Technical background on Bioremediation of Hydrocarbon Impacted Soils and Information on Eclipse Soils' Resource Recovery Centre

1 Introduction

The contamination of soils with hydrocarbons, such as petroleum products and crude oil, poses significant environmental risks, threatening ecosystems and human health. Traditional site remediation methods, such as excavation and disposal to landfill, is costly and does not address the root cause of contamination. Bioremediation, the use of microorganisms to degrade and transform hydrocarbons into beneficial end products, presents a sustainable and cost-effective solution to remediate contaminated soils while diverting materials from landfill.

Bioremediation is endorsed by Governments both nation-wide and globally as the preferred method for addressing hydrocarbon contamination within soils. Historically, contaminated soils such as those from hydrocarbon spills were disposed to landfill without treatment, which is the least preferred option (EPA (2000) *Guidance Statement for Remediation Hierarchy for Contaminated Land).*

The paper explores the various techniques for bioremediation and provides details of the benefits compared to traditional disposal methods. The paper also gives an overview of the Eclipse Soils Bioremediation Facility and examples of some key remediation projects completed at the facility.

2 Bioremediation Techniques

2.1 Biopile Remediation:

Biopile bioremediation involves the controlled treatment of contaminated soil in constructed stockpiles. This approach accelerates the natural degradation process by providing optimal conditions for hydrocarbon-degrading microorganisms. The construction of biopiles involves blending contaminated

soil with a combination of bulking agents, nutrients (nitrogen and phosphorus), and microbial inoculants.

Biopiles are aerated either actively using blowers or passively through the design of the pile. Water is added and monitored to maintain optimal moisture levels. Adequate oxygen, nutrients, and moisture are crucial for microbial growth and hydrocarbon biodegradation, resulting in the transformation of hydrocarbons into beneficial end products, such as carbon.

2.2 Landfarming

Landfarming is a low-cost and simple approach where contaminated soil is excavated and spread out on a designated area, rather than being treated in a stockpile. Nutrients are added and the soil is regularly tilled to maintain oxygen levels and enhance microbial activity. As with biopiles, adequate oxygen, nutrients, and moisture are crucial for microbial growth and hydrocarbon biodegradation.

2.3 Bioaugmentation

Bioaugmentation involves the introduction of specific hydrocarbon-degrading microorganisms into the contaminated soil to enhance the natural biodegradation process. Selected microbial strains with specialised metabolic pathways efficiently break down complex hydrocarbons into beneficial end products.

3 Factors Affecting Bioremediation Efficiency

Several factors influence the success of bioremediation processes, such as environmental conditions (temperature, pH, moisture), hydrocarbon concentration, nutrient availability, and the presence of toxic co-contaminants.

4 Benefits of Bioremediation

4.1 Better Sustainability Outcomes

Bioremediation is the most sustainable approach for dealing with hydrocarbon contamination as it addresses the root causes of the contamination, rather than

relocating contaminated soils to a landfill. It promotes natural processes that eventually lead to the complete breakdown of hydrocarbons into non-toxic end products. The process does not involve the use of harmful chemicals or the generation of additional waste.

4.2 Cost-Effectiveness

Bioremediation is much more cost effective than traditional methods such as disposal to landfill, especially for large-scale contaminated sites. It reduces the need for extensive excavation and disposal, thus lowering overall remediation expenses.

4.3 Enhanced Soil Health

Bioremediation not only removes hydrocarbon contaminants but also enhances soil health by promoting microbial diversity and activity, as well as adding carbon to the soil. The remediated soil becomes more fertile and better capable of supporting plant growth and other ecological functions.

4.4 Versatility and Applicability

Bioremediation techniques can be adapted to various types of hydrocarbon-contaminated soils and environments, making it a versatile and widely applicable remediation strategy.

5 Eclipse Soils Bioremediation Facility

Eclipse Soils operates the Abercrombie Road Postans Resource Recovery Centre, where soils that have been impacted with hydrocarbons (predominately diesel) are bioremediated in an impermeable HDPE fully lined and bunded cell.

Eclipse Soils is licenced to receive and undertake this process on soils with a classification as high as Class IV (according to the DWER Waste Classifications) and its management is in compliance with the Department of Environment (2004) *Bioremediation of hydrocarbon-contaminated soils in Western Australia.*

When bioremediated, many of these soils are carbon rich and suitable for landscape use. Once treated and validated, Eclipse uses bioremediated soils in blended soil products, or as good quality fill for landscape rehabilitation.

