1

Welcome – Thanks for joining us.
ITRC's Internet-based Training Program

Environmental Management at Operating Outdoor Small Arms Firing Ranges

ITRC Guidance for Environmental Management at Operating Outdoor Small Arms Firing Ranges

This training is co-sponsored by the EPA Office of Superfund Remediation and Technology Innovation

Small arms firing ranges are those ranges accepting 50-caliber or smaller non-exploding ammunition. The primary environmental concern is lead; however, there are other associated metals and a few organics to be considered where applicable. Range operators at military, law enforcement, commercial, and private ranges and the appropriate environmental professional who might be hired to manage a ranges' more complicated environmental issues should attend this Internet-based training on Environmental Management at Operating Outdoor Small Arms Firing Ranges (SMART-2, 2005). Government environmental professionals charged with preventing environmental impact and offering technical assistance to the community should also attend this training and refer to the guidance document whenever they encounter small arms range questions. Government environmental professional are encouraged to use the downloadable version of this training and the associated guidelines as an on-site training tool for range operators in their states and communities.

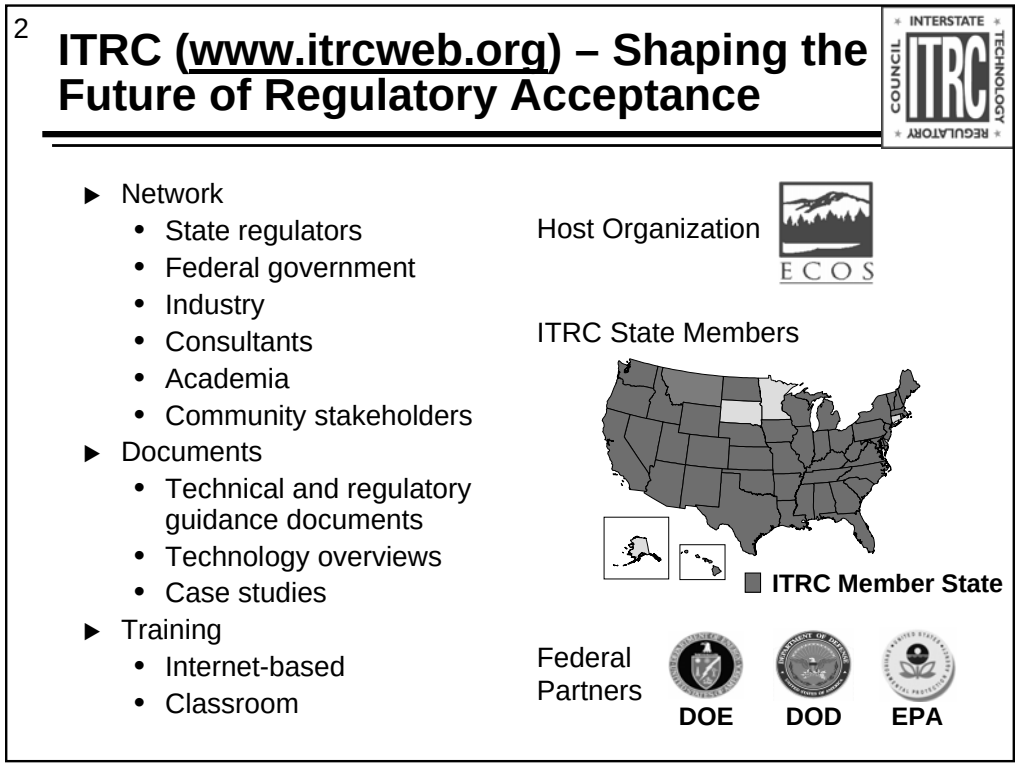
This training explains how environmental management planning at small arms firing ranges is a method for pollution prevention. The training uses a logic diagram to describe the appropriate steps an environmental professional or range manager should use to establish an operational understanding of a range and the impact it can have on the environment if left unattended. It assists the user to define the environmental characteristics at a range that, left unattended, could potentially impact the environment. It lists the appropriate questions range operators should ask when evaluating the potential for environmental impact. As any potential for impact becomes apparent, the training briefly describes a variety of new and conventional technologies and techniques (i.e., 'best management practices') available to prevent environmental impact on the range. Finally, students will be able to understand range operations and monitoring that will, when appropriately designed, enable the range to operate cost-effectively without endangering the environment or the shooting enthusiasts, law enforcement officers, the military, or the public.

This guidance is a follow-up to ITRC's Characterization and Remediation of Soils at Closed Small Arms Firing Ranges (SMART-1, 2003), which addresses the cleanup of closed ranges (the remediation of former ranges so that the locations may be suitable for some other future use). It also includes an easy-to-follow decision process for determining the best remedial alternatives for lead and lead-contaminated soils at closed ranges.

ITRC (Interstate Technology and Regulatory Council) www.itrcweb.org

Training Co-Sponsored by: EPA Office of Superfund Remediation and Technology Innovation (www.clu-in.org)

ITRC Course Moderator: Mary Yelken (myelken@earthlink.net)



The Interstate Technology and Regulatory Council (ITRC) is a state-led coalition of regulators, industry experts, citizen stakeholders, academia and federal partners that work to achieve regulatory acceptance of environmental technologies and innovative approaches. ITRC consists of 45 states (and the District of Columbia) that work to break down barriers and reduce compliance costs, making it easier to use new technologies and helping states maximize resources. ITRC brings together a diverse mix of environmental experts and stakeholders from both the public and private sectors to broaden and deepen technical knowledge and advance the regulatory acceptance of environmental technologies. Together, we're building the environmental community's ability to expedite quality decision making while protecting human health and the environment. With our network approaching 7,500 people from all aspects of the environmental community, ITRC is a unique catalyst for dialogue between regulators and the regulated community.

For a state to be a member of ITRC their environmental agency must designate a State Point of Contact. To find out who your State POC is check out the "contacts" section at www.itrcweb.org. Also, click on "membership" to learn how you can become a member of an ITRC Technical Team.

3

ITRC Course Topics Planned for 2006

Popular courses from 2005

- Alternative Landfill Covers
- Constructed Treatment Wetlands
- Environmental Management at Operational Outdoor Small Arms Ranges
- DNAPL Performance Assessment
- Mitigation Wetlands
- Perchlorate Overview
- Permeable Reactive Barriers: Lessons Learn and New Direction
- Radiation Risk Assessment
- Radiation Site Cleanup
- Remediation Process Optimization
- Site Investigation and Remediation for Munitions Response Projects
- Triad Approach
- What's New With In Situ Chemical Oxidation

New in 2006

- Characterization, Design, Construction and Monitoring of Bioreactor Landfills
- Direct-Push Wells for Long-term Monitoring
- Post Closure Care at Landfills
- Planning and Promoting of Ecological Re-use of Remediated Sites
- Rads Real-time Data Collection
- Remediation Process Optimization Advanced Training
- Risk-Based Screening Values: Determination and Application
- More in development…….

Training dates/details at www.itrcweb.org
Training archives at http://cluin.org/live/archive.cfm

More details and schedules are available from www.itrcweb.org under "Internet-based Training."

4

Environmental Management at Operating Outdoor Small Arms Firing Ranges

Logistical Reminders

- Phone line audience
  - ✓ Keep phone on mute
  - ✓ "*6" to mute, "*7" to un-mute to ask question during designated periods
  - ✓ Do NOT put call on hold
- Simulcast audience
  - ✓ Use  at the top of each slide to submit questions
- Course time = 2¼ hours

Presentation Overview

- Introduction
- Environmental stewardship principles
- Range environment
- Questions and answers
- Environmental issues
- Best management practices
- Environmental management plan, monitoring environmental conditions, and documentation
- Links to additional resources
- Your feedback
- Questions and answers

No associated notes.

5

Meet the ITRC Instructors

Mark Begley
Environmental Management Commission
Massachusetts Military Reservation
T 508-968-5127
mark.begley@state.ma.us

Richard Patterson
Sporting Arms and Ammunition Manufacturers' Institute, Inc
Newtown, Connecticut
203-426-4358
rpatterson@saami.org

Bonnie Packer
U.S. Army Environmental Center SFIMAEC-PCT
Aberdeen Proving Ground, Maryland
410-436-6846
bonnie.packer@aec.apgea.army.mil

Mike Warminsky
AMEC Earth & Environmental, Inc
Somerset, New Jersey
732-302-9500
mike.warminsky@amec.com

Mark Begley is the Executive Director of the Massachusetts Environmental Management Commission at Camp Edwards on the Massachusetts Military Reservation. He is responsible for assuring that military training at Camp Edwards is compatible with environmental protection standards. Previously, Mr. Begley was Division Director of the hazardous waste site cleanup program at the Massachusetts Department of Environmental Protection. Mr. Begley developed the Massachusetts Lead Shot Initiative and managed the program for its first six years. Mr. Begley served as co-team leader on the ITRC's Small Arms Team and has assisted in the development of several leading publications on environmental issues at shooting ranges. Mr. Begley earned a Masters Degree in Environmental Engineering from the School of Engineering at Northeastern University.

Rick Patterson is the Managing Director of the Sporting Arms and Ammunition Manufacturers' Institute Inc. (SAAMI), a standards-setting organization for the manufacturers of sporting arms and ammunition in the United States. In addition, Mr. Patterson is the Director of the Facility Development Division of the National Association of Shooting Ranges (NASR). NASR is dedicated to promoting and protecting target shooting facilities by providing leadership in information, communication and partnerships between ranges, industry and community. The program provides guidance on every aspect of developing and operating a safe and successful target shooting facility. Patterson developed and launched the Facility Development Series of guidance publications, the Rangeinfo Web Site-a comprehensive information resource for range operators and developers-the Range Video Series and the NASR 5-Star rating system. He has also developed successful partnerships with many state and federal wildlife, environmental and occupational health agencies to provide range operators and developers with guidance and resources on issues such as NEPA compliance, environmental management and employee safety. Prior to joining the NSSF team, Patterson was with Coastal-Mart, the retail motor fuel division of Coastal, a Fortune 50 petroleum refiner. He graduated from Montana State University, cum laude, with a degree in organizational and managerial communication. In his spare time Patterson is Chairman of the Roxbury Conservation Commission, a two-term elected member of the Roxbury Republican Town Committee and an avid fly-fisherman, shooter, hunter and maker of bamboo fly rods. He is a former state champion International Handgun Metallic Silhouette Association competitor (AAA division) and was Chairman of Trout Unlimited's intervention in the successful and precedent-setting Shepaug River lawsuit.

