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BC Wildlife Federation:
Standards and Best Practices for Lead Management

Implementation Manual

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1.0 Introduction

Public and regulatory concern about the potential effects of lead in the environment has dramatically increased over the years. Potential risks associated with environmental and human exposure to lead in air, paint, drinking water, surface waters, soils and sediments are potentially significant, and shooting ranges are under increasing scrutiny. At least one club with a shooting range has had legal action taken against it regarding allegations of lead pollution by a neighbour wanting to close down their range.

According to the US Environmental Protection Agency, “firing ranges can damage the environment and contaminate the soil, and possibly the groundwater, with lead from the bird-shot, bullets and bullet fragments, as well as produce airborne lead dust. The impacts of lead in firings ranges is long lasting, and when bullets are left in shooting ranges, the lead oxidizes in exposure to air and acidic soil conditions. These lead bullets, bullet particles, or dissolved lead can be moved by off site by storm water runoff. Dissolved lead can then migrate through soils to groundwater, leading to contamination of soil in the area.” In addition, shotgun ranges area of particular concern due to the small size of the projectiles and the wide area of dispersion. “

The issue of lead pollution at outdoor shooting ranges is a very real operational issue that gun clubs are going to have to deal with. If BCWF affiliated clubs are found to be polluting the environment, it could damage the credibility of the BCWF as a whole, and adversely affect our ability to promote environmental stewardship and conservation goals. The presence and allegations of a contaminated site could also present enormous financial costs that could eventually bankrupt the club, leading to its demise.

For example: As a result of a complaint by a neighbor, The Ministry of Environment ordered the Salt Spring Island Rod and Gun Club (SSIRG), to carry out a site investigation, despite the fact they were found not to be a pollution nuisance in an earlier proceeding. It would appear as though shooting ranges are vulnerable to allegations of lead pollution, and a club is required to prove they are not polluting. Proving innocence can become expensive if allegations are made, as a ministry required “site investigation report” and “summary site conditions report” cost can cost $75,000 and $17,500, respectively (or more).

Unlike in the US, there are currently no Canadian standards for lead management and remediation of outdoor shooting ranges. This lack of prescribed standards could result in clubs with outdoor shooting ranged contributing to lead pollution inadvertently.

The purpose of this document is to outline preliminary standards and best practices for lead management and provide actionable best management practises that can be implemented at ranges, as to be proactive, manage risk in regards to possible allegations, and maintain positive community goodwill.

2.0 Development of an Environmental Stewardship Plan

Pro-active management of environmental issues has become an essential component of sound operation of an outdoor shooting range. To prepare for and help minimize the potential consequences of an environmental challenge, ranges should pro-actively develop and implement a site-specific Environmental Stewardship Plan (ESP) for managing shooting-associated materials. An outline for the ESP can be found in appendix 1.

An ESP is a written guide or “road map” for planning, implementing, monitoring, and documenting the progress of environmental management and improvements at your shooting range. A site-specific ESP is the best and most cost-effective way for a range to minimize the potential for serious consequences from environmental issues. Developing and implementing an ESP tends to:

a. discourages (but not prevent) legal and regulatory actions
b. aid in systematically gathering and evaluating the information necessary to determine whether there are legitimate environmental concerns at your range
c. document the fact that no legitimate environmental issues are identified, or help identify effective and appropriate ways to resolve any legitimate environmental concerns that may be identified
d. demonstrates the need for action to members and/or shooters
e. assist in making prudent and cost-effective environmental management decisions help avoid potentially huge costs, long-term liabilities, legal uncertainties, and adverse public relations of dealing with environmental allegations

All ranges should have a site-specific ESP. Existing ranges that do not yet have an ESP should initiate ESP development and implementation promptly. Ranges in the planning or construction process should take advantage of the opportunity to coordinate ESP development and implementation into the design and construction process for maximum efficiency and so operations can begin with best environmental practices. Existing ranges planning expansions should integrate revision of their ESPs into expansion plans.

Development of an ESP is best approached in a series of sequential steps as follows. Following these steps will help overcome initial hurdles and provide the range with a useful initial ESP and the capability of revising and refining the ESP over time.

a. The first step is to take a formal action committing to development and implementation of an ESP consistent with the EPA guidance, (vote of the directors, decision by owners, etc.) and record the action in some “official” way to establish the date of formal initiation of ESP development.
b. The second step is to identify the personnel who will develop the ESP and assign them to the task.

c. The third step, and the first thing these personnel should do, is to read the EPA and NSSF guidance carefully in light of the conditions, environmental setting, and possible environmental issues at their range. The next few are intended to encourage and assist range personnel that may have little experience and perhaps little capability in environmental assessment or management in developing an ESP consistent with the environmental conditions, financial capabilities, and public relations needs specific to the particular range. This process will lead to development of an initial ESP that is complete, reliable, and useful, although there may well be areas in which it may be appropriate to add details and make refinements as experience is gained through implementation.

Those responsible for development of an ESP should decide whether the range should develop the ESP itself or have it developed professionally (in which case the responsible personnel should work closely with the professional throughout development of the ESP).

a. Self development of your ESP involves one, and preferably more, staff, members, or shooters interested in the topic, and will take a few to many months. Once a complete draft is developed, those responsible may well realize they can do a better job now that they are familiar with the topic, and will develop several iterations before they are comfortable staking the future of the range on the ESP. This process usually results in a helpful ESP and provides “buy-in” among shooters and members as the developers talk about their work as it progresses, and is inexpensive. However, it takes an unknown length of time, often many months, before a satisfactory ESP is available. Even then, a self-developed ESP may not provide the confidence that a professionally developed ESP offers.

b. Professional development of your ESP involves location of a qualified professional experienced specifically in developing ESPs for outdoor shooting ranges.

A qualified professional will provide a state-of-the-practice ESP consistent with current guidance and science/engineering, and can do so within a few weeks, if necessary. The cost of a professionally developed ESP varies with the variety of shooting activities addressed and the complexity of the environmental setting within which they take place. Professional development of an ESP is usually advisable if:

i. accumulated shot, targets, wads, or bullets are found at any point on the range property boundary
ii. Bullets, shot, wads or targets fall into water or wetlands iii.
iii. The range is on property previously used in a way that may have resulted in contamination of soil, sediment, surface water or groundwater, or is down gradient of property previously or presently used in such a way iv. any portion of the range property containing shot, targets, wads, or bullets contains, or provides critical habitat for, any listed State or Federal threatened or endangered plant or animal species v. any portion of the range property containing shot, targets, wads, or bullets is up gradient of a nearby drinking water well or a nearby surface water body used

for potable water vi. there is any reason to put a state-of-the-practice ESP in place quickly

Preparing an ESP involves six interrelated steps. Whether a range develops its ESP itself or has it professionally developed, the range personnel responsible for the ESP will be involved with the following general steps. During ESP development the emphasis is on the first four, with consideration of the last two. During ESP implementation the emphasis is on the latter two, which requires consideration of the first four.

a. evaluation of existing conditions
b. identification of site-specific environmental issues
c. identification of appropriate management actions
d. preparation of the ESP
e. ESP implementation
f. periodic ESP evaluation and updating

3.0 Lead Standards

Lead can be an issue at any outdoor shooting range for humans, wildlife, and plant-life. Ensuring that lead concentrations are within their legal limits is of the utmost importance because there are large social and economic costs associated with lead exceeding these standards. Important for developing an ESP, is understanding how the standards and regulation put in place for lead management interrelate with identifying site risk potential, as well as best management practices to deal with potential threats. Outlined in Appendix 2 and 3, are the basic ways in which lead is transported throughout the site and site characteristics that are conducive to increased risk of lead pollution.

