GRAIP-2 for ArcGIS 10 Installation and Use

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This document describes how to install and use the ArgGIS 10 toolbox developed for GRAIP-2. GRAIP-2 refers to the GRAIP version being developed for ArcGIS 10. This will supersede GRAIP version 1.0.x that was only compatible with ArcGIS 9. GRAIP-2 functionality is being developed using a combination of Python and C++ programs.

New Functions

Functions in GRAIP Tools

Road Surface Erosion Analysis

- Road Surface Erosion
- Stream Sediment Input

Mass Wasting Potential Analysis

- Add Stability Index to Database
- Mass Wasting Potential
- Length Slope Plot
- Stability Index with Road Impact

New TauDEM functions

SINMAP Stability Index

- Stability Index
- Calibration Parameter Region Grid

Prerequisites and Dependencies

GRAIP-2 assumes a Windows Computer with ArcGIS 10.3.1 or higher and Microsoft Office.

These instructions specifically refer to a computer with Windows 7 64 bit, ArcGIS 10.3.1 and Microsoft office 2010. Adjustments may be needed for different platforms. We have tested on both 32 and 64 bit Windows 7 operating systems.

ArcGIS 10.3.1 include Python 2.7. A number of Python libraries are required beyond the Python version installed with ArcGIS. GRAIP depends on numpy-1.8.1 from the ArcGIS 10.3.1 Python installation

TauDEM (version 5.3) is used to provide hydrologic terrain analysis and channel network delineation functionality. GRAIP depends on GDAL-1.9.2 from the TauDEM installation.

The GRAIP Preprocessor uses ODBC database drivers from Microsoft office to access the GRAIP mdb database, so a version of Microsoft office needs to be installed.

Installation

NOTE: If you have previously installed GRAIP-2, you need to uninstall GRIAP-2 first. From Windows list of installed programs, uninstall "GRAIP-2 Prerequisites version 2.0", "GRAIP-2 Python Tools version 1.0"

and "GRAIP-2 Preprocessor version 2.0". Since version number changes as software gets updated, you may have different versions for these three software packages.

- 1. Install graip_2_prerequisites_setup.exe. This installs the python libraries used. These include
 - pyodbc-3.0.7
 - Click-2.5 (Python command line interface creation kit)
 - scipy-0.15.1
 - matplotlib-1.1.0
 - setuptools-5.4.1
 - easyinstall-2.7

In case you have multiple versions of Python installed select Python Version 2.7 from ArcGIS (usually in folder c:\Python27\ArcGIS10.3\). During this install you need to be connected to the internet as the install script downloads python components that are part of setuptools and easyinstall.

- 2. Install graip_2_arcgis_python_tools_setup.exe. This includes
 - GRAIP Tools.tbx: This is an ArcGIS Toolbox that interfaces to Python Scripts
 - ArcGISRoadSurfaceErosion.py: ArcGIS Toolbox interface to Road Surface Erosion function
 - ArcGISStreamSedimentInput.py: ArcGIS Toolbox interface to Stream Sediment Input function
 - ArcGISStabilityIndexWithRoadImpact.py: ArcGIS Toolbox Stability Index with Road Impact interface to Stability Index function
 - ArcGISMassWastingPotential.py: ArcGIS Toolbox interface to Mass Wasting Potential function
 - ArcGISCalibrationRegionTool.py: ArcGIS Toolbox interface to Calibration Region Grid function
 - ArcGISLSPlot.py: ArcGIS Toolbox interface to Length Slope Plot function
 - RoadSurfaceErosion.py: Command line callable Road Surface Erosion function
 - StreamSedimentInput.py: Command line callable Stream Sediment Input function
 - StabilityIndex.py: Command line callable Stability Index function
 - MassWastingPotential.py: Command line callable Mass Wasting Potential function
 - LSPlot.py: Command line callable Length Slope Plot function
- 3. Install TauDEM from http://hydrology.usu.edu/taudem. TauDEM534.exe
- 4. Add the GRAIP ArcGIS Toolbox.
 - Open ArcMap 10.3.1 or higher.
 - Open ArcToolbox within ArcMap
 - Right click in white space to Add Toolbox



• Navigate to the GRAIP-2 > PythonTools folder and open GRAIP Tools.tbx.

