

Negative Evidence for Tectonic Deformation by Reverse-Activated Subsurface Faults Associated with Triassic Rifting

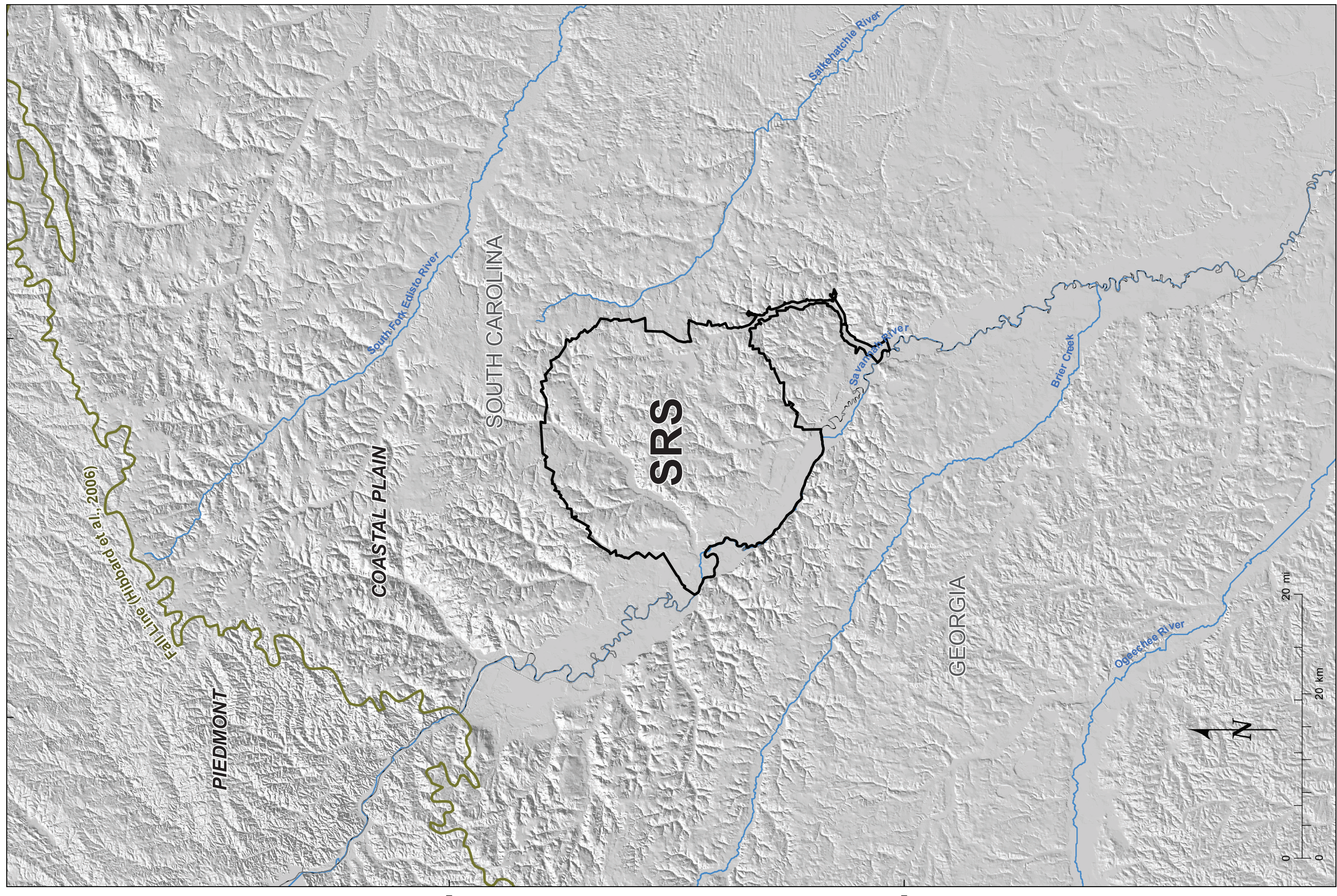
Christopher Kemp, Scott Lindvall , Ross Harlebb, Jason Finley, Randolph Cumbest, Frank Symms – *Fugro Consultants, Inc.*



