a "sustainability" model	✓
Environmental Issues Identified			
Asbestos		Lack of institutional capacity	✓
Cultural resource damage	✓	Natural resource damage	✓
Deforestation/desertification	✓	Petroleum releases	✓
Drinking water supply	✓	Solid/hazardous wastes	✓
Explosive remnants of war	✓	Surface water contamination	✓
Groundwater contamination	✓	Transboundary pollution	✓
Human migration	✓	Wastewater	✓

3.13. Mines Advisory Group (MAG), *Report on the Assessment Mission to the Central African Republic* (CAR), 2008

3.13.1. Background

This report summarizes the findings from MAG's assessment mission to the Central African Republic (CAR) in support of the Department of State's Office of Weapons Removal and Abatement. This study determined that small arms and light weapons (SALW) proliferation is a significant contributor to the CAR's ongoing instability and insecurity. Efforts to address SALW proliferation is a key objective within the current Security Sector Reform (SSR) initiative, but the CAR government lacks the resources and capacity needed to conduct an effective demobilization, disarmament, and reintegration (DDR) process.

Since independence from France in 1960, CAR has experienced deep-rooted poverty, ethnic tension, pervasive political instability, and armed conflict. The UN Development Program (UNDP) Human Development Index ranked CAR the sixth poorest country in the world (UNDP

2007). The population largely engages in subsistence farming, despite considerable agricultural, water, and mineral resources.

In the last 10 years, political instability caused CAR's economic and security situation to deteriorate, resulting partly from an influx of arms, ammunition, and refugees and a proliferation of rebel groups. The situation is especially precarious along the border in the northern areas, adjacent to the Darfur region. Ad hoc international engagements have achieved little effect on the security environment in CAR. The proliferation of SALW continues to undermine development, the safety and security of individuals, and the state. Government efforts to restrict SALW trafficking have been ineffective; consequently, SALW flow into and out of CAR without hindrance. The country's inability to protect its environment turned its territory into an open field for heavily armed and equipped poachers hunting wildlife for food and commercial gain.

During the assessment, MAG visited two military facilities where confiscated SALW are stockpiled. Both facilities contained a mix of assault rifles, reported light machine guns, rockets, mortars, and anti-personnel and anti-tank landmines. The stockpile management was wholly inadequate and left the facilities and the SALW contained within vulnerable to explosion and/or theft.

Figure 3-16: SALW Storage at Camp Beal, CAR

3.13.2. Assessment Method

The assessment methods involved historical research, interviews, and on-the-ground site visits. Photographs of the storage areas (e.g., Figure 3-16) clearly document the inadequate storage of SALW that have fallen into government hands. Specific information about the parties interviewed was not included in the report.

3.13.3. Summary of Findings

The report finds that SALW proliferation contributes to the political instability of the CAR government. Moreover, the inability to control related activities by bandits, rebel groups, and poachers is having a direct effect (e.g., loss of wildlife attributed to poaching) and an indirect effect (e.g., from migration of IDPs) on the environment in CAR. The report suggests that a coordinated, well-funded international intervention could bring about a reduction in SALW proliferation, removing one driving factor behind the ongoing environmental degradation. Such an intervention also would include establishing capacities for the safe storage of confiscated SALW before its safe and environmentally protective destruction.

3.13.4. Relevance to the U.S. Army

This report highlights the need for the U.S. military to be ready to handle small- and large-scale DDR efforts, commencing as soon as practicable after the cessation of combat operations. Ideally, not only would the U.S. military be equipped with knowledge of how to accomplish the operations, but also appropriate equipment would be available to ensure environmental

protection during the operations. Table 3-24 presents a summary scorecard for the assessment mission to the CAR.

Table 3-24: Summary Scorecard *MAG Report on the Assessment Mission to the CAR*

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations		Improve pre-deployment and field environmental training	✓
Encourage an environmental ethic throughout the U.S. Army that extends to contingency operations	✓	Invest more in environmental resources and good environmental practices for field operations	✓
Better incorporate environmental considerations into planning	✓	Use a "sustainability" model	✓
Environmental Issues Identified			
Asbestos		Lack of institutional capacity	✓
Cultural resource damage		Natural resource damage	✓
Deforestation/desertification	✓	Petroleum releases	
Drinking water supply		Solid/hazardous wastes	
Explosive remnants of war	✓	Surface water contamination	
Groundwater contamination		Transboundary pollution	✓
Human migration	✓	Wastewater	

3.14. U.S. Army, Command and General Staff College, *Creating Effective Post-Conflict Transition Organizations: Lessons from Panama, Bosnia, Afghanistan, and Iraq*, 2008

3.14.1. Background

Creating Effective Post-Conflict Transition Organizations: Lessons from Panama, Bosnia, Afghanistan, and Iraq is the thesis of Major Kellie J. McCoy, U.S. Army, submitted to the faculty of the U.S. Army Command and General Staff College in partial fulfillment of the requirements for the degree of Master of Military Art and Science. In his thesis, Major McCoy defends the premise that the successful outcome of future armed conflicts requires both planning for reconstruction and stabilization and an effective management organization that optimizes the use of available resources.

Although this thesis examines organizational management in the post-conflict period, there is no specific discussion of environmental issues; however, valuable observations about personnel and organizational structure apply to the management and execution of environmental issues projects in the reconstruction period.

3.14.2. Assessment Methodology

Major McCoy's thesis begins by identifying and explaining the essential tasks in executing stabilization operations (i.e., security, governance and participation, humanitarian assistance and social well-being, economic stabilization and infrastructure, and justice and reconciliation). The thesis then examines the contribution of various U.S. government organizations to the management of stability operations. Using four case studies, this thesis offers a series of recommendations for post-conflict transition procedures and an organizational model that best supports the projected needs of the U.S. Government. The cases studies were selected based on—

- Their implementation of a separate organization dedicated to reconstruction and stabilization efforts following the removal or failure of an existing regime
- Involvement of U.S. military forces and other U.S. government agencies.

The analytical criteria used in the case studies focused on evaluation of—

- **Simplicity—**an assessment of an organization's level of bureaucracy and its ability to achieve unity of command and unity of effort across diplomatic, informational, military, and economic areas
- **Responsiveness—**an evaluation of an organization's ability to quickly integrate into operational planning efforts whether they involve contingency or non-contingency plans
- **Flexibility—**a measure of an organization's adaptability to post-conflict environmental variables, such as the security situation, political conditions, cultural issues, and coalition partner involvement
- **Sustainability—**an assessment of a reconstruction organization's demand for resources, such as manning requirements, facilities, and funding
- **Efficiency—**an assessment of the level of success achieved in each of the identified essential tasks.

The analysis is premised on several assumptions and does not examine a host of issues, including the following:

- Future post-conflict transitions will occur between U.S.-led military control and U.S.-led (or advised) civilian control
- The Department of State will retain lead agency authority for reconstruction and stabilization operations
- The availability of resources is unconstrained
- It is not a complete study of historical American management of post-conflict transition and does not consider alternative models for reconstruction and stabilization such as the use of military governments
- It does not examine the geopolitical or environmental conditions necessary for transitioning from military to civilian authority.

3.14.3. Summary of Findings

First, success in the post-conflict reconstruction period requires that personnel with the required skills be assigned for sufficiently long periods in order for continuity to be maintained in the planning and execution of specific project. For example, one key challenge to the Panama reconstruction organization was personnel turnover, resulting in disjointed and poor planning that had lasting ramifications. The assumption that Army Reserve civil affairs units would provide all of the needed expertise in the post-conflict environment was particularly problematic because these units were not activated. Instead, the needed personnel were individual augmentees assigned for 31-day tours. This system created obvious turbulence. Further, the augmentees did not always possess the basic skill sets required for planning and executing the reconstruction mission. Another example was the lack of civil affairs personnel or engineers for

the rebuilding effort, "… which seems to be a common occurrence in U.S. transition operations."[7]

Second, clearly defining the roles and responsibilities of the various organizations involved in reconstruction is essential for organizational unity of effort. This was achieved in Bosnia through the Dayton Agreement that created a uniquely structured peacekeeping operation. The operation had both military and civilian components. The military side was the Implementation Force (IFOR) (later called the Stabilization Force [SFOR]), with the authority to enforce the cease-fire. The civilian component was the Office of the High Representative (OHR), the civilian organization that assisted the parties in implementing the agreement and coordinated international assistance efforts. These organizations comprised representatives from more than a dozen nations and their success stemmed from clearly defined roles, responsibilities, and authorities of each functional element within the overall organization. This allowed OHR to avert starvation, provide emergency health and medical care, and improve civilian living conditions by forming and sustaining social programs and systems. Most significantly, OHR also facilitated the return of the more than 2 million refugees and IDPs. In contrast, there is no overarching organization that unifies the ongoing reconstruction and stabilization efforts in Afghanistan. Although the Afghan government officially leads the reconstruction and stabilization efforts, it has minimal operational influence and does not provide coordination of the separate mandates that shape each organization's operations. NATO, the United States, the European Union, and the UN each lead separate missions with independent supporting organizations. Still, efforts are ongoing to provide a unified organizational structure that coordinates and prioritizes reconstruction activities, and the organizations in Afghanistan continue to demonstrate a willingness to change and improve as the reconstruction and stabilization requirements evolve.

