USACHPPM

U.S. Army Center for Health Promotion and Preventive Medicine

HAZARDOUS AND MEDICAL WASTE STUDY NO. 37-EF-5360-97
RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
28 OCTOBER - 1 NOVEMBER 1996

VOLUME I

Readiness Thru Health

U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE

The U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) lineage can be traced back over a half century to the Army Industrial Hygiene Laboratory which was established at the beginning of World War II under the direct jurisdiction of The Army Surgeon General. It was originally located at the Johns Hopkins School of Hygiene and Public Health with a staff of three and an annual budget not to exceed three thousand dollars. Its mission was to conduct occupational health surveys of Army-operated industrial plants, arsenals, and depots. These surveys were aimed at identifying and eliminating occupational health hazards within the Department of Defense's (DOD) industrial production base and proved to be extremely beneficial to the Nation's war effort.

Most recently, the organization has been nationally and internationally known as the U.S. Army Environmental Hygiene Agency (AEHA) and is located on the Edgewood area of Aberdeen Proving Ground, Maryland. Its mission had been expanded to support the worldwide preventive medicine programs of the Army, DOD and other Federal agencies through consultations, supportive services, investigations and training.

On 1 August 1994, the organization was officially redesignated the U.S. Army Center for Health Promotion and Preventive Medicine and is affectionately referred to as the CHPPM. As always, our mission focus is centered upon the Army Imperatives to that we are optimizing soldier effectiveness by minimizing health risk. The CHPPM's mission is to provide worldwide scientific expertise and services in the areas of:

- Clinical and field preventive medicine
- Environmental and occupational health
- Health promotion and wellness
- Epidemiology and disease surveillance
- Related laboratory services

The Center's quest has always been one of customer satisfaction, technical excellence and continuous quality improvement. Our vision is to be a world-class center of excellence for enhancing military readiness by integrating health promotion and preventive medicine into America's Army. To achieve that end, CHPPM holds everfast to its core values which are steeped in our rich heritage:

- Integrity is our foundation
- Excellence is our standard
- Customer satisfaction is our focus
- Our people are our most valuable resource
- Continuous quality improvement is our pathway

Once again, the organization stands on the threshold of even greater challenges and responsibilities. The CHPPM structure has been reengineered to include General Officer leadership in order to support the Army of the future. The professional disciplines represented at the Center have been expanded to include a wide array of medical, scientific, engineering, and administrative support personnel.

As the CHPPM moves into the next century, we are an organization fiercely proud of our history, yet equally excited about the future. The Center is destined to continue its development as a world-class organization with expanded preventive health care services provided to the Army, DOD, other Federal agencies, the Nation, and the world community.

DEPARTMENT OF THE ARMY
U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

EXECUTIVE SUMMARY
HAZARDOUS AND MEDICAL WASTE STUDY NO. 37-EF-5360-97
RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
28 OCTOBER - 1 NOVEMBER 1996

1. PURPOSE. The purpose of this study is to provide sufficient data to score Ravenna Army Ammunition Plant's previously uninvestigated sites, which are Defense Environmental Restoration Account (DERA)-eligible, according to the Relative Risk Site Evaluation (RRSE) guidelines. This study is not a Preliminary Assessment/Site Investigation (PA/SI), a Remedial Investigation (RI), or a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI). Data generated during this project will be used for program management purposes only, specifically to determine the order in which remedial/corrective activities will take place on an Army-wide basis. These data are minimal Level III data, as defined by the U.S. Environmental Protection Agency (USEPA), and are not intended to be used as definitive evidence of contamination presence or absence or to support quantitative health risk assessment.

2. CONCLUSIONS.

a. As of December 1996, 21 Ravenna Army Ammunition Plant (RVAAP) sites are listed in the Defense Site Environmental Restoration Tracking System (DSERTS) database, and the Installation Action Plan (IAP), as 'Not Evaluated.' Two additional sites RVAAP-23 and RVAAP-30 should be in the database, and are DERA-eligible, but are not included on the list. They were evaluated during this RRSE.

b. Four of the sites, RVAAP-10, RVAAP-12, RVAAP-13, and RVAAP-19 have already been funded for RI or other detailed environmental study and do not require any additional response in this RRSE. These sites therefore should be scored from data collected from the other environmental studies.

c. Using the RRSE criteria, four of these 19 sites evaluated scored High. These sites are RVAAP-02, Eire Burning Grounds; RVAAP-16, Quarry Landfill/Pond; RVAAP-33, Firestone Test Facility; and RVAAP-34, Sand Creek Disposal Landfill.

d. Of the remaining 15 sites evaluated, seven scored Medium and eight scored Low.

e. Stakeholder input, the final phase of the RRSE process, was not included as part of this investigation.

f. The IAP should be updated to reflect the finalized RRSE scores for the sites addressed in this report.

3. RECOMMENDATIONS. Seek stakeholder input from on-post, off-post, and regulatory parties prior to finalization of these RRSE scores. Update the IAP, as appropriate.

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VOLUME II

ANALYTICAL RESULTS

DEPARTMENT OF THE ARMY
U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

MCHB-DC-EHM

HAZARDOUS AND MEDICAL WASTE STUDY NO. 37-EF-5360-97
RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
28 OCTOBER - 1 NOVEMBER 1996

1. AUTHORITY. USACHPPM Form 250-R, Request for Service, Army Material Command, 24 April 1996.

2. REFERENCES. Appendix A contains a list of references used while preparing this report.

3. PURPOSE. The purpose of this study is to provide sufficient data to score Ravenna Army Ammunition Plant's (RVAAP's) previously uninvestigated sites, which are Defense Environmental Restoration Account (DERA)-eligible, according to the Relative Risk Site Evaluation (RRSE) guidelines. This study is not a Preliminary Assessment/Site Investigation (PA/SI), a Remedial Investigation (RI), or a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI). Data generated during this project will be used for program management purposes only, specifically to determine the order in which remedial/ corrective activities will take place on an Army-wide basis. These data are minimal Level III data, as defined by the U.S. Environmental Protection Agency (USEPA) (reference 1), and are not intended to be used as definitive evidence of contamination presence or absence or to support quantitative health risk assessment.

4. GENERAL.

a. Personnel. The Project Officer for this study is James Sheehy of the U.S. Army Center for Heath Promotion and Preventive Medicine (USACHPPM), Hazardous and Medical Waste Program (HMWP). Mr. Rocky Hoover and Mr. Robert DeSocio, USACHPPM Ground Water and Solid Waste Program, also assisted with this project.

b. Personnel Contacted.

(1) Mr. John A. Cicero, Jr., Commander's Representative; Mr. Tim Morgan, Forester; and Ms. Vicki Record, Management Assistant, RVAAP.

(2) Mr. William Talmon and Mr. James McGee, Mason and Hanger Corporation, Operating Contractor, RVAAP.

(3) Mr. Robert Whelove, U.S. Army Industrial Operations Command.

(4) Ms. Eileen Mohr, State of Ohio Environmental Protection Agency.

c. Background.

(1) The current Defense Environmental Restoration Program (DERP) management guidance requires that all sites eligible for cleanup must be scored and ranked to determine the degree of potential risk in relation to other Defense Environmental Restoration Account (DERA)-eligible cleanup sites prior to the allocation of remediation funding (reference 2). This process combines information about the level of contamination, the possibility of contamination migration, and the probability that the contamination will be contacted by people and by ecologically sensitive areas, to qualitatively address the risk each site potentially presents. In this manner, all Army sites may be compared on a uniform scale to facilitate a 'worst-first' allocation of funds. This process does not address the quantitative level of human health or ecological risk as defined in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. As a result, a 'high' relative risk score does not indicate a direct risk to human health and the environment exists, and a 'low' relative risk score does not indicate that the site does not warrant investigation.

(2) The U.S. Army Environmental Center maintains the Defense Site Environmental Restoration Tracking System (DSERTS) to track the Army's environmental sites and their status. At the installation level, the Installation Action Plan (IAP) describes all environmental restoration sites on the installation, their status, and projected future activities. As of December 1996, Ravenna Army Ammunition Plant has 21 sites delineated in the DSERTS database, and their IAP, as 'Not Evaluated,' meaning that a RRSE has not been accomplished. Of those 21 sites, four: RVAAP-10, RVAAP-12, RVAAP-13, and RVAAP-19 have already been funded for RI or other detailed environmental study and do not require any additional response in this RRSE. These sites therefore should be scored from data collected from the other environmental studies. Two sites are not included in the December 1996 DSERTS listing: RVAAP-23 and RVAAP-30. Both of these sites are 'not evaluated,' are DERA-eligible, and should be included in the list. The 19 sites to be evaluated are addressed below.

5. DISCUSSION OF FINDINGS.

a. Evaluation Framework. Guidance for the completion of RRSE scoring is contained in the Relative Risk Site Evaluation Primer (reference 3). This guidance defines six environmental media of concern for site evaluations. These media are ground water (human

endpoint), surface water (human endpoint), sediment (human endpoint), surface soil (human endpoint), surface water (ecological endpoint), and sediment (ecological endpoint). Each of these media are to be evaluated when appropriate, assessing the level of relative contamination, contaminant migration potential, and possible receptors of the contaminant. The final 'relative rank' for a site is then a combination of these components. These building blocks of the RRSE process and their relation to RVAAP's 'not evaluated' sites are described in more detail below. The final phase of the RRSE process is input from stakeholders, including on-post, off-post, and regulatory interests. This phase is not addressed in this report since it can be best handled by installation personnel.

(1) Media Evaluated.

(a) Ground Water (Human Endpoint). Shallow ground water exists on RVAAP. The depth to ground water in the primary bedrock aquifer is between 3 and 60 feet below the surface. In addition, ground water can also be found in unconsolidated geologic materials at RVAAP. The ground water on RVAAP was used for industrial and drinking water production at the installation through the 1980's, but is no longer used for any purpose (reference 4). Due to the potential for ground water migration of contaminants from RVAAP-23, RVAAP-26, and RVAAP-35 to reach receptors, this pathway was evaluated based on collected ground-water data at RVAAP-26. Subsurface soil data, using a standard linear equilibrium soil/water partition equation (to estimate contaminant release as soil leachate) and a dilution factor (to account for dilution of the leachate as it enters the aquifer), was used to evaluate RVAAP-23 and RVAAP-35 since recoverable ground water was not found during the sampling. This method is consistent with the derivation of soil screening levels and the investigation and modeling efforts conducted at Superfund sites to develop soil cleanup goals and ground-water protection goals (references 5 and 6). The ground-water pathway may be present at RVAAP-28 but, due to the extreme hazard associated with potential chemical warfare agents, was not evaluated during this study.

(b) Surface Water (Human Endpoint). Leachate or soil transported by runoff may result in contamination of surface water which may then be available to contact receptors. Surface water is only present at the following three locations: RVAAP-02, RVAAP-16, and RVAAP-33. Both the RVAAP-34 and RVAAP-36 sites have a creek running through or adjacent to the site, but due to the rapid turn-over in the surface water, sediment was the most appropriate media to sample. RVAAP-38 has an intermittent stream on the northwest perimeter of the site, but sediment was the most appropriate media to sample.

(c) Sediment (Human Endpoint). Similarly, leachate or soil transported by runoff may result in contamination of sediments associated with site surface water. Sediments were evaluated for human endpoints at RVAAP-02, RVAAP-16, RVAAP-33, RVAAP-34, RVAAP-36, and RVAAP-38.

(d) Surface Soil (Human Endpoint). The RVAAP climate is continental and most areas have vegetative covering, but there are still areas where the surface soil is exposed. Due to the potential for either pedestrian traffic (e.g., hunters, fishermen, Ohio National Guard soldiers) on or near study areas, the surface soil pathway is considered complete for 17 of 19 locations. This pathway is not considered complete for the following sites: RVAAP-02 and RVAAP-16. These areas are completely covered by surface water.

(e) Surface Water (Ecological Endpoint). The Primer states that surface water should only be evaluated for ecological endpoints when the surface water is part of a critical habitat or a specifically listed environment (reference 3). The surface water associated with RVAAP-02, RVAAP-16, and RVAAP-33 does not meet this requirement. Therefore, surface water was not evaluated for ecological endpoints.

(f) Sediment (Ecological Endpoint). Similarly, the Primer states that sediments should only be evaluated for ecological endpoints when the sediments are part of a critical habitat or a specifically listed environment. The sediments associated with RVAAP-34, RVAAP-36, and RVAAP-38 do meet this requirement. Therefore, sediments were evaluated for ecological endpoints.

(2) Contaminant Hazard Factor Determination. The level of contamination present at a site is evaluated by comparing the maximum contaminant concentrations measured to corresponding standards listed in the Primer's (reference 1) Appendix B. The ratio of measured concentration to standard concentration is calculated for each contaminant identified. The contaminant hazard factor (CHF) can then be determined by computing the sum of ratios for all identified contaminants and comparing this number to standard values. For ratio sums less than 2, the CHF is *minimal*. For ratio sums from 2 to 100, the CHF is *moderate*. For ratio sums greater than 100, the CHF is *significant*.

(3) Migration Pathway Factor Determination. The migration pathway factor (MPF) is a qualitative measurement of the possibility a contaminant may move from the identified site to a point allowing exposure. An MPF of *evident* means the contamination is known to have moved away from the source toward a point of exposure. An MPF of *confined* means that movement of the contaminant from the source has been restricted in some manner. An MPF of *potential* means that there is no indication that contamination has spread, but the source of contamination has not been confined.

(4) Receptor Factor Determination. The receptor factor (RF) is a qualitative measure of the potential for either humans or plants and animals (depending on the media being evaluated) to come into contact with the contamination. An RF of *identified* means that a known population contacts the contamination. An RF of *limited* means it is unlikely anyone would come into contact with the contamination. An RF of *potential* means there are no identified populations to contact the contamination, but the source is not restricted from access.

(5) RRSE Score. The CHF, the MPF and the RF are combined to determine the overall relative risk a site may pose and thus the relative priority of the site for action. The following Figure displays the decision flowchart from the Primer, which governs the assignment of the overall RRSE Score. All site evaluations contained in this study follow this decision flow chart.

b. Sampling Plan Modifications. The Sampling Plan and the Site Safety and Health Plan governing this study are contained in Appendix B. The only significant modification to the Sampling Plan is that ecological receptors are not present throughout the installation. They are only present at RVAAP-34, RVAAP-36, and RVAAP-38. The exact number of samples collected at each site is identified in the Site Scoring Worksheets located in Appendix C. Appendix D contains a listing of sample numbers and their associated sites as well as all analytical data in Volume II of this report.

c. Site Scores. Nineteen sites were evaluated using the sampling data collected and the evaluation framework described above. An RRSE Site Scoring Worksheet has been prepared for each site detailing the scoring procedure. These sheets are contained in Appendix C. The scoring results are shown in the following Table. The following four sites scored High: RVAAP-02, RVAAP-16, RVAAP-33, and RVAAP-34. Of the remaining 15 sites, seven scored Medium and eight scored Low, as shown.

6. CONCLUSIONS.

a. As of December 1996, 21 RVAAP sites are listed in the DSERTS database, and the IAP, as 'Not Evaluated.' Two additional sites, RVAAP-23 and RVAAP-30, should be in the database, and are DERA-eligible, but are not included on the list. They were evaluated during this RRSE.

b. Four of the sites, RVAAP-10, RVAAP-12, RVAAP-13, and RVAAP-19, have already been funded for RI or other detailed environmental study and do not require any additional response in this RRSE. These sites, therefore, should be scored from data collected from the other environmental studies.

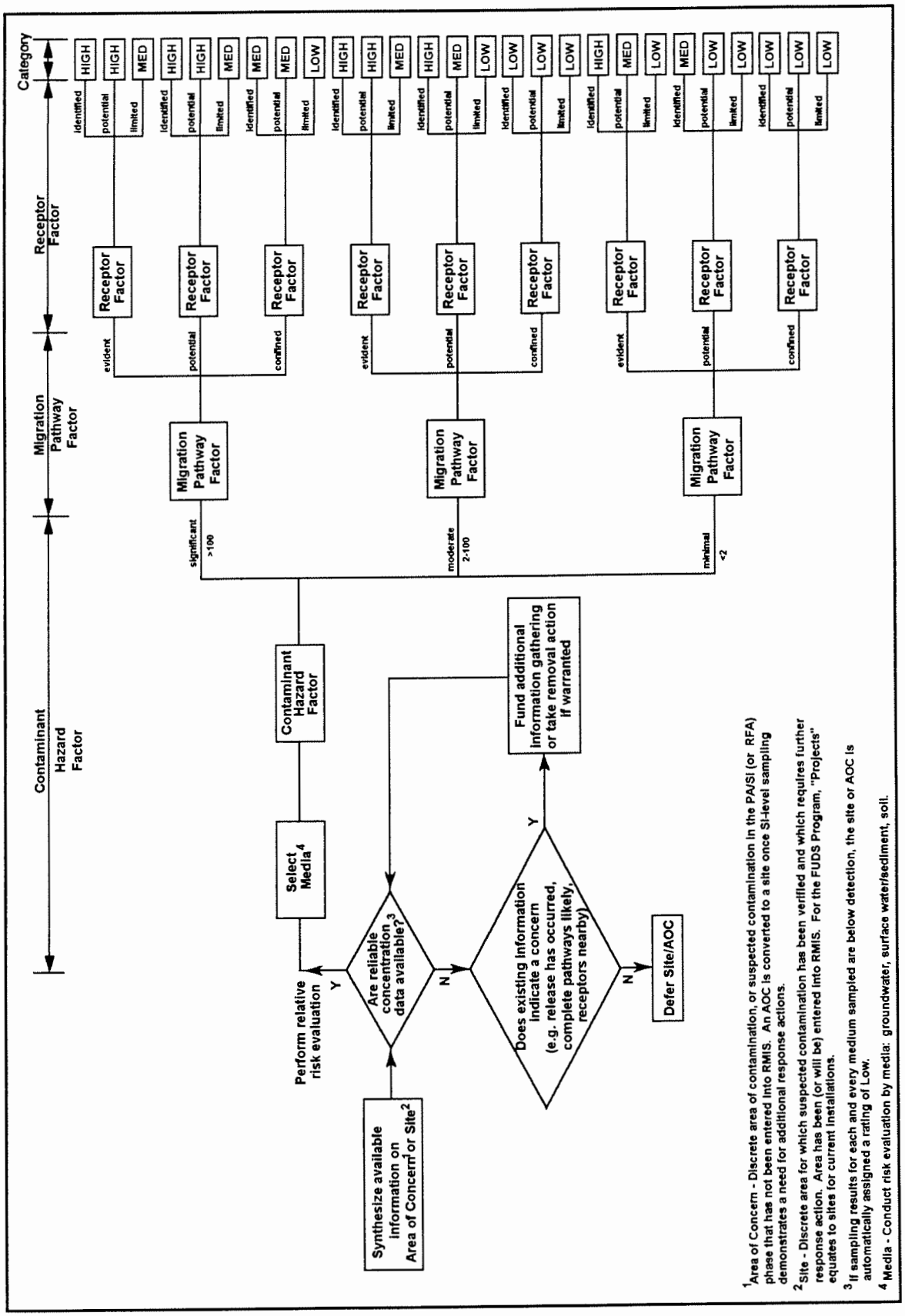
Contaminant Hazard Factor
Migration Pathway Factor
Receptor Factor
Category
Synthesize available information on Area of Concern[1] or Site[2]
Are reliable concentration[3] data available?
Y
N
Perform relative risk evaluation
Select Media[4]
Contaminant Hazard Factor
Does existing information indicate a concern (e.g. release has occurred, complete pathways likely, receptors nearby)
Y
N
Fund additional information gathering or take removal action if warranted
Defer Site/AOC
significant >100
moderate 2-100
minimal <2
evident
potential
confined
identified
potential
limited
HIGH
MED
LOW
[1] Area of Concern - Discrete area of contamination, or suspected contamination in the PA/SI (or RFA) phase that has not been entered into RMIS. An AOC is converted to a site once SI-level sampling demonstrates a need for additional response actions.
[2] Site - Discrete area for which suspected contamination has been verified and which requires further response action. Area has been (or will be) entered into RMIS. For the FUDS Program, "Projects" equates to sites for current installations.
[3] If sampling results for each and every medium sampled are below detection, the site or AOC is automatically assigned a rating of Low.
[4] Media - Conduct risk evaluation by media: groundwater, surface water/sediment, soil.

Table. RRSE Site Scoring Summary.

Site Number	Site Name	Ground-water	Surface Water	Sediment	Soil	Surface Water-Eco	Sediment Eco	Media of Concern	Score
RVAAP-02	ERIE BURNING GROUNDS	-	High	Medium	-	-	-	2	High
RVAAP-03	DEMO AREA 1	-	-	-	Medium	-	-	1	Medium
RVAAP-06	C BLOCK QUARRY DP	-	-	-	Low	-	-	1	Low
RVAAP-15	LOAD LINE 6 TREATMENT PLANT	-	-	-	Low	-	-	1	Low
RVAAP-16	QUARRY LANDFILL/POND	-	High	Medium	-	-	-	2	High
RVAAP-18	LOAD LINE 12 PINK WASTE WATER TREATMENT	-	-	-	Low	-	-	1	Low
RVAAP-23	UNIT TRAINING EQUIPMENT SITE UST	Medium	-	-	Low	-	-	2	Medium
RVAAP-24	WASTE OIL TANK	-	-	-	Low	-	-	1	Low
RVAAP-25	BLDG 1034 MOTOR POOL AST	-	-	-	Low	-	-	1	Low
RVAAP-26	FUSE /BOOSTER AREA SETTLING TANKS	Medium	-	-	Medium	-	-	2	Medium
RVAAP-28	MUSTARD AGENT BURIAL SITE	-	-	-	Low	-	-	1	Low
RVAAP-30	LOAD LINE 7 PINK WASTE WATER TREATMENT	-	-	-	Low	-	-	1	Low
RVAAP-32	40 & 60 MM FIRING RANGE	-	-	-	Medium	-	-	1	Medium
RVAAP-33	FIRESTONE TEST FACILITY	-	Medium	Low	High	-	-	3	High
RVAAP-34	SAND CREEK DISPOSAL LANDFILL	-	-	Low	Low	-	High	3	High
RVAAP-35	BUILDING 1037 - LAUNDRY WASTE WATER TANK	Medium	-	-	Low	-	-	2	Medium
RVAAP-36	PISTOL RANGE	-	-	Low	Medium	-	Low	3	Medium
RVAAP-37	PESTICIDE BUILDING S-4452	-	-	-	Low	-	-	1	Low
RVAAP-38	NACA TEST AREA	-	-	Low	Medium	-	Medium	3	Medium

c. Using the RRSE criteria, four of these 19 sites evaluated scored High. These sites are RVAAP-02, Eire Burning Grounds; RVAAP-16, Quarry Landfill/Pond; RVAAP-33, Firestone Test Facility; and RVAAP-34, Sand Creek Disposal Landfill.

d. Of the remaining 15 sites evaluated, seven scored Medium and eight scored Low.

e. Stakeholder input, the final phase of the RRSE process, was not included as part of this investigation.

f. The IAP should be updated to reflect the finalized RRSE scores for the sites addressed in this report.

7. RECOMMENDATIONS. Seek stakeholder input from on-post, off-post, and regulatory parties prior to finalization of these RRSE scores. Update the IAP, as appropriate.

8. TECHNICAL ASSISTANCE/FURTHER INFORMATION. Any questions or comments related to this study may be directed to any of the undersigned at commercial (410) 671-3652.

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LINDA L. BAETZ
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APPENDIX A

REFERENCES

1. U.S. Environmental Protection Agency, March 1987, EPA/540/G-87/003 Data Quality Objectives for Remedial Response Activities: Development Process.

2. Office of the Deputy Under Secretary of Defense (Environmental Security), April 1994. Management Guidance for Execution of the FY 94/95 and Development of the FY 96 Defense Environmental Restoration Program.

3. Office of the Deputy Under Secretary of Defense (Environmental Security), December 1995. Revised Draft Relative Risk Site Evaluation Primer.

4. U.S. Army Environmental Hygiene Agency, August 1988, Ground-Water Contamination Survey No. 38-26-0302-88, Evaluation of Solid Waste Management Units, Ravenna Army Ammunition Plant, Ravenna, Ohio.

5. U.S. Environmental Protection Agency, May 1996, EPA 540/R-95/128 Soil Screening Guidance: Technical Background Document.

6. McCarthy, Elissa S. Information Paper: Estimation of Groundwater Contamination Levels from Soil Data, dated September 4, 1996.

APPENDIX B

SAMPLING PLAN
AND
SITE SAFETY AND HEALTH PLAN

SAMPLING PLAN
RELATIVE RISK SITE EVALUATION FOR
RAVENNA ARMY AMMUNITION PLANT
PROJECT NUMBER 37-EF-5360-97
RAVENNA, OHIO
28 OCTOBER - 4 NOVEMBER 1996

1. AUTHORITY. USACHPPM Form 250-R, Request for Service, Army Material Command, dated 24 April 1996.

2. REFERENCES. Appendix A contains a list of references used to prepare this sampling plan.

3. PURPOSE. The purpose of this study is to provide sufficient data to score Ravenna Army Ammunition Plant's previously uninvestigated sites, which are Defense Environmental Restoration Account (DERA)-eligible, according to the Relative Risk Site Evaluation (RRSE) guidelines. This study is not a Preliminary Assessment/Site Investigation (PA/SI), a Remedial Investigation (RI), or a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI). Data generated during this project will be used for program management purposes only, specifically to determine the order in which PA/SI and RI activities will take place on an Army-wide basis. These data are minimal Level III data, as defined by the Environmental Protection Agency (EPA) (reference 1), and are not intended to be used as definitive evidence of contamination presence or absence or to support quantitative health risk assessment.

4. BACKGROUND.

a. The current Defense Environmental Restoration Program (DERP) management guidance requires that all sites eligible for cleanup must be scored and ranked to determine the degree of potential risk in relation to other DERA-eligible cleanup sites prior to the allocation of remediation funding (reference 2). The data necessary to score these sites do not exist for all Ravenna Army Ammunition Plant (RVAAP) Installation Restoration Program (IRP) sites. In particular, RVAAP has 27 sites delineated in the Defense Site Environmental Restoration Tracking System (DSERTS) database as not evaluated and which therefore require Relative Risk Site Evaluation (RRSE) scoring.

b. Mr. James Sheehy and Ms. Elissa McCarthy of the United States Army Center for Health Promotion and Preventive Medicine (USACHPPM) visited RVAAP on 11 and 12 June 1996 to establish the level of sampling which would be required to assess the 27 unevaluated sites. The results of that visit are summarized in Appendix B. Three sites are not DERA-eligible and therefore do not require RRSE scoring. Five sites have funding in place to conduct remedial investigations. The remaining 19 sites require sampling as detailed in the Site Specific Sampling Strategies on page 4 of this sampling plan.

5. SAMPLING STRATEGY.

a. Exposure Pathway Evaluation. The RRSE strategy is to rank known polluted sites by both the contaminant level/toxicity and the potential for contaminants to reach both human and ecological receptors. In this manner, those sites with the greatest potential to impact populations may be identified early and be remediated prior to those sites which pose little threat. Therefore, establishing which pathways allow the transfer of compounds from a study site to a human or ecological population is the first step in RRSE ranking (reference 3).

(1) Surface Soil. The RVAAP climate is continental and most areas have vegetative covering, but there are still areas where the surface soil is exposed. Due to the potential for either pedestrian traffic (e.g. hunters, fishermen, Ohio National Guard soldiers) on or near study areas, the surface soil pathway is considered complete for 17 of 19 locations. This pathway is not considered complete for the following sites: RVAAP-02 and RVAAP-16. These areas are completely covered by surface water.

(2) Surface Water and Sediment. Leachate or soil transported by runoff may result in contamination of surface water and associated sediments, which may then be available to contact receptors. This surface water and sediment pathway is only present at the following 3 locations: RVAAP-02, RVAAP-16, and RVAAP-33. The surface water pathway is not complete at any other study locations. Both the RVAAP-34 and RVAAP-36 sites have a creek running through or adjacent to the site, but due to the rapid turn-over in the surface water, sediment is the most appropriate media to sample. The sediment pathway is also being evaluated at RVAAP-38 where sediment has the potential to transport contamination from a site through runoff to a surface water source through an intermittent stream. Ecological receptors, as defined in Reference 3, are present throughout the installation and will be evaluated at all of the sites with surface water and sediment pathways.

(3) Ground Water. Shallow ground water exists on RVAAP. The depth to ground water in the primary bedrock aquifer is between 3 and 60 feet below the surface. In addition ground water can also be found in unconsolidated geologic materials at RVAAP. The ground water on RVAAP was used for industrial and drinking water production at the installation through the 1980's, but is no longer used for any purpose (reference 4). Due to the relatively shallow levels of ground water, the ground water is being considered a completed pathway for compounds to reach human receptors. The ground water pathway is present at three sites: RVAAP-23, RVAAP-26, and RVAAP-35. The ground water pathway may be present at RVAAP-28, but due to the extreme hazard associated with potential chemical warfare agents, will not be evaluated during this study. It is not complete at any other study locations. If the sampling equipment is unable to collect a ground water sample within 20-25 feet of the surface, the groundwater pathway will be evaluated with subsurface soil data using a standard linear equilibrium soil/water partition equation (to estimate contaminant release as soil leachate) and a dilution factor (to

account for dilution of the leachate as it enters the aquifer). This method is consistent with the derivation of soil screening levels and the investigation and modeling efforts conducted at Superfund sites to develop soil cleanup goals and groundwater protection goals (references 5 and 6).

b. Sample Collection Methodology.

(1) Surface Soil. Surface soil samples will be collected from the ground surface to 6 inches using either a stainless steel or a plastic scoop, except for RVAAP-38 where samples will be collected down to 12-14 inches with a hand auger in order to detect the possible presence of Volatile Organic Compounds (VOCs). Composite samples of 3-6 aliquots will be taken for each sample point. The soil will be placed in a large stainless steel bowl and homogenized prior to the filling of sample jars with the exception of VOCs. Samples to be analyzed for VOCs will be placed into sample jars directly from the sampling bit on the hand auger to reduce the potential for volatilization of compounds. Only enough soil will be collected to take a complete sample to reduce the disturbance to each site. Each sample bottle will be marked with indelible marker to identify the sample number, sample location, date and time of collection. This same information will be recorded into a field log book. All samples will be placed into coolers and iced to an approximate temperature of 4 degrees Celsius.

(2) Surface Water. Surface water samples will be collected by using a surface water sampler to fill the sample containers away from the perimetter of the source. Each sample bottle will be marked with indelible marker to identify the sample number, sample location, date and time of collection. This same information will be recorded into a field log book. All samples will be preserved according to applicable sampling methods (reference 7), placed into coolers, and iced to an approximate temperature of 4 degrees Celsius. Samples will be collected prior to collection of collocated sediment samples.

(3) Sediment. Sediment samples will be collected in a manner similar to surface soil samples. Samples will be collected after collocated water samples have been collected to ensure sample integrity (e.g. minimize turbidity, entraining materials held in sediments into water samples, etc.).

(4) Ground Water. Ground water will be collected using the Geoprobe hydropunch. To collect ground water samples the Geoprobe will hydraulically press a screen point ground water sampler to the depth that water is expected. The sampler is equipped with a stop pin/push rod assembly, which can be disengaged at the desired sampling depth, and the outer, protective sampler sheath is pulled up, exposing the screen insert. The sample is then collected into sample containers using a vacuum pump at the surface. When sampling is complete at each site, fine diameter bentonite pellets will be funnelled into the sample hole to grout the opening. Each sample bottle will be marked with indelible marker to identify the sample number, sample

location, date and time of collection. This same information will be recorded into a field log book. All samples will be preserved according to aplicable sampling methods (reference 8), placed into coolers, and iced to an approximate temperature of 4 degrees Celsius. The Geoprobe will be operated by trained, experienced personnel in accordance with reference 9.

(5) Subsurface Soil. If no ground water is discovered within 20 to 25 feet of the surface, or if the recovery rate from the site is not sufficient to collect the required amount of sample, subsurface soil samples will be collected using a Geoprobe hydropunch. The Geoprobe will hydraulically press an acetate-lined core sampler to the depth specified for each site. The core sampler is equipped with a stop pin/push rod assembly, which can be disengaged at the desired sampling depth. Once disengaged, the sampler is pushed another 18 inches into undisturbed soil, compressing a core sample in the acetate tubing. The sample is then pulled back to the surface and the soil removed by cutting the liner away. Samples are then processed exactly the same as surface soil samples. When sampling is complete at each site, fine diameter bentonite pellets will be funnelled into the sample hole to grout the opening. The Geoprobe will be operated by trained, experienced personnel in accordance with reference 9.

c. Quality Assurance/Quality Control. All samples collected during the study will be analyzed by the USACHPPM Directorate of Laboratory Services. Split samples will be collected during this study to identify variation in sample results due to the heterogeneous nature of soils, sampling method variability, and analytical variability. Split samples will be collected from the surface soil. The number of split samples is dependant on the total number of samples collected for each parameter (4 each for metals, 2 each for explosives, one each for SVOCs and one each for VOCs). Two split samples will be collected from the sediments (one for metals and one for explosives). Two duplicates each will be collected for surface water and ground water (one for metals and one for explosives). This is consistent with EPA guidance which recommends that between 5-10 percent of the samples collected be for quality assurance (reference 10). Split samples will not be collected for the other parameters and matrices due to the low number of samples being collected.

d. Site Specific Sampling Strategies. Appendix B contains a list of all RVAAP's not evaluated sites and their specific sampling strategies. The exact location of all sample point locations will be determined and documented during field activities. Maps of these locations and proposed sample points are located in Appendix C. Specific analyses within each category (i.e. Metals, Explosives, etc) are listed in Appendix D. Detection limits will vary depending on sample matrix and possible interferences. Below is a brief description of each site and the rationale of the types of samples and parameters to be taken. The information was found in references 11 and 12.

(1) RVAAP-02, Erie Burning Grounds. This site was used from 1941 to 1951 to conduct open burning of explosives and related items. Bulk, obsolete, nonspecification propellants, and

conventional explosives from throughout the installation were treated at the site. Metal items were treated to remove explosive residue before being processed as scrap. The area is now a swamp with up to several feet of water in places as a result of beaver activity. Two samples each of the surface water and sediment will be taken from the site and analyzed for explosives and metals.

(2) RVAAP-03, Demolition Area 1. Munitions were thermally treated at this site from 1941 through 1949 in a circular shaped bermed area. Bare areas of ground, fragments of metal, small arms primers, and fuzes have been seen outside the perimeter of the berm in previous surveys of the site. These were not observed in the scoping visit. Three soil samples (one outside and two inside the berm) will be taken and analyzed for explosives and metals.

(3) RVAAP-06, C-Block Quarry. This site is an unlined borrow pit that was used during the 1950's as a disposal area for annealing process wastes. Wastes that were disposed of in the pit were spent pickle liquors from brass finishing that contained lead, mercury, chromium, and sulfuric acid. The area is now heavily forested. Three soil samples will be taken and analyzed for metals and cyanide.

(4) RVAAP-15, Load Line 6 Treatment Plant. This treatment plant is a closed-system, dual activated carbon filter for the treatment of pink water operated from 1987 to 1993. The filters were contained in a building with a concrete floor. The discharges from the filters were sent to either the installations hazardous waste storage area or a waste water treatment plant. The only potential for release at the plant is for spillage or leakage to have been washed off of the floor and out of the door during the daily cleaning operations. One soil sample will be taken outside the door to the building and will be analyzed for explosives and metals.

(5) RVAAP-16, Quarry Landfill/Former Fuse and Booster Burning Pits/Pond. This site is an abandoned quarry that was used to burn sawdust waste from Load Lines 6 and 11 from 1945 to 1949. The site was also used as a landfill for spent brine regenerant and sand filtration backwash from the groundwater treatment plant, fuse and booster assemblies, projectiles, residual ash, and sanitary waste. The existing debris was removed from the site in 1976. There is no indication of regulatory oversight of the transfer process. The ponds were constructed prior to 1987 on the site to receive filter backwash from the potable water systerm. The ponds were operated as such from 1987 and 1993. Three samples each of surface water and sediment (one from each individual pond) will be taken and analyzed for explosives and metals.

(6) RVAAP-18, Load Line 12 Treatment Plant. This treatment plant is a closed-system, dual activated carbon filter for the treatment of TNT water operated from 1981 to 1983. The filters were contained in a building with a concrete floor. The discharges from the filters were sent to either the installations hazardous waste storage area or a waste water treatment plant. The only potential for release at the plant is for spillage or leakage to have been washed off of the

floor and out of the door during the daily cleaning operations. One soil sample will be taken outside the door to the building and will be analyzed for explosives and metals.

(7) RVAAP-23, Unit Training Equipment Site Waste Oil Tank. This site was formerly a 1000 gallon underground storage tank used to hold waste oil from a vehicle maintenance shop. The tank was never leak tested. The tank was removed from operation in 1988, and was removed some time after that. No results of any sampling to determine if any oil leaked from the tank are available. One surface soil sample and one ground water sample will be taken from the location of the tank and analyzed for metals and semivolatile organic compounds.

(8) RVAAP-24, Reserve Unit Maintenance Area Waste Oil Tank. This site was in operation from 1983 to 1995. There was one above-ground, 400 gallon tank used to store waste oil. The tank is no longer present at the site. Two surface soil samples will be taken in the area the tank was located and analyzed for metals and semivolatile organic compounds.

(9) RVAAP-25, Building 1034 Motor Pool Waste Oil Tank. This site was in operation from 1976 to 1995. There was one above-ground, 500 gallon tank used to store waste oil. The tank is no longer present at the site. Two surface soil samples will be taken in the area the tank was located and analyzed for metals and semivolatile organic compounds.

