SUSTAINABLE REMEDIATION DESIGN FOR A CLAY TARGET SHOOTING RANGE

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SUMMARY: The detrimental effects of clay target shooting include the deposition of lead shot and polycyclic aromatic hydrocarbons. Remedial options available to individual sites are highly variable and depend on soil type, topography and the presence of vegetation. Using a former gun club situated on public land as an example, the principles of Sustainable Remediation (SR) are applied to compare two different remedial approaches. The remediation technique with the most desirable SR profile was found to be the coarse sieving of the soil and on-site encapsulation of the fine soil fraction. An integral part of SR is community consultation and following selection of the preferred remedial option for the gun club site, consultation and development of a final future use plan is expected to take approximately one year.

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1. INTRODUCTION

Recreational clay target shooting is a popular sporting activity worldwide (Pardue, 2014). However, the effects of lead shot and polycyclic aromatic hydrocarbons (PAH) contamination from traditional clay targets can have lasting and detrimental legacies on the environment. The location, frequency of use and type of sports shooting dramatically alters the distribution of contamination with the slope of the land and direction of firing being the other major variables (Rooney and McLaren, 2000). Remediation techniques also need to respond to the individual characteristics of each site such as the presence of vegetation, other site users, final proposed land use and the proximity of environmental receptors, including residents (Woods & Nash, 2014).

The concept of sustainable remediation (SR) has a strong and growing support base from consultants, regulators and land owners in Australia. It is also well established in UK and USA as the Sustainable Remediation Forum (SuRF) and in Europe as the Network of Industrially Contaminated Sites in Europe (NICOLE). As an alternative to traditional remediation, SR was applied to the remedial design for a former recreational clay target shooting range in rural Victoria, approximately 30 km from the regional City of Geelong (population 220,000).

2. SITE SETTING

2.1. Background

The former Winchelsea Clay Target Shooting Club operated for approximately 60 years on an 11 hectare portion of public land on the edge of a town of approximately 2,200 people. The club was a community organisation with minimal management capacity or resources. In 2012, the municipal authority requested that the club cease shooting activities while further investigations into contamination of the site were undertaken. Up until this time, 70 members would attend meetings every fortnight for sporting clay target shooting including both the trap and skeet disciplines. Following more detailed investigations that revealed the extent of the contamination, the club was unable to resume shooting activities. Local and state government land management authorities shared responsibility for clean-up of the site. The town is within an agricultural district with stock grazing being the primary business.

2.2. Contamination Status

Initial investigations into the contamination were undertaken by another consultant in an unpublished report to Surf Coast Shire (SCS, 2014). Investigations noted that lead shot and clay target fragments covered much of the reserve as well as the surrounding public roadways. The total mass of lead, as 2 mm diameter pellets, calculated to have been deposited within the fallout zone was 150 tonnes. The lead was distributed across the shooting club area, nearby bushland, an adjacent go-kart track and un-sealed residential streets and road reserves. Investigations included a 40 m grid of investigation points where both chemical and physical testing occurred. Physical testing including sieving of soil to 1.18 mm and counting and weighing of the lead shot fragments. The maximum concentration of lead detected was 6400 mg/kg, including the lead shot fragments. The maximum concentration of polycyclic aromatic hydrocarbons (PAH) was 2900 mg/kg which was detected in surface soil where target fragments were visible. In late 2013, the reserve was fenced off and the community warned of the potential effects of contamination and requirement for remediation.

3. REMEDIATION CONSIDERATIONS

3.1. Site Usage and Constraints

A review was undertaken of site environmental, economic and social indicators and the following was noted:

- A large portion of the site consisted of native vegetation that represented a regionally and nationally protected ecosystem which could not be disturbed without special permits;
- The government authorities had no available budget for clean-up;
- The community requested minimal disruption and reopening the site as soon as possible;
- The site was to continue as public open space and managed as Crown land; and
- Long term management of residual contamination was allowable under the site governance structure.

The results of the site investigations were analysed using geographic information systems (GIS) in order to overlay the contamination, constraints (including the presence of protected vegetation) and the final required land-use. The assessment led to the creation of a series of separate remediation areas. Each area was separately analysed for risk and remediation opportunities in accordance with the SuRF framework (SuRF ANZ, 2011).

3.2. Sustainable Remediation Comparison

Two primary remediation methods were compared using the analysis methodology proposed in the SuRF framework.

