Waste Management for Deployed Forces

MARCH 2019

This publication supersedes TM 3-34.56/MCIP 4-11.01, dated 19 July 2013.

Headquarters, Department of the Army

Foreword

This publication has been prepared under our direction for use by our respective commanders and other commands as appropriate.

GARY A. MCCULLAR
Colonel, United States Marine Corps
Commanding Officer, Marine Corps Engineer School

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TM 3-34.56/MCRP 3-40B.7, C1

Change 1
Technical Manual
Publication No. 3-34.56

Headquarters
Department of the Army
Washington, D.C.

Marine Corps Reference
Publication No. MCRP 3-40B.7

Marine Corps Engineer School
Camp Lejeune, NC

09 September 2021

Waste Management for Deployed Forces

1. This change corrects the Marine Corps designator to 3-40B.7 and provides updates to multiple pages.

2. A bar (|) marks new or changed material.

3. TM 3-34.56 is changed as follows:

Remove Old Pages	Insert New Pages
Cover page	Cover page
Foreword	Foreword
i through iii	i through iii
iv	iv
v	v
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References-1	References-1
References-2	References-2
Back Cover	Back Cover

4. File this transmittal sheet in front of the publication for reference purposes.

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TM 3-34.56

09 September 2021

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Active Army, Army National Guard, and United States Army Reserve. Distributed in electronic media only(EMO).

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Technical Manual
No. 3-34.56

Headquarters
Department of the Army
Washington, DC
29 March 2019

Marine Corps Reference Publication
No. 3-40B.7

Marine Corps Engineer School
Camp Lejeune, NC
29 March 2019

Waste Management for Deployed Forces

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Preface

TM 3-34.56/MCRP 3-40B.7 provides best practices and techniques for conducting waste management activities while deployed and focuses on brigade level and below. It provides a better understanding of the waste streams that are generated and provides guidance on minimizing the harmful effects of waste on human health, the environment, and the mission. It describes the planning necessary to estimate generated waste, based on unit functions and activities, and provides guidance on generating and implementing waste management solutions to fulfill immediate and long-term waste requirements. While this publication is primarily aimed at subject matter experts in the occupational fields of engineering, logistics, safety, transportation, environmental management, and preventive medicine (PVNTMED), it contains beneficial information for commanders and staff officers, especially predeployment planning considerations and the integration of waste management into unit activities. This publication includes a compilation of techniques and procedures found in doctrine, lessons learned, and other reference material; it serves as a "how to" guide for managing waste that is generated at the tactical level. Because each situation will be uniquely different, based on operational and mission variables, this guide relies on the reader's ability to apply experience, common sense, and sound judgment while generating options and implementing solutions that will reduce the harmful effects of waste on human health and the environment to the fullest extent practicable. This guide is best used in combination with the subject matter expertise that resides within, or is available through, higher headquarters, supporting units, or reachback. A key reference and keystone document for this publication is ATP 3-34.5/MCRP 3-40B.2 (MCRP 4-11B).

The principal audience for TM 3-34.56/MCRP 3-40B.7 is Army and Marine Corps commanders, planners, engineers, environmental officers, and logisticians who conduct operations across the range of military operations. Trainers and educators throughout the Army and Marine Corps will also use this manual.

Commanders, staffs, and subordinates ensure that their decisions and actions comply with applicable United States, international, and in some cases host-nation laws and regulations. Commanders at all levels ensure that their Soldiers operate in accordance with the law of war and the rules of engagement. (See FM 6-27/MCTP 11-10C.)

TM 3-34.56/MCRP 3-40B.7 uses joint terms where applicable. Selected joint and Army terms and definitions appear in both the glossary and the text. Terms for which TM 3-34.56 is the proponent publication (the authority) are italicized in the text and are marked with an asterisk (*) in the glossary. Terms and definitions for which TM 3-34.56 is the proponent publication are boldfaced in the text. For other definitions shown in the text, the term is italicized and the number of the proponent publication follows the definition. Marine Corps readers will find the same information depicted in the current edition of MCRP 1-10.2.

TM 3-34.56/MCRP 3-40B.7 applies to the Active Army, Army National Guard/Army National Guard of the United States, United States Army Reserve, and the Total Force Marine Corps unless otherwise stated.

The proponent of TM 3-34.56/MCRP 3-40B.7 is the United States Army Engineer School (USAES). The preparing agency is the Fielded Force Integration Directorate, Doctrine Division, Maneuver Support Center of Excellence (MSCoE). Send comments and recommendations on DA Form 2028 (*Recommended Changes to Publications and Blank Forms*) to Commander, MSCoE, ATTN: ATZT-FFD, 14000 MSCoE Loop, Suite 270, Fort Leonard Wood, MO 65473-8929; by e-mail to usarmy.leonardwood.mscoe.mbx.engdoc@mail.mil; or submit an electronic DA Form 2028. Marine Corps personnel should submit suggestions and changes by e-mail to mces_s3_doctrine_smb@usmc.mil or written correspondence to Marine Corps Engineer School (ATTN: S-3), PSC Box 20069, Camp Lejeune, NC 28542-0069, or call (910) 440-7166.

Introduction

Waste management, regardless the number of deploying military and civilian personnel, must be integrated early in the planning process for all phases of deployed operations, including predeployment, deployment, and redeployment. Austere conditions can be challenging because of the lack of infrastructure and facilities; but, base camps with full facilities can also be challenging because of significant amounts of waste being generated. Water conservation and reuse become significant logistical and environmental issues in almost any location. Generated waste, if not dealt with properly, can contaminate food and water sources, contribute to the spread of disease, cause varying degrees of harm to the environment, and generate ill feelings with the host nation (HN). Experiences at deployed locations have demonstrated some of the consequences when waste generation is not considered during predeployment planning or when waste management solutions are poorly executed. Adverse consequences include health concerns associated with open-pit trash burning and the negative impacts (in terms of time and money) on base camp transfers and closures due to residual environmental impacts. The challenges associated with waste management will continue to confront United States (U.S.) forces in the future. Future operational environments will likely be complex and austere. Local or HN municipal waste disposal or treatment facilities or services may be nonexistent, incapacitated, or beyond reach due to their proximity, security, or political considerations—placing the burden for waste management on the deployed force. Commanders (supported by their staffs) must consider the various operational impacts of waste generation early in the planning phase and throughout the operation/deployment. Application of sound waste management practices will generally provide a positive impact toward mission success, while also helping to preserve the unit's combat readiness.

This publication is a dual-service publication. Any reference to the term Soldier throughout this document is inclusive of Soldier, Marine, Corpsman, and Seabee. Any reference to the term brigade is inclusive of brigade combat team (BCT)-sized equivalents. For the purposes of relative combat power comparison, any reference to the Army term BCT shall be deemed equivalent to a regimental combat team-based Marine air-ground task force (MAGTF). Any reference to the Army term military decisionmaking process (MDMP) is inclusive of the Marine Corps planning process as they are comparable, deliberate decision making methodologies that have similar visibility and connotation within each Service. Any reference to the Army term mission variables includes mission, enemy, terrain and weather, troops and support available, time available, and civil considerations (METT-TC), which corresponds to the Marine Corps mission, enemy, terrain and weather, troops and support available-time available (METT-T). See FM 6-0, MCWP 5-10, and ATP 2-01.3 for more information. Lastly, a reference to the Army term intelligence preparation of the battlefield (IPB) corresponds to the Marine Corps term intelligence preparation of the battlespace.

The term waste management includes activities involved with the reduction, generation, segregation, collection, transportation, processing (treatment), and disposal of waste materials. Waste management is executed to ensure a healthy and sanitary living environment, preserve the natural environment, maintain positive relationships with the HN, and sustain combat (unit) readiness. Waste management activities are primarily aligned with the sustainment and general engineering occupational fields. In the Army, engineers are the staff proponent for waste management; however, they rely on the contributions of subject matter experts (such as environmental, safety, transportation, logistics, chemical, biological, radiological, and nuclear (CBRN), and PVNTMED personnel) who serve as members of the waste management planning group. CBRN-contaminated waste is not addressed in this manual; for information about the management of contaminated waste and CBRN hazards, see ATP 3-11.32/MCWP 10-10E.8 and TM 3-11.91/MCRP 10.10E.4/NTRP 3-11.32/AFTTP 3-2.55. In the Marine Corps, the logistics staff section of the MAGTF headquarters is responsible for coordinating waste management for a deployed MAGTF. Commanders (supported by their staff) are responsible for addressing the implications of generated waste early in the planning phase and for ensuring that the unit effectively performs waste management throughout the operation.

This manual is organized as follows:

- **Chapter 1.** Waste Management for Deployed Forces.

- **Chapter 2.** Waste Management Integration.
- **Chapter 3.** Nonhazardous Solid Waste.
- **Chapter 4.** Wastewater.
- **Chapter 5.** Hazardous and Special Waste.
- **Chapter 6.** Medical Waste.
- **Appendix A.** Identifying and Classifying Waste Streams.
- **Appendix B.** OPLAN/OPORD Waste Management Appendix.
- **Appendix C.** Spill Prevention and Response Planning.
- **Appendix D.** Reachback Points of Contact.
- **Appendix E.** Safety Data Sheets.
- **Appendix F.** Base Camp Transition, Transfer, and Closure.

Unless this publication states otherwise, masculine nouns and pronouns do not refer exclusively to men.

A listing of preferred metric units for general use is contained in Federal Standard 376B <https://www.nist.gov/sites/default/files/documents/pml/wmd/metric/fs376-b.pdf>.

PART ONE

Waste Management

Part one of this publication is focused on defining waste management and describing how it is incorporated into mission planning by using a 6-step process. Waste management activities are employed to minimize the harmful effects of waste on human health, the environment, and the mission and to identify resources that can be reused or recycled for the benefit of U.S. forces and the HN. Effective waste management begins early in the planning phase by estimating the amount of waste that is likely to be generated by the force and determining the best practicable means for dealing with it, based on an assessment of the mission variables. Waste that is improperly managed presents an unnecessary risk to the health of personnel, detracts from the mission, and hinders base camp transfers or closures.

Chapter 1

Waste Management for Deployed Forces

Meeting America's strategic objectives hinges on the military's ability to rapidly deploy or project forces into any location, under any threat condition, against any adversary. Often, these locations lack the necessary infrastructure to accommodate the waste that will be generated by the deployed forces. Haphazardly stockpiling or disposing of waste can rapidly spread disease and threaten human health, contaminate food and water sources, harm the environment, misuse resources (time, money, and personnel), and negatively impact mission readiness. In support of the United States' commitment to environmental stewardship and to minimize the harmful impacts of waste on the population's health, the environment, and the mission, commanders at each echelon must ensure that waste management is incorporated throughout the operations process. This chapter describes waste management, its importance in sustaining deployed force operations, and some of the challenges that will inhibit the ability to achieve waste management effectively. It also describes key roles and responsibilities that are essential for effectively conducting waste management activities, which will be conducted in compliance with Status of Forces Agreements, HN laws and environmental policies, theater standard operating procedures (SOPs), and the concurrence of local population leaders. Waste management activities should be conducted in a manner that supports a sustainable force, protects personnel, reduces overall costs, and limits U.S. liability.

OVERVIEW

1-1. Any discarded material is considered waste, but it may not be without value or possible use. Waste is generally categorized as nonhazardous solid waste, wastewater (gray or black water), hazardous waste (HW),

special waste, or medical waste. Special waste is described as any waste material that does not meet the criteria for HW, but still requires special handling or disposal procedures due to its physical, chemical, or biological properties that pose a threat to human health, equipment, property, or the environment. The immediate effects of mismanaged waste may seem quite inconsequential at the time, perhaps only as an eyesore or the source of objectionable odors. However, the more significant effects that can threaten human health and the environment often go unnoticed. When mismanaged, waste becomes more harmful with time, thus generating long-term conditions that become more difficult and costly to rectify.

1-2. This manual provides waste management guidance for a full range of military operations, with circumstances ranging from a short duration in an austere environment to several years in a semipermanent base camp. Austere environments can be inherently uncertain, with poor or war-affected infrastructure that cannot accommodate deployed forces. Typically, under these conditions, planners will design waste management activities that are simpler and use fewer resources. The waste management options in any particular environment will be dictated by the available resources, the expected duration, and the number of personnel. Similarly, the best options will likely change over time as a camp matures, resources become available, and the mission changes. Base camps, generally with more developed facilities, are physical locations established to sustain and protect deployed forces. Establishing base camps helps extend and maintain operational reach and is vital in projecting and sustaining combat power. ATP 3-37.10/MCRP 3-40D.13 provides an integrated, systematic approach to base camps and serves as a guide to performing the various activities of the base camp life cycle during deployments. Waste management activities must be considered throughout any location's life cycle, including planning and design, construction, operations and maintenance, and transfer or closure.

1-3. To prevent mismanagement, it is necessary to approach waste management as a system of systems endeavor. Waste management planning is a deliberate process that can include innovative application of scientific principles to provide comprehensive waste management practices while striving to reach self-sustainability. Each waste component is not dealt with independently, but rather as an integrated and innovative process. This approach has been shown to provide significant cost savings. For example, gray water is not simply discharged away from a site, but instead is contained and reused. This approach reduces the amount of energy and water that must be produced or procured and transported. Dining facility waste can be used as a component in energy production or composted, both useful processes. Compost and sludge obtained from waste treatment processes can be used as micronutrients to bioremediate or land-farm petroleum-contaminated soils. These are only a few of the practices that may help reach the goal of self-sufficiency and sustainment.

DEFINITIONS

1-4. ***Waste management*** **is the collection, transportation, treatment, or disposal of waste materials in an effort to ensure a healthy and sanitary environment.** Integrated waste management is the management of the entire waste process, including generation, collection, storage, transportation, resource recovery, treatment, and disposal. It employs several waste control methods based on the waste hierarchy of avoidance, reduction, recycling, reuse, recovery, treatment, and disposal. Waste management operations are primarily general engineering tasks, part of the sustainment warfighting function (see ADRP 1-03), and include the planning, construction, operation, and maintenance of new (and the upgrade of existing) infrastructure and utilities for the purpose of waste management. Waste management activities are conducted to minimize the adverse impact of waste on operational readiness, health of personnel, and the environment. In addition to the engineers, technical advice is important from subject matter experts in the transportation, logistics, safety, and PVNTMED occupational fields. The roles and responsibilities for waste management are discussed later in this chapter.

1-5. The overall objective of waste management is to minimize the potential harm and cost that waste can cause by—

- Planning in detail and making the best decisions possible, with the best information available.
- Predicting short- and long-term hazards (risks) and implementing actions to mitigate the effects.
- Leveraging available resources.
- Developing options that are feasible, suitable, and sustainable (see chapter 2).

1-6. Integrated waste management activities may be performed sequentially or simultaneously and recur as necessary, based on mission variables. Basically, once waste has been generated, the following actions are taken:

- **Collect.** Collect waste at the point it is generated. Waste management works most effectively if the waste is segregated at the point of generation. This is also called source segregation.
- **Transport.** Transport waste from collection points to storage, treatment, disposal, or recycling facilities. Considerations for waste transport include planning to prevent personnel exposure when handling waste and waste containers and accidental release or spill of waste to the environment.
- **Recover.** Recover material from the waste stream that results in a product with a potential for economic or ecological benefit, while reducing the amount of waste that requires disposal. Recovery actions can include material recovery (such as recycling), energy recovery (such as reusing a fuel or creating a fuel from waste), biological recovery (such as composting), and reuse.
- **Treat/Dispose.** Treatment is the use of biological, chemical, or mechanical methods to change the character or composition of waste, and reduce or eliminate its potential as a hazard to human health or the environment. Treatment may be performed in conjunction with disposal or as a means of disposal in itself. Waste disposal is the final disposition of a discarded or discharged material. This includes general refuse that is destined for a landfill or incinerator, residual waste from reuse and recovery actions (which is not otherwise reused or recovered), and other specific waste categories that require specialized treatment.

1-7. As with other military functions, waste management is both an art and a science:

- The art is being able to visualize complex situations and understand what is possible when operating under less-than-ideal conditions with limited resources, and while continuously balancing mission requirements with environmental stewardship. The art is in understanding when it may be necessary to sacrifice efficiency for effectiveness, to create solutions that are practical, convenient, and easy to follow when personnel are tired, unaware of the process, or pressed for time. It is accepting that more preferred options may have to be deferred, but not abandoned, until the necessary conditions have been set to implement better solutions.
- The science is using algorithms and planning factors to forecast waste requirements and implementing proven solutions that are based on established procedures and methodologies to meet those requirements—while leveraging technology to improve efficiencies and safety.

CHALLENGES

1-8. Performing waste management in support of deployed forces will be a challenge. Units must be prepared to bear the entire burden for waste disposal, especially during the initial phases of an operation because the theater sustainment infrastructure will not have been established. Operational requirements may require forces to be positioned beyond the reach of existing or functional waste management facilities. When facilities are within reach, they may lack the capacity to process the additional load from the deployed force or may be inaccessible due to the threats associated with an uncertain or hostile operating environment. Even as operational phases, mission, or base camps change, characteristics and amounts of waste change.

1-9. Units must be prepared for population surges. During transitions, the base camp population can double for a couple of weeks, resulting in increased amounts of waste. In addition, the base camp population constantly changes due to transients temporarily using facilities and due to HN employees working for various contractors. The unpredictable nature of a base camp population makes it difficult for planners and engineers to provide consistently appropriate waste management.

1-10. Even though U.S. regulatory guidance does not typically apply to contingency operations, increases in the appreciation of full life cycle costs, environmental awareness, and sensitivities have resulted in more command emphasis on environmental considerations and on properly managing waste abroad. Essentially, the same environmental considerations that apply in the United States and on U.S. bases overseas are expected to be applied in the operational area to the fullest extent possible without impacting the mission. These can be challenging tasks. A commander's guidance will be highlighted in appropriate annexes and appendixes of operations orders issued by the higher headquarters of deployed forces. In the absence of

environmental guidance at contingency locations, DOD 4715.05-G can be a helpful reference in factoring environmental considerations.

1-11. It is important for leaders to reinforce with their personnel that they are setting the example for environmental stewardship within the HN. Establishing the appropriate environmental mind-set within all personnel on the base can be a challenge as some may perceive a total disregard for the environment, based on observation of common practices used by the indigenous population. Leaders must also enforce established environmental standards with local and nonlocal laborers working under U.S. contracts. Scopes of work and performance work statements must include the necessary guidelines that meet U.S. expectations for environmental protection, and inspections must be conducted to ensure compliance.

1-12. Leaders will be challenged in implementing suitable waste management plans with limited resources and capabilities needed for performing waste management. Specialized engineer units (such as the Army's facility engineer detachments and forward engineer support teams [FESTs]) may be available at the tactical level as part of specific augmentation, but they are normally employed at the operational and strategic levels where they are typically in high demand, especially during the initial phases of an operation. Waste management planners at BCT level and below may have to rely solely on reachback to access the technical expertise needed during the initial phases of an operation/deployment.

1-13. Given the unpredictable and fluid nature of most contingency operations, waste management planners will be challenged to determine how best to employ waste management systems. Waste management planners attempt to create waste management plans that will fulfill the current needs, while concurrently setting the conditions for enduring capabilities that will meet forecasted future requirements. Also, the waste management procedures should be documented in the relevant SOPs. Choosing the right location for enduring waste management systems from the start avoids the need for additional land (real estate) acquisitions and environmental assessments, while minimizing the total number of areas that will likely require remediation or rectification as part of base camp transfer and closure. If possible, waste management areas should be collocated. This maximizes available real estate and resources, especially manpower to operate the site. It also reduces the scope of engineer effort required to construct and operate the solid waste site (such as perimeter fencing or berms, signage, gates, interior road network, and office areas), simplifies environmental recordkeeping for the types and quantity of material disposed, and eases the burden on the base fire protection service.

1-14. Based on the size of a base and threat condition, units should establish and implement recycling and reuse programs whenever possible, even though this can be challenging at a deployed location. Recycling and reuse programs should be initiated for plastics, cardboard, paper, batteries, tires, wood, aluminum cans and other metals (ferrous and nonferrous). This will require source segregation, sorting facilities, compactors (sized for the base), and a sufficient source of recyclable materials to justify establishment and operation of a recycling/reuse program. Composting for food waste and land farming for petroleum-contaminated soils will also need consideration.

PLANNING AND DESIGN CONSIDERATIONS

1-15. Planning and design considerations will be based on multiple factors, including the mission, number of personnel, duration, and available land area and resources. Planning should include considerations for surges in population and potential growth or contraction of the base. If the available land area and resources are known, plan accordingly. Otherwise, if unknown, plan in accordance with a full range of potential resources and conditions, ranging from the best-case scenario to the potentially austere conditions for the given area. In other words, develop different courses of action based on a full range of potentially available resources.

1-16. Environmental considerations need to include natural resources, cultural resources, and threatened and endangered species. These challenges are unique to the theater of operations and even to the actual location of a camp and associated operations. To the fullest extent possible, integrate environmental guidance into operation plans (OPLANs) and operation orders (OPORDs). The intent is to prevent or limit damage to environmental resources, to prevent potential liability to the United States, and to achieve and maintain good relations in the HN. More information about environmental resources can be found in ATP 3-34.5/MCRP 3-40B.2 (MCRP 4-11B).

1-17. The design of the waste management facilities should incorporate a drainage system, application of gravel or hardstand in high traffic areas, and sufficient space for equipment and vehicle movement. Facilities must not be placed in areas that are susceptible to flooding or may become waterlogged due to a high water table. Additionally, waste management activities must not endanger water resources. The prevailing wind direction is an important factor in planning the layout of waste management activities; for example, locate a burn pit as far away as possible from dining, billeting, work areas, the flight line, hazardous material (HAZMAT) and HW areas, and fuel storage areas. The prevailing wind must push the smoke away from these areas.

1-18. Preengineered storage buildings (such as pole barns or metal buildings) should be set on a 1-meter-high wainscot concrete wall. This will reduce damage to light weight wall panels and prevent wall panel deterioration due to rust or acidic or basic/alkaline substances. Sliding doors are recommended on buildings to allow air flow during warm weather. Open-walled canopies are practical, especially in built-up areas (less uplift design required). Provide a large concrete pad as a loading/offloading area to prevent rutting of the yard surface. When possible, collocate compatible functions under one roof. A perimeter fence should be installed to catch blowing debris and control access to the yard. Include a retention pond to catch runoff from the waste management areas.

1-19. Waste management planners, throughout every phase of deployment, must always have contingency plans for waste disposal. For example, black water must always be managed to prevent the spread of diseases. Plan to use existing facilities, if possible. Otherwise, units can use field-expedient methods to ensure proper sanitation until other facilities are developed or until a contract is in place for wastewater management. At a more enduring location, plan to use existing facilities, Force Provider, package plants, sewage lagoons, or septic systems. Develop contingency plans with different courses of action based on the full range of potentially available resources and conditions. In addition, consider wastewater management aimed at reducing the amount of wastewater that is generated, especially the amount of black water that requires more intensive treatment. Wastewater that contains black water must be managed as black water, so the most effective way to limit the generation of black water is keeping gray water separate from black water. In addition, construct urine disposal facilities next to male latrines. Wastewater conservation standards, such as 4-minute showers and immediate repair of identified leaks, may need to be established and enforced to reduce wastewater generation. Use grease traps or oil-water separators, where applicable. Also, placement of wastewater activities is important; surface drainage, the groundwater table, and prevailing winds are all important factors in planning wastewater management activities, including contingency planning.

FUNDAMENTALS

1-20. Fundamentals provide a foundation to guide actions in any situation. They provide a basis for incorporating new ideas and technologies, while fostering the initiative needed for leaders to be adaptive, creative problem solvers. The fundamentals described here do not serve as a checklist, and their degree of application varies within each situation.

IMPROVISE

1-21. Waste management planners and executors must be able to improvise and adapt to unexpected situations or circumstances. They must be able to create, invent, arrange, or fabricate whatever is needed from whatever is available. They modify established techniques and procedures and local practices to fit the current situation.

PREVENT, REDUCE, REUSE, AND RECYCLE

1-22. Since all methods of waste disposal will impact the environment to some degree, waste minimization should be of primary importance during all deployments. Units should minimize the use of disposable products as much as possible (such as reducing reliance on disposable plastic containers and paper products and using bulk water containers instead of individually packaged, plastic water bottles). Instead, focus on prevention and source reduction through preengineered materials and supplies that will reduce the volume of generated waste. Efforts should be made to reuse materials (such as construction materials, wood pallets, and packaging material) whenever possible. Units should establish consolidated storage yards or areas for

construction materials and other common-use items so that they can be conveniently accessed and reused by multiple users. Maintenance facilities must change operations to maximize the reuse of petroleum products, fuels, and other fluids used in vehicles. Commanders and leaders at all levels must be aware of these issues and work with Logistics Civil Augmentation Program (LOGCAP) and other agencies to improve waste management practices.

1-23. Units should increase the purchase of sustainable products (for example, biodegradable paper cups instead of Styrofoam cups). Sustainable products contain recycled material, are biobased, or are water or energy efficient. They are environmentally preferable items and meet Federal and Department of Defense (DOD) Green Procurement program requirements. These items can be procured through such places as the General Services Administration and Defense Logistics Agency (DLA). Sustainable products conserve resources, save water and energy, save landfill space, and reduce pollution. Include sustainable products in contract specifications, and/or remove restrictions to purchasing sustainable products in contract specifications and purchase requests.

1-24. Units should establish and implement a recycling program whenever possible, even though this can be challenging at a deployed location. Functional local recycling centers in the operational area may be unavailable, and shipping recyclable materials to larger base camps may not be economically viable or practical. However, establishing or reconstructing local recycling facilities as part of capacity building efforts may offer long-term solutions, while bolstering the local economic situation.

1-25. DLA Environmental Products and Services includes DLA Disposition Services, DOD Shelf Life Program, Hazardous Material Information Resource System (HMIRS), and Pharmaceutical Reverse Distribution. DLA Disposition Services was formerly known as the Defense Reutilization and Marketing Office. DLA Disposition Services provides the same level of service and support to warfighters and other customers in the disposition of excess property, HW, and property requiring demilitarization. Additionally, these services include reuse/recycling programs, including electronics, and assistance with managing HAZMAT. DLA Disposition Services personnel are prepared to assist you in completing necessary documents, arranging for disposal contracts, and training your personnel in DLA disposal turn-in procedures. If necessary, DLA can dispose of items in-place; for example, large items that are not readily transportable to a DLA storage area, property that is held in remote locations, and property that DLA Disposition Services is unable to accept due to lack of facilities, technical expertise, or available resources. Acceptance of physical custody of hazardous property shall be determined based upon the guidelines in DODM 4160.21-V4. If DLA cannot accept physical custody, it will provide procedures for management and disposal. DLA is part of a global community that operates field sites in many states and countries across the world. Additional information and training can be found online at http://www.dla.mil/.

MAINTAIN VISIBILITY

1-26. Waste disposal is typically “behind the scenes” and often taken for granted. It is important to maintain visibility and command emphasis on the waste management situation, which can be achieved through the following tasks:

- Identify waste management requirements (funding, manpower, and equipment) in operation resource requirements (for example, budget, contracting, and manpower).
- Highlight pertinent waste management considerations during mission analysis, course of action (COA) analysis, and decision briefs as part of the MDMP.
- Inject relevant and realistic waste-related scenarios (such as responding to a significant HAZMAT spill near an area of cultural or historical significance) into wargaming and rehearsals.
- Establish roles and assign responsibilities in orders, plans, and SOPs clearly. Establish ownership for collection sites, and assign individual responsibilities for specific areas or portions of the waste management system.
- Provide updates or spotlight briefs to the commander and staff on waste management standards, compliance, and waste-related topics of interest on a regular or recurring basis (for example, during shift change briefs and working group meetings as part of unit battle rhythm).
- Include waste management instructions in attachments to OPLANs/OPORDs, when appropriate, instead of publishing separately.

- Ask subordinate units about their plans for waste disposal during mission briefs or rehearsals, as appropriate.
- Bring in subject matter experts to augment the planning, wargaming, and execution of waste management programs.

FOCUS AT THE POINT OF GENERATION

1-27. Waste should be segregated as near as possible to the point of generation. Not only does this help raise awareness of its existence and establish ownership, but it also minimizes handling and transportation requirements that will—

- Conserve resources (such as time, manpower, equipment, and money).
- Reduce the chance of mishaps (such as spills and littering).
- Minimize personnel exposure to potentially harmful materials.

ANTICIPATE

1-28. Waste management planners must anticipate challenges and exploit opportunities. Challenges may arise in terms of additional waste requirements resulting from task organization changes, unit strength surges (such as during the transfer of authority and right-seat rides when base camp populations are essentially doubled), and base camp realignment which prompts expansion and closure. The status of current waste management systems must be monitored to anticipate when initial design capacities will be exceeded. The equipment, funding, and space requirements for effective waste management programs must be planned and included in the contracting services and construction timelines to ensure that they are in place from base camp inception.

1-29. Waste management planners must look for and seize opportunities to reduce hazards (risks) by leveraging available capabilities and resources in a proactive manner and minimize the current and future impacts of waste. They look for opportunities to incorporate existing and emerging technologies (such as compactors, shredders, and fuel blenders) and ways to reduce, reuse, and recycle to minimize the overall volume of generated waste and improve the overall efficiency and effectiveness of waste management efforts.

SIMPLICITY

1-30. Waste management policies and procedures should be clearly written so they are easily understood, user-friendly, and promote compliance. For example, place trash receptacles and recycle bins together in a convenient location, and post signs that clearly explain what materials should be placed into each collection bin. The use of barriers (such as the size and shape of openings to containers and bins) is also a simple way to prevent the inadvertent mixing of waste types. It is beneficial if waste containers and recycling containers are not the same color. Associating a color with the material to be placed in a container can help improve the separation of trash from recyclables. When colored bins are not available, words can be clearly painted on their exterior to identify the contents suitable for each uncolored bin.

ARCHIVING AND DATA MANAGEMENT

1-31. The United States Army Public Health Center (APHC) (https://phc.amedd.army.mil/), under Deployment and Environmental Health, provides services and information pertinent to maintaining and improving environmental health in deployment locations. These services and information include topics on environmental quality to include air quality, water quality, solid waste, medical waste, and operational noise hazards; field PVNTMED; environmental medicine; environmental surveillance and data archiving; health risk assessment; threat assessment; entomology and pest management, and health risk communication. Environmental health-related data is archived and managed using multiple systems, including Defense Occupational and Environmental Health Readiness System (DOEHRS), Military Exposure Surveillance Library (MESL), and Deployment Environmental Surveillance Program, which can all be found under the link for Health Risk Assessment, Surveillance and Management. These data management systems contain additional information on environmental health risk assessment, environmental surveillance and surveillance data management, global threat assessment, technical risk communication and studies, and health education programs. DOEHRS is a system for entering, assessing, managing and reporting occupational and

environmental exposures. It is used for both garrison and deployed operations, is mandated by various DOD policies and public laws and is the system of record for the DOD individual longitudinal exposure record. MESL is the recommended document library for Health Risk Assessment, Surveillance, and Management. The MESL is where Occupational and Environmental Health Surveillance data is submitted. The Deployment Environmental Surveillance Program receives environmental samples that are collected and shipped from units while deployed to evaluate and assess environmental information, data analysis, and sampling and surveillance techniques. This information is used to assist PVNTMED personnel and commanders in their decision making during deployments.

ACCOUNTABILITY

1-32. Waste management activities should be conducted in a manner that supports a sustainable force, protects personnel, reduces overall costs, and limits U.S. liability. Accountability is key to achieving those goals. Accountability is the obligation of an individual, unit, or organization to make responsible decisions, accept responsibility for their actions, and to make timely corrections or adjustments. Accountability within waste management can be achieved by—

- Obtaining command emphasis from all levels on proper training, waste management, corrective actions, and documentation/recordkeeping.
- Taking ownership of applicable roles and responsibilities (see paragraphs 1-33 through 1-60), and including environmental considerations throughout all military operations.
- Including waste management within the command inspection program and correcting actions that could undermine the force's success.
- Documenting conditions at deployed locations, including preexisting conditions, changes during deployment, and conditions upon closure of a site. Use digital photographs and videos, maps, and required environmental documentation (see appendix F).
- Ensuring that contracts are written to specify that a contractor is liable for environmental impacts caused by their personnel, and establishing means (such as contracting officer's representatives [CORs] and contractor escorts) for ensuring contractor compliance.
- Consulting combatant command, as needed, for environmental guidelines and requirements, such as restoration guidelines, closure requirements, and archive instructions.

ROLES AND RESPONSIBILITIES

1-33. Commanders and leaders at all echelons need to ensure that waste management is incorporated throughout all operations in support of the DOD's commitment to environmental stewardship. Waste management minimizes the harmful impacts of waste on the health of all personnel, the environment, and the mission.

1-34. The key roles and responsibilities for performing the waste management oversight described below are aligned with the staff positions usually existing in most brigades and battalions. The commander will organize elements of the staff sections within command posts by warfighting function or planning horizon in a way best facilitating command and control. The organization of command posts and the assignment of waste management responsibilities within cells and staff sections will vary based on the echelon, type of unit, and the commander's current mission or needs. In some cases, the commander may decide to assign certain waste management responsibilities to specific individuals, regardless of their branch/military occupational specialty or functional area of responsibility, based on unique skills that they may possess as a result of military or civilian experiences and education.

1-35. The responsibilities for waste management at the company level are similar to those at the brigade and battalion level. Company commanders will arrange the waste management responsibilities outlined below to best suit their organizational structure, matching talent to tasks. Most of the duties and responsibilities for waste management will be assigned to individuals within the company headquarters as an additional duty, and it is important for these individuals to become familiar with and understand relevant terminology, definitions, and requirements. Each Army unit commander will appoint an environmental officer as an additional duty and ensure that they are properly trained as required by AR 200-1. In the Marine Corps, the environmental officer is referred to as the environmental compliance coordinator and is required to be

appointed by MCO P5090.2A. The environmental officer can be a commissioned or noncommissioned officer. The environmental officer will play an important role in effectively performing waste management at the company level.

1-36. Procedures for conducting waste management should be standardized and captured within unit SOPs when possible. SOPs provide units with standardized procedures for the execution of routine actions, save time in producing operation orders, and facilitate the training of new personnel on requirements and proper procedures. Additionally, procedures for spill prevention and response should be included within the SOPs.

BRIGADE, BATTALION, AND SQUADRON COMMANDERS

1-37. The commander ensures that the unit's generated waste and its impacts are considered early in the planning phase and that waste management is integrated throughout the operations process. Army commanders must be aware of the requirements in AR 200-1 to appoint and train an environmental officer. The environmental officer will generally be called upon to assist the engineer staff officer with the environmental mission or to undertake the program if there is not an engineer staff officer within the headquarters. The commander may establish a waste management working group within the command post to focus on solving waste-related problems. Within the Marine Corps, technical specialists are specifically trained for this purpose and are retained at the MAGTF command element level. Therefore, the activities of the environmental compliance coordinator and waste management planning will primarily be focused at the BCT level or above. The waste management working group may consist of engineers; logisticians; PVNTMED; the safety officer; Civil Affairs; CBRN personnel; the environmental officer; CORs; and other members of the staff. To facilitate effective waste management, the commander does the following:

- Allocates resources (manpower, equipment, material, and funding) to enable the effective performance of waste management activities throughout the command.
- Provides command emphasis on the importance of waste management and maintains visibility on the effectiveness of waste management activities.
- Provides guidance on the prioritization of waste streams to facilitate the timely development of waste management solutions. See appendix A for additional information.
- Ensures that the unit operates in a way that minimizes the effects of waste on human health, the environment, and indigenous populations and institutions.
- Ensures that subordinate units comply with established policies and procedures that govern waste management activities, to include those of the base camps on which they are tenants.
- Appoints a waste management working group facilitator if a working group is established.
- Ensures that personnel involved with handling waste receive the necessary training and appropriate personal protective equipment (PPE).

SENIOR ENGINEER STAFF OFFICER

1-38. For the Army, the senior engineer staff officer is the primary staff integrator for the environmental program, which includes waste management. If the commander establishes a waste management working group, the engineer staff officer may be appointed as the group's facilitator (see paragraph 1-48). The engineer staff officer is responsible for the following tasks:

- Identifying and coordinating waste requirements throughout the operations process.
- Addressing waste management considerations within the MDMP.
- Implement senior headquarters SOPs or standards for environmental programs, to include standards of design, construction, waste management systems, and the use of the United States Army Corps of Engineers (USACE), LOGCAP, or other groups to manage these overall programs. The engineer staff will create the SOPs or guidance in cases where published guidance does not already exist.
- Chairs the base camp environmental management board, establishing and coordinating policy for environmental matters.
- Monitoring waste streams with regard to waste type, quantities, and segregation efficiency to evaluate and determine optimal waste management procedures.

- Maintaining waste-related information within the running estimate and providing updates to the commander and staff to enable situational understanding and facilitate decision-making.
- Participating in the waste management working group, if established, and serving as the group's facilitator if appointed by the commander (see paragraph 1-48 for more details).
- Recommending priorities for waste management to facilitate the commander's allocation of resources.
- Conduct periodic assessments to identify ways to improve efficiency and effectiveness in managing the unit's waste.
- Monitoring the acquisition and distribution of waste management materials and equipment.
- Participating in contingency construction project review and environmental working group/board meetings, as required.
- Providing scopes of work or performance work statements within contracts as required, to include specifications for waste minimization and green procurement.

1-39. For the Marine Corps, there is not an engineer staff officer permanently assigned at the regimental combat team headquarters level; therefore, the MAGTF headquarters battalion or brigade logistics officer (S-4)/assistant chief of staff, logistics (G-4) will usually be assigned the responsibility for managing the waste generated by a deployed MAGTF.

ENVIRONMENTAL OFFICER/ENVIRONMENTAL COMPLIANCE COORDINATOR

1-40. Environmental officers must be designated in writing by the commander, receive appropriate environmental officer training, and be familiar with AR 200-1 and this publication. Environmental officers must be empowered by the commander to run the unit environmental program. The environmental officer manages environmental issues, ensures environmental compliance within the unit, keeps environmental records, and incorporates environmental considerations into unit planning and operations, including composite risk management assessments. (See ATP 3-34.5/MCRP 3-40B.2 (MCRP 4-11B) for more information on the roles and responsibilities of the environmental officer.) At the BCT level in the Army, the environmental officer may conduct the environmental mission instead of, or in addition to, the engineer staff officer. The environmental officer becomes part of, and/or may facilitate, the waste management working group to ensure that all aspects of the unit waste management plan are in compliance with established environmental policies and procedures by performing the following tasks:

- Working together with waste management planners at all levels of command to ensure that environmental considerations are included within waste management planning.
- Working together with the waste management working group to ensure that unit waste management activities are in compliance with environmental policies and procedures established for the operational area.
- Coordinating environmental issues with higher headquarters, developing areas of operation, and developing a waste-handling SOP (when necessary).
- Including waste management systems within environmental inspections.
- Conducting periodic assessments to identify ways to improve efficiency and effectiveness in managing the unit's waste.
- Ensuring that adequate quantities of PPE, spill response supplies, material for establishing hazardous-waste accumulation point (HWAPs), and waste packaging and marking supplies are on hand.
- Reviewing contracts for environmental compliance and ensuring that specifications for waste minimization and green procurement are included as appropriate. Ensure waste management contracts include prevention measures, response, and mitigation of waste releases to the environment.

2-41. Per MCO P5090.2A, commanding officers of Marine Corps units (battalion/squadron size and above) will appoint a unit environmental compliance coordinator to ensure unit environmental training and environmental compliance requirements are met, and to coordinate with the installation/base camp environmental staff, as required. At the MAGTF headquarters level, the G-4 is responsible for oversight of environmental compliance and waste management activities within the MAGTF's area of operation.

LOGISTICS STAFF OFFICER

1-42. The logistics staff officer (S-4/G-4) is the staff integrator for sustainment operations and the staff point of contact for unit movements and deployments. The S-4/G-4 provides staff oversight in the areas of supply, maintenance, transportation, and field services and works together with the engineer staff officer (or the environmental officer) and other staff members in performing waste management. Within the Marine Corps, the MAGTF headquarters logistics staff officer is usually assigned the primary responsibility for managing waste generated by the deployed MAGTF. The S-4/G-4 is specifically responsible for the following tasks:

- Procuring special handling materials, tools, and equipment needed to perform waste management tasks.
- Maintaining integrity of PPE by tracking expiration dates and ensuring equipment is stored in appropriate conditions for the climate.
- Reducing the unit's inventory of HAZMAT, based on the responsiveness of the supply system without risking mission readiness, using alternative materials that are nonhazardous, and using HAZMAT that can be recycled.
- Ensuring that warehousing and storage facilities comply with waste management policies and procedures.
- Backhauling waste during supported unit resupply missions.
- Working with waste management planners to identify and characterize waste requirements during planning.
- Integrating waste management tasks within sustainment plans and operations.
- Coordinating waste management tasks (staff actions) through sustainment channels with higher, adjacent, and subordinate units.
- Developing waste-related information during the sustainment preparation of the operational environment.
- Coordinating special transportation and shipping requirements for HAZMAT, HW, and special waste as required.
- Identifying and coordinating sustainment requirements in support of waste management activities throughout the operations process.
- Developing policies and procedures for the safe and effective transport of waste throughout the operational area if similar guidance does not exist, to include the retrograde movement of HW and special waste and recoverable items back to continental United States (CONUS) as required in coordination with DLA or a similar agency.
- Identifying materials that are recoverable through the supply system and providing policies and procedures for their effective and efficient recovery.
- Identifying materials and equipment that require demilitarization and providing the necessary instructions to ensure that they are properly handled.
- Coordinating with other waste management planners to develop recommended priorities for waste management in order to facilitate the commander's allocation of resources.
- Participating in the waste management working group and serving as the group's facilitator (see paragraph 1-49) if appointed by the commander.
- Conducting continuous monitoring and periodic assessments to identify ways to improve efficiency and effectiveness in managing the unit's waste.
- Monitoring the acquisition and distribution of waste management materials and equipment.
- Integrating waste management considerations within all acquisition programs.
- Reviewing and revising military specifications and standards to eliminate and/or reduce the use of hazardous substances and toxic chemicals, when appropriate.
- Implementing the necessary provisions within contracts to ensure that government-owned, contractor-operated facilities meet and remain compliant with environmental legal mandates and protect the United States from liability and/or fines due to a contractor's accidental or intentional noncompliance.

- Maintaining waste-related information within the logistics running estimate and updating the commander and staff to enable situational understanding and facilitate decision making.
- Coordinating with the radiation safety officer, radiation protection officer, radiation protection assistants, and CBRN personnel in all matters pertaining to radioactive material equipment.

OPERATIONS STAFF OFFICER

1-43. The operations staff officer is the coordinating staff officer for all matters concerning unit tactical operations. The operations staff officer, together with the engineer staff officer and the S-4/G-4 officer, integrate and synchronize waste management tasks within operations. Regarding waste management, the operations staff officer is specifically responsible for the following tasks:

- Integrating waste management considerations throughout the operations process.
- Synchronizing specified and implied waste management tasks within the concept of operations to achieve the commander's intent.
- Reviewing the appropriateness of waste management tasks included in plans and orders that are issued to subordinate units.

CIVIL AFFAIRS OPERATIONS STAFF OFFICER

1-44. Civil Affairs forces are the DOD's primary force specifically trained and educated to interact with HNs, regional partners, indigenous populations, and civilian institutions to enhance stability, to mitigate or defeat threats to civil society, and to assist in deterring or defeating future civil threats when deployed. The intent is to facilitate military operations and consolidate operational objectives. The assistant chief of staff, civil affairs operations (G-9)/battalion or brigade civil affairs operations staff officer (S-9) provides the commander with an analysis of the civil components (the last mission variable in METT-TC) that shape the operational environment, including the following:

- Environmentally sensitive or protected areas, including historical, religious, and cultural sites, as well as threatened and endangered species and their habitats.
- Natural resources, such as water, air, land, and minerals.
- Applicable construction standards, agreements, and policies and guidelines.
- Public and residential areas; livestock and agricultural areas; schools and childcare facilities; and hospitals, nursing homes, and community centers.
- Existing infrastructure and transportation networks.
- Local economy.

SAFETY OFFICER

1-45. The safety officer addresses safety management functions related to sustaining personnel during contingency and wartime conditions. Combining different types of units with varying degrees of modernization together with multinational forces and civilian agencies and contractors presents unique challenges to achieving effective and efficient unified action. Therefore, risk management is used to identify and control hazards. Regarding waste management, the safety officer is responsible for the following tasks:

- Serving as principal advisor to the commander in all Safety and Occupational Health-related matters of mission execution, and participating in the waste management working group.
- Executing the commander's Safety and Occupational Health Program, and enforcing safety standards.
- Employing risk management using METT-TC variables to systemically identify hazards, and ensuring that the risk management process is incorporated in SOPs, special orders, training plans, operational plans, and so forth, to minimize accident risk. SOPs shall be developed for all operations entailing risk of death, serious injury, occupational illness, or property loss.
- Communicating best practices and sharing lessons learned.

SURGEON

1-46. The command surgeon (for all command levels down to the maneuver battalion) is a medical officer who is the special staff officer responsible for advising the commander on the Army Health System mission and the health of the command. In support of waste management, the surgeon is responsible for the following tasks:

- Working with the unit's organic or augmenting PVNTMED personnel, the environmental officer, and the engineer staff officer to ensure that medical and other types of waste are appropriately dealt with to mitigate the risks to human health and the environment.
- Providing policy on the human health aspects of waste management operations.
- Establishing/implementing policies and procedures for the management of medical waste within the unit waste management plan.
- Monitoring the medical logistics needed for managing medical waste.
- Planning and implementing force health protection operations to counter health threats associated with exposure to waste or waste by-products.
- Incorporating policies and procedures for medical waste management into plans, orders, SOPs, and directives.
- Identifying health threats associated with waste generation and recommending techniques and procedures to mitigate the effects.
- Ensuring that health considerations are included in waste management planning.
- Monitoring occupational health surveillance in coordination with PVNTMED personnel.

PREVENTIVE MEDICINE PERSONNEL

1-47. PVNTMED personnel are assigned to various Army command staffs, based on mission demands. They serve as technical advisors to the command on pest management, environmental health, and sanitation issues. Within a BCT, PVNTMED support is provided by a PVNTMED section that is organic to the brigade support medical company. Within Marine Corps MAGTFs, PVNTMED detachments are not organically attached as they are within the Army. They often remain in the unit headquarters in general support of the entire task force and area(s) of operation. PVNTMED tasks that support waste management include the following tasks:

- Identifying health threats associated with waste generation and recommending techniques and procedures to mitigate effects.
- Integrating PVNTMED considerations and preventive measures into waste management planning.
- Conducting sanitary inspections of waste management systems (with a focus on medical facilities and those handling medical waste) and providing PVNTMED assessments and recommendations.
- Conducting and monitoring occupational health surveillance in coordination with the surgeon.
- Performing vector surveillance and pest management services in support of waste management activities.
- Establishing PVNTMED policies and procedures in support of waste management and incorporating preventive measures through plans, orders, SOPs, and directives.
- Participating in the waste management working group.

MEDICAL DETACHMENT

1-48. The medical detachment has the echelons above brigade mission to provide PVNTMED support and consultation in the areas of disease and nonbattle injury prevention, field sanitation, entomology, sanitary engineering, occupational and environmental health surveillance, and epidemiology to minimize the effects of environmental injuries, enteric diseases, vector-borne diseases, and other health threats on deployed forces in the theater. The detachment is capable of—

- Providing surveillance and controlling disease vectors and reservoirs in assigned areas.

- Monitoring pest management, field sanitation, water treatment and storage, waste disposal, and disease and nonbattle injury control practices of units in assigned areas, providing advice and training as necessary.
- Investigating and evaluating pest management, sanitation, water supply, waste disposal practices, and other environmental health-related problems and recommending corrective measures as necessary.
- Conducting medical surveillance activities in the supported area (to include coordinating, compiling, analyzing, and reporting medical surveillance data) to assist in evaluating conditions affecting the health of the supported force.
- Providing limited entomological control of disease vectors and reservoirs in assigned areas.
- Collecting environmental samples and specimens and performing selected analyses or evaluations to assist in the assessment of the health threat.

CHEMICAL, BIOLOGICAL, RADIOLOGICAL, AND NUCLEAR PERSONNEL

1-49. CBRN personnel are assigned to echelon staffs, and they are also represented in some company level organizations. They serve as technical advisors to the command on selected aspects of HW and HAZMAT that may overlap with possible CBRN concerns. See ATP 3-11.32/MCWP 10-10E.8 and TM 3-11.91/MCRP 10.10E.4/NTRP 3-11.32/AFTTP 3-2.55 for information on managing CBRN-contaminated waste and CBRN hazards. CBRN personnel will have access to specialized equipment to detect certain hazardous compounds that can support surveys and assessments. They have knowledge of—

- Sampling protocols (and equipment to conduct limited sampling).
- Toxic industrial material and industrial processes.
- Biological agent indicators.
- Chemical warfare agent indicators.
- Contamination mitigation.
- Personal and collective protective equipment.

WASTE MANAGEMENT WORKING GROUP FACILITATOR

1-50. When the commander establishes a waste management working group, a facilitator should also be appointed to be responsible for the group's collective efforts. The group facilitator is responsible for the following tasks:

- Synchronizing and integrating the group's efforts throughout the operations process.
- Recommending priorities for waste management to the commander to facilitate the allocation of resources.
- Establishing priorities of work to help the group achieve objectives.
- Managing information that the group gathers and generates, identifying waste-related relevant information, and updating the commander and staff to enable situational understanding and facilitate decision making.
- Conducting both continuous monitoring and periodic assessments of waste streams and management procedures to identify ways to improve efficiency and effectiveness in managing the waste.
- Disseminating waste management policies and procedures to first-line leaders.

FIRST-LINE LEADERS

1-51. Environmental stewardship and a sense of responsibility for the unit's generated waste must be instilled at the lowest levels. An effective unit waste management plan relies on first-line leaders to—

- Integrate waste management tasks within all operations.
- Keep personnel informed on the unit's waste management policies and procedures.
- Ensure that personnel understand their individual responsibilities in support of waste management.
- Enforce standards in performing waste management tasks.

BASE OPERATING SUPPORT–INTEGRATOR

1-52. The base operating support-integrator (BOS-I) is responsible for the overall day-to-day operations of the base camp. With regard to waste management, the BOS-I is specifically responsible for the following tasks:

- Ensuring that waste and its effects are integrated early into base camp development planning and included in base camp master planning.
- Ensuring that waste management activities are being efficiently and effectively conducted according to policies and procedures established for the theater of operations.
- Assessing the base camp waste management activities (based on the assessments conducted by the engineer staff officer, the environmental officer, and other staff members) and taking appropriate actions to improve effectiveness and efficiency of the waste management program.
- Conducting compliance inspections to ensure that the base camp's waste management program meets established policies and standards.
- Ensuring waste management facilities and systems are resourced with appropriate levels of manpower, equipment, and funding.

CONTRACTING OFFICER'S REPRESENTATIVE

1-53. Although the contracting officer has the overall responsibility of ensuring that the laws and regulations are followed for government contracts, the COR is usually delegated the authority to monitor the performance of contract vendors to ensure that they fulfill the requirements of the contract. The COR has the responsibility to—

- Act as the government's agent to accept services provided under a contract.
- Direct the flow of technical matters between the government and a contractor that are clearly authorized within the COR appointment memorandum.
- Maintain liaison and direct communications with the contractor and contracting officer.
- Verify that the contractor has performed the technical requirements of the contract or delivery order according to the terms, conditions, and specifications of the contract (with special emphasis on the quality provisions) and to the contractor's own quality control program.
- Ensure that the contractor complies with implied and specified waste management directives described in the contract, including the requirement that, as a representative of the U.S. Government, contractors are expected to display environmental stewardship and "always do what is right."
- Monitor the contractor's performance through inspections and assessments and notify the contractor of observed deficiencies and required corrective actions according to the Quality Assurance Surveillance Plan.
- Perform follow-up inspections to verify that identified deficiencies have been corrected by the contractor's personnel.
- Record and report to the contracting officer any incidents of faulty or nonconforming work, delays, or problems, such as waste-related liabilities that have been incurred as a result of contractor actions or inactions.
- Prepare and submit periodic reports on the performance of services as directed by the contracting officer.
- Conduct in-progress reviews with the contractor on a periodic basis to discuss any significant issues or concerns.
- Coordinate site entry for contractor personnel and ensure that government-furnished property or equipment is available when required.
- Maintain record files that contain memorandums for record, meeting minutes, inspection results, and other documentation pertaining to the acceptance of performance of services that provides a complete history of transactions to support any actions taken by the COR or the contracting officer.

SUPPORTING AGENCIES

1-54. The following agencies may provide assistance and support for waste management planning and waste management program development.

United States Army Public Health Center/Navy and Marine Corps Public Health Center

1-55. The APHC and Navy and Marine Corps Public Health Center (NMCPHC) provide health promotion and PVNTMED leadership and services to identify, assess, and counter environmental, occupational, disease, and injury threats to health, fitness, and readiness in support of the mission and the National Military Strategy. They serve as the linchpin for medical support to combat forces and the military managed-care system. They provide worldwide scientific expertise and services in clinical and field PVNTMED, environmental and occupational health, health promotion and wellness, epidemiology and disease surveillance, toxicology, and related laboratory sciences. Professional disciplines represented include chemists, physicists, engineers, physicians, optometrists, epidemiologists, audiologists, nurses, industrial hygienists, toxicologists, entomologists, and many others such as subspecialties within these professions.

1-56. The APHC and NMCPHC have experience in preparing and updating integrated waste management plans that conform to regulations and guidance and provide reachback and consultative services. A task-organized team of experts can provide a variety of services in support of deployed forces that include—

- Medical and HW management and disposal.
- Occupational and Environmental Health Site Assessments (OEHSAs).
- Environmental sample collection, data analysis, and management.
- Surface water and wastewater management and treatment.

U.S. Army Corps of Engineers/Naval Facilities Engineering Command

1-57. USACE is the Army's direct reporting unit assigned responsibility to execute Army and DOD military construction, real estate acquisition, and the development of the nation's infrastructure through its civil works program. USACE is organized into subordinate divisions, districts, laboratories, and centers that provide a broad range of engineering support to military departments, federal agencies, state governments, and local authorities in a cost-reimbursable manner. USACE supports operations through five major functions:

- **Warfighting.** Provides engineering and contingency support for missions conducted across the range of military operations.
- **Disasters.** Provides response and supports recovery from local, national, and global disasters.
- **Infrastructure.** Acquires, builds, and sustains critical facilities for military installations, theater support facilities, and public works.
- **Environment.** Restores, manages, and enhances ecosystems—local and regional.
- **Water resources development.** Balances requirements between water resources development and the environment.

1-58. The Naval Facilities Engineering Command (NAVFAC) is the U.S. Navy and Marine Corps equivalent to USACE with comparable expertise and similar visibility and connotation. See appendix D for contact information.

1-59. As part of its five major functions, USACE provides technical engineering support to deployed forces worldwide, primarily through field force engineering (FFE). FFE leverages reachback to technical subject matter experts throughout the USACE districts, divisions, laboratories, and centers of expertise. FFE is provided by technically specialized personnel and assets (deployed or participating through reachback) or through operational force engineer personnel linked into reachback capabilities using TeleEngineering when necessary. TeleEngineering is the communications architecture that facilitates reachback when the existing communications infrastructure will not support it. Every Army engineer headquarters, from battalion through brigade, and the two theater engineer commands are equipped for TeleEngineering access to FFE reachback support. To link deployed FFE elements with the cells and other expertise they need for additional technical support, USACE operates a reachback operations center to provide a one-stop reachback engineering capability that is enabled by deployable TeleEngineering communications equipment. This reachback

operations center enables deployed personnel to talk directly with experts when a complex problem in the field needs quick resolution. See FM 3-34 for more information on FFE.

