Comparative Analysis of Multiple Software Used In Aiding Geomorphic Reclamation

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INTRODUCTION

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  - Hydrologist In Training Certification – American Institute of Hydrology
  - M.S. Hydrology – Colorado School of Mines
  - B.S. Geology – West Virginia University

- Currently Hydrologist with the Office of Surface Mining Reclamation and Enforcement (OSM)

BACKGROUND

- Traditional Reclamation
  - Frequently disturbs stability of existing natural landforms
  - Hydrologic Functionality Altered – Streams are often removed or become armored ditches
  - Additional expenses

- Geomorphic Reclamation
  - Currently OSM Initiative
  - Design stable streams and landforms that mimic the look and functionality of nature

Empirical vs. Theoretical Based Softwares

- Empirical
  - Input parameters based on data collected in the field
  - Field Scale
- Theoretical
  - Input parameters based on assumptions and data collected in the laboratory
  - Laboratory Scale e.g. data collected from flume studies

Software Considered

- RIVERMorph Stream restoration software
- Carlson Natural Regrade™
- RUSLE2

DISCLAIMER: OSM IS NOT PROMOTING ONE SOFTWARE OVER ANOTHER. THERE ARE ALSO ADDITIONAL SOFTWARES OUT THERE THAT MAY BE USED IN GEOMORPHIC RECLAMATION THAT ARE NOT CONSIDERED IN THIS ANALYSIS

Theory Behind the Software

- RUSLE2 – Developed by Dr. Terry Toy and the USDA. Used to estimate soil loss for erosion control planning – Theoretical Software
  - Revised Universal Soil Loss Equation

Theory Behind the Software – Continued

- Design in both Rivermorph and Natural Regrade are based on Empirical Data (Input Parameters) collected in the field or measured at the field scale.

- Rivermorph
  - Rosgen Method – www.wildandhydrology.com

- Natural Regrade
  - GeoFluv Method – www.geofluv.com

Software Overview

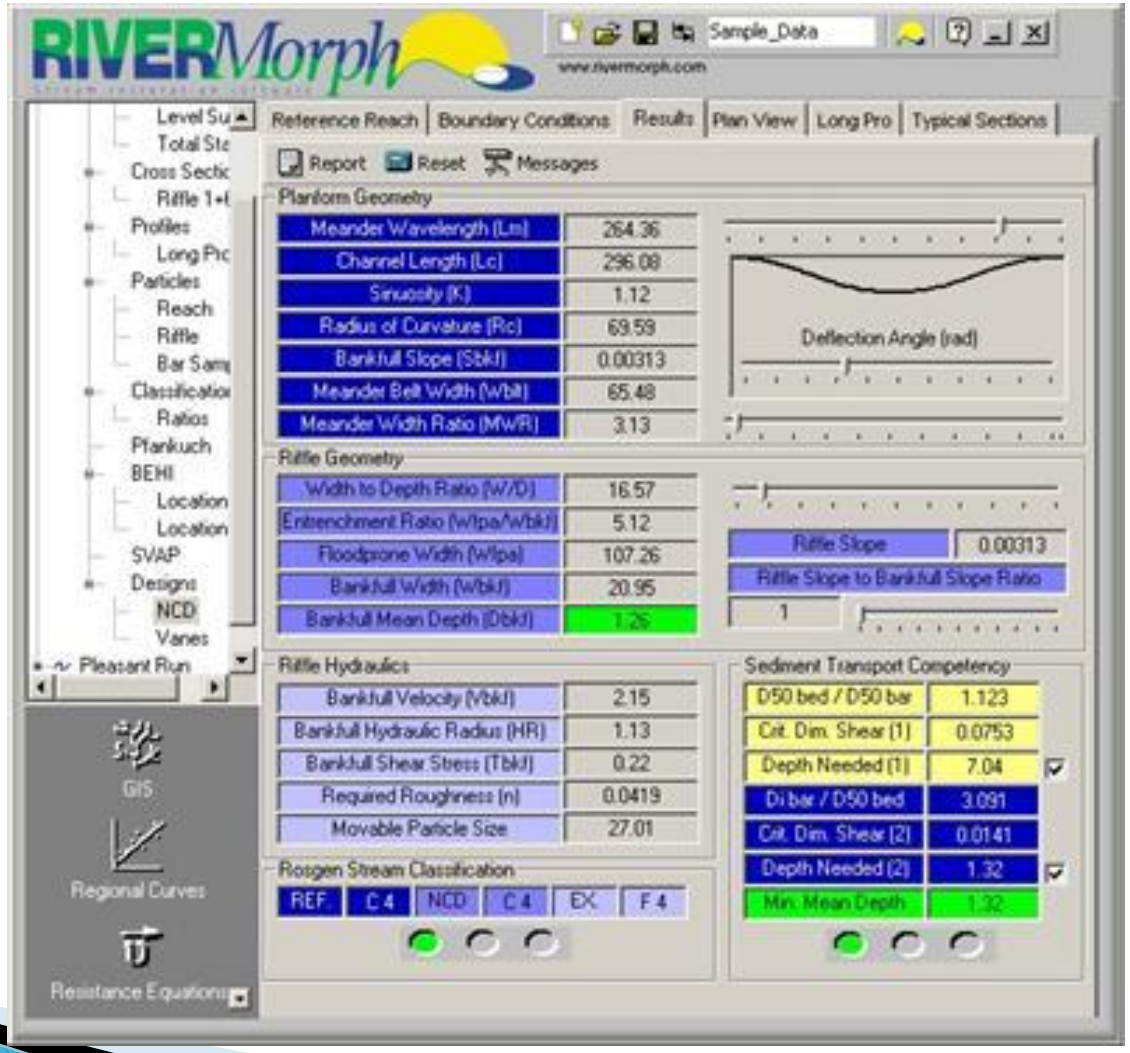
Software	Ease of Use	Software capability	Cost
RiverMorph	Need to be confident with Rosgen Method	2D Channel Design with Valley Type Consideration	$3500
Carlson Natural Regrade	Need to be confident with Geofluv Method and AutoCAD	3D Channel and Landform Design	$7000
RUSLE2	Familiar with Revised Universal Soil Loss Equation	Hortonian Overland Flow only – Used as a Guide for erosion control planning	FREE

