
West Virginia Conversion of Local Resolution Elevation Data for the National Elevation Dataset

Procedural Report (Draft)

June 27, 2005

Prepared by: Kurt Donaldson

WV GIS Technical Center

Department of Geology and Geography
West Virginia University
425 White Hall, P.O. Box 6300
Morgantown, West Virginia 26506-6300
Phone (304) 293-5603 ext. 4336
Fax (304) 293-6522
E-mail wvgis@wvu.edu
Web <http://wvgis.wvu.edu>

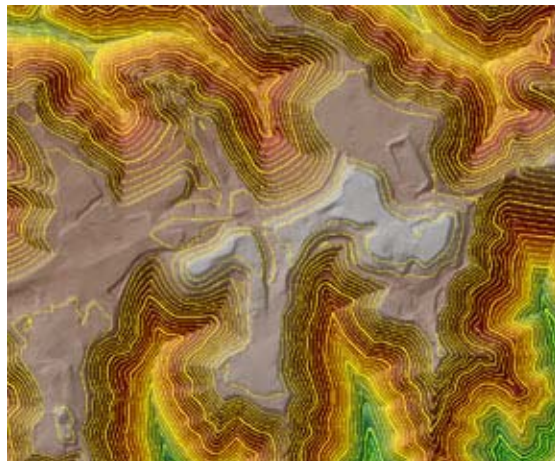


Table of Contents

Overview.....	1
Specifications.....	1
Procedures.....	2
Quality Assurance Procedures	4
APPENDIX A: File Organization.....	5
APPENDIX B: Microstation DGN Feature Codes.....	6
APPENDIX C: Quantity and sizes of mapping files	7
APPENDIX D: USGS Quadrangle Abbreviation List.....	8
APPENDIX E: Programming Scripts	19

Acknowledgements

Special recognition is given to the Statewide Addressing and Mapping Board and West Virginia Division of Highways, which provided the statewide elevation data to WVGISTC for the vector-to-raster conversion. In addition, the USGS should be acknowledged for funding this project and for their technical support to make this conversion project successful. Finally, principal contributors of the WV GIS Technical Center are Evan Fedorko, Kevin Kuhn, and Xuan Shi.

Overview

In cooperation with the U.S. Geological Survey (USGS) and West Virginia Statewide Addressing and Mapping Board (SAMB), the West Virginia GIS Technical Center (WVGISTC) is converting the vector SAMB elevation files to a raster Digital Elevation Model (DEM) for inclusion into the 1/9th arc second (3-meter) layer of the National Elevation Dataset (NED). The initial conversion for southwestern West Virginia will begin spring 2005, with the entire State scheduled for completion by 2006.

The main processes are TIN generation, TIN to DEM conversion, DEM hydrological enhancement, and edge checking elevation values of adjacent DEMs. Two main software applications perform the conversion and editing tasks: ESRI ArcGIS software for pre-processing the elevation and hydrographic SAMB vector files, and for generating the terrain surfaces; and Titan Corporation Delta3D software for enhancing surface drainage and edge checking adjacent DEMs.

Most of the procedures for creating the terrain surfaces have been automated. WVGISTC created ArcGIS python and arc macro language (AML) programming scripts to automate all the procedures required to create TIN and DEM terrain surfaces. For the Delta3D DEM editing software, USGS provided WVGISTC with a combination of automated scripts and manual editing routines to enhance the surface drainage. USGS also provided edge matching routines for adjacent surfaces if these routines are needed.

The completed 3-meter DEMs correspond in geographic extent to the USGS 7.5-minute topographic map series in West Virginia. Quality assurance checks of the final DEMs are done with both Delta3D and ArcGIS software before delivery to the USGS Mid-Continent Mapping Center for certification and publication into the NED.

Specifications

- 1) SOURCE DATA FORMAT: Photogrammetric-derived, Microstation format mass points, breaklines, and polygons for both elevation and hydrographic features.
- 2) Map Scale: 1:4800 (1"=400')
- 3) IMAGERY SOURCE DATE: Spring 2003
- 4) ACCURACY: Enhanced digital terrain model data (point and breakline) support topographically correct 10-foot contour intervals required to meet ASPRS Class II accuracies. This accuracy correlates to a raster DEM cell size (post spacing) of 5 meters.
- 5) NED RESOLUTION: The "local resolution" elevation data will be ingested into the 1/9th arc second (3 meters) layer of the National Elevation Dataset.
- 6) DIGITAL ELEVATION MODEL FORMAT: DEMs will be delivered to the USGS Mid-Continent Center in the following format: hydro enforced, edge matched, UTM Zone 17 North Coordinate System, horizontal datum NAD83, vertical datum NAVD88, map units in meters, vertical units in feet.
- 7) MAPPING UNIT: USGS 7.5-minute quadrangle.
- 8) DRAINAGE ENHANCEMENT: Small sinks are filled and stream channels are "burned" into the DEM. Users requiring "drainage enforcement" for delineating watersheds will have to employ additional processing, utilizing either ESRI's ArcHydro toolset or other software.

Procedures

I. PRE-PROCESSING: File organization; remove bridge breaklines; re-project files to UTM Coordinate System and NAD83/NAVD88 Datums; select elevation and hydro files to create terrain surface; convert polyline hydro files to DLG format for use in Delta 3D.

- 1) FILE ORGANIZATION. Create necessary file folders in accordance with file management plan (Appendix A).
- 2) PRE-PROCESSING OF ELEVATION AND HYDROGRAPHIC VECTOR FILES
 - a) Convert SAMB elevation and hydro files to ESRI format. Export Microstation DGN files to ESRI 3D Shapefiles, which are needed to create the surface TINs.
 - i) Elevation shapefiles are subdivided into line and point feature types.
 - ii) Hydro shapefiles are subdivided by level code (Appendix B) into line and polygon feature types.
 - b) Remove bridge breaklines from elevation files.
 - c) Define all elevation and hydro shapefiles as WV State Plane (Feet) North/South.
 - d) Reproject all vector files to UTM Zone 17 North, NAD 83 and NAVD88 Datums.
 - e) Export overedge hydro shapefile to DLG format for use with Delta 3D DEM editing software.

II. TERRAIN SURFACE CREATION: Create TIN surface for overedge 7.5-minute quadrangles. Convert TIN to raster DEM surface, created to USGS 7.5-minute quadrangle boundaries.

- 1) TIN Creation
 - a) Input layers
 - i) 3D Elevation Data
 - (1) Mass points
 - (2) Breaklines minus bridges
 - ii) 3D Hydro hard breaklines (polyline file)
 - (1) Single line streams
 - (2) Double line streams
 - (3) Double line drain islands streams
 - iii) 3D Hydro replacement polygons / water bodies (polygon file)
 - (1) Ponds and lakes
 - (2) Reservoirs
 - (3) Swamps and marshes
 - b) Program Script
 - i) Python: CreateTIN and EditTIN
- 2) TIN Definition. Define coordinate system and z unit of TIN
 - a) Arc: Projectdefine <TIN> <in_tin> parameters
- 3) TIN to DEM
 - a) Parameters. 3-meter distance between lattice mesh points; quintic smoothing; float data type; origin parameter x min y min, x max y max
 - b) Program Script:
 - i) Arc: TinLattice <in_tin> <out_lattice> quintic
 - ii) Parameters:
 - (1) Enter lattice origin <xmin> <ymin>: *quad specific*
 - (2) Enter lattice upper-right corner <xmax> <ymin>: *quad specific*
 - (3) Enter lattice resolution <n_points>:
 - (4) Enter distance between lattice mesh points <d>: 3
- 4) Lattice to USGS DEM
 - a) Program Script:
 - b) Arc: LatticeDEM <in_lattice> <out_DEM> 10 INT (Integer DEM with z-factor of 10; this is necessary due to the Delta 3D software)

III. DRAINAGE ENHANCEMENT: Utilize Delta 3D software to enhance drainage channels. Automatic and manual procedures may be employed to complete this step.

- 1) Macro: *Quadxx* – this macro is written from the OpenWV macro.
Import the *quadxx*.DEM (quadrangle) with desired parameters
Automatically set header information.
Correct for z-factor (*10ux* macro corrects the z-factor)
Change display units to feet (units 1 2)
- 2) Manual: Import *quadxx*.dlg (hydro) file
- 3) Macro: *fixdrains* - Automatically burns stream channels into the DEM
Single stream DLG vector file required
- 4) Macro: *puddlefix* – automatically locates and fills small area puddles (iterative).
Manual drainage enforcement/puddle fix after visual inspection

IV. EDGE MATCHING: If necessary, use Delta 3D software to edge-match adjacent quadrangles.

- 1) Manual edge matching (if necessary)

V. Export DEM

Export DEM from Delta3D to USGS format (*export dem <quad_?_version.dem> 1 0.000010 0*)

Quality Assurance Procedures

Quality assurance checks will be performed with ArcGIS ArcMap and ArcScene and Delta3D software. Reference data themes can include orthophotography, digital USGS topographic maps, or existing elevation products.

- 1) Terrain Surface.
 - a) Verify elevation ranges
 - b) Check integrity of terrain surface
- 2) Drainage Enhancement:
 - a) Drainage checks from a point using Delta 3D software *draw_flow* command
 - b) Surrounding ground above the water level using Delta 3D software – *monochrome* function in combination with *roll* command (visual inspection)
 - i) ArcHydro hydrologic tools
 - ii) Topo maps as guide for identifying valid depressions
 - c) Edge matching – cross quad elevations
 - d) Reference Layers
 - i) Source SAMB hydro and elevation layers
 - ii) Statewide SAMB orthophotos
 - iii) Digital topographic maps
 - iv) Existing elevation products
 - (1) USGS 1:24,000-scale hypsography Digital Line Graphs
 - (2) USGS 10- or 30-meter Digital Elevation Models
 - (3) LiDAR countywide data

APPENDIX A: File Organization

A.) Source Data

- 1) ELEVATION
 - a) ***** Raw Elevation DGN files ***** ELEV_DGN_50K_SP
 - i) NORTH folder: 50k tiles with DGN files
 - ii) SOUTH folder: 50k tiles with DGN files
 - b) ***** Processed Elevation UTM Files ***** ELEV_SHP_50K_UTM folder (exported to shapefiles; reprojected to UTM Zone 17 North; contain Z values)
 - i) 50K folder with point and line files
 - ii) 50K_NO32 folder minus Level 32 breaklines
- 2) HYDROGRAPHY
 - a) ***** Raw Hydrography DGN files ***** HYDRO_DGN__ZONE_SP folder
 - i) North and South DGN composite files
 - b) ***** Processed Hydro UTM Files ***** HYDRO_SHP_ZONE_UTM folder (exported to shapefiles for each feature type; reprojected to UTM Zone 17 NorthState Plane)
 - i) N_hydro_poly
 - ii) N_hydro_line
 - iii) S_hydro_poly
 - iv) S_hydro_line

B.) Processed Data

- 3) TIN Creation - *Quad_TIN* (ArcINFO Tin; 495 files)
- 4) LATTICE *Quad_LAT.GRD* (ArcINFO grid; 495 files)
- 5) DEM_USGS *Quad.DEM* (USGS DEM; 495 files)
- 6) DEM_HYDRO – Hydro-enforced DEMs; *Quad_h_version.DEM* (495 files)
 - a) ***** Extracted Hydro shp Files for Delta 3D ***** HYDRO_DLG_OVEREDGE_UTM folder (495 overedge quads; *Quad* – 6 character text)
 - i) *quad_hydro_line*
converted to dlg format
- 7) DEM_EDGEMATCH – Edge-matched hydro-enforced DEMs *Quad_e_version.DEM* (495 files)