1-60. The USACE organization for FFE includes deployable and nondeployable resources with a variety of critical specialties and skills. FFE deployable teams are force-tailored and serve as forward planning, execution, or liaison teams to support all deployed operations; nondeployable resources offer dedicated reachback support to the deployed teams and engineer units in need of technical support. *Force tailoring* is the process of determining the right mix of forces and the sequence of their deployment in support of a joint force commander (ADRP 3-0). USACE-deployable FFE teams that can provide technical support for waste management operations include the—

- **FEST-Main.** The FEST-main provides construction management, real estate, environmental, geospatial, and other engineering support, typically at the theater echelon level, and can provide command and control for deployed FFE teams. This team would typically support a joint task force or the land component of a joint task force, task-oriented to that headquarters or to a supporting engineer headquarters. The FEST-main operates as augmentation to the joint force engineer staff or the engineer headquarters element or may operate as a discrete headquarters element. It conducts a variety of core essential tasks in support of stability operations, consequence management or civil support, and technical engineering missions. It requires sustainment and security support from the gaining or supported unit.
- **FEST-Advance.** The FEST-advance provides infrastructure assessment; engineer planning and design; environmental, geospatial, and other technical engineering support from theater to BCT echelon; and augments the staff at those echelons. The FEST-advance typically operates as augmentation to the supported force engineer staff or the supporting engineer headquarters. It is designed to receive task-organized contingency real estate team and environmental support team elements when those capabilities are required. In some cases, a FEST-advance may provide FFE support within an assigned area as a subordinate element of a FEST-main.
- **Environmental support team.** It conducts environmental management tasks in support of base camps and other technical engineering missions. The environmental support team is typically task-organized as part of a tailored FEST and conducts environmental baseline surveys (EBSs), as well as other surveys and studies. This team could support any echelon, but will typically be tailored in support of an Army component command headquarters configuration with support missions requiring base camp development management. The environmental support team operates as augmentation to the supported force engineer staff or the supporting engineer headquarters. The team should be deployed as an initial element to perform assessments, identify hazards, and record environmental conditions. It should remain (or redeploy) as one of the last elements to provide corrective actions and support for base transfer or closure.

1-61. The nondeployable resources provide dedicated engineering assistance in response to requests from the deployed teams or from engineer units in the operational area. These resources consist of personnel with the technical capabilities to fulfill a variety of complex technical problems submitted as reachback requests. The United States Army Corps of Engineers Reachback Operations Center (UROC) consists of civilian and military subject matter experts. Its mission is to provide rapid, relevant, and reliable solutions to meet the requirements of deployed forces. Its reachback engineering capability allows deployed units to talk directly with experts when a problem in the field needs quick resolution. UROC personnel are trained to exploit the entire array of expertise within the USACE laboratories, centers of expertise, base camp development teams, USACE divisions and districts, other DOD or U.S. government agencies, and other organizations. Refer to appendix D for contact information.

1-62. The base camp development teams are managed and trained by the UROC district in which they are located and are operationally controlled by the UROC during their specified rotational readiness cycle. They provide base development engineering, master planning, and facilities design for staging bases, base camps, forward operating bases, displaced persons camps, and similar locations. The team's focus areas include the engineering-related planning and development issues involved in locating, surveying, designing, constructing, closing, and transferring base camps.

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Chapter 2

Waste Management Integration

The successful integration of waste management into operations requires a thorough understanding of a unit's waste requirements and capabilities. It also requires the practical ability to balance environmental stewardship and mission requirements in applying feasible, suitable, and sustainable waste management solutions. This chapter focuses on describing "how" waste management is integrated throughout the operations process. The discussion presented in this chapter provides the basis for developing waste management plans for the specific types of waste presented in part two of this publication.

OVERVIEW

2-1. Waste management is integrated throughout the operations process as shown in figure 2-1. As described in ADP 3-0, the operations process consists of the major mission command activities that are performed during operations and is driven by the commander. The cyclic activities of the operations process may be sequential or simultaneous. They are usually not discrete; they overlap and recur as circumstances demand.

2-2. As the primary staff integrator for the environmental program (which includes waste management), the engineer staff officer works with other members of the staff and/or the waste management working group in performing waste management tasks throughout the operations process. This ensures an understanding of the negative effects of generated waste and enables decision making in implementing solutions to minimize those effects. The commander may establish a waste management working group that consists of engineers, CORs, logisticians, transporters, PVNTMED and safety personnel, and other members of the staff as required to focus on solving waste-related problems, reducing waste generation, and coordinating waste management actions.

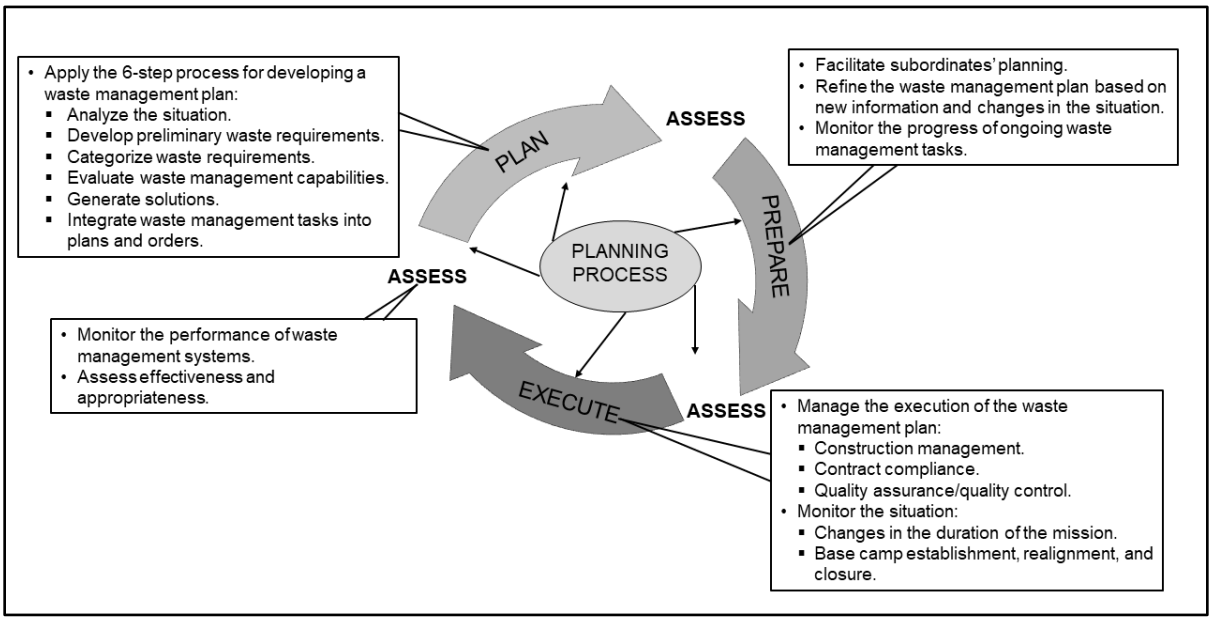


Figure 2-1. Waste management through the operations process

PLANNING

2-3. Commanders and their staff use the MDMP described in FM 6-0 (or the Marine Corps planning process described in MCWP 5-10) to develop the detailed information that is needed during the execution phase. Waste management planners should participate in every aspect of the MDMP to ensure that waste management is integrated into planning and that waste management tasks are coordinated and synchronized within the concept of operations as it is developed. Table 2-1 shows waste management considerations in relation to the seven steps of the MDMP. The Marine Corps uses similar waste management considerations, however, the Marine Corps planning process uses different terminology to describe the steps that are taken.

2-4. Waste management planners will meet and/or the waste management working group will convene at appropriate times throughout the MDMP to synchronize their efforts and consolidate the waste-related information being generated and gathered from their respective functional area. As waste-related relevant information is identified, it is disseminated to the appropriate staff sections for further analysis to determine operational impacts from their perspective and for inclusion in their running estimates to enable situational understanding. Managing information, focusing on obtaining relevant information, and preventing information overload are fundamental to effective planning. A planning SOP should be developed that describes roles and responsibilities for waste management planners and/or members of the waste management working group. The SOP should also stipulate who attends certain events during the MDMP and specify expected inputs and outputs.

2-5. Waste management planners must incorporate parallel and collaborative planning to leverage the information resources and planning support capabilities of higher headquarters and supporting units. Collaborative planning is the real-time interaction among commanders and staffs at two or more echelons who are developing plans for a particular operation. An example of collaborative planning is waste management planners at the BCT level who are planning the establishment of a composting site within the BCT area of operations, with a specialized engineer unit providing general support to the theater of operations.

Table 2-1. Waste management considerations during the MDMP

MDMP Steps	*Waste Management Considerations*
Receipt of the mission	• Identify potential sources of waste-related data and information to include relevant assessment products (such as existing EBSs, OEHSAs, and infrastructure assessments). • Request waste-related information and technical expertise from supporting units/agencies and higher headquarters through RFIs and reachback. • Disseminate waste-related information, as it is gathered, to the appropriate staff sections for inclusion in their running estimates.
Mission analysis	• Analyze the unit's waste streams to determine waste requirements. • As part of IPB, evaluate threat capabilities, terrain, weather effects, and civil considerations to determine potential impacts on waste management operations. • Assess the availability of existing waste management infrastructure/facilities within the operational area, and— ▪ Develop facts and assumptions to support assessments. ▪ Confirm or deny assumptions with RFIs, on-site reconnaissance, and infrastructure assessments when possible. • Identify specified and implied tasks that pertain to waste management. • Assess the availability of waste management capabilities to include joint and multinational forces, and local and nonlocal contractors.

Table 2-1. Waste management considerations during the MDMP (continued)

MDMP Steps	*Waste Management Considerations*
	• Determine constraints, such as— ▪ International and U.S. laws and regulations as applicable. ▪ HN laws, local customs, and local practices. ▪ Joint and Army directives and regulations. ▪ Higher headquarters policies, procedures, OPLANs/OPORDs, and directives. ▪ Allowable design and construction standards contained in theater-specific guidelines (such as U.S. Central Command Regulation 415-1). • Conduct a risk assessment as demonstrated in ATP 5-19. • Submit IR through appropriate channels. • Begin identifying and coordinating possible solutions for immediate, basic, expanded, enhanced, and transfer and closure waste requirements. • Recommend priorities of effort and priorities of support for the commander's approval. • Prioritize and coordinate tasks that support waste management solutions.
COA development	• Refine waste requirements and possible solutions, based on the array of forces. • Recommend areas that should be used, based on the— • Availability of existing waste facilities. • Suitability for accommodating disposed waste. • Recommend areas that should be avoided (such as environmentally sensitive areas; cultural, religious, and historical sites; and areas that impact the local population).
COA analysis	• Determine evaluation criteria (for example, the waste management fundamentals described in chapter 1) that will help evaluate the COAs from a waste management perspective. • Inject realistic and relevant waste-related situations or scenarios into wargaming (for example, how will Task Force 1 dispose of waste if positioned in AA Viking for more than a week?).
COA comparison	• Evaluate the advantages and disadvantages of each COA from a waste management perspective, using the evaluation criteria established during COA analysis.
COA approval	• Include updates on waste management issues or concerns within the COA decision brief to the commander as appropriate.
Orders production	• Integrate waste management tasks in OPLANs/OPORDs (see appendix B for a sample waste management appendix that can be included in the engineer or sustainment annex).
Legend:	
AA	assembly area
ATP	Army techniques publication
COA	course of action
EBS	environmental baseline survey
FM	field manual
HN	host nation
IPB	intelligence preparation of the battlefield/battlespace
IR	information requirements
MDMP	military decisionmaking process
OEHSA	Occupational and Environmental Health Site Assessment
OPLAN	operation plan
OPORD	operation order
RFI	request for information
U.S.	United States

2-6. During mission analysis, waste management planners focus on analyzing the unit's waste streams to determine the waste requirements for each stream. They also prioritize waste streams early in the planning phase to help focus planning efforts and allocate available resources. The prioritization of waste streams is based on an assessment of hazards and associated risks to human health, the environment, and the mission. Waste management planners identify and describe health and environmental hazards associated with generated waste to the staff. See appendix A of this publication and ATP 5-19 for more information. Health and environmental hazards are assessed, and risk (low, moderate, high, or extremely high) is assigned in terms of probability (frequent, likely, occasional, seldom, or unlikely) and severity (catastrophic, critical,

marginal, or negligible). Recommended priorities of effort and priorities of support are then presented to the commander so that they can be included in the commander's initial planning guidance. As the situation develops and more information becomes available, the commander is updated and priorities are adjusted as necessary.

2-7. As waste streams are analyzed and waste requirements are identified, waste management entails a 6-step process to develop a specific plan and meet the requirements for each type of waste. The six steps for developing a waste management plan are—

- **Step 1.** Analyze the situation.
- **Step 2.** Develop preliminary waste estimates.
- **Step 3.** Categorize waste requirements.
- **Step 4.** Evaluate waste management capabilities.
- **Step 5.** Generate solutions.
- **Step 6.** Integrate waste management tasks into plans and orders.

2-8. These six steps are performed parallel with the MDMP steps, since waste management planners must often work ahead in developing and coordinating their recommended solutions to ensure that they are feasible before they are integrated into each maneuver COA being developed. Some of the preparatory tasks or actions within each of the six steps may be performed concurrently or in advance to maximize the time available for planning.

STEP 1. ANALYZE THE SITUATION

2-9. Waste management planners use mission variables to frame the waste situation. The engineer staff officer or the waste management working group facilitator establishes priorities and focuses waste management planners' efforts in assessing the situation to ensure a unity of effort and to avoid any duplication of effort. Information is gathered through intelligence, surveillance, and reconnaissance collection (including environmental reconnaissance and infrastructure surveys) and through the submission of requests for information (RFIs) to lower, adjacent, and higher units. Information requirements are identified collectively, and then each planner gathers the necessary information within their area of expertise through their respective staff section or through reachback. For example, the engineer staff may pursue waste-related information through reachback to USACE support centers, while PVNTMED personnel might coordinate through APHC channels. When possible, predeployment site surveys or on-site reconnaissance is conducted to verify actual conditions as well as to confirm the availability and status of existing facilities.

2-10. Information management is critical to this step. Waste management planners must work together to determine how waste-related information will be collected, used, stored, and disseminated to ensure that the right information is provided to the right people, at the right time, to facilitate decision making. It is particularly important to avoid sending redundant or irrelevant RFIs to higher headquarters (or through reachback) and to ensure that RFIs from subordinate units are responded to in a timely manner.

Mission

2-11. Waste management planners consider the expected duration of the deployment and the mission that is to be accomplished. In general, the duration of the deployment is directly proportional to the amount of resources that should be invested in waste management systems.

2-12. Waste management planners evaluate the nature of the mission and the threat condition to assess the extent that civilians (local and nonlocal contractors) may be used in executing the waste management plan. When the security situation is such that civilians cannot safely operate, military personnel will play the prominent role in performing waste management tasks. In consideration of the mission, waste management planners analyze—

- The types and volume of waste that are forecasted to be generated (based on the type, size, and function of units within the task organization).
- The mobility and dispersion of the force and the reliance on centrally located fixed sites (for example, base camps) or decentralized field-expedient sites (for example, combat outposts).

- The potential impacts to operations and activities (for example, aviation impacted by bird strikes due to proximity to landfills and by smoke due to incinerator operations).
- The types of operations to be conducted as well as positioning of friendly forces.
- The expected duration of the mission to determine appropriate waste management system design, performance, and construction standards.

Enemy

2-13. Waste management planners assess the effects of the enemy or the security situation on waste management activities and assess the threats to deployed force personnel and contractors that may be used to perform waste management tasks (see table 2-2). Some waste management considerations within this variable include—

- Protection requirements for HAZMAT/HW storage areas, based on threat condition (especially hostile or uncertain).
- Security requirements that may restrict the access of non-U.S. contractors (employing local and nonlocal personnel) onto the base camp.
- Areas where certain contractor personnel cannot be used based on threat condition.
- Threats to transporting waste to off-post recovery or disposal sites.
- Waste items that require demilitarization or destruction before disposal to prevent them from being reused or exploited by the enemy.

Table 2-2. Waste management considerations in relation to mission variables

Mission Variables	***Considerations***
Mission	• Identification of all operations and activities that generate waste • Types of waste and where waste is generated • Waste management impacts to operations and activities • Existing infrastructure and transportation network • Duration at a given location and consideration of viable management options
Enemy (threat analysis)	• Protection of water resources and HAZMAT/HW storage areas • Threats while transporting wastes • Demilitarizing or deconstructing waste that could pose a threat to security or health • Limited access of local and nonlocal contractors
Terrain and Weather	• Land availability, land cover, and availability of fill/cover material • Soil composition (soil type) and drainage characteristics, and depth to the water table • Obstacles and opportunities • Surface slope/gradient (drainage issues/opportunities) and elevation • Precipitation types, quantities, and frequencies during mission, as well as runoff ▪ Position waste systems downstream and down gradient • Prevailing wind direction and speed (position waste systems downwind) • Temperatures ▪ Freezing temperatures slow down absorption, evaporation, and biological processes ▪ High temperatures can increase absorption, evaporation, and biological processes • High humidity and cloud cover hinders evaporation • Prolonged cold or arctic conditions are not conducive to some wastewater systems

Table 2-2. Waste management considerations in relation to mission variables (continued)

Mission Variables	Considerations
Troops and Support Available	• Knowledge and expertise ▪ Availability of specialized engineer units or contractors (local and nonlocal) ▪ Availability of a medical detachment, PVNTMED, and other EAB support ▪ USACE and APHC support or assistance teams • Equipment and materials • Availability of funds and contracting mechanisms (including local purchase) • Population stability and predictability
Time	• Timeline of events ▪ Mission, goals and objectives, contingency plans ▪ Arrival of troops, support, and equipment ▪ Acquisition of supplies, services (contractors), equipment, and materials ▪ Connections and construction of waste management systems • Roles and responsibilities • Life span of waste management systems (immediate, basic, expanded, or enhanced)
Civil Considerations	• Environmentally sensitive or protected areas ▪ Historical, religious, and cultural sites ▪ Threatened and endangered species and their habitats • Natural Resources, such as water, air, land, and minerals • Applicable construction standards, agreements, and policies and guidelines • Public and residential areas, livestock and agricultural areas, schools and childcare facilities, hospitals and nursing homes, and community centers • Existing infrastructure and transportation network • Local economy
Legend: APHC — United States Army Public Health Center EAB — echelons above brigade HAZMAT — hazardous material HW — hazardous waste PVNTMED — preventive medicine USACE — United States Army Corps of Engineers	

Terrain and Weather

2-14. Waste management planners evaluate land availability and the effects of terrain and weather on waste management activities. Terrain includes natural features (such as rivers and mountains) and man-made features (such as cities, airfields, and bridges). Planners review available geospatial information (including environmental and biological hazards) on potential base camp sites, reinforced with on-site reconnaissance and infrastructure assessments when possible. Geospatial engineering support, in the form of terrain analysis and tailored geospatial products, should be requested through appropriate channels to better understand and visualize the effects of terrain. See ATP 3-34.80 for more information about geospatial engineering. Waste management planners focus on the following terrain characteristics:

- Land availability, land cover, and availability of fill/cover material (for construction, landfills, backfill, and roads). Examples of land cover include vegetation, such as forests and crops, as well as artificial structures, such as buildings and pavement.
- Surface configuration (including slope and elevation) and its effects on land use, including potential air/smoke sinks that potentially cause issues with particulates, odor, and visibility.
- Soil composition (soil type and drainage characteristics) and water table depth, and their influence on system design, performance, and construction.

- Hydrology and the effects of surface and subsurface drainage on waste management activities.
- Water resource protection, including surface water (ponds, lakes, and streams), flood plains, wetlands/marshes, and groundwater.
- Man-made features that can impact or benefit base camp operations.
- Obstacles (such as minefields and contamination) and opportunities (such as craters and road networks).

2-15. Waste management planners consider the effects of weather on the design and performance capabilities of waste management systems. Weather information is typically evaluated and disseminated by the staff weather officer, who coordinates operational weather support and weather services through the G-2/S-2. The primary weather conditions that waste management planners consider are—

- **Temperature and humidity.** Temperatures and humidity can dramatically affect the efficiency and effectiveness of waste management systems, decomposition, and vector reproduction. Warm temperatures and low humidity typically improve the absorption and evaporation rates for liquids collected in wastewater lagoons and the combustion rates for materials that are incinerated. High humidity and cloud cover hinder evaporation. Extreme cold can impede digging and freeze water, which affects the flow of wastewater through piping systems and slows absorption and evaporation; prolonged cold or arctic conditions are not conducive to some wastewater systems. Organic decomposition in compost sites is greatly influenced by temperature; for decay, optimal temperatures range from 70°F to 100°F.
- **Precipitation types, quantities, and frequencies.** Common types of precipitation include rain, ice, hail, drizzle, sleet, freezing rain, and snow. Precipitation can affect road trafficability and visibility, and it can impede the ability of ground vehicles to collect or transport waste. Rainfall and melted snow/ice can render low-lying areas unusable. Runoff can overload drainage networks, cause containment systems to overflow, and contaminate surrounding areas.
- **Wind speed and direction.** Knowledge of the prevailing wind direction and speed is useful to determine the optimal position for waste management systems. Choosing sites that exploit the prevailing wind (position waste systems downwind) will generally reduce the likelihood that personnel in billeting and workspaces will be exposed to offensive odors, hazardous smoke, or fumes.

Troops and Support Available

2-16. Waste management planners determine the availability of engineer, transportation, and logistics units and specialized equipment (such as earthmoving and material-handling equipment) within the task organization that can be used to perform waste management tasks. They also assess the amount of construction materials on hand or readily available through the supply system and the ability to perform troop and/or contractor construction, based on the availability of manpower, funding, and contracting support. Waste management planners consider available support within the theater of operations that includes—

- Existing infrastructure and transportation network.
- Population stability and predictability.
- Joint and multinational engineering, logistics, and transportation units.
- Specialized engineer units, such as FESTs.
- Army PVNTMED detachments.
- Availability of funds and contracting mechanisms (including local purchase).
- Local and nonlocal contractors. Planners must determine if there are any areas that are not suitable for the use of certain local or nonlocal contractors, based on ethnic, religious, or political boundaries.
- Commercially available, specialized equipment (such as industrial compactors, shredders, and incinerators) and construction materials that can be acquired through local purchase or contingency contracting.
- USACE and APHC support and assistance teams (including availability through reachback).
- Governmental and nongovernmental organizations.

2-17. During analysis of the mission, waste management planners perform a troop-to-task examination using specified and implied waste management tasks. This examination may identify manpower, equipment, or funding shortfalls. The commander can address these by requesting external augmentation or supplemental funding via the operational chain of command. It is important to identify any shortfalls or special equipment requirements as early in the planning phase as possible. Long lead times will often be required in coordinating for specialized engineer teams, USACE and APHC support, and assistance teams since these organizations are relatively small in size and will likely be in high demand. When considering the use of contractors, the availability of funding is a key factor. When additional support is not available, waste management planners must be prepared to rely on technical expertise available through reachback.

Time Available

2-18. Waste management planners must first determine the time available for planning, and as they begin developing possible solutions, they consider the estimated times of arrival for organic and augmenting troops and equipment that are needed for performing waste management tasks. They also consider the time required for acquiring the necessary funding and approval for local purchases and for contracting services and support. A timeline of events should be established for the mission, specific goals and objectives, and support operations for the required connections or construction of waste management systems based on the estimated number of personnel being served. With the events identified along the timeline, roles and responsibilities need to be established. Also, the timeline should take into account the duration of the mission and changes that will occur as the base camp matures; for instance, the transition from immediate and basic services to expanded and enhanced services.

Civil Considerations

2-19. Waste management planners in coordination with the assistant chief of staff, civil affairs operations, or brigade civil affairs operations staff officer (G-9/S-9), ensure that the commander and staff fully understand the immediate and long-term effects of waste on all personnel within the operational area, on the local population, and on the environment. Plus, waste management must adhere to applicable construction standards, agreements, and policies and guidelines. Civil considerations include the effects on—

- Environmentally sensitive or protected areas (historical, cultural, or religious sites) and natural resources (such as food, water, and land). For more information, see ATP 3-34.5.
- Flora and fauna inhabiting the operational area, especially threatened and endangered species and their habitats.
- Troop billeting and work areas.
- Local populations and residential areas, livestock and agricultural areas, schools and childcare facilities, hospitals, nursing homes, and community centers.
- Ground and surface waters.
- Air quality (odor, visibility, and particulates).
- Livestock and agriculture.
- Local infrastructure that could be affected by transporting or disposing of waste, such as wear and tear on roads or residual debris from a heavy volume of transport vehicles.
- Local economy.

2-20. Information related to health hazards and environmental hazards in a particular location may be found in EBSs and OEHSAs if they have been prepared for areas previously surveyed by U.S. or multinational forces. EBSs and OEHSAs can be helpful in selecting the best methods for disposal and in determining what infrastructure is needed and/or available for performing waste management activities. An EBS documents the existing environmental conditions of a given area at the time the EBS is performed. Filed with an EBS, other helpful environmental documentation may be found, including environmental conditions reports (ECRs), an environmental site closure survey (ESCS), and an environmental site closure report (ESCR). ECRs are completed to track changes that occur during occupation and are filed with the EBS. Then, before transferring or closing a base camp, an Environmental Site Closure Survey and an ESCR should be completed and submitted with the EBS and ECRs to higher headquarters for ultimate submittal to the MESL. The OEHSA is focused on the occupational health conditions found at a location and uses the process of a

conceptual site model to identify potential exposure pathways for chemical, biological, and radiological hazards that may affect the health of deployed personnel. More information on these assessments can be found in appendix F, in the USAES Environmental Surveys Handbook: Contingency Operations (Overseas) at http://www.wood.army.mil/usaes/library/documents/Environmental_Surveys_Handbook.pdf, and at the APHC DOEHRS Resources Web site at https://phc.amedd.army.mil/topics/envirohealth/hrasm/Pages/DOEHRS_Resources.aspx.

STEP 2. DEVELOP PRELIMINARY WASTE ESTIMATES

2-21. Preliminary estimates for each type of waste are developed during mission analysis. These are continually refined as planning progresses and more information becomes available. Preliminary estimates are developed for each subordinate unit (one level down), while looking two levels down. Table 2-3 shows a sample matrix of estimated preliminary waste requirements. This work sheet is developed based on the data collected for each type of waste that the deployed force is expected to generate and can incorporate all subordinate units and all phases of an operation. It is intended to provide an overview of the projected waste, based on the mission variables. More information about how to determine waste requirements for each type of waste is provided in part two of this publication.

Table 2-3. Sample preliminary waste estimates work sheet

Subordinate Units	***Immediate***			
	Nonhazardous solid waste (pounds/day)	***Wastewater (gallons/day)***	***HW and Special Waste***	***Medical Waste***
Battalion (700 personnel)	2,800	1,400	Maintenance activities Contaminated soil	MTF
Note. This work sheet may be extended to incorporate all subordinate units and all categories of waste requirements (immediate, basic, expanded, enhanced, transfer and closure).				
Legend:				
HW	hazardous waste			
MTF	medical treatment facility			

2-22. The preliminary estimate of waste requirements will include figures produced using combat planning factors, the number of personnel, and the type of tasks or activities that will be performed. The combat planning factors are based on historical data from reports submitted during similar operations/exercises. The combat planning factors are shown as pounds per day for solid waste and gallons per day for liquid waste. When estimated quantities cannot be determined for a particular waste stream (which is frequently the case with hazardous, special, and medical waste), the primary or likely sources (which could be an activity or task) of that waste stream should be annotated to help focus waste management planners' and other staff members' efforts in generating or gathering additional information.

2-23. At the conclusion of mission analysis, waste management planners should have a firm grasp of the unit's preliminary waste requirements, based on—

- The unit's task organization.
- Specific unit functions (such as maintenance, medical, and food services).
- Equipment densities.
- Basic loads and stockage lists for parts and supplies.
- HAZMAT inventories and safety data sheets (SDSs).
- An analysis of mission variables.

2-24. Preliminary estimates of waste requirements are distributed to the appropriate staff sections (primarily the staff sections that are represented in the waste management working group) for further analysis and to help each section identify capability shortfalls and operational impacts within their functional area of responsibility. The resulting waste-related information is then consolidated and included in the engineer staff officer or the assistant chief of staff logistics portion of the mission analysis brief to ensure that the commander understands the potential impacts of waste on personnel, the environment, and the mission.

Waste estimates are also disseminated through appropriate channels to subordinate units and supporting units to facilitate collaborative and parallel waste management planning.

STEP 3. CATEGORIZE WASTE REQUIREMENTS

2-25. The waste requirements for each type of waste identified for subordinate units (one level down) are categorized, based on expected duration or occurrence. The categories of waste requirements are—

- **Immediate (less than 72 hours).** In the immediate category, the main concern for waste management planning will be solutions for disposal of solid waste and black water. Gray water, hazardous, and medical waste generation will be minimal, based on mission activity.
- **Basic (sustain operations for a minimum of 60 days and up to six months).** In the basic category, field expedient methods used in the immediate category will be continued until more durable solutions can be instituted. The implementation of an integrated solid waste management plan, for example, may begin with source segregation of waste at the point of generation and construction of a burn pit. If the intent is to sustain operations beyond basic services, a burn pit may be operated until a contract is in place, a landfill is constructed, or an incinerator can be purchased, received, installed, and operation and maintenance contracts established. Connections or contracts will likely be developed for wastewater management; otherwise, a septic system or lagoon will likely be constructed. HWAPs will be established at the appropriate level for proper management of HW.
- **Expanded (sustain operations for a minimum of 180 days and up to two to five years).** In the expanded category, more sustainable methods of waste management should be in place. The integrated solid waste management plan will continue to be improved upon. Burn pits will no longer be allowed to operate without proper approval, and a contract, a landfill, or incinerators should be in place where appropriate. Wastewater connections, contracts, or constructed treatment systems will be established, as well as a hazardous waste storage area (HWSA).
- **Enhanced (sustain operations more than two years and up to ten years).** Some services may be similar to the expanded category but, overall, enhanced services surpass expanded services. They have been improved to operate at optimal efficiency and sustained operations for an unspecified duration, but facilities are intended for a life expectancy of more than two years and less than ten years.
- **Transfer and closure (as required).** In the transfer and closure category, guidance will be received from the respective geographical combatant command regarding what areas will be transferred or closed, what actions and conditions are required at the site prior to departure, and what timeline or deadline is expected. Similarly, the DLA provides guidance about how to manage HW, HWAPs, and HWSAs. Generally, if a system or area is not transferred to the HN, guidance may include reverting back to field-expedient waste management methods while areas are deconstructed and closed.

2-26. For example, the wastewater requirements for a unit on the move or in an assembly area are categorized as immediate requirements if the anticipated duration of that requirement is less than 72 hours for a specific location. Once that unit reaches a location where a base camp will be established for a minimum of 60 days, its wastewater requirements are categorized as basic requirements.

2-27. Categorized waste requirements are shown for each subordinate unit (as shown in table 2-2) where they will provide the focus for the generation of solutions in step 5 of the planning phase. Requirements are also organized by critical friendly event or phase of the operation (if the operation is phased) to show its relation to the concept of operations. The full range of waste requirements is prepared to the fullest extent possible, based on the best available information for each COA being developed. When uncertainties arise, RFIs are submitted to higher headquarters and/or assumptions are made to facilitate the continuation of planning.

STEP 4. EVALUATE WASTE MANAGEMENT CAPABILITIES

2-28. This step can begin as early as mission analysis and will continue through COA approval. During this step, waste management planners evaluate the available resources (manpower, equipment, materials, and

funding) for each subordinate unit (one level down) according to the proposed task organization for each COA being developed. This evaluation determines a unit's ability to meet its waste requirements according to established design, performance, and construction standards. When a shortfall exists, the unit may be reinforced with additional support or provided additional resources (such as funding) that allow it to generate its own capabilities or acquire the needed support or services through contracting. Part of this analysis must also include an assessment of the unit's ability to sustain waste management systems that it employs, which may require sustainment training or special maintenance and services to meet or extend the design life or performance capabilities of the system. Waste management planners can create and use a simple matrix that shows requirements and capabilities to help identify shortfalls.

STEP 5. GENERATE SOLUTIONS

2-29. As planning progresses and waste management planners improve their understanding of the unit's waste requirements and waste management capabilities, they begin generating options or possible solutions to meet those requirements. As solutions are being developed, the tasks that are needed to support those solutions are integrated into the MDMP at the appropriate time for coordination and synchronization within the staff. Assuming LOGCAP or another contractor will handle this solution is not a good COA without providing detailed planning objectives, timelines for execution, and overall management expectations.

2-30. Waste management planners begin generating options as waste requirements are determined. They consider options provided in doctrinal publications, lessons learned, internet, and other sources of information. They also consider local practices that can be adapted to fit the unit's need, especially in meeting immediate and basic requirements. They seek the advice of subject matter experts residing within the unit, supporting units, assistance teams, higher headquarters, or support centers that are available through reachback to help uncover and explore the full range of possibilities. Table 2-4 shows possible waste treatment/disposal options while deployed.

Table 2-4. Waste treatment/disposal options while deployed

Waste Category	***Duration***		
	On the Move Immediate	***Basic***	***Expanded/Enhanced***
Solid Waste, Nonhazardous	Bury, Burn, Containerize	Open-pit Burn, Incinerate	Reuse/Recycle, Incinerate, Landfill
Wastewater, Gray Water	Soakage pit/trench, Discharge downstream	Multiple Soakage Pits, Evaporation Bed, Brine Lagoon, Collection and Reuse	Wastewater Treatment Plant, Purple Pipe Recycling System
Wastewater, Black Water	Disposable Human Waste Bag or Field Latrine (Cat-hole, Straddle Trench, Deep Pit, Bored-hole, Burn-out, Mound, Pail)	Contract Toilet, Septic System, Lagoon, Force Provider	Package Plant, Force Provider, Wastewater Treatment Plant
HW	Containerize	HWAPs, HWSA, DLA	HWAPs, HWSA, DLA
Medical Waste	Containerize	Retrograde (back haul), Autoclave, Incinerate	Retrograde, Autoclave, Incinerate

Table 2-4. Waste treatment/disposal options while deployed (continued)

Notes.
1. Use of existing infrastructure is always considered first and may require host nation approval and connections.
2. Containerizing is temporary until treatment/disposal can be achieved.
3. Contracts may include, but not be limited to, package plants, chemical toilets, landfill disposal, retrograde, hazardous and medical waste management, and storage and transfer from holding tanks and force provider.
4. Some construction, such as septic systems and lagoons, require technical expertise.
5. A grease trap or oil-water separator is required for POL-contaminated water.

Legend:			
DLA	Defense Logistics Agency	HWSA	hazardous-waste storage area
HW	hazardous waste	POL	petroleum, oils, and lubricants
HWAP	hazardous-waste accumulation point		

2-31. Options or possible solutions are considered based on an analysis of the mission variables and an evaluation of the unit's waste management capabilities. Waste management planners identify the required tasks that must be performed to implement each possible solution as it is being developed and then perform a troop-to-task analysis to determine the required manpower (including skill sets) and resources that are needed. Waste management planners coordinate with other staff members within the unit and with other waste management planners within subordinate, adjacent, and higher units as necessary. They conduct further analysis to ensure that possible solutions being developed are supportive of policies and procedures established for the theater of operations and exhibit the following characteristics:

- Feasible, based on the availability of—
  - Manpower (and skill sets).
  - Equipment.
  - Materials.
  - Funding.
  - Contracted support.
- Suitable, based on—
  - Terrain characteristics, such as soil composition, surface configuration, and slope.
  - Weather conditions, such as prevailing winds, humidity, and precipitation.
  - Environmental considerations, including environmentally sensitive areas and historical and cultural sites.
  - Health considerations in terms of health risk severity and probability and the ability to mitigate risk.
  - Cost effectiveness in terms of initial and sustainment costs.
- Sustainable, based on—
  - Mission demands.
  - Environmental considerations.
  - The acceptance or tolerance of the local population, HN, and the U.S. public.
  - Allowable design and construction standards.
  - Cost effectiveness in terms of initial and sustainment costs.

2-32. Waste management planners generate options and develop a tailored waste management plan for each maneuver COA being developed. They participate in COA development and analysis and alert the staff to potential hazards associated with waste and potential waste management shortfalls, based on the troop-to-task analysis that was performed for each supporting waste management task. This allows mission planners to make immediate adjustments (or assume risks) to ensure that maneuver COAs remain feasible (from a waste management perspective) as it is further developed.

STEP 6. INTEGRATE WASTE MANAGEMENT TASKS INTO PLANS AND ORDERS

2-33. Once a COA is approved by the commander, waste management planners finalize the waste management plan that supports that COA. The waste management plan provides details on the tasks that need to be performed (by whom, when, and to what standard of performance) to achieve objectives for each of the four major waste management activities (collect, transport, recover, and dispose). The plan also includes priorities of support and priorities of effort (work) for each phase of the operation. It also incorporates theater-specific guidance (such as U.S. Central Command Regulation [CCR] 415-1), orders, and directives that are provided by higher headquarters and describes the design, performance, and construction standards that are enforced through leader supervision and inspections. The following areas must also be addressed in OPLANs/OPORDs, unless they are already covered in a unit SOP:

- Requirements for training or certification of personnel performing waste management tasks.
- Requirements for establishing collection and accumulation sites.
- Requirements for secondary containment.
- Requirements for containers and container labeling.
- Considerations for general safety associated with handling, storing, and transporting the various waste streams that will likely be generated or encountered during the course of the operation.
- Procedures for characterizing, documenting, and marking HW and special waste.
- Procedures for handling and disposal, including turn-in and transportation requirements.
- Procedures and requirements for spill prevention, response, and reporting.
- Plans for inspections, including the checklists that will be used.
- Requirements for record keeping, to include any additional chain of command reporting requirements.
- Plans for transfer, transition, and closure of the waste management areas or the base camp.
- A list and map depicting waste generation activities and locations and waste collection points for each differing waste stream (residual and recyclable), including relevant information, like points of contact.
- A list of types of waste, including estimated quantities and disposal capacities.
- Necessary safety and health information applicable to specific wastes generated.
- A list of local authorities, local laws and regulations, and approved local contractors.
- A list of assignments of responsibilities, including emergency and response actions.

2-34. Waste management planners develop the necessary waste management tasks that will be performed by subordinate units in executing the waste management plan. Each task contains a purpose. Waste management planners review the troop-to-task analysis that was previously performed for each task to ensure that the unit assigned that task has the necessary capabilities and resources to perform it. The waste management tasks included in plans and orders are usually placed in the engineer annex, the sustainment annex or, as directed, in the unit planning SOPs. Waste management tasks can be provided in a matrix format and embedded within, or attached to, an annex (see appendix B for a sample waste management appendix).

2-35. Consider collocating some tasks and separating other tasks based on safety, resources, and logistics. Collocate areas to maximize real estate and resources and to simplify construction and operations (such as fencing, berms, signage, gates, roads, offices, recordkeeping, and response actions). Separate other areas for health and safety:

- Do not locate billeting or drainage features near HAZMAT/HW storage areas or motor pools.
- Do not construct dining facilities, food storage or water distribution near latrines or wastewater disposal.
- Do not plan landfills, incinerators, or burn pits upwind of the base camp or billeting.
- Do not construct billeting in low-lying flood-prone areas or near confined domestic animals.
- Do not excavate inside the perimeter to avoid drainage impacts.
- Do not locate waste sites in areas easily scavenged by the HN population.

PREPARATION, EXECUTION, AND ASSESSMENT

2-36. Waste management planning will continue into preparation and execution. Waste management planners make changes to the waste management plan as adjustments are made to the maneuver plan, based on changes in the situation and the availability of new information resulting from intelligence, surveillance, and reconnaissance collections.

PREPARATION

2-37. Mission success depends as much on preparation as planning. Preparation creates the conditions that improve friendly forces' opportunities for success. The waste management plan should be rehearsed, especially those aspects of the plan that are critical or complex. The S-4/G-4 ensures that subordinate units performing resupply have been provided the necessary instructions for backhauling wastes (for example, the locations and points of contact for waste collection and accumulation points or disposal sites and special instructions for safely handling and transporting HW and special waste). When possible, waste management rehearsals should be conducted in conjunction with other rehearsals, such as the unit's sustainment rehearsal.

2-38. A key preparation activity is planning refinement, based on situation updates and the answering of information requirements resulting from intelligence, surveillance, and reconnaissance collection, RFIs, and reachback. Waste management planners collectively monitor ongoing preparatory actions within their respective functional areas, which includes the continual gathering, generation, and refinement of waste-related information. Each member of the waste management working group provides timely updates to the group's facilitator, who then determines waste-related relevant information that is disseminated through the appropriate channels to facilitate decision making. Concurrently, waste management plans are reviewed and refined, based on changes in the situation, which might include the following:

- Revised unit arrival dates, based on deployment and movement timelines, which could affect the availability of waste management capabilities, such as specialized engineer teams or assistance teams.
- Increases in protection measures, based on the threat condition, which could impede movements or restrict local or nonlocal contractor access to base camps.
- Additions to the task organization that could increase waste generation estimates and exceed the design capacities of the current waste management plans.
- Changes in the availability or status of waste management resources (such as existing facilities, incinerators, or chemical latrines).
- Changes in the concept of operations and the positioning of forces into areas not previously considered or evaluated.

2-39. During preparation, waste management planners begin planning and coordinating waste management systems that may be necessary to provide expanded or enhanced capabilities. Initiating engineering construction projects often requires long lead times to acquire the necessary funds, construction materials, project approvals, and contracting support. Waste management planners must often look further in advance than the typical tactical planning windows that are observed at brigade level and below. During preparation, waste management planners may also become involved in base camp development planning that is being initiated by the higher headquarters or by a supporting engineer unit assigned to that task. See EP 1105-3-1 for more information on base camp development planning.

2-40. During preparation, waste management planners facilitate planning conducted by subordinate units, to include the following:

- Participating in collaborative planning.
- Coordinating for technical expertise when reachback is unavailable to subordinate units.
- Responding to RFIs.

EXECUTION

2-41. Execution is putting the plan into action. It involves monitoring the situation, assessing the operation, and adjusting the order as needed. Commanders continuously assess the operation's progress, based on

information from the common operational picture, running estimates, reports, and assessments obtained from subordinate commanders.

2-42. During execution, waste management planners focus on monitoring the situation regarding mission variables. They monitor the capability of waste management systems and anticipate when the maximum capacity and/or established health and environmental thresholds will be exceeded, based on increased demands due to unit task organization changes or base camp expansion. They also monitor the suitability of waste management systems, based on the applicable base camp construction standards established for the theater of operations (such as those contained in U.S. CCR 415-1), which will tend to become more enduring as the theater's infrastructure matures. Waste management planners upgrade waste management systems as necessary; establish triggers or change indicators that provide ample lead time for planning, approving, acquiring, and implementing improvements; and work closely with the BOS-I to incorporate waste management initiatives within base camp master planning. Waste management planners monitor such things as—

- Changes in the duration of operations.
- Changes in the types of operations being conducted that could generate an increase to a particular waste stream.
- Situations that may prompt base camp realignments, transfers, and closures that can affect base camp populations.
- Situations where units may become stationary in one area longer than expected.
- Changes in threat conditions that will impede the transportation of waste or the access of local or nonlocal contractors onto base camps.
- Changes in the terrain due to human or natural causes that will affect trafficability or access to roads and other infrastructure used in transporting waste.
- Changes in weather, such as shifts in wind directions or heavy rainfall that can affect the performance of waste management systems.
- Status of funding, project approvals, contracting, and construction of waste management systems.
- Status of waste collection, storage, disposal sites, and other critical components of the waste management plan.
- Linkups and integration of augmenting or supporting units, such as specialized engineer teams or APHC assistance teams.

ASSESSMENT

2-43. During planning, assessment focuses on understanding the current conditions in the operational environment and developing relevant COAs. During preparation and execution, it emphasizes evaluating progress toward the desired end state, determining variances from expectations, and determining the significance (challenge or opportunity) of those variances.

2-44. Waste management planners monitor and evaluate the current situation and the effectiveness of waste management activities using measures of performance and measures of effectiveness. Measures of performance answer the question, "Was the task performed as the commander intended?" Measures of effectiveness answer the question, "Is the unit doing the right things?" They also monitor the design capacities of collection, storage, and disposal sites, based on actual input, and evaluate whether field-expedient methods remain suitable for the situation, based on health, environmental, and civil considerations. As base camps become more developed, waste management planners and/or the waste management working group must evaluate the appropriateness of temporary waste management systems, based on the construction standards that are established for the theater of operations.

2-45. Running estimates serve as tools for assessing waste management activities. Feedback obtained from subordinate units in the field is also used in making assessments. Self-assessment checklists can be created and distributed to the units or personnel that are assigned responsibilities for collection, storage, and disposal sites to help assess effectiveness.

2-46. The waste management working group should convene on a regular basis to share information, determine the effectiveness of the waste management plan, and discuss ways to improve the waste management systems. The waste management working group facilitator should brief the commander and staff regularly to maintain visibility and command emphasis on the unit's waste management program.

PART TWO

Waste Categories

Part two of this publication is focused on providing the "how to" for developing the integrated waste management plan. An individual chapter is dedicated to each waste category and provides options for waste management systems. Each chapter uses the 6-step process that was described in chapter 2 to outline the discussion of the unique aspects of each type of waste that must be considered in tailoring waste management solutions to meet requirements. Each chapter concludes with special considerations that are applied in support of base camp transfer and closure.

Chapter 3

Nonhazardous Solid Waste

This chapter describes the components of a nonhazardous solid waste management system and explains how planners use the 6-step process described in chapter 2 to develop a plan for managing nonhazardous solid waste.

OVERVIEW

3-1. Solid waste is any material or substance (solid, liquid, or gas) that is inherently waste-like because it is no longer suitable for its originally intended purpose or is no longer needed and will be discarded. Solid waste includes HW and special waste, wastewater, medical waste, and nonhazardous solid waste. Nonhazardous solid waste is any waste material that does not exhibit a hazardous characteristic; it is generally recognized as garbage or general refuse. Nonhazardous solid waste includes items such as discarded paper, plastic, cardboard, wood, metal, glass, construction debris, and food waste.

MANAGEMENT SYSTEM

3-2. The primary components of a nonhazardous solid waste management system are prevention, segregation, recovery, collection, transportation, and disposal. All are necessary for successful and effective waste management. Each of these components should be included in a nonhazardous solid waste management plan and SOPs, including inspections, emergency response, possible groundwater monitoring, maintaining records and documentation (including photographs), and reporting procedures to higher headquarters.

PREVENTION

3-3. Prevention is to prevent items from entering the waste stream, and prevention happens primarily through source reduction or removal and reusing materials. The goal is to reduce the amount of waste that is generated and to reduce the challenges and resources required for waste disposal.

Reducing and Removing

3-4. Source reduction or removal refers to any change in the design, manufacture, purchase, or use of materials or products (including packaging) to reduce or remove their amount or toxicity before they become solid waste. Eliminating products that use glass removes a component from the solid waste stream that produces challenging disposal efforts. Actions should be taken to reduce the amount of solid waste generated through proper supply ordering, to include the procurement of products that generate less waste and products that can be reused. Reducing the amount of packaging waste generated by ordering in bulk or ordering products from companies that reduce packaging material is an example. Also, only ordering a supply of products that can be reasonably used in a given time period, especially when ordering HAZMAT, is another example. The source reduction of HAZMAT will create the added benefit of reducing the amount of HW generated. This reduction is to be achieved through product substitution, recycling, inventory control, and developing new industrial processes that use less HAZMAT.

Reusing

3-5. Reusing materials is an easy way to reduce the volume of waste requiring disposal. Units can facilitate reuse by declaring which materials are suitable for reuse, based on established supply guidelines and disposition instructions for excess property, and providing a consolidated storage area for those materials conveniently accessible to units. Some common nonhazardous items that can be reused include, but are not limited to the following:

- Leftover construction materials, such as lumber, concrete blocks, bricks, steel rebar, sand, cement, gravel, and nails.
- Pallets.
- Furniture.
- Excess office supplies.
- Packaging and shipping materials.
- Petroleum, oils, and lubricants (POL).
- Off-specification fuels can be used as accelerants.
- Metal.
- Tires.

3-6. Repairing and/or refurbishing used items instead of ordering new replacement items will reduce generated waste. This can be achieved by establishing a repair and reuse program within the unit or establishing that capability at a base camp.

SEGREGATION AND RECOVERY

3-7. Source segregation is a key component for any solid waste management solution. Segregation is each individual's responsibility, and source segregation begins when waste is placed into the appropriate container as it is generated. Examples include construction debris, wood/pallets, paper, plastics, cardboard, tires, classified waste, scrap metal (including demilitarized vehicles and equipment, appliances, spent ammo/weapons systems, and aerosol cans), decomposable organic matter, and reusable materials and supplies. To facilitate segregation, containers can be color-coded and should be labeled in a manner that prevents waste from being mistakenly placed in the wrong container, even in the dark. Segregation at the point or source of generation reduces the handling requirements during recovery and disposal and makes after-collection segregation more effective and efficient. Segregation is especially critical to recycling efforts. If recyclable materials are mixed with garbage, especially food waste, they are generally rendered nonrecyclable and end up being disposed of in a less desirable manner, such as general refuse or garbage. Source segregation is not difficult and makes a huge difference in the health and safety of the environment. Segregation processes are easiest to initiate at larger generating sources and demonstrate the greatest program success with the largest percentage of materials diverted from burn pits or landfills (for example, Army and Air Force Exchange Services, dining facilities, and logistics centers on any base). Segregation that is wholly postponed until post-collection and recovery is labor intensive and inefficient. Therefore, command emphasis and training on proper and timely segregation is important.

3-8. As discussed in chapter 1, recovery aims to divert waste material from the waste stream to reduce the volume of waste requiring disposal. In managing nonhazardous solid waste, waste management planners are primarily focused on material recovery through recycling, biological recovery through composting or feeding of edible food waste to livestock (when allowed), and reusing materials. Energy recovery or waste-to-fuel efforts (such as fuel blending) are also an option.

3-9. Recovery is initiated at the point of segregation. Segregation includes all of the necessary actions for separating recoverable materials into component streams for recycling, composting, or reuse and for maintaining that separation throughout the waste management process. Source segregation is the preferred method for achieving this separation. Source segregation occurs at or near the point of generation or at a collection point, and it is best achieved by providing individual, labeled, and color-coded containers for each type of waste. Segregation is a functional area responsibility (logistical, dining facility, construction, or maintenance) and an individual responsibility. It must be made as easy as possible with directions that can be easily understood and followed. Segregation requirements need to be reinforced at all levels.

3-10. For units on the move or engaged in combat, source segregation may not be practical. In those instances, separation may have to occur after collection through the use of a consolidated segregation yard or material recovery facility where assigned personnel manually segregate waste.

Recycling

3-11. Recycling is the process by which materials otherwise destined for disposal are collected, reprocessed, and eventually reused. As discussed in chapter 1, recycling programs may not be available at the onset of operations. Waste management planners must determine if it is feasible or practical to separate and store recyclable materials until the means for recycling, through contracting or a local recycling market, is established.

3-12. Waste management planners establish the necessary procedures and controls within plans and orders to ensure that waste being recycled is not contaminated with hazardous substances, does not need to be turned into the DLA, or does not require demilitarization. All U.S. identification markings should be removed through painting or sanding before turning waste over to non-U.S. entities.

3-13. The responsibility for collecting and storing recyclable material normally resides with the activity generating the waste (for example, the unit motor pool or supply area). Some of the primary unit activities or functions and the common types of recyclable materials they can generate include the following:

- **Morale, welfare, and recreation sites.** Aluminum cans, plastic beverage bottles, cardboard, and plastic food containers.
- **Kitchen areas.** Aluminum cans, plastic beverage bottles, plastic food containers, cardboard, steel cans, wooden pallets, and food waste. In some countries, edible food waste can be used for feeding livestock.
- **Supply areas.** Cardboard, packing materials, and pallets.
- **Maintenance areas.** Aluminum cans, plastic beverage bottles, cardboard, scrap metal, used oil and antifreeze, wood pallets, and recoverable maintenance parts.
- **Construction sites.** Construction debris and packing materials.

Composting

3-14. Depending on the duration of the deployment, waste management planners should consider composting as a means to reduce the volume of organic solid waste materials requiring disposal. Composting is a biological process for converting decomposable organic materials into a useable product. Some examples of compostable organic materials found within a base camp include sewage sludge, food waste that is not contaminated with grease or oil, wood debris, cardboard, and paper. The product produced from composting these items can be used as an agricultural soil amendment (adding material to soil to improve its properties), landfill cover, in erosion control or dust abatement projects, and as bulking material in land farming activities. Compost bioremediation can also be used to restore contaminated soils (soil remediation) and degrade volatile organic compounds.

3-15. In determining the viability of a base or unit composting program, waste management planners begin by analyzing the solid waste stream to determine what items are compostable, where those items are generated, and the unit's ability (resource-wise) to efficiently separate, collect, and transport compostable material to a compost site. A base camp population of 2,500 can generate approximately 5,500 cubic meters or 1,500 tons of compostable solid waste (including sewage sludge) per year. Planners must determine if space is available and suitable for establishing a compost site, determine who will use the composted material, determine what activities are appropriate for using the composted material, and compare the estimated compost generation with the forecasted demand. They must then evaluate and compare the advantages and disadvantages for establishing, maintaining, and closing a compost site against burning and burial options.

3-16. The composting site can be as simple as a concrete slab with built in drainage and overhead cover, or it can be a pole barn or a more complex engineered site. An engineered site should include 6 inches of compacted, well-graded gravel; over 12 inches of compacted, engineered base that covers a compacted base that's composed of low-permeable native soil or impermeable geotextile. If soil permeability is unknown, soil percolation tests must be conducted. The maximum site slope must be 3 percent. Storm water runoff from the site should be directed to a retention pond, and the pond may need a liner. If a petroleum sheen is observed on the surface of the retention pond, the runoff may need to be collected and treated. The site should contain all-weather access roads and may need electrical power service.

3-17. The major steps in the compost process are item screening, ingredient preparation, active composting, curing, and application. Controls must be implemented to screen the waste and remove HAZMAT and noncompostable materials prior to it being introduced into the composting system. A composting plan must address the following areas:

- Roles and responsibilities for personnel that will manage the compost program.
- Flow of material into and out of the compost site.
- Guidelines for developing quality compost, to include air and moisture management.
- Resources (personnel and equipment) and procedures for establishing, maintaining, and closing the compost site.
- Considerations for safety, health, and environment, to include odor, vector, leachate, and storm water management.

3-18. Determining the method to use will depend on the types of items being composted, availability of land space in the unit area, climate, and availability of funding and special equipment and/or contracted support. The following paragraphs briefly describe the three primary methods for composting and the advantages, disadvantages, and system requirements for each method. More information on composting can be found on the Environmental Protection Agency's Web site at https://www.epa.gov/biosolids/use-composting-biosolids-management.

Aerated Static Pile

3-19. The aerated static pile method employs a controlled process that involves using pumped air and a semipermeable membrane cover to promote accelerated decomposition of the heap ingredients. Some waste material may require an additional maturation phase (in addition to the standard intensive and curing phases). The typical total processing time for the aerated membrane process is 6 to 9 weeks. After the initial setup, the only time the heap is handled is when the entire heap is moved from the intensive phase to the curing phase. The membrane cover provides a physical barrier from vectors and precipitation. It provides a vapor layer that reduces the emission of odors and pathogen compounds in exhaust air. The membrane also provides even air distribution throughout the heap. The system includes a computer-controlled instrumentation component that regulates a blower using feedback from temperature and oxygen probes inserted inside the heap. Advantages of the aerated membrane method include simplicity, shorter processing times, automated operation, less potential for failure, protection from vectors and precipitation, odor reduction, and relatively long equipment life. Disadvantages include higher up-front costs; cost for aeration energy; and costs for the membrane cover, blower, and associated equipment. The major requirements for this system are as follows:

- Polyvinyl chloride aeration pipes, blowers, probes, a computer system, a membrane cover, and a container or fixed winding devices for the cover.
- A heavy-duty chipper or tub grinder. Most of the wood will be dry pallets and unusable building materials.

- A star or trommel screen.
- A bucket loader, 2.5- to 5-cubic-yard.
- A manure spreader (optional).
- A space of approximately 5,000 square meters per 1,500 annual tons or 5,500 annual cubic meters of organic-waste generation.

Windrow Method

3-20. In the windrow method, compostable material is formed into covered or uncovered rows or long piles (windrows) that are approximately 1 meter high. Turned windrows rely on mixing and aeration performed by mechanically turning the windrow. Passively aerated windrows use a perforated piping system (similar to that used for septic system leach fields) to supply air, which eliminates the need for turning. Finished compost material can be produced in 3 months to 2 years' time, depending on the type of waste, temperature, and turning frequency. Preshredding compostable items can accelerate decomposition and may become necessary if a large volume of waste needs to be processed at a small site. The advantage of this process is its lower up-front costs. Disadvantages include high maintenance and labor, high energy demand (tractor fuel), susceptibility to weather, vulnerability to vector and odor problems, and relatively short equipment life because of the corrosive environment. The open windrow process tends to be operationally complex, requiring careful management of the heaps. For this reason, it may be the least effective method for use at a base camp. The open windrow technology differs from the aerated membrane method in that its efficiency is managed by turning, based on manual temperature and oxygen readings taken daily. The major requirements for the windrow method of composting are as follows:

- A tractor with creeper gear and power take-off for windrow turner.
- Thermometers and oxygen probes.
- A windrow turner that fits the tractor or an all-in-one self-propelled windrow turner.
- A water tank that fits the tractor.
- A heavy-duty chipper. Most of the wood will be dry pallets and unusable building materials. A tub grinder is not recommended.
- A manure spreader.
- A star or trommel screen.
- A 2.5- to 5-cubic-yard bucket loader (preferably with a screener-crusher attachment).
- An area that is approximately 15,000 square meters per 1,500 annual tons or 5,500 annual cubic meters of annual organic-waste generation.

