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MKM Engineers, Inc.

Explosive Safety Submission

Removal of Oversize Stockpile

Seneca Army Depot Activity
Romulus, New York

Contract No. DAAA09-03-C-0046

Submitted to:

U.S. Army Joint Munitions Command
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INTRODUCTION

This Explosives Safety Submission (ESS) is being submitted to describe work to be performed to remediate munitions and explosives of concern (MEC) from the Oversize Stockpile at the Seneca Army Depot Activity (SEDA) located in Romulus, New York.

This ESS is being submitted for review and approval by the Department of Defense Explosives Safety Board (DDESB) and has been designed to meet the requirements of Chapter 12 of the Department of Defense (DOD) Ammunition and Explosives Safety Standards, in 6055.9-STD. This chapter states that DDESB approval must be given when plans are made for transferring, remediating or disposing of DOD real property outside of DOD control where MEC contamination exists or is suspected to exist. All mention to 6055.9-STD in this document refers to Rev 4, dated 5 Jan 2004 of the document dated 12 December 2002.

SCOPE

This ESS outlines the explosive safety aspects and operational procedures that will be used for the remediation of MEC from the Oversize Stockpile currently located north of the former Open Burning Grounds (OBG). This stockpile consists of oversize materials, including MEC, that were generated when a removal action was conducted at the 30-acre OBG. Further details related to progression of the OBG removal action is presented in paragraph 3.0 of this ESS.

SITE LOCATION AND DESCRIPTION

The 10,587-acre SEDA is located in Seneca County in the northwestern portion of New York State, between Cayuga Lake and Seneca Lake (refer to Figure 1, Appendix A). The city of Romulus, New York borders the eastern side of SEDA which was constructed in 1941. It has been owned by the United States Government and operated by the Department of the Army since that date. From 1941 through 1995, the mission of SEDA was the receipt, storage, maintenance and supply of military items, including munitions and equipment. Ordnance stored at SEDA included all classes of ammunition and explosives except for chemical ammunition (other than smoke). In 1995, SEDA was approved for closure by Congress under the BRAC program, and officially closed in July 2000. The area to be addressed under this ESS includes the approximate 20,000 cubic yards Oversize Stockpile located north of the former OBG within an area designated as the Open Detonation Ground (ODG). Figure 2 in Appendix A depicts the location of the oversize pile in relation to the former OBG and ODG.

1.0 REASON FOR MUNITIONS AND EXPLOSIVES OF CONCERN

The remediation of the OBG which generated the Oversize Stockpile began in June 1999, with the original ESS for the OBG removal action being dated July 1998. This original OBG ESS was amended once (10 August 2000) through the addition, and subsequent correction, of a procedure to address the oversize material. In addition to this amendment, the OBG ESS was revised (May 2003) to change the land use restrictions from unrestricted, as previously approved, to surface recreation only with deed restrictions requiring DOD UXO support for any future construction activities.

The Oversize Stockpile addressed in this ESS is an accumulation of the oversize materials that remained after approximately 120,000 cubic yards (CY) of soil were sifted and removed from the OBG. During the soil removal and sifting process, much of the oversize material was sifted three or more times to reduce its volume. The previously published and approved OBG ESS as amended and revised for the OBG removal effort contains information related to the reason for MEC at the OBG site, and therefore is relevant to the reason for MEC in the Oversize Stockpile. Additionally, previous amendments and corrections to the OBG ESS also contain a listing of the MEC items found during both the previous excavation and sifting operations and the previous MEC clearance survey conducted over the entire 30-acre OBG site. These listings of MEC indicate a large number and variety of MEC items that have been found to date by the various contractors that have worked at the site. Therefore, since the Oversize Stockpile contains MEC removed from the OBG during operations conducted under the OBG ESS, that ESS will be used as a reference for this Oversize Stockpile ESS regarding the munition with the greatest fragmentation distance (MGFD), minimum separation distance (MSD) and other such requirements.

2.0 MAPS

2.1 REGIONAL, SITE, AND QUANTITY DISTANCE MAPS

The following figures, maps and data are presented in Appendix A of this ESS:

1. Regional map showing the regional location of the OBG, ODG and Oversize Stockpile site (Figure 1).

2. Site map depicting locations of the OBG, ODG, Oversize Stockpile, proposed operations area, explosives storage magazines, and the proposed office and break trailers (Figure 2).

3. Schematic showing the proposed layout of sorting operations (Figure 3A), and photographs of proposed equipment to be used for the sorting operations (Figure 3B).

4. MSD maps showing:
   i. The MSD arc for initial clearance of the operations area (Figure 4);
   ii. The MSD arc for the oversize stockpile processing/sorting operations (Figure 5);
   iii. The MSD arc for MEC demolition operations (Figure 6).

The location of explosive storage magazines for MEC and demolition charges, with Q-D arcs based upon the maximum Net Explosive Weight (NEW) to be stored in each magazine, are shown in Figures 4, 5, and 6, as these Q-D arcs will apply during all phases of site operations.

2.2 SOIL SAMPLING MAPS

Soil sampling maps for the collection of samples for explosive analysis will not be required for this project.

3.0 AMOUNT AND TYPE OF MEC

3.1 INTRODUCTION

When the OBG MEC removal project began, little was known about the nature of MEC that could be encountered during the excavation of the soils and the subsequent anomaly investigations performed after the site was geophysically surveyed and mapped. Appendices A, B, and E of the revised OBG ESS (May 2003) contain listings of the MEC found at the site to date. The smallest and most numerous of the MEC found previously during the soil excavation and geophysical investigations was the 20mm projectile, but hundreds of larger projectiles (primarily disassembled and empty 75mm) were also found. This included inert-filled 3 inch and 4.2 inch stokes mortars and 2.36 inch white phosphorous (WP) warheads (without boosters). During previous removal actions, 20mm, 25mm, 37mm, 40mm, and 57mm projectiles were destroyed by detonation but the majority of the MEC located was classified as munitions debris (MD) since the items did not contain energetic materials. Since the Oversize Stockpile contains MEC and MD removed from the OBG during sifting processes, it is anticipated that the MEC found to date will be representative of the MEC that will be encountered in the Oversize Stockpile.

3.2 MOST PROBABLE MUNITIONS

3.2.1 General Information

The ESS requirements published by the DDESB and further specified in EP 385-1-95, require that the MSD for the protection of non-essential personnel be based upon the MGFD (formerly referred to as the Most Probable Munition). The MGFD is defined as the item with the greatest fragment distance that can reasonably be expected to exist in any particular MEC area. Use of the MGFD allows for the determination of the MSD for the protection of non-essential personnel and the determination of the team separation distance based upon the K50 or 200 foot requirement. The DDESB indicates that the MGFD be selected from historical data or sampling data, with sampling data being the best source of information since it contains data from actual anomaly investigations. The source for selection of the MGFD for this project is not only sampling data, but data gathered during past removal operations. If, during the course of the removal activities conducted under this ESS, an item with a greater fragment distance is encountered, then the MSD will be adjusted and an amendment to this ESS will be submitted for approval.

3.2.2 MGFD for the Clearance of the Operational Area

The operational area where the equipment for sorting the Oversize Stockpile will be set-up and where the processed soils will be staged is within the boundary of the ODG located north of the OBG. During past site characterization operations at the ODG, the M374 81mm mortar was identified and approved by the DDESB as the MGFD for the ODG (see the ESS for the Ordnance and Explosives Removal at the Open Detonation (OD) Grounds, dated September 2002). Therefore, during the surface clearance of the operational area, the M374 81mm mortar will also be used as the MGFD and the determination of the MSD for the surface clearance of the operational area. Use of the M374 81mm mortar as the MGFD will only occur during this initial surface clearance of the area within the ODG. All other operations will be conducted using the MGFD outlined in paragraph 3.2.3 of this ESS. Additional information and descriptions of the operational area and its use are presented in paragraph 6.2.3.

3.2.3 MGFD for the Oversize Stockpile Processing/Sorting

Based upon the known fuzed items previously located and identified during the OBG MEC removal actions that generated the Oversize Stockpile, the 37mm will be used as the MGFD for the Oversize Stockpile. This MGFD was previously submitted in Amendment 1 to the OBG ESS dated July 1998 and was approved by the DDESB as the MGFD. The blast protection requirements for the 37mm have also been presented previously in the OBG ESS and as such these safety precautions will be applied to the technical approach for the operations outlined in this ESS with all heavy equipment and blast shields being constructed of the Plexiglas and steel thicknesses previously specified and approved in the July 1998 OBG ESS. All further reference to hardened equipment or blast shields in this ESS will infer the use of shielded heavy equipment with 3-inches of Plexiglas shielding on the windows and blast shields (both metal and sand) designed to the specifications in the July 1998 OBG ESS Amendment 1.

4.0 START DATE

The anticipated start-up date for the removal of the oversize pile is June 01, 2004, with preliminary site setup operations beginning in mid-April.

5.0 FROST LINE

The frost line depth for the SEDA OBG remains at 40 inches as expressed in the initial ESS.

6.0 CLEARANCE TECHNIQUES/METHODOLOGY

6.1 GENERAL INFORMATION

The overall removal effort associated with this ESS will be the removal of MEC and MD from the Oversize Stockpile located outside the northern border of the OBG along the southern border of the ODG. While the oversize material originated in the OBG, the location of the current stockpile and all further actions taken to remediate MEC from the oversize pile will occur in the southern boundary area of the ODG and will in no way infringe into the OBG. Key to this effort will be the certification that the soil, rock and organic material remaining after the MEC and MD have been removed is in fact free of MEC and available for either re-use or disposal based upon the results of environmental sampling. To facilitate removal of the MEC and MD, the technical approach and safety precautions outlined below will be utilized.

6.2 SITE SET-UP AND LAYOUT

6.2.1 General Information

Figure 3A in Appendix A to this ESS presents the proposed layout of the site and the flow of material from the Oversize Stockpile through the separation process which will:

- Remove ferrous and non-ferrous MEC, MD and non-MD scrap from the soil and other non-MEC material;
- Verify the removal of ferrous and non-ferrous MEC, MD and non-MD scrap from the soil and other non-MEC material through the use of metal detectors;
- Separate MD (i.e., those MEC items without hazardous constituents) from known or potential MEC;
- Ensure proper demolition of MEC;
- Verify through stringent inspection and quality control (QC) that all MD is free of explosive hazards; and
- Shred all MD prior to it being offered for recycling.

