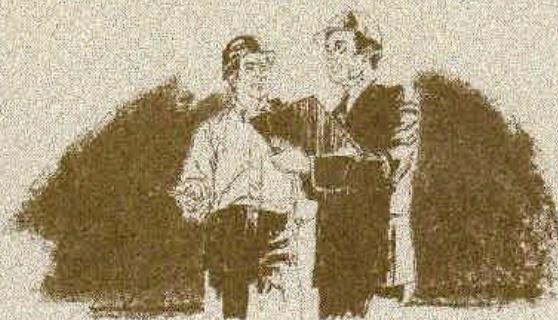


Environmental Aspects of Construction and Management of Outdoor Shooting Ranges



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ENVIRONMENTAL ASPECTS OF CONSTRUCTION AND MANAGEMENT OF OUTDOOR SHOOTING RANGES

DISCLAIMER

This manual is intended to provide useful general information to shooting range managers. The National Shooting Sports Foundation and EA Engineering, Science, and Technology, Inc. do not certify or approve ranges or range designs. While every effort has been made to provide up-to-date technical information, this manual is not to be used as a substitute for consultation with scientists, engineers, attorneys, and other appropriate professionals who should be called upon to make specific recommend actions for individual range design and management.

Environmental Aspects of Construction and Management of Outdoor Shooting Ranges
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PREFACE

Statement of Ideals for Environmental Stewardship at Outdoor Shooting Ranges

The shooting sports community has long been committed to protecting the quality of the environment for ourselves and the community. This commitment extends to managing our business operations to maintain and enhance the quality of the environment. We recognize our responsibility for, and the benefits of, managing our land, water and wildlife for the enjoyment of future generations. Our daily activities reflect the fundamental importance of well-founded environmental stewardship to the shooting sports community and to the public at large.

The shooting sports community is committed to well-founded environmental stewardship in all aspects of our service to our customers. To best serve our clients and our public community, shooting range owners, operators and employees will:

- N Design and operate ranges to minimize potential impact on wildlife resources
- N Employ practical means of managing spent ammunition to protect ground water, surface water, wetlands and wildlife
- N Employ erosion control and other practices to conserve soil and protect water quality
- N Employ practical means of managing sound

S A A M I

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Since 1926

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CONTENTS

	Page
Disclaimer	
Preface - Statement of Ideals	
List of Figures	v i
List of Tables	viii
How to Use This Manual	ix
1. PURPOSE, SCOPE, ORGANIZATION AND LEGAL/REGULATORY CONTEXT	1-1
1.1 INTRODUCTION	1-1
1.2 PURPOSE	1-1
1.3 SCOPE	1-2
1.4 SCIENTIFIC BASIS FOR THIS DOCUMENT	1-3
1.5 LEGAL/REGULATORY CONTEXT	1-3
1.5.1 Federal Laws and Regulations	1-4
1.5.1.1 Overview of the Clean Water Act (CWA)	1-4
1.5.1.2 Overview of Resource Conservation and Recovery Act (RCRA)	1-5
1.5.1.3 Overview of the Comprehensive Environmental Response, Compensation and Liability Act	1-6
1.5.2 State and Local Laws and Regulations	1-7
1.6 SUMMARY OF RELEVANT CASE LAW RELATING TO SHOOTING RANGES ...	1-7
1.6.1 Introduction	1-7
1.6.2 Implications of Current Rulings	1-8
1.6.2.1 Clean Water Act	1-8
1.6.2.2 Resource Conservation and Recovery Act	1-8
1.6.3 Conclusion	1-9
2. COMMUNITY RELATIONS	2-1
2.1 FUNDAMENTAL COMMUNITY RELATIONS ACTIVITIES	2-1
2.2 SOUND	2-3
2.2.1 Issue	2-3
2.2.2 Management Techniques	2-5
2.2.2.1 Operational Approaches	2-5
2.2.2.2 Siting Considerations	2-6
2.2.2.3 Engineering Approaches	2-6
2.2.2.4 Vegetative Approaches	2-7

3. ENVIRONMENTAL ISSUES AND TECHNIQUE S TO ADDRESS THEM	3-1
3.1 LEAD	3-1
3.1.1 Issues	3-5
3.1.1.1 Surface Water	3-5
3.1.1.2 Soil and Groundwater	3-7
3.1.1.3 Potential Contamination of Bird and Wildlife Food	3-8
3.1.2 Management Techniques	3-8
3.1.2.1 Recovery and Recycling	3-8
3.1.2.2 Management of Stormwater Runoff	3-10
3.1.2.3 Lead-Accumulating Vegetation	3-11
3.1.2.4 Clay Soils	3-12
3.1.2.5 Stabilization by Lime Addition	3-13
3.1.2.6 Phosphate Addition	3-14
3.1.2.7 Organic Matter	3-14
3.1.2.8 Cultivation/Tilling	3-14
3.1.2.9 Combined Approaches	3-15
3.2 SOIL EROSION	3-15
3.2.1 Issues	3-15
3.2.2 Management Techniques	3-16
3.2.2.1 Vegetative Control	3-16
3.2.2.2 Terracing of Slopes	3-16
3.2.2.3 Settling Basins	3-18
3.2.2.4 Other Techniques	3-18
3.3 Wildlife Habitat and Feeding	3-18
3.3.1 Issue	3-18
3.3.2 Management Techniques	3-18
3.3.2.1 Landscaping/Plantings	3-18
3.3.2.2 Management of Vegetation	3-20
3.3.2.3 Wildlife Habitat Enhancement	3-20
3.4 DUST	3-21
3.4.1 Issues	3-21
3.4.1.1 Potential Lead Exposure to Shooters	3-21
3.4.1.2 Potential Exposure During Recovery	3-21
3.4.1.3 Aesthetics	3-21

3.4.2 Management Techniques	3-21
3.4.2 .1 Lead Dust	3-21
3.4.2 .2 Soil Dust	3-21
3.5 RANGE SITING/REORIENTATION	3-22
4. APPROACHES SPECIFIC TO SHOTGUN RANGES	4-1
4.1 DISTRIBUTION OF SHOT	4-1
4.1.1 Shot Distribution at Trap Fields	4-6
4.1.2 Shot Distribution at Skeet Fields	4-6
4.1.3 Shot Distribution at Sporting Clays Courses	4-7
4.2 OPERATIONAL APPROACHES TO ENVIRONMENTAL MANAGEMENT ...	4-7
4.2.1 Addressing of Fundamental Issues Discussed in Section 3	4-7
4.2.2 Recovery and Recycling of Shot	4-7
4.2.3 Recovery of Targets	4-7
4.2 .4 Alternative Shot Materials	4-8
4.3 ENGINEERING APPROACHES TO ENVIRONMENTAL MANAGEMENT ...	4-8
4.3.1 Addressing Fundamental Issues Discussed in Section 3	4-8
4.3.2 Shotgun Range Siting	4-9
4.3.3 Clay Soil	4-9
4.3.4 Theoretical Physical Barriers to Shot Distribution	4-10
4.4 OTHER MANAGEMENT APPROACHES	4-10
5. APPROACHES SPECIFIC TO RIFLE/PISTOL RANGES	5-1
5.1 LEAD DISTRIBUTION	5-1
5.2 OPERATIONAL APPROACHES TO ENVIRONMENTAL MANAGEMENT ...	5-1
5.2.1 Addressing of Fundamental Issues Discussed in Section 3	5-1
5.2.2 Recovery and Recycling of Bullets	5-1
5.3 ENGINEERING APPROACHES TO ENVIRONMENTAL MANAGEMENT ...	5-3
5.3.1 Addressing of Fundamental Issues Discussed in Section 3	5-3
5.3.2 Range Siting	5-3
5.3.3 Bullet Containment	5-3
5.3.4 Berm Construction and Maintenance	5-4
5.3.5 Control of Runoff	5-6
5.4 OTHER MANAGEMENT APPROACHES	5-6

6.	ENVIRONMENTAL STEWARDSHIP PLAN	6-1
6.1	CONCEPT AND RATIONALE	6-1
6.2	PLAN DEVELOPMENT	6-1
6.2.1	Evaluation of Existing Conditions	6-2
6.2.1.1	General Environmental Conditions	6-2
6.2.1.2	General Range Characteristics	6-6
6.2.2	Identification of Environmental Issues	6-6
6.2.3	Identification of Management and Engineering Solutions	6-6
6.2.4	Preparation of Environmental Stewardship Plan	6-9
6.3	PLAN IMPLEMENTATION	6-12
6.4	RECORD-KEEPING AND EVALUATION	6-12
7.	SUMMARY AND CONCLUSIONS	7-1
8.	REFERENCES	8-1

Appendices :

Appendix A:	Sources for Additional Information
Appendix B:	Lead Recovery and Lead Recycling Firms
Appendix C:	Example Environmental Stewardship Plans
Appendix D:	Glossary of Terms
Appendix E:	Summary of Relevant Case Law Relating to Shooting Ranges
Appendix F:	Evaluation of this Manual

LIST OF FIGURES

Number	Title
2-1	Environmental stewardship is a key component of good community relations for outdoor shooting ranges.
2-2	The approaches to managing sound at outdoor shooting ranges fall into four main categories.
3-1	Conceptual illustration of ways lead can interact with the environment at outdoor shooting ranges.
3-2	Influence of pH or acidity on environmental activity of lead.
3-3	Various techniques can be used alone or in combination to manage lead in the environment.
3-4	Various techniques can be used alone or in combination to manage soil erosion at outdoor shooting ranges.
3-5	Various techniques can be used alone or in combination to manage wildlife habitat and feeding at outdoor shooting ranges.
4-1	Various kinds of approaches can be used alone or in combination in effective environmental stewardship at outdoor rifle/pistol ranges.
4-2	Theoretical shotfall zone and area of maximum shotfall at trap fields. The typical layout of multiple trap fields is shown at the top of the page and a modified layout to minimize the total shotfall zone is shown at the bot tom of the page.
4-3	Theoretical shotfall zone and area of maximum shotfall at skeet fields. A single field is shown at the top of the field and multiple adjacent fields are shown at the bot tom of the page.
4-4	Shotfall zones for a simple hypothetical sporting clays course, illustrating the wide area over which shot can be distributed and the possible overlap of multiple shotfall zones at some distance from the shooters. Note: If more than one party at a time we re to use a course laid out in a way resembling this illustration, there could be serious safety concerns. Shooter safety must be the primary consideration in range layout.
5-1	Various kinds of approaches can be used alone or in combination in effective environmental steward-ship at outdoor rifle/pistol ranges.
5-2	Examples of backs top berm and runoff trenching designed to collect bullets and lead runoff at rifle/pistol ranges.

LIST OF TABLES

Number	Title
3-1	Site checklist to compare various environmental characteristics.
3-2	Summary of ecological criteria for range siting decision-making.
6-1	Sources of information to help evaluate existing conditions.
6-2	Summary of potential management and engineering solutions for addressing environmental issues at shooting ranges.
6-3	Summary of potential operational and engineering approaches for control of lead at outdoor shooting ranges.
6-4	Sample project evaluation comparison sheet.
6-5	Sample outline: environmental stewardship plan.
6-6	Sample project implementation schedule.

HOW TO USE THIS MANUAL

Whatever the reader's primary purpose in using this manual, the first step should be to read the entire manual to get an overview of the information it contains. The reader can then return to the specific section(s) most relevant to his or her immediate needs. This approach is recommended because *much of the information is interrelated, and an overview of the entire document will provide the best basis for fully understanding the interrelationships between the material in each section.* Below is a brief summary of each section of the report.

Section 1 contains introductory material for the manual. Section 1.5 is especially important, since it describes the *current* regulatory and legal context for environmental concerns at outdoor shooting ranges.

Section 2 briefly introduces Community Relations Plans and describes the role of environmental management in establishing and maintaining good community relations.

Section 3 discusses the major environmental issues owners or operators of shotgun and outdoor rifle/pistol ranges face, as well as techniques to address them. *This section is the technical foundation of this manual, and should be read and understood by all because it is the basis for specific issues in Sections 4 and 5.*

Sections 4 and 5 focus on environmental issues specific to shotgun ranges (Section 4) and outdoor rifle/pistol ranges (Section 5).

Section 6 discusses how to develop and implement an Environmental Stewardship Plan for your range. It ties Sections 3, 4 and 5 together in the context of comprehensive implementation guidance.

Section 7 contains the summary and conclusions of the manual.

Section 8 lists the reference information cited throughout the manual. Specific references are listed in numerical order and identified in the text by numbers in parentheses.

Appendix A provides annotated sources of additional information on various aspects of environmental issues at ranges.

Appendix B represents a list of lead recovery companies and a list of lead recycling firms.

Appendix C contains example Environmental Stewardship Plans to show how to develop a plan for your range following the guidance in Section 6.

Appendix D is a glossary of terms used in this manual.

Appendix E contains a more detailed summary of relevant case law relating to shooting ranges.

Appendix F contains a form for evaluating this manual. Please complete and return to the address provided. Since management techniques and regulatory/legal considerations will likely evolve over time, updated editions of this manual are likely. This evaluation form gives you the opportunity to help ensure that future editions address your specific environmental needs.

1. PURPOSE, SCOPE, ORGANIZATION AND LEGAL/REGULATORY CONTEXT

1.1 INTRODUCTION

Shooting sports enthusiasts have been a positive environmental force for decades. Sportsmen and women have been leaders in preserving open space and supporters of scientific wildlife management. They have been good stewards of our environment and natural resources. This document is another contribution to the sportsman's long-standing record of environmental stewardship.

Legal, regulatory and public perception concerns about environmental issues at outdoor shooting ranges are being raised more frequently, and this trend will likely continue. At present there are no federal environmental regulations specific to outdoor shooting ranges.

Environmental regulations governing the management of military ranges, including small arms ranges, are in the process of being promulgated by the United States Environmental Protection Agency (EPA) and the Department of Defense (DOD). These regulations have not been finalized and it is unclear what impact they may have on private ranges.

However, various groups have filed lawsuits against civilian ranges in federal courts claiming that some environmental laws are applicable to outdoor ranges, and alleging that the ranges are in violation of these laws. These suits have only begun to clarify the legal and regulatory picture affecting shooting ranges. Furthermore, federal and state agencies have taken regulatory actions against some ranges on environmental grounds. The cumulative impacts of these actions point toward the desirability of range owners and operators (range managers) paying increasing attention to environmental issues related to range construction and management.

It is in the best interest of range managers to recognize the growing legal, regulatory and public concern about possible environmental issues at outdoor ranges. Range managers should neither ignore nor be frightened by the growing attention to environmental issues. Instead, these issues provide an opportunity for managers to seize the high ground by practicing good stewardship on their ranges. Range managers should be aware that there may be valid environmental concerns under some circumstances. However, they should be equally aware that environmental allegations can easily be blown out of proportion to the real potential for impacts.

Under conditions typical of many outdoor ranges, environmental issues should generally be relatively minor. However, an in depth assessment of environmental conditions needs to be under-taken to determine the real risks to the environment. But no matter how minor, proactive management of these issues is highly recommended. This manual identifies approaches that can reliably minimize potential adverse impacts that may exist.

1.2 PURPOSE

This manual provides guidance for range managers to follow to proactively develop and implement an Environmental Stewardship Plan (see Section 6) that would:

- N assess the physical and administrative operations of their range to identify potential environmental issues;
- N determine any areas of potential concern;
- N describe site-specific management techniques to address the identified areas of concern; and
- N provide a process to evaluate and document the success of management efforts.

This manual provides guidance on these topics. Because each range is different, this manual does not attempt to present actions that range managers “must” or “should” take. It presents issues and suggests ways of addressing them. Managers are encouraged to consider and adapt these suggestions into their own Environmental Stewardship Plan. Professional assistance may be appropriate in some instances (see Appendix A).

When a range manager begins implementing an Environmental Stewardship Plan, it may not be necessary to accomplish everything at once. Most often, the best process would be to (1) evaluate the specific set of environmental conditions at the range, (2) decide which management activities are appropriate, and (3) determine the sequence and timing for implementing each activity. This process is discussed in more detail in Section 5 of this manual.

The fact that conditions at many ranges may not cause adverse environmental impacts does not lessen the need for active management. Every range is potentially subject to legal and/or regulatory challenge. **All range managers would benefit from implementing appropriate aspects of the guidance in this manual to:**

- N build and manage ranges in a way that will be protective of the environment and open space;
- N apply good-faith efforts to keep any potential environmental problems to a minimum, thereby enhancing the quality of our environment while minimizing any likelihood of legal or regulatory challenge and establishing a positive public image of the shooting sports; and
- N help defend against unfounded or exaggerated allegations of environmental impact

In addition to these benefits, the range managers who implement a management plan will reap the public image benefit (for themselves and the shooting sports in general) of practicing good environmental stewardship.

1.3 SCOPE

This manual provides practical guidance on steps range managers can take to develop and implement an Environmental Stewardship Plan. This guidance is as detailed as practical while retaining broad applicability to ensure that it is useful to the greatest number of ranges. The manual addresses environmental issues pertinent to shotgun and outdoor rifle/pistol ranges. **It covers the design, development and management of new ranges as well as expansions or enhancements of existing ranges, and also provides environmental management guidance for all outdoor ranges.**

Because of its scope, many range managers will find this manual very helpful in their general community relations activities. However, it is beyond the scope of this manual to describe a range's specific role in community relations activities. Managers are advised to develop a separate Community Relations Plan (see Section 2). Similarly, while there are environmental benefits from some safety activities, these should be addressed in a range Safety Plan and are not discussed in this manual.

This manual addresses only environmental aspects of range construction and management. It is designed to complement the information in the range manuals developed by the National Rifle Association of America (NRA), Amateur Trapshooting Association (ATA), National Sporting Clays Association (NSCA), National Skeet Shooting Association (NSSA) and others. Each of these organizations has valuable information that may contribute to the overall success of any range operation. (See Appendix A for sources of additional information.)

1.4 SCIENTIFIC BASIS FOR THIS DOCUMENT

The information in this document is based on well-founded environmental science and engineering as well as practical experience at outdoor ranges. Much of the background information related to the environmental mobility of lead and potential ways to manage it is summarized from a document entitled "Lead Mobility at Shooting Ranges." That document, based on more than 100 scientific studies, was developed by the Sporting Arms and Ammunition Manufacturers' Institute, Inc. (SAAMI), through a contract to EA Engineering, Science and Technology, Inc. It is available for a nominal charge from SAAMI. (See Appendix A)

A number of other scientific and technical documents provided important support for the guidance in this manual. These are referenced throughout the text by numbers in parentheses. Full reference information may be found in Section 8 - References. All the referenced documents, except the NRA Range Manual, are available from the National Shooting Sports Foundation at the address in Appendix A. There may be a nominal charge to cover the costs of printing and postage for documents ordered from NSSF. The NRA Range Manual should be ordered directly from the NRA.

1.5 LEGAL/REGULATORY CONTEXT

This section provides a brief layman's overview of the *current* legal and regulatory situation regarding environmental issues at outdoor shooting ranges. **The fundamental reason for ranges to address environmental issues is to be good stewards of the environment. Environmental laws and regulations provide a framework for environmental stewardship, as well as substantial potential liabilities for poor stewardship.** These laws have been the basis for improvements in air and water quality and improved health and well being of the environment. However, environmental laws and regulations are complex and often confusing. This section provides a brief introduction to make the reader aware of the general provisions of these laws and regulations.

Clear "bright-line" legal precedents have not yet been established for outdoor shooting ranges and details on how laws and regulations will or may be applied are not fully established. Some cases have been settled out of court, some have been decided on very narrow grounds, and some decisions are still pending or may be appealed. This manual attempts to make the basic issues clear enough for range managers to recognize the

possible implications for their ranges. **The application of environmental laws and regulations to outdoor shooting ranges is evolving rapidly, and range managers are advised to contact the National Shooting Sports Foundation (NSSF) or SAAMI for updated information if the specific need arises.**

Should a range manager be notified that the range may face legal or regulatory action involving environmental issues, they should *immediately notify or obtain legal counsel.* Because environmental laws and regulations are extremely complex, it is often advisable to enlist the aid of counsel with specific experience in environmental law, particularly with experience in defending shooting ranges. The NSSF Facilities Development Division or SAAMI, both listed in Appendix A, may be of assistance in identifying possible counsel experienced with environmental laws and regulations at outdoor shooting ranges.

1.5.1 Federal Laws and Regulations

At the time this manual was written, legal or regulatory actions based on environmental issues have been taken against shooting ranges in a dozen or more states throughout the country. Some have been relatively minor, but several have been major. There is little doubt that more such actions will be taken in the future as ranges become more “visible” to regulators, environmental groups and the general public.

To date, most of the environmental actions against outdoor shooting ranges at the federal level have been either suits filed by citizen groups or activities undertaken by federal or state regulatory authorities at the urging of citizen groups. As noted previously, there are no federal environmental laws or regulations written expressly and specifically for outdoor shooting ranges. However, several broad environmental laws *have been claimed and/or have been found to apply to ranges.* The courts have agreed that these laws apply to many types of activities that are neither explicitly included nor excluded from coverage in the law. Actions to date have primarily involved the three laws discussed in this section. Additional allegations under these and other laws may be possible in the future.

1.5.1.1 Overview of the Clean Water Act (CWA)

The CWA and its amendments have been this country’s fundamental legislation controlling water pollution since 1972. Most of the CWA allegations against ranges involve the National Pollutant Discharge Elimination System (NPDES) program. The U.S. Environmental Protection Agency (EPA) has delegated the NPDES program to many of the states. The delegated states administer the program within their borders and have the authority to issue permits. (See Section 1.5.2.) Under this program of the CWA it is illegal to “discharge” any “pollutant” from a “point source” into “waters of the United States” without a permit to do so. **Under the CWA, waters of the United States encompass essentially all rivers, streams, lakes, ponds, drainage-ways, wetlands and similar features in the United States, including those entirely on private property.** Legal actions to date include *allegations* that (1) shooting into water (including wetlands) constitutes a “discharge,” (2) bullets, shot (whether of lead or any other material), wads and targets constitute “pollutants,” and (3) traps, shooting positions and ranges themselves constitute “point sources” under the CWA. At least one Federal Circuit Judge has agreed (Reference 2). Note that under these allegations a range would not have to be causing any adverse environmental impact to be in violation (Reference 3). Any range whose bullets, shot (regardless of type), wads or targets enter the “waters of the U. S.” may be potentially subject to similar claims.

It is important to note that the CWA *does not prohibit the discharge* of pollutants into waters of the U.S; **it merely requires a permit to do so**. Should the courts determine that it is necessary, ranges shooting into water would have to obtain a NPDES permit. Theoretically, regulators could issue a permit establishing conditions the range would have to meet to avoid unacceptable adverse environmental impact. A record of implementation of a good Environmental Stewardship Plan should help if a range had to apply for an NPDES permit.

1.5.1.2 Overview of Resource Conservation and Recovery Act (RCRA)
Passed by Congress in 1976, the Resource Conservation and Recovery Act (RCRA) is designed to be a “cradle-to-grave” system of ensuring the protection of human health and the environment when generating, storing, transporting or disposing of waste. RCRA’s primary focus is the regulation of hazardous solid wastes at operating facilities. It has some of the most complex and sometimes confusing regulations of any federal law.

Under RCRA, the term “solid waste” has two definitions: one by statute and the other by regulation. Under the *statutory* definition, solid waste is broadly defined as “discarded” material. The *regulatory* definition is more narrow, but more complex. (See Appendix E for a detailed discussion of case law involving these RCRA definitions.)

A waste must first meet the *statutory* definition of solid waste before it can be *regulated* under RCRA. If a material falls within the *regulatory* definition, its management is subject to specific regulations and limitations. If the RCRA solid waste is also hazardous, it is subject to even more stringent requirements. RCRA authority may also be delegated to the states.

Although Congress intended for RCRA to closely regulate certain types of wastes, it also intended for the Act to be a vehicle available to both the federal government (Section 7002) and private citizens (Section 7003) to prevent or remediate situations that may pose an “imminent or substantial endangerment to human health or the environment.” Therefore, even though a waste may not be *regulated* by RCRA, the Act can be invoked if the wastes suspected of causing an endangerment situation meet the *statutory* definition of solid waste. Neither the statute nor the legislative history addresses how far the reach of RCRA extends, and RCRA has been used against shooting ranges.

1.5.1.2.1 RCRA Definitions of Solid Waste as Applied to Shooting Ranges

1. **When used for its intended purpose, is lead ammunition a solid waste within EPA’s regulatory definition of solid waste?**

No. The EPA has taken the position that the discharge of ammunition at shooting ranges is the intended use of the product and the spent ammunition is not a solid waste. Under its regulations, the agency does not *regulate* shooting ranges as transportation, storage and disposal facilities subject to stringent hazardous waste requirements. **However, there are unsettled allegations by private parties that ranges can “abandon” a waste under RCRA by (1) leaving shot or targets on the ground for unspecified extended periods, or (2) permanently closing a shooting area without first removing the shot and targets.**

2. When used for its intended purpose, can lead ammunition become a solid waste within RCRA's statutory definition of solid waste?

Yes. Although spent shot does not fall under EPA's hazardous waste *regulatory* program definition, EPA has taken the position that it is still a solid waste under the *statutory* definition, and ranges are, therefore, not immune from RCRA "imminent hazard" actions under Sections 7002 and 7003. Section 7003 of RCRA is an enforcement provision which allows citizens—without EPA involvement—to bring a civil action in a federal district court against anyone whose past or present handling, storage, treatment, transportation or disposal of any solid or hazardous waste *may pose* an imminent and substantial endangerment to human health or the environment. The EPA may also bring such suits under Section 7002. The courts have the authority to require remedial action.

It only has to be shown that a waste *may pose* an "imminent and substantial endangerment to human health or the environment." This expansive language is intended to give the courts authority to eliminate risks posed by toxic wastes. "Imminent endangerment" does not require a showing that actual harm will occur immediately so long as the risk of harm is present. "Substantial" does not require quantification of the risk if there is a scientific basis for concluding that humans or the environment are at risk.

No allegation of a regulatory violation is needed to support an imminent hazard lawsuit.

Federal courts have applied RCRA's *statutory* definition of solid waste to spent lead ammunition in imminent hazard cases. Because lead shot and clay targets had been "left to accumulate long after they have served their intended purpose," a federal district court ruled that RCRA's broad *statutory* definition of solid waste applied. The court concluded that being a solid waste that also exhibited hazardous characteristics (toxicity), the lead shot which had accumulated endangered human health and the environment. In addition, there are unsettled allegations by private parties that ranges can "abandon" a waste under RCRA, by (1) leaving shot or targets on the ground for unspecified extended periods, or (2) permanently closing a shooting area without first removing the shot and targets.

Private parties can act under RCRA, including pressuring of EPA and other agencies to move against ranges. Liabilities under RCRA can be very large, and RCRA cases may take years to litigate at great expense. RCRA liabilities potentially could prevent the sale of property or its reuse for any new purpose until liability issues are resolved. RCRA (and CERCLA, discussed below) appear to be among the federal laws with the greatest potential implications for outdoor shooting ranges.

1.5.1.3 Overview of the Comprehensive Environmental Response, Compensation And Liability Act

This act, known as CERCLA and "Superfund," imposes clean-up cost liability on parties who own or manage a property at which there is a release of a "hazardous substance" into the environment. CERCLA and the regulations under it classify many materials, including lead, and some of the constituents of clay targets, as hazardous substances. CERCLA also authorizes the government and certain other parties to recover costs of natural resource damages resulting from discharges. Examples of natural resource damages might include loss of birds or wildlife, contamination of water, sediment or soil,

etc. Although private parties who have not incurred clean-up liabilities cannot sue under CERCLA, they can pressure EPA and other agencies to act. Liabilities under CERCLA can be substantial, and are generally not transferred with the property. Liabilities not only remain with the original owner, but also are imposed against a subsequent owner until the “hazard” is removed. CERCLA liabilities can prevent the sale of property or its use for any new purpose until environmental issues are resolved.

1.5.2 State and Local Laws and Regulations

Contamination-Oriented Laws and Regulations. The states that have a Clean Water Act NPDES program or a RCRA program approved by the EPA have their own regulations implementing the program. While all are generally similar to the EPA program and to each other, many have their own unique provisions. Most states have their own versions of CERCLA, each with its own requirements and procedures. There may also be other state environmental laws under which actions could be brought against ranges by citizen groups or regulators. In general, federal environmental laws always permit the states to adopt standards more stringent than the federal standards.

Local laws generally do not focus on pollution control, but range managers should be aware of what local requirements may exist. Legal counsel may be helpful in determining if any local requirements apply to a particular range.

Other Laws and Regulations. A variety of state and local laws and regulations deal with environmental issues other than contaminants that may affect ranges. Many local laws, ordinances and regulations address issues such as noise, zoning, traffic, soil erosion, wetlands protection, trash, nuisances and similar issues. These laws generally do not carry the liabilities of RCRA and CERCLA and their state counterparts. However, failure to comply can create a negative public image that can make every aspect of range operation a continuous problem. It is far better to be aware of these local requirements and be proactive in compliance so that your range can maintain a good public image. Developing a Community Relations plan will help achieve this.

1.6 SUMMARY OF RELEVANT CASE LAW RELATING TO SHOOTING RANGES

1.6.1 Introduction

To date, only three reported judicial decisions have directly addressed environmental issues that arise from shooting. The consistent factor among these ranges is that they were shooting over a body of water, be it a wetland, marsh, stream, lake or ocean.