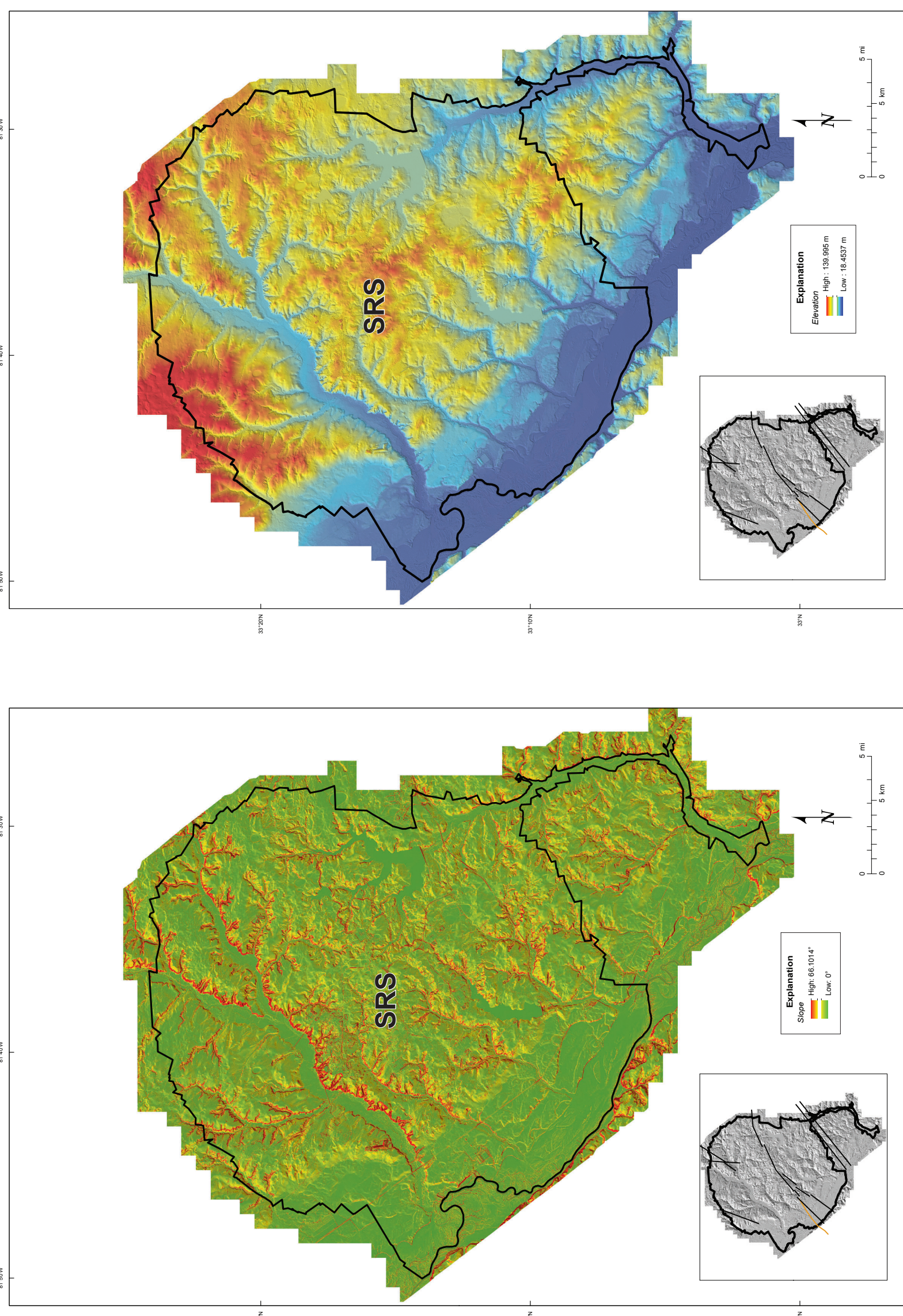
Abstract

The Savannah River Site (SRS), a U.S. Dept. of Energy facility near Augusta, GA, overlies a Triassic Basin border fault and other subsurface faults associated with Triassic rifting. Previous studies indicate that some of these basement faults were reactivated in a reverse sense during Cenozoic time and extend upward into overlying Coastal Plain sediments. To support recent seismic reflection data that suggest the faults do not reach the surface, we performed geomorphic analyses to assess evidence for tectonic surface deformation at the SRS. Using Light Ranging and Detection (LiDAR) data that cover the SRS, we 1) developed and interpreted site topographic data; 2) refined mapping of Quaternary alluvial terrace surfaces at the SRS; 3) developed and interpreted longitudinal profiles of streams and fluvial terrace surfaces; and 4) developed and interpreted hypsometric integrals of 12 tributary catchments of the Savannah River at and near the SRS using a 10m DEM from the National Elevation Dataset.

Visual inspection of LiDAR-derived topographic data reveals no non-anthropogenic topographic lineaments. Furthermore, no anomalous drainage patterns such as drainage capture, deflected drainages, or variable incision upstream or downstream of a mapped subsurface fault were observed. Profiles constructed for six streams at the SRS generally exhibit minor perturbations from a graded profile, all of which are attributable to anthropogenic modification or contrasting along-profile lithology. Fluvial terrace mapping and terrace surface profiling reveal < 5 m of short-wavelength relief within best-preserved surface remnants, similar to relief within the modern Savannah River floodplain. Finally, a low standard deviation and error of *E* calculated for the 12 tributary catchments suggests that the hypsometry of each basin is influenced by similar factors of regional extent, and not local influence associated with mapped subsurface faults. Taken together, the results constitute negative evidence for tectonic surface deformation at the SRS, and support the conclusion that the faults imaged in the subsurface at the SRS do not appear to deform the site landscape, consistent with previous studies at the SRS and the nearby Vogtle Electric Generating Plant.