3.14.4. Relevance to the U.S. Army

This thesis documents the need for a clearly defined organizational structure, in which the interactions among military and civilian agencies are documented and applied with a high degree of rigor. The thesis also documents the challenges facing personnel involved in reconstruction. Although the case studies focused on non-environmental reconstruction activities, the same challenges exist within environmental reconstruction efforts. Temporary personnel assignments or assignment of multiple reconstruction responsibilities to personnel (e.g., for security and environmental functions) are ineffective and prevent staff from building the institutional knowledge required for successful long-term success.

Finally, the thesis makes clear the need to consider reconstruction efforts of all kinds during the operational planning period. Doing so not only helps prevent the creation of environmental problems by the destruction of key elements of environmental infrastructure (e.g., wastewater treatment plants) but also ensures that the forces on the ground expected to address these issues are prepared to do so from the earliest possible moment. Table 3-25 presents a summary scorecard for the thesis.

[7] Page 36 of the subject document.

Table 3-25: Summary Scorecard *Creating Effective Post-Conflict Transition Organizations: Lessons from Panama, Bosnia, Afghanistan, and Iraq*

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations	✓	Improve pre-deployment and field environmental training	✓
Encourage an environmental ethic throughout the Army that extends to contingency operations		Invest more in environmental resources and good environmental practices for field operations	✓
Better incorporate environmental considerations into planning	✓	Use a "sustainability" model	✓
Environmental Issues Identified			
Asbestos		Lack of institutional capacity	✓
Cultural resource damage		Natural resource damage	
Deforestation/desertification		Petroleum releases	
Drinking water supply		Solid/hazardous wastes	
Explosive remnants of war		Surface water contamination	
Groundwater contamination		Transboundary pollution	
Human migration		Wastewater	

3.15. UNEP, *Environmental Assessment of the Gaza Strip Following the Escalation of Hostilities in December 2008–January 2009*, 2009

3.15.1. Background

Figure 3-17: Partially Demolished Building in Gaza City

Tensions between Israel and the Palestinian Authority continued following Israel's unilateral disengagement in the Gaza Strip. These tensions came to a head in December 2008, when the Israeli military executed a combined military operation in Gaza to suppress militants who fired rockets into Israel. The Israeli operation involved bombardment by land, sea, and air, and included incursions into the Gaza by Israeli forces.

As shown in Figure 3-17, with these operations taking place in densely populated areas, there was destruction of homes, agricultural and industrial facilities, and civil and commercial infrastructure. In particular, Gaza City suffered extensive damage. A unilateral Israeli ceasefire on 18 January 2009, followed by a unilateral ceasefire by Hamas and other Palestinian factions, put an end to the fighting.

As documented in the UNEP report from 2006, throughout Gaza there were known environmental issues, such as the presence of asbestos, poorly managed solid and hazardous wastes, and releases of petroleum into the environment. In the period between that report and the commencement of the December 2008–January 2009 Israeli operations, the environmental situation continued to deteriorate as a result of further releases to the environment,

underinvestment in environmental systems, lack of progress on priority environmental projects, and the collapse of governance mechanisms.

The December 2008–January 2009 Israeli operations added to the damage and increased the pressure on environmental facilities and institutions. Two examples cited in this report are the significant volume of demolition debris generated and serious damage to the sewage system. Other effects included the destruction of agricultural facilities, damage to small-scale industrial enterprises, and an increase in pollution discharged into the Mediterranean Sea and into the groundwater. Energy (e.g., electricity), telecommunications, transportation, and water and wastewater infrastructure also sustained damage.

In May 2009, a UNEP technical mission traveled to Gaza to perform another post-conflict environmental assessment of the environmental damage that was caused or exacerbated by this latest period of hostilities.

3.15.2. Assessment Method

The assessment method followed the standard UNEP protocol and included the following:

- Using historical research and remote sensing analyses to identify areas of interest
- Onsite visual assessments and where appropriate, in-the-field analyses or collection of samples of environmental media for subsequent quantitative analysis
- Identifying areas or issues of immediate public health concern
- Preparing a report summarizing the assessment findings, offering recommendations for subsequent actions.

The UNEP assessment examined the following areas:

- **Solid waste management.** As with any military campaign in an urbanized area, this period of hostilities generated a large quantity of solid waste, primarily building rubble. Such wastes often contain hazardous materials, in particular asbestos. Before the 2008–2009 engagement, there was no segregation and systematic approach to solid waste management. Consequently, the creation of large quantities of building rubble within a short period overloaded the already inadequate waste management infrastructure.
- **Wastewater management.** Before the Israeli operations, Gaza did not have an adequate sewage system; following the operations, the system was in worse shape, with damage to not only the sewage collection system but also the main sewage treatment plant. Consequently, there were increased discharges of untreated sewage into the environment, further aggravating an already serious public health situation.
- **Management of contaminated land.** Numerous small commercial enterprises (e.g., factories, cement plants, garages) were damaged or destroyed during the hostilities. This suggested the potential for releases of hazardous materials to urban and agricultural lands.
- **Institutional assessment.** UNEP also evaluated the condition of environmental measurement and information management systems in the Gaza Strip. Here, the assessment focused on understanding what systems were in place to monitor the environment in the Gaza Strip before this period of hostilities, making an assessment of the current status of this equipment, and determining what equipment and support were

needed to reestablish a robust environmental monitoring and information management system.

- **Economic assessment.** The final element of the UNEP evaluation was assessing the cost of rehabilitating the damage resulting from the escalation of violence. Key elements in this analysis were evaluation of the cost of (1) restoring the environmental and public health infrastructure; (2) collecting, handling, transporting, and disposing of the solid waste generated during the hostilities; (3) the cost remediation of contaminated lands; and (4) the cost of reestablishing environmental measurement and information management systems.

In all, the UNEP team visited 35 sites, shown in Table 3-26.

Table 3-26: Gaza Locations Visited by UNEP Team in 2009

Site	Site Description	Site	Site Description
1	Juice factory (damaged)	19	Beach near refugee camp
2	Cement packing plant (damaged)	20	Sewage outlet into the sea
3	Ready-mix concrete plant (damaged)	21	Sewage outfall
4	Gas station (damaged)	22	Sewage outlet (small)
5	Beit Lahia sewage lagoon (damaged)	23	Garbage dump near the sea
6	School (damaged)	24	Affected water and sediments from sewage
7	Site for disposal of rubble from 2005 disengagement	25	Domestic garbage disposal area, leachate flowing into groundwater
8	Waste dumping area reopened during December 2008/wastewater treatment plant	26	Dumping of asbestos and other debris
9	Boarder area with Egypt with destroyed housing	27	Water wells
10	Ready-mix concrete factory (damaged)	28	Wastewater outlet into the sea
11	Unlined sewage site	29	Agricultural area
12	Lined sewage ponds	30	Sewage disposal site
13	Affected agriculture/livestock area	31	Fishing area
14	Affected housing area	32	Fish landing area
15	Open drain of sewage to the ground	33	Al Deira hotel
16	Electrical transformer (damaged)	34	Power plant
17	Site of sewage treatment plant	35	Red Crescent warehouse
18	Beach, North Gaza		

3.15.3. Summary of Findings

Before this period of hostilities, the Gaza Strip faced many environmental challenges, including a limited potable water distribution network, inadequate sewage collection and treatment works, and an inadequate system for the management of solid and hazardous wastes. Although some of these challenges were attributable to previous military activities (e.g., the unilateral Israeli disengagement in 2006), the following paragraphs summarize only the discussion of the damage attributable to the December 2008–January 2009 period of military operations.

As shown in Figure 3-18, the damage attributed to military activities in the December 2008–January 2009 period was greatest in the northeastern and southwestern border areas of Gaza

(greatest density indicated by darker shades of brown). Overall, the assessment identified damage that was "clearly distinguishable" and attributed to this period of military operations as well as locations where these events contributed to furthering pre-existing environmental issues.

Figure 3-18: Munitions Effect Density in Gaza

Source: Environmental Assessment of the Gaza Strip Following the Escalation of Hostilities in December 2008–January 2009

Construction and demolition waste was the most obvious effect as large quantities of demolition debris were created throughout Gaza. Almost 2,700 buildings suffered damaged, with some destroyed and other damaged to the point of being unsafe. The UN estimated that building rubble alone amounted to almost 660,000 tons, a quantity that overwhelmed existing solid waste management capacity. Many of the destroyed buildings contained asbestos-containing materials, including materials made of friable asbestos. Collection and disposal of the asbestos waste was an added challenge to removal and disposal of building rubble.