APPENDIX B: Microstation DGN Feature Codes

Feature	DGN Feature Name	DGN Feature Type	Level	Color	Weight	Code
Road Centerlines	Interstate	Line	3	1	1	0
	US	Line	3	2	1	0
	State	Line	3	3	1	0
	County	Line	3	4	1	0
	Local	Line	3	5	1	0
	Tertiary - Logging road, etc.	Line	3	6	1	0
	Driveway centerline	Line	3	7	1	0
Tunnels (road)	Tunnel (road)	Polygon	17	1	1	0
Tunnels (railroad)	Tunnel (railroad)	Polygon	17	2	1	0
Bridges (road)	Bridge (road)	Polygon	17	3	1	0
Overpasses (road over road)	Overpass (road)	Polygon	17	4	1	0
Trestles (railroad bridge)	Trestles (railroad)	Polygon	17	5	1	0
Culverts (storm)	Culvert	Point	17	6	7	0
Railroad Centerlines	Active Rail	Line	18	1	1	0
	Abandoned Rail	Line	18	2	1	0
	Rail to Trail	Line	3	9	1	0
Sructures point	Structure_pt	Point	6	1	7	0
Sructures poly	Structure_poly	Polygon	6	2	1	0
Hydrology	Lake/pond	Polygon	4	1	1	0
	Reservoir	Polygon	4	2	1	0
	Swamp/marsh	Polygon	4	3	1	0
	Double line drain	Line	4	4	1	0
	Double line drain island	Line	4	9	1	0
	Single line drain	Line	4	5	1	0
	Canal(Centerline)	Line	4	6	1	0
	Dam(Concrete)	Polygon	17	7	1	0
	Dam(Earthen)	Polygon	17	11	1	0
	Spillway	Polygon	17	9	1	0
	Lock	Point	17	10	7	0
Obscured	Obscured	Polygon	57	1	1	0
	Clearing	Polygon	57	2	1	0
		DTM				
Breaklines (Soft)	Breaklines (Soft)	Line	20	1	1	0
Breaklines (Hard)	Breaklines (Hard)	Line	20	2	1	0
Exclusion Area	Exclusion Area	Line	20	3	1	0
Mass Points	Mass Points	Point	20	4	7	0
	-	-	-	-	-	-
	-	-	-	-	-	-
Bridge - Level 0	Bridge - Level 0	Line	32	15	1	0

Feature	DGN Feature Name	DGN Feature Type	Level	Color	Weight	Code
Cap - Level 0	Cap - Level 0	Line	34	71	1	0
Bridge - Level 1	Bridge - Level 1	Line	32	67	1	0
Cap - Level 1	Cap - Level 1	Line	34	66	1	0
Bridge - Level 2	Bridge - Level 2	Line	32	68	1	0
Cap - Level 2	Cap - Level 2	Line	34	67	1	0
Bridge - Level 3	Bridge - Level 3	Line	32	69	1	0
Cap - Level 3	Cap - Level 3	Line	34	68	1	0
Bridge - Level 4	Bridge - Level 4	Line	32	70	1	0
Cap - Level 4	Cap - Level 4	Line	34	69	1	0

APPENDIX C: Quantity and sizes of mapping files

File Type		Total Files	Individual File Size	Total File Size
Vector	TIN Input Files	495 x 7		5 GB
	DLG hydro files	495 x 7		
	7.5-Minute Neatline Boundary	495		
TIN	TIN	495 x 3	240 MB	119 GB
Raster	DEM LATTICE (ArcGrid)	495	70 MB	37 GB
	USGS DEM	495	102 MB	51 GB
	Hydro Enforced DEM	495	102 MB	51 GB
	Edge Matched DEM	495	102 MB	51 GB
<i>Estimated total file size:</i>				314 GB

APPENDIX D: USGS Quadrangle Abbreviation List

T:\Projects\QuadList\USGS24kquadlist

#	QuadName	Six_Let_Abbr	Latitude	Longitude	USGS_QD_ID	Counties
1	Addison	ADDISO	38 52' 30"	-082 07' 30"	38082-H2	Mason
2	Adolph	ADOLPH	38 37' 30"	-080 00' 00"	38080-F1	Randolph
3	Adrian	ADRIAN	38 52' 30"	-080 15' 00"	38080-H3	Lewis, Upshur
4	Alderson	ALDERS	37 37' 30"	-080 37' 30"	37080-F6	Greenbrier, Summers, Monroe
5	Alleghany	ALLEGH	37 37' 30"	-080 07' 30"	37080-F2	Monroe
6	Alton	ALTONX	38 45' 00"	-080 07' 30"	38080-G2	Randolph, Upshur
7	Alum Creek	ALUCRE	38 15' 00"	-081 45' 00"	38081-C7	Kanawha, Lincoln
8	Alvon	ALVONX	37 52' 30"	-080 07' 30"	37080-H2	Greenbrier
9	Amherstdale	AMHERS	37 45' 00"	-081 45' 00"	37081-G7	Boone, Logan, Wyoming
10	Amonate	AMONAT	37 07' 30"	-081 37' 30"	37081-B6	McDowell
11	Anawalt	ANAWAL	37 15' 00"	-081 22' 30"	37081-C4	McDowell
12	Annamoriah	ANNAMO	38 52' 30"	-081 07' 30"	38081-H2	Wirt, Calhoun, Roane
13	Ansted	ANSTED	38 07' 30"	-081 00' 00"	38081-B1	Nicholas, Fayette
14	Anthony	ANTHON	37 52' 30"	-080 15' 00"	37080-H3	Greenbrier
15	Antioch	ANTIOC	39 15' 00"	-079 00' 00"	39079-C1	Mineral, Grant
16	Apple Grove	APPGRO	38 37' 30"	-082 07' 30"	38082-F2	Mason
17	Arliee	ARLEEX	38 37' 30"	-082 00' 00"	38082-F1	Mason, Putnam
18	Arnett	ARNETT	37 45' 00"	-081 22' 30"	37081-G4	Raleigh, Wyoming
19	Arnoldsburg	ARNOLD	38 45' 00"	-081 07' 30"	38081-G2	Calhoun, Roane
20	Artemas	ARTEMA	39 37' 30"	-078 22' 30"	39078-F4	Morgan
21	Asbury	ASBURY	37 45' 00"	-080 30' 00"	37080-G5	Greenbrier
22	Athalia	ATHALI	38 30' 00"	-082 15' 00"	38082-E3	Cabell
23	Athens	ATHENS	37 22' 30"	-081 00' 00"	37081-D1	Mercer
24	Auburn	AUBURN	39 00' 00"	-080 45' 00"	39080-A7	Doddridge, Ritchie, Gilmer
25	Audra	AUDRAX	39 00' 00"	-080 00' 00"	39080-A1	Barbour, Upshur
26	Augusta	AUGUST	39 15' 00"	-078 37' 30"	39078-C6	Hampshire
27	Aurora	AURORA	39 15' 00"	-079 30' 00"	39079-C5	Preston, Tucker
28	Baileysville	BAILEY	37 30' 00"	-081 37' 30"	37081-E6	Wyoming, McDowell
29	Baker	BAKERX	39 00' 00"	-078 37' 30"	39078-A6	Hampshire, Hardy
30	Bancroft	BANCRO	38 30' 00"	-081 45' 00"	38081-E7	Putnam, Kanawha
31	Barboursville	BARBOU	38 22' 30"	-082 15' 00"	38082-D3	Cabell
32	Barnabus	BARNAB	37 37' 30"	-082 00' 00"	37082-F1	Logan, Mingo
33	Bastian	BASTIA	37 07' 30"	-081 07' 30"	37081-B2	Mercer
34	Beckley	BECKLE	37 45' 00"	-081 07' 30"	37081-G2	Raleigh
35	Beckwith	BECKWI	38 00' 00"	-081 07' 30"	38081-A2	Fayette
36	Beech Hill	BEEHIL	38 45' 00"	-082 00' 00"	38082-G1	Mason
37	Belington	BELING	39 00' 00"	-079 52' 30"	39079-A8	Barbour, Randolph
38	Bellegrove	BELLEG	39 37' 30"	-078 15' 00"	39078-F3	Morgan
39	Belle	BELLEX	38 07' 30"	-081 30' 00"	38081-B5	Kanawha, Boone
40	Belmont	BELMON	39 22' 30"	-081 15' 00"	39081-D3	Pleasants
41	Bens Run	BENRUN	39 22' 30"	-081 00' 00"	39081-D1	Tyler, Pleasants

#	QuadName	Six_Let_Abbr	Latitude	Longitude	USGS_QD_ID	Counties
42	Bentree	BENTRE	38 15' 00"	-081 07' 30"	38081-C2	Clay, Kanawha, Nicholas, Fayette
43	Bergoo	BERGOO	38 22' 30"	-080 15' 00"	38080-D3	Pocahontas, Webster
44	Bergton	BERGTO	38 45' 00"	-078 52' 30"	38078-G8	Hardy
45	Berlin	BERLIN	39 00' 00"	-080 15' 00"	39080-A3	Harrison, Lewis, Upshur
46	Berryville	BERRYV	39 07' 30"	-077 52' 30"	39077-B8	Jefferson
47	Bethany	BETHAN	40 07' 30"	-080 30' 00"	40080-B5	Brooke, Ohio
48	Beverly East	BEVEAS	38 45' 00"	-079 45' 00"	38079-G7	Randolph
49	Beverly West	BEVWES	38 45' 00"	-079 52' 30"	38079-G8	Randolph
50	Big Chimney	BIGCHI	38 22' 30"	-081 30' 00"	38081-D5	Kanawha
51	Big Creek	BIGCRE	38 00' 00"	-082 00' 00"	38082-A1	Lincoln, Logan
52	Big Isaac	BIGISA	39 07' 30"	-080 30' 00"	39080-B5	Harrison, Doddridge, Lewis
53	Big Pool	BIGPOO	39 30' 00"	-078 00' 00"	39078-E1	Morgan, Berkeley
54	Big Run	BIGRUN	39 30' 00"	-080 30' 00"	39080-E5	Wetzel
55	Blacksville	BLACKS	39 37' 30"	-080 07' 30"	39080-F2	Monongalia
56	Blackwater Falls	BLAFAL	39 00' 00"	-079 22' 30"	39079-A4	Tucker
57	Blackbird Knob	BLAKNO	39 00' 00"	-079 15' 00"	39079-A3	Grant, Tucker
58	Blue Creek	BLUCRE	38 22' 30"	-081 22' 30"	38081-D4	Kanawha
59	Bluefield	BLUEFI	37 15' 00"	-081 07' 30"	37081-C2	Mercer
60	Bowden	BOWDEN	38 52' 30"	-079 37' 30"	38079-H6	Randolph
61	Bradshaw	BRADSH	37 15' 00"	-081 45' 00"	37081-C7	McDowell
62	Bramwell	BRAMWE	37 15' 00"	-081 15' 00"	37081-C3	Mercer, McDowell
63	Branchland	BRANCH	38 07' 30"	-082 07' 30"	38082-B2	Cabell, Lincoln
64	Brandonville	BRANDO	39 37' 30"	-079 30' 00"	39079-F5	Preston
65	Brandywine	BRANDY	38 30' 00"	-079 07' 30"	38079-E2	Pendleton
66	Brownton	BROWNT	39 07' 30"	-080 07' 30"	39080-B2	Harrison, Taylor, Barbour
67	Bruceton Mills	BRUMIL	39 37' 30"	-079 37' 30"	39079-F6	Preston
68	Buckhannon	BUCKHA	38 52' 30"	-080 07' 30"	38080-H2	Upshur
69	Burnt House	BURHOU	39 00' 00"	-080 52' 30"	39080-A8	Ritchie, Gilmer
70	Burlington	BURLIN	39 15' 00"	-078 52' 30"	39078-C8	Mineral, Hampshire
71	Burnaugh	BURNAU	38 15' 00"	-082 30' 00"	38082-C5	Wayne
72	Burnsville	BURNSV	38 45' 00"	-080 37' 30"	38080-G6	Gilmer, Braxton
73	Burning Springs	BURSPR	38 52' 30"	-081 15' 00"	38081-H3	Wirt, Calhoun, Roane
74	Businessburg	BUSINE	39 52' 30"	-080 45' 00"	39080-H7	Marshall
75	Cairo	CAIROX	39 07' 30"	-081 07' 30"	39081-B2	Ritchie
76	Camden	CAMDEN	39 00' 00"	-080 30' 00"	39080-A5	Lewis
77	Cameron	CAMERO	39 45' 00"	-080 30' 00"	39080-G5	Marshall
78	Camden On Gauley	CAONGA	38 15' 00"	-080 30' 00"	38080-C5	Webster, Nicholas
79	Capon Bridge	CAPBRI	39 15' 00"	-078 22' 30"	39078-C4	Hampshire
80	Capon Springs	CAPSPR	39 07' 30"	-078 22' 30"	39078-B4	Hampshire
81	Cassity	CASSIT	38 45' 00"	-080 00' 00"	38080-G1	Randolph, Upshur
82	Cass	CASSXX	38 22' 30"	-079 52' 30"	38079-D8	Randolph, Pocahontas
83	Catlettsburg	CATLET	38 22' 30"	-082 30' 00"	38082-D5	Cabell, Wayne
84	Cedarville	CEDARV	38 45' 00"	-080 45' 00"	38080-G7	Gilmer, Braxton
85	Cedar Grove	CEDGRO	38 07' 30"	-081 22' 30"	38081-B4	Kanawha
86	Center Point	CENPOI	39 22' 30"	-080 37' 30"	39080-D6	Wetzel, Tyler, Doddridge
87	Century	CENTUR	39 00' 00"	-080 07' 30"	39080-A2	Harrison, Barbour, Upshur
88	Charleston East	CHAEAS	38 15' 00"	-081 30' 00"	38081-C5	Kanawha
89	Chapmanville	CHAPMA	37 52' 30"	-082 00' 00"	37082-H1	Lincoln, Logan, Mingo