Location of Savannah River Site and Geomorphic Provinces



Shaded Slope Map of the SRS

Color Shaded Relief Map of the SRS

Summary of Faults

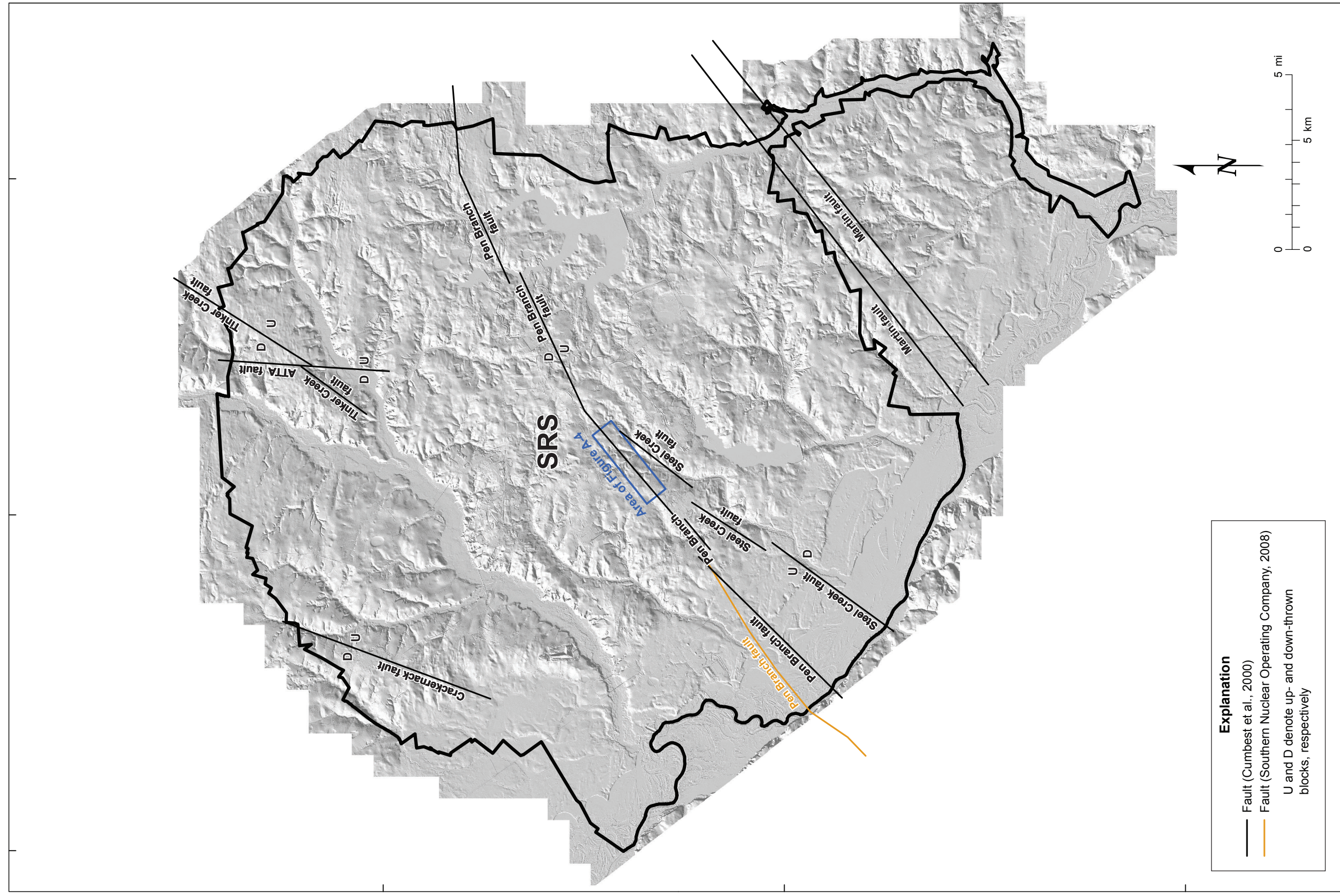
Fault Name*	Approx. Strike	Sense-of-slip	Offset at Top of Basement (m)	Source(s)
ATTA	N5°E	East-side-up reverse	25	1
Crackeneck	N30°E	South-up reverse	30	1
Martin	N55°E	?	30	1
Pen Branch	N45-66°E*	South-up reverse	28	1
Steel Creek	N45-66°E*	North-up reverse (?)	?	2, 3
Thinner Creek	N36°E	Reverse	24	1

