DEPARTMENT OF THE ARMY
BLUE GRASS ARMY DEPOT
431 BATTLEFIELD MEMORIAL HIGHWAY
RICHMOND, KENTUCKY 40475

June 13, 2017

SUBJECT: Response to Notice of Deficiency (NOD) for Permit Application for Open Burning and Open/Buried Detonation (OB/OD/BD)
Blue Grass Army Depot (BGAD), Richmond, KY
EPA ID #KY8-213-820-105, AI #2805

RCVD JUN 19 2017

Commonwealth of Kentucky
Department for Environmental Protection (KDEP)
Division of Waste Management
Hazardous Waste Branch
ATTN: Ms. April J. Webb, PE, Manager
300 Sower Boulevard, 2nd Floor
Frankfort, KY 40601

Dear Ms. Webb:

Enclosed for your technical review are responses, in hard copy and electronic format, to the NOD for the permit modification request to treat conventional munitions by OB/OD/BD (Subpart X application), submitted June 6, 2016, and the air modeling and risk assessment for both OB/OD/BD and the Controlled Destruction Chamber, submitted September 22, 2016. Also, enclosed in electronic format are redline and revised versions of the reissued Subpart X application and the air modeling and risk assessment.

If you have any questions, please contact Mr. Jim Hawkins at (859) 779-6246, or Mr. Joe Elliott at (859) 779-6021.

Sincerely,

Norbert A. Fochs

Norbert A. Fochs
Colonel, U.S. Army
Commanding

Enclosures

cc:
Dale Burton, KDEP
Heather Alexander, KDEP
Jim Hawkins, BGAD
Joe Elliott, BGAD

BLUE GRASS ARMY DEPOT

HAZARDOUS WASTE FACILITY PERMIT RCRA HAZARDOUS WASTE TREATMENT PERMIT APPLICATION FOR CONVENTIONAL MUNITIONS BY OPEN BURNING and OPEN/BURIED DETONATION EPA ID# KY8-231-820-105

Volume I

Prepared For:

US Army Corps of Engineers
Mobile District

June 2017

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List of Acronyms

µg/L	micrograms per liter
ADAM	Area Denial Anti-personnel Mine
AGM	air to ground missile
AOC	Area of Concern
AMO	authorized military official
ANAD	Anniston Army Depot
ANOVA	analysis of variance
APE	Army Peculiar Equipment
AR	Army Regulation
ARAR	Applicable or Relevant and Appropriate Requirement
AUL	Authorized Use List
BAM	Blasting Agent Manufacturing
BC	Bituminous Concrete
BEDS	Bulk Energetics Demilitarization System
BGAD	Blue Grass Army Depot
BGCA	Blue Grass Chemical Activity
BGCAPP	Blue Grass Chemical Agent-Destruction Pilot Plant
BMP	best management practice
BRAC	Base Realignment and Closure
LCeq	C weighted Equivalent Noise Level
CAD/PAD	Cartridge Actuated Device/Pressure Actuated Device
CAIRA	Chemical Accident Incident Response and Assistance
CDC	confined detonation/destruction chamber
CDNL	C-weighted Day-Night Level
CEs	Conditional Exemptions
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CO_2	carbon dioxide
COC	contaminant of concern
CONUS	continental United States
COPC	contaminant of potential concern
DA	Department of the Army
DAC	Defense Ammunition Center
dB	decibels
DDA	Designated Disposition Authority
DDESB	Department of Defense Explosives Safety Board
demil	demilitarize
DERP	Defense Environmental Restoration Program
DFD	Design for Demil
DoD	U.S. Department of Defense
DoDI	Department of Defense Instruction
DOT	U.S. Department of Transportation
DPG	Dugway Proving Ground
DPW	Directorate of Public Works

DQO	data quality objective
DRD	Demil Research and Development
DRMO	Defense Reutilization and Marketing Office
DU	depleted uranium
DWEL	Drinking Water Equivalent Level
DWM	Division of Waste Management
DWSU	Domestic Water Supply Use
EC	Environmental Coordinator
EHS	Extremely Hazardous Substance
EKU	Eastern Kentucky University
EOC	Emergency Operations Center
EPA	U.S. Environmental Protection Agency
EPM	Energetics Processing Module
ERC	Emergency Response Commission
FEMA	Federal Emergency Management Agency
FOTW	Federally Owned Treatment Works
ft/min	feet per minute
FY	Fiscal Year
GAC	Granular Activated Carbon
GS	General Service
HAZCOM	Hazard Communication
HAZMART	BGAD Hazardous Material Pharmacy
HC	Hexachloroethane
HERA	High-Explosive Rocket Assisted
HHGSL	Human Health Generic Screening Level
HHRA	human health risk assessment
HMMS	Hazardous Materials Management System
HMP	Hazardous Material Program
HWSU	Hazardous Waste Storage Unit
IC	Incident Commander
iSCWO	Industrial Supercritical Water Oxidation
JMC	Joint Munitions Command
KAR	Kentucky Administrative Regulation
KDEP	Kentucky Department for Environmental Protection
KDOW	Kentucky Division of Water
KPDES	Kentucky Pollutant Discharge Elimination System
KRS	Kentucky Revised Statutes
LCeq	C-weighted Equivalent Noise Level
lb	Pounds
LDR	Land Disposal Restriction
LEPC	Local Emergency Planning Committee
LTM	long-term monitoring
LTMOM	LTM Operations and Maintenance
LTSAP	Long-Term Sampling and Analysis Plan
LUPZ	Land Use Planning Zone
m	meter
MCL	maximum contaminant level

MDAS	Material Documented as Safe
MDS	Munitions Destruction System
mg/kg	milligrams per kilogram
MIDAS	Munitions Items Disposition Action System
MILSPECS	Military Specifications
MLRS	Multi Launch Rocket System
mm	millimeter
MMR	Military Munitions Rule
mph	mile per hour
MPPEH	Material Potentially Presenting an Explosive Hazard
MRC	Missile Recycling Center
MSD	Minimum Separation Distance
MSO	Molten Salt Oxidation
NAGPRA	Native American Graves Protection and Repatriation Act
NDAA	National Defense Authorization Act
NEW	Net Explosive Weight
NFA	No Further Action
NHPA	National Historic Preservation Act
NOD	Notices of Deficiency
NPL	National Priorities List
NRC	National Response Center
NSN	National Stock Number
O&M	Operation and Maintenance
OB/OD/CDC	Open Burn/Open Detonation/Confined Detonation Chamber
OD/BD	open detonation/buried detonation
OSHA	Occupational Safety and Health Administration
OJT	On-the-Job Training
PAO	Public Affairs Officer
PCB	polychlorinated biphenyl
PCF	Propellant Conversion to Fertilizer
PD	Position Description
PEP	Propellant, Explosives and Pyrotechnic
POC	point of compliance
POP	Performance Oriented Packaging
PPE	Personal Protective Equipment
PRG	preliminary remediation goal
psi	pounds per square inch
PVC	polyvinyl chloride
QA	Quality Assurance
QASAS	Quality Assurance Specialist (Ammunition Surveillance)
QRP	Qualified Recycling Program
R3	reduce, reuse and recycle
RBC	Running Buffalo Clover
RCRA	Resource Conservation and Recovery Act
RDT&E	Research, Development, Test and Evaluation
RDX	1,3,5-Trinitroperhydro-1,3,5-triazine
RFI	RCRA Facility Investigation

RIF	Reduction-in-force
RQ	Reportable Quantity
RSL	Regional Screening Level
SARA	Superfund Amendments and Reauthorization Act of 1986
SEM	Slurry Explosion Module
SCBA	Self-contained breathing apparatus
SCWO	Supercritical Water Oxidation
SDC	Static Detonation Chamber
SF_6	sulfur hexafluoride
SLERA	screening level ecological risk assessment
SMCA	Single Manager for Conventional Ammunition
SOP	Standard Operating Procedure
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TAR	Tone alert radios
TCE	Trichloroethene
TNT	Trinitrotoluene
TSDF	Treatment, Storage, or Disposal Facility
TTCDP	Thermal Treatment Closed Disposal Process
UHC	Underlying Hazardous Constituent
UCL	upper confidence limit
USGS	U.S. Geological Survey
UXO	unexploded ordnance
VOC	volatile organic compound
WMM	waste military munition
WSRA	Wild and Scenic Rivers Act
WWII	World War II
WWTP	Wastewater Treatment Plant

Kentucky Natural Resources and Environmental Protection Cabinet
Department for Environmental Protection
Division of Waste Management
14 Reilly Road - Frankfort, Kentucky 40601

DO NOT WRITE IN THIS SPACE

Part A of the Kentucky Hazardous Waste Permit Application

Facility's EPA ID No.	K	Y	8	2	1	3	8	2	0	1	0	5

FOR OFFICIAL USE ONLY

Fee Submitted: $ Receipt No.: Date:

☐ FIRST SUBMITTAL *(see INSTRUCTIONS)* ☒ REVISION PAGE 1 OF 21

☐ RENEWAL

1. Name of Facility: BLUE GRASS ARMY DEPOT

2. Location of Facility: 431 BATTLEFIELD MEMORIAL HIGHWAY

City: RICHMOND State: KY Zip Code: 40475-5060

3. County: MADISON *See INSTRUCTIONS:* Latitude: 37°42'00"N Longitude: 84°12'30"W

4. Name of Land Owner: *See INSTRUCTIONS:* U.S. DEPARTMENT OF THE ARMY

Legal status of Land Owner: ☒ Federal (F) ☐ State (S) ☐ County (C) ☐ Indian (I)

☐ Municipal (M) ☐ District (D) ☐ Private (P)

☐ Other (O) specify: ______

Land Owner's Mailing Address: 431 BATTLEFIELD MEMORIAL HIGHWAY

City: RICHMOND State: KY Zip Code: 40475-5001

Facility Land Owner's Telephone Number: (859) 779-6246

5. Existing Facilities, provide the date operation began or construction commenced: 1941
(Month, Day, Year)

New Facilities, provide the date operation is expected to begin: H sampling and EDT operations: TBD
(Month, Day, Year)

6. Facility Mailing Address: SAME AS LAND OWNER'S MAILING ADDRESS

City: ______ State: ______ Zip Code: ______

7. Facility Contact Person: JAMES L. HAWKINS

Title: BGAD, ENVIRONMENTAL CHIEF Phone Number: (859) 779-6268

Facility Contact Person may be reached at ☐ Mailing Address ☒ Location Address ☐ Other Specify: ______

Street Address: ______

City: ______ State: ______ Zip Code: ______

Facility's EPA ID Number

K	Y	8	2	1	3	8	2	0	1	0	5

8. Name of Facility Operator: *See INSTRUCTIONS:* See Sections I, II, III, and IV

Type of Owner: ☒ Federal (F) ☐ State (S) ☐ County (C) ☐ Indian (I)

☐ Municipal (M) ☐ District (D) ☐ Private (P)

☐ Other (O) specify: ____________________

Operator's Mailing Address: MAILING ADDRESSES REFLECTED ON RESPECTIVE SIGNATURE PAGES

City: __________ State: __________ Zip Code: __________

Facility Operator's Telephone Number: PHONE NUMBERS REFLECTED ON RESPECTIVE SIGNATURE PAGES

New Operators Assumed Responsibility for Facility on these Dates: BGAD (1941); BGCA (12/14/95); ACWA (07/11/2016); BPBG (6/13/2003)

9. Name of Facility Owner: *See INSTRUCTIONS*: U.S. DEPARTMENT OF THE ARMY

Legal status of Land Owner: ☒ Federal (F) ☐ State (S) ☐ County (C) ☐ Indian (I)

☐ Municipal (M) ☐ District (D) ☐ Private (P)

☐ Other (O) specify: ____________________

Owner's Mailing Address: SAME AS MAILING ADDRESS ABOVE

City: __________ State: __________ Zip Code: __________

Facility Owner's Telephone Number: (859) 779-6246

New Operator Assumed Responsibility for Facility on this Date: 1941
(Month, Day, Year)

10. SIC Codes: (1) 9711 (2) __________ (3) __________ (4) __________

Briefly describe the type of business conducted at this site: NATIONAL SECURITY (U.S. ARMY)

I. OPERATOR SIGNATURE: BGAD Commander Conventional Munition Related Items

I. The Blue Grass Army Depot (BGAD) Commander is responsible for operation of the BGAD Facility, including the units listed on page 4.

NORBERT A. FOCHS
COLONEL, U.S. ARMY
COMMANDING
431 BATTLEFIELD MEMORIAL HIGHWAY
RICHMOND, KY 40475
859-779-6246

Operator Certification: For operations listed on page 4 and waste streams 1-6, 22, 24, 25, and 26 listed on pages 15-16, I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

NORBERT A. FOCHS
COL, LG
Commanding
BGAD
Permit Operator

Norbert A Fochs — SIGNATURE

6 FEB 17 — DATE SIGNED

PAGE 4 OF 20	BGAD OPERATOR	Facility's EPA ID Number
11. PROCESS DESCRIPTION. *See Instructions*		K Y 8 2 1 3 8 2 0 1 0 5

Commercial Indicator	Unique Unit or Group Name	Legal Status Code	Process Codes	Process Design Capacity Of All Units Listed Under This Name	Unit of Measure	Number Of Individual Units In This Process	Operating Status Code	Description Of Process
3	Storage Container Igloo B402	PI	S01	16000.00	G	1	OP	Storage of Waste Other than Chemical Munitions Items.
3	Storage Container Igloo B404	PI	S01	16000.00	G	1	OP	Storage of Waste Other than Chemical Munitions Items.
4	Storage Igloos (B608, B612, G108, G109)	IT	S01	0.00	N/A	4	CC	Igloos that previously contained hazardous waste. Clean Closed 4-20-1999
3	Open Detonation / Buried Detonation	IS	X01	4.5	N	1	OP	Open detonation/buried detonation of waste military munitions and energetic waste.
3	Open Burning (1) & (2)	IS	X01	7.5	N	2	OP	Open burning of waste military munitions and energeticwaste.
3	Molten Salt Destruction Unit, Building 575	IT	X99	0.00	N/A	1	CC	Building that previously contained hazardous waste. Clean Closed 3-30-2011
3	Controlled Destruction Chamber	IS	X99	5.1	N	1	OP	Destruction of waste military munitions and energetic waste in an enclosed structure. It is not associated with chemical demilitarization.

DEP-7058A(JULY 1997)

II. OPERATOR SIGNATURE: BGCA Commander Chemical Storage Modification

II. The Blue Grass Chemical Activity (BGCA) Commander is responsible for operation of the Hazardous Waste Storage Units in the Chemical Limited Area as listed on pages 6-10.

LTC SCOTT D. GOULD
BGCA COMMANDER
431 BATTLEFIELD MEMORIAL HIGHWAY
RICHMOND, KY 40475
859-779-6891

Operator Certification: For operations listed on pages 6-10 and waste streams 7-21 and 23 listed on pages 15-16, I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

SCOTT D. GOULD
LTC, CM
Commanding
BGCA
Permit Operator

Scott D. Gould 2 Feb 17
SIGNATURE DATE SIGNED

BGCA OPERATOR

Facility's EPA ID Number											
K	Y	8	2	1	3	8	2	0	1	0	5

11. PROCESS DESCRIPTION. ***See Instructions***

Commercial Indicator	**Unique Unit or Group Name**	**Legal Status Code**	**Process Codes**	**Process Design Capacity Of All Units Listed Under This Name**	**Unit of Measure**	**Number Of Individual Units In This Process**	**Operating Status Code**	**Description Of Process**
4	Container Storage I	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, VX, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage J	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, VX, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage K	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, VX, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage L	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage M	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 1 - 3%); Treatment as defined by KRS 224.50-130
4	Container Storage N	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 2 – 3%) Treatment as defined by KRS 224.50-130
4	Container Storage O	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 3 - 4%) Treatment as defined by KRS 224.50-130
4	Container Storage P	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage Q	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage R	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130

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BGCA OPERATOR

Facility's EPA ID Number

11. PROCESS DESCRIPTION. ***See Instructions***	K	Y	8	2	1	3	8	2	0	1	0	5

Commercial Indicator	Unique Unit or Group Name	Legal Status Code	Process Codes	Process Design Capacity Of All Units Listed Under This Name	Unit of Measure	Number Of Individual Units In This Process	Operating Status Code	Description Of Process
4	Container Storage S	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage T	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, VX, (estimate 3 - 4%) Treatment as defined by KRS 224.50-130
4	Container Storage U	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage V	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage W	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage X	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage Y	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items and DOT Bottles, VX, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage Z	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage AB	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, VX, (estimate 2 – 3%) Treatment as defined by KRS 224.50-130

DEP - 7058A (July 1997)

BGCA OPERATOR

Facility's EPA ID Number

K	Y	8	2	1	3	8	2	0	1	0	5

11. PROCESS DESCRIPTION. ***See Instructions***

Commercial Indicator	Unique Unit or Group Name	Legal Status Code	Process Codes	Process Design Capacity Of All Units Listed Under This Name	Unit of Measure	Number Of Individual Units In This Process	Operating Status Code	Description Of Process
4	Container Storage CD	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, VX and/or H; (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage EF	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, VX, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage GH	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 3 - 5%) Treatment as defined by KRS 224.50-130
4	Container Storage IJ	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, VX, (estimate 3 - 6%); Treatment as defined by KRS 224.50-130
4	Container Storage KL	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, VX, (estimate 2 - 3%) Treatment as defined by KRS 224.50-130
4	Container Storage MN	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, VX, (estimate (3 -5%); Treatment as defined by KRS 224.50-130
4	Container Storage OP	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage QR	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 1 - 3%); Treatment as defined by KRS 224.50-130
4	Container Storage ST	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 1 - 3%); Treatment as defined by KRS 224.50-130

DEP - 7058A (July 1997)

BGCA OPERATOR

Facility's EPA ID Number

K	Y	8	2	1	3	8	2	0	1	0	5

11. PROCESS DESCRIPTION. ***See Instructions***

Commercial Indicator	Unique Unit or Group Name	Legal Status Code	Process Codes	Process Design Capacity Of All Units Listed Under This Name	Unit of Measure	Number Of Individual Units In This Process	Operating Status Code	Description Of Process
4	Container Storage UV	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage WX	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 2 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage YZ	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 1 - 4%); Treatment as defined by KRS 224.50-130
4	Container Storage ZA	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 1 - 3%); Treatment as defined by KRS 224.50-130
4	Container Storage YB	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 2 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage XC	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 2 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage WD	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 2 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage VE	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage UF	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage TG	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130

BGCA OPERATOR

Facility's EPA ID Number

K	Y	8	2	1	3	8	2	0	1	0	5

11. PROCESS DESCRIPTION. ***See Instructions***

Commercial Indicator	Unique Unit or Group Name	Legal Status Code	Process Codes	Process Design Capacity Of All Units Listed Under This Name	Unit of Measure	Number Of Individual Units In This Process	Operating Status Code	Description Of Process
4	Container Storage SH	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, VX, (estimate 1 - 3%); Treatment as defined by KRS 224.50-130
4	Container Storage RI	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage QJ	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, GB, (estimate 3 - 5%); Treatment as defined by KRS 224.50-130
4	Container Storage PK	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, H, (estimate 5 - 6%) Treatment as defined by KRS 224.50-130
4	Container Storage OL	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, H, (estimate 5 - 6%) Treatment as defined by KRS 224.50-130
4	Container Storage NM	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items and DOT Bottle, H, (estimate 5 - 8%) Treatment as defined by KRS 224.50-130
4	Container Storage MN (H)	PI	S01, T04	3831.00	G	1	OP	Storage of Chemical Munitions Items, H, (estimate 1 - 2%) Treatment as defined by KRS 224.50-130
4	Container Storage LO	PI	S01, T04	3831.00	G	1	OP	Storage of waste from the management of chemical munitions, chemical container, items in support of storage and mission. (Maintenance, Decontamination, PPE, etc.),(estimate 1 - 2%); Treatment as defined by KRS 224.50-130
4	Container Storage KP	PI	S01, T04	3831.00	G	1	OP	Storage of waste from the management of chemical munitions, chemical container, items in support of storage and mission. (Maintenance, Decontamination, PPE, etc.),(estimate 1 - 2%); Treatment as defined by KRS 224.50-130

III. OPERATOR SIGNATURE: PEO ACWA Site Project Manager Mustard Agent (H) Sampling Operation Modification

III. Program Executive Office, Assembled Chemical Weapons Alternatives (PEO ACWA) Site Project Manager is responsible for operation in the Chemical Limited Area (CLA) as listed on page 12.

JEFFREY L. BRUBAKER
PEO ACWA
SITE PROJECT MANAGER
830 EASTERN BYPASS SUITE 106
RICHMOND, KY 40475
859-779-7450

Operator Certification: For operations listed on page 12, and waste streams M1-M4 listed on pages 16-17, I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

JEFFREY L. BRUBAKER
PEO ACWA
Site Project Manager
Permit Operator

SIGNATURE

1 Feb 2017
DATE SIGNED

ACWA OPERATOR

Facility's EPA ID Number

11. PROCESS DESCRIPTION. ***See Instructions***

K	Y	8	2	1	3	8	2	0	1	0	5

Commercial Indicator	Unique Unit or Group Name	Legal Status Code	Process Codes	Process Design Capacity Of All Units Listed Under This Name	Unit of Measure	Number Of Individual Units In This Process	Operating Status Code	Description Of Process
4	H Sampling Facility	PI	T04	4.4	U	1	BC	Management of Mustard agent items in support of Treaty and de-mil requirements/mission. Operation to include but not limited to movement, drilling, sampling, plugging, and over-packing. Operation will be performed in a General Purpose Operations Shelter (GPOS), within a glove box, under engineering controls. Note: U=gallons per day based on agent fill. Estmated Process Design: 4 rounds/day × 11.7 lbs. per round ÷10.59 lbs/gallon ≈ 4.4 gallons/day DOT bottles are 14.75 lbs @ 10.59 lbs/gallon = 1.39 gallons/day [× 2 bottles≈2.78gallon/day] Treatment as defined by KRS 224.50-130.
4	Movement H Sampling	PI	T04	318.4	U	1	CN	Movement of mustard fill agent items from EDT service Magazine or Chemical HWSU to the Mustard (H) Sampling Facility and movement from H Sampling Facility to EDT or EDT service Magazine. To include movement at the H Sampling Facility. Note: U=gallons per day based on agent fill. Estmated Process Design (base on EONC capability): 72 H-rounds/trip × 11.7 lbs. per round ÷ 10.59 lbs/gallon ≈ 79.6 gallons/trip/EONC; for a maximum of 4 EONC/day X 79.6 ≈ 318.4 gallon/day. Treatment as defined by KRS 224.50-130.

DEP - 7058A (July 1997)

IV. OPERATOR SIGNATURE: BPBG Project Manager
EDT Facility Modification

IV. Bechtel Parsons Blue Grass (BPBG) Project Manager is responsible for operation in the Explosive Destruction Technologies (EDT) Portion of the Chemical Limited Area (CLA) also known as the "EDT Facility" as listed on pages 14.

RONALD HINK
BPBG PROJECT MANAGER
830 EASTERN BYPASS
RICHMOND, KY 40475
859-624-6240

Operator Certification: For operations listed on page 14 and waste streams E1-E9 listed on pages 17-18, I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

RON HINK
Bechtel Parsons Blue Grass
Project Manager
Permit Operator

Ron Hink — 26 JAN 2017

SIGNATURE — DATE SIGNED

BPBG Operator

Facility's EPA ID Number

K	Y	8	2	1	3	8	2	0	1	0	5

11. PROCESS DESCRIPTION. ***See Instructions***

Commercial Indicator	Unique Unit or Group Name	Legal Status Code	Process Codes	Process Design Capacity Of All Units Listed Under This Name	Unit of Measure	Number Of Individual Units In This Process	Operating Status Code	Description Of Process
4	Static Detonation Chamber (SDC) System	PI	X99	70.2	J	1	UC	Subpart X Unit will treat Mustard Agent - H Munitions/DOT bottles (only two in stockpile) containing mustard agent and provide agent destruction. Maximum processing rate is 6 containers per hour. Scrap metal from chamber is recycled.
4	Service Magazine	PI	S01, T04	1,328	G	1	UC	Provide RCRA storage of hazardous waste and staging area/ buffer for treatment operations. Maximum storage capacity is 1,206 projectiles that contain approximately 1,326.6 gallons of mustard agent and two DOT bottles that contain a total of approximately 1.4 gallons of mustard agent. As part of destruction process, these containers are transported by forklift from the ESM to Explosive Destruction Technology (EDT) Enclosure Building (EEB) for destruction. Treatment as defined by KRS 224.50-130.
4	Movement of Chemical Agent Filled Munitions and DOT Bottles	PI	T04	576	U	1	CN	Transportation of mustard-filled items [in Enhanced Onsite Containers (EONCs)] from chemical agent Hazardous Waste Storage Units (HWSUs) to EDT Facility for storage and destruction, from EDT Facility to H-sampling facility (treaty verification) with return transport to EDT Facility for destruction, and movement between the ESM and the EEB. Each EONC can contain a maximum of 72 H-filled projectiles. The EONCs and mustard filled items are transported only during daylight hours. Treatment as defined by KRS 224.50-130

Facility's EPA ID Number											
K	Y	8	2	1	3	8	2	0	1	0	5

12. WASTE STREAM DESCRIPTION. *See Instructions.*

WASTE STREAM NUMBER	ESTIMATE ANNUAL WASTE AMOUNT	UNIT OF MEASURE	EPA WASTE NUMBERS	PROCESS CODES ASSOCIATED WITH THIS WASTE
1	30.0	**TONS**	K045 Conventional Storage Section [Conventional Storage Section: (N)]	S01 Explosive contaminated granular activated charcoal.
2	2000.0	**TONS**	D003, K044 (N)	S01 Explosive sludge contaminated filters
3	5.0	**TONS**	D004, D005, D006, D007, D008, and/or D009 (N)	S01 Baghouse dust from Detonation Chamber
4	150.0	**TONS**	D006, D007, and/or D008 (N)	S01 Sandblast media from de-rusting operations
5	2700.0	**TONS**	D003, D006, D007, and/or D008 (N)	S01 Explosive ammunition and related components
6	5.0	**TONS**	K047 (N)	S01 Pink/red water from manufacturing and process of explosive
7	0.5	**TONS**	D007, N001, N002, and/or N003 [Chemical Storage Section: (C)]	S01, and/or T04 Agent contaminated carbon filters with Whetlerite. Treatment as defined by KRS 224.50-130.
8	2.0	**TONS**	D007 (C)	S01 Expired carbon filters with Whetlerite.
9	1.0	**TONS**	D001, D002, D003, D004, D011, D018, D022, D035, D036, D037, D039, D040, D043, U002, U044, U103, U127, U154, U165, U131, U210, F001, F002, F003, F004, N001, N002, N003, N701, N702, and/or N703 (C)	S01, and/or T04 Laboratory wastes. Treatment as defined by KRS 224.50-130.
10	425.0	**TONS**	D001, D003, D004, D009, D011, D012, D030, N001, and/or N002 (C)	S01, and/or T04 Explosive components. Treatment as defined by KRS 224.50-130.
11	90.0	**TONS**	D001, D003, D004, D008, D009, N001, N002 and/or N003 (C)	S01, and/or T04 Explosive components. Treatment as defined by KRS 224.50-130.
12	0.5	**TONS**	N001, N002, and/or N003 (C)	S01, and/or T04 Agent contaminated debris. Treatment as defined by KRS 224.50-130.
13	2.5	**TONS**	D002, N001, N002 and/or N003 (C)	S01, and/or T04 Spent decontamination waste. Treatment as defined by KRS 224.50-130.

	Facility's EPA ID Number
	K Y 8 2 1 3 8 2 0 1 0 5

12. WASTE STREAM DESCRIPTION. ***See Instructions.***

WASTE STREAM NUMBER	ESTIMATE ANNUAL WASTE AMOUNT	UNIT OF MEASURE	EPA WASTE NUMBERS	PROCESS CODES ASSOCIATED WITH THIS WASTE
14	0.5	**TONS**	D002 (C)	S01 Expired decontamination waste
15	2.0	**TONS**	N001, N002, and/or N003 (C)	S01, and/or T04 Agent exposed PPE. Treatment as defined by KRS 224.50-130.
16	1.0	**TONS**	D003, N001, N002, and/or N003 (C)	S01, and/or T04 Agent exposed reactive materials. Treatment as defined by KRS 224.50-130.
17	425.0	**TONS**	D003, D005, D008, N001, and/or N002 (C)	S01, and/or T04 Chemical agent munitions (non-explosive components). Treatment as defined by KRS 224.50-130.
18	90.0	**TONS**	D003, D005, D008, N003 (C)	S01, and/or T04 H-Mustard projectiles. Treatment as defined by KRS 224.50-130.
19	2.5	**TONS**	D003, and/or N001 (C)	S01, and/or T04 GB leaker reactive waste. Treatment as defined by KRS 224.50-130.
20	0.0	**TONS**	N001 (C)	S01, and/or T04 GB containers. Treatment as defined by KRS 224.50-130
21	0.5	**TONS**	N002, and/or N003 (C)	S01, and/or T04 VX and H-mustard DOT bottles. Treatment as defined by KRS 224.50-130.
22	0.5	**TONS**	D001, D006, D007, D018, D035, D039, F001, F002, F003, F004, and/or F005 (N)	S01 Paint waste and related material.
23	35.0	**TONS**	D002, D004-D011 and/or N001 (C)	S01, and/or T04 GB decontamination waste. Treatment as defined by KRS 224.50-130.
24	216.0	**TONS**	D003, D001, D004, D005, D006, D007, D008, D010, D011, and/or D030	X01, open detonation/buried detonation. Waste Military Munitions and energetic waste. The weight in short tons for waste streams are expressed as Net Explosive Weight (NEW).
25	340	**TONS**	D003, D001, D004, D005, D006, D007, D008, D010, D011, and/or D030	X99, controlled destruction chamber. Waste Military Munitions and energetic waste. Annual waste amount for Controlled Destruction Chamber estimated for 35,000 rocket motors (RM)/year at 20 lb NEW/RM. Estimate assumes the CDC is brought on-line from an operation perspective. The weight in short tons for waste streams are expressed as Net Explosive Weight (NEW).
26	800.0	**TONS**	D003, D008, and/or D030	X01, open burning. Waste Military Munitions and energetic waste. The weight in short tons for waste streams are expressed as Net Explosive Weight (NEW).
M1	0.25	**TONS**	N003 [H Sampling Operations Section: (M)]	S01, and/or T04 Agent contaminated debris/PPE. Treatment as defined by KRS 224.50-130.

	Facility's EPA ID Number											
	K	Y	8	2	1	3	8	2	0	1	0	5

12. WASTE STREAM DESCRIPTION. ***See Instructions.***

WASTE STREAM NUMBER	ESTIMATE ANNUAL WASTE AMOUNT	UNIT OF MEASURE	EPA WASTE NUMBERS	PROCESS CODES ASSOCIATED WITH THIS WASTE
M2	0.25	**TONS**	D001, D002, D003, D004, D011, D018, D022, D035, D036, D037, D039, D040, D043, U002, U044, U103, U127, U154, U1331, U210, F001, F002, F003, F004, and/or N703 (M)	S01, and/or T04 Laboratory wastes. Treatment as defined by KRS 224.50-130.
M3	0.25	**TONS**	D002 and/or N003 (M)	S01, and/or T04 Spent decontamination waste. Treatment as defined by KRS 224.50-130.
M4	0.25	**TONS**	D007 and/or N003 (M)	S01, and/or T04 Agent contaminated carbon filters Treatment as defined by KRS 224.50-130
E1	729*	**TONS**	D004, D005, D006, D007, D008, D009, D010, D011, and/or N203 [EDT Section: (E)]	X99 SDC (Static Detonation Chamber) Chamber Residue -- includes metallic munitions fragments and ash. Scrap metal will be recycled after waste and residues (ash, particulates, dust, and fine metals) and debris (small metallic pieces) are removed via shaking and vibration. If hazardous waste, residue and debris removed from the scrap metal will be included with waste stream E6. **Scrap metal to be recycled*
E2	1	**TONS**	D001, D002, D004, D005, D006, D007, D008, D009, D010, D011, D022, D026, D027, D028, D029, D030, D037, D039, D040, F001-F005, and/or N003 (E)	S01 Agent-contaminated Derived-From KY Wastes -- PPE, trash, rags, munitions dunnage, operations & maintenance wastes that have contacted agent or represent a hazard from other known conditions.
E3	1	**TONS**	D001, D002, D003, D004, D005, D006, D007, D008, D009, D010, D011, D022, D026, D027, D028, D029, D030, D037, D039, D040, F001-F005, and/or N703 (E)	S01 Laboratory generated analytical wastes, samples, and solvents.
E3	1	**TONS**	D001, D002, D003, D004, D005, D006, D007, D008, D009, D010, D011, D022, D026, D027, D028, D029, D030, D037, D039, D040, F001-F005, and/or N703 (E)	S01 Laboratory generated analytical wastes, samples, and solvents.

	Facility's EPA ID Number											
	K	Y	8	2	1	3	8	2	0	1	0	5

12. WASTE STREAM DESCRIPTION. ***See Instructions.***

WASTE STREAM NUMBER	ESTIMATE ANNUAL WASTE AMOUNT	UNIT OF MEASURE	EPA WASTE NUMBERS	PROCESS CODES ASSOCIATED WITH THIS WASTE
E4	1.5	**TONS**	D001, D002, D003, D004, D005, D006, D007, D008, D009, D010, D011, D022, D028, D030, D039, D040, F001-F005, and/or N003 (E)	S01 Miscellaneous Wastes which includes, but may not be limited to, oils, hydraulic fluids, paints, solvents, and other wastes that exhibit characteristics of ignitability, corrosivity, reactivity, or toxicity due to the chemical composition of the materials. May be agent-derived if there was agent contact.
E5	<1	**TONS**	D002, D004, D005, D006, D007, D008, D009, D010, D011, and/or N203 (E)	S01 Liquid from OTS (Off-gas Treatment System) Scrubbers when removed from the system; considered agent-derived.
E6	3	**TONS**	D004, D005, D006, D007, D008, D009, D010, D011, and/or N003 (E)	S01 Solids from the OTS Buffer Tank; considered agent-derived waste.
E7	4	**TONS**	D004, D005, D006, D007, D008, D009, D010, D011, and/or N203 (E)	S01 Dry Salts and Particulates from the OTS Spray Dryer; considered agent derived.
E8	10	**TONS**	D001, D004, D005, D006, D007, D008, D009, D010, D011, N003, and/or N203 (E)	S01 Particulates and vapors absorbed to the Carbon Beds, HEPA Filters, and Pre-filters from the IONEX 4000 and 16,000 filter banks; agent derived (N003). The filter located between the bleed water tank and the process water tank is agent-derived (N203).
E9	280	**TONS**	D004, D005, D006, D007, D008, D009, D010, D011, and/or N203 (E)	S01 Dust and Metal Oxides from the OTS Bag House Filters; agent-derived.

Facility's EPA ID Number											
K	Y	8	2	1	3	8	2	0	1	0	5

13. Existing Environmental Permits:

Inter-State Regional Program [A]:
Single Well (FURS) [B]:
County Program [C]:
DOE Program [D]:
Other EPA Program [E]: specify:
EPA 404 (dredge or fill program) [F]:
USGS Program [G]:
Area Wells (FURS) [H]:
NOTIS [J]:
Superfund (CERCLA) [K]:
FATES [L]:
Municipal (city, town, etc.) Program [M]:
NPDES/KPDES (discharges to surface water) [N]: KY0020737
PSD (Prevention of Significant Deterioration - Clean Air Act) [P]: Title V Air Permits [V-12-037, Rev. 2, & V-16-019]
CDS [Q]:
RCRA (hazardous wastes) [R]: KY8-213-820-105; EPA HSWA Permit for EDT
State Program [S]:
DOT Program [T]:
UIC (underground injection of fluids) [U]:
Intra-State Regional Program [W]:
Other Federal Program [X]: specify:
CICIS (OTS Chemicals in Commerce Information System) [Y]:
Other Non Federal Programs [Z]: Water Withdrawal Permit #1013

14 FACILITY STATUS:

☐ Waste is NOT received from off-site

☐ Accepts waste from any off-site source(s) [A]

☒ Accepts waste from only a restricted group of off-site sources(s) [R]:
Specify: Military Sources / Government Sources

15 PHOTOGRAPHS, DRAWING AND MAP - *See INSTRUCTIONS*
All existing facilities must include photographs (aerial or ground level) that clearly delineate all existing structures; existing storage, treatment or disposal areas; and sites of future treatment, storage or disposal areas. All existing facilities must include a drawing showing the general layout of the facility and a topographic map. The photographs, drawing and map must be attached to this form.

16 If the facility owner is also the facility operator, please skip this section and complete item 17 below.
Owner Certification - I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

NAME (PRINT OR TYPE)	SIGNATURE	DATE SIGNED
NORBERT A. FOCHS, COL, LG, Commanding	Norbert A. Fochs	6 FEB 17

17 Operator Certification - I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

NAME (PRINT OR TYPE)	SIGNATURE	DATE SIGNED
See Sections I, II, III, and IV Above		

18 Land Owner Certification - I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

NAME (PRINT OR TYPE)	SIGNATURE	DATE SIGNED
NORBERT A. FOCHS, COL, LG, Commanding	Norbert A. Fochs	6 FEB 17

ADDENDUM NOTES / OPERATOR CERTIFICATION

I. Operator Certification – Reflects the signature of the BGAD Commander, responsible for the operations listed on pages 3-4.

II. Operator Certification – Reflects the signature of the BGCA Commander, responsible for the operations listed on pages 5-10.

III. Operator Certification – Reflects the signature of the PEO ACWA Site Project Manager, responsible for the operations listed on pages 11-12.

IV. Operator Certification – Reflects the signature of the BPBG Project Manager, responsible for the operations listed on pages 13-14.

V. Owner Certification – Reflects the signature of the BGAD Commander, responsible for the Owner Certification and also as the Land Owner outlined in numbers 16 and 18; respectively, on page 19.

PART B. FACILITY DESCRIPTION [401 KAR 38:090 Section 2 & 40 CFR 270.14]

B-1 General Description [401 KAR 38:090 Section 2(1) & 40 CFR 270.14(b)(1)]

Blue Grass Army Depot (BGAD) is a Department of Defense (DoD) federal facility situated in Madison County, Kentucky, 6 miles southeast of the city of Richmond, Kentucky (an estimated population of 33,000) and 30 miles southeast of the city of Lexington, Kentucky (population 350,000). BGAD encompasses approximately 14, 600 acres with approximately 1,105 buildings, which include 902 storage igloos, 12 aboveground magazines, 2 small arms ammunition warehouses, and 7 depot transport support buildings. BGAD has approximately 152 miles of improved roads and 37 miles of internal rail system.

The entrance gates to the facility are located on the southwestern boundary of the facility off Battlefield Memorial Highway (U.S. Highway 421). This road continues and is joined by U.S. Highway 25 to form the western boundary of the installation. Other roads surrounding the facility include State Highway 52 on the north, State Highway 374 on the east, and State Highway 499 on the south. Access to Interstate 75 is 6 miles from the installation. The communities of Moberly, Speedwell, Kingston, Terrill, and Reed's Crossing border the installation on the northeast, southeast, south, west, and north, respectively.

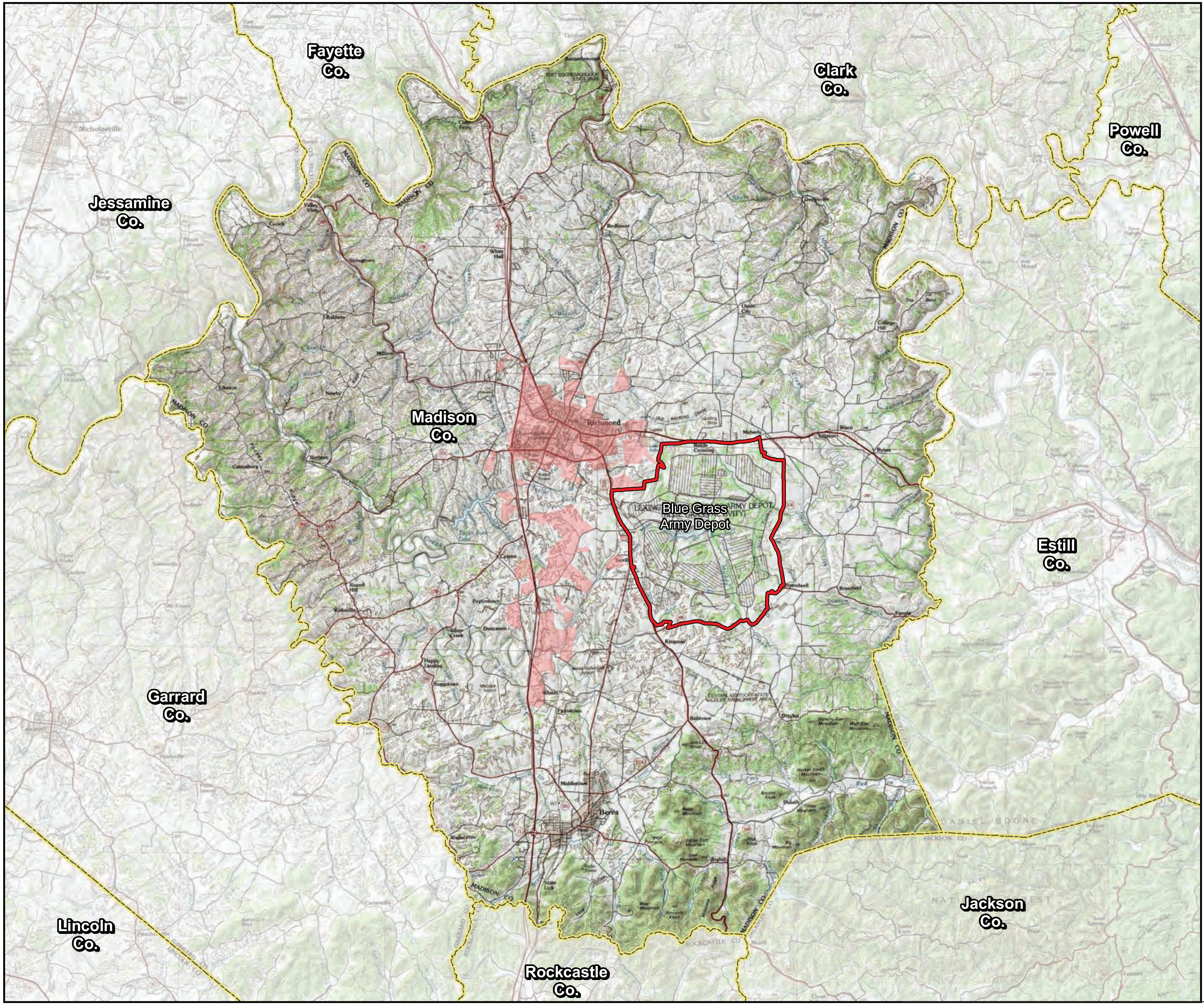
Figure B-1 presents the vicinity map for BGAD.

Land uses within the facility consist of storage of ordnance and munitions, grazing land for cattle, areas dedicated to the demolition of ordnance and munitions, and various other depot and tenant operations. Storage of ordnance and munitions is accomplished primarily through earth-covered magazines (igloos) and aboveground warehouses. Approximately 30 percent of the open land not used for depot operations is leased by the government to cattle ranchers for livestock grazing. Average annual rainfall is 41 inches. Average annual snowfall is 13 inches.

BGAD was established originally in April 1942 for the receipt, issuance, storage, maintenance, and disposal of ammunition. Construction of BGAD was a product of the War Department's expansion of ordnance supply depots during World War II (WWII). The installation was operated by the federal government until October 1943, at which time the operation was assumed by a corporation under the name of Blue Grass Ordnance Depot, Incorporated, a subsidiary of the Firestone Tire and Rubber Company. The corporation operated the installation until October 1945 when the federal government again assumed control. In 1964, it merged with the Lexington Signal Depot in Avon, Kentucky to become the Lexington-BGAD. The Lexington facility was selected for closure under the Base Realignment and Closure (BRAC) program in 1988, and closed in 1995. The remaining portion of the base in Richmond, Kentucky was then designated as BGAD.

The present day mission of BGAD is to provide munitions, chemical defense equipment, and special operations support to the DoD:

- Support to the Joint Warfighter by safely providing a full range of high-quality defense products and services at the right place and time.
- Maximize Warfighter capability through Ammunition Standard Depot Operations (store, issue, receipt, inspect, maintain, and demilitarize (demil)) of conventional munitions, missiles, non-standard ammunition, and chemical defense equipment.



Explanation:

- City of Richmond
- County Boundary
- Installation Boundary

0 0.5 1 2 3 4 5 Miles

0 5,000 10,000 20,000 30,000 Feet

N

Projection: KY State Plane South, Feet, NAD 1983

Location Map

Map Created By: USACE-LRL
Date: 2/10/2014

Data Sources:
Basemap - USGS Topo Quads
Installation Data - BGAD, 2012
Political Boundary - ESRI

FIGURE B-1
Vicinity Map
Blue Grass Army Depot
Madison County, KY

ch2m

Produce weapons system, combat vehicle, and ammunition components to fill critical Warfighter requirements today and in the future.

Three large tenants operate at BGAD:

- Lockheed Martin, a contractor-operated facility, performs helicopter maintenance.
- Blue Grass Chemical Activity (BGCA) provides oversight of the chemical weapon storage mission.
- Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP) is under construction and currently 80 percent complete for the chemical demilitarization program.

BGAD is a subordinate installation of the Joint Munitions Command (JMC). The depot's capabilities include the following:

- Industrial services support
- Ammunition maintenance, renovation, disassembly, and demilitarization
- Thermal arc coating for Air Force bombs
- Ultrasonic testing for mortar ammunition
- Quality assurance and joint logistics support
- Ammunition life-cycle management
- Large training ground for service members

As a Tier 1 designated Army depot, BGAD provides mission-essential ammunition surveillance, renovation, and conventional munitions demilitarization support to the DoD.

The DoD conventional munitions demilitarization program is a centralized system managed by the JMC. JMC headquarters is located at Rock Island, Illinois, and the command operates a nationwide network of ammunition plants and maintains a global presence wherever U.S. combat units are stationed. JMC is also the field operating agency for the DoD Single Manager for Conventional Ammunition (SMCA). The SMCA is responsible for managing DoD's demilitarization stockpile (the nation's stockpile of excess and unusable munitions). JMC manages the demilitarization program on a macro-level that includes, but is not limited to sales of unusable munitions to foreign services; intra- and inter- service munitions transfers; reduce, reuse and recycle (R3) programs; destruction by open burning (OB), open detonation/buried detonation (OD/BD) or alternative destruction technologies; and Research, Development, Test, and Evaluation (RDT&E) programs to develop new R3 and destruction technologies and to support the environmental assessment of munitions destruction. Munitions items are designated for sale, transfer, R3, or destruction by the Designated Disposition Authority (DDA). Destruction is specified only when other disposition opportunities (e.g., sales or R3) have been exhausted OB and OD/BD operations at BGAD are in direct support of JMC's demilitarization mission. Insufficient demilitarization capability or capacity would threaten BGAD's ability to support this mission. *[Note that this permit application uses the convention of "OD/BD" to clarify the use by BGAD of both detonations on the surface and below the surface. In general, the convention throughout the DoD, is to use the term "OD" to refer to both surface and buried detonations inclusively].*

Appendix B-1 provides a summary discussion of when military munitions in storage at BGAD become waste military munition (WMM) in accordance with the Military Munitions Rule (MMR) (40 Code of Federal Regulations [CFR] 266.202, incorporated by reference to 401 Kentucky Administrative Regulation [KAR] 36:080 with minor revisions). The Appendix additionally addresses the Conditional Exemptions (CEs) for transportation and storage of conventional WMM that are offered under the MMR and their application or potential application at BGAD. The capability to treat WMM safely and efficiently (i.e., at production levels sufficient to meet the demilitarization needs of the DoD) is critical for BGAD to fulfill its demilitarization mission. Given the inherent dangers associated with managing WMM and associated acute human health concerns, the technologies available to treat/dispose of WMM at production levels sufficient to meet the needs of the DoD are limited. BGAD currently has no other available options to fully execute its demilitarization mission. Appendix B-2 addresses alternative technologies for the destruction of conventional WMM and includes an evaluation of their potential applicability to BGAD's conventional munitions waste stream. Although the D100 controlled destruction chamber (CDC) offers an alternative to a fraction of the BGAD WMM waste stream, its capabilities and capacity are limited. BGAD is currently conducting market research regarding the cost and capabilities of contained burn systems to reduce its reliance on OB. Given the potential safety hazards associated with deteriorated and unstable propellant and limitations on technologies capable of withstanding detonations of significance, BGAD anticipates the need to retain both OB and OD/BD capability into the foreseeable future.

Conventional munitions storage, transport, and disposal operations at BGAD are executed by BGAD Mission Management. Treatment of conventional WMM at BGAD is the responsibility of the Ammunition Maintenance and Demilitarization Division and is accomplished through OB in burn pans, by OD/BD, and within a D-100 CDC housed in Building 280. Only OB and OD/BD are addressed in this permit application; the D-100 CDC is planned to be addressed in a separate permit application.

The use of OB at BGAD is restricted by 401 KAR 63:005 Section 4(5), which limits the use of open burning to fires set for prevention of a fire hazard, including the disposal of dangerous materials if no safe alternative is available. Waste propellant treated by OB at BGAD has been removed from use due to loss of lot integrity, deterioration, and/or chemical decomposition. These propellants are potentially unstable, are known to be capable of self-ignition, and pose a significant safety hazard if exposed to improper storage or handling conditions. To safeguard personnel charged with handling and disposal of WMM BGAD implements the cardinal rule of explosives safety by exposing the minimum number of people to the minimum amount of explosive for the minimum amount of time. The OB treatment process minimizes exposure of personnel to potential hazards and the destruction method is recommended by DoD explosives safety policy for destruction of this waste stream. No safe alternative to OB is currently available at BGAD. Appendix B-2 provides an assessment of proven, alternative treatment technologies. Included in the assessment are alternatives potentially applicable to BGAD's OB waste stream. Because of the deteriorated state of propellants managed at BGAD, it is imperative that any alternative limit the handling and manipulation (for example, physical resizing or grinding) for safety. BGAD is currently conducting market research regarding the cost and capabilities of contained burn systems to reduce its reliance on OB. However, given the potential safety hazards associated with deteriorated and unstable propellant and limitations on technologies capable of withstanding detonations of significance, BGAD will continue to require OB and OD/BD capability into the foreseeable future.

In addition to their use for Resource Conservation and Recovery Act (RCRA)-regulated treatment, the OB and OD/BD units may be used for non-RCRA regulated activities including training of personnel in the conduct of OB and OD/BD demilitarization techniques and procedures, emergency responses, and the conduct of RDT&E activities. Training, emergency response operations, and RDT&E activities are considered "use for intended purpose" and are exempt from RCRA permitting requirements per the MMR (refer to Appendix B-1).

The OB unit consists of approximately 10 acres and is delineated by a cleared zone bounded by a road (Route 117) on the north and a tree line to the south. The OB unit contains two separate, locally fabricated steel plate burn pans. The two pans are located on two separate concrete pads surrounded by crushed stone that provides for ingress and surface water drainage. OB Pan 1 is located east of OB Pan 2. The OD/BD unit is located approximately ¼ mile east of OB Pan 1 bounded by the top of a ridge to the north, an intermittent stream (Southern Tributary) and low-lying trees to the south, Muddy Creek to the east, and a gravel roadway to the west. The OD/BD unit encompasses approximately 65 acres, of which approximately 30 acres comprise the active treatment area that is barren soil. The remaining acreage is comprised of low vegetation.

Details regarding the construction and operation of the OB and OD/BD units are provided in Part D of this permit application.

B-1a Applicability and Identification Number and Required Notices [401 KAR 34:020, Section 1 & 2 & 40 CFR 264.10 and .11]

BGAD is a large quantity generator of hazardous waste and a RCRA Treatment, Storage, and Disposal Facility (TSDF). Hazardous wastes generated by BGAD include, but are not limited to, wastes from conventional mission such as waste resulting from the maintenance of conventional ammunition, industrial services operations, chemical defense equipment, and wastes resulting from the demilitarization of conventional ammunition. This includes flashing furnace residue, bag-house dust, ammunition waste, sandblasting media, spill cleanup residue, and paint related material.

BGAD is currently permitted (Hazardous Waste Management Facility Permit Renewal, Blue Grass Army Depot, EPA ID #KY8-213-820-105, Effective April 18, 2016, Expires April 18, 2026) to operate a variety of RCRA container storage units based on submittal of a separate and distinct storage permit application (Hazardous Waste Facility Permit, Part A Application and Part B RCRA Hazardous Waste Storage Permit Renewal Application for Conventional Munition Items, EPA ID# KY8-231-820-105, October 2015). In addition to container storage, BGAD conducts a number of RCRA regulated treatment activities.

This permit application specifically addresses conventional munitions treatment by OB and OD defined as Miscellaneous Units under 401 KAR 30:005/40 CFR 260.10 and requiring a permit under 401 KAR 34:250/40 CFR Subpart X.

The U.S. Environmental Protection Agency (EPA) Identification Number for BGAD is KY8-213-820-105.

B-1b Required Notices and Managed Waste Generated Off-Site [401 KAR 34:020 Section 3 & 40 CFR 264.12]

BGAD does not routinely accept hazardous waste from offsite sources. However, in order to provide continued support to the nationwide JMC demilitarization mission, BGAD seeks to retain the capability to accept offsite hazardous waste from other defense installation sources only. As reflected on the Part A form, hazardous wastes that may be received from offsite defense sources typically would include, but are not limited to, WMM (i.e., munitions designated as a waste) carrying the RCRA characteristic waste codes D003 (Reactivity), D001 (Ignitability), D004 (Arsenic), D005 (Barium), D006 (Cadmium), D007 (Chromium), D008 (Lead), D009 (Mercury), D011 (Silver), and D030 (2,4-Dinitrotoluene). BGAD does not accept WMM for the purpose of disposal by OB. In the event that hazardous wastes carrying other waste codes are to be received, a permit modification request will be submitted. The capability to receive WMM from offsite defense sources allows BGAD to support defense agencies/installations in the event that their existing disposal capabilities are insufficient or disrupted, for example. In the event that BGAD should receive WMM from an offsite defense source, the generator will be notified in writing of BGAD’s permit and authority to accept the waste stream offered.

Notification to offsite sources in accordance with 40 CFR §264.12 is not applicable since BGAD only accepts hazardous waste from other defense installation sources. Hazardous wastes are not accepted from foreign sources.

B-2 Topographic Map [401 KAR 38:090 Section 2(17)(a), (b), (c) and (d) & 40 CFR 270.14(b)(19)]

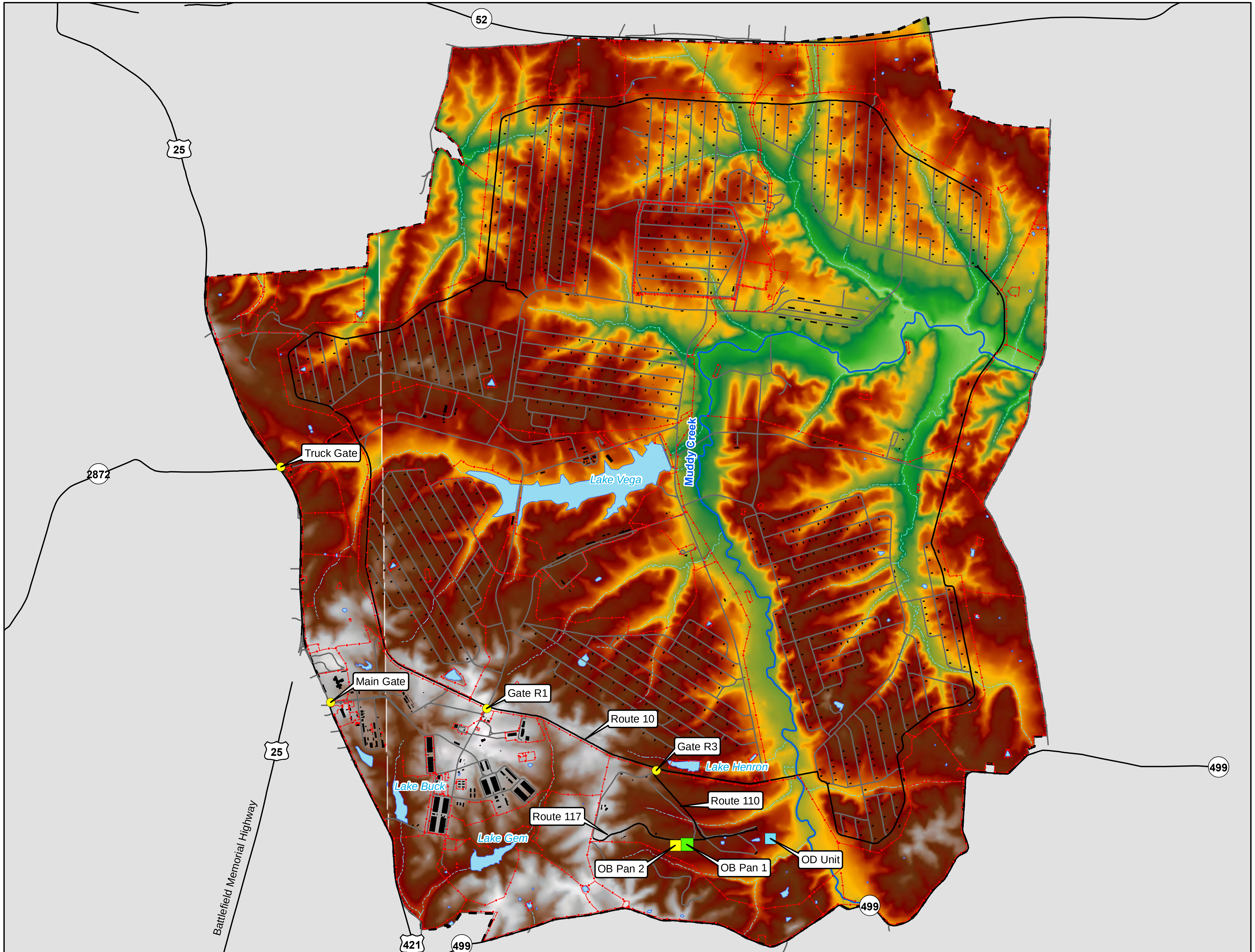
A topographic map of BGAD is provided on Figure B-2. The map scale, date and north arrow are included on the figure. Figure B-2 depicts contours at intervals of 20 to 25 feet, surface waters (including intermittent streams), the legal boundaries of the Depot, relevant access controls (i.e., gates) and internal roads, and the location of the OB and OD/BD units where hazardous waste is treated. BGAD does not have any injection wells or water withdrawal wells at the installation so none are shown.

Surface waters nearest to the OB and OD/BD units are Lake Henron to the north, Muddy Creek to the east of the OD/BD unit, an unnamed tributary of Muddy Creek to the south, and an unnamed tributary of Muddy Creek to the north of the ridge on which the OD unit is located. Muddy Creek enters the property at the southeast corner of the Depot and traverses the eastern portion of the installation in a northerly direction before turning nearly due east until leaving the installation at the eastern Depot boundary. The largest surface water body on the Depot is Lake Vega, a 135-acre, man-made lake located near the center of the facility and serves as the primary source of potable water for the facility. The primary route of surface drainage from the facility is Muddy Creek. Muddy Creek releases to the Kentucky River, the surface drainage receiving body of water for the entire county.

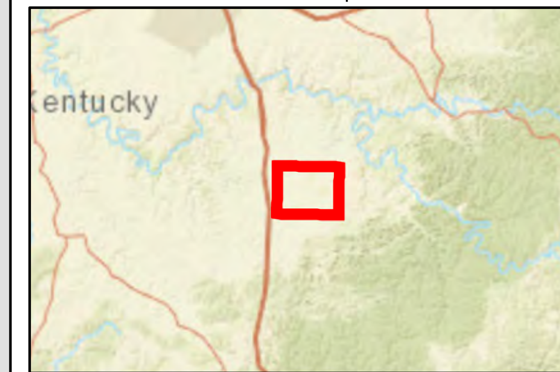
The closest surface waters to the OB and OD units are Lake Henron, Muddy Creek, and an unnamed tributary, hereinafter referred to as the Southern Tributary, located south of the OD area.

The OB and OD units are located approximately 2,200 feet north of the nearest legal boundary (which is the southern boundary of the facility). Most of the buildings and structures on BGAD are located in the southwestern portion of the installation as shown on Figure B-2.

Due to the size of the facility, additional Figures B-2a and B-2b are provided to show the OB and OD/BD units and 1,000 feet around them. The map scale, date, and north arrow are included on the figures. Figure B-2a and B-2b depict contour intervals at 10-foot and 2-foot intervals. These additional figures show the pattern of surface water flow in the vicinity of and from each of these units. At both units, predominant surface flow direction is to the south/southeast to the unnamed (southern) tributary and Muddy Creek. Access to the OB and OD/BD units is through gate R-3 at Route 10. Roads within 1,000 feet of the units include Route 110, which runs from the Demo Grounds Office southeast to the OD/BD unit, and Route 117, which runs east-west between the OB and OD/BD units. Because of the remoteness of the OB and OD/BD treatment units, no storm or sanitary sewers or outfalls are located near these units and so none are shown on the figures. Figure B-2b shows the outer limits of the OD/BD unit and the area devoid of vegetation (identified as the Area of Disturbance on the figure). The Area of Disturbance is the area encompassing the OD/BD pits and the immediate area surrounding the OB/DB pits that is routinely disturbed by heavy equipment and blast.



Locator Map



Legend

- Gate
- Installation Boundary
- Fence
- Named NHD Stream
- Unnamed NHD stream
- NHD Waterbody
- Building
- Road

Emission Sources

- OB Pan 1
- OB Pan 2
- OD/BD Unit

Terrain Elevation (Feet)

High : 1050

Low : 740

0 3,200 6,400
Feet

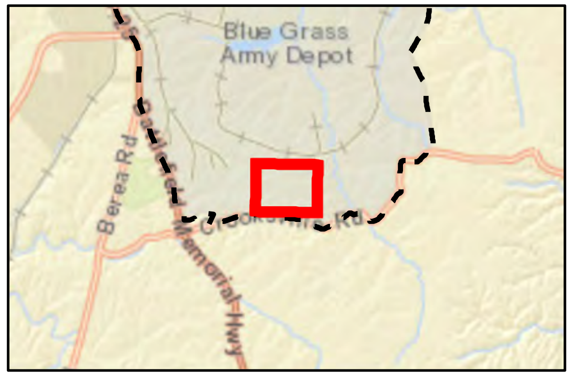
0 1,000 2,000
Meters

N

Figure B-2
Terrain Map
Blue Grass Army Depot
Madison County, KY

ch2m:

Locator Map



Legend

- Installation Boundary
- OB Pan 1
- OB Pan 2
- 1,000 ft Buffer for OB Unit
- Building
- Stream
- Fence
- Road
- Index Contour (10 ft)
- Topographic Contour (2 ft)

Source:
ESRI World Imagery Online Mapping Service
Image Date: July 11, 2014

N

0 400 800
Feet

0 125 250
Meters

Figure B-2a
1,000 Foot Buffer for Open Burn Unit
Blue Grass Army Depot
Madison County, KY

ch2m.

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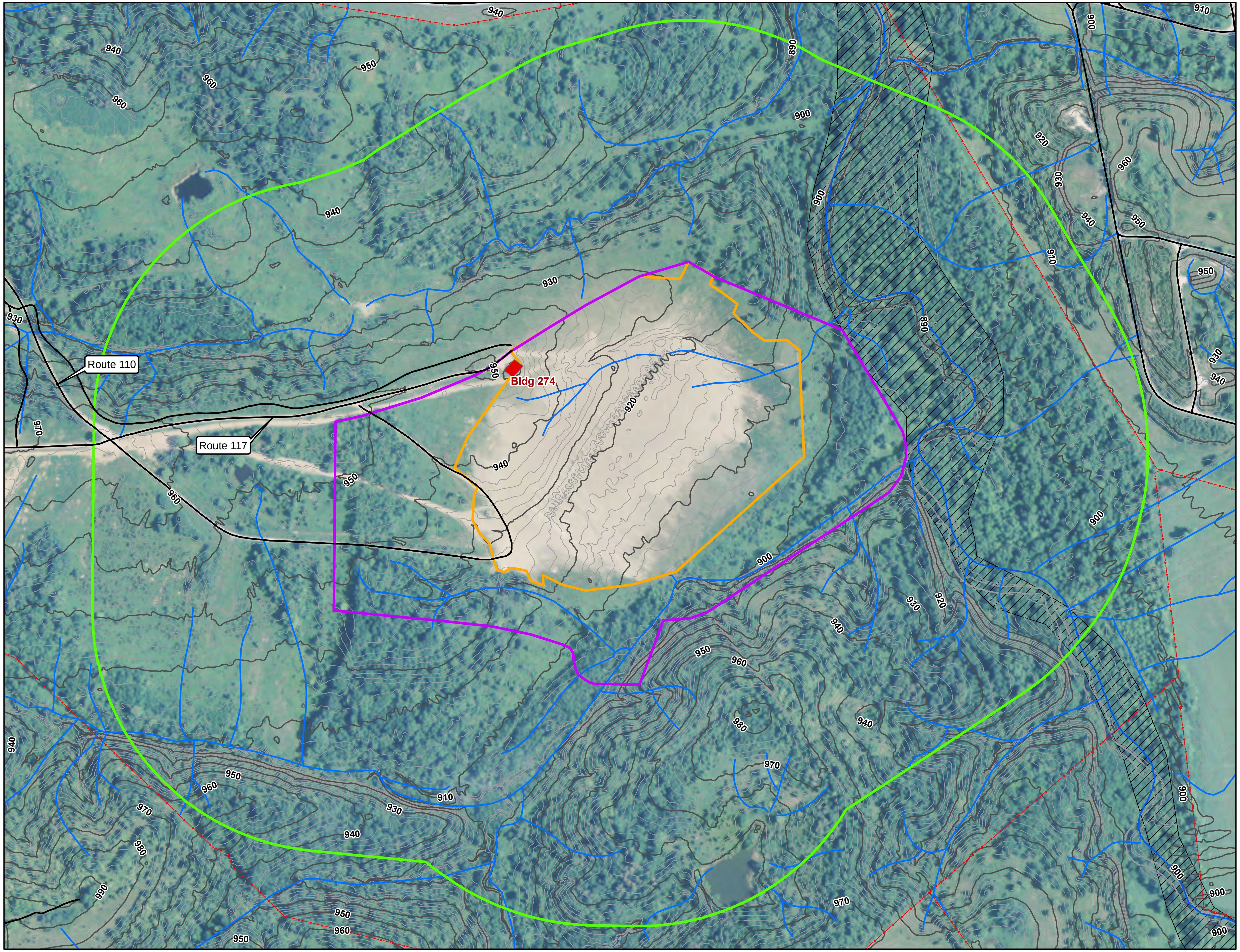
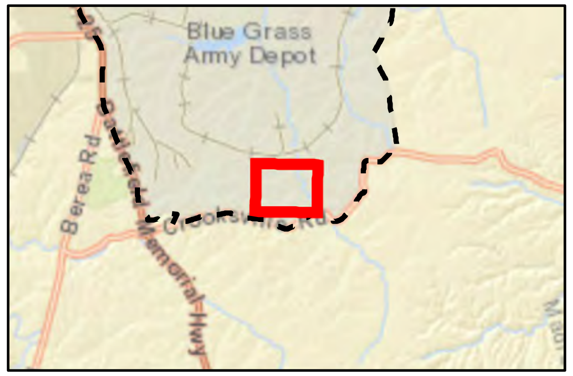


Locator Map



Legend

- Installation Boundary
- OD/BD Unit Area of Disturbance
- OD/BD Unit Outer Limits
- 1,000 ft Buffer for OD/BD Unit
- Building
- Floodplain
- Fence
- Stream
- Road
- Index Contour (10 ft)
- Topographic Contour (2 ft)

Source:
ESRI World Imagery Online Mapping Service
Image Date: July 11, 2014

N

0 400 800
Feet

0 125 250
Meters

Figure B-2b
1,000 Foot Buffer for Open Detonation Unit
Blue Grass Army Depot
Madison County, KY

ch2m:

A map showing land use and land cover within BGAD is provided in Figure B-3. Land use within the BGAD boundaries consists of an administrative area located in the southwest corner, conventional munitions treatment in the south-central portion, the BGCAPP located in the north central portion and munitions storage encompassing the remainder of the property. The OB and OD/BD units are in the southernmost portion of BGAD. Land use within and immediately surrounding the treatment units is predominantly unimproved vegetated and wooded area. No industrial or residential areas are located within 1,000 feet of these units (refer to Figures B-2a and B-2b). The nearest residential area (which is outside the property boundaries) lies approximately 2,300 feet south of the OD/BD unit. Land use immediately surrounding BGAD consists of improved and unimproved land and is primarily agricultural, rural community, and single family residential. Some areas of commercial and light industrial use also adjoin the installation.

An additional snow removal map is included as Figure B-4. This figure shows the BGAD boundary; access controls including the primary (Main Gate) entrance, secondary (Truck Gate) entrance, and fences; internal roads; water bodies; and buildings (including munitions igloos). The majority of occupied buildings at BGAD are administrative in nature and are located in the southwest corner of the Depot. The nearest onsite buildings to the OB and OD/BD units are Building 274 (Safety Bunker), Building 280 (which houses the CDC) and Building 270 (Demo Grounds Office). A recreational area is located at Lake Buck in the southwest portion of the installation.

Loading areas for WMM generated onsite and destined for treatment by OB or OD/BD may include any conventional munitions storage igloo. All conventional munitions storage igloos are located within the R-1 restricted access area in various designated areas of BGAD (see igloo area designations A through H, J and M on Figure B-4). WMM is transported by the most direct route to the designated treatment unit. Unloading occurs at the designated treatment unit just prior to commencing treatment. Fire control at the OB and OD/BD units is accomplished through administrative controls limiting ignition sources and by keeping dry brush minimized at and surrounding the units. The nearest fire hydrants are located at Building 270 and Building 280. There are no specific barriers or controls to prevent flooding at either the OB or OD/BD units.

Included as Figure B-5, the Federal Emergency Management Agency (FEMA) flood map shows that neither the OB nor OD/BD unit are situated in a 100-year flood zone.

Included as Figure B-6, the wind rose from January 2009 to September 2013 from BGAD's Meteorological Tower 1 at a height of 60 meters shows the wind direction information. Meteorological towers stationed on and in the vicinity of BGAD are managed by the tenant BGCA. The wind rose shows that winds blow primarily from the southwest at 3 to 5 meters per second.

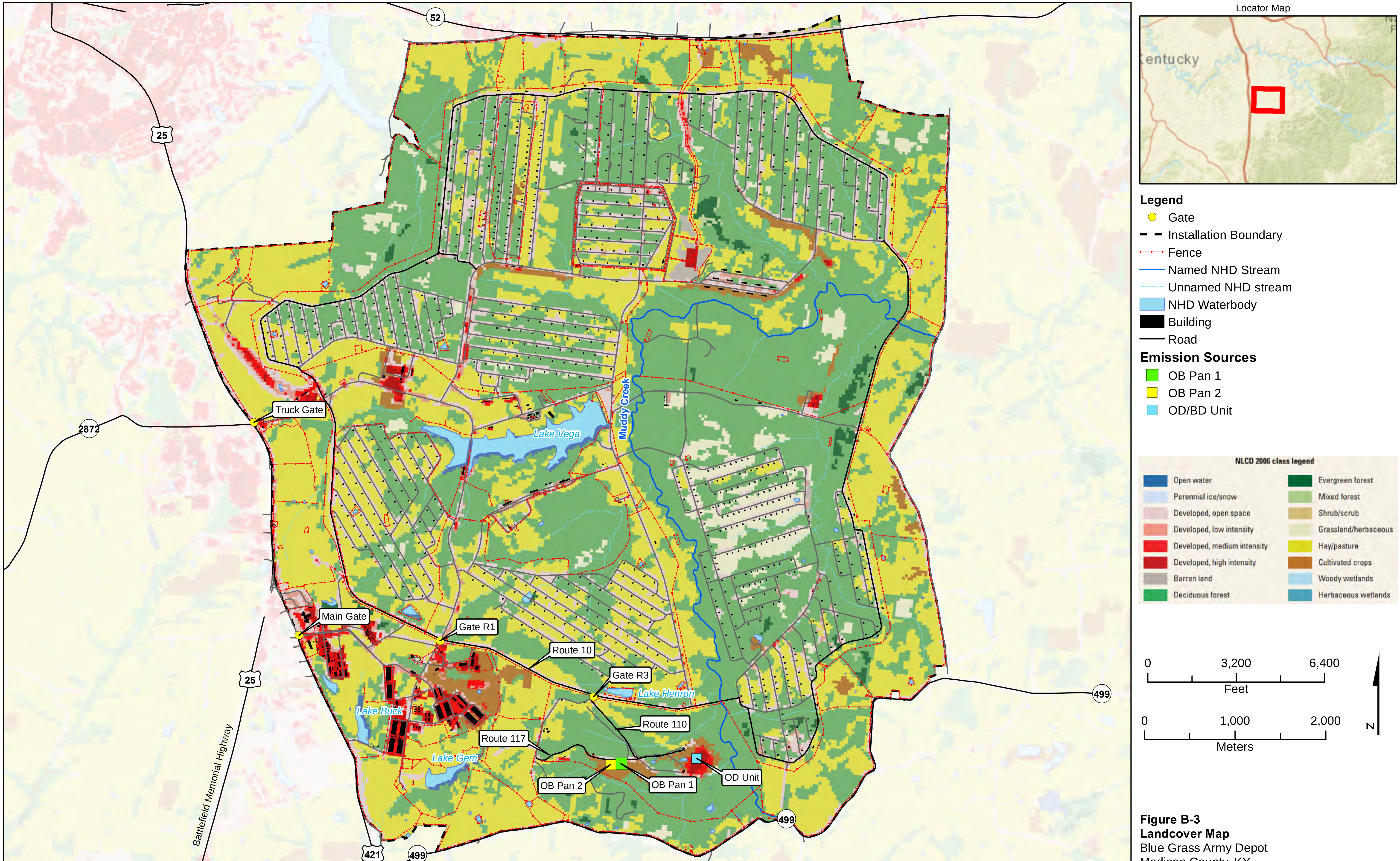


Figure B-3
Landcover Map
Blue Grass Army Depot
Madison County, KY

ch2m:

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Blue Grass Army Depot
Installation Map

0 500 1000 2000 Feet 0 150 300 600 meters
Graphic Scales
NORTH

Blue Grass Army Depot
Directorate of Public Works, GIS
Latest Update 08/10/2017
Drawn By: J.Stallard

Scale: 1" = 1000'
Grid Size = 3,000' x 4,000'

LEGEND:
- Building
- Earth Covered Magazine
- Road
- Rail Road
- Tower (MET or PA)
- Fencing
- Stream
- Water Body
- Demo Grounds

FIGURE B-4
Installation Map
Blue Grass Army Depot
Madison County, KY

Explanation:

- Railroad
- Primary Road
- Secondary Road
- Stream
- Water Body
- 100 yr Floodplain
- Installation Boundary
- OB Pan 1
- OB Pan 2
- OD/BD Unit

0 0.25 0.5 1 Miles

0 1,500 3,000 6,000 Feet

N

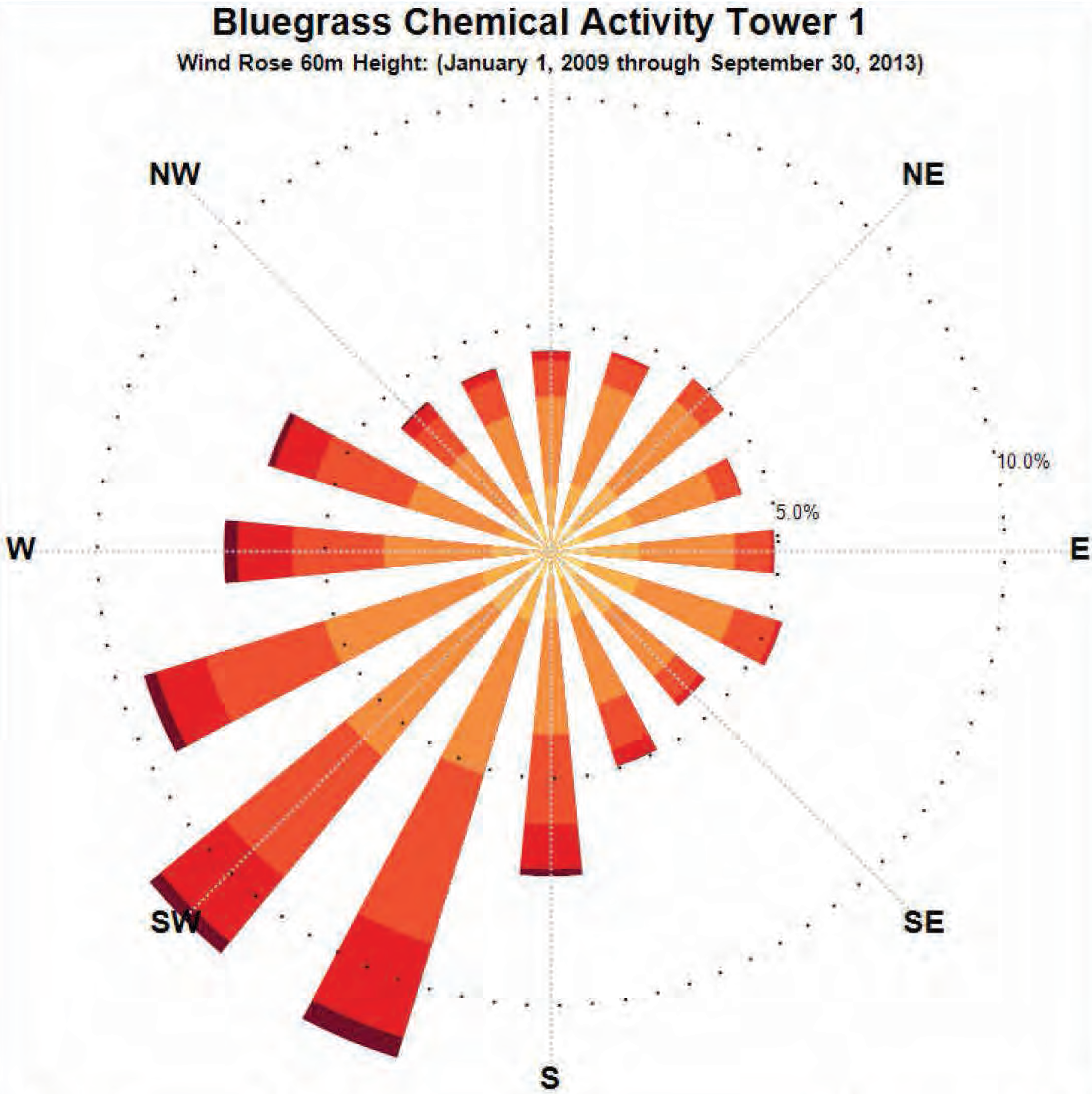
Projection: KY State Plane South, Feet, NAD 1983

Map Created By: USACE-LRL
Date: 2/10/2014

Data Sources:
Floodplain - FEMA
Transportation - KYTC, 2006
Installation Data - BGAD, 2012
Aerial Photography - ESRI, 2010

FIGURE B-5
Floodplain Map
Blue Grass Army Depot
Madison County, KY

ch2m:



REFERENCE

Wind rose created from data obtained by the Bluegrass Chemical Activity Tower at a height of 60 meters. Data was collected from January 1, 2009 through September 30, 2013. Entries were evaluated and wind rose created using WindRose Pro 3.1.

LEGEND

Wind speed (m/s)

- >10 (1.9%)
- 7 - 10 (9.8%)
- 5 - 7 (24.1%)
- 3 - 5 (38.8%)
- 2 - 3 (15.3%)
- 1 - 2 (8.3%)
- 0 - 1 (1.7%)

BLUE GRASS CHEMICAL AGENT-DESTRUCTION PILOT PLANT
RICHMOND, KENTUCKY

FIGURE B-6
Wind Rose
Blue Grass Army Depot
Madison County, KY

B-3 Location Standards [401 KAR 34:020 Section 9(1) and (2); 38:090 Section 2 (20) & Section 3; 40 CFR 264.18 & 40 CFR 270.14(b)(11)]

B-3a Geological Information

B-3a(1) Seismic Considerations

Madison County is not in the 401 KAR 34:340 list of counties for which seismic standards apply. The OB and OD/BD units are greater than 200 feet from any fault listed in the Kentucky area.

B-3a(2) Evaluation of Subsurface Geologic Formations and Surface Topography for Solution or Karst Features

BGAD lies in the Blue Grass Region of the Lexington Plain Section of the Interior Low Plateau Province. This region is a mature-to-old plain developed on weak rock, which is entrenched by rivers. The topography is gently rolling with elevations ranging between 850 and 1,020 feet above mean sea level.

Muddy Creek and its tributaries drain almost 90 percent of the surface area. Tributaries of Hays Fork Creek and small drainage ways feeding Lake Reba drain the remaining part of the installation.

The surface geology of BGAD consists of a blanket of residual, unconsolidated soils developed on extremely shallow limestone. The U.S. Department of Agriculture has mapped soil associations within BGAD (included as Figure B-7). Generally, the soil comprising the top 18 inches is a light to yellow, reddish brown, silty clay and is underlain by 16 to 20 inches of light olive brown, silty clay to clay. This silty clay grades into a somewhat darker clay and extends down to bedrock. The average soil depth is less than 10 feet as determined from 37 test holes and field observations. Limestone fragments have been encountered as shallow as 16 inches below the surface. Properties of these soils are tabulated in Table B-1.

A U.S. Geological Survey (USGS), Geologic Quadrangle Map, Moberly Quadrangle is included as Figure B-8 (East) and Figure B-9 (West). The subsurface consists of limestone, dolomite, shale, and recent alluvium. The Ashlock Formation (Ordovician) is divided into an upper and lower part, although both are predominantly limestone. The Ashlock Formation occurs in the central and western part of the installation (Figure B-9).

The Drakes Formation (Upper Ordovician) is dolomite and prevails throughout the installation. The Brassfield Dolomite (Lower Silurian) is found in small areas along the southeast boundary. Silurian and Devonian rocks, which are composed of shale and dolomite, are found as small remnants, also along the southeast boundary. Recent deposits, consisting of clay and silts, floor the drainage ways. Figures B-8 and B-9 identify the lithology and thickness as well as provide a description of the formations.

Most of the BGAD is underlain by the Drakes Formation, which is made up of dolomite, limestone, and shale. A small part of the BGAD (near the western boundary) is underlain by the lower part of the Ashlock Formation, made up mostly of silty limestone and dolomite. The Tates Creek Fault forms a boundary between the Drakes Formation and the lower part of the Ashlock Formation, and extends through the center of the Depot. Because of the high incidence of faulting in the area, it is probable that fractures in the Drakes Formation and the Ashlock Formation are common. A structural feature at BGAD includes the Tates Creek Fault, which crosses the northwest boundary and swings southeastwardly through Area J (Letters refer to areas as shown on map on Figure B-8.). From this point, the fault is inferred underneath the alluvium of Muddy Creek in Area L. A splinter fault branches from the Tates Creek Fault just south of the igloos in Area H, passes under the western part of Lake Vega, and terminates in Area K. The up thrown side of the Tates Creek Fault and the splinter fault are north and east respectively. An unnamed fault crosses the northeast corner of BGAD and another unnamed fault passes to the southwest of the installation. The faults appear to be seismically inactive.

Although BGAD is primarily underlain by limestone and dolomite, karst topographic features are not well developed or widespread. High content of clay in the limestone has limited solution weathering.

Because the site is in a region where limestone is present, a comprehensive site-specific evaluation of the OD/BD unit was prepared by a professional geologist in 1999, and reviewed and validated in 2014 to demonstrate that the facility (1) has been “designed” to withstand any gradual or sudden land subsidence that is characteristic of areas underlain by soluble limestone and (2) contamination into or through any fractures, channels, or solution features shall not occur.

Investigation of the subsurface geology and karst features underlying the OD/BD unit was accomplished in multiple phases spanning a number of years. The primary tasks associated with the investigation were a literature research, analysis of existing groundwater elevation data, site walkovers during high and low flow periods, analysis of aerial photographs, installation and sampling of additional wells, sampling of seeps, and analysis of 1 year's surface and groundwater elevation data. The results of the various phases have been reported and coordinated with the Kentucky Department for Environmental Protection (KDEP). Initial findings were reported in the Draft Final Hydrologic Evaluation (Radian, 1998a). This document additionally described the conceptual hydrologic model for the site. The Groundwater Sampling and Analysis Work Plan (Radian, 1999), submitted to KDEP in January 1999, established the groundwater monitoring network based on the site conceptual model defined in the Hydrologic Evaluation. KDEP approved the Groundwater Work Plan with the stipulation that an upgradient well would be installed and screened across the Ashlock formation. In February 1999, as a result of discussions with KDEP, the requirements of 401 KAR 38:090 Section 2(20)(b)2 were determined to be met if:

- An additional upgradient well was installed and screened across the Ashlock Formation and sampling of the well supported the conceptual model and
- A year’s worth of groundwater and surface water data were collected and verified the conceptual model.

Extensive investigation of the site revealed that the hydrologic setting is characterized as being moderately karstified with the shallow groundwater controlled predominantly by fractured flow. Bedding planes, joints, and faults control groundwater flow. A conduit flow system, characteristic of a mature karstified aquifer system, is not evident in the flow systems being monitored at the OD/BD unit. Pronounced solution features were not identified during logging of the rock core samples collected during monitoring well installation, and the mature karst features were not observed during the site walkovers. Additionally, in more than 65 years of detonations at the OD/BD unit, there is no evidence of the collapse of soluble features.

A review of aerial photography from 2004 through 2012 and visual site survey completed by a professional geologist licensed in the State of Kentucky in December 2013 identified no other potential surficial karst features that would indicate karst collapse or drainage feature development since the comprehensive site evaluation in 1999. Additional detail regarding geologic and hydrologic conditions and supporting the evaluation of subsurface geologic formations and subsurface topography for solution or karst features at the site are presented in Part E of this application and the referenced documents.

In summary, all phases of work support the conceptual hydrologic model and the requirements of 401 KAR 38:090 Section 2 (20)(b) and (c)1.

Explanation:

(line)	Primary Road
(line)	Secondary Road
(line)	Railroad
(line)	Stream
(fill)	Water Body
(outline)	Installation Boundary

Soil Type *(Map Unit Symbol)*

BaB	FdC	MuC
BaC	FdE	MvC3
BaD	HaB	Ne
BcC3	HaC	NhB
BcD3	Hu	NhC
BeB	Lc	OtC
BrC	Ld	OtE
BrE	LwB	OtF
CaB	LwC	Rb
CaC	LwD	ShB
CoF	LyE3	ShC
CyE	MnC	TrC
DAM	Mt	WhB
Du	MuA	WoB
Eg	MuB	

0 0.25 0.5 1 Miles

0 1,500 3,000 6,000 Feet

N

Projection: KY State Plane South, Feet, NAD 1983

Map Created By: USACE-LRL
Date: 2/10/2014

Data Sources:
Soil - USDA-NRCS
Transportation - KYTC, 2006
Installation Data - BGAD, 2012

FIGURE B-7
Soil Map
Blue Grass Army Depot
Madison County, KY

ch2m

Table B-1. Soil Properties at Blue Grass Army Depot

Soil Unit	Map Unit	Depth To Bedrock (Meters)	Depth From Surface (cm)	Classification* USDA	Classification* Unified	Permeability Centimeters per Hour	pH
Lowell	1	1.1-2.1	0-20	Silt loam	ML/CL	1.6-5.1	6.6-7.3
			20-61	Silty clay loam	CL-CH	1.6-5.1	5.1-6.0
			61-122	Clay	CH	1.6-5.1	5.1-6.0
Faywood	1	0.5-1.1	0-13	Silt loam	ML/CL	0.5-1.6	7.4-7.8
			13-76	Silty Clay	CL-CH	0.5-1.6	7.4-8.2
			76	Limestone	-	-	
Cynthiana	1	0.15-1.1	0-10	Silty clay loam	CL	0.5-1.6	6.1-7.3
			Oct-41	Silty clay	CL-CH	0.5-1.6	6.6-7.8
			41	Limestone	-	-	
Beasley	2	1.2-1.8	0-25	Silt loam	ML/CL	1.6-5.1	5.6-6.0
			25-41	Silty clay loam	CL/CH	0.5-1.6	5.6-6.0
			41-86	Silty clay/clay	CH	less than 0.5	5.6-6.5
			86-122	Loam	ML/CL	0.5-1.6	-
Brassfield	2	0.5-1.1	0-46	Silt loam	ML/CL	1.6-5.1	7.4-8.4
			46-91	Silt loam-loam	ML/CL	1.6-5.1	7.4-8.4
			91	Siltstone/ limestone			
Otway	2	0.5-1.1	0-18	Silty clay	CH/CL	0.5-1.6	7.4-8.4
			18-97	Heavy silty clay	MH/CL	0.5-1.6	7.4-8.4
			97	Limestone	-	-	
				Siltstone			
				Shale			
Shelbyville	3	1.5-2.5	0-14	Silt loam	ML/CL	1.6-5.1	5.6-6.0
			14-30	Silty clay loam	CL	1.6-5.1	5.6-6.0
			30-48	Silty clay/clay	CH/MH	0.5-1.6	5.6-6.0
Mercer	3-4	1.5-1.8	0-13	Silt loam	ML/CL	1.6-5.1	5.1-6.0
Nicholson	3	1.5-2.1	0-7	Silt loam	ML/CL	1.6-5.1	5.1-6.0
			29-Jul	Silty clay loam	CL	1.6-5.1	4.5-5.0
			29-47	Silty clay loam	CL	less than 0.5	4.5-5.0
			47-52	Silty clay loam or silty clay	CL/MH	0.5-1.6	4.5-5.0
Lawrence	4	1.2-2.1	0-18	Silt loam to	ML/CL	1.6-5.1	4.5-5.5
				light silty clay			
			18-48	Silty clay loam	CL	less than 0.5	4.5-5.5
Robertsville	4	1.2-1.8	0-15	Silt loam	ML	1.6-0.5	4.5-5.5
			15-48	Silty clay loam	ML/CL	less than 0.15	4.5-5.5

*USDA: United States Department of Agriculture Unified: Unified Soil Classification System

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
WILLIAM T. PECORA, DIRECTOR

PREPARED IN COOPERATION WITH
THE COMMONWEALTH OF KENTUCKY, UNIVERSITY OF KENTUCKY
KENTUCKY GEOLOGICAL SURVEY
WALLACE W. HAGAN, DIRECTOR AND STATE GEOLOGIST

Installation Boundary

NOMENCLATURE OF EARLIER WORKERS

Irvine Formation (Hall and Palmquist, 1960)

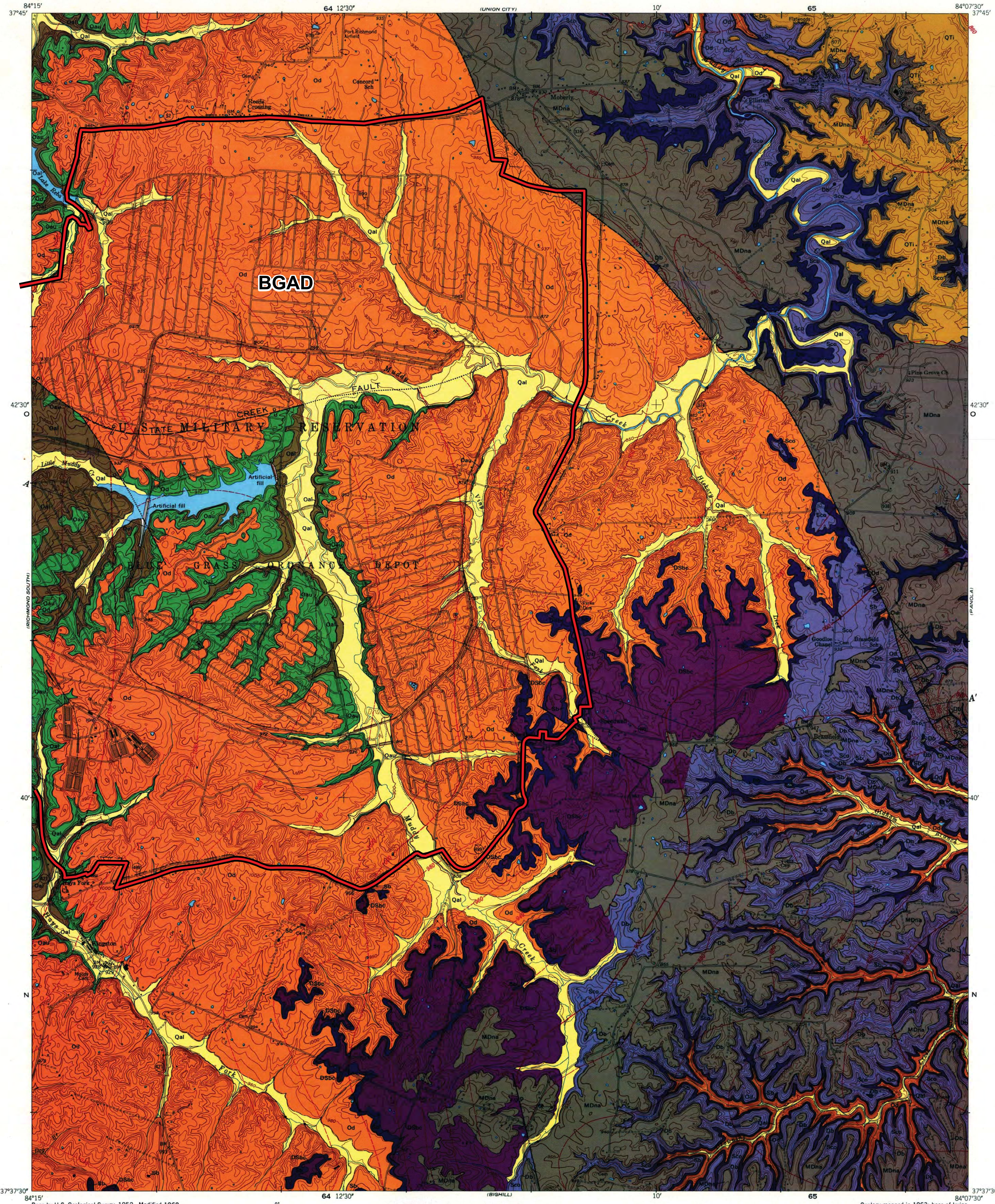
Chattanooga Shale (Campbell, M. R., 1898)
New Albany Shale (Campbell, Guy, 1946)
Sanderson Formation (Campbell, Guy, 1946)
Blackiston Formation (Campbell, Guy, 1946)
Trousedale Shale (Campbell, Guy, 1946)
Portwood Formation (Campbell, Guy, 1946)
Ohio Shale (Hall and Palmquist, 1960)

Onondaga (Mcfarlan and Goodwin, 1930)
Boyle Limestone (McFarlan and White, 1952)
Casey Limestone (McFarlan and White, 1952)
Duffin (McFarlan and White, 1952)

Panola Formation (Campbell, M. R., 1898)
Crab Orchard Group (Foerste, 1935)
Alger Formation (Foerste, 1906)
Estill Clay (Foerste, 1906)
Waco Limestone (Foerste, 1906)
Lulbegrud Clay (Foerste, 1906)
Indian Fields Formation (Foerste, 1906)
Oldham Limestone (Foerste, 1906)
Plum Creek Clay (Foerste, 1906)
Crab Orchard Group (Rexroad and others, 1965)
Estill Shale (Rexroad and others, 1965)
Noland Formation (Rexroad and others, 1965)
Brassfield Limestone (Hall and Palmquist, 1960)
Brassfield Formation (Rexroad and others, 1965)

Richmond Formation (Campbell, M. R., 1898)
Richmond Group (Hall and Palmquist, 1960)
Liberty and Whitewater Formations undifferentiated (Hall and Palmquist, 1960)
Liberty (McFarlan and Goodwin, 1930)
Waynesville Limestone (Hall and Palmquist, 1960)
Arnheim Formation (Hall and Palmquist, 1960)
Oregonia (McFarlan and Goodwin, 1930)
Sunset (McFarlan and Goodwin, 1930)
Maysville Group (Hall and Palmquist, 1960)
McMillan Formation (Hall and Palmquist, 1960)
Mt. Auburn-Tate (McFarlan and Goodwin, 1930)

SYSTEM	SERIES	FORMATION AND MEMBER	LITHOLOGY	THICKNESS, IN FEET	DESCRIPTION
QUATERNARY		Alluvium		0–20	Silt and clay, dark-brown, with rare gravel. Gravel topographically lower than the top of the Reba Member primarily consists of limestone pebbles; above the Reba Member it consists of dolomite pebbles. Fine gravel composed of limonite nodules ⅛ to ¼ inch in diameter is locally present; gravel composed of subangular chert fragments up to 3 inches in maximum dimension is present along Muddy Creek and tributaries east of the fault in northeast part of quadrangle.
TERTIARY OR QUATERNARY	Pliocene or Pleistocene	Irvine Formation		0–50	Sand and gravel: Sand, commonly with matrix of clay and silt, yellowish-brown to yellowish-orange; weathers grayish orange; very fine to fine, rarely medium-grained; locally weakly cemented with limonite. Gravel present locally at base, consists of rare pebbles of quartz, chert, and sandstone ¼ to 3 inches in diameter in sand matrix.
DEVONIAN AND MISSISSIPPIAN	Middle and Upper Devonian and Lower Mississippian	New Albany Shale		55+	Shale, black, with grayish-orange, grayish-red, and dusky-yellow surface blooms; even bedding, beds commonly 1/64 to ⅛ inch thick, in alternating sets of more and less resistant beds, commonly 1 to 2 inches thick, fissile; weathers to thin chips with planar surfaces; commonly jointed. Top not preserved.
				90+	Shale, black, grayish-black, and grayish-olive. Black shale, occurs in even beds 1/64 to ⅛ inch thick grading into shale, dolomitic, brownish-black; in irregular beds ⅛ to 1 inch thick; interbedded with shale, grayish-olive; even beds 1/16 to ⅛ inch thick, in sets ½ to 8 inches thick; sharp contacts with and less resistant than black and brownish-black shale.
				8–11	Shale and dolomite: Shale, dolomitic, brownish-black; weathers light olive gray; even beds ⅛ to ¼ inch thick, commonly in coherent sets as much as 12 inches thick; weathers to plates and chips with planar surfaces or to pieces whose surfaces are curved fractures; contains rare beds of shale, black, thin-bedded and fissile, ½ to 2 inches thick. Dolomite, in part argillaceous, olive- to light-olive-gray; weathers yellowish brown; fine grained; bedding obscure, exposed surfaces are curved fractures; beds 2 inches to 3 feet thick, in part even, in part lenticular.
				20–25	
DEVONIAN	Middle Devonian	Boyle Dolomite		0?–33	Dolomite, light-olive- to light-brownish-gray; weathers in bulk pale to moderate yellowish brown, surface weathers olive gray to olive black; fine grained; bedding obscure, beds commonly 1 to 3 feet thick, rarely 2 to 12 inches. Chert rare or absent where formation less than 10 feet thick, common where greater than 10 feet thick, mostly in topmost beds. Chert, occurs as nodules 2 to 6 inches in maximum dimension; pale brown to medium gray; weathers light gray to white, texture irregular; contains oölites and fossil fragments. Fossils rare, mostly silicified corals and brachiopods, largely fragmentary. Thickness variable, maximum is 33 feet west of Elliston, reduced to 4 feet near Waco; 20 feet near Pine Grove church, generally 2 to 5 feet south of Brassfield. Shown by colors where greater than 10 feet thick, by heavy line (locally by colors) where less than 10 feet thick. Combined with Crab Orchard Formation in belt from Hickory Lick to Hays Fork; here the Boyle is poorly exposed but probably present beneath the New Albany Shale, except near the south boundary of the quadrangle, where it may pinch out. Outcrops of Boyle indicated by symbol where observed. The Boyle may be present at other localities in this belt where isolated topographic highs project more than 50 feet above the base of the Brassfield Dolomite.
SILURIAN	Lower and Middle Silurian	Crab Orchard Formation		30–50	Shale and dolomite: Shale, dusky-yellowish-green and grayish- to pale-olive; weathers yellowish brown and dusky yellow; thin bedded and platy weathering, non-resistant, generally weathered to plastic clay at rare natural exposures. Dolomite, medium-light- to light-gray and light-olive- to greenish-gray; weathers in bulk grayish orange to light brown, surface weathers moderate brown to dusky yellowish brown; fine grained; present in beds a few inches thick interbedded with shale, and in units 1 to 5 feet thick containing dolomite beds 1 to 18 inches thick with shale partings. Fossils, mostly brachiopods, common in some dolomite beds. Formation thinnest near Brassfield, where it contains the most dolomite; thicker near Elliston and in south-central part of quadrangle. Thickens to 88 feet 3 miles east of Brassfield in the Panola quadrangle.
	Lower Silurian	Brassfield Dolomite		4–14; 8–24	Dolomite, medium- to light-gray and light-olive-gray; locally with petroleum staining and vugs containing tar; weathers in bulk grayish orange to light brown, surface weathers light brown to dusky yellowish brown; fine grained; wavy to very irregular beds 2 to 12 inches thick separated by shaly partings. Fossils common, mostly brachiopods, corals, and crinoid stems. Marker bed containing crinoid stem fragments ¼ to 1 inch in diameter, some with serrated outline, generally present within 2 feet of top of unit.
				4–10	Dolomite, light-olive- to greenish- to light-gray, locally speckled and stained with petroleum; weathers in bulk light brown, surface weathers moderate to dusky yellowish brown; fine grained; bedding obscure, even beds 1 to 10 inches thick seen only on etched surfaces or where otherwise very weathered; generally monolithic in appearance with beds 2 to 5 feet thick, weathering to large rectangular blocks. Fossils rare or absent. Thickness of entire Brassfield 8 to 10 feet along western belt of outcrop and at Elliston, 18 to 24 feet along Drowning Creek and near Brassfield.
ORDOVICIAN	Upper Ordovician	Drakes Formation		130±	Dolomite, shale, and limestone: Dolomite, greenish-gray, brownish-gray, and light-olive-gray, commonly streaked and mottled; weathers light olive gray to yellowish gray, silty and argillaceous; in part fine to medium grained; beds uneven, ½ to 8 inches thick, many contain vugs with petroleum; weathers to irregular blocks, relatively resistant, common in upper half of formation, rare in lower half; in part, fine-grained, greenish-gray, mottled or finely banded, in beds 4 to 8 inches thick; weathers to irregular fragments bounded by curved fractures; in part, micrograined to fine grained, light-olive-gray to greenish-gray; in even beds 1/16 to ½ inch thick, resembling shale; weathers to plates and chips with planar surfaces. Shale, dolomitic, light-olive- to greenish-gray, in even beds 1/16 to ½ inch thick; occurs in rare intervals near top, grades into silty dolomite. Limestone, medium-dark- to medium-light-gray, fine-grained, rare, beds 1 to 4 inches thick. Fossils sparse, a few bryozoans and brachiopods in limestone and fine- to medium-grained dolomite.
		Ashlock Formation, Upper part, Reba Member		9–10; 23–27	Limestone, dolomitic and silty, medium- to light-olive-gray, mottled with grayish-green, fine-grained; argillaceous streaks and calcite augen common; faint irregular bedding, beds 2 to 3 inches thick; weathers to blocks with curved surfaces. Fossils abundant, mostly brachiopods and bryozoans.
				5–6	Limestone, brownish- to olive-gray, commonly mottled with grayish-blue-green and dark-olive-gray; weathers light gray; micrograined to fine grained; beds even, ½ to 8 inches thick, with shaly partings. Fossils rare.
		Ashlock Formation, Upper part, Terrill Member		8–11	Dolomite, silty, greenish-gray to light-olive-gray; weathers light olive gray to pale olive; micrograined; commonly in even beds 1/16 to ½ inch thick that resemble shale; weathers to slabs and chips with planar surfaces; basal bed as much as 8 inches thick, weathers to irregular, curved pieces. Fossils absent.
		Ashlock Formation, Lower part, Stingy Creek Member		11–13; 85+	Limestone, silty and argillaceous, brownish- to olive-gray, commonly fine-, in part medium-grained; slightly uneven beds 3 to 24 inches thick, separated by sets of thin beds of very silty limestone, sets are 2 to 4 inches thick and non-resistant. Weathers to irregular pieces, silty beds weather to small fragments. Fossils abundant, mostly brachiopods and bryozoans.
		Ashlock Formation, Lower part, Gilbert Member		16–18; 60+	Limestone, medium-dark- to medium-gray, micrograined to fine-grained; prominent bedding, beds 1 to 6 inches thick, with wavy, irregular surfaces and shaly partings between beds. Unit is relatively resistant. Fossils abundant, mostly brachiopods and bryozoans.
		Ashlock Formation, Lower part, Tate Member		30+	Limestone, medium-dark- to light-gray and brownish-gray; weathers light to very light gray; fine to medium grained; very irregular texture; bedding obscure, beds 1 to 10 inches thick, wavy and uneven; weathers to rubbly appearance. Fossils abundant, mostly brachiopods and bryozoans. Base not exposed.



Base by U.S. Geological Survey, 1952. Modified 1968

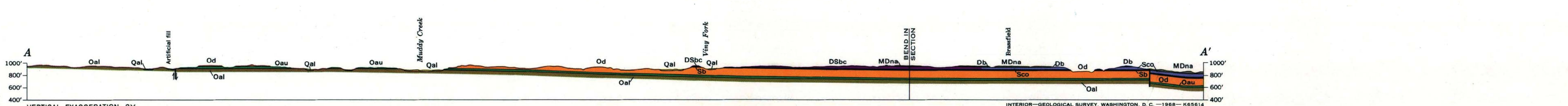
The Carter Coordinate System letters and numbers used to designate five-minute divisions of latitude and longitude are shown along the margins; tick marks indicate one-minute divisions

TRUE NORTH
APPROXIMATE MEAN DECLINATION, 1968

SCALE 1:24 000
1 ½ 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER
CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

KENTUCKY
QUADRANGLE LOCATION

Geology mapped in 1963; base of Irvine Formation mapped by Henry E. Kane



INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—1968—K65814

EXPLANATION

Qal — Alluvium

Pliocene or Pleistocene: QTi — Irvine Formation

Middle and Upper Devonian and Lower Mississippian: MDna — New Albany Shale

UNCONFORMITY

Middle Devonian: Db — Boyle Dolomite
Shown by line where too thin to show color

DSbc — Boyle Dolomite and Crab Orchard Formation undivided

UNCONFORMITY

Lower and Middle Silurian: Sco — Crab Orchard Formation

Lower Silurian: Sb — Brassfield Dolomite

Upper Ordovician: Od — Drakes Formation

Oau, Oal — Ashlock Formation
Oau, *upper part*
Oal, *lower part*

Contact
Dashed where approximately located; short dashed where inferred; dotted where concealed

D
U
Fault
Dashed where approximately located; short dashed where inferred; dotted where concealed. U, *upthrown side;* D, *downthrown side*

15
Strike and dip of beds

Strike of vertical joints

1000
Structure contours
Drawn on base of Brassfield Dolomite southwest of fault in northeastern part of quadrangle and on base of New Albany Shale northeast of fault. Long dashed where control less accurate. Short dashed where datum is above land surface. Hachures indicate closed basin. Contour interval 20 feet

Abandoned quarry

×
Outcrop of Boyle Dolomite where not mapped separately

ECONOMIC GEOLOGY

Five small abandoned quarries were located by the writer in the quadrangle. Two are in the Drakes Formation, one in the Reba Member of the Ashlock Formation, and two in the New Albany Shale. Rock from these formations is of little value for purposes other than fill. Dolomite of the Brassfield Dolomite or Boyle Dolomite may be suitable for crushed stone.