Add Toolb	ox
Look in:	🔁 PythonTools 🔹 👻
SRAIP 🎯	Home - Documents\ArcGIS Folder Connections C:\
	GRAIP-2
	PythonTools

The following tools should be added to your ArcToolbox list

- 🖃 📦 GRAIP Tools
 - 🖃 🗞 Mass Wasting Potential Analysis
 - 💐 Add Stability Index to Database
 - 🥞 Length Slope Plot
 - 🧃 Mass Wasting Potential
 - 💐 Stability Index with Road Impact
 - 🖃 🗞 Road Surface Erosion Analysis
 - 📑 Road Surface Erosion
 - 🧃 Stream Sediment Input
- If you wish this toolset to persist when you close and open ArcMap right click in white space in ArcToolbox and Save Settings > To Default.



- 5. Add the TauDEM ArcGIS toolbox from C:\Program Files\TauDEM\TauDEM5Arc and save settings to default if desired.
 - 🖃 🚳 TauDEM Tools
 - 🗄 🗞 Basic Grid Analysis
 - 표 🗞 Specialized Grid Analysis
 - 표 🗞 Stream Network Analysis
- 6. Install graip_2_preprocessor_setup.exe. This includes:
 - PySide Python GUI library

- GRAIP Database file (GRAIP.mdb) located under GRAIP_DB folder
- GRAIP demo data under the 'tutorial' folder
- This manual under the 'tutorial' folder
- GRAIP Icon file (GRAIPIco.ico)
- preprocessor.pyw (main script file for the preprocess application)
- utils.py (script file that contains utility functions for the preprocessor application)

In this install click Yes to the Folder Exists message

Folder Exist	ti l	23
?	The folder: C:\Program Files\GRAIP-2 already exists. Would you like to install to that folder anyway?	
	Yes No	

Note: During the Preprocessor install you need to be connected to the internet as the install script downloads PySide GUI library.

Run GRAIP

- 1. The GRAIP demo data is in C:\Program Files\GRAIP-2\Preprocessor\tutorial\demo.zip. Move the folder demo from this file to your working location.
- 2. Run the GRAIP-2 Preprocessor. Double Click GRAIP-2 Preprocessor shortcut.



Enter inputs

G GRAIP Preprocessor (Version 2.0)
File Setup
The GRAIP Preprocessor is a tool to import USDA Forest Service road inventory information into a MS Access database for use by GRAIP Analysis Tools in ArcGIS
GRAIP Database (*.mdb)
C:\Users\dtarb\Desktop\demo\test.mdb
Input Files
Road Shapefiles
C:\Users\dtarb\Desktop\demo\ShapeFiles\Road.shp Add Remove
Drain Points Shapefiles
C:\Users\dtarb\Desktop\demo\ShapeFiles\BBdip.shp C:\Users\dtarb\Desktop\demo\ShapeFiles\Diffuse.shp C:\Users\dtarb\Desktop\demo\ShapeFiles\DitchRel.shp C:\Users\dtarb\Desktop\demo\ShapeFiles\LeadOff.shp C:\Users\dtarb\Desktop\demo\ShapeFiles\Ned.shp C:\Users\dtarb\Desktop\demo\ShapeFiles\Str_Xing.shp C:\Users\dtarb\Desktop\demo\ShapeFiles\Sump.shp C:\Users\dtarb\Desktop\demo\ShapeFiles\Sump.shp
Options <u>N</u> ext Cancel

Click Next and OK through all the preprocessor windows that open. [Tom - it may be better to distribute a more recent example that does not trigger so many errors/warnings]