3.1 Measurement of Lead Levels

Lead levels are measured in two different ways. The first way in which lead is measured is by calculation of the mg/kg of lead in a certain sample. The second standard in which lead mobility is measured is through the TCLP (toxicity characteristic leaching procedure) method. This method is specified by the BC Ministry of Environment (MoE) Hazardous Waste Regulation (HWR) to determine whether a material leaches concentrations that would classify it as a hazardous waste. Since the TCLP method does not simulate the natural environment, samples should also be analyzed with using the Synthetic Precipitation Leaching Procedure (SPLP), which better simulates the conditions of the natural environment.

Soil standards are divided into categories based on land use. Agricultural land use (AL), urban park land use (PL), wild-lands land use (WL), residential land use (RL); commercial land use (CL), and industrial land use (IL) were each considered, to determine their applicability to the Site.

3.2 Regulations

	Lead Concentration (mg/kg)	TCLP (mg/L)
British Columbia Soil Standards	400	5

This table provides a simple introduction to general standards in BC for most shooting ranges. A majority of shooting ranges will be zoned under urban park (PL) and residential (RL), so these standards will apply in most cases. For a more in-depth table comparing different land use zones and geographical variables in regards to lead concentration standards, refer to Appendix 6.

These standards will need to be met under and site investigation order by the MoE upon request. For further information, visit section 3.4 for a brief on potential liabilities and consideration when dealing with the MoE.

3.3 Assessment

To determine range specifics regarding lead standards, it is recommended that a BC approved hazardous site professional be brought in to conduct a preliminary site investigation and detailed site investigation. Refer to Appendix 4 for a list of approved professionals. During this process, various samples and data will be analyzed to determine if environmental standards have been violated and the likeliness of an environmental concern in the future.

Concurrently, this will help communicate to the ministry that you are aware of the potential problem, and taking proactive measures to help mitigate any future concerns. Hiring a firm to perform a site investigation could potentially be an expensive process, but would yield invaluable knowledge for site planning and future litigation.

If this option is not economically feasible for your range, then there are some steps that range owners can go through to determine their site's risk of exceeding environmental standards. pH is an important factor when considering potential for lead to leach into the environment, so it would be advantageous to take period pH samples around the site every 6 months. pH meters can be purchased from most home and garden shops and they will give the range owner an idea of the potential problem. pH ranges from 6-8 indicate that it is unlikely lead will oxidation and leach off the property. A good rule of thumb is that lead will be very immobile when pH is greater than 7.5, but lead dissolved in acidic (less than 6) groundwater and soil may be very mobile.

The owner must also consider the geographical landscape of their site. For a brief summary of site factors and their impact on lead mobility, please refer to Appendix 3. Among many site

considerations, the most important is proximity to bodies of water. It should also be noted that the only way to reduce concentration of lead on site is to physically remove it, so consideration should be given for budgeting of lead removal and possibly lead containment traps for future use.

3.4 Liability

This section will provide a brief overview of the legal environment and the contaminated site standards enforced by the provincial government of British Columbia. The information that will be discussed is located in full form under chapter 53, part 4 of the BC's Environmental Management Act.

It is important to note that a director may order an owner or operator of a site, at the owner's expense, to undertake a preliminary site investigation or detailed site investigation and to prepare a report of the investigation in accordance with the regulations. A report can be requested if the director has a reasonable suspicion that the site is either contaminated, or contains substances that may threaten or cause adverse effects on human health or the environment. Also, the owner or operator is liable for any of the costs incurred by the site investigations, meaning that the shooting range will bear all of these costs. In the Salt Spring Island Gun Club case, the club was required to have a detailed site investigation done, costing $75,000 plus $17,500 for the MoE review.

If the site turns out to be a "contaminated site" under provincial lead standards, then it will be necessary to establish who is responsible for the cost of remediation. Under Division 3 of chapter 53 in The Environmental Management Act, persons responsible for remediation simply put are those who currently or historically owned or operated a contaminated site that produced the substance and caused the site to become contaminated.

If the contamination migrates on to another's property, similar rules apply where the owner or operator of the contaminated property is liable for the remediation and cleanup of any contamination that is directly caused by on-site activities. However, it should be noted that the purchaser is not liable for remediation if the site was contaminated and the person had no knowledge or reason to suspect that it could be contaminated, and took all appropriate inquiries into the previous ownership.

In short, the person or organization that is responsible for the pollution is responsible for the costs of remediation. In the case of leased land, the polluter is still responsible for the costs of remediation, unless there is a clause in the contract for this issue.

Outlined in Section 9.0, is a summary of a recent case in which the Salt Spring Island Rod and Gun Club has dealt with a neighbor who made allegations to the ministry regarding lead pollution leaching on to his neighboring property

4.0 Lead Management Best Practices (BMPs) to Consider

The information on the various alternatives presented below were collected from The US Environmental Protection Agency (EPA)'s "Best Practices for Lead at Outdoor Shooting Ranges", The NSSF's "Environmental Aspects of Construction and Management of Outdoor Shooting Ranges", WFSA case studies, and a variety of scholarly articles.

To operate an outdoor range that is environmentally protective requires implementing an integrated lead management program, which incorporates a variety of appropriate best management practices (BMPs). These BMPs create a four step approach to lead management:

Step 1 - Control and contain lead bullets and bullet fragments.
Step 2 - Prevent migration of lead to the subsurface and surrounding surface water bodies.
Step 3 - Remove the lead from the range and recycle.
Step 4 - Documenting activities and keeping records.

An effective lead management plan will require implementing and evaluating BMPs from each of the 4 steps. It should be noted that steps 1-2 do not negate the need the need for removal of lead, but are practices that should be completed between lead reclamation events. It's also important to note that cost and complexity of practises vary greatly, and it is your ranges individual characteristics that will determine which should be implemented. Refer to Appendix 7 for a full list of potential BMPs applicable to both shotgun ranges and rifle/pistol ranges. Refer to Appendix 5 for a list of vendors and service providers of these practices

4.1 Step 1 - Control and Contain Lead Bullet

Knowing where spent lead will allow the appropriate BMP to be used. The single most effective BMP for managing lead in these areas is by bullet containment. Owners/operators should employ a containment system that allows for the maximum containment of lead on-site. The BMPs listed in this section are only for reference because the applications needed for different site conditions vary greatly.

4.1.1 Earthen Berms and Sand Traps

The earthen backstop is the most common bullet containment mechanism for rifle and pistol ranges. The earthen backstop is generally between 15-20 feet high with a recommended slope as steep as possible. In many instances backstops are naturally occurring hillsides. With the earthen berm, the operator must ensure the berm is free of large rock and debris because these materials will increase chance of fragmentation, making lead reclamation activities more difficult.