Input Parameters

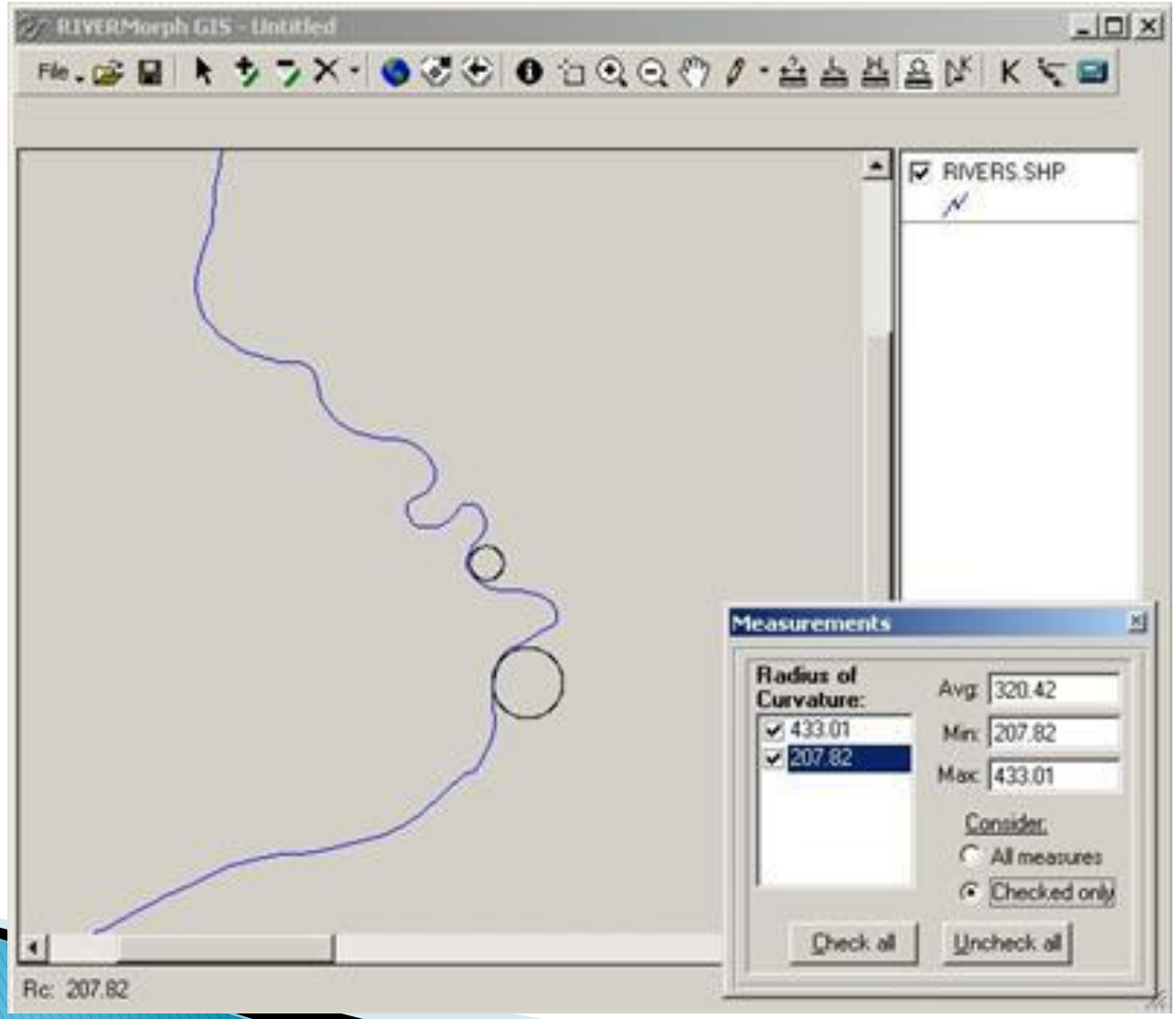
Software	Input Parameters
River Morph	- Cross Section - Longitudinal profile - Wolmann Pebble Count - Geometry and Sketch Map
Carlson Natural Regrade	- Local Base Elevation - Slope at local base level - Drainage density - Ridge to head of Channel - “A” Channel Reach Length
RUSLE2	- Location/Climate - Soil Type - Length and Steepness of Overland Flow Path - Cover Management Practice - Support Practices