However, the issues discussed have relevance to any outdoor shooting range. The issues are not limited to concerns relating to lead shot, and have general relevance to range managers who are interested in learning more about legal challenges that may be asserted against shooting ranges and gun clubs. **(More specific information on these cases is found in Appendix E.)**

1.6.2 Implications of Current Court Rulings

1.6.2.1 Clean Water Act

Three cases have been litigated regarding allegations of shooting ranges violating the CWA. All involved allegations of “discharging a pollutant into the waters of the United States” without the prerequisite National Pollution Discharge Elimination System (NPDES) permits.

In the first case, the United States Navy (*Weinberger v. Romero-Barcelo*, 456 U.S. 305, 102 S.Ct. 1798, United States Supreme Court, 1982) (*Romero-Barcelo*) was alleged to be in violation of the CWA because they were discharging munitions and targets into the waters off the coast of Puerto Rico without an NPDES permit. The lower court found that they were in violation of the CWA. However, no injunction was issued to stop this activity. Ultimately, the EPA issued an NPDES permit. The permit requires periodic monitoring of the environmental impacts of this activity.

The second case was the *Long Island Soundkeeper Fund, Inc. v. New York Athletic Club (NYAC)* (94 Civ. 0436, S.D.N.Y. March 20, 1996). The NYAC operated a trap shooting range on Travers Island. Because shot from the range fell into Long Island Sound, NYAC was sued on similar grounds as the Navy. This is the only case where this issue involving a *private club* shooting over water has been litigated. The court ruled that the *range* met the definition of “point source” within the CWA and that the club needed a NPDES (or state SPDES) permit. An injunction against shooting was granted until such a permit was obtained. NYAC has stopped shooting as a result of this suit. It is interesting to note that the State of New York has indicated that it cannot issue an SPDES permit at this time because of conflicts with other state environmental protection laws.

Similar allegations were made in a third case, *Connecticut Coastal Fisherman’s Association v. Remington Arms Co., Inc. (Coastal Fishermen)* (989 F.2d 1305, 2nd Cir. 1993). However, the court dismissed this portion of the case because the club had closed. An earlier, unrelated court ruling requires that alleged violations must be ongoing.

Several other clubs have been implicated and/or charged with violating the CWA. However, none of these allegations have been litigated. Most of the clubs involved in these allegations either went out of business, settled out of court, changed the direction of shooting and/or switched to non-toxic shot.

1.6.2.2 Resource Conservation and Recovery Act

Two cases (*NYAC* and *Coastal Fishermen’s*) have been reported regarding RCRA being applied to shooting ranges. Both cases involved two separate provisions of RCRA.

The first set of allegations claimed that these shooting ranges were in violation of RCRA’s *regulatory* requirements because they were “discarding” a hazardous waste without the proper permits. In both cases, the courts ruled that the discharge of ammunition at shooting ranges was the intended use of the product and therefore was not a discard of a “solid waste.” (Note: before a substance can become a “hazardous waste,” it must be a “solid waste.” See Section 1.5 for a discussion of RCRA and Appendix E for a detailed discussion of these cases.) These rulings relied heavily on briefs submitted by EPA that identified and supported the distinctions between the statutory and regulatory definitions of “solid waste.”

The second set of allegations presented in both cases was that the spent lead shot and target debris posed an “imminent and substantial endangerment to human health or the environment” under RCRA Section 7003. In the Connecticut Coastal Fishermen’s case, the court ruled that the scientific evidence indicated that the spent lead shot did pose an imminent endangerment to black ducks and other marine organisms. However, the scientific evidence showed that the target debris was not a hazard and did not have to be remediated under the RCRA authority. The NYAC case was settled out of court. However, in both instances the ranges were required to remediate the shot fall area to prevent any further endangerment. The target debris was also cleaned up. Several other clubs have been implicated and/or charged with violating RCRA. However, none of these allegations have been litigated. Most of the clubs involved in these allegations either went out of business and/or settled out of court. Many of them are actively remediating their ranges.

1.6.3 Conclusion

The Coastal Fishermen’s and NYAC decisions present mixed results. On the one hand, the courts held that discharged lead shot and clay targets do not constitute the kind of “solid waste” which would subject shooting ranges to the onerous and expensive RCRA treatment, storage and disposal requirements. This conclusion was supported by the EPA in its amicus briefs. On the other hand, the court ruled that if expended shot and targets present an imminent and substantial endangerment to the environment then shooting ranges may be subject to the more general RCRA provisions requiring remedial action.

Perhaps the most troubling ruling is in the NYAC case, where the court ruled that ranges shooting over waters of the United States (also interpreted very broadly and not limited to coastal waters) must obtain NPDES permits to operate. (Note: The decision in the Coastal Fishermen’s is only binding in the states within the Second Circuit and District Courts. Other courts are not required to follow these findings. However, as other courts are presented with these issues, they may find these prior cases persuasive and rule in a similar fashion.)

2. COMMUNITY RELATIONS

Developing and maintaining good community relations is vitally important for every range manager. Every aspect of range construction and operation influences community relations, including environmental activities. Every range manager should develop and implement a Community Relations Plan similar in concept to the Environmental Stewardship Plan (see Section 6).

A good working relationship between key community leaders and shooting ranges is of paramount importance to developing good community relationships. Range managers must recognize that they are part of the community and must follow state, county or municipality rules and regulations. Moreover, because range managers are members of the community, every effort should be made to take part in community events, meetings and beautification projects (Figure 2-1). As a rule, one of the best ways to maintain good community relations is to communicate and be involved in community functions much in the same manner as any other community resident. Specific examples of ways managers can sponsor good community relations are summarized below. For more information on community relations, read NSSF's "Guide To Community Relations For Shooting Ranges."

2.1 FUNDAMENTAL COMMUNITY RELATIONS ACTIVITIES

Use of Facilities. Managers can provide an open range day when local residents can use the range. Facilities with large clubhouses also can provide meeting places for the community during low range usage periods. Providing free range usage to any youth accompanied by an adult, or sponsoring organized youth events, is a good way to highlight the positive attributes of shooting ranges and foster good community relations. Ranges can sponsor fund-raising events for rescue squads, recreation departments or other community services. Inviting city, county and state officials, administrators and police, and members of community service clubs to use or join the range may be very valuable.

Cleanliness. Overall cleanliness is the responsibility of the shooting range management. Much as in any other business, overall cleanliness attracts customers. Inappropriate signs, unmaintained disposal areas and failure to maintain cosmetic appearances can contribute to the perception of environmental degradation. Attention should be given to keeping ranges as clean and neat as reasonably possible.

Figure 2-1

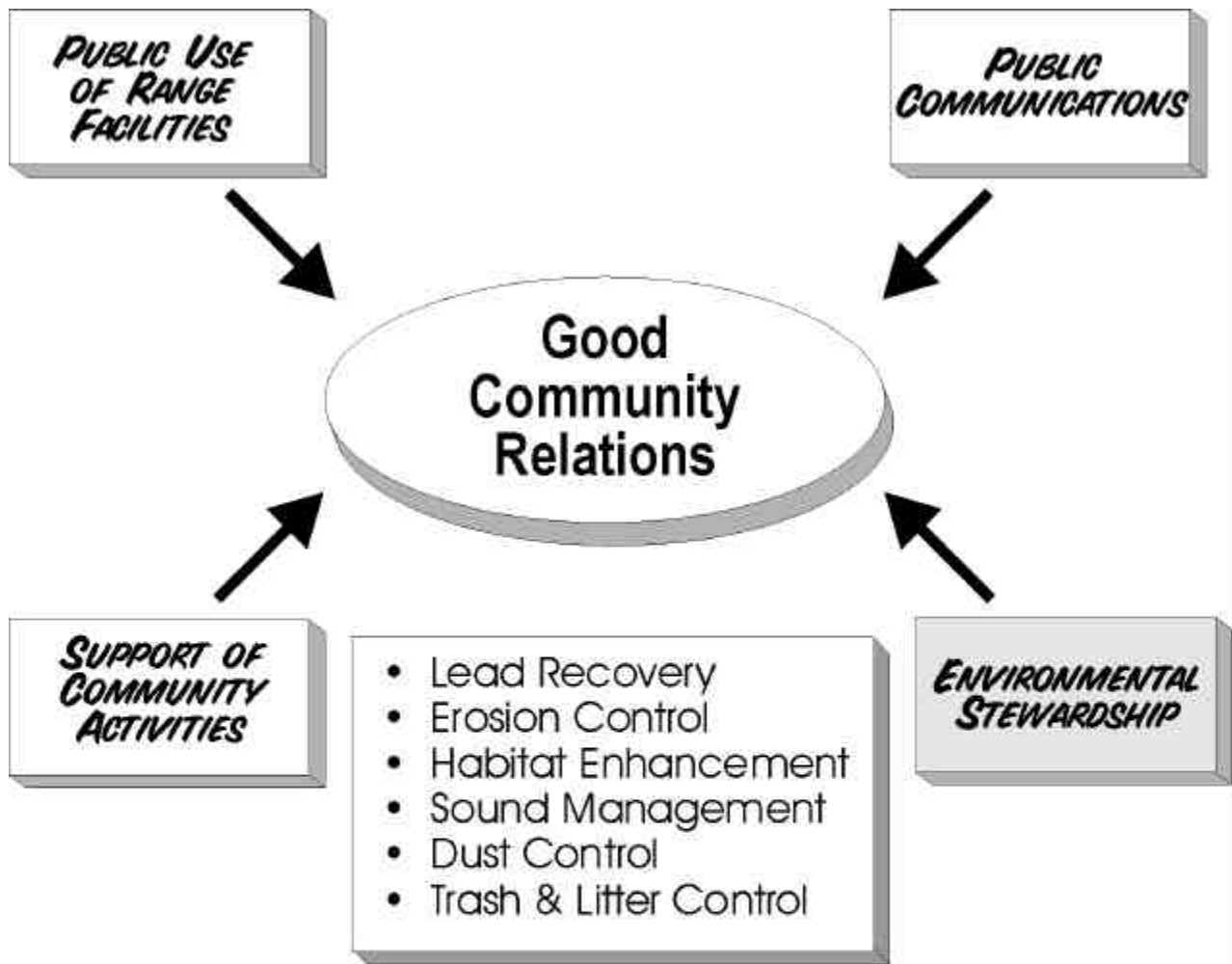


Figure 2-1. Environmental stewardship is a key component of good community relations for outdoor shooting ranges.

Litter Control. Several once-thriving, now-defunct ranges initially came under public scrutiny because of litter problems. Shell casings, wads, boxes, target remains and other waste residue from shooting constitute a significant and recurring trash and disposal challenge. In addition, ranges with high usage levels have issues associated with clean-up and overall range usage. Clay targets as litter at shotgun ranges are dealt with in Section 4.2.3. Plastics, paper and metal are the most significant litter byproducts of most shooting ranges. Many of these items are difficult to pick up because they are small, blend in with natural surroundings and can be scattered over a broad area. However, ranges should regularly conduct comprehensive “spring cleanings” to ensure that the range is aesthetically pleasing. Appropriate rules should be developed for range clean-up activities. Providing appropriate receptacles in convenient locations is highly recommended. Depending on specific circumstances, range managers can require that individual shooting stations be cleaned upon cessation of shooting activities.

2.2 SOUND

Sound is a phenomenon that can be measured by duration, frequency and loudness (in decibels). **Often, people who object to sound do so on the basis of their perception of the sound.** The perception of sound is both a psychological and physical process. Different people perceive sound differently depending on factors such as whether they like the cause of the sound (a waterfall may be less objectionable than the same level of sound from traffic), the time of day (sound levels acceptable during the day may be unacceptable at night), and the nature of the sound (sudden sharp sounds may be more objectionable than a steady, even sound at the same level). Local ordinances generally govern the duration and loudness of sounds being emitted from a location.

2.2.1 Issue

Sounds generated by shooting ranges can be perceived negatively by area residents. Range sounds may be perceived to drive wildlife from the area. However, in most situations wildlife become accustomed to range sounds and do not seem to be affected. By using a combination of management techniques described below, impacts from sound may be reduced, thus improving public perception about the quality of habitats in and around shooting ranges.

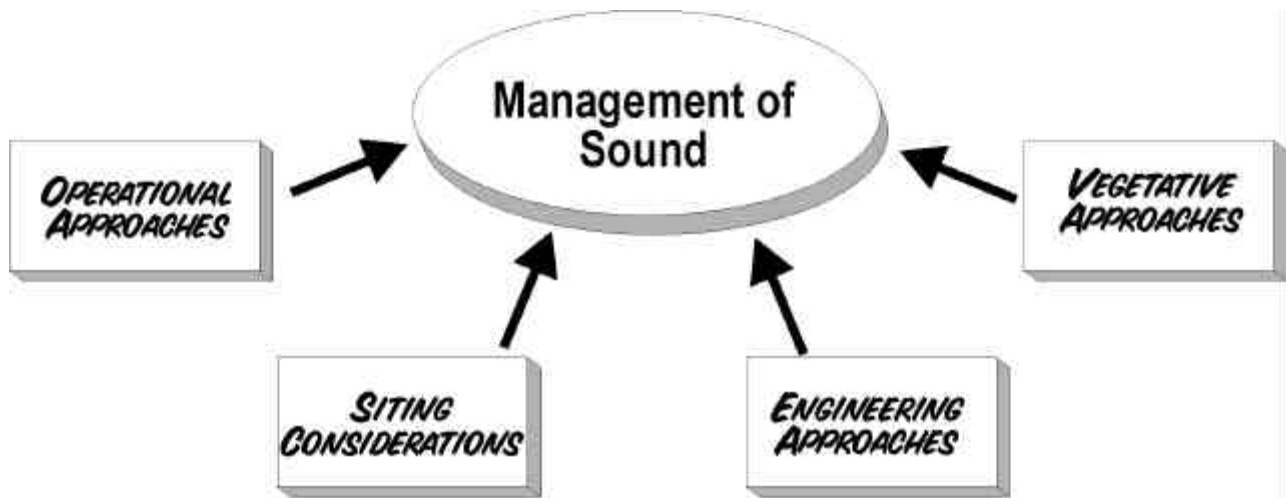


Figure 2-2. The approaches to managing sound at outdoor shooting ranges fall into four main categories.

Several benefits can be achieved by managing sound on a range:

- N Individual shooters can enjoy their sport for longer periods
- N Area residents and local government agencies may be more tolerant of range activities
- N Public perception of a range as a disruptive sound source may be minimized
- N Good community relations can be established and maintained

2.2.2 Management Techniques

Management of potential sound impacts is very important. Sound has become a public relations issue for many ranges, and this trend promises to continue in the future. The NRA has developed guidelines for managing acceptable sound levels on ranges. The NRA, consulting firms and other sources listed in Appendix A can help design a sound management program for your range. Four basic techniques (Figure 2-2) that can be used alone or in combination to manage sound on firing ranges are discussed below. **In many cases, optimum sound reduction has been achieved through a combination of these methods.** Individual ranges should determine which combination of these sound management recommendations will work best in their shooting environment.

2.2.2.1 Operational Approaches

Range Hours

Range operation hours may be adapted to allow shooting only during times that are least likely to be objectionable. Range managers may control sound levels by scheduling hours of operation which will have the lowest potential impact on area residents. The NRA (13) has developed guidelines on this method. Administrative techniques are easily implemented and may help considerably, but may be of less value on weekends when people are at home all day, and may conflict with the hours some range clients would prefer to shoot. Depending on market constraints, range managers can further reduce sound levels by delaying opening on weekend mornings and opening early during the week. Ranges in residential areas may be able to improve community relations significantly by preserving several additional hours of weekend morning quiet time.

The range manager should however, keep in mind that the times most objectionable to neighbors are likely to be the times participants have available to the range. From a business perspective, the reduction of hours must be very carefully considered prior to implementation.

Other operational methods to manage sound include offering special rates to encourage range utilization at times that are least likely to be objectional. Range managers can encourage using louder firearms at predetermined times or by special appointment. Range managers can also schedule special high-use events during cooler periods of the year when fewer people are out of doors.

Control of Shooters

Individual Controls — *All shooters should wear personal hearing protection whenever on or near the firing line.*

Group Controls — Another operational approach to managing sound is to control the number of active shooters at any one time. Rifles, pistols and shotguns produce different sounds, and the number of shooters using each type of equipment can be limited to keep sound frequency and intensity within levels established by the range manager.

2.2.2.2 Siting Considerations

The ability to manage sound is one consideration in determining the location of a new range. Siting studies should carefully examine the natural features that tend to influence how sound carries. Locations near present or anticipated future residential housing or other sound-sensitive areas should be selected for range construction/modification only if the range manager is fully prepared to deal with sound issues. Zoning ordinances and use of adjoining land may play a significant role in determining potential range locations. How sound will impact the perceived use or value of the adjoining property also should be evaluated.

Ranges should be located so as to minimize the potential for sound objections. In addition to avoiding sound-sensitive locations as discussed above, the layout of the ranges on the site can be important in sound management. It may help to orient ranges so shooting is away from, rather than toward, sound-sensitive areas. Shooting on hilltops may be heard more widely than shooting in valleys. Forested hillsides may dampen sound more than grassy or bare rocky hill-sides. Sound tends to carry long distances over water.

The NRA (13) has developed guidance on how to test for sound. In some cases, it is advisable to use sophisticated sound measuring equipment to determine present sound levels prior to making any changes at existing ranges. Contact local environmental engineering consultants for assistance in designing and administering these tests.

2.2.2.3 Engineering Approaches

Existing and new ranges can be engineered to minimize sounds generated from shooting activities. Sound control may be achieved by a combination of reflecting, redirecting, absorbing, containing or isolating the sound. As a general rule, hard, smooth, flat surfaces reflect more sound while soft, irregular, broken surfaces tend to better absorb sound. All materials have different capabilities to absorb or reflect sound. **No single material or construction technique can completely control sound, but the total effect of many techniques in combination can be very helpful.** Selection of specific materials may include insulation in walls, specially designed sound panels, acoustic tile, dividing walls, boxes, sound block and expanded wall areas (13). The basic approach is to identify how the sound source is affecting the surrounding area and then devise the appropriate method to keep sound within acceptable levels.

A vegetated berm is a simple example of an engineered attenuation feature coupled with a natural feature. By incorporating features to deflect or absorb sound (such as clay, soil, gravel and other materials) into berm design may reduce the sound. In addition, berm size, shape and width can contribute to further sound attenuation. Finally, the placement of a vegetated berm behind a range can serve to absorb considerable noise in addition to providing attractive landscaping.

2.2.2.4 Vegetative Approaches

A simple, aesthetically pleasing and effective way to reduce sound at virtually every shooting range is through effective use of vegetation. Fast growing trees, shrubs and ground covers can lend an aesthetic appeal in addition to providing sound buffering capacity. Placement of these plants along range borders could be an effective means of reducing sound. Vegetative selection plays an important part in creating an effective sound barrier. In general special attention should be given to selecting plants such as conifers (evergreens) or other species which maintain foliage year-round. Conifer trees and shrubs are generally fast growing, provide a visual barrier, and provide excellent sound buffering capacities. To further supplement these plantings, hedges can be placed in front of a conifer stand to further increase the sound buffering capacity as well as serving as a windbreak and providing aesthetic appeal. The most effective vegetation approach will be dependent on site specific conditions and should incorporate indigenous species wherever possible. Consulting with a landscape designer may be desirable. Optimum sound management at outdoor ranges may involve a combination of proper range siting, operational approaches, and range design and construction utilizing various engineering and vegetative materials appropriate to the particular range. Sound management consulting services are available from several of the sources listed in Appendix A.

3. ENVIRONMENTAL ISSUES AND TECHNIQUES TO ADDRESS THEM

This section discusses the main environmental issues which owners and operators of outdoor shooting ranges should be aware of.

These include:

- N lead
- N soil erosion
- N wildlife habitat and feeding
- N dust and air
- N range siting/reorientation

Each issue is introduced with a brief description of the nature of the concern, why it is important, and the conditions under which it is most likely to warrant attention. This is followed by a description of one or several operational and engineering techniques to manage this issue, including conditions under which each technique may be most appropriate. Section 3.1 deals with various aspects of lead in the environment at outdoor shooting ranges. The issues discussed in Sections 3.2 through 3.5 are indirectly related to contaminants, but deal briefly with other ways ranges interact with their environment. The issues discussed in Section 3 are common to all outdoor ranges and form the foundation for issues specific to shotgun (Section 4) and rifle/pistol (Section 5) ranges. Because issues are interrelated, Sections 3, 4 and 5 should be read carefully.

3.1 LEAD

Lead is the fundamental environmental issue facing all outdoor shooting ranges. Scientific evidence establishes that lead is harmful in excess quantities. However, the presence of lead shot or bullets in the environment does not necessarily mean that it will be ingested by birds and wildlife. The factors that determine whether lead will be ingested and affect birds and wildlife are discussed in Section 3.1.1. Methods to manage lead in the environment to minimize any such potential issue are discussed in Section 3.1.2.

Metallic lead, such as recently fired, unweathered bullets and shot, has relatively low chemical reactivity, low solubility in water and is generally inactive in the environment under conditions typical in many parts of the country. However, there may be valid environmental concerns under some circumstances. Even if only a small proportion of lead deposited becomes environmentally active at a range, it could become significant. Spent lead at ranges can interact with the environment in a variety of ways, if conditions allow, as illustrated in Figure 3-1.

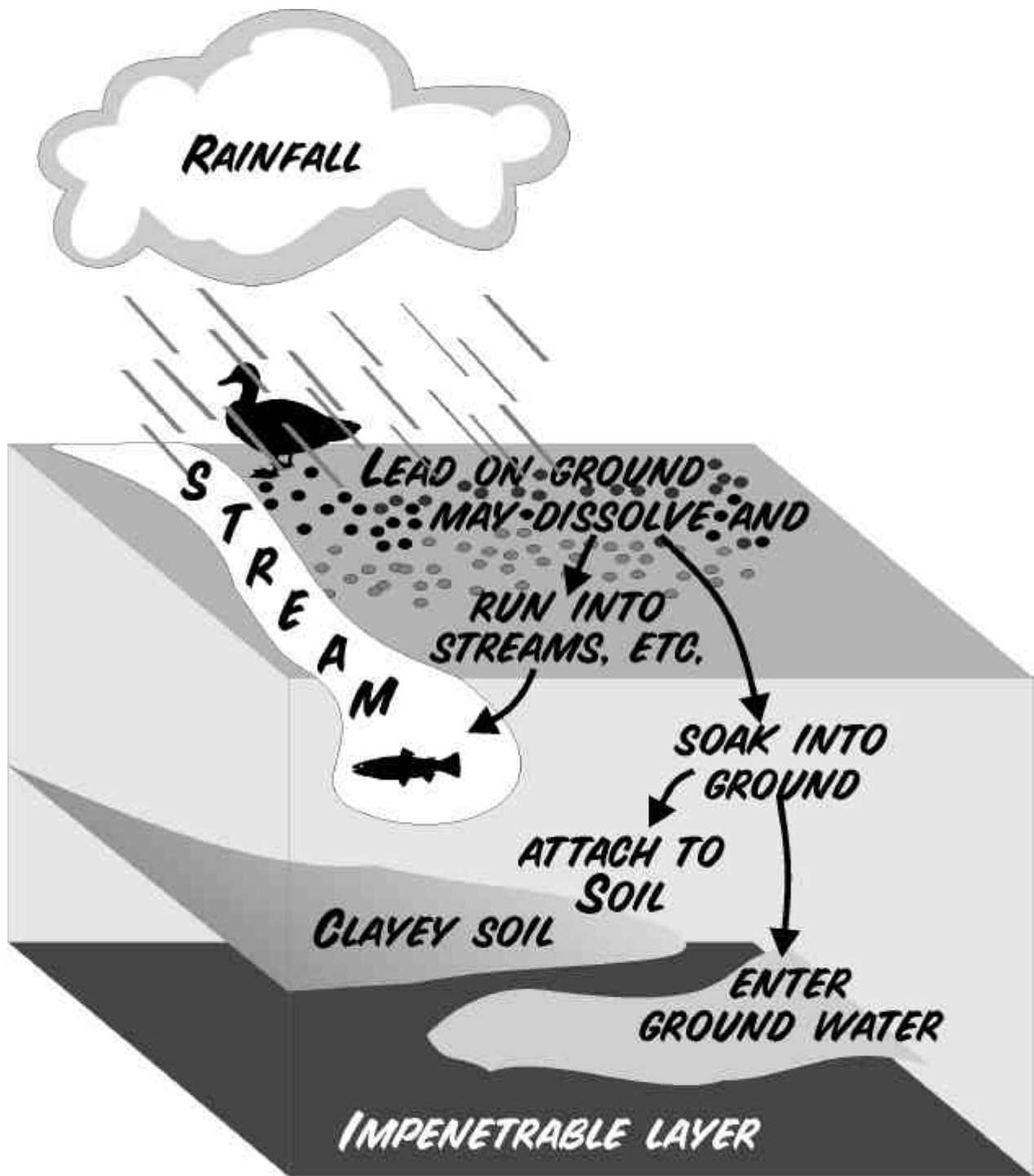


Figure 3-1. Conceptual illustration of ways lead can interact with the environment at outdoor shooting ranges.

The major factor that determines how lead interacts with the environment at outdoor shooting ranges is the acidity of the soil and water the lead is exposed to.

Acidity is measured in units called pH that can range from 1 to 14. A pH of 7 is neutral—that is, neither acid nor alkaline (basic). Values slightly below 7 indicate slightly acid conditions, and the lower the number, the more acid the conditions. At pH values above 7, conditions are alkaline with values slightly above 7 indicating slightly alkaline conditions, and higher values indicating more alkaline conditions. **Lead is least active in the environment at very slightly acid to slightly alkaline pH, or between approximately pH 6.5 and 8.5 (Figure 3-2).** In this pH range, lead is least soluble in water and tends to associate very strongly with clays, organic material, and other soil or sediment materials. All these associations tend to limit the environmental activity of the lead. As conditions become more acid (lower pH) or more alkaline (higher pH) than this range, lead tends to become more soluble and tends to associate less with clays, organic material, etc. This results in increasing environmental activity of lead as pH gets below 6.5 or above 8.5. In many areas of the United States (except certain parts of the west and southwest) acid conditions with pH less than 6.5 are much more likely than alkaline conditions with pH above 8.5. A much more detailed discussion of the environmental chemistry of lead and the factors that control it is available in Reference 1.

Lead can cause environmental problems only if it becomes mobile and/or is ingested in the body of birds, wildlife, aquatic organisms or people. This can happen if lead becomes:

- (1) dissolved or associated with fine suspended sediment particles in ground water or surface water that people or wildlife drink
- (2) eaten accidentally by wildlife while feeding on other things, mistaken for seeds, or picked up by birds as grit for the gizzard
- (3) associated with dust particles that may be inhaled, particularly by recovery/recycling workers

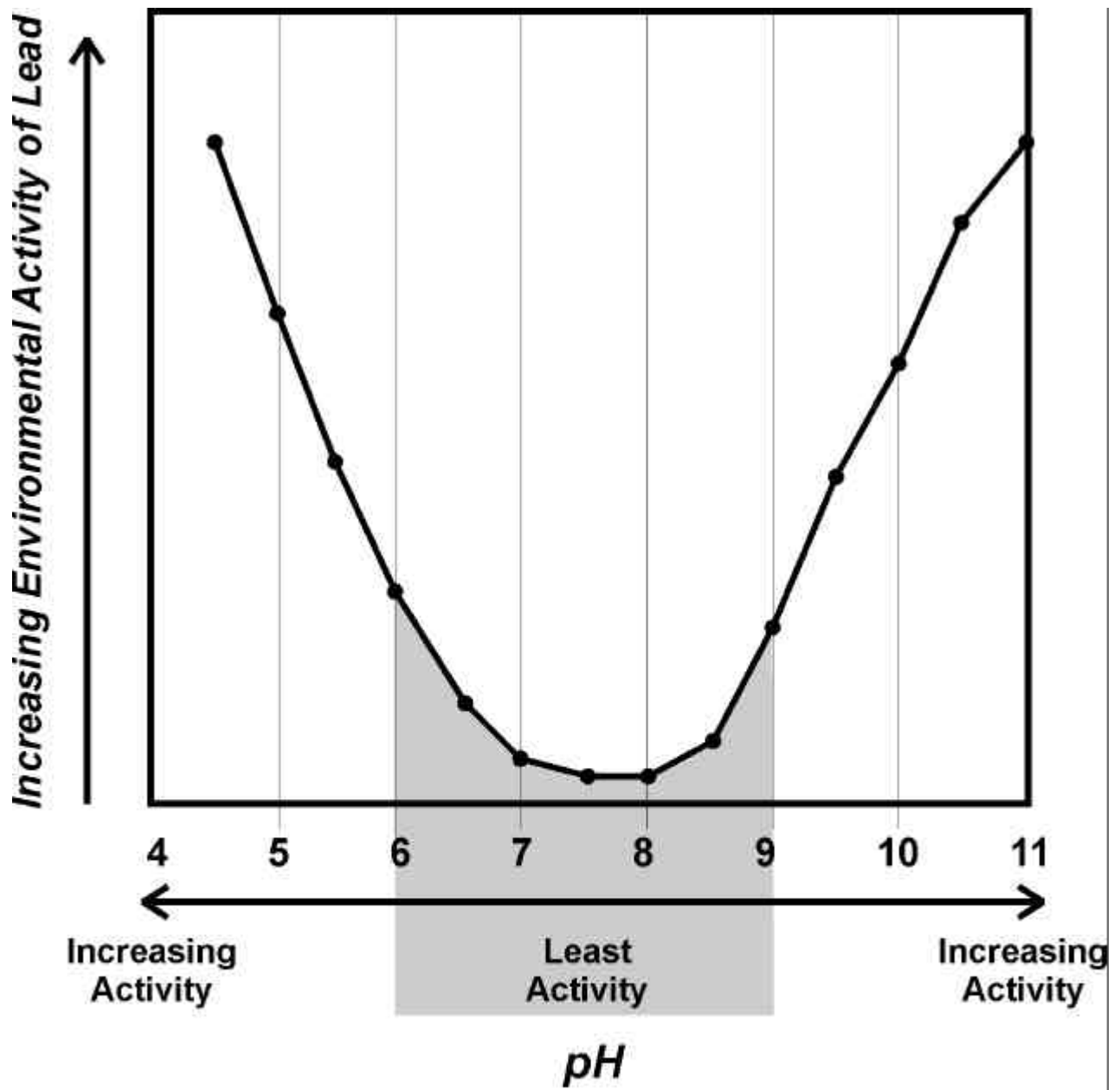


Figure 3-2. Influence of pH or Acidity on Environmental Activity of Lead.