A variation of the earthen backstop is the sand trap. The sand trap is normally a mound of soil between 15-20 feet high located directly behind the bullet target, serving as a tool for controlling lead and contact water. Like the earthen berm, periodic maintenance is required to ensure safety. The uppermost layer (to a depth of 1 to 2 feet) must be free of large rocks and other

debris to reduce ricochet and bullet fragmentation, and to facilitate reclamation efforts. There may also be an impermeable layer (e.g., clay or liner) under the sand to prevent lead from contacting the soil underlying the trap.

While both options are sufficient for short term control of lead, sand traps are the better option due to the lower lead concentration present because of sand's lower field capacity, organic matter, and a higher pH compared to soil (Liu 2012). Replacing a soil berm with sand would be a viable practice in reducing bullet weathering at a low cost. For existing earthen berms, a layer of ballistic sand (2-4 ft.) should be added to reduce the ability for lead to weather and leach into soil. Lime and phosphates should be mixed in with sand to raise pH and decrease the mobility of lead.

4.1.3 Containment Solutions for Shotgun Ranges

Unlike rifle and pistol ranges, the area impacted by lead shot fired at trap, skeet and sporting clay ranges is spread out and remains primarily on the surface. Knowing where spent lead is allowing for appropriate BMPs to be used. The most effective practice for management of lead at a trap and skeet range is reducing the shot fall zone. It is possible to concentrate the lead shot in a smaller area by modifying the shooting direction into a smaller, more condensed area to make the reclamation process simpler and more effective.

Trap Fields

One way to reduce the shot fall zone at trap fields is to build the fields at an angle to one another. This will make the shape of the shooting dispersal pattern smaller and more concentrated. However, if you do decide to choose this option, be aware of safety issues when designing the overlapping shortfall zones.

For a range with only one trap field, one way to minimize the shot fall zone is to keep trap machines set in as few holes as possible (e.g., the number two or three hole setting). This reduces the area of lead concentration by limiting the angles for pigeon (clay) throwing, and therefore the area for lead shot fall. However, when two or more trap fields are positioned side by side, the shot fall zone will be continuous regardless of the "hole" setting.

Shot Curtains and Ground Covering

Another method to consider for concentrating lead shot is the use of a shot curtain. This device is emerging as a potentially effective tool to keep lead shot out of selected areas of the range, thereby, reducing the size of the shot fall zone and corresponding cost of reclamation. Different designs and material have been utilized in shot curtains and a number are in operation.

An untested option would be to a have permeable layer of cloth, rubber, or polyester covering the ground of the shot fall zone. This permeable layer would allow water to pass through, but would catch lead and allow for easy reclamation. Lead could be collected routinely as to not pose an environmental risk through the weathering of lead. More research should be done on this, including viable materials, costs, and implementation, but in theory it has the potential to solve the problem of future lead deposits at shotgun ranges.

4.2 Step 2 – Best Management Practices to Prevent Lead Migration

4.2.1 Lime Addition

The best management practice for monitoring and adjusting soil pH is an important range program that can effect lead migration. Of high concern are soils with low pH values, because lead mobility increases in acidic soil conditions since the lead is more likely to break down. The ideal soil value for shooting ranges is between 6.5 and 8.5.

For this BMP there is an actionable step that owners/operators can take. To determine the pH of your soil, you can purchase a pH meter at any lawn and garden center. They are inexpensive and will allow you to have more control over the lead migration at your particular site. According to the US EPA, if pH is **less than 6**, it is recommended that pH should be raised by **spreading lime**. If pH **greater than 8,** do not add lime because this could increase mobility of lead. pH should be **checked annually**. Heavily wooded areas on sporting clay sites should be checked **semi-annually.** Multiple samples around the site should be taken.

Lime spreading should occur around earthen backstops, sand traps, trap and skeet shortfall zones, sporting clays courses and any other areas where the bullets/shots or lead fragments/dust accumulate. Spreading lime over the shot fall zone will help to raise the pH of the very top soil layer to a pH closer to ideal levels and reduce the migration potential of lead. This is an easy, low cost method. Spreading lime neutralizes the acidic soils, thus minimizing the potential for the lead to degrade.

Spreading bags of 50 pounds per 1000 square feet of range will raise pH approximately one pH unit for a period between one and fours years (US EPA). The market price of lime in either the granular or pelletized form commonly ranges from approximately $2.00 to $4.00 per fifty-pound bag (2016). Bags of lime can be purchased from most garden and lawn centers. It is important to measure pH at least once a year after application of lime because its effectiveness will decrease after time. If the site has a regular acidic pH, routine yearly applications will be necessary.

4.2.2 Phosphate Addition

In addition to lime spreading, another way to control lead migration is phosphate spreading. This method is recommended where lead is widely dispersed in range soils, a range is closing, or there is a high potential for vertical lead transport to groundwater (e.g., low soil pH, shallow

water table). Unlike lime spreading, the main purpose of phosphate spreading is not to adjust soil pH but to bind the lead particles. This process also decreases the potential amount of lead that can migrate off-site or into the subsurface. Phosphate spreading can be done either separately or in conjunction with lime spreading. Generally, 15 to 20 pounds of phosphate per 1,000 square feet will effectively control the lead.

Phosphate spreading is especially recommended for sporting clays ranges and those parts of ranges not easily accessible by reclamation equipment. Phosphate spreading should be repeated frequently during the range's lifetime. Phosphate can be bought in its pure form, or as phosphate rock, or as lawn fertilizer. The average 40 lb bag of fertilizer costs around $10 and contains 25% phosphate. This is a very cost effective options for controlling lead. A recent study found that phosphate amendment is most effective in immobilizing lead in any kinds of shooting range soils and it will bring TCLP concentration below the required standard (Cao 2008). Therefore, phosphate is more effective than lime spreading at controlling lead, however both practices should be used. Like lime spreading, phosphate should be reapplied on a yearly basis.

4.2.3 Controlling Runoff

The BMPs for controlling soil erosion and surface water runoff are important to preventing lead from migrating off-site. There are two factors that influence the amount of lead transported off-site by surface water runoff: the amount of lead fragments left on the range and the velocity of the runoff.

4.2.4 Vegetative Ground Cover

Planting vegetative ground cover (such as grass) is an easy erosion control method. Vegetation provides several benefits by minimizing the amount of lead that will run off the land surface during heavy rainfall. Ground cover absorbs rainwater, which reduces the amount of water the lead is in contact with, as well as the time that the lead is in contact with the water. Furthermore, the ground cover will divert and slow down surface water runoff, thus helping to prevent lead from migrating offsite. Grasses yield the greatest benefit at rifle and pistol ranges where the bullet impact areas are sloped, and water runoff and soil erosion may be more likely.

- Utilize quick growing turf grass (such as fescue and rye grass)
- Avoid vegetation that attracts bird or other animals
- Use grass to direct runoff water away from problem areas (e.g., planting them at the top of the backstop or sand-trap

Grass does a great job at slowing down the rate of flow and reducing the amount of lead entering the soil via rainwater. However, it does require periodic maintenance to maintain its effectiveness and aesthetic appeal.

4.2.5 Surface Covers

For outdoor rifle and pistol ranges, impact backstops and target areas can also be covered with roofed covers or other permanent covers to prevent rainwater from contacting berms. However, this method may be less desirable because of the cost to install the roof, which must be carefully designed to avoid safety issues with ricochets, etc.