Bonnie Packer has been working as a contractor for the US Army Environmental Center (USAEC) since 1996. She supports the USAEC's Acquisition and Technology Division, where she currently manages several projects for the government: the corrosion of unexploded ordnance in soil environments; munitions residues assessment; small arms range assessments; wear tolerant vegetation for arid training environments; and evaluating perchlorate treatment technologies. Many of her prior projects focused on small arms ranges, including the development of the Range Evaluation Software Tool, the Army Sampling and Analysis Plan for small arms ranges, and demonstration of several lead treatment and management technologies at Fort Rucker, Alabama. Bonnie also participates in the ITRC's perchlorate team. Before working on Army related projects, Bonnie worked on the Department of Energy's Yucca Mountain high-level nuclear waste disposal program, doing various analyses related to the safety of the waste repository. She has a MS (1985) and PhD (1990) in Geology from University of California, Los Angeles Department of Earth and Space Sciences, where her emphasis was on stable isotope geochemistry, stratigraphy and early life.

Mike Warminsky, Technical Director and AMEC Range Program Manager, has over 23 years' experience in civil engineering, remediation, and construction. In these roles, he has extensive experience in identifying, developing, and managing multi-disciplinary range projects for Department of Defense (DoD) and law enforcement facilities, with the last 10 years dedicated to range sustainability, maintenance, and remediation. He is a licensed engineer, and holds both a BS/Civil Engineering (1981) and an MBA (1995) from Lehigh University.

6

Operating Outdoor Small Arms Firing Ranges

- Includes military, public safety, commercial, and recreational small arms ranges (rifle, pistol, and shotgun ranges)
- 50 caliber or less, non-exploding ammunition
- United States ranges
  - DoD more than 3,000
  - Estimated 9,000 non-military ranges

No associated notes.

7

Management of Active Ranges vs. Remediation of Closed Ranges

- **Today's topic** environmental management of operating ranges, not the clean-up of closed ranges
- Two ITRC documents related to small arms ranges
  - **"Environmental Management at Operating Outdoor Small Arms Firing Ranges," 2005**
  - "Characterization and Remediation of Soils at Closed Small Arms Firing Ranges," 2003
- Environmental management of operating ranges and remediation of closed ranges are distinct topics with some shared elements

No associated notes.

8

Key Issues

- Lead and other metals
  - If left unmanaged
    - Can be transported into the environment
    - Directly discharged into wetlands or water bodies
- Proactive O&M at an active range is more practical than mandated clean-up of an active range

No associated notes.

9

Major Points of this Course

- Environmental stewardship **principles**
- **Elements** of environmental management
- **Technologies** and **practices** that can prevent environmental impacts
- Environmental management **planning**, **implementation**, and **monitoring** are part of routine range operations
- **Real** examples during the environmental management planning process

No associated notes.

10

This Environmental Management Approach is Supported by:

- Military
- States
- Sporting Arms and Ammunition Manufacturers' Institute
- National Shooting Sports Foundation
- U.S. EPA

States – Several states, including MA, FL and MI, are conducting outreach and providing technical assistance to shooting range managers to assist them in implementing environmental management plans.

Military - In April 2000, President Clinton signed EO 13148 "Greening the Government through Leadership in Environmental Management" that established a five-year Environmental Management System (EMS) implementation goal for all Federal Facilities. EO 13148 requires an EMS at all appropriate federal facilities by December 31, 2005. Developing and implementing an EMS is required at all Army installations. Evaluating and resolving environmental concerns associated with small arms ranges would be subject to the installation EMS. The International Organization for Standardization developed the ISO-14001 standard to provide a set of internationally recognized criteria for EMSs. The Army has chosen to use the ISO-14001 standard as a model for implementing EMSs at Army installations.

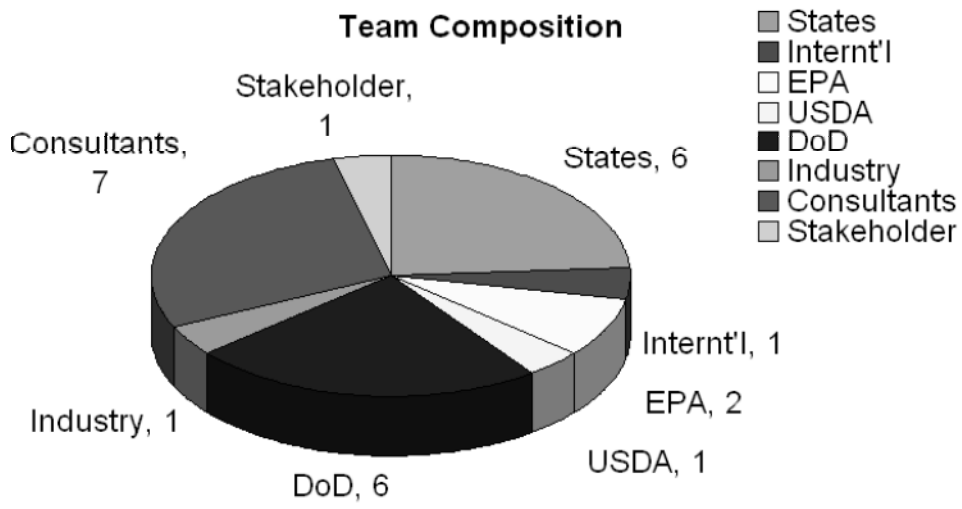
The Army has developed The Army Training Range Aspect and Impact Methodology to support and be an integral component of the installation-wide EMS. It provides appropriate, range-specific guidance on completing the assessment of environmental aspects and impacts and provides criteria to help characterize their relative significance. The methodology ensures that the installation's EMS addresses range environmental issues while focusing on its mission priorities.

Industry - The shooting sports industry has been one of the driving forces in promoting lead management at ranges. They wrote the first book (1997) on Environmental Stewardship have partnered with environmental agencies on outreach and technology development and have ongoing programs to educate range operators. In 2003, industry leaders (NSSF, NRA) signed a statement of principles on the industry's commitment to promoting environmental stewardship/BMPs at shooting facilities.

EPA – In 2001, EPA region 2 published Best Management Practices for Lead at Outdoor Shooting Ranges. This guidance was later adopted as national guidance by the agency. The guidance promotes the use of BMPs to manage the impact of lead projectiles in the environment.

11

ITRC Small Arms Team Composition



Massachusetts

Washington

New Jersey

Texas

Colorado

Florida

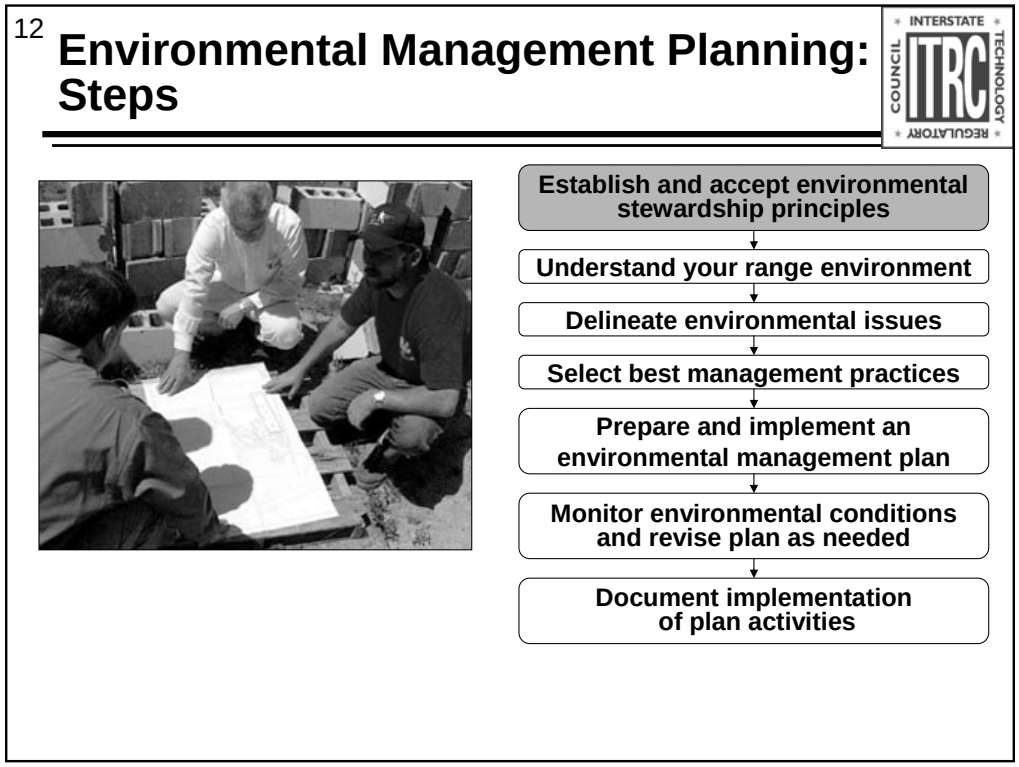


Figure 1-1 from ITRC's Environmental Management at Operating Outdoor Small Arms Firing Ranges (SMART-2, February 2005) available from the ITRC Web site (www.itrcweb.org) under "Guidance Documents" and "Small Arms Firing Ranges."