6.2.2 Explosives Storage

As depicted in Figure 2 in Appendix A of this ESS, on the east side of the ODG along the OB/OD ground perimeter road is a pair of earth-covered magazines that were previously used as storage magazines when the ODG was in operation. These magazines will be configured and used as outlined in the approved OBG ESS dated July 1998. Paragraph 6.0 of the July 1998 ESS indicated that one of the magazines was cited for the storage of MEC and the other one was cited for the storage of demolition materials. To ensure the safe storage of demolition items, initiators will be separated from all other demolition materials by a two-foot thick sandbag wall that is at least as tall as the materials stacked on either side. This storage configuration was approved for use in the 1998 ESS for the removal action at the OBG. Prior to the use of these magazines for explosives storage, the continuity and adequacy of the lightning protection system will be checked and verified. Additionally, the previously approved NEW limit of 100 pounds per magazine will be used during the operations addressed by this ESS. Information on the Q-D arcs associated with these magazines is presented in paragraph 8.0 of this ESS.

6.2.3 MEC Clearance of Operational Area

As depicted in Figure 2 in Appendix A of this ESS, the operational area for this project will be located in what is currently an open field northeast of the Oversize Stockpile. This field lies within the southern boundary of the ODG and is not associated with the OBG. Prior to using this area as an operational area for the equipment used in the sorting process, a surface MEC clearance will be conducted and a six inch layer of gravel will be placed on the surface. The surface clearance is needed due to the proximity of the planned operational area to the ODG and the potential for 'kick-outs' to be found near the surface. To perform the surface MEC clearance, the following operational sequence will be used.

- The boundaries of the operational area and the access lanes from the roads will be delineated and marked with flagging or some other high-visibility markers.

- The interior of the operational area will then be marked to create five foot search lanes that the UXO personnel will use to perform a magnetometer assisted surface sweep of the proposed operational area. All surface anomalies located will be inspected to determine their identity and the level of hazard associated with the item. Anomalies that are identified as MEC by the UXO technician who discovers the item will have their identity and hazard level verified by a second UXO technician. Items that are confirmed or suspect MEC found during the surface clearance will be quantified and documented.

- All MEC found to contain explosives or other hazardous materials (i.e., WP) will be disposed of through detonation. The location of the demolition site is presented on Figure 6 in Appendix A to this ESS. Those items that are unfuzed and safe to move will be collected and placed in the MEC storage magazine as discussed previously. Disposal of MEC found during the initial operations area clearance and stored for future disposal will be disposed of on a weekly basis unless a less frequent schedule can be used without exceeding the NEW of the demolition site as outlined in paragraph 8.0. If an item is fuzed or otherwise unsafe to move, the item will be left in place and disposed of using blow-in-place (BIP) procedures. Disposal of unsafe items by BIP procedures will occur daily using approved demolition procedures for the MEC item being disposed. Control of fragment for items disposed of by BIP procedures will be accomplished using sandbag mitigation techniques to prevent or minimize the potential for fragments to be dispersed into the OBG. Where possible, perforators will be used during disposal operations to minimize the potential dispersion of fragments. Specifications related to the demolition materials that will be used/stored are presented in paragraph 8.0 of this ESS.

6.3 GROSS REMOVAL OF FERROUS METAL

Due to the large amount of ferrous material present in the Oversize Stockpile, a hardened excavator with an electronic magnet attachment will be used to collect the ferrous materials from the Oversize Stockpile prior to it being excavated and placed in the hopper and conveyed through the separation system. This electro-magnet will deposit the ferrous scrap metal within its swing radius and create a stockpile that will be taken as needed by hardened front-end loader to a storage area on the north/northwest side of the operations area. During the use of the electro-magnet, the magnet operator will work in conjunction with the operator in either another hardened excavator or front-end loader who will scarify the pile as needed to expose as much of the ferrous metal as possible. This planned use of an electro-magnet will allow for the gross removal of the large ferrous objects, thereby minimizing the potential for large items to interfere with the conveying and sorting operations in the remainder of the system. Metals removed by the magnet will be stored at the specified location until such time as the entire Oversize Stockpile has been initially processed. These metals will then be processed using the procedures in paragraph 6.6 of this ESS.

6.4 INITIAL SORTING/SCREENING AND DE-WATERING

Because the Oversize Stockpile materials were stockpiled on plastic lining within a bermed area, and have been exposed to the environment, much of the stockpile was and continued to be saturated with water. Removal of water from the Oversize Stockpile (without having to spread out the materials) and allowing the stockpile to dry naturally is essential to the timely and safe separation of MEC and MD from the materials. Dewatering of the materials will minimize the handling of the oversize material and enhance the removal of MEC and MD in the separation processes outlined in paragraph 6.5 of this ESS. As such, several techniques will be explored to identify the best technology that may be applied. Paragraphs 6.4.1 through 6.4.3 outline the possible dewatering technologies that will be assessed both individually and together to determine the most effective dewatering process. All dewatering processes presented below will be conducted in accordance with (IAW) the general guidelines which require all personnel to be located either behind an approved blast shield or within the cab of hardened heavy equipment. Results of this evaluation process will be presented to the DDESB in the after action report.

6.4.1 Use of a Trommel Screen

One technology to be evaluated is the trommel screen. Use of this as the initial feed handler for the overall separation process will provide some degree of dewatering, and will also allow for smaller materials (i.e., less than two or three inches) to be initially removed from the larger items and fed separately into the conveyor separation process described in paragraph 6.5 of this ESS. This will create a more uniform flow of similar sized items through the conveyor separation process and may allow for better removal of items from the Oversize Stockpile by not allowing small items to be masked or interfered with by larger items. Any items not passing through the trommel screen (i.e., those greater than two to three inches) will also be fed into the conveyor separation process, but will be done so separately from the smaller items. It is anticipated that this staged approach to feeding the conveyor separation process will enhance the MEC and MD removal described in paragraph 6.5.

6.4.2 Use of the Rotar©

After the electro-magnet has been passed over the scarified areas, a hardened excavator with a Rotar© attachment may be used to excavate the oversize material and perform initial sizing and water removal operations. The Rotar© attachment is an excavator bucket and soil screening bucket in one attachment (please see Appendix B to this ESS for information on the Rotar©). After a bucket of material is scooped, the bottom of the bucket rotates to the top of the bucket covering the bucket top and exposing a screen on the bottom of the bucket. Once the screen is exposed, the material in the bucket is then spun using the hydraulic system. This system will be employed for two reasons. First, and foremost, the rotation of the materials will assist in the dewatering of the oversize material and make it easier for items to be seen and removed. Second the Rotar© will initially remove smaller material from the larger material which might otherwise interfere with the segregation process. The exact size of the screen used on the Rotar© will be determined in the field and will be optimized to remove water and enhance the MEC segregation process. (Note: Information in Appendix B regarding the Rotar© and the manner in which it was tested previously is for reference only and does not indicate how the Rotar© will be configured for this project).

After the moisture and smaller debris are spun out of the Rotar© onto a pile, the excavator will dump the remaining oversize material in an additional pile. Each pile will then be transported separately to the trommel screen by a hardened front-end loader for processing through the conveyor system.

6.4.3 Use of Lime and Other Dewatering Materials

During the initial startup and processing of the Oversize Stockpile materials, lime or similar dewatering materials may be applied to the stockpile after the electro-magnet has been used. The lime will absorb moisture and create small granules of moisture-laden lime. The lime treated materials will then be transported to the trommel screen by a hardened front-end loader for processing through the conveyor system.

6.5 CONVEYOR SEPARATOR PROCESS

6.5.1 General Description and Process Overview

The primary goal of the conveyor separation process is to safely and effectively remove all MEC and MD from the Oversize Stockpile so that the final piles of soil and other material can be certified as free of explosive hazards and MEC. The layout for this separation process is presented in Figure 3 in Appendix A of this ESS. To enhance safety, personnel manning the conveyor lines will have an emergency cut-off switch located at the conveyor work area. This switch will be used to immediately shut-down all conveyors and metal separators in the event that the conveyor lines need to be evacuated due to MEC. All conveyor personnel will be cognizant of the switch's location. The primary reasons for needing the emergency kill switches and the procedures that will be used to clear the conveyor are discussed in paragraph 6.5.2. To allow for detailed discussions of each element of the process, a generalized overview is presented below.

1. After the initial de-watering and sizing (using the trommel or Rotar©) has been conducted, material from the Oversize Stockpile will be fed to a conveyor that will transport the material to a ferrous metal separator. Ferrous items will be magnetically removed from the conveyor using an overhead drum magnet and conveyed off the side of the main conveyor at a 90-degree angle to another conveyor that will then pass through a blast shield and transport the ferrous objects past a series of UXO personnel. These personnel will inspect the ferrous objects on the conveyor and remove those MEC items that contain explosive hazards. Details related to this phase of the operation, to include blast protection and MEC removal procedures are located in paragraph 6.5.2 of this ESS.

2. Material that passes the ferrous magnet will then be transported on the conveyor to a rare earth non-ferrous metal separator (also called the eddy current separator) that will remove non-ferrous material from the remaining oversize. Non-ferrous metal will be conveyed away at a 90-degree angle from the primary conveyor to a stockpile location at the end of the belt. This material will be periodically removed and stockpiled for later inspection and subsequent disposal. Details related to this phase of the operation, to include blast protection and MEC removal procedures are located in paragraph 6.5.3 of this ESS.

3. Materials that pass through the rare earth separator will pass through a blast wall and under the metal detector where UXO personnel will remove any metal objects that were not previously captured by the ferrous and non-ferrous separators. Details related to this phase of the operation, to include blast protection and MEC removal procedures are located in paragraph 6.5.4 of this ESS.

4. Effluent materials leaving the metal detector line will be collected by a hardened front end loader or dozer and moved to a final location where the material may be run through a Rotar© to remove any remaining rocks or stones from the soil. This final separation will be done to reduce the amount of material that will require treatment for lead contamination. Rocks and stones will be stockpiled separately from homogenized soils.

5. The final steps in this process will be QC checks and shredding of all MD separated from the oversize pile. This will occur toward the end of the project when the shredder is brought on site. Details related to QC inspection of the MD are located in paragraph 6.8 of this ESS, and details on the shredding operations are located in paragraph 6.9 of this ESS.

6.5.2 Detailed Description of the Ferrous Metal Separation Process

After the material has been dewatered and initially sized, the material will be loaded into a hopper that will deposit the material onto a conveyor that will carry the oversize to the magnetic separator. This suspended electromagnet cross-belt separator will remove ferrous materials and deposit them on a conveyor at 90-degrees from the material flow. This secondary conveyor will then convey the ferrous debris through a blast shield (as depicted in Figure 3 in Appendix A). The blast shield shall be constructed of either 0.68 inch thick mild steel (as previously approved in the OBG ESS) or of sand filled plywood walls at least 18 inches thick. The blast shield shall be large enough to afford adequate protection to the personnel working on the conveyor line from a potential detonation at other areas of the site.

