TETRA TECH

WORK PLAN

REMEDIAL INVESTIGATION/FEASIBILITY STUDY

AT THE

FORMER KILGORE MANUFACTURING COMPANY PROPERTY

WESTERVILLE, OHIO

Performed for:

OTTERBEIN UNIVERSITY
Westerville, Ohio

Prepared by:

Tetra Tech
Foster Plaza 7
661 Andersen Drive
Pittsburgh, Pennsylvania 15220-2745

December 10, 2010

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DECEMBER 10, 2010

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1.0 INTRODUCTION

This Remedial Investigation/Feasibility Study (RI/FS) Work Plan and associated documents were prepared by Tetra Tech NUS, Inc. (TtNUS) on behalf of Otterbein University (Otterbein)for the former Kilgore Manufacturing Company Facility (the Site) located at 400 North Spring Road in Westerville, Ohio (Figure 1-1). The facility ceased operations in 1962, and the property was donated to Otterbein College. Otterbein is conducting environmental investigations at the following eight areas of concern (AOCs) at the Site:

- AOC 1 – Unidentified Rectangular Features
- AOC 2 – Drainage Ditch Near Former Manufacturing Area
- AOC 3 – Burial Area
- AOC 4 – Burn Pit
- AOC 5 – Manufacturing Area – Former UST Location.
- AOC 6 – Former Experimental Area
- AOC 7 – Cinder Area
- AOC 8 – Former Burial Trench Area

This Work Plan and associated documents presents a strategy for the investigations to be conducted at each AOC. The Work Plan includes the following:

- **Section 2: Site Background**
  - Describes potential or suspected sources of contamination,
  - Summarizes available information regarding physical site conditions and the types and concentrations of contaminants detected in the environmental media: and
  - Identifies potential exposure pathways (for human and ecological receptors).

- **Section 3: Initial Evaluation/ Conceptual Site Model**

- **Section 4: Work Plan Rationale**
  - Problem statement
  - RI sampling strategy and data use
  - Data quality objectives
  - Decision rules

- **Section 5: Remedial Investigation/Feasibility Study Tasks**

- **Section 6: Human Health Risk Assessment**

- **Section 7: Ecological Risk Assessment**

- **Section 8: Feasibility Study**

- **Section 9: Key Assumptions**

- **Sections 10: Schedule**

- **Section 11: Project Management organizational chart and roles/responsibilities**

- **Section 12: References**

- **Attachment A: Pre-Investigation Evaluation Report (PER)**
  - August 10, 2010 PER
  - OEPA comments to the PER
  - (The PER has not been modified; however, the OEPA PER comments have been incorporated into the CSM, site evaluation, and work rationale described in this Work Plan.)

- **Attachment B: Field Sampling Plan**

- **Attachment C: Quality Assurance Project Plan (QAPP)**

- **Attachment D: Health and Safety Plan**
  - Previously submitted HASP
  - OEPA Comments to HASP
  - Responses to OEPA HASP Comments

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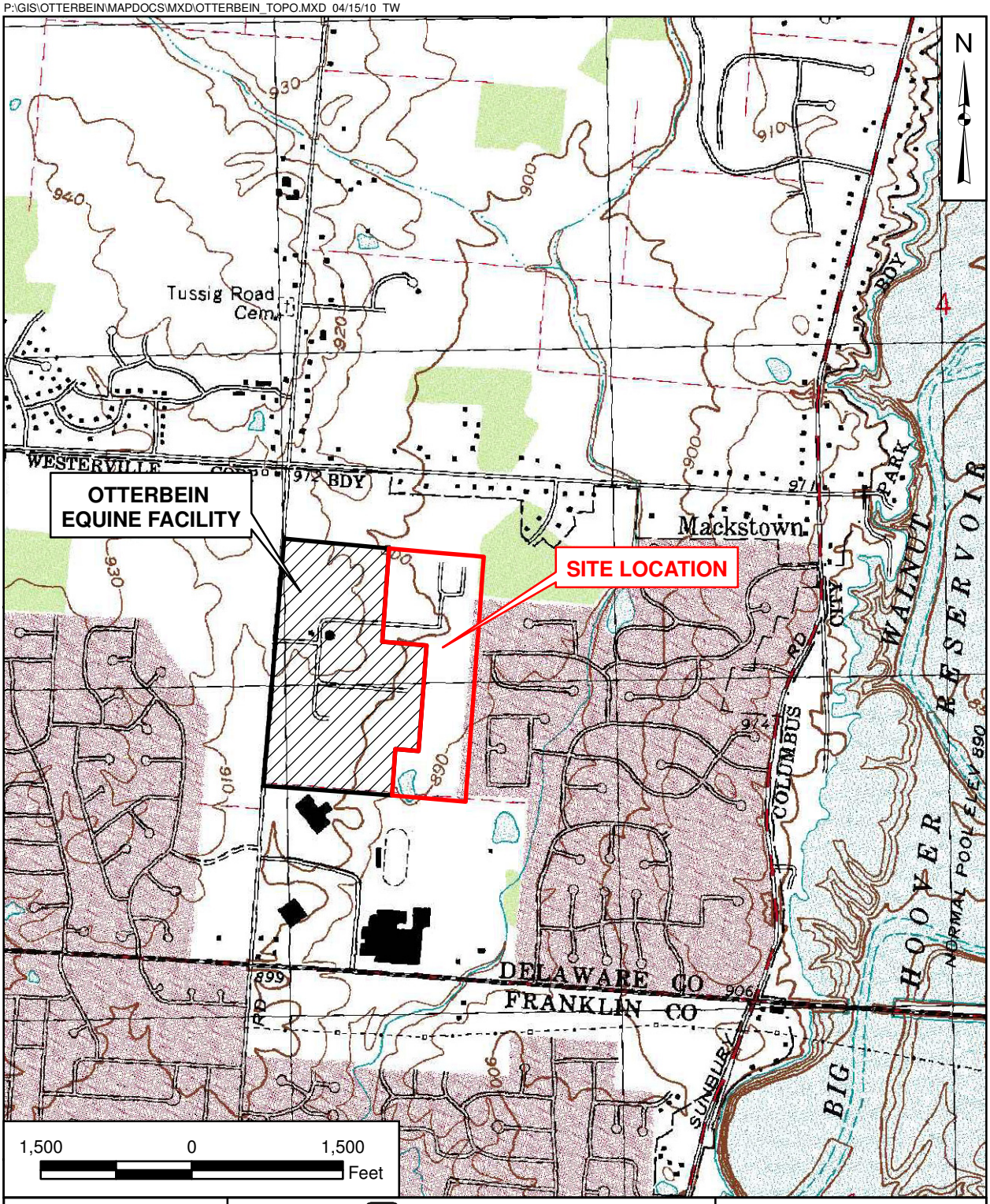

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CHECKED BY S. HILL	DATE 04/15/10	USGS TOPOGRAPHIC MAP	APPROVED BY ___ / DATE ___
COST/SCHEDULE AREA		FORMER KILGORE MANUFACTURING SITE WESTERVILLE, OHIO	APPROVED BY ___ / DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 1-1 / REV 0

TETRA TECH

SITE LAYOUT
FORMER KILGORE MANUFACTURING SITE
WESTERVILLE, OHIO

DRAWN BY	DATE	SCALE
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2.0 SITE BACKGROUND

The background information is summarized from the recently published Pre-Investigation Evaluation Report (PER) for the Kilgore Manufacturing Company Facility, Westerville Ohio [Tetra Tech (TtNUS), August 2010] or from documents referenced in the PER. Unless noted otherwise, the tables, figures, and appendices referenced in Part 1 are those presented in the PER; and are not presented again in this Work Plan, instead the PER is included in Attachment A. The PER and many historical documents describing the conditions at the AOCs have referenced the Ohio Environmental Protection Agency (OEPA) Voluntary Action Program (VAP) standards as points of comparison. In accordance with recent conversations with OEPA, future data evaluation/risk assessment documents prepared for the AOCs will use United States (US) EPA regional screening levels (RSLs) as screening levels for environmental contamination. In many cases, the VAP standards referenced in the PER and the following narrative are similar to the RSLs.

Information regarding site background, site history, and the environmental setting common to the eight AOCs is presented in Sections 3-4 through 3-10.

2.1 SITE BACKGROUND AND HISTORY

The Kilgore Farm property is located in the City of Westerville, in Delaware County central Ohio (Figure 1-1). In 1941, in response to the needs of the Army Chemical Warfare Service for World War II, Kilgore Manufacturing purchased the 111 acre former farm for conversion to a pyrotechnics and ordnance manufacturing facility. This facility consisted of a network of small magazines, concrete buildings (including a boiler house), Quonset huts, a water tower, and other ancillary support facilities. On site activities conducted by Kilgore Manufacturing included experimental work on explosives and other energetic materials, and the manufacture and assembly of explosives, incendiary items, and detonation devices. Over the course of operations, various types of flares were manufactured including parachute, floating, photoflash, battlefield, trip, high altitude, 3-minute, and highway emergency flares for military and civilian uses. Incendiary bombs included thermite and magnesium explosive bomb clusters and for a short period of time, the facility experimented with the production of shaped charges (Kuis, 2003). Other specific products built or stored included 155 millimeter (mm) illuminating shells, hand and smoke grenade fuses and primers, M1 flame throwers, rocket line launchers, phosphorous float lights, and M112 photoflash cartridges (Kuis, 2003). Pelletization of black powder also took place. Typical types/descriptions of MEC that may be present are described below (UXB, January and March, 2000). Previous indications that land mines may also have been produced (Lawhon & Associates, 1996) were later discredited.

After World War II, Kilgore Manufacturing made toy cap guns and pyrotechnics for public use and illuminating flares for civilian and military use until 1961 when the facility closed. Figure 3-1 of the PER (Attachment A) shows an aerial photograph of the Site in 1958 before it was closed. Otterbein College has owned the 111-acre former Kilgore Farm property since it was donated to the college in 1962 by the owner, Commercial Credit Corporation after operations ceased. Farming, notably of beans and corn, resumed after 1967 and ceased in 1986. In 2007, Otterbein successfully obtained a zoning change from rural residential to planned Neighborhood District for the entire 111 acres to allow the Site to be used for college expansion. Phase I of Site development included a 69.145-acre parcel adjacent to the Site that is the location of Otterbein's equine science field operations. Phase II Site development is associated with the remaining 39.818-acre Site parcel. The intended future use of the property is recreational/educational. Residential development of the property is expected to be prohibited by deed restriction.

Wastes generated during operations included burning/disposal of produced wastes, such as material from settling sumps in the manufacturing area, and those items not meeting military standards of acceptability. Waste disposal records are incomplete. Most information regarding the types and quantities of wastes produced, disposed, or treated on site have been derived from a series of cleanups and investigations that spanned from 1962 to 2007, including the removal of foundations and other building structures in 1996. Eight specific AOCs have been identified (Figure 1-2). Environmental investigations included geophysical surveys; an ordnance survey; on-site testing to determine if the materials found were shock sensitive; friction sensitive, or flammable; trenching to visually identify the limits of waste disposal areas and to assess buried geophysical anomalies; and chemical sampling of soil, groundwater, and surface water.

The AOC locations have been well researched and established. However, poor waste handling/disposal procedures were evident during site cleanups and investigations and based on unrecorded disposal of: both containerized and non-containerized materials, materials disposed in various forms, and various disposal practices including surface placement, shallow burial and burning of materials. After more than 40 years, some objects brought to the surface by plowing have displayed ignitability; therefore, time has not completely eliminated hazards associated with these wastes. In 2000, UBX International conducted an unexploded ordnance (UXO) assessment and trenching investigation and concluded that there was "...a very low risk of detonations on the surface." The report went on to conclude that the overall UXO threat assessment was "medium" with a "potential hazard to local population if not cleared" Moreover, elevated concentrations of metals, sulfateand phosphorus are present in soil samples. Some soil samples had a pH low enough to be classified as corrosive and at least one sample exceeded the Toxicity Characteristic Leaching Procedure (TCLP) regulatory level for chromium.

Potential chemicals of concern associated with the operations of the Kilgore Manufacturing Facility are presented in Table 2-1.

TABLE 2-1

HISTORIC VAP/MCL EXCEEDANCES OF REGULATORY STANDARDS
FORMER KILGORE MANUFACTURING COMPANY FACILITY
WESTERVILLE, OHIO

AOC Number	Soil	Temp Wells (1988/1996) (AOC 8) and Ph 2 (2000)		Permanent Wells Ph 2 (2005)	
		AOC Wells (Depth to GW/ Screen Interval	Ph 2 GW (Max conc. µg/L)	AOC Wells (Depth to GW/ Screen Interval	Ph2 GW (Max conc. µg/L)
AOC 1 Unidentified Rectangular Features	Sb: 120 As: 41 Pb: 1080 Zn: 130000 Cr: 111000 Cr6: NA	GW: MEB 2-7 (1.28/1.0-10.92) MEB 2-8 (1.68/1.0-19.10) MEB 2-9 (2.61/1.0-11.19) MEB 2-10 (1.68/1-19.86) SW: SW-1	GW: As: 30 Pb: 19 Sb: 48 SW: Sb: 48	MW-5 (13.8/13-18)	Incomplete based on well MW-5, which was only analyzed for VOCs, Cr, and perchlorate w/ no exceedances
AOC 2 Drainage Ditch Near Mfg. Area	Sb:460000 As: 41 Pb: 2230				
AOC 3 Burial Area ESE of Burn Pit	Sb: 710 As: As	MEB 3-2 (2.26/1.0-15.36)	NA	MW-9 (19.62/22-27)	None based on well MW-9
AOC 4 Burn Pit	As: 25*	NA	As: 12 (nominal)	MW-6 (27.48/35-40) MW-7 (39.2/35-40) MW-8 (4.34/21-26)	None based on well MW-6, MW-7, and MW-8. MW-6 and MW-7 were only analyzed for VOCs, Cr, and perchlorate

TABLE 2-1

HISTORIC VAP/MCL EXCEEDANCES OF REGULATORY STANDARDS
FORMER KILGORE MANUFACTURING COMPANY FACILITY
WESTERVILLE, OHIO

AOC Number	Soil	Temp Wells (1988/1996) (AOC 8) and Ph 2 (2000)		Permanent Wells Ph 2 (2005)	
		AOC Wells (Depth to GW/ Screen Interval	Ph 2 GW (Max conc. µg/L)	AOC Wells (Depth to GW/ Screen Interval	Ph2 GW (Max conc. µg/L)
AOC 5 UST in Former Mfg. Area	As :22.8*	MEB 5-2 (Unknown)	Sb:<300 As: 910 Pb: 1900 Zn:: 10800 Cr: 1000 Cr6: NA Ni: 2000 Th:28.6** Cd: 37 Hg: 7.9 Be: 33 Ba: 6300	MW-1 (2.95/15-20) MW-2 (3.70/10-15) MW-3 (4.95/16-21)	None based on Wells MW-1, MW-2, and MW-3; however these wells appear to be upgradient of the site
AOC 6 Former Experimental Area	As: 22.7* Pb: 487 PAHs	MEB 6-5 (Unknown)	Sb:<300 As: 830 Pb: 710 Zn: 6400 Cr:1100 Cr6:1300 Ni: 1500 Th: 30** Cd: 69 Hg: 4.1 Be: 18 Ba: 3200	MW-4 (7.68/22-27)	VAP: Based on MW-4 Th: 5.6**
AOC 7 Cinder Area SE of Burn Pit	None	NA	NA	MW-10 (6.44/19-24)	None based on Wells MW-10; however this well appears to be upgradient of the site.

TABLE 2-1

HISTORIC VAP/MCL EXCEEDANCES OF REGULATORY STANDARDS
FORMER KILGORE MANUFACTURING COMPANY FACILITY
WESTERVILLE, OHIO

AOC Number	Soil	Temp Wells (1988/1996) (AOC 8) and Ph 2 (2000)		Permanent Wells Ph 2 (2005)	
		AOC Wells (Depth to GW/ Screen Interval	Ph 2 GW (Max conc. µg/L)	AOC Wells (Depth to GW/ Screen Interval	Ph2 GW (Max conc. µg/L)
AOC 8 Former Burial Trench Area	None	N well (1988) W well (1988) S well (1988) SE well (1988) None from 1996	Pb: 1100 (1988)	NA	NA
Quonset Hut Area	NA	NA	NA	NA	NA
Farm/Former Residence Area	None	NA	NA	NA	NA

Note: Groundwater samples were analyzed for metals, perchlorate, VOCs w/ketones, SVOCs, and hexavalent chromium.

* Arsenic included as exceedance for Preliminary Phase 2 Sampling (Metcalf&Eddy, 2005) but. Subsequent Phase I Property Assessment Otterbein College Equine Facility (Brown and Caldwell, 2007) suggests that concentrations are indicative of background, statistically established at 25.3 mg/kg.
** Thallium believed to be a laboratory artifact.

3.0 INITIAL EVALUATION/CONCEPTUAL SITE MODEL

The sections below provide preliminary evaluations of the various AOCs at the site and in many cases reference earlier data to VAP standards, as was appropriate for the data evaluation at the times at which the data were developed and evaluated. Otterbein understands that VAP standards are not the appropriate standards for making decisions in the current RI/FS.

3.1 OVERVIEW OF PREVIOUS ENVIRONMENTAL INVESTIGATIONS

Phase I Assessments were performed by S. E. A., Inc. in 1986, and by Lawhon & Associates, Inc. in 1991.

A VAP Phase I investigation of the entire 111 acre property was conducted by Metcalf & Eddy, Inc. (M&E) in 1988 but the findings were not submitted to OEPA. The 1988 investigation identified 14 AOCs; however, further investigation reduced this number to 11. Four areas on the current Equine Center parcel were later determined to require no further action. The Former Burial Trench Area (AOC 8) was subsequently added to the list, resulting in eight AOCs on the current 40 acre eastern parcel. In 1998, M&E conducted a Site reconnaissance and issued a Phase I Property Assessment Amendment (M&E, 1998). The 1998 report added additional historical background, but did not suggest any significant changes to the original Phase I findings concerning contamination at the Site. The 1998 report is included in the PER as APPENDIX A (Attachment A).

In 1999 and 2000, M&E conducted field investigations that led to the completion of the Preliminary Phase II Property Assessment (M&E, 2003) for the Ohio VAP (see Figure 4-1 and Table 4-1 in the PER; Attachment A). This report provides the bulk of the available soil and groundwater assessment data (included as APPENDIX B to the PER [Attachment A]), and the data for individual AOCs are tabulated in tables presented in the PER.

M&E also prepared a VAP Phase I Property Assessment Amendment in June, 2005; however, no new characterization data was provided in the 2005 report. This report M&E, 2005, is included in the PER as APPENDIX C (Attachment A). The second and third volumes of the report are included in the PER as APPENDICES D and E, and a VAP Checklist is included in the PER as APPENDIX F (Attachment A).

In 2007, Brown and Caldwell prepared a Phase I Property Assessment specifically for the Equine Center property (Brown & Caldwell, 2007), just to the west of the Site. This report includes information pertaining to the 40 acre Site and is included in the PER as APPENDIX F for additional background information (Attachment A).

Results of the previous investigations where data is available are described in the Conceptual Site Model (CSM) identified by AOC.

3.2 CONCEPTUAL SITE MODEL

This CSM was revised following comments on the PER by the OEPA, and supersedes the CSM in the PER (Attachment A).

AOC-specific CSMs are presented below. A pictorial CSM is presented as attached Figure 3-1. This pictorial CSM depicts the general Site and AOC location, a simplified geologic cross section, and the potential human and ecological receptors for the Site. Relevant exposure pathways for current and future human receptors of concern (identified in the pictorial CSM) are listed in attached Table 3-1.

The Site is located on the east side of Spring Road, approximately 700 feet south of Maxtown Road in a residential area of Westerville, Ohio and is currently vacant. The Site is partially wooded and overgrown with dense grasses and brush. The majority of the Site is covered with mature woodland. Remnants of gravel roads are still visible but all above-ground structures have been razed. Site topography is generally level, with relief less than 10 feet (898 to 890 feet above mean sea level) from west to east across the Site.

The Site is surrounded by a mix of residential and school properties, vacant fields and wooded land [Figure 3-3 in the PER (Attachment A)]:

- North: Domestic housing and vacant field and wooded land
- East: Domestic housing
- South: Westerville North High School and Heritage Middle Schools
- West: The Otterbein University Equine Science Facility

The regional climate is cold in the winter and warm to hot in the summer. The average winter temperature is 31 degrees Fahrenheit (F) while the average summer temperature is 72 degrees F. The prevailing wind is from the south-southwest with an average wind speed of 11 miles per hour. The total annual precipitation is approximately 38 inches, of which 60 percent usually falls from April through September. The average annual snowfall is 28 inches, which occurs from late November until early March.

3.2.1 Hydrology

There are no permanently flowing rivers or streams on the Site, but there is an intermittent stream that flows in the northwest corner of the property during wet times of the year. The stream was formerly connected by a tile drain to a drainage ditch on the northern portion of the property (AOC 2). The tile drain is apparently plugged, causing overland flow toward the former drainage ditch. This overland flow reportedly initiates the largest wetland on the site. (Section 3.2.4) There is no sediment on the property; the material in the drainage ditch (AOC 2) becomes saturated during wet periods, but is most properly characterized as soil, as it consists mainly of topsoil and not material transported by moving water. Hoover Reservoir, located approximately 2,000 feet east of the Site is the nearest major surface water body; there are no direct drainage ways that connect the property to Hoover Reservoir, or other surface water bodies.

3.2.2 Geology

Site surface soils are brown weathered silty clay with varying amounts of sand and gravel/shale fragments. The weathered soil horizon extends to approximately 10 feet below ground surface (bgs). Beneath the weathered soils, the unweathered soils are of the same composition but are gray in color. There is approximately 50 feet of glacial drift above the bedrock. Figure 3-4 in the PER displays the location of geologic cross-sections at the Site and Figures 3-5 through 3-8 in the PER show cross-sections A-A', B-B', C-C', and D-D' (Attachment A).

3.2.3 Hydrogeology

The Site is in an area that contains thin lenses of sand and gravel interbedded in thick layers of clay and silt. Domestic and farm supply wells are generally 100 feet deep or less in glacial overburden. The Site is adjacent to an area with meager, often inadequate supplies of groundwater. Previous Site investigations have noted the presence of discontinuous sand seams in several different groundwater flow zones in the glacial till and none of the identified sand seams were found to be extensive. Site groundwater flow is to the east-southeast, consistent with regional flow direction.

3.2.4 Wetlands

A portion of the Site is covered by wetlands. A preliminary Jurisdictional Opinion (PJO) was conducted by Civil and Environmental Consultants, Inc. (CEC) in 2005 for the entire 111 acre former Kilgore Manufacturing property owned by Otterbein College. This report (included as Appendix G of the PER [Attachment A]) designates three areas of the Site as wetlands. Wetland A was described as a forested/scrub/shrub/emergent wetland covering approximately 14 acres in the forested, eastern portion of the Site. Wetland B was described as a forested/scrub/shrub wetland covering 2 acres in the

southwestern corner of the Site. The third was Wetland C, described as an aquatic bed/scrub/shrub wetland located in the southeastern corner of the Site.

A wetland delineation was conducted on the 70 acre parcel of the former Kilgore property, just west of the current Site prior to construction of the current Otterbein Equine Center. This study conducted by MAD, Scientist & Associates LLC is in Appendix H in the PER (Attachment A).

Another wetland delineation and request for a Jurisdictional Opinion (JO) is being conducted at the site by CEC for Otterbein at the onset of the RI/FS process. The study will define the types and extent of wetlands on the site, as well as all surface water bodies. Although the wetlands delineation study is not complete, the outline of the delineated wetlands is displayed on Figure 3-2 and on the proposed sampling location map provided with this Work Plan.

3.3 AOC 1 UNIDENTIFIED RECTANGULAR FEATURE

AOC 1 is located in the northeast portion of the Site, south of the former Manufacturing Area (AOC 5), and is defined by two rectangular features of unknown past use (M & E, 2005). No evidence remains of these horizontal structures. The original source(s) of potential contaminant releases in this area are unknown. Brown & Caldwell, (July 2007), using visual identification of “green material encountered in borings and trenches” (described below), estimated the size of AOC 1 to be:

Dimensions (feet)			Volume (cubic yard)*	Tonnage/Acreage
Length	Width	Depth		
75	125	3	1,094	1,860/0.22

* Includes 5 percent contingency

Previous Investigations

In late 1999 to mid-2005, a Preliminary Phase II Property Assessment was conducted at the Site. Geophysical results showed several anomalies attributed to surface metal debris; therefore, three trenches were excavated at the locations of the potential metallic anomalies with no finding of buried items. However, a prominent green silty material with orange sand was present and exceeded the unrestricted residential use standards under VAP for several metals. The chromium TCLP analysis also exceeded the solid waste toxicity standard. Approximately 35 hand auger borings were subsequently completed within the AOC (Brown & Caldwell, 2007 and M & E, 2005). Results of the most recent (and most complete) sampling at AOC 1 are presented in Table 4-3 in the PER (Attachment A).

3.4 AOC 2 DRAINAGE DITCH NEAR FORMER MANUFACTURING AREA

AOC 2 is a drainage ditch located in the northeast portion of the Site, between the former Manufacturing (AOC 5) and Experimental (AOC 6) Areas where wastes were reportedly buried. The burial reportedly consisted of off-specification material, buried parallel to and within 8 to 10 feet of either side of the ditch. The ditch has some flow, northwest to southeast, after precipitation events; however, there is no sediment in the ditch. The material in the drainage ditch becomes saturated during wet periods, but is most properly characterized as soil because it consists mainly of topsoil and not material transported by moving water (M & E, 2005). The original source(s) of releases in this area are unknown. The AOC 2 size was estimated by Brown & Caldwell (July 2007) based on the observed limits of waste in trenches and the boring results (see below) and the depth of the deepest waste in a given trench.

Dimensions (feet)			Volume (cubic yard)*	Tonnage/acreage
Length	Width	Depth		
400	30	3	1,400	2,380/0.28

* Includes 5 percent contingency

Previous Investigations

Geophysical investigations at AOC 2 revealed a few potential metallic anomalies, the most significant being at the eastern limit of the ditch. Higher conductivity areas outside the main ditch line may represent disturbed soils. Seven trenches were subsequently excavated and ordnance was identified both on the surface and at depth. Additional surface debris included glass, laboratory crockery, metal, brick and concrete. Buried debris included ordnance, gray and purple silt-like material, black granular material, white crystalline material, red and orange stained soils, metal, glass, and ceramic debris. Several metals exceeded the VAP standards.

Further investigation of AOC 2 included the installation of 10 borings, collection of a surface water sample, and a sample of the saturated soil from the drainage ditch. An additional trench was completed in a round feature located west of the former Manufacturing Area, where concrete and fill dirt were encountered. No analytical testing was conducted because the materials in the feature were identified in the field as construction debris. Two intact and potentially live primers were identified south of the western edge of the ditch. Soil samples were obtained from the trenches and from 10 borings. Soil exceeded the unrestricted residential use standards under VAP for several metals. Some of the soils had such a low pH that the soils would be classified as corrosive. Results of the most recent (and most complete) sampling at AOC 2 are presented in Tables 4-4 through 4-6 in the PER (Attachment A).

Groundwater samples were collected from four temporary wells and analytical results exceeded maximum contaminant levels (MCLs) and VAP unrestricted use standards for several metals; however, the groundwater samples collected from these wells had high turbidity. Thus, the available data were not believed to be representative of actual groundwater chemistry. A surface water sample from the ditch exceeded the MCL for antimony (Brown & Caldwell, 2007 and M & E, 2005).

3.5 AOC 3 BURIAL AREA

AOC 3 is a former Burial Area, reportedly used to dispose of cinders and nonflammable materials generated at the facility. The source(s) of wastes for AOC 3 is reportedly the Burn Pit (AOC 4) that was used once a week to burn off-specification materials and waste. AOC 4 was periodically excavated and resulting cinders and nonflammable material were buried in trenches at AOC 3 and/or AOC 8 (M & E, 2005). Purple powder, white crystalline material, and gray and black ash were observed in this area. This AOC was reportedly excavated to a depth of 10 feet and backfilled with clean soil (M & E, 2005). Brown & Caldwell, July 2007, estimated the size of AOC 3 using observed limits of waste in the trenches, and the depth of native material, as well as the soil boring analytical.

Dimensions (feet)			Volume (cubic yard)*	Tonnage
Length	Width	Depth		
100	100	5	1,945	3,112

* Includes 5 percent contingency

Previous Investigations

Fourteen borings (by direct push and hand auger) were installed within and around the waste.

The soil exceeded the unrestricted residential use standards under VAP for several metals and perchlorate. One sample was found to be flammable and “produced copious amounts of white smoke.” Another sample was “not flammable but produced red smoke when heated” (Brown & Caldwell, 2007 and M & E, 2005). Results of the most recent (and most complete) sampling at AOC 3 are presented in Tables 4-7 and 4-8 of the PER (Attachment A).

Geophysical investigations at AOC 3 revealed a potential for large amounts of buried metallic objects and areas of high conductivity associated with potentially disturbed soils. Three trenches were subsequently completed in the area. Several 55-gallon drums and drum fragments were located on the surface and numerous metallic objects and debris were excavated within the limits of the waste. The materials included ordnance, drum fragments, metal debris, wood, glass, burned debris, a white crystalline substance, purple powder, black to gray ash, slag, cinders, black granular material, and bright red silty

material. Five-gallon pails filled with unidentified residue were also observed. Ordnance was observed both on the surface and at depth and included flares, blasting caps, and canisters.

Groundwater samples were collected from a temporary well in 2000 and a permanent VAP-compliant well, MW-9, in 2005. Due to low well yield and slow recovery, this well was analyzed for only volatile organic compounds (VOCs), chromium, and perchlorate with no exceedances (Brown & Caldwell, 2007 and M & E, 2005).

3.6 AOC 4 BURN PIT

AOC 4 is a burn pit located east of the former Quonset hut site. According to a former employee (employed 1946 to 1961), the burn pit was used once a week to burn flares, caps, and other off-specification materials and waste. Extreme care was apparently taken to ensure that all materials in the burn pit were completely destroyed during each burning event in order to prevent accidents from occurring during the next burn event. The pit was periodically excavated and the cinders and nonflammable material was buried in trenches (AOC 8) (M & E, 2005). Prior to 1962, contaminated soil from the burn pit was excavated to a depth of 10 feet. The excavated material was disposed off=site and the excavation was backfilled (M & E, 1998). The AOC 4 size was estimated by Brown & Caldwell (July 2007):

Dimensions (feet)			Volume (cubic yard)*	Tonnage/Acreage
Length	Width	Depth		
100	75	10	2,187	3,500/0.17

* Includes 5 percent contingency

The potential contaminant source was reportedly removed more than 45 years ago. Unless contaminated fill was used in backfilling the excavation, no source of contamination remains at AOC 4.

Previous Investigations

Results of the most recent (and most complete) sampling at AOC 4 are presented in Tables 4-9 and 4-10 of the PER. No intrusive environmental investigations had been conducted at AOC 4 prior to 1998. The location of the burn pit was determined from aerial photographs, and a sizeable area of potentially disturbed soil was subsequently identified south of the Burn Pit in an electromagnetic survey. No metallic debris was identified by the geophysics.

Due to the reported excavation depths of the Burn Pit during its operation (up to 10 feet), trenching was not conducted at this AOC. Ten borings were installed in and around the Burn Pit and the associated

anomaly (potentially disturbed area) to the south. Silty clay fill was encountered to depths of approximately 10.5 feet bgs, below which native fill (dense silty clay) was encountered. Three soil samples collected exceeded the VAP residential standard for arsenic, although concentrations were noted as typical of native Ohio soils.

Groundwater samples were collected from three permanent VAP-compliant wells, MW-6, MW-7 and MW-8, in 2005. Wells MW-6 and MW-8 produced enough water for a full suite of analyses (VOCs, semi volatile organic compounds (SVOCs), inorganics, and perchlorate); however, due to low well yield and slow recovery, the MW-7 well was analyzed only for VOCs, chromium, and perchlorate. No VAP exceedances were noted except for thallium which was believed to be a laboratory artifact (Brown & Caldwell, 2007 and M & E, 2005).

3.7 AOC 5 MANUFACTURING AREA FORMER UNDERGROUND STORAGE TANK LOCATION

AOC 5 is associated with a former 2,500 gallon underground storage tank (UST) located in the northeast corner of the Site within the former Manufacturing Area. The tank was used for fuel oil storage. The former UST area represents a small portion of the AOC 5 outline presented on Figure 3-1. Because it was a fuel oil tank, it was unregulated by the State. The UST was abandoned in 1962 (Lawhon & Associates, 1991) and removed in 1997 along with surrounding contaminated soil (M & E, 2005). The tank was approximately 47 years old at the time of removal. During removal of the UST, water and residual petroleum product were pumped from the tank and disposed of as petroleum-contaminated liquids. Visibly contaminated soils were excavated, segregated from “clean” soils, and stockpiled on plastic sheeting. Verification soil samples were collected from the soil surrounding the tank and results led to the removal of additional soil, which was hauled off-site for disposal. A total of 104 cubic yards of impacted soils were removed from this former UST location. The area was designated as a Category 3 Site and a closure report was filed with the OEPA (Lawhon & Associates, 1997). The residual concentrations of petroleum constituents in the soil were determined to be below the Category 3 Action Levels and below the VAP Generic Numeric Cleanup Standards (M&E, 2003).

This former UST location continues to be identified as an AOC primarily as a result of hydrocarbon odors detected in soils recovered from a soil boring advanced at the location of the former tank. Brown & Caldwell (2007) did not recommend removal of soil in this area; therefore there is no estimate of the size of any impacted soil area.

Previous Investigations

During the Preliminary Phase II Property Assessment, one soil boring installed in 2000 at the location of the former fuel oil tank had a strong hydrocarbon odor in soils from 19 to 24 feet bgs; however, no samples were collected from this boring. Four additional borings were installed in 2004 and soils consisted of mostly silty clay or clayey silt with some thin sand and gravel lenses. Soil samples exceeded the VAP residential standard for arsenic. Results of the most recent (and most complete) sampling at AOC 5 are presented in Tables 4-11 and 4-12 in the PER (Attachment A).

Groundwater samples were collected from one temporary well located downgradient of the UST. Analytical results for the sample exceeded MCLs and VAP unrestricted use standards for several metals; however, groundwater samples were highly turbid and the available data were not believed to be representative of actual groundwater chemistry. Three permanent VAP-compliant wells, MW-1, MW-2 and MW-3 were installed and sampled. No VAP exceedances were detected in these wells except for thallium, which was believed to be a laboratory artifact (Brown & Caldwell, 2007 and M & E, 2005).

3.8 AOC 6 FORMER EXPERIMENTAL AREA

This area, located north of the former Quonset huts, was used to conduct research and testing of new products and processes. Surface waste observed at this AOC included drums, construction debris, ash, slag, cinders, and black, loose granular materials (M & E, 2005). The AOC 6 size was estimated by Brown & Caldwell (July 2007):

Dimensions (feet)			Volume (cubic yard)*	Tonnage/Acreage
Length	Width	Depth		
50	50	2	194	311/0.057

* Includes 5 percent contingency

Previous Investigations

Surficial waste was observed in the vicinity of AOC 6 during the Phase II investigation, and included drums and drum fragments, construction debris, 1-to 3-gallon metal cans, burned debris, ash, slag, cinders, and a black loose granular material. Samples were collected of black residue from inside a drum, of soils beneath a pile of the 1-to 3-gallon containers, and of soil beneath spilled material. During the excavation of burial trenches, drum fragments, construction debris, burned debris, ash, slag, cinders, and black granular material, flare casings, and black caps were removed. Scattered casings and caps were present on the ground surface. Approximately 100 black canisters were identified during a Site walk. Lead and polycyclic aromatic hydrocarbon (PAH) concentrations associated with the discarded

containers exceeded VAP standards. Three borings were installed to a depth of 16 feet and only arsenic VAP standards were exceeded. Results of the most recent (and most complete) sampling at AOC 6 are presented in Table 4-14 in the PER (Attachment A).

Groundwater samples were collected from one temporary well and in 2005, a VAP-compliant well, MW-4, was installed and sampled. Several metals in the groundwater samples exceeded MCLs and VAP unrestricted use standards and the regulatory action level for copper was also exceeded. However, the exceedances, except for thallium, all occurred in a highly turbid sample from the temporary well. Consequently, the data from the well are not believed to have been representative of actual groundwater chemistry. Thallium is believed to have been a laboratory artifact.

3.9 AOC 7 CINDER AREA

This AOC is defined by cinders, coal fragments, and slag found on top of native soils. The area is located near the southeast corner of the Site (M & E, 2005). MEC is not expected at AOC 7 based on information collected to date. The AOC 7 size was estimated by Brown & Caldwell (July 2007):

Dimensions (feet)			Volume (cubic yard)*	Tonnage/Acreage
Length	Width	Depth		
25	25	2	48	77/0.014

* Includes 5 percent contingency

Previous Investigations

Results of the most recent (and most complete) sampling at AOC 7 are presented in Tables 4-15 and 4-16 in the PER (Attachment A).

Cinders, coal fragments, and slag were found overlying the native clay loam soils in the latest investigation of AOC 7. The area was investigated using a hand auger. Coal fragments and slag were below VAP standards for SVOCs and metals, but orange and red fragments were present in the cinders and slag (Brown and Caldwell, 2007).

A VAP-compliant monitoring well, MW-10, was installed and sampled in 2005. There were no exceedances of MCLs or VAP unrestricted use standards in the groundwater samples collected from this well.

3.10 AOC 8 FORMER BURIAL TRENCH AREA

AOC 8, located in the southeast corner of the Site, was used as a burial area allocated for the disposition of waste including rejected materials from Site operations. The area was capped at the cessation of historical Site activities in the 1950s (M & E, 2005). The recorded disposition of waste and rejected materials is complete only from January, 1951 through May 1953 (Lawhon & Associates, 1991).

Wastes buried at AOC 8 were generally from settling sumps and consisted of mixtures of various chemicals used in the manufacturing process, primarily mixtures of red phosphorous, potassium chlorate, gum, and antimony trisulphide. Such mixtures, when dry, are highly explosive; therefore, much of the waste was packaged wet in cans, laid in open trenches and covered over with earth. The largest can used for burying was approximately 15 inches in diameter and 30 inches long.

Rejected materials, such as pyrotechnical devices, primary explosives, scrap powder, primers, detonators, and liquid flares were also placed in open trenches and covered with earth. The most dangerous of the buried materials was photoflash cartridges. For the most part, the trenches were oriented in the same direction and were equidistant apart (Lawhon & Associates, 1991 and W.R. Grace and Company, 1961). According to a former employee (employed 1952 to 1961), the trench burial area consisted of 20 trenches, 200 feet long by 3 feet wide by 5 feet deep (M & E, 1998). As new trenches were dug, excavated soil from the new trench was used to cover up the last trench.

