REFINING WATERSHED GRID FOR KINEROS2

Need to analyze soil depths of Stothoff, geology by Day et al. (1998) map, fracture characterization by Ferrill to see how to change the KINEROS2 grid for upper Split Wash and how to modify properties. In addition, Groeneveld will delineate talus, bedrock, scree from air photo/ground checks; this will be used in diverging/converging slope analysis to determine the possible impact of the detailed surficial material geometry on flow in watershed elements (scaling).

All of these will be overlayed in ArcView:

(1) The soils.e00 file from Gunther (see page 25) was imported into arcinfo (arc) and using the "describe" command, it was determined that the projection was state plane (ft). This was converted to UTM NAD27 (meters) to match up with the previous work (D:\AVData\Soils\soil-utm.shp) [see also D:/AVData/soil-Ron/* for Ron Martin conversions & creation of polygon info for Stothoff) The soils.e00 is from the Lundstrom soils map in the Site Atlas 1997, Yucca Mountain, Nevada; TRW, Environmental Safety Systems, Technical Data Management

(2) Topographic lines (10 ft contours) see page 2

(3.) Geology from Day et al. (1998) → see page 24

(4.) Soils data (from field confirmation & Stothoff's material balance model for soil depth). See the following pages.

(5.) Groeneveld's delineation of talus, bedrock, & scree using his air photos, the geo-rectified photo image of the Busted Butte quadrangle, and field confirmation (see field notebooks of Stothoff and Fedors). The ERDAS IMAGINE file image from the DOE technical database (Bustedbnwp5424073.mos.img) was obtained through Chad Glenn. This air photo has ~ 1 m² resolution. Ron Martin assisted in converting these files. Although ArcView can import IMAGINE formatted image files, it could not convert the files from NAD83 to NAD27 projection. It was clear from the alignments with other arcinfo coverages that the IMAGINE files were in NAD83. The describe command in arc noted the UTM coordinates of one corner of the image and it noted the length measurements in meters. For QA purposes, Ron set arc to re-project into NAD27 using the NADCON algorithms (see arc for details). For this small of an area, a simple shift (translation) of the corner coordinate would have been very accurate (but less defensible) and extremely fast. Each of 3 bands in the IMAGINE file took 1 hr & 20 minutes on VULCAN to re-project; then the 3 bands had to be "stacked" together in the new coordinate projection (NAD27 UTM [m]). Gridding, projecting, then assembling the 3 bands back together using makestack (GRID Command) & Gridimage (arc).

RF 9/14/99 Once all of these can be overlayed, the new grid can be determined. Delineation of the bedrock, in terms of infiltration properties, is in part a factor of matrix properties and of fracture characteristics. David Ferrill & Deb Waiting are collating the fracture info.

Readme file sent on cdrom with image files (top of this page) to David Groeneveld for Talus, Scree, Bedrock delineation.

The original file was in ERDAS Imagine format; bustedbnwp5424073.mos.img.
Do not use this file since it is in the wrong projection, I included it here for your reference. It is in NAD83 instead of NAD27 so I had to convert it (with Ron Martin's help).
I am putting all of our data into UTM NAD27 (m) projection/coordinates.

The ERDAS file was converted into two different formats, one is a .bip file and the other is a sunraster format. The re-projecting was done in ArcInfo using the NADCON algorithms to go NAD27.
The bip files are:

- airfoto_nw27.bip
- airfoto_nw27.bpw
- airfoto_nw27.hdr
- airfoto_nw27.lnw (actually this may be associated with the ERDAS format??)

The sunraster file is:

- airfoto_nw27.ras
- airfoto_nw27.rwx

ArcView recognizes either of these automatically when loading as a theme.
Use either the bip files or the sunraster files. There is a difference between them. Since the original file had 3 bands, the two file formats recombined the bands differently (the statistics are stored differently). The bip files show greater contrast (more nonlinear) while the sunraster file looks flat and probably more realistic (limited to linear contrast).
Your preference, plus your tweaking of the bands, will determine which format to use.

I also included the topographic contours (10 ft intervals) in UTM NAD27 (m) coordinates.
[RFedors 13Sep99]

D:\AVData\Dog* RF 9/14/99

9/14/99 RF

As a reminder, I am including the log file for importing, reprojecting, (all 3 bands of the IMAGINE files), and the writing a new file for ArcView to read in; these image format files have associated world files to set the coordinates of the pixels.

```
19990909 849    0      0      0rfedors cw busted
19990909 906    1      1      0rfedors arcplot
19990909 908    2      0      0rfedors arcedit
19990909 908    0      0      0rfedors createcatalog imagecat
19990909 909    0      0      0rfedors addimage bustedbnwp54424073.mos.img
imagecat
19990909 925   16      1      0rfedors arcplot
199909091258   72     10      0rfedors ap
199909101340    3    142      0rfedors IMAGEGRID bustedbnwp54424073.mos.img
bbnw
199909101343    0      1      0rfedors generate bbnw_box
199909101343    0      0      0rfedors build bbnw_box line
199909101345    0      0      0rfedors project cover BBNW_BOX BBNW_BOX27
nad83utm2nad27utm.prj
199909101345    0      1      0rfedors ae
199909101347    1      8      0rfedors ae
199909101515   84   4714      0rfedors project grid bbnwc1 bbnwc1n27
nad83utm2nad27utm.prj
199909101636   81   4779      0rfedors project grid bbnwc2 bbnwc2n27
nad83utm2nad27utm.prj
199909101755   79   4660      0rfedors project grid bbnwc3 bbnwc3n27
nad83utm2nad27utm.prj
199909131601    0      1      0rfedors MAKESTACK nw_rgb list BBNWC1N27
BBNWC2N27 BBNWC3N27
199909131601    0      0      0rfedors lg
199909131601    1      1      0rfedors grid
199909131604    2     48      0rfedors GRIDIMAGE nw_rgb # airfoto_nw27.bip
bip
199909131607    2      2      0rfedors ap
199909131610    2     24      0rfedors GRIDIMAGE nw_rgb # airfoto_nw27.ras
SUNRASTER
199909131620    3    122      0rfedors GRIDIMAGE nw_rgb # airfoto_nw27.gis
IMAGINE
199909131739   69    104      0rfedors ap
```

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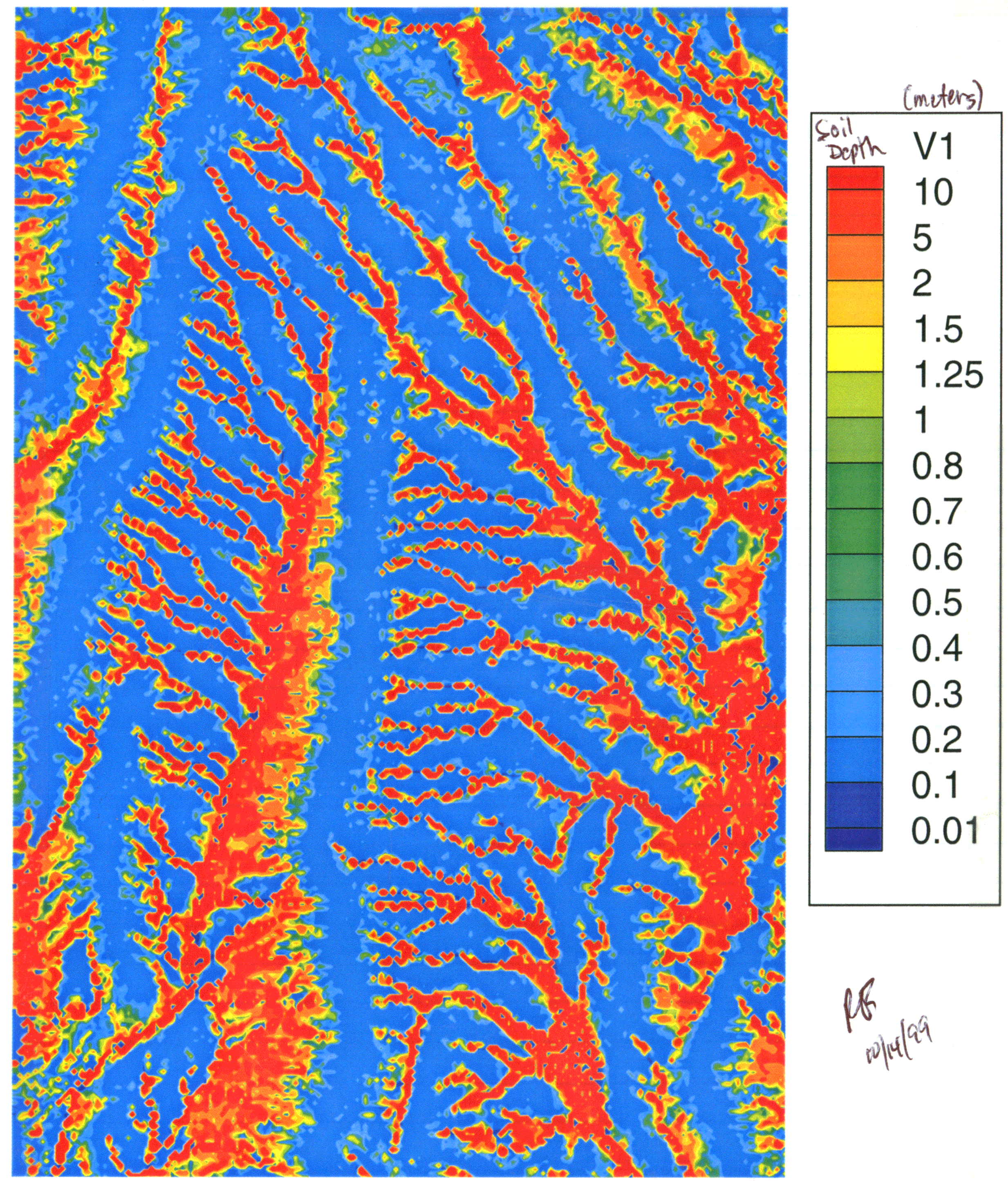
Using Stothoff Soil Depth Estimates for Split Wash Watershed Grid Generation

Attached is the TPA soil depth data (old Stothoff soil depths), on 30m x 30m pixel resolution, contoured in tecplot 7.0 on bren (SUN OS)



RF 10/14/99

 10/14/99
RF

According to Stothoff, this soil depth data needs to be updated in the TPA.

bubo : d:\AVData\WatershedGrid\
bren : ~/SoilDepthTPA
bubo : d:\AVData\~~TPA~~ (TPA) RF

I will use this data, and later (next page) the refined soil data, for now to help determine the watershed grid for Split Wash.
In order to create an image file of the contoured data to bring into ArcView to overlay on the current watershed grid, I used tecplot 7.0 and added the appropriate header lines (rows = 301, columns = 200, UTM lower left corner E 545010 m and N 4,074,000 m and cell size = 30 m square)
TPA file = soildem.dat and elevdem.dat
assumed to be UTM NAD27 since the elevdem.dat file lines up fairly well with the topographic (10 ft) contour lines I got from the USGS (converted to UTM NAD27) and lines up well with the arcinfo file geologic map/topo lines combo I got from the USGS (Day et al map of central block).

Writing a post script bit-mapped file of the contoured data (without axis or legend) out of tecplot, I then pull the image into Photoshop to crop out the borders, and then write out a tif file (Save copy as) from Photoshop 5.0. ArcView needs a world file of the same name, but with an extension *.TFW, that describes the cell size, and upper left corner of the image in some coordinate projection or lat/longitude. I am using UTM NAD27 (m). Note that I had to reverse the y-axis in tecplot before writing out the postscript file to account for the different ordering of the data.

d:\AVData\TPA\soil-30m.tif and soil-30m.TFW

Reading this image file into ArcView along with the themes of topography (10 ft. contour) (d:\AVData\WDay\Topo\) and the geologic contacts and faults (.\WDAY\) and the watershed grid that Deb Waiting digitized from Woolhiser's 1st cut at a grid (.\WatershedGrid\OriginalGrid*) I created the figure on the following pages. The missing topo lines and geologic contacts were lost in the translation of the postscript file in illustrator 8.0 for printing.