As the ferrous materials move down the line, the UXO personnel will visually observe the items on the conveyor and remove any items that could contain explosive hazards. Items of this nature will be placed in buckets or some other temporary holding container. Periodically the flow of metal down the conveyor will be halted and the items that have accumulated will be thoroughly inspected for explosive hazards. Those items that are found free of explosive hazards will be placed back onto the moving belt and carried to the MD pile at the end of the conveyor. Items with potential or known explosive fillers and hazards will be transported to the holding magazine and scheduled for disposal at the established demolition area. Since warheads containing WP have been found previously, buckets of water and wetted sand will be located within the sorting area as specified in the previously approved OBG ESS.

Demolition of MEC recovered in this process will be conducted IAW the demolition procedures outlined in paragraph 6.7 of this ESS.

In the event that a MEC item is identified on the conveyor that cannot be picked up and removed from the conveyor, the kill switch will be activated and all on-site operations will be halted. All personnel on the site will evacuate to outside the MSD or will be located behind appropriate blast protection. Once all personnel are appropriately protected, one UXO technician behind a blast protection device will remotely activate the conveyor and allow the item to roll off the end of the conveyor. An operator in a hardened front-end loader will then scoop up the item from the run-off pile and remove it to the demolition area. If it is an explosively configured item, it will be disposed of before the end of the day. Once the item has been removed to the demolition area, operations at the site may resume.

In the event that a smoking WP round is observed on the conveyor, it will be allowed to run off the end of the belt and all operations will be halted. All personnel on-site will either evacuate outside the MSD, or will relocate behind appropriate blast shielding. After all personnel are adequately protected, an operator in a hardened front-end loader will scoop up the item and remove it to the demolition area. Once there, it will be allowed to burn itself out before UXO personnel approach it to inspect and (if needed) conduct further demolition operations on the item. Once the item has been removed to the demolition area, operations at the site may resume.

6.5.3 Detailed Description of the Non-Ferrous Metal Separation Process

Soil and materials that pass through the ferrous removal magnet will proceed further on the conveyor to a rare earth, non-ferrous separator. Non-ferrous materials removed from the oversize will be conveyed away at 90-degrees and allowed to create a non-ferrous stockpile. Based upon the data collected to date regarding the MEC found previously, it is not anticipated that the non-ferrous items will represent a large volume of the MEC and MD, nor will it present a significant hazard related to the potential for a detonation. However, any personnel working near the non-ferrous stockpile while the belt is running will be located either inside hardened equipment or behind an approved blast shield.

During the sorting of the material removed by the electro-magnet (or at some other time when excavation of the Oversize Stockpile is not being conducted), UXO personnel will hand sort the non-ferrous material and remove any MEC. The sorting process will be the same as that described for the sorting of materials removed by the electro-magnet (see paragraph 6.6 of this ESS). Demolition of MEC recovered in this process will be conducted IAW the demolition procedures outlined in paragraph 6.7 of this ESS.

6.5.4 Detailed Description of the Final Inspection Process

Materials that pass through both the ferrous and non-ferrous metal separators will be conveyed through a blast shield to a final inspection area. The soils and rock on the conveyor will pass through a metal detector. This detector will be calibrated to detect the smallest MEC item anticipated for the project as determined by an inspection of the pile prior to start-up. In the event that the detector is sounded, UXO personnel will locate the metal object and remove it from the conveyor. Demolition of MEC recovered in this process will be conducted IAW the demolition procedures outlined in paragraph 6.7 of this ESS.

Materials that have passed this inspection process will be allowed to stockpile at the end of the conveyor and will be periodically collected and removed to the staging area where sampling for environmental concerns will be conducted.

6.6 SORTING OF FERROUS ITEMS REMOVED BY ELECTRO-MAGNET

Ferrous materials that have been stockpiled by the electro-magnet will be sorted after the entire Oversize Stockpile has been processed. During this phase, the system will be reconfigured to employ a hopper and conveyor designed to carry the ferrous materials through a blast shield and past the UXO technicians as described in paragraph 6.5.2. UXO personnel will be used to inspect the MEC and remove and stockpile any items found to be explosively configured. All MD and non-MD scrap will be removed and stockpiled with the remaining materials to be shredded. Demolition of MEC recovered in this process will be conducted IAW the demolition procedures outlined in paragraph 6.7 of this ESS.

6.7 DEMOLITION PROCEDURES

All demolition operations will be coordinated by the SUXOS and will be conducted IAW the procedures outlined in TM 60A-1-1-31 and the Engineering Pamphlet 385-1-95a, "Basic Safety Concepts and Considerations for Ordnance and Explosives Operations," dated 29 June 2001. MEC demolition will be conducted IAW the procedures outlined in the following paragraphs.

6.7.1 Surface Demolition

Surface demolition will be conducted only for items that are determined to be unsafe to move. The MSD for intentional surface detonations will be the Maximum Fragment Range or K328, whichever is greatest. The Maximum Fragment Range for a surface shot of the MGFD (M374 81mm) during clearance of the operational area is 1,233 feet. The Maximum Fragment Range for a surface shot of the Oversize Stockpile MGFD (37mm) is 980 feet. However, to comply with client requirements to reduce the potential for fragments re-contaminating the OBG, surface shots will be covered with sandbags IAW USACE publication *Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions*, (HNC-ED-CS-S-98-7, dated August 1998). Using Table 7 of the above referenced document, the sandbag thickness for defeating fragments for both the 81mm and the 37mm is 20 inches, with the resulting MSD being 200 feet. If a MEC item with a Maximum Fragment Range greater than above must be detonated, a new MSD for intentional detonations and the required sandbag thicknesses will be determined using the above referenced document.

6.7.2 Subsurface Demolition

With the exception of items that must be disposed of on the surface using BIP procedures as outlined in paragraph 6.7.1, all demolition shots will be made subsurface within the ODG (see Figure 6 in Appendix A). Demolition at the ODG will be conducted IAW the following procedures:

1. Demolition will be conducted on an as needed basis to ensure that a subsurface demolition limit of 25 pounds NEW is not exceeded for each demolition shot.

2. To meet client requirements to reduce noise and to prevent the possible recontamination of the former OBG, all consolidated shots in the ODG will be be conducted with soil tamping. The reference that will be used for buried explosions is Table 3, of *Buried Explosion Module (BEM): A Method For Determining The Effects Of Detonation Of A Buried Munition* (HNC-ED-DS-S-97-7, REV 1, January 1998). Table 3 provides information on the required thickness of earth cover for five items that were tested. The smallest item tested and reported was the 60mm mortar and it requires two feet of tamped earth and has an MSD of 271 feet. As such anything up to a 60 mm mortar will be buried two feet with an MSD of 271 feet. Additionally, according to Table 3, a three foot tamping is required for items up to an 81mm mortar, with the resulting MSD being 197 feet. As such, any items up to an 81mm mortar will be tamped with three feet of soil and the 197 feet MSD will be used. In the event that an item greater than the 81mm mortar must be disposed of in the ODG, the above reference will be consulted and assistance will be sought to obtain the appropriate soil tamping and MSD for the item. The new tamping requirement and MSD will be submitted to the DDESB for approval.

3. Perforators will be used (except with WP rounds) to control detonations. Demolition of WP rounds will be conducted using buster blocks configured to ensure complete burning of the WP.

4. In the event that multiple MEC items are consolidated in one shot, the consolidated shots will be conducted IAW "Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites," dated August 1998 and approved by the DDESB on 27 October 1998.

5. While preparing MEC for detonation, the UXOSO will ensure that the number of personnel on site is kept to the minimum required to safely accomplish the disposal mission. Authority to initiate demolition operations will rest solely with the SUXOS. The UXOSO will be responsible for ensuring all personnel have been accounted for and that the area is secure prior to authorizing the detonation of explosive charges. The SUXOS will ensure that all pertinent parties have been notified of an impending demolition shot.

6. Following the demolition shot, the area will be inspected for kick-out items and to ensure complete disposal of the MEC.

6.8 INSPECTION AND CERTIFICATION OF MD AND NON-MD

Regardless of the process used to separate them from the Oversize Stockpile, all ferrous and non-ferrous metals removed will be inspected prior to being declared as either MD or non-MD scrap. All metals will undergo a five step inspection/certification process described below. Steps 1 and 2 will take place on an inspection conveyor for ferrous metals, and during the sorting of the non-ferrous stockpile for non-ferrous metals.

1. Steps 1 and 2. At least one of the six UXO Specialists will initially inspect each item and the UXO Team Leader will verify the inspection before each item is initially declared as MD/non-MD scrap and stockpiled for shredding (as discussed in paragraph 6.9). Therefore, during the processing of metal on the ferrous inspection line or sorting of metal on the non-ferrous stockpile, the initial two quality control inspections will be conducted.

2. Step 3. After the MD and non-MD scrap are stockpiled, the UXO Quality Control Specialist (UXOQCS) will sample and inspect at least 10% of all MD items for the presence of explosive hazards. Once the UXOQCS has performed the inspection, the MD and non-MD scrap will be processed through the shredder as described in paragraph 6.9.

3. Step 4. The UXOSO will perform random checks of shredded MD and non-MD to verify that the scrap items are free from any explosive hazards.

4. Step 5. Prior to offering scrap metal for pick-up by the recycling contractor, the SUXOS will certify that the shredded MD and non-MD metal is free of explosive hazards. To do this, the SUXOS and the UXOSO will sign a DD 1348-1A certificate or an equivalent form stating "*This certifies that the material listed has been 100% properly inspected and to the best of our knowledge and belief, are free of explosive hazards*". The BRAC Environmental Coordinator (BEC) will then be provided with copies of the DD 1348-1A (or equivalent) along with the chain of custody and final disposition forms.

6.9 SCRAP SHREDDING

All MD scrap removed from the Oversize Stockpile will be subjected to shredding to make it unrecognizable as MD. During the processes used to remove MD, a volume of non-MD will also be removed from the oversize pile. Due to the minimal volume of non-MD anticipated and the time that would be required to separate MD from non-MD, all metal debris removed from the Oversize Stockpile will be subjected to shredding. This shredding process will ensure that the MD that is offered for recycling does not resemble MD.