13

Environmental Management Planning: Evaluate

- Establish and accept environmental stewardship principles
- Understand your range environment
- Delineate environmental issues
- Select best management practices
- Prepare and implement an environmental management plan
- Monitor environmental conditions and revise plan as needed
- Document implementation of plan activities

Liz briefly mentioned in her section ammunition used and site or range layout.

In order to understand your range environment you first need to understand the layout and extent of your range.

This next section will cover that area in more depth.

It is important to remember, ranges, and how they interact with the environment, are often very site specific.

14

Environmental Management Planning: Select and Implement

- Checklist for an Environmental Management Plan:
  - Document baseline site conditions (photos, maps, descriptions, test results)
  - Evaluate best management practices
  - Select alternatives
  - Schedule & Implementation

No associated notes.

15

Environmental Management Planning: Monitoring

- Monitor and evaluate whether
  - EMP is being implemented effectively
  - Adjustments must be made to the plan to achieve the desired goals
- Evaluate effectiveness relative to baseline conditions or most recent monitoring
- Quantitative and qualitative measurements can be used

No associated notes.

16

Principles of Environmental Stewardship

Employ practical means to -

- ✓ **Minimize potential impact on human health and the environment**
- ✓ **Protect groundwater, surface water, wetlands, and wildlife**
- ✓ **Prevent erosion**
- ✓ **Manage sound**

Various states and local government have rules or ordinances controlling noise

17

Regulatory Considerations

- Environmental management of SAFRs is **pollution prevention**
- RCRA applicability
  - At the time lead is discharged, it is not considered a hazardous waste because the lead is being used for its intended purpose
  - Once discharged, *if left unmanaged in the environment*, lead *may* be deemed "abandoned" and thus subject to RCRA
  - Lead that is recovered and recycled is considered scrap metal, not hazardous waste

EPA 2003 "Best Management Practices for Lead at Outdoor Shooting Ranges" (EPA-902-B-01-001 Revised March 2003 Region 2)

18

Regulatory Considerations (continued)

- Environmental management that includes effective technologies, practices, and documentation may help ensure that
  - Lead is not considered “abandoned”
  - A range operates in compliance with federal and state environmental laws
    - Clean Water Act
    - Wetlands protection laws (state)
    - Federal and state superfund laws

No associated notes.

19

Potential Contaminants

Table 2-1 Environmental Management at Operating Outdoor Shooting Ranges (www.itrcweb.org)

Constituent	Comment
Lead	Primary projectile constituent
Lead Styphnate/LeadAzide	Primer constituent
Antimony	Increases hardness
Arsenic	Used to increase roundness of small shot
Tin	Increases hardness
Copper and zinc	Jacket alloy metal
Tungsten	Tungsten-nylon Ammunition
Iron	Iron tips on penetrator rounds and steel shot
Cobalt and chromium	Some military rounds
Nickel	Coating improves shot performance; an alloy in center fire ammo
PAHs (Polycyclic Aromatic Hydrocarbons)	In limestone matrix of clay targets used at shotgun ranges

Arsenic – used In the production of small shot it increases the surface tension of dropped lead, thereby improving lead shot roundness

PAHs - Appears to be bound within the limestone matrix of the target. Concentration varies, but may be as high as 1000mg/kg. Manage as solid waste.

ITRC's Environmental Management at Operating Outdoor Small Arms Firing Ranges (SMART-2, February 2005) is available from the ITRC Web site (www.itrcweb.org) under "Guidance Documents" and "Small Arms Firing Ranges."

20

Baseline Range Conditions

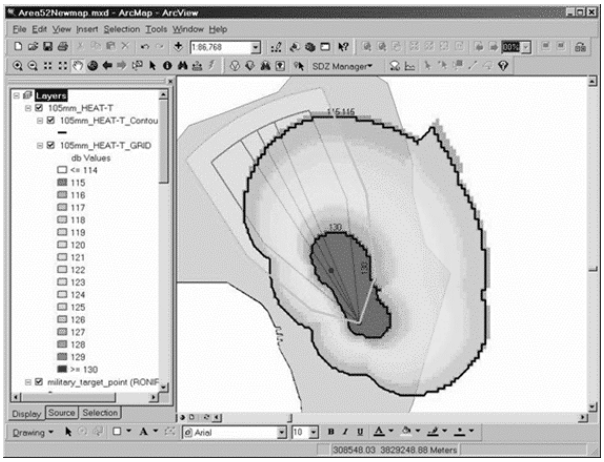
- Range-specific evaluation
- Evaluate
  - Distribution and approximate mass of potential contaminants
  - Fate and transport of potential contaminants
  - Potential exposure pathways and receptors

No associated notes.

21

Site and Facility Characteristics –
Information Relevant to a Baseline Evaluation

- Geology
- Soils
- Vegetation
- Topography
- Hydrology
- Wetland delineation
- Water quality
- Number of users, targets, ammunition types, operating hours, years in operation
- Site layout
  - Property boundaries
  - Target locations
  - Bullet/shot distribution
  - Aerial photographs



No associated notes.

22

Environmental Management Planning: Evaluate

- Establish and accept environmental stewardship principles
- **Understand your range environment**
- Delineate environmental issues
- Select best management practices
- Prepare and implement an environmental management plan
- Monitor environmental conditions and revise plan as needed
- Document implementation of plan activities

Liz briefly mentioned in her section ammunition used and site or range layout.

In order to understand your range environment you first need to understand the layout and extent of your range.

This next section will cover that area in more depth.

It is important to remember, ranges, and how they interact with the environment, are often very site specific.

23

Shot and Bullet Distribution

- Military/public safety
  - Range configuration depends on weapons and shooting scenario
  - Fixed distance/pop-up targets
- Commercial/recreational
  - Shotgun
    - Trap, skeet, and sporting clays
  - Rifle and pistol

Where the range is located, its design, the fire arms and the ammunition used, and how they are used, all effect the distribution of the projectiles, be they bullets or shot from shotguns.

The solders firing in the top photo are lying down, if they were standing, after passing through the target, the bullets would ultimately end up in a different location at this range.

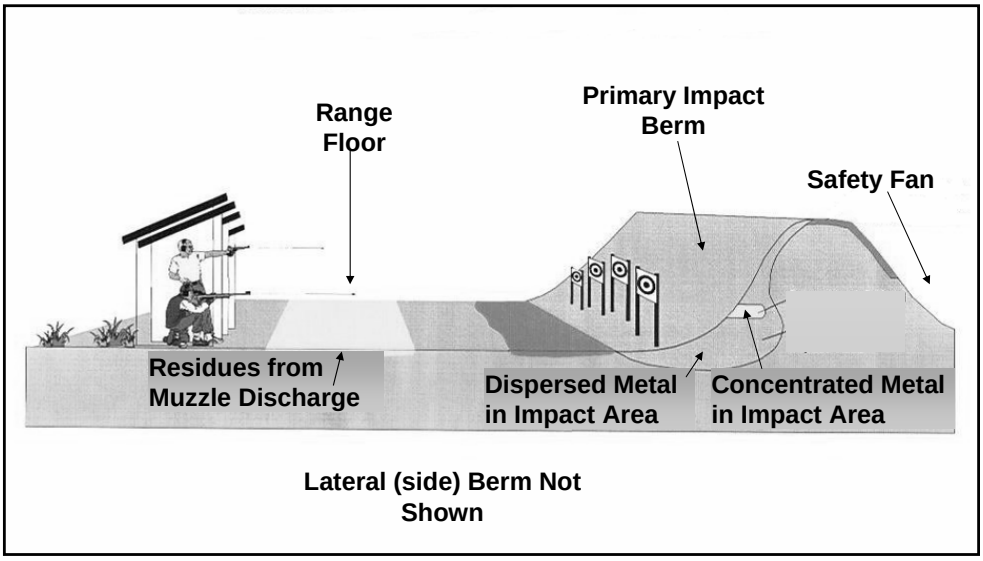
If there was an effective berm or mound of soil behind the targets, the bullets would end up hundreds of yards closer than they would at a range without a berm.

The fabric covered berm in the lower photo from the Olympics in Greece significantly changed the shot distribution at that event.

A hillside, trees, or a shot curtain all could similarly change the footprint of the range.

24

Characterization – Static Rifle and Handgun Range



The simplest rifle or handgun range design is a static range. The shooters stay in one location and the targets are stationary in another location. In an idealized world all the bullets end up in a concentrated bullet pocket.

Change this to a more dynamic or tactical range with moving shooters and/or moving targets and you can end up with a much less concentrated bullet impact area.

The aerial photo overlay Liz used nicely illustrated what a shot distribution pattern could look like at two shotgun ranges.

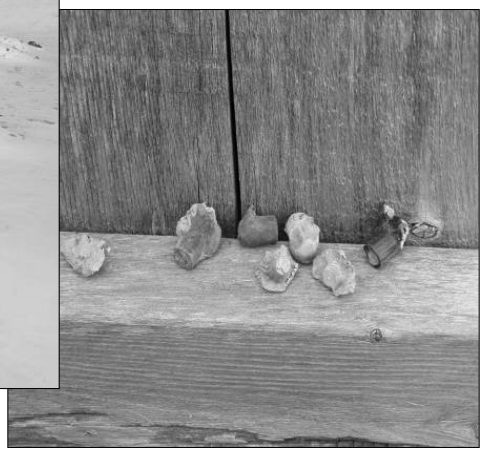
Similar maps or graphics are used at ranges to help identify the potential bullet distribution area or “surface danger zone” of a rifle or pistol range.

Not all of the metals end up in the berm, elevated lead levels can be found in the area immediately in front of the shooter at rifle, pistol, and shot gun ranges.

A lateral berm is an added safety feature at some ranges, it extends the berm around the sides of the range to help capture some of the ricochets. Some bullets end up on the back side of the berm, not because the go through the berm, but because they bounce up and over the berm.