3.1.1 Issues

The possibilities of lead affecting the environment are controlled by complex interactions of many factors. Natural mechanisms tend to prevent serious lead problems under the conditions typical of many ranges. In addition, range managers can identify situations in which problems could develop, and take steps to avoid the situations and protect the environment. *The following discussion addresses lead in surface water, lead in soil and groundwater, and lead ingestion by birds and wildlife.* Opportunities to properly manage lead in the environment and guidance on actions that can be helpful under specific circumstances are also discussed and depicted in Figure 3-3.

3.1.1.1 Surface Water

Under certain conditions, lead from shot or bullets may dissolve in water. Where conditions exist that can cause lead to dissolve, rainfall may carry the dissolved lead into streams, ponds, lakes and wetlands where the lead may affect water quality. It also may have the potential to be taken into the bodies of aquatic animals and plants, where it may affect these organisms or other organisms that eat them. **Whether enough lead will dissolve to cause adverse environmental effects depends on complex interactions of a variety of factors, and can only be determined by an evaluation of the specific site in question. Some of the most important factors determining how much lead will dissolve include:**

- N how acidic or alkaline the water is (pH below 6.5 or above 8.5 increases the rate at which lead dissolves); and
- N how long the water stays in contact with the lead (less lead dissolves if the contact time is short)



Figure 3-3. Various techniques can be used alone or in combination to manage lead in the environment.

If lead dissolves in the water, the amount of dissolved lead that enters streams, ponds, lakes and wetlands is determined in part by the amount of runoff. Several factors, listed below, affect the amount of runoff:

- N intensity and frequency of rainfall (less rain results in less runoff)
- N steepness of the slope the lead is on (gentle slopes result in less runoff)
- N amount and kind of vegetation on the slopes (dense ground cover results in less runoff)
- N how porous the soil is (porous soil results in less runoff)

With the exception of the intensity and frequency of rainfall, all these factors can be controlled to various extents by a combination of range siting and the management techniques described in Section 3.1.2.

3.1.1.2 Soil and Groundwater

As rainwater containing dissolved lead runs across the ground, dissolved lead generally becomes attached to soil particles that may later be eroded, potentially carrying lead to wherever the eroded soil is deposited. Water that soaks into the ground may be absorbed and held in the soil. When soil absorbs all the water it can hold, additional water trickles on downward, eventually reaching a layer of rock or clay it cannot readily penetrate. Water then accumulates above this layer, completely filling all the cracks and spaces. This accumulated water is called ground water. If lead reaches the groundwater, there may be potential for drinking water wells to be affected.

As described in Section 3.1.1.1, the amount of lead that dissolves in water is determined primarily by the pH of the water and how long the water is in contact with the lead. **If lead is dissolved in water, the amount of lead that attaches to the soil and the amount that enters the ground water is determined by several major factors, including:**

- N **how acidic or alkaline the soil is.** Lead tends to become more mobile at pH's below 6.5 and above 8.5. Lead tends to be relatively inactive at pH ranges between 6.5 and 8.5. (See Figure 3-2 and the discussion of pH in Section 3.1)
- N **amount of sand in the soil.** Relatively little lead will attach to sand, and most lead dissolved in water passing through sandy soil will remain dissolved.
- N **porosity of the soil.** Sandy soil tends to be porous, that is, water tends to pass quickly through it to deeper layers in the ground. This rapid percolation does not allow as much lead to adhere to the soils as could with soils with slower percolation rates.
- N **amount of clay in the soil.** More lead attaches to clay soil than to other soil types. However, solid clay layers can block water from penetrating deeply into the ground, and thus prevent dissolved lead from reaching the groundwater beneath the clay layer.
- N **amount of organic matter in the soil.** Lead attaches more readily to organic matter than to other soil materials except clay.
- N **depth to ground water.** The closer the ground water is to the surface, the higher potential for contamination.

Ranges in many parts of the country are likely to be in areas where these factors work together to minimize the potential for lead to enter ground water. However, ranges in other parts of the country may have environmental factors that may not minimize lead mobility. Any potential for lead to enter ground water should be carefully considered and managed. **The major factors that influence lead in soil and ground water can be controlled to various extents by a combination of range siting and the management techniques described in Section 3.1.2.**

3.1.1.3 Potential Contamination of Bird and Wildlife Food

Lead shot can be accidentally consumed by birds as grit for the gizzard, or can be mistaken for small seeds and eaten. This can occur whether birds are feeding on land or in the water. Waterfowl are particularly susceptible, which resulted in the ban on lead shot for waterfowl hunting. Lead shot and small bullet fragments can also be accidentally eaten with food by birds and animals feeding on earthworms, soil insects, fallen seeds and other foods that are eaten at the surface of the soil. Lead in the soil can be taken up by certain kinds of plants and may accumulate in leaves, seeds and other parts that can be eaten by birds or animals. Once lead particles or lead-contaminated food is taken in by a bird or animal, that lead can be passed on to predators. If a range shoots into a field of corn or similar crop, there may be potential for bird or wildlife ingestion of shot embedded in plants.

The major factors that determine whether lead accumulates in plants that are eaten by birds and wildlife can be controlled by an appropriate combination of the management techniques discussed in Section 3.1.2. Lead is addressed in relation to wildlife in more detail in Section 3.3.

3.1.2 Management Techniques

A variety of cost effective techniques can be used to successfully manage the environmental issues that lead can raise at an outdoor shooting range. These include both operational and engineering techniques, as illustrated in Figure 3-2.

Considering the spectrum of conditions found at outdoor shooting ranges across the United States, some ranges may have only a minimal need to manage lead. However, most ranges will benefit from a plan for some level of lead management. At ranges where lead management may be appropriate, it is unlikely that all the techniques discussed in this section would be used. **Some combination of techniques tailored to address site-specific conditions is likely to be the most efficient and cost-effective approach.**

In addition to the information provided below, lead management at outdoor shooting ranges is discussed in Reference 4 and from a regulatory perspective in Reference 5.

3.1.2.1 Recovery and Recycling

Routine recovery and recycling of lead may be one of the most basic and cost-effective environmental actions a range manager can undertake. Lead recovery and recycling on a regular schedule should be part of the Environmental Stewardship Plan for every shooting range. Simply put, lead that is removed from the range in a timely manner cannot cause a problem.

The advantages of recovery and recycling of lead as part of an environmental stewardship program for an outdoor shooting range include:

- N providing additional protection for the environment;
- N minimizing the amount of lead present in the environment that might have any potential for affecting surface water, ground water, birds or wildlife;
- N developing a general environmental and “good corporate citizen” record;
- N building positive public relations; and
- N potential recovery of some of the costs by selling the recovered lead.

Lead recovery and recycling are two distinct processes, both of which are necessary components of lead management at shooting ranges. Each component should be specifically identified in range’s Environmental Stewardship Plan.

Lead **recovery** involves picking up spent shot or bullets, usually by excavating the surface soil containing the lead, and separating the lead from other material. This is usually done with a series of screens, with the first screen catching sticks, rocks, and other material larger than the shot or bullets, and a smaller screen that catches the lead and lets soil particles pass through. Current lead recovery methods usually do not recover all the lead, but can recover a large percentage.

Lead **recycling** involves taking lead that has been used for one purpose and reprocessing it so it can be used again in another way. This usually requires separating all foreign materials, melting the lead and removing any impurities, and preparing it for sale to a company that will use it to manufacture a new product.

Lead recovery and recycling are usually done by different companies, although many lead recovery companies will sell the lead directly to a recycler. Range managers who deal with such recovery companies may not have to make separate arrangements for recycling. Lead recovery firms and lead recycling firms are listed separately in Appendix B, along with some information on selecting recovery/recycling firms.

The terms of a written contract between the recovery/recycling contractor and the range should detail the obligations of both parties. **Under certain circumstances a range may be financially liable for off-site contamination caused by the mishandling of the recovered lead, even after the recovery company has taken it off the range property.** Therefore, the contract should name the recycling facility to which the lead will be taken for processing and the trucking company that will transport it. The range should get references for the recovery company, the trucking firm and the recycling facility as part of the contract proposal. It would also be wise to contact state or local environmental agencies for information on the history and performance of the recovery and recycling companies. **It is the responsibility of the range to confirm that the recovery contractor, trucking firm and the recycler will obtain the necessary permits and comply with all applicable provisions of RCRA and other environmental laws and regulations.** The range managers can include in the contract any provisions it may require, such as:

- N site restoration measures following recovery (for example, restoring the topsoil layer, regrading and reseeding)

- N specifications on hours of operation (perhaps to avoid interference with peak shooting times, or to require working multiple shifts to complete the job as quickly as possible)
- N specifications about use of range facilities (for example, restrooms, utilities, parking spaces, etc.)

The range managers must recognize that any such contract provisions over and above simple recovery of the lead are not typical at present. These provisions may increase the contractor's cost, and therefore his price to the range. However, the range managers may have to bear some costs like regrading and reseeding whether or not they are included in the recovery/recycling contract, and inclusion in the contract may be easier and no more expensive for the range. Any such provisions should be discussed and negotiated with the contractor at the outset. Some contractors may not be willing to agree to such provisions. The contractor will want to know how much lead has been shot since the last recovery operation. Plan ahead and keep records for this.

Generally speaking, anything mixed in with the recovered shot interferes with lead recycling and lowers the value of the material for recycling. The most common materials are dirt, roots and vegetation. If the lead is not "clean" enough, recycling facilities will pay less for the lead, may charge to accept it or may not accept it at all. Some recyclers may consider metals other than lead used in making the shot, bullets or bullet jackets to be undesirable. Such issues should be fully investigated before recovery and recycling are begun.

Range managers may need to consider additional lead management actions (1) between recovery and recycling operations, because continued use of a range after a lead recovery operation reintroduces lead into the environment, and (2) in areas not included in the lead recovery/recycling program. Lead recovery is essentially a mining operation that recovers only the deposits of lead that have economical value. Lead may also be present when it may not be economically recovered, yet must still be addressed due to potential environmental impacts.

Lead recovery operations need to be planned and managed as part of the Environmental Stewardship Plan, since they affect several other components of the plan. For example, typically lead is not recovered from water or wetlands, or from steep, forested or bushy land due to the difficulty and cost, and where recovery is done, it typically destroys most vegetation, which can raise the possibility of soil erosion and the persistence of sound until the vegetation is reestablished. These issues are discussed in Section 3.2 and relate to management of rainfall runoff as discussed in Section 3.1.2.2. Recovery and separation of lead particles from soil can result in dust, which is discussed in Section 3.4.

3.1.2.2 Management of Stormwater Runoff

Stormwater runoff occurs when rain, snow or other precipitation has fallen or melted in a quantity and/or a rate greater than the soil's capacity to absorb the water. Under certain conditions, water flowing across the surface of the ground may dissolve lead and may transport soil particles, along with any lead attached to them, into streams, ponds, lakes, wetlands and other water bodies. Erosion is also a concern of stormwater management and is discussed in Section 3.2.

There are a variety of ways to manage stormwater runoff to minimize its potential impacts to the environment. Methods to manage lead mobility through management of stormwater runoff include:

- N **Infiltration**, or decreasing the rate of runoff by allowing more water to soak in. Vegetation slows the flow of water across the soil surface and allows more to soak into the ground. Sandy or loamy soils allow water to soak in easier than clay soils, but may also be easier to erode. However, clay, if allowed to erode, travels much further by remaining in suspension for extended periods of time. Natural or man-made areas that allow water to soak into the soil also will decrease the amount of storm water runoff. If the water soaking into the ground contains dissolved lead, this could increase the amount of lead entering the soil. Therefore, managing runoff by encouraging water to soak in under conditions where dissolved lead may be a concern should only be considered as part of a multi-pronged environmental stewardship program. Additional suggestions and precautions are discussed elsewhere in Section 3.
- N **Diversion**, or directing rainfall runoff away from areas containing lead, to minimize the contact between lead and water. For example, the “eyebrow” on a back-stop berm might be modified to serve as a rain shelter for the berm. Storm water runoff can be diverted around shotfall zones through the use of vegetated swales and berms to minimize the amount of storm water runoff coming into contact with lead shot.
- N **Interruption of water flow**, or decreasing the velocity of water flow, will decrease its ability to carry off soil particles. Placing straw bales or rock rip-rap across drainage ditches will cause water to slow and sediments to settle out.
- N **Retention**, or temporarily holding back the runoff and releasing it slowly so it does not erode soil particles. Stormwater retention ponds can be designed and constructed to collect stormwater runoff and release it slowly to prevent it from entering streams and other water bodies too quickly. This allows eroded soil particles and any lead that may be attached to them to settle out of the water in the retention pond. The accumulated sediment may need to be removed from the retention pond periodically to restore capacity. If the material removed from retention ponds is going to be moved offsite, it should be tested to ensure that it is properly disposed of. If appropriate, this soil material may be considered for reuse on the range berm or other suitable location. Because of the cost and complexities involved, obtaining professional assistance in the design, construction, and management of ponds is strongly recommended. Retention ponds need to be managed so that they do not encourage the migration of lead into ground water. In many locations, a permit must be obtained from a local drainage authority to construct a retention basin.

3.1.2.3 Lead-Accumulating Vegetation

Certain kinds of plants can take dissolved lead out of the soil and store it in their leaves and stems. These plants can then be cut and removed. This process is still being studied, and may prove to be a useful management tool for shooting ranges. In laboratory studies,

crop plants such as Indian mustard (*Brassica juncea*) and lawn grasses such as colonial bent grass (*Agrostis tenuis*), centipede grass (*Eremochloa ophiuroides*) and Bermuda grass (*Cynodon dactylon*) have shown considerable lead-accumulating ability (References 6, 7). Plants that collect lead from the soil are currently being used experimentally at industrial sites. More research needs to be done on this application before it will be widely accepted as a management tool. Although at present lead-accumulating plants cannot be recommended for routine use at ranges, the concept is promising, might be worth investigating in some situations and may be recommended in the future. These plant species may have the potential to reduce the amount of water-soluble lead in the soil. They cannot remove insoluble lead. However, it is the soluble lead that causes the greatest environmental concern, and reducing the amount of soluble lead could be a great advantage under conditions where lead tends to dissolve. Since plants can only remove soluble lead from the soil, they are most likely to be only one part of a lead management program at ranges where such a program is appropriate. Lead-accumulating vegetation might be planted in the shotfall zone at shotgun ranges, the foreground at rifle/pistol ranges, or in areas that receive surface water runoff from areas of lead deposition. These plants could also help to minimize soil erosion (see Section 3.2 for erosion control techniques in addition to vegetative cover). However, they may provide attractive habitat for birds and small mammals, which could increase wildlife's exposure to lead. Therefore, if these plants are included in a lead management program, they would have to be cut regularly to minimize potential wildlife exposure. When cut and moved offsite, these plants may need to be tested and disposed of in an appropriate manner.

3.1.2.4 Clay Soils

Lead tends to attach to clay particles in the soil, especially if the soil is not acidic (i.e., pH greater than 6.5). Lead attached to clay has very little potential to enter groundwater, and only enters surface water attached to clay particles that are eroded into the stream, pond, lake, wetland, etc. Ground water that is below clayey soils is not likely to be contaminated by lead because (1) water doesn't penetrate clay layers very well, and (2) lead in water that does reach clay layers tends to attach to the clay particles and not stay entrained in the water. Clay may make it more difficult to establish vegetation for erosion control (see Section 2.2) and may increase surface runoff (see Section 3.1.2.2).

The thickness of the clay layer necessary to effectively take lead out of suspension depends on the amount of dissolved lead present, how acidic the soil and water are, and the type of clay. Clays are composed of various types of clay minerals. Soils containing a high percentage of the type of clay mineral called montmorillonite can remove up to five times more lead from solution than soils composed mostly of the type of clay mineral called kaolinite. Therefore, a much thinner layer of montmorillonite clay is required to remove the same amount of lead from solution compared with kaolinite (Reference 8).

Ranges can take advantage of clay layers in a lead management program by:

- **Siting.** New ranges can be located where clay soils are at or near the surface of the areas where the greatest amount of lead will be deposited. This depends on clayey soils occurring in locations that have all the other desired characteristics, but adds no cost to range construction.

- **Mixing.** Clay can be mixed or tilled into sandy soils to increase the soil's lead retaining capacity and decrease its percolation rate. Mixing clay into existing soils is generally more cost effective and easier than constructing a clay layer.
- **Construction.** A clay layer can be placed under the area where the most lead will accumulate when a new range is built or an existing range is upgraded or expanded. This allows selection of the kind of clay used, and careful construction of a continuous layer in the desired area. This adds to initial construction costs, but can provide substantial lead control and may be cost-effective in the long run as part of a lead management program under conditions that otherwise tend to favor lead mobility. Clay layers, if installed, need to be placed below the level of soil disturbance caused by reclaiming operations to avoid destroying the layer. Constructing clay layers can be difficult and generally requires special technical skills and equipment.

The county Natural Resources Conservation Service (NRCS) office, environmental consulting firms, landscape firms, plant nurseries, state or local natural resources departments, and others listed in Appendix A can be contacted for further consultations and assistance in evaluating clay layers as part of a lead management program.

3.1.2.5 Stabilization by Lime Addition

Generally, metallic lead is very stable. However, the rate at which lead dissolves increases under acidic conditions. **Lead also attaches to clay particles and organic matter in the soil more easily under non-acidic conditions.** Therefore, **a lead management program in areas with acidic water or acidic soil will benefit from efforts to control soil and water acidity.**

Addition of agricultural lime (crushed limestone or calcium carbonate) to the soil to maintain pH in the 6.5-8.5 range may provide one of the least expensive ways of controlling lead mobility in soils at shooting ranges. Lime is inexpensive and can be applied on the surface of the range soil using common agricultural equipment and techniques. Because lime is used up in the chemical process that controls acidity, it must be replaced periodically. Liquid or powdered lime controls acid very quickly, but is used up quickly. Lime applied as larger particles does not act as quickly, but lasts longer. A large excess of lime can have results similar to not enough lime by raising the pH above the level (pH 8.5) at which lead becomes mobile under alkaline conditions.

Besides spreading on the soil surface, limestone may be beneficial in some cases as part of structural control of runoff (see Section 3.1.2.2). Lining drainage ditches and settling ponds with crushed limestone could help lower water acidity, encouraging lead to attach to soil particles and reducing dissolved lead concentrations. The amount of lime needed should be determined by a soil test performed by the county NRCS office environmental consulting firm, landscaping firm or other source in Appendix A. These sources should also be contacted for assistance in determining the best application program and type of lime to use. No more lime than necessary to bring the soil into the pH range of 6.5 to 8.5 (see section 3.1 and Figure 3-2) should be applied.

The disadvantages of lime application are that lime is of value only in areas with acidic conditions, requires periodic replacement and may affect the current vegetation. If plants in the limed area are kinds that prefer soil in the 6.5 to 8.5 pH range, the lime may

enhance their growth. If they prefer other pH, vegetative cover may decrease temporarily until plants that prefer the new pH become well-established.

3.1.2.6 Phosphate Addition

Lead can react chemically with many naturally-occurring substances in the environment to form a variety of lead compounds (Reference 1). Most of these lead compounds are less soluble in water and less environmentally active than metallic lead. Generally speaking, only the forms of lead that can dissolve in water can affect surface or groundwater quality or be taken up into plant tissues. **Therefore, one very effective method to control lead effects is to provide materials that combine with lead to form lead compounds that do not dissolve in water. One such material is phosphate fertilizer.** Commercially available, finely ground phosphate rock has been used as phosphate fertilizer for years, especially in acidic soils (Reference 9). Lead phosphates are the most insoluble forms of lead, can form rapidly in the presence of lead and available phosphate, and are effective under various conditions with a variety of soil and phosphate rock types. (References 9, 10, 11.)

Addition of finely ground phosphate rock to lead-contaminated soils may provide one of the least expensive ways of controlling lead mobility in soils at shooting ranges.

Advantages of phosphate additions are effectiveness and relative low cost. Limitations of adding phosphate are that it is most effective under somewhat acidic conditions, requires periodic replenishment and *even moderate use can adversely affect water quality in nearby water bodies unless carefully managed.* Powdered phosphate is the most effective form, but requires the most frequent replenishment. Crushed phosphate lasts longer. If agricultural fertilizer is used, it should be high phosphate and low nitrate. That is, the first of the three-number fertilizer designation should be *low* and the second number should be *high*. Optimal use of phosphates would include a mixture of powdered and crushed rock applied at a rate determined by site-specific range conditions. Guidance is available from a county NRCS office, environmental consulting firms, landscape firms, plant nurseries, state or local natural resource departments, or other sources listed in Appendix A.

Because phosphate has a high potential to adversely affect water quality, it should be used carefully and in small quantities and only as necessary.

3.1.2.7 Organic Matter

Generally lead particles are also attracted to and bind with organic matter in the soil. Adding organic material to soils, especially sandy soils, can slow percolation rates and provide a lead binding location. However, organic material tends to make soils more acidic and provide relatively short term protection because the lead is re-released when the material breaks down.

3.1.2.8 Cultivation/Tilling

Cultivation and tilling of soil at shotgun ranges have been shown to increase the weathering of lead shot (Reference 12) and may increase the mobility of lead in soils. However, tilling has been shown to decrease the availability of lead shot to wildlife. Some tilling may be necessary to optimize plant growth but excessive tilling may damage established vegetation. The use of tilling may have negative consequences and should be evaluated on a case-by-case basis and should be used in conjunction with other lead management activities such as lime and phosphate additions.

3.1.2.9 Combined Approaches

Conditions will rarely be so simple that only one lead management technique will meet all a range manager's needs. Routine periodic lead recovery/recycling should be seriously considered as a fundamental part of most lead management programs. The lead management program may also include some aspects of range siting to minimize potential environmental issues coupled with runoff management, use of clay layers, lime or phosphates. Each of the various techniques discussed in Section 3.1.2 may be applied on different parts of a range where it would be most effective. Environmental consulting firms and other sources identified in Appendix A are able to help develop a cost-effective approach to lead management as part of an Environmental Stewardship Plan for an outdoor shooting range. See Appendix C for sample Environmental Stewardship Plans.

When considering lead management, range managers should evaluate both pathways by which lead can potentially move in the environment:

- N dissolving in surface water or groundwater
- N ingestion by birds and wildlife

Some range managers may need to consider one or the other of these possible pathways, some may need to consider both, and some may not need an intensive lead management program. Where a lead management program is appropriate, some combination of the issues discussed in Sections 3.1.1 may exist and some combination of the management techniques discussed in Section 3.1.2 may be appropriate.

3.2 SOIL EROSION

3.2.1 Issues

Erosion results in the loss of topsoil and can degradate water quality and aquatic habitats. Erosion also may transport soil with lead attached to adjacent property. The amount and intensity of rainfall, soil texture, soil structure, slope of ground, and vegetative cover are important factors which will determine when, where and how soils will erode. Rainwater, snowmelt, wave action and wind blowing across the soil surface are primary causes of erosion. Water runoff can cause erosion of two primary types:

- N Sheet erosion occurs when water flows in broad paths over the surface of the soil
- N Channel erosion occurs when water is directed in gulleys or channels over the soil surface. Channels concentrate the runoff and thus are serious components of erosion and flooding.

When soil is eroded, finer particles are usually transported greater distances than coarser particles and can be carried into aquatic environments. In general, soils composed of more easily eroded materials (i.e., silts and fine sand) and subject to greater erosional forces will have the greatest susceptibility to erosion. Soil erosion and subsequent sedimentation can be controlled through proper management techniques (Figure 3-4).

Evaluating your range for erosion and runoff potential is highly recommended. Bear in mind that construction projects, addition of parking lots, etc. will all affect the erosion potential. These activities need to be incorporated into any erosion control plan.

3.2.2 Management Techniques

Many techniques for controlling soil erosion exist, including vegetative controls, terracing of slopes and the use of settling basins (Figure 3-4). Management of open or sparsely vegetated lands by natural or artificial methods serves to protect the soil from the effects of water and wind erosion. If management is necessary, the best approach often combines protection and stabilization of the soil and diversion of runoff from erosion-prone areas. Protection and stabilization include vegetation to break the impact of rainfall and hold the soil in place with the roots and stone or other covering in water channels to prevent further channel erosion. Diversion includes approaches like terracing of slopes and settling basins. A combination of techniques is often advantageous. Selection of the most appropriate management techniques requires careful planning. The techniques to be selected depend upon the nature of the erosion problem, the site where the problem occurs, the funds available and any environmental or aesthetic issues. Assistance is available from several of the sources in Appendix A.

3.2.2.1 Vegetative Control

Vegetative cover reduces erosion by slowing down water and wind and effectively holding the soil in place. This technique is natural, relatively inexpensive and self-perpetuating through production of seeds or roots by the plants. Another benefit of vegetative cover, in addition to erosion control, is to filter nutrients and pollutants from runoff. Vegetation can be uprooted by rapidly flowing water, increasing the erosion of soil.

Decisions regarding vegetative control include the location needing treatment, kinds of plants (i.e., trees, shrubs, grasses and herbs), how to get the plants started (i.e., plants, rhizomes or seeds), and quantity of plants needed to adequately cover the soil area. A wide array of vegetation is available for soil stabilization. The most effective vegetative plantings include a variety of long-lived trees, fast-growing nurse trees, and shrubs interspersed with grasses and herbs. Cost of vegetative plantings is comparatively low; however, periodic care and maintenance will be required whenever new plantings are established. Some of the kinds of plants that can be effective in erosion control attract birds and wildlife, and may not be suitable for shotgun ranges (see Section 4). Others may not be suitable for berms or foregrounds at rifle/pistol ranges (see Section 5).

Additional assistance in selecting plants may be obtained from local landscaping firms, county NRCS office, and environmental consulting firms. Woody vegetation should not be planted in impact and shotfall areas where it is likely to impede lead recovery.

3.2.2.2 Terracing of Slopes

One important factor which determines the potential for soil erosion is the steepness of slopes. All other factors being equal, the steeper the slope, the greater the potential for erosion. Terracing is the placement, through grading, of level shelves on the face of the slope and results in the interruption of runoff flowing down the slope. A good vegetative cover greatly enhances the effectiveness of terracing in slowing runoff from the slope. Consulting with landscape designers is recommended when steep slopes and rocky areas are involved.

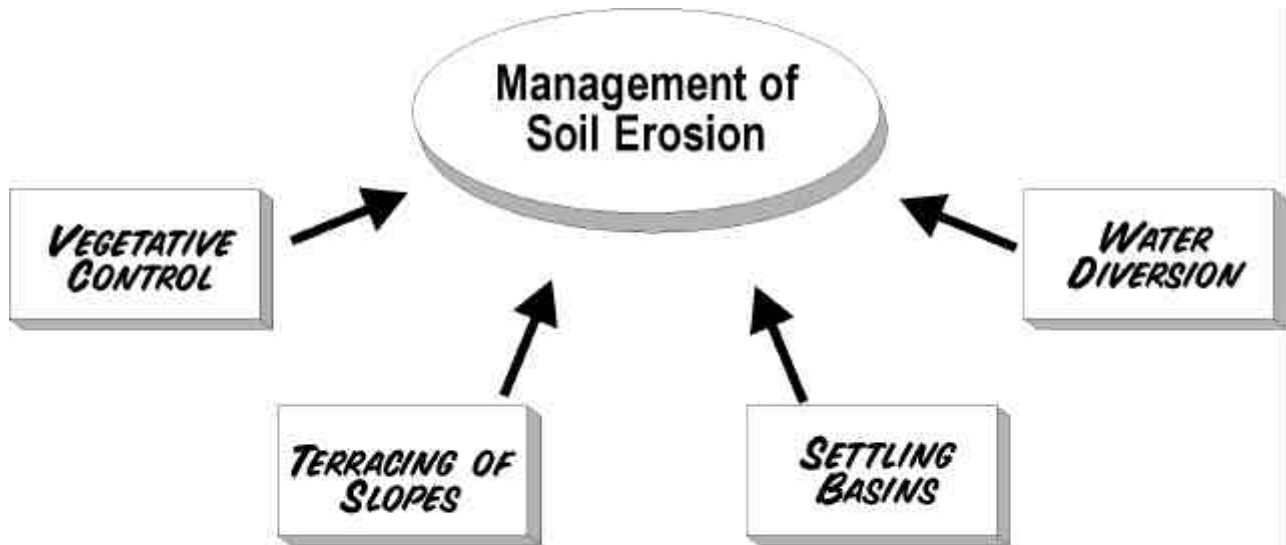


Figure 3-4. Various techniques can be used alone or in combination to manage soil erosion at outdoor shooting ranges.