#	QuadName	Six_Let_Abbr	Latitude	Longitude	USGS_QD_ID	Counties
90	Charles Town	CHATOW	39 15' 00"	-077 45' 00"	39077-C7	Jefferson
91	Charleston West	CHAWES	38 15' 00"	-081 37' 30"	38081-C6	Kanawha
92	Cherry Run	CHERUN	39 37' 30"	-078 00' 00"	39078-F1	Morgan
93	Cheshire	CHESHI	38 52' 30"	-082 00' 00"	38082-H1	Mason
94	Chester	CHESTE	39 00' 00"	-081 52' 30"	39081-A8	Mason
95	Chloe	CHLOEX	38 37' 30"	-081 00' 00"	38081-F1	Gilmer, Calhoun, Roane, Braxton, Clay
96	Circleville	CIRCLE	38 37' 30"	-079 22' 30"	38079-F4	Pendleton
97	Clarksburg	CLARKS	39 15' 00"	-080 15' 00"	39080-C3	Harrison
98	Clay	CLAYXX	38 22' 30"	-081 00' 00"	38081-D1	Clay
99	Clendenin	CLENDE	38 22' 30"	-081 15' 00"	38081-D3	Clay, Kanawha
100	Clio	CLIOXX	38 30' 00"	-081 15' 00"	38081-E3	Roane, Kanawha
101	Clover Lick	CLOLIC	38 15' 00"	-079 52' 30"	38079-C8	Pocahontas
102	Clothier	CLOTHI	37 52' 30"	-081 45' 00"	37081-H7	Boone, Logan
103	Colebank	COLEBA	39 07' 30"	-079 45' 00"	39079-B7	Preston, Barbour, Tucker
104	Coolville	COOLVI	39 07' 30"	-081 45' 00"	39081-B7	Wood
105	Corliss	CORLIS	38 00' 00"	-080 45' 00"	38080-A7	Nicholas, Greenbrier, Fayette
106	Cornstalk	CORNST	37 52' 30"	-080 30' 00"	37080-H5	Greenbrier
107	Cottageville	COTTAG	38 45' 00"	-081 45' 00"	38081-G7	Jackson, Mason
108	Cowen	COWENX	38 22' 30"	-080 30' 00"	38080-D5	Webster
109	Cow Knob	COWKNO	38 37' 30"	-079 00' 00"	38079-F1	Pendleton
110	Craigsville	CRAIGS	38 15' 00"	-080 37' 30"	38080-C6	Webster, Nicholas
111	Crab Orchard	CRAORC	37 37' 30"	-081 07' 30"	37081-F2	Raleigh
112	Craig Springs	CRASPR	37 22' 30"	-080 15' 00"	37080-D3	Monroe
113	Cresaptown	CRESAP	39 30' 00"	-078 45' 00"	39078-E7	Mineral
114	Crumpler	CRUMPL	37 22' 30"	-081 15' 00"	37081-D3	Wyoming, Mercer, McDowell
115	Cumberland	CUMBER	39 37' 30"	-078 45' 00"	39078-F7	Mineral
116	Cuzzart	CUZZAR	39 30' 00"	-079 30' 00"	39079-E5	Preston
117	Danese	DANESE	37 52' 30"	-080 52' 30"	37080-H8	Fayette
118	Davis	DAVISX	39 07' 30"	-079 22' 30"	39079-B4	Preston, Grant, Tucker
119	Davy	DAVYXX	37 22' 30"	-081 37' 30"	37081-D6	Wyoming, McDowell
120	Dawson	DAWSON	37 45' 00"	-080 37' 30"	37080-G6	Greenbrier, Fayette, Summers
121	Delbarton	DELBAR	37 37' 30"	-082 07' 30"	37082-F2	Mingo
122	Denmar	DENMAR	38 00' 00"	-080 07' 30"	38080-A2	Pocahontas, Greenbrier
123	Diana	DIANAX	38 30' 00"	-080 22' 30"	38080-E4	Webster
124	Doe Hill	DOEHIL	38 22' 30"	-079 22' 30"	38079-D4	Pendleton
125	Dorothy	DOROTH	37 52' 30"	-081 22' 30"	37081-H4	Kanawha, Fayette, Boone, Raleigh
126	Droop	DROOPX	38 00' 00"	-080 15' 00"	38080-A3	Pocahontas, Greenbrier
127	Duo	DUOXXX	38 00' 00"	-080 30' 00"	38080-A5	Greenbrier
128	Durbin	DURBIN	38 30' 00"	-079 45' 00"	38079-E7	Randolph, Pocahontas
129	East Liverpool North	EALINO	40 37' 30"	-080 30' 00"	40080-F5	Hancock
130	East Liverpool South	EALISO	40 30' 00"	-080 30' 00"	40080-E5	Hancock
131	Eccles	ECCLES	37 45' 00"	-081 15' 00"	37081-G3	Raleigh
132	Edray	EDRAYX	38 15' 00"	-080 00' 00"	38080-C1	Pocahontas
133	Elizabeth	ELIZAB	39 00' 00"	-081 22' 30"	39081-A4	Wood, Wirt
134	Elkhurst	ELKHUR	38 22' 30"	-081 07' 30"	38081-D2	Clay, Kanawha
135	Elkins	ELKINS	38 52' 30"	-079 45' 00"	38079-H7	Randolph

#	QuadName	Six_Let_Abbr	Latitude	Longitude	USGS_QD_ID	Counties
136	Ellamore	ELLAMO	38 52' 30"	-080 00' 00"	38080-H1	Barbour, Randolph, Upshur
137	Ellenboro	ELLENB	39 15' 00"	-081 00' 00"	39081-C1	Tyler, Pleasants, Ritchie
138	Elmwood	ELMWO	38 37' 30"	-081 45' 00"	38081-F7	Jackson, Mason, Putnam
139	Erbacon	ERBACO	38 30' 00"	-080 30' 00"	38080-E5	Braxton, Webster
140	Eskdale	ESKDAL	38 00' 00"	-081 22' 30"	38081-A4	Kanawha, Boone
141	Evitts Creek	EVICRE	39 37' 30"	-078 37' 30"	39078-F6	Mineral
142	Fairmont East	FAIEAS	39 22' 30"	-080 00' 00"	39080-D1	Monongalia, Marion, Taylor
143	Fairmont West	FAIWES	39 22' 30"	-080 07' 30"	39080-D2	Marion, Harrison, Taylor
144	Fallsburg	FALLSB	38 07' 30"	-082 37' 30"	38082-B6	Wayne
145	Falling Spring	FALSPR	37 52' 30"	-079 52' 30"	37079-H8	Greenbrier
146	Fayetteville	FAYETT	38 00' 00"	-081 00' 00"	38081-A1	Fayette
147	Fellowsville	FELLOW	39 15' 00"	-079 45' 00"	39079-C7	Preston, Barbour, Tucker
148	Flat Top	FLATOP	37 30' 00"	-081 00' 00"	37081-E1	Raleigh, Summers, Mercer
149	Folsom	FOLSOM	39 22' 30"	-080 30' 00"	39080-D5	Wetzel, Tyler, Harrison, Doddridge
150	Forest Hill	FORHIL	37 30' 00"	-080 45' 00"	37080-E7	Summers, Monroe
151	Fork Mountain	FORMOU	38 07' 30"	-080 22' 30"	38080-B4	Webster, Nicholas, Greenbrier
152	Fort Seybert	FORSEY	38 37' 30"	-079 07' 30"	38079-F2	Pendleton
153	Fort Spring	FORSPR	37 37' 30"	-080 30' 00"	37080-F5	Greenbrier, Monroe
154	Franklin	FRANKL	38 37' 30"	-079 15' 00"	38079-F3	Pendleton
155	Friendsville	FRIEND	39 37' 30"	-079 22' 30"	39079-F4	Preston
156	Gallipolis	GALLIP	38 45' 00"	-082 07' 30"	38082-G2	Mason
157	Gap Mills	GAPMIL	37 30' 00"	-080 22' 30"	37080-E4	Monroe
158	Garretts Bend	GARBEN	38 15' 00"	-081 52' 30"	38081-C8	Putnam, Kanawha, Lincoln
159	Gary	GARYXX	37 15' 00"	-081 30' 00"	37081-C5	McDowell
160	Gassaway	GASSAW	38 37' 30"	-080 45' 00"	38080-F7	Braxton
161	Gauley Bridge	GAUBRI	38 07' 30"	-081 07' 30"	38081-B2	Kanawha, Nicholas, Fayette
162	Gay	GAYXXX	38 45' 00"	-081 30' 00"	38081-G5	Jackson, Roane
163	Gilbert	GILBER	37 30' 00"	-081 45' 00"	37081-E7	Mingo, Wyoming, McDowell
164	Gilboa	GILBOA	38 15' 00"	-080 52' 30"	38080-C8	Clay, Nicholas
165	Gilmer	GILMER	38 52' 30"	-080 37' 30"	38080-H6	Lewis, Gilmer, Braxton
166	Girta	GIRTAX	39 00' 00"	-081 15' 00"	39081-A3	Ritchie, Wirt
167	Glace	GLACEX	37 37' 30"	-080 15' 00"	37080-F3	Greenbrier, Monroe
168	Gladesville	GLADES	39 22' 30"	-079 52' 30"	39079-D8	Preston, Monongalia, Marion, Taylor
169	Glady	GLADYX	38 45' 00"	-079 37' 30"	38079-G6	Randolph
170	Glen Easton	GLEEAS	39 45' 00"	-080 37' 30"	39080-G6	Marshall
171	Glengary	GLENGA	39 22' 30"	-078 07' 30"	39078-D2	Morgan, Berkeley
172	Glenville	GLENVI	38 52' 30"	-080 45' 00"	38080-H7	Gilmer
173	Glenwood	GLENWO	38 30' 00"	-082 07' 30"	38082-E2	Mason, Cabell
174	Glover Gap	GLOGAP	39 30' 00"	-080 22' 30"	39080-E4	Wetzel, Marion
175	Gore	GOREXX	39 15' 00"	-078 15' 00"	39078-C3	Hampshire
176	Gorman	GORMAN	39 15' 00"	-079 15' 00"	39079-C3	Mineral, Grant
177	Goshen	GOSHEN	38 37' 30"	-080 15' 00"	38080-F3	Randolph, Upshur, Webster
178	Grafton	GRAFTO	39 15' 00"	-080 00' 00"	39080-C1	Taylor, Barbour
179	Grantsville	GRANTS	38 52' 30"	-081 00' 00"	38081-H1	Gilmer, Calhoun
180	Grant Town	GRATOW	39 30' 00"	-080 07' 30"	39080-E2	Monongalia, Marion
181	Green Bank	GREBAN	38 22' 30"	-079 45' 00"	38079-D7	Pocahontas
182	Great Cacapon	GRECAC	39 30' 00"	-078 15' 00"	39078-E3	Morgan

