

Explosives Safety Submission MEC Support Services

for

Interim Action Soil Removal Landfill 4/Demolition Area 1 Camp Bonneville, Washington



April 19, 2004



Prepared for:

Department of the Army

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10 MAY 2004



DDESB-KO

MEMORANDUM FOR DIRECTOR, DEFENSE AMMUNITION CENTER
ATTENTION: SJMAC-ESM

SUBJECT: Explosives Safety Submission (ESS) for the Landfill 4/Demolition Area 1 Interim
Cleanup Action at Camp Bonneville, Washington

- References: (a) DAC SJMAC-ESM memorandum, 24 February 2004, Subject as above
- (b) E-mail message from Mr. Karl Rauc, DAC, to Ms. Lydia E. Sanchez, DDESB
Secretariat, 20 April 2004, Subject: Revised Camp Bonneville ESS
- (c) DoD 6055.9-STD (Re-write) approved by the DoD Explosives Safety Board at its
325th Meeting, 11 December 2002

The DoD Explosives Safety Board (DDESB) Secretariat has reviewed the subject ESS, forwarded by references (a) and (b), against the requirements of reference (c). Based on this review, we approve the ESS to perform munitions and explosives of concern (MEC) avoidance, removal, and disposal as necessary to support an environmental remediation project at Landfill 4/Demolition Area 1, Camp Bonneville, WA (with one correction as discussed in subparagraph d(5) below). The Army is conducting this response as a construction support effort. In summary:

- a. The site includes a former landfill (non-MEC) underneath a former munitions training area and MEC open burning/ open detonation site. The approximate size of the work site is 200 feet by 280 feet. The environmental remediation of the site will remove landfill soils to a depth of approximately 12 feet below ground surface. Support for necessary MEC response is intended to protect site workers from the hazards of MEC potentially present on the site.
- b. The most probable munition (MPM) for the landfill/demolition area is the 155mm M107 HE Projectile. The minimum separation distance (MSD) for this MPM is 447 feet, based on the hazardous fragment distance (HFD) from accidental detonation of a single round.
- c. Once the landfill area to be excavated has been cleared of MEC, the MPM for the soil excavation will be the 20mm HE M56A4 projectile. The Army based this decision on the possibility that an MEC item the size of the 20mm projectile or smaller could escape detection during the initial construction support effort. The HFD of 200 feet for this MPM will be applied as an exclusion zone during soil excavation.

d. The soil removed from the landfill during the MEC investigation and removal (Mag & Dig) operation will be screened to removed MFC items that may have gone undetected during Mag & Dig. Per reference (a), munitions as large as a 20mm projectile could escape detection and could be present in the excavated soil. Therefore, the MPM for the soil stockpiling and screening operations also will be the 20mm HE M56A4 projectile.

(1) The hopper for the screening operation will be armored to protect the earth-moving machinery (EMM) operator from unintentional detonation of the MPM. Shielding will be as described in Appendix E of reference (a).

(2) The technician operating the screen will be protected by an armored shield. Shielding will be as described in Appendix E of reference (a).

(3) The inhabited building separation distance (IBD) for the screening operation is 318 feet, based on the maximum fragment distance for the MPM at this site. The public traffic route separation distance (PTRD) is 191 feet.

(4) IBD for the soil stockpiled prior to screening is 200 feet, based on the HFD for the MPM at this site. The PTRD is 120 feet.

(5) ILD (K18) for both, the soil stockpile and soil screening operation, is 5.33 feet, based on the net explosive weight for quantity distance (NEWQD, 0.026 pounds) for the 20mm HE M56A4. NOTE: A correction needs to be made to the K24 distance (remotely controlled operations) mentioned in paragraph 3.7.9, page 3-8 of the ESS at reference (b). The correct K24 distance is 7.11 feet, based on the NEWQD for the MPM.

e. Per reference (a), blades and buckets on the EMM provide sufficient shielding to protect the EMM operator from an accidental detonation of the MPM.

f. MEC found at the site that is not acceptable to move will be blown-in-place. MEC found on the site or during the screening operation and that is acceptable to move will be intentionally detonated at the existing demolition site on the south end of the landfill.

(1) The demolition site is approved for an NEW limit of 20 pounds hazard division (HD) 1.1 materials.

(2) To reduce fragment and blast effects during intentional detonation, the DDESB-approved sandbag mitigation method will be used in all intentional detonations, whether the MEC is blown-in-place or at the demolition site.

(3) The 220 feet IBD will be applied as an exclusion zone for intentional detonation operations, whether at the demolition site or blown-in-place, based on the hazardous fragment distance for the MPM using the DDESB-approved sandbag mitigation method.

g. A Bureau of Alcohol, Tobacco and Firearms (BATF) Type 2 storage magazine is authorized to store a NEW limit of 50 lbs HD 1.1 materials. Per reference (a), blasting caps will be stored in a BATF Type 3 day box next to the magazine, separated by sandbags. These magazines will store only donor explosives for use during intentional detonation operations.

(1) The minimum inhabited building separation distance (IBD) for the magazine and day box combined is 601 feet, based on the hazardous fragment distance. The PTRD is 361 feet.

(2) The minimum intraline separation distance (ILD) from the magazine and day box combined is 66 feet, based on the NEW limit.

h. The Site Control Center/Command Post will be located at no less than IBD from each of the explosive sites (landfill, explosives storage, screening site, demolition site).

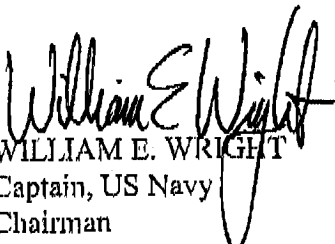
i. Intrusive operations, intentional detonations, or magazine access will not be conducted concurrently.

For all explosives safety distances established in the above paragraphs, we encourage application of greater/safer distances, whenever possible, to protect against potential rogue fragments.

This ESS does not address remediation of soil contaminated with explosives in concentrations that would render the soil explosive itself. Should the site contain explosive soil, an ESS addressing the affected areas must be submitted to this office for review and approval.

If at any time in the future the Army determines additional response action is necessary for the areas covered in this ESS, an amendment or update to this ESS must be submitted to this office.

The point of contact for this action is Ms. Lydia E. Sanchez, (703) 325-1373, DSN 221-1373, E-mail address Lydia.Sanchez@ddesb.osd.mil.


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EXPLOSIVES SAFETY SUBMISSION
MEC SUPPORT SERVICES
FOR
INTERIM ACTION SOIL REMOVAL
LANDFILL 4/DEMOLITION AREA 1
CAMP BONNEVILLE, WASHINGTON

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April 19, 2004

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Rev	Prepared	Reviewed	Approved	Date	Pages Affected

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ACRONYMS

AOC	Area of Concern
BATF	Bureau of Alcohol, Tobacco, and Firearms
BIP	Blown-in-Place
BRAC	Base Realignment and Closure
DDESB	Department of Defense Explosives Safety Board
DoD	Department of Defense
EMM	Earth Moving Machinery
EOD	Explosive Ordnance Disposal
ESQD	Explosive Safety Quantity Distance
ESS	Explosives Safety Submission
HD	Hazard Division
HFD	Hazard Fragmentation Distance
HE	High Explosive
IBD	Inhabited Building Distance
ILD	Intraline Distance
IMD	Intermagazine Distance
MC	Munitions Components
MEC	Munitions and Explosives of Concern
MFD	Maximum Fragmentation Distance
MPM	Most Probable Munition
NEW	Net Explosive Weight
OB/OD	Open Burning/Open Detonation
OE	Ordnance and Explosives
PANG	Portland Air National Guard
PD	Point Detonating
PES	Potential Explosion Source
PETN	Pentaerythritoltetranitrate
PTRD	Public Traffic Route Distance
Tetra Tech	Tetra Tech, Incorporated
TNT	Trinitrotoluene
USACE	U.S. Army Corps of Engineers
UXO	Unexploded Ordnance

DEFINITIONS

Discarded Military Munitions (DMM)—Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, and military munitions that have been properly disposed of consistent with applicable environmental laws and regulations (10 U.S.C. 2710 (e)(2)).

Exclusion Zone (EZ)—Restricted access areas where hazards are known or likely to be present, or areas that, because of activity, have the potential to cause harm to personnel. The exclusion zone shall be large enough to protect other personnel from the blast and fragmentation hazards of accidental detonation.

Munitions and Explosives of Concern (MEC)—This term, which distinguishes specific categories of military munitions that may pose unique explosive safety risks, means:

- (a) Unexploded ordnance (UXO), as defined in 10 U.S.C. 2710 (e) (g);
- (b) Discarded military munitions (DMM) as defined in 10 U.S.C. (e)(2); or,
- (c) Munitions constituents (e.g., TNT, RDX) present in high enough concentrations to pose an explosive hazard.

Munitions Constituents (MC)—Any materials originating from unexploded ordnance, discarded military munitions, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions.

Unexploded Ordnance (UXO)—Military munitions that:

- (a) Have been primed, fuzed, armed, or otherwise prepared for action;
- (b) Have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and,
- (c) Remain unexploded either by malfunction, design or any other cause.

UXO Personnel—Contractor personnel who have completed specialized Explosive Ordnance Disposal (EOD) military or Department of Defense-approved civilian training in EOD methods. Various grades and contract positions are established based on skills and experience.

1. PURPOSE

The purpose of this Explosives Safety Submission (ESS) is to obtain Department of Defense Explosives Safety Board (DDESB) approval for Munitions and Explosives of Concern (MEC) operations to support an interim remedial action regarding contaminated soil removal at Landfill 4/Demolition Area 1 (Landfill 4), Camp Bonneville, Washington (see Appendix A, Figure A-1). The MEC operations are construction support for the remedial action and do not constitute a MEC clearance. This is the second ESS for Camp Bonneville, which was closed by the Base Realignment and Closure (BRAC) 95 Commission. The first ESS was for a Time Critical Removal Action of MEC on 40mm ranges. This time critical action was completed in 1999.