Sand of the Irvine Formation is available in large quantities and may be suitable for building purposes after washing.

There has been little known exploration for oil and gas. A single exploratory hole near Elliston penetrated the top of the Knox Dolomite (Lower Ordovician) but no production was obtained.

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GEOLOGIC MAP OF THE MOBERLY QUADRANGLE, MADISON AND ESTILL COUNTIES, KENTUCKY

By
Robert C. Greene
1968

FIGURE B-8
Geologic Map
Moberly Quadrangle
Madison and Estill Counties, KY

ch2m.

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
WILLIAM T. PECORA, DIRECTOR

PREPARED IN COOPERATION WITH
THE COMMONWEALTH OF KENTUCKY, UNIVERSITY OF KENTUCKY
KENTUCKY GEOLOGICAL SURVEY
WALLACE W. HAGAN, DIRECTOR AND STATE GEOLOGIST

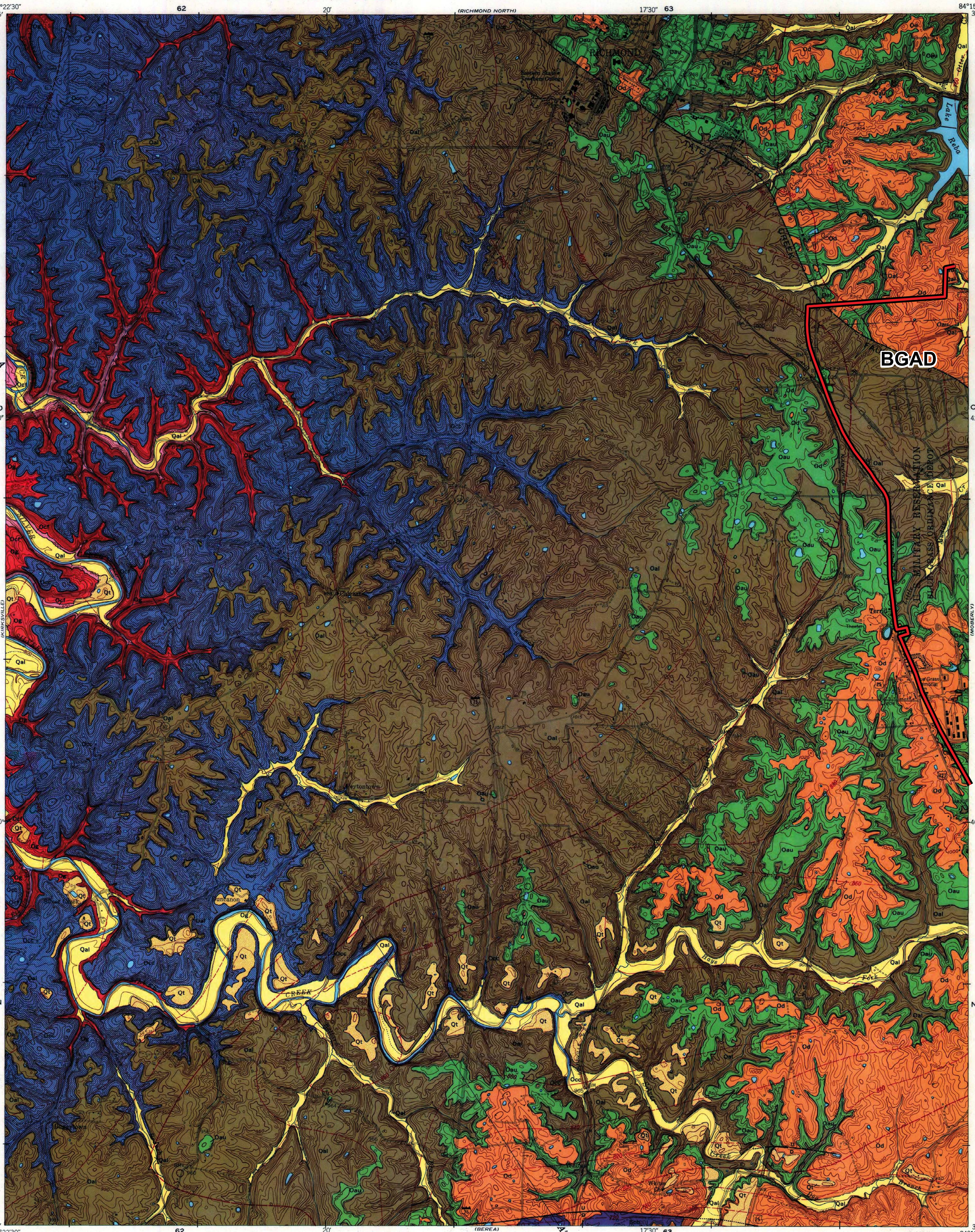
GEOLOGIC QUADRANGLE MAP
RICHMOND SOUTH QUADRANGLE, KENTUCKY
GQ-479

Installation Boundary

NOMENCLATURE OF EARLIER WORKERS

System	Series	Formation, member, and bed	Lithology	Thickness, in feet	Fossil collections	Description
Quaternary		Alluvium		0–20		Silt and clay, dark-brown, interbedded with gravel. Gravel consists of rounded pebbles and cobbles as much as 4 inches in diameter with matrix of clay and silt: Pebbles and cobbles are dominantly limestone and dolomite.
Quaternary		Terrace deposits and lag gravels		0–10		Gravel, silt, and clay: Gravel consists of well-rounded quartz pebbles ⅛ to 1 inch in diameter, limonite concretions as much as 2 inches in diameter, subangular chert and granular quartz fragments ¼ to 2 inches in maximum dimension; with light- to moderate-brown silty-clay matrix; gravel commonly concentrated at surface.
Silurian	Lower and Middle Silurian	Crab Orchard Formation		11+		Dolomite and shale: Dolomite, light-olive-, greenish-, and light-gray; weathers moderate yellowish brown with dusky-yellowish-brown surface, fine- to medium-grained; beds 2 to 6 inches thick with flat to undulatory surfaces. Shale, interbedded with dolomite, greenish-gray to grayish-green; weathers light olive brown to light yellowish brown, thin-bedded and fissile; weathers to soft, plastic clay. Fossils rare.
Silurian	Lower Silurian	Brassfield Dolomite		7–10		Dolomite and shale: Dolomite, light-olive- to greenish-gray; weathers grayish orange to moderate yellowish brown with dark-yellowish-brown surface, fine- to medium-grained, in part composed of crinoidal debris; black petroliferous streaks and vugs containing petroleum common; beds 1 to 12 inches thick, bedding very irregular. Shale, greenish-gray, platy, occurs as partings between dolomite beds. Fossils, mostly crinoid stem fragments, common in upper 3 feet, rare elsewhere.
Ordovician	Upper Ordovician	Drakes Formation		130+		Dolomite, shale, and limestone: Dolomite, silty and argillaceous, greenish-, brownish-, and light-olive-gray commonly streaked and mottled; weathers light olive to yellowish gray, in part fine- to medium-grained; beds uneven, ½ to 8 inches thick, many contain vugs with petroleum; dolomite weathers to irregular blocks, relatively resistant, common in upper half of formation, rare in lower half; in part, greenish-gray, mottled or finely banded, in beds 4 to 8 inches thick; weathers to irregular fragments bounded by curved fractures; in part micrograined to fine-grained, light-olive- to greenish-gray, in even beds $\frac{1}{16}$ to ½ inch thick, resembling shale; weathers to plates and chips with planar surfaces. Shale, dolomitic, light-olive- to greenish-gray, in even beds $\frac{1}{16}$ to ½ inch thick; few beds near top. Shale grades into silty dolomite. Limestone, medium-dark- to medium-light-gray, fine-grained, rare thin beds. Fossils sparse, a few bryozoans and brachiopods in limestone and fine- to medium-grained dolomite.
Ordovician	Upper Ordovician	Ashlock Formation (125–135); Upper part (23–27); Reba Member		9–10		Limestone, dolomitic and silty, medium- to light-olive-gray, mottled with grayish-green, fine-grained; argillaceous streaks and calcite augen common; faint irregular bedding, beds 2 to 3 inches thick; weathers to blocks with curved surfaces. Fossils abundant, mostly brachiopods and bryozoans.
Ordovician	Upper Ordovician	Ashlock Formation; Upper part; Reba Member		5–6		Limestone, brownish- to olive-gray, commonly mottled with grayish-blue-green and dark-olive-gray; weathers light gray, micrograined to fine-grained; beds even, ½ to 8 inches thick, with shaly partings. Fossils rare.
Ordovician	Upper Ordovician	Ashlock Formation; Upper part; Terrill Member		8–11		Dolomite, silty, greenish-gray to light-olive-gray; weathers light olive gray to pale olive, micrograined; commonly in even beds $\frac{1}{16}$ to ½ inch thick that resemble shale; weathers to slabs and chips with planar surfaces; basal bed as much as 8 inches thick, weathers to irregular, curved pieces. Fossils absent.
Ordovician	Upper Ordovician	Ashlock Formation; Lower part (100–110); Stingy Creek Member		11–13	A	Limestone, silty and argillaceous, brownish- to olive-gray, commonly fine-grained, in part medium-grained; slightly uneven beds 3 to 24 inches thick, separated by sets of thin beds of very silty limestone; sets are 2 to 4 inches thick and nonresistant. Weathers to irregular pieces, silty beds weather to small fragments. Fossils abundant, mostly bryozoans and brachiopods, including *Platystrophia ponderosa* Foerste.
Ordovician	Upper Ordovician	Ashlock Formation; Lower part; Gilbert Member		16–18		Limestone, medium-dark- to medium-gray, micrograined to fine-grained; prominent bedding, beds 1 to 6 inches thick, with wavy, irregular surfaces and shaly partings between beds. Unit is relatively resistant. Fossils abundant, mostly brachiopods and bryozoans.
Ordovician	Upper Ordovician	Ashlock Formation; Lower part; Tate Member		40–45		Limestone, medium-dark- to light-gray and brownish-gray; weathers light to very light gray, fine- to medium-grained, very irregular texture; bedding obscure, beds 1 to 10 inches thick, wavy and uneven; weathers to rubbly appearance. Fossils abundant, mostly brachiopods and bryozoans.
Ordovician	Upper Ordovician	Ashlock Formation; Lower part; Tate Member		20–25		Dolomite, silty, light-olive- to greenish-gray; weathers greenish gray and grayish orange, micrograined; bedding even, beds $\frac{1}{16}$ to ½ inch thick, resembles shale; weathers to slabs and chips with planar surfaces. Grades into limestone above. Fossils absent.
Ordovician	Upper Ordovician	Ashlock Formation; Lower part; Tate Member; Back Bed		3–4	B	Limestone, medium-light- to brownish-gray, micrograined to fine-grained; beds slightly uneven, 2 to 12 inches thick. Fossils abundant, mostly bryozoans and brachiopods, commonly silicified, including *Hebertella sinuata* (Hall) and *Platystrophia ponderosa* Foerste.
Ordovician	Upper Ordovician	Ashlock Formation; Lower part; Tate Member		6–8		Dolomite, silty, light-olive- to greenish-gray; weathers greenish gray and grayish orange, micrograined; bedding even, beds $\frac{1}{16}$ to ½ inch thick, resembles shale; weathers to slabs and chips with planar surfaces. Fossils absent.
Ordovician	Upper Ordovician	Calloway Creek Limestone		90–105	C D	Limestone and shale: Limestone, medium-dark- to medium-light-gray; weathers light to moderate olive gray and brown, generally fine- to medium-grained, in part coarse-grained. Beds commonly 1 to 4 inches thick, rarely as much as 12 inches thick. Shale, calcareous, light-gray to light-olive-gray; present as partings between limestone beds; quantity decreases downwards from 30 percent near top to 10 percent near base of formation. Fossils abundant, mostly bryozoans and brachiopods, including the following: *Platystrophia ponderosa* Foerste, *Plectorthis plicatella* (Hall), *Strophomena planoconvexa* Hall, *Rafinesquina* sp., and *Zygospira* sp. Basal contact gradational, mapped at top of highest prominent siltstone bed.
Ordovician	Upper Ordovician	Garrard Siltstone		60–70		Siltstone, shale, and limestone: Siltstone, medium- to light-gray and light-olive- to greenish-gray, calcareous; weathers to dark- to light-brown and orange, porous friable siltstone. Characterized by lenticular beds, 6 to 18 inches thick, with bedding surfaces steeply dipping, curving, and discontinuous. Lenticular beds generally show fine internal laminae $\frac{1}{16}$ to ¼ inch thick that curve parallel to bedding surfaces. Other siltstone beds continuous, 2 to 6 inches thick. Shale, medium-light-gray to light-olive-gray; weathers to platy to blocky fragments the same colors as weathered siltstone. Shale envelops siltstone lenses and fills interstices; constitutes 10 to 30 percent of section. Limestone, medium-light-gray, coarse-grained, present as thin lenticular beds near top and base of formation. Fossils sparse in siltstone and shale, abundant in limestone, chiefly brachiopods. Lower contact gradational; mapped at base of rock that is more than 50 percent siltstone.
Ordovician	Middle and Upper Ordovician	Clays Ferry Formation		80+		Limestone and shale: Limestone, medium-dark- to light-gray and light-olive-gray, fine- to coarse-grained. Most fine-grained limestone is medium dark gray and uniform in texture; medium- to coarse-grained limestone is mottled light gray to olive gray, irregular in texture; contains abundant fossil debris. Weathered surfaces stained light brownish gray to light greenish gray. Beds 1 to 12 inches thick, commonly interbedded with shale. Thinner beds lenticular, thicker beds continuous. Shale, medium-gray and olive- to greenish-gray; weathers to plates, blocks, and irregular bits, commonly with light-gray chalky surfaces. Bedding generally thin and regular, in part irregular and obscure. Fossils abundant in limestone and in some shale beds. Exposed part of formation contains 60 to 80 percent limestone; base not exposed.

× Denotes bed from which fossil collections were made. Letter designates collection. Identification by R. B. Neuman



Base by U.S. Geological Survey, 1953

The Carter Coordinate System letters and numbers used to designate five-minute divisions of latitude and longitude are shown along the margins; tick marks indicate one-minute divisions

MAGNETIC NORTH
TRUE NORTH
APPROXIMATE MEAN DECLINATION, 1966

SCALE 1:24 000

1 MILE

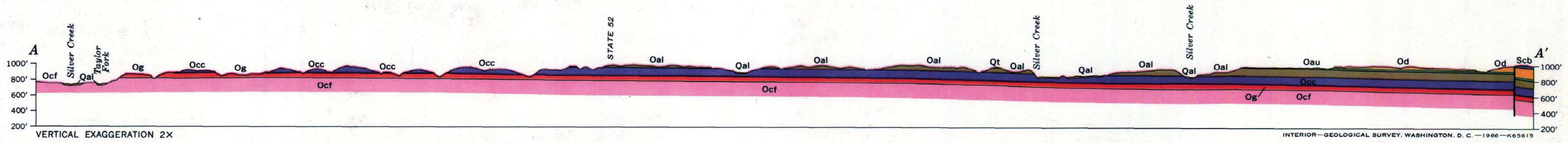
7000 FEET

1 KILOMETER

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

KENTUCKY
QUADRANGLE LOCATION

Geology mapped in 1962–63



VERTICAL EXAGGERATION 2×

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—1966

EXPLANATION

QUATERNARY

Qal — Alluvium

Qt — Terrace deposits and lag gravels

SILURIAN — *Lower and Middle Silurian*

Scb — Crab Orchard Formation and Brassfield Dolomite

ORDOVICIAN — *Upper Ordovician*

Od — Drakes Formation

Oau / Oal — Ashlock Formation
Oau, *upper part*
Oal, *lower part*

Occ — Calloway Creek Limestone

Og — Garrard Siltstone

Middle and Upper Ordovician

Ocf — Clays Ferry Formation

Contact
Dashed where approximately located; dotted where concealed

U / D
Fault
Dashed where approximately located; dotted where concealed. U, *upthrown side;* D, *downthrown side*

900
Structure contours
Drawn on base of Ashlock Formation. Long dashed where control less accurate. Short dashed where datum is above land surface. Hachures indicate closed basin. Contour interval 20 feet

Abandoned quarry

×A
Fossil collection
Letter designates USGS fossil collection number

USGS Fossil collection numbers
A, *USGS, 4195-CO*
B, *USGS, 4194-CO*
C, *USGS, 4197-CO*
D, *USGS, 4196-CO*

ECONOMIC GEOLOGY

Seven small abandoned quarries were located by the writer in the quadrangle. All are in the Ashlock Formation, two in the thin-bedded dolomite of the Tate Member and five in the limestone of the Stingy Creek and Gilbert Members. The largest quarry is in the city of Richmond near the north boundary of the quadrangle. Large quantities of limestone suitable for road metal, concrete aggregate, or agricultural stone occur in the Stingy Creek and Gilbert Members and the upper part of the Tate Member of the Ashlock Formation and in the Calloway Creek Limestone.

Ground water is plentiful in the quadrangle. The best water-producing horizon, as indicated by abundant springs, is the base of the Calloway Creek Limestone.

There has been little known exploration for oil and gas. A single exploratory well located just east of Dixie Highway and south of Hays Fork collared near the base of the Drakes Formation and penetrated the top of the Tyrone Limestone (Middle Ordovician) at 769 feet and the top of the Knox Dolomite (Upper Cambrian and Lower Ordovician) at 1475 feet (McGuire and Howell, 1963). The well was drilled 40 feet into the Knox Dolomite and abandoned.

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GEOLOGIC MAP OF THE RICHMOND SOUTH QUADRANGLE, MADISON COUNTY, KENTUCKY

By

Robert C. Greene

1966

FIGURE B-9
Geologic Map
Richmond South Quadrangle
Madison and Estill Counties, KY

ch2m

Price $1.00

B-3a(3) Floodplains

As a Federal Facility, the BGAD does not come under the National Flood Insurance Program. A flood plain map from the FEMA is enclosed displaying the facility (see Figure B-5). The OB and OD units are not located in a 100-year floodplain area.

B-4 Traffic Information [401 KAR 38:090 Section 2(10) & 40 CFR 270.14(b)(10)]

The information in this section describes the general traffic patterns and roads at BGAD and discusses the procedures used when transporting WMM onsite. Roadways within and near BGAD are shown on various figures, including Figure B-4.

The total average daily vehicular traffic into the BGAD facility is approximately 1,100 vehicles. This traffic includes the main security in gate and the secondary truck entrance. The majority of vehicles are passenger cars, but the traffic also includes jeeps, light trucks, and heavy trucks. The daily traffic through Gate R-1 (see Figure B-2), beyond which the hazardous waste management facilities are located, is approximately 400 vehicles per day – 350 passenger cars and other light vehicles (Government and Contractors) and 48 heavy trucks. This count is for a 24-hour period, from 0001 to 2400. Adding the guards, which pass through security on three shifts, the daily average total is 450 vehicles.

By design, only authorized vehicles are allowed to travel past the Gate R-1 security check point. Traffic volumes to and from the OB and OD/BD treatment units are generally very light (i.e., 10 vehicles per operating day). A straddle carrier typically is used to transport WMM from designated loading areas to the designated treatment unit. The maximum load of these vehicles is 32,000 pounds (lb). The waste volume moved per movement per vehicle varies depending on the operational requirements for the day, not to exceed the maximum load of 32,000 lb. Additional vehicles that may be used at the treatment units include rough terrain forklifts and bulldozers. Vehicles that may be used to transport personnel and/or miscellaneous equipment to and from the treatment units include standard military vehicles such as pickup trucks and vans. The maximum weight transported is defined by safety approvals, which place explosive limits on each site. The maximum carrying capacity based on safety limits is 7,000 lb Net Explosive Weight (NEW).

All roads on the facility are designed to handle a load-bearing capacity of 55,000 lb per single axle load. All bituminous concrete (BC) roads on the facility have approximately a 12-inch dense graded aggregate sub-base, a 4-6 inch BC base, and a 2- to 3-inch BC surface. All gravel roads on the facility are composed of number 6 to 10 size gravel base with an approximately 4-inch base. Paved highway roads provide access to BGAD.

Most roads within the developed portions of the reservation are paved with asphalt, and unimproved roads are routinely maintained. Conventional WMM is transported by the most direct route from the designated munitions igloo area (see Figure B-5) to the appropriate treatment units. All vehicles enter the Demo Grounds area through Gate R-3 on Route 10 and access the OB and OD/BD units from Route 110 and Route 117, respectively. Descriptions of these roads are provided in Table B-2. The roads leading to the OB and OD/BD units have been regularly traveled by various sized vehicles for more than 65 years and are regularly maintained.

Table B-2. Description of Roads Associated with Hazardous Waste Management at BGAD

Route	Class	Width (ft)	Surface	Condition
10	Primary B	18	asphalt	excellent
110	Primary F	12	asphalt	good
117	Primary F	12	asphalt	good

In general, the posted speed limit for BGAD is 20 miles per hour (mph) unless otherwise posted. All intersections at the facility are controlled with stop signs or yield signs. Both guarded and locked and posted gates maintain traffic control to the OB and OD/BD units. By design, all traffic to the OB and/or OD/BD units must have business directly relating to Demo Grounds activities. Through traffic is prohibited.

As stated in Part B-1b, BGAD does not routinely accept hazardous waste from offsite sources, but does seek to retain the capability to accept WMM from offsite defense installation sources in support of the nationwide JMC demilitarization mission. BGAD does not accept WMM for the purpose of disposal by OB, however. A discussion related to transport/receipt of WMM from offsite sources is included in Appendix B-1. Should conventional WMM be received from offsite sources, these would arrive by tractor trailer with appropriate U.S. Department of Transportation (DOT) placards and in compliance with DOT vehicle standards. Deliveries scheduled to arrive on the day of treatment would be received by BGAD at the truck entrance and would advance directly to the treatment unit once inspected by Mission Management personnel. Alternately, WMM would be placed into approved conventional munitions storage igloos prior to treatment and stored under the CE for WMM storage in accordance with the MMR as discussed in Appendix B-1.

B-5 Requirements for Applicants for Construction Permits [401 KAR 38:090 Section 2(18) & KRS 224.46 520(1)]

Not applicable. BGAD is not applying for a construction permit.

B-6 Past Compliance Record [401 KAR 38:090 Section 2(19) & KRS 224.46-520(1)]

Not applicable. BGAD is a Federal facility previously regulated under interim status and with an existing Part B permit.

B-7 Financial Responsibility to Construct and Operate [401 KAR 38:090 Section 2(24); KRS 224.40-325; 40 CFR 270.14(b)(18) & 40 CFR 264.150]

BGAD is a federal facility owned and operated by DoD and therefore is exempt from the requirement to demonstrate financial ability to operate the facility per 40 CFR 265.140(c) and 401 KAR 35:080, Section 2(3).

B-8 Public Participation [401 KAR 38:050 Section 14; 38:090, Section 2(25) & 40 CFR 270.42(c)]

This permit application has been developed in response to Notices of Deficiency (NOD 002) dated April 19, 2013 with official date of receipt of May 13, 2013 and comprises a Class 3 modification to an existing permit. The requirements for public participation, including pre-application meeting and public notice, will be met by BGAD.

B-9 Fees [401 KAR 39:120 & KRS 224.46-016 and 018]

BGAD is subject to the applicable fees at time of submittal of this application. Application and review fees for this renewal application are estimated as $23,660, assigned as follows: Part A Filing Fee, $1,000; Part A Review Fee, $3,700; Part B Filing Fee, $3,160; and Part B Review Fee, $15,800.

Appendix B-1
The Military Munitions Rule and its Application to Munition Management Procedures at Blue Grass Army Depot, Kentucky

This Appendix B-1 summarizes regulatory requirements related to the acceptance, management, transportation, storage, and treatment of waste conventional military munitions at Blue Grass Army Depot (BGAD), Richmond, Kentucky. This Appendix is based on the Federal, State, Department of Defense (DoD) and BGAD regulations, policies, permits, and standard operating procedures (SOPs) that are in place at the time of this writing.

1.0 General

The Military Munitions Rule (MMR) [40 Code of Federal Regulations (CFR) Subpar M and 401 KAR 36:080] defines WHEN used and unused munitions are a solid waste and provides requirements for the safe transport and storage of solid waste military munitions (WMM). The MMR defines special requirements for the management of WMM that differ from how other wastes are managed under the Resource Conservation and Recovery Act (RCRA) regulations that govern the management of hazardous waste. As a Federal regulation, it establishes a minimum standard for the management of WMM in the United States and U.S. Trust Territories. The MMR integrates the principles of environmental regulation, munitions management, and explosive safety into a regulatory scheme for the management of WMM. The rationale for the requirements of the rule are documented in the MMR as published in Federal Register/Vol.62, No.29/Wednesday, February 12, 1997/Rules and Regulations.

Under RCRA, the U.S. Environmental Protection Agency (EPA) may authorize a State or Territory, instead of the Federal government, to administer and enforce RCRA. While the regulations adopted by a State or Territory have to be at least as stringent as the Federal regulations, RCRA allows States and Territories to impose standards that are more stringent than those in the Federal program. The state of Kentucky has generally adopted the Federal language of the MMR at 401 KAR 36:080 with special exceptions pertaining to chemical agents that Kentucky has “listed” (i.e., GB, VX, and H). The definitions of “when” a military munitions is deemed a solid waste, the CE for transportation and standards applicable to emergency responses are consistent with the federal language. The CE for storage is also consistent with the federal language as it pertains to conventional military munitions. Other neighboring states, Alabama and Tennessee, have also adopted the Federal rule, including the CE for transportation.

Key elements of the MMR pertinent to BGAD operations are listed below:

- 40 CFR 266.202(a)(iii) - An unused military munition, or component thereof, that is being repaired, reused, recycled, reclaimed, disassembled, reconfigured, or otherwise subject to materials recovery activities, unless such activities involve *use constituting disposal* or *burning for energy recovery* (as defined by 40 CFR 261.2) is NOT a solid waste. Unused munitions and their components that are being processed for R3 are not considered waste and are not subject to RCRA. The disassembly or reconfiguration of military munitions to recover usable components or reconfigure the munitions to a usable state is considered reduce, reuse and recycle (R3) and not subject to RCRA. If the R3 process generates military munitions material that is “discarded,” then this discarded military munitions material is a solid waste (and may be a hazardous waste if it displays a hazardous waste characteristic or is a RCRA listed waste).
- 40 CFR 266.202(b)(2) - An unused military munition IS a solid waste when it is removed from storage in a military magazine or other storage area for the purpose of being disposed of, burned, or incinerated, or treated prior to disposal. This provision is also known as the “igloo door rule.” Military munitions in storage that have not already been “declared a waste” (i.e., assigned a specific code designating it as waste), become a waste when removed from storage for the purpose of disposal or treatment prior to disposal. This includes military munitions shipped to another installation for the purpose of disposal or treatment prior to disposal.
- 40 CFR 266.202(b)(3) - An unused military munition IS a solid waste when it is deteriorated or damaged (i.e., the integrity of the munition is compromised by cracks, leaks, or other damage) to

the point that it cannot be put into serviceable condition, and cannot reasonably be recycled or used for other purposes. The DoD's MMR implementation policies require that munitions custodians (at the installation level) conduct preliminary evaluation and reporting of the condition to the Item Manager or the inventory official and the Designated Disposition Authority (DDA), as appropriate. If the Item Manager or inventory management official determines that the munitions cannot be returned to serviceable condition or used for another purpose, they must coordinate this determination with and request disposition instructions from the appropriate DDA. DoD's policies are clear that most military munitions will not be considered WMM without a specific DoD DDA's or Component DDA's designation as such. The exception for unused munitions is when the unused munition is abandoned by being disposed of by burial, burned, detonated, incinerated, or treated prior to disposal.

- 40 CFR 266.202(b)(4) - An <u>unused</u> military munition <u>IS</u> a solid waste when it has been "declared a solid waste" by an authorized military official (AMO) or the DDA.
- 40 CFR 266.202(a)(1)(I and (ii) - Military munitions used for their intended purpose, including in training military personnel or explosives and munitions emergency response specialists (including training in proper destruction of unused propellant or other munitions) or in RDT&E of military munitions, weapons, or weapon systems, are not a solid waste.
- 40 CFR 266.205(a) - Conventional WMM in storage that exhibit a hazardous characteristic or are listed hazardous waste are NOT subject to regulation under 40 CFR Parts 260 through 279 as long as the WMM (1) are not chemical agents or chemical munitions, (2) are subject to the jurisdiction of the DDESB, (3) are stored in accordance with DDESB storage standards applicable to WMM, and (4) the following conditions are met:
  - BGAD must notify KDEP of the location of any waste storage unit used to store WMM for which the CE is claimed within 90 days of when a storage unit is first used to store WMM.
  - BGAD must notify KDEP within 24 hours of becoming aware of any loss or theft of WMM or failure to meet any CE condition that may endanger health or the environment, followed by a written notification within 5 days.
  - BGAD must inventory the WMM at least annually, inspect the WMM at least quarterly, and maintain records of the findings of these inventories and inspections for at least 3 years.
  - BGAD must limit access to the stored WMM to appropriately trained and authorized personnel.
- 40 CFR 266.203(a) – Conventional WMM that are being transported that exhibit a hazardous characteristic or are listed hazardous waste are NOT subject to regulation under 40 CFR 260 through 279 as long as the WMM (1) are not chemical agents or chemical munitions; (2) are transported in accordance with the DoD shipping controls applicable to the transport of military munitions; (3) are transported from a military owned or operated installation to a military owned or operated treatment, storage ,or disposal facility; (4) the transporter of the waste provides oral notice to KDE within 24 hours of becoming aware of any loss or theft of WMM or failure to meet any CE condition that may endanger health or the environment followed by written notice within 5 days; and (5) if BGAD does not receive the WMM within 45 days of the day of waste shipment, BGAD reports the non-receipt to KDEP within 5 days.

The explosives safety aspects of military munitions operations are governed by DoD 6055.09-M. Explosives safety is tantamount when managing military munitions. Military munitions, whether or not subject to the MMR, must be handled and stored responsibly to minimize the potential for harm to human health and the environment. DoD 6055.9-M, which establishes explosives safety standards, will govern military munitions. WMM within the DoD, must be managed per the MMR, DoD's munition rule implementation policies, and any applicable Federal, State, or local regulations. In the event such regulations conflict with DoD 6055.9-STD, DoD components are directed to follow DoD 6055.9-STD for purposes of explosive safety until the conflict is resolved (DoD, 1998).

2.0 BGAD Conventional Munitions Related Mission Operations

BGAD receives, stores, transports, evaluates, repairs, disassembles, reconfigures, reclaims, and recycles military munitions. Military munitions received by BGAD for these operations are NOT waste, but are useable products managed as such. By and large, military munitions operations at BGAD are not waste management activities under RCRA. The notable exception at BGAD is when military munitions are removed from product igloos for the express purpose of treatment at one of the installation's interim status or permitted conventional munitions treatment units (open burning [OB] unit, open detonation (OD)/buried detonation (BD) unit, or contained destruction chamber [CDC]). Munitions removed from a storage igloo for the purpose of treatment at these units are waste when they are removed (40 Code of Federal Regulations [CFR] 266.202(b)(2)).

Although it has not yet occurred, in order to support its nationwide munitions demilitarization mission, BGAD seeks to retain the ability to receive WMM from offsite defense sources. If the munitions have been declared a waste (i.e., they are not being sent to BGAD for evaluation, repair, disassembly, reconfiguration, or R3, but are determined to be waste and being shipped for the purpose of disposal), they must be managed as such from the point of generation (recognizing however the allowances offered by the CEs discussed later in this Appendix). The waste determination is the responsibility of the generating facility in coordination with the munitions Item Manager.

2.1 Storage of Conventional Hazardous Waste Military Munitions at BGAD

BGAD stores large quantities of conventional military munitions in its munitions storage igloos. Munitions in storage at BGAD are under the jurisdiction of the Department of Defense Explosives Safety Board (DDESB). Munitions in storage at BGAD are not waste, unless specifically declared as such.

Note that Kentucky has adopted the CE for storage offered under the MMR. CE storage is DoD's preferred alternative for storage of conventional WMM. In essence, the CE for storage of WMM allows WMM to be stored under DDESB storage standards in lieu of RCRA Subtitle C regulation as long as all CE conditions are met.

CE storage is not authorized for chemical agents or chemical munitions and is only available for conventional munitions. Storage units used for CE storage must meet DoD explosives storage standards and no waivers may be in place for the storage unit. There is no storage time limit when implementing CE storage, because, in effect, munitions in CE storage are not subject to RCRA Subtitle C regulation. To use the CE, BGAD would notify KDEP within 90 days of the date the unit was first used to store WMM under CE and to again notify KDEP when waste storage under CE is ended. Both munitions product and WMM may be stored together in one storage unit, as long as the WMM are physically separated (e.g., on a separate pallet or shelf) from non-WMM. Other requirements and management practices apply.

In addition to the CE and traditional RCRA storage, a new RCRA unit standard (Subpart EE) was promulgated as part of the MMR. BGAD does not currently utilize, nor does it plan to utilize Subpart EE storage.

For small quantity or short-term accumulation, BGAD may use satellite or less than 90-day accumulation areas for WMM. Where this is the case, both RCRA and explosives safety requirements must be met.

Kentucky has adopted the CE standards applicable to storage of WMM at 401 KAR 36:080, Section 6, which references 40 CFR 266.205(a) through (c) and (e) with the following exceptions:

- Waste military munitions that are chemical agents or chemical munitions and that exhibit a hazardous waste characteristic or are listed as hazardous waste under 401 KAR 31:040, Section 7 (*now Section 6*), shall be listed or identified as a hazardous waste and shall be subject to the applicable regulatory requirements of 401 KAR Chapter 30 through 38, including the storage prohibitions of 401 KAR 37:050.
- The citation to Subtitle C of RCRA in the federal regulation referenced in subsection (1) of this section shall be replaced with KRS 224.46.

The criteria for hazardous waste regulation of WMM that are not chemical agents or chemical munitions and are not listed as hazardous waste under 401 KAR 31:040, Section 7 in storage at 40 CFR 266.205 are as follows:

- Waste military munitions in storage that exhibit a hazardous waste characteristic or are listed as hazardous waste under 40 CFR Part 261, are listed or identified as a hazardous waste (and thus are subject to regulation under 40 CFR Parts 260 through 279), unless all the following conditions are met:
  - The waste military munitions may not be chemical agents or chemical munitions.
  - The waste military munitions must be subject to the jurisdiction of the Department of Defense Explosives Safety Board (DDESB).
  - The waste military munitions must be stored in accordance with the DDESB storage standards applicable to waste military munitions.
  - Within 90 days of August 12, 1997 or within 90 days of when a storage unit is first used to store waste military munitions, whichever is later, the owner or operator must notify the Director of the location of any waste storage unit used to store waste military munitions for which the CE is claimed.
  - The owner or operator must provide oral notice to the Director within 24 hours from the time the owner or operator becomes aware of any loss or theft of the waste military munitions, or any failure to meet a condition of the CE that may endanger health or the environment. In addition, a written submission describing the circumstances shall be provided within 5 days from the time the owner or operator becomes aware of any loss or theft of the waste military munitions or any failure to meet a condition of the CE.
  - The owner or operator must inventory the waste military munitions at least annually, must inspect the waste military munitions at least quarterly for compliance with the conditions of the CE, and must maintain records of the findings of these inventories and inspections for at least three years.
  - Access to the stored waste military munitions must be limited to appropriately trained and authorized personnel.
  - The owner or operator must notify the Director when a storage unit used to store WMM under the CE conditions will no longer be used to store waste military munitions.

The CE applies only so long as all of the conditions listed above are met. If any WMM loses its CE, an application may be filed with the Director for reinstatement of the CE from hazardous waste storage regulation with respect to such munition as soon as the munition is returned to compliance with the conditions of the CE. If the Director finds that reinstatement of the CE is appropriate based on factors such as the owner's or operator's provision of a satisfactory explanation of the circumstances of the violation, or a demonstration that the violations are not likely to recur, the Director may reinstate the CE. If the Director does not take action on the reinstatement application within 60 days after receipt of the application, then reinstatement shall be deemed granted, retroactive to the date of the application. However, the Director may terminate a CE reinstated by default if he or she finds that reinstatement is inappropriate based on factors such as the owner's or operator's failure to provide a satisfactory explanation of the circumstances of the violation, or failure to demonstrate that the violations are not likely to recur. In reinstating the CE, the Director may specify additional conditions to ensure and document proper storage to protect human health and the environment.

The DDESB storage standards applicable to WMM, referenced in the CE, are DOD 6055.9-STD (“DOD Ammunition and Explosive Safety Standards”), which became effective on November 8, 1995, except as provided in the following sentence: “Any amendments to the DDESB storage standards shall become effective for purposes of the CE on the date the Department of Defense publishes notice in the Federal Register that the DDESB standards referenced in the CE have been amended.”

2.2 Transportation of Conventional Hazardous Waste Military Munitions to/from BGAD

Offsite transport of unused military munitions that are solid waste (i.e., have been declared a solid waste by the DDA) and are hazardous (i.e., either exhibits a RCRA characteristic or is a RCRA listed waste), must be in accordance with RCRA hazardous waste transportation requirements, including the use of a RCRA hazardous waste manifest unless all states through which transport will occur have adopted the CE for transportation offered under the MMR. Note that Kentucky has adopted the CE for transportation offered under the MMR. CE transport is DoD’s preferred alternative for transportation of WMM, if available and applicable. To date, BGAD has not received or transported offsite munitions that have been declared WMM.

Kentucky has adopted the CE standards applicable to transportation of WMM at 401 KAR 36:080, Section 4, which references 40 CFR 266.203. The criteria for hazardous waste regulation of waste non-chemical military munitions in transportation at 40 CFR 266.203 are as follows:

- Waste military munitions that are being transported and that exhibit a hazardous waste characteristic or are listed as hazardous waste under 40 CFR part 261, are listed or identified as a hazardous waste (and thus are subject to regulation under 40 CFR parts 260 through 270), unless all the following conditions are met:
  - The waste military munitions are not chemical agents or chemical munitions;
  - The waste military munitions must be transported in accordance with the Department of Defense shipping controls applicable to the transport of military munitions;
  - The waste military munitions must be transported from a military owned or operated installation to a military owned or operated treatment, storage, or disposal facility; and
  - The transporter of the waste must provide oral notice to the Director within 24 hours from the time the transporter becomes aware of any loss or theft of the waste military munitions, or any failure to meet a condition of paragraph (a)(1) of this section that may endanger health or the environment. In addition, a written submission describing the circumstances shall be provided within 5 days from the time the transporter becomes aware of any loss or theft of the waste military munitions or any failure to meet a condition of paragraph (a)(1) of this section.
- If any waste military munitions shipped under paragraph (a)(1) of this section are not received by the receiving facility within 45 days of the day the waste was shipped, the owner or operator of the receiving facility must report this non-receipt to the Director within 5 days.

- The exemption in paragraph (a)(1) of this section from regulation as hazardous waste shall apply only to the transportation of non-chemical waste military munitions. It does not affect the regulatory status of waste military munitions as hazardous wastes with regard to storage, treatment or disposal.

The CE applies only so long as all of the conditions of the CE are met. If any waste military munition loses its exemption, an application may be filed with the Director for reinstatement of the exemption from hazardous waste transportation regulation with respect to such munition as soon as the munition is returned to compliance with the conditions of the CE. If the Director finds that reinstatement of the exemption is appropriate based on factors such as the transporter's provision of a satisfactory explanation of the circumstances of the violation, or a demonstration that the violations are not likely to recur, the Director may reinstate the exemption. If the Director does not take action on the reinstatement application within 60 days after receipt of the application, then reinstatement shall be deemed granted, retroactive to the date of the application. However, the Director may terminate a CE reinstated by default in the preceding sentence if the Director finds that reinstatement is inappropriate based on factors such as the transporter's failure to provide a satisfactory explanation of the circumstances of the violation, or failure to demonstrate that the violations are not likely to recur. In reinstating the exemption, the Director may specify additional conditions as are necessary to ensure and document proper transportation to protect human health and the environment.

Note that the Department of Defense shipping controls applicable to the transport of military munitions referenced in the CE are Government Bill of Lading (GBL) (GSA Standard Form 1109), requisition tracking form DD Form 1348, the Signature and Talley Record (DD Form 1907), Special Instructions for Motor Vehicle Drivers (DD Form 836), and the Motor Vehicle Inspection Report (DD Form 626) in effect on November 8, 1995, except as provided in the following sentence: “Any amendments to the Department of Defense shipping controls shall become effective for purposes of the CE on the date the Department of Defense publishes notice in the Federal Register that the shipping controls referenced in the CE have been amended.”

3.0 Statements of the Application of the Military Munitions Rule at BGAD

The following statements list various potential applications of the MMR at BGAD:

- Unused munitions are stored in conventional munitions igloos throughout BGAD. Unused munitions in storage and not otherwise declared a waste are product. Munitions storage is not a waste management activity.

- Unused munitions are removed from storage and transferred to maintenance facilities for <u>disassembly</u> (e.g., separate projectile and cartridge case and remove primer and propellant) and <u>repair</u> (e.g., new primer and propellant installed). Military munitions being repaired or disassembled are not solid waste and munitions disassembly and repair operations are not waste management activities. Potentially reusable military munitions components may be returned to storage for potential future use. Components that are removed for which there is no potential reuse or recycling opportunity are solid waste, and if hazardous, are managed as hazardous waste. One example is deteriorated propellant that is removed and replaced during projectile repair. The deteriorated propellant in this case is placed in RCRA-compliant storage (e.g., less than 90-day storage) prior to onsite disposal via OB.

- Unused munitions when, removed from storage for the purpose of treatment via OB, OD, or CDC are solid (and hazardous) waste when they are removed from the igloo door on the date of disposal (also known as the "igloo door rule"). The waste determination in this case is by definition and does not require a DDA or AMO designation.

- Unused munitions are at times removed from product igloos for purposes other than for the purpose of being disposed of, burned, or incinerated prior to disposal. For example, munitions may be removed from an igloo for reconfiguration, repacking, or for R3. At BGAD, unused munitions removed from igloo storage for reconfiguration, repacking, component separation, or other R3 processes that have not otherwise been declared a waste by an authorized military official or assigned Condition Code V are not waste; therefore, the act of component separation does not constitute waste treatment. Unused munitions transferred from one igloo to another for any reason remain within an accountable storage system. The intent to dispose is demonstrated only when the unused munitions are finally removed from storage for the purpose of disposal or treatment prior to disposal (i.e., when destined to the Demo Grounds for treatment by open burning or open detonation).
- Should BGAD have a need to store WMM in quantities or for periods of time for which satellite or less than 90-day accumulation do not suffice, BGAD intends to avail itself of the CE for storage offered under the MMR and adopted by Kentucky.
- BGAD Ammunition Maintenance and Demilitarization Division personnel who are trained in conventional munitions and explosives handling and destruction techniques are considered "explosive or munitions emergency response specialists." As such, BGAD Demilitarization personnel responding to an explosives or munitions emergency (i.e., a situation that presents an immediate threat to human health, public safety, property, or the environment from the known or suspected presence of military munitions, other explosive material or an explosive device) are not required to comply with RCRA standards during the conduct of the response.
- Should BGAD receive WMM from a military owned or operated installation for the purpose of treatment at its OD/BD or CDC unit, BGAD anticipates the use of the CE for transportation (therefore no manifest would be issued, but rather DoD shipping controls would be employed) and anticipates use of CE storage should temporary storage prior to disposal be required. All CE transportation and storage requirements would be met.

Appendix B-2
Alternative Technologies
Evaluation

1.0 Purpose

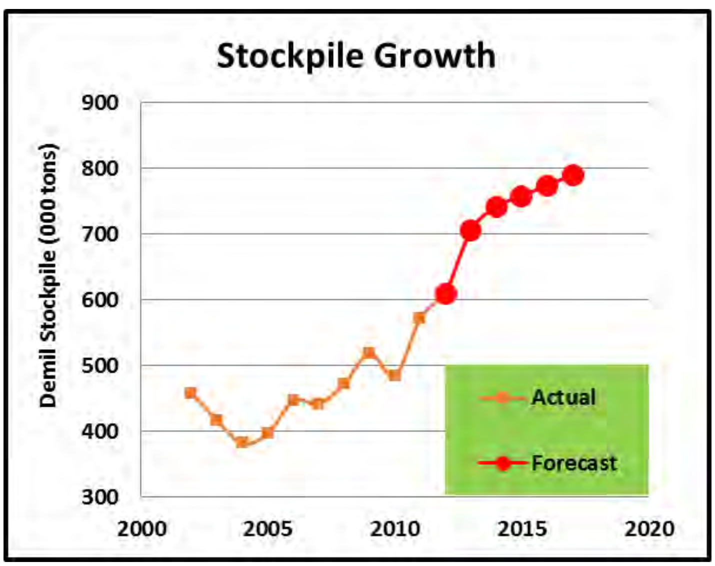
The purpose of this Appendix B-2 is to address the Kentucky Department for Environmental Protection (KDEP) Division of Waste Management (DWM) comments in Notice of Deficiency (NOD 2) issued April 19, 2013, to provide for an alternative technologies evaluation that justifies the use of open burning (OB) and open detonation/buried detonation (OD/BD) at Blue Grass Army Depot (BGAD) as the current chosen treatment technologies. The alternatives evaluation is preceded by an overview of the Department of Defense (DoD)'s Demilitarization program to provide program perspective.

2.0 Department of Defense Demilitarization Program Overview

The DoD has designated the Secretary of the Army as the Single Manager for Conventional Ammunition (SMCA). As the SMCA, the Army is responsible for funding and executing the DoD's conventional ammunitions requirements, including the demilitarization of conventional ammunition for all the Military Services. The SMCA has delegated authority to the Army's Product Manager Demilitarization (PM Demil) Office for strategic-level management for munitions demilitarization, including planning, budgeting, funding, and execution. Execution is accomplished through an extended matrix of resources that includes a diverse group of people, locations, and infrastructure to include the Joint Munitions Command and its 14 ammunition installations. PM Demil's four strategic goals include:

1. 1. Reduce the demilitarization stockpile by 6 percent annually.
2. 2. Continuously improve the efficiency and effectiveness of demilitarization capabilities within the Enterprise.
3. 3. Implement "Design for Demil" for all new and modified conventional ammunition products (i.e., design munitions with end-of-life-cycle management in mind).
4. 4. Implement closed disposal/resource, recovery, and recycling (R3) when economically viable.

Unfortunately, at current funding levels, the stockpile is only expected to grow.



Source: Demilitarization Program Overview, Industry Day, November 2012, Mr. Larry Gibbs, Product Manager Demilitarization

Ammunition products are transferred to the demilitarization stockpile (also known as the B5A account) when they are declared excess, obsolete, or defective by the military Services' Item Managers.

Alternatives considered before making a decision for demilitarization include (1) use of items to support training/testing, (2) offer of munitions from one DoD Service to another, (3) offer to other government agencies, (4) foreign military sales, and (5) free transfer to foreign militaries.

BGAD is one of the Joint Munitions Command (JMC)'s 14 ammunition installations located throughout the continental United States (CONUS). Half of these installations, BGAD included, are also operational sites where demilitarization execution is performed. In addition to the seven government-owned/government or contractor-operated depots (Crane, Indiana; Hawthorne, Nevada; McAlester, Oklahoma; Anniston, Alabama; Blue Grass, Kentucky; Letterkenny, Pennsylvania; and Tooele, Utah), the DoD utilizes commercial industrial resources such as the explosives destruction facilities currently operated by General Dynamics-Ordnance & Tactical Systems in Joplin, Missouri.

At the end of Fiscal Year (FY) 2012, the CONUS-based demilitarization stockpile was estimated at nearly 600,000 tons, funded at approximately $101 million per year with an annual execution of approximately 80,000 tons and an OB/OD to Resource, Recovery, and Recycling (R3) to incineration split of 19 percent-79 percent-2 percent, respectively.

An estimated 37 percent of this stockpile tonnage falls within 10 DoD Identification Codes (DODICS) while the remaining 63 percent falls within over 7,600 DODICs. The top 10 DODICs include:

- D563: 155 millimeter (mm) M483 Dual Purpose Improvised Conventional Munitions (DPICM)
- D533: 155mm Propelling Charge (M119)
- H104: M26 Multi Launch Rocket System (MLRS) DPICM Rocket Pod
- D864:155mm Extended Range DPICM
- D509: 155mm Remote Anti-armor Munition (FASCAM)
- D532: 155mm Propelling Charge (M203)
- B103: 30mm Cartridge Armor Piercing (Depleted Uranium)
- C520: 105mm Cartridge Target Practice (TP)
- D502: 155mm Projectile High Explosive (HE) (Area Denial Anti-personnel Mine (ADAM)
- B632: 60mm HE

The demilitarization stockpile is dynamic with DODICs leaving the system as workloads are completed and new DODICs entering the system as munitions and weapons systems become obsolete or reach the end of their shelf-life.

At the end of FY2012, BGAD stored an estimated 4.5 percent of the conventional munitions demilitarization stockpile. Crane, Hawthorne, and McAlester combined hold an estimated 80 percent, while Tooele, Letterkenny, and Anniston Army Depot hold the remaining 15.5 percent.

Munitions demilitarization via R3 is technically challenging, requiring the means to safely disassemble munitions items to remove reusable components, segregate recyclable components, and extract energetic fillers. R3 is a significant source of return to the DoD, primarily through cost savings of reusable components and scrap metal recycling sales following disassembly. Not all munitions items in the demilitarization inventory lend themselves to disassembly, however. Life cycle management principles now in place in the munitions manufacturing industry were not always present, resulting in munitions items without pre-planned strategies for final disposition. As always, safety is tantamount within the demilitarization community. Tragic accidents such as the explosion at the Ammonium Perchlorate reprocessing facility at Redstone Arsenal, Alabama in May 2010, which resulted in the deaths of two AMTEC employees, is a stark reminder of the inherent hazards associated with handling of energetic materials. Critical factors, including static charge, humidity, friction, spark, sympathetic and detonation, can have devastating effects when handling munitions and explosive materials. No matter the technologies, munitions and explosives that have deteriorated and become unstable do not lend themselves to R3 processes.

Because there is such a wide variety of ammunition assembled using a variety of methodologies with differing energetic fillers, the Demilitarization Enterprise has explored numerous technologies to address complete demilitarization of munitions items. In most cases, a munitions item must be subjected to a variety of processes to provide complete demilitarization including methods to disassemble the item and remove components and energetic fillers. Once disassembled, recovered metal components typically can be recycled. Some energetic fillers can be salvaged or processed for reuse while others must be treated/disposed. Although a variety of technologies have been evaluated to recycle energetic fillers into commercially usable products, very few have proven safe, effective, and viable. Technologies being explored or known to have been explored by DoD are listed below and presented in four categories: technologies for disassembly or removal of energetic components, technologies for reuse or recycling of energetic materials (e.g., versus their destruction), technologies for destruction, and technologies for treatment:

- Disassembly/Removal – Note that the following list is limited to technologies available for disassembly, size reduction, and/or providing access to energetic fillers. These are not treatment or disposal technologies, nor are they alternatives to OB and or OD/BD; therefore, they are not further addressed in this evaluation.
  - Abrasive Waterjet Cutting – used to cut through munitions bodies and explosives, as appropriate, to provide access to energetic fillers or reduce size
  - Robotic Disassembly – used in munitions-specific configurations to disassemble munitions components
  - Mechanical Disassembly – used to disassemble munitions components
  - Autoclave Melt-out of high explosives – following process to provide for an opening in munition body, munitions item is placed into an autoclave where heat/steam are introduced to melt cast explosives out of the munitions body
  - Hot-Water and/or High Pressure Washout of high explosives – following process to provide for an opening in munitions body, hot water and high pressure are introduced to wash explosives fillers out of the munitions body
  - Ultrasonic Fragmentation – directed ultrasonic used to fragment, remove, and separate energetic fillers from munitions bodies (not demonstrated at production levels)
- R3 of Energetic Materials
  - ArcTech Propellant Conversion to Fertilizer (PCF)
  - Reformulation to commercial use (a variety of blending, mixing, slurry processes to convert military energetic materials to commercial use)
  - Comp B, trinitrotoluene (TNT), HMX Recovery
  - Magnesium Recovery/Reuse
  - Ammonium Perchlorate Recovery
  - Red Phosphorous R3 Alternatives
  - White Phosphorous to Phosphoric Acid Conversion
  - Explosive D Conversion to Picric Acid
- Destruction
  - Explosive Waste Incinerator
  - Fluidized Bed Incinerator

- Static Kiln Incinerator
- Bulk Energetic Demilitarization System (i.e., rotary kiln incinerator)
- Confined Burn (of rocket motors)
- Explosive Destruction Technology (contained detonation/static detonation)
- Cartridge Actuated Device/Pressure Actuated Device (CAD/PAD) Chemical Hydrolysis
- Cryofracture Technology
- Plasma Arc Thermal Treatment

- Waste Stream Treatment
  - Molten Salt Oxidation (MSO)
  - Supercritical Water Oxidation (SCWO)

(Source: Innovative Approaches for Recycling Munitions Workshop, presented at ISRI Conference 19 April 2007, Demilitarization Enterprise Strategic Plan, June 15, 2009 and Environmental Impact of Munition and Propellant Disposal, TR-AVT-115, February 2010)

In addition, munitions or weapons-specific demilitarization capabilities have been or are being researched to include capabilities for the MLRS, Stinger, Javelin, Hellfire, M433, Hydra, Bradley reactive armor tiles and others (Demilitarization Enterprise Strategic Plan, 2009).

Unfortunately, funding for research and development within the demilitarization community has been significantly impacted by funding cuts. The limited available resources are being directed primarily at meeting mandated obligations (e.g., destruction of Intercontinental Missiles and Cluster Bomb Units) and improving the safety, efficiency, and effectiveness of current, proven demilitarization technologies. In addition, successful recycling of energetic fillers requires a consistent market for the reformulated material. Because of the stringent Military Specifications (MILSPECS) for military-grade explosives, reformulated energetics typically are suitable only for commercial applications. The recent example at Camp Minden, Louisiana, where a commercial enterprise (Explo Systems, Inc.) received millions of pounds of military propellant with the intent to reprocess for commercial use is a stark reminder that recyclable materials are only as valuable as the market will bear; an explosion at the site in October 2012 prompted investigations that uncovered in excess of 16 million pounds of improperly stored propellant. In the end, energetic materials that cannot be reused must be treated or disposed of as hazardous waste.

3.0 Alternative Technologies Evaluation

BGAD participates heavily in R3 programs, utilizing a variety of the aforementioned disassembly technologies to recover re-useable components during maintenance, repair, or demilitarization of munitions items (e.g., mechanical and robotic disassembly). In addition, BGAD previously participated in the recovery of Composition B from washout when the facility's washout facility was operational. BGAD also previously operated a pilot-project to demonstrate the effectiveness of MSO for treatment of propellant; however, the pilot plant was not proven effective and the facility was closed. BGAD additionally operates the D100 CDC, one of a handful of proven, explosive destruction technologies in the industry.

As part of the required response, KDEP has requested a discussion of available and viable alternative technologies to OB and OD/BD. As previously mentioned, OB and OD/BD at BGAD are reserved for those circumstances where viable reuse and R3 alternatives are not available (due to technology or safety limitations) or when maintenance, disassembly, demilitarization, or R3 have resulted in an unusable waste product. For example, where 105mm projectiles are repaired at BGAD, primers can be recovered for potential reuse, but propellant recovered during the repair operations is not reusable and must be managed and disposed of as hazardous waste.

Available, production-level, treatment/disposal technologies for munitions and explosives waste are further described below. Table 1, at the end of this Appendix, tabulates these viable technologies and assesses their applicability to BGAD operations. Unproven or conceptual technologies/designs or those proven only at pilot-scale are not addressed. As previously mentioned, BGAD already operates a D100 CDC. The D100 CDC was recently shown to be potentially viable for contained static burn of the M67 and J165 rocket motors. Enclosed detonation is a viable technology for a portion of BGAD's munitions waste stream. See Table 1 for an applicability assessment.

3.1 Enclosed Burning/Incineration (Subpart 0)

Explosive waste incinerators (i.e., thermal destruction in an enclosed device using controlled flame combustion) are available for thermal destruction of bulk energetic waste that would otherwise be subjected to OB and also for very low net explosive weight (NEW) items that pose the potential to detonate but not damage the equipment (e.g., small arms ammunition). For bulk energetic waste (e.g., uncased propellant), such incinerators typically use a grinder to reduce the waste to an appropriate size and/or a slurry-based process to feed energetic waste into the incinerator. Some energetic waste material cannot be disposed of through incineration because it is incompatible with the grinding or incineration process used. Examples of energetic material incompatible with the incineration process are water reactives, rubbery material that is not grindable, and overly sensitive or unstable energetic material. Fluidized bed incineration has also been demonstrated for use with propellants and explosives. Fluidized bed technology uses the thermal capacity of hot fluidizing sand to provide for uniform incineration. Research performed in support of this alternatives technology evaluation found no evidence of current use of fluidized bed incineration for production demilitarization at any location.

A rotary kiln incinerator/rotary kiln deactivation furnace is an incineration technology in use by the Army and also available in commercial designs. In fact, the Army's own version, the APE (Army Peculiar Equipment) 1236 Deactivation Furnace (a rotary kiln incinerator with a thick walled combustion chamber), was previously in operation at BGAD, but was mothballed when the unit was not selected for air pollution control upgrades required to meet air standards.

Explosive waste incinerators are in use within the Army and at commercial facilities. For example, an incinerator is present at Picattiny Arsenal, New Jersey. Two incinerators for the purpose of disposing of reactive waste are located at the commercial facility operated by General Dynamics Ordnance and Tactical Systems Munitions Services in Joplin, Missouri. One rotary kiln incinerator (main incinerator) is designed for the sole purpose of treating explosive devices, including configured munitions and bulk explosives. A car bottom furnace incinerator is used occasionally to treat large, unusual or irregular shaped meal pieces and energetic-contaminated solid wastes. Each incinerator has its own waste feeding system; however, exhaust gases from both incinerators are pulled into a shared secondary combustion chamber and air pollution control system.

Hawthorne Army Depot operates the Bulk Energetics Demilitarization System (BEDS). The HWAD BEDS plant consists of bulk slurry feed and handling systems, rotary kiln, combustion chamber, air pollution control equipment, and plant support systems for the destruction of propellant.

Explosive waste incineration is a viable technology that could be used for a portion of BGAD's munitions waste stream. See Table 1 for an applicability assessment.

3.2 Enclosed Burning (Subpart X) - Static Kiln and Thermal Treatment Units for Submunitions

Submunitions demilitarization has been a focus area for the Enterprise because of international treaty compliance obligations. In 2009, the State of Missouri issued a Class 3 Permit Modification to General Dynamics Ordnance and Tactical Systems Munitions Services (Joplin, Missouri) to allow for the installation of eight Subpart X Miscellaneous Treatment Units (four treatment chambers and two pairs of static kilns), specifically for demilitarization and treatment of M42/M46/M77 submunitions (grenade bodies and fuzes) from Class 1.1 D military munitions. The Static Kiln units consist of an electrically-heated vertically-arranged burn chamber into which munition components are fed and ignite upon proper heating. The treatment chambers (or Thermal Treatment Units) consist of a burn chamber and pilot/ignition flame used to ignite the explosives in a submunition or munition component. The process comprises four demilitarization lines able to process up to 500 pounds per hour per line. One air pollution control system pulls exhaust gases from the static kilns and two additional systems pull the exhaust gases from the chambers.

See Section 3.5 for additional information pertaining to thermal treatment of submunitions. See Table 1 for an applicability assessment.

3.3 Enclosed Burning (Subpart X) - Thermal Treatment Units for MLRS Rocket Motors

In addition to submunitions treatment units, Missouri additionally permitted the General Dynamics Ordnance and Tactical Systems Munitions Services (Joplin, Missouri) to install four Subpart X Miscellaneous Treatment Units, specifically for the demilitarization and treatment by enclosed burning of Class 1.3 D MLRS rocket motors. The process comprises two demilitarization lines that are able to process up to 1,005 pounds per hour per line. Two rocket motor saws cut the rocket motors into 8 to 10 segments. The segments are fed into one of two thermal treatment chambers where they are ignited and allowed to burn. One air pollution control system pulls the exhaust gases from the chambers.

Rocket motors of various sizes that are Class 1.3 explosives are a potential component of the BGAD munitions waste stream. Enclosed thermal treatment (i.e., burning) employing ignition other than controlled flame combustion is a viable technology for Class 1.3 rocket motors. The limiting factors for the technology are primarily the size of the rocket motor (not all rocket motors are amenable to resizing), associated heat produced during treatment, and the propellant composition, which dictates air emissions control requirements. Rocket motors that are Class 1.2 pose the potential to detonate and therefore are not typically amenable to enclosed burning unless the rocket motor propellant can be safely extracted from the rocket motor casing. See Table 1 for an applicability assessment.

3.4 Industrial Supercritical Water Oxidation (iSCWO)

The iSCWO system was previously evaluated by BGAD to reduce the dependency on OB. General Atomics is the systems contractor for the design, manufacturing, and implementation of the iSCWO system. SCWO takes advantage of the unique properties exhibited by water when used above its critical point, 705°F and 3210 pounds per square inch. The organic content of the waste feed is converted to carbon dioxide (CO_2), water (H_20), and salts with negligible production of carbon monoxide (CO), nitrogen oxide (NO_X), or sulfur oxide (SO_X). Feed is prepared for the iSCWO in a slurry-grind system, which mixes the solids with water while reducing the particle size prior to injection into the iSCWO system. The 10 gallons per minute iSCWO was proposed to process 1240 pounds per hour of typical propellant.

This water slurry is oxidized in the iSWCO by reaction with injected air at high pressure (greater than 3200 pounds per square inch gauge [psig]) and temperature (greater than 1200^0F). The reactor products (primarily liquid water) are condensed and filtered through a heavy metal removal system before release to the onsite wastewater treatment facility. This system includes a combination of filters and ion-exchange beds to remove particulate matter and suspended/dissolved metals. Non-condensables, including nitrogen (N_2), oxygen (O_2), CO_2, and water vapor are routed to a discharge vent that includes a continuous CO monitor to verify efficient oxidation of the wastes.

The iSCWO system, though designed to treat a broader spectrum of propellant types and categories, has not been proven for this use at a production level suitable for the Demilitarization Enterprise. A RCRA Subpart X permit application for this unit was submitted to KDEP's DWM in July 2007. BGAD and the DWM held several progress update meetings and discussions since the first application submittal. Unfortunately, deficiencies identified by KDEP could not be resolved within a suitable timeframe and funding for the iSCWO was lost. Deficiencies focused on the inability to provide detailed component and emission information for the system as the system was still in a design phase. Although the iSCWO system had already been approved by the Kentucky Division for Air Quality as an operational unit and registered as EU24 in the revised Title V air permit (Revision 2) issued in December 2007, BGAD has withdrawn its permit application for the iSCWO.

The SCWO technology is a viable treatment process for some waste feed streams. For example, SCWO has been successfully used to process TNT-contaminated wastewater from a TNT melt-out operation. The requirement for a liquid feed and the high cost of operation limits the suitability of the process to very specific items that can be safely converted and managed as a slurry and exist in bulk (to reduce costs). Though SCWO could potentially be used for some small fraction of BGAD's munitions waste stream, for the reasons identified above, the technology is not a viable treatment technology for the bulk of BGAD's munitions waste stream. See Table 1 for an applicability assessment.

3.5 Enclosed Burning (Subpart X) - Thermal Treatment Closed Disposal Process

Anniston Army Depot (ANAD) in Anniston, Alabama, currently conducts OB and OD/BD under RCRA Hazardous Waste Facility Permit Number AL3 210 020 027.

In addition to waste treatment, ANAD also operates facilities for recycling of specific munitions items. Of note is the Missile Recycling Center (MRC). The MRC provides for recycling of tactical missiles (previously the tube-launched, optically tracked, wire-guided missile and currently the MLRS). The recycling process for the tube launched optically tracked wire guided missile (TOW) consisted of removal of the missile from its fiberglass launch tube and further rendering down of the components including warheads, coupling assemblies, batteries, flight motors, propellants, explosives, copper lining and copper wiring. Non-recyclable, reusable components such as the waste propellants and explosives were disposed of by OB/OD/BD.

M77 Grenade

To further facilitate the current MLRS recycling process, a Thermal Treatment Closed Disposal Process (TTCDP) is planned at ANAD for disposal of M77 submunitions and fuzes downloaded from the MLRS. The TTCDP will have two separate thermal treatment processes for (1) treatment of energetics contained within fuze-less M77 grenade bodies and their copper cones, and (2) treatment of energetics contained within M77 fuze-assemblies. The TTCDP will be comprised of three major component systems: (1) a tunnel furnace, (2) a Munitions Destruction System (MDS), and (3) an off-gas treatment system. Movement of grenade components within the TTCDP will be provided by remotely operated conveyors. The TTCDP will be operated and monitored remotely from the TTCDP human-machine interface located in an onsite control room. The nominal process design capacity for the TTCDP is planned at 2,880 grenades per hour.

Within the tunnel furnace, ignition will be accomplished by an electrically heated coil that is moved into the grenade and touches the Comp A5 surface area. After ignition, the igniter will be moved away from the burning grenade into its home position. The copper cones will be decontaminated by the hot flame of the burning Comp A5 of the grenade underneath. Dynasafe's MDS is an indirectly heated destruction system originally designed for small arms ammunition that will be used to thermally treat the fuzes. The MDS is constructed of rugged, welded steel with three major sub-components: the feed hopper, the detonation chamber, and the dropout flap. The detonation chamber consists of a kiln case with internal fragmentation protection and venting, external lateral bearing construction, and integrated electric heating that is fully insulated.

The MDS or similar technology (i.e., an enclosed chamber that is suitably armored to withstand detonations of very small explosives items and provides sufficient temperatures and residence time to destroy the energetic compositions) is a potential option for a portion of BGAD's munitions waste stream. See Table 1 for an applicability assessment.

3.6 Enclosed Detonation (Subpart X) - Static Detonation Chamber

Currently in operation at ANAD, and has been constructed at BGAD in support of the chemical demilitarization program is Dynasafe's Static Detonation Chamber (SDC) technology. The SDC technology is uses indirect heating to destroy munitions and munitions components. Destruction is achieved by heating the energetic material above its auto initiation temperature which results in burning of the energetic material, deflagration or detonation. The size, shape, confinement and type of explosives determine the type of reaction. The most common reaction is burning and deflagration. The process also generates a significant amount of off-gas that is transferred to an off-gas treatment system. The SDC process is remotely controlled thereby minimizing material handling. The SDC is not currently in use for production level munitions disposal.

The SDC system at ANAD is designed to accept a maximum gross weight of up to 330 pounds including the feed tray. The explosive capacities for the SDC unit are:

- Up to 2.2 pounds of mass detonating material (TNT equivalent, NEW, such as confined Class 1.1 material) per feed cycle
- Up to 6.7 pounds of non-mass detonating material (TNT equivalent, NEW) per feed cycle

For the purposes of destruction in the SDC, most Class 1.1 materials that are not confined and Class 1.2 and Class 1.3 materials confined or unconfined are considered non-mass-detonating as they typically deflagrate in the SDC. Exceptions are the primary Class 1.1 explosives, which always mass detonate whether confined or not. The NEW of a munition represents the combined explosive weight of all energetics contained in a munition item or items. SDC technology is a potential option for a portion of BGAD's munitions waste stream. See Table 1 for an applicability assessment.

3.7 Tactical Rocket Motor Contained Burn System (Subpart X)

El Dorado Engineering, under contract to ECC, Inc., is currently constructing a confined burn facility for processing up to 10,000 rocket motors per year with pollution control and no downsizing at Letterkenny Army Depot, Oklahoma. The 18-foot by 118-foot chamber will be constructed of 1-inch armored steel on a concrete pad. A rocket motor will be ignited in the chamber with the gases captured and scrubbed. The remaining metallic salt is planned to be landfilled. The project is estimated at $32 million and testing is planned to begin in fall 2016.

With the exception of a limited number of air to ground missile (AGM) 130 rocket motors, BGAD does not anticipate the need to demilitarize rocket motors of the size and type for which the Letterkenny system was designed. See Table 1 for an applicability assessment.

3.8 Propellant Reformulation

Several processes have been studied and demonstrated to effectively reformulate military grade propellant for commercial uses such as commercial explosives and fertilizer. Of note is that only specific military energetic formulations will result in effective, efficient, and safe commercial explosives formulations. Unfortunately, the commercial value of reprocessed military propellants and explosives has failed to generate commercial interest. Facilities such as the Blasting Agent Manufacturing (BAM) facility at Hawthorne Army Deport, and the Slurry Explosion Module (SEM) and Energetics Processing Module (EPM) facilities at Anniston Army Depot further described below, have been shelved until such time that economic value can be derived.

None of the propellant reformulation technologies are currently considered sufficiently proven or viable for use at BGAD. Propellant formulation is therefore excluded from the assessment presented in Table 1.

3.8A Blasting Agent Manufacturing (BAM) Facility, Hawthorne Army Depot

The Hawthorne Army Depot in west central Nevada was selected for the demonstration of production–level capability to produce blasting agents for the mining industry from high content (i.e., greater than 60 percent) large grain gun propellants. The blasting agent was intended to compete with, complement, and/or supplement Ammonium Nitrate Fuel Oil formulations with higher detonation velocity, higher relative bulk strength, and water resistance. The BAM process at Hawthorne Army Depot is not currently in operation. The process was completed and the final safety review and hazards analysis performed. It was during this final review that it was determined that there was an unacceptable risk associated with the potential loss of propellant lot identity that could result when mixing different propellants into the various blasting agent slurry formulations. This risk, along with the problems associated with the fluctuations of the blasting agent mining markets (and subsequent risks arising from the need to stockpile downloaded propellant and the associated potential for speculative accumulation violations), led to the abandoning of the BAM process in 2010. Currently there are no plans to pursue the BAM process as a safe and viable alternative to OB at Hawthorne Army Depot.

3.8B Slurry Explosion Module (SEM) and Energetics Processing Module (EPM), Anniston Army Depot

Two major planned modules to the Missile Recycling Center at Anniston Army Depot included the SEM and EPM. The function of the SEM was to take the various grades of propellants retrieved from the defunct missiles and mix them together for commercial purposes. The EPM was to involve the same process, but with the different types of explosives used in the missiles. Primary limitations to SEM/EPM as an alternative to OB are capacity and formulations; therefore, the SEM and EPM modules have been shelved.

3.8C Propellant Conversion to Fertilizer (PCF)

This process involves chemically converting excess gun propellant into fertilizer using a proprietary a-HAX reagent. Water-wet propellant is reacted with 3 percent humic acid in aqueous solution (Actosol) and potassium hydroxide to denitrate the propellant. After denitration, nitrate and nitrite are incorporated into the humic acid molecular matrix by a chelation process. This results in the Actosol fertilizer product. Currently there are no PCF processes operating within the Demil Enterprise. The process is not an alternative to OB for propellants mainly because of a variety of technical challenges associated with bringing the prototype system to a Demil production readiness level. There were also concerns regarding the presence of bioaccumulative heavy metals discovered in the final fertilizer product that were suspected of being introduced to the process via the proprietary chemical reagent that was being used in the PCF process.

3.9 Caustic Hydrolysis of Aluminum-Bodied Munitions

Tooele Army Depot in Utah was selected for the demonstration of this destruction technology, which was designed to process munitions with aluminum bodies or possibly others that have an aluminum metal pathway to their energetics. The primary focus of the demonstration project is to focus on Cartridge Actuated Devices and Propellant Actuated Devices. Candidate munitions items are loaded into baskets that are then lowered into a Sodium Hydroxide bath, processed, and removed. The remaining tramp material is then flashed as an extra safety measure to ensure all energetics are gone.

The Caustic Hydrolysis process at Tooele is operational and has been used to process vast quantities of aluminum bodied CAD/PAD items within the Demil stockpile. However, these aluminum bodied items have almost been exhausted at Tooele Army Depot, resulting in the need for either identifying additional aluminum bodied stockpile items that are conducive to the caustic process, or pursuing an upgrade to the current process in order to accommodate a wider variety of non-aluminum stockpile items. Hence, the caustic process at Tooele Army Depot is currently a viable alternative for a limited array of aluminum bodied munitions items.

Caustic hydrolysis could potentially be employed for a small fraction of BGAD’s munitions waste stream. See Table 1 for an applicability assessment.

3.10 Cryofracture

Cryofracture involves cooling a munition in liquid nitrogen and fracturing its casing in a press, followed by the decontamination of the fragments by either incinerator or by an alternative system such as a neutralization reactor, followed by a supercritical water oxidation. Cryofracture technology has been developed and field tested by General Atomics, and proven successful for the destruction of small munitions items at Yuma Proving Ground and McAlester Army Ammunition Plant. The cryofracture technology could be similarly applied to a small fraction of BGAD’s waste stream, rendering munitions items safe for further treatment of the reactive characteristic.

Cryofracture itself is not an alternative to OB/OD, but is a component of a larger process to destroy munitions items, which are then treated to neutralize or drive off the energetic hazard. Cryofracture is typically used in conjunction with a deactivation furnace. Cryofracture is therefore excluded from the assessment presented in Table 1.

3.11 Mobile Plasma Treatment System

Crane Army Ammunition Activity in Indiana was selected for the demonstration of the Mobile Plasma Treatment System. This destruction technology can process smaller pyrotechnics, smokes and dyes, fuzes, small arms ammunitions, and small high explosive items (less than 0.35 pounds NEW Hazard Class 1.1). The principal focus of this technology is the use of a plasma arc torch to melt materials present in the crucible by employing high-temperature plasma, which is formed utilizing electrical energy supplied to the plasma torch, to ionize and heat a process gas to temperatures in excess of 12,000°F. Feed materials are melted by this high-temperature plasma and are contained in a stationary hearth that is connected to the bottom of the primary processing chamber. Inorganic materials collect in the hearth in a hot molten pool that is periodically tapped to form either a non-hazardous vitrified slag or recyclable metal. Effluent gases exiting the primary processing chamber are treated in a pollution abatement system prior to release to the environment.

The Mobile Plasma Treatment System at Crane Army Ammunition Activity is not operational. The project was officially canceled 2 years ago by the PM Demil Office because of a variety of technical challenges associated with trying to bring the prototype system up to a production readiness level of operation. As a result, the process was never formally permitted nor did it ever reach the Low Rate Initial Production testing milestone that is required before a prototype system can be transitioned to production Demil. Mobile plasma treatment is therefore excluded from the assessment presented in Table 1.

3.12 Enclosed Burning (Subpart X) Thermal Treatment of Propellant

Although not currently available within the demil Enterprise, enclosed thermal destruction by burning utilizing ignition other than controlled flame is a technology recently installed and currently in use at Camp Minden, Louisiana for the destruction of deteriorated and unstable, uncased propellant. The unit installed at Camp Minden was designed by El Dorado Engineering, Salt Lake City, Utah, and provides for a batch feed system and air pollution control system. The system efficiency and effectiveness of the air pollution controls are yet to be fully demonstrated. El Dorado Engineering offers various designs that are scalable.

Deteriorated, uncased propellant comprises a significant portion of the BGAD waste stream. An enclosed treatment system that includes minimal handling of propellant (i.e., eliminates the need for downsizing, grinding, preparation of slurries) and thus providing for a safe alternative for deteriorated or unstable propellant is a potential option for a significant portion of BGAD’s munitions waste stream. See Table 1 for an applicability assessment.

4.0 Summary

Table B-2-1 provides a summary of potentially viable alternative technologies to OB and OD/BD. The various technologies are grouped into categories where appropriate. This assessment evaluates the potential applicability of known, proven technologies to BGAD’s current munitions waste stream, provides commentary on potential regulatory issues, and recommends the most viable subset of technologies for further evaluation. This assessment indicates that alternative technologies to OB and OD/BD are available for at least a portion of BGAD’s current munitions waste stream. Because OB of uncased, deteriorated propellant makes up the most significant portion of BGAD’s current munitions waste stream, further assessment of enclosed burn technology (preferably eligible for permitting under Subpart X) is recommended as a priority. BGAD is currently conducting market research regarding the cost and capabilities of contained burn systems to reduce its reliance on OB. However, given the potential safety hazards associated with deteriorated and unstable propellant and limitations on technologies capable of withstanding detonations of significance, BGAD will continue to require OB and OD/BD capability into the foreseeable future. The D100 CDC provides the highest NEW detonation capability among the known contained detonation technologies. In consideration of the required donor charge, the D100 CDC is capable of detonation of munitions items up to approximately 20 pounds of NEW. This limits the chamber’s use for larger NEW cased munitions items and also severely limits production rates. Use of the chamber in an enclosed, static burning configuration has recently been demonstrated. Use of the CDC in the burn configuration may prove to be a more efficient use of this existing system. The SDC, currently being assembled at BGAD for use in the chemical demilitarization program, offers a viable alternative for a fraction of the BGAD OD/BD munitions waste stream and is recommended for conversion to conventional use when the chemical demilitarization program is complete. This was previously done at Anniston Army Depot. No currently known technology offers a viable alternative to the bulk of BGAD’s OD/BD munitions waste stream.

Table B-2-1. Alternatives Assessment

Technology	Variations	Applicability	Applicability to BGAD Munitions Waste Stream	Regulatory Assessment	Summary
Enclosed Burning/ Incineration using controlled flame (Subpart 0)	Slurry Feed (see Section 3.1)	Stable, uncased propellant	Potentially applicable to fraction (i.e., propellant known to be stable) of OB waste stream	Subpart 0 extremely challenging and costly to permit	Not recommended for further consideration
	Rotary Kiln/Deactivation Furnace (see Section 3.1)	Very small NEW munitions items (e.g., small arms ammunition, fuzes)	Applicable to <5% of OD/BD waste stream	Subpart 0 extremely challenging and costly to permit	Not recommended for further consideration
Enclosed Burning using alternate ignition source (Subpart X)	Static Kiln/Thermal Treatment of Submunitions (see Section 3.2)	Submunitions	Potentially applicable to a fraction of future BD workload	Potential future modification to Subpart X reasonable	Unique technology that is owned and operated by a private entity that provides demil services to DoD. The service is available to DoD at cost for munitions items that can be safely transported to the site.
	Enclosed Burning for MLRS (see Section 3.3)	MLRS	Potentially applicable to a fraction of OB waste stream	Potential future modification to Subpart X reasonable	Unique technology that is owned and operated by a private entity that provides demil services to DoD. The service is available to DoD at cost for munitions items that can be safely transported to the site.
	Batch or Continuous Feed (see Section 3.12	Stable and potentially also deteriorated, uncased propellant	Potentially applicable to significant fraction of OB waste stream	Potential future modification to Subpart X reasonable	Recommended for further consideration – high priority
	Tactical Rocket Motor Contained Burn System (see Section 3.7)	Large, Ammonium Perchlorate Rocket Motors	Potentially applicable to small fraction (i.e., AGM 130s) of OB waste stream	Only limited number of AGMs at BGAD better suited for Temporary Authorization Request	Not recommended for further consideration
	Thermal Treatment Closed Disposal Process (TTCDP) (see Section 3.5)	Submunitions	Potentially applicable to a fraction of future BD workload	Potential future modification to Subpart X reasonable	Unique technology unlikely to be funded at BGAD and therefore not recommended for further consideration

Table B-2-1. Alternatives Assessment

Technology	Variations	Applicability	Applicability to BGAD Munitions Waste Stream	Regulatory Assessment	Summary
	D100 Controlled Detonation (Destruction) Chamber in static burn configuration (see Section 3.6)	Some rocket motors	Applicable (based on recent study findings) to fraction of OB/BD waste stream	Potential future modification to Subpart X reasonable	Recommended for further consideration – high priority
Enclosed Detonation (Subpart X)	D100 Controlled Detonation (Destruction) Chamber (see Section 3.6)	Cased High Explosives up to ~ 20 lbs NEW Submunitions	Applicable	Potential future modification to Subpart X reasonable	Already installed
	Da Vinch (see Section 3.6)	Unknown	Unknown		Not recommended for further consideration
	Dynasafe Static Detonation Chamber (see Section 3.6)	Yes	Applicable to fraction of OD/BD waste stream	Potential future modification to Subpart X reasonable	Recommended for further consideration – conversion to conventional use at completion of chemical destruction – medium priority
	Dynasafe Munitions Destruction System (see Section 3.6)	Very small NEW munitions items (e.g., fuzes)	Applicable to small fraction	Potential future modification to Subpart X reasonable	Recommended for further consideration – low priority
Super Critical Water Oxidation	General Dynamics iSCWO (see Section 3.4)	Stable, uncased propellant that can be safely converted to a liquid feed	Potentially applicable to a small fraction	Prior attempt to permit failed	Not recommended for further consideration
Hydrolysis	(see Section 3.9)	Aluminum bodied cartridge/pressure actuated devices	Potentially applicable to small fraction	Potential future modification to Subpart X reasonable	Not recommended for further consideration

PART C. WASTE ANALYSIS PLAN [401 KAR 34:020 Section 4; 401 KAR 37; 401 KAR 38:090 Section 2(3); 40 CFR 264.13(b); 40 CFR 268 & 40 CFR 270.14(b)(3)]

Characterization of conventional WMM/energetic waste treated by OB and OD/BD and resulting treatment residues are addressed in this Part C of the permit application. The required Waste Analysis Plan (WAP) is included as Appendix C-1 to this Part. Wastes in containers are not stored at the OD/BD units. Treatment residue generated as a result of OB may be accumulated in containers (e.g., satellite accumulation) within a CONEX located at the OB unit. There are no waste tanks, waste piles, surface impoundments, incinerators, landfills, or land treatment units associated with the OB and OD/BD miscellaneous units at BGAD.

C-1 Introduction

BGAD conducts treatment by OB and OD/BD of conventional WMM/energetic waste generated on-site and requests the continued allowance to receive and treat conventional WMM by OD from off-site sources (as described in Part B-1 of this application).

Military munitions are defined in 40 CFR 260.10 as follows:

> *All ammunition products and components produced or used by or for DoD or the U.S. Armed Services for national defense and security, including military munitions under the control of DoD, the U.S. Coast Guard, U.S. Department of Energy (DOE), and National Guard personnel. The term includes confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries used by DoD components, including bulk explosives and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof.*

Munitions are hazardous materials because of their reactive fillers and other hazardous components. Unused (non-expended) munitions become a RCRA solid (and therefore a hazardous) waste when they are:

- Abandoned by being disposed of, burned, incinerated, or treated prior to disposal
- Removed from storage in a military magazine or other storage area for the purpose of being disposed of, burned, incinerated, or treated prior to disposal
- Deteriorated or damaged to the point that it cannot be put into serviceable condition, and cannot reasonably be recycled or used for other purposes
- Declared a solid waste by a DoD Designated Disposition Authority (DDA)

At the Demil Enterprise level the DDA determines when specific munitions items can no longer be used for their intended purpose and funds disposition in accordance with available R3 or disposal options. The majority of WMM treated by OB and OD/BD at BGAD require disposal because the military munitions item or component thereof, has exceeded its shelf life or is otherwise deteriorated and the DDA has determined that it cannot otherwise be reused or recycled. These military munitions typically become WMM when removed from the various conventional munitions storage igloos at BGAD. Appendix B-1 of Part B of this permit application provides additional information on how WMM are generated at BGAD.

The WMM treated by OB and OD/BD do not contain pesticides, herbicides, dioxins, or polychlorinated biphenyls (PCBs). BGAD does not treat WMM that contains flechettes, submunitions, white phosphorus, red phosphorous, colored smoke, HC (Hexachloroethane) smoke, riot control agents, chemical agents, biological agents, nuclear components or devices, or depleted uranium (DU) except that in the case of an emergency as determined by a an explosives or munitions emergency response specialist. In the case of such an emergency, whereby an otherwise prohibited item was destroyed at BGAD, KDEP Division of Waste Management would be notified within 24 hours.

Conventional WMM treated at the BGAD thermal treatment units are manufactured in accordance with military specifications and strict manufacturing requirements. The WMM are off-the-shelf items with well-defined physical and chemical characteristics. The availability of published documentation to support the characterization of the pre-treatment WMM makes direct representative sampling and analysis unnecessary. The Munitions Items Disposition Action System (MIDAS), developed and maintained by the U.S. Army Joint Munitions Command (JMC) in McAlester, Oklahoma, with programmatic support from Argonne National Laboratory, provides a central source of the most accurate information on the structure and composition data for conventional munitions. MIDAS supports demilitarization planning and environmental permitting and impact assessments. Access to MIDAS is restricted to protect national security interests. BGAD Ammunition Maintenance and Demilitarization Division planners have access to MIDAS and download munitions-specific MIDAS reports, as needed, to support planning and waste characterization. MIDAS Propellant, Explosives and Pyrotechnic (PEP) reports provide energetic composition information for assessing the applicability of waste codes. MIDAS PEP reports for the BGAD munitions waste stream will be made available to KDEP upon request.

Table C-1 lists common military munitions, propellants, and pyrotechnic wastes grouped into “families” based on common characteristics and examples of each. The list provides a cross-section of the types of wastes that may be generated at BGAD (or potentially received from off-site U.S. defense installations).

Table C-1 additionally provides the most appropriate treatment type based on family. The selection of an appropriate treatment method is based primarily on the (1) characteristics of the energetic filler contained in the military munitions waste stream (2) fragmentation potential of the casing and (3) NEW. OD/BD is appropriate for treatment of waste military munitions that have the potential to detonate or deflagrate when subjected to an initiating source and to fragment. OB is appropriate for treatment of waste military munitions designed burn readily when subjected to an initiating source. OB is not appropriate for waste military munitions that detonate, but may accommodate treatment of waste military munitions that deflagrate. OB is not appropriate for waste military munitions that fragment. As discussed in Part B of this permit application, the use of OB at BGAD is limited to the disposal of WMM for the prevention of fire hazards where no other alternative is available (401 KAR 63:005, Section 4). There currently is no alternative for OB at BGAD. Missions and operations requirements are additionally considered when selecting the appropriate treatment technology. Note that a subset of the munitions families listed in Table C-1 may also be treated using contained destruction in BGAD’s D100 CDC. Though the CDC is not addressed in this permit application, the information has been retained in Table C-1 for completeness.

Table C-1. Military Munitions Families

Munitions Family	Example Waste Items	Available Treatment Method
Pyrotechnics/Illumination/ Tracer	Includes a variety of ammunition used for illumination, marking, spotting, signaling, simulating or tracing	OD
High Explosive Components and Devices	Detonators, boosters, bursting charges not otherwise configured with an ammunition	OD or CDC
High Explosive Cartridges	Artillery or gun ammunition with HE projectile and a propelling charge such as 90 mm, 81 mm mortar, 30 mm fuzed and unfuzed cartridges	OD or CDC
High Explosive D	Ammunition containing Explosive D (also known as ammonium picrate or yellow D)	OD or CDC
Bulk High Explosive	TNT, pentaerythritol tetranitrate (PETN), cyclotetramethylenetetranitramine (HMX), RDX, Comp A, Comp B, Comp C-4, plastic bonded explosives (PBXs), Black Powder	OD or CDC
High Explosive Grenades	Hand or rifle grenades containing explosive fillers	OD or CDC
High Explosive Depth Charges and Underwater Munitions	High explosive marine depth charges and underwater mines	OD or CDC
High Explosive Cluster Bomb Units and Submunitions	Anti-tank mines, anti-personnel grenades or bomb loaded units, projectiles or warheads containing submunitions	OD or CDC
High Explosive Projectiles and Warheads	Projectiles, warheads, mortars or similar devices that do not have a cartridge case, propellant or rocket motor associated	OD or CDC
HE Rockets	Includes complete rounds of rocket ammunition containing warhead, fuze, and rocket motor.	OD or CDC
Demolition Material	Includes all demolition materials such as TNT, C-4, cratering charges, shaped charges, detonating cord, flexible sheet explosives, miscellaneous standard and non-standard items used as donor material, plastic caps, time fuze, det cord, etc.	OD or CDC
Land Mines	Includes all high explosive filled land mines including dispersing mines and dispersing devices	OD or CDC
Bulk Propellants	Includes all propellants in bulk form	OB
Propellant Charges and Increments	Includes packaged propelling charges and propelling increments	OB
Propellant Munitions Components	Rocket motors, cartridge actuated devices, propellant actuated devices, expelling charges, 20 mm or larger ammunition with inert (except may include tracers or incendiary mixes) or flechette projectiles, etc.	OB, OD or CDC
Small Arms Ammunition	Small caliber ammunition	OD
Fuzes	Fuzes – all types	OB, OD or CDC

In addition to WMM, BGAD may have occasion to generate small quantities of other energetic wastes associated with munitions activities but not defined as military munition or WMM. For example such energetic waste streams could include solid waste (e.g., gauze, q-tips, wipes, paper towels) determined to be contaminated with energetic materials to the extent that these pose a potential fire hazard when disposed in the solid waste stream. Other potential energetic wastes include metallic debris that, due to size or concentration of energetic material, cannot be processed through the flashing furnace. For example, during future decommissioning of the washout facility, portions of pipe that contain hidden high concentrations of explosives posing a potential explosive hazard could be safely disposed by BD or large metal equipment too large or unwieldy for the flashing furnace could be placed into a burn pan with propellant waste and “flashed”. Washout facility decommissioning could also result in dried, energetic sludge that could be used as donor or grossly contaminated carbon filters determined unsafe for off-site transport. BGAD requests through this application, the inclusion of energetic wastes such as these that are not specifically defined as WMM.

C-1a Waste Codes and Regulatory Basis for Waste Being Hazardous

The conventional WMM/energetic waste treated by OB and OD/BD at BGAD possess the RCRA hazardous characteristic of reactivity (D003) defined in 40 CFR 260.23.

In addition to the reactivity characteristic (D003), wastes treated by OB and OD/BD may also be classified as hazardous due to the characteristics of ignitability (D001), and/or certain toxicity characteristics including (D004 (Arsenic), D005 (Barium), D006 (Cadmium), D007 (Chromium), D008 (Lead), D010 (Selenium), D011 (Silver) and D030 (2,-4-Dinitrotoluene)). The OB waste stream typically displays only a subset of these toxicity characteristics including D008 and D030.

The conventional WMM/energetic waste treated at BGAD do not contain liquids. BGAD does not currently manage any listed wastes (EPA waste codes F, K, P, and U) at its OB and OD/BD units. While BGAD's energetic washout facility was in operation, BGAD routinely disposed or used as donor material, wastes determined to be listed as K044 and/or K045. The washout facility is no longer operational and there is no identified on-going need to treat these listed wastes. As previously stated, it is feasible that a future need could arise during closeout of the washout facility for example, for BGAD to treat by OB or OD/BD dried energetic sludge or grossly contaminated carbon filters. As these would not be produced as a result of a manufacturing process (BGAD does not manufacture munitions or explosives), these wastes would be characterized as D003 reactive waste.

The hazardous wastes managed at BGAD are identified by U.S. Environmental Protection Agency (EPA) Waste Codes on the RCRA Part A Application, Section 12 (Waste Stream Description), as revised. OB and OD/BD may treat wastes displaying the same or similar hazardous characteristics. The units are limited in capability from a physical rather than chemical standpoint. That is, OB is most appropriate for bulk propellant not contained in shells or casings and OD is most appropriate for high explosive that is contained in casings or shells. Therefore, the waste characteristic data presented in this section are applicable to both OB and OD/BD.

The hazardous characteristics and basis for hazard designation for each of these materials are listed in 401 KAR Chapter 31. This Part B permit application has been specifically developed to address treatment of WMM/energetic waste listed in the Part A Application, Section 11 (Process Description), as OB and OD with a process code of X01. The hazardous characteristics and basis for hazard designation for the BGAD waste stream treated by the thermal treatment processes are presented in Table C-2.

Table C-2. Hazardous Waste Codes, Characteristics, and Basis for Hazard Designation

EPA Hazardous Waste Code(s)	Hazardous Characteristic and Basis for Hazard Designation
D003 (R)	WMM/energetic waste displaying the characteristic of reactivity (explosives subcategory)
D003, D001 (R, I)	WMM/energetic waste displaying the characteristic of reactivity (explosives subcategory) and the characteristic of ignitability due to the presence of *flammable solids or oxidizers* contained in the energetic formulation
D003, D004 (R, E)	WMM/energetic waste displaying the characteristic of reactivity (explosives subcategory) and the characteristic of toxicity due to the presence of *arsenic* contained in the energetic formulation
D003, D005 (R,E)	WMM/energetic waste displaying the characteristic of reactivity (explosives subcategory) and the characteristic of toxicity due to the presence of *barium* contained in the energetic formulation
D003, D006 (R,E)	WMM/energetic waste displaying the characteristic of reactivity (explosives subcategory) and the characteristic of toxicity due to the presence of *cadmium* contained in the energetic formulation
D003, D007 (R,E)	WMM/energetic waste displaying the characteristic of reactivity (explosives subcategory) and the characteristic of toxicity due to the presence of *chromium* contained in the energetic formulation
D003, D008 (R,E)	WMM/energetic waste displaying the characteristic of reactivity (explosives subcategory) and the characteristic of toxicity due to the presence of *lead* contained in the energetic formulation
D003, D010 (R,E)	WMM/energetic waste displaying the characteristic of reactivity (explosives subcategory) and the characteristic of toxicity due to the presence of *selenium* contained in the energetic formulation

Table C-2. Hazardous Waste Codes, Characteristics, and Basis for Hazard Designation

EPA Hazardous Waste Code(s)	Hazardous Characteristic and Basis for Hazard Designation
D003, D011 (R,E)	WMM/energetic waste displaying the characteristic of reactivity (explosives subcategory) and the characteristic of toxicity due to the presence of *silver* contained in the energetic formulation
D003, D030 (R,E)	WMM/energetic waste displaying the characteristic of reactivity (explosives subcategory) and the characteristic of toxicity due to the presence of *2,4-dinitrotoluene* contained in the energetic formulation
D003, D001, D004, D005, D006, D007, D008, D010, D011, and/or D030 (R,E)	WMM/energetic waste displaying the characteristic of reactivity (explosives subcategory) and the characteristic of toxicity due to ignitability, corrosively, the presence certain metals , and /or 2,4-dinitrotoluene

R = Reactive, I = Ignitable, C = Corrosive, E = Toxicity Characteristic

C-1b Estimate of Amount of Waste Managed

Table C-3 provides the process design capacity expressed in terms of maximum per-event, daily, and annual treatment quantities for each unit, expressed in pounds NEW.

Table C-3. Process Design Capacities

Description	Quantity (lb NEW)
Open Burning	
Maximum per-event treatment quantity (determined as 2 pans at 2,500 lb NEW/pan)	5,000 lb NEW/event
Maximum daily treatment quantity (3 events per day)	15,000 lb NEW/day
Maximum annual treatment quantity	2,500,000 lb NEW/year
Open Detonation/Buried Detonation	
Maximum per-event treatment quantity	100 lb NEW/pit × 30 pits/event = 3,000 NEW lb/event
Maximum daily treatment quantity	3,000 lb NEW/event × 3 events/day = 9,000 lb NEW/day
Maximum annual treatment quantity	1,500,000 lb NEW/year

Table C-3 represents the treatment capacity sought by BGAD, determined to be necessary to support maximum DoD mission readiness and used in the air modeling and risk assessment that was prepared to support the Environmental Performance Standards demonstration for this permit application as required by RCRA Subpart X. *[The air modeling and risk assessment is presented in Volume II of this application].* Actual treatment quantities are dependent on the needs of the DoD, but at no time will the limits identified in Table C-3 be exceeded (with the exception of an emergency permit or Temporary Authorization Request).

The average OB treatment quantity for the 8-year period from 2007 – 2014 was approximately 980,000 lbs NEW with the peak occurring in 2012 at approximately 2,491,000 lbs NEW. The average OD/BD treatment quantity for the same 8-year period was approximately 433,000 lb NEW with the peak occurring in 2009 at approximately 860,000 lb NEW. In addition to the treatment quantity limitations identified in Table C-3, BGAD has instituted the following limits/restrictions to its munitions waste stream consistent with assumptions employed in the air modeling and risk assessment effort (presented in Volume II to this application):

- Maximum of 1,000 each Delay Assembly F/155MM HERA, National Stock Number 1320-01-054-5121 disposed by OD/BD annually. This item contains barium chromate. The self-imposed restriction is established to mitigate Chromium VI releases.

- Maximum of 1,400 lbs of lead or lead compounds in the energetic (i.e., Propellant, Explosive or Pyrotechnic) compounds (excluding inert materials) disposed by OD/BD on a 12-month rolling average basis.

C-1c Waste Composition

The DoD demilitarization stockpile (the stockpile of military munitions that are no longer useable by DoD) consists of thousands of single line items of military munitions of various types and sizes. The munitions types within the stockpile change constantly as weapons systems are retired or munitions types reach the end of their useful life. For this reason, it is essential to BGAD's continued DoD mission that it retain a permit that is not WMM-item specific, but that accommodates the range of potential munitions waste constituents. A list of munitions items treated by OB and OD/BD over the past three years is provided in Table C-4 to provide information regarding the general types of munitions that may be treated. The table should not be considered comprehensive.

Table C-4. Waste Military Munitions Treated by OB and OD/BD at BGAD (January 2013 – December 2015)

National Stock Number	Nomenclature
1390001512556	PRIMER PERC M28A2
DTYGTF$$$$	PROP M1
1315008251384	CHG PROP M67
1375013893854	CHG DEMO M112 W/TAGGANT
1315012379775	CHG PROP M67
1345000285106	BOOSTER AT MINE M120
1320009351922	CHG PROP 155MM GB M3A1
1345000285078	FUZE MINE M603
1345000285111	ACTIVATOR M1
1390001512556	PRIMER PERC M28A2
1320012028938	CHG PROP 155MM M203A1
1376014791067	TNT TYPE III (RECLAIMED)
1315001135912	CTG 105MM HE M1 W/PD FUZE
1315011588199	CTG 81MM HE M824 W/FUZE M734
1375009263985	CHG DEMO M183
1315010326127	CTG 105MM TPDS-T M724A1
1320010936856	CHG PROP 155MM M119A2
1375000285224	BLASTING CAP TYPE 2 ELECT J-2
1375001809356	CORD DETONATING
1370001982566	BLAST SIMULATOR ASSY
1345012454950	84MM C995 (AT-4)
1376008712829	PROP PWDR (PROP M1)
1375009263985	CHG DEMO M183
1315004986407	CTG 81MM HE M374A2 W/PD FUZE
1376007648041	HE MATL (COMP B)
1320008240811	SUPPL CHG
1375007249613	MILITARY DYNAMITE M1
1375006911671	IGN TIME BLASTING M60
XFL_Y3FCTD03	CTG 81MM PRAC SHORT RANGE M880 W/FUZE M775
1320010339394	CHG PROP 155MM M203

Table C-4. Waste Military Munitions Treated by OB and OD/BD at BGAD (January 2013 – December 2015)

National Stock Number	Nomenclature
M8JT0D$$$$	UNIT CHG ASSY
1375002839442	CAP BLASTING ELECT M6
1375014151235	IGN TIME BLASTING FUSE M81
1315009264069	CTG 105MM HE RAP M548
1375008892003	CAP BLASTING ELECT M6
1305000038803	CTG CAL .50 4 API M8/1 API-T M20
1305009352017	CTG CAL .50 4 API M8/1 TR M17 LNKD
1375007247040	CHG DEMO M112
1315009351992	CTG 81MM TP M43A1 W/PD FUZE
1315012167071	CTG 81 MM PRAC SHORT RANGE M880 W/FUZE M775
1320009351923	CHG PROP 155MM WB M4
1336014261572	FWD WHD PRECURSOR (FWP) ASSY
1376007648064	HE MATL (TNT)
1345007294263	MINE AT HEAVY M21
1325013239171	FUZE SYSTEM BOMB FMU-143B/B
1370007528060	FLARE SURF TRIP M49A1
1305013702594	CTG CAL .50 4 BALL M33/1 TR M17 LNKD M9
1336015278763	HELLFIRE 2 INSENSITIVE FWD WHD ASSY
G6HJCC$$$$	COMP C4
1310013625295	CTG 40MM HEDP M430A1
1376000069651	HE MATL (TNT)
1320014574063	CHG PROP 155MM MACS M232
1310015642160	CTG 40MM HE
1345003488646	MINE AT HEAVY M19 NON METALLIC
1345000285118	MINE AT HEAVY M15
1320014544603	CHG PROP 155MM MACS M231
1315005637067	CTG 81MM HE M374A3 W/PD FUZE
1320010476009	PROJ 155MM HE RAP M549A1
1320015266523	CHARGE PROPELLING M232A1 FOR 155MM HOW
1325011287220	FUZE SYSTEM BOMB
1336015320521	MAC WHD
1375000285168	CORD DETONATING
1375000285246	FUSE BLASTING TIME M700 4000FT
1315012379775	CHG PROP M67
1340011603075	PROP GRAIN MK90 MOD0
1340011603075	PROP GRAIN MK90 MOD0
1375000963095	DYNAMITE
1376006539816	HE MATL (COMP B)
1376006721067	HE MATL (TNT)
1376007721370	PROP PWDR (PROP IMR 4064)
1305012689373	CTG 30MM HEDP M789
1305014198202	CTG 7.62MM NATO SPEC BALL M118
1315012885545	CTG 120MM TPCSDS-T M865

Table C-4. Waste Military Munitions Treated by OB and OD/BD at BGAD (January 2013 – December 2015)

National Stock Number	Nomenclature
1315013696612	CTG 120MM TP-T M831A1
1315015504811	CTG 120MM M865
1320009351923	CHG PROP 155MM WB M4
1340009269301	FUZE RKT PROX M429
1345000285131	MINE APERS M16
1376010767268	HE MATL (TNT)

Due to national security interests, it is not appropriate to detail the specific chemical makeup of individual munitions items in a public document. Although the munitions types within the demilitarization stockpile number in the thousands, the reactive compounds contained within them are can be divided into three classes according to use:

- Propellants
- Explosives
- Pyrotechnics

The total weight of energetic materials contained within a military munitions item or munitions component is expressed as net explosive weight (NEW). NEW and not the gross weight, is used throughout this permit application to define the amount of explosives treated.

Explosives and propellants, when initiated, evolve large quantities of gas in a short time. The difference between explosives and propellants is the rate at which the reaction proceeds. For explosives, a fast reaction produces a very high pressure in the surrounding medium; this pressure is capable of significant destruction. In propellants, a slower reaction produces lower pressure over a longer period of time. This lower sustained pressure is used to propel objects. Pyrotechnics evolve large amounts of heat but much less gas than propellants or explosives.

Propellants cannot be distinguished from explosives by chemical composition alone or by chemical reaction rate, although propellants characteristically react (burn) at a rate that is much lower than the detonation rate of explosives. Propellants are characterized by the ability to be made to burn at reproducible, controllable, and predetermined rates. When confined to the breech and barrel of a gun, the evolved gases produce high pressures, which provide the propulsion for the projectile. Under certain conditions, however, propellants can be made to detonate, and conversely, explosives that characteristically detonate may simply burn if the proper conditions of confinement, dimensions, degree of consolidation, and other factors are chosen. Table C-5 provides information on the general chemical composition of typical energetics (propellants and explosives) that are present in military ordnance.

Propellants: Propellants can be grouped into five classes:

1. Single-base propellant compositions are used in cannons, small arms, and grenades. These compositions contain the propellant nitrocellulose as their chief ingredient. In addition to containing a stabilizer, they may also contain inorganic nitrates, nitro-compounds, and non-explosive materials such as metallic salts, metals, carbohydrates, and dyes.

2. Double-base propellant compositions are used in cannons, small arms, mortars, rockets, and jet propulsion units. This term generally applies to compositions containing both nitrocellulose and nitroglycerine. They can also be defined as a propellant containing nitrocellulose and a liquid organic nitrate that will gelatinize nitrocellulose. The presence of an active gelatinizer makes double-base propellants more energetic than single-base propellants. The ballistic potential is increased correspondingly. The flame temperature and resulting barrel erosion is also increased. Additives are

frequently used in addition to a stabilizer. Ballistite is a double-based propellant procured in the form of sheets, carpet-rolls, and grains used in various forms as the propellant in rocket motors and some guided missile boosters and sustainers.

3. Triple-base propellant compositions are used in cannon units. This term is applied to propellants containing three explosive ingredients, with nitroguanidine as the major ingredient and the other two usually nitroglycerine and nitrocellulose.

4. Mixed nitrate esters are a propellant composition developed to replace the triple-base composition during times of nitroguanidine shortages. As an example, the XM35 composition contains TMETN (1,1,1-trimethylolethane trinitrate), TEGDN (triethylene glycol dinitrate), and DEGN (diethylene glycol dinitrate). As another example, the XM34 composition contains nitrocellulose, BTTN (1,2,4-butanetriol trinitrate), TMETN, and TEGDN.

5. Composite propellants contain neither nitrocellulose nor an organic nitrate. They are usually a physical mixture of a fuel such as metallic aluminum, a binder (which is normally a synthetic rubber that is also a fuel), and an inorganic oxidizing agent, such as ammonium perchlorate. Composite propellants are used primarily in rocket assemblies and jet propellant propulsion units.

Table C-6 provides the formulations of common military propellants.

Explosives: Explosives are substances or mixtures capable by chemical reaction of producing gas at high temperature and pressure as to cause damage to the surroundings. Explosives can include high explosives, low explosives, propellants, igniters, primers, initiating, and pyrotechnic compositions. Fuel-air explosives, together with liquid fuels and oxidants, are included in this definition even though the individual substances may not be explosives.

Primary Explosives: Primary explosives are often used in ordnance items in small quantities to initiate an explosive reaction. Primary explosives are very sensitive and relatively easy to detonate by heat, impact, or friction. In large quantities, these materials are extremely hazardous because of their great sensitivity. Primary explosives can be used in combination with fuels and oxidizers in ordnance. The other ingredients are used to increase the sensitivity of the mixture to the desired property such as percussion or heat. These primary explosives are:

- Lead azide,
- Mercury fulminate*,
- DDNP (5, 7-dinitro-1,2,3-benzoxadiazole),
- Lead styphnate,
- Tetracene,
- KDNBF (potassium dinitrobenzofuroxane), and
- LMNR (lead mononitroresorcinate).