#	QuadName	Six_Let_Abbr	Latitude	Longitude	USGS_QD_ID	Counties
183	Greenville	GREENV	37 30' 00"	-080 37' 30"	37080-E6	Summers, Monroe
184	Greenland Gap	GREGAP	39 07' 30"	-079 07' 30"	39079-B2	Grant
185	Griffithsville	GRIFFI	38 07' 30"	-081 52' 30"	38081-B8	Lincoln, Boone
186	Hacker Valley	HACVAL	38 37' 30"	-080 22' 30"	38080-F4	Lewis, Upshur, Braxton, Webster
187	Hager	HAGERX	38 07' 30"	-082 00' 00"	38082-B1	Lincoln
188	Hamlin	HAMLIN	38 15' 00"	-082 00' 00"	38082-C1	Putnam, Cabell, Lincoln
189	Hancock	HANCOC	39 37' 30"	-078 07' 30"	39078-F2	Morgan
190	Hanging Rock	HANROC	39 15' 00"	-078 30' 00"	39078-C5	Hampshire
191	Harpers Ferry	HARFER	39 15' 00"	-077 37' 30"	39077-C6	Jefferson
192	Harman	HARMAN	38 52' 30"	-079 30' 00"	38079-H5	Tucker, Randolph, Pendleton
193	Harrisville	HARRIS	39 07' 30"	-081 00' 00"	39081-B1	Ritchie
194	Headsville	HEADSV	39 22' 30"	-078 45' 00"	39078-D7	Mineral, Hampshire
195	Hedgesville	HEDGES	39 30' 00"	-077 52' 30"	39077-E8	Berkeley
196	Henlawson	HENLAW	37 52' 30"	-081 52' 30"	37081-H8	Boone, Logan
197	Herold	HEROLD	38 30' 00"	-080 45' 00"	38080-E7	Braxton, Clay, Nicholas
198	Hightown	HIGHTO	38 22' 30"	-079 37' 30"	38079-D6	Pocahontas
199	Hillsboro	HILLSB	38 07' 30"	-080 07' 30"	38080-B2	Pocahontas
200	Hinton	HINTON	37 37' 30"	-080 52' 30"	37080-F8	Raleigh, Summers
201	Holden	HOLDEN	37 45' 00"	-082 00' 00"	37082-G1	Logan, Mingo
202	Hopeville	HOPEVI	38 52' 30"	-079 15' 00"	38079-H3	Grant, Tucker, Randolph, Pendleton
203	Hundred	HUNDRE	39 37' 30"	-080 22' 30"	39080-F4	Monongalia, Wetzell, Marion
204	Huntington	HUNTIN	38 22' 30"	-082 22' 30"	38082-D4	Cabell, Wayne
205	Hurricane	HURRIC	38 22' 30"	-082 00' 00"	38082-D1	Mason, Putnam, Cabell, Lincoln
206	laeger	IAEGER	37 22' 30"	-081 45' 00"	37081-D7	McDowell
207	Interior	INTERI	37 22' 30"	-080 30' 00"	37080-D5	Monroe
208	Inwood	INWOOD	39 15' 00"	-078 00' 00"	39078-C1	Berkeley, Jefferson
209	Ivydale	IVYDAL	38 30' 00"	-081 00' 00"	38081-E1	Calhoun, Roane, Clay
210	Jerrys Run	JERRUN	37 45' 00"	-080 07' 30"	37080-G2	Greenbrier
211	Julian	JULIAN	38 07' 30"	-081 45' 00"	38081-B7	Kanawha, Lincoln, Boone
212	Junior	JUNIOR	38 52' 30"	-079 52' 30"	38079-H8	Barbour, Randolph
213	Kanawha	KANAWH	39 07' 30"	-081 22' 30"	39081-B4	Wood, Wirt
214	Keedysville	KEEDYS	39 22' 30"	-077 37' 30"	39077-D6	Jefferson
215	Kenna	KENNAX	38 37' 30"	-081 37' 30"	38081-F6	Jackson, Putnam, Kanawha
216	Kentuck	KENTUC	38 37' 30"	-081 30' 00"	38081-F5	Jackson, Roane
217	Kermit	KERMIT	37 45' 00"	-082 22' 30"	37082-G4	Wayne, Mingo
218	Kettle	KETTLE	38 30' 00"	-081 22' 30"	38081-E4	Roane, Kanawha
219	Keyser	KEYSER	39 22' 30"	-078 52' 30"	39078-D8	Mineral
220	Keystone	KEYSTO	37 22' 30"	-081 22' 30"	37081-D4	Wyoming, McDowell
221	Kiahsville	KIAHSV	38 00' 00"	-082 15' 00"	38082-A3	Wayne, Lincoln
222	Kingwood	KINGWO	39 22' 30"	-079 37' 30"	39079-D6	Preston
223	Kitzmilller	KITZMI	39 22' 30"	-079 07' 30"	39079-D2	Mineral
224	Knoxville	KNOXVI	40 22' 30"	-080 37' 30"	40080-D6	Hancock, Brooke
225	Lake Lynn	LAKLYN	39 37' 30"	-079 45' 00"	39079-F7	Preston, Monongalia
226	Lake Sherwood	LAKSHE	38 00' 00"	-080 00' 00"	38080-A1	Pocahontas, Greenbrier
227	Laneville	LANEVI	38 52' 30"	-079 22' 30"	38079-H4	Tucker, Randolph, Pendleton
228	Largent	LARGEN	39 22' 30"	-078 22' 30"	39078-D4	Morgan, Hampshire
229	Lavalette	LAVALE	38 15' 00"	-082 22' 30"	38082-C4	Cabell, Wayne

#	QuadName	Six_Let_Abbr	Latitude	Longitude	USGS_QD_ID	Counties
230	Lead Mine	LEAMIN	39 07' 30"	-079 30' 00"	39079-B5	Preston, Tucker
231	Lerona	LERONA	37 22' 30"	-080 52' 30"	37080-D8	Summers, Mercer
232	Lester	LESTER	37 37' 30"	-081 15' 00"	37081-F3	Raleigh, Wyoming
233	Levels	LEVELS	39 22' 30"	-078 30' 00"	39078-D5	Hampshire
234	Lewisburg	LEWISB	37 45' 00"	-080 22' 30"	37080-G4	Greenbrier
235	Lindside	LINDSI	37 22' 30"	-080 37' 30"	37080-D6	Monroe
236	Little Birch	LITBIR	38 30' 00"	-080 37' 30"	38080-E6	Braxton, Webster, Nicholas
237	Little Hocking	LITHOC	39 15' 00"	-081 37' 30"	39081-C6	Wood
238	Littleton	LITTLE	39 37' 30"	-080 30' 00"	39080-F5	Marshall, Wetzel
239	Liverpool	LIVERP	38 52' 30"	-081 30' 00"	38081-H5	Wirt, Jackson, Roane
240	Lobelia	LOBELI	38 07' 30"	-080 15' 00"	38080-B3	Pocahontas, Webster, Greenbrier
241	Lockwood	LOCKWO	38 15' 00"	-081 00' 00"	38081-C1	Clay, Nicholas
242	Logan	LOGANX	37 45' 00"	-081 52' 30"	37081-G8	Logan
243	Lonaconing	LONACO	39 30' 00"	-078 52' 30"	39078-E8	Mineral
244	Looneyville	LOONEY	38 37' 30"	-081 15' 00"	38081-F3	Roane
245	Lorado	LORADO	37 45' 00"	-081 37' 30"	37081-G6	Boone, Logan, Wyoming
246	Lost River State Park	LORIST	38 52' 30"	-078 52' 30"	38078-H8	Hardy
247	Lost City	LOSCIT	38 52' 30"	-078 45' 00"	38078-H7	Hardy
248	Louisa	LOUISA	38 00' 00"	-082 30' 00"	38082-A5	Wayne
249	Lubeck	LUBECK	39 07' 30"	-081 37' 30"	39081-B6	Wood
250	MacFarlan	MACFAR	39 00' 00"	-081 07' 30"	39081-A2	Ritchie, Wirt, Calhoun
251	Madison	MADISO	38 00' 00"	-081 45' 00"	38081-A7	Boone
252	Majestic	MAJEST	37 30' 00"	-082 00' 00"	37082-E1	Mingo
253	Majorsville	MAJORS	39 52' 30"	-080 30' 00"	39080-H5	Marshall
254	Mallory	MALLOR	37 37' 30"	-081 45' 00"	37081-F7	Logan, Mingo, Wyoming
255	Mammoth	MAMMOT	38 15' 00"	-081 15' 00"	38081-C3	Clay, Kanawha
256	Mannington	MANNIN	39 30' 00"	-080 15' 00"	39080-E3	Monongalia, Marion
257	Man	MANXXX	37 37' 30"	-081 52' 30"	37081-F8	Logan, Mingo
258	Marietta	MARIET	39 22' 30"	-081 22' 30"	39081-D4	Wood
259	Marlinton	MARLIN	38 07' 30"	-080 00' 00"	38080-B1	Pocahontas
260	Martinsburg	MARTIN	39 22' 30"	-077 52' 30"	39077-D8	Berkeley, Jefferson
261	Masontown	MASONT	39 30' 00"	-079 45' 00"	39079-E7	Preston, Monongalia
262	Matewan	MATEWA	37 30' 00"	-082 07' 30"	37082-E2	Mingo
263	Matheny	MATHEN	37 37' 30"	-081 30' 00"	37081-F5	Wyoming
264	Matoaka	MATOAK	37 22' 30"	-081 07' 30"	37081-D2	Mercer
265	Maysville	MAYSVI	39 00' 00"	-079 07' 30"	39079-A2	Grant
266	McGraws	MCGRAW	37 37' 30"	-081 22' 30"	37081-F4	Raleigh, Wyoming
267	Meadow Bridge	MEABRI	37 45' 00"	-080 45' 00"	37080-G7	Greenbrier, Fayette, Summers
268	Meadow Creek	MEACRE	37 45' 00"	-080 52' 30"	37080-G8	Fayette, Raleigh, Summers
269	Medley	MEDLEY	39 07' 30"	-079 00' 00"	39079-B1	Mineral, Grant, Hardy
270	Middlebourne	MIDBOU	39 22' 30"	-080 52' 30"	39080-D8	Tyler, Ritchie
271	Middleway	MIDWAY	39 15' 00"	-077 52' 30"	39077-C8	Berkeley, Jefferson
272	Milam	MILAMX	38 45' 00"	-079 00' 00"	38079-G1	Grant, Hardy, Pendleton
273	Mill Creek	MILCRE	38 37' 30"	-079 52' 30"	38079-F8	Randolph
274	Millstone	MILLST	38 45' 00"	-081 00' 00"	38081-G1	Gilmer, Calhoun
275	Milo	MILOXX	37 52' 30"	-082 30' 00"	37082-H5	Wayne
276	Milton	MILTON	38 22' 30"	-082 07' 30"	38082-D2	Cabell

