



## **Issue 4: Water Quality**

**Description:** The geospatial goal of priority area delineation for Issue 4 Water Quality was to establish priority rankings by 12 digit Hydrologic Unit Codes (HUC-12) sub-watersheds. This was done by combining the reclassified values of several input layers. The input layers contributed to composite scores used for prioritizing sub-watersheds for “restoration” and “protection” efforts, as well as a composite score for both. Prioritization of HUC-12s for protection and restoration used two slightly different ranking methods and input layers. See restoration and protection tables A1 and A2 for input layers and associated reclassification values assigned. All input data was calculated and summarized by HUC-12 sub-watershed polygon and captured within the attribute table of the HUC-12 shapefile. Composite scores were derived by summing the restoration and protection scores. The following is a description of each GIS input layer used and the summary and reclassifications assigned to each.

### **Input Layer Processing and Reclassification**

#### **Initial Base layer - HUC-12 sub-watershed boundaries**

**Data Source:** WV GIS Technical Center, “wvWbdHu12\_NRCS\_2009\_utm83.shp” downloaded September, 2009 available at <http://wvgis.wvu.edu//data/data.php>

**Description and GIS Process:** A HUC-12 polygon shapefile was clipped by the latest West Virginia county shapefile “county\_24k\_drg\_utm83\_NEW.shp”, used as the study area for all assessment GIS analysis datasets. This clipped HUC-12 dataset was used for storing the individual input layer calculation results and reclassified input layer values, as well as summed HUC-12 scores. A “clipped acres” field was created and acres for each HUC were calculated. New fields were added to this shapefile representing all of the input layers and associated statistics and reclassification values to be calculated by HUC-12. These were used for HUC-12 prioritization using the summarized scores for protection, restoration, and a composite score.

#### **Input layer 1: Man-made structure density (Structures /Acre by HUC-12 sub-watershed)**

**Data Source:** WV GIS Technical Center, “structurePointsNorth\_SAMB\_2003\_utm83.shp” and “structurePointsSouth\_SAMB\_2003\_utm83.shp” downloaded June, 2009. Available at: <http://wvgis.wvu.edu//data/data.php>

**Description and GIS process:** Two shapefiles of building point locations provided from 2003 imagery and developed by the WV State-wide Address and Mapping Boards E911 project were merged to form “structurePoints\_SAMB\_2003\_utm83.shp”. The merged point file was used in calculating the number of structures per acre for each HUC-12 sub-watershed in West Virginia. A spatial join between the newly merged structure shapefile and the “wvWbdHu12\_NRCS\_2009\_utm83.shp” shapefile, using the “completely within” parameter, resulted in a HUC-12 intermediate shapefile with the number of structures within each HUC-12. The intermediate shapefile was then table joined to “wvWbdHu12\_NRCS\_2009\_utm83.shp”, so that the number of structures could be carried over using the “field calculator”. Using the HUC-12 acres field, the structures per acre field was populated by again using the “field calculator”.



Using a natural breaks algorithm, four classes, based on the number of structures per acre by HUC-12, were determined and reclassification values were captured in the “wvWbdHu12\_NRCS\_2009\_utm83.shp” base shapefile. See restoration and protection tables A1 and A2 for specific reclassification values assigned, as well as Map 4.2 on page 187 for the extent of this input layer.

### **Input layer 2: Public Water Intakes (Number per HUC-12 sub-watershed)**

**Data Source:** Feng, Jonathan. 2006. West Virginia Department of Health and Human Resources Bureau for Public Health, Office of Environmental Health Services, Environmental Engineering Division. Source Water Assessment Program, “WV Public Water Sources (01-30-06)” database.

**Description and GIS process:** Using the “WV Public Water Sources” database, a shapefile of these point locations was created using the coordinates provided. Using the public water intakes shapefile, the number of public water intakes per HUC-12 sub-watershed was calculated using a “spatial join”. The resulting table provided the number of intakes per HUC-12 sub-watershed and those values were captured in the HUC-12 base layer attribute table for ranking. Using a natural breaks algorithm, four classes, based on of number of intakes per sub-watershed, were determined and reclassifications values were captured in the “wvWbdHu12\_NRCS\_2009\_utm83.shp” base shapefile. See restoration and protection tables A1 and A2 for specific reclassification values assigned, and Map 4.8 on page 199 for the extent of this input layer.

### **Input layer 3: Timber Harvesting Pressure\* (Percent area HUC-12 sub-watershed reported as harvested over 5 years).**

**Data Source:** WVDOF GIS Harvest Locations 2005-2009. *\*This is point data not available by polygon, so these acreages may not be exactly correct for each watershed, but they do indicate the general area in which timber was harvested.*

**Description and GIS process:** Using a point shapefile of harvest locations, with acres harvested associated with each point, a “spatial join” was used to calculate the summarized harvest acres by sub-watershed. The resulting shapefile was table joined to the “wvWbdHu12\_NRCS\_2009\_utm83.shp” base shapefile, so that harvested acres by sub-watershed could be carried over and used to calculate the percentage of land area harvested by sub-watershed. Once percentages were calculated, they were reclassified and these values were recorded in the “wvWbdHu12\_NRCS\_2009\_utm83.shp” base shapefile. See restoration and protection tables A1 and A2 for specific reclassification values assigned, and Map 4.5 on page 195 for the extent of this input layer.



#### **Input layer 4: Ability to Produce Clean Water (APCW by HUC-12 sub-watershed)**

**Data source:** Barnes, M.C., A.H. Todd, R.W. Whitney, and P.K. Barten. 2009. “wvpcw” 30 meter grid from *“Forests, Water and People: Drinking Water Supply and Forest Lands in the Northeast and Midwest United States”*. NA-FR-01-08. USDA Forest Service.

**Description and GIS process:** The ability to produce clean water (APCW) characterization score by HUC-12, found in the recent “Forests, Water, and People” (FWAP) study, is an index of water quality and watershed integrity based on six attributes: forest land, agricultural land, riparian forest cover, road density, soil erodibility, and housing density. The APCW scores were provided as raw scores by 30 meter grid and were summarized by HUC-12. Then the mean APCW score was derived by using the “zonal statistics” function in ArcInfo. These APCW scores were then copied into the HUC-12 shapefile and are important input into developing priority watersheds for both restoration and protection prioritization.