In-Vessel System

3-21. These commercially available systems take raw waste and place it in a completely enclosed system that has built-in aeration and mechanical mixing equipment. This offers protection from adverse weather and better odor control than other methods; however, the system is expensive to build, maintain, and operate. An additional 3- to 8-week curing cycle (using open windrows) is required after the material is removed from the container, for a total processing time of approximately 11 weeks. This system may be useful for base camps with small volumes of compostable material where a centralized task force composting facility is not available or readily accessible. The advantages to this process include shorter reaction times, protection from vectors, mitigation of environmental influences, transportability, and reusability. Disadvantages include potential odor issues; costs for aeration energy; the potential for vector and precipitation problems during the curing phase; and the need for manufactured vessels, blowers, and associated equipment. The major requirements for this system are as follows:

- Aerated vessels. The number required is based on the volume of compostable material produced daily. For example, a camp producing 5 cubic meters of compostable material will use about 5 cubic meters of bulking agent a day. Therefore, a 3-week, in-vessel composting cycle will require six 40-cubic meter containers.
- A heavy-duty truck or crane that can dump the contents of the vessel at the curing site.
- Instrumentation.

- A heavy-duty chipper. Most of the wood will be dry pallets and unusable building materials. A tub grinder is not recommended.
- A star or trommel screen.
- A bucket loader, 2.5- to 5-cubic yard (preferably with a screener-crusher attachment).
- A manure spreader (optional).
- An area that is approximately 5,000 square meters per 1,500 annual tons or 5,500 annual cubic meters of annual organic-waste generation.

COLLECTION

3-22. Nonhazardous solid waste is moved from individual points of generation and consolidated at established collection sites, where it is then transported to a recovery or disposal site. At the point of generation, nonhazardous solid waste should be placed in clear disposable plastic bags (to allow visibility of materials in the bag, providing one more check to prevent items such as uniforms or sensitive items from entering the waste stream), tied, and consolidated as soon as practical at designated waste collection points. Bagging items such as cardboard boxes may not be practical; instead, items like this should be broken down and bound together to ease handling, prevent littering during movement, and reduce volume. Dining facility waste should be segregated from other nonhazardous solid waste as much as possible to prevent contamination.

3-23. Collection points should have an adequate number of containers to accommodate the various types of waste to be segregated. Also, the containers should be correctly sized to handle the volume of waste that will be generated in the immediate area. Collection points should use containers that can be secured (closed), such as dumpsters or garbage cans with lids. They should be leakproof, noncombustible, nonabsorbent, and corrosion-resistant. Containers should be equipped with suitable lifting devices or handles that allow for convenient and safe lifting and handling, while preventing the collector from coming into direct contact with the content. All food waste should be stored in tight-fitting, covered containers that are nonabsorbent, leak proof, durable, easily cleaned, and equipped with handles. Food waste receptacles, dumpsters, and compactors used by dining establishments should be cleaned according to the guidelines in Technical Bulletin Medical (TB MED) 530.

3-24. A collection point manager should be appointed to ensure the maintenance and effectiveness of collection points. The duties of a collection point manager and the procedures for establishing and operating collection points should be captured in a unit SOP to standardize the requirements and to facilitate the training of new personnel.

3-25. A key task for waste management planners is determining the number, location, and dispersion of collection points, based on mission variables, while managing throughput to ensure that the capacity of collection assets is not exceeded. Waste management planners must devise collection methods that optimize efficiency and effectiveness, without jeopardizing the safety of personnel and mission readiness. Considerations include the wear and tear on vehicles and equipment, minimizing health hazards, and preserving the environment. As an operation progresses and base camps become more developed, waste management planners continue to refine their plans for waste collection in order to improve efficiency and effectiveness and to reduce costs and save time.

3-26. The primary considerations in determining the placement of collection points are health, safety, and environmental factors. In addition to these considerations, collection points must also be conveniently located and secure from scavengers. Waste collection points should be located at least 100 feet from dining facilities. Threat condition, security considerations, and prevailing wind direction may also affect placement.

3-27. The schedule for removing waste from the collection points is driven by the volume of waste that is generated and the capacity of the collection points. Initially, the schedule should accommodate waste removal from food service facilities daily and other nonhazardous solid waste removal at least every two days.

3-28. Waste management planners implement controls to ensure that segregated waste remains segregated. This segregation ensures the integrity and viability of recyclables and minimizes the amount of individual waste handling. These controls must also be conveyed in contracts if contractors are used to perform

collection tasks. Waste collection contracts should specify a pickup schedule and contain the necessary provisions to allow for adjustments if the base camp population changes.

3-29. Units on the move may be required to temporarily store and transport nonhazardous solid waste until collection can occur; or waste may be collected from subordinate units, transported to a consolidation area, and temporarily stored until further instructions are provided. Plans for temporary storage must ensure that the waste does not—

- Create a health or environmental hazard.
- Create a fire hazard.
- Attract or harbor insects and rodents.
- Present a litter problem, which can be compounded by strong winds or heavy rain.

TRANSPORTATION

3-30. Nonhazardous solid waste is normally hauled from collection points to a recovery or disposal site in collection vehicles. This function can be performed by military personnel and/or local or nonlocal contractors. Solid waste should be collected in a vehicle dedicated for that purpose. Vehicles designated to perform trash collection should have a low tailgate for easy access, suitable cover or other means to prevent trash from blowing out during movement, and PPE to retrieve dropped or spilled waste. Vehicles used to transport trash must be cleaned before use for other missions. Vehicles subsequently used for transporting food items must be cleaned and disinfected with a chlorine solution (use 6.4 ounces of bleach per 1 gallon of water to achieve a 200 parts per million ratio).

3-31. Transportation routes are planned and coordinated in the same manner as any other tactical movement, with consideration for protection and safety, based on the threat condition, road conditions, and traffic patterns. Waste management planners work closely with logistic and transportation planners to ensure that units performing transportation tasks are provided with clear instructions on the special handling, storage, and transportation requirements and safety measures for the various waste streams being transported. Those requirements are captured in SOPs and referenced in OPLANs/OPORDs. The following are some general considerations that waste management planners use when developing the nonhazardous solid waste transportation plan:

- Avoid repetitively uploading and offloading (double-handling) waste.
- Maintain segregation throughout the transportation phase.
- Include the estimated quantities of waste (in tons and/or cubic yards) requiring movement within transportation tasks to subordinate units to facilitate their planning and allocation of resources.
- Minimize routes through billeting areas, and perform dust abatement as necessary.

3-32. During transportation, waste management planners monitor and assess the transportation plan and make adjustments as necessary to improve efficiency and effectiveness while continuously managing risks. Feedback and lessons learned should be solicited from subordinate units to gain insight on how to improve transportation tasks.

DISPOSAL

3-33. The two primary disposal methods for nonhazardous solid waste by deployed forces are burial and burning:

- Burial in a properly designed and authorized landfill, preferably an existing landfill.
- Burial in open pits or trenches when a landfill does not exist, an existing landfill is too far away, or units are unable to transport waste to an existing landfill due to threat condition or lack of resources.
- Burning in authorized solid waste incinerators, preferably with controlled emissions.
- Burning in authorized open-air burn pits according to DOD guidance.

Note. Ensure that HW and regulated medical waste are not disposed with nonhazardous solid waste. Additionally, coordinate with DLA for proper disposal of demilitarized items and weapons systems, and coordinate with the command security manager for proper disposition and destruction of classified waste (AR 380-5). Aboveground waste piles or open dumps are not allowed. All burial or burning activities will be conducted as authorized, in accordance with published guidance and applicable environmental laws. In general, deployed forces should comply with the most restrictive guidance/laws.

3-34. Waste management planners must consider mission variables and health and environmental factors for each situation when determining how best to dispose of nonhazardous solid waste, to include the following:

- Resources, such as skilled personnel, equipment, and land availability.
- Existing occupational health conditions stated in the OEHSA.
- Environmental impacts and existing conditions stated in the EBS (see paragraph 2-20 and appendix F).
- Risks to groundwater, surface water, and sources of potable water.
- Air pollution, dust control, odor, and respiratory health hazards.
- Noise and litter control.
- Fire safety and airport safety.
- Segregation capabilities (if unable to segregate, landfilling may be the best option).
- Vector, animal, and bird control.
- Habitat, especially for threatened or endangered species and for food sources.
- Gas generation and migration of dissolved constituents (sanitary landfills).
- Throughput capacity of the disposal method to meet estimated generation rates.
- Risks to transporting waste to existing landfills, based on the threat and road conditions.

3-35. Plans should be integrated with the theater commander's concept of operation for supply chain management to capitalize on the removal of recoverable or recyclable material. Site selection criteria should include the ability to expand the scope of burial or burning to meet emergency needs (such as enemy interdiction of ground lines of communication that prevents contracted solid waste haulers from removing camp solid waste to a municipal or commercial landfill). Open-burning site plans should include sufficient flexibility to allow shut down for maintenance or ash removal (this may require more than one burn pit in an area of operations due to the size of the base camp's population) or replacement of an operational burn pit with an incinerator (when it becomes available). During execution, waste management planners monitor the means for disposal and anticipate when the maximum capacity and/or established health and environmental thresholds will be exceeded, based on increased demands due to changes in task organization or base camp expansion. Waste management planners establish triggers or change indicators that provide ample lead time for planning, approving, acquiring, and implementing additional disposal means. As part of future planning, disposal methods should be upgraded according to the applicable base camps construction standards established for the theater of operations (such as those contained in U.S. CCR 415-1), which will tend to become more enduring as the theater matures. Waste management planners work closely with the BOS-I and other planners to incorporate waste management initiatives within base camp master planning.

Waste Burial

3-36. The two options for the burial of nonhazardous solid waste are landfills and burial pits or trenches. Preexisting landfills should be used when possible. If an adequate landfill does not exist, specialized or general engineer units or contractors will have to be used to design and construct one. The establishment and operation of a landfill is a resource-intensive, long-term solution to contingency solid waste disposal requirements.

Landfills

3-37. A sanitary landfill is an engineered disposal method in which solid waste is spread, compacted, and covered with soil daily. When properly designed, they can accommodate nearly all types of solid waste, while safeguarding the environment. In considering whether the construction of a landfill is a viable option for the operational area, waste management planners should first seek the expertise available through higher headquarters, supporting units, specialized engineer units, or reachback to USACE and APHC. Other considerations include the following:

- Land availability and accessibility, based on existing road networks.
- Land use restrictions, such as cultural resource sites, sensitive habitat, and the proximity to local populations and airfields. Landfills must be at least 10,000 feet away from airfields to prevent the threat of bird strikes.
- Landfill effects on local populations and future land use.
- Landfill effects on future operations.
- Landfill effects on the environment (gas generation and groundwater) and potential contamination.
- Duration estimate (to justify the costs and efforts associated with constructing, operating, monitoring, and closing a landfill) and potential long-term monitoring requirements.
- Adequate availability of cover material. Landfills generally require a waste-to-cover ratio of 4:1, and POL-contaminated dirt may be used as cover material.
- Equipment and labor costs for construction, operation, maintenance, monitoring, and remediation upon closure.
- Leachate management, including containment, testing, treatment, and disposal.

3-38. If a landfill is to be constructed, waste management planners perform an initial analysis of the situation to determine the most suitable location for a landfill. In general, landfills can be constructed on virtually any terrain; however, some land features require extensive site improvements and expensive operational techniques. Flat or gently rolling terrain that is not subject to flooding is typically best suited for landfills, though depressions (canyon and ravines) can be more efficient if sufficient cover material will be available and surface water runoff can be controlled. Man-made features like strip mines, quarries, and open-pit mines can usually be safely and economically reclaimed as landfills. Other important considerations include the following:

- Landfills should be downstream, as far away as possible from water sources. Surface water that infiltrates cover soil leads to rapid decomposition, leachate, and groundwater pollution hazards.
- Landfills cannot be sited within a 100-year flood plain and should not be located in areas with a high water table. There must be adequate clearance, based on soil characteristics and the effectiveness of liners, between the height of the water table and the lowest point of the landfill to reduce the risk of leachate migration and groundwater contamination.
- Landfills are not suitable for hilltops, highly permeable or porous areas (such as gravel beds), swamps or marshes, natural drainage channels, wildlife sanctuaries or threatened or endangered species habitat, flood plains, land having karst features (such as limestone formations which can lead to the formation of sinkholes and depressions), and steep slopes.
- Soil conditions must be suitable for preventing groundwater pollution, excavating and covering the fill, and providing vehicle access.
- Underground utilities and structures must be avoided.
- Once constructed, landfills must be properly operated and maintained.

3-39. Site closure can be expensive and difficult if it's not included as part of the initial landfill design. Upon closure, the date the landfill was opened and closed and accurate map coordinates are reported to higher headquarters. A photograph history that documents the entire process from preconstruction to closure should be recorded and reported, as well. This information will be useful in settling potential liability claims and supporting environmental corrective actions. Three basic goals need to be achieved when closing a landfill:

- Minimize the need for further maintenance and monitoring at the site.
- Place the landfill in a condition that will minimize future environmental impacts.
- Prepare the site for future use.

3-40. Depending on the region, local waste burial pits or excavation sites typically lack liners, daily cover, run-off controls, or other modern techniques for managing sanitary landfills. These disposal site conditions present environmental effects, such as leachate, vector attraction (rodents, flies, mosquitoes, and other organisms capable of transporting infectious agents), and gas generation (such as methane) that could impact your site. Therefore, it is important to consider your proximity to these local disposal sites and reduce the overall volume and toxicity of the solid waste if contracted to be disposed there.

3-41. If existing landfills are available, waste management planners will need to determine how best to access them. They must consider existing conditions of access roads, threat condition, and the need to establish transfer stations. Transfer stations are intermediate locations for gathering waste and may be needed when—

- The distance from collection points to disposal sites is too far away to be economically feasible for direct haul.
- Movement to the disposal site is restricted or hazardous and must be limited.
- Access to the base camp by local contractors is restricted and must be limited to "on call" collection.
- Small capacity collection trucks are used.

3-42. Transfer stations can also be used on base camps to facilitate the collection by contractors. Transfer stations should be located near contractor access gates (or search areas), with barriers in place to prevent access to the rest of the base camp for security reasons.

Hasty Burial

3-43. Hasty burial may be conducted by tactical maneuver units during an operational pause in close combat. Its employment is driven by the unit's need to safely dispose of its accumulated solid waste to maintain operational security, combat effectiveness, and tactical agility. Very rapidly, a field expedient disposal site is selected by the officer or noncommissioned officer in charge and excavated using available or organic resources. After solid waste is deposited, the site is capped with soil, and the unit reports its location through the chain of command. Even though rapidly executed by a maneuver unit, hasty burial must be performed in accordance with published solid waste disposal guidelines, especially regarding the recording and reporting of the burial location.

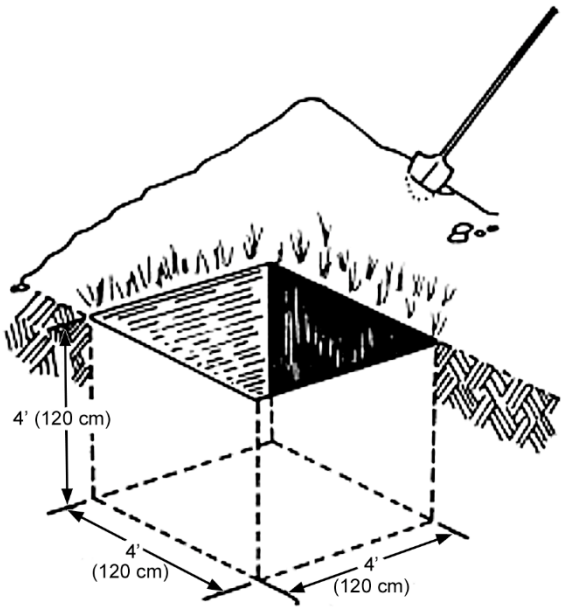
Tactical Waste Burial

3-44. When units are on the move or stationary for less than 1 week, nonhazardous solid waste should be buried in pits or trenches.

- **Pits.** Pits are preferred for overnight halts. A pit 4 feet square and 4 feet deep is suitable for 1 day for a unit of 100 individuals (see figure 3-1). The pit is filled to within 1 foot from the top and then covered with a 1-foot mound of compacted dirt. For halts longer than 2 days, a continuous trench is preferable since it can accommodate a larger volume of garbage and allows for a daily coverage of dirt as the trench is extended.
- **Trenches.** The trench is first dug about 2 feet wide, 4 feet deep, and long enough to accommodate the garbage for the first day. As in the pit method, the trench is filled to within 1 foot from the top and then covered with a 1-foot mound of compacted dirt. The trench is extended as required, and the excavated dirt is used to cover the garbage already deposited. This procedure is repeated daily or as often as solid waste is dumped.

3-45. At a minimum, waste burial sites are located at least 100 meters from any natural water source used for cooking or drinking, such as a stream, lake, pond, or well. The waste burial site will also be at least 30 meters from field kitchens and eating areas to minimize problems with insects, rodents, and odor.

3-46. When closing a waste burial site, place signage at the site that indicates the type of pit or trench, the date it was closed, and the unit designation if the situation allows. An 8-digit grid coordinate is recorded for each waste burial site and reported to higher headquarters. This information will be helpful in resolving disputes with landowners or a HN government and in performing any future corrective actions that may be required.



Legend:
cm centimeter

Figure 3-1. Tactical waste burial pit

Burning

3-47. When contractor support is unavailable and waste burial is not possible, the preferred method of nonhazardous solid waste disposal is burning in an open-air burn pit or incinerator. Burning will only be used according to DOD guidance. A distinction must be made between open burning and disposing of waste with the use of an incinerator:

- Open burning is the burning of any substance in such a manner that products of combustion are emitted directly into the surrounding outside air without passing through an adequate stack, duct, or chimney.
- An incinerator is an enclosed device that uses controlled flame combustion for the process of burning waste. An incinerator may also include a heat recovery system for hot water or steam generation.

3-48. Burning solid waste produces pollutants, such as dioxins, particulate matter, polycyclic aromatic hydrocarbons, volatile organic compounds, carbon monoxide, hexachlorobenzene, and ash. Highly toxic dioxins, produced in small amounts in most burning processes, can be produced in elevated levels with the increased combustion of certain plastic or organic waste materials (such as polyvinyl chloride pipe or discarded bottles) and if the combustion is not performed at a high enough temperature. Inefficient combustion of medical or latrine waste can create disease-laden emissions. The incineration of medical waste is discussed in chapter 6.

3-49. There are several controls that can reduce the potential health and environmental impacts associated with burning:

- Establish burn pits and incinerator sites far away (at least 450 feet for burn pits) from and downwind of inhabited areas, such as work and billeting areas and HN populations. Position according to local prevailing winds expected during the time of year of the deployment. In addition, do not burn in flight paths or near HAZMAT or fuel storage areas. If possible, attempt to site all combustion activities away from potential future expansion locations for the base camp.
- Ensure that anyone operating and maintaining open-burning operations and incinerators comply with existing environmental guidance and manufacturer's instructions. This may require obtaining manufacturer-sponsored training as part of an incinerator procurement package. Purchase orders

or contracts should stipulate that liability will be retained by the manufacturer (or contractor) for getting the incinerator into compliance with allowable emission standards (if applicable).

- Divert dining facility waste to a compost facility or to a landfill. Wet waste in the burn pit or incinerator will reduce the efficiency of combustion. Since incinerators will not handle wet garbage well, it is necessary to separate the solid from the liquid portions of the garbage. This is done by straining the garbage with a coarse strainer, such as an old bucket, salvaged can, or oil drum with holes punched in the bottom. The solids remaining in the strainer are incinerated, and the liquids are poured through a grease trap (see chapter 4) into a soakage pit.
- Ensure that no HAZMAT, HW, special waste, lithium batteries, or heavy metals are incinerated, which could result in explosions or toxic gases. Also make certain that regulated medical waste is not mixed and disposed with nonhazardous solid waste. See chapter 5 for more information on HW and special waste and chapter 6 for medical waste.
- Increase combustion temperatures to destroy biohazards, decompose dioxins and other toxic compounds, and loft the plume higher for better dilution.
- Prevent low heat or smoldering fires, which tend to emit toxic compounds and fail to loft the plume high enough for atmospheric dilution, by providing ample ventilation and carefully adding an appropriate amount of fuel.
- Ensure that personnel supporting the burn activity wear the appropriate PPE for respiratory protection, biohazard shielding, heat protection, and fire hazard.
- Analyze the meteorological conditions and only conduct burning when the conditions ensure the protection of downwind populations and promote plume lofting and mixing.
- Seek advice from experts, such as those within APHC who can assist units in monitoring burning operations and assessing health and environmental impacts.
- Establish emergency response procedures and an emergency response team.
- Emplace security fencing or berms, secure the area, and limit access to burn area operations. Take precautions, such as daily cover, to prevent vectors and scavengers.
- Provide trained operators to ensure that prohibited waste is not burned and to prevent unrestricted burning.
- Establish burn times to optimize effective burning and to take weather conditions into consideration.
- Ensure that activities are appropriately supervised to ensure safe, efficient, and controlled burning.
- Disseminate base camp SOPs to senior commanders of tenant organizations before burning activities begin. The enforcement of the SOP by leaders within the chain of command will increase individual awareness and confidence in the process, eliminate the unnecessary use of small-unit burn barrels, discourage unauthorized midnight garbage dumping, and increase the habitability and safety of the camp.
- Maintain quality control to ensure personnel safety and accurate recordkeeping. Resources required to perform open burning may transition from unit manpower and equipment to commercial or contracted over the course of the base camp life cycle.

3-50. Subject matter expertise (available through higher headquarters, supporting specialized engineer units, FFE, or reachback) should be sought before constructing or using any incineration device. Open burning, to include burn barrels that are described below, should only be used in emergency situations when waste burial is not possible and only until approved incinerators can be obtained. The improper use of incinerators or burning methods poses significant health hazards.

3-51. Open burning is usually conducted inside an excavated area, such as a pit, but may occur above ground. Open burning can be harmful to human health and the environment and should only be used until more suitable disposal applications are established, such as the procurement and installation of a solid waste incinerator. There are several different ways that open burning operations can be conducted, but strict adherence to DOD guidance and theater environment SOPs must occur.

3-52. Once established, an open-burning site maintains fixed operating hours, usually during daylight hours only, and may operate seven days per week. A designated person or crew opens the site for the acceptance of materials for incineration. The contents of each tipping vehicle, or garbage bag for burn barrels, are

inspected to ensure that prohibited items are not intermixed. This also supports the collection of data for recordkeeping purposes. Consumable and sustainable supplies (fuel, fire extinguishers, communications gear, hand tools, PPE) are maintained at the site to support daily activities. Before daily burning begins, the base camp fire service is alerted to the activities. As it becomes necessary, routine site maintenance (removal of ash and burn residue) and environmental quality monitoring are performed. Depending on the scope of maintenance or environmental monitoring, engineer equipment and industrial or occupational health technical support may be required.

Hasty Burning

3-53. Hasty burning may be conducted by tactical maneuver units during an operational pause in close combat. The decision to employ the hasty burn method is driven by two factors:

- The units need to safely dispose of accumulated solid waste to maintain operational security, combat effectiveness, or tactical agility.
- Hasty burial is not a viable option.

3-54. The officer or noncommissioned officer in charge selects a site for the hasty burning. It may be a natural depression in the terrain or a rapidly excavated depression to use as a burn pit. After solid waste is deposited, a fuel source is applied and safely ignited. Once the contents have been eliminated, the site is capped with soil and the location is reported through the chain of command. Hasty burning is similar to hasty burial in that both actions must adhere to published solid waste disposal guidelines.

Burn Pit

3-55. A burn pit, or open-pit burning, is the most convenient method of burning, but it is also the least preferred method because of the inherent health, safety, and environmental hazards. Consequently, burn pit usage and management will follow DOD guidance, starting with DODI 4715.19. For each contingency operation, the operational commander shall develop and approve a solid waste management plan, and the use of open-air burn pits shall not be allowed unless included within this plan. An open-air burn pit is an area, not containing a commercially manufactured incinerator or other equipment specifically designed and manufactured for burning of solid waste, designated for the purpose of disposing of solid waste by burning in the outdoor air at a location with more than 100 attached or assigned personnel and that is in place longer than 90 days. Generally, open-air burn pits can be used to burn nonhazardous solid waste in contingency locations; however, the use should be a short-term solution with minimal disposal where no other alternative is feasible. More importantly, burn pits shall not be used to burn covered waste unless no alternative is feasible in a contingency location and properly prepared determinations have been submitted to the Under Secretary of Defense for Acquisition and Sustainment. Thereafter, justification for continued burning of covered waste must be provided every 180 calendar days.

3-56. Covered waste includes the following materials:

- HW.
- Medical waste.
- Tires.
- Treated wood.
- Batteries.
- Plastics, except insignificant amounts.
- Munitions and explosives.
- Compressed gas cylinders.
- Fuel containers.
- Aerosol cans.
- Polychlorinated biphenyls (PCBs).
- POL products (other than fuel used to start the burning).
- Asbestos-containing material.
- Mercury.
- Foam tent material.

- Any item containing any of the above items.

3-57. In addition to the covered waste listed above, materials that create unreasonable amounts of smoke, fumes, or hazardous air pollutants should not be burned in a burn pit, burn box, or incinerator. These include, but are not limited to, rubber, tar paper, asphalt shingles, drywall, paint, paint thinner and strippers, pesticides, pesticide containers, appliances and electrical equipment, and electrical wires. For more information about the use of open-air burn pits in contingency operations, refer to DODI 4715.19.

3-58. Burn pits can be shallow excavations or surface features with berms. Operations shall be conducted in a manner that prevents or minimizes risks to health, safety, and the environment. Therefore, the controls listed throughout this Burning section must be implemented to mitigate the health and environmental hazards associated with burn pits. Waste management planners must develop a plan to transition to an incinerator, engineered landfill, or other accepted solid waste management practice as soon as practical as the base camp matures and/or the population increases. Alternative waste management practices (such as source reduction, recycling, incinerators, and landfills) should be considered first before installing burn pits, or should be used in conjunction with burn pits, because of their reduced health, safety, and environmental hazards compared to burn pits.

3-59. Noncombustible materials (such as metal) should be separated and stockpiled for recycling or appropriately landfilled as a last resort.

3-60. Solid waste should be burned completely to ash. When burn pits are not actively burning, they should be covered with 4 to 6 inches of soil to prevent exposure to vectors and scavengers. Upon closure, the date the burn pit was opened and closed and an accurate map with grid coordinates is reported to higher headquarters. This information will be useful in supporting environmental corrective actions, as needed. Before-photographs should have been included as part of an EBS or ECR, and closure photographs are required as part of the ESCR when the base camp is transferred or closed (see appendix F for more information).

Burn Barrel

3-61. A burn barrel (see figure 3-2) will effectively handle solid waste produced by a company-size or smaller unit. This is an excellent mechanism for dry trash, but wet material disrupts proper draft and does not burn easily. A stack is made from a 55-gallon drum with both ends cut out or with one end cut out and the other end liberally punched with holes to admit draft air. Holes are punched through the sides of the drum and steel rods are inserted. The steel rods create a grate. The drum is set up on rocks, bricks, or other nonflammable material. A fire is built under the drum and the waste is added, one shovelful at a time, on top of the grate.

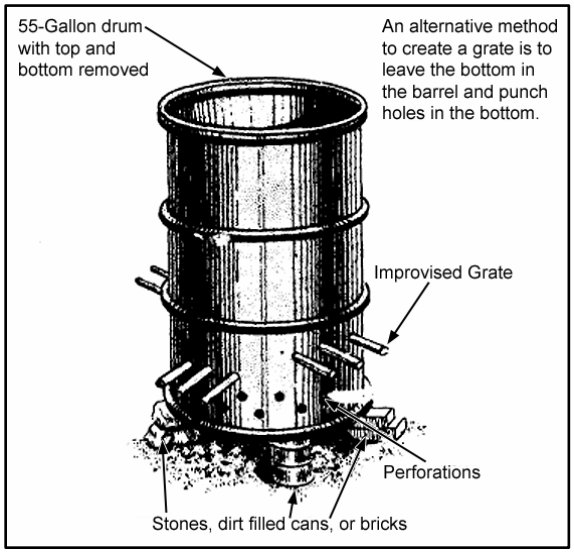


Figure 3-2. Burn barrel

Inclined-Plane Burner

3-62. An inclined-plane burner (with vapor burner) achieves effective combustion, is minimally affected by wind or rain, and will dispose of the solid waste for an entire battalion-size unit. However, building the burner requires time and skill.

3-63. As shown in figure 3-3 the inclined-plane burner is constructed by inserting a sheet of metal through telescoped oil drums that have had both ends removed. The metal plane should extend approximately 2 feet beyond the upper end of the telescoped barrels to serve as a loading or stoking platform. A grate is positioned at the lower end of the plane, and a wood or fuel oil fire is built under the grate. After the burner becomes hot, drained garbage is placed on the stoking platform. As the garbage dries, it is pushed down the incline in small amounts to burn. Final combustion takes place on the grate.

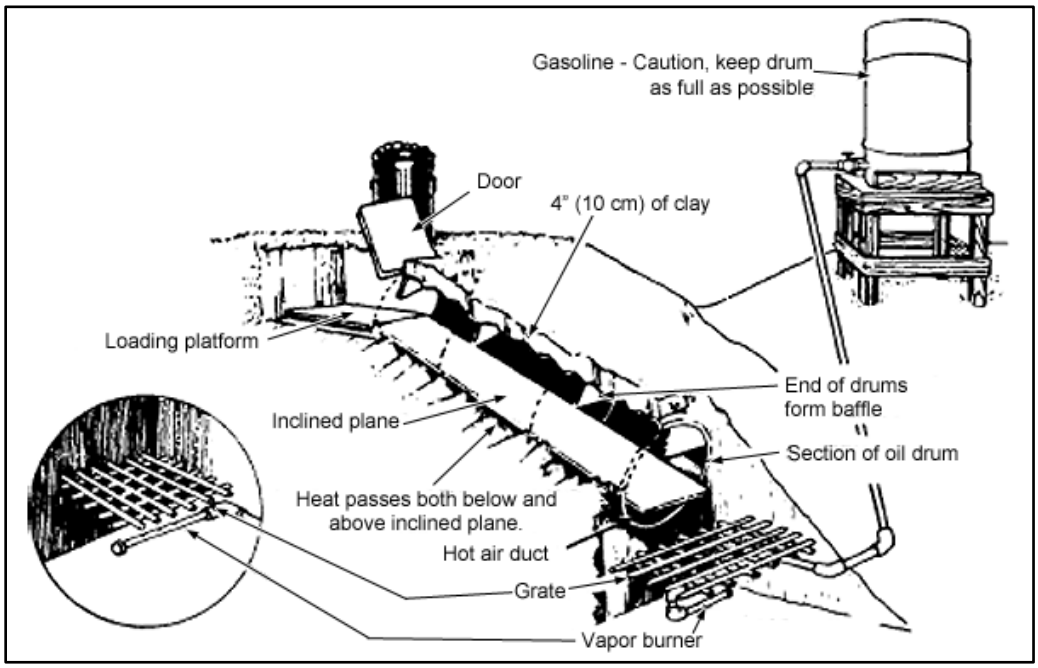


Figure 3-3. Inclined-plane burner

3-64. Because the burn barrel and inclined plane burner are considered open burning, planners must ensure that open burning is permitted within the operational area, based on guidance established for the theater of operations. Other considerations include the following:

- Operate from 3 hours after sunrise to 3 hours before sunset to ensure good smoke dispersion.
- Use approximately 1 gallon of fuel per each cubic meter of waste.
- Locate downwind of work and billeting areas.
- Ensure that personnel are trained and available to operate and maintain burners.
- Ensure PPE and fire extinguishers are on hand.
- Ensure that the area around the burners is free of refuse.
- Manage collection and delivery schedules of refuse to the burner. Manage the throughput so that it is neither overloaded nor operating at fractional capacity.
- Ensure that time is allowed for cleaning and trimming the fire before closing.
- Allow 0.5 to 0.75 man-hours per each ton of refuse processed, excluding residue removal and major repairs.

Incinerators

3-65. Incinerators are designed and operated in a manner that minimizes the production of nonstack, fugitive emissions. They have enclosed combustion chambers that provide a more complete burn, reduce large

volumes of waste in a minimal amount of space, and create less air pollution. The dimensions of incinerators should be considered when planning the design of an incineration area, and incinerators should be placed on concrete pads constructed to withstand their weight and the weight of any other equipment or vehicles on the pads. Incinerators may not be immediately available during early stages of deployment, if at all, and it will likely be contracted or purchased as commercial off-the-shelf equipment. They may not be appropriate for austere conditions, tactical operations, or an outlying base, post, camp, or station (see paragraph 3-66 to learn about the challenges of using incinerators). In addition, operational security restrictions may prevent using incinerators because of smoke/flame signatures. Nonhazardous solid waste incinerators will not be used to dispose of HW or medical waste. Incinerators specifically designed to handle HW and medical waste, if used, will have specific emissions standards required for those two waste streams. Therefore, there could be three or more different incinerators handling three different waste streams: nonhazardous solid waste, HW (see chapter 5), and medical waste (see chapter 6).

3-66. There are challenges that will need to be addressed regarding incinerators:

- Incinerators must be installed, inspected, maintained, and operated by trained personnel. Without a contract, personnel must be dedicated to the incinerator and receive new equipment training. During and after turnover of personnel, training must occur to continue operations.
- Using an incinerator is expensive, regardless if it is contracted or purchased.
- Incinerators can take considerable time to plan for, acquire, and operate. Planning includes determining the capacity, parameters, and specifications for viable incinerators.
- Transportation to the site of installation will need to be considered and may require contracted transportation.
- The life expectancy and size of the base camp may fluctuate, and an appropriate amount of incineration capacity must be decided for installing the proper incinerator. Smaller incinerators that are portable may provide commanders with the flexibility to relocate or adjust as waste volumes fluctuate.
- A feeding system is essential to the proper flow of waste through an incinerator and should not be overlooked during the purchasing process.

3-67. An incinerator must be able to provide controlled burning conditions that ensure the proper mixture of air, temperature, fuel, and the time to allow thorough destruction of organic material. Even with the proper design features, trained operators are essential for the safe and proper operation of an incinerator. Operators should understand the principles of good combustion and be familiar with the equipment. This may require obtaining manufacturer-sponsored training as part of the procurement package. Careful attention to waste segregation, fuel blending ratios, and waste burn rates are essential to an effective incineration program. Routine maintenance, inspection, and instrument calibration should be conducted and recorded. Safety and emergency response plans that address likely failure scenarios must be in place, documented, and shared with mutual aid activities.

3-68. Residual materials (noncombustible solid waste and ash) must be removed from the incinerator and transported for disposal. Residual materials should be tested for waste characterization to determine a proper disposal method. Contact PVNTMED for assistance with sampling and testing. If ash testing and waste characterization cannot be completed at a contingency location, knowledge about how the incinerated waste was produced and handled and about what constituents are likely to be present should be used to determine a suitable disposal method for the incinerator ash. In general, ash containing hazardous constituents should be disposed as HW; otherwise, it is nonhazardous solid waste.

3-69. Nonhazardous incinerator ash will generally be buried for disposal. Landfills can facilitate the use of incinerators by providing an alternative disposal option for certain items that hinder efficient combustion and provide a location for the disposal of ash. In addition, the disposal of dining facility waste in landfills or by composting removes this waste from burn pits and incinerators, which will ultimately improve combustion.

Air Curtain Destructors

3-70. The air curtain introduces a controlled velocity of air across the upper portion of the combustion chamber in which waste is loaded. The curtain of air created in the process traps unburned particles beneath it in the high temperature zone where temperatures can reach 1,800º F. Increased combustion time and

turbulence of the air curtain burning results in a re-burn and more complete combustion of the loaded waste. The escaping particles are reduced to near base elements. Burn boxes are one type of incinerator device that creates an air curtain to help reduce emissions and accelerate the combustion. They are designed for the destruction of wood waste materials only. They do not contain a dual combustion chamber or a stack for dispersing emissions and are not designed for solid waste (food waste or plastic). If used to combust wet waste or plastic, resulting air emissions could exceed the long-term exposure guidelines for coarse particles.

MANAGEMENT PLAN

3-71. Waste management planners apply the waste management fundamentals described in chapter 1 and the 6-step process introduced in chapter 2 to develop a nonhazardous solid waste management plan. The plan must address the life cycle of solid waste management; the established hierarchy for managing solid waste is waste prevention and reduction, sustainable procurement, reuse, donation, recycling, composting, waste-to-energy recovery, incineration, and landfilling. For more information, see DODI 4715.23. The following 6-step process describes considerations and development of the management plan.

STEP 1. ANALYZE THE SITUATION

3-72. As discussed in chapter 2, waste management planners use the mission variables to frame their assessment of the waste situation. Table 3-1, page 3-18, provides some examples of the considerations that are focused on nonhazardous solid waste.

3-73. Starting with mission analysis and continuing throughout the MDMP, waste management planners analyze each mission variable and develop a full list of considerations that could positively or negatively impact operations and influence nonhazardous solid waste management. They attempt to better understand how and where this waste will be generated by the unit and what the challenges and opportunities will be in disposing of it, based on the current situation. Information management is critical to this step. Information is gathered through intelligence, surveillance, and reconnaissance collection (including environmental reconnaissance and infrastructure surveys) and through the submission of RFIs to lower, adjacent, and higher units. For example, a site survey such as an EBS or ESCS is used to collect information (see paragraph 2-20 for more information about site surveys and reports).

3-74. Waste management planners share their knowledge during the planning process to help determine suitable locations for management activities. Waste management planners focus on anticipated situations where units will become stationary for more than 72 hours. Sustainment areas (supply, maintenance, and food services) and other areas where supplies and materials are unpackaged and placed into unit configurations tend to generate large amounts of nonhazardous solid waste. Throughout the planning and operations processes, it is important to ensure the nonhazardous solid waste management plan remains supportive of the sustainment plan.

STEP 2. DEVELOP PRELIMINARY WASTE ESTIMATES

3-75. Steps 2 and 3 (categorize waste requirements) are completed simultaneously. When waste management planners are determining the unit's preliminary estimates of nonhazardous solid waste, they start with established planning factors and then tailor the estimates based on the considerations identified in step 1 (analyze the situation). Consequently, the generation rate for a particular waste stream can vary.

3-76. Waste management planners can use the planning factors listed in ATP 3-37.10/MCRP 3-40D.13 as a basis for developing tailored, nonhazardous solid waste generation rates. For units on the move or stationary less than 72 hours, the waste is typically general refuse and food-related waste that will be backhauled, burned, or buried. When establishing basic services, planners can start with a generation rate of 4 pounds per person, per day. With expanded and enhanced services, 6 and 10 pounds per person, per day, respectively, can be used as a basis. Waste management planners, in addition to considering the mission variables that impact waste estimates, consider ways to reduce the amount of waste requiring disposal by reusing, donating, recycling, or composting discarded or unwanted materials. Such materials are identified as "recoverable" and include plastics, scrap wood, scrap metal, paper, sewage sludge, and food. They must determine a generation rate based on the materials that are being consumed while accounting for any materials that are recovered. If a unit is in a base camp where plastic bottles are being recycled, then the unit's gross amount of waste will

be the same, but the amount that must be disposed of is reduced. Another factor to consider is that dependence on nonlocal supplies requires disposal of packaging material, such as pallets, plastic, and cardboard that will result in higher generation rates in those solid waste categories. Therefore, obtaining supplies locally can decrease generation rates. Post exchange services and dining facility activities also result in increased solid waste from packaging, drinks, food, and so forth. As shown in table 3-2, page 3-20, nonhazardous solid waste estimates can be developed by multiplying the appropriate nonhazardous solid waste generation rate by the number of personnel. Waste management planners can apply this rate to determine the unit's nonhazardous solid waste requirements for each critical friendly event or phase of the operation (if phases are used), based on the anticipated duration in number of days. In general, hub-like bases will generate higher waste amounts. These bases host a fluctuating number of transient personnel who eat at the dining facility, purchase products at a field exchange, and leave waste packaging behind. Senior level headquarters also produce larger amounts of waste (such as furniture, computers, printed products, consumables, and wastewater) due to the nature of their activities.

Note. When examining the rates for the various waste streams, keep in mind that much waste is produced as shipments come in and supplies are unpacked. The waste is not limited to post-consumer generated waste; instead, all waste produced at a site is reflected as a rate per person in order to make estimates and calculations for planning purposes.

3-77. As planning progresses and throughout execution, the unit's requirements for each critical event or phase are adjusted to reflect anticipated changes in the duration of events or phases. The unit's generation rate is also adjusted, based on changes in the situation, such as when a unit is no longer on the move or different materials are being consumed or recycled.

Table 3-1. Nonhazardous solid waste considerations in relation to mission variables

Mission Variables	*Considerations*
Mission	• Identification of all operations and activities that generate solid waste • Where and when solid waste generation takes place (for example, supply, maintenance, and DFACs) • Types and amounts of solid waste (based on functions, number of personnel, and inventories) • Duration at a given location and consideration of viable management options • Limitations or mandatory actions/orders that could impact solid waste management
Enemy	• Threats while transporting solid waste • Prevent information, especially classified, from entering the waste stream • Limited access of local and nonlocal contractors • Operational security restrictions on burying and burning (smoke/flame signatures)
Terrain and Weather	• Land availability for solid waste systems and terrain/land cover obstacles to construction • Prevailing wind direction and potential to contaminate air; place systems downwind • Soil composition and obstacles to digging and burying • Potential to contaminate water resources with buried solid waste • Effects of burying nonhazardous solid waste on future land use • Predominate weather conditions and ability to operate different solid waste systems

Table 3-1. Nonhazardous solid waste considerations in relation to mission variables (continued)

Mission Variables	*Considerations*
Troops and Support Available	• Capacity of subordinate units to manage, operate, and maintain solid waste systems • Need for knowledge and expertise ▪ Availability of specialized engineer units or contractors (local and nonlocal) ▪ Availability of a medical detachment, PVNTMED, and other EAB support ▪ USACE and APHC support or assistance teams • Equipment and materials (for construction, collection/storage, transport, treatment, and disposal) • Availability of specialized equipment (such as shredders, compactors, and incinerators) • Availability of funds and contracting mechanisms (including local purchase) • Population stability and predictability
Time	• Timeline of events to meet goals and objectives ▪ Development of a solid waste management plan, including contingency plans ▪ Acquisition of supplies, services (contractors), equipment, and materials ▪ Arrival of troops, support, and equipment/materials ▪ Installation or construction of solid waste management systems ▪ Operation and maintenance of system(s) ▪ Closure and documentation of all solid waste systems • Roles and responsibilities, from point of generation through proper disposal and closure • Life span of solid waste systems (immediate, basic, expanded, or enhanced)
Civil Considerations	• Potential impacts to environmentally sensitive or protected areas ▪ Historical, religious, and cultural sites ▪ Threatened and endangered species and their habitats • Natural Resources, such as water, air, land, and minerals • Potential to attract vectors and spread disease • Construction and treatment standards, agreements, and policies and guidelines • Materials that are compostable, recoverable, reusable, or recyclable • Impacts (beneficial and negative) to local communities
Legend: APHC DFAC EAB PVNTMED USACE	 United States Army Public Health Center dining facility echelons above brigade preventive medicine United States Army Corps of Engineers

Table 3-2. Sample nonhazardous solid waste requirements work sheet

Subordinate Unit	Basic							Expanded						
	Number of Personnel	Generation Rate (pounds/person/day)	Unit Generation Rate (pounds/day)	Duration (days)	Unit Generation Total (pounds)	Unit Generation Total (cubic yards)	Required Resources and Solutions	Number of Personnel	Generation Rate (pounds/person/day)	Unit Generation Rate (pounds/day)	Duration (days)	Unit General Total (pounds)	Unit Generation Total (cubic yards)	Required Resources and Solutions
Battalion	700	4	2,800	60	168,000	168	Donation area, collection containers, trucks and fuel (to haul to local existing landfill)	700	6	4,200	180	756,000	756	Donation area, segregation containers, trucks and fuel (to haul to local recycling market and landfill)
Company	100	4	400	60	24,000	24	Excavation equipment (for open-pit burn), collection containers, truck, and fuel	100	6	600	180	108,000	108	Donation area, reusable materials, collection containers, truck, fuel, incinerator, and ash pit

Notes.
1. 1,000 pounds ≈ 1 cubic yard. This conversion factor is dependent on the amount of waste compaction that is possible with the equipment available. If compaction is not possible, 1,000 pounds will exceed 1 cubic yard.
2. This work sheet should be extended to incorporate all subordinate units and phases of an operation.
3. For the enhanced category, the generation rate of 10 pounds/person/day can be used as a basis for developing a tailored generation rate (see ATP 3-37.10/MCRP 3-40D.13 for more information on base camp utilities planning factors). Higher generation rates have been found after limited characterization studies. A generation rate of 18.2 pounds/person/day was found in one characterization study performed by the United States Army Corps of Engineers after 14 days of sorting mixed nonhazardous solid waste at a semipermanent phase base camp in the Balkans in 2006. Later, in 2011, the United States Army Corps of Engineers completed two characterization studies in Afghanistan concluding 15.9 pounds/person/day as a reasonable planning factor as well as 18.2 pounds/person/day.

STEP 3. CATEGORIZE WASTE REQUIREMENTS

3-78. As described in chapter 2, the waste requirements are categorized (immediate, basic, expanded, enhanced, or transfer/closure) based on expected duration. The categorization of waste requirements is included in the nonhazardous solid waste requirements work sheet (see table 3-2) to help with organization, planning, and execution. The work sheet should be extended, as needed, to cover all phases of the operation. In table 3-2, for example, the work sheet was extended to include expanded waste requirements.

STEP 4. EVALUATE WASTE MANAGEMENT CAPABILITIES

3-79. Waste management planners evaluate the waste management capabilities and resources (manpower, equipment, materials, and funding) for each subordinate unit (one level down) according to the proposed task organization for each COA being developed. The results of this evaluation drive the generation of capability-based solutions in step 5.

STEP 5. GENERATE SOLUTIONS

3-80. Waste management planners first generate solutions that take advantage of existing waste handling facilities within the HN or within existing base camps. When existing facilities and contractor support are

not available, waste management planners generate capability-based solutions to meet the nonhazardous solid waste requirements. Capability-based solutions are based on the capabilities that are available in the current task organization or will likely be made available, based on augmentation from higher headquarters. In the latter case, a critical assumption must be made and captured during the planning process (see ADP 5-0, FM 6-0, and MCWP 5-10for more information on making assumptions during planning). As solutions are generated for each requirement, they are depicted for each critical event or phase as shown in table 3-2 with the corresponding required resources and solutions needed to fulfill the requirement. The information placed within the work sheet should be as detailed as necessary to facilitate planning (only limited information was put in table 3-2 to conserve space). The work sheet is continually refined as planning progresses and new information becomes available.

3-81. Waste management planners must not constrain brainstorming or the generation of options, based solely on existing capabilities. They consider options that leverage emerging commercial technologies and best practices and incorporate those initiatives within future planning, to include base camp master planning. Best practices and optimal conditions for nonhazardous solid waste management may include—

- The drop-off area for customers is an open circulation area that is sized and placed to accommodate the typical vehicles that drive into this area and the multiple storage bins for materials such as metals, plastics, and wood. The number and size of bins will depend on the needs of the base and the number of personnel.
- Locate the administration building where supervisors can see operations in the various waste management areas and where customers can easily find it. Ensure ample space is available for parking and maneuver. When feasible, position supervisor offices, with wrap around windows, on the second story, which will allow them to oversee operations. Outside stairs are recommended. Scales should be located near the administration building, and the maintenance building should be centrally located. Provide access for large trucks to pick up materials, away from the main traffic flow, if possible, and plan for a pole barn or metal building for heavy equipment storage.
- The sorting area includes a concrete floor and a pole barn covering a significant part of the area. Removable siding and sliding doors should be used in warm areas for ventilation. Locate the sorting area near the compacting facility and burn/incineration area with ample allowance for traffic flow. Consider a belt picking system for large bases.
- Noncombustible solid waste and ash must be removed from burn areas and transported for disposal. Nonhazardous ash will generally be buried. An ash pit needs to be adjacent to the burn/incineration area, or nonhazardous ash may be composted or landfilled.
- Locate a compacting area near the sorting area and customer drop-off area. Plan for a metal preengineered building sized to accommodate the number of balers and compactors that will be used. Plan for as much pole barn covered storage as possible for baled or loose materials. The collected materials from the sorting area can be moved in boxes, by conveyor belt, or by hand to the compacting area.
- Locate a composting area with easy access to and minimal distance from the sorting area and ash pit. Nonhazardous ash may be composted.
- A land farming area can be used for the bioremediation of petroleum-contaminated soils. A land farming area should have an impermeable surface (such as concrete or landfill liner) and controls so that contaminated dirt does not leach into the ground and contaminate ground water. The same equipment that is used for composting may be used for land farming.
- A power generation area is optional in the solid waste management facility, based on the design of the power grid for the base. Power distribution lines may be run from a centrally located base power plant. Locate power generation near areas with the highest electrical load, such as compacting and sorting areas. The administration building and the maintenance facility will generally use less power. When feasible, construct concrete pads with secondary containment under generators. The use of buried power distribution lines, if planned for in advance, is better than using overhead lines suspended by poles.
- Use more sustainable materials or methods. For example, reuse water bottles or canteens with bulk water storage and procure supplies locally.

STEP 6. INTEGRATE WASTE MANAGEMENT TASKS INTO PLANS AND ORDERS

3-82. Once a COA is approved by the commander, waste management planners finalize the nonhazardous solid waste management plan that supports that COA, and they should review and update the plan annually. Waste management planners coordinate and synchronize the supporting waste management tasks with other staff members and higher headquarters as necessary. The waste management tasks are then incorporated into plans and orders as described in chapter 2. Waste management tasks should be included in logistics rehearsals and backbriefs to ensure that the plans are feasible and supportable by higher headquarters.

BASE CAMP TRANSFER AND CLOSURE

3-83. Proper environmental site closure or transfer is the responsibility of the departing unit. Upon receipt or in anticipation of a notice to close or transfer the base camp, waste management planners develop a closure plan that describes the disposition of solid waste management sites and the actions necessary to return those areas to their preexisting states or to the required condition for closure or transfer. The ESCR is the mechanism used to document the final condition of the occupied property and to ensure that units have properly prepared sites for closure or transfer. The permanent closure of an open-burning site involves informing the base camp tenant commanders, securing access to the location, filling in burn pit depressions, and coordinating the transfer of historical records through the theater chain of command. Open-burning site plans must allow the closure to correspond with the phased reduction or elimination of the camp population. It must be completed before the unit is released of its responsibility for the site. The EBS, ECRs, and ESCS completed during occupation of the site will be used as the basis for the ESCR (see appendix F for more information about transitions, transfers, and closure). The unit environmental officer will coordinate through the area environmental office or the environmental officer at higher headquarters for any support needed.

3-84. The site closure plan will include detailed information regarding waste management requirements to properly close or transfer a base camp. It will describe the required actions, tasks, and standards necessary and should be sequenced with the ESCS timeline. The plan complements and supports SOPs, orders, and plans issued at the unit level and by higher headquarters. The following areas should be addressed in site closure plans and/or SOPs:

- The disposition of reusable and recyclable materials.
- The termination of waste management contracts.
- The disposition of waste material generated through the deconstruction of the base camp.
- The closure and cleanup of incinerators, burn pits, and ash pits.
- The closure of composting and land farming operations and the cleanup of the sites.
- The disposition of HAZMAT and HW with instructions for cleanup of HWAPs and storage areas.
- The cleaning and disposition of equipment used in waste management areas.
- The disposition of medical waste.
- The proper closure and marking instructions for latrines.
- The proper shutdown of the water production site, the disposition of the wastewater and brine lagoon, and the potential need for water monitoring.
- The disposition of wastewater treatment systems.
- The disposition of above- and underground storage tanks.
- The cleanup of sorting, compacting, and customer drop-off areas and the disposition of customer drop-off containers.
- The disposition of trash receptacles, to include standards for turn-in.
- The removal of generators, fuel bladders, secondary containment liners, and associated fuel distribution equipment and the remediation standards necessary for any affected areas.
- The disposition of secondary containment and force protection berms.
- The disposition of landfills, with instructions for proper closure and marking.

3-85. Grid coordinates for waste management activities will be recorded and post-closure digital photographs and videos of the sites should be taken. These records will be incorporated into the ESCR. See appendix F for more information about base camp transition, transfer, and closure.

Chapter 4

Wastewater

Wastewater is categorized and managed as either gray water or black water. The distinction is that black water potentially contains disease-causing organisms, or pathogens; whereas, gray water is unlikely to contain pathogens. The primary source of black water is toilet wastewater, and the primary sources of gray water are laundry, showers, and kitchens. All wastewater must be managed properly, but the requirements for black water are much more stringent in order to prevent the spread of diseases. This chapter covers wastewater management methods, and it expands on the discussion presented in chapter 2 and describes how to develop a wastewater management plan. This chapter is organized into the two categories of wastewater: gray water and black water.

OVERVIEW

4-1. Commanders at every level must incorporate wastewater management planning throughout all phases of the MDMP to maintain optimal combat readiness, protect the environment, and promote a self-sustaining force. Refer to the HN laws and final governing standards (FGS) to determine the rules and regulations for disposal of wastewater. Otherwise, refer to DOD 4715.05-G and consult and coordinate with higher headquarters for guidance. Wastewater is a much bigger issue than most people initially realize. Factors to consider include volume and characteristics, operations (duration of stay and intensity of combat), geologic conditions (terrain, soil, and groundwater depth), climate (precipitation and temperatures), engineer support availability, accessibility (of location and fixed sewage collection, treatment, and disposal), and applicability of environmental regulations. Assuming that contractors will be available immediately to manage wastewater is unwise. Similarly, a "pump and dump" strategy for wastewater disposal is reckless and unacceptable. It is especially important to be aware of water resources in the area; discharge of untreated wastewater to streams, rivers, or other water bodies is prohibited. Disposal and treatment options shall be explored and integrated into planning, including contingency planning in the event of contract or system failure. Simple solutions that can be managed by troop labor or local nationals should be emphasized. On the other end of the spectrum, a more complex system of managing wastewater may be optimal if the necessary resources are available. Keep in mind that after contingency operations are concluded, many existing bases will be turned over for HN use, and some systems may not be transferable due to their complexity. For detailed information about designing and constructing wastewater systems, also consult TM 3-34.70/MCRP 3-17.7E, which is a detailed guide for engineer personnel with information on calculations, field testing, distribution, and drainage. UFC 3-240-01 and UFC 3-240-02 also contain helpful information, including guidance about design, best management practices, and oil-water separators. Consult ATP 4-25.12 for the importance of proper waste management and for the role that unit field sanitation teams provide in PVNTMED and maintaining the health of Service members.

PETROLEUM, OILS, AND LUBRICANTS-CONTAMINATED WASTEWATER

4-2. Wastewater from dining facilities, motor pools, POL storage areas, and wash racks commonly contain POLs that must be caught prior to discharging the wastewater for treatment or disposal. The POLs must be removed to prevent oil and grease from accumulating and obstructing flow in piping and from accumulating in sludge, requiring sludge disposal as HW. Also, POLs must be removed to prevent them from reaching and contaminating water sources. Typically, POL-contaminated wastewater is filtered through grease traps or directed to oil-water separators for POL removal.

Grease Traps

4-3. The wastewater generated from dining facilities that is contaminated with food particles, cooking oils, grease, detergents, or other cleaning agents shall discharge to a grease trap. These contaminates can clog wastewater systems, rendering them ineffective and requiring them to be closed. Grease traps are constructed to remove these contaminates from the wastewater before disposal. Grease traps must be cleaned frequently and the contents burned or landfilled according to the guidance or procedures established for the theater of operations. A grease trap should be large enough to prevent the addition of hot, greasy water from heating the cool water already in the trap. Otherwise, grease will pass through the trap instead of congealing and rising to the top of the water.