The size of A0C 8 has been reported as small as 2.5 acres and as large as 8 acres. Impacted material was previously noted at depths up to 10 feet bgs (Brown & Caldwell, July 2007).

Previous Investigations

The initial (1962) clean-up of AOC 8 consisted of the excavation of known trenches. Over 120 tons of explosives and flares were removed and destroyed, including 3,500 boosters and 200,000 fuses. A cap mix (red phosphorous, potassium chlorate gum, and antimony trisulphide), black powder, magnesium flares, phosphorus sweepings, ammonium and potassium picrate, caps and primers, M1 flamethrowers, M112 photoflash cartridges, land flares, 155 mm illuminating shells, 3-minute flares, and M6, MK5, and M501-type materials were destroyed on the property by burning and/or detonation and the trenches were backfilled (Lawhon & Associates, 1991). Subsequent information sources clarified that some materials were destroyed by burning and/or detonation and the remaining materials were relocated to an area near the easternmost Quonset hut for staging prior to shipment from the Site (M & E, 2005).

In 1985, a Site visit associated with the potential sale of the farm resulted in the discovery of approximately 70 flare canisters that had apparently been dug up by plow blades during farming activities.

One of the canisters was detonated as a test by the Ordnance Department at Wright-Patterson Air Force Base (AFB). In September 1985, the canisters were delivered to Wright-Patterson AFB. In 1986, an additional 80 flare canisters were encountered and removed by Wright-Patterson AFB (Lawhon & Associates, 1991).

In January 1988, S.E.A, Inc. was contracted by Westerville Schools, which was interested in purchasing a portion of the farm, to conduct an environmental study of the Site, including the Burial Trench Area. This investigation included monitoring well installation and groundwater sampling. From this, it determined that groundwater contamination was not an environmental concern. One area investigated with a metal detector revealed the presence of many small unidentifiable metal objects. Excavation of this area occurred and a variety of waste materials related to Kilgore operations were encountered including parachute flares (dated 1954), black plastic caps, short cylinders composed of gray/blue/purple cylindrical-shaped material, gray-white layered solid granular substance, aluminum flitter/sodium nitrate, sulfur, and many filled aluminum canisters. Trenches were dug throughout the burial area but only a few pieces of debris were encountered. The trenches were not backfilled. Examination of the excavated items by the Columbus Bomb Squad found that materials could not be exploded (Lawhon & Associates, 1991).

As part of the Phase I Environmental Audit, a magnetic survey was conducted over the property and it was determined that several anomalies still existed in the southeast corner of the Site where the old burial trenches (AOC 8) were located (Lawhon & Associates, 1991).

In the 1996/1997 Phase I Environmental Site Assessment, 15 trenches were excavated, each 3 feet wide by 6 feet deep and of variable length, for a total excavation of 3,330 linear feet. A pit measuring 30 feet by 40 feet by 5 feet deep was also excavated. Six drums of miscellaneous materials were removed, including a 5-gallon bucket of material that segregated and thought to be potentially energetic; these materials were detonated. Empty M112 photoflash casings, M56 projectile fuses, various pyrotechnic debris, and two 55-gallon drums of reddish material, assumed to be red phosphorous, were removed. Excavated materials were staged at Quonset huts near the old farmhouse.

Groundwater in this area was sampled from three wells installed immediately following the trenching (previous wells had been abandoned); groundwater samples were analyzed for VOCs, SVOCs, and Resource Conservation and Recovery Act (RCRA) 8 metals. Data from three wells previously installed during the 1998 Phase I Property Assessment are of minimal value due to conflicting locational information; limited analytical suite (Extractional Procedure (EP) Toxicity metals only); the exclusion of some primary metals of concern such as antimony, elevated detection limits; and use of a chemical test

kit for nitrate. Target analytes in groundwater and soil samples were either nondetect and/or at concentrations suspected to represent natural conditions (Brown and Caldwell, 2007 and M & E, 2005).

This AOC was not included in the Preliminary Phase II Property Assessment conducted from late 1999 to mid-2005 because the area was capped and groundwater was not deemed to be contaminated (M & E, 2005).

TABLE 3-1

POTENTIAL HUMAN EXPOSURE PATHWAYS
FORMER KILGORE MANUFACTURING COMPANY FACILITY
WESTERVILLE, OHIO

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Surface Soil	Surface Soil	On-site	Trespassers	Adolescents	Ingestion Dermal	Quant Quant	Trespassers may contact surface soil while at the site.
			Off-site	Residents	Child	Ingestion Dermal	None None	Off-site residents do not have contact with on-site surface soil (unless they are the trespassers specified above).
					Adult	Ingestion Dermal	None None	
		Air	On-site	Trespassers	Adolescents	Inhalation	Quant	Adolescent trespassers may be exposed to fugitive dust and volatile emissions while at the site.
			Off-site	Residents	Child	Inhalation	Qual	Off-site residents may be exposed to fugitive dust and volatile emissions from the site.
					Adult	Inhalation	Qual	
	Subsurface Soil	Subsurface Soil	On-site	Trespassers	Adolescents	Ingestion Dermal	None None	Trespassers do not have contact subsurface soil while at the site.
			Off-site	Residents	Child	Ingestion Dermal	None None	Off-site residents do not have contact with on-site subsurface soil.
					Adult	Ingestion Dermal	None None	
		Air	On-site	Trespassers	Adolescents	Inhalation	None	Trespassers do not have contact subsurface soil while at the site.
			Off-site	Residents	Child	Inhalation	None None	Off-site residents do not have contact with on-site subsurface soil (unless they are the trespassers specified above).
					Adult	Inhalation	None None	
	Groundwater	Groundwater	On-site	Trespassers	Adolescents	Ingestion Dermal	None None	Adolescent trespassers are not exposed to COPC that have volatilized from groundwater.
			Off-site	Residents	Child	Ingestion Dermal	TBD TBD	Based on currently available information, off-site residents do not have contact with on-site groundwater. This conclusion is pending the results of the Remedial Investigation.
					Adult	Ingestion Dermal	TBD TBD	
		Air	On-site	Trespassers	Adolescents	Inhalation	None None	Adolescent trespassers do not have contact with groundwater.
			Off-site	Residents	Child	Inhalation	TBD TBD	Based on currently available information, off-site residents do not have contact with on-site groundwater. This conclusion is pending the results of the Remedial Investigation.
					Adult	Inhalation	TBD TBD	
			Off-site Vapor Intrusion	Residents	Child	Inhalation	TBD TBD	Based on currently available information, off-site residents do not have contact with on-site groundwater. This conclusion is pending the results of the Remedial Investigation.
					Adult	Inhalation	TBD TBD	

TABLE 3-1

POTENTIAL HUMAN EXPOSURE PATHWAYS
FORMER KILGORE MANUFACTURING COMPANY FACILITY
WESTERVILLE, OHIO

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
	Surface Water	Surface Water	On-site	Trespassers	Adolescents	Ingestion Dermal	Quant Quant	Adolescent trespassers may have contact with surface water.
			Off-site	Residents	Child	Ingestion Dermal	TBD TBD	Off-site residents do not have contact with on-site surface water (unless they are the trespassers specified above). If the wetlands investigation determines the on-site wetlands are connected to the off-site wetlands, then this pathway will be quantitatively evaluated for off-site residents.
					Adult	Ingestion Dermal	TBD TBD	
	Sediment	Sediment	On-site	Trespassers	Adolescents	Ingestion Dermal	Quant Quant	Adolescent trespassers may have contact with sediment.
			Off-site	Residents	Child	Ingestion Dermal	TBD TBD	Off-site residents do not have contact with on-site sediment (unless they are the trespassers specified above). If the wetlands investigation determines the on-site wetlands are connected to the off-site wetlands, then this pathway will be quantitatively evaluated for off-site residents.
					Adult	Ingestion Dermal	TBD TBD	
Future	Surface Soil	Surface Soil	On-site	Construction Workers	Adult	Ingestion Dermal	Quant Quant	Construction workers may have contact with surface soil during excavation activities.
				Industrial Worker	Adult	Ingestion Dermal	Quant Quant	Industrial workers may contact surface soil during normal work activities.
				Recreational Users	Child	Ingestion Dermal	Quant Quant	Recreational users may contact surface soil while at the site.
					Adult	Ingestion Dermal	Quant Quant	
				Residents	Child	Ingestion Dermal	Quant Quant	Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions. (Residential land use will be prohibited by deed restriction.)
					Adult	Ingestion Dermal	Quant Quant	
			Off-site	Residents	Child	Ingestion Dermal	Quant Quant	Off-site residents do not have contact with on-site surface soil.
					Adult	Ingestion Dermal	Quant Quant	
		Air	On-site	Construction Workers	Adult	Inhalation	Quant	Construction workers may be exposed to fugitive dust and volatile emissions during construction activities.
				Industrial Worker	Adult	Inhalation	Quant	Industrial workers may be exposed to fugitive dust and volatile emissions during work activities.
				Recreational Users	Child	Inhalation	Quant	Recreational users may be exposed to fugitive dust and volatile emissions while at the site.
					Adult	Inhalation	Quant	
				Residents	Child	Inhalation	Quant Quant	Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions. (Residential land use will be prohibited by deed restriction.)
					Adult	Inhalation	Quant Quant	

TABLE 3-1

POTENTIAL HUMAN EXPOSURE PATHWAYS
FORMER KILGORE MANUFACTURING COMPANY FACILITY
WESTERVILLE, OHIO

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
			Off-site	Residents	Child	Inhalation	Qual	Off-site residents may be exposed to fugitive dust and volatile emissions from the site.
					Adult	Inhalation	Qual	
	Subsurface Soil	Subsurface Soil	On-site	Construction Workers	Adult	Ingestion Dermal	Quant Quant	Construction workers may have contact with subsurface soil during excavation activities.
				Industrial Worker	Adult	Ingestion Dermal	Quant Quant	Although exposure to subsurface soil by industrial workers is considered unlikely at the site, this scenario is included to aid in future risk management decisions.
				Recreational Users	Child	Ingestion Dermal	Quant Quant	Although exposures to subsurface soil by recreational users is considered unlikely at the site, this scenario is included to aid in future risk management decisions.
					Adult	Ingestion Dermal	Quant Quant	
Future	Subsurface Soil	Subsurface Soil	On-site	Residents	Child	Ingestion Dermal	Quant Quant	Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions. (Residential land use will be prohibited by deed restriction.)
					Adult	Ingestion Dermal	Quant Quant	
			Off-site	Residents	Child	Ingestion Dermal	Quant Quant	Off-site residents do not have contact with on-site subsurface soil.
					Adult	Ingestion Dermal	Quant Quant	
		Air	On-site	Construction Workers	Adult	Inhalation	Quant	Construction workers may be exposed to fugitive dust and volatile emissions during construction activities.
				Industrial Worker	Adult	Inhalation	Quant	Although exposure to subsurface soil by industrial workers is considered unlikely at the site, this scenario is included to aid in future risk management decisions.
				Recreational Users	Child	Inhalation	Quant	Although exposure to subsurface soil by recreational users is considered unlikely at the site, this scenario is included to aid in future risk management decisions.
					Adult	Inhalation	Quant	
				Residents	Child	Inhalation	Quant Quant	Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions. (Residential land use will be prohibited by deed restriction.)
					Adult	Inhalation	Quant Quant	
			Off-site	Residents	Child	Inhalation	None	Off-site residents do not have contact with on-site subsurface soil.
					Adult	Inhalation	None	

TABLE 3-1

POTENTIAL HUMAN EXPOSURE PATHWAYS
FORMER KILGORE MANUFACTURING COMPANY FACILITY
WESTERVILLE, OHIO

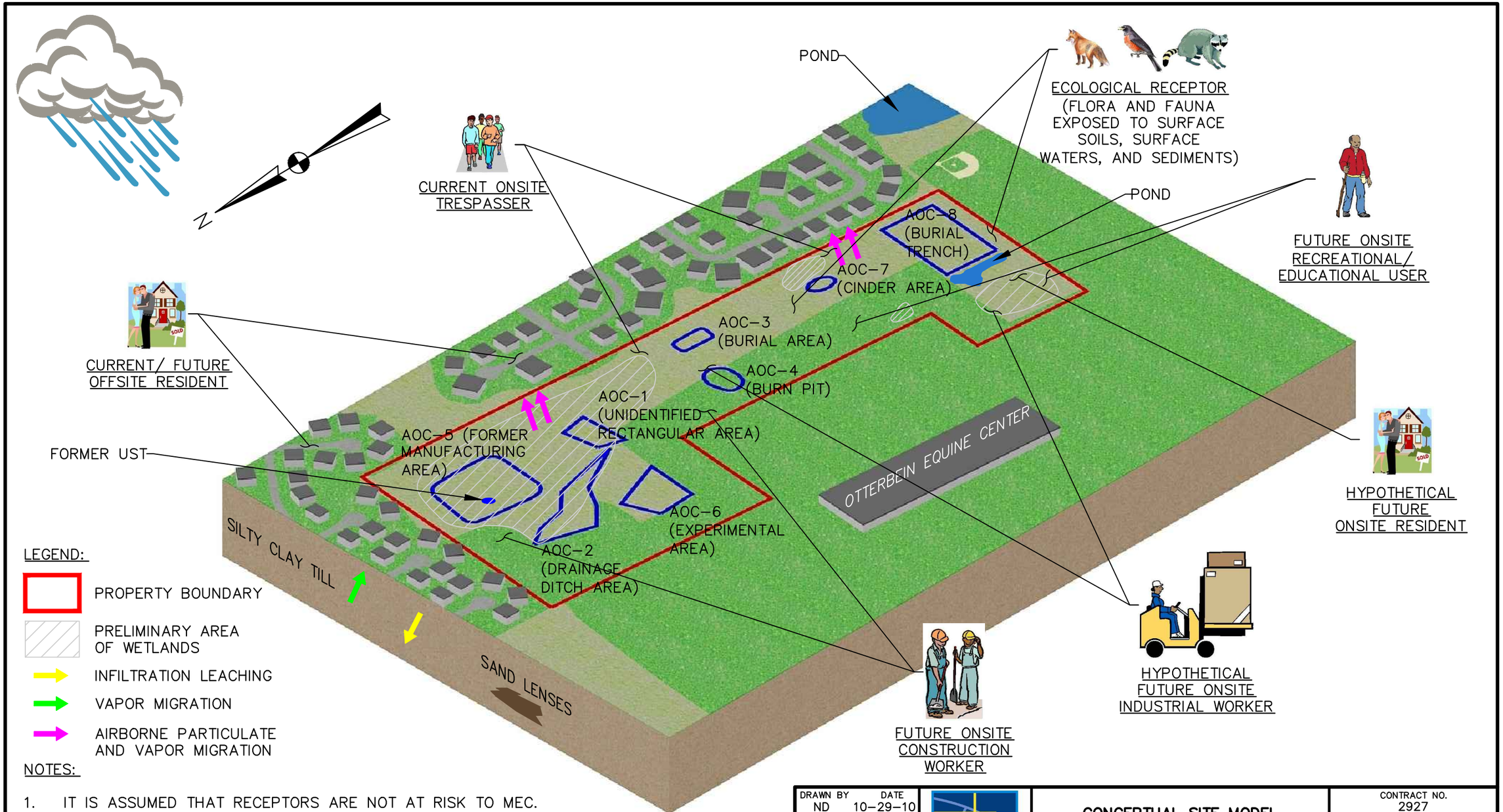
Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
	Groundwater	Groundwater	On-site	Construction Workers	Adult	Ingestion	None	Construction workers are not expected to ingest groundwater.
						Dermal	Quant	Construction workers may have dermal contact with ground water during excavation activities.
				Industrial Worker	Adult	Ingestion	None	Industrial workers are not expected to have contact with groundwater.
						Dermal	None	
				Recreational Users	Child	Ingestion	None	Recreational users are not expected to be exposed to groundwater.
						Dermal	None	
					Adult	Ingestion	None	
						Dermal	None	
				Residents	Child	Ingestion	Quant	Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions. (Residential land use will be prohibited by deed restriction.)
						Dermal	Quant	
					Adult	Ingestion	Quant	
						Dermal	Quant	
			Off-site	Residents	Child	Ingestion	TBD	Based on currently available information, off-site residents are not exposed to on-site groundwater. This conclusion is pending the results of the Remedial Investigation.
						Dermal	TBD	
					Adult	Ingestion	TBD	
						Dermal	TBD	
Future	Groundwater	Air	On-site	Construction Workers	Adult	Inhalation	Quant	Construction workers may be exposed to COPC that have volatilized from groundwater during excavation activities.
				Industrial Worker	Adult	Inhalation	Quant	Industrial workers are not expected to be exposed to COPC that have volatilized from groundwater.
							Quant	
				Recreational Users	Child	Inhalation	Quant	Recreational users are not expected to be exposed to COPC that have volatilized from groundwater.
							Quant	
					Adult	Inhalation	Quant	
							Quant	
				Residents	Child	Inhalation	Quant	Although a future residential scenario is considered unlikely at the site this scenario is included to aid in future risk management decisions. (Residential land use will be prohibited by deed restriction.)
					Adult	Inhalation	Quant	
			Off-site	Residents	Child	Inhalation	TBD	Based on currently available information, off-site residents are not exposed to on-site groundwater. This conclusion is pending the results of the Remedial Investigation.
					Adult	Inhalation	TBD	
			Off-site Vapor Intrusion	Residents	Child	Inhalation	TBD	Based on currently available information, off-site residents are not exposed to on-site groundwater. This conclusion is pending the results of the Remedial Investigation.
					Adult	Inhalation	TBD	

TABLE 3-1

POTENTIAL HUMAN EXPOSURE PATHWAYS
FORMER KILGORE MANUFACTURING COMPANY FACILITY
WESTERVILLE, OHIO

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
			On-site Vapor Intrusion	Industrial Worker	Adult	Inhalation	Quant	Industrial workers may be exposed to COPC that have volatilized from groundwater and migrated through building foundations into indoor air.
				Residents	Child	Inhalation	Quant	Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions. (Residential land use will be prohibited by deed restriction.)
					Adult	Inhalation	Quant	
	Surface Water	Surface Water	On-site	Construction Workers	Adult	Ingestion Dermal	Quant Quant	Construction workers may be exposed to surface water during excavation activities.
				Industrial Worker	Adult	Ingestion Dermal	Quant Quant	Industrial workers may have contact with surface water.
				Recreational Users	Child	Ingestion Dermal	Quant Quant	Recreational users may have contact with surface water
					Adult	Ingestion Dermal	Quant Quant	
				Residents	Child	Ingestion Dermal	Quant Quant	Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions. (Residential land use will be prohibited by deed restriction.)
					Adult	Ingestion Dermal	Quant Quant	
			Off-site	Residents	Child	Ingestion Dermal	TBD TBD	Off-site residents do not have contact with on-site surface water. If the wetlands investigation determines the on-site wetlands are connected to the off-site wetlands, then this pathway will be quantitatively evaluated for off-site residents.
					Adult	Ingestion Dermal	TBD TBD	
Future	Sediment	Sediment	On-site	Construction Workers	Adult	Ingestion Dermal	Quant Quant	Construction workers may be exposed to sediment during excavation activities.
				Industrial Worker	Adult	Ingestion Dermal	Quant Quant	Industrial workers may have contact with sediment.
				Recreational Users	Child	Ingestion Dermal	Quant Quant	Recreational users may have contact with sediment
					Adult	Ingestion Dermal	Quant Quant	
				Residents	Child	Ingestion Dermal	Quant Quant	Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions. (Residential land use will be prohibited by deed restriction.)
					Adult	Ingestion Dermal	Quant Quant	
			Off-site	Residents	Child	Ingestion Dermal	None None	Off-site residents do not have contact with on-site sediment. If the wetlands investigation determines the on-site wetlands are connected to the off-site wetlands, then this pathway will be quantitatively evaluated for off-site residents.
					Adult	Ingestion Dermal	None None	

Notes:
Quant - Quantitative. Qual - Qualitative. COPC - Chemical of potential concern. TBD - To be determined.



LEGEND:

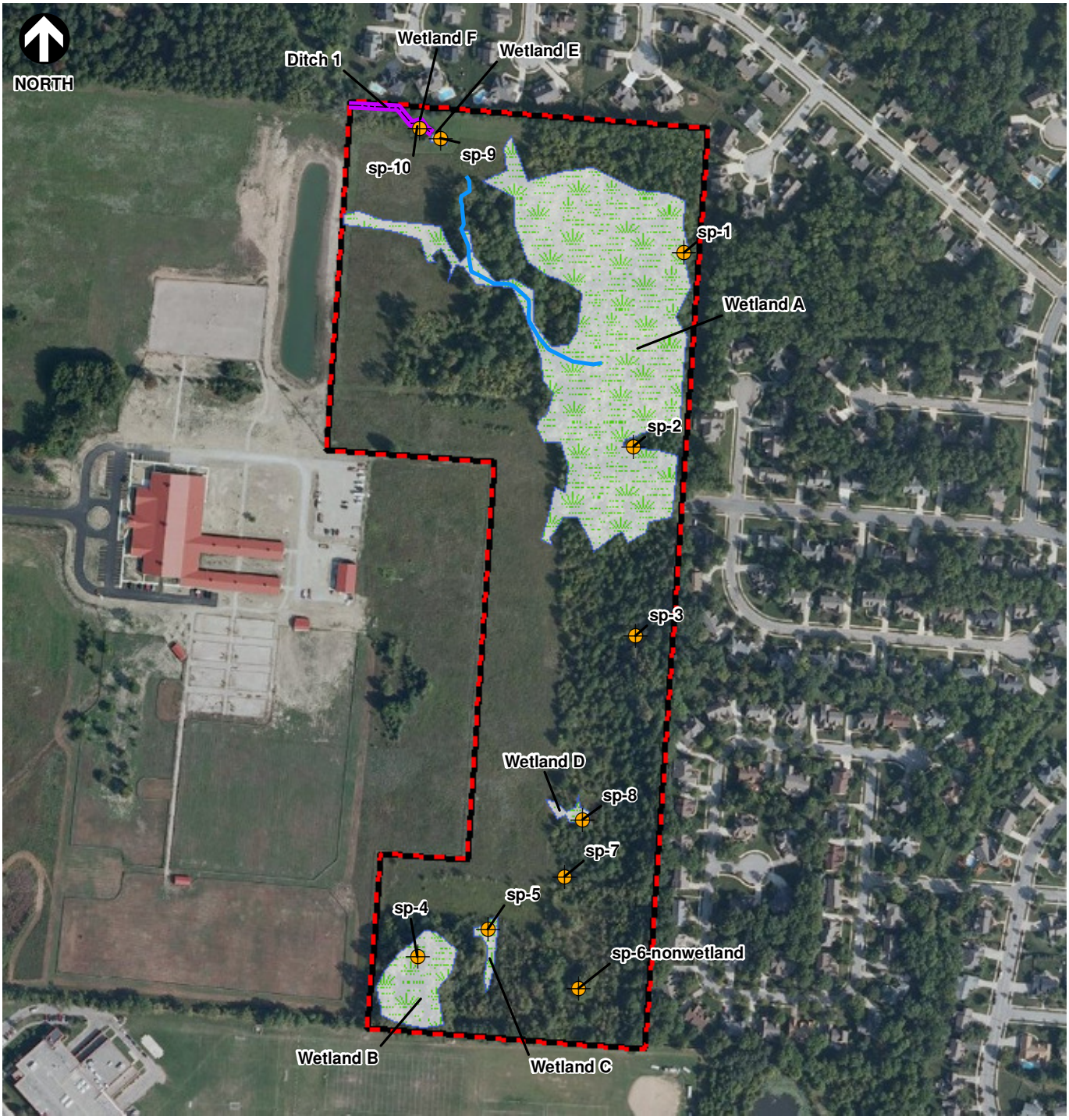
- PROPERTY BOUNDARY
- PRELIMINARY AREA OF WETLANDS
- INFILTRATION LEACHING
- VAPOR MIGRATION
- AIRBORNE PARTICULATE AND VAPOR MIGRATION

NOTES:

1. IT IS ASSUMED THAT RECEPTORS ARE NOT AT RISK TO MEC.
2. EXPOSURE PATHWAYS ARE PRESENTED IN TABLE 1.
3. HYPOTHETICAL FUTURE INDUSTRIAL WORKERS AND RESIDENTS WILL BE EVALUATED IN THE RISK ASSESSMENTS FOR PURPOSES OF COMPLETENESS.
4. WETLAND AREAS ARE FROM HISTORICAL DOCUMENT. FINAL DELINEATION TO BE DETERMINED FALL, 2010

DRAWN BY ND	DATE 10-29-10	CONCEPTUAL SITE MODEL LOCATIONS OF AREAS OF CONCERN FORMER KILGORE MANUFACTURING SITE WESTERVILLE, OHIO	CONTRACT NO. 2927
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE NOT TO SCALE		NAVFAC	DRAWING NO. FIGURE 3-1 / REV. 0

R:\2927 – Former Kilgore Manufacturing Site\CSM\2927CSM01.dwg PIT NICHOLE.DILLA 12/6/2010 9:32:40 AM



Approximate Wetland Determination Test Pit
Approximate Ditch Location
Approximate Swale Feature
Approximate Wetland Boundary
Approximate Site Boundary

200 0 200 400 Feet

SOURCE: PORTION OF THE ESRI ONLINE ARCGIS MAPPING WEBSITE SERVICE - "WORLD_IMAGERY" - AERIALS EXPRESS - COLUMBUS 2009.

Civil & Environmental Consultants, Inc.
Cincinnati, OH
(513) 985-0226 (800) 759-5614
Pittsburgh, PA Chicago, IL Cleveland, OH Columbus, OH Detroit, MI
Export, PA Indianapolis, IN Nashville, TN St. Louis, MO

Figure 3-2 Preliminary Wetlands Delineation

OTTERBEIN COLLEGE

Kilgore Tract - Westerville
Westerville, Delaware County, Ohio

DWN. BY: MJB	SCALE: 1 " = 400 '	DATE: 11/30/2010	PROJECT NO: 101-641
CHKD. BY: KD			

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4.0 WORK PLAN RATIONALE

Results from earlier investigations have suggested the presence of a variety of constituents of concern (COC) at each of the eight AOCs. The earlier investigations compared the analytical results with the Ohio VAP standards, and these comparisons have been cited in both historical reports and the current PER, Technical Memorandum and this Work Plan. The VAP standards were used to determine the severity of impact at the various AOCs; however, the proposed RI/FS will evaluate both the historical and newly-acquired analytical results against RSLs.

In the case of each AOC a boring will be performed at the location of the historical soil sample with the highest concentration of a COC. The results of samples from this boring will serve to validate the earlier sample results. The validation boring and additional borings will be performed to gather additional data (including expanded analytical testing) for the site characterization.

4.1 AOC 1 – UNIDENTIFIED RECTANGULAR FEATURE

Problem Statement

Previous investigations indicate that surface and subsurface soil are contaminated with metals at unacceptable concentrations. It is unknown if other COCs such as explosives are present. It is also unknown if the previously detected chromium contamination is in the more toxic hexavalent form. The amount of MEC present, if any, is also unknown. COCs present in shallow soils could infiltrate vertically deeper into the subsurface soil, and potentially leach from the soil into shallow groundwater.

4.2 AOC 2 DRAINAGE DITCH NEAR FORMER MANUFACTURING AREA

Problem Statement

Surface and subsurface soil were determined to contain metals at unacceptable concentrations. It is unknown if other contaminants such as explosives are also present. Contaminants could infiltrate vertically deeper into the subsurface soil and leach from the soil into the shallow groundwater. MEC is known to be present at the Site and would be dangerous if contacted. Previous investigations may not have identified and removed all MEC, and the total amount of MEC potentially present is unknown.

4.3 AOC 3 BURIAL AREA

Problem Statement

Surface and subsurface soil were determined to contain metals at unacceptable concentrations. Because this area was used for the disposal of materials burned in the former Burn Pit (AOC 4) there exists the potential for combustion-related COCs such as dioxins and furans, which have not been previously investigated. It is unknown if other contaminants such as explosives are present at AOC 3. Also, COCs could leach from soils/munitions items and further potentially impact soil and groundwater.

MEC is a known risk at the surface and subsurface but previous investigations may not have identified and removed all items and the total amount remaining is unknown. It will be difficult to remove the MEC risk without completely excavating the soils in this AOC.

4.4 AOC 4 BURN PIT

Problem Statement

Materials at the former burn pit were removed routinely from the area and disposed of in a separate area (AOC 7). In addition, all of the soil was removed and replaced with fill more than 45 years ago. During previous investigations, only arsenic was detected at concentrations exceeding a VAP standard. Further evaluation of the reported arsenic concentration indicates that the concentration is less than the background concentration established for the Site (Brown & Caldwell, 2007). Groundwater concentrations in the area were determined to be within acceptable limits, with the exception of a nominal VAP exceedance of arsenic. MEC is not expected at the Site based on Site use history and the previous remediation efforts.

Surface and subsurface soil at AOC 4 are not perceived to be contaminated based on the Site historical source removal effort and a review of available data from Site investigations. Therefore, there does not appear to be an environmental contamination problem at this AOC. However, if additional soil sampling will be conducted to confirm this finding. In addition, if the proposed sampling of AOC 3 indicates the presence of dioxins and furans in materials that were routinely excavated from the burn pit, the burn pit will then be investigated for dioxins and furans.

4.5 AOC 5 MANUFACTURING AREA FORMER UST LOCATION

Problem Statement

The former fuel oil UST and surrounding contaminated soil were removed and a closure report was submitted to OEPA more than 12 years ago and only arsenic in soil was cited as exceeding the VAP standard in soil borings at AOC 5. Further evaluation of the arsenic concentration indicates that the concentration is less than the background concentration established after the investigation (Brown & Caldwell, 2007). Because the UST and surrounding contaminated soils have been removed, only residual impacted groundwater should remain. While several fuel oil constituents were detected, such as benzene and toluene, concentrations were well below unrestricted land use standards.

MEC is not expected to be present at the Site based on Site history, previous investigations and remediation efforts. Surface and subsurface soil are not considered to be contaminated based on Site historical source removal efforts and a review of available data from Site investigations. Residual groundwater contamination appears to be at acceptable levels. Therefore, there does not appear to be an environmental contamination problem at the former UST location within this AOC.

4.6 AOC 6 FORMER EXPERIMENTAL AREA

Problem Statement

Surface and subsurface soil have been found to contain COCs at concentrations exceeding VAP residential standards (PAHs and lead). These contaminants could also infiltrate further vertically into the subsurface soil and potentially leach from the soil into the shallow groundwater. It is unknown if other contaminants such as explosives are present. MEC is a known risk at the surface and subsurface. Previous investigations may not have identified and removed all MEC items and the total amount of MEC potentially remaining at this AOC is unknown. A UXO assessment has not been conducted to date. It will be difficult to remove potential MEC at this AOC without completely excavating the Site soils.

4.7 AOC 7 CINDER AREA

Problem Statement

Solid wastes were disposed at AOC 7 although the sample analyses completed to date do not indicate exceedances of VAP criteria. It is unknown if explosive residuals are present. The orange and red fragments may be of concern because they remain unidentified. The amount of MEC, if any, is unknown, and a UXO assessment has not been conducted to date. Although MEC has not been encountered to date, the uncertain history of the AOC and the proximity to MEC findings reported for nearby AOC 2 make

the presence of MEC suspect. Also, munitions constituents (MC) and other chemical constituents could leach from munitions items and further contaminate the soil.

4.8 AOC 8 FORMER BURIAL TRENCH AREA

Problem Statement

Although soil and groundwater VAP standards were not exceeded in samples collected from AOC 8, it is reasonable to assume that at least some portion of the soils at this AOC are impacted with wastes from the Kilgore manufacturing process. Moreover, there may be unknown COCs not previously investigated present in the area. For example, groundwater and soil samples were not previously collected and analyzed for explosives constituents. The outer perimeter of the AOC is not clearly defined, an important data gap considering the large size of the AOC, which could greatly impact the evaluation of remedial alternatives.

The impacted materials at AOC 8 may extend to a depth of approximately 10 feet bgs. Any COCs present in the surface/shallow subsurface zones could infiltrate further vertically into the subsurface soil and leach from the soil into the shallow groundwater. Although groundwater samples collected to date have been previously evaluated as acceptable, this observation is questionable considering the limited analyses conducted to date and unknown well construction methodology. Moreover, the age of the data is important. The area has been disturbed and conditions may have changed over time. These factors may impact the potential for contaminant migration to and with the groundwater underlying AOC 8. Moreover, AOC 8 is of extra concern since it is at the property boundary and contamination, if present in the groundwater could migrate off- site.

MEC is a known risk at the surface and subsurface. The previous investigations have not likely identified and removed all MEC. The total amount of potentially remaining MEC is unknown.

5.0 REMEDIAL INVESTIGATION/FEASIBILITY STUDY TASKS

The following tasks have or will be completed by TtNUS as part of the RI/FS study in compliance with the OEPA guidelines:

5.1 CLIENT / REGULATORY MEETINGS

The initial task related to the RI/FS was a meeting between representatives of Otterbein and TtNUS to discuss the pending Consent Agreement with the State of Ohio and the expected requirements of the RI/FS specified in the Agreement. TtNUS subsequently developed a preliminary scope of work designed to meet the requirements of the Agreement and the anticipated future use of the site by Otterbein.

A meeting was held at the site on July 12, 2010, with representatives of OEPA, Otterbein, and TtNUS in attendance. Following a short presentation of anticipated RI/FS tasks by Tetra Tech, the OEPA Site Coordinator, Robin Roth outlined the expectations of OEPA and informed Otterbein of various permit issues related to planned site investigations. At the completion of the meeting, the group toured the site.

TtNUS conducted a file review of the OEPA files related to the site later in the same day (July 12, 2010).

Two conference calls were held between OEPA, Otterbein and TtNUS following the OEPA review of the PER. The purpose of the calls was to gain concurrence on the scope of the RI/FS.

5.2 PRE-INVESTIGATION EVALUATION REPORT AND TECHNICAL MEMORANDUM

The first deliverable of the RI/FS process was the PER, which was submitted by Otterbein to OEPA on August 10, 2010. The PER is a document designed to present the environmental data known about the site and the results of the preliminary scoping tasks, thus establishing the framework for subsequent development of the RI/FS Work Plan. OEPA responded to Otterbein with comments related to the PER by September 28 and the PER comments led to the two conference calls between representatives of Otterbein and OEPA about the findings of the PER and the structure of the RI/FS. It was decided that Otterbein should prepare an interim document which would clarify the Otterbein proposed RI/FS approach. The PER and the OEPA comments are included in Attachment A.

TtNUS prepared a Technical Memorandum Strategy for Environmental Investigations at the Kilgore Manufacturing Company Facility (Technical Memorandum, November 2, 2010). The Technical Memorandum presented the strategy for the investigations to be conducted at each AOC and was

intended to facilitate discussions between Otterbein and OEPA regarding the scope of the investigation. The Technical Memorandum included:

- An updated CSM
- A sampling and data use approach, and
- A generalized table of contents for the RI/FS Work Plan

OEPA responded to the Technical Memorandum on November 10, 2010 with both general and specific comments. Those comments were taken into consideration by Otterbein in the preparation of this Work Plan.

5.3 RI/FS WORK PLAN

This RI/FS Work Plan follows the guidance provided by OEPA (and specifically outlined in the USEPA Guidance for performing a RI/FS). According to the guidance the Work Plan consists of four documents:

- Work Plan
- PER and OEPA cComments (Attachment A)
- Field Sampling Plan (Attachment B)
- Quality Assurance Project Plan (Attachment C)
- Health and Safety Plan (Attachment D)

This Work Plan includes by reference the previously submitted documents: the PER [Tetra Tech, August 10, 2010 (Attachment A)] and the Technical Memorandum (Tetra Tech, November 2, 2010).

5.4 SITE CHARACTERIZATION AND DATA MANAGEMENT

5.4.1 Site Characterization

Otterbein has evaluated pre-2010 site characterization data gathered from numerous earlier site investigation and the results of this evaluation are presented in the PER (Attachment A). The PER identified a number of data gaps and the proposed RI is designed to fill those gaps and provide data sufficient to fulfill the needs of the RI/FS. The data gathered by the proposed site investigation will be combined with the existing data to update the Conceptual Site Model and to provide data of sufficient quality and quantity to support the RI/FS.

The proposed additional site characterization will consist of: a wetlands characterization; a soil investigation; a UXO avoidance investigation; a test pit investigation; and a groundwater investigation.

The various site characterization investigations are briefly described below, and are described in detail in the FSP (Attachment B).

5.4.1.1 Wetlands Characterization

The wetlands characterization will consist of four tasks and multiple subtasks:

- Water Resources Investigation
  - Wetland delineation and survey
  - Wetland functional assessment
  - Watercourse investigation and survey
  - Watercourse functional assessment
  - Impact Analysis and Delineation Report
  - Delineation field review
  - Mitigation planning

- Cultural Resources Investigation
  - Literature review
  - On-site review
  - Test pit sampling

- Threatened and Endangered Species Investigation
  - Coordination with U.S. Fish and Wildlife Service and ODNR
  - Field investigations (if indicated by existing data)

- Permit Applications
  - Pre-application meeting with US Army Corps of Engineers and OEPA
  - Application for appropriate permits

The Wetlands Characterization is being conducted by CEC of Columbus, OH. CEC has subcontracted Mr. Ryan Weller of Weller & Associates, a Registered Professional Archaeologist, to complete the Cultural Resources Investigation.

The Wetlands Characterization is being performed in accordance with methodology described in the 1987 Corps of Engineers Wetlands Delineation Manual and the U.S. Fish and Wildlife Service's National List of Plant Species that Occur in Wetlands: Northeast (Region 1).CEC will also use the Ohio Rapid Assessment Method for Wetlands v. 5.0 (ORAM) to evaluate the wetlands. The watercourse Functional Assessment will be conducted in accordance with the guidance provided in Rapid Bioassessment

Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish (EPA 841-B-99-002).

As this RI/FS Work Plan is being submitted to OEPA, CEC has completed the wetland delineation field task, and the other tasks are scheduled to occur as quickly as possible (to avoid delaying any field work associated with the Remedial Investigation).

5.4.1.2 UXO Avoidance Investigation

Although the possibility of encountering MEC is remote a UXO trained technician will be onsite for all intrusive investigations. The technician will support the investigations by performing UXO anomaly avoidance procedures, designed to avoid contact with potential MEC at the Site. The technician will use a Schonstedt GA-52Cx magnetic locator or a White's spectrum XLT all metals detector to screen each boring location. The magnetometer will be used to clear the surface area in the vicinity of the boring/well, and then a down hole magnetometer will be used to screen each 2 foot depth of the boring as drilling progresses, until the desired boring depth is attained.

If the detector indicates the potential presence of subsurface UXO, the boring will be moved to a nearby area, and the location of the anomaly recorded for future evaluation. (The detection of subsurface anomalies alone is not considered evidence of MEC. If the technician uncovers actual UXO, the project will be stopped, the University will be notified, and additional UXO technicians will be mobilized to dispose of the UXO.

