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NATICK/TR-00/021

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AN ANALYSIS OF MILITARY FIELD-FEEDING WASTE

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U.S. Army Soldier and Biological Chemical Command
Soldier Systems Center
Natick, Massachusetts 01760-5020

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14. ABSTRACT

Personnel from Natick Soldier Center (NSC) conducted a study at Ft. Campbell, KY 23 to 28 April 95, to determine the amount of solid waste generated during field feeding operations. With the U.S. Army-mandated need in mind, 'to identify waste management capabilities on the battlefield', this field study attempted to collect specific information regarding the volume, weight and type of waste produced. These findings were obtained to aid in identifying equipment or procedures which will enhance management of field feeding waste. Fiberboard and paperboard were major contributors to the daily waste stream. Plastic contributed significantly to the waste stream; metals also added substantial weight to daily field waste. Glass, while present, was a negligible contributor.

15. SUBJECT TERMS

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PREFACE

This report describes a data collection effort to determine the amount of solid waste generated during field feeding operations. Personnel from Natick Soldier Center (NSC) conducted a study at Ft. Campbell, KY 23 to 28 April 95. With the U.S. Army-mandated need in mind (to identify waste management capabilities on the battlefield), this field study attempted to collect specific information regarding the volume, weight and type of solid waste produced. These findings were obtained to aid in identifying equipment and / or procedures which would enhance the management of field feeding waste. While the overall volume and weight of waste are germane to any recommendations, the types of waste will also be a determining factor, particularly in regard to any equipment proposals.

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AN ANALYSIS OF FIELD FEEDING WASTE

INTRODUCTION

Management of solid waste generated from field feeding on the training field / battlefield is top priority of the U.S. Army Quartermaster Corps and School and is an integral component of Army Field Feeding System-2000 (AFFS-2000). The relevance of environmental regulations is noted in the Basic Doctrine for Army Field Feeding (FM 10-23), which points out that Commanders must determine the proper waste disposal procedures in order to comply with host nation laws. In addition to environmental issues associated with battlefield waste, operations in field feeding generates a large volume of solid waste. A need exists to identify logistically efficient and environmentally acceptable capabilities for managing this waste.

BACKGROUND

Field Manual 10-23, Basic Doctrine for Army Field Feeding, states that garbage and rubbish must be buried or burned. For short stays of less than one week, it should be buried and covered daily. For periods lasting longer than one week the garbage and rubbish may have to be burned. However, once burned the ashes should be buried. Garbage pits (Figure 1), used to prevent accumulation of garbage in the unit area, should be constructed at least 30 yards from the food service area. In the past several years military facilities have adopted various trash maintenance policies. On-post recycling centers have been developed at several facilities and many training areas now have dumpsters maintained by commercial firms. Though many bases have adopted modern strategies to handle field trash, basic doctrine procedures are often used in active battlefield environments due to the limits of manpower, vehicle availability and country doctrine.

Each squad, platoon, company, battalion and military base deals with trash maintenance slightly different during field training but with one common philosophy: field training procedures take precedence over trash maintenance. At a field kitchen site, trash is stored away from the Mobile Kitchen Trailer (MKT) in bags or in a dumpster. However, a squad of foot soldiers may leave their trash in large plastic bags or in fiberboard boxes on the side on the road for pick up at a later time. Most field waste consists of food related trash because the typical soldier takes little with him to a field training exercise that can be disposed of besides food. When there is a unit using artillery, some of the trash may consist of spent artillery shells, and a medical unit may dispose of certain types of medical related trash. Typically during a field training exercise, the trash is removed on a daily basis and disposed of on-post at the trash maintenance site whether it be a land fill or a recycling center.

According to the food service personnel at Ft. Campbell, food and kitchen waste is placed, un-separated, in plastic bags or empty fiberboard cartons. These are temporarily placed in a shallow garbage "pit" dug in the ground several yards away from the MKT area (Figure

1). This is to isolate the trash and prevent the appearance of insects and/or rodents. Trash is collected daily from the MKT area by Army vehicles at approximately the same time each morning following the breakfast meal, and brought to a recycling center located on-post. Again, field training procedures take precedence over trash maintenance.