2. SCOPE

Tetra Tech's scope of work, with respect to this ESS, is to perform MEC avoidance, removal, and disposal as necessary to support safe removal and disposal of contaminated soils at Landfill 4 (see Appendix B, Figure B-1) that are affecting groundwater quality in the vicinity of the landfill. The project is not a MEC clearance, but rather an environmental remediation project requiring MEC support. The MEC operations/activities at Landfill 4 will require several explosives safety measures, which are described in this ESS, including:

- Establishment of exclusion zones around Landfill 4 for MEC operations such as surface clearance, magnetometer-aided identification of anomalies, and dig removal of MEC
- Siting of one portable magazine for the storage of donor explosives for MEC disposal
- Siting of a Demolition Area at Landfill 4 for explosive disposal operations
- Establishment of an exclusion zone around MEC screening equipment located near the old Camp Bonneville cantonment area southwest of the landfill.

The soil removal (and MEC support activities) at Landfill 4 will be conducted in the following phases:

- Installation of Temporary Road and Stream Crossing Improvements
- Conventional Land Survey of The Landfill 4 Work Area, Establishment of Boundaries
- Brush Removal and Surface Clearance for MEC
- Geophysical Surveys to Verify Size of Work Area
- Tiered Excavation of MEC Contaminated Soils (Using Mag & Dig Technique)
- Geophysical Survey to Identify Deep Anomalies
- Excavation of Deep Anomalies/Removal of MEC
- General Excavation of Landfill Soils Under UXO Observation
- Screening of Soils Excavated From Landfill 4 to Remove Residual MEC
- Disposal of MEC and Disposition of Metal Scrap

The objective of the UXO personnel will be to perform, or support the performance of, the tasks listed in a manner that will ensure the safety of themselves and other site personnel.

3. BACKGROUND AND HISTORY

3.1 CAMP BONNEVILLE HISTORY

Camp Bonneville is a military reservation situated in the southeastern region of Clark County, Washington adjacent to Proebstel, Washington, 12 miles northeast of Vancouver, Washington (see Appendix A, Figure A-1). Camp Bonneville was established in 1909 as a drill field and rifle range for Vancouver Barracks. The 3,020 acres upon which Camp Bonneville was established was purchased by the federal government in 1919. The U.S. Army used Camp Bonneville for live fire of small arms, assault weapons, artillery, and field and air defense artillery between 1910 and 1995. The facility has also been used for weekend and summer training by the U.S. Army Reserve units in Southern Washington and Northern Oregon and is currently a sub-installation of Fort Lewis in Tacoma, Washington.

The reservation is U.S. government property that was selected for transfer and reuse by the BRAC 95 Commission. The U.S. Army BRAC Headquarters at Fort McPherson, Georgia is managing environmental investigation and cleanup activities.

3.2 SITE HISTORY

Landfill 4 is located in the northwestern part of the Camp Bonneville military reservation (see Appendix B, Figure B-1). The demolition area is underlain by the landfill. The landfill reportedly received building debris during the mid-1960s. The demolition area was reportedly used for open burning/open detonation (OB/OD) of unexploded ordnance and explosives training.

The site consists of a clearing surrounded by wooded areas and a gravel roadway along the eastern edge. The site slopes downward to the west, toward the north fork of Lacamas Creek. The area of concern (AOC) is reported to be 120 by 200 feet (see Appendix C, Figure C-1) based on aerial photographs showing the location of disposal trenches. Previous study data for the site indicates that the landfill is more than 11 feet deep; however, it is not known what portion of that depth has been impacted by MEC disposal operations and explosives training at Demolition Area #1.

Little specific information regarding the exact types and amounts of materials destroyed at the landfill/demolition area is available. However, review of available historical information has resulted in a general understanding of the types of ammunition commonly used, stored, or disposed of at Camp Bonneville during and after World War II. Limited information regarding the types of MEC potentially present at Landfill 4 was also obtained from the records. The information presented in this ESS was taken from two specific reports:

- The Final Archives Search Report Findings (USACE 1997)
- The Supplemental Archive Search Report (URS Greiner Woodward Clyde 1999).

Table 3-1 lists MEC and MEC-related items found or known to have been disposed of at the landfill/demolition area. During a recent site visit, a 20mm round was observed in a shallow crater at the site, confirming that this particular type of ammunition is present at the site. In addition to the items listed in Table 3-1, car bodies, railroad ties, railroad rails, and old appliances have been found at Landfill 4.

Table 3-1. MEC-Related Items Found or Known to Have Been Disposed of at Landfill 4

Class C Fireworks	F-84 Ejection Seats	C-119 JATO Bottle
20mm Ammunition	2.75-inch Rockets	155mm Round
AIM 4 Falcon Missiles (warheads and motors)	AIM 9 Warheads	AIM 75 Sparrow Missiles
Mark 38 Rocket Motors	C4 Explosive (training)	Rifle Grenades
TNT (training)	Detonation Cord (training)	Time Fuze
Small Arms	Grenade Spoons	

A personal interview was held with Mr. Jerry Cummings, the facilities Manager of Camp Bonneville on May 13, 1997 by URS personnel. At that time, Mr. Cummings identified the ordnance listed in Table 3-2 as having been found at Camp Bonneville. The 155mm round was found within the Landfill 4 site and is included in the list of items presented in Table 3-1. Details of the type/nomenclature of the discovered 155mm round could not be obtained.

Table 3-2. MEC Items Found at Camp Bonneville

Buried 3.5-inch Practice Rockets
40mm Grenades (HE) for an M203 Grenade Launcher
3-inch Trench Mortar (sand filled) Stokes
White Phosphorus Hand Grenade
2.36-inch Rocket
155mm Round
105mm Round

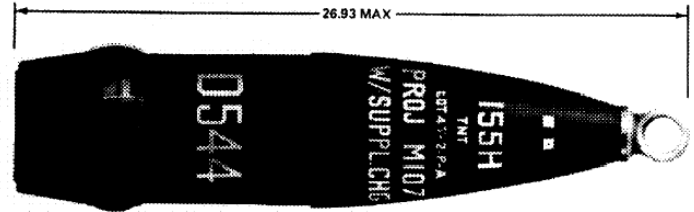
Currently, the Army intends to retain Camp Bonneville until the entire base is ready for transfer. When the property is transferred in the future, the most likely land use for Landfill 4 is wildlife habitat. While the construction support MEC operations outlined in this ESS are relatively rigorous, particularly in the upper 4 feet of the landfill soil, any future transfer of the property may require additional MEC clearance activities by the Army with DDESB approval.

3.3 AMOUNT AND TYPE OF MEC

Based on the discovery of a 155mm round at the Landfill 4 site, the Projectile, 155-Millimeter: HE, M107 was selected as the Most Probable Munition (MPM) for most of the MEC operations

planned during soil removal activities at the site. An HE projectile was chosen from among the various types of 155mm rounds based on the greater hazard associated with this type of projectile. The hazards of an M107 projectile are based on an un-fired round.

- HE fill: 14.6 pounds of TNT or 15.4 pounds of Composition B
- Fuzing: No fuzing or PD: M557, M78 series; M739 series; MK399 MOD 1; MTSQ: M564, M582 series; Prox: M728, M732 series.



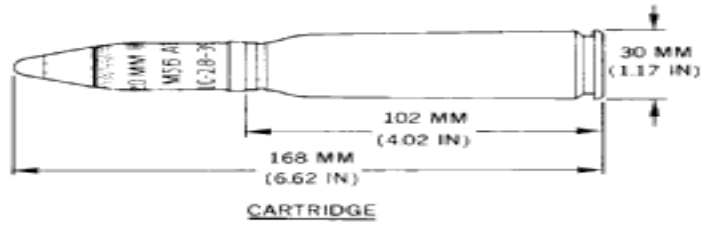
According to Technical Paper 16, Revision 1, 1 December 2003, Table B-1 (DDESB 2003), the Hazardous Fragmentation Distance for an accidental detonation of a single item of an M107 155mm projectile is 447 feet.

Two of the planned operations at the site involve soil that has been carefully cleared of MEC. These operations listed below have a different MPM.

1. Tiered soil removal after Mag & Dig clearance (see Section 3.7.5)
2. Soil screening for removal of residual MEC following either Mag & Dig clearance or intrusive investigation (see Sections 3.7.5 through 3.7.9).

Since these operations follow removal of MEC from the soils using effective, instrument-aided techniques, it is not reasonable to expect that any residual munitions larger than 20mm could be present in the soils. The only confirmed disposal of 20mm ammunition at Landfill 4 was conducted by the Portland Air National Guard (PANG). Anecdotal information obtained from Sergeant Tyson Morris of PANG, who participated in past disposal operations at Camp Bonneville, indicates that the 20mm ammunition disposed of was PGU 27 TPT ammunition. This information was relayed to Tetra Tech personnel via a telephone conversation with Senior Master Sergeant Dan Conner who supervises munitions storage for PANG (Conner 2003). This particular round is a target practice munition that has no explosive filler and poses little hazard to site workers; however, no specific records are available to ensure that this was the only type of 20mm ammunition destroyed at the landfill. Based on this uncertainty, a 20mm round containing a high-average amount of filler has been selected as the MPM for soil screening to provide added protection for site workers. The 20mm M56A4 contains 9 grams of filler, which is at the high end of the net explosive weight (NEW) for a majority of the 20mm projectiles made in the United States. Information regarding the shielding needed to defeat fragments from an unintentional detonation of this munition are readily available from Dr. Michelle Crull at the U.S. Army Corps of Engineers (USACE). The hazards of M56A4 20mm ammunition are based on an un-fired round.

- HE fill: 9 gms of RDX, Wax, Aluminum (A-1X-2)
- Fuzing: Centrifugally armed point detonating fuzes. PD: M505A3.