5.4.1.3 Soil/Sediment Investigation

Soil samples will be collected at all eight identified AOCs for site wide characterization to assist in determining remediation. After sampling, each borehole will be backfilled to within 6 inches of grade using the soil cuttings removed from the borehole. A minimum 6-inch thick grout/bentonite seal will then be placed to grade at each boring. The surface will be returned to its original condition.

A drilling subcontractor will utilize direct push technology (DPT) methods to advance the proposed soil borings to their required depths. Soil sampling will proceed continuously from the land surface to the total depth of each boring. The subcontractor will provide appropriately sized disposable acetate liners capable of containerizing each 4 (or 5) foot interval.

A soil boring log will be prepared for each boring with soil descriptions and all relevant information, observations, depth to saturated soil/water table, and photoionization detector (PID) field screening results. Soil samples will be collected from two intervals per location and analyzed for Target Analyte List

(TAL) Metals, strontium, explosives, and at some locations PAHs. Soil samples will be collected in laboratory provided jars and placed immediately in an iced cooler for shipment to a fixed base laboratory. Soil sample depths will be included on each log.

Further detail of soil and sediment sample methods are described in Section 5.2 and 5.3 of the FSP (Attachment B).

5.4.1.4 Test Pit Investigation

Two long pits will be installed in AOC 8 – the Former Burial Trench Area to determine the “lateral extent” of contamination. Test pits will be approximately 6 feet deep and extend on the north and west sides for up to 800 feet. Up to eight soil samples will be collected based on visual observations.

Further detail of soil and sediment sample methods are described in Section 5.2 and 5.3 of the FSP (Attachment B).

5.4.1.5 Groundwater Investigation

Eleven new permanent monitoring wells will be installed on site. Seven wells will be installed within the boundaries of established AOCs and four will be installed along the property boundary.

Prior to groundwater sampling, existing monitoring wells will be inspected for physical integrity. If wells are damaged or unsuitable this information will be reported in the Remedial Investigation Report.

Newly installed monitoring wells will be developed no sooner than 48 hours after well installation. Existing wells have not been sampled or developed in several years; therefore, they will be redeveloped prior to sampling.

Groundwater sampling will be collected in laboratory provided bottles from six existing monitoring wells and the 11 newly installed permanent wells. All groundwater samples will be collected for TAL metals, strontium, perchlorate, and explosives. Additionally, the three southern boundary wells down gradient of AOC 8 will be sampled for VOCs and PAHs. All samples will be sent to an OEPA approved laboratory.

Further detail of soil and sediment sample methods are described in Section 5.2 and 5.3 of the FSP (Attachment B).

5.4.1.6 Surface Water Investigation

There is one existing pond onsite; however depending on the time of year, water may accumulate in low lying areas in and around the wetlands. The surface water sample in the existing pond will be sampled and if other ponds are present during the time of the field event, samples may also be collected there. One surface water sample will also be collected form an off-site pond. Surface water samples collected from these locations will be sampled for TAL metals, strontium, explosives, and PAHs

Further detail of soil and sediment sample methods are described in Section 5.2 and 5.3 of the FSP (Attachment B).

5.4.2 Data Management

Newly-collected data will be compiled, along with existing data, in spreadsheets and maps in order to evaluate the potential environmental impairment of the site. Products of the data management will include:

- Groundwater potentiometric maps
- Contaminant distribution maps
- Wetlands delineation maps
- Updated AOC location maps
- Analytical results tables
  - Contaminant exceedance tables and tag map
  - Contaminant hits table
  - Occurrence and distribution of contaminants in soil and groundwater
  - Positive detections table for soil and groundwater

All new and previously existing data will be compared to RSLs to facilitate decisions about the site.

5.5 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENTS

A Human Health Risk Assessment (HHRA) will be conducted to evaluate current and potential future threats to human health in the absence of any remedial action. The assessment will be done in a manner consistent with the US EPA Risk Assessment Guidance for Superfund (RAGs), EPA/540/1-82/002 (RAGS, Part A, 1989) and other relevant federal and Ohio guidance as appropriate. The HHRA is described in detail in Section 6.0 of this Work Plan. An Ecological Risk Assessment (ERA) will be prepared to evaluate current or potential future adverse effects (in the absence of any remedial action) to the flora and fauna at the Site. The ERA is more fully described in Section 7.0 of this Work Plan

5.6 REMEDIAL INVESTIGATION REPORT

Following completion of confirmatory sampling activities and sample analysis data validation, TtNUS will submit a Remedial Investigation Report. The report will include:

- A description of sampling methodology, tabular summary of soil and groundwater analytical data, tag maps, laboratory analytical data, monitoring well location data, boring logs, sample log sheets, test pit drawings, and potentiometric surface maps.

- A description of field activities, any deviations from the work plan, summary of geology and hydrogeology of the site, discussion of current site conditions and site history, current site use and historical use, and analytical data identifying areas of contamination.

- Recommendations for future work at the site.

The Remedial Investigation Report will be written in accordance with the Draft RI Format, as outlined in Appendix J of the OEPA Generic Scope of Work for Conducting Remedial Investigations and Feasibility Studies (OEPA, 2006).

5.7 REMEDIAL ALTERNATIVE DEVELOPMENT

Otterbein will further develop the preliminary Remedial Action Objectives (RAOs) identified in the PER and prepare an alternatives Array Document. These tasks are described in the more detail in Section 8.0 Feasibility Study.

5.8 FEASIBILITY STUDY REPORT

A Feasibility Study Report will be prepared to present a detailed analysis of the remedial alternatives. This task is described in more detail in the Section 8.0 Feasibility Study.

5.9 MONTHLY PROJECT REPORTS

Otterbein has been preparing monthly progress reports in accordance with provisions of the proposed Consent Agreement since July 2012 and these will continue until the end of the project. The items included in the monthly reports include:

- Status of the Work
- Difficulties Encountered
- Activities Planned for the Upcoming Month
- Key Personnel Changes
- Target Completion Dates for Activities
- Deviation From the Schedule
- Analytical Data Received
- Soil/Waste/Water Treated or Removed

6.0 HUMAN HEALTH RISK ASSESSMENT

This section presents the methodology that will be used to prepare an HHRA of chemicals detected in soil, groundwater, surface water, and sediment at the former Kilgore Manufacturing Site, Westerville, Ohio. The HHRA will evaluate whether detected concentrations of chemicals in the study area media pose a significant threat to potential human receptors under current and/or future land uses. Potential risks to human receptors will be estimated based on the assumption that no actions will be taken to control contaminant releases. Primary sources of guidance will include the OEPA Generic Statement of Work for Conducting Remedial Investigations and Feasibility Studies (OEPA, September 1, 2006). Current guidance and reports published by the USEPA were also considered in preparing this protocol and will be considered during the preparation of the HHRA:

- Soil Screening Guidance: Technical Background Document. Office of Solid Waste and Emergency Response (OSWER), Washington, D.C. EPA/540/R 95/128 (USEPA, 1996a).

- Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Office of Solid Waste and Emergency Response Washington, D.C., OSWER 9355.4 24 (USEPA, 2002a).

- Exposure Factors Handbook. Office of Health and Environmental Assessment, Washington, D.C. EPA/600/P 95/002Fa (USEPA, 1997a).

- Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure-Factors. OSWER Directive 9285.6 03, OSWER, Washington, D.C. (USEPA, 1991).

- Distribution of Preliminary Review Draft: Superfund's Standard Default Exposure-Factors for Central Tendency and Reasonable Maximum Exposure. OSWER, Washington, D.C. (USEPA, 1993a).

- Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. Office of Emergency and Remedial Response, Washington, D.C. OSWER 9285.6 10 (USEPA, 2002b).

- RAGS, Volume I: Human Health Evaluation Manual (Part A) (USEPA, 1989).

- RAGs, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Final. Office of Superfund Remediation and Technology Innovation, Washington, D.C. 20460 EPA/540/R/99/005, OSWER 9285.7 02EP; PB99 963312 (USEPA, 2004a).

- Guidelines for Carcinogen Risk Assessment. EPA/630/P 03/001B. March 2005 (USEPA 2005a).

- Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens. EPA/630/R 03/003F (USEPA, 2005b).

- RAGS, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment), Final. Office of Superfund Remediation and Technology Innovation, Washington, D.C. 20460 EPA 540 R 070 002, OSWER 9285.7 82 (USEPA, 2009a).

The HHRA for the former Kilgore Manufacturing Site will be structured and reported according to the guidelines of the RAGS, Human Health Evaluation Manual, Part D: Standardized Planning, Reporting, and Review of Superfund Risk Assessments (RAGS Part D) (USEPA, 2001). The HHRA will consist of six components (see sections 1 through 6 for a more complete discussion):

- Data evaluation
- Toxicity assessment
- Uncertainty analysis
- Exposure assessment
- Risk characterization
- Development of remedial goal options

6.1 DATA EVALUATION METHODOLOGY

Data evaluation, the first component of a baseline HHRA, is a medium specific task that begins with compilation of relevant analytical data and concludes with selection of chemicals of potential concern (COPC) to be evaluated in the assessment. First, the data available for the relevant study area(s) are reviewed in terms of data quality; typically only validated data is used in a HHRA. However, historical data that has been subjected to a quality assurance review (if not fully validated) will be included in the HHRA, and the uncertainty associated with the use of historical data (e.g., due to differences in validation procedures) will be noted. Environmental samples selected for HHRA are summarized in tables. Second, a medium specific list of COPCs (used to quantitatively and/or qualitatively determine potential human health risks) are selected based on a toxicity screen (i.e., a comparison of site contaminant concentrations to conservative toxicity-screening values).

6.1.1 Data to be Evaluated HHRA

Validated data collected during the following primary environmental investigations will be used to assess risks to potential human receptors:

- October/November 1996 Soil and Groundwater Samples
- July 1997 Soil Samples
- February/March 2000 Soil Samples
- December 2000 Soil and Groundwater Samples
- January 2001 Soil Samples
- April 2004 Soil and Groundwater Samples
- June 2005 Groundwater Samples
- Proposed Soil, Groundwater, Surface Water, and Sediment Samples recommended in this Work Plan

Fixed base analytical results (i.e., results from a fixed base laboratory and not from field analytical results) from field investigations for lists of target analytes will be used in the quantitative risk evaluation. F ield measurements and data regarded as rejected (i.e., that were qualified as “R” during data validation) will not be used in the quantitative risk assessment. If a chemical was not detected in an environmental medium, but its reported detection limits [sample quantitation limits (SQLs)] for the environmental samples exceeds the COPC toxicity screening-levels, that chemical will be qualitatively discussed in the uncertainty analysis section.

6.2 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Selecting COPCs is a qualitative screening process to limit the number of chemicals quantitatively evaluated in the baseline HHRA to those site related constituents that dominate overall potential risks. Screening by risk based concentrations focuses the risk assessment on meaningful chemicals and exposure routes. In general, a chemical will be selected as a COPC and retained for further quantitative risk evaluation if the maximum detection in an environmental data set exceeds the lowest risk based screening concentration. Chemicals eliminated from further evaluation are assumed to present minimal risks to potential human receptors.

6.2.1 Derivation of Screening Criteria

The primary COPC screening criteria for all media within the study area will be derived from USEPA RSLs developed by the U.S. Department of Energy’s Oak Ridge National Laboratory (ORNL) (USEPA, 2010a). These risk based concentrations are based on exposure pathways for which generally accepted methods, models, and assumptions have been developed (i.e., ingestion, dermal contact, inhalation) and for specific land use conditions (residential, industrial). They do not consider effects on groundwater or ecological receptors. The COPC screening levels used to evaluate soil data are defined in the following narrative.

Soil/Sediment Screening Levels for all Parameters Except Lead — Screening levels to select COPC for direct human contact exposures to surface and subsurface soil will be based on the following criteria:

- RSLs for Residential Soil (USEPA, 2010a).
- Generic Soil Screening Levels for Transfers from Soil to Air ($SSLs_{air}$) (published on the USEPA Website: http://rais.ornl.gov/epa/ssl1.shtml).
- Federal Soil Screening Levels (SSLs) for Groundwater Protection (USEPA, 2010a).

COPC screening levels based on the USEPA RSLs correspond to a systemic hazard quotient (HQ) of 0.1 for noncarcinogens or an incremental lifetime cancer risk of 1×10^{-6} for carcinogens. In contrast, USEPA RSLs for noncarcinogens are based on an HQ of 1. The COPC screening levels derived for soil are based on an HQ of 0.1 to account for the potential cumulative effects of several chemicals affecting the same target organ or producing the same adverse noncarcinogenic effect. USEPA RSLs for residential soil will conservatively be used for soil COPC selection. Because risk-based sediment screening levels are not available and because sediment may be periodically exposed rather than continually submerged (i.e., in some cases the study area sediment samples are more soil-like than sediment-like), USEPA RSLs for residential soil will also conservatively be used for sediment COPC selection.

The SSL_{air} values for chemical migration from soil to outside air (published online at http://rais.ornl.gov/epa/ssl1.shtml) will be used to select COPC for surface and subsurface soil. These values are more recent than those in the 1996 and 2002 soil screening level SSL guidance documents (USEPA, 1996a and USEPA, 2002a). The SSLsair are based on an HQ of 1; however, the COPC screening values will be adjusted to be based on an HQ of 0.1. The SSLair values do not apply to sediment because sediment is typically submerged and not subject to volatilization or particulate emissions.

Maximum chemical concentrations in soil will be compared to federal SSLs for groundwater protection, which were designed to protect groundwater at most sites (as published in the USEPA RSL table). These groundwater protection SSLs allow an initial qualitative evaluation of the potential for chemical migration from soil to groundwater. Chemicals with concentrations exceeding the SSL criteria may potentially migrate from soil to groundwater in sufficient quantities to pose groundwater quality problems. Chemicals detected at concentrations exceeding the federal SSL for groundwater protection, but at concentrations less than COPC screening levels for direct contact risk will not be evaluated quantitatively in the HHRA. However, these chemicals will be further evaluated qualitatively using the approach presented in Section 4.3.

Groundwater/Surface Water Screening Levels for all Parameters Except Lead — Screening levels to select COPC for direct human contact exposures to groundwater will be based on the following criteria:

- RSLs for Tap Water (USEPA, 2010a).
- Federal Safe Drinking Water Act (SDWA) MCLs (USEPA, 2009d).
- Generic Screening Levels for Groundwater for Evaluating Vapor Intrusion to Indoor Air (GSL_{vapor}) (USEPA, 2002a).

COPC screening levels based on the USEPA RSLs correspond to a systemic HQ of 0.1 for noncarcinogens or an incremental lifetime cancer risk of 1×10^{-6} for carcinogens. In contrast, USEPA RSLs for noncarcinogens are based on an HQ of 1. The COPC screening levels derived for tap water are based on an HQ of 0.1 to account for the potential cumulative effects of several chemicals affecting the same target organ or producing the same adverse noncarcinogenic effect. Criteria based on USEPA RSLs for tap water will conservatively be used for COPC selection for groundwater. For surface water, the screening levels used for groundwater will be adjusted upward by a factor of 10 (i.e., multiplied by 10) to account for anticipated reduced exposure to surface water (i.e., the surface water within the study area is not a potential domestic water supply source).

Federal SDWA MCLs for public drinking water supplies are enforceable standards designed to protect human health, promulgated under the federal SDWA. Primary MCLs are based on laboratory or epidemiological studies and apply to public water systems. A public water system is defined as a system providing water to the public for human consumption that either has at least 15 service connections or regularly serves an average of 25 individuals daily for at least 60 days per year. Primary MCLs are designed to prevent adverse human health effects but also reflect the technical feasibility of removing a contaminant from water. Primary (i.e., health based) and secondary (i.e., aesthetic based) MCLs are promulgated under the SDWA. Secondary MCLs are provided for reference purposes only and are not used in COPC selection. The SDWA MCLs are not relevant to the selection of COPC for surface water because surface water bodies are not potential drinking water sources.

The GSL_{vapor} are published in Table 2C of the USEPA's Evaluating Vapor Intrusion into Indoor Air [EPA530 F 02 052 (USEPA 2002a)], and in updates to that table. The values correspond to a target cancer risk level of 1×10^{-6} or a hazard index of 1 for carcinogens and noncarcinogens, respectively. The GSL_{vapor} were derived to identify chemical concentrations in groundwater that may adversely affect the indoor air quality of a building overlying subsurface VOC contamination. The GSL_{vapor} assume a subsurface attenuation factor of 0.001 for groundwater to indoor air concentrations. Consistent with USEPA guidance, the COPC screening levels are based on an HQ of 1. GSL_{vapor} are not relevant to the

selection of COPC for the surface water because buildings would not be constructed atop surface water bodies.

Screening Levels for Lead — Guidance from the USEPA Office of Prevention, Pesticides, and Toxic Substances and the OSWER recommends 400 milligram per kilogram (mg/kg) as the lowest screening level for lead contaminated soil in a residential setting where children are frequently present (USEPA, 1994). To be conservative, 400 mg/kg will be used as the screening level for COPC selection for soil and sediment. However, guidance from the USEPA Technical Review Workgroup for Lead indicates that "a reasonable screening level for soil lead at commercial/industrial (i.e., non residential) sites is 750 mg/kg" for a typical non contact intensive worker (1999); 800 mg/kg is the current USEPA RSL for soil, assuming an industrial land use scenario. The SDWA action level of 15 micrograms per liter (µg/L) will be used as the screening level for lead in groundwater and surface water.

6.2.2 Decision Rules for Establishing COPC

The following decision rules will be used to select COPC:

- A chemical detected in study area media will be selected as a COPC for the HHRA if the maximum detected chemical concentration exceeds its respective screening level.

- Essential nutrients will not be selected as COPCs. USEPA guidance (USEPA, 1989) states that "Chemicals that are (1) essential human nutrients, (2) present at low concentrations (i.e., only slightly elevated above natural occurring levels), and (3) toxic at very high doses (i.e., much higher than those that could be associated with contact at the site) need not be considered further in the quantitative risk assessment." Examples of such chemicals are magnesium, calcium, potassium, and sodium. Historical information available for the study area indicates that no unusual use or disposal of these constituents occurred there. The recommended daily allowance (RDA) and recommended daily intake (RDI) values indicate that soil concentrations greater than 1,000,000 mg/kg (i.e., pure mineral intake) would be required before receptor intake would exceed RDA and RDI values. A review of current analytical data for the study area indicates that such concentrations have not been detected in study area media.

- Surrogate COPC screening levels will be used for some chemicals. For example, risk based COPC screening levels are not currently available for some chemicals [e.g., acenaphthylene, benzo(g,h,i)perylene, phenanthrene] detected in the study area media due to lack of toxicity criteria. In the COPC screening, acenaphthene will be used as a surrogate for acenaphthylene; pyrene will be used as a surrogate for benzo(g,h,i)perylene and phenanthrene.

Chemicals without COPC screening levels or appropriate surrogate-chemical COPC screening levels will be evaluated qualitatively in the COPC selection section and/or in the uncertainty section of the HHRA. The evaluation will consider the number of times the chemical was detected and the magnitudes of the observed concentrations.

6.3 EXPOSURE ASSESSMENT METHODOLOGY

The exposure assessment component of an HHRA defines and evaluates, either quantitatively or qualitatively, the type and magnitude of human exposure to the chemicals present at or migrating from a site. It is designed to depict the physical setting of the site, to identify potentially exposed populations and applicable exposure pathways, to calculate concentrations of COPC to which receptors might be exposed, and to estimate chemical intakes under the identified exposure scenarios. Actual or potential exposures at a site are dependent upon the most likely pathways of contaminant release and transport as well as on patterns of human activity. A complete exposure pathway has four components: a source of chemicals that can be released to the environment, a route of contaminant transport through an environmental medium, an exposure or contact point for a human receptor, and an exposure route.

6.3.1 Conceptual Site Model

The HHRA will include an update to the CSM provided in this Work Plan. The updated CSM will identify the exposure pathways by which human receptors may come in contact with environmental media within the study areas (or contaminated off-site environmental media). The CSM will depict the relationships among the following elements of a complete exposure pathway (i.e., a pathway that potentially results in human exposure and is evaluated [qualitatively or quantitatively] in an HHRA):

- Site sources of contamination
- Contaminant release mechanisms and transport/migration pathways
- Exposure routes
- Potential receptors

These CSM elements establish the manner and degree to which a potential receptor may be exposed to chemicals present at a site. The degree of risk incurred by a potential receptor varies according to the means of exposure, the duration of exposure, and the specific chemical to which the receptor is exposed. An exposure does not necessarily result in an “unacceptable” health or environmental risk, although risks generally increase with increased frequency and/or duration of exposure.

The CSM will identify the sources of possible contamination and discuss contaminant release mechanisms and transport and migration pathways relevant to the study area soil. The CSM is the basis of the exposure pathways evaluated in the HHRA. The CSM analysis will be comprehensive and will

consider both current and plausible future land use. Consequently, while the current/anticipated future land use at the former Kilgore Manufacturing Site is recreational/educational, the HHRA will also present risks assuming a residential land use. These risk estimates are included in the assessment to support risk management decisions. Risks to the following potential receptors will be evaluated:

- Construction workers — Construction workers are plausible on site adult receptors under future land uses. Construction workers could be exposed to chemicals in surface and subsurface soil (0–2 feet bgs and 2–10 feet bgs or to the zone of saturation, respectively) through incidental ingestion and dermal contact and through inhalation of airborne contaminants emanating from soil. It is assumed that direct contact with the deeper [saturated zone] soil is limited and, thus, direct contact with soil greater than approximately 10 feet bgs (or greater the saturated zone if determined to be within 10 feet bgs) will not be evaluated quantitatively. Such soil (i.e., the saturated zone soil) will be evaluated qualitatively in the uncertainty analysis. Construction workers could also be exposed to chemicals in groundwater through dermal contact and through inhalation of airborne contaminants; however, construction workers are not expected to ingest groundwater. Additionally, construction workers could be exposed to chemicals in surface water and sediment through ingestion and dermal contact.

- Industrial workers — Industrial workers are plausible on site adult receptors under future land uses. These receptors could be directly exposed to chemicals in surface soil (0–2 feet bgs) through incidental ingestion, dermal contact, and inhalation of airborne particulates and vapors emitted from the soil. Industrial worker exposure to subsurface soil (2–10 feet bgs) is unlikely. However, because future construction could potentially bring subsurface soil to the surface, exposure to subsurface soil via incidental ingestion, dermal contact, and inhalation will be evaluated for this receptor to aid in risk management decisions. This receptor is expected to be exposed to soil equally as often (but less intensely) than the construction worker. Industrial workers could also be exposed to chemicals in groundwater that have volatilized into indoor air; however, industrial workers are not expected to have direct contact with groundwater. Additionally, industrial workers could be exposed to chemicals in surface water and sediment through ingestion and dermal contact.

- Adolescent trespassers — Adolescent trespassers are plausible on-site receptors under current land use. These receptors may be exposed to potentially contaminated surface soil (0–2 feet bgs) through incidental ingestion, dermal contact, and inhalation of chemicals emitted from soil to the air. Adolescent trespassers do not have contact with subsurface soil while at the site. Additionally, adolescent trespassers may be exposed to chemicals in surface water and sediment through ingestion and dermal contact.

- Child, adolescent, and adult recreational users — Recreational users are potential receptors for study area contaminants under future land use. A recreational user may be exposed to potentially contaminated surface soil (0–2 feet bgs) through incidental ingestion, dermal contact, and inhalation of chemicals emitted from soil to the air. Because future construction activities could redistribute subsurface soil at the surface, recreational users will be evaluated for risks to subsurface soil (2-10 feet bgs) to aid in risk management decisions. Recreational users could also be exposed to chemicals in surface water and sediment through ingestion and dermal contact. Recreational users are not expected to have contact with groundwater.

- Current child, adolescent, and adult off-site residents — The off-site resident is a plausible receptor under current land use. Off-site residents are not expected to have exposure to chemicals in surface soil (0–2 feet bgs) through ingestion and dermal contact except as trespassers, which are evaluated separately. Off-site residents may be exposed to chemicals in surface soil through fugitive dust and volatile emissions from the site. Current off-site residents are not exposed to on-site subsurface soil (2–10 feet bgs). Based on currently available information, off-site residents do not have contact with on-site groundwater through ingestion and dermal contact; however, this conclusion is pending the results of the RI. However, off-site residents may be exposed to chemicals in groundwater volatilizing into indoor air (vapor intrusion). Current off-site residents are not expected to be exposed to on-site surface water and sediment except as trespassers, which are evaluated separately. However, if the wetlands investigation determines that the on-site wetlands are connected to the off-site wetlands, then off-site residents will be evaluated to exposures to chemicals in surface water and sediment via ingestion and dermal contact.

- Future child, adolescent, and adult on-site residents— The hypothetical future residential scenario is typically evaluated in a risk assessment to facilitate risk management decisions. However, this scenario is extremely conservative for the study area because on-site residential land use will be prohibited by deed restriction. We assume that a hypothetical resident may be exposed to chemicals in surface soil (0–2 feet bgs) through ingestion, dermal contact, and inhalation of chemicals emitted from soil to air. To aid in risk management decisions, hypothetical residents will also be evaluated for risks posed by exposure to subsurface soil (2–10 feet bgs), since future construction could potentially redistribute subsurface soil to the surface. Additionally, future on-site residents could be exposed to chemicals in groundwater through ingestion (i.e., drinking water), dermal contact (e.g., showering/bathing), and inhalation of chemicals that have volatilized into indoor air. Future on-site residents may also be exposed to surface water and sediment through ingestion and dermal contact.

6.3.2 Central Tendency Exposure versus Reasonable Maximum Exposure

Traditionally, exposures evaluated in an HHRA were based on the concept of a "reasonable maximum exposure" (RME) only, defined as "the maximum exposure that is reasonably expected to occur at a site" (USEPA, 1989). Subsequent risk assessment guidance (USEPA, 1992) stipulates the need address an average case, or central tendency, exposure (CTE). However, in this HHRA, only the RME scenario will be evaluated, since the RME scenario is designed to provide the reasonable maximum exposure likely to occur, it is more conservative than the CTE scenario, and is typically the basis of risk management decision making.

6.3.3 Exposure Point Concentration

Exposure point concentration (EPC), calculated for COPCs only (both site related and naturally occurring), is an estimate of chemical concentrations in an exposure unit (EU); EPCs estimate exposure intakes. An EU is the area over which receptor activity is expected. The following paragraphs discuss the EU that will be evaluated in the HHRA and the guidelines for calculating EPCs.

Each Area of Concern (AOC) within the site will be evaluated as a single EU. The following guidelines will be used to calculate EPCs for COPC concentrations in each AOC:

- For soil, groundwater, surface water, and sediment data sets containing at least five samples, the 95 percent upper confidence limit (UCL) on the arithmetic mean, which is based on the distribution of the data set, will be selected as the EPC unless the UCL value exceeds the maximum detected concentration. In this case, the maximum detected concentration will be used as the EPC. The maximum concentration will also be used as the EPC in the event of an insufficient number of detections to calculate a 95% UCL (i.e., less than four positive detections in a data set) in accordance with USEPA guidance (USEPA, 2010c). EPCs will be calculated following USEPA's Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites (USEPA, 2002b) and using USEPA's ProUCL software (USEPA, 2010c).

- The sample quantitation limit will be used as an input for non detects in the USEPA's ProUCL software to calculate the 95percent UCL in accordance with ProUCL guidance (USEPA, 2010c). Duplicates will be averaged to calculate the EPCs for COPC in all media within the study area.

In accordance with the USEPA's Integrated Exposure Uptake Biokinetic Model (IEUBK) Model (USEPA, 1994, 2009b) and their Technical Review Workgroup (TRW) Adult Lead Model (USEPA, 2003b), average lead concentrations will be used to estimate blood lead levels from exposure to lead. This is because the

first step in the model calculations is the development of a central estimate of blood lead concentrations, which requires an “appropriate average concentration” for an individual.

6.3.4 Chemical Intake Estimation

Intakes for the identified potential receptor groups will be calculated using current USEPA risk assessment guidance (as recommended by OEPA September 1, 2006, guidance) and presented in the risk assessment spreadsheets. Risk assessment results will be presented using the USEPA RAGS Part D Table format. Exposure assumptions to be used in the calculations will be compiled and submitted to OEPA as a preliminary deliverable prior to calculating risks (this interim risk assessment deliverable will likely be submitted while the field investigation is being conducted).

Noncarcinogenic intakes are typically estimated using the concept of an average annual exposure. Carcinogenic intakes are calculated as an incremental lifetime exposure, which assumes a life expectancy of 70 years. Several USEPA guidance documents (e.g., 1989, 1991, 1993a, 1997a, 2004a) will be consulted for exposure assumptions. The exposure assumptions will reflect the current primary guidance used for exposure assumption development.

Standard chemical-intake equations presented in USEPA guidance (e.g., 1989, 2004a, 2009a) will be used to calculate chemical intakes for soil (ingestion, dermal contact, and inhalation), groundwater (ingestion and dermal contact), surface water (ingestion and dermal contact), and sediment (ingestion and dermal contact). Inhalation of chemicals in groundwater that have volatilized during construction activities will be evaluated for construction worker using guidance for the Virginia Department of Environmental Quality (VDEQ) (2004). Inhalation of chemicals that have volatilized from groundwater into indoor air will be evaluated for residents using the Johnson and Ettinger Volatilization Model (USEPA, 2004a). The model assumes that volatile chemical vapors emitted from groundwater migrate through subsurface soil and cracks in building foundations to accumulate in the air inside a building.

6.3.4.1 Assessing Cancer Risks from Early Life Exposures

The USEPA’s Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens (USEPA, 2005b) recommends adjusting the toxicity of carcinogenic chemicals that act mutagenically when evaluating early life exposures to contaminants. The guidance recommends using age dependent adjustment factors (ADAFs) in concert with age specific exposure estimates when assessing cancer risks. Absent chemical specific data, the supplemental guidance recommends the following default adjustments, which reflect that cancer risks are generally higher from early life exposures than from similar exposures later in life:

- For exposures before two years of age (i.e., spanning a two year interval from the first day of birth until a child's second birthday), a 10 fold adjustment.

- For exposures between two and less than 16 years of age (i.e., spanning a 14 year time interval from a child's second birthday until their sixteenth birthday), a three fold adjustment.

- For exposures after reaching 16 years of age, no adjustment.

These adjustments will be applied using the same method as that used by USEPA to develop the RSLs. Children will be evaluated in two age groups, ages 0–2 and 2–6 years old. Adolescents will be evaluated as one age group, 6–16 years old. Adults will be evaluated as one age group (16–30 years old). Using this approach, the intakes for adolescent trespassers, recreational users, and residents are calculated as follows:

$$\text{Intake}_{\text{Child}} = \text{Intake}_{(\text{ages } 0\text{— } 2 \text{ years})} \times 10 + \text{Intake}_{(\text{ages } 2\text{— } 6 \text{ years})} \times 3$$

$$\text{Intake}_{\text{Adolescent}} = \text{Intake}_{(\text{age } 6\text{— } 16 \text{ years})} \times 3$$

$$\text{Intake}_{\text{Adult}} = \text{Intake}_{(\text{ages } 16\text{— } 30 \text{ years})} \times 1$$

This approach will be used only for chemicals identified as mutagenic in the USEPA RSL screening table [e.g., carcinogenic polycyclic aromatic hydrocarbons (cPAHs), hexavalent chromium].

Risks to receptors involving different age groups are sums of the cancer risks calculated for individual children, adolescents, and adult receptors. Therefore, lifelong cancer risks from chemicals that act via the mutagenic pathway are assessed through the lifelong off-site resident, lifelong recreational user, and lifelong on-site resident receptor scenarios.

6.3.4.2 Exposure to Lead

The equations and methodology presented in the previous section cannot be used to evaluate exposure to lead because of the absence of published dose response parameters. Thus, exposure to lead will be assessed using the following models:

- The latest version of USEPA's IEUBK Model for Lead, (USEPA, 2009b). This model is typically used to evaluate lead exposure assuming a residential land use scenario.

- USEPA's TRW Model for Lead (USEPA, January 2003b; model version date: 06/21/2009). This model is typically used to evaluate lead exposure assuming a non residential land use scenario.

The IEUBK model for lead (USEPA, 1994, 2009b) is designed to estimate blood levels of lead in children under seven, based on either default or site specific input values for air, drinking water, diet, dust, and soil exposure. Studies indicate that infants and young children are extremely susceptible to adverse effects from exposure to lead. Considerable behavioral and developmental impairments have been noted in children with elevated blood lead levels. The threshold for toxic effects from this chemical is believed to be in the range of 10–15 micrograms per deciliter (µg/dL). Blood lead levels greater than 10 µg/dL are considered a "concern."

For the study area, the IEUBK model for lead will be used to address exposure to lead in children when detected soil concentrations exceed the OSWER soil screening level of 400 mg/kg for residential land use (USEPA, 1994). Average chemical concentrations, as well as default parameters for some input parameters, will be used in the evaluation. Estimated blood lead levels and probability density histograms will be presented to support this analysis, and will be appended to the HHRA. Site-specific average groundwater concentrations will be used as an input to the model if available. The SDWA action level of 15 µg/L will be used as the screening level for lead in groundwater.

Non residential adult exposure to lead in soil will be evaluated using USEPA's TRW model for lead (USEPA, 2003a, 2009c). In this model, adult exposure to lead in soil is addressed evaluating the relationship between lead concentration in site soil and the blood lead concentration in the developing fetuses of adult women. The adult lead model generates a spreadsheet for each exposure scenario evaluated (i.e., construction, industrial, recreational). The spreadsheet output is the probability that blood lead concentrations in the fetus will exceed 10 µg/L. That probability is calculated in accordance with the following USEPA guidelines:

- Use of the TRW Interim Adult Lead Methodology in Risk Assessment (USEPA, 1999)
- Frequently Asked Questions (FAQs) on the Adult Lead Model (USEPA, 2010b)

No models are currently available to evaluate periodic exposure of adolescent receptors to lead. Therefore, the results of the IEUBK model for children will be used to qualitatively assess this receptor's exposure risk. The qualitative discussion will assert that potential adverse effects from exposure to lead are expected to be of lesser magnitude for adolescent receptors than for young children.

6.4 TOXICITY ASSESSMENT

The toxicity assessment seeks to identify potential adverse health effects in exposed populations. Quantitative estimates of the relationship between the magnitude and type of exposures and the severity or probability of human health effects are defined for the identified COCs. Quantitative toxicity values

determined during this component of the risk assessment are integrated with exposure assessment outputs to characterize the potential occurrence of adverse health effects for each receptor group.

The reference dose (RfD) is the toxicity value used to evaluate noncarcinogenic health effects for ingestion and dermal exposures. The reference concentration (RfC) is used to evaluate noncarcinogenic health effects for inhalation exposures. The RfD and RfC estimate a daily exposure level for a human population that is unlikely to pose an appreciable risk during a portion of or for all of a human lifetime. It is based on a review of animal and/or human toxicity data, with adjustments for various data uncertainties. Carcinogenic effects are quantified using the cancer slope factor (CSF) for ingestion and dermal exposures and using inhalation unit risks (IUR) for inhalation exposure that are plausible upper bound estimates of the probability of the development of cancer per unit intake of the chemical over a lifetime. These are typically based on dose response data from human and/or animal studies.

6.4.1 Toxicity Criteria for Oral and Inhalation Exposures

Oral RfDs and CSFs and inhalation RfCs and IURs used in the risk assessment will be obtained from the following primary USEPA literature sources (USEPA, 2003c):

- IRIS — USEPA's "Integrated Risk Information System" online database.

- USEPA's Provisional Peer Reviewed Toxicity Values (PPRTVs) — USEPA's Office of Research and Development/National Center for Environmental Assessment (NCEA) Superfund Health Risk Technical Support Center develops chemical specific PPRTVs when requested by USEPA's Superfund program.

- Other toxicity values — These sources include, but are not limited to, California Environmental Protection Agency (Cal/EPA) toxicity values, Federal Agency for Toxic Substances and Disease Registry (ATSDR) values, and the Annual Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997b).

Although toxicity criteria can be found in several toxicological sources, USEPA's IRIS online database is the preferred source of toxicity values. This database is continuously updated, and its values are verified by USEPA.

6.4.2 Toxicity Criteria for Dermal Exposure

RfDs and CSFs in the scientific literature are typically expressed as "administered" (i.e., not absorbed) doses. Therefore, these values are considered inappropriate for estimating risks associated with dermal

exposures. Oral dose response parameters based on administered doses must be adjusted to absorbed doses before they can be compared to estimated dermal exposure intakes.

When oral absorption is essentially complete (i.e., 100 percent), an absorbed dose is equivalent to the administered dose; therefore no toxicity adjustment is necessary. Conversely, when the gastrointestinal absorption of a chemical is poor (e.g., 1 percent), the absorbed dose is smaller than the administered dose; thus, toxicity factors based on the absorbed dose should be adjusted to account for the difference in the absorbed dose relative to the administered dose. USEPA (2004a) recommends a 50 percent absorption cut off to reflect the intrinsic variability in analyzing absorption studies. Therefore, the adjustment from administered to absorbed dose was only performed when the chemical specific gastrointestinal absorption efficiency was less than 50 percent. The adjustment from administered to absorbed dose was made using chemical specific gastrointestinal absorption efficiencies published in numerous sources of guidance [e.g., USEPA 2004a (the primary reference), IRIS, ATSDR toxicological profiles, etc.], using the following equations:

$$RfD_{dermal} = (RfD_{oral})(ABS_{GI})$$

$$CSF_{dermal} = (CSF_{oral}) \ / \ (ABS_{GI})$$

where:

ABS_{GI}	=	absorption efficiency in the gastrointestinal tract
RfD_{dermal}	=	reference dose for dermal exposures
RfD_{oral}	=	reference dose for oral exposures
CSF_{dermal}	=	cancer slope factor for dermal exposures
CSF_{oral}	=	cancer slope factor of oral exposures

As noted, the preceding adjustment of the oral toxicity criteria (i.e., reference doses, cancer slope-factors) is necessary so that the dermal route of exposure may be quantitatively evaluated in the baseline risk assessment. Further explanation of this procedure and its necessity are presented in Appendix A of the USEPA RAGS Part A.

6.4.3 Chromium Toxicity

Toxicity criteria are available for different forms of chromium, which is considered more toxic in the hexavalent state. In the USEPA's most recent RSL table, hexavalent chromium is listed as a carcinogen that has been determined to act "mutagenically" and the corresponding RSL for residential soil is less than 1 mg/kg. The USEPA Guidelines for Carcinogen Risk Assessment (USEPA, 2005a) and Supplemental Guidance of Assessing Susceptibility from Early Life Exposure to Carcinogens (USEPA,

2005b) specify the use of ADAFs for carcinogens, such as chromium, that act mutagenically. In contrast, the RSL for residential soil for trivalent chromium (not listed as a carcinogen/mutagen) is 120,000 mg/kg. The site history information, conceptual site model, and available analytical data for the study area (total chromium, hexavalent chromium) will be reviewed to determine what percentage (if any) of the chromium in soil is present/likely to be present in the hexavalent form. The HHRA will evaluate chromium assuming it is present in the trivalent state unless analytical data or site history indicates hexavalent chromium is present in the soil. No chemical specific ADAFs have been derived for hexavalent chromium; therefore, default ADAFs will be used to evaluate exposures to hexavalent chromium as discussed in Section 2.4.4.