3.2.2.3 Settling Basins

Settling or sediment basins serve to capture sediments before they reach aquatic or wetland areas. Eroded soils and any attached lead may be trapped by settling basins and subsequently removed from the basin for proper disposal. Such basins may be of varying shapes and sizes to fit site-specific characteristics. Settling basins can often be combined with vegetative controls and slope terracing to further enhance sediment trapping capabilities. It is recommended that basins be designed in a manner that facilitates periodic sediment removal. In some areas permits may be required to construct settling basins.

3.2.2.4 Other Techniques

There are a number of structural design measures (geotextile fabrics, porous concrete, filter barriers, etc.) that can be used to reduce or eliminate impacts from erosion. However, these can be costly and unsightly, and should be considered only where other, more natural methods fail. Consulting with landscape designers or engineers is recommended when faced with difficult slopes.

3.3 WILDLIFE HABITAT AND FEEDING

3.3.1 ISSUE

As described in Section 3.1.1.3 spent lead may be available to wildlife, and if so, may result in detrimental effects. Under existing law (RCRA and CERCLA), suits and/or regulatory actions can be brought upon parties that are thought to be involved with damage to natural resources, including wildlife populations or their habitats. Ranges can take the steps discussed in Section 3.3.2 to minimize potential lead exposure and reduce the opportunity for birds and other animals to ingest lead. The presence of wildlife near shooting ranges is often desirable. Most range operators and shooters are conservationists and enjoy having wildlife around. The goal of protecting wildlife in areas where lead is present can go hand in hand with the goal of having wildlife present with high quality habitat on other parts of the range property. Certain specific measures that can be taken to protect this resource are identified below and illustrated in Figure 3-5.

3.3.2 MANAGEMENT TECHNIQUES

3.3.2.1 Landscaping/Plantings

The pattern and type of vegetation at a range influences the suitability of habitat and the types of wildlife that occurs there. Any time there are vegetated areas present, there is the potential for wildlife to use the area. Most ranges are intentionally maintained in relatively open condition to establish a clear field of view for shooting. These open, often grass-covered areas, are suitable habitat for deer, small mammals and ground-foraging birds. Preferred wildlife food, such as plants that produce edible fruits and seeds, should not be planted around active range areas. Other areas of shooting facilities (away from the firing ranges) may be managed to support wildlife, as detailed in Section 3.3.2.3. Issues related to erosion control (Section 3.2) should be kept in mind when selecting plantings. Plantings in some areas will be disrupted by lead recovery/recycling activities (See Section 3.1.2.1).



Figure 3-5. Various techniques can be used alone or in combination to manage wildlife habitat and feeding at outdoor shooting ranges.

3.3.2.2 Management of Vegetation

Vegetation can be managed through mowing, cutting, trimming or chemical herbicide application. Mowing as an approach to vegetation management can be desirable because grass provides limited habitat for many animals. Grassy areas should be planted in less palatable plants such as fescue and Bermuda grass. Your local NRCS agent or state wildlife agency (see Appendix A) may be able to suggest other plants that are *not* attractive to wildlife in your area. Mowing should be conducted to keep grass somewhat as a lawn would look if the homeowner had been on vacation for a month. These management techniques can be used to keep shooting areas in open cover, to keep weedy vegetation away from structures and equipment, and to manage ornamental plantings for aesthetic purposes.

Vegetation condition also determines where, when, and how wildlife use a site. Deterring sensitive wildlife (such as waterfowl) from a range pond is important. Not planting, or discouraging preferred food or cover plants, will create marginal habitat in areas of potential lead deposition. Planting trees or other tall woody plants on the edges of ponds will deter some waterfowl, such as geese and swans, from landing and using the pond. In field areas, dense, rank, higher vegetation and small shrubs may deter geese, crows, gulls and several other types of birds from landing. However, as is the case with many factors of range use, the actual management techniques and vegetative condition of range areas depends upon the specific situation of a range layout and the associated shooting needs. Vegetation should be considered in conjunction with other elements of an Environmental Stewardship Plan.

3.3.2.3 Wildlife Habitat Enhancement

Areas of range facilities where active shooting does not occur are potential areas to undertake wildlife food and habitat enhancement, if desired by the range manager. There are many types of fruit-bearing trees and shrubs that can be planted for wildlife value, including apples, cherries, blueberries, blackberries, dogwoods, grapes and nut-bearing trees such as beeches, hickories and oaks, among others. Field areas can be planted in wildlife food and cover, including grasses, wildflowers, clover, lespedezas, etc. to provide for wildlife needs. The exact species of plants best suited to a given area differ depending on the region of the country and associated climate and soils. Many state natural resources departments, wildlife divisions, heritage programs, and other similarly named agencies have recommended planting lists for important native species valuable to wildlife as well as lists of invasive exotic/non-native plant species (e.g., multiflora rose) that should be avoided. Planting guidance for wildlife enhancement may be obtained from NRCS offices, environmental consulting firms, landscape firms, plant nurseries, state or local natural resource departments, and others as listed in Appendix A.

It is important to note that wildlife should be kept wild and well away from areas used by people. If an artificial feeding program is undertaken, only recommended foods should be used. Bread products or other human food items should be avoided. Feeding areas should be kept well away from lead impact on shotfall areas. Artificial feeding may quickly attract animals that become problems. Any feeding should be carefully evaluated before it is initiated and only after seeking the advice of the states natural resources department.

3.4 DUST

3.4.1 ISSUES

Environmental concerns about dust at outdoor shooting ranges can arise for three primary reasons.

3.4.1.1 Potential Lead Exposure to Shooters

Dust arising from bullets impacting berms and from lead recovery/recycling operations can contain lead. Lead recovery may be a large generator of dust at shotgun and rifle/pistol ranges. Lead dust can also enter the air from (a) vaporization due to the heat of the burning powder acting on bullet base with exposed lead, (b) friction between the barrel and an unjacketed bullet, and (c) burning of lead compounds used in primer mixtures. These minute lead particles can fall onto shooting benches or to the ground where they mix with or attach to soil. These particles may become airborne or dust when the soils are disturbed. Several of these sources of lead may occur close to the breathing zone of the shooter. These processes introduce lead into the air, where it could be inhaled. Range managers should be aware of potential concerns about inhalation of lead and take appropriate steps to control dust. Dust from these sources, especially lead recovery operations, can also contribute to aesthetic concerns discussed above.

3.4.1.2 Potential Exposure During Recovery

Mechanized lead shot recovery equipment is designed to scrape the upper layer of soil, which inevitably generates airborne particles. Some of the particles can contain lead. The amount of dust generated by these operations will be dependent upon timing. Recovery that is done when soil is moist may generate less dust. However, any dust generated from these activities could result in lead exposure to range operators and nearby areas (see 3.4.1.3).

3.4.1.3 Aesthetics

Dust can arise from gravel parking lots and paths, foot traffic across bare ground, mowing sparsely vegetated areas, and other incidental activities. This dust primarily affects range customers by settling on cars, shooting benches and other equipment, etc. In some situations, dust can blow into adjacent property and could be objectionable to neighbors, resulting in poor public perception of the range.

3.4.2 MANAGEMENT TECHNIQUES

3.4.2.1 Lead Dust

The possibility of inhaling lead from the air is probably greatest for recovery/recycling workers, who should always wear respiratory protection and otherwise comply with applicable safety and health standards. Good ventilation should be maintained at the shooting positions to minimize any potential for inhalation of lead by shooters.

3.4.2.2 Soil Dust

Soil dust can be managed by minimizing potential sources. Roads and parking areas can be paved or traffic speeds can be controlled to minimize dust generation. Foot traffic can be kept to paved walkways or paths covered with bark, wood chips or pea gravel.

3.5 RANGE SITING/REORIENTATION

Selection of a range site to optimize environmental benefits and minimize adverse environmental impacts is an important decision in developing an outdoor shooting range. The location of a site for construction of a new outdoor shooting range should be selected carefully. Choosing an outdoor shooting range site requires a technical screening process based upon a site's particular environmental and engineering suitability. Traditionally the siting of most outdoor shooting ranges has been considered a prerogative of business enterprises or individuals, based upon their own technical and economic criteria. However, sites for outdoor shooting ranges should be chosen that are safe for the environment, the surrounding community and range patrons.

Care should be taken to minimize impacts caused by expansions and upgrades of existing shooting facilities, even though there is inherently less flexibility in doing so. The candidate sites for consideration for new facilities or the expansion/upgrade of existing shooting ranges should be subjected to screening criteria.

Table 3-1 is a sample checklist that can be used to help identify optimal sites for a range from an environmental perspective. A similar approach can be used to help locate the best place for expansion of an existing range. Using a checklist is an easy way to compare various characteristics of potential range sites.

Site characteristics such as topography, soil types and depth to ground water affect the level of design and engineering effort necessary to prevent potential degradation of natural resources associated with a site. Initially, potential locations should be evaluated to exclude clearly inappropriate sites from consideration, such as sites that would require shooting over or into wetlands, water or sites too small for the proposed facility. The next level of criteria should then be used to screen sites having *favorable environmental characteristics* (e.g., appropriate site soils and topography and drainage). Distance to present or anticipated future sound-sensitive areas and natural features that would help minimize sound (see Section 2.2) should also be kept in mind.

TABLE 3-1. Site Checklist To Compare Various Environmental Characteristics*

Variables	Site 1	Site 2	Site 3	Site 4	Site 5
No surface water (i.e., ponds, streams) on-site					
No wetland areas on-site					
Area is relatively flat					
Sufficient distance between site and existing development for sound and dust attenuation					
Presence of natural sound buffers (e.g., hills, existing berms, woody vegetation) between site and nearest development					
Groundwater 10 or more feet below the surface					
Presence of site soils capable of minimizing migration of lead off-site (i.e., clayey soils at or near the surface and having a pH of 6.5 - 8.5)					
No known sensitive wildlife habitats					
No known rare, threatened, or endangered plant and/or animal species					
Soil in planned shotfall zone can support healthy plant growth					
Community acceptance of future outdoor shooting range facilities					
Zoning of site and adjacent parcels compatible with placement of an outdoor shooting facility					

* **X** all rows that apply for a given site. The site with the most **X**'s may be the best place to site an outdoor shooting facility.

Potential sites possessing favorable environmental characteristics should be compared to one another in detail. Detailed investigations may include factors such as geology, soils, presence of surface water, depth to groundwater, ecological habitats; cultural and infrastructure factors such as transportation access, surrounding and downstream land uses; and special consideration, such as the potential existence of archeological sites, should be investigated to determine the feasibility of locating outdoor shooting range facilities.

Avoid range sites that would require shooting over or into wetlands or surface water. The vast majority of ranges that have been the subject of environmental lawsuit/enforcement action to date have been shooting into or over water or wetlands. In addition to potential environmental impacts, lead recovery for recycling is much more difficult and expensive from water and wetlands than from many upland areas. Surface water on-site may also attract wildlife that may be at risk due to possible access to lead. See Sections 3.1.1.3 and 3.3 for a discussion of wildlife and outdoor shooting ranges.

Sites with a shallow depth to ground water should be carefully evaluated. This will minimize the real or perceived possibility of lead moving through the soil column to reach the ground water (see Section 3.1.1.2). Sites with steep slopes have higher erosion potential and higher surface water runoff velocities. These attributes increase the potential of lead migration to surface waters. Steeply sloping land will require more costly engineered controls to minimize erosion and the migration of lead off-site. See Section 3.2.2 for methods to limit soil erosion potential.

Avoid sites that support known rare, threatened or endangered plant or animal species to avoid potential impacts to those species and to minimize difficult remediation/mitigation scenarios.

To the maximum extent possible, shooting positions should be oriented so that lead is deposited within an area that is well stabilized, relatively unattractive to wildlife and facilitates lead recovery. Impact areas should not be associated with sensitive areas such as wetlands, open water, areas with woody vegetation, or high quality wildlife habitat. Impact areas where lead fragments accumulate should be designed or engineered to limit the migration of lead off-site through the use of swales, terracing, etc. See Sections 4.2 and 5.2 for recommended design features.

When comparing the environmental characteristics of potential sites, keep in mind the costs and effort associated with engineering controls that would be necessary for the construction and operation of an outdoor shooting facility. Sites with level topography having soils with lead adsorptive capabilities and relatively low percolation potential are more desirable than sites with steep slopes and sandy or rocky soil with a high rate of water infiltration. Level topography may minimize the need for grading to direct surface water from the areas of lead deposition. Sites containing soils with lead adsorptive capabilities and low percolation potential (e.g., certain clays) will benefit the environment and reduce construction costs. However, low percolation means higher runoff, and these must be balanced.

Site selection should also consider the characteristics of the surrounding community. Zoning; local ordinances concerning noise, traffic and other legal restrictions; and the existence of local residences and/or businesses should be taken into consideration during the site selection process.

Shooting ranges should become a part of the community, and efforts should be directed to encourage its activities to fit in with the community's existing character. **Community opposition to the placement of a new shooting range is best overcome by proper planning design and open communication.** A checklist such as Table 3-1 comparing the various characteristics of potential outdoor shooting range sites may be useful in site comparisons. A summary of the ecological conditions that should aid in decision making for range siting are presented in Table 3-2.

TABLE 3-2. Summary Of Ecological Criteria For Range Siting Decision-Making

	Relative Critical Rating	
	High	Low
Slope Steepness	<ul style="list-style-type: none"> • Increased runoff • May decrease percolation 	<ul style="list-style-type: none"> • Decreased runoff • Less erosion
Soil Percolation	<ul style="list-style-type: none"> • Increased potential for lead migration 	<ul style="list-style-type: none"> • Increased runoff and erosion potential
Amount of Clay in Soil	<ul style="list-style-type: none"> • Increased lead absorption (decreased lead mobility) • Decreased percolation 	<ul style="list-style-type: none"> • Increased percolation
Amount of Sand in Soil	<ul style="list-style-type: none"> • Increased percolation • Decreased lead absorption potential 	<ul style="list-style-type: none"> • Decreased percolation
Vegetative Cover	<ul style="list-style-type: none"> • Decreased erosion • Attracts wildlife (a) • Increases aesthetics • May increase maintenance needs 	<ul style="list-style-type: none"> • High erosion potential • Lower habitat value • Could simplify maintenance
Amount of Woody Plants	<ul style="list-style-type: none"> • Good habitat value— attract wildlife (a) • Potential increase of sound buffer • Good visual barrier 	<ul style="list-style-type: none"> • No visual barrier to adjoining properties • Decrease sound buffer potential • Lower habitat value
Surface Water or Wetlands on Site	<ul style="list-style-type: none"> • Increased habitat value (a) • Increased potential for lead mobility (surface waters) • Increased potential for sensitive species 	<ul style="list-style-type: none"> • Lower habitat value • Lower potential for lead mobility (surface waters) • Lower potential of sensitive species

(a) Wildlife attraction could be beneficial or a nuisance depending on how close the wildlife is to active shooting areas.

4. APPROACHES SPECIFIC TO SHOTGUN RANGES

Section 4 builds on the discussions of Section 3 that are applicable to all ranges, and addresses issues and management approaches that are specific to shotgun ranges (Figure 4-1). Most of these issues relate directly or indirectly to managing lead mobility or ingestion of lead particles. The discussions in Section 4 are applicable to existing ranges, expansions or upgrades to existing ranges, and new ranges. Section 4 builds on the assumption that the general issues discussed in Section 3 are already understood by the reader.

4.1 DISTRIBUTION OF SHOT

The primary characteristic of all shotgun ranges (trap, skeet and sporting clays) from an environmental perspective is the wide distribution of shot. This results in a relatively large area in which there might be a concern about lead dissolving into surface or ground water, entering the soil, or being ingested by birds or wildlife. When a target is hit, even if it is “smoked” by a well-centered shot, only a relatively few of the several hundred pellets in the shot string actually strike the target. These may be deformed or deflected and fall to the ground nearby, but most of the pellets in the load continue beyond where the target was hit.

The full extent of the total shotfall zone from all trap and skeet fields and all sporting clays stations must be known before effective lead management practices can be implemented. Careful examination of the ground around the perimeters (indicated by the size and shape of the theoretical shotfall zones in Figures 4-2, 4-3 and 4-4) for the presence of shot may be required for this determination. The actual shotfall zones should not be considered to be any smaller than those illustrated in the figures unless unusual topography exists. If shots are fired on a downhill slope, the actual shotfall zones could be considerably larger than indicated in the figures.

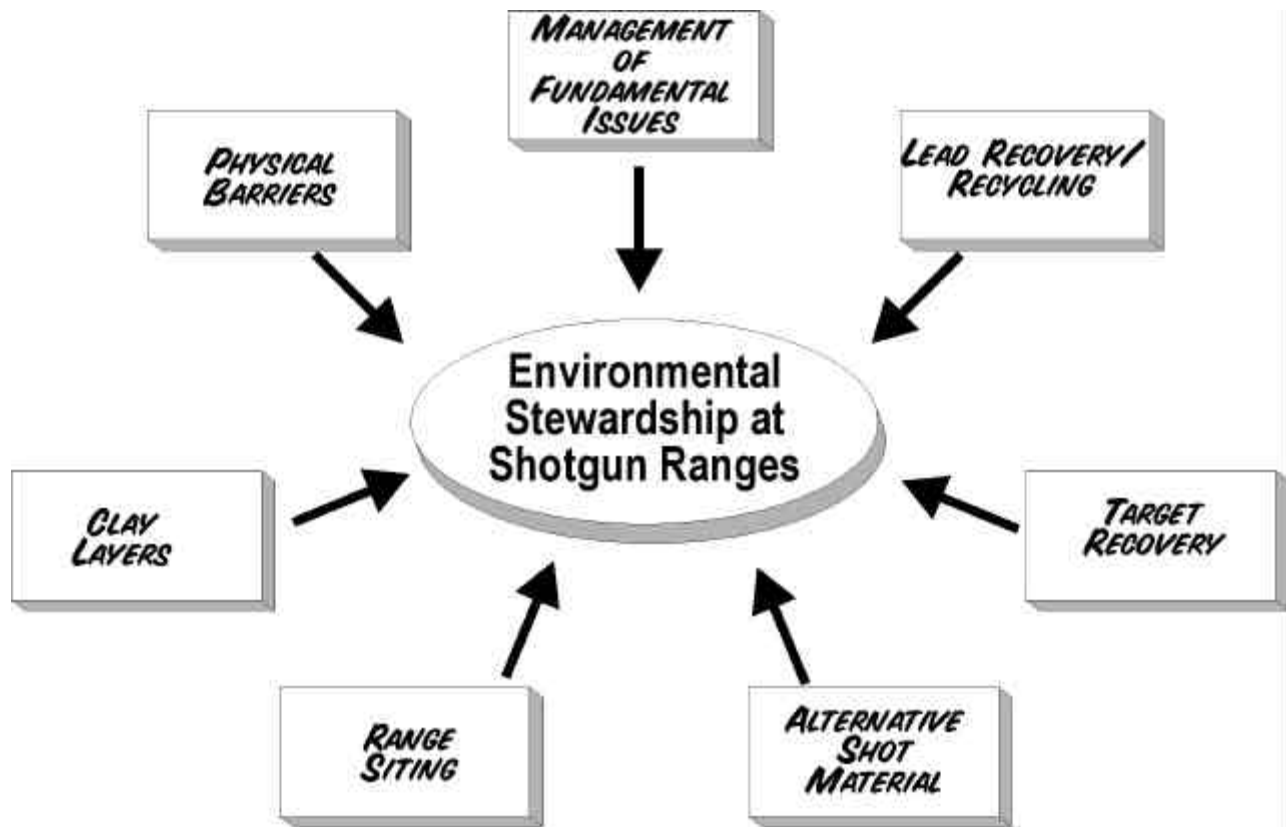


Figure 4-1. Various kinds of approaches can be used alone or in combination in effective environmental stewardship at shotgun ranges.

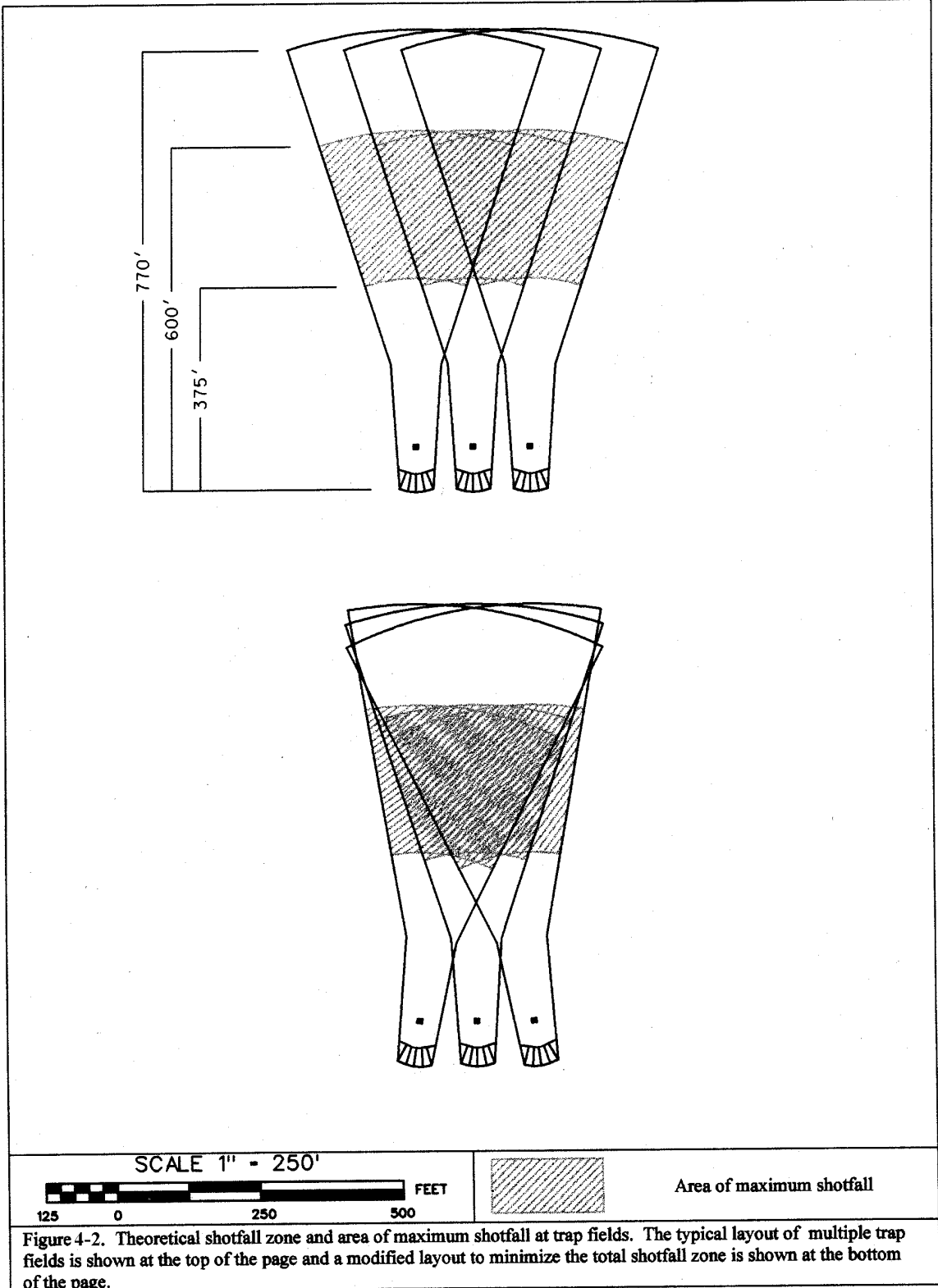


Figure 4-2. Theoretical shotfall zone and area of maximum shotfall at trap fields. The typical layout of multiple trap fields is shown at the top of the page and a modified layout to minimize the total shotfall zone is shown at the bottom of the page.

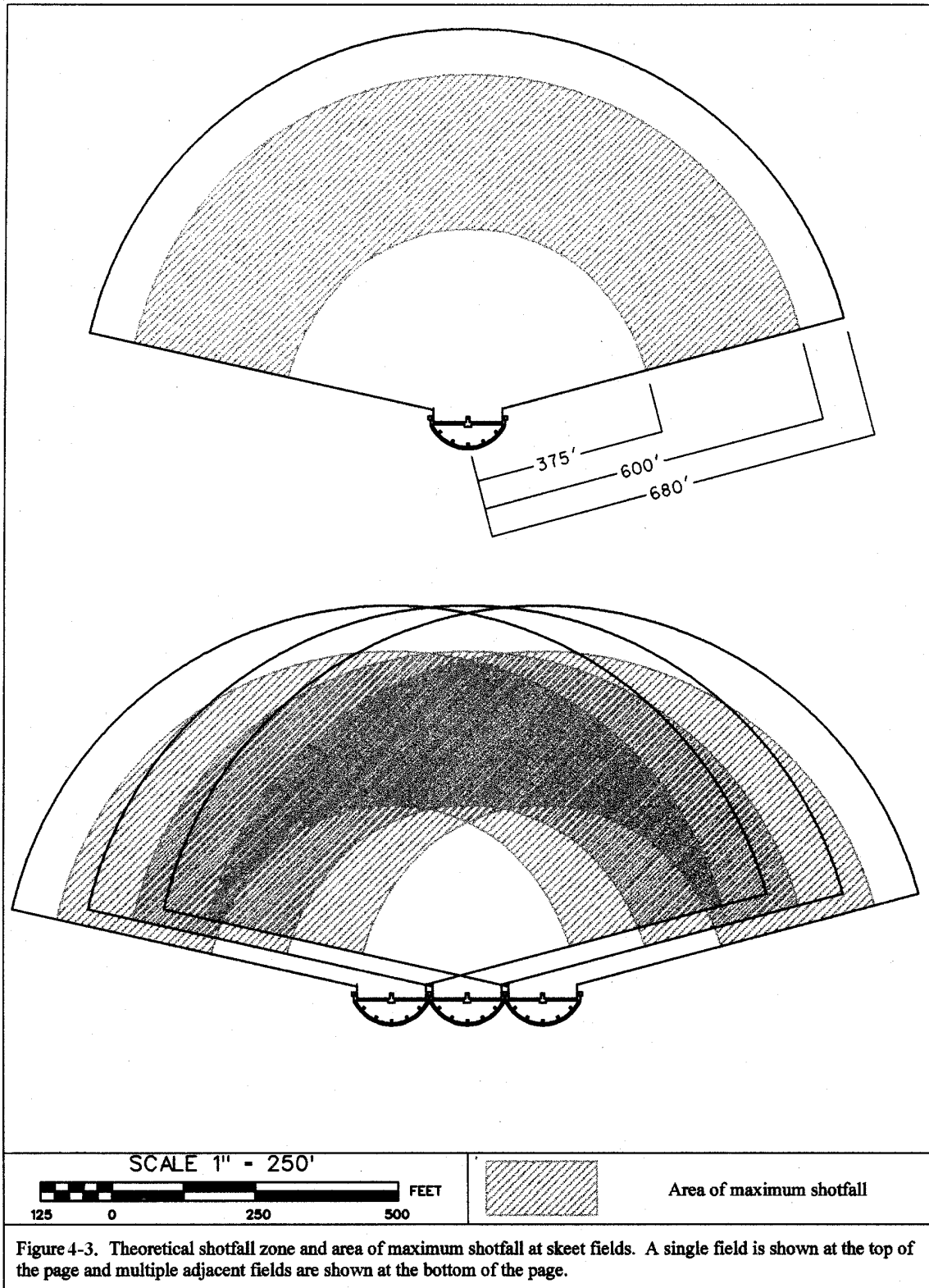


Figure 4-3. Theoretical shotfall zone and area of maximum shotfall at skeet fields. A single field is shown at the top of the page and multiple adjacent fields are shown at the bottom of the page.

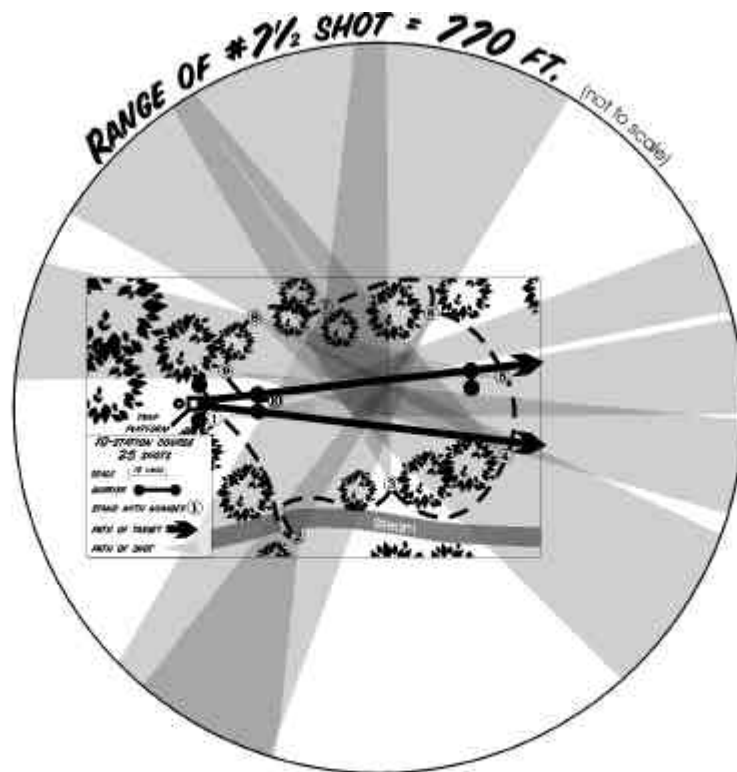


Figure 4-4. Shotfall zones for a simple hypothetical sporting clays course, illustrating the wide area over which shot can be distributed and the possible overlap of multiple shotfall zones at some distance from the shooters. Note: If more than one party at a time were to use a course laid out in a way resembling this illustration, there could be serious safety concerns. Shooter safety must be the primary consideration in range layout.