EXAMPLES

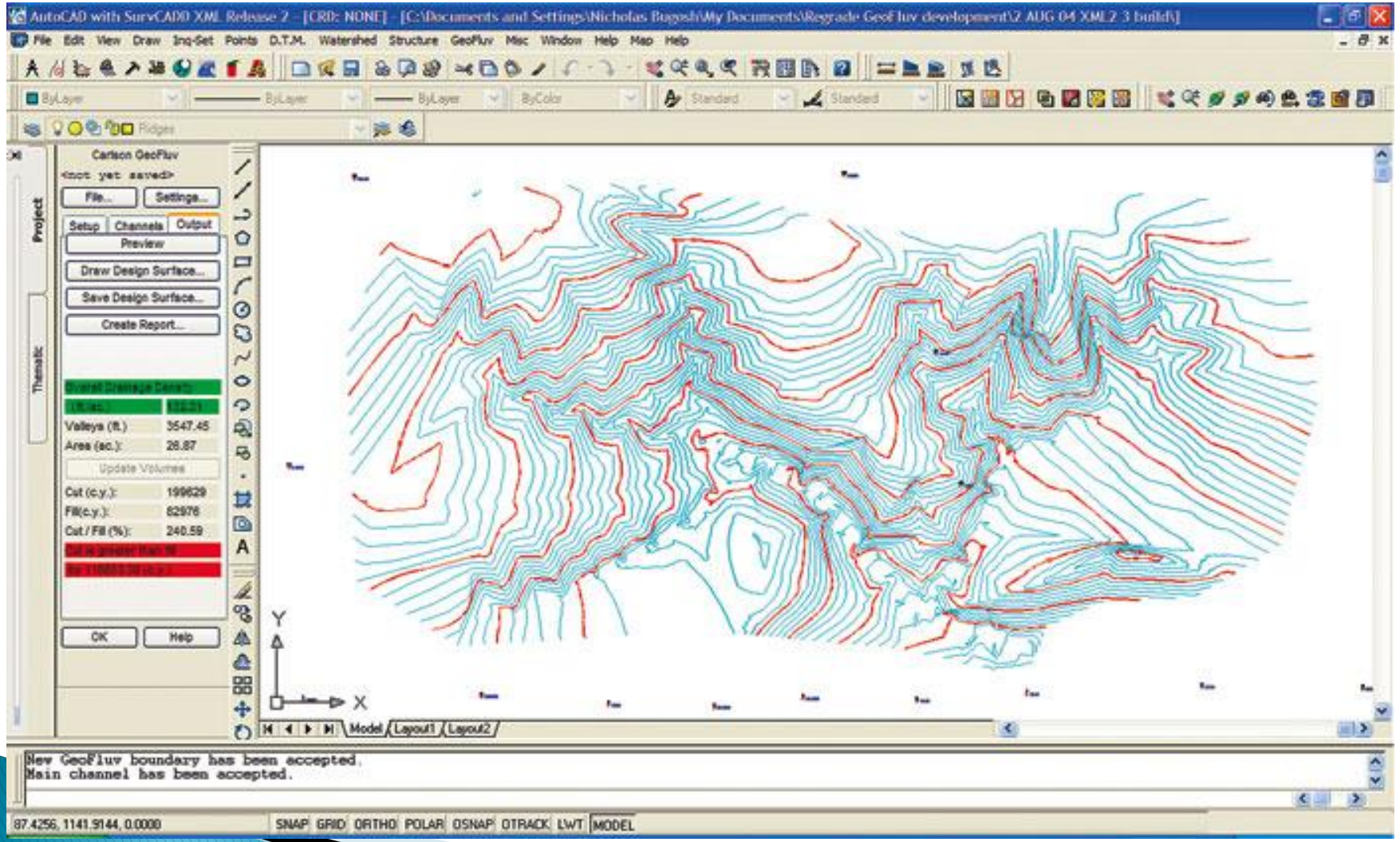
Rivermorph


RIVERMorph
www.rivermorph.com
Sample_Data
Reference Reach
Boundary Conditions
Results
Plan View
Long Pro
Typical Sections
Report
Reset
Messages
Planform Geometry
Meander Wavelength (Lm) 264.36
Channel Length (Lc) 296.08
Sinuosity (K) 1.12
Radius of Curvature (Rc) 69.59
Bankfull Slope (Sbkf) 0.00313
Meander Belt Width (Wblt) 65.48
Meander Width Ratio (MWR) 3.13
Deflection Angle (rad)
Riffle Geometry
Width to Depth Ratio (W/D) 16.57
Entrenchment Ratio (Wfpa/Wbkf) 5.12
Floodprone Width (Wfpa) 107.26
Bankfull Width (Wbkf) 20.95
Bankfull Mean Depth (Dbkf) 1.26
Riffle Slope 0.00313
Riffle Slope to Bankfull Slope Ratio
1
Riffle Hydraulics
Bankfull Velocity (Vbkf) 2.15
Bankfull Hydraulic Radius (HR) 1.13
Bankfull Shear Stress (Tbkf) 0.22
Required Roughness (n) 0.0419
Movable Particle Size 27.01
Sediment Transport Competency
D50 bed / D50 bar 1.123
Crit. Dim. Shear [1] 0.0753
Depth Needed [1] 7.04
Di bar / D50 bed 3.091
Crit. Dim. Shear [2] 0.0141
Depth Needed [2] 1.32
Min. Mean Depth 1.32
Rosgen Stream Classification
REF. C 4 NCD C 4 EX. F 4
Level Su
Total Sta
Cross Sectic
Riffle 1+(
Profiles
Long Pro
Particles
Reach
Riffle
Bar Samp
Classificatio
Ratios
Pfankuch
BEHI
Location
Location
SVAP
Designs
NCD
Vanes
Pleasant Run
GIS
Regional Curves
Resistance Equations