In addition to disposing of building rubble, completing the demolition of unsafe structures, especially multi-story structures, was a significant challenge. Explosive-based deconstruction was not a viable solution in most cases because of the proximity of undamaged buildings or the inability to safely enter and set charges for a controlled implosion. Use of sophisticated building deconstruction machinery (e.g., high-reach nibbler cranes and shears) also was not an option because that type of machine was simply unavailable in Gaza. The remaining option of using low-technology machines (e.g., bulldozers, wrecking balls) was the sole viable option; however, UNEP stated that if health and safety were not to be compromised, specialized outside technical assistance would be needed to plan and execute these actions.

As with the findings of the assessment following the Israeli disengagement in 2006, releases of hazardous waste into the environment was not a significant issue. Although UNEP found small-scale releases of petroleum products, the lack of industrialization in the affected areas prevented widespread or highly concentrated contamination.

Dead animals also presented a significant issue in terms of disease control and disposal of unusable carcasses. According to the Palestinian government, the hostilities killed some 36,000 cattle, goats, and sheep and more than 1 million birds and chickens. These carcasses, estimated to weigh 1,650 tons, were an additional strain on the already overtaxed solid waste disposal system. The Palestinian government ordered disposal of the carcasses by various means (e.g., internment following treatment with lime); nonetheless, the UNEP team observed numerous carcasses left unattended months after the ceasefire.

There was also widespread destruction of orchards, greenhouses, and open fields. According to an UN-sponsored agricultural survey, 17 percent of the total cultivated area of the Gaza Strip was destroyed, including 17.5 percent of the orchards and 9.2 percent of open fields. The damage to the land itself was a result of the mechanical ripping and removal of trees, shrubs, and crops. This loss of vegetative cover moved, mixed, and thinned the topsoil over large areas, reducing future productivity. Tracked and heavy wheeled vehicles compacted soils that now require heavy plowing with machinery to make it again suitable for agriculture; however, at the time of the UNEP study, such machinery was unavailable in the Gaza Strip. Third, the destruction of the vegetation cover makes the land vulnerable to desertification. There are also issues with reestablishing many of the mature orchards because of an unrelated increase in irrigation water salinity. Although mature plants (e.g., fruit, olives) could tolerate the higher salinity levels, newly planted trees might not fare as well or be able to develop rapidly enough to be productive enough to meet farmers' needs. The cumulative effect of these various forms of degradation is a high cost of restoration and a long-term reduction in agricultural productivity.

The Az Zaitoun wastewater treatment plant, the primary wastewater treatment plant in Gaza, also was damaged. One anaerobic treatment pond embankment was destroyed, releasing more than 100,000 cubic meters of wastewater and sludge, affecting about 55,000 square meters (14 acres) of agricultural land. Extensive damage also occurred to the water supply and sewage network. UNEP identified damage to individual and community wells, the water distribution network, sewage collection network, and water storage tanks.

Table 3-27: Environmental Costs of Damage Directly Linked to the Escalation of Hostilities December 2008–January 2009

Environmental Damage	Cost ($M)
Removal and safe disposal of rubble and asbestos	$17.5
Restoring the solid waste management system	$4.8
Direct cost of restoring water and wastewater systems	$6.2
Environmental costs linked to water and wastewater systems	$3.8
Cost associated with dealing with damages and suspected contamination of agricultural land	$11.7
Total	**$44.00**

Finally, UNEP estimated the cost of repairing the damage associated with the December 2008–January 2009 hostilities. Table 3-27 summarizes the result of these estimates.

In two areas, the cost estimates are notable in that they reflect damage attributable to the hostilities that may have been, at least in part, avoidable. Resolving the building rubble issues was the highest cost, estimated at $17.5 million. Although some destruction of buildings is inevitable in urban warfare, it is possible that more careful targeting of structures would have reduced associated costs. For example, the UNEP team visited a gas station in

Figure 3-19: Destroyed Gas Station in Northern Gaza

northern Gaza destroyed during the fighting (shown in Figure 3-19). Another site that UNEP visited was a concrete plant, destroyed along with the plant's trucks used for the delivery of concrete to building sites. In this case, the loss of the plant had direct first and second order effects in the post-conflict reconstruction phase.

Although it is impossible to know from the UNEP report the reason the Israeli military deemed these two facilities legitimate military targets, the destruction of both facilities presents environmental and economic issues for any post-conflict reconstruction. Similarly, the damage to agricultural lands, estimated at nearly $12 million, might have been avoidable had the Israeli military considered the preservation of these facilities as a military objective.

Table 3-28 presents an abridged version of the UNEP recommendation related to resolving the effects of the December 2008–January 2009 period of hostilities. In general, these recommendations reflect the primary findings, such as the need for increased capacity for clearing, sorting, recycling, and disposing of building rubble.

Table 3-28: UNEP Recommendations

Establish a facility to handle construction and demolition waste	Existing landfill capacity and operating practices were insufficient to handle the quantity of waste, especially building rubble, generated by the hostilities. Maximize recycling and reuse of the debris, including crushing the rubble for reuse in the reconstruction work.
Systematically sort demolition rubble during the rubble removal phase	In addition to sorting out recyclable components, segregate hazardous materials and use proper disposal techniques as necessary elements in any plan to reclaim and reuse building rubble.
Perform due diligence	Assess sites affected during conflict periods to ensure no residual contamination poses long-term risks
Provide technical support for farmland and orchard restoration	Assist in restoration of lost vegetation cover as soon as possible, planting new crops where salinity issues prevent reestablishment of pre-existing orchards.
Repair water supply and sewage systems	Require priority repair or replacement of water supply and sewage systems affected by hostilities, including water wells, to prevent water contamination and health effects.
Dispose of hazardous materials in a controlled manner	Establish a hazardous waste management facility to handle petroleum contaminated soil and other hazardous waste streams.
Ensure health and safety during demolition	Coordinate outside technical assistance in building demolition required to ensure the safe demolition of unsafe structures.

3.15.4. Relevance to the U.S. Army

This report is relevant to the Army in that it shows the principal types of environmental issues—namely, petroleum releases and creation of large quantities of solid waste, mostly building rubble, that are the direct consequences of limited scale warfare. Here too, the hazards posed to human health and the environment are limited if the hazards posed by partially destroyed structures are not considered as part of the assessment. It would be possible to further reduce even these limited environmental effects by restricting targeting of locations that if destroyed would release some hazardous material into the environment (e.g., petroleum distribution facilities). This PCEA also shows that forces entering a metropolitan area that has been targeted

during a conflict face a considerable challenge in managing destroyed and partially destroyed buildings. Table 3-29 presents a summary scorecard for the Gaza Strip.

Table 3-29: Summary Scorecard *Environmental Assessment of the Gaza Strip Following the Escalation of Hostilities in December 2008—January 2009*

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations	✓	Improve pre-deployment and field environmental training	
Encourage an environmental ethic throughout the Army that extends to contingency operations		Invest more in environmental resources and good environmental practices for field operations	
Better incorporate environmental considerations into planning	✓	Use a "sustainability" model	
Environmental Issues Identified			
Asbestos	✓	Lack of institutional capacity	✓
Cultural resource damage	✓	Natural resource damage	✓
Deforestation/desertification	✓	Petroleum releases	✓
Drinking water supply	✓	Solid/hazardous wastes	✓
Explosive remnants of war		Surface water contamination	✓
Groundwater contamination	✓	Transboundary pollution	✓
Human migration		Wastewater	✓

3.16. UNEP, *From Conflict to Peacebuilding: The Role of Natural Resources and the Environment,* 2009

3.16.1. Background

As an increasing global population demands considerably more resources, significant potential for conflicts exists over natural resources to intensify in the coming decades. This report asserts that since 1990 the exploitation of natural resources has fueled at least 18 violent conflicts, and during the last 60 years at least 40 percent of all intrastate conflicts have had a link with natural resources. Civil wars in Liberia, Angola, and the Democratic Republic of Congo centered on control of valuable resources like timber, diamonds, gold, and oil. Other conflicts, including those in Darfur and the Middle East, involve control of scarce resources (e.g., fertile land and water). The report also offers a conceptual model for the role of environment and natural resources in conflict and peacebuilding (see Figure 3-20).