4.1.1 Shot Distribution at Trap Fields

The positions of the shooters and the angles at which trap targets are thrown result in a “funnel-shaped” theoretical shotfall zone(1) as illustrated in Figure 4-2. Depending on the load, the angle at which the shot was fired, and wind and other factors, typical lead trap loads can reach about 770 feet from the shooter, although most shot typically tends to fall roughly 375 to 600 feet from the shooter. (Note: the maximum range of shot is highly variable and is directly related to the elevation above sea level.) The theoretical shotfall zone and the area of maximum shotfall at a trap field is illustrated in Figure 4-2. Note the overlap of the shotfall zones from adjacent fields, resulting in areas with increased amounts of lead. The theoretical shotfall zone of a single trap field covers approximately 4 acres, and about 1-3/4 acres are added with each additional overlapping field (assuming the trap houses are spaced 100 ft apart). The top of Figure 4-2 illustrates a typical layout for multiple trap fields. The lower portion of Figure 4-2 illustrates a slightly different layout to maximize the overlap of the shotfall zones, which confines the lead to a smaller area and results in easier recovery and less potential environmental disturbance.

If shooting games other than regulation trap are shot on a trap field, the shotfall zone and area of maximum shotfall will tend to expand to the sides depending on the angles at which targets are thrown and shots fired. At a maximum, they would resemble the shape described below for skeet fields, with an outer perimeter about 770 ft. from the shooters.

4.1.2 Shot Distribution at Skeet Fields

The positions of the shooters and the angles at which skeet targets are thrown result in a “fan-shaped” theoretical shotfall zone. Depending on the load, the angle at which the shot was fired, and wind and other factors, typical lead skeet loads can reach about 680 feet from the shooter, although most shot typically tends to fall roughly 375 to 600 feet from the shooter. The theoretical shotfall zone and the area of maximum shotfall at a skeet field are illustrated at the top of Figure 4-3. The lower part of Figure 4-3 shows the shotfall zone and area of maximum shot-fall from several adjacent skeet fields. The theoretical shotfall zone of a single skeet field is approximately 14 acres, and about 2 acres are added with each additional overlapping field.

Even if shooting games other than regulation skeet are shot on a skeet field, the shotfall zone and area of maximum shotfall are typically no larger than described above for standard skeet.

The shotfall zone at a single combination trap and skeet field is very similar to the shotfall zone at a single skeet field, except that the “funnel” of trap shotfall extends about 90 ft beyond the perimeter of the skeet shotfall zone due to the greater range of typical trap loads. The areas of maximum shotfall overlap, producing an area of maximum lead in the center of the “fan.” Where there are several adjacent combination trap and skeet fields, multiple shotfall zones and areas of maximum shotfall overlap.

(1) The theoretical *shotfall zones* discussed in Section 4.1 and illustrated in Figures 4-2, 4-3 and 4-4 are based on the likely distribution of shot. Refer to the NRA Range Manual (Reference 13) and elsewhere for additional *safety* requirements. Environmental considerations must not result in design or operation that compromises safety.

4.1.3 Shot Distribution at Sporting Clays Courses

The defining feature of sporting clays courses is the complete flexibility in target angles and shooting directions. Because there is no “standard” layout for a sporting clays course, it is impossible to illustrate a “standard” shotfall zone or area of maximum shotfall. Figure 4-4 illustrates one of many possible layouts for a sample 10-station, sporting clays course. The shaded areas indicate the potential shotfall zones from the various shooting positions on the course, with darker areas indicating the overlap of shotfall zones from more than one station. This illustration makes it clear that sporting clays courses can distribute shot widely and can result in overlap of multiple shotfall zones at some distance from the shooting positions. The theoretical shotfall zones could extend 770 ft from the shooting positions, depending on the loads and angles at which they are fired.

4.2 OPERATIONAL APPROACHES TO ENVIRONMENTAL MANAGEMENT

4.2.1 Addressing Fundamental Issues Discussed in Section 3

The relatively small size of the shot in trap, skeet and sporting clays ammunition makes shot ingestion by birds or wildlife potentially more likely than ingestion of bullets or bullet fragments at rifle/pistol ranges. The extent to which the shotfall zone includes desirable bird or wildlife habitat generally determines the extent to which these animals might ingest shot. The entire area of the shotfall zone may require management of stormwater runoff, as well as lead management techniques such as recovery/recycling, clay layers, lime or phosphate additions or planting lead-accumulating plants.

4.2.2 Recovery and Recycling of Shot

The general guidance on lead recovery and recycling in Section 3.1.2.1 is applicable to shotgun ranges, in addition to the information below.

As described above and shown in Figures 4-2, 4-3 and 4-4, lead shot is spread widely at shotgun ranges. **Recovery and recycling of lead can be made much easier if shotgun ranges are constructed and operated in a manner consistent with periodic lead recovery and removal.** Strategically positioning shooters or targets so that shotfall areas overlap (for example as at the bottom of Figure 4-2) will concentrate the shot and lessen the area needed to be mined. **Recovery of shot from water or wetlands, steep slopes, and bushy or wooded areas can be very difficult, inefficient and expensive.** Recovery is generally easiest from relatively smooth grassy areas. Lead recovery contractors will want to know the approximate amount of lead present. Records of the number of rounds shot annually should be kept for this purpose. Past use may be estimated from the number of targets purchased annually.

Recovered lead should not be stored or accumulated on the premises and should be sent to a recycler as soon as possible.

4.2.3 Recovery of Targets

Most clay targets presently sold in the United States are composed of approximately 2/3 limestone dust and about 1/3 petroleum pitch. Some environmental questions have been raised about the possibility of environmental effects resulting from some of the components of the petroleum pitch. Petroleum pitch contains polycyclic aromatic hydrocarbons (PAHs). PAHs are a large chemical family that have members linked to certain cancers. However, the pitch is bound so tightly that the chemical and ecological

studies of targets conducted to date have consistently shown that under those circumstances, new or weathered target fragments do not adversely affect water quality and are not toxic to aquatic life (14, 15). **However, the sharp edges of target fragments may pose a hazard to some animals if ingested. Grazing domestic animals in shotgun areas should be discouraged.**

Targets can be viewed as a form of litter, and unsightly piles of fragments may give the impression that range managers are not paying close attention to the environment. Shooters may not notice accumulations of target fragments, or may regard them as normal features at a range. However, they may be much more noticeable and perhaps considered unsightly by new shooters, who are essential to successful range operations. **The possibility of adverse perception of target fragment accumulations should be considered by range managers, especially those that produce target accumulations visible to the public.**

Because of the possible littering aspect of target accumulation, range managers should consider periodic recovery and removal of target fragments as one of the “good housekeeping” aspects of their environmental stewardship plan (see Section 6). Depending on the terrain, target fragments can be hand-raked into piles or scraped together with a blade for pick-up, and a front-loader or other equipment can be used to load them into a truck. Target fragments typically meet the environmental requirements for placement in a solid waste landfill. In at least one case, target fragments have been accepted for recycling by an asphalt plant.

4.2.4 Alternative Shot Materials

In response to environmental concerns associated with lead, manufacturers have examined a variety of alternative shot materials, and efforts are continuing to develop additional non-toxic materials. Today, **steel shot** is the most common alternative to lead, and steel target loads are presently available in most areas of the country. Although more costly than lead and ballistically different, steel is the most viable alternative shot material available today for shotgun target shooting. Manufacturers continue to develop practical target loads with shot materials such as bismuth, tungsten, molybdenum and other substances. If such loads are introduced in the future, they should be considered for their potential environmental benefits. **Ranges that shoot into or over water, wetlands or other sensitive areas should consider switching to steel shot or other material as this becomes practical.** (See Appendix E for relevant case law regarding shooting over water or wetlands.)

It should be noted that other metals used as a replacement for lead shot may have properties different than lead. For example, lead shot produces very little ricochet, but steel shot produces high energy ricochets off many surfaces. If a range manager switches to steel or other shot material, care should be taken to update safety measures appropriate for that material.

4.3 ENGINEERING APPROACHES TO ENVIRONMENTAL MANAGEMENT

4.3.1 Addressing Fundamental Issues Discussed in Section 3

Inexpensive engineering approaches designed to reduce soil erosion, enhance bird and wildlife habitat and feeding, reduce sound impacts, reduce levels of dust and improve overall air quality, and enhance community relations should be considered as parts of an

environmental stewardship plan for shotgun ranges. Specific engineering measures can address each of these important environmental issues.

As discussed in Section 3.2, range design can have a significant role in determining soil erosion potential. Berms, vegetative swales, terraced slopes, rock-lined drainage channels, settling basins and other engineered features can significantly reduce erosion. At existing ranges, such features may be the most cost effective and efficient method to reduce erosion and maintain the aesthetic appeal of the range. Erosion in the shotfall zone is often the most important issue to address. Many of the management measures discussed in Section 3 can be applied directly to managing erosion in shotfall zones.

Enhancing bird and wildlife habitat and feeding at shotgun ranges (see Section 3.3) requires some attention to shotfall zones and specific habitats within those zones. It is not advisable that habitat within the shotfall zone be attractive to wildlife species because of potential lead uptake issues. However, because of erosion issues neither should these areas be devoid of vegetation. Utilization of grasses (such as fescues and Bermuda grasses) that have limited habitat value and a maintenance schedule that maximizes erosion control while minimizing wildlife risks are recommended.

Sound impacts associated with shotgun ranges can be reduced by employing engineered sound attenuation devices such as berms and barriers as discussed in Section 3.4. In some cases existing site features can be adapted to better reduce sound impacts, or constructed barriers can be placed in such a manner to reduce sound impacts. Many of these engineered sound attenuation features can increase the aesthetic appeal of ranges. Dust levels and overall air quality as discussed in Section 2.2 are usually not issues associated with operating shotgun ranges. However, these issues can become important during lead recovery/recycling activities.

4.3.2 Shotgun Range Siting

The basic environmental considerations involved in siting an outdoor shooting range apply to both shotgun and rifle/pistol shooting ranges. See Section 3.6 for a discussion of major environmental variables to be considered, and the presentation of a sample checklist to assist in the comparison of several potential range sites.

The shotfall zone of shotgun ranges typically covers a large area (see Figures 4-2, 4-3 and 4-4) and recovering the lead shot can be fairly costly. **The shotfall zones at shotgun ranges should therefore be located on land from which shot could be effectively recovered.**

4.3.3 Clay Soil

Layers of clay soil, either natural or constructed, can act as barriers to control mobility of lead. As discussed in Section 3.1.2.4., a subgrade clay layer can restrict downward (but not lateral) movement of dissolved lead particles and lead. Constructing a clay layer as a part of a new shooting range is much more cost effective, less disruptive and more practical than adding that layer to an existing range. Natural clay may suffice in some situations, thus minimizing costs. Even if the clay has to be imported from an off-site source, costs per acre would usually be relatively low, depending on the location and the size of the shotfall zone. However, considering the size of shotfall zones as discussed in Section 4.1, fairly large areas have to be treated. Properly installing a clay layer requires

specialized skills and equipment to avoid inadvertent environmental harm. Professional assistance is often needed.

4.3.4 Theoretical Physical Barriers to Shot Distribution

In a general sense, the wider the distribution of shot, the greater the potential for environmental concern. The concept of a physical barrier that would be erected just beyond the trajectory of targets to intercept shot is attractive because distribution of shot could be reduced considerably. The use of a barrier would make recovering spent shot for recycling easier and reduce the potential of wildlife accidentally ingesting shot. It would also reduce the potential for surface or ground water contamination and the amount of land needed for a range. However, physical barriers are still in the conceptual stage and have not been designed and adequately demonstrated for general application.

This concept may be worth consideration at ranges where limiting the distribution of shot would be especially helpful. Assistance in designing and constructing barriers may be available from some of the sources listed in Appendix A.

4.4 OTHER MANAGEMENT APPROACHES

Measures to prevent potential impact of shotgun ranges on the environment may include natural barriers (topography, site selection), safeguards in operating procedures and maintenance, engineered safeguards (facility design), and monitoring (on site and off site if necessary).

Actions not specifically described elsewhere in this manual that may be carried out as part of an Environmental Stewardship Program at shotgun ranges include:

1. Design new ranges and reconfigure existing ranges to divert shot from falling into water. It is in the best interest of the shooting range not to shoot lead shot into water. This will reduce the possibility of lead contamination and will certainly reduce the potential for legal or regulatory challenge.
2. Modifying the shotfall area to make it as relatively flat and obstacle-free as possible. Planting this area with a perennial grass provides a shotfall zone from which lead shot, target fragments and wads would be more easily recovered.
3. Grade the shotfall zone to prevent temporary ponding of surface water and promote rapid drainage, while maintaining a gentle enough slope to minimize soil erosion. This will minimize the time lead shot is in contact with water.
4. Orient traps and shooting positions to maximize the overlap of shotfall zones for ease of recovery/recycling. In doing so, give careful consideration to shooter safety.
5. Avoid using shotfall areas for other activities such as athletic fields, play areas, raising crops or livestock grazing.

5. APPROACHES SPECIFIC TO RIFLE/PISTOL RANGES

This section builds on the discussions of Section 3 that are applicable to all ranges, and addresses issues and management approaches that are specific to outdoor rifle/pistol ranges (Figure 5-1). Most of these issues relate directly or indirectly to managing lead mobility or ingestion of lead particles. These discussions are applicable to existing ranges, expansions or upgrades to existing ranges, and new range construction. This section builds on the assumption that the general issues discussed in Section 3 have already been understood and adequately considered.

5.1 LEAD DISTRIBUTION

From an environmental perspective, the major differences between rifle/pistol ranges and shotgun ranges relate to the differences in the physical distribution of the lead. The vast majority of the lead at a rifle/pistol range is typically concentrated in a *very small* area of the backstop berm right behind the targets (and most of this lead is immediately recovered if bullet traps are used). Although bullets may occasionally strike the side berms or foreground between the firing line and the targets, lead is usually sparsely distributed throughout these areas relative to the concentration on the backstop berm.

5.2 OPERATIONAL APPROACHES TO ENVIRONMENTAL MANAGEMENT

5.2.1 Addressing Fundamental Issues Discussed in Section 3

Typically the foreground at a rifle/pistol range is relatively flat and free of tall vegetation or obstructions. This, coupled with the confinement of most of the lead to a relatively small area, makes lead recovery/recycling theoretically easier at the typical rifle/pistol range compared to the typical shotgun range. **Although the same basic methods of lead management are applied to both shotgun and rifle/pistol ranges, they are implemented differently as a result of the different lead distribution patterns. Because bullets are much larger than the shot used at shotgun target ranges, there is far less potential for accidental ingestion of lead by feeding birds and wildlife.**

Soil erosion is often a more important issue at rifle/pistol ranges because bullets are continually hitting the ground in the same places behind the targets. This creates continually disturbed areas where the bullets strike the ground. The impact produces bullet fragments of all sizes, including microscopically small lead particles. The soil and the small lead particles can be eroded from the disturbed areas directly behind the targets. Management of this issue is discussed in Section 5.2.5 on control of runoff.

Sound management at rifle/pistol ranges differs from shotgun ranges due to the presence of the backstop berm and side berms. The characteristics of the sound produced by rifles and pistols differs from the sound characteristics of shotguns. Management of sound is discussed in Section 3.4.

5.2.2 Recovery and Recycling of Bullets

Lead recovery and recycling is discussed in general in Section 3.1.2.1. This section discusses recovery and recycling specifically at rifle/pistol ranges.

Lead recovery at rifle/pistol ranges involves two types of areas: (1) the backstop berm or bullet traps where most of the lead will be concentrated, and (2) the side berms and

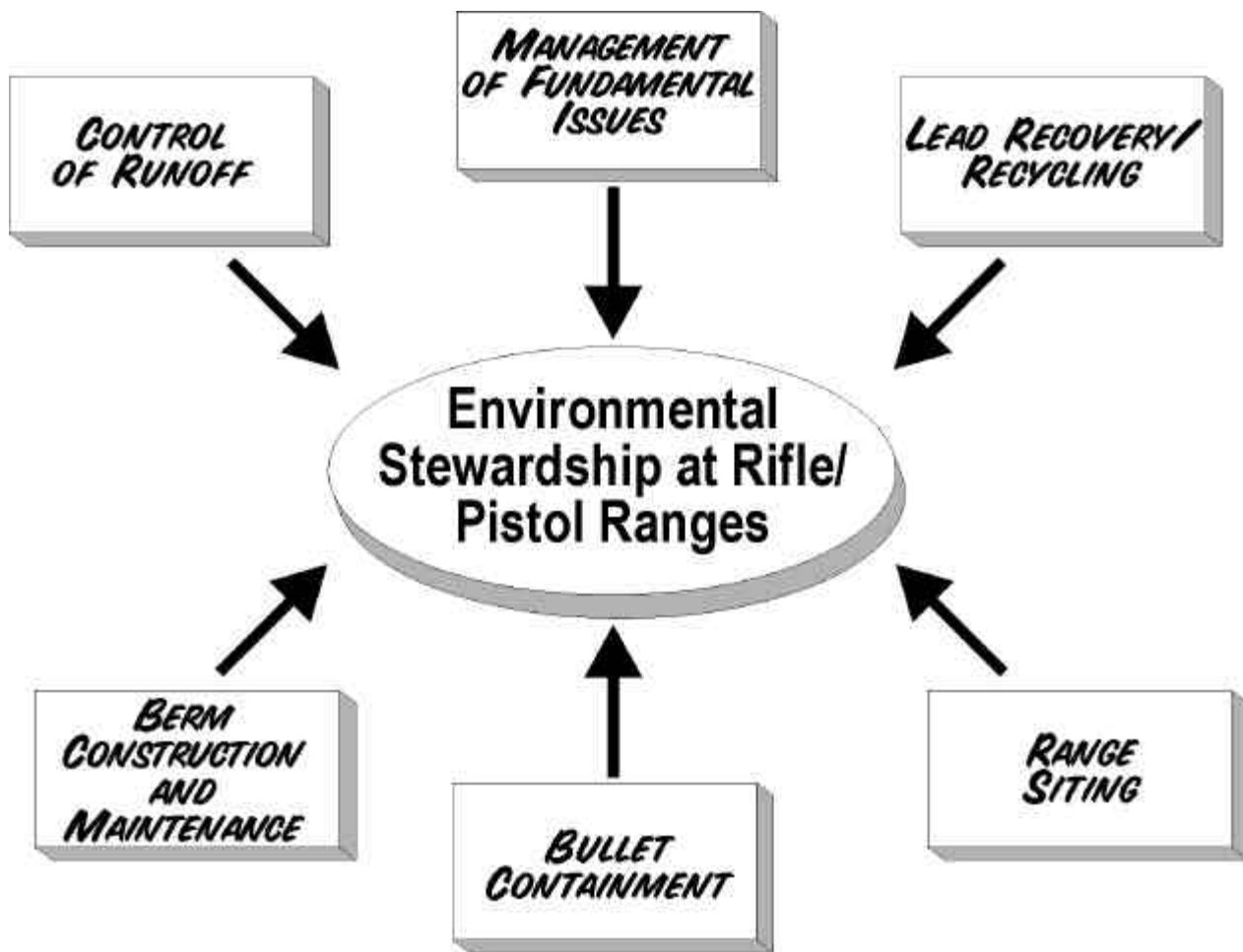


Figure 5-1. Various kinds of approaches can be used alone or in combination in effective environmental stewardship at outdoor rifle/pistol ranges.

foreground between the firing line and the targets. Recovery from both areas may be appropriate. For ranges with effective bullet traps, recovering bullets may be as easy as emptying the catchment areas of the traps. Bullets in earthen berms may be imbedded deeply into the berm, and these bullets usually should be included in the recovery operation. This typically requires excavation of several feet of the entire face of the berm, mechanical screening of the soil to separate the bullets, and replacement of the soil on the berm face. Ranges should consider adding soil amendments, such as lime or phosphates, to the soil prior to replacing on the backstop berm (see Sections 3.1.2.5 and 3.1.2.6). Recovery from side berms and the foreground is similar, although typically excavation does not have to be nearly as deep nor does it have to be conducted as frequently. These activities might be done by range personnel at low-use facilities, especially small-bore ranges where bullets do not penetrate as deeply into the berm. However, it may be best to use a lead recovery/recycling firm (see Appendix B). It is best to allow only specially trained range personnel or employees of the recovery/recycling firm to conduct the work, due to the possibility of inhalation of lead dust.

After the lead recovery is completed, the areas should be regraded and vegetation re-established to control soil erosion. Vegetation may be re-established fairly easily and erosion controlled effectively in the foreground, on the side berms and on much of the backstop berm. The areas directly behind the targets on ranges without bullet traps will continue to be disturbed when shooting resumes. Any material that might leave these areas can be managed as part of runoff control as discussed in Section 5.2.5.

5.3 ENGINEERING APPROACHES TO ENVIRONMENTAL MANAGEMENT

5.3.1 Addressing Fundamental Issues Discussed in Section 3

Many of the issues discussed in relation to shotgun ranges in Section 4.3.1 are similar for rifle/pistol ranges. Refer to Section 4.3.1 for engineering approaches to address the fundamental issues discussed in Chapter 3. However, because of range dimensions, safety requirements, and the size of the target areas, some engineering measures unique to rifle/pistol ranges may be required. Sources listed in Appendix A can provide assistance with site-specific aspects of developing and implementing Environmental Stewardship Plans for rifle/pistol ranges.

5.3.2 Range Siting

The basic environmental considerations involved in outdoor shooting range facility siting decisions apply to both shotgun and rifle/pistol shooting ranges. See Section 3.6 for a discussion of environmental issues that should be investigated and for a checklist to assist in the comparison of potential range sites.

5.3.3 Bullet Containment

Bullet containment is extremely important for safety reasons, but lead recovery and protecting the environment should also be considered when choosing methods for bullet containment. Berms, bullet traps, and ground, overhead and canopy baffles are all important parts of bullet containment at rifle/pistol ranges.

Bullets should be contained in the defined area of the range. This includes bullets that may ricochet off previously fired rounds or small rocks in the backstop berm, or off the surface of the side berms or the foreground soil.

There are several ways to contain bullets after hitting the targets on rifle/pistol ranges. The most common is a simple earth berm behind the targets. More sophisticated containment systems include sand traps, water traps, shock-absorbing cement, shredded tires and other materials that improve safety on the range and collect the bullets for easier recovery. Some state-of-the-art bullet traps of hardened steel make bullet recovery very easy and significantly reduce the chance of ricochets. Bullets that do not hit the targets can also be contained on a range by installing baffles. Ground baffles are used to catch bullets that are fired or ricochet toward the ground. Overhead baffles can be installed to satisfy the “no blue sky” rule. They can confine bullets fired too high from leaving the range, as well as confine low-angle ricochets on the range. Canopy baffles are installed at the firing line and are used in conjunction with overhead baffles. Ranges can be constructed so that all shots are fired through tubes of such a size and length that the bullets must hit the backstop.

Selection of bullet containment involves many factors, including the size of the range, the location of the range, and the number and types of rounds to be fired. An engineering firm with shooting range experience can provide assistance with new range construction or existing range upgrading. Bullet containment is discussed much more thoroughly in the NRA Range Manual (Reference 13).

5.3.4 Berm Construction and Maintenance

Backstop berms and side berms are commonly the major components of the bullet containment system at outdoor rifle/pistol ranges. Typically, backstop berms have to be constructed. However, a fairly steep, natural hill may serve as the backstop berm at some ranges. If so, the lower part of the hill where bullets hit should be actively managed as a backstop berm.

Berm construction is usually best left to a local contractor who can provide heavy equipment to do the job properly. An environmental consulting firm or an engineering firm with shooting range experience can be contacted to design new berms or changes in existing berms. They can also provide construction oversight or construction services for the berm construction.

The possibility for lead in the backstop berm to dissolve can be minimized by reducing the contact between water and lead. A variety of berm designs can help keep water away from lead in berms. In addition, many approaches can be used to control the pH which would reduce the potential for lead to dissolve in water. Figure 5-2, adapted from reference 4, illustrates one helpful approach. This consists of a waterproof material over the top of the berm to prevent water from soaking in. The material can be extended to include an “eyebrow” to reduce the amount of rain hitting the face of the berm. Figure 5-2 also illustrates an approach that collects water running off the berm and manages its pH with limestone. A similar approach could be applied in conjunction with ground baffles in the foreground of rifle/pistol ranges.

Berm maintenance between lead recovery and recycling operations typically involves periodically replacing eroded dirt, reseeding bare areas, and fertilizing, watering and otherwise maintaining vegetation. On small ranges, maintenance may be performed by people who operate or use the range. It can be done with hand tools such as rakes and shovels, and should be done according to a schedule in the Environmental Stewardship Plan (see Section 6). On larger ranges, a contractor or range personnel with training and appropriate machinery will be able to perform maintenance more efficiently.

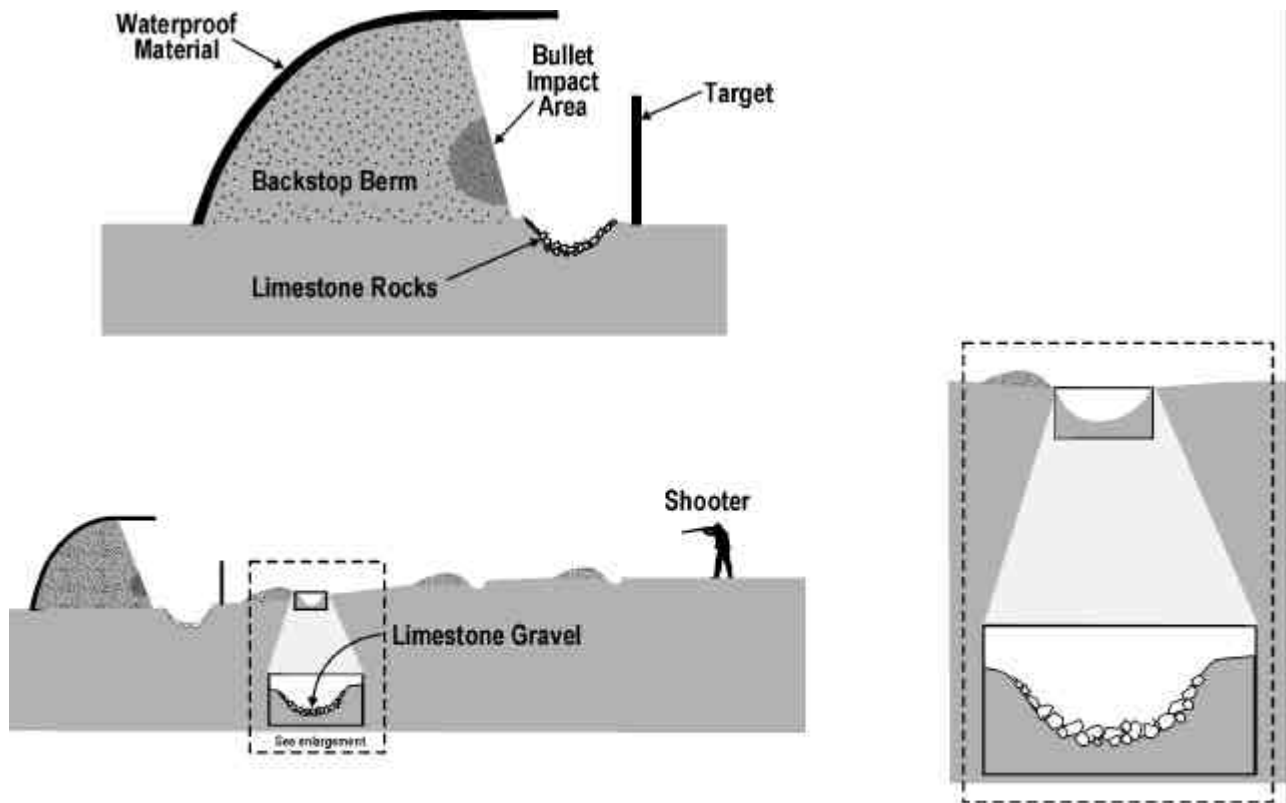


Figure 5-2. Examples of backstop berm and runoff trenching designed to collect bullets and lead runoff at rifle/pistol ranges.

5.3.5 Control of Runoff

Management of storm water runoff is discussed in general in Section 3.1.2.2. At rifle/pistol ranges, runoff from rain and snowmelt within the berms can be collected and channeled through appropriately sized ditches along the inside toe of the berms. These can come together and exit the bermed area through a culvert in a side berm. It may be useful to have the runoff from the backstop berm pass through a settling basin sized to allow fine lead particles and much of the eroded soil to settle out before the water leaves the range area. This basin should be emptied as frequently as necessary to maintain its efficiency as a settling basin. The sediment can be used to replace the face of the berm as part of the berm maintenance program. Before the sediment is considered for transportation off-site, it should be tested to determine whether it contains enough lead to require special handling. In some areas, settling basins may require permits. Design and installation of effective runoff controls requires experience and should be undertaken with the help of an engineering or landscape architect firm. Assistance is available from sources listed in Appendix A. Special consideration should be given to the definition of a “point source” in designing any water control structure.