6 Projects

Eclipse undertakes bioremediation on a wide range of project for both the private and government sectors, some examples of the projects include:

- Working with first responders to aid in the clean-up of soils impacted with diesel from tanker truck rollovers. Volumes of up to 120,000 L of diesel can be spilled during a single rollover, impacting up to 3,000 tonnes of soil. This soil must be removed, preferably immediately for treatment, to minimise environmental impacts;
- Treatment of hydrocarbon and dieldrin impacted soils from Western Power sites throughout WA;
- Treatment of oil impacted soils from Muja And Kwinana Power Stations;
- Treatment of hydrocarbon impacted soil from the PTA marshalling yards, Leighton Beach and the former railway workshop land, Midland; and
- Remediation of service station sites for the major oil companies

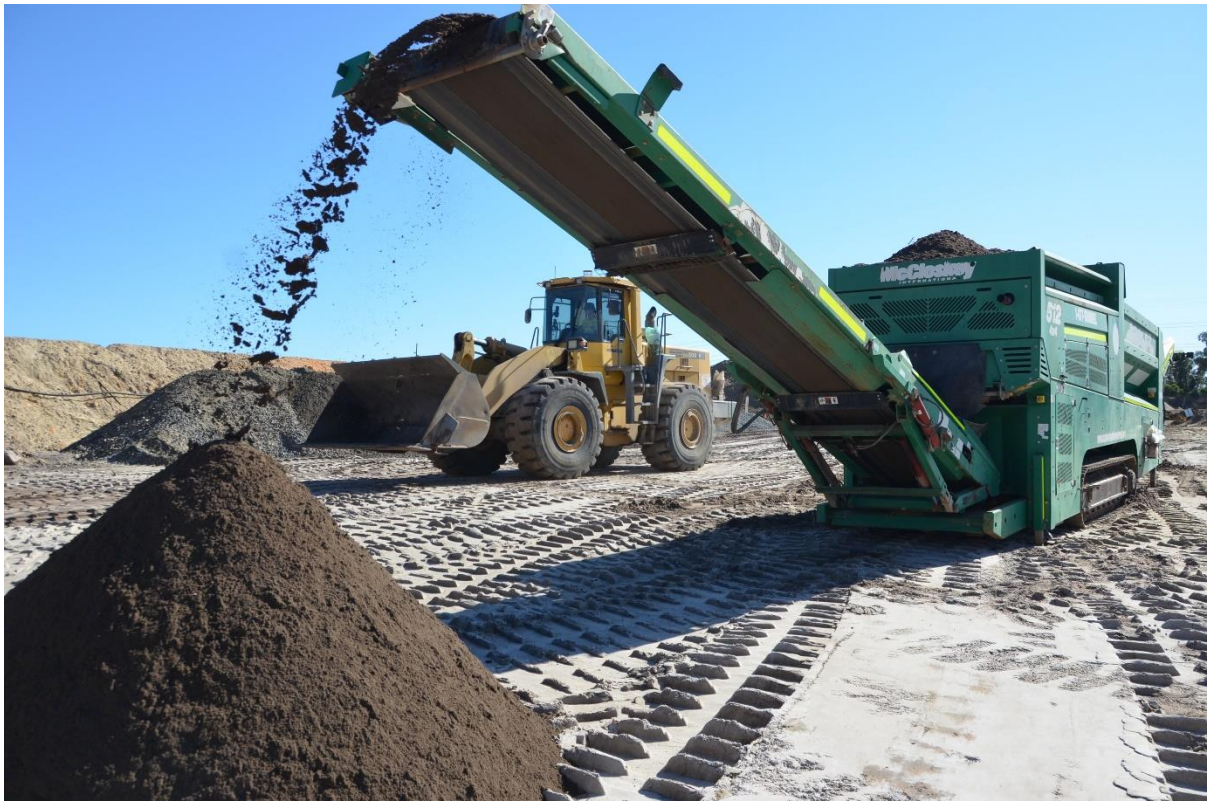

Photo: Bioremediation of hydrocarbon impacted soils in Eclipse' Biocell.

7 Conclusion

Bioremediation offers a sustainable and cost-effective approach for the remediation hydrocarbon contaminated soils. The diverse range of bioremediation techniques, along with the numerous environmental and economic benefits, makes it the optimum solution to address hydrocarbon contaminated soils. Eclipse Soils utilises bioremediation to provide practical and sustainable outcomes on a wide range of contaminated soil projects.