**Mercury fulminate is no longer used by the military because of poor stability. It is listed here because of its historical use and the fact that it may be contained in munitions found in the U.S. demilitarization account. BGAD treatment logs used to develop the list of chemicals of potential concern for the air modeling and resulting risk assessment did NOT include explosives containing mercury fulminate, neither are such explosives currently stored at BGAD for future treatment.*

Primary Compositions: Primary compositions are mixtures of primary explosives, fuels, oxidizers, and other ingredients used to initiate detonation in high explosive charges or to ignite propellants and pyrotechnics. Fuels commonly used in primary compositions are lead thiocyanate, antimony sulfide, and calcium silicide. Oxidizing agents include potassium chlorate and barium nitrate. Several other ingredients may include primary explosives and binders.

Secondary Explosives: The second element in the explosive train is the booster, which contains a larger quantity of less sensitive, but more powerful, material called a secondary high explosive. The booster is used either as an intermedial stage to detonate material that is too insensitive to be detonated by the relatively weak initiator or to ensure complete detonation of the main charge. The main charge is also a secondary explosive. It is the least sensitive material but comprises the bulk of the explosive charge. Secondary explosives can be divided into several classes that are less sensitive than primary explosives. These consist of aliphatic nitrate esters, nitramines, nitroaromatics, ammonium nitrate, binary mixtures, ternary mixtures, quaternary mixtures, plastic-bonded explosives, black powders, fuel-air explosives, pyrotechnics, and non-energetic constituents that are discussed in the following sections.

Aliphatic nitrate esters. There are several common compounds in this category. These compounds are prepared by attaching an oxygen atom to the compounds being nitrated.

- 1,2,4-butanetriol trinitrate is a good gelatinizer for nitrocellulose and can be used as a substitute for nitroglycerin in double-base propellants.
- Diethyleneglycol dinitrate can be used as an explosive and can be used in propellants as a colliding agent for nitrocellulose.
- Nitrocellulose is a mixture of nitrates obtained by nitrating cellulose. There are five recognized and used grades of nitrocellulose that include pyroxylin, pyrocellulose, guncotton, high nitrogen nitrocellulose, and blended nitrocellulose.
- Nitroglycerin is a clear, colorless, odorless, and oily liquid with a sweet, burning taste and a molecular weight of 227.1. Nitroglycerin is used extensively in propellant compositions as a gelatinizing agent for nitrocellulose, as well as in dynamites and for the shooting of oil wells.
- Nitrostarch is a mixture of nitrates obtained by nitrating starch. The structure of starch is the same as for nitrocellulose, with the exception that the polymer chains are spiral rather than straight. Nitrostarch has a wide variety of gelatinizing agents and is used in place of nitrocellulose in explosive compositions chiefly as a substitute for nitroglycerin.
- Pentaerythritol tetranitrate (PETN) is a white solid with a molecular weight of 316.2. PETN is used in the explosive core of industrial detonating fuses, in the charge of commercial blasting caps, and as the entire explosive charge in exploding bridge wire detonators. PETN is also used in certain plastic-bound explosives and in a mixture with TNT called pentolite.
- Triethylene glycoldinitrate (TEGN) is a light yellow, oily liquid with a molecular weight of 240.20. TEGN is used as a component in a liquid explosive, a plasticizer in the fabrication of flexible explosive sheets, and as a plasticizer in pyrotechnic flares.
- 1,1,1-Trimethylolethane trinitrate is a slightly turbid, viscous oil with a molecular weight of 255.15.

Nitramines. Compounds in this class include:

- Cyclotetramethylenetetranitramine (HMX),
- Cyclotrimethylenetrinitramine (RDX),
- Ethylenediamine dinitrate (EDDN),
- Ethylenedinitramine (Halite),
- Nitroguanidine (NQ), and
- 2,4,6-trinitrophenolmethlynitramine (Tetryl).

Nitroaromatic. Compounds in this class include:

- Ammonium picrate,
- 1,3-diamino-2,4,6-trinitrobenzene (DATB),
- 2,2’,4,4’,6,6’-hexanitroazobenzene (HNAB),
- Hexanitrostilbene (HNS),

- 1,3,5-triamino-2,4,6-trinitrobenzene (TATB), and
- 2,4,6-trtrinitrotoluene (TNT).

Ammonium Nitrate. Ammonium nitrate is in a crystal form with a molecular weight of 80.05.

Compositions: Compositions are explosives in which two or more explosive compounds are mixed to produce an explosive with suitable characteristics for a particular application. Normally the characteristics of the compositions are an intermediate between the characteristics of the individual explosive ingredients. Compositions can include binary mixtures, ternary mixtures, and quaternary mixtures.

Binary Mixtures.

- Amatols are mixtures of ammonium nitrate and TNT. Composition A consists of a series of formulations of RDX and desensitizer. Composition B consists of mixtures of RDX and TNT. Composition C contains about 88.3 percent RDX and 11.7 percent of a nonexplosive oily plasticizer. Composition CH-6 is an explosive mixture containing RDX, calcium stearate, graphite, and polyisobutylene. Composition CH-6 is primarily used for boosters and leads. Ednatols are mixtures of Haleite and TNT. Ednatols are used for the satisfactory bursting of charges in ammunition.
- Octols are mixtures of HMX and TNT. Octols are used as an oil well formation agent and in fragmentation and shaped charges.
- Pentolites are unstable explosive mixtures containing PETN and TNT.
- Picratol is a mixture of ammonium picrate and TNT.
- Tetrytols are mixtures of TNT and Tetryl. The United States no longer uses Tetrytols. Tetrytols are cast into munitions.
- Tritonal is a mixture of TNT and flaked aluminum. Tritonal is used as a filler in bombs and shells.

Ternary Mixtures.

- Amatex 20 consists of RDX and ammonium nitrate and is used as filler in ammunition items.
- Ammonals are mixtures containing, as principle ingredients, ammonium nitrate and powdered aluminum incorporated with high explosives such as TNT, DNT, and RDX. The major use of this composition is as a projectile filler.
- High blast explosives have three compositions: HBX-1, HBX-3, and H-6. HBX-1 and HBX-3 consist of RDX, TNT, aluminum, wax, and lecithin. The formulation of H-6 is the same except for the deletion of TNT.
- HMX, TNT, and aluminum mixture 3 (HTA-3) is cast as munitions.
- Minol-2 consists of TNT, ammonium nitrate, and aluminum and is used in four types of ordnance: underwater depth bombs, block buster bombs, concrete fragmentation bombs, and general-purpose bombs.
- Torpex consists of RDX, TNT, and aluminum powder and is cast into munitions.

Quaternary Mixtures.

- The depth bomb explosives (DBX) is the only explosive covered under this category and consists of TNT, RDX, ammonium nitrate, and aluminum. The DBX is a binary explosive. It is an unstable mixture consisting of 40 percent TNT, 21 percent RDX, 21 percent ammonium nitrate, and 18 percent powdered aluminum. It is normally cast at a density between 1.61 and 1.69 and is used as a bursting charge in depth charges.

Plastic-Bonded Explosives.

- Plastic-bonded explosives are explosive materials, such as RDX or ammonium perchlorate (AP), that are held together by various plastic bonding agents, including polystyrene, viton, rubber epoxies, and polyurethane. Explosives coated with plastic materials are also referred to as plastic-bonded explosives.

Black Powders.

- Black powders are explosive materials composed of a mixture of potassium nitrate or sodium nitrate and charcoal, and sulfur. The Navy uses black powder in the form of grains or granules of varying sizes and degrees of fineness depending on its specific purpose or function. There are two primary types of black powder: potassium nitrate-based black powder and sodium nitrate-based black powder.

Fuel-air Explosives.

- Fuel-air explosives (FAE) are liquids or slurries that exhibit explosive properties when mixed with air. The individual substances may not be explosives. By the nature of the role they are required to perform, fuel-air mixtures are sensitive to a range of thermal and electrical stimuli. Currently, two divisions of FAE are employed: ethylene oxide (EO) or propylene oxide (PO).

Pyrotechnics: Pyrotechnics compositions are substances or mixtures of substances which, when ignited, undergo an energetic chemical reaction at a controlled rate intended to produce, on demand and in various combinations, specific time delays or quantities of heat, noise, smoke, gas, light, or infrared to perform. Many pyrotechnic compositions are insensitive. However, some pyrotechnic compositions are relatively sensitive and can give rise to a rapid deflagration, which appears to be an explosion similar to that produced by a high explosive.

Pyrotechnics adapted to military purposes are divided into signaling, simulators, smoke screening, incendiary, and illuminating types. These classes are further subdivided into surface and aircraft pyrotechnics, although some items are common to both subdivisions.

Non-energetic Constituents: Energetic materials contained in munitions and explosives may contain both energetic and non-energetic compounds. The energetic compounds will consist of propellants, explosives, and pyrotechnics, such as those described above. The non-energetic compounds in energetic materials typically serve as binders and stabilizers. Examples of these additives are ethyl cellulose, graphite, carbon black, calcium carbonate, cellulose acetate, and charcoal.

Table C-5. Chemical Compositions of Typical Energetics

Constituent	CAS No.	Formula or Composition
Propellants[(a)]		
Nitrocellulose	9004-70-0	$C_{12}H_{14}(ONO_2)_6O_4$
Nitroglycerine	55-63-0	$C_3H_5N_3O_9$
Nitroguanidine	556-88-7	$CH_4N_4O_2$
Primary Explosives[(b)]		
2, 4, 6, 8, 10, 12-hexanitrohexaazaisowurtzitane (CL-20)	NA	NF
Lead azide	13424-46-9	N_6Pb (71% Pb)
Diazodinitrophenol (DDNP)	87-31-0	$C_6H_2N_4O_5$
Lead styphnate	15245-44-0	$C_6HN_3O_8Pb$ (44.2% Pb)
Tetracene	92-24-0	$C_{18}H_{12}$
Potassium dinitrobenzofuroxane (KDNBF)	NA	$C_6H_2N_4O_6K$
Lead mononitroresorcinate (LMNR)	NA	$C_6H_3NO_2Pb$ (57.5% Pb)

Table C-5. Chemical Compositions of Typical Energetics

Constituent	CAS No.	Formula or Composition
Fuels		
Lead thiocyanate	592-87-0	$Pb(SCN)_2$ (64% Pb)
Antimony sulfide	1315-04-4	Sb_2S_3
Calcium silicide	12013-55-7	$CaSi_2$
Hydrazine	302-01-2	H_4N_2
Monomethyl hyrazine (MMH)	60-34-4	CH_6N_2
1, 1-Dimethylhydrazine (UDMH)	57-14-7	$C_2H_8N_2$
2-Dimethylaminoethylazide	NA	NF
Oxidizers		
Ammonium nitrate (AN)	6484-52-2	$H_4N_2O_3$
Ammonium dinitramide (ADN)	NA	NF
Potassium chlorate	3811-04-9	$KClO_3$
Ammonium perchlorate	7790-98-9	NH_4ClO_4
Barium nitrate	10022-31-8	$Ba(NO_3)_2$
Calcium resinate	9007-13-0	$Ca\ (C_{44}H_{62}O_4)_2$
Strontium peroxide	1314-18-7	SrO_2
Barium peroxide	1304-29-6	BaO_2
Strontium nitrate	10042-76-9	$Sr(NO_3)_2$
Potassium perchlorate	7778-74-7	$KClO_4$
Nitric acid	7697-37-2	HNO_3
Nitrogen tetroxide (N_2O_4)	101022-44-0	N_2O_4
Hydrofluoric acid	7664-39-3	FH
Water	7732-18-5	H_2O
Plasticizer		
Dioctyl adipate (DOA)	103-23-1	$C_{22}H_{42}O_4$
Dioctyl phthalate (DOP)	117-81-7	$C_{24}H_{38}O_4$
Dioctyl sebacate (DOS)	122-62-3	$C_{26}H_{50}O_4$
Binder Polymer		
Hydroxy-terminated polybutadiene (HTPB, R45M)	69102-90-5	NF
Hydroxy-terminated polyether (HTPE)	NA	NF
Carboxyl-terminated polybutadiene (CTPB)	NA	NF
Ballistic/Stabilizer Additives		
Lead citrate	512-26-5	$C_{12}H_{10}O_{14}Pb_3$
Lead salicylate	NA	NF
Bismuth citrate	813-93-4	$C_6H_5BiO_7$
Bismuth salicylate	NA	NF
Zirconium carbide (ZrC)	12070-14-3	ZrC
Aluminum oxide (Al_2O_3)	1344-28-1	Al_2O_3
Carbon black	1333-86-4	C
N-methyl para nitroaniline (MNA)	100-15-2	$C_7H_8N_2O_2$
2-nitrodiphenylamine (2-NDPA)	119-75-5	$C_{12}H_{10}N_2O_2$
Lead oxide (Pb_3O_4)	1314-41-6	Pb_3O_4
Aluminum powder	7429-90-5	Al
Iron oxide	1309-37-1	Fe_2O_3
CATOCENE® (2,2-Bis Ethyl Ferrocenyl) Propane	69279-97-6	NF

Table C-5. Chemical Compositions of Typical Energetics

Constituent	CAS No.	Formula or Composition
Titanium oxide	12065-65-5	NF
Triphenyl bismuth (TPB)	603-33-8	$C_{18}H_{15}Bi$
Maleic anhydride	108-31-6	$C_4H_2O_3$
Hydantoin	461-72-3	$C_3H_4N_2O_2$
Binder Curative		
Desmodur isocyanates (N100 or N3200)	NA	NF
Isophorone diisocyanate (IPDI)	4098-71-9	$C_{12}H_{18}N_2O_2$
Aliphatic diisocyanate (DDI)	68239-06-5	$C_{38}H_{70}N_2O_2$
Booster and Secondary Explosives (High Explosives)		
Aliphatic Nitrate Esters		
1,2,4-Butanetriol trinitrate (BTN)	6659-60-5	$C_4H_7N_3O_9$
Diethylene glycol dinitrate (DEGDN)	693-21-0	$C_4H_8N_2O_7$
Nitroglycerine (NG)	55-63-0	$C_3H_5N_3O_9$
Nitrostarch (NS)	NA	$C_6H_{10}O_5NO_2$
Pentaerythritol tetranitrate (PETN)	78-11-5	$C_5H_8N_4O_{12}$
Triethylene glycol dinitrate (TEGDN)	111-22-8	$C_6H_{12}O_4N_2O_4$
1,1,1-Trimethylolethane trinitrate (TMETN)	3032-55-1	$C_5H_9O_9N_3$
Nitrocellulose (NC)	9004-70-0	$C_{12}H_{14}(ONO_2)_6O_4$
Nitramines		
Cyclotetramethylene tetranitramine (HMX)	2691-41-0	$C_4H_8N_8O_8$
Cyclotrimethylene-trinitramine (RDX)	121-82-4	$C_3H_6N_6O_6$
Ethylenediamine dinitrate (EEDN, Haleite)	505-70-5 (Haleite)	$C_2H_6N_4O_4$
Nitroguanidine (NQ)	556-88-7	$CH_4N_4O_2$
2,4,6-Trinitrophenylmethylnitramine (Tetryl)	479-45-8	$C_7H_5N_5O_8$
Ammonium picrate (Explosive D)	131-74-8	$C_6H_3N_3O_7H_3N$
1,3-Diamino-2,4,6-trinitrobenzene (DATB)	28930-29-2	$C_6H_4N_5O_6$
2,2'4,4'6,6'-Hexanitroazobenzene (HNAB)	19159-68-3	$C_{12}H_4N_8O_{12}$
Hexanitrostilbene (HNS)	20062-22-0	$C_{14}H_2N_6O_{12}$
1,3,5-Triamino-2,4,6-trinitrobenzene (TATB)	3058-38-6	$C_6H_6N_6O_6$
2,4,6-Trinitrotoluene (TNT)	118-96-7	$C_7H_5N_3O_6$
Ammonium nitrate	6484-52-2	$NH_4(NO_3)$
Binary Mixtures		
Amotols	NA	ammonium nitrate + TNT
Composition A	NA	RDX + desensitizer
Composition B	NA	RDX + TNT
Composition C	NA	RDX + plasticizer
Ednatols	NA	haleite + TNT
LX-14	NA	HMX-95.5 + estane 5702-F-1
Octols	NA	HMX + TNT
Pentolite	8066-33-9	PETN + TNT
Picratol	NA	[ammonium picrate (52%) + TNT (48%)]
Tetrytols	NA	TNT + tetryl

Table C-5. Chemical Compositions of Typical Energetics

Constituent	CAS No.	Formula or Composition
Ternary Mixtures		
Amatex 20	NA	[RDX (40%) + TNT (40%) + ammonium nitrate (20%)]
Ammonels	NA	NH_3 - NO_3 + Al + TNT, DNT a/o RDX
HBX	NA	(high blast explosives) TNT, RDX + Al
HTA-3	NA	HMX, TNT, AL - mixture 3
Minol-2	NA	TNT, ammonium nitrate + aluminum
Torpex	NA	[RDX (41.6%), TNT (39.7%), Al (18.0%) wax (0.7%)]
Quaternary Mixtures		
DBX	NA	[TNT (4%), RDX (21%), Ammonium Nitrate (21%), Al (18%)]
Plastic Bonded Explosives (PBX)		
Basic explosive [RDX, HMX, HNT, or PETN + polymeric binder (polyester, polyurethane, nylon polystyrene, rubbers, nitrocellulose, Teflon)]		

CAS No. – Chemical Abstracts System Number
NA – Not applicable
NF – Not found

(a) These three primary constituents can be used separately or in various combinations along with metals, metallic salts, and organic polymer binders.

(b) Primary composition includes a mixture of primary explosives, fuels, oxidizers, and binders (e.g., paraffin wax).

Table C-6. Common Military Propellant Compositions

Propellant Model Designation Component	M1	M2	M5	M6	M7	M8	M9	M10	M12	M13	M14
Nitrocellulose	85.0	77.45	81.95	87.0	54.6	52.15	57.75	98.00	97.70	57.30	90.00
Nitroglycerin		19.50	15.00		35.5	43.00	40.00			40.00	
Nitroguanidine											
Dinitrotoluene	10.0			10.0							8.00
Dibutylphthalate	5.0			3.0							2.00
Diethylphthalate						3.00					
Diphenylamine	1.0[a]			1.0[a]				1.0	0.80		1.00[a]
Ethyl Centralite		0.60	0.60		0.9	0.60	0.75			1.00	
Barium Nitrate		1.40	1.40								
Potassium Nitrate		0.75	0.75			1.25	1.50				
Potassium Perchlorate					7.8						
Lead Carbonate	1.0[b]										
Potassium Sulfate	1.0[b]			1.0[a]				1.0	0.75	1.50	
Tin									0.75		
Carbon Black					1.2					0.05[a]	
Graphite		0.30	0.30					0.10			
Cryolite											
	M15	**M17**	**M18**	**M26**	**M26E1**	**M30**	**M30A1**	**M30A2**	**M31**	**M31A1**	**IMR**
Nitrocellulose	20.00	22.00	80.00	67.25	68.70	28.00	28.00	27.00	20.00	20.00	100.00
Nitroglycerine	19.00	21.50	10.00	25.00	25.00	22.50	22.50	22.50	19.00	19.00	
Nitroguanidine	54.70	54.70				47.70	47.00	46.25	54.70	54.00	
Dinitrotoluene											8.00
Dibutylphthalate			9.00						4.50	4.5	
Ethyl Centralite	6.00	1.50		6.00	6.00	1.50	1.50	1.5			
Barium Nitrate				0.75							
Potassium Nitrate				0.70				2.75			
Lead Stearate											
2-Dinitrodiphenyldiamine									1.50		
Potassium Sulfate							1.00			1.5	1.00[a]
Graphite		0.10		0.30	0.30	0.10					
Cryolite	0.30	0.30				0.30			0.30		
2-Dinitrophenyldiamine									1.50		

[a] Added basis

[b] When specified, added basis

The information contained in this chart is an approximation only. Specific information regarding percentages and tolerances of components should be obtained from appropriate specifications and standards.

In addition, these sources may provide information about perforation and web thickness applicable to a particular weapon or round of ammunition.

Numbers within chart are percentages by weight.

When these munitions are treated, various combustion and detonation products are formed. These combustion products are no longer reactive but may result in some impact to environmental media. Due to the nature of the treatment process, the primary products of thermal treatment are gaseous. Part D and the accompanying air modeling and risk assessment (presented in Volume II to this permit application) provide a detailed analysis of the environmental effects of the wastes treated at the OB and OD/BD units.

C-1d Treatment Residues

The violent nature of OD treatment allows for complete destruction of the energetic materials, leaving munitions-related scrap metal debris (i.e., metal fragments and components) as the only remaining visible treatment residue from OD. The process for visual inspection of scrap metal debris recovered from a military range is described in Department of Defense Instruction (DoDI) 4140.62 and is intended to ensure its safe handling from an explosives safety standpoint. Consistent with DoD management practices, BGAD manages scrap metal debris collected from the OD unit, first as Material Potentially Presenting an Explosive Hazard (MPPEH), conducting the visual inspection described in DoD Instruction (DoDI) 4140.62 (and further described in the following paragraph) to make a determination as to whether or not the material is safe from an explosives standpoint (i.e., Material Documented As Safe). Once determined safe, the metallic debris is collected, containerized and managed as scrap metal. If the metallic debris is determined through visual inspection by qualified personnel to contain residual energetic material, it is determined to be potentially explosive (Material Documented as an Explosives Hazard) and is managed according to BGAD's low order/UXO procedures described in Part D of this permit application and re-treated with the next scheduled shot. Potential releases to the soil in the form of chemical constituents not visible to operators is discussed in Part E of the permit application.

OD operators responsible for picking up and inspecting munitions-related scrap metal wear leather gloves and do not directly contact the scrap metal. In accordance with DoDI 4140.62, munitions-related scrap metal debris collected at the OD unit undergoes a 100% visual inspection by qualified Ammunition Maintenance and Demilitarization Division personnel (i.e., a visual inspection of each individual piece) before placing it in a collection bin at the OD unit. Though not specifically required by the DoDI, munitions-related scrap metal debris collected from the OD unit at BGAD is subsequently flashed at the BGAD flashing furnace. It is then certified as free of explosive hazard (i.e., a visual inspection of a sampling of the scrap metal debris) by two qualified personnel by signature on a DA Form 1348-1. This scrap metal debris is then removed to the MWR QRP yard on BGAD. Scrap metal debris managed at the QRP is moved mechanically and would not typically be handled. Personnel working in the QRP yard also wear leather gloves in the rare circumstance that they would physically handle scrap metal. Munitions-related scrap metal is transferred off-site for recycling. Scrap metal that is recycled is not a solid waste and not subject to Subtitle C controls.

OB treatment generally results in propellant ash in the pan (and potentially some small quantity expelled from the pan during the burn); remnants/ash from burned time fuzes on portions of the concrete pad; and expended igniters around the pan (shown in photo).

Treatment residue around the pan is cleaned up when the pan has reached a temperature that it can be safely approached by personnel at the end of each operating day. If sufficiently cooled, the ash in the pan is also removed at this time. If the pan remains too hot for personnel approach, the area around the pans is cleaned to the extent it can be done safely and the pan lids are placed on the pans using a fork lift. Ash from inside the pan is then removed prior to the next burn event. Waste profiles from historical sampling indicate that ash generated from burning of propellant (i.e., in the pan) typically contains lead and potentially in concentrations sufficient to be determined to be D008 waste. Analysis of OB ash is further discussed in Part C-3d and Table C-1-2. The analyses include select metals and explosives, and may include other parameters as determined by BGAD. Method 8330 explosives analyses include 2,4-Dinitrotoluene for determining the applicability of the D030 waste code.

Expended igniters can be hazardous waste. The waste characteristics for expended igniters is based on MIDAS and user knowledge. Expended igniters are collected and managed in accordance with the waste characterization. The M700 time fuze in use at BGAD are comprised of a plastic outer cover and contain black powder. Black powder is comprised of potassium nitrate (~70%), charcoal (~16%) and sulfur (~13%). The ash from expended M700 time fuzes is not hazardous but because of the potential for propellant ash to be expelled from the pan, all ash removed from around the pan is collected together and managed as hazardous waste (D008 or based on analysis).

Treatment residue is collected in appropriately sized-U.S. Department of Transportation (DOT) approved containers, removed from the OB unit and managed according to waste characteristics.

OB pans are closed with lids when not in use and are closed with lids as soon as these can be safely approached with the fork lift at the end of the operating day. Lids mitigate the accumulation of precipitation. In the event that precipitation should accumulate in pans to the extent that it interferes with operation, the precipitation would be removed from the pans into DOT approved containers when the ash is removed.

The design of the OB units incorporates a sediment catchment system as described in Part D. The system includes a filter basket that is routinely inspected in accordance with the General Inspection Schedule for the OB and OD/BD Units (Part F, Table F-2). When determined necessary, the filter basket is cleaned and sediment collected into DOT approved containers for waste determination and disposal.

Treatment residue containers are removed to satellite accumulation located within a CONEX box in the vicinity of the OB unit, to a 90-day accumulation area, or directly to igloos B402 or B404 for sampling and pending laboratory analysis (or application of user knowledge where sufficient data have been collected). Treatment residues from OB and OD/BD are managed in accordance with Module II of BGAD's conventional munitions storage permit application and disposed of off-site at properly permitted hazardous or solid waste disposal facilities.

C-2 Waste Characterization [401 KAR 34:020 Section 4; 38:090 Section 2(2); 40 CFR 264.13 & 270.14(b)(2)]

Appendix B-1 of Part B of this permit application describes the circumstances under which munitions stored at BGAD may become WMM.

C-2c Waste Generated Off-Site [401 KAR 38:090 Section 2(3); 34:020 Section 4 & 40 CFR 264.13(c)]

BGAD requests, through this application, the continued allowance to accept conventional WMM from off-site U.S. defense sources. To-date, BGAD has not received WMM from off-site, but requires the capability in order to support its national defense mission as described in Part B-1. WMM from off-site sources would display the same characteristics and contain the same constituents described for on-site generated WMM. This Part C of the permit application addresses characterization of conventional WMM generated on-site and that could be received from off-site sources.

C-2d Additional Requirements for Facilities Handling Ignitable, Reactive, or Incompatible Waste [401 KAR 34:020 Section 4; 40 CFR 264.13(b)(6) & 264.17]

Personnel at BGAD are committed to managing hazardous waste in a safe and efficient manner. Personnel are aware of and familiar with the additional requirements for handling ignitable, reactive, or incompatible wastes. Additionally, all personnel are fully aware of the hazards associated with the wastes and the physical/chemical characteristics. Chemical composition and associated characteristics of all wastes stored and treated at the facility is well documented. These requirements address the following precautions and preventive measures:

- Precautions to prevent ignition or reaction of ignitable or reactive waste;
- General precautions for handling ignitable or reactive waste and mixing of incompatible waste;
- Management of ignitable or reactive wastes in containers;
- Management of incompatible waste in containers; and
- BGAD intends to prevent accidental ignition or reactions from occurring by providing the personnel with training and requiring them to follow SOPs.

All sources of ignitions or reactions are limited in the restricted area where the OB and OD/BD units are located. 40 CFR §264.17 requires that "No Smoking" signs be conspicuously placed wherever there is a hazard from ignitable or reactive waste. However, BGAD's security when entering the Restricted Area inspects and insures that no flammable materials be permitted in the area where the OB and OD/BD units are located. KDEP is in agreement that this is acceptable. Wastes are separated and protected from sources of ignition or reaction including but not limited to: open flames, smoking, cutting and welding, hot surfaces, frictional heat, sparks (static, electrical, mechanical), spontaneous ignition such as from heat-producing chemical reactions, and radiant heat.

C-3 Additional Waste Analysis Requirements Pertaining to Land Disposal Restrictions [401 KAR 37 & 40 CFR 268]

Additional waste analysis requirements pertaining to LDRs are addressed in the Waste Analysis Plan (Appendix C-1 to this Part C of the permit application). Note that although the OD thermal treatment method incorporates the soils as part of the unit's engineering control (e.g., a primary liner of soil), the wastes are not left in place and OD is not considered a form of land treatment. Federal Register (FR) 46946, Volume 52, No. 237, Thursday, December 10, 1987, contains the Final Rule for Hazardous Waste Miscellaneous Units; Standards Applicable to Owners and Operators. The summary of the rule states the following: "Over the past several years, the Agency has promulgated standard for specific types of treatment, storage, and disposal units, including containers, tanks surface impoundments, was piles, ***land treatment units***, landfills, incinerators, underground injection wells, and research, development, and demonstration facilities. However, because some hazardous waste management technologies are not covered by the existing permitting standards, owners and operators facilities utilizing them cannot obtain the RCRA permits necessary to operate them. To fill this gap, the Agency is today promulgating a new set of standards under Subpart X of Part 264."

The scope of Subpart X is later identified in the rule as follows: "The Agency is regulating under today's rules most of those units that are not covered by a subpart under Part 264 of Part 146. For example, units that do not fit the definition of any of the units covered by the standards of Part 264 or Part 146 would be regulated as miscellaneous units. In addition, unless otherwise excluded, if a new type of unit were developed that did not fit the definition of tank, container, surface impoundment, waste pile, ***land*** *treatment unit*, landfill, incinerator, boiler, industrial furnace, or underground injection well, it would be regulated under Subpart X." OB/OD of explosive wastes is specifically listed as an example of units covered under Subpart X at 46952 FR.

It is clear from the language contained in the preamble to the rule that the Agency interprets OB/OD as falling outside of the scope of land treatment.

Appendix C-1
Waste Analysis Plan

This WAP describes the procedures and responsibilities for evaluating the chemical properties of conventional WMM treated and treatment residue generated at the BGAD OB and OD/BD units. Specifically, the WAP describes procedures to:

- Determine the RCRA hazard classification of wastes;
- Obtain the chemical and physical data required to properly treat the hazardous waste;
- Determine whether wastes have been treated in accordance with LDRs; and
- Provide adequate information to off-site disposal facilities to comply with RCRA land ban notification requirements.

The responsibility for hazardous waste identification of conventional WMM lies primarily with the BGAD Ammunition and Maintenance and Demilitarization Division and secondarily with the Environmental Office. Regardless of the activity that identifies the waste, characterization will be accomplished in accordance with the procedures specified in this WAP.

C-3a Parameters for Which Each Hazardous Waste Will Be Analyzed and Rationale for Parameters [401 KAR 34:020 Section 4 & 40 CFR 264.13(b)(1)]

Conventional WMMs treated at BGAD are off-the-shelf items with well-defined physical and chemical characteristics. Due to the nature of the reactive and unstable energetic materials in this waste stream, direct representative sampling and analysis is not required. Extensive WMM chemical and physical characterization data are available through process knowledge and/or reference to the sources listed in Table C-1-1. Data contained in these references and/or provided by the information sources is sufficient to determine the suitability of the WMM for treatment at BGAD and compliance with Subpart X environmental performance standards. Due to the sensitive and classified nature of the information, it is not appropriate to include the constituents of individual munitions items in this public document.

Upon notification of a potential new WMM workload at BGAD, the BGAD Ammunition Maintenance and Demilitarization Division is responsible for coordinating with the BGAD Environmental Office to review the WMM characteristics (based primarily on MIDAS) and to determine whether the waste is suitable for treatment by OB or OD/BD. The BGAD Environmental Office will review the waste characterization data to:

- Determine if the WMM workload is acceptable in accordance with BGAD's hazardous waste and air permits
- Determine the appropriate EPA waste codes
- Evaluate groundwater monitoring needs (i.e., determine if additional waste parameters are indicated for the groundwater monitoring program)
- Evaluate the waste to identify waste analysis requirements of treatment residue (if any)

Table C-1-1. Technical References for Munitions Characteristics and Constituents

DA Technical Manual (TM) 43-0001-28, Army Ammunition Data Sheets: Artillery Ammunition Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers, and Artillery Fuzes
TM 43-0001-29, Army Ammunition Data Sheets: Grenades
TM 43-0001-36, Army Ammunition Data Sheets: Land Mines
DA Field Manual 5-25, Explosives and Demolitions
DA, Material Development, and Readiness Command (DARCOM) Pamphlet 700-3-2, Complete Round Chart: Ammunition through 20 mm

Table C-1-1. Technical References for Munitions Characteristics and Constituents

DARCOM Pamphlet 700-3-3, Complete Round Chart: Activity Ammunition and Fuzes
MIDAS/www.dac.army.mil/td/midas/index.htm
Toxics Release Inventory Data Delivery System
Package Information and distinctive markings to include Federal Supply Class, DoD Identification Code, DoD Ammunition Code, NSN
Direct contact with the Single Manager for Conventional Munitions (SMCA) at the Joint Munitions Command (JMC)

Any energetic waste that would be generated on-site as a result of munitions activities that is not specifically defined as WMM by the Military Munitions Rule would nonetheless contain or be contaminated with a known, military energetic material and would similarly require no sampling but only knowledge of the generating process.

The conventional WMMs treated at BGAD do not contain liquids.

BGAD does not manage any listed wastes (EPA waste codes F, K, P, and U) at its OB and OD/BD units. While BGAD's energetic washout facility was in operation, BGAD routinely disposed or used as donor material, wastes determined to be listed as K044 and/or K045. The washout facility is no longer operational and there is no identified on-going need to treat these listed wastes. It is feasible that a future or short-term need should arise for BGAD to treat by OB or OD/BD, wastewater treatment sludges or spent carbon from the treatment of wastewater that contains sufficient quantities of energetics to be determined reactive and thus requiring on-site disposal. As these would not be produced as a result of a manufacturing process (BGAD does not manufacture munitions or explosives), these wastes would be characterized as D003.

The wastes treated by OB and OD/BD do not contain pesticides, herbicides, dioxins, or polychlorinated biphenyls (PCBs). BGAD does not treat WMM that contains flechettes, submunitions, white phosphorus, red phosphorous, colored smoke, HC (Hexachloroethane) smoke, riot control agents, chemical agents, biological agents, nuclear components or devices, or depleted uranium (DU) except that in the case of a Munitions Emergency Response as determined by an explosives or munitions emergency response specialist. In the case of such an emergency, whereby an otherwise prohibited item was destroyed at BGAD, KDEP Division of Waste Management would be notified within 24 hours.

Additionally, no unknown waste streams are accepted for treatment at the thermal treatment units. An unknown waste item suspected of containing explosive material would qualify as an explosives or Munitions Emergency Response Action (see definition in 40 CFR 260.10). Management of an item as an explosives or Munitions Emergency Response would be exempt from RCRA permitting requirements, to include characterization (see Appendix B-1 to Part B of this permit application). In the case of such an emergency KDEP Division of Waste Management would be notified within 24 hours. Note that routine "re-treatment" of unexploded ordnance (UXO), low-order detonations, or other kick-outs that occur as a result of routine treatment are not considered Munitions Emergency Response Actions and do not require notification.

Treatment residue requiring management as solid and potentially as hazardous waste is limited to that generated as a result of OB and includes ash (potentially wet with precipitation), expended time fuze residue, expended igniters, and sediment extracted from the sediment catchment system. User knowledge and laboratory analysis is used to ensure that it is properly managed and disposed of. Table C-1-2 provides the parameters and rationale for OB treatment residue analyses.

Table C-1-2. Waste Stream Parameters and Rationale

Waste	Parameter	Rationale
WMM	Not analyzed	Sufficient technical information is available in existing published documentation to ensure proper waste characterization. Unknown WMMs are not treated.
Treatment residue from OB units	Toxicity characteristic leaching procedure (TCLP) – arsenic, barium, cadmium, chromium, lead, selenium, silver Explosives by Method 8330 Others as required to determine underlying hazardous constituents	Solid waste containing leachable metals Method 1311 and Solid waste containing low-level explosives Method 8330 LDR determinations Method varies

Note that explosives analysis (Method 8330) includes 2,4-Dinitrotoluene and is used for determining the applicability of the D030 waste code.

Treatment residue generated from OB operations is containerized and transferred for accumulation or storage (i.e., satellite accumulation, 90-day accumulation or permitted storage in igloos B402 or B404). From there these wastes are managed in the manner described in this WAP. This plan discusses the methods used to ensure hazardous wastes transported to off-site TSDFs are managed properly, to include compliance with the LDRs. The Environmental Office is responsible for reviewing waste analyses and ensuring compliance with the LDR. See Module II of the BGAD storage permit application for additional details.

C-3b Test Methods [401 KAR 34:020 Section 4 & 40 CFR 264.13(b)(2)]

Post-treatment sampling is performed on the treatment residue when it is removed from the OB unit to assist in making hazardous waste determinations. With the exception of munitions-related metallic debris, no other visible residue separate from the soil remains after the OD treatment process; therefore, post-treatment residues from OD activities are not analyzed.

Treatment residue generated as a result of OB is tested by a Kentucky certified laboratory. The laboratory conducts all analytical tests in accordance with the protocols specified in “Test Methods for Evaluating Solid Waste; Physical/Chemical Methods (SW-846),” most recent; “Methods for Chemical Analysis of Water and Wastes” (EPA-600/4-79-020); or an equivalent method approved by the Regional Administrator. The apparatus, reagents, calibration methods, quality controls (QCs), analytical procedures, and calculation methods specified in these protocols are incorporated into this WAP by reference.

Munitions-specific characteristics based on MIDAS, process and generator knowledge are used to select appropriate analytical testing for the OB treatment residue. Treatment residue removed from the OB unit is thoroughly inspected and determined free of reactive material prior to its removal from the burn pans; therefore, reactivity testing is not necessary. Specifically, treatment residues are visually inspected by demilitarization operators. Demil operators are trained to identify the presence/absence of reactive material.

C-3c Methods Used to Obtain Representative Samples of the Waste Being Analyzed [401 KAR 34:020 Section 4 & 40 CFR 264.13(b)(3)]

The sampling equipment and collection/handling methods used follow EPA-approved sampling protocols contained in the most recent edition of SW-846. The following general procedures and precautions are followed as appropriate:

- Samples are not taken when the waste is either excessively warm or partially frozen.
- Containers holding unknown, potentially dangerous materials are approached from upwind and with caution.
- Appropriate safety equipment such as gloves, apron, face shield, respirator, and goggles are worn when sampling. The requirement for protective gear varies based on the specific chemical properties of the waste and the circumstances under which it is being sampled.
- Non-sparking equipment is utilized during sampling (i.e., a brass bung wrench is used for opening containers) as determined necessary.
- All necessary sampling equipment, bottles, rags, and bags are within reach of the sampler as the sample is drawn. The ash or other residue will be sampled using only stainless steel scoops.

Typically, a single sample is collected and analyzed for each new OB workload to confirm the determinations made by user knowledge. Since ash is typically collected over a series of burn events until the container is full, composite sampling is used to ensure the sample is representative. The following sampling procedures are used as appropriate:

- Choose a stainless steel or Teflon-lined scoop.
- Clean sampling devices and containers before use. All used non-disposable containers and samplers are washed with warm detergent solution (e.g., Liquinox, Alconox, or equivalent), rinsed at least three times with tap water, rinsed with distilled water, and air dried or wiped dry.
- Wear necessary protective clothing and gear and observe required sampling precautions.
- When using an auger, extend the auger through the entire volume of waste. Bottles will be filled by spooning portions of the augured core into the sample bottles. Stirring the sample in the stainless steel is not recommended to avoid the generation of fine dust and exposure to sampling personnel.
- Cap the sample container, attach label and seal, record in field logbook, and complete analysis request sheet and chain-of-custody (COC) record as applicable.
- Clean sampler on-site and place in clean plastic bag. Store the cleaned and packaged equipment in an appropriate area away from potential contamination.
- Deliver the sample to the laboratory for analysis.

Other Sampling Considerations

As a general guide, 500 grams (approximately 1 pint) will be taken for solid samples. Glass containers are relatively inert to most chemicals and will be used to collect hazardous waste samples. Samples to be analyzed for toxicity will be preserved by cooling to 4°C and will not be held for more than 24 hours prior to initiating analyses.

The sample collector immediately upon collection properly identifies each sample. Identifying information is annotated on sample labels, the COC form, and in the field logbook when appropriate. Sample labels are used to prevent misidentification of samples. A waterproof pen is used to write on the label and will include at least the following information:

- Name of collector,
- Date and time of collection,
- Generating facility,
- Sample identification number that uniquely identifies the sample, and
- Sample preservatives used.

Sample seals will be used to preserve the integrity of the sample from the time it is collected until it is opened in the laboratory. Gummed paper or plastic (shrink-fitted) will be used as official sample seals.

To establish the documentation necessary to trace sample possession from the time of collection, a COC record will be filled out and accompany every sample. A sample COC form is shown in Figure C-1-2. The COC must include the following minimum information:

- Place of collection (sample ID);
- Date and time of collection;
- Sample type (grab or composite);
- Sample description (waste type);
- Number of containers (1 of 2, etc.);
- Signatures of people involved in the chain of possession; and
- Inclusive dates of possession.

Samples will be delivered to the laboratory as soon as practicable. A COC record will accompany the sample. Samples will be delivered to the person in the laboratory authorized to receive samples. Samples shipped to the laboratory will be wrapped in bubble plastic to avoid breakage.

If the contact laboratory is located within a reasonable distance of BGAD, facility personnel may be dispatched to deliver the sample directly to the laboratory. If a commercial shipper is to be used, the last signee must ensure that the sample package is monitored and secured until the shipper accepts the package.

Analytical results will be retained at the Environmental Office as a part of the facility operating record for a minimum of 3 years.

C-3d Frequency of Analysis [401 KAR 34:020 Section 4 & 40 CFR 264.13(b)(4)]

WMMs that are treated in the thermal treatment units have been manufactured in accordance with military specifications and strict manufacturing requirements. As previously discussed, no pre-treatment analyses will be completed on the WMM waste streams. However, post-treatment analyses will be performed to confirm waste determinations made using user knowledge to ensure proper disposition of treatment residue.

SAMPLE CHAIN OF COUSTODY

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

Laboratory	**NAME**
Address	**ADDRESS 1**
	ADDRESS 2
Phone	**(AC) Number**

Page ___ of ____ Pages

Project No.		**Required Analysis**	____Standard Report Delivery
Project Name and Location			____ Expedited Report Delivery
Client Name	Client Manager		Date due _____
Client Address (City, State, Zip)			

Sample		**Sample Identification**	**Matrix Type**	**Number of Containers Submitted**											**Remarks**
Date	**Time**														

Relinquished by: (signature)	Date	Time	Relinquished by: (signature)	Date	Time	Relinquished by: (signature)	Date	Time
Received by: (signature)	Date	Time	Received by: (signature)	Date	Time	Received by: (signature)	Date	Time

Laboratory Use Only

Received by: (signature)	Date	Time	Custody Intact YES ____ NO ____	Custody Seal No.	SL Log No.	Laboratory Remarks

Figure C-1-2. Sample Chain of Custody – Typical Format

A combination of published information (e.g., MIDAS), user knowledge, and laboratory analysis is used to generate a Waste Profile for each individual OB workload (e.g., 105mm, 155 mm, etc.). Once the Waste Profile is generated, no additional sampling is completed for the workload unless there is an indication of waste or process change. Waste Profiles are evaluated annually to verify that the information still holds true and to determine if additional sampling is needed.

C-3e Additional Requirements for Wastes Generated Off-Site [401 KAR 34:020 Section 4 & 40 CFR 264.13(b)(5) and (c)]

Should WMM be accepted from off-site, the waste generator would be required to provide complete National Stock Number (NSN), DoD Identification Code (DODIC) and nomenclature. A copy of the MIDAS report would also be required.

Though no WMM have been received for treatment to date, as described in Part B of this permit application, BGAD requests the allowance to accept WMM shipments from other U.S. defense installations providing appropriate notification, characterization, manifesting (if required), DoD shipping documents, and other transportation conditions are met.

Generators requesting treatment of WMM at BGAD would submit their request to BGAD and include the following information at a minimum:

- Complete nomenclature, NSN, and NEW;
- Quantity to be treated;
- A statement that the items were manufactured under military contract, are U.S. government property, and are authorized for treatment; and

Upon receipt of the request, BGAD Ammunition Maintenance and Demilitarization Division personnel would verify that the shipment is authorized for treatment in accordance with the Subpart X permit. Nomenclature, NSN, NEW, and quantity are sufficient data to fully characterize the waste stream and evaluate compliance with permit conditions. BGAD Ammunition Maintenance and Demilitarization Division personnel would coordinate with the BGAD Environmental Office and will apply technical knowledge and/or published data to ascertain waste characteristics. Following this evaluation of the submitted request, treatment would be scheduled. Part B of this permit application describes the process for receiving conventional WMM for treatment at the OB and OD/BD units.

No WMMs are accepted for treatment until BGAD Ammunition Maintenance and Demilitarization Division personnel and the BGAD Environmental Office are satisfied that the administrative, physical, and chemical data are sufficient to ensure the selected treatment process is appropriate, effective, and safe.

C-3f Additional Waste Analysis Requirements Pertaining to LDRs [401 KAR 34:020 Section 4 & 40 CFR 264.13(b)(6)]

Treatment residue generated as a result of OB treatment operations are subject to LDR requirements.

The disposal prohibition component of the LDR program requires that, before a hazardous waste can be land disposed, treatment standards specific to that waste material must be met. A facility may meet such standards by either treating hazardous constituents in the waste to meet required treatment levels or treating waste using a treatment technology specified by EPA.

With the exception of certain prohibitions of California-listed wastes, generators must test a sample of the waste (using methods of 401 KAR 31:010 Section 1), or use generator knowledge of the waste to determine whether the hazardous waste is restricted from land disposal. If the generator determines that the waste is a restricted waste and the waste does not meet the treatment standards, the generator must send a written notification and signed certification statement to the TSDF informing the facility that the waste does not meet the treatment standard. LDR notices and certifications are required whether the waste is sent to on-site or off-site treatment, storage, or disposal.

Even though the LDRs apply to the *disposal* of hazardous wastes, EPA has decided that the point of generation must be used to determine whether a waste is restricted. It is illegal to dilute wastes below concentration limits. By evaluating the waste at the point of generation, this practice is prevented.

Hazardous waste determinations and 40 CFR 268 LDR requirements will be re-evaluated in the event of a future mission change, or acceptance of hazardous waste from other government installations. Existing published and documented data is used for characterization of the OB treatment residue and LDR determinations.

LDR review will include the following:

- All hazardous waste codes will be identified;
- 40 CFR 268.40 table will be checked for treatment standard;
- Determination regarding satisfaction of the treatment standard will be made; and
- Notification information will be provided as required by 40 CFR §268.7.

40 CFR 268.40 contains two forms of treatment standards: concentration-based and technology-based. If a technology-based standard is designated, then the technology-based standard must be used. If a concentration-based standard is designated, any treatment method can be used, but the specified concentration must be met before land disposal. If the 40 CFR 268.40 table also requires that 268.48 standards be met, then the waste must not only be treated for the hazardous constituents that caused it to be subject to hazardous waste regulation, but also for all underlying hazardous constituents (UHCs). UHCs are defined in 40 CFR 268.2 as any constituent listed in 268.48 (except fluoride, selenium, sulfides, vanadium, and zinc) which can reasonably be expected to be present at the point of generation of the hazardous waste at a concentration above the constituent-specific universal treatment standard.

BGAD coordinates hazardous waste shipments and LDR determinations with the Defense Reutilization and Marketing Office (DRMO). In the event that hazardous waste characteristics may have changed due to introduction of a process or mission change, shipment may be made with enough information such that the receiving treatment facility can make the treatment determination. A one-time written notice will accompany the initial shipment to each treatment or storage facility. Records will be maintained as identified in 40 CFR 268.7(a), “Generator Paperwork Requirements Table”, and will include, as appropriate for OB treatment residues, EPA Hazardous Waste Numbers and Manifest Number of first shipment; UHCs in characteristic wastes, unless the waste will be treated and monitored for all constituents; waste analysis data; and contaminants subject to treatment for hazardous debris, consistent with 40 CFR 268.45; and constituents subject to treatment consistent with 40 CFR 268.49. Alternatively, if BGAD chooses not to make a treatment determination, a notification may instead be provided that includes the EPA Hazardous Waste Numbers and Manifest Number of the first shipment, stating “This hazardous waste may or may not be subject to the LDR treatment standards. The treatment facility must make the determination.” Records are maintained at the BGAD Environmental Office (Building S-14).

C-3g Surface Impoundments [401 KAR 34:020 Section 4 & 40 CFR 264.13(b)(7)]

Not applicable.

C-3h Air Emission Standards of Subpart CC [401 KAR 34:020 Section 4 & 40 CFR 264.13(b)(8)]

Not applicable.

PART D. PROCESS INFORMATION [401 KAR 34:250; 34:370; 38:230; 40 CFR 264.600; 266.202; & 270.23]

D-1 Containers [401 KAR 34:180 and 38:150 & 40 CFR §264.170–179 and 270.15]

Containers are addressed in Module II, Conventional Munitions Related Items Permit Application.

D-2 Tanks [401 KAR 34:190 and 38:160 & 40 CFR §264.190 and 270.16]

Not applicable.

D-3 Waste Piles [401 KAR 34:210 and 38:180 & 40 CFR §264.250 and 270.18]

Not applicable.

D-4 Surface Impoundments [401 KAR 34:200 and 38:170 & 40 CFR §264.220 and 270.17]

Not applicable.

D-5 Incinerators [401 KAR 34:240 and 38:190 & 40 CFR §264.340 and 270.19]

Not applicable.

D-6 Landfills [401 KAR 34:230 and 38:210 & 40 CFR §264.300 and 270.21]

Not applicable.

D-7 Land Treatment [401 KAR 34:220 and 38:200 & 40 CFR 264.270 and 270.20]

Not applicable.

D-8 Miscellaneous Units [401 KAR 38:230; 34:250; 40 CFR 270.23 and 264.600]

On 10 December 1987, under 52 FR 46946, EPA issued the Subpart X regulations, outlining the procedures for issuing permits to *miscellaneous units* that treat, store, or dispose of hazardous waste. *Miscellaneous units* are defined as those that do not meet any of the definitions in Part 264 of other types of hazardous waste management units. The OB and OD/BD treatment units are used at BGAD for the treatment of WMM/energetic waste that cannot be managed safely or effectively in other types of hazardous waste management units. These units are defined as miscellaneous treatment units because they do not meet any of the definitions in Part 264.

Conventional munitions storage, transport, and disposal operations at BGAD are executed by BGAD Mission Management. Treatment of conventional WMM at BGAD is the responsibility of the Ammunition Maintenance and Demilitarization Division and is accomplished through OB in burn pans, by OD/BD, and within a D-100 confined detonation/destruction chamber (CDC) housed in Building 280. Only OB and OD/BD are addressed in this permit application. The D-100 CDC is planned to be addressed in a separate permit application.

BGAD is a subordinate installation of the JMC. JMC is responsible for the production, storage, issue, and demilitarization of conventional ammunition for all U.S. military services. JMC headquarters is located in Rock Island, Illinois, and the command operates a nationwide network of ammunition plants and maintains a global presence wherever U.S. combat units are stationed. As a Tier 1 designated Army depot, BGAD provides mission-essential ammunition surveillance, renovation, and conventional munitions demilitarization support to the DoD. JMC is additionally the field operating agency for the DoD Single Manager for Conventional Ammunition (SMCA). The SMCA is responsible for managing DoD's demilitarization stockpile (the nation's stockpile of excess and unusable munitions). This is accomplished through munitions sales to foreign services, inter-service munitions transfers, R3 of unusable munitions where possible, and disposal of unusable munitions where necessary. The OB and OD/BD units at BGAD are used to support the JMC's demilitarization mission by providing necessary disposal capability.

The capability to treat WMM/energetic waste safely and efficiently (i.e., at production levels sufficient to meet the demilitarization needs of the DoD) is critical for BGAD to fulfill its demilitarization mission. Given the inherent dangers associated with managing WMM/energetic waste and associated acute human health concerns, the technologies available to treat/dispose of WMM/energetic waste at production levels sufficient to meet the needs of the DoD are limited. Appendix B-2 provides an assessment of available technologies and their potential applicability to the BGAD WMM/energetic waste stream. BGAD currently has no other available options to fully execute its demilitarization mission. Although the D100 CDC offers an alternative to a fraction of the BGAD WMM/energetic waste stream, its capabilities and capacity are limited. As presented in Appendix B-2, BGAD is actively pursuing an alternative technology to reduce its reliance on OB. Given the potential safety hazards associated with deteriorated and unstable propellant and limitations on technologies capable of withstanding detonations of significance, BGAD will nonetheless continue to require OB and OD/BD capability into the foreseeable future.

D-8a Detailed Description of Miscellaneous Units Being Used [40 CFR 270.23]

Use

Under 40 CFR 265.382 (referenced by 401 KAR 35:250 Section 6), there is a general ban on the open burning of hazardous waste except for the burning and detonation of waste explosives. Waste explosives include waste that has the potential to detonate and bulk military propellants that cannot safely be disposed of through other modes of treatment. The OB thermal treatment process is appropriately used at BGAD to treat bulk military propellants and propellant charges, while OD is used to treat munitions and explosives with the potential to detonate. The use of OB at BGAD is additionally restricted by 401 KAR 63:005 Section 4(5), which limits the use of open burning to fires set for prevention of a fire hazard, including the disposal of dangerous materials if no safe alternative is available. Waste propellant treated by OB at BGAD has been removed from use because of the loss of lot integrity, deterioration, and/or chemical decomposition. These propellants are potentially unstable, are known to be capable of self-ignition, and pose a significant safety hazard if exposed to improper storage or handling conditions. BGAD limits the use of OB to the destruction of deteriorated and potentially unstable propellants in a configuration known to be capable of self-ignition.

BGAD conducts treatment by OB and OD/BD of conventional WMM/energetic waste generated onsite and requests the continued allowance to receive and treat conventional WMM by OD from offsite sources (as described in Part B-1 of this application). The physical and chemical characteristics of the BGAD OB and OD/BD waste stream are detailed in Part C of this application.

Uses other than for RCRA Treatment

As described in Part B of this permit application, the OB and OD/BD units also may be used for non-RCRA regulated activities including training of personnel in the conduct of OB and OD/BD demilitarization techniques and procedures, emergency responses, and the conduct of Research, Development, Test and Evaluation (RDT&E) activities. Training, emergency response operations, and RDT&E activities are considered "use for intended purpose" and are exempt from RCRA permitting requirements per the Military Munitions Rule (refer to Appendix B-1 of Part B of this permit application).

Prohibitions and Restrictions

The WMM treated by OB and OD/BD do not contain pesticides, herbicides, dioxins, or polychlorinated biphenyls (PCBs). BGAD does not treat WMM that contains flechettes, submunitions, white phosphorus, red phosphorous, colored smoke, hexachloroethane (HC) smoke, riot control agents, chemical agents, biological agents, nuclear components or devices, or depleted uranium (DU), except in the case of an emergency as determined by an explosives or munitions emergency response specialist. In the case of such an emergency, whereby an otherwise prohibited item was destroyed at BGAD, KDEP Division of Waste Management would be notified within 24 hours (reference Appendix B-1 for a discussion regarding the MMR and explosives or munitions emergency responses).

In addition to these, BGAD has implemented the following restrictions to mitigate specific pollutant emissions:

- Maximum of 1,000 each Delay Assembly F/155mm High-Explosive Rocket Assisted (HERA), National Stock Number 1320-01-054-5121 disposed by OD/BD annually. This item contains barium chromate. The self-imposed restriction is established to mitigate Chromium VI releases.
- Maximum of 1,400 lb of lead or lead compounds in the energetic (i.e., Propellant, Explosive, or Pyrotechnic) compounds (excluding inert materials) disposed by OD/BD on a 12-month rolling average basis.

Upon notification of a potential new WMM/energetic waste workload at BGAD, the Ammunition Maintenance and Demilitarization Division Planning Team is responsible for coordinating with the BGAD Environmental Office to review the WMM/energetic waste characteristics (based primarily on the Munitions Items Disposition Action System [MIDAS]) and to determine whether the waste is suitable for treatment by OB or OD/BD. The BGAD Environmental Office will review the waste characterization data to:

- Determine the appropriate EPA waste codes.
- Evaluate against specific restrictions.

- Evaluate against groundwater monitoring needs (i.e., determine if additional waste parameters are indicated for the groundwater monitoring program).
- Coordinate with the Ammunition Maintenance and Demilitarization Division to determine if the WMM/energetic waste workload is acceptable in accordance with BGAD's hazardous waste and air permits.
- Evaluate the waste to identify waste analysis requirements of treatment residue (if any).

D-8a(1) Physical Characteristics, Materials of Construction and Dimensions of the Unit [40 CFR 270.23 (a)(1)]

D-8a(1)(a) Open Burn Unit

The OB unit consists of approximately 10 acres and is delineated by a cleared zone bounded by a road (Route 117) on the north and a tree line to the south. The OB area contains two separate, locally fabricated steel plate burn pans. The two pans are located on two separate concrete pads surrounded by crushed stone that provides for ingress and surface water drainage. OB Pan 1 is located east of OB Pan 2. The location of the two burn pans and associated terrain, land use, proximity to the flood plain, soil types, and proximity to wetlands are shown on Figures B-2, B-3, B-5, B-7, and J-1, respectively. Figure B-2a additionally shows the area within 1,000 feet of the OB unit including elevations, nearby streams, roads, and fencelines.

The OB treatment process is used at BGAD to treat bulk military propellant and propelling charges with waste characteristics as described in Part C of this permit application. No liquid wastes or wastes containing free liquids are treated by OB and no accelerants (e.g., diesel fuel) are used.

The maximum volume authorized for treatment at the OB unit on a per-pan, per-event, per-day, and per-year basis is presented in Table C-3. A maximum of 2,500 lb NEW of WMM/energetic waste is authorized to be burned in each pan. A typical burn event is comprised of a series of two pans of 2,500 lb NEW each that are ignited with 10 to 20 minutes between ignitions (i.e., second pan is ignited when the flames from the first pan are extinguished) for a total volume of 5,000 lb NEW per event. Depending on the propellant type, a single burn time ranges from 10 to 20 minutes from ignition to dissipation of smoke and a maximum of one burn event (total of two pans) can be accomplished within a single 1-hour period.

The OB pans are constructed of ¼-inch A36 hot rolled steel plate, each measuring 4 feet wide by 56 feet long by 1 foot deep atop two 6-inch I-beams. Pan lids are constructed in 8 foot segments of 11-gauge A36 hot rolled sheet metal. Lids are placed onto and removed from the pans using a forklift. Lids remain on pans when pans are not in use and are placed onto pans as soon as possible following the last burn event of the day. The pans are located on top of two separate concrete pads, each constructed of reinforced concrete with control joints (3/4-inch-deep saw cut) spaced every 12 feet in each direction with a minimum compressive strength of 5,000 pounds per square inch (psi) atop a 6-inch-thick layer of compacted dense graded aggregate compacted to a minimum of 96 percent of its maximum laboratory density. Concrete pads are reinforced with 6x6-W4xW4 welded wire fabric and sloped approximately 2 percent towards the south. The concrete pad at OB Pan 1 (farthest east) measures 74.5 feet long by 59 feet 8 inches wide (approximately 75 feet by 60 feet), while the concrete pad at OB Pan 2 measures 81.5 feet long by 59 feet 8 inches wide (approximately 82 feet by 60 feet).

Each pan is surrounded on the east, west, and south sides by 4-inch-wide by 4-inch-high reinforced concrete curing with (#4 rebar running horizontally and vertically every 12 inch on center). A drain covered with a grate that measures approximately 1 foot by 1.5 feet is located in the downgradient location within each pad. The drain leads to a polyvinyl chloride (PVC) pipe with a 90-degree elbow that runs below the pad and discharges into a 50-gallon capacity low profile sediment catch basin located on the south side of the concrete pad. A ball valve with manual lever is present before the catch basin for manual control of flow to the basin.

The concrete pads are surrounded on all sides by a 4-inch base of #57 crushed stone and drainage swales that are approximately 10 feet wide and divert surface water run-on around the concrete pads. Drainage swales are lined with riprap. Ingress to the pads is provided by a driveway with a 6-inch base of #57 crushed stone.

Together, the two burn pans, the reinforced concrete pads, the area covered in crushed stone, and the area of cleared vegetation, constitute the OB unit.

D-8a(1)(b) Open Detonation/Buried Detonation Unit

The OD/BD unit is located approximately ¼ mile east of OB Pan 1 bounded by the top of a ridge to the north, an intermittent stream (Southern Tributary) and low-lying trees to the south, Muddy Creek to the east, and a gravel roadway to the west. The OB/BD unit encompasses approximately 65 acres, of which approximately 30 acres comprises the active treatment area that is barren soil. The remaining acreage is comprised of low vegetation. The location of the OD/BD unit and associated terrain, land use, proximity to the flood plain, soil types, and proximity to wetlands are shown on Figures B-2, B-3, B-5, B-7, and J-1, respectively. Figure B-2b additionally shows the area within 1,000 feet of the OD/BD unit including elevations, nearby streams, roads and fencelines.

The OD/BD treatment process is used at BGAD to treat WMM/energetic waste with the potential to detonate, with waste characteristics as described in Part C of this permit application. No liquid wastes or wastes containing free liquids are treated by OD/BD.

The maximum volume authorized for treatment at the OD/BD unit on a per-event, per-day, and per-year basis is presented in Table C-3. BD is conducted in a series of 30 pits aligned approximately centrally within the OD/BD unit. WMM/energetic waste and donor charges with a combined NEW of not more than 100 lb are treated within each of the pits. Pits are excavated using bull dozers and pit dimensions are consistent with a D8 bulldozer blade (i.e., 16 feet). Pits are dug to approximately 8 to 10 feet deep and not less than 25 feet from the adjacent pit. Detonations (or "shots") are initiated approximately 15 seconds to 1 minute apart such that a typical shot series of 30 pits takes approximately 20 minutes without misfires. OD (detonation on the soil surface) are not typical and occur only as part of a "clean-up shot" (i.e., to dispose of unused donor materials that require demilitarization) or if unexploded ordnance (UXO) is discovered. Even when not buried, OD typically would still occur in a pit but without soil cover. The maximum total estimated NEW for a surface detonation is 20 lb NEW.

Soils within the OD/BD unit consist of a combination of native soils and fill dirt underlain by a bedrock shelf. The soil at the site is primarily a non-distinct silty/clayey mixture because it has been repeatedly disturbed by detonations and earthmoving equipment. Both OD (detonation on the soil surface) and BD (detonation beneath the soil surface) treatment processes are used at the OD/BD unit, although primary use is for BD. Features associated with the OD/BD unit include the safety bunker (Building 274) along the northern ridge where the firing controls are located and permanent subsurface firing wires that lead first to two junction boxes through buried conduit and then to six additional junction boxes also through buried conduit. Junction boxes measure 3 feet by 3 feet by 3 feet and are constructed of ¾-inch A36 steel, hardened and protected from blast. In addition, there are two erosion control features associated with the OD/BD unit, identified as the Northeast and Southwest erosion control barriers. These permanent features are constructed of riprap and measure approximately 107 feet (Northwest) and 140 feet (Southeast) long and 7 feet wide.

The OD/BD unit is described as the area of disturbance (i.e., the area encompassing the OD/BD pits and the immediate area surrounding the OB/DB pits that is routinely disturbed by heavy equipment and blast and thus devoid of vegetation) and surrounding property, incorporating the safety bunker and extending south to the unnamed southern tributary, east to Muddy Creek and west to incorporate staging area for equipment. The approximated boundaries are shown on Figure B-2b (OD/BD Unit outer limits).

D-8a(2) Detailed Plans and Engineering Reports Describing Location, Design, Construction, Operation, Maintenance, Monitoring, Inspection and Closure [40 CFR 270.23(a)(2)]

D-8a(2)(a) Location

The primary consideration for the siting of treatment units within the Depot is explosives safety. As military facilities managing munitions and explosives, the treatment units fall under the jurisdiction of the DoD Explosives Safety Board (DDESB). The DDESB establishes uniform safety standards in DoD Ammunition and Explosives Safety Standards (DoD 6055.9-M). The locations of the units have been reviewed by the DDESB to be consistent with standards for blast pressure, primary and secondary fragments, and thermal hazards, and have been approved. The units are located at adequate distances from physical structures and public traffic routes. Where appropriate, traffic routes to or from the units may be closed during treatment operations.

Other siting criteria include accessible topography, proximity to traffic routes, and proximity to potential groundwater users. OB and OD/BD operations have been active since the 1940s and no documentation is available to establish engineering considerations for locations of the OB and OD/BD units. Encroachment of residences along the southern boundary of BGAD has occurred during the life of the OB and OD/BD units. Operating procedures, including tamping (i.e., burying) of charges and monitoring of wind direction, have been established in order to address concerns regarding visible emissions and noise by residents located south of the BGAD boundary.

Location standards are further addressed in Part B-3 of this permit application.

D-8a(2)(b) Design and Construction

Appendix D-1 provides drawings and diagrams associated with the construction of the OB unit pans, lids, pads, sediment catchment basin, and surface water run-on/drainage controls. Appendix D-2 provides the floor plan for the safety bunker (Building 274) and the partial site electrical plan for the safety bunker panel depicting modifications to the system in 2016 as well as an aerial photo that shows the location of the two sediment control barriers associated with the unit. There are no other engineering drawings or diagrams associated with the OD/BD unit. Appendix D-3 provides a photo log showing features of the OB and OD/BD unit.

Although not associated directly with the OB and OD/BD operations, operation of the units is assisted by the provisioning of meteorological data available from a series of meteorological towers positioned within (Towers 1 through 4) and around (Towers 5 through 8) BGAD, and operated by BGCA in support of the chemical demilitarization program. The four onsite towers are described below:

Tower 1 has the following sensors:

- 10-meter (m), 30-m, and 60-m platforms provide wind speed and wind direction. Peak wind speed and peak wind direction are reported (where peak wind speed is the highest wind speed for 1 second during the 15-minute period and the peak wind direction is the wind direction for that one second of the highest wind speed). The system calculates the standard deviation of the wind direction.
- 2-m, 10-m, 30-m, 60-m platforms provide air temperature. Temperature differentials of 2 to 10 m, 2 to 30 m, and 2 to 60 m are calculated.
- Ground level precipitation sensors and a temperature sensor are in a concrete block.
- 2-m platform provides solar radiation, relative humidity, and barometric pressure.

Towers 2, 3, and 4 have the following sensors:

- 10-m platform provides wind speed and wind direction. Peak wind speed and peak wind direction are reported. The system calculates the standard deviation of the wind direction.

- 2-m and 10-m platform provides air temperature.
- 2-m platform provides relative humidity and barometric pressure.
- Tower 4 does not have barometric pressure but does have solar radiation at 2 m.

The sensors measure data in 1 second increments. The tower dataloggers average the values to produce 15-minute average values. Data typically can be provided in 15-and 30-minute; 1-, 2-, 3-, 4-, 6-, 12-, 24-, 48-, and 72-hour; or 1-week increments.

A sketch map indicating location of the four on-post and 4 off-depot meteorological towers is provided in Appendix D-2. Tower 3 is located closest to OB and OD/BD operations; however, Tower 1 collects data that meet EPA requirements and is considered to provide certifiable data, and provides wind speed and direction at 10 m, 30 m, and 60 m. Tower 1 has mechanically aspirated air temperature sensors at 2 m, 10 m, 30 m, and 60 m; this type of sensor is required for the temperature differentials between the various levels to be used for some purposes. Tower 3 provides wind speed and direction only at 10 m and is not considered to provide certifiable data. Tower 3 has naturally aspirated air temperature sensors at 2 m and 10 m.

While the Ammunition Maintenance and Demilitarization Division Planning Team and Supervisor have access and consider the data from all the available Towers when monitoring Webpuff (the software program that receives data from the BGAD Met Towers and provides data reports), the Tower 1 60-m platform is considered the definitive source for meteorological data pertinent to OB and OD/BD operations. Experience has shown this tower and height consistently useful in predicting the direction of OD/BD plume drift.

D-8a(2)(c) Operation

Explosives operations are intrinsically hazardous. All operations are conducted with personnel safety as the primary consideration. Part G of this permit application identifies response procedures for incidents that require implementation of the Contingency Plan. The scenarios identified below do not require implementation of the Contingency Plan but do require specific responses by personnel involved in the conduct of OB and OD/BD operations. During OB and OD/BD operations, the identified operational Supervisor (or Leader as alternate) will act as the onsite Emergency Coordinator reachable at the Demo Grounds Office by dialing 6232 or 6460.

- **Fire Scenario –** work crew will assess the fire and take immediate action by fighting the fire with the nearest fire extinguisher (if trained in its use). If the fire is too large to extinguish with a portable extinguisher, then workers will alert personnel and evacuate while the Supervisor or Leader notifies the fire department.
- **Lightning Scenario –** the Supervisor or Leader will alert personnel by announcing that the Red Light is “ON.” Work crew will evacuate to the Demo Grounds Office (Building 270) until Red Light “OFF” is announced.
- **Tornado Scenario –** the Supervisor or Leader will alert personnel. Work crew will evacuate to the safety bunker until the all clear has been given on the radio by the Emergency Operations Center (EOC).
- **Explosion Scenario –** the Supervisor or Leader will alert personnel to evacuate to the Demo Grounds Office using a route away from the hazard and then will notify the Fire Department and account for personnel.
- **Specific Item Hazard –** specific hazards may include smoking rounds, misfires, low order detonations, and UXO. Although BGAD no longer accepts White Phosphorous for treatment, it is possible that these may be present from historical operations. White Phosphorous burns when exposed to air and presents a fire and safety hazard. Misfires occur when WMM/energetic wastes

are capped but fail to detonate. WMM/energetic wastes that are capped present an increased explosive safety hazard. Low order detonations are partially detonated items with exposed energetic material and thus present an increased explosive safety hazard. UXO is a munition item that failed to detonate during the detonation process (the item may have been thrown clear or "kicked out" of the pit, for example). Munitions items subjected to shock of detonation present an increased explosive safety hazard. Procedures for response to smoking rounds or pits, misfires, low order detonations, and UXO are included in the operating procedures described in this Part of the permit application.

The operating conditions and procedures for OB and OD/BD treatment operations are below.

D-8a(2)(c)(i) Open Burn Unit

Operating Conditions

Treatment by OB is conducted by placing propellant and/or propelling charges up to 2,500 lb NEW into each pan, attaching an appropriate length of an M700 safety fuse (or equivalent) and igniting with an M60 igniter (or equivalent). The OB pans contain the ashes and residues generated by the OB process with the exception of the time fuze residue and kickout (if any). The concrete pad provides a measure of protection in the event that residues are ejected from the trays during particularly violent burns and from time fuze residues. The OB pans were designed wide and shallow to provide maximum exposure of propellant to air (i.e., surface area) to facilitate a fast burn.

General OB operating conditions per BGAD demilitarization SOPs are as follows:

- OB may be conducted year round as weather permits.
- The use of personal electronics and cell phones is strictly prohibited during any operation involving exposed explosives or unpackaged munitions.
- The day's weather forecast is interpreted by the Planning Team from available predictive sources to include the National Weather Service at www.weather.gov (using the zip code 40475 for local forecast information from Madison Airport/Richmond, Kentucky), Doplar radar, and the BGCA Emergency Operations Center program (called Webpuff), which is accessible at https://bluea0cmg-bwps1.csepp.army.mil/ via the Depot's secure intranet. Weather data for Lexington Bluegrass Airport, Bluegrass Field Weather Service, Flight ServiceWeather and Fort Knox, Kentucky also may be used. These data sources are interpreted to assess the conditions for the operating day and to make an initial decision to proceed ("go") or not proceed ("no-go") with the day's planned OB operations and to assess if a full or partial day of operation is indicated (e.g., mornings but not afternoons). *Note that none of the data sources listed above are "real-time". For example, the National Weather Service may predict a thunderstorm or episode of rain, and Webpuff data (which is averaged over 15-minute increments) may indicate conditions indicative of a thunderstorm or rain, but the Supervisor may have clearly observed that the thunderstorm or rain has passed such that operations can begin or continue. Such a decision will not be made without first consulting the available data sources.*
- OB may not be conducted during electrical storms, thunderstorms, or during periods of forecasted high probability (50 percent or greater), as provided by the sources listed above or as determined and documented by the Supervisor. Note that the Supervisor has the authority and ultimate responsibility, based on position and experience to make the decision to load and ignite the pans and is responsible for documenting the basis of the decision (i.e., source of forecast data and local observations). Electrical storms and thunderstorms present a safety hazard to persons handling energetic materials and the Supervisor will always make a decision based on sound explosives safety principals.

- OB may not be conducted during periods of precipitation or high probability (75 percent or greater), as provided by the sources listed above or as determined and documented by the Supervisor. Note that the Supervisor has the authority and ultimate responsibility, based on position and experience to make the decision to load and ignite the pans and is responsible for documenting the basis of the decision (i.e., source of forecast data and local observations). Note that the authority given the Supervisor recognizes changing weather conditions and the fact that weather forecasts are not real time. The Supervisor cannot override the weather restrictions for OB during lightning and precipitation but can authorize operations to proceed if it is clear by observation or weather data that the risk is reduced from the prior forecast. The Supervisor must suspend operations and evacuate the demo grounds, no exceptions, when the red light is on, indicating lightning is within 20 miles of BGAD and may not resume operations until the red light is off.
- Once WMM/energetic waste is loaded into the pans, the burn event must be completed prior to the end of the operating day because of safety concerns.
- Relative humidity levels are verified prior to daily operations. A relative humidity above 60 percent is considered safe (no static electricity generated). A relative humidity less than 60 percent increases danger and OB of D532 propellant will not be conducted.
- Typical equipment in use for OB operations includes a bulldozer for clearing of vegetation (as needed), a forklift, and an emergency vehicle (i.e., a work vehicle that is used for the purpose of speedy egress; does not refer to an ambulance), fire extinguishers, thermal indicator, and ohmmeter.
- Personal Protective Equipment (PPE) includes cotton gloves when removing propellant from containers, safety shoes, long-sleeve coveralls, safety glasses or goggles, and hearing protection (as needed), legstats, and wriststats. Personnel also are evaluated by Industrial Hygiene to determine the need for other PPE, such as respirators, for specific operations.
- If additional burn events are to be conducted in the same pan during an operating day, the temperatures of the pan will be assessed by thermal indicator and when temperature is acceptable, the pan will be cleaned of ash and debris. Temperatures ≤155 degrees Fahrenheit are acceptable.
- An emergency vehicle (i.e., a work vehicle that is used for the purpose of speedy egress; does not refer to an ambulance) will be positioned on the access road within line of sight (but no closer than 25 feet) from the burn pans prior to initiating burns.
- A minimum of two personnel trained in demilitarization procedures will be present at the Demo Grounds during all OB operations.
- A visual inspection of the bonding system will be conducted before each burn to ensure that components are not broken, in disrepair, corroded, or otherwise damaged to the point it affects equipment integrity.
- Safety fuzes will be tested for burn rate at the beginning of each day's operation and the beginning of each new roll used by attaching a fuse igniter to a 3-foot length of fuse and timing the burn rate. The test determines the length of fuze required to allow for safe withdrawal time of at least 4 minutes. A minimum of 6 feet of time fuze will be used.
- Burn pans are ignited in quick succession.
- A mandatory 30-minute wait time is required in the event of a misfire.
- Only two persons approach pans to investigate misfire.
- Burn pans will not be reused within a 2-hour period and until temperature is verified with thermal indicator.

- OB pans are covered with lids when not in use. Lids are placed onto pans as soon as they are cool enough for approach at the end of the operating day.
- Treatment residue around the pan is cleaned up when the pan has reached a temperature at which it can be safely approached by personnel at the end of each operating day. If sufficiently cooled, the ash in the pan is also removed at this time. If the pan remains too hot for personnel to approach, the area around the pans is cleaned to the extent it can be done safely and the pan lids are placed on the pans using a forklift. Ash from inside the pan is then removed prior to the next burn event.

Procedures

The standard procedures for the conduct OB operations are provided below:

Pre-Treatment

1. Meteorological conditions are verified by the Supervisor and the information noted on an Open Burn Authorization Sheet.
2. The red range flag is raised at the entrance to the Demo Grounds prior to the day’s burn operations.
3. Burn pan lids are removed from pans using a forklift.
4. Burn pans are visually inspected for integrity and to ensure that residue from previous burns has been removed. If residue from a previous burn is still present within the pan, it will be placed into a waste container.
5. Palletized waste is removed from the carrier using a forklift.
6. Supervisor documents incoming material in logbook (date, document number, National Stock Number (NSN), lot number, and quantity).
7. Operators de-palletize and remove banding (if any). Lead seals and banding are placed into collection containers for recycling.
8. Carrier is withdrawn to a safe location until destruction is complete.
9. Waste containers are staged at the burn pans with a minimum of 5 feet between containers and are grounded.
10. Operators ground themselves by touching burn pan by the use of wriststats or legstats.
11. Operators open propellant container using non-ferrous tool(s).
12. Operators pour/place propellant into burn pan to form a layer 3 inches deep, or one charge equivalent.
13. Operators visually inspect container to ensure they are empty and to verify that propellant has not been spilled.
14. Operators close and remove empty containers a distance of at least 150 feet from pans. Empty containers may be returned to storage for reuse or transferred to the flashing furnace (if required) prior to turn-in for recycling. Hazardous waste labels are removed prior to turn-in.

Treatment

1. The roadway (Route 117) is blocked to traffic in both directions.
2. Emergency vehicle (i.e., a work vehicle that is used for the purpose of speedy egress; does not refer to an ambulance) is verified to be positioned and running for rapid exit if necessary.
3. Operator inserts one end of a safety fuze into ignition charge and places ignition charge on propellant or propelling charges and then duplicates this ignition train.

4. Operator gives hand signal for ignition of the fuze. The pan farthest from the direction of egress is lit first.
5. Operator activates the fuze igniter and confirms ignition by stating, "I see SMOKE." If fuze does not ignite, Operator repeats the attempt to ignite and uses the second ignition train if required. If both ignitors do not ignite the waste, Operator removes the fuze from pan, secures the site, and exits to secure additional igniters.
6. The burn is observed from a safe position.
7. When determined safe, Operators visually inspect the ash. Any unburned propellant/kickout is collected and re-burned once the pans are sufficiently cooled for another operation.

Post-Treatment

1. Operators complete a visual safety sweep around the pans to detect any brush fires.
2. When pans are cool enough for approach, treatment residue around the pan is cleaned up. If sufficiently cooled, the ash in the pan is also removed at this time. Residue is collected in appropriately sized-U.S. Department of Transportation (DOT)-approved containers for waste determination.
3. Pan lids are placed on top of pans at the end of the day's operations by forklift.
4. If pans are too hot to remove ash/residue from inside the pans at the end of the operating day, then it is removed prior to the next operating day's treatment event.
5. A Certificate of Destruction (Department of the Army [DA] Form 4508) is signed by the Supervisor and Quality Assurance Specialist (Ammunition Surveillance) (QASAS) or QASAS representative.
6. Recyclable materials such as lead seals and banding is collected and removed from the OB unit for subsequent turn-in for recycling through the MWR Qualified Recycling Program (QRP).

D-8a(2)(c)(ii) Open Detonation/Buried Detonation Unit

Operating Conditions

Treatment by BD is conducted by placing WMM/energetic waste and donor charges up to a combined weight of 100 lb NEW into a series of 30 pits that are prepared by bulldozer with a minimum of 3 feet thickness of soil between the bottom of each pit and bedrock, attaching detonation cord, covering the pits with a minimum of 6 feet of soils, and igniting electrically from firing controls within the safety bunker. The use of OD is limited to up to 20 lb NEW cleanup shots of donor material where there is no fragmenting hazard and thus no need for soil cover. The conduct of the operation for OD is the same as BD except that no soil cover is used. The OD/BD treatment process is instantaneous and results in complete destruction of the energetic component of the waste stream. Only metal fragments remain as visible residue from the treatment process.

General OD/BD operating conditions per BGAD demilitarization SOPs are as follows:

- OD/BD is conducted when the ground is amenable to digging of pits and occurs approximately from April through November.
- The use of personal electronics and cell phones is strictly prohibited during any operation involving exposed explosives or unpackaged munitions.
- OD/BD operations will not be initiated until at least ½ hour before sunrise and will be completed by at least ½ hour before sunset.
- The day's weather forecast is interpreted by the Planning Team from available predictive sources to include the National Weather Service at www.weather.gov (using the zip code 40475 for local forecast information from Madison Airport/Richmond, KY), Doplar radar, and the BGCA Emergency

Operations Center program called Webpuff, which is accessible at https://bluea0cmg-bwps1.csepp.army.mil/ via the Depot's secure intranet. Weather data for Lexington Bluegrass Airport, Bluegrass Field Weather Service, Flight ServiceWeather and Fort Knox, Kentucky also may be used. These data sources are interpreted to assess the conditions for the operating day and to make a general decision to proceed ("go") or not proceed ("no-go") with the day's planned OD/DB operations or if conditions are such that operations may proceed for a partial day (e.g., mornings but not afternoons). The following forecasted conditions will result in a "no-go" or decision to limit operations to a partial day:

- Forecasted electrical storms, thunderstorms, or high probability (50 percent or greater) thereof, as provided by Webpuff or the National Weather Service. Electrical storms and thunderstorms present a safety hazard to persons handling energetic materials and the Supervisor will always make a decision based on sound explosives safety principals.
- Forecasted precipitation or high probability (75 percent or greater), as provided by Webpuff or the National Weather Service.
- Forecasted visibility of less than 5 miles.
- Forecasted cloud cover greater than 80 percent and cloud ceiling less than 2,000 feet, as provided by Webpuff or National Weather Service.
- Forecasted persistent unfavorable wind speeds [i.e., very low (less than 3 mph) or very high (above 20 mph).
- Forecasted persistent unfavorable wind direction blowing from north to south.

- Note that none of the data sources listed above are "real-time" and also that weather conditions may change after a "go" decision has been made. For example, the National Weather Service may predict a thunderstorm or episode of rain, and Webpuff data (which is averaged over 15-minute increments) may indicate conditions indicative of a thunderstorm or rain, but the Supervisor may have clearly observed that the thunderstorm or rain has passed such that operations can begin or continue. The Supervisor has the authority and ultimate responsibility, based on position and experience to make the decision to load the pits, cap off (i.e., attach blasting caps), and detonate the WMM/energetic waste and is responsible for documenting the basis of the decision (i.e., source of forecast data and local observations). Such a decision will not be made without first consulting the available data sources. Note that the authority given the Supervisor recognizes changing weather conditions and the fact that weather forecasts are not real time. The Supervisor cannot override the weather restrictions for OB during lightning and precipitation but can authorize operations to proceed if it is clear by observation or weather data that the risk is reduced from the prior forecast. The Supervisor must suspend operations and evacuate the demo grounds, no exceptions, when the red light is on, indicating lightning is within 20 miles of BGAD and may not resume operations until the red light is off.
- After an initial "go" decision, the Supervisor will continue to monitor weather conditions during the day's pre-treatment procedures and has the authority and responsibility to suspend operations as needed until favorable conditions return. Any such decision along with the basis for the decision will be documented by the Supervisor.
- Prior to initiating capping operations (i.e., attaching blasting caps), the Supervisor will verify wind speed and direction. OD/BD will not be initiated when:
  - Surface average wind speeds are less than 3 miles per hour or greater than 20 mph (with gusts less than 30 mph) as provided by Webpuff Tower 1 or (if Webpuff is not functioning, the National Weather Service Madison Airport).

- Winds are blowing from 300 degrees to 65 degrees, where north is 360 degrees.
- The definitive data source for wind speed and direction will be Webpuff Tower 1 at the 60-m height, or National Weather Service Madison Airport (only if Webpuff is not available).
- A wind vane and anemometer have been installed at the Demo Grounds Office for localized, real time wind speed and direction information, and to serve as verification and to monitor for changes during the detonation sequence. The wind vane and anemometer will supplement existing data sources. The wind vane and anemometer will be in use during the 2017 operating season for a trial period to assess its usefulness. Future use of the wind vane and anemometer will be discussed with KDEP once sufficient data are gathered for evaluation.

- Operators will watch for airplanes, helicopters, etc., flying over the area during preparation for and during OD/BD operations and if an aircraft is spotted, will call for a “CEASE FIRE” until the airspace is observed to be clear.
- Just prior to detonation, two designated Observers will observe the sky in each of the four cardinal directions to the horizon to ensure there are no aircraft in the area.
- Prior to initiating the detonation sequence, a minimum of three Observers will be positioned to watch the detonation plume movement. Each of the Observers will ensure clear communication is established (via radio) and maintained with the Supervisor throughout the detonation sequence. If the detonation plume is observed to drift or begin to drift (e.g., due to a shift in wind direction) toward the south or southwest toward or onto public land, the Observer(s) will call for a “CEASE FIRE” until wind conditions are re-evaluated (via Webpuff or National Weather Service) and verified to be within the allowable restrictions and favorable by the Supervisor.
- Red flags posted at the Demo Grounds Office and at the safety bunker provide additional, localized, “real time” indicators of sudden shifts in wind direction.
- WMM/energetic waste with blasting caps attached present a potential safety hazard. When OD/BD operations are halted for any reason, including unfavorable weather conditions, safety dictates that the detonations must be completed by ½ hour before sunset of the operating day. If OD/BD operations are halted prior to attachment of blasting caps, WMM/energetic waste may remain in place in pits until conditions are favorable and requires that a security person be posted until the detonation operation can be completed.
- Typical equipment in use for OD/BD operations includes a bulldozer for digging of pits, forklift for unloading, fire extinguishers, galvanometer, and No. 47 radio pilot lamp.
- PPE includes leather gloves, safety shoes, short or long-sleeve coveralls, safety glasses or goggles, and hearing protection (as needed).
- A minimum of two personnel trained in demilitarization procedures will be present at the Demo Grounds during all OD/BD operations to observe the airspace and watch for weather changes.
- The galvanometer will be tested prior to each use by holding a piece of metal across its two terminals.
- The firing control circuit will be tested prior to each use with the galvanometer. If the circuit test indicates a break in the firing wire, the break will be located and repaired by splicing.
- The presence of radio frequency energy and/or extraneous electricity will be tested prior to OD/BD operations using a No. 47 radio lamp. Any glow in the lamp is viewed as evidence of the presence of possible dangerous amounts of radio frequency/extraneous electricity. If test is positive, operations will cease until the source is identified and eliminated.

- The door to the safety bunker (Building 274) will have two separate locks and the keys will be kept separately such that two responsible persons are required to open the safety bunker and access the firing controls.
- Pits are detonated in succession by command of the Supervisor.
- The shot configuration (i.e., how munitions are placed into the pits, type of munitions or combinations thereof, and what donor material is used and how it is placed) is determined by the Planning Team well in advance of operations and conveyed to operators through SOPs and instruction and in consideration of safety requirements. In no case does the shot exceed the 100-lb NEW limit.
- A mandatory 60 minutes wait time is required in the event of a misfire, low order detonation, or smoking round.
- Only two persons approach pits to investigate a misfire.

Procedures

The standard procedures for the conduct OD/BD operations are provided below:

Pre-Treatment

1. Meteorological conditions are verified by the Supervisor and the information noted on an Open Detonation Authorization Sheet.
2. A maximum of 30 pits are dug using bulldozers. Pits are dug approximately 8 to 10 feet deep with a distance of 25 feet or more between pits.
3. Boxed or palletized waste is removed from the carrier using a forklift.
4. Carrier is withdrawn to a safe location until destruction is complete.
5. Supervisor documents incoming material in logbook (date, document number, NSN, lot number, and quantity).
6. Operators de-palletize/unpack and remove banding (as required). WMM/energetic waste may arrive pre-configured in a box or pallet for direct placement into pits, otherwise Operators configure the shot per the SOP. Pre-configured boxes of WMM/energetic waste may already contain some donor materials; otherwise, donor materials may be added to boxes at the staging area. Lead seals and banding are placed into collection containers for recycling.
7. Operators receive donor charge material to include TNT, Comp B, C-4, Demo Blocks and/or detonation cord as determined by the Planning Team for the waste type. Strict accountability of donor material is maintained by documenting the NSN, lot number, and quantity in logbook.
8. Donor materials are unloaded no closer than 50 feet to the nearest pit and the carrier withdrawn to a safe location until destruction is complete.
9. Operators unpack donor material and remove banding (as required). Lead seals and banding are placed into collection containers for recycling.
10. Operators place donor materials in and around WMM/energetic waste.
11. Operators place two demolition blocks in/on each configured shot.
12. The red range flag is raised at the entrance to the Demo Grounds prior to initiating OD/BD operation.
13. Prior to receiving blasting caps, road and rail blocks are established and the Commander, Security, and the Public Affairs Officer (PAO) is notified that road/rail blocks are in place.

Treatment

1. All terrain forklifts are used to position boxed/palletized WMM/energetic waste/donor material in each pit.
2. Operators position boxed/palletized WMM/energetic waste/donor material in pits by hand using a two-man lifting procedure and maintain at least a five-pit separation distance from bulldozers during digging operations (not applicable to ground guide).
3. Operators dual prime the shot by securing detonation cord snugly to each of the two demolition blocks. Operators maintain a five-pit separation distance from bulldozers at all times.
4. Operators ensure demolition blocks (or C-4) is in contact with WMM/energetic waste items.
5. Operators close the box lids, allowing the detonation cord to protrude and exercising care to prevent accidental cutting of the cord.
6. Bulldozer operators cover WMM/energetic waste with at least 6 feet of soil, allowing at least 6 feet of detonation cord to protrude from the soil cover. A ground guide will use hand signals to guide the bulldozer operator.
7. When all pits are covered, all personnel withdraw to the Demo Grounds Office or safety bunker, except two Operators.
8. The two remaining Operators receive the blasting caps and test each using a galvanometer. Prior to handling electric blasting caps, Operators will physically ground themselves.
9. Operators attach a blasting cap a minimum of 6inches from end of each length of detonation cord protruding from the pits.
10. Operators attach firing wire (i.e., wire coming from junction box) to the lead wire of each blasting cap.
11. Operators return to the safety bunker, unlock the door, enter, and call (hard line phone or radio) the Demo Ground Office to verify personnel and equipment are clear. Open communication is maintained throughout the demolition sequence.
12. The firing panel covers are unfastened and a continuity check performed using a galvanometer. If continuity reading is not obtained, the Operators shunt the firing wires, ensure the Firing Control System is unplugged and firing panels are in “OFF” position, lock the safety bunker, and go down range to inspect firing wire and blasting cap for defects and to make repairs (as needed).
13. Detonations are initiated electrically by depressing the firing button on the panel or, if electric is not available, may be initiated by inserting lead wires attached to a blasting machine into the jack on the panel and pressing the handle down on the blasting machine.
14. Firing is under the direction of the Supervisor who is stationed at the Demo Ground Office (Building 270). If all conditions are favorable, shots may be fired as quickly as 15 seconds apart.
15. Verbal confirmation is given when all shots are fired.
16. Operators at the safety bunker will observe the OD/BD unit area with binoculars.
17. Misfire procedures and/or responses to smoking rounds, UXO, or low order detonations will be followed as required.

Post-Treatment

1. Two Operators complete a safety sweep of the OD/BD unit looking for unexploded items.
2. If the area is clear, Operators will announce “ALL CLEAR” by phone or radio and the work crew will proceed down range.

3. Misfire procedures and/or responses to smoking rounds will be followed as required.
4. Surface exposed metal fragments will be collected and placed into a collection container for further management in accordance with Material Potentially Presenting an Explosive Hazard (MPPEH) procedures.
5. A Certificate of Destruction (DA Form 4508) is signed by the Supervisor and QASAS (or QASAS representative).
6. Recyclable materials such as lead seals and banding is collected and removed from the OD/BD unit for subsequent turn-in for recycling through the Depot's QRP.

MPPEH Procedures

1. Munitions related scrap metal debris is managed as MPPEH in accordance with Department of Defense Instruction (DoDI) 4140.62.
2. Operators responsible for picking up and inspecting munitions-related scrap metal onsite wear leather gloves and do not directly contact the scrap metal.
3. Munitions related scrap metal debris collected at the OD/BD unit undergoes two 100 percent inspections by two different Operators before placing it in a collection bin at the OD/BD unit.
4. Munitions related scrap metal debris is subsequently certified as free of explosive hazard by third inspector (who completes a visual inspection of a sampling of the scrap metal debris).
5. Munitions related scrap metal debris is then verified as free of explosive hazard by a QASAS or Ammunition Inspector working under a QASAS by signing a statement on a DA Form 1348. Following verification on a DA Form 1348, the scrap bin is removed to the flashing furnace for flashing prior to recycling (i.e., through the MWR QRP).
6. Scrap metal debris is moved mechanically and typically would not be handled.
7. Personnel working in the QRP yard also wear leather gloves in the rare circumstance that they would physically handle scrap metal.
8. Munitions-related scrap metal is transferred offsite for recycling. Scrap metal that is recycled is not a solid waste and not subject to Subtitle C controls.

Procedures for Smoking Rounds or Pits, Misfires, Low Order Detonations and/or UXO

1. In case of smoking round or pit or misfire, all personnel withdraw to safety bunker or Demo Grounds Office (Building 270) and wait for 60 minutes from misfire or after the round/pit has finished smoking.
2. One qualified person will approach the round/pit, while the second remains clear using natural barriers or obstructions for protection and maintaining line of site.
3. If a misfire occurs, the qualified person will inspect firing wire and blasting cap for defects and make repairs to firing wire and/or remove and replace the defective cap (defective cap is taped to detonation cord and will thus be detonated with the shot). Personnel evacuate to the safety bunker and follow standard procedures to initiate the charge.
4. Any time that UXO or a low-order item (i.e., partially exploded) is identified, the location will be marked with a red flag and the item inspected to see if it is safe to move to a pit for detonation. If the item is fuzed or determined to be unsafe, then it will be destroyed in place per the below procedure.
5. If detonation of misfire, low order detonation and/or UXO cannot be achieved using the in place firing system and initiated from the safety bunker for any reason, the item in question will be detonated in place using a fuse igniter, safety (time) fuse, demolition block (e.g., TNT, C4, or plastic

explosives), and non-electric blasting cap. All personnel except the two ignition Operators evacuate to the safety bunker or Demo Grounds Office, and Operators ignite the safety (time) fuze and evacuate a minimum of 2,500 feet.

D-8a(2)(c) Maintenance, Monitoring and Inspection [40 CFR 270.23(a)(2) and 40 CFR 264.602]

A program has been established to inspect, monitor, and maintain all components of the OB and OD/BD units. Inspections are conducted in order to prevent, detect, and respond to situations that may pose a risk to human health or the environment, as detailed in Part F of this permit application. The Inspection Schedule is included as Table F-1 and F-2 in Part F of this permit application. Ammunition Maintenance and Demilitarization Division personnel conduct inspections before and after each treatment operation. While the Ammunition Maintenance and Demilitarization Division is primarily responsible for site inspections, as discussed in Part F, the Division is supported by other facility organizations such as security, the Environmental Office, and the fire department, as discussed in Part F. While Division personnel may complete minor repairs and are responsible for identifying the need to repair or replace equipment (through submittal of a work order, as needed), major repairs are the responsibility of the Directorate of Public Works (DPW) and funding for repairs and replacement (i.e., corrective action) are the responsibility of various entities including Mission Management, DPW/Environmental Office, and JMC.

The pans used for the OB treatment process may warp over time as the result of extreme heat and cooling. Pans may also deteriorate over time. Replacement of pans is considered a maintenance activity and, as long as dimensions remain unchanged, not considered a modification to the operating unit or requiring a permit modification. In the event that burn pans deteriorate or are damaged and require replacement, BGAD will notify KDEP in writing but will not initiate a permit modification. Should the pan design or dimensions change, a permit modification would be initiated.

D-8a(2)(d) Closure [40 CFR 270.23(a)(2)]

Closure of the Miscellaneous Units is addressed in Part I of this permit application.

D-8a(3) Disposal Units [40 CFR 270.23(a)(3)]

Contingent post-closure care (in the event the Miscellaneous Unit(s) re required to be closed with waste in place (i.e., as a disposal unit) is addressed in Part I of this permit application.

D-8b Detailed Hydrologic, Geologic, and Meteorologic Assessments to Address Environmental Performance Standards [40 CFR 270.23(b)]

Information pertaining to hydrologic, geologic and meteorologic assessments to address the Environmental Performance Standards of 40 CFR Part 264.601 has been consolidated to Part E of this permit application.

D-8c Information on the Potential Pathways of Exposure of Humans or Environmental Receptors to Hazardous Waste or Hazardous Waste Constituents and the Potential Magnitude and Nature of Such Exposures [40 CFR 270.23(c)]

Potential pathways of exposure of humans and environmental receptors, and the potential magnitude and nature of such exposures, have been addressed through an air modeling and risk assessment analysis that is presented in Volume II to this permit application. The analysis addresses offsite human receptors and onsite human receptors that are not OB and OD/BD operators. OB and OD/BD operators are protected by the Occupational Safety and Health Administration (OSHA), are provided with PPE specific to site hazards, and are enrolled in a medical surveillance program.

D-8d Report on the Demonstration of Effectiveness of Treatment [40 CFR 270.23(d)]

OB and OD/BD are effective treatment processes for WMM/energetic wastes disposed of at BGAD. The military energetics contained in the items result in the classification of these items as reactive (D003) because of their potential to explode. Energetics are designed to explode or burn vigorously and react completely when exposed to an initiating source. These explosions, or vigorous reactions, occur whether they are used as designed in warfare or treated by OB and OD/BD. The BGA OB and OD/BD treatment processes are designed to ensure that complete reaction occurs. In the case of OD/BD, the quantity and placement of donor explosive material is designed to direct explosive forces toward the waste item to ensure that all the energetics contained in the waste materials are destroyed. In the case of OB, placement into pans helps to ensure that the maximum quantity of oxygen is available to ensure complete combustion.

Two lines of evidence demonstrate that OB and OD/BD is an effective treatment method for D003 wastes. These are (1) physical transformations of the D003 waste material as shown by visual observation and (2) test data of OB and OD emissions and treatment residues.

D003 waste items treated by OD/BD generally consist of the energetics and components that are enclosed in a metallic case. Energetics have a discrete physical form (block, plug, granule, etc.). Following complete detonation, the only potential residue is metal fragment. The OD/BD area is inspected and metal fragments removed. Metal fragments that are collected and removed are visually inspected for evidence that the energetic component of the item has been treated. The presence of metal fragments that are free of explosive hazard and the reactivity characteristic is evidence that the energetics have been effectively destroyed by the detonation.

OB results in the generation of treatment residue. Treatment residue can be generated only as the result of combustion. The physical form of treatment residue is distinctly different from unburned energetics. Treatment residue is a fine powdery or feathery material, while energetics have a distinct physical form. Therefore, the presence of treatment residue, which is free of energetics, is evidence that the energetics have been effectively destroyed by the burning.

DoD has evaluated the effectiveness of the OD treatment process. The U.S. Army's Dugway Proving Ground (DPG) conducted a series of trials to identify and quantify emissions produced by OD of energetic items. The best available technologies were used to detect and quantify emissions, and all detected emissions were identified except for some compounds not in current spectra libraries. All trials were conducted at the DPG within a flexible test chamber, commonly known as the BangBox, using a thermal treatment emissions system successfully audited by environmental agencies.

In these tests, a laboratory assay was conducted using supercritical fluid chromatography/mass spectrometry, gas chromatography/mass spectrometry, or both. High performance liquid chromatography was used in a few instances for comparison. Statistical analysis included characterization of the BangBox chamber using results obtained from sulfur hexafluoride (SF_6) tracer gas released and sampled during each trial, and calculating emission factors from the results of laboratory assay after considering flow rates as recorded by the Data Acquisition System, chamber atmosphere dilution as determined from SF_6 concentration data, and background. EPA provided Quality Assurance (QA) support for the test. Representatives from EPA's Atmospheric Research and Exposure Assessment Laboratory's QA Division visited the test site and supporting laboratories. In all instances, nearly all carbon in the explosive mixtures was converted to carbon dioxide (CO_2) during the detonation processes. All detected emissions were found at very low levels, typically at the parts per trillion or not detectable range.

D-8e Additional Information [40 CFR 270.23(e)]

D-8e(1) Noise Considerations

The Noise Control Act requires federal facilities to implement measures to reduce noise emissions. Generally, federal agencies whose activities result in increased environmental noise in the surrounding community are responsible for compliance with state and local environmental noise requirements. The operating federal agency is responsible for conducting studies necessary to determine the impact of environmental noise on the surrounding community and for making the community aware of these impacts.

For the purposes of this application, noise is defined as “unwanted” sound caused by activities that are not part of the natural setting of a locality and that are heard as such by people and animals. Noise is superimposed on the background (ambient) environment, and combined effects of superimposed noise and ambient noise can be measured by standardized sound level meters that provide a measurement of sound level in decibel (dB) units.

Studies have shown that extensive noise exposure on humans has adverse physical impacts, with hearing impairment the most prominent effect. Damage to hearing is common to those who experience extended noise levels of 100 dB and greater. The threshold for pain occurs at 140 dB.

Existing Noise Environment

In order to address community noise issues, BGAD has established a proactive noise management program implemented through the BGAD Installation Operational Noise Management Plan. The plan quantifies the noise environment from operational sources using Army noise assessment metrics defined in Army Regulation (AR) 200-1, supplemented by metrics applied to predict the probability of community noise annoyance and complaints. Other elements of the plan include education about noise and Army noise metrics, complaint management, and when necessary, noise abatement procedures.

Through AR 200-1, noise exposure on communities is translated into Noise Zones. AR 200-1 lists housing, schools, and medical facilities as examples of noise-sensitive land uses. Regulation guidelines state for land use planning purposes, noise-sensitive land uses are acceptable within the Noise Zone I, normally not recommended in Noise Zone II, and not recommended in Noise Zone III. The Land Use Planning Zone (LUPZ) is a subdivision of Zone I. The LUPZ is 5 dB lower than Zone II. Within this area, noise-sensitive land uses are generally acceptable. However, communities and individuals often have different views regarding what level of noise is acceptable or desirable. To address this, some local governments have implemented land use planning measures beyond the Zone II limits. Additionally, implementing planning controls within the LUPZ can develop a buffer to avert future noise conflicts. AR 200-1 offers land use recommendations, which, if adopted both on and off the Depot, would facilitate future development that is unaffected by military noise.

The existing noise environment at BGAD was assessed in 2014 by the U.S. Army’s Medical Command and Noise Zones generated through modeling to describe the noise environment. The resulting Noise Zones for OD/DB operations are shown on Figure D-1. The Noise Zones are based on daily operation totals of up to 6,000 lb NEW per day and are averaged over 250 days.

For OD/BD operations, the Noise Zones are expressed in terms of C-weighted Day-Night Level (CDNL) (dB), where the LUPZ is defined as 57 to 62 CDNL (dB), Zone I as <62 CDNL (dB), Zone II as 62 to 70 CDNL (dB) and Zone III as >70 CDNL (dB). These Noise Zones show that the greatest annual impact outside of the Depot boundary is concentrated geographically south of the installation. The LUPZ extends beyond the Depot boundary by approximately 540 m. Zone II extends beyond the southern Depot boundary to a much lesser degree (<150 m) and Zone III is entirely contained within the Depot boundary. Because these Noise Zones are expressed as an annual average, and since OD/BD operations are seasonal, the Noise Zones contain days with detonation activity and many days without.

Although using the CDNL has proven effective for long term land use planning, it may not provide an accurate picture of a busy day when OD/BD operations are active. For this purpose, a 24-hour C-weighted Equivalent Noise Level (LCeq) was assessed and as depicted in Figure D-1. This LCeq is based on the same NEW totals as the CDNL. However, by removing inactive days and concentrating on a single active busy day, the LCeq can identify area that have a greater potential for increased noise doses during frequent OD/BD activity. This busy day assumes 60 detonations in one 24-hour period (2 sequences of 30 pits each). The 24-hour LCeq would not be used for land use planning purposes, but rather it provides an indication of areas that may periodically be exposed to higher noise levels than shown in the CDNL Noise Zones. As seen on Figure D-2, the 62 dB contour (outer edge of color variant) extends roughly 1,500 m beyond the south boundary and the 70 dB contour extends nearly 500 m.

Peak levels are useful for estimating the risk of receiving a noise complaint as they correlate with the receiver's perception of noise levels. Noise complaints typically are attributable to a specific event rather than annual average noise levels. The Army's Complaint Risk Guidelines indicate that the risk of receiving noise complaints is low at <115 dB Peak, Moderate at115 to 130 dB Peak, and High at >130 dB Peak. Peak levels can vary significantly for the same activity dependent on weather conditions. Generally, several different weather scenarios will be considered when assessing complaint risk potential. However, because BGAD has implemented specific OD/BD meteorological restrictions, only one weather scenario was considered. PK50 (met) is the Peak level that would be expected 50 percent of the time. These levels would be expected during neutral weather conditions, or those conditions that do not favor noise propagation in any given direction. Figure D-3 depicts the complaint risk areas for OD/BD activity under neutral weather conditions. The Moderate Complaint Risk area extends beyond the installation boundary to the south 1.4 kilometers, while the High Complaint Risk area remains within the BGAD boundary. Based on complaint risk guidelines, the risk of complaints from OD/BD operations during neutral weather conditions is considered moderate.

In addition to the modeling analysis, onsite monitoring was performed in June 2014 to address complaints at that time. The purpose of onsite monitoring was to determine actual sound levels from OD/BD operations at the southern boundary and to determine if further mitigation techniques were feasible. Noise monitors were placed at three outdoor locations, two just inside the fence line along the south boundary and one along the north boundary. Monitored levels at these sites were less than the predicted levels, suggesting that modeling is a good predictor of actual noise levels and that the noise levels just outside the south boundary correlate with Moderate complaint risk. Monitored results at the north boundary location showed that noise from detonation activities was barely audible.