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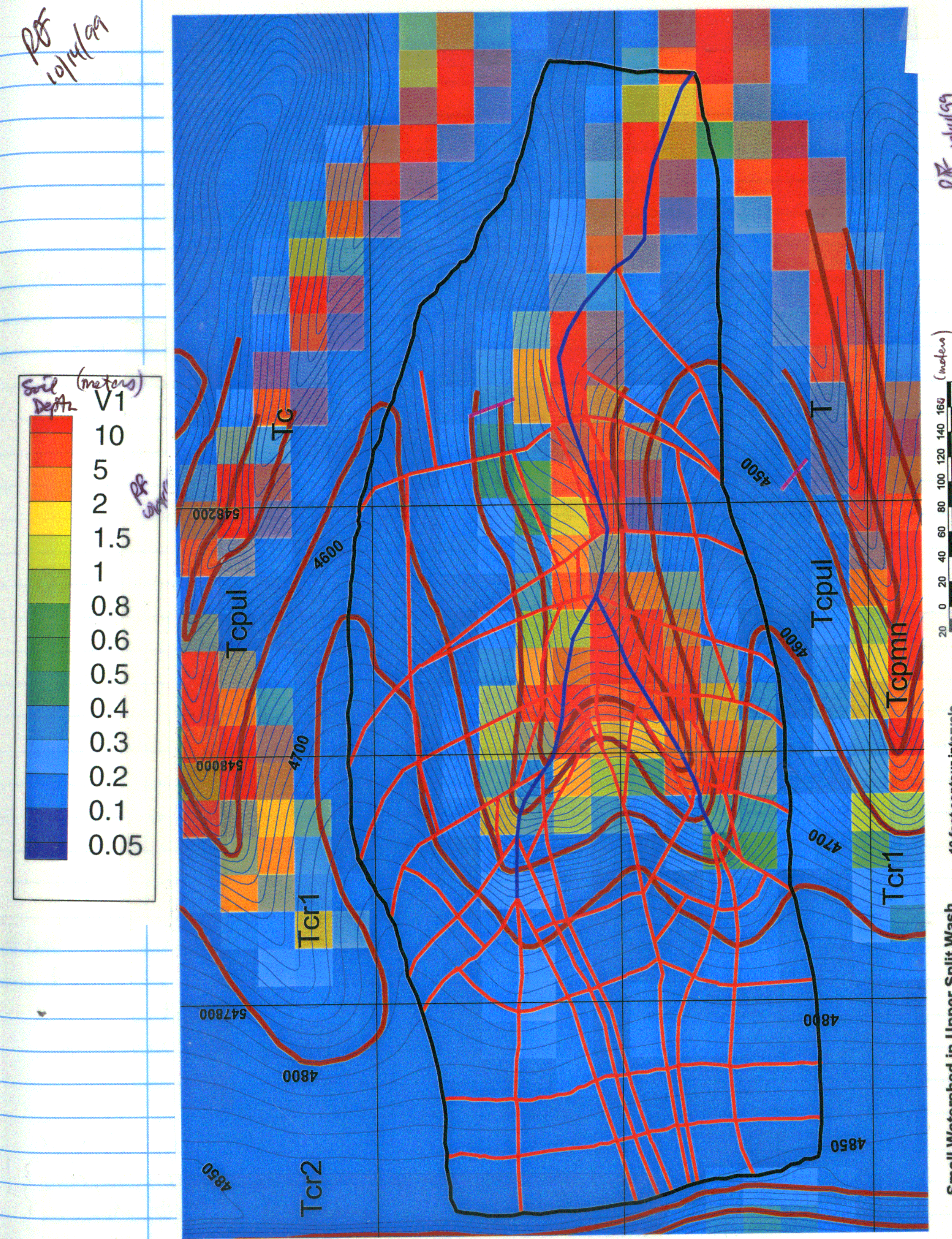


10 foot contour intervals
UTM NAD27 (meters)

Small Watershed in Upper Split Wash
Sept 1999 (watershed-soildepth.apr)

RF 10/14/99

The format of the TFW file in ascii text :

		soil-30m.TFW
ΔX		30.0
rotation row		0.0
rotation column		0.0
-Δy	note negative	-30.0
easting or (latitude)	} upper left corner	545010
northing (longitude)		4083000

As long as the names are correct & the files are both in the same directory, ArcView automatically sees the world file.
ArcView version 3.1 on bubo is being used for these.

I had tried to get Mathematica to create an image file directly, both as a contoured image or as a density plot (the latter would be to bin the data into categories for a palette). I will summarize some of the commands used but this was not successful as Mathematica only read in part of the data set (approx 1/3 of the rows were parsed)

Mathematica 4.0 (case-dependent commands)
SetDirectory["D:\AVData\WatershedGrid\Soil-Calculated\"]
(then shift-return to get kernel to execute the command)
soil=Import["SWDepth.asc", "List"] or use "Table" if in 2D array
defining variable name for latter use ← J
soilparse = Partition[soil, 737]

{ SWDepth.asc from Stu has a single column of data with x changing fastest nx=737, ny=417

ContourGraphics[%]

Show[%]

% refers to last result
%% refers to 2 results ago

or
ContourGraphics[soil_parse]
Show[%, ColorFunction -> Hue, Contours -> {0.1, .2, .3, .4, .5, .6, .8, 1., 1.5, 2., 5., 10.}]
Export["file.tif", %, ImageRotated -> False, ImageResolution -> etc....]

So I used tecplot approach and got Stothoff's estimates for soil depths on a more refined grid for the Watershed area.
bubo: d:\AVData\WatershedGrid\Soil-calculated\SWDepth.asc
and described by Stothoff in the file: Readme.txt

As described on page 30, I created another image file (postscript) in tecplot
bubo:~/Soil DepthStu/Soil1.ps

SWDepth.asc has 737 columns and 417 rows of data written out in a single column (x changing fastest) with the corners at N 4078680 and N 4077900 m
E 548880 and E 547500 m
Stothoff subdivided the topo DEM 30m x 30m pixels into subcells of 16 x 16 for each 30m x 30m pixel
hence the cell size is based on

417 subcells, 780 m overall north-south length
737 subcells, 1380 m overall east-west length

After dividing the pixels into a finer resolution, Stothoff estimated soil depths for each subcell using his mass balance approach as described in the report to NRC
Stothoff, Castellaw, & Bagtzoglou 1996
Simulating the Spatial Distribution of Infiltration at Yucca Mountain, Nevada

soil22.tif and soil22.TFW were created -
↳ ΔX = 0.557576
-Δy = -0.557541
easting = 547500
northing = 4078680

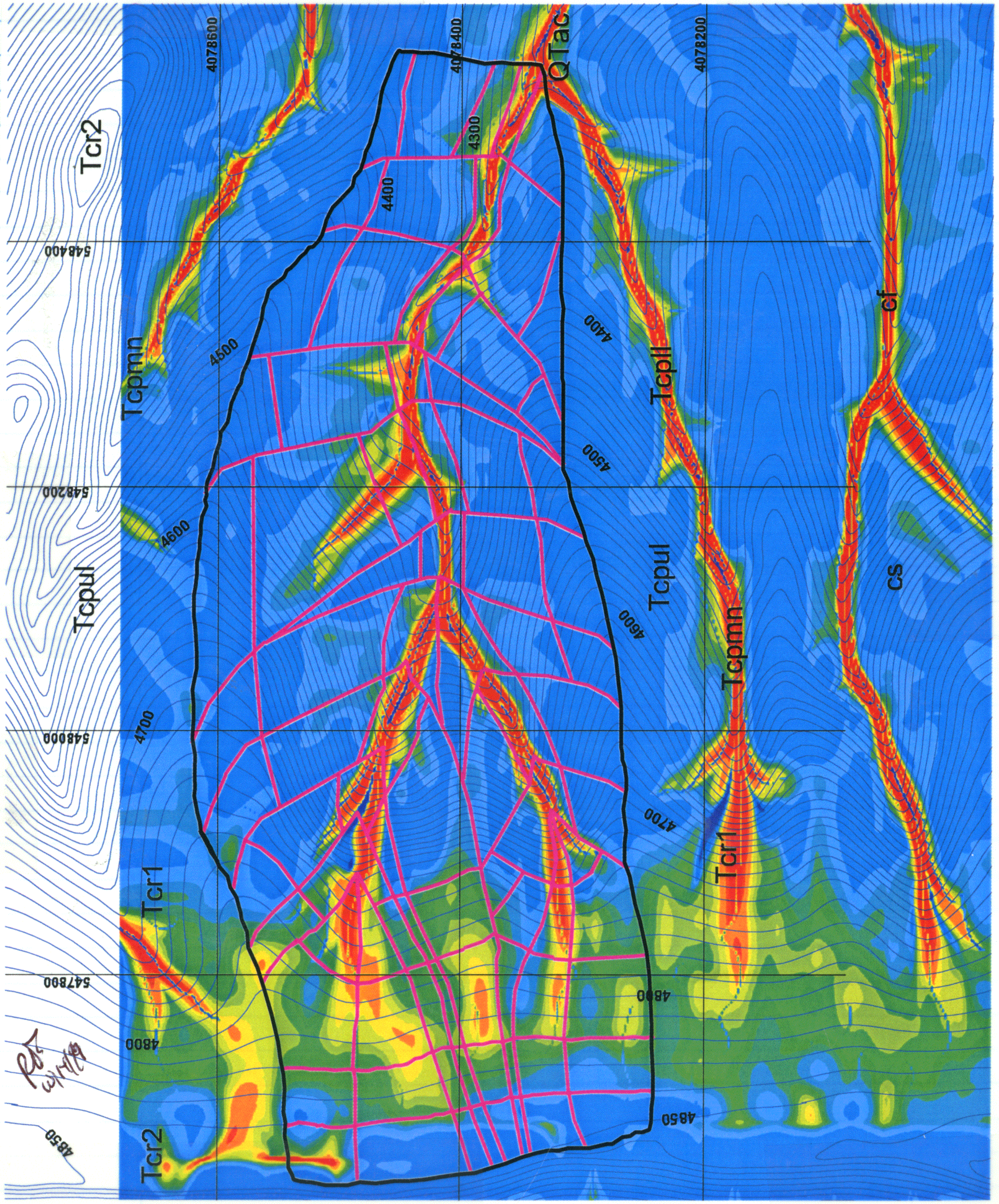
ΔX is from the tif file image size 2475 x 1399
covering an area of 1380 m by 780 m
(ΔX = 1380/2475 = 0.557576)

The following pages (34 & 35) contain the ArcView print-outs (ArcView writes eps by exporting, then Illustrator 8.0 prints properly)

 PF 10/14/99

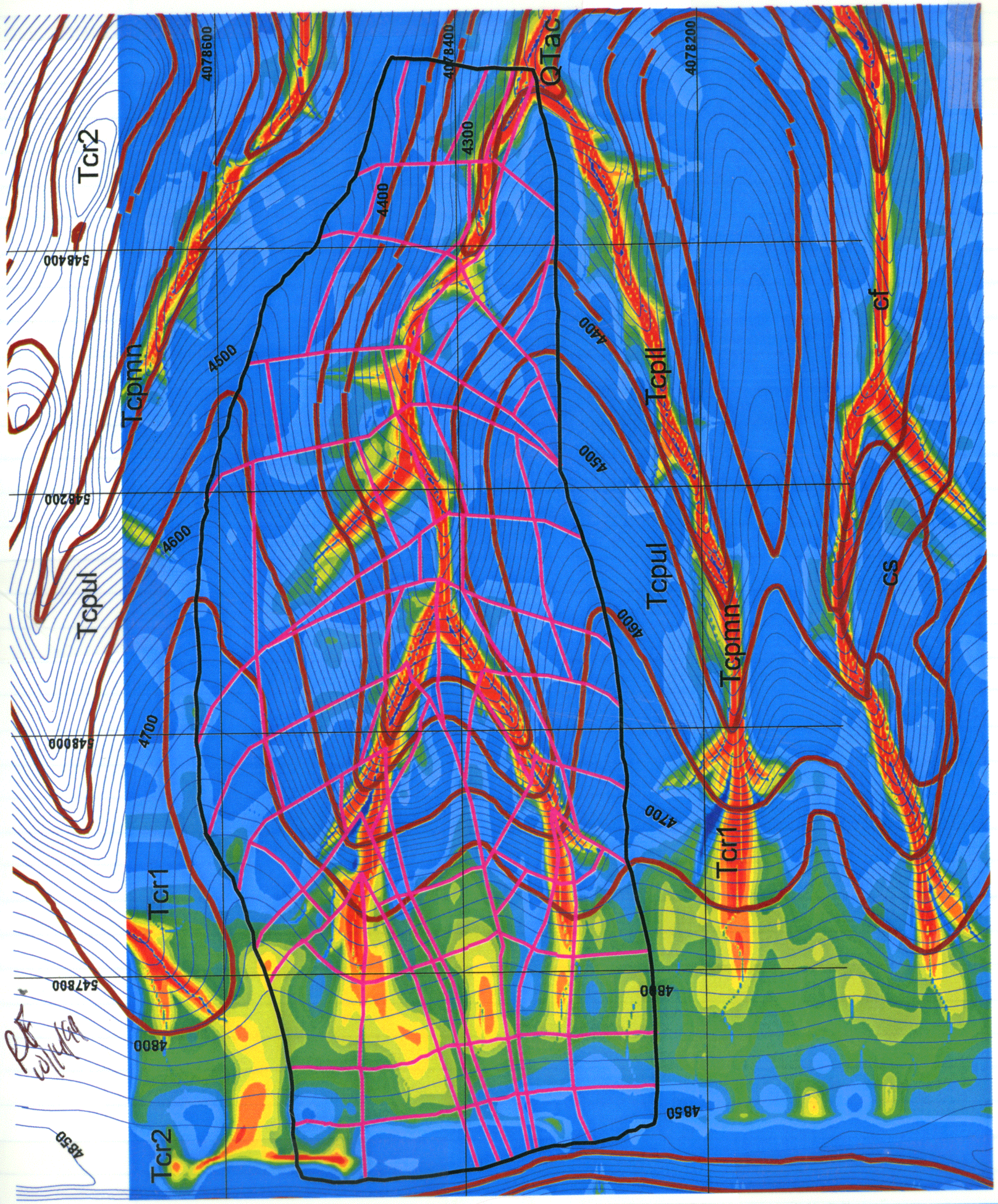
No Geologic Contacts, Stothoff refined Soil Depths
Same legend as on page 31