25

Berms, Bullets, and Target Placement

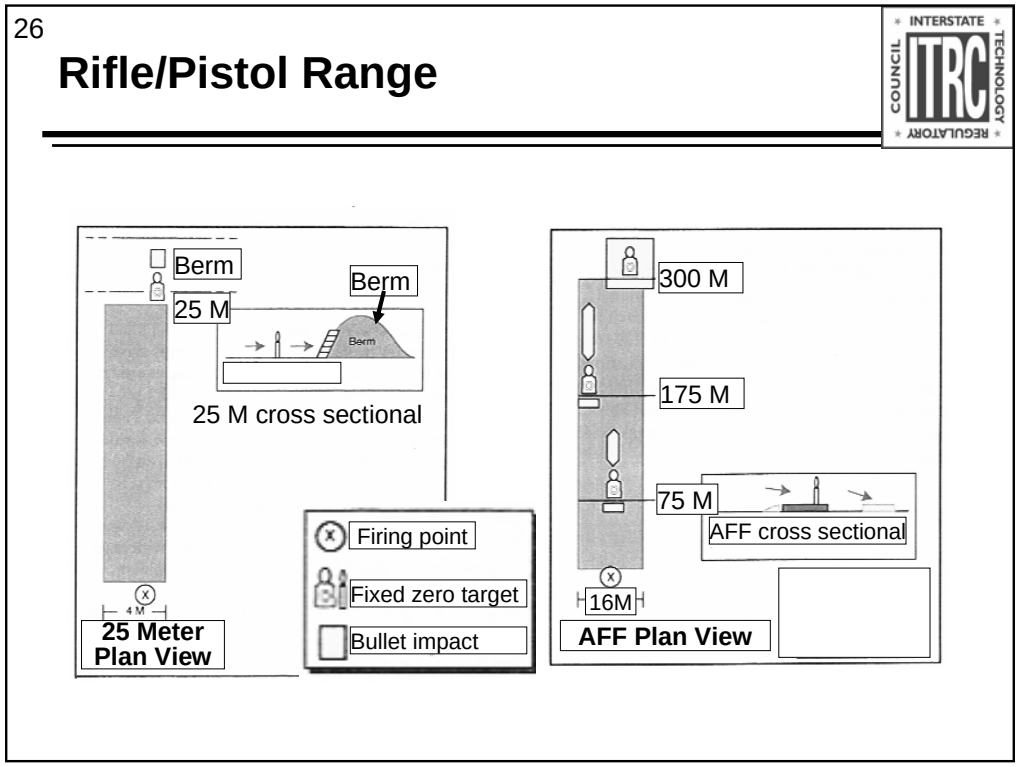


Not only can berms be found behind or to the side of the targets, they can also be in front of the targets. At the range seen in the left picture, the berm protects the mechanism on a pop up target range.

The type of ammunition, its size or caliber, the amount of powder used to project it down the barrel of the gun, the metals in the projectile, and the material the bullet impacts all play a role in bullet distribution and ultimately its interaction with the environment.

Bullets fired into sand from a handgun, as shown in the photo on the right, may remain generally in tact.

Bullets traveling at a very high rate of speed from a rifle, shot into a rocky gravel can smear on surfaces and often fragment into small pieces that provide a greater surface area to oxidation, acid rain, and erosion.



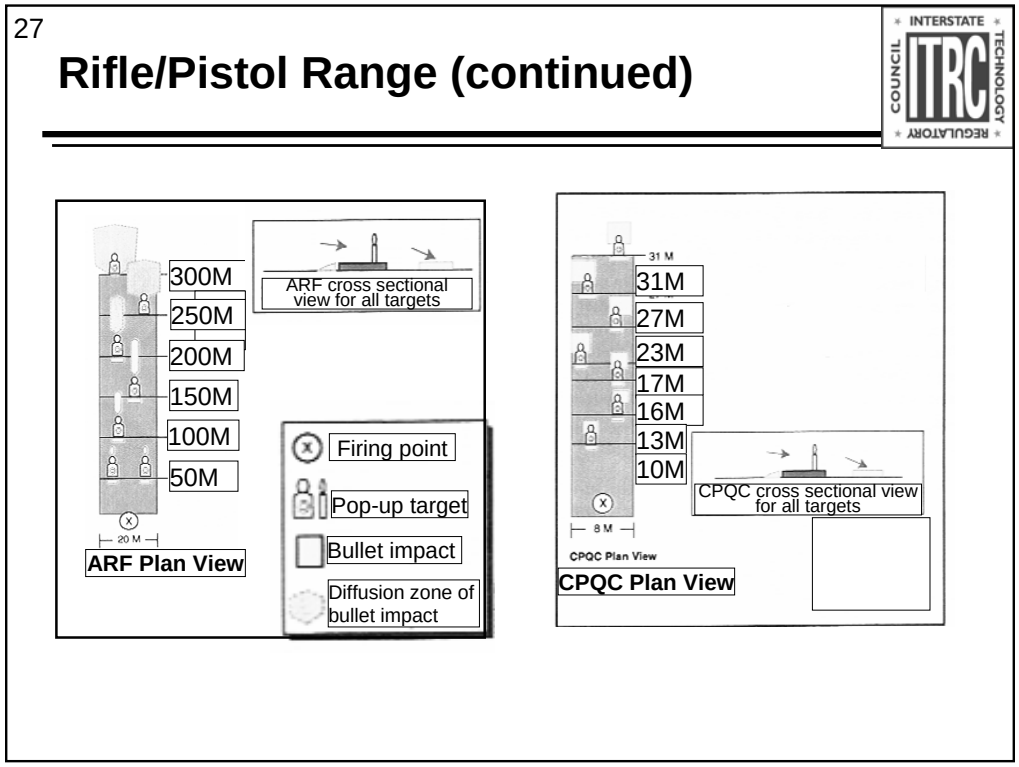
Distance to the target will effect the distribution of the projectiles and the foot print of the range you are evaluating.

A rifle shooting at a target 25 meters away will normally have a much smaller bullet impact area than a range with a target 300 meters away.

Does your range have one target or multiple targets?

Be careful of your assumptions on a range layout. Were those targets shown on the range on the right hand side of the slide always in there current location?

What other weapons systems were used at that range? It is not that unusual to find grenades at some military small arms ranges.



With many of the military ranges, you can go to any part of the country and find range designs that look very similar from base to base. But one of them may have groundwater at 100 feet below ground surface, the other may have groundwater at 3 feet. The difference can be very significant.

Add in the base lets local law enforcement use the range and now you have different firing points and different ammunition being used.

Go to a police range and the lay put can vary from one town to the next.

The rod and gun club trap range may be where the local police fire their shotguns and pistols.

Again each range is different and has to be evaluated given its uses and environmental setting.

28

Rifle/Pistol Range (continued)

How different can two rifle ranges be?

These two pictures show two outdoor military rifle ranges.

They could not be more different:

One range is so enclosed with baffles so much that it looks like it is indoors, it has a rain water collection system, its bullets are captured by a bullet trap, a conveyer takes the bullets to a drum.

The other has no bullet containment systems of any kind other that the native soil and groundwater.

They do both have one thing in common, neither use lead ammunition.

29

Shotgun Ammunition

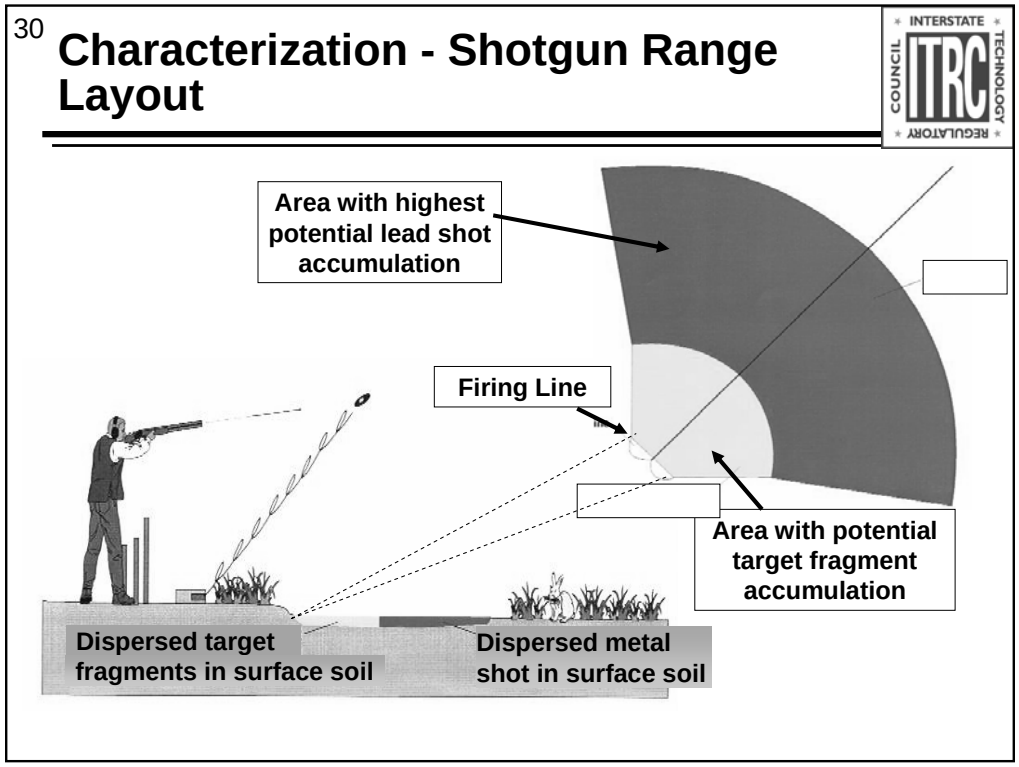
Time to switch from talking about bullets and let's talk about shotgun ammo. Shot is fired from a shot gun. Shot may be lead, steel, copper, tungsten or a number of other metals.