#	QuadName	Six_Let_Abbr	Latitude	Longitude	USGS_QD_ID	Counties
277	Mingo	MINGOX	38 22' 30"	-080 00' 00"	38080-D1	Randolph, Pocahontas
278	Minnehaha Springs	MINSPR	38 07' 30"	-079 52' 30"	38079-B8	Pocahontas
279	Moatstown	MOATST	38 30' 00"	-079 22' 30"	38079-E4	Pendleton
280	Monterey	MONTER	38 22' 30"	-079 30' 00"	38079-D5	Pendleton
281	Montgomery	MONTGO	38 07' 30"	-081 15' 00"	38081-B3	Kanawha, Fayette
282	Montrose	MONTRO	39 00' 00"	-079 45' 00"	39079-A7	Barbour, Tucker, Randolph
283	Moorefield	MOOREF	39 00' 00"	-078 52' 30"	39078-A8	Hardy
284	Morgantown North	MORNOR	39 37' 30"	-079 52' 30"	39079-F8	Monongalia
285	Morgantown South	MORSOU	39 30' 00"	-079 52' 30"	39079-E8	Preston, Monongalia
286	Mount Storm Lake	MOSTLA	39 07' 30"	-079 15' 00"	39079-B3	Grant, Tucker
287	Mount Alto	MOUALT	38 45' 00"	-081 52' 30"	38081-G8	Jackson, Mason
288	Mount Clare	MOUCLA	39 07' 30"	-080 15' 00"	39080-B3	Harrison
289	Mountain Falls	MOUFAL	39 00' 00"	-078 22' 30"	39078-A4	Hampshire
290	Mountain Grove	MOUGRO	38 00' 00"	-079 52' 30"	38079-A8	Pocahontas, Greenbrier
291	Moundsville	MOUNDS	39 52' 30"	-080 37' 30"	39080-H6	Marshall
292	Mount Nebo	MOUNEB	38 07' 30"	-080 45' 00"	38080-B7	Nicholas
293	Mount Olive	MOUOLI	38 30' 00"	-082 00' 00"	38082-E1	Mason, Putnam, Cabell
294	Mount Storm	MOUSTO	39 15' 00"	-079 07' 30"	39079-C2	Mineral, Grant
295	Mozer	MOZERX	38 45' 00"	-079 07' 30"	38079-G2	Grant, Hardy, Pendleton
296	Mozark Mountain	MOZMOU	39 00' 00"	-079 30' 00"	39079-A5	Tucker, Randolph
297	Mud	MUDXXX	38 00' 00"	-081 52' 30"	38081-A8	Lincoln, Boone, Logan
298	Mullens	MULLEN	37 30' 00"	-081 22' 30"	37081-E4	Wyoming
299	Mustoe	MUSTOE	38 15' 00"	-079 37' 30"	38079-C6	Pocahontas
300	Myrtle	MYRTLE	37 45' 00"	-082 07' 30"	37082-G2	Logan, Mingo
301	Narrows	NARROW	37 15' 00"	-080 45' 00"	37080-C7	Monroe, Mercer
302	Naugatuck	NAUGAT	37 45' 00"	-082 15' 00"	37082-G3	Mingo
303	Needmore	NEEDMO	39 00' 00"	-078 45' 00"	39078-A7	Hardy
304	Nestlow	NESTLO	38 07' 30"	-082 15' 00"	38082-B3	Cabell, Wayne, Lincoln
305	Nestorville	NESTOR	39 07' 30"	-079 52' 30"	39079-B8	Barbour
306	Nettie	NETTIE	38 07' 30"	-080 37' 30"	38080-B6	Nicholas, Greenbrier
307	Newburg	NEWBUR	39 22' 30"	-079 45' 00"	39079-D7	Preston
308	New Haven	NEWHAV	38 52' 30"	-081 52' 30"	38081-H8	Jackson, Mason
309	New Martinsville	NEWMAR	39 37' 30"	-080 45' 00"	39080-F7	Marshall, Wetzel
310	New Matamoras	NEWMAT	39 30' 00"	-081 00' 00"	39081-E1	Tyler
311	New Milton	NEWMIL	39 07' 30"	-080 37' 30"	39080-B6	Doddridge, Lewis
312	Newton	NEWTON	38 30' 00"	-081 07' 30"	38081-E2	Roane, Clay, Kanawha
313	Newville	NEWVIL	38 37' 30"	-080 30' 00"	38080-F5	Braxton, Webster
314	Normantown	NORMAN	38 45' 00"	-080 52' 30"	38080-G8	Gilmer, Calhoun, Braxton
315	Oak Hill	OAKHIL	37 52' 30"	-081 07' 30"	37081-H2	Fayette, Raleigh
316	Oakland	OAKLAN	39 22' 30"	-079 22' 30"	39079-D4	Preston
317	Oakvale	OAKVAL	37 15' 00"	-080 52' 30"	37080-C8	Mercer
318	Oceana	OCEANA	37 37' 30"	-081 37' 30"	37081-F6	Logan, Wyoming
319	Odd	ODDXXX	37 30' 00"	-081 07' 30"	37081-E2	Raleigh, Wyoming, Mercer
320	Old Fields	OLDFIE	39 07' 30"	-078 52' 30"	39078-B8	Mineral, Hampshire, Grant, Hardy
321	Oldtown	OLDTOW	39 30' 00"	-078 30' 00"	39078-E5	Hampshire
322	Onego	ONEGOX	38 45' 00"	-079 22' 30"	38079-G4	Pendleton
323	Orkney Springs	ORKSPR	38 45' 00"	-078 45' 00"	38078-G7	Hardy
324	Orlando	ORLAND	38 45' 00"	-080 30' 00"	38080-G5	Lewis, Braxton

#	QuadName	Six_Let_Abbr	Latitude	Longitude	USGS_QD_ID	Counties
325	Osage	OSAGEX	39 37' 30"	-080 00' 00"	39080-F1	Monongalia
326	Oxford	OXFORD	39 07' 30"	-080 45' 00"	39080-B7	Doddridge, Ritchie
327	Paden City	PADCIT	39 30' 00"	-080 52' 30"	39080-E8	Wetzel, Tyler
328	Paddy Knob	PADKNO	38 15' 00"	-079 45' 00"	38079-C7	Pocahontas
329	Paint Bank	PAIBAN	37 30' 00"	-080 15' 00"	37080-E3	Monroe
330	Palo Alto	PALALT	38 22' 30"	-079 15' 00"	38079-D3	Pendleton
331	Panther	PANTHE	37 22' 30"	-081 52' 30"	37081-D8	McDowell
332	Parkersburg	PARKER	39 15' 00"	-081 30' 00"	39081-C5	Wood
333	Parsons	PARSON	39 00' 00"	-079 37' 30"	39079-A6	Tucker, Randolph
334	Patterson Creek	PATCRE	39 30' 00"	-078 37' 30"	39078-E6	Mineral, Hampshire
335	Patterson	PATTER	37 15' 00"	-081 52' 30"	37081-C8	McDowell
336	Paw Paw	PAWPAW	39 30' 00"	-078 22' 30"	39078-E4	Morgan, Hampshire
337	Pax	PAXXXX	37 52' 30"	-081 15' 00"	37081-H3	Kanawha, Fayette, Raleigh
338	Peniel	PENIEL	38 45' 00"	-081 22' 30"	38081-G4	Roane
339	Pennsboro	PENNSB	39 15' 00"	-080 52' 30"	39080-C8	Tyler, Doddridge, Ritchie
340	Petersburg East	PETEAS	38 52' 30"	-079 00' 00"	38079-H1	Grant, Hardy
341	Petroleum	PETROL	39 07' 30"	-081 15' 00"	39081-B3	Wood, Ritchie, Wirt
342	Peterson	PETSON	38 52' 30"	-080 30' 00"	38080-H5	Lewis, Gilmer, Braxton
343	Peterstown	PETTOW	37 22' 30"	-080 45' 00"	37080-D7	Summers, Monroe, Mercer
344	Petersburg West	PETWES	38 52' 30"	-079 07' 30"	38079-H2	Grant, Pendleton
345	Philippi	PHILIP	39 07' 30"	-080 00' 00"	39080-B1	Taylor, Barbour
346	Pickens	PICKEN	38 37' 30"	-080 07' 30"	38080-F2	Randolph, Upshur, Webster
347	Pilot Knob	PILKNO	37 45' 00"	-081 30' 00"	37081-G5	Boone, Logan, Raleigh, Wyoming
348	Pineville	PINEVI	37 30' 00"	-081 30' 00"	37081-E5	Wyoming, McDowell
349	Pine Grove	PINGRO	39 30' 00"	-080 37' 30"	39080-E6	Wetzel, Tyler
350	Pipestem	PIPEST	37 30' 00"	-080 52' 30"	37080-E8	Summers, Mercer
351	Pocatalico	POCATA	38 22' 30"	-081 37' 30"	38081-D6	Putnam, Kanawha
352	Pomeroy	POMERO	39 00' 00"	-082 00' 00"	39082-A1	Mason
353	Pond Creek	PONCRE	39 00' 00"	-081 37' 30"	39081-A6	Wood, Jackson
354	Porters Falls	PORFAL	39 30' 00"	-080 45' 00"	39080-E7	Wetzel, Tyler
355	Portland	PORTLA	39 00' 00"	-081 45' 00"	39081-A7	Jackson
356	Potts Creek	POTCRE	37 30' 00"	-080 07' 30"	37080-E2	Monroe
357	Powellton	POWELL	38 00' 00"	-081 15' 00"	38081-A3	Kanawha, Fayette
358	Powhatan Point	POWPOI	39 45' 00"	-080 45' 00"	39080-G7	Marshall
359	Prichard	PRICHA	38 07' 30"	-082 30' 00"	38082-B5	Wayne
360	Prince	PRINCE	37 45' 00"	-081 00' 00"	37081-G1	Fayette, Raleigh
361	Princeton	PRITON	37 15' 00"	-081 00' 00"	37081-C1	Mercer
362	Pullman	PULLMA	39 07' 30"	-080 52' 30"	39080-B8	Doddridge, Ritchie
363	Quick	QUICKX	38 15' 00"	-081 22' 30"	38081-C4	Kanawha
364	Quinwood	QUINWO	38 00' 00"	-080 37' 30"	38080-A6	Nicholas, Greenbrier
365	Racine	RACINE	38 07' 30"	-081 37' 30"	38081-B6	Kanawha, Boone
366	Radnor	RADNOR	38 00' 00"	-082 22' 30"	38082-A4	Wayne
367	Rainelle	RAINEL	37 52' 30"	-080 45' 00"	37080-H7	Greenbrier, Fayette
368	Ranger	RANGER	38 00' 00"	-082 07' 30"	38082-A2	Wayne, Lincoln
369	Ravenswood	RAVENS	38 52' 30"	-081 45' 00"	38081-H7	Jackson
370	Raven Rock	RAVROC	39 22' 30"	-081 07' 30"	39081-D2	Pleasants
371	Reddish Knob	REDKNO	38 22' 30"	-079 07' 30"	38079-D2	Pendleton
372	Reedy	REEDYX	38 52' 30"	-081 22' 30"	38081-H4	Wirt, Roane