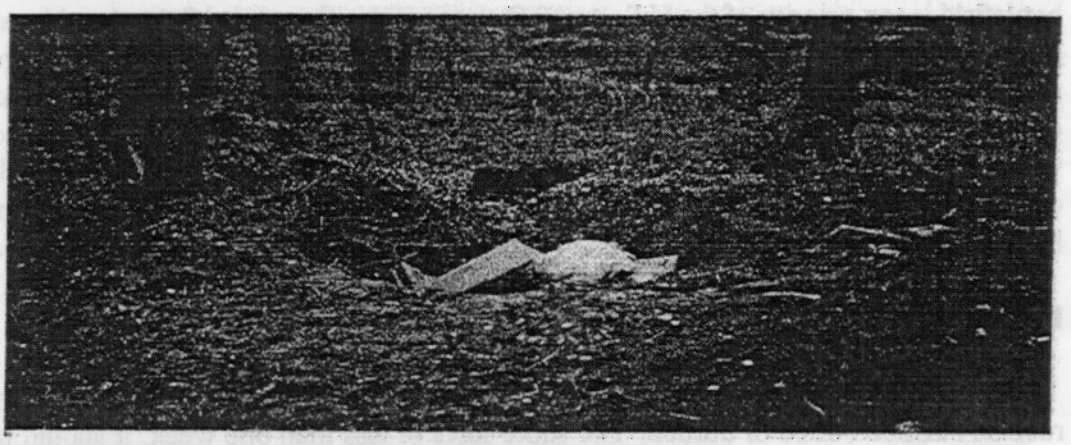

Fig. 1 - Field Site Trash Pit

The Ft. Campbell Recycling Center is a double-fenced area used for the disposal, recycling, and separation of field and household waste for both military and civilian customers of the base. There are about 25 dumpsters situated along the fence, each designated for a type of trash (i.e. fiberboard, metal, misc.). Trash that is flammable, incendiary, or artillery-related are not disposed of at this recycling center. There is a separate disposal center designated for hazardous materials. In a normal scenario, trash brought to the collection center is deposited into the appropriate dumpster (Figure 2).

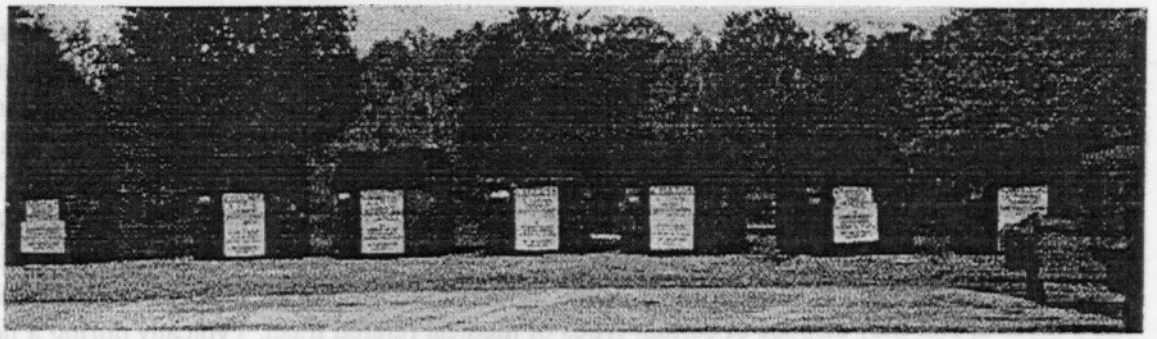

Fig. 2 - Ft. Campbell Recycling Center

During normal trash disposal, Natick personnel saw only some companies separate fiberboard cartons from other trash for disposal in the cardboard/paper recycling unit (Figure 3). The supervisory personnel at the recycling center also reported that items from the field are rarely separated and placed in the individual recycling containers but are placed in a container for un-separated waste. In the case of metal cans, a base regulation states they are to be rinsed out

before placement in recycling bins. This leads to the question as to how feasible it would be to rinse cans, either in a field setting or at a recycling center, where water is often limited and the disposal of the waste water from the cleaning process generates further disposal issues.

