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REMEDIATION COST SCENARIOS FOR PROPOSED FILLING STATION, PRESIDENT PARK, WITBANK.

1. INTRODUCTION

Geo Pollution Technologies – Gauteng (Pty) Ltd (hereafter GPT) was requested to present the potential remediation costs involved with the decommissioning or spills at the proposed President Park filling station development, located on property Ext 6 within Witbank. The filling station will comprise of underground petrol and diesel tanks (23 000ℓ x 5), fuel pumps, a canopy covered forecourt and a convenience store. It is estimated that the proposed filling station would be a 500 000L/month site. Without limited information on the site itself, it is only possible to provide general costs associated with certain technologies. At the same time such costs are sensitive to assumptions and general assumptions on the site and potential remedial technologies need to be made.

This letter details general remedial technologies applicable to petroleum hydrocarbons and medium sized filling stations. Using conservative assumptions illustrative costs for planning purposes are provided.

2. CONTAMINATION ASSOCIATED WITH PETROLEUM STORAGE AND HANDLING SITES

GPT uses the Risk Based Corrective Action technique to assess and conduct remediation of contaminated sites. This process identifies primary sources (like tanks and pipelines) as well as secondary sources of contamination. Examples of secondary sources are mobile Liquid Non-Aqueous Phase Liquid (LNAPL) plumes, affected soil where residual product is present and dissolved phase plumes.

When such sources of contamination are linked to a receptor through a pathway, active remediation needs to be conducted. Such remediation could be directed to source remediation or plume remediation. In the case of an active site where contamination has occurred, it is possible that low key interventions can be used to reduce the risk to receptors. Alternatively, regulatory requirements might necessitate source removal in cases where the risk that is posed by the contamination is acceptable.

Some of the ways in which contamination can occur at a filling station is when the tanks or pipelines leak, when there are overfills of the tanks or when significant spillage takes place during refilling of tanks and vehicles. Some events can be catastrophic (such as the loss of the contents of a tank overnight), while others happen slowly over a long period of time. The way in which a loss occurs and over what time period are some of the important determining factors of the remedial cost. For example, should a small loss occur over a long period of time, it is possible that a significant liability can be associated with it due to the large volume that could eventually have spread into the subsurface.

The geology and hydrogeology into which a loss occurs play an important role in the eventual remediation costs. Some sites are easier to remediate, since it is easier to get to the contamination, while others are much more difficult due to the underlying geology. An example of this is where product is lost into an aquifer where the water level is deeper than 10 m. In such a case, assessment costs are higher due to the need to drill deeper, and the possible applicable technologies are limited. Sometimes it is the on-site buildings that cause the complexity and consequently the costs.

The fact that petroleum products are immiscible with water and hydrophobic, mean that petroleum hydrocarbons generally tend to adhere strongly to the soil or rock into which it is lost. The volatile nature of some of the products is used to remediate the product by encouraging volatilisation. However, petroleum products are complex mixtures of more than 200 compounds and the less volatile compounds tend to be found at petroleum storage sites over extended periods of time. GPT has conducted assessments at sites where the infrastructure had been removed more than 10 years previously and high levels of contamination were still found.

These factors together pose many challenges when considering remediation for petroleum storage and handling sites.

3. POSSIBLE REMEDIAL TECHNOLOGIES & COSTS

Possible remedial technologies are listed below, together with advantages and disadvantages.

Possible Remedial Option	Advantages	Disadvantages
Monitored Natural Attenuation (MNA)	• Destroys contaminants. • Simple to implement.	• Takes a very long time. • Does not work where free phase product is present due to toxic high concentrations. • Often seen as a 'do nothing' approach. • Can only be implemented on stable plumes.
Enhanced bioremediation	• Destroys contaminants. • Simple to implement in some cases. • Uses resident organisms to break down contamination	• Takes a very long time. • Does not work where free phase product is present due to toxic high concentrations. • Often seen as a 'do nothing' approach. • Can only be implemented on stable plumes.
Excavation & biopiles or landfarming or Dig & dump	• Targets contaminated areas to be remediated. • Contaminants are destroyed in the process. • Is mostly effective in reducing concentrations significantly, even to below detection limits. • Depending on the equipment available, such a project can be completed in a relatively short timeframe. • Can be straightforward to implement at shallow depths (<5 m)	• Requires buildings to be demolished. • Heavier compounds might be more difficult to remediate in this manner. • Some dewatering will have to take place in order to remove all contaminated soil if there is a shallow groundwater table.
Vacuum Enhanced Recovery (VER)	• Volatilises certain organic compounds. • Increases oxygen levels in the ground, which could aid in biodegradation. • Air flow in sandy layers might reduce contaminants significantly. • Might lead to dewatering the shallow aquifer leading to increased air flow that has been found to reduce volatile contaminants significantly. • High gradient to extraction holes also act as containment	• Air flow expected in preferential paths in some setting if there is wide spread presence of clay. • O&M costs are likely to be significant. • Safety requirements for intrinsically safe equipment might increase cost significantly. • Technology does not apply to less volatile compounds. • Should free phase NAPL be intercepted by the system, emulsification is possible. • Proper coverage of installation during operational phase might be challenging
In-situ Chemical Oxidation (ISCO)	• Destroys a wide variety of contaminants. • Can be completed below the surface leaving the site operational.	• Distribution of chemicals likely to be difficult if it is a low hydraulic conductivity setting. • Possible safety issues working with strong oxidants that might cause exothermic reactions. • Cost might be high due to the large volume of treatment chemicals that might be required if there is a large plume. • Regulatory approval might be difficult due to the use of chemicals to be injected into the subsurface. • Cannot be used where free phase is present.

Using certain assumptions, a cost model for a general filling station site was developed. The illustrative costs are presented in Table 1 together with the ideal timeframes for each method. Note that the actual situation in the case of a remediation site will determine the method. As stated, the geology and hydrogeology will play an important role in this regard together with the volume of product that was lost (i.e. size of the plume), as well as the size of the installation.

Table 1: General cost estimates involved with remediation.

Remedial strategy	Total cost (thousands)	Estimated timeframes*
VER (mobile)	R 600 000	<3 years
Dig & Dump $100m^3$	R 300 000	<6 months
MNA	R 900 000	5 years
ISCO/ Bioremediation	R 650 000	1-2 years

Note: Assuming all factors in favour of the method. Based on estimated standard filling station capacity (unknown at the time of the request).

From the table above it can be seen that the costs range from R 300 000 to R 900 000 for a remediation project. The average cost is R 612 500. Since the geology and the hydrogeology of a site are outside the control of the operator, the remediation costs can only be influenced by the volume of product lost to the environment. By minimizing the volume that is lost, either in a once off event or over a long period of time, the potential remedial costs can be minimized. Through proper construction of storage facilities, handling of product and inventory reconciliation it is possible to manage the potential remedial costs to less than R 500 000.

Please feel free to contact GPT should you have any queries or comments regarding this letter.

Kind regards

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