Match a source field	from the input	:me:⊥ OT & : file to the appropria	ite targel	field in the database		
File being imported	sktopidemoiSt	hapeFiles\BBdip.shp				
Set Field Names						
Drain Point Type						
Broad base dip	G Misma	itch				
Target f CDate CTime		'FILL_EROS' in sha	pefile.'B	3dip.shp'.A default value will	be used.	E
		VEHICLE	•			
VehicleID						
VehicleID StreamConnec	tID	STREAM_CON	•			
VehicleID StreamConnec SlopeShapeID	tD	STREAM_CON SLOPE_SHAP	•			 -
VehicleID StreamConnec SlopeShapeID	tID	STREAM_CON	•			-

Open ArcMap and run TauDEM to get a stream network.

3. Add original DEM and run Pit Remove

🏐 Pit Remove	- • ×
Input Elevation Grid	
dem	- 🖻
Fill Considering only 4 way neighbors (optional)	
Input Depression Mask Grid (optional)	
	- 🖻
Input Number of Processes	
	8
Output Pit Removed Elevation Grid	
C:\Users\dtarb\Desktop\demo\DEM\demfel.tif	🖻 👻
OK Cancel Environments	Show Help >>

If you receive a TauDEM firewall warning you may dismiss it with either allow or cancel. The program runs regardless as it does not actually access the network.

4. D8 Flow Directions

I D8 Flow Directions	- • •
Input Pit Filled Elevation Grid (must be .tif)	^ ^
demfel.tif	I 🖻
Input Number of Processes	
	8 =
Output D8 Flow Direction Grid (must be .tif)	
C:\Users\dtarb\Desktop\demo\demp.tif	
Output D8 Slope Grid (must be .tif)	
C:\Users\dtarb\Desktop\demo\demsd8.tif	- 12
OK Cancel Environments	Show Help >>

5. D8 Contributing area with outlet

💐 D8 Contributing Area	- • ×
Input D8 Flow Direction Grid (must be .tif)	^
C:\Users\dtarb\Desktop\demo\demp.tif	- 🖻
Input Outlets Shapefile (must be .shp) (optional)	
C:\Users\dtarb\Desktop\demo\Outlet2.shp	- 🖻
Input Weight Grid (must be .tif) (optional)	
	- 🖻
Check for edge contamination	
Input Number of Processes	
	8
Output D8 Contributing Area Grid (must be .tif)	
C:\Users\dtarb\Desktop\demo\demad8.tif	
	_
OK Cancel Environments	Show Help >>

6. (a) Expedient alternative. Stream Definition by Threshold (This is an expedient approach with contributing area threshold 1000. In general it may be better to use one of the more elaborate TauDEM methods. See TauDEM manual)

Stream Definition By Threshold	- • ×
Input Accumulated Stream Source Grid (must be .tif)	*
demad8.tif	- 🖻
Input Mask Grid (must be .tif) (optional)	
	- 🖻
Threshold	
	1002
Input Number of Processes	8
Output Stream Raster Grid (must be .tif)	Ū
C:\Users\dtarb\Desktop\demo\demsrc.tif	
	-
OK Cancel Environments	Show Help >>

(b) Rigorous Alternative. Peuker Douglas Stream Definition. (This performs a stream drop analysis to select a channelization threshold that produces a stream network with geomorphologically based drainage density. This requires an outlet file that has its outlets precisely positioned on the stream paths.)