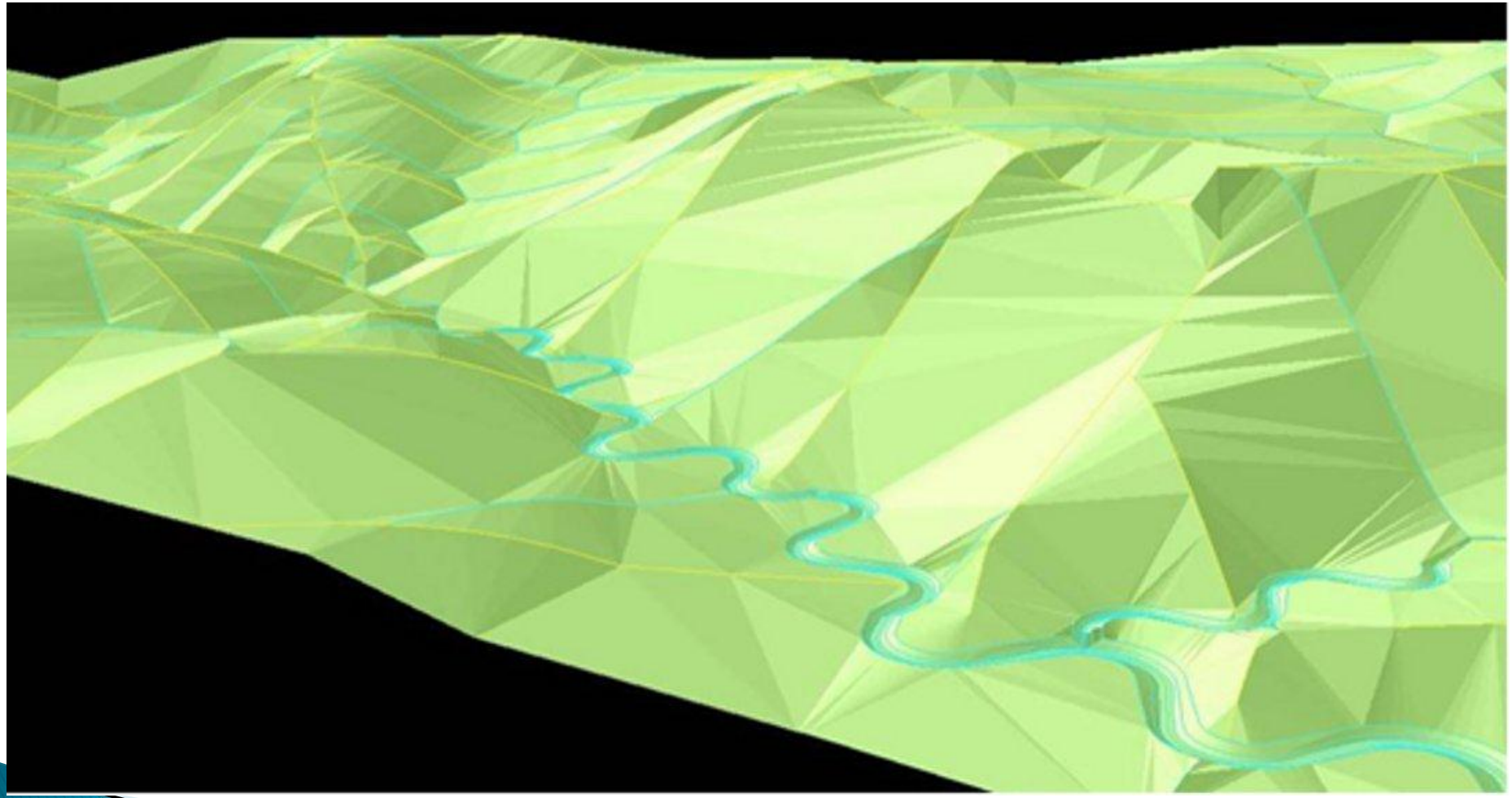
Rivermorph


RIVERMorph GIS - Untitled
File
RIVERS.SHP
Measurements
Radius of Curvature:
433.01
207.82
Avg: 320.42
Min: 207.82
Max: 433.01
Consider:
All measures
Checked only
Check all
Uncheck all
Rc: 207.82

Carlson Natural Regrade



Carlson Natural Regrade Design



Future Work

- Select Site
- Collect Site Specific Input Parameters
- Use all software discussed to design Geomorphic Reclamation i.e real world application

SUMMARY AND CONCLUSIONS

- Know your input parameters and where they came from.
- All software has it usefulness, time and place.
- Geomorphic Reclamation software should be used in conjunction with each other to provide optimal design and cost effectiveness.

Thank You!

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