4.2.6 Engineered Runoff Controls

At shotgun ranges, dams and dikes can also be used to reduce the velocity of surface water runoff. Dams and dikes must be positioned perpendicular to the direction of runoff to slow the flow of surface water runoff. To accomplish this, determine the direction of the range's surface water runoff. This will be particularly obvious at ranges with sloped terrain. The dams or dikes should be constructed using mounds of dirt that are approximately a foot high. These mounds should transect the entire range, perpendicular to the storm water runoff direction.

These runoff controls are most important at ranges at which off-site runoff is a potential problem, such as ranges where the lead accumulation areas are located up-gradient of a surface water body or an adjacent property. Since lead particles are heavier than most other suspended particles, slowing the velocity of surface water runoff can reduce the amount of lead transported in runoff.

4.3 Lead Removal and Recycling

To successfully minimize lead migration, the most important BMP for lead management is lead reclamation. Implementing a regular reclamation program will allow you to avoid expensive remediation and potential litigation costs. Ranges in regions with high precipitation and/or with acidic soil conditions may require more frequent lead recovery since the potential for lead migration is greater.

4.3.1 Hand Raking and Sifting

A simple BMP that can be done by club members, particularly at small ranges, is raking and/or sifting bullet fragments from the soil. Sifting and raking activities should be concentrated at the surface layer. This is a low technology and low-cost management alternative for lead reclamation.

At trap and skeet ranges, conducting sifting and raking activities in the shot fall zone (approximately 125 - 150 yards from the shooting stations) will yield the most lead. For sporting clay ranges, these activities should be conducted around tree bases, where lead shot tends to collect. Basically, the process consists of raking with a yard rake the topsoil in the shot fall areas into piles, as if you were raking leaves, removing any large debris (e.g., rocks, twigs, leaves, etc.), and then sifting the soil using screens.

Once the soil has been raked and collected, pass it through a standard 3/16-inch screen to remove the large particles. This process will allow the lead shot sized particles to pass through the screen. The sifted material (those not captured by the 3/16-inch screen) should be passed through a 5/100-inch screen to capture the lead and lead fragments. Screens can be purchased at many local hardware stores.

Raking and sifting can be performed by club members on a volunteer basis. It is recommended that the club provides incentives for participation, such as reduced fees, or special events. Ranges have been known to hire high school and college students in the summer. This technique may be a cost effective strategy for small scale ranges, but larger ranges may not benefit.

4.3.2 Hiring a Professional Reclamation Company

Another option for lead removal is to hire a professional reclamation company. Lead reclamation companies claim to recover 75%-95% of the lead in the soils. Generally, with reclamation companies there is no minimum range size requirement for lead reclamation. Concentration of lead is more important than quantity spread over a field, especially if it is a difficult range for reclamation (e.g., hilly, rocky, a lot of clay in the soil). Many Ranges may even find lead reclamation to be a profitable endeavour due to the high value of lead.

These companies are often in high demand, and it may take over a year for the company to start at your club. It would be wise to plan ahead and make the call as soon as possible.

Some reclamation companies require a site visit to view the topography, the soil composition, and amount of lead observed on the ground. During the visit, some companies may even do a site analysis to determine whether or not it is feasible to reclaim. This analysis identifies the location of lead, the expected recovery amount, and the depth lead reaches into the soils. It is recommended by reclamation companies that lead be reclaimed every 5-10 years depending on site condition and range usage. Some ranges may break even, or possibly profit off of lead reclamation activities.

4.4 Documenting Activities and Record Keeping

Documenting activities and keeping good records is of paramount importance for an effective lead management program at a range. Owners/operators should document all activities done at the range with respect to BMPs and recycling of lead. Records should be kept on when services were provided and who provided them. Refer to Appendix 2 for a template to record maintenance activities.

The records should be kept for the life of the range. Records may be used to show that owners/operators are doing their part to help prevent lead migration off-site, and that they are doing their part to be stewards of the environment.

4.4.1 Shot Counting and Lead Estimation

The easiest way ranges can determine the amount of lead at their shooting range is by keeping track of how many sporting clays that have been thrown at the shotgun range. According to the NSSF, a 12-guage shot contains 1/12th pounds of lead. This means that the range operator could assume that 1/12th a pound of lead is being deposited within the shortfall zone of the range per clay. With full information of reclaimable lead, the range operator has a greater ability to consult with a reclamation company to perform reclamation activities at the point when there is enough lead for it to be profitable. According to MT2, a U.S. company specializing in lead reclamation and soil remediation, a range with average use can reclaim their lead profitably between 5-10 years.

4.5 Non-Lead Alternatives

Another method of preventing lead contamination at pistol, rifle, trap, skeet, or sporting clays ranges is to use less toxic or non-lead ammunition. While non-lead alternatives may not be the most ideal best management practise currently, it presents the best opportunity for the long-term sustainability of sport shooting.
Currently Steel (soft iron) shot is being pushed by the ISSF to replace lead shot in the Olympics. The push for lead based shotgun ammunition is based on the enormous volume of cartridges fired by competitors, parity with prices for lead cartridges, the suitability of steel shot to be used in trap and skeet events, and the ease of substitution for lead shot in conventional 12 and 20-gauge shotgun cartridges. Given the lower density of steel shot versus lead shot, it is necessary to use steel shot of a larger diameter than the lead equivalent, coupled with an increase in shot velocity, to achieve the same ballistic efficiency and effective range. Thus a shot diameter of 2.6 mm might be advisable for Olympic trap shooting, in which targets may be broken at a longer distance than in skeet shooting.

Detractors from the use of steel shot cartridges argue that damage to the choke of barrels could occur. That is a possibility with heavy magnum steel cartridge loads with large diameter shot ([3.6 mm) fired through barrels with abrupt large choke constrictions (i.e., full and extra full choke).

A switch to steel shot for shotgun disciplines will effectively eliminate the large amount of lead pellets currently being deposited into the environment.

5.0 Issues Management

5.1. Be Proactive

Under all the laws and regulations, the province puts forth, the range is responsible for knowing the requirements and the meeting them. Ranges that are in alleged to be in violation face at very least an uphill expensive, and uncertain legal/regulatory battle and public relations battle to put an end to the allegations in some way.

The most fundamental encouragement for ranges is to develop an environmental stewardship plan. Once a legal or regulatory environmental action is triggered, specific legal/regulatory processes come into play. These often result in actions selected by persons other than range managers with objectives different from those range managers and therefore could threaten wellbeing of the range. Pro-active development and implementation of a site-specific ESP allows range managers to identify and address issues within their budget and schedules in a way consistent with long-term range operation.

Another way to stay ahead of potential allegations is to maintain a proactive and continuous public relations effort. Completely eradicating the potential for lead to end up on a neighbor's property may not be possible. Therefore, proactively maintaining good relationships with your neighbors, town, and local media is an extremely important interaction that can assist in preventing lead pollution complaints. For public relations it is essential that your range communicate to the public that you have an environmental stewardship plan for dealing with lead. Outline what you are doing to problems from occurring. This will help create goodwill and trust amongst those worried about the issue of lead pollution. Provide your environmental stewardship plan on your club or range website to show that you are indeed meeting your responsibilities. The key is being open and honest with the public about what you are doing to ensure you are doing your part.

5.2. Dealing with Allegations/Complaints

When dealing with potential allegations or complaints, it is crucial that they are taken seriously and responded to with utmost professionalism. Refer to **Appendix 9** for a template in dealing with issues brought to attention by allegiants.