APCW scores were reclassified into four categories with the highest APCW category (scores 21-23) reclassified to “1”, as areas that aren’t at high risk and are largely remote forested land. These areas are not expected to change much over the next five years. Therefore, they do not merit much weighting when looking at either protection or restoration. A value of “0” was given to the FWAP lowest scored areas (APCW scores 10-13), simply because they lie almost exclusively in areas that are urbanized or populated and are difficult to address via traditional forestry means. These areas must be addressed through urban forestry initiatives. The highest prioritizations, reclassified values of “6”, were given to sub-watersheds that had reasonable abilities to produce clean water (APCW scores 17-18). These sub-watersheds, due to population growth, or removal of forest cover, and soil type weren’t scored as high as the remote forested areas with the highest APCW scores, according to the FWAP study. Finally, HUCs with APCW scores of 14-16 and 19-20 were reclassified to “4”. Reclassification values were captured in the “wvWbdHu12\_NRCS\_2009\_utm83.shp” base shapefile. See restoration and protection tables A1 and A2 for specific reclassification values assigned, and Map 4.1 on page 186 for the extent of this input layer.

#### **Input layer 5: Oil and Gas well density (Well permits/acre)**

**Data Source:** Bocan, John. 2009. “WVOG\_Wells\_20091113Q” shapefile. West Virginia Geological and Economic Survey (WVGES).

**Description and GIS process:** The shapefile “WVOG\_Wells\_20091113Q” was used to determine the number of oil and gas well permits per HUC-12 sub-watershed using a spatial join. The resulting table with values on the number wells per HUC-12 was then captured in the HUC-12 attribute table for reclassification. Using the “field calculator” the number of wells per acre in each HUC-12 was derived and used for reclassification based on a natural breaks algorithm. Reclassification values were captured in the “wvWbdHu12\_NRCS\_2009\_utm83.shp” base shapefile. See restoration and protection tables A1 and A2 for specific reclassification values assigned, and Map 4.3 on page 190 for the distribution of this input layer.



## **Input layer 6: Surface mine and valley fill permits (Percent area of HUC-12 sub-watershed)**

### **Data Sources:**

1. Evans, Larry. Manager, Technical Applications and Geographic Information Systems (TAGIS) WVDEP, [Mining Permit Boundaries](http://gis.wvdep.org/data/omr.html) (updated daily) “perbd” accessed September 2009. Available at: <http://gis.wvdep.org/data/omr.html>.
2. WV GIS Technical Center, “mining\_fills-southern\_wv.shp”, downloaded September, 2009. Available at: <http://wvgis.wvu.edu//data/data.php>.

**Description and GIS process:** Both mining permit input layer polygon shapefiles were merged and dissolved to get rid of any overlap. The resulting merged polygon file was converted and snapped to a WV 30 meter snap grid. The resulting mined areas grid was then used as input for a “tabulate area” zonal statistics tool found within “spatial analyst” to derive the number of mine permit area square meters in each HUC-12 sub-watershed. The resulting square meters were converted to acres and calculated against the HUCs total area to derive the percentage of mine permit area by HUC-12 using the “field calculator”. Using a natural breaks algorithm, reclassified values were captured in the “wvWbdHu12\_NRCS\_2009\_utm83.shp” base shapefile. See restoration and protection tables A1 and A2 for specific reclassification values assigned, and Map 4.4 on page 193 for the distribution of this input layer.

## **Input layer 7. Public Land (Percent area of 12 digit HUC watershed in public land)**

**Data Source:** WVDOF GIS Public lands shapefile “WV\_Public\_Lands\_Steward.shp” created Dec. 2009.

**Description and GIS process:** The newly derived “WV\_Public\_Lands\_Steward.shp” shapefile was converted and snapped to a 30 snap grid. The public lands grid was then used as input for a “tabulate area” spatial analyst zonal statistics tool calculation to derive the number of public land area square meters in each HUC-12 sub-watershed boundary. Square meters were converted to acres and calculated against the HUCs total area to derive the percentage of public land by HUC. HUCs with more than 75 percent of their area under public land were identified and reclassified with values of “0”. These sub-watersheds were scored, but excluded as priority sub-watersheds. Reclassification values were captured in the “wvWbdHu12\_NRCS\_2009\_utm83.shp” base shapefile. See restoration and protection tables A1 and A2 for specific reclassification values assigned.

## **Input layer 8P. 303d Impaired Streams (Stream miles per 12 digit HUC watershed)**

**Data Source:** Montali, Dave. 2009. “WV2008\_Impaired\_by\_pollutant\_draft\_20090520.shp” shapefile. West Virginia Department of Environmental Protection.



**Description and GIS process:** The “WV2008\_Impaired\_by\_pollutant\_draft\_20090520.shp” shapefile provided by WVDEP was “Definition queried” for “Bio” and “Iron” using the “Impairment” field of the attribute table. The resulting data records were clipped by the HUC-12 sub-watershed boundary file and the newly clipped shapefile was used to derive impaired stream miles by first using the “calculate geometry” function within the attribute table “field calculator”. Next, the “summarize” field function was run on the newly calculated miles field and summarized by HUC-12 code, resulting in a “.dbf” output table. This table was joined to “wvWbdHu12\_NRCS\_2009\_utm83” base input file and the summarized number of impaired stream miles per sub-watershed was calculated and then reclassified using a natural breaks algorithm. Reclassification values were captured in the “wvWbdHu12\_NRCS\_2009\_utm83.shp” base shapefile. See restoration and protection tables A1 and A2 for specific reclassification values assigned, as well as Map 4.6 on page 197 for the distribution of this input layer.

#### **Input layer 8R. High Quality Streams (Stream miles per 12 digit HUC watershed)**

**Data Source:** WV GIS Technical Center, “wv\_nhd\_hq\_merge\_utm83.shp”, downloaded September, 2009 available at: <http://wvgis.wvu.edu//data/data.php>.

**Description and GIS process:** The “wv\_nhd\_hq\_merge\_utm83.shp” shapefile provided by WVDEP was clipped by the HUC-12 sub-watershed boundary file. The newly clipped shapefile was used to derive high quality stream miles by first using the “calculate geometry” function within the attribute table “field calculator”. Next, the “summarize” field function was run on the newly calculated miles field and summarized by HUC-12 code resulting in a “.dbf” table. This table was “table joined” to “wvWbdHu12\_NRCS\_2009\_utm83” base input file and the summarized number of high quality stream miles was then reclassified, using a natural breaks algorithm. Reclassification values were captured in the “wvWbdHu12\_NRCS\_2009\_utm83.shp” base shapefile. See restoration and protection tables A1 and A2 for specific reclassification values assigned, as well as Map 4.7 on page 198 for the distribution of this input layer.

#### **Issue 4: Priority Area Determinations**

Three Priority Area maps were generated including a map for protection, one for restoration, and a final composite map combining both restoration and protection scores. The input layers used, and associated reclassification values, were slightly different between restoration and protection HUC-12 sub-watershed prioritization, as shown in tables A1 and A2. Once scores for protection and restoration were established, a composite score was developed by further summing the restoration and protection scores. Sub-watersheds having higher structure density or more than 75 percent of the land area in public lands were scored, but excluded as priority areas. This was done because these areas require different strategies and encounter different issues compared to other watersheds.