5.4 OTHER MANAGEMENT APPROACHES

Measures to prevent potential impacts of rifle/pistol ranges on the environment may include natural barriers (topography, site selection), safeguards in operating procedures and maintenance, engineered safeguards (facility design), and monitoring (on site and off site if necessary). Actions not specifically described elsewhere in this manual that may be carried out as part of an Environmental Stewardship Program at an outdoor rifle/pistol range include:

1. Design new ranges and reconfigure existing ranges to minimize any potential for bullets to fall, or lead to run off, into water.
2. Grade the foreground and construct ground baffles to prevent temporary ponding of surface water and promote rapid drainage, while maintaining a gentle slope and good vegetative cover to minimize soil erosion. This will minimize the time lead is in contact with water.

6. ENVIRONMENTAL STEWARDSHIP PLAN

This section provides guidance on developing an Environmental Stewardship Plan for an outdoor shooting range. It also discusses how to assess environmental conditions at a particular location, determine how to apply solutions to site-specific conditions, develop and implement an Environmental Stewardship Plan, and evaluate and update the Plan over time.

6.1 CONCEPT AND RATIONALE

An Environmental Stewardship Plan represents a written plan or “road map” for planning, implementing, and monitoring the progress of environmental improvements at shooting ranges. **By developing and implementing an Environmental Stewardship Plan, you will document your commitment to the environment and to the community.** Specific benefits of developing and implementing an Environmental Stewardship Plan for your range are:

- N Increasing protection of the environment (see preface for other goals).
- N Providing tangible evidence of proactive efforts to be good environmental citizens. This can be very valuable if a legal or regulatory action is taken against the range on environmental issues.
- N Discouraging legal or regulatory action. This is especially true if implementation of the Plan has begun.
- N Systematically gathering and evaluating the information necessary to determine whether there are legitimate environmental concerns at your range. This record can become a valuable historical record for the range, as well as being helpful in defending against environmental allegations.
- N Identifying effective and appropriate ways of resolving any legitimate environmental concerns that may be found.
- N Documenting the fact that no legitimate environmental concerns were identified.
- N Planning expenditures and demonstrating the need (and enlisting support) for funding.
- N Assisting in making prudent and cost-effective decisions that will maximize your legal and regulatory protection.

Development of an Environmental Stewardship Plan for your range can be part of a larger and comprehensive evaluation of how business is conducted at your facility. Therefore, it can have much in common with the planning you might already do for other aspects of your business operations.

6.2 PLAN DEVELOPMENT

Every outdoor shooting range should develop an Environmental Stewardship Plan.

This section provides guidance on developing a Plan for your range. Appendix C contains example Environmental Stewardship Plans for *hypothetical* shotgun and rifle/pistol ranges. *These are examples only, and should not be used directly at any range.* The examples simply illustrate what a typical Environmental Stewardship Plan might look like to help in developing a Plan specific to the needs identified at your range.

Developing an Environmental Stewardship Plan can involve several interrelated steps. These include:

- N Evaluation of Existing Conditions
- N Identification of Environmental Issues
- N Identification of Management and Engineering Solutions
- N Preparation of an Environmental Stewardship Plan
- N Plan Implementation
- N Plan Evaluation and Update

6.2.1 Evaluation of Existing Conditions

6.2.1.1 General Environmental Conditions

The first step in preparing an Environmental Stewardship Plan is evaluating the facility to determine its general environmental features and physical characteristics, and its operational attributes. Several sources of information may already be available at the facility or readily obtainable through public sources such as those identified in Appendix A. Table 6-1 provides some sources of information available to help compile this profile.

Table 6-1 SOURCES OF INFORMATION TO HELP EVALUATE EXISTING CONDITIONS

Type of Information	Source	Purpose
Geological	U. S. Geological Survey (U. S. G. S.) and State Geological Survey Maps	<ul style="list-style-type: none"> • Evaluate drainage • Factors affecting acidity • Land use planning constraints • Background lead concentrations
Hydrologic	U. S. G. S. and State Geological Survey	<ul style="list-style-type: none"> • Depth to subsurface groundwater • Drainage patterns • Flood potential and frequency • Land use planning
Soil	U. S. Natural Resource Conservation Service (NRCS), Soil Conservation Surveys (by county)	<ul style="list-style-type: none"> • Soil properties • Soil stability • Drainage characteristics • Vegetation limitations • Background lead concentrations
Wetland Delineation	NRCS (by county)	<ul style="list-style-type: none"> • Soil properties • Soil stability • Drainage characteristics • Vegetation limitations
Topographic	U. S. G. S. 7.5 Minute Quadrangles	<ul style="list-style-type: none"> • Site elevations • Drainage patterns • Land use
Aerial Photographs	U. S. G. S., Local Universities, Planning Departments	<ul style="list-style-type: none"> • Drainage • Ground cover (vegetation) • Stressed areas • Land use
Site Layouts	Construction plans, maps produced for site design and operations	<ul style="list-style-type: none"> • Shooting positions and shotfall zones • Berms • Buildings • Roads

Table 6-1 continued

Type of Information	Source	Purpose
Water Quality Data	U. S. G. S. databases; laboratory results from on-site sampling; county extension agent; local university agriculture department; state and local environmental agencies	<ul style="list-style-type: none"> • Support facilities (water and sewer lines, etc.) • Acidity • Background lead concentrations • Muddy water in water bodies • Concentration of other contaminants
Number of Users	Operating records, business plans, club meeting notes	<ul style="list-style-type: none"> • Parking, restroom, trash facilities • Amount of lead • Frequency of recovery/ recycling • Feasibility studies and projected use figures for new and/ or expansion projects
Number of Targets	Operating records, business plans, club meeting notes	<ul style="list-style-type: none"> • Amount of lead • Amount of target fragments • Frequency of recovery/ recycling • Feasibility studies and projected use figures for new and/ or expansion projects
Months, days, and hours of operation	Business plans, club meeting notes	<ul style="list-style-type: none"> • Presence of migratory birds & wildlife • Timing of recycling • Magnitude of sound • Feasibility studies and projected use figures for new and/ or expansion projects
Current land use laws and regulations	Planning boards or governments	<ul style="list-style-type: none"> • Maintaining compliance • Planning expansions

The basis for every Environmental Stewardship Plan should include at least one, and preferably several, soil samples from the impact on shotfall areas. These samples should be taken according to directions provided by your County Natural Resource Conservation Service (NRCS) office or local nursery (see Appendix A). *The samples should be analyzed to determine soil pH, types and amounts of clay present, and other soil characteristics relevant to lead management as discussed in Section 3.1.* Soil analysis can also provide information on soil additions needed for best plant growth. The NRCS office or local nursery can also provide guidance on erosion control, pH control, selection of plants for various purposes, etc. Depending on the complexity of the situation at your range, it may be advisable to seek professional help in developing an Environmental Stewardship Plan. Help with various aspects of a Plan may be available from the NRCS office, environmental consulting firms, engineering firms, landscaping companies, local universities and other sources discussed in Appendix A.

Geological maps are useful for determining the depth to groundwater and whether there are any groundwater sources (aquifers) locally used for drinking water. Information concerning bedrock also may be an indicator of conditions affecting the acidity of surface waters (i.e., limestone areas would typically not be acidic).

Hydrologic maps give further information on depth to groundwater tables, show the drainage patterns created by rivers, creeks and lakes, and sometimes show the flooding potential of streams which may influence decisions on development within floodplain areas.

Soil maps provide useful information regarding the type of soil likely to be found at any particular site along with a wealth of information regarding soil properties such as drainage, permeability, engineering characteristics and vegetation limitations.

Many wetland areas have been mapped by the U.S. Fish and Wildlife Service or state natural resource agencies. Some areas may be categorized as wetlands because they meet certain technical criteria, yet they may not appear to be “wet,” “marshy” or “swampy” to the public. These maps provide official designation of these areas which may be important in making range development or range modification decisions.

Note: Wetlands, including those entirely on private property, are protected by law and cannot be filled, dredged or otherwise modified without a permit. Range managers should consult county NRCS offices to determine if there is a wetland on their range. Caution: even though an area is not “officially designated” on government maps, or may be too small to show on a map, it may nevertheless qualify as a wetland. Only a trained professional can make a reliable evaluation. If there is any doubt whether an area is a wetland, a qualified environmental consulting firm should be contacted.

Topographic maps show site elevations (which affect drainage), line of site, steepness of slopes, and man-made features. If your range is small and the USGS maps are not at an appropriate scale to provide useful information, many County planning departments and local universities may provide local mapping at a larger scale free of charge.

Aerial photographs can supplement map information. A “snapshot” aerial view using an aerial photograph oftentimes helps pinpoint areas of environmental problems such as stressed vegetation, eroding slopes and affected water bodies.

Finally, each facility is likely to have some level of site mapping showing structures, firing ranges and supporting utilities. These maps are important for comparing existing or planned changes with the environmental “lay of the land” provided by other map and photo sources.

The county extension agent and local university agriculture departments, identified in Appendix A, can be valuable sources of general information about conditions in the vicinity of your range that are relevant to environmental issues. They can be helpful sources of information useful in preparing environmental stewardship plans.

6.2.1.2 General Range Characteristics

In addition to general site characteristics, the other components of the baseline information needed for developing an Environmental Stewardship Plan are the overall operating characteristics of the range. The necessary information is probably available in business and operating records of existing ranges, although it may have to be located and brought together for this purpose. Any information related to the kind and amount of use of the range (e.g., number of shooters, amount of lead used, number of targets thrown, history of lead recovery/recycling) is important. Projections of the type of information should be included in the business plans for range modifications, expansions and new ranges. These factors are indicated in Table 6-1.

6.2 .2 Identification of Environmental Issues

Environmental issues or areas of concern can be identified in a variety of ways including:

- N Comparison of existing conditions to existing operations
- N Comparison of existing conditions to planned range modifications
- N Comparison of existing conditions to plans for new ranges
- N Issues identified through environmental litigation
- N Issues identified by governmental inspection of a range
- N Suggestions or concerns expressed by the public or customers at your range
- N Proactive environmental audits of a range by a trained professional

Section 3 of this manual discusses typical environmental issues that may exist at shooting ranges and techniques to address them. Regardless of whether these issues emerge as a result of proactive identification by the range manager through comparison of data described in Section 6.1 or by identification by the public, a public agency or through some legal action, the gathering of information about existing conditions is essential. This information will help you determine which environmental issues you focus on and their priority in the Environmental Stewardship Plan.

6.2.3 Identification of Management and Engineering Solutions

Section 3 of this manual summarizes potential management techniques for addressing typical environmental issues at shooting ranges. These are summarized in Table 6-2. Table 6-3 summarizes specific potential actions that can be taken at shotgun and outdoor rifle/pistol ranges. Once the environmental issues of concern at a particular facility have been identified, the actions listed in these tables, supplemented by the background information provided in Section 3, will provide a useful starting point for identification of site-specific solutions.

Table 6-2. Summary of Potential Management and Engineering Solutions For Addressing Environmental Issues at Shooting Ranges.

Issue	Potential Resources Impacted	Potentially Available Management Techniques
Lead Mobility	<ul style="list-style-type: none"> • Soil and sediment • Surface water quality • Groundwater quality • Direct ingestion by wildlife 	<ul style="list-style-type: none"> • Recovery/recycling • Stormwater runoff management • Lead accumulating vegetation • Adding clay/mixing/clay layer • Lime addition • Phosphate addition • Other natural or synthetic materials • Cultivation/tilling • Combined approaches
Soil Erosion	<ul style="list-style-type: none"> • Surface water quality • Fish and wildlife habitat • Wetlands 	<ul style="list-style-type: none"> • Vegetative control • Slope terracing • Settling basins • Other artificial measures to stabilize slopes
Bird and Wildlife	<ul style="list-style-type: none"> • Habitat • Individual animals 	<ul style="list-style-type: none"> • Landscaping • Plantings • Wildlife habitat management
Dust/Air Quality	<ul style="list-style-type: none"> • Range users • Aesthetics 	<ul style="list-style-type: none"> • Vegetative approaches (slope and soil stabilization) • Operational approaches (water and wetting agents)
Sound	<ul style="list-style-type: none"> • Human neighbors • Wildlife populations • Aesthetics 	<ul style="list-style-type: none"> • Range siting • Engineering approaches (i.e., use of sound absorbing materials, berm construction) • Vegetative approaches
Trash/Litter	<ul style="list-style-type: none"> • Aesthetics • Public perception • Wildlife 	<ul style="list-style-type: none"> • Waste management • Trash receptacles

Table 6-3. Summary of Potential Operational and Engineering Approaches For Control of Lead at Outdoor Shooting Ranges.

	Shotgun Ranges	Rifle/Pistol Ranges
Potential Operational Approaches	<ul style="list-style-type: none"> • Shot recovery and recycling • Target recovery • Alternative shot materials • Lime and phosphate application 	<ul style="list-style-type: none"> • Bullet recovery and recycling • Lime and phosphate application
Potential Engineering Approaches	<ul style="list-style-type: none"> • Range siting • Clay layers/mixing • Physical barriers to shot distribution (experimental) • Shotfall zones designed to be outside of surface water bodies • Ranges designed to maximize overlap of shotfall zones while maintaining shooter safety • Elimination of depressions that may hold water • Stormwater management/erosion control 	<ul style="list-style-type: none"> • Range siting • Clay layers/mixing • Bullet containment • Baffles/tube ranges • Berm construction and maintenance • Bullet traps • Runoff controls • Stormwater management/erosion control

6.2.4 Preparation of Environmental Stewardship Plan

Preparation of an Environmental Stewardship Plan involves selecting the appropriate management and engineering solutions for the range and documenting the intended course of action. Selection of these solutions is dependent on a number of factors, including cost, availability of technology, ease of implementation, potential benefits, timing, and other topics specific to site and business considerations. A useful tool to aid in decision-making is a comparison sheet that lists the potential solutions against specific criteria. Table 6-4 provides a simple evaluation matrix that could be used as a basis for evaluating alternative courses of action. By assigning relative “scores” to each of the solutions (i.e., high, medium, low or using a simple numerical ranking), you can systematically reach a decision on which solution best fits your situation.

This step should include a realistic appraisal of the site-specific practicability, cost and effectiveness of alternative solutions. This information is necessary to accurately assess the various options and document how decisions were made. It will also guide range managers in setting site-specific goals that are within the means of the individual range (time, budgets, etc.). This can be helpful if any question of management priorities arises from either internal or external sources.

Once the decision-making process is complete, the decisions should be documented in the Environmental Stewardship Plan. Table 6-5 provides a sample outline for a typical Plan. Each Plan can be as detailed or simple as desired. The outline provided is intended as a starting point for tailoring a Plan to a particular site. **However simple or intricate the format, it is important that some documentation take place to record the basis for decisions and to lay out a plan to guide future actions.**

Table 6-4. Sample Project Evaluation Comparison Sheet.

Criteria	Alternative Projects (list each in a separate column heading)					
Environmental benefits						
Cost						
Level Professional						
Assistance Needed						
Impact on range operations						
Ease of implementation						
Timing						
Regulatory benefits						
Health and safety impacts						
Total Score						

Table 6-5. Sample Outline Environmental Stewardship Plan

I. FACILITY ENVIRONMENTAL STEWARDSHIP PLAN

II. SITE ASSESSMENT

Facility Description
Range and Support Facilities Description
Existing Environmental Conditions
Current and Past Operating Practices

III. PLAN OF ACTION

Alternatives Identification

- Practicability
- Cost
- Effectiveness
- Time needed for implementation

Selection of Options for Implementation

- Management Actions
- Site Improvements/Modifications
- Site Design Features (*new sites*)

IV. PLAN IMPLEMENTATION

List of Proposed Actions
Schedule for Implementation
Responsibilities

V. MEASURING SUCCESS

Tracking Progress and Benefits
Periodic Assessments and Adjustments to Plans.

6.3 PLAN IMPLEMENTATION

Your Environmental Stewardship Plan should contain a general schedule for implementing the desired actions. These actions need not occur all at once; in fact, staging of the actions over time may be desirable from a logistics standpoint and may be advantageous or necessary from a financial point of view. Easily implementable options that do not have high costs should be implemented first (i.e., changing the mowing schedule or changing positioning of planned vegetative improvements). These may achieve considerable environmental benefits and improve the facility's public image at minimum cost. Consideration of when to implement options requiring a capital investment must be integrated in overall business planning decisions. Low-cost sources of assistance from colleges and universities, civic and volunteer groups, youth organizations, public programs (i.e., local agricultural extension office) should not be over-looked as alternative, low-cost methods of implementing various parts of the Plan.

In addition to a schedule, plans should contain information concerning the primary person(s) or contractors responsible for carrying out the recommendations of the Plan, and outline the actions required to initiate and implement each environmental improvement. Table 6-6 provides a sample format for documenting important information for each planned improvement.

6.4 RECORD-KEEPING AND EVALUATION

Evaluation of the success of an Environmental Stewardship Plan should occur one or more times per year. Keeping the Plan current will help the range make mid-course corrections where necessary and document the results from the previous year's initiatives. **The focus of the evaluation should be to determine whether the Environmental Stewardship Plan has been implemented as intended, the problems (if any) encountered, and what types of adjustments should be made to the plan for the future.** In addition, it will be useful to monitor the environmental benefits that have resulted from implementation of management and engineering actions. This will demonstrate the effectiveness of the actions that have been taken.

Just as with other aspects of business, record-keeping is essential for evaluation of the Environmental Stewardship Plan. Typical records that may be useful in evaluating the effectiveness of a Plan may include:

- N Range "inspections" by range manager.
- N Photographs of pre-existing conditions versus conditions after environmental improvements have been implemented ("before" and "after" photographs).
- N Log of actual implementation dates, problems addressed, associated costs, conditions, problems encountered and follow-up actions.
- N Frequency of changed operational practices (i.e., mowing on poorly vegetated soils) and observed results.
- N Comparison of changes in operational costs related to changed procedures; and
- N Frequency and type of environmentally related complaints from customers or the public.

Quantitative measurement of environmental improvements will most likely be beyond the capabilities of range managers and need not be sought unless they are necessary to support legal proceedings. In these cases, support from outside consultants may be in order. Local universities or non-profit groups with an environmental research interest may also represent a viable source of assistance.

7. SUMMARY AND CONCLUSIONS

Potential environmental issues at outdoor shooting ranges are attracting increasing legal and regulatory attention. The shooting sports community has established the Environmental Stewardship Statement that forms the Preface to this manual as the cornerstone of its commitment to the environment. This manual provides guidance to range managers on steps to determine their environmental status, and practical environmental management measures that can be taken if warranted. The overall conclusions of this manual are included in the following section.

Legal and regulatory challenges to ranges on environmental issues have been primarily under the CWA, RCRA and CERCLA. Each of these laws addresses different environmental issues, and each creates specific requirements and liabilities that could be applied to ranges. To date, legal or regulatory actions have been taken against ranges in a dozen or more states. Most of these actions have involved ranges shooting into or over water or wetlands. It is not yet clear exactly how CWA, RCRA, CERCLA and perhaps other federal, state and local laws will be applied to ranges. However, range managers would be wise to become aware of the basic provisions of these laws and regulations so that they are prepared to protect their interests through good environmental stewardship as regulatory and legal attention to environmental issues at ranges increase.

Positive environmental actions on a range should be thought of as one part of good community relations. Good community relations are very important, often inexpensive, usually cost-effective to establish and maintain, and have high benefits. A *Community Relations Plan* should be developed, describing how good relations with the public will be established and maintained for your range. *Sound* and potential sound impacts should be a key focal point of any community relations plan.

Lead and lead mobility are the primary environmental concerns at outdoor shooting ranges. Under certain conditions, lead at shotgun and rifle/pistol ranges has the potential to affect:

- N surface water, ground water and soil (primarily through dissolving in water that runs off ranges or soaks into the ground)
- N birds and wildlife (primarily through ingestion); and
- N range personnel (primarily lead recovery workers)

Many natural processes tend to minimize the potential effects, and under conditions typical of many ranges, lead may not cause substantial environmental effects. At ranges where conditions might not lend to prevent effects, natural processes can be enhanced and potential lead problems minimized through techniques discussed in this manual, such as:

- N lead recovery and recycling
- N management of stormwater runoff
- N lead-accumulating vegetation
- N clay soils
- N addition of lime
- N addition of phosphate
- N range sittings; and

N combinations of these approaches

Periodic, regular lead recovery and recycling should be part of the Environmental Stewardship Plan for every range. Each range is different, and a combination of lead management approaches tailored to specific range needs is most likely to provide optimum lead management. *Other topics like soil erosion and wildlife habitat addressed in this manual are environmental issues in their own right and are also related to managing lead.*

The distribution of lead is different at shotgun and rifle/pistol ranges, and this influences the potential effects of lead. Shotgun ranges tend to distribute lead over large areas that can serve as habitat for birds and wildlife, while at rifle/pistol ranges lead is concentrated in the berm and foreground which often provide little desirable bird or wildlife habitat. Although these differences influence many issues, such as erosion and potential wildlife exposure, the chemical factors that determine the fate of lead apply equally at all types of ranges.

Range managers should consider environmental issues in the context of an *Environmental Stewardship Plan*. Such a Plan:

- N documents present conditions at a range;
- N describes future management activities; and
- N provides a framework for documenting success in protecting the environment at a range.

The Plans can be very effective in enhancing the range's public image and in legal/regulatory actions (should they occur), as well as serving their primary purpose (environmental protection). This manual contains guidance on developing both an Environmental Stewardship Plan and a Community Relations Plan for your range.

8. REFERENCES

Note: All of these references, except Reference 13, are available from NSSF. A nominal charge may be assessed to cover the costs of printing and postage. Reference 13 is available from the NRA

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13. National Rifle Association (NRA). 1988. The Range Manual: A Guide to Planning and Construction. NRA Range Department, Fairfax, Virginia.
14. Baer, K.N., D.G. Hutton, R.L. Boeri, T.J. Ward and R.G. Stahl, Jr. 1995. Toxicity evaluation of trap and skeet shooting targets to aquatic test species. *Ecotoxicol.* Vol 4:385-392.
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Appendix A

Sources for Additional Information

APPENDIX A

SOURCES OF ADDITIONAL INFORMATION

This appendix lists sources of additional environmental information relevant to issues discussed in this manual. A brief discussion of each listing identifies the kinds of information that may be available from that source. The listings are in no particular order.

Many of the sources listed here provide information on a non-profit basis, although there may be nominal charges to cover expenses in some cases. Many sources also provide services on a for-profit basis. Before hiring a firm to provide environmental assistance, it is usually advisable to talk about a range's needs with several firms, ask for references from past clients and check with other ranges and established shooting organizations. Firms with an established track record of successfully handling environmental issues for outdoor shooting ranges might be expected to provide the greatest confidence of good service and value.

1. COMPREHENSIVE ENVIRONMENTAL INFORMATION

Sporting Arms and Ammunition Manufacturers' Institute, Inc.

11 Mile Hill Road
Newtown CT 06470-2359
Phone: (203) 426-4358
Fax: (203) 426-1087

Wildlife Management Institute, Inc.

1101 14th Street, N. W.
Suite 801
Washington, D. C. 20005
Phone: (202) 371-1808
Fax: (202) 408-5059

National Shooting Sports Foundation

Facilities Development Division
11 Mile Hill Road
Newtown CT 06470-2359
Phone: (203) 426-1320
Fax: (203) 426-1087

COMPREHENSIVE RANGE CONSTRUCTION GUIDANCE

Several organizations representing specific shooting disciplines offer technical advice on range design, sometimes for a nominal charge. The most comprehensive guidance readily available on all aspects of range construction is the National Rifle Association (NRA) Range Manual.

National Rifle Association

Range Department
11250 Waples Mill Road
Fairfax, VA 22030
Phone: (703) 267-1000
Fax: (703) 267-3909

*(To order the Range Manual, call 1-800-336-7402
or write to: NRA, Attn: Sales Department,
P.O. Box 5000, Kearneysville, WV 25430-5000)*

Amateur Trapshooting Association

601 W. National Road
Vandalia, OH 45377
Phone: (937) 898-4638
Fax: (937) 898-5472

National Skeet Shooting Association

2931 Rofit Road
San Antonio, TX 78253-9261
Phone: (210) 688-3371
Fax: (210) 688-3014

National Sporting Clays Association

5931 Rofit Road
San Antonio TX 78253-9261
Phone: (210) 688-3371
Fax: (210) 688-3014

National Shooting Sports Foundation

11 Mile Hill Road
Newtown, CT 06470-2359
Phone: (203) 426-1320
Fax: (203) 426-1087
Web site: www.rangeinfo.org

3. LEGAL COUNSEL

When a range is first notified that it may face legal or regulatory action involving environmental issues, it should immediately notify its legal counsel. If your counsel is not experienced in environmental law as it relates to outdoor shooting ranges, he or she may be able to refer you to attorneys who are. It is usually advisable to select legal counsel only after discussing your needs with several qualified candidates, asking for references from past clients and checking with other ranges and established shooting organizations. Law firms with an established track record of successfully handling environmental issues for outdoor shooting ranges might be expected to provide the greatest confidence of good service and value. It may be appropriate to contact the organizations listed under "Comprehensive Environmental Information" above to obtain a list of law firms experienced in representing outdoor shooting ranges in environmental matters.

4. ENVIRONMENTAL CONSULTING FIRMS

Environmental consulting firms can provide a variety of valuable services, including site assessments, wetland delineations, assistance in range siting or design to minimize potential impacts, stormwater management, water quality management, development of site-specific environmental stewardship plans, or any unusual or complex environmental question. These types of services can be obtained whenever a range chooses, as part of an overall range environmental management program, or your legal counsel may contract these firms to provide specific scientific and environmental engineering support in legal or regulatory actions. Once a legal or regulatory action has been initiated, environmental consulting firms often are brought in as part of the defense team and typically work in direct support of counsel on whatever tasks are appropriate in the specific case.

Range managers should select their environmental consultant carefully and clearly define the services they are asked to provide. Many environmental consulting firms deal with subjects unrelated to the issues discussed in this manual. Others may deal with the appropriate subjects but tend to be rote followers of EPA approaches, and therefore may not be fully effective advocates for their clients.

Range managers may find it helpful to contact the organizations listed under “Comprehensive Environmental Information” or “Comprehensive Range Construction Guidance” above to obtain names of potentially helpful environmental consulting firms with successful experience supporting outdoor shooting ranges. It is usually advisable to select an environmental consultant only after discussing your needs with several qualified candidates, asking for references from past clients, and checking with other ranges and established shooting organizations. Firms with an established track record of successfully handling environmental issues for outdoor shooting ranges might be expected to provide the greatest confidence of good service and value. It may be helpful to involve legal counsel in selection of an environmental consultant and defining the services they will perform. This is essential if the services are to be performed in support of counsel in defending a range in a legal or regulatory action.

4.1 Environmental Consultants Listing

The following list of environmental consultants has been consolidated by the National Shooting Range Symposium (NSRS) and updated from the National Rifle Association, *Business Journal* and *1997 Black's Wing and Clay Shotgunner's Handbook*. It is reprinted with permission from the National Shooting Range Symposium.

The National Shooting Range Symposium provides this information as a public service. While every effort has been made to assure that the following information is factually correct, the symposium makes no express or implied warranty or other representation as to the quality, characteristics or suitability of the processes or techniques utilized by the firms listed herein, and the National Shooting Range Symposium and its sponsors specifically disclaim any responsibility therefore.

To obtain a complete copy of NRA's *1996 Business Journal of Shooting Range Related Products and Services*, contact the NRA at 800-336-7402.

To obtain a copy of *1997 Black's Wing and Clay Shotgunner's Handbook*, contact Black's Sporting Directories, P.O. Box 2029, 43 W. Front Street, Red Bank, NJ 07701; 908-224-8700.

Auglias Environmental Corporation
P.O. Box X
McLean, VA 22101
703-471-4952

EA Engineering, Science & Technology., Inc.
11019 McCormick Road
Hunt Valley, MD 21031
410-527-2445
Fax: 410-785-2309

Eagle Industrial Hygiene Associates
Attn: Keith Crawford
359 Dresher
Horsham, PA 19044
215-672-6088

Environmental & Engineering Solutions, Inc.
Attn: John Carter
250 South Main
Mendon, UT 84325-0280
801-753-6062

Environmental Equipment Services
12-18th Place
Long Beach, CA 90803
310-438-8807

Environmental and Turf Services, Inc.
Corporate Headquarters
11141 Georgia Avenue, Suite 208
Wheaton, MD 20902
301-933-4700

MARCOR
Attn: Paul Redding
Box 1043
Hunt Valley, MD 21030
410-785-0001
Fax: 410-771-0348

Property Solutions, Inc.
Attn: Edward M. Gallagher,
Timothy M. Downes
501 Delran Parkway, Unit C
Delran, NJ 08075
609-764-6000

R.M.T. Incorporated
2178 Commons Parkway
Okemos, MI 48864
517-347-0910

Dick Peddicord & Company
1762 Parsonage Road
Parkton, MD 21120
(410) 357-4893

5. SITE-SPECIFIC INFORMATION

Range managers will need basic information about their site to develop and implement an environmental stewardship plan as discussed in Section 5. Sources of information about the site that will be very helpful in creating and carrying out an environmental stewardship plan are discussed below.