↑ North



↑ North

Includes Geologic Contacts, legend page 31 PF 10/14/99



The ArcView project file for the figures on the previous 2 pages ⇒ bubo: D:\AVData\WatershedGrid\watershed-soildepth-calc.apr
This arcview project file has both the themes for soil depths from TPA input (theme called soil-30m.tif) and Stothoff refined scale soil depths (theme called soil22.tif)

I was curious about the number of soil depths in the range 10-20 m in the Upper Split Wash watershed, so I went back to the original data files (swdepth.asc), re-formatted them so I could readily plot any transects (north-south) across the watershed. Since the spreadsheet programs (EXCEL) are limited to 256 columns & I need 737 columns I am using SigmaPlot; however, even SigmaPlot had some troubles so I imported half the data at a time. The script used to re-format the data:

```
          program readStu
c  Reads Stu's files of 1 column data, reformats the data to table array form,
c  and writes to 2 files (so that sigmaPlot can import; EXCEL stopped
c  at 256 columns); the 2 files are columns 1-350 and 351-737.

      implicit  none
      integer*2  mx, my, i, j, nx, ny
      parameter(mx=1000, my=1000)
      character infile*12, outfile*12, outfile2*12
      real*4  depth(mx,my)

      nx = 737
      ny = 417
      infile = 'swdepth.asc'
      outfile = 'swdepth1.dat'
      outfile2 = 'swdepth2.dat'
      open(8,file=infile,status='unknown')
      open(9,file=outfile,status='unknown')
      open(10,file=outfile2,status='unknown')

c File is read row by row starting from the NW corner.

      do 20 j = 1,ny
       do 20 i = 1,nx
        read(8,*) depth(i,j)
 20   continue

      do 40 j = 1,ny
        write(9,'(350f7.3)') ( depth(i,j), i=1,350 )
 40   continue

      do 60 j = 1,ny
        write(10,'(387f7.3)') ( depth(i,j), i=351,nx )
 60   continue

      stop
      end
```

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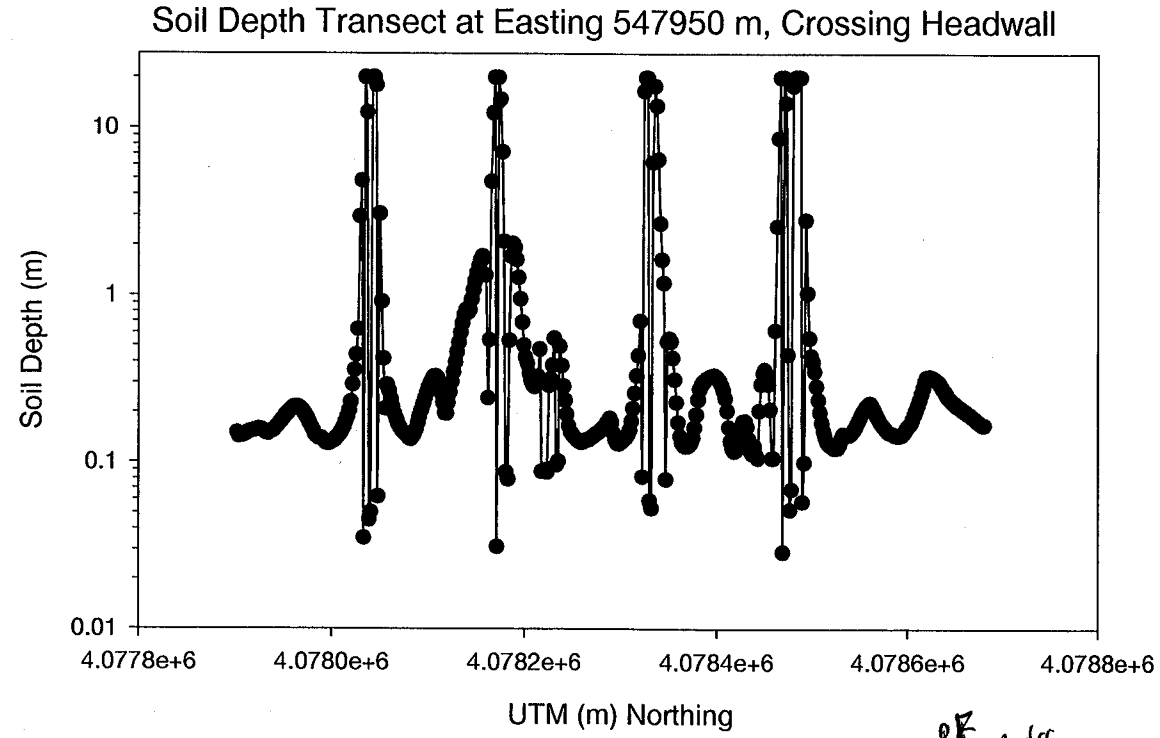
The SigmaPlot (version 4.0) file (bubo: D:\AVData\WatershedGrid\Soilcalculated\swdepth-16subcell.JNB) does not had easting positions as column titles, they must be determined knowing that the range is 1380 m and the number of columns is 737. Hence each column in SigmaPlot file represents an increase of 1.872456 m in UTM Easting, then add 1 column since it starts at column 1 instead of column "0".

These transects are located in the upper part of the Upper Split Wash watershed where soil depths vary (field estimates) between 0-2 meters



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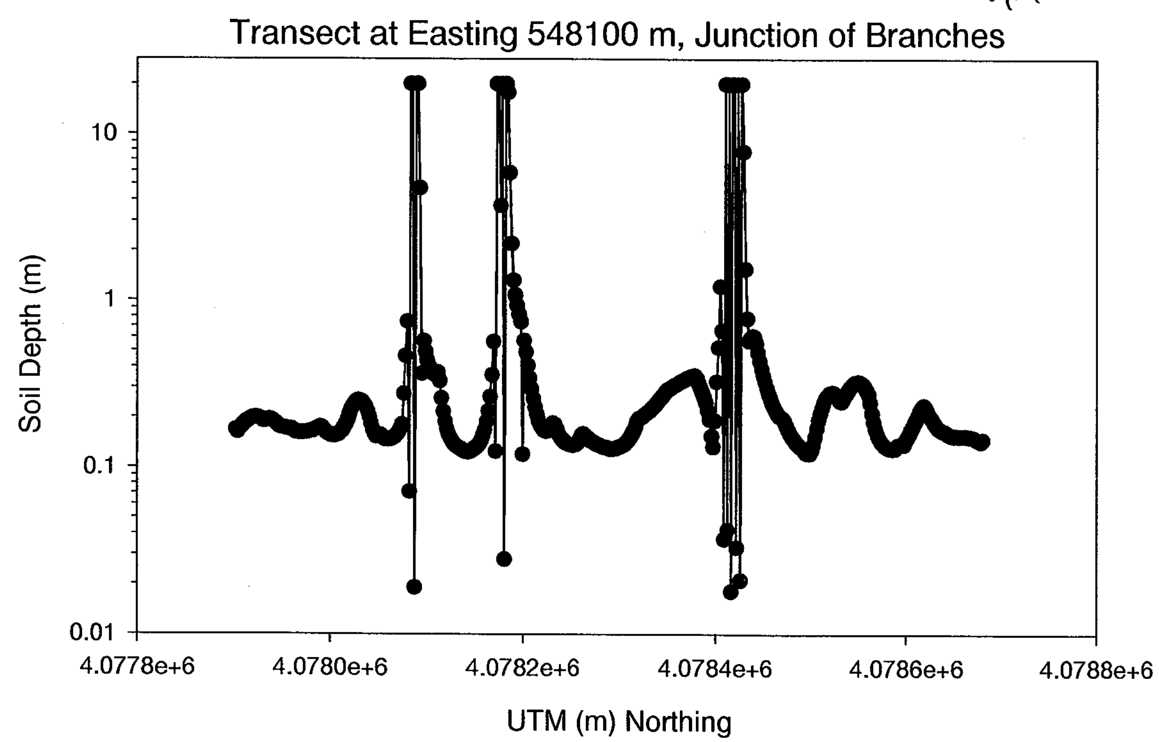


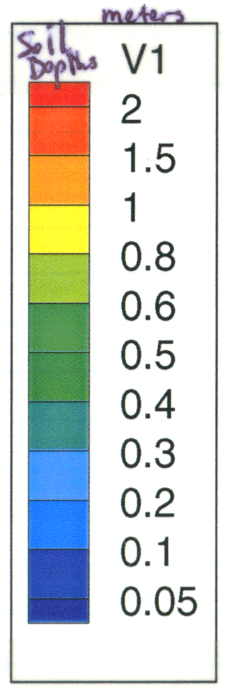
10/14/99 RF

This discrepancy within the channels between Stothoff estimates and field observations were presented to Stothoff who noted that alternative options could be used plus better restrictions imposed on his mass balance model. He already uses restrictions in flat areas due to unrealistic soil depths being produced by the model

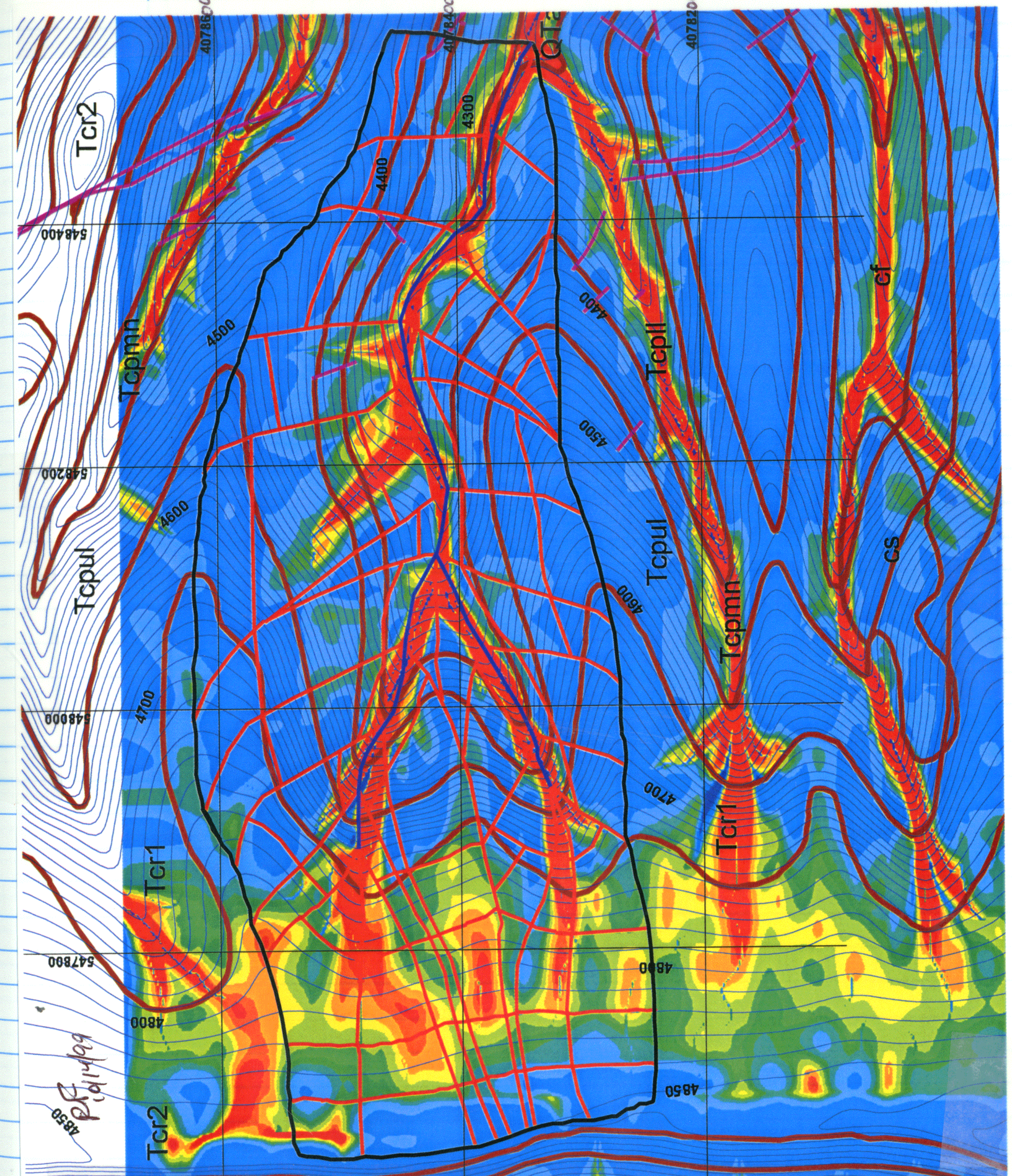
I re-created the soil depth tif file by lumping all depths >2 m into one category and I will visually ignore the channel depths (especially the width of the channel) when creating a new grid for the watershed.

bubo: D:\AVData\Watershed\watershed-soildepth-calc.apr
soils.tif & soils.TFW & soil-legend.tif
also watershed-soildepth-calc8x11.apr for prints
with layout set to 8½ x 11 in paper output.