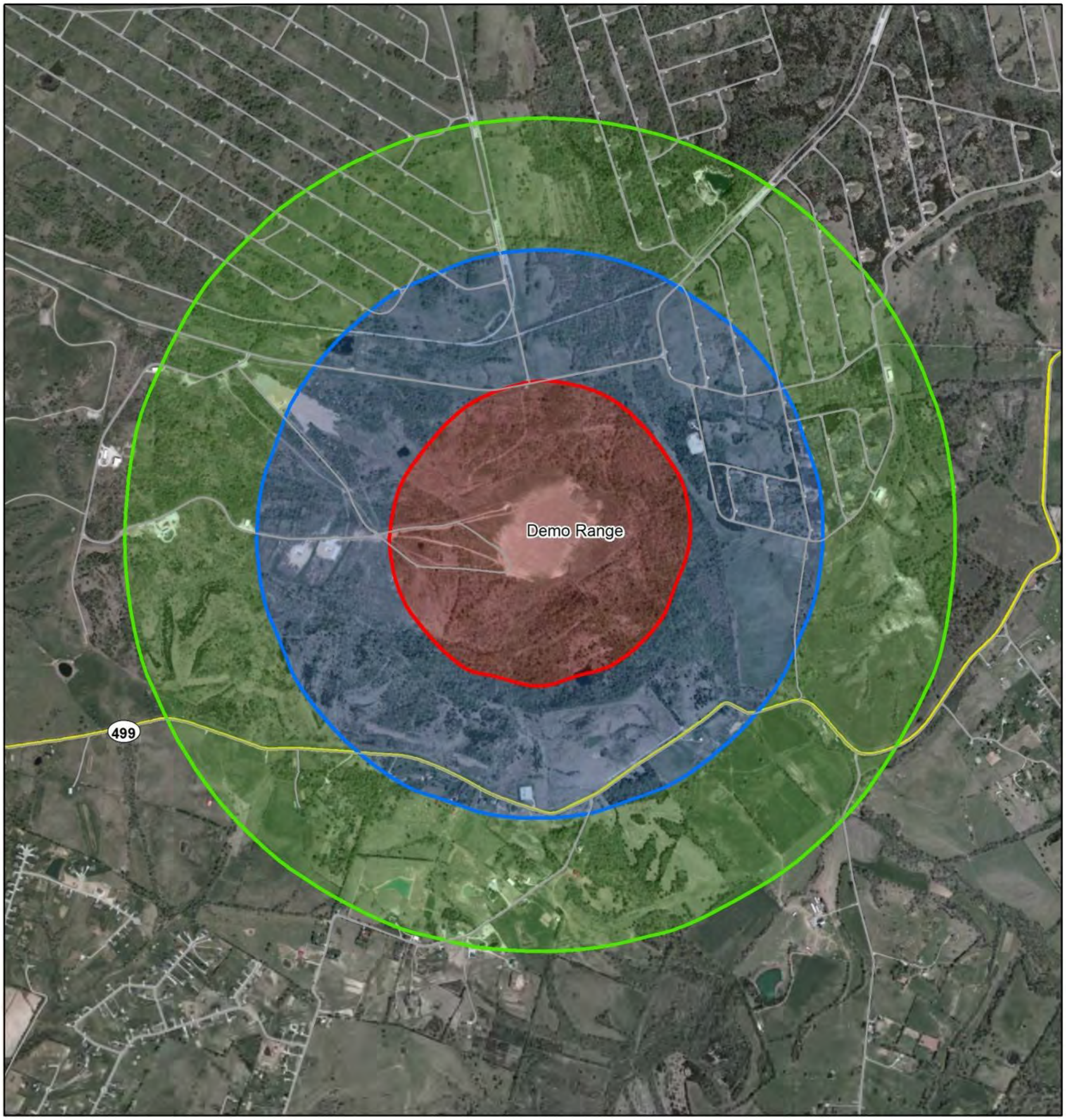
While population centers around BGAD are primarily northwest (Richmond) and southwest (Berea), several single-family subdivisions and singular homes are scattered throughout the areas just south of the Depot boundary. Based on the assessment and according to Army guidelines, the noise from OD/BD is considered compatible with the majority of surrounding land use. The LUPZ and Zone II extend beyond the southern boundary, while Zone III remains contained to the Demo Grounds. Agricultural lands account for 84 percent of the land within LUPZ and Zone II. However, although zoned for agricultural use, several homes scattered within these areas are contained within the LUPZ. According to complaint risk guidelines, there is a Moderate risk of noise complaints from OD/BD operations during neutral weather conditions. The High Complaint Risk area does not extend beyond the Depot boundary. The Moderate Complaint Risk area extends beyond the Depot boundary to the south. There are noise-sensitive land uses just south of the boundary contained within the Moderate Complaint risk area.

It is important to note that the noise environment outside the Demo Grounds changes on a seasonal basis with quiet periods (November to March) and noisy periods (April to November). Thus, with a relatively low ambient noise environment, noise complaints would more likely occur in the early months when OD/BD operations resume.

Noise Management Program

The BGAD noise management program is described in its Installation Operational Noise Management Plan. The plan is designed to provide the information needed so installations can work with communities to solve issues of noise incompatibility. The plan, along with an effective noise complaint procedure, have been implemented at BGAD to address complaints, to advise local planning commissions of the BGAD noise environ, and to assist in developing action plans that limit future encroachment threats.

BGAD has imposed restrictions based on meteorological conditions that mitigate OD/BD noise. Wind and temperature significantly influence how far sound travels from a source, and how loud it will be at the receiver's location. As sound travels through air, a receiver downwind of the source will be subjected to higher sound levels than a receiver upwind; in effect, the wind is actually helping move the sound to the downwind receiver. BGAD restricts OD/BD operations when winds are blowing from 300 to 65 degrees where north is at 360 degrees.



LEGEND

- LUPZ - 57-62 dB CDNL
- Zone II - 62-70 dB CDNL
- Zone III - >70 dB CDNL
- BGAD Boundary

0 1,000 2,000 4,000 Feet

0 250 500 1,000 Meters

Source: ESRI, BGAD, USAPHC
Date: August 2014

N
W E
S

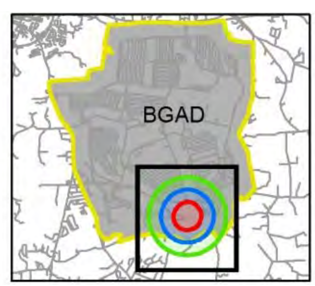
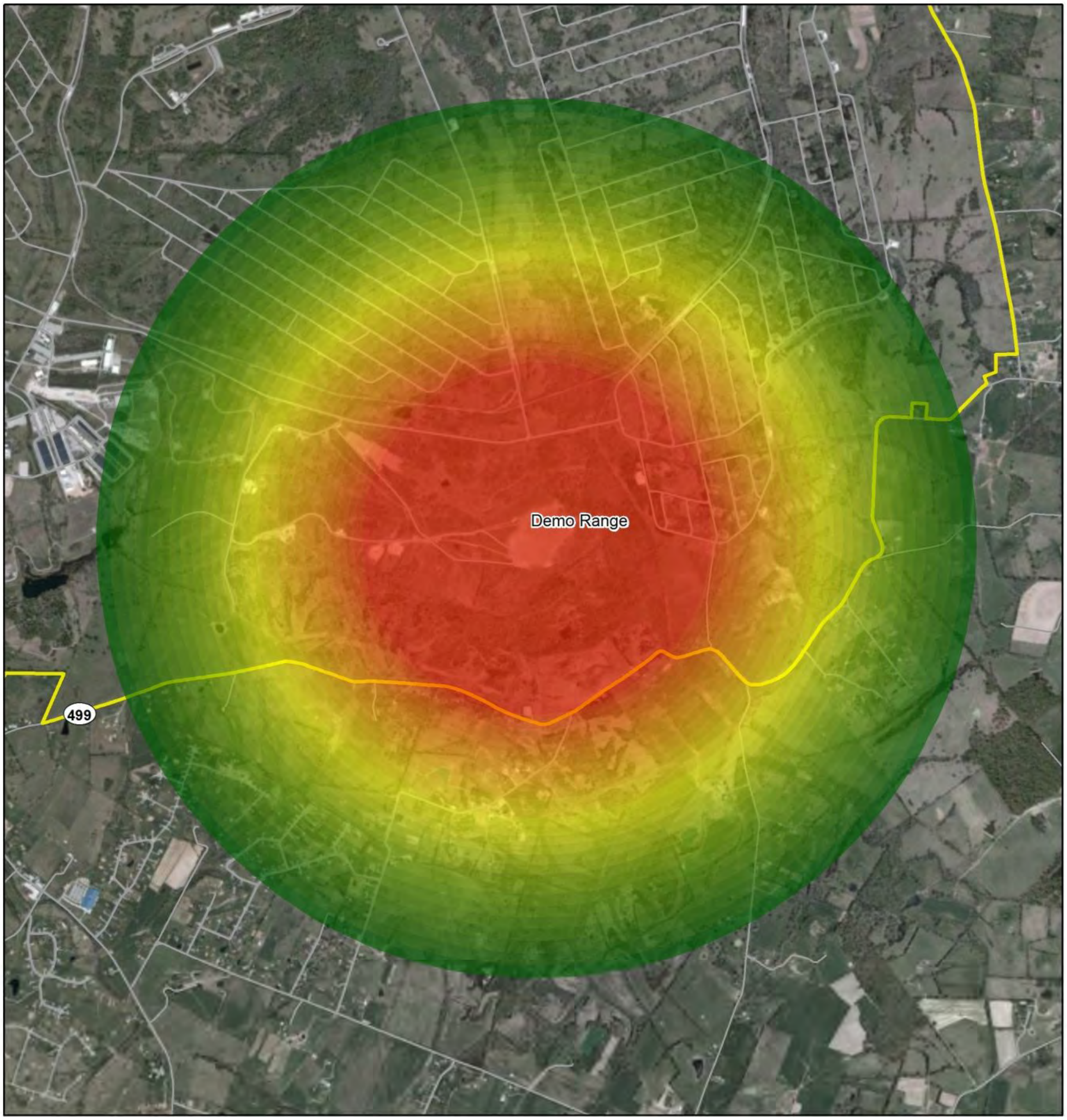
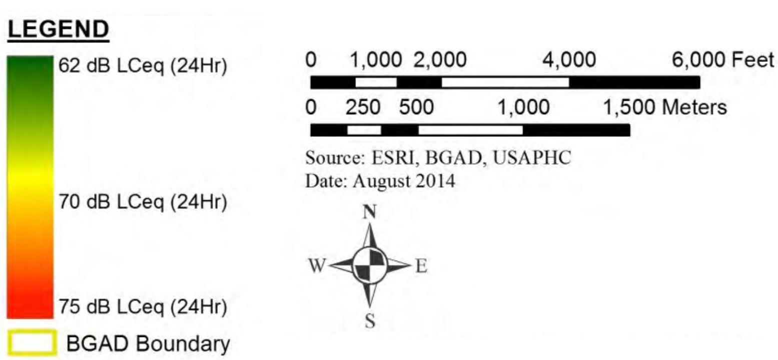


FIGURE D-1
Open Detonation Operations
CDNL Noise Zones
Blue Grass Army Depot
Madison County, KY

CH2MHILL.





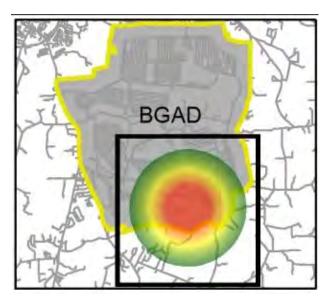


FIGURE D-2
24-Hour LCeq Supplemental Noise Levels
Blue Grass Army Depot
Madison County, KY

CH2MHILL

LEGEND

- Moderate Complaint Area 115-130 dB PK50(met)
- High Complaint Area >130 dB PK50(met)
- BGAD Boundary

0 1,000 2,000 4,000 6,000 Feet

0 250 500 1,000 1,500 Meters

Source: ESRI, BGAD, USAPHC
Date: August 2014

N W E S

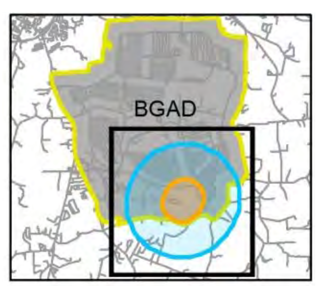


FIGURE D-3
Open Detonation Operations Complaint Risk Areas (Neutral Weather)
Blue Grass Army Depot
Madison County, KY

Complaint Management

Experience has shown at Army installations that a centralized procedure to log and investigate noise complaints is most effective when responding to public inquiries. This makes monitoring, recording, and archiving noise complaints more efficient and useful. Specific procedures are in place to effectively manage public complaints. The BGAD Public Affairs Officer is the single point of contact for all inquiries regarding noise and vibration. The contact phone number is listed on BGAD's public web page. The PAO responds to each complaint, generally within 24 hours. A log is maintained containing pertinent information about each complaint/inquiry, such as the date, name address, contact information, the nature of the complaint, and the action taken. The goal of a complaint procedure is to reduce the potential for noise complaints by keeping the public informed about what is happening and to satisfy the complainants so that noise complaints do not escalate.

Table D-1 provides a tabular and narrative summary of all complaints received related to OB and OD/BD activities from 2013 to 2016.

Public Awareness

The PAO is responsible for the public awareness function of the complaint management program. Public awareness involves providing information to the public regarding complaint procedures, ongoing efforts to reduce noise, as well as informing the public of upcoming unusual or exceptional noise events. The PAO telephone number is published in community relations articles and pamphlets, and announced during local television and radio programming when necessary.

D-8e(2) Airblast

The nearest inhabited facility is conservatively assumed to be located at the nearest installation boundary, 2,000 feet south of the OD/BD unit. This distance is more than adequate to comply with minimum separation distances as required by DoD regulation. DoD [DoD 6055.09, DoD Ammunition and Explosives Safety Standards: Criteria for Unexploded Ordnance, Munitions Response, Waste Military Munitions and Material Potentially Presenting an Explosive Hazard, Volume 7, February 29, 2008, Administratively Reissued August 4, 2010, Chapter V7.E3.7 Minimum Separation Distance (MSD) for UXO] uses the following equation to calculate minimum safe distances for blast overpressure for a given NEW quantity:

$$D = K \times \sqrt[3]{W}$$

Where:
D = the required distance in feet
K = the protection factor (328 for disposal ranges)
$\sqrt[3]{W}$ = the cube root of NEW in pounds

For OD operations at BGAD,

D = 328 × (cube root of 100)
D = 1522.44 feet

Table D-1. Summary, BGAD Open Burning and Open Detonation/Buried Detonation Complaints, Calendar Years 2013 - 2016

Total Complaints	No. of Individuals Registering Complaints	OB	ODBD	Dates	Complaint Characteristics (Some calls describe multiple characteristics)						
					Vibrations	**Noise, Too Strong**	**Smoke**	**Ash/Dust**	**Disturbed Animals**	**Damage**	**Time of Day**
2013											
7	7	0	7	Jun - Aug	7						
2014											
10	10	0	10	May - Oct	5	2	1	2	1	1	
2015											
25	17	0	25	May - Oct	11	13	1	1	3	8	1
2016											
5	3	0	5	Jul - Nov	2	2			1	1	
				Total Complaints by Category	**25**	**17**	**2**	**3**	**5**	**10**	**1**
				% by Category	**39.7%**	**27.0%**	**3.2%**	**4.8%**	**7.9%**	**15.9%**	**1.6%**

During the past four years of operations, BGAD received 47 complaints regarding its demo operations. All complaints were related to OD/BD operations. No complaints have been received regarding OB operations. Most were received in 2015, with a dramatic decrease in complaints in 2016. Approximately 55.5% of the complaints were related to vibration, perceived vibration, or damage related to vibration. Complaints regarding noise made up approximately 27% , and complaints related to disturbance to animals or disturbance during published non-operational days or hours made up approximately 9.5%. The remaining 8% of complaints were attributed to visible smoke and/or ash/dust outside of the BGAD property boundary. BGAD operates OB/BD under strict meteorological conditions to mitigate the potential for visible smoke/ash/dust moving off the installation. To further address this issue, following the 2015 season, BGAD added a third observer (discussed in Section D-8a(2)(c)(ii) stationed outside the southern BGAD boundary to monitor changing wind conditions. The observer has the authority and responsibility to halt OD/BD operations in the event that smoke/ash/dust is observed moving off the installation.

D-8e(3) Ground Vibration

30 CFR 816.67(d) allows the use of a scaled-distance factor to determine whether ground vibration restrictions are met without seismic monitoring. The regulation states that at 301 to 5,000 feet from the blasting site, a scaled-distance factor of 55 should be used in the equation below:

$$W = (D/Ds)^2$$

Where:
W = the maximum weight of explosives, in pounds
D = the distance, in feet, from the blasting site to the nearest protected structure
Ds = the scaled-distance factor.

For BGAD, where the maximum weight of explosive is 100 lb:

$$100 = (D/55)^2$$

D = 550 feet (the required distance to the nearest protected structure)

The potential impact of ground vibration is insignificant, and no potential health impacts are expected. Therefore, no program to measure or mitigate ground vibration is warranted.

D-8e(4) Minimum Protective Distances [40 CFR 265.382]

Table D-2 presents minimum protective distances specified in 40 CFR 265.382 for OB and OD/BD.

Table D-2. Minimum Protective Distances

Pounds of Waste Explosives or Propellants	Minimum Distance from OB or OD to the Property of Others
0 to 100	204 m (670 feet)
101 to 1000	380 m (1,250 feet)
1001 to 10000	530 m (1,730 feet)
10001 to 30000	690 m (2,260 feet)

The maximum pounds of explosive detonated at BGAD during a single treatment event is 100 lb NEW. The distance to the BGAD boundary from the perimeter of the OD/BD unit is approximately 2,300 feet.

The blasting standards at 805 KAR 4:020 were reviewed for this submittal. The standards establish a maximum peak particle velocity of the ground motion in any direction of 2 inches per second at the immediate location of any dwelling house, public building, school, church, commercial or institutional building (“excluding the property owned, leased or contracted by the blaster”). The standard also requires a delay time of 8 milliseconds between consecutive subcharges within any charge.

For purposes of this review, the nearest off-site residence is assumed to be located at the nearest installation boundary 2,000 feet from the OD/BD unit. Typical time between pits is 15 seconds to 1 minute; therefore, each is considered a charge and not a subcharge. The total weight of explosives per pit is 100 lbs. Applying the formula $W=(D/50)^2$, the calculated allowable total weight of explosives per charge at 2,000 feet is 1,600 lbs.

The expected peak particle velocity can be determined by $PPV = K \times SD^{1.6}$ (where K is the ground transmission constant [and 160 is used if no other seismic data is available] and SD = scaled distance factor which is determined as $D/W^{1/2}$). For BGAD, where D=2,000 feet and W = 100 lbs, the SD=200 and the PPV = 0.033 in/sec.

At BGAD, where the distance to the nearest installation boundary is 2,000 feet, a detonation of approximately 16,500 lbs would be required to approach the 2 inch per second regulatory allowance.

D-8f Environmental Performance Standards [40 CFR 264.601]

RCRA Subpart X does not specify minimum technology or monitoring requirements for miscellaneous units, but specifies an environmental performance standard that must be met through conformance with appropriate design, operating, detection, and monitoring provisions, as well as requirements for responses to releases of hazardous waste or hazardous constituents from the unit. This performance-based standard requires the prevention of releases that present an unacceptable level of risk to the groundwater or subsurface environment, surface soil, surface water, wetlands, and air.

The evaluation and protection of these media, with the exception of air, are addressed in Part E of the permit application. Where applicable, implementation of media-specific monitoring programs during the operational life of the OB and OD/BD units, as permitted units, will ensure detection and protection through corrective action, as needed. Impact to air has been assessed through air modeling, human health risk assessment (HHRA) and a screening level ecological risk assessment (SLERA). The assessment and results are presented in Volume II to this application.

D-8c(3) Design Features and Operational Procedures that Minimize Potential Adverse Effects on Human Health and the Environment

Human Health

OB and OD/BD operations are conducted in a manner that is safe for the waste handler. OB and OD/BD operations are conducted in accordance with operating procedures defined by and approved by the DA. These operating conditions and procedures are detailed in Part D-8a of this permit application. In addition, procedures to prevent hazards during OB and OD/B operations have been developed and are included in Part F of this permit application. An OB and OD/DB Contingency Plan has been developed that describes procedures for dealing with emergencies resulting from OB and OD/BD operations. The Contingency Plan is included in Part G. All workers responsible for conducting OB and OD/BD operations are trained to conduct their job function as described in Part H.

Operation of the OB and OD/BD units is conducted in accordance with BGAD SOPs. SOPs are reviewed and updated annually or whenever a change in operations occurs. The SOPs pertaining to the conduct of OB and OD/BD are required to be read and signed by Ammunition Maintenance and Demilitarization Division personnel with duties at the unit at least once per quarter during continuing operations and after absence from the job in excess of 15 consecutive work days.

The following is a list of additional engineering controls and operational procedures that mitigate releases that may have adverse effects on human health:

- **Site Security –** includes site security controls (fences, gates, patrols, badging requirements) limit access of the public, trespassers, and onsite personnel without a need to the OB and OD/BD units and any waste or waste constituents that may be present there.
- **Mechanized Heavy Equipment –** is used to transport and transfer wastes and to dig pits, thereby limiting direct exposure by personnel.
- **Personal Protective Equipment –** protective clothing including gloves and long-sleeve coveralls mitigates direct personal exposure to hazardous waste or waste constituents.
- **Withdrawal –** personnel withdraw away from the waste treatment site during active treatment, withdrawing upwind from any plume.
- **Restrictions –** no other routine activities other than inspections and groundwater sampling activities take place at the OB and OD/DB units. Hunting and cattle grazing are not authorized within the Demo Grounds area of the Depot.

- **Medical Surveillance –** operators are monitored through the BGAD medical surveillance program. The surveillance program requires annual physical examinations and blood testing of all operators for early detection of potential health concerns.
- **Meteorological restrictions –** restrictions on wind direction during OD/BD operations mitigate the potential for emissions to impact nearby offsite receptors. Restrictions on minimum wind speed facilitate plume dispersion.

As previously noted, a risk assessment to evaluate potential effects on human receptors outside of the treatment area and outside the Depot boundary, has been conducted and submitted as Volume II to this permit application.

Environment

In addition to assessment of potential impacts to ecological receptors as part of a risk assessment presented in Volume II, and the monitoring program established in Part E of this application, the following is a list of engineering controls and operational procedures that mitigate releases that may have adverse effects on the environment due to migration of waste constituents on the soil surface, the subsurface, in the groundwater, in surface water or wetlands:

Containment – OB is conducted in a containment device (burn pan) that provides protection to the soil surface/subsurface environ, groundwater beneath the unit and nearby surface water (i.e., the unnamed southern tributary of Muddy Creek).

Lids – cover the interior of pans and any residuals from precipitation and prevents accumulation and overflow of potentially contaminated rain water; thereby providing protection to the soil surface/subsurface environ, groundwater beneath the unit and nearby surface water (i.e., the unnamed southern tributary of Muddy Creek).

Barrier – OB pans are on top of concrete pads, which provide a barrier to ash/residue that is generated from burning of time fuzes or kickouts from the pan, thereby providing protection to the soil surface/subsurface environ, groundwater beneath the unit and nearby surface water (i.e., the unnamed southern tributary of Muddy Creek).

Drainage Swales – the area surrounding the OB pans has been graded and drainage swales constructed with riprap to divert surface water run on around the concrete pads; thereby mitigating contaminant run-off from the pads and providing protection to the soil surface/subsurface environ, groundwater beneath the unit and nearby surface waters (i.e., the unnamed southern tributary of Muddy Creek).

Sediment Catchment Basin – the basins have been constructed downgradient of the OB units to capture potentially contaminated sediment or particles that may run off of the concrete pads, thereby mitigating contaminant run-off from the and providing protection to the soil surface/subsurface environ, the unit and nearby surface waters (i.e., the unnamed southern tributary of Muddy Creek).

Diversionary Grading – the OD/BD unit is graded to divert surface water run-on around the active treatment unit, thereby mitigating contaminant run-off and providing protection to the soil surface/subsurface environ and nearby surface waters (i.e., the unnamed southern tributary of Muddy Creek).

Permanent Sediment Controls – riprap barriers have been constructed in two locations (east and west) along the southern boundary of the OD/BD unit just north of the unnamed southern tributary/west of Muddy Creek. Sediment that has accumulated as a result of the barriers has promoted vegetation growth in this area; thereby further mitigating sediment run-off from the unit. As part of routine maintenance activities, sediment that has accumulated in this area may be excavated and redistributed within the OD/BD unit. At no time is sediment or soil intentionally removed from within the OD/BD unit boundaries. In addition, as part of routine maintenance activities, soils may be brought onto the OD/BD unit to supplement the existing soil liner and to provide sufficient soil cover. Prior to the 2016 operational season, 6,080 tons of soil was placed at the unit from an off-site source. Prior to 2016, it is estimated that soils were last introduced to the unit 8 to 10 years ago. Information pertaining to soil volume and source of soil for placement at the OD/BD unit is retained by the BGAD contracting office. These barriers mitigate sediment run-off, thereby mitigating contaminant run-off from the OD/BD unit and providing protection to the soil surface/subsurface environ, groundwater beneath the unit and nearby surface waters (i.e., the unnamed southern tributary of Muddy Creek).

Pits – pits are filled and regraded when precipitation is expected or when the OD/DB unit is not operational to mitigate the collection/infiltration of surface water, thereby mitigating potential contaminant infiltration and providing protection to the subsurface environ and groundwater beneath the unit.

Solid wastes – only solid wastes and no liquid wastes are treated, thereby mitigating spill potential and providing protection to the soil surface/subsurface environ, groundwater beneath the unit and nearby surface waters (i.e., the unnamed southern tributary of Muddy Creek).

Accelerants – no accelerants (e.g., diesel fuel) are used at either the OB or OD/BD units, thereby mitigating spill potential and reducing potential contaminants and providing protection to the soil surface/subsurface environ, groundwater beneath the unit and nearby surface waters (i.e., the unnamed southern tributary of Muddy Creek).

Appendix D-1
OB Unit Drawings and Diagrams

APPENDIX D-1

Table of Contents

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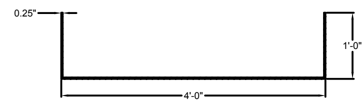
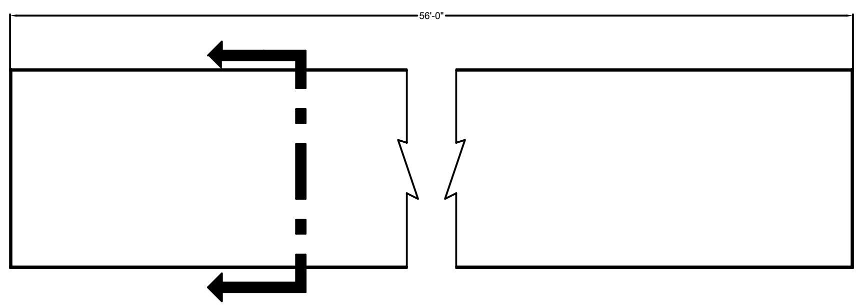
REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	-	Initial	7/02/2012	PS

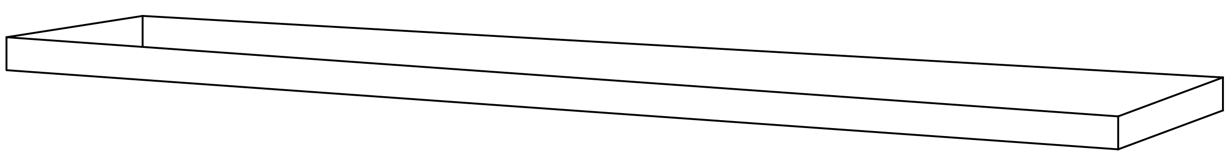
NOTES:

BURN PAN TO BE 1/4" STEEL CONSTRUCTION.



SECTION "A-A"

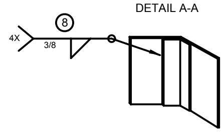


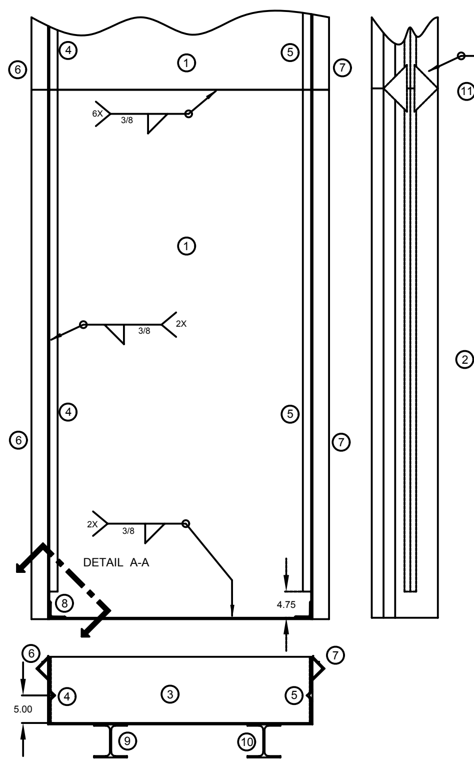


MEASUREMENTS IN INCHES UNLESS OTHERWISE SPECIFIED	BGAD Engin-Planning
	OB Pan Dimensions
NOT SCALED	DWG NO. 01

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	-	Initial	6 /19/2012	PS
	A	RELEASED FOR PRODUCTION	6 /21/2012	PS
	B	ADDED PART NUMBERS & WELDMENTS	6 /25/2012	PS
	C	UPDATED PARTS LENGTH & QUANTITY	6 /25/2012	PS

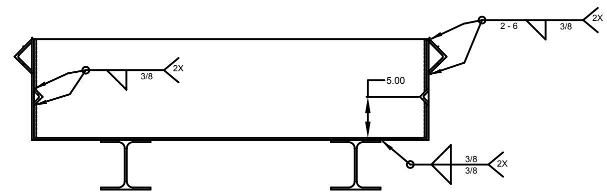
DETAIL A-A





11 GUSSET PLACEMENT INSIDE TYPICAL;
EXACT ORIENTATION AND PLACEMENT TBD

REFERENCE VIEW



REFERENCE VIEW
(SHOWING WELDMENTS)

MATERIALS

ITEM NO.	DESCRIPTION	QUANTITY FOR 1 PAN	COMBINED QUANTITY (7 PANS)
1	BG3000 - 001 BOTTOM 48" X 96" X .25", A36	1	7
2	BG3000 - 002 SIDE PANEL 12" X 96" X .25", A36	2	14
3	BG3000 - 003 END PANEL 12" X 47.5" X .25", A36	1 TYP AT EACH OUTSIDE END	2
4	BG3000 - 004 LINE ANGLE - 1, A36, 1.00" X 1.00" X 15.58' X .25"	2 TYP STARTING WITH FIRST PAN	2
5	BG3000 - 005 LINE ANGLE - 2, A36, 1.00" X 1.00" X 20.00' X .25"	2	4
6	BG3000 - 006 TOP SIDE ANGLE - 1, A36, 2-1/2" X 2-1/2" X 16.00' X .25"	2	2
7	BG3000 - 007 TOP SIDE ANGLE - 2, A36, 2-1/2" X 2-1/2" X 40.00' X .25"	2	2
8	BG3000 - 008 CORNER ANGLE - 2, A36 2-1/2" X 2-1/2" X 12.00" X .25"	2 TYP FIRST PAN AND LAST PAN	4
9	BG3000 - 009 I-BEAM SUPPORT - 1, A36 6.00" X 3.565" X .465" X 16.00'	2	2
10	BG3000 - 010 I-BEAM SUPPORT - 2 , A36 6.00" X 3.565" X .465" X 40.00'	2	2
11	BG3000 - 011 SUPPORT GUSSET, 6" X 6" X .25" A36	8	56

MEASUREMENTS IN INCHES UNLESS OTHERWISE SPECIFIED

NOT SCALED

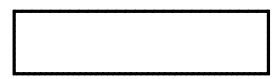
OB Pan Parts & Assembly

SIZE	FSCM NO.	DWG NO.	REV
		02	
SCALE		SHEET	

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	-	Initial	7/02/2012	PS

NOTES:

BURN PAN TO BE 1/4" STEEL CONSTRUCTION.



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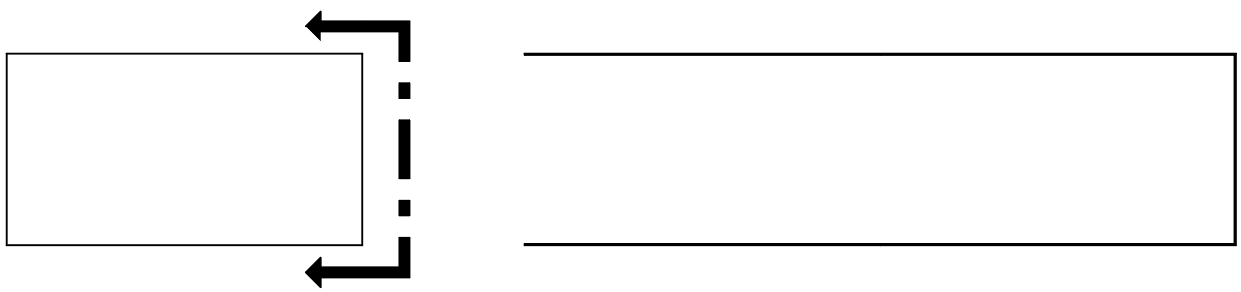
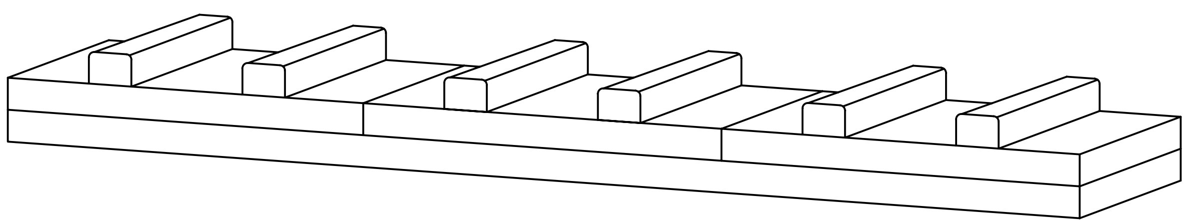




MEASUREMENTS IN INCHES UNLESS OTHERWISE SPECIFIED

NOT SCALED

OB Lid Assembly

SIZE	FSCM NO.	DWG NO. 03	REV
SCALE		SHEET	

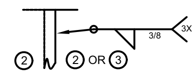
REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
	-	Initial	7/02/2012	PS
	A	UPDATE MATERIALS QTY TO REFLECT 2 SETS	7/09/2012	PS

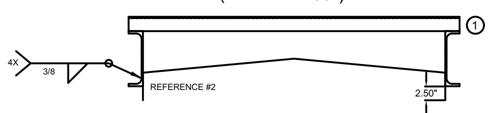
MATERIALS TO CONSTRUCT A LEFT & RIGHT EXTERIOR COVER:

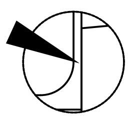
ITEM NO.	DESCRIPTION	QUANTITY FOR 1 COVER	QUANTITY FOR 2 COVERS	QUANTITY FOR 2 SETS
1	BG3000 - 100 COVER SUPPORT ASSEMBLY + WELDMENT	2	4	8
2	BG3000 - 201 COMMON BURN PIT COVER	3	6	12
3	BG3000 - 201 - 1 OUTSIDE BURN PIT TOP COVER	1	2	4
4	BG3000 - 201 - 3 BURN PIT END COVER	1	2	4
5	BG3000 - 201 - 4 SIDE SUPPORT GUSSET	4	8	16
6	BG3000 - 201 - 5 MIDDLE SUPPORT GUSSET	2	4	8
7	BG3000 - 201 - 6 END SUPPORT GUSSET	4	8	16

DETAIL A-A
(3X OVERLAP ENDS 2.00" THEN WELD)

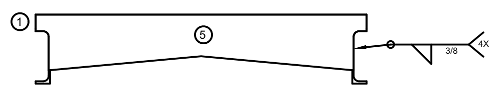


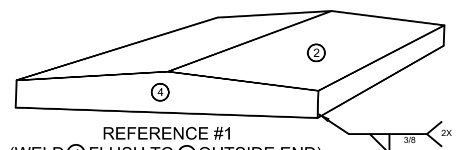
1
DETAIL B-B
(ROTATED 90°)





DETAIL C-C
(ROTATED 90°)
(WELD 5 TO 1 BOTH SIDES, THEN TO 2 OR 3)

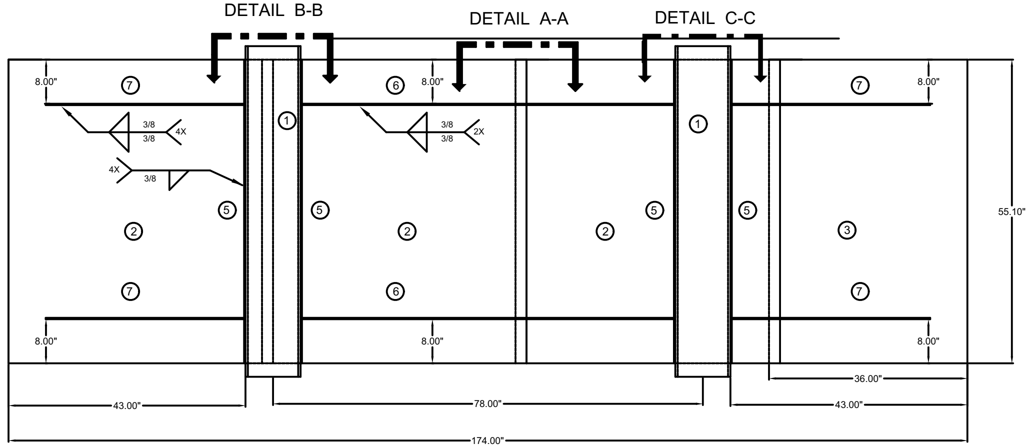




REFERENCE #1
(WELD 4 FLUSH TO 2 OUTSIDE END)

DETAIL B-B
DETAIL A-A
DETAIL C-C

REFERENCE #1



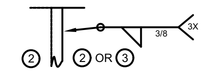
MEASUREMENTS IN INCHES UNLESS OTHERWISE SPECIFIED	OB Lid End Segments
NOT SCALED	SIZE / FSCM NO. / DWG NO. 04 / REV
	SCALE / SHEET

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	-	Initial	7/02/2012	PS
	A	UPDATE MATERIALS QTY TO REFLECT 2 SETS	7/09/2012	PS

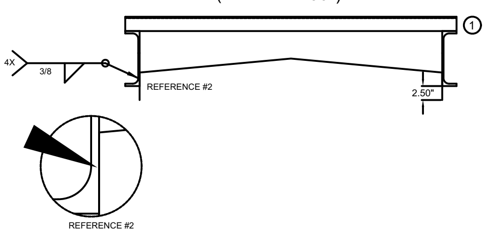
MATERIALS TO CONSTRUCT X2 INTERIOR COVERS:

ITEM NO.	DESCRIPTION	QUANTITY FOR 1 COVER	QUANTITY FOR 2 COVERS	QUANTITY FOR 2 SETS
1	BG3000 - 100 COVER SUPPORT ASSEMBLY + WELDMENT	2	4	8
2	BG3000 - 201 COMMON BURN PIT COVER	3	6	12
3	BG3000 - 201 - 2 INSIDE BURN PIT TOP COVER	1	2	4
4	BG3000 - 201 - 4 SIDE SUPPORT GUSSET	4	8	16
5	BG3000 - 201 - 5 MIDDLE SUPPORT GUSSET	2	4	8
6	BG3000 - 201 - 6 END SUPPORT GUSSET	4	8	16

DETAIL A-A
(3X OVERLAP ENDS 2.00" THEN WELD)



1
DETAIL B-B
(ROTATED 90°)



DETAIL C-C
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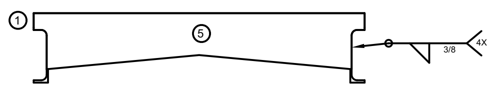

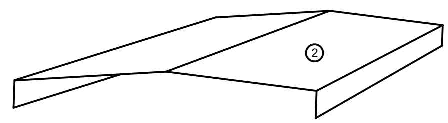

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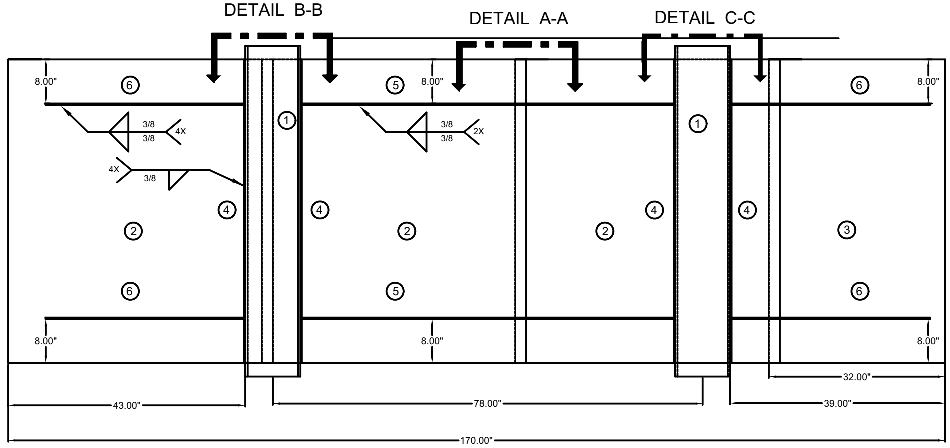
DETAIL B-B
DETAIL A-A
DETAIL C-C

REFERENCE #1



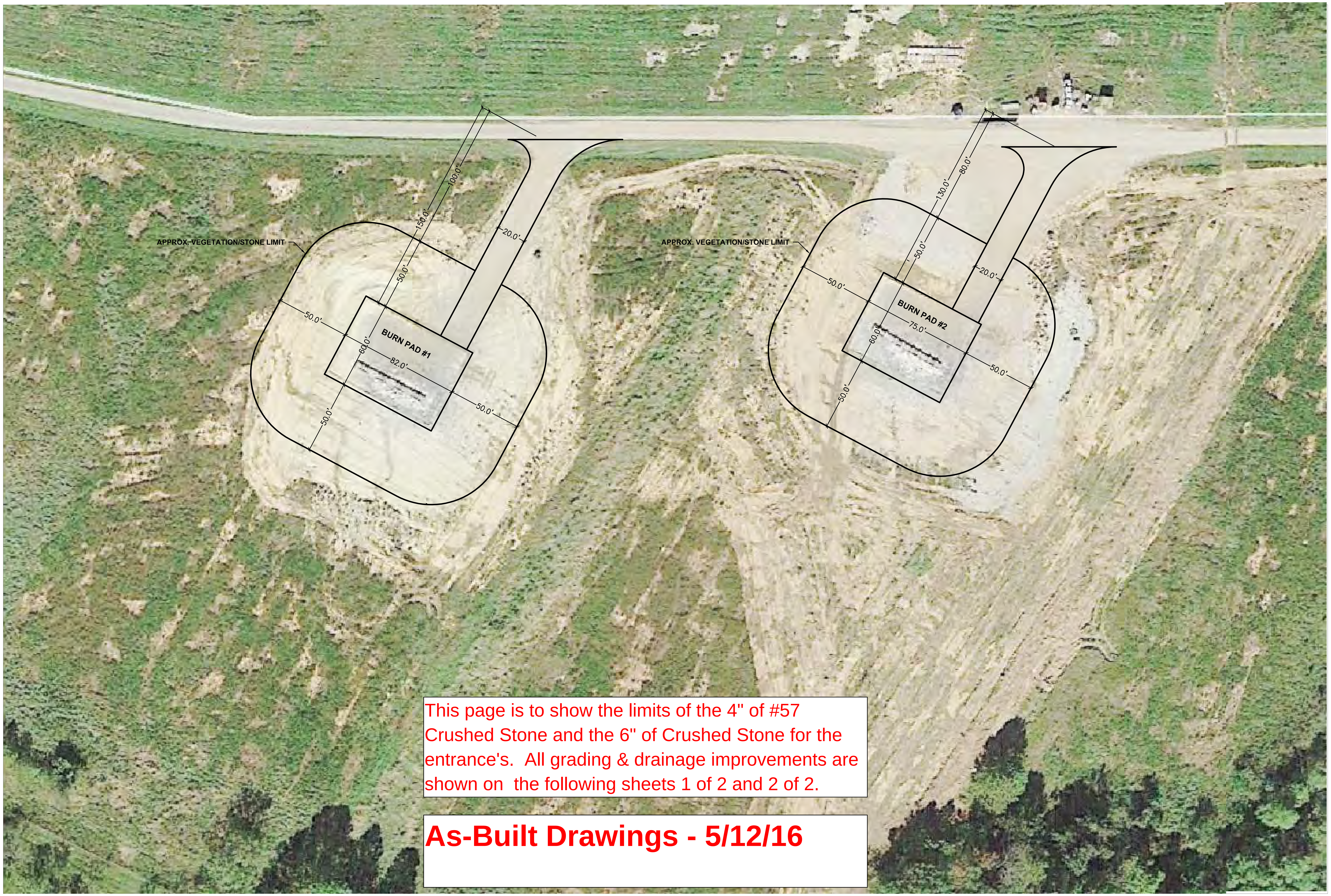
MEASUREMENTS IN INCHES UNLESS OTHERWISE SPECIFIED

OB Lid Center Segments

NOT SCALED

SIZE	FSCM NO.	DWG NO.	REV
		05	

SCALE		SHEET



This page is to show the limits of the 4" of #57 Crushed Stone and the 6" of Crushed Stone for the entrance's. All grading & drainage improvements are shown on the following sheets 1 of 2 and 2 of 2.

As-Built Drawings - 5/12/16

Limits of Stone - BGAD Demo Grounds - Burn Pads

Scale: 1" = 30'-0"

STATE OF KENTUCKY FREDERICK R. EASTRIDGE 13565 LICENSED PROFESSIONAL ENGINEER

06

0' 30' 60' 90'

Graphic Scale: 1" = 30'-0"

BLUE GRASS ARMY DEPOT
Richmond, KY 40475
Phone: (309) 782-5630

K. HAYES LIMITED
431 S. Broadway #332
Lexington, KY 40508
Phone: (859) 263-3102
Fax: (859) 263-3192

DATE: NOVEMBER 3, 2015

REVISIONS	DATE
LIMITS OF STONE ONLY	1/11/16

EMAIL:	brian@khayeslimited.com
SOLICITATION:	–
PROJECT NO:	–
DRAWN:	AC
CHECKED:	–
SCALE:	AS NOTED
PRINT SIZE:	24" x 36"

SHEET TITLE: LIMITS OF STONE AT BURN PADS

PROJECT: DEMOLITION GROUNDS IMPROVEMENTS

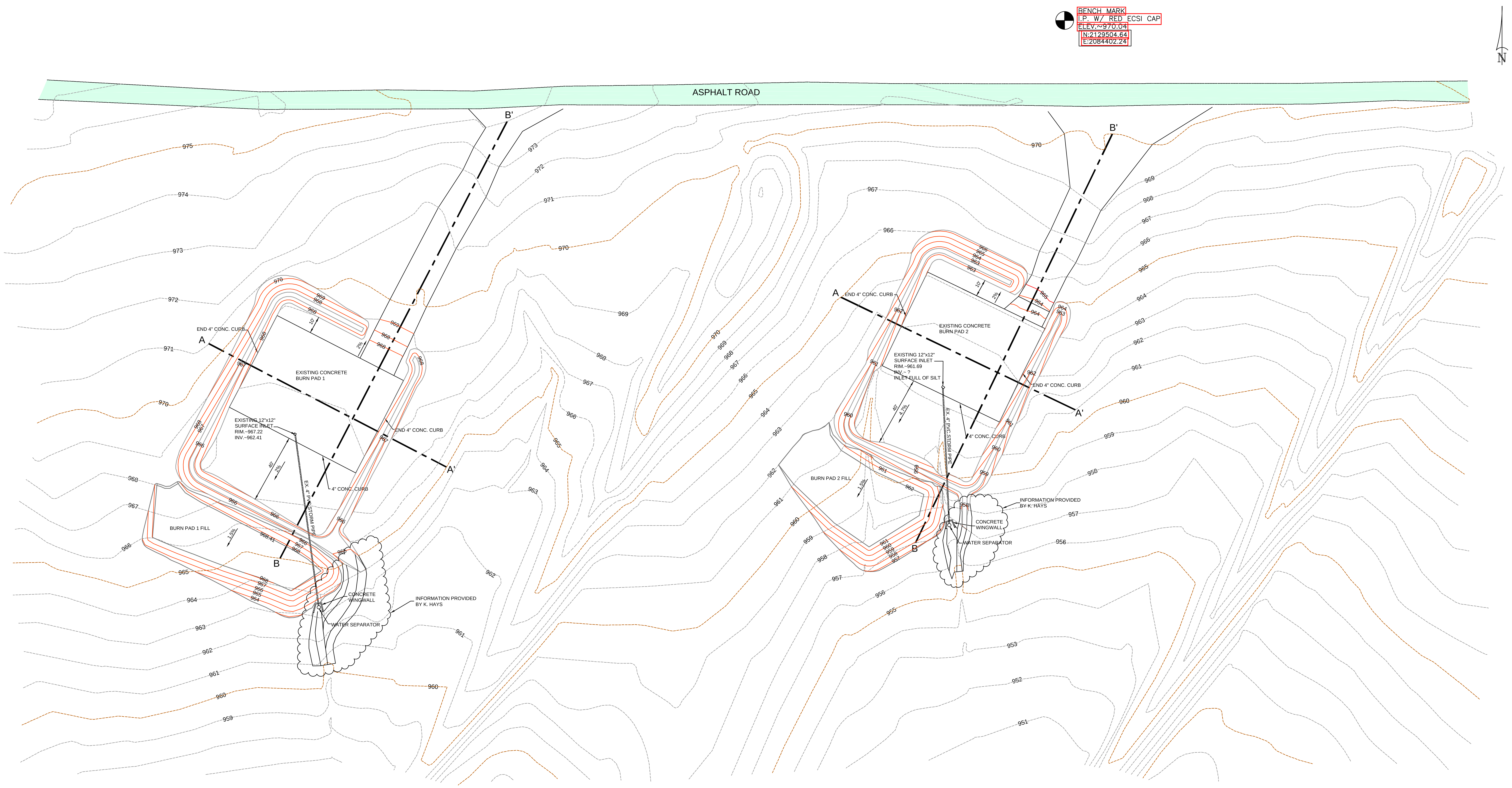
OWNER/CLIENT: BLUE GRASS ARMY DEPOT

LOCATION: RICHMOND KY, 40475

NOT FOR CONSTRUCTION

SHEET: CS-02

SHEET: 1 OF –



RECORD DRAWING

THE INFORMATION USED TO PREPARE THIS RECORD DRAWING WAS TAKEN FROM FIELD SURVEY INFORMATION PROVIDED BY K. HAYES AND CONSTRUCTION RECORDS. WHILE THE DRAWING IS BELIEVED TO BE REASONABLY CORRECT, THERE IS NO IMPLIED GUARANTEE OF ACCURACY, COMPLETENESS, OR ADEQUACY IN USING THIS TERM.

0' 15' 30' 60' 90'

SCALE IN FEET

SCALE: 1" = 30'

CONTOUR INTERVAL: 1'

NOTES:

1. PROPOSED CONTOURS ARE TO FINISHED GRADE.
2. A WATER SEPARATOR IS LOCATED AT THE DOWNSTREAM REAR OF EACH BURN PAD. GRADE AROUND THE PIPE LEADING TO THE WATER SEPARATOR AND AROUND THE SEPARATOR SO THAT FINAL GRADE IS SMOOTH IN THE AREA. INSTALL CHANNEL LINING DOWNSTREAM OF THE WATER SEPARATOR FOR A DISTANCE OF 5'. PLACE 4" OF #57 STONE FROM THE OUTSIDE EDGE OF THE DRAINAGE SWALE OUT TO WHERE THE CURRENT VEGETATION HAS BEEN ERADICATED.
3. EXCESS SOIL GENERATED FROM DITCH CONSTRUCTION SHALL BE PLACED IN WASTE FILL AT SOUTHWEST CORNER OF EACH PAD. SHAPE FILL WITH 3:1 SIDE SLOPES AND TOP SURFACE SLOPE AT APPROXIMATELY 1.5% SLOPE.

As-Built Drawings - 5/12/16

07

STATE OF KENTUCKY FREDERICK R. EASTRIDGE 13565 LICENSED PROFESSIONAL ENGINEER

ECSI LLC
Engineers • Consultants • Scientists • International
340 S Broadway • Lexington, KY • 40508 • 859-233-2103 • fax 859-259-3394

BURN PADS #1 AND #2 PLAN VIEWS (RECORD DRAWING)

BLUEGRASS ARMY DEPOT ~ BURN PADS

RICHMOND, MADISON COUNTY, KENTUCKY

THIS TOPOGRAPHIC SURVEY DOES NOT REPRESENT A BOUNDARY SURVEY IS NOT INTENDED FOR LAND TRANSFER.

DATE: 05/09/2016

PROJECT: 9195.004

DESIGNED: E KING

DRAWN: E KING

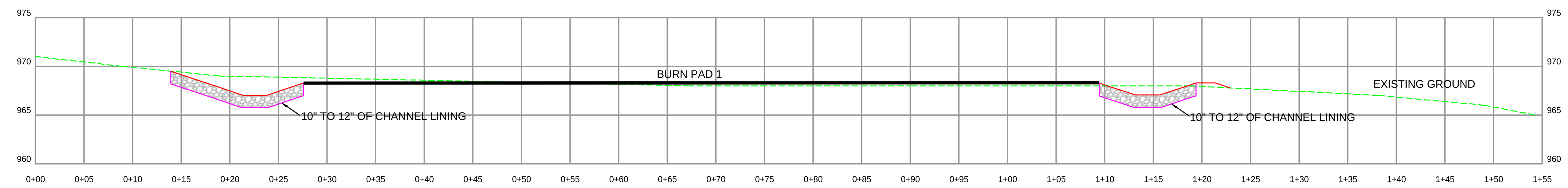
CHECKED:

REVISIONS:

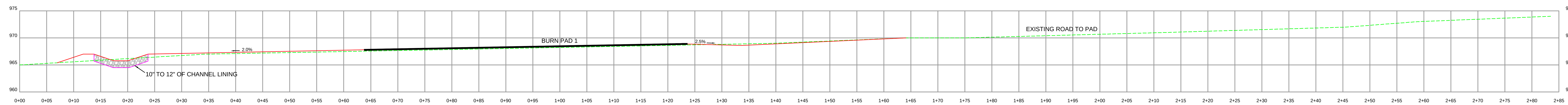
Kentucky 811

SHEET

1 OF 2



PROFILE A-A'

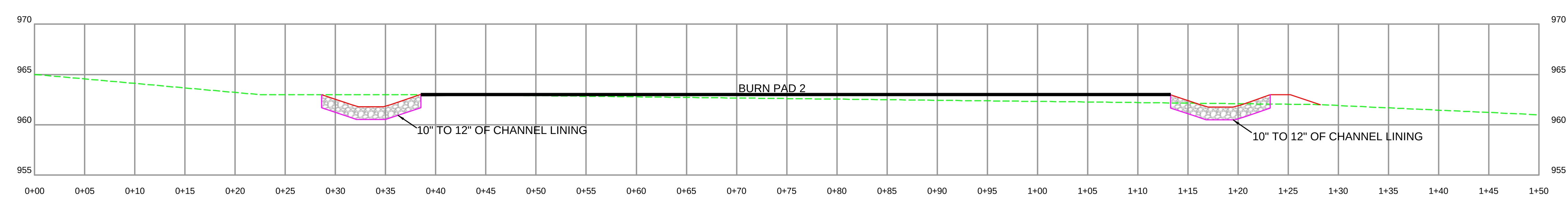


PROFILE B-B'

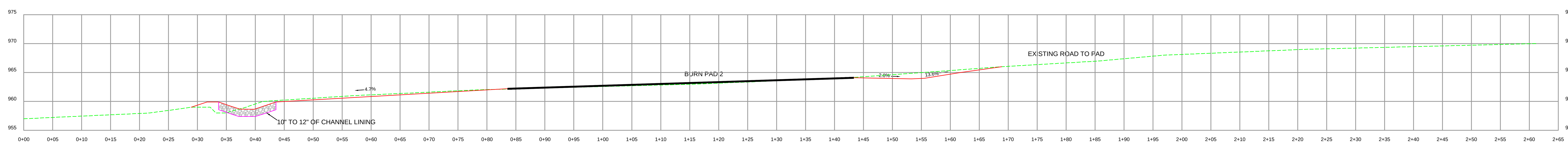
BURN PAD 1 PROFILES

0 10 20 30

SCALE: 1" = 10'



PROFILE A-A'



PROFILE B-B'

BURN PAD 2 PROFILES

0 10 20 30

SCALE: 1" = 10'

As-Built Drawings - 5/12/16

08

STATE OF KENTUCKY FREDERICK EASTRIDGE 13565 LICENSED PROFESSIONAL ENGINEER

ECSI LLC
Engineers • Consultants • Scientists • International
340 S Broadway • Lexington, KY • 40508 • 859-233-2103 • fax 859-259-3394

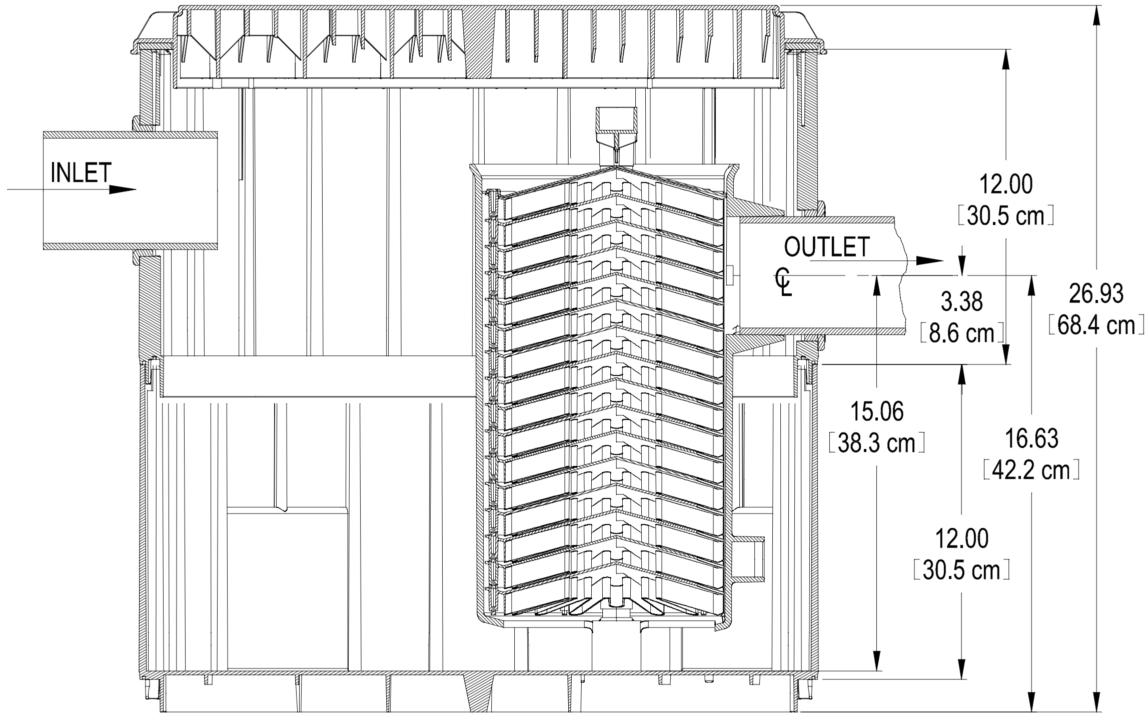
BURN PAD #1 AND #2 PROFILES
BLUEGRASS ARMY DEPOT ~ BURN PADS
RICHMOND, MADISON COUNTY, KENTUCKY

THIS TOPOGRAPHIC SURVEY DOES NOT REPRESENT A BOUNDARY SURVEY IS NOT INTENDED FOR LAND TRANSFER.

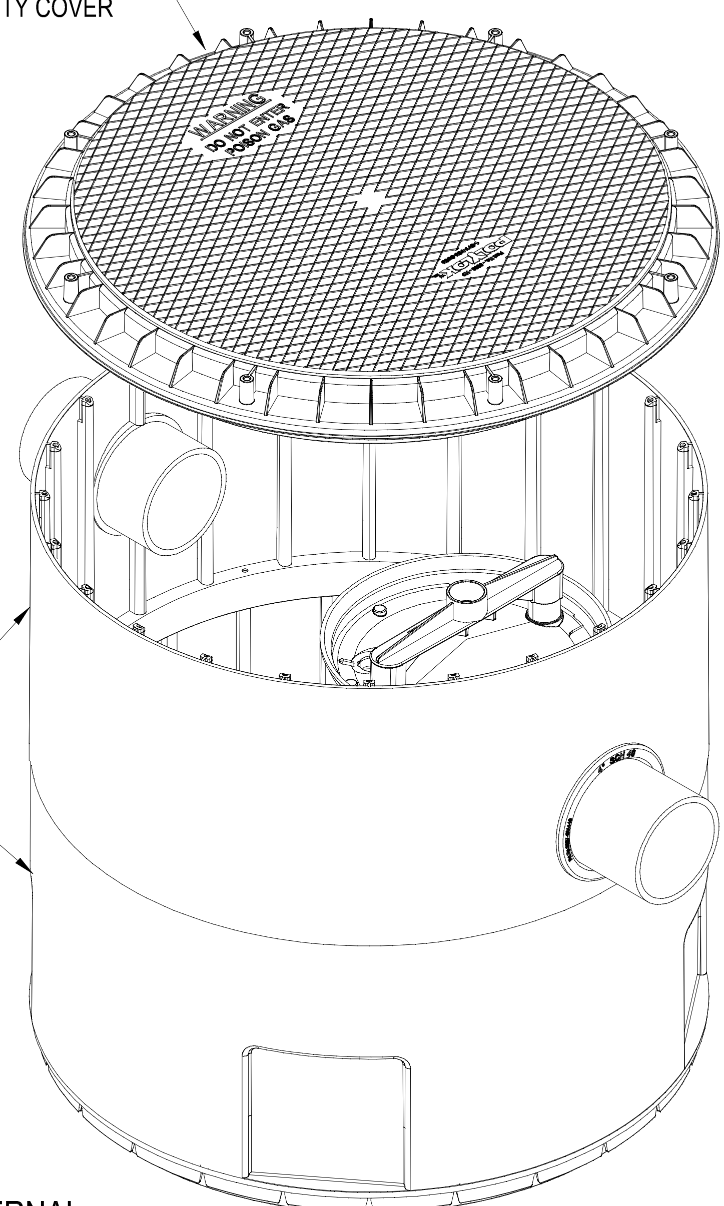
DATE: 01/11/2016
PROJECT: 9195.004
DESIGNED: E KING
DRAWN: E KING
CHECKED:
REVISIONS:

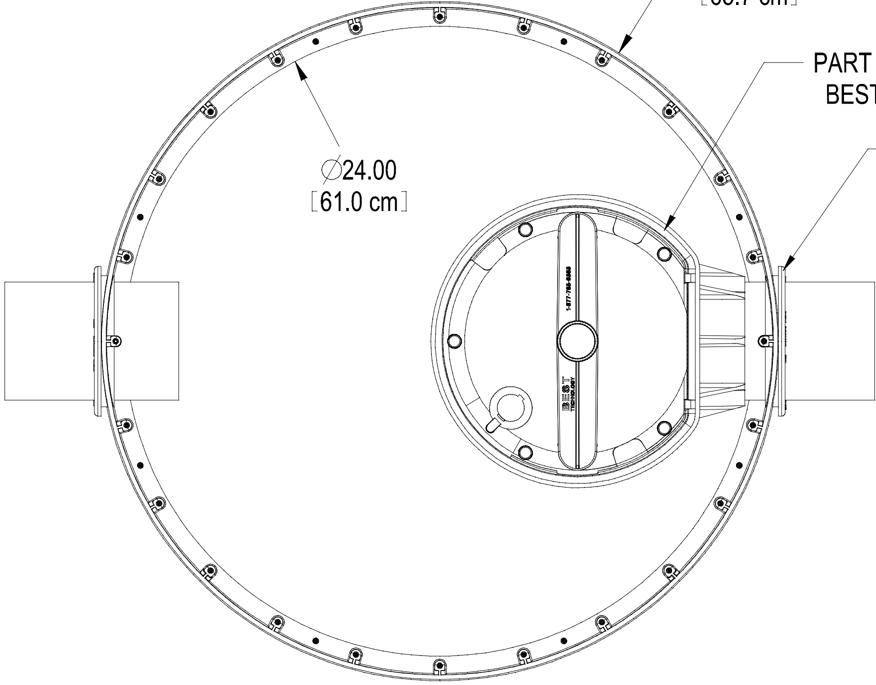
Kentucky 811

SHEET
2 OF 2



CUT - AWAY



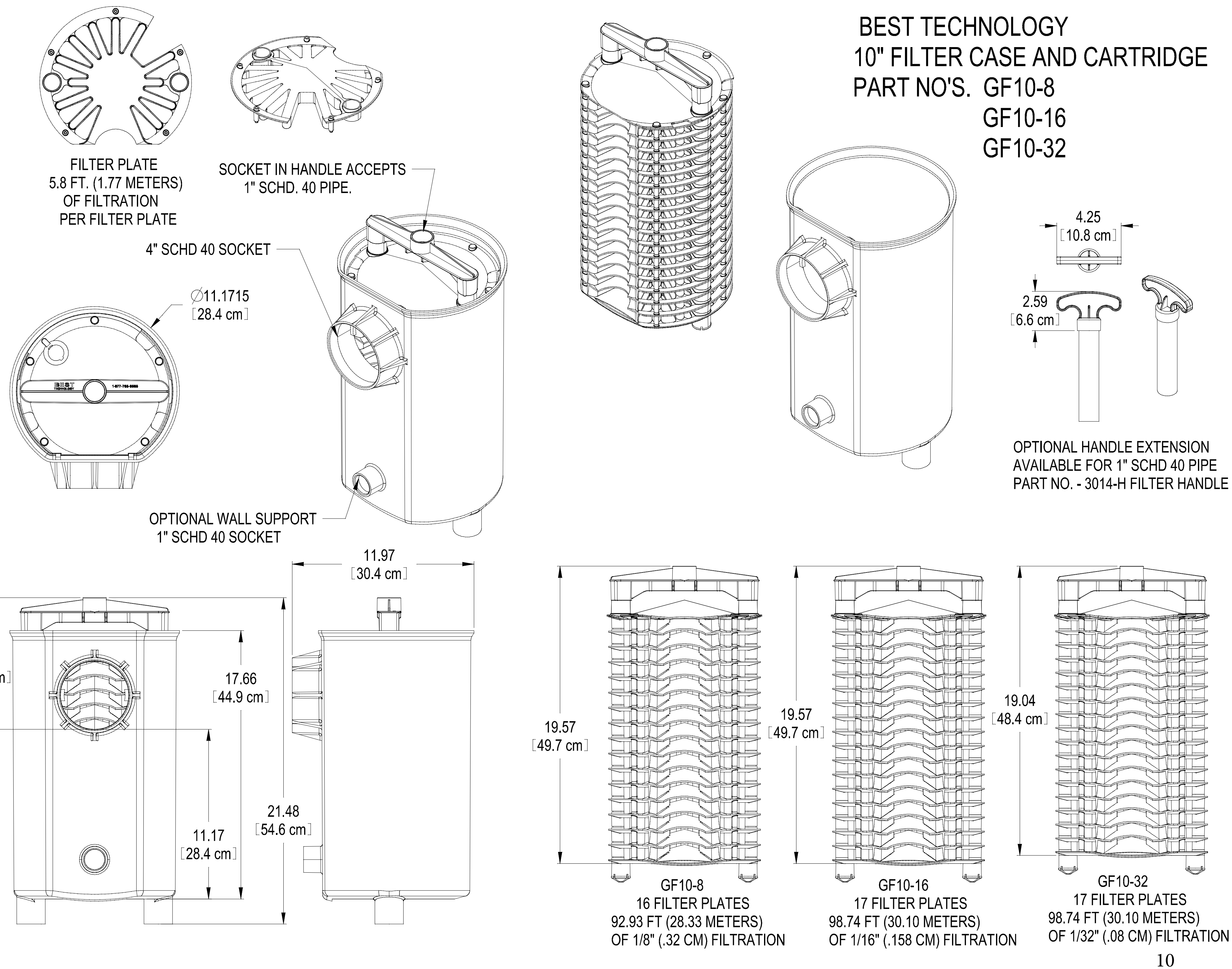


LOW PROFILE EXTERNAL
FILTER AND BASIN
PART NO'S:

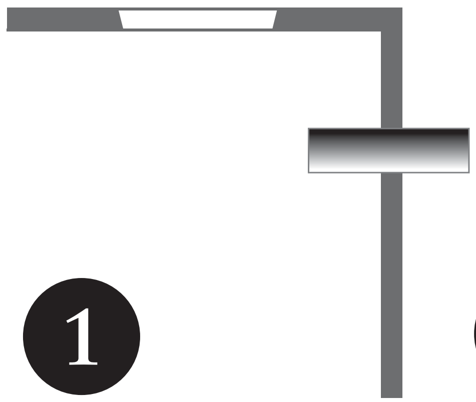
3008-LPFB8 - 1/8" FILTRATION
3008-LPFB16 - 1/16" FI;TRATION
3008-LPFB32 - 1/32" FILTRATION

TOTAL VOLUME - 50 GALLONS [189.25 LITERS]

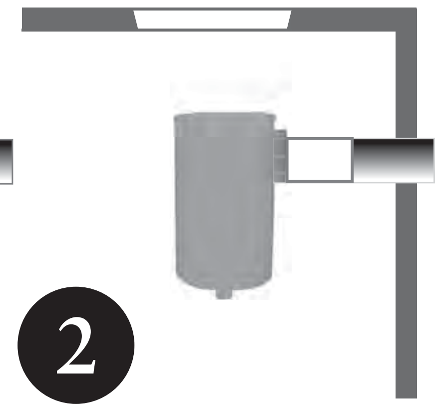
BEST TECHNOLOGY
10" FILTER CASE AND CARTRIDGE
PART NO'S. GF10-8
GF10-16
GF10-32



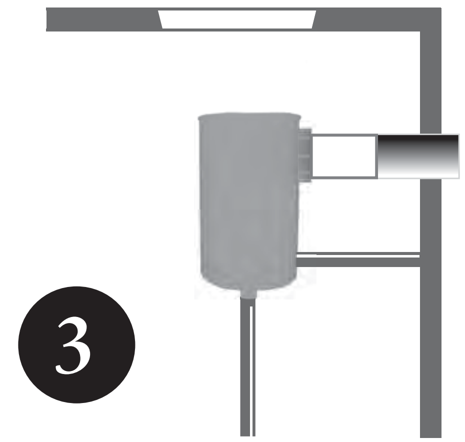
Installation Instructions for the GF10 Filter



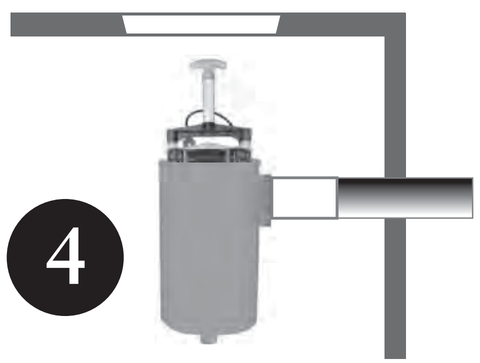
Step 1: Locate and remove the septic tank cover, on the outlet side of tank.



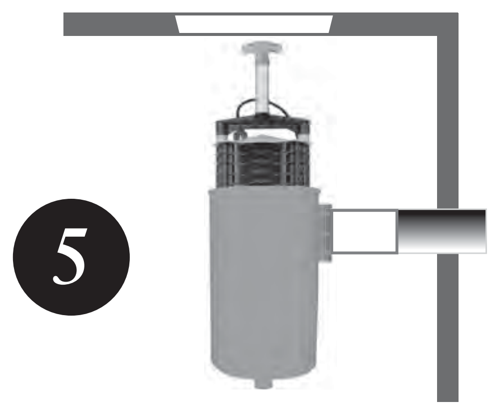
Step 2: Before installation, place the filter case on to the outlet pipe. Make sure the case is positioned so the filter can be removed from the tank for maintenance and service



Step 3: For installations that require or desire additional support. (If additional support is not needed, go to Step 4) Glue a section of 1" Sch. 40 pipe to the two hubs located on the bottom of the case and the hub located on the side of the case.



Step 4: Glue the filter case onto the outlet pipe. Insert the filter cartridge into the case. (Make sure the filter is completely inserted into the case.)



Step 5: For installations where it will be difficult to reach the handle, place 1" Schedule 40 pipe into the tee on the handle and extend it to height that will make it easy to remove the filter.

BEST TECHNOLOGY

Installation of an existing system.

Same as a new system only the septic tank must be pumped prior to installation.

Maintenance of the GF10 Filter

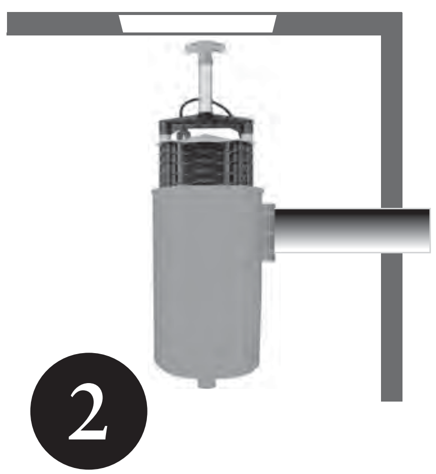
A time frame in which septic tanks are serviced is set by state and local codes. Although they may be different, most regulatory agencies suggest two to five years. We recommend the GF10 filter be cleaned when the septic tank is normally cleaned and pumped, or as needed.

WARNING: If the liquid level in the tank is above the top of the filter, pump the tank prior to removing the filter cartridge.

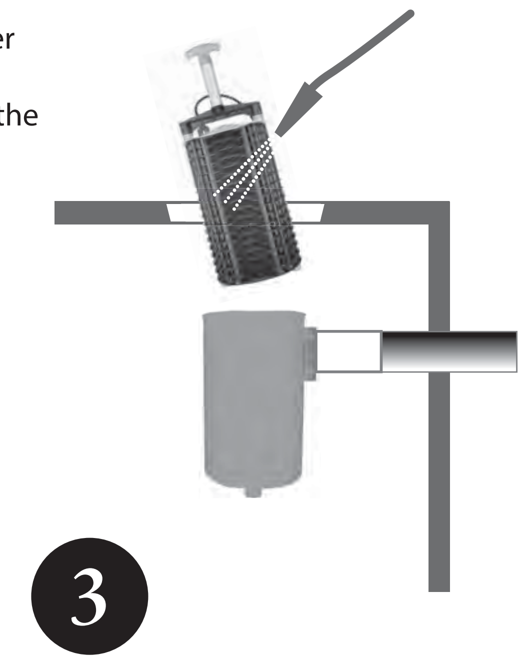
1

CAUTION: USE RUBBER GLOVES WHEN HANDLING FILTERS!

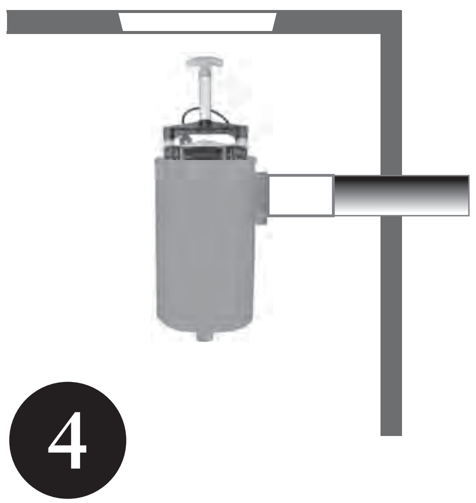
Step 1: Remove the septic tank cover and pump the tank if necessary to prevent any solids from escaping to the field when the filter is removed.



Step 2: Pull the filter handle and slide the filter out of the case.



Step 3: While holding the filter cartridge over the access opening of the tank, rinse the cartridge off with fresh water. Take care to make sure all solid material falls back into the tank

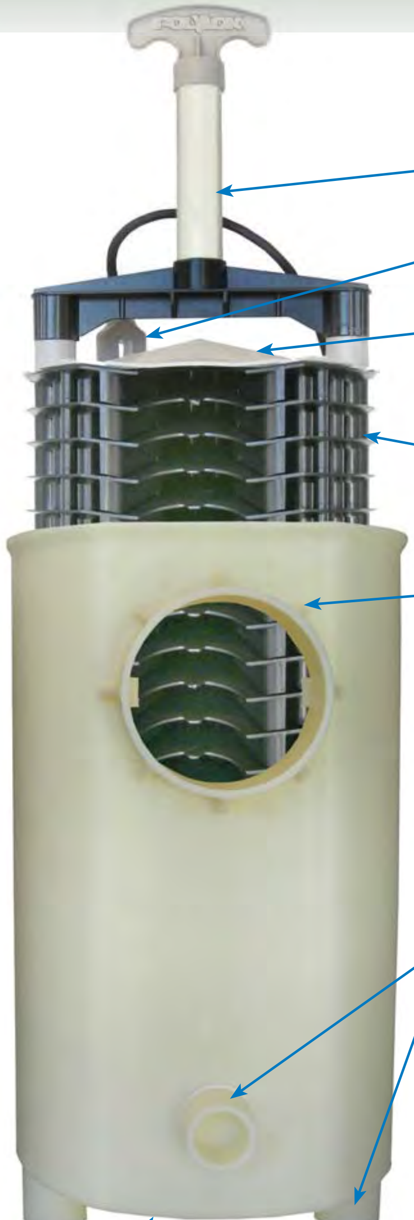


Step 4: Insert the cartridge back into the case making sure that it is properly aligned and completely inserted into the case.

BEST TECHNOLOGY
3 Fairfield Blvd, Wallingford, CT 06492
1-877-765-9565 Fax: 203-284-8514

BEST TECHNOLOGY

The GF10 is 10"x18" and is available in three filtration designs 1/8", 1/16" and 1/32"



Accepts 1" PVC Handle Extension

Alarm Switch

The D-Shaped Inlet makes replacing the cartridge easy.

The cartridge locks into the case, so the filter will never float up and cause the system to back up.

The outlet has eight gussets which insures maximum strength and stability under any load.

OutdoorSmart Filter Alarm
All Polylok/Zabel filters accept the SmartFilter® switch and alarm.

The open bottom inlet decreases turbulence and allows material to fall back down into the tank

The case has two optional molded-in hubs on the bottom for additional support and one molded-in hub on the side for stability.

Single-Piece Filter Case

No Glue-No Joints-No Problems
10" diameter x 18" high

Heavy-Duty outlet

4" outlet molded into case with eight gussets
Will not crack or break under extreme weight

Open Bottom Inlet

Decreases turbulence and lowers chance of filter floating up in case
Decreases possibility of unwanted material becoming trapped in the filter

Molded-In Hubs

2 hubs on the bottom provide optional support
Side hub provides additional stability
2 bottom hubs have tabs that securely lock the cartridge into case

POLYLOK Inc.
Innovations in Precast, Drainage & Wastewater Products
Zabel® A Division of Polylok Inc.

3 Fairfield Blvd, Wallingford, Connecticut 06492
1-877-765-9565 Fax: 203-284-8514
email: sales@polylok.com
Web site: www.polylok.com

Made In The U.S.A.

A Great Design

The Best GF10 filter doesn't just trap solids, its unique conical shape design allows unwanted material to flow over the plates and fall back into the tank. The filter has a one-piece housing made of impact resistant PVC.

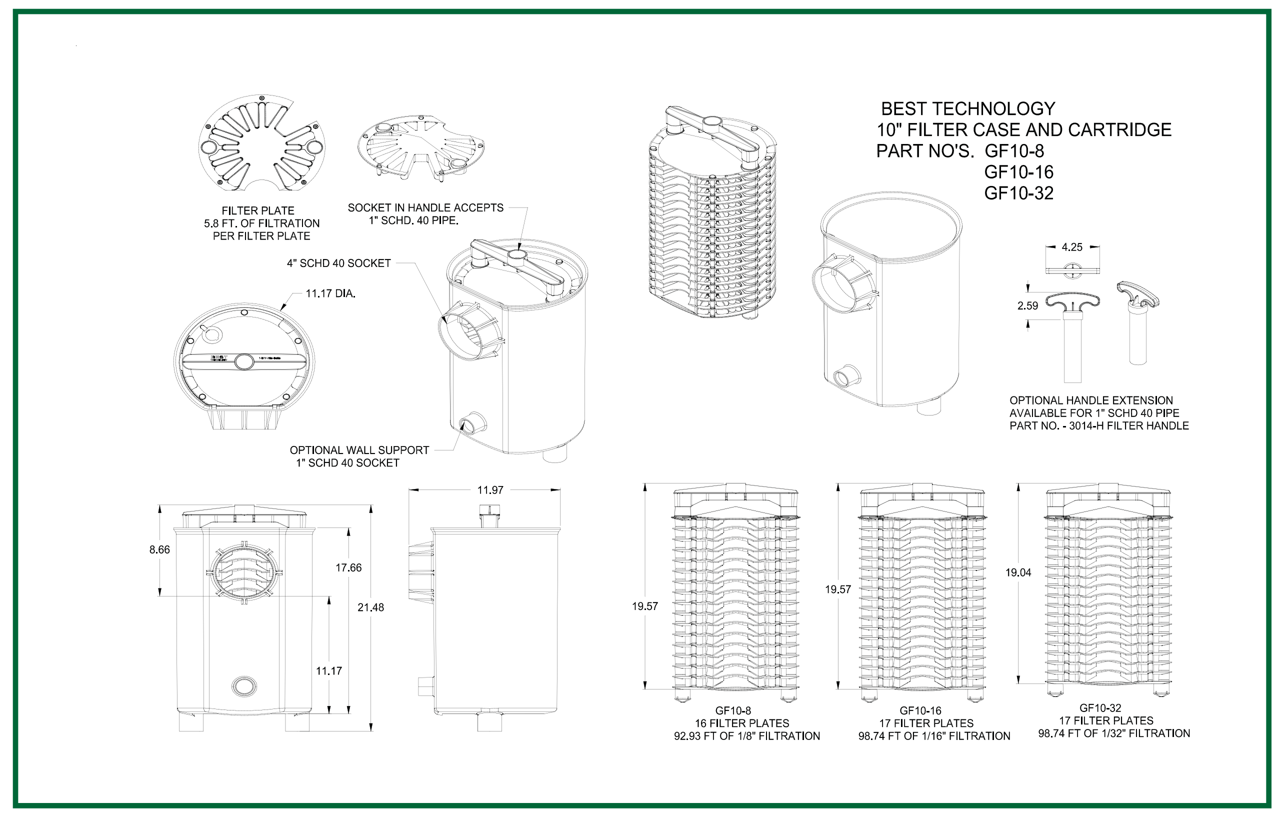
The GF10 filter plates are locked together with five ribs and two sections of ¾" Schedule 40 PVC pipe. This unique configuration provides even weight distribution and maximum strength.

The GF10 is rated at 2500 GPD and is available in 1/8", 1/16" and 1/32" filtration levels. The smaller filtration levels are ideal for residential settings and the 1/32" filtration can be used in most commercial applications including wastewater treatment systems, grease traps, dog kennels or salons.

The GF10 is known for its strength. The housing, as well as the outlet were designed with durability in mind. To show just how strong the filter is, we placed a 420 pound concrete riser on top of the GF10 filter case and connected it to a 4" Sch 40 pipe.

To further improve the strength of this filter, our engineers redesigned the handle, making it even sturdier than the original design.

BEST 10" FILTER



BEST FILTERS

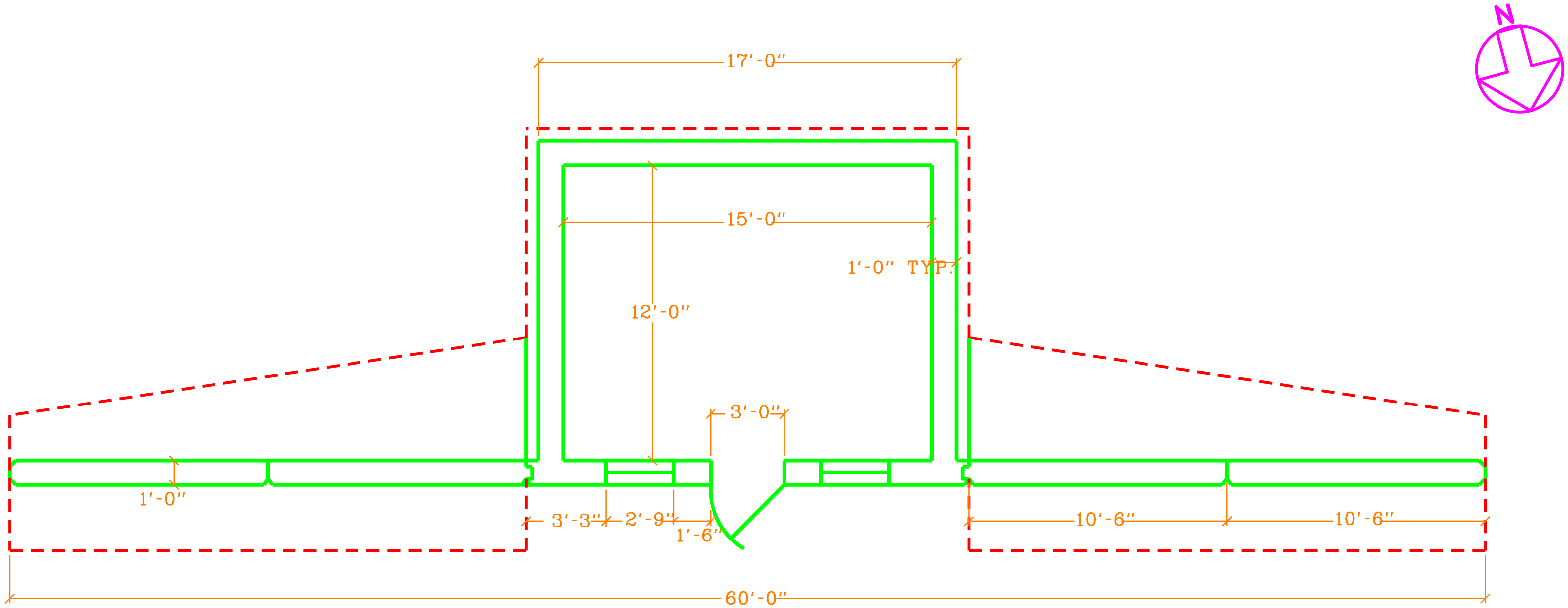
Model	Filtration Size	Filter Rating/GPD	Max Flow/GPD	Max Flow/GPD 80% Plugged	Maintenance Interval
GF10-8	1/8"	2500/gpd	3500/gpd	700 gpd	*
GF10-16	1/16"	2500/gpd	3000/gpd	600 gpd	*
GF10-32	1/32"	2500/gpd	2500/gpd	500 gpd	*

*Checked or inspected yearly and then as system dictates.

PRODUCT PART NUMBERS

Item No	Description	Filtration Size	GPD
GF10-16	BEST 1/16 FILTRATION 10 x 18 FILTER ASSEMBLY	1/16"	2500
GF10-16-NO CASE	BEST 1/16 FILTRATION FILTER W/O CASE	1/16"	2500
GF10-32	BEST 1/32 FILTRATION 10 x 18 FILTER ASSEMBLY	1/32"	2200
GF10-32-NO CASE	BEST 1/32 FILTRATION FILTER W/O CASE	1/32"	2200
GF10-8	BEST 1/8 FILTRATION 10 x 18 FILTER ASSEMBLY	1/8"	3000
GF10-8-NO CASE	BEST 1/8 FILTRATION FILTER W/O CASE	1/8"	3000
GF10-H	HANDLE FOR BEST FILTER		

Appendix D-2
OD/BD Unit Drawing and Diagrams



FLOOR PLAN BUILDING 274

SCALE: 1/2" = 1'-0"

0 1 2 3 6

BAR SCALE

LEXINGTON-BLUE GRASS ARMY DEPOT
OFFICE OF THE FACILITY ENGINEER

DRAWN BY: PVO

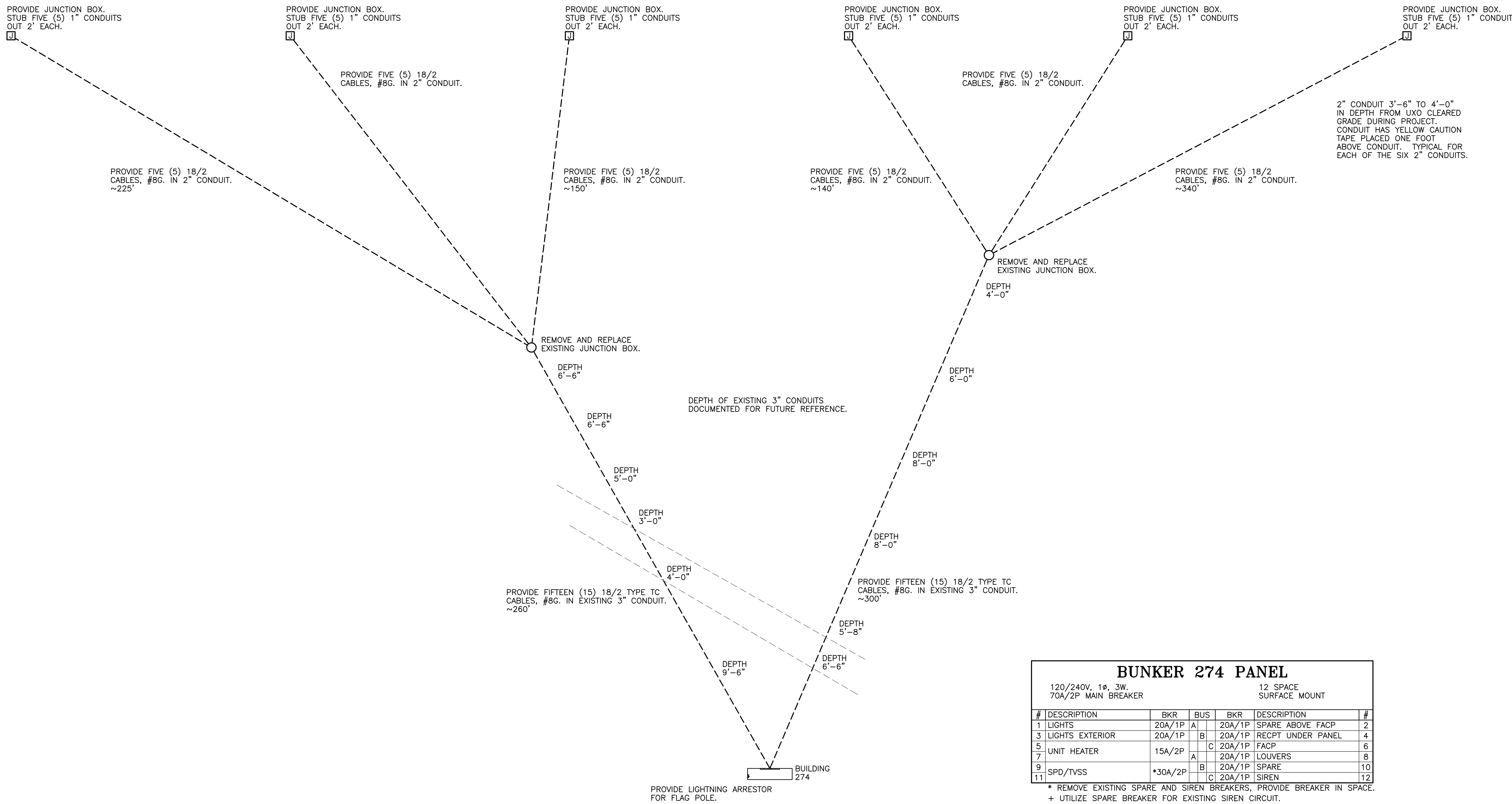
BUILDING 274

B274.DGN:1

FLOOR PLAN

SCALE 1/2"

SHEET 1 OF 1



BUNKER 274 PANEL

120/240V, 1ø, 3W.
70A/2P MAIN BREAKER

12 SPACE
SURFACE MOUNT

#	DESCRIPTION	BKR	BUS			BKR	DESCRIPTION	#
1	LIGHTS	20A/1P	A			20A/1P	SPARE ABOVE FACP	2
3	LIGHTS EXTERIOR	20A/1P		B		20A/1P	RECPT UNDER PANEL	4
5	UNIT HEATER	15A/2P			C	20A/1P	FACP	6
7			A			20A/1P	LOUVERS	8
9	SPD/TVSS	*30A/2P		B		20A/1P	SPARE	10
11					C	20A/1P	SIREN	12

* REMOVE EXISTING SPARE AND SIREN BREAKERS, PROVIDE BREAKER IN SPACE.
+ UTILIZE SPARE BREAKER FOR EXISTING SIREN CIRCUIT.
PROVIDE SQUARE D TYPE EMA SPD/TVSS TVS1EMA12A.
PROVIDE 4#10 FROM BUNKER 274 PANEL TO SPD/TVSS.

PARTIAL SITE ELECTRICAL PLAN

SCALE: 1" = ~30'-0"

NO.	DESCRIPTION	DATE
	REVISIONS	

HENDERSON SERVICES, LLC

HENDERSON SERVICES, L.L.C.

STATE OF KENTUCKY GREGORY L. BRAY 20694 LICENSED PROFESSIONAL ENGINEER

DEMO GROUNDS BGAD

RICHMOND, KENTUCKY

DRAWN BY: GLB

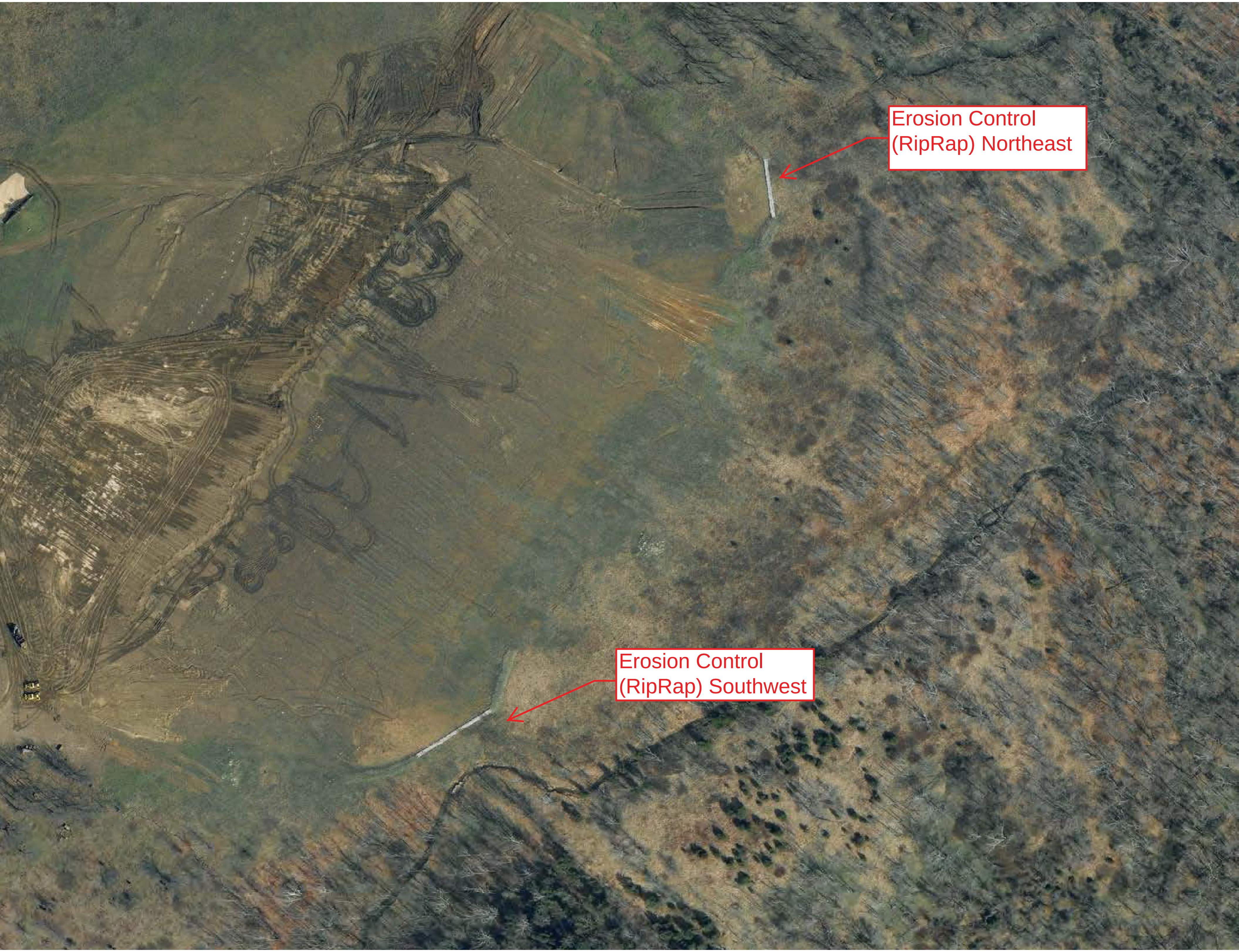
JOB NO.: BB4613

DATE: 01-14-2016

RECORD DRAWING
04-03-2016

DRAWING NO.
E1

FILE: BGAD_BUNKERS_E1
XREF: BGAD_TBB


Erosion Control
(RipRap) Northeast
Erosion Control
(RipRap) Southwest

OD UNIT EROSION CONTROL - NORTHEAST

Length of Rock Rip-Rap
Line measurement
Length: 107.223473 Feet

Width of Rock Rip-Rap
Line measurement
Length: 7.154022 Feet

NE endpoint of Rock Rip-Rap
2,087,796.104 2,129,881.224 Feet
Or
84°12'15.494"W 37°40'3.426"N

SE endpoint of Rock Rip-Rap
2,087,809.660 2,129,786.778 Feet
or
84°12'15.345"W 37°40'2.491"N

Using Projection:
NAD_1983_StatePlane_Kentucky_South_FIPS_1602_Feet
Projection: Lambert_Conformal_Conic
False_Easting: 1640416.666667
False_Northing: 1640416.666667
Central_Meridian: -85.750000
Standard_Parallel_1: 36.733333
Standard_Parallel_2: 37.933333
Latitude_Of_Origin: 36.333333
Linear Unit: Foot_US

OD UNIT EROSION CONTROL - SOUTHWEST

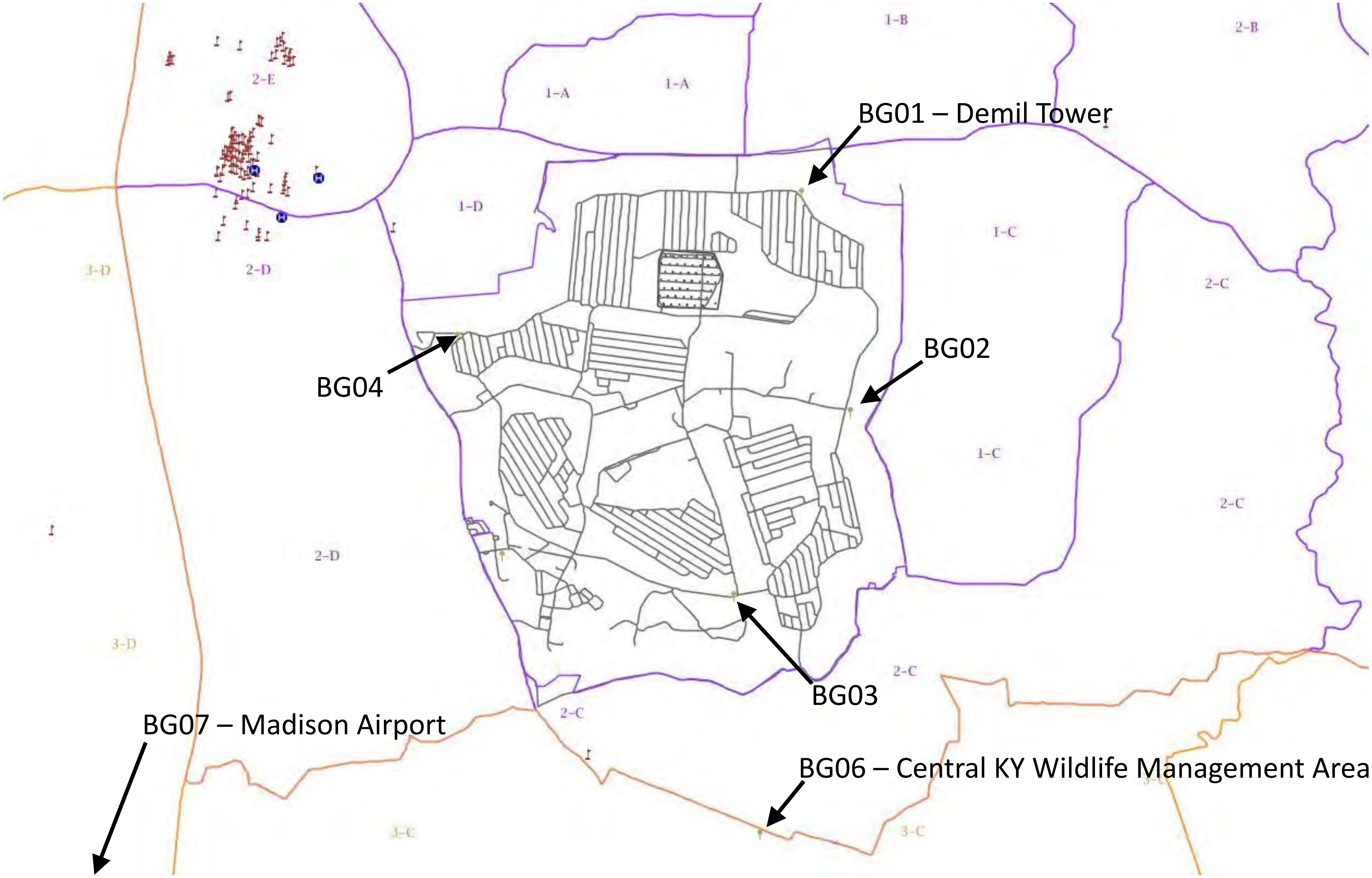
Length of Rock Rip-Rap
Line measurement
Segment: 140.087554 Feet
Length: 140.087554 Feet

Width of Rock Rip-Rap
Line measurement
Length: Apprx 7.2 Ft

NE endpoint of Rock Rip-Rap
2,087,361.294 2,129,007.566 Feet
Or
84°12'21.079"W 37°39'54.86"N

SE endpoint of Rock Rip-Rap
2,087,247.083 2,128,929.141 Feet
or
84°12'22.515"W 37°39'54.104"N

Using Projection:
NAD_1983_StatePlane_Kentucky_South_FIPS_1602_Feet
Projection: Lambert_Conformal_Conic
False_Easting: 1640416.666667
False_Northing: 1640416.666667
Central_Meridian: -85.750000
Standard_Parallel_1: 36.733333
Standard_Parallel_2: 37.933333
Latitude_Of_Origin: 36.333333
Linear Unit: Foot_US


BG01 – Demil Tower
BG02
BG03
BG04
BG06 – Central KY Wildlife Management Area
BG07 – Madison Airport
1-A
1-A
1-B
2-B
2-E
1-D
1-C
1-C
2-C
2-C
3-D
2-D
2-D
3-D
2-C
2-C
3-C
3-C

Appendix D-3
Photo Log

Photo 1: OB Unit – Looking North - Burn Pan with Lids and Crushed Stone Base Surrounding Pan

Photo 2: OB Unit – Looking West - Propellant Charges in Concrete Pad with Time Fuze


Photo 3: OB Unit – Looking Northeast - Drainage Swale/Diversion Around Concrete Pads


Photo 4: OB Unit – Looking South - Drainage Swale/Diversion

Photo 5: OB Unit – Looking South - Sediment Catchment - Manual Lever at Rear of Concrete Wall

Photo 6: OB Unit - Looking North - Sediment Catchment – Outfall


Photo 7: OB Unit - Sediment Catchment - Interior


Photo 8: OB Unit - Sediment Catchment – Filter Basket


Photo 9: OD/BD Unit - Looking from Northwest to Southeast - Top of Soil Burden where Pits are Dug


Photo 10: OD/BD Unit – Looking from Southwest to Northeast – Soil Slope Where Pits are Dug

Photo 11: OD Unit - Looking West - Junction Boxes and Safety Bunker

Photo 12: OD Unit - Detail of Junction Box


Photo 13: OD Unit - Looking Southeast - Eastern Sediment Control (Rip-Rap)


Photo 14: OD Unit - Looking South - Along Eastern Sediment Control (Rip-Rap)


Photo 15: OD Unit - Looking North - Along Eastern Sediment Control (Rip-Rap)


Photo 16: OD Unit - Looking Southeast - Diversionary Trench

PART E. PROTECTION OF GROUNDWATER [401 KAR 38:090 Section 4 & 40 CFR 270.14(c)], ENVIRONMENTAL PERFORMANCE STANDARDS [401 KAR 34:250 Section 2 & 40 CFR 264.601] and INFORMATION REQUIREMENTS FOR SOLID WASTE MANAGEMENT UNITS [401 KAR 38:090 Section 5 & 40 CFR 270.14(d)]

This Part E of the permit application consolidates the information required for protection of groundwater; the Environmental Performance Standards demonstration for prevention of releases that may have adverse effects on human health or the environment due to migration of waste constituents to the surface, subsurface, groundwater, surface water and wetlands; and the information requirements for solid waste management units (SWMUs). The Environmental Performance Standard for prevention of releases that may have adverse effects on human health or the environment due to migration of waste constituents in air are addressed in the air modeling and risk assessment presented in Volume II to this application.

E-1 Protection of Groundwater [401 KAR 38:090 Section 4 & 40 CFR 270.14(c)]

401 KAR 38 requires that specific information be provided by owners or operators of hazardous waste facilities containing a *regulated unit*. A *regulated unit* is defined in 401 KAR 34:060 as a surface impoundment, waste pile, or land treatment unit or landfill that receives hazardous waste. OB and OD of explosive wastes is specifically listed as examples of the types of units covered under Subpart X at 46952 FR and is are not defined as regulated units under 401 KAR 38. Nonetheless, OD/BD treatment does incorporate the soil as part of its engineering design and 401 KAR 34:250 does require that detailed hydrologic and geologic assessments be provided in order to demonstrate compliance of the miscellaneous units with each component of the Environmental Performance Standards of 401 KAR 34:250. Therefore, the following information is provided in support of the Environmental Performance Standards for groundwater protection, 401 KAR 30:031 Section 5.

E-1a Interim Status Groundwater Data [401 KAR 38:100 Section 2(1) & 40 CFR 270.14(c)(1)]

Three permanent groundwater monitoring wells (MW4004C01 through MW4004C03) were installed at the OD/BD unit in 1989 to monitor the shallow groundwater system associated with RCRA Facility Investigation (RFI) of former operations. These wells are located downgradient of the southwest portion of the OD/BD unit. As a result of a hydrologic evaluation performed at the OD/BD unit from March to September 1998, it was determined that additional wells were needed in order to meet the point of compliance (POC) monitoring requirements for a RCRA regulated unit. Five additional permanent groundwater monitoring wells (MW4004C04, MW4004C05, MW4004C06, MW4004C08, and MW4004C09) were installed at the boundary of the OD/BD unit on April 6 through 15, 1999. The POC groundwater monitoring network for the OD/BD unit was established in coordination with KDEP and as presented in the Work Plan[1]. Wells MW4004C04, MW4004C05, and MW4004C06 were installed downgradient of the OD/BD unit to evaluate the potential impact of OD operations on groundwater quality. Wells MW4004C04 and MW4004C05 were installed in a cluster. Well MW4004C06 was installed as a single shallow well. Well MW4004C07 had been designated to be a deep well adjacent to MW4004C06. The borehole for this well was left open for 5 days, and no water recharged into the borehole. It was determined in the field that this well would not bear water, and MW4004C07 was properly abandoned per KDEP requirements. Monitoring wells MW4004C08 and MW4004C09 were installed upgradient of the OD/BD unit to represent background groundwater for this area. Well MW4004C08 was intended to represent the upgradient deep well screened across the Ashlock Formation. Well MW4004C09 was intended to represent the upgradient shallow well, screened where water was first encountered.