For soil sifting, a Maximum Fragment Distance for non-essential personnel is required. According to Technical Paper 16 (DDESB 2003), the Maximum Fragment Distance (MFD) for the M56A4 is 318 feet. For excavation and stockpiling of the suspect soil Hazardous Fragment Distance is required. According to Technical Paper 16 (DDESB 2003), the Hazardous Fragment Distance for the M56A4 is 200 feet.

3.4 MAPS

Distances to the closest roads and installation boundaries from Landfill 4 are listed below. The distance to the installation boundary is also shown on Figure D-1 in Appendix D. The distance to the nearest highway or power transmission line is too great to show on the maps at an appropriate scale.

- Camp Bonneville boundary (fence line) 1,350 feet (north)
- Public highway – 3.5+ miles (southwest)
- Power transmission and utility lines – 2+ miles (west [local delivery lines]).

No inhabited buildings are associated with this project. The abandoned bunker at Landfill 4 will be torn down during the site preparation work.

Distances to the closest roads and installation boundaries from the soil screening/stockpile area are listed below. The distance to the installation boundary is also shown on Figure D-2 in Appendix D. The distance to the nearest highway or power transmission line is too great to show on the maps at an appropriate scale.

- Camp Bonneville boundary 2,600 feet (north)
- Public highway – 3+ miles (southwest)
- Power transmission and utility lines – 1.5+ miles (west [local delivery lines])
- Power service to former Camp Bonneville cantonment 6,200 feet (northwest).

No inhabited buildings are associated with this project. The buildings at the former Camp Bonneville cantonment area are not currently in use.

3.5 START DATE OF INTRUSIVE ACTIVITIES

Intrusive activities will not begin until this safety submission is approved. The estimated date for the beginning of intrusive operations at Landfill 4 is June 14, 2004.

3.6 FROST LINE DEPTH

The frost line depth for Vancouver Washington is 10 to 12 inches. Landfill soils will be removed to an approximate depth of 12 feet; therefore, no provisions for monitoring future movement of MEC in the subsurface at Landfill 4 are required.

3.7 REMEDIATION APPROACH

3.7.1 Site Set-up

Two staging/work areas will be created to facilitate the ordnance activities. One area will be created at Landfill 4 (Figure C-1, Appendix C) to facilitate on-site activities. This area will be used for:

- A sited magazine for storage of donor explosives (see Section 3.9 for details)
- A Conex box or other temporary storage unit for short-term storage of inert munitions components (MC) in both the scrap and waste categories
- Storage of materials and chemicals used on site.

A second staging area will be created near the former Camp Bonneville cantonment area (Figure C-2, Appendix C). This staging area will be used for:

- Soil screening
- Soil stockpiles.

Further set-up requirements for magazine bunkering and grounding, exclusion zones establishment, and demolition area needs will be placed at this time.

3.7.2 Conventional Survey of the Landfill 4 Work Area, Establishment of Boundaries

Prior to beginning field activities in the Landfill 4 work area, it will be necessary to delineate the work area boundaries. Tetra Tech personnel or professional land surveyors will stake the boundary of the work area. The estimated footprint of the landfill is a rectangle measuring 120 feet by 200 feet. The work area has been defined as the landfill footprint, plus a 40-foot-wide buffer zone, bringing the size of the work area to 200 feet by 280 feet. The boundary of the work area will be staked using available benchmarks/monuments near the landfill. Stakes (or other approved markers) will be placed at appropriate intervals around the boundary of the work area.

The team performing the staking work will be accompanied by a qualified UXO Technician, who will provide MEC avoidance. The UXO technician will sweep the areas where survey

personnel will walk or place stakes. Surface MEC/MC items will be flagged/marked for future removal and survey team members will be instructed not to walk in areas near these items. Survey personnel will also be instructed to leave the work area if an item is discovered that is considered to be immediately dangerous.

3.7.3 Surface Clearance for MEC and Brush Removal

A UXO team will perform the surface clearance and brush removal. The team will set up survey lanes and perform a detector-aided sweep to identify all surface anomalies entirely or partially visible on the ground surface. Concurrently, brush and small trees growing on the landfill will be cut to within 2 to 3 inches of ground level and removed. No intrusive work will be conducted during the surface clearance.

3.7.4 Geophysical Surveys to Verify Size of Work Area

Following surface clearance and brush removal, a geophysical team will conduct a survey of the Landfill 4 work area using a Geonics EM-61 time-domain, electromagnetic metal detector. The purpose of this survey will be to verify the estimated size and layout of the historical ordnance disposal area. Data will be collected over the entire surface area of the work site and these data will be interpreted only to the degree necessary to obtain general information regarding the extent of subsurface metallic anomalies potentially representing buried MEC/MC. It is not anticipated that specific targets will be identified or located.

3.7.5 Tiered Excavation of MEC/MC Contaminated Soils (Using Mag & Dig Technique)

This phase of MEC operations is intended to incrementally remove MEC and MC from the upper soil horizon of the landfill. After the Mag & Dig clearance of the upper 1 foot of the landfill, earth moving machinery (EMM) will be used to carefully remove a 6-inch lift of soil under the observation of UXO Technicians. A non-UXO-qualified member of the team may operate the EMM. A traffic path will be configured so that dump trucks entering the work area to transport excavated soils will not be on the excavation site. The excavated soil will be stockpiled in the former cantonment area for future screening (see Section 3.7.9).

Tiered soil removal (i.e., Mag & Dig of the upper 1 foot of soil followed by removal of 6 inches of soil) will continue until no metallic targets are detected in the upper 1 foot of the soil. It is anticipated that this will occur at a depth of approximately 4 feet below original grade at the landfill/demolition area. The estimated depth is based upon anecdotal information from PANG indicating that they have used trenches approximately 4 feet deep for disposal of MEC/MC at Landfill 4 in the past. If metallic items are found below this depth during the Mag & Dig operations, these operations will continue until no metallic targets are found in the upper 1 foot of the soil.

Since the soils excavated during this phase will have been carefully cleared of MEC, the MPM for the excavation phase of the tiered removal is the M56A4 20mm projectile (see Section 3.3). This is the largest munition that can reasonably be expected to escape detection and removal during the Mag & Dig preceding excavation of each soil tier. EMM operators will be shielded from accidental detonation of the MPM by the blades and buckets on the EMM. These blades and buckets are constructed of hardened steel approximately 0.5 inch thick. The required thickness for shielding from the MPM is 0.06 inch. The backup data for the selected shielding are contained in an e-mail sent from Dr. Michelle Crull of the USACE to Mr. Eric Waehling at Fort Lewis, the BRAC Environmental Coordinator. A copy of this e-mail is contained in Appendix E. In order to further protect the EMM operators, loader buckets will be filled to 2/3 capacity or less to ensure that any MEC items present do not fall behind the bucket.

After completion of the tiered soil removal, the steps outlined in the following sections will be taken to identify and remove residual MEC in the deeper landfill soils and to protect construction personnel who are removing these soils for testing and disposal.

3.7.6 Geophysical Survey to Identify Deep Anomalies

After an appropriate amount of soil has been removed using the tiered removal process, a second geophysical survey similar to the first (see Section 3.7.4) will be conducted. The data from this survey will be fully interpreted and compared to the first survey data to yield a target list with horizontal locations (coordinates) and estimated depths for all valid anomalies. Data sets and maps will be prepared as appropriate to guide UXO teams excavating the anomalies.

3.7.7 Excavation of Deep Anomalies

All valid target anomalies identified during the geophysical survey will be prosecuted to determine the cause of the anomaly. EMM may be used to assist in deep excavation efforts. A non-UXO-qualified member of the team may operate the EMM. When an anomaly excavation gets within approximately 12 inches of an anomaly, hand tools will be used to complete the excavation. The anomaly's exact location will be determined and monitored during excavation using geophysical instruments and non-metallic probes.

After the probable source of the anomaly is identified and removed, a geophysical instrument will be used to validate the process. If the geophysical instrument does not continue to detect an anomaly, then the excavation may be backfilled. In the event an anomaly is still detected, the excavation work will continue to clear the target area to a maximum depth of 60 inches below grade. If target anomalies are present below this depth, the location will be noted and the anomaly may be investigated in greater detail during general excavation of landfill soils.

3.7.8 General Excavation of Landfill Soils

Following the excavation of deep anomalies at Landfill 4, general excavation of the remaining landfill soils will be performed. The MEC/MC removal activities described in the previous sections will result in identification and removal of a very large percentage of the MEC/MC present at Landfill 4; however, all detection techniques used to identify ordnance-related items have limitations based upon the design of the metal detectors employed and the composition, size, depth, and orientation of the target items. In order to ensure the safety of construction personnel performing soil removal, all activities will be observed by trained UXO personnel. These individuals will provide constant monitoring of intrusive actions to allow prompt identification and removal of MEC/MC from the work area.

Soils generated during this phase of work will be transported to the stockpile area near the Camp Bonneville cantonment area, but will not be screened for MEC. They will be stored in an area separate from soils identified for screening.

3.7.9 Mechanical Screening of Soils Excavated From Landfill 4 for MEC

The soil removed from the landfill during the Mag & Dig operations may still contain relatively small metallic items and some small MEC/MC (small arms ammunition and potentially 20mm projectiles). Therefore, this soil will be screened using mechanical screening techniques to separate debris and metallic items from the soil. Processed soil will be stockpiled for chemical evaluation and disposal. Debris and metallic items will be individually inspected to ensure no residual explosive materials or MEC remain. Because the soils subjected to screening will have been carefully cleared of MEC, the MPM for this process is the M56A4 20mm projectile. This is the largest munition that can reasonably be expected to escape detection and removal during previous clearance phases.