(10) RVAAP-26, Fuse and Booster Area settling tanks. This site consists of 15 concrete tanks located throughout Load Lines 5, 7, 9, 10, and 11. All but one of the tanks are underground. Load Line 5 has one 3840 gallon tank. Load Line 7 had one 1350 gallon tank removed in 1988. Load Line 9 has two tanks with capacities of 4800 gallons and 2880 gallons. Load Line 10 has nine tanks, seven with 3480 gallon capacity, one tank with 405 gallon capacity, and the above ground storage tank with an unknown capacity. Load Line 11 has three tanks with 3480 gallon capacity. These tanks were used as settling basins for explosive contaminated waste water from 1941 to 1971. The sludge was collected periodically and thermally treated at one of the burning grounds. The tanks were emptied, cleaned and covered in 1971. They have not been used since they were cleaned. Sampling data showing the level of decontamination are not available. Four of the tanks will be selected at random on the site and one surface soil sample and one ground water sample will be taken and analyzed for explosives and metals.

(11) RVAAP-28, Mustard Agent Burial Site. This site is a 15 by 18 by 18 foot area where mustard agent was buried prior to 1950 according to former employees. In 1969, an EOD unit excavated a suspected mustard agent burial site nearby and found one 50 gallon drum and 7 small rusty cans. No contamination was found during the excavation. An unidentified and undocumented source reported that the site had not been correctly identified and was adjacent to the area excavated. There have been no attempts to excavate this new site, and it was fenced off. The fence has since fallen. Two surface samples will be taken and analyzed for metals and

thiodiglycol (a mustard agent decomposition byproduct). No attempt will be made to take subsurface samples at this site due to the hazards associated with chemical warfare agents.

(12) RVAAP-30, Load Line 7 Treatment Plant. This treatment plant is a closed-system, dual activated carbon filter for the treatment of pink water operated from 1989 to 1993. The filters were contained in a building with a concrete floor. The discharges from the filters were sent to either the installations hazardous waste storage area or a waste water treatment plant. The only potential for release at the plant is for spillage or leakage to have been washed off of the floor and out the door during the daily cleaning operations. One soil sample will be taken outside the door to the building and will be analyzed for explosives and metals.

(13) RVAAP-32, 40 and 60 mm Firing Range. This site was used as a test firing range for munitions from the 1940's through the 1950's. It is unknown how many munitions were fired at the site since little historical information exists on the site. Three soil samples will be taken and analyzed for explosives and metals. No attempt will be made to take subsurface samples at this site due to the hazards associated with unexploded ordinance.

(14) RVAAP-33, Firestone Test Facility. This site at Load Line 6 was operated by a government contractor conducting classified experiments on explosives and munitions. Shaped explosive charges were tested in several structures and one underwater test facility. The facility is no longer active, but the dates of operation for the facility are not known. Seven soil samples, one surface water sample, and one sediment sample will be taken and analyzed for explosives and metals.

(15) RVAAP-34, Sand Creek Disposal Landfill. This site was used as a construction debris landfill for the disposal of concrete, wood, asbestos debris, and fluorescent light tubes. The facility is no longer active, but the dates of operation for the facility are not known. Three soil samples and one sediment sample will be taken and analyzed for metals.

(16) RVAAP-35, Building 1037, Laundry Waste Water Tank. This site is a concrete sump used a settling tank for RVAAP's laundry facility. The sump was filled with soil after operation ceased. The dates of operation of the facility are not known. The building is now used as the RVAAP Headquarters Building. No evidence of cleaning or decontamination of the sump have been documented. One soil and one ground water sample will be taken and analyzed for explosives and metals.

(17) RVAAP-36, Pistol Range. This site was used by the installations security personnel for pistol qualifications. Personnel fired into a soil embankment. The facility is no longer active, but the dates of operation for this facility are not known. Three soil samples and one sediment sample will be collected and analyzed for metals.

(18) RVAAP-37, Pesticide Building. This building was used from 1970's to 1993 as a pesticide storage and mixing facility. The building is a wooden structure with a crawl space. The floor of the facility was not impermeable. Two soil samples will be taken and analyzed for pesticides and herbicides.

(19) RVAAP-38, NACA Test Area. This area was used as an aircraft test area. Airplanes with full fuel loads were rammed into an obstacle that sheared off the left side landing gear to intentionally cause crashes. These tests were to develop explosion proof fuel tanks and/or fuels. The area was used during the 1950's. Five soil samples and one sediment sample will be taken and analyzed for metals, semivolatile organic compounds, and volatile organic compounds (soil only for VOCs).

e. Decontamination. Personnel will wear disposable latex gloves which will be changed between each sampling location. Any equipment reused between sampling locations, such as stainless steel bowls, stainless steel or plastic scoops, hand augers, and Geoprobe equipment will be cleaned by rinsing with potable water, scrubbing with Alconox soap, and finally rinsing with deionized (distilled) water. All rinseate will be collected in a separate container and sampled for hazardous waste characteristics. A report on the results of the hazardous waste sampling will be forwarded to the installation when the data is received.

f. Record Keeping. Detailed notes will be maintained by the project officer to record the exact location, sample number, date and time for each sample collected as well as any appropriate observations. An inventory of samples will accompany each cooler of samples delivered to the USACHPPM laboratories identifying sample numbers, date and time of collection, analyses to be performed, and any other appropriate instructions.

g. Safety. A site safety and health plan has been prepared for this study under separate cover.

6. SCHEDULE. This study is planned to occur between 28 October and 4 November 1996. Analytical results should be received by the project officer not later than thirty days after their submission to the laboratory. A final report scoring all DERA-eligible will be prepared within sixty days of receiving laboratory data.

7. TECHNICAL ASSISTANCE/FURTHER INFORMATION. Any questions or comments related to this study may be directed to any of the undersigned at commercial (410) 671-3652.

JAMES R. SHEEHY
Environmental Engineer
Project Officer

REVIEWED BY:

THOMAS R. RUNYON
Team Leader, Special Studies and Technologies
Hazardous and Medical Waste Program

APPROVED BY:

/s/ LINDA BAETZ
Acting Program Manager
Hazardous and Medical Waste

APPENDIX A

REFERENCES

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3. Office of the Deputy Under Secretary of Defense (Environmental Security), December 1995. Revised Draft Relative Risk Site Evaluation Primer.

4. U.S. Army Environmental Hygiene Agency, August 1988, Ground-Water Contamination Survey No. 38-26-0302-88, Evaluation of Solid Waste Management Units, Ravenna Army Ammunition Plant, Ravenna, Ohio.

5. U.S. Environmental Protection Agency, May 1996, EPA 540/R-95/128 Soil Screening Guidance: Technical Background Document.

6. McCarthy, Elissa S. Information Paper: Estimation of Groundwater Contamination Levels from Soil Data, dated September 4, 1996.

7. U.S. Environmental Protection Agency, January 1990, SW-846 Test Methods for Evaluating Solid Waste.

8. U.S. Environmental Protection Agency, December 1988, EPA/600/4-88/039 Methods for the Determination of Organic Compounds in Drinking Water.

9. U.S. Army Center for Health Promotion and Preventive Medicine, June 1996, Draft Standard Operating Procedure, Operating Guidelines for the Geoprobe System.

10. U.S. Environmental Protection Agency, March 1989, EPA 600/8-89/046 Soil Sampling Quality Assurance User's Guide.

11. Science Applications International Corporation, February 1996, Preliminary Assessment for the Ravenna Army Ammunition Plant, Ravenna, Ohio.

12. Mason and Hanger-Silas Mason Co., Inc., April 1996, FY 96 Installation Action Plan for Ravenna Army Ammunition Plant.

APPENDIX B

RAVENNA ARMY AMMUNITION PLANT
RELATIVE RISK SITE EVALUATION
NOT EVALUATED SITE SUMMARY

Hazardous and Medical Waste Program Study No. 37-EF-5360-97, 28 OCT - 4 NOV 1996

RAVENNA ARMY AMMUNITION PLANT RRSE Not Evaluated Site Summary

Site #	Site Name	DERA Eligible	RI in progress	Migration Pathway Factor (Number of samples to be collected)				Receptor Factor H-Human E-Ecological	Recommended Sampling
				Surface Soil	Ground Water	Sediment	Surface Water		
RVAAP-02	ERIE BURNING GROUNDS	Y	N	N/A	N/A	Potential (2)	Potential (2)	H-Identified E-Identified	Metals, Explosives
RVAAP-03	DEMO AREA 1	Y	N	Potential (3)	N/A	N/A	N/A	H-Potential	Metals, Explosives
RVAAP-06	C BLOCK QUARRY DP	Y	N	Potential (3)	N/A	N/A	N/A	H-Potential	Metals, Cyanide
RVAAP-10	LOAD LINE 3 DILUTION SETTLING POND	Y	Y	N/E	N/E	N/E	N/E	N/E	NONE
RVAAP-12	LOAD LINE 12-DILUTION SETTLING POND	Y	Y	N/E	N/E	N/E	N/E	N/E	NONE
RVAAP-13	BLDG 1200-DILUTION SETTLING POND	Y	Y	N/E	N/E	N/E	N/E	N/E	NONE
RVAAP-15	LOAD LINE 6 TREATMENT PLANT	Y	N	Potential (1)	N/A	N/A	N/A	H-Potential	Metals, Explosives

N/A - Not Appropriate for consideration at the site.
N/E - Not Evaluated as part of this scoring effort.

Site #	Site Name	DERA Eligible	RI in progress	Migration Pathway Factor (Number of samples to be collected)				Receptor Factor H-Human E-Ecological	Recommended Sampling
				Surface Soil	Ground Water	Sediment	Surface Water		
RVAAP-16	QUARRY LANDFILL/POND	Y	N	N/A	N/A	Potential (3)	Potential (3)	H-Identified E-Identified	Metals, Explosives
RVAAP-18	LOAD LINE 12 PINK WASTE WATER TREATMENT	Y	N	Potential (1)	N/A	N/A	N/A	H-Potential	Metals, Explosives
RVAAP-19	LANDFILL NORTH OF WINLEPECK BURNING GROUND	Y	Y	N/E	N/E	N/E	N/E	N/E	NONE
RVAAP-20	SAND CREEK SEWAGE TREATMENT PLANT	N	N	N/E	N/E	N/E	N/E	N/E	NONE
RVAAP-21	DEPOT SEWAGE TREATMENT PLANT	N	N	N/E	N/E	N/E	N/E	N/E	NONE
RVAAP-22	GEORGE ROAD SEWAGE TREATMENT PLANT	N	N	N/E	N/E	N/E	N/E	N/E	NONE

N/A - Not Appropriate for consideration at the site.
N/E - Not Evaluated as part of this scoring effort.

Site #	Site Name	DERA Eligible	RI in progress	Migration Pathway Factor (Number of samples to be collected)				Receptor Factor H-Human E-Ecological	Recommended Sampling
				Surface Soil	Ground Water	Sediment	Surface Water		
RVAAP-23	UNIT TRAINING EQUIPMENT SITE UST	Y	N	Potential (1)	Potential (1)	N/A	N/A	H-Potential	Metals, Semivolatile Organic Compounds
RVAAP-24	WASTE OIL TANK	Y	N	Potential (2)	N/A	N/A	N/A	H-Potential	Metals, Semivolatile Organic Compounds
RVAAP-25	BLDG 1034 MOTOR POOL AST	Y	N	Potential (2)	N/A	N/A	N/A	H-Potential	Metals, Semivolatile Organic Compounds
RVAAP-26	FUSE BOOSTER AREA SETTLING TANKS	Y	N	Potential (4)	Potential (4)	N/A	N/A	H-Potential	Metals, Explosives
RVAAP-27	BUILDING 854 PCB STORAGE	Y	Y	N/E	N/E	N/E	N/E	N/E	NONE
RVAAP-28	MUSTARD AGENT BURIAL SITE	Y	N	Potential (2)	N/E	N/A	N/A	H-Potential	Metals, Thiodiglycol
RVAAP-30	LOAD LINE 7 PINK WASTE WATER TREATMENT	Y	N	Potential (1)	N/A	N/A	N/A	H-Potential	Metals, Explosives

N/A - Not Appropriate for consideration at the site.
N/E - Not Evaluated as part of this scoring effort.

Site #	Site Name	DERA Eligible	RI in progress	Migration Pathway Factor (Number of samples to be collected)				Receptor Factor H-Human E-Ecological	Recommended Sampling
				Surface Soil	Ground Water	Sediment	Surface Water		
RVAAP-32	40 & 60 MM FIRING RANGE	Y	N	Potential (3)	N/A	N/A	N/A	H-Potential	Metals, Explosives
RVAAP-33	FIRESTONE TEST FACILITY	Y	N	Potential (7)	N/A	Potential (1)	Potential (1)	H-Potential E-Identified	Metals, Explosives
RVAAP-34	SAND CREEK DISPOSAL LANDFILL	Y	N	Potential (3)	N/A	Potential (1)	N/A	H-Potential E-Identifed	Metals
RVAAP-35	BUILDING 1037 - LAUNDRY WASTE WATER TANK	Y	N	Potential (1)	Potential (1)	N/A	N/A	H-Potential	Metals, Explosives
RVAAP-36	PISTOL RANGE	Y	N	Potential (3)	N/A	Potential (1)	N/A	H-Potential E-Potential	Metals
RVAAP-37	PESTICIDE BUILDING S-4452	Y	N	Confined (2)	N/A	N/A	N/A	H-Limited	Pesticides, Herbicides
RVAAP-38	NACA TEST AREA	Y	N	Potential (5)	N/A	Potential (1)	N/A	H-Potential E-Potential	Metals, Semivolatile Organic Compounds, Volatile Organic Compounds

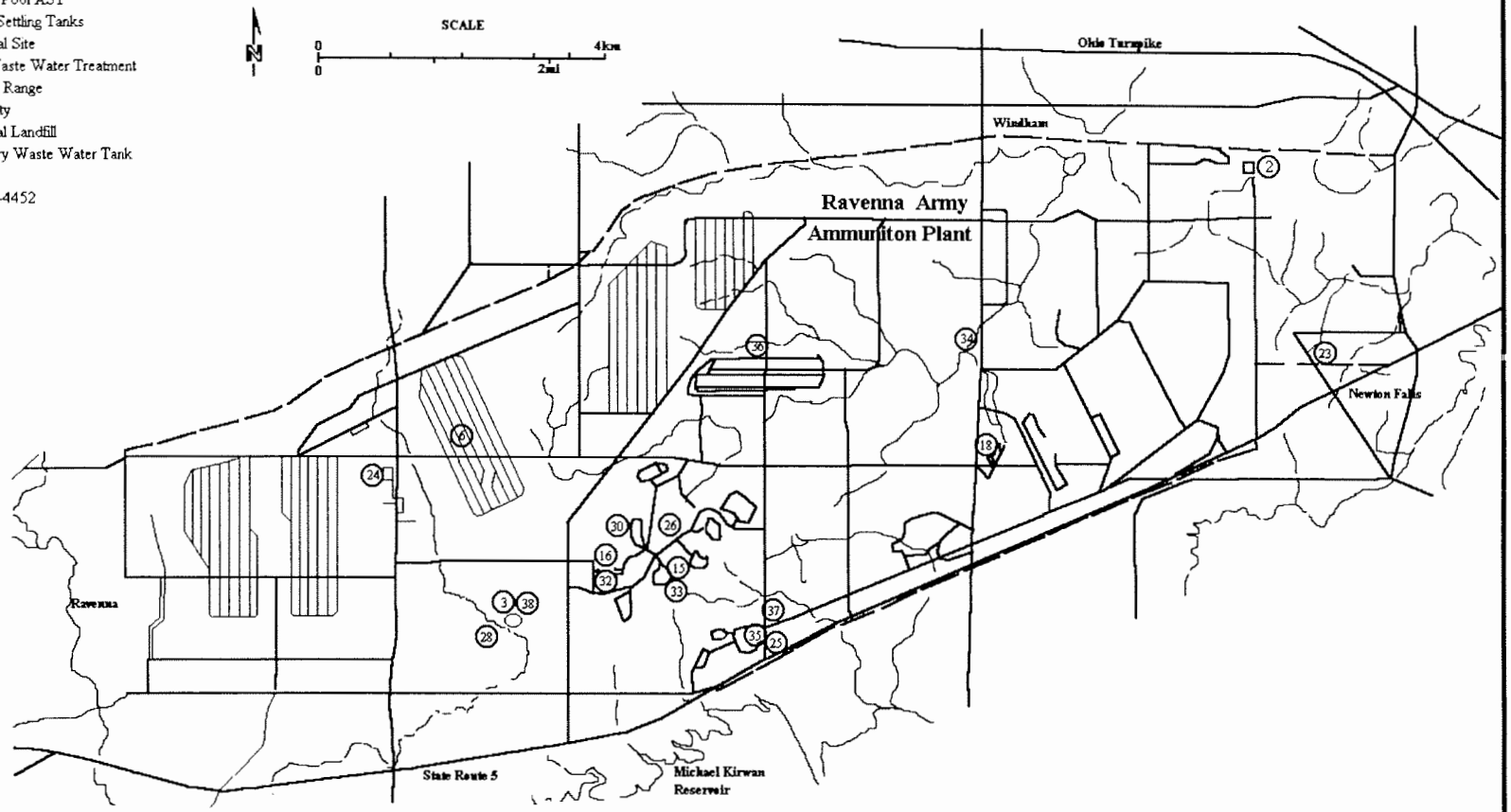
N/A - Not Appropriate for consideration at the site.
N/E - Not Evaluated as part of this scoring effort.

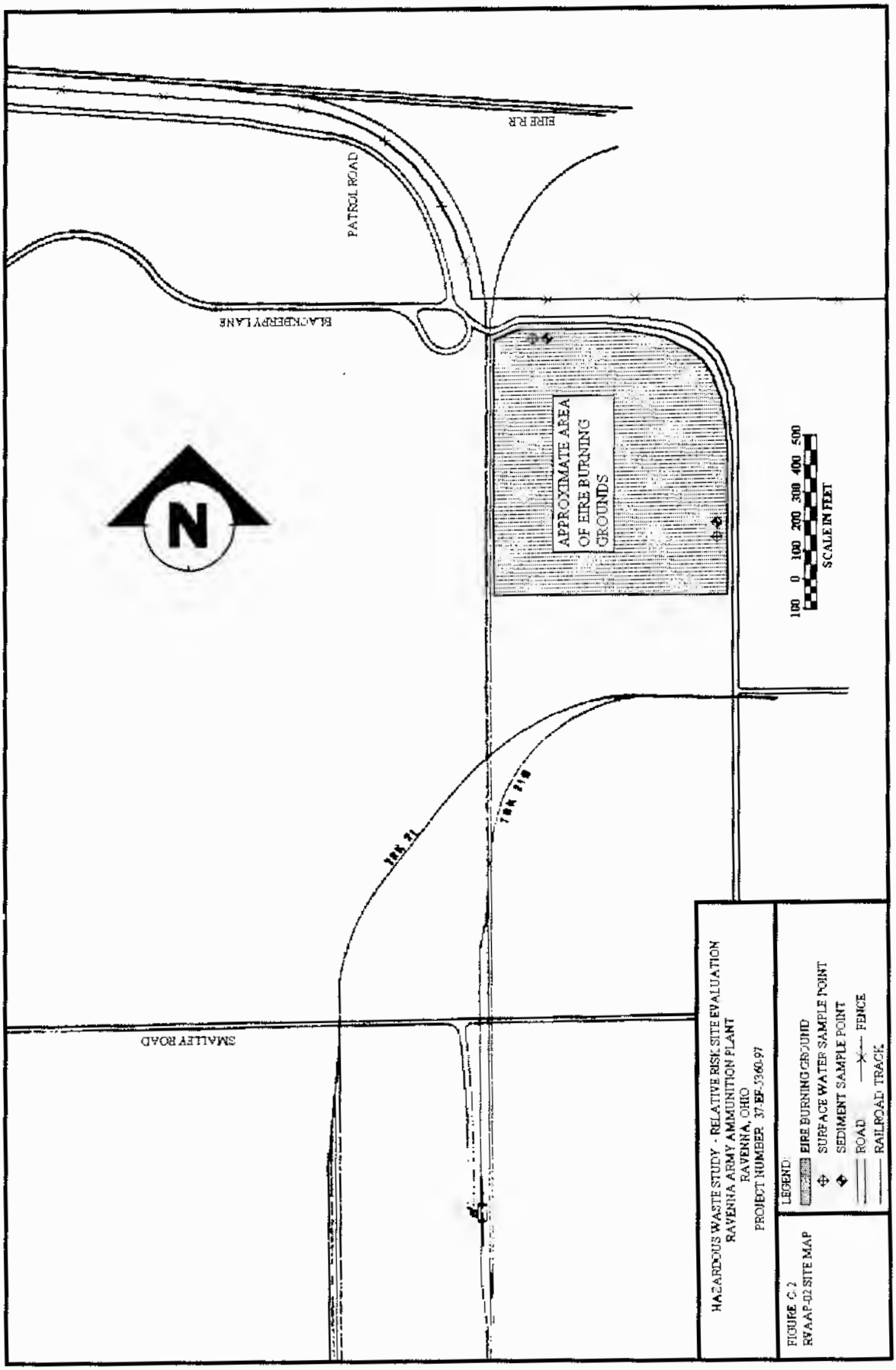
APPENDIX C

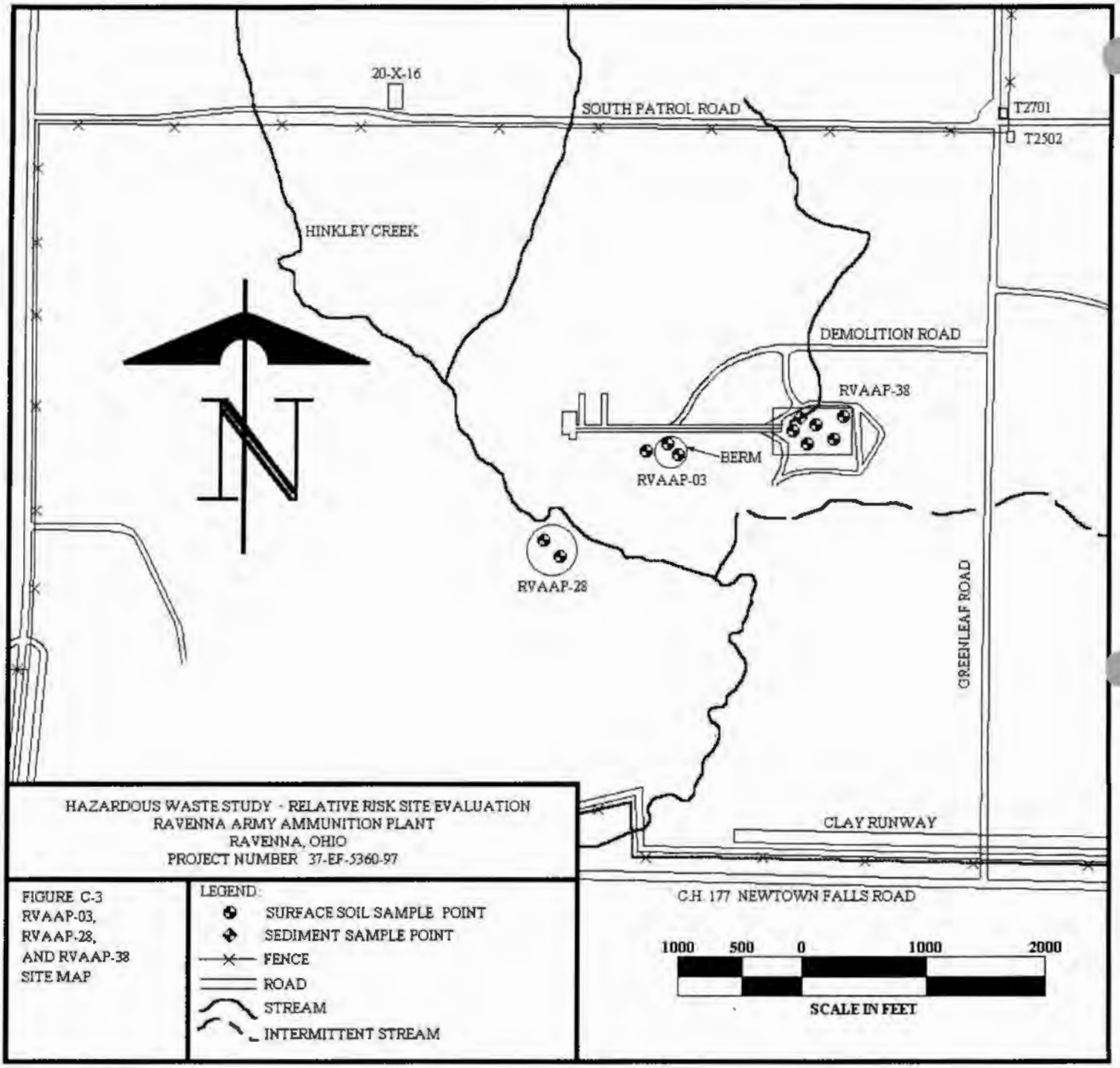
SITE MAPS

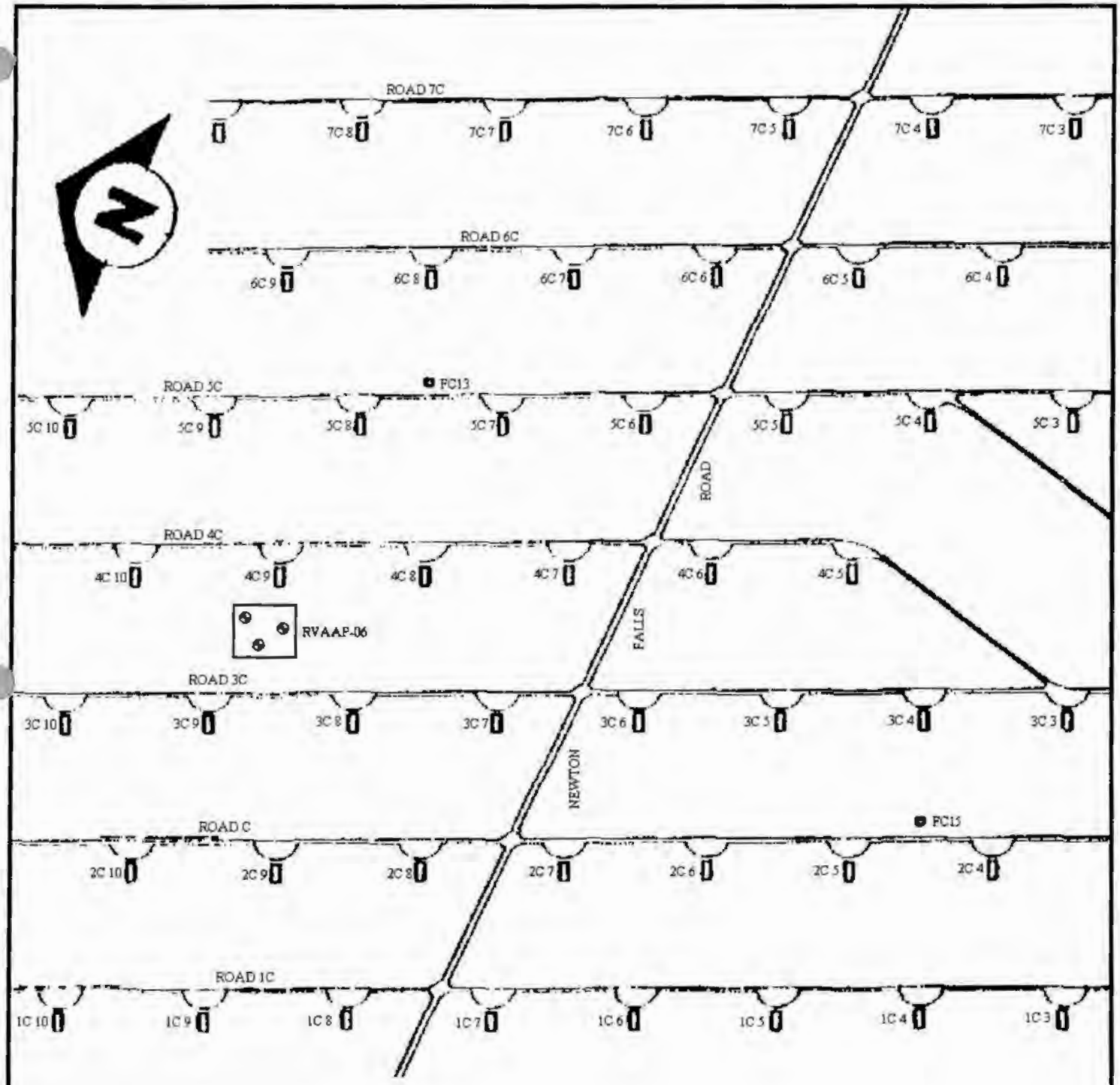
Figure C-1
Ravenna Army Ammuntion Plant
RRSE "Not-Evalutated" Sites

2 - Fire Burning Grounds
3 - Demo Area 1
6 - C Block Quarry DP
15 - Load Line 6 Treatment Plant
16 - Quarry Landfill/Pond
18 - Load Line 12 Pink Waste Water Treatment
23 - Unit Training Equipment Site UST
24 - Waste Oil Tank
25 - BLDG 1034 Motor Pool AST
26 - Fuze Booster Area Settling Tanks
28 - Mustard Agent Burial Site
30 - Load Line 7 Pink Waste Water Treatment
32 - 40 and 60mm Firing Range
33 - Firestone Test Facility
34 - Sand Creek Disposal Landfill
35 - BLDG 1037 Laundry Waste Water Tank
36 - Pistol Range
37 - Pesticide Building S-4452
38 - NACA Test Area




EIRE R.R
PATROL ROAD
BLACKBERRY LANE
APPROXIMATE AREA OF EIRE BURNING GROUNDS
N
100 0 100 200 300 400 500
SCALE IN FEET
SMALLEY ROAD
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
LEGEND
EIRE BURNING GROUND
SURFACE WATER SAMPLE POINT
SEDIMENT SAMPLE POINT
ROAD
FENCE
RAILROAD TRACK
FIGURE C-2
RVAAP-02 SITE MAP


20-X-16
SOUTH PATROL ROAD
T2701
T2502
HINKLEY CREEK
DEMOLITION ROAD
RVAAP-38
BERM
RVAAP-03
RVAAP-28
GREENLEAF ROAD
CLAY RUNWAY
C.H. 177 NEWTOWN FALLS ROAD
1000 500 0 1000 2000
SCALE IN FEET
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
FIGURE C-3
RVAAP-03,
RVAAP-28,
AND RVAAP-38
SITE MAP
LEGEND:
SURFACE SOIL SAMPLE POINT
SEDIMENT SAMPLE POINT
FENCE
ROAD
STREAM
INTERMITTENT STREAM

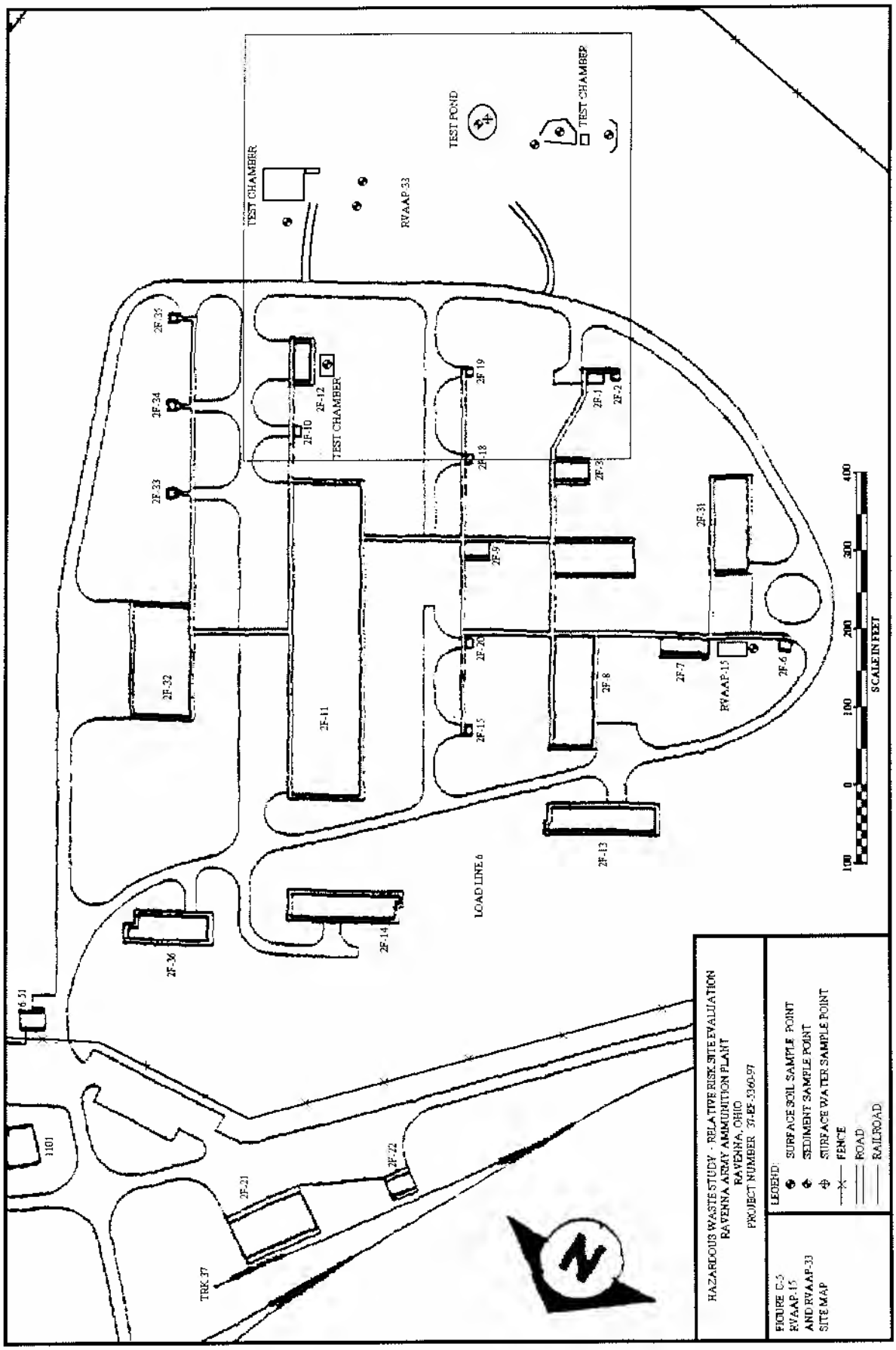


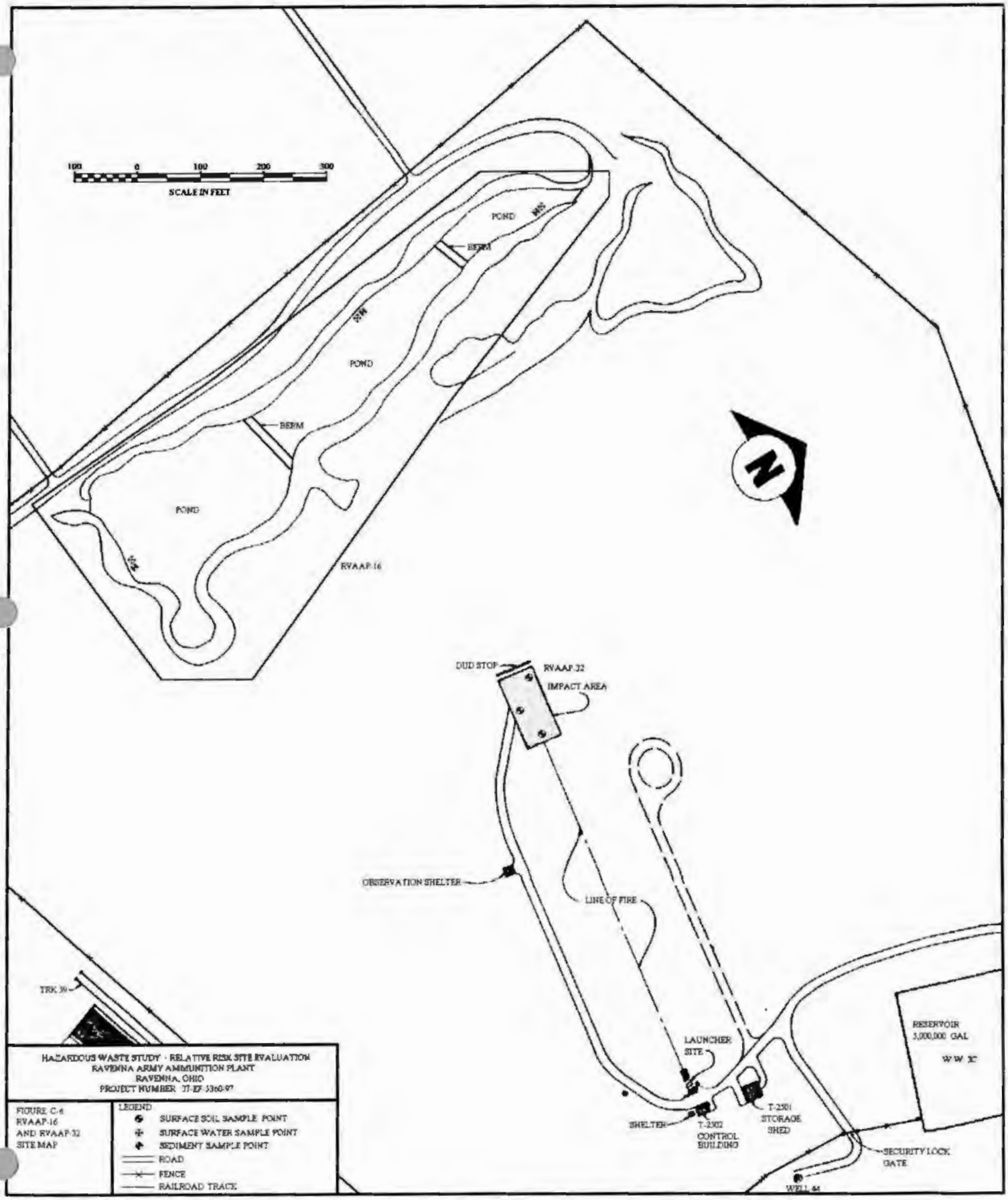
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97