Stu also noted that he restricted all soil depths to be less than 20 m in his mass balance model for all of YM, hence the limit on the scatter plot on page 37.



← North Soil Depths 2-20 m in one bin RF 10/14/99



 10/15/99 RF

Determining Absolute Locations of Soil Depth Transects

WWNF (Wren Wash North Facing)
Stu Stothoff Notebook (Field) Jan 29, 1998 entry
Noted a few pages earlier [(1/27/98) entry] that transects start near UZN24 borehole
→ E 548622.2 m N 4079259 m
UTM (m) NAD27
(this corresponds to Stu's GPS reading in NAD83 accounting for shift of 190 m south and 80 m east to get to NAD27 and then Stu's GPS reading is ± 100 m since it was a single GPS unit)

WWNF transect starts south of UZ-N24 at base of slope; given the adjustment for slope angle, orient the line so that the distance is correct knowing the caprock ledge location: Loading 10 ft contour data (topo10.shp) and borehole locations (Extbhutm.shp), UZ-N24 is found, assume Stu headed perpendicular up the north-facing slope; match adjusted distance to line on map so that endpoint is below caprock ledges; used air photo underlay (bubo: D:\AVData\Dog\airphoto_nw27.bip) to assist in locating transects; The adjusted distance is the map distance or the measured distance adjusting for slope

For the transects from my field notebook (#255), it was easier to locate them on the ArcView UTM(m) NAD27 figure because of my sketches, but I still had to do some approximating; I also had the tie-ins to Stu's coordinate system in the streams (he flagged every 50 m in the channels of Split Wash (upper)

Page 41 includes the summary of data stored in
bubo: D:\Randy\Soils\SOILDEP.xls EXCEL97 spreadsheet

Page 43 contains the ArcView 3.1 figure with the transects (UTM NAD27 (m))

Summary of Field Soil Depth Measurements

10/15/99 RF

Soil Depths
Field Trips: Jan26-29, May 13-18, 1998
Normalized map distance is map distance from bottom of slope, but normalized to entire map length from bottom to top flat on ridge

RF 10/15/99

Site	top=1 & bottom=9	max depth,cm	Measured Distance(m) from bottom	Map Distance Normalized to Total Map Hillslope (m)	surface slope, deg	bedrock slope,deg	average depth,cm	min depth,cm	size of hole, cm	Comments

south facing slope between Whaleback and Antler Ridges; typical case is abundant carbonate as fracture fill and at bedrock-soil interface, no open fractures, soil is dry nearly down to bedrock of lithophysal unit, uneven (stepped) and highly fractured bedrock surface — RFedors #255, p.2-9
187 = Map Distance from bottom of slope to nearly flat on ridge (meters)
187 = Map Distance of transect from bottom of slope (meters)
0.42219 24.2 = slope angle of transect in radians and degrees, (arc-cosine of map distance over measured distance)

Site	top=1 & bottom=9	max depth,cm	Measured Distance(m) from bottom	Map Distance Normalized	surface slope, deg	bedrock slope,deg	average depth,cm	min depth,cm	size of hole, cm	Comments
GDS-1	7	27	50	0.244	19	6	19	10	40	
GDS-2	6	35	60	0.293	22	14	21	1	60	
GDS-3	5	42	70	0.341	28	11	32	22	50	
GDS-4	4	60	100	0.488	23	uneven	42	42	50	massive x-stal rich, little carbonate
GDS-5	3	29	130	0.634	27	22	28	26	65	
GDS-6	2	33	165	0.805	19	11	24	16	120	
GDS-7	1	36	205	1.000	0	0	36	36	55	top of ridge
average		37			23 (excluding top of ridge)					

north-facing slope on Antler Ridge in Split Wash, typical case is moderate amount of carbonate as fracture-fill, no open fractures, soil is wet nearly to surface, highly fractured bedrock at surface — RFedors #255, P.13-20
215 = Map Distance from bottom of slope to nearly flat on ridge (meters)
182.3 = Map Distance of transect from bottom of slope (meters)
0.42388 24.3 = slope angle of transect in radians and degrees, (arc-cosine of map distance over measured distance)

Site	top=1 & bottom=9	max depth,cm	Measured Distance(m) from bottom	Map Distance Normalized	surface slope, deg	bedrock slope,deg	average depth,cm	min depth,cm	size of hole, cm	Comments
GDN-1	8	16	23	0.098	20	18	16	15	70	
GDN-2	7	38	50	0.212	22	22	22	12	65	
GDN-3	6	50	75	0.318	25	uneven	50	50	60	soil dry below 30cm
GDN-4	5	25	100	0.424	25	15	18	12	75	
GDN-5	4	25	125	0.530	28	25	23	20	60	
GDN-6	3	21	150	0.636	22	21	21	20	100	abundant calcite
GDN-7	2	25	175	0.742	22	uneven	24	23	60	massive, less fractures
GDN-8	1	17	200	0.848	20	uneven	15	13	70	
average		27			23					

south-facing slope in Wren Wash above NW portion of ESF footprint; typical case is moderate amount of carbonate as fracture-fill, no open fractures, soil is dry except at bedrock where it may be moist — RFedors, #255 p.23-28
152 = Map Distance from bottom of slope to nearly flat on ridge (meters)
131 = Map Distance of transect from bottom of slope (meters)
0.50879 29.2 = slope angle of transect in radians and degrees, (arc-cosine of map distance over measured distance)

Site	top=1 & bottom=9	max depth,cm	Measured Distance(m) from bottom	Map Distance Normalized	surface slope, deg	bedrock slope,deg	average depth,cm	min depth,cm	size of hole, cm	Comments
WWSF-1	6	32	25	0.144	26	15	29	25	80	
WWSF-2	5	31	50	0.287	22	0	11	0	70	
WWSF-3	4	15	75	0.431	31	uneven	3	0	60	
WWSF-4	3	29	100	0.575	23	0	20	10	60	
WWSF-5	2	24	125	0.718	29	27	17	10	60	
WWSF-6	1	42	150	0.862	27	11	28	12	100	
average		29			26					

north-facing slope on Diobolus Ridge (into Drill Hole Wash); — SStothoff #?, p.45-
Stu Stothoff notebook: dry top 10 cm
176 = Map Distance from bottom of slope to nearly flat on ridge (meters)
158 = Map Distance of transect from bottom of slope (meters)
0.37798 21.7 = slope angle of transect in radians and degrees, (arc-cosine of map distance over measured distance)

Site	top=1 & bottom=9	max depth,cm	Measured Distance(m) from bottom	Map Distance Normalized	surface slope, deg	bedrock slope,deg	average depth,cm	min depth,cm	size of hole, cm	Comments
WWNF-1	7	95	25	0.132	20					alluvial toe, did not hit bedrock
WWNF-2	6	61	50	0.264	24	27				no fractures, some carbonate
WWNF-3	5	3	75	0.396	31	31				calcite-filled fissure in lithophysal
WWNF-4	4	37	100	0.528	26	22				talus, buried soil was moist
WWNF-5	3	18	125	0.660	23	22				
WWNF-6	2	40	150	0.792	27	25				
WWNF-7	1	35	170	0.898	23	25				
average		41			25					

Headwall transect in small watershed at top of Split Wash; east-west transect across wash; — RFedors, #255 p.46-50
south-facing slope
92 = Map Distance from bottom of slope to nearly flat on ridge (meters)
91 = Map Distance of transect from bottom of slope (meters)
0.29122 16.7 = slope angle of transect in radians and degrees, (arc-cosine of map distance over measured distance)

RF 10/15/99

Site	top=1 & bottom=9	max depth,cm	Measured Distance(m) from bottom	Map Distance Normalized	surface slope, deg	bedrock slope,deg	average depth,cm	min depth,cm	size of hole, cm	Comments
HWW1	1	43	95	0.989	9					} map slope angles
HWW2	2	40	45	0.469	26					
HWW3	3	22	20	0.208	33					
HWW4	4	22	5	0.052	39					
average		32								

south-facing slope — RFedors, #255 p.50-54
89 = Map Distance from bottom of slope to nearly flat on ridge (meters)
89 = Map Distance of transect from bottom of slope (meters)
0.14921 8.5 = slope angle of transect in radians and degrees, (arc-cosine of map distance over measured distance)

Site	top=1 & bottom=9	max depth,cm	Measured Distance(m) from bottom	Map Distance Normalized	surface slope, deg	bedrock slope,deg	average depth,cm	min depth,cm	size of hole, cm	Comments
HWW5	6	15	15	0.167	29					
HWW6	5	45	30	0.333	27					
HWW7	4	35	45	0.500	30					
HWW8	3	20	60	0.667	33					
HWW9	2	20	75	0.833	30					map slope
HWW10	1	55	90	1.000	27					
average		32								

east-west headwall of small watershed in upper Split Wash — RFedors, #255 p.55-61
250 = Map Distance from bottom of slope to nearly flat on ridge (meters)
228 = Map Distance of transect from bottom of slope (meters)
0.38492 22.1 = slope angle of transect in radians and degrees, (arc-cosine of map distance over measured distance)

Site	top=1 & bottom=9	max depth,cm	Measured Distance(m) from bottom	Map Distance Normalized	surface slope, deg	bedrock slope,deg	average depth,cm	min depth,cm	size of hole, cm	Comments
HDW1	1	12	246	0.912	29					
HDW2	2	55	221	0.819	27					
HDW3	3	10	196	0.727	26					
HDW4	4	12	171	0.634	26					
HDW5	5	25	146	0.541	22					
HDW6	6	28	121	0.449	21					
HDW7	7	20	96	0.356	21					
HDW8	8	21	71	0.263	21					
HDW9	9	6	46	0.171						
average		21								

north-facing slope of small watershed in upper Split Wash, upper part — RFedors, #255 p.70-76
137 = Map Distance from bottom of slope to nearly flat on ridge (meters)
133.3 = Map Distance of transect from bottom of slope (meters)
0.15887 9.1 = slope angle of transect in radians and degrees, (arc-cosine of map distance over measured distance)

Site	top=1 & bottom=9	max depth,cm	Measured Distance(m) from bottom	Map Distance Normalized	surface slope, deg	bedrock slope,deg	average depth,cm	min depth,cm	size of hole, cm	Comments
HDN1	1	24	135	0.973	6					
HDN2	2	70	85	0.613	24					
HDN3	3	32	35	0.252	25					
average		42								

north-facing slope of small watershed in upper Split Wash; lower part — RFedors, #255 p.55-61
119 = Map Distance from bottom of slope to nearly flat on ridge (meters)
119 = Map Distance of transect from bottom of slope (meters)
0.31109 17.8 = slope angle of transect in radians and degrees, (arc-cosine of map distance over measured distance)

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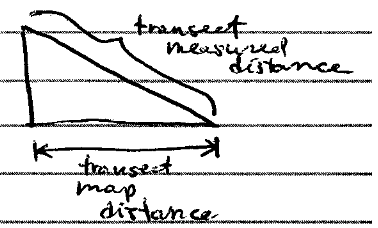
Site	top=1 & bottom=9	max depth,cm	Measured Distance(m) from bottom	Map Distance Normalized	surface slope, deg	bedrock slope,deg	average depth,cm	min depth,cm	size of hole, cm	Comments
NFW1	1	26	125	1.000	14					ridgetop
NFW2	2	31	100	0.800	24					
NFW3	3	40	75	0.600	23					map slope
NFW4	4	38	50	0.400	21					
NFW5	5	43	25	0.200	22					map slope
average		36								

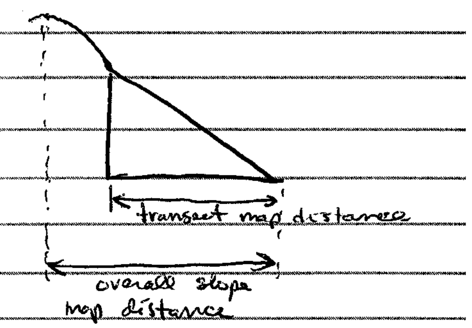
Broad slope of crest above south branch of upper Split Wash modeling area — RFedors, #255 p.72-73, broad slope of YM crest

Site	top=1 & bottom=9	max depth,cm
RTW1		60
RTW2		50

Since not all transects include soil depths at top of ridges, I estimated an overall distance ("Map distance from bottom of slope to nearly flat on ridge") to use when normalizing the measurement positions

$$\text{angle} = \cos^{-1}\left(\frac{\text{transect map dist}}{\text{transect meas}}\right)$$