Shredding of metal will occur towards the end of the project once the Oversize Stockpile has been excavated and processed, and the only other MEC-related process being conducted is the inspection of the ferrous and non-ferrous stockpiles created by the various magnets used in the separation procedure. The shredder to be used has been manufactured by American Pulverizer and designed for use with MEC. Since other MEC operations (i.e., ferrous and non-ferrous scrap inspection on the metal inspection line) will be conducted, the operator of the equipment used to load the shredder will be inside a hardened cab as defined in this ESS. Additionally, all other personnel within the MSD will be either behind approved blast shielding or inside hardened equipment.

7.0 ALTERNATE TECHNIQUES

No alternate techniques are planned to destroy MEC recovered from the Oversize Stockpile.

8.0 QUANTITY-DISTANCE

8.1 MEC AREAS

MSD restrictions from MEC areas to non-essential personnel will be applied during both the clearance of the operations area and oversize sorting operations. Essential personnel are defined as those MKM and subcontractor personnel essential to the safe performance of the Oversize Stockpile removal operations. Essential personnel will be designated by the SUXOS. All other personnel are non-essential personnel. The team separation distance for the site will be 200 feet, which is greater than the K50 (0.9 psi over pressure) for the MGFD listed.

As stated in paragraph 3.2.2, the MGFD for the clearance of the operational area is the M374 81mm mortar. As stated in Table B-1 of DDESB TP 16, the MSD for the M374 81mm will be the Hazardous Fragment Range of 234 feet. This MSD is shown in Figure 4 in Appendix A.

As stated in paragraph 3.2.3, the MGFD for the oversize sorting operations is the 37mm projectile. As stated in Table B-1 of DDESB TP 16, the MSD for the 37mm will be the Maximum Fragment Range of 980 feet. This MSD is shown in Figure 5 in Appendix A.

8.2 STORAGE OF EXPLOSIVES

The restrictions and storage procedures outlined in the approved OBG ESS shall be applied to the operations conducted under this ESS. As such, the Q-Ds for the magazine are a minimum of 500 feet (front) and 250 feet (rear and sides) as presented in Table C9.T1 of DOD 6055.9-STD. These Q-Ds are shown in Figures 4, 5, and 6 in Appendix A. The back and sides of the existing magazines that will be used face the operational areas proposed for this project. As such, the 250 foot Q-D is easily met by the current configuration.

8.3 PLANNED OR ESTABLISHED DEMOLITION AREAS

As stated previously, an established demolition site will be determined and agreed upon prior to the initiation of site operations. This site will be located within the ODG where demolitions were conducted previously. The MSD for intentional surface detonations will be the Maximum Fragment Range or K328, whichever is greatest. The Maximum Fragment Range for the MGFD (M374 81mm) during clearance of the operational area is 1,233 feet. The Maximum Fragment Range for the MGFD (37mm) during oversize sorting operations is 980 feet however, this will be reduced as described in paragraph 6.7.2 when the items are buried under two feet of tamping. These MSDs are shown in Figure 6 in Appendix A.

In the event that a MEC item with a Maximum Fragment Range greater than above must be detonated, a new MSD for intentional detonations will be established using DDESB TP 16 and an ESS amendment with the new MSD will be prepared and submitted for approval.

8.4 FOOTPRINT AREAS

8.4.1 Blow-in-Place

It is anticipated that the only BIP operations that may be needed will be if MEC is located during the initial surface clearance which is identified as unsafe to move. In such situations, the MSD for the MGFD (M374 81mm) will be used as the default distance unless there is a potential that the item has a larger MSD. Additionally, as stated in paragraph 6.7.1, sandbag mitigation will be used to defeat the fragments and prevent re-contamination of the OBG. For items up to 81mm, 20 inches of sand bags will be used on all sides to defeat the fragmentation hazards and a MSD of 200 feet will be used. In the event that a MEC item with a Maximum Fragment Range greater than above must be detonated, a new MSD and sandbag thickness for intentional detonations will be established using Table 7 of USACE publication *Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions*, (HNC-ED-CS-S-98-7, dated August 1998).

8.4.2 Collection Points

Collection points are those areas used to temporarily accumulate MEC within an area pending transportation to either the approved storage magazine or the planned demolition area. Collection points will be established in each area where ferrous and non-ferrous materials removed from the oversize are inspected to identify MEC items. Since the collection points will be inside the boundary for the MEC area as described in paragraph 8.1, the same MSD for the removal area will apply to the collection points.

8.4.3 In-Grid Consolidated Shots

No in-grid consolidated shots will be required. If items are safe to move, they will be taken to the ODG and detonated there. The only in-grid shots that may be required will be items to be BIP. However, they will not be consolidated.

9.0 OFF-SITE DISPOSAL

All explosives disposal operations will be conducted at the SEDA facility. No explosive contaminated items will be removed from the site for disposal.

10.0 TECHNICAL SUPPORT

10.1 CONTRACTOR SUPPORT

The Joint Munitions Command (JMC), located at Rock Island Arsenal, Rock Island, Illinois, has contracted MKM Engineers, Inc. (MKM) to conduct the sorting and remediation of the Oversize Stockpile created by the OBG MEC removal actions.

10.2 MILITARY SUPPORT

No chemical warfare materiel (CWM) is suspected at this site. The contractor will positively identify all recovered MEC before items are removed or destroyed. If suspect CWM is encountered, or a MEC item is encountered that cannot be positively identified, the contractor will contact the BEC and report the occurrence. The BEC will then be responsible for summoning appropriate military Technical Escort Unit (TEU) or Explosive Ordnance Disposal (EOD) Detachment [725th Ordnance (EOD) out of Fort Drum] for assistance. In the event that TEU is required, contractor personnel will be stationed in a safe up-wind position to observe and secure the area until TEU support arrives. The BEC will be responsible for contacting any local law enforcement agencies needed to secure any public roads that require blocking or to evacuate local residents.

11.0 LAND USE RESTRICTIONS

Land use restrictions will not apply to this removal action since no property is actually involved. Land use restrictions for the land under the Oversize Stockpile and that used for the operational area will be a component of a future ESS involving the remediation actions for the ODG.

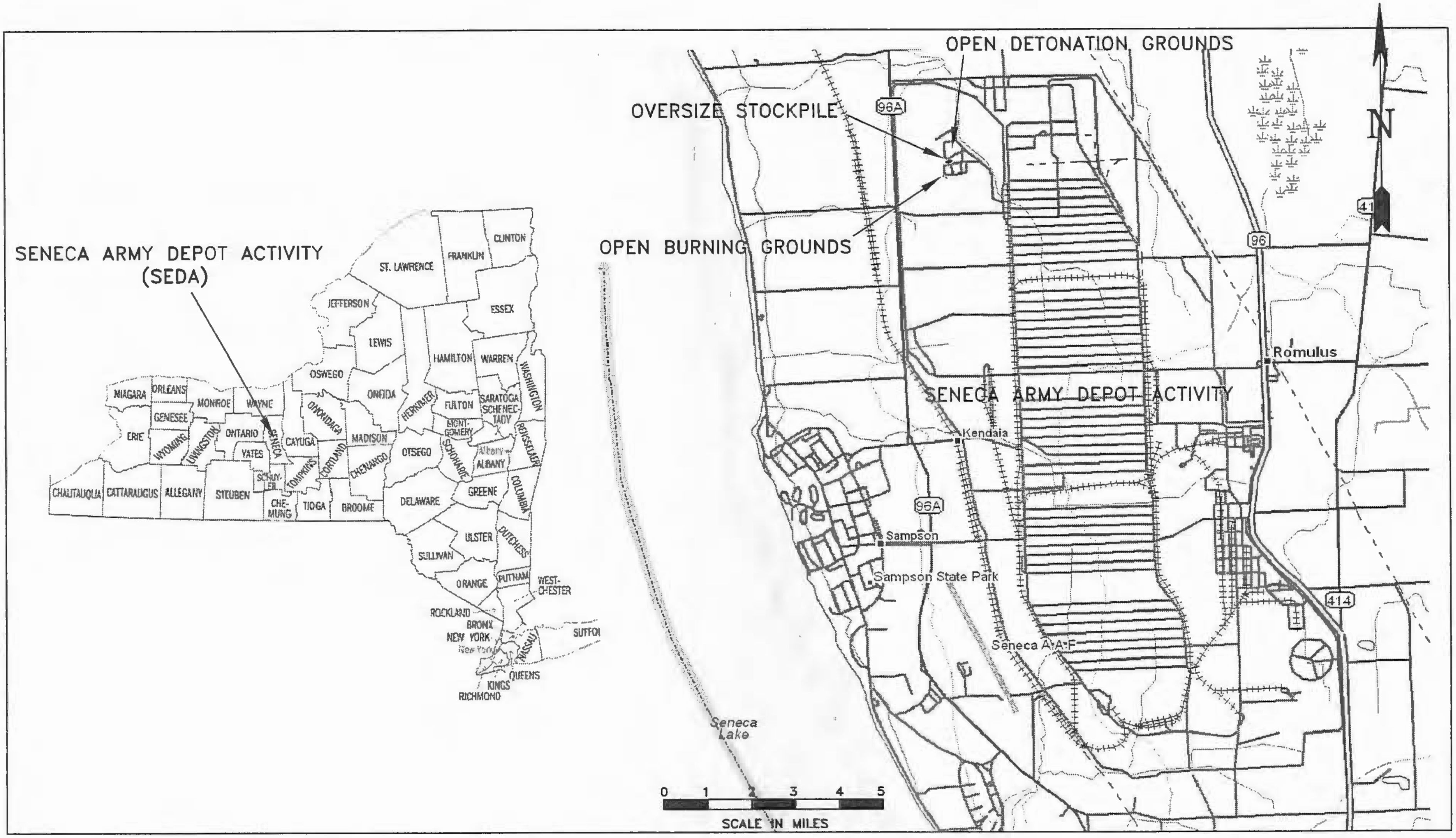
12.0 PUBLIC INVOLVEMENT

The public involvement process required for projects conducted under CERCLA is already in place with the SEDA BEC taking the lead in the process.