💐 Peuker Douglas Stream Definition		x
Input Elevation Grid (must be .tif)		*
C:\Users\dtarb\Desktop\demo\demfel.tif		
Input D8 Flow Direction Grid (must be .tif)		
C:\Users\dtarb\Desktop\demo\demo.tif		
	0.4	
Weight Side		
	0.1	
Weight Diagonal		
	0.05	
Accumulation Threshold		
	50	
Check for Edge Contamination		
Input Outlets Shapefile (must be .shp) (optional)		
C:\Users\dtarb\Desktop\demo\Outlet2.shp		
Input Mask Grid (must be .tif) (optional)		
	-	
, Input D8 Contributing Area for Drop Analysis (must be .tif) (optional)		
C:\Users\dtarb\Desktop\demo\demad8.tif		
Input Number of Processes		
	8	
Output Stream Source Grid (must be .tif)		
C:\Users\dtarb\Desktop\demo\demss.tif		
Output Accumulated Stream Source Grid (must be .tif)		
C:\Users\dtarb\Desktop\demo\demssa.tif	🔁	
Output Stream Raster Grid (must be .tif)		
C:\Users\dtarb\Desktop\demo\demsrc.tif		
Output Drop Analysis Table (must be .txt) (optional)		
C:\Users\dtarb\Desktop\demo\demdrp.txt		
1 1		
Use the range below to automatically select threshold by grop analysis		
Minimum Threshold Value		
	5	
Maximum Threshold Value	500	
Number of Threshold Values	300	
Number of Threshold Values	10	
✓ Use Logarithmic spacing for threshold values		
ОК	Cancel Environments Show Help >>	>

In what follows the results from (b) are used.

7. Stream Reach and Watershed

🗊 Stream Reach And Watershed 📃 🗖	
Input Pit Filled Elevation Grid (must be .tif)	*
C:\Users\dtarb\Desktop\demo\demfel.tif	2
Input D8 Flow Direction Grid (must be .tif)	
C:\Users\dtarb\Desktop\demo\demp.tif	2
Input D8 Drainage Area (must be .tif)	
C:\Users\dtarb\Desktop\demo\demad8.tif	2
Input Stream Raster Grid (must be .tif)	
C:\Users\dtarb\Desktop\demo\demsrc.tif	2
Input Outlets Shapefile as Network Nodes (must be .shp) (optional)	
C:\Users\dtarb\Desktop\demo\Outlet2.shp	2
Delineate Single Watershed	_
	8
Output Stream Order Grid (must be .tif)	
C:\Users\dtarb\Desktop\demo\demord.tif	2
Output Network Connectivity Tree (must be .txt)	_
C:\Users\dtarb\Desktop\demo\demtree.txt	2
Output Network Coordinates (must be .txt)	_
C:\Users\dtarb\Desktop\demo\demcoord.txt	2
Output Stream Reach Shapefile (must be .shp)	
C:\Users\dtarb\Desktop\demo\demnet.shp	2
Output Watershed Grid (must be .tif)	
C:\Users\dtarb\Desktop\demo\demw.tif	2
	-
OK Cancel Environments Show Hel	p >>

Now we are ready to run GRAIP functions

- 8. Add DrainPoints.shp and Roadlines.shp shapefiles to ArcMap.
 - C:\Users\dtarb\Desktop\demo
 DrainPoints

🖃 🗹 RoadLines

٠

- 9. Add DrainPoints and Roadlines tables from GRAIP mdb to ArcMap. (Not needed for execution, only added for visualization)
 - C:\Users\dtarb\Desktop\demo\test.mdb
 - 🔟 DrainPoints
 - 🖩 RoadLines
- 10. Run the Road Surface Erosion tool with the following inputs.

🗊 Road Surface Erosion					• 🗙	
Input Drainpoints Shapefile					_	1
DrainPoints				-	2	l
Input Roadlines Shapefile						
RoadLines				-	2	
Input Graip Database (must be .mdb)						
C:\Users\dtarb\Desktop\demo\test.mdb					2 =	
Input DEM Raster						
dem				-	2	l
Output Drainpoint Sediment Weight Raster (output data in tif for	mat)					l
C:\Users\dtarb\Desktop\demo\DEM\demdpsi.tif					2	
✓ Stream Connected					-	#
	ОК	Cancel	Environments	Show He	elp >>	

Note that the DEM raster input has to be at the same scale of the TauDEM flow direction DEM that will be used in later functions so that the Output Drainpoint Sediment Weight raster is produced at the same scale as the DEM to use in TauDEM weighted flow accumulation. Earlier versions of GRAIP used a higher resolution interpolated DEM here to better compute road segment slopes. This is no longer necessary as we have implemented bilinear interpolation on the given input DEM in the extraction of road line end point elevations used for the computation of slope.