The map distances were obtained directly from the estimate of slope angle (counting contours crossed by the transect) and the field measured distances

10/15/99 RF

Notes from locating transects

Start
548622
4079238
end
548622
4079079

WWNF 170 m measured transect.
vertical relief ~205 ft = 62.7 m
map transect distance ~157.97 m, angle ≈ 22

WWSF 150 m measured, vertical relief ~240 ft = 73 m
Start 548,623 m end 548 641 m
4079,284 m 4079 394 m

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UTM NAD27 (m) locations read from arcview figure, cursor location

GDN 270 ft vertical relief
bottom 548836 4078096 top 548835 4077913

GDS 270 ft vertical, 205 m measured transect
top 548812 m 4077792 m bottom 548783 4077608

HWW1-4 top 547897 m 4078582 m bottom
HWW5-10 top 547914 m 4078402 m bottom
} 547908 m 4078490 m

HDW 300 ft vertical, 246 measured transect
top 547892 m 4078400 m bottom 548121 m 4078120 m

HDN 60.5 m up from confluence (45 vertical ft in channel)
70 vertical ft in transect
548071 4078395 548175 4078308
hence 58.9 meters map distance from confluence

NFW vertical relief ≈130 ft bottom 548276 m 4078443 m
top 548268 m 4078324 m

RTW1 E547809m N4078257m
RTW2 E547731 m N4078249 m
} located by taking straight line from road to south branch channel (at headwall) & tieing my local coordinates into Stu's local coordinate flags

correction for slope angle
to get map distances (downslope only)
1st 100 m from road ~1 m
2nd 100 m from road ~4 m

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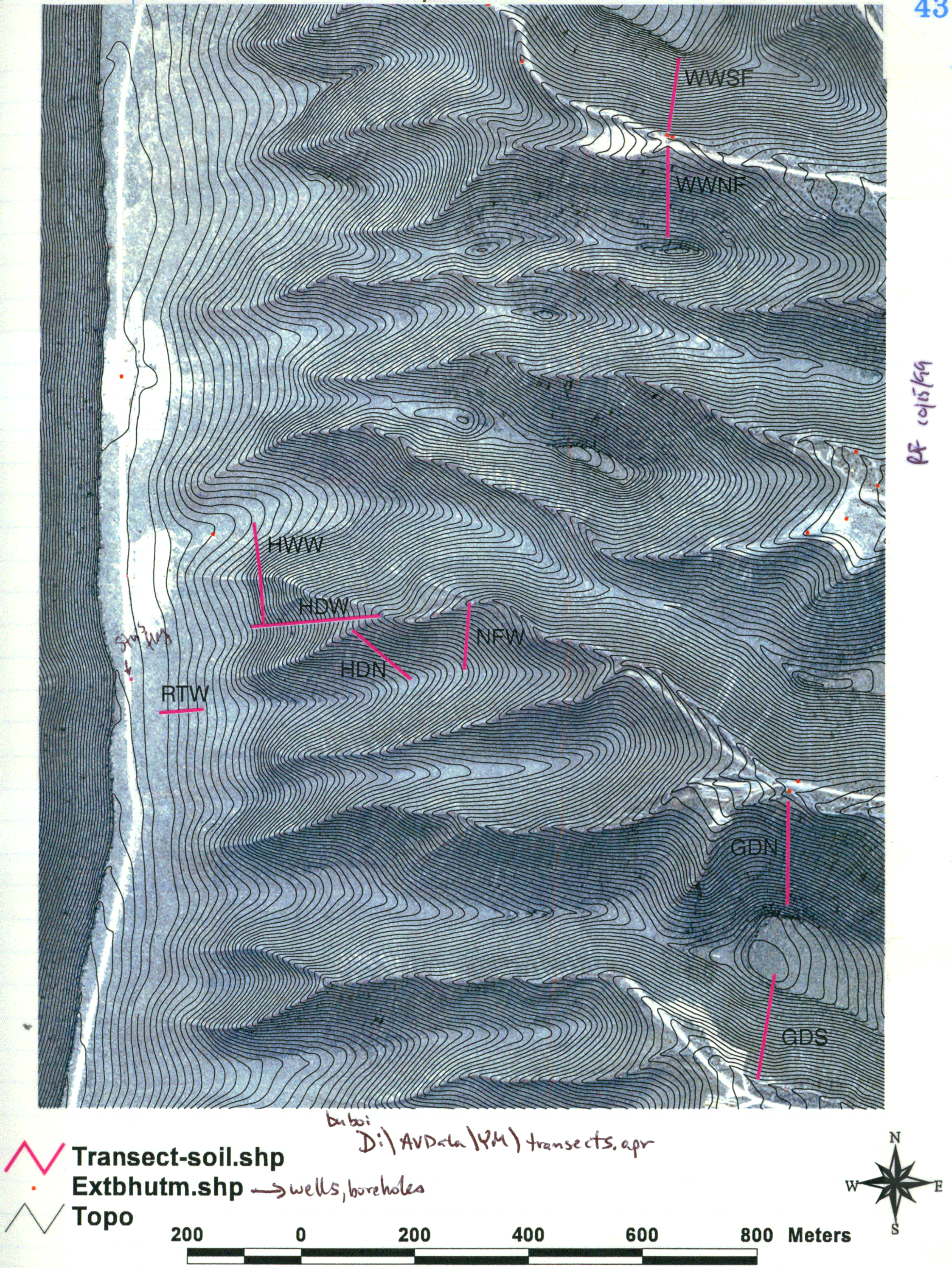


Dubois D:\AVData\(PM)\transects.apr
Extbhutm.shp → wells, boreholes

RF 10/15/99

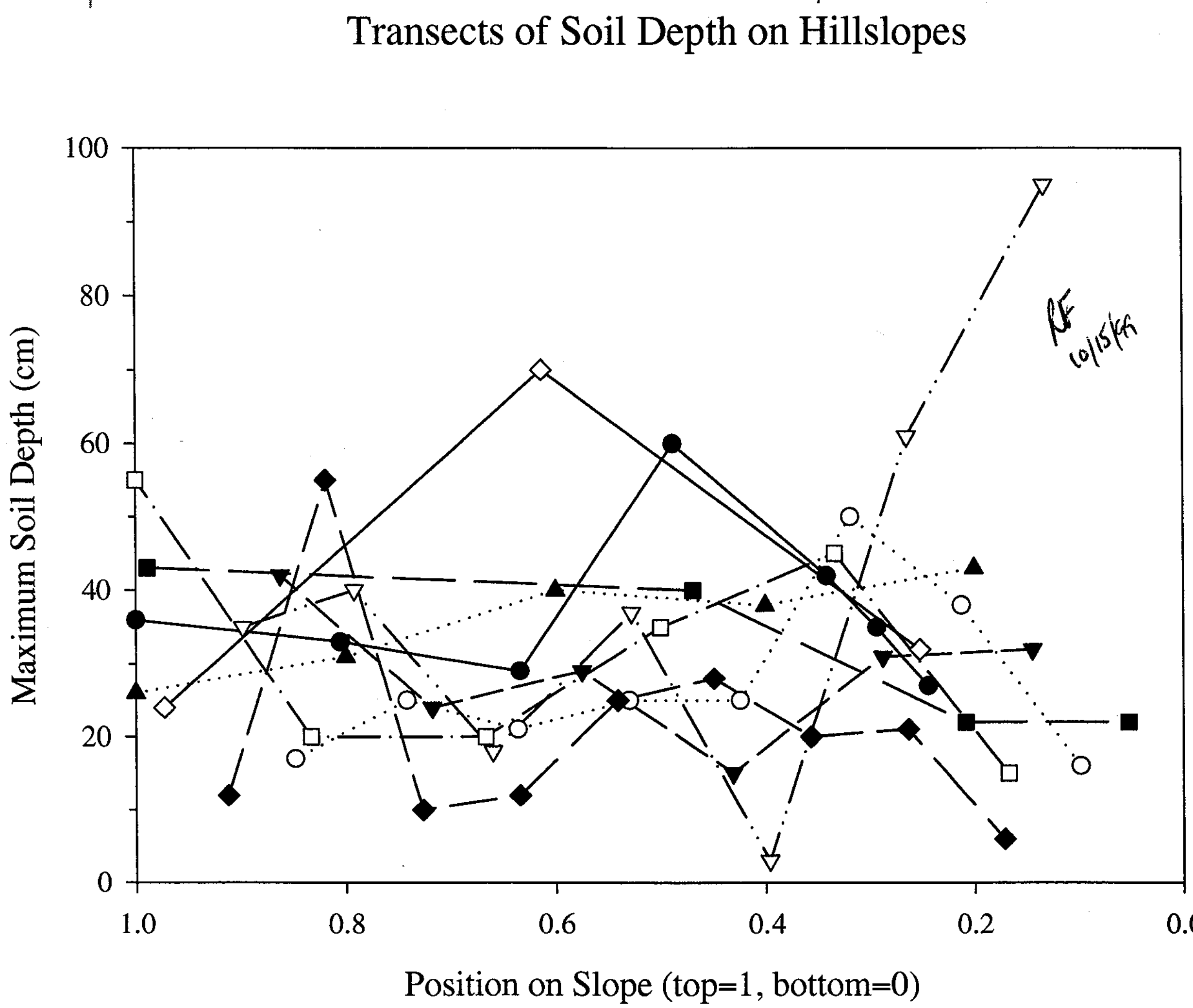
10/15/99 RF

SigmaPlot 4.0 figure Soil Depths along Hillslopes

Two points can be made about the distribution of depths along hillslopes: (1) No difference between north & south-facing slopes can be gleaned from this data, and (2) the ridge top & upper slopes are more uniform (narrower range) than the widely varying soil depths on the lower portions of the hillslopes

A visual estimate of the typical range of soil depths would be 15-50 cm depth

Obviously, this is too little data to make sweeping pronouncements but this does fit with our qualitative observations



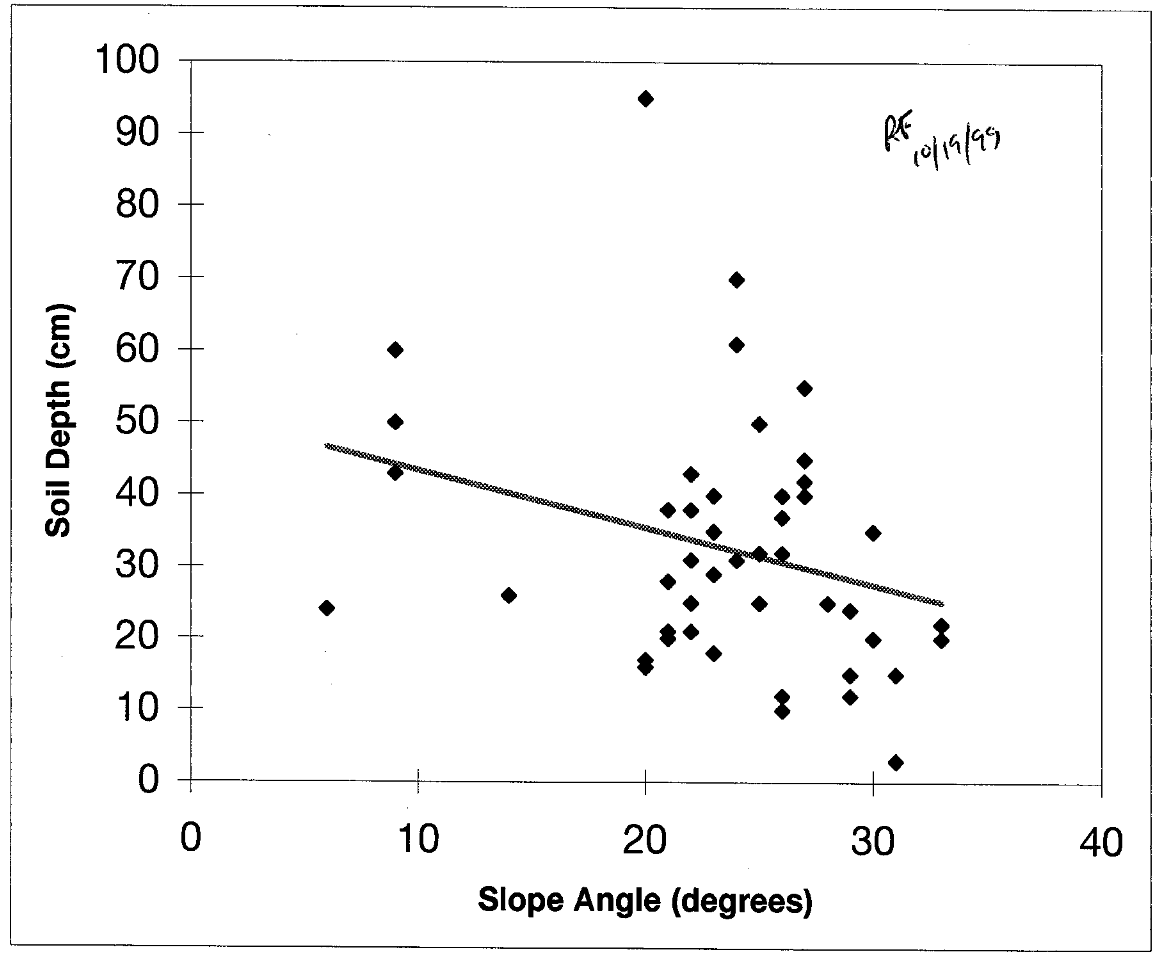
Regression of Soil Depth Against Slope Angle

10/18/99 RF

bubo: D:\Randy\Soils\SOILDEP.xls

Although a slight trend is observed in the data based on the density of dots, the regression definitely approaches a shotgun pattern type of R^2 (.08).

$$\text{Soil depth (cm)} = 51.4276 - 0.79704\,(\text{slope angle degrees})$$



 10/29/99
RF

Woolhiser's Scientific Notebooks

(1) Three volumes of David Woolhiser's scientific notebook were bound & sent to Mabrito. These three volumes contain the work from Solitario Canyon watershed modeling coordinated by Gordon Wittmeyer and Stuart Stothoff. They (Gordon & Stu) did not keep scientific notebooks but Woolhiser did retain a good record of loose-leaf notes. This work began in 1995 and continued until this year.