Since the MoE may consider allegations made with minimal or no substantial evidence, it is crucial that the range be in a position to refute the possibility of the lead contamination with a site investigation report that has timely data. It is important to show empathy and legitimate concern for the complainant's issue, but the facts are necessary to prove that in fact, you are either aware of potential contamination, or there is substantial evidence that the range operations comply with government regulations.

- Please heed the following considerations and questions should your range receive a sound complaint: Who is the complainant?
- What is the basis for the concerns?
- Can the concerns be addressed? How?
- Is the club in violation of any regulations?
- Has a site investigation been conducted? Need to be conducted?
- What were the results?
- What needs to be done?

6.0 Appendices

Appendix 1 – Environmental Stewardship Plan (ESP) Template

a. Introduction. General overview of the property and the shooting activities that occur there
b. Purpose and Goals. Summary of the purpose of the ESP and the goals that is implementation will achieve
c. Site Assessment. Description of the environmental setting of the range, including summary of previous uses of the property that may affect environmental conditions, considering such things as:
    i. Types, intensity, and history of shooting activities
    ii. Topography and drainage
    iii. Surface water and wetlands
    iv. Soil type and characteristics that may affect shooting associated materials
    v. Geology and groundwater
    vi. Vegetation and habitat for birds and wildlife
    vii. Special site considerations
d. Plan of Action. Description of the specific actions to be implemented to achieve the purpose of the ESP in the context of the site assessment. This section will describe specific management actions in conjunction with design features and site characteristics to manage and minimize consequences of shooting-associated materials in the environment, Consider such things as:
    i. Periodic lead reclamation/recycling
    ii. Retention of bullets, shots, wads, and targets on range property
    iii. Minimization of potential for lead to rust and dissolve in surface or ground water
    iv. Minimization of physical mobility of lead
    v. Human and wildlife exposure to lead
    vi. Other relevant topics specific to the site
e. Measuring success. Guidance on documenting accomplishment of the plan of action items, such as:
    i. Purchase records

ii. Dated before and after photographs
iii. Work logs
iv. Etc.

f. Appendices. Appendices can be used to provide supplemental information to aid in implementing key plan of action items. Topics such as the following might helpfully be addressed in appendices:
    i. Implementation Schedules
    ii. Information about lead reclamation companies
    iii. Records of lead reclamation
    iv. Soil pH monitoring records
    v. Items identified above under “measuring success”

Appendix 2 - Physical transport of lead at shooting ranges

There are four primary mechanisms in which lead is transported off-site; including:

- **Dissolved in storm runoff** - Lead shot or bullet fragments in the field may weather and rust through time into more water-soluble compounds (Section 3) and subsequently be transported into surface waters. Factors influencing the amount of dissolved lead in storm water runoff may include annual precipitation rate, pH (or acidity) of rain and surface water, contact time, soil cover, and forms of lead present.

- **Lead particles or lead on soil particles in storm runoff** - Lead present as shot or bullet fragments may be physically transported by storm runoff into surface waters. This pathway is dependent on rainfall intensity, topographic slope, soil type, velocity of runoff, and presence of vegetative cover or man-made structures. Lead fragments are dense and would not normally be as subject to transport by runoff as would lead absorbed to soil particles.

- **Dissolved in ground water** - Water-soluble forms of lead may be transported to groundwater under certain conditions that may be found at some ranges and can be influenced by annual precipitation rate, soil type, soil chemistry, depth to groundwater and pH of groundwater.

- **Wind-driven lead dust or lead associated with wind driven soil particles** - Airborne lead dust occurs during the firing process and upon bullet impact with a berm, where dust production is influenced by bullet construction and velocity, soil type and soil moisture.

Appendix 3 - Site Characteristics to Consider in Assessment

This section identifies the physical characteristics that must be considered when evaluating your range.

Range Size

Shotgun range design and type affects the ease of lead shot collection. Larger ranges typically tend to have lead shot that is dispersed over a wider area, while smaller ranges tend to concentrate lead shot in a smaller area. Reducing the area of the shortfall zone will concentrate the shot within a smaller area, allowing for easier cleanup and reclamation. BMP techniques for reducing the shortfall zone at trap and skeet ranges, as well as sporting clay ranges, are discussed in section 4.1.3.

Soil Characteristics

Spent lead bullets and shot are most often deposited directly on and into soil during shooting. When lead is exposed to air and water, it may oxidize and form one of several compounds. The specific compounds created, and their rate of migration, are greatly influenced by soil characteristics, such as pH and soil types. Knowing the soil characteristics of an existing range site is a key component to developing an effective lead management plan. Soil acidity is measured as pH on a scale between 1 (most acidic) and 14 (most alkaline, or basic), where 7 is termed neutral. Ideal soil pH for shooting ranges is 6.5 to 8.5

Soil Physical Characteristics

The migration rate of specific lead compounds is affected by the physical characteristics of soil. For example, dense soils, consisting of heavy clays, will prevent the lead compound from moving quickly through the subsurface. Any “free” lead ions become attached to clay particles, with this bond helping to prevent migration. However, with denser soils, the amount of surface runoff increases.

Although clay soils inhibit migration, lead reclamation by contemporary removal machinery tends to be more difficult in clayey conditions. Clayey soils tend to clog the screens and “bind” with shot and bullets. This situation may require additional traditional screening, or perhaps screening using water to enhance separation.

In contrast, sandy soils or gravel may not impede migration because the open pores of these soils allow lead compounds to percolate quickly. Fortunately, lead reclamation activities are more easily conducted in sandy soils. With this in mind, ranges located in sandy soils should remove lead more frequently.

Annual Precipitation

One of the most important factors that influences lead degradation (i.e., chemical reactions) and migration is precipitation. Water, most often in the form of rain, provides the means by which lead is transported. In general, ranges located in areas with high annual/seasonal rainfall will have a higher risk of lead migration than those located in arid regions. This is especially true of outdoor ranges using "Steel Bullet Traps."

Steel bullet traps build up a layer of lead residue; these particles are extremely small and more easily transported by rain/water. Also, the smaller the particle, the quicker it will degrade. A bullet trap needs to have a means to collect contact water, or be covered to prevent water from reaching it, and to minimize releases and degradation.

Topography/Runoff Directions

The topography of your range impacts both the ease of lead reclamation and the mobility of the lead. For example, lead reclamation is more successful at ranges where the shortfall zone is relatively flat, since many lead reclamation companies use heavy machinery that cannot operate on slopes or steep hills.

Another important characteristic is the direction in which your range topography slopes. During and after periods of rain, storm water runoff may wash lead particles or lead compounds off the range. If there are surface water bodies such as lakes, rivers, or wetlands downgradient, the potential for lead to adversely affect the surrounding environment is even greater. Therefore, it is important to identify and control the direction of surface water runoff at your range.

Groundwater

Groundwater depth should be considered when developing a lead management plan since the closer the groundwater is to the surface, the greater the potential for dissolved lead to reach it.

Vegetation

Vegetative ground covers can impact the mobility of lead and lead compounds. Vegetation absorbs rainwater, thereby reducing the time that the lead is in contact with water. Vegetation also slows down surface water runoff, preventing the lead from migrating off-site. However, excessively wooded areas (such as those often used for sporting clay ranges) inhibit lead reclamation by making the soils inaccessible to some large, lead-removal machinery. Understanding the type, concentration and variety of vegetation on your range is necessary for developing your lead management program and implementing BMPs at your range.

