

## Modeling Results

The modeling results are based on an 'intermediate case' assessment whereby partial failure of the cliff and a bulking factor of 2:1 fill onto the existing boulder field, at the angles agreed by the Port Hills Working Group. This is based on the scenario of a large scale cliff collapse.

Rockfall modeling of the intermediate case indicated that 6% would reach the base of the slope, and would have a maximum bounce height of 1.2m at this point (Figure 9). Of these rockfalls, none (< 1/10,000) had sufficient velocity to reach the line of the existing containers (Figure 10).

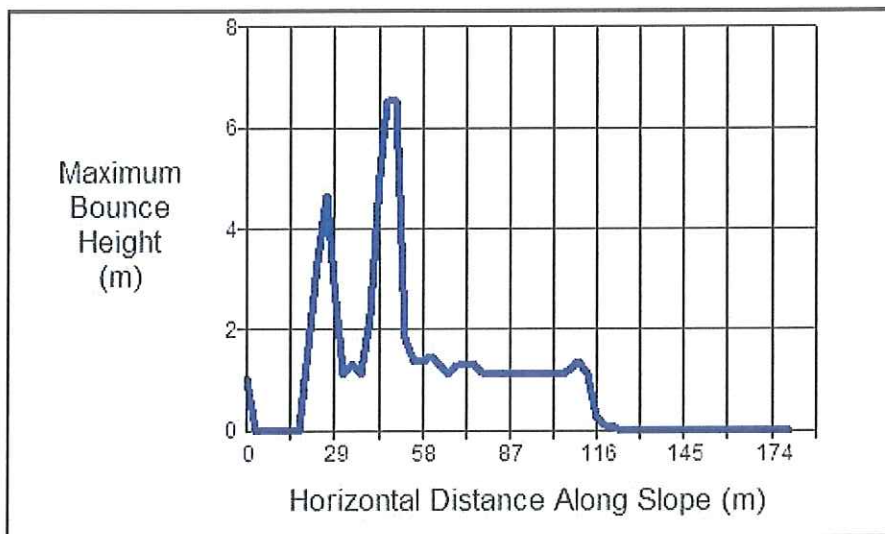


Figure 9: Case 1 Maximum Bounce Height

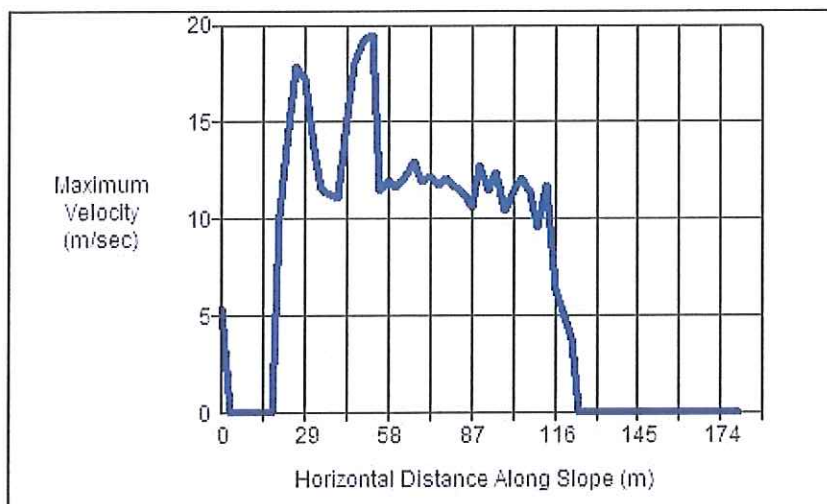


Figure 10: Case 1 Maximum Velocity

### Sensitivity Analysis

A sensitivity analysis was undertaken, assuming a toppling horizontal velocity at rockfall source of 1.5m/s, and have varied the Tangential Coefficient, and relative Surface Roughness to those reasonably applicable for a soft talus slope and more relatively smooth slope as it compares to the 2.2m diameter source boulder.

The sensitivity analysis confirms that anticipated bounce heights are 0.5-1.0m, with maximum velocities relatively low at approximately 9m/s (33km/h) and that no significant bounce or travel continues past the 118m Analysis Point (Figure 11).

The assessment indicates that there is negligible variance in velocity at the base of the slope (analysis Point 1, at ch118) and only 4 more boulders (per 1,000) reached the toe of the slope (Figure 12). No boulders travel to the 130m mark.