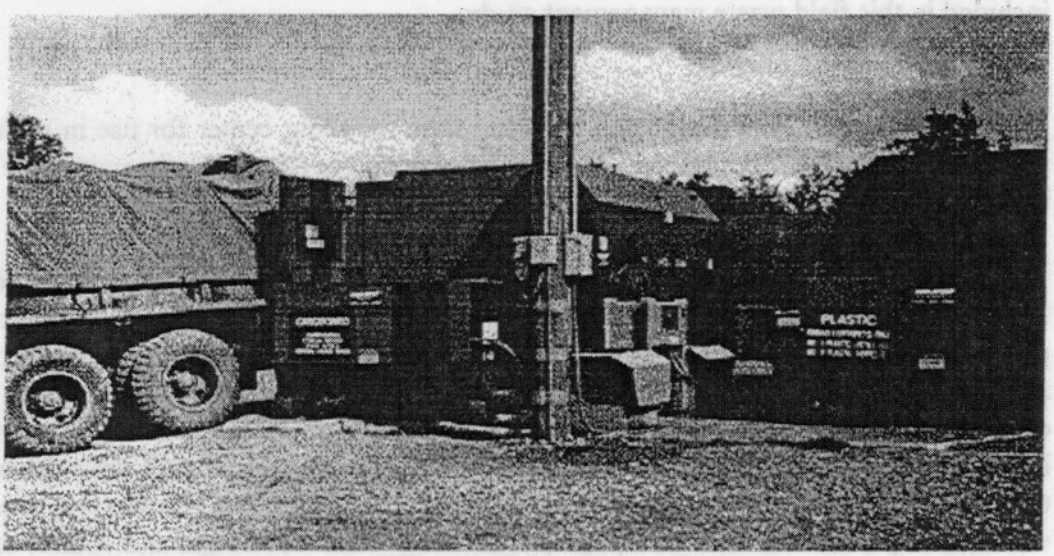

Fig 3 - Cardboard/Paper Recycling Unit

During a prior large-scale NSC field study with infantry units at Ft. Campbell, waste was handled at the Battalion level. Before each breakfast and dinner meal of Unitized Group Rations (UGR), each company dispatched a High Mobility Multipurpose Vehicle (HMMV) (typically, operated by the 1st SGT and his driver) to the Battalion Support Area (BSA), to pick up the food for the company. The majority of soldiers consumed the meal in a single location, disposing of all waste in large plastic bags. At the conclusion of the meal all waste was bagged and brought back to the BSA by the 1st SGT for disposal in large dumpsters for general trash. Frequency and method for transport of this waste to the rear (e.g. to a site such as the post recycling center) was not observed. However, it was noted that little in the way of volume reduction (e.g., flattening or stacking of cans, trays, or boxes) or trash separation occurred.

Furthermore, during a ration acceptability field study conducted at Ft. Lewis, WA, MKT personnel were questioned regarding waste removal issues and procedures. Investigators were told that environmental issues are of prime importance, and trash disposal is carefully regulated. At Ft. Lewis dumpsters are located at kitchen field sites during field exercises. In spite of the on-site dumpster, the trash must be removed from the field site by the unit. Like other military bases, a dedicated vehicle to remove the trash from the field can sometimes be a problem. Trash is not removed on the weekend, hence, the issue of insect and rodent infestation arises.

METHODOLOGY

Subjects

Four companies; Alpha, Bravo, Charlie, and Headquarters Support Battalion (HSB), members of the 1/320th Field Artillery Unit, containing approximately 60 soldiers each, were included in this field waste management study.

Procedures

Natick personnel designated an area in the recycling center for use in evaluating the waste brought by these companies. For the 4-day period of this study, the units were requested to bring all field trash at or around 0900 to the designated areas.

A total of 216 bags and boxes of field waste was weighed and their volume determined. A SECA® body weight scale was used to weigh each bag/box and a 32-gallon commercial plastic trash barrel was used to measure volume. A plastic barrel with the dimensions of 20.5, x23.5, x34.5 inches was hand calibrated in order to measure the volume of each bag. The hand calibration consisted of dividing the height of the barrel into 10 segments. Increments at 3.45 inches (34.5/10) were marked on the inside of the barrel and labeled with the numbers 1 through 10. A trash bag was placed in the plastic barrel and the volume was measured by where the top of the trash fell on the hand calibration. After the weight and volume of each bag was determined, the contents were emptied out, separated into categories (Table 1), counted, and weighed (as applicable) in order to ascertain the categories of waste and their relative contributions to the total.

Table 1
Category Breakdown of Waste

Fiberboard: All fiberboard and paperboard (Not MRE), commercial food/beverage shipping containers, drinking cups, meal trays, artillery tubings and inserts for cushioning artillery rounds.
Metal: T-ration trays, all metal cans (vegetables, fruits, juices, soda), commercial aerosol cans, miscellaneous (e.g., baling wire).
Food/Paper: Food and paper items that could not be separated from each other. The paper items include newspaper and napkins.
Plastic: T-ration and dining utensils, commercial plastic wrappers, light sticks, cereal bowls, commercial beverage containers, artillery packaging, miscellaneous (e.g., plastic sheeting, plastic strapping tape).
MRE: All MRE related trash including fiberboard, paper, food pouches, ration meal bags, MRE food and miscellaneous MRE trash.
Paper: Napkins, commercial wrappings, miscellaneous.
Miscellaneous: Shirt, sandbag,
Food Waste: T-rations, commercial food/beverage items.

