Strada Aggregates Inc. Application to the Ministry of Natural Resources for a licence to operate a pit and quarry below the water table in the Township of Melancthon should not be approved. The applicant's Blast Impact analysis does not provide adequate protection from flyrock for the people living in close proximity to the proposed quarry.

Contrary to Explotech's assurances that flyrock is rare and manageable and therefore the residents should "not worry" about it, research papers published, by institutes and sponsored by mining companies in China, Japan, Australia, South Africa and Turkey, characterize flyrock as inherently non-linear, chaotic and unpredictable. *(ref. 1,2,3,4)*
Many of the research papers look to the field of Chaos Theory for more reliable methods of predicting the maximum throw of flyrock, stating that "the shortcoming of correlation techniques is that they give no information on the influence of rock size and shape on the flight distance"*(ref. 1).*

Each of the cited papers presents a different approach offering incremental improvements over the current empirical blasting formulas. They all recognize non-linear and inherently chaotic nature of rock under stress of blasting. For example, "The deformation and failure process of holed limestone can be divided into the following five stages: nonlinear oscillation, nonlinear transcritical stability weakening, nonlinear stability, period-doubling bifurcation before chaos, and the chaotic stage."(ref. 3) and, "fractures of rock under impact loads are typically sudden and unexpected" (ref. 2)

As as result, no method can rule out the chaotic phenomenon known as the "butterfly effect", a term coined by Edward Lorenz to illustrate how, in chaotic systems, a very small input change can produce a massive difference in output. Examples in the rock blasting world include; "Stojadinovic, Pantovic, and Zikic (2011) noted a sizeable rock punching a hole through the brick wall of a double-storey residence located 360 m from the bench; and, Lundborg (1981) published a photograph of a 3 t boulder that landed 300 m from and 40 m above its source" *(ref. 1)*.

Outside of Canada, injuries and fatalities due to fly rock are acknowledged as being a significant issue for the aggregate industry. Canada does not collect country wide statistics. The United States National Institute for Occupational Safety and Health defines flyrock as "any debris that lands outside the designated blasting area. It can vary in mass from marble-sized to car-sized and can be incredibly dangerous and potentially fatal." A NIOSH report determined that flyrock killed or injured 311 people over a 26 year period. Relatively rare perhaps, but what is the acceptable body count per million tons of aggregate?

Flyrock frequency cannot be predicted and the maximum rock travel cannot be reliably calculated. The only real protection for people living in the proximity of blasting quarries is DISTANCE. Strada's proposed operation does not provide for this essential safely measure.

> Regulations in Nova Scotia state that "No person responsible for the operation of a quarry shall blast within: 800 m of the foundation or base of a structure located off site. This distance can be reduced with written consent from all individuals owning structures within 800 m."
> In Quebec "The operating site of a new quarry must be located at a minimum distance of 600 m from any dwelling, unless the dwelling is owned by or rented to the owner or operator of the quarry."
> And in New Brunswick a quarry must be "600 metres from any drinking water supply well, unless the written permission of the well owner(s) within the 600 metres is obtained and

submitted to the Department for acceptance. “

Contrast this with Ontario where “a licensee or permitted shall take all reasonable measures to prevent fly rock from leaving the site during blasting if a sensitive receptor is located within 500 metres of the boundary of the site.” In addition, the regulation offers no definition of what constitutes “reasonable measures”.

There is a mounting body of evidence and expert opinion that a minimum set back for safety from flyrock should be set at 1000 meters *(ref. 1, 5).* Unless Strada is prepared to commit to this minimum level of safety, for the residents of Melancthon living in the shadow of this proposed blasting quarry, their application should NOT BE APPROVED.

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2.) ***State-of-the-Art Review and Prospect of Modelling the Dynamic Fracture of Rocks Under Impact Loads and Application in Blasting***

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