(2) Since last December, Woolhiser has been working with me on modeling in upper Split Wash. I gave him an official bound scientific notebook (#362) from QA at the CNWRA in June of 1999. He created a supplement to #362 that contains his notes from December 1998 to the summer of 1999, after which he used the notebook I gave him.

For both of these notebooks, Woolhiser's work is clearly stated and his results can be readily re-produced

Creation of New Watershed Grid

Used ArcView to create polygons (watershed outline and separate polygons for each plane element) and lines (stream channel elements)
ArcView 3.1 can readily calculate areas of polygons, something needed for KINEROS2 input, by adding a new field to the theme table.
Steps to do this are:

(1) select theme by highlighting it, then choose Theme → Start Editing
(2) open Theme Table icon
(3) From Edit menu, choose Add Field, then fill in pop-up menu
new Values can now be added to table itself

or,

(4) to calculate area, click on heading in Theme → table pop-up table
Then click on calculate icon to get new popup menu box
set to appropriate field &
Type in large space → [Shape].ReturnArea

To create separate polygons in ArcView 3.1

(1) Add New Theme
↳ polygons
(2) Starting from outline of entire watershed [already created as a polygon] (make sure it is a shapefile, use convert to shapefile if necessary), use splitting tool (change icon & select) to split entire watershed into smaller polygons. If part of outline of watershed gets lost, use to complete a polygon having unclosed polygon sides ↳ Auto complete tool
(3) It is difficult to delete polygons since the deletion always removes more than you want it to; use the Edit → undo feature menu choice (there is a history stored on most recent features add).

RF 11/3/99

The project file is called watershed-grid.apr

D:\AVData\WatershedGrid*

plane1.shp
channel1.shp
outline1.shp
} created as new grid

RF 11/3/99 ~~sto~~

Rules for creating grid are noted below. pdf files of eps exported files from ArcView are found on the following pages:
geol-grid.pdf, photo-grid.pdf, soil22-grid.pdf
Groeneveld's air photos were also pieced together (see page 52) and the Lundstrom soil map (page 53).

Watershed Discretization Comments

RF 11/3/99

1. Followed the rules that were apparent from the first grid (Woolhiser's) such as: (i) flow in planes should not spill into laterally adjacent planes, hence design sides of planes so that they are perpendicular to the topographic lines; and (ii) flow from any plane should only go into one downslope element (plane or channel element).

2. Woolhiser's grid was the beginning point; modifications were made based on: (i) the first level consideration went to the correlated slope angle and soil depths; and (ii) bedrock geology was considered at a secondary level (of course, the bedrock lithology does influence the slope angle).

3. Inclusion of soil depths in designing planes: Stuart's calculated soil depths on a 2m x 2m grid were qualitatively incorporated. There are some problems with his soil depths near channels. I also used Groeneveld's air photos, the DOE ortho-rectified air photo, measured soil depths on hillslopes in and near the watershed, and my observations in the watershed to make the grid.

4. Inclusion of bedrock geology: I constructed the channel elements to follow the lithologic changes at the expense of slight offsets of plane element from the geologic contacts. The 5 units in the watershed are the Tcr2, Tcr1, Tcpul, Tcpmn, and Tcpll. The hydraulic properties of the two caprock units (Tcr2, Tcr1) are similar as are the upper and lower lithophysal units (Tcpul, Tcpll). However, soil depths over the caprock units appears to differ since the Tcr1 is the dominant cliff (ledge) former and thus has smaller soil depths. The contact between Tcr2 & Tcr1 roughly corresponds to the break in slope and hence, the change in soil depths. The air photos were used to confirm the expected soil depth change near the Tcr1/Tcr2 contact. The fracture data from Throckmorton and Verbeek (1995) suggests that the upper lithophysal (Tcpul) are readily distinguished from the other units. But since the Tcpul and Tcpll are separated by the Tcpmn, these units all warrant consideration in the discretization.

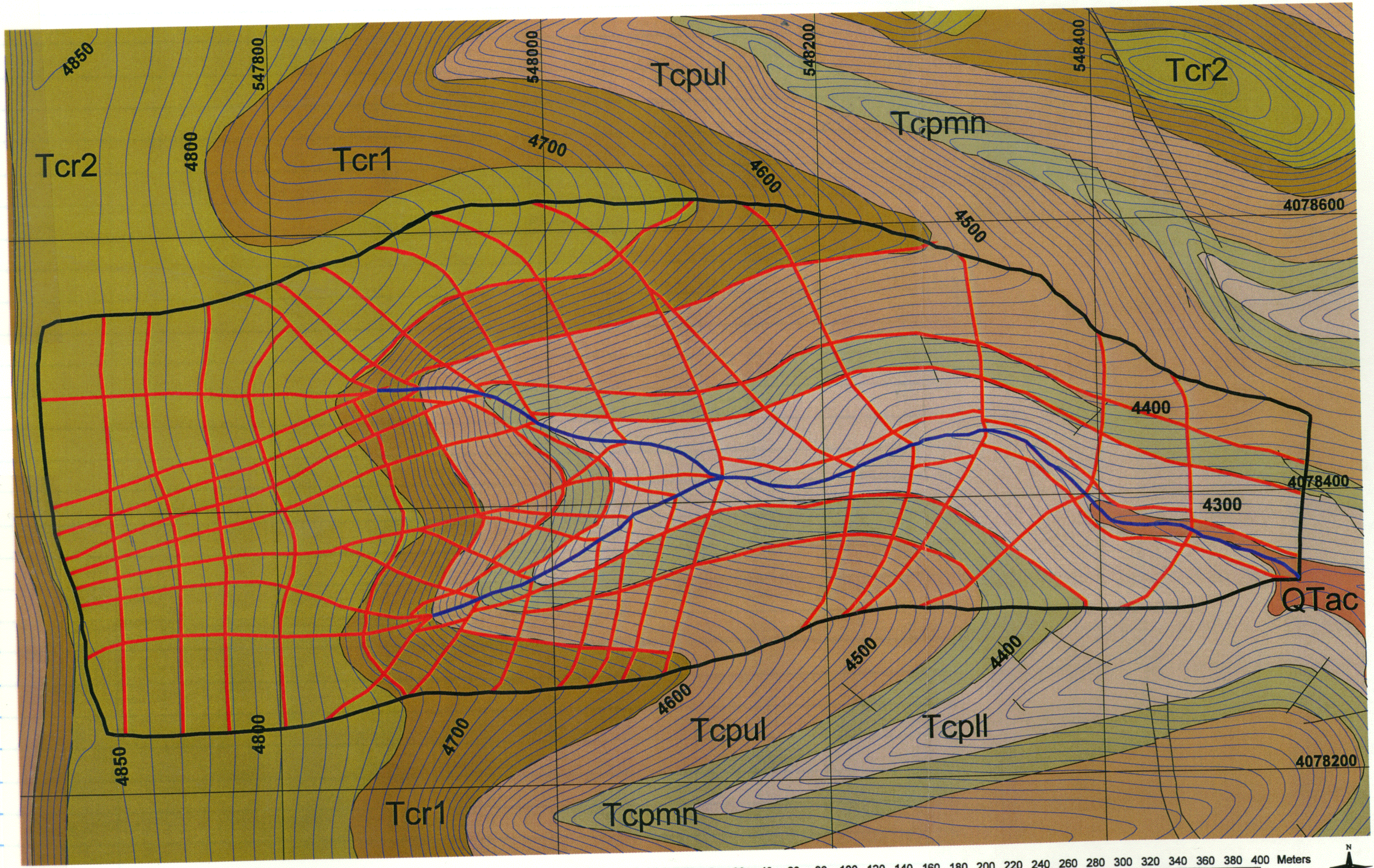
5. I included the 3 channel sections in the southern branch that I had re-evaluated last June in a site visit.

6. Disturbed area in the northwest corner of the grid is readily delineated in both the DOE ortho-rectified air photo and in the Lundstrom soil map. Plane elements were adjusted to correspond with this area.

7. Areas of talus, scree, and bedrock exposure predominance may be delineated by Groeneveld at some later time (soon?) from his air photos.

Grid overlayed on bedrock Geology (geology in directory D:\AVData\WDay\cb) 11/3/99 RF

RF 11/3/99



Small Watershed in Upper Split Wash
Nov 2, 1999 (watershed-grid.apr)

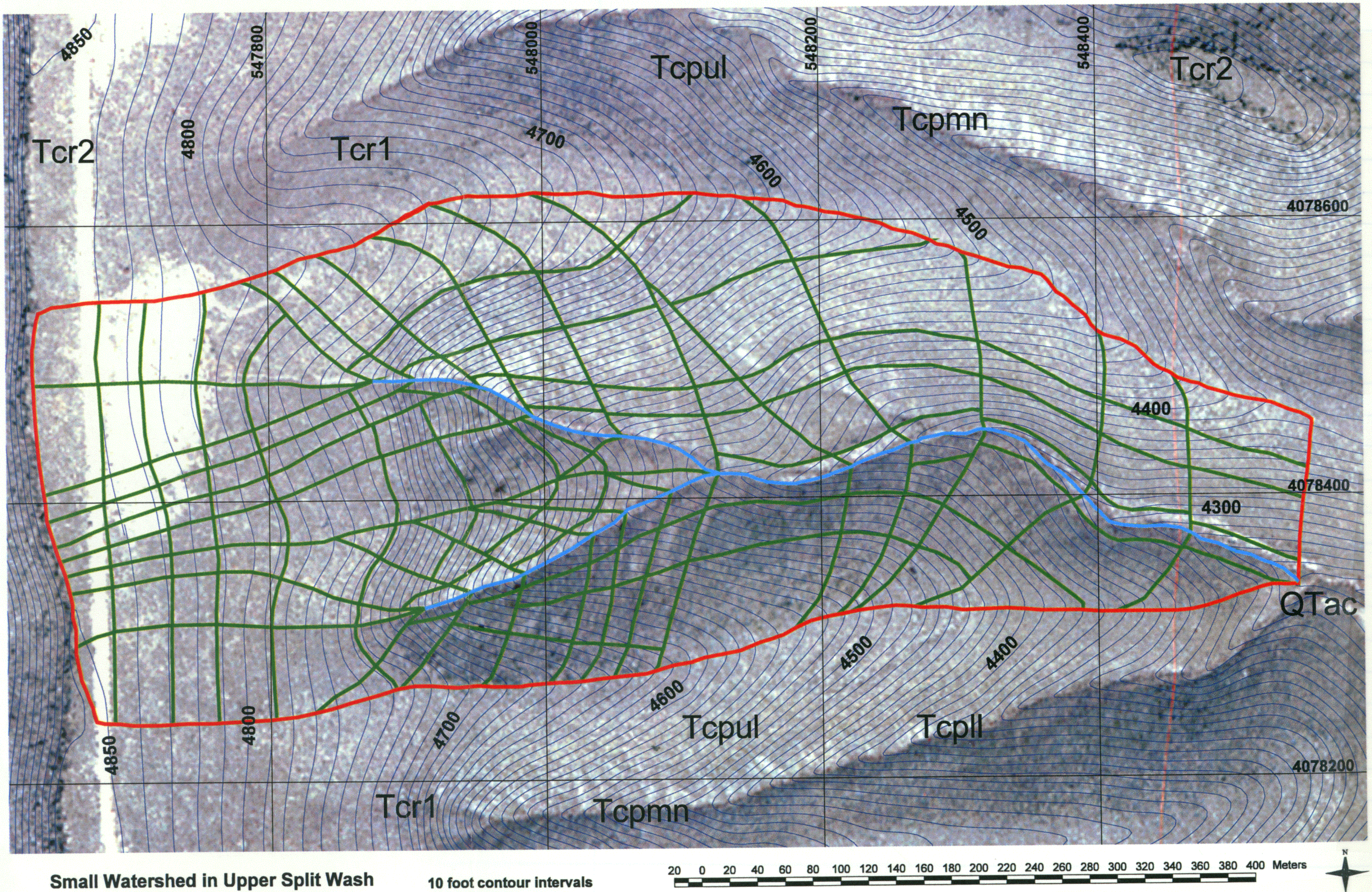
10 foot contour intervals
UTM NAD27 (meters)