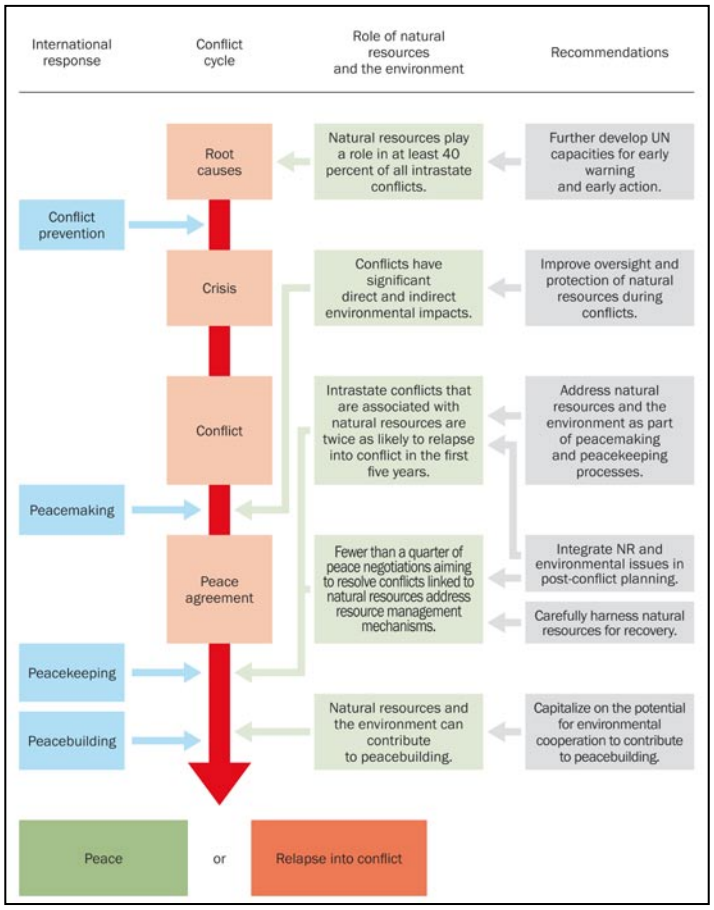
The report concludes that integrating environment and natural resources into peacebuilding is no longer an option—it is a security imperative. Because natural resources and the environment often cause or contribute to conflict, this UNEP report suggests that effective peace maintenance requires active management of environmental issues. For example, natural resources and the environment contribute to economic development and the generation of employment, whereas cooperation over the management of shared natural resources provides new opportunities for cooperative governance.

3.16.2. Assessment Method

This report was based entirely on existing literature research. In examining the issues identified, the report considered the following:

- Role of natural resources and environment in contributing to, financing, and sustaining conflict, and undermining peacemaking
- Direct, indirect, and institutional effects of conflict on natural resources and the environment
- Role of natural resources and environment in supporting economic recovery; developing sustainable livelihoods; and contributing to dialog, confidence building, and cooperation.

Figure 3-20: From Conflict to Peacebuilding: The Role of Natural Resources



Each area was accompanied by a case study highlighting a real-world instance in which UNEP's assertions are borne out in practice and including the following:

- Role of Liberian forces in former Liberian President Charles Taylor's 1991–1992 attempt to gain control of lucrative Sierra Leonean diamond fields
- Role of natural resource control (e.g., diamonds, oil) in fueling the conflict in Angola
- Direct environmental effects of NATO military operations in Kosovo
- Consequence of decades of conflict on the ability of Afghanistan to provide for its people.

The report concludes with a series of policy recommendations for the UN Peacebuilding Commission to consider as it moves forward on its evaluation of the peacebuilding process.

3.16.3. Summary of Findings

The establishment of the UN Peacebuilding Commission was an opportunity for the international community to address environmental and natural resource issues in the context of conflict prevention and peace building. The report offers the recommendations shown in Table 3-30 as a starting point for integrating such considerations into peacebuilding interventions and conflict prevention.

Table 3-30: Recommendations for Integrating Environmental Considerations into Peacebuilding Interventions and Conflict Prevention

Recommendation	Summary
Further develop UN capacities for early warning and early action	Strengthen UN capacity to deliver early warning and early action in countries that are vulnerable to conflicts over natural resources and environmental issues. Simultaneously, view the effective governance of natural resources and the environment as an investment in conflict prevention.
Improve oversight and protection of natural resources during conflicts	Increase international oversight of "high-value" resources in international trade to minimize the potential for these resources to finance conflict. Use international sanctions as the primary instrument to stop the trade in conflict resources. Require member states to act against sanction violators. Develop new legal instruments to protect natural resources and environmental services during violent conflict.
Address natural resources and the environment as part of the peacemaking and peacekeeping process	Wealth sharing is a fundamental issue that can "make or break" a peace agreement. Often, this includes sharing natural resources (e.g., minerals, timber, land, and water). Therefore, parties to a peace mediation process require sufficient technical information and training to make informed decisions on the sustainable use of natural resources. Align subsequent peacekeeping operations with national efforts to improve natural resource and environmental governance.
Include natural resources and environmental issues into integrated peacebuilding strategies	The UN often undertakes post-conflict operations with little or no prior knowledge of what natural resources exist in the affected country, or of what role these resources might have played in fueling the conflict. Often, it is years into an intervention before natural resource management receives sufficient attention. Failure to respond to the environmental and natural resource needs of the population may complicate the task of fostering peace or even contribute to conflict relapse.
Carefully harness natural resources for economic recovery	Proper management of natural resources strengthens a post-war economy and contributes to economic recovery. The international community must help national authorities manage the extraction process and revenues in ways that do not increase risk of further conflict or are unsustainable in the longer term. This effort must go hand in hand with ensuring accountability, transparency, and environmental sustainability in their management.
Capitalize on the potential for environmental cooperation to contribute to peacebuilding	Every state needs to use and protect vital natural resources (e.g., forests, water, fertile land, energy, and biodiversity). Environmental issues can serve as an effective platform or catalyst for enhancing dialogue, building confidence, exploiting shared interests and broadening cooperation between divided groups and between states.

3.16.4. Relevance to the U.S. Army

This report offers a series of recommendations for building environmental considerations into the pre-conflict intervention process and into the post-conflict reconciliation process. This report suggests that analysts of environmental factors may provide an additional tool in predicting conflicts and may be used as tools in identifying key points for intervention to deescalate or end a conflict (e.g., propose new means for resource sharing, attack the sources of money financing a conflict). Although these are not traditional military considerations, the U.S. Army may find value in using natural resource scarcity analysis or economic benefit distribution analysis as a

tool in developing scenarios for national security assessments. Table 3-31 presents a summary scorecard for the role of natural resources and the environment.

Table 3-31: Summary Scorecard *From Conflict to Peacebuilding: The Role of Natural Resources and the Environment*

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations	✓	Improve pre-deployment and field environmental training	
Encourage an environmental ethic throughout the Army that extends to contingency operations		Invest more in environmental resources and good environmental practices for field operations	✓
Better incorporate environmental considerations into planning	✓	Use a "sustainability" model	✓
Environmental Issues Identified			
Asbestos		Lack of institutional capacity	✓
Cultural resource damage		Natural resource damage	✓
Deforestation/desertification	✓	Petroleum releases	✓
Drinking water supply	✓	Solid/hazardous wastes	✓
Explosive remnants of war		Surface water contamination	✓
Groundwater contamination		Transboundary pollution	✓
Human migration	✓	Wastewater	

3.17. UNEP, *Integrating Environment in Post-Conflict Needs Assessments: UNEP Guidance Note*, 2009

3.17.1. Background

This document provides additional guidance on integrating environmental considerations into the UNDG and the World Bank (WB) *Post-Conflict Needs Assessment* (PCNA) method. It is one of four additional guides that address cross-cutting issues, with the other three issues being gender, human rights, and HIV/AIDS. The purpose of this guidance is as follows:

- Advise PCNA practitioners on how to ensure knowledge of environment issues is available and used during the PCNA process
- Facilitate the identification of priority interventions for consideration
- Give guidance on core indicators relevant for most any context, as well as suggested indicators for specific contexts to enable monitoring and evaluation of environmental issues.

3.17.2. Assessment Method

The assessment method for developing the guide was experience based, accompanied by a literature search of UNEP and other organizations that have examined the role of the environment in conflict.

3.17.3. Summary of Findings

The report references the growing recognition of environment as a key issue in post-conflict peacekeeping operations (e.g., the UN Security Council's emphasis on the need to highlight these issues in post-conflict operations). With regard to environment considerations, the PCNA review panel concluded:

> *[W]here conflict analyses are conducted, particular attention has to be paid to the links between environment, conflict and peace consolidation. Overlooking or failing to prioritize environmental needs adequately presents risks to human health, livelihoods, and the maintenance of ecosystem services. Bearing in mind the important role environment plays in populations' lives and the economies of most post-conflict countries, all of these risk factors can negatively impact sustained peace and recovery. Pre-existing chronic environmental problems pre-dating the conflict, e.g. land degradation, must be addressed in order to ensure sustainable recovery and reconstruction, especially where they affect livelihoods.*

The report also addresses conducting a desk study to examine the risks, effects, and opportunities related to environment and natural resources during the pre-assessment. Previous PCNAs included desk studies on environmental effects at the end of the assessment phase, far too late in the process to inform PCNA leads about environmental issues. Consequently, environmental information was largely left out of most PCNA recommendations. To resolve this issue, the guide suggests that consideration of environmental issues needs to—

- Ensure that the assessment explores links between environmental issues and conflict risks, effects, and peacebuilding opportunities
- Map the analysis to peacebuilding to indicate how identified environmental risks, their effect, and opportunities potentially influence peacebuilding
- Identify key stakeholders related to the conflict and natural resources, including their interrelationships
- Help prioritize interventions related to the environment and natural resources, with a specific focus on those with a high peace dividend and potential for stabilization.
- Outline the steps required in anticipation of the assessment phase, including by identifying knowledge gaps, and suggesting methods of operation and expected outcomes for the final assessment
- Present information about environmental, infrastructure, and natural resources issues as an independent chapter in the PCNA (as opposed to embedding it in other chapter or inclusions as an annex to the main document). This effort ensures the visibility of environmental and natural resource issues as a key ingredient in the success of peacebuilding and post-conflict reconstruction efforts.