*Cumbest et al. (2000) "first order" faults and the Steel Creek fault

(1) Cumbest et al., 2000

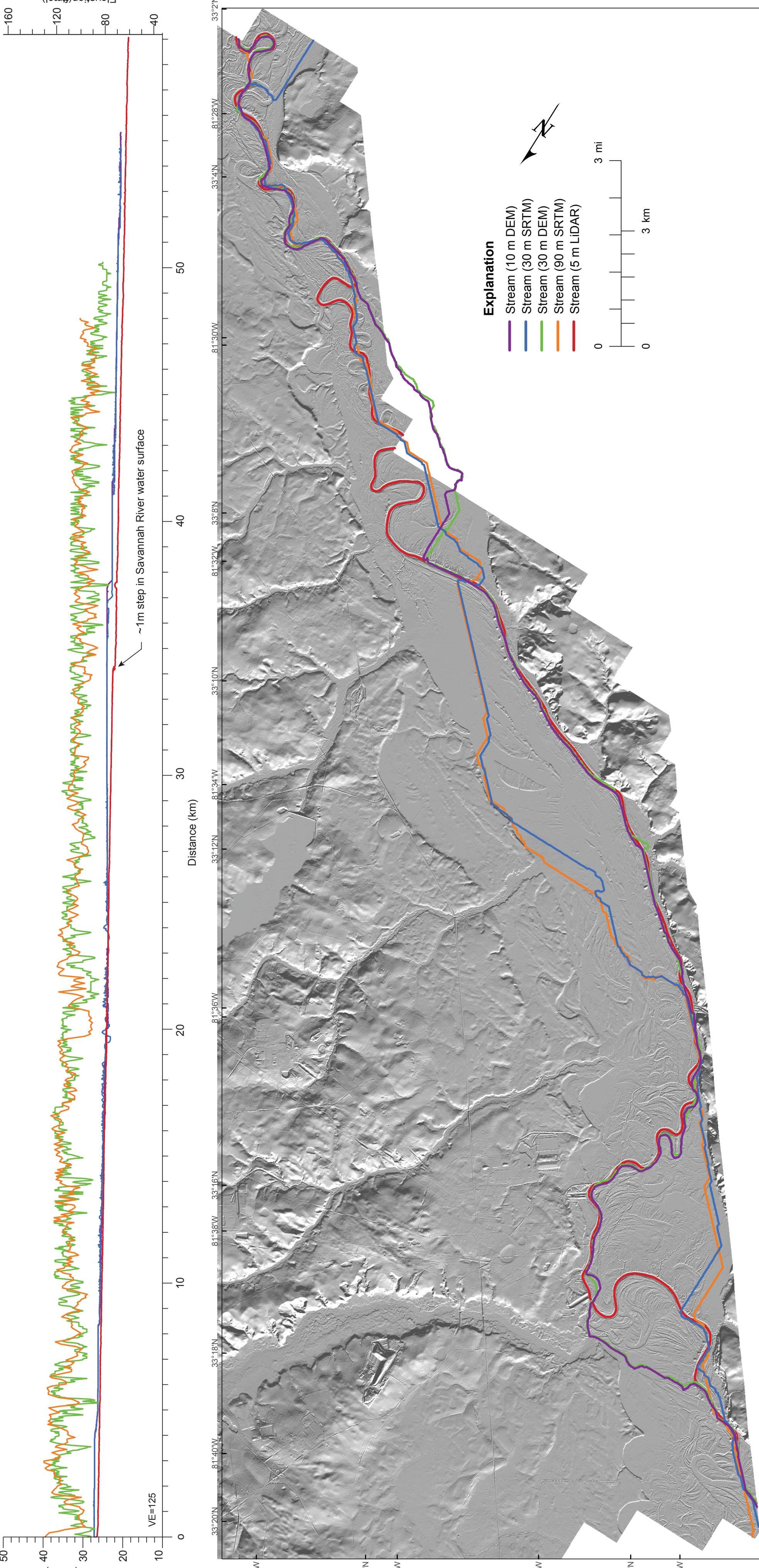
(2) Dowd et al., 1984

(3) Dowd et al., 1984

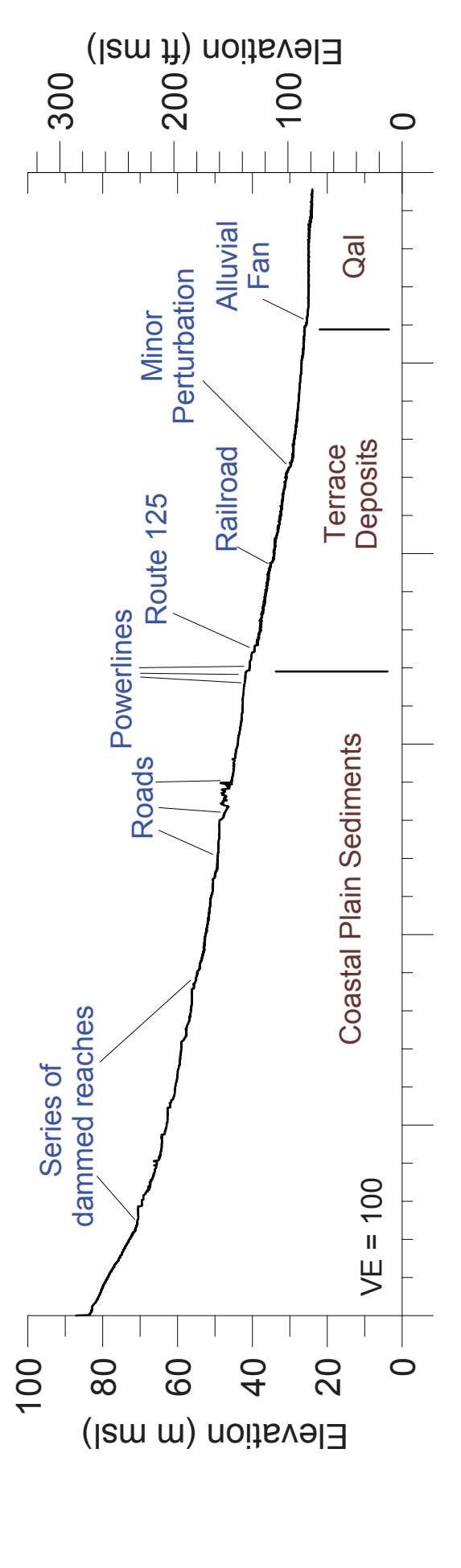


Site Shaded Relief Map of the SRS from 5m LiDAR Data Showing Locations of First Order Faults