## Restoration Priority HUC-12 Sub-watersheds

A map for prioritizing HUC-12 sub-watersheds for restoration efforts was developed using the summarized reclassified input layer values described above and found in table A1 below. The reclassified values for each input layer were added using the “field calculator” and recorded in a restoration score attribute table field. Restoration scores were then sorted into four classes using a natural breaks algorithm. The results are shown in Map 4.10 on page 203.

Table A1: Restoration priority sub-watershed input layer reclassification values.

Restoration Input Layer Weighting and Prioritization by HUC-12 Sub-Watershed								
Data Layer	Sub-Watershed Reclassification Values							Unit of Measure
	0	1	2	3	4	5	6	
Impaired Streams		<11	11-34	> 34				Stream Miles
Public Land	>75*	51-75	26-50	<26				percent Public Land
Surface and Fill Mining	>20		5-20	<5				percent of HUC-12
FWP APCW score	10-13	21-23			19-20 14-16		17-18	FWP APCW Comp. Score
Oil and Gas well density		<0.004	~	<0.025				Wells per Acre
Public Water Intakes		<4	4-9	>9				Intakes per HUC-12
Harvest Pressure		<3	3-5	6-7	>7			percent of HUC-12
Structural Density	>0.25*	<=0.25						Structures per Acre
* HUC-12s with a calculated structure density >0.25 structures/acre (urban sub-watersheds) and more than 75 percent public land area were scored, but excluded as priority areas.								



### Protection Priority HUC-12 Sub-watersheds

A map for prioritizing HUC-12 sub-watersheds for protection efforts was developed using the summarized reclassified input layer values described above and found in table A2 below. The reclassified values for each input layer were added using the “field calculator” and recorded in a protection score attribute table field. Protection scores were then sorted into four classes using a natural breaks algorithm. The results are shown in Map 4.11 on page 205.

Table A2: Protection priority sub-watershed input layer reclassification values.

Protection Input Layer Weighting and Prioritization by HUC-12 Sub-Watershed								
Data Layer	Sub-watershed Reclassification Values							Unit of Measure
	0	1	2	3	4	5	6	
High Quality Streams		<8	8-20	>20				Stream Miles
Public Land	>75*	51-75	26-50	<26				percent Public Land
Surface and Fill Mining	>20		5-20	<5				percent of HUC-12
FWP Ability to Produce Clean Water Score	10-13	21-23			19-20 14-16		17-18	APCW Composite Score
Oil and Gas Well Density		<0.004	~	<0.025				Wells per Acre
Public Water Intakes		<4	4-9	>9				Intakes per HUC-12
Harvest Pressure		<3	3-5	6-7	>7			percent of HUC-12
Structural Density	>0.25*	<=0.25						Structures per Acre
* HUC-12s with a calculated structure density >0.25 structures/acre (urban sub-watersheds) and more than 75 percent public land area were scored, but excluded as priority areas.								

### Composite Priority HUC-12 Sub-watersheds

A final composite map was developed to prioritize sub-watersheds for both water quality restoration and protection efforts by combining the protection and restoration scores. Composite scores were then sorted into four classes using a natural breaks algorithm. The results are shown in Map 4.12 on page 206.



## **Issue 5: Wildfire Management, Resource Protection, and Public Safety**

**Description:** The geospatial goal of priority area delineation for Issue 5: Wildfire Management-Resource Protection and Public Safety was to establish priority areas to focus efforts for resource protection and public safety. The input data used in priority area determination came from the WVDOF's more than 20 years of fire occurrence point data, as well as grid data provided by a recent USDA Forest Service Northeastern Area (NA) regional Wildfire Risk Assessment. These datasets were combined and summarized by county and used to designate priority areas on a county level basis. The following is a description of the input layers and methods used.

### **Input Layer Processing and Reclassification**

#### **Northeastern Area Wildfire Risk Assessment (WRA) 2009**

**Data Source:** Chavez, Quinn. 2009. Personal communications regarding "fire\_final.zip", containing NA Wildfire Risk Assessment (WRA) data, United States Department of Agriculture, Forest Service, Northern Research Station Northeastern Area, State and Private Forestry.

**Description and GIS Process:** Spatial data files were provided by the staff of the Northeastern Area (NA) Northern Research Station, which contained regional 30 meter grid data for Wildland Urban Interface (WUI) scores classifying areas where human activity meets with forested areas. The "wui-1-5\_final" grid was clipped and snapped to a West Virginia 30 meter snap grid used for all raster input data used in the Assessment. Map 5.12 on page 230 depicts extent of this input layer for West Virginia.

Also included was a "topography module" "topo\_final" raster for the NA 20-state region, which combines areas of slope greater than 20 percent and aspects between 135<sup>0</sup> and 315<sup>0</sup>. The "topo\_final" grid was clipped and snapped to a West Virginia 30 meter snap grid used for all raster input data used in the Assessment. Map 5.18 on page 237 depicts the distribution of this input layer for West Virginia.

#### **WVDOF Fire Occurrence 1987-2009**

**Data Source:** WVDOF GIS, 2009. Fire occurrences 1987-2009 point shapefile.

**Description and GIS Process:** A copy of the Microsoft Access database file of fire occurrence maintained by the WVDOF was provided in September 2009. The database file contained UTM coordinates for every reported wildfire occurrence in West Virginia since 1987. The UTM coordinates were used to create a GIS point "feature class" using ArcCatalog. Using fires from 1999-2009 from this point feature class, a density raster was calculated using the "simple



density” tool found within the ArcGIS “spatial analyst” extension. This calculation derives a magnitude per unit area from point features that fall within a neighborhood around each cell. The results were calculated on 30 meter grid using “square miles” for “area units” and 1/2 mile for the “search radius”, and using the same geographic extent as the West Virginia 30 meter snap grid. The resulting raw scores were then reclassified using a natural breaks algorithm for three classes.

### **Issue 5: Priority Area Determination**

The two NA Wildfire Risk Assessment grids “wui-1-5\_final” and “topo\_final”, now clipped to the West Virginia 30 meter snap grid, were reclassified so that only the highest values would be counted in an overlay. The highest values “5” found in both grids were reclassified to “1” and the rest as “0”, to only count the most extreme WUI and topography areas in the state, as determined by the NA WRA study. The top class from newly derived 1999-2009 fire occurrence density raster was also reclassified, so that only the highest density fire occurrence areas would be counted. These areas were assigned a value of “1” and the rest as “0”. All three input layers were then combined in a raster overlay to identify areas of overlapping extreme fire conditions and occurrence. The resulting values were reclassified in “Low-High” priority areas for wildfire concern shown in Map S5.3 on page 381. A final summary composite map was developed by calculating the summarized mean overlay score by county, using the “zonal statistics” function within ArcGIS “spatial analyst”. The resulting output table was joined to a West Virginia county shapefile. The results were reclassified using the natural breaks algorithm to produce “High”, “Medium”, and “Low” priority counties depicted in Map S5.4 on page 382.



