Hazard Analysis of Post-Fire Debris-Flow Potential in Arizona

I. SUMMARY
Using data from the 2010 Schultz Fire near Flagstaff, Arizona (Figure 1), we tested 3 models developed by the USGS to predict the probability of postwildfire debris-flow occurrence (Cannon and others, 2010, GSA Bull, 122(1-2), 127-144).

II. MOTIVATION
Burned Area Emergency Response (BAER) teams assess damages to resources and potential hazards to values at risk after a wildfire, and make recommendations for emergency stabilization. Following the 2011 Wallow, Monument, and Horseshoe 2 fires one of the models tested here (Model A) was used to identify burned basins with a high probability for post-fire debris-flows (Nuddy, 2011, OFR 2011-1181, OFR 2011-1197). Neither Model A, nor the other 2 Interagency West USGS models (Models B and C), however, have been tested for the varied physiographic provinces of Arizona.

III. POST-FIRE DEBRIS-FLOW MODELS
Three post-fire debris-flow models developed by the USGS (Cannon and others, 2010) were tested using Schultz Fire data. The probability of debris-flow occurrence is calculated by: P = e^(-1/ε)^3. Three models calculate the variable 'ε'.

Model A: ε = -0.7 + 0.35SG + 1.6(OM + 0.06(AB) + 0.28CL) + 0.6(1-HD) + 0.7(FL)
Model B: ε = -1.7 + 1.8(OM + 0.06AB) + 0.9(1-HD) + 0.06(FL)
Model C: ε = 4.8 + 0.05AB + 0.26CL - 0.4(1-HD) + 0.07FL

Model Parameters

IV. METHODS
Rainfall Data
Three tipping-bucket raingauges were installed within the burned area (Figs 2, 4, 6). Five storms with the shortest duration and highest intensity were selected for model testing (Figure 3, Table 1).

<table>
<thead>
<tr>
<th>Storm</th>
<th>Total (mm)</th>
<th>Duration (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 20th</td>
<td>58.0</td>
<td>0.75</td>
</tr>
<tr>
<td>July 22nd</td>
<td>24.2</td>
<td>0.45</td>
</tr>
<tr>
<td>Aug 1st</td>
<td>32.0</td>
<td>0.80</td>
</tr>
<tr>
<td>Aug 16th</td>
<td>48.2</td>
<td>0.65</td>
</tr>
</tbody>
</table>

V. RESULTS

Models A and B predicted a high probability (260%) of debris flows under certain storm conditions. Model C did not predict debris flows under any storm conditions (Table 2).

VI. CONCLUSIONS AND ONGOING WORK
Data from the 2010 Schultz Fire were used to assess 3 post-fire debris-flow models for use in Arizona:

- Model A generally performed better than Model B in this environment.
- Model C failed to predict debris flows under any storm conditions.
- Testing will continue with data collected from the 2011 Wallow, Horseshoe 2 and Monument Fires.