5.1 Topography, Drainage, Surrounding Features

An overview of the range site in the context of its surroundings can be obtained from topographic maps known as U.S.G.S. 7.5 minute quadrangles, more commonly called "Quad Sheets" or topo maps. These are available for any location in the United States. Many map and outdoor equipment stores carry quad sheets. They can also be purchased through the mail from:

U.S. Geological Survey
12201 Sunrise Valley Drive
Reston, VA 20192
Phone: 800-872-6277

Quad sheets provide a good overview of topographic information, but may not show recent developments, especially in rapidly growing areas. Topography on these sheets may not be of sufficient detail or appropriate scale, especially for smaller sites. More detailed topographic information is often available from local planning and zoning offices, natural resource agencies or other local government agencies. These local agencies typically can be found in the government section of the local phone book. In addition, these offices may be able to provide low cost black and white aerial photographs or blueline paper prints. As with topographic maps, aerial photos available from these agencies may be somewhat dated. Local planning commissions may be able to provide useful information on anticipated development and associated development regulations.

5.2 Soil and Vegetation

Valuable information on soil characteristics, selection and maintenance of plants for various purposes, erosion control and similar topics can be obtained from the **State Extension Services of many state universities.** This information is also available from the local agent of the U. S. Agriculture Department's Natural Resources Conservation Service. Both are usually listed in the "Government" section of local telephone directories. Generally, both sources can provide soil tests to determine the pH and nutrient characteristics of soil on various parts of a range. Based on these results, they can determine the optimal kind, amount and timing of applications of soil amendments such as lime and fertilizers to optimize plant growth and minimize lead mobility.

Appendix B
Lead Recovery and
Lead Recycling Firms

APPENDIX B LEAD RECOVERY AND LEAD RECYCLING FIRMS

DISCLAIMER

The activity of recovering or reclaiming lead from a range is different from the activity of recycling lead at a smelter. Many range managers are likely to want a firm that will recover the lead from the range and have it recycled. At one time it was common practice for range managers to be paid for the recovered lead and make money by having their lead reclaimed and recycled. This practice may become less common in the future, and managers should not necessarily expect it.

LEAD RECLAMATION COMPANIES

Lead recovery firms are listed separately from lead recycling firms below.

The following list of lead reclaiming companies has been consolidated by the National Shooting Range Symposium and updated from the National Rifle Association *1996 Business Journal* and *1997 Black's Wing and Clay Shotgunner's Handbook*. It is reprinted with permission from these contributors.

The National Shooting Range Symposium provides this information as a public service. While every effort has been made to assure that the following information is factually correct, the symposium makes no express or implied warranty or other representation as to the quality, characteristics or suitability of the processes or techniques utilized by the firms listed herein, and the National Shooting Range Symposium and its sponsors specifically disclaim any responsibility therefore.

To obtain a complete copy of NRA's *Business Journal*, contact the NRA at 800-336-7402 and ask for product number 14845.

To obtain a copy of *1997 Black's Wing and Clay Shotgunner's Handbook*, contact Black's Sporting Directories, P.O. Box 2029, 43 W. Front Street, Red Bank, NJ 07701; 908-224-8700.

B.E.C. Productions, Inc.
Attn: Fred Bichsel
398 Gary Lee Drive
Gahanna, OH 43230
614-475-7122

Liberty Metal (lead recycling)
2233 E. 16th Street
Los Angeles, CA 90021
213-581-9171

Environmental & Engineering Solutions, Inc.
Attn: John Carter
250 South Main
Mendon, UT 84325-0280
801-753-6062

National Range Recovery Corporation
Contact: Thomas P. Schafer
735 Fox Chase, Suite 111
Coatesville, PA 19320
800-795-7550

Karl & Associates, Inc.
Attn: David Shirey
Remediation Contractor
P.O. Box 1790
Mohnton, PA 11540
610-856-7700

Gene Sears Supply Company
Attn: Garland Sears
P.O. Box 38
El Reno, OK 73036
800-522-3314
Fax: 405-262-2811

Lead Reclamation
Division of Hardcast Enterprises, Inc.
Attn: Fred W. Wooldridge
23128 Wildwood Road
Newhall, CA 91321
805-259-4796

MARCOR
Attn: Paul Redding
Box 1043
Hunt Valley, MD 21030
410-785-0001
Fax: 410-771-0348

Brice Environmental Services Corp. (BESCORP)
Attn: Craig Jones
3200 Shell Street, P.O. Box 73520
Fairbanks AK 99707
(907) 456-1955

LEAD RECYCLING COMPANIES

Lead Recycling 1994 Directory

The following directory is the most up-to-date directory available. It is reprinted with permission of the Lead Industries Association, Inc.

Introduction

This directory of lead recyclers is designed as a resource to guide holders of lead scrap to the nearest recycling location. Lead, the most recycled of all industrial metals, is a valuable natural resource. It is used in lead batteries, electronics, medical X-ray shielding and a number of other vital applications for which there is no viable substitute. By recycling your lead scrap, you are helping to save a natural resource that we rely upon every day.

Purpose

This excerpt from the Lead Recycling Directory lists companies throughout the United States and Canada that recycle shooting range soils and spent lead ammunition. By using this directory, you will be helping to increase the amount of lead that is recycled and extend the longevity of an important, useful metal. To obtain a complete list of lead recycling companies that handle other types of lead scrap, please contact LIA at the address and phone number listed below.

Product Stewardship Program

The Lead Industries Association, Inc., which developed this directory, began the LIA Product Stewardship Program in 1991 to further enhance worker safety, childhood safety around lead smelters, and other issues including recycling. The program is ongoing and continues to expand in scope. You can help the LIA in its effort to increase lead recycling by informing them of any lead recyclers that are not listed in the directory. Simply call the Lead Media Hotline at 800-922-LEAD.

The Lead Industries Association provides this information as a public service. While every effort has been made to assure that the information in this publication is technically and factually correct, Lead Industries Association makes no express or implied warranty or other representation as to the quality, characteristics or suitability of the processes or techniques utilized by the firms listed herein, and the Lead Industries Association specifically disclaims any responsibility therefore.

For Media Inquiries Call:

Lead Media Hotline
800-922-LEAD

For other inquiries call:

Lead Industries Association, Inc.
295 Madison Avenue
New York, NY 10017
Phone: 212-578-4750
Fax: 212-684-7714

Alphabetical Listing of Recyclers:

ASARCO, Inc.
180 Maiden Lane
New York, NY 10038
Contact: Glendon F. Acher
212-510-2215
Focus: shooting range soils

Canada Metal Co. Ltd.
721 Eastern Avenue
Toronto, Ontario M4M 1E6
Contact: Robert O'Brien
416-465-4684 Ext. 236
Focus: spent lead ammunition

Canada Metal Co. Ltd.
1221 St. James St.
Winnipeg, Manitoba R3H 0K9
Contact: Bob Morrison
204-774-7455
Focus: spent lead ammunition

Cominco Ltd.
Trail, British Columbia
Canada V1R 4L8
Contact: Hugh Hamilton, Bill Bradley
604-364-4138
Focus: spent lead ammunition

The Doe Run Co.
Highway KK
Boss, MO 65440
Contact: Louis J. Magdits
314-626-3476
Focus: shooting range soils and spent lead ammunition

The Doe Run Co.
881 Main Street
Herculaneum, MO 63048
Contact: Anthony Worchester
314-933-3107
Focus: shooting range soils and spent lead ammunition

East Penn Manufacturing Company, Inc.
Deka Road
Lyon Station, PA 19536
Contact: Dan Breidegam, Rick Leiby,
Ken Pike
215-682-6361
Focus: spent lead ammunition

Encycle Texas, Inc.
5500 Up River Road
Corpus Christi, TX 78407
Contact: R.N. George, J.W. O'Neill
512-289-0300
800-443-0144
Focus: shooting range soils and spent lead ammunition

Exide Corp.
645 Penn St.
P.O. Box 14205
Reading, PA 19612-4205
Contact: Robert Jordan
800-437-8495
Focus: shooting range soils and spent lead ammunition.

Gopher Smelting & Refining
3385 Highway 149
Eagan, MN 55121
Contact: Mark Kutoff
612-454-3310
Focus: shooting range soils and spent lead ammunition

Kinsbursky Brothers, Inc.
1314 N. Lemon St.
Anaheim, CA 92801
Contact: Michael Margolies
714-738-8516
Focus: spent lead ammunition

LEAD RECLAMATION COMPANIES (from Lead Industries Association, Inc.)

Noranda Minerals
Brunswick Mining & Smelting Corp. Ltd.
Belledune, New Brunswick
Canada E0B 1G0
Contact P. Evans
506-522-2100
K. McGuire
416-982-7495
Focus: shooting range soils and spent lead
ammunition

Nova Lead, Inc.
1200 Garnier
Ville Ste.-Catherine
Quebec, Canada J0L 1E0
Contact: Brian McIver
514-632-9910
Focus: shooting range soils and spent lead
ammunition

Refined Metals Corp.
257 W. Mallory, Memphis, TN 38109
3700 Arlington, Beech Grove, IN 46107
Contact: Bill Freudiger
901-775-3770
Focus: shooting range soils

Schuykill Metals Corporation
Box 74040
Baton Rouge, LA 70874
Contact: Glen Krause
800-621-8236
Focus: spent lead ammunition

Schuykill Metals Corporation
P.O. Box 156
Forest City, MO 64451
Contact: Ken Fisher
816-446-3321
Focus: spent lead ammunition

Appendix C
Example Environmental
Stewardship Plans

ENVIRONMENTAL STEWARDSHIP PLAN FOR XYZ TRAP, SKEET AND SPORTING CLAYS RANGE

The range described in this example is *hypothetical*. Its description has been created to illustrate the features of an Environmental Stewardship Plan, and therefore is not meant to represent any actual range.

THE EXAMPLE PLAN IS FOR ILLUSTRATION PURPOSES ONLY, AND SHOULD NOT BE APPLIED DIRECTLY TO ANY ACTUAL RANGE. It should be used only as an example when following the guidance in Section 5 to develop an Environmental Stewardship Plan specific to your range.

This is an example Environmental Stewardship Plans for a shotgun range. This example is formatted like an actual Plan might be set up. *To make this example more helpful in developing a site-specific Environmental Stewardship Plan, notes and explanations appear in italics throughout the example.*

Example only-Shotgun

C(1)-1. ENVIRONMENTAL STEWARDSHIP PLAN

In an ongoing effort to properly manage the environmental resources at XYZ Trap, Skeet and Sporting Clays Range, the management has developed this Environmental Stewardship Plan. The goals of the Environmental Stewardship Plan, along with the actions necessary to meet the goals, are detailed in this document.

The purpose of this document is to:

- N Identify issues of potential environmental concern that may exist or develop at XYZ Trap, Skeet and Sporting Clays Range;
- N Identify, evaluate and prioritize appropriate actions to manage these issues;
- N Generate a list of short- and long-term action items and the steps necessary to implement each item;
- N Develop a schedule for implementation of these actions;
- N Identify ways the success of any site modifications or changes in site management techniques will be measured;
- N Annually evaluate the progress toward the environmental stewardship goals, and identify goals, actions and any appropriate revisions to the Environmental Stewardship Plan for subsequent years.

Environmental Goals

- N Avoid shooting over or into water and wetlands.
- N Prevent migration of lead particles/shot off-site through ground water and surface water runoff.
- N Recover lead from shotfall areas.
- N Discourage ingestion of lead by wildlife.
- N Encourage wildlife utilization outside of the shotfall zones.
- N Maintain soil pH of in the range 6.5-8.5 in the shotfall area.

Example only-Shotgun

C(1)-2. SITE ASSESSMENT

C(1)-2.1 Description of the Range and Support Facilities

The XYZ Trap, Skeet and Sporting Clays Range consists of three trap fields, two combination trap/skeet fields, and a 10-station, sporting clays course. The range is located in a rural setting away from residential areas.

The trap/skeet fields shoot over a 100-ft wide strip of closely mowed, sparse grass. Beyond the mowed grass is unmaintained grass, brush and small trees 4-8 feet tall. One trap field is adjacent to a wetland large enough to attract/support wildlife, and the remaining trap fields and the combination fields extend away from the wetland. There is no open water associated with the wetland area. The topography is relatively flat with most surface water draining toward the wetland area. Approximately 500,000 targets are thrown annually. The facility is about 20 years old, and lead was recovered once about 10 years ago before the brush grew up.

The sporting clays course is along the edge of a woods with mature trees and open fields of tall grass. The topography here is also relatively flat with good vegetative cover. Approximately 125,000 targets are thrown per year at the sporting clays course. This course is about five years old, and there has been no recovery of lead.

C(1)-2.2 Existing Environmental Conditions

[This section identifies the most significant potential environmental issues associated with the range. These issues were identified based on evaluation of the site characteristics, information from soil tests and consideration of the issues discussed in Sections 2 and 3 of this manual]

C(1)-2.2 .1 Trap/Skeet Fields

- N Portion of the shotfall zone with closely mowed, sparse grass is susceptible to erosion.
- N The tall grass, brush and small trees in the shotfall zone are attractive to wildlife.
- N Shot falls several hundred feet into the wetland on the left end of the field.
- N

C(1)-2.2 .2 Sporting Clays Course

- N Shot falls in mature woods making future lead reclamation efforts difficult.
- N The woods are known to attract/support wildlife.
- N

C(1)-3. PLAN OF ACTION

C(1)-3 .1 Potential Management Alternatives

[This part of the Plan lays out various alternative approaches which could be taken to achieve the goals identified in the Plan. At this step, the purpose is to list all alternatives that might be considered, with no attempt to evaluate them or eliminate any from consideration. The next step (Section C(1)-3.2) addresses selection of the alternative(s) to be implemented. Alternatives are developed by range management in conjunction with outside consultants, if appropriate.]

Example only-Shotgun

Alternative 1	Achieve all of the environmental goals identified simultaneously.
Alternative 2	Work on one goal this year and address all others later.
Alternative 3	Choose a few goals that can be implemented immediately.
Alternative 4	Vegetate sparse grass area of trap/skeet field.
Alternative 5	Reorient trap fields to avoid lead shot entering the wetland area.
Alternative 6	Reorient sporting clays stations to maximize the amount of shot falling in the open fields where it can be more easily recovered for recycling.
Alternative 7	Limit users of trap/skeet to only stations that do not have wetland area within shotfall zone.
Alternative 8	Apply lime and/or phosphate to shotfall zones (trap/skeet and sporting clays) if soil test results indicate this would be beneficial.
Alternative 9	Do site work in preparation for reclaiming.
Alternative 10	Contact companies to get bids for reclaiming.
Alternative 11	Lead reclamation within trap/skeet shotfall zone.
Alternative 12	Lead reclamation within sporting clays shotfall zone.
Alternative 13	Change mowing frequency of closely mowed grass area of trap/skeet shotfall zone.

C(1)-3 .2 Selection of Management Alternatives to be Implemented

[Range management must choose the alternative(s) to be implemented, perhaps with the help of consultants who can advise on the relative costs and benefits to be gained from each alternative. Chosen alternatives are specific to the range being evaluated. The choice may be influenced by environmental benefit provided, cost, availability of adequate funds, customer base, personal preferences of managers and regular customers, local community pressures, regulatory pressures, skills of volunteer labor, etc.]

C(1)-3 .2 .1 Alternatives Selected

[This section identifies the alternatives from the list above that the range has selected for implementation. The reason for the selections and rejections should be briefly stated.]

Based on the environmental stewardship goals of this Plan, the environmental benefits provided and the current availability of funds, the following priorities were chosen for the current calendar year. The choices were made to address: (1) the most pressing environmental concerns, (2) those most easily resolved, and (3) then initiate management practices that would create longer-term environmental benefits.

Alternative 3	Choose a few goals that can be implemented immediately.
Alternative 4	Vegetate sparse grass area of trap/skeet field.
Alternative 5	Reorient trap fields to avoid lead shot entering the wetland area.
Alternative 8	Apply lime and/or phosphate to trap, skeet and sporting clays shotfall zones if soil test results indicate the need to do so.
Alternative 9	Do site work in preparation for reclaiming.
Alternative 10	Contact companies to get bids for reclaiming.
Alternative 13	Change mowing frequency of closely mowed grass area of trap/skeet shotfall zone.

Example only-Shotgun

C(1)-3 .2 .2 Management Actions

[This section identifies the specific operational actions and site modifications that will be taken to implement the selected alternatives.]

C(1)-3 .2 .2 .1 Operational Actions

- N Collect soil samples from shotfall zone to test for pH, available phosphorous, pH, clay and organic content, and other nutrients. This may be best done by a consultant or resource agent that can also interpret the results, make recommendations for amending or balancing the soil, and suggest ways to carry out recommendations. Consult the county soil maps to determine soil types, parent material and depth to bedrock.
- N Contact Natural Resource Conservation Service, Local Soil Conservation District and/or the Local Cooperative Extension Agent and request recommendations for plant species best suited for erosion control in the shotfall zones.
- N Contact same agencies as above to determine the proper mowing frequencies and heights for the vegetation present.
- N Implement mowing height/frequency recommendation.

C(1)-3 .2 .2 .2 Construction Actions

Trap/Skeet Fields

- N Do site work in preparation to reclaim shot.
- N Contact companies and get bids for shot reclamation.
- N Add lime, phosphate, other plant fertilizer and grass seed at application rates recommended by NRCS, extension agent or others based on soil test results to maintain optimum pH and other soil conditions to minimize lead mobility and maximize plant growth for erosion control. Establish grass over entire shotfall zone, including formerly brushy areas.
- N Mow grassy areas at recommended frequency to keep plants healthy and the right height to discourage use by waterfowl and other birds.
- N Reorient trap fields (as illustrated in Figure 3-2) so that shotfall zone does not include any wetlands and concentrate shot where it can be most easily reclaimed at a later date.

Sporting Clays Course

- N Do site work in preparation to reclaim shot.
- N Contact companies and get bids for shot reclamation.
- N Reorient shooting stations so that as much lead shot as practical falls outside the wooded area and is concentrated in the open fields to facilitate lead reclamation at a later date.
- N If recommended by soil test analysis, apply lime and/or phosphorus to minimize the amount of available lead in the environment.

Example only-Shotgun

C(1)-4. PL AN IMPLEMENTATION

C(1)-4.1 Schedule for Implementation

[This section helps to move the management ideas into action and helps plan activities at the appropriate times. It also documents a commitment to achieve remaining goals on an established schedule, and provides a basis for budgeting for future work.]

C(1)-4.1 .1 Trap/Skeet Fields

Winter/Spring:

- N Soil collection and analysis for pH, clay, organics, and phosphorous.
- N Contact Natural Resource Conservation Service, Soil Conservation District, Cooperative Extension Service for plant species recommendations.
- N Reorient trap fields so that shotfall zone does not include wetland areas.
- N Realign shooting stations to avoid lead shot entering the wetland area and to concentrate it where it can be reclaimed at a later date.

Summer /Fall:

- N Prepare site for reclaiming.
- N Contact companies and get bids for shot reclamation.
- N Apply nutrients, lime and seed per recommendations to increase plant density and prevent or minimize erosion and lead particle runoff.
- N If recommended by soil test analysis, apply lime and/or phosphorus to minimize the amount of available lead in the environment.

As Needed, Beginning Immediately:

- N Mow areas at recommended times, height and frequency to keep grass healthy and vigorous, and maintain proper height to discourage use by waterfowl and other birds.

C(1)-4.1.2 Sporting Clays Course

Winter/Spring:

- N Soil test sample collection and analysis for pH, organics, clay and phosphorous.

Summer /Fall:

- N If indicated by soil test analysis, apply lime and/or phosphorus to minimize the amount of available lead in the environment.

During First Slow Usage Period Within the Next Twelve Months:

- N Reorient shooting stations so that as much lead shot as practical falls outside the wooded area and is concentrated in the open fields to facilitate lead reclamation at a later date.

C(1)-4.2 Responsibilities

[This section assigns responsibility to specific range personnel for completion of identified action items]

Example only-Shotgun

C(1)-4.2 .1 Trap/Skeet Fields

Grounds Maintenance Foreman:

- N Contact Natural Resource Conservation Service, Local Soil Conservation District and/or the Local Cooperative Extension Agent and request recommendations for plant species best suited for erosion control in the shotfall zones.
- N Contact same agencies as above to determine the proper mowing frequencies and heights for the vegetation present.
- N Implement mowing height/frequency recommendation.
- N Apply nutrients, lime and grass seed per recommendations to increase plant density and prevent or minimize erosion.
- N Mow areas at recommended times, height and frequency to keep plants healthy and vigorous.
- N Immediately mow previously unmaintained area and at greater frequency to dissuade use by wildlife and to facilitate future lead reclamation.
- N If indicated by soil test analysis, apply lime and/or phosphorus to minimize the amount of available lead in the environment.

Range Manager:

- N Have soil samples collected in shotfall zones and analyzed for pH, clay, organic material, available phosphorus and other nutrient levels.
- N Select and contract qualified professionals to collect samples, make recommendations and carry out recommendations, if necessary.
- N Limit use of trap field with shotfall zone that reaches the wetland until it can be reoriented.
- N Initiate construction to reorient trap field to take shotfall zone out of the wetland.

C(1)-4.2.2 Sporting Clays Course

Grounds Maintenance Foreman:

- N If indicated by soil test analysis, apply lime and/or phosphorus to minimize the amount of available lead in the environment.

Range Manager:

- N Reorient shooting positions so that most of the lead shot is deposited outside of the wooded area and concentrated in the open fields to facilitate lead reclamation at a later date.

C(1)-5. MEASURING SUCCESS

[It is important to document the results of actions taken as part of your Environmental Stewardship Plan. This will help determine which actions to continue in the future and how or if they should be modified. It will also provide a record of actions you have taken to benefit the environment. Such a record could be very valuable in responding to any regulatory or legal challenges or public relations opportunities that may arise. The items to be measured, the way they will be measured and the frequency of measurement should be laid out in the Plan. The Site Assessment (Section 2) in the update of the Plan for the next year should include the results of measuring the success of this year's actions.]

The following parameters will be monitored as described:

- N Vegetation density — monthly during growing season. Measured as visual estimate of percentage of ground surface covered by vegetation.
- N Wildlife usage of shotfall zone — visual observations on a regular basis. Kinds, numbers and frequency birds and animals commonly seen will be recorded.
- N Measure pH of the surface runoff.
- N Soil pH and available phosphorus levels — twice annual soil test
- N Erosion and soil loss — monthly. Conduct a range inspection: to document existing conditions and note any significant change in the size and/or depth of ditches, gulleys or dry stream beds as well as the relative clarity of the runoff.

Photos can be valuable in tracking physical changes in the environment over time. Analytical test results will be necessary to determine trends in pH and available phosphorus levels.

C(1)-6. PERIODIC ASSESSMENTS AND ADJUSTMENTS TO THE PLAN

This Environmental Stewardship Plan will be reviewed at the “December” range meeting to assess the achievement of the prioritized goals listed in Section 3.2.1 of the Environmental Stewardship Plan and to set goals for next year(s).

Questions to be answered include:

- N Were the Environmental Stewardship Goals achieved that were identified for this plan?
- N In what areas (if any) did the plan fall short?
- N What can be done better with additional time and funds?

C(1)-6.1 Next Steps

- N Continue to monitor the environment and review the Environmental Stewardship Plans on an annual basis.
- N Update Plan and set goals for subsequent years.

Also determine:

- N Which alternatives listed in Section 3.1 of this Plan not addressed this year should be considered for implementation.
- N If it is it still feasible to attempt to complete them.
- N Identify additional goals previously put on hold. Estimated time frame the club may be ready to attempt these goals.

Recommended future (year 2-3) actions based upon original goals:

- N Recover shot in shotfall zones of trap/skeet and sporting clays fields.
- N Identify areas of the site outside of the shotfall zones to encourage wildlife to utilize areas away from highest concentrations of lead shot.

Example only-Rifle/Pistol

ENVIRONMENTAL STEWARDSHIP PLAN

FOR XYZ RIFLE/PISTOL RANGE

The range described in this example is *hypothetical*. Its description has been created to illustrate the features of an Environmental Stewardship Plan, and therefore is not meant to represent any actual range.

THE EXAMPLE PLAN IS FOR ILLUSTRATION PURPOSES ONLY AND SHOULD NOT BE APPLIED DIRECTLY TO ANY ACTUAL RANGE. It should be used only as an example when following the guidance in Section 5 to develop an Environmental Stewardship Plan specific to a range.

This is an example Environmental Stewardship Plan for a rifle/pistol range. This example is formatted like an actual Plan might be set up. *To make this example more helpful in developing a site-specific own Environmental Stewardship Plan, notes and explanations appear in italics throughout the example.*

Example only-Rifle/Pistol

C(2)-1. ENVIRONMENTAL STEWARDSHIP PLAN

In an ongoing effort to properly manage the environmental resources at XYZ Rifle/Pistol Range, the management has developed this Environmental Stewardship Plan. The goals of the Environmental Stewardship Plan, along with the actions necessary to meet the goals, are detailed in this document.

The purpose of this document is to:

- N Identify issues of potential environmental concern that may exist or develop at XYZ Rifle/Pistol Range;
- N identify, evaluate and prioritize appropriate actions to manage these issues;
- N Generate a list of short- and long-term action items and the steps necessary to implement each item;
- N Develop a schedule for implementation of these actions;
- N Identify ways the success of any site modifications or changes in site management techniques will be measured; and
- N Annually evaluate the progress toward the environmental stewardship goals, and identify goals, actions and any appropriate revisions to the Environmental Stewardship Plan for subsequent years.

Environmental Goals

- N Minimize erosion of backstop berm.
- N Prevent migration of lead off-site through ground water and surface water runoff.
- N Recover lead from berms.
- N Encourage wildlife utilization outside of the impact areas.
- N Maintain soil pH of impact area in the 6.5-8.5 range.

Example only-Rifle/Pistol

C(2)-2. SITE ASSESSMENT

C(2)-2.1 Description of the Range and Support Facilities

This range consists of a 10-position, 50-yard range and a 20-position, 100-yard range. Most activity at the 50-yard range is pistol and smallbore. The backstop is the base of a hillside that is wooded above the active backstop area. There is no side berm on one side, and on the other an earthen side berm separates this range from the adjacent 100-yard range. The backstop berm and both side berms at the 100-yard range are earthen. All the berms are covered with unmaintained grass and brush except for the impact areas on the backstop berm. A small wet-weather stream runs across the ranges just in front of the firing line. Both ranges are about 20 years old, and lead has never been recovered. Soil that slumps from the impact areas of the backstop berms is put back on the berm with a tractor and front loader on a periodic, as needed basis. Annual usage is estimated at 150,000 rounds on the 50-yard range and 75,000 rounds on the 100-yard range.

C(2)-2.2 Existing Environmental Conditions

[This section identifies the most significant potential environmental issues associated with the range. These issues were identified based on evaluation of the site characteristics, information from soil tests and consideration of the issues discussed in Sections 2 and 3 of this manual.]

- N The unvegetated areas on the backstop berm are eroding and periodically need repair.
- N Eroded sediment and any lead that may be associated with it could enter the small stream in the foreground of both ranges, where it might affect aquatic resources.
- N The stream in front of the firing line on both ranges could directly receive bullets or fine particulate lead from shooting.
- N Lead has never been removed from the site in its twenty-year history and may possibly be acting as a source of lead to the environment.

C(2)-3. PLAN OF ACTION

C(2)-3.1 Potential Management Alternatives

[This part of the Plan lays out various alternative approaches which could be taken to achieve the goals identified in Section 1 of the Plan. At this step, the purpose is to list all alternatives that might be considered, with no attempt to evaluate them or eliminate any from consideration. The next step (Section C[2]-3.2) addresses selection of the alternative(s) to be implemented. Alternatives are developed by range management in conjunction with outside consultants, if appropriate.]

- | | |
|---------------|---|
| Alternative 1 | Work on all environmental goals simultaneously. |
| Alternative 2 | Work on one goal this year and address all others later. |
| Alternative 3 | Choose a few goals that can be implemented immediately and begin planning the longer-term alternatives. |
| Alternative 4 | Vegetate the backstop berm to minimize erosion. |
| Alternative 5 | Culvert the stream through the shooting ranges. |

- Alternative 6 Install runoff management systems, including settling ponds and limestone riprapped channel to stream.
- Alternative 7 Apply lime and phosphate to berms and foreground if soil test analysis determines it is necessary.
- Alternative 8 Begin planning to recover and recycle lead from both ranges. Reclaiming activities should be completed within ____ months.

C(2)-3 .2 Selection of Management Alternatives to be Implemented

[Range management must choose the alternative(s) to be implemented, perhaps with the help of consultants who can advise on the relative costs and benefits to be gained from each alternative. Chosen alternatives are specific to the range being evaluated. The choice may be influenced by environmental benefit provided, cost, availability of adequate funds, customer base, personal preferences of managers and regular customers, local community pressures, regulatory pressures, skills of volunteer labor, etc.]

C(2)-3 .2 .1 Alternatives Selected

[This section identifies the alternatives from the list above that the range has selected for implementation. The reason for the selections and rejection of options should be briefly stated.]

Based on the environmental stewardship goals of this Plan, the environmental benefits provided and the current availability of funds, the following priorities were chosen for the current calendar year. The choices were made to first address the most pressing environmental concerns and those most easily resolved, and then initiate management practices that would create longer-term environmental benefits.