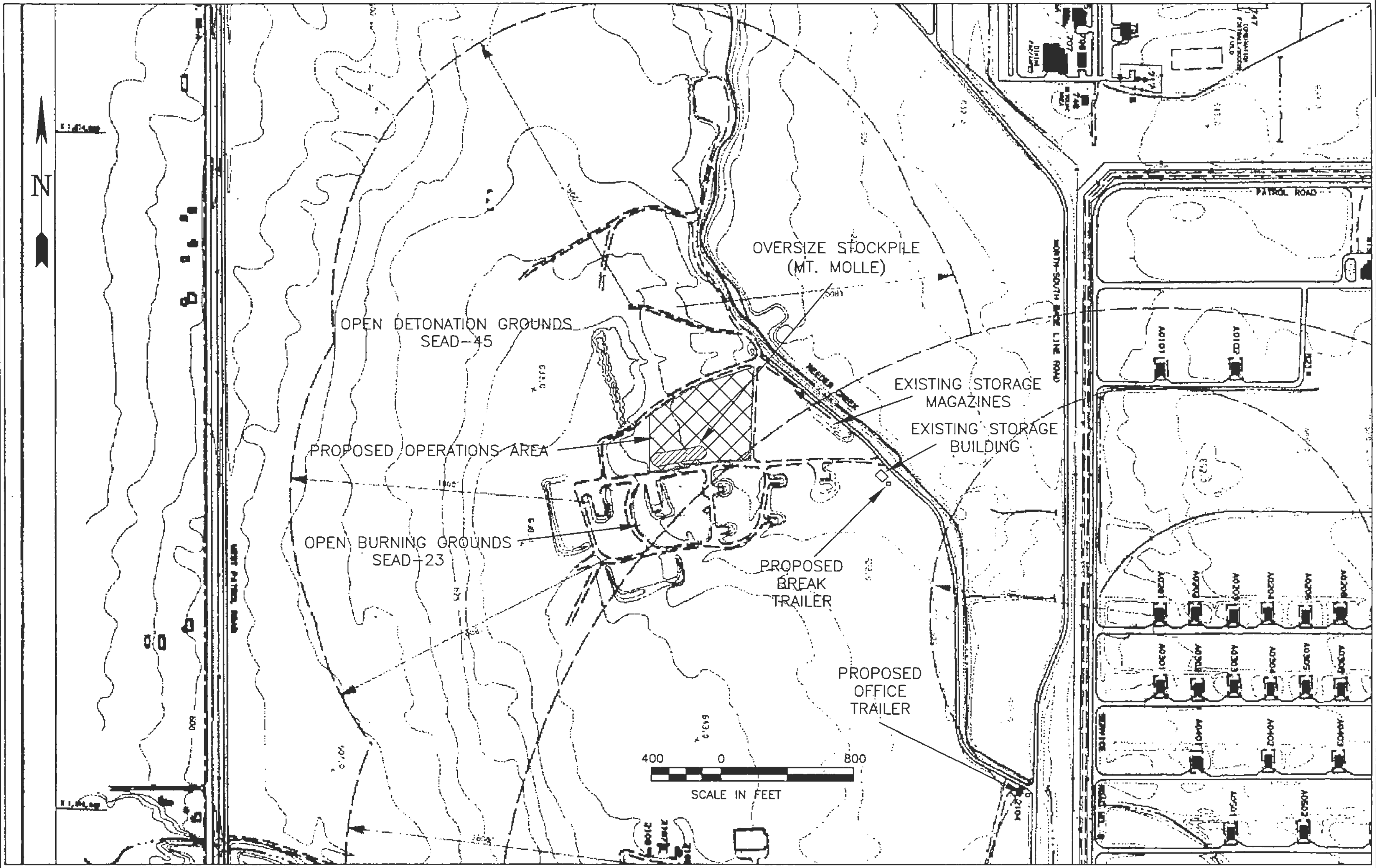
13.0 AFTER ACTION REPORT

At the end of this action, the JMC will submit a copy of an after action report to each office that has been responsible for reviewing this ESS. The after-action report will summarize the MEC discovered by type.

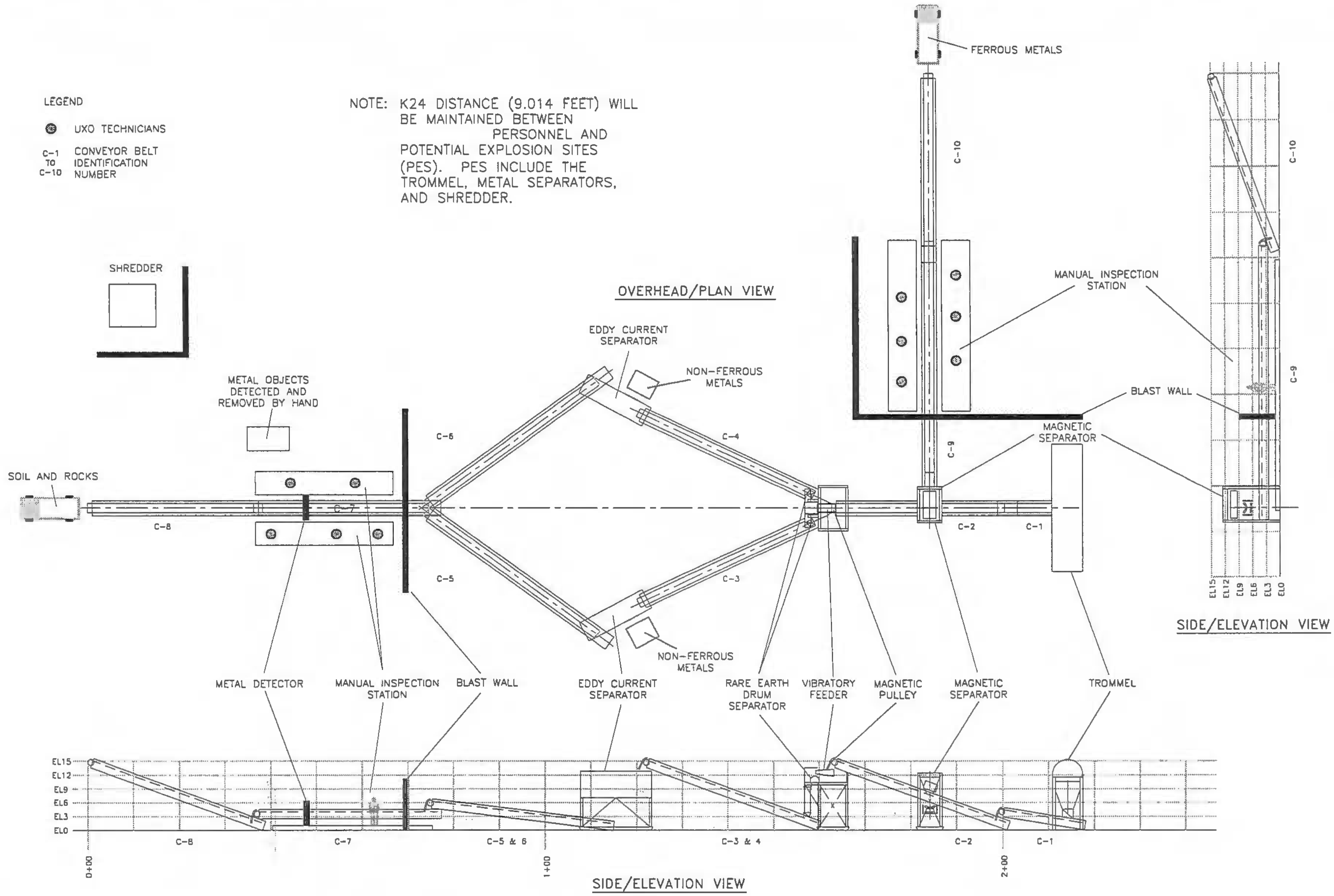
Appendix A – Figures and Maps



MKM www.mkmeng.com	MKM ENGINEERS, INC.				FIGURE 1 – REGIONAL MAP SHOWING LOCATION OF SEDA REMOVAL OF OVERSIZE STOCKPILE SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY
	PROJECT NO.:	02108	DRAWING NO.:	SEDA_FIG1	
	DATE DRAWN:	04/30/2004	SCALE:	AS SHOWN	
	DRAWN BY:	CVJ	APPROVED BY:	SHK	



MKM	MKM ENGINEERS, INC.				FIGURE 2 – SITE MAP OF OVERSIZE STOCKPILE (MT. MOLLE)
	PROJECT NO.:	02108	DRAWING NO.:	SEDA_FIG2	REMOVAL OF OVERSIZE STOCKPILE
	DATE DRAWN:	04/02/2004	SCALE:	AS SHOWN	SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY
www.mkmeng.com	DRAWN BY:	CVJ	APPROVED BY:	SHK	