During the field assessment, the guide recommends that the assessment focus on the following:

- Validating the desk study findings with field analysis focused on the assumptions and conclusions made in the desk study, and determining which of the risks and effects identified in the desk phase are of the highest priority

- Using this validated information to set capacity-building priorities, and determining the nature of international best suited to achieving the peacebuilding objectives.

The guide suggests several key organizational ingredients essential to the success of post-conflict environmental assessments:

- Selection of the environmental leads or joint coordination with a partner organization
- Having a field-level presence for environment and natural resources issues during the PCNA
- Closely cooperating with national counterparts to ground-truth findings, strengthen local capacities, and increase integration of environmental issues into the overall national/sub-national recovery agenda and processes
- Preventing the illegal trade of natural resources from financing continued conflict through action by national authorities and the international community (e.g. Liberia, Iraq, and Somalia)
- Removing incentives for spoilers by engaging them in the peace process and minimizing spoiling opportunities (e.g., Liberia, Sudan).

In the post-conflict period, the environmental agenda should consider the following:

- Building sustainable livelihoods to promote disarmament, demobilization, and reintegration of ex-combatants; preserve intact local communities; or enable the return and resettlement of displaced people and refugees
- Ensuring fair access to natural resources, including land, in the decommissioning of refugee camps and the resettlement of displaced people; the land used for refugee camps should be restored properly to prevent potential grievances by local communities
- Restoring public confidence in the government through actions to address acute environmental and human health hazards
- Creating jobs through sound governance and management of environmental rehabilitation and "high-value" extractive industries (e.g., diamond and gold mines, oil and gas production)
- Mitigating chronic environmental problems. Environmental damage or degradation inflicted on critical natural resources (e.g., fertile land and water) may threaten lives. Clean-up operations should be initiated to protect health and restore public confidence in governance (e.g., Iraq, Liberia, Somalia)
- Building and empowering governance capacity in the ministries relevant to environment and natural resources at the national and sub-national levels.

3.17.4. Relevance to the U.S. Army

This guide, an annex to a large guide on the post-conflict needs assessment process, is relevant to the U.S. Army in three key ways.

First, it highlights the importance of considering environmental and natural resource issues during the planning process. By considering the effect of environmental issues in the development of the larger context of national peacebuilding and reconstruction efforts, it may be possible to prevent direct environmental damage or mitigate issues that could give rise to a

resurgence of fighting. The U.S. Army should consider elevating its consideration of environmental and natural resource management issues in developing operational plans and in the presenting that information in the operational plan itself (current environmental issues appear in an annex to plans for contingency operations).

Second, this guide highlights the importance of having trained and equipped staff embedded within the teams performing post-conflict needs assessments. By embedding staff who have environmental and natural resource expertise, it is possible to identify potential environmental "show stoppers" or conditions that if left unaddressed will contribute to difficulties during the reconstruction process.

Finally, this guide suggests that bringing in training environmental specialists earlier in the process enables them to provide the technical assistance needed to prevent or mitigate other issues later in the peacebuilding process. Table 3-32 presents a summary scorecard for integrating environmental considerations.

Table 3-32: Summary Scorecard *Integrating Environment in Post-Conflict Needs Assessments: UNEP Guidance Note*

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations	✓	Improve pre-deployment and field environmental training	✓
Encourage an environmental ethic throughout the Army that extends to contingency operations	✓	Invest more in environmental resources and good environmental practices for field operations	✓
Better incorporate environmental considerations into planning	✓	Use a "sustainability" model	✓
Environmental Issues Identified			
Asbestos		Lack of institutional capacity	✓
Cultural resource damage		Natural resource damage	✓
Deforestation/desertification	✓	Petroleum releases	✓
Drinking water supply		Solid/hazardous wastes	✓
Explosive remnants of war		Surface water contamination	✓
Groundwater contamination		Transboundary pollution	✓
Human migration	✓	Wastewater	✓

3.18. UNEP, *UNEP in Afghanistan: Laying the Foundations for Sustainable Development,* 2009

3.18.1. Background

Following more than 30 years of civil war, international conflict, and occupation, the interim and transitional Afghanistan government requested UN assistance in assessing the environmental effects of the war on people's lives, livelihoods, and security, and in recommending ways to address these issues during the reconstruction process.

The UNEP's PCDMB, working closely with the Afghan government, mobilized five teams of Afghan and international experts to perform an initial assessment, published in 2003 as *The Afghanistan Post-Conflict Environmental Assessment Report*. That 2003 report documented a country in turmoil, in which millions of people died or fled their homes. Those who remained

faced tremendous challenges in daily life, partly a result of the destruction of 60 percent of Afghanistan's infrastructure and capacity for governance and sound resource management.

In contrast, this report documents the remarkable success of the Afghan government at reestablishing environmental governance, sustainable resource management, and reconstruction of civil infrastructure. This report was not intended as an assessment of conditions following a conflict; rather, its purpose was to demonstrate the effectiveness of the coalition of Afghan and international resources at improving the environment across Afghanistan and to chart a path forward into the second decade of the 21st century.

3.18.2. Assessment Method

The method used was a comparison of conditions identified during the assessment, which concluded in 2003 with conditions as of the end of 2008. The comparison examined the changes made by projects addressing issues in water and wetlands protection, forests and rangeland management, agriculture, establishing protected areas and wildlife habitats, and improving conditions in urban areas. The report also provides a summary review of the process the Afghan government, the UN, and the international community followed in bringing about these improvements.

3.18.3. Summary of Findings

As stated in the report, the UNEP's long-term objective in Afghanistan is to create a truly lasting foundation for environmental management and sustainable development. This report documents many of the successes achieved under difficult circumstances in each phase completed to date and the next phase, which runs through 2010 (see Table 3-33). UNEP will stay in Afghanistan as long as it is needed—an unprecedented commitment advancing environmental programs to a point at which the Afghan government can assume total ownership and control.

Table 3-33: Summary of UNEP Programme for Afghanistan Phases

Phase	Period	Summary
1	2002–2003	• Produced an assessment of the post-conflict environmental situation in Afghanistan. • Developed an action plan for addressing the key issues.
2	2003–2007	• Focused on building the basic infrastructure and capacity required for effective environmental management at the national level. • Produced an institutional structure for a national environmental policy act, an environment law, and associated regulations, policy papers, government-level environmental coordination groups, community-based resource management projects, awareness-raising of environmental issues through the training of journalists and the development of educational materials, and progress in the implementation of several multilateral environmental agreements.
3	2008–2010	• At the Afghan government's request and with funding from the European Commission, continue to assist national environmental authorities in implementing their plans and projects nationwide. • Support the Natural Resources Division (NRD) of the Ministry of Agriculture, Irrigation, and livestock to build its capacity related to environmental law and policy. Establish and mentor a Protected Areas Central Management Authority under regulations of the environment law, and improve the NRD's capacity to develop community-based natural resource management at the field level. • With the Afghan government, accomplish the environmental agency's 5-year goals to put in place new regulations and management services for the

Table 3-33: Summary of UNEP Programme for Afghanistan Phases

Phase	Period	Summary
		protection of air and water quality, waste management, pollution control, and natural resource management. • Strengthen Afghan government technical capacity, expand its environmental awareness campaigns, and ensure that environmental issues are integrated thoroughly into governmental programs and policies.

3.18.4. Relevance to the U.S. Army

This report serves as an excellent example of documenting the success of environmental programs. This report was not intended for a technical audience; rather, it was clearly targeted at showing and convincing decision makers that the UNEP engagement has been a success to date and that additional work remains if these early achievements are to become permanent within the Afghan government and civil society.

The U.S. Army should consider this UNEP report as an example of positive messaging and should consider incorporating this approach into U.S. Army public outreach programs related to environmental sustainment missions. Table 3-34 presents a summary scorecard for laying foundations for sustainable development in Afghanistan.