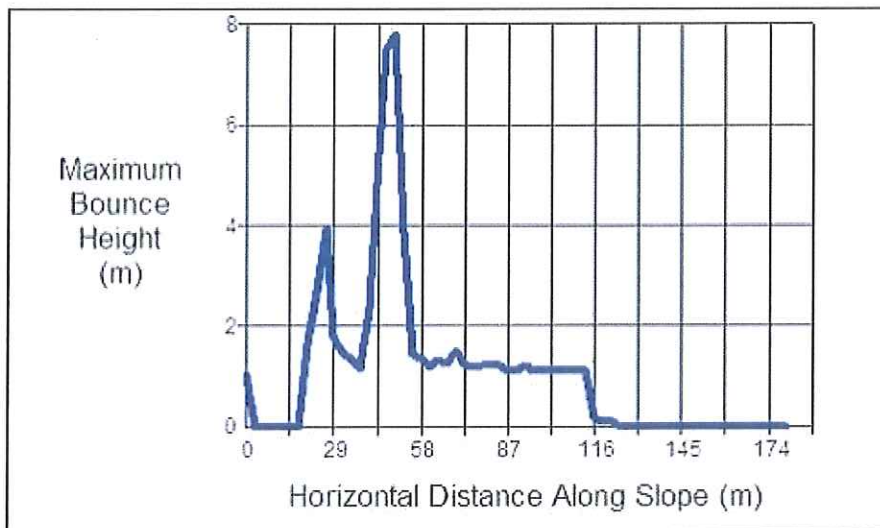


Figure 11: Case 2 Maximum Bounce Height

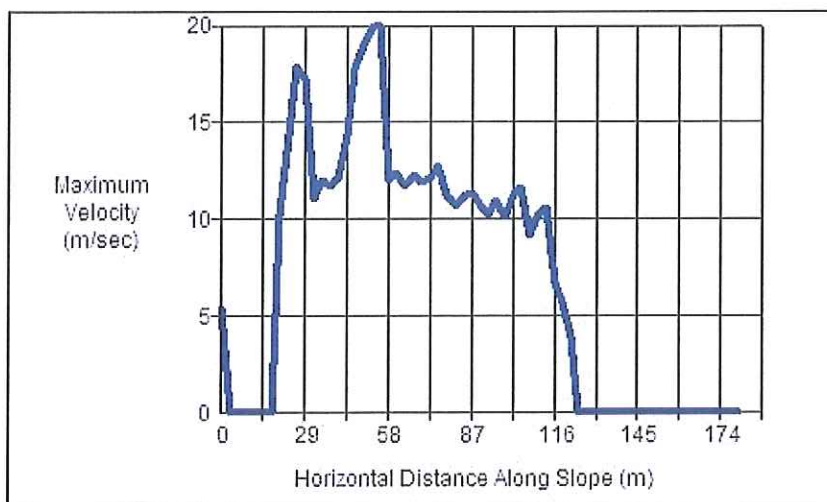


Figure 12: Case 2 Maximum Velocity

### Extreme Analysis

Further to the reasonably predicted maximum values for Roughness, Tangent coefficients and Normal coefficients, we have undertaken an analysis using hypothetical extremes to assess the maximum potential results.

Roughness values of 0.1 were assumed throughout the face model; Tangent Coefficients of 0.95 were assumed over the face, and 1.0 on the grass; Normal Coefficients were taken at the recommended extremes of 0.3 for a rock face, and 0.2 for the grass.

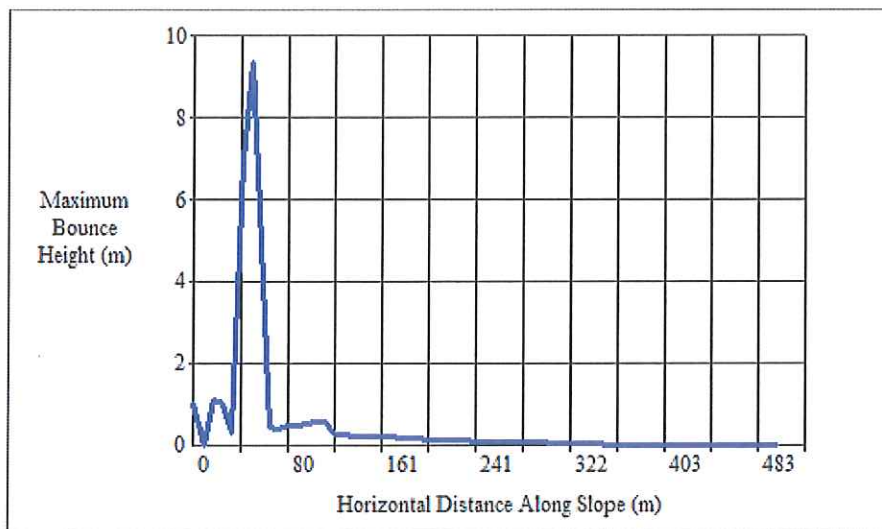


Figure 13: Extreme Case Maximum Bounce Height

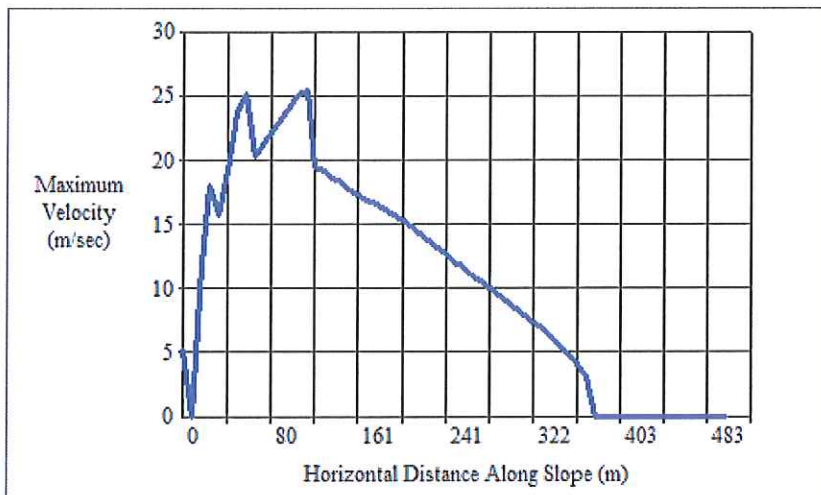


Figure 14: Extreme Case Maximum Velocity

Under this extreme analysis approximately 25% of the rock falls pass 160m (40m from the toe). Maximum velocity would be 18m/s.

The maximum run out distance is approximately to chainage 350m, or 230m from the toe of the slope.