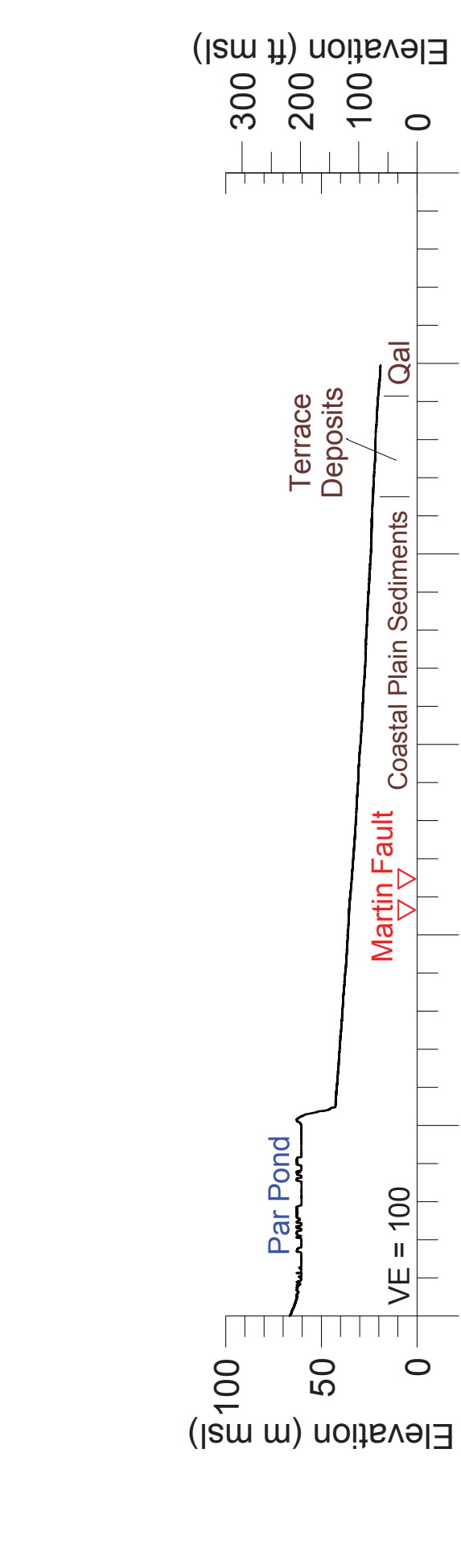
Assessment of Longitudinal Stream Profiles



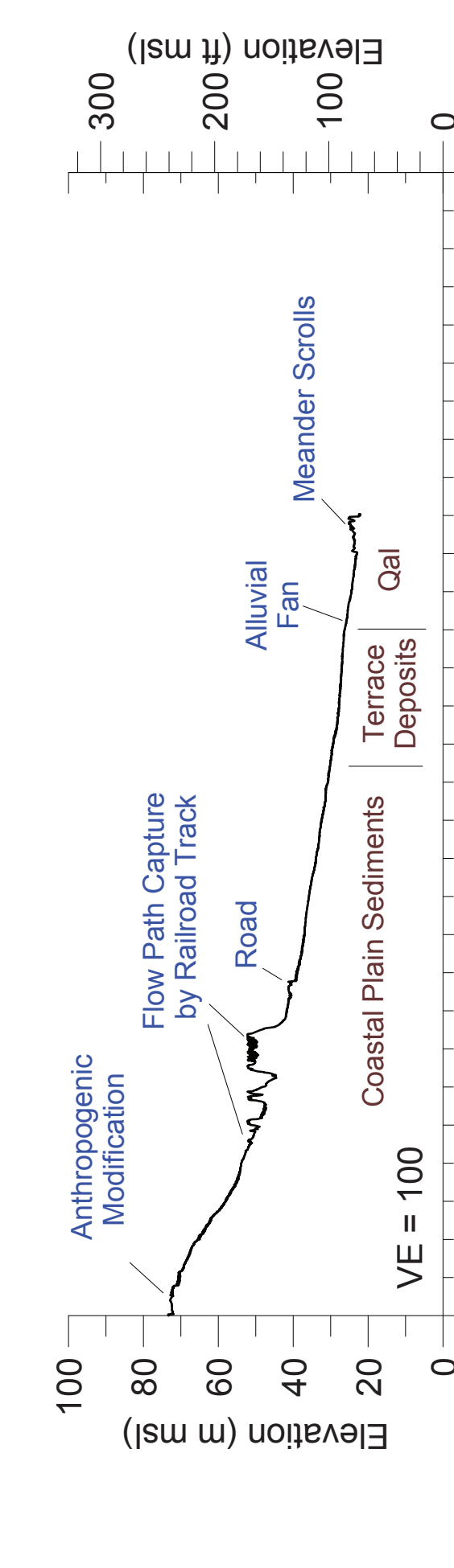
Comparison of Stream Profiles and Flow Paths from Various Topographic Data