The mechanical screen used for this project will have a feed hopper, a grizzly, and one or more shaker screens. Soils will be fed into the hopper using a standard loader or other EMM. The hopper will be armored using 0.07-inch-thick mild-steel plating or 0.06-inch-thick hardened-steel plating to protect the EMM operator from an accidental detonation of the MPM. The UXO Technician running the screen and observing the screening process will work behind an armored shield constructed of Ecology Blocks and 0.46-inch-thick Plexiglas. Ecology Blocks are manufactured concrete blocks measuring 2.5 feet by 5 feet by 2.5 feet tall that are designed to be stacked. The backup data for the selected shielding are contained in an e-mail sent from Dr. Michelle Crull of the USACE to Mr. Eric Waehling at Fort Lewis, the BRAC Environmental Coordinator. A copy of this e-mail is contained in Appendix E. In addition to being positioned behind a shield, the screen operator will remain at least 7.11 feet (K24) from the hopper, conveyors, and screens during operation of the screen plant.

The debris deposition areas for the soil screen (i.e., the points at which debris falls from the grizzly or shaker screens) will be surrounded on three sides by Ecology Block walls a minimum of 5 feet tall (see Figure D-3, Appendix D).

Periodically, the screening operation will be halted to allow clearing of the screens (if necessary) and inspection of the screen and grizzly debris (oversize material) for MEC/MC. MEC/MC found during screening will be transported to Landfill 4 for disposal. If MEC/MC are determined to be unsafe to move, these items will be removed by remote means or blown in place (BIP). In the event that MEC/MC are observed in the soil screening plant (in the hopper, on the conveyor belts, or on the screens), screening operations will be halted until these items are safely removed for disposal. The Senior UXO Supervisor will determine the safest, most efficient means to remove these items. Munitions debris will be transported to Landfill 4 for storage and later disposal. Metal debris and inert materials (non-ordnance material) will be stored at an approved location for later disposal.

3.7.10 Disposal of MEC

All MEC discovered during the course of this project, whether it is discovered at the landfill or during soil screening operations, will be disposed of at a demolition site on the south end of Landfill 4 (see Appendix C, Figure C-1). Disposal will be accomplished using the guidelines in HNC-ED-CS-S-98-7, Use of Sandbags for Mitigation of Fragmentation and Blast Effects due to Intentional Detonation of Munitions (USACE 1998). Implementation of these guidelines will provide a safe, consistent disposal routine and will mitigate the effects caused by the disposal of larger items that would normally require an Explosive Safety Quantity Distance (ESQD) that would extend beyond the boundaries of Camp Bonneville.

MEC will be disposed of on a daily basis. Because donor explosives will be kept on site in an approved, sited magazine, it will not be necessary to store MEC overnight. Disposal will normally be conducted between 4 and 6 pm daily to allow neighborhood residents to plan for this operation; however, BIP operations will be conducted as necessary to ensure the safety of site personnel.

3.8 ACCESS CONTROL

Non-essential personnel will not be allowed within exclusion zones that are in effect. Intrusive operations, demolition operations, or magazine access will not be conducted concurrently as a safety measure to avoid overlapping active exclusion zones.

During site operations, the number of personnel within the work zone must be kept to a minimum to ensure site safety and control. A Site Control Center (Command Post) will be established to control access and maintain accountability of personnel entering, visiting, or

working on the project, and will function as a central base for communications. The command center will be located at Camp Killpack near the front gate to Camp Bonneville and will be well outside of the exclusion zones for all MEC operations. The Senior UXO Supervisor or designee will man the Command Post. Exclusion zones will be maintained using barricades on the access roads leading to the landfill and the soil screening/stockpile area as necessary.

3.9 EXPLOSIVE SAFETY QUANTITY DISTANCE ARCS

Several ESQD arcs are needed for the various work areas and project-related facilities on site (work areas, magazine, demo site, soil sifting site, and soil stockpile site).

Landfill 4—Intrusive Activities

The work at Landfill 4 will require the establishment of four safety arcs/ESQDs. The work will require a Hazard Fragmentation Distance (HFD) arc for Hazard Division 1.1 (HD 1.1) Munitions, an Inhabited Building Distance arc (IBD), an Intermagazine Distance (IMD) arc, and a Public Traffic Route Distance arc (PTRD). The MPM for this set of safety arcs is the 155mm projectile, HE, M107 (see Section 3.3). According to Technical Paper 16 (DDESB 2003), the Hazardous Fragmentation Distance for an accidental detonation of this MPM is 447 feet. This distance is also the IBD for intrusive work at the landfill. The IMD is 51 feet. This is the K11 value from Table C9.T7B in the Department of Defense (DoD) Ammunition and Explosives Safety Standards, 6055.9-STD (DoD 2003). Finally, in accordance with paragraph C9.4.1.2.1.1.1 of the Ammunition and Explosives Safety Standards (DoD 2003), the PTRD is equal to 60 percent of the IBD, or 304 feet. There are no public traffic routes within 304 feet of Landfill 4. Applicable safety arcs are shown on Figure D-1 in Appendix D.

Donor Explosive Magazine

Donor explosives for disposal of MEC found at Landfill 4 will be stored on site. One Bureau of Alcohol, Tobacco and Firearms (BATF) Type 2 magazine will be used for this purpose. This magazine will be placed in the Landfill 4 staging area (Figure D-1, Appendix D) and store no more than 50 pounds NEW of the demolition explosives listed below.

- 1 pound PETN charges (HD 1.1)
- 36-gram shape charges (HD 1.1)
- Detonating cord (HD 1.4)
- Ammonium nitrate binary explosive charges (Nitro methane stored separately a minimum of 100 feet from explosive locations)
- No more than 50 number 8 electric blasting caps (HD 1.4).

BATF specifications and requirements for the magazine are contained in Appendix F. The magazine will have a Lightning Protection System in accordance with DA PAM 385-64 (see Appendix F).

The blasting caps will be stored in a BATF type 3 Day Box and separated from the HD 1.1 explosives by a sandbag barrier.

The storage magazine will require an HFD arc for HD 1.1 Explosives, an Intraline Distance (ILD) arc for an un-barricaded structure and a PTRD arc. According to paragraph C9.4.1.2.1.1.1.6 and Table C9.T2 of DoD (2003), the HFD for a magazine storing less than 50 pounds of HD 1.1 explosives is 601 feet. The ILD for the magazine is 66 feet according to paragraph C9.4.1.4 and Table C9.T5 of the Ammunition and Explosives Safety Standards (DoD 2003). The referenced table provides the ILD from potential explosion sources (PESs) other than earth-covered magazine. The IDL established is superceded by the HFD distance for the demolition area created for this project (see the following section, Demolition Area 1). Finally, in accordance with paragraph C9.4.1.2.1.1.1 (DoD 2003), the PTRD is equal to 60 percent of the HFD, or 361 feet. There are no public traffic routes located within 361 feet of the magazine. Applicable safety arcs are shown on Figure D-1 in Appendix D.

Demolition Area 1

Camp Bonneville Demolition Area 1 has been used by the Air Force, U.S. Army Explosive Ordnance Disposal (EOD), Police Bomb Squad, and the FBI over the years. Archive Search Reports indicate that the range was sited with a NEW limit set at 4 pounds in the 1980s. This limit dropped to one-quarter pound in 1988 and is still in force at the current time. This project will require re-siting of Demolition Area 1 with a range limit of 20 pounds NEW of HD 1.1 explosives to dispose of a single 155mm projectile plus donor explosives, using the DDESB-approved sandbag method.

According to paragraph C5.5.4.1.2, Ammunition and Explosives Safety Standards (DoD 2003), the exclusion zone should be 4,000 feet unless barricading, earth-tamping, or other control measures are applied during the disposal operations. The demolition range exclusion zone must not exceed Camp Bonneville property boundaries. This limits the fragmentation range/exclusion zone to 1,260 feet.

In order to reduce fragmentation effects and meet the criteria in the Ammunition and Explosives Safety Standards, paragraph C4.3.1.2, the guidelines in HNC-ED-CS-S-98-7, Use of Sandbags for Mitigation of Fragmentation and Blast Effects due to Intentional Detonation of Munitions (USACE 1998) will be used to limit blast overpressure and fragmentation. A demolition pit will be constructed at the south end of Landfill 4. Once the area is cleared by UXO Technicians, a backhoe will be used to create a demolition pit for tamping fragment-producing disposal shots.

The pit will be lined with sandbags and all items disposed of will be tamped with sandbags in accordance with the referenced guidance. The application of this methodology for fragment control reduces the required HFD for the disposal operation to 220 feet. This HFD is shown on Figure D-1 in Appendix D.

If MEC is encountered that cannot be moved to the demolition area, the item(s) will be BIP using the sandbag tamping methodology in HNC-ED-CS-S-98-7 (USACE 1998).

Soil Screening Area

The soil screening conducted in the staging area near the Camp Bonneville cantonment will require the establishment of four ESQD arcs. The screening itself will require an MFD arc for HD 1.1 Munitions, an IBD, and a PTRD. The soil stockpile will require an HFD. The MPM for this set of safety arcs is the 20mm projectile, HE, M56A4 (see Section 3.3). According to Technical Paper 16 (DDESB 2003), the MFD for an accidental detonation of this MPM is 318 feet. This distance is also the IBD for the soil screening operation. In addition, because the soil being stockpiled for screening may contain the MPM, an HFD is required. According to Technical Paper 16 (DDESB 2003), the HFD for the accidental detonation of the MPM is 200 feet. Finally, in accordance with paragraph C9.4.1.2.1.1.1 of the Ammunition and Explosives Safety Standards (DoD 2003), the PTRD is equal to 60 percent of the IBD, or 142 feet. Applicable safety arcs are shown on Figure D-2 in Appendix D.

The soil screen operator will be required to remain at a minimum distance of 7.11 feet (K24) from the hopper, conveyors, grizzly, and shaker screens when the screen plant is in operation. This individual will also be positioned behind a shield in accordance with Section 3.7.9. The typical screen plant layout is shown on Figure D-3 along with the required separation distance for the operator.