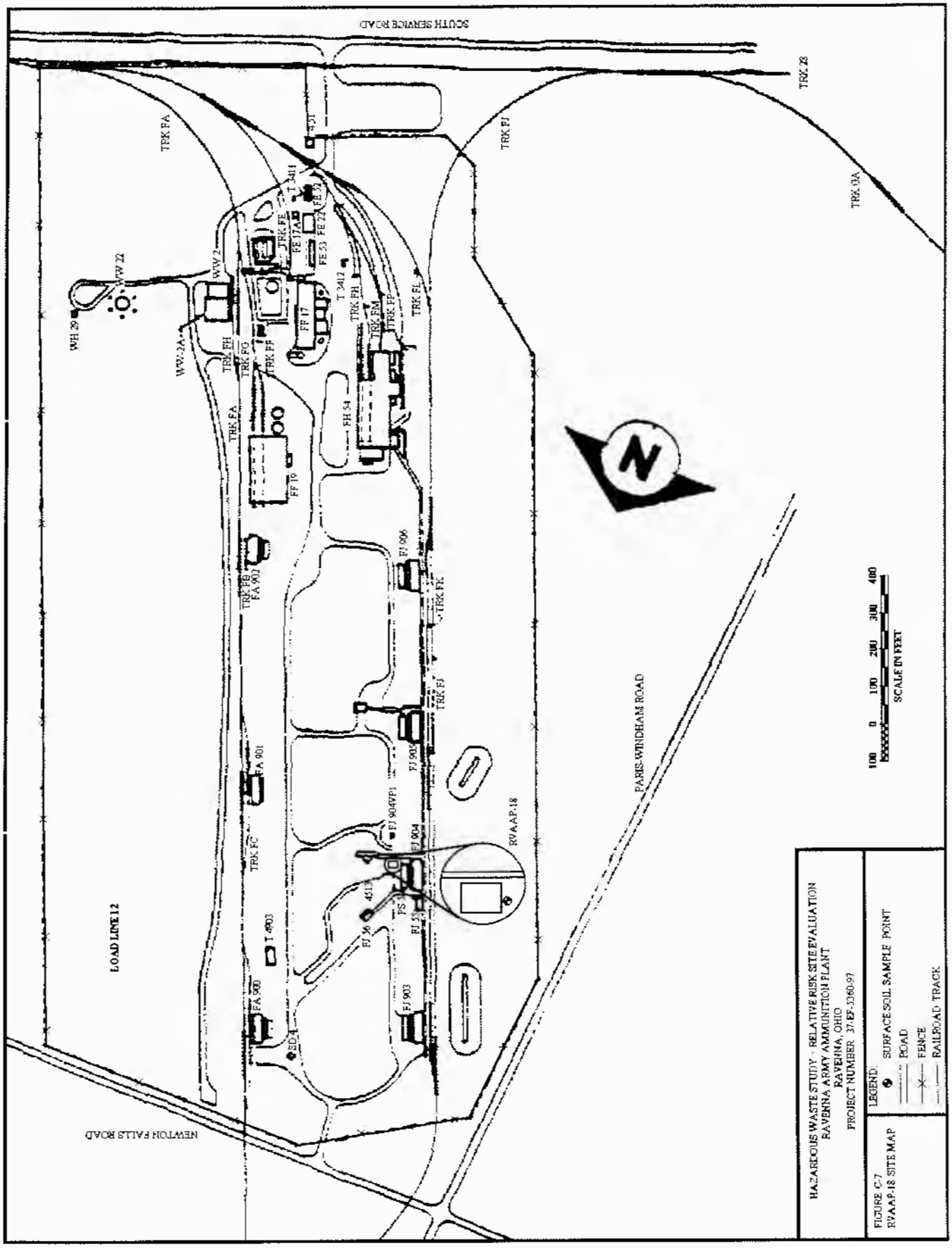
FIGURE C-4
RVAAP-06
SITE MAP

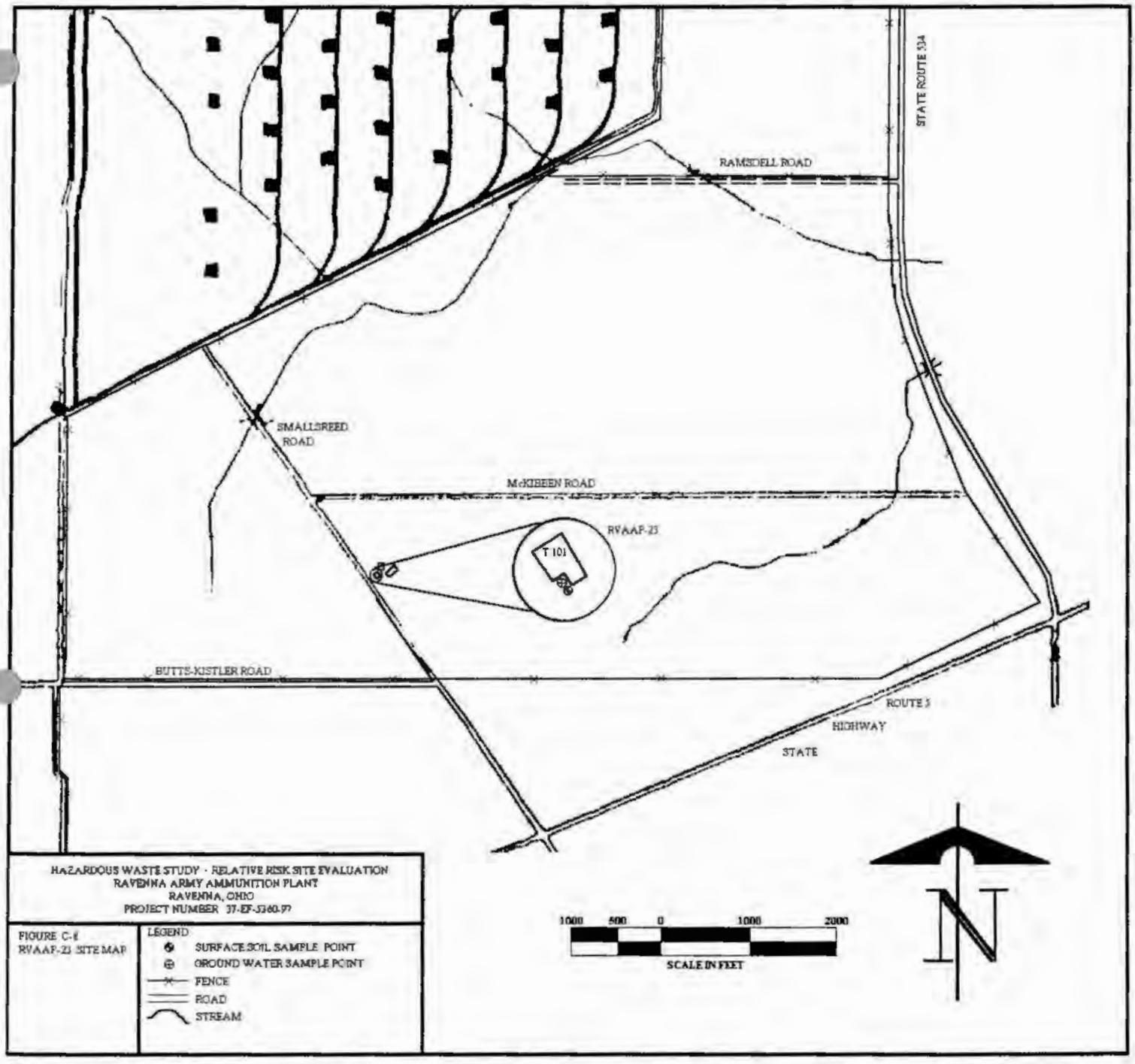
LEGEND
- SURFACE SOIL SAMPLE POINT
- ROAD

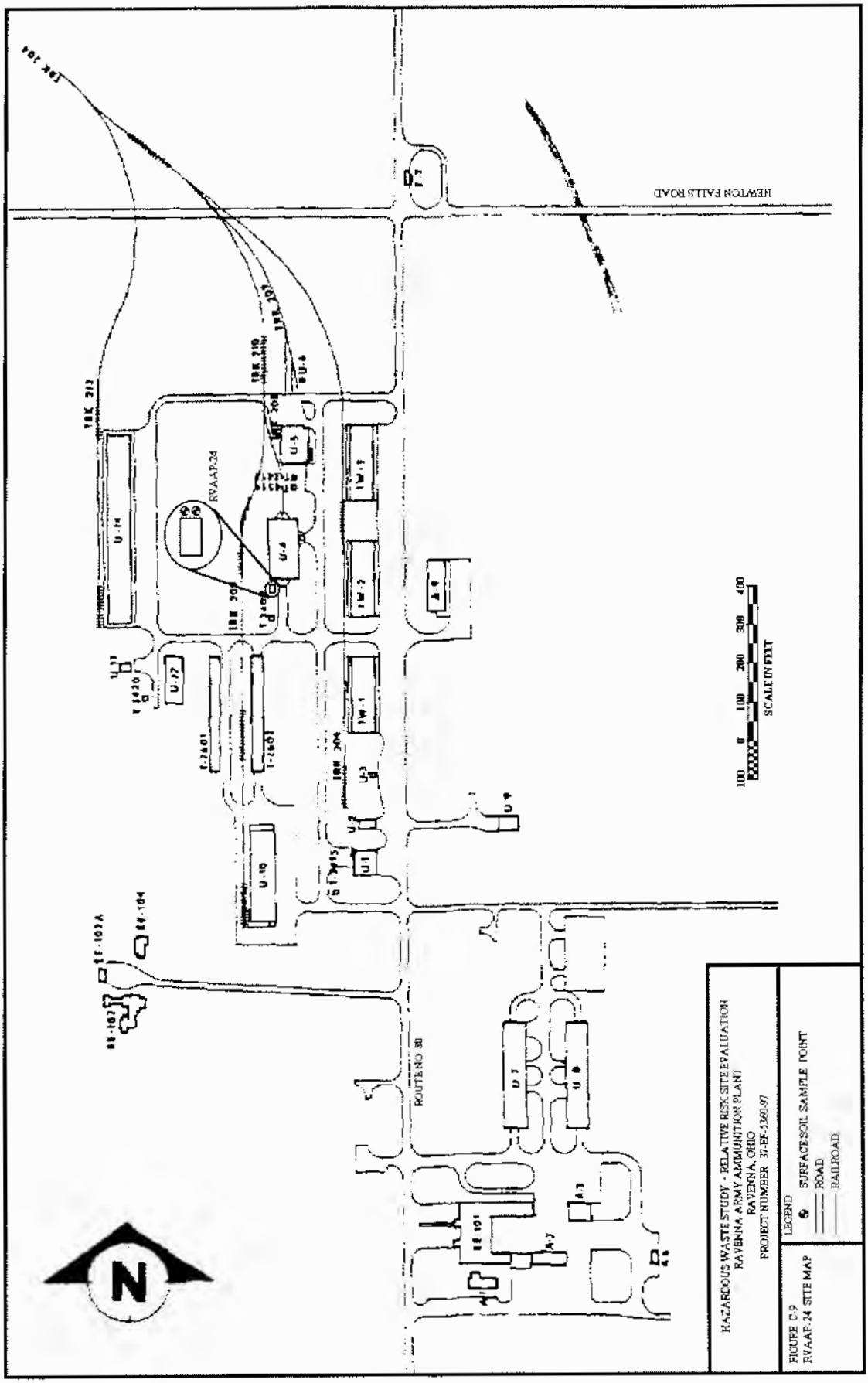
100 0 100 200 300 400 500
SCALE IN FEET

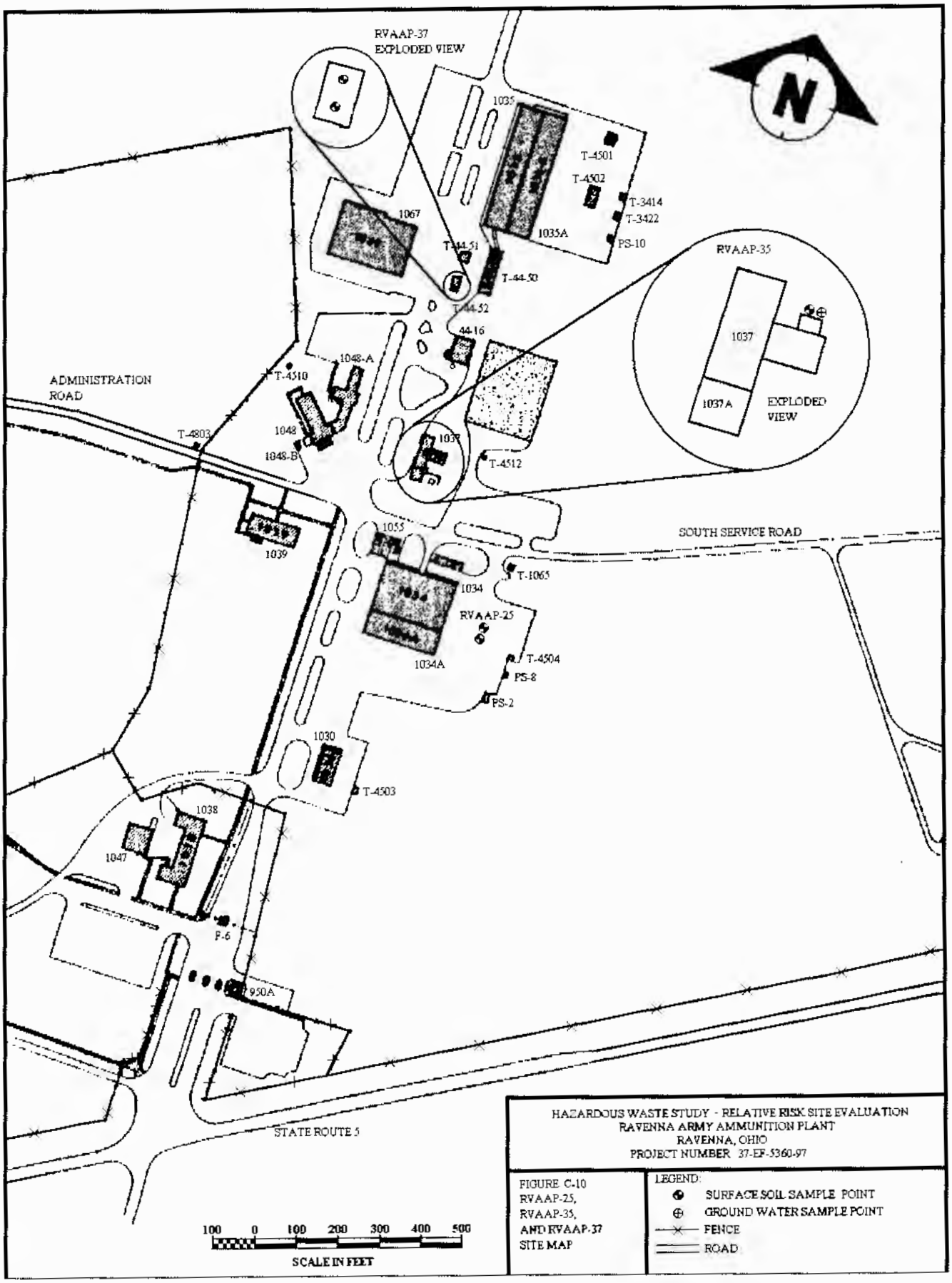

TEST CHAMBER
TEST POND
TEST CHAMBER
RVAAP-33
TEST CHAMBER
2F-35
2F-34
2F-33
2F-12
2F-10
2F-19
2F-1
2F-2
2F-18
2F-3
2F-31
2F-9
2F-32
2F-11
2F-20
2F-8
2F-7
RVAAP-15
2F-6
2F-15
2F-13
LOAD LINE 6
2F-14
2F-36
6.51
1101
2F-21
2F-22
TRK 37
N
SCALE IN FEET
100
0
100
200
300
400
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
LEGEND:
SURFACE SOIL SAMPLE POINT
SEDIMENT SAMPLE POINT
SURFACE WATER SAMPLE POINT
FENCE
ROAD
RAILROAD
FIGURE B-5
RVAAP-15
AND RVAAP-33
SITE MAP

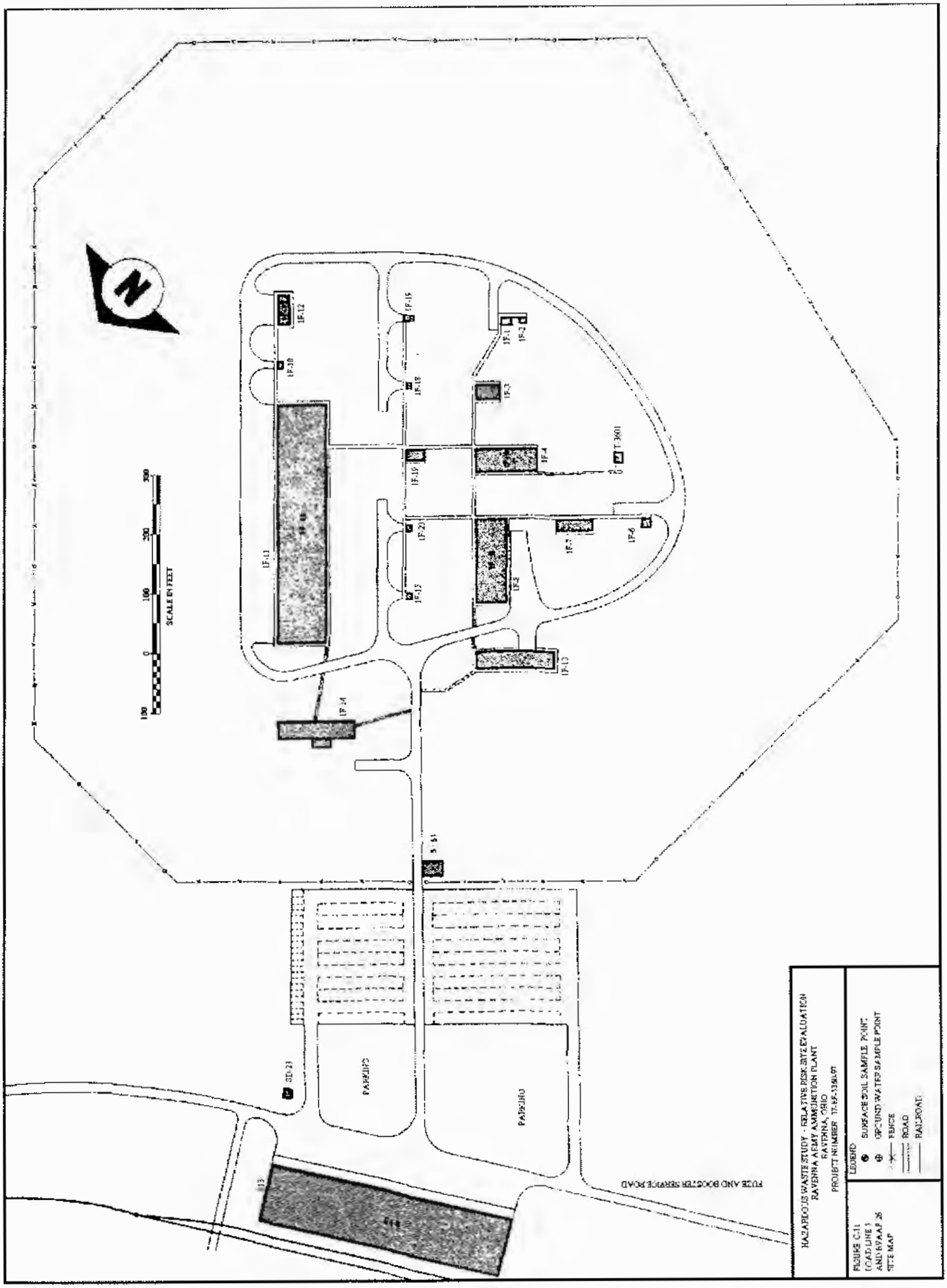

100 0 100 200 300
SCALE IN FEET
POND
BERM
POND
BERM
POND
RVAAP-16
N
DUD STOP
RVAAP-32
IMPACT AREA
OBSERVATION SHELTER
LINE OF FIRE
TRK 39
LAUNCHER SITE
SHELTER
T-2302 CONTROL BUILDING
T-2301 STORAGE SHED
RESERVOIR 3,000,000 GAL
WW IC
SECURITY LOCK GATE
WELL 44
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
FIGURE C-6
RVAAP-16
AND RVAAP-32
SITE MAP
LEGEND
SURFACE SOIL SAMPLE POINT
SURFACE WATER SAMPLE POINT
SEDIMENT SAMPLE POINT
ROAD
FENCE
RAILROAD TRACK

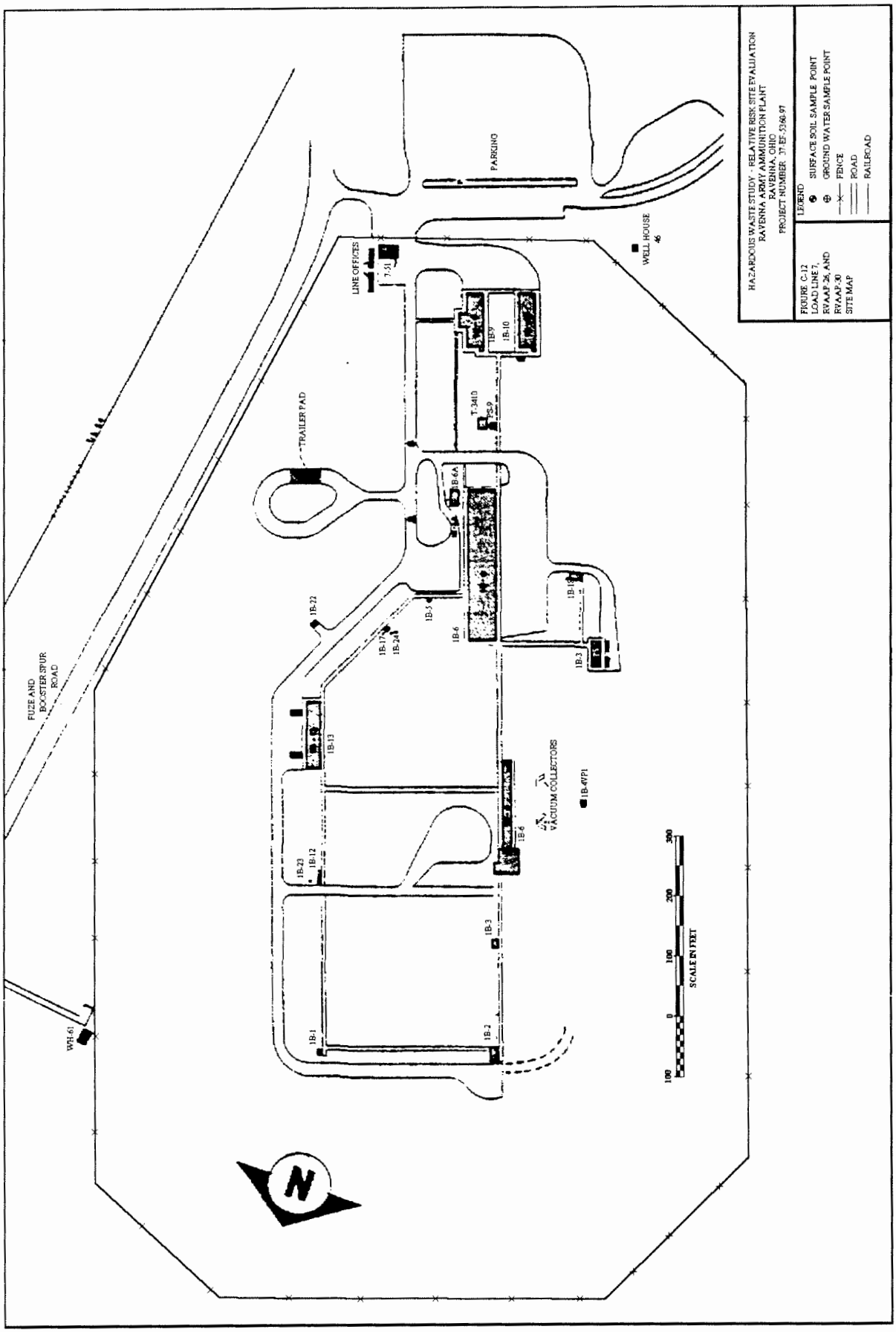

SOUTH SERVICE ROAD
NEWTON FALLS ROAD
PARIS-WINDHAM ROAD
LOAD LINE 12
RVAAP-18
N
SCALE IN FEET
100 0 100 200 300 400
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
FIGURE C-7
RVAAP-18 SITE MAP
LEGEND:
SURFACE SOIL SAMPLE POINT
ROAD
FENCE
RAILROAD TRACK

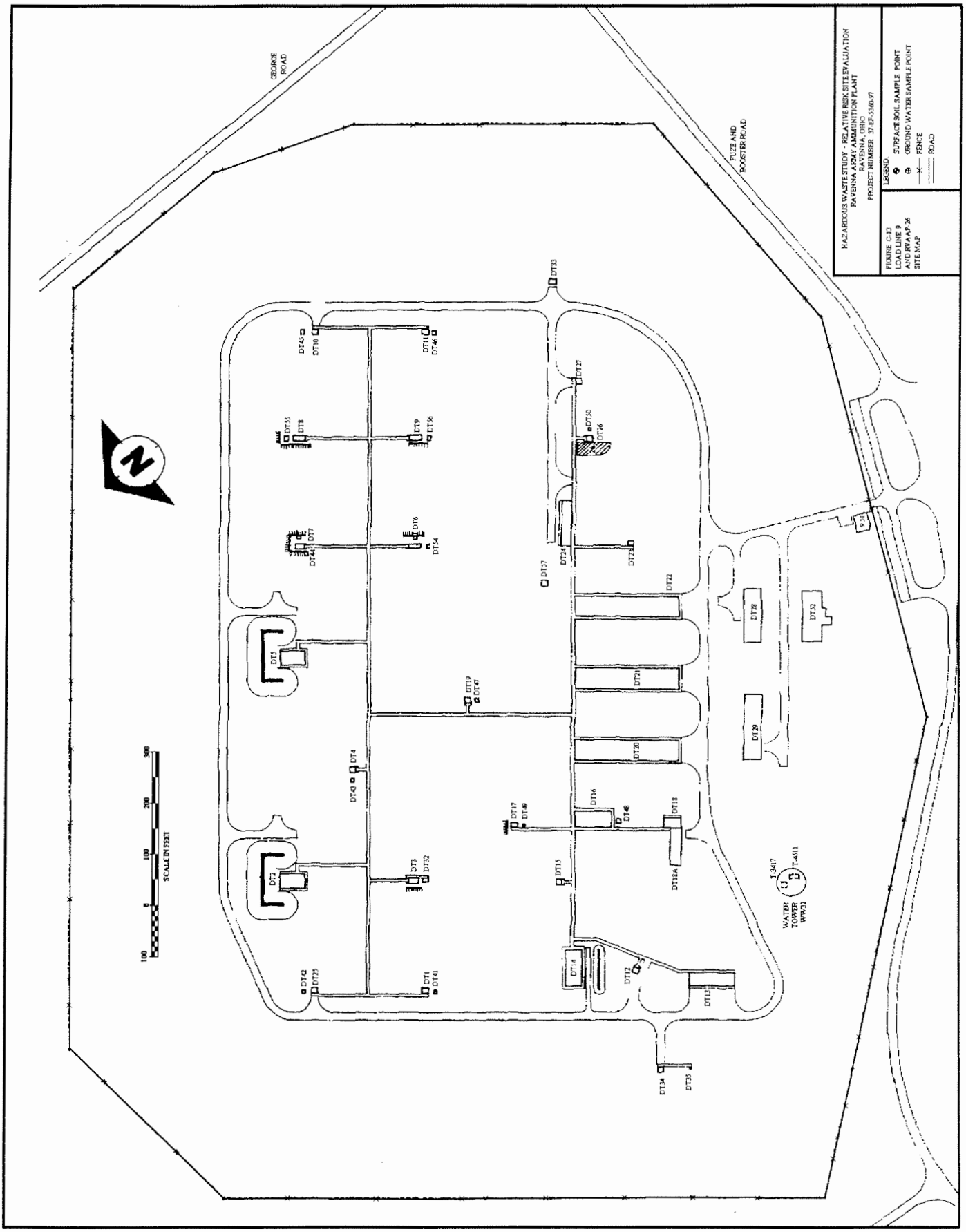

STATE ROUTE 534
RAMSDELL ROAD
SMALLSREED ROAD
McKIBBEN ROAD
RVAAP-23
T 101
BUTTS-KISTLER ROAD
ROUTE 5
HIGHWAY
STATE
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
FIGURE C-6
RVAAP-23 SITE MAP
LEGEND
SURFACE SOIL SAMPLE POINT
GROUND WATER SAMPLE POINT
FENCE
ROAD
STREAM
1000 500 0 1000 2000
SCALE IN FEET
N

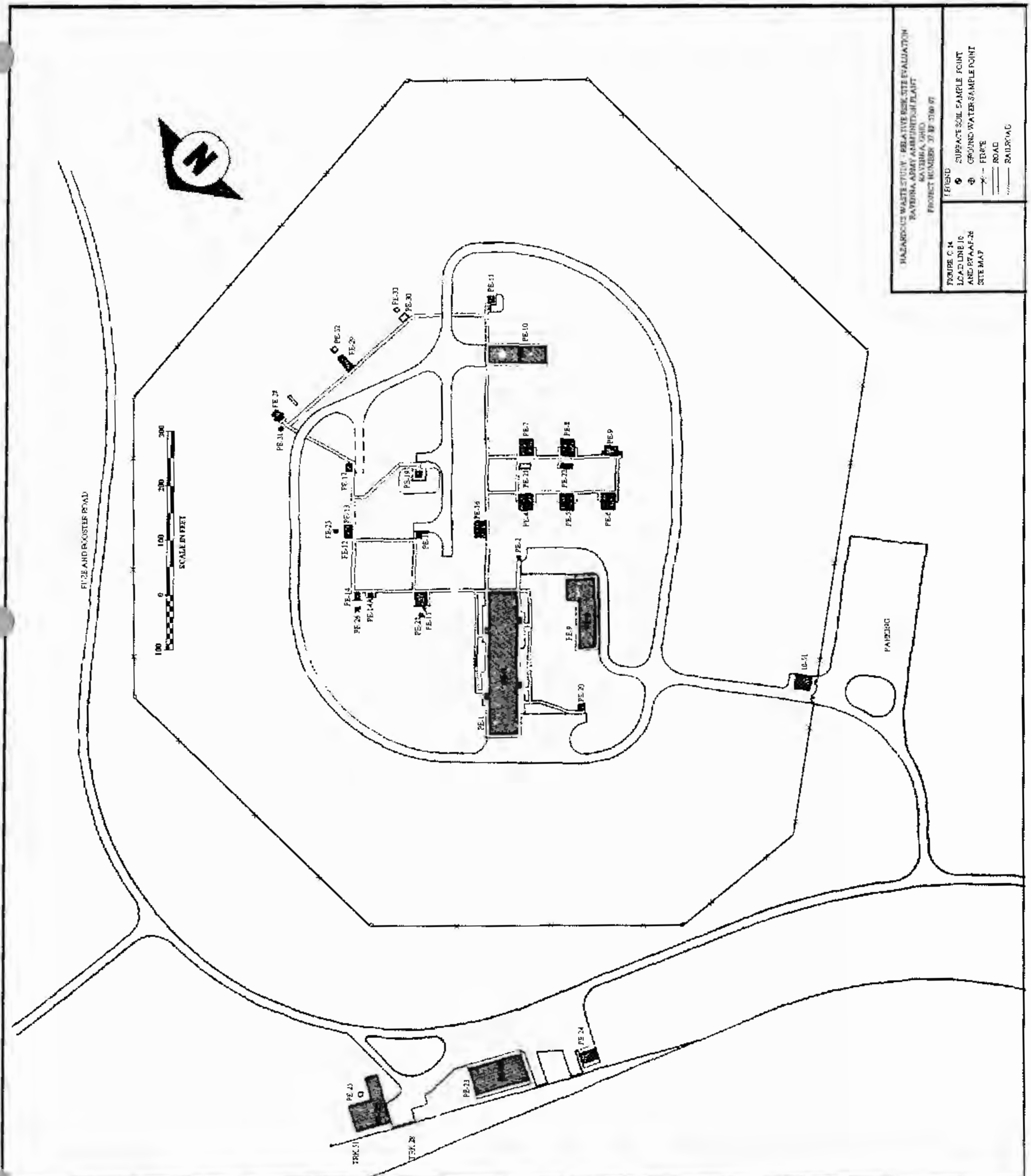

NEWTON FALLS ROAD
RVAAP-24
ROUTE NO 80
SCALE IN FEET
100 0 100 200 300 400
N
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
FIGURE C-9
RVAAP-24 SITE MAP
LEGEND
SURFACE SOIL SAMPLE POINT
ROAD
RAILROAD

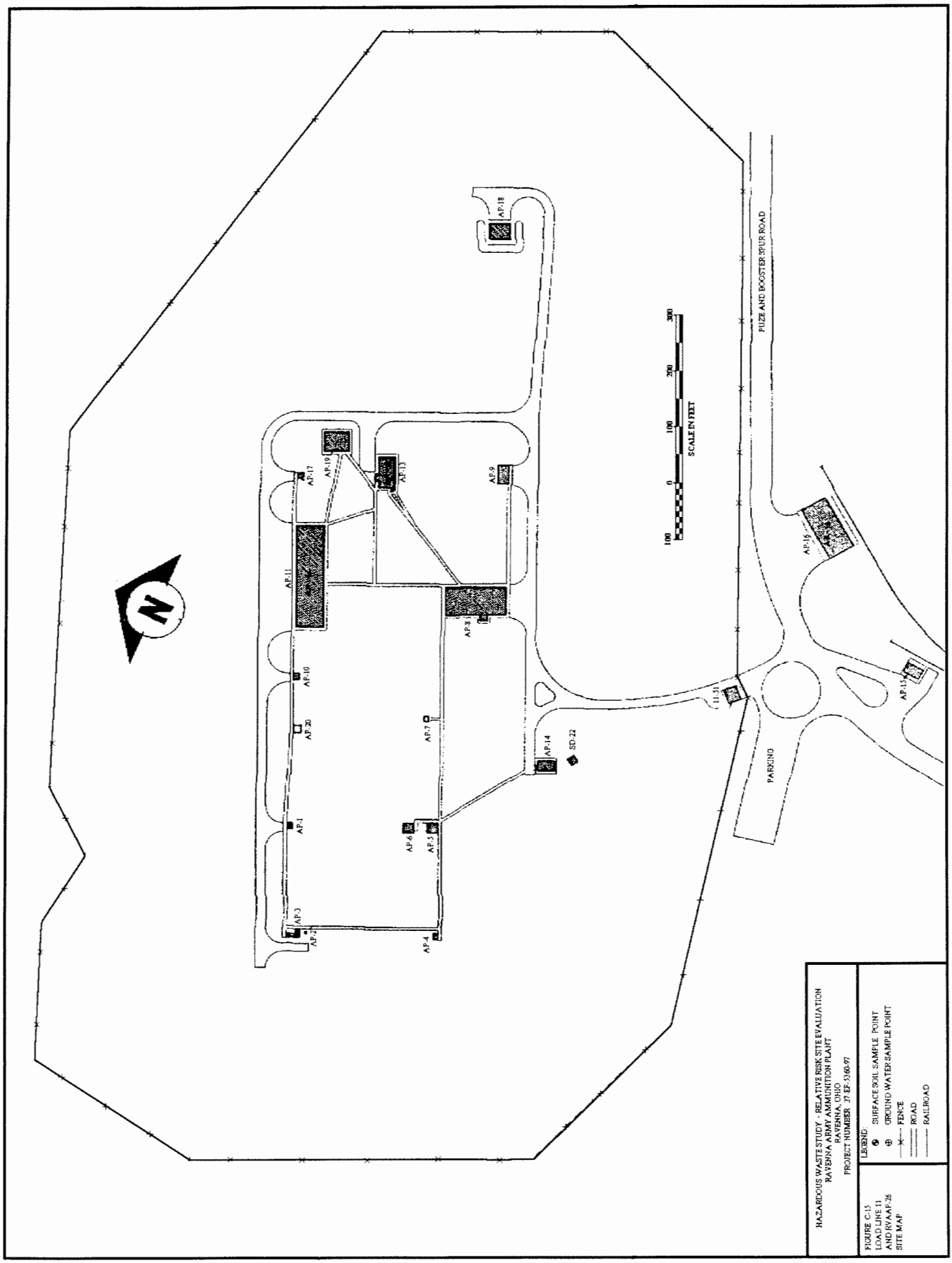

RVAAP-37
EXPLODED VIEW
N
1035
T-4501
T-4502
T-3414
T-3422
PS-10
1035A
1067
T-44-51
T-44-50
T-44-52
44-16
RVAAP-35
1037
1037A
EXPLODED
VIEW
ADMINISTRATION
ROAD
1048-A
T-4510
1048
1048-B
T-4803
1037
T-4512
1039
1055
SOUTH SERVICE ROAD
T-1065
1034
RVAAP-25
1034A
T-4504
PS-8
PS-2
1030
T-4503
1038
1047
P-6
950A
STATE ROUTE 5
100 0 100 200 300 400 500
SCALE IN FEET
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
FIGURE C-10
RVAAP-25,
RVAAP-35,
AND RVAAP-37
SITE MAP
LEGEND:
SURFACE SOIL SAMPLE POINT
GROUND WATER SAMPLE POINT
FENCE
ROAD