Note that the units on drainpoint sediment weight raster are kg/yr consistent with the units in Roadlines and Drainpoints tables.

11. Weighted D8 Contributing Area to evaluate drain point sediment accumulation.

💐 D8 Contributing Area		- • ×
Input D8 Flow Direction Grid (must be .tif)		^
demp.tif		- 🖻
Input Outlets Shapefile (must be .shp) (optional)		
C:\Users\dtarb\Desktop\demo\Outlet2.shp		- 🖻
Input Weight Grid (must be .tif) (optional)		
C:\Users\dtarb\Desktop\demo\demdpsi.tif		- 🖻
Check for edge contamination		
Input Number of Processes		
		8
Output D8 Contributing Area Grid (must be .tif)		
C:\Users\dtarb\Desktop\demo\demsac.tif		
	OK Cancel Environments	Show Help >>

12. Stream Sediment Input

Stream Sediment Input		- • ×
Input Stream Network Shapefile		^
C:\Users\dtarb\Desktop\demo\demnet.shp		
Input Contributing Area Raster		
C:\Users\dtarb\Desktop\demo\demad8.tif		
Input Sediment Accumulation Raster		
C:\Users\dtarb\Desktop\demo\demsac.tif		
Dinfinity		
Output Specific Sediment Accumulation Raster		
C:\Users\dtarb\Desktop\demo\demspe.tif		2
		-
	OK Cancel Environments	Show Help >>

The specific sediment accumulation raster is computed as the ratio of sediment accumulation raster to contributing area raster, with units adjustments and fields SedAccum, SpecSed, SedDir and SpecSedDir are added to the stream network shapefile.

Note that the units on sediment accumulation are kg/yr as this inherits from dpsi. The units on the specific sediment accumulation raster are Mg/km^2/yr. This is evaluated as (sac/1000)/(ad8*dx*dy/10^6)



13. Using the Dinfinity approach.

Dinfinity flow directions

I D-Infinity Flow Directions		
Input Pit FIlled Elevation Grid (must be .tif)		^
demfel.tif		I 🖻
Input Number of Processes		
		8
Output D-Infinity Flow Direction Grid (must be .tif)		_
C:\Users\dtarb\Desktop\demo\demang.tif		
Output D-Infinity Slope Grid (must be .tif)		_
C:\Users\dtarb\Desktop\demo\demslp.tif		-
	OK Cancel Environments	Show Help >>

14. Dinfinity contributing area

🕄 D-Infinity Contributing Area	- • ×
Input D-Infinity Flow Direction Grid (must be .tif)	*
demang.tif	I 🖻
Input Outlets Shapefile (must be .shp) (optional)	
	- 🖻
Input Weight Grid (must be .tif) (optional)	
	- 🖻
Check for Edge Contamination	
Input Number of Processes	
Output D-Infinity Specific Catchment Area Grid (must be .tif)	8
C:\Users\dtarb\Desktop\demo\demsca.tif	2
	-
OK Cancel Environments	Show Help >>

15. Weighted Dinfinty Contributing Area

S D-Infinity Contributing Area	- • ×
Input D-Infinity Flow Direction Grid (must be .tif)	^
demang.tif	- 🖻
Input Outlets Shapefile (must be .shp) (optional)	
	- 🖻
Input Weight Grid (must be .tif) (optional)	
C:\Users\dtarb\Desktop\demo\demdpsi.tif	I 🖻
Check for Edge Contamination	
Input Number of Processes	
	8
Output D-Infinity Specific Catchment Area Grid (must be .tif)	
C:\Users\dtarb\Desktop\demo\demsacdinf.tif	2
	~
OK Cancel Environments	Show Help >>