For items that did not belong to one of the main categories (e.g., cloth, wood, glass), a 'Miscellaneous' category was created and separate entries were made and the weight and/or number of items were recorded. Items in this category were minimal. For fiberboard shipping containers, the dimensions and weight were determined. In some instances, data collectors

Fig 4 - Data Collection

were not able to separate food and paper trash. In these specific instances, these items were combined in a food/paper category. See the Appendix for an example of the data collection sheets used for data collection.

Data Management

Each bag, box and individual piece of waste was counted, weighed and recorded on the data collection sheet (Appendix). Items readily measured in terms of counts (e.g., metal ration trays and cans, paper cups and plates), were later converted to total weights using the software Statistical Package for the Social Science (SPSS). For example, counting the number of tray ration cans is quicker than weighing, and the predetermined weight of one tray was used to convert the overall count to a weight. Once all data were collected, items that did not readily fit into a specific category were assigned to one of the main categories or to the 'Miscellaneous Category'. Data collected over the course of the study were entered into a computer database and checked for accuracy.

RESULTS

A small number of bags containing medical waste were presented to the data collectors. Due to safety reasons, they were only assessed for overall weight and volume. These weights and volumes were taken into account when computing totals, but were not incorporated into specific item descriptions, and included in the miscellaneous category. Bravo Company did not

provide field waste on one day, and this fact was taken into account when computing weight or volume per soldier per meal. The total number of individual soldier meals was calculated as 2349, using the following formula: 210 (# soldiers) x 4 (days) x 3 (meals) - 171 (missing Bravo day).

Weight and Frequency

Total Weight: Total waste weight by categories is shown in Table 2. Using overall weight and number of soldier-meals, the calculated waste weight per soldier meal was 1.05 lbs. and the average cubic feet per soldier per meal was 0.21. This is nearly identical to the average reported in a prior large-scale analysis (Cox et al., 1991). Fiberboard was found to be the major contributor to trash at 40.9% of the total weight and was found in 92% of the bags evaluated. Though plastic contributed to only 8.3% of the total weight, it was found in 67.6% of the bags. Metal was the second highest contributor to trash weight, 20.2% of the total weight and appearing in 57.9% of the bags. Food and paper, paper alone, and food alone contribute a further 18.5% of the total weight of the trash. Items such as glass, MRE pouches, flameless ration heaters, and other miscellaneous items, while present, contribute little to the overall waste weight.

Table 2

Total Waste Weight by Major Waste Categories

	Total Measured Weight	% of Bags in Which Item Appeared	Average Weight per Bag/Box	% of Total Weight
Fiberboard	1011.1	92.1	4.7	40.9
Metal	498.5	57.9	2.3	20.2
Food/Paper	276.2	37.5	1.3	11.2
Plastic	204.3	67.6	0.9	8.3
MRE	196.5	43.2	0.9	8.0
Paper	121.2	38.9	0.6	4.9
Miscellaneous	92.7	20.4	0.4	3.8
Food	58.5	7.9	.27	2.4
Glass	10.6	11.6	.05	0.4

Fiberboard: The majority of the fiberboard trash was from food items. Miscellaneous items were categorized into small, medium, and large. Small items consist of single serving cereal or juice boxes, cigarette boxes; medium fiberboard items were full-size cereal boxes, 4x6x12 mailing boxes, 12-pack soda boxes; and large items were MRE fiberboard shipping sleeves.

Table 3
Occurrence of Fiberboard-related Waste by Specific Type

	Total Number Of Items	% of Bags in Which Item Appeared
Paper Cups	1406	58.8
Empty Milk Cartons	909	58.8
Meal Trays	762	59.3
Medium Mortar	233	12.0
Large Mortar	216	10.2
Small Mortar	212	12.0
Full Milk Cartons (1/2 pint)	147	6.9
Round Plates	129	10.6
Commercial Wrappers	76	12.5
Small Items	73	15.7
Mortar Inserts	32	1.9
Medium Items	21	5.6
Milk Case Box	18	4.2
Large Items	3	1.4
Extra Large Mortar	1	0.5

Metal: Almost all of the metal trash was food containers. These items, for ease of tabulation, were categorized. Items in the small category were tins in the 4 to 8 oz size, while16 oz cans were considered medium items and #10 tin cans were large items.