20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 Meters

11/3/99 RF

Grid overlayed on air photo (DOE orthorectified Busted Butte quad)
D:\AVData\Dog\

RF 11/3/99

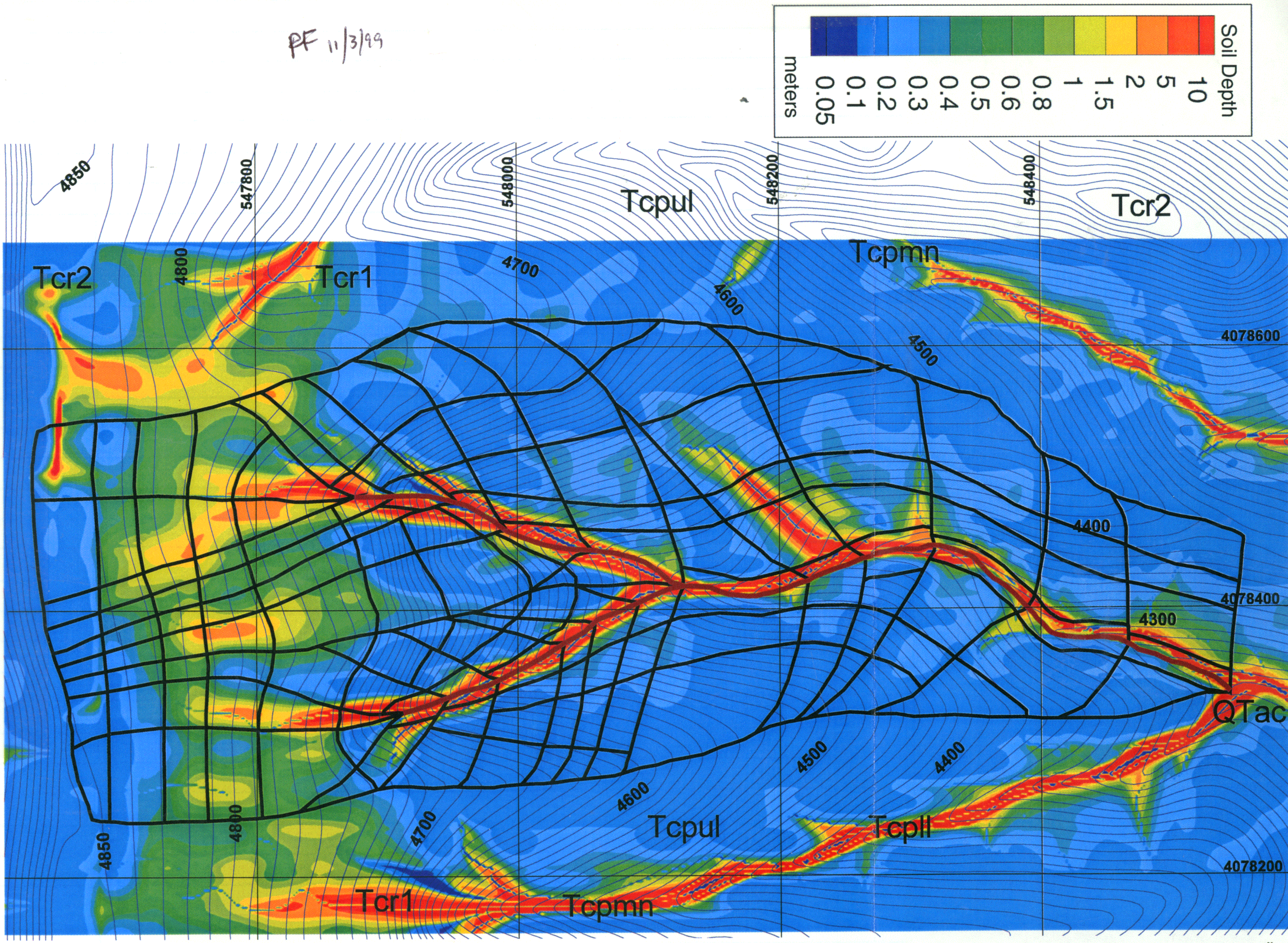


Small Watershed in Upper Split Wash
Nov 2, 1999 (watershed-grid.apr)

10 foot contour intervals
UTM NAD27 (meters)

Grid overlayed on calculated soil depths
(soil depths from D:\AVData\WatershedGrid\Soil-calculated\soil22.tif)
11/3/99 RF

RF 11/3/99



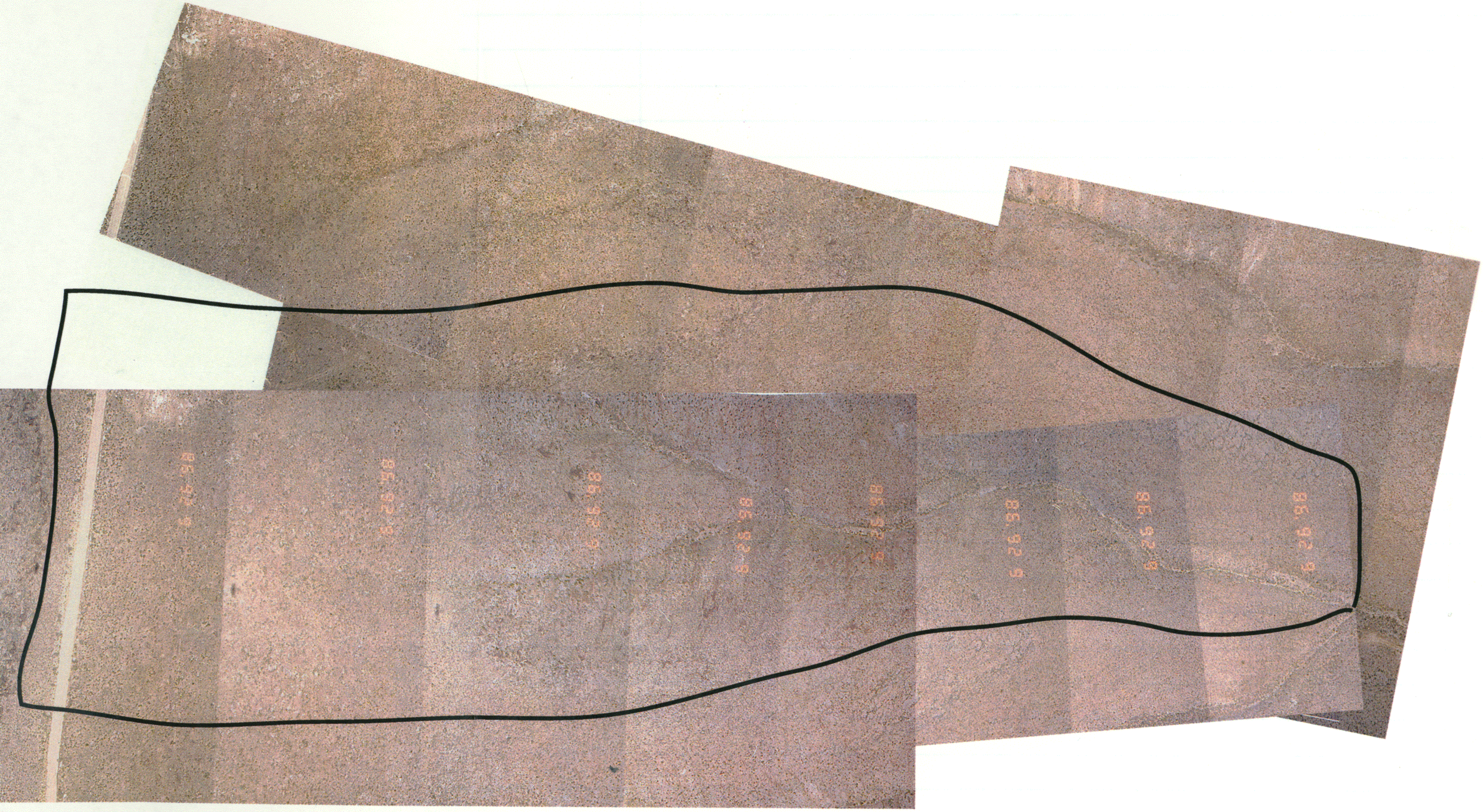
Small Watershed in Upper Split Wash
Nov 2, 1999 (watershed-grid.apr)

10 foot contour intervals
UTM NAD27 (meters)

20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 Meters

52 RF 11/3/99 Groenevelds air photos pieced together with approximate watershed outline (D:\Randy\woolhiser\SplitWash\Photos\splitwash.pdf)

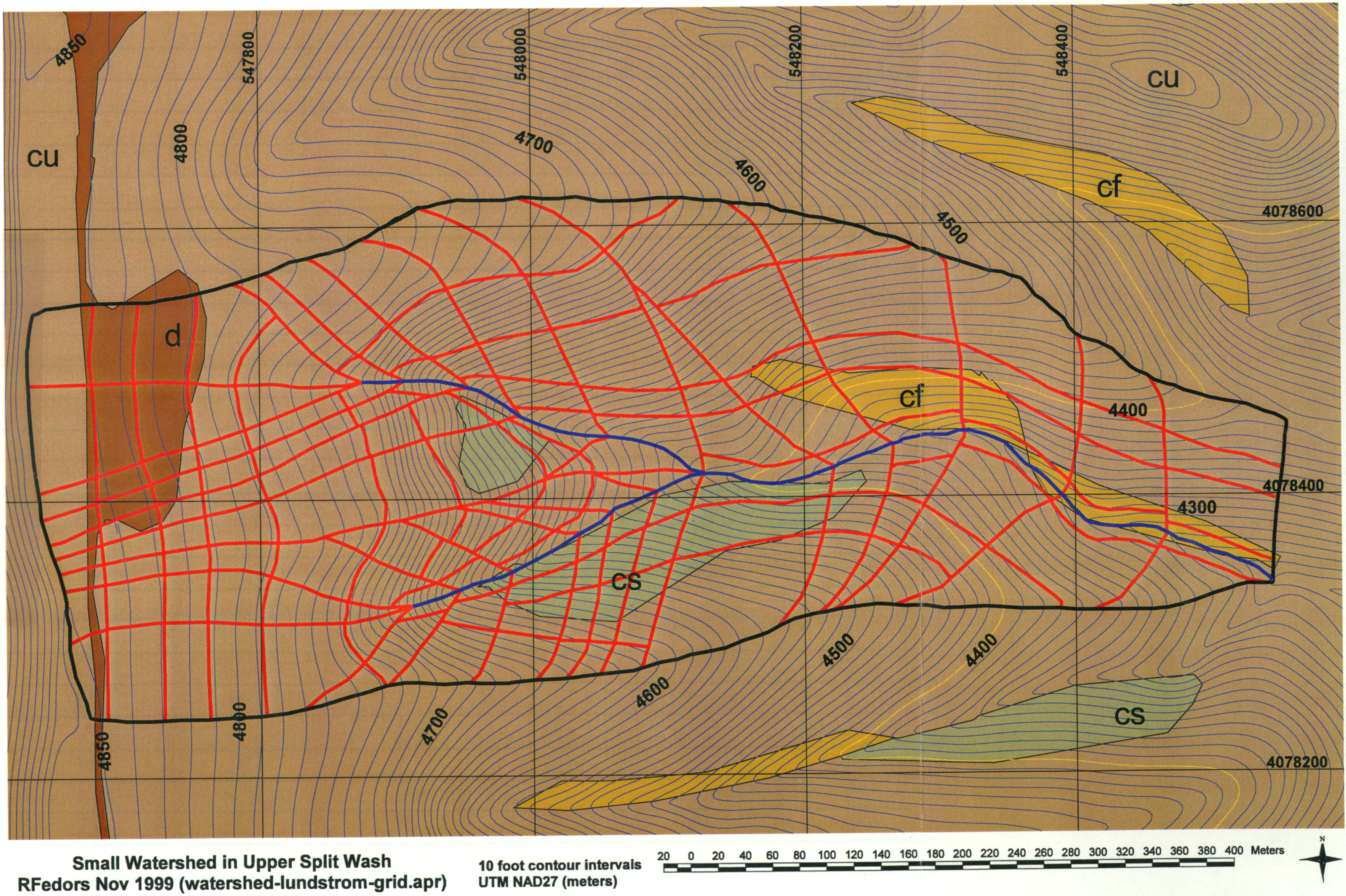
RF 11/3/99



Grid overlayed on Lundstrom's soil map

RF 53
11/3/99

RF 11/3/99



Small Watershed in Upper Split Wash
RFedors Nov 1999 (watershed-lundstrom-grid.apr)

11/10/99 The following page contains the fax sent by Woolhiser with his suggested change to add the small subchannel in the middle of the watershed. He commented that the exact shape of the elements for this channel & associated additional planes is somewhat arbitrary since the topo lines are not refined enough to help out. The air photo & field observations are the primary support for its existance & possible impact (effect) on runoff. Woolhiser also suggested that the road on the crest be added as plane elements though, as we discussed, it will be difficult to include the roads' effects because water runs laterally (northward) down the road until the disturbed area in the northwest corner of the watershed where the water then flows eastward (consistent w/ topographic lines).