3.10 SITE-SPECIFIC TRAINING

As part of the mobilization process, Tetra Tech will perform site-specific training for all on-site personnel assigned to ordnance support tasks. The purpose of this training is to ensure that all on-site personnel fully understand the operational procedures and methods to be used at this site, including individual duties and responsibilities and all safety and environmental concerns associated with operations. Any personnel arriving at the site after this initial training session will have to complete the training before starting work. The Senior UXO Supervisor and the UXO Safety Officer will conduct the training, which will include the following topics:

- Operation of field equipment including safety measures
- Operating procedures including safety requirements
- Site and task specific hazards, including physical, biological, and chemical hazards

- Specific MEC hazards (MEC, MC, and demolition materials) potentially found on site or proposed for use in disposal of MEC/MC
- First Aid and CPR (including first aid for white phosphorus burns)
- Emergency procedures including emergency evacuation and notification of local emergency responders.

3.11 PUBLIC INVOLVEMENT

The Project Manager is responsible for interfacing with the client on a day-to-day basis. The client is responsible for informing the appropriate Regulatory Agencies and the Public of important events and activities associated with this project. Regulatory agencies and the public will be provided with an opportunity to comment on planned remedial operations, including MEC disposal, prior to execution of the work plan for soil removal at Landfill 4.

4. REFERENCES

- Conner, D. 2003. Senior Master Sergeant, Portland Air National Guard. Personal conversation with Carol Hutley, Tetra Tech, Inc., December 1, 2003 regarding disposal of 20mm ammunition at Camp Bonneville, Landfill 4.
- DDESB (Department of Defense Explosives Safety Board). 2003. Technical Paper No. 16, Methodologies for Calculating Primary Fragment Characteristics. Revision 1. December 1, 2003.
- DoD (Department of Defense). 2003. DoD 6055.9-STD, DoD Ammunition and Explosives Safety Standards, Working Copy. September 2003.
- URS Greiner Woodward Clyde. 1999. Supplemental Archive Search Report, Camp Bonneville, Vancouver, Washington. Prepared for U.S. Army Corps of Engineers, Seattle, Washington. August 1999.
- USACE (U.S. Army Corps of Engineers). 1998. HNC-ED-CS-S-98-7, Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions. Engineering and Support Center, Huntsville, Alabama. August 1998.
- USACE. 1997. Final Archives Search Report Findings, Camp Bonneville, Clark County, Washington. U.S. Department of Defense Program, Base Realignment and Closure Ordnance, Ammunition and Explosives. July 1997.

APPENDIX A
Figure A-1 – Location Map

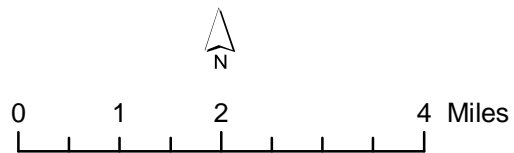
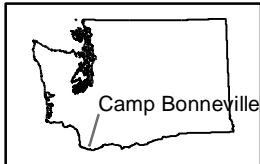
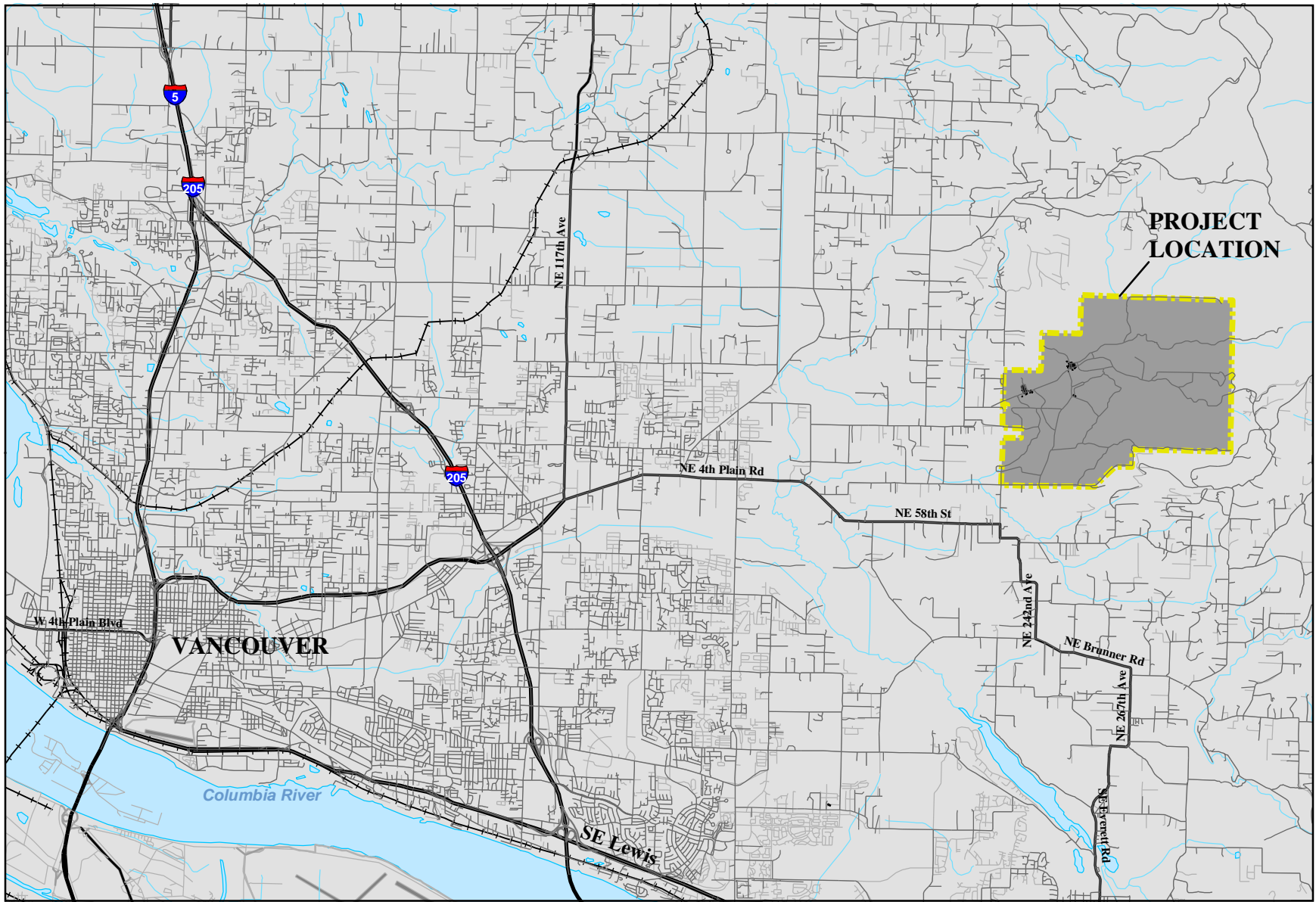


Figure A-1
 Location Map
 Camp Bonneville
 Military Reservation
 Clark County, WA

APPENDIX B
Figure B-1 – Site Vicinity Map

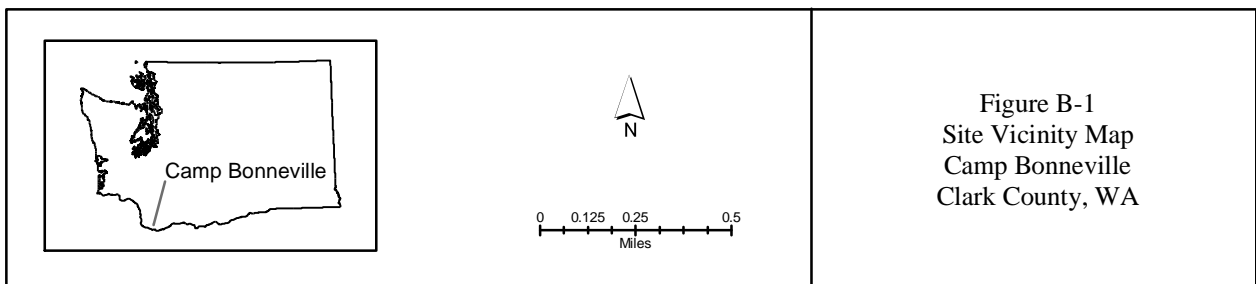
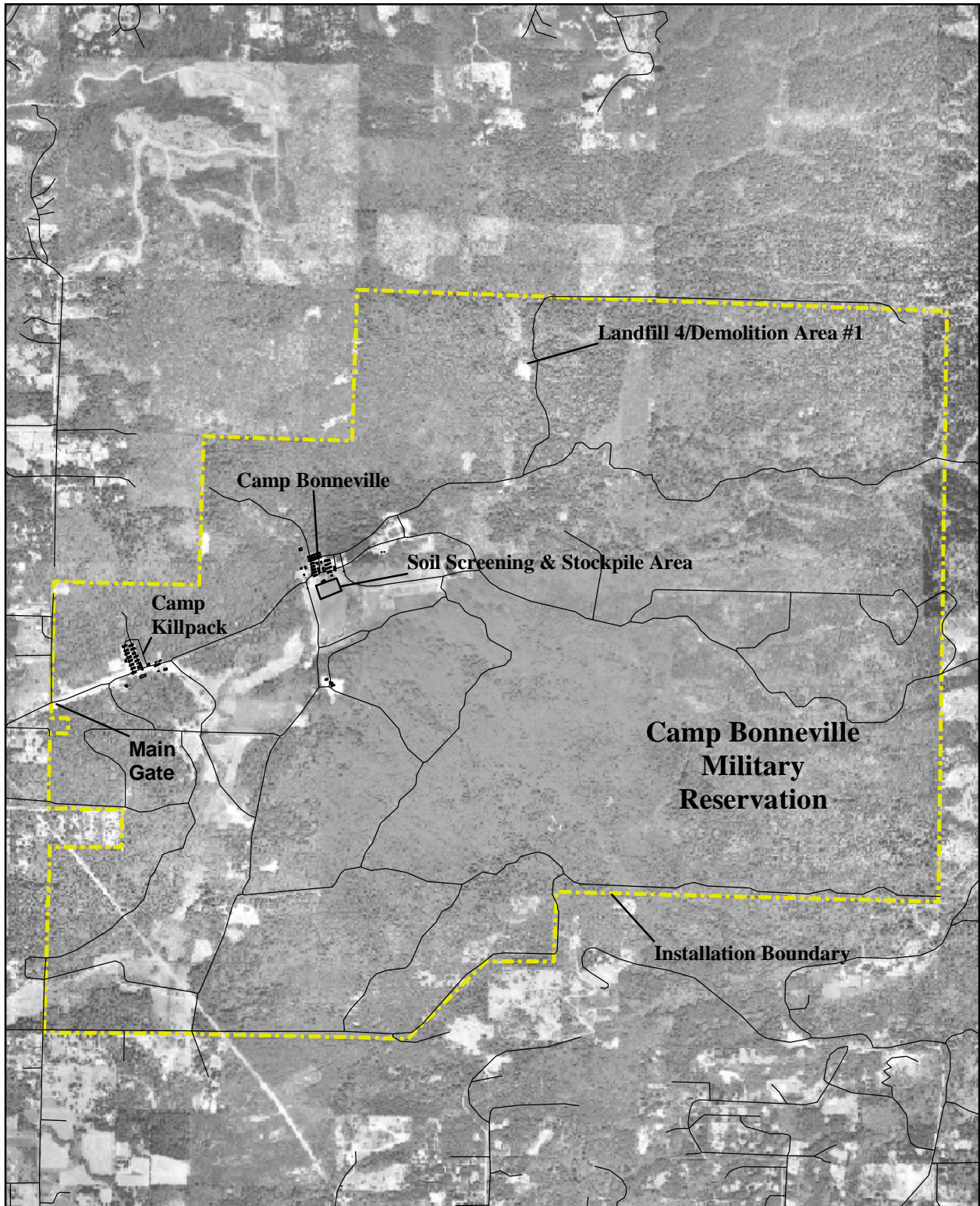