Baffle Grease Trap

4-4. A baffle grease trap is constructed from a 55-gallon drum or box (see figure 4-1). The box or drum is divided vertically into unequal chambers by a wooden baffle. This baffle should extend to within 1 inch of the bottom. Waste is poured through a strainer into the large chamber. It then passes under the baffle and flows out into the small chamber. In the large chamber, the trap should have a removable lid and a strainer. The strainer may be a box with openings in the bottom. Fill the strainer with straw or burlap to remove coarser solids. Clean the strainer frequently by scrubbing it with soap and water to prevent clogging. Insert a 1-inch pipe 3 to 6 inches below the top of the smaller chamber to carry liquid from the trap to a soakage pit. Clean the trap frequently to ensure proper operation. Remove the grease, drain the trap, and remove the sediment from the bottom.

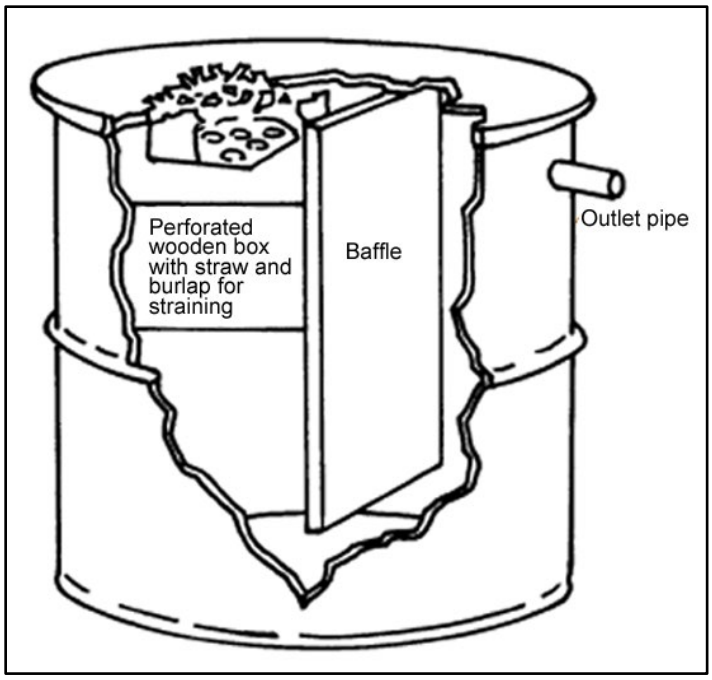


Figure 4-1. Baffle grease trap

Barrel Filter Grease Trap

4-5. The barrel filter grease trap is constructed from a 30- to 55-gallon barrel or drum (see figure 4-2). Remove the barrel top and bore a number of large holes into the bottom. Place 8 inches of gravel or small stones in the bottom of the barrel, and cover them with 12 to 18 inches of clean wood ashes or sand. Fasten a piece of burlap to the top of the barrel to serve as a coarse strainer. Place the trap directly over a soakage pit or on a platform with a trough leading to a pit. If the trap is placed over a pit, remove the bottom instead of boring holes into it. Empty the trap every 2 days. Wash the trap, remove and dispose of the ashes or sand, and refill the trap with fresh ashes or sand. Wash the burlap strainer every day or replace it.

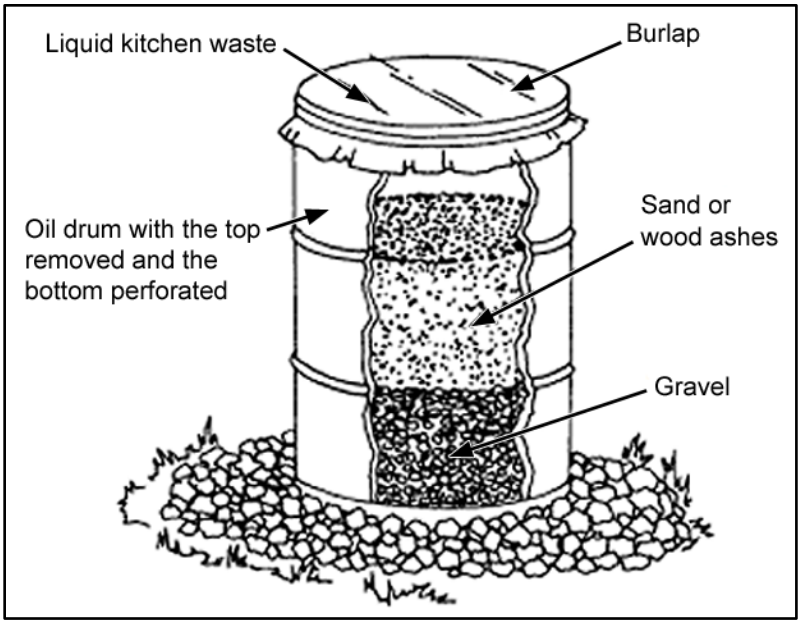


Figure 4-2. Barrel filter grease trap

Oil-Water Separators

4-6. The wastewater runoff from motor pools, POL storage areas, and washrack activities is treated using an oil-water separator. These areas should be constructed with impermeable surfaces and measures to prevent wastewater pollution as much as possible. The locations of these areas should be coordinated with the unit or base camp environmental officer before beginning construction. To help oil-water separators function properly, controls must be established to prevent POL products, solvents, or antifreeze from being dumped into the drainage system. An oil-water separator is not a disposal system, but a filtering mechanism. It is also necessary to ensure that emulsifying agents (such as soaps, detergents, and solvents) are not used in conjunction with the oil-water separators. Emulsifying agents will collect oil-based material and carry it through the system, thereby rendering the system ineffective for its intended purpose. Trash cans should be situated nearby for the collection of general refuse to prevent trash from entering separators. Oil-water separators should be regularly inspected to ensure that they are functioning properly. A field expedient washrack with an oil-water separator is shown in figure 4-3, page 4-4. As base camps mature, more permanent washracks should be installed. For design guidance, see USACE Engineer Research and Development Center/Construction Engineering Research Laboratory TR-00-40.

4-7. Routine oil removal from the surface of the separation chamber is critical. One way to remove the surface oil is to suction it to a truck with a tank approved for such purposes. Oil and oily sludge removed from oil-water separators may be disposed of by reuse/recovery, incineration, DLA Disposition Services, waste hauler, landfill, and land farming. The sludge may require disposal as a HW if levels of pollutants exceed acceptable levels. Evaluate disposal options with the Environmental Officer, DLA Disposition Services, or higher headquarters to determine acceptable disposal options and the most cost-effective system. See UFC 3-240-01 for more information about oil-water separators.

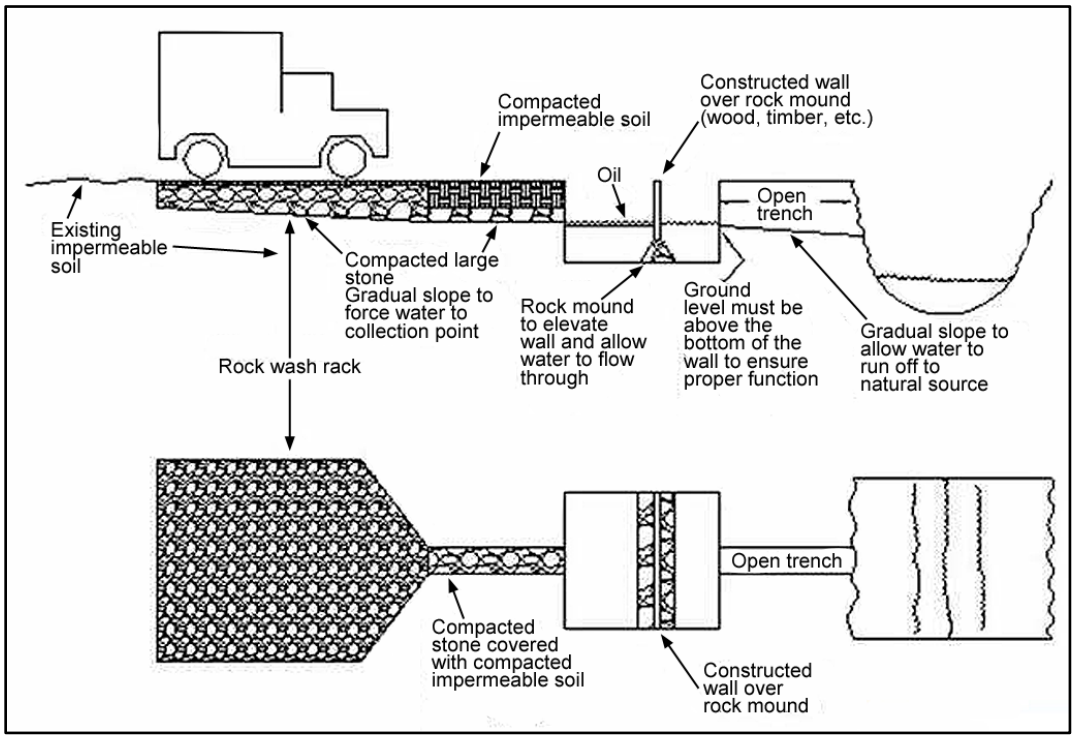


Figure 4-3. Oil-water separator

URINE DISPOSAL FACILITIES

4-8. When on the move, there are commercial off-the-shelf urine collection and disposal devices that can be used. When constructing field latrines (see black water management systems), separate urine disposal facilities should be collocated with male latrines. Urine, by itself, can be managed using urine disposal facilities to reduce the area and resources required for field latrines. At least one urine disposal facility is required for each male latrine or for every 100 male personnel in the unit. For more information about urine disposal facilities, see ATP 4-25.12.

Urine Soakage Pit

4-9. The best field device for urine disposal is a urine soakage pit (see figure 4-8), or a soakage trench may be used when the groundwater table or bedrock prevent digging a pit. The pit can be dug 4 feet square and 4 feet deep and filled with an aggregate material (rocks, brick, broken glass, or other nonporous rubble). The pit is covered with small stones, creating a surface layer 4 inches deep that extends 6 inches past the edge of the pit on all sides. For the urine soakage pit to function properly, pipe urinals with funnels or trough urinals should be used with this pit, and urination onto the surface of the pit must not be allowed. An optional feature is ventilating shafts with screened openings that extend from about 8 inches above the pit to within 6 inches of the bottom of the pit. Funnels and troughs must be cleaned daily with soap and water. The funnels must be replaced as necessary. Oil and grease must never be poured into the pit because they will clog it and because they can leach through soil and contaminate groundwater.

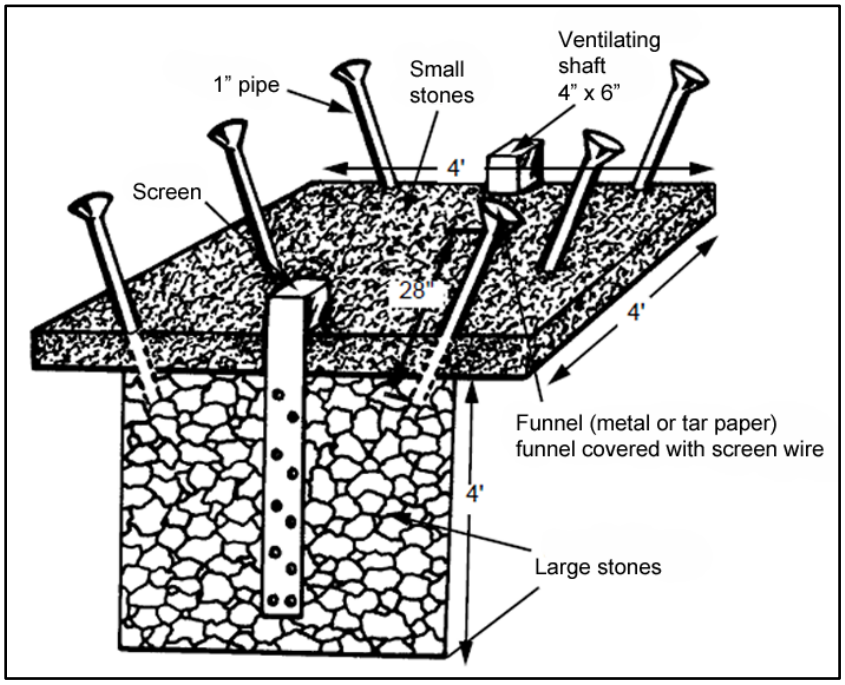


Figure 4-8. Urine soakage pit with pipe urinals

Pipe Urinals

4-10. Pipe urinals should be at least 1 inch in diameter and approximately 38 inches long. They should be placed at each corner of the soakage pit and, if needed, on the sides, halfway between the corners. The pipes are inserted at least 8 inches below the surface of the pit. A funnel made of tar paper, sheet metal, or similar material is placed in the top of each pipe and covered with a screen. The upper rim of the funnel should extend approximately 30 inches above the ground surface.

Trough Urinal

4-11. If more durable facilities are desired and materials are available, a trough urinal can be constructed (see figure 4-9, page 4-6). The trough is U- or V-shaped, approximately 10 feet long, and made of sheet metal or wood. If wood is used, it must be lined with heavy tar paper. The legs supporting the trough are cut slightly shorter on one end so the trough slopes slightly downward, where a pipe carries the urine into a soakage pit.

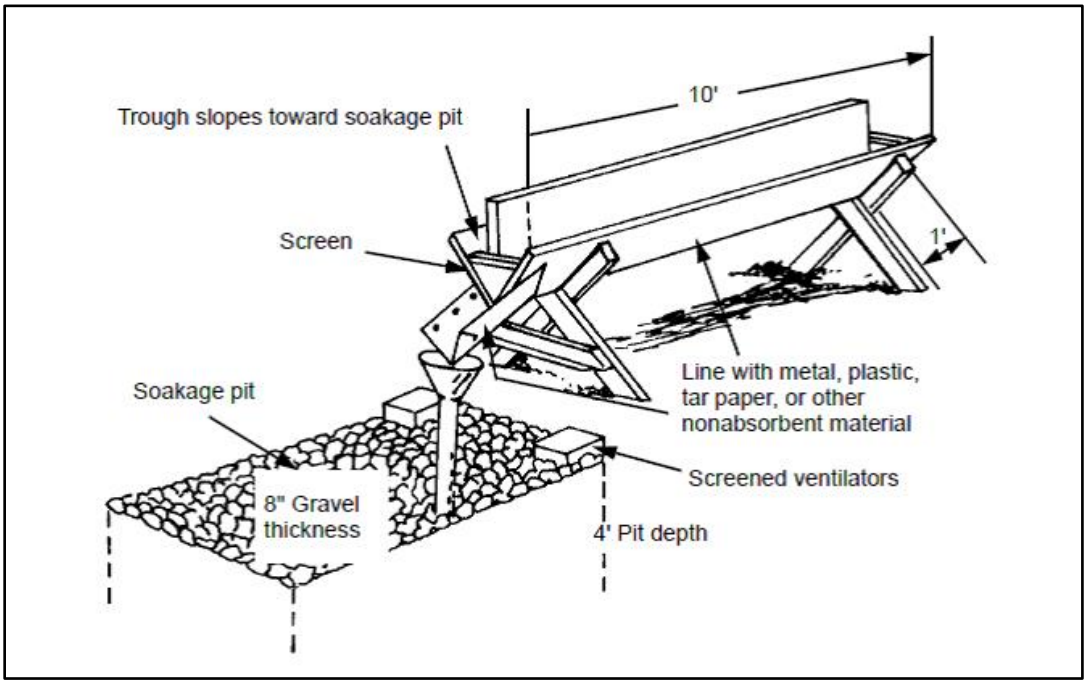


Figure 4-9. Trough urinal

Urinoil

4-12. In areas where the groundwater level is more than 3 feet below the surface, the urinoil (see figure 4-10) is an acceptable substitute for other types of urine disposal facilities. The urinoil is a 55-gallon drum, containing oil, which is placed over a recessed soakage pit. Waste POL can be used, but vegetable oil is preferred. Urine entering through a screen immediately sinks through the oil where it is trapped at the bottom of the drum. As urine is added, the urine level rises within a 3-inch-diameter pipe braced vertically in the drum. This continues until the urine level reaches an overflow pipe in the center of the drum that sends the urine to a soakage pit. The oil acts as an effective seal against odors and flies. The screen is easily lifted with attached hooks for the removal of debris. The urinoil will operate in place as long as the soakage pit will accept the urine.

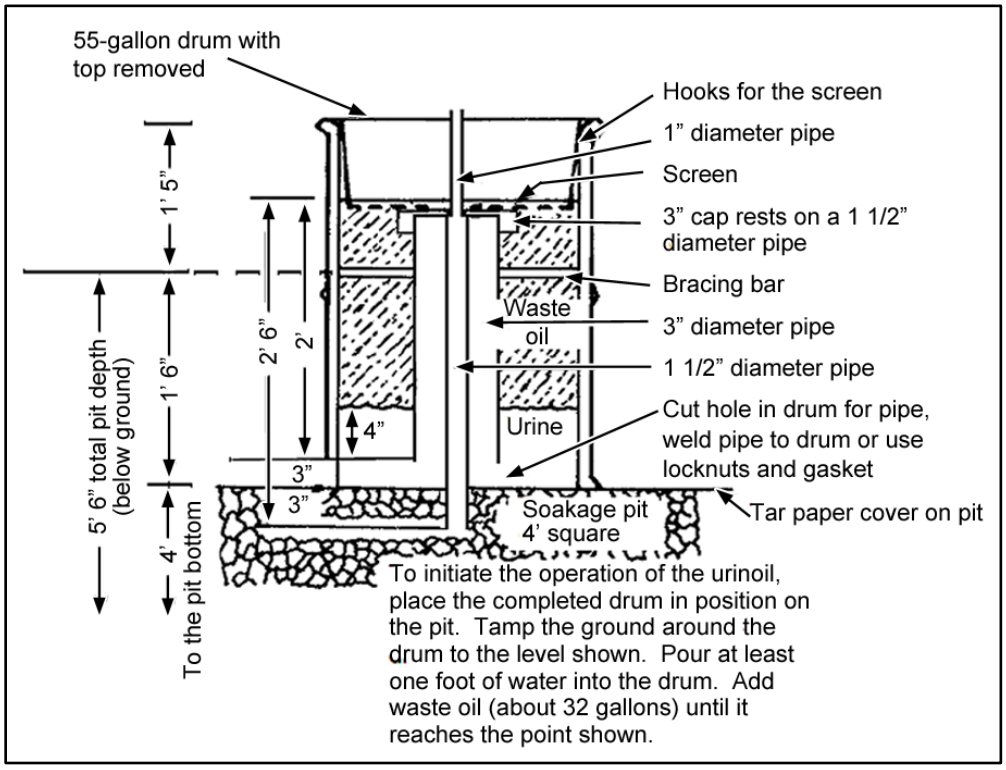


Figure 4-10. Urinoil

Closure

4-13. When a urine soakage pit is being abandoned or becomes clogged, it is sprayed with an approved residual insecticide and covered with a 1-foot mound of compacted dirt. A rectangular sign is placed on the mound indicating the type of pit and date it was closed.

GRAY WATER MANAGEMENT SYSTEM

4-14. Gray water generally includes the wastewater from laundry, showers, hand-washing devices, washracks, and water purification systems. Wastewater from dining facilities can be categorized as gray water if it is unlikely to contain pathogens; if wastewater potentially contains pathogens, it is considered black water. With dining facility activities, it is the wastewater that contains food wastes that is potentially pathogenic and managed as black water. For example, wastewater from food preparation areas, dishwashers, and garbage disposals. Some gray water will require treatment; for example, gray water contaminated with POLs must be treated to remove the POLs. Some gray water may require separate (individual) management plans altogether; for example, gray water containing by-products from water purification systems may be managed independently. The gray water management system consists of all the different processes and parts that work to manage gray water, including treatment of POL-contaminated gray water (see paragraph 4-2), field disposal methods, treatment systems, and the management of gray water generated from water treatment systems (such as reverse osmosis water purification units[ROWPUs]). Effectively managing gray water begins by understanding the requirements and options early in the planning phase. Then, a gray water management plan is developed using the 6-step process described here and in chapter 2.

GRAY WATER FIELD DISPOSAL METHODS

4-15. Field disposal methods are typical when on the move or when staying for a short duration in one place, and at the initial stages of a base camp. These traditional methods for disposing of gray water include evaporation beds, soakage pits, and soakage trenches. Based on soil characteristics and weather conditions,

these methods will usually be sufficient to handle the generated gray water. General engineering or specialized engineer support may be needed to design and possibly construct and operate these devices, and earthmoving equipment may be necessary, based on the volume of gray water generated. Waste management planners must attempt to identify the requirements and request augmentation as early in the planning phase as possible. See TM 3-34.70 for construction guidance and more detailed information, and consult engineers specialized in civil engineering practices. Also, assistance in the form of technical advice may be obtained from supporting engineer units, unit field sanitation teams, higher headquarters, USACE and APHC support teams, or through reachback.

4-16. These methods are generally constructed for small volumes of gray water. They can be effective for larger volumes depending on the site, resources available, soil types, existing infrastructure, water table, and duration of occupation with proper design and operation. Before discharging to field disposal devices, remember that wastewater from kitchens and washracks require effective pretreatment such as grease traps and oil-water separators to remove grease, oil, or particulate matter.

4-17. Field disposal methods may not be suitable in cold environments or in areas with high water tables. In these situations, the use of constructed wetlands or holding basins may be an alternative if the necessary heavy construction assets are available; if not, the only alternative may be to temporarily contain gray water in tanks or drums for removal by military units or contractors. Requirements for alternate methods must be identified as early in the planning phase as possible to facilitate long lead times for fund acquisition, contracts, project approval, design, and construction.

Evaporation Beds

4-18. An evaporation bed (see figure 4-4) is probably the simplest method of disposing of larger amounts of gray water. It may be used in hot, dry climates and in places where a high groundwater table or clay soil (poor soil percolation) prevents the use of standard soakage pits. Evaporation beds configured in three tiers (see figure 4-5) can be used when confined by available land area.

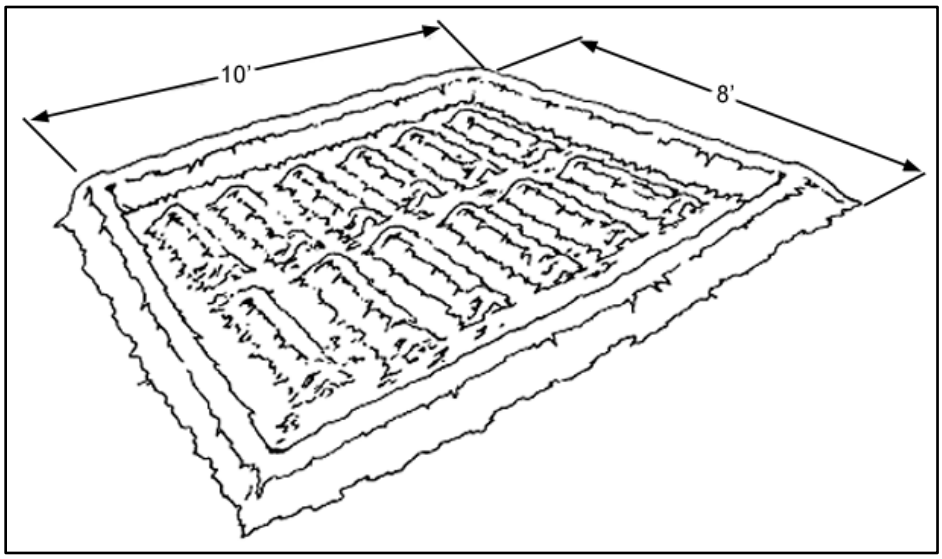


Figure 4-4. Evaporation bed

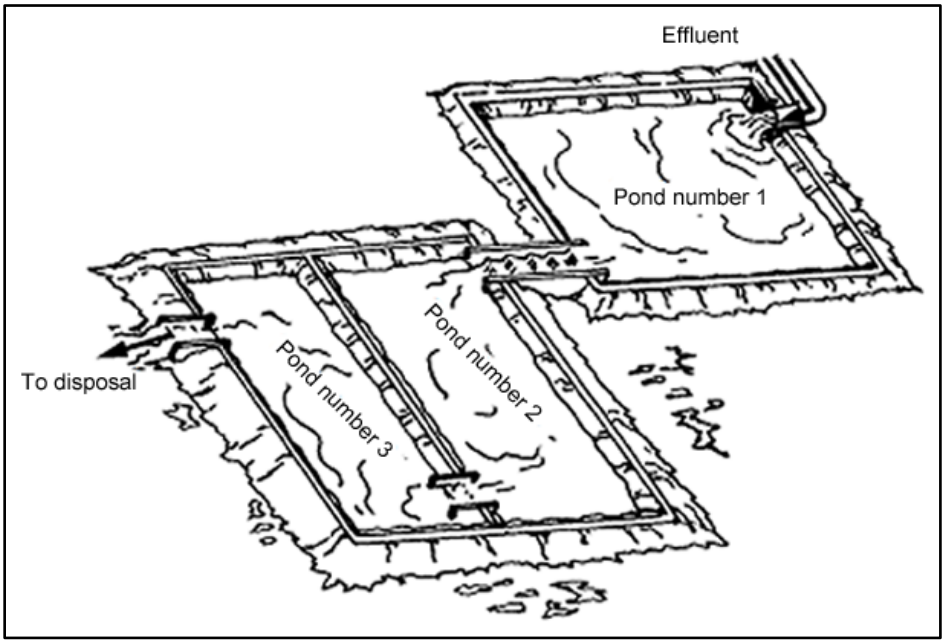


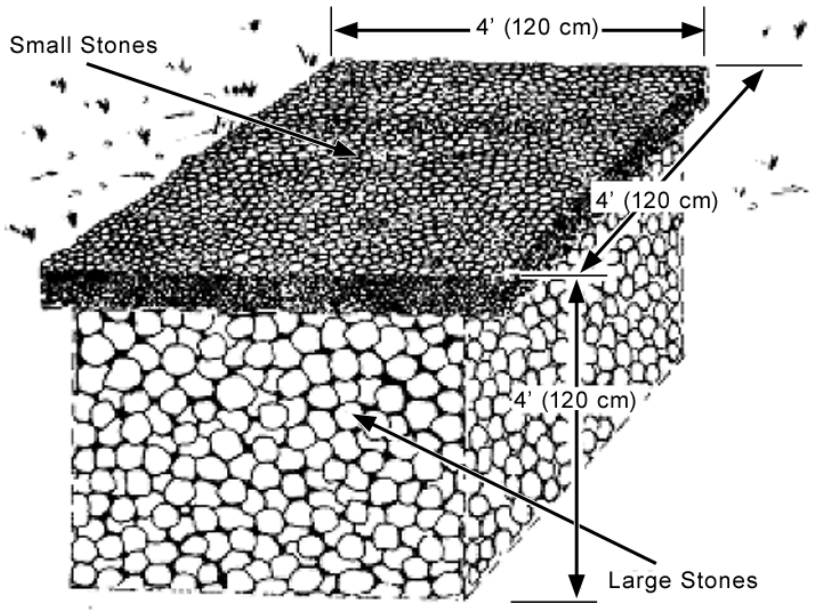
Figure 4-5. Three-tier evaporation beds

4-19. Seek technical support to perform percolation tests and to determine the total daily effluent, application rate, and required acreage. Construct the beds so that the waste can be distributed to any one of the beds. Scrape the topsoil to the edges, forming a small dike around the bed. Spade the ground in the bed to a depth of 10 to 15 inches. Rake it into a series of rows, with the ridges approximately 6 inches above the depression. Form the rows lengthwise or crosswise, depending on which one allows the best water distribution. Locate the beds outside the base camp and in an open, sunny area. Give careful attention to the proper rotation, maintenance, and dosage of the evaporation beds. If used properly, the beds do not have insect problems and have only a slight odor.

4-20. General guidelines are to rotate use of the beds. During the day, flood one bed with gray water to the top of the ridges. This is equivalent to an average depth of 3 inches over the bed. Allow the wastewater to evaporate and percolate. After 3 or 4 days, the bed may be sufficiently dry for respading and reforming. Flood the other beds on successive days and follow the same sequence of events. Give careful attention to proper rotation, maintenance, and dosage.

Soakage Pits

4-21. In general, a soakage pit should be 4 to 6 feet deep and dug as a square or rectangle (see figure 4-6, page 4-10). The required size of a soakage pit can be determined from a percolation test and the estimated amount of effluent to be received (seek technical guidance). If the camp is to be occupied for several weeks, construct soakage pits in pairs and alternate their usage on a daily basis to provide a rest period and help prevent clogging. A clogged soakage pit will not accept liquid and must be properly closed.



Legend:
cm centimeter(s)

Figure 4-6. Soakage pit

4-22. Pits should not be deeper than 6 feet to prevent the need for wall shoring during construction and further increase the construction effort. The bottom of the pit should be at least 2 feet above the groundwater table and 5 feet above rock or other impermeable soil conditions. The pits should be located outside the base camp and at least 100 feet down gradient from any water source.

4-23. To accommodate a larger quantity of gray water using a soakage pit, a longer, rectangular pit (not deeper) or several pits may be dug. In this situation, if several pits are used to accommodate a larger volume, ensure that there is equal distribution of the wastewater to all the pits. The distance between soakage pits should be at least twice the size of the pits. The effective absorption area of a pit or number of pits is based on the total area of the sidewalls in the pit and not the bottom of the pit.

4-24. To close a soakage pit, backfill and compact with soil 1 foot above the grade and mark the pit with a rectangular sign, indicating the contents, the date it was closed, and the unit that filled it. Document the 8-digit grid coordinates for the location in closure reports to higher headquarters so that future site work or building plans can anticipate or avoid the buried obstruction.

Soakage Trenches

4-25. If the groundwater level or a rock formation prevents digging a pit, a soakage trench may be used if excavating a depth of 1.5 feet is acceptable. A soakage trench consists of a central pit that is 2 feet square and 1 foot deep. The central pit has a trench radiating outward from each side for a distance of 6 or more feet (see figure 4-7). The trenches are 1 foot wide and increase in depth from 1 foot at the central pit to 1.5 feet at the outer end. The central pit and the radiating trenches are filled with gravel or broken rock. Multiple units may be built with their usage alternated on a daily basis. A grease trap (see paragraph 4-4) is used with the soakage trench for kitchen waste. The trench is closed as described in paragraph 4-18. The length of the trench may vary as required based on the volume of wastewater being received (seek technical guidance).

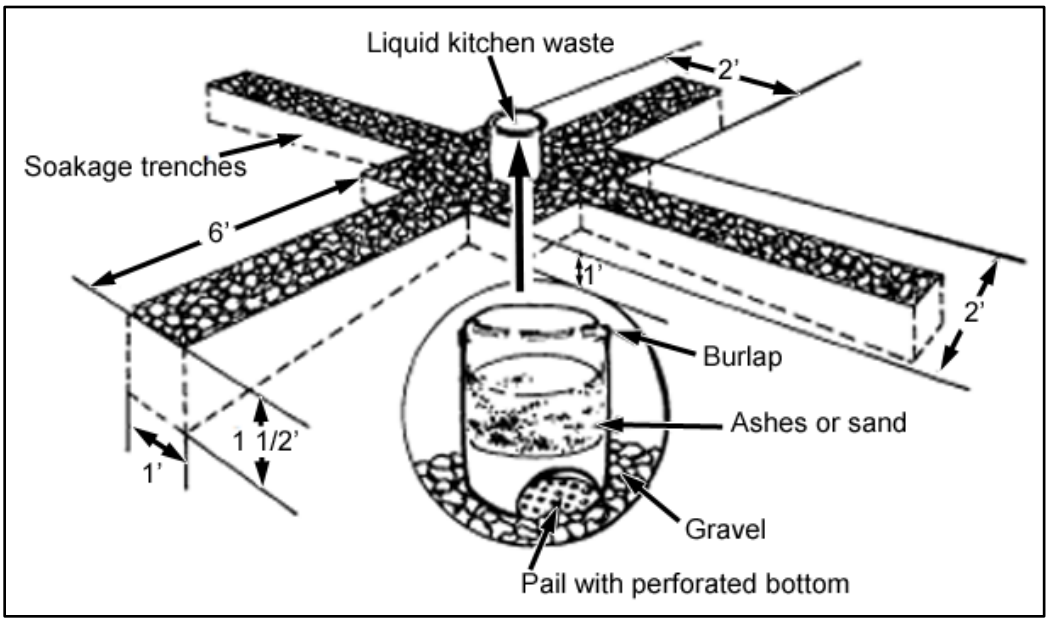


Figure 4-7. Soakage trench with barrel filter grease trap

Soakage Areas

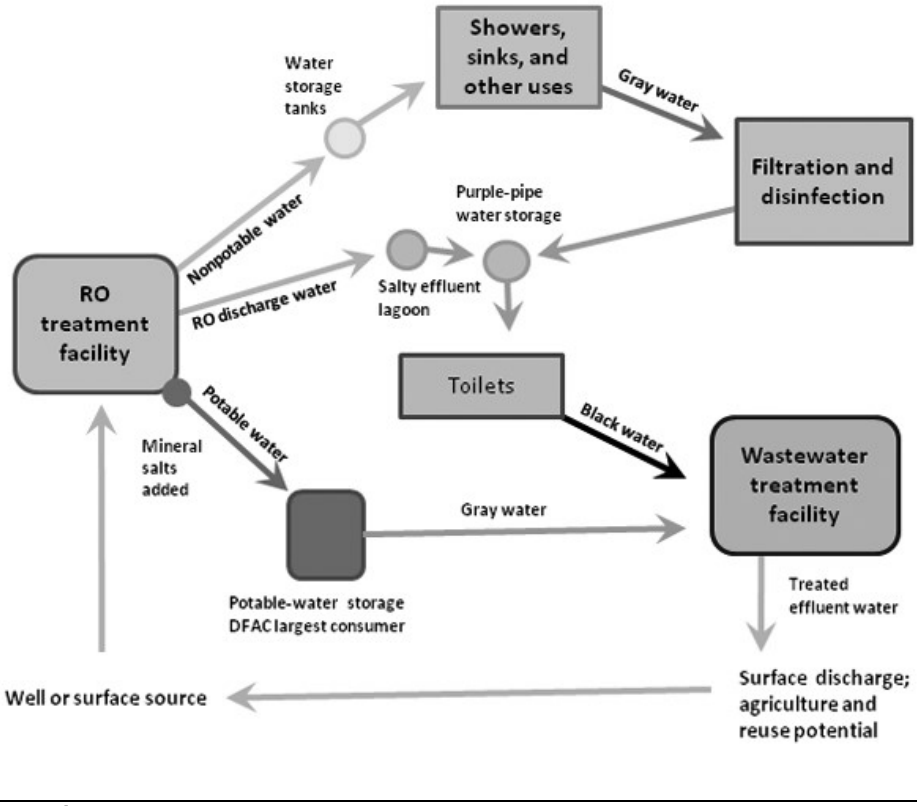
4-26. Outdoor devices, such as hand-washing stations and lister bags, that can cause mud or pools to form on the ground should have a soakage area. Excavate the area underneath and a few inches out from the devices on all sides. Fill the excavated holes with small stones to form a soakage area. Soakage areas receive only incidental drainage; whereas, soakage pits/trenches and evaporation beds are built to dispose of gray water and require sufficient sizing and management.

GRAY WATER TREATMENT SYSTEMS

4-27. Existing wastewater treatment facilities should be used whenever possible. Base camps should be placed near existing facilities that are functioning and have sufficient capacity to take advantage of the situation. Facility engineer assistance will be needed to make required connections and access the system. Pretreatment through grease traps or filters may be required for the dining facility waste stream to remove grease and particulate matter because it could affect the operation of the wastewater pumps. If facilities exist but cannot be connected due to operational considerations, gray water can be temporarily collected in containers (such as expandable pillow tanks or drums) and transferred to an existing facility by military units or contractors when the situation allows. Because the necessary storage containers, wastewater tank trucks, and pumps likely will not be organic equipment in most units, this option requires prior planning and coordination. It is also possible, with coordination and approval from PVNTMED, to treat gray water with a water treatment system, such as a ROWPU, or with filtration and disinfection and reuse it.

4-28. If possible, discharging gray water to a purple pipe recycled water distribution system is a preferred way to manage gray water, save water resources, and bring a camp into a more sustainable posture. A purple pipe system is a water distribution system of recycled, nonpotable water that is treated to levels suitable for reuse. Typically, gray water can be discharged from showers, sinks, and laundry to a standard purple pipe recycled water distribution system for treatment and reuse in toilets, irrigation/agriculture, firefighting, dust control, and vehicle washing. The piping generally used is a shade of purple to ensure that this piping system is never mistakenly interconnected to a potable water distribution system. To protect the population's health, this water must meet certain criteria before it can be reused. The criteria depend on the location and agreements with the HN, and PVNTMED personnel must be consulted and approve the application of the recycled water. In base camp designs, it is possible to have the toilets receive water from the purple pipe recycled water distribution system. Then, water flushed from toilets will be processed into the black water

system and sent through that water treatment process, such as a lagoon system or water treatment facility. Purple pipe water can also be used for washing vehicles and then collected and returned to the purple pipe recycled water distribution system or collected in a separate collection system for the washracks. Wastewater, or brine, that is discharged from a ROWPU during the process of purifying source water may also be added to a purple pipe recycled water distribution system for reuse, but prior approval from PVNTMED is required. Figure 4-11 shows a flow chart of how a purple pipe recycled water distribution system can be designed.



Legend:
DFAC dining facility
RO reverse osmosis

Figure 4-11. Purple pipe recycled water distribution system diagram

GRAY WATER GENERATED FROM WATER TREATMENT SYSTEMS

4-29. Water treatment systems, such as ROWPUs and other water purification equipment, are used to produce potable water for deployed forces, but they also produce gray water that must be managed. The gray water generated from water treatment systems can be further categorized as brine wastewater, filter backwash wastewater, and membrane cleaning wastewater. Each type of wastewater carries different treatment by-products and, therefore, can pose different threats to the environment, ranging from nonhazardous to hazardous. Therefore, water treatment personnel and wastewater managers must coordinate and consider applicable environmental guidelines and requirements for disposal of each waste stream (consult theater command, if needed). To determine management procedures and disposal options for the gray water containing hazardous chemicals, see the chapter on HW.

4-30. Disposal options for the nonhazardous gray water may include discharging to a wastewater treatment plant, brine wastewater lagoon, or soakage pit/trench. Furthermore, it may be possible to connect a brine lagoon to a purple pipe recycled water distribution system, as described in paragraph 4-28. It is important to note, though, that this wastewater should not be discharged directly to an aerobic system (such as an aerobic lagoon) that is being used for black water treatment because it will kill the bacteria the system needs to treat

the black water. Similarly, excess or unused treated water may not be directly discharged into natural water systems for disposal because it contains chemicals, such as chlorine, at concentrations that would upset the ecological balance of the system.

4-31. The amount of wastewater generated from a water treatment system is based on the size of the unit, amount of water being processed, hours of operation per day, weather, and quality of the water source. Table 4-1, for example, provides the brine production guidelines for various ROWPU systems. More information about wastewater production from water treatment systems can be found in ATP 4-44/MCRP 3-40D.14 and TB MED 577. It is imperative, whether dealing with the treatment of water or performing system maintenance, that operators and supervisors are familiar with the SDSs for associated chemicals and that required PPE (hearing protection, face shield, chemical gloves, apron) is worn during the operation and handling of chemicals.

Table 4-1. Brine generation rates of ROWPUs

Source	***Estimated Brine Production (GPH)***
ROWPUs[1] (operated 20 hours/day)	From fresh water/sea water
− LWP (@ intake rate of 300 GPH)	− 90/140
− 600 GPH (@ intake rate of 2,000 GPH)	− 1,100/1,400
− TWPS (@ intake rate of 4200 GPH)	− 1,750/2,050
− 3,000 GPH (@ intake rate of 6,000 GPH)	− 3,000/4,000
Legend:	
GPH	gallons per hour
ROWPUs	reverse osmosis water purification units
LWP	lightweight water purifier
TWPS	tactical water purification system
[1]Reference TB MED 577	

GRAY WATER MANAGEMENT PLAN

4-32. Waste management planners apply the waste management fundamentals described in chapter 1 and the 6-step process introduced in chapter 2 to develop a gray water management plan. The following steps describe considerations during planning.

STEP 1. ANALYZE THE SITUATION

4-33. As discussed in chapter 2, waste management planners use the mission variables to frame their assessment of the gray water situation. Table 4-2, page 4-14, provides some examples of considerations related to gray water management.

4-34. Information management is critical to this step. Information is gathered through intelligence, surveillance, and reconnaissance collection (including environmental reconnaissance and infrastructure surveys) and through the submission of RFIs to lower, adjacent, and higher units. For example, a site survey such as an EBS or ESCS is used to collect information. Starting with mission analysis and continuing throughout the MDMP, waste management planners analyze each mission variable and develop a full list of considerations that could positively or negatively impact operations and influence gray water management.

Table 4-2. Gray water considerations in relation to mission variables

Mission Variables	*Considerations*
Mission	• Identification of all operations and activities that will generate gray water • Where and when gray water generation takes place • Number of personnel generating gray water • Duration at a given location and consideration of viable management options • Limitations or mandatory actions/orders that could impact gray water management
Enemy	• Threats while transporting gray water • Potential to contaminate water resources with gray water • Limited local and nonlocal waste contractors' access to the base camp
Terrain and Weather	• Land availability for gray water systems and terrain/land cover obstacles to construction • Precipitation and surface drainage into gray water systems increases waste volume • Soil composition (soil type) and its drainage characteristics impact application rates • Positioning gray water systems downwind and downstream/downslope • Obstacles (such as snow and mountains) and opportunities (warm weather and dry air) • Temperature impacts on absorption and evaporation (heat increases, cold decreases) • High humidity and cloud cover hinders evaporation of gray water • Prolonged cold or arctic conditions are not conducive to absorption and evaporation
Troops and Support Available	• Knowledge and expertise in gray water management planning and systems ▪ Availability of specialized engineer units or contractors (local and nonlocal) ▪ Availability of a medical detachment, PVNTMED, and other EAB support ▪ USACE and APHC support or assistance teams • Equipment and materials to construct, operate, and maintain gray water systems • Availability of funds and contracting mechanisms (including local purchase) • Population stability and predictability
Time	• Timeline of events to meet goals and objectives ▪ Development of a gray water management plan, including contingency planning ▪ Acquisition of supplies, services (contractors), equipment, and materials ▪ Arrival of troops, support, and equipment ▪ Connections and construction of gray water management system(s) ▪ Operation and maintenance of system(s) ▪ Closure and documentation of all gray water systems • Roles and responsibilities, from point of generation through proper disposal and closure • Life span of gray water systems (immediate, basic, expanded, or enhanced)
Civil Considerations	• Potential impacts to environmentally sensitive or protected areas ▪ Historical, religious, and cultural sites ▪ Threatened and endangered species and their habitats • Applicable construction standards, agreements, and policies and guidelines • Treatment and reuse reduces water demand (for local livestock/agriculture, construction, and other approved applications) • Potential to contaminate drinking water resources and local communities with gray water • Existing infrastructure and transportation network for gray water management
Legend: APHC — United States Army Public Health Center EAB — echelons above brigade PVNTMED — preventive medicine USACE — United States Army Corps of Engineers	

4-35. Waste management planners share their knowledge during the planning process to help in determining the most suitable locations for field services (specifically food service, laundry, and showers) and other activities (such as washracks) that generate gray water. Throughout the operations process, waste management and base camp planners continue to work closely with logistics planners to ensure that the gray water management plan remains supportive of the sustainment plan as adjustments are made to both.

STEP 2. DEVELOP PRELIMINARY ESTIMATES

4-36. Step 2 is completed together with step 3, categorize waste requirements (below). During this step, waste management planners develop preliminary gray water estimates for each subordinate unit (one level down) and for each maneuver COA being developed. The sources of gray water should have been identified during mission analysis, including dining facilities, laundries, showers, water purification equipment, hand-washing devices, and washracks. Using a matrix, such as the sample work sheet shown in table 4-3, page 4-16, waste management planners perform this step by adding any quantifying information, such as the number of personnel and the expected duration in a particular location or during a particular operational phase. Planners then apply the appropriate generation rate (in gallons per day, per person) to determine how much gray water will be generated by the unit (in gallons per day and over the total expected duration). Table 4-3 lists a gray water generation rate of one gallon per day, per person, during the immediate phase. This generation rate is primarily based on meal preparation and the unit mobile kitchen, if available. Otherwise, the unit will be eating field rations and washing their hands with wet wipes. In this scenario, the gray water generated will probably be negligible and determined by the mission and unit capabilities. If the unit is on the move, there is little likelihood that personnel will be taking showers, doing laundry, or washing vehicles.

4-37. ATP 3-37.10/MCRP 3-40D.13, appendix E, provides generation rates that can be used as general guidelines and planning factors. If other factors are known (for example, rationing of showers or laundry), planners can create more accurate generation rates. If known, they can consider the amount of water that will actually be supplied to sources of gray water. Roughly 80 percent of all water used for purposes other than human consumption ends up as wastewater, generally gray water. Most gray water is generated from the laundries, showers, and dining facilities. These correlations allow waste management planners to have a general understanding of where and how much gray water will be generated.

4-38. Planners should consider, when feasible, treating and recycling gray water to achieve a more sustainable posture. It is feasible that disinfected or filtered gray water could be collected and then reused for vehicle washing if PVNTMED approves. Washrack activities can also provide a settling basin where gravity clarified water can be reused. See paragraph 4-28 for more information about recycling gray water.

4-39. With Force Provider operations (ATP 4-45), modules include shower, laundry, latrine, and food service systems that produce wastewater. Four 150-person modules, collocated, can generate 20,000 gallons per day of gray water. The modules have gray water collection systems that can each store 40,000 gallons. Gray water disposal must be managed using existing treatment facilities or field methods, as described herein and in accordance with base camp policies and HN laws and regulations. To reduce the amount of gray water produced in a module, an add-on kit called a Shower Water Reuse System is available that processes and recycles 75 percent of the discarded shower water.

Table 4-3. Sample gray water requirements work sheet

Subordinate Unit	Immediate						Expanded					
	Number of Personnel	Generation Rate (GPD/person)	Unit Generation Rate (GPD)	Duration (days)	Unit Generation Total (gallons)	Required Resources and Solutions	Number of Personnel	Generation Rate (GPD/person)	Unit Generation Rate (GPD)	Duration (days)	Unit Generation Total (gallons)	Required Resources and Solutions
Battalion	700	1.0	700	3	2100	Grease trap (before discharging downstream)	700	24	16,800	180	3,024,000	Connections to existing wastewater treatment plant
Company	100	1.0	100	3	300	Excavation equipment (for soakage pit) and grease trap	100	24	2,400	180	432,000	OWS, collection containers (for reuse), and excavation equipment (for multiple soakage pits)

Notes.

1. This work sheet may be extended to incorporate all subordinate units and phases of an operation.
2. For the basic and enhanced categories, the generation rates of 16 and 40 GPD/person, respectively, can be used. See ATP 3-37.10/MCRP 3-40D.13 for more information on base camp utilities planning factors.

Legend:

GPD	gallons per day
OWS	oil-water separator

STEP 3. CATEGORIZE WASTE REQUIREMENTS

4-40. As described in chapter 2, the waste requirements, based on expected durations, are categorized as immediate, basic, expanded, enhanced, or transfer/closure. The categorization of waste requirements is included in the gray water requirements work sheet (see table 4-3) and helps with organization and planning. The work sheet should be extended, as needed, to cover all phases of the operation. In table 4-3, for example, the work sheet was extended to include gray water rough estimates for an expanded base camp using a planning factor of 24 gallons per person, per day (see ATP 3-37.10/MCRP 3-40D.13).

STEP 4. EVALUATE WASTE MANAGEMENT CAPABILITIES

4-41. Waste management planners evaluate the existing and available capabilities and resources (manpower, equipment, materials, and funding) according to the proposed task organization for each COA being developed. The results of this evaluation will drive the generation of capability-based solutions and required resources in step 5.

STEP 5. GENERATE SOLUTIONS

4-42. Waste management planners first generate options that take advantage of existing wastewater treatment facilities within the HN or within existing base camps. When existing facilities or contractor support are not available, waste management planners generate capability-based solutions (such as soakage pits, trenches, and evaporation beds that are described beginning in paragraph 4-9) to meet the gray water requirements. They also consider ways that gray water can be recycled and reused to reduce the amount of gray water requiring disposal and to reduce water demand. For example, gray water from showers, sinks, and laundries can be collected in aboveground storage bladders, treated with a water purification unit, disinfected, and

reused for toilets, laundry, vehicle washing, firefighting, dust suppression, and construction activities. Solutions must be feasible (based on the availability of resources, subordinate unit capabilities, and soil conditions) and suitable for the operational environment. In addition, solutions include considerations for collection, storage, transportation, construction, connections, and any other system components necessary for achieving effective gray water management. In the gray water requirements work sheet (see table 4-3), solutions and the corresponding required resources are placed in the appropriate column under each category (immediate, basic, expanded, enhanced, or transfer/closure). The information placed within the work sheet should be as detailed as necessary to facilitate planning (only limited information was put in table 4-3 to conserve space). The work sheet is continually refined as planning progresses and new information becomes available.

4-43. Waste management planners must not constrain brainstorming or the generation of options based solely on capabilities currently available. They consider options that leverage emerging commercial technologies and best practices and incorporate those initiatives within future planning, to include base camp master planning.

STEP 6. INTEGRATE WASTE MANAGEMENT TASKS INTO PLANS AND ORDERS

4-44. Once a COA is approved by the commander, waste management planners finalize the gray water management plan that supports that COA. Waste management planners coordinate and synchronize the supporting waste management tasks with other staff members and higher headquarters as necessary. The waste management tasks are then incorporated into plans and orders as described in chapter 2. Waste management tasks should be included in logistics rehearsals and mission briefs to ensure that the plans are feasible and supported by higher headquarters.

BLACK WATER MANAGEMENT SYSTEM

4-45. Black water refers to wastewater that potentially contains pathogens (disease-causing organisms, such as bacteria, viruses, and parasites). The primary source of black water is toilet wastewater, but another source can be kitchen wastewater containing food wastes. The effective treatment and disposal of black water (to include the waste generated by service animals such as military working dogs) must be accomplished to prevent disease and to ensure that an area does not become infested with insects or rodents that can spread disease. Effectively managing black water begins by understanding the requirements early in the planning phase. The material contained in this section is meant to provide waste management planners an overview of treatment and disposal options. A black water management plan is then developed using the 6-step process described in chapter 2.

GENERAL CONSIDERATIONS

4-46. Some general considerations for creating a black water management system are included below.

Location

4-47. Surface drainage is an important consideration when planning and laying out a site, and construction should allow for proper drainage of the site without negatively impacting the surrounding populations or communities. In addition, consider ground elevation relationships, and design the site to prevent contamination of personnel, facilities, food, and water. Figure 4-12, page 4-18, provides a guideline for ground elevation relationships at a contingency location.

4-48. Latrines should be located at least 100 meters (~300 feet) downwind, based on prevailing winds, and down gradient from food service facilities and at least 30 meters (~100 feet) from the nearest water source. Latrines are usually built at least 30 meters downwind from unit billeting and work areas, too, with equal access to its intended users. Chemical and containerized latrines, as well as holding tanks, must be placed so that service vehicles can access them for regular waste removal and cleaning. Latrines shall be located and constructed as to not contaminate the groundwater or a water source. The groundwater table can be determined from geospatial data sources, from local inhabitants, or by excavating until water is reached.

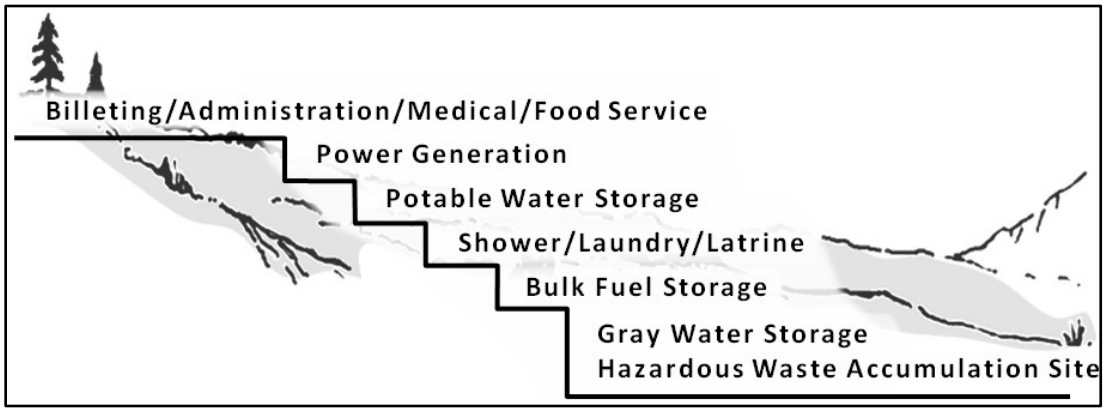


Figure 4-12. Ground elevation relationship

4-49. Latrines should be lighted at night if the tactical situation permits or staked off with rope or tape to serve as a guide. Place a canvas or brush screen around each latrine or enclose it in a tent. If possible, heat the shelter in cold climates. A drainage ditch should be constructed, if needed, to keep surface drainage out of latrines or to contain the wastewater in the event of an overflow or release.

Hand-Washing Devices

4-50. A simple hand-washing device should be installed at each latrine (ATP 4-25.12). Place the device on top of a soakage area to prevent the area from becoming muddy. The device should be easy to operate and have a constant supply of water. The importance of hand-washing devices must be emphasized and enforced throughout the unit. Hands contaminated with fecal matter can transmit disease.

Maintenance

4-51. Latrines should be cleaned daily using disinfectant or soap and water. Specific units or individuals should be assigned the responsibility of ensuring latrines are properly maintained and that adequate cleaning supplies are kept on hand. The unit field sanitation team should be notified about pest issues. They are trained to use pesticides and employ procedures in accordance with ATP 4-25.12. Before closing or transferring a base camp, proper closure actions are required (see paragraph 4-82).

FIELD LATRINES

4-52. During short halts when units are on the move, personnel should use a commercially available disposable human waste bag or dig a cat-hole latrine. During the initial stages of a base camp, until more long-term facilities are established, units must use field-expedient methods to ensure proper sanitation. Field latrines typically include straddle trench latrines, deep pit latrines, or bored-hole latrines. However, if unable to dig or if the water table is too high, options include burn-out latrines, mound latrines, and pail latrines. For males, provide urine disposal facilities (see paragraph 4-8) in addition to field latrines.

Cat-Hole Latrine

4-53. The simplest field-expedient human waste disposal method is the cat-hole latrine (see figure 4-13). This latrine is used by individuals who are on the move or stationary for 1 to 3 days with no established facilities available. A cat-hole latrine should be dug at least 1 foot square and 1 foot deep. After use, the removed dirt is replaced and packed down.

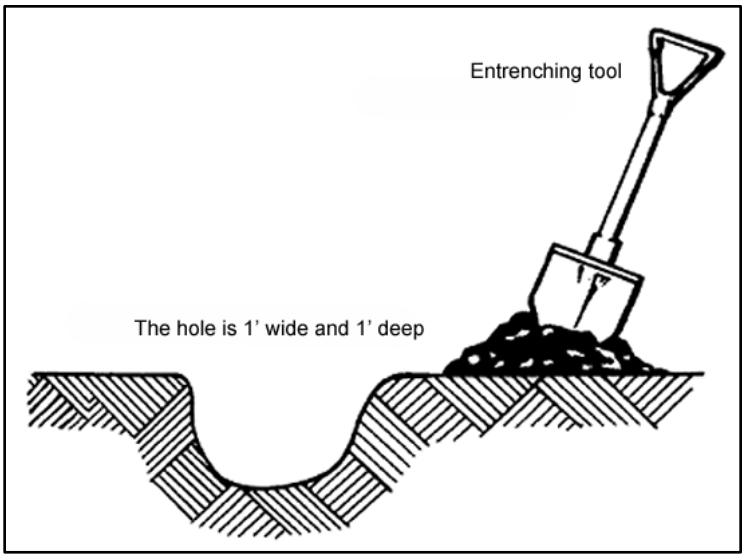


Figure 4-13. Cat-hole latrine

Straddle Trench Latrine

4-54. The most common type of latrine for units that are stationary for 1 to 3 days is the straddle trench (or, slit trench) latrine shown in figure 4-14. The trench is dug 1 foot wide, 2 1/2 feet deep, and 4 feet long. One trench will accommodate two persons at the same time. Trenches are constructed parallel to one another and at least 2 feet apart. The removed dirt is piled at the end of the trench, and a shovel or paddle is provided so that individuals can promptly cover their excreta and toilet paper. Since there are no seats on this type of latrine, boards may be placed along both sides of the trench to provide better footing. Toilet paper should be placed on suitable holders and protected from inclement weather by a tin can or other covering. The straddle trench latrine is closed using the method described in paragraph 4-82.