6.4.4 Toxicity Criteria for the Carcinogenic Effects of cPAHs

Limited toxicity values are available to evaluate the carcinogenic effects from exposure to cPAHs. The most extensively studied cPAH is benzo(a)pyrene, which is classified by USEPA as a probable human carcinogen. Although CSFs are available for benzo(a)pyrene, insufficient data are available to calculate CSFs for other cPAHs. The toxic effects of these chemicals will be evaluated using toxicity equivalency factors (TEFs) based on the potency of each compound relative to that of benzo(a)pyrene, as presented in current USEPA guidance (USEPA, 1993b). TEFs are used to convert each individual cPAH concentration into an equivalent concentration of benzo(a)pyrene.

As discussed above, the USEPA's Guidelines for Carcinogen Risk Assessment (USEPA, 2005a) and Supplemental Guidance of Assessing Susceptibility from Early Life Exposure to Carcinogens (USEPA, 2005b) specify the use of ADAFs for carcinogens that act mutagenically. The cPAHs are included in the group of chemicals determined to act mutagenically. No chemical specific ADAFs have been derived for cPAHs; therefore, the default ADAFs will be used as discussed in Section 2.4.4.

6.5 RISK CHARACTERIZATION

This section of the HHRA will characterize the potential human health risks associated with exposures to study area media. Potential risks (noncarcinogenic and carcinogenic) for human receptors from exposures as outlined in the exposure assessment will be quantitatively determined. Sections 4.1 and 4.2 outline the methods used to quantitatively estimate the type and magnitude of potential risks to human receptors.

6.5.1 Quantitative Analysis of Constituents Other Than Lead

Quantitative estimates of risk for chemicals other than lead will be calculated according to risk assessment methods outlined in USEPA guidance (USEPA, 1989). Lifetime cancer risks are expressed in the form of dimensionless probabilities referred to as incremental lifetime cancer risks (ILCRs), based

on CSFs and IURs. Noncarcinogenic risk estimates are presented in the form of HQs, which are determined by comparing intakes against published RfDs and RfCs. ILCR estimates for ingestion and dermal exposures will be generated for each COPC using estimated exposure intakes and published CSFs, as follows:

$$\text{ILCR} = (\text{Estimated Exposure Intake})(\text{CSF})$$

If the equation above produces an ILCR greater than 0.01, the following equation is used:

$$\text{ILCR} = 1\ [\exp(\text{ Estimated Exposure Intake})(\text{CSF})]$$

ILCR estimates of inhalation exposures are generated for each COPC using estimated exposure concentrations and published IURs, as follows:

An ILCR of 1×10^{-6} indicates that the exposed receptor has a one in one million chance of developing cancer under the defined exposure scenario. Alternatively, such a risk may be interpreted as representing one additional case of cancer in an exposed population of one million persons.

Noncarcinogenic risks will be assessed using the concept of HQs and hazard indices (HIs). The HQ for a COPC is the ratio of the estimated intake to the RfD and is calculated for ingestion and dermal exposures as follows:

$$\text{HQ} = (\text{Estimated Exposure Intake})/(\text{RfD})$$

For inhalation exposures, the HQ is calculated as follows:

$$\text{HQ} = (\text{Exposure Concentration})/(\text{RfC})$$

An HI will be generated by summing the individual HQs for all COPC. The HI is not a mathematical prediction of the severity of toxic effects; therefore, it is not a true probabilistic “risk;” it is simply a numerical indicator of the possibility of the occurrence of noncarcinogenic (threshold) effects.

6.5.2 Interpretation of Risk Assessment Results

To interpret the quantitative risk estimates and aid risk managers in determining the need for remediation, quantitative risk estimates are compared to typical OEPA and USEPA risk benchmarks. Calculated ILCRs are interpreted using the OEPA risk benchmark (1×10^{-5}) for cumulative risk and the USEPA target

cancer risk range (1×10^{-4} to 1×10^{-6}); HIs are evaluated using a value of 1.0. Current USEPA policy regarding lead exposures is to limit the childhood risk of exceeding a 10 µg/dL blood lead level to 5 percent.

USEPA defines the range of 1×10^{-4} to 1×10^{-6} as the ILCR target range for hazardous waste facilities addressed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). Individual or cumulative ILCRs greater than 1×10^{-4} are generally considered "unacceptable" by the USEPA. Risk management decisions are necessary when the ILCR is within 1×10^{-4} to 1×10^{-6}. USEPA typically does not require remediation when the cumulative ILCR is less than 1×10^{-6}. Similarly, cumulative ILCRs greater than 1×10^{-5} are generally considered "unacceptable" by OEPA; remediation may or may not be necessary when the cumulative ILCR exceeds 1×10^{-5}.

An HI exceeding unity (1.0) indicates that noncarcinogenic health risks may be associated with exposure. If an HI exceeds unity, target organ effects associated with exposure to COPC are considered. Only those HQs for chemicals affecting the same target organ(s) or exhibiting similar critical effect(s) are regarded as truly additive. Consequently, the cumulative HI could exceed 1.0, but no adverse health effects would be anticipated unless the COPC affected the same target organ or exhibited the same critical effect (i.e., unless target organ /critical effect specific HIs exceeded 1).

As a general guideline, a "no further action" recommendation will be forwarded to OEPA whenever the cancer risk estimates and total HIs (estimated on a target organ/target effect basis) for receptors of concern are less than 1×10^{-5} and 1, respectively; and when risks associated with lead exposure are below the USEPA risk benchmark. Otherwise, in most cases, the need for remedial action (including institutional controls) will be evaluated in an FS. However, the 1×10^{-5} risk benchmark should not be viewed as a discrete limit. Risks slightly greater than 1×10^{-5} may be considered "acceptable" (i.e., protective) if justified by site specific conditions, including any uncertainties about the nature and extent of contamination and associated risks. Consequently, a "no further action" recommendation may be forwarded to OEPA risk managers for review and discussion when the 1×10^{-5} risk benchmark is exceeded. Those reviews and discussions may affect the analyses presented in the FS. The following factors will be considered in this determination:

- The magnitude of the media specific risk estimates.
- Significant uncertainties in the baseline HHRA that would overestimate baseline risk assessment results.
- Significant uncertainties in EPC estimates that would overestimate baseline risk assessment results.

6.5.3 Refined Evaluation of Chemical Migration from Soil to Groundwater

Chemicals of potential concern for migration from soil to groundwater will be selected, as detailed in Section 2. However, a more refined evaluation of the potential for such migration will be included in the risk characterization component of the HHRA and will be based on the following considerations:

- Does the maximum detected soil concentration exceed the SSL at a dilution attenuation factor of 20 (DAF_{20})?
- Does the mean of positive detections in soil exceed the SSL at a DAF_{20}?
- What is the frequency of detections exceeding the SSL at a DAF_{20}?
- Was the chemical selected as a COPC in groundwater?
- Does the maximum concentration in groundwater exceed the SDWA MCL?
- What is the frequency of detections in groundwater exceeding the USEPA RSL for tap water (based on an ILCR of $1x10^{-6}$ or an HI of 1)?
- What is the frequency of detections in groundwater exceeding 10 times the USEPA RSL for tap water (based on an ILCR of $1x10^{-6}$ or an HI of 1)?

These factors will be considered when selecting COC for groundwater protection. Constituents selected as COPC for migration from soil to groundwater in the initial screening will not be retained as COC if any of the following is true:

- The maximum soil concentration is less than the groundwater protection SSL, based on a DAF_{20}.
  Rationale: A dilution attenuation factor of 1 (DAF_1) is conservative; a DAF_{20} is assumed to be more accurate at most sites (USEPA, 1996a).
- The frequency of detections greater than the SSL at a DAF_{20} is less than 5 percent (when at least 20 samples are included in the data set and no contamination “hot spot” is present). A “hot spot” is defined as a concentration that exceeds twice the SSL at a DAF_{20}.
  Rationale: Chemicals are unlikely to pose risks to water quality through leaching from soil to groundwater if they are detected infrequently (i.e., less than 5 percent) in soil.

- The chemical was not selected as a COPC in groundwater.
  Rationale: If a chemical was not detected in site groundwater, the data do not indicate that water quality has been adversely affected. This is an important consideration because the contamination events within the study area occurred more than 40 years ago. Thus, given the passage of time, groundwater concentrations likely reflect the potential for chemical migration from soil to groundwater.

- The maximum concentration in groundwater is less than the SDWA MCL.
  Rationale: SDWA MCLs are federally enforceable drinking water standards. Concentrations of chemicals in groundwater that are less than corresponding SDWA MCLs indicate that groundwater has not been adversely affected.

- The frequency of detections greater than the USEPA tap water RSL is less than 5 percent (when at least 20 samples are included in the data set and no contamination "hot spot" is present). A "hot spot" is defined as a concentration twice the tap water RSL.
  Rationale: Chemicals are unlikely to pose risks to water quality through leaching from soil to groundwater if they are detected infrequently (i.e., less than 5 percent) in groundwater.

6.6 UNCERTAINTY ANALYSIS

The uncertainty analysis component of the HHRA will provide a summary of uncertainties inherent in the risk assessment and will include a discussion of how they may affect the quantitative risk estimates and conclusions of the risk analysis. The baseline HHRA for the study area will be performed in accordance with current USEPA guidance. However, varying degrees of uncertainty are associated with any baseline HHRA. A brief discussion of uncertainty issues generally considered in an HHRA is provided in the following narrative.

Uncertainty in COPC selection is related to the status of the available databases, the grouping of samples, the numbers, types, and distributions of samples, data quality, and the procedures used to include or exclude constituents as COPC. Uncertainty associated with the exposure assessment includes the values used as input variables for a given intake route or scenario, the assumptions made to determine EPCs, and the predictions regarding future land uses and population characteristics. Uncertainty in the toxicity assessment includes the quality of the existing toxicity data needed to support dose response relationships and the weight of evidence used to determine the carcinogenicity of COPC. Uncertainty in risk characterization is associated with exposure to multiple chemicals and the cumulative uncertainty from combining conservative assumptions made in earlier steps of the risk assessment.

Whereas various sources of random uncertainty and bias exist, the magnitude of bias and uncertainty and the direction of bias are influenced by the assumptions made throughout the risk assessment,

including selection of COPC and selection of values for dose response relationships. Throughout the risk assessment, assumptions that consider safety factors will be made to overestimate the final calculated risks. Generally, risk assessments carry two types of uncertainty: measurement and informational uncertainty.

Measurement uncertainty refers to the usual variance that accompanies scientific measurements. For example, this type of uncertainty is associated with the analytical data collected for each site. The risk assessment reflects the accumulated variances of the individual values used.

Informational uncertainty stems from inadequate availability of information needed to complete the toxicity and exposure assessments. This gap is often significant, such as the absence of information on the effects of human exposure to low doses of a chemical, the biological mechanism of chemical action, or the behavior of a chemical in soil.

After the risk assessment is complete, the results must be reviewed and evaluated to identify the type and magnitude of uncertainty involved. Relying on risk assessment results without considering the uncertainties, limitations, and assumptions inherent in the process can be misleading. For example, to account for uncertainties in developing exposure assumptions, conservative estimates will be made to ensure that the particular assumptions protect sensitive subpopulations or maximally exposed individuals.

If a number of conservative assumptions are combined in an exposure model, the resulting calculations can propagate the uncertainties associated with those assumptions, thereby producing much larger uncertainty in the results. This uncertainty is biased toward over predicting both carcinogenic and noncarcinogenic risks. Thus, both the results of the risk assessment and the uncertainties associated with them must be considered when making risk management decisions.

This interpretation of uncertainty is especially relevant when the risks exceed the point of departure for defining “acceptable” risk. For example, when risks calculated using a high degree of uncertainty are less than an “acceptable” risk level (i.e., 10 6), the interpretation of “no significant risk” is typically straightforward. However, when risks calculated with a high degree of uncertainty exceed an acceptable risk level (i.e., $1x10^{-4}$), a conclusion can be difficult unless uncertainty is considered. The draft HHRA will be conducted using the most recent USEPA RSLs available at the time of preparation. However, the RSLs are “evergreen” screening values and are subject to change as new toxicity information becomes available and is evaluated by the USEPA. Consequently, the COPC could change if the RSLs change.

6.7 REMEDIAL GOAL OPTIONS

Cleanup goals will be developed for those study areas with ILCRs greater than 1×10^{-5} and a total HI greater than 1.0. Cleanup goals will be derived for those COCs that contribute significantly to the cancer risk and/or HI for each exposure pathway in a given land-use scenario for a receptor group. Chemicals that are not considered to be significant contributors to risk will not be included as COCs if their individual carcinogenic risk contribution is less than 1×10^{-6} and their non carcinogenic HQ is less than 0.1. Cleanup goals will be calculated using the following equation:

$$\text{Cleanup Goal [chemical i]} = \text{EPC[chemical i]} \times \text{Target Risk/Calculated Risk[chemical i]}$$

where:

Cleanup goal [chemical i]	=	chemical specific cleanup goal
EPC [chemical i]	=	exposure point concentration used in risk assessment calculations
Target risk	=	target risk for carcinogens or the target hazard quotients for noncarcinogens
Calculated risk [chemical i]	=	total risk calculated for a specific chemical in the risk assessment

7.0 ECOLOGICAL RISK ASSESSMENT

7.1 INTRODUCTION

The goal of the ERA will be to determine whether adverse ecological impacts are present as a result of exposure to chemicals released to the environment through historical activities at the Former Kilgore Manufacturing Site, Westerville, Ohio. The ERA will contain information that enables risk managers to conclude that either ecological risk at the site is negligible or that further information is necessary to evaluate the potential ecological risk.

The ERA methodology will be in accordance with guidance presented in the following documents:

- Guidance for Conducting ERAs, DERR-00-RR-031 (State of Ohio, EPA, Division of Emergency and Remedial Response, October 2006, Revised April 2008).
- Final Guidelines for ERA (USEPA, 1998).
- ERA Guidance for Superfund: Process for Designing and Conducting ERA (USEPA, 1997).

This ERA will consist of Levels I, II, and III of the Ohio Environmental Protection Agency (OEPA) ERA Guidelines which generally follow Steps 1, 2, and the first part of Step 3 (often referred to as Step 3a) of the eight step USEPA ERA process. The Level III baseline assessment will only be conducted if warranted based on the results of the Level II ERA. Also, in the event that a Level III baseline assessment is conducted, no tissue samples or toxicity testing is planned at this time. Collection of that data would require additional planning and coordination with OEPA, which cannot be done until the initial ERA is prepared.

The following narrative briefly outlines the components of the ERA to be prepared for the study areas within the former Kilgore Manufacturing Site. Details (e.g., exposure assumptions) will be compiled and submitted to OEPA as a preliminary deliverable prior to formal preparation of the ERA (this interim risk assessment deliverable will likely be submitted while the field investigation is being conducted).

7.2 LEVEL 1 SCOPING

The Level 1 scoping is similar to the screening-level problem formulation step in the USEPA ERA process. It includes general descriptions of the study area with emphasis on the habitats and ecological receptors present. This phase also involves characterization of site-related chemicals, chemical sources, migration routes, and an evaluation of routes of chemical exposure.

7.3 LEVEL 2 -SCREENING

The Level 2 screening will be conducted to determine the need for further ecological evaluation of a site (i.e., whether a Level III baseline assessment is needed). This screening will consist of comparison of site analytical data to background levels and the screening levels described in the OEPA ERA Guidelines.

The media screening will be conducted for soil, sediment, and surface water because samples from these media will be collected. Although groundwater data will also be collected, it will not be evaluated in the Level 2 screening because surface water samples will be collected and that will be the exposure point for groundwater.

A detailed site survey as part of the Level II ERA is not needed and will not be conducted because a wetland delineation has already been conducted in the area.

After the screening is conducted, a decision will be made as to whether the Level III baseline assessment is needed.

7.4 LEVEL III BASELINE ASSESSMENT

In the event that a Level III baseline assessment is needed, the following describe some of the general steps that would be conducted and receptors that may be evaluated.

7.4.1 Environmental Setting

The objectives of this step are to 1) initially identify and characterize the habitats and ecological resources throughout the site, and, 2) describe the likely chemical sources, release mechanisms, migration pathways, and the fate of chemicals resulting from site-related activities, as well as ecological receptors that could be adversely affected by chemicals.

7.4.2 Potential Receptors

A site visit was completed to evaluate the quality of the wetlands present at the site. Several forested, scrub/shrub, and emergent wetland areas covering half of the 40-acre site were identified. The remaining 20 acres consist of dense grasses and brush. Based on the habitat at the site, soil invertebrates, birds and mammals are likely present at the site and are potential ecological receptors of concern. An aquatic bed was identified in one of the wetland areas creating habitat for amphibians.

7.4.3 Endpoints

7.4.3.1 Assessment Endpoints

An assessment endpoint is an explicit expression of the environmental value that is to be protected (USEPA, 1997). The selection of these endpoints is based on the habitats present, the migration pathways of chemicals, and the routes that chemicals may take to enter receptors.

For this ERA, the assessment endpoints will include the protection of the following groups of receptors from a reduction in growth, survival, and/or reproduction caused by site-related chemicals:

- Soil invertebrates
- Terrestrial vegetation
- Benthic invertebrates
- Terrestrial invertivorous birds and mammals
- Terrestrial herbivorous birds and mammals
- Wetland invertivorous birds and mammals

The following paragraphs discuss why the above assessment endpoints exemplify those important for this ERA.

Soil Invertebrates: Soil invertebrates present within the study area aid in the formation of soil, as well as in the redistribution and decomposition of organic matter in the soil, and serve as a food source for higher trophic-level organisms. They can also accumulate some contaminants, which can then be transferred to the higher trophic-level organisms that consume invertebrates.

Terrestrial Vegetation: Terrestrial vegetation within the study area consists of grasses, shrubs, and trees. These plant types serve as a food source, provide shade and cover for many organisms, and help prevent soil erosion, among other important functions. They can also accumulate some contaminants, which can then be transferred to the higher trophic-level organisms that consume plants.

Benthic Invertebrates: Benthic invertebrates serve as a food source for higher trophic-level organisms (i.e., fish, amphibians, birds, mammals). They can also accumulate contaminants, which can be transferred to higher trophic-level organisms that consume invertebrates.

Terrestrial Herbivorous Birds and Mammals: Herbivorous birds and mammals (i.e., animals that consume only plant tissue) are present within the study area. Their role in the community is essential because

without them, higher trophic levels could not exist (Smith, 1966). They may be exposed to and accumulate contaminants that are present in the plants they consume, and soil they incidentally ingest.

Terrestrial Invertivorous Birds and Mammals: Birds and mammals that consume primarily invertebrates are considered first-level carnivores. They serve as a food source for higher trophic level carnivores and may be exposed to and accumulate chemicals present in the food items they consume, and soil they incidentally ingest.

Wetland Invertivorous Birds and Mammals: Birds that consume primarily invertebrates are considered first-level carnivores. They serve as a food source for higher trophic level carnivores and may be exposed to and accumulate chemicals present in the food items they consume, and sediment they incidentally ingest.

As indicated in USEPA (1997), "it is not practical or possible to directly evaluate risks to all of the individual components of the ecosystem at a site. Instead, assessment endpoints focus the risk assessment on particular components of the ecosystem that could be adversely affected by contaminants from the site." Therefore, the ERA will focus on the endpoints that tend to yield the highest risks, which will account for endpoints that have lower risks.

Carnivorous birds and mammals generally have large home ranges. The study area covers approximately 40 acres of land. When the size of the study area is compared to the home range of top carnivores, such as the red-tailed hawk and the red fox, carnivores would receive only a very small portion of their diet from the study area; therefore, they will not be included as receptors in the ERA. Threshold oral toxicity values for reptiles and amphibians are not available for most chemicals, so risks to reptiles and amphibians will not be quantitatively evaluated. With the above factors in mind, amphibians, reptiles, and carnivores will not be selected as assessment endpoints for the ERA.

7.4.3.2 Measurement Endpoints

Measures of effects are estimates of biological impacts (i.e., survival, growth and/or reproduction) that are used to evaluate the assessment endpoints. The following measures of effects are examples of those that will be used to evaluate the assessment endpoints in this ERA.

- Decreases in survival, growth, and/or reproduction of plants, terrestrial invertebrates, and benthic invertebrates will be evaluated by comparing measured concentrations of chemicals in surface soil and sediment to screening values designed to be protective of ecological receptors.

- Decreases in survival, reproduction, and/or developmental effects of birds and mammals will be evaluated by comparing the estimated ingested dose of contaminants in surface soil and sediment to no-observed-adverse-effects levels (NOAELs) and lowest-observed-adverse-effects levels (LOAELs) for surrogate wildlife species.

7.5 CONCEPTUAL SITE MODEL

A CSM in ERA problem formulation is a written description of predicted relationships between ecological entities and the stressors to which they may be exposed (USEPA, 1998). The CSM will consist of two primary components: predicted relationships among stressor, exposure, and assessment endpoint response, and a diagram that illustrates the relationships (USEPA, 1998).

7.6 ECOLOGICAL EFFECTS EVALUATION

The ecological effects assessment is an investigation of the relationship between the exposure to a chemical and the potential for adverse effects resulting from exposure. In this step, screening levels for toxicity of the chemicals to ecological receptors are compiled. Screening levels recommended by the Ohio EPA will be considered in the evaluation and will be forwarded to the Ohio EPA for review and comment prior to incorporation into the ERA.

7.7 CHARACTERIZATION OF EXPOSURE

This portion of the ERA will include identification of contaminant concentration data used as the EPCs to represent ecological exposure in various media. The total exposure dose for terrestrial wildlife hypothetically exposed to chemicals in soil, sediment, and associated food items such as plants and invertebrates will be estimated using food chain models. Selection of a particular species will be required so that intake through ingestion can be estimated. The availability of exposure parameters (i.e., body mass, and ingestion rates) will be factors in selecting surrogate receptor species.

The equations used to determine contaminant intake will be provided in the interim risk assessment deliverable referenced in the preceding narrative.

7.8 RISK CHARACTERIZATION

The risk characterization is the final phase of an ERA, and compares exposure to ecological effects. It is at this phase that the likelihood of adverse effects occurring as a result of exposure to a stressor is evaluated. An ecological effects quotient (EEQ) approach will be used to characterize the potential risk to ecological receptors by comparing exposure concentrations and doses to effects data. When EEQ values exceed 1.0, it is an indication that ecological receptors are potentially at risk; additional evaluation

or data may be necessary to confirm with greater certainty whether ecological receptors are actually at risk, especially since most benchmarks are developed using conservative exposure assumptions and/or studies. The EEQ value should not be construed as being probabilistic; rather, it is a numerical indicator of the extent to which an EPC exceeds or is less than a benchmark. The equations used to calculate the EEQs will be provided in the interim risk assessment deliverable referenced in the preceding narrative.

The final part of the screening evaluation is selection of COPCs. Chemicals that are not selected as COPCs are assumed to present negligible risk to ecological receptors and are not further evaluated in the ERA for those receptors. Chemicals that are initially selected as COPCs in the Level II screening will be evaluated further in Level III. As part of the risk characterization, a refinement of the conservative exposure assumptions and concentrations will be conducted to evaluate the potential risks to ecological receptors (e.g., plants, invertebrates, and wildlife receptors). The objective of the evaluation is to further refine the number of chemicals that are retained as COPCs in order to focus additional efforts (if necessary) on chemicals that are of significant ecological concern. The following describes the process that will be used to further evaluate chemicals initially selected as COPCs in soil and sediment.

The following factors will be evaluated, as appropriate, to determine if the risks are great enough to warrant additional evaluations. Note that all of these factors might not be applicable for each chemical and/or receptor group.

- Magnitude of criterion exceedance: Although the magnitude of the risks may not relate directly to the magnitude of a criterion exceedance, the magnitude of the criterion exceedance may be one item used in a lines-of-evidence approach to determine the need for further site evaluation. The greater the criterion exceedance, the greater the probability and concern that an unacceptable risk exists.

- Frequency of chemical detection and spatial distribution: A chemical detected at a low frequency typically is of less concern than a chemical detected at higher frequency if toxicity and concentrations and spatial areas represented by the data are similar. All else being equal, chemicals detected frequently will be given greater consideration than those detected relatively infrequently. In addition, the spatial distribution of a chemical may be evaluated to determine the area that a sample represents.

- Contaminant bioavailability: Many contaminants (especially inorganics) are present in the environment in forms that are typically not bioavailable, and the limited bioavailability will be considered when evaluating the exposures of receptors to site contaminants. Contaminants with generally less bioavailability will be considered to be less toxic than the more bioavailable contaminants, all other factors being equal.

- More Appropriate Benchmarks: More appropriate benchmarks will be used to further evaluate risks to specific groups of ecological receptors (e.g., plants and invertebrates) because while screening levels are useful for initial screening, they might not be appropriate for evaluating all of the assessment endpoints.

8.0 FEASIBILITY STUDY

The Feasibility Study (FS) will be conducted in accordance with USEPA RI/FS Guidance, Chapter 4. Otterbein developed and evaluated a range of remedial alternatives during the RI/FS scoping presented in the PER. Otterbein will continue to develop and evaluate the remedial alternatives initially developed during project scoping as the RI data becomes available.

8.1 REFINE REMEDIAL ACTION OBJECTIVES (USEPA RI/FS GUIDANCE SECTION 4.2.1)

Otterbein will further refine the preliminary RAOs identified during project scoping.

RAOs for protection of human health should specify a site-specific PRG, an exposure pathway and receptor, and preliminary points of compliance. An ITM will be prepared and submitted identifying the refined RAOs for protection of human health and the environment and detailing the methods and procedures used to refine them. Otterbein will revise the refined RAOs per Ohio EPA's comments, if any, and include the refined RAOs in the Alternatives Array Document described in 8.2 below.

8.2 ALTERNATIVES ARRAY DOCUMENT (USEPA RI/FS GUIDANCE CHAPTER 4)

Otterbein will prepare an Alternatives Array Document (MD) which documents the methods, rationale, and results of the technology, process option, and alternatives development and the screening process. Respondent shall include an evaluation of whether the amount and type of data existing for the Site will support the subsequent detailed analysis of the alternatives. Respondent shall modify the alternatives based on Ohio EPA's comments, if any, to assure identification of an appropriate range of viable alternatives for consideration in the detailed analysis. The MD, as revised by Respondent to incorporate Ohio EPA comments, shall be combined with the detailed analysis of alternatives to form the FS Report described in Section 9 and Appendix M of this SOW.

8.3 TREATABILITY STUDIES

At this time there is no plan to conduct a treatability study at the Site. Should the data collected in the RI suggest the need to change the potential remedial alternatives, and a treatability study be indicated, Otterbein would submit a plan to OEPA detailing the proposed treatability study.

8.4 DETAILED ANALYSIS OF ALTERNATIVES

Once it has been determined that sufficient data exist to proceed, Otterbein will conduct a detailed analysis of the alternatives surviving the screening process to provide Ohio EPA with the information

needed for selection of a site remedy. The detailed analysis shall consist of an individual analysis of each alternative against eight evaluation criteria followed by a comparative analysis of the alternatives using the same evaluation criteria as the basis for comparison.

8.5 FEASIBILITY STUDY REPORT (USEPA RI/FS GUIDANCE SECTION 6.5)

Otterbein will prepare and submit a FS Report for review and approval. The AAD, revised based on comments received from Ohio EPA, shall be incorporated into the FS as it is prepared. Otterbein will refer to Table 6-5 of the USEPA RI/FS Guidance for an outline of the FS Report format and required report content.

9.0 KEY ASSUMPTIONS

There are several key assumptions concerning the status of the Site which have been considered in the preparation of this RI/FS. These assumptions are presented below:

- The site has been investigated on at least eight occasions and data from those investigations will be used in the RI/FS to the extent possible.

- Since 1962, remediation has been conducted at the site on at least six separate occasions.

- The majority of the remedial activities undertaken in the past involved the removal of UXO materials.

- UXO materials remaining on the site (if any) are expected to be below the ground surface.

- The Remedial Investigation will therefore be conducted under the supervision of trained UXO personnel providing UXO support.

- The intrusive portions of the RI will be conducted using UXO avoidance practices.

- In the event that potentially dangerous UXO materials are discovered, the location of the material will be marked, the findings reported to Otterbein, and appropriate measures will be undertaken to remove the UXO safely, and in accordance with standard protocols.

- Otterbein University intends to act conservatively regarding residual contamination remaining at the eight AOCs. It is anticipated that, for most AOCs, residual contamination detected or assumed to be present (e.g., munitions and explosives of concern [MEC]) will likely be excavated and disposed off-site

- The site is immediately adjacent to a residential neighborhood and facilities of the Westerville School District. Because of the high public visibility for this project, citizen involvement and communication will be a key requirement for all future site activities.

- The United States Department of Justice and the Department of Defense are funding a portion of the RI/FS and it is expected that the representatives of the Federal government will monitor ongoing site activities.

- Otterbein has not finalized plans for future property use and no firm decisions on future use are expected in the near-term.

- Otterbein has indicated a strong preference to conduct conservative remedial measures in order to eliminate all future environmental liabilities and concerns to the public.

- It is understood by Otterbein that the proposed scope of work may not be sufficient to support a No Action alternative at some of the AOCs.

10.0 SCHEDULE

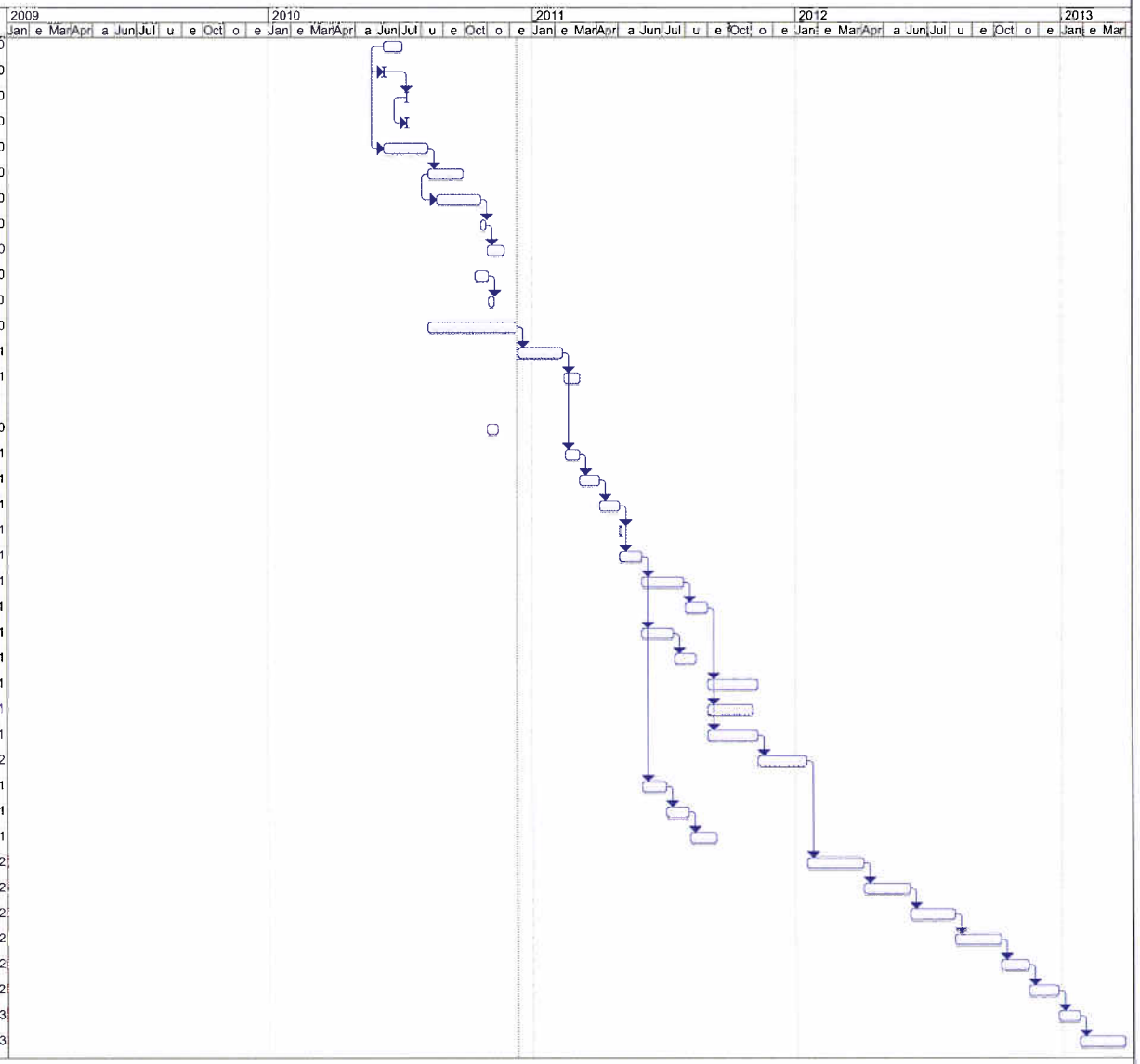
Although the draft Consent Order had not been signed as of the date of this Work Plan, Otterbein and OEPA mutually agreed to proceed with the RI/FS process in June 2010. The work began with a Site Investigation on July 12, 2010, and continues with the submission of this Work Plan.

As with most investigations, there are several factors which can significantly impact the schedule of a RI/FS. In the case of the Kilgore RI/FS, the most significant factor appears to be the presence of wetlands on a large portion of the Site. Work has begun on the wetlands delineation project and a report will be submitted to the Corps of Engineers in the very near future; however, the report may initiate a permit process which could delay the start of field investigations. The wetlands could also impact the schedule by dictating the time of year in which the site is accessible to drilling and excavation equipment.

The anticipated schedule for the Kilgore RI/FS is presented as a Gantt chart on Figure 10-1. Because of the many uncertainties related to the wetlands issue the Gantt chart does not include the wetlands tasks. Delays in obtaining wetland-related permits may delay many of the dates shown in the chart.

KILGORE RI \ FS

ID	Task Name	Duration	Start	Finish
1	Project Management	18 days	Thu 6/10/10	Mon 7/5/10
2	Project Intiation	1 day	Thu 6/10/10	Thu 6/10/10
3	Project Kickoff \ Site Visit	1 day	Mon 7/12/10	Mon 7/12/10
4	OEPA File Review	1 day	Mon 7/12/10	Mon 7/12/10
5	Pre-Investigation Evaluation Report	44 days	Thu 6/10/10	Tue 8/10/10
6	OEPA Review	35 days	Wed 8/11/10	Tue 9/28/10
7	Prepare HASP	45 days	Mon 8/23/10	Fri 10/22/10
8	OEPA Review HASP	6 days	Sat 10/23/10	Fri 10/29/10
9	Prepare Final HASP	17 days	Mon 11/1/10	Tue 11/23/10
10	Technical Memorandum	14 days	Fri 10/15/10	Tue 11/2/10
11	OEPA Review of TM	6 days	Wed 11/3/10	Wed 11/10/10
12	RI/FS Work Plan	89 days	Wed 8/11/10	Fri 12/10/10
13	OEPA Review of RF/FS WP	45 days	Mon 12/13/10	Fri 2/11/11
14	Final RI\FS Work Plan	16 days	Mon 2/14/11	Mon 3/7/11
15				
16	Laboratory Procurement	11 days	Mon 11/1/10	Mon 11/15/10
17	Drilling Procurement	14 days	Wed 2/16/11	Mon 3/7/11
18	Field Mobilization	20 days	Tue 3/8/11	Mon 4/4/11
19	RI Field Work	20 days	Tue 4/5/11	Mon 5/2/11
20	Surveying	3 days	Tue 5/3/11	Thu 5/5/11
21	Laboratory Analysis	23 days	Tue 5/3/11	Thu 6/2/11
22	Validation	41 days	Fri 6/3/11	Fri 7/29/11
23	Data Management	23 days	Mon 8/1/11	Wed 8/31/11
24	HHRA Assumptions Document	31 days	Fri 6/3/11	Fri 7/15/11
25	OEPA Review Draft HHRA	21 days	Mon 7/18/11	Mon 8/15/11
26	HHRA	50 days	Thu 9/1/11	Wed 11/9/11
27	ERA	45 days	Thu 9/1/11	Wed 11/2/11
28	RI Report	50 days	Thu 9/1/11	Wed 11/9/11
29	OEPA Review RI Report	48 days	Thu 11/10/11	Mon 1/16/12
30	Refined Remedial Action Objectives	23 days	Fri 6/3/11	Tue 7/5/11
31	OEPA Review	23 days	Wed 7/6/11	Fri 8/5/11
32	Alternatives Array Document	26 days	Mon 8/8/11	Mon 9/12/11
33	Feasibility Study Report	55 days	Tue 1/17/12	Mon 4/2/12
34	OEPA Review FS	45 days	Tue 4/3/12	Mon 6/4/12
35	Final RI/FS Report	45 days	Tue 6/5/12	Mon 8/6/12
36	RD \ RA Work Plan	45 days	Tue 8/7/12	Mon 10/8/12
37	OEPA Review Remedial Design WP	28 days	Tue 10/9/12	Thu 11/15/12
38	Pre-Design Study	29 days	Fri 11/16/12	Wed 12/26/12
39	Remedial Design Laboratory	21 days	Thu 12/27/12	Thu 1/24/13
40	Final Remedial Design	45 days	Fri 1/25/13	Thu 3/28/13



Project: Kilgore_GANTT_Chart
Date: Fri 12/10/10

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

11.0 PROJECT MANAGEMENT

The RI/FS project is being conducted in accordance with the draft consent decree between Otterbein, OEPA and the US Department of Justice. Otterbein retained TtNUS Pittsburgh, PA to conduct the RI/FS on behalf of the university.

In accordance with the draft consent decree OPA and Otterbein have named Site Coordinators who will serve as points of contact for the respective groups. OEPA named Mr. Robin Roth of the OEPA Division of Emergency and Remedial Response Central Division as the OEPA Site Coordinator. Otterbein named Mr. Al Quagliotti of TtNUS as the Site Coordinator for the university.

Ms Jennifer Pearce of Otterbein will serve as the Public Relations Officer for the project and will serve as the liaison with the public regarding activities and conditions at the Site. TtNUS has assigned several professionals specific roles in the RI/FS. Mr. Al Quagliotti P.G. will serve as the Project Manager of the project. Ms Shannon Hill will serve as the Field Operations Leader (FOL) for activities conducted at the Site. A variety of other personnel are named to specific positions in the Health and Safety Plan (HASP).

