

# A MATHEMATICAL MODEL FOR THE EFFECTS OF STRIP MINING IN URBAN AREAS

A proposal to the Center for Environmental Studies at HMC by Alfonso Castro, Professor of Mathematics.

**Starting date:** June 1, 2006

**Location:** Department of Mathematics at HMC

**Proposed research:** Motivated by ongoing controversy in the City of Claremont due to the interest of a large corporation to strip mine sand and gravel within the city limits, this project aims to develop a mathematical model that analyzes the costs and benefits of strip mining in urban areas. Variables such as new jobs, lower cost of construction materials, additional tax revenues, impact on air quality (small particles), and impact public health (lung disease, work and school absentia) will be related in a single mathematical model. The model will be a system of differential equations capable of providing decision makers (regulators, investors, etc.) a reliable tool for authorizing strip mining operations in urban areas. A mathematical study of this type, conducted by HMC Professor R. Borelli, played a central role in banning the use of lead in gasoline.

Guided by Professor Alfonso Castro, HMC rising senior Iván Ventura will investigate the the parameters involved in the strip mining of sand and gravel. By searching the technical literature and archives of government agencies such as the Environmental Protection Agency (EPA) he will collect and study information on the effect of small particle addition to the highly polluted Southern California air. Effects of particle size, wind direction and velocity, daily temperature, ozone concentration, distance from source to densely populated areas, and other pollutants will documented. Similarly, the economic effect of new jobs, added tax base, and lower cost of construction materials will be immersed in the model.

**Educational value:** This is an excellent opportunity for a mathematics HMC student to work on a real life problem of direct local interest. The project will result in Mr. Ventura using his knowledge of differential equations, linear algebra, probability and statistics, and numerical methods to analyze multiple variables of interest to the community. The student will be required to

consult journals not usually consulted by mathematicians, e.g. the Journal of Environmental Engineering, giving him an additional opportunity to reach into multidisciplinary topics. The projects will also require the student to interview government officers, scientists, and executives which will enhance his self confidence and leadership skills.

**Significance of research for environmental quality:** Short and long term cost of air quality deterioration due to strip mining of sand and gravel is the fundamental objective of this project. This is particularly timely as high cost of real estate makes it more and more attractive to mine these materials near urban areas. The City of Claremont is just a case in point, other cities are already dealing with the consequences of this type of mining operations.

**Feasibility:** Mr. Ventura has the mathematical background needed for the project. The HMC library, internet access to the archives of the EPA, and the accessibility of officers of the City of Claremont provide a wealth of information on which to base the project. Data from nearby communities such as Duarte and Asuza which already have difficulties with strip mining of sand and gravel will prove very useful for this project.

**Proposed Budget:**

- Student stipend \$4000.00
- Faculty honorarium \$ 500.00
- Others (travel, documentation, supplies, etc.) \$1000.00
- Total \$5500.00

The student may need to travel to various locations in California, mainly in Southern California, to consult with experts on data not easily accessible over the Internet. Some of these data may not be free of charge.

**External Funding:** No external funding is sought at this time. Based on the results of this project, Professor Castro will consider developing a wider scope proposal for a government agency (local, state, EPA, NIH) where the mathematical model will be further studied and applied.