The two upgradient monitoring wells, MW4004C08 and MW4004C09, were abandoned in January 2002 with the approval of KDEP Division of Waste Management, per the recommendations of the Phase II Sitewide Groundwater Assessment Report[2]. The monitoring wells were identified for abandonment due to the lack of groundwater production and poor surface conditions. A new shallow upgradient monitoring well, MW4004B01A, was installed northwest of the OD/BD unit in December 2001 and was incorporated into the monitoring well network.

In its response to the Phase II Sitewide Groundwater Assessment, KDEP requested the installation of an additional downgradient shallow monitoring well (designated MW4004C10) located southwest of MW4004C02, and incorporation of seep SP-65 to the compliance monitoring system. MW4004C10 was installed in January 2002 and monitors the southwest boundary of the OD/BD unit. There are currently eight existing groundwater monitoring wells (MW4004C01, MW4004C02, MW4004C03, MW4004C04, MW4004C05, MW4004C06, MW4004C10, and MW4004B01A) available for monitoring groundwater quality at the OD/BD unit. MW4004B01A currently serves as the background well for the hydrologic unit containing the OD/BD unit. Figure E-1 shows the estimated limits of the OD/BD unit and the monitoring well locations that currently comprise the point of compliance monitoring well network. Monitoring well logs and as-builts for the POC monitoring wells are included in Appendix E-1.

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[1] Radian International. 1998. *Work Plan for Monitoring Well Installation and Groundwater, Surface Water and Sediment Sampling Activities at the Open Detonation Area*. October.

[2] URS. 2001. P*hase II Sitewide Groundwater Assessment Monitoring System Evaluation Final Report*. May.

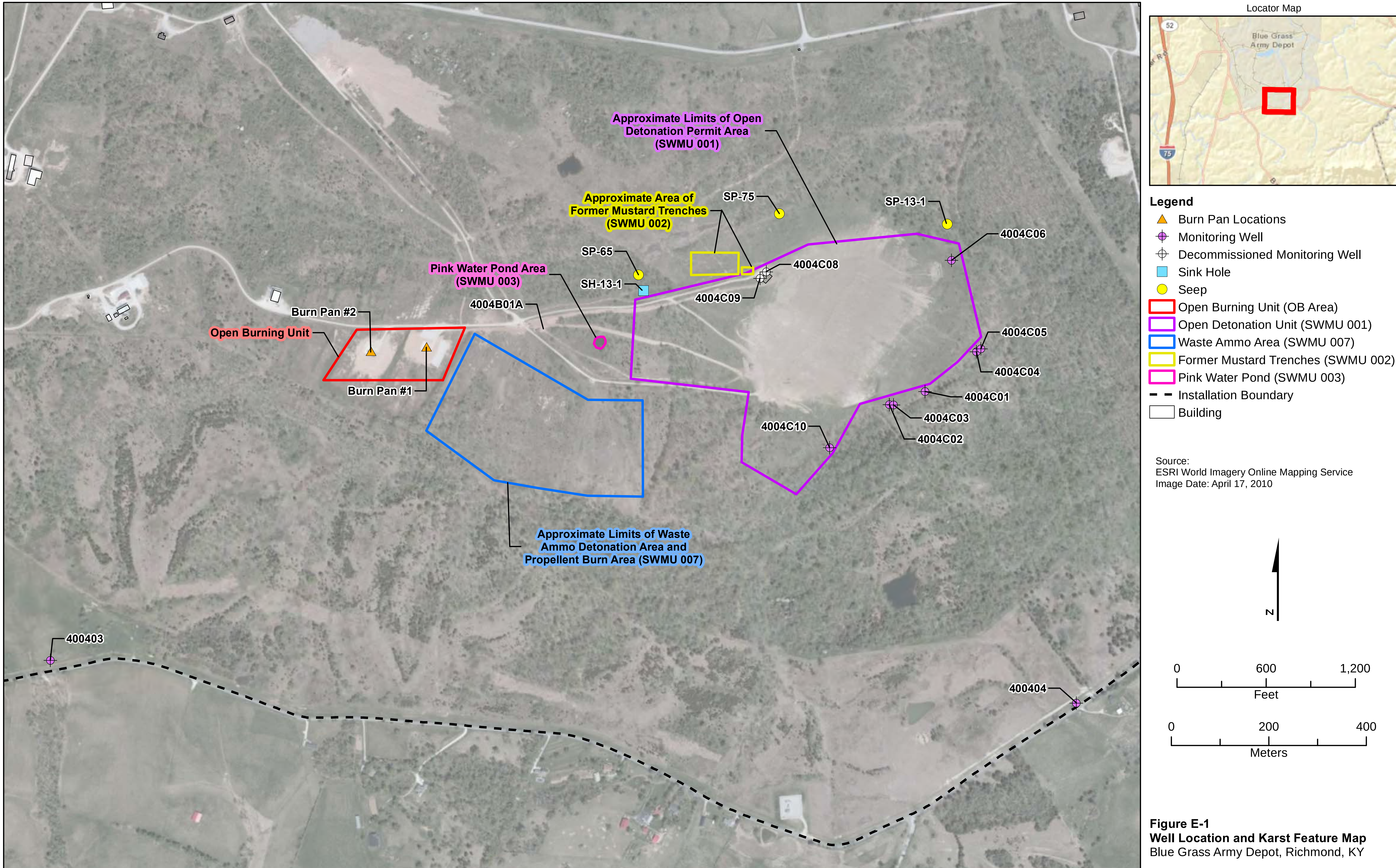

Figure E-1
Well Location and Karst Feature Map
Blue Grass Army Depot, Richmond, KY

DVR R:\GIS\HOU\Bluegrass\MapFiles\Bluegrass_PermitApp_E1.mxd gtwigg 1/28/2014 1:44:36 PM

In 2004, BGAD, in coordination with KDEP, implemented a site-wide program of long-term monitoring (LTM) in accordance with the KDEP-approved LTM Operations and Maintenance (LTMOM) plan[3]. Due to the active status of the OD/BD unit, groundwater monitoring under the DoD's Installation Restoration Program (which funded the site-wide LTM program) initially was not to be included in the program. However, allowances were made, and the wells and seeps at the OD/BD unit were incorporated into the annual LTM program in 2004. The wells were later determined not to be eligible and were removed from the LTM program in 2011.

LTM is conducted in accordance with the approved Long-Term Sampling and Analysis Plan (LTSAP). The overall LTM program includes monitoring of groundwater, surface water, sediment, springs/seeps, and landfill gas at the Mustard Burn Area, Pink Water Pond, Former Waste Ammo Area, Old Landfill, New Landfill and Perimeter Well 400201, Old TNT Lagoon Area, Fire Training Area, and New TNT Washout Area, and included the OD/BD unit from 2004 through 2010. LTM sampling results are presented to KDEP annually in the Long-Term Sampling and Analysis Program Annual Reports.

E-1a(1) Summary of Groundwater Monitoring Data Obtained During Interim Status Period [40 CFR 270.14(b)(c)(1)]

In January 1996, a site investigation of the Former Waste Ammunition Detonation Area, located just outside of the southern OD/BD unit boundary, showed explosive and metal constituents in the groundwater[4]. At the same time, a groundwater study of the Mustard Burn Site/Mustard Trenches Area located along the northern boundary of the OD/BD unit was completed, showing detectable levels of three explosive constituents and seven metals[5]. In February 1996, groundwater samples were collected from MW4004C01, MW4004C02, and MW4004C03 within the cleared area on the southwest side of the OD/BD unit and analyzed for total and dissolved metals by Method 6010/7470/7471 and explosives by Method 8330. Results indicated the presence of both metal and explosive constituents in the groundwater[6]. However, the studies summarized that the low concentration levels did not indicate an unacceptable level of risk to human health or the environment.

All available groundwater monitoring results for the OD/BD unit from 1997 through 2010 are summarized in the figures and graphs included in Appendix E-2. For a more complete description, refer to the appropriate LTSAP Annual Reports on file at the BGAD Environmental Office and/or as provided to KDEP. Analyses performed for the OD/BD unit included explosives (2,4,6-Trinitrotoluene, 2-Amino-4,6-dinitrotoluene, 4-Amino-2,6-dinitrotoluene, 3-Nitrotoluene, HMX and RDX) and metals (aluminum, arsenic, barium, beryllium, cadmium, chromium, lead, manganese, mercury, selenium, silver and zinc). The results of analyses under the LTM program were compared to agreed-to Applicable or Relevant and Appropriate Requirements (ARARs) as a screening tool. These groundwater ARARs were developed as discussed in the LTMOM plan from a review of existing standards at the time (May 2004) to include: (1) U.S Environmental Protection Agency (EPA) MCLs (2) Drinking Water Equivalent Levels (DWELs) determined from exposure concentrations protective of adverse, non-cancer health effects (3) Water Quality for the Protection of Human Health from the Consumption of Fish Tissue (401 KAR 5:031 Section2) (4) Warm Water Aquatic Habitat Criteria (401 KAR 5:031 Section 4), and (5) Domestic Water Supply Use (DWSU) Standards (401 KAR 5:031 Section 5). Following review of these standards, the groundwater ARARs were generally adopted from the MCL for each constituent. Where a MCL was not

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[3] URS Corporation.2004. S*ite-wide Long-Term Monitoring, Operations, and Maintenance Plan at Blue Grass Army Depot, Richmond, Kentucky*. May.

[4]Sverdrup Environmental, Inc. 1996. *Final Site Investigation (SI) Report for the Former Waste Ammunition Detonation Area (SWMU #7)*, January.

[5]Sverdrup Environmental, Inc. 1996. *Final Interim Remedial Action Plan Study, Groundwater at the Mustard Burn Site/Mustard Trenches Area (SWMU #2)*, January.

[6]Sverdrup Environmental, Inc. 1996. *Final Letter Report for the Groundwater Sampling at the OD Area (SWMU #1)*, February.

available, the DWEL was used. The figures included in Appendix E-2 summarize the metal and energetics detections for the OD/BD unit from1997 to 2010. Detected constituents that exceeded their ARARs are shown in red print; detected constituents that have never exceeded an ARAR at a given location are not illustrated.

During the most recent LTM sampling event that included the OD/BD unit in 2010, total arsenic was reported above the ARAR of 10 micrograms per liter (µg/L) from shallow well MW4004C01 at a concentration of 22.2 µg/L, total cadmium was detected above the ARAR of 5 µg/L in MW4004C04 at a concentration of 33.5 µg/L, and total lead was detected above the ARAR of 15 µg/L in MW4004C04 and MW4004C06 at concentrations of 33.7 µg/L and 31.3 µg/L, respectively. All other metals and all energetic detections during the 2010 LTM sampling event were below detection or below their respective ARARs. Appendix E-2 additionally includes trend plots for total arsenic, cadmium, lead, and selenium that exceeded ARARs in one or more wells. No statistical analyses were prepared for the historical data set. Comparison to upgradient well results was frequently hampered because of insufficient well volume in MW4004B01A.

Wells associated with the OD/BD unit were last sampled in October to November 2015 and results reported to KDEP in a Technical Memorandum[7]. Included within the reported groundwater sampling event were seven downgradient groundwater wells (MW4004C01, MW4004C02, MW4004C03, MW4004C04, MW4004C05 and MW4004C10) and one seep (SP-65). The identified upgradient groundwater well (MW4004B01) was dry and no samples could be extracted or reported. The following analyses were completed:

E353.2	Nitrate/Nitrite
SW6010	Metals
SW6020	Metals
SW6850	Perchlorate
SW7470	Mercury
SW8260B	Volatile Organic Compounds (VOCs)
SW8270	SVOCs
SW8270SIM	SVOCs
SW8330	Explosives
SW9012A	Cyanide

Results were compared to EPA MCLs for drinking water and regional screening levels (RSLs) for tap water although groundwater at BGAD does not serve as a drinking water source.

- VOCs – Two VOCs were detected above EPA tap water RSLs but below MCLs for drinking water. Benzene was detected in MW4004C05 at 1.5 µg/L. The EPA tap water RSL for benzene is 0.46 µg/L, while the MCL for drinking water is 5 µg/L. Trichloroethene (TCE) was detected at 1.7 µg/L in MW4004C02 and at 2.1 µg/L in MW4004C04. Both of these results are estimated (i.e., “J” qualified). The EPA tap water RSL for trichlorethene is 0.49 µg/L, while the MCL for drinking water is 5 µg/L. VOCs were not detected in the seep sample.
- SVOCs – One SVOC was detected above EPA tap water RSLs. Dimethlyaminoazobenzene was detected in MW4004C03 at 1.3 µg/L. This result is estimated (i.e., “J” qualified). The EPA tap water

[7] CH2M 2016. Technical Memorandum: *Groundwater and Seep Sampling Results and Data Validation Summary, Open Detonation Area, Blue Grass Arm Depot, Richmond, Kentucky.* March 8.

RSL for dimethylaminoazobenzene is 0.005 µg/L. There is currently no published MCL for this chemical. SVOCs were not detected in the seep sample.

- Metals – Two metals were detected above EPA tap water RSLs. Arsenic was detected in MW4004C01 at 2.6 µg/L. This result is estimated (i.e., “J” qualified). The EPA tap water RSL for arsenic is 0.052 µg/L. The drinking water MCL however is 10 µg/L. Cadmium was detected in MW4004C04 at 61 µg/L. The EPA tap water RSL is 9.2 µg/L, while the MCL for drinking water is 5 µg/L. No metals were detected above comparison criteria in the seep sample.
- Cyanide – Cyanide was detected above the EPA tap water RSL but below the MCL for drinking water. Cyanide was detected in MW4004C04 at 10 µg/L. The EPA tap water RSL is 1.5 µg/L, while the MCL for drinking water is 200 µg/L.
- Nitrate/Nitrite – Nitrate/Nitrite was reported as detected in 5 of 6 wells sampled. No result was above the comparison criteria (i.e., 10,000 µg/L MCL for nitrite).
- Perchlorate – Perchlorate was not detected in any well.
- Explosives – One explosive was detected above the EPA tap water RSL. RDX was detected in MW4004C04 at 6.8 µg/L and in MW4004C06 at 5.8 µg/L. The EPA tap water RSL is 0.7 µg/L. RDX was additionally detected at 2.3 µg/L in the seep sample.

In summary, results generally show the presence of low level concentrations of constituents in shallow groundwater beneath the OD/DB unit that may be associated with historical and/or current WMM/energetic waste treatment at the OD/BD unit. Shallow groundwater contamination at the Depot is not localized at the OD/BD unit, but occurs at other sites as well. Of the maximum concentration limits for constituents identified in Table 1 of 40 CFR 264.94, only cadmium exceeded the criteria during the most recent (2015) sampling event. No statistical analyses (40 CFR 264.97(b)) has been performed to date and the historical data are not known to be of a quality or in a format for such an analysis. In addition, due primarily to the lack of a productive upgradient well, background quality has not been established for the OD/BD unit.

E-1a(2) Identification of the Aquifer, Groundwater Flow Direction and Rate [40 CFR 270.14(b)(c)(2)]

Groundwater elevation data from the monitoring well network indicate that two separate flow systems are being monitored at the OD/BD unit. POC wells MW4004C04 and MW4004C06 are screened in the first groundwater encountered, which generally occurs at the soil/bedrock interface. MW4004C03 and MW4004C05 are screened across the first water-bearing structures below the shallow water-bearing zone.

Groundwater elevation data collected during previous investigations and sampling events were used to evaluate groundwater flow conditions at the OD/BD unit. The data indicate that uppermost groundwater is generally present at the soil/rock interface for most of the year and that it moves down the slope of this horizon. The slope of the soil/rock interface generally mimics the downhill direction of the ground surface topography, which results in groundwater flow to the east and southeast beneath the OD/BD unit. Figure E-2 is a shallow groundwater piezometric map generated from the most recent (2010) LTM results and showing OD/DB unit wells and the interpreted groundwater flow direction.

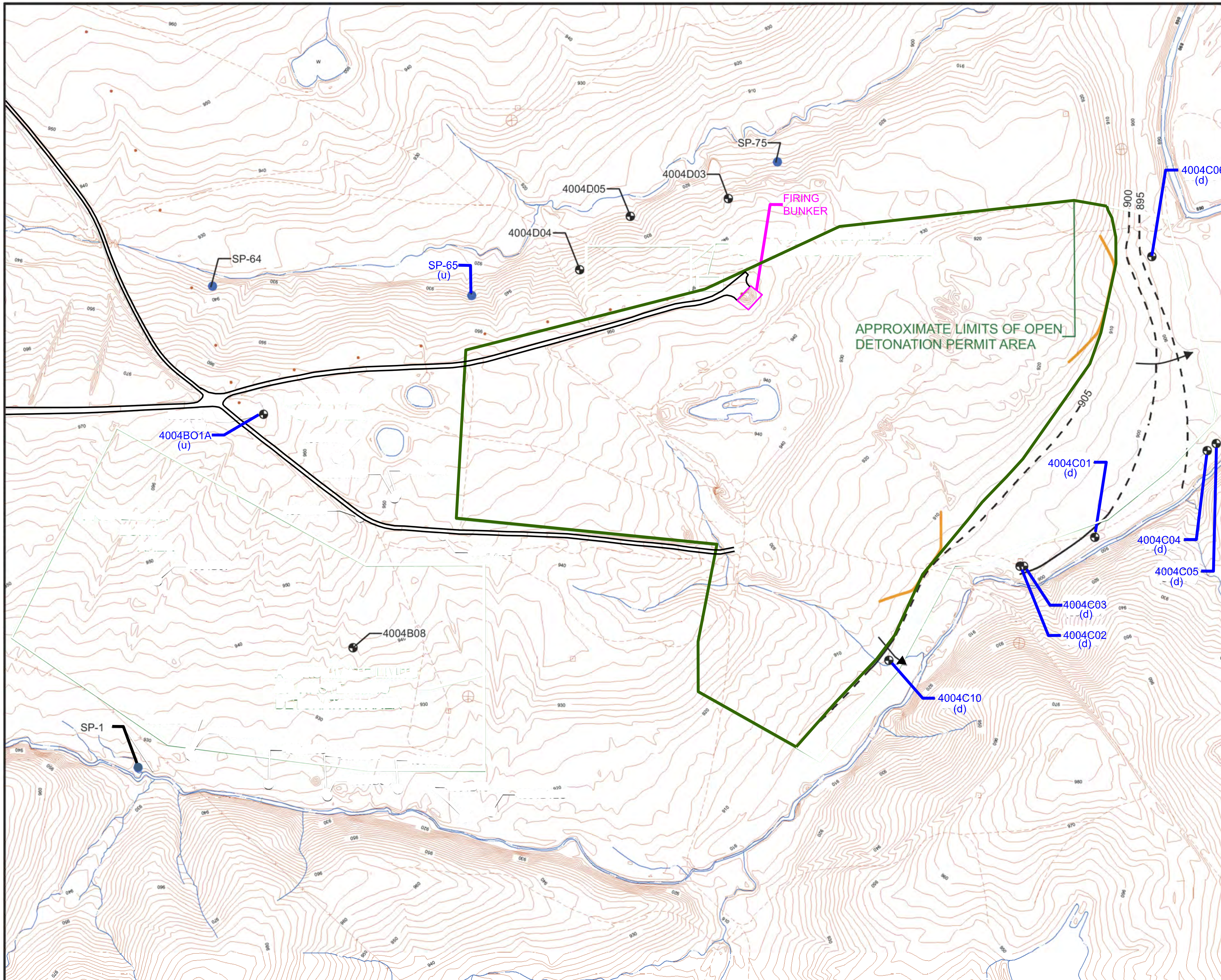
The groundwater velocity of the shallow groundwater system beneath the OD/BD unit was calculated in 1999 using the water table elevation map of the soil/bedrock groundwater data that are presented on Figure E-2. The groundwater elevations as established for the upgradient well (MW4004C09; this well has since been abandoned) to the downgradient well (MW4004C04) were used as the hydraulic gradients to measure groundwater flow velocity at the OD/BD unit. The Darcy equation $V = KI/n$ was used to calculate the flow rates, where V is velocity of groundwater flow (flow rate), I is the hydraulic gradient, K is the hydraulic conductivity determined from slug tests, and n is the estimated porosity of the porous medium.

$$V = \frac{\frac{K\ (h_1\ -\ h_2)}{L}}{n}$$

Where:

V = Actual velocity of groundwater flow
K = Hydraulic conductivity (3.47×10^{-4} feet per minute [ft/min])
I = ($h_1 - h_2$) = Difference in hydraulic head [MW4004C09 (936.22) and MW4004C04 (893.24)]
L = Distance along flow path between points h_1 and h_2 (1,540 feet)
n = Average effective porosity (15 percent)

A flow rate of 6.5×10^{-5} ft/min was calculated using the hydraulic conductivity value of 3.47×10^{-4} ft/min determined from a slug test in monitoring well MW4004C03 conducted by Law Environmental in 1989 and an estimated porosity of 15 percent.



N

LEGEND/NOTES:

Stream/Creek

Monitoring Well Location

Spring Location

4004BO1A/ SP-65 (u) Compliance Monitoring Well / Seep (upgradient)

4004C10 (d) Compliance Monitoring Well (downgradient)

4004D04 Restoration Program Monitoring Well in the Vicinity

SP-75 Seep in the Vicinity

Topographic Contour (Feet, msl) (2' Interval)

895.00' Shallow Groundwater Elevation Measured on March 30, 2010

Shallow Groundwater Piezometric Surface Contour (Feet, msl) (Dashed where inferred)

Apparent Groundwater Flow Direction

Sediment Controls, Installed 2006

0 150 300 450 600

Feet

BASE MAP SOURCE:
Provided by Blue Grass Army Depot

FIGURE E-2a

Blue Grass Army Depot
Richmond, KY

OPEN DETONATION AREA
AND THE MONITORING WELLS

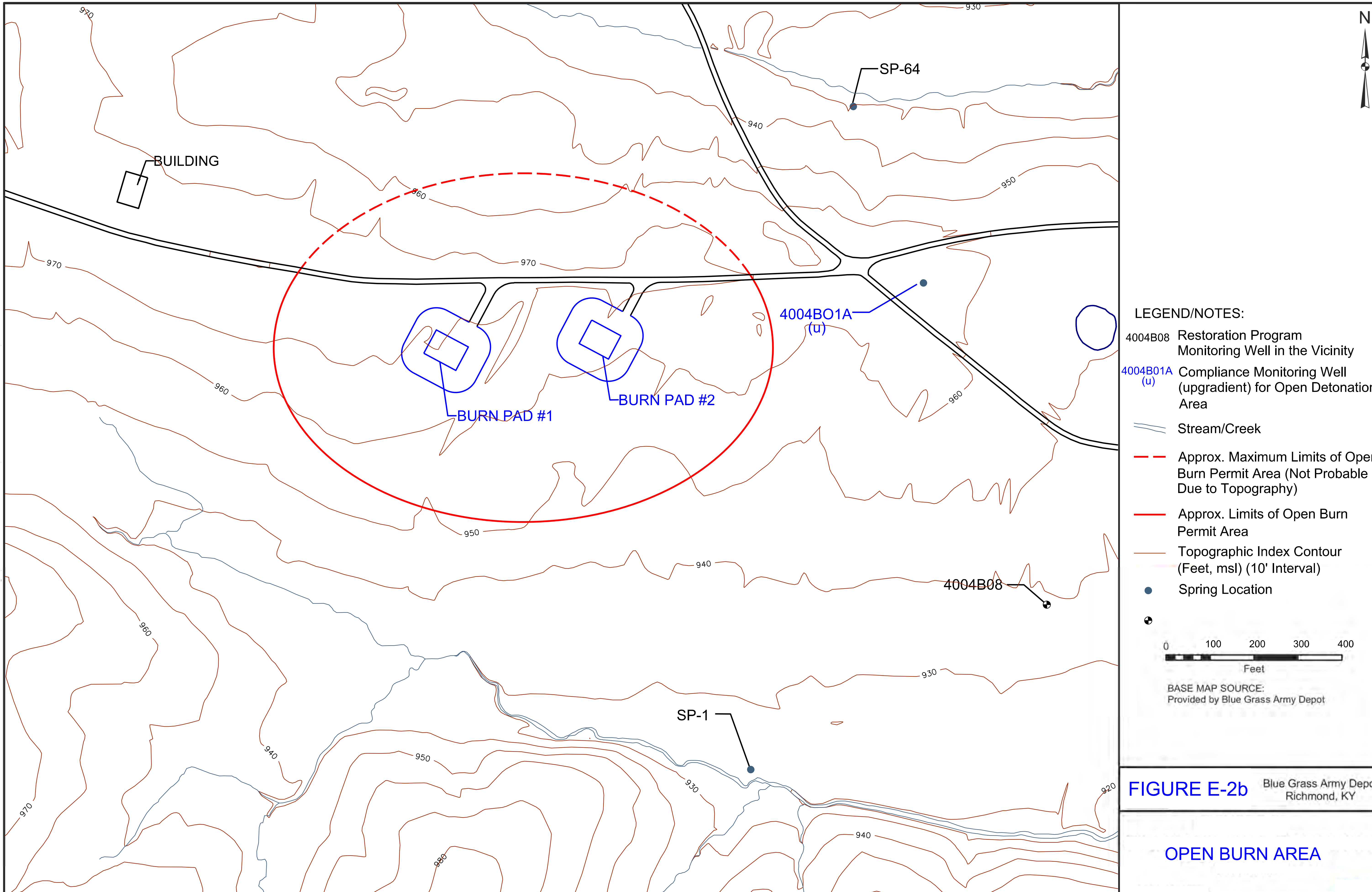


FIGURE E-2b

Blue Grass Army Depot
Richmond, KY

OPEN BURN AREA

E-1a(3) Contaminant Plume Description [40 CFR 270.14(b)(c)(4)]

Refer to Section E-1a(2) for a discussion of constituent concentrations detected at the OD/BD unit to date and refer to Appendix E-2 for a figure depicting constituent concentrations through the 2010 sampling event. Background quality has not been established for the unit and no statistical analyses have been performed.

E-1a(4) Evaluation of Subsurface Geologic Formations and Surface Topography for Solution or Karst Features [401 KAR 38:090 Section 2(20)]

A discussion of the subsurface geologic formations underlying the Depot and Demo Ground area is provided in Section B-3a(2). The subsurface geology and hydrology were investigated through a series of surveys, and through evaluation of groundwater elevation measurements and sampling in 1998 and 1999, and results reported to KDEP and included in the 2004 Part B Subpart X submittal[8].

As noted in Section B-3a, a regulatory meeting was held with KDEP in February 1999. As a result of those discussions, the requirements of 401 KAR 38:090 Section 2(21) were interpreted to be met if:

- An additional upgradient well was installed and screened across the Ashlock Formation and sampling of the well supported the CSM, and
- A year's worth of groundwater and surface water data were collected and verified the conceptual model.

Contaminants were not detected in the upgradient well screened across the Drake/Ashlock Formation, which indicates at the time of sampling the Drake/Ashlock Formation contact was not a contaminant migration pathway to the north of the OD/BD unit. The sampling results supported the site conceptual model that depicted the intermediate groundwater beneath the OD/BD unit flowing to the south/southeast and discharging to the unnamed southern tributary and Muddy Creek.

Interpretation of data collected to date indicate at this time that shallow groundwater flow at the OD/BD unit is controlled predominantly by interfacial flow at the soil/bedrock interface and fractured flow. The ridge where the safety bunker is located represents the northern boundary of the OD/BD unit hydrogeologic regime. This ridge is a recharge area for the shallow and deep groundwater systems. The unnamed southern tributary that flows east into Muddy Creek represents the southern hydraulic boundary of the shallow flow system and discharge point for the shallow groundwater system at the OD/BD unit. The shallow groundwater system at the OD area flows south and southeast into the southern tributary and Muddy Creek, with Muddy Creek representing base flow for the OD/BD unit.

Groundwater and surface water data to date, along with visual observation at the time of data collection, support the original site conceptual model. The northern tributary is at a higher elevation than the southern tributary and went dry before the southern tributary during times of low flow. Groundwater and surface water data collected from June 1999 through February 2002 and reported to KDEP concurred with the proposed site conceptual model. Groundwater fluctuated due to seasonal climate changes, and indicating the southern tributary and Muddy Creek were gaining streams, with Muddy Creek representing base flow for the OD/BD unit immediate surrounding area. The groundwater and surface water data collected adjacent to the southern tributary indicated the southern tributary was a gaining stream during low flow periods and, during periods of elevated flow (flood stages), temporarily became a losing stream.

In essence, all phases of work support the conceptual hydrologic model and the requirements of 401 KAR 38:090 Section 2(21)(b) and (c)1. 401 KAR 38:090 2(21)(b) requires the owner/operator to

[8] URS Group, Inc. 2004. Subpart X of the Part B Permit Application for Blue Grass Army Depot, Richmond, Kentucky.

demonstrate that the facility is “designed” to withstand gradual or sudden land subsidence and that no contamination into or through any fractures, channels, or solution features will occur.

Extensive investigation of the site revealed that the hydrologic setting is characterized as being moderately karstified with shallow groundwater predominantly controlled by fractured flow. Bedding planes, joints, and faults control groundwater flow. A conduit flow system, characteristic of a mature karstified aquifer system, is not evident in the flow systems monitored at the OD/BD unit. Pronounced solution features were not identified during logging of the rock core samples collected during monitoring well installation, and the mature karst features were not observed during the site walkovers.

These conclusions were revisited as part of BGAD’s response to Notice of Deficiency 02[9]. In 2014, a professional geologist licensed in the State of Kentucky and under contract to BGAD completed a review of aerial imagery from 2004 to 2012 and completed a visual site survey and surrounding area on December 18, 2013. The results of these activities were documented in a Technical Memorandum submitted to KDEP[10]. The review of the imagery showed that there was very little observed changes outside of the disturbed area over the time interval evaluated (2004 to 2012). The most significant change was a removal of trees and vegetation in a wide are extending northwest from the northern side of the OD/BD unit that occurred between 2006 and 2008 photos. There were no observable changes to the site topography or drainage to suggest the development of karstic collapse features or conduit flow since 2004. The results of the visual site survey are summarized in the bullets below:

- Many low lying areas and depressions were observed to have standing water in them within the disturbed area of the OD/DB unit. Flowing water was present in the drainage swale to the southwest of the OD/DB unit and draining into the southern tributary to Muddy Creek near monitoring well MW4004C10. This is an indication of the low permeability, poor drainage potential for the clay residuum soils present at the site.
- Site personnel indicated that they had observed occasional water seepage from the western-most detonation pit that periodically appears when the pit is excavated close to the soil bedrock interface. Based on the description, the encountered groundwater is likely perched at the soil bedrock interface and is only observed during saturated conditions when the pit depth approaches the interface elevation.
- Four karst related features were identified and their locations surveyed with a hand held Global Positioning System unit. Two of the features has been previously identified in LTSAP Annual Reports as DP-65 and SP-75, the two other located features are not known to have been previously identified and are described below:
  - Seep SP-13-1 (GPS coordinates N 37° 40’ 06.1”, W 84° 12’14.8”). This feature exists as a shallow depression that was saturated and with discernibly different vegetation than the surrounding area indicating that it was frequently to continuously wet. No flowing water was observed. The depression is located at the base of a steep break in slope slightly above the floodplain level of Muddy Creek to the east-northeast of the OD/DB unit. Seep SP-13-1 occurs at an elevation of about 905 feet at the mapped contact between the Drakes Formation and the upper part of the Ashlock Formation. The area around the seep was soil and vegetation covered so direct observation of the bedrock was not possible.
  - Sinkhole SH-13-1 (GPS coordinates N 37° 40’ 02.0”, W 84° 12’ 40.3”). This feature is a small sinkhole that was located upslope and south-southeast of SP-65. The sinkhole was approximately 4 feet in diameter by 3 feet deep with no visible rock. It appeared to have

[9] KDEP. 2013. *Notice of Deficiency (NOD 2) to the Subpart X of the Part B Permit Application for Blue Grass Army Depot dated 2004 and response to NOD 1 dated May 2007*.

[10] CH2M HILL. 2014. *Technical Memorandum, Open Detonation Area Karst Feature Survey*, January.

developed recently with minimal erosion around the edges or debris in it. Based on the orientation of Sink SH-13-1 with SP-65 they do not appear to follow an alignment pattern with the surrounding surface (topographic) drainage features. While they are in close proximity, connectively between the two features is uncertain.

- Observable rock exposures were limited to the base of Muddy Creek and limited exposes on the steeper south bank of the southern tributary to Muddy Creek. No significant fracture patterns or conduit development were observed in these limited exposures.
- Based on the aerial imagery review and the visual site survey, no other potential surficial karst features were identified that would indicate karst collapse or drainage feature development since 2004.

In summary, in more than 50 years of detonations at the OD/BD unit, there is no evidence of the collapse of soluble features.

E-1b Proposed Groundwater Monitoring Program [40 CFR 270.14(b)(c)(5)]

The OB unit is not a land treatment unit. It is an engineered structure that does not receive or contain liquid waste or waste containing free liquids; is designed to exclude liquid, precipitation, and other run-on and run-off; and has both inner (pan) and outer (concrete pad) layers of containment. The OB unit was investigated in 1997 in accordance with a KDEP-approved plan[11] and results reported to KDEP in 1998[12]. The results are summarized in Appendix E-3. Surface soils at the OB unit were additionally sampled in 2009 prior to the installation of the concrete pads that now serve to provide a barrier between the OB pan and the underlying soils. The sampling was coordinated and attended by KDEP and results reported in a Technical Memorandum[13]. Based on the results of the 1997 sampling event, analyses were limited to SVOCs and none were detected. The concrete pads have been in place since 2009. Erosion surrounding the pads observed in 2014-2015 was repaired in 2016 and the area surrounding the pads has been graded and permanent drainage swales constructed with riprap. A downgradient sediment basin has also been installed and administrative controls are in place to ensure that the area around the pans is cleaned of ash/debris as soon as possible after heat is adequately dissipated. Surface water run-on/run-off and not vertical migration to groundwater is the predominant pathway for potential exposure from the OB unit. Nonetheless, a groundwater monitoring well network is proposed to be installed at the OB unit.

The OD/BD unit is not specifically defined as a regulated unit under 401 KAR 34:060; however, it does incorporate soil as part of its engineering design and is subject to the groundwater monitoring program requirements.

In order to evaluate the impact of OD/BD treatment operations on the uppermost aquifer, BGAD proposes to conduct groundwater monitoring pursuant to a detection monitoring program [40 CFR 270.14(b)(c)(6)] established in coordination with KDEP. Data collected under this program will determine whether hazardous constituents are present at the point of compliance at concentrations exceeding established risk-based criteria and as established by approved statistical methods. The proposed groundwater monitoring program will be revised if, upon review and statistical evaluation of

[11] Radian International. 1997. *Sampling and Analysis Plan for Soil Site Characterization of the OB/OD Units at Blue Grass Army Depot*, October.

[12] Radian International. *Soils Site Characterization Report for the OB/OD Units at Blue Grass Army Depot, Richmond, Kentucky*, September.

[13] CH2M HILL. 2009. *Technical Memorandum, Soil Sampling at Open Burning (OB) Unit*, July.

the groundwater monitoring data, a compliance monitoring program is required (i.e., site-specific exceedance criteria are established).

E-1b(1) Groundwater Monitoring System [40 CFR 264.97(a), (b), and (c)] & 264.98(b)]

There are currently eight existing groundwater monitoring wells available for monitoring groundwater quality at the OD/BD unit, seven downgradient (MW4004C01, MW4004C02, MW4004C03, MW4004C04, MW4004C05, MW4004C06, MW4004C10) and one upgradient (MW4004B01A). MW4004B01A currently serves as the background well for the hydrologic unit containing the OD/BD unit but is chronically dry and recommended to be abandoned. The seven existing downgradient monitoring wells are recommended for inclusion in the detection monitoring program. Figure E-1 shows the monitoring well locations that currently comprise the POC monitoring well network. Monitoring well logs and as-builts for the POC monitoring wells are included in Appendix E-1.

POC monitoring wells for the OB unit will be determined in coordination with KDEP and installed in accordance with a KDEP-issued compliance schedule.

E-1b(2) Sampling and Analysis Procedures [40 CFR 264.97(d)]

The following procedures are proposed to be implemented to collect groundwater samples in support of the proposed detection monitoring program. Upon permit issuance, it is anticipated that a permit monitoring plan will be developed in coordination with KDEP to describe the sampling and analysis procedures.

E-1b(2)(a) Sample Collection

Groundwater will be purged and groundwater samples will be collected from each monitoring well using a submersible pump in accordance with the low-flow protocols as described in *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures EPA/540/S-95/504* (EPA 1996) to the extent possible. Use of this method will help minimize sample turbidity. Purging and sampling will be completed using a peristaltic pump, bladder pump, or other downhole submersible pump capable of achieving the low-flow discharge target range of 0.1 to 0.5 liter per minute. The pumps will be affixed with new, disposable tubing for each well. Field parameters for pH, temperature, specific conductance, turbidity, oxidation-reduction potential, and dissolved oxygen will be measured during the purging process with a water quality meter calibrated per manufacturer's recommendations. The water level in the well also will be monitored throughout the purging process to determine that the minimal drawdown criteria are met. If the water level declines more than 0.2 foot, the discharge rate should be reduced.

Monitor wells should be purged until the field parameters have stabilized within the ranges specified below and the water level is stable. The field parameter stabilization criteria are as follows:

Table E-1. Field Parameter Stabilization Criteria

Field Parameter	Stabilization Criterion
Water Levels	Total drawdown of <2 ft and an appreciable drawdown of no more than 0.33 ft
DO	0.10 mg/L or 10% of value (whichever is greater)
Specific Conductance	+/- 3% Full Scale Range
pH	+/- 0.10 pH unit
Temp	+/- 0.2 Deg. C
Turbidity	+/- 10% (<10 NTU)
Oxidation Reduction Potential (ORP)	+/- 10 mV

Field parameters will be documented on a field sampling log sheet.

In the event that stabilization criteria cannot be achieved, the conventional “three-well-volume” purging method may be used. The following equations should be used to calculate threewell volumes:

$$Vw = (H \times 0.163) \times 3 \text{ (for 2-inch wells)}$$

$$Vw = (H \times 0.653) \times 3 \text{ (for 4-inch wells)}$$

Where: Vw is the volume of water to be removed from the well in gallons and H is the height of the water column in feet. This formula takes all conversions into consideration. Wells will be purged for a minimum of three well volumes and until the parameters of temperature, pH, and specific conductance have stabilized.

For certain wells in the complex, groundwater yield is so low that the low-flow and the conventional three-well-volume methods are rendered impractical. For these wells, the most practical sampling method is to purge the well dry and collect a groundwater sample as soon as a sufficient volume of water has recharged into the well and within 24 hours of being purged dry. Groundwater samples will be collected in the order of the parameters’ volatilization sensitivity (greatest to least).

If the three-well-volume method is used, purging may be accomplished using a pump or disposable or stainless steel bailers. Clean nylon rope will be used to haul bailers and will be discarded after well sampling is complete. When the pump is used, clean poly tubing will be used at each sampling location. The pump is controlled such that discharge rates do not exceed 1 gallon per minute during purging. The pump will be decontaminated between sample locations and tubing will be discarded.

At locations sampled using bailers, sample bottles will be filled by pouring water from the bailer top at a slow rate to minimize turbulence. At locations sampled using a pump, a flow rate of 500 milliliters per minute or less will be maintained during sample collection. Bottles will be filled directly from the pump discharge tube. Once filled, the sample bottles will be capped, labeled, placed on ice, and chain of custody records completed.

Duplicate and split samples will be collected from at least 10 percent of the sample locations and field matrix spike/matrix spike duplicate samples will be collected from at least 5 percent of the sample locations.

E-1b(2)(b) Sample Preservation and Handling

Groundwater samples will be collected in appropriate sample containers, properly preserved, sealed, and labeled. Table E-2 presents sample containers, preservation methods, and holding times. Each sample container will be identified by affixing a pressure-sensitive, gummed label. This label will contain the sample identification number, date and time of collection, source preservative used, analysis required, and the collector’s initials. All samples will be recorded on a chain of custody record (see Figure E-3).

Standard chain of custody procedures will be followed to track possession of the samples from sample collection until analysis. A sample will be considered under custody if it is (1) in the possession of the sampling team, (2) in view of the sampling team, or (3) transferred to a secure area. An area is considered secure only when it is locked and access is controlled.

Table E-2. Sample Analyses, Containers, Preservation and Holding Times

Analyses	Sample Matrix	Container	Preservative	Holding Time
Explosives	W S	1-L amber glass 8-oz glass	Cool 4°C Cool 4°C	7/40 days 14/40 days
Metals (Total with Mercury)	W S	250-mL polyethylene 4-oz glass	HNO_3, pH < 2 Cool 4°C Cool 4°C	Mercury: 28 days Other metals: 6 months Mercury: 28 days Other metals: 6 months
Metals (Dissolved with Mercury)	W	250-mL polyethylene	Cool 4°C	Mercury: 28 days Other metals: 6 months
Perchlorate	W	250-mL polyethylene	Cool 4°C	28 days

Notes:
°C = degrees Celsius
L = liter
mL = milliliter
S = Sediment and Surface Soil
W = Water

The field supervisor is responsible for custody of the collected samples in the field until they have been properly packaged, documented, and transferred to a courier or directly to the laboratory. If samples are not immediately transported to the analytical laboratory, they will remain in the custody of the field supervisor. A chain of custody record will be used for all samples collected under the compliance monitoring program. A sample chain of custody record form is shown in Figure E-3. The laboratory will follow its own internal chain of custody procedures.

SAMPLE CHAIN OF CUSTODY

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

Laboratory	**NAME**
Address	**ADDRESS 1**
	ADDRESS 2
Phone	**(AC) Number**

Page ___ of ____ Pages

Project No.				**Required Analysis**											____Standard Report Delivery ____ Expedited Report Delivery Date due
Project Name and Location															
Client Name		Client Manager													
Client Address (City, State, Zip)															
Sample		**Sample Identification**	**Matrix Type**												**Remarks**
Date	**Time**			**Number of Containers Submitted**											

Relinquished by: (signature)	Date	Time	Relinquished by: (signature)	Date	Time	Relinquished by: (signature)	Date	Time
Received by: (signature)	Date	Time	Received by: (signature)	Date	Time	Received by: (signature)	Date	Time

Laboratory Use Only

Received by: (signature)	Date	Time	Custody Intact YES ____ NO ____	Custody Seal No.	SL Log No.	Laboratory Remarks

Figure E-3. Sample Chain of Custody Form – Typical Format

Sample identifiers will identify the media sampled, the monitoring well number, the sample number, and date. An example identifier is "GWMW11080197" (groundwater sample from monitoring well 1, sample 1, collected August 1, 1997).

Sample labels will be affixed to all sample containers prior to or at the time of sampling. Sample seals will be used to detect tampering of samples prior to analysis. The seal will be attached in such a way that it is necessary to break the seal in order to open the sample container. As an alternative to using sample seals, evidence tape with the collector's initials and date may be used. Labels will be completed with black indelible ink and, at a minimum, will contain the sample identifier, date, time, sampler's initials, analysis to be conducted, preservative, site name, and type of sample.

At the end of each sampling day, samples requiring shipment will be repackaged in shipping containers with double-bagged wet ice as specified by the laboratory and analytical protocols. The samples will be packaged to prevent leakage and breakage during shipping. Each shipping container will be sealed with a custody seal and sent to the laboratory by an overnight delivery service.

E-1b(3) Analytical Procedures and Frequency [40 CFR 264.97(e) & 268.98(a), (c) and (d)]

Hazardous constituents are constituents identified in 401 KAR 31:170 (which references 40 CFR 261 Appendix VIII) that have been detected in the groundwater in the uppermost aquifer underlying a regulated unit and that are reasonably expected to be in, or otherwise likely to be derived from, wastes treated at the facility or other materials that were used. Groundwater monitoring efforts to date have not included sampling for all 401 KAR 31:170 analytes or those found in 401 KAR 34:360 (which references 40 CFR 264 Appendix IX), which are used specifically for groundwater monitoring purposes.

The list of proposed hazardous constituents for the detection monitoring program was developed based on:

- Knowledge of past treatment operations
- Types, quantities, and concentrations of constituents likely to be present in the wastes treated
- Constituents previously detected in the groundwater
- Potential for adverse impact to human health and the environment

Groundwater samples will be properly packaged and shipped to Kentucky-certified analytical laboratories. Analyses will be performed in accordance with EPA Method SW-846, latest version. Table E-2 presents the proposed analyses for the detection monitoring program.

Samples will be collected in the following order:

1. Metals (total and dissolved)
2. Perchlorate
3. Explosives

Perchlorate is proposed to be sampled for a total of four sampling events (beginning with the 2015 event at the OD/BD unit). If results indicate no detections above screening criteria, perchlorate sampling is proposed to be discontinued unless indicated by a change in the BGAD OD waste stream. Dissolved metals analyses will only be performed on analytes detected above their respective MCL during the associated total metals analyses. Groundwater samples collected for dissolved metals analyses will be filtered by the receiving laboratory.

Semi-annual sampling will be instituted at the OB and OD/BD units to assess seasonal fluctuations. BGAD may petition KDEP to move from semi-annual to annual sampling after sufficient data have been collected to show minimal variation in the data between seasons and justify reduced monitoring.

E-1b(4) Determination of the Groundwater Surface Elevation [40 CFR 264.97(f)]

Prior to each groundwater sampling event, the groundwater surface elevation in each well will be measured with a clean, electric water level indicator from a reference point at the top of the PVC casing. Water levels will be recorded to the nearest 0.01 foot.

E-1b(5) Procedures for Establishing Background [40 CFR 264.97(g)]

Background groundwater quality has not yet been established for the proposed monitored parameters. The concentrations and values of each monitoring parameter will be collected from a newly established or identified background monitoring well in coordination with KDEP. The initial background arithmetic mean and variance will be calculated by averaging at least four replicate measurements for respective parameter concentrations or values in samples obtained from the upgradient well. These average values will be used to represent initial background concentrations.

E-1b(6) Statistical Procedures [40 CFR 264.97(h) &264.98(f)]

Statistical analysis of the results of metals analysis in groundwater will be performed in accordance with 40 CFR 264.97(h) and 264.98(f). While the use of interwell statistics (comparison of upgradient to downgradient wells) is preferred, given the uncertainty of locating a suitable upgradient sampling point, as well as the potential spatial variability that can occur through the development of preferential pathways within karst groundwater systems, intrawell statistical procedures (comparison of the data from within an individual well) may be appropriate for the site conditions encountered.

Use of intrawell statistical methods will be predicated on the inability to establish an upgradient monitoring point or as the result of spatial variability in the downgradient monitoring locations and aquifer conditions. While the most commonly applied statistical method, Parametric analysis of variance (ANOVA), may be used for intrawell evaluations, other methods indicated in 40 CFR 264.97 (h) (e.g. tolerance intervals) may be more appropriate. Before the preferred statistical method can be determined, the monitoring network needs to be established and baseline/background samples collected. At that time, the data can be reviewed and an appropriate statistical method selected. The selected statistical method based on the monitoring network configuration and baseline data will comply with the procedures identified in 40 CFR 264.97 (h) and the methodologies presented in the EPA *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance (2009)*.

Should ongoing sampling indicate that an alternate statistical method not identified in 40 CFR 264.97 (h) is more appropriate for the site, BGAD will submit a written request to KDEP justifying the alternate method.

E-1b(7) Groundwater Flow Direction and Rate [40 CFR 264.98(e)]

Groundwater flow rate and direction will be determined annually by assessing groundwater elevation data collected during sampling events.

E-1b(8) Recordkeeping and Reporting [40 CFR 264.97]

Groundwater monitoring data will be used to prepare monitoring reports to be submitted to KDEP no later than 90 days after the sampling event and will summarize the groundwater data and determinations made pursuant to the permit and 40 CFR 264.98(f) and (h). Analytical results will be tabulated and compared against the most current permitted concentration or MCL. In the absence of a permitted concentration limit or MCL, the most current RSL for tap water will be used. The monitoring reports and supporting data will be maintained in the BGAD operating record.

E-1c Detection Monitoring Program [40 CFR 264.98]

As previously described, BGAD has proposed to enter into a detection monitoring program. The purpose of the detection monitoring program is to monitor groundwater at the OB and OD/DB unit to ensure that the units continue to operate in a manner that poses no unacceptable level of risk to human health or the environment. The proposed data quality objectives (DQOs) for the detection monitoring program were established based upon EPA Guidance[14], and serve as the basis for its design. The DQOs identify the type, quality, and quantity of data to be collected and how the data are to be used to make appropriate decisions with respect to the permit.

The DQOs were developed through a seven-step process used to establish the final data collection design. The first five steps of the process identify mostly qualitative criteria, such as what problem has initiated the monitoring (i.e., ensure the unit is operated in a manner that poses no unacceptable level of risk to human health or the environment) and what decision is needed to resolve it (i.e., determine whether contaminants generated from OB and OD/DB operations are present at levels that exceed acceptable risk criteria). These steps also define the type of data to be collected, where and when the data will be collected, and a decision rule that defines how the decision will be made. The sixth step defines quantitative criteria, expressed as limits on decision errors that can be tolerated by the decision-maker. Decision errors are minimized by ensuring quality measures and controls throughout groundwater monitoring well installation, sampling, and analysis. The final step is the development of the data collection design using the criteria developed in the previous six steps. The final output of the process is the data collection design that meets the qualitative and quantitative needs of the project. The following proposed DQOs have been identified:

- Monitor the levels of constituents of potential concern in the point of compliance monitoring network through a systematic and routine sampling regime.
- Define the level and extent of identified contaminants of concern (COCs, i.e., those contaminants of potential concern [COPCs] that exceed concentration limits).
- Compare groundwater analytical results with MCLs or current RSLs (formerly called EPA preliminary remediation goals [PRGs]) for tap water (in the absence of MCLs) or as established by KDEP in the final operating permit.
- Complete a statistical analysis of the results of metals analysis within the POC and background well network in accordance with 40 CFR 264.97(h).

E-1d Compliance Monitoring Program [40 CFR 264.99]

In the event that statistical analysis of the groundwater monitoring data during the detection monitoring period shows that a statistically significant increase has occurred at the point of compliance suggesting that a release may have occurred from the unit, BGAD will notify KDEP in writing. BGAD then has the opportunity to submit a demonstration that a source other than the regulated unit caused the statistically significant change in groundwater quality, or that the apparent groundwater degradation is the result of an error in groundwater sampling, analyses, or evaluation. If the demonstration is successful, then BGAD will submit an application to make appropriate changes in the detection monitoring program, as necessary. BGAD will continue to monitor groundwater quality in accordance with the conditions of its permit and this application until the modification is approved.

Should the presence of a release from the OB or OD/BD unit be confirmed, BGAD will abide by the requirements of 40 CFR 264.98 by immediately sampling the groundwater in all monitoring wells and

[14] U.S. Environmental Protection Agency (EPA). 2000. *Guidance for the Data Quality Objectives Process*, EPA QA/G-4. August.

determine whether constituents in the list of Appendix IX of Part 264 (or subset thereof, as agreed to by KDEP) are present, and if so, at what concentration. BGAD will work in coordination with KDEP to establish a compliance monitoring program consistent with 40 CFR 264.99.

E-1e Corrective Action Program [40 CFR 264.100]

Upon confirmation of a release from the OB or OD/BD unit beyond the established point of compliance at concentrations above concentration limits and as determined through approved statistical analysis procedures, BGAD will establish a corrective action program in coordination with KDEP.

E-2 Environmental Performance Standards Demonstration [401 KAR 34:250 & 40 CFR 264.601]

This section addresses the Environmental Performance Standards demonstration for prevention of releases that may have adverse effects on human health or the environment due to migration of waste constituents to the surface, subsurface, groundwater, surface water, and wetlands. The Environmental Performance Standards for prevention of releases that may have adverse effects on human health or the environment due to migration of waste constituents in air are addressed in the air modeling and risk assessment report that accompanies this application.

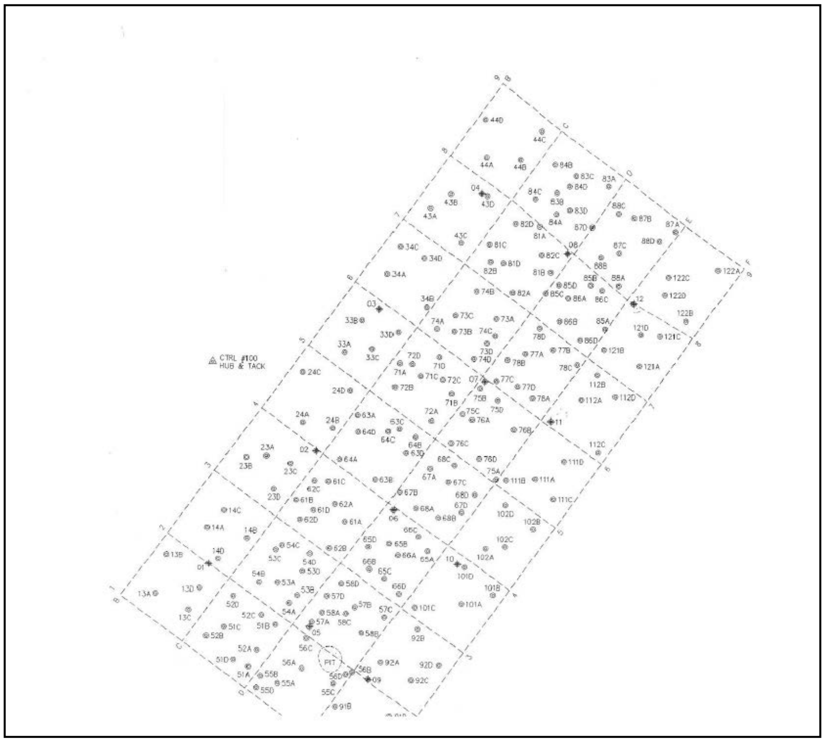
E-2a Surface and Subsurface Soils

Soils within the OB and OD/DB unit were characterized as part of a baseline comprehensive site characterization in 1998. The sampling plan and implementation were coordinated with KDEP and results reported in the Soils Site Characterization Report[15]. The results are additionally summarized in Appendix E-3. Identified COPCs for the study included explosives, metals, SOVCs, and cyanide. VOCs were not selected as COPCs because of the high potential for volatilization at the OD/DB unit and absence of the use of fuel oils at the OB unit. The intended sampling protocol included a single subsurface sample for geotechnical analysis from the OB unit and two from the OD/DB unit. However, repeated subsurface borings within the OD/BD unit failed to identify an undisturbed layer of soil. The OD/DB unit was found to consist of a disturbed layer of a mixture of natural soils and fill ranging from a depth of 0.5 foot to 10 feet, underlain by a bedrock shelf. The field team concluded that geotechnical analysis of the disturbed soils had little value because of the introduction of fill material from varying origins to the OD/DB unit. Therefore, Geotechnical analysis was limited to a single sample collected approximately 30 feet southwest of Burn Pan 2.

At the OB unit, surface soil samples were collected and composited from a series of concentric circles surrounding the pans at a distance of 1 foot, 5 feet, 10 feet, and 25 feet. Each composited sample consisted of four discrete samples collected from each of the four sides of the pan. The samples were composited by ring to identify contaminant concentration trends that may occur as a result of kickout and ash/residue deposition around the pans. One subsurface soil boring was also completed at a distance of approximately 30 feet downgradient from each of the two pans. Eight surface soil and two subsurface soil samples were submitted for analysis for SVOCs, metals, explosives, and cyanide. Sampling was completed within 24 hours following an OB event.

[15] Radian International. 1998. *Soils Site Characterization Report for the OB/OD Units at Blue Grass Army Depot, Richmond, Kentucky*. September.

At the OD/DB unit, the sampled area was defined by a 400-foot by 800-foot sampling grid (shown in the inset) centered on the centerline of the most recent line of pits. Each grid measured approximately 100 feet by 100 feet. The sampling grid and sampling points were surveyed for horizontal control by a state-licensed survey company. Surface soils were composited within each grid. Each composited sample consisted of four discrete samples taken from random locations within each grid. One composited surface soil sample was additionally collected from each of the outlying grids (farthest from the line of pits), while two composited surface soil samples were collected from each of the inner grids (grids containing the pits). The samples were composited to determine an estimate of the mean concentration of COPCs across the active treatment area of the OD/DB unit. A total of 48 surface and 11 subsurface samples were submitted for analysis for SVOCs, metals, explosives, and cyanide. In addition to these, pre- and post-treatment samples were also collected from clean fill material within a single pit as part of a field test. The field test was conducted to verify the effectiveness of the OD/BD treatment process in eliminating the reactive characteristic of the waste. Samples were submitted for explosives analysis only.



A background soil sampling location was selected based on similar soil types (as represented by the USGS geological map) as those naturally occurring in the OB and OD/DB units and isolation from known current and historical industrial activities. Four discrete surface and two subsurface soil samples were collected from the background location.

In addition to these, two sediment samples were taken from within surface water drainage channels on the downgradient slope of the OD/BD unit. One sample was taken at the point of sediment deposition (identified by visual inspection) of each of the drainage channels. The two sediment samples were submitted for SVOC, metals, explosives, and cyanide analyses. A single grab surface water sample also was collected from a pond that was previously located within the OD/DB unit and submitted for the same analyses. The pond was later drained and filled.

By recommendation of KDEP, screening levels at the time were those published in the Human Health Generic Screening Levels (HHGSL) table from the former 401 KAR 100:050 Risk Assessment Guidance. The sample results reported for the 1998 baseline characterization study were excerpted from the report and are presented in Appendix E-3. The data have additionally been related to the current EPA RSLs.

The data collected during the baseline site characterization effort showed that the greater than 50 years of DoD operations in and in the vicinity of the OB and OD/DB units have contributed to increased levels of some hazardous constituents in the soils beneath the active units.

A soil sampling protocol to assess current concentrations within soil media at the OB and OD/BD units will be developed in coordination with KDEP and implemented in accordance with a KDEP-issued compliance schedule. Geotechnical analysis for particle size distribution for OD/BD unit soils will be included as directed by KDEP.

E-2b Surface Water and Sediments

Initial surface water and sediment sampling was completed by Radian International in June 1999. The scope of the sampling effort was to identify contamination within Muddy Creek, the southern tributary, and two seeps located within the northern tributary and the western drainage channel. Sampling was conducted in accordance with a KDEP-approved Work Plan[16]. Both upgradient and downgradient sediment and surface water sampling was performed within the tributary and creek. Sampling results are provided in Appendix E-3.

In 2002, Environmental Chemical Corporation completed a surface cleanup of munitions related debris within Muddy Creek adjacent to the OD/DB unit and a report issued. The summary report was not located in preparation of this permit application but the laboratory report was reviewed. The results were not decipherable to a great degree in the absence of narrative. In general, the results show that a small number of upgradient and downgradient (of the work effort) surface water and sediment samples collected from within Muddy Creek during the cleanup were submitted for explosives and metals analysis and results show detections of both. Similar to other results, arsenic and lead in sediment appear elevated in both upgradient and downgradient sampling locations. Low concentrations of explosives (2,4,6-Trinitrotoluene, 4-Amino-2,6-Dinitrotoluene, HMX, and RDX) were detected in downgradient surface waters.

Additional soil/sediment grab samples were collected within the bounds of the OD/DB unit by BGAD in 2006. Three grab samples were collected from within a drainage channel that had formed within the eastern boundary of the treatment area and two grab samples were collected from a drainage channel that had formed within the western boundary of the treatment area. All samples were analyzed for the explosives 2,4,6-Trinitrotoluene, HMX and RDX, SVOCs, metals, and perchlorates. The samples were collected for general information and not as part of a sampling program or approved protocol, and data validation was not completed. There were no detections of explosives or perchlorates in any sample and only a single SVOC (1,2-Dichlorobenzene) was detected at 0.57 milligrams per kilogram (mg/kg) at one location within the western drainage channel. Metals were detected consistently at all locations. Comparison to residential and industrial RSLs indicates elevated levels of aluminum, arsenic, cobalt, iron, lead, and manganese at some grab sample locations.

BGAD operates under a Kentucky Pollutant Discharge Elimination System (KPDES) permit issued by the Surface Water Permits Branch of KDEP. Ten outfall locations are identified in the permit. Outfalls 8 and 9 are associated with the point source discharges from the OB unit sediment control basins. These outfalls are required to be sampled monthly and analyzed for iron, lead, total suspended solids, hardness, and pH. One outfall, Outfall 5, is located downgradient of OB and OD/BD operations at the location where Muddy Creek exits the Depot along the northeast installation boundary. No monitoring of this outfall location is required by the KPDES permit. The KPDES additionally requires implementation of best management practices (BMPs) that prevent or minimize the potential for the release of pollutants from ancillary activities through site runoff; spillage or leaks, sludge or waste disposal, or drainage from raw material. The significant upgrades to the OB unit, inclusive of site grading, drainage swales, riprap, and sediment control basin, are included in the Depot's BMPs and intended to mitigate surface water run-off

[16] Radian International. 1998. *Work Plan for Monitoring Well Installation and Groundwater, Surface Water and Sediment Sampling Activities at the Open Detonation Area*. October.

and provide protection of nearby surface water (unnamed tributary of Muddy Creek) and its sediment. Therefore, no additional monitoring or controls are proposed for the OB unit.

Previous sampling results indicate that the sediment and potentially the surface water within the unnamed southern tributary of Muddy Creek and Muddy Creek itself are impacted by contaminants and/or naturally occurring constituents. The results indicate that both upgradient and downgradient locations of the OD/BD unit may be impacted. It is not known whether the impact is a result of historical operations or whether current operations are contributing.

A sediment sampling protocol to assess the impact of sediment runoff from the OD/BD unit will be developed in coordination with KDEP and implemented in accordance with a KDEP-issued compliance schedule.

Effective sediment control measures (i.e., riprap barriers) have been in place for approximately a decade. These controls mitigate the potential for contaminant runoff. Historical photography shows the improvement in the control of erosion and sediment runoff from the site. During the conduct of soils site characterization in November 1997, two distinct drainage channels were noted along the eastern and western ends of the line of pits. Hay bales were installed as a temporary measure to mitigate sediment run-off until the permanent riprap barriers were installed. The effectiveness of these barriers is evident today. The southern portion of the OD/BD unit has filled in with sediment and vegetation growth is considerable. BGAD maintains the unit with a combination of grading to divert surface water from the line of pits/detonation area and maintenance of the riprap barriers. No additional engineering controls are recommended.

E-2c Groundwater

Groundwater is addressed in Section E-1. A program of groundwater monitoring is recommended in Section E-1 to detect and evaluate potential COPCs that may be migrating to the groundwater beneath the OB and OD/BD unit.

E-2d Wetlands

Wetlands are addressed in Part J of this application. Wetlands mapped on BGAD are shown on Figure J-1 of Part J of this permit application. Wetlands are not located proximate to the OB or OD/BD units and will not be impacted by their operation.

E-3 Corrective Action for SWMUs and AOCs [401 KAR 34:060 Section 12]

Under the Defense Environmental Restoration Program (DERP) established by Congress in Title 10 United States Code 2701-2702 and 2810, all DoD installations are required to clean up sites posing a threat to human health and safety. The DERP provides for centralized management of the cleanup of DoD hazardous waste sites consistent with the provision of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR §300) and Executive Order 12580, Superfund Implementation. The DERP also provides for limited activities to reduce the amount of hazardous waste generated and disposed of.

Policy requires installations to take immediate action to eliminate human exposure to contamination and remove imminent threats to health. This is to be accomplished by development of partnerships with EPA, state, and local regulatory agencies by identifying points of contact, consulting with them early and throughout the Installation Restoration Program process, soliciting their comments as appropriate on plans and reports, and engaging them in joint reviews of requirements and available resources. Defense and State Memoranda of Agreement will be signed by the Deputy Under Secretary of Defense Environmental Security with interested states and territories to expedite cleanup and to reimburse them for technical support services at National Priorities List (NPL) and non-NPL sites.

Installation Restoration activities shall be carried out subject to and in a manner consistent with the requirements of the RCRA for corrective action under sections 3004(u), (v) and 3008(h) will be followed where appropriate.

BGAD has SWMUs and Areas of Concerns (AOCs) for which groundwater monitoring activities occur unrelated to this permit renewal application. The status of the SWMUs and AOCs is provided below for reference only.

Groundwater monitoring data for wells at BGAD during interim status are referenced in the following reports for convenience:

- RFI, Draft Final Report of the Pink Water Pond Area, Law Engineering and Environmental Services, Inc. (Law) 1989
- Final Report, RFI of the Propellant Burn Area, Law 1989
- RFI, Final Report of the Mustard Trench Area, Law 1989
- RFI, Final Report of the Open Detonation Area, Law 1989
- RFI, Final Report of the Dry Acid Pond Area, Law 1989 and RFI Phase II, Sverdrup Environmental, Inc. (SVE) 1994
- RFA, Final Report of the Fire Training Area, Law 1989
- RFI, Final Report of the New Landfill Area, Law 1989
- RFI, Final Report of the TNT Lagoon Area, Law 1989 and RFI Phase II, SVE 1996
- RFI, Final Report of the Propellant Burn Area, Law 1989
- RFI, Final Report of the Old Landfill Area, Law 1989 and Phase II, SVE 1996
- LTM, Quarterly Monitoring Reports, IT Corp. (IT) 1998/1999
- Dry Acid Pond, Final Report, Sang Corp., 1998
- Final Groundwater Sampling at the Open Detonation Area, SVE 1996
- BGAD Fire Training Area Sampling and Analysis Report, Ogden 1994
- Final Sampling Report, Soil Sampling DRMO Stockpile Area, BGAD, Richmond, Kentucky, SVE 1994
- Final Report, Interim Remedial Action Plan Study (Groundwater) for New Landfill, SVE 1994
- Final Report, Interim Remedial Action Plan Study (Groundwater) for Old Landfill, SVE 1994
- Final SI Report, Combined Sites, Vols. I, II and III, SVE 1996
- Final Report Battery Burial Area, SVE 1995
- Final Report for SI, at Additional SWMUs Group B Vols. I – VII, SVE 1995
- Remedial Design Investigation Activities Report, New Landfill, SVE 1996
- Remedial Design Investigation Activities Report, Old Landfill, SVE 1996
- Final Letter Report, Groundwater Sampling at the Open Detonation Area, SVE 1996

- Final SI Report, Former Waste Ammunition Detonation Area Vols. I – II, SVE 1999
- Final PIA Report for Interim Action Plan Study at Mustard Burn Site/Mustard Trenches, SVE 1994
- Final 1st, 2nd, and 3rd Long-Term Sampling and Analysis Program Report, IT 2000
- Final 5th,6th,7th and 8th Long-Term Sampling and Analysis Program Report, IT 2001
- Final 1988 & 1999 Annual Reports for Long-Term Sampling and Analysis Program, IT 2001
- Final 2000 & 2001 Annual Reports for Long-Term Sampling and Analysis Program, IT 2002
- Final Report for the RCRA Facility Investigation at the Burning Grounds, Jacobs/Stratum 2002
- Final Report for Conceptual Sitewide Groundwater Flow Model, URS Consultants, Inc. (URS) 2000
- Final Report for Phase II Sitewide Groundwater Assessment Monitoring System Evaluation, URS 2001
- Final Report for the Facility Wide Screening Level Ecological Risk Assessment, Jacobs/Stratum 2002
- Final Report for the Depot-Wide Background Soil Investigation, Jacobs/Stratum 2001
- Pristine Background Report (Addendum to the Final Depot-Wide Background Soil Investigation Report), Jacobs/Stratum 2002
- Final 2002 Annual Report for Long-Term Sampling and Analysis Program, IT August 2002
- Final 2003 January Annual Report for Long-Term Monitoring Event, Shaw Environmental and Infrastructure, Inc. (Shaw) 2003
- Final 2003 January Report Phase 3 Groundwater Assessments, URS 2003
- Corrective Measure Study (SWMU 17) Fire Training, URS 2003
- Remedial Investigations at SWMUs 12, 15, and 16, Shaw 2003
- Removal Action Closure Report (Old TNT Lagoons Area), Environmental Chemical Corporation, 2003
- Final 2004 January Report Long Term Sampling and Analysis Program, URS 2004
- Sitewide LTM, Operations, and Maintenance Plan, URS, 2004

E-3a Description of Wells

The 78 groundwater monitoring wells at BGAD are categorized as follows:

- LTM: 55
- Piezometers: 13
- Decommissioned: 10

Depths and screening are referenced in the following reports (copies on file at KDEP):

- RFI, Draft Final Report of the Pink Water Pond Area, Law 1989
- Final Report, RFI of the Propellant Burn Area, Law 1989
- RFI, Final Report of the Mustard Trench Area, Law 1989
- RFI, Final Report of the Open Detonation Area, Law 1989
- RFI, Final Report of the Dry Acid Pond Area, Law 1989 and RFI Phase II, SVE 1994
- RFA, Final Report of the Fire Training Area, Law 1989

- RFI, Final Report of the New Landfill Area, Law 1989
- RFI, Final Report of the TNT Lagoon Area, Law 1989 and RFI Phase II, SVE 1996
- RFI, Final Report of the Propellant Burn Area, Law 1989
- RFI, Final Report of the Old Landfill Area, Law 1989 and Phase II, SVE 1996
- Final 1st, 2nd, and 3rd Long-Term Sampling and Analysis Program Report, IT 2000
- Final 5th,6th,7th and 8th Long-Term Sampling and Analysis Program Report, IT 2001
- Final 1988 & 1999 Annual Reports for Long-Term Sampling and Analysis Program, IT 2001
- Final 2000 & 2001 Annual Reports for Long-Term Sampling and Analysis Program, IT 2002
- Final Report for Conceptual Sitewide Groundwater Flow Model, URS 2000
- Final Report for Phase II Sitewide Groundwater Assessment Monitoring System Evaluation, URS 2001
- Final 1st, 2nd, and 3rd Long-Term Sampling and Analysis Program Report, IT 2000
- Final 5th,6th,7th and 8th Long-Term Sampling and Analysis Program Report, IT 2001
- Final 1988 & 1999 Annual Reports for Long-Term Sampling and Analysis Program, IT 2001
- Final 2000 & 2001 Annual Reports for Long-Term Sampling and Analysis Program, IT 2002
- Final Report for Conceptual Sitewide Groundwater Flow Model, URS 2000
- Final Report for Phase II Sitewide Groundwater Assessment Monitoring System Evaluation, URS 2001
- Final Report for the Depot-Wide Background Soil Investigation, Jacobs/Stratum 2001
- Pristine Background Report (Addendum to the Final Depot-Wide Background Soil Investigation Report), Jacobs/Stratum 2002
- Final Report for the RCRA Facility Investigation at the Burning Grounds, Jacobs/Stratum 2002
- Sitewide LTM, Operations, and Maintenance Plan, URS, 2004

Casing description: Referenced in the following reports (copies on file at KDEP):

- RFI, Draft Final Report of the Pink Water Pond Area, Law 1989
- Final Report, RFI of the Propellant Burn Area, Law 1989
- RFI, Final Report of the Mustard Trench Area, Law 1989
- RFI, Final Report of the Open Detonation Area, Law 1989
- RFI, Final Report of the Dry Acid Pond Area, Law 1989 and RFI Phase II, SVE 1994
- RFA, Final Report of the Fire Training Area, Law 1989
- RFI, Final Report of the New Landfill Area, Law 1989
- RFI, Final Report of the TNT Lagoon Area, Law 1989 and RFI Phase II, SVE 1996
- RFI, Final Report of the Propellant Burn Area, Law 1989
- RFI, Final Report of the Old Landfill Area, Law 1989 and Phase II, SVE 1996
- Final Report for Conceptual Sitewide Groundwater Flow Model, URS 2000

- Final Report for Phase II Sitewide Groundwater Assessment Monitoring System Evaluation, URS 2001
- Final Report for the Depot-Wide Background Soil Investigation, Jacobs/Stratum 2001
- Pristine Background Report (Addendum to the Final Depot-Wide Background Soil Investigation Report), Jacobs/Stratum 2002
- Final Report for the RCRA Facility Investigation at the Burning Grounds, Jacobs/Stratum 2002
- Sitewide LTM, Operations, and Maintenance Plan, URS, 2004

Other well construction details: Referenced in the following reports (copies on file at KDEP):

- RFI, Draft Final Report of the Pink Water Pond Area, Law 1989
- Final Report, RFI of the Propellant Burn Area, Law 1989
- RFI, Final Report of the Mustard Trench Area, Law 1989
- RFI, Final Report of the Open Detonation Area, Law 1989
- RFI, Final Report of the Dry Acid Pond Area, Law 1989 and RFI Phase II, SVE 1994
- RFA, Final Report of the Fire Training Area, Law 1989
- RFI, Final Report of the New Landfill Area, Law 1989
- RFI, Final Report of the TNT Lagoon Area, Law 1989 and RFI Phase II, SVE 1996
- RFI, Final Report of the Propellant Burn Area, Law 1989
- RFI, Final Report of the Old Landfill Area, Law 1989 and Phase II, SVE 1996
- Final 1st, 2nd, and 3rd Long-Term Sampling and Analysis Program Report, IT 2000
- Final 5th,6th,7th and 8th Long-Term Sampling and Analysis Program Report, IT 2001
- Final 1988 & 1999 Annual Reports for Long-Term Sampling and Analysis Program, IT 2001
- Final 2000 & 2001 Annual Reports for Long-Term Sampling and Analysis Program, IT 2002
- Final Report for Conceptual Sitewide Groundwater Flow Model, URS 2000
- Final Report for Phase II Sitewide Groundwater Assessment Monitoring System Evaluation, URS 2001
- Final Report for the Depot-Wide Background Soil Investigation, Jacobs/Stratum 2001
- Pristine Background Report (Addendum to the Final Depot-Wide Background Soil Investigation Report), Jacobs/Stratum 2002
- Final Report for the RCRA Facility Investigation at the Burning Grounds, Jacobs/Stratum 2002
- Sitewide LTM, Operations, and Maintenance Plan, URS, 2004

Identification of upgradient wells and down gradient wells is discussed in the following reports (copies on file at KDEP):

- RFI, Draft Final Report of the Pink Water Pond Area, Law 1989
- Final Report, RFI of the Propellant Burn Area, Law 1989
- RFI, Final Report of the Mustard Trench Area, Law 1989
- RFI, Final Report of the Open Detonation Area, Law 1989

- RFI, Final Report of the Dry Acid Pond Area, Law 1989 and RFI Phase II, SVE 1994
- RFA, Final Report of the Fire Training Area, Law 1989
- RFI, Final Report of the New Landfill Area, Law 1989
- RFI, Final Report of the TNT Lagoon Area, Law 1989 and RFI Phase II, SVE 1996
- RFI, Final Report of the Propellant Burn Area, Law 1989
- RFI, Final Report of the Old Landfill Area, Law 1989 and Phase II, SVE 1996
- Final 1^{st}, 2^{nd}, and 3^{rd} Long-Term Sampling and Analysis Program Report, IT 2000
- Final 5^{th},6^{th},7^{th} and 8^{th} Long-Term Sampling and Analysis Program Report, IT 2001
- Final 1988 & 1999 Annual Reports for Long-Term Sampling and Analysis Program, IT 2001
- Final 2000 & 2001 Annual Reports for Long-Term Sampling and Analysis Program, IT 2002
- Final Report for Conceptual Sitewide Groundwater Flow Model, URS 2000
- Final Report for Phase II Sitewide Groundwater Assessment Monitoring System Evaluation, URS 2001
- Final Report for the Depot-Wide Background Soil Investigation, Jacobs/Stratum 2001
- Pristine Background Report (Addendum to the Final Depot-Wide Background Soil Investigation Report), Jacobs/Stratum 2002
- Final Report for the RCRA Facility Investigation at the Burning Grounds, Jacobs/Stratum 2002
- Sitewide LTM, Operations, and Maintenance Plan, URS, 2004

E-3b Description of Sampling/Analysis Procedures

Sampling and analysis procedures are referenced in the following reports (copies on file at KDEP):

- Revised Long Term Monitoring Plan, IT, Inc., 1998
- Dry Acid Pond, Final Report, Sang Corp., 1998
- Sampling and Analysis Plan for Battery Burial Area Remedial Design Investigation Activities, SVE, 1994
- Sampling and Analysis Plan for Interim Remedial Action Plan Study for Mustard Burn/Mustard Trench
- Sampling and Analysis Plan for Site Investigation for Former Waste Ammo Area
- Draft Sampling and Analysis Plan for Interim Remedial Action Plan Study for New Landfill, SVE 1994
- Final Report, Interim Remedial Action Plan Study (Groundwater) for New Landfill, SVE 1994
- Draft Sampling and Analysis Plan for Interim Remedial Action Plan Study for Old Landfill, SVE 1994
- Final Report, Interim Remedial Action Plan Study (Groundwater) for Old Landfill, SVE 1994
- Draft Report for Interim Remedial Action Plan Study and Long Term Monitoring at New Landfill Area, SVE 1996
- Draft Report for Interim Remedial Action Plan Study and Long Term Monitoring at Old Landfill Area, SVE 1996

- Final Sampling Report, Soil Sampling DRMO Stockpile Area, BGAD, Richmond, Kentucky, SVE 1994
- Final Sampling and Analysis Plan for Combined Sites at the Blue Grass Facility, Richmond, KY, SVE 1994
- Final Sampling and Analysis Plan for the SI at the Battery Burial Area, BGAD, SVE 1994
- Final Sampling and Analysis Plan for the RFI Phase II at the Dry Acid Pond Area, BGAD, SVE 1995
- Final Sampling and Analysis Plan addendum for the Remedial Design Investigation Activities at the Dry Acid Pond Area, BGAD, SVE 1995
- Final Sampling and Analysis Plan for the RFI Phase II at the Old TNT Lagoon Area BGAD, SVE 1994
- Final Sampling and Analysis Plan for the SI for the New TNT Washout Lagoons and Boiler Blowdown Tank Discharge Areas, BGAD, SVE 1994
- Sampling and Analysis Plan for SI at the Former Waste Ammunition Detonation Area, SVE 1994
- BGAD Fire Training Area Sampling and Analysis Report, Ogden 1994
- Final Groundwater Sampling at the Open Detonation Area, SVE 1996
- Draft Final Long Term Monitoring, O&M Plan for Old Landfill, SVE 1995
- Draft Final Long Term Monitoring, O&M Plan for New Landfill, SVE 1995
- Final 1st, 2nd, and 3rd Long-Term Sampling and Analysis Program Report, IT 2000
- Final 5th,6th,7th and 8th Long-Term Sampling and Analysis Program Report, IT 2001
- Final 1988 & 1999 Annual Reports for Long-Term Sampling and Analysis Program, IT 2001
- Final 2000 & 2001 Annual Reports for Long-Term Sampling and Analysis Program, IT 2002
- Final Report for Conceptual Sitewide Groundwater Flow Model, URS 2000
- Final Report for Phase II Sitewide Groundwater Assessment Monitoring System Evaluation, URS 2001
- Final Report for the Depot-Wide Background Soil Investigation, Jacobs/Stratum 2001
- Pristine Background Report (Addendum to the Final Depot-Wide Background Soil Investigation Report), Jacobs/Stratum 2002
- Final Report for the RCRA Facility Investigation at the Burning Grounds, Jacobs/Stratum 2002
- Sitewide LTM, Operations, and Maintenance Plan, URS, 2004

E-3c Monitoring Data

Discussed in the following reports (copies on file at KDEP):

- LTM, Quarterly Monitoring Reports, IT Corp. 1998/1999
- Dry Acid Pond, Final Report, Sang Corp., 1998
- Final Groundwater Sampling at the Open Detonation Area, SVE 1996
- BGAD Fire Training Area Sampling and Analysis Report, Ogden 1994
- Final Sampling Report, Soil Sampling DRMO Stockpile Area, BGAD, Richmond, Kentucky, SVE 1994
- Final Report, Interim Remedial Action Plan Study (Groundwater) for New Landfill, SVE 1994

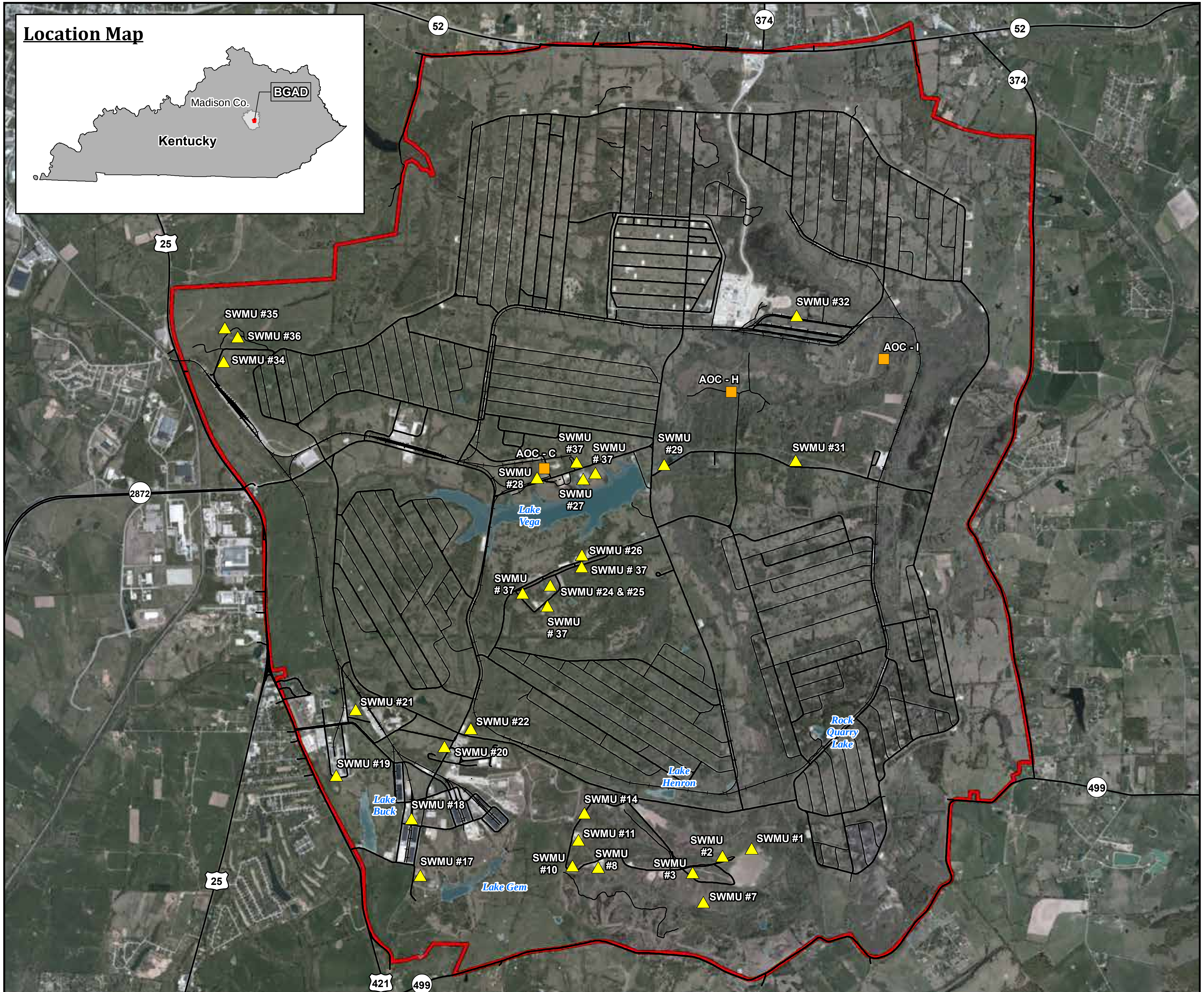
- Final Report, Interim Remedial Action Plan Study (Groundwater) for Old Landfill, SVE 1994
- Final SI Report Combined Sites, Vols. I, II & III, SVE 1996
- Final Report Battery Burial Area, SVE 1995
- Final Report for SI at Additional SWMUs Group B Vols. I- VII, SVE 1995
- Remedial Design Investigation Activities Report, New Landfill, SVE 1996
- Remedial Design Investigation Activities Report, Old Landfill, SVE 1996
- Final Letter Report, Groundwater Sampling at the Open Detonation Area, SVE 1996
- Final SI Report, Former Waste Ammunition Detonation Area Vols. I – II, SVE 1999
- Final PIA Report for Interim Action Plan Study at Mustard Burn Site/Mustard Trenches, SVE 1994
- Final 1^{st}, 2^{nd}, and 3^{rd} Long-Term Sampling and Analysis Program Report, IT 2000
- Final 5^{th},6^{th},7^{th} and 8^{th} Long-Term Sampling and Analysis Program Report, IT 2001
- Final 1988 & 1999 Annual Reports for Long-Term Sampling and Analysis Program, IT 2001
- Final 2000 & 2001 Annual Reports for Long-Term Sampling and Analysis Program, IT 2002
- Final Report for Conceptual Sitewide Groundwater Flow Model, URS 2000
- Final Report for Phase II Sitewide Groundwater Assessment Monitoring System Evaluation, URS 2001
- Final Report for the Depot-Wide Background Soil Investigation, Jacobs/Stratum 2001
- Pristine Background Report (Addendum to the Final Depot-Wide Background Soil Investigation Report), Jacobs/Stratum 2002
- Final Report for the RCRA Facility Investigation at the Burning Grounds, Jacobs/Stratum 2002

Subsequent to interim status groundwater reports:

- 2005 Annual Report for Long-Term Management Inactive Waste Management Areas RCRA Facilities, URS August 2006
- 2006 Annual Report for Long-Term Management Inactive Waste Management Areas RCRA Facilities, URS October 2006
- 2007 Annual Report for Long-Term Management Inactive Waste Management Areas RCRA Facilities, URS October 2007
- 2008 Annual Report for Long-Term Management Inactive Waste Management Areas RCRA Facilities, URS November 2008
- 2009 Annual Report for Long-Term Management Inactive Waste Management Areas RCRA Facilities, URS November 2009
- 2010 Annual Report for Long-Term Management Inactive Waste Management Areas RCRA Facilities, HydroGeologic, Inc. October 2010
- Final 2011 Long-Term Monitoring Report Inactive Waste Management Areas, HydroGeologic, Inc. June 2012
- Final 2012 Long-Term Monitoring Report Inactive Waste Management Areas, HydroGeologic, Inc. June 2012

- Final 2013 Long-Term Monitoring Report Inactive Waste Management Areas, HydroGeologic, Inc. August 2013
- Final Closure Phase 2 Resource Conservation and Recovery Act Facility Investigation for Site Closeout for Washout Lagoons, ERT Inc. October 2013
- Final Project Management Plan Environmental Restoration Services, FPM Remediations Inc. May 2014
- Monitoring Well Abandonment Plan Environmental Restoration Services, FPM Remediations Inc. January 2015
- Final 2014 Annual Long Term Monitoring Report: SWMU 002 (BLGR-006)-Former Mustard Trenches Area and SWMU 029 (BLGR-012)-Old Trinitrotoluene Lagoons, FPM Remediations Inc. September 2015

Figure E-4 is a map showing the approximate locations of all SWMUs and AOCs that required further investigation.



Explanation:

- AOC
- SWMU
- Railroad
- Primary Road
- Secondary Road
- Water Body
- Installation Boundary

0 0.25 0.5 1 Miles

0 1,500 3,000 6,000 Feet

N

Projection: KY State Plane South, Feet, NAD 1983

Map Created By: USACE-LRL
Date: 2/11/2014

Data Sources:
Transportation - KYTC, 2006
Installation Data - BGAD, 2012
Aerial Photography - ESRI, 2010

FIGURE E-4
Active SWMU and AOC Map
Blue Grass Army Depot
Madison County, KY

ch2m:

Appendix E-1
Groundwater Monitoring
Well Logs

TYPE II MONITORING WELL INSTALLATION DIAGRAM

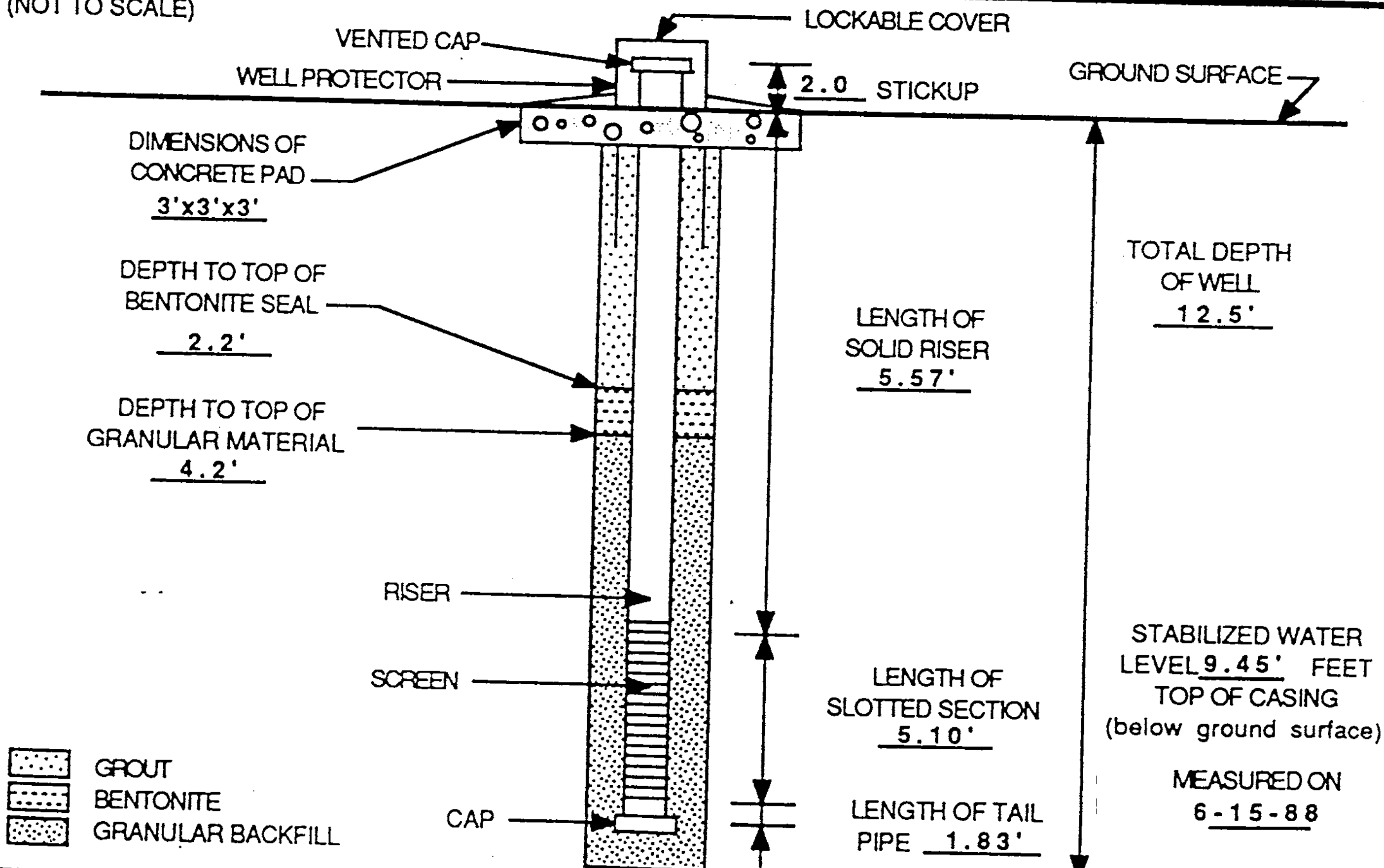
LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION
KENNESAW, GEORGIA

WELL NO. MW4004C01
JOB NO. 11-7006-01
DATE 5-3-88 TIME 1328-1432
WELL LOCATION DEMO GROUND

GROUND SURFACE ELEVATION 901.03 (MSL)
TOP OF SCREEN ELEVATION 895.93 (MSL)
REFERENCE POINT ELEVATION 902.69 (MSL)
TYPE SAND PACK SILICA GRADATION 320
SAND PACK MANUFACTURER WEDRON
SCREEN MATERIAL SCH 40 PVC FLUSH
MANUFACTURER DIEDRICH
RISER MATERIAL SCHYO PVC FLUSH
MANUFACTURER DIEDRICH
RISER DIAMETER 2"
DRILLING TECHNIQUE TOR HSA
BIT SIZE AND TYPE 8 1/4 FINGER
DRILLING TECHNIQUE TOR DIAMOND CORE
BIT SIZE AND TYPE HQ IMPREG

BENTONITE TYPE PEL LET PLUG 1/4"
MANUFACTURER POLYMER DRLG SYSTEMS
CEMENT TYPE PORTLAND W/ 5% QUK GEL
MANUFACTURER QUIKRETE BAROID
BOREHOLE DIAMETER 8-1/4 TO TOR 3-25/32
SCREEN DIAMETER 2" SLOT SIZE 0.010
LAW ENVIRONMENTAL, INC. FIELD REPRESENTATIVE T. MOODY
DRILLING CONTRACTOR LAW ENGINEERING, INC.
AMOUNT BENTONITE USED 0.5 ft^3
AMOUNT CEMENT USED 0.75 FT^3
AMOUNT SAND USED 0.5 FT^3
STATIC WATER DEPTH (after dev.) 9.45
INSTALLATION TIME 1328-1432

(NOT TO SCALE)



QA / QC

INSTALLED BY: GPM INSTALLATION OBSERVED BY: T. MOODY
DISCREPANCIES: SOIL HOLE SWELLED IN ANNULUS TOOK LESS SA THAN CALCULATED

Law Environmental, Inc.
Government Services Division

TEST BORING RECORD

BORING NUMBER MW-4004C01
JOB NUMBER 11-7006-01
DATE STARTED 5/3/88
DATE COMPLETED 5/3/88
DRILLED BY G.P.
LOGGED BY T.M.
CHECKED BY G.P.M.

REMARKS: PAGE 1 OF 1

Boring drilled with:
- 8-inch OD hollow stem auger from 0.0 to 5.4 feet.
- HQ core barrel from 5.4 to 12.4 feet.

Top of PVC riser 902.69 feet msl.

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	CR	S	LT	STP N VALUE
901.03	0.0	Firm to stiff brown (5YR 5/4) silty CLAY (ML-CL) with roots and fine to medium sand (dry becoming wet)				8
						10
896.03	4.5	Hard black (5YR 2.5/1) fine to medium sandy silty CLAY (ML-CL) with trace of gravel (wet).				7
	5.4	Top of Rock				
891.03		Gray shaly LIMESTONE with calcite filled vugs and fossils				
	12.4	Boring Terminated				
886.03						

CR- ROCK CORE SIZE WITH % RECOVERY
S- SYMBOLS - SEE COVER SHEET
LT- LABORATORY TESTS PERFORMED

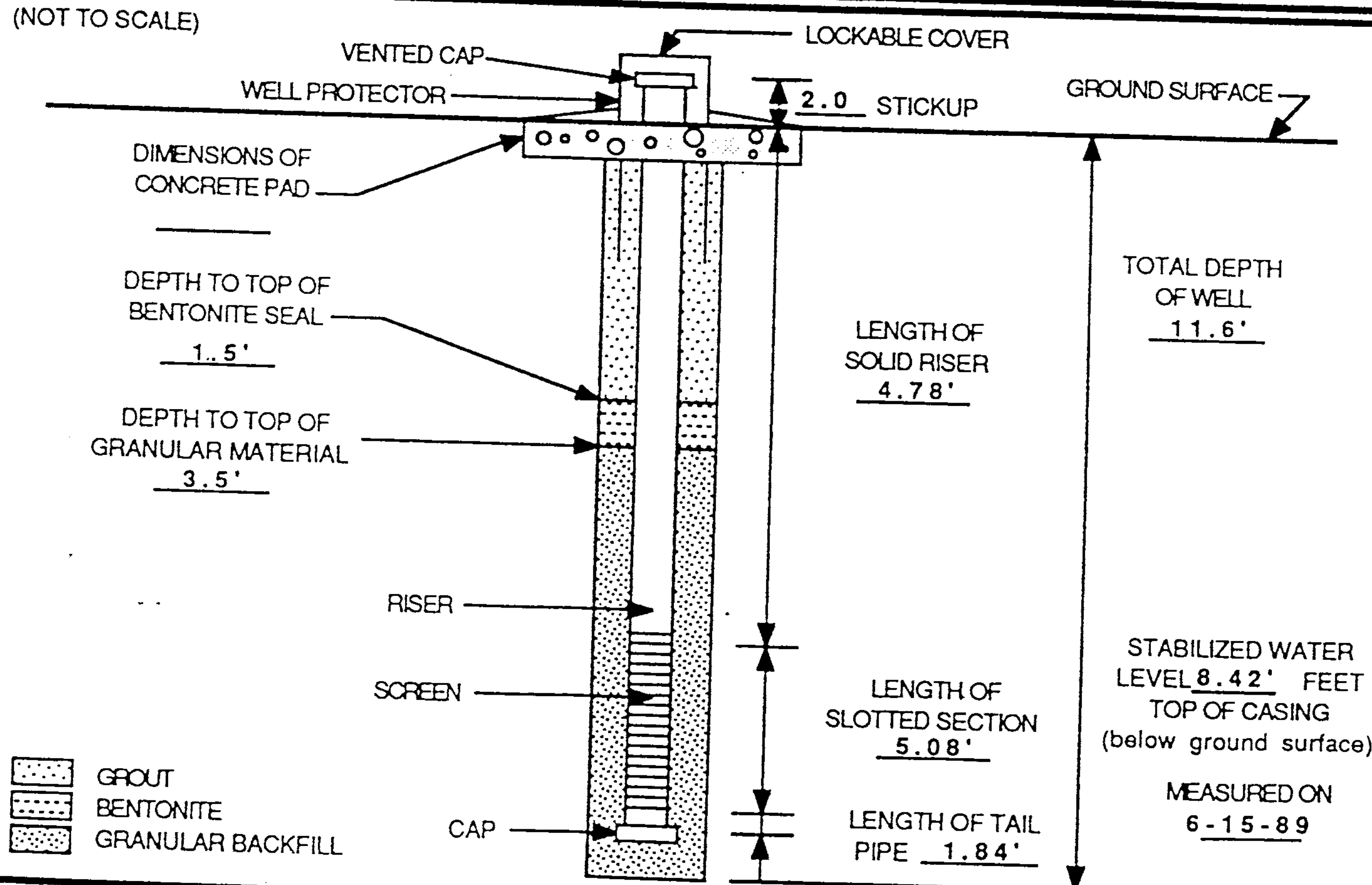
TYPE II MONITORING WELL INSTALLATION DIAGRAM

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION
KENNESAW, GEORGIA

WELL NO. MW4004C02
JOB NO. 11-7006-01
DATE 5-3-88 TIME
WELL LOCATION DEMO GROUND

GROUND SURFACE ELEVATION 903.63 (MSL)
TOP OF SCREEN ELEVATION 898.85 (MSL)
REFERENCE POINT ELEVATION 905.02 (MSL)
TYPE SAND PACK SILICA GRADATION 320
SAND PACK MANUFACTURER WEDRON
SCREEN MATERIAL SCH 40 PVC FLUSH
MANUFACTURER DIEDRICH
RISER MATERIAL SCHYO PVC FLUSH
MANUFACTURER DIEDRICH
RISER DIAMETER 2"
DRILLING TECHNIQUE TOR HSA
BIT SIZE AND TYPE 8 1/4 FINGER
DRILLING TECHNIQUE TOR DIAMOND CORE
BIT SIZE AND TYPE HQ IMPREG

BENTONITE TYPE PEL LET PLUG 1/4"
MANUFACTURER POLYMER DRLG SYSTEMS
CEMENT TYPE PORTLAND W/ 5% QUK GEL
MANUFACTURER COPLAY BAROID
BOREHOLE DIAMETER 8-1/4 TO 3-25/32
SCREEN DIAMETER 2" SLOT SIZE 0.010
LAW ENVIRONMENTAL, INC. FIELD REPRESENTATIVE T. MOODY
DRILLING CONTRACTOR LAW ENGINEERING, INC.
AMOUNT BENTONITE USED 0.5 ft^3
AMOUNT CEMENT USED 0.75 FT^3
AMOUNT SAND USED 0.5 FT^3
STATIC WATER DEPTH (after dev.) 8.42
INSTALLATION TIME 0849-1025; 1533-1601



QA / QC

INSTALLED BY: GPM INSTALLATION OBSERVED BY: T. MOODY
DISCREPANCIES: SAND WONT SETTLE BECAUSE OF THICK MUD, CANNOT BAIL COMPLETELY LET SIT 5 HTRS. - OK / FINISH COMPLETION.

Law Environmental, Inc.
Government Services Division

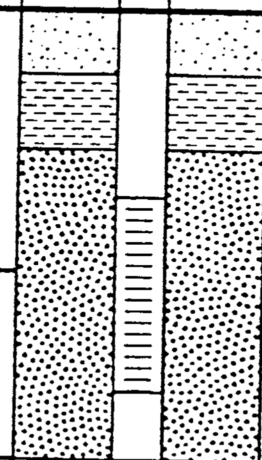
TEST BORING RECORD

BORING NUMBER	MW-4004C02
JOB NUMBER	11-7006-01
DATE STARTED	5/2/88
DATE COMPLETED	5/2/88
DRILLED BY	G.P.
LOGGED BY	T.M.
CHECKED BY	G.P.M.

REMARKS: PAGE 1 OF 1

Boring drilled with:
- 8-inch OD hollow stem auger from 0.0 to 6.7 feet.
- HQ core barrel from 6.7 to 11.7 feet.

Top of PVC riser 905.36 feet msl.



ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	CR	S	LT	STP N VALUE
903.63	0.0	Firm to stiff dark reddish brown (5YR 3/3) silty CLAY (CL) with roots and trace of fine sand				13
						11
[illegible]8.63						8
	6.7	Top of Rock				11
		Gray fossiliferous LIMESTONE with calcite filled vugs and numerous fractures				
893.63						
	11.7	Boring Terminated				

CR- ROCK CORE SIZE WITH % RECOVERY
S- SYMBOLS - SEE COVER SHEET
LT- LABORATORY TESTS PERFORMED

TYPE II MONITORING WELL INSTALLATION DIAGRAM

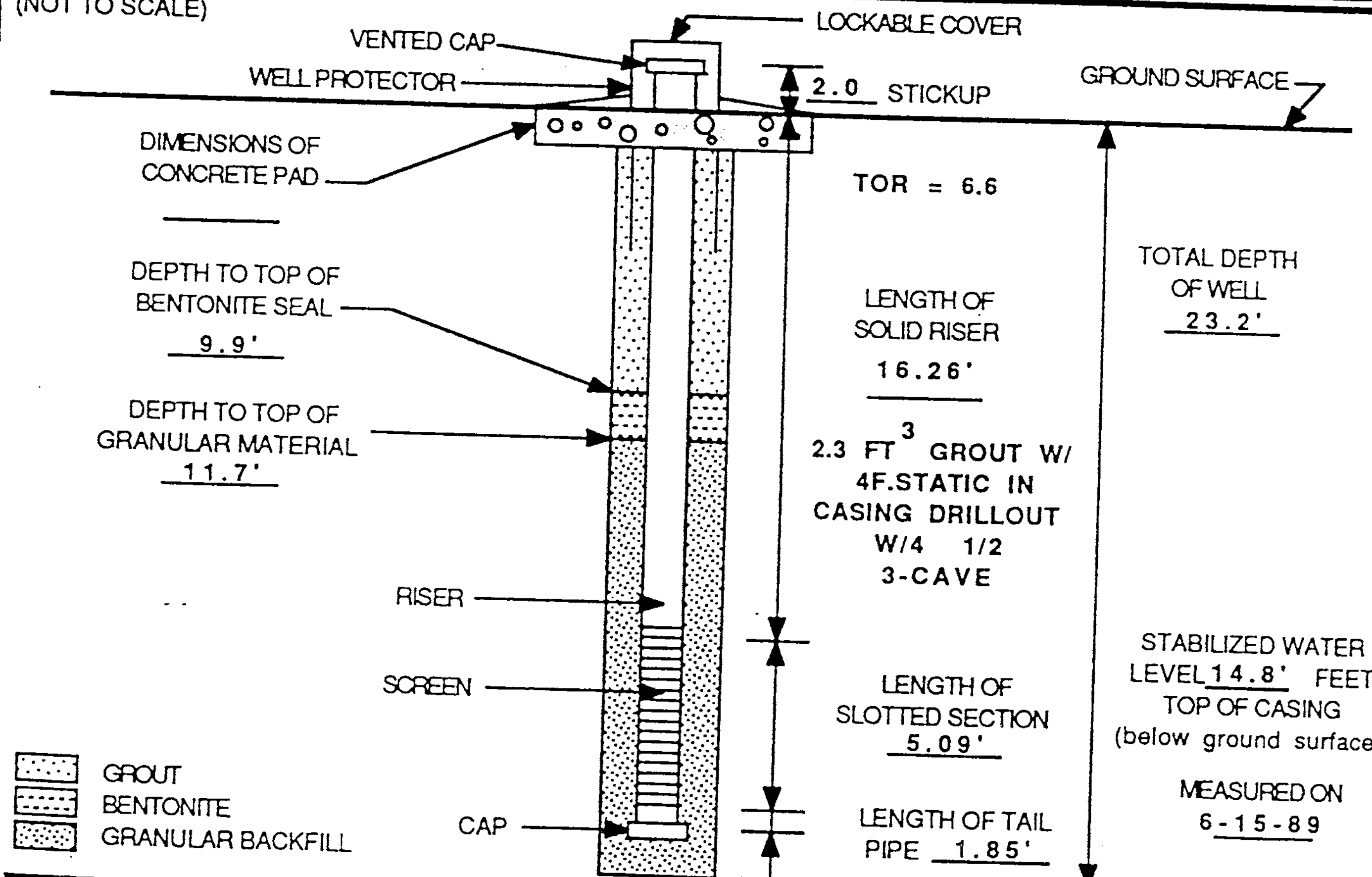
LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION
KENNESAW, GEORGIA

WELL NO. MW4004C03
JOB NO. 11-7006-01
DATE 5-3-88 TIME 1840-1945
WELL LOCATION DEMO GROUND

GROUND SURFACE ELEVATION 903.52 (MSL)
TOP OF SCREEN ELEVATION 887.26 (MSL)
REFERENCE POINT ELEVATION 905.02 (MSL)
TYPE SAND PACK SILICA GRADATION 320
SAND PACK MANUFACTURER WEDRON
SCREEN MATERIAL SCH 40 PVC FLUSH
MANUFACTURER DIEDRICH
RISER MATERIAL SCHYO PVC FLUSH
MANUFACTURER DIEDRICH
RISER DIAMETER 2"
DRILLING TECHNIQUE HSA, 3-CONE
BIT SIZE AND TYPE 8 1/4 FINGER 7 7/8"
DRILLING TECHNIQUE DIAMOND CORE
BIT SIZE AND TYPE HQ IMPREG

BENTONITE TYPE PEL LET PLUG 1/4"
MANUFACTURER POLYMER DRLG SYSTEMS
CEMENT TYPE PORTLAND W/ 5% QUK GEL
MANUFACTURER COPLAY BAROID
BOREHOLE DIAMETER 8-1/4 ; 7 7/8; 3 25/32
SCREEN DIAMETER 2" SLOT SIZE 0.010
LAW ENVIRONMENTAL, INC.
FIELD REPRESENTATIVE T. MOODY
DRILLING CONTRACTOR LAW ENGINEERING, INC.
AMOUNT BENTONITE USED 0.25 ft^3
AMOUNT CEMENT USED 1.3 FT^3
AMOUNT SAND USED 0.75 FT^3
STATIC WATER DEPTH (after dev.) 14.8
INSTALLATION TIME 1840-1945

(NOT TO SCALE)



QA / QC

INSTALLED BY: GPM INSTALLATION OBSERVED BY: T. MOODY
DISCREPANCIES: WELL INSTALLED ON 1.59 FT CAVEIN - SUSPECT L.S. FRAYS

Law Environmental, Inc.
Government Services Division

TEST BORING RECORD

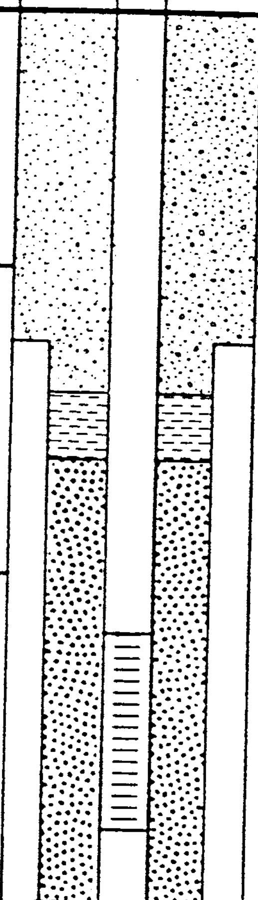
BORING NUMBER MW-4004C03
JOB NUMBER 11-7006-01
DATE STARTED 5/2/88
DATE COMPLETED 5/2/88
DRILLED BY G.P.
LOGGED BY T.M.
CHECKED BY G.P.M.