## **Issue 6: Sustainability of Urban Forests**

**Description:** The geospatial goal of priority area delineation for Issue 6: Sustainability of Urban Forests was to establish priority rankings for the 282 Urban and Census Defined Places (CDP) in West Virginia by combining the reclassified values of several input layers. The input layers contributed to individual sub-issue scores used for prioritizing urban areas using a variety of methods and weighting. Each CDP's calculated population density was used as a tie breaker for urban areas having the same initial sub-issue score, with high population density being the priority. Composite scores were also derived by combining individual sub-issue results. All input data was calculated and summarized by a census defined urban area polygon shapefile used by the Maryland Method and captured within in the attribute table of the shapefile. The following is a description of each GIS input layer used, the reclassifications assigned to each, and how these layers were used to derive priority urban areas for each sub-issue.

### **Initial Base Input Layer – Maryland Method Urban and Census Defined Places (CDP) of West Virginia**

**Data Source:** USDA Forest Service Northeastern Area (NA) GIS Team, "Places4MdMethod.shp" Maryland Method Urban and Census Defined Places (CDP), Available at: [ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Urban/Maryland\\_Method/](ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Urban/Maryland_Method/)

**Description and GIS Process:** The NA GIS team provided a shapefile "Places4MdMethod.shp" which contained urban and census defined places in the NA 20 state region. Urban areas for West Virginia were definition queried using the "STFIPS" field for values of "54" representing 282 urban areas. These were then exported to a UTM NAD 83 Zone 17 projection shapefile. The Maryland Method shapefile contains five attribute table fields for determining risk for urban forests using the following four criteria:

- Greater than state average population
- Greater than state average urbanized area
- Greater than state average impervious surface area
- Less than state average urban tree canopy (UTC)

The fifth field in this dataset contains a summary of the number of "Maryland Method" criteria exhibited by each urban area. This summary field was used to assign a reclassification value for each of the 282 urban areas in West Virginia. This initial base layer served as an input data source, as well as containing all additional input layers evaluated, with the results stored in the attribute table within fields added for each of the input layers. A reclassification field was also added for each input layer, which was used in a summary score for each sub-issue investigated, as well as two composite scores.



## Sub-Issue 1: Building Program Capacity at the Community Level

### Input Layer 1: Maryland Method Places

**Data Source:** USDA Forest Service Northeastern Area (NA) GIS Team, 2009. Maryland Method Urban and Census Defined Places (CDP) of West Virginia, Available at: [ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Urban/Maryland\\_Method/](ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Urban/Maryland_Method/)

**Description and GIS Process:** The NA GIS team provided a shapefile “Places4MdMethod.shp”, which contained urban and census defined places in the NA 20-state region. Urban areas for West Virginia were definition queried using the “STFIPS” filed for values of “54” representing 282 urban areas. These were then exported to a UTM NAD 83 Zone 17 projection. Fields were added to the attribute table for criterion calculations, criterion reclassification values, sub-issue scores, and composite scores. Using the Maryland Method number of criteria for values “3” or “4”, urban areas were identified. These values were used to reclassify urban areas for criteria 1 and 2.

### Input Layer 2: Community Accomplishment Reporting System (CARS) data

**Data Source:** USDA Forest Service, Community Accomplishment Reporting System (CARS) 2008. Available at: <ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Urban/CARS/>

**Description and GIS Process:** Using the CARS dataset, communities with no advocacy group, no ordinance, no professional staff, or no inventory/management plan were identified. These were used to reclassify urban areas for criterions 3-5.

### Sub-Issue 1 Urban Priority Area Determinations:

Using the two data sources identified above, six criteria were evaluated, two from the Maryland Method data and four from the CARS data. Below is a list of the criteria and the reclassification values used for each.

Criterion 1 – Maryland Method # of Criteria = 4 - Reclassified to 3

Criterion 2 – Maryland Method # of Criteria = 3 - Reclassified to 2

Criterion 3 – CARS - No Advocacy group - Reclassified to 2

Criterion 4 – CARS - No Ordinance - Reclassified to 2

Criterion 5 – CARS - No Inventory/Management plan - Reclassified to 2

Criterion 6 – CARS - No Professional staff - Reclassified to 1

Urban areas meeting these criteria were given the associated reclassified values and those not meeting them were given values of “0”. These reclassification values were calculated and stored in the West Virginia Maryland Method attribute table. Reclassified values were summed and tie scores were broken using the “POPDEN00” attribute field from the Maryland Method data. This represents an urban area population density from the year 2000 census. A ranking value was assigned to each urban area, using a “descending” order of population density, and used to assign



a final ranking based on the reclassification scores from the six input criteria. The final urban area rankings were broken into four quantiles with the top 25<sup>th</sup> percentile being classified as “High Priority” urban areas; the middle 50<sup>th</sup> percentile classified as “Medium Priority”; and the lower 25<sup>th</sup> as “Low Priority” urban areas. The 282 urban area priorities for sub-issue 1 are found in Maps 6.1 and the top 30 listed in table 6.1, both found on page 250.

## **Sub-Issue 2: Climate Change Mitigation and Energy Conservation**

### **Input Layer 1: Maryland Method Places ½ mile buffer**

**Data Source:** USDA Forest Service Northeastern Area (NA) GIS Team, 2009. Maryland Method Urban and Census Defined Places (CDP) of West Virginia, Available at: [ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Urban/Maryland\\_Method/](ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Urban/Maryland_Method/)

**Description and GIS Process:** The NA GIS team provided a shapefile “Places4MdMethod.shp”, which contained urban and census defined places in the NA 20 state region. Urban areas in West Virginia were definition queried using the “STFIPS” attribute field for values of “54”, representing West Virginia’s 282 urban areas. These were then exported to a UTM NAD 83 Zone 17 projection. Fields were added to the attribute table for criterion calculations, criterion reclassification values, sub-issue scores, and composite scores. Each urban area polygon was also buffered by ½ mile and used to calculate the forested area within each buffer used for criterion 3.

### **Input Layer 2: Priority Planting Index**

**Data Source:** Greenfield, Eric, J. 2009. “Priority Planting Index” (PPI). UNRI, Urban Natural Resources Institute. Calculated for RPA report, available at: <http://www.nrs.fs.fed.us/data/urban/> USDA Forest Service Northern Research Station Unit 08, Syracuse, NY.

**Description and GIS Process:** The Priority Planting Index (PPI) values provided in a USDA Forest Service Northern Research Station “places” shapefile were table joined and carried over into the Maryland Methods base input layer. The PPI incorporates population density, canopy green space, and tree canopy per capita into one index used to reclassify urban areas for criterion 1.