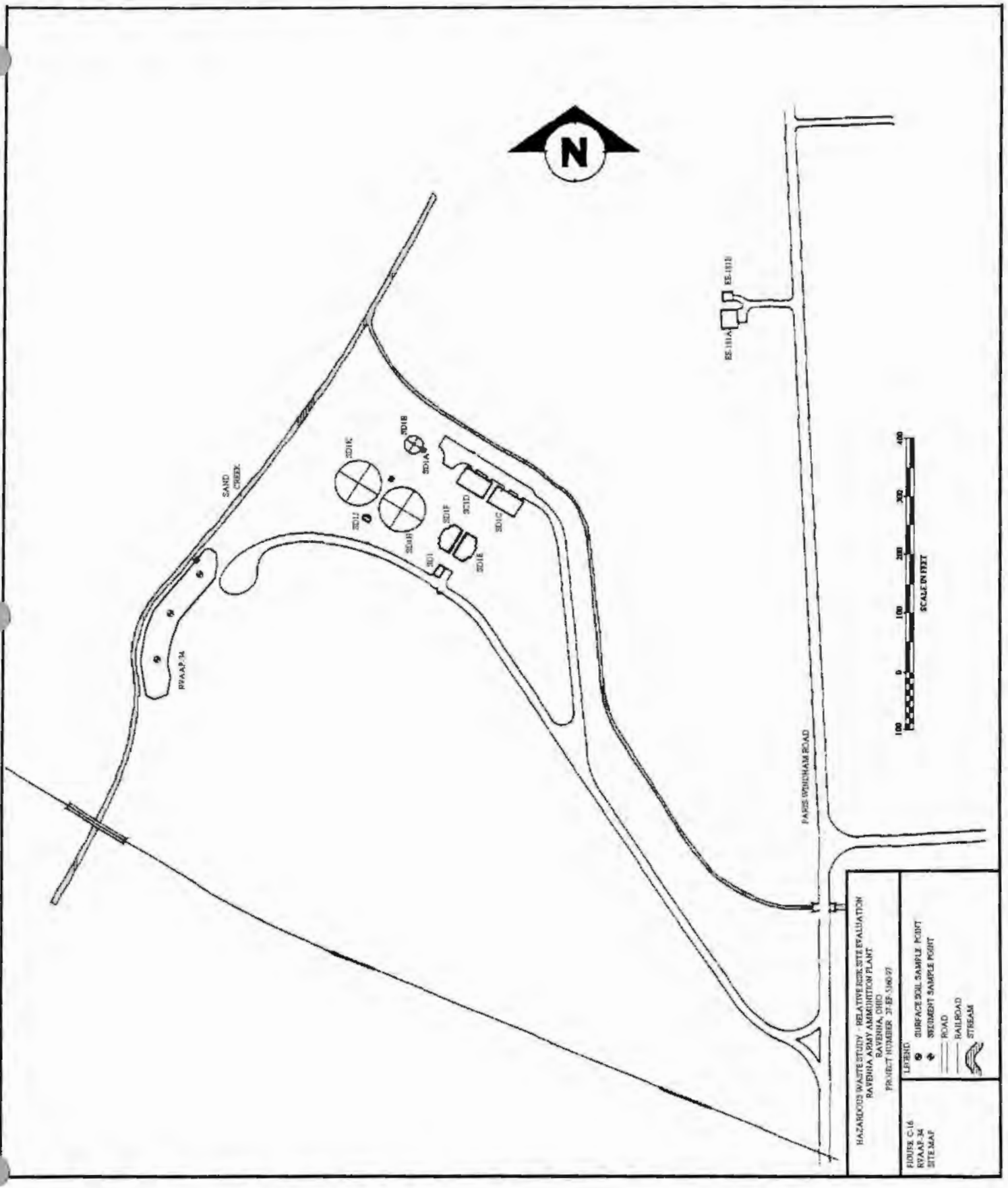

N
SCALE IN FEET
300
150
0
150
300
IF-12
IF-11
IF-10
IF-18
IF-15
IF-1
IF-2
IF-3
IF-4
T-3001
IF-20
IF-19
IF-5
IF-7
IF-6
IF-13
IF-14
S-51
PARKING
PARKING
FUDE AND BOOSTER SERVICE ROAD
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
LEGEND
SURFACE SOIL SAMPLE POINT
GROUND WATER SAMPLE POINT
FENCE
ROAD
RAILROAD
FIGURE C-11
LOCATION OF LINE 1
AND 69 AAP 26
SITE MAP

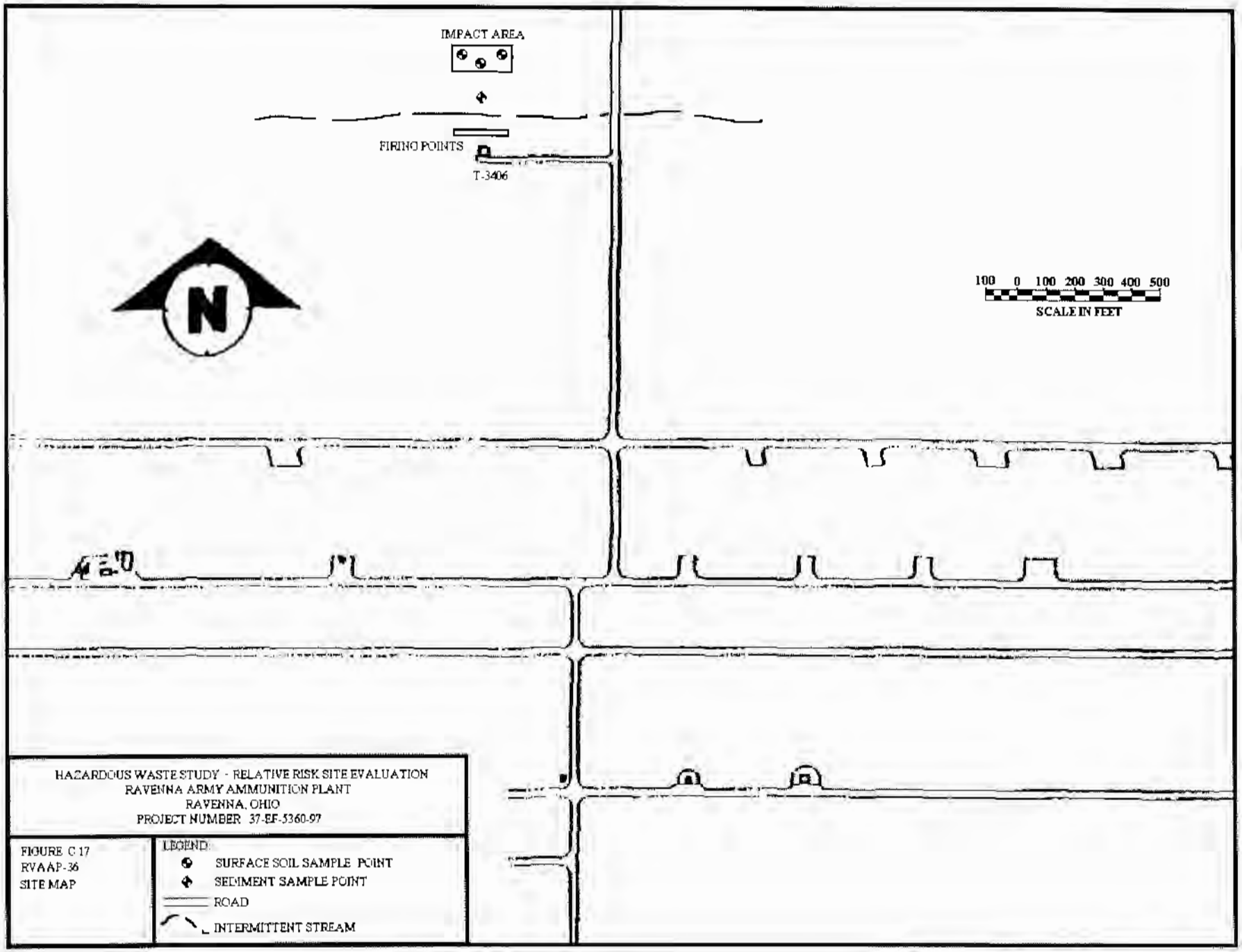

HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
FIGURE C-12
LOAD LINE 7,
RYAAP-26, AND
RYAAP-30
SITE MAP
LEGEND
SURFACE SOIL SAMPLE POINT
GROUND WATER SAMPLE POINT
FENCE
ROAD
RAILROAD
PARKING
WELL HOUSE 46
LINE OFFICES
T-51
TRAILER PAD
T-3410
FUZE AND BOOSTER SPUR ROAD
VACUUM COLLECTORS
SCALE IN FEET
100
0
100
200
300
N


HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
FIGURE C-13
LOAD LINE 9
AND RRAAP 26
SITE MAP
LEGEND
SURFACE SOIL SAMPLE POINT
GROUND WATER SAMPLE POINT
FENCE
ROAD
OSBORN ROAD
FUZE AND BOOSTER ROAD
SCALE IN FEET
WATER TOWER WW32


HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
LEGEND
SURFACE SOIL SAMPLE POINT
GROUND WATER SAMPLE POINT
FENCE
ROAD
RAILROAD
FIGURE C-14
LOAD LINE 10
SITE MAP
SCALE IN FEET
PARKING


N
SCALE IN FEET
100 0 100 200 300
FUZE AND BOOSTER SPUR ROAD
PARKING
AP-1
AP-2
AP-3
AP-4
AP-5
AP-6
AP-7
AP-8
AP-9
AP-10
AP-11
AP-13
AP-14
AP-15
AP-16
AP-17
AP-18
AP-20
SD-22
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
LEGEND
SURFACE SOIL SAMPLE POINT
GROUND WATER SAMPLE POINT
FENCE
ROAD
RAILROAD
FIGURE C-15
LOAD LINE 11
AND RVAAP-26
SITE MAP


N
SAND CREEK
RVAAP-34
SD1
SD1A
SD1B
SD1C
SD1D
SD1E
SD1F
SD1G
SD1H
SD1I
SD1J
ES-101A
ES-101B
PARIS RAVENNA ROAD
SCALE IN FEET
100
0
100
200
300
400
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
LEGEND
SURFACE SOIL SAMPLE POINT
SEDIMENT SAMPLE POINT
ROAD
RAILROAD
STREAM
FIGURE C-16
RVAAP-34
SITE MAP


IMPACT AREA
FIRING POINTS
T-3406
N
100 0 100 200 300 400 500
SCALE IN FEET
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
FIGURE C 17
RVAAP-36
SITE MAP
LEGEND:
SURFACE SOIL SAMPLE POINT
SEDIMENT SAMPLE POINT
ROAD
INTERMITTENT STREAM

APPENDIX D

RAVENNA ARMY AMMUNITION PLANT
TARGET ANALYTE LIST

TABLE 1. METALS.

Silver	Lead
Arsenic	Selenium
Barium	Antimony
Cadmium	Copper
Chromium	Zinc
Mercury	

TABLE 2. EXPLOSIVES.

2,4,6-TNT	TETRYL
1,3,5-TNB	HMX
2,4-DNT	RDX
1,3-DNB	4-amino-2,6-dinitrotoluene
2,6-DNT	4-amino-4,6-dinitrotoluene

TABLE 3. PESTICIDES/POLYCHLORINATED BIPHENOLS/HERBICIDES

Pesticides/Polychlorinated Biphenols			Herbicides
Aldrin	Dieldrin	PCB (Aroclor 1016)	2,4,5-T
BHC-alpha	Endosulfan I	PCB (Aroclor 1221)	2,4,-D
BHC-beta	Endosulfan II	PCB (Aroclor 1232)	2,4,-DB
BHC-delta	Endosulfan Sulfate	PCB (Aroclor 1242)	Dalapon
Chlordane, cis-	Endrin	PCB (Aroclor 1248)	Dicamba
Chlordane, technical	Endrin Aldehyde	PCB (Aroclor 1254)	Dinoseb
Chlordane, trans-	Heptachlor	PCB (Aroclor 1260)	Pentachlorophenol
DDD, p,p'-	Heptachlor Epoxide	Toxaphene	Picloram
DDE, p,p'-	Lindane		Silvex
DDT, p,p'-	Methoxychlor		

TABLE 4. SEMIVOLATILE ORGANIC COMPOUNDS.

Phenol
2-Chlorophenol
1,4-Dichlorobenzene
1,2-Dichlorobenzene
bis(2-chloroisopropyl) ether
N-Nitrous-di-n-propylamine
Nitrobenzene
2-Nitrophenol
bis(-2-Chloroethoxy) methane
1,2,4-Trichlorobenzene
4-Chloroaniline
4-Chloro-3-methylphenol
Hexachlorocyclopentadiene
2,4,5-Trichlorophenol
2-Nitroaniline
Acenaphthylene
3-Nitroaniline
2,4-Dinitrophenol
Dibenzofuran
Diethylphthalate
Fluorene
4,6-Dinitro-2-methylphenol
4-Bromophenyl-phenylether
Pentachlorophenol
Anthracene
Fluoranthene
Butylbenzylphthalate
Benzo(a)anthracene
bis(2-Ethylhexyl) phthalate
Benzo(b)fluoranthene
Benzo(a)pyrene
Dibenzo(a,h) anthracene
bis(-2-Chloroethyl) ether
1,3-Dichlorobenzene
Benzyl_alcohol
2-Methylphenol
4-Methylphenol
Hexachloroethane
Isophorone
2,4-Dimethylphenol
2,4-Dichlorophenol
Naphthalene
Hexachlorobutadiene
2-Methylnaphthalene
2,4,6-Trichlorophenol
2-Chloronaphthalene
Dimethyl_Phthalate
2,6-Dinitrotoluene
Acenaphthene
4-Nitrophenol
2,4-Dinitrotoluene
4-Chlorophenyl-phenylether
4-Nitroaniline
N-nitrosodiphenlyamine
Hexachlorobenzene
Phenanthrene
Di-n-butylphthalate
Pyrene
3,3'-Dichlorobenzidine
Chrysene
Di-n-octyl_Phthalate
Benzo(k)fluoranthene
Indeno(1,2,3-cd) pyrene
Benzo(g,h,i) perylene

TABLE 5. VOLATILE ORGANIC COMPOUNDS

Benzene
Bromochloromethane
Bromoform
N-Butylbenzene
Carbon tetrachloride
Chloroethane
Chloromethane
4-Chlorotoluene (P-Chlorotoluene)
1,2-Dibromo-3-chloropropane (DBCP)
Dibromomethane
1,3-Dichlorobenzene (M-Dichlorobenzene)
Dichlorodifluoromethane
1,2-Dichloroethane
cis-1,2-Dicloroethene
1,2-Dichloropropane
2,2-Dichloropropane
cis-1,3-Dichloropropene
Ethyl benzene
Isopropybenzene (Cumene)
Naphthalene
Styrene
1,1,2,2-Tetrachloroethane
Toluene
1,2,4-Trichlorobenzene
1,1,2-Trichloroethane
Trichlorofluoromethane
1,2,4-Trimethylbenzene
Vinyl chloride
Bromobenzene
Bromodichloromethane
Bromomethane
Tert-Butylbenzene
Chlorobenzene
Chloroform
2-Chlorotoluene (O-Chlorotoluene)
Dibromochloromethane
1,2-Dibromoethane (EDB)
1,2-Dichlorobenzene (O-Dichlorobenzene)
1,4-Dichlorobenzene (P-Dichlorobenzene)
1,1-Dichloroethane
1,1-Dichloroethene
trans-1,2-Dichloroethene
1,3-Dichloropropane
1,1-Dichloropropene
trans-1,3-Dichloropropene
Hexachlorobutadiene
Dichloromethane (Methylene chloride)
N-Propylbenzene
1,1,1,2-Tetrachloroethane
Tetrachloroethene
1,2,3-Trichloropropane
1,1,1-Trichloroethane
Trichloroethene
1,2,3-Trichloropropane
1,3,5-Trimethylbenzene
Xylenes (O/M/P-Xylene)

SITE SAFETY AND HEALTH PLAN
RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
PROJECT NUMBER 37-EF-5360-96
RAVENNA, OHIO
28 OCTOBER - 4 NOVEMBER 1996

1. Introduction.

a. Plan Purpose. The purpose of this site safety and health plan (SSHP) is to identify the activities to be performed during study activities and to identify the necessary precautions and activities to protect study personnel.

b. Study Purpose. The purpose of this study is to provide sufficient data to score Ravenna Army Ammunition Plant's (RVAAP's) previously uninvestigated sites, which are Defense Environmental Restoration Account-eligible, according to the Relative Risk Site Evaluation guidelines.

c. Summary of Proposed Activities.

(1) RVAAP-02, Erie Burning Grounds. This site was used from 1941 to 1951 to conduct open burning of explosives and related items. Bulk, obsolete, nonspecification propellants, and conventional explosives from throughout the installation were treated at the site. Metal items were treated to remove explosive residue before being processed as scrap. The area is now a swamp with up to several feet of water in places as a result of beaver activity. Two samples each of the surface water and sediment will be taken from the site with hand sampling devices. No attempt will be made to wade or otherwise enter the water.

(2) RVAAP-03, Demolition Area 1. Munitions were thermally treated at this site from 1941 through 1949 in a circular shaped bermed area. Bare areas of ground, fragments of metal, small arms primers, and fuzes have been seen outside the perimeter of the berm in previous surveys of the site. These were not observed in the scoping visit. Three soil samples (one outside and two inside the berm) will be collected with hand scoops.

(3) RVAAP-06, C-Block Quarry. This site is an unlined borrow pit that was used during the 1950's as a disposal area for annealing process wastes. Wastes that were disposed of in the pit were spent pickle liquors from brass finishing that contained lead, mercury, chromium, and sulfuric acid. The area is now heavily forested. Three soil samples will be collected with hand scoops.

(4) RVAAP-15, Load Line 6 Treatment Plant. This treatment plant is a closed-system, dual activated carbon filter for the treatment of pink water operated from 1987 to 1993. The filters were contained in a building with a concrete floor. The discharges from the filters were sent to either the installations hazardous waste storage area or a waste water treatment plant. The only potential for release at the plant is for spillage or leakage to have been washed off of the floor and out of the door during the daily cleaning operations. One soil sample will be taken with a hand scoop outside the door to the building.

(5) RVAAP-16, Quarry Landfill/Former Fuse and Booster Burning Pits/Pond. This site is an abandoned quarry that was used to burn sawdust waste from Load Lines 6 and 11 from 1945 to 1949. The site was also used as a landfill for spent brine regenerant and sand filtration backwash from the groundwater treatment plant, fuse and booster assemblies, projectiles, residual ash, and sanitary waste. The existing debris was removed from the site in 1976. There is no indication of regulatory oversight of the transfer process. The ponds were constructed prior to 1987 on the site to receive filter backwash from the potable water system. The ponds were operated as such from 1987 and 1993. Three samples each of surface water and sediment (one from each individual pond) will be taken from the site with hand sampling devices. No attempt will be made to wade or otherwise enter the water.

(6) RVAAP-18, Load Line 12 Treatment Plant. This treatment plant is a closed-system, dual activated carbon filter for the treatment of TNT water operated from 1981 to 1983. The filters were contained in a building with a concrete floor. The discharges from the filters were sent to either the installations hazardous waste storage area or a waste water treatment plant. The only potential for release at the plant is for spillage or leakage to have been washed off of the floor and out of the door during the daily cleaning operations. One soil sample will be collected using a hand scoop outside the door to the building.

(7) RVAAP-23, Unit Training Equipment Site Waste Oil Tank. This site was formerly a 1000 gallon underground storage tank used to hold waste oil from a vehicle maintenance shop. The tank was never leak tested. The tank was removed from operation in 1988, and was removed some time after that. No results of any sampling to determine if any oil leaked from the tank are available. One surface soil sample will be collected with a hand scoop and one ground water sample will be collected using the Geoprobe hydropunch from the location of the tank.

(8) RVAAP-24, Reserve Unit Maintenance Area Waste Oil Tank. This site was in operation from 1983 to 1995. There was one above-ground, 400 gallon tank used to store waste oil. The tank is no longer present at the site. Two surface soil samples will be collected using hand scoops in the area the tank was located.

Use of company names does not imply endorsement by the U.S. Army but is intended only to assist in identification of a specific product.

(9) RVAAP-25, Building 1034 Motor Pool Waste Oil Tank. This site was in operation from 1976 to 1995. There was one above-ground, 500 gallon tank used to store waste oil. The tank is no longer present at the site. Two surface soil samples will be collected using hand scoops in the area the tank was located and analyzed for metals and semivolatile organic compounds.

(10) RVAAP-26, Fuse and Booster Area settling tanks. This site consists of 15 concrete tanks located throughout Load Lines 5, 7, 9, 10, and 11. All but one of the tanks are underground. Load Line 5 has one 3840 gallon tank. Load Line 7 had one 1350 gallon tank removed in 1988. Load Line 9 has two tanks with capacities of 4800 gallons and 2880 gallons. Load Line 10 has nine tanks, seven with 3480 gallon capacity, one tank with 405 gallon capacity, and the above ground storage tank with an unknown capacity. Load Line 11 has three tanks with 3480 gallon capacity. These tanks were used as settling basins for explosive contaminated waste water from 1941 to 1971. The sludge was collected periodically and thermally treated at one of the burning grounds. The tanks were emptied, cleaned and covered in 1971. They have not been used since they were cleaned. Sampling data showing the level of decontamination are not available. Four of the tanks will be selected at random on the site and one surface soil sample will be collected using a hand scoop and one ground water sample will be collected using the Geoprobe hydropunch.

(11) RVAAP-28, Mustard Agent Burial Site. This site is a 15 by 18 by 18 foot area where mustard agent was buried prior to 1950 according to former employees. In 1969, an EOD unit excavated a suspected mustard agent burial site nearby and found one 50 gallon drum and 7 small rusty cans. No contamination was found during the excavation. An unidentified and undocumented source reported that the site had not been correctly identified and was adjacent to the area excavated. There have been no attempts to excavate this new site, and it was fenced off. The fence has since fallen. Two surface samples will be collected using hand scoops. No attempt will be made to take subsurface samples at this site due to the hazards associated with chemical warfare agents.

(12) RVAAP-30, Load Line 7 Treatment Plant. This treatment plant is a closed-system, dual activated carbon filter for the treatment of pink water operated from 1989 to 1993. The filters were contained in a building with a concrete floor. The discharges from the filters were sent to either the installations hazardous waste storage area or a waste water treatment plant. The only potential for release at the plant is for spillage or leakage to have been washed off of the floor and out the door during the daily cleaning operations. One soil sample will be collected using a hand scoop outside the door to the building.

Use of company names does not imply endorsement by the U.S. Army but is intended only to assist in identification of a specific product.

(13) RVAAP-32, 40 and 60 mm Firing Range. This site was used as a test firing range for munitions from the 1940's through the 1950's. It is unknown how many munitions were fired at the site since little historical information exists on the site. Three soil samples will be collected using hand scoops. No attempt will be made to take subsurface samples at this site due to the hazards associated with unexploded ordinance.

(14) RVAAP-33, Firestone Test Facility. This site at Load Line 6 was operated by a government contractor conducting classified experiments on explosives and munitions. Shaped explosive charges were tested in several structures and one underwater test facility. The facility is no longer active, but the dates of operation for the facility are not known. Seven soil samples will be collected using hand scoops, one surface water sample will be collected with a hand sampler, and one sediment sample will be collected using a hand sampler at the site.

(15) RVAAP-34, Sand Creek Disposal Landfill. This site was used as a construction debris landfill for the disposal of concrete, wood, asbestos debris, and fluorescent light tubes. The facility is no longer active, but the dates of operation for the facility are not known. Three soil samples and one sediment sample will be collected using hand scoops.

(16) RVAAP-35, Building 1037, Laundry Waste Water Tank. This site is a concrete sump used a settling tank for RVAAP's laundry facility. The sump was filled with soil after operation ceased. The dates of operation of the facility are not known. The building is now used as the RVAAP Headquarters Building. No evidence of cleaning or decontamination of the sump have been documented. One soil sample will be collected using a hand scoop and one ground water sample will be collected using the Geoprobe hydropunch.

(17) RVAAP-36, Pistol Range. This site was used by the installations security personnel for pistol qualifications. Personnel fired into a soil embankment. The facility is no longer active, but the dates of operation for this facility are not known. Three soil samples and one sediment sample will be collected using hand scoops.

(18) RVAAP-37, Pesticide Building. This building was used from 1970's to 1993 as a pesticide storage and mixing facility. The building is a wooden structure with a crawl space. The floor of the facility was not impermeable. Two soil samples will be collected by first sawing a hole in the floor, and then sampling the soil beneath the floor with a hand auger.

(19) RVAAP-38, NACA Test Area. This area was used as an aircraft test area. Airplanes with full fuel loads were rammed into an obstacle that sheared off the left side landing gear to intentionally cause crashes. These tests were to develop explosion proof fuel tanks and/or

fuels. The area was used during the 1950's. Five soil samples and one sediment sample will be collected using hand auger.

2. Personnel and Responsibilities.

a. Creighton Jacobson, U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM) Safety and Occupational Health Manager. Ensures all CHPPM personnel are aware of the safety concerns related to their specific duties and are enrolled in an appropriate medical surveillance program.

b. Linda Baetz, Acting Program Manager, Hazardous and Medical Waste Program (HMWP), CHPPM. Provides Program oversight including assurance that all legal and safety issues are addressed.

c. Thomas Runyon, Team Leader, Special Studies and Technologies Team (SSTT), HMWP. Ensures all SSTT personnel are covered by the medical surveillance program and receive all safety training required for job performance. Ensures team personnel prepare and staff project specific SSHPs.

d. James R. Sheehy, Project Officer and Site Safety Manager, SSTT, HMWP. Identifies project safety hazards and prepares a comprehensive plan to preclude hazardous exposures and physical accidents. Ensures that all study team members are aware of the potential hazards, follow established protocols, and are familiar with emergency procedures. Stops work in the event of exposures or increased work site hazards.

e. Rocky Hoover, Engineering Technician, Ground Water and Solid Waste Program (GWSWP). Sampling systems operator. Provides sampling assistance.

f. Robert DeSocio, Engineering Technician, GWSWP, CHPPM. Provides sampling assistance.

e. John A. Cicero, Jr., Commanders Representative, RVAAP. Is aware of CHPPM activities on site and ensures all site specific safety threats and procedures are considered prior to site activities.

3. Personnel Training.

a. All study personnel have successfully completed an accredited 40-hour hazardous waste operations and emergency response (HAZWOPER) course, along with requisite 8-hour annual refresher training. Each individual should carry a copy of their current certification during site operations. All site visitors must have completed appropriate training to be on the

study site. In addition, the Project Safety Manager has completed the 8-hour basic HAZWOPER supervisor's course.

b. A minimum of two onsite personnel will have received first aid and cardiopulmonary resuscitation (CPR) training. Current certification from an accredited organization/program will be available, upon request, from the Program Manager's designee.

c. Tailgate safety meetings will be conducted prior to each day's activities. These meetings are mandatory for all study personnel. Topics will include, but are not limited to, study activities and procedures, associated health and safety issues, and required personnel protective equipment.

4. Medical Surveillance. All USACHPPM personnel involved in field activities participate in the medical surveillance program operated through the U.S. Army Health Clinic, Aberdeen Proving Ground-Edgewood Area. Personnel are re-assessed on an annual basis.

5. Hazard Assessment.

a. Chemical Hazards. The contaminants of concern for this study - explosives, heavy metals, semivolatile organic compounds, volatile organic compounds, pesticides, herbicides, cyanide, and thiodiglycol - are not expected to be present in sufficient quantities to pose an air-borne/inhalation hazard. To prevent dermal contact, incidental ingestion, and removal of site contaminants to other areas, Tyvek®[1] suits and latex gloves will be worn during sampling activities. Gloves will be changed between sampling locations; Tyvek will be changed between each site and at the end of each day. No food will be consumed onsite. To prevent potential exposure to mustard agent, no subsurface sampling will be conducted at RVAAP-28.

b. Physical Hazards. Numerous physical hazards are associated with hydraulic push sampling equipment or the operation of power tools. Care will be taken at all times to avoid potentially dangerous situations. In addition, steel-toed boots will be worn at all times. Hearing protection will be worn during Geoprobe operation. Safety glasses be available at all times and will be required by the site safety manager during Geoprobe, power tool operation, or if the situation warrants as directed by the site safety manager. Given the timing of this study, heat or cold weather related injuries should not be a problem. Proper hydration and wear of clothing will be utilized to avoid both. During the project scoping visit, no UXO was observed at the surface at RVAAP-32, however, to avoid potential contact with UXO, no subsurface sampling will be conducted at that location.

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[1]Tyvek is a registered trademark of E.I. DuPont de Nemours & Co., Inc., Wilmington, Delaware.

c. Biological Hazards. Many of the study areas are in grassy or wooded outdoor areas. To avoid ticks, biting flies, etc., commercial insect and tick repellant will be worn during site activities if arthropods are discovered.

6. Personnel Protective Equipment.

a. Based on site history and the hazard assessment completed above, the level of personnel protective equipment to be worn is a modified level D. The Personal Protective Equipment (PPE) to be worn by all personnel while conducting this study (as described in the hazard assessment) follows: disposable, Tyvek coveralls, steel-toed work boots, hearing protection, safety glasses, and latex gloves.

7. Site Control Measures. The study sites to be sampled during this investigation are not 'uncontrolled hazardous waste sites' as defined by relevant regulations. Therefore, exclusionary zones will not be established nor maintained during site activities. No personnel, beyond those listed in the SSHP, will be permitted to handle sampling equipment or the samples themselves.

8. Decontamination Procedures.

a. Decontamination involves the controlled removal of chemical contamination from equipment and PPE. It is an essential step to protect worker health, prevent the spread of contamination offsite, and to preclude the cross-contamination of equipment and samples onsite.

b. Latex gloves will be changed between sample collection locations using care not to touch the glove exteriors during doffing and placed in a plastic bag. Tyvek suits will be discarded between study sites and at the end of each day, using care not to touch the suit exterior during doffing and placed in a plastic bag. Sampling equipment will be decontaminated by rinsing with potable water, scrubbing with Alconox®[2] soap, and finally rinsing with distilled water.

c. The determination had been made that the potential for exposure to contamination by study personnel is low. Therefore, the protection offered to work boots by the Tyvek suit is deemed sufficient to prevent contamination of upper surfaces. Care will be taken to avoid stepping in areas of disturbed soil to prevent contamination of the soles. Shoe soles will be brushed off as each site is exited. Finally, hands will be washed prior to eating and at the end of each day. Disposable cups will be used for drinking during study activities.

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[2] Alconox is a registered trademark of Alconox Incorporated, New York, New York.

9. Emergency Procedures. In the event of an emergency, the installation emergency phone number - (330) 358-7409- will be called using a cellular telephone which will be carried at all times. This phone number is the guard house at the RVAAP Main Gate. The answering security guard will be informed we are having an emergency, the nature of the emergency (i.e. fire or medical), and the location of the emergency. The security guard will then contact the appropriate emergency service. The location of the nearest medical facility, Robinson Memorial Hospital, is shown in the attached Figure. Directions to the facility are on the Figure.

10. Personnel Certification. A pre-entry briefing will be held prior to all sampling activities. This briefing will consist of the familiarization of project personnel with the sample locations and methodologies, site safety procedures, and emergency response procedures. The following individuals acknowledge that they have been notified of the contents of this SSHP, understand its requirements, and agree to comply with the identified procedures:

Name	Signature	Date
James R. Sheehy	James R Sheehy	15 OCT 96
Rocky Hoover		28 Oct 96
Robert DeSocio	Robert deSocio	28 OCT 96

PREPARED BY:

James R Sheehy 15 OCT 96

JAMES R. SHEEHY DATE
Project Officer/Site Safety Manager

REVIEWED BY:

Thomas R. Runyon 18 Oct 96

THOMAS R. RUNYON DATE
Team Leader
Special Studies/Technology Team

Hazardous and Medical Waste Program Study No. 37-EF-5360-97, 28 OCT - 4 NOV 1996

CONCURRENCE BY:

for Thomas R. Runyon 18 Oct 96

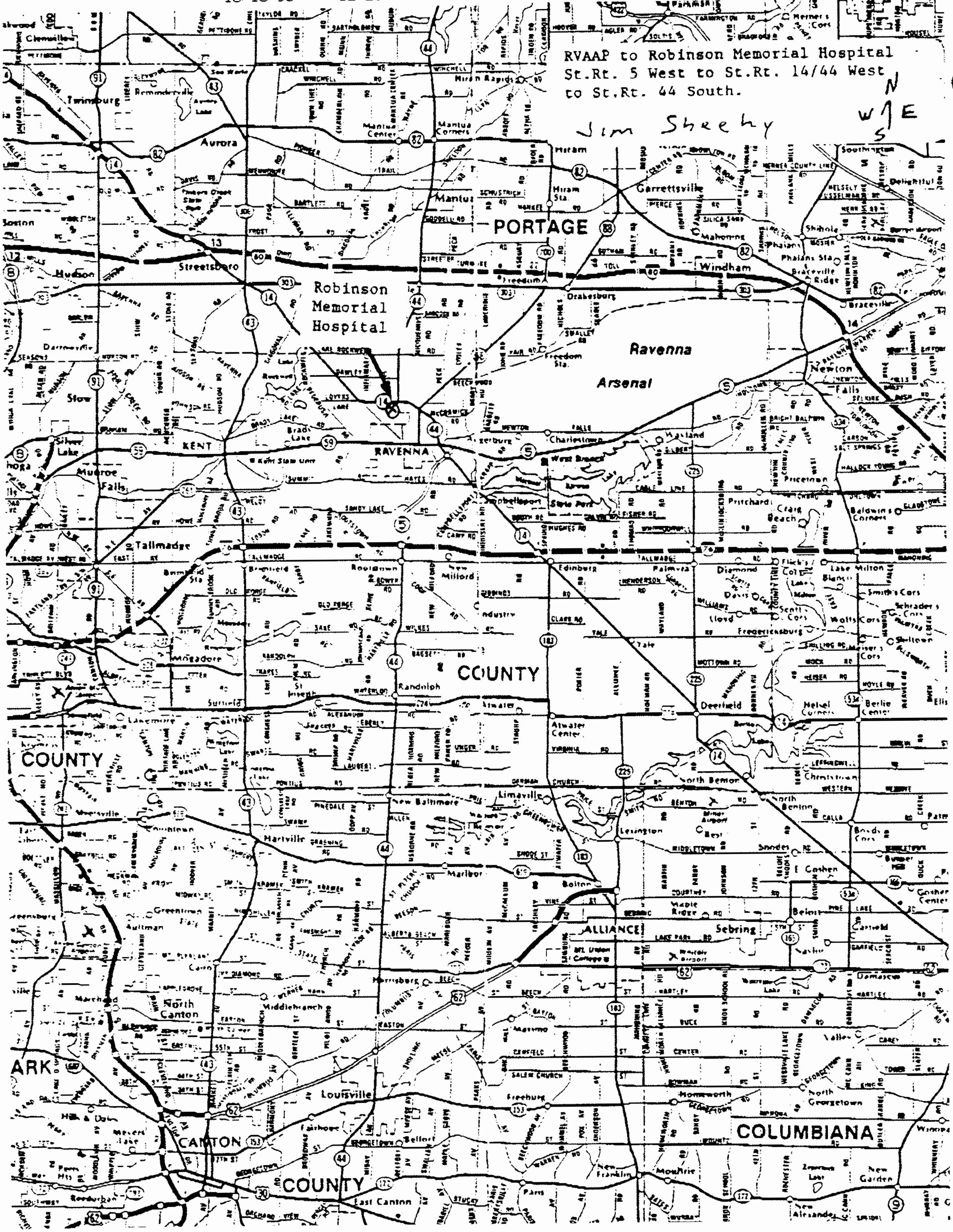
LINDA L. BAETZ DATE
Acting Program Manager
Hazardous and Medical Waste
USACHPPM

for Thomas R. Runyon

CREIGHTON P. JACOBSON DATE
Safety and Occupational Health
Manager
USACHPPM

28 Oct 96

JOHN A. CICERO, JR. DATE
Commanders Representative
RVAAP


RVAAP to Robinson Memorial Hospital
St.Rt. 5 West to St.Rt. 14/44 West
to St.Rt. 44 South.
Jim Sheehy
N
W E
S
Robinson
Memorial
Hospital
Ravenna
Arsenal
PORTAGE
COUNTY
COLUMBIANA
CANTON
ALLIANCE
RAVENNA
KENT
Aurora
Twinsburg
Streetsboro
Hudson
Stow
Tallmadge
Garrettsville
Windham
Newton Falls
Deerfield
Sebring
Louisville
East Canton
North Canton
Freedom
Mantua
Hiram
Edinburg
Palmyra
Atwater
Randolph
Limaville
Charlestown
Mogadore
Hartville
Homeworth
North Georgetown
Marlboro
Alliance
Middlebranch
Diamond
Lake Milton
Berlin Center
New Franklin
Moultrie
Freeburg

APPENDIX C

RELATIVE RISK SITE EVALUATION
SITE SCORING WORKSHEETS

1. **Site Name**: RVAAP-02, Erie Burning Grounds.

