A table of most of the equations we have used (click here for river equations)
Note, the symbols don't translate with some browsers… I am working on the problem

Basic		
Force balance	$\sum F = 0$, or $\sum F = ma$	The second form is used if there are any accelerations
Hydro or litho static pressure	$P = \rho g d$	ρ is the material density, and d is the depth of burial
Slope stability		
Shear stress, parallel to slope at some depth (perpendicular to slope)	$T = \rho g d \sin \alpha$	See notes on slope angles and depths
Normal stress, perpendicular to slope	$\sigma = \rho gd \cos\alpha$	
Coefficient of friction	$\mu = \tan \phi$	ϕ is the internal angle of friction. In the absence of cohesion, ϕ is the angle at which a block will slide.
Factor of Safety for a slice of a potential failure surface	$FS = (\sigma_{eff} \tan \phi + S) / \tau_s$	General form of the FS equation. The ratio of resisting stresses to driving stresses. Th

		e coefficient of friction is tan ϕ or μ.
Factor of Safety for a straight dry slope	$FS = (\rho gd \cos\alpha \tan\phi + S) / \rho gd \sin\alpha$	Where d is the perpendicular to slope depth
Water pressure in a 'shallow soiled hillslope'	$P_w = \rho_w g d_{wt} \cos\alpha$	Where d is the 'perpendicular to slope' depth from the watertable down to the point of interest
Effective pressure	$\sigma_{eff} = \sigma_n - P_w$	Normal stress reduction, as a result of water pressure
FS for a wet straight slope, using the 'shallow soil hillslope' approx. for water pressure	FS = $[((\rho_s g d_s + \eta \rho_w g d_{wt}) - \rho_w g d_{wt} \cos\alpha)$ $\cos\alpha \tan\phi + S]$ $/ (\rho_s g d_s + \eta \rho_w g d_{wt}) \sin\alpha$	Note this only applies directly to the specified type of failure
After failure, the mass will tend to fall at an acceleration of:	$a = g(\sin\alpha - \cos\alpha \tan\phi)$	This is just the sum of forces divided by the mass. If the slope doesn't change the acceleration a is a constant.
Useful formula for motion, with constant acceleration	$V^2 = 2aL$ and $2L = at^2$	Where v is velocity, L is the slide path length, and t is the time since the

		acceleration (a) was applied
Stress, Strain and Strain Rate		
Stress	Force per area	This is a tensorial quantity, with magnitude and two directions
Strain τφ	Change of length with length. Example: a normal strain component (only for very small Δx) $\varepsilon_{xx} = \Delta x$ / (original length in x) A shear strain is more complex $\varepsilon_{xy} = \frac{1}{2}$ [Δy / (original x) + Δx / (original y)]	Although dimensionless, this is also a tensor!
Strain rate	Calculation of shear strain rate in a fluid $\varepsilon^{o}_{xy} = \frac{1}{2} [\Delta V_y / \Delta x + \Delta V_x / \Delta y]$	The shear strain rate is determined by gradients in the velocities
Debris flow equations		
	A page of velocity equations here	
Two useful velocity equations	$V = (2\ g\ z)^{1/2}$ $V = (g\ (R/W)\ z)^{1/2}$	Where z is the superelevation. The first can be used for water piling up against an obstacle, the 2nd for water going around a bend of radius R and flow width W.

Convolution for Shallow Soiled Hillslope approximation, and other distributed input to point output processes.	$$d_{w.t.}(t,X)=\frac{1}{K_{sat}\sin\alpha}\left\{\sum_{\tau=t_{start}}^{\tau=t}R(t-\tau)\Delta x\right\}$$ $$\Delta\tau=\frac{\Delta x}{K_{sat}\sin\alpha}$$ $$t_{start}=t-(\frac{X}{K_{sat}\sin\alpha})$$	This gives the water table at time ‘t’, at some distance X downslope. The sum runs from sometime in the past (see note below) to time ‘t’, and the time step size (to step thru the sum) is given by $\Delta\tau$. This form only works for constant slope and water velocity. Note, the start time of the sum, is the time in the past when water that is passing the point you are interested in, fell on the top of the hill. In other words: τ (lower limit) is [slope length/water velocity], note this is a [past] time.