Figure B-1
Site Vicinity Map
Camp Bonneville
Clark County, WA

APPENDIX C

Figure C-1 – Site Map - Landfill 4

Figure C-2 – Site Map – Soil Screening/Stockpile Area

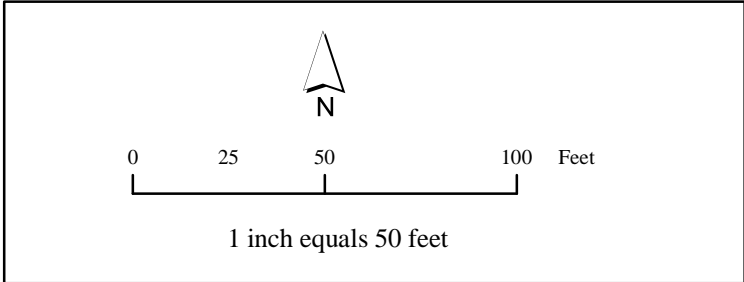
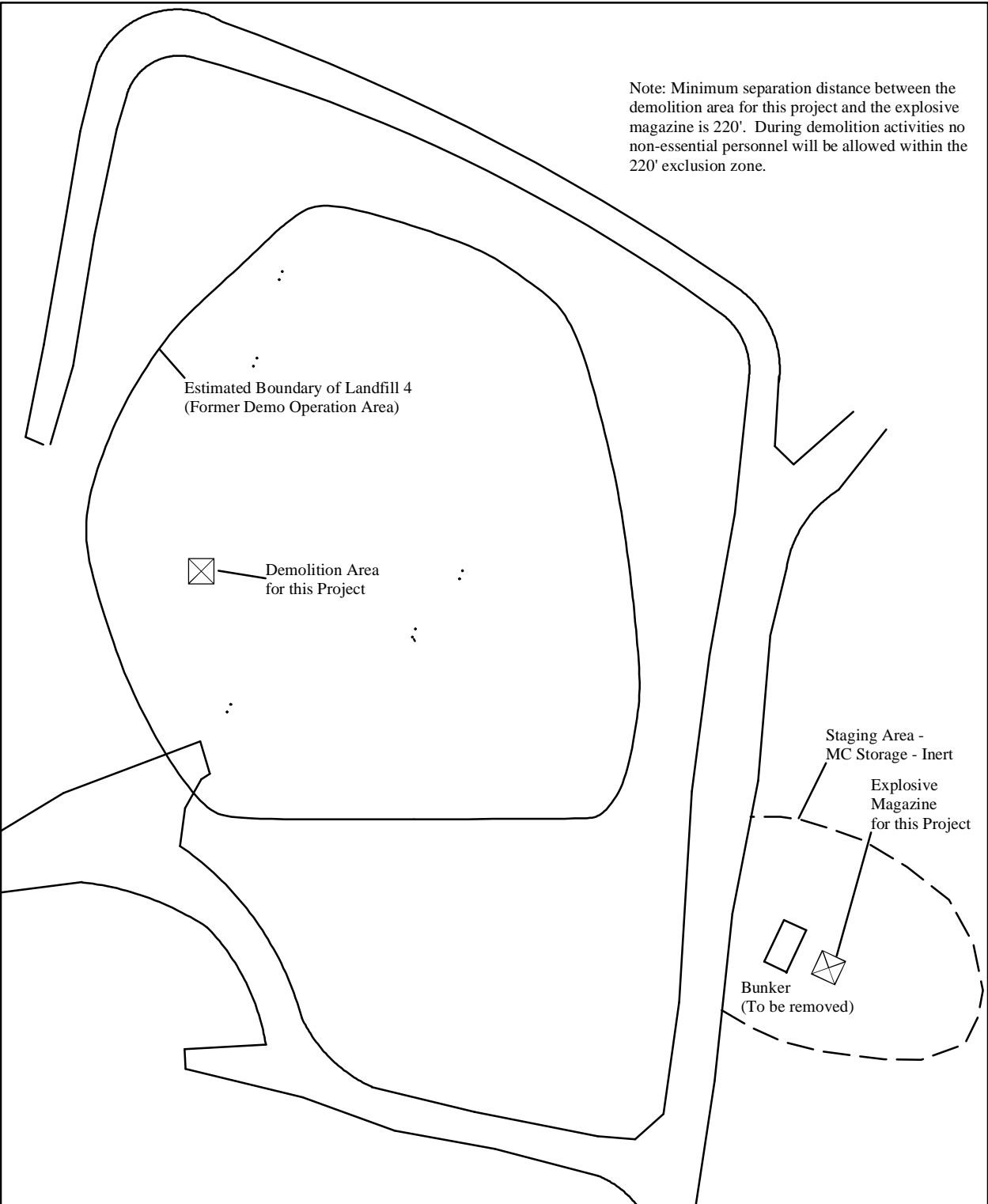


Figure C-1
 Site Map - Landfill 4
 Camp Bonneville
 Clark County, WA

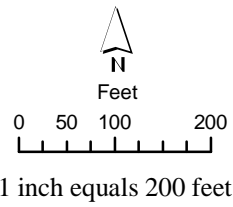
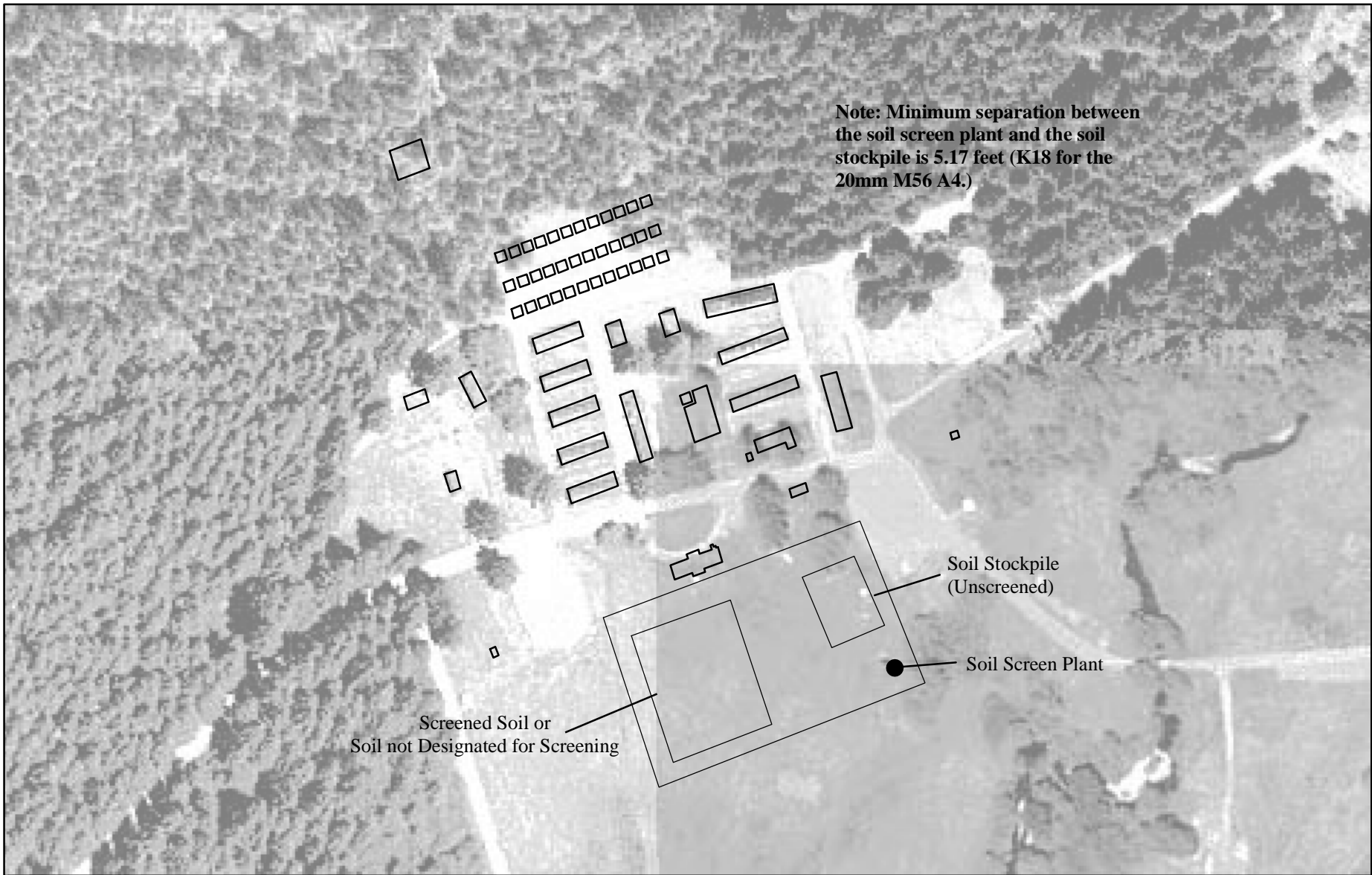