MKM

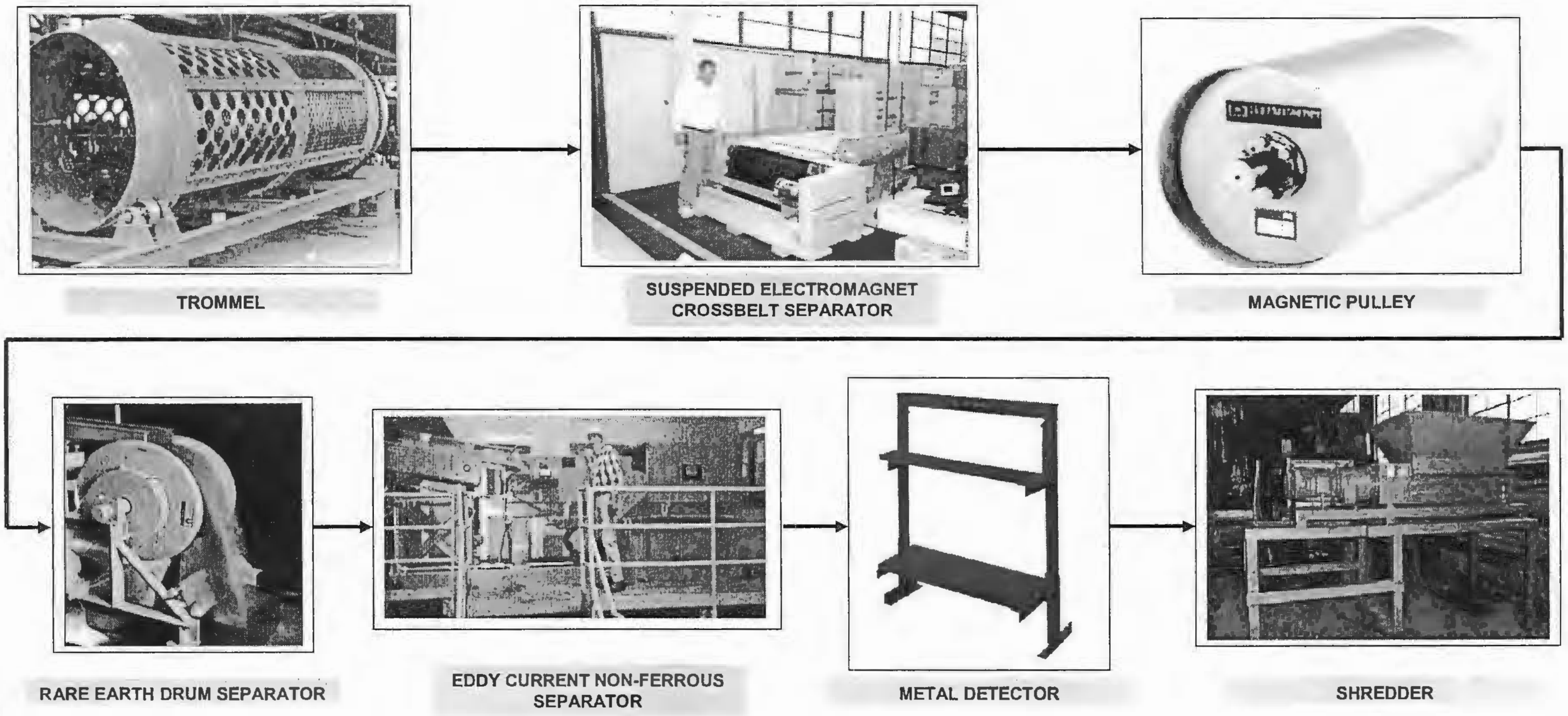
www.mkmeng.com

MKM ENGINEERS, INC.			
PROJECT NO.:	02108	DRAWING NO.:	SEDA_FIG3
DATE DRAWN:	04/30/2004	SCALE:	AS SHOWN
DRAWN BY:	CVJ	APPROVED BY:	SHK

FIGURE 3A – SCHEMATIC OF PROPOSED SORTING OPERATIONS

REMOVAL OF OVERSIZE STOCKPILE

SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY



REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED

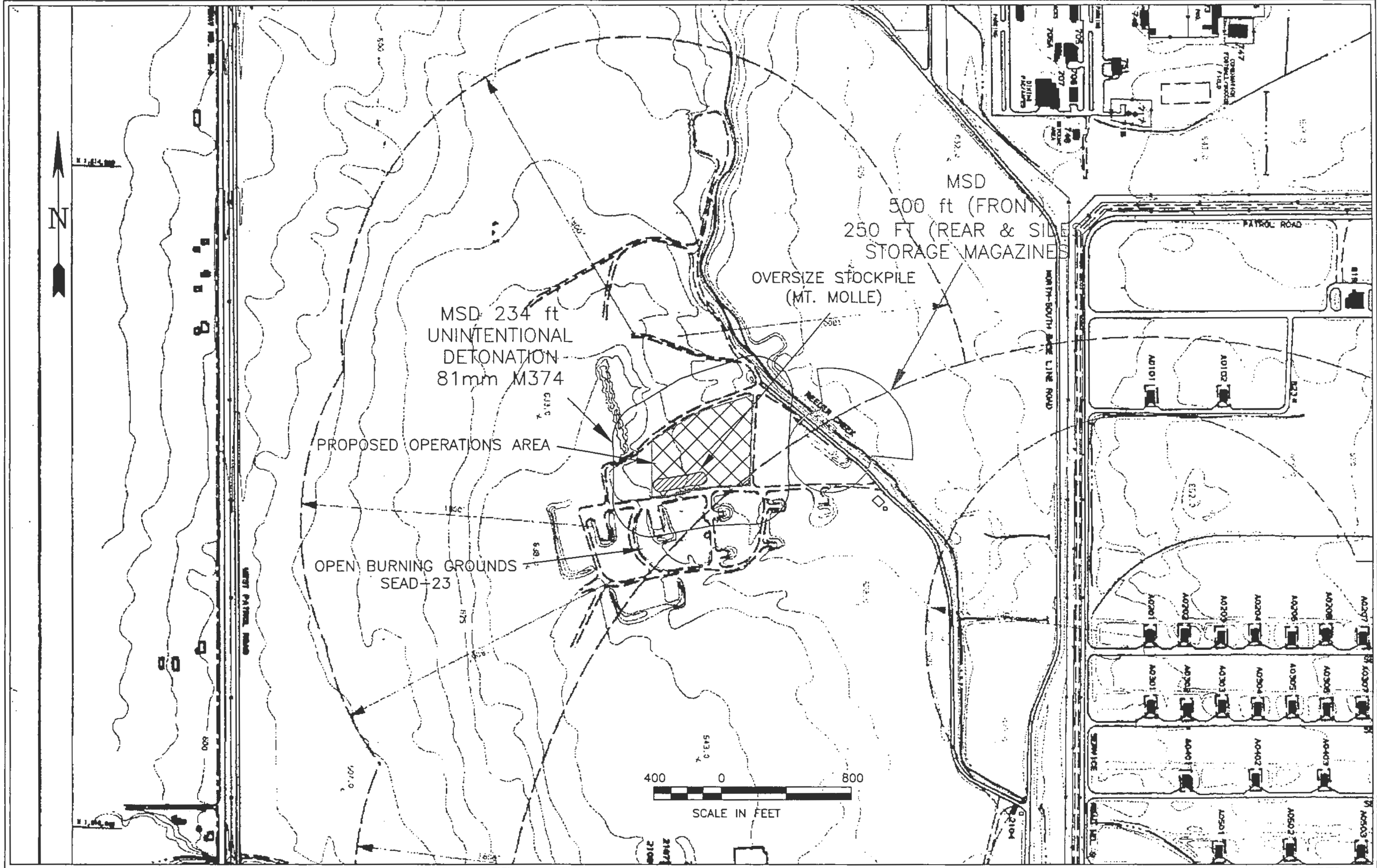
MKM ENGINEERS, INC.

DATE DRAWN 04-02-2004

FIGURE 3B – PHOTOGRAPHS OF PROPOSED PROCESSING EQUIPMENT
REMOVAL OF OVERSIZE STOCKPILE
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

SIZE	PROJECT NO.	DWG NO	REV.
B	02106	SEDA_FIG3A	

DRAWN BY	CVJ	APPR. BY	JHM



MKM ENGINEERS, INC.

PROJECT NO.:	02108	DRAWING NO.:	SEDA_FIG4
DATE DRAWN:	04/30/2004	SCALE:	AS SHOWN
DRAWN BY:	CVJ	APPROVED BY:	SHK

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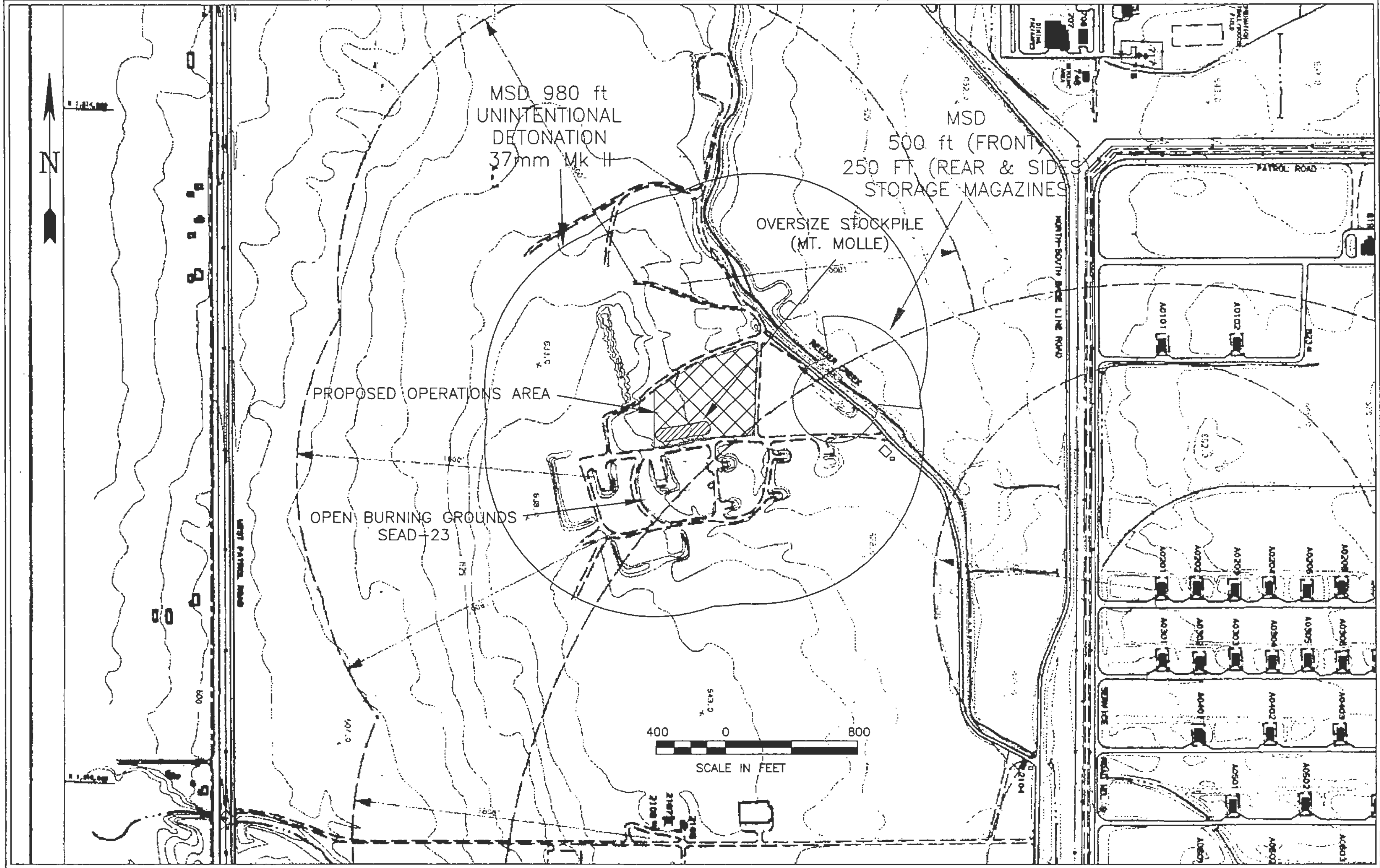
FIGURE 4 – MINIMUM SEPARATION DISTANCE (MSD) FOR INITIAL CLEARANCE OF OPERATIONS AREA

REMOVAL OF OVERSIZE STOCKPILE
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY



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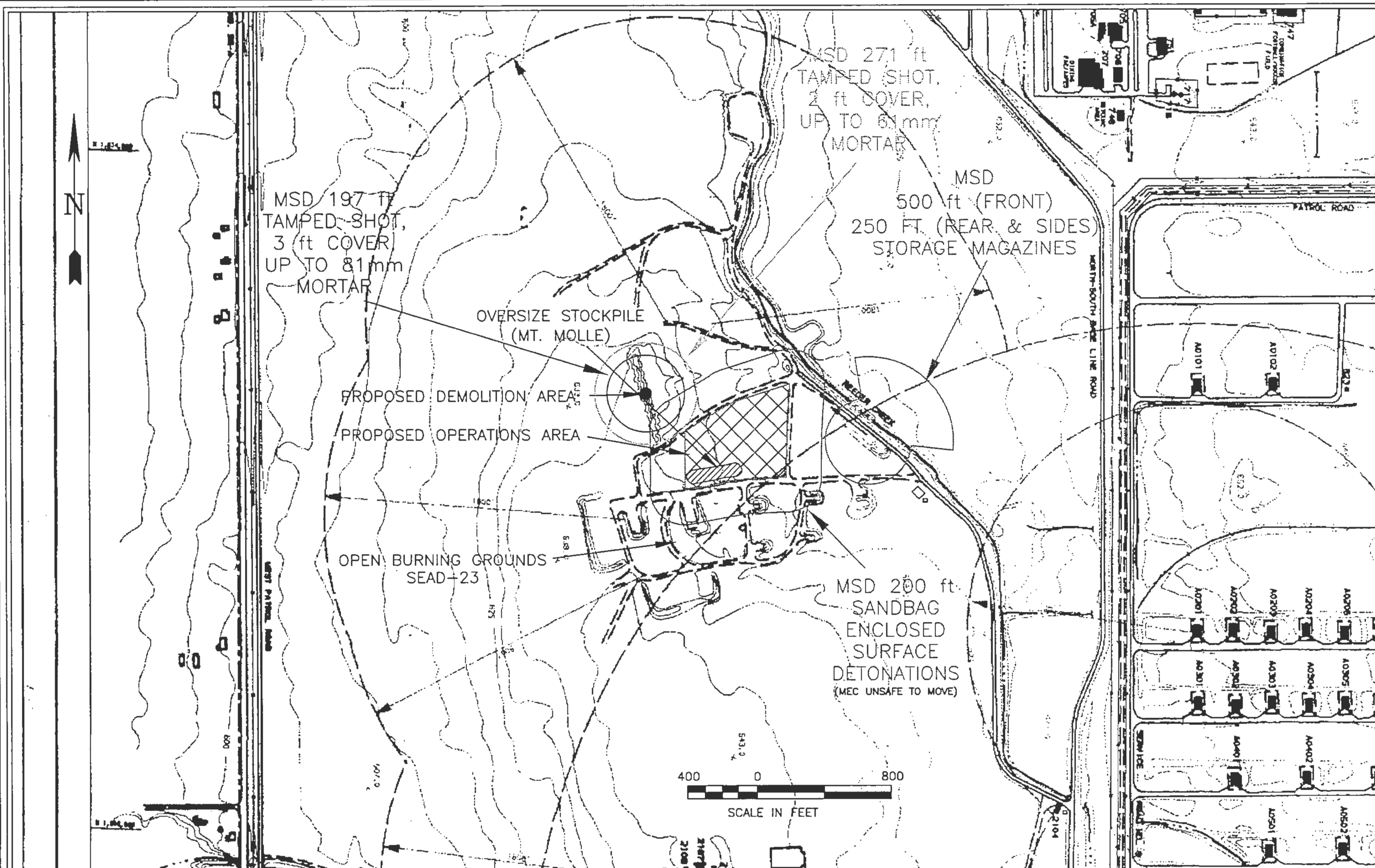
MKM ENGINEERS, INC.			
PROJECT NO.:	02108	DRAWING NO.:	SEDA_FIG5
DATE DRAWN:	04/30/2004	SCALE:	AS SHOWN
DRAWN BY:	CVJ	APPROVED BY:	SHK

FIGURE 5 – MINIMUM SEPARATION DISTANCE (MSD) FOR THE PROCESSING OF THE OVERSIZE STOCKPILE

REMOVAL OF OVERSIZE STOCKPILE

SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY



MKM ENGINEERS, INC.			
PROJECT NO.:	02108	DRAWING NO.:	SEDA_FIG6
DATE DRAWN:	04/30/2004	SCALE:	AS SHOWN
DRAWN BY:	CVJ	APPROVED BY:	SHK

MKM
www.mkmeng.com

FIGURE 6 – MINIMUM SEPARATION DISTANCE (MSD) FOR MEC DEMOLITION OPERATIONS

REMOVAL OF OVERSIZE STOCKPILE

SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

Appendix B – Rotar© Specifications

Information in this appendix regarding the Rotar© and the manner in which it was tested is for reference only and does not indicate how the Rotar© will be configured for this project. Only selective pages (1 thru 6, 15 and 16) of the test report are included in this appendix. The entire report can be viewed at www.humanitarian-demining.org/demining/pubs.asp.

FINAL REPORT

Test Report of Improved Backhoe

July 2003

Prepared by

Institute for Defense Analyses
4850 Mark Center Drive
Alexandria, VA 22311-1882

for

Humanitarian Demining Research and Development Program
Night Vision and Electronic Sensors Directorate
10221 Burbeck Road, Suite 430
Fort Belvoir, VA 22060

Office of the Assistant Secretary of Defense Special Operations & Low-Intensity Conflict
2500 Defense Pentagon
Washington, DC 20301-2500

FOREWORD

The success of the Improved Backhoe test program was the result of the efforts of a large team of people from several organizations. The Project Engineer, Mr. Mike Collins, not only designed the improvements made to the commercial backhoe, but also directed the manufacturing and installation of all the armor upgrades to the JCB 215S backhoe and to the special equipment installations of the ROTAR© and the SETCO tires. A special debt of gratitude is paid to Mr. John Snellings, the Improved Backhoe operator throughout the test program, who managed to keep his cool even when temperatures inside the cab reached 120 °F+. The Test Engineer was Ms. Sewaphorn (Noy) Rovira from Fibertek, Inc. (now Major Rovira, U.S. Army, as of December 2002) who provided background from previous test programs. Mr. Art Limerick, a member of the Humanitarian Demining staff at the NVESD/CM test site, rendered test support in the field. Mr. Harold Bertrand, Mr. Isaac Chappell, and Ms. Sherryl Zounes of the Institute for Defense Analyses (IDA) provided technical test support and were the authors of this report.

The equipment used on the Improved Backhoe and product information appearing in this report was obtained from the following organizations:

ROTAR International b.v.
Schering 27, 8281 JW Genemuiden
P.O. Box 174, 8280 AD Genemuiden
The Netherlands

Tel: + 31 (0) 38 385 54 71
Fax: + 31 (0) 38 385 54 02
e-mail: www.rotar.nl

SETCO Tire Company,
P.O. Box 809
Idabel, OK 74745
Phone: (580) 286-6531 - Toll Free: 1-877-SETCO-JYD
Fax: (580) 286-6743 - Email: **setco@oio.net**

Pacific Recycling Attachments, Inc.
P.O. Box 24407
San Francisco, CA 94124-407
(707) 766-9511 Voice; (707) 766-9049 Fax
E-mail: info@pacificrecycling.com

1 INTRODUCTION

1.1 Background

During many humanitarian demining operations, especially those in which extensive use is made of mechanical mine-clearing equipment, the mine-removal process frequently results in moving large amounts of surface soil and dirt from its original location to piles or berms located to the side of the clearing machine and running in a line parallel to the direction of the machine's movement. Clearing machines most apt to form berms are tillers, graders, and bulldozers. Experience has shown that the anti-personnel (AP) mines these machines are intended to destroy, uncover, or remove are frequently physically moved with the dirt and end up buried in the berms. Therefore, a machine that can be used to remove the AP mines [and other unexploded ordnance (UXO)] buried in the untreated berms is needed.

1.2 Objective

The objective of this test program was to evaluate the operational effectiveness of an improved commercial off-the-shelf (COTS) JCB 215S, Series 3, four-wheel steer (4WS) backhoe equipped with a Rotar International b.v. ROTAR©, model HPL 800 S soil sifter mounted on the front of the backhoe (see Figure 1). The Improved Backhoe was tested under conditions approximating those found by humanitarian demining organizations in easy to moderately difficult soil and terrain conditions. The ROTAR© subsystem was tested for its ability to remove mines from berms that were created by plowing or tilling operations and to continue to operate after sustaining an AP-mine-equivalent explosive charge. Vehicle on- and off-road handling was evaluated, and logistic considerations (e.g., spares and fuel/oil consumption) of importance to a user were measured and/or noted. Human factors issues (e.g., operator visibility and comfort under various moving situations) and maintenance issues were also addressed.

2 EQUIPMENT USED

2.1 Improved Backhoe

Starting with a JCB 215S, Series 3, 4WS (also capable of 2 wheel steer (2WS) and crab steer) commercial backhoe, the Modeling and Mechanical Fabrication Shop of the U.S. Army Communications & Electronics Command, Night Vision and Electronic Sensors Directorate (NVESD), Ft. Belvoir, Virginia, made structural modifications to the vehicle to improve its survivability in a hostile, land-mine environment. The modifications included a blast-resistant cab and armored chassis intended to protect the operator and the vehicle from a small-arms fire (up to 12.75 mm) attack and from shrapnel caused by a detonated AP mine under the vehicle or an anti-tank (AT) mine in near proximity to the vehicle. (An AT mine detonated under the improved backhoe would more than likely disable the vehicle and cause injury to the operator.)

Figure 1. Improved Backhoe With HPL 800 S ROTAR©

The changes made to the commercial backhoe were as follows:

- The fiberglass engine cowling[1] was replaced with 12.7 mm (0.5 inch) 6061 aluminum plate. This plating was also installed under the engine and cab area of the body. A 6.35-mm (0.25-in.) T-1 steel blast plate was mounted across the front lifting arms to protect the hydraulic lines from AP and AT mine shrapnel.

- The fiberglass shell of the cab was replaced with 6.35-mm (0.25-in.) T-1 steel. The fore and aft wind screen and side curtains were replaced with 31.75 mm (1.25 in.) of LEXAN©[2]. Exposed vehicle hydraulic lines were hardened to withstand fragmentation damage.