### **Input Layer 3: Housing Units per acre**

**Data Source:** ESRI. 2009. “placeply.shp”. Environmental Systems Research Institute, Inc. Redlands, CA.



**Description and GIS Process:** The “HOUSEUNITS” attribute table field values, provided in an ESRI 2009 “placepoly” shapefile, was table joined and carried over into the Maryland Methods base input layer. These values were calculated against the acreage of each urban area to derive housing units per acre or “development level” for each urban area. This calculation was used to establish the mean housing units per acre statewide and to reclassify urban areas for criterion 2.

#### **Input Layer 4: Forested urban area buffer**

**Data Source:** Riemann, Rachel; Lister, Tonya; Lister, Andy; Meneguzzo, Dacia; Parks, Sarah 2009. *Development of Issue-Relevant State Level Analyses of Fragmentation and Urbanization*. In: McWilliams, Will; Moisen, Gretchen; Czaplewski, Ray. Forest Inventory and Analysis (FIA) Symposium 2008; October 21-23, 2008; Park City, UT. Proc. RMRS-P-56CD. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 24 p. GIS grid “nrs\_fonly” accessed at: [ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Forest\\_Frag/Riemann/](ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Forest_Frag/Riemann/).

**Description and GIS Process:** The 2001 NLCD-derived “nrs\_fonly” 30 meter grid that was snapped to the West Virginia 30 meter grid was used to calculate the percentage of forest cover in the ½ mile buffer around each urban area in West Virginia. All 282 urban areas were buffered by ½ mile with the acreage calculated and this buffer was used as “zone” input using the fips code as the zone value in a “tabulate area” spatial analyst function. The resulting table was converted from square meters to acres and table joined to the Maryland Method shapefile to capture urban area ½ mile buffer forested acres. Each acreage value was compared against the total ½ mile buffer acreage of that urban area to derive the percent area forested in each buffered area. This percentage calculation was used to establish the mean percent forest cover to reclassify urban areas for criterion 3.

#### **Sub-Issue 2 Urban Priority Area Determinations:**

Using the four data sources identified above, three criteria were evaluated. Below is a list of the criteria and the reclassification values used for each.

Criterion 1 – Communities with a PPI of  $\geq 59$  percent (mean PPI) – Reclassified to 6

Criterion 2 – Development Level of  $\geq 1$  (mean) housing unit/acre – Reclassified to 2

Criterion 3 – Forest Cover of  $\leq 56$  percent (mean) within ½ mile of polygon perimeter expressed as percent of land area by community – Reclassified to 2

Urban areas meeting these criteria were given the associated reclassified values and those not meeting them were given values of “0”. These reclassification values were assigned to each of the 282 urban areas and inserted in the “WV Maryland Method” attribute table. Reclassified input layer values were summed for each urban area and tie scores were exhibited. Tie scores



were broken by using the “POPDEN00” attribute field existing in the Maryland Method data, where high population density was given priority. This field represents an urban area population density from the year 2000 census. A ranking value was assigned to each urban area based on a “descending” order for population density and used to assign a final ranking based on the population density and summed reclassification scores from the three input criteria. The final urban area rankings were broken into four quantiles with the top 25<sup>th</sup> percentile being classified as “High Priority” urban areas; the middle 50<sup>th</sup> percentile classified as “Medium Priority”; and the lower 25<sup>th</sup> as “Low Priority” urban areas. The 282 urban area priorities for sub-issue 2 are found in Map 6.2 on page 252 and the top 30 listed in Table 6.2 on page 253.

### **Sub-Issue 3: Population Dynamics and Resource Allocation**

#### **Input Layer 1: CARS data**

**Data Source:** USDA Forest Service, Community Accomplishment Reporting System (CARS) 2008. Available at: <ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Urban/CARS/>

**Description and GIS Process:** Using the CARS dataset communities with no advocacy group, no ordinance, or no inventory/management plan were identified. These were used to reclassify urban areas for criteria 3-5.

#### **Input Layer 2: Urban area Census population 2008**

**Data Source:** US Census Bureau, 2008. Population Estimates Program, West Virginia. Available online at: [http://factfinder.census.gov/servlet/GCTTable?\\_lang=en&-ds\\_name=PEP\\_2008\\_EST&CONTEXT=gct&mt\\_name=PEP\\_2008\\_EST\\_GCTT1\\_ST9&-tree\\_id=808&-redoLog=false&-geo\\_id=04000US54&-format=ST-9|ST-9S&-](http://factfinder.census.gov/servlet/GCTTable?_lang=en&-ds_name=PEP_2008_EST&CONTEXT=gct&mt_name=PEP_2008_EST_GCTT1_ST9&-tree_id=808&-redoLog=false&-geo_id=04000US54&-format=ST-9|ST-9S&-)

**Description and GIS Process:** A downloaded 2008 census spreadsheet with population estimates for each urban area in West Virginia was table joined with the Maryland Method shapefile and population estimates were carried over using the “field calculator”. Urban areas with less than 10,000 residents were identified and used for criterion 1.

#### **Input Layer 3: Urban area Census income estimates**

**Data Source:** US Census Bureau, 2006. Census 2000 Urban and Rural Classification. Available at: [http://www.census.gov/geo/www/ua/ua\\_2k.html](http://www.census.gov/geo/www/ua/ua_2k.html) (accessed fall 2009).

**Description and GIS Process:** A downloaded 2008 census spreadsheet with average income estimates for each urban area in the state was table joined with the Maryland Method shapefile and estimates were carried over using the “field calculator”. These estimates were used to calculate the mean average income for urban areas, and then further used to identify and reclassify urban areas for criterion 2.



### **Sub-Issue 3 Urban Priority Area Determinations:**

Using the three data sources identified above, five criteria were evaluated. Below is a list of the criteria and the reclassification values used for each.

Criterion 1 – Communities with population < than 10,000 - Reclassified to 3

Criterion 2 – Median household incomes < than State average of \$29,696 - Reclassified to 2

Criterion 3 – CARS - No Advocacy group - Reclassified to 2

Criterion 4 – CARS - No Ordinance - Reclassified to 2

Criterion 5 – CARS - No Inventory/Management plan - Reclassified to 1

Urban areas meeting these criteria were given the associated reclassified values and those not meeting them were given values of “0”. These reclassification values were calculated and stored in the WV Maryland Method attribute table. Reclassified values were summed and tie scores were broken using the “POPDEN00” attribute field from the Maryland Method data. This represents an urban area population density from the year 2000 census. A ranking value was assigned to each urban area using a “descending” order of population density and used to assign a final ranking based on the reclassification scores from the five input criteria. The final urban area rankings were broken into four quantiles with the top 25<sup>th</sup> percentile being classified as “High Priority” urban areas; the middle 50<sup>th</sup> percentile classified as “Medium Priority”; and the lower 25<sup>th</sup> as “Low Priority” urban areas. The 282 urban area priorities for sub-issue 3 are found in Map 6.3 on page 255 and the top 30 listed in table 6.3, also on page 255.