#	QuadName	Six_Let_Abbr	Latitude	Longitude	USGS_QD_ID	Counties
373	Rhodell	RHODEL	37 30' 00"	-081 15' 00"	37081-E3	Raleigh, Wyoming, Mercer
374	Richwood	RICHWO	38 07' 30"	-080 30' 00"	38080-B5	Nicholas, Greenbrier
375	Ridge	RIDGEX	39 22' 30"	-078 15' 00"	39078-D3	Morgan, Hampshire
376	Rig	RIGXXX	39 00' 00"	-079 00' 00"	39079-A1	Grant, Hardy
377	Rio	RIOXXX	39 07' 30"	-078 37' 30"	39078-B6	Hampshire, Hardy
378	Ripley	RIPLEY	38 45' 00"	-081 37' 30"	38081-G6	Jackson
379	Rivesville	RIVESV	39 30' 00"	-080 00' 00"	39080-E1	Monongalia, Marion
380	Roanoke	ROANOK	38 52' 30"	-080 22' 30"	38080-H4	Lewis, Upshur
381	Robertsburg	ROBERT	38 37' 30"	-081 52' 30"	38081-F8	Mason, Putnam
382	Rock Cave	ROCCAV	38 45' 00"	-080 15' 00"	38080-G3	Upshur
383	Rockport	ROCKPO	39 00' 00"	-081 30' 00"	39081-A5	Wood, Wirt, Jackson
384	Romance	ROMANC	38 30' 00"	-081 30' 00"	38081-E5	Jackson, Roane, Kanawha
385	Romney	ROMNEY	39 15' 00"	-078 45' 00"	39078-C7	Mineral, Hampshire
386	Ronceverte	RONCEV	37 37' 30"	-080 22' 30"	37080-F4	Greenbrier, Monroe
387	Rosedale	ROSEDA	38 37' 30"	-080 52' 30"	38080-F8	Gilmer, Calhoun, Braxton, Clay
388	Rosemont	ROSEMO	39 15' 00"	-080 07' 30"	39080-C2	Harrison, Taylor
389	Round Bottom	ROUBOT	39 37' 30"	-080 52' 30"	39080-F8	Wetzel
390	Round Hill	ROUHIL	39 07' 30"	-077 45' 00"	39077-B7	Jefferson
391	Rowlesburg	ROWLES	39 15' 00"	-079 37' 30"	39079-C6	Preston, Tucker
392	Rucker Gap	RUCGAP	37 52' 30"	-080 00' 00"	37080-H1	Greenbrier
393	Rupert	RUPERT	37 52' 30"	-080 37' 30"	37080-H6	Greenbrier
394	Saint Albans	SAIALB	38 22' 30"	-081 45' 00"	38081-D7	Putnam, Kanawha
395	Saint George	SAIGEO	39 07' 30"	-079 37' 30"	39079-B6	Tucker
396	Salem	SALEMX	39 15' 00"	-080 30' 00"	39080-C5	Harrison, Doddridge
397	Samp	SAMPXX	38 30' 00"	-080 07' 30"	38080-E2	Randolph, Webster
398	Sandyville	SANDYV	38 52' 30"	-081 37' 30"	38081-H6	Jackson
399	Sang Run	SANRUN	39 30' 00"	-079 22' 30"	39079-E4	Preston
400	Schultz	SCHULT	39 15' 00"	-081 07' 30"	39081-C2	Pleasants, Wood, Ritchie
401	Scott Depot	SCODEP	38 22' 30"	-081 52' 30"	38081-D8	Putnam, Kanawha
402	Sector	SECTOR	39 07' 30"	-078 45' 00"	39078-B7	Hampshire, Hardy
403	Sharp Knob	SHAKNO	38 22' 30"	-080 07' 30"	38080-D2	Randolph, Pocahontas, Webster
404	Shady Spring	SHASPR	37 37' 30"	-081 00' 00"	37081-F1	Raleigh, Summers
405	Shepherdstown	SHEPHE	39 22' 30"	-077 45' 00"	39077-D7	Berkeley, Jefferson
406	Shinnston	SHINNS	39 22' 30"	-080 15' 00"	39080-D3	Marion, Harrison
407	Shirley	SHIRLE	39 22' 30"	-080 45' 00"	39080-D7	Tyler, Doddridge
408	Sinks of Gandy	SIOFGA	38 37' 30"	-079 37' 30"	38079-F6	Randolph, Pendleton, Pocahontas
409	Sissonville	SISSON	38 30' 00"	-081 37' 30"	38081-E6	Jackson, Putnam, Kanawha
410	Skelt	SKELTX	38 30' 00"	-080 15' 00"	38080-E3	Webster
411	Smithburg	SMITHB	39 15' 00"	-080 37' 30"	39080-C6	Doddridge
412	Smithville	SMITHV	39 00' 00"	-081 00' 00"	39081-A1	Ritchie, Gilmer, Calhoun
413	Snowy Mountain	SNOMOU	38 30' 00"	-079 30' 00"	38079-E5	Pendleton, Pocahontas
414	Snyder Knob	SNYKNO	38 30' 00"	-079 52' 30"	38079-E8	Randolph, Pocahontas
415	South Parkersburg	SOUPAR	39 07' 30"	-081 30' 00"	39081-B5	Wood
416	Spencer	SPENCE	38 45' 00"	-081 15' 00"	38081-G3	Roane
417	Springfield	SPRING	39 22' 30"	-078 37' 30"	39078-D6	Mineral, Hampshire
418	Spruce Knob	SPRKN0	38 37' 30"	-079 30' 00"	38079-F5	Randolph, Pendleton, Pocahontas
419	Steubenville East	STEEAS	40 15' 00"	-080 30' 00"	40080-C5	Brooke
420	Stephenson	STEPHE	39 07' 30"	-078 00' 00"	39078-B1	Jefferson

#	QuadName	Six_Let_Abbr	Latitude	Longitude	USGS_QD_ID	Counties
421	Steubenville West	STEWES	40 15' 00"	-080 37' 30"	40080-C6	Brooke
422	Stotlers Crossroads	STOCRO	39 30' 00"	-078 07' 30"	39078-E2	Morgan, Berkeley
423	Strange Creek	STRCRE	38 30' 00"	-080 52' 30"	38080-E8	Braxton, Clay, Nicholas
424	Sugar Grove	SUGGRO	38 30' 00"	-079 15' 00"	38079-E3	Pendleton
425	Summersville Dam	SUMDAM	38 07' 30"	-080 52' 30"	38080-B8	Nicholas, Fayette
426	Summersville	SUMMER	38 15' 00"	-080 45' 00"	38080-C7	Nicholas
427	Sunrise	SUNRIS	38 07' 30"	-079 45' 00"	38079-B7	Pocahontas
428	Sutton	SUTTON	38 37' 30"	-080 37' 30"	38080-F6	Braxton
429	Swandale	SWANDA	38 22' 30"	-080 52' 30"	38080-D8	Clay, Nicholas
430	Sylvester	SYLVES	38 00' 00"	-081 30' 00"	38081-A5	Kanawha, Boone
431	Table Rock	TABROC	39 15' 00"	-079 22' 30"	39079-C4	Preston, Grant
432	Tablers Station	TABSTA	39 22' 30"	-078 00' 00"	39078-D1	Berkeley
433	Talcott	TALCOT	37 37' 30"	-080 45' 00"	37080-F7	Summers
434	Tanner	TANNER	38 52' 30"	-080 52' 30"	38080-H8	Gilmer
435	Tariff	TARIFF	38 37' 30"	-081 07' 30"	38081-F2	Calhoun, Roane
436	Tazewell North	TAZNOR	37 07' 30"	-081 30' 00"	37081-B5	McDowell
437	Terra Alta	TERALT	39 22' 30"	-079 30' 00"	39079-D5	Preston
438	Thornton	THORNT	39 15' 00"	-079 52' 30"	39079-C8	Preston, Taylor, Barbour
439	Thornwood	THORNW	38 30' 00"	-079 37' 30"	38079-E6	Pendleton, Pocahontas
440	Thurmond	THURMO	37 52' 30"	-081 00' 00"	37081-H1	Fayette, Raleigh
441	Tiltonsville	TILTON	40 07' 30"	-080 37' 30"	40080-B6	Brooke, Ohio
442	Tioga	TIOGAX	38 22' 30"	-080 37' 30"	38080-D6	Webster, Nicholas
443	Trace	TRACEX	37 52' 30"	-082 07' 30"	37082-H2	Wayne, Lincoln, Logan, Mingo
444	Trout	TROUTX	38 00' 00"	-080 22' 30"	38080-A4	Greenbrier
445	Union	UNIONX	37 30' 00"	-080 30' 00"	37080-E5	Monroe
446	Upper Tract	UPPTRA	38 45' 00"	-079 15' 00"	38079-G3	Pendleton
447	Vadis	VADISX	39 00' 00"	-080 37' 30"	39080-A6	Doddridge, Lewis, Gilmer
448	Valley Grove	VALGRO	40 00' 00"	-080 30' 00"	40080-A5	Ohio, Marshall
449	Valley Head	VALHEA	38 30' 00"	-080 00' 00"	38080-E1	Randolph
450	Valley Mills	VALMIL	39 15' 00"	-081 22' 30"	39081-C4	Wood
451	Valley Point	VALPOI	39 30' 00"	-079 37' 30"	39079-E6	Preston
452	Wadestown	WADEST	39 37' 30"	-080 15' 00"	39080-F3	Monongalia, Marion
453	Waiteville	WAITEV	37 22' 30"	-080 22' 30"	37080-D4	Monroe
454	Walkersville	WALKER	38 45' 00"	-080 22' 30"	38080-G4	Lewis, Upshur, Braxton
455	Wallace	WALLAC	39 22' 30"	-080 22' 30"	39080-D4	Wetzel, Marion, Harrison
456	Walton	WALTON	38 37' 30"	-081 22' 30"	38081-F4	Roane
457	Wardensville	WARDEN	39 00' 00"	-078 30' 00"	39078-A5	Hampshire, Hardy
458	War	WARXXX	37 15' 00"	-081 37' 30"	37081-C6	McDowell
459	Wayne	WAYNEX	38 07' 30"	-082 22' 30"	38082-B4	Wayne
460	Webb	WEBBXX	37 52' 30"	-082 22' 30"	37082-H4	Wayne, Mingo
461	Webster Springs	WEBSPR	38 22' 30"	-080 22' 30"	38080-D4	Webster
462	Weirton	WEIRTO	40 22' 30"	-080 30' 00"	40080-D5	Hancock, Brooke
463	Welch	WELCHX	37 22' 30"	-081 30' 00"	37081-D5	Wyoming, McDowell
464	Wellsville	WELLSV	40 30' 00"	-080 37' 30"	40080-E6	Hancock
465	West Hamlin	WESHAM	38 15' 00"	-082 07' 30"	38082-C2	Cabell, Lincoln
466	West Milford	WESMIL	39 07' 30"	-080 22' 30"	39080-B4	Harrison, Lewis
467	Webster Springs SE	WESPSE	38 15' 00"	-080 15' 00"	38080-C3	Pocahontas, Webster