REMARKS: PAGE 1 OF 1

Boring drilled with:
- 8 inch OD hollow stem auger from 0.0 to 6.6 feet
- HQ core barrel from 6.6 to 24.8 feet.

Top of PVC riser elevation 905.02 for msl.

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	CR	S	LT	STP N VALUE
903.52	0.0	Stiff to hard reddish brown (5 YR 4/3) silty CLAY (CL-ML) with roots, trace of fine sand and shrapnel				19
						10
?98.52						9
	6.6	Top of Rock				11
		Gray shaly fossilifierous LIMESTONE with calcite filled seams-slightly glauconitic				
893.52						
888.52	14.8	Greenish gray slightly glauconitic fossiliferous LIMESTONE-competant				
883.52						
878.52	24.8	Boring Terminated				

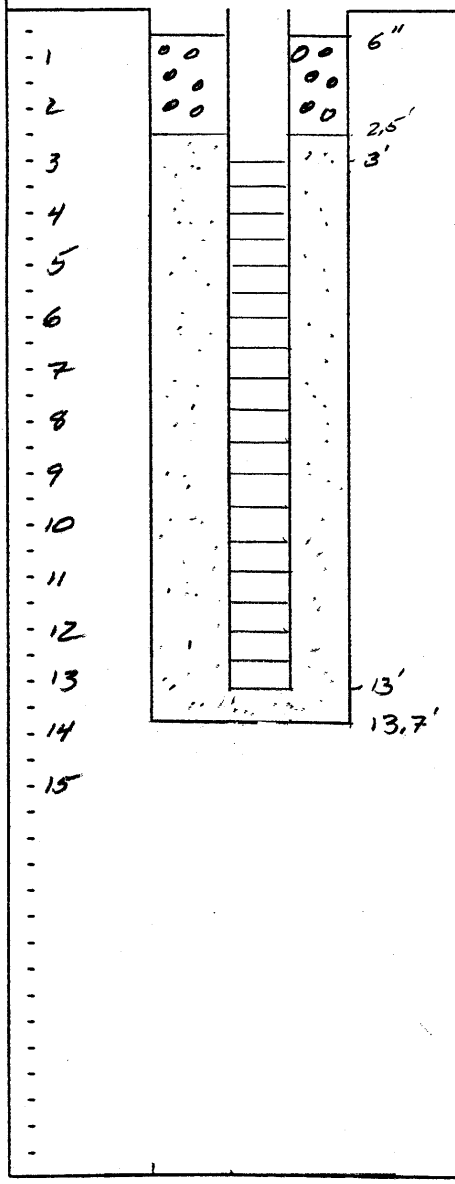


CR- ROCK CORE SIZE WITH % RECOVERY
S- SYMBOLS - SEE COVER SHEET
LT- LABORATORY TESTS PERFORMED

RADIAN INTERNATIONAL LLC
MONITORING WELL / PIEZOMETER CONSTRUCTION SUMMARY

Installation ID: MW4004C04 Project: BGAD OD Area.
Site ID: BGAD / OD Area
Monitoring Well or Piezometer (circle one) ID: MW4004C04
Drilling Company: Geotek Drilling Co. Drilling Method: Air Rotary
Radian Drilling Supervisor's Name or Initials: Chris Walsh
Construction Start Date: 4/8/99 Construction Finish Date: 4/8/99
Final Groundwater Depth: ______ Feet Below Measuring Point

DEPTH
FT.



LOCATION
North Coordinate: ______
East Coordinate: ______
Coordinate System: ______
Surface Elevation: ______ Feet MSL

MEASURING POINT
Location: TOC PVC
Elevation: TOC 900.14 Feet MSL
Height AGL: ______ Feet

SURFACE PROTECTION
Protective Casing Description: Above grade Steel
Pad Description (if used): 4'x4' Concrete

SURFACE SEAL and CASING
Type: ______
Amount: ______
Bottom Depth BGL: ______
Emplacement Method: ______
Surface Casing Diameter: ______
Surface Casing Bottom Depth BGL: ______

RISER PIPE and SCREEN
Riser Type: Sch 40 PVC
Riser/Screen Diameter: 2"
Riser Length: 3' BGS
Riser Height AGL: ≈ 2'
Screen Type: Sch 40 PVC 10 slot
Screen Top Depth BGL: 3'
Screen Bottom Depth BGL: 13
Screen Slot Size: 10 Slot

ANNULAR SEAL
Top Depth BGL: 6"
Type: Bentonite Pellets 3/8"
Amount: ≈ 6 gal
Emplacement Method: placed.

FILTER PACK
Top Depth BGL: 2.5'
Grain Type and Size: Silica 20/30
Grain Mineralogy: Silica
Amount: 5-50 lb bags
Emplacement Method: tremie

BOREHOLE
Borehole Diameter: 6"
Total Depth of Borehole BGL: 13.7'

Page ___ of ___ (See opposite side for code explanation)

HTRW DRILLING LOG

DISTRICT		HOLE NUMBER MW 4004-C04
1. COMPANY NAME Radian Int.	2. DRILL SUBCONTRACTOR Geotek Drilling Co.	SHEET 1 OF SHEETS 2
3. PROJECT BGAO.	4. LOCATION OD Area.	
5. NAME OF DRILLER Larry	6. MANUFACTURER'S DESIGNATION OF DRILL Schramm Air Rotary	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT 5 7/8" ϕ Rock bit.	8. HOLE LOCATION shallow, downgradient, Southern Tib	
	9. ~~SURFACE~~ ELEVATION TOC - 900.14	
	10. DATE STARTED 4/8/99	11. DATE COMPLETED 4/8/99
12. OVERBURDEN THICKNESS 6.3'	15. DEPTH GROUNDWATER ENCOUNTERED ≈ 6' BGS	
13. DEPTH DRILLED INTO ROCK 7.4	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED 6.75 ≈ 48hr. TOC	
14. TOTAL DEPTH OF HOLE 13.7	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
—	—	—	—

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY — %
—	—	—	—	—	—	

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		✓		[signature]

LOCATION SKETCH/COMMENTS

SCALE:

See Permit Application for Monitoring Well location Plan.

PROJECT BGAO OD Area.	HOLE NO. MW4004-C04

ENG FORM 5056-R, AUG 94

(Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER: MW4004 CO4

PROJECT: BGAD ODANA

INSPECTOR: Chris Welsh

SHEET 2 OF 2 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	1						
	2	No samples collected. CO4 & CO5 are a well cluster. Refer to CO5 log for lithology & CO4 well asbuilt.					
	3						
	4						
	5	MW4004-CO4 is a shallow well					
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14	TD @ 13.7					
	15						

PROJECT: BGAD

HOLE NO. CO4

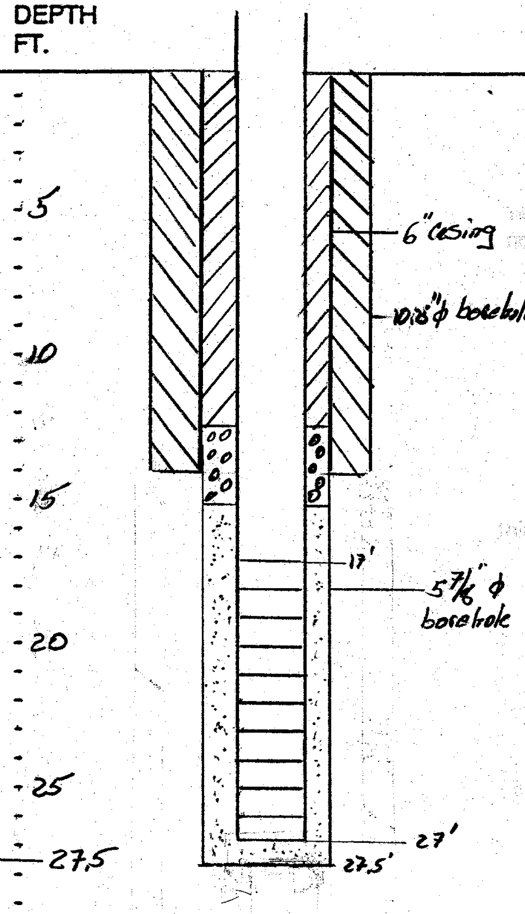
ENG FORM 5056A-R, AUG 94

(Proponent: CECW-EG)

RADIAN INTERNATIONAL LLC
MONITORING WELL / PIEZOMETER CONSTRUCTION SUMMARY

Installation ID: MW4004C05 Project: BGAD ODArea
Site ID: BGAD / OD Area
Monitoring Well or Piezometer (circle one) ID: MW4004C05
Drilling Company: Geotek Drilling Co. Drilling Method: Air Rotary
Radian Drilling Supervisor's Name or Initials: Chris Wesh
Construction Start Date: 4/7/99 Construction Finish Date: 4/10/99
Final Groundwater Depth: ______ Feet Below Measuring Point

DEPTH FT.



LOCATION
North Coordinate: ______
East Coordinate: ______
Coordinate System: ______
Surface Elevation: ______ Feet MSL

MEASURING POINT
Location: TOC PVC
Elevation: 900.36 Feet MSL
Height AGL: ______ Feet

SURFACE PROTECTION
Protective Casing Description: ______
Pad Description (if used): ______

SURFACE SEAL and CASING
Type: 6" ϕ Steel
Amount: 0 - 13.7'
Bottom Depth BGL: 13.7'
Emplacement Method: Tremie Grout in place
Surface Casing Diameter: ______
Surface Casing Bottom Depth BGL: ______

RISER PIPE and SCREEN
Riser Type: Sch 40 PVC
Riser/Screen Diameter: 2"
Riser Length: 17' BGS
Riser Height AGL: ≈ 2'
Screen Type: Sch 40 PVC 10 slot
Screen Top Depth BGL: 17
Screen Bottom Depth BGL: 27'
Screen Slot Size: 10 Slot

ANNULAR SEAL
Top Depth BGL: 12.5
Type: Bentonite Pellets 3/8"
Amount: ≈ 7.5 gal
Emplacement Method: Tremie

FILTER PACK
Top Depth BGL: 15
Grain Type and Size: Silica Sand 20/30
Grain Mineralogy: Silica
Amount: 4 bags
Emplacement Method: Tremie

BOREHOLE
Borehole Diameter: 0 - 13.7' = 11"ϕ 13.7 - 27.5 - 5 7/8"
Total Depth of Borehole BGL: 27.5'

Page ___ of ___ (See opposite side for code explanation)

HTRW DRILLING LOG

HTRW DRILLING LOG	DISTRICT	HOLE NUMBER MW 4004-C05
1. COMPANY NAME Radian Int.	2. DRILL SUBCONTRACTOR Geotek Drilling Co.	SHEET 1 OF 5 SHEETS

3. PROJECT BGAD	4. LOCATION OD Area
5. NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL Schramm Air Rotary
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT 2"ϕ Split Spoon pressed, HX core barrel 10' long, 10.25"ϕ rock bit, 13.7' of 6"ϕ steel casing, 5⅞"ϕ rock bit.	8. HOLE LOCATION deep downgradient Southern Trib.
	9. SURFACE ELEVATION TOC 900.36'
	10. DATE STARTED 4/7/99 — 11. DATE COMPLETED 4/10/99
12. OVERBURDEN THICKNESS 6.3'	15. DEPTH GROUNDWATER ENCOUNTERED 9.5 BGS
13. DEPTH DRILLED INTO ROCK 21.2'	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED ≈12.3' 4/11/99
14. TOTAL DEPTH OF HOLE 27.5'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY) —

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
—	—	—	—

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
—	—	—	—	—	—	— %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
—	—	✓	—	[signature]

LOCATION SKETCH/COMMENTS SCALE:

See Permit Application for Monitoring Well location Plan.

PROJECT BGAD — HOLE NO. MW 4004-C05

ENG FORM 5056-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER: MW 400+ C05

PROJECT: BGAD OD Area

INSPECTOR: Chris Welsh

SHEET 2 OF 5 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	0	Topsoil				SS-1 Pressed 0-2' 24/24	UXO measurements after SS-1 → SS-3 No readings.
	1	Dk brown (10YR 3/3) Silty Clay, moist med-stiff, low-med plasticity Trace <10% m-f Sand root system throughout.					
	2					SS-2 pressed 2-4' 24/24	
	3	SAA					
	4	SAA, stiff @5', med plasticity, Trace <10% m-f Sand, med size Gravel in Tip				SS-3 pressed 4-6' 20/24	Tip of SS wet @ 6'
	5					SS-4 pressed 6'-6'3"	Refusal pressing SS @ 6'3"
	6					4/8/99	Core Run #1 6.5-12.5' with carbide bit & HX barrel.
	7	Limestone Gray N6-N5 hard - very hard, freshly weathered, thinly spaced ½-2" from 6.5-7.5 fossiliferous from 6.5 to 7.5' Bivalves & Bryozoans. From 7.5-12.5' only 1.5' of core recovered.					Note: Worn bit causing non-representative core run time. Change bits to new carbide @ 9'.
	8						
	9					4/9/99	Stopped Run #1 @ 12.5'
	10						

PROJECT: BGAD

HOLE NO. C05

ENG FORM 5056A-R, AUG 94

(Proponent: CECW-EG)

HTRW DRILLING LOG

(CONTINUATION SHEET)

HOLE NUMBER: MW4004-C05

PROJECT: BGAD OD Area

INSPECTOR: Chris Welsh

SHEET 3 OF 5 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
		No core Recovered 7.5-12.5'					Air bubbles observed in S. Trib. from 6.5-12.5'. No influence to S. Trib @ 12.5'.
	11						
	12						Core Run #1 6.5-12.5' Pen 6' Rec 2.6' RQD: .5/6 = 8%
	13	From 12.5 to 14.5' No sample collected.					Reamed core hole with 10.25" rk bit to 13.7'. Set 6" casing & grouted to surface. Will let grout set & complete well.
	14						
	15	Limestone gray, very thinly bedded & interbedded with thinly greenish gray siltstone, hard, freshly weathered, dolomitic, calcite stringers throughout, hard.				4/10/99	drilled out grout plug to 14.5'.
	16						Core Run #2 14.5-22' Carbide bit & HX core barrel.
	17						14.5-15' 3 min 15-16' 8 min 16-17' 7 min 17-18' 7 min
	18						18-19' 6 min
	19						19-20' 5 min
	20						

PROJECT: BGAD

HOLE NO. C05

ENG FORM 5056A-R, AUG 94

(Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER	SHEET	SHEETS
MW4004-C05	4	OF 5

PROJECT BGAD 8D Area

INSPECTOR Chris Welsh

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
		SAA.					20-21' 7 min
21							21-22' 10 min, Core Run #2 14.5-22' Pen 7.5' Rec 7.5'
22							Core Run #3 22'-26'
23		23.7' grading to gray Limestone, hard, very thickly bedded, med. fine grain, sparsely fossiliferous, calcite inclusions throughout. No fractures.					22-23' 10 min, 23-24' 6 min
24							24-25' 11 min
25							25-26' 12 min. Run #3 22-26' Pen - 4' Rec - 4' RQD = 4/4' = 100%
26							Reamed Corehole 6" ϕ rock bit to 27.5'. Overream 1.5'. Will set well from 17'-27'.
27							
28'		TD 27.5'					

PROJECT BGAD HOLE NO. C05

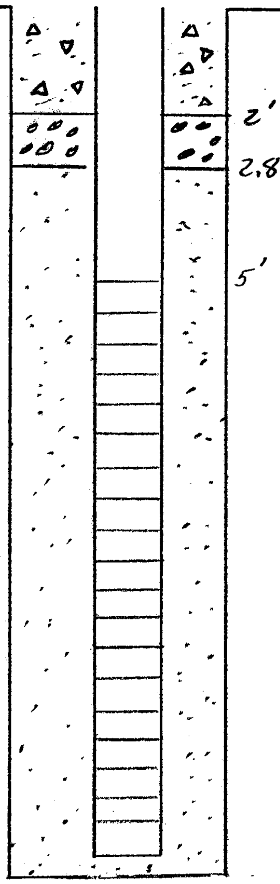
ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

RADIAN INTERNATIONAL LLC
MONITORING WELL / PIEZOMETER CONSTRUCTION SUMMARY

Installation ID: MW 4004 C06 Project: BGAD OD Area.
Site ID: BGAD / OD Area
Monitoring Well or Piezometer (circle one) ID:
Drilling Company: Geotek Drilling Drilling Method: Air Rotary
Radian Drilling Supervisor's Name or Initials: Chris Walsh
Construction Start Date: 4/9/99 Construction Finish Date: 4/9/99
Final Groundwater Depth: ______ Feet Below Measuring Point

DEPTH FT.

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- 15
- 16



LOCATION
North Coordinate:
East Coordinate:
Coordinate System:
Surface Elevation: ______ Feet MSL

MEASURING POINT
Location: TOC PVC
Elevation: TOC 900.57 Feet MSL
Height AGL: ______ Feet

SURFACE PROTECTION
Protective Casing Description: Above grade Steel
Pad Description (if used): 4x4' Concrete.

SURFACE SEAL and CASING
Type:
Amount:
Bottom Depth BGL:
Emplacement Method:
Surface Casing Diameter:
Surface Casing Bottom Depth BGL:

RISER PIPE and SCREEN
Riser Type: Sch 40 PVC
Riser/Screen Diameter: 2"
Riser Length: 5' BGS
Riser Height AGL: ≈ 2'
Screen Type: Sch 40 PVC
Screen Top Depth BGL: 5'
Screen Bottom Depth BGL: 15.2'
Screen Slot Size: 10 Slot

ANNULAR SEAL
Top Depth BGL: 2'
Type: Bentonite Pellets 3/8"ø
Amount: ≈ 5 gal.
Emplacement Method: placed.

FILTER PACK
Top Depth BGL: 2.8'
Grain Type and Size: Silica Sand 20/30
Grain Mineralogy: Silica
Amount: 4 1/2 bags 50lb
Emplacement Method: tremie

BOREHOLE
Borehole Diameter: 6"
Total Depth of Borehole BGL: 15.5'

Page ___ of ___ (See opposite side for code explanation)

HTRW DRILLING LOG

DISTRICT		HOLE NUMBER MW4004-C06
1. COMPANY NAME Radian Int.	2. DRILL SUBCONTRACTOR Grotek Drilling Co.	SHEET 1 OF 2 SHEETS
3. PROJECT BGAD	4. LOCATION OD Area.	
5. NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL Schramm Air Rotary	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT 5 7/8" ø Rock bit	8. HOLE LOCATION Shallow, downgradient, Muddy Creek	
	9. ~~SURFACE~~ ELEVATION TOC 900.57	
	10. DATE STARTED 4/9/99	11. DATE COMPLETED 4/9/99
12. OVERBURDEN THICKNESS 7.5'	15. DEPTH GROUNDWATER ENCOUNTERED ≈ 7.5' BGS	
13. DEPTH DRILLED INTO ROCK 8.0'	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED 8.9' after ≈24' TOC.	
14. TOTAL DEPTH OF HOLE 15.5'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
—	—	—	

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
—	—	—	—	—	—	

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
—	—	—	—	[signature]

LOCATION SKETCH/COMMENTS SCALE:

See permit Application for Monitoring Well location plan.

PROJECT BGAD. HOLE NO. C06.

ENG FORM 5056-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG

(CONTINUATION SHEET)

HOLE NUMBER	
MW 4004 C06	

PROJECT	INSPECTOR	SHEET	SHEETS
BGAD OD Area	Chris Wesh	2	OF 2

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	1	No Samples collected.					
	2	C06 & C07 are a well cluster. Refer					
	3	to C07 log for					
	4	lithology & C06 Well					
	5	asbuilt.					
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16	TD - 15.5'					

PROJECT BGAD OD Area. HOLE NO. C06

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG

DISTRICT	
HOLE NUMBER	4004C10
1. COMPANY NAME	
2. DRILLING CONTRACTOR	Harriss Drilling
SHEET 1 OF 3 SHEETS	
3. PROJECT	Blue Grass Army Depot Phase III Investigation
4. LOCATION	Richmond, Kentucky
5. NAME OF DRILLER	Chuck Harriss/John McMullan
6. MANUFACTURER'S DESIGNATION OF DRILL	CME-750 ATV
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	4.25" HSA 2' Split Spoon 3" Wireline Coring with water 8 1/4" HSA 7 7/8" Roller Bit Reaming with water
8. HOLE LOCATION	Open Detonation Area SWMU 001
9. TOP OF CASING/GS ELEVATION (ft. MSL)	908.61/905.81
10. DATE STARTED	12/11/2001
11. DATE COMPLETED	1/14/2002
12. OVERBURDEN THICKNESS (ft.)	7.5
13. DEPTH DRILLED INTO ROCK (ft.)	5.0
14. TOTAL DEPTH OF HOLE (ft.)	12.5
15. DEPTH GROUNDWATER ENCOUNTERED	2.2' BGS
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	1.19' BGS, 16 Days
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	2.23' BGS (03/06/02)

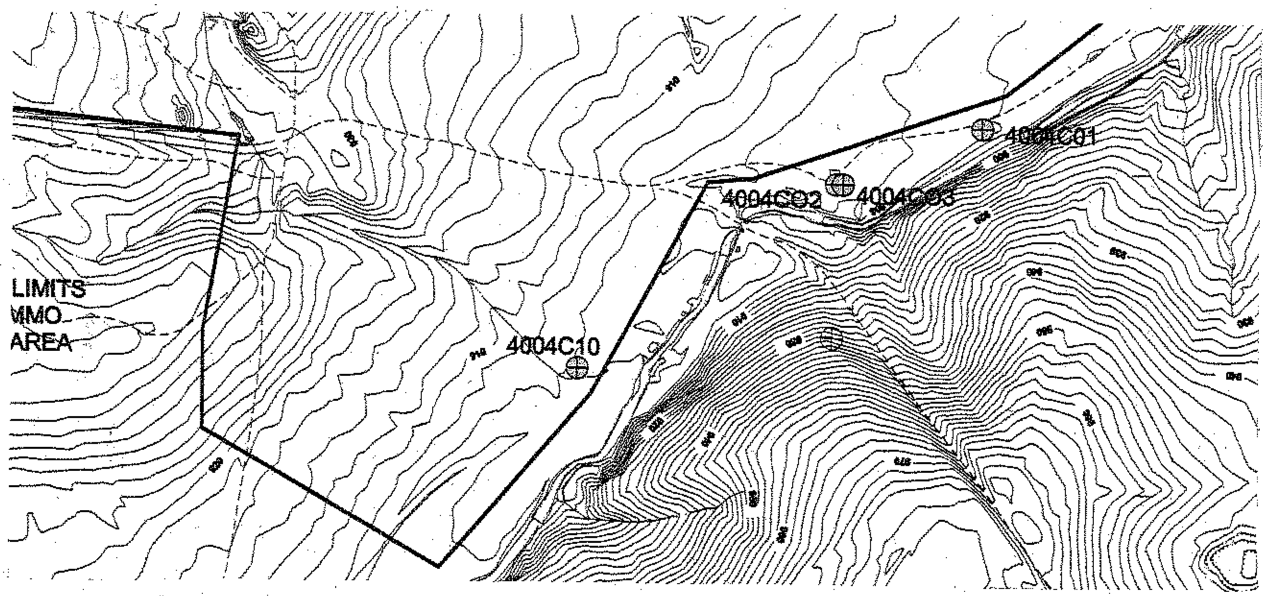
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	-	-	1

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
None	-	-	-	-	-	94 %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
Monitoring Well		X	—	Thomas Thalasm for K. Fields

LOCATION SKETCH/COMMENTS

SCALE: 1" = 300'



PROJECT	HOLE NO
Blue Grass Army Depot Phase III Investigation Richmond, Kentucky	4004C10

ENG FORM 5056-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER	SHEET	SHEETS
4004C10	2 OF	3

PROJECT: Blue Grass Army Depot Phase III Investigation Richmond, Kentucky

INSPECTOR: K. Fields

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	DRILL TIME (Rate, min./ft.) (f)	BLOW COUNT (g)	REMARKS (h)
	0	Brown clayey SILT (ML) with rootlets, soft, moist					Lost sample due to UXO augering
	1						
	2	grades with wood fragments, wet				1, 2, 3, 4	Run 2.0' Recovered 1.0' Loss 1.0'
	3						
	4	grades gray with reddish-brown				2, 6, 4, 5	Run 2.0' Recovered 2.0' Loss 0.0'
	5						
	6	grades with abundant black nodules, medium stiff				5, 6, 50/6"	Run 1.5' Recovered 1.5 Loss 0.0'
	7						
		Weathered BEDROCK fragments, weak HCL reaction					
	8	Medium gray to dark gray silty DOLOSTONE, moderately hard,					Run 5.0' Recovered 4.7'

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER	
4004C10	

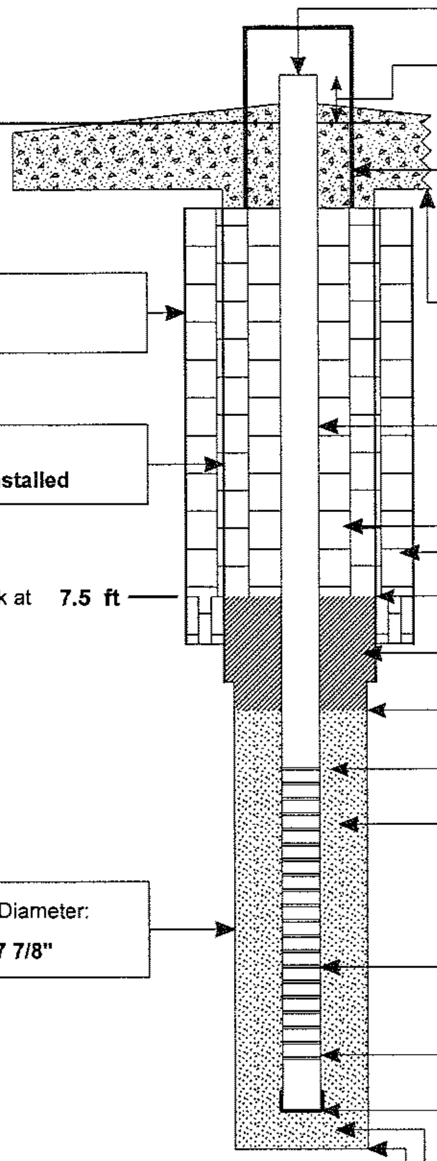
PROJECT	INSPECTOR	SHEET	SHEETS
Blue Grass Army Depot Phase III Investigation Richmond, Kentucky	K. Fields	3 OF	3

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	DRILL TIME (Rate, min./ft.) (f)	BLOW COUNT (g)	REMARKS (h)
	8	argillaceous, fossiliferrous (Brachiopods and Bryozoans)	Fracture Fracture		2		Loss 0.3' RQD 94%
	9		Tl spin		1.75		
	10		Fracture		1.75		
	11		Fracture		2		
	12				2		
	13	End of coring at 12.5' bgs with no water loss. Monitoring well screened 6.5' to 11.5' bgs.					
	14						
	15						
	16						

PROJECT	HOLE NO
Blue Grass Army Depot Phase III Investigation Richmond, Kentucky	4004C10

Project: Blue Grass Army Depot Phase III Investigation **Project Location: Richmond, Kentucky** **Project Number: 24637-080-121**	**WELL CONSTRUCTION LOG** **Well Number** **4004C10**

Well Location	**Open Detonation Area SWMU 001**	Date(s) Installed	**1/14/2002**	Time	**NA**
Installed By	**Harriss Drilling**	Observed By	**K. Fields**	Total Depth	**12.5 feet**
Method of Installation	**HS Auger/Wireline Coring/Water rotary**				
Screened Interval	**6.5'-11.5' bgs**	Completion Zone	**Soil/Bedrock Interface**		
Remarks	**Protected by ~3.1' tall (6" x 6" square) steel protective casing, surrounded by 4, 3' tall (3" OD) protective posts.**				



Elevation of Top of Riser Pipe: **908.61**

Height of Riser Above Ground: **2.80 ft**

Ground Elevation: **905.81**

ID/Type of Surface Casing: **6"x6" Steel Protective Casing**

Depth of Surface Seal: **0.5 ft**

Type of Surface Seal: **Concrete**

Boring Diameter: **13"**

ID/Type of Riser Pipe: **4" ID Schedule 40 PVC**

PVC Casing: **Not installed**

Type of Backfill: **Cement/Bentonite Grout (~0.8ft^3)**

Depth of Top of Bedrock at **7.5 ft**

Depth of Seal: **2.5 ft**

Type of Seal: **Bentonite (~0.8ft^3)**

Depth of Top of Filter Pack: **4.5 ft**

Depth of Top of Screen: **6.5 ft**

Type of Filter Pack: **Global #5 (~3.2ft^3)**

Boring Diameter: **7 7/8"**

ID/Type of Screen: **4" ID PVC**

Screen Slot Size: **0.010"**

Depth of Bottom of Screen: **11.5 ft**

Depth of Bottom of Plugged Blank Casing: **12.0 ft**

Type of Backfill or Seal Below Well: **Global #5**

Total Depth of Boring: **12.5 ft**

NOTE: DIAGRAM IS NOT TO SCALE

BGAD WELL CONS DIAGRAM TEST.GPJ WC-CORP2.GDT 9/30/02

URS

HTRW DRILLING LOG

HTRW DRILLING LOG	DISTRICT	HOLE NUMBER **4004B01A**
1. COMPANY NAME	2. DRILLING CONTRACTOR **Harriss Drilling**	SHEET 1 OF 3 SHEETS

3. PROJECT **Blue Grass Army Depot Phase III Investigation**		4. LOCATION **Richmond, Kentucky**
5. NAME OF DRILLER **John McMullan**		6. MANUFACTURER'S DESIGNATION OF DRILL **CME-750 ATV**
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	4.25" HSA	8. HOLE LOCATION **Pink Water Pond SWMU 003**
	2' Split Spoon	
	3" Wireline Coring with water	9. TOP OF CASING/GS ELEVATION (ft. MSL) **971.22/968.32**
	8 1/4" HSA	
	7 7/8" Roller Bit Reaming with water	10. DATE STARTED **11/30/2001** / 11. DATE COMPLETED **11/30/2001**
12. OVERBURDEN THICKNESS (ft.) **7.75**		15. DEPTH GROUNDWATER ENCOUNTERED **7.1' BGS**
13. DEPTH DRILLED INTO ROCK (ft.) **5.55**		16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED **Dry, 6 Days**
14. TOTAL DEPTH OF HOLE (ft.) **13.3**		17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY) **Dry (03/06/02)**

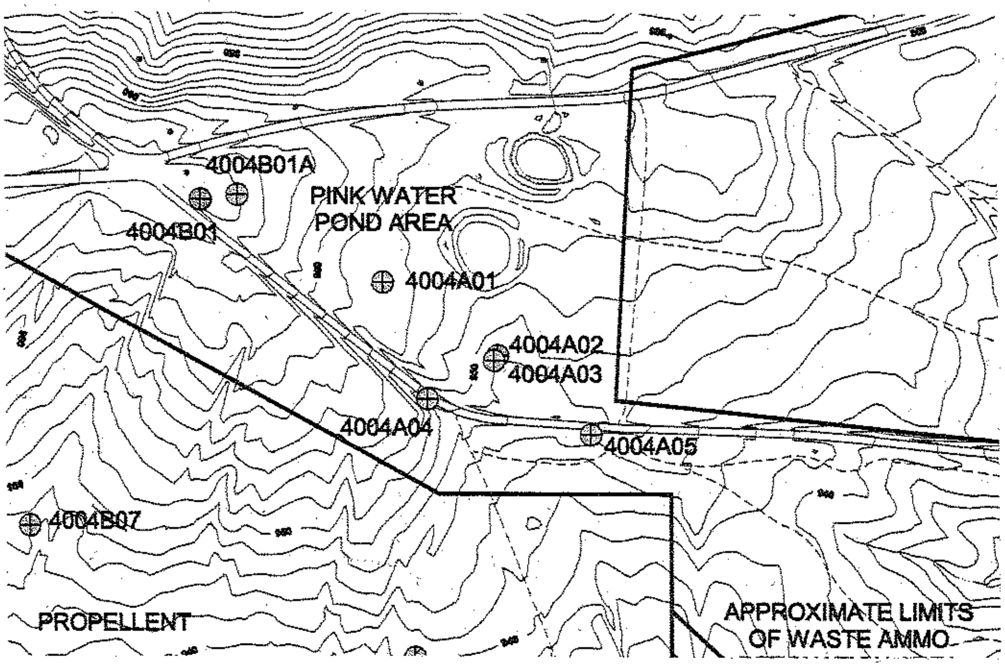
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	-	-	1

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
None	-	-	-	-	-	90 %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
Monitoring Well		X	---	[illegible] for K. Fields

LOCATION SKETCH/COMMENTS

SCALE: 1" = 300'



PROJECT	HOLE NO
Blue Grass Army Depot Phase III Investigation Richmond, Kentucky	4004B01A

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER **4004B01A**

PROJECT: Blue Grass Army Depot Phase III Investigation Richmond, Kentucky

INSPECTOR: K. Fields

SHEET 2 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	DRILL TIME (Rate, min./ft.) (f)	BLOW COUNT (g)	REMARKS (h)
	0	Yellowish red clayey SILT (ML), with trace sand, soft, moist				4	Run 2.0'
							Recovered 1.7'
						6	Loss 0.3'
	1	grades brown, medium stiff					
						8	
						12	
	2					4	Run 2.0'
		grades brownish yellow with black nodules					Recovered 1.2'
						8	Loss 0.8'
	3					12	
		grades stiff				16	
	4	grades to silty CLAY (CL) without sand, very stiff				3	Run 2.0'
							Recovered 1.8'
						9	Loss 0.2'
	5					14	
						17	
	6					3	Run 1.75'
							Recovered 1.65'
						8	Loss 0.1'
	7	grades with very fine sand, soft, wet				10	
		Light brown fine SAND (SM), loose to medium dense				50/3"	
	8	Gray to light gray DOLOMITE and					

PROJECT: Blue Grass Army Depot Phase III Investigation Richmond, Kentucky

HOLE NO: 4004B01A

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER	SHEET	SHEETS
4004B01A	3	OF 3

PROJECT: Blue Grass Army Depot Phase III Investigation Richmond, Kentucky

INSPECTOR: K. Fields

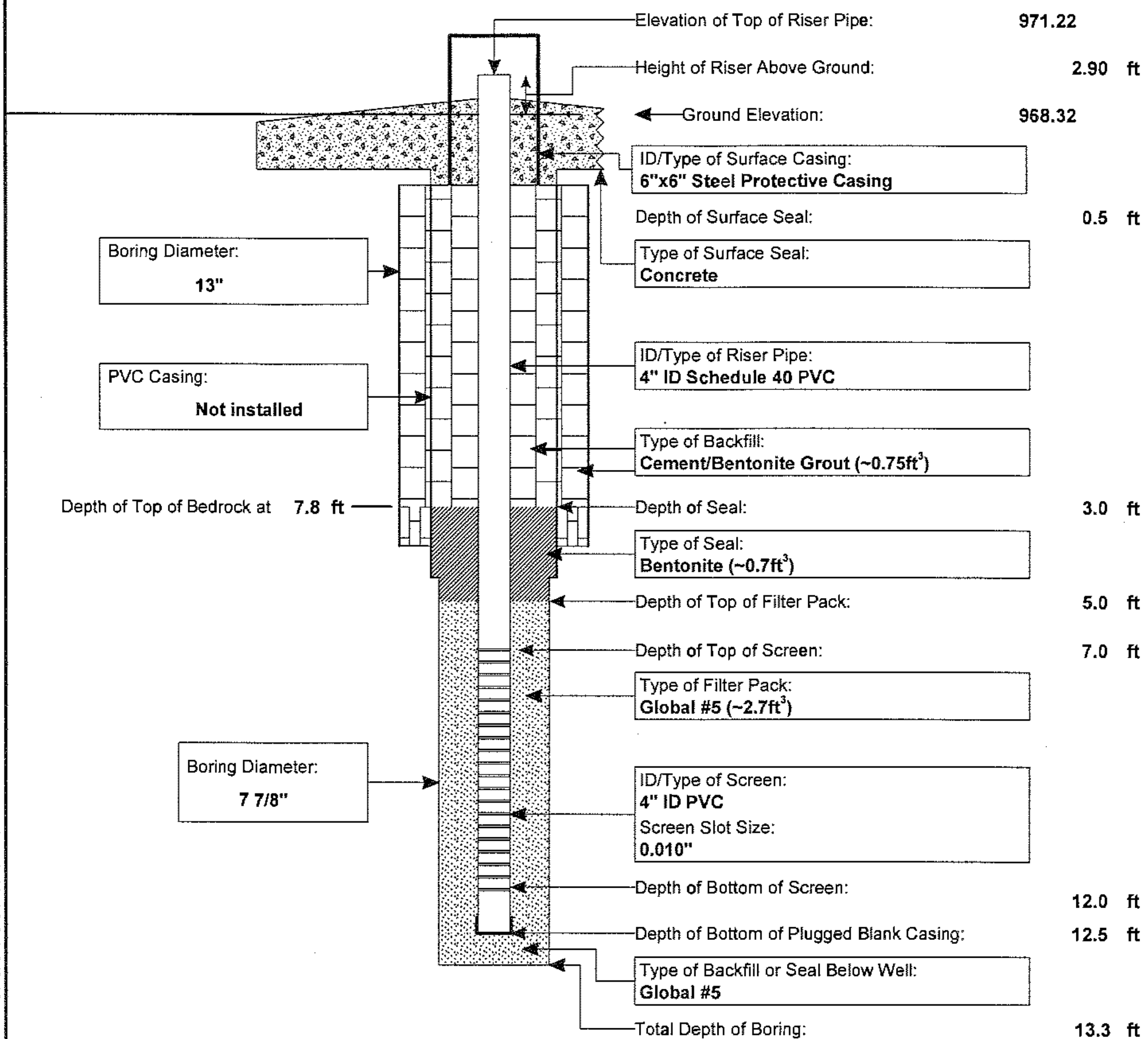
ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	DRILL TIME (Rate, min./ft.) (f)	BLOW COUNT (g)	REMARKS (h)
	8	shale, soft, silty, argillaceous					
					1.5		Run 5.0' Recovered 4.5' Loss 0.5' RQD 36%
	9		Fractures every 0.1 to 0.2' from 8.5' to 9.5' bgs				
					1.5		
	10		Shale seam		1.75		
	11		Shale seam (fractured) every 0.1 to 0.2' from 10.8' to 12.9' bgs		1.5		
	12		Tl spin		1.25		
	13		Tl break				
	14	End of coring at 13.3' bgs with no water loss. Monitoring well screened 7.0' to 12.0' bgs.					
	15						
	16						

PROJECT: Blue Grass Army Depot Phase III Investigation Richmond, Kentucky

HOLE NO: 4004B01A

Project: Blue Grass Army Depot Phase III Investigation **Project Location:** Richmond, Kentucky **Project Number:** 24637-080-121	**WELL CONSTRUCTION LOG** **Well Number** **4004B01A**

Well Location	**Pink Water Pond SWMU 003**	Date(s) Installed	**11/30/2001**	Time	**NA**
Installed By	**Harriss Drilling**	Observed By	**K. Fields**	Total Depth	**13.3 feet**
Method of Installation	**HS Auger/Wireline Coring/Water rotary**				
Screened Interval	**7.0'-12.0' bgs**	Completion Zone	**Soil/Bedrock Interface**		
Remarks	**Protected by ~3.4' tall (6" x 6" square) steel protective casing, surrounded by 4, 3' tall (3" OD) protective posts.**				

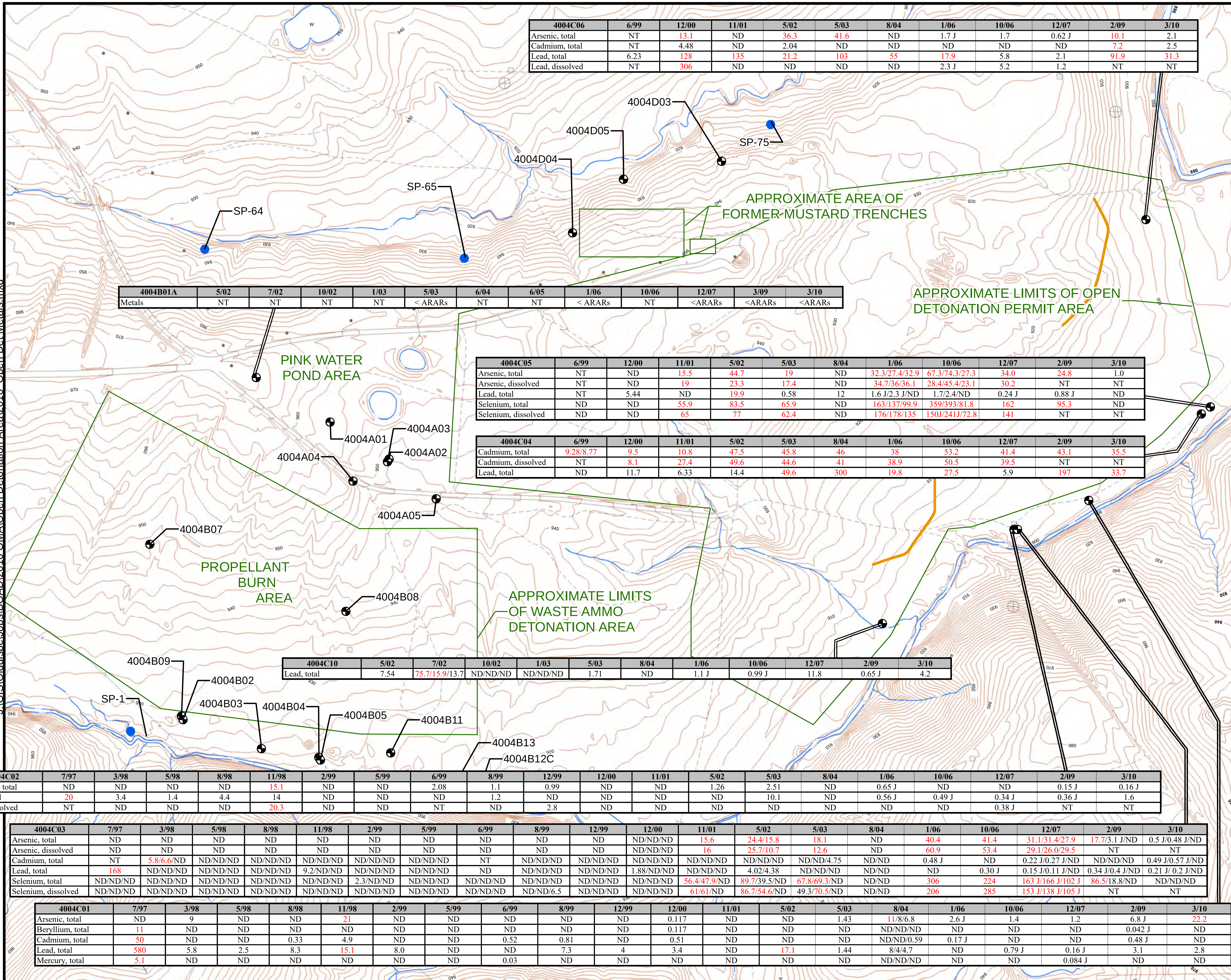


NOTE: DIAGRAM IS NOT TO SCALE

BGAD WELL CONS DIAGRAM TEST.GPJ WC-CORP2.GDT 9/30/02

URS

Appendix E-2
Long-term Monitoring Summary of Analytical Results and Trend Analyses



4004C06	6/99	12/00	11/01	5/02	5/03	8/04	1/06	10/06	12/07	2/09	3/10
Arsenic, total	NT	13.1	ND	36.3	41.6	ND	1.7 J	1.7	0.62 J	10.1	2.1
Cadmium, total	NT	4.48	ND	2.04	ND	ND	ND	ND	ND	7.2	2.5
Lead, total	6.23	128	135	21.2	103	55	17.9	5.8	2.1	91.9	31.3
Lead, dissolved	NT	306	ND	ND	ND	ND	2.3 J	5.2	1.2	NT	NT

4004B01A	5/02	7/02	10/02	1/03	5/03	6/04	6/05	1/06	10/06	12/07	3/09	3/10
Metals	NT	NT	NT	NT	< ARARs	NT	NT	< ARARs	NT	<ARARs	<ARARs	<ARARs

4004C05	6/99	12/00	11/01	5/02	5/03	8/04	1/06	10/06	12/07	2/09	3/10
Arsenic, total	NT	ND	15.5	44.7	19	ND	32.3/27.4/32.9	67.3/74.3/27.3	34.0	24.8	1.0
Arsenic, dissolved	NT	ND	19	23.3	17.4	ND	34.7/36/36.1	28.4/45.4/23.1	30.2	NT	NT
Lead, total	NT	5.44	ND	19.9	0.58	12	1.6 J/2.3 J/ND	1.7/2.4/ND	0.24 J	0.88 J	ND
Selenium, total	ND	ND	55.9	83.5	65.9	ND	163/137/99.9	359/393/81.8	162	95.3	ND
Selenium, dissolved	ND	ND	65	77	62.4	ND	176/178/135	150J/241J/72.8	141	NT	NT

4004C04	6/99	12/00	11/01	5/02	5/03	8/04	1/06	10/06	12/07	2/09	3/10
Cadmium, total	9.28/8.77	9.5	10.8	47.5	45.8	46	38	53.2	41.4	43.1	35.5
Cadmium, dissolved	NT	8.1	27.4	49.6	44.6	41	38.9	50.5	39.5	NT	NT
Lead, total	ND	11.7	6.33	14.4	49.6	300	19.8	27.5	5.9	197	33.7

4004C10	5/02	7/02	10/02	1/03	5/03	8/04	1/06	10/06	12/07	2/09	3/10
Lead, total	7.54	75.7/15.9/13.7	ND/ND/ND	ND/ND/ND	1.71	ND	1.1 J	0.99 J	11.8	0.65 J	4.2

4004C02	7/97	3/98	5/98	8/98	11/98	2/99	5/99	6/99	8/99	12/99	12/00	11/01	5/02	5/03	8/04	1/06	10/06	12/07	2/09	3/10
Cadmium, total	ND	ND	ND	ND	15.1	ND	ND	2.08	1.1	0.99	ND	ND	1.26	2.51	ND	0.65 J	ND	ND	0.15 J	0.16 J
Lead, total	20	3.4	1.4	4.4	14	ND	ND	ND	1.2	ND	ND	ND	ND	10.1	ND	0.56 J	0.49 J	0.34 J	0.36 J	1.6
Lead, dissolved	NT	ND	ND	ND	20.3	ND	ND	NT	ND	2.8	ND	ND	ND	ND	ND	ND	ND	0.38 J	NT	NT

4004C03	7/97	3/98	5/98	8/98	11/98	2/99	5/99	6/99	8/99	12/99	12/00	11/01	5/02	5/03	8/04	1/06	10/06	12/07	2/09	3/10
Arsenic, total	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND/ND/ND	15.6	24.4/15.8	18.1	ND	40.4	41.4	31.1/31.4/27.9	17.7/3.1 J/ND	0.5 J/0.48 J/ND
Arsenic, dissolved	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND/ND/ND	16	25.7/10.7	12.6	ND	60.9	53.4	29.1/26.0/29.5	NT	NT
Cadmium, total	NT	5.8/6.6/ND	ND/ND/ND	ND/ND/ND	ND/ND/ND	ND/ND/ND	ND/ND/ND	NT	ND/ND/ND	ND/ND/ND	ND/ND/ND	ND/ND/ND	ND/ND/ND	ND/ND/4.75	ND/ND	0.48 J	ND	0.22 J/0.27 J/ND	ND/ND/ND	0.49 J/0.57 J/ND
Lead, total	168	ND/ND/ND	ND/ND/ND	ND/ND/ND	9.2/ND/ND	ND/ND/ND	ND/ND/ND	ND	ND/ND/ND	ND/ND/ND	1.88/ND/ND	ND/ND/ND	4.02/4.38	ND/ND/ND	ND/ND	ND	0.30 J	0.15 J/0.11 J/ND	0.34 J/0.4 J/ND	0.21 J/ 0.2 J/ND
Selenium, total	ND/ND/ND	ND/ND/ND	ND/ND/ND	ND/ND/ND	ND/ND/ND	2.3/ND/ND	ND/ND/ND	ND/ND/ND	ND/ND/ND	ND/ND/ND	ND/ND/ND	56.4/47.9/ND	89.7/39.5/ND	67.8/69.3/ND	ND/ND	306	224	163 J/166 J/102 J	86.5/18.8/ND	ND/ND/ND
Selenium, dissolved	ND/ND/ND	ND/ND/ND	ND/ND/ND	ND/ND/ND	ND/ND/ND	ND/ND/ND	ND/ND/ND	ND/ND/ND	ND/ND/6.5	ND/ND/ND	ND/ND/ND	61/61/ND	86.7/54.6/ND	49.3/70.5/ND	ND/ND	206	285	153 J/138 J/105 J	NT	NT

4004C01	7/97	3/98	5/98	8/98	11/98	2/99	5/99	6/99	8/99	12/99	12/00	11/01	5/02	5/03	8/04	1/06	10/06	12/07	2/09	3/10
Arsenic, total	ND	9	ND	ND	21	ND	ND	ND	ND	ND	0.117	ND	ND	1.43	11/8/6.8	2.6 J	1.4	1.2	6.8 J	22.2
Beryllium, total	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.117	ND	ND	ND	ND/ND/ND	ND	ND	ND	0.042 J	ND
Cadmium, total	50	ND	ND	0.33	4.9	ND	ND	0.52	0.81	ND	0.51	ND	ND	ND	ND/ND/0.59	0.17 J	ND	ND	0.48 J	ND
Lead, total	580	5.8	2.5	8.3	15.1	8.0	ND	ND	7.3	4	3.4	ND	17.1	1.44	8/4/4.7	ND	0.79 J	0.16 J	3.1	2.8
Mercury, total	5.1	ND	ND	ND	ND	ND	ND	0.03	ND	ND	ND	ND	ND	ND	ND/ND/ND	ND	ND	0.084 J	ND	ND

N

LEGEND:

- Long Term Monitoring Well
- Long Term Spring/Seep
- Topographic Contour (Feet, msl) (2' Interval)
- 10.3 Metal Concentration (ug/L) in Groundwater
- 55 Concentration Exceeds ARAR Screening Level
- Silt Fence, Constructed 2006

Metal	ARAR (ug/L)
Arsenic	10
Beryllium	4
Cadmium	5
Lead	15
Mercury	2
Selenium	50

ND = Not Detected
NT = Not Tested
J = Estimated Concentration

0 150 600
Approximate Scale in Feet

BASE MAP SOURCE:
Provided by Blue Grass Army Depot

U.S. Army Corps of Engineers

Blue Grass Army Depot
Richmond, KY

FIGURE 4
METALS CUMULATIVE DETECTION SUMMARY ABOVE ARARs
OPEN DETONATION AREA
MARCH 2010

JOB NO. 14948395

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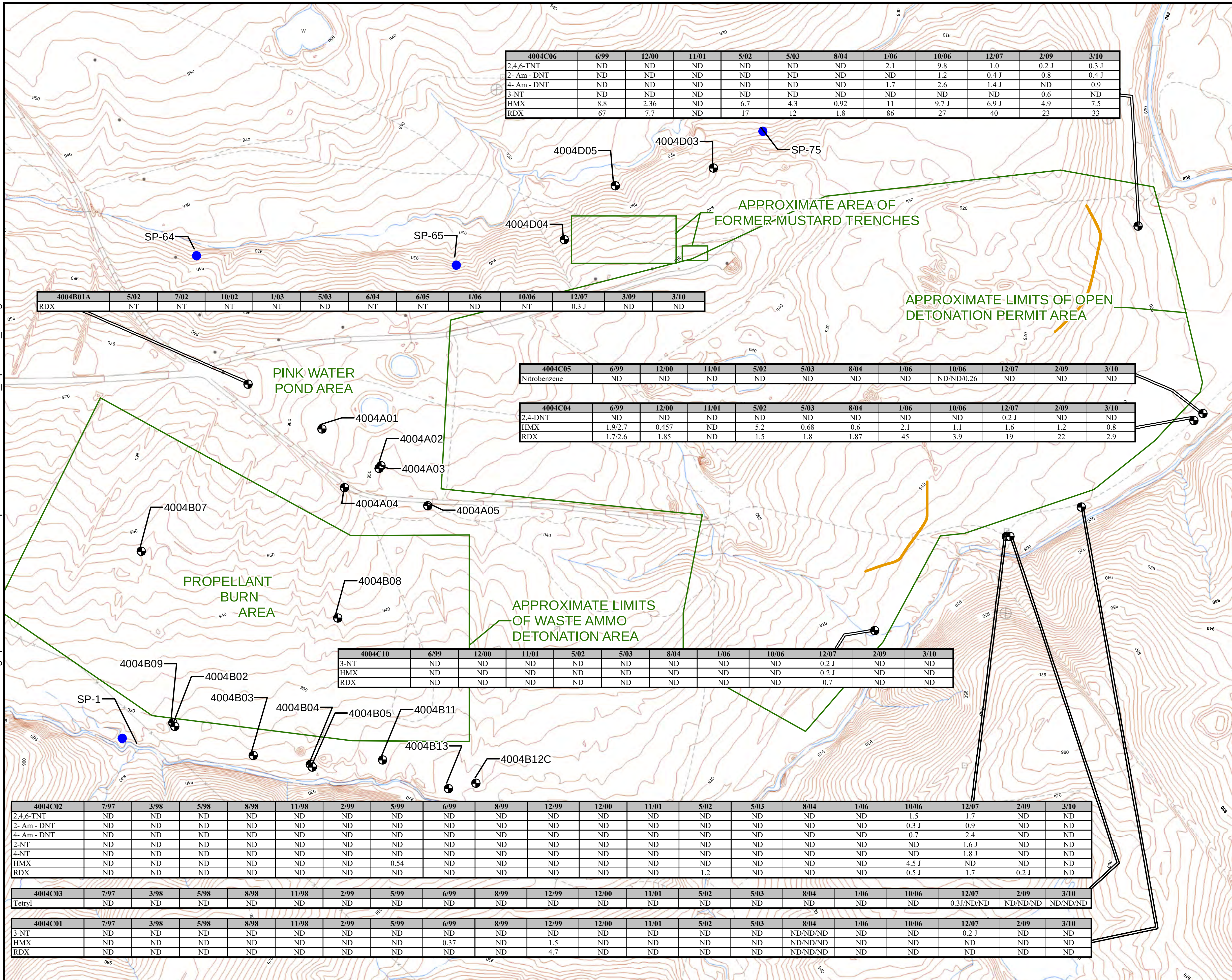


4004C06	6/99	12/00	11/01	5/02	5/03	8/04	1/06	10/06	12/07	2/09	3/10
2,4,6-TNT	ND	ND	ND	ND	ND	ND	2.1	9.8	1.0	0.2 J	0.3 J
2- Am - DNT	ND	ND	ND	ND	ND	ND	ND	1.2	0.4 J	0.8	0.4 J
4- Am - DNT	ND	ND	ND	ND	ND	ND	1.7	2.6	1.4 J	ND	0.9
3-NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.6	ND
HMX	8.8	2.36	ND	6.7	4.3	0.92	11	9.7 J	6.9 J	4.9	7.5
RDX	67	7.7	ND	17	12	1.8	86	27	40	23	33

4004B01A	5/02	7/02	10/02	1/03	5/03	6/04	6/05	1/06	10/06	12/07	3/09	3/10
RDX	NT	NT	NT	NT	ND	NT	NT	ND	NT	0.3 J	ND	ND

4004C05	6/99	12/00	11/01	5/02	5/03	8/04	1/06	10/06	12/07	2/09	3/10
Nitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND/ND/0.26	ND	ND	ND

4004C04	6/99	12/00	11/01	5/02	5/03	8/04	1/06	10/06	12/07	2/09	3/10
2,4-DNT	ND	ND	ND	ND	ND	ND	ND	ND	0.2 J	ND	ND
HMX	1.9/2.7	0.457	ND	5.2	0.68	0.6	2.1	1.1	1.6	1.2	0.8
RDX	1.7/2.6	1.85	ND	1.5	1.8	1.87	45	3.9	19	22	2.9

4004C10	6/99	12/00	11/01	5/02	5/03	8/04	1/06	10/06	12/07	2/09	3/10
3-NT	ND	ND	ND	ND	ND	ND	ND	ND	0.2 J	ND	ND
HMX	ND	ND	ND	ND	ND	ND	ND	ND	0.2 J	ND	ND
RDX	ND	ND	ND	ND	ND	ND	ND	ND	0.7	ND	ND

4004C02	7/97	3/98	5/98	8/98	11/98	2/99	5/99	6/99	8/99	12/99	12/00	11/01	5/02	5/03	8/04	1/06	10/06	12/07	2/09	3/10
2,4,6-TNT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5	1.7	ND	ND
2- Am - DNT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.3 J	0.9	ND	ND
4- Am - DNT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.7	2.4	ND	ND
2-NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.6 J	ND	ND
4-NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.8 J	ND	ND
HMX	ND	ND	ND	ND	ND	ND	0.54	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.5 J	ND	ND	ND
RDX	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND	0.5 J	1.7	0.2 J	ND

4004C03	7/97	3/98	5/98	8/98	11/98	2/99	5/99	6/99	8/99	12/99	12/00	11/01	5/02	5/03	8/04	1/06	10/06	12/07	2/09	3/10
Tetryl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.3J/ND/ND	ND/ND/ND	ND/ND/ND

4004C01	7/97	3/98	5/98	8/98	11/98	2/99	5/99	6/99	8/99	12/99	12/00	11/01	5/02	5/03	8/04	1/06	10/06	12/07	2/09	3/10
3-NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND/ND/ND	ND	ND	0.2 J	ND	ND
HMX	ND	ND	ND	ND	ND	ND	ND	0.37	ND	1.5	ND	ND	ND	ND	ND/ND/ND	ND	ND	ND	ND	ND
RDX	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.7	ND	ND	ND	ND	ND/ND/ND	ND	ND	ND	ND	ND

N

LEGEND:

- Long Term Monitoring Well
- Long Term Spring/Seep
- Topographic Contour (Feet, msl) (2' Interval)
- 10.3 Energetic Concentration (ug/L) in Groundwater
- 55 Concentration Exceeds ARAR Screening Level
- Silt Fence, Constructed 2006

Energetic	ARAR (ug/L)
Nitrobenzene	NA
2,4,6- TNT	20
2-Am- DNT	NA
4-Am- DNT	NA
HMX	2,000
RDX	100

ND = Not Detected
NT = Not Tested
J = Estimated Concentration

0 150 600
Approximate Scale in Feet

BASE MAP SOURCE:
Provided by Blue Grass Army Depot

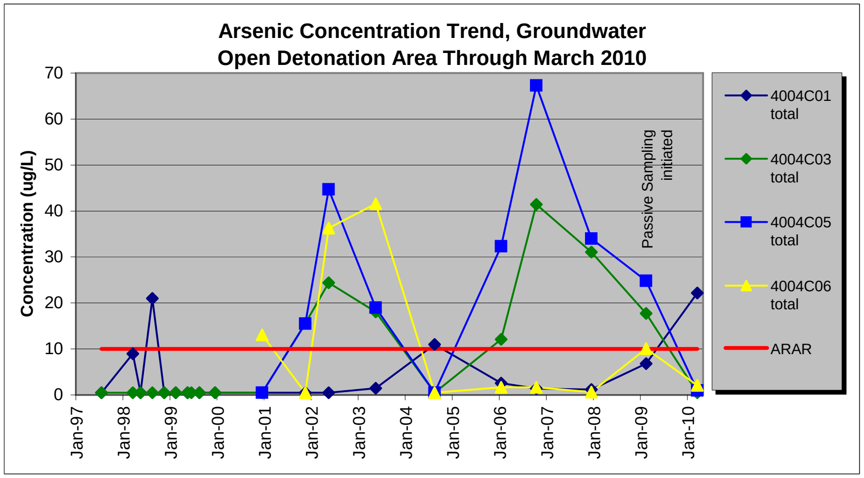
U.S. Army Corps of Engineers

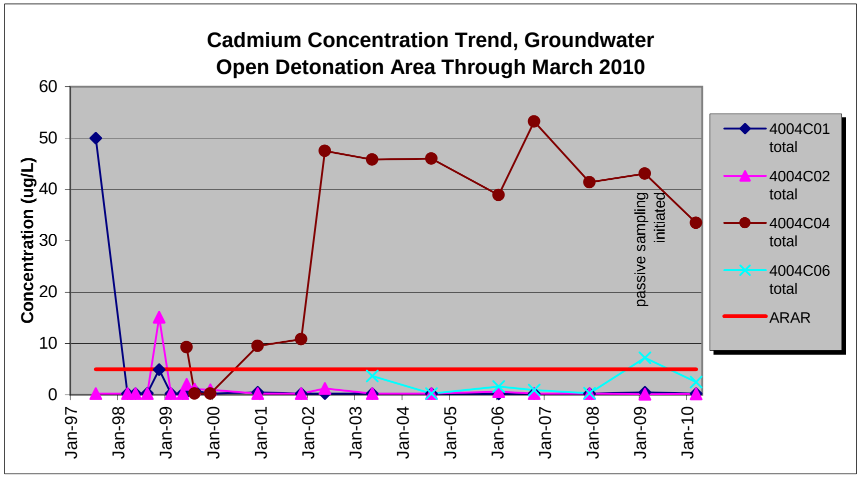
Blue Grass Army Depot
Richmond, KY

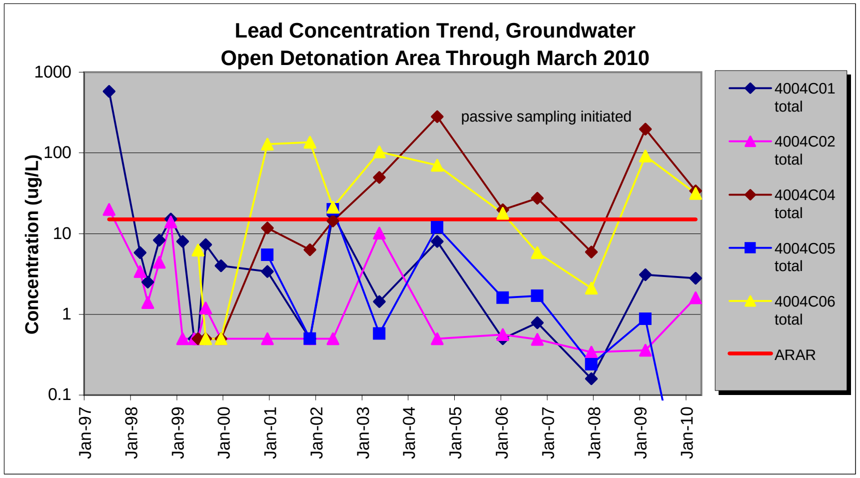
FIGURE 5
ENERGETICS CUMMULATIVE DETECTION SUMMARY
OPEN DETONATION AREA
MARCH 2010

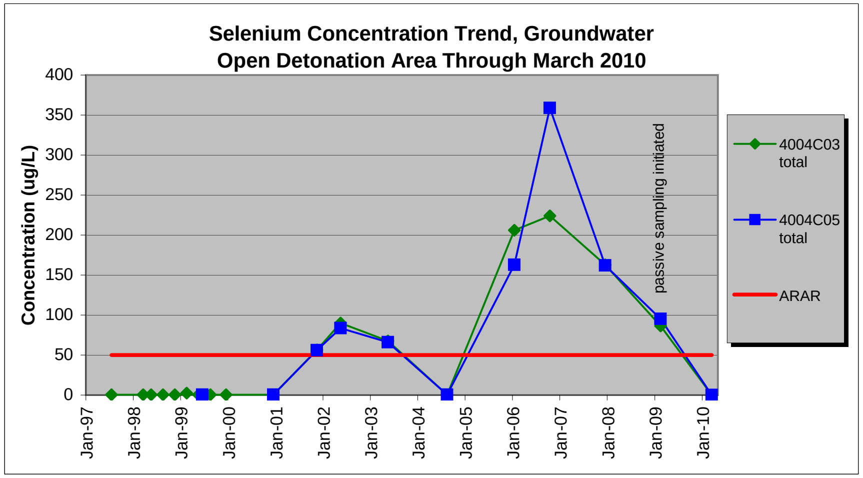
JOB NO. 14948395

URS


Arsenic Concentration Trend, Groundwater
Open Detonation Area Through March 2010
Concentration (ug/L)
Passive Sampling initiated
4004C01 total
4004C03 total
4004C05 total
4004C06 total
ARAR
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10


Cadmium Concentration Trend, Groundwater
Open Detonation Area Through March 2010
Concentration (ug/L)
passive sampling initiated
4004C01 total
4004C02 total
4004C04 total
4004C06 total
ARAR


Lead Concentration Trend, Groundwater
Open Detonation Area Through March 2010
Concentration (ug/L)
passive sampling initiated
4004C01 total
4004C02 total
4004C04 total
4004C05 total
4004C06 total
ARAR


Selenium Concentration Trend, Groundwater
Open Detonation Area Through March 2010
Concentration (ug/L)
passive sampling initiated
4004C03 total
4004C05 total
ARAR

Appendix E-3
1998 Soils Site Characterization Sampling Results and 1999 Sediment and Surface Water Sampling Results

1998 Soils Site Characterization Sampling Results

1998 Soils Site Characterization Sampling Results

According to the 1998 Soils Site Characterization Report for the OB/OD Units at Blue Grass Army Depot, Richmond Kentucky, September 1998 (from which this Appendix E-3 is excerpted), by recommendation of KDEP, soil screening levels (SSLs) used at the time were those published in the Human Health Generic Screening Levels (HHGSL) Table (401 KAR 100:050, Risk Assessment Guidance, 11 October 1995) or the U.S. Environmental Protection Agency (EPA) Region IX Preliminary Remediation Goals (PRGs) screening values (1 August 1996) where no HHGSL was published. The HHGSLs were never promulgated. As this Appendix E-3 is an excerpt from the 1998 report, the narrative discusses the results in reference to HHGSLs, 0.1 of HHGSLs and PRGs.

The complete 1998 soil sampling results are tabulated in Table E-3-7 of this Appendix E-3. In support of this permit application, Table E-3-7 has been modified to also provide a column that presents the current (May 2017) EPA Industrial Regional Screening Level (RSL) for comparison purposes. The EPA RSLs have been added to tables presenting mean and maximum concentrations (Tables E-3-1 through E-3-5).

1 Open Burn Area Sampling Results

Semivolatile Organic Compounds

Di-n-butyl phthalate was the only SVOC detected consistently within the OB area. This compound was detected in the surface soils only.

Di-n-butyl phthalate was detected at 74 mg/kg, 15 mg/kg, and 2.2 mg/kg at distances of 1 feet, 5 feet, and 10 feet from Pan 1, respectively. At the time of the study, no HHGSL or PRG was published for this compound. The compound was also detected at 40 mg/kg at 1 foot from Pan 2, and was not detected at greater distances from Pan 2.

Aniline (also known as phenylamine or aminobenzene) was detected at levels below the reported detection level (and below the published HHGSL) at a single, isolated location within the surface soils. N-nitroso-di-n-propylamine was detected at 0.38 mg/kg and 3.8 mg/kg, both values below their respective reported detection levels and above the published HHGSL (used as the screening criteria at the time) of 0.06 mg/kg.

Total Analytical List Metals

Generally, metals concentrations within surface and subsurface soils were consistent, with no notable trends either horizontally or vertically. Mean and maximum concentrations of metal contaminants of potential concern within the OB area (surface and subsurface soils combined) are shown in Table E-3-1.

TABLE E-3-1
Mean and Maximum Concentrations of Metals of Potential Concern for the OB Area

Metal	Mean Concentration (mg/kg)	Maximum Concentration (mg/kg)	EPA Industrial RSL (mk/kg)[1]
Aluminum	13,543.57	26,400.00	1,100,000
Arsenic	8.65	15.40	3
Beryllium	0.92	1.30	2,300
Chromium[2]	19.68	34.00	1,800,000
Iron	32,627.86	42,800.00	820,000
Lead	83.08	578.00	800
Manganese	1,185.85	2,790.00	26,000

[1] Current EPA Industrial RSL as of June 11, 2017 provided for comparison to past results. Exceedances of the maximum concentration is highlighted in bold.

[2] Total Chromium was measured. The Industrial RSL for trivalent chromium is presented for comparison.

Arsenic, beryllium, and manganese exceeded the published HHGSLs (used as the screening criteria at the time) of 0.32 mg/kg, 0.14 mg/kg, and 380 mg/kg, respectively, at all sampling locations within the burn area.

The value of 0.32 mg/kg represents the cancer endpoint for arsenic, assuming a residential exposure scenario. However, since naturally occurring arsenic is frequently higher than this value, Kentucky published an alternative HHGSL for arsenic of 22 mg/kg, based on non-cancer endpoints that were considered still protective of cancer risks (i.e., falls within EPA's acceptable risk range of 10^{-6} to 10^{-4}). No arsenic concentrations at any sampling location exceeded the non-cancer endpoint HHGSL.

The HHGSL values (used as the screening criteria at the time) of 0.14 mg/kg and 380 mg/kg for beryllium and manganese likewise assume a residential exposure scenario. The EPA-published PRGs, assuming an industrial exposure scenario, at the time, were 1.3 mg/kg for beryllium and 47,000 mg/kg for manganese. The PRG for residential exposure to manganese was 1,800 mg/kg. No beryllium concentrations at any sampling location within the OB area exceeded the industrial PRG value at the time of 1.3 mg/kg. Manganese concentrations at all sampling locations within the OB area were below the residential PRG value of 1,800 mg/kg except one. The maximum manganese concentration of 2,430 mg/kg was detected in the subsurface soils collected from the soil boring downgradient from Pan 1.

Aluminum, chromium, and lead concentrations were consistently detected at levels exceeding 0.1 HHGSL within the OB area. The published HHGSLs (used for screening at the time) for these compounds were 77,000 mg/kg, 30 mg/kg, and 50 mg/kg, respectively. No aluminum concentration exceeded the HHGSL. The maximum concentration of chromium, detected at 25 feet from Pan 1, was 34 mg/kg, which exceeded the published HHGSL. All other chromium hits were below the HHGSL. Concentrations of lead exceeded the HHGSL in the samples collected 25 feet from Pan 1 (60.40 mg/kg); and 1 foot from Pan 2 (578 mg/kg), and in the duplicate sample collected 15 feet from Pan 2 (128 mg/kg); all others were below the HHGSL (used for screening at the time).

Although there was no published HHGSL for iron, PRG values of 23,000 mg/kg for a residential exposure scenario and 610,000 mg/kg for an industrial exposure scenario had been published by EPA. Iron concentrations within the OB area consistently exceeded the residential PRG value, but were well below the industrial PRG used for screening at the time.

Explosives

Concentrations of the two explosives detected within the OB area, DNT24 and 2,6-Dinitrotoluene, were greatest nearest to the pans and decreased as the sampling distance from the pans increased.

DNT24 was detected at levels greater or equal to the HHGSL (used for screening at the time) of 130 mg/kg at 1 foot (430 mg/kg) and 5 feet (130 mg/kg) from Pan 1, and at levels below 0.1 HHGSL at 10 feet (9 mg/kg) and 25 feet (0.21 mg/kg) from Pan 1. DNT24 was detected at a level greater than 0.1 HHGSL at 1 foot (120 mg/kg) from Pan 2, at levels well below 0.1 HHGSL at 5 feet (1.0 mg/kg) and 10 feet (0.20 mg/kg) from Pan 2, and was not detected at 25 feet from Pan 2.

The published HHGSL for 2,6-Dinitrotoluene was 65 mg/kg. This compound was detected at a level greater than 0.1 HHGSL at 1 foot (12 mg/kg) from Pan 1, and at a level well below 0.1 HHGSL at 15 feet (0.22 mg/kg) from Pan 1. 2,6-Dinitrotoluene was detected at a level slightly less than 0.1 HHGSL at 1 foot (6.3 mg/kg) from Pan 2 and at a level well below 0.1 HHGSL at 10 feet (0.10 mg/kg) from Pan 2. The compound was not detected at any other sampling locations within the OB area.

2 Open Detonation Area Sampling Results

Table E-3-7 provides the analytical results for soil samples collected in the active OD area. Results are compared to the historical HHGSL and 0.1 HHGSL and the current EPA Industrial RSL. Note that a single grab surface water sample was also collected during the 1998 soil sampling event. The surface water sample was collected from a pond that was formerly located within the bounds of the OD/BD unit. The pond was subsequently drained and filled by recommendation of KDEP. Screening criteria used for surface water was the published KDEP HHGSL at the time of the study.

Semivolatile Organic Compounds

The SVOCs listed in Table E-3-2 were detected consistently throughout the surface soils within the detonation area. These same explosives were detected within the subsurface soils, but much less frequently. SVOC constituents in subsurface soils were detected most frequently at sampling locations aligned within the row of pits. Subsurface samples within Sectors 1, 2, and 3 were free of SVOCs, with the exception of very low levels of Bis(2-ethylhexyl)phthalate detected in the subsurface boring within Sector 3.

TABLE E-3-2

Mean and Maximum Concentrations of SVOCs of Potential Concern for the Surface and Subsurface Soils of the OD Area

SVOC	Surface Soils		Subsurface Soils		EPA Industrial RSL (mg/kg)[1]
	Mean Concentration (mg/kg)	Maximum Concentration (mg/kg)	Mean Concentration (mg/kg)	Maximum Concentration (mg/kg)	
Benzo[a]anthracene	0.15	0.84	0.10	0.13	2.9
Benzo[a]pyrene	0.16	0.97	0.13	0.16	0.29
Benzo[b]fluoranthene	0.23	1.80	0.11	0.17	1.8
Benzo[g,h,i]perylene	0.14	0.55	0.00	0.00	NA
Bis(2-ethylhexyl)phthalate	0.32	3.10	0.23	0.53	160
Chrysene	0.15	0.88	0.09	0.14	290
Di-n-butyl phthalate	0.31	1.20	2.12	6.00	82,000
Fluoranthene	0.24	1.50	0.18	0.37	30,000
Indeno(1,2,3-cd)pyrene	0.17	0.55	0.05	0.08	2.9
N-nitroso-di-n-propylamine	0.21	0.80	0.95	1.80	**0.33**
Pentachlorophenol	0.08	0.10	0.21	0.21	4
Phenanthrene	0.16	0.68	0.37	0.79	NA
Pyrene	0.45	1.80	0.40	0.89	23,000

[1] Current EPA Industrial RSL as of June 11, 2017 provided for comparison to past results. Exceedances of the maximum concentration is highlighted in bold.

Of the SVOCs shown in Table E-3-2, Benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, and benzo[g,h,i]perylene were detected most consistently throughout the surface soils within the detonation area. Of these, only benzo[a]pyrene consistently exceeded the published HHGSL (used for screening at the time) of 0.06 mg/kg. Benzo[a]anthracene and benzo[b]fluoranthene consistently exceeded 0.1 HHGSL (0.06 mg/kg for both).

Bis(2-ethylhexyl)phthalate, chrysene, di-n-butyl phthalate, fluoranthene, and indeno(1,2,3-cd)pyrene, n-nitroso-di-phenylamine, phenanthrene, and pyrene were also detected throughout the surface soils, but with less consistency. The published HHGSLs for bis(2-ethylhexyl)phthalate, chrysene, fluoranthene, indeno[1,2,3-cd]pyrene, n-nitroso-di-phenylamine, and pyrene were 32 mg/kg, 24 mg/kg, 2,600 mg/kg, 610 mg/kg, 91 mg/kg, and 2,000 mg/kg, respectively. There were no published HHGSLs or PRGs for di-n-butyl phthalate or phenanthrene. Of these, only indeno[1,2,3-cd]pyrene frequently exceeded the

0.1 HHGSL of 61 mg/kg, and on two occasions exceeded the HHGSL of 610 mg/kg. All others were either detected at levels below 0.1 HHGSL or there was no available published value for comparison.

Additionally, pentachlorophenol was detected within several surface and a single subsurface soil sample, but at levels well below 0.1 HHGSL (0.25 mg/kg).

A single surface soil sample (SSOD0053) collected from Sector 5, Quadrant 2 and two subsurface soil samples (SBOD007 and SBOD008) collected from Sectors 7 and 8 contained SVOCs not detected in any other locations, including 2-methylnaphthalene, acenaphthylene, anthracene, and naphthalene. Anthracene and naphthalene were both detected at levels below the 0.1 HHGSL values. There were no published screening levels for 2-methylnaphthalene or acenaphthylene at the time.

SVOCs detected in the drainage channels include benzo[a]pyrene, benzo[b]fluoranthene, fluoranthene, di-n-butyl phthalate, bis(2-ethylhexyl)phthalate, inden(1,2,3-cd)pyrene, phenanthrene, and pyrene Levels were comparable to those detected in the active detonation area.

No SVOCs were detected in the surface water sample.

It must be noted that the results for each of the detected SVOCs frequently, if not always, exceeded the stated detection levels. As shown in Appendix B, the reported results for these SVOCs are flagged with a "J," indicating that the result was less than the stated detection limit but greater than or equal to the specified reporting limit.

Total Analytical List Metals

In general, metals concentrations throughout the detonation area soils were consistent with no vertical variance. Although mean concentrations for some metals tended to be slightly higher in surface soils than in subsurface soils, no notable horizontal trends were noted. Mean and maximum concentrations of metals of potential concern within the surface and subsurface soils within the detonation area are shown in Table E-3-3.

TABLE E-3-3
Mean and Maximum Concentrations of Metals of Potential Concern for the Surface and Subsurface Soils of the OD Area

Metal	Surface Soils		Subsurface Soils		EPA Industrial RSL (mg/kg)[1]
	Mean Concentration (mg/kg)	Maximum Concentration (mg/kg)	Mean Concentration (mg/kg)	Maximum Concentration (mg/kg)	
Aluminum	12,212.90	20,100.00	11,764.12	16,600.00	1,100,000
Arsenic	8.92	14.80	7.54	11.50	**3**
Beryllium	1.44	2.57	1.38	1.96	2,300
Cadmium	2.60	5.80	3.31	12.80	980
Chromium[2]	21.93	58.50	17.36	23.80	1,800,000
Copper	185.81	4,120	91.6	138	47,000
Iron	55,556.45	115,000.00	51,970.59	100,000.00	820,000
Lead	67.96	123.00	63.22	114.00	800
Manganese	2,643.37	5,500.00	2,635.76	4,470.00	26,000

[1] Current EPA Industrial RSL as of June 11, 2017 provided for comparison to past results. Exceedances of the maximum concentration is highlighted in bold.

[2] Total Chromium was measured. The Industrial RSL for trivalent chromium is presented for comparison.

The same metals, arsenic, beryllium, and manganese, detected at levels exceeding the published HHGSLs (used for screening at the time) in the burn area were detected at comparable levels at all soil sampling locations within the detonation area.

No arsenic concentrations at any sampling location within the active OD area exceeded the non-cancer endpoint HHGSL of 22 mg/kg. Beryllium concentrations within surface and subsurface soils throughout the detonation area exceeded the industrial PRG value at the time of 1.3 mg/kg, although only slightly. Manganese concentrations throughout the surface and subsurface soils within the detonation area exceeded the residential PRG value at the time of 1,800 mg/kg, with few exceptions; none exceeded the industrial PRG value at the time of 47,000 mg/kg.

Aluminum, chromium, and lead concentrations were consistently detected at levels exceeding 0.1 HHGSL throughout the surface and subsurface soils within the detonation area. Cadmium and copper were also detected at levels exceeding 0.1 HHGSL at few surface and subsurface soil sampling locations within the detonation area. The published HHGSLs (used for screening at the time) for cadmium and copper were 38 mg/kg and 2,800 mg/kg, respectively. Although the maximum concentration of copper (4,120 mg/kg) detected in the surface soils exceeded the published HHGSL, this was an isolated occurrence.

Iron concentrations within the active detonation area consistently exceeded the residential PRG value at the time, but were below the industrial PRG.

The metals of potential concern listed in Table E-3-3 for the active detonation area were also detected at elevated levels within the drainage channels. Arsenic, beryllium, chromium, iron, lead, and manganese all exceeded published HHGSLs and/or PRGs (used for screening at the time), while aluminum exceeded the 0.1 HHGSL value. Arsenic exceeded the non-cancer endpoint HHGSL in the split sample collected in drainage channel east. Beryllium exceeded the industrial PRG in all drainage channel samples and manganese exceeded the residential PRG in all drainage channel samples. The maximum concentrations of arsenic, beryllium, chromium, copper, iron, thallium, and vanadium over the entire study area were detected in drainage channel east. This suggests that heavy metals have begun to accumulate in the sediment downgradient from the detonation area.

With the exception of manganese, all metals detected in the surface water sample (collected from the pond which was later drained and filled) were below the 0.1 HHGSL value. Manganese was detected at 29.3 µg/L, which exceeds the 0.1 HHGSL value of 18 µg/L.

Explosives

Several explosives, RDX, TNT, HMX, and DNT24, were detected consistently throughout the surface soils within the detonation area. These same explosives were detected within the subsurface soils, but much less frequently and at lower concentrations. Explosives constituents in subsurface soils were detected most frequently at sampling locations aligned within the row of pits. Subsurface samples within Sectors 1, 2, and 3 were free of explosives, with the exception of very low levels of nitroglycerin and tetryl detected in the subsurface boring within Sector 3. 2-Amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, and 1,3,5-trinitrobenzene, were also detected throughout the site, but with less frequency. Tetryl and nitroglycerin were detected in five or fewer samples only. Mean and maximum concentrations of explosives of potential concern within the surface and subsurface soils of the detonation area are shown in Table E-3-4.

TABLE E-3-4

Mean and Maximum Concentrations of Explosives of Potential Concern for the Surface and Subsurface Soils of the OD Area

Explosive	Surface Soils		Subsurface Soils		EPA Industrial RSLs (mg/kg)[1]
	Mean Concentration (mg/kg)	Maximum Concentration (mg/kg)	Mean Concentration (mg/kg)	Maximum Concentration (mg/kg)	
1,3,5-Trinitrobenzene	0.31	0.49	0.29	0.29	32,000
2-Amino-4,6-Dinitrotoluene	0.54	0.83	0.54	0.69	2,300
4-Amino-2,6-Dinitrotoluene	0.42	0.49	0.33	0.39	2,300
2,4-Dinitrotoluene	1.06	25.00	3.40	16.00	**7.4**
HMX	2.22	4.60	2.50	3.20	57,000
Nitroglycerin	1.93	4.40	11.52	24.00	82
RDX	11.71	37.00	10.03	23.00	28
Tetryl	0.80	1.00	0.18	0.18	2,300
TNT	2.74	16.00	0.58	1.10	96

[1] Current EPA Industrial RSL as of June 11, 2017 provided for comparison to past results. Exceedances of the maximum concentration is highlighted in bold.

The published HHGSLs (used for screening at the time) for RDX, TNT, HMX, and DNT24 were 4 mg/kg, 48 mg/kg, 3,300 mg/kg, and 130 mg/kg, respectively. RDX concentrations exceeded the published HHGSL of 4 mg/kg throughout the detonation area, with some few hits at levels below the HHGSL but above 0.1 HHGSL. TNT was consistently detected at levels less than 0.1 HHGSL (4.8 mg/kg), with only 15 percent of the TNT hits exceeding this value. HMX was detected at levels below 0.1 HHGSL (330 mg/kg) throughout the detonation area. DNT24 was detected at levels below 0.1 HHGSL (13 mg/kg), with only one detection of 25 mg/kg exceeding this level.

At the time of the study (1998), there were no published HHGSLs or PRGs for 2-amino-4,6-dinitrotoluene or 4-amino-2,6-dinitrotoluene. The published HHGSL (used for screening at the time) for 1,3,5-trinitrobenzene is 3.3 mg/kg. All 1,3,5-trinitrobenzene concentrations were below the HHGSL, but exceeded 0.1 HHGSL in 33 percent of the detections.

Tetryl was detected in four sampling locations within the OD area at levels well below the published HHGSL of 650 mg/kg. Nitroglycerin was detected in five separate samples. There was no published HHGSL or PRG for nitroglycerin.

Explosives detected in the drainage channels included 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, DNT24, HMX, nitroglycerin, RDX, and TNT. Concentrations were less than those detected within the active detonation area, with only RDX exceeding the 0.1 HHGSL value.

HMX and RDX were both detected in the surface water sample that was collected from the pond which was later drained and filled. The RDX concentration of 1.6 µg/L exceeded the HHGSL of 0.61 µg/L for RDX in surface waters, while HMX was well below the 0.1 HHGSL value of 1,800 µg/L.

Background Sampling Results

Table E-3-7 provides the sampling results of the background sample analyses. Table E-3-5 provides the mean and maximum concentrations in background soils for those metals identified as potential contaminants of concern for the OB and OD areas. The mean concentrations of all these metals, except beryllium and aluminum, were somewhat lower than those for the active OB and OD areas, but still generally exceeded the published screening values at the time. Lead and manganese levels were notably lower in the background samples.

Surface soils in the background location were free of explosives and bis(2-ethylhexyl)phthalate was the only SVOC detected.

TABLE E-3-5

Mean and Maximum Concentrations of Selected Metals in Background Soils

Metal	Mean Concentration (mg/kg)	Maximum Concentration (mg/kg)	EPA Industrial RSL (mg/kg)[1]
Aluminum	12,721.11	18,100.00	1,100,000
Arsenic	4.06	6.30	**3**
Beryllium	1.18	2.10	2,300
Cadmium	0.35	0.66	980
Chromium[2]	17.71	29.70	1,800,000
Iron	30,655.56	45,500.00	820,000
Lead	25.50	33.30	800
Manganese	940.22	1,310.00	26,000

[1] Current EPA Industrial RSL as of June 11, 2017 provided for comparison to past results. Exceedances of the maximum concentration is highlighted in bold.

[2] Total Chromium was measured. The Industrial RSL for trivalent chromium is presented for comparison.

Subsurface boring SBBG001 was free of both SVOCs and explosives. Subsurface boring SBBG002 contained very low levels of several SVOCs and explosives. This boring location is therefore eliminated as a representative background sample.

The University of Kentucky College of Agriculture has published background levels of heavy metals in some Kentucky soils[17]. The study includes samples collected in Fayette and Powell counties located northwest and east of Madison County, respectively. The study concludes that levels of chromium, manganese, molybdenum, and nickel are generally higher in Kentucky than other soils in the United States. Table E-3-6 shows measured values of selected metals in surface soils (0 to 17 centimeters) in Fayette and Powell counties.

TABLE E-3-6

Concentrations of Selected Metals in Some Kentucky Soils

County	Chromium (mg/kg)	Manganese (mg/kg)	Lead (mg/kg)
Fayette	137	>700	13
Fayette	183	2716	20
Powell	35	1147	22

[17] University of Kentucky, College of Agriculture. 1993. *Background Levels of Heavy Metals in Some Kentucky Soils*, Bulletin 727, October.

3 Burn Pan Ash Sampling Results

Table E-3-7 provides the sampling results of the burn pan ash analyses. All metals, with the exception of mercury, were detected at some level in the burn pan ash residue. In addition to the metals, by-products of explosives combustion, DNT24, 2,6-dinitrotoluene, 2-nitrotoluene, and di-n-butyl phthalate, were also detected.

4 Fill Material Sampling Results

Table E-3-7 provides analytical results of a field test of fill material. Four pre-blast samples were collected during the field test to verify that the fill was originated from an uncontaminated source. No explosives were detected in three of the four samples. RDX, in a concentration of 5.9 mg/kg, was detected in one of the four pre-blast samples. Because the pre-blast samples were collected after the bulldozer had placed the fill and dug the pit, it is highly likely that the positive result is due to cross-contamination.

The post-blast results demonstrate that only very low levels of explosives (TNT, RDX, and DNT24) remained in the soils after detonation of 100 lb NEW of explosive waste and donor charge. Explosives concentrations in the soil for this test ranged from 0.25 to 3.5 mg/kg for TNT, 1.3 to 4.4 mg/kg for RDX, and 0.25 to 0.34 mg/kg for DNT24. These levels are much lower than those associated with “explosive soils.” Explosive soil is defined by U.S. Army policy as soil containing 10 percent (100 mg/kg) or more, by dry weight, of explosive compounds. This is considered a conservative limit, accepted by the EPA Regions. This definition has been derived from extensive DoD testing in which soil samples, contaminated by various levels of explosives, have been tested for reactivity utilizing the Zero Gap and Deflagration to Detonation Transition tests.

TABLE E-3-7
Analytical Results

Explosives Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2]
OB Area							
Surface Soils							
Pan 1 at 1 ft	SSOB0011-01	2,4-Dinitrotoluene	13	430.03	130	13	7.4
Pan 1 at 5 ft	SSOB0012-01	2,4-Dinitrotoluene	2.5	130.03	130	13	7.4
Pan 2 at 1 ft	SSOB0021-01	2,4-Dinitrotoluene	2.5	120	130	13	7.4
OD Area							
Surface Soils							
Sector 1/Quad 3	SSDO0013-01	HMX	2.2	2.8	4	0.4	57,000
	SSDO0013-01	RDX	1	15.03	4	0.4	28
Sector 1/Quad 4	SSOD0014-01	RDX	1	7.5	4	0.4	28
Split	SSOD0014-02	1,3,5-Trinitrobenzene	0.097	0.49	3.3	0.33	32,000
	SSOD0014-02	TNT	0.133	16	48	4.8	96
	SSOD0014-02	RDX	0.133	18	4	0.4	28
Duplicate	SSOD0014-03	RDX	1	9.5	4	0.4	28
Sector 2/Quad 3	SSDO0023-01	HMX	2.2	1.8	4	0.4	57,000
	SSDO0023-01	RDX	1	10.03	4	0.4	28
Sector 2/Quad 4	SSDO0024-01	RDX	1	14.03	4	0.4	28
Sector 3/Quad 3	SSDO0033-01	HMX	2.2	2.3	4	0.4	57,000
	SSDO0033-01	RDX	1	14.03	4	0.4	28
Sector 3/Quad 4	SSDO0034-01	HMX	2.2	2.3	4	0.4	57,000
	SSDO0034-01	RDX	1	11.03	4	0.4	28
Split	SSOD0034-02	1,3,5-Trinitrobenzene	0.097	0.41	3.3	0.33	32,000
	SSOD0034-02	RDX	0.133	20	4	0.4	28
Duplicate	SSDO0034-03	HMX	2.2	2.1	4	0.4	57,000
	SSDO0034-03	RDX	1	9.8	4	0.4	28
Sector 4/Quad 3	SSDO0043-01	1,3,5-Trinitrobenzene	0.25	0.43	3.3	0.33	32,000
	SSDO0043-01	HMX	2.2	2.7	4	0.4	57,000
	SSDO0043-01	RDX	1	14.03	4	0.4	28

Explosives Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2]
Sector 4/Quad 4	SSDO0044-01	HMX	2.2	2.5	4	0.4	57,000
	SSDO0044-01	RDX	1	18.03	4	0.4	28
Sector 5/Quad 1	SSOD0051-01	RDX	1	5.8	4	0.4	28
	SSOD0052-01	RDX	1	5.9	4	0.4	28
Sector 5/Quad 2	SSOD0053-01	HMX	2.2	3.4	4	0.4	57,000
	SSOD0053-01	RDX	1	13.03	4	0.4	28
Split	SSOD0053-02	RDX	0.133	21	4	0.4	28
Duplicate	SSOD0054-01	RDX	1	1.5	4	0.4	28
Sector 5/Quad 3	SSOD0055-01	HMX	2.2	1.5	4	0.4	57,000
	SSOD0055-01	RDX	1	10.03	4	0.4	28
	SSOD0056-01	RDX	1	10.03	4	0.4	28
Sector 5/Quad 4	SSOD0057-01	RDX	1	7.03	4	0.4	28
Sector 6/Quad 1	SSDO0061-01	RDX	1	2.2	4	0.4	28
	SSDO0062-01	HMX	2.2	1.1	4	0.4	57,000
	SSDO0062-01	RDX	1	3.6	4	0.4	28
Sector 6/Quad 2	SSDO0063-01	HMX	2.2	1.1	4	0.4	57,000
	SSDO0063-01	RDX	1	10.03	4	0.4	28
	SSDO0064-01	RDX	1	4.7	4	0.4	28
	SSDO0064-01	TNT	0.25	9.7	48	4.8	96
Sector 6/Quad 3	SSDO0065-01	RDX	1	5.4	4	0.4	28
	SSDO0066-01	RDX	1	1.1	4	0.4	28
Sector 6/Quad 4	SSDO0067-01	RDX	1	9.8	4	0.4	28
	SSDO0067-01	TNT	0.25	5.1	48	4.8	96
	SSDO0068-01	HMX	2.2	2.6	4	0.4	57,000
	SSDO0068-01	RDX	1	12.03	4	0.4	28
	SSDO0068-01	TNT	0.25	16.03	48	4.8	96
Sector 7/Quad 1	SSOD0071-01	1,3,5-Trinitrobenzene	0.25	0.4	3.3	0.33	32,000
	SSOD0071-01	HMX	2.2	2.8	4	0.4	57,000
	SSOD0071-01	RDX	1	12.03	4	0.4	28
	SSOD0072-01	HMX	2.2	3.03	4	0.4	57,000

Explosives Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2]
	SSOD0072-01	RDX	1	15.03	4	0.4	28
Split	SSOD0072-02	RDX	0.133	21	4	0.4	28
Duplicate	SSOD0072-03	HMX	2.2	2.5	4	0.4	57,000
	SSOD0072-03	RDX	1	16.03	4	0.4	28
Sector 7/Quad 2	SSOD0073-01	HMX	2.2	1.9	4	0.4	57,000
	SSOD0073-01	RDX	1	18.03	4	0.4	28
	SSOD0074-01	HMX	2.2	1.8	4	0.4	57,000
	SSOD0074-01	RDX	1	13.03	4	0.4	28
Sector 7/Quad 3	SSOD0075-01	2,4-Dinitrotoluene	0.5	25.03	130	13	7.4
	SSOD0075-01	HMX	4.4	2.6	4	0.4	57,000
	SSOD0075-01	RDX	2	22.03	4	0.4	28
	SSOD0075-01	TNT	0.5	6.03	48	4.8	96
	SSOD0076-01	HMX	2.2	2.9	4	0.4	57,000
	SSOD0076-01	RDX	1	21.03	4	0.4	28
Sector 7/Quad 4	SSOD0077-01	HMX	2.2	3.03	4	0.4	57,000
	SSOD0077-01	RDX	1	22.03	4	0.4	28
	SSOD0078-01	HMX	2.2	2.9	4	0.4	57,000
	SSOD0078-01	RDX	1	15.03	4	0.4	28
Sector 8/Quad 1	SSOD0081-01	HMX	2.2	1.1	4	0.4	57,000
	SSOD0081-01	RDX	1	11.03	4	0.4	28
	SSOD0081-01	TNT	0.25	14.03	48	4.8	96
	SSOD0082-01	HMX	2.2	1.2	4	0.4	57,000
	SSOD0082-01	RDX	1	12.03	4	0.4	28
	SSOD0082-01	TNT	0.25	12.03	48	4.8	96
Sector 8/Quad 2	SSOD0083-01	RDX	1	12.03	4	0.4	28
	SSOD0084-01	HMX	2.2	1.1	4	0.4	57,000
	SSOD0084-01	RDX	1	9.6	4	0.4	28
	SSOD0084-01	TNT	0.25	4.9	48	4.8	96
Sector 8/Quad 3	SSOD0085-01	HMX	2.2	3.3	4	0.4	57,000
	SSOD0085-01	RDX	1	32.03	4	0.4	28

Explosives Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2]
	SSOD0086-01	HMX	4.4	4.6	4	0.4	57,000
	SSOD0086-01	RDX	2	37.03	4	0.4	28
Sector 8/Quad 4	SSOD0087-01	HMX	2.2	1.8	4	0.4	57,000
	SSOD0087-01	RDX	1	15.03	4	0.4	28
	SSOD0088-01	RDX	1	3.4	4	0.4	28
Sector 9/Quad 1	SSOD0091-01	RDX	1	16.03	4	0.4	28
Split	SSOD0091-02	RDX	0.133	11	4	0.4	28
Duplicate	SSOD0091-03	HMX	2.2	1.3	4	0.4	57,000
	SSOD0091-03	RDX	1	12.03	4	0.4	28
Sector 9/Quad 2	SSOD0092-01	RDX	1	8.7	4	0.4	28
Sector 10/Quad 1	SSOD0101-01	RDX	1	13	4	0.4	28
Sector 10/Quad 2	SSOD0102-01	RDX	1	18	4	0.4	28
Sector 11/Quad 1	SSOD0111-01	TNT	2.5	170	48	4.8	96
Sector 11/Quad 2	SSOD0112-01	RDX	2	27	4	0.4	28
Sector 12/Quad 1	SSOD0121-01	RDX	1	12	4	0.4	28
Sector 12/Quad 2	SSOD0122-01	RDX	1	16	4	0.4	28
Subsurface Soils							
Boring Sector 7	SBOD007-01/00	HMX	2.2	1.7	4	0.4	57,000
	SBOD007-01/00	RDX	1	6.5	4	0.4	28
Boring Sector 8	SBOD008-01/00	RDX	1	2.8	4	0.4	28
Split	SBOD008-02/00	RDX	0.133	16	4	0.4	28
Duplicate	SBOD008-03/00	RDX	1	1.9	4	0.4	28
Boring Sector 10	SBOD010-01/00	HMX	2.2	3.2	4	0.4	57,000
	SBOD010-01/00	RDX	1	23.03	4	0.4	28
Boring Sector 11	SBOD011-01/00	RDX	1	10.03	4	0.4	28
Drainage Channels							
East/Split	SSDE-02	RDX	0.133	1.1	4	0.4	28
Pond							
	SW001	RDX	0.84	1.6	0.61	0.061	28

Explosives Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2]
Background Location							
Subsurface Soils							
Location 2	SBBG002-01	1,3,5-Trinitrobenzene	0.25	0.65	3.3	0.33	32,000
	SBBG002-01	RDX	1	2	4	0.4	28
	SBBG002-01	TNT	0.25	8.4	48	4.8	96
QA/QC							
No Hits							

[1] Soil screening levels used at the time and presented as soil screening levels (SSLs) were those published in the Human Health Generic Screening Levels (HHGSL) Table (401 KAR 100:050, Risk Assessment Guidance, 11 October 1995) or the US Environmental Protection Agency (EPA) Region IX Preliminary Remediation Goals (PRGs) screening values (1 August 1996) where no HHGSL was published.

[2] Current EPA Industrial RSL as of June 11, 2017 provided for comparison to past results. Exceedances of the maximum concentration is highlighted in bold.