Shotgun shells often have plastic tops, like the red ones pictured on a shell box in the top left photo. They usually have a crimped top that holds in the shot. The smaller sized shot is often used for bird hunting or clay target shooting, as shown on the box.

The box often lists the specs of the ammo, such as the gauge or diameter of the shell, the size of the shot i.e., 7 ½ shot, how much all of the shot weights, what it does not give is the number of pieces of shot anywhere from 1 slug to 2300 projectiles for #12 shot.

Within the shell, there is often a plastic wad that cups the shot. A polyethylene wad is pictured at the top right.

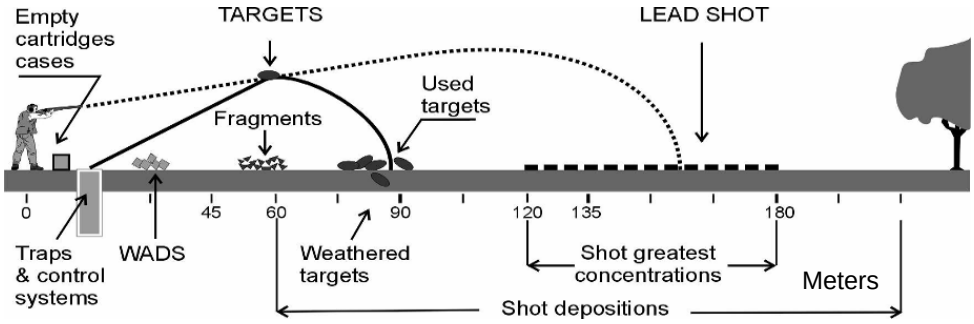
How can the number of projectiles vary by several hundred? Size. The picture in the lower right of the slide is of 4 copper slugs fired from 4 different shot shells. The picture in the lower left is of 5, #9 pellets (about 2 mm in diameter), that were fired over a skeet range. The total number of pellets in the shell were most likely somewhere around 600 pellets (lots of surface area).



Refer to Figure 2-1 in the document. ITRC's Environmental Management at Operating Outdoor Small Arms Firing Ranges (SMART-2, February 2005) is available from the ITRC Web site (www.itrcweb.org) under "Guidance Documents" and "Small Arms Firing Ranges."

31

Cartridges, Clay Targets, and Other Debris



1 meter = 3.28 feet

This graphic is from a European manual and it is in meters, but it does a nice job in laying out approximately where materials drop on a trap range.

Un-burned powder, and shards or fragments of shot are often found in close to the shooter as are the wads.

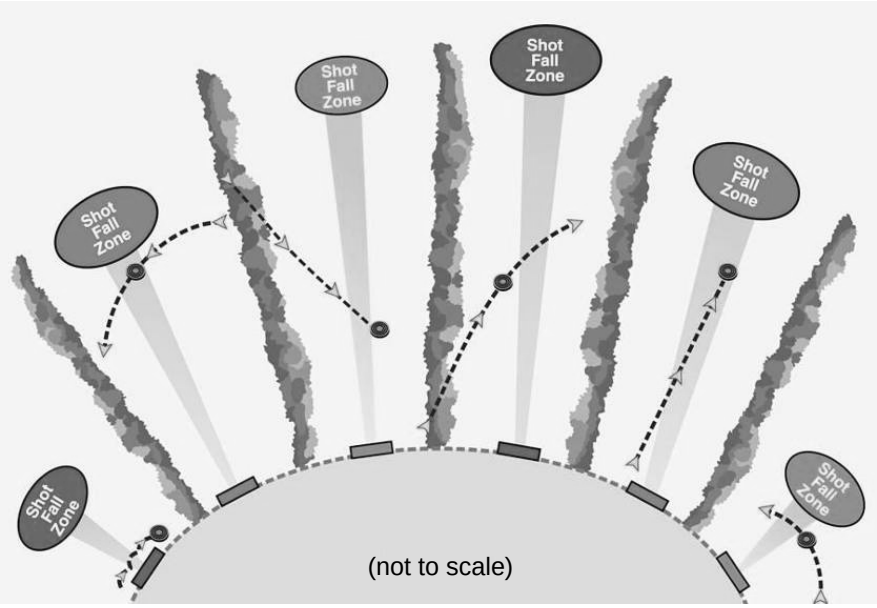
The target fragments and targets are found out further as is the start of the shot deposition area.

The earlier photo of the Olympics and this diagram show a nice neat box to catch the empty shells, the photo above the diagram is more typical, the blues, yellows and orange colors on the ground are empty shells scattered on the ground.

Not only can the empty shells be a source of lead, they can be a slip and fall hazard and give a heavily littered appearance to a range.

32

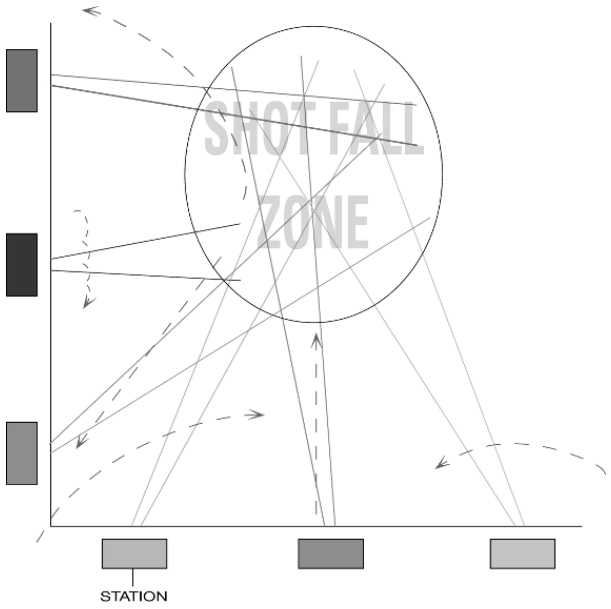
Sporting Clays Configuration (Traditional)



No associated notes.

33

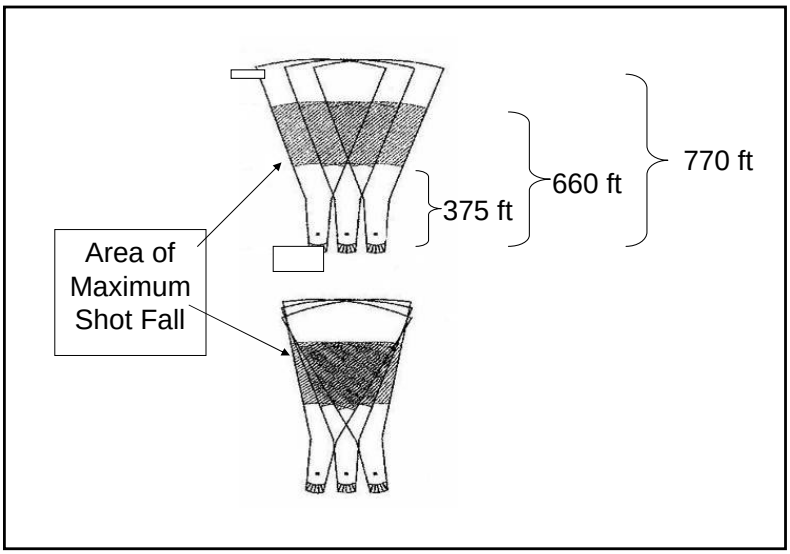
Sporting Clays Configuration (Ideal)



Traditionally Sporting Clays are configured randomly and have not allowed for concentrated shotfall. This diagram depicts retrofitted and new range configurations concentrating the shotfall.

34

Characterization - Trap Range Layout



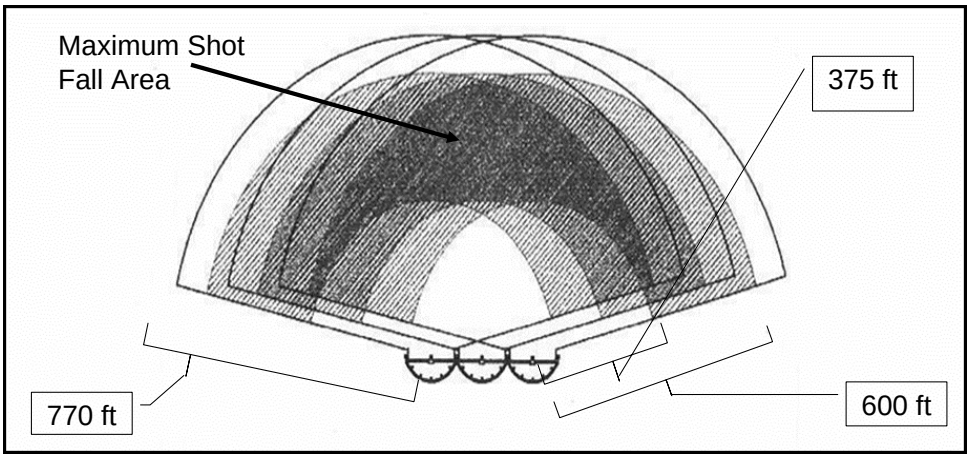
Refer to Figure 2-1 in the document. ITRC's Environmental Management at Operating Outdoor Small Arms Firing Ranges (SMART-2, February 2005) is available from the ITRC Web site (www.itrcweb.org) under "Guidance Documents" and "Small Arms Firing Ranges."

An individual trap range has approximately a 4 acre drop zone, with 1 ¾ acres per additional trap range.

The suggested overlapping of drop zones is supported by NSSF, SAAMI, and other national organizations to help reduce the footprint of a range. The overlap also makes recovery more feasible.

35

Characterization – Skeet Range Layout



On skeet ranges, 680 feet is the number normally used for the maximum distance when using skeet ammo loads of # 8 or #9 shot, if # 7.5 shot is used the number can jump up to 770 feet, same as with trap.