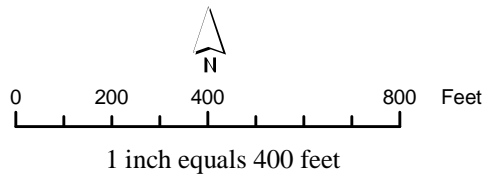
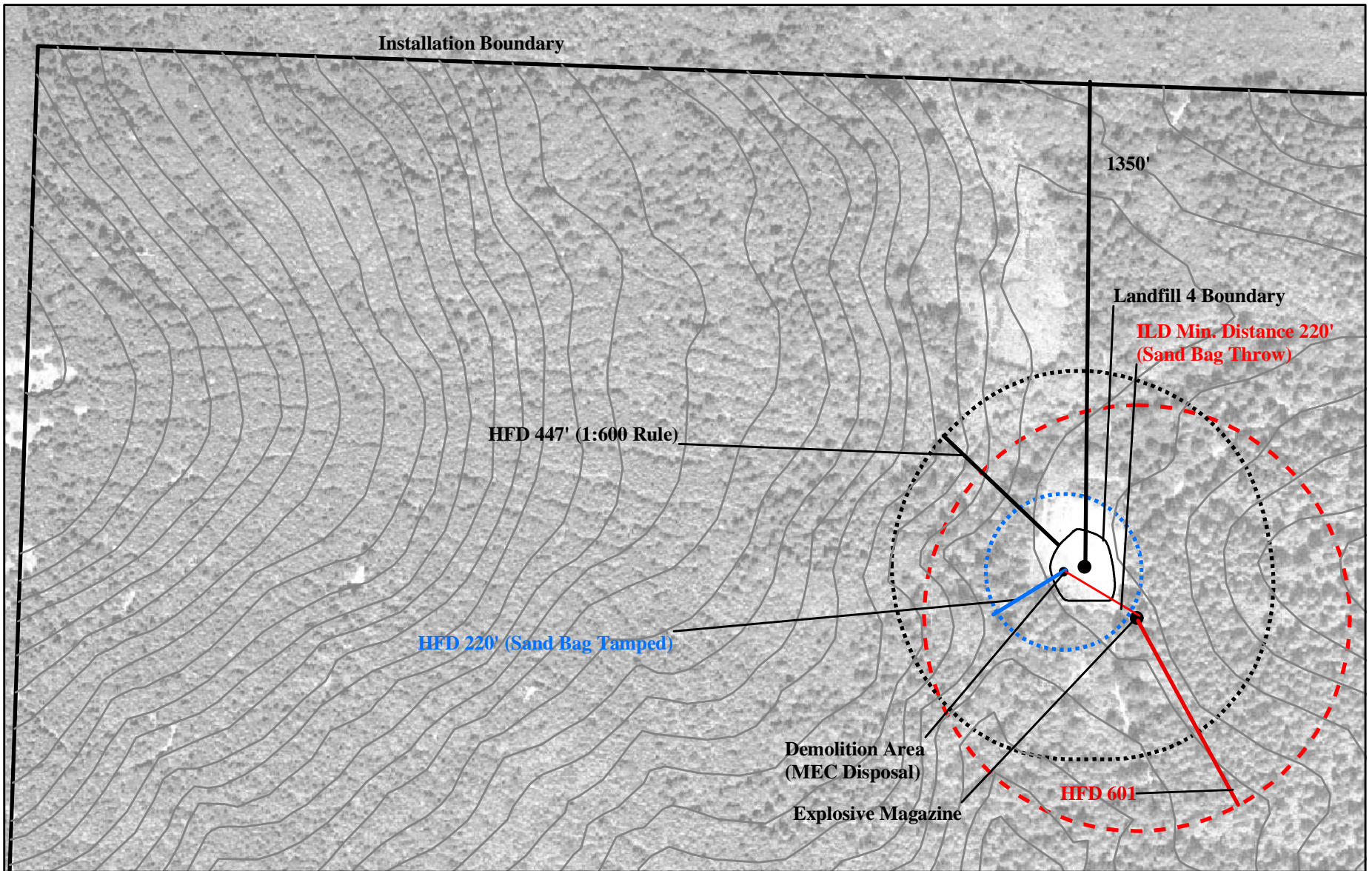
Figure C-2
 Site Map
 Soil Screening/Stockpile Area
 Camp Bonneville
 Clark County, WA

APPENDIX D

Figure D-1 – ESS Boundaries and Exclusion Zones for Landfill 4 Area

**Figure D-2 – ESS Boundaries and Exclusion Zones for the Soil
Screening/Stockpile Area**

Figure D-3 – Typical Screen Plant Layout and Exclusion Zones



Legend




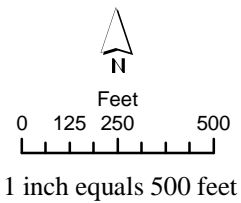
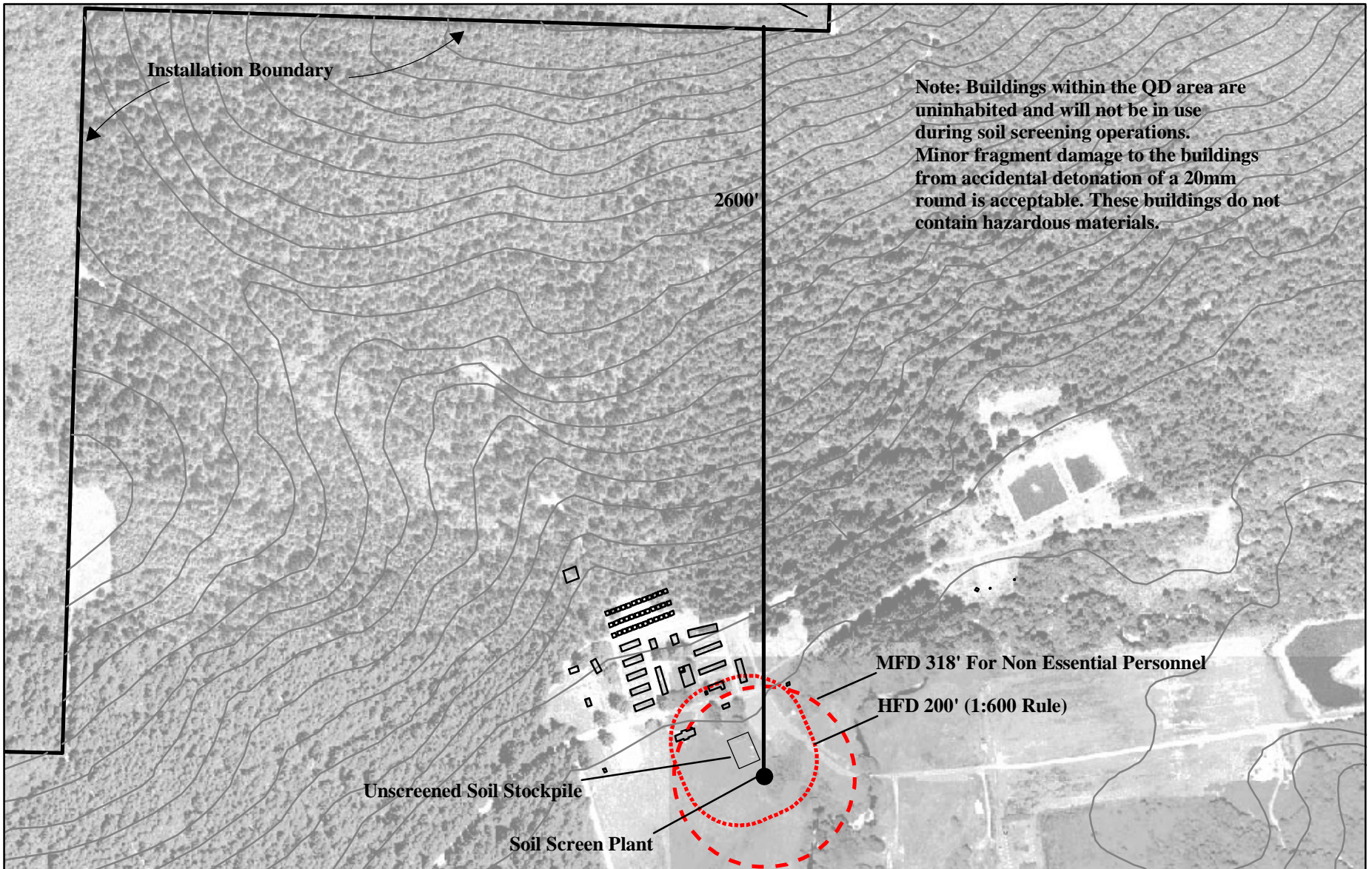
-  Exclusion Zones From Boundary of Landfill
-  Exclusion Zones From Explosive Magazine
-  Exclusion Zone From Demolition Area

Figure D-1
 ESS Boundaries &
 Exclusion Zones
 Landfill 4 Area
 Camp Bonneville
 Clark County, WA