### **Sub-Issue 4: Air Quality**

#### **Input Layer 1: Maryland Method Places ½ mile buffer**

**Data Source:** USDA Forest Service Northeastern Area (NA) GIS Team, 2009. Maryland Method Urban and Census Defined Places (CDP) of West Virginia, Available at: [ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Urban/Maryland\\_Method/](ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Urban/Maryland_Method/)

**Description and GIS Process:** The NA GIS team provided a shapefile “Places4MdMethod.shp” which contained urban and census defined places in the NA 20-state region. Urban areas for West Virginia were definition queried using the “STFIPS” filed for values of “54” representing 282 urban areas. These were then exported to a UTM NAD 83 Zone 17 projection. Fields were added to the attribute table for criteria calculations, criterion reclassification values, sub-issue scores, and composite scores. Each urban area polygon was also buffered by ½ mile and used to calculate the forested area within each buffer used for criterion 4.

#### **Input Layer 2: EPA Non-Attainment Areas**

**Data Source:** WV GIS Technical Center, “airPollutionNonAttainmentAreas\_WVDEP\_200802\_utm83”, downloaded September, 2009 available at: <http://wvgis.wvu.edu//data/data.php>.



**Description and GIS Process:** A shapefile of EPA air quality “non-attainment areas” was downloaded and used to identify urban areas within these areas. Using a spatial selection query, urban areas within non-attainment areas were identified and used for criterion 1.

### **Input Layer 3: Priority Planting Index**

**Data Source:** Greenfield, Eric, J. 2009. “Priority Planting Index” (PPI). UNRI, Urban Natural Resources Institute. Calculated for RPA report, available at: <http://www.nrs.fs.fed.us/data/urban/> USDA Forest Service Northern Research Station Unit 08, Syracuse, NY.

**Description and GIS Process:** The Priority Planting Index (PPI) values provided in a USDA Forest Service Northern Research Station “places” shapefile were table joined and carried over into the Maryland Methods base input layer. The PPI incorporates population density, canopy green space, and tree canopy per capita into one index and was used for criterion 2.

### **Input Layer 4: EPA Toxic Release Inventory**

**Data Source:** US Environmental Protection Agency, 2007. Toxic Release Inventory (TRI) Program [http://www.epa.gov/tri/tridata/current\\_data/index.html](http://www.epa.gov/tri/tridata/current_data/index.html)

**Description and GIS Process:** A downloaded 2007 EPA TRI spreadsheet was used containing location information for 78 West Virginia facilities involved in a reported release incident of at least one of 20 known EPA carcinogens. The location information was used to generate a point feature class in ArcCatalog. These point features were then used in a spatial selection query, to identify urban areas within five miles of these reported point sources. Identified urban areas were used for criterion 3.

### **Input Layer 5: Forested urban area buffer**

**Data Source:** Riemann, Rachel; Lister, Tonya; Lister, Andy; Meneguzzo, Dacia; Parks, Sarah 2009. *Development of Issue-Relevant State Level Analyses of Fragmentation and Urbanization*. In: McWilliams, Will; Moisen, Gretchen; Czaplewski, Ray. Forest Inventory and Analysis (FIA) Symposium 2008; October 21-23, 2008; Park City, UT. Proc. RMRS-P-56CD. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 24 p. GIS grid “nrs\_fonly” accessed at: [ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Forest\\_Frag/Riemann/](ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Forest_Frag/Riemann/)

**Description and GIS Process:** The 2001 NLCD derived “nrs\_fonly” 30 meter grid that was snapped to the West Virginia 30 meter grid was used to calculate the percentage of forest cover in the ½ mile buffer around each urban area in West Virginia. All 282 urban areas were buffered by ½ mile with the acreage calculated. This buffer was used as “zone” input using the fips code as the zone value in a “tabulate area” spatial analyst function. The resulting table was converted from square meters to acres and table joined to the Maryland Method shapefile to capture urban area ½ mile buffer forested acres. Each acreage value was compared against the total ½ mile buffer acreage of that urban area to derive the percent area forested in each buffered area. This



percentage calculation was used to establish the mean percent forest cover to reclassify urban areas for criterion 4.

#### **Sub-Issue 4 Urban Priority Area Determinations:**

Using the five input layers identified above, four criteria were evaluated. Below is a list of the criteria and the reclassification values used for each.

Criterion 1 - Communities within EPA particulate matter ( $< 2.5 \mu\text{m}$ ) - Reclassified to 3

Criterion 2 - Priority Planting Index of  $\geq 59$  percent (mean PPI) Reclassified to 3

Criterion 3 - Communities within 5 miles of a facility releasing one of 20 known EPA carcinogens in 2007 – Reclassified to 2

Criterion 4 - Forest cover  $\leq 56$  percent (mean) within  $\frac{1}{2}$  mile of polygon perimeter expressed as percent of land area by community - Reclassified to 2

Urban areas meeting these criteria were given the associated reclassified values and those not meeting them were given values of “0”. These reclassification values were calculated and stored in the WV Maryland Method attribute table. Reclassified values were summed and tie scores were broken using the “POPDEN00” attribute field from the Maryland Method data. This represents an urban area population density from the year 2000 census. A ranking value was assigned to each urban area, using a “descending” order of population density, and then used to assign a final ranking based on the reclassification scores from the four input criteria. The final urban area rankings were broken into four quantiles with the top 25<sup>th</sup> percentile being classified as “High Priority” urban areas; the middle 50<sup>th</sup> percentile classified as “Medium Priority”; and the lower 25<sup>th</sup> as “Low Priority” urban areas. The 282 urban area priorities for sub-issue 4 are found in Map 6.4 on page 257, and the top 30 listed in Table 6.4 found on page 258.

#### **Sub-Issue 5: Public Drinking Water Quality and Quantity**

##### **Input Layer 1: Maryland Method Places $\frac{1}{2}$ mile buffer**

**Data Source:** NA GIS Team, Maryland Method Urban and Census Defined Places (CDP) of West Virginia, Available at:

[ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Urban/Maryland\\_Method/](ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Urban/Maryland_Method/)

**Description and GIS Process:** The NA GIS team provided a shapefile “Places4MdMethod.shp”, which contained urban and census defined places in the NA 20-state region. Urban areas for West Virginia were definition queried using the “STFIPS” attribute field for values of “54”, representing West Virginia’s 282 urban areas. These were then exported to a UTM NAD 83 Zone 17 projection. Fields were added to the attribute table for individual criterion calculations, criterion reclassification values, sub-issue scores, and composite scores. Each urban area polygon was also buffered by  $\frac{1}{2}$  mile and used to calculate the forested area



within each buffer for criterion 3. Additionally all urban areas within the eight county eastern panhandle region of West Virginia were identified as urban areas within the Chesapeake Bay watershed and used as input for criterion 4.