Table 4
Occurrence of Metal Waste by Specific Type

	Total # of Items	% of Bags in Which Item Appeared
Soda/Aluminum cans	268	34.7
Large Pieces	81	13.0
Small Pieces	80	15.3
Medium Pieces	54	12.0
Tray Ration Tray	70	9.3
Miscellaneous	28	6.5
Unopened T-Rat Can	18	3.2
Commercial Tin can	3	0.9

Paper: These items included napkins, newspaper (medium paper), and miscellaneous paper including cigarette packs, writing paper and newspaper.

Table 5
Occurrence of Paper Waste by Specific Type

	Total # of Items	% of Bags in Which Item Appeared
Napkins	456	16.2
Misc. Paper	10	1.9
Medium Paper	4	1.9
Small Paper	1	0.5

Plastics: This category includes small items such as light wands, mortar cups, and plastic reclosable bags. The medium pieces were 1- or 2- liter bottles and the large pieces included garbage bags, and an extremely large piece of plastic sheeting. The plastic food wrappers found were 6-pack soda rings, and cookie/snack package wrapping. The cereal containers were the individual tubs with a formed plastic bottom that can be used as a bowl.

Table 6
Occurrence of Plastic Waste by Specific Type

	Total # of Items	% of Bags in Which Item Appeared
Utensils	1769	52.3
Medium Pieces	343	22.2
Cereal Boxes	322	36.1
Small Pieces	126	11.6
Food Wrappers	82	6.0
Misc Plastic	64	9.3
Commercial Food Wrap	33	5.1
Large Pieces	12	3.7

MRE: All trash related to the MRE was placed in this category which included the ration meal bag, food item pouches, food paperboard boxes, hot sauce bottles, and Misc MRE trash. Though basic doctrine states that all flameless ration heaters be activated before disposal, 35 unactivated FRH were found in the analyzed waste.

Table 7
Occurrence of MRE Waste by Specific Type

	Total # of Items	% of Bags in Which Item Appeared
Food Pouches	983	19.9
Ration Meal Bag	334	42.6
Fiberboard	213	14.4
Misc. Trash	38	1.0
Hot Sauce	32	4.6
Paper	7	1.4

Miscellaneous: Items that could not be identified or that could not fit into a major waste category such as soap, batteries, wood, propane cylinders, sandbags, styrofoam cups, and clothing were included in this category. This category was 3.8% of total weight and appeared in about 20% of the bags.

Soldier Feedback

Informal discussions, as well as a focus group with cooks and First Sergeants, indicated that management of waste is a significant problem during field exercises. This is mainly due to the time (1 hour to rear area) and resource requirements needed to transport the waste. For these particular units, trash is typically collected and brought to the disposal site on a daily basis. If waste accumulates for longer than a day, a larger vehicle (5-ton) or multiple HUMMV trips are necessary. Given that most units cannot dedicate a vehicle solely for trash removal, this effort must be coordinated with other manpower and vehicular needs. It is also important that waste not accumulate for much longer than one day, as it inevitably attracts insects and/or rodents. Depending on the unit's activities and location in the field, waste collection and disposal can take up to several hours on any given day.

Soldiers believe that efforts to reduce either the quantity of waste generated (i.e., source reduction) and/or the volume of the waste through compaction or similar methods would be a valuable effort. Questions raised regarding a compactor were related to its ability to handle different volumes and types of waste. Power for waste management equipment was also addressed. These troops indicated that diesel-fueled equipment would make the most sense and that a need for electrical power or other fuels may be problematic. With regard to the location of a compactor or similar item, participants believed that the best location would be a BSA or another centralized site in the field (in contrast to the on-post site used at Ft. Campbell). Exactly how this process would work would vary according to the post, nature of the training, and factors such as vehicle availability. However, at the Company level, transportation is typically sufficient to carry the waste generated by one meal without need for a dedicated vehicle. Companies frequently travel to such BSAs or centralized locations for

other reasons, therefore a BSA-type site would greatly reduce the vehicular/time costs associated with waste transportation if done on a regular basis so that Companies were only dealing with small volumes of waste. Locating waste reducing equipment at a BSA would eliminate the need for a vehicle at the Company level for transport of the equipment. In addition, centralizing waste removal / reduction in the field would provide a sufficient volume of trash to make full use of waste reduction equipment.