Mr. Bill Acton of Civil and Environmental Consultants (CEC) will serve as manager of the wetlands delineation project and wetland permitting activities.

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ATTACHMENT A

PER AND OEPA COMMENTS

TETRA TECH

PRE-INVESTIGATION EVALUATION REPORT

OF THE

KILGORE MANUFACTURING COMPANY FACILITY

WESTERVILLE, OHIO

Performed for:

OTTERBEIN COLLEGE
Westerville, Ohio

Prepared by:

Tetra Tech
Foster Plaza 7
661 Andersen Drive
Pittsburgh, Pennsylvania 15220-2745

August 10, 2010

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APPENDIX A

VAP PHASE I ASSESSMENT 1998

Property of Otterbein College

KILGORE FARM PROPERTY
800 TUSSIC STREET
WESTERVILLE, OHIO

Latitude: 40° 08' 26"N
Longitude: 82° 54' 08"W

VOLUNTARY ACTION PROGRAM
0AC 3745-300-06
PHASE I PROPERTY ASSESSMENT AMENDMENT

CERTIFIED ENVIRONMENTAL PROFESSIONAL
GERALD R. MYERS, C.E.P. 131

Prepared for:

Davidson Phillips, Inc.
1152 Goodale Blvd.,
Columbus, Ohio 43212

and

The Keethler Company
7670 Olentangy River Rd., Suite 200
West Worthington, Ohio 43235

May, 1998

Metcalf & Eddy
An Air & Water Technologies Company

2800 Corporate Exchange Drive, Suite 250
Columbus, Ohio 43231
(614) 890-5501

OC 015321

KILGORE FARM PROPERTY
800 TUSSIC STREET
WESTERVILLE, OHIO

Latitude: 40° 08' 26"N
Longitude: 82° 54' 08"W

VOLUNTARY ACTION PROGRAM
0AC 3745-300-06
PHASE I PROPERTY ASSESSMENT AMENDMENT

CERTIFIED ENVIRONMENTAL PROFESSIONAL
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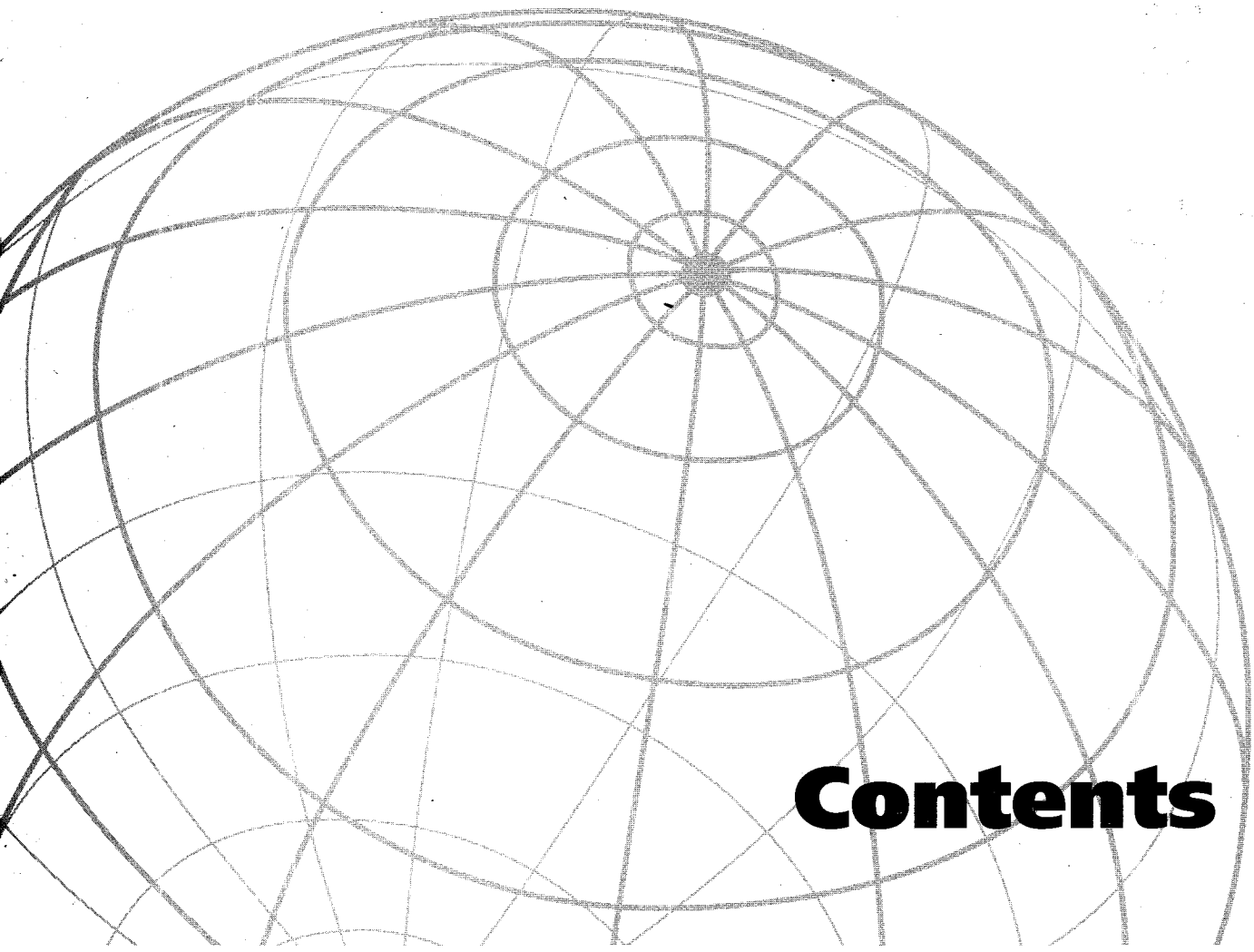
May, 1998



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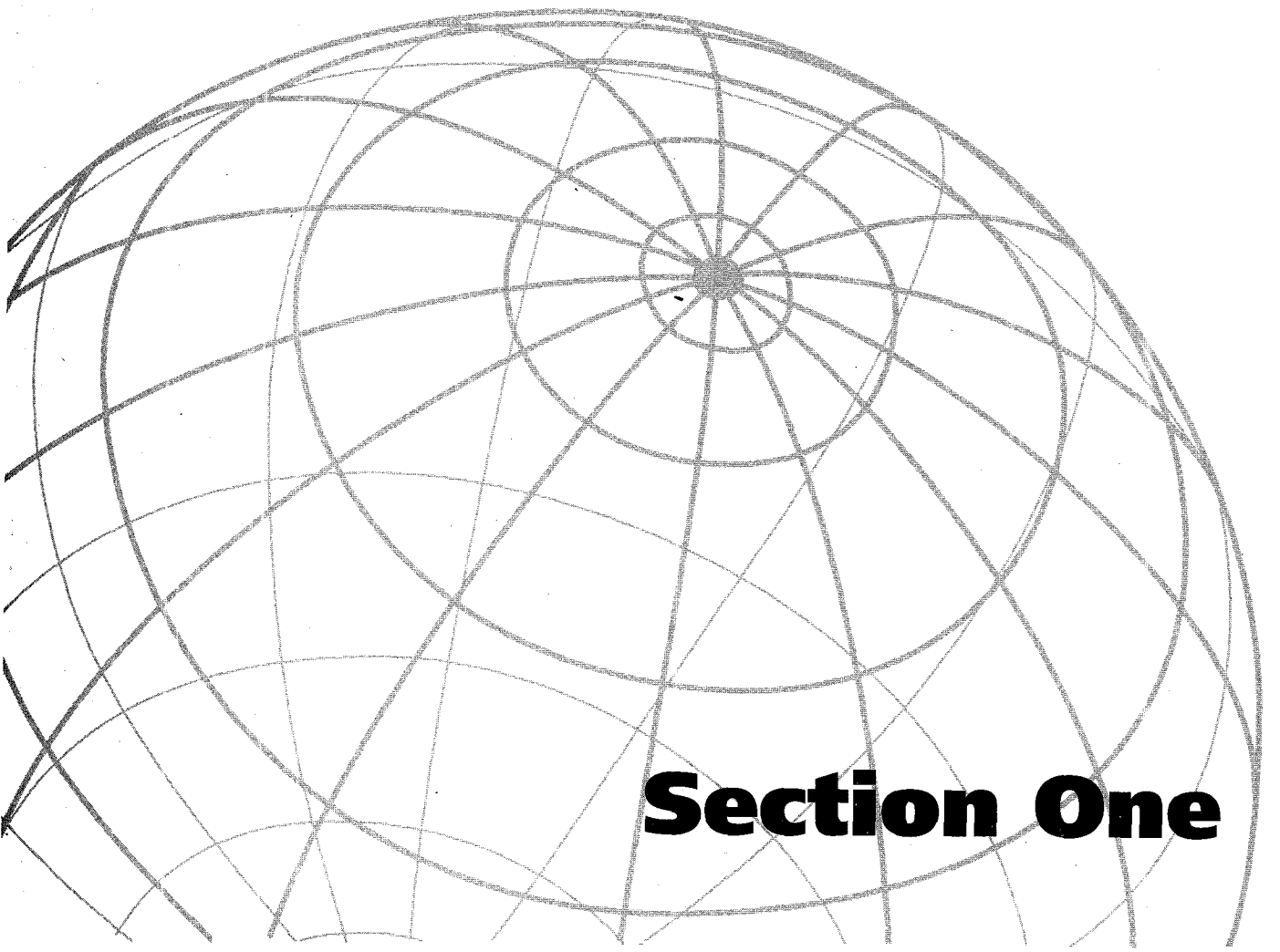

Section One

OC 015327

1.0 INTRODUCTION

Metcalf & Eddy of Ohio, Inc. (M&E) was retained by Davidson Phillips to provide an amendment to the Phase I report on the Kilgore Farm Property provided to the Ohio Environmental Protection Agency (Ohio EPA) by Lawhon & Associates (L&A), in April 1997. The amendment is consistent with the Ohio Voluntary Action Program (VAP) described in the Ohio Revised Code 3745-300-06. The purpose of this amendment is to submit additional information and documentation concerning the Kilgore Farm Property for the purpose of possible participation in the VAP and to determine the necessity and scope of a Phase II Assessment.

This report describes the methodologies used, the information sources reviewed, persons interviewed, the findings, and conclusions developed during the Amendment to the Phase I Assessment.

1.1 ELIGIBILITY

As described in Section 3745-300-2 of the Ohio Administrative Code, The Kilgore Farm Property owned by Otterbein University has been determined to be eligible for entry into the Ohio Voluntary Action Program. The subject property or any portion thereof is not described by Paragraph C of OAC 3745-300-02. Furthermore, manufacturing operations ended at the property prior to promulgation of any of the environmental regulations described in Paragraph C.

1.2 PROJECT PERSONNEL

The personnel who have worked on this project include:

OC 015328

METCALF & EDDY, INC.

Gerald R. Myers, Vice President, CEP

Michael S. Raimonde, Project Manager

Jeffrey D. Stevenson, Project Geologist

Todd Aebie, Staff Geologist

Alexis W. Lemmon, Jr., Chemical Engineer

A copy of each person's resume and affidavit as it relates to his efforts is located in Appendix A.

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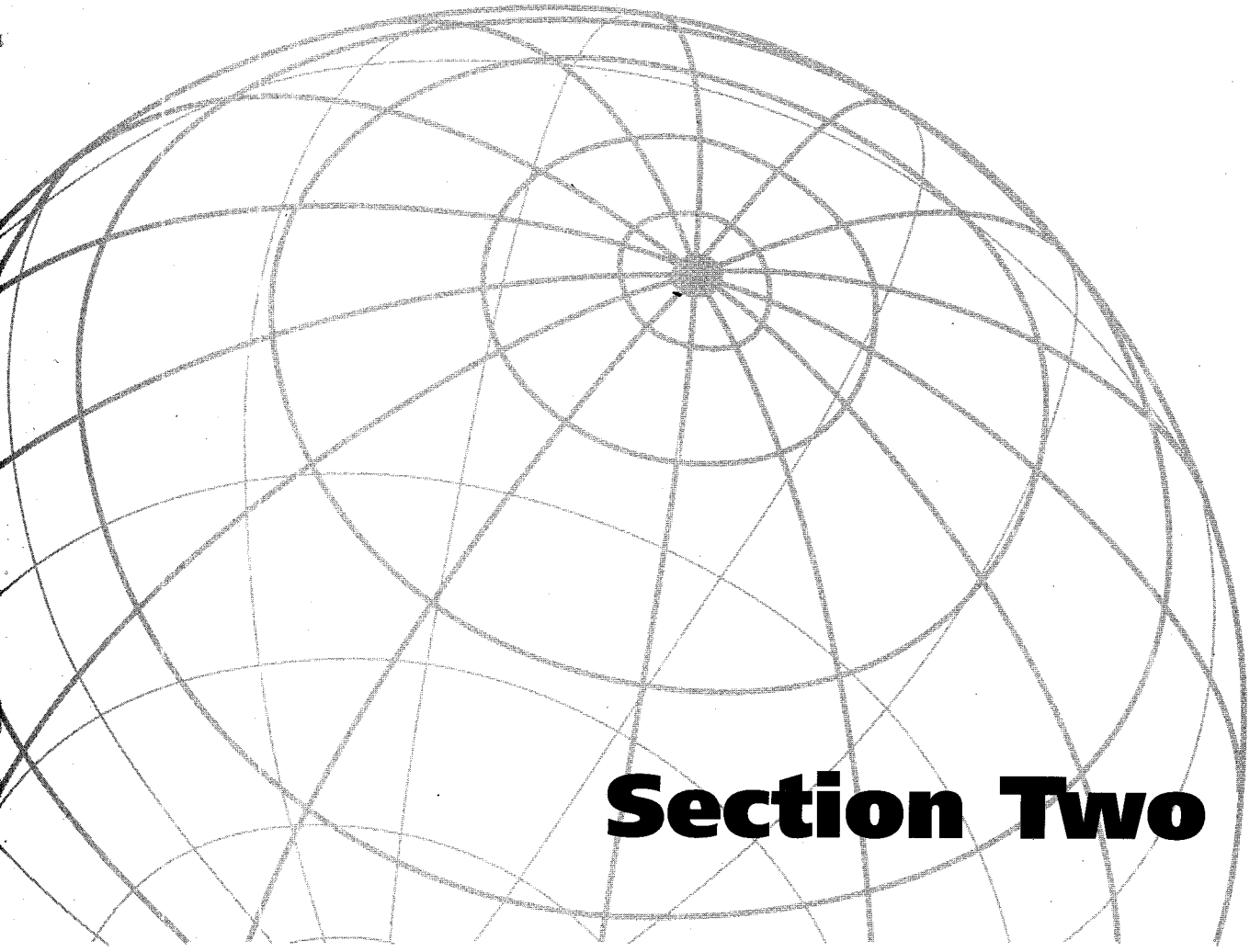

Section Two

2

OC 015330

2.0 CURRENT AND SURROUNDING LAND USAGE

The Kilgore Farm Property is located at 800 Tussic (Spring Road) Road, in the City of Westerville, Delaware County, Ohio. The property is approximately 110 acres in area, and is now vacant. The latitude of the property is 40 degrees, 08 minutes, 26 seconds north, and the longitude of the property is 82 degrees, 54 minutes, and 08 seconds west. Gravel roads are still visible on the property. All remaining structures have been razed. A legal description of the facility is contained in Appendix B.

The Kilgore Farm Property is located in a very rapidly growing residential area of the City of Westerville, Ohio. The Property is surrounded by a mix of residential, school, and agricultural lands. The following land usage surrounds the property:

North: The property immediately to the north is wooded, with houses within 0.5 miles north of the property along Maxtown Road.

South: The City of Westerville Schools owns the land south of the property. Westerville North High School, Heritage Middle School and their athletic fields bound the property. Within 0.5 miles, residential neighborhoods are encountered.

East: Residential developments, and vacant property.

West: Agricultural, farmland and limited residential development.

Figure 1 shows the location of the Kilgore Property. Figure 2 shows the surrounding land use within ½ mile of the property.

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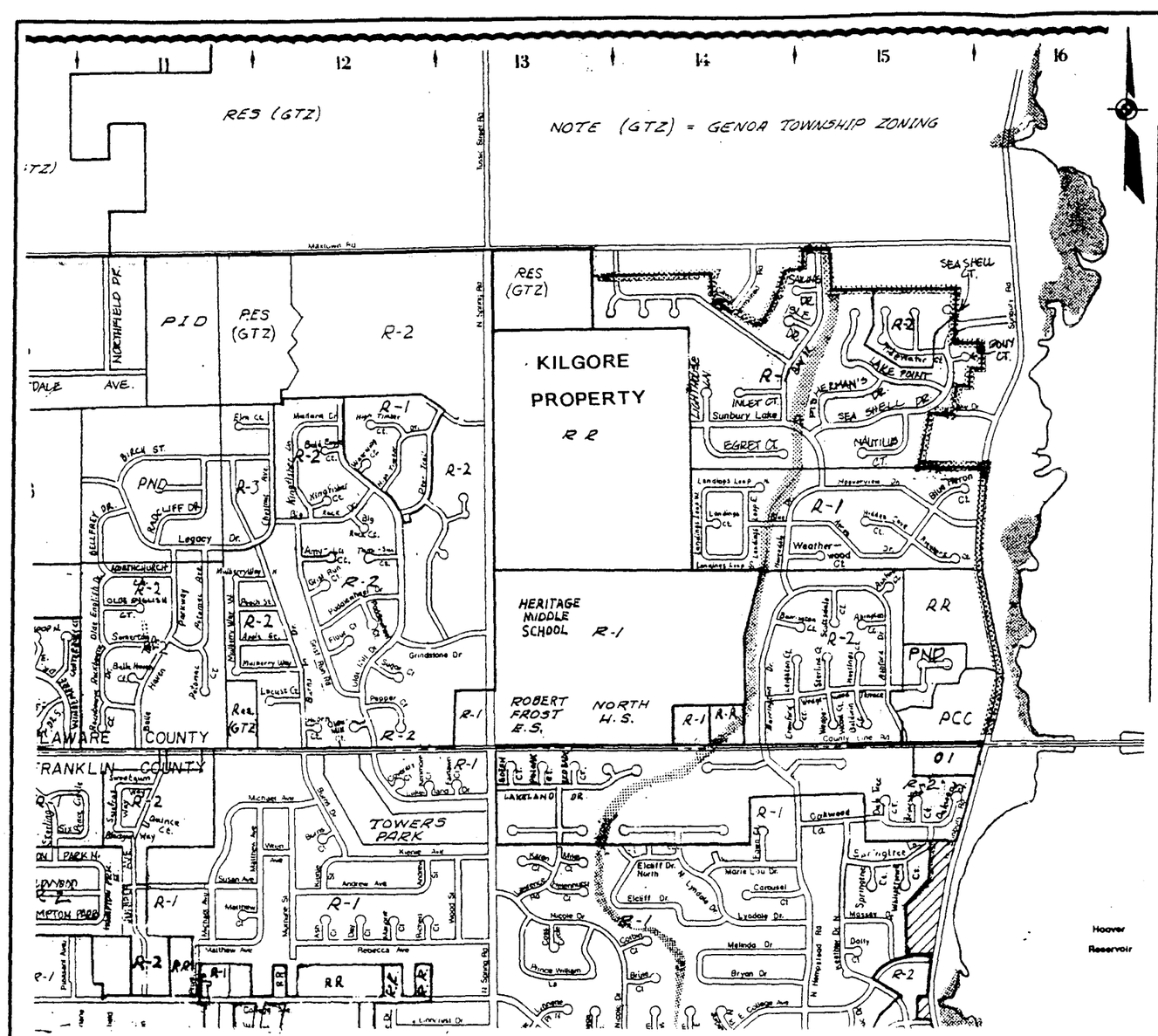

PHOTOREPRODUCTION

ZONING DISTRICTS

	STANDARD	PLANNED
Residential:	RR Rural Residential	PND Planned Neighborhood District
	R-1 Single Family	PRD Planned Residential District
	R-2 Single Family	
	R-3 Two - Family	
	R-4 Multiple Family	
	R Single Family	
Commercial:	ER Estate Residential	PCC Planned Community Commercial
	CC Community Commercial	PD Planned Development
	UD Uptown District	
	ARD Architectural Review District	
Office & Institutional:	O I Office – Institutional	PO Planned Office
Industrial:	I Industrial	PID Planned Industrial District
Special Districts:	OS Open Space	
	SFH Special Flood Hazard Area (Flood Plain)	
	(SOD) Special Overlay District	
	Unincorporated Area	

APPROXIMATE SCALE 1" = 1250'

MAP BASED ON CITY OF WESTERVILLE ZONING MAP APRIL, 1998

M&E Metcalf & Eddy

KILGORE PROPERTY

PROPERTY LOCATION AND SURROUNDING LAND USE MAP

WESTERVILLE, OHIO

FILE NAME	CHECKED	DRAWN	DATE	PROJECT NO.	FIGURE
	TJA	TJA	5/12/98	021796	2

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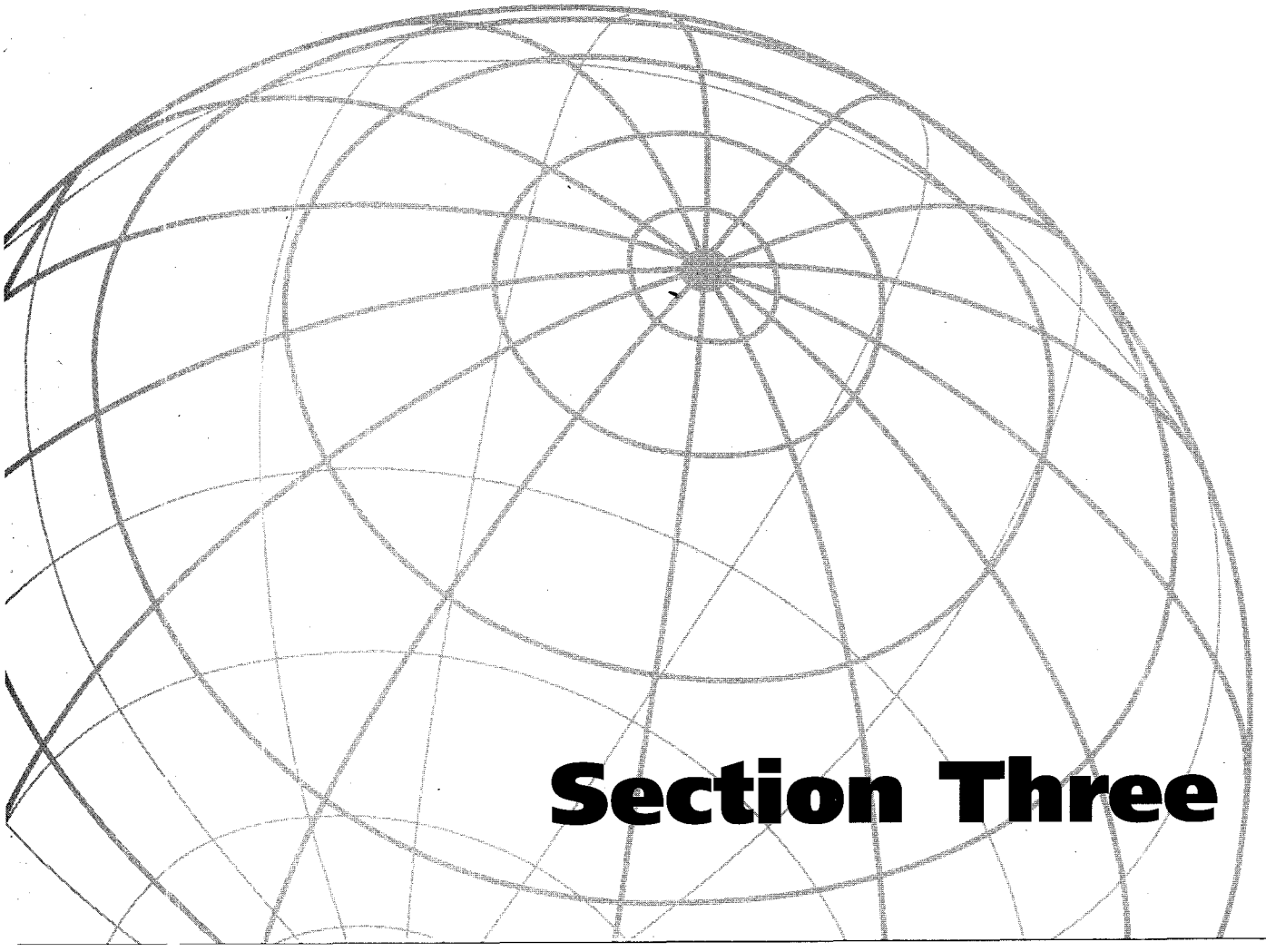

Section Three

OC 015333

3.0 HISTORIC LAND USAGE

This section describes the information obtained and reviewed to establish the historical operations of the Property. Figure 3 shows the historical layout of the Property during operations in 1950 and Figure 4 shows the historical layout of the Property in 1956.

3.1 PROPERTY HISTORY ANALYSIS

An analysis of the history of the Kilgore Farm Property and the surrounding property was conducted by M&E by reviewing the following available resources. The source and a brief summary of information obtained are listed below:

3.1.1 Aerial Photographs

Aerial photographs were obtained from The City of Westerville, Ohio Department of Natural Resources, Delaware County Engineer, and the Franklin County Soil and Water Conservation District. The dates of the aerial photographs are 1938, 1950, 1956, 1957, 1964, 1967, and 1994. Aerial photographs were used to establish the location of roads, buildings, burial and disturbed areas and the surrounding land use. (Appendix C)

3.1.2 Topographic Maps

Topographic maps from 1955, 1964 and 1983 were used to establish surrounding land usage and topography. (Appendix D)

3.1.3 Historical Records

Historical documents and correspondence were gathered and reviewed. Information reviewed included:

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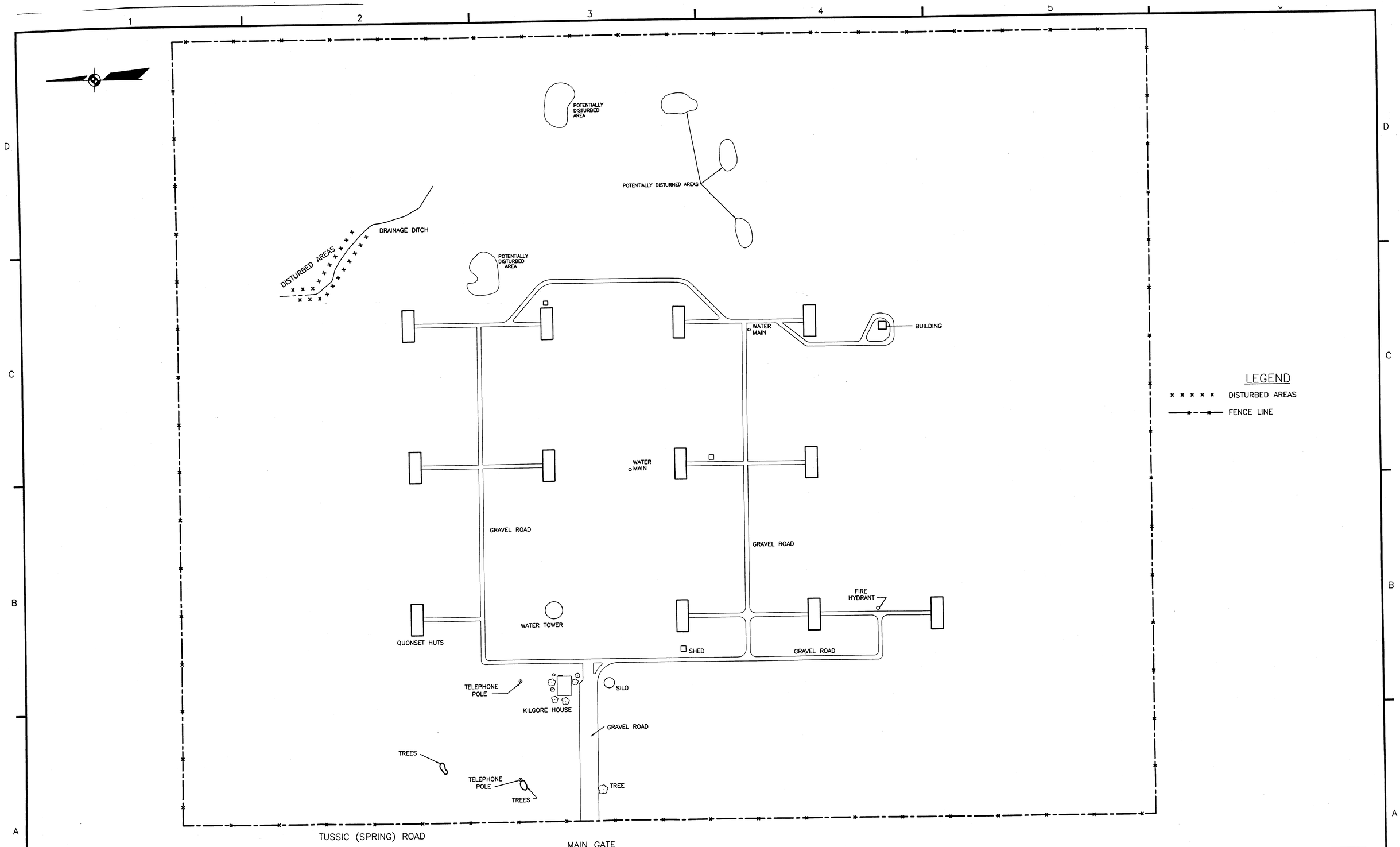


* MAP BASED ON A 1950 AERIAL PHOTOGRAPH

NUMBER	DATE	MADE BY	CHECKED BY	DESCRIPTION

REVISIONS

DRAWN BY FGS

DEPT. CHECK

PROJ. CHECK

M&E Metcalf & Eddy

REG. PROF. ENGR. DATE

SCALE: 1" = 100'

SCALE IN FEET 0 50 100

UNLESS OTHERWISE NOTED OR CHANGED BY REPRODUCTION

PLOT DATE: 5/21/98

KILGORE PROPERTY

SITE LAYOUT – 1950

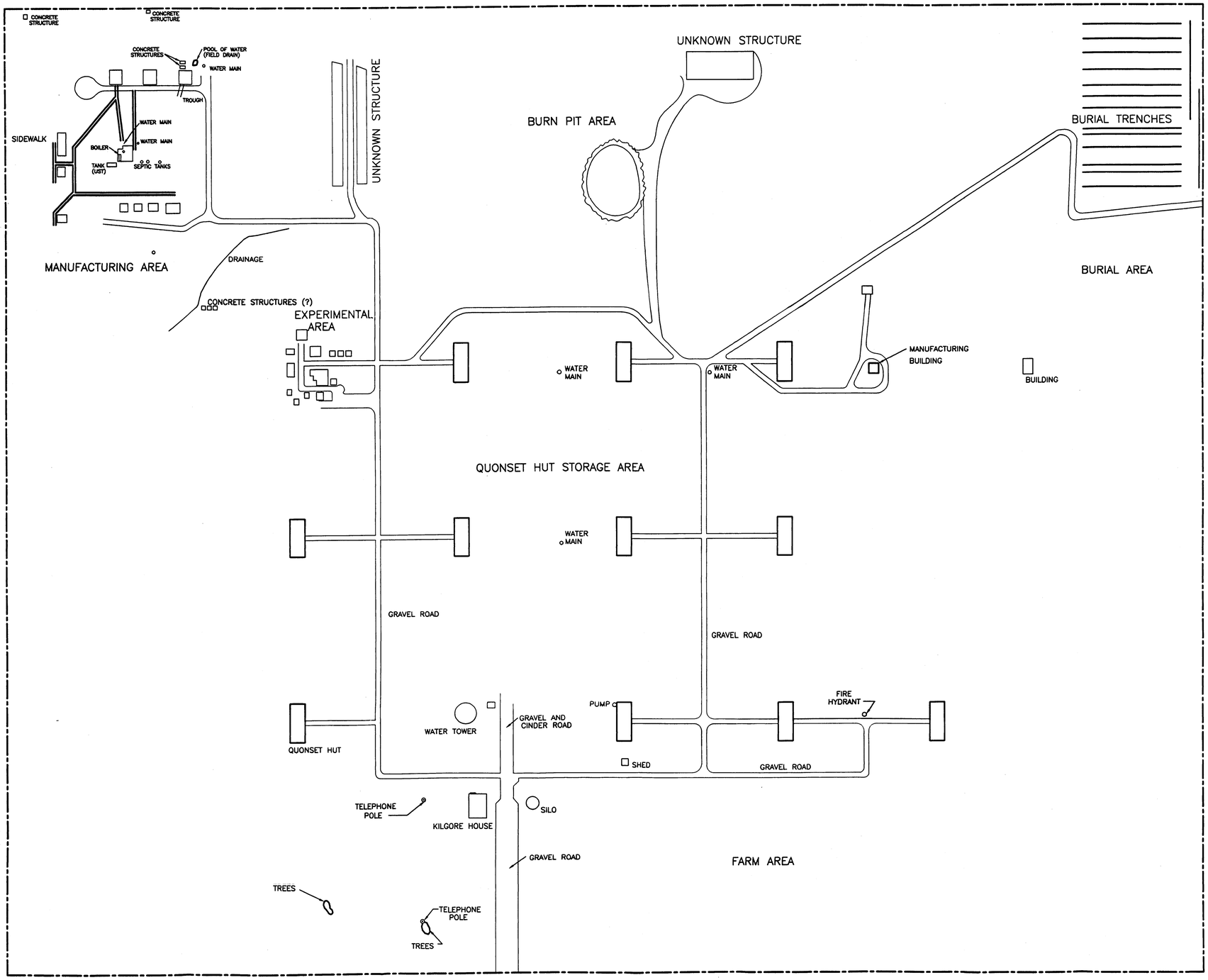
WESTERVILLE, OHIO

JOB 021796-0001

FILE NO. 021796-4

FIGURE 3

OC 015335



* MAP BASED ON A 1957 AERIAL PHOTOGRAPH

NUMBER	DATE	MADE BY	CHECKED BY	DESCRIPTION

REVISIONS

DRAWN BY: FGS
DEPT. CHECK
PROJ. CHECK

M&E Metcalf & Eddy

REG. PROF. ENGR. _____ DATE _____

SCALE: 1" = 100'
SCALE IN FEET 0 50 100
UNLESS OTHERWISE NOTED OR CHANGED BY REPRODUCTION
PLOT DATE: 5/12/98

KILGORE PROPERTY
SITE LAYOUT – 1957
WESTERVILLE, OHIO

JOB 021796-0001
FILE NO. 021796-5
FIGURE 4

OC 015336

- Memo from Mr. Horace Mann, Personnel Manager at Kilgore Manufacturing Company (April 1956)
- Letter from Mr. Sanders Frye, Otterbein University to the Commander of the Joliet Ammunition Procurement and Supply Agency (April 1962)
- Letter from Mr. Sanders Frye, Otterbein University, to the Commander of the Joliet Ammunition Procurement and Supply Agency (August 1962)
- Letter from Mr. Virgil Carpenter, Technical Supervisor for the U. S. Army during clean-up, to Mr. Sanders Frye, Otterbein University (August 1962)
- Letter from Mr. Earnest Frische, Otterbein University, to United States Corps of Engineers, Mr. David Douthat (July 1986)
- Environmental Site Evaluation Report (SEA, 1988), Phase I Reports (L&A 1991, 1996), Phase II Sampling Report (L&A, 1997), and Work Plan (L&A, 1997).

Copies of the information listed above are presented in Appendix E .

3.1.4 Otterbein University Files

Files from the University Archives and Steve Storck, Otterbein College Business Manager, were reviewed. Historic correspondence between Sandy Frye and Earnest Frische were included in these files. Additionally, a 1953 map of the burial area indicating the location of some of the trenches was reviewed in the personal files of Steve Storck. Copies of the information reviewed are presented in Appendix F.

3.1.5 City of Westerville Public Library

Public records and documents relating to the history of the Kilgore Farm Property were requested from the librarian at the Westerville Public Library. Newspaper accounts regarding operation, accidents and closure of the Farm Property were reviewed. Newspaper accounts documented the closing of the facility in 1961. In addition, there were accounts of incidents of fire or explosions that occurred at the site while the facility was in operation. Accounts of

OC 015337

detonation of suspected ordnance in 1988 by the Wright-Patterson Air Force Base Ordnance Division were also found. No other records were found indicating that any injuries or deaths have occurred on the site during clean up activities conducted at the site since 1962. Copies of the newspaper accounts obtained from the City of Westerville Library are located in Appendix G .

3.1.6 Ohio Historical Society

Public records and documents, relating to the history of the Kilgore Farm Property were requested. The only documents on file were related to the presentation of an award from the United States Army to Kilgore for excellence in war time production. No other information of historical significance was found regarding the operations, storage, or disposal of munitions at the Kilgore Farm Property.

3.1.7 Columbus Dispatch

Newspaper accounts of accidents, operations, and closing of the Kilgore Farm Property were requested. Articles regarding the closure of the site in 1961 and accidents that occurred during operation of the site were reviewed. No records were found to indicate that any injuries or deaths occurred during cleanup of the site following closure. Copies of the newspaper accounts were obtained from the Columbus Metropolitan Library and are presented in Appendix G .

3.1.8 Interviews with Former Kilgore Employees

Three former employees were interviewed to provide factual eyewitness accounts as to the operation and history of the Kilgore Farm Property.

Mr. and Mrs. Richard Eierman were interviewed on March 24, 1998, regarding their employment at the Kilgore Farm property. Mrs. Eierman worked as a secretary in the office

OC 015338

of the Westerville Facility from 1952 to 1961. Mrs. Eierman had limited knowledge of site operations at the Kilgore Farm Property.

Mr. Eierman was employed in the maintenance shop at the Kilgore Farm Property for a period of approximately one year in 1952. After leaving Kilgore, Mr. Eierman continued to work at the facility as an excavation subcontractor until the facility closed in 1961. In addition to digging plumbing and utility trenches, Mr. Eierman was also responsible for the installation of burial trenches, placement of wastes and covering of wastes after placement in the southeast corner of the property. According to Mr. Eierman, wastes from the site as well as the Facility located in Westerville were buried in the trenches located on the southeast portion of the property. Mr. Eierman recalled that approximately 20 trenches roughly 200 feet long, 3 feet wide and 5 feet deep were excavated prior to the site closure. Mr. Eierman was not aware of any other burial areas on the Kilgore Farm Property. During the time he was a subcontractor, Mr. Eierman was also a volunteer fireman for The City of Westerville.

Mr. Eldon Adams, former Manufacturing Supervisor at the Westerville Kilgore Plant, was interviewed on March 30, 1998. Mr. Adams worked for Kilgore Manufacturing from 1946 until 1961 when the Facility closed. Although, Mr. Adams was employed at the manufacturing facility in Westerville, he was also responsible for operation of the burn pit located on the Kilgore Farm Property. Mr. Adams positively identified the location of the burn pit on a 1956 aerial photograph. According to Mr. Adams, the pit was used an average of once a week to burn waste or off-specification materials. Periodically, the burn pit was excavated to remove cinders and non-flammable residual wastes. These excavated materials were subsequently buried in the trenches located on the southeast portion of the site. Interview records from the former employees are located in Appendix H.