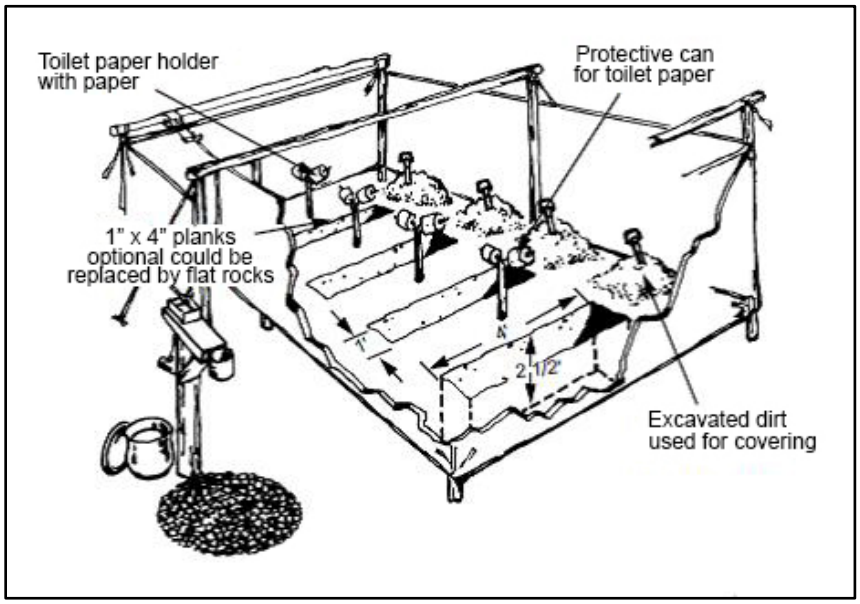


Figure 4-14. Straddle trench latrine

Deep Pit Latrine

4-55. To sustain basic latrine operations for a few weeks, the deep pit latrine (see figure 4-15) can be used with a standard four-seat latrine box that is issued to, or built by, the unit. The latrine box can be assembled in the field and installed over an excavation. The four-seat box is 8 feet long, 2 1/2 feet wide at the base, and 18 inches high. The pit is dug 2 feet wide and 7 1/2 feet long, which allows 3 inches of ground surface to support the box on all sides. The depth of the pit depends on the estimated life span of the latrine's use at that location. As a guide, a depth of 1 foot is allowed for each week of estimated use by 50 personnel, plus 1 foot of depth for dirt cover when the latrine is closed. Consequently, one deep pit latrine that is 6 feet deep may last approximately five weeks before it must be closed, but it also depends on the number of personnel using it. Rock or high groundwater levels may limit the depth of the pit, but it should be no more than 6 feet deep to reduce the risk of the walls collapsing. Support may also be needed in some types of soil, in which case planking or other similar material should be used. Pack the dirt tightly around the bottom edges of the box to seal any openings through which flies could enter. Maintain a good fly control program to prevent flies from breeding and to reduce odors. Cover the holes with flyproof lids, and flyproof cracks with strips of wood or tin. The box and latrine seats should also be scrubbed daily with soap and water. Applying lime to the pit contents or burning it does not effectively control flies or odor. This latrine can be used until it is filled to within 1 foot of the top, and then it must be properly closed.

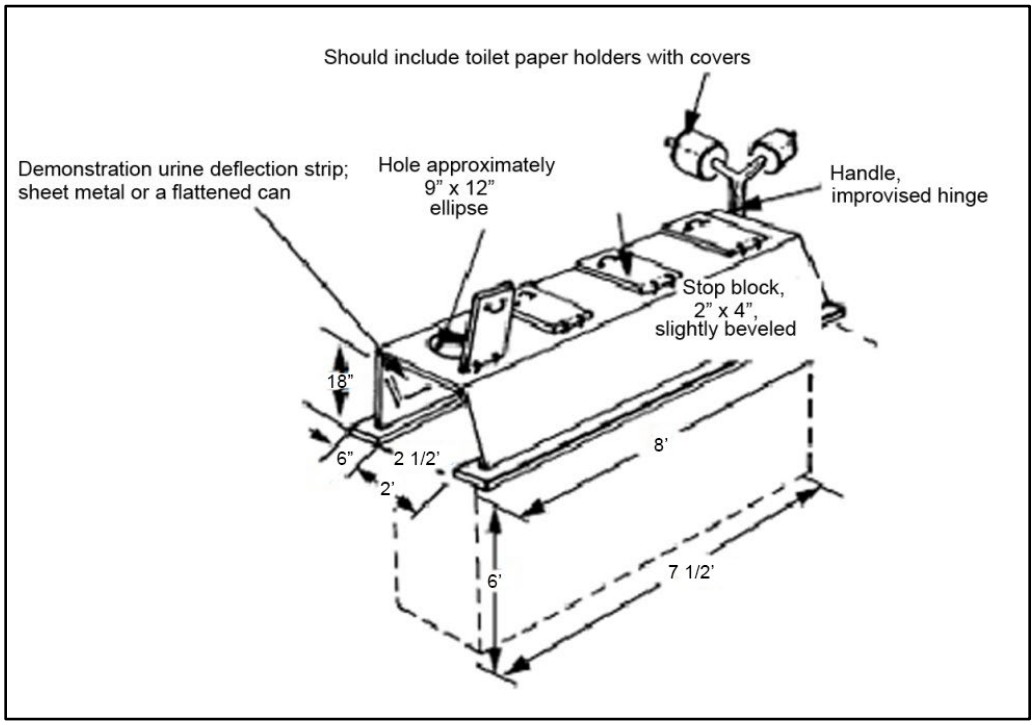


Figure 4-15. Deep pit latrine

Bored-Hole Latrine

4-56. A bored-hole latrine (see figure 4-16) consists of a hole that is about 18 inches in diameter and 15 to 20 feet deep. It can be quickly dug with engineer equipment that have an auger attachment. The actual diameter of the hole is not critical and should be based on the largest size auger available. The hole is covered by a one-hole latrine box, using a metal drum with both ends removed that is sunk into the ground. Use a flyproof seat cover and lid that fit the top of the drum. If a drum is not available, construct a flyproof, wooden box that is 18 inches high. This latrine can be used until it is filled to within 1 foot of the top, and then it must be properly closed. The length of time this latrine will be used before closing depends on the number of personnel using it.

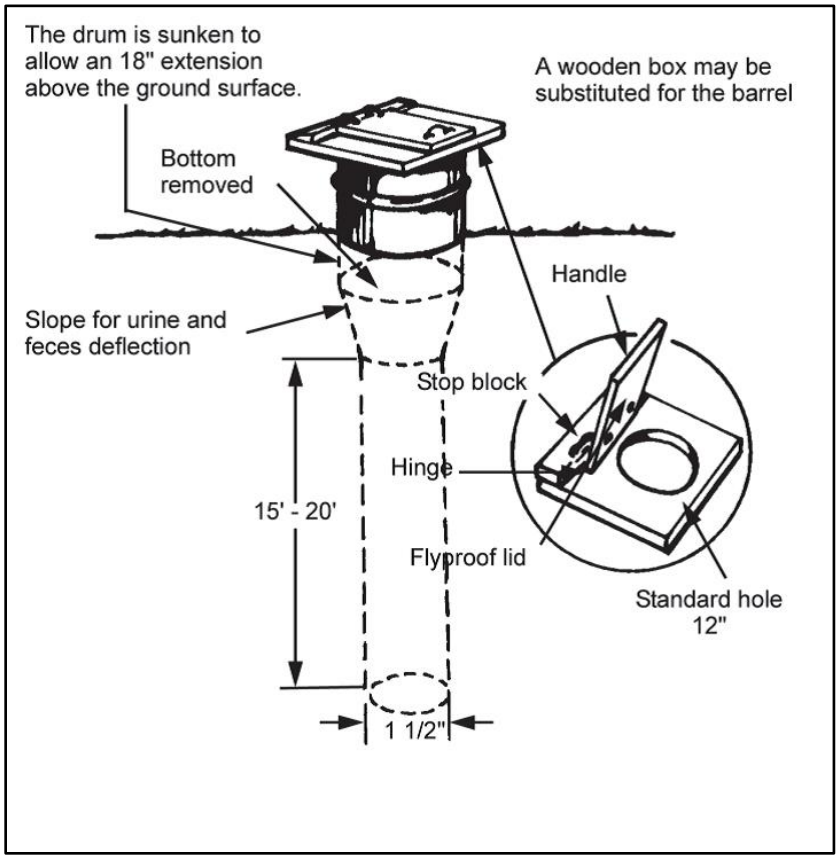


Figure 4-16. Bored-hole latrine

Field Latrines Where Digging Cannot Be Achieved

4-57. In locations where digging a pit, trench, or hole for a latrine cannot be achieved, the following types of field-expedient latrines can be used. Conditions that may prevent or limit digging include a high groundwater table or hard, rocky, or frozen ground. It is important to protect the groundwater and prevent contamination, therefore the level of the groundwater table (including seasonal levels) may limit or prevent digging if there is a possibility of contaminating it with wastewater.

Burn-out Latrine

4-58. A basic burn-out latrine (see figure 4-17, page 4-22) can be constructed by placing a 55-gallon drum in the ground while leaving enough of the drum aboveground for a comfortable sitting height (for example, 18 inches). The drum may be cut in half, making two latrines of less capacity. Place a flyproof wooden seat with a flyproof, self-closing lid on top of the drum. Weld handles to the sides of the drum, allowing two persons to carry the drum with ease, because it must be moved before the contents are burned out. Based on the expected duration of latrine use and the availability of construction materials and engineer capabilities, burn-out latrines can be constructed with enclosures (see figure 4-18, page 4-22). Design details for a burn-out latrine are available in the Joint Construction Management System.

4-59. Have two sets of drums, if possible, so that one set can be used while the other set is being burned out. Direct male personnel to urinate into a separate urine disposal facility (see paragraph 4-21) rather than a burn-out latrine because more fuel is required for waste with a higher liquid content.

4-60. Personnel, wearing appropriate PPE, must burn-out the contents of the latrine daily by adding sufficient fuel to incinerate the contents completely. Highly volatile fuel, such as gasoline, should not be used alone because of its explosive nature, and unserviceable fuel should be used before serviceable vehicle fuel.

A mixture of 1 quart of gasoline to 4 quarts of jet propulsion fuel grade 8 (JP-8) or diesel fuel is effective but must be used with caution. Burn the contents again if they are not rendered dry and odorless in one burning. Any remaining ash should be buried.

Note. As a safety measure, drums should be filled with water before cutting them to prevent igniting any residual fumes, which could result in an explosion. Also, the burning location must be downwind of the base camp.

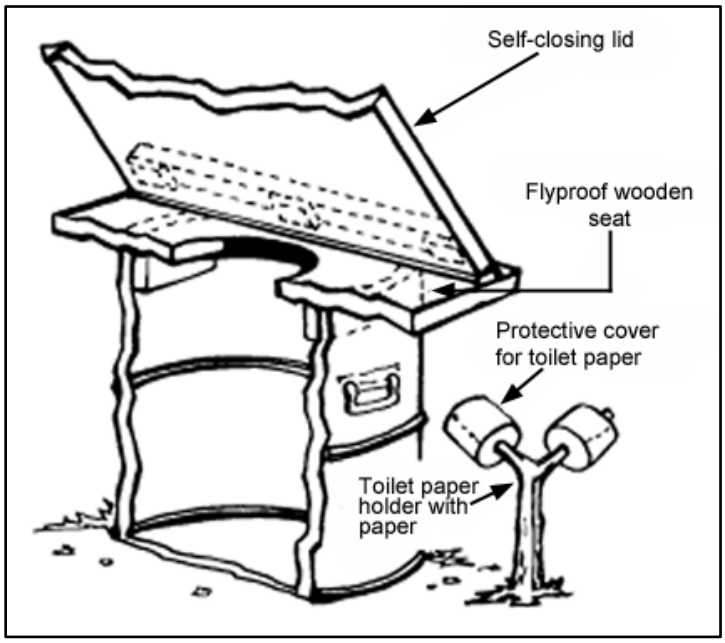


Figure 4-17. Burn-out latrine

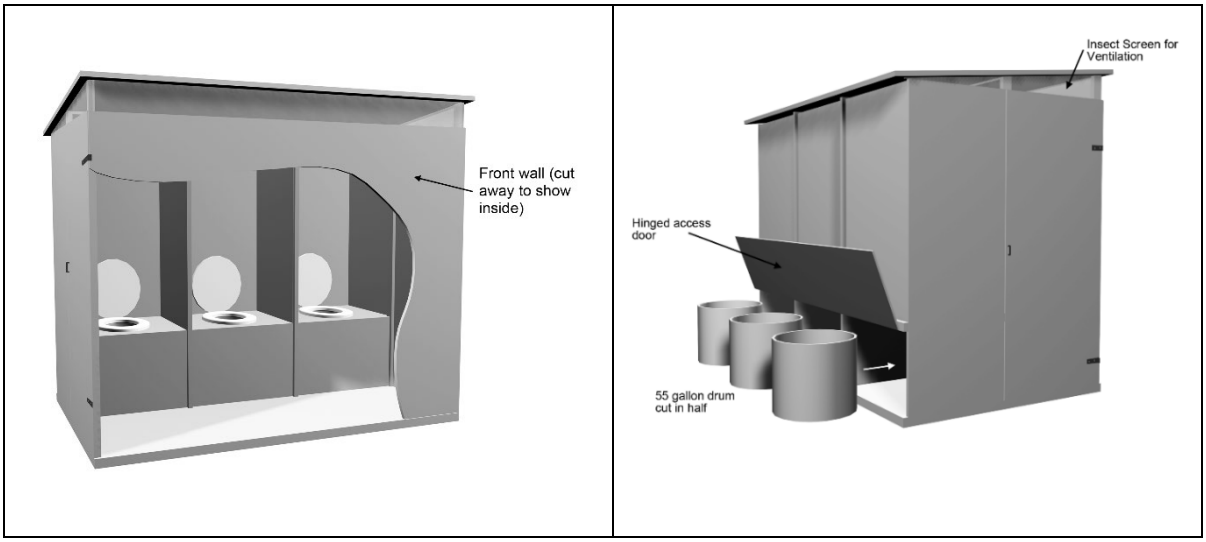


Figure 4-18. Enclosed burn-out latrine

Mound Latrine

4-61. A mound latrine is similar to a deep pit latrine (see paragraph 4-54), except the pit is built in a mound above the surface of the ground. A dirt mound makes it possible to build a pit without extending into the

groundwater or rock. A mound of dirt is constructed that is at least 6 feet wide and 12 feet long on top and supports a four-seat latrine box. The mound must be high enough to meet the pit depth requirement while allowing a 1-foot buffer between the base of the pit and the groundwater table or rock level. Scarify or plow the area where the mound latrine is to be placed to aid in the seepage of liquids from the pit. If timber is available, build a crib of the desired height to enclose the pit and support the latrine box. Build the mound by compacting each successive l-foot layer up to the top of the crib (as shown in figure 4-19). Roughen the surface of each layer (by raking) before adding the next. If timber for a crib is unavailable, construct the mound to the desired height in l-foot layers as described, and dig the pit into the mound. It may be necessary to brace the walls with wood, sandbags, or other material to prevent them from collapsing. Enclose and flyproof a mound latrine the same as a deep pit latrine. The size of the mound base depends on the characteristics of the soil being used. The base can be expanded and/or steps can be provided to counter a steep slope. The mound latrine is closed as described in paragraph 4-82.

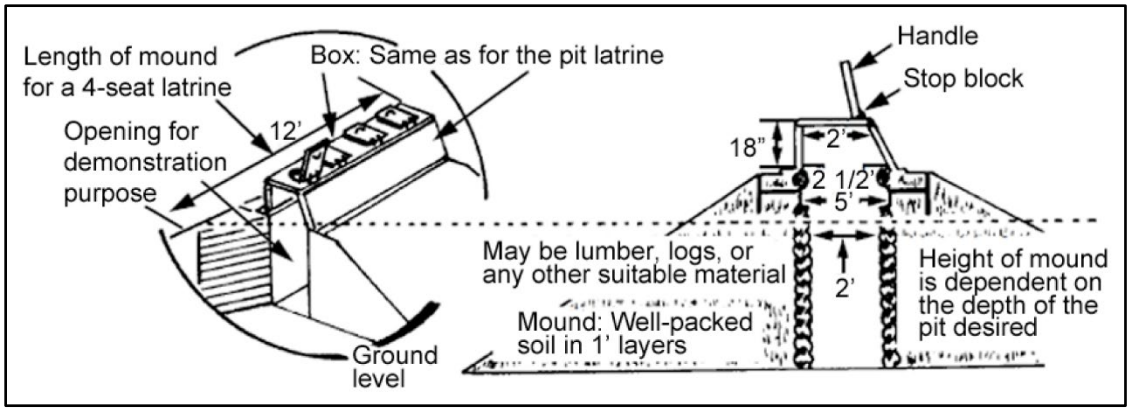


Figure 4-19. Mound latrine

Pail Latrine

4-62. A pail latrine (see figure 4-20, page 4-24) is constructed using a four-seat latrine box that is modified by placing hinged doors on the rear of the box, adding a floor, and placing a pail under each seat. If the box is located in a building or tent, it should be positioned to form part of an outer wall so that the rear door of the box can be opened from outside the building/tent. The box should be flyproof, and the seats and rear doors should be self-closing. The floor of the box should be made with an impervious material (concrete, if possible) and should slope toward the rear enough to facilitate the rapid drainage of washing water. Plastic bag liners may be used in the pails. Once filled, the bags are tied at the top before disposal. If available, use and reuse plastic transport barrels to haul bags, and clean and sanitize the barrels between each use. The waste can be burned or hauled to a suitable area for proper burial or other means of proper disposal. Pails should be cleaned at least daily. In addition, separate urine disposal facilities should be installed with male latrines. If the latrine is located inside a building, a urine disposal device can be installed with a drainpipe leading outside to a urine soakage pit or other disposal mechanism (see paragraph 4-21).

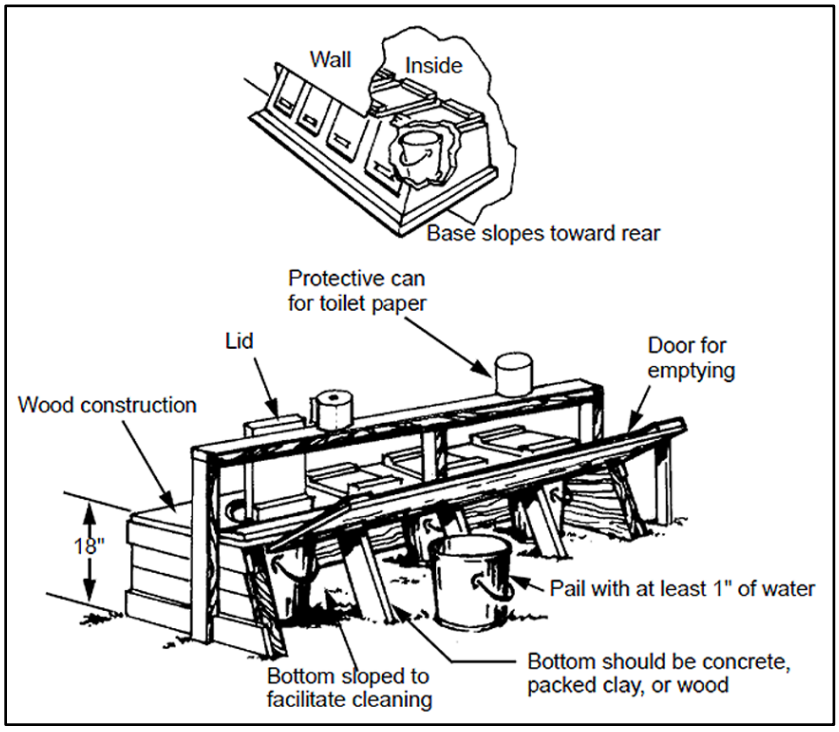


Figure 4-20. Pail latrine

BLACK WATER TREATMENT SYSTEMS

4-63. Waste management at expanded or enhanced locations, like a base camp, likely requires more enduring facilities, such as a black water treatment system. Specialized engineer or contractor support is required, as well as prior planning and coordination. For example, items such as wastewater storage containers, pumps, and tank trucks are not standard equipment, and facilities generating greasy or oily wastewater, such as dining facilities and motor pools, require grease traps and oil-water separators. Base camps will likely employ one or more of the following treatment options for black water:

- Engineered connection to an existing sanitary sewer/treatment facility.
- Engineer/contractor support with collection, storage, and transport to a sanitary sewer or treatment facility; Force Provider configurations (see ATP 4-45); or packaged wastewater treatment plants.
- Engineered construction of a wastewater treatment system, such as a sewage lagoon or septic system.

4-64. If the camp is not connected to an existing system, black water can be collected and stored using chemical toilets or holding tanks until connections are made or until transported to an existing treatment facility. Chemicals from chemical toilets can interfere with treatment systems, especially if overwhelmed with formaldehyde, bleach, or similar chemicals; therefore, prior planning must include making certain that a treatment facility will accept such waste. Chemical latrines are preferable human waste disposal devices in the field when the necessary services (primarily contractors) to sustain them are available and when suitable for the situation. Chemical latrines should be cleaned daily. The contents must be pumped out for disposal in an appropriate sewage system, and the frequency for emptying is based on usage. Waste management planners must ensure that chemical latrine contracts stipulate all necessary requirements and are inspected for compliance. This includes verifying that the contractor (to include subcontractors) is properly disposing of the contents in a manner that protects human health and the environment. This typically entails initially verifying the means are available and periodically verifying the correct actions are taken.

4-65. Force Provider modules have containerized latrines that use 3,000-gallon tanks to simply collect and store black water. Four 150-person modules, collocated, can generate 3,000 gallons of black water each day.

Engineer/contractor support is still required to transport the wastewater for disposal and treatment. Each module comes with an evacuation tank/trailer unit for transporting black water. Note that Force Provider is an Army base camp life support system containing multiple components. It requires specialized training to operate and maintain, and it will not be transferred to the HN. It is intended to sustain deployments of 45 days to 2 years.

4-66. Package wastewater plants, which are considered small treatment systems, are not typically desirable with wastewater flows greater than 0.5 million gallons per day (0.022 m^3/s). They may be an option for more sustainable base camps if specialized engineer/contractor support is available to install, maintain, and operate the system. A civil engineer must determine performance requirements that will meet the needs of the users and determine if package plants are a viable option. According to UFC 3-240-02, packaged treatment plants combine processes such as aeration, settling, and solids treatment in a single multi-compartment tank. Typical types include extended aeration (activated sludge), complete mix (activated sludge), step aeration (activated sludge), contact stabilization (activated sludge), biofiltration, rotating biological contactors, and sequencing batch reactors. Package plants, while typically modular, scalable, and deployable wastewater treatment systems, are complex systems that will not normally be transferred to the HN.

4-67. The two primary types of constructed treatment methods commonly used during contingency operations are sewage lagoons and septic systems. Both of these systems may be transferred to the HN and are described in more detail in the following paragraphs.

Sewage Lagoons

4-68. Sewage lagoons are engineered earthen basins (ponds) used to treat black water. Lagoons naturally contain bacteria from the soil and wastewater that digest/breakdown organic matter, and over time pathogens die off. Typically, this method of black water treatment is capable of meeting discharge criteria, except in cold regions. If construction and management assistance is not readily available, it is available through higher headquarters or reachback to USACE/NAVFAC. Lagoon construction requires civil engineering expertise because lagoons are affected by physical, chemical, and biological aspects inside and outside the system, they require a significant land area that must be calculated, they require planning for equipment and material considerations, and they can produce very foul odors if poorly constructed or managed. In addition, absorption from sewage lagoons into the surrounding soil must be minimized through compaction and/or the use of a clay or membrane liner. Lagoons should be located downwind at least half of a mile from any populated area so that discharges will not have a negative impact on the environment or populations. The resulting increased length of the sewer system, compounded by the possible need for automatic lift stations, can significantly increase the material cost and construction effort required for a complete system. Some base camps may have pumper trucks to collect sewage from latrines and dump the sewage into the lagoon, as opposed to using piping and lift stations.

4-69. Diverting gray water from the black water system will significantly decrease the amount of black water requiring treatment in a sewage lagoon (see paragraphs 4-2 through 4-31 about gray water management systems). In addition, lagoon designs may include constructing parallel basins (multiple basins receiving wastewater at the same stage of treatment) or constructing a series of basins (with wastewater flowing through two to three consecutive basins), or both. A sand filter area or a wetland zone can be incorporated at the effluent end to provide further particulate filtering, if needed. Instead of simply discharging, the naturally treated effluent water generated from this process can be reclaimed for agriculture or other uses, if approved by PVNTMED personnel.

4-70. Sewage lagoons are suitable technology to be turned over to most HNs. Once established, lagoons are fairly easy to maintain with minimal equipment or trained operators. More sophisticated technology, while perhaps more efficient, has a greater risk of failing without trained operators and regular maintenance.

Septic System With Drain Field

4-71. A septic system with drain field (also known as a leach field) is another option for black water treatment and disposal. Like sewage lagoons, designing a septic system requires civil engineering expertise

and should only be conducted by a licensed, experienced engineer who is familiar with the various alternative systems and components that may be available.

4-72. A septic tank (see Figure 4-21) separates and retains most solids from the sewage flow. The solids settle to the bottom of the tank and undergo anaerobic digestion (primary treatment) while the liquid (effluent) passes through the tank to the drain field to undergo aerobic digestion in the soil. The preferred tank is a precast concrete or fiberglass septic tank that is sized for the anticipated volume of black water, or a concrete one may be constructed in place. Septic tanks must be emptied every 3 to 5 years, or sooner if more than 1 foot of solids/sludge accumulates at the bottom (see paragraphs 3-13 through 3-20 for composting methods).

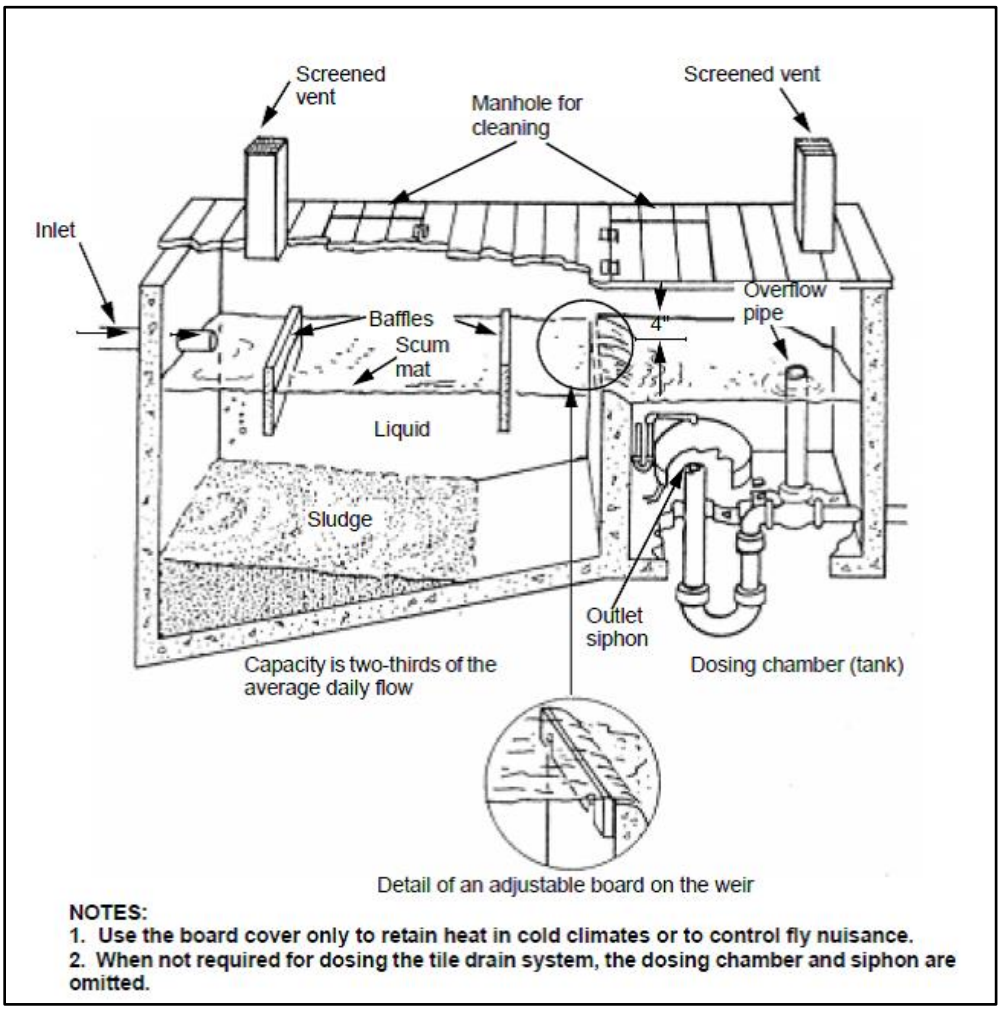


Figure 4-21. Septic tank

4-73. The effluent from the septic tank is dispersed into nearby soil (drain field/leach field) through buried, perforated pipes (lateral lines). Prior to use, the drain field is constructed by digging trenches and burying the perforated pipe system. As with lagoons, a drain field requires a significant amount of land. Although it does not completely remove the land area from use, it does limit traffic to only personnel or vehicles that will not crush or damage the buried pipe system. The following conditions are important if constructing a drain field:

- The topography must accommodate installing the piping at the appropriate slope for drainage.
- The groundwater table must be well below the level of the drain field.
- The soil in the absorption field must be able to absorb the volume of black water being generated.
- There must be at least 300 feet between the drain field and any existing source of drinking water, and the risks of contaminating that water source (particularly shallow or driven wells in the vicinity) are negligible.

4-74. A septic system may require a pump if wastewater must be discharged to the drain field at a particular rate required to meet treatment needs and optimize system effectiveness. A pump discharges a dose, or prescribed amount, of effluent from the septic tank to the drain field at a given time. The drain field becomes saturated, but then it is allowed time to drain and rest before becoming saturated again by the next dose.

BLACK WATER MANAGEMENT PLAN

4-75. Waste management planners apply the waste management fundamentals described in chapter 1 and the 6-step process introduced in chapter 2 to develop a black water management plan. The following steps describe considerations during planning.

STEP 1. ANALYZE THE SITUATION

4-76. As discussed in chapter 2, waste management planners use the mission variables to frame their assessment of the black water situation. Table 4-4 provides some examples of considerations related to black water management.

4-77. Information management is critical to this step. Information is gathered through intelligence, surveillance, and reconnaissance collection (including environmental reconnaissance and infrastructure surveys) and through the submission of RFIs to lower, adjacent, and higher units. For example, a site survey such as an EBS or ESCS is used to collect information. Starting with mission analysis and continuing throughout the MDMP, waste management planners analyze each mission variable and develop a full list of considerations that could positively or negatively impact operations and influence black water management.

4-78. Knowing where forces will be positioned allows waste management planners to focus their analysis on determining the availability of existing toilet and treatment facilities in those areas or in determining the most suitable locations for contracted activities or construction. In addition, waste management planners must determine the impacts from burning and/or burying human waste in those areas. Throughout the planning and operations processes, it is important to ensure the black water management plan remains supportive of the sustainment plan.

Table 4-4. Black water considerations in relation to mission variables

Mission Variables	***Considerations***
Mission	• Locations of latrines and DFACs (black water generators) • Males and females have different latrine requirements • Duration at a given location and consideration of viable management options • Limitations or mandatory actions/orders that could impact black water management
Enemy	• Threats while transporting black water • Potential to contaminate water resources or cause health concerns with black water • Limited local and nonlocal waste contractors' access to the base camp • Contingency plans based on threat levels
Terrain and Weather	• Land availability for black water systems and terrain/land cover obstacles to construction • Prevent rain and surface drainage into black water systems (increases waste volume) • Soil composition and drainage characteristics impact digging and application rates • Positioning black water systems downwind and downstream/downslope • Obstacles (for example, snow and shallow groundwater) and opportunities (warm weather and wind) • Temperature impacts on absorption and evaporation (heat increases, cold decreases) • Prolonged cold or arctic conditions can prevent digging and hinder biological processes

Table 4-4. Black water considerations in relation to mission variables (continued)

Mission Variables	*Considerations*
Troops and Support Available	• Knowledge and expertise in black water management planning and systems ▪ Availability of specialized engineer units or contractors (local and nonlocal) ▪ Availability of a medical detachment, PVNTMED, and other EAB support ▪ USACE and APHC support or assistance teams • Equipment and materials to construct, operate, and maintain black water systems • Availability of funds and contracting mechanisms (including local purchase) • Population stability and predictability
Time	• Timeline of events to meet goals and objectives ▪ Development of a black water management plan, including contingency planning ▪ Acquisition of supplies, services (contractors), equipment, and materials ▪ Arrival of troops, support, and equipment ▪ Connections and construction of black water management system(s) ▪ Operation and maintenance of system(s) ▪ Closure and documentation of all black water systems • Roles and responsibilities, from point of generation through proper disposal and closure • Life span of black water systems (immediate, basic, expanded, or enhanced)
Civil Considerations	• Potential impacts to environmentally sensitive or protected areas ▪ Historical, religious, and cultural sites ▪ Threatened and endangered species and their habitats • Construction and treatment standards, agreements, and policies and guidelines • Impacts (beneficial and negative) to local communities • Use existing infrastructure and transportation network for black water management
Legend:	
APHC	United States Army Public Health Center
DFAC	dining facility
EAB	echelons above brigade
PVNTMED	preventive medicine
USACE	United States Army Corps of Engineers

STEP 2. DEVELOP PRELIMINARY ESTIMATES

4-79. Step 2 is completed together with step 3, categorize waste requirements (below). Waste management planners develop preliminary black water requirements for each maneuver COA being developed. Black water requirements (such as toilets, storage, disposal methods, and required equipment) are based primarily on the number and gender of personnel within a unit. Using a matrix (see table 4-5), waste management planners begin this step by listing each subordinate unit with its personnel strength (including the number of males and females), based on the task organization for each COA. Planners then determine the black water requirements for each critical event or phase of the operation, based on the expected duration that a unit will

be in a certain location using the categories shown in step 3. To determine the number of toilets required, multiply the total number of males by 4 percent and the total number of females by 6 percent, rounding up to the nearest whole number. Or, with Force Provider operations that have containerized latrines with collection/storage tanks, four 150-person modules, collocated, may generate 3,000 gallons of black water per day (see ATP 4-45).

Table 4-5. Sample black water requirements work sheet

Subordinate Unit	Immediate					Basic					
	Number of Personnel	Number of Males	Number of Females	Duration (days)	Required Resources and Solutions	Number of Personnel	Number of Males	Number of Females	Duration (days)	Number of Latrines	Required Resources and Solutions
Battalion	700	500	200	3	Excavation equipment, shovels, and boards (for straddle trench latrines)	700	500	200	60	20 male 12 female	Contract (for waste disposal from Force Provider wastewater storage tanks)
Company	100	80	20	3	Fuel and drums (for burn-out latrines)	100	80	20	60	4 male 2 female	Excavation equipment and latrine boxes (for deep pit latrines)

Notes.
1. This work sheet may be extended to incorporate all subordinate units and phases of an operation.
2. When figuring the necessary number of latrines, for males multiply the total number of males by 0.04, and for females multiply the total number of females by 0.06. Round up to the nearest whole number for both.

STEP 3. CATEGORIZE WASTE REQUIREMENTS

4-80. As described in chapter 2, the black water requirements are categorized (immediate, basic, expanded, enhanced, or transfer/closure) based on expected duration. The categorization of waste requirements is included in the black water requirements work sheet (see table 4-5) and helps with organization and planning. The work sheet should be extended, as needed, to cover all phases of the operation. In table 4-5, for example, the work sheet was extended to include basic waste requirements. Where units will be stationary for more than 72 hours (3 days), some field methods can be unsuitable, and units should be transitioning to more sustainable management methods.

STEP 4. EVALUATE WASTE MANAGEMENT CAPABILITIES

4-81. Waste management planners evaluate the existing and available capabilities and resources (manpower, equipment, materials, and funding) for each subordinate unit (one level down) according to the proposed task organization for each COA being developed. The results of this evaluation will drive the generation of capability-based solutions and required resources in step 5.

STEP 5. GENERATE SOLUTIONS

4-82. Waste management planners first generate options that take advantage of existing facilities with adequate toilets and sewerage systems, without risking the mission. Commanders must decide if the added health benefits offset tactical considerations. When existing facilities or contractor support are not available, waste management planners generate capability-based solutions (such as field latrines that are described beginning in paragraph 4-52 and treatment systems that are described beginning in paragraph 4-63) to meet

the black water requirements. There may also be interim solutions, to include the temporary containment of black water in tanks and other large containers for treatment at a later time or for transportation to an approved treatment site elsewhere in the theater of operations. These may be referred to as holding tanks or bladders, and it is very important that they be clearly labeled with their contents to ensure that they are not confused with potable water bladders.

4-83. Solutions must be feasible (based on the availability of resources, subordinate unit capabilities, and soil conditions) and suitable (based on the risks to human health and the environment). Solutions include considerations for collection, storage, transportation, construction, connections, and any other necessary system components. PVNTMED personnel and the unit field sanitation team are helpful in determining the right type, location, number, and size of field latrines. When planning basic or higher black water management systems (waterborne sewerage systems), waste management planners must coordinate with base camp planners and others involved in conducting base camp development planning, to include engineer units and contractors that will actually build the base camp. In the black water requirements work sheet (see table 4-5, page 4-29), solutions and required resources are placed in the appropriate column under each category (immediate, basic, expanded, enhanced, or transfer/closure). The information placed within the work sheet should be as detailed as necessary to facilitate planning (only limited information was included in table 4-5 to conserve space). The work sheet is continually refined as planning progresses and new information becomes available.

STEP 6. INTEGRATE WASTE MANAGEMENT TASKS INTO PLANS AND ORDERS

4-84. Once a COA is approved by the commander, waste management planners finalize the black water management plan that supports that COA. Waste management planners coordinate and synchronize the supporting waste management tasks with other staff members and higher headquarters as necessary. The waste management tasks are then incorporated into plans and orders as described in chapter 2. Waste management tasks should be included in logistics rehearsals and back briefs to ensure that the plans are feasible and supportable by higher headquarters.

BASE CAMP TRANSFER AND CLOSURE

4-85. When alerted to transfer or close a base camp, planners should seek assistance from higher headquarters and the USACE and PVNTMED teams supporting the area. When closing a base camp, the wastewater facilities (such as latrines, soakage pits/trenches, lagoons, and septic systems) must be properly closed and marked, identifying the contents and date. While methods generally involve only covering and compacting the sites with dirt, agreements with the HN may require more detailed methods and some form of long-term monitoring to detect potential groundwater contamination. In the absence of formal guidance, best management practices must be used. This may entail enlisting environmental experts to ensure the best possible solutions are implemented. See appendix F for more information about base camp transition, transfer, and closure.

4-86. When closing a latrine, the following procedures are usually applied in order to prevent flies from hatching and emerging, though local requirements may vary:

- Allow at least 1 foot of space between the contents of the latrine and the top/opening of the pit to complete closure actions.
- The contents, side walls, and ground surface (to a distance of 2 feet from the side walls) are sprayed with an approved insecticide.
- The pit is filled to ground level with successive 3-inch layers of compacted dirt.
- Each layer is sprayed with a DOD-approved insecticide before the next layer is added.
- The latrine pit is covered with a 1-foot mound of compacted dirt.
- Mark the location with a rectangular sign that is marked “CLOSED LATRINE” with the date it is closed and the unit that closed it (if the situation allows). Document the 8-digit grid coordinates for the latrine location in closure reports to higher headquarters so that future site work or building plans can anticipate or avoid the buried obstruction.

4-87. When closing a septic tank, the following procedures are usually applied, though local requirements may vary:

- Pump out the septic tank, and dispose of the contents as appropriate.
- Disconnect the sanitary line from the septic tank.
- Remove or crush the top of the tank.
- Break the tank bottom open so that it will not hold surface runoff and form an unwanted reservoir.
- Fill in the septic tank with stone, rubble, or soil to prevent a future collapse hazard once any required inspections have been performed.
- Mark the location with a rectangular sign, indicating the contents of the filled-in tank, the date it was filled, and the unit that filled it (if the situation allows). Document the 8-digit grid coordinates for the tank location in closure reports to higher headquarters so that future site work or construction plans can anticipate or avoid the underground obstruction.

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Chapter 5
Hazardous and Special Waste

This chapter addresses HW and special waste and how to develop a plan for managing it. It is a continuation of the discussion presented in chapter 2. For additional information, see ATP 3-34.5/MCRP 3-40B.2 (MCRP 4-11B), DOD 4715.05-G, DOD 4160.21-M, DODM 4160.21-V4, AJEPP-2, TM 38-410, and TG 217.

OVERVIEW

5-1. HAZMAT is any substance that has the potential to harm humans, animals, or the environment either by itself or by interaction with other substances. HAZMAT is specifically identified under federal law, and it is supplied with a SDS (supplied by the manufacturer) with comprehensive information for managing the material. Special storage, use, handling, and shipment safety procedures and protocols must be followed to help protect against accidental exposure. Where possible, it is advisable to substitute a nonhazardous material for HAZMAT, and HAZMAT supplies with the soonest expiration dates should be used first. HAZMAT becomes HW if it can no longer be used for its intended purpose due to the expiration date, contamination, or spillage. HAZMAT may also become HW through the process in which it is used if the generated waste is characterized as hazardous. Containers of HAZMAT that have less than one year remaining on their shelf life should not be shipped into contingency locations. The transnational shipment of HW is a significant administrative problem during most contingency operations. The need to minimize the amount of HW that needs to be shipped across international borders is critical. Do not automatically classify HAZMAT with an expired shelf life as HW unless it represents an immediate hazard to human health and/or the environment. The first action when HAZMAT with an expired shelf life is encountered is to determine if the shelf life can be administratively extended. This can be determined by working through the unit supply specialist, contacting the logistic office, or using the military quality control storage standard and the quality status list that can both be found on the DOD Shelf-Life Program Web site at https://www.shelflife.dla.mil/site/.

5-2. *HW* is a solid waste that is listed as such in federal law or exhibits any of the hazardous characteristics of ignitability, corrosiveness, reactivity, or toxicity. (ATP 3-34.5/MCRP 3-40B.2 [MCRP 4-11B]) (Also see DOD 4715.05-G.) Examples of common HW include used solvents, waste fuel filters, contaminated fuel, paint waste, nonpunctured aerosol cans, and petroleum-contaminated dirt from spills. Also, HW is a type of covered waste as it relates to items that should not be burned in open-air burn pits (see paragraphs 3-55 and 3-56). If the composition of a substance is unknown, it must be tested to determine if it is hazardous. According to theater SOPs, the handling and disposal of some materials may be permitted in on-site remediation or reuse. For example, petroleum-contaminated dirt should be bioremediated on-site, and contaminated fuels and waste oils can be used as accelerants in incinerators if the proper tanks are installed. All commanders need to take steps to reduce the amount of material that enters the HW stream by applying some simple logistical practices. For example, establishing a consolidated HAZMAT storage area where HAZMAT can be accepted and reissued to prevent them from becoming HW. Recycling used oil into vehicles, using fuel-oil blending technology, should be considered for all maintenance operations. Do not designate usable HAZMAT as HW in order to simply clean up a motor pool or work space.

5-3. Special waste is any waste material that does not meet the criteria for HW, but which still requires special handling or disposal procedures due to its physical, chemical, or biological properties that pose a threat to human health, equipment, property, or the environment. Many of the items listed below can be recycled or cleaned for continued use by specialized equipment. Every effort needs to be made to use best practices to reduce the amount of material entering the HW stream. Some examples of special waste that units may have to contend with include the following:

- Used POL.
- Used antifreeze.
- Asbestos-containing materials.
- Sludge resulting from treatment of black water.
- Petroleum-contaminated dirt.
- Incinerator ash.
- Debris and residue from spill cleanup or remediation efforts.

HAZARDOUS WASTE AND SPECIAL WASTE MANAGEMENT SYSTEM

5-4. The components of a HW and special waste management system are the same as a nonhazardous solid waste system. These components are segregation, collection, transportation, recovery, and disposal. However, there are special planning considerations for these components and, specifically, for HWAPs and HW storage areas (HWSAs). Training will be important to ensure proper management from the point of generation through disposal and record keeping.

SEGREGATION

5-5. HW and special waste must remain segregated from other waste streams, which begins with proper segregation at the point of generation. Proper segregation at the point of generation eases the overall management of HW and special waste and allows for easier waste characterization and disposal. Allowing HW and special waste to mix with nonhazardous waste generates more HW and special waste, complicates turn-in procedures, increases disposal costs, increases potential health risks, and could result in dangerous chemical reactions. Once segregated, waste must remain segregated while it is being accumulated to prevent incompatible materials from coming into contact in the event of a leak or spill. The segregation of waste within accumulation points is discussed in paragraph 5-21.

COLLECTION

5-6. HW and special waste are collected at or near the point of generation and are temporarily accumulated in a HWAP established near the work site. Accumulated waste is then transferred to a larger HWAP within the same unit element or directly to a HWSA established within the theater of operations. The HWSA is the last stop within the theater of operations where HW and special waste are accumulated in preparation for treatment or disposal. The HWSA is generally under the direct control of the DLA or a qualified contractor.

5-7. The waste generator is responsible for the proper accumulation, maintenance, and housekeeping of the unit HWAP. The waste generator must understand the appropriate procedures before establishing a HWAP to ensure that—

- Waste streams are not mixed.
- No waste other than the specified waste for that waste stream (approved for the container) is placed in the collection container.
- Required secondary containment is provided.
- All leaks, spills, and other releases are responded to appropriately, recorded, and reported as directed.
- Small leaks or spills around the container openings are cleaned up with absorbent material (see table 5-1) or rags and then properly packaged, labeled, and disposed of as HW as required.

- Each HW container should be segregated, based on its hazardous characteristics (reactive, ignitable, corrosive, or toxic) as described in paragraph 5-21.
- Containers are not overfilled, to allow for expansion, as described in paragraph 5-27.
- Containers are opened, handled, filled, emptied, and stored in a manner that avoids rupture or leakage.

Table 5-1. Stock numbers for specific absorbents

National Stock Number	*Item Description*
7930-00-269-1272	Absorbent, oil and water (44-pound bag)
5640-00-801-4176	Insulation, thermal, vermiculite (bag)
4235-01-423-1466	Absorbent, loose, 1-cubic-foot bag (4 each per box)
4235-01-423-0711	Absorbent, loose, 2-cubic-foot bag (3 each per case)
4235-01-423-1463	Pads, 18 by 18 by 3 inches (30 each per box)
4235-01-423-1465	Socks, 4 inches by 8 feet (10 each per box)
4235-01-423-1467	Socks, 2 inches by 10 feet (20 each per box)
4235-01-423-2787	Boom, with clamps, 10 inches by 10 feet
6850-01-420-3082	Micro-Blaze remediation tool

PLANNING CONSIDERATIONS FOR HWAPS AND HWSAS

5-8. The location, size, and number of HWAPs within base camps and HWSAs within the theater will depend on the amount of, and location where, HW and special waste are being generated; the availability of qualified contractors; and safety, security, terrain, and environmental considerations identified during the MDMP.

5-9. Planners must consider the sensitivity and vulnerability of adjacent areas (such as billeting, work areas, and ammunition supply points) and locate HWAPs and HWSAs at least 100 meters from any water resource, inhabited building distance away from ammunition supply points, and down gradient and downwind of billeting and dining facilities. Also, ensure all HW is located away from any flame source and heavy traffic. HWAPs and HWSAs should be located on generally flat and level ground and away from low-lying areas that are prone to flooding during heavy rains. They should be located where access is controlled or limited and where accidental spills and discharges will not flow into surface waters, drains or runoff areas. They should also be near roadways to accommodate transportation vehicle access. Size is based on the anticipated accumulation and storage needs that are derived by analyzing the types and functions of units, types and quantities of HAZMAT within unit inventories, and estimated consumption rates. HWAPs and HWSAs must be large enough to provide ample aisle space that allows expedient and unobstructed movement of personnel, material handling equipment, firefighting equipment, decontamination equipment, and spill control equipment.

5-10. The number of HWAPs and HWSAs will vary. In small base camps, one HWAP may suffice, depending on how much waste can be accumulated and on limits established for the theater of operations. In larger base camps with multiple large units, more than one HWAP may be needed. In these situations, the BOS-I should establish procedures to consolidate the shipments of HW and special waste from the base camp HWAP to the HWSA.

5-11. HWAPs need to be located at or near the point of generation. HWAPs and HWSAs must be designed, constructed, maintained, and operated to minimize the risk of a fire, explosion, or any unplanned release of HW or its constituents into the air, soil, groundwater, or surface water that could threaten human health or the environment. Procedures and controls for managing HWAPs and HWSAs should be contained in SOPs, plans, and orders.

5-12. As long as the requirements for proper storage are met, there are no limits on volume or time that HW and special waste can be stored in a HWSA. However, waste management planners must consider that the

volume of stored HW proportionately increases the potential for health risks and environmental liabilities if a catastrophic event occurs. As a general rule in contingency locations, once a container is full in a HWAP, the generator should arrange for transport.

5-13. The S-4/G-4 coordinates the movement of HW and special waste between HWAPs and to the HWSA. The collection and/or transfer of HW and special waste within the unit is normally performed in conjunction with the issue and turn-in of HAZMAT as part of resupply operations to minimize transportation requirements.

5-14. Only waste that is properly identified, documented, marked, and packaged is allowed into the HWSA. Any unknown substance or waste discovered must be sampled and characterized. The following procedures should be performed when waste is turned in to a HWSA:

- Complete all appropriate turn-in documentation, including DLA Form 2511 (*Hazardous Waste Profile Sheet*), DD Form 1348-1A (*Issue Release/Receipt Document*), and a copy of the SDS (if applicable) for each type of waste.
- Ensure that the waste is properly segregated and packaged in appropriate containers (see table 5-2 for a list of containers) that are properly marked.
- Ensure that the HWSA operator properly logs all received material and that records of HW turn-ins are kept for 3 years (DOD 4715.05-G), or as required by the combatant command.

Table 5-2. Stock numbers for specific containers

NSN	***Item Description***
8125-00-174-0852	Bottle, plastic, 1-gallon (polyethylene)
8125-00-731-6016	Battle, plastic, 13-gallon
8110-00-254-5719	Drum, steel, 1-gallon
8100-00-128-6819	Drum, steel, 1-gallon (17C)*
8100-00-254-5722	Drum, steel, 4-gallon
8110-00-282-2520	Drum, steel, 5-gallon (17C)*
8110-00-254-5713	Drum, steel, 6-gallon (with ring)*
8110-00-366-6809	Drum, steel, 30-gallon (17C)*
8110-00-030-7780	Drum, steel, 50-gallon (17C)[*1]
8110-01-282-7615	Drum, polyethylene, 55-gallon*
8110-01-101-4055	Drum, steel, disposal, 85-gallon (no lining)*
8110-01-101-4056	Drum, steel, recovery, 85-gallon (epoxy phenolic lining)*
8110-01-343-1697	Drum, plastic, 55-gallon[*2]
8110-01-150-0677	Drum, plastic, 55-gallon[*3]
8110-00-292-9783	Drum, steel, 55-gallon[4]
Legend:	
NSN	national stock number
POL	petroleum, oils, and lubricants
*Open-top containers	
[1]For POL contaminated solids	
[2]For corrosive contaminated solids	
[3]For corrosives or broken batteries	
[4]For contaminated POL products	

5-15. As the primary staff integrator for the Army environmental program, which includes waste management, the engineer staff officer is responsible for developing and coordinating the necessary information that subordinate units will need to establish and operate HWAPs and/or HWSAs. At the company level and in units that do not have an engineer staff officer, this responsibility will likely be assigned to the environmental officer. The logistics staff officer in the MAGTF command element performs similar duties

for their respective deployed MAGTF. At a minimum, SOPs and OPLANs/OPORDs must collectively address the following areas:

- Training requirements for personnel managing and operating HWAPs and HWSAs (see paragraphs 5-71 through 5-74).
- Protection measures.
- Secondary containment.
- Segregation.
- Emergency preparedness.
- Inspections.
- Recordkeeping.
- Container requirements, to include marking and labeling.
- Safety measures when handling HW and special waste.

Protection

5-16. HWAPs and HWSAs must be adequately covered and protected to keep rain out of accumulation and storage areas (including the secondary containment) and prevent materials from being exposed to the sun. Tarps may be used as a temporary expedient method as long as they remain secure during adverse weather.

5-17. Because of the potential hazards, access to the accumulation site must be controlled by 24-hour monitoring or barriers that will restrict entry. HWAP and HWSA site managers should use control measures (such as signs, rope, yellow and black cautionary tape, and fencing) to restrict access and control activities in and around the sites. Warning signs (such as National Fire Protection Association [NFPA] or applicable international signs) shall be posted that are appropriate for the waste being accumulated. In addition, each site must be properly designated as a HWAP or HWSA with signs that are posted on all sides that state "HAZARDOUS WASTE ACCUMULATION POINT (or HAZARDOUS WASTE STORAGE AREA)–DANGER UNAUTHORIZED PERSONNEL KEEP OUT" and "NO SMOKING WITHIN 50 FEET" in English and any other language that is prominent for the operational area. Signage should be legible from at least 25 feet away and should include contact information. Consideration must also be made to ensure that barriers and fencing will not obstruct the access of material handling equipment, transportation, and emergency vehicles.

Secondary Containment

5-18. Secondary containment is required for all waste containers to prevent the spread of spills and leaks. Examples of secondary containment include, but are not limited to, plastic tubs; sumps; concrete pads with curbs to prevent runoff; spill control pallets; and plastic-lined pits, trenches, dikes, or berms. As a field-expedient method, secondary containment can also be achieved by placing containers of waste on a large plastic tarp, with filled sandbags stacked around the perimeter, and the edges of the tarp draped over the top of the sandbags. Whatever method is used, overhead cover should be in place to prevent precipitation from collecting in the secondary containment devices and to prevent containers from rusting. If rainwater does collect in the secondary containment, it should be inspected and/or tested prior to release. Contaminated rainwater is managed as HW.

5-19. Secondary containment must have the capacity to hold 10 percent of the total volume contained or 100 percent of the volume of the single largest container, whichever is greater, plus sufficient freeboard, or extra space, to allow for precipitation and expansion. For example, using eight 55-gallon drums, 10 percent of the total contained volume is 44 gallons (8 x 55 x .10 = 44), and 100 percent of the volume of the single largest container is 55 gallons; therefore, the secondary containment must have the capacity to contain the greater 55 gallons plus extra space for precipitation and expansion. As a general rule, add an extra 10 percent capacity (55 x .10 = 5.5 gallons) to account for that extra needed space. With this example, the final containment volume for eight 55-gallon drums would require 60.5-gallon capacity (55 + 5.5).

5-20. As the theater matures and base camp construction standards become more enduring, HWAPs and HWSAs should be improved. This includes emplacing concrete hardstands with built-in containment features or installing better overhead and side cover to protect against the weather and unauthorized entry.

Segregation Within HWAPs and HWSAs

5-21. HW and special waste must be segregated within HWAPs and HWSAs with different secondary containment to prevent incompatible waste from coming into contact in the event of a leak or spill and producing an adverse chemical reaction or toxic fumes. See TM 38-410 for extensive information on storage compatibility considerations. HW is initially segregated based on hazard characteristics into four major sections: reactives, ignitables, corrosives, and toxics (see table 5-3, page 5-6). Further segregation may be required, based on the compatibility of individual materials as indicated on SDSs or as determined by waste characterization. For example, acids must be separated from bases, and compressed gas cylinders cannot be stored with special waste that is flammable. The following general incompatibilities should be avoided through segregation:

- Reactives from ignitables.
- Acids (pH < 7) from bases (pH > 7).
- Corrosives from ignitables.
- Oxidizers from everything.
- Organic reactives from inorganic reactives.

Table 5-3. Storage segregation chart

Reactives	*Ignitables*	*Corrosives*	*Toxics*
Chlorination kits Decontaminants Lithium (batteries) Magnesium Sodium Zinc powder	Chemical agent-resistant coating–toxic Class III and V waste Cleaning compounds Deicing agents Fuels Lacquers/varnishes Paints Paint thinners Parts cleaners Sealants Solvents Waste fuels Windshield cleaners	Battery acids Carbon removers Degreasers Paint strippers Rust removers Radiator leak compounds Weapons cleaners	Grease Insect repellants Lubricants Oils Oil-contaminated solids Paint primers

5-22. Each storage section should be separated by a distance of 6 feet or by a physical barrier (such as an earthen/HESCO© berm or T walls). Ensure the wastes are separated and protected from sources of ignition and reaction. If possible, areas that store containers holding ignitable or reactive waste should be located at least 50 feet inside the boundary of the camp. Signs with "NO SMOKING WITHIN 50 FEET" should be prominently displayed, and all metal containers should be grounded.