2. **Site Summary**: This site was used from 1941 to 1951 to conduct open burning of explosives and related items. Bulk, obsolete, nonspecification propellants, and conventional explosives from throughout the installation were treated at the site. Metal items were treated to remove explosive residue before being processed as scrap. The area is now a swamp with up to several feet of water in places as a result of beaver activity. Two samples each of the surface water and sediment were collected from the site and analyzed for explosives and metals. There are no nearby workers. However, hunters have access to the site.

3. **Pathway Evaluation**:

a. **Ground Water**: *Not Evaluated.* There is no ground water associated with this site.

b. **Surface Water/Human Endpoint**: *High.*

(1) **Contaminant Hazard Factor**: *4.92 = Moderate*

Contaminant	Max Concentration (µg/L)	Standard (µg/L)	Ratio
arsenic	4	4.5	0.89
barium	29	2600	0.01
copper	29	1400	0.02
lead	16	4	4

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Identified.* This area is not used for production. However, hunters and fishermen have access to the site and use it for recreational activities. Access to the site is not restricted in any manner.

c. **Sediment/Human Endpoint**: *Medium.*

(1) **Contaminant Hazard Factor**: *0.50 = Minimal*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	9.94	22	0.45
barium	113	5300	0.02
chromium	18.6	3000	0.01
copper	32.8	2800	0.01
zinc	217	23000	0.01

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

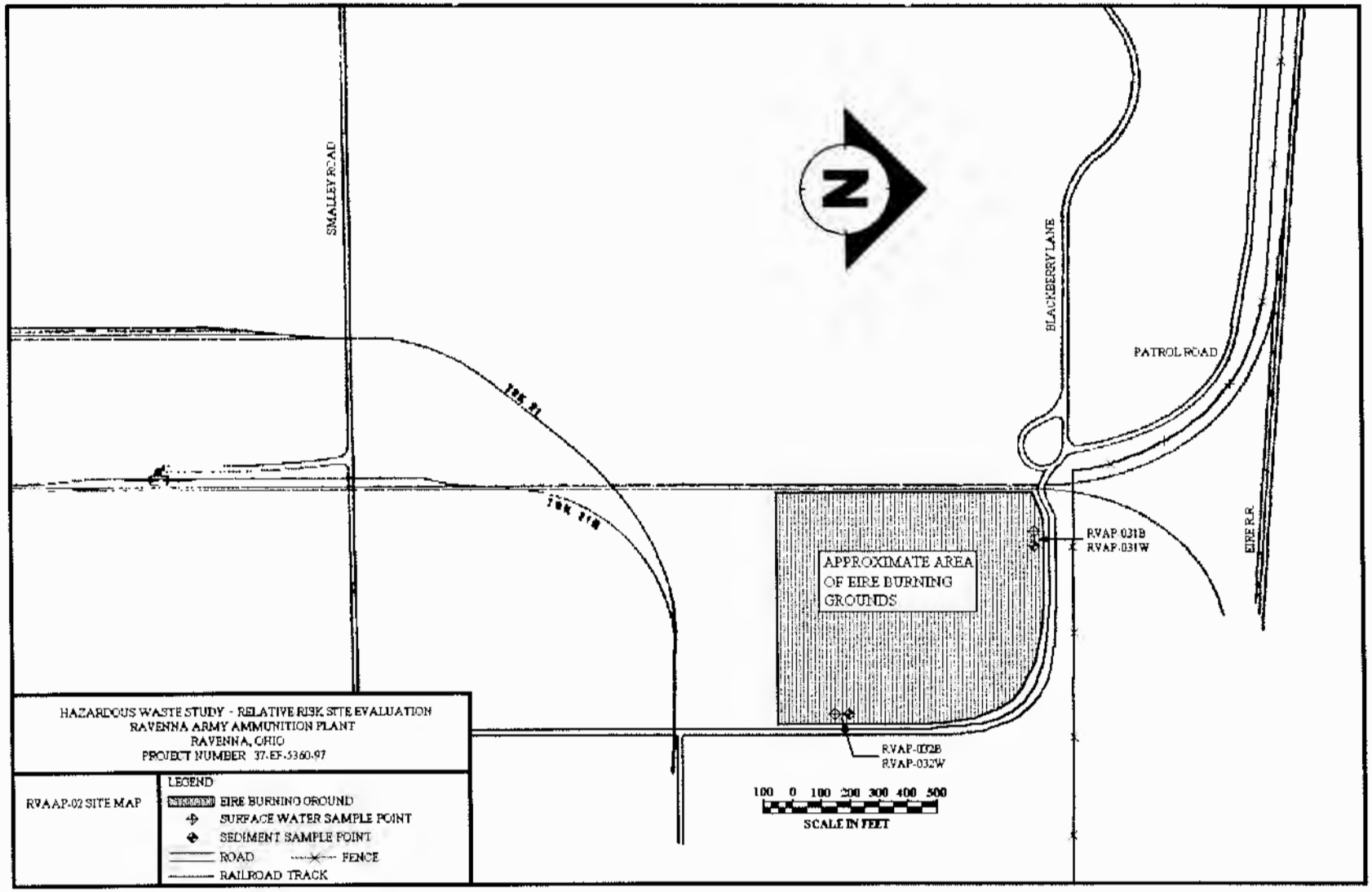
(3) **Receptor Pathway Factor**: *Identified.* This area is not used for production, but hunters and fishermen have access to the site and use it for recreational activities. Access to the site is not restricted in any manner.

d. **Surface Water/Ecological Endpoint**: *Not Evaluated.* The surface water at this site does not impact any critical habitat, as defined in the *Primer*.

e. **Sediment/Ecological Endpoint**: *Not Evaluated.* The sediment associated with this site does not impact any critical habitat, as defined in the *Primer*.

f. **Surface Soil**: *Not Evaluated.* There is no surface soil associated with this site.

4. **Final Score**. High (1), two Media of Concern.


SMALLEY ROAD
BLACKBERRY LANE
PATROL ROAD
EIRE R.R.
APPROXIMATE AREA OF EIRE BURNING GROUNDS
RVAP-031B
RVAP-031W
RVAP-032B
RVAP-032W
100 0 100 200 300 400 500
SCALE IN FEET
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
RVAAP-02 SITE MAP
LEGEND
EIRE BURNING GROUND
SURFACE WATER SAMPLE POINT
SEDIMENT SAMPLE POINT
ROAD
FENCE
RAILROAD TRACK

1. **Site Name**: RVAAP-03, Demolition Area 1.

2. **Site Summary**: Munitions were thermally treated at this site from 1941 through 1949 in a circular shaped bermed area. Bare areas of ground, fragments of metal, small arms primers, and fuzes have been seen outside the perimeter of the berm in previous surveys of the site. These were not observed in the scoping visit. Three soil samples (one on the berm and two inside the berm) were taken and analyzed for explosives and metals.

3. **Pathway Evaluation**:

a. **Ground Water**: *Not Evaluated.* There is no ground water associated with this site.

b. **Surface Water/Human Endpoint**: *Not Evaluated.* There is no surface water associated with this site.

c. **Sediment/Human Endpoint**: *Not Evaluated.* There is no sediment associated with this site.

d. **Surface Water/Ecological Endpoint**: *Not Evaluated.* There is no surface water associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

e. **Sediment/Ecological Endpoint**: *Not Evaluated.* There is no sediment associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

f. **Surface Soil**: *Medium.*

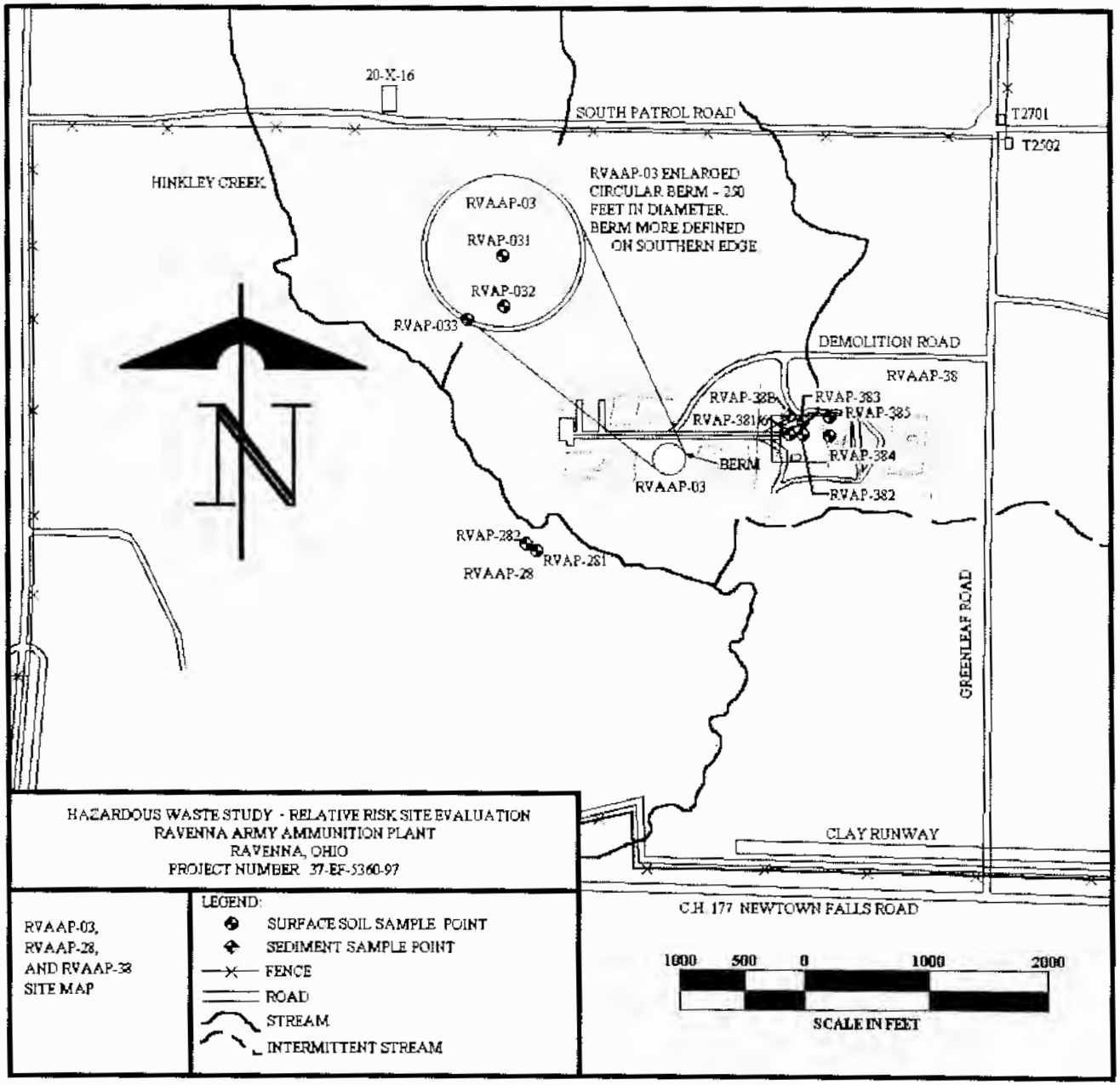
(1) **Contaminant Hazard Factor**: *16.88 = Moderate*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	9	22	0.41
barium	162	5300	0.03
cadmium	41.1	38	1.08
chromium	33.8	3000	0.01
copper	13.3	2800	0
mercury	0.26	23	0.01
zinc	61.5	23000	0
2,4,6-TNT	23000	1500	15.33

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* Access to this site is not restricted, and nearby areas are used by the Ohio National Guard for training.

4. **Final Score**. Medium (2), one Medium of Concern.


20-X-16
SOUTH PATROL ROAD
T2701
T2502
HINKLEY CREEK
RVAAP-03
RVAP-031
RVAP-032
RVAP-033
RVAAP-03 ENLARGED CIRCULAR BERM - 250 FEET IN DIAMETER. BERM MORE DEFINED ON SOUTHERN EDGE
DEMOLITION ROAD
RVAAP-38
RVAP-38B
RVAP-383
RVAP-381C
RVAP-385
RVAP-384
BERM
RVAAP-03
RVAP-382
RVAP-282
RVAP-281
RVAAP-28
GREENLEAF ROAD
CLAY RUNWAY
C.H. 177 NEWTOWN FALLS ROAD
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
RVAAP-03,
RVAAP-28,
AND RVAAP-38
SITE MAP
LEGEND:
SURFACE SOIL SAMPLE POINT
SEDIMENT SAMPLE POINT
FENCE
ROAD
STREAM
INTERMITTENT STREAM
1000 500 0 1000 2000
SCALE IN FEET

1. **Site Name**: RVAAP-06, C-Block Quarry.

2. **Site Summary**: This site is an unlined borrow pit that was used during the 1950's as a disposal area for annealing process wastes. Wastes that were disposed of in the pit were spent pickle liquors from brass finishing that contained lead, mercury, chromium, and sulfuric acid. The area is now heavily forested. Three soil samples were taken and analyzed for metals and cyanide.

3. **Pathway Evaluation**:

a. **Ground Water**: *Not Evaluated.* There is no ground water associated with this site.

b. **Surface Water/Human Endpoint**: *Not Evaluated.* There is no surface water associated with this site.

c. **Sediment/Human Endpoint**: *Not Evaluated.* There is no sediment associated with this site.

d. **Surface Water/Ecological Endpoint**: *Not Evaluated.* There is no surface water associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

e. **Sediment/Ecological Endpoint**: *Not Evaluated.* There is no sediment associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

f. **Surface Soil**: *Low.*

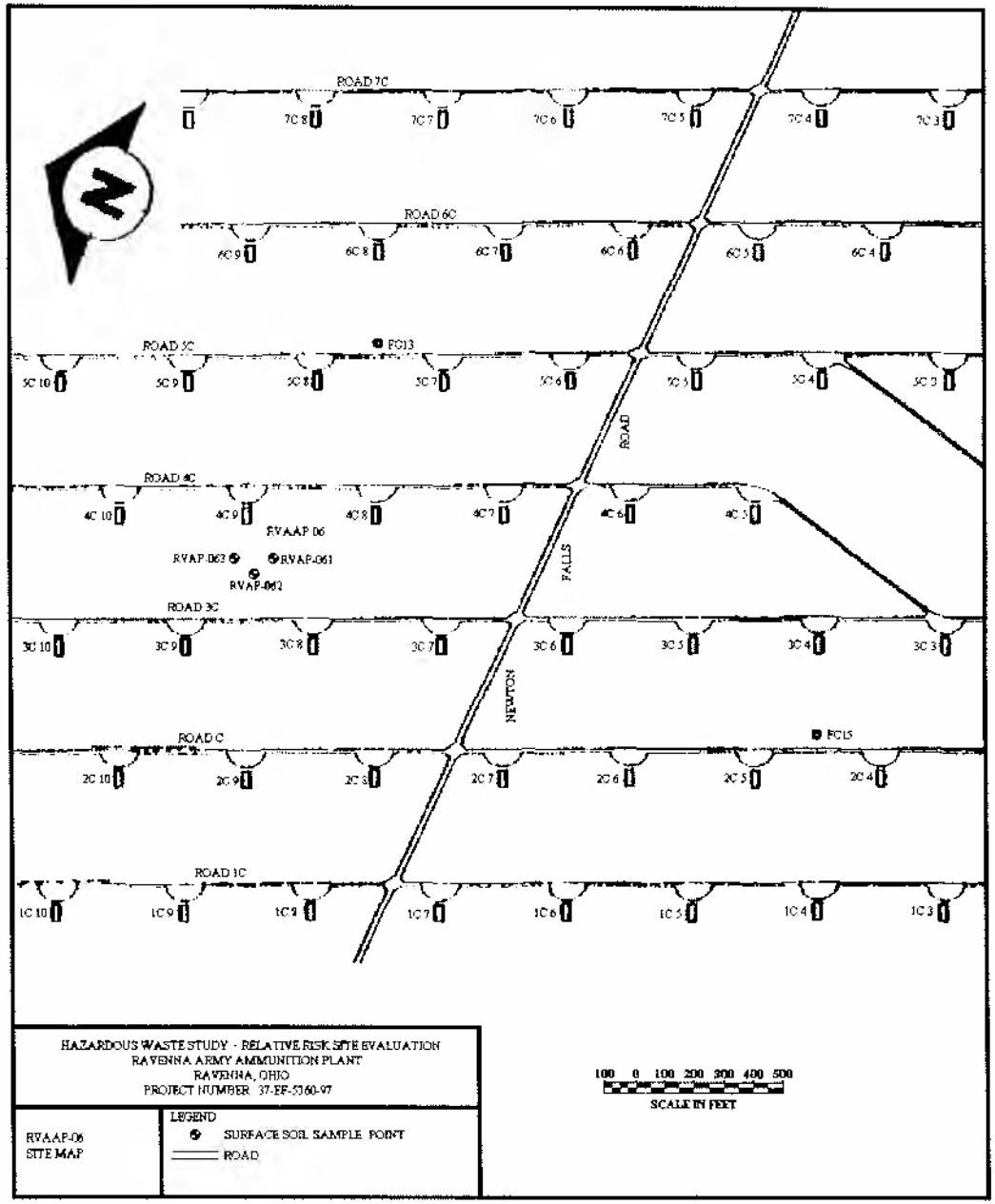
(1) **Contaminant Hazard Factor**: *0.80 = Minimal.*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	12.3	22	0.56
barium	104	5300	0.02
chromium	394	3000	0.13
copper	20.3	2800	0.01
lead	31.2	400	0.08
zinc	59.5	23000	0

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* This area is not used for production and is not populated with workers. However, access to the site is not restricted in any manner.

4. **Final Score**. Low (3), one Medium of Concern.


ROAD 7C
7C 8
7C 7
7C 6
7C 5
7C 4
7C 3
ROAD 6C
6C 9
6C 8
6C 7
6C 6
6C 5
6C 4
ROAD 5C
FC13
5C 10
5C 9
5C 8
5C 7
5C 6
5C 5
5C 4
5C 3
ROAD
ROAD 4C
4C 10
4C 9
4C 8
4C 7
4C 6
4C 5
RVAAP 06
RVAP-063
RVAP-061
RVAP-062
FALLS
ROAD 3C
3C 10
3C 9
3C 8
3C 7
3C 6
3C 5
3C 4
3C 3
NEWTON
ROAD C
FC15
2C 10
2C 9
2C 8
2C 7
2C 6
2C 5
2C 4
ROAD 1C
1C 10
1C 9
1C 8
1C 7
1C 6
1C 5
1C 4
1C 3
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
RVAAP-06
SITE MAP
LEGEND
SURFACE SOIL SAMPLE POINT
ROAD
100 0 100 200 300 400 500
SCALE IN FEET

1. **Site Name**: RVAAP-15, Load Line 6 Treatment Plant.

2. **Site Summary**: This treatment plant is a closed-system, dual-activated-carbon filter for the treatment of pink water, which was operated from 1987 to 1993. The filters were contained in a building with a concrete floor. The discharges from the filters were sent to either the installation's hazardous waste storage area or a waste water treatment plant. The only potential for release at the plant is for spillage or leakage to have been washed off of the floor and out of the door during the daily cleaning operations. One soil sample was taken outside the door to the building and analyzed for explosives and metals.

3. **Pathway Evaluation**:

a. **Ground Water**: *Not Evaluated.* There is no ground water associated with this site.

b. **Surface Water/Human Endpoint**: *Not Evaluated.* There is no surface water associated with this site.

c. **Sediment/Human Endpoint**: *Not Evaluated.* There is no sediment associated with this site.

d. **Surface Water/Ecological Endpoint**: *Not Evaluated.* There is no surface water associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

e. **Sediment/Ecological Endpoint**: *Not Evaluated.* There is no sediment associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

f. **Surface Soil**: *Low.*

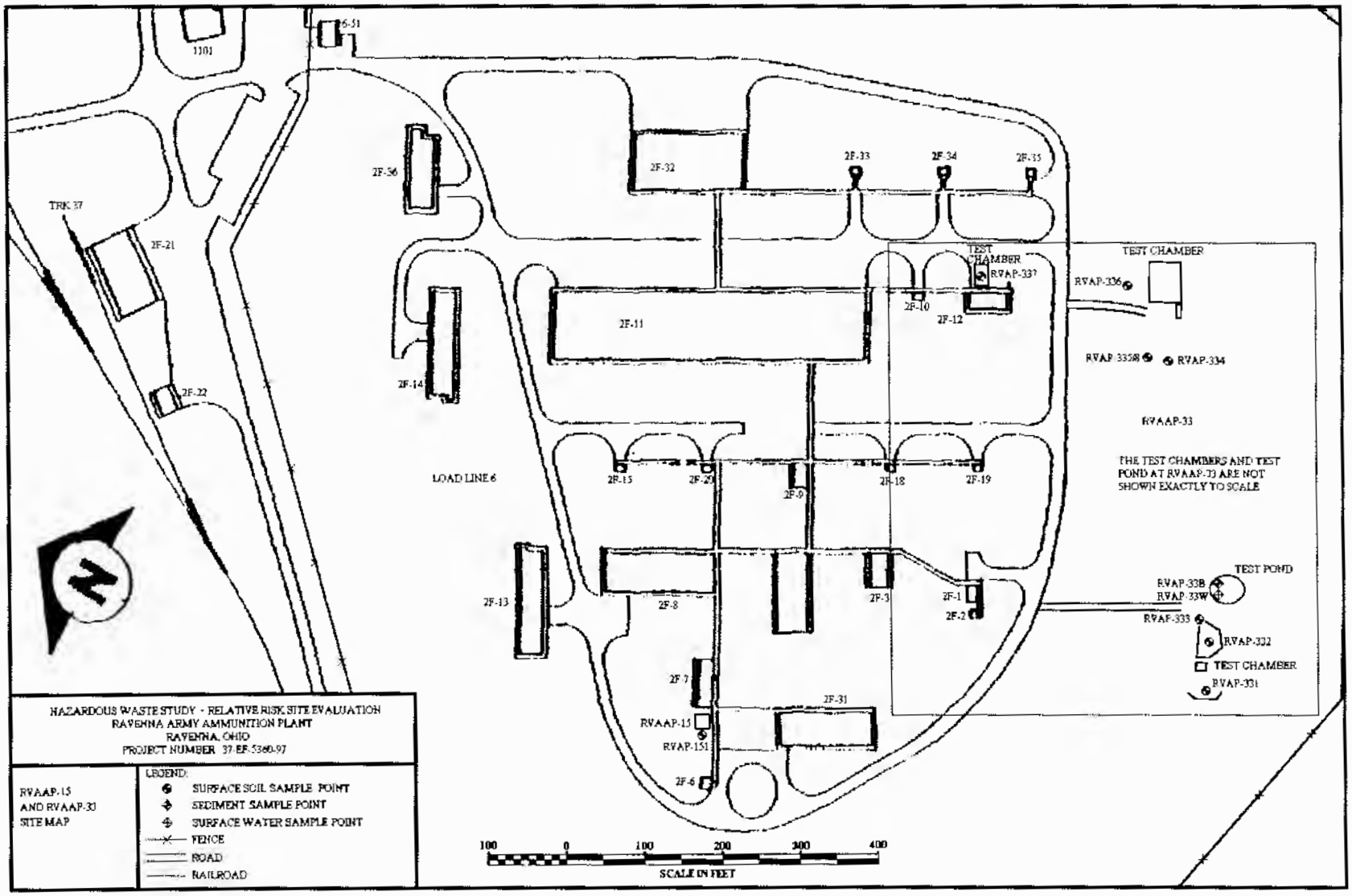
(1) **Contaminant Hazard Factor**: *0.73 = Minimal.*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	15	22	0.68
barium	158	5300	0.03
chromium	22.6	3000	0.01
copper	11.7	2800	0
zinc	62	23000	0

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* This area is not used for production and is not populated with workers. However, access to the site is not restricted in any manner.

4. **Final Score**. Low (3), one Medium of Concern.


1101
6-51
2F-56
2F-32
2F-33
2F-34
2F-35
TRK 37
2F-21
2F-22
2F-14
2F-11
TEST CHAMBER
RVAP-337
2F-10
2F-12
TEST CHAMBER
RVAP-336
RVAP 335B
RVAP-334
RVAAP-33
THE TEST CHAMBERS AND TEST POND AT RVAAP-33 ARE NOT SHOWN EXACTLY TO SCALE
LOAD LINE 6
2F-15
2F-20
2F-9
2F-18
2F-19
2F-13
2F-8
2F-3
2F-1
2F-2
TEST POND
RVAP-33B
RVAP-33W
RVAP-333
RVAP-332
TEST CHAMBER
RVAP-331
2F-7
2F-31
RVAAP-15
RVAP-151
2F-6
N
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
RVAAP-15
AND RVAAP-33
SITE MAP
LEGEND:
SURFACE SOIL SAMPLE POINT
SEDIMENT SAMPLE POINT
SURFACE WATER SAMPLE POINT
FENCE
ROAD
RAILROAD
100 0 100 200 300 400
SCALE IN FEET

1. **Site Name**: RVAAP-16, Quarry Landfill/Former Fuse and Booster Burning Pits/Pond.

2. **Site Summary**: This site is an abandoned quarry that was used to burn sawdust waste from Load Lines 6 and 11 from 1945 to 1949. The site was also used as a landfill for spent brine regenerant and sand filtration backwash from the ground-water treatment plant, fuse and booster assemblies, projectiles, residual ash, and sanitary waste. The existing debris was removed from the site in 1976. There is no indication of regulatory oversight of the transfer process. The ponds were constructed prior to 1987 on the site to receive filter backwash from the potable water system. The ponds were operated as such from 1987 and 1993. Three samples each of surface water and sediment (one from each individual pond) were taken and analyzed for explosives and metals.

3. **Pathway Evaluation**:

a. **Ground Water**: *Not Evaluated.* There is no ground water associated with this site.

b. **Surface Water/Human Endpoint**: *High.*

(1) **Contaminant Hazard Factor**: *5.85 = Moderate.*

Contaminant	Max Concentration (μg/L)	Standard (μg/L)	Ratio
antimony	6	15	0.4
arsenic	5	4.5	1.11
barium	73	2600	0.03
copper	69	1400	0.05
lead	17	4	4.25
zinc	98	11000	0.01

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Identified.* This area is not used for production, but hunters and fishermen have access to the site and use it for recreational activities. Access to the site is not restricted in any manner.

c. **Sediment/Human Endpoint**: *Medium.*

(1) **Contaminant Hazard Factor**: *0.92 = Minimal*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	7.13	22	0.32
barium	137	5300	0.03
cadmium	1.9	38	0.05
chromium	40.1	3000	0.01
copper	37.6	2800	0.01
lead	96.7	400	0.24
mercury	5.52	23	0.24
zinc	340	23000	0.01

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

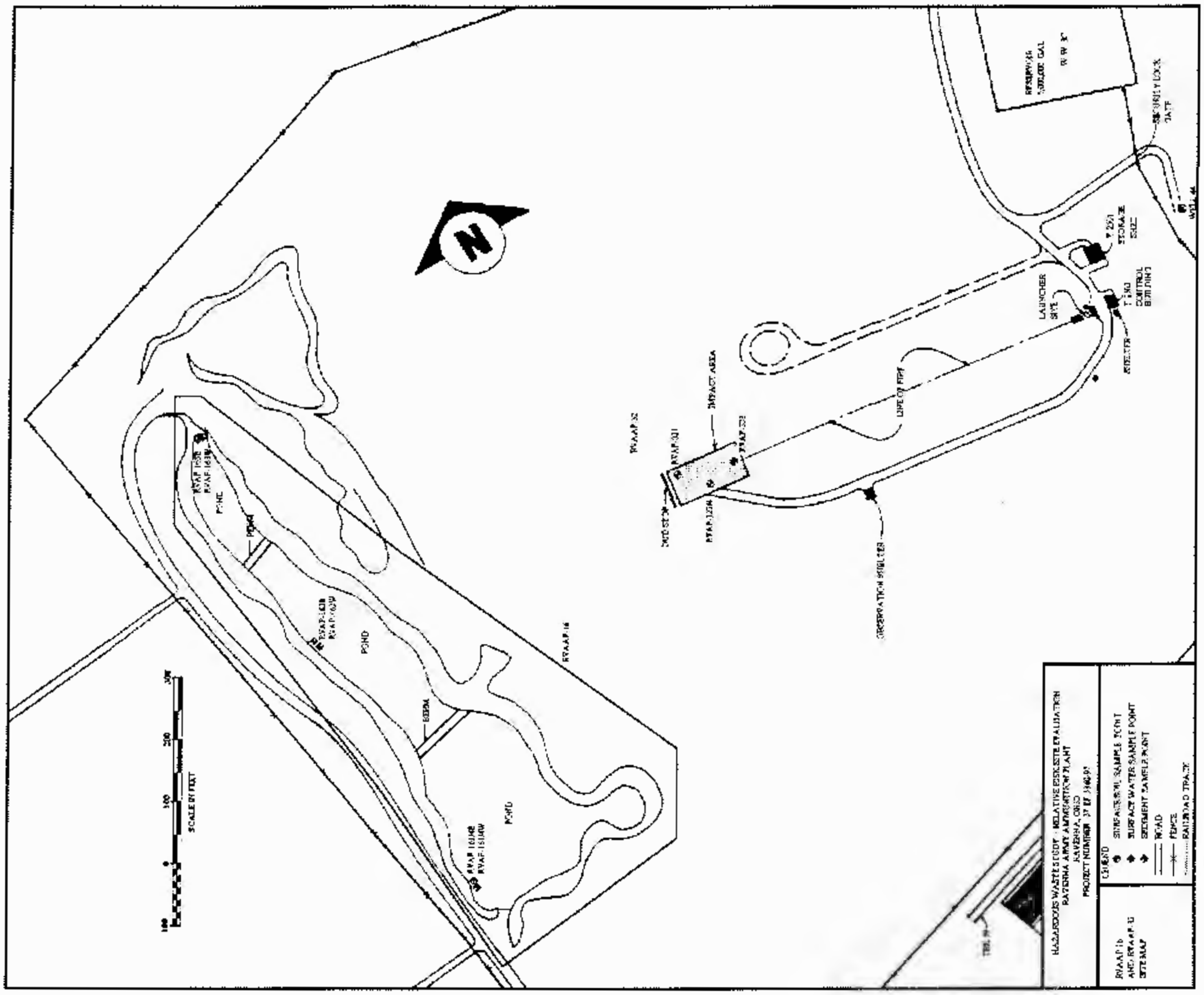
(3) **Receptor Pathway Factor**: *Identified.* This area is not used for production. However, hunters and fishermen have access to the site and use it for recreational activities. Access to the site is not restricted in any manner.

d. **Surface Water/Ecological Endpoint**: *Not Evaluated.* The surface water at this site does not impact any critical habitat, as defined in the *Primer*.

e. **Sediment/Ecological Endpoint**: *Not Evaluated.* The sediment associated with this site does not impact any critical habitat, as defined in the *Primer*.

f. **Surface Soil**: *Not Evaluated.* There is no surface soil associated with this site.

4. **Final Score**. High (1), two Media of Concern.


SURFACE WATER SAMPLE POINT
ROAD
FENCE
LEGEND
SCALE IN FEET
POND
IMPACT AREA
LAUNCHER SITE
LINE OF FIRE
OBSERVATION SHELTER
STORAGE
CONTROL BUILDING

1. **Site Name**: RVAAP-18, Load Line 12 Treatment Plant.

2. **Site Summary**: This treatment plant is a closed-system, dual-activated-carbon filter for the treatment of TNT water, which operated from 1981 to 1983. The filters were contained in a building with a concrete floor. The discharges from the filters were sent to either the installation's hazardous waste storage area or a waste water treatment plant. The only potential for release at the plant is for spillage or leakage to have been washed off of the floor and out of the door during the daily cleaning operations. One soil sample was taken outside the door to the building and analyzed for explosives and metals.

3. **Pathway Evaluation**:

a. **Ground Water**: *Not Evaluated.* There is no ground water associated with this site.

b. **Surface Water/Human Endpoint**: *Not Evaluated.* There is no surface water associated with this site.

c. **Sediment/Human Endpoint**: *Not Evaluated.* There is no sediment associated with this site.

d. **Surface Water/Ecological Endpoint**: *Not Evaluated.* There is no surface water associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

e. **Sediment/Ecological Endpoint**: *Not Evaluated.* There is no sediment associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

f. **Surface Soil**: *Low.*

(1) **Contaminant Hazard Factor**: *1.44 = Minimal.*

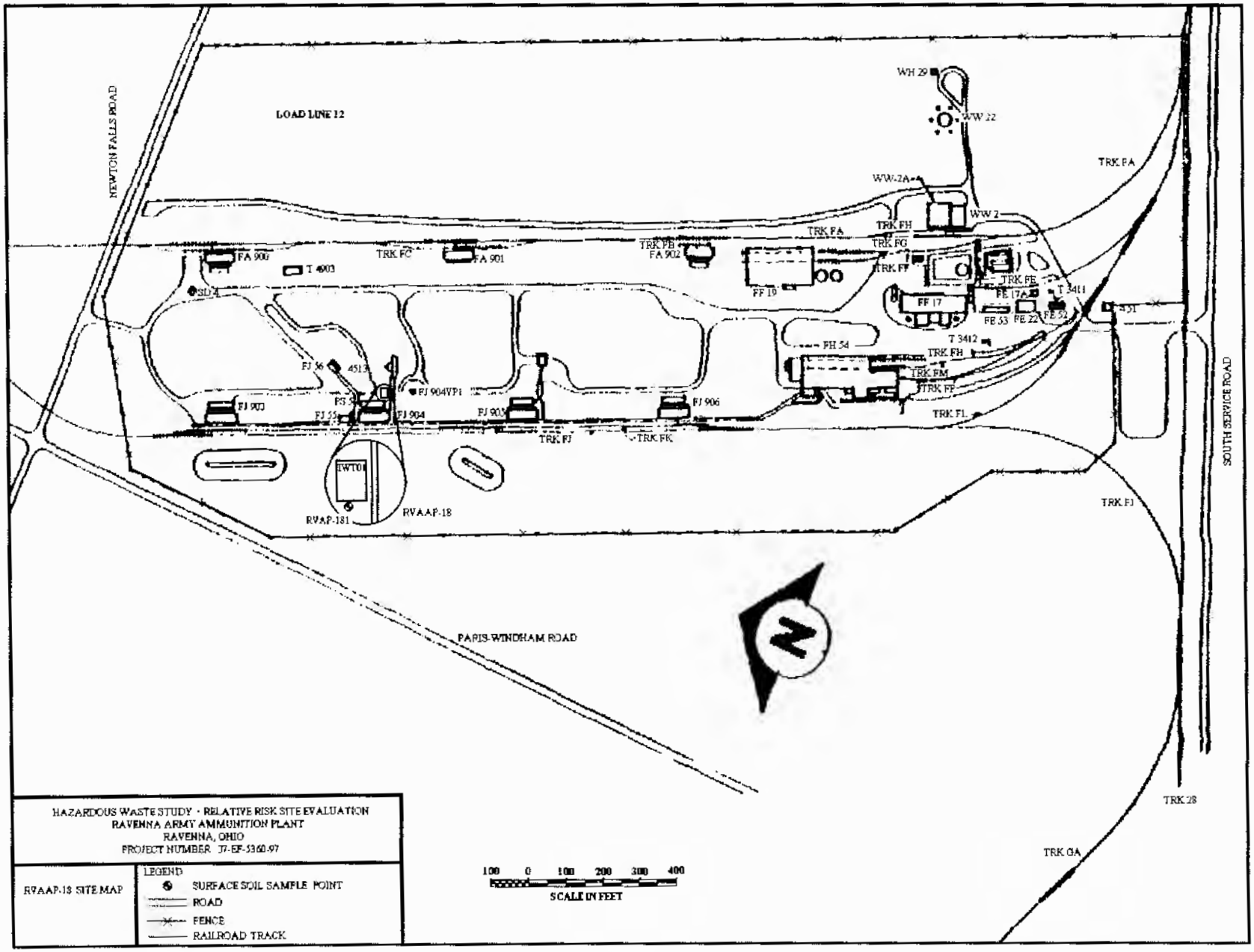
Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	2.86	22	0.13
barium	229	5300	0.04
chromium	15.3	3000	0.01
copper	12	2800	0

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
selenium	2.16	380	0.01
zinc	73.8	23000	0
2,4,6-TNT	33	1500	0.02
HMX	73	3300	0.02
RDX	480	400	1.2

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Limited.* This area is sparsely populated with workers, and the area is surrounded by a fence with locked gates.

4. **Final Score**. Low (3), one Medium of Concern.


LOAD LINE 12
NEWTON FALLS ROAD
SOUTH SERVICE ROAD
PARIS-WINDHAM ROAD
WH 29
WW 22
WW-2A
WW 2
TRK FA
TRK FB
TRK FC
TRK FD
TRK FE
TRK FF
TRK FG
TRK FH
TRK FJ
TRK FK
TRK FL
TRK FM
TRK GA
TRK 28
FA 900
FA 901
FA 902
T 4903
SD 4
FF 10
FF 17
FE 17A
FE 53
FE 22
FE 52
T 3414
451
T 3412
FH 54
FJ 56
451
FJ 904VP1
FJ 903
FJ 55
FJ 904
FJ 905
FJ 906
IWTO1
RVAP-181
RVAAP-18
N
100 0 100 200 300 400
SCALE IN FEET
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 39-EF-5360-97
RVAAP-18 SITE MAP
LEGEND
SURFACE SOIL SAMPLE POINT
ROAD
FENCE
RAILROAD TRACK

1. **Site Name**: RVAAP-23, Unit Training Equipment Site Waste Oil Tank.