3.1.9 Interview with Former Resident and Kilgore Employee

Mr. Leonard "Skip" Day, Jr. was interviewed by M&E on April 7, 1998. Mr. Day was a resident on the Kilgore Farm Property with his parents and siblings from 1945 to 1949. Mr.

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Day served in the United States Army during the Korean War from 1950 until 1952 where he worked with munitions. After receiving an honorable discharge from the Army, Mr. Day worked as a third shift supervisor in the manufacturing portion of the Facility until 1954. After leaving Kilgore, Mr. Day was employed as a Police Officer with The City of Westerville. Mr. Day's father was the head chemist for Kilgore and caretaker of the Kilgore Farm Property. Mr. Day's parents lived in the Kilgore farm house from 1945 until 1961. Mr. Day provided first hand knowledge of manufacturing, storage and disposal activities conducted at the farm. From a 1956 aerial photograph, Mr. Day identified the burial area, burn pit, manufacturing and experimental areas, farm lands, and a ditch in the northeast portion of the property where waste and off-spec materials were buried. A record of the interview with Mr. Day is located in Appendix I.

3.1.10 Contact with the Kilgore Manufacturing Parent Company

Alliant Technology, successor to Kilgore, was contacted by telephone to see if any historic files or records could be obtained regarding the history of operations at the former Kilgore Farm Property. No information was provided by Alliant Technology.

3.1.11 Wright-Patterson Air Force Base

Wright-Patterson Air Force Base was contacted by telephone to request historical records related to the excavation and removal of buried wastes from the Kilgore Farm Site. Historical records reviewed in the files obtained from Otterbein College indicated that the Ordnance Disposal Unit at the Base was involved with previous cleanup activities conducted at the site.

- The Base historian, Mr. Bill Elliott, was contacted to request any Air Force historical files regarding the Facility. No information was found.
- Mr. Don Smith of the Base Engineering Department was contacted to request any historical maps or plans related to the former Kilgore Farm Property. No information was found.

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- First Lt. Appleby, Unit Commander of The Explosive Ordnance Disposal Unit (EOD) at Wright-Patterson Air Force Base was contacted to request files related to cleanup activities conducted at the Kilgore Farm Property. According to Lt. Appleby, records are kept for only 3 years and there was no information in his files concerning the Kilgore Farm Property.

3.1.12 Ohio Fire Marshal - Bureau of Underground Storage Tanks

During a removal of wastes at the Kilgore Farm in 1988, potentially energized materials were sampled and sent to the State Fire Marshall's Bureau for testing. The Ohio Fire Marshal prepared a report on May 10, 1988. A copy of this report was reviewed and is located in Appendix L.

In addition, Mr. Bob Rhodes of the Bureau of Underground Storage Tank Regulations was contacted regarding any other historic information regarding underground storage tanks (USTs) located at the Kilgore Farm Site. Mr. Rhodes indicated that BUSTR did not any files regarding UST closures at the Kilgore Farm site. A record of the telephone conversation with Mr. Rhodes is located in Appendix L.

3.1.13 Joliet Ammunition and Supply Depot

The original decontamination effort conducted at the site in 1961 was overseen by personnel from the Joliet Ammunition and Supply Depot (Joliet ASD). Ms. Pat Muzzarelli, Depot secretary, was contacted to request historic files. Ms. Muzzarelli stated that the Depot is no longer active and any or all historic files were sent to the Rock Island Arsenal or were destroyed (Appendix M). Therefore, no files were available from Joliet ASD.

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3.1.14 Rock Island Army Depot

The Rock Island Army Depot is now the repository of the records from the Joliet Ammunition and Supply Depot. Mr. Andy Poppen, Environmental Engineer, from Base Environmental Engineering was contacted by telephone regarding the Kilgore Farm Property (Appendix M). Mr. Poppen did not find any information in the Base files or any information concerning the decontamination performed by personnel from the Joliet ASD.

3.1.15 Ohio Preservation Society

The Ohio Preservation Society was contacted by telephone to see if any historic records were available for the Kilgore Farm Property. The Kilgore Farm Property was not listed on the State of Ohio or the National Register of Historic Places (Appendix M).

3.1.16 Westerville Preservation Society

Files were requested by telephone from the Westerville Preservation Society to determine if any records were available relating to the Kilgore Farm Property. The Preservation Society could not find any information regarding the subject property (Appendix M).

3.1.17 Columbus Metropolitan Library

The library was contacted to obtain copies of specific newspaper accounts in the Columbus Dispatch related to the Kilgore Farm Property. Copies of newspaper accounts related to the Kilgore Site are located in Appendix G.

3.1.18 Ohio Department of Natural Resources

The Delaware County Soil Survey was obtained and reviewed to determine information on soil types at the subject property. Additionally, the ODNR soil survey had historic aerial

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photographs (1956, 1964 and 1994) available for review. Copies of aerial photographs reviewed are located in Appendix C.

3.1.19 City of Westerville Surveyor

Mr. Charles Destefani, P.S., Surveyor for The City of Westerville was contacted regarding City of Westerville involvement in the Kilgore Farm Property. Mr. Destefani provided M&E with a 1956 aerial photograph of the property. Mr. Destefani also provided M&E with the names of Mr. and Mrs. Richard Eierman, people who he knew worked at the Facility in the past.

3.1.20 Franklin County Soil and Water Conservation District

The Franklin County Soil and Water Conservation District was contacted to request aerial photographs of the Kilgore Farm site. Copies of aerial photographs from 1938, 1967, and 1994 were obtained and are located in Appendix C.

3.2 HISTORICAL LAND USAGE

Using the historical information described in Section 3.1, M&E compiled a history of operations at the Kilgore Farm. Figure 5 shows a timeline and history of development operation and environmental activities conducted at the Kilgore Farm Site. Kilgore purchased the Farm Property from Joe and Eva Morris in December 1941. Prior to that date the property was used for agricultural purposes. Along with its other operations located in Westerville, the purchase of the farm property on Tussic Road allowed Kilgore to conform to the military standards of storage and manufacturing of munitions. Initial storage and production at the Kilgore Farm Site was related to manufacturing and assembly of military ordnance. Based on our review of the historical records and interviews with former employees, M&E has compiled a list of items that were reported to be manufactured or stored at the Kilgore Farm Property.

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TABLE 1
BULK CHEMICALS
KILGORE FARMS MANUFACTURING FACILITY
WESTERVILLE, OHIO

CHEMICAL NAME	USE
Aluminum	Photoflash Flares, Smoke Flare, Incendiary Bombs
Antimony	Colored Flares
Antimony Trisulfide	Igniter, Primer in Flame Throwers
Ammonium Chloride	Smoke Flares
Ammonium Perchlorate	Smoke Flares
Ammonium Picrate	Ignitors, Primer
Barium Nitrate	Photoflash Flare, Parachute Flares,
Barium Rhodanide	Stab Primers
Barium Sulfate	Float Flares, Underwater Flares
Black Powder	Accelerant in flares, Black Caps
Boron Phosphide	Ignitor, Primer
Calcium	Colored Flares,
Castor Oil	Binder, oxidation inhibitor for Al and Mg, and lubricant
Copper Oxide	Colored Flares
Hexachlorobenzene	Colored Flares
Hexachloroethane	Smoke Flares
Iron Oxide	Colored Flares
Laminac	Unsaturated Polyester binder
Lead Azide	Stab Primers
Lead Thiocyanate	Stab Primers
Lead Oxide	Stab Primers
Lead Styphnate	Stab Primers
Linseed Oil	Binder in Black Powder Pelletization Process, oxidation inhibitor
Magnesium	High and medium intensity Flares, Incendiary Bombs
Mercury Fulmanate	Primer
Phosphorous	Combined Light and Smoke Flares
Potassium Chlorate	Flares
Potassium Nitrate	Gun Powder Formulation, Flares
Potassium Perchlorate	Photoflash Flares, High Altitude Flash Charges, Smoke Flares
Sodium Hypophophite	Igniter
Sodium Nitrate	Gun Powder Formulation, High Intensity Flares
Sodium Oxalate	Colored Flares
Sodium Perchlorate	High Altitude Flash Charges
Strontium Nitrate	Colored Flares
Strontium Oxalate	Slow Burning Flares, Road Flares
Sulfur	Gun Powder Formulation, Accelerants
Tetryl	Primer
Trinitrotoluene (TNT)	Shaped Charges
Zinc	Smoke Flares
Zinc Oxide	Smoke Flares
Zirconium Hydroxide	Parachute Flare, Igniter

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Figure 5
Timeline History of
KILGORE FARMS SITE
WESTERVILLE, OHIO

Late 1941-1961

Acquisition of 110 acre farm for purpose of manufacturing, storing, and disposing of a variety of explosive and incendiary materials. Rejected materials and waste powder were systematically buried in the southeast corner.

1941-1950

Quonset hut construction and limited manufacturing.

1950-1961

Construction of manufacturing and experimental area, burn pit, burial trenches.

Early 1961

Kilgore discontinues operations at Manufacturing Co., Westerville, Ohio

May 1962

Donation of Kilgore properties in Westerville, Ohio, by Commercial Credit Corporation to Otterbein College. (This included the 110 acre Kilgore Farm.)

Official notification from grantor to grantee, as written in the deed, establishes that the grantee (Otterbein College) has full knowledge that the premises were used for the storage, burial, and disposal of explosives, pyrotechnics, chemicals, and other incendiary materials

July-August 1962

Clean up of known burial site, located in the southeast corner of the Kilgore Farm, was initiated by Sanders Frye of Otterbein College and supervised by Virgil Carpenter of Ammunition Procurement and Supply Agency, Joliet, Illinois. Marked trenches were cleaned out, materials were disposed of, and the trenches were re-filled.

August 24, 1962

Decontamination of Kilgore Farms burial site completed. Virgil Carpenter, in a letter to Sanders Frye, stated that the property had been decontaminated and that, in his opinion, no significant hazard remained.

1962-1986

Portions of the Kilgore Acreage were used to farm beans and corn. This practice continued throughout the years and finally ceased in 1986.

January 1985

Discovery of canisters on the surface in the southeast corner of the Farm by E. Fritsche. The canisters had been dug up by plow blades. Ohio Fire Marshal's Office and Ordnance Department and Wright-Patterson AFB were called in to identify and dispose of nearly 70 canisters. The canisters were tested and could only be made reactive by attaching and exploding a counter-charge.

June-September 1985

The search for other canisters continued and more were found. Dave Douthat, a safety engineer with the U.S. Corps of Engineers, visited the Kilgore Farm with E. Fritsche and officers from the Ohio Fire Marshal's Office. He believed that there was more to be cleaned up. Canisters found were later hauled away.

January-February 1988

An environmental study was conducted on a 22-acre plot. S.E.A., Inc. of Worthington, Ohio, was contracted by the Westerville schools to do a site investigation on the southeast corner of the property. This involved testing the groundwater for contaminants, and a walk-through with a metal detector. Site investigators located an area with many unidentifiable metal objects.

May 3-10, 1988

Excavation of the area that contained unidentifiable metal objects was performed by Lama Excavation Company as contracted by Westerville Schools. Excavation uncovered a variety of materials related to Kilgore operations in the 1940s and 1950s. Many other trenches were dug, but only a few pieces of debris were found.

Examination of some of these materials by the Columbus Bomb Squad found that the materials could not be exploded.

June 1988

Explosive ordnance disposal at Wright-Patterson AFB stated that they will pick up any hazardous materials found on the property (Sgt. Smith).

March 1991

Lawhon & Associates conducts Phase I audit of property. Flare canisters and black caps removed from the site.

1996-1997

Removal of fire suppression lines, demolition of farmhouse and quonset hut foundations, UST removed from the manufacturing area.

Figure 5
Timeline History of
KILGORE FARMS SITE
WESTERVILLE, OHIO

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Detonators	Hand Grenade Fuses; Primers
M1 Flame Throwers	Flare Pistols
Rocket Line Launchers	Explosive Caps
Battle Field Flares	Parachute Flares
Signal Flares	Landing Flares
M112 Photoflash Cartridges	3 Minute Flares
155 mm Illuminating Shells	High Altitude Rocket Flares
Trip Flares	Phosphorous Float Lights
Highway Emergency Flares	Magnesium incendiary bombs

We believe that this list represents the most accurate account of products built or stored at the farm to date.

Mr. Day stated that limited production of magnesium incendiary bombs also occurred at the site during the initial months of World War II. Furthermore, Mr. Day also stated that for a short period of time, the facility experimented with the production of shaped charges.

Previous Phase I Reports prepared in 1988 and 1991 indicated that land mines may have been produced at the site. According to Mr. Day and Mr. Adams, land mines were manufactured in Kilgore's facility located in Newark, New Jersey, and not at the Kilgore Farm Facility located in Westerville, Ohio.

After World War II, Kilgore returned to the manufacturing of toy cap guns, pyrotechnics for public use, and illuminating flares for civilian and military use. This manufacturing continued until 1961 when Kilgore Manufacturing Inc. closed the downtown Westerville and Kilgore Farm property facilities and moved its manufacturing operations to Bolivar, Tennessee.

3.2.1 Development and Operational History

1941 to 1950

On December 19, 1941 Kilgore Manufacturing purchased a 110-acre farm north of The City of Westerville, near the Delaware/Franklin County line from Joe and Eva Morris. During the period from 1941 to 1950, a series of 12 Quonset huts were constructed on the site. These

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huts were situated in the central portion of the property and connected to one another by a series of roads. Each hut had water service supplied from a water tower located on the farm. As seen on aerial photographs, these huts appeared to be approximately 65 feet by 30 feet in size and were spaced approximately 300 feet from one another. Based on interviews of former employees (Mr. Day and Mr. Eierman) it is believed that the Quonset huts were primarily used for storage purposes. However, based on an interview with Mrs. Keethler, some manufacturing or assembly may have occurred in the Quonset huts in the 1940s. Another building, shown on the 1950 aerial photograph, is located south of the southeastern-most Quonset hut. This building may have been used for manufacturing purposes.

An aerial photograph from 1950 shows the location of the farm house, the Quonset huts, a possible manufacturing building and several roads on the site. In addition to the huts, there are several areas of ground surface along the eastern side of the property that appear to have been disturbed. The 1950 aerial photo does not show any evidence of manufacturing buildings located in the northeast portion of the site, disposal trenches or the burn pit. There is evidence of disturbed soils adjacent to the small drainage area located in the northeast section of the property. The property located along the western, northwestern and southwestern border of the property line was farmed. Portions of the farmed land extended to the Quonset huts. Mr. Day further stated that while he lived on the property from 1945 to 1949, livestock grazed over the unfarmed portions of the property.

1950 - 1957

Aerial photographs taken in 1956 and 1957 show that the property underwent substantial development between 1950 and 1956. Mr. Day reported that he was employed in the manufacturing area in 1952 which indicates that it was constructed between 1950 and 1952. Mr. Eierman also recalled construction of the manufacturing facilities in 1951 or 1952. On the 1956 and 1957 aerial photographs two clusters of buildings are shown in the northeast portion of the property. The first cluster was comprised of 11 larger buildings and several smaller buildings located near the northeast border of the property. A well developed system of sidewalks and roads ran between these buildings. The central building in the cluster was

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the boiler house that generated and supplied heat to the other buildings. This portion of the Kilgore Farm Property was utilized for manufacturing and product assembly according to Mr. Day and Mr. Adams. The second cluster of buildings, located east of the manufacturing areas and referred to as the experimental area by Mr. Day and Mr. Adams was where product development and experiments were conducted. Approximately ten larger buildings and several smaller buildings were located in the experimental area. The two clusters of buildings were separated by a small drainage area that is visible on the 1956 and 1957 aerial photographs. A burn pit is located on the west central area of the site and was positively identified by Mr. Adams and Mr. Day. The burn pit was approximately 50 feet in diameter and had a soil berm located around the outer edge of it. The 1957 aerial photograph also shows the location of disposal trenches in the southeast corner of the property as reported by Mr. Day, Mr. Eierman and Mr. Adams. The property north, west and south of the Quonset huts was being farmed.

Two rectangular shaped features are shown on the 1956 and 1957 aerial photographs located south of the manufacturing area. M&E has not been able to ascertain the identity or use of these features. West of the burn pit, a disturbed area is visible on the aerial photographs. Mr. Skip Day recalled that there was a building located in that area of the property where work was conducted related to the development of "shaped" charges. He recalled that an explosion occurred in the area where shaped charges were being formulated and that the building was destroyed. He believes that the area southeast of the burn pit was this area. No other areas of soil disturbance are evident on the 1956 or 1957 aerials photos. Figure 4 shows the facility layout in 1957 and identifies the items described above.

During operation of the Kilgore Property, waste and off-specification materials were reportedly managed on the property by either burning or burial. Based on historical records, interviews with former employees and aerial photographs, there were apparently three main areas in which disposal activities reportedly occurred. These areas were the burn pit, the burial trenches along the southeast corner of the property and along the drainage ditch in the northeast portion of the property. In addition, aerial photographs from 1950, 1956, and 1957 show two areas (two rectangular shaped features south of the manufacturing area and a

OC 015348

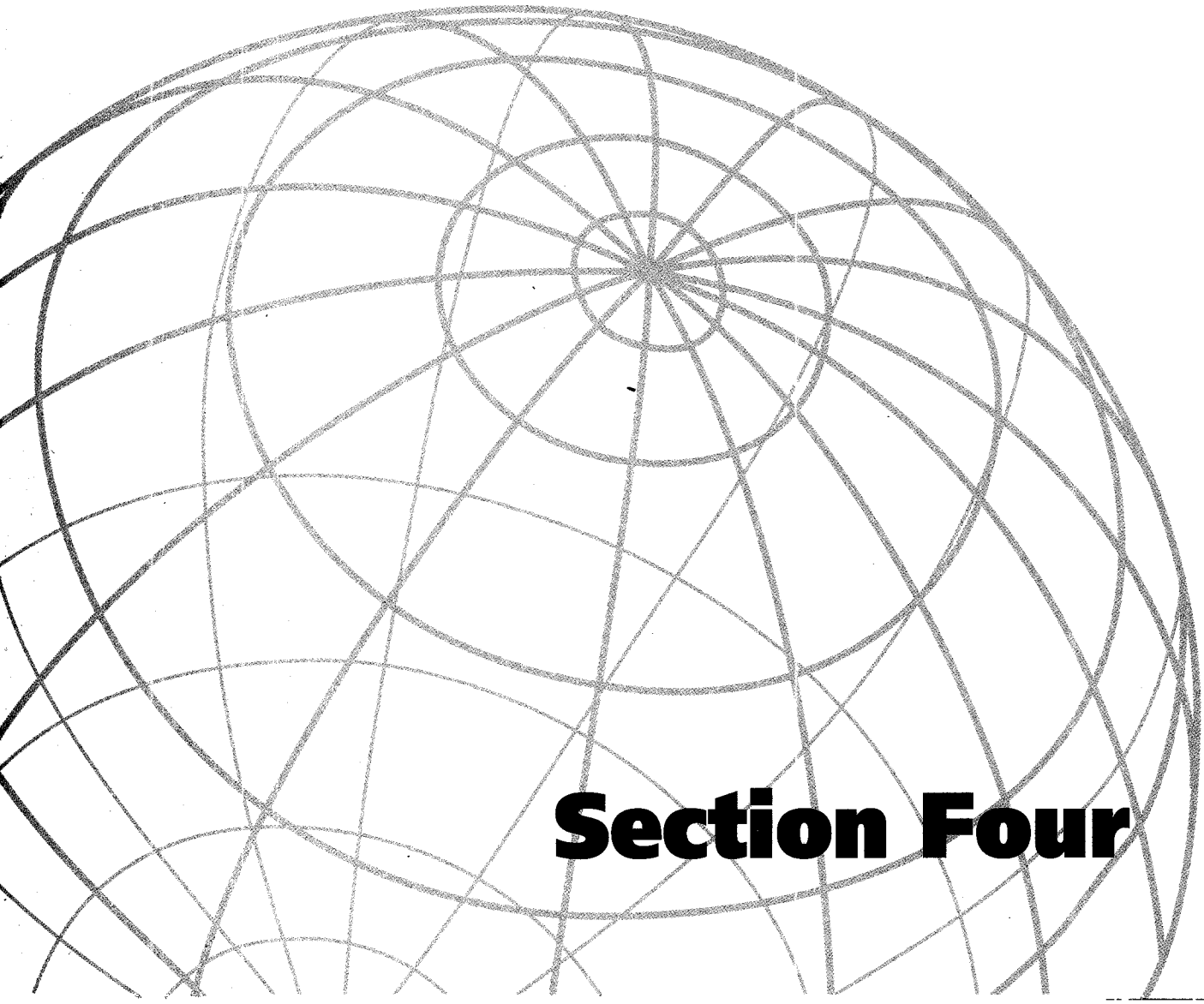
disturbed area located east and south of the burn pit) where waste management activities may have occurred. This usage has not been determined.

Kilgore ceased manufacturing operations at the site in 1961. Otterbein University took ownership of the property in 1962. After decontamination activities were conducted in 1962, the much of the property was farmed until 1986. Farming activities were conducted in the former Quonset hut, the burn pit area, and the farm and residence area and extended to the edges of the former burial trench area.

1986 to Present

Since 1986, the property has remained vacant. The City of Westerville Jaycees reportedly utilized the farm house as a haunted house at Halloween during this period. In 1996, the remaining structures in the manufacturing and experimental areas, the Quonset hut foundations, the farm house and the water tower were razed.

OC 015349



Section Four

4

OC 015350

4.0 SITE ENVIRONMENTAL HISTORY REVIEW

This section describes the environmental history of the Kilgore Farm Property. To facilitate a review of the environmental history, M&E has divided the 110-acre farm site into to 5 parcels based on historical land usage as determined through interviews with past site employees and review of historical aerial photographs (see Figure 6). These parcels shall be identified hereafter as: 1) the former manufacturing area, 2) the former Quonset hut storage area, 3) the former fire pit area 4) the disposal trench area, and 5) the farm and residence area. Details of each of the areas will be described below including: a summary of historic operations, identification of areas of concern based on historical records, a brief summary of environmental activities conducted in each area to date and a listing of outstanding issues.

4.1 FORMER MANUFACTURING AREA

The former manufacturing area is shown on Figure 6 and a detail of this area is shown on Figure 7. This area is located in the northeast portion of the property and is approximately 12.6 acres in size.

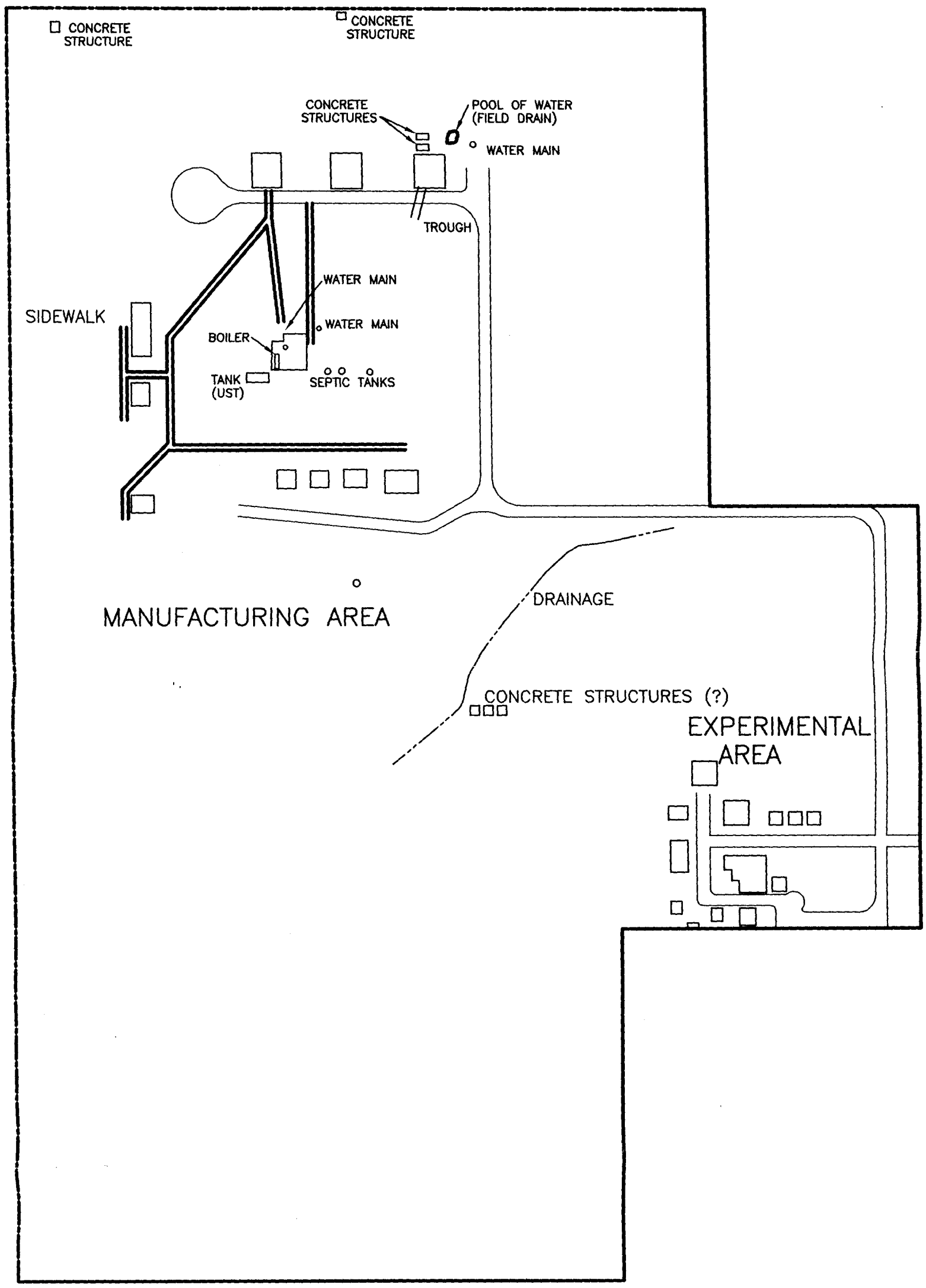
4.1.1 Summary of Operations

Based on interviews conducted with former Kilgore employees, the manufacturing area of the Kilgore Farm Property was constructed in the early 1950s. By 1956, at least 24 buildings were constructed in this area and are clearly visible on historical aerial photographs. Building activities were centered in two separate areas. The larger of the areas (located adjacent to the northeastern property line) was where manufacturing, assembly and maintenance facilities were located. The buildings were constructed in a square pattern with a large building located in the center of the other buildings. This building housed a boiler that supplied steam heat to the other buildings. The boiler was fired using diesel fuel which was stored in a 2,500-gallon underground storage tank located on the north side of the building. Major activities conducted in this area would have included assembly of products and pelletization of black powder.

OC 015351

Figure 6 - Subdivided Kilgore Property Map

OC 015352



NOTE: BASED ON 1957 AERIAL PHOTOGRAPH

SCALE IN FEET
0 50 100

M&E Metcalf & Eddy

KILGORE PROPERTY
MANUFACTURING AREA
SITE MAP
WESTERVILLE, OHIO

FILE NAME	DRAWN	DATE	PROJECT NO.	FIGURE
021796-3	FGS	5/8/98	021796	7

The other cluster of buildings in this area is located southwest of the manufacturing area. This area was identified by Mr. Adams and Mr. Day as the experimental area. This area was used to conduct research and testing of new products and processes.

The manufacturing and experimentation areas were heated with steam and were powered by electricity. Water was supplied to the site from an on-site well located near the farm house. Presumably, the site utilized a septic system to manage domestic waste water. Off-specification and waste materials generated in these areas were managed by either on-site burial or burning.

According to Mr. Day, there may have been some disposal activity conducted during the 1940 and 1950s in the northeast area of the Kilgore Farm along a small drainage ditch that ran between the two clusters of buildings. Aerial photographs taken in 1950, 1956 and 1957 show evidence of disturbance along this drainage area. The nature of activities conducted along the drainage area has not been well established.

4.1.2 Environmental Activities Conducted in the Former Manufacturing Area

In 1997, Lawhon and Associates removed a 2,500-gallon heating oil UST located adjacent to the former boiler house building. Because the UST contained fuel oil used for heating purposes the tank was unregulated by the Bureau of Underground Storage Tank Regulations. The tank was approximately 47 years old based on the I.D. tag plate (C-213198).
The tank removal activities began on February 24, 1997, by uncovering the tank and stockpiling the soils on plastic. On February 26, 1997, the residual product (3,500 gallons of residual product and water) was pumped from the tank and disposed of as petroleum contaminated liquids. The tank was removed and visually observed to contain numerous holes. Visibly contaminated soils were excavated and stockpiled on plastic. Verification soil samples were collected from the tank cavity. On June 25, 1997, the remaining impacted soils were removed, the tank cavity was sampled and backfilled with clean gravel. During removal of the UST, a total of 104 cubic yards of impacted soils were excavated. Using the BUSTR

OC 015354

Site Features Scoring System, the Kilgore Farm Property was scored as a Category 3 site. The residual concentrations of petroleum constituents in soils were below the Category 3 action levels and below the VAP Generic Numeric Cleanup Standards.

From 1996 to 1997, Lawhon and Associates conducted demolition of remaining concrete structures in the Manufacturing and Experimental Areas. During that time, concrete pads and foundations were broken up, and water/steam lines were removed and hauled from the site.

4.1.3 Former Manufacturing Area - Unresolved Features

During a site visit and interview conducted on April 7, 1998, Mr. Day identified a drainage ditch, located in the northeast corner of the site west of the former manufacturing area, where he recalled that waste materials were buried by Kilgore in the past. Mr. Day indicated that while his family lived in the farmhouse in the 1940s, he and his siblings were not allowed to play in the area of the drainage ditch due to materials being placed there. Mr. Day believed that flares and off-specification materials were buried within 8 to 10 feet of either side of the ditch. An aerial photo taken in 1950 shows evidence of some disturbance along the ditch and there appears to be a road or path that extended to the northern end of the drainage ditch. Aerial photographs taken in 1956 and 1957 also show evidence of disturbance along the ditch that may be related to waste disposal activities. No investigation or removal activities have been conducted in the area of the drainage ditch.

4.2 FORMER QUONSET HUT STORAGE AREA

In the central portion of the Kilgore Farm Property, a series of 12 Quonset huts were constructed and used for storage (see Figure 6). This Quonset hut storage area is approximately 31 acres in size.

OC 015355

4.2.1 Summary of Operations

Historically, this area was used to store assembled munitions/flares, cardboard packing crates, and raw materials used in the manufacturing process. A total of twelve storage huts were located in this area, and were spaced approximately three hundred feet apart. The storage huts were made of metal with a concrete floor and foundation. Aerial photographs show that there were also several small structures located in between the Quonset huts. According to Mr. Adams and Mr. Day, these small buildings were used to store fire fighting equipment for emergency situations. The storage huts and fire huts were serviced by a water line for fire suppression. The waterline was fed from the water tower located at the northwest portion of this area. The waterline ran from the northern road south, extending to all of the storage huts. The storage huts were heated with steam provided from a boiler located in the basement of the farm house.

During the operation of the Kilgore Farm Facility, portions of the Quonset hut storage area were also farmed or used to graze cattle. Aerial photographs of the site document that the area around the Quonset huts was either grasslands or was used for agricultural purposes. Based on interviews with former resident and Kilgore employee, Mr. Day, and aerial photographs, there is no historical evidence to suggest that any wastes were buried in this area.

The Quonset huts were used, as stated previously, to store manufactured flares, pyrotechnics, and munitions. Additionally, raw materials, packing crates, and empty munitions canisters were stored in the storage bunkers. It is possible that any chemicals or materials used in the manufacturing process were stored in bulk form.

4.2.2 Environmental Activities Conducted in the Former Quonset Hut Storage Area

During clean-up activities conducted in the burial trench area of the site conducted in 1988, empty flare canisters and black caps were moved to the Quonset hut area and staged on the ground surface near the farm house prior to disposal. Most of these materials were

OC 015356

subsequently removed from the site in 1962 or by Lawhon and Associates in 1996. A few empty flare casings and black caps remain on the surface, possibly the result of incomplete removal or littering by trespassers in the past.

Waterlines and steam lines in the Quonset hut storage area were excavated and removed by Lawhon and Associates in 1996. During excavation, no evidence of buried wastes was observed. While the waterline was being removed, the foundations for the storage buildings were demolished and removed from the site.

4.2.3 Former Quonset Hut Storage Area - Unresolved Features

Although there is no evidence based on the historical records and interviews, it is possible that some spillage of bulk materials of finished products occurred around the Quonset huts. No investigations have occurred in these areas to date.

In 1962 during removal of buried wastes in the trench area located in the southeast portion of the property, some wastes were staged on the ground near two Quonset huts located near the farm house. Most of these materials have been subsequently removed. However, some empty flare canisters and black caps are visible on the ground surface at the former location of the two Quonset huts located nearest to the farm house. No investigations have been conducted in this area.

4.3 FORMER BURN PIT AREA

In the tract of property located south of the former manufacturing area and east of the Quonset storage huts, a burn pit historically operated to destroy off-specification materials. This tract of land, approximately 18 acres in area, which includes the former burn pit shall be referred to hereafter as the "Burn Pit Area". The exact location of the Burn Pit Area is shown on the 1956 and 1957 aerial photographs and was positively identified by Mr. Adams (See Figure 6).

OC 015357

4.3.1 Summary of Operations

From 1951 to 1961, a burn pit was operated on the tract of land located east of the Quonset hut storage area. The burn pit, approximately 10 - 12 feet deep, approximately 40 - 50 feet in diameter, was bermed with dirt to prevent the spread of fires. Mr. Adams and Mr. Day, former Kilgore employees, stated during interviews, that the burn pit was used to destroy flares, caps, and other off-specification materials at a frequency of approximately once a week. According to Mr. Adams, some wastes from the Kilgore Facility located near downtown Westerville were also destroyed in the burn pit. Both Mr. Day and Mr. Adams stated that extreme care was take to ensure that all materials placed in the burn pit were completely destroyed during each burning event. This was necessary to prevent accidents from occurring during the next burn event. Mr. Day stated that the ashes in the burn pit were occasionally excavated and he believed that they were placed in the burial trench area.

Review of the aerial photograph from 1950, several areas where the ground surface is distrubed are noted. These five unknown areas are irregular in shape. The use of these unknown features was not able to be determined through employee interviews or historical records.

During review of aerial photographs taken of the site in 1956 and 1957, two additional areas of unknown use were identified in the Burn Pit Area. The first area consists of two rectangular shaped features that are located immediately south of the former manufacturing area. A road extending from the manufacturing area and running between the two features is clearly visible. The use of this area was not able to be determined through employee interviews or historical records.

The other unknown area is located along the eastern property line just south of the burn pit. According to Mr. Day, there used to be a building at that location where experimental work was conducted with "shaped" charges. Mr. Day recalled that two men were killed while working with the shaped charges at a building previously located there. The building was

OC 015358

heavily damaged during the explosion and was subsequently razed. Mr. Day believed that the feature visible on the aerial photograph represents the remnants of the razed building.

The remainder of the Burn Pit Area was never developed. According to Mr. Day, he was not aware of any other disposal activities being conducted in this area.

4.3.2 Environmental Activities - Former Burn Pit Area

No environmental investigations related to the burn pit, or the unknown features noted on the aerial photographs have been conducted to date. A wetlands survey and delineation has been conducted by Lawhon and Associates south of the manufacturing area in the general area where the two rectangular features were previously located.

4.3.3 Former Burn Pit Area - Unresolved Features

Environmental investigations have not been conducted in the vicinity of the burn pit or in the two areas of unknown use noted on the 1956 and 1957 aerial photographs. Investigations of these areas will be necessary to determine if environmental impacts are present.

4.4 FORMER TRENCH DISPOSAL AREA

During operations at Kilgore, waste and off-specification materials were generated. From 1951 to 1961, these materials were disposed in trenches excavated in a 4-acre area located in the southeast corner of the Kilgore Farm Property (see Figure 6).

4.4.1 Summary of Operations

Based on aerial photographs, trenching operations in the southeast portion of the property began after 1950 and likely coincided with the construction and operation of the manufacturing areas in 1951 and 1952. By 1957, a well developed system of burial trenches are clearly

OC 015359

visible on an aerial photograph. The burial area was used for the disposal of off-specification materials and other wastes generated during the operation of the Kilgore manufacturing facilities. In addition, Mr. Adams stated that some wastes from the Kilgore facility located in downtown Westerville were also disposed of in the trenches.

According to Mr. Richard Eierman, a former excavation subcontractor employed by Kilgore, the burial trenches were installed starting in the southeast corner of the property and extending to the west. Trenching operations were predominantly oriented north to south and covered an area approximately 400 feet by 400 feet in area. Trenches were installed using a trackhoe and were approximately 200 feet long, 5 feet deep, and 3 feet wide with a typical spacing of 5 to 10 feet. Mr. Eierman recalled installing 15 to 20 trenches at the Kilgore Farm from 1952 to 1961. A previous subcontractor installed 1 or 2 trenches in 1951 prior to Mr. Eierman beginning work at the Kilgore facility. As new trenches were dug, excavated soil from the new trench was used to cover up the last trench. Mr. Adams and Mr. Eierman stated that the trenches were filled with 2 to 3 feet of waste before being backfilled.

Waste materials were packaged in wet cans (30" long by 15" in diameter) for disposal in the trenches. These cans were then laid in open trenches and covered with earth. Various rejected materials such as pyrotechnic devices, primary explosives, such as scrap powder primer, detonators, and liquid flares, were also placed in the open trenches and covered with earth. Based on the list of materials manufactured at the property in the past, the following wastes could have been placed in the burial trenches: red phosphorous, aluminum flitter, sodium hypophosphite, ammonium and potassium picrates, lead azide, black powder, powdered aluminum/magnesium, boron phosphide, antimony trisulfide, sulfur, sodium nitrate, permanganate, barium rhodanide, and potassium perchlorate. A historical record of wastes buried in 1951 to 1953 and a map showing the locations and dimensions of some of the trenches is located in Appendix J.

OC 015360

4.4.2 Environmental Activities - Former Burial Trench Area

Investigation and removal of buried wastes has occurred in the former burial trench area since Kilgore ceased operations at the facility in 1961. A summary of the activities conducted follows:

- In 1961, Mr. Sanders Frye, Business Manager for Otterbein University, initiated actions to begin a clean-up of the burial site at the Kilgore Farm Property. On April 5, 1962, Mr. Frye contacted the Joliet Ammunition and Supply Procurement Agency located in Joliet, Illinois, and retained Mr. Virgil Carpenter, Supervising Safety Engineer for Ammunition Procurement and Supply Agency in Joliet, Illinois, to supervise the decontamination at the site. The clean-up began on July 8, 1962, and was completed on August 24, 1962. George Igel and Company, Inc. were hired to perform the clean-up under the supervision and direction of the Ammunition Procurement and Supply Agency. The clean-up began with the marking of the trench locations and removal of the earthen cover. Some of the buried materials were destroyed on the property by burning and/or detonation. The remaining materials were relocated to an area near the easternmost Quonset Hut and staged prior to shipment from the site.