- Alternative 3 Choose a few goals that can be implemented immediately and begin planning the longer term alternatives.
- Alternative 4 Vegetate the backstop berms to minimize erosion.
- Alternative 5 Culvert the stream through the shooting ranges.
- Alternative 7 Apply lime and phosphate to berms and foreground if soil test analysis determines it is necessary.
- Alternative 8 Begin planning to recover & recycle lead from both ranges. Reclaiming activities should be completed within ____ months.

C(2)-3 .2 .2 Management Actions

[This section identifies the specific operational actions and site modifications that will be taken to implement the selected alternatives.]

C(2)-3 .2 .2 .1 Operational actions

- N Collect soil samples from shotfall zone to test for available phosphorous, pH, clay and organic content, and other nutrients. This may be best done by a consultant or resource agent that can also interpret the results, make recommendations for amending or balancing the soil, and suggest ways to carry out recommendations.
- N Contact Natural Resource Conservation Service, Local Soil Conservation District and/or the Local Cooperative Extension Agent and request recommendations for plant species best suited for erosion control on the berms.
- N Contact environmental regulatory agencies to determine the conditions under which the stream can be culverted. Contract with a qualified engineer and apply for all necessary environmental and construction permits.

C(2)-3.2.2.2 Construction actions

- N Recover and recycle lead
- N Add lime, phosphate, other plant fertilizer and grass seed, at application rates recommended by NRCS, Extension Agent or others based on soil test results, to maintain optimum pH and other soil conditions to minimize lead mobility and maximize plant growth for erosion control.
- N Once all permits are obtained, construct culvert for stream through the 50-yard range.

C(2)-4. PLAN IMPLEMENTATION

C(2)-4.1 Schedule for Implementation

[This section helps to move the management ideas into action and helps plan activities at the appropriate times. It also documents a commitment to achieve remaining goals on an established schedule and provides a basis for budgeting for future work.]

Winter/Spring:

- N Have soil samples collected from the backstop berm area and analyzed for pH, clay, organic material, available phosphorus and other nutrient levels.
- N Select and contract qualified professionals to collect samples, make recommendations, and carry out recommendations, if necessary.
- N Contact Natural Resource Conservation Service, Local Soil Conservation District, and/or the Local Cooperative Extension Agent and request recommendations for plant species best suited for erosion control on the berms.
- N Contact Natural Resource Conservation Service, Local Soil Conservation District, and/or the Local Cooperative Extension Agent and request recommendations for plant species best suited for erosion control on the berms.
- N Contact environmental regulatory agencies to determine the conditions under which the stream can be culverted. Contract with a qualified engineer and apply for all necessary environmental and construction permits.
- N Apply nutrients, lime, and seed per recommendations to increase plant density and prevent or minimize erosion and lead particle runoff.
- N If indicated by soil test analysis, apply lime and/or phosphorus to minimize the amount of available lead in the environment.

During First Slow Usage Period Within the Next Twelve Months:

- N Apply for permits to construct culvert for stream through the ranges after obtaining all necessary permits.
- N Design culvert to withstand heavy equipment for travel.
- N Contact firms to get bids and schedule time to recover and recycle lead.

Example only-Rifle/Pistol

C(2)-4.2 Responsibilities

[This section assigns responsibility to specific range personnel for completion of identified action items.]

Grounds Maintenance Foreman:

- N Contact Natural Resource Conservation Service, Local Soil Conservation District and/or the Local Cooperative Extension Agent and request recommendations for plant species best suited for erosion control on the berms.
- N Apply nutrients, lime and seed per recommendations to increase plant density and prevent or minimize erosion and lead particle runoff.
- N If indicated by soil test analysis, apply lime and/or phosphorus to minimize the amount of available lead in the environment.

Range Manager:

- N Have soil samples collected in the backstop berm area and analyzed for pH, clay, organic material, available phosphorus and other nutrient levels.
- N Select and contract qualified professionals to collect samples, make recommendations and carry out recommendations, if necessary.
- N Contact environmental regulatory agencies to determine the conditions under which the stream can be culverted. Contract with a qualified engineer and apply for all necessary environmental and construction permits.
- N Initiate construction of culvert after obtaining all necessary permits.
- N

C(2)-5. MEASURING SUCCESS

[It is important to document the results of actions taken as part of your Environmental Stewardship Plan. This will help you determine which actions to continue in the future and how they should be modified. It will also provide a record of actions you have taken to benefit the environment. Such a record could be very valuable in responding to any regulatory or legal challenges or public relations opportunities you may face in the future. The items to be measured, the way they will be measured and the frequency of measurement should be laid out in the Environmental Stewardship Plan. The Site Assessment (Section C[2]-2) in the update of the Plan for the next year should include the results of measuring the success of this year's actions.]

The following parameters will be monitored as described:

- N Vegetation density — monthly during growing season. Measured as visual estimate of percentage of ground surface covered by vegetation.
- N Wildlife usage of berms and foregrounds — visual observations on a regular basis. Kinds, numbers and frequency birds and animals are commonly seen will be recorded.
- N pH of surface runoff.
- N Test every 6 months for soil pH and available phosphorus.
- N Erosion and soil loss — monthly. Document existing conditions and note any significant change in the size and/or depth of ditches, gulleys or dry stream beds and the relative clarity of the surface runoff.

Example only-Rifle/Pistol

Photos will be used to document changes over time. Analytical test results will be necessary to determine trends in pH and available phosphorus levels.

C(2)-6. PERIODIC ASSESSMENTS AND ADJUSTMENTS TO THE PLAN

This Environmental Stewardship Plan will be reviewed at the “December” range meeting to assess the achievement of the prioritized goals listed in Section C(2)-3.2.1 of this plan and to set goals for next year(s).

Questions to be answered include:

- N Were the Environmental Stewardship Goals achieved that were identified for this plan?
- N In what areas (if any) did the plan fall short?
- N What is necessary to fully implement the plan in these areas?
- N

C(2)-6.1 Next Steps

- N Continue to monitor the environment and review the Environmental Stewardship Plans on an annual basis.
- N Update Plan and set goals for subsequent years.

Also determine:

- N Which alternatives listed in Section 3.1 of this plan not addressed this year should be considered for implementation.
- N If it is still feasible to attempt to complete them.
- N Identify additional goals previously put on hold. Estimate when these goals will be addressed.

Recommended future (year 2-3) actions based upon original goals:

- N Recover lead on a periodic basis.
- N Identify areas of the site well away from the presence of lead to encourage wildlife use.

Appendix D

Glossary of Terms

APPENDIX D

GLOSSARY OF TERMS

This glossary contains terms that are important to understanding this manual, but that may be unfamiliar to the reader or have a special meaning in this manual. This glossary is not a substitute for a dictionary, but provides the meaning of the terms in the context of this manual.

Acid: pH below 7.0. Under acid conditions, lead tends to dissolve and not adhere to particles. The lower the pH, the more acidic the conditions and the more lead tends to dissolve.

Aesthetics: Appearance — An aesthetically pleasing range looks well-managed, is attractive to customers and instills confidence in the public.

Alkaline: Not acidic; basic; pH above 7.0. Under moderately alkaline conditions, lead tends to adhere tightly to soil and other particles. However, under strong alkaline conditions, lead mobilization may be increased.

Berm: A wall of earthen materials that separates two physical features. Can be a man-made or natural feature. In the context of this manual, a berm would be a (generally man-made) mound or wall of earth that would delineate the back and/or sides of a firing range.

Discharge of Pollutant: As defined by the Clean Water Act, “any addition of any pollutant to navigable waters from any point source.”

Foreground: The area between the firing line and the backstop berm (and between the side berms) at an outdoor rifle/pistol range.

Navigable Waters or Waters of the United States: As defined by the Clean Water Act, any river, stream, lake, pond, or other water in the United States, including wetlands. All waters of the United States, including those entirely on private property, are regulated under the CWA.

“No Blue Sky Rule”: A jargon phrase that applies to baffled ranges only. It refers to the placement of a series of overhead baffles in such a manner that “no blue sky” can be seen from the firing line.

pH: a measure of how acid or alkaline a material is. A pH of 7 is neutral, that is, neither acid nor alkaline. The farther the pH is below 7, the more acidic the material, and the farther the pH is above 7, the more alkaline the material.

Point Source: As defined by the Clean Water Act, “any discernable, confined and discrete conveyance, including, but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container...from which pollutants are or may be discharged.”

Pollutant: As defined by the Clean Water Act, “dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions...wrecked or discarded equipment...discharged into the water.”

Shotfall zone: The area at a trap, skeet or sporting clays range on which spent shot falls. The shotfall zone as discussed in this manual should not be confused with the similarly-shaped but somewhat larger safety zone.

Wetland: Any intertidal area, swamp, marsh, bog or similar area, including areas that may not appear to be wetlands to non-scientists. Construction in or modification of wetlands, including those entirely on private property, are regulated under the Clean Water Act.

Appendix E
Summary of Relevant Case Law
Relating to Shooting Ranges

SUMMARY OF RELEVANT CASE LAW RELATING TO SHOOTING RANGES

Introduction

To date, only three reported judicial decisions have directly addressed environmental issues that arise from shooting.⁽¹⁾ While the key fact that seems to push certain situations towards litigation is shooting over a body of water, be it a wetland, marsh, stream, lake or ocean, the issues discussed below, in the Connecticut Coastal Fishermen's Association and the New York Athletic Club cases, have relevance to any outdoor shooting range or club, public or private. The issues raised and addressed in these decisions are not limited to concerns relating to lead shot, and have general relevance to range managers who are interested in learning more about legal challenges that may be asserted against shooting ranges and gun clubs based on the presence of lead shot, targets and/or wadding.

Case Summaries

1. Weinbergerv. Romero-Barcelo 456 U.S. 305, 102 S. Ct. 1798 (1982).

The United States Navy, in the course of its training operations conducted at a facility it owns off the coast of Puerto Rico, regularly discharged munitions and targets into the surrounding ocean waters. The Commonwealth of Puerto Rico and individual residents sued to enjoin the Navy's operations, claiming that the discharge of ordnance, including targets, into the water without a permit constitutes a violation of the Federal Water Pollution Control Act, 33 U.S.C. §§ 1251-1387, as amended (the "Clean Water Act").

Section 301 of the Clean Water Act makes it unlawful to discharge any pollutant into a navigable water without first obtaining a National Pollutant Discharge Elimination System ("NPDES") permit issued pursuant to section 402 of the Act 33 U.S.C. § 1342. A "discharge of pollutant" is defined as "any addition of any pollutant to navigable waters from any point source." 33 U.S.C. § 1362(12). "Pollutant" is defined as: dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions ... wrecked or discarded equipment ... discharged into the water.

33 U.S.C. / 1362(6).

"Navigable waters" is defined as the "waters of the United States," 33 U.S.C. § 1362(7), a term which is interpreted very broadly, even to include a drainage ditch, and a "point source" is "any discernible, confined and discrete conveyance, including, but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container ... from which pollutants are or may be discharged."

33 U.S.C. / 1362(14).

Applying these provisions to the Navy's conduct, the District Court found that the release of ordnance from aircraft or ships into navigable waters is a discharge of pollutants, even though the United States Environmental Protection Agency ("U.S. EPA"), which administers the Act, has not promulgated any specific regulations for this category of discharge. See 456 U.S. at 309, citing Romero-Barcelo v. Brown 478 F. Supp. 646 (P.R. 1979). Although the District Court found the discharge to be prohibited, the court denied the Commonwealth of Puerto Rico's request for an injunction ordering the Navy to cease violation of the Clean Water Act. The Commonwealth appealed the denial of the injunction.

(1) As additional cases are reported, they will appear as a continuation of this document. This low number of cases is not a true indication of activity in the area; many shooting range cases are resolved in the early stages of litigation through consent orders under which the ranges agree to close down and perform further environmental investigations and cleanup at the range.

The United States Circuit Court of Appeals reversed and vacated the District Court's order, and remanded the case to the District Court with instructions that it issue the requested injunction. The Navy then appealed the Court of Appeals' decision to the Supreme Court.

The United States Supreme Court addressed the issue of whether a district court must immediately enjoin discharges that do not comply with the permit requirements of the Clean Water Act 456 U.S. at 313-320. The Supreme Court held that courts maintain discretion under the Clean Water Act to order whatever relief they deem appropriate to achieve compliance, and that such relief is not limited by the Act to injunctions. The Court of Appeals' decision was therefore reversed and an injunction was not issued against the Navy. Through both appeals, however, the portion of the District Court's ruling imposing Clean Water Act compliance on the Navy's shooting over water remained intact.

Application to the Lincoln Park Traps, Inc. Gun Club, Chicago, Illinois.

In 1990, the Chicago Regional Office (Region 5) of U.S. EPA was asked to give a legal opinion as to whether the Lincoln Park Traps Gun Club was violating the Clean Water Act. Lincoln Park Traps had operated its gun club on the shores of Lake Michigan in Chicago for approximately 80 years, discharging shot, wadding and clay targets directly into the lake.

In its letter-opinion, the U.S. EPA found that the facts of the Lincoln Park Traps fell squarely within the United States Supreme Court's decision in Romero-Barcelo v. Brown discussed previously, and that at a minimum, the club was required to obtain an NPDES permit for its shooting activities. U.S. EPA, Office of Regional Counsel, Letter Opinion, dated September 6, 1990. U.S. EPA noted further that an enforcement action pursuant to section 309 of the Clean Water Act could be brought against Lincoln Park Traps.

In 1991, with the opinion from U.S. EPA in hand, the Illinois Attorney General sued representative members of the club seeking an order finding the club liable for the costs of any cleanup work along the lakefront that may be necessary as a result of its shooting activities. The Chicago Park District, the property owner, also decided not to renew the club's lease, and the club was forced to stop operations. During 1992-1993, further investigation led to the excavation and removal of 18 inches of lead-bearing soils at the site, and a study indicated that lead in the offshore sediments near the club was not creating a significant impact. Because the club at this point was defunct with no available funds, the Chicago Park District paid for the environmental investigations and cleanup. The excavated areas were backfilled and the property has since been returned to park use.

2. Connecticut Coastal Fishermen's Association v. Remington Arms Co., Inc., 989 F.2d 1305 (2nd Cir. 1993).

Remington Arms had owned and operated a trap and skeet shooting club at Lordship Point in Stratford, Connecticut, since the early 1920's. Lordship Point is adjacent to Long Island Sound. A wildlife refuge called Nells Island Marsh is located just north of Lordship Point. The marsh is a habitat for one of the state's largest populations of Black Duck.

It was estimated that over its 70 years of operation, the club's shooting activities had resulted in the deposition of more than 5 million pounds of lead shot and 11 million pounds of clay targets on the land and into the surrounding waters of Long Island Sound.

In 1987, the Connecticut Coastal Fishermen's Association, a public interest group (the "Association"), brought a citizen suit against Remington, claiming violations of both the Clean Water Act (discharging pollutants without a permit, as in the Romero-Barcelo case), and the Resource Conservation and Recovery Act ("RCRA"), 42 U.S.C. § 6901-6992k (disposal of solid waste, and perhaps hazardous waste, in violation of RCRA regulations).

a. Clean Water Act Issue.

By the time the Association filed suit in 1987, the club had closed and ceased all shooting activities. Accordingly, the Association's Clean Water Act claims failed because it was unable to show that the Clean Water Act violations were "continuing." The Court of Appeals therefore held that because the plaintiff's Clean Water Act claim was based solely on wholly past violations, it had to be dismissed. The court's rejection of the Clean Water Act claims was based upon the United States Supreme Court decision in Gwaltney of Smithfield, Ltd. v. Chesapeake Bay Found. 484 U.S. 49 (1987). In Gwaltney, the Supreme Court found that while a citizen may bring a civil action against a person alleged to be in violation of the discharge permit requirements of the Clean Water Act, the citizen must "allege a state of either continuous or intermittent violation — that is, a reasonable likelihood that a past polluter will continue to pollute in the future." 484 U.S. at 57. Since the club had ceased all activities before suit was filed, the Association's Clean Water Act suit was based solely on past violations with no likelihood of future violations and, therefore, its claim could not satisfy the Gwaltney standard. As a result of these facts, the court did not have to address the issue of whether such a shooting range is required to obtain an NPDES discharge permit. (This issue was decided by the court in the New York Athletic Club case in March of 1996, however. This decision is discussed below on pages 11- 13.)

b. RCRA Issues .

The Association also argued that Remington operated an unpermitted facility for the storage and disposal of hazardous wastes in violation of RCRA. Remington asserted, by way of defense, that lead shot and clay targets are not "solid wastes" under the RCRA definitions, and hence could not be hazardous wastes regulated by RCRA — thus, there was no permit requirement. Remington argued that RCRA did not apply to the spent shot and targets, because the deposition of lead shot and targets that occurred at Lordship Point did not constitute "disposal," but were merely incidental to the normal use of the products.

To understand the significance of Remington's arguments about "disposal," and the meaning of "solidwaste," a brief background discussion of the RCRA statute and regulations is appropriate.

RCRA establishes a cradle-to-grave regulatory structure for the treatment, storage and disposal of "solid" and "hazardous" wastes. Hazardous wastes are a subset of solid wastes. Accordingly, for a waste to be a hazardous waste, it must first fall within the RCRA definition of "solid waste." Under RCRA, hazardous wastes are regulated much more stringently than solid wastes, and one who disposes of hazardous waste on his property is required to possess a RCRA permit.

The RCRA statute defines "solid waste" as "any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material ... resulting from industrial, commercial, mining and agricultural operations, and from community activities."

42 U.S.C. / 6903(27) (emphasis added).

Remington admitted that the gun club was both a commercial operation and a community activity. It disputed, however, the assertion that the lead shot and clay target debris were "discarded material." Because the statutory definition itself does not resolve the ambiguity as to when a product becomes discarded, or how far the reach of RCRA was intended to extend, the court looked to regulations promulgated by USEPA for further guidance.

The court found that the RCRA statutory and separate regulatory definitions present a dichotomy in the definition of "solid waste." Depending on whether the term is used in a regulatory—versus a remedial—context, the court decided that the term must be given different breadth and meaning. The regulatory definition of "solid waste" goes beyond the statutory definition, further defining the term "discarded material" to be materials which are either "abandoned" or "disposed of," instead of the statutory definition's broader term, "discarded material." 40 CFR §§ 261.2(a)(2), 261.2(b)(1). The Coastal Fishermen's court found that while a given material may be "solid waste" under the broader statutory definition ("discarded material"), it must meet a more narrow test (i.e., it must

truly have been “abandoned” or “disposed of”) if the responsible party is to be made to comply with the stringent RCRA permitting scheme established under the regulations.

The reason that the Coastal Fishermen’s court found analysis of the definitional dichotomy to be relevant is because two different bases for citizen suits are authorized by RCRA. The first basis enables private citizens to enforce USEPA’s hazardous waste regulations against those who fall within the intended scope of such regulations. 42 U.S.C. § 6972(a)(1)(A). That is to say that a defendant’s waste must first be found to fall within the more narrow regulatory definition if a claim under this section is to succeed. The second basis allows private citizens to sue to abate an “imminent and substantial endangerment to health or the environment.” 42 U.S.C. § 6972(a)(1)(B). In actions under this so-called “imminent endangerment” section, the defendant’s waste need only fall within the less narrow statutory definition of solid waste, although under this section, the plaintiff then has the added burden of showing an imminent endangerment to human health or the environment.

Recognizing both the definitional dichotomy for solid waste and the two distinct forms of citizen suits available under RCRA, the Coastal Fishermen’s court first concluded that it need not decide whether the spent shot and clay targets met the narrower regulatory definition of solid waste, because the Association had alleged only past RCRA violations of the hazardous waste regulations, and, therefore, its claim could not satisfy the Gwaltney standard. Although the court declined to resolve whether expended shot and targets fell within the regulatory definition, it did acknowledge that U.S. EPA, in its amicus brief, took the position that the lead shot and clay targets did not fall within the regulatory definition.⁽²⁾ The court commented that U.S. EPA’s position was reasonable because “the words of the statute contemplate that the EPA would refine and narrow the definition of solid waste for the sole purpose of” RCRA permitting.

The court also held that the Association’s claim of unpermitted hazardous waste storage failed because the lead shot and clay targets were not “stored” in the waters of Long Island Sound under RCRA’s definition.

The court then turned its attention to the Association’s claim that the lead shot and targets in the Sound were creating an “imminent and substantial endangerment.” As to this claim, the court concluded that the Gwaltney analysis did not apply because under an imminent endangerment citizen suit, “the endangerment must be ongoing, but the conduct that created the endangerment need not be.”

The court then found that the shot and targets were “solid waste” under the broader statutory definition of “discarded material.” The court’s reasoning was consistent with a U.S. EPA amicus brief in which the agency concluded the materials at Lordship Point were discarded because they were “left to accumulate long after they have served their intended purpose.” The court refused to establish a “bright-line” test as to how long materials must accumulate before they become discarded. It simply agreed with the Association and U.S. EPA that the shot and targets had “accumulated long enough to be considered solid waste.”

Having concluded that both the lead shot and target debris were solid wastes within the general RCRA definition, the court addressed the issue of whether either material was also a hazardous waste within the meaning of the “waste classification” RCRA regulations. RCRA defines “hazardous waste” as “a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.”

(2) U.S. EPA has consistently taken this position in all court cases and also in letter-opinions issued to parties who have requested the agency’s view of this issue.

42 U.S.C. / 6903(5)(B).

There are essentially two ways that a waste can be deemed a hazardous waste under this definition. First, U.S. EPA has prepared lists of wastes which it believes are hazardous, and therefore must be treated under RCRA as hazardous. See 40 C.F.R. § 261.30. Lead or lead shot does not appear as a listed hazardous waste. Secondly, a waste is also deemed hazardous if it exhibits any of the following characteristics: ignitability, corrosivity, reactivity or toxicity. 40 C.F.R. § 261.20-24. Lead is toxic, and therefore hazardous if, using appropriate testing methods (primarily the "Toxicity Characteristic Leaching Procedure," or TCLP standard), an "extract from a representative sample of the waste contains any of the contaminants listed (in the regulations) . . . at a concentration equal to or greater than" that specified. 40 C.F.R. § 261.24(a).(3)

In the Coastal Fishermen's case, a comprehensive environmental report called the Battelle Study was commissioned by the Association and considered by the court. The study concluded that over 45 percent of the sediment samples in the vicinity of the range exceeded the acceptable levels for lead, and that the lead shot itself also exceeded the toxicity standards discussed above. The Battelle Study also concluded that the accumulation of lead in mussels and ducks at Lordship Point was sufficient to indicate a lead contamination problem warranting remediation. Based upon this study, the court concluded that the lead shot was hazardous waste, and that the plaintiffs action under the "imminent endangerment" provisions was viable. Notably, the court made no determination about the spent clay targets, because at the time of the decision, test results on the targets were incomplete.(4)

In summary, while the court did not address the issue of whether the shooting range was, because of its activities, subject to the onerous "treatment, storage and disposal" regulations, the court found that the lead shot was nevertheless a solid waste and a hazardous waste, which could pose an imminent hazard to human health and the environment, as documented by the Battelle Study.

3 .Long Island Soundkeeper Fund, Inc. v. New York Athletic Club, 94 Civ. 0436 (S.D.N.Y. March 20, 1996).

In January of 1994, the Long Island Soundkeeper Fund and the New York Coastal Fishermen's Association sued the New York Athletic Club ("NYAC"), alleging violations of the Clean Water Act and RCRA. Beginning around 1930 and during the months from November to April, NYAC had operated a trap shooting range on its property on Long Island Sound at Travers Island, Pelham Manor, New York. Prior to the 1994-95 trap shooting season, lead shot was used at the NYAC range. During the 1994-95 season, NYAC switched to steel shot. Unlike the range in the Coastal Fishermen's case, NYAC did not cease range use before the suit was filed.

The parties cross-moved for summary judgment on certain issues raised in the complaint. In their motion, plaintiffs Soundkeeper and Fishermen's Association contended that they were entitled to summary judgment on their claim that NYAC violated the Clean Water Act because it had not obtained an NPDES permit regarding its shooting activities into the Sound. In its motion, NYAC claimed that it was not subject to either the Clean Water Act or RCRA permitting requirements. The court also requested amicus briefs by U.S. EPA and the New York Department of Environmental Conservation ("NYDEC") on the permitting issues.

(3) The specified concentration for lead is very low (5.0 ppm). If pure lead is in the environment, it may fail the TCLP test and be considered toxic, and therefore hazardous. Results will differ, however, when the lead is mixed with other constituents, such as soil.

(4) Subsequently, further testing proved to the satisfaction of the Connecticut Department of Environmental Protection that the targets were not, in fact, "hazardous" within the meaning of RCRA.

a. Clean Water Act Issue.

The plaintiffs in the NYAC case made the same arguments as the plaintiff in Coastal Fishermen's—that the club was discharging a pollutant into the waters of the United States from a point source without an NPDES permit. The two issues to be decided were whether the range, or some aspect of it, constituted a “point source” and whether the spent shot and targets were “pollutants” within the meaning of the Clean Water Act.

The plaintiffs did not contend that the persons shooting into the Sound were point sources (one court had previously determined that individuals are not point sources within the meaning of the Act(5)), but that the range itself, with its mechanical target launchers and shooting platforms, constituted a point source. In an amicus brief requested by the court, U.S. EPA supported the plaintiffs' position.(6) The court reviewed several cases that discussed the distinction between point and nonpoint pollution sources and agreed that the definition of a point source should be broadly interpreted. The court therefore found that the range constituted a point source.

The court next examined whether the spent shot and targets were pollutants within the meaning of the Act. As with the definition of point source, the court found that the definition of pollutant should also be broadly interpreted. The court found that the shot and targets were pollutants and therefore granted the plaintiffs' motion for summary judgment on the Clean Water Act issue. 'The court ordered the club to stop operating its trap shooting range until it had obtained an NPDES permit.

b. RCRA Issues.

Unlike the court in the Coastal Fishermen's case, the NYAC court directly addressed the issue of whether spent shot and targets fall within the regulatory definition of solid waste. In reaching its conclusion that spent shot and targets do not fall within the narrow regulatory definition of solid waste, the court was obviously influenced by U.S. EPA's long-standing position that spent ammunition and target fragments are not “discarded material” within the meaning of RCRA's regulations and, therefore, shooting ranges are not hazardous waste disposal facilities subject to RCRA permitting requirements.(7) The court was also persuaded by the principle that U.S. EPA's interpretation of its own regulations should be accorded substantial deference. The court sided with the club on this issue and concluded that its operations were not subject to RCRA's permitting requirements.

Neither the plaintiffs nor NYAC moved for summary judgment on the plaintiffs' claim that the operation of the range results in the disposal of waste which may present an imminent and substantial endangerment, probably because resolution of this claim will depend on the presentation of factual and expert testimony not easily done by a summary judgment motion.

(5) If individuals were found to be point sources, hunters shooting over water could be required to obtain NPDES permits. U.S. EPA, in its amicus, brief in the NYAC case, however, acknowledged that the United States had previously indicated in the Weinberger case that individual duck hunters do not need to obtain NPDES permits to shoot in United States waters.

(6) Notably, the NYDEC also supported the plaintiffs' position even though it had previously written to the NYAC in May of 1995 stating that, “This will advise that the Department does not regulate shooting activities on ranges and that current environmental laws do not require permits for discharge of lead or steel shot on shooting ranges.”

(7) Because the court found that the spent shot and targets were not “discarded material,” they could not be solid waste under RCRA's regulatory definition. And since the spent shot and targets were not solid waste, they consequently could not be hazardous waste. (See discussion at pp. 6-7.)

CONCLUSION

The Coastal Fishermen's and NYAC's decisions present mixed results. On the one hand, the courts' findings establish that discharged lead shot and clay targets do not constitute the kind of "solid waste" that would subject shooting ranges to the onerous and expensive RCRA treatment storage and disposal requirements. Furthermore, the U.S. EPA, in its amicus briefs, supported this conclusion, which suggests that the agency will not, in the future, be amending its regulations to impose special requirements on spent shot and targets that remain deposited in the environment in the normal course of range activities.(8)

On the other hand, the Coastal Fishermen's court's decision establishes (at least in the Second Circuit) that expended shot and targets, if they present an imminent and substantial endangerment to the environment, expose shooting ranges to RCRA suits by the government or by citizens under the more general RCRA provisions.

Although it may appear irrelevant whether an action lies under one provision or the other of RCRA, the court's holding has significant evidentiary ramifications for the government or public-interest plaintiffs. For under the regulatory arm of the RCRA suit provisions, the mere violation of specific treatment, storage or disposal requirements establishes both liability and the grounds for an injunction. Under the more general "imminent endangerment" provisions, however, the plaintiff need first establish just that — imminent endangerment. And, establishing such a case requires scientific study and expert opinion on highly technical issues, making the burden of proof on the ultimate question a much more difficult task.

Perhaps most troubling is the NYAC court's ruling that ranges shooting over waters of the United States (also interpreted very broadly and not limited to coastal waters, such that most streams and lakes no matter where located may be covered by the definition) must obtain NPDES permits to operate. This decision gives citizens' groups significant support in their attempts to shut down certain ranges, and the case will almost certainly be used against other shooting ranges that shoot over water, regardless of whether they employ lead or steel shot.

(8) U.S. EPA's regulatory position on in situ lead at a shooting range should not be confused with its regulation of the accumulation, storage and disposal of spent shot by range owners. Although presently RCRA regulations provide certain exemptions to those who responsibly collect and recycle scrap metal, including spent shot, these regulations are complex and a subject of intense debate between government and industry. These regulations may be changed if the RCRA definition of "solid Waste" is amended; lead recycling issues are the subject of a separate SAAMI memorandum.