### **Input Layer 2: WVDEP Impaired streams**

**Data Source:** Montali, Dave. 2009. “WV2008\_Impaired\_by\_pollutant\_draft\_20090520.shp” shapefile. West Virginia Department of Environmental Protection.

**Description and GIS process:** The “WV2008\_Impaired\_by\_pollutant\_draft\_20090520.shp” shapefile, provided by WVDEP, was used to identify HUC-12 sub-watersheds with impaired streams and subsequently urban areas within impaired HUC-12 sub-watersheds. This was used as input for criterion 1.

### **Input Layer 3: HUC-12 sub-watershed boundaries**

**Data Source:** WV GIS Technical Center, “wvWbdHu12\_NRCS\_2009\_utm83.shp” downloaded September, 2009 available at <http://wvgis.wvu.edu//data/data.php>

**Description and GIS Process:** A HUC-12 polygon shapefile was clipped by the latest West Virginia county shapefile, “county\_24k\_drg\_utm83\_NEW.shp”, and used as the study area for all assessment GIS analysis datasets. This clipped HUC-12 dataset was first used for identifying sub-watersheds with impaired streams. Then, urban areas within these newly identified impaired sub-watersheds were selected using a “spatial selection query” and used as input for criterion 1.

### **Input Layer 4: Percent Impervious**

**Data Source:** Greenfield, Eric, J. 2009. “Priority Planting Index” (PPI). UNRI, Urban Natural Resources Institute. Calculated for RPA report, available at: <http://www.nrs.fs.fed.us/data/urban/> USDA Forest Service Northern Research Station Unit 08, Syracuse, NY.

**Description and GIS Process:** The “Impervious Percent” (IMPER) values provided in a USDA Forest Service Northern Research Station “places” shapefile, were table joined and carried over into the Maryland Methods base input layer. The IMPER is a calculation of the percentage of impervious surface area estimated in each urban area polygon and was used for criterion 2.

### **Input Layer 5: Forested urban area ½ mile buffer**

**Data Source:** Riemann, Rachel; Lister, Tonya; Lister, Andy; Meneguzzo, Dacia; Parks, Sarah 2009. *Development of Issue-Relevant State Level Analyses of Fragmentation and Urbanization*. In: McWilliams, Will; Moisen, Gretchen; Czaplewski, Ray. Forest Inventory and Analysis (FIA) Symposium 2008; October 21-23, 2008; Park City, UT. Proc. RMRS-P-56CD.



Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 24 p. GIS grid “nrs\_fonly” accessed at:

[ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Forest\\_Frag/Riemann/](ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Forest_Frag/Riemann/)

**Description and GIS Process:** The 2001 NLCD derived “nrs\_fonly” 30 meter grid that was snapped to the WV 30 meter grid was used to calculate the percentage of forest cover in the ½ mile buffer around each urban area in West Virginia. All 282 urban areas were buffered by ½ mile and the acreage was calculated. This buffer was used as “zone” input using the “fips” code as the zone value in a “tabulate area” spatial analyst function. The resulting table was converted from square meters to acres and table joined to the Maryland Method shapefile to capture urban area ½ mile buffer forested acres. Each acreage value was compared against the total ½ mile buffer acreage of that urban area to derive the percent area forested in each buffered area. This percentage calculation was used to establish the mean percent forest cover to reclassify urban areas for criterion 3.

### **Sub-Issue 5 Urban Priority Area Determinations:**

Using the five input layers identified above, four criteria were evaluated. Below is a list of the criteria and the reclassification values used for each.

Criterion 1 – Communities within a US EPA 303(d) impaired watershed - Reclassified to 4

Criterion 2 – Communities with impervious surfaces  $\geq$  15 percent of total area - Reclassified to 3

Criterion 3 – Forest cover of  $\leq$  56 percent (mean) within ½ mile of polygon perimeter expressed as percent of land area by community – Reclassified to 2

Criterion 4 – Communities within the Chesapeake Bay drainage - Reclassified to 1

Urban areas meeting these criteria were given the associated reclassified values and those not meeting them were given values of “0”. These reclassification values were calculated and stored in the WV Maryland Method attribute table. Reclassified values were summed and tie scores were broken using the “POPDEN00” attribute field from the Maryland Method data. This represents an urban area population density from the year 2000 census. A ranking value was assigned to each urban area using a “descending” order of population density, and then further used to assign a final ranking based on the reclassification scores from the four input criteria. The final urban area rankings were broken in to four quantiles with the top 25<sup>th</sup> percentile being classified as “High Priority” urban areas; the middle 50<sup>th</sup> percentile classified as “Medium Priority”; and the lower 25<sup>th</sup> as “Low Priority” urban areas. The 282 urban area priorities for sub-issue 5 are found in Map 6.5 on page 260, and the top 30 listed in Table 6.5 on page 261.



## Issue 6: Combined Assessment Composite Maps

Two composite maps were generated, further prioritizing urban areas of the state, by combining results from the individual sub-issue analyses described above. The composite maps used two separate methods for combining individual sub-issue high priority urban areas: one focusing on smaller urban areas with populations less than 10,000 residents; and the other on larger urban areas with more than 10,000 residents. Sub-issue 6: Recreation, did not have an individual GIS analysis, but instead was incorporated into these composite maps through the other five sub-issue inputs.

### Combined Assessment 1: Identifying Large, Urbanized Priority Areas

The Combined Assessment 1 composite map combined only high priority urban areas identified through the GIS analysis of sub-issues 1, 2, 4, and 5. This method was used to prioritize larger urban areas in the state and applied equally weighted reclassification values to the following sub-issues:

Criterion 1 – High priority communities of Sub-Issue 1 analysis: *Building Program Capacity at the Community Level* - Reclassified to 1.

Criterion 2 – High priority communities of Sub-Issue 2 analysis: *Climate Change Mitigation and Energy Conservation* - Reclassified to 1.

Criterion 3 – High priority communities of Sub-Issue 4 analysis: *Air Quality* - Reclassified to 1..

Criterion 4 – High priority communities of Sub-Issue 5 analysis: *Public Drinking Water Quality/Quantity* - Reclassified to 1.

