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Title of the Thesis: Evaluation of Energy Potential from Unsecured Landfill Site in India

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ABSTRACT

This research was undertaken to evaluate the energy potential of an unsecured landfill. The scope of the research included quantification and characterization of disposed and fresh Municipal Solid Waste (MSW) at the landfill, conducting pump test/field studies to assess its energy potential, developing statistical MSW and Landfill Gas (LFG) models, and perform LFG modeling to evaluate LFG generation/recovery potential from the landfill. The methodology and approach followed in the research included 1) evaluation of available information for the landfill, including physical characteristics of solid waste, landfill management and waste disposal practices, 2) Disposed and fresh MSW sample collection and analysis for various physico-chemical parameters, 3) Designing of LFG extraction system, boring of LFG wells and monitoring of LFG parameters such as flow and composition and 4) Modeling of methane generation to determine the LFG generation and recovery potential for the landfill.

The results obtained from the experimental analysis demonstrate the element of variation in MSW characteristics at the sampling locations. Also variations in the MSW characteristics were found in the vertical profile of the landfill. These variations were found to influence the density and biodegradation rate of organic matter in the landfill. The difference in Gross Calorific Value (GCV) and Net Calorific Value (NCV) were lower due

to reduction in the moisture over time and drying conditions at the landfill. The experimental data was analyzed using Multiple Regression (MR) to predict the GCV and NCV values. The obtained results indicate an agreement between model output and actual heating values.

The experimental results showed that the fresh MSW is mainly composed of food waste. This implies that LFG will be generated at a higher rate. In order to validate the experimental results, a comparison with energy content models developed by other researchers was done. The regression models derived from proximate and ultimate analysis accurately predicted the energy content of MSW from the landfill. The model from this research will provide a new reference for other studies related to determination of energy content of MSW.

The gas quality measured at the well under static condition was observed to be good. Monitoring results indicate that LFG recovery appears to be maximized at high suction levels. The concentration of methane was lower under dynamic condition as compared to static condition. With the exception of one model, all the models predicted higher LFG generation values when compared to actual measured values for the data sets.

It is expected that the developed model will be important during the pre-feasibility and detailed feasibility studies for LFG to energy projects given the high initial capital investments and risks associated with these projects. The developed models may also be of importance to regulators and policymakers in evaluating the LFG mitigation measures.

Key words: Energy Content; Calorific Value; Methane; Landfill Gas; Municipal Solid Waste; LFG modeling