2. **Site Summary**: This site was formerly a 1,000-gallon underground storage tank used to hold waste oil from a vehicle maintenance shop. The tank was never leak tested. The tank was removed from operation in 1988, and physically removed some time after that. No results of any sampling to determine if any oil leaked from the tank are available. One surface soil sample and one ground-water sample were taken from the location of the tank and analyzed for metals and semivolatile organic compounds.

3. **Pathway Evaluation**:

a. **Ground Water**: *Medium.* Ground-water concentrations were estimated from subsurface soil data from a soil sample collected from 7 to 11 feet using a standard linear equilibrium soil/water partition equation (to estimate contaminant release as a soil leachate) and a dilution factor (to account for dilution of the leachate as it enters the aquifer). This method is consistent with the derivation of soil screening levels and the investigation and modeling efforts conducted at Superfund sites to develop soil cleanup goals and groundwater protection goals (references 5 and 6). A sample equation is shown below:

$$C_{gw} = \frac{C_t}{DAF * \left[K_d + \frac{\theta^w + \theta_a H'}{\rho_b} \right]}$$

where: C_{gw} = estimated ground-water concentration in mg/L
C_t = is the measured total soil contaminant concentration in mg/kg
DAF = the dimensionless dilution attenuation factor = 20
K_d = chemical-specific, pH dependent, soil-water partition coefficient in L/kg (Table 1)
θ_w = water-filled soil porosity in L_{water}/L_{soil} = 0.30
θ_a = air-filled soil porosity in L_{air}/L_{soil} = 0.13
H' = unitless, adjusted Henry's law constant = 41*H
H = chemical-specific, Henry's law constant in atm-m^3/mol
ρ_b = dry soil bulk density in kg/L = 1.5

for arsenic in sample RVAP-231b:

C_{gw} = estimated groundwater concentration in mg/L
C_t = 15.1 mg/kg
DAF = 20
K_d = 30
θ_w = 0.30
θ_a = 0.13
H' = 41*H = 0
H = 0
ρ_b = 1.5

so:

$$C_{gw} = \frac{15.1}{20 * \left[30 + \frac{0.3}{1.5}\right]} = 0.025 mg/L$$

(1) **Contaminant Hazard Factor**: *5.84 = Moderate*

Contaminant	Max Soil Concentration (mg/kg)	pH	K_d	θ_w/ρ_b	Max Groundwater Concentration. (μg/L)	Standard (μg/L)	Ratio
arsenic	15.1	7.4	30	0.2	25	4.5	5.56
barium	27.8	7.4	45	0.2	30.75	2600	0.01
chromium	16	7.4	16	0.2	49.38	180	0.27
zinc	57.2	7.4	130	0.2	21.97	11000	0.01

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* Ground water from this near this area may be used for irrigation purposes, however, the shallow ground water is not used for drinking water.

b. **Surface Water/Human Endpoint**: *Not Evaluated.* There is no surface water associated with this site.

c. **Sediment/Human Endpoint**: *Not Evaluated.* There is no sediment associated with this site.

d. **Surface Water/Ecological Endpoint**: *Not Evaluated.* There is no surface water associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer.*

e. **Sediment/Ecological Endpoint**: *Not Evaluated.* There is no sediment associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer.*

f. **Surface Soil**: *Low.*

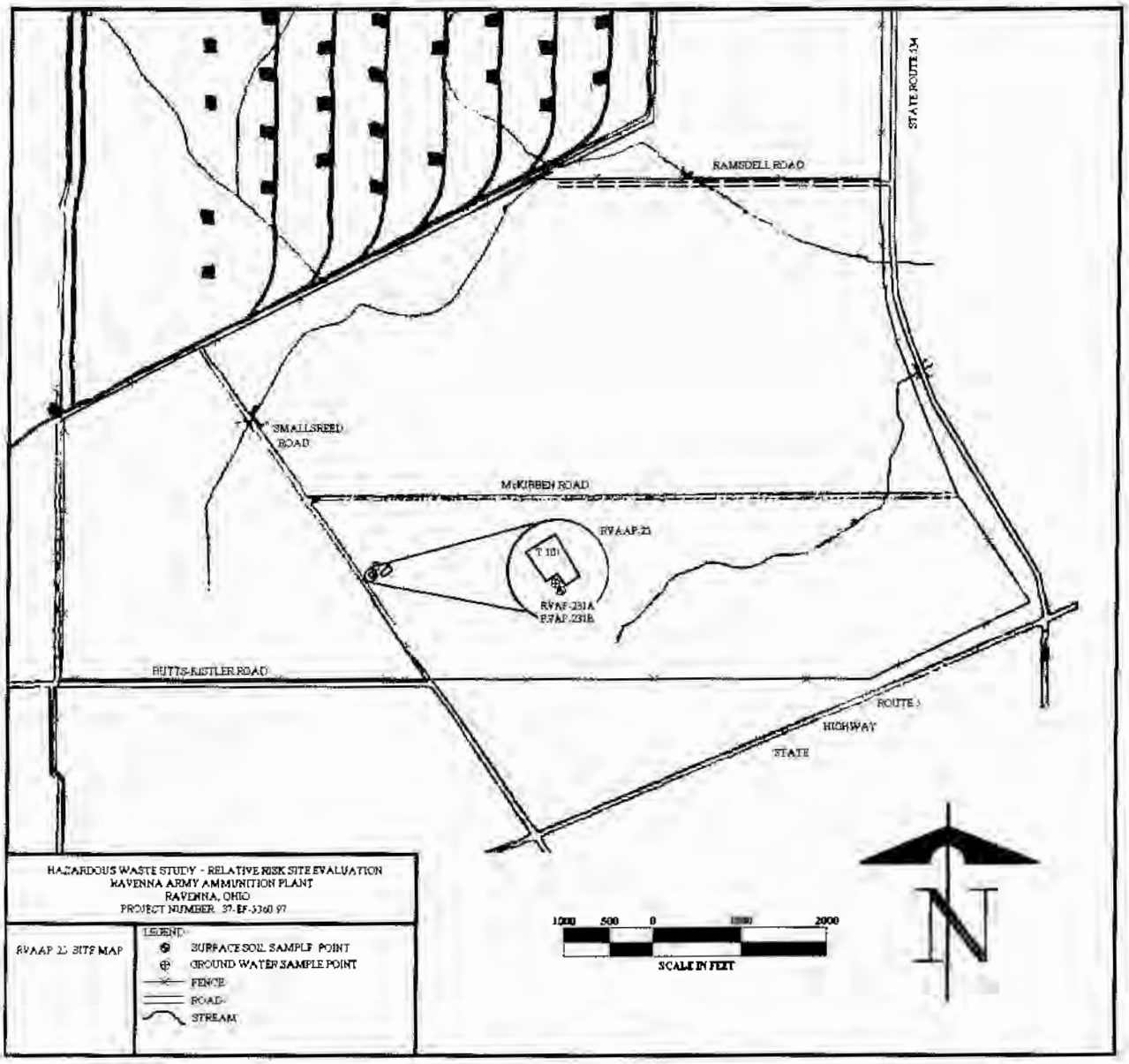
(1) **Contaminant Hazard Factor**: *1.03 = Minimal.*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	19.2	22	0.87
barium	140	5300	0.03
chromium	77.5	3000	0.03
copper	17.6	2800	0.01
lead	33.9	400	0.08
zinc	267	23000	0.01

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* This area is located behind a building being used to perform vehicle maintenance and access to the site is not restricted in any manner.

4. **Final Score**. Medium (2), two Media of Concern.


STATE ROUTE 534
RAMSDELL ROAD
SMALLSEED ROAD
McKIBBEN ROAD
RVAAP-23
T 101
RVAAP-23IA
RVAAP-23IB
BUTTS-KISTLER ROAD
ROUTE 5
HIGHWAY
STATE
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360 97
RVAAP 23 SITE MAP
LEGEND
SURFACE SOIL SAMPLE POINT
GROUND WATER SAMPLE POINT
FENCE
ROAD
STREAM
1000 500 0 1000 2000
SCALE IN FEET
N

1. **Site Name**: RVAAP-24, Reserve Unit Maintenance Area Waste Oil Tank.

2. **Site Summary**: This site was in operation from 1983 to 1995. There was one above-ground, 400-gallon tank used to store waste oil. The tank is no longer present at the site. Two surface soil samples were taken in the area the tank was located and analyzed for metals and semivolatile organic compounds.

3. **Pathway Evaluation**:

a. **Ground Water**: *Not Evaluated.* There is no ground water associated with this site.

b. **Surface Water/Human Endpoint**: *Not Evaluated.* There is no surface water associated with this site.

c. **Sediment/Human Endpoint**: *Not Evaluated.* There is no sediment associated with this site.

d. **Surface Water/Ecological Endpoint**: *Not Evaluated.* There is no surface water associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

e. **Sediment/Ecological Endpoint**: *Not Evaluated.* There is no sediment associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

f. **Surface Soil**: *Low.* One compound, Phenanthrene, was detected in both samples at a maximum concentration of 6.3 mg/kg, but it was not in the *Primer* and was not used in determining the Contaminant Hazard Factor.

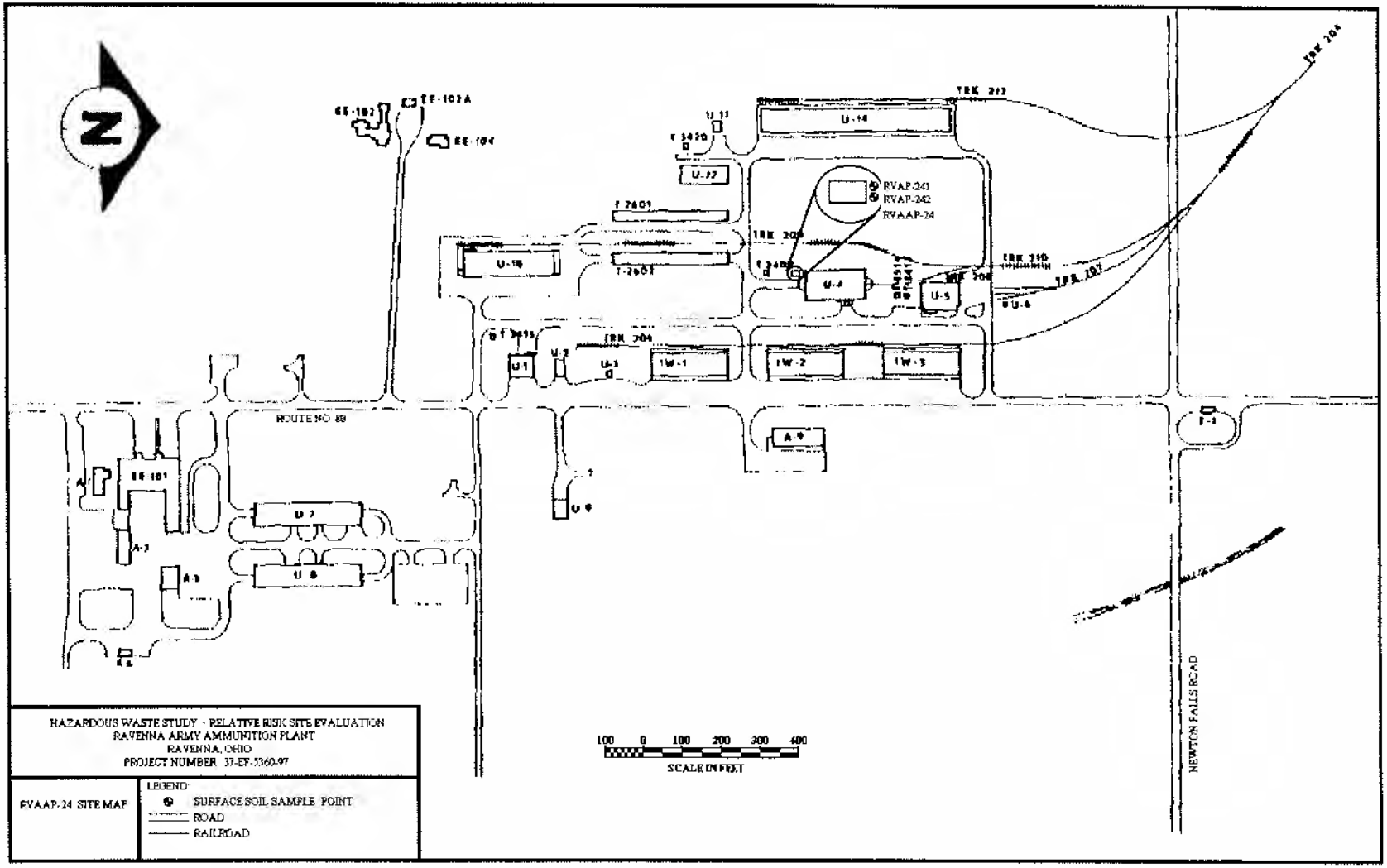
(1) **Contaminant Hazard Factor**: *1.04 = Minimal.*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	11.7	22	0.53
barium	243	5300	0.05
chromium	38.5	3000	0.01
copper	6.72	2800	0
selenium	1.89	380	0
zinc	60.7	23000	0
anthracene	2	19	0.11
fluoranthene	4.8	2600	0
pyrene	2.7	2000	0
benzo(a)anthracene	1.7	61	0.02
chrysene	1.5	24	0.06
benzo(b)fluoranthene	1.2	61	0.02
benzo(k)fluoranthene	0.98	610	0
benzo(a)pyrene	1.2	6.1	0.2
naphthalene	1.2	800	0
acenaphthene	0.55	360	0
dibenzofuran	1.1	260	0
fluorene	1.1	300	0
indeno(1,2,3-cd)pyrene	0.55	61	0.01

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* This area is not used for production and is not populated with workers. However, access to the site is not restricted in any manner.

4. **Final Score**. Low (3), one Medium of Concern.


N
RVAP-241
RVAP-242
RVAAP-24
ROUTE NO. 88
NEWTON FALLS ROAD
SCALE IN FEET
100 0 100 200 300 400
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
RVAAP-24 SITE MAP
LEGEND
SURFACE SOIL SAMPLE POINT
ROAD
RAILROAD

1. **Site Name**: RVAAP-25, Building 1034 Motor Pool Waste Oil Tank.

2. **Site Summary**: This site was in operation from 1976 to 1995. There was one above-ground, 500-gallon tank used to store waste oil. The tank is no longer present at the site. Two surface soil samples were taken in the area the tank was located and analyzed for metals and semivolatile organic compounds.

3. **Pathway Evaluation**:

a. **Ground Water**: *Not Evaluated.* There is no ground water associated with this site.

b. **Surface Water/Human Endpoint**: *Not Evaluated.* There is no surface water associated with this site.

c. **Sediment/Human Endpoint**: *Not Evaluated.* There is no sediment associated with this site.

d. **Surface Water/Ecological Endpoint**: *Not Evaluated.* There is no surface water associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

e. **Sediment/Ecological Endpoint**: *Not Evaluated.* There is no sediment associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

f. **Surface Soil**: *Low.* Two compounds: Phenanthrene, with a concentration of 4.5 mg/kg, and Benzo(g,h,i)perylene, with a concentration of 1.0 mg/kg, were detected in sample RVAP-251, but were not in the *Primer* and were not used in determining the Contaminant Hazard Factor.

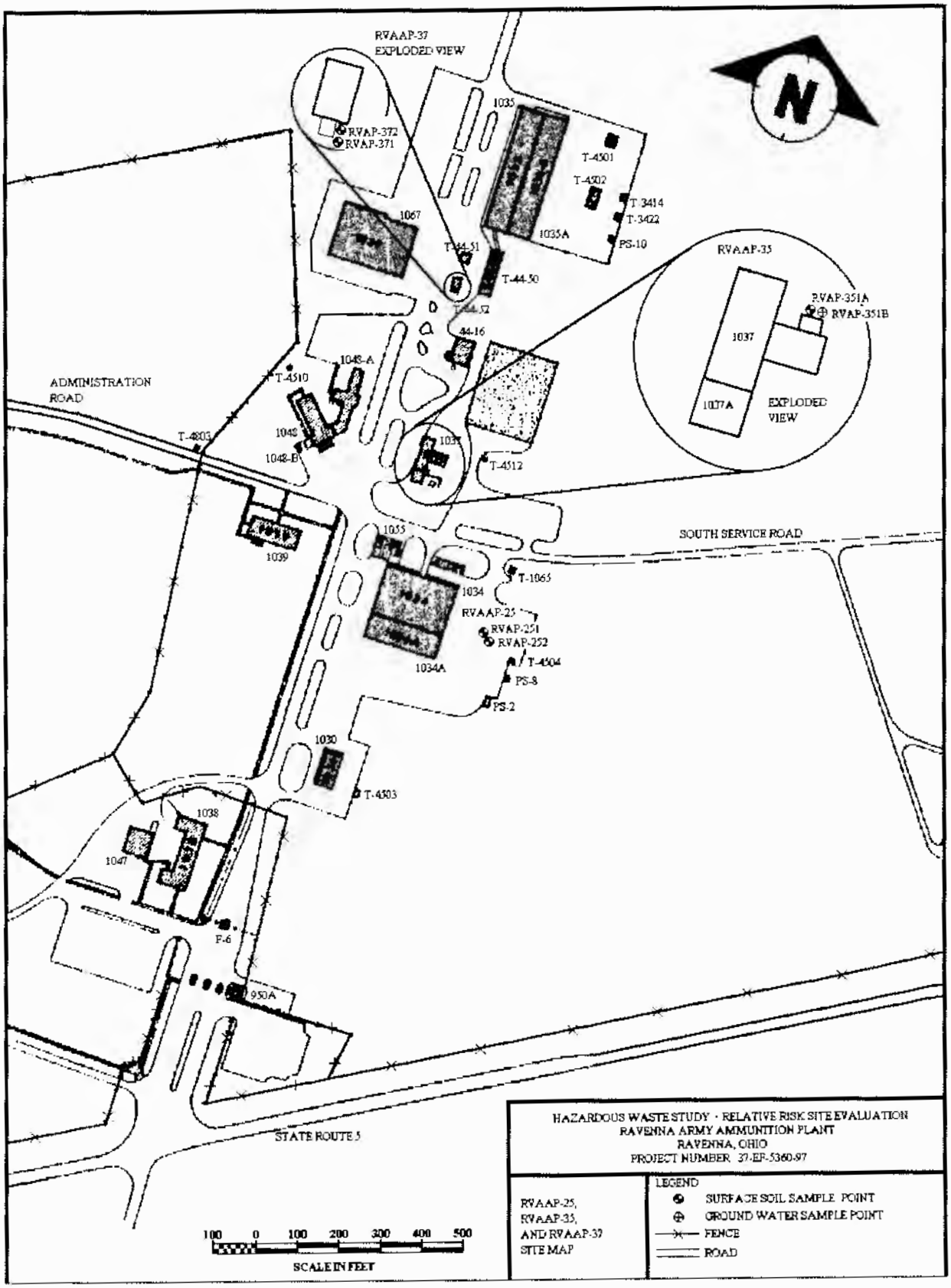
(1) **Contaminant Hazard Factor**: *1.34 = Minimal.*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	16.9	22	0.77
barium	107	5300	0.02
chromium	37.1	3000	0.01
copper	7.77	2800	0
zinc	57.4	23000	0
anthracene	1.3	19	0.07
fluoranthene	5.3	2600	0
pyrene	3.9	2000	0
benzo(a)anthracene	2.3	61	0.04
chrysene	2	24	0.08
benzo(b)fluoranthene	1.9	61	0.03
benzo(k)fluoranthene	1.2	610	0
benzo(a)pyrene	1.7	6.1	0.28
naphthalene	0.44	800	0
acenaphthene	0.52	360	0
dibenzofuran	0.41	260	0
fluorene	0.82	300	0
indeno(1,2,3-cd)pyrene	1.2	61	0.02

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* This area is in a parking area behind the building used by the operating contractor for maintenance operations and access to the site is not restricted in any manner.

4. **Final Score**. Low (3), one Medium of Concern.


RVAAP-37
EXPLODED VIEW
RVAP-372
RVAP-371
1035
T-4501
T-4502
T-3414
T-3422
PS-10
1067
1035A
T-44-51
T-44-50
T-44-52
44-16
RVAAP-35
RVAP-351A
RVAP-351B
1037
1037A
EXPLODED
VIEW
ADMINISTRATION
ROAD
T-4510
1048-A
1048
1048-B
T-4803
1035
T-4512
1039
1055
SOUTH SERVICE ROAD
T-1065
1034
RVAAP-25
RVAP-251
RVAP-252
T-4504
PS-8
PS-2
1034A
1020
T-4503
1038
1047
F-6
950A
STATE ROUTE 5
100 0 100 200 300 400 500
SCALE IN FEET
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
RVAAP-25,
RVAAP-35,
AND RVAAP-37
SITE MAP
LEGEND
SURFACE SOIL SAMPLE POINT
GROUND WATER SAMPLE POINT
FENCE
ROAD

1. **Site Name**: RVAAP-26, Fuse and Booster Area settling tanks.

2. **Site Summary**: This site consists of 15 concrete tanks located throughout Load Lines 5, 7, 9, 10, and 11. All but one of the tanks are underground. Load Line 5 has one 3,840-gallon tank. Load Line 7 had one 1,350-gallon tank removed in 1988. Load Line 9 has two tanks with capacities of 4,800 gallons and 2,880 gallons. Load Line 10 has nine tanks, seven with 3,480-gallon capacity, one tank with 405-gallon capacity, and the above-ground storage tank with an unknown capacity. Load Line 11 has three tanks with 3,480-gallon capacity. These tanks were used as settling basins for explosive contaminated waste water from 1941 to 1971. The sludge was collected periodically and thermally treated at one of the burning grounds. The tanks were emptied, cleaned and covered in 1971. They have not been used since they were cleaned. Sampling data showing the level of decontamination are not available. Four of the tanks were selected at random on the site, and one surface soil sample and one ground-water sample at each sampled tank was taken and analyzed for explosives and metals. One tank each from Load Lines 5, 9, 10, and 11 was sampled. The exact tanks and location are shown in the figures.

3. **Pathway Evaluation**:

a. **Ground Water**: *Medium.* Ground-water concentrations were taken from a sample from Load Line 5. This was the only sample point where ground water was recovered.

(1) **Contaminant Hazard Factor**: *48.2 = Moderate*

Contaminant	Max Concentration (µg/L)	Standard (µg/L)	Ratio
Arsenic	14	4.5	3.11
Barium	593	2600	0.23
Chromium	42	180	0.23
Copper	102	1400	0.07
Lead	178	4	44.5
Mercury	0.31	11	0.03
Zinc	289	11000	0.03

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* Ground water from near this area may be used for irrigation purposes. However, the shallow ground water is not used for drinking water.

b. **Surface Water/Human Endpoint**: *Not Evaluated.* There is no surface water associated with this site.

c. **Sediment/Human Endpoint**: *Not Evaluated.* There is no sediment associated with this site.

d. **Surface Water/Ecological Endpoint**: *Not Evaluated.* There is no surface water associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer.*

e. **Sediment/Ecological Endpoint**: *Not Evaluated.* There is no sediment associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer.*

f. **Surface Soil**: *Medium.*

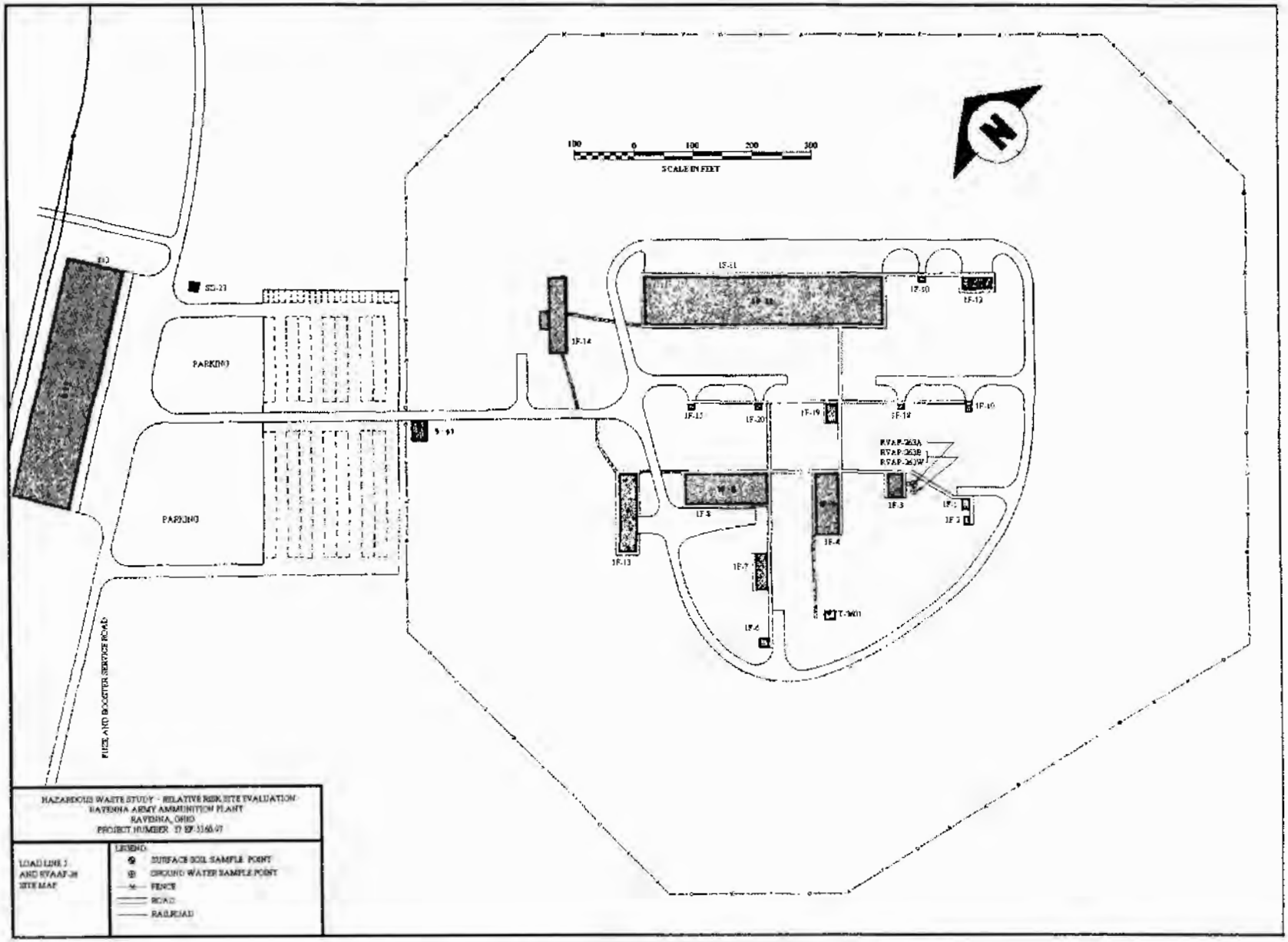
(1) **Contaminant Hazard Factor**: *2.87 = Moderate.*

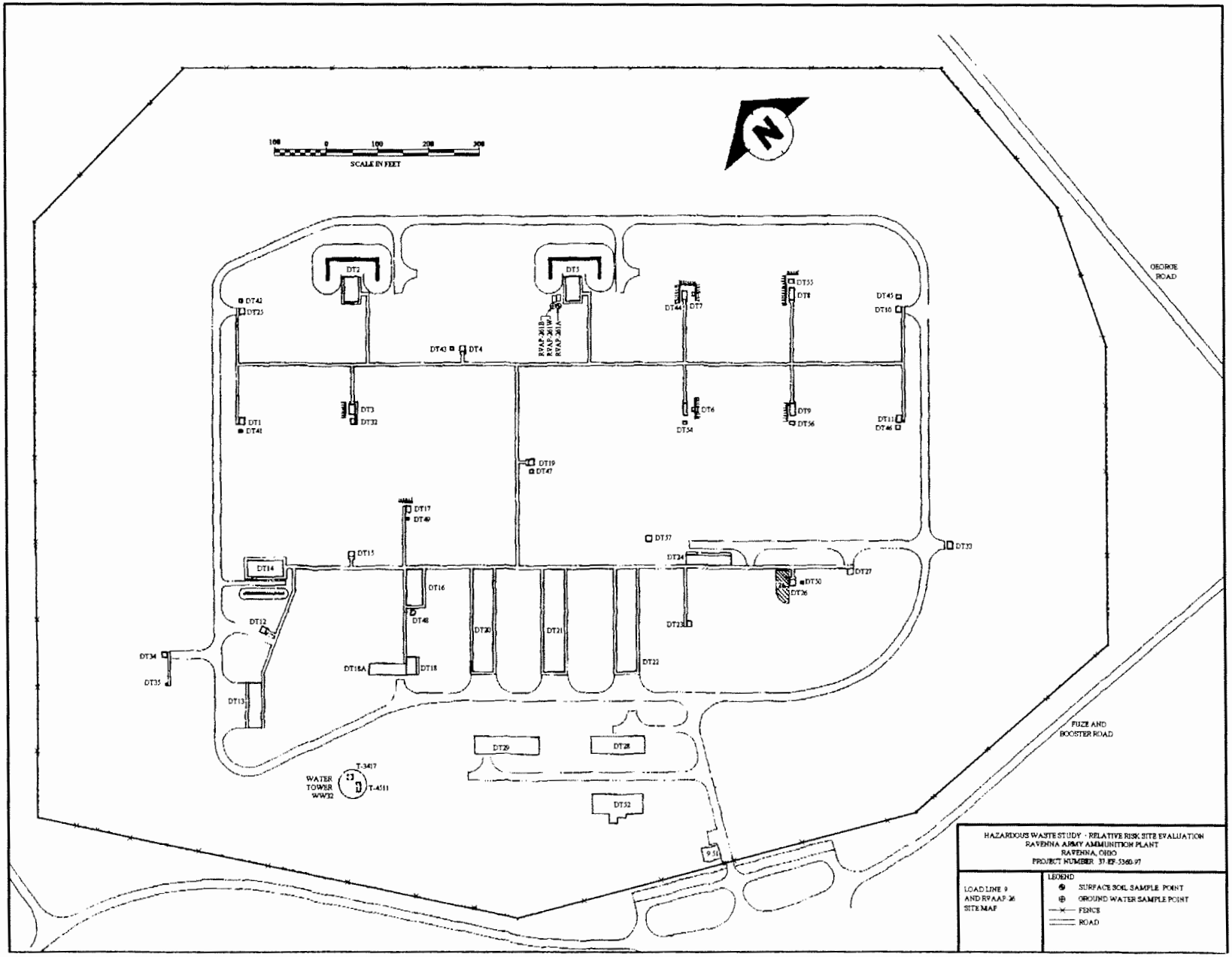
Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	17.2	22	0.78
antimony	41.9	31	1.35
barium	147	5300	0.03
cadmium	2.89	38	0.08
chromium	21.1	3000	0.01
copper	26	2800	0.01
lead	214	400	0.54
mercury	1.51	23	0.07
zinc	261	23000	0.01

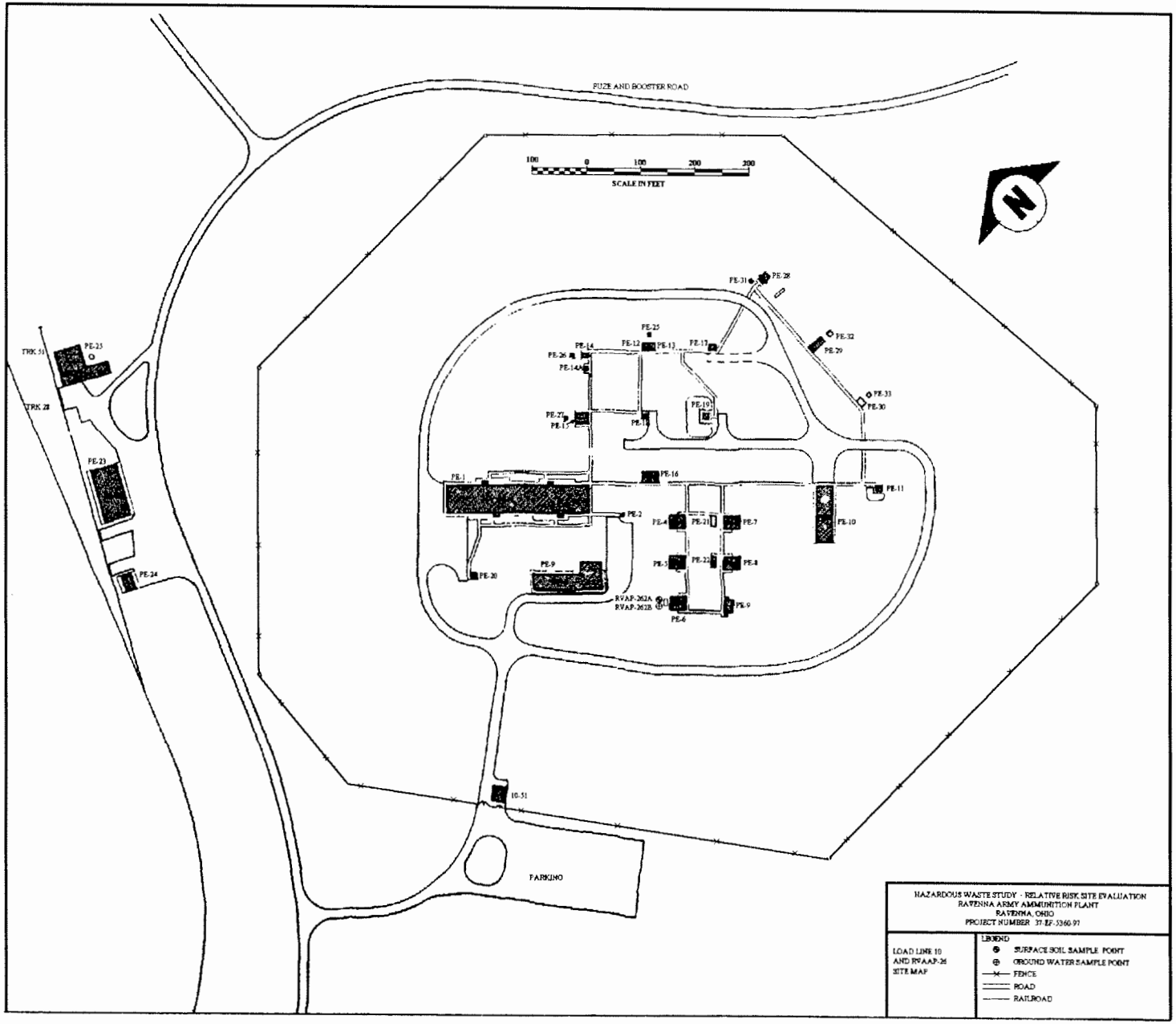
(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

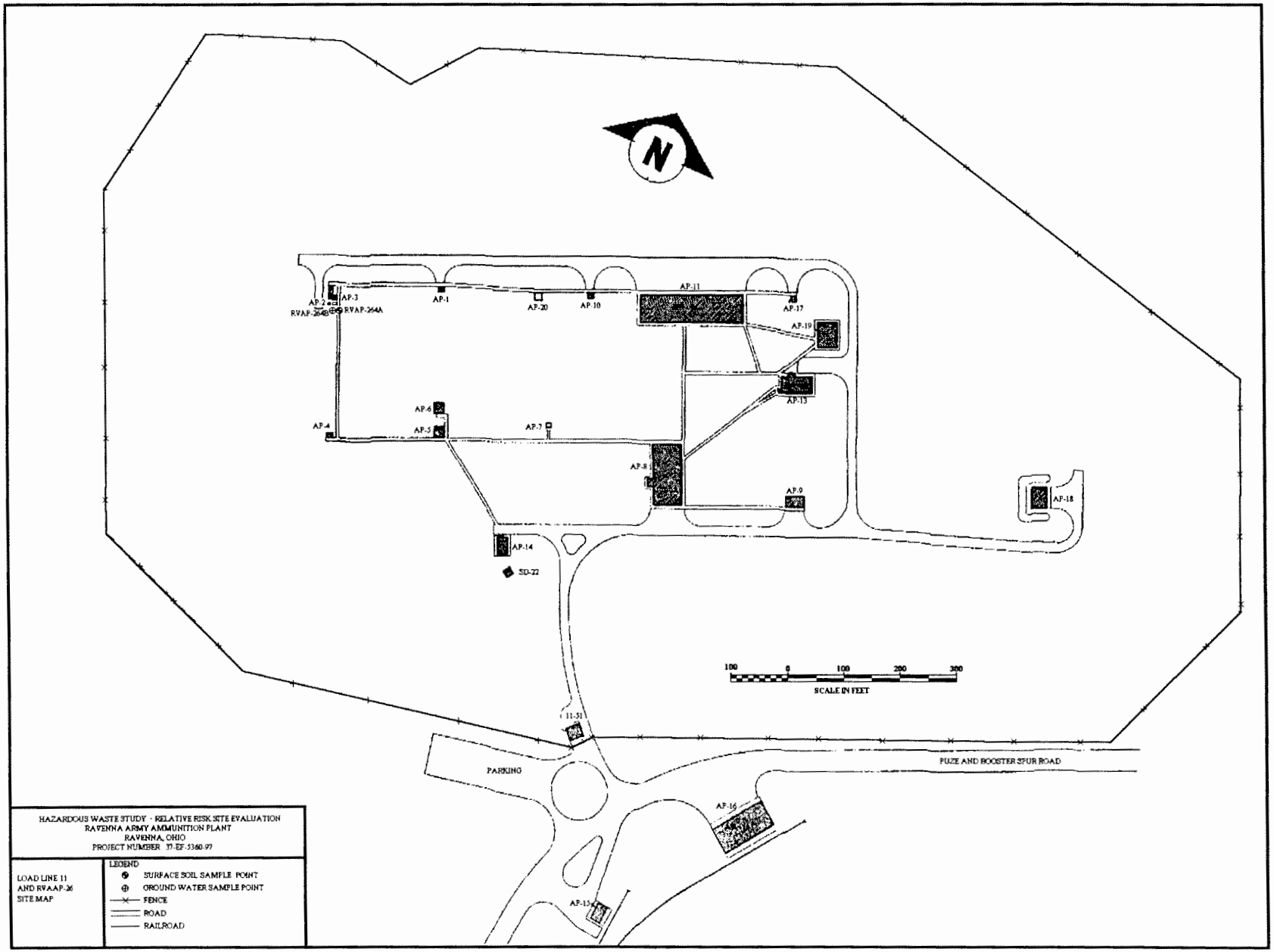
(3) **Receptor Pathway Factor**: *Potential.* This area is located behind a building being used to perform vehicle maintenance and access to the site is not restricted in any manner.