Emergency Preparedness

5-23. Each HWAP and HWSA must have a posted spill response plan that describes the proper actions to take (to include responsibilities, immediate notification, reporting requirements, and points of contact) and the proper use of the appropriate equipment to respond to any on-site emergency. The spill response plan and use of equipment should be rehearsed (for example, simulating a spill incident) to ensure that personnel working within HWAPs and HWSAs understand the procedures. HWAPs and HWSAs have similar emergency preparedness requirements, just not on the same scale as determined by the amount of waste on site. Each HWAP and HWSA must have the appropriate emergency equipment, to include—

- Spill kits compatible with the types of HW on site that will assist with containment and cleanup. At a minimum, a HWAP should have approximately 15 pounds of absorbent, two nonsparking shovels, two brooms, and plastic bags to hold contaminated absorbent. HWSAs will likely store a greater amount of HW and will have a need for larger quantities of spill kit material.

- ABC-type fire extinguishers of the appropriate size/quantity for the operation.
- Potable water for eye washing and decontamination.
- Four sets of appropriate PPE (two for cleanup and two for a backup team).
- An emergency communication or alarm device.

Inspections

5-24. Environmental officers will monitor all HWAPs within their unit and assigned areas according to the environmental SOP for the local area of operations. They will implement procedures for routine inspections of HWAPs to ensure that all requirements are being met and that containers remain in good condition. It is recommended that the environmental officer inspect their areas of operation at least weekly, while the waste generators inspect their assigned areas daily. Any deficiencies noted should be immediately corrected. A root cause analysis should be performed on instances of noncompliance to identify any negative trends and to prevent them from recurring. A record of inspections should be maintained with the unit level environmental records to include the date and time of inspection, the name of the inspector, a notation of the observations made, and the date and nature of corrective actions that were taken. HWSAs will be monitored and inspected by the DLA, or the COR according to the contract requirements.

Recordkeeping

5-25. An accurate inventory must be maintained, to include tracking the duration of storage for all HW and special waste. A log should be kept to track the type and quantity of waste received, the date received, and the identity of the unit that generated it. A record is maintained for each container that tracks the type and amount of material that is added, and it accompanies the container when it is transferred. This record helps in the verification of waste characterization before disposal and prevents the need for sampling containers of unknown waste, which can become very expensive and add to the total cost for disposal. The manager for each HWAP/HWSA is responsible for filling out the appropriate turn-in documentation (such as DD Form 1348-1A and DLA Form 2511) and any other applicable local forms. In addition, the manager must keep and maintain current training records. All HW management records must be maintained for at least 3 years or as determined by the combatant commander (CCDR). Upon base camp transfer or the transfer of authority, the incoming unit must be provided the necessary records. Eight-digit grid coordinates and inventories of the accumulation areas are reported to higher headquarters in the event that the unit must rapidly evacuate the area. The inventories should be loaded to DOEHRS–Environmental Health.

Container Requirements

5-26. When possible, HW and special waste will be collected in steel or polyethylene containers that meet United Nations requirements for storage and transportation. Table 5-2, page 5-4, provides ordering information for various containers. The best container is often the original container that the material was shipped in, as long as it is capable of being closed and approved for transport. In general, grounded steel drums should be used for toxic and ignitable waste and polyethylene (plastic) should be used for corrosive acids, bases, and oxidizers. If the original container or United Nations-approved containers are unavailable, any container may be used that is in good condition (free from severe rusting, bulging, dents, holes, or structural defects), compatible with the waste stream, and capable of being closed and approved for transport. When containers are reused, any labels or markings that no longer apply to the new content must be removed or covered with spray paint, and the containers shall be relabeled as appropriate.

5-27. Containers used to collect HW and special waste must be kept closed when not adding or removing waste. When filling a container with liquid waste, ensure that adequate headspace remains to allow for the expansion of material. Allow approximately 4 inches in a 55-gallon drum, 2 inches in a 5-gallon container, and 1 inch in a 1-gallon container. For extremely hot climates (desert regions), these headspace allowances should be doubled. Funnels or other flow control devices should be used to minimize spills when transferring liquids to or from containers. However, funnels must be removed (unless self-closing funnels are used) and containers closed after the transfer is complete. Additionally, only nonsparking tools and grounded, metal containers should be used to containerize ignitable waste and corrosive waste should only be collected in plastic or plastic-lined containers.

5-28. When necessary, HW and special waste may be held in small compatible containers in work areas. The container must be labeled with the chemical name and the hazards and used only for a particular waste stream. The container must be emptied into the larger container at the HWAP at the end of each work shift. Always keep incompatible materials separated, and ensure materials are properly identified and labeled.

Marking

5-29. As shown in figure 5-1, each container of waste is marked or labeled with its contents (for example, "used oil" or "contaminated soil"), the hazards of the material (such as "ignitable"), and the generating unit designation or unit identification code. Also, the container is marked "Hazardous Waste" with the date that waste is actually placed in the container to indicate when accumulation began. It should be dated again when the container is transferred to the HWSA or as directed by the theater environmental SOP. Labeling should be applied with an indelible paint pen or stencils in English and in any other predominant language in the area. All lettering should be at least one inch in size and in a color that contrasts with the color of the container so that it is visible from a distance. The containers should be arranged in the accumulation area so that the markings are facing outward for ease of viewing.

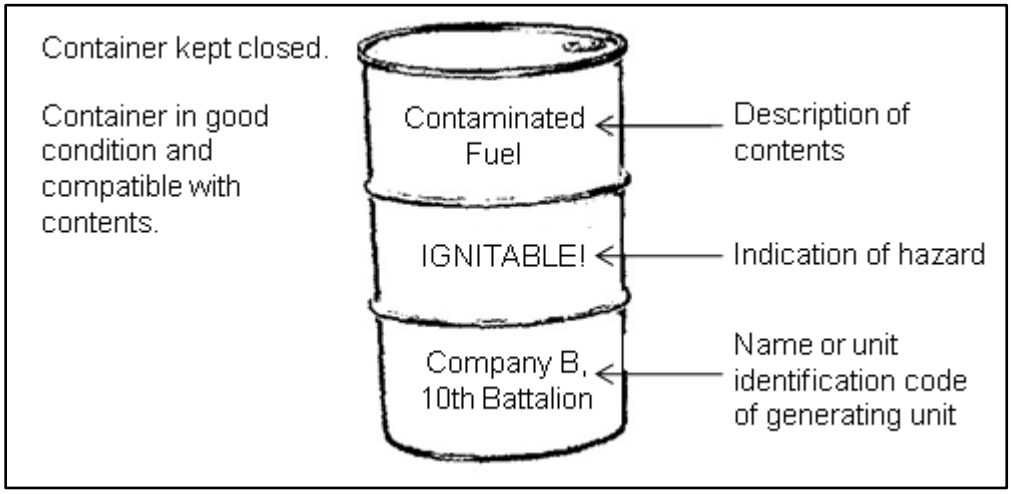

Figure 5-1. Marking requirements for HW containers

Handling

5-30. Handling shall occur in accordance with DOD requirements in the joint service regulation, Army TM 38-410. The most important aspect of HAZMAT, HW, and special waste handling is correctly identifying the hazards associated with each individual chemical so that necessary measures can be taken to minimize the risks to personnel and the environment. SDSs provide critical information, such as the hazardous characteristics of a substance, the appropriate PPE, spill response procedures, signs and symptoms of overexposure, and first aid procedures. SDSs can be obtained through unit supply channels and are required to be maintained at HAZMAT and HW storage areas, refueling sites, maintenance facilities, and medical treatment facilities for every HAZMAT stored and used on site. It is important to note that SDSs are material- and manufacturer-specific, which means that each brand name of a chemical has a different SDS. The date of manufacture is also important when looking for the appropriate SDS because manufacturers may periodically reformulate chemicals and issue a new SDS. The SDS should accompany any HAZMAT that is received through the supply system. If an SDS is missing, it can normally be obtained in several ways, such as downloading from the manufacturer's Web site, submitting a request directly to the manufacturer via e-mail, using the DLA's HMIRS if the product has an national stock number, or requesting assistance through the environmental officer. Binders containing SDSs for all HAZMAT stored or used on site are required to be maintained and readily available to personnel on site for familiarization and in the case of a spill or fire. SDSs should be updated at least every 5 years and upon issuance of a new SDS. SDSs are discussed in further detail in appendix E.

5-31. HW and special waste will generally not have an SDS unless the waste consists of an unused HAZMAT or a HAZMAT with an expired shelf life or it is a "pure" waste that only contains the HAZMAT and was not contaminated or chemically altered during its use. An SDS may provide general information regarding the chemical properties of the constituents of a waste material; however, HW will require laboratory analysis for definitive waste characterization. The waste generator's knowledge may be used for characterization when the waste material has been analyzed previously, occurs often, and is generated through the same process. If a process or products used in the process change, the waste stream must be reanalyzed. The environmental officer should include information on waste stream names and synonyms, the specific waste characterization, and handling or management procedures within the unit HW SOP and be prepared to respond to subordinate units that require further information or clarification.

5-32. PPE is the primary means of safeguarding human health when handling HAZMAT, HW, and special waste. The need for PPE must be evaluated before handling any waste. When selecting PPE, it is important to check all applicable manufacturer's SDSs for hazards and/or seek subject matter expertise regarding the hazardous properties of the HW or special waste. Table 5-4, page 5-10, lists national stock numbers for PPE that are commonly used when handling waste in a tactical environment. Waste handlers should decontaminate or dispose of contaminated PPE as soon as possible after use. Contaminated PPE must be characterized to determine if it must be managed as a HW. If respiratory protection is required, contact PVNTMED for assistance. Respirators will only be used by personnel who have received a pulmonary fitness test and have been properly fit tested by PVNTMED or trained personnel. For those respirators that use filter cartridges, there is no universal cartridge that will protect from all chemicals so it is important to consult the SDS or the PPE manufacturer's guidance. Those personnel who operate HWAPs or HWSAs may be required to wear additional PPE, to include fully encapsulating protective suits. Consult with the theater of operations environmental staff for guidance.

5-33. When the recommended PPE is unavailable, individual protective equipment should be used to help protect personnel when handling HAZMAT/HW or in the event of a spill. However, individual protective equipment (such as field gloves, goggles, and wet-weather gear) should only be used when the required PPE is unavailable because it does not provide the same level of protection.

Table 5-4. PPE

National Stock Number	*Description*
Aprons	
8415-01-189-6228	Rubber material, acid-resistant
8415-01-100-7742	Plastic material, oil-resistant and waterproof
Gloves	
8415-01-092-3910	Gloves, heat-protective, type 2, thermal protection (large)
8415-00-266-8673	Gloves, synthetic rubber, industrial, type 1, acid- and alkali-resistant (size 12)
8415-00-266-8675	Gloves, synthetic rubber, industrial, type 1, acid- and alkali-resistant (size 11)
8415-00-266-8677	Gloves, synthetic rubber, industrial, type 1, acid- and alkali-resistant (size 10)
8415-00-266-8679	Gloves, synthetic rubber, industrial, type 1, acid- and alkali-resistant (size 9)
8415-01-138-2497	Gloves, butyl rubber, acid- and alkali-resistant
8415-01-138-2498	Gloves, butyl rubber, acid- and alkali-resistant
Eye and Face Protection	
6850-01-353-9947	Eyewash, self-contained, portable
6850-01-444-3371	Eyewash solution
4230-01-026-9305	Shower, emergency drench
4240-00-202-9473	Face shield, industrial
4240-01-292-2818	Goggle, industrial
4240-00-052-3776	Molded-plastic flexible frame with clear plastic lenses and adjustable headband
4240-01-292-2818	Polycarbonate plastic lenses with molded plastic frame (may be worn over glasses)

TRANSPORTATION

5-34. Generally, HW and special waste are transported from unit or camp HWAPs to the theater HWSA where treatment and disposal are handled by the DLA or qualified contractors. Shipments shall be packaged in accordance with the appropriate standard required by the FGS, HN, or international shipping regulations. The transboundary movement of all wastes must be effected within the scope of national and international law. Drivers must be certified to transport hazardous cargo, which is coordinated through the supporting transportation unit. HW and special waste should only be transported in vehicles approved for that purpose. Each approved vehicle should be inspected to ensure that it has the appropriate placards and manifests for the materials being transported, a copy of the spill response plan, and the necessary emergency equipment, to include—

- Spill kits, based on the types of HW being transported, which will provide containment and allow cleanup. At a minimum, each vehicle should carry approximately 25 pounds of absorbent, two nonsparking picks, two nonsparking shovels, one broom, and several small and large heavy-plastic bags to hold contaminated soil and/or absorbent.
- ABC-type fire extinguisher.
- Potable water for eye washing and decontamination.

- Two sets of appropriate PPE, based on the type of HW and SDSs.
- Means of communication.

5-35. Personnel that sign the shipping documents must successfully complete an approved certification course and stay current with required training. Transportation forms that may be required include—

- DD Form 2890, *DOD Multimodal Dangerous Goods Declaration*.
- DD Form 1348-1A, *Issue Release/Receipt Document*.
- DD Form 1348-2, *Issue Release/Receipt Document with Address Label*.
- DA Form 3161, *Request for Issue or Turn-In*.
- Bill of lading.
- Other applicable HN form.

5-36. There are also special requirements if HW must be transported on military aircraft. Waste management planners should coordinate those requirements with the unit transportation officer. Vehicles used to transport radioactive waste must be surveyed by a radiation safety officer or CBRN personnel after each use to assess any residual contamination. The vehicle may not be used for transporting nonradioactive materials until cleared by the radiation safety officer or CBRN personnel.

RECOVERY

5-37. As discussed in chapter 1, recovery aims to divert material from waste streams to reduce the overall amount of waste requiring disposal. In managing HW and special waste, just as with managing nonhazardous solid waste (see chapter 3), waste management planners focus on reducing, recycling, and reusing to minimize the amount of waste that requires disposal. Since recycling may not be available at the onset of operations, waste management planners must be prepared to store recyclable HAZMAT until the means for recycling through contracting or a local recycling market are established.

5-38. Using nonhazardous materials instead of HAZMAT, if possible, is the easiest way to reduce the amount of HW and special waste requiring disposal. Also, using minimal amounts of HAZMAT can reduce the volume of HW and special waste that is generated. To facilitate reuse, units can keep usable materials out of the HAZMAT waste stream and create suitable reuse strategies in a consolidated storage area or HAZMAT reuse issue facility that is conveniently accessible to units. Some common HAZMAT within units that can be reused include, but are not limited to—

- Paint.
- POL.
- Solvents.

5-39. Used-oil blenders can be used to blend used engine oil (only from diesel engines) into the fuel tanks of vehicles and generators that burn diesel fuel. Blenders are specially designed shop tools that collect used oil from a diesel engine crankcase, collect an equal amount of fuel from the vehicle or generator fuel tank, blend the two products together, and filter the blended product before pumping it back into the tank as fuel. This procedure avoids the cost of collecting, storing, transporting, and disposing of used engine oil. In addition, the cost of the fuel displaced by the engine oil is avoided, and the total volume of fuel needed and transportation requirements are reduced. It is recommended that maintenance personnel be consulted prior to implementing a used oil-fuel blending program to determine its practicality based on the anticipated range of military operations.

5-40. Oil that cannot be used for its intended purpose may be transferred through a government contract to local vendors for use as fuel in various manufacturing processes (such as oil refineries). The environmental officer will verify and document this use before transferring oil to a local vendor. If authorized by theater or brigade SOPs, oils can be blended with diesel fuels and used as accelerants in incinerators that have the proper tanks installed.

TREATMENT

5-41. If possible, implement treatment methods that reduce the volume or hazardous characteristics of wastes. Wastes that no longer exhibit any hazardous characteristic may be disposed of as solid waste. Some

of the methods to consider include biodegradation, chemical degradation, stabilization or fixation with heavy metals, neutralization of corrosives, and composition changes to material to eliminate characteristics of reactivity. Seek assistance and approval from higher headquarters, APHC, and DLA.

DISPOSAL

5-42. The primary means for disposing of HW and special waste within a theater of operations will be through a qualified contractor or a DLA facility established in theater. Local contracts must be approved through the chain of command to ensure that they meet the disposal criteria established for the theater of operations. If local contractors cannot be used, waste must be transported to a DLA facility or HWSA within the theater. Units may never incinerate or bury HW (and certain special waste) unless explicitly approved by both U.S. and HN authorities. Generally, disposal actions shall comply with the applicable FGS, HN regulations, or DOD 4715.05-G, and with international shipping requirements, if applicable. Always consult and coordinate with the contractor or facility in theater to determine the appropriate disposal actions. DOD 4715.05-G contains general HW disposal information, as well as information about incineration disposal and treatment methods that may be used to reduce the volume or hazardous characteristics of wastes. DODM 4160.21 contains disposal information about most of the materials in the following paragraphs. Related information can also be found in the AJEPP-2, published by the North Atlantic Treaty Organization (NATO) Standardization Office, which covers best practices and standards for military camps in NATO operations. Both DOD 4715.05-G and DODM 4160.21, as well as other DOD issuances may be found at http://www.esd.whs.mil/Directives/issuances/dodm/.

5-43. Upon request, DLA can provide the necessary forms and training on how to complete the forms. DLA may also assist in determining proper identification of materials/waste and providing analytical laboratory services, if needed. More information about DLA Disposition Services can be found at http://www.dla.mil/DispositionServices.aspx, and assistance with understanding documentation requirements can be found within the DLA Disposition Services Turn-In Smartbook at http://www.dla.mil/Portals/104/Documents/DispositionServices/Library/CAH/DISP_Smartbook_160419.pdf.

Batteries

5-44. Used lead-acid, nickel-cadmium, mercury, lithium, silver, and magnesium batteries usually meet the criteria for classification as HW and are subject to all of the HW management requirements previously discussed. Additionally, each type will have specific segregation requirements regarding compatibility (batteries should not be comingled). Some batteries may be required to have their terminals taped off to prevent the possibility of sparking in case a residual charge exists. Lead-acid batteries may be palletized as long as they are protected from the weather and damage. They should not be stacked more than two-high to prevent the possibility of fire or explosion. Lead-acid batteries at CONUS or outside the CONUS installations are generally on a one-for-one exchange program because they are highly recyclable. If recycling is possible in the theater of operations, all recyclable batteries should be recycled. It is also important to note that magnesium batteries can emit hydrogen gas and, therefore, should not be collected in airtight containers. However, once they are 50 percent depleted, they are no longer HW and become solid waste. Used alkaline batteries are not HW and may be landfilled with regular trash. If trash is burned locally, alkaline and magnesium batteries should be collected and disposed separately to prevent injury from batteries bursting in the fire. See TB 43-0134 for more detailed information on battery disposition, disposal, and safety.

Aerosol Cans

5-45. Intact aerosol cans meet the criteria for reactive HW. Local policy may authorize the use of commercial puncturing devices to render that waste nonhazardous; however, units must ensure that any remaining substances in the cans do not meet the requirements for classification as a HW. Once punctured, most cans may be recycled for scrap metal. Aerosol cans containing paint are discussed in paragraph 5-56. A commercial puncturing device captures the remaining contents and vapors from the aerosol can. A separate puncturing system must be used for each waste stream. For example, use separate puncturing systems for aerosol paint cans and aerosol pesticide cans so that these waste streams are not mixed.

Light Bulbs

5-46. Spent lamps (including fluorescent, high intensity discharge, neon, mercury vapor, sodium vapor, and metal halide) contain heavy metals and may meet the criteria for classification as toxic HW. Although most commonly used lamps contain extremely low levels of toxic substances, discarded bulbs can still pose environmental and health hazards when landfilled in large quantities. The best practice is to collect all spent lamps—especially mercury-containing bulbs (like fluorescent lamps)—in containers that will help prevent breakage (such as the cardboard sleeve or box the replacement bulbs are removed from) then turn in for recycling. If lamps are broken, ventilate the area where breakage occurred, sweep up the residue, and place it in a sealed plastic bag. Broken, mercury-containing bulbs should be disposed of as HW.

5-47. Expended light ballasts, especially older versions, may be hazardous with PCBs. In fluorescent fixtures, PCBs may be found in ballasts either within small capacitors or in the form of a black, tar-like compound. Discarded fluorescent light ballasts should be evaluated for PCB content and disposed of through the DLA. Unless the casing specifically states that it is an electronic ballast that does not contain PCBs or that it is not an Environmental Protection Agency HW, it must be assumed to contain PCBs and handled as HW. For more details, refer to DODM 4160.21.

Petroleum-Contaminated Soil

5-48. Fuel spills are the most common source of HW during a deployment. Information on spill response is provided in appendix C. Some potential treatment options for petroleum-contaminated soil include destroying the contaminants by incinerating, bioremediating, land farming, encapsulating the contaminated soil, and excavating and containerizing the soil for shipment to a treatment facility (consult DLA or theater command). For example, the resulting contaminated soil and absorbent from a small spill can be shoveled into leakproof containers (such as heavy plastic bags, drums, or plastic-lined containers) and transported to a designated collection facility or HW accumulation site for petroleum-contaminated dirt.

Pesticides

5-49. The disposal instructions printed on pesticide container labels or package inserts must be followed. Many waste pesticides meet the criteria for classification as HW. The best way to minimize pesticide waste is to carefully plan the amount needed before mixing so that all of the product will be expended during use. Additional disposal guidance for pesticides can be found in the AFPMB TG 21. If a pesticide is packaged in an aerosol can, the can will need to be punctured in a commercial puncturing device. The residue and vapor will be captured and must be managed as HW. It will need to be collected and segregated from other waste material and cannot be containerized with paint waste. A pesticide for personal use and application needs to be properly and completely applied before disposing of the empty container as solid waste. If personal-use pesticides have been allowed to exceed their shelf life and will be disposed of in bulk, they must be handled as HW.

Flameless Ration Heaters

5-50. When exposed to water, flameless ration heaters produce heat and hydrogen gas. In small numbers, these hazards are not great enough to warrant classification or management as HW, and the heaters may be disposed of with regular trash. However, bulk quantities of unused flameless ration heaters (not issued to personnel and not packaged with meals, ready-to-eat) do meet the criteria for reactivity and are HW. The best management practice is to collect unused flameless ration heaters for future use/reissue or instruct personnel to activate the flameless ration heaters with their meal before disposal in the regular trash.

Maintenance Waste

5-51. Not all maintenance waste is HW. Maintenance waste must be evaluated to determine if it is HW or special waste. For example, used oil and antifreeze are categorized as special waste. Waste solvents, grease, dry sweep, and used rags must be evaluated for classification as a HW. Generally, used rags can be laundered and reused (if facilities are available). Oil dry/dry sweep will generally be nonhazardous or special waste unless it is used to absorb a material that is hazardous. Oil, fuel, and other filters (not including air filters) must also be segregated from regular trash and collected for recycling or HW disposal. Used oil filters should

be gravity-drained, with both the liquid contents and the drained filter collected separately in metal drums. Non-terne plated used oil filters should be gravity hot-drained, crushed, and recycled with scrap metals.

5-52. Cleaner, lubricant, and preservative manufactured after March 1994 (for example, Break Free®) are nonhazardous; and the rags, towels, and swabs used with it can generally be disposed of as regular trash. Cleaner, lubricant, and preservative manufactured before March 1994, and waste generated from using it, should be collected and undergo a waste characterization analysis to determine proper handling and disposal requirements. The waste characterization of weapons-cleaning waste should also be analyzed to verify that it is not hazardous for lead content.

5-53. Solvents used for parts cleaning should be evaluated based on the SDS and lab analysis to determine waste characterization when spent. There are solvents available that are approved for military applications and are considered nonhazardous and more user-friendly and environmentally friendly. Efforts should be made to prevent solvents from impacting the environment due to evaporation, spills, or drips. For example, allow excess solvent to drain from a part before it is removed from the basin to prevent solvent from dripping onto the ground (referred to as "drag out"), and keep the lids on solvent tanks closed except when not being actively used to prevent evaporation.

5-54. When cleaning solvent tanks, there are three distinctive waste streams that must be considered: the spent solvent, the sludge that develops at the bottom of the tank, and the solvent filter used to extend the life and usefulness of the solvent. If the solvent being used is hazardous, all three must be handled as HW. If the solvent being used is environmentally friendly, the solvent may remain nonhazardous after use. However, the solvent filter and the sludge at the bottom of the tank will probably be hazardous due to heavy metals that have been picked up while parts were being cleaned. All three waste streams will need to be individually evaluated.

Paints

5-55. Open paint containers with leftover paint should be turned in to unit supply for reissue or redistribution. The handling requirements for discarded paint and paint containers will vary based on the type of paint. For example, latex paint is water-based and is not considered hazardous. Small amounts (for example, the waste generated through brush cleaning) may be flushed into a sanitary wastewater treatment facility (excluding septic tank systems) or allowed to dry and then disposed of with the regular trash. Oil-based paint is considered hazardous and must be containerized as HW for disposal. Oil-based paint becomes nonhazardous solid waste once it is dry and may also be disposed of with the regular trash. Paint thinner is hazardous and can be combined in the same container with the oil-based paint for disposal. Chemical agent-resistant coating paint can be hazardous due to heavy metals unless a water-based version is being used. The waste characterization of chemical agent-resistant coating paint should be verified.

5-56. Spray paint cans should be punctured and drained into the appropriate paint waste container. The can should be allowed to dry and be disposed of as scrap metal or with the regular trash. Aerosol cans containing paint should not be placed in the general refuse. The aerosol can is considered hazardous if not punctured because the paint and propellant remaining inside the container are flammable.

Field Sanitation Team Waste (including calcium hypochlorite)

5-57. Several unit field sanitation team supplies (including pesticides) become HW when discarded. Manage granular calcium hypochlorite as HW (even though some formulations may not meet the criteria for HW) because of the dangers posed by its highly corrosive and oxidizing nature. Calcium hypochlorite should not be burned with regular trash or buried in landfills.

Asbestos

5-58. Asbestos is toxic by inhalation and is a carcinogen. Asbestos can still be found in some pipe insulation, roofing and siding, floor tiles, and brake shoes. All asbestos abatement activities should be performed by approved contractors or other certified personnel. Waste that contains asbestos is a special waste. Material containing asbestos should be wetted and double-bagged and sealed with duct tape or placed in an airtight container. Label all containers of asbestos waste with the following warning: "DANGER—CONTAINS ASBESTOS FIBERS—AVOID CREATING DUST—CANCER AND LUNG DISEASE HAZARD."

Disposal will normally occur in an approved landfill. More information can be found in the references listed in paragraphs 5-42 and 5-43.

Range and Ammunition Residue

5-59. All range residue (such as used and unused ammunition, ammunition boxes, and spent casings) should be returned to the ammunition supply point. Range residues will be segregated for HW disposal or recycling at the ammunition supply point.

Radioactive Waste

5-60. Radioactive waste should be managed and handled only by designated personnel according to AR 700-48 (Army) or MCO 5104.3B (Marine Corps). DLA does not manage radioactive waste. Disposable gloves should be worn before handling small quantities of suspected low-level radioactive items (such as damaged tritium compasses, fire control azimuths, or chemical-agent monitors). Low-level radioactive items should be double-bagged in plastic bags. Ensure that the package is marked as "SUSPECTED RADIOACTIVE WASTE" and that the items are not removed from the bags until the package reaches its ultimate destination. Maintain a strict chain of custody for these items during transport. DA Form 4137 (*Evidence/Property Custody Document*) may be used to document the chain of custody. Record the names and units of any personnel that may have come into contact with the contaminated items and the dates of exposure. Provide this information to radiation safety and medical personnel.

Chemical, Biological, Radiological, and Nuclear Waste

5-61. Turn in used protective mask filters, protective garments, personal decontamination kits, and CBRN detectors to the unit CBRN noncommissioned officer for proper disposal. All items suspected of chemical or biological contamination should be sealed in leakproof bags or drums and disposed of as HW. Items suspected of radiological contamination should follow guidance in paragraph 5-60. Record the names and units of any personnel that may have come into contact with the contaminated items and the dates of exposure, provide this information to medical personnel. Bulk decontamination agents are extremely corrosive and must be managed as HW when discarded. See ATP 3-11.32/MCWP 10-10E.8 and TM 3-11.91/MCRP 10.10E.4/NTRP 3-11.32/AFTTP 3-2.55 for information on managing CBRN-contaminated waste and CBRN-related materials.

Leachate

5-62. Leachate is the liquid that drains from land-disposed waste, or landfills. Leachate can be hazardous to the public and the environment; therefore, any liquid draining from a landfill shall drain to a leachate collection basin that is managed and secure. If leachate must be disposed, it is possible that a wastewater treatment facility that is capable of handling industrial effluent can accept such waste (with approval). Or, it is possible to recirculate the leachate by pumping it back onto the surface of the waste with the intent that some will evaporate and the rest will undergo anaerobic digestion within the landfill and that any re-emerging leachate will be less hazardous. Leachate must never be allowed to enter or discharge to a water source. The leachate collection system shall be designed to prevent soil infiltration and groundwater contamination and to prevent migration of HW, hazardous constituents, or leachate from a facility, especially to water supply wells, irrigation wells, or surface water. In addition to leachate, runoff water that has come in contact with composted waste, materials stored for composting, or residual waste must be diverted to a leachate collection and treatment system.

Polychlorinated Biphenyls

5-63. PCBs are toxic and known to cause skin diseases, digestive disturbances, and even death in humans at higher concentrations. They are persistent in the environment, do not easily decompose, and biomagnify up the food chain. Some uses of PCBs include, but are not limited to, transformers, capacitors, heat transfer systems, hydraulic systems, electromagnets, switches and voltage regulators, circuit breakers, reclosers, and cables. All transformers will be considered and treated as PCB transformers unless information to the contrary exists. It is important to prevent PCBs from entering any water resource or system; therefore, it is important to prevent PCBs from entering floor drains and storm drains. The site spill contingency plan should include all PCB-containing equipment (including those in use, in storage, and those set aside for disposal),

including a written inventory of where they are located and what amount is present. For disposal, laboratory analysis may be required to determine the amount of PCBs in parts per million. PCB material, especially liquid forms, must be packaged as enclosed, nonleaking, and safe to handle. Disposal of PCB items will be through DLA or their approved, qualified contractor. DOD-generated PCB items manufactured in the United States will be returned to the United States for delivery to a permitted disposal facility if the host country or third country disposal is not possible, is prohibited, or would not be managed in an environmentally sound manner. For more details on disposal requirements, refer to DOD 4715.05-G. Due to the attention that PCBs require, sites should minimize its use as long as mission performance is not degraded. In addition, it is helpful to have all equipment that commonly or potentially contains PCBs labeled with its PCB hazard (in parts per million or PCB-free).

Electronic Waste

5-64. Electronic waste, or e-waste, is discarded, unwanted, or unusable electrical or electronic devices. E-waste includes, but is not limited to, computers, printers, fax machines, cell phones, and televisions. If landfilled, e-waste can result in the release of toxins, in particular heavy metals (for example, lead, cadmium, and mercury). If burned in the open, such waste can release toxic air pollutants, including dioxins and furans. Therefore, when possible, electronic waste should be collected, recycled, and reprocessed; minimize disposal of electronic devices. DLA Disposition Services responsibly recycles and disposes of electronics in accordance with DOD policies to protect national security, personally identifiable information, and the environment. DLA Disposition Services should be contacted for turn-in procedures and requirements.

Tires

5-65. Both unused and used tires contain harmful chemicals, take up valuable space, and are potential breeding grounds for insects and other pests. Therefore, it is important to emphasize proper procurement, storage, and disposal of tires. In addition, emergency response plans should include tire fires. Store tires in a manner minimizing the potential for insect or rodent infestations and tire fires. To prevent water from collecting in tires and providing a breeding ground for pests, store tires in inside storage (if possible). Otherwise, cover the tires with a secured waterproof cover and allow sufficient aisle space so tires may be examined and purged of water, or treated, if needed. Used tires may be reused for tire wall construction of dams, fences, barriers, and other approved structures. Also, if tires are properly stacked, filled with dirt and covered with stucco, they are well insulated and less resistant to fire and insect infestation. Investigate local and regional opportunities for reuse of unwanted tires. If a tire shredder is available, shred tires as soon after receipt as possible, and use the shredded pieces in walkways, landfills, embankments, roadways, and construction. Unwanted/used tires should be reused, if possible; but if tires must be disposed, DLA Disposition Services should be contacted for turn-in procedures and requirements.

HAZARDOUS WASTE AND SPECIAL WASTE MANAGEMENT PLAN

5-66. A HW and special waste management plan is developed using the 6-step process that was introduced in chapter 2. The keys to a successful HW and special waste management plan are—

- Understanding which wastes are hazardous or special.
- Reducing the amount of waste that is generated.
- Safeguarding HW and special waste throughout collection, transportation, and disposal.
- Knowing the standards and requirements for the theater of operations.
- Assigning responsibilities and establishing procedures and standards for each aspect of the plan (segregate, collect, transport, recover, and dispose), including spill response.
- Establishing the means to enforce standards through training, supervised execution, and inspections.

5-67. The S-4/G-4, engineer staff officer, and environmental officer must work together and coordinate with other members of the staff to effectively manage HW and special waste. The S-4/G-4 is the staff proponent for distributing, transporting, storing, and recovering HAZMAT and ensures that subordinate units have the necessary equipment and materials needed to establish proper HWAPs and HWSAs. The Army engineer staff officer—as the primary staff integrator for the environmental program, which includes waste management—

is responsible for integrating HW and special waste into the unit waste management plan and incorporating the necessary tasks within operation orders and plans to ensure that HW and special waste are effectively managed (also see paragraph 5-15). The environmental officer assists the S-4/G-4 and the safety officer in developing the management plans. Because of the relation between HAZMAT, HW, and special waste, the environmental officer incorporates relevant HAZMAT-related information within the HW and special waste management plan and SOP.

5-68. The environmental officer also establishes the standards and requirements for conducting inspections as a means of ensuring compliance. The HW and special waste management plan and SOP must collectively address the proper characterization of HW and the requirements for accumulation areas, container management, labeling, documentation, inspections, and recordkeeping.

5-69. One of the primary objectives in managing HW and special waste is reducing the amount that is generated. This can be achieved by—

- Using alternative nonhazardous or less-hazardous materials and/or HAZMAT that can be recycled.
- Reducing the inventory of HAZMAT, based on the responsiveness of the supply system without jeopardizing unit readiness.
- Preventing subordinate units from stockpiling HAZMAT and ensuring that excess HAZMAT is turned back in for redistribution.
- Ensuring that HAZMAT is used before the shelf life expiration (first in, first out) or extending an expired shelf life when appropriate.
- Ensuring that HAZMAT is properly stored and safeguarded.
- Reusing or recycling HAZMAT.
- Ensuring that waste streams are segregated to prevent HW from mixing with nonhazardous waste.

5-70. Waste management planners must understand the standards for HAZMAT, HW, and special waste management established for the theater of operations. The requirements in each theater will likely be different from those in CONUS or outside the continental United States installations, which are based on U.S. federal, state, and local regulations. Theater-specific requirements will be based on the FGS, DOD 4715.05-G, Status of Forces Agreement, NATO standards, and HN laws. In some cases, where the FGS and Status of Forces Agreement have not been established and HN laws are indefinite or nonexistent, U.S. forces will follow the Overseas Environmental Baseline Guidance Document or U.S. federal environmental laws as closely as practical.

5-71. Personnel at every level should receive annual environmental awareness training. HAZMAT, HWAP, and HWSA managers, handlers, commanders, EOs, and first-line leaders should be familiar with AR 200-1, ATP 3-34.5/MCRP 3-40B.2 (MCRP 4-11B), TM 38-410, and this publication. Commanders must ensure that subordinate units are knowledgeable on the theater-specific requirements for handling, accumulating, and storing HAZMAT, HW, and special waste before setting up storage and accumulation sites. Leaders down to the lowest level must understand and enforce these standards with their personnel. Training should be directed at first-line leaders and personnel involved in actual or potential exposure to HW, including spill response, maintenance, fuel, motor pool, supply, transportation, and water production activities. Additional training should be provided to personnel involved in using, handling, and managing hazardous substances. Refer to TM 38-410 for extensive training information. The training contents and requirements shall—

- Include sufficient information to perform assigned duties and comply with requirements.
- Be conducted by qualified trainers.
- Prepare facility personnel to respond effectively to emergencies.
- Address container types, labeling, handling, storage, and transportation.
- Cover employee protection, including PPE, safety and health hazards, and worker exposure.
- Include recordkeeping, security, inspections, contingency plans, and segregation requirements.

6-72. Training should be performed and documented before deployment and before appointing personnel to HAZMAT and/or HW responsibilities. Thereafter, annual refresher training is required. At a minimum, HAZMAT and HW training should include—

- Hazard communication (such as hazard information on markings, labels, and SDSs).

- HAZMAT training (handling, storage, and use of HAZMAT).
- Emergency and spill response training.
- HW training (planning, management, and operations).
- Environmental officer training (including inspections, corrections, and recordkeeping).

5-73. Additional training in the following areas is recommended:

- Composite risk management/operational risk management.
- Transportation of HAZMAT/HW.
- Disposal requirements and procedures of HW and special waste.
- Lead/asbestos awareness training.
- Safety awareness training.
- Available treatments that reduce or eliminate HW volume or hazard characteristics.

5-74. There are resources to obtain training, available as classroom or web-based training. Check with your organic or supporting environmental office or Environmental Officer first for the availability of training for deploying/deployed forces. They may be able to provide or find the appropriate training for the mission. Also, the USAES, Directorate of Environmental Integration (DEI), supports a web-based Environmental Officer Course that can be found on the Fort Leonard Wood Blackboard Portal <https://www.blackboard.wood.army.mil/> under the Engineer tab. DEI web-based training requires an Army Knowledge Online account to gain access. DEI also provides non-web-based training, including resident training and mobile training, and can be contacted via email at usarmy.leonardwood.engineer-schl.mbx.dei@mail.mil or their Web site at http://www.wood.army.mil/usaes/DEI.html. Additional resources for classroom or web-based environmental training include—

- USAES DEI https://www.us.army.mil/suite/page/547917.
- United States Army Public Health Center (APHC) https://phc.amedd.army.mil/Pages/Training.aspx.
- DLA http://www.dla.mil/ddsr/.
- DOD Interservice Environmental Education Review Board (ISEERB) https://www.afit.edu/CE/page.cfm?page=546.
- Naval Civil Engineer Corps Officers School (CECOS) http://www.netc.navy.mil/centers/csfe/cecos/Courses.htm#tab1.

STEP 1. ANALYZE THE SITUATION

5-75. As explained in chapter 2, waste management planners use the mission variables to frame their assessment of the HW and special waste situation. Table 5-5 shows the considerations that are focused on HW and special waste.

5-76. Starting with mission analysis and continuing throughout the MDMP, waste management planners analyze each mission variable and develop a full list of consideration that could positively or negatively impact operations and influence HW management. They attempt to gain a better understanding of how, where, and what types of HW and special waste will be generated by the unit. Since U.S. laws and regulations will generally not apply within the theater of operations, additional guidance will be required that specifies what constitutes HW and special waste and what requirements apply. In situations where planners are uncertain of the categorization or characteristics of a waste material, they should submit a RFI through higher headquarters and/or seek subject matter expertise or assistance through the environmental officer or reachback. When uncertainties exist, waste management planners should make planning assumptions or temporarily contain the waste in question using the more stringent standards for storage or disposal while awaiting clarification.

5-77. Information management is critical to this step. Information is gathered through intelligence, surveillance, and reconnaissance collection (including environmental reconnaissance and infrastructure surveys) and through the submission of RFIs to lower, adjacent, and higher units. For example, a site survey such as an EBS or ESCS is used to collect information.

Table 5-5. HW and special waste considerations in relation to mission variables

Mission Variables	*Considerations*
Mission	• Identification of all operations and activities that generate hazardous waste and special waste • Where and when waste generation takes place (for example, supply, maintenance, and airfield) • Types and amounts of hazardous material/hazardous waste (based on functions and number of personnel and equipment) • Duration at a given location and consideration of viable management options • Limitations or mandatory actions/orders that could impact hazardous waste management
Enemy	• Threats while transporting hazardous material, hazardous waste, and special waste • Limited access of local and nonlocal contractors • Vulnerability of hazardous material storage, hazardous-waste accumulation points and hazardous-waste storage areas
Terrain and Weather	• Land availability for proper storage and segregation, and impacts of land cover • Prevailing wind direction and potential to contaminate air; place systems downwind • Potential to contaminate water resources if leaks or spills occur (soil type and slope) • Effects from using and storing hazardous material/hazardous waste on future land use • Predominate weather conditions and ability to contain hazardous material and prevent releases
Troops and Support Available	• Capability of units to manage, operate, and maintain hazardous systems • Capability of host nation to treat/dispose of hazardous waste and special waste • Need for knowledge and expertise ▪ Availability of Defense Logistics Agency facilities in theater ▪ Availability of specialized engineer units or contractors (local and nonlocal) ▪ Availability of United States Army Corps of Engineers and United States Army Public Health Center support or assistance teams (reachback) • Equipment and materials (for construction, operations, maintenance, and decontamination) • Availability of specialized equipment (for treatment or disposal) • Availability of funds and contracting mechanisms (including local purchase) • Population stability and predictability
Time	• Timeline of events to meet goals/objectives and mission ▪ Development of a hazardous material/hazardous waste management plan, including contingency plans ▪ Acquisition of supplies, services (contractors), equipment, and materials ▪ Arrival of troops, support, and equipment/materials ▪ Installation or construction of hazardous material/hazardous waste management systems ▪ Operation and maintenance of system(s) ▪ Closure and documentation of all systems • Roles and responsibilities, from point of acquisition through proper disposal, closure • Life span of hazardous material/hazardous waste systems (immediate, basic, expanded, or enhanced)
Civil Considerations	• Potential impacts to environmentally sensitive or protected areas ▪ Historical, religious, and cultural sites ▪ Threatened and endangered species and their habitats • Natural Resources, such as water, air, land, and minerals • Potential impacts to local communities (people, livestock, environment, economy) • Construction and treatment standards, agreements, and policies and guidelines • Materials that are recoverable, reusable, or recyclable • Existing infrastructure and transportation network (such as roads and facilities)

STEP 2. DEVELOP PRELIMINARY WASTE ESTIMATES

5-78. Waste management planners determine preliminary HW and special waste requirements as far in advance as possible by estimating consumption rates of HAZMAT, which are determined by analyzing unit equipment density lists, HAZMAT inventories, and the types of activities that will likely be performed during the course of the deployment. While planning, they must be particularly aware of certain types of equipment. For example, equipment that relies on batteries will likely be considered hazardous when discarded. Such equipment may not have presented a problem during short duration training exercises near U.S. military installations, but could become a challenge during a protracted operation in an austere environment. As COAs and associated concepts of the operation are developed, waste management planners develop preliminary HW and special waste requirements for each subordinate unit (one level down). Using a matrix, such as the sample work sheet shown in table 5-6, waste management planners begin this step by listing the activities that generate HW and special waste and estimating the amounts that will be generated, based on the activity and its frequency of occurrence.

5-79. Waste management planners must determine and characterize the HW and special waste generated by the unit. They identify inherent hazardous characteristics associated with a waste in terms of physical properties (such as solid, liquid, or contained gases), chemical properties (such as chemical constituents, technical, or chemical name), and/or other descriptive properties (such as ignitable, corrosive, reactive, and toxic). A HW SOP should be developed that contains a HW profile sheet (such as DD Form 1348-1A and DLA Form 2511) that is used to identify each HW stream that provides waste management guidance. The HW profile sheet must be updated, as necessary, to reflect any new waste streams or process modifications that change the character of the HW being handled, collected, accumulated, or stored. The theater senior engineer staff officer and environmental officer work together to develop the necessary guidance and/or a HW SOP for the theater of operations and update it with new information as appropriate.

Table 5-6. Sample HW and special waste requirements work sheet

	Immediate			***Expanded***		
Subordinate Unit	***Activities that Generate HW and Special Waste***	***Estimated Amount Generated by Activity***	***Required Resources and Solutions***	***Activities that Generate HW and Special Waste***	***Estimated Amount Generated by Activity***	***Required Resources and Solutions***
Company	Motor vehicle breakdown or collision with fluid loss on the ground	Amount of fluid loss and contaminated soil will be dependent on the vehicles involved and collision	PPE and fire extinguisher Drip pans Spill kits with absorbent, shovels, labels, and containers/ overpack	Semi-annual services for 100 HMMWVs (2 gallons of engine oil twice/year)	34 gallons of used oil/ month 17 filters/ month	Materials to set up HWAP in the motor pool Spill kits with absorbent, shovels, labels, and containers/overpack Means to transport containers to HWSA PPE and fire extinguisher
Note. This work sheet may be extended to incorporate all subordinate units and phases of an operation.						

Legend:

HMMWV	high mobility multipurpose wheeled vehicle
HW	hazardous waste
HWAP	hazardous waste accumulation point
HWSA	hazardous waste storage area
PPE	personal protective equipment

5-80. Several sources of information are available online, such as the DLA HMIRS and the APHC Military Items Disposal Instructions (MIDI) database, that are helpful in determining the harmful characteristics of a

material and whether or not it becomes a HW or special waste when discarded. The HMIRS is a central repository for information on HAZMAT used by the DOD, including SDSs for military supply items. The DLA maintains this database and allows users to search for product information by several means, such as by nomenclature or national stock number. The database provides information on the characteristics of specific materials, such as flash point, acidity, concentration, and toxicity. The HMIRS can be accessed through the DLA Web site at http://www.dla.mil/HQ/InformationOperations/Offers/Products/LogisticsApplications/HMIRS.aspx. The MIDI database provides guidance for the disposal of military items. It is accessible through the APHC Web site at https://phc.amedd.army.mil/topics/envirohealth/wm/Pages/Military-Item-Disposal-Instructions.aspx. Although the expressed focus of the MIDI database is unused or expired items (HAZMAT), and disposal information is based on federal regulations, there is useful information about hazard characteristics, storage, safety and control measures, and disposal that can also be applied to HW.

STEP 3. CATEGORIZE WASTE REQUIREMENTS

5-81. As discussed in chapter 2, the waste requirements are categorized (immediate, basic, expanded, enhanced, or transfer/closure) based on the expected length of the deployment. The categorization of HW and special waste requirements is included in the work sheet, as seen in table 5-6, to help with organization, planning, and execution. The work sheet should be extended, as needed, to cover all phases of the operation, based on the best information that is currently available, for each COA being developed. When uncertainties arise, RFIs are submitted to higher headquarters and/or assumptions are made to facilitate the continuation of planning.

STEP 4. EVALUATE WASTE MANAGEMENT CAPABILITIES

5-82. Waste management planners evaluate the available capabilities (to include skill sets) and resources (manpower, equipment, materials, and funding) for each subordinate unit (one level down). This evaluation determines a unit's ability to meet HW and special waste requirements for each phase of the operation and allows capability-based solutions to be generated to meet those requirements. When a shortfall exists between the capabilities and requirements, the subordinate unit can be reinforced with additional support or provided additional resources (to include funding) that will allow it to generate its own capabilities or acquire and sustain the needed support or services through contracting.

STEP 5. GENERATE SOLUTIONS

5-83. In consideration of the mission variables, waste management planners generate capability-based solutions to meet the requirements of the estimated HW and special waste that will be generated. Capability-based solutions are feasible, based primarily on the capabilities that are available in the current task organization, or that are likely to be made available, based on augmentation from higher headquarters, DLA Disposition Services, or through contracted support—in which case, a critical assumption must be made and captured during the planning process. Waste management solutions and the required resources are depicted for each requirement (within each critical event or phase) in the work sheet, as seen in table 5-6.

STEP 6. INTEGRATE WASTE MANAGEMENT TASKS INTO PLANS AND ORDERS

5-84. Once the COA is approved by the commander, waste management planners finalize the waste management tasks that need to be performed to achieve objectives for segregating, collecting, transporting, recovering, and disposing of HW and special waste. This includes reviewing the troop-to-task analysis for each task to ensure that the unit assigned that task has the necessary resources and capabilities to perform it. Waste management planners may also need to coordinate those tasks with other staff sections and other waste management planers at higher, adjacent, and lower units to ensure that they are appropriate and/or supportive of other requirements. The finalized tasks and other information that subordinate units will need to effectively manage HW and special waste that is not already included in SOPs is then integrated within the OPLAN/OPORD, usually in the engineer or the sustainment annex or as directed in the unit planning SOP. Waste management tasks can be provided in a matrix format and embedded within, or attached to, an annex.

5-85. The information contained in HAZMAT, HW, special waste, and environmental SOPs; guidelines and policies established for the theater of operation; and the OPLAN/OPORD provides subordinate units with the details needed to effectively manage HW and special waste. Waste management planners at all echelons must work together to ensure that the information provided in these documents is mutually supportive and collectively addresses the following areas, at a minimum:

- Safety and risk management in mitigating the health and environmental hazards associated with HAZMAT, HW, and special waste, to include the requirements for spill prevention, response, and reporting.
- Staff and subordinate unit responsibilities for segregating, collecting, transporting, recovering, and disposing of HW and special waste.
- Requirements for storing, issuing, and turning in HAZMAT.
- Requirements for accumulating, treating, and disposing of HW and special waste.
- Requirements for establishing and operating HWAPs and HWSAs.
- Inspection requirements (when and by whom) for HWAPs and HWSAs and the checklists that will be used.
- Priorities of support and priorities of effort (work) for each phase of the operation if the operation is phased.
- Training and certification requirements for personnel performing or supervising HW and special waste management tasks.
- General safety considerations associated with handling various types of HW and special waste.
- Procedures for characterizing, documenting, and marking HW and special wastes.

5-86. Tasks that support the HW management plan should also be included in logistics rehearsals and backbriefs to ensure that subordinates plans are feasible and/or supportable by higher headquarters.

BASE CAMP TRANSFER AND CLOSURE

5-87. Plans and SOPs for base camp transfer and closure should be considered in the initial planning stages of the base camp (during predeployment) and included in the waste management plan. Proper environmental site closure or turn-over is the responsibility of the departing unit, and DLA Disposition Services can be contacted for guidance about HW and special waste. Upon receipt or in anticipation of a notice to close or transfer the base camp, waste management planners update the closure plan that describes the disposition of HW and special waste and closure of accumulation points and storage areas. The plan must also include the actions necessary to return those areas to their preexisting state or the required condition for closure or transfer.

5-88. The unit site closure plan provides detailed information that subordinate units will need to properly close or transfer a base camp. The plan complements, and is supportive of, information contained in unit SOPs, orders, and plans issued by higher headquarters. The following areas should be addressed in site closure plans and/or SOPs:

- The disposition of HAZMAT.
- The requirement for packaging, containerizing, inventorying, labeling, and turning in HW and special waste for disposal.
- The removal of equipment and the cleanup of the surrounding area.
- The disposition of empty HW and special waste containers, to include standards for turn-in.
- The removal of fuel bladders, secondary containment liners, and associated fuel distribution equipment and the remediation standards necessary for any affected areas.
- The disposition of secondary containment and force protection berms.

5-89. The unit site closure plan also describes the required actions, tasks, and standards that will need to be completed within a certain time frame and/or within a certain sequence to ensure that the base camp can be closed or transferred in a timely manner. These include the following:

- Sixty days prior to closure/transfer—

- Make initial coordination with the appropriate environmental office or designated representative for the removal of HW and special waste from HWAPs.
- Make initial coordination through the environmental officer for preliminary (30 days out) and final (24 hours out) ESCS.
- Conduct an internal ESCS to identify critical environmental issues that must be resolved, and take necessary action.
- Request support through appropriate channels for environmental support beyond the unit capability.
- Ensure that proper supplies are on hand or on order to properly package and ship HW and special waste, including approved containers, labels, placards, and SDSs.
- Ensure that proper supplies and equipment are available to clean up identified or anticipated areas that will likely require action.

- Thirty days prior to closure/transfer—
  - Confirm that the final removal of HW and special waste has been coordinated.
  - Conduct the preliminary ESCS.
  - Take the necessary action on final site closure issues and requirements as identified by the preliminary ESCS.
  - Ensure that issues and requirements are resolved before the final ESCS.
- Twenty-four hours prior to closure/transfer—
  - Conduct the final ESCS.
  - Resolve any last minute environmental issues identified by the final ESCS.

5-90. The ESCR is the mechanism used to document the final condition of the occupied property and to ensure that units have properly prepared sites for closure or transfer. It must be completed before the unit is released of its responsibility for the site. The ESCS is the mechanism used to initiate the closure process, and the EBS and ECRs that have been completed during occupation of the site will be used as the basis for the ESCS. The unit environmental officer will coordinate through the area environmental office or the environmental officer at higher headquarters for any support needed to conduct the ESCS and finalize the ESCR. All documents are maintained by the occupying unit until the base camp is closed or transferred to the gaining unit. All documents are maintained at the base camp level, and the lead Service forwards completed environmental documentation to the CCDR for review and submission to the MESL. The MESL provides a system to manage and archive contingency location environmental surveys and reports and other related documentation. See appendix F for more information about base camp transition, transfer, and closure.

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Chapter 6
Medical Waste

This chapter provides waste management planners with an overview of medical waste and the roles and responsibilities for managing it at brigade level and below. Because of its unique characteristics and potential to cause infection and disease, this chapter describes different requirements that must be considered in developing a plan for segregating, collecting, storing, transporting, and disposing of medical waste.

OVERVIEW

6-1. *Medical waste* is any waste that is generated in the diagnosis, treatment, research, or immunization of human beings or animals that is potentially capable of causing disease or may pose a risk to either individuals or community health if not handled or treated properly. Common sources of medical waste include medical, dental, research and development, and veterinary facilities. Terminology will vary based on locality, so medical waste may also be called regulated medical waste, infectious waste, biohazardous waste, clinical waste, biomedical waste, and healthcare waste. Medical waste is further divided into nine categories, which are shown in table 6-1, page 6-2. (See MEDCOM Regulation 40-35 for more information about regulated medical waste.)

6-2. The responsibility for the management of medical waste rests with commanders at all levels who are supported by the engineering, logistics, and medical units. The policies and procedures for characterizing, segregating, collecting, storing, and disposing of medical waste will be tailored to the theater of operations (based on the FGS or Overseas Environmental Baseline Guidance Document, and governing international and HN laws and policies). This effort is initiated by the Medical Command (Deployment Support) in coordination with engineers, logisticians, environmental officers, and other staff members at the theater level. Once theater-specific medical waste guidance has been established, it is disseminated to subordinate units through an OPLAN/OPORD, policy memorandums, and SOPs for incorporation into unit medical waste management plans and SOPs, down to the lowest appropriate levels.

6-3. There may be unique diseases within the respective theater of operations. Based on the nature of the disease, its prevalence, the means in which it is transmitted, and other medical and scientific factors, the theater surgeon or designated medical representative will designate whether or not nonbloody wastes generated from the treatment of these diseases are declared as medical waste.

RESPONSIBILITIES

6-4. In addition to the roles and responsibilities for waste management described in chapter 1, the individual and staff responsibilities for medical waste management are outlined in the following paragraphs.

UNIT COMMANDER

6-5. The commander is responsible for the actions that a unit takes or fails to take. The commander's role in medical waste management includes the following tasks:

- Integrating medical waste considerations early in the planning phase and within each phase of the operation.
- Ensuring that subordinate units understand the requirements for medical waste and that the appropriate personnel are properly trained in managing it from the point of generation to disposal.
- Ensuring that subordinate units perform the necessary medical waste management tasks to standard.

Table 6-1. Categories of medical waste

Group	*Description*
1–Cultures, stocks, and vaccines	Cultures and stocks of infectious agents and associated biologicals, including cultures from medical and pathological laboratories. Discarded live and attenuated vaccines. Culture dishes and devices used to transfer, inoculate, and mix cultures.
2–Pathological waste	Human pathological waste, including tissues, organs, body parts, and extracted human teeth. Body fluids that are removed during surgery, autopsy, or other medical procedures.
3–Blood and blood products	Free-flowing liquid human blood, plasma, serum, and other blood derivatives that are waste (such as blood in blood bags and blood or bloody drainage in suction containers). Items such as gauze or bandages that are saturated or dripping with human blood, including items produced in dental procedures such as gauze or cotton rolls saturated or dripping with saliva. This does not include products used for personal hygiene (such as sanitary napkins/tampons). Items caked with dried blood and capable of releasing blood during normal handling procedures.
4–Used sharps[1]	Sharps used in animal or human patient care or treatment in medical, research, or support laboratories or when used for live training purposes, to include— Hypodermic needles. Syringes (with or without the attached needle). Pasteur pipettes. Scalpel blades. Blood collection tubes and vials. Needles attached to tubing. Culture dishes. Broken or unbroken glassware, such as used slides and cover slips, that came in contact with infectious agents.
5–Animal waste	Contaminated animal carcasses, body parts, and bedding of animals known to have been exposed to infectious agents during research (excluding carcasses of roadkills, euthanized animals, or animals dying of natural causes, and waste produced by general veterinary practices).
6–Isolation wastes	Bedding from patients or animals with etiologic agents classified by the Centers of Disease Control and Prevention as biosafety level 4 (including biological waste and discarded material contaminated with blood, excretions exudate, or secretions from humans who are isolated to protect others from highly communicable diseases such as pox viruses and arboviruses).
7–Unused sharps[1]	Same as 4–used sharps.
8–Other	Fluids that are designated by the local infection control authority, to include, but not limited to, semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, and amniotic fluid. These designated fluids are medical waste when free-flowing, dripping, or saturated on substrates.
9–Chemotherapy trace wastes	Needles, empty vials and syringes, gowns, and tubing that contained chemotherapeutic pharmaceuticals or were exposed to chemotherapeutic pharmaceuticals during the treatment of patients.
[1]Syringes without needles, not tainted with body fluids, and used for procedures such as irrigation, may be discarded as regular trash unless directed otherwise. Discard unused and noninfectious glassware in boxes designated and labeled for “broken glass;” these boxes are usually found in laboratories.	