  After the trenches were dug and the wastes were removed, the empty trenches were backfilled. In a letter dated August 24, 1962, Mr. Virgil Carpenter stated that "the contaminated area has been decontaminated in accordance with current Ordnance Corps procedure and in the opinion of the undersigned, no significant hazard remains which will prevent the use of this area for any purpose or endanger the lives of individuals or the public." In a written letter to Col. E. W. Grubbs, Ordnance Commander, Ammunition Procurement Supply Agency in Joliet, Illinois, dated August 30, 1962, Mr. Sanders Frye of Otterbein College stated that during decontamination 120 tons of explosives and flares as well as some 3500 boosters, and 200,000 fuses were dug up and disposed. In addition there was cap mix, black powder, magnesium flares and numerous other odds and ends.

OC 015361

The total time to dig up this material was six weeks "...without a single lost time accident or the slightest damage to the earth moving equipment."

- In June of 1985, Mr. Earnest Fritsche, who was a board member and business manager for Otterbein University, and a World War II explosives expert, was asked to look into the sale of the Kilgore Farm property. Mr. Fritsche visited the site on June 15 and 16, 1985, and discovered approximately seventy flare canisters in the southeast portion of the property. The flare canisters had apparently been dug up by the farming activities conducted in the southeast portion of the site in or near the former burial area after Kilgore ceased operations at the site. Mr. Fritsche buried the canisters at the location they were discovered and marked the area

  Mr. Fritsche called the Ohio Fire Marshall's Office (OFMO) and the Ordnance Department at Wright-Patterson Air Force Base and requested that they identify the canisters and determine whether or not they were hazardous. Mr. Fritsche stated in a summary letter that the results from the OFMO and Ordnance Department indicated that the canisters could only be made reactive by attaching a counter-charge and detonating the material. However, on the following day, dry pieces of the exploded canisters and contents (presumed to be phosphorous) burst into flame. On September 5, 1985, a team from the Hazardous Materials Division of the OFMO collected the canisters found by Mr. Fritsche and delivered them to the Ordnance Department at Wright-Patterson Air Force Base for disposal. Copies of this correspondence are contained in Appendix F.

- Mr. Fritsche returned to the Kilgore Farm in March and in mid-June, 1986, and found thirty-four flare canisters in the area of the former trench burial site. The area was marked and arrangements were made for later pick-up. Officers from the OFMO and Ordnance at Wright-Patterson Air Force Base visited the property in May, 1986, and Sergeant Smith from Ordnance recommended that the entire 110 acres be swept with mine detectors. Records to do not indicate that sweeping was conducted at the site.

OC 015362

On July 7, 1986, Mr. David Douthat, a safety engineer with the U.S. Corps of Engineers, visited the Kilgore Property with Mr. Fritsche. Approximately fifty canisters were found in the area of the former trench burial area during their visit. These canisters, plus the canisters found earlier in the year by Mr. Fritsche, were removed from the property by the Ordnance Department from Wright-Patterson Air Force Base.

- In 1987, Westerville Schools contacted Otterbein College and expressed interest in purchasing twenty-two acres of the Kilgore Farm north of, and adjacent to, the Westerville North High School grounds. In January, 1988, Westerville Schools contracted S.E.A., Inc. of Worthington, Ohio, to conduct an environmental study of the desired portion of the property, which included the six-to-eight-acre former burial site. S.E.A., Inc. performed a detailed site investigation of the acreage in question. This investigation involved installing monitor wells and testing the ground water for contaminants. A walk-through with a metal detector located one area that produced many small unidentifiable metal objects. This report indicates that "...there does not appear to be any large metal structures beneath the top two feet of the surface on the property..." and "...the groundwater did not contain any volatile aromatic or chlorinated hydrocarbons above detectable limits..." The report further concludes that "...there was no contamination of the groundwater with PCBs above detectable limits," and, furthermore, "...although metals were detected in the groundwater, they were below the EP toxicity limits." Additionally, the report states that "...the concentration of nitrates in the groundwater is below the Safe Drinking Water Act..." A copy of this report is included in Appendix K.

- Westerville Schools contracted with Lama Excavation Company in May, 1988, to excavate the area in the southeast portion of the property containing the metal objects identified by S.E.A. On May 3, 1988, excavation uncovered a variety of materials related to Kilgore operations from the 1940s and 1950s, including parachute flares (dated 1954); black plastic caps; cylinders containing gray, blue and purple granular substances; and many filled aluminum canisters. It was then decided to dig a series of trenches throughout the former trench burial site. Excavation uncovered only a few pieces of debris. A total of 15

OC 015363

trenches were dug throughout the former burial area. Each trench was approximately 3 feet wide by 6 feet deep and varied in length. The total amount of linear footage excavated was approximately 3,330 feet. In addition, a pit measuring 30' x 40' x 5' deep was excavated. Excavated materials moved from the trench burial area and staged near the old farmhouse prior to removal. The trenches were not filled in by Lama excavating at that time.

- In June, 1988, in an attempt to test the reactivity of materials found during the excavation process, the Columbus Bomb Squad placed blasting caps on all items. When detonated, the caps exploded but the materials did not. Given the age of the materials and the conditions of burial, it was determined by Chief Morrison of the Columbus Bomb Squad, after receiving the OFMO report on the materials sampled, that the canisters and other materials were not explosive in their current state, but could be dangerous and advised removal and disposal of the materials (Appendix L).

- In 1996, Lawhon and Associates conducted additional trenching throughout the former trench burial area. Trenches were dug to a depth of approximately 10 feet or until native soils were observed. A total of six drums of miscellaneous materials were placed in drums. Representatives of the Wright-Patterson explosive Ordnance Division thoroughly examined the contents of all six drums and separated a five-gallon bucket of materials that were thought to be potentially energized. The EOD personnel detonated the material in the five-gallon bucket on site using plastic explosives. EOD personnel identified the following excavated materials: Empty M112 photoflash casings, M56 projectile fuses, various pyrotechnic debris, and 2 55-gallon drums of a reddish material assumed to be red phosphorous. Immediately following trenching activities, Lawhon and Associates installed three monitoring wells in the former burial trench area (wells installed by S.E.A had been previously abandoned). The samples were analyzed for VOCs, SVOCs, and the eight RCRA metals. VOCs and SVOCs were not detected above the method detection limit of 1 μg/l. Low concentrations of barium, cadmium, and selenium were detected but were at concentrations suspected to represent natural conditions. Soil samples were collected

OC 015364

during drilling of the monitoring wells and submitted to testing of VOCs, SVOCs and metals. Metals were detected at concentrations similar to concentrations reported for Ohio Farm Soils. A copy of Lawhon's report is located in Appendix E.

4.4.3 Unresolved Issues

Based on field measurements, nearly 5,000 linear feet of exploratory trenches have been installed and over 125 tons of suspect materials have been removed and disposed of from the former burial area. However, investigations conducted in the past have not thoroughly characterized the nature of the wastes excavated from the trenches. Furthermore, residual wastes continue to be observed locally in the burial area. Additional testing and waste characterization will be necessary in the area to determine the types of wastes present and if they present any threat to human health or the environment.

4.5 FORMER FARM AND RESIDENCE AREA

From the time Kilgore purchased the property in 1941, an area of approximately 36 acres located west of the farm house, and north and south of the Quonset huts was continually farmed. The farmed portions of the site, are identified on Figure 6.

4.5.1 Summary of Operations

During operation of the facility by Kilgore, portions of the property were still actively farmed and Kilgore employees resided in the house. Farming was conducted west of the farm house and north and south of the Quonset huts. According to Mr. Day, former resident of the Kilgore farm, crops grown on the site included: beans, corn and wheat. Aerial photographs taken in 1950, 1956 and 1957 substantiate Mr. Day's recollection of the areas farmed. No evidence of disturbed areas is visible in the farming area.

OC 015365

Structures in this area included: a farm house, silo, and water tower. The house had a septic system and water was provided by a well. In the basement of the house, there was a coal-fired boiler that heated the house and supplied heat to the Quonset huts.

Based on interviews and historical aerial photographs, there is no evidence that any wastes generated from the Kilgore manufacturing process have ever been placed on the farmed portions of the property. According to the Delaware County Agricultural Extension Agency the use of pesticides in the 1940s and 1950s in Delaware County was uncommon, especially for small private farms. The use of herbicides was more commonplace. According to Dr. William Lawhon, it is unlikely that any residual herbicides would remain on the site.

4.5.2 Environmental Activities - Farm and Residence Area

In the southwest corner of the property, a 2.31-acre parcel of the property which is located in the Farm and residence area was investigated separately and a No Further Action letter was submitted to the Ohio Voluntary Action Program. A Phase I Assessment was conducted, and limited exploratory test trenches were installed at the request of Ohio EPA. A Covenant Not To Sue was granted by the Ohio EPA on May 27, 1997.

In 1991, asbestos-containing materials were identified in the building materials of the farm house. In 1997, Lawhon and Associates arranged for the demolition of the house and the water tower. The asbestos-containing materials were removed prior to demolition of the site. The remaining demolition debris was removed from the site.

4.5.3 Unresolved Areas

Based on former employee interviews, and review of aerial photographs, there are no unresolved areas in the former farm and residence area.

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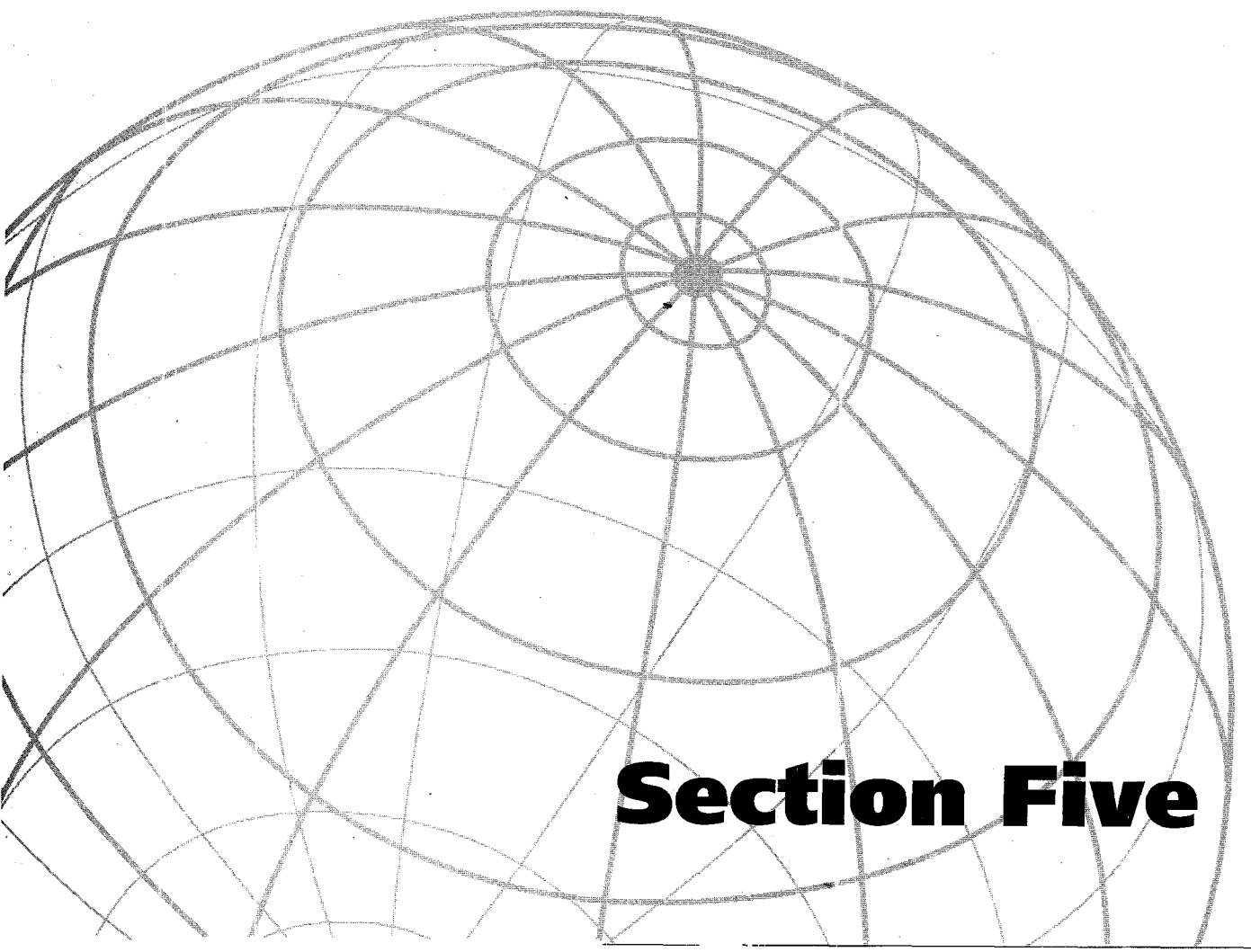


Section Five

OC 015367

5.0 IDENTIFICATION OF CHEMICALS OF CONCERN

During the manufacturing operations at the facility, a variety of chemical compounds were used. The following sections list the chemicals suspected to have been used or disposed of at the sight and briefly evaluate their environmental stability.

5.1 BULK CHEMICALS AND MATERIALS

Table 1 presents a list of chemicals used in manufacturing at the Kilgore Farm property during its operational history. This list is based on information ascertained through review of historical manufacturing records that describe the products manufactured, employee interviews, disposal records, and based on literature regarding the manufacturing of military ordnance.

5.2 ENVIRONMENTAL EVALUATION OF CHEMICALS

In this report section, various chemical compounds which have been reported to have been used or present on the Kilgore Farm Site along with common chemicals known to be used in the pyrotechnics industry are evaluated in terms of their probable persistence or degradation in the natural environment. Because no specific written documentation of the disposal of any specific component at this site exists, the term "postulated" is used to describe a possible use or disposal. The use of this term does not mean that use or disposal has been documented; only that use existed at other typical sites and within the industry.

Criteria used in this evaluation include: estimated persistence when exposed to natural environmental conditions, hazards potentially due to rapid decomposition in a degraded state, and the potential for human toxicity of these materials in their predictable present state.

OC 015368

TABLE 1
BULK CHEMICALS
KILGORE FARMS MANUFACTURING FACILITY
WESTERVILLE, OHIO

CHEMICAL NAME	USE
Aluminum	Photoflash Flares, Smoke Flare, Incendiary Bombs
Antimony	Colored Flares
Antimony Trisulfide	Igniter, Primer in Flame Throwers
Ammonium Chloride	Smoke Flares
Ammonium Perchlorate	Smoke Flares
Ammonium Picrate	Ignitors, Primer
Barium Nitrate	Photoflash Flare, Parachute Flares,
Barium Rhodanide	Stab Primers
Barium Sulfate	Float Flares, Underwater Flares
Black Powder	Accelerant in flares, Black Caps
Boron Phosphide	Ignitor, Primer
Calcium	Colored Flares,
Castor Oil	Binder, oxidation inhibitor for Al and Mg, and lubricant
Copper Oxide	Colored Flares
Hexachlorobenzene	Colored Flares
Hexachloroethane	Smoke Flares
Iron Oxide	Colored Flares
Laminac	Unsaturated Polyester binder
Lead Azide	Stab Primers
Lead Thiocyanate	Stab Primers
Lead Oxide	Stab Primers
Lead Styphnate	Stab Primers
Linseed Oil	Binder in Black Powder Pelletization Process, oxidation inhibitor
Magnesium	High and medium intensity Flares, Incendiary Bombs
Mercury Fulmanate	Primer
Phosphorous	Combined Light and Smoke Flares
Potassium Chlorate	Flares
Potassium Nitrate	Gun Powder Formulation, Flares
Potassium Perchlorate	Photoflash Flares, High Altitude Flash Charges, Smoke Flares
Sodium Hypophophite	Igniter
Sodium Nitrate	Gun Powder Formulation, High Intensity Flares
Sodium Oxalate	Colored Flares
Sodium Perchlorate	High Altitude Flash Charges
Strontium Nitrate	Colored Flares
Strontium Oxalate	Slow Burning Flares, Road Flares
Sulfur	Gun Powder Formulation, Accelerants
Tetryl	Primer
Trinitrotoluene (TNT)	Shaped Charges
Zinc	Smoke Flares
Zinc Oxide	Smoke Flares
Zirconium Hydroxide	Parachute Flare, Igniter

OC 015369

An initial basis for this evaluation has been that all of these materials have been disposed by being buried, without containment, in the soils. The presumption here is that any contained materials, in intact containers, will have been removed in a prior operation.

The principal reference for this evaluation has been *The Merck Index* (Merck, 1993). (Note that a number in parentheses after a compound is the Merck Index reference number.) References for phosphorus have been Burns *et al* (Burns, 1981), Bailar *et al* (Bailar, 1973), and Grogson *et al* (Grogson, 1985).

Base Metals and Oxides. Base metals and oxides are postulated as having been used in manufacturing at the Kilgore Farm Site. These include aluminum, magnesium, antimony, calcium, zinc, copper oxide, zinc oxide, and iron oxide. (Lead oxide is discussed separately.) the base metals and oxides are generally non-reactive at normal temperatures. But when dispersed in the natural environment the base metals will oxidize and form oxides. All of these oxides are considered to be non-hazardous and essentially nontoxic.

Chlorates and Perchlorates Chlorates and perchlorates, postulated as having been used at the Kilgore Farm Site, include potassium chlorate (7494), potassium perchlorate (7535), sodium perchlorate (8493), and ammonium perchlorate (559). All of these compounds are strong oxidizers. When dispersed in the natural environment these compounds will oxidize organic material and metals in the soils. These compounds are soluble in water and will be rapidly dispersed. In their degraded state none of these compounds are considered to be hazardous or toxic.

Picrate Salts. At the Kilgore Farm Site ammonium (566) and potassium picrate (7545) are postulated as having been used during manufacturing operations. These compounds are salts of trinitrophenol. Because of the presence of the trinitro groups in the compound as manufactured, these materials are very sensitive and are intended to explode. But, these materials are very soluble in water and will not persist in the soils when dispersed in the

OC 015370

natural environment. Because of their solubility, the ammonium nitrate and potassium nitrate would be expected to be assimilated by soil bacteria and plants.

Nitrates. Nitrates are postulated as having been used at the Kilgore Farm Site. These include barium nitrate (983), potassium nitrate (7528), sodium nitrate (8485), and strontium nitrate (8712). These nitrate salts are highly soluble in water, so that, if dispersed in the natural environment, these materials will dissolve and it is considered that much of the nitrate will be utilized by soil bacteria and plants. There may be some potential human sensitivity to the strontium salt, but this should not be a persistent situation because of its water solubility.

Sulfates. Barium sulfate (994) is postulated as having been used in the manufacture of float flares at the Kilgore Farm Site. This material is not hazardous and is practically insoluble. According to the *Merck Index* (Merck, 1993), it is not reactive or toxic so that it would be expected to remain in an inert state when dispersed in the natural environment. Barium sulfate is radiopaque and as such is used internally as a human diagnostic aid.

Oxylates. Strontium (8713) and sodium (8489) oxylates are postulated as having been used to produce colored flares at the Kilgore Farm Site. Sodium oxylate is soluble in water but strontium oxylate is only sparingly soluble. Thus, they both may be somewhat dispersed in the natural environment. Toxicity by ingestion is reported by the *Merck Index* (Merck, 1993).

Lead Azide. Lead azide (5232) was reportedly used at the Kilgore Farm Site in the production of primers. This material is shock sensitive. This material is slightly soluble in water and more soluble in dilute acids. Therefore, when disposed in the natural environment over a long period of time it would be dispersed. Human toxicity exists because of the lead content.

Antimony Trisulfide. Antimony trisulfide (738) is postulated as having been used for the production of striking surface in primers and as pigments in flares. It is not hazardous and is substantially nontoxic. Because this material is relatively insoluble in water, it may remain as an inert material when dispersed in the natural environment.

OC 015371

Hexachlorobenzene and Hexachloroethane. Hexachlorobenzene (4573) and hexachloroethane (4574) may have been used in the manufacture of smoke and colored flares at the Kilgore Farm Site. One of the uses of hexachlorobenzene is as a fungicide. Both of these compounds are insoluble but sublime slowly. Hexachlorobenzene may be moderately irritating to skin and mucous membranes. When dispersed in the natural environment over a long period of time both of these materials would probably sublime and not be present.

Ammonium Chloride. Ammonium chloride (522) was reportedly used in the production of smoke flares at the Kilgore Farm Site. It is a component of pharmaceuticals. This compound is soluble in water and when dispersed in the natural environment would solubilize and be assimilated by soil bacteria and plants.

Tetryl. Interviews with Kilgore employees suggest that tetryl (6416) may have been used at the site in the production of primers. This material is shock sensitive because of the presence of four NO_2 groups in the compound. When heated to 180-190° C tetryl will explode. It is insoluble in water and irritating to skin and mucous membranes.

Mercury Fulminate. Mercury fulminate was a common primer material used historically and is postulated as having been used at the Kilgore Farm Site. It is shock sensitive and will explode when heated. It is slightly soluble in water and, when dispersed in the natural environment for a long period of time, would become inert and nonhazardous because of its solubility. Mercury, however, potentially could be a slight toxicity problem for humans.

Thiocyanates. Lead thiocyanate (5268) and barium thiocyanate (998) (also known as barium rhodanide) were used in the production of primers historically and are postulated as having been used at the Kilgore Farm Site. These thiocyanate salts are soluble in water and when dispersed in the natural environment would dissolve and be deactivated. Both compounds, however, in the concentrated states are listed as being poisonous.

OC 015372

Lead Styphnate. Lead styphnate is a salt of styphnic acid (8730). This is another shock-sensitive compound used historically in the production of primers. It is postulated that this compound may have been used in the production of primers at the Kilgore Farm Site. This is an unstable compound which deflagrates upon heating. However, because of its solubility when dispersed in the natural environment, it will likely be utilized by soil bacteria and plants and therefore will not be present except as nontoxic, nonhazardous residues.

Sulfur. Elemental sulfur is a common material used in the formulation of gunpowder and the manufacture of flares. It is a naturally occurring material that is safe to handle. It is commonly used in agricultural and home garden applications. Although it will be slowly oxidized, some may persist at the Kilgore Farm Site.

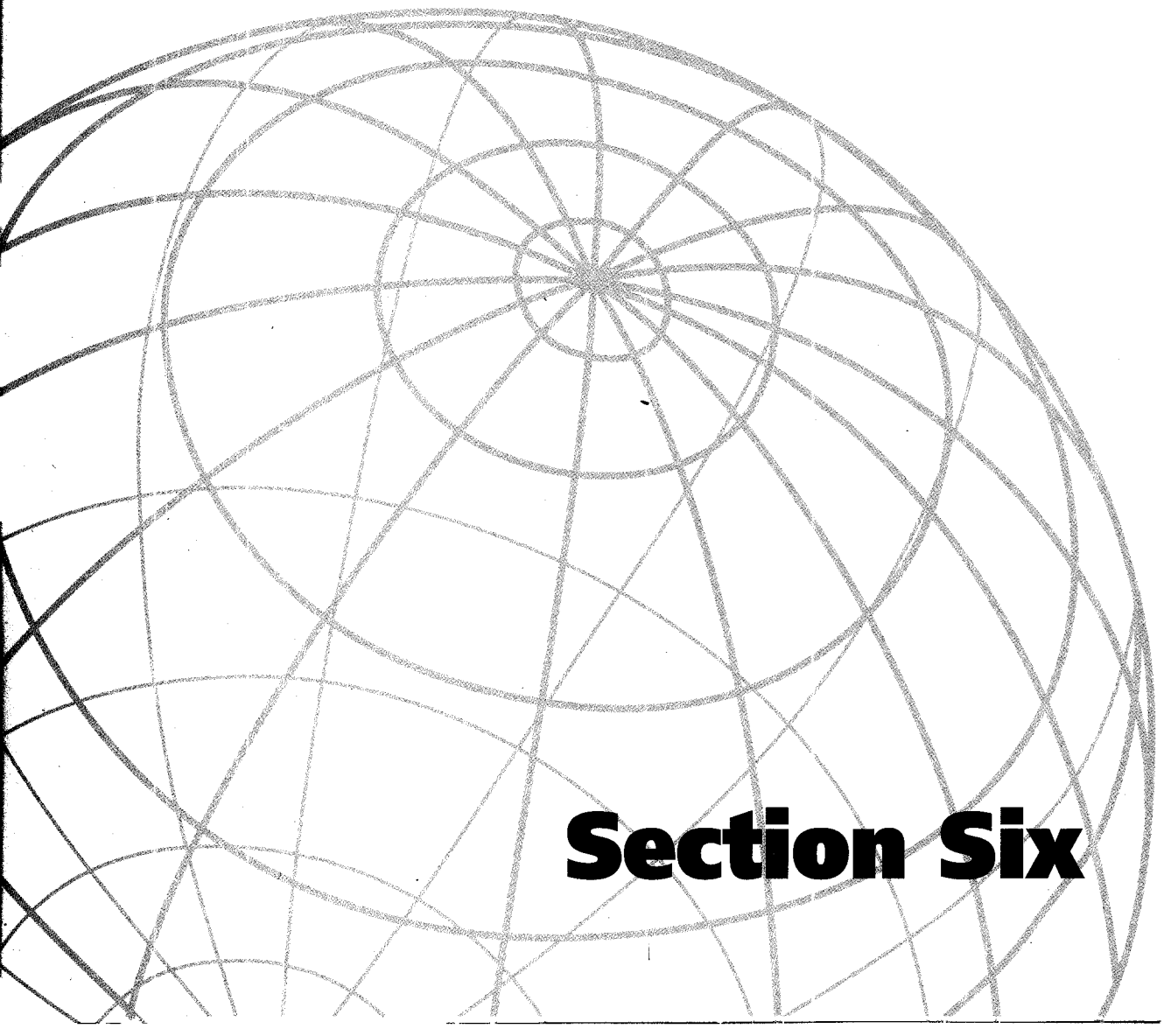
Lead Oxide. The "brown oxide" or lead dioxide (5241), PbO_2, and the "yellow oxide" or lead monoxide (5251), PbO, are materials used historically and are postulated as being used at the Kilgore Farm Site. The "yellow oxide", although so named by chemists, has a red to reddish-yellow color according to the *Merck Index* (Merck, 1993). thus, this "yellow oxide" is called "red lead". It also is known commonly as "litharge" and when combined with glycerol is used by plumbers and others as a cement in joining metallic parts. Other forms of lead oxide probably were never present because of their instability at ambient temperatures. Both the dioxide and the monoxide are classed as poisons and both are insoluble in water. These compounds might persist when disposed in the natural environment but would represent a threat to human health only if ingested or inhaled. They are not explosives.

TNT. Trinitrotoluene (9534), also known as TNT, is a compound that contains three nitrate radicals. It is highly explosive but must be detonated by a high velocity initiator. TNT vapors are toxic and may be absorbed through the skin to cause toxic reactions. Because it is sparingly soluble in water, TNT over time would become inert through solution and utilization of nitrate by soil bacteria and plants.

OC 015373

Phosphorus. It is postulated that two forms of elemental phosphorus (7231), white and red, may have been used at the Kilgore Farm Site. White phosphorus is readily oxidized in air and will ignite at temperatures as low as 34°C. Even without ignition, oxidation is fairly rapid. Red phosphorus reacts more slowly than the white; with water vapor and oxygen of the air, red phosphorus is reported to produce phosphine and phosphorus oxy acids at ambient temperatures. Phosphine (PH_3)(7224) is a gas and, though toxic, will dissipate rapidly. The oxides formed by both white and red phosphorus react readily with water to form water-soluble acids. Disposal in the natural environment will result in the conversion of both forms of phosphorus into these water-soluble acids. The phosphoric acid thus formed would be expected to be utilized by soil bacteria and plants in their biologic processes.

OC 015374



Section Six

6

OC 015375

6.0 ENVIRONMENTAL COMPLIANCE HISTORY OF THE SITE AND THE SURROUNDING AREA

In accordance with the Ohio VAP, Lawhon & Associates conducted a comprehensive environmental database search using ERIIS to assess the known environmental issues on the property and the surrounding properties. The target property, Kilgore Farm, is reported as a hazardous waste site on the State of Ohio Master Sites List in the ERIIS database. The site has not been prioritized by Ohio EPA. The Kilgore Farm site is not listed in any of the other databases. Within 1/2 mile of the property the ERIIS databases identify a RCRA Small Quantity Generator, a registered underground storage tank, and a leaking underground storage tank. None of these sites is located adjacent to the subject property or is unlikely to pose any environmental threat. A copy of the environmental database search is provided in Appendix M. The databases searched and distances from the Kilgore Farm Property are summarized below:

Database	Radius (miles	Property to 1/4 mile	1/4 to 1/2 mile	1/2 to 1 mile
NPL	2.0	0	0	0
CERCLIS	2.0	0	0	0
RCRIS_TS	2.0	0	0	0
RECRIS_LG	2.0	0	0	0
RECRIS_SG	2.0	0	0	1
ERNS	2.0	0	0	0
LRST	2.0	0	1	0
RST	2.0	0	0	1
SWF	2.0	0	0	0
HWS	2.0	1	0	0
NFRAP	2.0	0	0	0
Open dump	NR			
TRI	2.0	0	0	0
Spills	2.0	0	1	1
Totals		**1**	**2**	**3**

NR = Not Reported

OC 015376

Additional records and data bases checked included:

- City of Westerville Fire Department

  The local fire department has no records of incidents regarding the Kilgore site with the exception of numerous telephone calls related to the detonation of suspect materials by the Wright-Patterson Explosive Ordinance Division in 1996.

- The Ohio EPA Central District Office

  The Ohio Division of Emergency Remedial Response (DERR) visited the site in 1988 and 1992 and prepared a Preliminary Assessment Report. A copy of this Report is located in Appendix M. In this report, Ohio EPA recommended a low priority ranking for the site.

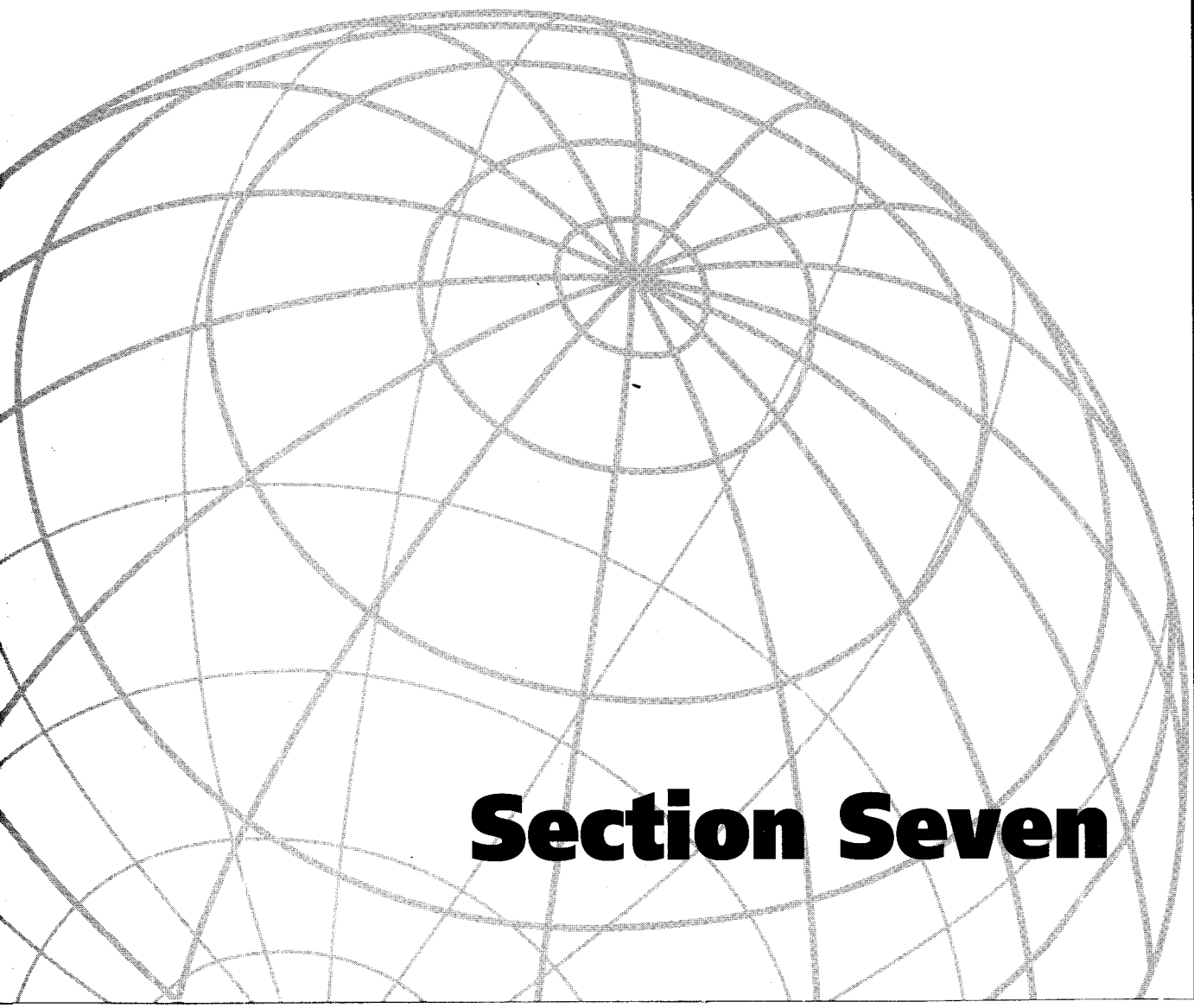
- Delaware County Health Department

  Lawhon & Associates contacted the local Health Department, no information regarding the Kilgore Property was on file.

- The Ohio Department of Natural Resources, Oil and Gas Division

  According to ODNR there are no oil or gas wells located on the property.

OC 015377



Section Seven

OC 015378

7.0 PROPERTY INSPECTIONS

Phase I Audits were conducted by S.E.A and Lawhon & Associates in 1986 and 1991, respectively. In April 1998, Metcalf & Eddy, Inc. conducted a property inspection to update the information described in the previous Phase I Assessment.

7.1 LAWHON PHASE I SUMMARY

Lawhon & Associates performed a Phase I Environmental Audit on the Kilgore Farm Property from January 23 to February 6, 1991. Figure 8 shows the items identified during the property inspection conducted by Lawhon & Associates. In this audit, dated March 1, 1991, Lawhon & Associates recommended the following actions be undertaken at the facility.

1. Removal of the flares, caps, primers and other metallic objects.
2. Demolition of the remaining buildings and foundations.
3. Removal of the underground storage tank.
4. Removal of the septic tanks.
5. Removal of the asbestos materials from the existing house.
6. Wetland mitigation investigation.

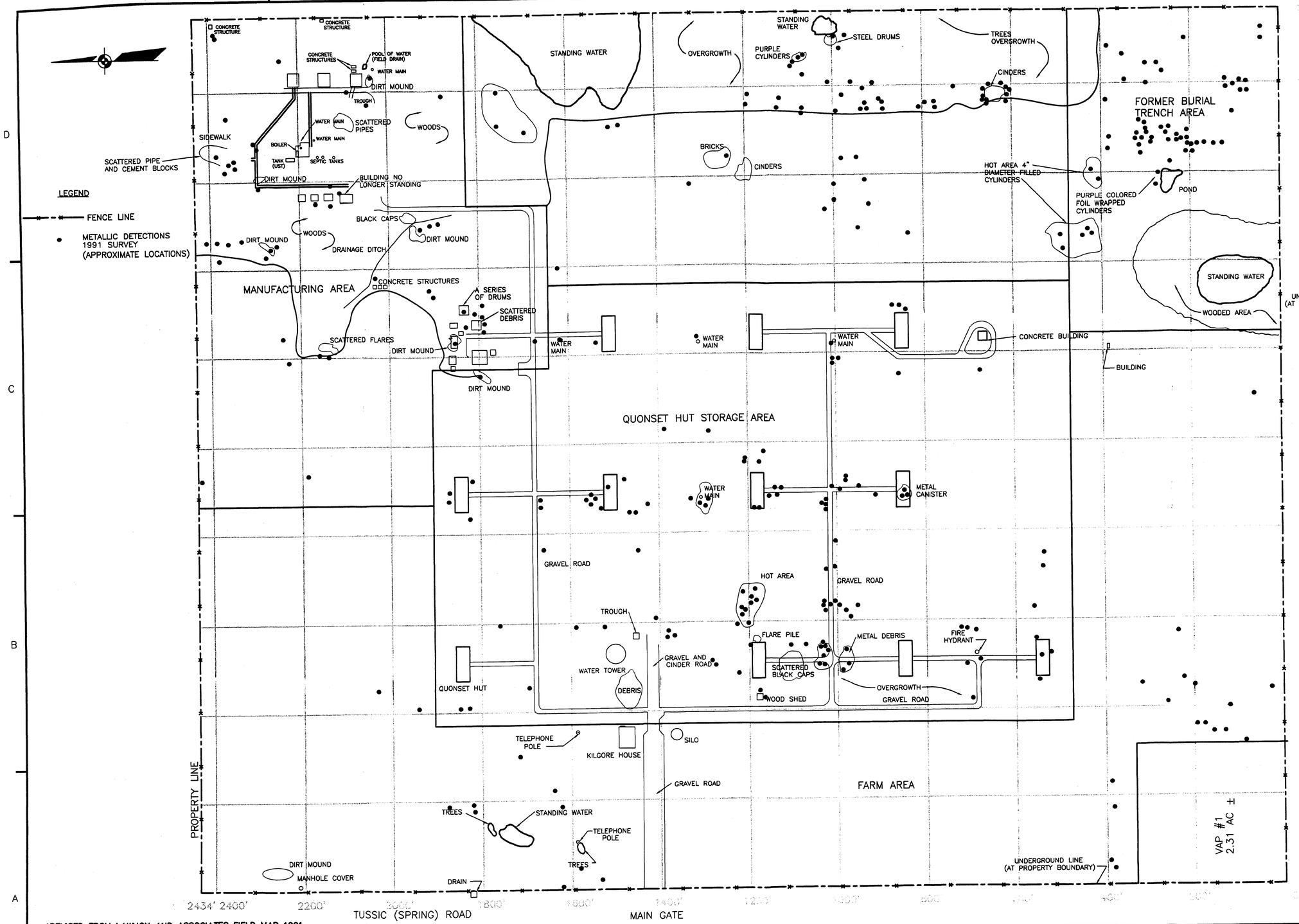
In addition, the Lawhon & Associates audit concluded:

1. Based on the review of the data, groundwater contamination was deemed unlikely.
2. Pyrotechnic materials found at the site posed little threat to the site soil conditions.