4. **Final Score**. Medium (2), two Media of Concern.


100 0 100 200 300
SCALE IN FEET
N
PARKING
PARKING
RVAAP-263A
RVAAP-263B
RVAAP-263W
T-9001
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
LOAD LINE 1
AND RVAAP-39
SITE MAP
LEGEND
SURFACE SOIL SAMPLE POINT
GROUND WATER SAMPLE POINT
FENCE
ROAD
RAILROAD


SCALE IN FEET
GEORGE ROAD
FUZE AND BOOSTER ROAD
WATER TOWER WW32
T-3417
T-4511
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
LOAD LINE 9 AND RVAAP-36 SITE MAF
LEGEND
SURFACE SOIL SAMPLE POINT
GROUND WATER SAMPLE POINT
FENCE
ROAD


FUZE AND BOOSTER ROAD
100 0 100 200 300
SCALE IN FEET
N
TRK 31
TRK 28
PE-23
PE-24
PE-25
PE-26
PE-14A
PE-14
PE-12
PE-13
PE-17
PE-27
PE-18
PE-19
PE-31
PE-28
PE-32
PE-29
PE-33
PE-30
PE-1
PE-16
PE-11
PE-2
PE-4
PE-21
PE-7
PE-10
PE-5
PE-22
PE-8
PE-20
PE-9
RVAP-262A
RVAP-262B
PE-6
10-51
PARKING
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
LOAD LINE 10 AND RVAAP-26 SITE MAP
LEGEND
SURFACE SOIL SAMPLE POINT
GROUND WATER SAMPLE POINT
FENCE
ROAD
RAILROAD


N
AP-2
RVAP-264B
AP-3
RVAP-264A
AP-1
AP-20
AP-10
AP-11
AP-17
AP-19
AP-15
AP-6
AP-4
AP-5
AP-7
AP-8
AP-9
AP-18
AP-14
SD-22
100 0 100 200 300
SCALE IN FEET
11-31
PARKING
FUZE AND BOOSTER SPUR ROAD
AP-16
AP-13
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
LOAD LINE 11
AND RVAAP-26
SITE MAP
LEGEND
SURFACE SOIL SAMPLE POINT
GROUND WATER SAMPLE POINT
FENCE
ROAD
RAILROAD

1. **Site Name**: RVAAP-28, Mustard Agent Burial Site.

2. **Site Summary**: This site is a 15-by-18-by-18-foot area where mustard agent was buried prior to 1950 according to former employees. In 1969, an EOD unit excavated a suspected mustard agent burial site nearby and found one 50-gallon drum and seven small rusty cans. No contamination was found during the excavation. An unidentified and undocumented source reported that the site had not been correctly identified and was adjacent to the area excavated. There have been no attempts to excavate this new site, and it was fenced off. The fence has since fallen. Two surface samples were taken and analyzed for metals and thiodiglycol (a mustard agent decomposition byproduct). No attempt was made to take subsurface samples at this site due to the hazards associated with chemical warfare agents.

3. **Pathway Evaluation**:

a. **Ground Water**: *Not Evaluated.* Ground water was not evaluated at this site due to the potential dangers associated with chemical warfare agents.

b. **Surface Water/Human Endpoint**: *Not Evaluated.* There is no surface water associated with this site.

c. **Sediment/Human Endpoint**: *Not Evaluated.* There is no sediment associated with this site.

d. **Surface Water/Ecological Endpoint**: *Not Evaluated.* There is no surface water associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer.*

e. **Sediment/Ecological Endpoint**: *Not Evaluated.* There is no sediment associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer.*

f. **Surface Soil**: *Low.*

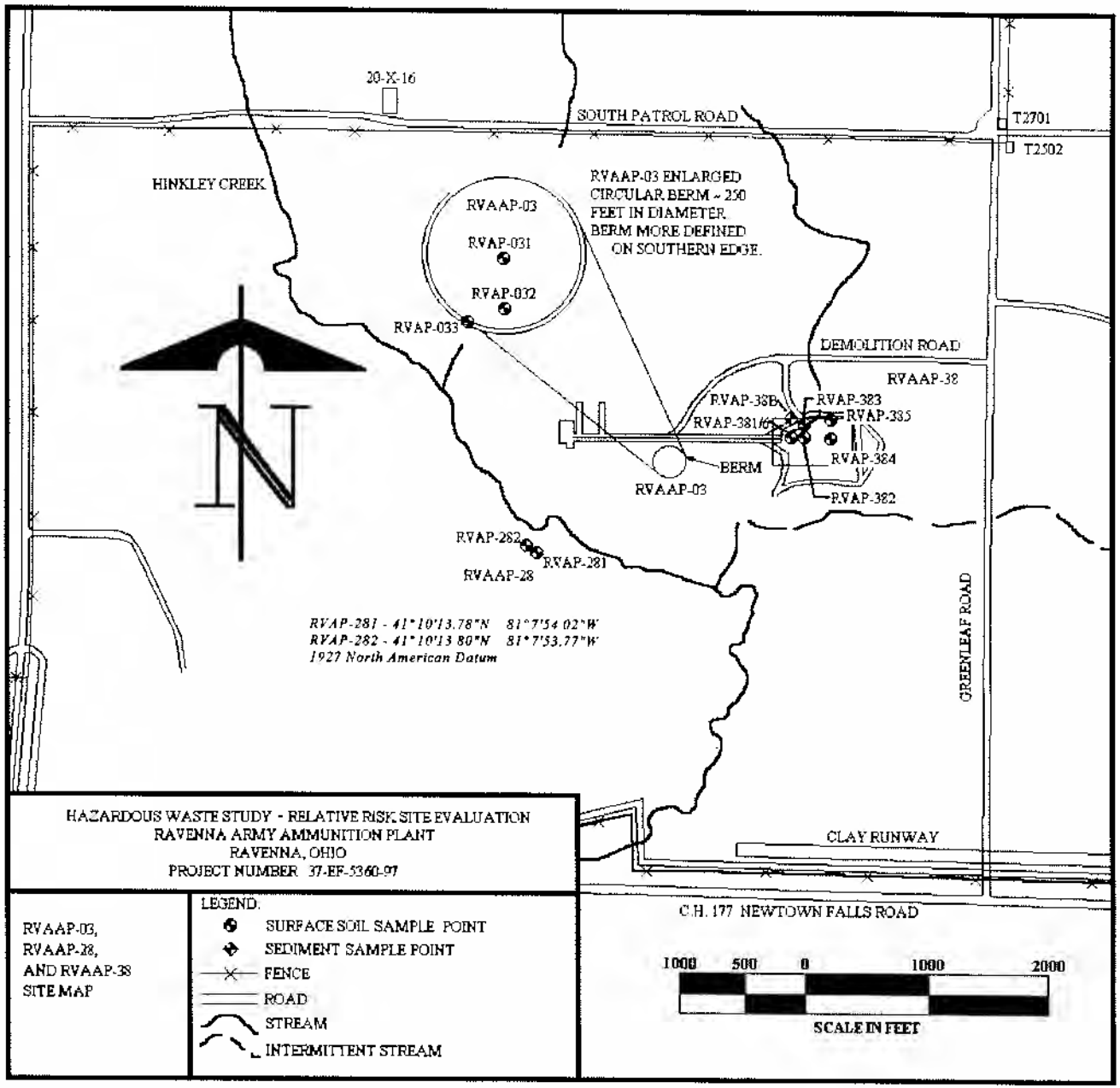
(1) **Contaminant Hazard Factor**: *0.43 = Minimal.*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	5.38	22	0.24
barium	114	5300	0.02
cadmium	1	38	0.03
chromium	15.6	3000	0.01
copper	138	2800	0.05
lead	29.5	400	0.07
zinc	315	23000	0.01

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* This area is not used for production and is not populated with workers. However, access to the site is not restricted in any manner (the fence that used to surround the site has fallen down).

4. **Final Score**. Low (3), one Medium of Concern.


20-X-16
SOUTH PATROL ROAD
T2701
T2502
HINKLEY CREEK
RVAAP-03
RVAP-031
RVAP-032
RVAP-033
RVAAP-03 ENLARGED
CIRCULAR BERM ~ 250
FEET IN DIAMETER.
BERM MORE DEFINED
ON SOUTHERN EDGE.
DEMOLITION ROAD
RVAAP-38
RVAP-38B
RVAP-383
RVAP-381/6
RVAP-385
RVAP-384
BERM
RVAAP-03
RVAP-382
RVAP-282
RVAP-281
RVAAP-28
RVAP-281 - 41°10'13.78"N 81°7'54.02"W
RVAP-282 - 41°10'13.80"N 81°7'53.77"W
1927 North American Datum
GREENLEAF ROAD
CLAY RUNWAY
C.H. 177 NEWTOWN FALLS ROAD
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
RVAAP-03,
RVAAP-28,
AND RVAAP-38
SITE MAP
LEGEND.
SURFACE SOIL SAMPLE POINT
SEDIMENT SAMPLE POINT
FENCE
ROAD
STREAM
INTERMITTENT STREAM
1000 500 0 1000 2000
SCALE IN FEET

1. **Site Name**: RVAAP-30, Load Line 7 Treatment Plant.

2. **Site Summary**: This treatment plant is a closed-system, dual-activated carbon filter for the treatment of pink water operated from 1989 to 1993. The filters were contained in a building with a concrete floor. The discharges from the filters were sent to either the installations hazardous waste storage area or a waste water treatment plant. The only potential for release at the plant is for spillage or leakage to have been washed off of the floor and out the door during the daily cleaning operations. One soil sample was taken outside the door to the building and analyzed for explosives and metals.

3. **Pathway Evaluation**:

a. **Ground Water**: *Not Evaluated.* There is no ground water associated with this site.

b. **Surface Water/Human Endpoint**: *Not Evaluated.* There is no surface water associated with this site.

c. **Sediment/Human Endpoint**: *Not Evaluated.* There is no sediment associated with this site.

d. **Surface Water/Ecological Endpoint**: *Not Evaluated.* There is no surface water associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

e. **Sediment/Ecological Endpoint**: *Not Evaluated.* There is no sediment associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

f. **Surface Soil**: *Low.*

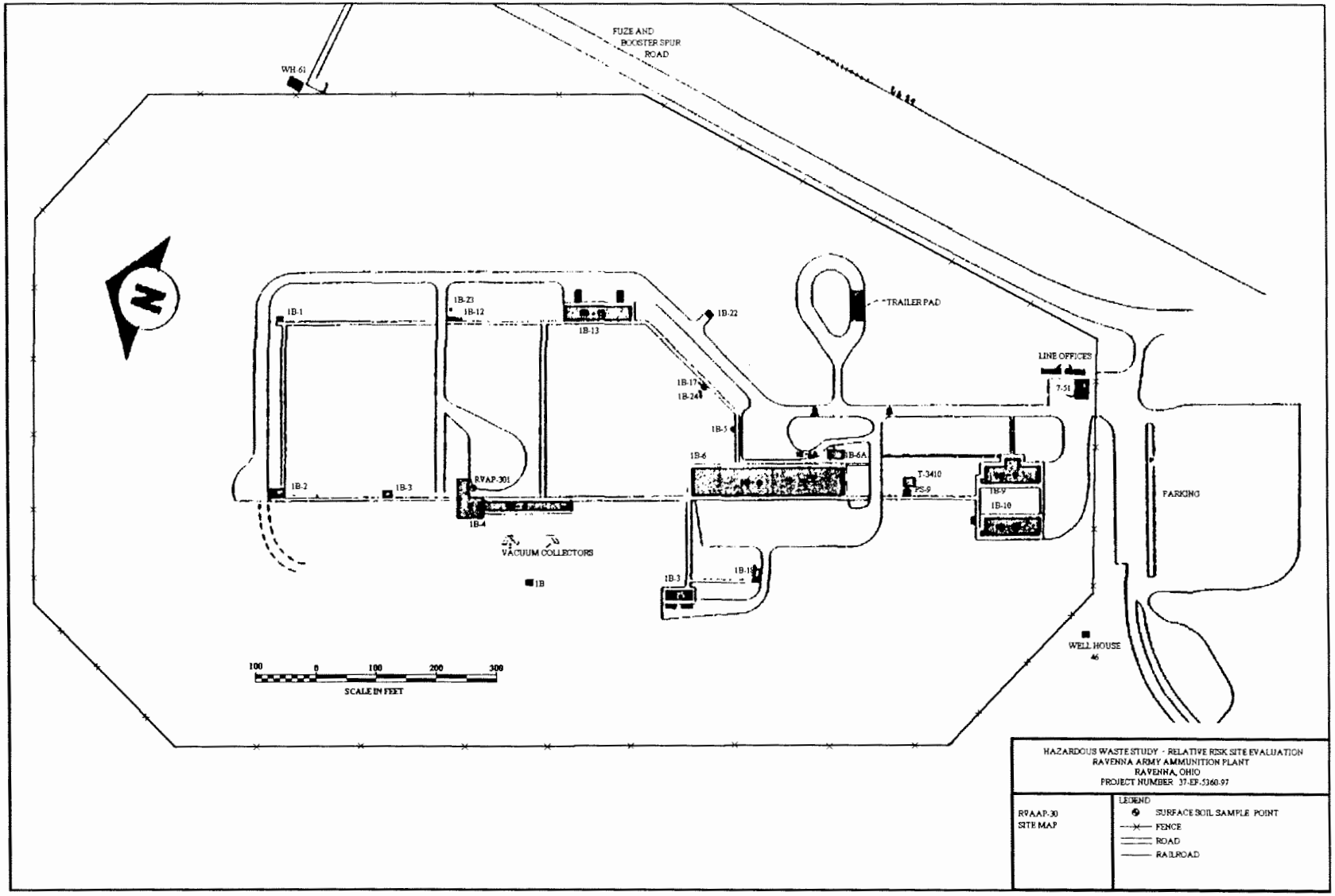
(1) **Contaminant Hazard Factor**: *0.39 = Minimal.*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
Arsenic	8.05	22	0.37
Barium	46	5300	0.01
Chromium	15.3	3000	0.01
Copper	10.1	2800	0
Zinc	60.5	23000	0
HMX	14	3300	0

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* This area is not used for production and is not populated with workers. However, access to the site is not restricted in any manner.

4. **Final Score**. Low (3), one Medium of Concern.


FUZE AND
BOOSTER SPUR
ROAD
WH-61
N
1B-1
1B-23
1B-12
1B-13
1B-22
TRAILER PAD
LINE OFFICES
7-51
1B-17
1B-24
1B-5
1B-6
1B-6A
1B-2
1B-3
RVAP-301
1B-4
T-3410
1B-9
1B-10
PARKING
VACUUM COLLECTORS
1B
1B-3
1B-18
WELL HOUSE
46
100 0 100 200 300
SCALE IN FEET
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
RVAAP-30
SITE MAP
LEGEND
SURFACE SOIL SAMPLE POINT
FENCE
ROAD
RAILROAD

1. **Site Name**: RVAAP-32, 40 and 60 mm Firing Range.

2. **Site Summary**: This site was used as a test firing range for munitions from the 1940's through the 1950's. It is unknown how many munitions were fired at the site, since little historical information exists on the site. Three soil samples were taken and analyzed for explosives and metals. No attempt will be made to take subsurface samples at this site due to the hazards associated with unexploded ordinance.

3. **Pathway Evaluation**:

a. **Ground Water**: *Not Evaluated.* There is no ground water associated with this site.

b. **Surface Water/Human Endpoint**: *Not Evaluated.* There is no surface water associated with this site.

c. **Sediment/Human Endpoint**: *Not Evaluated.* There is no sediment associated with this site.

d. **Surface Water/Ecological Endpoint**: *Not Evaluated.* There is no surface water associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

e. **Sediment/Ecological Endpoint**: *Not Evaluated.* There is no sediment associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

f. **Surface Soil**: *Medium.*

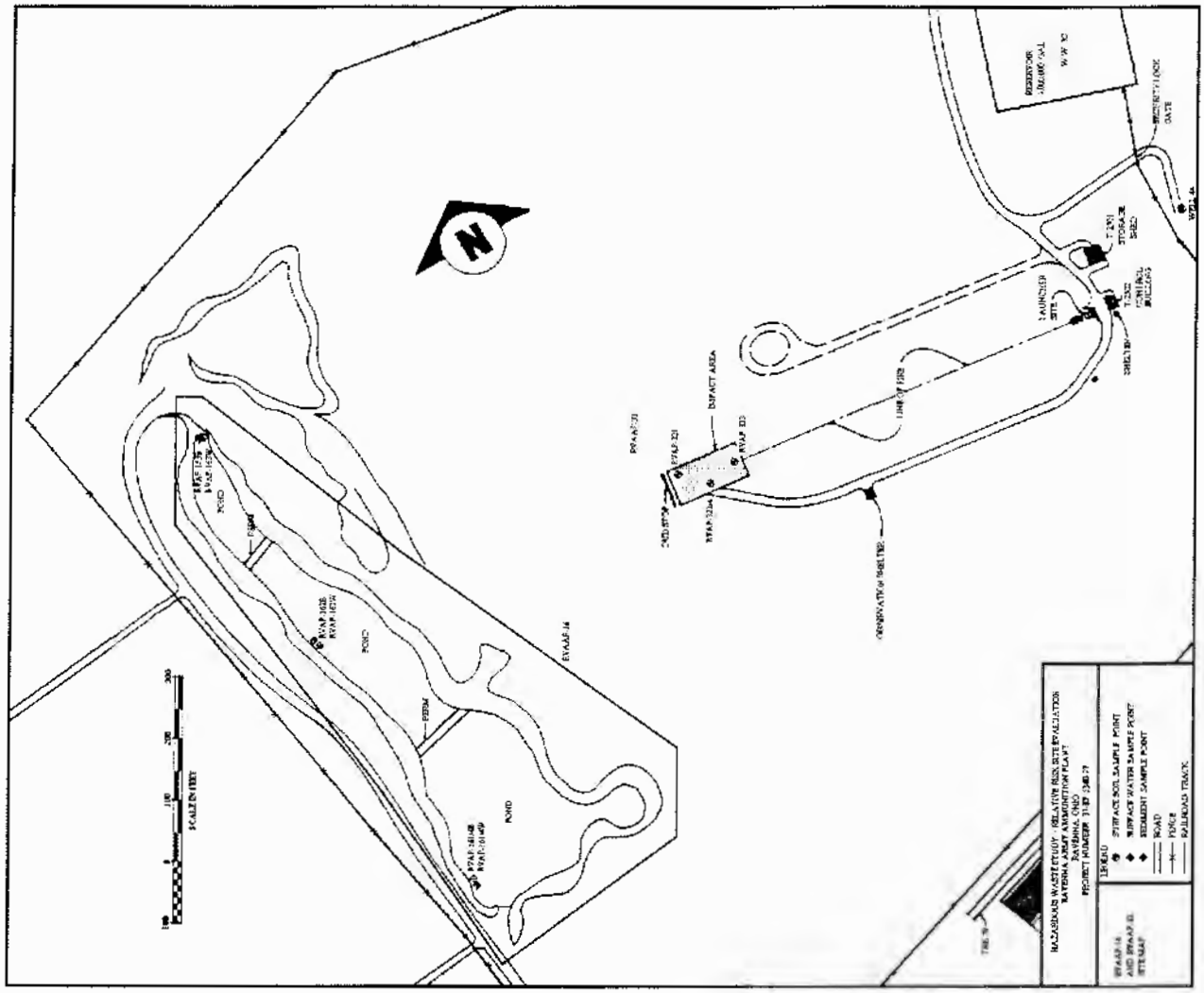
(1) **Contaminant Hazard Factor**: *6.44 = Moderate.*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	91	22	4.14
barium	89.4	5300	0.02
cadmium	76.3	38	2.01
chromium	162	3000	0.05
copper	274	2800	0.1
lead	43.2	400	0.11
zinc	531	23000	0.02

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* This area is not used for production and is not populated with workers. However, access to the site is not restricted in any manner.

4. **Final Score**. Low (3), one Medium of Concern.



1. **Site Name**: RVAAP-33, Firestone Test Facility.

2. **Site Summary**: This site at Load Line 6 was operated by a government contractor conducting classified experiments on explosives and munitions. Shaped explosive charges were tested in several structures and one underwater test facility. The facility is no longer active, but the dates of operation for the facility are not known. Seven soil samples, one surface water sample, and one sediment sample were taken and analyzed for explosives and metals.

3. **Pathway Evaluation**:

a. **Ground Water**: *Not Evaluated.* There is no ground water associated with this site.

b. **Surface Water/Human Endpoint**: *Medium.*

(1) **Contaminant Hazard Factor**: *5.03 = Moderate*

Contaminant	Max Concentration (µg/L)	Standard (µg/L)	Ratio
barium	24	2600	0.01
copper	33	1400	0.02
lead	20	4	5

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* This area is not used for production and is not populated with workers. However, access to the site is not restricted in any manner.

c. **Sediment/Human Endpoint**: *Low.*

(1) **Contaminant Hazard Factor**: *0.39 = Minimal*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	5.78	22	0.26
barium	76.7	5300	0.01
chromium	33	3000	0.01
copper	21.8	2800	0.01
lead	33.2	400	0.08
selenium	1.65	380	0
zinc	60.4	23000	0

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* This area is not used for production and is not populated with workers. However, access to the site is not restricted in any manner.

d. **Surface Water/Ecological Endpoint**: *Not Evaluated.* This site does not impact any critical habitat, as defined in the *Primer*.

e. **Sediment/Ecological Endpoint**: *Not Evaluated.* This site does not impact any critical habitat, as defined in the *Primer*.

f. **Surface Soil**: *High.*

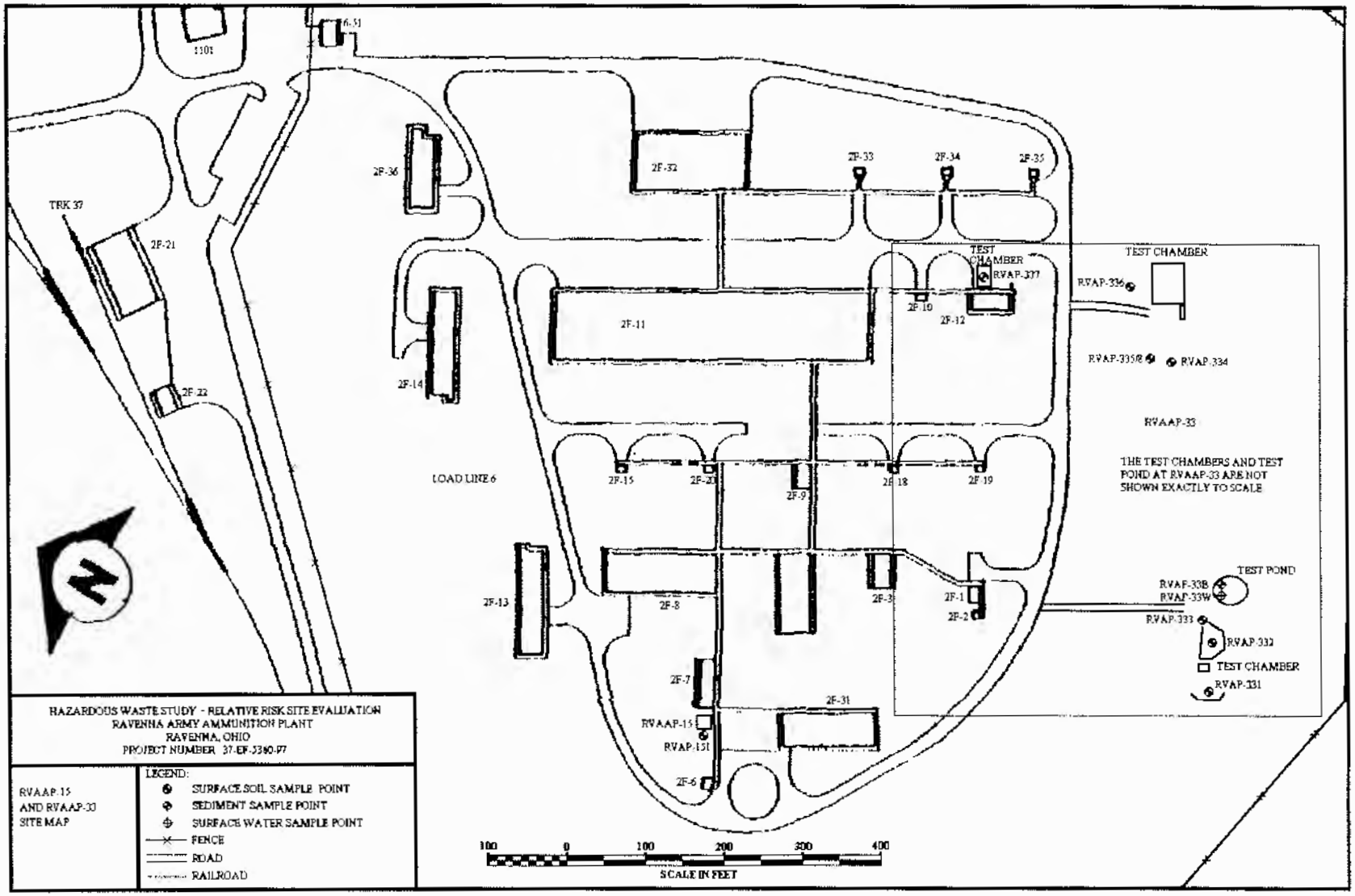
(1) **Contaminant Hazard Factor**: *114.38 = Significant*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	17.6	22	0.8
antimony	58.5	31	1.89
barium	394	5300	0.07
cadmium	15.7	38	0.41
chromium	984	3000	0.33
copper	304000	2800	108.57
lead	910	400	2.28
selenium	2.58	380	0.01
zinc	454	23000	0.02

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* This area is not used for production and is not populated with workers. However, access to the site is not restricted in any manner.

4. **Final Score**. High (1), three Media of Concern.


1101
TRK 37
2F-21
2F-22
2F-36
2F-32
2F-33
2F-34
2F-35
TEST CHAMBER
RVAP-337
2F-10
2F-12
2F-11
2F-14
LOAD LINE 6
2F-15
2F-16
2F-9
2F-18
2F-19
2F-13
2F-8
2F-3
2F-1
2F-2
2F-7
2F-31
RVAAP-15
RVAP-151
2F-6
TEST CHAMBER
RVAP-336
RVAP-335
RVAP-334
RVAAP-33
THE TEST CHAMBERS AND TEST POND AT RVAAP-33 ARE NOT SHOWN EXACTLY TO SCALE
TEST POND
RVAP-33B
RVAP-33W
RVAP-333
RVAP-332
TEST CHAMBER
RVAP-331
N
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-3380-97
RVAAP-15
AND RVAAP-30
SITE MAP
LEGEND:
SURFACE SOIL SAMPLE POINT
SEDIMENT SAMPLE POINT
SURFACE WATER SAMPLE POINT
FENCE
ROAD
RAILROAD
100 0 100 200 300 400
SCALE IN FEET

1. **Site Name**: RVAAP-34, Sand Creek Disposal Landfill.

2. **Site Summary**: This site was used as a construction debris landfill for the disposal of concrete, wood, asbestos debris, and fluorescent light tubes. The facility is no longer active, but the dates of operation for the facility are not known. Three soil samples and one sediment sample were taken and analyzed for metals.

3. **Pathway Evaluation**:

a. **Ground Water**: *Not Evaluated.* There is no ground water associated with this site.

b. **Surface Water/Human Endpoint**: *Not Evaluated.* There is no surface water associated with this site.

c. **Sediment/Human Endpoint**: *Low.*

(1) **Contaminant Hazard Factor**: *0.52 = Minimal.*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	11.2	22	0.51
barium	40.6	5300	0.01
chromium	5.01	3000	0
copper	9.43	2800	0
zinc	54.1	23000	0

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* This area is not used for production and is not populated with workers. However, access to the site is not restricted in any manner.

d. **Surface Water/Ecological Endpoint**: *Not Evaluated.* There is no surface water associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

e. **Sediment/Ecological Endpoint**: *High.*

(1) **Contaminant Hazard Factor**: *3.10 = Moderate.*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	11.2	6	1.87
chromium	5.01	26	0.19
copper	9.43	16	0.59
zinc	54.1	120	0.45

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Identified.* Sediment running off of this site enters into Sand Creek, which is known habitat for State Endangered Species.

f. **Surface Soil**: *Low.*

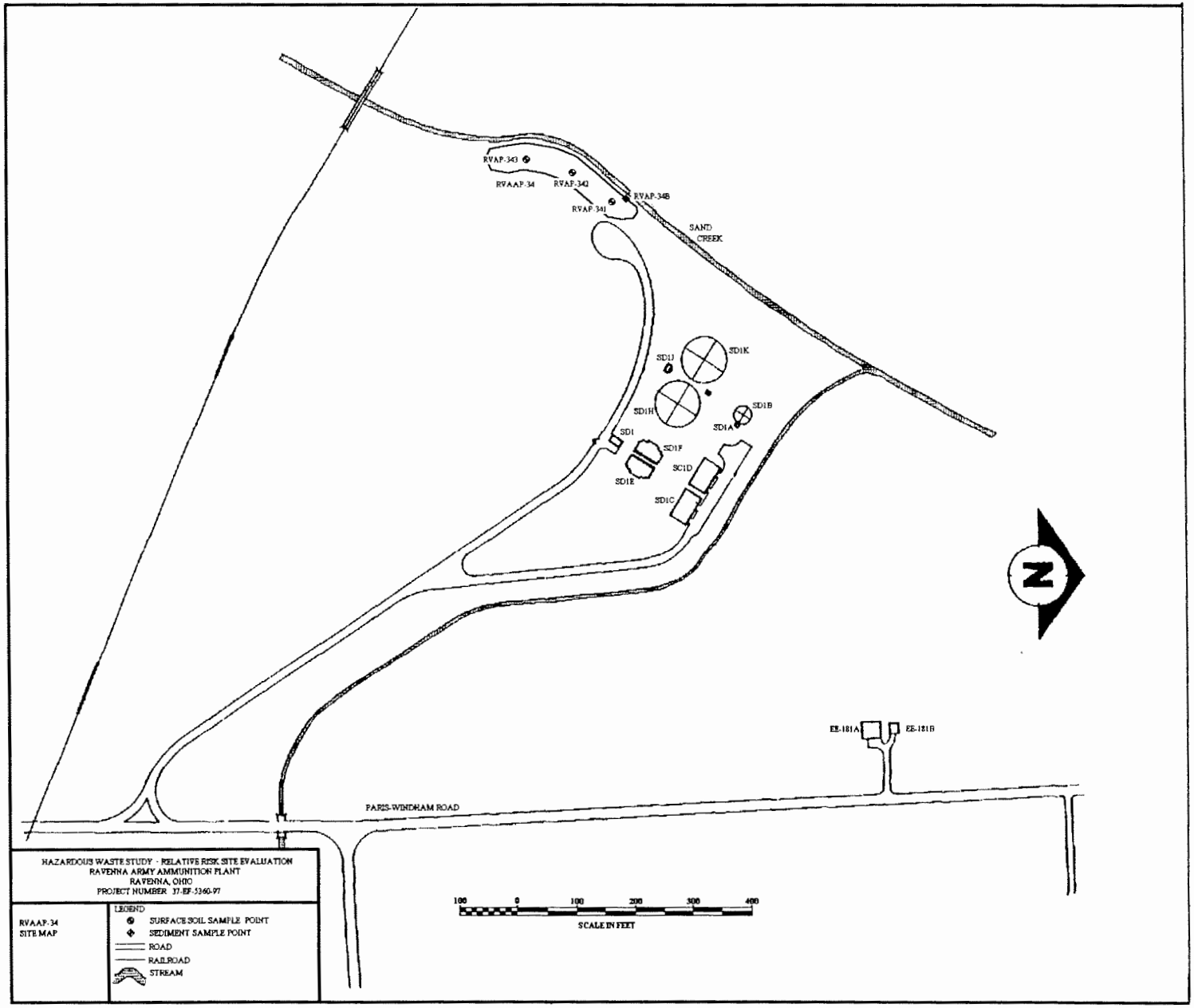
(1) **Contaminant Hazard Factor**: *0.49 = Low.*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	10.31	22	0.47
barium	61	5300	0.01
chromium	13.9	3000	0
copper	9.85	2800	0
zinc	109	23000	0

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* This area is not used for production and is not populated with workers. However, access to the site is not restricted in any manner.

4. **Final Score**. High (1), three Media of Concern.


RVAP-343
RVAAP-34
RVAP-342
RVAP-341
RVAP-34B
SAND CREEK
SD1J
SD1K
SD1H
SD1B
SD1A
SD1
SD1F
SD1D
SD1E
SD1C
N
EE-181A
EE-181B
PARIS-WINDHAM ROAD
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
RVAAP-34
SITE MAP
LEGEND
SURFACE SOIL SAMPLE POINT
SEDIMENT SAMPLE POINT
ROAD
RAILROAD
STREAM
100 0 100 200 300 400
SCALE IN FEET

1. **Site Name**: RVAAP-35, Building 1037, Laundry Waste Water Tank.

2. **Site Summary**: This site is a concrete sump used as a settling tank for RVAAP's laundry facility. The sump was filled with soil after operation ceased. The dates of operation of the facility are not known. The building is now used as the RVAAP Headquarters Building. No evidence of cleaning or decontamination of the sump has been documented. One soil and one groundwater sample were taken and analyzed for explosives and metals.

3. **Pathway Evaluation**:

a. **Ground Water**: *Medium.* Ground-water concentrations were estimated from subsurface soil data from a soil sample collected from 10-12 feet using a standard linear equilibrium soil/water partition equation (to estimate contaminant release as a soil leachate) and a dilution factor (to account for dilution of the leachate as it enters the aquifer). This method is consistent with the derivation of soil screening levels and the investigation and modeling efforts conducted at Superfund sites to develop soil cleanup goals and groundwater protection goals (references 5 and 6). A sample equation is in the worksheet for RVAAP-23. HMX was detected in the subsurface soil at a concentration of 1.3 mg/kg, but is insoluble in water and is not in the *Primer*. HMX was not used to determining the CHF for the groundwater.

(1) **Contaminant Hazard Factor**: *3.90 = Moderate*

Contaminant	Max Soil Concentration (mg/kg)	pH	K_d	θ_w/ρ_b	Max Groundwater Concentration. (μg/L)	Standard (μg/L)	Ratio
arsenic	10.22	7.9	31	0.2	16.38	4.5	3.64
barium	29.7	7.9	50	0.2	29.58	2600	0.01
chromium	12.5	7.9	14	0.2	44.01	180	0.24
zinc	43.8	7.9	400	0.2	5.47	11000	0

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* Ground water from near this area may be used for irrigation purposes, however, the shallow ground water is not used for drinking water.

b. **Surface Water/Human Endpoint**: *Not Evaluated.* There is no surface water associated with this site.

c. **Sediment/Human Endpoint**: *Not Evaluated.* There is no sediment associated with this site.

d. **Surface Water/Ecological Endpoint**: *Not Evaluated.* There is no surface water associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

e. **Sediment/Ecological Endpoint**: *Not Evaluated.* There is no sediment associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

f. **Surface Soil**: *Low.* Spacing

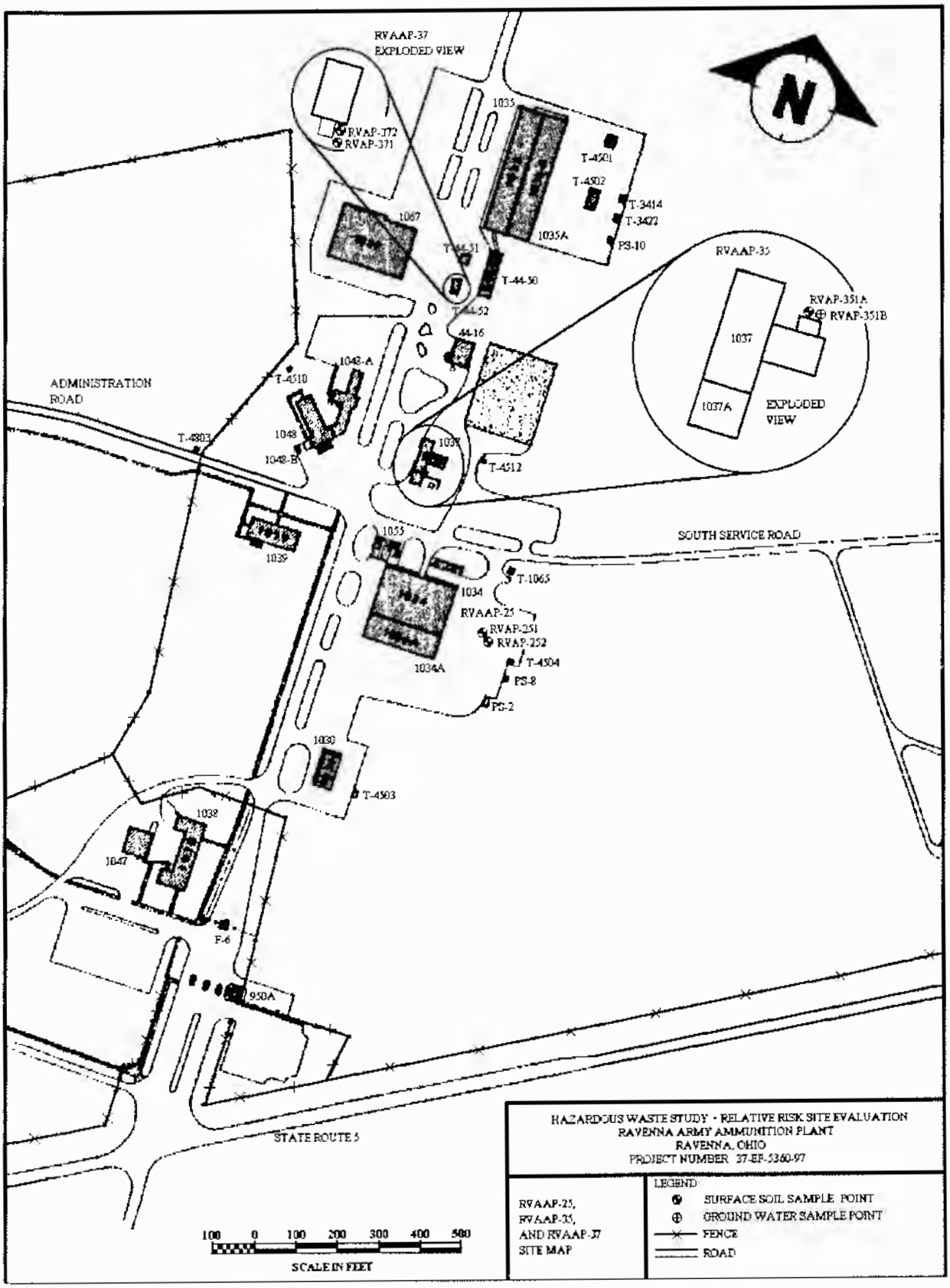
(1) **Contaminant Hazard Factor**: *0.77 = Minimal.*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	16.4	22	0.75
barium	61.1	5300	0.01
chromium	18.5	3000	0.01
copper	14.4	2800	0.01
zinc	79.5	23000	0

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* This area is located behind a building being used to perform vehicle maintenance and access to the site is not restricted in any manner.