The theoretical drop zone of a single skeet field is 14 acres according to the NSSF. About 2 acres are added for each additional skeet range.

This diagram shows three skeet ranges side by side. Not all skeet ranges are so closely aligned and have as much overlap.

36

Understanding Your Range Environment – Summary

- Range configuration is an important design parameter
- Helps define the range area where potential problems may occur
- Next we will learn more about the physical and chemical characteristics of potential contaminants on a range

The range configuration or layout is the initial roadmap where you may find your range interacting with the environment.

However it is seldom a straight road, there are often twists and turns, projectiles do not always go where they are intended to go, just go to a range when the soil is very dry and see where the dust flies up or go to a military range at night and watch where the tracers ricochet fly.

Once you know the real aerial extent of the range, you then see what other environmental receptors may be effected.

As Bonnie will cover, not everything stays put, and lastly not all ranges are ideally located to minimize their impact to the environment.

37

Questions and Answers

No associated notes.

38

Environmental Management Planning: Evaluate

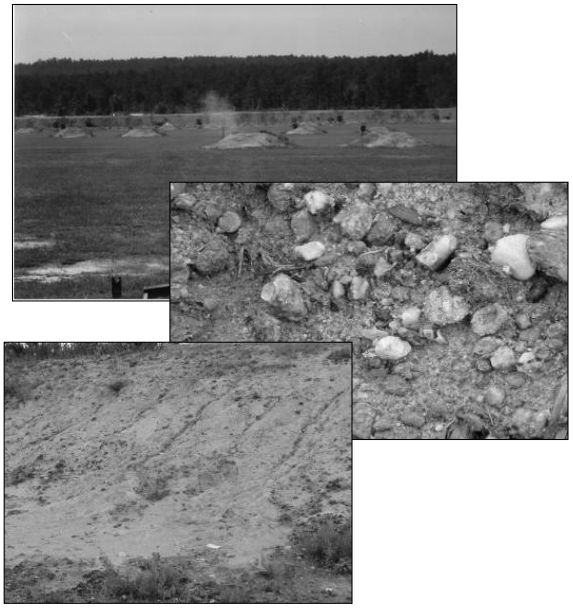
- Establish and accept environmental stewardship principles
- Understand your range environment
- **Delineate environmental issues**
- Select best management practices
- Prepare and implement an environmental management plan
- Monitor environmental conditions and revise plan as needed
- Document implementation of plan activities

No associated notes.

39

Fate and Transport

- Mass
  - How much?
  - How distributed?
- Physical processes
  - Bullet fragmentation
  - Water transport
  - Wind transport
- Chemical processes (principally vertical migration to groundwater)
  - Dissolution - precipitation
    - pH
    - Corrosion
    - Sorption/desorption/ crystallization



No associated notes.

40

Surface Water Particulate Transport

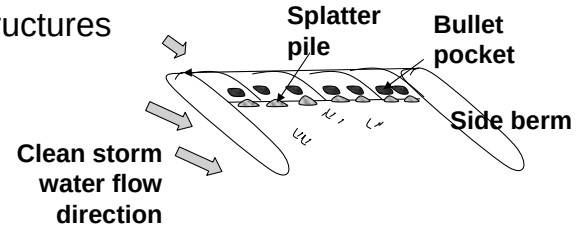
- Soil and/or lead
- Resources potentially impacted
  - Surface water quality
  - Fish and wildlife habitat
  - Wetlands
- Erosion factors
  - Particle sizes/masses
  - Rainfall intensity/ water velocity
  - Availability of particles to water

No associated notes.

41

Surface Water Particulate Transport

- Management options (may need more than one)
  - Particle availability: vegetative control / soil amendments
  - Velocity: slope, rip-rap, water baffles, settling basing, range orientation, side berms
  - Lead mass by periodic removal
  - Containment structures



No associated notes.

42

Air Particulate Transport

- Soil and/or lead
- Resources potentially impacted
  - Surface water quality
  - Grazing and wildlife habitat
  - Aesthetics
  - Range workers
- Erosion factors
  - Particle sizes/masses
  - Air velocity
  - Availability of particles to wind

No associated notes.

43

Air Particulate Transport

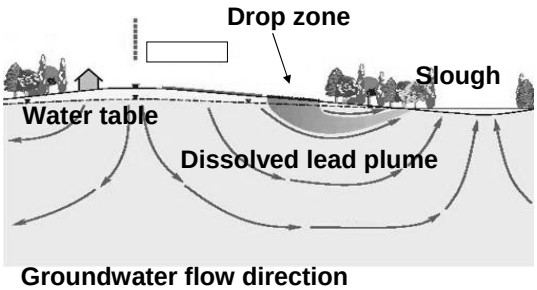
- Management options (may need more than one)
  - Particle availability: vegetative control / soil amendments
  - Velocity: windbreaks (trees, brush, berms), range orientation
  - Lead mass by periodic removal
  - Containment structures

No associated notes.

44

Dissolution

- Lead
- Resources potentially impacted
  - Groundwater
  - Surface water/ wetlands
  - Fish and wildlife
- Factors
  - pH
  - Corrosion
  - Adsorption
  - Crystallization



Conceptual model of groundwater flow in an area of shallow groundwater, permeable soil and low pH. Taken from Soeder 2003, Groundwater Contamination from Lead Shot at Prime Hook National Wildlife Refuge, Sussex County, Delaware, USGS Water Resource Investigation Report 02-4282 (http://md.water.usgs.gov/publications/wrir-02-4282/wrir_02_4282.pdf). Not to scale.

No associated notes.

45

Dissolution (continued)

- Management options (may need more than one)
  - pH amendments: carbonate, phosphate
  - Stabilization
  - Sorption to retard vertical movement: e.g. clay barrier
  - Alternative ammunition
  - Lead mass by periodic removal
  - Containment structures

No associated notes.

46

Additional Issues

Exposure
- Range workers
- Shooters
- Plants, foraging animals, waterfowl, grazing livestock

- Encroachment
- Protected wildlife species

No associated notes.

47

Additional Issues

- Shooting sound
  - Resource impacted: neighbors
  - Management techniques
    - Range orientation
    - Range operations
    - Sound barriers and berms
    - Sound suppressors (military and law enforcement)
- Trash, litter, and debris
  - Resource impacted
    - Aesthetics
    - Public perception
    - Target waste
  - Management techniques
    - Routine collection and disposal
    - Trash receptacles
    - Netting to capture windblown litter
- Unexploded ordnance (UXO) management

No associated notes.

48

Delineate Environmental Issues – Summary

- Mass
- Surface water
- Groundwater
- Air

- **Control lead and keep it on the ranges**

Mass

- How much?
- Distribution

Surface water

- Rain fall
- Distance from range to a stream
- Orientation/vegetation

Groundwater

- Soil characteristics
- Distance
- pH

Air

- Wind speed
- Soil type
- Vegetation

Control lead and keep it on the ranges

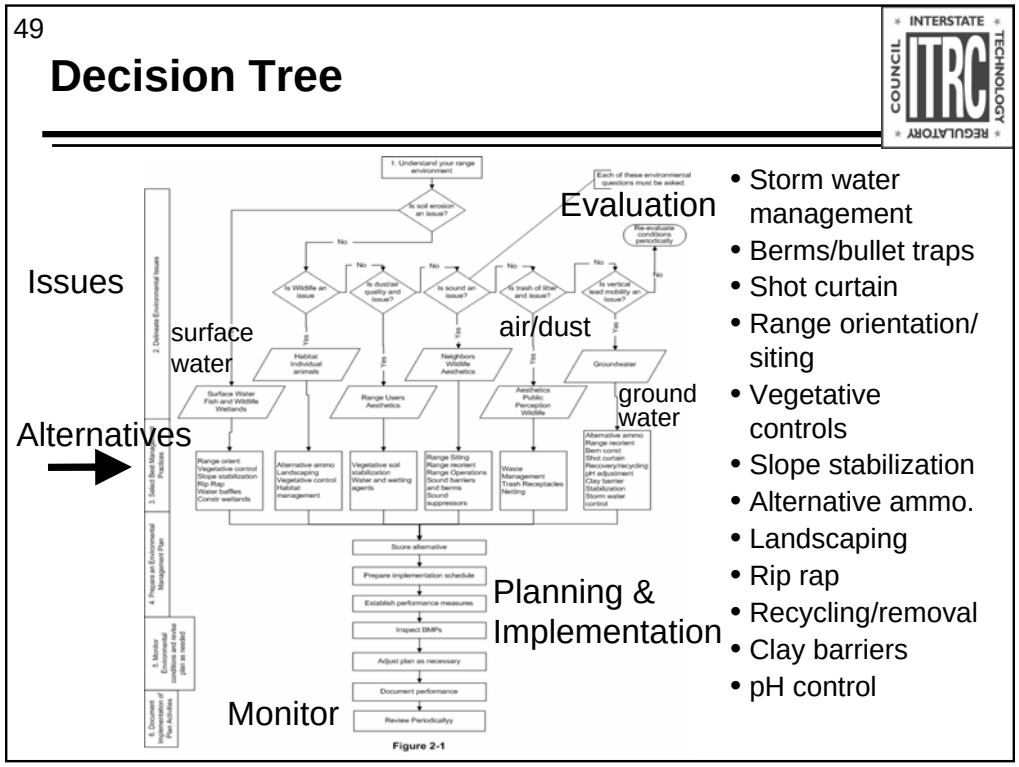


Figure 2-1, Environmental Management at Operating Outdoor Small Arms Firing Ranges, ITRC Smart-2, 2005

ITRC's Environmental Management at Operating Outdoor Small Arms Firing Ranges (SMART-2, February 2005) is available from the ITRC Web site (www.itrcweb.org) under "Guidance Documents" and "Small Arms Firing Ranges."