Accessibility

Accessibility to shortfall zones and backstops is extremely important for lead reclamation activities. A range that is not accessible to reclamation equipment will have difficulty implementing lead reclamation practices

Appendix 4 - Risk Based Standards Approved Professionals

A list of British Columbia approved standards professionals that will complete an environmental assessment of the range that is in compliance with a mandate from the BC Ministry of the Environment. Their services often include groundwater and surface water monitoring, waste classification and management, risk assessment, containment, and more.

NAME	CONTACT INFORMATION
Patrick Allard, *R.P.Bio. Risk* **Azimuth Consulting Group**	218 – 2902 West Broadway, Vancouver, BC V6K 2G8 Email: pallard@azimuthgroup.ca Work Phone: 604-730-1220
Marc Cameron, *R.P.Bio. Risk* **Core6 Environmental Ltd.**	1410 – 777 Hornby St., Vancouver BC, V6Z 1S4 Email:mcameron@core6.ca Work Phone: 250-686-0405
Craig Harris P. Geo., *R.P.Bio. Risk* **AECOM**	200 – 415 Gorge Road, Victoria, BC V8T 2W1 Email:craig.harris@aecom.com Work Phone: 250-475-6355
Blair McDonald, *R.P.Bio. Risk* **Golder Associates Ltd.**	200 – 2920 Virtual Way, Vancouver, BC V5M 0C4 Email:bgmcdonald@golder.com Work Phone: 604-297-2013
Michael McLeay, *R.P.Bio Risk* **Hemmera Envirochem Inc.**	303 – 1221 Broad Street, Victoria, BC V8W 2A4 Email:mmcleay@hemmera.com Work Phone: 250-388-3584, ext. 605
Patricia Miller, *R.P.Bio Risk* **Golder Associates Ltd.**	200 – 2920 Virtual Way, Vancouver, BC V5M 0C4 Email:tamiller@golder.com Work Phone: 604-296-4250
Cindy Ott, P.Ag, *Geo.L & PChem Standards/Risk* **SLR Consulting (Canada) Ltd.**	200 – 1620 West 8th Ave, Vancouver, BC V6J 1V4 Email:cott@slrconsulting.com Work Phone: 604-742-3876

Beth Power, *R.P.Bio Risk* **Azimuth Consulting Group**	218 – 2902 West Broadway, Vancouver, BC V6K 2G8 Email: bpower@azimuthgroup.ca Work Phone: 604-730-1220
Stefan Quaglia, *R.P. Bio, Risk* **Trillium Environmental**	203-126 Ingram St., Duncan, BC V9L 2M9 Email:squaglia@trilliumenviro.com Cell Phone: 250-466-9990
Michael Rankin *R.P. Bio. Risk* **AECOM**	4th Floor, 3292 Production Way, Burnaby, BC V5A 4R4 Email: michael.rankin@aecom.com Work Phone: 604-444-6600
Sam Reimer, *P.Ag Standards/Risk* **SLR Consulting (Canada) Ltd.**	6 – 40 Cadillac Ave, Victoria, BC V8Z 1T2 Email:sreimer@slrconsulting.com Work Phone: 250-475-9595 Ext 236
Tara Siemens Kennedy, *P. Chem, Risk* **SNC Lavalin Inc.**	8648 Commerce Court, Burnaby, BC V5A 4N6 Email:Tara.kennedy@snclavalin.com Work Phone: 604-515-5190
Gregory Sutherland, *R.P.Bio. Standards/Risk* **Parsons Canada Ltd.**	19890 – 92 A Ave, Langley, BC V1M 3A9 Email:greg.sutherland@parsons.com Work Phone: 604-513-1003
Christine Thomas, *R.P.Bio Risk* **Golder Associates Ltd**	200 – 2920 Virtual Way, Vancouver, BC V5M 0C4 Email:cthomas@golder.com Work Phone: 604-298-6623
Audrey Wagenaar, *P.Chem Risk* **Golder Associates Ltd**	200 – 2920 Virtual Way, Vancouver, BC V5M 0C4 Email:awagenaar@golder.com Work Phone: 604-297-2036
David Williams, Ph.D, *P.Eng. Risk* **Millennium EMS Solutions Ltd.**	10933 Inwood Road, North Saanich, BC V8L 5H9 Email:dwilliams@mems.ca Work Phone: 250-999-9829

Ross Wilson, *R.P.Bio Risk* **Wilson Scientific Consulting Inc.**	91 West 28th Ave, Vancouver, BC V5Y 2K7 Email:rosswilson@telus.net Work Phone: 604-221-6565

Appendix 5 - Vendors and Services

Appendix 5 offers a list of companies that offer products or services that may be of help to ranges looking into reclamation activities, site assessment, lead recycling, range construction, and bullet containment systems.

Product/Service	CONTACT INFORMATION
MT2 Soil Remediation, Lead Reclamation, Engineering, Lead Abatement and recovery, Consulting	Mike Burkett 14045 West 66th Avenue Arvada, CO 80004 Phone 303-465-6977 E-mail mburkett@metalstt.com Website Http://www.mt2.com/index.htm
Keystone Environmental Risk assessment, Contaminated Sites, Remediation, Engineering	Dominion Street Burnaby, BC V5G 4G3 Tel: 604.430.0671 Fax: 604.430.0672 Toll free: 1.866.417.8007
Pacific Group Developments Water and Soil Analysis, Phase 1 and 2 assessment, and Contaminated Soil Remediation	Victoria, BC (250) 889-0007 contact@pacificgroupdevelopments.com
NMC Lead Abatement	404 N. Berry Street Brea, CA 92821 Phone: 714-672-3500 Website: Http://www.ncmgroup.com/

Capital Salvage Lead Recycling	1919 Triumph Street Vancouver, BC, V5L 1K6 Phone: (604) 253-8481 Fax: (604) 253-2307 Website: Recycle@CapitalSalvage.ca

Appendix 6 – BC Lead Standards

Lead (Chemical Abstract Service # 7439-92-1)

COLUMN I	COLUMN II	COLUMN III	COLUMN IV	COLUMN V	COLUMN VI	Note
Site-specific Factor	**SOIL STANDARD FOR PROTECTION OF SITE-SPECIFIC FACTOR**					
	Agricultural (AL)	**Urban Park (PL)**	**Residential (RL)**	**Commercial (CL)**	**Industrial (IL)**	**2**
HUMAN HEALTH PROTECTION						
Intake of contaminated soil	400	400	400	700	4 000	3,4
Groundwater used for drinking water						
pH < 6.0	100	100	100	100	100	5,6
pH 6.0 — < 6.5	250	250	250	250	250	5,6
pH ≥ 6.5	4 000	4 000	4 000	4 000	4 000	5,6
ENVIRONMENTAL PROTECTION						
Toxicity to soil invertebrates and plants	1 000	1 000	1 000	2 000	2 000	
Livestock ingesting soil and fodder	350					

Major microbial functional impairment	NS					7
Groundwater flow to surface water used by aquatic life						
pH < 5.5	150	150	150	150	150	5,6
pH 5.5 — < 6.0	250	250	250	250	250	5,6
pH 6.0 — < 6.5	2 000	2 000	2 000	2 000	2 000	5,6
pH ≥ 6.5	40 000	40 000	40 000	40 000	40 000	5,6
Groundwater used for livestock watering						
pH < 5.5	150					5,6
pH 5.5 — < 6.0	250					5,6
pH 6.0 — < 6.5	1 500					5,6
pH ≥ 6.5	30 000					5,6
Groundwater used for irrigation						
pH < 5.5	150	150	150			5,6
pH 5.5 — < 6.0	400	400	400			5,6
pH 6.0 — < 6.5	3 500	3 500	3 500			5,6
pH ≥ 6.5	100 000	100 000	100 000			5,6

Notes

1. All values in µg/g unless otherwise stated. Substances must be analyzed using methods specified in a director's protocol or alternate methods acceptable to the director.