Legend



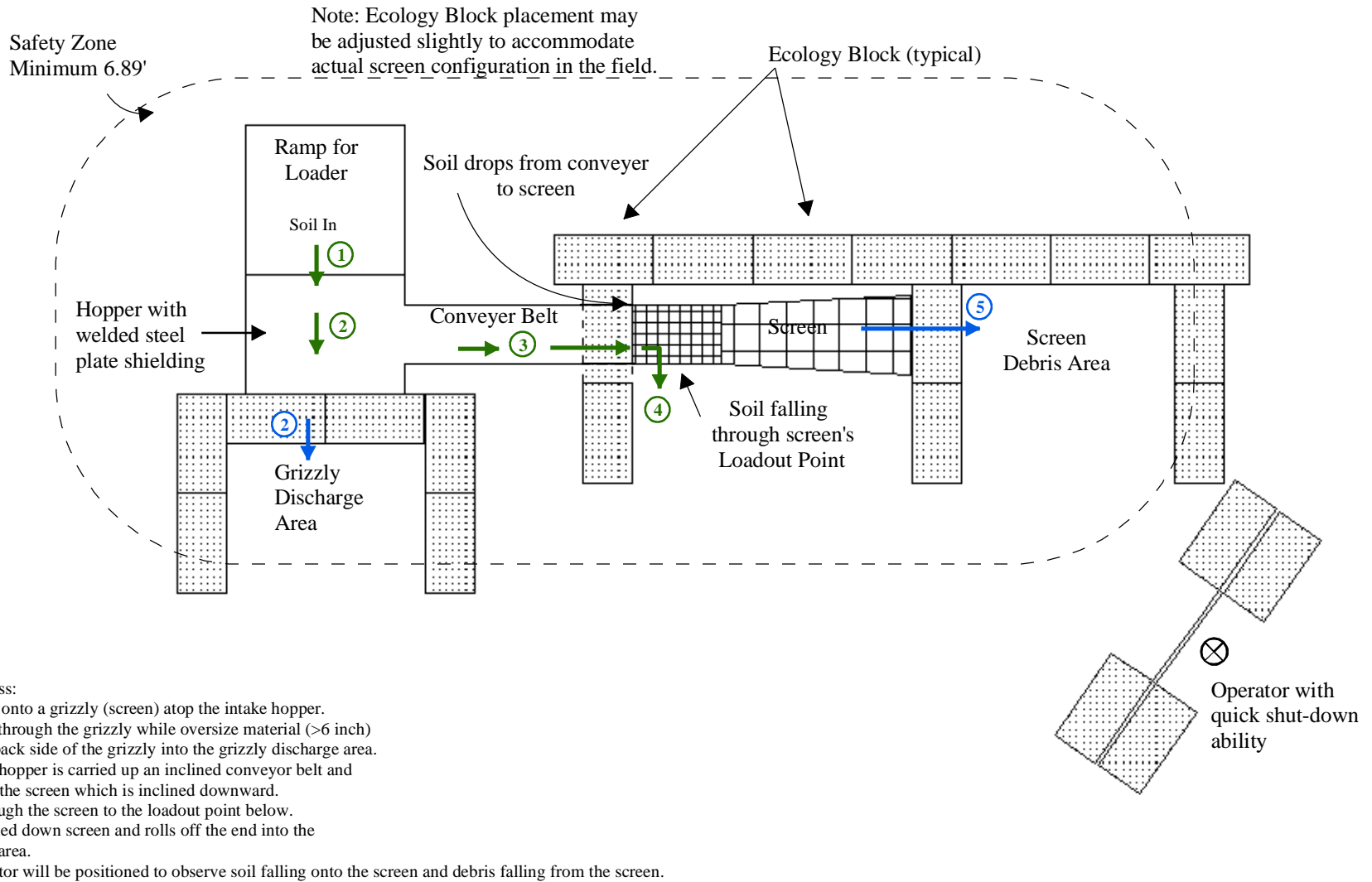
-  Exclusion Zones From Soil Screening Plant
-  Exclusion Zones From Soil Stockpile Area

Figure D-2
 ESS Boundaries &
 Exclusion Zones
 Soil Screening / Stockpile Area
 Camp Bonneville
 Clark County, WA



Scale: 1 inch equals 8 feet

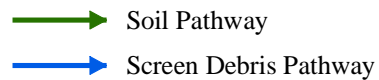


Figure D-3
 Typical Screen Plant
 Layout and Exclusion Zone
 Camp Bonneville
 Clark County, WA

APPENDIX E
Backup Data for Shielding Measures

**Partial Copy of Email Text
Material Not Pertaining to the Shielding Issue Has Been Removed**

-----Original Message-----

From: Crull, Michelle M HNC [mailto:Michelle.M.Crull@hnd01.usace.army.mil]

Sent: Friday, November 21, 2003 10:26 AM

To: 'Doyle, Clifford'; Crull, Michelle M HNC

Cc: Eric Waehling (E-mail)

Subject: RE: Shield Thicknesses

Eric,

Here's the thicknesses of materials required to defeat the fragments from an unintentional detonation of a 20mm M56A4.

Mild steel (A36 or higher) = 0.07in

Hardened steel = 0.06in

Aluminum = 0.17in

LEXAN = 1.10in

Plexiglas = 0.46in

Bullet Resistant Glass = 0.31in

Michelle Crull, PhD, PE
US Army Engineering & Support Center, Huntsville
Attn: CEHNC-ED-SY-T (Crull)
PO Box 1600
Huntsville, AL 35807-4301
Commercial: (256) 895-1653 DSN: 760-1653
Fax: (256) 895-1737

APPENDIX F
BATF Specifications and Requirements for Type 2 Magazines

BATF Specifications and Requirements for Type 2 Magazines

These specifications are taken directly from ATF P 5400.7 (09/00), Federal Explosives Law and Regulations, page 42.

§ 55.208 Construction of type 2 magazines.

A type 2 magazine is a box, trailer, semi trailer, or other mobile facility.

(a) Outdoor magazines.

(1) General. Outdoor magazines are to be bullet-resistant, fire-resistant, weather-resistant, theft-resistant, and ventilated. They are to be supported to prevent direct contact with the ground and, if less than one cubic yard in size, must be securely fastened to a fixed object. The ground around outdoor magazines must slope away for drainage or other adequate drainage provided. When unattended, vehicular magazines must have wheels removed or otherwise effectively immobilized by kingpin locking devices or other methods approved by the Director.

(2) **Exterior construction.** The exterior and doors are to be constructed of not less than ¼-inch steel and lined with at least two inches of hardwood. Magazines with top openings will have lids with water-resistant seals or which overlap the sides by at least one inch when in a closed position.

(3) **Hinges and hasps.** Hinges and hasps are to be attached to doors by welding, riveting, or bolting (nuts on inside of door). Hinges and hasps must be installed so that they cannot be removed when the doors are closed and locked.

(4) **Locks.** Each door is to be equipped with:

- (i) Two mortise locks;
- (ii) Two padlocks fastened in separate hasps and staples;
- (iii) A combination of a mortise lock and a padlock;
- (iv) A mortise lock that requires two keys to open; or,
- (v) A three-point lock.

Padlocks must have at least five tumblers and a case-hardened shackle of at least 3/8-inch diameter. Padlocks must be protected with not less than ¼-inch steel hoods constructed so as to prevent sawing or lever action on the locks, hasps, and staples.

These requirements do not apply to magazine doors that are adequately secured on the inside by means of a bolt, lock, or bar that cannot be actuated from the outside.

EM 1110-1-4009
23 Jun 00

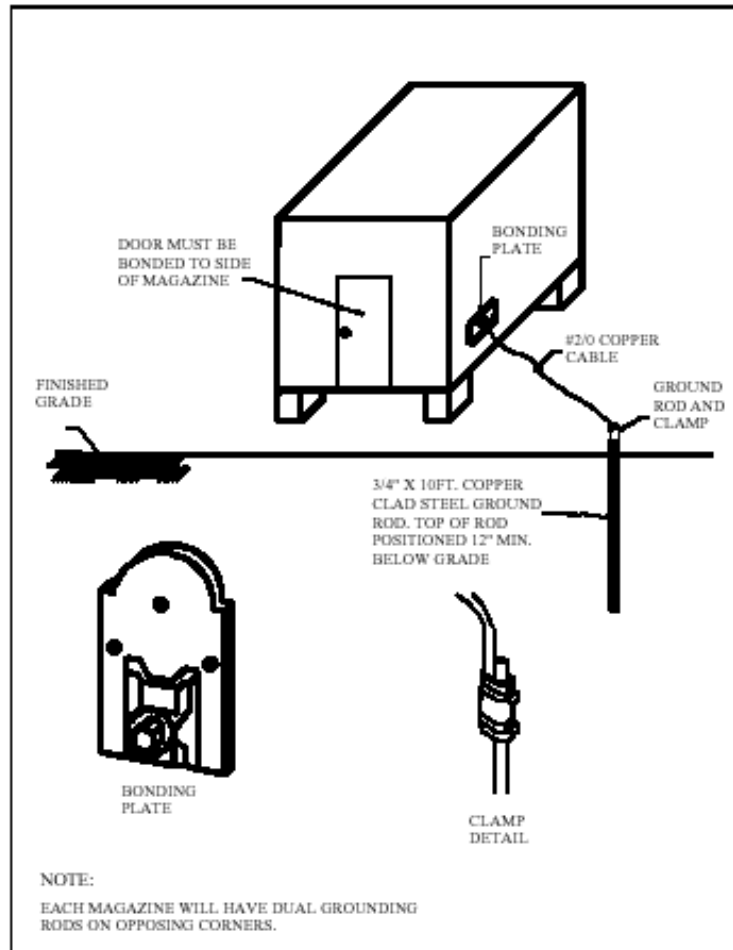


Figure 11-1. Magazine Grounding Detail