Following the audit conducted in 1991, several of the items listed above were further investigated or remediated. Actions conducted at the site by Lawhon and Associates since 1991 include:

Foundations and the remaining building structures were demolished and removed in 1996.

OC 015379



*REVISED FROM LAWHON AND ASSOCIATES FIELD MAP 1991

NUMBER	DATE	MADE BY	CHECKED BY	DESCRIPTION

REVISIONS

DRAWN BY FGS

DEPT. CHECK

PROJ. CHECK

M&E Metcalf & Eddy

REG. PROF. ENGR. _____ DATE _____

SCALE: 1" = 100'

SCALE IN FEET 0 50 100

UNLESS OTHERWISE NOTED OR CHANGED BY REPRODUCTION

PLOT DATE: 5/21/98

KILGORE PROPERTY

1991 SITE INSPECTION MAP

WESTERVILLE, OHIO

JOB 021796-0001

FILE NO. 021796-8

FIGURE 8

OC 015380

- Piles of empty flare canisters, caps, and other metallic objects located on the surface of the site and identified as "hot spots" on the investigation map prepared in 1991 have been removed.
- The underground fuel oil storage tank was removed and soil contamination was removed to concentrations below the BUSTR Category 3 Action Levels.
- Asbestos-containing materials were removed and the house was demolished.
- Groundwater monitoring wells were installed in the area of the burial trenches and samples were collected. The chemical analytical results indicated that there is no impact to the groundwater from the burial area.

7.2 METCALF & EDDY, INC. SITE INSPECTION UPDATE

On April 7, 1998, Gerry Myers, CEP; Mike Raimonde, Project Manager; Jeff Stevenson, Project Geologist; and Todd Aebie, Geologist; conducted a site inspection of the entire Kilgore Farm facility to ascertain the current site conditions. A summary of M&E observations is presented on Table 2. Figure 9 shows the location of key items observed during the site inspection and a photographic log is located in Appendix N.

7.2.1 Former Manufacturing Area

During the site inspection of the former manufacturing area, several items of interest were noted.

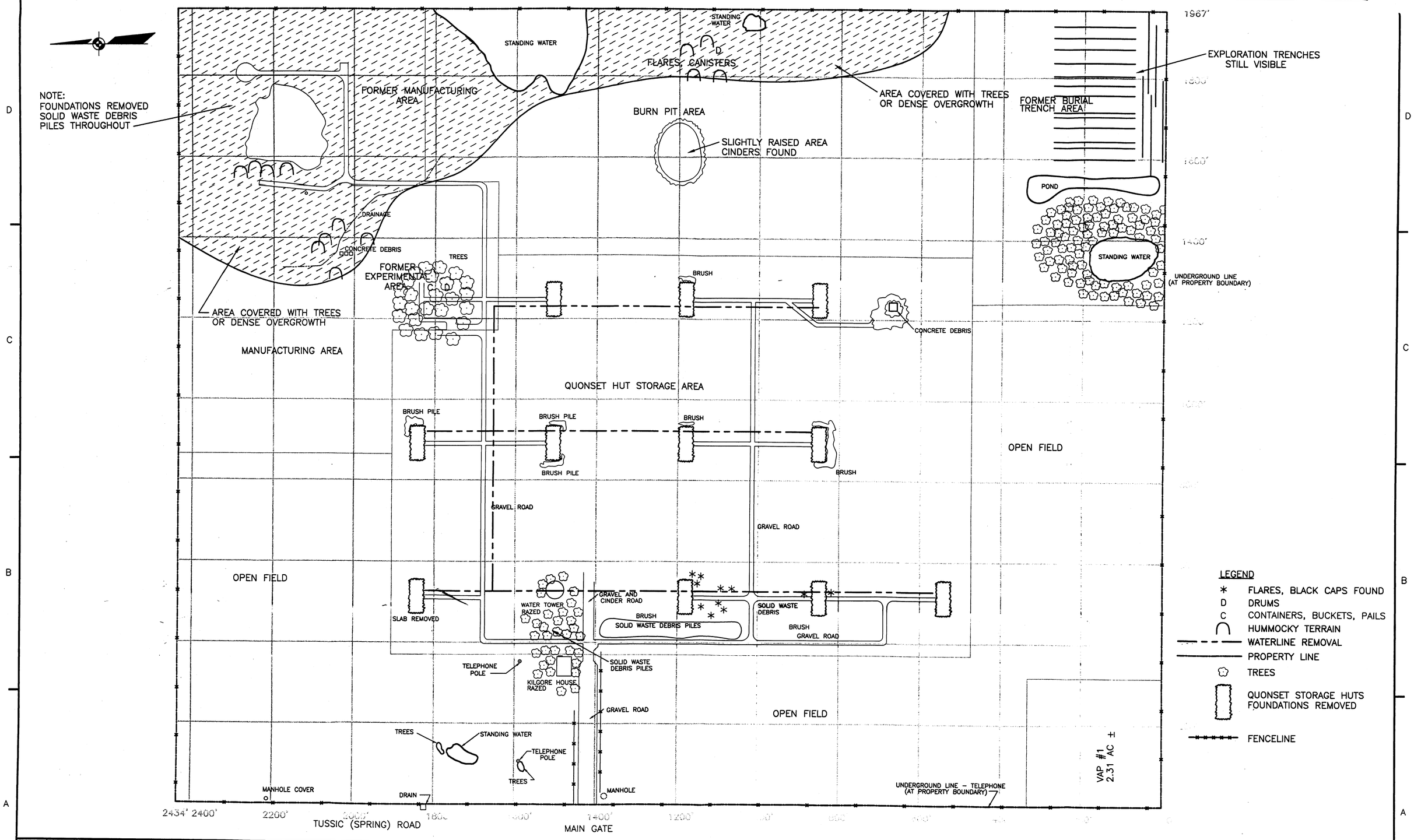
Near the former experimental area six drums were noted. Two of the drums were found to have lids in place. In the immediate vicinity of the drums, numerous 1- to 5-gallon cans, and buckets were observed. Along with these items, piles of demolition debris, such as miscellaneous metal, wood, and plastic, were also observed. The majority of the debris was found immediately adjacent to the old facility roadways and former buildings.

OC 015381

Metcalf & Eddy, Inc. Site Walk Inspection Checklist
Kilgore Farms Site, Westerville, Ohio

Site Inspection Items	Areas of Concern As Identified Through Historical References				
	Manufacturing Area	Storage Area	Fire Pit Area	Disposal Area	Farm / Residence Area
Geologic Conditions	yes	yes	yes	yes	yes
Structures	no	no	no	no	no
Roads	yes	yes	yes	yes	yes
Potable Water	no	no	no	no	no
Sewage Disposal	no	no	no	no	no
Hazardous Substances	unk	unk	unk	unk	unk
Petroleum Products	unk	unk	unk	unk	unk
Storage Tanks	no	no	no	no	no
Odors	no	no	no	no	no
Pools of Liquid	no	no	no	no	no
Drums	yes	no	yes	no	no
Hazardous Substances and Petroleum Containers	yes	no	no	no	no
Unidentified Containers	yes	no	no	no	no
PCBs	no	no	no	no	no
Heating / Cooling	NA	NA	NA	NA	NA
Stains or Corrosion	no	no	no	no	no
Drains and Sumps	no	no	no	no	no
Pits, Ponds, Lagoons	no	no	no	yes	no
Stained Soils	no	no	yes	yes	no
Solid Waste	yes	yes	yes	no	yes
Waste Water	no	no	no	no	no
Wells	no	no	no	no	no
Septic Systems	no	no	no	no	no

NA = not applicable to the site
unk = unknown, but suspect materials observed
no = not observed
yes = observed



NUMBER	DATE	MADE BY	CHECKED BY	DESCRIPTION

REVISIONS

DRAWN BY FGS

DEPT. CHECK

PROJ. CHECK

M&E Metcalf & Eddy

REG. PROF. ENGR. DATE

SCALE: 1" = 100'

SCALE IN FEET 0 50 100

UNLESS OTHERWISE NOTED OR CHANGED BY REPRODUCTION

PLOT DATE: 5/ 19/98

KILGORE PROPERTY

SITE INSPECTION MAP, 1998

WESTERVILLE, OHIO

JOB 021796-0001

FILE NO. 021796-7

FIGURE 9

OC 015383

In the vicinity of the former manufacturing area hummocky piles of earth and piles of miscellaneous debris (metal, wood and plastic) were observed. The majority of the debris was found along the old facility roadways and at the locations of the former buildings.

M&E inspected the drainage ditch that ran between the former manufacturing area and experimental area during the site inspection. The banks of the ditch are hummocky in appearance and a few flare canisters were found. In addition, miscellaneous debris consisting mostly of concrete was observed along the ditch. This area was heavily vegetated.

7.2.2 Former Quonset Hut Area

All of the former Quonset hut locations were inspected during M&E's site visit. The concrete pads and the huts have been removed from the site. Some demolition debris consisting of concrete and brush piles was present around most of the former Quonset hut locations.

In the area around two Quonset huts, located southeast of the former farm house, several empty flare canisters and black caps were observed scattered on the ground surface. This was the area where excavated flares and caps removed from the burial trench area in 1988 were staged prior to disposal. In addition, small brush piles and miscellaneous wood and metal debris were also observed in this area.

With the exception of the small area located near the former farm house, the areas located between most of the Quonset huts was free of debris and there was no evidence of disturbed soils or distressed vegetation.

7.2.3 Former Burn Pit Area

The eastern portion of the property, the former Burn Pit Area, was inspected during the site visit. The approximate area where the burn pit is located on the 1956 and 1957 aerial photographs was noted. A limited amount of cinders and ash-like materials were observed on

OC 015384

the ground surface in the area of the former Burn Pit Area. In addition, the area is slightly elevated as compared to the surrounding ground surface.

In the wooded portion along the eastern edge of the Burn Pit Area, several (approximately 8) rusted, empty drums were noted. In addition, a few empty flare canisters were also observed on the ground surface in the vicinity of the empty drums. None of the flare canisters appeared to contain any materials.

M&E tried to locate the two rectangular features south of the former manufacturing area and the disturbed area along the eastern property line south of the former Burn Pit Area. No evidence of either structure was observed during the site inspection.

7.2.4 Former Burial Trench Disposal Area

M&E inspected the former burial trench disposal area. The site is highly disturbed. Evidence of exploratory trenches installed in 1997 was readily apparent. Traces of several of the trenches were still clearly visible. During the inspection of this area, a few flares, containing a purple colored, granular material, were observed and a few empty flare canisters were observed. No discolored soils or evidence of past wastes were observed.

Three monitoring wells were also observed during M&E's inspection of the former burial trench disposal area. These wells were installed by Lawhon & Associates in 1996 to evaluate any potential impact to the groundwater from the burial area.

7.2.5 Farm and Residence Area

The farm and residence area were inspected during M&E's site visit. The area where the Kilgore farm house and water tower used to stand was observed. The basement of the farm house has been backfilled with stone and soils. The remainder of the area around the house is covered by trees and brush. Brush piles and various metal, wood and plastic debris were

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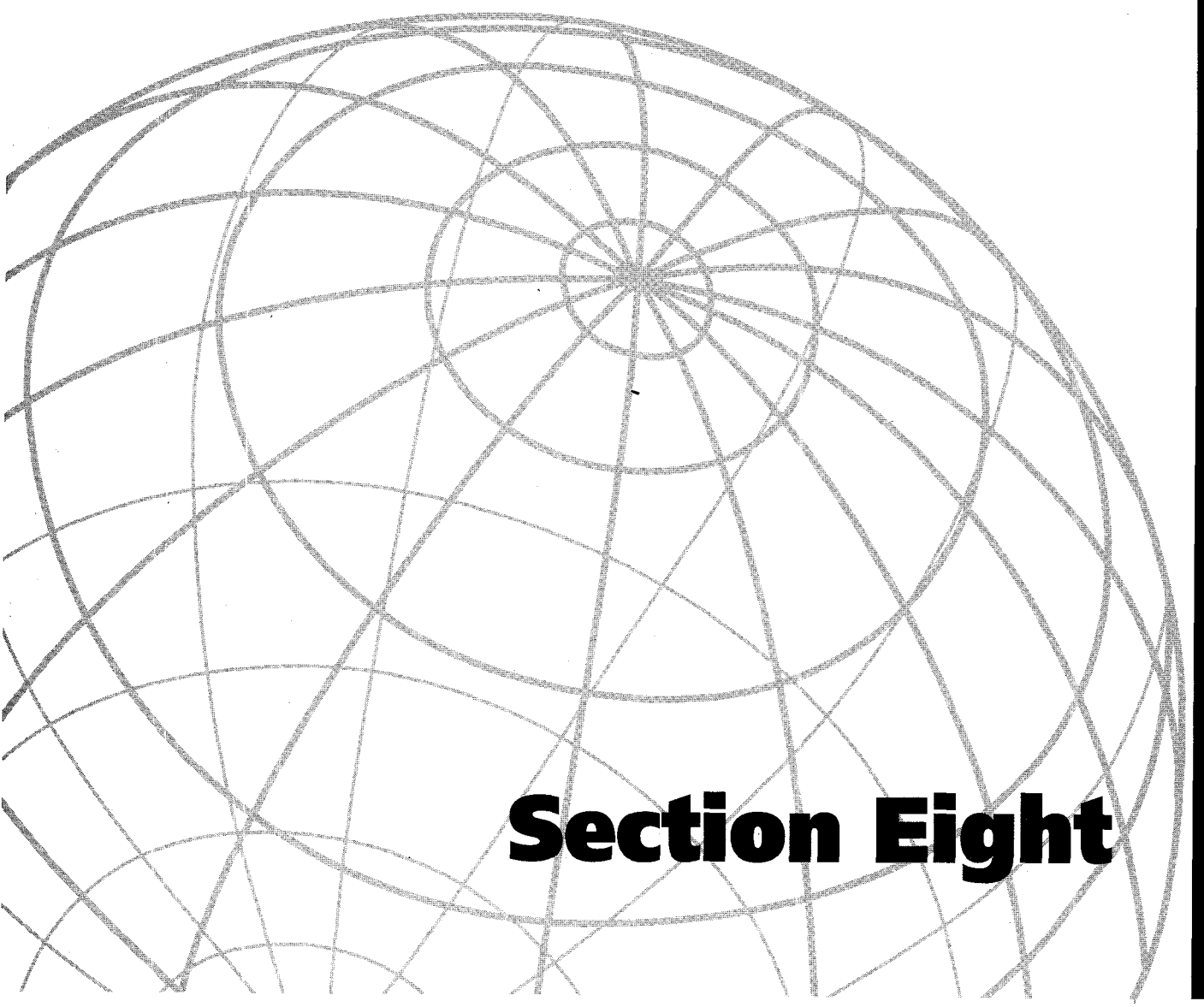

Section Eight

8

OC 015386

8.0 ENVIRONMENTAL SETTING

The Kilgore Farm Property is located within Delaware County in central Ohio. The majority of the land in the County was previously used for farming or not developed until recently. Over the past 10 to 15 years, the City of Westerville has experienced tremendous growth northward into Delaware County. The Kilgore Farm property is located in an area where residential growth is currently occurring.

8.1 REGIONAL GEOLOGY, HYDROGEOLOGY, PHYSIOGRAPHY

The area lies within the Till Plains Section of the Central Lowlands Physiographic Province. Within the Till Plains, the preglacial features are covered by extensive glacial deposits. The topography of the area is characteristically considered to be of low relief with greater relief present near major streams and river valleys.

The bedrock underlying the site consists of the Devonian age, Ohio Shale, Devonian (408 to 360 million years before present). This shale is typically dark gray to black in color, carbonaceous, with very thin laminae to massively bedded. The Ohio Shale in the area can range up to 400 to 500 feet thick. Outcrops in the area are common due to the valleys created during previous continental glaciation.

The regional flow of groundwater in the area is to the east - southeast. Groundwater wells completed in the shale usually have typical yields of less than 5 gallons per minute. Most wells in the area are completed in the overlying glacial overburden, where sand and gravel lenses may locally produce yields sufficient for single residential use.

8.2 KILGORE FARM PROPERTY GEOLOGY AND HYDROGEOLOGY

Ground surface elevations range from approximately 898 to 890 feet above mean sea level (msl) from west to east across the site. According to the Drift Thickness Map of Delaware

OC 015387

County (Vormelker, 1982) there is approximately 50 feet of glacial drift above the bedrock. The shale bedrock is at an elevation of 840 to 850 feet msl (Bedrock Topography Map of Delaware County, Vormelker, 1982). The overlying unconsolidated sediments encountered at the site consist of glacial deposits composed of thin lenses of silty to clayey sand, ranging from less than 0.5 to 2.0 inches thick. These sands are interbedded with thick clay-rich till deposits. Wells in the area of the site are generally completed in the sand and gravel lenses found in the glacial till.

Surface soils at the site consist of brown weathered silty clay, with varying amounts of sand and trace amounts of gravel and shale fragments. The weathered soil horizon extends from the surface to approximately ten feet below the ground surface. Beneath the weathered soils, the unweathered soils are of the same composition but are gray in color.

Four monitoring wells were installed in the southern portion of the site by a previous consultant to determine if the groundwater was being impacted from the past burial activities. The well logs are provided in Appendix N. Attempts were made to construct a potentiometric map across the site from the groundwater elevations gathered from these wells. Because the wells were screened in discontinuous sand seams, a meaningful potentiometric map could not be drawn. The discontinuous sand lenses produce limited yields of water and can be purged dry rather quickly.

8.3 CLIMATE

Delaware County is cold in the winter and warm to hot in the summer. The average winter temperature is 31 degrees Fahrenheit while the average summer temperature is 72 degrees F. The prevailing wind is from the south-southwest with an average wind speed of 11 miles per hour.

The total annual precipitation for Delaware County is approximately 38 inches. Of the total amount of precipitation, 22 inches, or 60 percent, usually falls in the period of April through

OC 015388

September, which is the growing season for most crops. The average annual snowfall is 28 inches, which occurs from late November until early March.

8.4 SURFACE WATER

There are no permanently flowing rivers or streams on the Kilgore Farm Property. There is a drainage ditch on the northern portion of the property which has some surface water flow in times of precipitation. The flow in the ditch is from the northwest to the southeast. Additionally, ponded surface water occurs on the southern portion of the property. Aerial photographs prior to 1964 do not show the ponded water bodies. It is surmised that low areas may have been created during closure of the site or during decontamination activities.

Small wetland areas have been identified and delineated on two portions of the Kilgore Farm Property. One of the areas (1.3 acres in size) is located along the southern property line just west of the former burial trench area. The other area (approximately 4.0 acres) is located along the northeast property line just south of the former manufacturing area

Hoover Reservoir, located approximately 2,000 feet east of the site, is the nearest surface water body to the Kilgore Farm site. There are no direct drainage ways that connect Kilgore Farm to the Reservoir.

OC 015389

Section Nine

OC 015390

9.0 POTENTIAL MIGRATION PATHWAYS

There is limited potential for contaminant migration at the Kilgore Farm Property. The clay rich nature of thick glacial overburden present at the site would retard the vertical movement of any potential contaminants and ground water occurs only in discontinuous, thin sand seams at the site. Furthermore, the types of potential contaminants that would be associated with the past operations of the site consist of inorganic compounds that would typically oxidize and become immobile.

However, there were some subsurface utilities present at the site in past and there are currently subsurface utilities located along the western property boundary.

9.1 POTENTIAL MIGRATION PATHWAYS PRESENT DURING KILGORE OPERATIONS

During operations at the Kilgore Site, from 1941 until 1961, water and possible steam lines were located underground at the site. The water lines ran from the water tower to each of the Quonset storage huts. The waterline ran north to south, east along the northern access road and branched off to run south to the Quonset storage huts. The waterline provided the huts with fire suppression and potable water. In addition to the waterlines, Mr. Day stated that steam or heating lines ran to each of the Quonset storage huts from the farm house. These lines may also have acted as a conduit for migration of contaminates. These lines were excavated and removed in 1996 by Lawhon and Associates. No evidence of contamination was reported by Lawhon and Associates (Appendix P).

Within the manufacturing area, there may have been underground steam heating lines from the boiler building to the other buildings. In addition, a small septic system may have been used in that area of the facility. These lines have been removed by Lawhon and no evidence of contamination was reported by Lawhon (Appendix P).

OC 015391

Electric and telephone at the Kilgore Farm Property were brought in by overhead wires.

9.2 CURRENT POTENTIAL MIGRATION PATHWAYS

Since decommissioning of the Kilgore Farm site in 1961, substantial development has occurred in southern Delaware County. To keep up with development, the County and the City of Westerville have provided utilities to newly developed areas. Along Spring Street, waterlines, sewer lines, and telephone lines have been installed below the ground surface. These utilities run parallel to the portions of the property that were continually farmed during operations at the Kilgore site. Therefore, there is no migration potential for contaminants present at the Kilgore Site to migrate along these lines.

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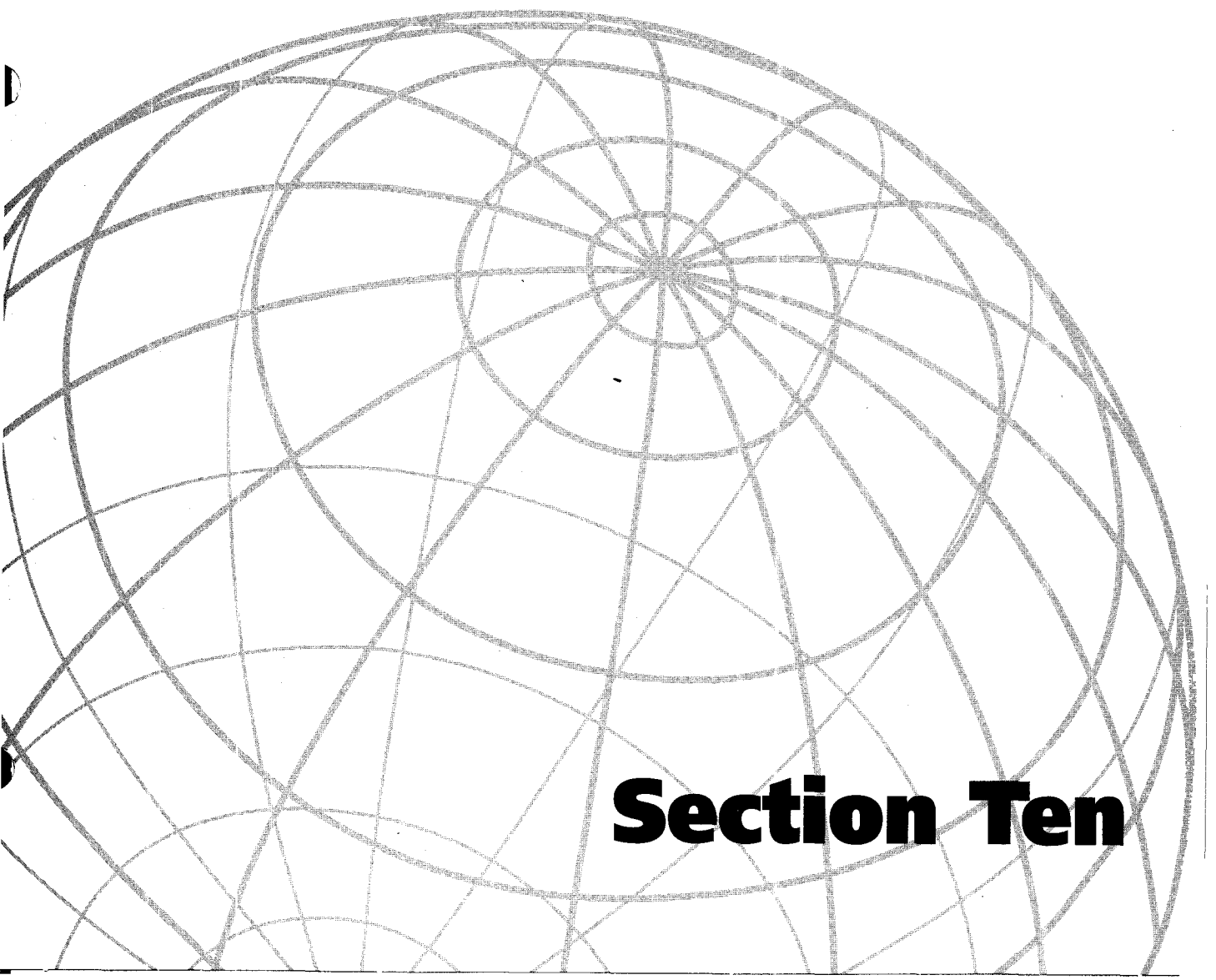

Section Ten

OC 015393

10.0 IDENTIFICATION OF AREAS OF CONCERN

Based on the review of historical operations, aerial photographs, previous environmental investigations, and interviews with former Kilgore employees, 14 potential areas of concern (AOCs) have been identified at the former Kilgore Farm property. The AOCs identified, the chemicals of concern, the media of concern, and recommended actions are listed on Table 3.

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AREAS [illegible]ONCERN
KILGORE FARM, WESTERVILLE, OHIO

KILGORE AREA	IDENTIFIED AREA	CHEMICALS OF CONCERN	MEDIA OF CONCERN	REQUIRED ACTIONS	RECOMMENDED ACTIONS
MANUFACTURING AREA	Underground Storage Tank and Manufacturing Area	VOCs (UST) Perchlorate/Chlorate Nitrate/Nitrite PAHs (UST) Metals	Soil Groundwater	Yes Yes	Shallow Soil Borings (7) Monitoring Well Installation and Sampling(1 Well)
MANUFACTURING AREA	Drainage Ditch	Metals Nitrate/Nitrite Sulfide/Sulfate Perchlorate/Chlorates Thyocyanate Ignitability	Soil Groundwater	Yes Yes	Exploratory Trenching (2 @ 300 feet each) 5 samples from each Trench Monitoring Well Installation and Sampling(1 well)
MANUFACTURING AREA	Discarded Drums and Cans and Experimental Area	VOCs/SVOCs Chlorides Metals Ignitability	Soil Groundwater Drums	Yes No Yes	Soil Borings (7 shallow borings) Testing and Off Site Disposal
MANUFACTURING AREA	Round Feature (West of Manufacturing Area)	VOCs/SVOCs Chlorides Metals Ignitability	Soil Groundwater	Yes No	Soil Borings (2 shallow borings, 1 deep boring)
FORMER BURN PIT AREA	Burn Pit Area	Metals Nitrate/Nitrite Sulfide/Sulfate Perchlorate/Chlorate Thyocyanate Ignitability	Soil Groundwater	Yes Yes	Soil Borings (4 borings to 25 feet) Monitoring Well Installation and Sampling (1 well)
FORMER BURN PIT AREA	Disturbed Area South of Main Area	Metals Nitrate/Nitrite Sulfide/Sulfate Perchlorates/Chlorates Thyocyanate Ignitability	Soil Groundwater	Yes No	Soil Borings (2 Shallow borings)
FORMER BURN PIT	Cinder Area	Metals Nitrate/Nitrite Sulfide/Sulfate Chloride Ignitability	Soil Groundwater	Yes No	Soil Borings (2 Shallow borings)
FORMER BURN PIT	Rectangular Features (South of Manuf. Area)	Metals Nitrate/Nitrite Sulfide/Sulfate Perchlorates/Chlorates Thyocyanate Ignitability	Soil Groundwater	Yes Yes	Exploratory Trenching (3@100 feet each) 2 Samples from each trench Monitoring Well Installation and Sampling (1 well)

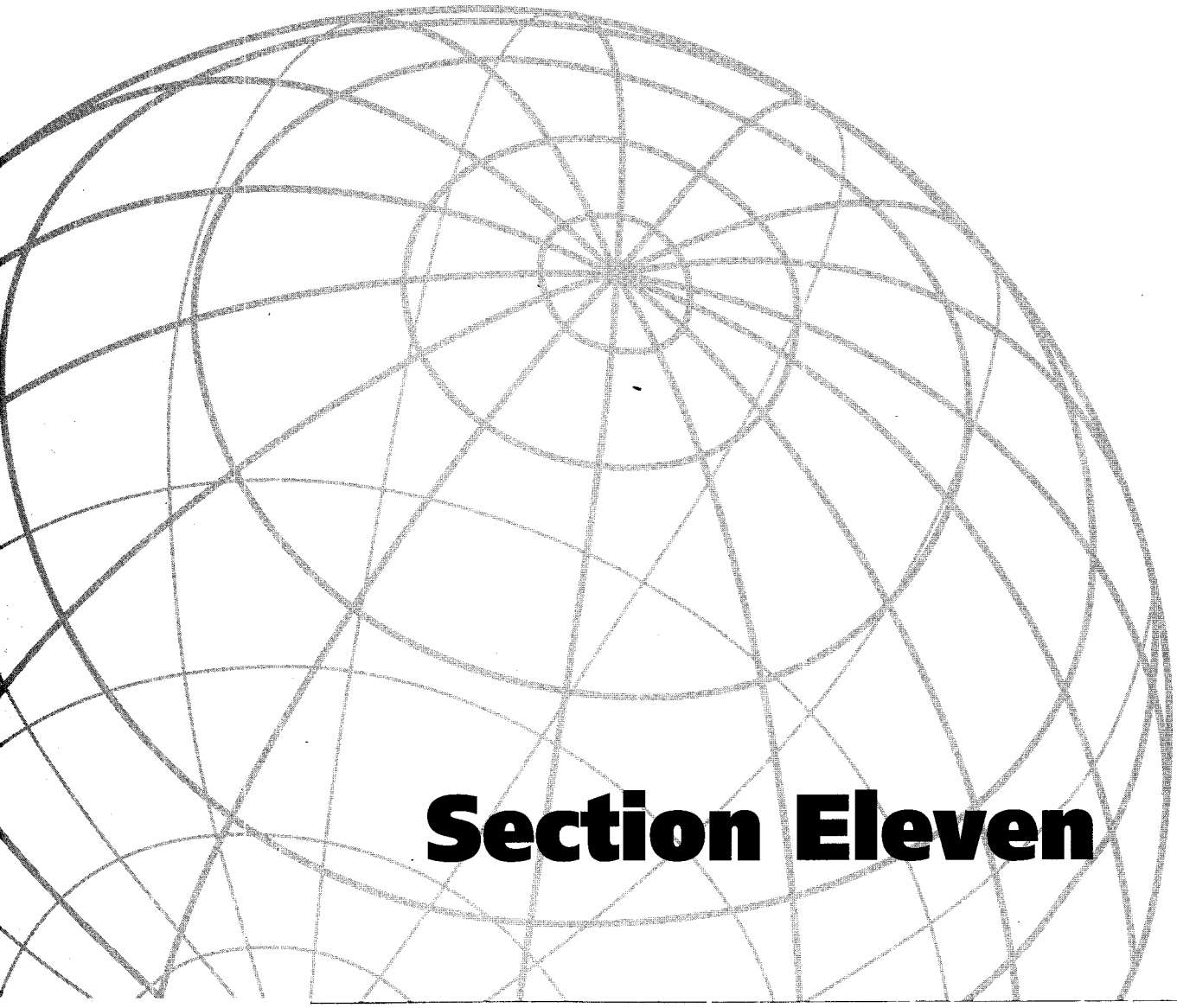
TABLE 3 (Continued)

OC 015395

AREAS ONCERN
KILGORE FARM STERVILLE, OHIO

KILGORE AREA	IDENTIFIED AREA	CHEMICALS OF CONCERN	MEDIA OF CONCERN	REQUIRED ACTIONS	RECOMMENDED ACTIONS
FORMER BURN PIT AREA	Disturbed Area (South East of Burn Pit)	Metals Nitrate/Nitrite Sulfide/Sulfate Perchlorates/Chlorates Thyocyanates Ignitability	Soil Groundwater	Yes Yes	Exploratory Trenching (2@ 100 feet each) Soil Sampling 2 per trench Monitoring Well Installation and Sampling (1 well)
FORMER BURN PIT AREA	Discarded Drums and Cans	VOCs SVOCs Metals Chlorides	Soil Groundwater Drums	Yes No Yes	Soil Borings (7 shallow borings) Testing and Off Site Disposal
QUONSET HUT AREA	Huts	Metals Nitrate/Nitrite Sulfide/Sulfate Chloride	Soil	Yes	Shallow Soil Borings - 2 at each
QUONSET HUT AREA	Scattered Flares on Surface	Metals Nitrate/Nitrite Sulfide/Sulfide Perchlorates/Chlorates	Soil	Yes	Pick up and dispose of empty flare casings and black caps. Hand auger samples (4)
FARM AREA	None	Herbicides Pesticide Metals Chlorides	Soil	Yes	Hand Auger Sampling (6)
BURIAL TRENCH AREA	Burial Trench Area	Metals + Hg Nitrate/Nitrite Sulfide/Sulfate Perchlorates/Chlorates Thyocyanates	Soil Groundwater	Yes Yes	Waste Characterization Sample 3 existing wells

OC 015396



Section Eleven

OC 015397

11.0 STATEMENT OF LIMITATIONS

The data present and the opinions expressed in the report are qualified as follows:

1. The sole purpose of the investigation and of this report is to assess the physical characteristics of the Site with respect to the presence or absence in the environment of oil or hazardous materials substances, as defined in the applicable state and federal environmental laws and regulations, and to gather information regarding current and past environmental conditions at the Site.

2. Metcalf & Eddy, Inc. (M&E) derived the data in the report primarily from visual inspections and examination of records in the public domain, and interviews with individuals with information about the Site. The passage of time, manifestation of latent conditions or occurrence of future events may require further exploration at the site, analysis of the data, and re-evaluation of the findings, observations and conclusions expressed in the report.

3. In preparing the report, M&E has relied upon and presumed accurate certain information (or the absence thereof) about the Site and adjacent properties provided by governmental officials and agencies, the Client, and others identified herein. M&E has not attempted to verify the accuracy or completeness of any such information.

4. The data reported and the findings, observations and conclusions expressed in the report are limited by the Scope of Services.

5. Because of the limitations stated above, the findings, observations and conclusions expressed by M&E in the report are not, and should not be considered an opinion concerning the compliance of any past or present owner or operator of the Site with any federal, state or local law or regulation. No warranty or guarantee, whether express or implied, is made with respect to the data reported or findings, observations and

OC 015398

conclusions expressed in the report. Further, such data, findings, observations and conclusions are based solely upon Site conditions in existence at the time of investigation.

6. The report has been prepared on behalf of and for the exclusive use of the Client, and is subject to and issued in connection with the Agreement and the provisions thereof.

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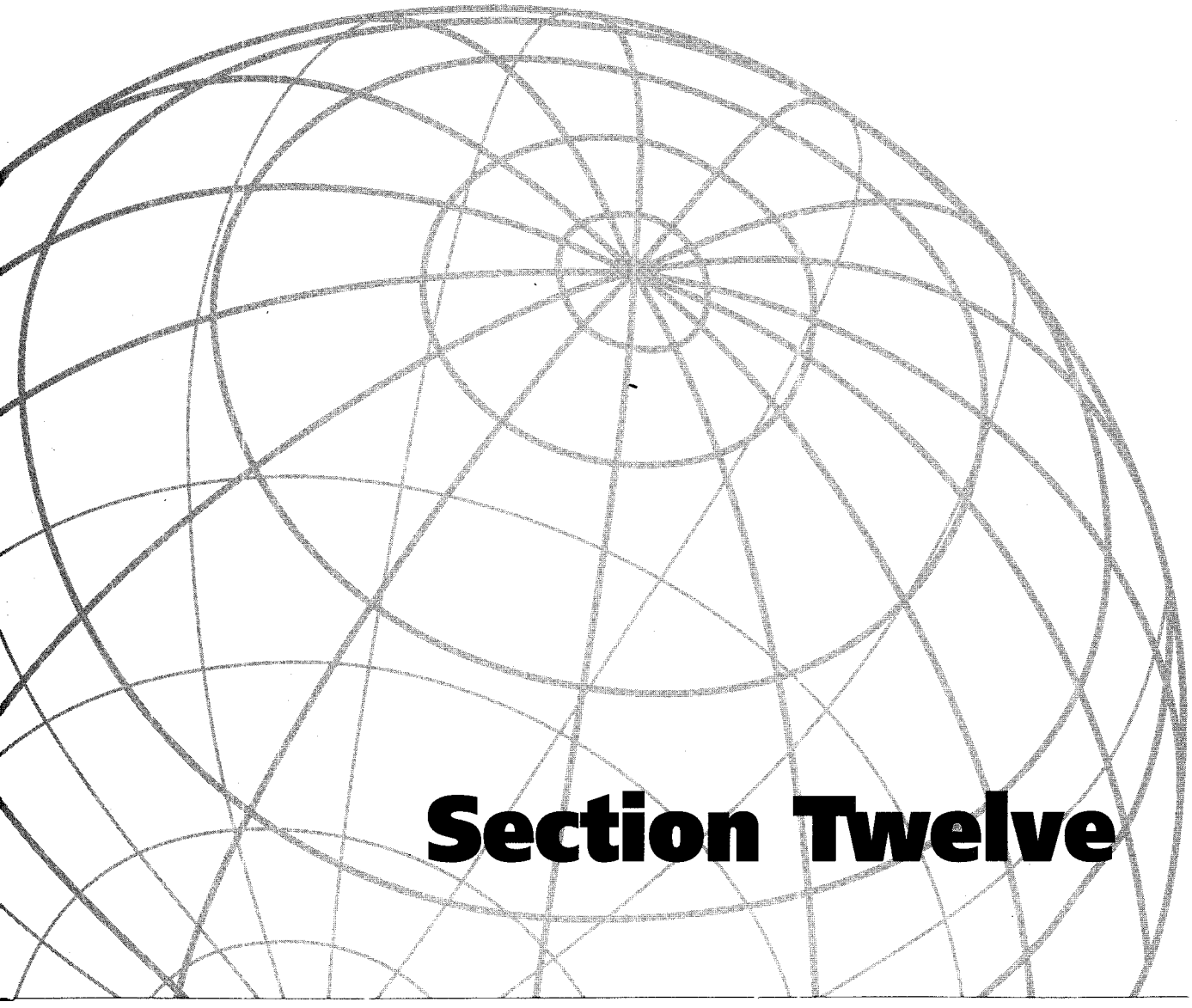

Section Twelve

12

12.0 FINDINGS AND CONCLUSIONS

Based on literature reviewed related to the manufacturing and formulation of pyrotechnics and interviews with past employees of Kilgore, the primary chemicals of concern identified at the Site are predominately inorganic compounds, most of which are readily degraded when exposed to the environment.

However, upon the review of historical operations, aerial photographs, previous environmental investigations, and interviews with former Kilgore employees, there is sufficient evidence of potential environmental impacts and on site disposal to warrant a Phase II Investigation at the former Kilgore Farm Property.

OC 015401

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OC 015402

Appendix A