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
OB Area							
Surface Soils							
Pan 1 at 1 ft	SSOB0011-01	ARSENIC	0.288	6.00003	22	2.2	3
	SSOB0011-01	BERYLLIUM	0.006	0.48	0.14	0.014	2,300
	SSOB0011-01	CHROMIUM	0.03	12.8	30	3	1,800,000
	SSOB0011-01	LEAD	0.668	43.9	50	5	800
	SSOB0011-01	MANGANESE	0.006	525	380	38	26,000
Pan 1 at 5 ft	SSOB0012-01	ARSENIC	0.293	5.5	22	2.2	3
	SSOB0012-01	BERYLLIUM	0.006	0.5	0.14	0.014	2,300
	SSOB0012-01	CHROMIUM	0.031	9.5	30	3	1,800,000
	SSOB0012-01	LEAD	0.136	20.7	50	5	800
	SSOB0012-01	MANGANESE	0.006	433	380	38	26,000
Pan at 10 ft	SSOB0013-01	ARSENIC	0.288	5.1	22	2.2	3
	SSOB0013-01	BERYLLIUM	0.006	0.4	0.14	0.014	2,300
	SSOB0013-01	CHROMIUM	0.03	8.2	30	3	1,800,000
	SSOB0013-01	LEAD	0.133	12.5	50	5	800
	SSOB0013-01	MANGANESE	0.006	261	380	38	26,000
Pan 1 at 25 ft	SSOB0014-01	ALUMINUM	0.717	12600	77000	7700	1,100,000
	SSOB0014-01	ARSENIC	0.324	11.9	0.32	0.032	3
	SSOB0014-01	BERYLLIUM	0.006	1.1	0.14	0.014	2,300
	SSOB0014-01	CHROMIUM	0.034	34.00	30	3	1,800,000
	SSOB0014-01	MANGANESE	0.034	1710	380	38	26,000
Pan 2 at 1 ft	SSOB0021-01	ALUMINUM	0.783	14100	77000	7700	1,100,000
	SSOB0021-01	ARSENIC	0.354	11.2	0.32	0.032	3
	SSOB0021-01	BERYLLIUM	0.007	0.89	0.14	0.014	2,300
	SSOB0021-01	CHROMIUM	0.037	22.6	30	3	1,800,000
	SSOB0021-01	LEAD	0.821	578	50	5	800
	SSOB0021-01	MANGANESE	0.007	917	380	38	26,000
Pan 2 at 5 ft	SSOB0022-01	ALUMINUM	0.75	13700	77000	7700	1,100,000
	SSOB0022-01	ARSENIC	0.339	10.1	0.32	0.032	3
	SSOB0022-01	BERYLLIUM	0.007	1.1	0.14	0.014	2,300

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
	SSOB0022-01	CHROMIUM	0.036	24.1	30	3	1,800,000
	SSOB0022-01	LEAD	0.786	47	50	5	800
	SSOB0022-01	MANGANESE	0.007	1110	380	38	26,000
Pan 2 at 10 ft	SSOB0023-01	ALUMINUM	0.749	15300	77000	7700	1,100,000
	SSOB0023-01	ARSENIC	0.338	9.1	0.32	0.032	3
	SSOB0023-01	BERYLLIUM	0.007	1.2	0.14	0.014	2,300
	SSOB0023-01	CHROMIUM	0.036	21.4	30	3	1,800,000
	SSOB0023-01	LEAD	0.786	29.5	50	5	800
	SSOB0023-01	MANGANESE	0.007	1130	380	38	26,000
Split	SSOB0023-02	ALUMINUM	4	23000	77000	7700	1,100,00
	SSOB0023-02	ARSENIC	0.19	15.4	0.32	0.032	3
	SSOB0023-02	BERYLLIUM	0.14	1.3	0.14	0.014	2,300
	SSOB0023-02	CHROMIUM	0.0748	21.6	30	3	1,800,000
	SSOB0023-02	LEAD	0.126	115	50	5	800
	SSOB0023-02	MANGANESE	0.068	8190	380	38	26,000
Duplicate	SSOB0023-03	ALUMINUM	0.734	13100	77000	7700	1,100,000
	SSOB0023-03	ARSENIC	0.331	7.8	0.32	0.032	3
	SSOB0023-03	BERYLLIUM	0.007	0.9	0.14	0.014	2,300
	SSOB0023-03	CHROMIUM	0.035	15.9	30	3	1,800,000
Duplicate	SSOB0023-03	LEAD	0.77	26.2	50	5	800
	SSOB0023-03	MANGANESE	0.007	1010	380	38	26,000
Pan 2 at 25 ft	SSOB0024-01	ALUMINUM	0.812	14000	77000	7700	1,100,000
	SSOB0024-01	ARSENIC	0.367	10.1	0.32	0.032	3
	SSOB0024-01	BERYLLIUM	0.007	1	0.14	0.014	2,300
	SSOB0024-01	CHROMIUM	0.039	25.7	30	3	1,800,000
	SSOB0024-01	LEAD	0.851	33.7	50	5	800
	SSOB0024-01	MANGANESE	0.007	973	380	38	26,000
Subsurface Soils							
Soil Boring 1/0-5 ft	SBOB001-01/00-05	ALUMINUM	0.737	13300	77000	7700	1,100,000
	SBOB001-01/00-05	ARSENIC	0.332	9.6	0.32	0.032	3
	SBOB001-01/00-05	BERYLLIUM	0.007	1.1	0.14	0.014	2,300

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
	SBOB001-01/00-05	CHROMIUM	0.035	21.5	30	3	1,800,000
	SBOB001-01/00-05	LEAD	0.772	35.7	50	5	800
	SBOB001-01/00-05	MANGANESE	0.035	2430	380	38	26,000
Soil Boring 1/5-10 ft	SSOB001-01/05-10	ALUMINUM	0.753	13800	77000	7700	1,100,000
	SSOB001-01/05-10	ARSENIC	0.34	4.7	0.32	0.032	3
	SSOB001-01/05-10	BERYLLIUM	0.007	1.00003	0.14	0.014	2,300
	SSOB001-01/05-10	CHROMIUM	0.036	12.7	30	3	1,800,000
	SSOB001-01/05-10	LEAD	0.789	12.7	50	5	800
	SSOB001-01/05-10	MANGANESE	0.007	807	380	38	26,000
Soil Boring 2/0-3.8 ft	SSOB002-01/00-3.8	ALUMINUM	0.789	18400	77000	7700	1,100,000
	SSOB002-01/00-3.8	ARSENIC	0.356	5.9	0.32	0.032	3
	SSOB002-01/00-3.8	BERYLLIUM	0.007	1.00003	0.14	0.014	2,300
	SSOB002-01/00-3.8	CHROMIUM	0.038	19.5	30	3	1,800,000
	SSOB002-01/00-3.8	LEAD	0.828	19.8	50	5	800
	SSOB002-01/00-3.8	MANGANESE	0.038	1320	380	38	26,000
OD Area							
Surface Soils							
Sector 1/Quadrant 3	SSOD0013-01	ALUMINUM	0.738	13300	77000	7700	1,100,000
	SSOD0013-01	ARSENIC	0.333	10.1	0.32	0.032	3
	SSOD0013-01	BERYLLIUM	0.007	1.4	0.14	0.014	2,300
	SSOD0013-01	CHROMIUM	0.035	20.3	30	3	1,800,000
	SSOD0013-01	LEAD	0.773	96.2	50	5	800
	SSOD0013-01	MANGANESE	0.035	3040	380	38	26,000
	SSOD0014-01	ALUMINUM	0.739	11700	77000	7700	1,100,000
	SSOD0014-01	ARSENIC	0.333	14.8	0.32	0.032	3
	SSOD0014-01	BERYLLIUM	0.007	1.5	0.14	0.014	2,300
	SSOD0014-01	CHROMIUM	0.035	18.1	30	3	1,800,000
	SSOD0014-01	LEAD	0.774	73.2	50	5	800
	SSOD0014-01	MANGANESE	0.035	2860	380	38	26,000
Sector 1/Quadrant 4	SSOD0014-02	ALUMINUM	4.28	16300	77000	7700	1,100,000
	SSOD0014-02	ARSENIC	0.204	9.81	0.32	0.032	3

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
	SSOD0014-02	BERYLLIUM	0.15	1.25	0.14	0.014	2,300
	SSOD0014-02	CADMIUM	0.265	4.8	38	3.8	980
	SSOD0014-02	CHROMIUM	0.0802	18.3	30	3	1,800,000
	SSOD0014-02	COPPER	0.0568	300	2800	280	47,000
Sector 1/Quadrant 4	SSOD0014-02	LEAD	0.135	76.4	50	5	800
	SSOD0014-02	MANGANESE	0.0729	2230	380	38	26,000
Sector 2/Quadrant 3	SSOD0023-01	ALUMINUM	0.731	12300	77000	7700	1,100,000
	SSOD0023-01	ARSENIC	0.33	9.6	0.32	0.032	3
	SSOD0023-01	BERYLLIUM	0.007	1.6	0.14	0.014	2,300
	SSOD0023-01	CHROMIUM	0.035	23.6	30	3	1,800,000
	SSOD0023-01	COPPER	0.047	292	2800	280	47,000
	SSOD0023-01	LEAD	0.766	81.5	50	5	800
	SSOD0023-01	MANGANESE	0.035	2630	380	38	26,000
Sector 2/Quadrant 4	SSOD0024-01	ALUMINUM	0.72	12100	77000	7700	1,100,000
	SSOD0024-01	ARSENIC	0.325	8.3	0.32	0.032	3
	SSOD0024-01	BERYLLIUM	0.007	1.2	0.14	0.014	2,300
	SSOD0024-01	CHROMIUM	0.034	19.00003	30	3	1,800,000
	SSOD0024-01	LEAD	0.754	82.3	50	5	800
	SSOD0024-01	MANGANESE	0.034	2630	380	38	26,000
Sector 3/Quadrant 3	SSOD0033-01	ALUMINUM	0.732	10100	77000	7700	1,100,000
	SSOD0033-01	ARSENIC	0.331	8.1	0.32	0.032	3
	SSOD0033-01	BERYLLIUM	0.007	1.8	0.14	0.014	2,300
	SSOD0033-01	CHROMIUM	0.035	20.5	30	3	1,800,000
	SSOD0033-01	LEAD	0.768	94.6	50	5	800
	SSOD0033-01	MANGANESE	0.035	2970	380	38	26,000
Sector 3/Quadrant 4	SSOD0034-01	ALUMINUM	0.72	10200	77000	7700	1,100,000
	SSOD0034-01	ARSENIC	0.325	10.9	0.32	0.032	3
	SSOD0034-01	BERYLLIUM	0.007	1.6	0.14	0.014	2,300
	SSOD0034-01	CHROMIUM	0.034	25.7	30	3	1,800,000
	SSOD0034-01	LEAD	0.755	84.6	50	5	800
	SSOD0034-01	MANGANESE	0.034	3100	380	38	26,000

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
Split	SSOD0034-02	ALUMINUM	4.24	14000	77000	7700	1,100,000
	SSOD0034-02	ARSENIC	0.202	10.9	0.32	0.032	3
	SSOD0034-02	BERYLLIUM	0.148	1.56	0.14	0.014	2,300
	SSOD0034-02	CADMIUM	0.263	4.89	38	3.8	980
	SSOD0034-02	CHROMIUM	0.0794	16.7	30	3	1,800,000
	SSOD0034-02	LEAD	0.133	64	50	5	800
	SSOD0034-02	MANGANESE	0.0722	2140	380	38	26,000
Duplicate	SSOD0034-03	ALUMINUM	0.725	10400	77000	7700	1,100,000
	SSOD0034-03	ARSENIC	0.327	9.6	0.32	0.032	3
	SSOD0034-03	BERYLLIUM	0.007	1.6	0.14	0.014	2,300
	SSOD0034-03	CHROMIUM	0.035	22.00003	30	3	1,800,000
	SSOD0034-03	LEAD	0.76	86.00003	50	5	800
	SSOD0034-03	MANGANESE	0.035	3550	380	38	26,000
Sector 4/Quadrant 3	SSOD0043-01	ALUMINUM	0.736	10700	77000	7700	1,100,000
	SSOD0043-01	ARSENIC	0.332	9.00003	0.32	0.032	3
	SSOD0043-01	BERYLLIUM	0.007	1.5	0.14	0.014	2,300
	SSOD0043-01	CHROMIUM	0.035	19.4	30	3	1,800,000
	SSOD0043-01	LEAD	0.772	83.9	50	5	800
	SSOD0043-01	MANGANESE	0.035	2750	380	38	26,000
Sector 4/Quadrant 4	SSOD0044-01	ALUMINUM	0.728	11000	77000	7700	1,100,000
	SSOD0044-01	ARSENIC	0.329	12.2	0.32	0.032	3
	SSOD0044-01	BERYLLIUM	0.007	1.9	0.14	0.014	2,300
	SSOD0044-01	CHROMIUM	0.035	29.5	30	3	1,800,000
	SSOD0044-01	LEAD	0.763	86.8	50	5	800
	SSOD0044-01	MANGANESE	0.035	3520	380	38	26,000
Sector 5/Quadrant 1	SSOD0051-01	ALUMINUM	0.739	13600	77000	7700	1,100,000
	SSOD0051-01	ARSENIC	0.333	8.5	0.32	0.032	3
	SSOD0051-01	BERYLLIUM	0.007	1.5	0.14	0.014	2,300
	SSOD0051-01	CHROMIUM	0.035	20.1	30	3	1,800,000
	SSOD0051-01	LEAD	0.774	55.5	50	5	800
	SSOD0051-01	MANGANESE	0.035	2590	380	38	26,000

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
Sector 5/Quadrant 1	SSOD0052-01	ALUMINUM	0.737	13000	77000	7700	1,100,000
	SSOD0052-01	ARSENIC	0.332	7.6	0.32	0.032	3
	SSOD0052-01	BERYLLIUM	0.007	1.4	0.14	0.014	2,300
	SSOD0052-01	CHROMIUM	0.035	17.7	30	3	1,800,000
	SSOD0052-01	LEAD	0.772	60.4	50	5	800
	SSOD0052-01	MANGANESE	0.035	2600	380	38	26,000
Sector 5/Quadrant 2	SSOD0053-01	ALUMINUM	0.732	13100	77000	7700	1,100,000
	SSOD0053-01	ARSENIC	0.33	4.3	0.32	0.032	3
	SSOD0053-01	BERYLLIUM	0.007	1.00003	0.14	0.014	2,300
	SSOD0053-01	CHROMIUM	0.035	15.2	30	3	1,800,000
	SSOD0053-01	LEAD	0.767	20.3	50	5	800
	SSOD0053-01	MANGANESE	0.035	1830	380	38	26,000
Split	SSOD0053-02	ALUMINUM	4.06	18100	77000	7700	1,100,000
	SSOD0053-02	ARSENIC	0.193	8.16	0.32	0.032	3
	SSOD0053-02	BERYLLIUM	0.142	0.986	0.14	0.014	2,300
	SSOD0053-02	CHROMIUM	0.0759	29.4	30	3	1,800,000
	SSOD0053-02	LEAD	0.127	21.1	50	5	800
	SSOD0053-02	MANGANESE	0.069	1550	380	38	26,000
Duplicate	SSOD0053-03	ALUMINUM	0.749	13600	77000	7700	1,100,000
	SSOD0053-03	ARSENIC	0.338	6.6	0.32	0.032	3
	SSOD0053-03	BERYLLIUM	0.007	1.3	0.14	0.014	2,300
	SSOD0053-03	CHROMIUM	0.036	19.5	30	3	1,800,000
	SSOD0053-03	LEAD	0.786	19.2	50	5	800
	SSOD0053-03	MANGANESE	0.036	3130	380	38	26,000
Sector 5/Quadrant 2	SSOD0054-01	ALUMINUM	0.74	13000	77000	7700	1,100,000
	SSOD0054-01	ARSENIC	0.334	6.5	0.32	0.032	3
	SSOD0054-01	BERYLLIUM	0.007	1.4	0.14	0.014	2,300
	SSOD0054-01	CHROMIUM	0.035	22.6	30	3	1,800,000
	SSOD0054-01	LEAD	0.776	20.7	50	5	800
	SSOD0054-01	MANGANESE	0.035	1320	380	38	26,000
Sector 5/Quadrant 3	SSOD0055-01	ALUMINUM	0.73	13000	77000	7700	1,100,000

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
	SSOD0055-01	ARSENIC	0.329	9.5	0.32	0.032	3
	SSOD0055-01	BERYLLIUM	0.007	1.8	0.14	0.014	2,300
	SSOD0055-01	CHROMIUM	0.035	23.5	30	3	1,800,000
	SSOD0055-01	LEAD	0.765	62.1	50	5	800
	SSOD0055-01	MANGANESE	0.035	2640	380	38	26,000
Sector 5/Quadrant 3	SSOD0056-01	ALUMINUM	0.707	11900	77000	7700	1,100,000
	SSOD0056-01	ARSENIC	0.319	6.9	0.32	0.032	3
	SSOD0056-01	BERYLLIUM	0.006	1.3	0.14	0.014	2,300
	SSOD0056-01	CHROMIUM	0.034	16.4	30	3	1,800,000
	SSOD0056-01	LEAD	0.741	48.6	50	5	800
	SSOD0056-01	MANGANESE	0.034	2110	380	38	26,000
Sector 5/Quadrant 4	SSOD0057-01	ALUMINUM	0.732	11400	77000	7700	1,100,000
	SSOD0057-01	ARSENIC	0.33	5.4	0.32	0.032	3
	SSOD0057-01	BERYLLIUM	0.007	1.1	0.14	0.014	2,300
	SSOD0057-01	CHROMIUM	0.035	14.7	30	3	1,800,000
	SSOD0057-01	LEAD	0.767	36.9	50	5	800
	SSOD0057-01	MANGANESE	0.035	5500	380	38	26,000
Sector 5/Quadrant 4	SSOD0058-01	ALUMINUM	0.677	10900	77000	7700	1,100,000
	SSOD0058-01	ARSENIC	0.306	6.5	0.32	0.032	3
	SSOD0058-01	BERYLLIUM	0.006	1.1	0.14	0.014	2,300
	SSOD0058-01	CHROMIUM	0.032	20.7	30	3	1,800,000
	SSOD0058-01	LEAD	0.71	35.5	50	5	800
	SSOD0058-01	MANGANESE	0.032	1810	380	38	26,000
Sector 6/Quadrant 1	SSOD0061-01	ALUMINUM	0.73	11600	77000	7700	1,100,000
	SSOD0061-01	ARSENIC	0.329	7.3	0.32	0.032	3
	SSOD0061-01	BERYLLIUM	0.007	1.6	0.14	0.014	2,300
	SSOD0061-01	CHROMIUM	0.035	19.3	30	3	1,800,000
	SSOD0061-01	LEAD	0.765	33.3	50	5	800
	SSOD0061-01	MANGANESE	0.035	1920	380	38	26,000
Sector 6/Quadrant 1	SSOD0062-01	ALUMINUM	0.728	14400	77000	7700	1,100,000
	SSOD0062-01	ARSENIC	0.329	6.7	0.32	0.032	3

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
	SSOD0062-01	BERYLLIUM	0.007	1.3	0.14	0.014	2,300
	SSOD0062-01	CHROMIUM	0.035	19.5	30	3	1,800,000
	SSOD0062-01	LEAD	0.763	37.2	50	5	800
	SSOD0062-01	MANGANESE	0.035	1960	380	38	26,000
Sector 6/Quadrant 2	SSOD0063-01	ALUMINUM	0.725	10900	77000	7700	1,100,000
	SSOD0063-01	ARSENIC	0.327	8.2	0.32	0.032	3
	SSOD0063-01	BERYLLIUM	0.007	1.3	0.14	0.014	2,300
	SSOD0063-01	CHROMIUM	0.035	17.1	30	3	1,800,000
	SSOD0063-01	LEAD	0.76	75.5	50	5	800
	SSOD0063-01	MANGANESE	0.035	2810	380	38	26,000
Sector 6/Quadrant 2	SSOD0064-01	ALUMINUM	0.695	10800	77000	7700	1,100,000
	SSOD0064-01	ARSENIC	0.313	8.00003	0.32	0.032	3
	SSOD0064-01	BERYLLIUM	0.006	2.2	0.14	0.014	2,300
	SSOD0064-01	CHROMIUM	0.033	25.00003	30	3	1,800,000
	SSOD0064-01	LEAD	0.728	58.6	50	5	800
	SSOD0064-01	MANGANESE	0.033	1900	380	38	26,000
Sector 6/Quadrant 3	SSOD0065-01	ALUMINUM	0.726	13300	77000	7700	1,100,000
	SSOD0065-01	ARSENIC	0.328	7.9	0.32	0.032	3
	SSOD0065-01	BERYLLIUM	0.007	1.3	0.14	0.014	2,300
	SSOD0065-01	CHROMIUM	0.035	24.6	30	3	1,800,000
	SSOD0065-01	LEAD	0.762	123	50	5	800
	SSOD0065-01	MANGANESE	0.035	2510	380	38	26,000
Sector 6/Quadrant 3	SSOD0066-01	ALUMINUM	0.703	11700	77000	7700	1,100,000
	SSOD0066-01	ARSENIC	0.317	13.7	0.32	0.032	3
	SSOD0066-01	BERYLLIUM	0.006	1.3	0.14	0.014	2,300
	SSOD0066-01	CHROMIUM	0.034	38.1	30	3	1,800,000
	SSOD0066-01	LEAD	0.737	65.8	50	5	800
	SSOD0066-01	MANGANESE	0.034	2790	380	38	26,000
Sector 6/Quadrant 4	SSOD0067-01	ALUMINUM	0.707	10200	77000	7700	1,100,000
	SSOD0067-01	ARSENIC	0.319	9.00003	0.32	0.032	3
	SSOD0067-01	BERYLLIUM	0.006	1.5	0.14	0.014	2,300

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
	SSOD0067-01	CHROMIUM	0.034	19.7	30	3	1,800,000
	SSOD0067-01	LEAD	0.742	72.1	50	5	800
	SSOD0067-01	MANGANESE	0.034	2610	380	38	26,000
Sector 6/Quadrant 4	SSOD0068-01	ALUMINUM	0.72	10700	77000	7700	1,100,000
	SSOD0068-01	ARSENIC	0.325	8.8	0.32	0.032	3
	SSOD0068-01	BERYLLIUM	0.007	1.5	0.14	0.014	2,300
	SSOD0068-01	CADMIUM	0.116	4.6	38	3.8	980
	SSOD0068-01	CHROMIUM	0.034	18.8	30	3	1,800,000
	SSOD0068-01	LEAD	0.754	97.6	50	5	800
	SSOD0068-01	MANGANESE	0.034	3180	380	38	26,000
Sector 7/Quadrant 1	SSOD0071-01	ALUMINUM	0.715	11600	77000	7700	1,100,000
	SSOD0071-01	ARSENIC	0.323	8.8	0.32	0.032	3
	SSOD0071-01	BERYLLIUM	0.006	1.6	0.14	0.014	2,300
	SSOD0071-01	CADMIUM	0.115	5.8	38	3.8	980
	SSOD0071-01	CHROMIUM	0.034	24.5	30	3	1,800,000
	SSOD0071-01	LEAD	0.75	81	50	5	800
	SSOD0071-01	MANGANESE	0.034	2850	380	38	26,000
Sector 7/Quadrant 1	SSOD0072-01	ALUMINUM	0.739	10900	77000	7700	1,100,000
	SSOD0072-01	ARSENIC	0.333	10.5	0.32	0.032	3
	SSOD0072-01	BERYLLIUM	0.007	1.5	0.14	0.014	2,300
	SSOD0072-01	CHROMIUM	0.035	20.4	30	3	1,800,000
	SSOD0072-01	LEAD	0.774	90.3	50	5	800
	SSOD0072-01	MANGANESE	0.035	3180	380	38	26,000
Split	SSOD0072-02	ALUMINUM	3.62	12800	77000	7700	1,100,000
	SSOD0072-02	ARSENIC	0.172	8.17	0.32	0.032	3
	SSOD0072-02	BERYLLIUM	0.127	1.11	0.14	0.014	2,300
	SSOD0072-02	CADMIUM	0.225	4.93	38	3.8	980
	SSOD0072-02	CHROMIUM	0.0678	15.3	30	3	1,800,000
	SSOD0072-02	LEAD	0.114	54.4	50	5	800
	SSOD0072-02	MANGANESE	0.0617	2050	380	38	26,000

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
Duplicate	SSOD0072-03	ALUMINUM	0.729	10300	77000	7700	1,100,000
	SSOD0072-03	ARSENIC	0.329	8.9	0.32	0.032	3
	SSOD0072-03	BERYLLIUM	0.007	1.3	0.14	0.014	2,300
	SSOD0072-03	CHROMIUM	0.035	18.9	30	3	980
	SSOD0072-03	LEAD	0.764	82.00003	50	5	800
	SSOD0072-03	MANGANESE	0.035	3090	380	38	26,000
Sector 7/Quadrant 2	SSOD0073-01	ALUMINUM	0.695	11200	77000	7700	1,100,000
	SSOD0073-01	ARSENIC	0.313	9.1	0.32	0.032	3
	SSOD0073-01	BERYLLIUM	0.006	1.5	0.14	0.014	2,300
Sector 7/Quadrant 2	SSOD0073-01	CHROMIUM	0.033	20.00003	30	3	1,800,000
	SSOD0073-01	LEAD	0.728	76.1	50	5	800
	SSOD0073-01	MANGANESE	0.033	2600	380	38	26,000
	SSOD0074-01	ALUMINUM	0.695	10500	77000	7700	1,100,000
	SSOD0074-01	ARSENIC	0.314	8.3	0.32	0.032	3
	SSOD0074-01	BERYLLIUM	0.006	1.2	0.14	0.014	2,300
	SSOD0074-01	CHROMIUM	0.033	17.6	30	3	1,800,000
	SSOD0074-01	LEAD	0.729	105	50	5	800
	SSOD0074-01	MANGANESE	0.033	2820	380	38	26,000
Sector 7/Quadrant 3	SSOD0075-01	ALUMINUM	0.707	11200	77000	7700	1,100,000
	SSOD0075-01	ARSENIC	0.319	9.7	0.32	0.032	3
	SSOD0075-01	BERYLLIUM	0.006	1.6	0.14	0.014	2,300
	SSOD0075-01	CHROMIUM	0.034	25.3	30	3	1,800,000
	SSOD0075-01	COPPER	0.228	4120	2800	280	47,000
	SSOD0075-01	LEAD	0.741	97.2	50	5	800
	SSOD0075-01	MANGANESE	0.034	3020	380	38	26,000
Sector 7/Quadrant 3	SSOD0076-01	ALUMINUM	0.707	10400	77000	7700	1,100,000
	SSOD0076-01	ARSENIC	0.319	9.7	0.32	0.032	3
	SSOD0076-01	BERYLLIUM	0.006	1.4	0.14	0.014	2,300
	SSOD0076-01	CHROMIUM	0.034	20.8	30	3	1,800,000
	SSOD0076-01	LEAD	0.741	85.1	50	5	800
	SSOD0076-01	MANGANESE	0.034	2900	380	38	26,000

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
Sector 8/Quadrant 4	SSOD0077-01	ALUMINUM	0.697	10700	77000	7700	1,100,000
	SSOD0077-01	ARSENIC	0.315	10.4	0.32	0.032	3
	SSOD0077-01	BERYLLIUM	0.006	1.5	0.14	0.014	2,300
	SSOD0077-01	CHROMIUM	0.033	23.5	30	3	1,800,000
	SSOD0077-01	LEAD	0.731	83.2	50	5	800
	SSOD0077-01	MANGANESE	0.033	2740	380	38	26,000
Sector 8/Quadrant 4	SSOD0078-01	ALUMINUM	0.7	10800	77000	7700	1,100,000
	SSOD0078-01	ARSENIC	0.316	8.3	0.32	0.032	3
	SSOD0078-01	BERYLLIUM	0.006	1.5	0.14	0.014	2,300
	SSOD0078-01	CADMIUM	0.113	4.2	38	3.8	980
	SSOD0078-01	CHROMIUM	0.033	20.1	30	3	1,800,000
	SSOD0078-01	LEAD	0.734	83.3	50	5	800
	SSOD0078-01	MANGANESE	0.033	2830	380	38	26,000
Sector 8/Quadrant 1	SSOD0081-01	ALUMINUM	0.716	11100	77000	7700	1,100,000
	SSOD0081-01	ARSENIC	0.323	14.6	0.32	0.032	3
	SSOD0081-01	BERYLLIUM	0.006	1.6	0.14	0.014	2,300
	SSOD0081-01	CHROMIUM	0.034	36.7	30	3	1,800,000
	SSOD0081-01	LEAD	0.751	74.8	50	5	800
	SSOD0081-01	MANGANESE	0.034	3070	380	38	26,000
Sector 8/Quadrant 1	SSOD0082-01	ALUMINUM	0.709	11500	77000	7700	1,100,000
	SSOD0082-01	ARSENIC	0.32	8.7	0.32	0.032	3
	SSOD0082-01	BERYLLIUM	0.006	1.4	0.14	0.014	2,300
	SSOD0082-01	CHROMIUM	0.034	18.6	30	3	1,800,000
	SSOD0082-01	LEAD	0.743	65.2	50	5	800
	SSOD0082-01	MANGANESE	0.034	3070	380	38	26,000
Sector 8/Quadrant 2	SSOD0083-01	ALUMINUM	0.724	11500	77000	7700	1,100,000
	SSOD0083-01	ARSENIC	0.327	9.6	0.32	0.032	3
	SSOD0083-01	BERYLLIUM	0.007	1.4	0.14	0.014	2,300
	SSOD0083-01	CHROMIUM	0.035	43.2	30	3	1,800,000
	SSOD0083-01	LEAD	0.759	53.9	50	5	800
	SSOD0083-01	MANGANESE	0.035	2630	380	38	26,000

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
Sector 8/Quadrant 2	SSOD0084-01	ALUMINUM	0.729	11400	77000	7700	1,100,000
	SSOD0084-01	ARSENIC	0.329	9.5	0.32	0.032	3
	SSOD0084-01	BERYLLIUM	0.007	1.2	0.14	0.014	2,300
	SSOD0084-01	CHROMIUM	0.035	17.4	30	3	1,800,000
	SSOD0084-01	LEAD	0.764	62.9	50	5	800
	SSOD0084-01	MANGANESE	0.035	2600	380	38	26,000
Sector 8/Quadrant 3	SSOD0085-01	ALUMINUM	0.699	11700	77000	7700	1,100,000
	SSOD0085-01	ARSENIC	0.316	10.9	0.32	0.032	3
	SSOD0085-01	BERYLLIUM	0.006	1.3	0.14	0.014	2,300
	SSOD0085-01	CHROMIUM	0.033	58.5	30	3	1,800,000
	SSOD0085-01	LEAD	0.733	79	50	5	800
	SSOD0085-01	MANGANESE	0.033	2950	380	38	26,000
Sector 8/Quadrant 3	SSOD0086-01	ALUMINUM	0.708	11900	77000	7700	1,100,000
	SSOD0086-01	ARSENIC	0.32	8.6	0.32	0.032	3
	SSOD0086-01	BERYLLIUM	0.006	1.4	0.14	0.014	2,300
	SSOD0086-01	CHROMIUM	0.034	18.1	30	3	1,800,000
	SSOD0086-01	LEAD	0.742	73.2	50	5	800
	SSOD0086-01	MANGANESE	0.034	3070	380	38	26,000
Sector 8/Quadrant 4	SSOD0087-01	ALUMINUM	0.717	11600	77000	7700	1,100,000
	SSOD0087-01	ARSENIC	0.324	8.8	0.32	0.032	3
	SSOD0087-01	BERYLLIUM	0.006	1.4	0.14	0.014	2,300
	SSOD0087-01	CHROMIUM	0.034	19.2	30	3	1,800,000
	SSOD0087-01	LEAD	0.752	65.1	50	5	800
	SSOD0087-01	MANGANESE	0.034	2590	380	38	26,000
Sector 8/Quadrant 4	SSOD0088-01	ARSENIC	0.324	10.6	0.32	0.032	3
	SSOD0088-01	BERYLLIUM	0.007	1.4	0.14	0.014	2,300
	SSOD0088-01	CADMIUM	0.115	4.6	38	3.8	980
	SSOD0088-01	CHROMIUM	0.034	22.9	30	3	1,800,000
	SSOD0088-01	LEAD	0.753	47.7	50	5	800
	SSOD0088-01	MANGANESE	0.034	2840	380	38	26,000
Sector 9/Quadrant 1	SSOD0091-01	ALUMINUM	0.714	11300	77000	7700	1,100,000

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
	SSOD0091-01	ARSENIC	0.322	9.1	0.32	0.032	3
	SSOD0091-01	BERYLLIUM	0.006	1.3	0.14	0.014	2,300
	SSOD0091-01	LEAD	0.748	61.1	50	5	800
	SSOD0091-01	MANGANESE	0.034	2540	380	38	26,000
Split	SSOD0091-02	ALUMINUM	4.12	15700	77000	7700	1,100,000
	SSOD0091-02	ARSENIC	0.196	2.6	0.32	0.032	3
	SSOD0091-02	BERYLLIUM	0.144	0.643	0.14	0.014	2,300
	SSOD0091-02	CHROMIUM	0.0771	12	30	3	1,800,000
	SSOD0091-02	LEAD	0.129	6.94	50	5	800
	SSOD0091-02	MANGANESE	0.0701	149	380	38	26,000
Sector 9/Quadrant 1	SSOD0091-03	ALUMINUM	0.673	10900	77000	7700	1,100,000
	SSOD0091-03	ARSENIC	0.304	7.4	0.32	0.032	3
	SSOD0091-03	BERYLLIUM	0.006	0.99	0.14	0.014	2,300
	SSOD0091-03	CHROMIUM	0.032	15.6	30	3	1,800,000
	SSOD0091-03	LEAD	0.705	60.7	50	5	800
	SSOD0091-03	MANGANESE	0.032	2600	380	38	26,000
Sector 9/Quadrant 2	SSOD0092-01	ALUMINUM	0.704	11300	77000	7700	1,100,000
	SSOD0092-01	ARSENIC	0.318	9.8	0.32	0.032	3
	SSOD0092-01	BERYLLIUM	0.006	1.4	0.14	0.014	2,300
	SSOD0092-01	CHROMIUM	0.034	21.1	30	3	1,800,000
	SSOD0092-01	LEAD	0.738	70.5	50	5	800
	SSOD0092-01	MANGANESE	0.034	2360	380	38	26,000
Sector 10/Quadrant 1	SSOD0101-01	ALUMINUM	0.755	10800	77000	7700	1,100,000
	SSOD0101-01	ARSENIC	0.341	7.4	0.32	0.032	3
	SSOD0101-01	BERYLLIUM	0.007	1	0.14	0.014	2,300
	SSOD0101-01	CHROMIUM	0.036	14.6	30	3	1,800,000
	SSOD0101-01	LEAD	0.791	65.2	50	5	800
	SSOD0101-01	MANGANESE	0.036	2400	380	38	26,000
Sector 10/Quadrant 2	SSOD0102-01	ALUMINUM	0.744	10800	77000	7700	1,100,000
	SSOD0102-01	ARSENIC	0.336	11.2	0.32	0.032	3
	SSOD0102-01	BERYLLIUM	0.007	1.5	0.14	0.014	2,300

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
	SSOD0102-01	CHROMIUM	0.036	35.9	30	3	1,800,000
	SSOD0102-01	LEAD	0.78	86.8	50	5	800
	SSOD0102-01	MANGANESE	0.036	2540	380	38	26,000
Sector 11/Quadrant 1	SSOD0111-01	ALUMINUM	0.717	10600	77000	7700	1,100,00
	SSOD0111-01	ARSENIC	0.324	8.9	0.32	0.032	3
	SSOD0111-01	BERYLLIUM	0.006	1.2	0.14	0.014	2,300
	SSOD0111-01	CHROMIUM	0.034	17.7	30	3	1,800,000
	SSOD0111-01	LEAD	0.752	86.7	50	5	800
	SSOD0111-01	MANGANESE	0.034	2720	380	38	26,000
Sector 11/Quadrant 2	SSOD0112-01	ALUMINUM	0.72	10100	77000	7700	1,100,000
	SSOD0112-01	ARSENIC	0.325	8.7	0.32	0.032	3
	SSOD0112-01	BERYLLIUM	0.007	1.2	0.14	0.014	2,300
	SSOD0112-01	CHROMIUM	0.034	19.4	30	3	1,800,000
	SSOD0112-01	LEAD	0.755	73.3	50	5	800
	SSOD0112-01	MANGANESE	0.034	2370	380	38	26,000
Sector 12/Quadrant 1	SSOD0121-01	ALUMINUM	0.753	11000	77000	7700	1,100,000
	SSOD0121-01	ARSENIC	0.34	10.5	0.32	0.032	3
	SSOD0121-01	BERYLLIUM	0.007	1.6	0.14	0.014	2,300
	SSOD0121-01	CHROMIUM	0.036	21.4	30	3	1,800,000
	SSOD0121-01	LEAD	0.789	84.3	50	5	800
	SSOD0121-01	MANGANESE	0.036	2670	380	38	26,000
Sector 12/Quadrant 2	SSOD0122-01	ALUMINUM	0.747	10700	77000	7700	1,100,000
	SSOD0122-01	ARSENIC	0.337	7.8	0.32	0.032	3
	SSOD0122-01	BERYLLIUM	0.007	1.2	0.14	0.014	2,300
	SSOD0122-01	CHROMIUM	0.036	17.8	30	3	1,800,000
	SSOD0122-01	LEAD	0.783	78.8	50	5	800
	SSOD0122-01	MANGANESE	0.036	2550	380	38	26,000
Sector 1	SBOD001-01/00	ALUMINUM	0.78	16600	77000	7700	1,100,000
	SBOD001-01/00	BERYLLIUM	0.007	1.2	0.14	0.014	2,300
	SBOD001-01/00	CHROMIUM	0.037	17.7	30	3	1,800,000
	SBOD001-01/00	LEAD	0.818	4.8	50	5	800

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
	SBOD001-01/00	MANGANESE	0.007	618	380	38	26,000
Sector 2	SBOD002-01/00	ALUMINUM	0.739	10600	77000	7700	1,100,000
	SBOD002-01/00	ARSENIC	0.334	6.5	0.32	0.032	3
	SBOD002-01/00	BERYLLIUM	0.007	1.2	0.14	0.014	2,300
	SBOD002-01/00	CHROMIUM	0.035	12.8	30	3	1,800,000
	SBOD002-01/00	LEAD	0.775	39.1	50	5	800
	SBOD002-01/00	MANGANESE	0.035	2700	380	38	26,000
Sector 3	SBOD003-01/00	ALUMINUM	0.72	11400	77000	7700	1,100,000
	SBOD003-01/00	ARSENIC	0.325	7.7	0.32	0.032	3
	SBOD003-01/00	BERYLLIUM	0.007	1.4	0.14	0.014	2,300
	SBOD003-01/00	CHROMIUM	0.034	16.6	30	3	1,800,000
	SBOD003-01/00	LEAD	0.754	40.7	50	5	800
	SBOD003-01/00	MANGANESE	0.034	4470	380	38	26,000
Split	SBOD003-02/00	ALUMINUM	4.23	10500	77000	7700	1,100,000
	SBOD003-02/00	ARSENIC	0.201	6.52	0.32	0.032	3
	SBOD003-02/00	BERYLLIUM	0.148	1.11	0.14	0.014	2,300
	SBOD003-02/00	CADMIUM	0.0262	4.46	38	3.8	980
	SBOD003-02/00	CHROMIUM	0.0791	14.6	30	3	1,800,000
	SBOD003-02/00	COPPER	0.0561	517	2800	280	47,000
	SBOD003-02/00	LEAD	0.133	53.4	50	5	800
	SBOD003-02/00	MANGANESE	0.072	2200	380	38	26,000
Duplicate	SBOD003-03/00	ALUMINUM	0.729	10100	77000	7700	1,100,000
	SBOD003-03/00	ARSENIC	0.329	8.2	0.32	0.032	3
	SBOD003-03/00	BERYLLIUM	0.007	1.4	0.14	0.014	2,300
	SBOD003-03/00	CHROMIUM	0.035	19.5	30	3	1,800,000
	SBOD003-03/00	LEAD	0.764	114	50	5	800
	SBOD003-03/00	MANGANESE	0.035	2630	380	38	26,000
Sector 4	SBOD004-01/00	ALUMINUM	0.739	12000	77000	7700	1,100,000
	SBOD004-01/00	ARSENIC	0.333	11.5	0.32	0.032	3
	SBOD004-01/00	BERYLLIUM	0.007	1.6	0.14	0.014	2,300
	SBOD004-01/00	CHROMIUM	0.035	18.5	30	3	1,800,000

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
	SBOD004-01/00	LEAD	0.774	51.3	50	5	800
	SBOD004-01/00	MANGANESE	0.035	3440	380	38	26,000
Sector 5	SBOD005-01/00	ALUMINUM	0.728	13800	77000	7700	1,100,000
	SBOD005-01/00	ARSENIC	0.329	7.00003	0.32	0.032	3
	SBOD005-01/00	BARIUM	0.007	901	5300	530	220,000
	SBOD005-01/00	BERYLLIUM	0.007	1.4	0.14	0.014	2,300
	SBOD005-01/00	CHROMIUM	0.035	15.6	30	3	1,800,000
	SBOD005-01/00	LEAD	0.763	46.4	50	5	800
	SBOD005-01/00	MANGANESE	0.035	2640	380	38	26,000
Sector 6	SBOD006-01/00	ALUMINUM	0.719	9680	77000	7700	1,100,000
	SBOD006-01/00	ARSENIC	0.324	8.9	0.32	0.032	3
	SBOD006-01/00	BERYLLIUM	0.007	0.99	0.14	0.014	2,300
	SBOD006-01/00	CADMIUM	0.116	12.8	38	3.8	980
Sector 6	SBOD006-01/00	CHROMIUM	0.034	16.7	30	3	1,800,000
	SBOD006-01/00	LEAD	0.754	83.2	50	5	800
	SBOD006-01/00	MANGANESE	0.034	2540	380	38	26,000
Sector 7	SBOD007-01/00	ALUMINUM	0.692	11500	77000	7700	1,100,000
	SBOD007-01/00	ARSENIC	0.312	10.9	0.32	0.032	3
	SBOD007-01/00	BERYLLIUM	0.006	1.5	0.14	0.014	2,300
	SBOD007-01/00	CHROMIUM	0.033	19.9	30	3	1,800,000
	SBOD007-01/00	LEAD	0.726	84.1	50	5	800
	SBOD007-01/00	MANGANESE	0.033	2720	380	38	26,000
Sector 8	SBOD008-01/00	ALUMINUM	0.715	10300	77000	7700	1,100,000
	SBOD008-01/00	ARSENIC	0.323	8.5	0.32	0.032	3
	SBOD008-01/00	BERYLLIUM	0.006	1.2	0.14	0.014	2,300
	SBOD008-01/00	CHROMIUM	0.034	18.7	30	3	1,800,000
	SBOD008-01/00	LEAD	0.749	67.8	50	5	800
	SBOD008-01/00	MANGANESE	0.034	2180	380	38	26,000
Split	SBOD008-02/00	ALUMINUM	4.19	13200	77000	7700	1,100,000
	SBOD008-02/00	ANTIMONY	3.3	0	31	3.1	470
	SBOD008-02/00	ARSENIC	0.199	7.53	0.32	0.032	3

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
	SBOD008-02/00	BERYLLIUM	0.146	1.04	0.14	0.014	2,300
	SBOD008-02/00	CADMIUM	0.259	4.16	38	3.8	980
	SBOD008-02/00	CHROMIUM	0.0784	16.2	30	3	1,800,000
	SBOD008-02/00	LEAD	0.132	67.7	50	5	800
	SBOD008-02/00	MANGANESE	0.0713	1880	380	38	26,000
Duplicate	SBOD008-03/00	ALUMINUM	0.696	11100	77000	7700	1,100,000
	SBOD008-03/00	ARSENIC	0.314	8.6	0.32	0.032	3
	SBOD008-03/00	BERYLLIUM	0.006	1.6	0.14	0.014	2,300
	SBOD008-03/00	CHROMIUM	0.033	23.8	30	3	1,800,000
	SBOD008-03/00	LEAD	0.73	77.5	50	5	800
	SBOD008-03/00	MANGANESE	0.033	3260	380	38	26,000
Sector 9	SBOD009-01/00	ALUMINUM	0.732	9610	77000	7700	1,100,000
	SBOD009-01/00	ARSENIC	0.33	3.7	0.32	0.032	3
	SBOD009-01/00	BERYLLIUM	0.007	0.98	0.14	0.014	2,300
	SBOD009-01/00	CHROMIUM	0.035	11.00003	30	3	1,800,000
	SBOD009-01/00	LEAD	0.767	36.7	50	5	800
	SBOD009-01/00	MANGANESE	0.035	2310	380	38	26,000
Sector 10	SBOD010-01/00	ALUMINUM	0.715	10900	77000	7700	1,100,000
	SBOD010-01/00	ARSENIC	0.323	7.8	0.32	0.032	3
	SBOD010-01/00	BERYLLIUM	0.006	1.5	0.14	0.014	2,300
	SBOD010-01/00	CHROMIUM	0.034	19.4	30	3	1,800,000
	SBOD010-01/00	LEAD	0.75	102	50	5	800
	SBOD010-01/00	MANGANESE	0.034	2650	380	38	26,000
Sector 11	SBOD011-01/00	ALUMINUM	0.73	11400	77000	7700	1,100,000
	SBOD011-01/00	ARSENIC	0.329	9.7	0.32	0.032	3
	SBOD011-01/00	BERYLLIUM	0.007	1.5	0.14	0.014	2,300
	SBOD011-01/00	CHROMIUM	0.035	18.7	30	3	1,800,000
	SBOD011-01/00	LEAD	0.765	64.8	50	5	800
	SBOD011-01/00	MANGANESE	0.035	3610	380	38	26,000
Drainage Channels							
East	SSDE-01	ALUMINUM	3.613	14200	77000	7700	1,100,000

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
	SSDE-01	ARSENIC	1.631	20.6	0.32	0.032	3
	SSDE-01	BERYLLIUM	0.035	4.6	0.14	0.014	2,300
	SSDE-01	CHROMIUM	0.174	67.6	30	3	1,800,000
	SSDE-01	LEAD	0.757	109	50	5	800
	SSDE-01	MANGANESE	0.035	4130	380	38	26,000
	SSDE-01	VANADIUM	0.291	90.2	540	54	5,800
Duplicate	SSDE-03	ALUMINUM	3.69	14000	77000	7700	1,100,000
	SSDE-03	ARSENIC	1.666	19.9	0.32	0.032	3
	SSDE-03	BERYLLIUM	0.035	4.5	0.14	0.014	2,300
	SSDE-03	CHROMIUM	0.178	48.5	30	3	1,800,000
	SSDE-03	LEAD	1.547	74.6	50	5	800
	SSDE-03	MANGANESE	0.035	4560	380	38	26,000
	SSDE-03	VANADIUM	0.297	89.9	540	54	5,800
West	SSDW-01	ALUMINUM	0.757	11500	77000	7700	1,100,000
	SSDW-01	ARSENIC	0.342	10.4	0.32	0.032	3
	SSDW-01	BERYLLIUM	0.007	1.5	0.14	0.014	2,300
	SSDW-01	CHROMIUM	0.036	22.2	30	3	1,800,000
	SSDW-01	LEAD	0.794	73.2	50	5	800
	SSDW-01	MANGANESE	0.036	2970	380	38	26,000
Pond							
Pond	SW001	MANGANESE	0.1	29.3	180	18	26,000
Background Location							
Surface Soils							
Location 1	SSBG001-01	BERYLLIUM	0.006	0.6	0.14	0.014	2,300
	SSBG001-01	CHROMIUM	0.032	7.8	30	3	1,800,000
	SSBG001-01	LEAD	0.141	21.5	50	5	800
	SSBG001-01	MANGANESE	0.006	407	380	38	26,000
Location 2	SSBG002-01	ALUMINUM	4.397	11900	77000	7700	1,100,000
	SSBG002-01	ARSENIC	1.985	6.3	0.32	0.032	3
	SSBG002-01	BERYLLIUM	0.042	2	0.14	0.014	2,300
	SSBG002-01	CHROMIUM	0.212	20	30	3	1,800,000

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
	SSBG002-01	LEAD	0.922	29.3	50	5	800
	SSBG002-01	MANGANESE	0.042	1090	380	38	26,000
Location 3	SSBG003-01	ALUMINUM	0.881	13400	77000	7700	1,100,000
	SSBG003-01	ARSENIC	0.398	2.3	0.32	0.032	3
	SSBG003-01	BERYLLIUM	0.008	1	0.14	0.014	2,300
	SSBG003-01	CHROMIUM	0.042	13	30	3	1,800,000
	SSBG003-01	LEAD	0.184	27.7	50	5	800
	SSBG003-01	MANGANESE	0.008	911	380	38	26,000
Location 4	SSBG004-01	ALUMINUM	0.915	12500	77000	7700	1,100,000
	SSBG004-01	ARSENIC	0.413	4.3	0.32	0.032	3
	SSBG004-01	BERYLLIUM	0.008	1	0.14	0.014	2,300
	SSBG004-01	CHROMIUM	0.044	17.3	30	3	1,800,000
	SSBG004-01	LEAD	0.96	33.3	50	5	800
	SSBG004-01	MANGANESE	0.008	1010	380	38	26,000
Split	SSBG004-02	ALUMINUM	4.69	15600	77000	7700	1,100,000
	SSBG004-02	ANTIMONY	3.69	0	31	3.1	470
	SSBG004-02	ARSENIC	0.223	5.22	0.32	0.032	3
Split	SSBG004-02	BERYLLIUM	0.164	0.996	0.14	0.014	2,300
	SSBG004-02	CHROMIUM	0.0878	20.4	30	3	1,800,000
	SSBG004-02	LEAD	0.147	29.2	50	5	800
	SSBG004-02	MANGANESE	0.0798	993	380	38	26,000
Duplicate	SSBG004-03	ALUMINUM	0.863	11600	77000	7700	1,100,000
	SSBG004-03	ARSENIC	0.39	4.7	0.32	0.032	3
	SSBG004-03	BERYLLIUM	0.008	0.97	0.14	0.014	2,300
	SSBG004-03	CHROMIUM	0.041	17	30	3	1,800,000
	SSBG004-03	LEAD	0.905	32.7	50	5	800
	SSBG004-03	MANGANESE	0.008	938	380	38	26,000
Subsurface Soils							
Boring 1	SBBG001-01/00-03	ALUMINUM	0.705	11100	77000	7700	1,100,000
	SBBG001-01/00-03	BERYLLIUM	0.006	0.77	0.14	0.014	2,300
	SBBG001-01/00-03	CHROMIUM	0.034	11.00003	30	3	1,800,000

Metals Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2,3]
	SBBG001-01/00-03	LEAD	0.739	4.7	50	5	800
	SBBG001-01/00-03	MANGANESE	0.006	673	380	36	26,000
Boring 2	SBBG002-01/00-05	ALUMINUM	3.66	13500	77000	7700	1,100,000
	SBBG002-01/00-05	BERYLLIUM	0.035	2.1	0.14	0.014	2,300
	SBBG002-01/00-05	CHROMIUM	0.177	29.7	30	3	1,800,000
	SBBG002-01/00-05	LEAD	0.767	18.8	50	5	800
	SBBG002-01/00-05	MANGANESE	0.055	1310	380	38	26,000
QA/QC							
No Hits							

[1] Soil screening levels used at the time and presented as soil screening levels (SSLs) were those published in the Human Health Generic Screening Levels (HHGSL) Table (401 KAR 100:050, Risk Assessment Guidance, 11 October 1995) or the US Environmental Protection Agency (EPA) Region IX Preliminary Remediation Goals (PRGs) screening values (1 August 1996) where no HHGSL was published.

[2] Current EPA Industrial RSL as of June 11, 2017 provided for comparison to past results. Exceedances of the maximum concentration is highlighted in bold.

[3] Total Chromium was measured. The Industrial RSL for trivalent chromium is presented for comparison.

SVOC Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2]
OB Area							
Surface Soils							
Pan 1 at 1 ft	SSOB0011-01	2,4-DINITROTOLUENE	34000	330000	130000	13000	7.4
	SSOB0011-01	2,6-DINITROLOUENE	34000	12000(J)	65000	6500	1.5
Pan 1 at 5 ft	SSOB0012-01	2,4-DINITROTOLUENE	17000	71000	130000	13000	7.4
	SSOB0021-01	2,4-DINITROTOLUENE	11	20	130	13	7.4
	SSOB0021-01	2,6-DINITROLOUENE	11	6.3	65	6.5	1.5
Subsurface Soils							
Boring 1 at 0-5 ft	SBOB001-01/00-05	N-Nitrosodi-N-Propylamine	400	380(J)	63	6.3	0.33
OD Area							
Surface Soils							
Sector 1/Quad 3	SSOD0013-01	BENZO[B]FLUORANTHENE	400	170(J)	610	61	1.89
	SSOD0013-01	BENZO[A]PYRENE	400	110(J)	61	6.1	0.29
	SSOD0013-01	BENZO[A]ANTHRACENE	400	100(J)	610	61	2.9
Sector 1/Quadrant 4/Split	SSOD0014-02	BENZ[A]ANTHRACENE	8.94	179	610	6.1	2.9
	SSOD0014-02	BENZO[A]PYRENE	11	215	61	6.1	0.29
	SSOD0014-02	BENZO[B]FLUORANTHENE	10	295	610	6.1	1.89
	SSOD0014-02	DIBENZ[A,H]ANTHRACENE	10	31.3	61	6.1	0.29
	SSOD0014-02	INDENO[1,2,3-CD]PYRENE	13.4	103	610	61	2.9
Duplicate	SSOD0014-03	BENZO[A]ANTHRACENE	400	96(J)	610	6.1	2.9
	SSOD0014-03	BENZO[A]PYRENE	400	140(J)	61	6.1	0.29
	SSOD0014-03	BENZO[B]FLUORANTHENE	400	230(J)	610	61	1.89
Sector 2/Quadrant 3	SSOD0023-01	BENZO[B]FLUORANTHENE	390	150(J)	610	61	1.89
	SSOD0023-01	BENZO[A]PYRENE	390	100(J)	61	6.1	0.29
Sector 3/Quadrant 4	SSOD0034-01	BENZO[B]FLUORANTHENE	390	110(J)	610	61	1.89
	SSOD0034-01	BENZO[A]ANTHRACENE	390	90(J)	610	61	2.9
	SSOD0034-01	BENZO[A]PYRENE	390	81(J)	61	6.1	0.29
Split	SSOD0034-02	BENZ[A]ANTHRACENE	8.7	163	610	6.1	2.9
	SSOD0034-02	BENZO[A]PYRENE	10.7	200	61	6.1	0.29
	SSOD0034-02	BENZO[B]FLUORANTHENE	9.77	239	610	6.1	1.89
	SSOD0034-02	DIBENZ[A,H]ANTHRACENE	9.81	30.3	61	6.1	0.29

SVOC Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2]
	SSOD0034-02	INDENO[1,2,3-CD]PYRENE	3.1	91.8	610	61	2.9
Sector 5/Quadrant 1	SSOD0051-01	BENZO[B]FLUORANTHENE	400	210(J)	610	61	1.89
	SSOD0051-01	BENZO[A]PYRENE	400	120(J)	61	6.1	0.29
	SSOD0051-01	BENZO[A]ANTHRACENE	400	100(J)	610	61	2.9
Sector 5/Quadrant 2	SSOD0053-01	BENZO[B]FLUORANTHENE	390	550(J)	610	61	1.89
	SSOD0053-01	BENZO[A]ANTHRACENE	390	360(J)	610	61	2.9
	SSOD0053-01	BENZO[A]PYRENE	390	340(J)	61	6.1	0.29
	SSOD0053-01	INDENO[1,2,3-C,D]PYRENE	390	200(J)	610	61	2.9
Split	SSOD0053-02	BENZ[A]ANTHRACENE	42.7	61.5	610	61	2.9
Sector 5/Quadrant 3	SSOD0055-01	BENZO[B]FLUORANTHENE	390	210(J)	610	61	1.89
	SSOD0055-01	BENZO[A]PYRENE	390	120(J)	61	6.1	0.29
	SSOD0055-01	BENZO[A]ANTHRACENE	390	110(J)	610	61	2.9
	SSOD0056-01	BENZO[B]FLUORANTHENE	380	270(J)	610	61	1.89
	SSOD0056-01	BENZO[A]PYRENE	380	160(J)	61	6.1	0.29
	SSOD0056-01	BENZO[A]ANTHRACENE	380	140(J)	610	61	2.9
	SSOD0056-01	INDENO[1,2,3-C,D]PYRENE	380	94(J)	610	61	2.9
Sector 5/Quadrant 4	SSOD0058-01	BENZO[B]FLUORANTHENE	360	150(J)	610	61	1.89
	SSOD0058-01	BENZO[A]PYRENE	360	99(J)	61	6.1	0.29
	SSOD0058-01	BENZO[A]ANTHRACENE	360	78(J)	610	61	2.9
Sector 6/Quadrant 1	SSOD0061-01	BENZO[B]FLUORANTHENE	390	140(J)	610	61	1.89
	SSOD0061-01	BENZO[A]PYRENE	390	85(J)	61	6.1	0.29
Sector 6/Quadrant 1	SSOD0062-01	BENZO[B]FLUORANTHENE	390	240(J)	610	61	1.89
	SSOD0062-01	BENZO[A]PYRENE	390	150(J)	61	6.1	0.29
	SSOD0062-01	INDENO[1,2,3-C,D]PYRENE	390	100(J)	610	61	2.9
Sector 6/Quadrant 2	SSOD0063-01	BENZO[B]FLUORANTHENE	390	46(J)	610	61	1.89
	SSOD0064-01	BENZO[B]FLUORANTHENE	370	74(J)	610	61	1.89
	SSOD0064-01	BENZO[A]PYRENE	370	52(J)	61	6.1	0.29
	SSOD0064-01	BENZO[A]ANTHRACENE	370	46(J)	610	61	2.9
Sector 6/Quadrant 4	SSOD0067-01	BENZO[B]FLUORANTHENE	760	1800	610	61	1.89
	SSOD0067-01	BENZO[A]PYRENE	760	970	61	6.1	0.29
	SSOD0067-01	BENZO[A]ANTHRACENE	760	840	610	61	2.9

SVOC Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2]
	SSOD0067-01	INDENO[1,2,3-C,D]PYRENE	760	550(J)	610	61	
Sector 7/Quadrant 1	SSOD0071-01	BENZO[B]FLUORANTHENE	380	110(J)	610	61	1.89
	SSOD0071-01	BENZO[A]PYRENE	380	88(J)	61	6.1	0.29
	SSOD0071-01	BENZO[A]ANTHRACENE	380	82(J)	610	61	2.9
	SSOD0072-01	BENZO[B]FLUORANTHENE	400	110(J)	610	61	1.89
	SSOD0072-01	BENZO[A]PYRENE	400	89(J)	61	6.1	0.29
	SSOD0072-01	BENZO[A]ANTHRACENE	400	84(J)	610	61	2.9
Split	SSOD0072-02	BENZO[A]ANTHRACENE	8.68	189	610	61	2.9
	SSOD0072-02	BENZ[A]PYRENE	10.7	235	61	6.1	0.29
	SSOD0072-02	BENZO[B]FLUORANTHENE	9.74	301	610	61	1.89
	SSOD0072-02	DIBENZ[A,H]ANTHRACENE	9.78	358	61	6.1	0.29
	SSOD0072-02	INDENO[1,2,3-CD]PYRENE	13	109	610	61	2.9
	SSOD0072-02	PENTACHLOROPHENOL	299	927	2500	250	4.0
Duplicate	SSOD0072-03	BENZO[B]FLUORANTHENE	390	94(J)	610	61	1.89
	SSOD0072-03	BENZO[B]FLUORANTHENE	390	47(J)	610	61	1.89
	SSOD0072-03	BENZO[A]PYRENE	390	41(J)	61	6.1	0.29
	SSOD0072-03	BENZO[A]ANTHRACENE	390	40(J)	610	61	2.9
Sector 7/Quadrant 2	SSOD0073-01	BENZO[B]FLUORANTHENE	370	85(J)	610	61	1.89
	SSOD0074-01	PENTACHLOROPHENOL	1900	95(J)	2500	250	4.0
	SSOD0074-01	BENZO[B]FLUORANTHENE	370	77(J)	610	61	1.89
	SSOD0074-01	BENZO[A]PYRENE	370	71(J)	61	6.1	0.29
	SSOD0074-01	BENZO[A]ANTHRACENE	370	60(J)	610	61	2.9
Sector 7/Quadrant 3	SSOD0076-01	BENZO[B]FLUORANTHENE	380	100(J)	610	61	1.89
	SSOD0076-01	BENZO[A]PYRENE	380	89(J)	61	6.1	0.29
	SSOD0076-01	BENZO[A]ANTHRACENE	380	83(J)	610	61	2.9
Sector 7/Quadrant 4	SSOD0077-01	BENZO[B]FLUORANTHENE	370	76(J)	610	61	1.89
	SSOD0077-01	BENZO[A]PYRENE	370	71(J)	61	6.1	0.29
	SSOD0077-01	BENZO[A]ANTHRACENE	370	67(J)	610	61	2.9
Sector 8/Quadrant 1	SSOD0081-01	BENZO[B]FLUORANTHENE	390	97(J)	610	61	1.89
	SSOD0081-01	PENTACHLOROPHENOL	1900	94(J)	2500	250	4.0
	SSOD0081-01	BENZO[A]PYRENE	390	89(J)	61	6.1	0.29

SVOC Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2]
	SSOD0082-01	BENZO[B]FLUORANTHENE	380	110(J)	610	61	1.89
	SSOD0082-01	PENTACHLOROPHENOL	1900	92(J)	2500	250	4.0
	SSOD0082-01	BENZO[A]PYRENE	380	91(J)	61	6.1	0.29
	SSOD0082-01	BENZO[A]ANTHRACENE	380	81(J)	610	61	2.9
Sector 8/Quadrant 3	SSOD0085-01	BENZO[B]FLUORANTHENE	380	120(J)	610	61	1.89
	SSOD0085-01	BENZO[A]ANTHRACENE	380	97(J)	610	61	2.9
	SSOD0086-01	BENZO[B]FLUORANTHENE	380	350(J)	610	61	1.89
	SSOD0086-01	BENZO[A]ANTHRACENE	380	210(J)	610	61	2.9
	SSOD0086-01	BENZO[A]PYRENE	380	210(J)	61	6.1	0.29
	SSOD0086-01	INDENO[1,2,3-C,D]PYRENE	380	100(J)	610	61	2.9
Sector 8/Quadrant 4	SSOD0087-01	BENZO[A]ANTHRACENE	390	78(J)	610	61	2.9
Sector 9/Quadrant 1/Split	SSOD0091-02	BENZ[A]ANTHRACENE	43	186	610	61	2.9
	SSOD0091-02	BENZO[A]PYRENE	53	223	61	6.1	0.29
	SSOD0091-02	BENZO[B]FLUORANTHENE	483	351	610	61	1.89
	SSOD0091-02	INDENO[1,2,3-CD]PYRENE	646	143	610	61	2.9
Duplicate	SSOD0091-03	BENZO[B]FLUORANTHENE	360	200(J)	610	61	1.89
	SSOD0091-03	BENZO[A]ANTHRACENE	360	110(J)	610	61	2.9
	SSOD0091-03	BENZO[A]PYRENE	360	110(J)	61	6.1	0.29
Sector 10/Quadrant 2	SSOD0102-01	BENZO[A]ANTHRACENE	220(J)	400	610	61	2.9
	SSOD0102-01	BENZO[A]PYRENE	210(J)	400	61	6.1	0.29
	SSOD0102-01	BENZO[B]FLUORANTHENE	280(J)	400	610	61	1.89
Subsurface Soils							
Boring Sector 7	SBOD007-01/00	BENZO[B]FLUORANTHENE	370	120(J)	610	61	1.89
	SBOD007-01/00	BENZO[A]PYRENE	370	100(J)	61	6.1	0.29
	SBOD007-01/00	BENZO[A]ANTHRACENE	370	90(J)	610	61	2.9
Boring Sector 8/Split	SBOD008-02/00	BENZ[A]ANTHRACENE	8.43	131	610	61	2.9
	SBOD008-02/00	BENZO[A]PYRENE	10.4	163	61	6.6	0.29
	SBOD008-02/00	BENZO[B]FLUORANTHENE	9.46	170	610	61	1.89
	SBOD008-02/00	INDENO[1,2,3-CD]PYRENE	12.6	77.7	610	61	2.9
Duplicate	SBOD008-03/00	BENZO[A]ANTHRACENE	370	78(J)	610	61	2.9

SVOC Analyses

Sample Location	Sample ID	Analyte	DL (mg/kg)	Result (mg/kg)	SSL[1] (mg/kg)	1/10 SSL (mg/kg)	Industrial RSL (mg/kg)[2]
Drainage Channels							
East	SSDE-01	BENZO[A]PYRENE	390	82(J)	61	6.1	0.29
	SSDE-01	BENZO[B]FLUORANTHENE	390	150(J)	610	61	1.89
Split	SSDE-02	BENZO[A]PYRENE	10.5	36.6	61	6.1	0.29
West	SSDW-01	BENZO[B]FLUORANTHENE	410	99(J)	610	61	1.89
Pond							
No Hits							
Background Location							
Surface Soils							
Location 1	SSBG001-01	Bis(2-ethylhexyl) phthalate	360	730	3200	320	160
	SBBG002-01/00-05	BENZO[B]FLUORANTHENE	390	120	610	61	1.89
Subsurface Soils							
No Hits							
QA/QC							
No Hits							

Soil screening levels used at the time and presented as soil screening levels (SSLs) were those published in the Human Health Generic Screening Levels (HHGSL) Table (401 KAR 100:050, Risk Assessment Guidance, 11 October 1995) or the U.S. Environmental Protection Agency (EPA) Region IX Preliminary Remediation Goals (PRGs) screening values (1 August 1996) where no HHGSL was published.

[2] Current EPA Industrial RSL as of June 11, 2017 provided for comparison to past results. Exceedances of the maximum concentration is highlighted in bold.

1999 Sediment and Surface Water Sampling Results

Surface Water and Sediment Sampling Results 1999
Explosives Analyses (SW 8330) Results

Sample Identification[1]	Sample Location	Surface Water (µg/L)									
		2-Amino-4,6-dinitrotoluene	4-Amino-2,6-dinitrotoluene	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	Hexahydro-1,3,5-trinitro-1,3,5-triazine	1,3,5-Trinitrobenzene	2,4,6-Trinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene	Methyl-2,4,6-trinitrophenyl nitramine	2-Nitrotoluene
SWMC01	Muddy Creek 1	<DL	<DL	0.95 J	0.97 J	0.13 J	<DL	<DL	0.10 J	<DL	0.34 J
SWMC02	Muddy Creek 2	0.11 J	0.23 J	1.1	0.90 J	<DL	<DL	<DL	<DL	<DL	<DL
SWMC03	Muddy Creek 3	<DL	<DL	<DL	3.4	<DL	<DL	<DL	<DL	<DL	<DL
SWMC03-02	Muddy Creek 3 – duplicate	<DL	<DL	1.1	4.3	<DL	<DL	<DL	<DL	<DL	<DL
SWST01	Southern Tributary 1	0.22 J	0.42 J	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
SWST02	Southern Tributary 2	<DL	0.27 J	2.2	4.3	<DL	<DL	<DL	<DL	<DL	<DL
SWWDCSEEP	Western Drainage Channel Seep	1.3	1.6	5.8	14	<DL	<DL	<DL	<DL	.25J	<DL
SWNTSEEP	Northern Tributary Seep (Sampled 8 May 2000)	<DL	<DL	11.0	2.0	<DL	<DL	<DL	<DL	<DL	<DL
SDMC01	Muddy Creek 1	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
SDMC02	Muddy Creek 2	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
SDMC03	Muddy Creek 3	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
SDMC03-02	Muddy Creek 3 – duplicate	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
SDSTO1	Southern Tributary 1	<DL	<DL	<DL	<DL	<DL	880	9600	<DL	<DL	<DL
SDST01-02	Southern Tributary 1 (Resampled 7 Feb 2000)	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
SDST02	Southern Tributary 2		<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL

[1] Figure E3-1 located at the end of this section shows the historic sampling locations.

B = Analyte detected in method blank at concentration greater than the reporting limit (and greater than 0).

F = Interference or coelution suspected.

J = The presence of a compound that meets the identification criteria, but the result is less than the sample reporting limit and greater than the method detection limit.

SVOCs (8270) Analyses Results

Sample Identification[1]	Sample Location	Surface Water		
		Compound	Result (µg/L)	
Surface Water				
SWMC01	Surface Water Muddy Creek 1	bis(2-Ethylhexyl)phthalate	2.82	B
SWMC02	Surface Water Muddy Creek 2	bis(2-Ethylhexyl)phthalate	12.8	B
SWMC03	Surface Water Muddy Creek 2	No SVOCs detected		
SWMC03-02	Surface Water Muddy Creek 3 - duplicate	No SVOCs detected		
SWST01	Surface Water Southern Tributary 1	bis(2-Ethylhexyl)phthalate	<DL	B
		Di-n-octylphthalate	2.82	
SWST02	Surface Water Southern Tributary 2	bis(2-Ethylhexyl)phthalate	<DL	B
SWWDCSEEP	Surface Water Western Drainage Channel Seep	bis(2-Ethylhexyl)phthalate	<DL	B
SWNTSEEP	Surface Water Northern Tributary Seep (Sampled 8 May 2000)	No SVOCs detected		
Sediment				
		Compound	**Result (mg/kg)**	
SDMC01	Sediment Muddy Creek 1	No SVOCs detected		
SDMC02	Sediment Muddy Creek 2	Pyrene	0.362	
SDMC03	Sediment Muddy Creek 3	No SVOCs detected		
SDMC03-02	Sediment Muddy Creek 3 - duplicate	No SVOCs detected		
SDSTO1	Sediment Southern Tributary 1	Diphenylamine	0.0685	F
SDST02	Sediment Southern Tributary 2	Pyrene	0.532	

[1] Figure E3-1 located at the end of this section shows the historic sampling locations.

B = Analyte detected in method blank at concentration greater than the reporting limit (and greater than 0).

F = Interference or coelution suspected.

J = The presence of a compound that meets the identification criteria, but the result is less than the sample reporting limit and greater than the method detection limit.

Metals (6010/7470) Analyses Results

Sample Identification[1]	Sample Location	Surface Water (mg/L)									
		Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper
SWMC01	Muddy Creek 1	0.286 B	<DL B	<DL B	0.0602 B	<DL	<DL	48.9 B	0.00057 B	<DL B	0.0032
SWMC02	Muddy Creek 2	0.219 B	0.0028 B	<DL B	0.113 B	<DL	<DL	47.3 B	0.00052 B	0.001 B	0.00653
SWMC03	Muddy Creek 3	0.194 B	<DL B	0.0018 B	0.0615 B	<DL	<DL	44 B	<DL B	0.0008 B	0.00657
SWMC03-02	Muddy Creek 3 - duplicate	0.169 B	<DL B	0.0013 B	0.615 B	<DL	<DL	44.8 B	0.00043 B	0.00084 B	0.00665
SWST01	Southern Tributary 1	0.142 B	0.00431 B	<DL B	0.084 B	<DL	<DL	67.5 B	<DL B	0.00052 B	0.00655
SWST02	Southern Tributary 2	4 B	<DL B	0.00243 B	0.194 B	0.00033	0.00128	47.5 B	0.00388 B	0.00399 B	0.0413
SWWDCSEEP	Western Drainage Channel Seep	0.125 B	<DL B	<DL B	0.191 B	<DL	0.00051	95.5 B	0.00043 B	0.00386 B	0.00399
SWNTSEEP	Northern Tributary Seep (Sampled 8 May 2000)	<DL	<DL	<DL	<DL	<DL	<DL	39	<DL	<DL	<DL
Sample Identification	Sample Location	Sediment (mg/L)									
		Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper
SDMC01	Muddy Creek 1	12200 B	1.99	90.5	329	3.73	0.52	4100	55.7	52.2	48
SDMC01-02 (Sampled 7 Feb 2000)	Muddy Creek 1 - Resample	18000	<DL	57	310	3	<DL	8700	72	47	63
SDMC02	Muddy Creek 2	16600 B	0.742	7.28	149	0.917	3.02	9180	15.3	11.6	90.1
SDMC03	Muddy Creek 3	16300 B	0.62	15.6	140	1.73	1.71	19300	27.2	15.6	55.9
SDMC03-02	Muddy Creek 3 - duplicate	12800 B	0.937	21.5	498	1.45	1.41	9950	20.1	28	62.9
SDSTO1	Southern Tributary 1	13700 B	2.79	16.5	517	1.6	0.561	12900	32.4	29.1	53.7
SDST02	Southern Tributary 2	18400 B	<DL	5.81	239	0.929	3.43	22800	16.5	12.3	97.3

[1] Figure E3-1 located at the end of this section shows the historic sampling locations.

B = Analyte detected in method blank at concentration greater than the reporting limit (and greater than 0).

F = Interference or coelution suspected.

J = The presence of a compound that meets the identification criteria, but the result is less than the sample reporting limit and greater than the method detection limit.

Metals (6010/7470) Analyses Results (Continued)

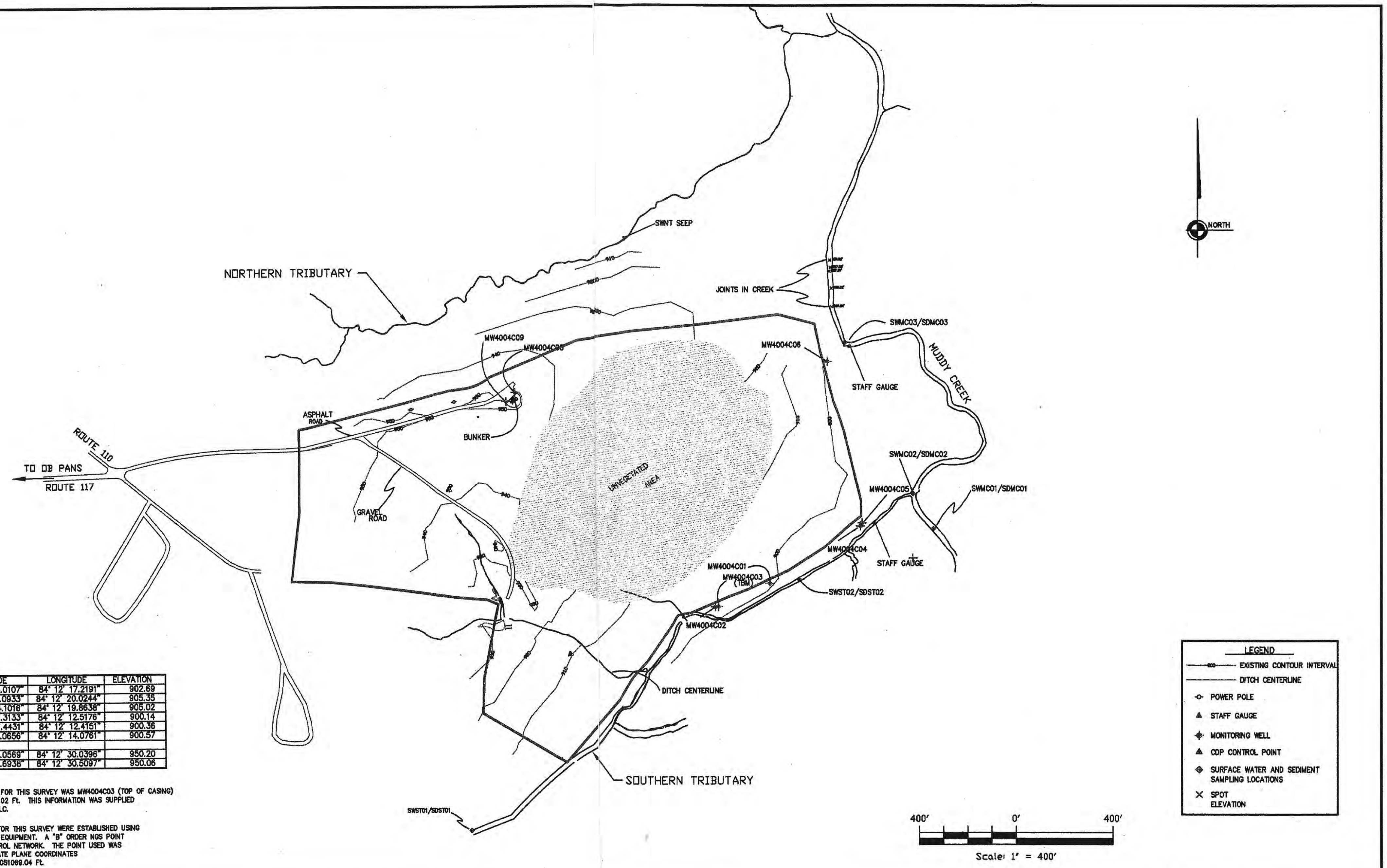
Sample Identification[1]	Sample Location	Surface Water (mg/L)												
		Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
SWMC01	Muddy Creek 1	0.399 B	<DL	23 B	0.138	ND	0.00161	4.75 B	<DL	ND	4.01	ND	0.00094	0.015
SWMC02	Muddy Creek 2	0.246 B	0.00339	22.8 B	0.294	ND	0.00199	4.59 B	ND	<DL	3.83	ND	0.00077	0.0258
SWMC03	Muddy Creek 3	0.166 B	0.00458	20.1 B	0.111	ND	0.00114	4.4 B	ND	<DL	3.32	ND	0.0006	0.025
SWMC03-02	Muddy Creek 3 - duplicate	0.107 B	0.00334	20.5 B	0.109	ND	0.00164	4.46 B	ND	<DL	3.27	<DL	0.00063	0.0245
SWST01	Southern Tributary 1	0.102 B	0.00604	31.4 B	0.139	<DL	0.00083	1.47 B	ND	ND	2.09	<DL	0.00074	0.00646
SWST02	Southern Tributary 2	8.26 B	0.0256	30.4 B	0.544	0.00015	0.00466	3.96 B	ND	<DL	3.19	ND	0.00669	0.211
SWWDCSEEP	Western Drainage Channel Seep	0.0339 B	0.00208	56.9 B	0.226	<DL	0.00175	6.06 B	ND	<DL	7.92	<DL	0.00107	0.0215
SWNTSEEP	Northern Tributary Seep (Sampled 8 May 00)	0.13	<DL	16	<DL	<DL	<DL	<DL	<DL	<DL	1.4	<DL	<DL	<DL
Sample Identification	**Sample Location**	**Sediment (mg/L)**												
		Iron	**Lead**	**Magnesium**	**Manganese**	**Mercury**	**Nickel**	**Potassium**	**Selenium**	**Silver**	**Sodium**	**Thallium**	**Vanadium**	**Zinc**
SDMC01	Muddy Creek 1	218000	62.6	1810 B	6720	0.00783	59.6	617	ND	0.203	44.3	1.29	134	184
SDMC01-02 (Sampled 7 Feb 00)	Muddy Creek 1 - Resample	190000	69	3300	6300	0.17	45	870	2.8	<DL	71	4.1	98	210
SDMC02	Muddy Creek 2	31100	62.9	5260 B	1360	0.306	16.4	3040	0.708 B	0.244	113	0.644	26.9	507
SDMC03	Muddy Creek 3	56700	50.9	7270 B	1910	0.156	21.2	2200	0.633 B	0.179	78.7	0.783	46.9	281
SDMC03-02	Muddy Creek 3 - duplicate	62400	52.8	4700 B	5840	0.145	19.1	1620	2.19 B	0.265	64	<DL	41.9	215
SDSTO1	Southern Tributary 1	60000	364	6230 B	6140	0.034	18.3	1690	1.69 B	0.194	67.4	ND	46.7	129
SDST02	Southern Tributary 2	30300	71.1	11200 B	2080	0.572	15.2	3460	<DL B	<DL	160	ND	26.4	533

[1] Figure E3-1 located at the end of this section shows the historic sampling locations.

B = Analyte detected in method blank at concentration greater than the Reporting Limit (and greater than 0).

F = Interference or coelution suspected.

J = The presence of a compound that meets the identification criteria, but the result is less than the sample Reporting Limit and greater than the Method Detection Limit.



DESCRIPTION	LATITUDE	LONGITUDE	ELEVATION
MW4004C01	37° 39' 55.0107"	84° 12' 17.2191"	902.69
MW4004C02	37° 39' 54.0933"	84° 12' 20.0244"	905.35
MW4004C03	37° 39' 54.1016"	84° 12' 19.8638"	905.02
MW4004C04	37° 39' 57.3133"	84° 12' 12.5176"	900.14
MW4004C05	37° 39' 57.4431"	84° 12' 12.4151"	900.36
MW4004C06	37° 40' 04.0656"	84° 12' 14.0761"	900.57
MW4004C08	37° 40' 03.0569"	84° 12' 30.0396"	950.20
MW4004C09	37° 40' 02.6938"	84° 12' 30.5097"	950.06

NOTE:
THE ELEVATION DATUM USED FOR THIS SURVEY WAS MW4004C03 (TOP OF CASING) USING AN ELEVATION OF 905.02 Ft. THIS INFORMATION WAS SUPPLIED BY RADIAN INTERNATIONAL, LLC.

NOTE:
STATE PLANE COORDINATES FOR THIS SURVEY WERE ESTABLISHED USING GLOBAL POSITIONING SYSTEM EQUIPMENT. A "B" ORDER NGS POINT WAS USED IN THE GPS CONTROL NETWORK. THE POINT USED WAS "RICHPORT"- WHICH HAS STATE PLANE COORDINATES OF (N) 2115324.16 Ft., (E) 2051069.04 Ft.

RADIAN INTERNATIONAL
A DAMES & MOORE GROUP COMPANY

Figure 1. Groundwater, Surface Water, Seep, and Sediment Sampling Locations for the OD Area, Blue Grass Army Depot, Kentucky

REV. 0

DATE: 03-Sep-99

DRAWN BY: G. BIRD

CHECKED BY: C. Wesh

N:\655784\05\Memo FIG1.dwg

PART F. PROCEDURES TO PREVENT HAZARDS [401 KAR 38:090 Section 2(4), (5), (6), (8) and (9); 34:250, Section 8; 34:020, Section 6 and Section 8; 40 CFR 270.14(b)(4), (5), (6), (8) and (9); 264.602; 264.15 & 264:17]

F-1 Security [401 KAR 34:020 Section 5 & 40 CFR 264.14]

Overall security of the BGAD installation is the responsibility of the on-site security force. BGAD is a secure military installation, surrounded by security fencing and requires entry through manned entry points. Access to the thermal treatment units is posted and restricted by physical means.

F-1a Waiver [401 KAR 38:090, Section 2(4) & 40 CFR 270.14(b)(4)]

BGAD has installed the proper equipment and implemented procedures to prevent unknown entry and the possibility for unauthorized entry of persons or livestock. BGAD is not requesting a security procedures and equipment waiver; therefore, the requirements of 401 KAR 34:020 Section 5(1)(a) and (1)(b) do not apply.

F-1b Security Procedures and Equipment [401 KAR 38:090, Section 2(4), 34:020 Section 5; 40 CFR 270.14(b)(4) & 264.14]

F-1b(1) 24-Hour Surveillance System

The OB and OD/BD units are located in the restricted area, which is separated from the administrative area and the public by two 6-ft chain link fences and security check points.

BGAD guards patrol all areas of the facility 24 hours per day. A secondary truck entrance has a security guard posted during normal duty hours providing an entry checkpoint. During non-duty hours the secondary truck entrance is locked and patrolled. Specific entry procedures for the storage areas are addressed in subsequent sections. All guards have direct communications with the main facility security force.

All entrants to the restricted area must obtain a clearance to enter the restricted area or must be escorted by an individual with clearance authorization, at all times while in the area. All personnel entering the secured area must carry at least one fire extinguisher per vehicle. At the security check points, all sources of ignition (i.e., lighters, matches) are relinquished to the security guards at the entrance gates. To leave the restricted area, individuals must check out through a security checkpoint. In addition to the security at the checkpoint, the restricted area is patrolled on a regular 24-hours a day basis.

F-1b(2) Barrier and Means to Control Entry

F-1b(2)(a) Barrier
The perimeter of BGAD is fully enclosed by 6-ft. high chain link security fencing. Guards visually inspect the integrity of fencing and gates daily. Additional fencing encloses all restricted access areas on the installation. The OB and OD/BD treatment units are located within the restricted area, accessed through gate R-1. Besides the main gate and the truck entrance, there are no other entrances to the restricted area. The Demo Grounds, which encompasses the conventional munitions treatment operations (OB, OD/BD, and CD units) is enclosed within a third fenced and controlled area, accessed through gate R-3.

F-1b(2)(b) Means to Control Entry
In addition to the main gate and/or truck entry check-in points, secure points of entry restrict access to the treatment units. Visitors and BGAD employees must be in possession of a security badge obtained prior to entering and departing the restricted area. Prior to entering the Demo Grounds, personnel and visitors must also pass through gate R-3 (at Building 270), which is unlocked only during duty hours. All personnel entering the restricted area must carry at least one fire extinguisher per vehicle, and no one is authorized entry without a valid badge. All sources of ignition (e.g., lighters and matches) are relinquished to security guards at the R-1 gate.

F-1c Warning Signs [401 KAR 34:020 Section 5 & 40 CFR 264.14(c)]

Warning signs, legible from a distance of 25 ft, are posted at the access gates to the restricted area. These signs state “Warning – Restricted Area” and “Danger Explosives – ID Badges Required Beyond this Point.” “No Smoking” signs and additional warning signs are posted on fences throughout the area. During the conduct of OB or OD operations, road and railroad blocks are initiated with posted “DO NOT ENTER” and “ROAD CLOSED” signs that are clearly legible.

Additional warning measures include the raising of a red range flag prior to OB or OD/BD operations and the stationing of road blocks and rail blocks prior to OD/BD operations. Before any thermal treatment activities begin, telephonic or radio notification is made to (1) security, (2) internal rail section, and (3) Depot facility engineers.

F-2 Inspection Schedule [401 KAR 38:090 Section 2(5); 34:020, Section 6; 40 CFR 270.14(b)(5) & 264.15]

The written inspection schedule required by 401 KAR 34:020, Section 6 (which references 40 CFR 264.15) is presented in Tables F-1 and F-2.

F-2a General Inspection Requirements

Operations of the OB and OD/BD treatment units at BGAD fall under the auspices of the Ammunition Maintenance and Demilitarization Division. The Ammunition Maintenance and Demilitarization Division continuously interacts with support activities such as the Directorate of Public Works (DPW), Environmental Office, fire Department, security, and safety office. A program has been established to inspect all components of the treatment units for malfunctions and deterioration of:

- Monitoring equipment,
- Emergency and safety equipment,
- Security devices, and
- Operating and structural equipment

and to complete the testing of such equipment, as applicable.

These inspections are necessary to prevent, detect, and respond to situations that may pose a risk to human health or the environment.

Inspection of equipment and facilities directly relating to the conduct of OB and OD/BD treatment operations are performed weekly, prior to, or following treatment operations by Ammunition Maintenance and Demilitarization Division personnel as shown in the inspection schedule provided Table F-1. Additional inspections, as shown in the inspection schedule provided in Table F-2, are performed by other installation support activities.

F-2a(1) Types of Problems

Types of problems encountered with each type of equipment are annotated on the inspection schedules presented in Tables F-1 and F-2.

F-2a(2) Frequency of Inspections

The inspection schedules provided in Tables F-1 and F-2 show the frequencies of inspections. Inspection frequencies are consistent with the potential deterioration of the equipment or materials being inspected to ensure the availability and usage of the items.

In addition to these, the QASAS representative that is assigned to the day's thermal treatment activities performs QA inspections of the operations for SOP compliance, operational effectiveness, quality, and safety deficiencies. This is done at least once on treatment days or as often as time allows throughout the treatment day.

Table F-1. Weekly, Daily, Pre- and Post- Treatment Inspection Schedule for the OB and OD units

Equipment	Potential Problems	Frequency	Responsible Activity
Monitoring Equipment			
Access to meteorological information	Computer or internet not operable	Daily during periods of operation and after use	Ammunition Maintenance and Demilitarization Division
Weather vane/anemometer	Broken, missing	Daily during periods of operation and after use	Ammunition Maintenance and Demilitarization Division
Safety and Emergency Equipment			
Showers, emergency shower, emergency eye wash – Building 270 and 280	Lack of water pressure, leaking, improper drainage	Weekly during periods of operation	Ammunition Maintenance and Demilitarization Division
Propellant/ash spill equipment [Broom, Dustpan, Drum, Shovel] – CONEX at OB Unit	Missing/Deteriorated	Daily during periods of operation	Ammunition Maintenance and Demilitarization Division
Fire extinguishers – vehicle-mounted	Missing/Discharged	Daily during periods of operation and after use	Vehicle Operator
Two-way Radios – Building 270, Safety Bunker	Missing/Not operable/Replacements or backups not available	Prior to each treatment event	Ammunition Maintenance and Demilitarization Division
Protective clothing – Long or short sleeve coveralls, Leather gloves (OD ops) Steel-toed boots, Safety glasses or goggles, hearing protection	Missing/In disrepair/ not properly worn	Prior to each treatment event	Ammunition Maintenance and Demilitarization Division

Table F-1. Weekly, Daily, Pre- and Post- Treatment Inspection Schedule for the OB and OD units

Equipment	Potential Problems	Frequency	Responsible Activity
Security Devices			
Red Range Flag - Building 270 and at safety bunker	Damaged, missing	Prior to each treatment event	Ammunition Maintenance and Demilitarization Division
Gate to Demo Grounds	Damaged, missing lock	Daily during periods of operation	Ammunition Maintenance and Demilitarization Division
Operating and Structural Equipment			
OB Unit:			
Run-on and run-off drainage controls (channels and rip-rap)	No effective/rip-rap scattered/visible signs of erosion	Prior to each treatment event	Ammunition Maintenance and Demilitarization Division
Concrete Pads	Cracked or damaged to extent not effective in mitigating contaminant migration – surface spalling expected	Prior to each treatment event	Ammunition Maintenance and Demilitarization Division
Burn pans	Corroded or damaged to extent no longer provides complete containment/loss of integrity	Prior to each treatment event	Ammunition Maintenance and Demilitarization Division
Burn pan lids	Improper fit – not effective in mitigating precipitation from entering	End of operating day	Ammunition Maintenance and Demilitarization Division
OD Unit:			
Bulldozers	Inoperable/fluid leaks	Prior to each treatment event	Ammunition Maintenance and Demilitarization Division
Safety bunker/Firing controls/Firing wires	Door inoperable/Broken Not functioning	Prior to each treatment event	Ammunition Maintenance and Demilitarization Division

1

Table F-2. General Inspection Schedule for the OB and OD/BD Units

Equipment	Potential Problems	Frequency	Responsible Activity
Monitoring Equipment and Controls			
Point of Compliance Groundwater Monitoring Wells	Damaged/missing or rusted locks	Semi-annually	Environmental Office
Metal fragments	Collected, contained, and removed from site for recycling.	On-going	Ammunition Maintenance and Demilitarization Division
Safety and Emergency Equipment			
Forklifts and Bulldozers	Inoperable/Load capacity not adequate Preventive Maintenance Life Cycle Testing	Semi-annually Annually	Equipment Management
Fire Extinguishers – Building 270	Inoperable	Monthly Quarterly	Ammunition Maintenance and Demilitarization Division Fire Department
Security Devices			
Restricted Area gates and fences	Damaged/Missing locks	Daily	Depot security
Restricted Area warning signs	Missing, damaged, not readable from 25 ft	Daily	Depot security

Table F-2. General Inspection Schedule for the OB and OD/BD Units

Equipment	Potential Problems	Frequency	Responsible Activity
Operating and Structural Equipment			
OB Unit Sediment Catch Basin (one at each pan)	Not functional, sediment basket full, breakthrough	Monthly	Directorate of Public Works (or support contractor)
OD Unit Sediment Controls/Sediment Run-off	Damaged, ineffective in mitigating sediment runoff to nearby streams	Semi-annually	Environmental Office
OD Unit Soil	Insufficient volume available to provide sufficient base over bedrock (minimum of 3 ft) or to cover pits (minimum of 6 ft)	Annually prior to operational season and periodically throughout the operating season as needed	Ammunition Maintenance and Demilitarization Division

F-2b Specific Process Inspection Requirements [401 KAR 38:090 Section 2(5) & 40 CFR 270.14(b)(5)]

This Part F of the permit application describes the process inspection requirements for the OB and OD/BD units which are RCRA miscellaneous units.

F-2b(1) Container inspection

Not applicable.

F-2b(2) Tank System Inspection

Not applicable.

F-2b(3) Surface Impoundment Inspection

Not applicable.

F-2b(4) Waste Pile Inspection

Not applicable.

F-2b(5) Land Treatment Inspection

Not applicable.

F-2b(6) Landfill Inspection

Not applicable.

F-2b(7) Incinerator Inspection

Not applicable.

F-2b(8) Containment Building Inspection

Not applicable.

F-2b(9) Miscellaneous Units Inspection

Not applicable.

F-2b(10) Air Emission Standards for Process Vents

Not applicable.

F-2b(11) Air Emission Standards for Equipment Leaks

Not applicable.

F-2b(12) Air Emission Standards for Tanks, Surface Impoundments and Containers

Not applicable.

F-2c Remedial Action

Thermal treatment operations are stopped immediately whenever a safety or compliance deficiency is evident. Deficiencies are corrected prior to resumption of the operation. All deficiencies are noted and brought to the attention of the Supervisor and QASAS. If possible, the deficiency is corrected on the spot by Ammunition Maintenance and Demilitarization Division personnel, equipment, and resources. Should remedial action be required that is outside of the Division’s capabilities, the concern is directed by work order or suspense memorandum to the DPW for corrective action. The remedial work is documented by a formal report prepared by the inspector and kept on file for a minimum of 3 years. Copies of supporting information (such as purchase orders for supplies and outside services) are kept with the report.

With respect to maintenance of the OB unit catch basins (which are inspected monthly as indicated in Table F-2), experience has shown that the basins require emptying at approximately 6-month intervals. If, during inspection, the catch basins are found to be full, they will be emptied into DOT-approved drums and managed as hazardous waste pending analytical results. OB operations will continue only after the catch basins have been emptied.

With respect to maintenance of OD/BD unit minimum soil requirements (i.e., minimum of 3 ft of soil over bedrock and minimum of 6 ft of soil over pits), the minimum soil cover criteria will be measured by survey or other measurement technique at the start of the operating season, and as necessary throughout the season (see Table F-2). If, during the operating season, soils are determined to be depleted such that minimum soil requirements cannot be met for individual pits, those pits failing the criteria will not be used until the soil is sufficiently replenished. If soil is determined to be needed, soils will typically be replenished between operating seasons. The Ammunition Maintenance and Demilitarization Division will be notified when soils are added.

Inspections are used to detect and remedy deterioration and malfunction and to ensure that problems do not lead to an environmental or human health hazard. If, in the course of an inspection (or during normal operations) a problem exists (or is imminent) that may pose a human health or environmental hazard, the Contingency Plan in Part G will be implemented.

F-2d Inspection Records and Recordkeeping

Appendix F-1 provides the inspection checklists used by the Ammunition Maintenance and Demilitarization Division to document pre- and post-treatment inspections. Should the format of these checklists change, the following information, at a minimum must be included: date and time of inspection, name/signature of inspector, observations made, comments and remedial action required. These inspection checklists are maintained at Building 270 for at least 3 years.

Additional inspections performed by other installation support activities are documented (as applicable) according to their operating procedures.

F-3 Preparedness and Prevention Requirements [401 KAR 38:090, Section 2(6); 34:030; 40 CFR 270.14(b)(8) & 264 Subpart C]

Hazardous waste management facilities are required to minimize the possibility of fire, explosion, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to the air, soil, or surface water that could threaten human health or the environment. BGAD does not request a waiver for the preparedness and prevention requirements for the OB and OD/BD units.

F-3a Equipment Requirements [401 KAR 34:030 Section 3 & 40 CFR 264.32]

F-3a(1) Internal Communications

Immediate instructions for emergency situations occurring at the OB and OD/BD treatment units are communicated by voice. At least one two-way communication device is on-site at all times during OB and OD/BD treatment operations (i.e., intrinsically safe two-way radio or cellular telephone), allowing individuals to call supervisory personnel to obtain help, declare an emergency, or receive emergency instructions. In addition to two-way radios and cellular phones, the Safety Bunker, Building 280 and the Demo Ground Office (Building 270) are equipped with wired telephones.

F-3a(2) External Communications

The intrinsically safe two-way radio or cellular telephones can be used to call in an emergency situation or condition where additional assistance may be required. Wired telephones are can be used to contact the fire department or other individuals or groups at BGAD for support.

Personnel conducting and/or supervising thermal treatment operations are trained in the location and operation of alarm and communications systems. Manually activated alarms are available at the OD/BD unit Safety Bunker and Demo Ground Office (Building 270).

F-3a(3) Emergency Equipment

Tables F-1 and F-2 identify the type and location of emergency equipment associated with the OB and OD/BD treatment units and provide the schedules for inspecting and testing emergency equipment. Emergency equipment is repaired and/or replaced when any deficiencies are noted.

Fire extinguishers are carried in all vehicles and are available at Building 270 and 280. Showers for decontamination and an eye wash are available at Building 270 and an emergency shower and eye wash are available at Building 280. Spill response equipment including a minimum of one drum, dustpan, broom and shovel for immediate cleanup of any solid propellant or ash spills are available at the CONEX located at the OB unit. Emergency response team would provide for all equipment to cleanup liquid spills.

Emergency medical and spill response equipment is maintained on mobile units and a site plan showing equipment location would not be appropriate. Emergency medical equipment is available on ambulance units operated by both the Health Clinic and the Fire Department. The Fire Department is equipped with a mobile spill response unit and serves as the designated housing and parking area for emergency mobile units. The Health Clinic is fully equipped with emergency medical supplies. See Figure G-1 for the marked locations of the Fire Department, Health Clinic, Building 270 and Building 280.

F-3a(4) Water for Fire Control

There are eight fire hydrants located between Building 270 and 280 for fire control and decontamination. Based on the most recently available documentation, these provide for an average pressure of 1,044 feet per minute. The OB and OD/BD units are serviced by the facility fire department. The fire department has a tank truck with a 1200-gallon capacity. A brush truck is available with a 250-galllon capacity. Additionally, there are two fire engine pumpers with a total water capacity of 1,060 gallons.

F-3b Aisle Space Requirements [401 KAR 34:030 Section 6 & 40 CFR 264.35]

OB and OD/BD treatment operations are conducted in an outdoor setting where space is not a constraint to the unobstructed movement of personnel and emergency equipment to any area of the facility. WMM/energetic waste brought to the units are not stored at the treatment units but are treated promptly after unloading.

F-4 Preventive Procedures, Structures, and Equipment [401 KAR 38:090 Section 2(8) & 40 CFR 270.14(b)(8)]

F-4a Preventing Hazards in Unloading Operations [401 KAR 38:090 Section 2(8)(a) & 40 CFR 270.14(8)(i)]

The unloading areas for WMM/energetic waste received at the OB and OD/BD treatment units are open and accessible for ease of maneuvering. OB and OD/BD standard operating procedures prohibit the loading and unloading of wastes after dark. It is also BGAD policy to maintain the area free of non-essential personnel when unloading wastes at the OB and OD/BD units. For heavy and bulk loads, mechanized equipment such as all terrain forklifts or bull dozers are available. Motor vehicles and equipment employing internal combustion engines used for transporting WMM/energetic waste are equipped with exhaust systems fitted with effective spark and flame arresting devices in the exhaust lines. Crates and boxes containing WMM/energetic waste are carried and not dragged over the floor of the truck. Crates and boxes are lifted and placed in the truck or on the ground by hand, one at a time, or loaded/unloaded using a rough terrain forklift.

F-4b Preventing Run-Off from Hazardous Waste Handling Areas or to Prevent Flooding [401 KAR 38:090 Section 2(8)(b) & 40 CFR 270.14(8)(ii)]

OB and OD/BD treatment operations are not conducted during periods of precipitation thereby eliminating run-off while wastes are in place. Run-off from the OB unit is further controlled through the use of a pan that remains covered at all times except when in use or when determined to be too hot for replacement of lids and through an engineered sediment catchment system that includes drainage controls, a concrete pad, and a sediment filter. While the detonation area is subject to run-off, the area is continuously graded to divert run-on and pits are filled with on-site soil and graded following detonation. In addition, any observed undetonated wastes are promptly retreated and not left in the area. Permanent sediment controls are also in place at the OD unit to mitigate sediment run-off to nearby receiving streams. The thermal treatment units are located outside of the 100-year floodplain, as described in Part B-3a(3) and no engineering controls are in place or necessary to prevent flooding.

More details regarding the engineering controls mitigating run-off are provided in Part D of this permit application.

F-4c Preventing Contamination of Water Supplies [401 KAR 38:090 Section 2(8)(c) & 40 CFR 270.14(8)(iii)]

The BGAD obtains its drinking water from Lake Vega. The run-off from the OB and OD/BD units does not drain into the Lake Vega drainage area. Air modeling and risk assessment performed in support of this permit application (and presented in Volume II) evaluates the impact of downwind deposition (and run-off) from the OB and OD/BD units to water supplies.

F-4d Mitigating Effects of Equipment Failure and Power Outages [401 KAR 38:090 Section 2(8)(d) & 40 CFR 270.14(8)(iv)]

Equipment associated with the OB unit is limited to the mechanized heavy equipment in use for unloading and removing of pan lids. BGAD has on-site capability for equipment maintenance and repair and sufficient backup equipment to mitigate the potential effects of failure of this equipment. Power is not required for OB operations and OB operations are conducted only during daylight hours; therefore, OB operations are not affected by power outages.

Equipment associated with the OD unit includes mechanized heavy equipment for unloading of wastes and digging of pits. As noted above, BGAD has on-site capability for equipment maintenance and repair and sufficient backup equipment to mitigate the potential effects of failure of this equipment. Other equipment includes the firing controls/system whereby firing is initiated from the safety bunker. This equipment is continuously maintained and BGAD has on-site capability for equipment repair. Should a power outage occur and electric ignition not be available at the safety bunker, the blasting machine would be used instead (requires not power).

F-4e Prevent Undue Exposure of Personnel to Hazardous Waste [401 KAR 38:090 Section 2(8)(e) & 40 CFR 270.14(8)(v)]

The dangers associated with the wastes treated by OB and OD/BD are primarily of a physical rather than a chemical nature. Personnel will not tamper with any safety devices or protective/industrial equipment. Personnel are responsible for wearing safe attire, such as long sleeved coveralls, steel-toed safety shoes, leather or leather palmed gloves for OD operations and cotton gloves for some OB operations, safety glasses or goggles, and hearing protection. The use of PPE is dependent on the working environment per the BGAD Safety Plan 385-5. Eye and hand protection are required during the handling of hazardous wastes. Hearing protection is dependent on the condition of the working environment. PPE is issued Ammunition Maintenance and Demilitarization Division personnel charged with the conduct of OB and OD treatment operations.

Other significant personnel protective measures are listed below:

- The areas with 200 ft of the OB and OD/BD units is kept free of combustible materials in quantities to be a fire hazard
- While operators are in any area where they are exposed to explosives/unpackaged munitions or they are operating any type of machinery/equipment (stationary or moving), no electronics, to include personal cell phones, are allowed.
- OB and OD/BD operations will not be initiated until at least one-half hour before sunrise and will be completed by at least one-half hour before sunset.
- OD/BD operations will not be conducted during electrical storms, thunder storms, or during periods of forecasted high probability of such (50 percent or greater).
- OD/BD operations will not be conducted during periods when visibility is less than five miles.
- Once wastes have been downloaded and prepared for treatment by OB, a maximum of three personnel and one vehicle will remain on-site to conduct the burn operation. The vehicle will be located no closer than 25 ft to the burn pan and will remain running during the operation to facilitate rapid evacuation of operating personnel.

- Prior to placing propellant into pans, operators will ground themselves by touching burn pan, by the use of wriststats, legstats, or standing on grounding mat.
- OD unit firing control system is unplugged and firing panels are in the “OFF” position until such time that detonations are ready to be initiated.
- Only two personnel remain on-site within the confines of the safety bunker during the conduct of OD operations.
- Due to safety concerns, halted OD operations in which blasting caps have been attached will be completed by one half hour before sunset of that day.

All waste handlers and thermal treatment operators and their supervisors are required to read and be familiar with the requirements of SOPs in which personal protective measures are detailed.

F-4f Prevent Releases to the Atmosphere [401 KAR 38:090 Section 2(8)(f) & 40 CFR 270.14(8)(vi)]

The uncontrolled nature of the OB and OD/BD treatment processes intrinsically involves releases to the atmosphere. The potential impact to human health and the environment as a result of OB and OD/BD operations has been assessed through the conduct of air modeling and risk assessment, the results of which are submitted in Volume II of this application.

To control the potential for visible emissions impacting nearby residential areas, wind speed and direction are monitored and OD/BD operations are halted when:

- Wind speed is less than 3 mph or greater than 20 mph or
- When wind gusts exceed 30 mph or
- When winds blow from 300 to 65 degrees, where North is 360 degrees

In addition, a minimum of 3 observers with direct communications to the Supervisor are positioned to have a clear view of the OD/BD plume. If designated observers identify visible emissions that have the potential to drift onto public lands, the observers will immediately contact the Supervisor who will immediately cease OD/BD operations and monitor the meteorological conditions until more favorable conditions return. Due to safety concerns, if blasting caps have already been fixed to the shots, the waste must be treated prior to ½ hour before sunset on that day. If blasting caps have not yet been fixed to the shots, treatment may be halted overnight, but requires posting of security. Note there are no wind speed or direction restrictions for OB operations.

At the request of KDEP, BGAD has researched the use of dust mitigation controls for use at the OD unit. Specifically market research was conducted with commercial sources including Dust Control Technology of Peoria, IL, which markets the Dust Boss DB-100. This particular mobile unit appears to be one of the larger mobile units commercially available and in use at landfills for dust control. The DB-100 is a portable, diesel powered unit that provides mobile dust control that will cover approximately 280,000 square feet. The area where detonations occur at the OD unit measures approximately 1,100 ft x 650 ft (715,000 square feet) (see Figure inset below).

Assuming normal coverage estimated by the vendor, 3 mobile units would be required to provide adequate coverage. A market research cost estimate of $151,400 per unit was provided by the vendor. Additional costs would be incurred to provide for the fabrication/construction of a damage control shelter system to protect the units from shrapnel produced by OD operations. A rough order of magnitude cost for 3 mobile units, personnel support, and facilities is approximately $1,000,000. Cost estimate details are available at the Depot for review. In addition to the significant cost, the following additional considerations have been identified by safety and operations staff:

- Response to misfire events is hampered by wet conditions resulting in potentially unsafe conditions to personnel required to walk down to the wetted pit area to investigate the source of the misfire
- The portable generators required to power the dust boss units would introduce an electrical component to the area where sensitive explosives (i.e., blasting caps) are in use, thereby increasing the potential for premature detonation and unsafe conditions to personnel. Additionally, the machine controls of this commercial product are not likely to be explosion proof (i.e., intrinsically safe), and therefore may not be safe to use around/in the same vicinity as blasting caps

Figure 1 - BGAD Open Detonation Area

- The increase in moisture content of the OD unit soils will increase the likelihood that bulldozers used to prepare the grounds could get stuck. This presents risks to both equipment readiness, as well as operator safety. Additionally, the dust boss misting trailers require a tractor to pull the units to place them into position. The increased moisture on the demolition ground soil increases the potential for these tractors to get stuck
- Introducing water to the operation would contribute to surface water runoff to receiving streams
- The DB-100 utilizes water tanks mounted to a portable trailer. If the water supply from the portable tanks proves to be inadequate, water hoses could be extended from the hydrant near Building 280 to supplement the misting water supply, but introduces risk of cutting of the hose by shrapnel and associated significant water losses/run off and safety concerns

Given these concerns, BGAD has determined that wetting of the OD unit is not a safe or operational sound engineering control for use at this time. BGAD has imposed wind speed and direction restrictions and administrative controls to control dust at the OD unit.

F-5 Prevention of Accidental Ignition or Reaction of Ignitable, Reactive or Incompatible Wastes [401 KAR 38:090 Section 2(9); 34:020 Section 8; 40 CFR 270.14(b)(9) & 264.17]

F-5a Precautions to Prevent Accidental Ignition or Reaction of Ignitable or Reactive Wastes

BGAD BGMC personnel are specifically trained to manage ignitable and reactive wastes and are fully aware of the proper procedures to prevent accidental ignition. Precautions and procedures are as follows:

- Incompatible wastes are not managed at the OB and OD/BD units
- No personal ignition sources (lighters, matches, cigarettes/cigars/pipes, etc.) are allowed in the restricted access area
- Non-sparking tools are used where appropriate to prevent frictional heat or spark

- Equipment is grounded to prevent the transfer of electrostatic charges to WMM/energetic waste
- Motor vehicles and equipment employing internal combustion engines used in the vicinity of explosive areas or for transporting WMM/energetic waste are equipped with exhaust systems fitted with effective spark and flame arresting devices in the exhaust lines
- Blasting caps are stored in approved containers only and separate from explosives
- OB operations are conducted in a containment device (burn pan)
- OB and OD/BD operations are not conducted during or upon the approach of an electrical storm
- The maximum allowable quantity of explosives per treatment event is not exceeded
- Combustible materials (dry grass, leaves, etc.) are removed to a radius of 200 ft from the treatment site
- A thorough search of the treatment area is made after each OB and OD/BD event for any unburned or undetonated material and brush fires

F-5b General Precautions for Handling Ignitable or Reactive Waste and Mixing of Incompatible Waste

OB and OD/BD procedures meet or exceed the standards as required by the DoD Ammunition and Explosives Safety Standards (DoD 6056.9-M), latest version. This Standard establishes uniform safety standards applicable to ammunition and explosives, to associated personnel and property, and to unrelated personnel and property exposed to the potential damaging effects of an accident involving ammunition and explosives during their development, manufacturing, testing, transportation, handling, storage, maintenance, demilitarization, and disposal.

The very nature of thermal treatment processes to deactivate explosive wastes results in violent reactions producing heat, explosion, fire, and dust. However, appropriate procedures and precautions are in place to ensure that reactions are controlled and do not threaten either human health or the environment, nor damage the structural integrity of the treatment units. Part D describes in detail how the OB and OD units are designed, maintained, and operated to accomplish this goal.

The procedures employed during treatment operations are designed to mitigate and prevent accidental ignition and reaction and are describe in Part F-5a above. All waste handlers and thermal treatment operators and their supervisors are required to read and be familiar with the requirements of these procedures as detailed in SOPs.

F-5c Management of Ignitable or Reactive Wastes in Containers

Not applicable.

F-5d Management of Incompatible Waste in Containers

Not applicable.

F-5e Management of Ignitable or Reactive Waste in Tanks

Not applicable.

F-5f Management of Incompatible Waste in Tanks

Not applicable.

F-5g Management of Ignitable or Reactive Waste in Waste Piles

Not applicable.

F-5h Management of Incompatible Waste in Waste Piles

Not applicable.

F-5i Management of Ignitable or Reactive Waste in Surface Impoundments

Not applicable.

F-5j Management of Incompatible Waste in Surface Impoundment

Not applicable.

F-5k Management of Ignitable or Reactive Wastes in Landfills

Not applicable.

F-5l Management of Incompatible Waste in Landfills

Not applicable.

F-5m Management of Liquid Waste in Landfills

Not applicable.

F-5n Special Requirements for Containers Disposed in Landfills

Not applicable.

F-5o Management of Ignitable or Reactive Waste in Land Treatment Units

Not applicable.

F-5p Management of Incompatible Waste in Land Treatment Units

Not applicable.