2. The site-specific factors of human intake of contaminated soil and toxicity to soil invertebrates and plants specified in this matrix apply at all sites.
3. Intake pathway of exposure modeled is inadvertent ingestion of soil.
4. Standards have been derived based on results of clinical studies at sites. Standards represent the rounded sum of the toxicologically-based value plus the applicable soil ingestion clinical study factor, if one is available. For AL, PL and RL, the soil ingestion clinical study factor is 385 µg/g. For CL, the soil ingestion clinical study factor is 650 µg/g. For IL, no soil ingestion clinical study factor is available, therefore the IL standard was set equal to the toxicologically-based value.
5. The pH is the pH of the soil at a site.
6. Standard has been adjusted based on a reference provincial background soil concentration. Standard represents the rounded sum of the toxicologically-based value plus the reference provincial background soil concentration. For all land uses, the reference provincial background soil concentration is 108.6 µg/g.
7. NS — no standard. Insufficient acceptable scientific data exists, so no standard is calculated.

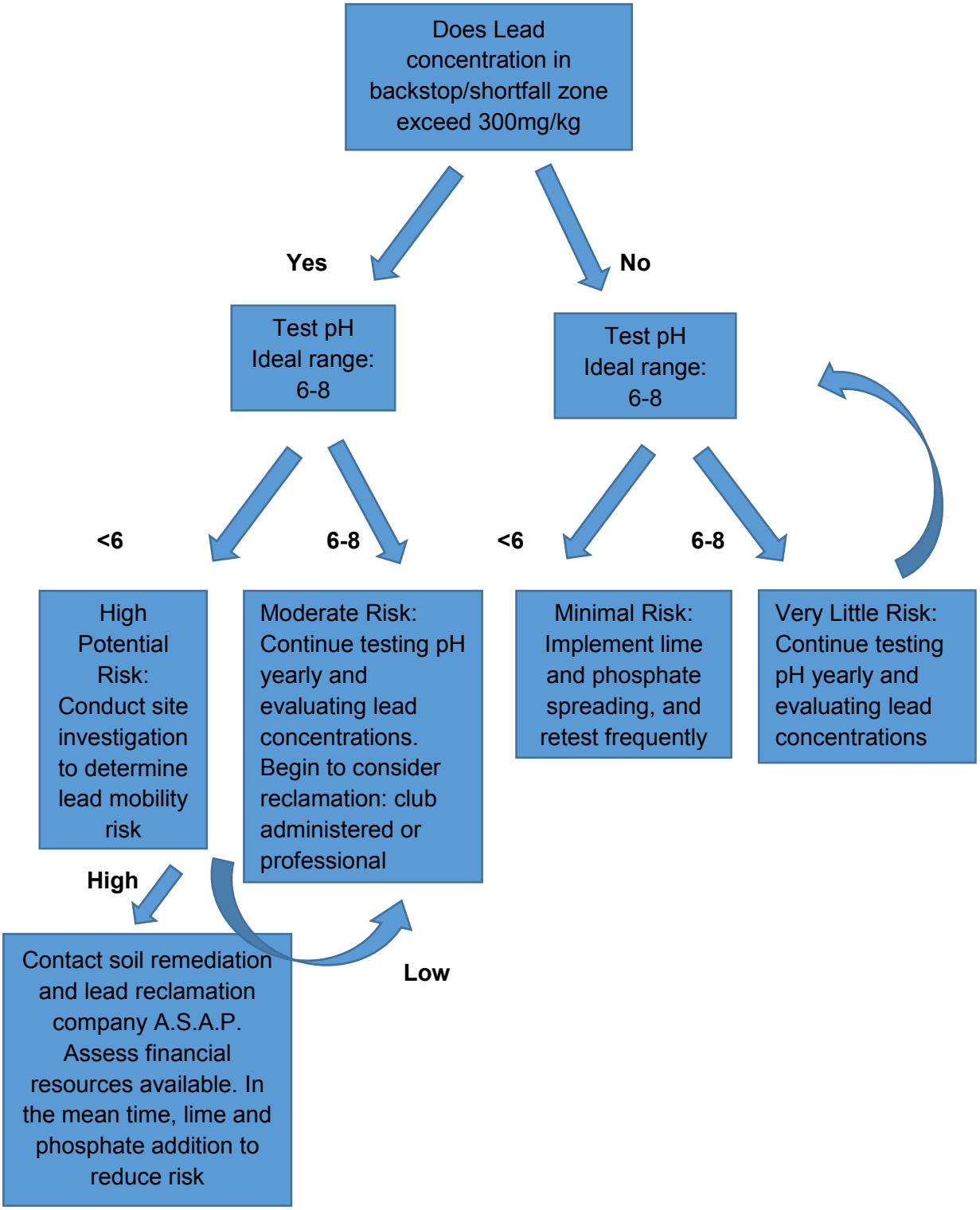
BC Ministry of Environment (BC MoE). 2014. Contaminated Sites Regulation, Schedule 9: Generic Numerical Sediment Criteria (includes amendments up to B.C. Reg. 4/2014, January 31, 2014). B.C. Reg. 375/96. O.C. 1480/96 and M271/2004. Effective April 1, 1997. Victoria, B

Appendix 7 - Summary of Potential Best Management Practices for Lead

	Shotgun Ranges	Rifle/Pistol Ranges
Potential Operational Approaches	• Shot recovery and recycling • Alternative shot materials • Lime and phosphate application	• Bullet recovery and recycling • Lime and phosphate application
Potential Engineering Approaches	• Range siting • Clay layer/mixing • Physical barriers to shot distribution • Shortfall zones designed to be outside of surface water bodies • Ranges designed to maximize overlap of shortfall zones, while maintain 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

Appendix 8 - Lead Management Flow Chart

Review regulations (is there a mandatory reporting threshold), agenda item for next Club Executive, increase sampling sites, ensure record keeping is fully up to date, and all documents are copied and backed up.



Appendix 9 – Sample Maintenance Checklist

Maintenance needs may include such items as: mowing, fertilizing, and watering grass to minimize erosion potential; removing accumulated sediment from catchment basins to maintain their efficiency; applying lime or other material to adjust soil acidity; reclaiming and recycling lead; and other maintenance activities necessary to implement the site-specific ESP.