Table 3-34: Summary Scorecard *UNEP in Afghanistan: Laying the Foundations for Sustainable Development*

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations	✓	Improve pre-deployment and field environmental training	
Encourage an environmental ethic throughout the Army that extends to contingency operations		Invest more in environmental resources and good environmental practices for field operations	
Better incorporate environmental considerations into planning	✓	Use a “sustainability” model	✓
Environmental Issues Identified			
Asbestos		Lack of institutional capacity	✓
Cultural resource damage	✓	Natural resource damage	✓
Deforestation/desertification	✓	Petroleum releases	
Drinking water supply	✓	Solid/hazardous wastes	✓
Explosive remnants of war	✓	Surface water contamination	✓
Groundwater contamination	✓	Transboundary pollution	✓
Human migration	✓	Wastewater	✓

4. Conclusions

The review of these UNEP and other documents offers insight into numerous issues:

- The growing recognition of the importance of environmental and natural resource issues at the strategic and tactical levels
- The kinds of environmental harm expected to result directly from military activities (e.g., creation of vast quantifies of building rubble and other solid wastes, release of chemicals or petroleum into the environment)

- The kinds of harm often associated with large-scale human population displacements (e.g., deforestation, creation of aid-dependent population, the need to restore refugees camps once closed).

The rollup of the summary scorecards in Table 4-1 shows that three of the recommendations in the *Green Warriors* report have greater applicability to issues in the UNEP reports:

- Better incorporate environmental considerations into planning
- Improve the policy and guidance for environmental considerations in contingency operations
- Use a "sustainability" model.

After reviewing the UNEP reports in which these recommendations were considered applicable, only one appears in all 18 reports reviewed: *Better incorporate environmental considerations into planning*.

The reason for this is simple: *Current U.S. doctrine focuses on addressing the environmental footprint only of U.S. forces*.

The guidance on integrating environmental considerations into the OPLAN for a contingency operation does not necessarily direct consideration of environmental, natural resource, or civil infrastructure in *all* aspects of operational planning.

Table 4-1: Summary Scorecard Rollup

Relationship to *Green Warriors* Recommendations			
Improve the policy and guidance for environmental considerations in contingency operations	14	Improve pre-deployment and field environmental training	10
Encourage an environmental ethic throughout the Army that extends to contingency operations	6	Invest more in environmental resources and good environmental practices for field operations	9
Better incorporate environmental considerations into planning	18	Use a "sustainability" model	14
Environmental Issues Identified			
Asbestos	3	Lack of institutional capacity	13
Cultural resource damage	5	Natural resource damage	17
Deforestation/desertification	13	Petroleum releases	13
Drinking water supply	15	Solid/hazardous wastes	16
Explosive remnants of war	8	Surface water contamination	15
Groundwater contamination	12	Transboundary pollution	14
Human migration	13	Wastewater	14

The environmental issues discussed in the UNEP and other reports indicated that there is consistency in the kinds of environmental issues found in nations that have undergone changes because of conflict. One interesting note is that threats from explosive remnants of war were not a common issue. This finding might be a result of the majority of the reports not examining the issue in detail, not because unexploded ordnance is not present. For example, the report *From Conflict to Peacebuilding: The Role of Natural Resources and the Environment* does not mention a need for addressing explosive remnants of war, though resolving such issues may be essential elements in the conflict–to–post-conflict transition or in building a secure, sustainable nation.

All environmental issues identified are addressed in various DoD publications about integrating environmental considerations into planning a contingency operation. For example, Table 4-2 summarizes one view of the integration of environmental, natural resource, and civil infrastructure considerations needed for identifying and building into an operational plan. Here, the focus is on managing environmental issues from the perspective of protecting the health and safety of U.S. forces. An operational plan must consider such factors as establishing a local safe supply of drinking water and managing solid and hazardous wastes. These considerations are driven by different forces—for example, the military need to protect the health of our soldiers, or the legal imperative to manage wastes in a manner that is consistent with applicable laws. As suggested by the *Green Warriors* case studies, a lack of policy or guidance is not generally the cause of instances in which the U.S. military does not meet its own high standards in this area. Those cases arise from inadequate consideration of environmental issues in the planning of the operation and the concomitant unavailability of the necessary resources.

Table 4-2: Elements of Environmental Planning

Policies and responsibilities to protect and preserve the environment during the deployment
Certification of local water sources by appropriate medical field units
Solid and liquid waste management: • Open dumping • Open burning (currently not an acceptable practice) • Disposal of gray water • Disposal of pesticides • Disposal of human waste • Disposal of hazardous waste
Hazardous materials management including the potential use of pesticides
Flora and fauna protection
Archeological and historic site preservation
Base field spill plan
Source: Joint Pub 4-04, *Joint Doctrine For Civil Engineering Support*, 26 September 1995

There is, however, a more valuable lesson in the UNEP and other reports reviewed. The evolution of the UNEP post-conflict assessment program shows a growing understanding of the importance of environmental and natural resource issues at the strategic and tactical levels. In its early years (e.g., late 1990s), the program focused on assessing the direct environmental consequences of military action (e.g., Albania, Macedonia). As UNEP gained experience and understanding of the environmental consequences of military action, it began to recognize that the larger environmental issues stemmed from the displacement of human populations and the breakdown of governance.

Large-scale population displacement poses challenges to humanitarian relief. As the UNEP witnessed in Africa, there are consequences for the environmental setting; the migrating population eventually stops because they are either safe from conflict or can no longer continue to flee. Moreover, UNEP began to see linkages in effects from human population displacement to the long term and often widespread environmental issues associated with conflicts. For example, a population that fled a civil war (e.g., Sudan, Liberia) eventually stops and begins to search for and consume wood for fuel. Once this population consumes the available fuel supply, it begins to cut down trees, potentially consuming an entire forest or orchard as fuel. The loss of these trees can have a direct effect on the available food supply (e.g., destruction of centuries-old pistachio forests in Afghanistan), leading to the loss of topsoil and reducing overall agricultural productivity.

The Army could benefit from the UN's widening view of environmental, natural resource, and civil infrastructure issues (e.g., water supplies, wastewater treatment). Clearly, UNEP is moving

to a paradigm that recognizes the strategic importance of environmental, natural resource, and civil infrastructure. The UNEP also recognizes the existence of environmental, natural resource, and civil infrastructure issues across a conflict's lifecycle and that these issues can affect the course of the conflict and post-conflict periods. The Army could further embrace a holistic view of how these issues affect operations in the pre-conflict, conflict, and post-conflict phases.

This recognition exists in a limited way in existing doctrinal publications. For example, Army FM No. 3-100.4/Marine Corps Reference Publication (MCRP) No. 4-11B *Environmental Considerations in Military Operations* (15 June 2000) opens with discussion of a much broader view of the role environment, natural resources, and civil infrastructure play in conflicts. Specifically, there is a clear recognition that—

> *Environmental threats will confront theater commanders in the form of natural resource issues as strategic and operational factors before, during, and after future conflicts.*

This FM/MCRP notes the following among the strategic views of environment, natural resources, and civil infrastructure:

- Resource scarcity can threaten regional security and lead to armed interventions
- Renewable or "sustainable" resources, clean air, water, croplands, and forests are difficult to replace and can be a catalyst of conflict
- Environmental degradation, natural disasters, famines, epidemics, and climate change can lead to human population migrations, which cause population overload and natural resource scarcity
- Industrial activity, acts of war, or terrorism, the destruction of civil infrastructure such as water supplies, polluting the water supply or air of another country can have environmental effects that threaten stability and security.

Table 4-3: Environmental Considerations in Staff Estimates

Topography and soils
Vegetation, including crops
Air quality
Wildlife and livestock
Archaeological and historic sites
Safety and public health
Land and facility use, occupation, and return
Water quality, including surface water, groundwater, storm water, and wetlands
HM and HW disposal and potential cleanup requirements
Socioeconomic and political condition sensitivities and desired end states pertaining to or functions of environmental conditions

Despite this recognition, the document continues to describe integration of environmental issues largely from a viewpoint of managing the force's environmental footprint. For example, although the document indicates a need to incorporate environmental considerations (see Table 4-3) into staff estimates, the output of the process is likely a matrix focused on management of the wastes generated at the unit level (see Table 4-4).

Table 4-4: Notional Environmental Protection Matrix

	Level 1	Level 2	Level 3	Level 4
Waste Management				
Solid waste	Unit SOP	Incineration or burial	Incineration (currently not an acceptable practice)	Landfill
Medical waste	Unit Standard Operating Procedure (SOP)	Field collection, consolidate disposal	U.S. or host nation (HN) disposal methods	Same
Hazardous waste	Unit SOP	Field collection, battalion disposal	Unit collection point, classify/label for contract disposal	Resource Conservation and Recovery Act (RCRA) or HN procedures
Natural Resources				
Water	Unit SOP	Unit SOP	Erosion control	No degradation of water
Air	Unit SOP	Non-hazardous dust suppression	Control open fires, fugitive dust	Controls incineration and traffic
Adapted from *Figure 2-6. Notional environmental protection matrix* in FM 3-100.4/MCRP 4-11B				

Adopting the UNEP's broad understanding of the role of environment, natural resources, and civil infrastructure in conflict requires consideration of these issues across the conflict lifecycle (i.e., pre-conflict–conflict–post-conflict), and in each lifecycle phase, the Army would need to consider new ideas, areas of analysis, and engagement.