Longitudinal Stream Profile of Fourmile Branch

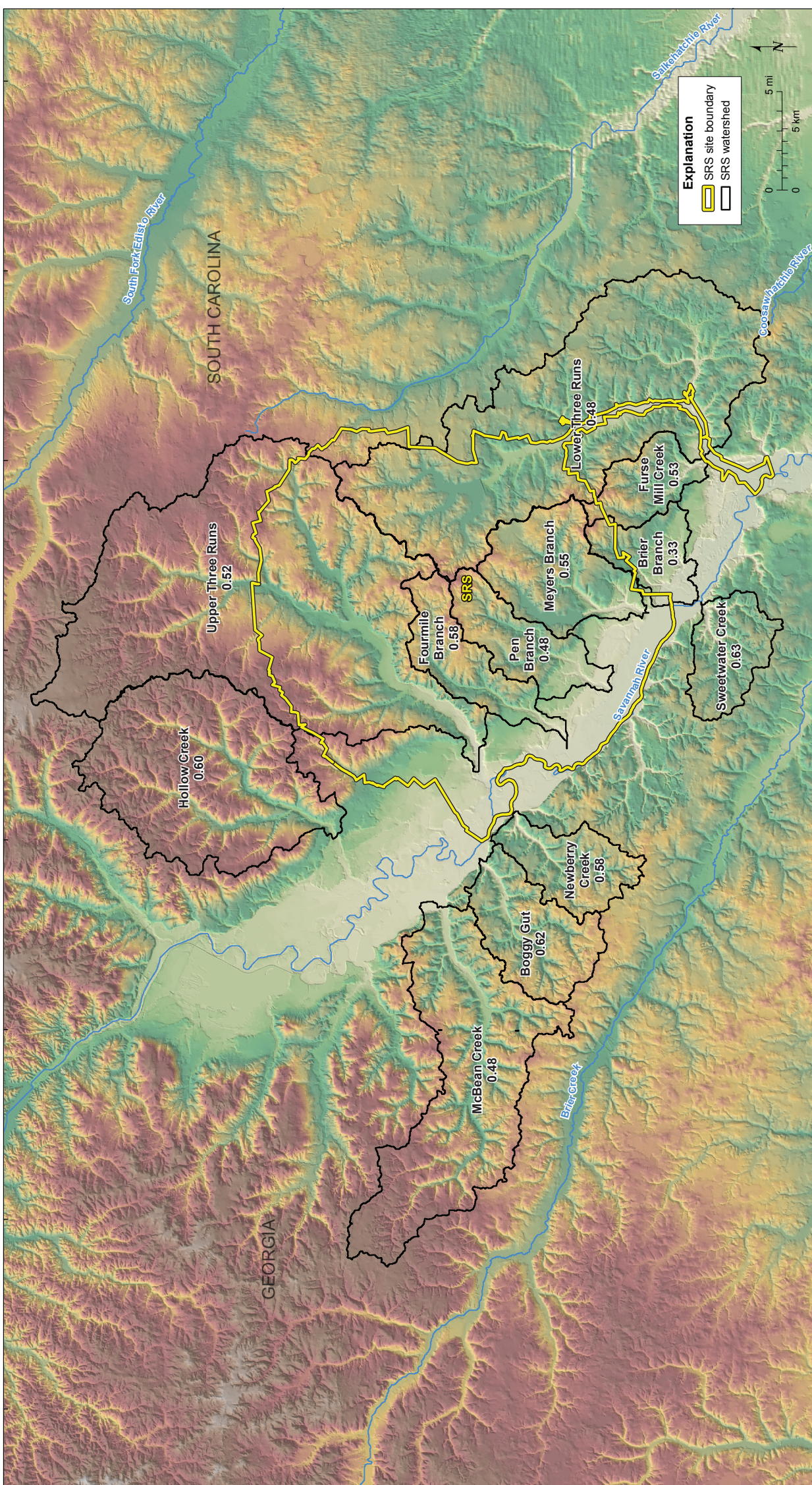


Longitudinal Stream Profile of Pen Branch



Longitudinal Stream Profile of Meyers Branch

Assessment of Basin Hypsometry



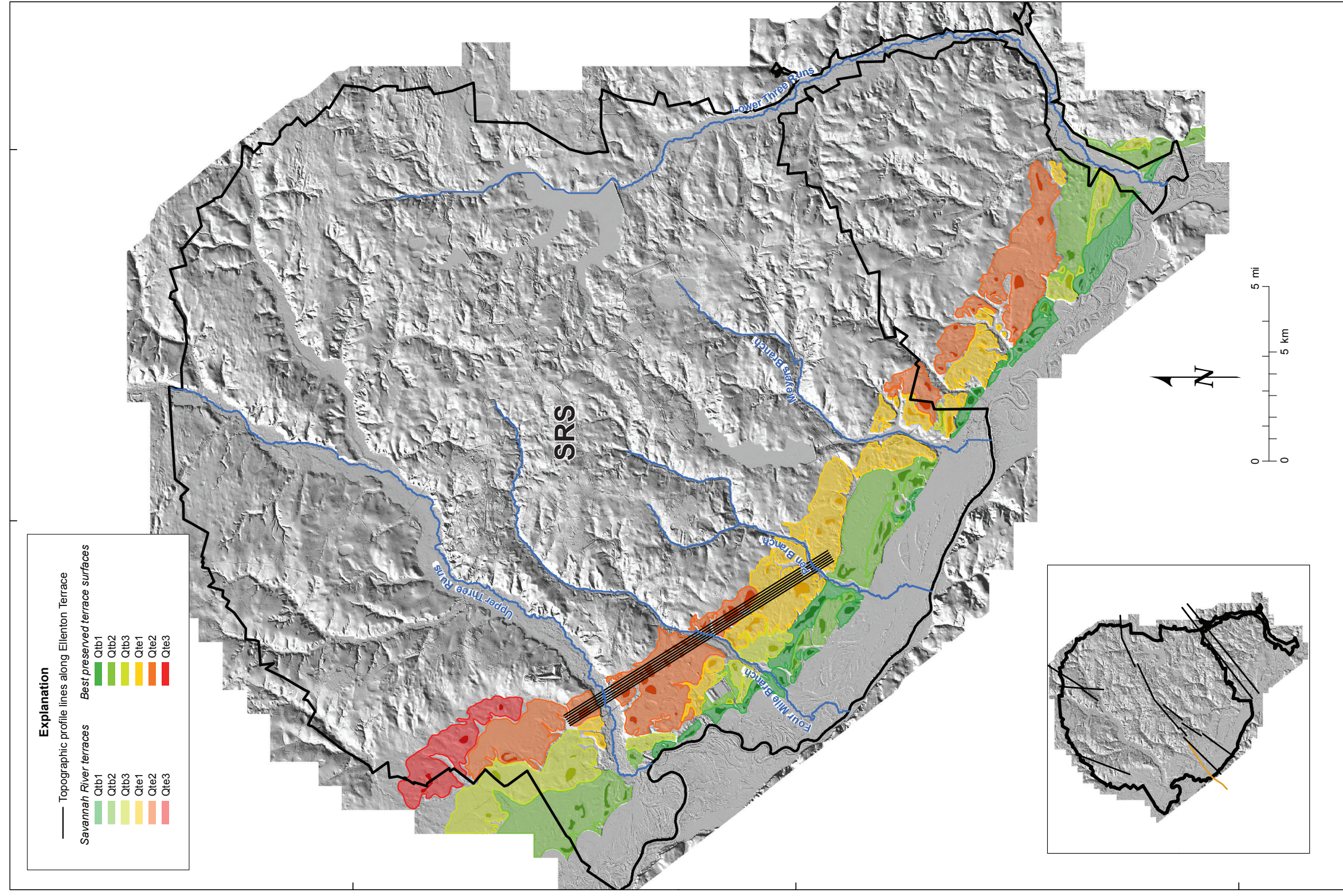
Hypsometric Integrals (*E*) of Selected Drainage Basins in the Vicinity of the SRS

Drainage Basin Name	Area km ²	<i>E</i>
Boggy Gut	80.3	0.62
Brier Branch	44.2	0.33
Fourmile Branch	60.4	0.58
Furze Mill Creek	42.3	0.53
Hollow Creek	229.6	0.60
Lower Three Runs	391.3	0.48
McBean Creek	227.0	0.48
Meyers Branch	89.6	0.55
Newberry Creek	57.1	0.58
Pen Branch	61.1	0.48
Sweetwater Creek	52.4	0.63
Upper Three Runs	522.8	0.52
Mean		0.53
Standard Deviation		0.08
Standard Error		0.02
R ² (Area, <i>E</i>)		-0.10