#	QuadName	Six_Let_Abbr	Latitude	Longitude	USGS_QD_ID	Counties
468	Webster Springs SW	WESPSW	38 15' 00"	-080 22' 30"	38080-C4	Webster, Nicholas, Greenbrier
469	Westernport	WESTER	39 22' 30"	-079 00' 00"	39079-D1	Mineral
470	Weston	WESTON	39 00' 00"	-080 22' 30"	39080-A4	Harrison, Lewis
471	West Union	WESUNI	39 15' 00"	-080 45' 00"	39080-C7	Tyler, Doddridge
472	Wharnccliffe	WHARNC	37 30' 00"	-081 52' 30"	37081-E8	Mingo, McDowell
473	Wharton	WHARTO	37 52' 30"	-081 37' 30"	37081-H6	Boone
474	Wheeling	WHEELI	40 00' 00"	-080 37' 30"	40080-A6	Ohio, Marshall
475	White Hall	WHIHAL	39 15' 00"	-078 07' 30"	39078-C2	Berkeley
476	Whitesville	WHITES	37 52' 30"	-081 30' 00"	37081-H5	Boone, Raleigh
477	Whitmer	WHITME	38 45' 00"	-079 30' 00"	38079-G5	Randolph, Pendleton
478	White Sulphur Springs	WHSUSP	37 45' 00"	-080 15' 00"	37080-G3	Greenbrier
479	Widen	WIDENX	38 22' 30"	-080 45' 00"	38080-D7	Clay, Nicholas
480	Williamsburg	WILBUR	37 52' 30"	-080 22' 30"	37080-H4	Greenbrier
481	Wilsondale	WILDAL	37 52' 30"	-082 15' 00"	37082-H3	Wayne, Lincoln, Mingo
482	Wildell	WILDEL	38 37' 30"	-079 45' 00"	38079-F7	Randolph, Pocahontas
483	Wileyville	WILEYV	39 37' 30"	-080 37' 30"	39080-F6	Marshall, Wetzel
484	Willow Island	WILISL	39 15' 00"	-081 15' 00"	39081-C3	Pleasants, Wood, Ritchie
485	Williams Mountain	WILMOU	38 00' 00"	-081 37' 30"	38081-A6	Boone
486	WilliamSPORT	WILPOR	39 30' 00"	-077 45' 00"	39077-E7	Berkeley
487	Williamson	WILSON	37 37' 30"	-082 15' 00"	37082-F3	Mingo
488	Winfield	WINFIE	38 30' 00"	-081 52' 30"	38081-E8	Putnam
489	Winona	WINONA	38 00' 00"	-080 52' 30"	38080-A8	Nicholas, Greenbrier, Fayette
490	Winslow	WINSLO	38 15' 00"	-082 15' 00"	38082-C3	Cabell, Wayne, Lincoln
491	Wolf Gap	WOLGAP	38 52' 30"	-078 37' 30"	38078-H6	Hardy
492	Wolf Summit	WOLSUM	39 15' 00"	-080 22' 30"	39080-C4	Harrison
493	Woodrow	WOODRO	38 15' 00"	-080 07' 30"	38080-C2	Pocahontas
494	Woodstock	WOODST	38 52' 30"	-078 30' 00"	38078-H5	Hardy
495	Yellow Spring	YELSPR	39 07' 30"	-078 30' 00"	39078-B5	Hampshire, Hardy

APPENDIX E: Programming Scripts

Python, ArcObjects with VBA, and AML were used for data processing in this project. The main functions used in the programs can be summarized as shown in the following table.

Program		Functions
VBA/ArcObjects		<ul style="list-style-type: none"> • Create file organization framework for the processed data based on USGS Quad by attribute query • Process spatial query to extract both hydroline and hydropolygon features from the statewide hydro dataset into USGS Quad based segments • Create python scripts for TIN creation • Create AML script to convert TIN lattice into USGS DEM
Python	Data conversion	gp.FeatureClassToShapefile_conversion(input1, outputDir1)
	Define projection	gp.DefineProjection_management(input, Projection)
	Delete features	gp.Select_analysis(input, output, "\"Level\" <=>32")
	Reprojection	gp.Project_management(input2, output2, Projection)
	Create TIN	gp.CreateTin_3d(dirTINsps, Projection)
	Add mass points and breaklines	gp.EditTin_3d(inputTIN, "masspoint, and hardline features", outputTIN)
	Add hydrolines	gp.EditTin_3d("F:/test/ProcessedData/AMHERS/TIN/ELEV/amhers", "F:/test/ProcessedData/AMHERS/hydro/hydrolines.shp Shape <None> hardline true", Output_TIN)
Add hydropolygons	gp.EditTin_3d("F:/test/ProcessedData/AMHERS/TIN/hydroline/amhers", "F:/test/ProcessedData/AMHERS/hydro/hydroPolys.shp Shape <None> hardreplace true", Output_TIN)	
AML		<ul style="list-style-type: none"> • tinlattice • projectdefine grid • latticedem

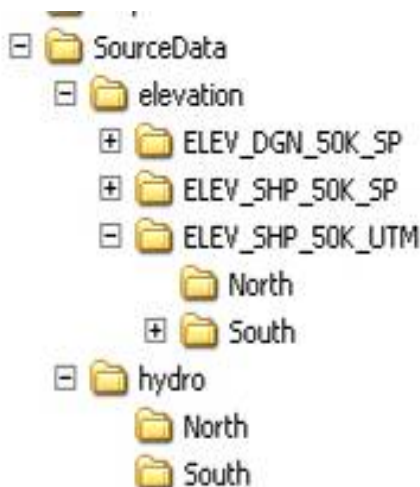
Source Data Conversion

Source data consists of elevation mass points, elevation breaklines, and hydrography. The data was provided by the SAMB contractor in MicroStation Version 8 DGN format. The elevation source data was exported directly from DGN format to ESRI shapefile format. The hydro .dgn data was taken into Microstation, saved as a V7 .dgn file, then converted to ESRI shapefile format. This was necessary due to an incompatibility between formats, which resulted in feature loss. This problem did not affect the elevation data. After the data was converted to shapefile format, the data coordinate system was defined as West Virginia State Plane North/South, North American Datum 1983. USGS requires the DEM data to be submitted to the National Elevation Dataset in UTM NAD 83. Because it is more efficient to re-project the vector data rather than raster data, reprojection occurred before TIN creation. The following paragraphs outline the Python scripts used for the data conversion process.

- **Create file organization framework:**

The source DGN data was provided in two different zones, WV North and WV South. Each zone contains a folder tree based on the SAMB index tile system. Each folder named from the 50K SAMB tiles contains the 10K SAMB source DGN files. The converted dgn data will be saved in the same file directory for further process. The *createDirectories.py* python script is listed below for reference.

createDirectories.py



```
import sys, os, os.path
##print os.getcwd()
dirDGN =
"F:/test/SourceData/elevation/ELEV_DGN_50K_SP/South_Zone"
dirSHPsps =
"F:/test/SourceData/elevation/ELEV_SHP_50K_SP/South/"
dirSHPutm =
"F:/test/SourceData/elevation/ELEV_SHP_50K_UTM/South/"
dirs= os.listdir(dirDGN)
for d in dirs:
    os.mkdir(dirSHPutm+d)
    os.mkdir(dirSHPsps+d)
newD=os.listdir(dirSHPsps)
for n in newD:
    os.makedirs(dirSHPsps+n+"/Point")
    os.makedirs(dirSHPsps+n+"/Breakline")
    os.makedirs(dirSHPsps+n+"/BreaklineNo32")
```

- **Convert DGN file into shape file**

The elevation mass points and breaklines will be converted from the source DGN data into ESRI shapefile format. These files will be used to create the elevation TIN. The *DGN2SHPsps.py* python script is listed below for reference.

DGN2SHPsps.py

```
# Import system modules
import sys, string, os, win32com.client, os.path
# Create the Geoprocessor object
gp = win32com.client.Dispatch("esriGeoprocessing.GpDispatch.1")
# Load required toolboxes...
gp.AddToolbox("F:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Conversion Tools.tbx")
dirDGN = "F:/test/SourceData/elevation/ELEV_DGN_50K_SP/South_Zone"
dirSHPsps = "F:/test/SourceData/elevation/ELEV_SHP_50K_SP/South/"
dirs= os.listdir(dirDGN)
for d in dirs:
    dgnFolder = dirDGN + "/" + d
    dgns = os.listdir(dgnFolder)
    for dgn in dgns:
        outputDir1 = dirSHPsps + d + "/Point"
        outputDir2 = dirSHPsps + d + "/Breakline"
        Point = dgnFolder + "/" + dgn + "/Point"
        Polyline = dgnFolder + "/" + dgn + "/Polyline"
        input1 = Point
        input2 = Polyline
        # Process: Feature Class To Shapefile (multiple)...
        gp.FeatureClassToShapefile_conversion(input1, outputDir1)
        gp.FeatureClassToShapefile_conversion(input2, outputDir2)
```

- **Define the projection of shape file**

The converted shapefile will be defined as West Virginia State Plane North/South with the datum as NAD83. The *defineprojection.py* python script is listed below for reference.

defineprojection.py

```
# Import system modules
import sys, string, os, win32com.client, os.path
# Create the Geoprocessor object
gp = win32com.client.Dispatch("esriGeoprocessing.GpDispatch.1")
# Load required toolboxes...
gp.AddToolbox("F:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Data Management Tools.tbx")
dirSHPsps = "F:/test/SourceData/elevation/ELEV_SHP_50K_SP/South/"
Projection = "F:/Program Files/ArcGIS/Coordinate Systems/Projected Coordinate Systems/State Plane/NAD 1983 (Feet)/NAD 1983 StatePlane West Virginia South FIPS 4702 (Feet).prj"
dirs= os.listdir(dirSHPsps)
for d in dirs:
    SHPspsFolderPoint = dirSHPsps + d + "/Point"
    shpsPoint = os.listdir(SHPspsFolderPoint)
    SHPspsFolderLine = dirSHPsps + d + "/Breakline"
    shpsLine = os.listdir(SHPspsFolderLine)
    for shpP in shpsPoint:
        if shpP.endswith("shp"):
```

```

input = SHPspFolderPoint + "/" + shpP
dsc = gp.Describe(input)
if dsc.SpatialReference.Name == "Unknown":
    # Process: Define Projection...
    gp.DefineProjection_management(input, Projection)
else:
    print "Projection already defined and will not be changed."
for shpL in shpsLine:
    if shpL.endswith("shp"):
        input = SHPspFolderLine + "/" + shpL
        dsc = gp.Describe(input)
        if dsc.SpatialReference.Name == "Unknown":
            # Process: Define Projection...
            gp.DefineProjection_management(input, Projection)
        else:
            print "Projection already defined and will not be changed."