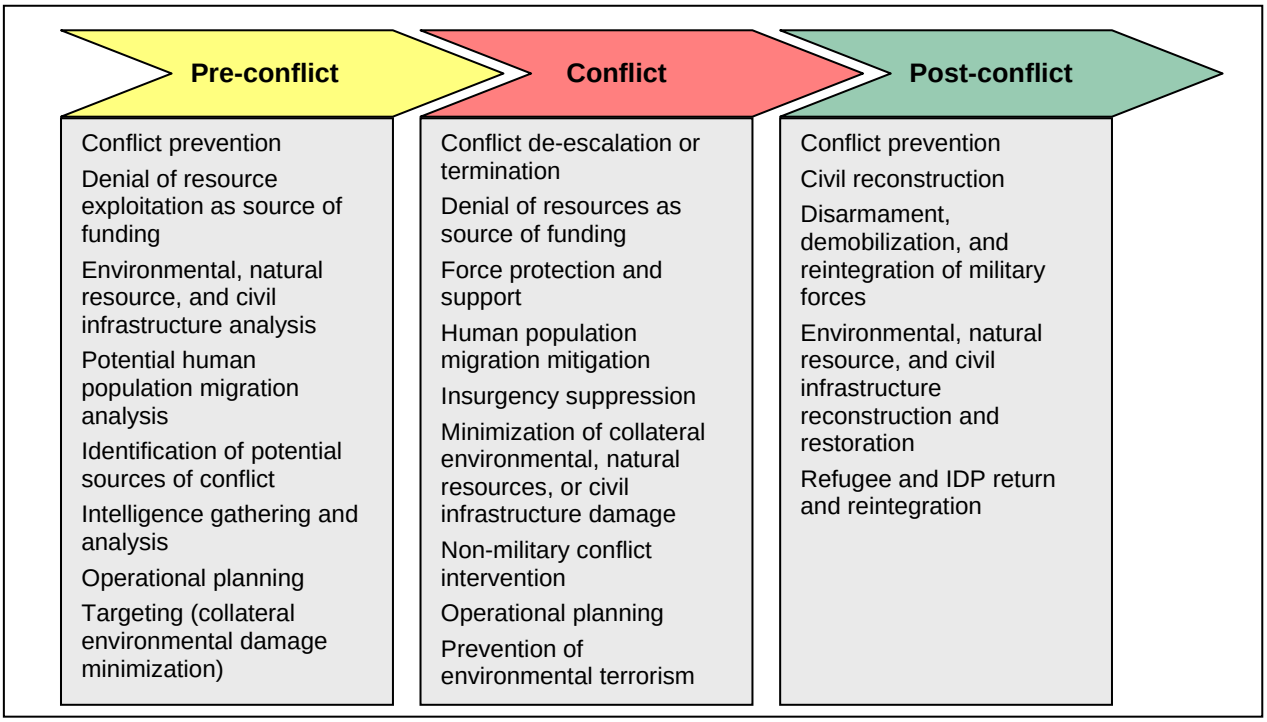
Pre-conflict Phase Consideration of Environmental, Natural Resource, and Civil Infrastructure Issue

For example, as shown in Figure 4-1, in the Pre-conflict Phase, the Army could examine how the exploitation of natural resources was contributing to the conflict or instability. An example of this was the recognition that illicit diamonds from Liberia and Sierra Leone (i.e., conflict or "blood diamonds") were providing the primary source of funds the warring parties used to obtain arms. In December 2000, the United Nations General Assembly unanimously adopted resolution A/RES/55/56 on the role of diamonds in fueling conflict, urging:

All States to support efforts of the diamond producing, processing, exporting and importing countries and the diamond industry to find ways to break the link between conflict diamonds and armed conflict, and encourages other appropriate initiatives to this end, including improved international cooperation on law enforcement….

Where a linkage between a natural resource and the ability of one party to initiate or sustain armed action against another is confirmed, the Army, in consultation with other U.S. government entities (e.g., the Departments of State and Commerce) or the international community (e.g., NATO) could then examine non-military options to break those links, reducing the likelihood of a conflict starting. This concept is the essence of economic warfare, in which one targets the

Figure 4-1: Integration of Environmental Considerations Across the Conflict Lifecycle



wealth needed to sustain conflict, as opposed to strategic, commodity-based warfare such as the U.S. Army Air Corps campaign to destroy German oil production and the U.S. Navy submarine campaign against Japanese oil imports during the Second World War.

Conflict Phase Consideration of Environmental, Natural Resource, and Civil Infrastructure Issues

In the conflict phase, the United States has already engaged in a military action in which prevention of an environmental catastrophe was a principal military objective: seizure and protection of the Iraqi oil fields at the start of OIF. During the early phases of the advance into Iraq in 2003, concerns over the potential for repeating Saddam's act of environmental terrorism in Kuwait following the Iraqi defeat in OPERATION DESERT STORM prompted the deployment of coalition forces (e.g., 1st Marine Expeditionary Force, British 16th Air Assault Brigade) with the mission of seizing and defending these facilities. The success of these forces is

shown by the limited damage inflicted on the oil fields and the prevention of an environmental disaster like that in Kuwait in 1991 (see Figure 4-2).

Figure 4-2: Oil Field Fires in Kuwait, 1991

The *Green Warriors* report also cites recent examples of where consideration of environmental, natural resource, and civil infrastructure played a role in shaping the battlefield in Iraq. From fall 2003 and throughout 2004, the 1st Cavalry Division developed, managed, and worked on numerous sewage, water, electrical, and trash (SWET) projects throughout Baghdad. Projects included cleaning and repairing sewers, collecting trash, and building a new landfill. Later, intelligence officers determined that the insurgency was strongest in areas with little or no water or sewer service, faltering electricity, and high unemployment—most notably, restoration of these services coincided with a sharp decline in insurgent activity.

Post-Conflict Consideration of Environmental, Natural Resource, and Civil Infrastructure Issues

The experience of U.S. reconstruction efforts in Afghanistan and Iraq demonstrates the importance of integrating environmental considerations into the planning of military operations. As previously mentioned, locations in which environmental, natural resource, or civil infrastructure degradation existed were hotbeds of insurgent activity.

The U.S. plan for OIF does not appear to have fully considered the pre-war condition of environmental, natural resource, or civil infrastructure in these nations, or the contribution to stability operations that might accrue from addressing these issue areas via quick, decisive intervention once the United States achieved its military objectives.

For example, in 2003, the International Committee of the Red Cross (ICRC) reported[8] the condition of Iraq's water and wastewater infrastructure and services as "… outdated and decaying owing to over 11 years of embargo…." The ICRC also noted direct war-related damage at key water and sewage plants (e.g., Qanat station in Baghdad, Wafa al Qaed water plant in Basra). The ICRC noted further that the disruption of the electricity supply affected operations after the end of the initial invasion, preventing these facilities from operating at full capacity. This action resulted in urban areas not having a supply of tap or drinking water, sometimes for several days at a time. Given the experience of the 1st Cavalry Division (e.g., decreased insurgent activity in which basic services such as sewage, water, electrical, and trash collection existed), there is a question of whether rapid decisive action to restore these services might have minimized or prevented the rise of the insurgency that raged from 2004 until quelled by the surge of forces that began in 2007.

[8] http://www.icrc.org/web/eng/siteeng0.nsf/htmlall/5nfl8f?opendocument.

There also is evidence that engagement on environmental, natural resource, and civil infrastructure issues has the benefit of increasing the value the host nation's (HN) population places on the U.S. presence—for example, the National Guard Agribusiness Development Teams (ADT) operating in Afghanistan.

In 2007, the Secretary of the Army, Commanders within the National Guard, and civil and political leaders in state governments realized the importance of developing Afghanistan's agriculture and agricultural products distribution capabilities to long-term economic development and stability. Moreover, they realized that the limited Afghan, U.S. Government, other governments, and NGO civilian staff operating in Afghanistan could not effectively address such a large and complex challenge; however, a significant body of untapped, relevant expertise existed within the National Guard. The strategic concept behind the ADT initiative was that improving the economy and the security situation gave Afghans a viable alternative to supporting the Taliban and would separate the people physically and psychologically from the enemy.