50

Identify Best Management Practices

No associated notes.

51

Range Environmental Management Goals

- Goal
  - Manage potential impacts posed by range activities on the environment, public health and/or public welfare
- Approach
  - Keep lead on-site and in its metallic form
    - "High Speed" – projectiles landing off site
    - "Low Speed" – erosion/dissolution
  - Prevent projectiles from impacting wetlands or surface waters
  - Reduce noise impacts to surrounding properties

No associated notes.

52

Range Environmental Management

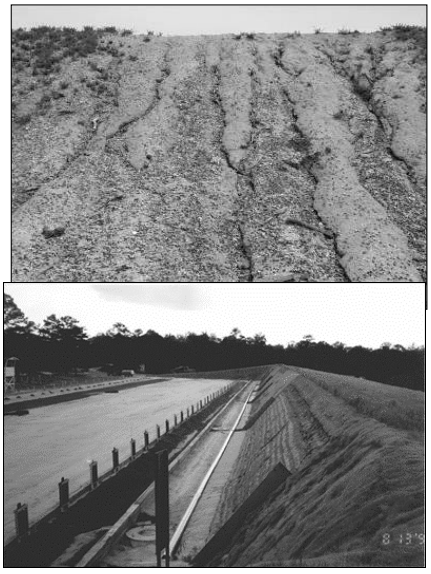
- Options are range specific
- Require a thorough understanding of range's environmental issues
- Understand the possible consequences of unmanaged issues
- Costs effectiveness and scheduling considerations

No associated notes.

53

Proactive Lead Management

- Lead removal/recycling
  - Surficial lead build-up creates safety issue
  - Mechanized or hand sifting (berms, trap, and skeet ranges)
  - Mixed metals may hinder recycling
- Grading/slope maintenance
  - Prevent erosion/washout
  - Improve bullet capture



When purchasing treatment additives, the range owner/manager should:

determine the credibility of the vendor,

review the application instructions to determine if the owner/manager has the capabilities to meet the requirements,

review the warranty that accompanies the additive to insure that the owner/manager protected from product failure,

require treatability study using range soil before purchasing.

ITRC's Characterization and Remediation of Soils at Closed Small Arms Firing Ranges (SMART-1, January 2003) is available from the ITRC Web site (www.itrcweb.org) under "Guidance Documents" and "Small Arms Firing Ranges."

54

Proactive Lead Management (continued)

- **Soil pH adjustment**
  - **Prevents lead dissolution ("slow speed")**
  - **Ideal pH range for lead**
    - **6.5 to 8.5**
  - **Adjust through amendment addition**
- **Chemical stabilization**
  - **Chemically binds dissolved lead**
  - **Commercially available products for lead**
    - **Phosphates**
    - **Sulfates**

See www.itrcweb.org "Characterization and Remediation of Soils at Closed Small Arms Firing Ranges" (Smart-1, 2003)

ITRC's Characterization and Remediation of Soils at Closed Small Arms Firing Ranges (SMART-1, January 2003) is available from the ITRC Web site (www.itrcweb.org) under "Guidance Documents" and "Small Arms Firing Ranges."

55

Proactive Lead Management (continued)

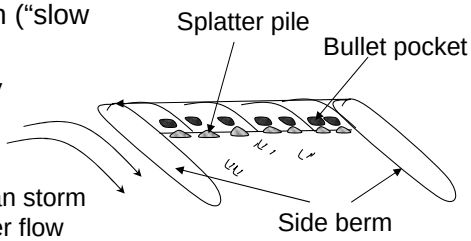
- Non-lead ammunition
  - Bullets
    - Copper, tungsten
    - Tungsten being reappraised
  - Shot
    - Steel
    - Others
- Advantages
  - Significantly reduces potential exposure to lead
  - May reduce need/cost of other lead management techniques
- Disadvantages
  - Higher cost of ammunition
  - May require more stringent oversight/compliance measures
  - Safety concerns

No associated notes.

56

Storm Water Management/Erosion Control

- Storm water management most significant issue in controlling lead migration ("slow speed")
  - Terracing/altering topography
  - Retention ponds
  - Side berms



- Erosion control
  - Rip-rap
  - Vegetation
  - Hay bales

Slow and divert water flow around high concentration areas

Regrade range floor to promote slower water flow if necessary

Keep berms and range floor vegetated (rhizome grasses) to prevent erosion and keep splatter pile from migrating

Amend soils on berms and range floor to promote vegetation (organic material, fertilizer, and lime)

Use 2:1 slopes or less on the berm face to discourage high rates of water movement and erosion

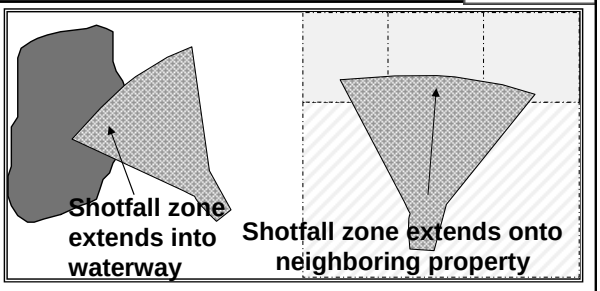
Compact soil in berm rather than use push and dump

Periodic removal of lead from highest concentration areas

57

Management to Prevent Impacts to Surface Water Bodies/Wetlands

- Realign to avoid shooting into them or onto adjacent property
- Containment
  - Shot curtain
  - Berms
- Non-lead ammunition



Alternatives include

- Steel
- Bismuth
- Tungsten alloys
- Copper

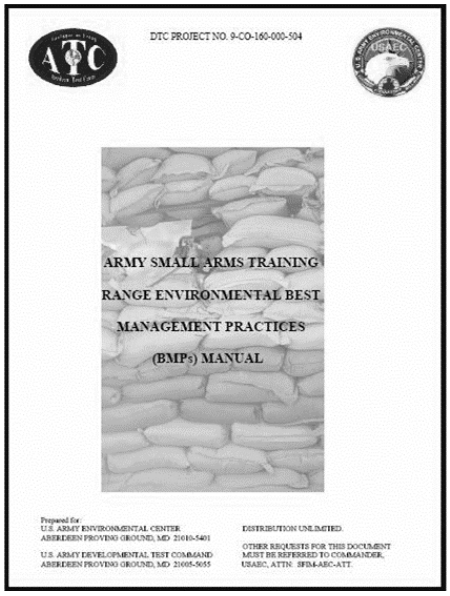
Consideration for use of alternatives

- Life-cycle cost
- Ballistics
- Health and environmental risk
- Safety
- Less supporting environmental product research
- Ammunition ban (e.g. not publicly available)

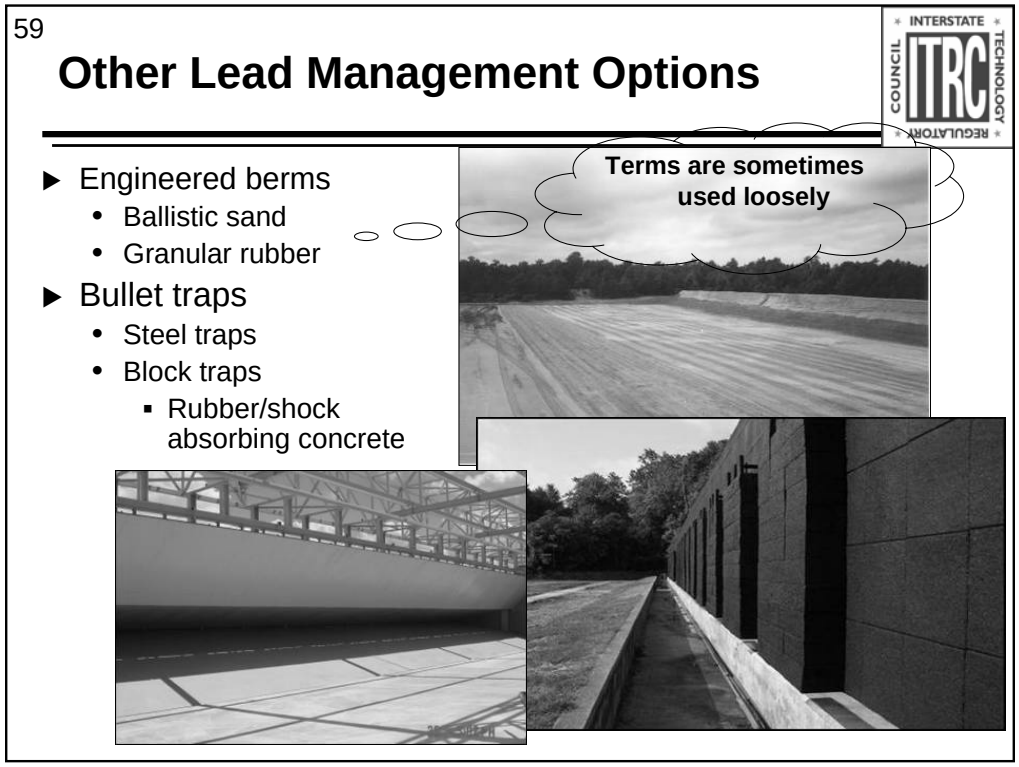
58

Management to Minimize Wildlife Exposure

- **Do not** shoot into water
  - Operational planning/Best Management Practices (BMPs)
- Incorporate vegetation that will not attract wildlife
  - Fescue grasses
- Manage other areas **away from** the range to be attractive to wildlife
- Proactive lead management



No associated notes.