Task #	Date	Task Description	Frequency	Due Date
1.				
2.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

Appendix 10 – pH Monitoring Schedule

Testing of pH must become integrated into regular operation of a range. pH testing should be done annually, but for some ranges (or when threshold values are being approached), semi-annually may be necessary. Trap and skeet ranges that shoot over heavily wooded area will require semi-annual testing due to the pH volatility and likeliness of lowered pH in these areas. Ideal pH is between 6-8, if the pH is less than 6, then the range operator should implement lime and phosphate to lower the pH and reduce the mobility of oxidized lead. However, pH greater than 8 produces little risk as well, and lime should not be added, in doing so could cause greater mobility. It is recommended that 3-5 samples be taken per site. Larger sites will require more samples due to increased variability, while 3 samples should be taken at smaller sites. The samples taken should be spread out and cover any areas of potential risk, including: backstop/berms, foreground, perimeters of site, and areas where water accumulates. pH testers can be purchased inexpensively from most garden shops.

Site 1 (e.g. Rifle/Pistol):

Date	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5

Site 2:

Date	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5

Site 3:

Date	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5

Appendix 11 – Phosphate and Lime Addition Schedule

If pH is **less than 6**, it is recommended that pH should be raised by **spreading lime**. By spreading lime on areas where soil pH is greater than 8.5, this result in the mobilization of lead. Lime spreading should occur around earthen backstops, sand traps, trap and skeet shortfall zones, sporting clays courses and any other areas where the bullets/shots or lead fragments/dust accumulate. Spreading lime over the shot fall zone will help to raise the pH of the very top soil layer to a pH closer to ideal levels and reduce the migration potential of lead. Spreading bags of 50 pounds per 1000 square feet of range will raise pH approximately one pH unit for a period between one and fours years (US EPA). The market price of lime in either the granular or pelletized form commonly ranges from approximately $2.00 to $4.00 per fifty-pound bag (2016). Bags of lime can be purchased from most garden and lawn centers. If the site has a regular acidic pH, routine yearly applications will be necessary.

Unlike lime spreading, the main purpose of phosphate spreading is not to adjust soil pH but to bind the lead particles. This process also decreases the potential amount of lead that can migrate off-site or into the subsurface. Phosphate spreading can be done either separately or in conjunction with lime spreading. Generally, 15 to 20 pounds of phosphate per 1,000 square feet will effectively control the lead.

Phosphate spreading is especially recommended for sporting clays ranges and those parts of ranges not easily accessible by reclamation equipment. Phosphate spreading should be repeated frequently during the range's lifetime. Phosphate can be bought in its pure form, or as phosphate rock, or as lawn fertilizer. The average 40 lb bag of fertilizer costs around $10 and contains 25% phosphate. This is a very cost effective options for controlling lead. A recent study found that phosphate amendment is most effective in immobilizing lead in any kinds of shooting range soils and it will bring TCLP concentration below the required standard. Like lime spreading, phosphate should be reapplied on a yearly basis, and can be done at the same time as lime is applied.

Site 1:

Date Applied	Treatment 1	Treatment 2	Task Description	Results pH= 6-8?

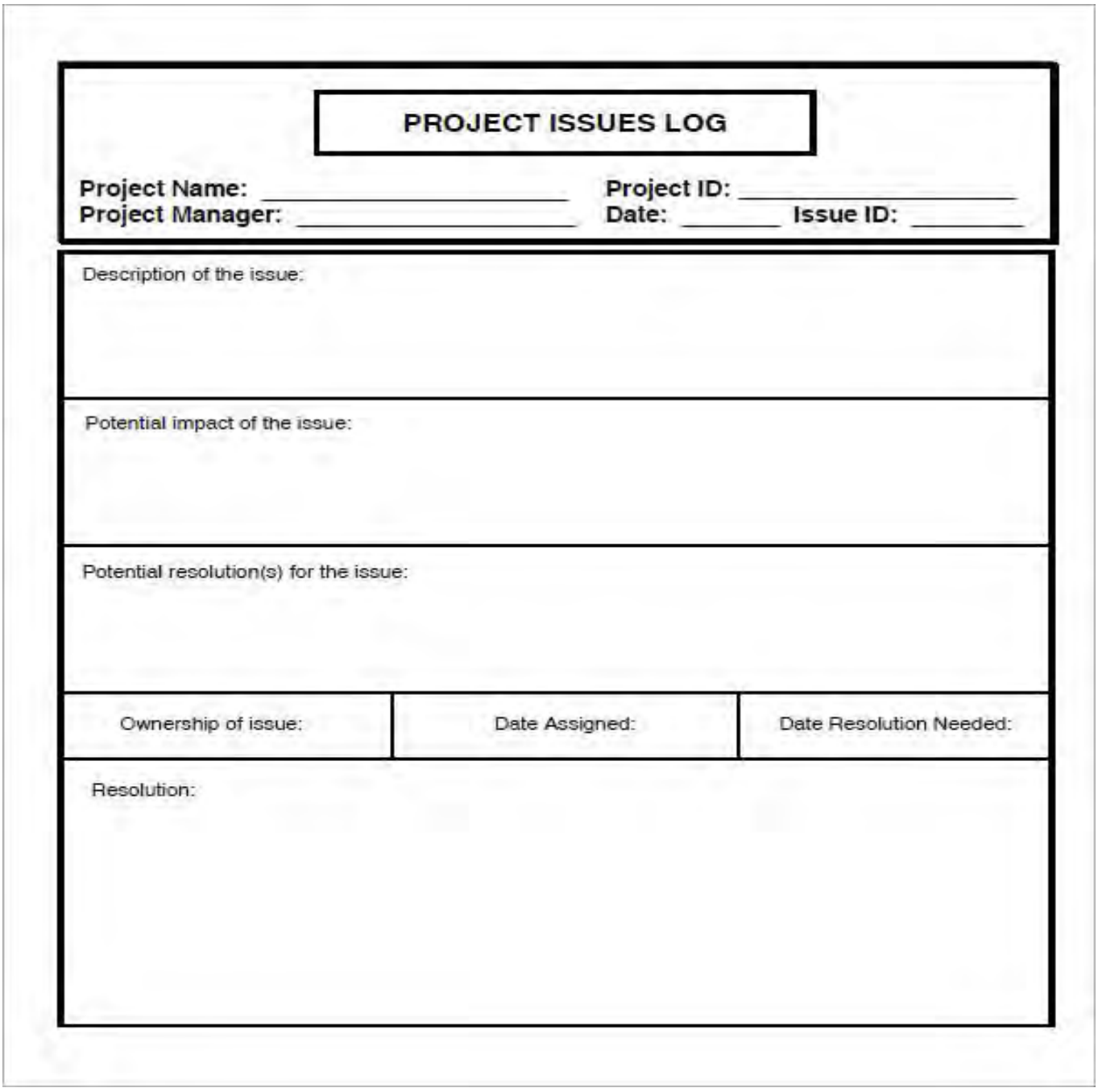
Site 2:

Date Applied	Treatment 1	Treatment 2	Task Description	Results pH= 6-8?

Site 3:

Date Applied	Treatment 1	Treatment 2	Task Description	Results pH= 6-8?

Appendix 12- Issues log



PROJECT ISSUES LOG

Project Name: _____ **Project ID:** _____
Project Manager: _____ **Date:** _____ **Issue ID:** _____

Description of the issue:		
Potential impact of the issue:		
Potential resolution(s) for the issue:		
Ownership of issue:	Date Assigned:	Date Resolution Needed:
Resolution:		