ENGINEER STAFF OFFICER

6-6. As the primary staff integrator for the Army environmental program, which includes waste management, the engineer staff officer is responsible for incorporating the medical waste management plan into the unit waste management plan. The engineer staff officer performs the following tasks:

- Includes medical waste hazards into the overall risk assessment performed for waste management.
- Ensures that medical waste management tasks are incorporated into the unit waste management plan that is conveyed through mission plans and orders.
- Works with medical staff officers in devising medical waste disposal methods that are supportive of the waste management plan, to include the development of scopes of work in initiating contracting support.

Note: The logistics officer in the MAGTF command element performs similar functions for their respective MAGTF.

LOGISTICS OFFICER

6-7. The S-4/G-4 coordinates with the medical personnel assigned to the BCT headquarters and/or the brigade support medical company as appropriate to ensure that subordinate units have the necessary materials and supplies to manage medical waste.

MEDICAL PERSONNEL

6-8. The medical personnel assigned to the BCT headquarters and/or the brigade support medical company, as appropriate, will coordinate with the S-4/G-4 to ensure that subordinate units have the necessary materials and supplies to manage medical waste.

6-9. The medical personnel working within the facilities that provide medical, dental, and veterinary care are the primary generators of medical waste and are responsible for segregation at the point of generation. They are individually responsible for correctly categorizing the various types of waste and placing it into the designated containers for each waste type.

SURGEON

6-10. The surgeon works with PVNTMED personnel to develop unit procedures for managing medical waste according to the policies and guidance established for the theater of operations.

PREVENTIVE MEDICINE PERSONNEL

6-11. The PVNTMED personnel, organic to or augmenting the unit, work with the surgeon to develop unit procedures for managing medical waste according to the policies and guidance established for the theater of operations. They perform the following tasks:

- Provide medical waste management training to personnel working in medical treatment facilities.
- Monitor all phases of the medical waste management plan.
- Provide technical advice in identifying and characterizing medical waste.

INFECTION CONTROL OFFICER

6-12. Infection control officers work with PVNTMED personnel to monitor all aspects of the medical waste management plan. They also provide technical advice in identifying and characterizing medical waste.

MEDICAL WASTE MANAGEMENT SYSTEM

6-13. Waste management planners use the approach described in chapter 2 to analyze the current situation using the mission variables and to develop requirements for managing medical waste. Solutions are

developed to fulfill the requirements that are feasible and suitable (based on unit capabilities, available resources, mission requirements, and health and environmental considerations). The tasks required to support medical waste management and the detailed information that subordinate units will need to execute those tasks are included in OPLANs/OPORDs, which complement established procedures contained in unit SOPs. Records and documentation of medical waste management must be maintained for at least three years.

6-14. Personnel must be properly trained in the management of medical waste, to include the wearing of proper PPE for the task, according to guidance from PVNTMED personnel. For more information on medical waste management, see DOD 4715.05-G, DA Pamphlet 40-11, MEDCOM Regulation 40-35, TG 177, and AJEPP-2. Additional information can also be found on the APHC Web site at https://phc.amedd.army.mil/topics/envirohealth/wm/Pages/default.aspx.

CHARACTERIZATION AND SEGREGATION

6-15. Properly characterizing and segregating medical waste are critical tasks in effectively managing it. Not all of the waste generated by medical activities is medical waste. In most cases, the items that provide universal precautions (such as gloves and masks) can be classified as regular trash, not medical waste. Waste that is generated in patient sleeping or therapy rooms, diagnostic procedure rooms, doctor offices, and nursing units (such as soiled dressings, bandages, disposable catheters, swabs, and used disposable drapes, gowns, masks, gloves, feminine hygiene products, soiled diapers, and empty [used] specimen containers or cups) may not require any treatment and can be disposed of as regular trash.

COLLECTION

6-16. Segregate and secure medical waste from the point of generation through proper disposal, and do not mix medical or infectious waste with hazardous or radioactive waste. Medical waste is collected in red bags, or another specified color for the theater of operations, with a minimum thickness of 3 mils or that meets the 165 gram Impact Strength American Society for Testing and Materials (ASTM) D 1709-01 and 480 gram Tear Strength ASTM D1922-15 standards. Efforts must be made to ensure that the waste being placed into red bags does not contain any ammunition, unexploded ordnance, or other explosive hazards. All bags or receptacles used to segregate, transport, or store medical waste must be clearly marked with the universal biohazard symbol and the word “BIOHAZARD” in English (see figure 6-1) and any other language that is prevalent in the operational area.

Figure 6-1. Universal biohazard symbol

6-17. Sharps are collected in puncture-resistant, leak-resistant, and uniquely colored or marked containers. If proper containers are not available through the supply system, any rigid plastic or metal container (such as coffee cans or plastic drink bottles) can be used for collection. These expedient containers should be placed into red bags or proper sharps containers as soon as possible for disposal. Medical waste is never compacted

before disposal. When being sealed, bags containing medical waste must not be shaken or squeezed in an attempt to reduce volume.

6-18. Universal precautions must be taken when handling, transporting, and disposing of medical waste. This includes wearing protective gloves, masks, aprons, or other PPE that will reduce risks associated with medical waste.

STORAGE

6-19. Medical waste storage areas should be located near medical units and where access can be controlled. Medical waste must be stored in access-controlled areas that are ventilated and offer protection from the sun, rain, and pests. Medical waste must never be mixed or stored with regular trash or HW. The type, quantity, and disposition of stored medical waste should be recorded in a logbook or electronic journal for proper tracking purposes.

6-20. If the situation allows, the usual time for freezer storage of medical waste is approximately 30 days. Medical waste (other than sharps containers) should not be stored above 40°F for more than 5 days. Medical waste must be stored in a manner that prevents it from becoming a further hazard to the health and well-being of Soldiers. Storage areas must be away from food and common areas. Storage areas must be indicated by clearly displaying the universal biohazard symbol and the word "BIOHAZARD" in English and any other language that is predominately used in the operational area. A covered cargo trailer may be used for storage to facilitate the follow-on transportation of the waste from the medical treatment facility as long as storage requirements can be met.

6-21. Besides the space needed for storing medical waste, additional space should be allocated for storing supplies, including spill and cleanup kits, medical storage bags, sharps containers, storage drums, PPE, and shipping labels. Space will also be needed for power generators and refrigeration units that are required for storing pathological wastes.

TRANSPORTATION

6-22. Medical waste is considered a HAZMAT for transportation purposes and must comply with the requirements described in chapter 5. Medical waste may be transported in military, government, or contractor vehicles. It must be secured to prevent excessive movement and cannot be transported in the same vehicle with food items. Vehicles used to transport medical waste must be cleaned and disinfected before being used for any other purpose. Drivers must be properly trained prior to transporting medical waste.

6-23. A spill kit must be readily available to decontaminate any surfaces in the event of a leak or spill. The spill kit should include appropriate PPE, a disinfectant, absorbent material, and equipment used to gather spill residue. The kit may be assembled at the unit level or purchased commercially.

TREATMENT AND DISPOSAL

6-24. Contractors with the requisite training, skills, and equipment should be used for medical waste disposal whenever possible. Scopes of work for contracts must be precise in outlining the proper procedures for disposing medical waste. Medical waste contracts should be based on weight (not volume) or the number of containers. Once a contract is awarded, the contracting officer or the COR is responsible for monitoring the contractor's performance for compliance according to the performance work statement within the contract (additional COR responsibilities are described in chapter 1). The environmental officer and the surgeon should jointly inspect any HN disposal facilities before disposing of medical waste to confirm that the waste will be reduced to a safe environmental standard.

6-25. When contractor services are unavailable, the hierarchy for medical waste is high temperature two-stage incineration, sterilization, retrograding, burial, or alternative technologies to treat and dispose of medical waste according to guidance provided for the theater of operations. See MEDCOM Regulation 40-35 for more information on treatment and disposal methods for medical waste.

Incineration

6-26. The preferred method for disposing of medical waste is by incineration in an approved medical waste incinerator. Open burning of medical waste is prohibited during contingency operations, except when no alternative disposal method is feasible. Burning medical waste may be permitted using approved open-burning methods if approved through the commander of the respective geographic combatant command, who has the authority and responsibility, as delegated by the Secretary of Defense, to determine situations or circumstances under which no alternative disposal method is feasible. The open burning of medical waste must conform to policies and procedures established for the theater of operations and be outlined in the solid waste management plan for the contingency operation. At locations where medical waste is being disposed of through open burning, the respective combatant command will issue specific engineering and medical guidance that maximizes the protection of human health and safety.

6-27. Incineration and burn activities should be conducted as far downwind as possible (at least 450 feet) from inhabited areas. The use of a commercial incinerator that is capable of subjecting the waste to a minimum burn temperature of 1,500°F for at least 1 hour is the preferred method of destruction. A berm or fence with the appropriate warning signs should be constructed around the medical waste incinerator to prevent unauthorized access.

6-28. Incinerator operators must be trained on proper operating and maintenance procedures, safety measures (to include PPE use), emergency response, and environmental requirements. Incinerator bottom ash and air pollution control ash (if applicable) must be tested for HW properties prior to disposal in a solid waste landfill. Ash that is characterized as HW must be properly managed and disposed of as HW as described in chapter 5. Aerosol cans, gas cylinders, batteries, and other items that present an explosive hazard must never be incinerated. Seek approval through the chain of command before operating field-expedient devices, such as the inclined-plane burner that is described below.

6-29. The inclined-plane burner that is described in chapter 3 and shown in figure 3-3, is currently the best available, field-expedient means to treat and destroy medical waste, including sharps. It can accommodate the waste for a combat support hospital or similar-size medical unit. The waste feed to the inclined-plane burner should be mixed at approximately 10 percent, by weight, medical waste (to include sharps) to 90 percent, by weight, of regular trash. This mixture will help ensure the hottest and cleanest burn possible. Burning should be avoided when the wind will blow the resulting smoke toward the base camp or other inhabited areas. Depending on the guidance established for the theater of operations, if the ash does not contain any sharps and has been evaluated for hazardous qualities, it can be buried with other solid waste. If it is determined to be hazardous, it will be managed as HW. If it is nonhazardous but contains sharps, it will be placed in 55-gallon drums that will be retrograded to an approved landfill when filled. A retrograde shipment of drums containing this ash is not considered a HAZMAT shipment. If retrograding sharps is not an option, they may be buried below scavenger depth (approximately 8 feet), preferably in conjunction with sterilization or grinding.

6-30. Personnel involved in the actual burning of medical waste must wear skin protection and respiratory protection. An air-purifying respirator (cartridge or canister) with a high-efficiency particulate air filter is recommended. Paper surgical masks do not protect from hazards inherent in the burning of waste and should not be substituted for an air-purifying respirator. Wearing an individual's personal protective mask is also not recommended. Although a personal protective mask is equipped with a high-efficiency particulate air filter, it is best used to protect the individual against chemical and biological attacks.

6-31. An alternative to the incineration of sharps is the use of a sharps management system. When the container is full, two chemicals are added to the liquid, which generates a chemical reaction that heats the contents and then solidifies it into a solid mass. Once the chemical reaction has completed, the container is no longer a biohazard and may be disposed of as nonhazardous solid waste.

Sterilization

6-32. Steam sterilization, also known as autoclaving, is an alternative to the incineration of medical waste. Ensure that the waste is secured in autoclave bags (regular plastic bags may melt) before placement in the sterilizer. Autoclave indicator tape, if available, will show when sterilization is complete. Follow the manufacturer's instructions for proper time and temperature requirements. After the medical waste is

sterilized and has cooled, the waste may be managed as regular trash (solid waste). Ensure that care is taken when handling the waste to prevent needle sticks. Field sterilizers that are used to autoclave medical waste should never be used to sterilize other medical items (such as surgical packs) and should be permanently and indelibly marked with "FOR MEDICAL WASTE ONLY—DO NOT USE FOR STERILIZATION" or words to that effect. Units relying on a field sterilizer to sterilize waste should establish a contingency plan since field sterilizers tend to break down with extensive use. Autoclaves should be regularly tested (weekly, according to DOD 4715.05-G), using bacterial spores, to ensure that they are functioning properly. Table 6-2 contains product ordering information for portable steam sterilizers and various other medical waste disposal products.

Table 6-2. Medical-waste disposal products

National Stock Number	*Item*
6530-01-107-5799	Biohazard bags, 26 by 18 inches per package of 200 (autoclavable)
6530-01-107-5798	Biohazard bags, 36 by 24 inches per package of 100 (autoclavable)
6530-01-294-2865	Sharps containers (small)
6530-01-274-5099 6530-01-183-2863	Sharps containers (medium)
6530-01-484-1593	Sharps containers (large)
6530-00-477-6720	Bacillus stearothermophilus spore strips
6840-00-753-4797 7930-01-378-4561 7930-01-379-5269 7930-01-379-5692	Disinfectant, germicidal fungicidal concentrate (nonphenolic type)
7930-01-378-4564	Disinfectant, Germicidal Fungicidal Concentrate (phenolic type)
6530-01-340-8001 6530-01-142-8235 6530-01-137-8475	Sterilizers Portable, counter-top installed sterilizers (inside dimensions: width by length by height) 16 inches by 26 inches by 16 inches 20 inches by 38 inches by 20 inches

Retrograding

6-33. If use of a medical waste incinerator or sterilization is not possible, medical waste may have to be transported to a sustainment area where the appropriate facilities are available. These movements must be coordinated with higher headquarters to ensure compliance with any governing international agreements.

Burial

6-34. The last resort is burying untreated medical waste in a sanitary landfill located in an area with a deep groundwater table. Medical waste must be buried below 8 feet to prevent scavenging. A layer of lime may be placed over the waste prior to burial to accelerate decomposition and provide a measure of chemical disinfection. Medical waste burial sites must be marked and grid locations reported through the chain of command to facilitate the possible requirement that it will have to be recovered in the future.

Alternative Methods

6-35. If connected to a suitable wastewater treatment plant, some medical waste may be poured into clinical sinks after being properly sterilized. Always consult PVNTMED personnel and obtain approval from higher headquarters prior to disposing any treated medical waste to a wastewater treatment plant.

Pharmaceutical Disposal

6-36. For guidance on pharmaceutical disposal, consult SB 8-75-11 and the APHC MIDI database (https://phc.amedd.army.mil/topics/envirohealth/wm/Pages/Military-Item-Disposal-Instructions.aspx). The MIDI system provides hazard information and disposal options for hazardous and nonhazardous items. It aids the PVNTMED officer and the logistician in proper disposal of outdated medical and nonmedical items. Also, the database serves the DLA in their disposal mission.

MEDICAL WASTE MANAGEMENT PLAN

6-37. Waste management planners develop a medical waste management plan using the 6-step process that was introduced in chapter 2. The keys to a successful medical waste management plan are—

- Understanding which waste is medical waste and proper segregation at point of generation
- Safeguarding medical waste throughout collection, transportation, treatment, and disposal
- Assigning responsibilities and establishing procedures and standards for each aspect of the plan (segregation, collection, transportation, treatment, and disposal)
- Establishing the means to enforce standards through training, supervised execution, and inspections

6-38. The steps to developing the medical waste management plan are similar to the steps taken to develop the HW and special waste management plan. Assess the medical waste situation, refer to the 6-step process described in chapter 5 (starting at paragraph 5-75), and develop the medical waste management plan.

BASE CAMP TRANSFER AND CLOSURE

6-39. The components of a medical waste closure plan are similar to the components in the HW and special waste closure plan described in chapter 5 (starting with paragraph 5-86). Upon receipt or in anticipation of a notice to close or transfer the base camp, waste management planners develop a closure plan that describes the disposition of medical waste and the actions necessary to return areas to their preexisting state or the required condition. The plan complements, and is supportive of, information contained in unit SOPs, orders, and plans issued by higher headquarters. See the base camp transfer and closure information in chapter 5 and appendix F. The following areas should be addressed in site closure plans and/or SOPs:

- The removal or disposition of unused or reusable medical products, supplies, and equipment.
- The treatment of medical waste to allow for disposal as solid waste.
- The requirement for containerizing, inventorying, labeling, and turning in medical waste for disposal.
- The removal of medical equipment and required site work.

Appendix A

Identifying and Classifying Waste Streams

This appendix provides a graphical decision aid to facilitate waste management planning. It is intended as a planning tool and relies on the user's thorough understanding of the material presented throughout this publication.

WASTE SOURCES

A-1. As discussed in chapter 2, waste management planners use the 6-step process for developing a waste management plan. As part of step 1 (analyze the situation), waste management planners analyze the unit's waste streams by focusing on the type, size, and functions of units. Figure A-1, page A-2, shows some of the unit functions and activities that are typically performed in supporting an operation and tend to be the primary sources of most waste streams. The waste items that are listed within each function are not all-inclusive and will depend largely on the types of materials being consumed by the unit. As planners determine the waste items that will likely be generated, they then must categorize the waste.

WASTE CLASSIFICATION

A-2. After determining the waste items that are generated, based on the unit functions and activities being performed (see figure A-1), waste management planners use the flowcharts shown in figure A-2, page A-3, and figure A-3, page A-4, to classify the waste as one of the six primary types of waste, which are—

- Nonhazardous solid waste (see chapter 3).
- Gray water (see chapter 4).
- Black water (see chapter 4).
- HW (see chapter 5).
- Special waste (see chapter 5).
- Medical waste (see chapter 6).

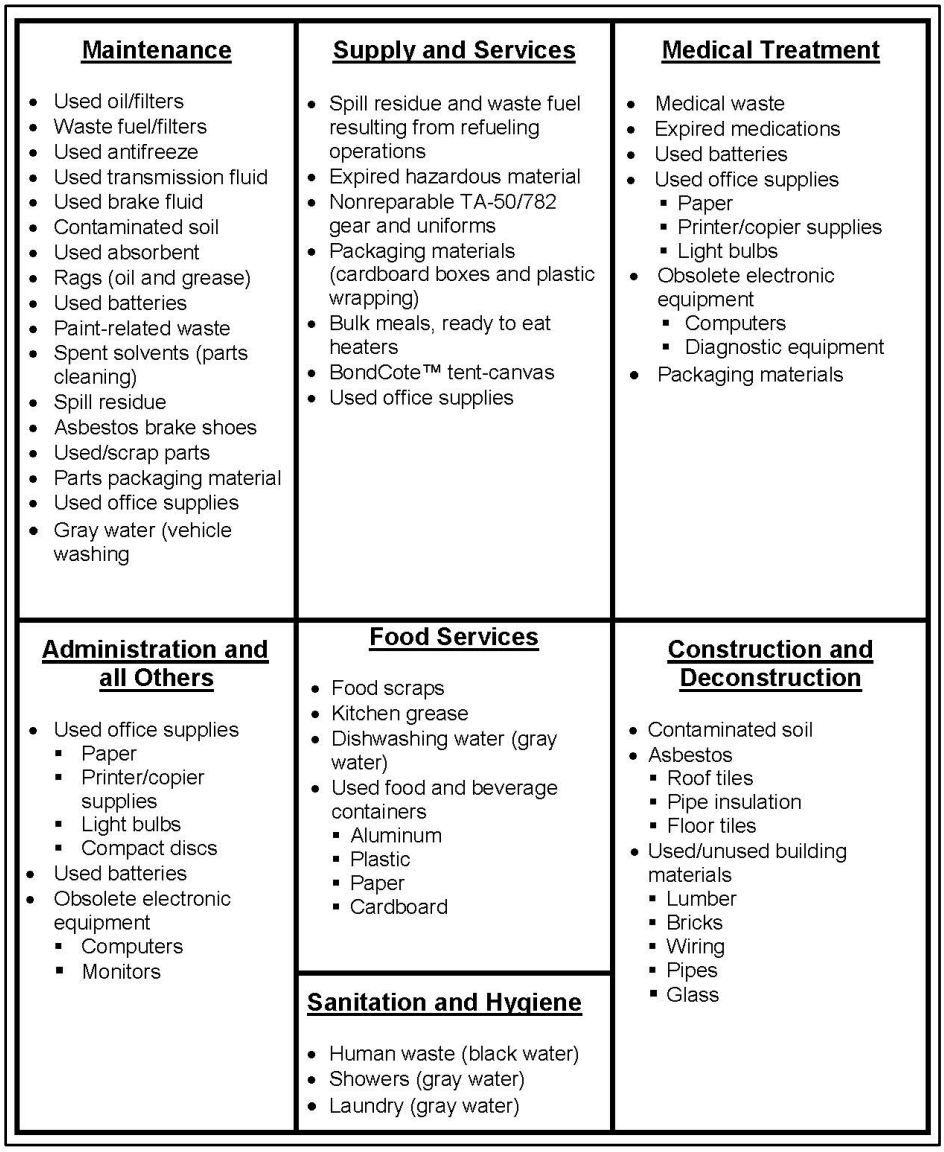
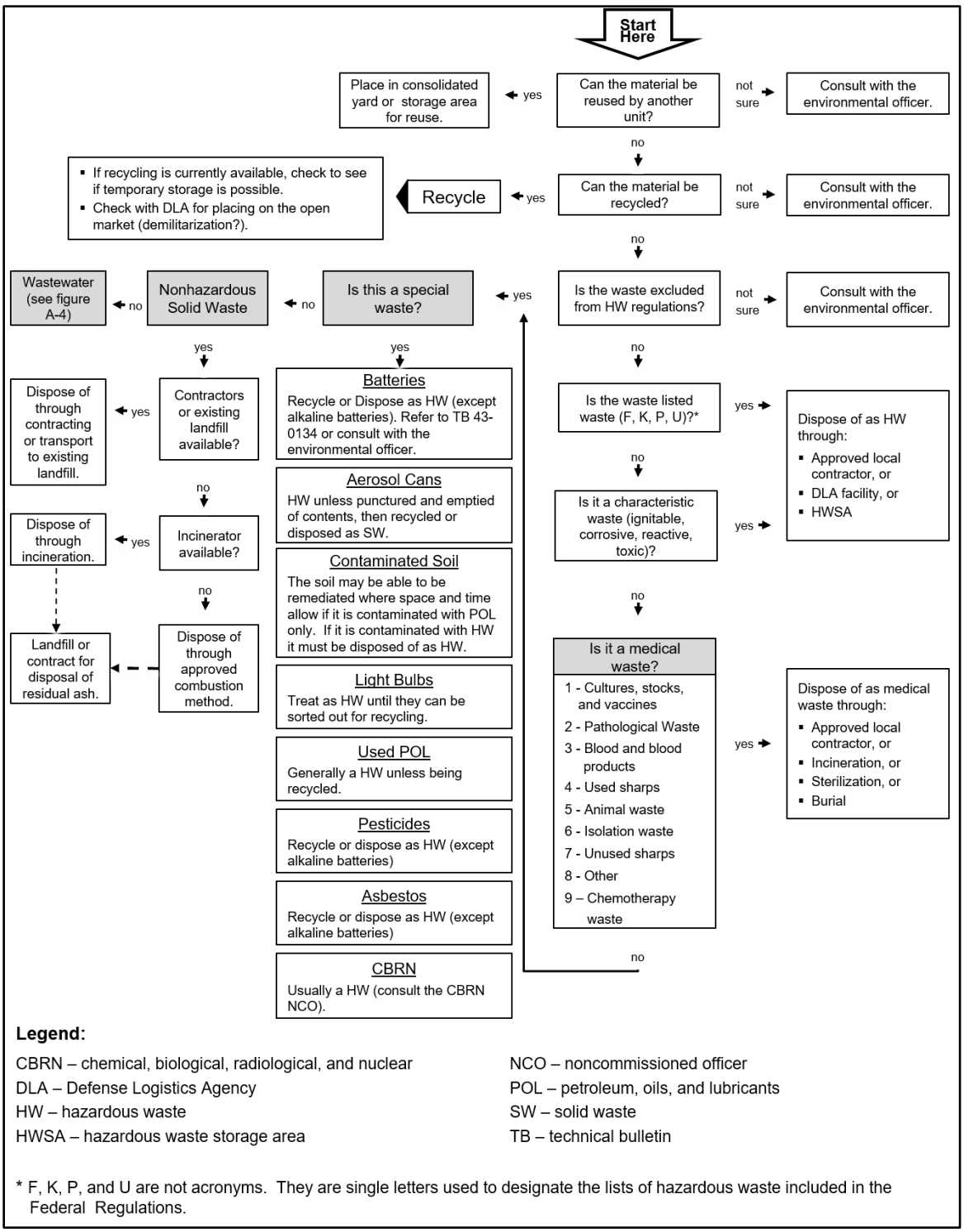


Figure A-1. Sources of waste for unit functions and activities



Legend:

CBRN – chemical, biological, radiological, and nuclear
DLA – Defense Logistics Agency
HW – hazardous waste
HWSA – hazardous waste storage area
NCO – noncommissioned officer
POL – petroleum, oils, and lubricants
SW – solid waste
TB – technical bulletin

* F, K, P, and U are not acronyms. They are single letters used to designate the lists of hazardous waste included in the Federal Regulations.

Figure A-2. Waste classification flowchart

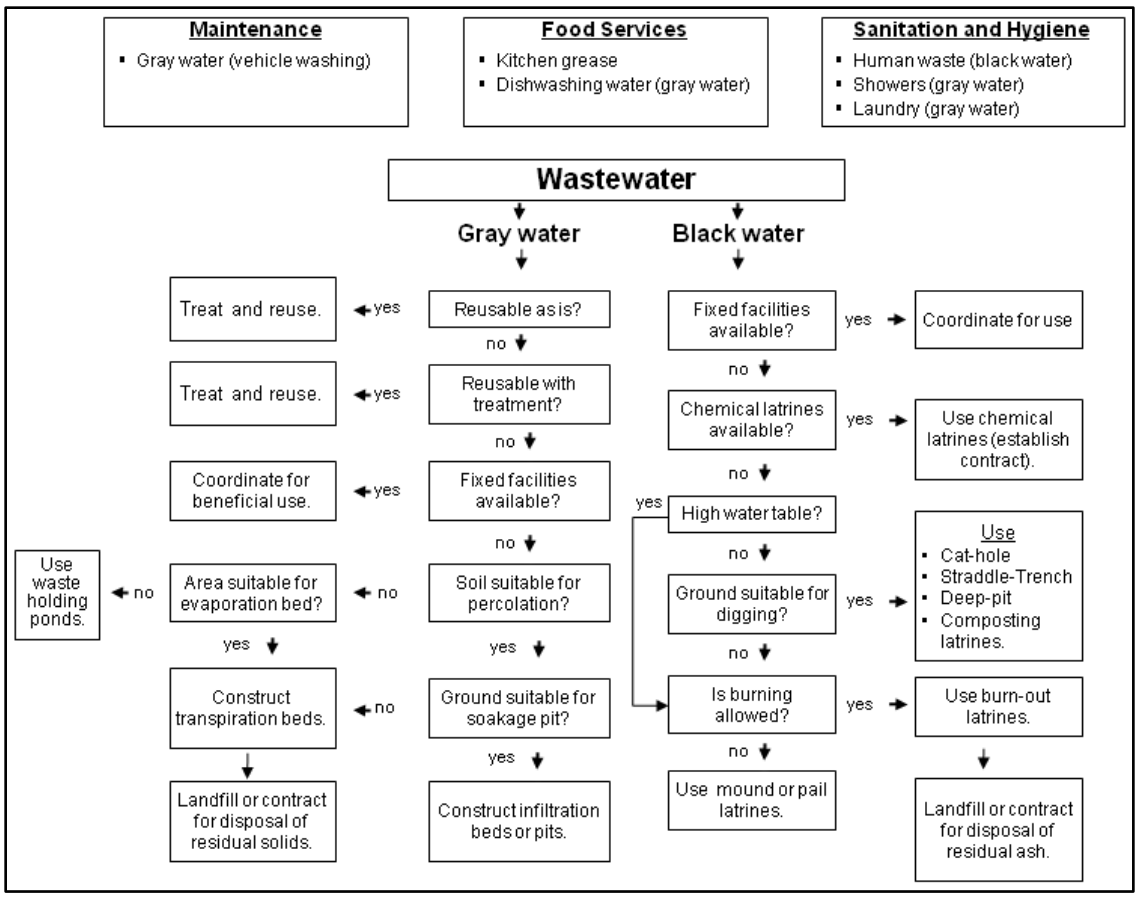


Figure A-3. Wastewater flowchart

Appendix B

OPLAN/OPORD Waste Management Appendix

This section provides guidelines for creating a waste management appendix that may be part of the engineer or sustainment annex used within an Army OPLAN/OPORD. Refer to ADP 5-0, FM 6-0, and MCWP 5-10 for more information on planning and orders.

GENERAL GUIDELINES

B-1. OPLANs/OPORDs are critical components to mission command/command and control. They convey the commander's intent, assigning tasks and purposes to subordinates, and providing the minimum coordinating measures necessary to synchronize the operation. To maintain clarity and simplicity, OPLANs/OPORDs include attachments (annexes, appendixes, tabs, and exhibits). Attachments contain information, administrative support details, and instructions that expand upon the base order; and they are used only when necessary and only when they pertain to the entire command. Appendixes contain information necessary to expand annexes and enable subordinate unit planning and successful mission execution.

B-2. The waste management appendix aims at unifying the waste management effort applied at the various echelons. It can be part of the engineer annex or the sustainment annex, depending primarily on the echelon and how the waste management functional area is organized within the staff.

B-3. The sample waste management appendix shown in figure B-1, page B-2, follows the Army's five-paragraph format for attachments prescribed in ADP 5-0 and FM 6-0. Similar information for the Marine Corps can be found in MCWP 5-10. These should be used as guidelines. The waste management appendix can include any combination of text, matrices, and graphics to best communicate information to subordinates. Though the content may vary based on unit SOPs and unit skill level, the waste management appendix should meet the following general criteria:

- Contain all critical information and tasks pertaining to the waste management effort not covered elsewhere in the order.
- Does not contain items covered in SOPs, unless the mission requires a change to the SOP.
- Provide information that is clear and concise.
- Include only information and instructions that have been fully coordinated in other parts of the plan or order.

RESPONSIBILITIES

B-4. The engineer staff officer, environmental officer, S-4/G-4, and other waste management planners within the staff must work together to effectively integrate the necessary information to perform waste management. As the primary staff integrator for waste management, which is part of the environmental program, the senior engineer staff officer ensures that the optimal amount of information and the necessary tools that subordinate units will need for waste management planning and execution are provided in OPLANs/OPORDs. The information needed is generated by various staff elements, such as environmental, PVNTMED, logistics, and others. The engineer staff officer is responsible for collecting and consolidating the necessary information into the waste management appendix and ensuring that the information and instructions are consistent with other information contained throughout the OPLAN/OPORD.

[Classification]

(Place the required classification at the top and bottom of every page of the appendix.)

Copy ## of ## copies

Issuing headquarters

Place of issue

Date-time group of signature

Message reference number

Include heading if attachment is distributed separately from the base order or higher-level attachment.

APPENDIX __ (WASTE MANAGEMENT) TO ANNEX _____ TO OPERATION PLAN/ORDER NO___.

References:

Time Zone Used Throughout the Order:

1. SITUATION. Include information affecting waste management operations that is not covered in the base order or the engineer or sustainment annexes.

a. Area of Interest. Refer to Annex B (Intelligence) as necessary.

b. Area of Operations. Refer to appendix 2 (Operations Overlay), Annex C (Operations), as necessary.

(1) Terrain. Describe how the terrain will impact waste management operations. Refer to Tab A (Terrain), appendix 1 (Intelligence Estimate), Annex B (Intelligence), as necessary.

(2) Weather. Describe how weather will impact waste management operations. Refer to Tab B (Weather), appendix 1 (Intelligence Estimate), and Annex B (Intelligence) as necessary.

c. Enemy Forces. Describe how the enemy will impact waste management operations. Refer to Annex B (Intelligence) as necessary.

d. Friendly Forces. Outline the higher headquarters plan as it pertains to waste management operations. List higher, adjacent, and other functional area assets that support or impact the issuing headquarters waste management capabilities or require coordination and additional support.

e. Interagency, Intergovernmental, and Nongovernmental Organizations. Identify and describe other organizations in the area of operations that may impact waste management operations.

f. Civil Considerations. Describe the impacts of civil considerations on waste management operations. Refer to Annex K (Civil Affairs Operations) as necessary.

g. Attachments and Detachments. List waste management assets, attached or detached, only as necessary to clarify task organization.

h. Assumptions. List any waste management-specific assumptions that support the annex development.

2. MISSION. State the waste management mission in support of the operation.

[Classification]

Figure B-1. Sample waste management appendix

[Classification]

3. EXECUTION.

a. Scheme of Support. Describe how waste management tasks support the commander's intent and concept of operations. State waste management priorities of effort and priorities of support (by unit or area) for each phase of the operation. Supplement the concept of sustainment (paragraph 4 of the base order) with any additional information that clarifies waste management tasks and purposes. The four major activities of waste management (collect, transport, recover, and dispose) may be used to structure this narrative.

b. Tasks to Subordinate Units. List waste management tasks assigned to specific subordinate units not contained in the base order.

- AA Patriot (immediate category): Construct field expedient latrines to accommodate black water requirements according to the unit waste management SOP. Prepare a closure plan to close the latrines before movement.
- FOB Baker (basic category): Establish contracts for the placement and servicing of chemical latrines that will accommodate 600 males and 200 females for a minimum of 90 days.
- Camp Lancer (expanded category): Ensure a HWAP is properly established and managed according to TM 3-34.56/MCRP 3-40B.7 and UFC 4-440-01. Disseminate the grid coordinates of the hazardous-waste accumulation point and all waste transportation procedures to subordinate units.

c. Coordinating Instructions. List instructions that apply to two or more subordinate units not covered in the base order. This may include, but is not limited to—

- Measures for reducing health risks associated with generated waste.
- Measures for preventing pollution.
- Information on waste collection and accumulation sites.
- Disposition or disposal instructions for specific waste items.
- Requirements for waste-related information. Include requests for information that have been submitted to higher and adjacent units that may be relevant to subordinate units planning.
- Channels for contacting support agencies (reachback) for technical assistance.
- Instructions for disseminating waste-related information.

4. SUSTAINMENT. Identify priorities for the sustainment for waste management key tasks and specify additional instructions as required. Describe stockage levels or basic loads for personal protective equipment, waste containers, spill prevention/response materials, and other waste management-related items to be maintained by subordinate units. Describe the appropriate channels for ordering, acquiring (local purchases), and contracting waste management supplies, materials, and services that are not covered in Annex F (Sustainment) as necessary.

5. COMMAND AND SIGNAL.

a. Command. State the location of key personnel involved with waste management.

b. Liaison Requirements. State any waste management liaison requirements not covered in the base order.

c. Signal. Address communications requirements or reports used for managing waste.

ACKNOWLEDGE: Include only if distributed separately from the base order.

OFFICIAL:

[Authenticator's name]

[Authenticator's position]

The commander or the coordinating staff officer responsible for waste management may sign the appendix.

ATTACHMENT: List any tabs as required.

DISTRIBUTION: Show only if distributed separately from the base order or higher-level attachment.

[page number]
[Classification]

Figure B-1. Sample waste management appendix (continued)

Legend:	
AA	assembly area
FOB	forward operating base
SOP	standard operating procedure

Figure B-1. Sample waste management appendix (continued)

Appendix C

Spill Prevention and Response Planning

Emergency spill response plans are developed to mitigate the impacts of spills during the accumulation, storage, or transportation of HAZMAT and HW and special waste. A spill response plan provides the necessary details to allow personnel to appropriately respond to a spill. Spill response plans are required for all base camps and units who are responsible for HAZMAT, HW, and special waste. Response plans are posted within storage and accumulation sites and are rehearsed to ensure that personnel will respond appropriately.

SPILL PLANNING

C-1. An environmental officer is normally assigned to develop a spill prevention and response plan.

PREVENTION

C-2. Risk management is the process of detecting, assessing, and controlling risk that arises from operational factors and balancing that risk with mission benefits (see ATP 5-19). One of the main goals of risk management is to reduce the level of risk to low or none. Pollution prevention can greatly reduce that risk. The key to pollution prevention is proper planning; for example, plan to build areas to prevent accidental spills and releases.

C-3. Monitoring spill prevention and enforcing spill cleanup standards reduces risks to human health and helps avoid future cleanup costs (in terms of time and money) that will be required upon base camp transfer or closure.

ACCUMULATION AND STORAGE SITES

C-4. Keep HAZMAT and HW areas clean and orderly to reduce accidents in the storage area and ease the cleanup of spills. Remember to **C-H-E-C-K**:

- **Containment.** Ensure that secondary containment is used and in good condition. Empty water from the secondary containment on a regular basis. If the collected water shows any obvious signs of contamination (such as a sheen), properly dispose of it at the HW accumulation point.
- **HAZMAT and HW locations.** Choose appropriate HAZMAT and HW locations. Erect warning signs, and keep the areas clean and orderly.
- **Environmental documentation.** Maintain an SDS for each HAZMAT, and update the unit SOP and spill response plan regularly. Maintain documentation of waste removal.
- **Containers.** Check the condition of containers, and ensure that they are properly labeled. Keep containers of incompatible materials separated. Keep lids and bungs closed when containers are not in use.
- **Kits.** Place spill, first aid, and emergency response kits near HAZMAT and HW areas. Ensure that PPE fits and that replacement items are available for the operation.

C-5. The proper location of accumulation and storage sites also reduces the tactical risk of an adversary using chemicals against friendly forces. Consider the following when choosing a location for HAZMAT and HW areas:

- Locate HAZMAT and HW areas away from billeting, bunkers, ammunition storage facilities, outer perimeter fence lines, and dining facilities.
- Develop HAZMAT areas near locations where they will be used.

- Develop HW areas near generation points to reduce the potential for a spill.

SAFETY DATA SHEETS

C-6. Maintain SDSs (see appendix E) as follows:

- Keep an SDS for each HAZMAT stored or collected in HAZMAT and HW areas.
- Ensure that SDSs are readily available to all unit members.
- Review SDSs before accepting unfamiliar HAZMAT.
- Know the PPE requirements for each HAZMAT used.
- Keep copies of the unit environmental SOP and spill response plan in HAZMAT at and HW areas.

COMPATIBILITY OF MATERIALS

C-7. Different classes of HAZMAT and HW are required to be stored and disposed of separately. SDSs describe the classifications of HAZMAT. Four common classifications are—

- Flammable (fuels).
- Corrosive (acids).
- Reactive (explosives).
- Toxic (insecticides).

SECONDARY CONTAINMENT

C-8. All liquid HAZMAT and HW must have secondary containment. In order to effectively contain a spill, the secondary containment should—

- Hold 10 percent of the total HAZMAT and HW stored or 110 percent of the largest container.
- Contain a seamless, ultraviolet-resistant plastic liner. As a field-expedient method, containers can be placed on a large plastic tarp with sandbags stacked around the perimeter, the edges of the tarp draped over the top of the sandbags, and the tarp folded back into the storage area. Specialized secondary containment pallets or systems are available through the supply system and should be used as base camps become more enduring.
- Provide overhead cover to protect containers from the elements and prevent rainwater from accumulating in the secondary containment system.

SPILL RESPONSE

C-9. While good management practices minimize the chance of HAZMAT/HW spills, accidents will still happen. When they do, it is imperative that personnel are trained and prepared to mitigate the damage and to clean up the spills as quickly, safely, and effectively as possible.

SPILL RESPONSE PLAN

C-10. A spill response plan must be available for each operation. The following organizations should have a copy of this plan: tactical refueling, maintenance, and HAZMAT/HW accumulation and transportation. The plan should address, at a minimum, site-specific response procedures and spill response equipment requirements for each major operation. A sample spill prevention and response plan is shown in figure C-1.

[Classification]

SPILL PREVENTION AND RESPONSE PLAN

1. SITE MAP. Include a map or sketch of the site and surrounding area.

2. SITE DESCRIPTION. Describe and highlight HAZMAT facilities and areas on the site map, to include:

- Prevailing wind direction and vulnerable areas (such as work and billeting areas) that may need to be evacuated in the event of a spill or release.
- Environmentally sensitive areas that must be avoided, including drainage systems and water resources, endangered species habitat, and cultural resources.
- Location of key personnel (when on and off duty).
- Location of emergency response services, such as fire, police, and medical.

3. RESPONSIBILITIES. Provide the name, title, responsibilities, duties, and contact information for those who have a role in spill prevention and response. Address procedures for inspecting the site for prevention and control deficiencies (frequency of inspections and inspection checklists). Include monitoring requirements for the early detection of spills.

a. Subordinate Units and/or Chain of Command.

B. Facility Incident Commander and Alternate.

c. Environmental Officer.

d. Storage or Accumulation Site Manager and Alternate.

e. Facility (Site) Response Team Coordinator.

f. Facility (Site) Response Team. Include the name, emergency contact information, and location (building/tent/bunk number) for each team member.

g. Emergency Response Contact Information. Provide the necessary information for contacting fire, police, and emergency medical services.

4. SITE MATERIAL INVENTORY. For each facility/area, list all HAZMAT with quantities.

5. SITE SPECIALIZED RESPONSE.

- Probable surface flow routes of spillage, based on predicted draining patterns.
- Immediate response actions that must be taken once a spill is discovered.
- Communication plan to notify spill response team members and emergency services of a spill.
- Procedures and techniques to contain and clean up spills.
- Procedures for the proper disposal of recovered HAZMAT and contaminated absorbent materials.
- Steps to be accomplished before resuming operations at the site (replacing materials and PPE, notifications, and recordkeeping).

6. SITE EVACUATION PLAN.

- Describe signals (primary and alternate) to be used to initiate evacuation.
- Describe evacuation routes (primary and alternate) and designated assembly points.

TABS: (as necessary)

DISTRIBUTION:

[Classification]

Figure C-1. Sample spill prevention and response plan

Legend:	
HAZMAT	hazardous material
PPE	personal protective equipment

Figure C-1. Sample spill prevention and response plan (continued)

C-11. The spill response plan is updated periodically or whenever there is a significant change in the situation, such as changes in responsibilities, procedures, use of equipment, or base camp or site layout.

SPILL RESPONSE PROCEDURES

C-12. In the event of a HAZMAT or HW spill, the procedures listed below must be implemented immediately by trained personnel within the unit. Personal safety must never be compromised during the response. If the situation exceeds unit capabilities, evacuate the area, inform the chain of command, and contact the local HAZMAT spill response team or local fire department if one exists. Emergency telephone numbers or radio frequencies should be obtained and distributed throughout the unit, as necessary, before the operation begins. Personnel should—

- **Step 1.** Protect themselves and other personnel. Sound the alarm, give a verbal warning, or contact emergency response personnel as appropriate. Have another person call for assistance while efforts are made to contain the spill. Evacuate all nonessential personnel from the immediate area, as necessary, based on the material spilled. Use the required PPE as detailed on the SDS for the spilled material. Extinguish smoking materials and all sources of ignition. Turn off power if there is the possibility of fire. Ventilate the area.
- **Step 2.** Stop the flow if possible to do so safely. The flow of HAZMAT and HW must be stopped at the source to control the spill. This may be as simple as placing the container upright or closing a valve. In the event of a flammable material spill, use only nonsparking tools and ensure that metal-to-metal contact is avoided.
- **Step 3.** Contain the spill. The purpose of this step is to prevent the spread of contamination. This can be achieved by placing drip pans to catch the spilled material, constructing earthen berms or placing sandbags around the contaminated area, or placing absorbent material in the area of the spill. Divert the flow, if necessary, to prevent it from entering storm water or sewer drains or other waterways.
- **Step 4.** Report the spill. Notify the chain of command and unit environmental officer immediately. A sample spill report is shown in figure C-2. A more detailed written report is prepared after cleanup is completed.
- **Step 5.** Clean the spill. Equipment used to clean a spill must be chosen carefully. Use only nonsparking tools if the material is flammable or explosive. For corrosive materials, use equipment that will not corrode or deteriorate, such as nonmetallic equipment. Collect used absorbent and contaminated soil in plastic bags, and transfer the bags into a labeled, sturdy container to be disposed of as HW.
- **Step 6.** Prepare and submit a detailed written report through the chain of command.
- **Step 7.** Replace spill response equipment. Obtain replacement spill response equipment through the unit supply channels to ensure that personnel can properly respond in the event of subsequent spills.

Line 1–Date and time	DTG
Line 2–Reporting unit	Unit making the report
Line 2A–Reporting POC	Rank, first name, and last name
Line 2B–Reporting e-mail	AKO or theater e-mail account
Line 2C–Reporting phone	DSN, voice, DNVT, or commercial
Line 3–DTG of discovery	DTG of spill discovery
Line 3A–DTG of spill	DTG
Line 4–Material spilled	JP-8, MOGAS, oil, solvent, other, or unknown
Line 5–Quantity spilled	Quantity of spilled material, in gallons
Line 5A–Type of surface	Unknown, bare soil, concrete, or asphalt
Line 5B–Type of Containment?	Was spill contained? Yes, No, or Unknown.
Line 6–Location	UTM or eight-digit grid coordinates with MGRS grid zone designator of spill
Line 6A–Base camp	Base camp name
Line 7–Cause	Accident, enemy fire, or negligence
Line 8–Size of area affected	Size of affected area, in square feet
Line 9–Hazards to environment	Did the spill cause any potential damage to environmental receptors, such as parks, forests, monuments, wildlife preserves, or waterways (irrigation canals, rivers, lakes, or water wells)?
Line 10–Hazards to personnel	Did the spill pose any obvious and immediate threat to the safety of personnel (such as exposure to strong fumes, fire hazards, or contaminated food or drinking-water sources)?
Line 10A–Personnel injuries	Did the spill result in any injuries to personnel? Yes, No, or Unknown.
Line 11–Actions	Remediated spill, none, or unknown
Line 12–Responsible unit	Supervising unit POC
Line 12A–Responsible POC	Rank, first name, and last name
Line 12B–Responsible e-mail	AKO or theater e-mail account
Line 12C–Responsible phone	DSN, voice, DNVT, or commercial
Line 13–Assistance	Assistance required or requested? Yes, No, or Unknown.
Line 14–Narrative	Brief summary of the spill events.

Legend:

AKO	Army Knowledge Online
DSN	Defense Switched Network
DNVT	digital nonsecure voice terminal
DTG	date-time group
JP-8	jet propulsion fuel grade 8
MGRS	Military Grid Reference System
MOGAS	motor gasoline
POC	point of contact
UTM	Universal Transverse Mercator

Figure C-2. Sample spill report

SPILL RESPONSE EQUIPMENT

C-13. Spill response equipment is essential to protecting the environment in the event of a HAZMAT or HW spill. The type and amount of spill response equipment needed depends on the operation. Units also need to

acquire hydrophobic POL-absorbent materials for operations conducted near water resources or in areas prone to receive precipitation.

Tactical Refueling Operations

C-14. Tactical refueling activities are limited to the handling of fuel products, such as diesel and gasoline. The extent of the operations and load-carrying capabilities of fuel tankers and heavy expanded mobile tactical trucks restrict the amount and type of spill response equipment needed. In the event of a major spill during refueling activities, personnel primarily need two nonsparking picks and two nonsparking shovels to excavate contaminated soil and several large, plastic bags to contain the excavated soil for disposal as HW. Approximately 10 pounds of absorbent and several small, plastic bags are sufficient to respond to small-volume spills on a hardstand. Additional resources may be obtained through supply channels, as required.

Field Maintenance Operations

C-15. Field maintenance activities routinely deal with all Class III items. Repeated small-volume spills are indicative of field maintenance activities. Approximately 25 pounds of absorbent; two nonsparking shovels; two brooms; and several small, plastic bags for contaminated absorbent are sufficient to maintain field maintenance activities during a deployment. Additional resources may be obtained through supply channels, as required.

HAZMAT Storage and HW Accumulation Operations

C-16. HAZMAT storage and HW accumulation operations deal with all Class III items. Leaking containers and small-volume spills are indicative of field HAZMAT storage or HW accumulation operations. Approximately 15 pounds of absorbent; two nonsparking shovels; two brooms; and several small, plastic bags for contaminated absorbent are needed at each storage area. Additional resources may be obtained through supply channels, as required.

HW and HW Transportation

C-17. Transportation of HAZMAT and HW involves handling several classes of supply in different-size containers. Leaking containers and small-volume spills are common when transporting HAZMAT/HW; however, the potential exists for large-volume spills in the event of an accident. Each vehicle approved for transport of HAZMAT/HW should maintain approximately 25 pounds of absorbent; two picks; two nonsparking shovels; one broom; and several small and large plastic bags for contaminated soil. Additional resources may be obtained through supply channels, as necessary.

SPILL CLEANUP PROCEDURES

C-18. The steps taken to clean up after a spill will vary depending on the material that was spilled. The SDS will provide vital information regarding PPE, materials incompatible with the spill substance, and suggestions for spill response and cleanup. Check the SDS before responding to a spill.

Spill Cleanup for Flammable and Combustible Organic Liquids

C-19. Follow the spill cleanup procedures below for flammable and combustible organic liquids:

- **Respond to the spill.**
  - Keep flammable liquids away from any potential heat, spark, or flame.
  - Use proper PPE.
  - Enclose spilled combustible liquid with a dike of sawdust or solid absorbent.
  - Use foam (such as aqueous film forming foam), if available, and pump free liquid into a suitable container. Use an intrinsically safe pump if available.
  - Use another type of absorbent if free liquid cannot be collected, such as sawdust, cat litter, soil, or other solid absorbent material.
  - Wash all clothing after use, and have the equipment cleaned before reuse.

- **Clean up the spill.** Use enough absorbent to soak up all the spilled liquid. Since most organic liquids are flammable, avoid all sources of ignition or sparking. Scoop up spent solid absorbent with a nonsparking shovel. Place absorbent in the proper waste container.
- **Contain the spill.** Use a metal or plastic drum to containerize spill residue.
- **Use PPE.** Vapors heavier than air tend to accumulate in low places. Avoid having flammable vapors come in contact with ignition sources to prevent flashback. Persons involved in cleaning up a spill must wear the following PPE:
  - Rubber or neoprene gauntlet gloves, 46 centimeters (18 inches) in length.
  - Rubber or neoprene apron.
  - Rubber, high-top shoes or overshoes.
  - Disposable coveralls.
  - Protective mask.
  - Full face shield (when not wearing a mask and still working with open chemicals).
- **Use fire extinguishers (carbon dioxide or dry-chemical).** In case of fire, call the fire department. Cool nearby drums with a stream of water to prevent ignition and the possibility of pressure increase in the containers.
- **Respond to emergencies.**
  - Move any victims to fresh air, and provide basic first aid. Have someone call for emergency assistance. Determine what chemicals were involved in order to aid emergency personnel with first aid treatment.
  - Remove contaminated clothing. Wash the victim's skin for 15 minutes by having the victim stand under an emergency shower. Transport the victim to the nearest medical clinic or hospital.
  - Flush the victim's eyes for 15 minutes using an eye-wash unit if the chemical got in the victim's eyes. Transport the victim to the nearest medical clinic or hospital.
  - Be prepared to tell the doctor what chemicals are involved.

Spill Cleanup for Acids

C-20. The pH scale is a numeric scale from 0 to 14 used to specify if a substance is an acid or base. The pH scale can be divided into five simple ranges: 0-4 is acidic, 4-6 is slightly acidic, 6-8 is neutral, 8-10 is slightly basic/alkaline, and 10-14 is basic/alkaline. Take special precautions when handling acids and bases because they can be harmful. A small amount of spilled acid (a gallon or less) can be safely neutralized. Follow the spill cleanup procedures below:

- **Respond to the spill.**
  - Stay upwind.
  - Use proper PPE.
  - Enclose spilled acid with a dike of solid absorbent, absorbent socks, or pads.
  - Do not add water to acid.
  - Wash all clothing after use, and have the equipment cleaned before reuse.
- **Neutralize the spill.** Add sodium bicarbonate (such as baking soda) to the liquid acid spill until it is completely covered. Test with pH paper and continue to add sodium bicarbonate until a pH of 6-8 is achieved.
- **Clean up the spill.** Add sawdust, clay, or dry sweep until the acid and sodium bicarbonate are completely covered. Scoop up spent solid absorbent material with a nonsparking shovel that has a long handle, and scoop up the contaminated soil. Place spent waste in the proper container.
- **Contain the spill.** Use plastic or rubber containers for the spent waste.
- **Use PPE.** Personnel involved in cleaning up an acid spill must wear the following PPE:
  - Rubber or neoprene gauntlet gloves, 46 centimeters (18 inches) in length.
  - Rubber or neoprene apron.
  - Rubber, high-top shoes or overshoes.

- Long-sleeve shirt.
- Protective mask.
- Full face shield (when not wearing a mask and still handling a spill).
- Use fire extinguishers. Use dry chemical or carbon dioxide extinguishers, as necessary.

- **Respond to emergencies.**
  - Be aware that acids can cause burns to the skin and eyes upon contact. It may also be harmful if inhaled or swallowed.
  - Move any victims to fresh air. Have someone call for emergency assistance immediately. If a person ingests acid or breathes acid fumes, transport the victim to the nearest medical clinic or hospital at once.
  - Remove contaminated clothing. Transport the victim to a shower point, and wash the victim's skin for 15 minutes by having him stand under the shower. Transport the victim to the nearest medical clinic or hospital.
  - Flush the victim's eyes for 15 minutes using an eye-wash unit, if a chemical got in the victim's eyes. Transport the victim to the nearest medical clinic or hospital.
  - Be prepared to tell the doctor what chemicals are involved.

Note. If a large amount of acid is spilled, request assistance from emergency responders or personnel properly trained to respond to chemical spills. The use of respirators may be necessary for response—personnel must be properly trained, have undergone a pulmonary fitness test, and been fit tested to use respirators.

Spill Cleanup for Bases

C-21. As described in the previous paragraph, a substance with a pH of 8-10 is slightly basic and a pH of 10-14 is basic. Take special precautions when handling bases. It is imperative to review the SDS of bases. Some strong bases, such as sodium hydroxide, have a violent reaction with water. If basic materials are used, ensure that a spill kit specifically designed for cleanup of bases is on hand. If the basic material is liquid and a large spill, evacuate the area and request assistance from trained emergency response personnel. If the spill (liquid, solid, powder, pellet, or flake) is small (a gallon or less) follow the spill cleanup procedures below:

- **Respond to the spill.**
  - Stay upwind and away from low areas.
  - Use proper PPE.
  - Enclose spilled base with a dike of solid absorbent (sawdust, vermiculite, or clay).
  - Wash all clothing after use, and have the equipment cleaned before reuse.
- **Neutralize the spill.** A weak acid, such as acetic acid or diluted hydrochloric acid, can be added to the spilled liquid base. If the spilled base is a solid, powder, pellet, or flake, clean it up by containerizing as much of the material as possible, then add water to the remaining material. Test with pH paper for a pH reading of 6 to 8. If needed, acetic acid or diluted hydrochloric acid may be added until a neutral pH is reached.
- **Clean up the spill.** Add more absorbent if necessary. Scoop up spent solid absorbent material with a nonsparking shovel or scoop that has a long handle. Place the absorbent in the proper spent-waste container. The waste container should be properly color-coded and labeled.
- **Contain the spill.** Use plastic or rubber containers for the spent waste.
- **Use PPE.** Spilled bases are very slippery. Care must be taken to avoid falls. Personnel involved in cleaning up spills must wear the following protective clothing and equipment:
  - Rubber or neoprene gauntlet gloves, 46 centimeters (18 inches) in length.
  - Long-sleeve shirt.
  - Rubber or neoprene apron.
  - Rubber, high-top boots or overshoes.

- Disposable coveralls.
- Full face shield (when a respirator is not being worn and still working with open chemicals).
- Respirator with filter cartridges appropriate to the material (for mists or fumes).