> ***"Soldiers and Marines are expected to be nation builders as well as warriors. They must be prepared to help reestablish institutions and local security forces and assist in rebuilding infrastructure and basic services."***
>
> General David H. Petraeus
> Commander, U.S. Central Command
> General James F. Amos
> Assistant Commandant, U.S. Marine Corps
> From FM 3-24/Marine Corps Warfighting Publication (MCWP) 3-33.5, *Counterinsurgency*

As a result, the 935th ADT of the Missouri Army National Guard—soldiers who volunteered for the mission—deployed to Afghanistan, bringing with them a broad spectrum of military occupational skills and their wealth of civilian farming skills and agribusiness knowledge. Since then, ADTs from the California, Indiana, Kansas, Kentucky, Nebraska, Oklahoma, South Carolina, Tennessee, and Texas National Guard have deployed for ADT assignments in Afghanistan. Bringing with them many "no-tech/low-tech" solutions ideal of the Afghanistan situation, the ADTs have performed projects implementing solutions sustainable with local assets, such as building an abattoir and meat inspection facility, helping develop a fish farm and providing maintenance of farm equipment; veterinary and animal husbandry services; and offering instruction on various farming techniques for fertilizing, planting, marketing, storage, and distribution of crops. Evidence of the success of the ADT initiative is borne out by the numerous requests from other provinces and districts for similar support.

Finally, the Army should come to grips with an unpleasant reality: in many nations in which U.S. military intervention is likely, in the post-conflict period the citizens will look to the U.S. military for direction and assistance because their own military was likely viewed as the dominant power in their lives. Although the Army's mission revolves around combat forces, in the post-conflict chaos, the Army may be the only organization present that is able to take the decisive actions needed for addressing immediate issues related to environmental and natural resource protection and the restoration of basic civil infrastructure. Pre-conflict identification and analysis of these issue areas, careful and judicious application of military strength during the conflict to prevent unnecessary damage, and being prepared and equipped to handle the kinds of issues likely to be faced in the post-conflict period can only serve the Army and U.S. national interests.

In conclusion, the UNEP and other reports reviewed as part of this effort not only highlight the environmental consequences of armed conflict but also show an evolving understanding of warfare and the societal importance placed on environmental, natural resource, and civil infrastructure issues. The longstanding approach to managing the footprint of U.S. forces deployed in contingency operations is insufficient to meet the evolving expectations for military cognizance of these issues in the 21st century; however, as shown by Army's growing understanding of how these issues shape both the battle and the peace that follows, the Army can and will adapt to meet and overcome these challenges.

Appendix A: Acronyms

Acronym	Definition
ADT	Agricultural Development Team
AEPI	Army Environmental Policy Institute
ANBP	Afghanistan New Beginnings Programme
APL	Albanian Party of Labor
CALL	Center for Army Lessons Learned
CAR	Central African Republic
CLEA	Contaminated Land Exposure Assessment
CPA	Coalition Provisional Authority
CTC	Combat Training Center
DDR	Demobilization, Disarmament, and Reintegration
DoD	Department of Defense
DoDD	Department of Defense Directive
DoDI	Department of Defense Instruction
EIZ	Erez Industrial Zone
EO	Executive Order
ESOH	Environment, Safety, and Occupational Health
FM	Field Manual
FRY	Federal Republic of Yugoslavia
FYR	Former Yugoslav Republic
GONU	Government of National Unity
GOSS	Government of Southern Sudan
HN	Host Nation
HQDA	Headquarters, Department of the Army
ICRC	International Committee of the Red Cross
IDP	Internally Displaced Person
IETC	International Environmental Technology Centre
IFOR	Implementation Force
IPR	In-Progress Review
JEU	Joint Environment Unit
JFC	Joint Force Commanders
kg	Kilogram
MAG	Mines Advisory Group
MCRP	Marine Corps Reference Publication
MCWP	Marine Corps Warfighting Publication
MoEN	Ministry of Environment
MOOTW	Military Operations Other Than War
NATO	North Atlantic Treaty Organization
NEA	National Environment Agency
NEPA	National Environmental Policy Act
NGO	Non-Governmental Organization
NRD	Natural Resources Division

Acronym	Definition
OEBGD	Overseas Environmental Baseline Guidance Document
OHR	Office of the High Representative
OIF	OPERATION IRAQI FREEDOM
OJE	OPERATION JOINT ENDEAVOR
OJF	OPERATION JOINT FORGE
OJG	OPERATION JOINT GUARD
OPLAN	Operation Plan
OPORD	Operation Order
OSD	Office of the Secretary of Defense
PCBs	Polychlorinated Biphenyls
PCDMB	UN Post-Conflict and Disaster Management Branch
PCEA	Post-Conflict Environmental Assessments
PCNA	Post-Conflict Needs Assessment
PEQA	Palestinian Environment Quality Authority
PNA	Palestinian National Authority
RCRA	Resource Conservation and Recovery Act
SALW	Small Arms and Light Weapons
SFOR	Stabilization Force
SME	Subject Matter Expert
SOP	Standard Operating Procedure
SSR	Security Sector Reform
SSTR	Stability, Security, Transition, and Reconstruction
SWET	Sewage, Water, Electrical, and Trash
TF	Task Force
TFG	Transitional Federal Government
U.S.	United States
USC	United States Code
UDMH	Unsymmetrical dimethylhydrazine
UN	United Nations
UNCHS/Habitat	UN Centre for Human Settlements
UNDG	United Nations Development Group
UNDP	UN Development Program
UNEP	UN Environment Programme
USACE	U.S. Army Corps of Engineers
USAID	U.S. Agency for International Development
WB	World Bank

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Appendix C: Summary of *Green Warrior* Report Findings and Recommendations

Table C-1: Principal Findings of *Green Warriors*

Finding	Summary
Environmental issues can significantly affect operations	Environmental issues can (1) have a significant effect on all phases of contingency operations; (2) be a key strategic consideration because of the potential to influence operations and end states; (3) pose health risks to soldiers; (4) directly disrupt Army operations; and (5) result in diplomatic disputes.
Environmental considerations can be particularly important for success in the post-conflict phase	Environmental issues affect post-conflict stability, security, transition, and reconstruction (SSTR) activities. Bases that U.S. forces use require fully integrated environmental management to prevent damage to natural resources, hazards to soldier health and safety, or incurrence of damage claims when the base closes. Local reconstruction activities outside base camps or larger strategic projects provide basic services, support economic and social stability, and contribute to the viability of a host nation (HN) government.
Environmental considerations in contingency operations differ significantly from those experienced in normal operations in the United States	Environmental conditions before U.S. entry often increase health- and environmental-exposure risks (e.g., water/wastewater treatment facilities might be inoperative resulting from damage during the conflict). Therefore, contingency operations plans must address the need for clean drinking water, wastewater treatment, and solid/hazardous waste management. Deployed forces often rely on organic assets to perform these functions when civilian or contracted support is unavailable. Finally, because HN, international, and U.S. laws usually do not apply during contingency operations, forces in the field tend to focus on higher priority issues and actions.
Environmental issues can have far-reaching effects across operations and Army organizations and around the world	Environmental issues affect contingency operations across many dimensions (e.g., mission, soldier health, safety, cost, diplomatic relations, reconstruction) and organizations (e.g., engineers, logisticians, medical staff; transport personnel, Department of State agencies, NGOs). These issues may have a transboundary aspect because air and water quality and species migration patterns do not respect international boundaries.
Inadequate environmental practices in contingency operations can increase risks and costs	Inadequate consideration or response to environmental issues results affect mission success, increase health and safety hazards, increase costs, and negatively affect interpersonal relations at all levels (e.g., from the local population to internationally).
The Army could improve its understanding of environmental considerations and better incorporate such considerations into plans and operations	Many contingency operation plans do not fully consider the strategic effects of environmental considerations. Environmental annexes focus on tactical level issues but do not cover strategic issues, desired end states, and the importance of environmental considerations in the post-conflict phase. For example, in Iraq, establishing clean water and sewage treatment infrastructure contributed to social and governmental stability, but planners did not consider the pre-invasion condition, potential for damage during operations, or need to bring these systems into operation after major combat operations ended. Resolving these issues requires the following: training operations planners on the strategic importance of environmental issues (especially in the post-conflict and reconstruction phases), access to reliable environmental intelligence on the environmental and ecosystem conditions and the technological level of the existing infrastructure, and integration of this information into the formulation and execution of contingency operations plans.

Table C-1: Principal Findings of *Green Warriors*

Finding	Summary
The Army has no comprehensive approach to environmental considerations in contingencies, especially in the post-conflict phase	Most DoD and service-level policies and doctrinal documents explicitly exclude contingency operations or provide inadequate guidance regarding the importance of these considerations in contingency operations. Ground-components and Joint Force Commanders (JFC) must include an environmental annex to a war plan, but such annexes are typically limited in scope or strategic vision and rarely address the post-conflict phase or how to achieve desired environmental end states. This issue is attributed to a combination of policy and guidance inadequacies; lack of training and awareness; lack of necessary fiscal, materiel, and personnel resources; and failure to adopt and disseminate lessons learned from previous operations.

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