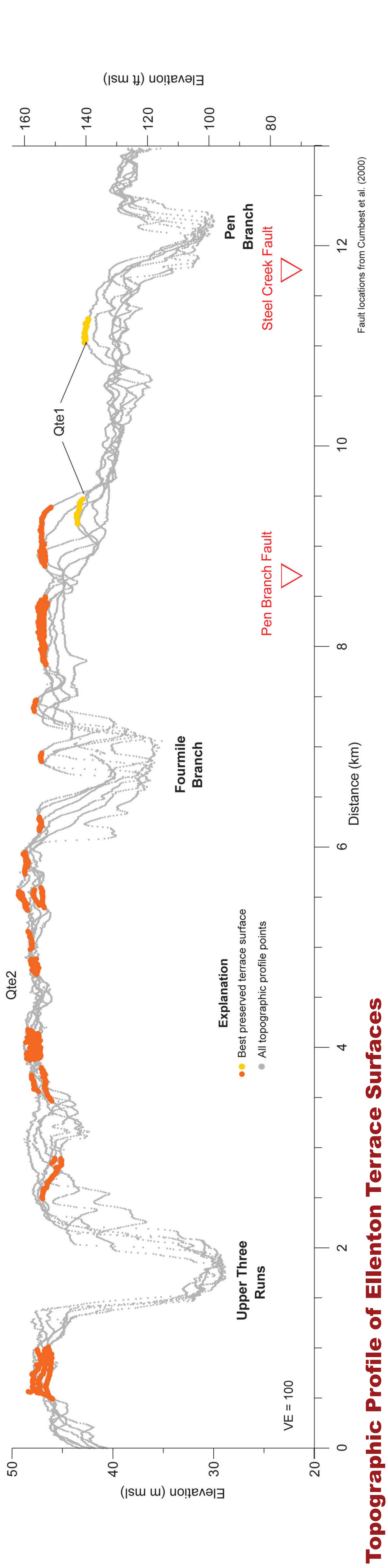
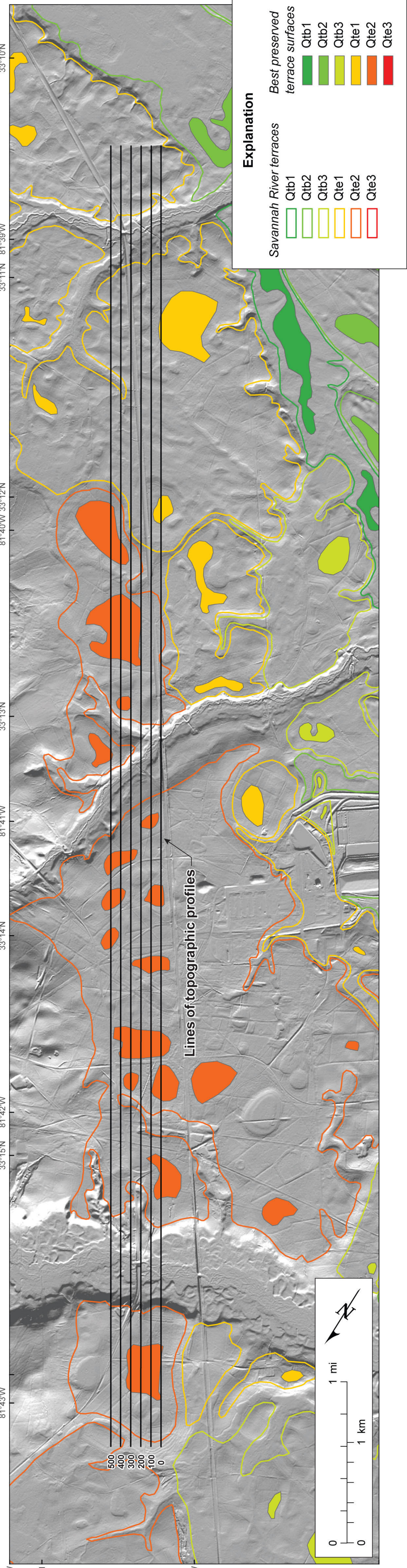
E = Mean Elevation - Minimum Elevation

E = Maximum Elevation - Minimum Elevation

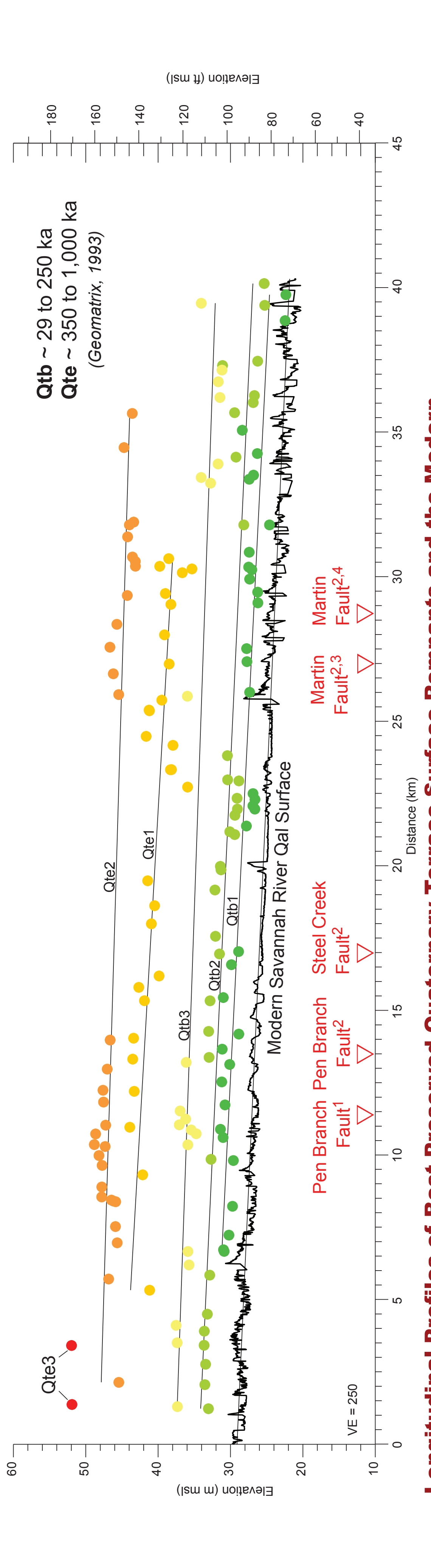
Assessment of Quaternary Terrace Surfaces



Quaternary Terrace Surface Mapping Showing Locations of Longitudinal Stream and Terrace Surface Profiles



Topographic Profile of Ellenton Terrace Surfaces



Longitudinal Profiles of Best-Preserved Quaternary Terrace Surface Remnants and the Modern Savannah River Qal Floodplain Surface