- 16. Create copy of stream network onto which to write dinfinty results so as not to clober D8 results computed earlier: demnetdinf.shp. Delete the last 4 fields in this copy.
- 17. Stream Sediment Input

🟐 Stream Sediment Input	- • ×
Input Stream Network Shapefile	^
C:\Users\dtarb\Desktop\demo\demnetdinf.shp	
Input Contributing Area Raster	
C:\Users\dtarb\Desktop\demo\demsca.tif	
Input Sediment Accumulation Raster	
C:\Users\dtarb\Desktop\demo\demsacdinf.tif	
✓ Dinfinity	
Output Specific Sediment Accumulation Raster	_
C:\Users\dtarb\Desktop\demo\demspedinf.tif	
	_
1	Ŧ
OK Cancel Environments	Show Help >>

SINMAP

18. Create Parameter Region Grid.

SINMAP parameters are specified using an integer grid that serves as an index into an attribute lookup table. This is evaluated using the TauDEM SINMAP Create Parameter Region Grid

🏐 Create Parameter Region Grid		
Input DEM Dataset	*	Input DEM Dataset 🔶
C:\Users\dtarb\Desktop\demo\DEM\dem 🗾 🔁		
Select Region Creation Option		Digital elevation Model grid
Create One Uniform Region 🗸		(cell size rows and
Input Region Raster (optional)		columns and spatial
		reference) of the region
Input Region Feature Class (optional)		grid.
Select Feature Class Attribute ('FID' is not a valid attribute) (optional)		
v la		
Output Parameter Region Grid (.tif format)		
C:\Users\dtarb\Desktop\demo\DEM\demreg.tif		
Output Parameter Table Text File (must be .txt or .csv or .dat)		
C:\Users\dtarb\Desktop\demo\DEM\dempar.csv		
	Ŧ	*
OK Cancel Environments) << Hide Help		Tool Help

The following default SINMAP parameter file is written to dempar.csv.

SiID, tmin, tmax, cmin, cmax, phimin, phimax, SoilDens 1,2.708,2.708,0.0,0.25,30.0,45.0,2000.0

If different parameters are desired this file may be edited by hand.

Input Slope Raster		-	Stability Index
C:\Users\dtarb\Desktop\demo\DEM\demslp.tif		- 🖻	
Input Specific Catchment Area Raster			Computes terrain stability
C:\Users\dtarb\Desktop\demo\DEM\demsca.tif		- 🖻	SINMAP method based on
Input Parameter Region Raster			the infinite plain slope
C:\Users\dtarb\Desktop\demo\DEM\demreg.tif		- 🖻	stability model. SI values
Input Parameter Attribute Table Text File			are written to the output
C:\Users\dtarb\Desktop\demo\DEM\dempar.csv			documentation on SINMAP
Minimum Terrain Recharge (m/hr)			web page for an
		0.0009	understanding of what this
Maximum Terrain Recharge (m/hr)			to documentation on the
		0.00135	GRAIP web page for use of
Output Stability Index Raster			this including the impacts
C:\Users\dtarb\Desktop\demo\DEM\demsi.tif			may alter terrain stability
Output Saturation Raster			indy and contain stability.
C:\Users\dtarb\Desktop\demo\DEM\demsat.tif			
Intermediate Output Files Location			
C:\Users\dtarb\Desktop\demo\DEM\temp_output_files			
☑ Delete Intermediate Output Files Upon Completion			
			r

19. Stability index. (From the TauDEM tools, SINMAP without road impacts)

Note that the previous version of SINMAP used T/R as a single parameter. The new implementation uses T and R as separate parameters, with Rmin and Rmax input on the dialog above and spatially uniform, while T is a value lookup by parameter zone as specified in the parameter attribute table.