CONCLUSIONS and RECOMMENDATIONS

It is clear that waste management in Army field feeding is a major concern, which encompasses issues of logistics, time, environment, sanitation, safety, and state / host nation laws. As seen in this field study, which analyzed data from artillery units, a need exists for safe, efficient and quick management of a variety of waste generated during a typical field exercise. On-site waste management equipment would reduce the need for a dedicated vehicle to transport waste either to a rear collection area or, as in the case of Ft. Campbell, to the Recycling Center. Such equipment would also minimize the sanitation and environmental issues associated with garbage pits.

In interviews and focus groups conducted by NSC investigators at Ft. Campbell and elsewhere, MKT cooks and individual soldiers repeatedly indicated that they believed the concept of waste-reducing equipment was a good one, since it would address these issues of sanitation, time, and state / host nation restrictions regarding trash disposal. A recurring concern, however, was the question of where the equipment would be physically located, i.e., on a dedicated vehicle or pulled behind a vehicle in the same manner as the water buffalo or placed at a central location such as a BSA. Equipment using diesel fuel would be most beneficial because of the availability of that type of fuel in field situations.

The data indicates that fiberboard and paper are major contributors to the daily waste stream. The size of these items range from a small cup to large shipping containers for the Tray Rations. The fiberboard containers often create storage and disposal problems for field personnel. Plastic, particularly in the form of commercial food wrappers, drink bottles, and MRE pouch material contribute significantly to the waste stream; metals, such as food and juice cans from the Tray Ration and T-ration trays also add substantial weight to daily field waste. Glass, while present, is a negligible contributor; most of the glass collected on this field evaluation was in the form of tiny, individual-use hot sauce bottles from the MRE. Equipment purchased for field use should be able to dispose / manage the cardboard boxes and the metal cans generated from field use.

If waste reduction / management equipment is employed in a field environment, proper disposal of hazardous waste needs to be enforced. During this data collection effort, medical waste, motar casings and un-activiated flameless ration heaters were found in several of the trash bags. By policy, Flameless Ration Heaters should be activated before disposal or they

require hazardous waste disposal as do motar casing. It is possible that the improper disposal of these items could have negative implications for the use of on-site waste reduction / management equipment.

The findings in this study also have implications for issues such as waste doctrine and discipline, environmental regulations, and economic incentives. Recycling programs on a large scale, civilian or military, are relatively new but offer financial incentives for proper waste management, particularly as landfill space becomes a premium and the waste management industry continues to grow. Items such as paper and fiberboard, if separated, are a potential source of income. Proper handling of waste ensures that environmental regulations are met and potential penalties avoided. Success at source separation initiatives will require waste discipline involving, for example, the use of such techniques as color-coded bags or containers for different waste categories.

The findings of this evaluation point to the scope and complexity of the problems involved in dealing with the logistics of solid waste management. Waste management for the Army clearly necessitates not only proper changes/development of equipment, but also issues related to how individual soldiers and commanders approach the modern day demands of waste management.

This document reports research undertaken at the U.S. Army Soldier and Biological Chemical Command, Soldier Systems Center, and has been assigned No. NATICK/TR-01021 in a series of reports approved for publication.

Appendix

TRASH DATA SHEET

DAY /DATE _____

	MEASUREMENTS	TRASH BAG #	TRASH BAG #	TRASH BAG #	TRASH BAG #	TRASH BAG #
WEIGHT	LBS					
HEIGHT	INCHES					
WIDTH	INCHES					
DEPTH	INCHES					
MEAL TYPE:	Circle One	A T M B	A T M B	A T M B	A T M B	A T M B
TRAY RATION TRASH						
PAPERBOARD EATING TRAYS	N					
PAPER CUPS	N					
PAPER NAPKINS	N					
TRAY RATION METAL FOOD TRAYS	N					
ALUMINUM CANS	N					
TIN CANS	N					
UTENSILS/METAL	N					
UTENSILS/PLASTIC	N					
FOOD TRASH	ESTIMATE					
BOTTLES	N					
CARDBOARD	lb					
MRE TRASH						
OUTER RATION BAGS	N					
ENTREE BAGS	N					
PLASTIC UTENSILS	N					
FOOD	ESTIMATE					
FRH	N					
MKT TRASH						
WRAPS: PLASTIC, ALUMINUM, ETC	LBS					
FOOD	LBS					
ALUMINUM CANS	N					
TIN CANS	N					
BOTTLES	N					

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