3.2.1 Scenario 1

Scenario one was proposed in unpublished reported to SCS (2014), to be a base case of excavation of contaminated soil and then treatment of the soil with a highly specialised machine which removes lead fragments from the soil. Remediated soil would be replaced on the site with minimal on-going management requirements. This approach included excavation of soil from the majority of the affected areas and recycling of the lead shot from the soil for recycling. Some areas of high ecological value were not to be excavated and were instead subject to hand collection, vacuuming and fencing. Trees with large quantities of impregnated lead shot were proposed to be felled, chipped and landfilled. The estimated cost of this option including remediation of the public roadways and reserve was $AUD2.3 million.

3.2.2 Scenario 2

Scenario two was developed by the authors and represented a risk based approach to restoring effective use of the parkland while retaining contamination within suitable areas under control of a management plan.

Buildings on-site that were impacted by lead shot and clay targets were proposed to be dismantled and relocated to an alternative site. In order that contamination was not transported to any new site, the clean-up plan proposed a combination of pressure cleaning and manual sweeping and collection of all debris for further sifting and recycling. Approximately 1000 tyres, formerly used by a go-kart club were also noted to contain a large quantity of lead shot. The clean-up plan proposed to establish a treatment pad to shake the lead shot out of the tyres prior to recycling of both the lead and tyres.

An on-site stockpile consisting of waste soils from the site as well as imported soil from unknown locations was observed to contain lead shot and clay targets, as well as a large quantity of concrete and bricks. The clean-up plan proposed to remove the solid inert waste prior to sampling and disposal of the fine soil fraction.

A large portion of the site contained trees and grass of high ecological value which are protected under Federal legislation. Remediation was designed to be as least intrusive as possible and consisted of trimming of trees which were heavily impacted (impregnated) by lead shot, vacuuming the soil surface with a high powered unit and creation of walk-through pathways and fencing. As remnant contamination would inevitably be present, the cleaned pathways were intended to be the only access through the area. This method preserved the integrity of the protected vegetation, restored connections from one side of the park to the other and minimised the duration of works in the area.

Contaminated areas outside of the protected ecosystem, including the surrounding roadways had less sensitive vegetation and hence some shallow excavation was proposed. The target depth was 0.05 m based on the investigation data. Instead of fully separating the lead from the soil, sieving was proposed to remove all larger boulders and vegetation and concentrate the lead shot in the finer soil fraction. The proposed fractions based on available machinery were: <10 mm fine soil and lead shot, >10 mm coarse soil/ boulders and clay targets and >50 mm grass and roots with minimal soil. The fine fraction of sieved soil (60%) containing lead shot was proposed to be encapsulated beneath a planned asphalt pavement (car park) within the site and maintained with an on-going management plan. The >10 mm coarse soil was proposed to be disposed off-site following total and leachable fraction testing proving the absence of lead. The >50 mm fraction is to be composted and reused.

3.2.3 Tier 1 Comparison

The SuRF framework suggests 18 indicators by which to rank a range of remediation options. For the purpose of this study, a value between 1 and 5 was assigned to each indicator. A value of 1 indicates an unacceptable outcome whereas a value of 5 indicates a positive, low-risk outcome. Intermediate values represent the author's judgement based on the importance of the particular issue to the local community.

Table 1: Comparison of Two Remediation Methods using Sustainability Principals

Indicators	Scenario 1 value	Scenario 2 Value
Environmental		

1. Impacts on air	3	4
2. Impacts on soil	2	3
3. Impacts on water	4	4
4. Impacts on ecology	1	4
5. Use of natural resources and generation of waste	2	4
Social		
1. Impacts on human health and safety	3	3
2. Ethical and equity considerations	4	3
3. Impacts on neighbourhoods or regions	2	3
4. Community involvement and satisfaction	4	3
5. Compliance with policy objectives and strategies	4	4
6. Uncertainty and evidence	3	3
Economic		
1. Direct economic costs and benefits	2	5
2. Indirect economic costs and benefits	2	3
3. Employment and capital gain	4	3
4. Induced economic benefit	4	3
5. Life-span and 'project risks'	2	3
6. Project flexibility	2	4
TOTAL	48	59

With reference to Table 1, the scenario with the highest net benefit is Scenario 2, the risk based remediation option, and is therefore preferable.

4. FUTURE IMPLEMENTATION

The government authorities are currently planning for community consultation to ensure the future use of the site is supported by the community. As part of the initial stages, all club infrastructure will be cleaned and removed from the site for their private use. It is expected that the community consultation and development of final future use plan will take approximately one year.

Upon commencement, it is expected that the proposed remedial actions, based on the principals of SR would take approximately three months to complete if delivered consecutively. Given the limited financial and human resources available for this project, the estimated cost of $AUD 680,000 for Scenario 2 is only a quarter of the original estimated remediation cost and the related works will take only around half the duration of conventional remediation techniques.

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