Typical pathways for migration are overshooting, ricochet, or erosion/runoff

Berms, bullet traps and baffles are all components of a containment system

Containment critical for shooter/public safety

Berm are major components of outdoor rifle and pistol ranges

Berms consist of several types

Soil Berm – uses site or imported soils

Engineered Berm – Copius sand trap/Passive Reactive Berm

Granular Rubber Berm – similar to engineered berm, substituting granular rubber for sand

Managed for both safety and environmental stewardship

Periodic restoration to original dimensions and removal of the projectiles

Soil amendments

Reducing the contact between water and projectiles

60

Engineered Berms

- Typical berm detail
- Ballistic sand
  - Uses specifically graded sand
  - Simplifies maintenance
- Granular rubber
  - Some incorporate integral fire retardant
  - Same as ballistic sand, only uses granular rubber as ballistic material

No associated notes.

61

Granular Rubber Trap/Berm Construction

No associated notes.

62

Maintenance of Engineered Berms

- Patching/replacement of cover material
- Maintenance consistent with earthen berm
  - Periodic restoration to original dimensions
  - Proactive lead management
  - Storm water management

No associated notes.

63

Bullet Traps

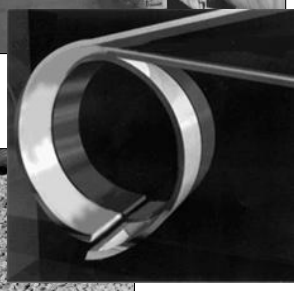
- Bullet traps are engineered systems for high-use/small footprint ranges
- Bullet traps consist of several types
  - Steel bullet traps – top/bottom ramp with deceleration chamber
    - May incorporate dust collection/filtration or “wet trap” design
  - Rubber or shock absorbing concrete block trap construction – media blocks stacked to serve as ballistic wall
- Managed for both safety and environmental stewardship
  - Periodic visual inspection of trap
  - Lead recovery and recycling
  - Reducing the contact between water and projectiles
  - Managing storm water runoff

No associated notes.

64

Maintaining a Steel Bullet Trap

- **Trap maintenance**
  - **Visual inspection**
  - **Periodic maintenance of conveyance systems**
  - **Periodic cleaning of filters (if equipped with filtration system)**
  - **Maintenance of water circulation system for "wet trap" (if equipped with wet system)**
- **Periodic lead removal**
  - **Individual buckets**
  - **Automated auger system**
- **Maintenance considerations**
  - **Frequency and duration of range downtime for maintenance**
  - **Bolt-in wear parts**
  - **Generally 10 year plus cycle for wear parts**



No associated notes.

65

Maintaining a Block Trap

- Trap maintenance
  - Visual inspection
  - Rotate target positions to extend trap life
  - Periodic replacement of "saturated" blocks
- Periodic lead removal
  - Shock absorbing concrete disposed of as non-hazardous waste
  - Rubber blocks recycled at a secondary smelter
- Maintenance considerations
  - Frequency and duration of range downtime for maintenance
  - Weight of blocks
  - Replacement of a block requires removal of all blocks above it in the ballistic wall

No associated notes.

66

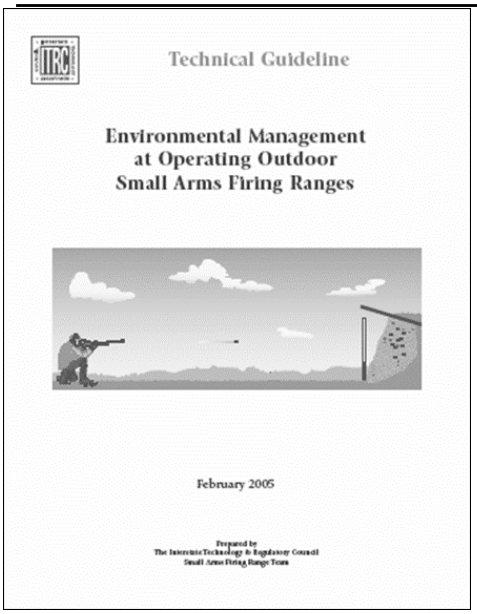
Best Management Practices – Summary

- Range management requirements to be considered
  - Size and location of the range
  - Types of weapons/training requirements
  - Number and types of rounds to be fired per lane
  - Targetry system requirements
- Site-specific environmental conditions
  - Static temperature during operations
  - Statutory snow and wind loads (bullet traps)
  - Anticipated rainfall
- Visit an operating range with similar equipment is suggested prior to design/procurement
  - Interview end-user
  - "Kick the tires"
- Get "real" O&M costs and design/procure based on life-cycle cost analysis
  - Range down time needs to be factored into life-cycle costs

No associated notes.

67

Environmental Management Planning: Select and Implement



- Establish and accept environmental stewardship principles
- Understand your range environment
- Delineate environmental issues
- **Select best management practices**
- **Prepare and implement an environmental management plan**
- Monitor environmental conditions and revise plan as needed
- Document implementation of plan activities

www.itrcweb.org SMART-2, 2005

No associated notes.

68

Select Best Management Practices

	Shotgun Ranges	Rifle/Pistol Ranges
Potential Operational Approaches	Shot recovery and recycling Target recovery Alternative shot materials Chemical soil treatment/amendment	Bullet recovery and recycling Chemical soil treatment/amendment Non-lead bullets
Potential Engineering Approaches	Range siting Clay layers/mixing Physical barriers to shot distribution 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 Storm water management/erosion control	Range siting Clay layers/mixing Bullet containment Baffles/tube ranges Berm construction and maintenance Bullet traps Runoff controls Storm water management/erosion control

No associated notes.

69 **Select Best Management Practices**

Table 4-2 Environmental Management at Operating Outdoor Small Arms Firing Ranges

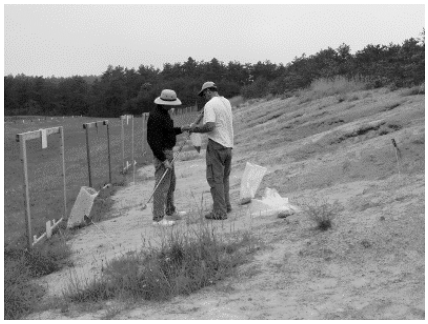
Criteria	Weighting Factor	Alternative 1	Alternative 2	Alternative 3
Health and safety impacts				
Erosion prevention				
Wildlife benefits				
Air benefits				
Surface water benefits				
Groundwater benefits				
Soil benefits				
Cost				
Professional assistance level needed				
Range operations impact				
Ease of implementation				
Timing				
Regulatory benefits				
Maintenance				
Reliability				
Total Score				

ITRC's Environmental Management at Operating Outdoor Small Arms Firing Ranges (SMART-2, February 2005) is available from the ITRC Web site (www.itrcweb.org) under "Guidance Documents" and "Small Arms Firing Ranges."

70

Complete the Environmental Management Plan (EMP)

- However simple or detailed the planned actions may be for a range, it is important to record the basis for decisions and to lay out a guide for future actions in an Environmental Management Plan



No associated notes.

71

Contents of an Environmental Management Plan

- Checklist for an Environmental Management Plan (EMP)
  - Establish baseline site conditions (photos, maps, descriptions of range conditions, any test results)
  - Evaluate alternative best management practices
  - Justification for selected alternatives
  - Implementation description and schedule
  - Operation and monitoring schedule and results (range conditions during and after Best Management Practice activities)
  - Plan review and modifications

ITRC's Environmental Management at Operating Outdoor Small Arms Firing Ranges (SMART-2, February 2005) is available from the ITRC Web site (www.itrcweb.org) under "Guidance Documents" and "Small Arms Firing Ranges."

72

Environmental Management Planning: Monitoring

- Monitor and evaluate whether
  - EMP is being implemented effectively
  - Adjustments must be made to the plan to achieve the desired goals
- Evaluate effectiveness relative to baseline conditions or most recent monitoring
- Quantitative and qualitative measurements can be used

No associated notes.

73

Implementation Documentation

Table 4-4 Environmental Management at Operating Outdoor Small Arms Firing Ranges

Project or Action	Person or Primary Responsibility	Initial or Recurring	Start Date	Completion Date	Cost

Table 4-4 Environmental Management at Operating Outdoor Small Arms Firing Ranges

ITRC's Environmental Management at Operating Outdoor Small Arms Firing Ranges (SMART-2, February 2005) is available from the ITRC Web site (www.itrcweb.org) under "Guidance Documents" and "Small Arms Firing Ranges."

74

Environmental Management Planning – Summary

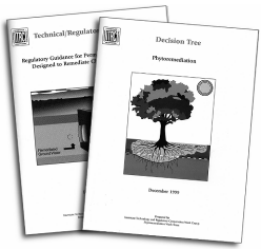
- Put an Environmental Management Plan together
  - Identify baseline conditions: disposition of lead/other metals, impacts
  - Identify appropriate Best Management Practices
  - Select and implement
  - Review periodically, revise plan as needed and implement
  - Document, document, document

No associated notes.

75

Thank You for Participating

- **Links to additional resources**
  - **http://www.clu-in.org/conf/itrc/smartemp/resource.cfm**
- **2nd question and answer session**



Links to additional resources:

http://www.clu-in.org/conf/itrc/smartemp/resource.cfm

Your feedback is important – please fill out the form at:

http://www.clu-in.org/conf/itrc/smartemp

The benefits that ITRC offers to state regulators and technology developers, vendors, and consultants include:

Helping regulators build their knowledge base and raise their confidence about new environmental technologies

Helping regulators save time and money when evaluating environmental technologies

Guiding technology developers in the collection of performance data to satisfy the requirements of multiple states

Helping technology vendors avoid the time and expense of conducting duplicative and costly demonstrations

Providing a reliable network among members of the environmental community to focus on innovative environmental technologies

How you can get involved with ITRC:

Join an ITRC Team – with just 10% of your time you can have a positive impact on the regulatory process and acceptance of innovative technologies and approaches

Sponsor ITRC's technical team and other activities

Be an official state member by appointing a POC (State Point of Contact) to the State Engagement Team

Use ITRC products and attend training courses

Submit proposals for new technical teams and projects