Appendix F-1
Inspection Logs

DATE:	NAME:	SIGNATURE:			
		Status			
Item	**Types of Problems**	**Acceptable**	**Unacceptable**	**Observations**	**Date and Nature of Repairs/Remedial Action**
Pre-Treatment Inspections					
Meteorological conditions	Have the meteorological conditions been verified with the Planning Team and documented?				
Combustible material	Is area free of combustible material within 200 feet of pan?				
Range flag	Is red range flag raised for operations?				
Emergency vehicle (work vehicle for egress)	Is an emergency personnel vehicle positioned on the access road within line of sight of the burn pans?				
Fire extinguisher	Is a fire extinguisher available in vehicle				
Telephone or 2-way radio communication	Has communication been established between burn site and Demo Ground Office?				
Burn pan	Has the pan lid been removed and has the pan been inspected for integrity, bonding, 2-hour wait, temperature (=<155 degrees), and has ash/residue been emptied?				
PPE	Are personnel wearing proper PPE?				
Non-essential personnel	Are non-essential personnel and vehicles evacuated from the area?				
Post-Treatment Inspections					
Unburned materials/kickout	Is all propellant burned so that no unburned/reactive materials remain?				
Burn pan	Have lids been replaced at end of operating day?				
Ash/residue	Has visible residue within an area safe to approach around the pan been removed and containerized?				
Treatment residue containers	Have containers been closed and removed from the OB unit to CONEX or other off-site storage location?				
Unused material, empty containers, recyclable materials, trash	Have unused materials been removed to storage and have empty containers, recyclable materials (e.g., banding) and trash been containerized and removed from the unit?				
Safety sweep	Has a safety sweep been completed to detect brush fires?				

Figure IV F-2. Operational OB Unit Inspection Log

DATE:	NAME:	SIGNATURE:			
Item	**Types of Problems**	**Status**		**Observations**	**Date and Nature of Repairs/Remedial Action**
		Acceptable	**Unacceptable**		
Pre-Treatment Inspections					
Meteorological Conditions	Have the meteorological conditions been verified with the Planning Team and documented?				
Wind vane/anemometer	Are the instruments working and has wind direction been verified?				
Range flag	Is red range flag raised for operations?				
Telephone or 2-way radio communication	Has communication been established between safety bunker and Demo Ground Office?				
PPE	Are personnel wearing proper PPE				
Road and rail blocks	Are road and rail blocks in place				
Notifications	Have the Commander, Security, and Public Affairs been notified and has radio announcement been made of road black?				
Non-essential personnel	Are non-essential personnel and vehicles evacuated from the area?				
Observers	Have the 3 required observers been positioned to detect visible emissions towards installation boundary?				
Post-Treatment Inspections					
Unexploded materials	Have inspections for UXO/low order detonations been completed and properly managed (if any)?				
Material Potentially Presenting an Explosive Hazard (MPPEH)	Has all MPPEH removed from the OD unit been inspected to determine the absence of explosive hazard?				
Unused material, empty containers, recyclable materials, trash	Have unused materials been removed to storage and have empty containers, recyclable materials (e.g., banding) and trash been containerized and removed from the unit?				

1 Figure IV F-3. Operational OD Unit Inspection Log

PART G. CONTINGENCY PLAN [401 KAR 38:090, Section 2(7); 34:040; 40 CFR 264.50-264.56; & 270.14(7)]

The information contained in this Part G of the permit application is submitted in accordance with the requirements for a hazardous waste facility Contingency Plan. This plan pertains to the operation of the OB and OD/BD units at BGAD.

As an owner and operator of hazardous waste storage facilities, BGAD has developed this Contingency Plan to minimize hazards to human health or the environment from fire, explosion, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, or surface water resulting from the operation of the OB and OD/BD units.

The identification or notification of an actual or suspected chemical accident/incident initiates a Chemical Accident Incident Response and Assistance (CAIRA) Plan response phase. Module III of the BGCA permit application specifically addresses contingency response as related to the BGCA.

The provisions of this plan shall be carried out immediately whenever an imminent or actual incident could threaten human health or the environment as described in Section G-3 of this plan. If an incident does not meet any of the situations listed in Section G-3 of this plan and personnel are definitively not at risk, the incident may be contained and abated by operating personnel.

The provisions of this Contingency Plan will be carried out immediately whenever any of the events identified below occur at the OB or OD/BD units.

G-1 General Information [401 KAR 34:040 and 40 CFR 264.52]

BGAD is a DoD federal facility situated in Madison County, Kentucky, 6 miles southeast of the city of Richmond, Kentucky (an estimated population of 33,000) and 30 miles southeast of the city of Lexington, Kentucky (population 350,000). The entrance gates to the facility are located on the southwestern boundary of the facility off Battlefield Memorial Highway (U.S. Highway 421). The communities of Moberly, Speedwell, Kingston, Terrill, and Reed's Crossing border the installation on the northeast, southeast, south, west, and north, respectively. Land uses within the facility consist of storage of ordnance and munitions, grazing land for cattle, areas dedicated to the demolition of ordnance and munitions and various other depot and tenant operations. Storage of ordnance and munitions is primarily accomplished through earth-covered magazines (igloos) and aboveground warehouses. Approximately 30 percent of the open land not used for Depot operations is leased by the government to cattle ranchers for livestock grazing.

Conventional munitions storage, transport and disposal operations at BGAD are executed by BGAD Mission Management. Treatment of conventional WMM/energetic waste at BGAD is the responsibility of the Ammunition Maintenance and Demilitarization Division and is accomplished through OB in burn pans, by OD/BD, and within a D-100 CDC housed in Building 280. Only OB and OD/BD are addressed in this permit application.

The OB and OD/BD units are located in the southern portion of the Depot as shown on Figure G-1. Most of the buildings and structures on BGAD are located in the southwestern portion of the installation. Surface waters nearest to the OB and OD/BD units are Lake Henron to the north, Muddy Creek to the east of the OD/BD unit, an unnamed tributary of Muddy Creek to the south, and an unnamed tributary of Muddy Creek to the north of the ridge on which the OD unit is located. Muddy Creek enters the Evacuation Plan property at the southeast corner of the Depot and traverses the eastern portion of the installation in a northerly direction before turning nearly due east until leaving the installation at the eastern Depot boundary. The largest surface water body on the Depot is Lake Vega, a 135-acre, man-made lake located near the center of the facility and serves as the primary source of potable water for the facility. The primary route of surface drainage from the facility is Muddy Creek. Muddy Creek releases to the Kentucky River, the surface drainage receiving body of water for the entire county.

The OB unit consists of approximately 10 acres and is delineated by a cleared zone bounded by a road (Route 117) on the north and a tree line to the south. The OB area contains two separate, locally fabricated steel plate burn pans. The two pans are located on two separate concrete pads surrounded by crushed stone that provides for ingress and surface water drainage. OB Pan 1 is located east of OB Pan 2. The OD/BD unit is located approximately ¼ mile east of OB Pan 1 bounded by the top of a ridge to the north, an intermittent stream (Southern Tributary) and low-lying trees to the south, Muddy Creek to the east, and a gravel roadway to the west. The OB/BD unit encompasses approximately 65 acres of which approximately 30 acres comprises the active treatment area that is barren soil. The remaining acreage is comprised of low vegetation.

The safety of all personnel is of paramount concern to the Installation Commander. All operations conducted concerning WMM/energetic waste treatment are done in accordance with SOPs that are reviewed at least annually or when any part of the operation is changed. The review of SOPs is accomplished by submittal of the proposed operation procedures to safety and environmental management personnel and others, such as explosive professionals, as appropriate. All reviewing officials sign and date the updated document that will be used to perform all operations. All supervisors and operators read or are orally informed of the procedures to be followed during operations, and sign and date the operating procedures. The use of SOPs to relay information and/or train personnel is an acceptable practice within the DoD.

All operations personnel are trained to respond to emergencies in accordance with this plan, as directed by the Installation Commander. The BGAD Fire Department and the Environmental Office personnel will carry out primary emergency response and fire fighting. Environmental Office and Fire Department personnel have the requisite experience, equipment, and training necessary to respond to a broad spectrum of emergencies.

The intent of this plan is to provide a framework for emergency response that complies with all applicable regulations; however, the Installation Commander must evaluate each situation and notify capable parties who can supply the most effective and immediate resolution to each incident.

This Contingency Plan will be reviewed and immediately amended by BGAD, if necessary, when any of the following conditions exist:

- The facility Part B permit is revised.
- The Contingency Plan fails in an emergency.
- The facility changes in a way that materially increases the potential for fires, explosions or releases of hazardous waste or hazardous constituents, or changes the response necessary in an emergency.
- The list of emergency equipment changes in a manner that reduces facility capabilities.

Locator Map

Legend

- Installation Boundary
- Evacuation Route
- Building
- Road

Emission Sources

- OB Pan 1
- OB Pan 2
- OD/BD Unit

Source:
ESRI World Imagery Online Mapping Service
Image Date: July 11, 2014

0 1,200 2,400
Feet

0 400 800
Meters

N

Figure G-1
Evacuation Plan
Blue Grass Army Depot
Madison County, KY

Whenever the Contingency Plan is revised, BGAD will ensure revisions are distributed to BGAD directorates and offices that perform hazardous waste operations. BGAD also will distribute revisions to external agencies that are designated in Section G-6. In accordance with KDEP permit modifications provisions, the revised plan will also be submitted to the Director and, if appropriate, EPA Region IV.

The hazardous wastes generated at BGAD covered by this Contingency Plan are included in Table G-1. BGAD generally does not routinely accept hazardous waste from offsite sources. However, in order to provide continued support to the nationwide JMC demilitarization mission, BGAD seeks to retain the capability to accept offsite conventional WMM from other U.S. defense installation sources only, as described in Section B-1. WMM are not accepted from foreign sources and are not received for the purpose of disposal by OB.

Waste types and characteristics may change in the event of a mission or process change. A modification to the permit application Part A and Part B will be submitted, as appropriate, in accordance with 401 KAR 38:040 (and 40 CFR 270.41). Generally, a permit modification will be required if a mission or process change results in a need for the application of permit conditions that are different from or absent those in the existing permit.

Table G-1. Hazardous Wastes Treated at the OB and OD/BD Units

Description	Characteristic or Listing	Code
Waste Military Munitions [Cased and Uncased[2]] and Energetic Waste[1]	Reactive Characteristic Waste with secondary characteristics potentially including ignitability and toxicity	D003, D001, D004, D005, D006, D007, D008, D011, D030

[1] No liquid wastes are treated at the OB and OD/BD units

[2] Cased WMM are disposed at the OD/BD unit cannot result in a spill. Uncased WMM (i.e., propellant) is disposed at the OB unit and because it is uncased, has the potential to spill

G-2 Emergency Coordinator/Incident Commander [401 KAR 34:040 Section 6; 40 CFR 264.52(d) & 264.55]

The BGAD Installation Commander is the Incident Commander (IC) for all contingency operations, and fulfills the role as Emergency Coordinator as described in 40 CFR 264.55. At all times, the Installation Commander is either on the premises or on call, i.e., available to respond to an emergency by reaching the facility within a short period of time, and has responsibility to coordinate all emergency response measures. To ensure that there is, at all times, at least one employee who may fulfill Emergency Coordinator responsibility on the premises or on call, alternate ICs have been identified. If the Installation Commander is unavailable, an alternate IC will be designated as the Emergency Coordinator and will be responsible to coordinate all emergency response measures.

During response to this Contingency Plan the Installation Commander, as the IC, has full authority to designate an alternate IC to take appropriate actions and make assessments. These alternates are listed below:

- Non-CAIRA incident
  - First alternate IC – the BGCA Commander
  - Second alternate IC – the BGAD Chief of Staff
- CAIRA incident
  - First alternate IC – the BGCA Commander
  - Second alternate IC – the BGAD Chief of Staff

All potential ICs are thoroughly familiar with and have full responsibility for the following:

- All aspects of the facility's Contingency Plan
- All operations and activities at the facility
- Location and characteristics of waste handled
- Location of all records within the facility
- Facility layout

The IC has authority to commit the resources necessary to carry out the Contingency Plan.

In the event of an emergency at BGAD, the observer of the accident or incident will notify the BGAD 24-hour Dispatch Desk Sergeant (Security Desk) at 859-779-6380, 911 from any Depot phone, or 859-779-6911, or by radio. The Security Desk is operational 24 hours a day, 7 days a week, i.e., 24/7. The Duty Officer has a recall roster containing phone numbers and addresses for the primary and alternate Emergency Coordinators (ICs). Upon notification of an emergency at the BGAD, either the primary or alternate IC will reach the facility in a short period of time.

G-2a Regulatory Requirements

Hazardous waste regulations have very specific requirements defining the duties of an IC. These are summarized below:

- Notify facility personnel and request necessary assistance.
- Identify the quantity and type of wastes involved.
- Assess hazards due to the wastes.
- Report the incident to the involved regulatory agencies if areas outside the BGAD facility boundaries are affected, and assist in evacuation if necessary.
- Attempt to keep the emergency situation from spreading.
- Make sure that operations
  - Do not result in danger due to incompatible wastes reacting.
  - Do not resume until all emergency equipment is replenished.
- Arrange for disposal of debris after the emergency is over.
- Submit a written report to the required regulatory agencies within 15 days of the emergency.

G-2b Security Procedures and Equipment

BGAD has significant resources that are available in an emergency, including the following:

- BGAD Fire Department – A civilian fire prevention and protection force that maintains coverage 24 hours a day, 7 days a week, including emergency medical services
- Heavy equipment, such as trucks, tractors, sweepers and front-end loaders, located at the facilities roads and grounds section
- Fire-fighting equipment from local fire departments, through reciprocal fire protection agreements for use as back up

The responsibility for coordination of on-scene operations, including utilization of outside agencies outside the incident area, is assigned to the IC or alternate IC. These outside agencies do not provide emergency services within the facility, but only serve as backup for BGAD emergency operations.

G-3 Implementation [401 KAR 34:040 Section 2 & 40 CFR 264.51]

The decision to implement the Contingency Plan depends upon whether or not an imminent or actual incident could threaten human health or the environment. If an incident does not meet any of the situations listed in Section G-3 of this plan and personnel are definitively not at risk, the incident may be contained and abated by operating personnel. In the event of an emergency situation, the exact sequence and timing of events are at the discretion of the IC.

The provisions of this Contingency Plan will be carried out immediately whenever any of the events identified below occur at the OB or OD/BD units.

G-3a Fire and/or Explosion

Explosion in the context of the Contingency Plan refers to an unplanned, uncontrolled explosion. The OD/BD treatment process involves planned, controlled detonations. This Contingency Plan will be implemented when any of the following situations need to be addressed:

- A fire causes the release of toxic fumes in quantities to migrate offsite or cause harm to personnel.
- The fire spreads and could possibly ignite materials at other locations on-site or could trigger heat-induced explosions.
- The fire could possibly spread to offsite areas.
- Use of water and/or chemical fire suppressants could result in contaminated run-off.
- An imminent danger exists that an explosion could occur, causing a safety hazard because of flying fragments or shock waves.
- An imminent danger exists that an explosion could ignite other hazardous waste at the facility.
- An imminent danger exists that an explosion could result in the uncontrolled release of hazardous constituents into the environment.
- An explosion has occurred.

Only a half operating day of WMM/energetic waste may be received at the OB and OD/BD units at any one time. Wastes that are received are promptly treated and no WMM/energetic waste are stored at the units. These explosives safety practices limit the volume of WMM/energetic waste that is subject to accidental fire or explosion while being managed at the units. Additionally, the OB and OD/BD units are located within established explosives safety exclusion zones. When WMM/energetic waste is present at the units, non-essential personnel are excluded from entering the zones, thereby limiting potential threat to human health.

G-3b Spill or Material Release

Sudden or non-sudden unplanned spills and releases may occur due to human error, (tipping or puncturing a drum), or deterioration of container structural integrity. Potential media that may be contaminated because of a release or spill include soil, water, and air, depending on the material involved and location of the release.

No liquid wastes are managed at the OB or OD/BD units. Solid WMM/energetic waste are delivered to the units on the treatment day prior to the treatment event. The volume of WMM/energetic waste present at the units at any given time is limited to a half day’s treatment quantity. Wastes disposed at the OD/BD unit are cased munitions items and cannot result in a spill. Wastes disposed at the OB unit are uncased and could potentially result in a spill, however. Drums used for the storage of explosive solid wastes and OB treatment residues that may be managed within the OB unit are limited to a maximum of 55-gallon capacity, which represents the maximum potential release. Any spilled material will be contained immediately to reduce the potential for spread of contamination. For these reasons, a major emergency involving a hazardous waste spill at the OB and OD/BD units is not expected.

This Contingency Plan will be implemented when any of the following situations need to be addressed.

- The spill could result in the release and harmful migration of hazardous constituents from WMM/energetic waste or treatment residue.
- The spill could result in the release and harmful migration of hazardous constituents in the form of explosive dusts.
- The spill can be contained onsite, but the potential exists for soil, surface water, or groundwater contamination.
- The spill cannot be contained onsite and may result in offsite soil, surface water, and/or groundwater contamination.

G-4 Emergency Response Procedures [401 KAR 34:040 Section 7 & 40 CFR 264.56]

Whenever there is an imminent or actual emergency situation, the IC (or his designee when the IC is on call) must immediately 1) activate internal facility alarms or communication systems, where applicable, to notify all facility personnel, and 2) notify appropriate State or local agencies with designated response roles if their help is needed.

This section is to be used in coordination with the Chemical Accident/Incident Response and Assistance Plan to the BGAD Disaster Control Plan, Annex C, Figure G-1, and the BGAD Chemical Accident/Incident Emergency Evacuation Procedures, Figure G-2, Module III of the BGCA application. In the event of a chemical accident or spill, the CAIRA Plan assumes operations priority.

G-4a Notification [40 CFR 264.56(d)]

BGAD personnel have established reliable channels that allow rapid communications. These channels ensure officials responsible for emergency response receive swift, accurate, and complete information and assessments. In all cases of a fire, explosion, or spill event triggering this plan, the IC will be notified. The following information will be provided to the IC:

- Location of the incident
- Material involved, quantity, and extent or potential for contamination of soil, air, or water
- Known injuries and estimated risk to human health
- Initial response actions taken

Upon discovering that a fire, explosion, spill, or other release has occurred or potentially may occur, the operator immediately relays the known information to the onsite supervisor or alternate (Leader). The supervisor is responsible for notifying workers in the surrounding area of the emergency or impending emergency. In all cases, the BGAD Fire Department and the Environmental Office also are immediately notified.

Upon notification from the operator, the supervisor will attempt to classify the emergency based on a review of the available information. The onsite supervisor will attempt to determine whether it can be handled by operating personnel. The onsite supervisor will inform Environmental Office personnel with as much of the information as possible about the emergency including:

- Location and time of the emergency
- Type and quantity of the released material
- Person responsible for the emergency
- Any injuries and the extent of those injuries, if known
- Any action taken to contain or clean up the material

If the onsite supervisor or the Environmental Office personnel determine that a threat to human health and the environment exists, the IC will be contacted by telephone or two-way radio and informed of the emergency. In all circumstances, whether a human health or environmental threat exists or an event that can be handled by on-scene personnel, the IC will be notified and assessed of the situation. Based upon the hazard assessment discussed in section G-4c of this plan, the IC will determine response actions.

The IC, based upon the information provided, will direct the notification of agencies as required in accordance with the CAIRA Plan for all CAIRA events and in accordance with 40 CFR Part 302 under the Federal Superfund or Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, for reportable quantity (RQ) release of hazardous substances; and for release of extremely hazardous substances (EHSs) designated in 40 CFR §Part 355 under Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA); 40 CFR Subpart D Contingency Plan and Emergency Procedures; and any other reporting required by law.

If the IC determines that the facility has had a release, fire, or explosion that could threaten public health, or the environment, outside the facility, he/she must report his/her findings as follows:

If the assessment indicates that evacuation of local areas may be advisable, he/she must immediately notify appropriate local authorities;

- The IC must be available to help appropriate officials decide whether local areas should be evacuated.

- The IC must immediately notify the Madison County Emergency Operations Center (by phone at 859-624-4787); the State of Kentucky 24-hour emergency response line (Kentucky Emergency Response Commission – ERC, toll free at 800-928-2380); and the National Response Center (NRC) (using their 24-hour toll free number 1-800-424 8802). Memorandums of Understanding or Agreement (MOUs/MOAs) documenting coordination agreements with off-post responders and other DoD agencies are presented in Module III, Part G-6, of the BGCA permit application.

The report must include:

1. Name and telephone number of reporter
2. Name and address of facility
3. Time and type of incident (e.g., release, fire)
4. Name and quantity of material(s) involved, to the extent known
5. Extent of injuries, if any
6. Possible hazards to public health or the environment outside the facility
7. Name of the IC

If offsite evacuation is necessary, the IC will notify the appropriate Local Emergency Planning Committee (LEPC), who will initiate additional Contingency Plans.

If an EPA-designated substance is released into the environment, specifically a hazardous substance listed in Table 302.4 (40 CFR §Part 302), during any 24-hour period and its quantity equals or exceeds its RQ, the IC will direct personnel to immediately notify the NRC at 800-424-8802 or by website, and the

KDEP Emergency Response team. The NRC notification will identify the time and type of incident, quantity of materials involved, extent of any injuries, and possible hazards to human health or the environment. See Table G-2 for agency contact information.

In the case that an EHS listed in Appendix A to 40 CFR §Part 355 is released at or above its RQ, resulting in exposures to persons outside the facility boundaries, the IC will direct personnel to provide information known at the time of the release to the off-depot agencies, Madison County Emergency Management Agency, which is the LEPC for the areas likely to be affected by the release and the Kentucky ERC. EHS notification must identify the substance(s) released and whether the substance is an EHS, the quantity of the materials involved, time and duration of the incident, medium or media into which the release occurred, known or anticipated acute or chronic health risks and advice regarding medical attention necessary for exposed individuals, proper precautions to take (including evacuation), and the name and telephone numbers of persons to be contacted for further information.

The following information will be provided in the notification:

- Location of the release or threatened release
- Material released or threatened to be released
- Approximate quantity and concentration of the release or threatened release

All telephone numbers of all agencies that are to be contacted at the direction of the Emergency Coordinator are provided in Table G-2. The IC may direct additional notifications.

Table G-2. Off-Facility Emergency Notification Numbers and Agencies

Agency Name	Notification Number
NRC	800-424-8802 (The online reporting tool may also be used http://nrc.uscg.mil/)
LEPC of Madison County (Madison County Emergency Management Agency Director)	859-624-4787
State of Kentucky 24-hour emergency response line (Kentucky ERC)	1-800-928-2380 or 502-564-2380

G-4b Identification of Hazardous Materials [40 CFR 264.56(b)]

Conventional WMMs treated at the OB and OD/BD units are off-the-shelf items with well-defined physical and chemical characteristics and recognizable by shape, color, and markings. Ammunition Maintenance and Demilitarization Division personnel who operate the OB and OD/BD units are trained in identifying munitions types and their associated hazards.

Any spill resulting in a release equal to or greater than an RQ of the material will result in activation of the Contingency Plan by the IC. Facility personnel will immediately identify the characteristics, exact source, amount, and extent of the released material. This may require review of the waste inventory and other facility records. The IC will then direct the level of response based on a risk assessment.

G-4c Hazard Assessment [40 CFR 264.56(c)]

Whenever there is a release, fire, or explosion, the IC must immediately identify the character, exact source, amount, and areal extent of any released materials. For WMM/energetic waste managed at the OB and OD/BD units, the IC may do this by consultation with Ammunition Maintenance and Demilitarization Division personnel, observation, or review of facility records.

The IC must assess possible hazards, both direct and indirect, to human health or the environment that may result from the release, fire, or explosion, such as effects of any toxic, irritating, or asphyxiating gases that are generated, or the effects of any hazardous surface water run-off or groundwater infiltration from water or chemical agents used to control fire and heat-induced explosions. Waste inventory records and waste characteristic data will provide useful information for this hazard assessment. In the event of a fire, the primary potential hazards will involve burns; smoke inhalation; ignition of adjacent structures, grass, and trees; and initiation of explosions. The primary potential hazard for incidences involving WMM/energetic waste is explosion. Explosions may present all of these hazards in addition to flying debris. During rainy periods, contamination of surface water and groundwater may be of concern.

In all cases where the Contingency Plan is initiated, the IC will make or direct the report of the incident in accordance with Section G-4a.

G-4d Control Procedures [40 CFR 264.56(e)]

This section discusses specific responses and control procedures to be taken in the event of a fire, explosion, or release. This plan concerns the treatment of WMM/energetic waste by OB and OD/BD; therefore, waste feed is not an issue. Ammunition Maintenance and Demilitarization Division supervisors ensure that WMM/energetic waste treatment operations are conducted in accordance with SOPs, which are consistent with procedures established by the U.S. Army and DoD. These SOPs incorporate specific procedures and quality assurance checks to reduce the potential of fire, explosions, and releases to the environment. Supervisors check the following at least once a shift during thermal treatment operations:

- Appropriate wind and weather conditions
- Procedures to reduce static charge
- Use of non-sparking tools, as appropriate
- Integrity of burn pans when conducting OB operations
- Appropriate grounding during all treatment operations
- Proper waste and donor charge configuration when conducting OD operations
- Integrity of containers used to collect treatment residues following treatment operations

G-4d(1) Control Procedures – Fire and Explosions

Fire fighting and other emergency vehicles and equipment can easily access the OB and OD/BD units. The Facility Fire Department can be utilized as directed by the IC in controlling fires. In the event of a fire, maximum efforts initially will be placed on preventing the fire from spreading. The following actions will be taken as appropriate.

1. Routine work in all affected areas will be shutdown.
2. The discoverer will notify the onsite supervisor using hand-held two-way radio.
3. The Fire Department and Environmental Office will be notified.
4. The Emergency Coordinator will be contacted and outside assistance will be called if required.
5. The area will be cleared of all personnel not actively involved in fighting the fire or containing the release.
6. All injured persons will be removed and qualified personnel administer medical treatment.

If a fire is involved and is concentrated at the source, the IC will determine the need for evacuation of people downwind. Firefighting will not be done at the unnecessary risk of injury to the persons involved. However, early containment of fires can significantly decrease total damage. The Facility Fire Department will be responsible for all firefighting efforts. In the event of a fire, the IC will make the determination as to whether any portions of the facility should be evacuated. Notification of an evacuation will be through fire bells or over the public address system, and will follow established posted evacuation routes. All personnel have been familiarized with evacuation procedures and means of exit from their respective work areas.

Because of the reactive nature of the wastes treated at the thermal treatment units, potential explosive hazard will be of primary concern to all response personnel and the following additional actions taken as appropriate:

1. WMM/energetic waste in the vicinity of the fire are removed from the site if this can be accomplished without undo risk to personnel.
2. The onsite supervisor or other qualified Ammunition Maintenance and Demilitarization Division personnel is consulted by the Fire Department to assess the explosive hazard and to determine whether fire fighting can be accomplished without undo risk to fire fighting personnel.
3. Should the explosive hazard be too great, all personnel are evacuated and efforts focused on mitigating blast damage and controlling the spread of fire.

An "all clear" notification will be given by radio and/or telephonic means when the fire has been extinguished and the safety of personnel is no longer endangered. All emergency equipment used will be cleaned and fit for use prior to resumption of operations in the affected area.

G-4d(2) Control Procedures – Spills and Leaks

No liquid wastes are treated at the OB and OD/BD unit and potential spills are limited to the OB unit where uncased munitions (i.e., propellant) and ash residue is managed. Therefore a major emergency involving a spill is not expected. Nonetheless, in the event of a major emergency involving a hazardous waste spill, the following general procedure will be used for rapid and safe response and control of the situation.

If an employee discovers a spill, he/she will immediately report it to their onsite supervisor. The onsite supervisor will notify Fire Department personnel and the Environmental Office of the spill. The onsite supervisor will provide the following minimum information to the Environmental Office:

- Material spilled or released
- Location of the release or spill
- Estimate of quantity released and the rate at which it is being released
- Direction in which the spill is heading
- Any injuries involved
- Fire and/or explosion or possibility of these events
- Area and materials involved and the intensity of the fire or explosion

Because fire is always a potential hazard in spills involving energetics, all possible sources of ignition in the immediate area will be eliminated. This will include, but not be limited to vehicular traffic. Such restrictions will be imposed until the spill is contained and safety is restored.

If a large quantity of energetic waste is released, all nonessential personnel in the immediate area will be removed. All potential ignition sources, such as motor vehicles, will be kept at least 100 feet away from the probable ignition area.

If the incident is determined to be within the facility's emergency response capabilities, the IC will contact and deploy the necessary personnel. If the incident is beyond facility capabilities, the IC will contact the appropriate agencies. If a spill or leak is of a type that triggers notification requirements, the State and Federal agencies are to be notified. If there is an imminent hazard to the health and welfare of the local population or environment, local agencies and authorities will be notified.

The initial response to any emergency will be to protect human health and safety, and then the environment. Identification, containment, treatment, and disposal assessment will be the secondary response.

If a liquid spill occurs outside of the buildings, any drainage away from the storage facility will be blocked immediately. The IC will direct the use of absorbent materials and other equipment as he deems necessary to collect the spill.

Any over-turned container will be immediately up-righted to reduce the amount of spilled wastes. Any punctured container will be plugged to stop the leak or placed in an over pack container. All wastes that were contained in a damaged container will be transferred to a new container or the existing container will be overpacked.

When any spill occurs, only those persons involved in overseeing or performing emergency operations will be allowed within the designated hazard area. The impacted spill area will be clearly identified and access limited, or blocked if possible.

Facility personnel will accomplish the control and cleanup of a spill, release, or fire. If the IC determines that the facility is unable to handle the emergency, an Army spill response contractor or augmentation unit may be contacted.

Emergency procedures and cleanup operations at the site will include the following procedures:

1. Make sure all unnecessary persons are removed from the hazard area.
2. Put on protective clothing, e.g., gloves, etc., where applicable.
3. Remove all ignition sources.
4. If possible, stop or contain the spill.
5. Remove all surrounding materials that could be reactive with materials in the waste.
6. Use absorbent, earth, sand, and other inert materials to contain, divert, and clean up a spill.
7. Place all containment and cleanup materials in drums for proper disposal.

G-4d(3) Containment and Abatement

The decision to implement the Contingency Plan depends upon whether or not an imminent or actual incident could threaten human health or the environment. If a spill does not meet any of the situations listed in section G-3 of this plan and personnel are definitively not at risk, a spill may be contained and abated by operating personnel. In the event of an emergency situation, the IC will decide the exact sequence and timing of events.

G-4e Prevention of Recurrence or Spread of Fires, Explosions, or Releases [40 CFR 264.56(e)]

During an emergency, BGAD will take the necessary steps to ensure that fire, explosions, or releases do not occur, reoccur, or spread to other hazardous waste or activities at the facility. Upon discovering an emergency incident, operating employees will halt operations and notify the appropriate persons. Provided no threat to human health or safety is present and personnel can avoid exposure (e.g., inhalation of released fumes), employees will relocate containers, pallets, and other materials that may either catch on fire or be incompatible with the spilled material. These items will be moved to unaffected (and compatible) areas, thereby isolating the emergency incident and affording emergency personnel sufficient area to conduct response activities.

When spills do occur, every effort will be made to minimize the quantity of waste and spill residue generated consistent with applicable regulations and requirements of KDEP, EPA, and the Army. Spills will be confined if possible to prevent mixing with other materials and to prevent possible contamination of ground or surface water and property.

The OB and OD/BD units were specifically designed and are maintained to treat WMM/energetic waste. The potential for spread of fires, explosions, or releases is reduced by the use of burn pans and concrete pads at the OB unit, by the control of vegetation and other combustible materials at both units, and through administrative controls that limit the quantity of WMM/energetic waste that may be received at the units at a given time. Additionally, security provisions strictly forbid the introduction of any ignition sources such as cigarette lighters and matches into the restricted area.

Collection and containment of potentially released wastes solid waste propellants is accomplished using containers and spill control equipment onsite. Spill equipment is readily available at the OB unit CONEX for use in collection and containerization of released propellant wastes or ash residue. Reference Section G-5 for a specific description of emergency response equipment available.

If propellant is spilled on site, it is immediately removed from the spill site using a container, broom non-sparking shovel and non-sparking dust pan and placed into the burn pan for treatment. Spilled propellant will not be returned to storage as a spill will result in potential contamination of the propellant and potentially making it more unsafe to manage.

G-4f Monitoring for Leaks, Pressure Buildup, Gas Generation or Ruptures [40 CFR 264.56(f)]

The OB unit is comprised of a pan, concrete pad and associated sediment catchment system. The OD unit is a large open area with a primary liner of soil. There are no valves, pipes, or other equipment associated with these units that are susceptible to leaks, pressure buildup, gas generation, or ruptures.

G-4g Storage and Treatment of Released Material [40 CFR 264.56(g)]

When the IC determines that no further action is required or the incident (e.g., spill) is under control and is not immediately dangerous to life and health, he/she will immediately direct arrangements for treatment, storage, or disposal of recovered waste, contaminated soil, surface water, or any other contaminated material. The IC may use facility personnel and equipment or contractor services, or a combination of both. The IC will ensure that all contractual agreements governing response actions and disposal of response residues contain provisions that require the management procedures and operations are carried out in accordance with applicable regulations. Once the actual emergency is abated and the material of concern is collected, the primary focus of the IC shifts from directing emergency response activities to ensuring activities achieve regulatory compliance while managing the recovered substance(s).

G-4h Incompatible Waste [40 CFR 264.56(h)(1)]

The IC will ensure that incompatible wastes will not be treated, stored, or located in any area involved in a fire, explosion, or release. The IC will have all information pertaining to the items involved in the incident and will ensure decisions to store the items are based on this knowledge.

G-4i Post-Emergency Equipment Maintenance [40 CFR 264.56(h)(2)]

Personnel and equipment used during response to emergency incidents may become contaminated in a number of ways including: contacting vapors, gases, mists, particulate in the air; being splashed by materials while sampling or opening containers, walking through puddles; and laying equipment or sitting/kneeling on contaminated concrete or soil. Good work practices reduce contamination but even with safeguards contamination may occur.

Decontamination—the process of removing or neutralizing contaminants that have accumulated on personnel and equipment—combined with correct doffing of personal protective equipment (PPE) and the use of site work zones minimizes the extent of contamination. Prior to implementing response actions, a decontamination area will be established in an area that minimizes the exposure of uncontaminated employees, environmental media, and equipment to contamination. Decontamination areas will be far enough from the incident to avoid contamination and exposure, yet close enough to the scene to be readily available and not cause off-scene contamination. The initial location will assume personnel and equipment leaving the Exclusion Zone are grossly contaminated. The decontamination area will consist of at least one wash and rinse, and will consider the type and amount of contamination, levels of protection required, type of protective clothing worn, and the type of equipment needed to accomplish emergency response activities.

Therefore, the IC will establish work zones and implement PPE and equipment decontamination will be conducted in designated area(s). The extent of decontamination depends on a number of factors including: the type and amount of contamination; levels of protection required; type of protective clothing worn; and the type of equipment needed to accomplish response activities. Trained personnel wearing appropriate PPE will conduct final decontamination procedures.

When decontaminating protective clothing and emergency equipment, material used in the decontamination process (brushes, rags, and soap) will be accumulated. All emergency equipment listed in the Contingency Plan will be cleaned and ready for use. Cleaning procedures will include scrubbing, water rinses, neutralization, and solvent rinses as needed. All contaminated rinse liquids and removed solids will be stored and disposed of in an environmentally sound manner as defined by their chemical/physical characteristics.

Prior to resuming operations, an inspection of all safety equipment will be conducted using the Inspection Schedule identified in Table G-3. All safety equipment and PPE used in the emergency must be restocked, cleaned, inspected, and prepared for use in a subsequent emergency. If safety equipment or PPE cannot be adequately decontaminated, it will be disposed of in an environmentally sound manner and replaced promptly prior to resumption of operations.

The IC will notify the Cabinet (and appropriate State and local authorities) that no waste, which is incompatible with the released material, is being stored in the affected area and that all emergency equipment listed has been cleaned in accordance with this plan and is fit for its intended use.

Table G-3. Inspection Schedule

Equipment Type	Description	Types of Problems	Inspection Frequency	Responsibility
Equipment	Forklift	Inoperative load capacity not adequate		Equipment Management
	Vehicle Preventive Maintenance		6 months	
	Life Testing		Yearly	
Safety and Emergency Equipment	Fire Extinguishers - in Vehicles	Not Charged	Daily During Operations	Vehicle Operator/ Security
	Locked Fences and Doors	Trespassing	Daily	Security
	Propellant/Ash Spill Equipment (OB Unit CONEX) including a container, broom, dustpan, and shovel	Not present deteriorated	Daily During OB Operations	Mission Management
	Showers and Eye Wash (Building 270) and Emergency Shower and Eye Wash (Building 280)	Inoperative	Weekly	Mission Management
Security Devices	Two-way Radio	Inoperative or malfunctioning	Daily During Operations	User

G-4j Container Spills and Leaks

Refer to Section G-4d and 4e.

G-4k Tanks Spills and Leaks

Not applicable.

G-4l Waste Piles

Not applicable.

G-4m Surface Impoundments Spills, Leakage, and Sudden Fluid Level Drops

Not applicable.

G-4n Landfill Leakage

Not applicable.

G-4o Requirements for Hazardous Waste F020, F021, F022, F023, F026, and F027

Not applicable.

G-5 Emergency Equipment [401 KAR 34:040 Section 3 & 40 CFR 264.52(e)]

Spill control and fire control equipment available at BGAD is listed in Table G 4. All equipment that would be used for response in an emergency situation is dynamic, with each directorate or office responsible for the maintenance and inspection, and tracking on a daily basis the equipment availability and location.

Telephones and two-way radios (including hand held sets) are available throughout BGAD for emergency communications. Personnel operating the OB and OD/BD units are provided with intrinsically safe two-way radios or cellular telephones to carry with them in the vehicles.

A minimum of one dustpan, shovel, broom and container are stored in the CONEX at the OB unit for immediate cleanup of any propellant or ash/residue spills. The emergency response team will provide all equipment to clean up liquid waste spills.

Emergency medical and spill response equipment is maintained on mobile units and a site plan showing equipment location would not be appropriate. Emergency medical equipment is available on ambulance units operated by both the Health Clinic and the Fire Department. The Fire Department is equipped with a mobile spill response unit and serves as the designated housing and parking area for emergency mobile units. The Health Clinic is fully equipped with emergency medical supplies. See Figure G-1 for the marked locations of the Fire Department, Health Clinic, Rally Point (Building 270), and evacuation routes from OB and OD/BD units.

Table G-4. Emergency Response Equipment

Description	Capabilities	Location
Dust Pan, Shovel, Broom and Container	Spill control and cleanup	OB Unit CONEX and all emergency response vehicles
Forklift	Spill control and cleanup	Dynamic – in control of Mission Management
Two-way Radios	Emergency Communication	Location Dynamic with operator

Table G-4. Emergency Response Equipment

Description	Capabilities	Location
AtHOC computer/telephone based mass notification system	Emergency Communication	BGCA Emergency Operations Center (EOC) and Security, LEPC and strategic locations on post
Emergency notification and broadcast system (Air raid sirens and tone alert radios (TAR))	Emergency Communication	Located throughout the facility and in the local community.
Ambulance	First aid and medical supplies	Location is dynamic with tracking by Health Clinic Building S-1 and Fire Department Building 52770
Shower, Emergency Shower, and Eyewash	Decontamination	Demo Grounds Office Building 270 and CDC Building 280
First aid and Medical Supplies	First aid and medical supplies	Located at Building S-1, Health Clinic, and available on Ambulances tracked by Health Clinic and Fire Department, Building 52770
Self contained breathing apparatus (SCBA)	PPE	Fire Department Building 52770
Fire Hydrants (Average of 1,044 feet per minute based on most recent measurements)	Fire Control	8 between Building 270-280
Fire Extinguishers - in vehicles	Fire control	Location dynamic and tracked by vehicle operator
Fire Trucks, tankers	Fire control	Dynamic with tracking by Fire Department 52770
Absorbents, broom, dust pan	Spill control and cleanup	Located on HAZ Mat and Environmental response trucks

G-6 Coordination Agreements [401 KAR 34:040 Section 3 & 40 CFR 264.52(c)]

BGAD has coordination agreements with off-depot responders and other DoD agencies. The agencies are listed in Table G 5. Copies of the CAIRA Plan, Emergency Evacuation Procedures, maps, and all MOAs/MOUs are provided in Module III, Part G, of the BGCA permit application.

Table G-5. Memorandums of Agreement/Understandings

Agreement between BGAD and
Kentucky State Police, Post 7
Madison County, Kentucky Sheriff’s Department
Berea City, Kentucky, Police Department
Richmond, Kentucky Police Department
Clark County Medical Center, Winchester, Kentucky
Berea Hospital, Berea, Kentucky
Baptist Health Hospital, Richmond, Kentucky
Madison County Emergency Medical Services
Madison County, Kentucky Fire Department
Richmond Kentucky Fire Department
Meteorological Data and Meteorological Services
Mutual Support Agreement, Madison County, Kentucky

Periodic emergency exercises are conducted both on- and off-depot in coordination with emergency response agencies. These exercises are utilized to ensure that local fire departments, hospitals, and state and local emergency response teams are familiarized with the facility and the actions necessary in the case of an emergency.

An up-to-date copy of the Contingency Plan is submitted to the following organizations:

- BGAD, Commander, Fire Department, Environmental Office, Directors, Chiefs, and Tenant Organizations
- BGCA, Commander, Directors, Chiefs
- LEPC of Madison County, to include local authorities and hospitals
- Kentucky ERC
- Kentucky Department of Environmental Protection, Division of Waste Management
- EPA Region IV (as needed)

G-7 Evacuation Plan [401 KAR 34:040 Section 3 & 40 CFR 264.52(f)]

The IC, upon assessment of emergency situations, will determine which portions of the Contingency Plan need to be implemented, including evacuation. Upon determination by the IC that employees must be evacuated, the Security Force will serve to direct traffic and guide employees from the area of concern. A number of notification methods may be employed to notify employees of the evacuation, dependent upon their location in respect to the evacuation area. Communications that may be utilized include announcement on intrinsically safe two-way radio, red-phone notification, telephone communication, air raid, civil defense siren, and notification. Relay of evacuation instruction will be the responsibility of the supervisor receiving the information.

All contractors working onsite and visitors of the facility have a government contact. It is the responsibility of the government contacts to ensure their contractors are notified in the case of emergencies. These notifications will be made in person, by telephone, or by radio. As a part of the security in-brief process, prior to entering the other areas of the installation, personnel are informed of their requirements when an emergency situation has been announced.

The evacuation traffic control will be monitored by the security patrol to prevent accidents. Visitors will be escorted from the facility by the personnel.

All personnel will be accounted for by their supervisors who in turn will advise the Security Desk of anyone not accounted for.

Emergency teams responding to a chemical accident will not evacuate the area unless specifically directed to do so by the IC.

If any area outside the BGAD lies within the contaminated range, BGAD personnel will follow the instruction of civil authorities in proceeding to their homes.

Evacuation of the surrounding local community will be accomplished through notification of the Local Emergency Response teams. Local emergency plans will be instituted utilizing their respective Contingency Operations with full support from the IC.

Figure G-1 shows the evacuation routes and Rally Point for personnel requiring to evacuate from the OB and OD/BD units.

Part H. PERSONNEL TRAINING [401 KAR 38:090 Section 2 (11); 34:020 Section 7; 40 CFR 264.16 & 270.14(b)(12)]

H-1 Outline of Training Program [401 KAR 38:090 Section 2(11); 34:020 Section 7; 40 CFR 264.16 & 270.14(b)(12)]

BGAD personnel involved with the handling of hazardous wastes, including those personnel involved in treatment of WMM/energetic waste at the OB and OD/BD units, are required to complete combinations of on-the-job training (OJT) and/or classroom and/or computer-based training to ensure they are competent to correctly and safely perform their duties within 6 months of initial assignment. Personnel who have not received initial training must work under the direct supervision of a trained supervisor and are not allowed to independently assume hazardous waste management duties until receipt of the required OJT and/or classroom training.

After initial training, annual refresher training is provided by means of a combination of classroom instruction, computer-based training, and/or instruction through the use of job specific SOPs that outline procedures to be followed and hazards involved. Employees are required to remain current with this training requirement within 365 days with a grace period of 30 days. All training provided is designed to address the specific hazards that employees are working with and to ensure the level of employee proficiency meets or exceeds regulatory standards for handling hazardous wastes to ensure their safety, the safety of others, and protection of the environment.

Personnel working in hazardous waste management activities receive training that includes methods to effectively respond to contingencies. Personnel are taught emergency procedures, equipment availability, and emergency system operations. Included as an integral part of this training instruction are the following:

- Procedures for using, inspecting, repairing, and replacing emergency and monitoring equipment
- Operations of communications systems
- Appropriate response to fires and explosions
- Response to potential groundwater contamination incidents
- Shutdown of operations

There are no automatic waste feed cutoff systems used in the operation of the OB or OD/BD units. Training requirements are established by the requirements of the Department of Defense, Department of the Army, JMC, and BGAD Chief of Ammunition Maintenance and Demilitarization Division.

H-1a Job Title and Duties

Each employee whose position at BGAD is related to hazardous waste management has personnel records maintained in the Directorate for which the employee works. These records include as a minimum the following information:

- Job Title
- Job Duties
- Position Description (PD)

H-1b Training Content, Frequency, and Techniques

Personnel may receive training using formal classroom instructions both onsite and offsite, and may receive computer-based training. Additionally, OJT is provided for hands-on experience, as needed to ensure personnel thoroughly understand and can safely perform the operations. OJT at BGAD encompasses documented operational and safety communications (e.g., quarterly safety briefings). The content of the training provided is directly related to the tasks that employees perform.

Initial training is conducted for all employees involved in hazardous waste management within the first 6 months from the date of assignment to the position. After initial training, frequency of training is at a minimum annually or when any process changes could impact personnel safety, significantly modify the response of the employee in an emergency, or jeopardize regulatory compliance.

Offsite training is conducted by means of directed discussions and classroom sessions. Onsite training includes classroom training, may include computer-based training, and primarily relies on annual review of SOPs, permits, and regulations. If a new process is initiated or the process changes, a new or updated SOP is developed and reviewed by the supervisor with the employee. All training conducted and techniques used are in keeping with the level of understanding of the operations personnel to ensure compliance and safe operations.

The level of training of personnel responsible for conducting OB and OD/BD operations at BGAD is consistent with their responsibilities.

H-1b(a) Initial Training

All personnel involved in demilitarization operations at the OB and OD/BD units receive initial training designed to teach basic safety and technical aspects involved in hands-on exposure to ammunition and explosives items and/or operations. This course (currently designated as Ammo-45) is provided as a web-based course and a current summary of the course is provided below:

- **Ammo-45-DL:** This is a certification course in accordance with AR 385-10/DA Pam 385-64. It is designed to teach basic safety and technical aspects involved in hands-on exposure to ammunition and explosives items and/or operations. This course provides training in basic safety and fundamental technical aspects involved in hands-on exposure to ammunition items and/or operations. Course content introduces the characteristics of different classes of ammunition and explosives, also the safe handling procedures and explosive safety requirements for the receipt, storage, maintenance, demilitarization, and issue of ammunition at U.S. Army installations. The course length is approximately 12 hours (self-paced learning). This course is provided as a web-based course. Course topics are as follows:
    - Ammunition
    - Operational Safety
    - Storage and Facilities
    - Transportation Requirements

Personnel directly involved in the operations (e.g., handle igniters, time fuzes, blasting caps, and detonating cord) receive an initial 2-week basic course (currently designated as Ammo-04), which is held offsite. A current summary of the course is provided below:

- **Ammo-04:** This course provides training for ammunition personnel in the various methods, procedures, and techniques of performing ammunition demilitarization. Emphasis is placed on procedures required for open burning and detonation. Students are introduced to the emerging technologies for resource recovery and recycling. This course includes a live explosives exercise in which students conduct setup and detonation using both electric and non-electric methods on the demolition range. Training also is provided on the changing impact of environmental requirements and decontamination methods. The course length is 2 weeks, 3 days. Course topics are as follows:
  - Publications, Forms and Terms
  - Environmental Requirements
  - Reports and Documentation
  - Demil Safety
  - Demo Materials
  - Demil Processes
  - Demil Tour Demonstration
  - Range SOP Review and Range Walk
  - Instructor Electric and Non-Electric Shot Demonstration
  - Student Electric and Non-Electric Shot Demonstration
  - After Action Report, Cleanup, and Range Sweep

Major emphasis is on the safe handling of munitions and the course is determined to satisfy the requirements of 49 CFR 1910.120(a)(1)(iv) and 1910.120(p), which cover operations involving hazardous waste that are conducted at Treatment, Storage and Disposal Facilities (TSDFs) regulated by 40 CFR Parts 264 and 265 pursuant to RCRA.

Upon assignment to a supervisory level staff position, including supervisor, planner, and quality assurance, personnel receive the course currently designated as Ammo-31, which is designed to familiarize the learner with environmental considerations that must be taken into account during all phases of ammunition and explosives operations. The course is summarized below.

- **Ammo-31-DL:** This course is designed to familiarize the learner with environmental considerations that must be taken into account during all phases of ammunition and explosive operations. This course is based on environmental laws and regulations that have the most influence over ammunition and explosive operations. It presents environmental considerations that must be taken into account during all phases of ammunition and explosive operations. The course length is approximately 4 hours (self-paced learning). This course is provided as a web-based course. Course topics are as follows:
  - Environmental Laws and Regulations
  - Hazardous Waste Identification
  - Hazard Communication and Training
  - Spill Prevention, Response, and Reporting
  - Hazardous Waste Management

Note that titles/numbers for Defense Ammunition Center (DAC) courses may occasionally change.

In addition to these training courses, initial training for all personnel involved in demilitarization operations includes supervised initial detailed review of the SOPs applicable to their job position and OJT.

In addition to training specific to ammunition operations, personnel assigned to OB and OD/BD operations are required to attend initial and annual Environmental Awareness Training.

H-1b(b) Recurring Training

The requirements for recurring training to meet Occupational Safety and Health Administration (OSHA) and RCRA requirements are met through a combination of:

- Supervised review of SOPs pertinent to their tasks
- Environmental Awareness Training
- Annual refresher training to meet the 49 CFR 1910.120 standard is conducted by a combination of SOP review and OJT under the direction of the Safety Officer and each worker's immediate supervisor and emphasizing personnel safety, including personnel protective equipment (PPE) and emergency response procedures

Environmental Awareness Training covers all significant environmental permits, programs, and regulations in addition to the focus on the RCRA program relevant to BGAD conventional mission. This awareness training also covers some key overlapping elements of safety, Hazard Communication (HAZCOM), and the Army ISO14001, Environmental Management System initiatives. The annual training program broad outline is provided below:

- Discussion of the Integrated Management System
- Information on Environmental Management System
- Review of Pollution Prevention requirements affecting environmental programs
- Provide understanding of Clean Air Act and Title V Permits
- Understanding RCRA
- Discussion on identifying hazardous waste, labeling containers, conducting inspections, and signing manifests
- Content of Spill Prevention, Control and Countermeasure Plan
- Understanding Spill Reporting Requirements
- Introduction and background on Kentucky Pollutant Discharge Elimination System (KPDES)
- Review of hazardous waste handling procedures, elements of the spill containment program, location of spill response kits or equipment

The sub-topics under the broad outline emphasize any key regulatory issues, lessons learned from the previous year incidents, regulatory inspections, etc. The Environmental Coordinator (EC), along with the Environmental Office staff and the ISO14001 Office, develops and reviews the refresher training topics annually in the fall timeframe for conducting the next calendar year training. The Environmental Awareness Training is provided annually in the February through April timeframe.

Upon periodic inspection of the OB and OD/BD treatment site and operations, OJT instruction is provided on an as-needed basis by Environmental personnel to enhance the structured training program.

H-1c Training Director

The BGAD EC is responsible for oversight of the BGAD RCRA hazardous waste training program. This training program incorporates the professional instruction and guidance from the facility industrial hygienist, occupational health staff, and safety staff. The BGAD EC maintains records of Environmental Awareness Training of facility personnel. The adequacy and appropriateness of the program, duration of training, course content, and course agendas are considered to ensure that all aspects of hazardous waste storage, treatment, and disposal conducted at this site and specific emergency preparedness and response are sufficiently covered.

The Depot Chief of Staff Directorate Training Coordinator is responsible for oversight of the ammunition-related training program. This training program incorporates the professional instruction and guidance of the DAC and the Chief of Ammunition Maintenance and Demilitarization Division.

H-1d Relevance of Training to Job Position

Training of BGAD personnel is geared toward the safe and successful implementation of their duties. Conventional ammunition workers receive training in basic technical ammunition information, for example: types of ammunition, how to identify ammunition, storage requirements, safety features, sources of information on ammunition, and how to use the sources. Major emphasis is on the safe handling of munitions, the major component of the hazardous waste at BGAD. Standard safety training (e.g., use of PPE) is provided both onsite and on-the-job under the direction of the Safety Officer and each worker's immediate supervisor. All employees are given contingency instruction for emergency operations and response based upon their level of performance with hazardous waste activities.

In accordance with 40 CFR 264.16 (d)(2), the details regarding the degree of specificity and qualifications for employees potentially managing hazardous waste at the OB and OD/BD units are discussed in this section. This was also addressed with KDEP-DWM, in response to a notice of violation in September 2013. Table H-1 summarizes initial and recurring training requirements for OB and OD/BD operators.

Table H-1. Training Matrix

Position	Position Description	Initial Training	Recurring Training
Quality Assurance Surveillance, Ammunition Specialist	PD# AUX0270	Ammo-4 Ammo-45 Ammo-31 Initial SOP review Initial OJT	Environmental Awareness Training Recurring SOP reviews Recurring OJT
Ammunition Inspector	PD# AU85003	Ammo-4 Ammo-45 Ammo-31 Initial SOP review Initial OJT	Environmental Awareness Training Recurring SOP reviews Recurring OJT
Planner [Production Controller (Ammunition)]	PD# AU239537	Ammo-4 Ammo-45 Ammo-31 Initial SOP review Initial OJT	Environmental Awareness Training Recurring SOP reviews Recurring OJT
Explosives Operator Supervisor	PD# AU96042	Ammo-4 Ammo-45 Ammo-31 Initial SOP review Initial OJT	Environmental Awareness Training Recurring SOP reviews Recurring OJT
Explosives Operator Leader Explosives Operator	PD# AU96021 PD# AU96012	Ammo-4 Ammo-45 Initial SOP review Initial OJT	Environmental Awareness Training Recurring SOP reviews Recurring OJT
Explosives & Material Handler Supervisor, Leader, and Handler Motor Vehicle Operator	PD# AU96042 PD# AU96044 PD# AU378332 PD# AU83096	Ammo-45 Initial SOP review Initial OJFT	Environmental Awareness Training Recurring SOP reviews Recurring OJT

A brief summary of the various position descriptions (PDs) potentially managing hazardous waste at the OB and OD/BD units is provided below:

PD # AUX0270, Quality Assurance Surveillance, Ammunition Specialist
With respect to the OB and OD/BD units, performs inspections of quality of work and prepares and certifies quality inspection records. Verifies Material Potentially Presenting an Explosive Hazard (MPPEH) as Material Documented as Safe (MDAS).

PD# AU85003, Ammunition Inspector
With respect to the OB and OD/BD units, assists Quality Assurance Specialist Ammunition Surveillance (QASAS) in performing inspection of quality of work. When delegated by QASAS, verifies MPPEH as MDAS.

PD# AU239537, Planner (Production Controller)
With respect to the OB and OD/BD units, plans, schedules, and coordinates operations. Includes coordinating with the Environmental Office as part of the process to evaluate workload for compliance with environmental permits, waste determination, and disposition of treatment residues.

PD #AU96042, Explosive Operator Supervisor/Explosive & Material Handler Supervisor
With respect to the OB and OD/BD units, serves as a supervisor, plans and coordinates work, provides technical direction, and provides direct oversight of personnel conducting OB and OD/BD operations or personnel transporting, packing, or unpacking of WMM/energetic waste. Leads initial and recurring SOP reviews.

AU96021, Explosive Operator Leader/AU96012, Explosives Operator
Works under the supervision of an Explosive Operator Supervisor. Leaders serve as working leaders of 12 to 25 personnel. With respect to the OB and OD/BD units, operators work under the supervision of a Leader to receive, inspect, and perform the destruction of WMM/energetic waste.

AU96044, Explosive & Material Handler Leader/AU378332, Explosives & Material Handler
Works under the supervision of an Explosive & Material Handler Supervisor. Leaders serve as working leaders of 12 to 25 personnel. With respect to the OB and OD/BD units, Handlers work under the supervision of a Leader to pack and unpack WMM/energetic waste.

AU83096, Motor Vehicle Operator
With respect to the OB and OD/BD units, operates equipment (e.g., trucks, trailers, fork lifts, bulldozers).

H-1e Training for Emergency Response

Personnel working in hazardous waste management in all cases include training to respond effectively to emergencies. Personnel are taught emergency procedure, usage of exigency equipment (e.g., emergency spill kits.), and emergency system operations. Included as an integral part of this training is instruction in the following:

- Procedure to use for using, inspecting, repairing, and replacing emergency and monitoring equipment
- Operations of communications systems
- Appropriate response to fires or explosions
- Groundwater Protection Plan
- Shutdown of operations

No automatic waste feed cutoff systems are used in OB or OD/BD operations at BGAD. Various operations are often shut down for a short period of time between workloads. However, when the operations commence again, all associated personnel will be checked to ensure the completion of the required training/walk-through prior to beginning the work. In addition, a contingency plan is developed that documents the procedure for the OB and OD/BD units, as presented in Part G.

H-2 Implementation of Training Program [401 KAR 34:020 Section 7; 40 CFR 264.16]

The training programs in use at BGAD have been long established and are an integral part of all operations. Initial training is conducted for all employees involved in hazardous waste management within the first 6 months from the date of assignment to the position. After initial training, frequency of training is at a minimum of annually or when any process changes could impact personnel safety, significantly modify the response of the employee in an emergency, or jeopardize regulatory compliance. New hires are not permitted to work in hazardous waste positions unsupervised until they have completed their job-related training requirements.

Onsite training is documented through signed SOP records maintained in the employing Directorate or through the signed classroom rosters maintained at the Environmental Office and/or the appropriate Directorate of the employee. Offsite training is documented via training certificates maintained in the employing Directorate. Documentation of training is additionally retrained in a computerized personnel file and is maintained for all employees engaged in hazardous waste activities. All records for training are maintained for a minimum of 3 years.

PART I. CLOSURE PLAN, POST-CLOSURE PLAN, AND FINANCIAL REQUIREMENTS [401 KAR 34:070; 34:090 Section 2 (12), (13), (14), (15) and (16); 34:230; 34:250; 34:287; 40 CFR 264.110-.120; 264.197, 264 Subpart S, 264.601; 264.603 & 270.14(b)(13)]

I-1 Closure Plan [401 KAR 34:070 38:090 Section 2(12); 40 CFR §270.14(b)(13) & 264.112-116]

BGAD is located in Madison County approximately 6 miles southeast of Richmond, Kentucky. It was originally established in April 1942 for the receipt, issuance, storage, maintenance, and disposal of ammunition. Construction of the Blue Grass Facility was a product of the War Department's expansion of ordnance supply depots during WWII. The federal Government has had control of the facility since October 1945. The hazardous waste management units addressed in this closure plan are the OB and OD/BD units located in the south central to eastern portion of the Depot (see Figure B-2).

These units obtained interim status when BGAD submitted its initial Part A Application following promulgation of the RCRA Subpart X regulations in December 1987. The OB and OD/BD units have existed at their current location throughout the interim status period. Former OB and/or OD/BD activities that may have been conducted at other locations on the installation have been identified through the RCRA Facility Assessment/Investigation process and have been or are being addressed under BGAD's RCRA Corrective Action process as discussed in Part E-3, Corrective Action for SWMUs and AOCs.

The OB unit consists of approximately 10 acres and is delineated by a cleared zone bounded by a road (Route 117) on the north and a tree line to the south. The OB area contains two separate, locally fabricated steel plate burn pans. The two pans are located on two separate concrete pads surrounded by crushed stone that provides for ingress and surface water drainage. OB Pan 1 is located east of OB Pan 2. The OD/BD unit is located approximately ¼ mile east of OB Pan 1 and is bounded by the top of a ridge to the north, an intermittent stream (Southern Tributary) and low-lying trees to the south, Muddy Creek to the east, and a gravel roadway to the west. The OB/BD unit encompasses approximately 65 acres, of which approximately 30 acres comprises the active treatment area that is barren soil. The remaining acreage is comprised of low vegetation.

This plan identifies the steps necessary to complete a closure of the OB and OD/BD units in accordance with 401 KAR 34:070 Sections 1 through 6. Once implemented, this plan is designed with the intent of closing these units in a manner that is protective of human health and the environment. When closure is indicated, BGAD will coordinate with KDEP to revise and update this closure plan (and to prepare, as necessary, additional or supplementary plans) to reflect the most current requirements, standards, guidance, and procedures for assessing the nature and extent of contamination and completing the necessary corrective action to close the units. Because of the potential for explosive hazards, DoD, the

U.S. Army, and USACE requirements and guidance will be adhered to. This final closure plan will be sufficiently descriptive such that an independent third party could perform closure of the units. A copy of this plan will be maintained by the BGAD Environmental Office until the units are certified as closed.

A discussion of post-closure requirements also is included per the requirements of 401 KAR 34:070 Section 9 and 401 KAR 38:090 Section 2(13). A Post-Closure Plan is required only if all contaminated soils or groundwater cannot be completely removed or decontaminated during closure of the treatment units.

I-1a Closure Performance Standards [401 KAR 34:070 Section 2 & 40 CFR 264.111]

This closure plan complies with the requirements of Section 3 of 401 KAR 34:070. This plan is intended to ensure that the OB and OD/BD units will be closed in a manner that controls, minimizes, or reduces post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or waste decomposition products to soils, surface waters, groundwater, and the atmosphere, to the extent necessary to protect human health and the environment. To this end, the plan provides for facility and equipment decontamination, soil removal and remediation, and groundwater (and other media) remediation and monitoring, as applicable.

I-1b Partial and Final Closure Activities

Closure of the OB and/or OD/BD units would constitute partial closure as it relates to the installation as a whole.

Final Closure Activities

In the event that future circumstances or mission changes compel BGAD to discontinue treatment operations at the OB unit and/or OD/BD unit, preparations for final closure of the unit(s) will begin. All closure activities will be conducted in close coordination with KDEP. Upon initiating closure, no further volume of WMM/energetic waste will be accepted for treatment at the units with the exception of wastes that are generated from closure activities and for munitions emergency responses.

I-1c Maximum Waste Inventory in Storage and Treatment during the Life of the Facility

WMM/energetic waste is not stored at the OB or OD/BD treatment units, but rather are transported to the treatment units just prior to the treatment event. The maximum waste quantity, expressed as NEW, known to have been located at the OB and OD/BD units during their active life is 6,000 lb NEW at the OB unit and 3,000 lb NEW at the OD unit.

I-1d Schedule for Closure

Operation of the BGAD OB and OD/BD treatment units is expected to continue at least for the duration of the RCRA Part B, which is being applied for per submittal of this permit application. Additionally, no trust fund is being used to establish financial assurance under 401 KAR 34:090 and 401 KAR 34:100. Therefore, no closure date can be estimated per the requirements of 401 KAR 34:070 Section 3(2)(g) at this time.

I-1d(1) Time Allowed for Closure

Table I-1 shows the schedule for closure activities. Closure activities will be completed within 360 days of the notification to KDEP of intent to close these facilities in accordance with this plan as mandated by 401 KAR 34:070 Section 4(2) and 40 CFR §264.113, or an extension for closure time will be submitted.

Table I-1. Closure Schedule for OB and OD/BD Units

Activity	Time Sequence (Days)	Total Elapsed Time (Days)
Notification of Intent to Close*	-180	0
Receipt of Last Waste	0	180
Removal of all Wastes	30	210
Removal/Remediation	90	300
Certification of Closure	60	360

*No additional WMM/energetic waste will be accepted for treatment upon notice of intent to close.

I-1d(2) Extensions for Closure Time

If an extension to the proposed closure time frame is warranted, a request or petition for an extension of the closure time will be submitted to KDEP in accordance with the requirements of 40 CFR 264.113. This petition will identify the need for the extension, the status of the facility, and the actions required to prevent threats to the environment or human health during the extension period. The written request will include a copy of the amended closure schedule.

I-1e Disposal and/or Decontamination of Equipment, Structures, and Soils [401 KAR 34:070 Sections 5 & 40 CFR 264.114]

A closure investigation will be planned to support determination of extent of contamination in the soil and underlying groundwater, nearby surface waters, and their sediments. Contamination will be remediated to risk-based criteria established at the time of closure in coordination with KDEP.

Since OD/BD operations involve the treatment of energetic wastes pits or on the soil surface, surface and subsurface soil and groundwater contamination from the OD unit at the time of closure is a possibility. Therefore, it is reasonable that closure of the OD unit will involve closure with waste in place and post-closure maintenance and monitoring. An accurate determination of all closure requirements cannot be made until the site is assessed at the time of closure. At that time, a pre-closure site investigation will be conducted in accordance with KDEP and EPA-approved sampling protocols. If the closure assessment indicates the presence of contamination in environmental media above appropriate background and/or risk-based standards, additional site characterization will be performed to assess the extent of contamination and to identify corrective action options. Appropriate plans will be prepared and submitted to the U.S. Army (e.g., Department of Defense Explosives Safety Board) and KDEP for approval. Upon approval and modification of the closure plan, the identified corrective actions will be implemented. Anticipated closure activities are listed below:

OB Unit

- Decontamination and offsite disposition (e.g., recycling) of burn pans and lids
- Surface and subsurface soil, groundwater, surface water, and sediment sampling, as determined necessary in coordination with KDEP
- Based on analytical results, excavation of surface and potentially of subsurface soils
- Other appropriate remediation, as determined in coordination with KDEP to include but not limited to, as appropriate, in situ treatment and offsite disposal

OD/BD Unit

- Geophysical survey
- Soils removal in lifts employing robotic or non-robotic armored, mechanized equipment
- Sifting or other manual means for separating Material Potentially Presenting an Explosive Hazard (MPPEH) from soil media
- Onsite treatment of UXO using DoD-approved blow-in-place or consolidated shot procedures
- Offsite disposition (e.g., recycling) of metallic debris that is determined to be safe
- Surface and subsurface soil sampling, groundwater sampling, and surface water sampling, as determined necessary in coordination with KDEP
- Based on analytical results, additional excavation of soils and verification sampling until cleanup standards are met
- Other appropriate remediation, as determined in coordination with KDEP to include but not limited to, as appropriate, in situ treatment and offsite disposal

I-1e(1) Geophysical Survey

The potential for UXO exists at the OD/BD unit. UXO poses an acute explosives safety hazard during the conduct of site investigations and remedial actions as well as for future land use. To assist in identifying and determining the extent of the area impacted by OD/BD treatment activities, a geophysical survey is anticipated as part of closure activities. The survey would incorporate all areas that may have been impacted by UXO, including the kickout area. There are limitations with respect to depths of detection associated with geophysical equipment, however, and these limitations will be considered when employing this equipment as an investigative tool.

I-1e(2) Sampling

Based upon past operating procedures, previous site investigations, and visual observations of the site, soil contamination from treatment residue and waste debris within the bounds of the two units is possible. In addition, based on observed surface water runoff patterns, contamination of sediments in the unnamed tributary along the southern boundary of the units and Muddy Creek would need be assessed. Media investigations will incorporate “step-out” protocols to address the potential contamination of adjacent properties such that both nature and extent are adequately assessed. Surface soil, subsurface soil, and sediment sampling will be conducted in accordance KDEP-approved plans and KDEP- and EPA-approved sampling protocols to determine the nature and extent of contamination.

All available groundwater and surface water data at the time of closure will be evaluated to determine whether additional groundwater monitoring well and/or surface water sampling is warranted to support closure. It is anticipated that at a minimum, the pre-closure site investigation will include a single round of samples from each of the existing point of compliance wells associated with the OB and OD/BD units at the time of closure and surface water samples from both the unnamed southern tributary that lies south and downgradient to the units and Muddy Creek. Part E describes the results of groundwater and surface water sampling conducted to date and describes the proposed groundwater monitoring program for the life of the permitted unit. Additional groundwater sampling points that may support closure initiatives include seeps and springs.

Samples will be analyzed in accordance with EPA Method SW-846, *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods* (latest EPA approved version). The number, type, and location of samples will be based on the established data quality objectives (DQOs). The proposed soil sampling scheme is likely to combine both incremental and discrete sampling. Incremental sampling is appropriate where a mean contaminant concentration across specified site boundaries is sufficient to assess site conditions. Discrete sampling is appropriate when the sample area is small, where contamination migration is of interest, to identify hot spots, for verification of sampling results, or where required by the DQOs.

Actual sample locations will be subject to change depending upon conditions encountered at the site at closure. The exact location, dimensions, and depth of the sampled areas will be noted during sample collection. Based on initial sampling results, the sampling regime may be expanded, as necessary, to adequately define the extent of contamination.

Stainless steel hand augers, direct push sampling methods, and/or stainless steel or disposable spoons and bowls will be used to collect soil samples. Low-flow, bailing, or other sampling techniques will be used for groundwater sampling and scoops and jars for surface water sampling. All re-useable field sampling equipment will be pre-cleaned prior to arrival onsite and will be decontaminated before each use. A decontamination area will be established and maintained onsite for all decontamination activities. The decontamination area will be located in the vicinity of the unit being sampled at a suitable isolated location to assist in preventing cross-contamination of sampling equipment. Sampling equipment, sample containers, preservatives, field measurements, decontamination procedures, and waste disposal will be addressed in work plan(s) that will be prepared and developed and approved by KDEP prior to initiating any closure activities.

The results of basewide background surveys and/or results of additional sampling performed may be used for background contamination comparison.

Verification sampling and analysis following soil removal are anticipated to be based on either incremental or grab samples collected from all areas where soils are removed.

I-1e(3) Analyses

Media samples (e.g., soil, surface water, sediment, groundwater) will be analyzed to account for all known hazardous wastes, hazardous constituents, and/or degradation by-products that are the result of operations conducted at the treatment units and for which EPA analytical protocols exist. Based on the waste characteristics associated with the current and historical OB and OB/OD waste stream, the proposed analytes and analytical methods are shown in Table I-1.

Table I-2. Analytical Methods and Analytes

Analytical Method	Analyte
EPA Method SW-8330	Explosives – all available for the method
EPA Method SW-6010/6020/7470	Total Metals – all available for the method
EPA Method SW-8270	Semi-Volatile Organic Compounds – subset of those available for the method as determined in coordination with KDEP
EPA Method SW-8260	Volatile Organic Compounds – subset of those available for the method as determined in coordination with KDEP
EPA Method SW-6850	Perchlorate

Additional analytes may be identified in coordination with KDEP at the time of closure. As appropriate, a risk-based methodology will be devised in coordination with KDEP and used to determine site-specific indicator contaminants and concentrations for post-removal verification sampling.

Equipment and structures directly associated with the treatment units are as follows:

- OB Unit - two burn pans with lids, reinforced concrete pads underneath each and associated sediment catchment system
- OD/BD Unit - electrical wires and heavy equipment such as forklifts, backhoes and bulldozers

The surfaces of all equipment known to have been in contact with wastes or waste residues are assumed to be contaminated. The proposed decontamination procedures are as follows:

OB Unit

- The burn pans will remain at the site and will be used during closure activities as needed. After all wastes have been removed from the site, the burn pans will be decontaminated in place by flashing (i.e., by burning diesel fuel or other combustible material in the pan to cause the temperature of the pan to exceed the autoignition temperature of the energetic materials that were originally burned in the pans). Treatment residue remaining in the pans after flashing will be collected manually and will be containerized, sampled, and handled as discussed below. The flashing process will be repeated until no contamination is visible. The burn pan lids have never been directly exposed to the waste stream. These will be decontaminated by high-pressure, cold water wash without detergent or solvents or as per the approved closure plan. Verification sampling will be conducted as discussed below. Once decontaminated, the burn pans and lids will be either transferred to another DoD facility for similar use, recycled as scrap metal, or disposed of in accordance with Kentucky solid waste regulations.
- The reinforced concrete pad beneath the burn pans will be visually inspected. Concrete that is visibly stained will be decontaminated. The reinforced concrete will be washed with high-pressure cold water and detergent or as per the approved closure plan. The concrete pad and associated sediment catchment system will be evaluated to determine whether they may remain in place or removed for offsite disposal as debris.

OD/BD Unit

- The electrical wires are required for remote detonation and will remain in place for use during closure activities as needed. The heavy equipment is expected to be required throughout the closure process and will be decontaminated when all closure actions are complete. Once final detonation activities have been performed, the electrical wires will be decontaminated by wiping as they are lifted and rolled around a spool. Heavy equipment will be decontaminated by high-pressure, cold water wash without detergent or solvents, brushing, scraping, and/or shaking. Verification sampling will be conducted as discussed below. Once decontaminated, the electrical wires will be recycled or disposed of in accordance with Kentucky solid waste regulations. The heavy equipment will be transferred to another DoD facility for similar use.
- Because of the volume of soil that is contained within the boundaries of the OD unit, in situ remediation techniques will be evaluated and selected upon closure of the unit. A detailed plan describing the selected remediation techniques will be developed in coordination with KDEP upon closure of the unit. The plan will describe the measures to control run-on and run-off from contaminated soils, and sampling and monitoring to ensure the effectiveness of the processes.

Equipment

- Decontamination of equipment associated with the OB and OD/BD units will occur at a staging area. The area will be of sufficient size to accommodate a decon area, a “dirty” area, and a “clean” area. This staging area is anticipated to consist of a compacted earthen foundation surrounded by 1-foot-high earthern berms. The foundation and berms will be overlain by a 30-mil-thick HDPE liner of sufficient durability to withstand decontamination activities. Sand will be spread on top of the liner to prevent tearing. The staging area will be graded to slope toward a corner so that decontamination fluids from pressure cleaning can be collected in a lined catch basin consisting of a plastic-lined 500-gallon drum recessed into the earth. Decontamination waters will be removed from the drum via a pump and transferred to DOT-approved shipping containers and placed in the “dirty” area. Run-on and run-off are prevented through the use of a berm/liner system and by using plastic sheeting that covers the staging area during precipitation.

Contaminated Media and Wastes

- All contaminated or potentially contaminated media, including soils, solid and hazardous wastes, disposable PPE, rags, brooms, towels, etc., will be accumulated onsite at the designated “dirty” area of the staging area. Liquids will be containerized separately from solids. All wastes will be classified, sorted, containerized, sampled, labeled, and managed according to type. All wastes are first classified as hazardous waste, non-hazardous waste, or reusable material. Process knowledge and/or analysis will be used to determine whether the wastes exhibit hazardous characteristics. The sorted wastes will be containerized and labeled. Solid wastes that are not contaminated will be collected in appropriate containers and disposed of at a local solid waste management facility in accordance with KDEP regulations. Hazardous wastes will be disposed of through a DoD contract vehicle at a properly permitted hazardous waste TSDF. All waste streams will be logged and manifests will be prepared for all hazardous waste streams.
- Verification sampling will be accomplished through a combination of wipe samples from the surfaces of equipment and structures, soil samples to verify that sufficient soils have been removed, concrete core or chip samples, and decon water samples. Additionally, all waste streams that may potentially be contaminated with explosive material or display a hazardous characteristic will be sampled. Samples will be analyzed by the appropriate EPA method to determine hazardous waste characteristics and underlying hazardous constituents and as required by the disposal facility (e.g., decon waters may be disposed to onsite waste water treatment plant if all pre-treatment requirements are met and approved by KDEP).

Sampling Equipment

- All reusable sampling equipment will be decontaminated prior to, between, and after sampling. Decontamination of the sampling equipment will include a potable water rinse, liquid detergent wash, potable water rinse, deionized water rinse, and an isopropanol double rinse. The equipment will be air dried and wrapped in aluminum foil. All decontamination solutions will be collected, sampled, and disposed of in accordance with sampling results.

Health and Safety Procedures

- A site-specific health and safety plan will be developed prior to the conduct of any sampling activities at the OB and/or OD/BD units. Because of the potential presence of Munitions and Explosives of Concern (MEC), DoD, U.S. Army, and USACE protocols will dictate safety requirements. It is anticipated that prior to commencing corrective action that a DDESB approved Explosives Safety Submission would be required to identify explosive hazards and mitigation methods.
- Personnel performing sampling will use the proper protective equipment deemed necessary to accomplish sampling tasks. Sampling personnel will be properly trained in hazardous waste sampling and will have appropriate medical monitoring and certification. Sampling personnel at the OB and OD/BD units will either themselves be or will be accompanied by qualified UXO technicians at all times when operating in an area where UXO may be present.

I-1f Closure Certification [401 KAR 35:070 Section 6 & 40 CFR 264.115]

Within 60 days of the completion of final closure, BGAD will submit to the Director, by registered mail, a certification signed by a principal executive officer and a registered professional engineer. The certification will state that the OB and OD/BD units have been closed in accordance with the specifications contained in the approved closure plan. A certification checklist will specify the required documentation to be submitted to the Director.

Documentation supporting the independent, qualified, registered professional engineer's certification will be furnished to the state of Kentucky upon request. Since BGAD is a Federal Facility, the PE is not required to be registered with the state of Kentucky; the PE can maintain registered certification from any U.S. state.

I-1g Amendment of Closure Plan [401 KAR 35:070 Section 3 & 40 CFR 264.112]

Personnel will notify KDEP and amend the closure plan if unexpected events occur during closure plan implementation that require a modification to the approved closure plan.

I-2 Post-Closure Plan [401 KAR 34:070 Sections 8 and 9; 34:090 Section 2(12); 40 CFR 264.117-120 & 270.14(b)(13)]

I-2a Post-Closure Plan

Prior to soil removal and/or groundwater remediation, it may be determined that achieving the clean closure performance standards is not feasible because of the continued presence of contaminated media above risk-based cleanup standards. In this case, a contingent Post-Closure Plan will be implemented based on the conditions found at the site.

This plan constitutes the contingent Post-Closure Plan for the OB and OD/BD treatment units. When post-closure is indicated, BGAD will coordinate with KDEP to revise/update this plan (and to prepare, as necessary, additional or supplementary plans) to reflect the most current requirements, standards, guidance, and procedures for continued monitoring and remediation, as necessary, until such time that media specific cleanup goals are met and the post-closure period is agreed to end.

I-2b Inspection, Monitoring and Maintenance [401 KAR 34:070 Section 9 & 40 CFR 264.118]

Table I-3 lists specific items proposed to be inspected and monitored during the post-closure care period, as well as their respective schedules, rationale to be used to determine the need for corrective maintenance activities, and a description of the corrective maintenance procedures. If clean closure cannot be achieved, the treatment units are proposed to be monitored in accordance with provisions similar to those provided in the groundwater detection monitoring. The details of the post-closure groundwater monitoring plan will be established by BGAD in coordination with KDEP when the post-closure period begins.

All inspections that are conducted will be recorded in an inspection log that is kept at the Environmental Office. The inspection log will include the date and time of the inspection, name of the inspector, a notation of observations made, and the date and nature of any repairs or remedial measures taken to correct the problem. Figure I-1 provides an example of the post-closure inspection log.

Table I-3. Inspection, Monitoring and Maintenance Plan for OB and OD/BD Treatment Units

Area/Equipment	Specific Items	Rationale	Corrective Action Maintenance	Frequency
Security devices, access controls and signage	Facility fence	Broken	Repair immediately if damaged	Quarterly
	Access gates	Locking mechanism jammed	Repair/replace	
	Warning signs	Illegible	Replace	
Erosion Damage	Erosion and sediment control systems	Compromised, damaged, ineffective	Replace hay bails	Quarterly
Vegetative Cover	Vegetation	Bare, sparse	Seed and cover with straw	Spring Fall
		Overgrown	Mow	
Detection/Monitoring equipment	Monitoring wells	Unlocked well caps, damaged casings, protective posts or well pads	Secure well caps; if damage precludes the use of the well, seal damaged well and install a replacement well	Quarterly
		Analytical results	Evaluate sampling results to determine whether contamination is being released to groundwater	
			Establish appropriate remedial activities (e.g., pump and treat)	
Benchmarks	N/A	Damage	Replace if damaged	Quarterly

If an inspection reveals deterioration or breakage of equipment and/or structures, maintenance will be implemented to prevent or mitigate any harm to human health and the environment. When such a hazard is recognized as being an imminent threat, remedial action will be taken immediately.

I-2c Post-Closure Care for Miscellaneous Units [401 KAR 34:250 Section 4 & 40 CFR 264.603]

BGAD fully anticipates the achievement of clean closure for its OB unit. Post-closure requirements, however, are anticipated for the OD/BD unit. If contaminated soils within the unit cannot be fully decontaminated to concentrations at or below risk-based levels, the unit will be closed with contaminated soil left in place (closed as a landfill), and post-closure monitoring will be completed. If the groundwater remains contaminated above risk-based levels, groundwater contamination will be evaluated to determine the remedial options that are appropriate. Groundwater monitoring will continue until contamination is shown to be below risk-based levels. This alternative requires the development of risk assessments that demonstrate that there are no impacts to human health or the environment by leaving the waste in place. Additional sampling and monitoring activities may be required by KDEP under this scenario.

Date: ____

Time of Inspection: ____

Inspector: ____

OBSERVATION OF AREA/EQUIPMENT

Security Devices

General condition of facility fence and gate, locks, legibility of signs
Identify existing problems requiring repair or replacement, if any

Final Cover

Description of cover conditions/appearance
Identify areas >25 ft^2 requiring revegetation, resurfacing, and grading, if any

Drainage Control

Identify areas containing significant volumes of ponded water (i.e., >25 ft^2); identify areas of >25 ft^2 of eroded cover

Identify other areas indicative of degradation, blockage, settlement, etc.

Detection/Monitoring Equipment

Notation of any monitoring wells that are not locked
Notation of damaged casings, protective posts, eroded well pads

Benchmarks

Description of any damage to benchmarks

REPAIRS OR REMEDIAL MEASURES

A narrative of the date and nature of repairs or remedial actions taken since the previous inspection. Documentation may include photographs and/or sketches of the deteriorated conditions prior to corrective action.

Figure I-1. Post-Closure Inspection Log – Typical Format

Based on the results of the risk assessment(s), the following mechanisms may be used:

- Prohibit the use of the contaminated groundwater aquifer as a drinking supply.
- Minimize disturbance of the soils by restricting access and limiting the use of the site to emergency treatment and/or training.
- Limit the use of nearby surface water uses, if any (e.g., recreational uses).

The post-closure use of property will be limited to activities commensurate with the closure activities completed. If clean closure performance standards are achieved for both soil and groundwater, no limitations on use of the property are anticipated. However, if clean closure is not achievable, property use will be limited to activities that will not cause any disturbance of the area, endangerment of personnel entering the area, or disturbance/damage to the facility’s monitoring and/or remediation systems (i.e., groundwater monitoring wells). BGAD will maintain the fences, gates, and all monitoring devices until termination of the post-closure period.

The post-closure care period will begin upon completion of closure, including, if applicable, all required corrective action measures. The post-closure period will continue for 30 years or a reduced or extended period determined by KDEP sufficient to protect human health and the environment.

I-2d Post-Closure Security [401 KAR 34:070 Section 9 & 40 CFR 264.118]

The area where the OB and OD/BD units are located within BGAD is a restricted area and is not intended for public access. Therefore, security requirements will already be in place at closure. Post-closure security will be ensured by the existing 6-foot-high wire fence with a gate surrounding the Demo Grounds area.

I-2e Post-Closure Contact [401 KAR 34:070 Section 9 & 40 CFR 264.118]

Copies of the Post-Closure Plan will be maintained by the Environmental Office at BGAD, until the post-closure care period is completed, certified by the permittee, and signed by a registered professional engineer. Documentation supporting the independent, qualified, registered professional engineer's certification shall be furnished to the state of Kentucky upon request. Since BGAD is a Federal Facility, the PE is not required to be registered with the state of Kentucky; the PE can maintain registered certification from any U.S. state.

This plan will be updated as necessary by issuing either page changes or new copies, as appropriate, to all plan addressees. The title of the individual responsible for storing and updating the facility copy of the Post-Closure Plan and the address where copies will be maintained are as follows:

Title: Environmental Coordinator

Address: Commanding Officer
Blue Grass Army Depot
431 Battlefield Memorial Highway
Richmond, KY 40475

The individual responsible for updating the facility copy of the Post-Closure Plan (as listed above) will be responsible for issuing page changes or new copies, as appropriate, to all plan addressees.

I-2f Post-Closure Certification [401 KAR 34:070 Sections 11 & 40 CFR 264.120]

A certification that the post-closure care period for the thermal treatment units was performed in accordance with the specifications in the approved Post-Closure Plan will be submitted by registered mail to the Director of KDEP no later than 60 days following completion of the established post-closure care period. The certification will be signed by an authorized official of BGAD and an independent and a registered professional engineer. Documentation supporting the independent, qualified, registered professional engineer's certification shall be furnished to the state of Kentucky upon request. Since BGAD is a Federal Facility, the PE is not required to be registered with the state of Kentucky; the PE can maintain registered certification from any U.S. state.

Within 60 days of the completion of final closure BGAD will submit to the Director, by registered mail, a certification signed by a principal executive officer and a registered professional engineer. The certification will state that the OB and OD/BD units have been closed in accordance with the specifications contained in the approved closure plan. A certification checklist will specify the required documentation to be submitted to the Director.

Documentation supporting the independent, qualified, registered professional engineer's certification will be furnished to the state of Kentucky upon request. Since BGAD is a Federal Facility, the PE is not required to be registered with the state of Kentucky; the PE can maintain registered certification from any U.S. state.

I-2g Amendment of Post-Closure Plan [401 KAR 34:070 Sections 9 & 40 CFR 264.118]

An amended Post-Closure Plan will be submitted for review and approval by the Director of KDEP if (1) changes in the operating plans or facility design affect the approved Post-Closure Plan or (2) events occur during the active life of the facility that affect the approved Post-Closure Plan.

The Post-Closure Plan will be amended at least 60 days prior to a proposed change in facility design or operation or no later than 60 days after an unexpected event has occurred that affects the Post-Closure Plan.

I-2h Post-Closure Notices [401 KAR 38:070 Section 10 & 40 CFR 264.119]

The requirements for post-closure notices are not applicable to Federal property. Deeds are also not in use for federal properties or land transfers to another federal entity. In the event that the properties where the OB and OD/BD units are located should transfer outside of the DoD to a non-federal entity, a notation in the deed would inform potential purchasers of restrictions, as applicable, associated with the former OB and OD/BD units. In addition, a copy of an insurance policy demonstrating compliance with 401 KAR 34:120 is not necessary since Federal Facilities are exempt from financial assurance requirements per 40 CFR 265.140(c).

I-3 Closure Cost Estimate [401 KAR 34:080 Section 2(3); 34:090 Section 2(14) & 40 CFR 264.142]

Not applicable; BGAD is a Federal installation.

I-4 Financial Assurance Mechanism for Closure [401 KAR 34:080 Section 2(3); 34:090 Section 2(14) & 40 CFR 264.146]

Not applicable; BGAD is a Federal installation.

I-5 Post-Closure Cost Estimate [401 KAR 34:080 Section 2(3); 34:090 Section 2; 34:100 Section 1 & 40 CFR 264.144]

Not applicable; BGAD is a Federal installation.

1-6 Financial Assurance Mechanism for Post Closure [401 KAR 34:080 Section 2(3), 34:090 Section 2; 34:100 Section 2 & 40 CFR 264.146]

Not applicable; BGAD is a Federal installation.

I-7 Liability Requirements [401 KAR 34:120 & 40 CFR 264.147]

Not applicable; BGAD is a Federal installation.

PART J. OTHER FEDERAL LAWS

Environmental issues pertinent to this permit application are addressed under the provision of the National Environmental Policy Act, 40 CFR Parts 1500.4 (b), (f) and (i). The requirements of the following Federal laws must be met when they apply to the OB and OD/BD units at BGAD:

- Wild and Scenic Rivers Act (WSRA)
- National Historic Preservation Act (NHPA)
- Native American Graves Protection and Repatriation Act (NAGPRA)
- Endangered Species Act
- Coastal Zone Management Act
- Fish and Wildlife Coordination Act

Several large wetland areas have been mapped at BGAD. Potential jurisdictional wetlands are present in narrow bands associated with the streams and lakes. The locations of wetlands to the OB and OD/BD units are shown on Figure J-1. The operations of the OB and OD/BD units at BGAD identified in this permit application will not impact wetlands.

J-1 The Wild and Scenic Rivers Act [16 US Code 1271-1287]

The only river identified by the Wild and Scenic Rivers Act in Kentucky is the Red River. The portion designated under the Wild and Scenic Rivers Act of the Red River will not be affected by the operations of the OB or OD/BD units.

J-2 The National Historic Preservation Act of 1966 [16 US Code 470 et seq.]

There are 182 recorded archaeological sites on BGAD. One property on the installation is listed on the National Register of Historic Places (Battle of Richmond Historic Areas) and an additional six properties are considered eligible for listing. The operations of the OB and OD/BD units at BGAD identified in this permit application will not impact archaeological sites or historic properties.

J-3 Native American Graves Protection and Repatriation Act [25 US Code 3001 et seq]

Two archaeological sites are known to contain Native American burials and several more are suspected to contain Native American burials. The operations of the OB and OD/BD units at BGAD identified in this permit application will not impact Native American burials.

J-4 The Endangered Species Act [16 US Code 136, 1531 et seq.]

Running Buffalo Clover (RBC) (*Trifolium stoloniferum)* has been documented at 16 sites at BGAD (Running Buffalo Clover 5 Year Review, June 2011). BGAD-wide, qualitative RBC surveys were completed by Eastern Kentucky University (EKU) personnel in 2001 and 2002, and these efforts were followed by a more quantitative, BGAD-wide approach in 2003. Since 2003, EKU personnel completed BGAD-wide quantitative surveys in 2004, 2005, 2006, 2008 and 2010. Significant damage from an ice storm and tornado in 2009 opened the canopy over several populations of RBC, and flooding in 2010 led to submersion, scouring, and deposition of debris and sedimentation of populations (Brown and Goode, 2010[1]).

RBC occurs most commonly on rich soils in habitats with filtered light such as open woodlands, savannas, floodplains, and mesic stream terraces on well-drained sites. A Rare Species and Aquatic Faunal Survey of Blue Grass Army Depot, Kentucky (Bloom et al., 1995[2]) was conducted by the Kentucky State Nature Preserves Commission from 1992 to 1994 to locate threatened, endangered, and rare species of plants and animals on the depot. This information was mapped by Mr. Tom Bloom of the Kentucky State Nature Preserves. BGAD actively manages the RBC population in accordance with its *Endangered Species Management Plan.* A copy is available upon request.

The endangered Indiana bat (*Myotis sodalist)* may exist on the depot, although previous surveys have been inconclusive. Given the proximity of BGAD to known hibernacula, presence of the Indiana bat is presumed. Tree clearing is prohibited from 1 June to 1 August and must be coordinated through the U.S. Fish and Wildlife Service (USFWS) outside that time frame. The current *Endangered Species Management Plan* is being updated to include recent USFWS direction.

The northern long-eared bat (*Myotis septentrionalis*) occurs on the depot. Tree clearing is prohibited from 1 June to 1 August and must be coordinated through USFWS outside that time frame. The current *Endangered Species Management Plan* is being updated to include recent USFWS direction.

The bald eagle (*Haliaeetus leucocephalus*) no longer listed as threatened or endangered, remains a protected species under several other federal laws. The bald eagle probably occurs as a migrant at BGAD and is most likely to be seen around Lake Vega and other water bodies on the depot and in the region. No nesting has occurred on the depot and no resident birds exist.

The only other species of concern at BGAD is the eastern wood rat (*Neotoma floridana*), a federal candidate, which has been found within the Moberly, Kentucky USGS topographic quadrangle. It commonly occurs in bluff-lines and other rocky areas that contain crevices. Wood rats construct houses of sticks and twigs, supplemented with any readily available suitable materials. Houses are approximately 1 to 2 meters in diameter and 1 meter high. The houses are found under rock ledges, abandoned buildings, brush-piles, and the base of trees (Wiley, 1980[3]).

The OB and OD/BD units have been in operation at BGAD for more than 65 years. Their continued operation will not affect any endangered or threatened species plants or animals at the depot.

J-5 The Coastal Zone Management Act [16 US Code 1451-1464]

The operation of the OB and OD/BD units at BGAD will not affect any coastal zone areas.

J-6 The Fish and Wildlife Coordination Act [16 US Code 661 et seq.]

The operation of the OB and OD/BD units at BGAD does not result in the impoundment, diversion, control or modification of any surface water bodies; therefore, this act is not applicable.

BGAD operations are implemented in compliance with applicable environmental laws and policies. Records are maintained as required by 401 KAR 34:050, which defers to 40 CFR 264.73 and 264.74.

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[1] Brown, D. and L., Goode. 2010. Summary of Running buffalo clover survey activities conducted by Eastern Kentucky University (at Blue Grass Army Depot). Prepared for the Blue Grass Army Depot and Kentucky State Nature Preserve Commission. 21 pp.

[2] Bloom, T., R.R. Cicerello, and B. Palmer-Ball, Jr. 1995. *Rare Species and Aquatic Faunal Survey of Bluegrass Army Depot*, Kentucky. Technical Report prepared by Kentucky State Nature Preserves Commission, Frankfort, Kentucky for Blue Grass Army Depot, Richmond, Kentucky.

[3] Wiley, R. 1980. Neotoma floridana. Mammalian Species, Vol. 139: 1-7.

Explanation:

Railroad
Primary Road
Secondary Road
Water Body
Wetland
Installation Boundary
OB Pan 1
OB Pan 2
OD/BD Unit

0 0.25 0.5 1 Miles

0 1,500 3,000 6,000 Feet

N

Projection: KY State Plane South, Feet, NAD 1983

Map Created By: USACE-LRL
Date: 2/11/2014

Data Sources:
Wetlands - BGAD, 2012
Transportation - KYTC, 2006
Installation Data - BGAD, 2012
Aerial Photography - ESRI, 2010

FIGURE J-1
Wetlands Map
Blue Grass Army Depot
Madison County, KY

ch2m:

PART K. WASTE MINIMIZATION [401 KAR 38:090, Section 2(23); Section 38:030 Section 1 & 40 CFR 270.30]

BGAD is committed to environmental protection and pollution prevention in its waste management operations. The operation is designed and managed as much as possible to reduce usage of hazardous materials and releases of pollutants into the environment.

Waste minimization efforts for BGAD operations are addressed in Module II, Part K of *Hazardous Waste Facility Permit, RCRA Hazardous Waste Storage Permit Renewal Application for Conventional Munition Related Items*. The renewal application discusses the use of the HAZMART program and Hazardous Materials Management System for single-point accountability over the requisitioning, receipt, repackaging and issue of hazardous material. These management tools are not available for use with military munitions, the focus of this permit application.

Resource, recovery, and recycling (R3) are integral to demilitarization Enterprise operations, of which BGAD is a part. R3 principals are incorporated at all operational levels to reduce the generation of WMM that requires treatment/disposal. Key to the success of the Enterprise R3 program is language that was codified in the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2007. With passage of NDAA 07, the Army has legal authority to establish and operate a recycling program that will benefit the demil program by offsetting demil R3 operations cost and allowing the Army to sell recyclable munitions materials resulting from demil and reinvesting the proceeds into demil R3 operations. The FY2007 law complements the Demil Research and Development (DRD) Program and the Design for Demil (DFD). DRD has major thrust areas focusing on disassembly and reusing existing munitions. DFD seeks to influence future munitions design for easier disassembly. Both of these initiatives can help maximize the recycling value of demil residual products by reducing the cost of a more valuable end product.

Although no longer operational, BGAD's explosives washout facility is one example of the application of R3 principals to reduce both the volume and toxicity of hazardous waste associated with the conventional munitions demilitarization operation. When operating, the washout facility was used to remove energetic materials from metal munitions casings. Millions of pounds of metal was recovered and recycled from the effort. In addition, the energetic material extracted from the munitions items was dried and repackaged and used on and off-site as donor material. BGAD's D100 CDC is another example of the application of technology to reduce at least the toxicity of hazardous waste. The D100 is fitted with an air pollution control system that significantly reduces air emissions associated with conventional demilitarization by detonation. Appendix B-1 of this permit application discusses alternative technologies employed across the Demil Enterprise to reduce the toxicity of hazardous waste and identifies priority alternatives under evaluation by BGAD to further reduce its reliance on OB and OD/BD and further minimize the impact of its operations.

BGAD maintains records in compliance with the waste minimization certification requirement for uniform hazardous waste manifests as found in 401 KAR 32:020 Sections 1 and 5 (incorporating 40 CFR 262.27).

PART L. SIGNATURES [401 KAR 38:070, Section 7 & 40 CFR 270.11]

"I certify under penalty of law that this document (Permit Application for Treatment of Conventional Munitions, May 2016) and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for known violations."

Date: 13-FEB-2018

Norbert A. Fochs

Norbert A. Fochs
Colonel, U.S. Army
Commanding

PART M. SUPPLEMENTAL INFORMATION; BGAD Responses to KDEP Final Comments Dated November 22, 2017 and Path Forward on OB/OD Permit January 22, 2018

M-1 KDEP Comment:

Pursuant to the meeting on September 21, 2017 and follow-up discussions, KDEP needs the following items to be addressed:

1. We need maps that show definite boundaries to the OB and OD hazardous waste management units. Please note that all monitoring wells should be outside of these boundaries.

   BGAD RESPONSE: The revised maps for Open Detonation Area (Figure E-2a) and Open Burn Area (Figure E-2b) are included in the application.

2. We need a PE certification on the OB As-Built Drawings, which show the pad layout and drainage contours. The referenced cross-sections should be certified as well. The drawings are labeled as "As-Built Drawings – 5/12/16" in the application.

   BGAD RESPONSE: The As-Built Drawings originals with the PE certification have been mailed to KDEP under separate cover. Copies of these drawings are included in the application, in place of the non-PE certified drawings.

3. We need a specific proposal for the groundwater statistical method to use at OD. We anticipate an initial method which does not require a background well. We anticipate that the statistical method will be revised upon successful implementation of a background well (which will be addressed through a compliance schedule requirement).

   BGAD RESPONSE: Statistical analysis of the groundwater analytical results will be performed in accordance with 40 CFR 264.97(h) and 264.98(f). Because of the lack of existing background data for the monitoring well network, an alternative dataset will need to be utilized for statistical data evaluation until such time that a background monitoring point can be established and sufficient data acquired. In accordance with 40 CFR 264.97(h)(3), the tolerance interval procedure will be used to develop upper tolerance limits for the individual detected parameters within the monitoring network following the procedures specified in the US EPA Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance (2009).

   As with most statistical methods, a minimum dataset is required for proper evaluation. Tolerance limits can be calculated with as few as 3 observation points, although a minimum of 8 data points is preferred. To overcome this limitation, an intrawell methodology will be employed to evaluate the monitoring network data by pooling the data from the entire existing well network to create an adequately-sized background dataset (USEPA, 2009). This method will be continued until such time that a minimum of three data points (either on an intrawell or interwell basis) become available. That way, the tolerance limit will be based on the data representing the existing well network and will be able to easily identify a statistical outlier or a significant change in concentration between sampling events.

Once a minimum of three sampling events has been completed, the tolerance limit calculations will be adjusted to use data from an established background monitoring point (interwell) to calculate the upper tolerance limit going forward.

While the use of interwell statistics (comparison of upgradient to downgradient wells) is preferred, given the uncertainty of locating a suitable upgradient sampling points, as well as the potential spatial variability that can occur through the development of preferential pathways within karst groundwater systems, intrawell statistical procedures (comparison of the data from within an individual well) may be appropriate for the site conditions encountered. Use of intrawell statistical methods in place of interwell methods will be determined based on the ability to establish a representative upgradient monitoring point for the monitoring well network. If an appropriate background monitoring point cannot be established, then the data from each individual well will be used to calculate well-specific (intrawell) upper tolerance intervals.

Should ongoing sampling indicate that an alternate statistical method compliant with 40 CFR 264.97 (h) is more appropriate to evaluate the site data, then BGAD will submit a written request to KDEP to revise the approach.

4. Table E-3 Solid Waste Management Units and Areas of Concern at BGAD should be removed from the application.

   BGAD RESPONSE: The table has been removed from the application.

5. There are some items related to modeling and risk assessment that were not adequately addressed in the NOD responses, and require further responses:

   a. NOD Item 40b. While some contaminants may naturally degrade, others, such as arsenic, do not. OD operations have the potential to disperse contaminants such as arsenic that are already present in the soil but that would otherwise not be dispersed. Please provide evidence that dispersion of such contaminants due to operations does not impact human health and safety.

      BGAD RESPONSE: During the detonation, the soil at the unit forms in clumps and rains down as those clumps on the unit. Moisture holds the soil together, so little dispersion is expected and results in reduced long-range transport.

      <u>KDEP FOLLOW-UP COMMENT for #5a:</u>

      We have observed detonations and seen evidence that contradicts the statement "During the detonation, the soil at the unit forms in clumps and rains down as those clumps on the unit. Moisture holds the soil together, so little dispersion is expected and results in reduced long-range transport." While some of the soil may clump, the plume appears to carry fine, dust-like particles, too. In addition, even if little long-range transport occurs, any amount of soil dispersion has the potential to distribute arsenic in a manner that wouldn't occur without OD operations. The draft compliance schedule item which requires soil sampling will also require sampling to determine the soil particle size distribution in representative samples from the OD area, as well as estimates of arsenic dispersion due to OD operations. In the meantime, please provide an estimate of the amount of fill dirt that is brought in, on an annualized basis. We understand that bringing in fill dirt does not occur on a fixed schedule, but please provide your best estimate.

      BGAD RESPONSE: BGAD can find no information indicating a historic or current source of arsenic contamination on the OD grounds. Arsenic is not present in any of the waste streams disposed of on the OD grounds. Based on additional research, it is now clear that arsenic is naturally occurring in KY soils, often in very high concentrations. It should be noted that this is a regional phenomenon occurring across Appalachia and not just localized. While the majority of the soil ejected during a buried detonation remains on the site, some soil will leave the site and be dispersed. The observation of small quantities of fine dust in a detonation plume is valid and may be a result of soil dust as well as carbon soot from the detonation. There is no mechanism for arsenic to be selectively removed from soil and dispersed in the detonation process. Given the broad, natural background distribution of arsenic in KY soils, soils dispersed from the detonation site may not necessarily increase arsenic concentrations in soils of receptor locations. It is equally likely that any dispersed soils would not increase arsenic concentrations and may actually decrease arsenic concentrations in receptor soils through dilution.

BGAD brought in fill dirt for the demolition grounds as follows:

- December 2016 – March 2017 5,875 tons
- Summer 2017 (BGAD Project) 60,300 tons
- July 2015 – January 2016 6,480 tons

The data was not readily available prior to July 2015. BGAD stored away an estimated 40,200 cubic yards of additional dirt from a construction project last summer. It equates to 60,300 tons of dirt based on typical soil density of 1.5 tons per cubic yard (www.soildirect.com). This is a one-time activity and based on the amount of dirt brought in from external sources earlier, the stored away dirt is expected to support the demolition ground operations for more than a decade.

b. NOD Item 40e. The comment asks for evidence that the composition of soil-bound constituents is consistent over time. BGAD's response discusses the use of soil sampling to further understand site processes over time. No soil sampling has been conducted recently, and no plans for soil sampling has been proposed to KDEP. Please note that we anticipate that the permit will require soil sampling as a compliance schedule item.

BGAD RESPONSE: We acknowledge KDEP's comment that it will be a compliance schedule requirement.

c. NOD Item 46. Please provide the loss constants as they were calculated within the program. If that is not possible, provide the inputs that were used to calculate the loss constants.

BGAD RESPONSE: Per the HHRA Appendix B, loss constants are empirically derived from field studies completed by USEPA. The loss constants are shown in Appendix Table B-2.

d. NOD Item 51. It is still unclear how much KPDES Outfall 005 is impacting Muddy Creek. Please provide data from samples collected upstream of KPDES Outfall 005, including any data upstream of the OD/OB areas.

BGAD RESPONSE: Samples continue to be collected after the cartridge filter of each OB unit and submitted with the compliance reports, as required by the KPDES permit. The problem will soon be eliminated with the installation of new lift stations from each OB unit and piping them to the force main and then to the wastewater treatment plant and monitoring prior to discharge, per KPDES permit.

e. Chromium Restriction:

i. BGAD has stated that review of worst-case emissions showed higher than expected levels of hexavalent chromium [Cr(VI)]. (See Slide 21 from Nov. 1, 2016, meeting.)

ii. Because F/155M HERA delay assemblies are a significant chromium VI contributor, BGAD has decided to treat no more than 1000 of these munitions each year. However, BGAD has not specified the annual throughput of these assemblies before the restriction was taken.

iii. Similarly, BGAD has provided the surrogate composition of barium chromate prior to taking this restriction (approximately 2.5%, as stated on Slide 12 from Sept. 30, 2015, meeting) but has not stated the surrogate composition after the restriction was imposed.

iv. Therefore, KDEP does not have enough information to compare chromium emissions before and after the restriction was implemented. Please provide either:

- The percentage surrogate composition for OD/BD of barium chromate currently being used, or
- The number of 155 mm delay fuzes that were being detonated annually before the 1000 fuze limit was self-imposed.

KDEP FOLLOW-UP COMMENT (for #5e):

Please provide the MIDAS report for the 155 mm fuzes as part of the response.

BGAD RESPONSE: In developing the surrogate emission factors, the worst case emissions of each pollutant from past waste streams were selected. This is a very conservative and protective approach for identifying emissions of concern that were successfully used in this case to identify the 155 mm delay fuse as a source of emissions that could potentially produce exposure levels in excess of acceptable risk levels if large numbers of the item were regularly disposed of. By arbitrarily setting an annual maximum limit of 1000 delay fuses, the emissions of concern were sufficiently reduced to produce acceptable risk numbers. Incorporation of these limits produced the acceptable risk numbers presented in the application. The use of a numeric count on the source of the emissions (155 mm delay fuse) as a limit was implemented because an annual numeric count is easier for verification and compliance.

Eight years of disposal data FY07-FY15 was used to develop a surrogate munitions composition that is based on a weighted average and is documented in the Risk Assessment Report. However, the item hasn't been detonated yet after taking the restriction.

The MIDAS report for the requested items have been provided to KDEP under the "For Official Use Only" provisions in a separate cover, consistent with the practice for similar reports BGAD provided KDEP, when requested by KDEP during review of the permit application.

6. (New item for consideration) – Table C-4 of the permit application indicates that NSN 1340011603075, propellant grain MK90 MOD 0, is included as an item treated at BGAD by OB. A MIDAS report was included on the MK66 rocket motor; but please provide a MIDAS report for the MK90 propellant. Tests on MK90 propellant at Radford Army Ammunition Plant indicated arsenic as an emission (Characterization of Air Emissions from Open Burning at the Radford Army Ammunition Plant, by Johanna Aurell and Brian Gullett, August 23, 2017). Please verify that MK90 MOD 0 propellant is treated at BGAD and whether this may be a source of arsenic.

BGAD RESPONSE: The MIDAS report for the requested items have been provided to KDEP under the "For Official Use Only" provisions in a separate cover, consistent with the practice for similar reports BGAD provided KDEP, when requested by KDEP during review of the permit application. There is no arsenic present in this item based on review of the MIDAS report.