- **Use fire extinguishers.** Use water spray (if appropriate), dry chemical, or carbon dioxide, as necessary.
- **Respond to emergencies.**
  - Be aware that bases and alkaline substances can cause burns to the skin and eyes upon contact and can be harmful if inhaled or swallowed.
  - Move any victims to fresh air. Have someone call for emergency assistance if the victim comes in contact with the chemicals so that firefighters or emergency medical personnel can assist with first aid treatment. Transport the victim to the nearest medical clinic or hospital. If the victim ingests a base or breaths basic fumes, transport the victim to the nearest medical unit or hospital at once.
  - Remove the victim's contaminated clothing. Wash the victim's skin for 15 minutes by having the victim stand under an emergency shower. Transport the victim to the nearest medical clinic or hospital.
  - Flush for 15 minutes using an eye-wash unit if a chemical got in the victim's eyes. Transport the victim to the nearest medical clinic or hospital.
  - Be prepared to tell the doctor what chemicals are involved.

SPILL RESPONSE SUPPLIES

C-22. At a minimum, units deploy with enough spill response supplies (such as drums, overpack barrels, and absorbent material) to contain 10 percent of their POL and HAZMAT inventory or to handle a spill from the largest container being used (see table C-1.)

Table C-1. Spill response ordering information

NSN	*Description*
Sweeping Compound	
7930-00-132-5265	100-pound container, contents include sawdust and sand
7930-00-633-9849	100-pound container, contents include sawdust and sand
7930-01-090-9831	1-gallon container of sand
Oil Sorbent	
9330-01-013-3105	Boom form, minimum diameter of 8 inches, minimum length of 8 feet, reusable capability of at least five times
9330-01-308-5150	Sheet form, 100 per package, 18 inches long and 18 inches wide
9330-01-281-0337	Boom form, 4 per package, 10 feet by 8 inches
Shovels	
5120-00-222-4505	Nonsparking hand shovel
5120-00-222-4506	Nonsparking hand shovel

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Appendix D
Reachback Points of Contact

This appendix provides contact information (see table D-1) for key supporting agencies that can provide technical assistance to plan and conduct waste management activities.

D-1. The UROC provides reachback engineering support and environmental solutions, including waste management guidance, to deployed forces who can talk directly with experts in the United States when a problem in the field needs quick resolution. UROC staff respond to incoming information requests and provide analyses and solutions to problems, which is especially beneficial when limited expertise is available in the field. The NAVFAC provides reachback support to the Navy and Marine Corps in a similar manner as the nondeployable UROC does for the Army. USACE and NAVFAC support is described further in chapter 1.

D-2. The APHC and NMCPHC provide worldwide scientific expertise and services in clinical and field PVNTMED, environmental and occupational health, epidemiology and disease surveillance, toxicology, and related laboratory sciences. They, too, provide reachback and consulting services related to waste management. APHC and NMCPHC support is also described further in chapter 1.

Table D-1. Reachback points of contact

Organization	***Contact Information***
Army	
UROC	Commercial: (601) 634-2439 Toll-free: (877) ARMY-ENG DSN: (312) 446-2439 E-mail: uroc@usace.army.mil Secure e-mail: uroc@mail.smil.mil Web site: https://uroc.usace.army.mil
APHC	Commercial: (800) 222-9698 CONUS DSN: 584-4375 OCONUS DSN: (312) 584-4375 Web site: https://phc.amedd.army.mil
Navy	
NAVFAC	Chief Engineer: (202) 685-9167 Environmental: (202) 685-9312 Web site: https://www.navfac.navy.mil
NMCPHC	Commercial (757) 953-0700 Environmental: (757) 953-0932 Web site: http://www.nmcphc.med.navy.mil/
Legend: APHC CONUS DSN NAVFAC NMCPHC OCONUS UROC	 United States Army Public Health Center continental United States Defense Switched Network Naval Facilities Engineering Command Navy and Marine Corps Public Health Center outside the continental United States United States Army Corps of Engineers Reachback Operations Center

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Appendix E
Safety Data Sheets

SDSs, formerly Material Safety Data Sheets (MSDSs), along with container labeling and personnel training, are intended to provide comprehensive hazard information about chemicals and chemical mixtures. This information is used to safeguard human health and protect the environment. Chemical manufacturers or importers are required to classify the hazards of chemicals that they produce or import on SDSs, and distributors are required to provide SDSs with purchased chemicals. It is then the unit's responsibility to establish a workplace hazard communication program to provide training on the hazardous characteristics of substances, labeling, appropriate PPE, spill response procedures, signs and symptoms of exposure, and first aid procedures. For more information about hazard communication, see Part 1910.1200, Title 29, Code of Federal Regulations (29 CFR 1910.1200). For information about CBRN hazards, see TM 3-11.91, which contains scientific and technical information similar to SDSs on chemical agent properties, selected pathogens and toxins of military significance, and radiological and nuclear hazard supplemental information.

E-1. A SDS is a summary of information on a given chemical that identifies the material, its health and physical hazards, its exposure limits, and the precautions involved. A SDS also describes the hazards of a material and provides information on the way the material may be safely handled, used, and stored. This information allows a unit to—

- Protect the health of personnel.
- Store materials safely.
- Respond to spills and emergencies quickly and correctly.

E-2. SDSs are unique for each material and vary based on the manufacturer (brand name). Manufacturers include a current SDS with their shipment. A sample SDS for unleaded gasoline is shown in figure E-1, page E-3. It is important that the SDS on hand is the correct one for the product being used. Binders containing SDSs for HAZMAT stored or used on-site must be maintained on-site and made available to personnel for familiarization and in the event of a spill or fire.

E-3. Ensure SDSs are available in English and in other relevant languages for the areas of operation. Minimum information required on SDSs, including sections and associated information, is outlined in 29 CFR 1910.1200(g). Table E-1, page E-18, provides examples of information required on an SDS. The degree of detailed information and where it is presented within the SDS may vary based on the manufacturer. Manufacturers tend to withhold certain detailed information that they consider as proprietary, which often results in recommended disposal requirements being very generic (for example, disposal procedures must comply with federal, state, and local regulations). In these instances, waste management planners must seek out additional information from the environmental officer, the higher headquarters, or the DLA Disposition Services.

E-4. Much of the information provided in an SDS is technical and requires training to fully understand its usefulness. Waste management planners should seek the expertise from environmental officers and others that are HAZMAT-trained and -certified. Some of the terms used in SDSs include the following:

- **Flash point.** This is the minimum temperature a substance produces sufficient flammable vapors to ignite. This is especially important information when operating in extremely hot climates (such as deserts). Waste management planners must ensure that storage areas are protected from the heat and that adequate ventilation is provided. Flammable liquids have a flash point less than or equal to 140°F. Combustible liquids have a flash point greater than or equal to 141°F.

- **Flammable limits.** When dealing with flammable gases or liquids, it is important to monitor flammable (or explosive) limits to minimize the potential for fire or explosions. Gas mixtures are only flammable under certain conditions. The upper explosive limit and lower explosive limit describe the richest and leanest flammable mixture (concentration) that is needed for a particular combustible gas to ignite and explode. Limits are normally expressed in volume percentage at 25°C and atmospheric pressure. The lower explosive limit is the concentration when there is not enough fuel to burn. The upper explosive limit is the concentration when there is too much fuel and not enough oxygen to burn. However, being above the upper limit does not ensure safety, since sudden ventilation or exposure to an air source can dilute the concentration into the flammable limit range. Flammable or explosive limits are affected by temperature, pressure, and the concentration of an oxidizer.
- **Hazardous characteristic code.** Though not required by the U.S. Occupational Health and Safety Administration on SDSs, the HMIRS uses a two-digit alphanumeric hazardous characteristic code to classify materials by their primary hazard characteristic. When used in conjunction with Storage and Handling of Hazardous Materials, this code serves as a tool to ensure proper segregation and physical separation of incompatible substances being stored.
- **Vapor pressure.** This is the pressure exerted by a vapor against the sides of a closed container. Higher temperatures can cause more vapor to form. Chemicals with high vapor pressure in a hot environment will exert more pressure, which could result in bulging, rupture, or explosion.
- **Vapor density.** The density of a gas or vapor can be compared to the density of the ambient atmosphere (dry air equals 1.0). Vapor or gas that is greater in density than the ambient air tends to settle to the lowest point. Those that are close to, or lower than, the density of air tend to disperse in the atmosphere. A substance with a vapor density greater than 1.0 can generate a fire or explosive hazard as a vapor trail that can form and extend beyond the liquid. Flashback can occur if an ignition source is present.
- **Specific gravity.** This is a relative measure that compares the density of a liquid or solid to the density of water (1.0). Chemicals with a specific gravity less than 1.0 will float in water; those with a specific gravity greater than 1.0 will sink. This information is used in determining where to position booms and absorbent materials as part of a spill response.
- **Evaporation rate.** This is the rate that a material will vaporize (change from liquid to vapor). It can be useful in evaluating the health and fire hazards of a material. For example, a substance with a high evaporation rate will readily form a vapor that can be inhaled or explode.
- **Solubility in water.** This is the ability or tendency of a substance to blend or dissolve uniformly in water. It is an important consideration for spill prevention and response. For example, preventing a water-soluble chemical from entering a body of water would greatly reduce the overall cleanup effort.
- **Freezing point.** This is the temperature at which a liquid becomes a solid at normal atmospheric pressure. Some materials must not be allowed to freeze (or melt) to protect their integrity or the product packaging.
- **pH.** The pH scale measures the relative strength (corrosivity) of acid and alkaline (base). Pure water has a pH of 7. Generally, bases have a pH greater than 7, and acids have a pH less than 7. It is important to know the pH of substances because they may be corrosive or react with incompatible materials. Acids and bases should not be stored or used near each other since their accidental combination could generate a great amount of heat and possibly result in an explosion.
- **Appearance, odor, and physical state.** These are basic descriptions of a substance that may be helpful in identifying it or discovering a leak or release. For example, sulfur-based chemicals produce a rotten egg smell; cyanides have a burnt-almond smell; and some ketones and aldehydes have a sickly, sweet smell.
- **Boiling point.** This is the temperature that a liquid changes to a gas. It is an important consideration in determining how a toxic substance will enter the body. For liquids with high boiling points, the most common means of entry is through contact (skin absorption); for low boiling point liquids, it is inhalation.
- **Viscosity.** This is the measure of a fluid's resistance to flow. Engine oil is an example of a highly viscous liquid. The viscosity of a liquid generally decreases as the temperature increases.

- **Volatile organic compounds.** These organic chemicals have a high vapor pressure and easily form vapors at normal temperature and pressure. This term is generally applied to organic solvents, certain paint additives, aerosol spray can propellants, fuels, petroleum distillates, and many other industrial and consumer products, ranging from office supplies to building materials. These compounds present a significant health and environmental concern, and exposure must be minimized through proper controls (ventilation) and the use of PPE.

Safety Data Sheet
GASOLINE, UNLEADED E-10

NFPA: Flammability 3 Health 1 Reactivity 0 Specific Hazard

TESORO

SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	GASOLINE, UNLEADED E-10		
Synonyms	:	Blend of highly flammable petroleum distillates, also containing 10% ethanol, 888100008808		
SDS Number	:	888100008808	**Version**	: 2.14
Product Use Description	:	Fuel		
Company	:	For: Tesoro Refining & Marketing Co. 19100 Ridgewood Parkway, San Antonio, TX 78259		
Tesoro Call Center	:	(877) 783-7676	**Chemtrec (Emergency Contact)**	: (800) 424-9300

SECTION 2. HAZARDS IDENTIFICATION

Emergency Overview

Classifications

Flammable Liquid – Category 1 or 2 depending on formulation.
Aspiration Hazard – Category 1.
Carcinogenicity – Category 2
Specific Target Organ Toxicity (Repeated Exposure) – Category 2
Specific Target Organ Toxicity (Single Exposure) – Category 3
Skin Irritation – Category 2
Eye Irritation – Category 2B
Chronic Aquatic Toxicity – Category 2

Pictograms :

Signal Word : **Danger**

Hazard Statements :

Extremely flammable liquid and vapor.
May be fatal if swallowed and enters airways – do not siphon gasoline by mouth.
Suspected of causing blood cancer if repeated over-exposure by inhalation and/or skin contact occurs.
May cause damage to liver, kidneys and nervous system by repeated or prolonged inhalation or skin contact.
Causes eye irritation. Can be absorbed through skin.

Figure E-1. Sample SDS, page 1 of 15

Repeated or prolonged skin contact can cause irritation and dermatitis.
May cause drowsiness or dizziness. Extreme exposure such as intentional inhalation may cause unconsciousness, asphyxiation and death.

Precautionary statements :

Prevention : Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Keep away from heat, sparks, open flames, welding and hot surfaces.
No smoking.
Keep container tightly closed.
Ground and/or bond container and receiving equipment.
Use explosion-proof electrical equipment.
Use only non-sparking tools (if tools are used in flammable atmosphere).
Take precautionary measures against static discharge.
Wear gloves, eye protection and face protection (as needed to prevent skin and eye contact with liquid).
Wash hands or liquid-contacted skin thoroughly after handling.
Do not eat, drink or smoke when using this product.
Do not breathe vapors.
Use only outdoors or in a well-ventilated area.

Response : In case of fire: Use dry chemical, CO_2, water spray or fire fighting foam to extinguish.
If swallowed: Immediately call a poison center, doctor, hospital emergency room, medical clinic or 911. Do NOT induce vomiting. Rinse mouth.
If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
If in eye: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
If skin or eye irritation persists, get medical attention.
If inhaled: Remove person to fresh air and keep comfortable for breathing.
Get medical attention if you feel unwell.

Storage : Store in a well ventilated place. Keep cool. Store locked up. Keep container tightly closed . Use only approved containers. Some containers not approved for gasoline may dissolve and release flammable gasoline liquid and vapors.

Disposal : Dispose of contents/containers to approved disposal site in accordance with local, regional, national, and/or international regulations.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS-No.	Weight %
Gasoline, natural; Low boiling point naphtha	8006-61-9	10 - 30%
Toluene	108-88-3	10 - 30%

Figure E-1. Sample SDS, page 2 of 15 (continued)

Xylene	1330-20-7	10 - 30%
Ethanol; ethyl alcohol	64-17-5	10%
Trimethylbenzene	25551-13-7	1 - 5%
Isopentane; 2-methylbutane	78-78-4	1 - 5%
Naphthalene	91-20-3	1 - 5%
Benzene	71-43-2	0.1 - 4.7%
Pentane	109-66-0	1 - 5%
Cyclohexane	110-82-7	1 - 5%
Ethylbenzene	100-41-4	1 - 5%
Butane	106-97-8	1 - 20%
Heptane [and isomers]	142-82-5	0.5 - 0.75%
N-hexane	110-54-3	0.5 - 0.75%

SECTION 4. FIRST AID MEASURES

Inhalation : If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Seek medical attention immediately.

Skin contact : In case of contact, immediately flush skin with plenty of water. Take off contaminated clothing and shoes immediately. Wash contaminated clothing before re-use. Contaminated leather, particularly footwear, must be discarded. Note that contaminated clothing may be a fire hazard. Seek medical advice if symptoms persist or develop.

Eye contact : Remove contact lenses. Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Seek medical advice if symptoms persist or develop.

Ingestion : Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Obtain medical attention.

Notes to physician : Symptoms: Dizziness, Discomfort, Headache, Nausea, Kidney disorders, Liver disorders. Aspiration may cause pulmonary edema and pneumonitis. Swallowing gasoline is more likely to be fatal for small children than adults, even if aspiration does not occur.

SECTION 5. FIRE-FIGHTING MEASURES

Suitable extinguishing media : SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray or fire fighting foam. LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers. Keep containers and surroundings cool with water spray.

Specific hazards during fire fighting : Extremely flammable liquid and vapor. This material is combustible/flammable and is sensitive to fire, heat, and static discharge.

Figure E-1. Sample SDS, page 3 of 15 (continued)

Special protective equipment for fire-fighters	:	Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.
Further information	:	Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam. Exposure to decomposition products may be a hazard to health. Use extinguishing measures that are appropriate to local circumstances and the surrounding environment. Use water spray to cool unopened containers. Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Personal precautions	:	Evacuate personnel to safe areas. Ventilate the area. Remove all sources of ignition. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).
Environmental precautions	:	Discharge into the environment must be avoided. If the product contaminates rivers and lakes or drains inform respective authorities.
Methods for cleaning up	:	Contain and collect spillage with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations.

SECTION 7. HANDLING AND STORAGE

Precautions for safe handling	:	Keep away from fire, sparks and heated surfaces. No smoking near areas where material is stored or handled. The product should only be stored and handled in areas with intrinsically safe electrical classification.
	:	Hydrocarbon liquids including this product can act as a non-conductive flammable liquid (or static accumulators), and may form ignitable vapor-air mixtures in storage tanks or other containers. Precautions to prevent static-initated fire or explosion during transfer, storage or handling, include but are not limited to these examples: (1) Ground and bond containers during product transfers. Grounding and bonding may not be adequate protection to prevent ignition or explosion of hydrocarbon liquids and vapors that are static accumulators. (2) Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil or diesel) is loaded into tanks previously containing low flash point products (such gasoline or naphtha). (3) Storage tank level floats must be effectively bonded. For more information on precautions to prevent static-initated fire or explosion, see NFPA 77, Recommended Practice on Static Electricity (2007), and API Recommended Practice 2003, Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents (2008).
Conditions for safe storage, including incompatibilities	:	Keep away from flame, sparks, excessive temperatures and open flame. Use approved containers. Keep containers closed and clearly labeled. Empty or partially full product containers or vessels may contain explosive vapors. Do not

Figure E-1. Sample SDS, page 4 of 15 (continued)

pressurize, cut, heat, weld or expose containers to sources of ignition. Store in a well-ventilated area. The storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

Reports suggest that government-mandated ethanol, if present, may not be compatible with fiberglass gasoline tanks. Ethanol may dissolve fiberglass resin, causing engine damage and possibly allow leakage of explosive gasoline.

: Keep away from food, drink and animal feed. Incompatible with oxidizing agents. Incompatible with acids.

: No decomposition if stored and applied as directed. Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Store only in containers approved and labeled for gasoline.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Guidelines

List	Components	CAS-No.	Type:	Value
OSHA	Benzene	71-43-2	TWA	1 ppm
		71-43-2	STEL	5 ppm
		71-43-2	OSHA_ACT	0.5 ppm
OSHA Z1	Xylene	1330-20-7	PEL	100 ppm 435 mg/m3
	Ethanol; Ethyl alcohol	64-17-5	PEL	1,000 ppm 1,900 mg/m3
	Naphthalene	91-20-3	PEL	10 ppm 50 mg/m3
	Cyclohexane	110-82-7	PEL	300 ppm 1,050 mg/m3
	Ethylbenzene	100-41-4	PEL	100 ppm 435 mg/m3
	Heptane [and isomers]	142-82-5	PEL	500 ppm 2,000 mg/m3
	N-hexane	110-54-3	PEL	500 ppm 1,800 mg/m3
ACGIH	Toluene	108-88-3	TWA	50 ppm
	Xylene	1330-20-7	TWA	100 ppm
		1330-20-7	STEL	150 ppm
	Ethanol; Ethyl alcohol	64-17-5	TWA	1,000 ppm
	Trimethylbenzene	25551-13-7	TWA	25 ppm
	Isopentane; 2-Methylbutane	78-78-4	TWA	600 ppm
	Naphthalene	91-20-3	TWA	10 ppm
		91-20-3	STEL	15 ppm
	Benzene	71-43-2	TWA	0.5 ppm
		71-43-2	STEL	2.5 ppm
	Pentane	109-66-0	TWA	600 ppm

Figure E-1. Sample SDS, page 5 of 15 (continued)

	Cyclohexane	110-82-7	TWA	100 ppm
	Ethylbenzene	100-41-4	TWA	100 ppm
		100-41-4	STEL	125 ppm
	Heptane [and isomers]	142-82-5	TWA	400 ppm
		142-82-5	STEL	500 ppm
	N-hexane	110-54-3	TWA	50 ppm

Engineering measures : Use adequate ventilation to keep gas and vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces. Use only intrinsically safe electrical equipment approved for use in classified areas.

Eye protection : Safety glasses or goggles are recommended where there is a possibility of splashing or spraying. Ensure that eyewash stations and safety showers are close to the workstation location.

Hand protection : Gloves constructed of nitrile or neoprene are recommended. Consult manufacturer specifications for further information.

Skin and body protection : If needed to prevent skin contact, chemical protective clothing such as of DuPont TyChem®, Saranex or equivalent recommended based on degree of exposure. Flame resistant clothing such as Nomex ® is recommended in areas where material is stored or handled.

Respiratory protection : A NIOSH/ MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, ANSI Z88.2-1992, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection. Use a NIOSH/ MSHA-approved positive-pressure supplied-air respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

Work / Hygiene practices : Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Clear to straw colored liquid
Odor	Characteristic hydrocarbon-like
Odor threshold	0.5 - 1.1 ppm
pH	Not applicable

Figure E-1. Sample SDS, page 6 of 15 (continued)

Melting point/freezing point	About -101°C (-150°F)
Initial boiling point & range	Boiling point varies: 30 – 200°C (85 – 392°F)
Flash point	< -21°C (-5.8°F)
Evaporation rate:	Higher initially and declining as lighter components evaporate
Flammability (solid, gas)	Flammable vapor released by liquid
Upper explosive limit	7.6 %(V)
Lower explosive limit	1.3 %(V)
Vapor pressure	345 - 1,034 hPa at 37.8 °C (100.0 °F)
Vapor density (air = 1)	Approximately 3 to 4
Relative density (water = 1)	0.8 g/mL
Solubility (in water)	Negligible
Partition coefficient (n-octanol/water)	2 – 7 as log Pow
Auto-ignition temperature	Approximately 250°C (480°F)
Decomposition temperature	Will evaporate or boil and possibly ignite before decomposition occurs.
Kinematic viscosity	0.64 to 0.88 mm²/s range reported for gasoline
Conductivity (conductivity can be reduced by environmental factors such as a decrease in temperature)	Hydrocarbon liquids without static dissipater additive may have conductivity below 1 picoSiemens per meter (pS/m). The highest electro-static ignition risks are associated with "ultra-low conductivities" below 5 pS/m. See Section 7 for sources of information on defining safe loading and handling procedures for low conductivity products.

SECTION 10. STABILITY AND REACTIVITY

Reactivity	: Vapors may form explosive mixture with air. Hazardous polymerization does not occur.
Chemical stability	Stable under normal conditions.
Possibility of hazardous reactions	Can react with strong oxidizing agents, peroxides, alkaline products and strong acids. Contact with nitric and sulfuric acids will form nitrocresols that can decompose violently.
Conditions to avoid	Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources. Avoid static charge accumulation and discharge (see Section 7).
Hazardous decomposition products	Ignition and burning can release carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

SECTION 11. TOXICOLOGICAL INFORMATION

Skin irritation	: Irritating to skin. Can be partially absorbed through skin.

Figure E-1. Sample SDS, page 7 of 15 (continued)

Eye irritation	Irritating to eyes.
Ingestion	Aspiration hazard if liquid is inhaled into lungs, particularly from vomiting after ingestion. Aspiration may result in chemical pneumonia, severe lung damage, respiratory failure and even death. Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest and death may occur.
Inhalation and further information	Acute toxicity of benzene results primarily from depression of the central nervous system (CNS). Inhalation of concentrations over 50 ppm can produce headache, lassitude, weariness, dizziness, drowsiness, over excitation. Exposure to very high levels can result in unconsciousness and death. Repeated over-exposure may cause liver and kidney injuries. Components of the product may affect the nervous system. IARC has determined that gasoline and gasoline exhaust are possibly carcinogenic in humans. Inhalation exposure to completely vaporized unleaded gasoline caused kidney cancers in male rats and liver tumors in female mice. The U.S. EPA has determined that the male kidney tumors are species-specific and are irrelevant for human health risk assessment. The significance of the tumors seen in female mice is not known. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with effects to the central and peripheral nervous systems, liver, and kidneys. The significance of these animal models to predict similar human response to gasoline is uncertain. This product contains benzene. Human health studies indicate that prolonged and/or repeated overexposure to benzene may cause damage to the blood-forming system (particularly bone marrow), and serious blood disorders such as aplastic anemia and leukemia. Benzene is listed as a human carcinogen by the NTP, IARC, OSHA and ACGIH.

Component:

Gasoline, natural; Low boiling point naphtha	8006-61-9	Acute oral toxicity: LD50 rat Dose: 500 mg/kg Acute inhalation toxicity: LC50 rat Dose: 20.7 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Mild skin irritation Eye irritation: Classification: Irritating to eyes. Result: Moderate eye irritation
Toluene	108-88-3	Acute oral toxicity: LD50 rat Dose: 636 mg/kg Acute dermal toxicity: LD50 rabbit Dose: 12,124 mg/kg Acute inhalation toxicity: LC50 rat Dose: 49 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Mild skin irritation Prolonged skin contact may defat the skin and produce dermatitis. Eye irritation: Classification: Irritating to eyes.

Figure E-1. Sample SDS, page 8 of 15 (continued)

		Result: Mild eye irritation
Xylene	1330-20-7	Acute oral toxicity: LD50 rat Dose: 2,840 mg/kg Acute dermal toxicity: LD50 rabbit Dose: ca. 4,500 mg/kg Acute inhalation toxicity: LC50 rat Dose: 6,350 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Mild skin irritation Repeated or prolonged exposure may cause skin irritation and dermatitis, due to degreasing properties of the product. Eye irritation: Classification: Irritating to eyes. Result: Mild eye irritation
Ethanol; Ethyl alcohol	64-17-5	Acute oral toxicity: LD50 rat Dose: 6,200 mg/kg Acute dermal toxicity: LD50 rabbit Dose: 19,999 mg/kg Acute inhalation toxicity: LC50 rat Dose: 8,001 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Mild skin irritation Prolonged skin contact may cause skin irritation and/or dermatitis. Eye irritation: Classification: Irritating to eyes. Result: Mild eye irritation Mild eye irritation
Naphthalene	91-20-3	Acute oral toxicity: LD50 rat Dose: 2,001 mg/kg Acute dermal toxicity: LD50 rat Dose: 2,501 mg/kg Acute inhalation toxicity: LC50 rat Dose: 101 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Mild skin irritation Eye irritation: Classification: Irritating to eyes. Result: Mild eye irritation Carcinogenicity: N11.00422130
Benzene	71-43-2	Acute oral toxicity: LD50 rat Dose: 930 mg/kg Acute inhalation toxicity: LC50 rat Dose: 44 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Mild skin irritation Repeated or prolonged exposure may cause skin irritation and dermatitis, due to degreasing properties of the product. Eye irritation: Classification: Irritating to eyes. Result: Risk of serious damage to eyes.
Pentane	109-66-0	Acute oral toxicity: LD50 rat Dose: 2,001 mg/kg

Figure E-1. Sample SDS, page 9 of 15 (continued)

		Acute inhalation toxicity: LC50 rat Dose: 364 mg/l Exposure time: 4 h Skin irritation: Repeated or prolonged exposure may cause skin irritation and dermatitis, due to degreasing properties of the product. Eye irritation: Classification: Irritating to eyes. Result: Mild eye irritation
Cyclohexane	110-82-7	Acute dermal toxicity: LD50 rabbit Dose: 2,001 mg/kg Acute inhalation toxicity: LC50 rat Dose: 14 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Skin irritation Eye irritation: Classification: Irritating to eyes. Result: Mild eye irritation
Ethylbenzene	100-41-4	Acute oral toxicity: LD50 rat Dose: 3,500 mg/kg Acute dermal toxicity: LD50 rabbit Dose: 15,500 mg/kg Acute inhalation toxicity: LC50 rat Dose: 18 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Mild skin irritation Eye irritation: Classification: Irritating to eyes. Result: Risk of serious damage to eyes.
Heptane [and isomers]	142-82-5	Acute oral toxicity: LD50 rat Dose: 15,001 mg/kg Acute inhalation toxicity: LC50 rat Dose: 103 g/m3 Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Skin irritation Repeated or prolonged exposure may cause skin irritation and dermatitis, due to degreasing properties of the product. Eye irritation: Classification: Irritating to eyes. Result: Mild eye irritation
N-hexane	110-54-3	Acute oral toxicity: LD50 rat Dose: 25,000 mg/kg Acute dermal toxicity: LD50 rabbit Dose: 2,001 mg/kg Acute inhalation toxicity: LC50 rat Dose: 171.6 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Skin irritation Eye irritation: Classification: Irritating to eyes. Result: Mild eye irritation Teratogenicity: N11.00418960

Figure E-1. Sample SDS, page 10 of 15 (continued)

Carcinogenicity

NTP	Naphthalene (CAS-No.: 91-20-3) Benzene (CAS-No.: 71-43-2)
IARC	Gasoline, natural; Low boiling point naphtha (CAS-No.: 8006-61-9) Naphthalene (CAS-No.: 91-20-3) Benzene (CAS-No.: 71-43-2) Ethylbenzene (CAS-No.: 100-41-4)
OSHA	Benzene (CAS-No.: 71-43-2)
CA Prop 65	WARNING! This product contains a chemical known to the State of California to cause birth defects or other reproductive harm. Toluene (CAS-No.: 108-88-3) Benzene (CAS-No.: 71-43-2)

SECTION 12. ECOLOGICAL INFORMATION

Additional ecological information : Keep out of sewers, drainage areas, and waterways. Report spills and releases, as applicable, under Federal and State regulations.

Component:

Toluene	108-88-3	Toxicity to fish: LC50 Species: Carassius auratus (goldfish) Dose: 15 mg/l Exposure time: 96 h Acute and prolonged toxicity for aquatic invertebrates: EC50 Species: Daphnia magna (Water flea) Dose: 11.5 mg/l Exposure time: 48 h Toxicity to algae: IC50 Species: Selenastrum capricornutum (green algae) Dose: 12 mg/l Exposure time: 72 h
Ethanol; Ethyl alcohol	64-17-5	Toxicity to fish: LC50 Species: Leuciscus idus (Golden orfe) Dose: 8,140 mg/l Exposure time: 48 h Acute and prolonged toxicity for aquatic invertebrates: EC50 Species: Daphnia magna (Water flea) Dose: 9,268 - 14,221 mg/l Exposure time: 48 h
Isopentane; 2-Methylbutane	78-78-4	Toxicity to fish: LC50 Species: Oncorhynchus mykiss (rainbow trout) Dose: 3.1 mg/l Exposure time: 96 h Acute and prolonged toxicity for aquatic invertebrates: EC50 Species: Daphnia magna (Water flea)

Figure E-1. Sample SDS, page 11 of 15 (continued)

		Dose: 2.3 mg/l Exposure time: 96 h
Naphthalene	91-20-3	Toxicity to algae: EC50 Species: Dose: 33 mg/l Exposure time: 24 h
Pentane	109-66-0	Acute and prolonged toxicity for aquatic invertebrates: EC50 Species: Daphnia magna (Water flea) Dose: 9.74 mg/l Exposure time: 48 h
Cyclohexane	110-82-7	Acute and prolonged toxicity for aquatic invertebrates: EC50 Species: Daphnia magna (Water flea) Dose: 3.78 mg/l Exposure time: 48 h
Heptane [and isomers]	142-82-5	Toxicity to fish: LC50 Species: Carassius auratus (goldfish) Dose: 4 mg/l Exposure time: 24 h Acute and prolonged toxicity for aquatic invertebrates: EC50 Species: Daphnia magna (Water flea) Dose: 1.5 mg/l Exposure time: 48 h
N-hexane	110-54-3	Toxicity to fish: LC50 Species: Pimephales promelas (fathead minnow) Dose: 2.5 mg/l Exposure time: 96 h Acute and prolonged toxicity for aquatic invertebrates: EC50 Species: Daphnia magna (Water flea) Dose: 2.1 mg/l Exposure time: 48 h

SECTION 13. DISPOSAL CONSIDERATIONS

Disposal : Dispose of container and unused contents in accordance with federal, state and local requirements.

SECTION 14. TRANSPORT INFORMATION

CFR

Proper shipping name	: Petrol
UN-No.	: 1203
Class	: 3
Packing group	: II

TDG

Proper shipping name	: Gasoline
UN-No.	: UN1203
Class	: 3
Packing group	: II

Figure E-1. Sample SDS, page 12 of 15 (continued)

IATA Cargo Transport

UN UN-No.	: UN1203
Description of the goods	: Gasoline
Class	: 3
Packaging group	: II
ICAO-Labels	: 3
Packing instruction (cargo aircraft)	: 364
Packing instruction (cargo aircraft)	: Y341

IATA Passenger Transport

UN UN-No.	: UN1203
Description of the goods	: Gasoline
Class	: 3
Packaging group	: II
ICAO-Labels	: 3
Packing instruction (passenger aircraft)	: 353
Packing instruction (passenger aircraft)	: Y341

IMDG-Code

UN-No.	: UN1203
Description of the goods	: Gasoline
Class	: 3
Packaging group	: II
IMDG-Labels	: 3
EmS Number	: F-E S-E
Marine pollutant	: No

SECTION 15. REGULATORY INFORMATION

TSCA Status : On TSCA Inventory

DSL Status : . All components are on the Canadian DSL list.

2-Ethoxy-2-Methylpropane 637-92-3

SARA 311/312 Hazards : Fire Hazard
Acute Health Hazard
Chronic Health Hazard

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIROMENT)
The CERCLA definition of hazardous substances contains a "petroleum exclusion" clause which exempts crude oil. Fractions of crude oil, and products (both finished and intermediate) from the crude oil refining process and any indigenous components of such from the CERCLA Section 103 reporting requirements. However, other federal reporting requirements, including SARA Section 304, as well as the Clean Water Act may still apply.

California Prop. 65 : WARNING! This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

Figure E-1. Sample SDS, page 13 of 15 (continued)

Toluene	108-88-3
Benzene	71-43-2

SECTION 16. OTHER INFORMATION

Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Revision Date : 07/30/2012

19, 21, 26, 85, 1502, 1503, 1504, 1505, 1655, 1657, 1658, 1690, 1702, 1704, 1810, 1849, 1850, 1960

Figure E-1. Sample SDS, page 14 of 15 (continued)

Legend:	
ACGIH	American Conference of Industrial Hygienist
BOD	biochemical oxygen demand
C	Celsius
CAS	Chemical Abstracts Service
CERCLA	Comprehensive Response Compensation and Liability Act
CFR	Code of Federal Regulations
CO2	carbon dioxide
co	company
COD	chemical oxygen demand
CPR	Canadian Controlled Products Regulation
DSL	Canadian Domestic Substances List
e.g.	for example
EINECS	European Inventory of Existing Commercial Chemical Substances
F	Fahrenheit
gm	gram
g/mL	grams per millilitre
h	hour
hPa	hectopascal
Inc	incorporated
IARC	International Agency for Research on Cancer
IDL	Canadian Ingredient Disclosure Act
IMDG	International maritime dangerous goods
kg	kilograms
lb	pound
ml	milliliters
mg	milligrams
mg/L	milligrams per litre
MSHA	Mining Safety and Health Administration
NDSL	Nondomestic Substances List
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
no	number
NTP	National Toxicology Program
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit
P.O.	post office
PPM	parts per million
prop	proposition
RCRA	Resource Conservation and Recovery Act
RQ	reportable quantity
SARA	Superfund Amendments and Reauthorization Act
SDS	safety data sheet
sect	section
TDG	transport of dangerous goods
TSCA	Toxic Substances Control Act
TX	Texas
TWA	time-weighted average
UEL	upper explosive limit
UN	United Nations
U.S.	United States
USA	United States of America

Figure E-1. Sample SDS, page 15 of 15 (continued)

E-5. Units must maintain a SDS for every chemical being stored or used within the unit area. SDSs are maintained at HAZMAT and HW storage areas, refueling points, maintenance areas, medical treatment facilities, and other places where HAZMAT is stored or used. SDSs for all chemicals, solvents, and materials used in a work area are kept in a file or binder that is readily accessible to personnel who work there. Leaders brief their personnel on chemical hazards, PPE requirements, first aid, and spill response before allowing

them to use HAZMAT. Commanders establish policies for periodically reviewing SDSs to ensure that they are current and to ensure a quick response when identifying symptoms and handling emergencies.

E-6. Individuals should receive a copy of a SDS when issued a HAZMAT through supply channels. If an SDS is unavailable for a particular HAZMAT, it can be obtained through supply channels, the HMIRS (see chapter 5), or directly from the manufacturer or supplier. The SDS is retained and used again during turn-in.

Table E-1. SDS guide

Section/Topic	*Typical Contents*
Section 1–Identification	• Product name and synonyms • Recommended use of the chemical and restrictions on use • Name, address, and telephone number of the chemical manufacturer, importer, or other responsible party • Emergency phone number
Section 2–Hazards Identification	• Hazard classification of the chemical • Signal word, hazard statements, symbols, and precautionary statements (hazard symbols may be provided as graphical reproductions in black and white or the name of the symbol [flame, skull and crossbones]) • Description of any hazards not otherwise classified that have been identified during the classification process • For a mixture that contains an ingredients with unknown toxicity, a statement describing how much (percentage) of the mixture consists of ingredients with unknown acute toxicity. Please note that this is a total percentage of the mixture and not tied to the individual ingredients.
Section 3–Composition/Information on Ingredients	For substances: • Chemical name • Common name and synonyms • Chemical Abstract System number and other unique identifiers • Impurities and stabilizing additives which are themselves classified and which contribute to the classification of the substance For mixtures (in addition to the information required for substances): • The chemical name and concentration (exact percentage) or concentration ranges of ingredients, which are classified as health hazards For chemicals claimed as trade secrets: • A statement that the specific chemical identity and/or exact percentage(concentration) of composition has been withheld as a trade secret
Section 4–First Aid Measures	• Description of necessary measures, subdivided by the different routes of exposure (inhalation, absorption through skin or eye contact, and ingestion) • Most important symptoms/effects, acute and delayed • Indication of immediate medical attention and special treatment needed, if necessary
Section 5–Fire-Fighting Measures	• Suitable (and unsuitable) extinguishing media • Specific hazard considerations during firefighting • Explosion data • Special protective equipment and precautions for firefighters • Firefighting information and guidance
Section 6–Accidental Release Measures	• Steps taken in the event of a spill or release • Personal precautions, personal protective equipment, and emergency procedures • Environmental precautions • Methods and materials for containment and cleaning up

Table E-1. SDS guide (continued)

Section/Topic	*Typical Contents*
Section 7–Handling and Storage	• Precautions for safe handling • Conditions for safe storage, including any incompatibilities
Section 8–Exposure Controls/Personal Protection	• Exposure guidelines and limits used or recommended by the chemical manufacturer, importer, or employer preparing the safety data sheet • Engineering controls (such as exhaust and ventilation systems) • Individual protection measures (such as personal protective equipment and work/hygiene practices)
Section 9–Physical and Chemical Properties	• Appearance (physical state, color) • Odor and odor threshold • pH • Melting point/freezing point • Initial boiling point and boiling range • Flash point • Evaporation rate • Flammability (solid, gas) • Upper/lower explosive limits • Vapor pressure, vapor density, and relative density • Specific gravity • Solubility (in water) • Partition coefficient (n-octanol/water) • Auto-ignition temperature • Decomposition temperature • Viscosity • Conductivity • Explosive and oxidizing properties
Section 10–Stability and Reactivity	• Reactivity • Chemical stability • Possibility of hazardous reactions • Conditions to avoid (static discharge, shock, vibration) • Incompatible materials • Hazardous decomposition products
Section 11–Toxicological Information	• Description of potential toxicological (health) effects/symptoms based on routes of exposure (absorption, ingestion, and inhalation) • Hazardous components with Chemical Abstract System number and numerical measures of toxicity • Hazardous components with Chemical Abstract System number listed as carcinogenic on any recognized official list

Table E-1. SDS guide (continued)

Section/Topic	*Typical Contents*
Section 12–Ecological Information	• Ecotoxicity (aquatic and terrestrial, where available) • Persistence and degradability • Bioaccumulation potential • Mobility in soil • Other adverse effects (such as hazardous to the ozone layer)
Section 13–Disposal Considerations	• Description of waste residues and information on safe handling and methods of disposal, including the disposal of any contaminated items
Section 14–Transport Information	• Identification number • Proper shipping name • Transport hazard class • Packing group and instructions • Labels • Environmental hazards (such as marine pollution) • Transport in bulk • Special precautions that a user needs to be aware of, or needs to comply with, in connection with transport or conveyance within or outside their premises
Section 15–Regulatory Information	• Specific safety, health, and environmental regulatory information
Section 16–Other Information	• Date of preparation or last revision of the safety data sheet • Other potentially useful information

Appendix F

Base Camp Transition, Transfer, and Closure

At the end of its life cycle, a base camp may be transitioned, transferred, or closed. A base camp may be transitioned to an enduring location. For CCDRs to nominate a base camp for transition to an enduring location, transition procedures can be found in DODI 3000.12. Depending on the location, size, and mission of the base camp, this process generally takes 90-365 days. A base camp may be partially or completely transferred. Transfer involves turning over all or portions of a base camp's real estate to a designated entity, such as another U.S. command, a multinational Partner, the HN, or private landowner. A base camp may be partially or completely closed (if no longer needed) with closure standards being met and real estate returned to a private landowner or HN, or based on the situation, some locations may be abandoned. Abandonment or destruction may be necessary in response to an emergency or controlled evacuation.

F-1. The CCDR develops the policies and procedures for transitions, transfers, and closures as part of the theater basing strategy. This guidance is based on operational variables; mandated timelines for force reductions, retrograde, and withdrawal as part of the exit strategy; cost-benefit analyses; existing United States and HN laws and regulations; and agreements and negotiations with HNs and private landowners. It is developed in cooperation with multinational forces and governmental and nongovernmental organizations and adjusted as needed.

F-2. The theater base camp transition, transfer, and closure guidance provides the information to develop the transition, transfer, or closure plan. The plan may be part of the base camp's master plan or be a standalone plan. Regardless, the plan must be consistent with the CCDR's theater basing strategy. The plan details the required actions, tasks, and standards that must be completed, including the time frame and/or sequence to ensure actions are completed according to established timelines. The basic concept of the plan is to reverse the actions taken to build the base camp and to scale capabilities appropriately to accommodate fluctuations in populations and demands. For base camps being transferred, commanders must consider the proposed timelines for transfers and the desired condition at the time of transfer. For base camps being closed, capabilities are reduced to basic levels at a pace and to a degree that does not diminish critical functions and disrupt the provision of essential support and services. As populations decrease, essential service and support contracts are right-sized, while those that are nonessential are closed out. Operational and support areas are reduced and consolidated into as few facilities as possible. To avoid conflict with operational/tactical mission requirements, a phased approach can help maximize the use of the following:

- Protection, security, and defense resources.
- Transportation assets needed for moving personnel, equipment, reusable supplies and materials and disposing of waste (including debris generated from deconstruction).
- Engineering and construction assets or specialized teams needed for environmental cleanup and dismantling or repair of facilities and infrastructure.
- Assets and specialized teams needed for material disposition actions to include environmental and agricultural decontamination of equipment and material and the proper disposal of decontamination waste (equipment and material must be decontaminated before transfer or preparation for transport to another base camp, enduring location, or home station).
- Contracts supporting base operations support or other mission services.

F-3. Additionally, plans must include procedures for abandoning or destroying base camps in response to an emergency or controlled evacuation. In these scenarios, sensitive items are accounted for and removed or destroyed to prevent their use by hostile forces. The procedures should include evacuation routes, rallying

points, and personnel accountability actions, and they must ensure tenant and transient units understand their requirements.

F-4. Although transitions, transfers, and closures occur at the end of a base camp's life cycle, keep in mind that their processes require proper planning, documentation, and execution efforts that start in the initial planning stages of the base camp's master plan. These proper efforts support operational priorities. The timely retrograde or withdrawal of joint forces reduces costs, prevents undue environmental liabilities, protects U.S. interests, and promotes good will and understanding with the international community, while also addressing the expectation of the HN. Efforts can be labor-intensive, such as deconstruction of facilities and mitigation of environmental hazards, depending on the specific agreements that may exist. To improve the efficient use of resources and eliminate redundant efforts, a designated unit may perform the required actions. Additionally, legal and financial considerations must be integrated to minimize the cost and effort to satisfy U.S. obligations. Required tasks are often completed in parallel, leading to the final end state of completed documentation and final transition, transfer, or closure.

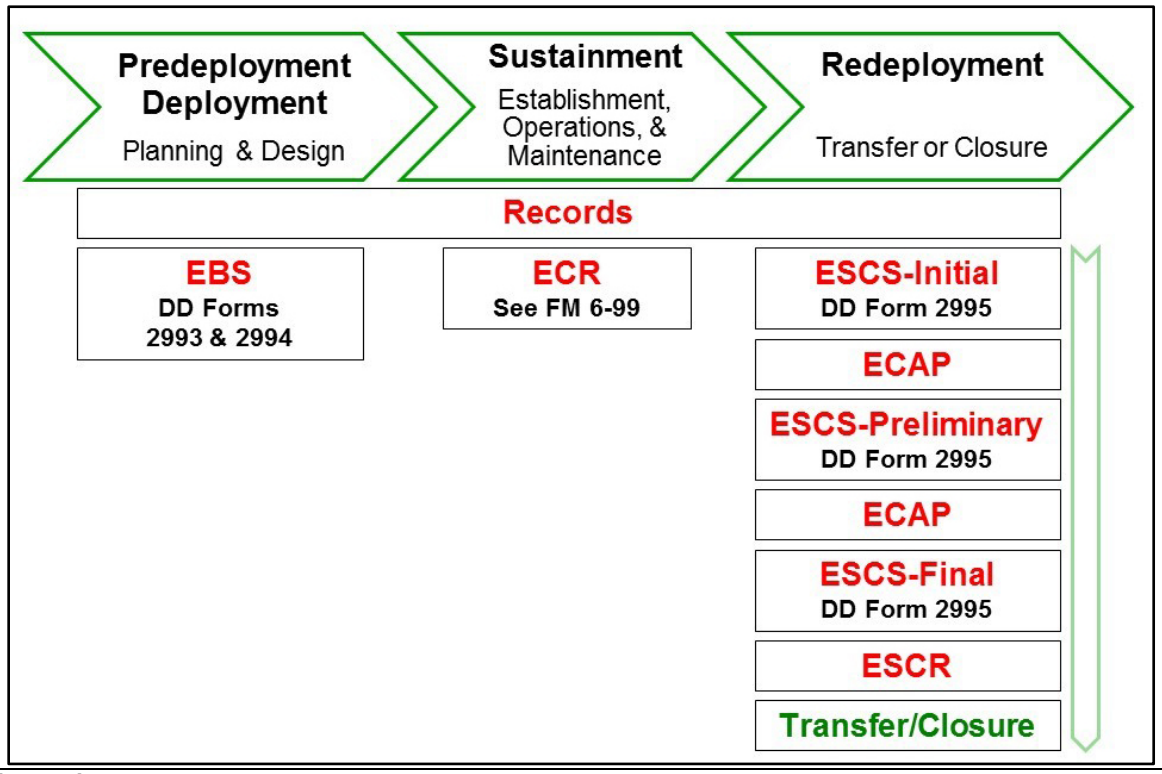
F-5. Consult combatant command, as needed, for requirements regarding completion of environmental documentation and archive of records. The following list describes the environmental documentation timeline for base camps (figure F-1 illustrates the process):

- **EBS.**
  - DD Form 2993 (*Environmental Baseline Survey [EBS] Checklist*) and DD Form 2994 (*Environmental Baseline Survey (EBS) Report)*. See ATP 3-34.5/MCRP 3-40B.2 (MCRP 4-11B).
  - Completed during base camp planning phase/predeployment.
  - Documents environmental conditions preoccupation.
- **ECR.**
  - See format in *Environmental Surveys Handbook: Contingency Operations (Overseas)* or FM 6-99.
  - Completed during base camp establishment, operation, sustainment, and maintenance, as needed.
  - Documents changes to environmental conditions and incidents affecting the environment (archived with EBS).
- **Environmental Records.**
  - Various formats (consult combatant command for requirements).
  - Completed throughout base camp life cycle, as needed.
  - Documents appointment orders, inspections, training, lab results, spill reports, corrective actions, and other notable actions.
- **ESCSs.**
  - DD Form 2995 (*Environmental Site Closure Survey*), completed three times (Initial, preliminary, and final). See ATP 3-34.5/MCRP 3-40B.2 (MCRP 4-11B).
  - Completed upon base camp transfer/closure notification (initial), 30 days prior to transfer/closure (preliminary), and upon correcting findings from the Preliminary survey and subsequent Environmental Corrective Action Plan (final).
  - Documents environmental conditions, provides information to determine closure actions required to meet the negotiated standards for transfer/closure, and facilitates development of the Environmental Corrective Action Plan and request for resources.
- **Environmental Corrective Action Plan.**
  - Consult combatant command for requirements and see guidance in *Environmental Surveys Handbook: Contingency Operations (Overseas)*.
  - Completed after the Initial ESCS and updated after the Preliminary ESCS.
  - Documents environmental standards that must be met and tasks necessary for proper transfer/closure.
- **ESCR.**
  - See format in *Environmental Surveys Handbook: Contingency Operations (Overseas)*.

- Completed at the time of transfer/closure, after all corrective actions have been completed.
- Documents the final environmental condition of the base camp at transfer/closure.

F-6. Other major environmental tasks to be completed during transfers and closures (see figure F-1, page F-4) include the following:

- Identification and mitigation of negative environmental effects on the base camp (closing ranges and cleaning up HAZMAT, HW, and POL spills).
- Removal of force protection measures including protective berms, fighting positions, and wire and vehicle barriers.
- Establishment and subsequent closure of equipment decontamination sites (for hazardous and biological contamination).
- Closure of maintenance facilities and vehicle/aircraft washracks.
- Closure of waste management facilities (solid, hazardous, medical, wastewater, and special wastes).
- Proper accumulation, collection, transport, management, and treatment/disposal of all waste.
  - Base camp environmental officers must contact the CCDR's staff upon transfer/closure notification for guidance related to removal of HAZMAT, HW, and special waste.
  - Disposition of reusable and recyclable materials.
  - Requirements for packaging, inventorying, labeling, and turning in hazardous and special waste for disposal and cleaning up of HW accumulation areas.
  - Termination of waste management contracts, removal of contractor-furnished equipment, and cleanup of the surrounding area.
  - Disposition of empty hazardous and special waste containers, including standards for turn-in.
  - Removal of fuel bladders, secondary containment liners, and associated fuel distribution equipment and establishment of cleanup standards for any affected areas.
  - Disposition of secondary containment and protective berms.
  - Disposition of waste material generated from base camp deconstruction.
  - Closure and cleanup of all waste management areas, such as incinerators, landfills, recycling operations, composting sites, and land farming operations.
  - Disposition of medical waste.
  - Proper shutdown of water purification systems, the disposition of the wastewater and brine lagoon, and the need for a water survey.
  - Disposition of wastewater treatment systems.
  - Disposition of aboveground and underground storage tanks.
  - The closure and marking of all latrines, soakage pits, landfills, trash burial sites, and septic systems. Their locations must be recorded and archived. While methods may involve only covering some areas with dirt, agreements with the HN may require more detailed methods and a form of long-term monitoring to detect potential groundwater contamination. In the absence of formal guidance, best management practices must be used, which may require consultation with environmental experts.
  - Recording of all grid coordinates and archiving digital photographs of each waste management site are required upon final transfer or closure. This information is incorporated into the ESCR.



Legend:

DD	Department of Defense
EBS	Environmental Baseline Survey
ECAP	Environmental Corrective Action Plan
ECR	Environmental Conditions Report
ESCR	Environmental Site Closure Report
ESCS	Environmental Site Closure Survey

Figure F-1. Base camp transfer/closure environmental documentation timeline

Glossary

The glossary lists acronyms and terms with Army or joint definitions. Terms for which TM 3-34.56/MCRP 3-40B.7 is the proponent are marked with as asterisk (*). Marine Corps acronyms, terms, and definitions can be found in MCRP 1-10.2.

SECTION I – ACRONYMS AND ABBREVIATIONS

ADP	Army doctrine publication
ADRP	Army doctrine reference publication
AFMAN	Air Force manual
AFJMAN	Air Force joint manual
AFPMB	Armed Forces Pest Management Board
AFTTP	Air Force tactics, techniques, and procedures
AJEPP	Allied Joint Environmental Protection Publication
ANSI	American National Standard Institute
APD	Army Publishing Directorate
APHC	United States Army Public Health Center
API	American Petroleum Institute
AR	Army regulation
ATP	Army techniques pubication
ATSM	American Society for Testing and Materials
attn	attention
BCT	brigade combat team
BOS-I	base operating support-integrator
C	Celcius
CAR	Central Army Registry
CBRN	chemical, biological, radiological, and nuclear
CCDR	combatant commander
CDID	Capabilities Development and Integration Directorate
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERL	Construction Engineering Research Laboratory
CFR	Code of Federal Regulations
COA	course of action
CODDD	Concepts, Organizations, and Doctrine Development Division
CONUS	continental United States
COR	contracting officer’s representative
DA	Department of the Army
DD	Department of Defense

DEI	Directorate of Environmental Integration
DLA	Defense Logistics Agency
DOD	Department of Defense
DODI	Department of Defense instruction
DODM	Department of Defense manual
DOEHRS	Defense Occupational and Environmental Health Readiness System
EBS	environmental baseline survey
ECR	environmental conditions report
EP	engineer pamphlet
EPA	Environmental Protection Agency
ERDC	Engineer Research and Development Center
ESCR	environmental site closure report
ESCS	environmental site closure survey
F	Fahrenheit
FEST	forward engineer support team
FFE	field force engineering
FGS	final governing standards
FM	field manual
G-4	assistant chief of staff, logistics
G-9	Assistant chief of staff, civil affairs operations
GTA	graphic training aid
HAZMAT	hazardous material
HMIRS	Hazardous Materials Information Resource System
HN	host nation
HW	hazardous waste
HWAP	hazardous-waste accumulation point
HWSA	hazardous-waste storage area
IPB	intelligence preparation of the battlefield/battlespace
JP	joint publication
JP-8	jet propulsion fuel 8
LOGCAP	Logistics Civil Augmentation Program
M1D1	military item disposal instruction
MAGTF	Marine air-ground task force
MCRP	Marine Corps reference publication
MCIP	Marine Corps Interim Publication
MCO	Marine Corps order
MCRP	Marine Corps reference publication
MCTP	Marine Corps tactical publication
MCWP	Marine Corps warfighting publication
MDMP	military decisionmaking process
MED	medical

MEDCOM	U.S. Army Medical Command
MESL	Military Exposure Surveillance Library
METT-T	mission, enemy, terrain, troops, and time available
METT-TC	mission, enemy, terrain and weather, troops and support available, time available, and civil considerations
MIDI	military items disposal instructions
MIL-STD	military standard
MO	Missouri
MSCoE	Maneuver Support Center of Excellence
NATO	North Atlantic Treaty Organization
NAVFAC	Naval Facilities Engineering Command
NAVMED	Navy medicine
NAVSUP	Navy supplement
NCMI	National Center for Medical Intelligence
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
NMCPHC	Navy and Marine Corps Public Health Center
NTRP	Navy tactical reference publication
NTTP	Navy tactics, techniques, and procedures
OEHSA	Occupational and Environmental Health Site Assessment
OPLAN	operation plan
OPORD	operation order
PCB	polychlorinated biphenyl
POL	petroleum, oils, and lubricants
PPE	personal protective equipment
PUB	publication
PVNTMED	preventive medicine
ROWPU	reverse osmosis water purification unit
RFI	request for information
S-4	battalion or brigade logistics officer
S-9	battalion or brigade civil affairs operations staff officer
SARA	Superfund Amendments and Reauthorization Act
SB	supply bulletin
SDS	safety data sheet
SOP	standard operating procedure
TB	technical bulletin
TB MED	technical bulletin, medical
TC	training circular
TG	technical guide
TM	technical manual
UFC	Unified Facilities Criteria
UROC	United States Army Corps of Engineers Reachback Operations Center

U.S.	United States
US EPA	United States Environmental Protection Agency
USACE	United States Army Corps of Engineers
USAES	United States Army Engineer School
VA	Virginia

SECTION II – TERMS

***waste management**

The collection, transportation, treatment, or disposal of waste materials in an effort to ensure a healthy and sanitary environment.

References

REQUIRED PUBLICATIONS

These documents must be available to intended users of this publication. Most Army publications are available online at <https://armypubs.army.mil>. Most joint publications are available online at <www.dtic.mil/doctrine/new_pubs/jointpub.htm>.

DOD Dictionary of Military and Associated Terms. January 2019.

ADP 1-02. *Terms and Military Symbols*. 14 August 2018.

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RELATED PUBLICATIONS

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29 March 2019

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