Figure 2 provides a silhouette of the Improved Backhoe. The reader should refer to this figure when as he examines the measurement and weight information in Tables 1 and 2. If the 6-in-1 bucket is also shipped with the Improved Backhoe, an additional 1,830 pounds must be added to the weights in Table 2.

To show the weight impact of providing ballistic survivability along with the soil sifting capability of the ROTAR© soil sifter, Table 3 provides a breakdown of the weight of the Improved Backhoe.

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[1] The engine cowling is a covering that houses the engine.

[2] LEXAN© is an engineering thermoplastic.

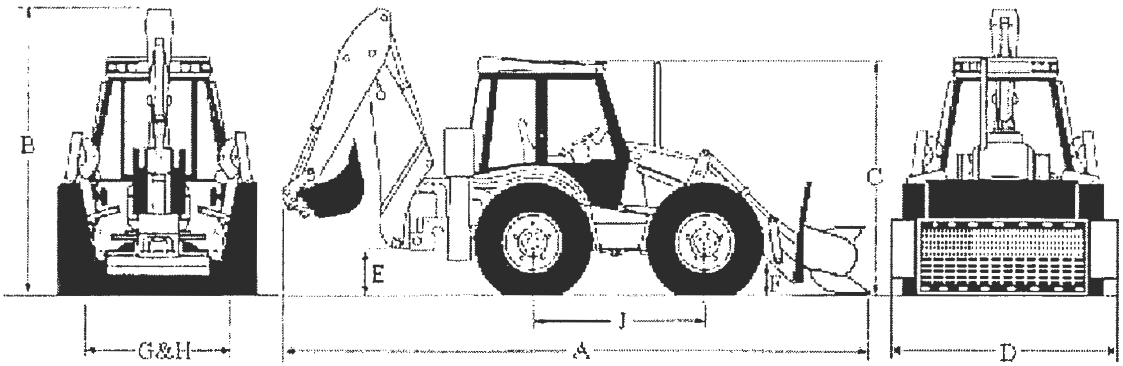


Figure 2. Silhouette of Improved Backhoe

Table 1. Dimensions of Improved Backhoe

	ft-in. (meter)		ft-in. (meter)
A. Transport length	24-6 (7.47)	E. Ground clearance - mainframe	1-1.5 (0.34)
B. Transport height	12-10 (3.91)	F. Ground clearance – front axle	1-5.7 (0.45)
C. Height to top of cab	9-5 (2.87)	G&H. Front/rear wheel track	6-3 (1.91)
D. Overall width with ROTAR©	7-10 (2.30)	J. Wheelbase	7-7 (2.31)

Note for Table 1: *Letters refer to dimensions in Figure 2.*

Table 2. JCB and Improved Backhoe Weights

Backhoe	Weight lb (kg)
JCB 215S-4WS Backhoe	18,765 (with extradig) (8,514)
Improved Backhoe (with ROTAR©)	27,300 (12,387)

2.2 ROTAR© Soil Sifter

The ROTAR© soil sifter, model HPL 800 S (manufactured by ROTAR© International, The Netherlands) used during this test was a COTS unit. The ROTAR© soil sifter comes in several sizes, ranging from light use to very heavy-duty use. Appendix A provides a list of over 600 commercial wheel loaders that will accept a ROTAR© soil sifter.

Table 3. JCB 215S to Improved Backhoe Weight Statement

	Item Weight lb (kg)	Vehicle Cumulative Weight lb (kg)
COTS JCB 215S (4WS)	18,114 (8,219)	18,114 (8,219)
Less cab and engine cowling	685 (310.8)	17,429 (7,908)
Less standard loader bucket	948 (430)	16,481 (7,478)
Less four tires	1,920 (871)	14,561 (6,607)
Plus ROTAR© Soil Sifter	2,855 (1,295)	17,416 (7,902)
Plus four SETCO Tires	6,600 (2,995)	24,016 (10,897)
Plus armored cab, engine cowling, and vehicle blast plate = Improved Backhoe	3,284 (1,490)	27,300 (12,386)

Note for Table 3: *Does not include 1,830 lb (832 kg) for 6-in-1 bucket.*

The ROTAR© model HPL 800 S selected for this test was mounted on the front loader arms of the JCB backhoe using the same attachment points used to mount the standard loader bucket. The NVESD Modeling and Mechanical Fabrication Shop manufactured the interface to mate the ROTAR© to the quick-disconnect mounting points. The ROTAR© barrel is constructed with 20-mm S2-3 steel bars to form a grid of 45-mm squares. Figure 3 is a picture of a COTS ROTAR© mounted to a wheel loader. Table 4 gives the specifications of the HPL 800 S ROTAR© sifter. Appendix B contains the specifications for the ROTAR© used in this test program.

Figure 3. COTS ROTAR© Soil Sifter

Table 4. HPL 800 S ROTAR© Soil Sifter Technical Specifications

ROTAR© Sifter	HPL 800 S
Capacity [1]	800 liters
ROTAR© weight	2,855 lbs (1298 kg)
Total width	93.7 in. (2,380 mm)
Drum width	70.9 in. (1,800 mm)
Bar diameter	0.79 in. (20 mm)
Distance between bars	1.77 in. (45 mm)
Material of frame/drum	S2-3 Steel
Cutting edge	Hardox 500
Drive	Hydromotor Char-lynn Eaton 104-1390
Maximum rotations (drum)	28/min

Note 1 for Table 4: *Working capacity is 2/3 of the drum capacity.*

2.3 SETCO Tires

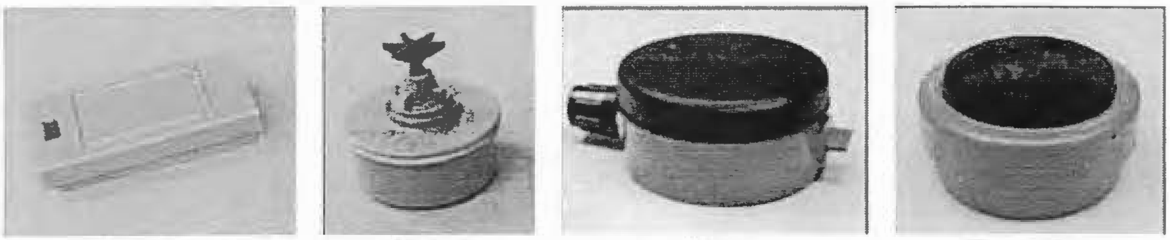
The standard tires that came with the JCB backhoe were replaced with COTS SETCO solid rubber tires, manufactured by the SETCO Tire Company, Idabel, Oklahoma (see Figure 4). SETCO tires are a commercial product and are adaptable to any wheeled loader. Using SETCO tires (vs. standard tires) added 4,680 pounds (2,123 kg) to the gross vehicle weight of the Improved Backhoe.[3] The SETCO tires will withstand the blast from a 500-gm AP mine, with only slight blast abrasion to the rubber tire and *no* damage/deformation to the metal tire rim.

Figure 4. SETCO Solid Rubber Tire

[3] SETCO tires sized to fit the JCB 215S weigh 1,650 lbs (748 kg) each. Standard tires weigh 480 lbs (218 kg) each.

2.4 Test Targets

All operational berm-cleaning tests of the ROTAR© soil sifter were made using AP mechanical reproduction mines (MRM) manufactured by Amtech Aeronautical Limited, Medicine Hat, Alberta, Canada. MRMs were buried in random patterns on the top and sides of the berms at depths ranging from surface to approximately 400 mm. The MRMs used were PMA-1, PMA-2, PMN, and Type 72A AP mines. Figure 5 shows pictures of the MRMs used during ROTAR© soil sifter operational tests.



PMA-1 **PMA-2** **PMN** **Type 72A**

Figure 5. AP MRMs Used During ROTAR© Soil Sifter Operational Tests

Six explosive tests were conducted against the ROTAR© soil sifter, using ¼-lb (113.4 gm), ½-lb (226.8 gm), and 1-lb (453.7 gm) blocks of trinitrotoluene (TNT) command-detonated inside the closed ROTAR© barrel. Nine blast tests were conducted against the right front SETCO tire, using eight ½-lb blocks of TNT and a 1-lb block of TNT, all detonated by a small AP mine.[4] One test was conducted against the chassis/cab, using an AT mine containing 22 lbs (10 kg) of explosives was conducted. See paragraph 3.4 for a discussion of these survivability tests.

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3.4 Survivability Tests

Survivability in a mine blast test was conducted in three separate steps. The first was against the ROTAR©, the second was against the SETCO tires, and the third was against the overall vehicle. All survivability testing was done at Test Site 2. All explosive charges were TNT, initiated by either a blasting cap or a small AP mine.

3.4.1 ROTAR© Blast Test

Six blast tests were conducted against the ROTAR©. The sizes of the explosive charges used were ¼-, ½-, and 1-lb blocks of TNT. Two blast tests were conducted for each size explosive: one with the ROTAR© barrel half filled with dirt (in which the explosive was buried) and the other with no dirt in the barrel (the explosive was suspended on the axis of rotation). In all cases, the explosive was remotely detonated. For the 1-lb explosive test, the test in the half-filled barrel resulted in damage to the barrel's steel liner at the midpoint of its length. Therefore, when the explosive test was conducted without dirt in the barrel, the explosive was suspended on the axis of rotation, at a point one-fourth the length of the barrel from the right side of the barrel. Table 8 presents the results of the explosive test in the ROTAR©. Some of the blast damage to the steel liner caused pieces of the steel liner to be pushed through the mesh of the reinforcing bars of the barrel. The protruding steel liner had to be beaten almost flush with the barrel bars to eliminate interference with the ROTAR© frame. Figure 16 is a picture of the bowing distortion to the ROTAR© barrel from the 1-lb block of TNT in Test 6. Figure 17 shows the damage to the steel liner from this series of tests.

Table 8. Blast Tests on ROTAR©

Test No.	Weight of Explosive	Soil Contents	Damage to ROTAR©	ROTAR© Operable?
1	¼ lb	½ full	No damage.	Yes
2	½ lb	½ full	No damage.	Yes
3	1 lb	½ full	1-11/16" × 5/8" hole in steel barrel liner. Some outward bowing of longitudinal bars.	Yes
4	¼ lb	Empty	5" × 3" hole in steel barrel liner.	Yes
5	½ lb	Empty	13" × 4.5" hole in steel barrel liner.	Yes
6	1 lb	Empty	Pressure-rise tearing of steel barrel liner at juncture with end of barrel. Noticeable bowing of longitudinal barrel bars.	Yes. ROTAR© able to close, lock, and spin.

Figure 16. Blast Distortion (Bowing) to ROTAR©