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ACARP MATTERS

CRATER HELPS MINES MANAGE IMPACTS OF EXTREME WEATHER CONDITIONS

Australian coal mines are now able to assess their vulnerability to extreme weather conditions and identify adaptation options to reduce that vulnerability using a methodology developed by CSIRO.

Known as climate related adaptation from terrain evaluation results (CRATER), this methodology uses a geographic information system (GIS) to perform:

- **Multi-criteria evaluations by ranking natural conditions such as elevation, slope, drainage and soils at the mine;**
- **Fault tree analysis to identify the reasons a failure occurs and the counter measures or adaptation options that are available;**
- **Five-capitals analysis to assess the mine's capacity to adapt using each adaptation option.**

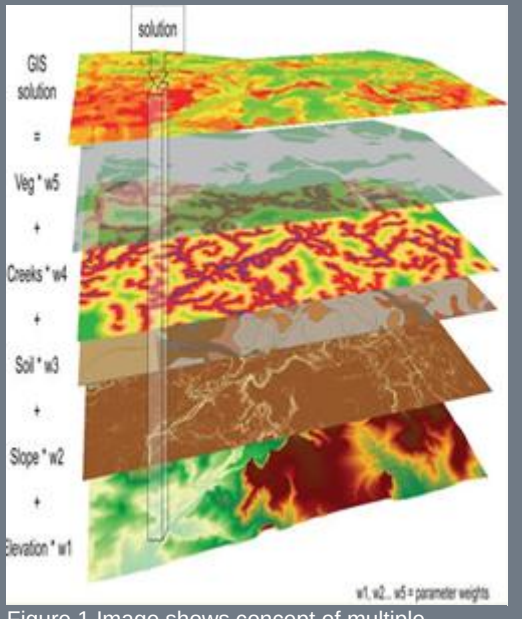

Figure 1 Image shows concept of multiple layering of different data that is compiled to perform multi-criteria evaluation of the mine site with the uppermost later being a resulting map.

CRATER can be integrated into a mine's current risk assessment methodology. It does not require new software or knowledge and uses pre-existing data that is available on site. This data can be used to model a range of 'what if' scenarios that are specific to the mine being evaluated, including mine size, positioning of infrastructure, location of pits, site morphology and resources/capital available. The three-step process is designed to help decision-making by identifying hot spots, adaptation options and the options most suited to the mine at the time.

The method provides semi-quantitative information to help mines decide the level of investment required for their specific adaptation options. CRATER can also be used at the pre-mining phase to assess the most appropriate sites to locate infrastructure

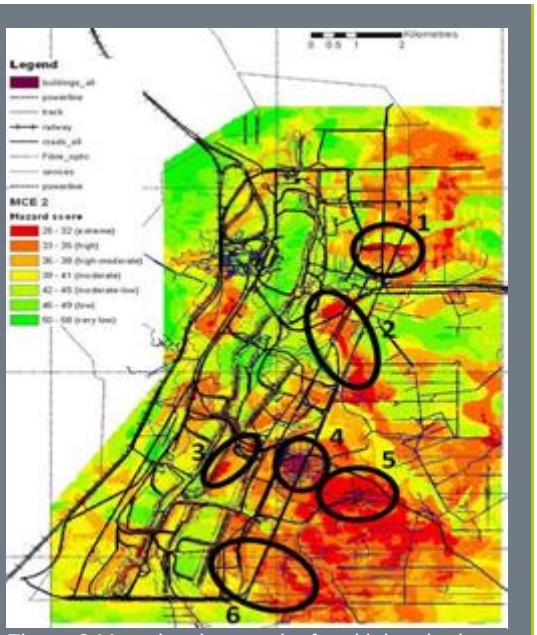

Figure 2 Map showing result of multiple criteria evaluation (MCE) where green areas are low hazard/vulnerability and red areas are high. Mine infrastructure has been placed over the MCE result and areas where critical mine infrastructure coincides with red zones, there areas are circled, indicating areas most requiring adaptation.

The Researcher
Jane Hodgkinson
Geologist, Research Scientist
CSIRO Earth Science and Resource Engineering
(07) 3327 4118
jane.hodgkinson@csiro.au

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ACARP
Australian Coal Industry's Research Program
PO Box 7148 Riverside Centre
Qld 4001 Australia

Phone 07 3229 7661
Email acarpmatters@acarp.com.au

in relation to managing climate vulnerability. It can also be re-run with new GIS data as mining progresses and the mine is developed.

Project Leader Jane Hodgkinson said that recent consultation with mine personnel confirmed that mines were vulnerable to extreme weather events.

"During such events, mines are typically reduced to either limited or no production. Mapping and addressing the management of variability in multiple ways across a mine will assist in reducing downtime and prioritising future adaptive or transformational work," she said.

"Results from our other work have shown that few companies have performed a vulnerability assessment (prior to the Queensland floods in 2011). This was mainly due to a reported paucity of understanding and knowledge in the industry around certainty or consideration of potential future risk and, in some cases, a lack of resources for performing any such assessment.

"Additionally, this may also be due to loss of skill sets related to dealing with drainage and rainfall issues, having previously been exposed to long-term drought, hence the importance of embedding a new methodology into business practices to ensure mines will always be ready for an extreme event."

Jane said the challenge was to identify the key areas requiring adaptation around a mine site and to prioritise expenditure based on levels of certainty and vulnerability.

"The coal industry has needed to declare force majeure to relieve it of the need to deliver on promised contracts due to unforseen events," she said.

"However, if a similar event occurs in the near future, it may not be deemed 'unforeseeable' and force majeure may be less easy to declare; this would force a mine to deliver on a contract despite not being able to produce. Purchasing the coal from the market may be the mine's only option to fulfil the contract."

Micaela Grigorescu, who performed the multi-criteria evaluation work, said that the process was an excellent way of bringing together pre-existing data for developing new knowledge.

"We would expect most mines to have basic terrain and hydrologic information, which can then be augmented by public databases at a similar scale," she said.

ACARP Industry Monitor Stuart Ritchie said impacts to the mining industry from the recent series of extreme wet seasons in the Bowen Basin had resulted in significant losses to the industry.

"This has, in turn, driven a strong management focus on understanding a mine's vulnerability to flood and/or rainfall runoff impact, as well as developing and implementing appropriate operational responses," he said.

"The outcomes of this project provide a semi-quantitative to quantitative risk assessment methodology that greatly enhances the ability of a mining operation to prepare for, and respond to, extreme rainfall events."

Already CSIRO plans to develop an automated terrain analysis tool that would allow iterative modelling to assess the pit's vulnerabilities and where its hot spots lie over time, as the pit progresses and as climate changes. This will speed up the analysis and the integration of new updated datasets.

Researchers will also perform multiple 'what-if' scenarios across a mine to show how it can be used in pre-mining and how current mines can be projected into a future climate scenario to see how they will cope and what adaptation may be needed.

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