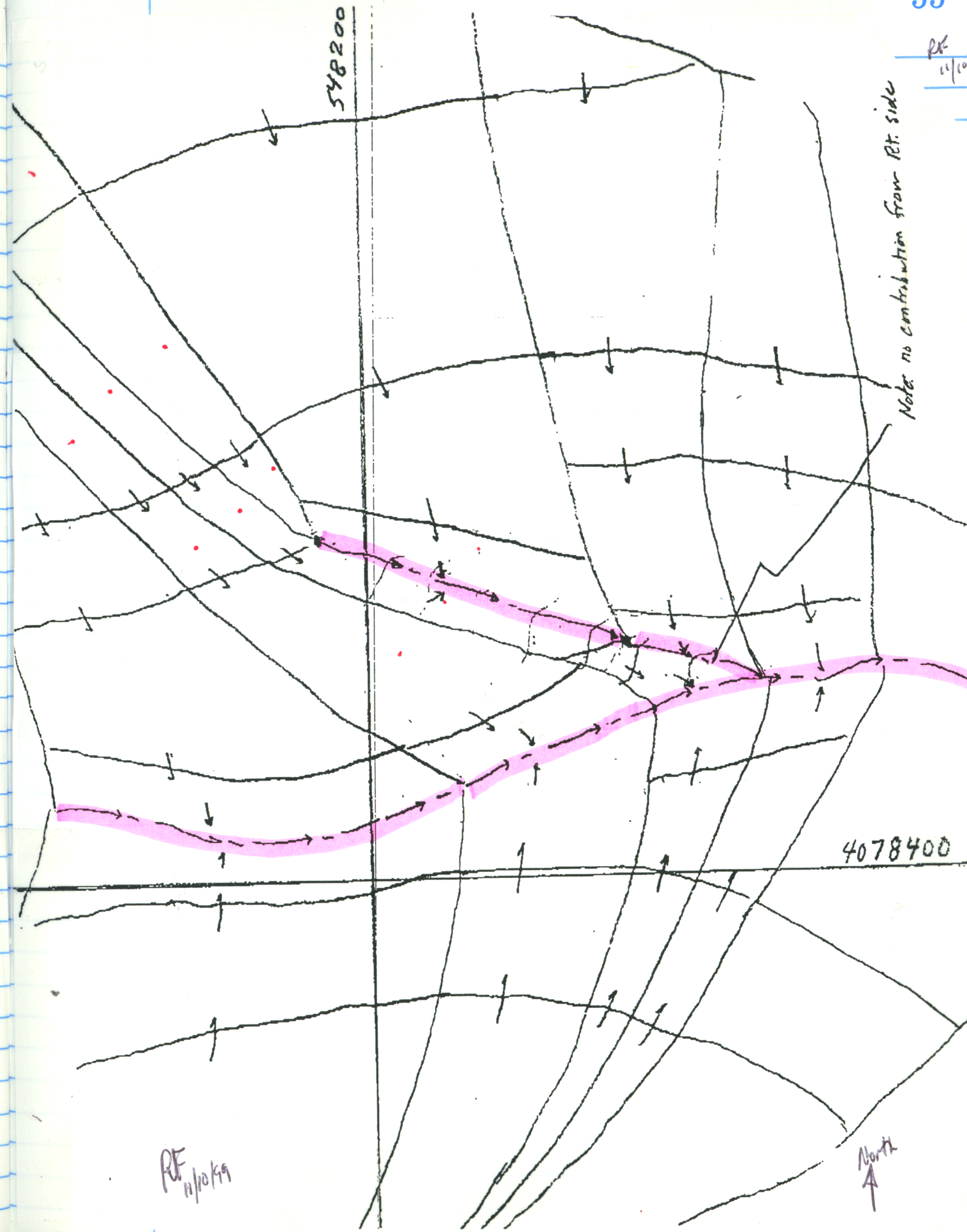
11/11/99 After cleaning up the grid (cross-over points, extra polygons (miniature) at connection pts, etc.), fields were added to the planes theme and the channel theme - the ID number and the area or length, respectively. To get the area (length), open the table when that theme is highlighted, then Edit → Add Field. Once field is in place, use calculator icon to add the statements: [Shape].ReturnArea or [Shape].ReturnLength

[R] to select while table is active
[IR] to edit entry

See page 56 for print out of plane elements overlayed on air photo
See page 57 for printout of channel elements overlayed on geology

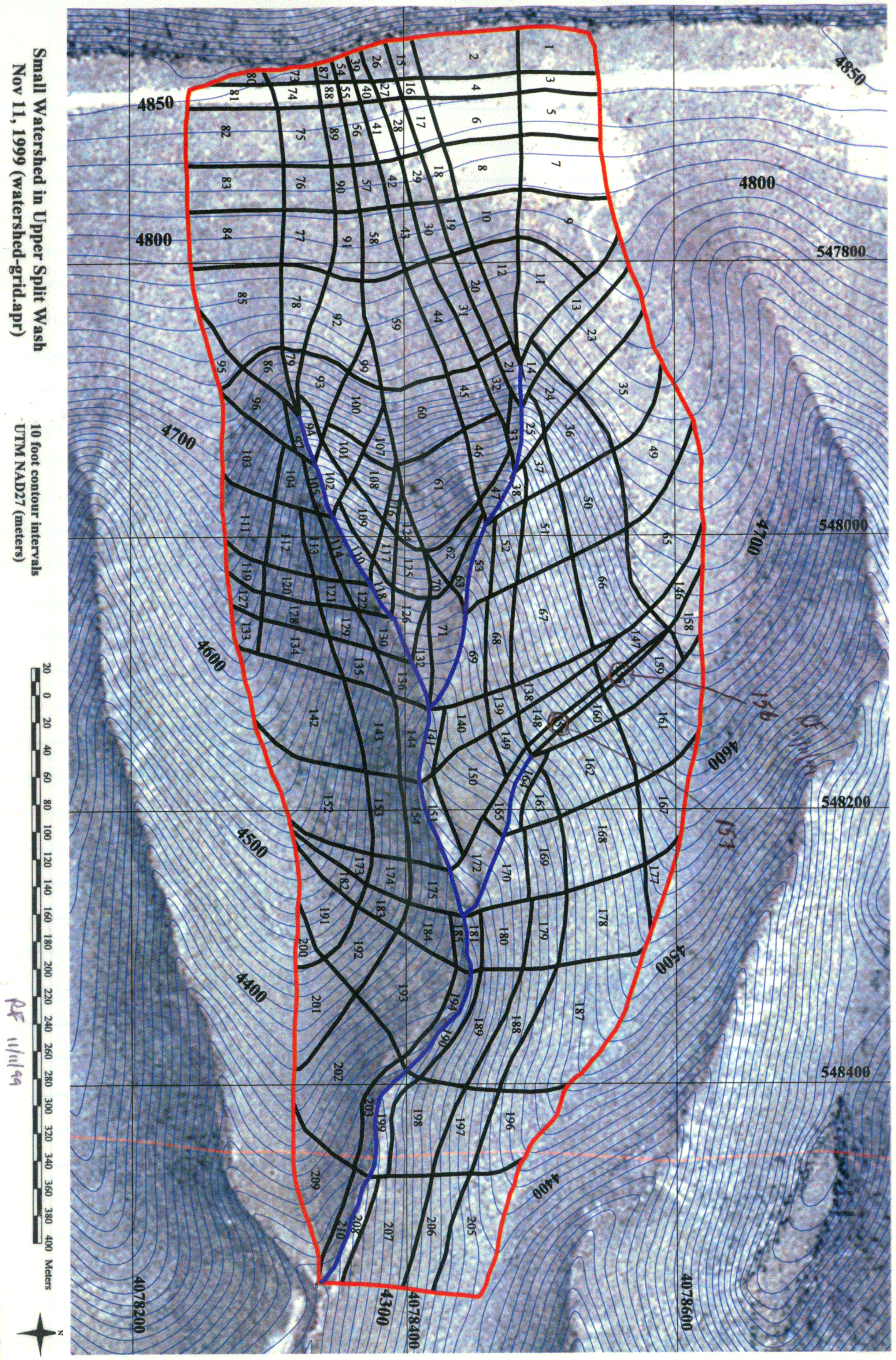
Files: bubo: D:\AVData\WatershedGrid*
.\watershed-grid.apr
.\watershed-grid-channel.apr (channels labeled)
.\watershedgrid.plane.apr (planes labeled)

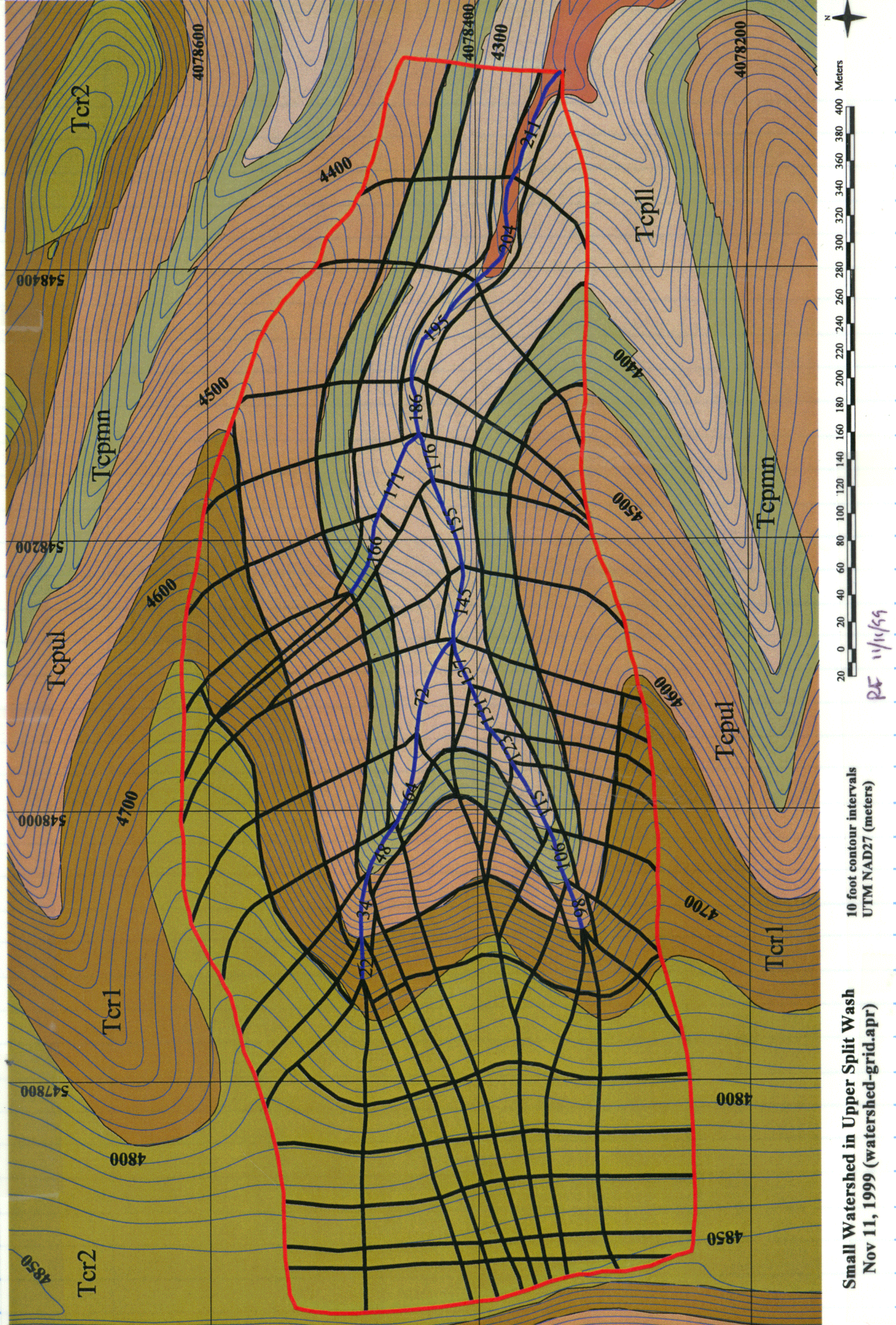
RF 11/10/99



RF 11/11/99

Plane Element Numbers





RF 11/11/99

Channel Element Numbers