```

- **Delete features from the projected shape file**

The elevation breakline shape files used in TIN creation contain coded bridge lines. When these lines are added to the TIN, it interferes with the stream channel drainage, often creating puddles. To avoid this problem, the bridge lines are removed from the breakline files prior to adding them to the TIN. The *deleteFeature32.py* python script, listed below for reference, automatically extracts the bridge lines and creates a new breakline shape file that is then added to the TIN.

deleteFeature32.py

```

# Import system modules
import sys, string, os, win32com.client, os.path

# Create the Geoprocessor object
gp = win32com.client.Dispatch("esriGeoprocessing.GpDispatch.1")

# Set the necessary product code
gp.SetProduct("ArcInfo")

# Load required toolboxes...
gp.AddToolbox("F:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Analysis Tools.tbx")

dirSHPsps = "F:/test/SourceData/elevation/ELEV_SHP_50K_SP/South/"

dirs= os.listdir(dirSHPsps)

for d in dirs:
    SHPspFolder = dirSHPsps + d + "/Breakline"
    SHPspDelFolder = dirSHPsps + d + "/BreaklineNo32"
    shps = os.listdir(SHPspFolder)

    for shp in shps:
        if shp.endswith("Polyline.shp"):
            input = SHPspFolder + "/" + shp
            output = SHPspDelFolder + "/" + shp
            # Process: Select...
            gp.Select_analysis(input, output, "\"Level\" <> 32")

```


- **Reproject shape file into UTM projection**

Both mass point and breakline files (without bridge lines) will be re-projected from State Plane Feet into the UTM coordinate system. The *SP2UTMprojection.py* python script is listed below for reference.

SP2UTMprojection.py

```
# Import system modules
import sys, string, os, win32com.client, os.path

# Create the Geoprocessor object
gp = win32com.client.Dispatch("esriGeoprocessing.GpDispatch.1")

# Load required toolboxes...
gp.AddToolbox("F:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Data Management Tools.tbx")

dirSHPsps = "F:/test/SourceData/elevation/ELEV_SHP_50K_SP/South/"
dirSHPutm = "F:/test/SourceData/elevation/ELEV_SHP_50K_UTM/South/"

Projection = "F:/Program Files/ArcGIS/Coordinate Systems/Projected Coordinate
Systems/Utm/Nad 1983/NAD 1983 UTM Zone 17N.prj"

dirs= os.listdir(dirSHPsps)

for d in dirs:
    SHPspsFolderP = dirSHPsps + d + "/Point"
    SHPspsFolderL = dirSHPsps + d + "/BreaklineNo32"

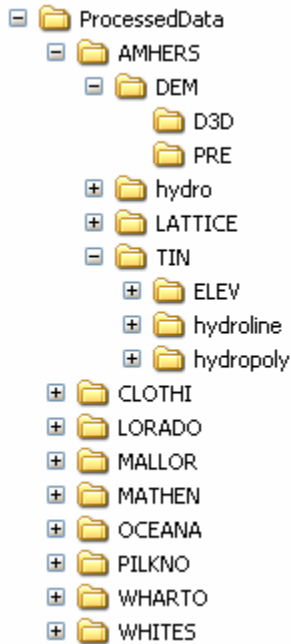
    SHPutmFolder = dirSHPutm + d

    shpsP = os.listdir(SHPspsFolderP)
    shpsL = os.listdir(SHPspsFolderL)

    for shpP in shpsP:
        if shpP.endswith("shp"):
            input1 = SHPspsFolderP + "/" + shpP
            output1 = SHPutmFolder + "/" + shpP
            # Process: Project...
            gp.Project_management(input1, output1, Projection)

    for shpL in shpsL:
        if shpL.endswith("shp"):
            input2 = SHPspsFolderL + "/" + shpL
            output2 = SHPutmFolder + "/" + shpL
            # Process: Project...
            gp.Project_management(input2, output2, Projection)
```

1. Processed data folder tree (created by ArcObjects program)



Since the final delivered product will be a DEM that coincides with the USGS 7.5minute quadrangle boundaries, all processed data will be organized based on the 7.5 minute USGS Quadrangle (quad) index. The new folder organization will be based on the 6-digit USGS Quad name, which is the full quadrangle name abbreviated to six letters. The ArcObjects VBA program will loop through each quad name in the file and create the folder structure that will contain all of the processed data for that quad. The tree begins with a parent directory named from the 6-digit quad, and sub-folders that contain the data used for (or created at) various stages in the process, the hydrography data, the pre-enhancement DEM and the post-enhancement DEM.

2. TIN creation

The primary TIN file for each quad is created from multiple elevation mass point and breakline files. Because the USGS quad and SAMB index systems do not coincide, there are as few as 20 or up to 30 SAMB tiles needed for each USGS 7.5 minute quadrangle. The 10k SAMB tile index was referenced to the USGS index system using ArcMap. The USGS Quad index and the SAMB 10k tile index were unioned and the resulting shape file contained the attributes for both full USGS quad name and 6-digit Quad abbreviation as well as the 10k SAMB index tile number. Two Python scripts used for TIN creation are listed below:

- *create TIN*

```
# Import system modules
import sys, string, os, win32com.client
# Create the Geoprocessor object
gp = win32com.client.Dispatch("esriGeoprocessing.GpDispatch.1")
# Check out any necessary licenses
gp.CheckOutExtension("3D")
# Load required toolboxes...
gp.AddToolbox("F:/Program Files/ArcGIS/ArcToolbox/Toolboxes/3D Analyst Tools.tbx")
# Local variables...
dirTINsps = "F:/test/ProcessedData/AMHERS/TIN/ELEV/AMHERS"
Projection = "F:/Program Files/ArcGIS/Coordinate Systems/Projected Coordinate
Systems/Utm/Nad 1983/NAD 1983 UTM Zone 17N.prj"
# Process: Create TIN...
gp.CreateTin_3d(dirTINsps,Projection)
```

- *add mass points and breaklines*

```

# Import system modules
import sys, string, os, win32com.client
# Create the Geoprocessor object
gp = win32com.client.Dispatch("esriGeoprocessing.GpDispatch.1")
# Check out any necessary licenses
gp.CheckOutExtension("3D")
# Load required toolboxes...
gp.AddToolbox("F:/Program Files/ArcGIS/ArcToolbox/Toolboxes/3D Analyst Tools.tbx")
# Local variables...
Output_TIN = ""
gp.EditTin_3d(input, "Point.shp Shape <None> masspoints true; Polyline.shp Shape <None>
hardline true; .....", output)

gp.EditTin_3d("F:/test/ProcessedData/AMHERS/TIN/ELEV/amhers",
"F:/test/SourceData/elevation/ELEV_SHP_50K_UTM/South/s-f11/s-f11-17_dgn_Point.shp Shape
<None> masspoints true;F:/test/SourceData/elevation/ELEV_SHP_50K_UTM/South/s-f11/s-f11-
17_dgn_Polyline.shp Shape <None> hardline
true;F:/test/SourceData/elevation/ELEV_SHP_50K_UTM/South/s-f11/s-f11-18_dgn_Point.shp
Shape <None> masspoints true;F:/test/SourceData/elevation/ELEV_SHP_50K_UTM/South/s-
f11/s-f11-18_dgn_Polyline.shp Shape <None> hardline
true;F:/test/SourceData/elevation/ELEV_SHP_50K_UTM/South/s-f11/s-f11-19_dgn_Point.shp
Shape <None> masspoints true;F:/test/SourceData/elevation/ELEV_SHP_50K_UTM/South/s-
f11/s-f11-19_dgn_Polyline.shp Shape <None> hardline
true;F:/test/SourceData/elevation/ELEV_SHP_50K_UTM/South/s-f11/s-f11-20_dgn_Point.shp
Shape <None> masspoints true;F:/test/SourceData/elevation/ELEV_SHP_50K_UTM/South/s-
f11/s-f11-20_dgn_Polyline.shp Shape <None> hardline

```

3. TIN creation

The hydrographic features are extracted from the two larger North/South West Virginia hydro files into USGS Quad based shapefiles. These quad based shapefiles are then added into the TIN files for drainage enhancement. These procedures are supported by VBA programming with ArcObjects in ArcMap, since both spatial and attribute queries have to be performed to select necessary features that intersect the boundary of each USGS Quad to extract the data and produce the python script for TIN creation and enhancement.

Feature layers of USGS Quad, statewide hydroline and statewide hydropolygon are used in this project. By looping through each USGS Quad, each individual quad feature is selected, then a spatial query is performed by selecting either hydroline or hydropolygon features that are intersected with the selected quad. Selected hydro features are then extracted and exported into separate hydroline or hydropolygon shape files and saved in the hydro folder that is contained in processed data file framework for each USGS Quad. Two Python scripts used for editing the TIN are listed below:

- *add hydrolines*

```
# Import system modules
import sys, string, os, win32com.client
# Create the Geoprocessor object
gp = win32com.client.Dispatch("esriGeoprocessing.GpDispatch.1")
# Check out any necessary licenses
gp.CheckOutExtension("3D")
# Load required toolboxes...
gp.AddToolbox("F:/Program Files/ArcGIS/ArcToolbox/Toolboxes/3D Analyst Tools.tbx")
# Local variables...
Output_TIN = "F:/test/ProcessedData/AMHERS/TIN/hydroline/amhers"
gp.EditTin_3d("F:/test/ProcessedData/AMHERS/TIN/ELEV/amhers",
"F:/test/ProcessedData/AMHERS/hydro/hydrolines.shp Shape <None> hardline true",
Output_TIN)
```

- *add hydropolygons*

```
# Import system modules
import sys, string, os, win32com.client
# Create the Geoprocessor object
gp = win32com.client.Dispatch("esriGeoprocessing.GpDispatch.1")
# Check out any necessary licenses
gp.CheckOutExtension("3D")
# Load required toolboxes...
gp.AddToolbox("F:/Program Files/ArcGIS/ArcToolbox/Toolboxes/3D Analyst Tools.tbx")
# Local variables...
Output_TIN = "F:/test/ProcessedData/AMHERS/TIN/hydropoly/amhers"
gp.EditTin_3d("F:/test/ProcessedData/AMHERS/TIN/hydroline/amhers",
"F:/test/ProcessedData/AMHERS/hydro/hydroPolys.shp Shape <None> hardreplace true",
Output_TIN)
```

2. TIN to LATTICE to USGS DEM

The TIN file is then converted to an ESRI Grid (lattice) file. An AML is used for part batch process. AML file is created by VBA programming with ArcObjects in ArcMap to derive the minx, miny, maxx, maxy values of each USGS Quad. The sample AML code is listed below for reference.

```
tinlattice F:\test\ProcessedData\AMHERS\TIN\hydropoly\amhers
F:\test\ProcessedData\AMHERS\LATTICE\amhers quintic
422917.5,4178341.5
434038.5,4192306.5
~
3

projectdefine grid F:\test\ProcessedData\AMHERS\LATTICE\amhers
zunits feet
parameters

latticedem F:\test\ProcessedData\AMHERS\LATTICE\amhers
F:\test\ProcessedData\AMHERS\DEM\PRE\amhers.dem 10 int
```