The values used for testing above were Rmin = 0.0009025 m/hr and Tmax = 2.708 m²/hr which gives T/Rmax = 3000.5 m, and Rmax = 0.0013535 m/hr and Tmin = 2.708 m²/hr which gives T/Rmin =2000.7 m. These are close to the default SINMAP parameters of T/Rmin = 2000 m and T/Rmax = 3000 m, for checking of results.

20. GRAIP Tools -> Mass Wasting Potential Analysis -> Add Stability Index to Database.

Input Graip Database (must be .mdb)		^	Add Stability Index to Database	
C:\Users\dtarb\Desktop\demo\test.mdb				
Input Drain Points Shapfile			Adds stability index from the stability index grid file to the SI	
C:\Users\dtarb\Desktop\demo\DrainPoints.shp			column of the drainpoints table of the graip database.	
Input Stability Index Raster				
C:\Users\dtarb\Desktop\demo\DEM\demsi.tif	– 🔁			
	_			
		Ŧ		

This function looks up the Stability Index grid values at each drainpoint and stores them in the SI field in the Drainpoints table of the GRAIP database.

21. Stability Index with Road Impact. (From GRAIP tools)

🕄 Stability Index with Road Impact	
Input Slope Raster	*
demslp.tif	
Input Specific Catchment Area Raster	_
C:\Users\dtarb\Desktop\demo\DEM\demsca.tif	–
Input Flow Direction Raster	
C:\Users\dtarb\Desktop\demo\DEM\demang.tif	–
Input Parameter Zone Raster	
C:\Users\dtarb\Desktop\demo\DEM\demreg.tif	–
Input Parameter Attribute Table Text File	
C:\Users\dtarb\Desktop\demo\DEM\dempar.csv	
Input Drain Point Shapefile	
C:\Users\dtarb\Desktop\demo\DrainPoints.shp	2
Input Graip Database (must be .mdb)	
C:\Users\dtarb\Desktop\demo\test.mdb	
 Broad use dip Diffuse drain Ditch relief Lead off Non-engineered Stream Crossing Sump Water bar Excavated Stream Crossing Select All Unselect All 	Add Value
Road Width (m)	
	5
Minimum Terrain Recharge(m/hr)	0.0000
Mariana Tanaia Dashana (alka)	0.0009
Maximum remain Recharge (nyin)	0.00135
Minimum Additional Road Surface Runoff (m/hr)	
	0.001
Maximum Additional Road Surface Runoff (m/hr)	
	0.002
Output Road Impacted Stability Index Raster	
C:\Users\dtarb\Desktop\demo\DEM\demsir.tif	
Output Road Impacted Saturation Raster	
C:\Users\dtarb\Desktop\demo\DEM\demsatr.tif	
Intermediate Output Files Location	
C: (Users (acard (Desktop) demo) (DEM) temp_output_riles	
Delete Intermediate Files Upon Completion	~

Once the graip database is selected, drain point types will be automatically loaded from the DrainTypeDefinitions table of the selected graip database as a list of checkboxes for the user to select specific drain point types. Changes to the selection of drain point types are saved back to the CCSI column in the DrainTypeDefinitions table in the database as a record of the drain point types used in the road impacted stability index calculation.

Slope Average Down	· Kussechi				x
Input D8 Flow Direction Grid		_	^	Distance	*
demp.tif	-	2			
Input Pit Filled Elevation Grid				Input parameter of downslope distance over which to calculate the slope (in horizontal	
C:\Users\dtarb\Desktop\GraipTest\demo\DEM\demfel.tif	•	2		map units).	
Distance				• •	
		150			
Input Number of Processes					
Output Slope Average Down Crid		0			
C:\Users\dtarb\Desktop\GrainTest\demo\DEM\demslpd.tif					
			-		-
		de trale		Telliste	
OK	Cancel Environments	de Help		I OOI HEIP	

22. TauDEM Tools -> Specialized Grid Analysis -> Slope Average Down

This function uses the D8 flow directions approach to trace downslope and find the average slope for each grid cell over the specified averaging distance. The output from this function is the slope grid with downslope averaging (Suffix .slpd).