4. **Final Score**. Medium (2), two Media of Concern.


RVAAP-37
EXPLODED VIEW
RVAAP-372
RVAP-371
1035
T-4501
T-4502
T-3414
T-3422
PS-10
1035A
1067
T-44-51
T-44-50
T-44-52
44-16
RVAAP-35
RVAP-351A
RVAP-351B
1037
1037A
EXPLODED VIEW
ADMINISTRATION ROAD
T-4510
1048-A
T-4803
1048
1048-B
1038
T-4512
1039
1033
SOUTH SERVICE ROAD
T-1065
1034
RVAAP-25
RVAP-251
RVAP-252
1034A
T-4504
PS-8
PS-2
1036
T-4503
1032
1047
F-6
950A
STATE ROUTE 5
N
100 0 100 200 300 400 500
SCALE IN FEET
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
RVAAP-25,
RVAAP-35,
AND RVAAP-37
SITE MAP
LEGEND
SURFACE SOIL SAMPLE POINT
GROUND WATER SAMPLE POINT
FENCE
ROAD

1. **Site Name**: RVAAP-36, Pistol Range. This site was used by the installation's security personnel for pistol qualifications. Personnel fired into a soil embankment. The facility is no longer active, but the dates of operation for this facility are not known. Three soil samples and one sediment sample were collected and analyzed for metals.

2. **Site Summary**:

3. **Pathway Evaluation**:

a. **Ground Water**: *Not Evaluated.* There is no ground water associated with this site.

b. **Surface Water/Human Endpoint**: *Not Evaluated.* There is no surface water associated with this site.

c. **Sediment/Human Endpoint**: *Low.*

(1) **Contaminant Hazard Factor**: *0.38 = Minimal.*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	8.03	22	0.37
barium	56	5300	0.01
chromium	6.85	3000	0
copper	5.62	2800	0
zinc	31.3	23000	0

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* This area is not used for production and is not populated with workers. However, access to the site is not restricted in any manner.

d. **Surface Water/Ecological Endpoint**: *Not Evaluated.* There is no surface water associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

e. **Sediment/Ecological Endpoint**: *Medium.*

(1) **Contaminant Hazard Factor**: *2.21 = Moderate.*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	8.03	6	1.34
chromium	6.85	26	0.26
copper	5.62	16	0.35
zinc	31.3	120	0.26

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* Sediment running off of this site could enter into Sand Creek, which is known habitat for State Endangered Species.

f. **Surface Soil**: *Medium.*

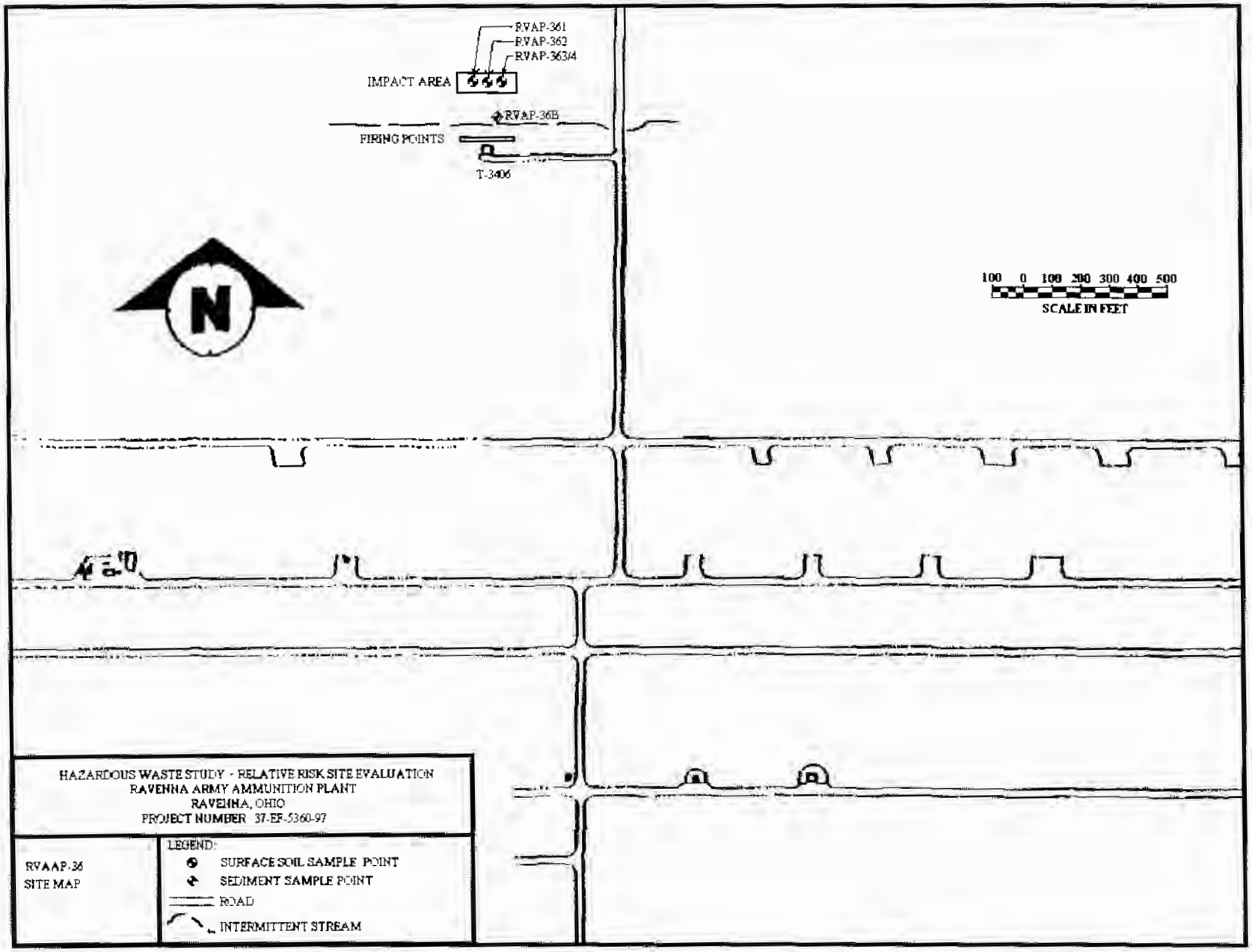
(1) **Contaminant Hazard Factor**: *11.73 = Moderate.*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	17.4	22	0.79
barium	80.9	5300	0.02
chromium	54.6	3000	0.02
copper	372	2800	0.13
lead	4309	400	10.77
zinc	155	23000	0.01

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* This area is not used for production and is not populated with workers. However, access to the site is not restricted in any manner.

4. **Final Score**. Medium (2), three Media of Concern.


RVAP-361
RVAP-362
RVAP-363/4
IMPACT AREA
RVAP-36B
FIRING POINTS
T-3406
N
100 0 100 200 300 400 500
SCALE IN FEET
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
RVAAP-36
SITE MAP
LEGEND:
SURFACE SOIL SAMPLE POINT
SEDIMENT SAMPLE POINT
ROAD
INTERMITTENT STREAM

1. **Site Name**: RVAAP-37, Pesticide Building.

2. **Site Summary**: This building was used from 1970's to 1993 as a pesticide storage and mixing facility. The building is a wooden structure with a crawl space. The floor of the facility was not impermeable. Two soil samples were taken and analyzed for pesticides and herbicides.

3. **Pathway Evaluation**:

a. **Ground Water**: *Not Evaluated.* There is no ground water associated with this site.

b. **Surface Water/Human Endpoint**: *Not Evaluated.* There is no surface water associated with this site.

c. **Sediment/Human Endpoint**: *Not Evaluated.* There is no sediment associated with this site.

d. **Surface Water/Ecological Endpoint**: *Not Evaluated.* This site does not impact any critical habitat, as defined in the *Primer*.

e. **Sediment/Ecological Endpoint**: *Not Evaluated.* This site does not impact any critical habitat, as defined in the *Primer*.

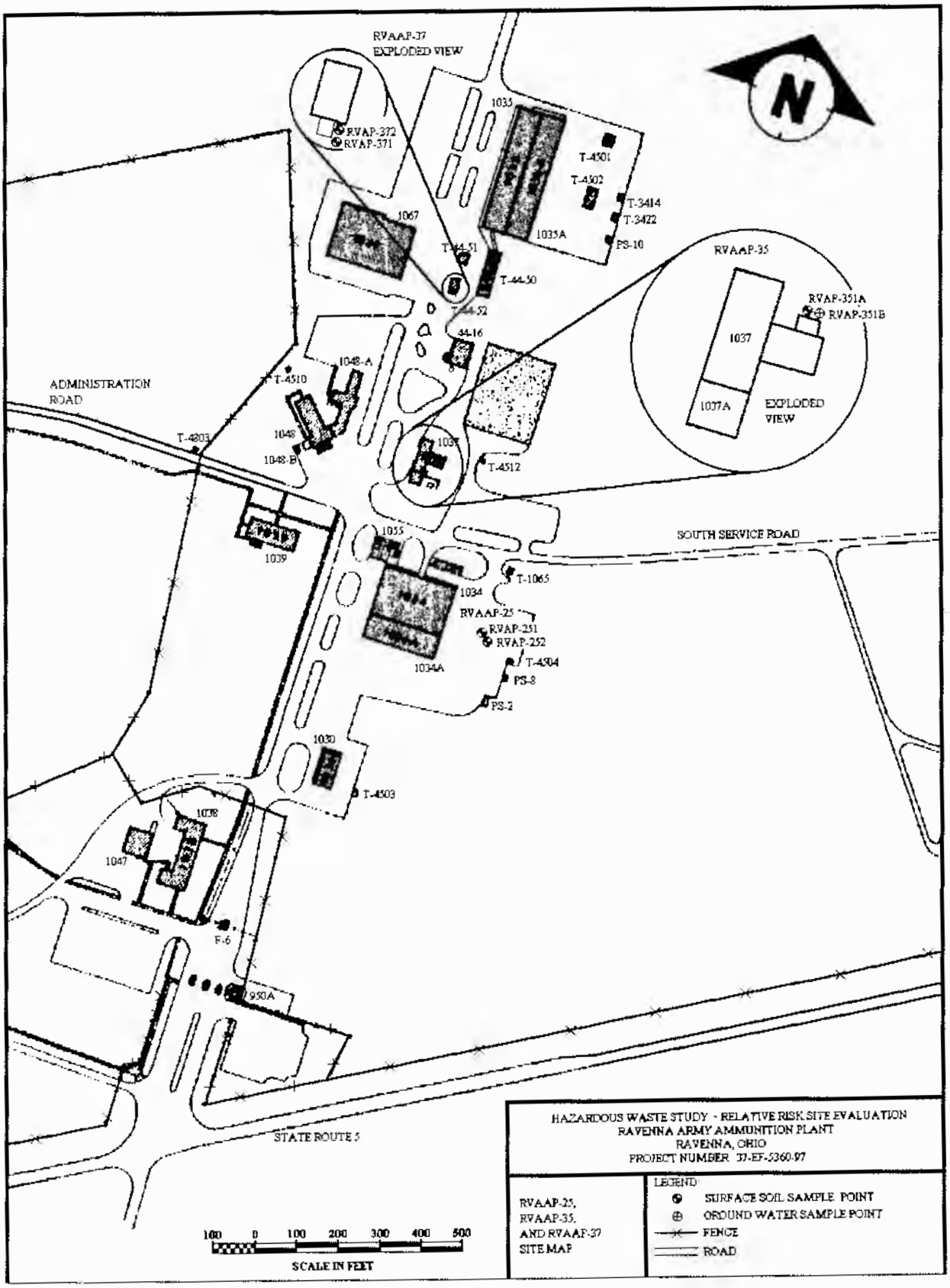
f. **Surface Soil**: *Low.*

(1) **Contaminant Hazard Factor**: *Minimal.* No Pesticides or Herbicides were detected in the samples collected at this site.

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* This area is not used for production and is not populated with workers. However, access to the site is not restricted in any manner.

4. **Final Score**. Low (3); one Medium of Concern. If no compounds are detected in any of the samples collected for all media concerned, the site is scored Low by default.


RVAAP-37
EXPLODED VIEW
RVAP-372
RVAP-371
1033
T-4501
T-4502
T-3414
T-3422
PS-10
1035A
1067
T-44-51
T-44-50
T-44-52
44-16
RVAAP-35
RVAP-351A
RVAP-351B
1037
1037A
EXPLODED
VIEW
ADMINISTRATION
ROAD
T-4510
1048-A
1048
1048-B
T-4203
1039
T-4512
1055
SOUTH SERVICE ROAD
T-1065
1034
RVAAP-25
RVAP-251
RVAP-252
1034A
T-4504
PS-8
PS-2
1030
T-4503
1038
1047
F-6
950A
STATE ROUTE 5
N
100 0 100 200 300 400 500
SCALE IN FEET
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
RVAAP-25,
RVAAP-35,
AND RVAAP-37
SITE MAP
LEGEND
SURFACE SOIL SAMPLE POINT
GROUND WATER SAMPLE POINT
FENCE
ROAD

1. **Site Name**: RVAAP-38, NACA Test Area.

2. **Site Summary**: This area was used as an aircraft test area. Airplanes with full fuel loads were rammed into an obstacle that sheared off the left side landing gear to intentionally cause crashes. These tests were to develop explosion-proof fuel tanks and/or fuels. The area was used during the 1950's. Five soil samples and one sediment sample were taken and analyzed for metals, semivolatile organic compounds, and volatile organic compounds (soil only for VOCs).

3. **Pathway Evaluation**:

a. **Ground Water**: *Not Evaluated.* There is no ground water associated with this site.

b. **Surface Water/Human Endpoint**: *Not Evaluated.* There is no surface water associated with this site.

c. **Sediment/Human Endpoint**: *Low.* Two compounds: 4-chloro-3-methyphenol at a concentration of 4 mg/kg and 2-methylnaphthalene at a concentration of 1.6 mg/kg were detected in the sediment sample, but are not in the *Primer* and are not included in calculating the CHF.

(1) **Contaminant Hazard Factor**: *0.63 = Minimal.*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
arsenic	3.9	22	0.18
barium	67.6	5300	0.01
chromium	20.3	3000	0.01
copper	4.95	2800	0
zinc	44.2	23000	0
phenol	3.8	39000	0
2-chlorophenol	3.6	330	0.01
1,3-dichlorobenzene	2	2800	0
1,4-dichlorobenzene	1.9	740	0
n-nitroso-di-n-propylamine	2.3	6.3	0.37
1,2,4-trichlorobenzene	2.1	620	0
acenaphthene	2	360	0
2,4-dinitrotoluene	2.2	130	0.02
4-nitrophenol	3.9	4800	0
pentachlorophenol	4.4	250	0.02
pyrene	2.2	2000	0

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* This area is not used for production and is not populated with workers. However, access to the site is not restricted in any manner.

d. **Surface Water/Ecological Endpoint**: *Not Evaluated.* There is no surface water associated with this site. Furthermore, this site does not impact any critical habitat, as defined in the *Primer*.

e. **Sediment/Ecological Endpoint**: *Medium.*

(1) **Contaminant Hazard Factor**: *6.60 = Moderate.*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
Arsenic	3.9	6	0.65
Chromium	20.3	26	0.78
Copper	4.95	16	0.31
Zinc	44.2	120	0.37
Pyrene	2.2	0.49	4.49

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* Sediment running off of this site could enter into Sand Creek, which is known habitat for State Endangered Species.

f. **Surface Soil**: *Medium.*

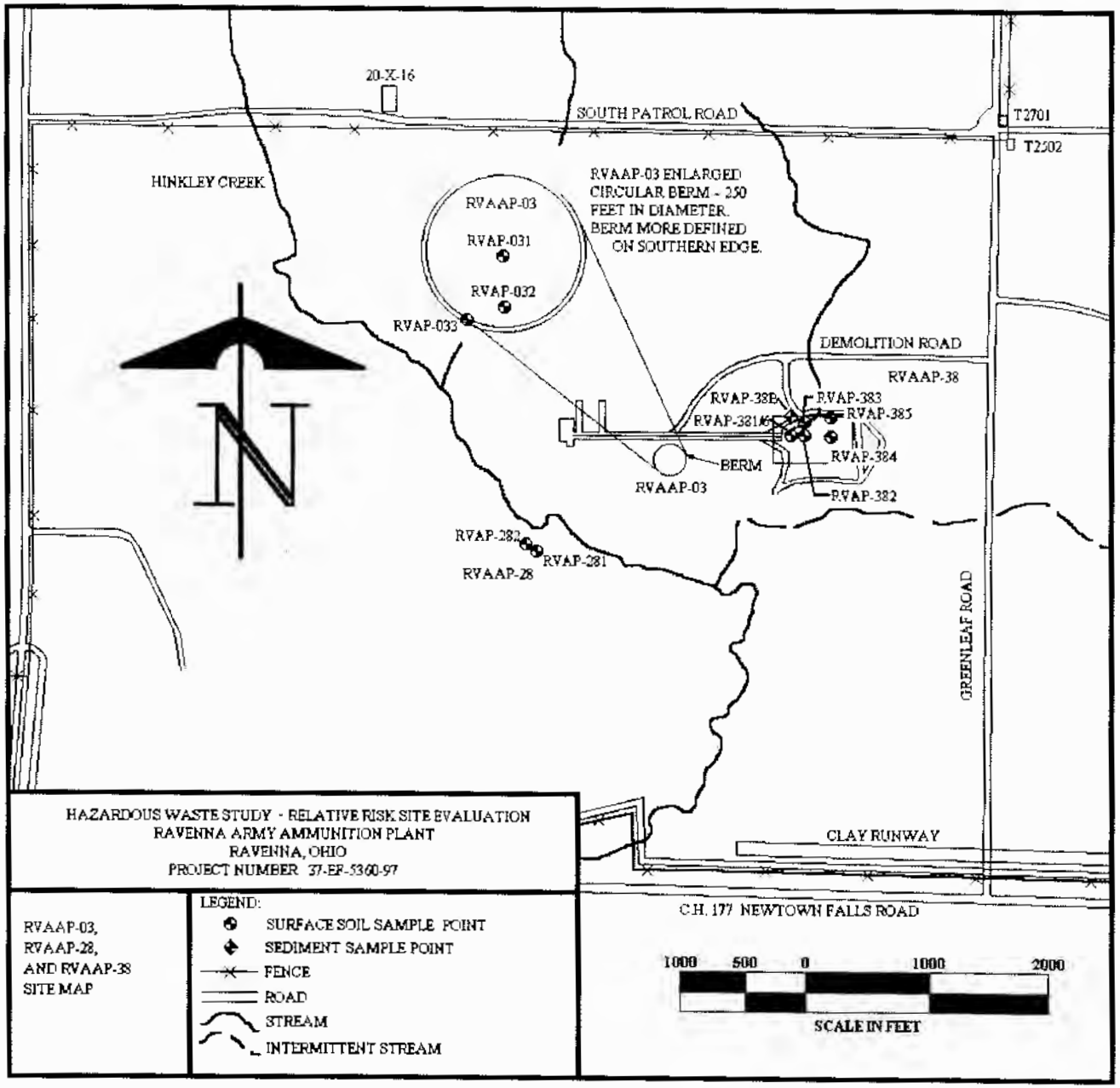
(1) **Contaminant Hazard Factor**: *3.20 = Moderate.*

Contaminant	Max Concentration (mg/kg)	Standard (mg/kg)	Ratio
Arsenic	12.7	22	0.58
Barium	179	5300	0.038
Cadmium	46	18	2.56
Chromium	48.3	3000	0.02
Copper	13.4	2800	0
Zinc	53	23000	0
Methylene Chloride	12	1100	0.01

(2) **Migration Pathway Factor**: *Potential.* There is no evidence that site contaminants are migrating. However, there are no physical barriers in place to prevent migration.

(3) **Receptor Pathway Factor**: *Potential.* This area is not used for production and is not populated with workers. However, access to the site is not restricted in any manner.

4. **Final Score**. Medium (2), three Media of Concern.


20-X-16
SOUTH PATROL ROAD
T2701
T2502
HINKLEY CREEK
RVAAP-03
RVAP-031
RVAP-032
RVAP-033
RVAAP-03 ENLARGED CIRCULAR BERM - 250 FEET IN DIAMETER. BERM MORE DEFINED ON SOUTHERN EDGE.
DEMOLITION ROAD
RVAAP-38
RVAP-383
RVAP-385
RVAP-384
RVAP-382
BERM
RVAAP-03
RVAP-282
RVAP-281
RVAAP-28
GREENLEAF ROAD
CLAY RUNWAY
C.H. 177 NEWTOWN FALLS ROAD
1000 500 0 1000 2000
SCALE IN FEET
HAZARDOUS WASTE STUDY - RELATIVE RISK SITE EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
PROJECT NUMBER 37-EF-5360-97
RVAAP-03, RVAAP-28, AND RVAAP-38 SITE MAP
LEGEND:
SURFACE SOIL SAMPLE POINT
SEDIMENT SAMPLE POINT
FENCE
ROAD
STREAM
INTERMITTENT STREAM

APPENDIX D

DATA SUMMARY

Summary of Detected Compounds

Site Number		RVAAP-02				RVAAP-03			RVAAP-06			RVAAP-15
Sample Type		Sediment		Surface Water		Surface Soil			Surface Soil			Surface Soil
Sample Number		031B	032B	031W	032W	031	032	033	061	062	063	151
Compound (soil/sediment mg/kg - surface/groundwater µg/L)	antimony	-	-	-	-	-	-	-	-	-	-	-
	arsenic	3.99	9.94	-	0.004	8.55	9.0	5.97	4.7	12.3	10.4	15.0
	barium	35.7	113	0.029	0.027	74.7	126	162	32.8	79.6	104	158
	cadmium	-	-	-	-	-	-	41.1	-	-	-	-
	chromium	3.61	18.6	-	-	19.5	21.1	33.8	394	27.5	163	22.6
	copper	5.31	32.8	0.029	0.029	10.2	13.3	6.2	11.7	15.4	20.3	11.7
	lead	-	-	0.011	0.016	-	-	-	26.8	28.8	31.2	-
	mercury	-	-	-	-	-	-	0.26	-	-	-	-
	zinc	38.3	217	-	-	61.5	52.6	58.2	22.1	59.5	51.5	62.0
	2,4,6-TNT	-	-	-	-	23,000	-	-	-	-	-	-
	cyanide	-	-	-	-	-	-	-	-	-	-	-

Summary of Detected Compounds (Cont)

Site Number		RVAAP-16								RVAAP-18	RVAAP-23	
Sample Type		Sediment				Surface Water				Surface Soil	Surface Soil	Subsurface Soil
Sample Number		161B	162B	163B	164B	161W	162W	163W	164W	181	231A	231B
Compound (soil/sediment mg/kg - surface/groundwater µg/L)	pH	-	-	-	-	-	-	-	-	-	-	7.4
	antimony	-	-	-	-	0.006	0.004	-	-	-	-	-
	arsenic	6.56	4.64	7.13	5.56	0.005	-	-	-	2.86	19.2	15.1
	barium	124	74.1	97.1	137	0.073	0.04	0.033	0.071	229	140	27.8
	cadmium	1.9	-	-	-	-	-	-	-	-	-	-
	chromium	40.1	19.0	26.3	13.4	-	-	-	-	15.3	77.5	8.33
	copper	32.9	7.47	37.6	32.3	0.069	0.058	0.049	0.047	12.0	17.6	17.8
	lead	84.5	-	96.7	69.6	0.008	0.017	0.014	0.013	28.8	33.9	-
	mercury	5.52	0.17	1.54	1.02	-	-	-	-	-	-	-
	selenium	-	-	-	-	-	-	-	-	2.16	-	-
	zinc	132	43.8	212	340	0.095	-	-	0.098	73.8	267	57.2
	2,4,6-TNT	-	-	-	-	-	-	-	-	33	-	-
	HMX	-	-	-	-	-	-	-	-	73	-	-
	RDX	-	-	-	-	-	-	-	-	480	-	-

Summary of Detected Compounds (Cont)

Site Number		RVAAP-24		RVAAP-25		RVAAP-26								
Sample Type		Surface Soil		Surface Soil		Surface Soil				Subsurface Soil				Groundwater
Sample Number		241	242	251	252	261A	262A	263A	264A	261B	262B	263B	264B	263W
Compound (soil/sediment mg/kg -surface/groundwater µg/L)	pH	-	-	-	-	-	-	-	-	7.2	6.4	7.5	7.5	-
	antimony	-	-	-	-	-	-	-	41.9	-	-	-	-	-
	arsenic	11.7	3.21	16.9	10.2	10.4	11.2	6.7	17.2	11.0	9.38	14.5	20.2	14
	barium	126	243	98.2	107	74.2	46.1	147	27.8	39.3	36.0	32.2	55.3	593
	cadmium	-	-	-	-	-	-	2.89	-	-	-	-	-	-
	chromium	38.5	13.1	37.1	34.4	19.7	13.3	21.1	6.97	15.4	17.9	15.9	20.3	102
	copper	6.72	-	7.18	7.77	20.1	14.7	26.0	5.98	14.5	11.9	13.3	17.9	102
	lead	-	-	-	-	145	-	214	-	27.2	-	-	-	178
	mercury	-	-	-	-	1.21	-	1.51	-	-	-	-	-	0.31
	selenium	-	1.89	-	-	-	-	-	-	-	-	-	-	-
	zinc	60.7	7.48	57.4	56.8	153	72.8	261	135	63.6	57.3	63.8	62.3	289
	phenanthrene	2.1	6.3	4.5	-	-	-	-	-	-	-	-	-	-
	anthracene	0.59	2.0	1.3	-	-	-	-	-	-	-	-	-	-
	fluoranthene	2.2	4.8	5.3	-	-	-	-	-	-	-	-	-	-
	pyrene	1.5	3.7	3.9	-	-	-	-	-	-	-	-	-	-
	benzo(a)anthracene	0.81	1.7	2.3	-	-	-	-	-	-	-	-	-	-
	chrysene	0.7	1.5	2.0	-	-	-	-	-	-	-	-	-	-
	benzo(b)fluoranthene	0.61	1.2	1.9	-	-	-	-	-	-	-	-	-	-
	benzo(k)fluoranthene	0.54	0.98	1.2	-	-	-	-	-	-	-	-	-	-
	benzo(a)pyrene	0.65	1.2	1.7	-	-	-	-	-	-	-	-	-	-
	naphthalene	-	1.2	0.44	-	-	-	-	-	-	-	-	-	-
	acenaphthene	-	0.55	0.52	-	-	-	-	-	-	-	-	-	-
	dibenzofuran	-	1.1	0.41	-	-	-	-	-	-	-	-	-	-
	fluorene	-	1.1	0.82	-	-	-	-	-	-	-	-	-	-
	indeno(1,2,3-cd)pyrene	-	0.55	1.2	-	-	-	-	-	-	-	-	-	-
	benzo(g,h,i)perylene	-	0.48	1.0	-	-	-	-	-	-	-	-	-	-

Summary of Detected Compounds (Cont)

Site Number		RVAAP-28		RVAAP-30	RVAAP-32				RVAAP-34			
Sample Type		Surface Soil		Surface Soil	Surface Soil				Surface Soil			Sediment
Sample Number		281	282	301	321	322	323	324	341	342	343	34B
Compound (soil/sediment mg/kg - surface/groundwater µg/L)	pH	-	-	-	-	-	-	-	-	-	-	-
	antimony	-	-	-	-	-	-	-	-	-	-	-
	arsenic	5.18	5.38	8.05	7.31	8.62	91	12	5.52	10.31	8.16	11.2
	barium	97.3	114	46	89.4	57.6	47	51.5	40.8	36.2	61	40.6
	cadmium	-	1.0	-	9.65	3.33	76.3	4.64	-	-	-	-
	chromium	14.4	15.6	15.3	21.6	17.0	162	23.3	9.29	9.81	13.9	5.01
	copper	138	14.3	10.1	228	274	185	202	5.42	9.31	9.85	9.43
	lead	-	29.5	-	43.2	29.7	29.3	26.8	-	-	-	-
	mercury	-	-	-	-	-	-	-	-	-	-	-
	selenium	-	-	-	-	-	102	-	-	-	-	-
	zinc	156	315	60.5	223	531	196	471	37.7	55.8	109	54.1
	HMX	-	-	14	-	-	-	-	-	-	-	-
	Thiodiglycol	-	-	-	-	-	-	-	-	-	-	-

Summary of Detected Compounds (Cont)

Site Number		RVAAP-33										RVAAP-35	
Sample Type		Surface Soil								Sediment	Surface Water	Surface Soil	Subsurface Soil
Sample Number		331	332	333	334	335	336	337	338	33B	33W	351A	351B
Compound (soil/sediment mg/kg - surface/groundwater µg/L)	pH	-	-	-	-	-	-	-	-	-	-	-	7.9
	antimony	-	58.5	-	-	-	-	-	-	-	-	-	-
	arsenic	11.2	9.23	2.33	4.17	17.6	4.07	12.4	5.65	5.78	-	16.4	10.22
	barium	90.9	67	228	321	333	239	85.2	394	76.7	24	61.1	29.7
	cadmium	-	15.7	-	-	3.83	-	-	-	-	-	-	-
	chromium	24.8	418	9.39	67.6	984	39.8	38	514	33	-	18.5	12.5
	copper	58	304000	164	48.8	333	51.3	310	160	21.8	33	14.4	10.04
	lead	-	910	-	33.6	-	30.7	49.1	52.5	33.2	20	-	-
	mercury	-	-	-	-	-	-	-	-	-	-	-	-
	selenium	-	-	2.22	1.66	2.5	2.54	-	2.58	1.65	-	-	-
	zinc	56.3	454	6.56	36.4	48.2	39.1	100.8	22.5	60.4	-	79.5	43.8
	HMX	-	-	-	-	-	-	-	-	-	-	-	1.3

Summary of Detected Compounds (Cont)

Site Number		RVAAP-36					RVAAP-38						
Sample Type		Surface Soil				Sediment	Surface Soil						Sediment
Sample Number		361	362	363	364	36B	381	382	383	384	385	386	38B
Compound (soil/sediment mg/kg -surface/groundwater µg/L)	arsenic	11.3	16.6	17.4	11.7	8.03	8.82	12.7	11.6	10.0	9.94	10.5	3.9
	barium	80.9	72.9	48	64	56	162	179	142	115	50.5	105	67.6
	cadmium	-	-	-	-	-	46	-	-	-	-	-	-
	chromium	21.6	54.6	20.4	18.1	6.85	48.3	37.1	24.7	20	36.8	34.6	20.3
	copper	15.7	174	214	372	5.62	13.4	11.8	9.68	9.56	7.88	9.15	4.95
	lead	39	1682	2840	4309	-	-	-	-	-	-	-	-
	zinc	155	67.6	81.4	106	31.3	50.9	51.7	51.9	50.4	30.7	53	44.2
	methylene chloride	-	-	-	-	-	0.006	0.009	0.012	-	0.01	-	-
	phenol	-	-	-	-	-	-		-	-	-	-	3.8
	2-chlorphenol	-	-	-	-	-	-		-	-	-	-	3.6
	1,3-dichlorobenzene	-	-	-	-	-	-		-	-	-	-	2
	1,4-dichlorobenzene	-	-	-	-	-	-		-	-	-	-	1.9
	n-nitroso-di-n-propylamine	-	-	-	-	-	-		-	-	-	-	2.3
	1,2,4-trichlorobenzene	-	-	-	-	-	-		-	-	-	-	2.1
	4-chloro-3-methyphenol	-	-	-	-	-	-		-	-	-	-	4
	2-methylnaphthalene	-	-	-	-	-	-		-	-	-	-	1.6
	acenaphthene	-	-	-	-	-	-		-	-	-	-	2
	2,4-dinitrotoluene	-	-	-	-	-	-		-	-	-	-	2.2
	4-nitrophenol	-	-	-	-	-	-		-	-	-	-	3.9
	pentachlorophenol	-	-	-	-	-	-		-	-	-	-	4.4
	pyrene	-	-	-	-	-	-		-	-	-	-	2.2

Ravenna Progress for ecological risk at Ravenna

Notes re
assessment endpoints
(valuable ecological resources)
developed

Thursday, May 8, 1997

Contents:

- Lists of terrestrial assessment endpoints / next one
- Lists of aquatic assessment endpoints
- above from VU-graph work
- above from VU-graph work

David
Barry
Brian
Manjusha

Lists of Assessment endpoints at Cavenna

Terrestrial food webs are valuable.

5/8/92

Trophic	generic Taxon	possible species	
plants			
soil-dwelling	earthworms	earthworm sp. (V)	
herbivores	mammals	deer	rabbit
		squirrel	ground hogs
		vole (V)	mice
		beavers.	
	birds		
invertebrate-eaters	shrews	Blarina brevicauda (V)	robins
		mole (V)	
omnivores	mammals	Killdeer	
		raccoon (V)	
		opossum	
carnivores	birds	red-tailed hawk (V)	
		Kestrel	
	mammals	mink (V)	
		fox (V)	
		coyote	
		rs	
T & E		Barn owl (V)	
		marsh hawk (V)	
		a moth	
		state endangered plant?	

Sources: resource inventories
Nature Conservatory
EPA 1993 Wildlife Handbook

V = OEPA showed preference

Lists of Assessment endpoints at Raveman

Aquatic food webs are valuable.

5/8/97

trophic	generic taxon	possible species
plants	emergents	Typha cattail Sparganium dock ?
benthic bottom-dwellers	benthic fish	benthic organisms (V) carp (V)
	bivalves	bivalves
herbivores		
	snails	
	birds	mallard (V) canada geese (V) wood duck
carnivores	fish	channel cat large-mouth bass (V)
	frogs salamanders reptiles	
	birds	water snakes Great blue heron (V) King fisher (V)
T & E		lamprey

V = OEPA showed preference

DEPARTMENT OF THE ARMY
U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
5158 BLACKHAWK ROAD
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

MCHB-DC-EHM (40)

11 March 1997

MEMORANDUM FOR Commander's Representative, Ravenna Army Ammunition Plant, 8451 State Route 5, Ravenna, OH 44266-9297

SUBJECT: Hazardous and Medical Waste Study No. 37-EF-5360-97, Relative Risk Site Evaluation, Ravenna Army Ammunition Plant, Ravenna, Ohio, 28 October - 1 November 1996

Two copies of this report are enclosed. The point of contact for this report is James Sheehy. He may be reached at DSN 584-5211 or commercial (410) 671-5211. Additional comments or concerns may be directed to the undersigned at DSN 584-3651 or commercial (410) 671-3651.

FOR THE COMMANDER:

Encl

LINDA L. BAETZ
Acting Program Manager
Hazardous and Medical Waste

CF (w/encl):
CDR, AMC, ATTN: AMCEN-A (Vol I only)
CDR, IOC, ATTN: AMSIO-EQE (Mr. Whelove) (Vol I and II)
CDR, MEDCOM, ATTN: MCHO-CL-W (exec sum only)
CDR, NORTH ATLANTIC RMC (Vol I only)
CDR, WRAMC, ATTN: PVNTMED SVC (Vol I only)
CDR, IRELAND ARMY COMM HOSPITAL, ATTN: PVNTMED SVC (2 cy) (Vol I only)
CDR, USAEC, ATTN: SFIM-AEC-EC (Vol I only)
CDR, DSA-N (Vol I only)

Readiness thru Health