23. TauDEM Tools -> Specialized Grid Analysis -> D8 Distance To Streams

Input D8 Flow Direction Grid C:\Users\dtarb\Desktop\GraipTest\demo\DEM\demp.tif Input Stream Raster Grid C:\Users\dtarb\Desktop\GraipTest\demo\DEM\demsrc.tif Input Number of Processes Output Distance to Streams Grid C:\Users\dtarb\Desktop\GraipTest\demo\DEM\demdist.tif Input Number of Processes B Output Distance to Streams Grid C:\Users\dtarb\Desktop\GraipTest\demo\DEM\demdist.tif	
8 Output Distance to Streams Grid C: \Users\dtarb\Desktop\GraipTest\demo\DEM\demdist.tif	Aut D8 Flow Direction Grid
	Trillit

This function uses the D8 flow directions approach to trace downslope and find the distance from each grid cell to the streams.

24	GRAID	Tools ->	Mace	Wasting	Potential	Analysis	-> Maco	Wasting	Potential
Z4.	GRAIP	10012	111922	vvasting	FULEIILIAI	Allalysis		vvasting	FULEIILIAI

S ^e Mass Wasting Potential		
Input Graip Database (must be .mdb)	^	Mass Wasting Potential
C:\Users\dtarb\Desktop\GraipTest\demo\test.mdb		
Input Drainpoint Shapefile		Populates the drainpoint table in GRAIP
C: \Users \dtarb \Desktop \GraipTest \demo \DrainPoints.shp		Galabase
Input D8 Slope with Downslope Averaging Grid		
C:\Users\dtarb\Desktop\GraipTest\demo\DEM\demslpd.tif		
Input Exponent Alpha		
2 Input Stabilty Index Grid (optional)		
demsi.tif 🗾 🖻		
Input Combined Stability Index Grid (optional)		
C:\Users\dtarb\Desktop\GraipTest\demo\DEM\demsir.tif		
Input D8 Distance to Stream Grid (optional)		
C:\Users\dtarb\Desktop\GraipTest\demo\DEM\demdist.tif		
	Ŧ	
OK Cancel Environments << Hide Help		Tool Help

This tool evaluates the Erosion Sensitivity Index (ESI) at each drain point and adds the value to the ESI field in the Drainpoints table. ESI is calculated as L S^(alpha) where S is the slope and L the effective length of road draining to each drain point.

This tool also optionally adds stability index, combined stability index, and D8 distance to stream values to the fields SI, SIR, and DistToStream in the Drainpoints table, also used to assess Mass Wasting Potential at drain points. Stability index should be from SINMAP. Combined stability index should be from SINMAP stability index with road impacts and D8 distance to stream from TauDEM.

25. GRAIP Tools -> Mass Wasting Potential Analysis -> Length Slope Plot

🟐 Length Slope Plot			
Input Graip Database (must be .mdb)		Length Slope Plot	
C:\Users\dtarb\Desktop\GraipTest\demo\test.mdb			
Input Low ESI		This function shows the Length-Slope plot	
	1.25	X-axis. This is used to identify drain points	
Input Medium ESI		where drainage has a high potential to initiate	
	8	erosion and gullying. With ESI defined as L	
Input High ESI	25	effective length of road draining to each drain	
Toput Alaba	23	point, ESI partitioning lines are drawn with	
a put Apria	2	threshold values input. These are used to	
		separate the domain into erosion sensitivity	
		summarize the number of drain points in	
		each ESI class.	
		v	
OK Cancel Environments <<< Hide Help Tool Help			
		,	

This function generates the Length-Slope plot with Length on the Y-axis and Slope on the X-axis.