Urban areas meeting these criteria were given the associated reclassified values and those not meeting them were given values of “0”. These reclassification values were calculated and stored in the West Virginia Maryland Method attribute table. Reclassified values were summed and tie scores were broken using the “POPDEN00” attribute field from the Maryland Method data. This represents an urban area population density from the year 2000 census. A ranking value was assigned to each urban area, using a “descending” order of population density, and then further used to assign a final ranking based on the reclassification scores from the four input criteria. The final urban area rankings were broken into four quantiles with the top 25<sup>th</sup> percentile being classified as “High Priority” urban areas; the middle 50<sup>th</sup> percentile classified as “Medium Priority”; and the lower 25<sup>th</sup> as “Low Priority” urban areas. The urban priority areas for Combined Assessment 1 are found in Map 6.6 on page 263, and the top 50 listed in Table 6.6 on page 264.



## Combined Assessment 2: Identifying Smaller, Urbanized Priority Areas

The Combined Assessment 2 composite map combined only high priority urban areas identified through the GIS analysis of sub-issues 2, 3, 4, and 5. This method was used to prioritize smaller urban areas in the state and applied equally weighted reclassification values for the following sub-issues:

Criterion 1 – High priority communities of Sub-Issue 2 analysis: *Climate Change Mitigation and Energy Conservation* - Reclassified to 1.

Criterion 2 – High priority communities of Sub-Issue 3 analysis: *Population Dynamics and Resource Allocation* - Reclassified to 1.

Criterion 3 – High priority communities of Sub-Issue 4 analysis: *Air Quality* - Reclassified to 1.

Criterion 4 – High priority communities of Sub-Issue 5 analysis: *Public Drinking Water Quality and Quantity* - Reclassified to 1.

Urban areas meeting these criteria were given the associated reclassified values and those not meeting them were given values of “0”. These reclassification values were calculated and stored in the WV Maryland Method attribute table. Reclassified values were summed and tie scores were broken using the “POPDEN00” attribute field from the Maryland Method data. This represents an urban area population density from the year 2000 census. A ranking value was assigned to each urban area, using a “descending” order of population density, and then further used to assign a final ranking based on the reclassification scores from the four input criteria. The final urban area rankings were broken into four quantiles with the top 25<sup>th</sup> percentile being classified as “High Priority” urban areas; the middle 50<sup>th</sup> percentile classified as “Medium Priority”; and the lower 25<sup>th</sup> as “Low Priority” urban areas. The urban priority areas for Combined Assessment 2 are found in Map 6.7 on page 265, and the top 50 listed in Table 6.7 on page 266.



## **Issue 7: Forest Health**

### **Data Sources:**

1. Krist, F.J., Jr.; Sapio, F.J.; Tkacz, B.M. 2007. *Mapping Risk From Forest Insects and Diseases*. FHTET 2007-06. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Forest Health Technology Enterprise Team. 115p. available at: [http://www.fs.fed.us/foresthealth/technology/pdfs/FHTET2007-06\\_RiskMap.pdf](http://www.fs.fed.us/foresthealth/technology/pdfs/FHTET2007-06_RiskMap.pdf)
2. McCauley Shawn. 2009. Forest Health Protection Aerial Survey Data. West Virginia Department of Agriculture.

### **Description and GIS Process:**

The data used in the GIS analysis to determine priority areas for Issue 7, Forest Health, were provided by the USDA-Forest Service National Insect Disease Risk Map (NIDRM). The raster datasets predict risk of basal area loss over a 15 year period at one kilometer resolution for individual forest pests and diseases. Additional geospatial data were collected in the field by the West Virginia Department of Agriculture through Forest Health Protection surveys. The data was compiled by pest or disease type, and through a Boolean weighted overlay, priority areas were determined. Additional priorities were assigned to habitats where pests and diseases are known to occur, or by habitats conducive to the introduction of pests and diseases yet to be found in West Virginia.



## **Issue 8: Utilization, Marketing, and Economic Development**

The geospatial goal of priority area delineation for Issue 8 was to establish priority county rankings by combining the reclassified values of sub-issue data source input layers. Seven input layers were established and summarized by county because some of the input data was only available at the county level. Summarized values were reclassified and combined to establish priority areas for forest industry retention. Further analysis was done to establish priority counties for both primary and secondary mill expansion. All input layer data was captured in the attribute table of a county boundary shapefile for West Virginia. The following is a description of each GIS input layer used, the reclassifications assigned to each, and how input layers were combined to derive priority areas.

### **Initial Base Input Layer – WV County Boundary**

**Data Source:** WV GIS Technical Center, “county\_24k\_drg\_utm83\_NEW.shp”. Data available at: <http://wvgis.wvu.edu//data/data.php>

**Description and GIS Process:** A county shapefile “county\_24k\_drg\_utm83\_NEW.shp” was used as a base input layer for storing the individual input layer calculations, and reclassified input layer values, as well as county priority scores. The “acres” field existing in this shapefile was used to calculate area percentages for many of the input layers. New fields were added to this shapefile representing all of the input layers and associated statistics and reclassification values to be calculated by county. These were used for county prioritization using the summarized scores of the individual input layers..

### **Input layer 1: FIA Biomass estimates (Metric tons per hectare 250 meter grid)**

**Data Source:** Ruefenacht, Bonnie. 2008. USDA Forest Service Remote Sensing Applications Center “conus\_forest\_biomass\_mg\_per\_ha.img”, Available at: <http://svinetfc4.fs.fed.us/rastergateway/biomass/>

**Description and GIS process:** Using the WV county shapefile as an analysis mask in the raster calculator, the West Virginia portion of the raw “conus\_forest\_biomass\_mg\_per\_ha.img” file was extracted and projected to a UTM NAD 83, Zone 17 projection. Then using the “zonal statistics” function within the spatial analyst extension of ArcINFO, the mean value of metric tons per hectare of biomass was summarized by county. The resulting table was joined to the WV county shapefile and resulting values were carried over. The resulting values were then reclassified into “High”, “Medium” and Low” (HML) classes using a natural breaks algorithm and assigned values of “3”, “2” and “1” respectively for each of the state’s 55 counties. Reclassification values were captured in the county shapefile to be used in a priority county summary.

**Input layer 2: Percent county forested** (2001 NLCD 30 meter grid)

**Data Source:** Riemann, Rachel; Lister, Tonya; Lister, Andy; Meneguzzo, Dacia; Parks, Sarah 2009. *Development of Issue-Relevant State Level Analyses of Fragmentation and Urbanization*. In: McWilliams, Will; Moisen, Gretchen; Czaplewski, Ray. Forest Inventory and Analysis (FIA) Symposium 2008; October 21-23, 2008; Park City, UT. Proc. RMRS-P-56CD. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 24 p. GIS grid “nrs\_fonly” accessed at: [ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Forest\\_Frag/Riemann/](ftp://ftp2.fs.fed.us/incoming/nagis/Assessments/Forest_Frag/Riemann/).

**Description and GIS Process:** Using the 2001 NLCD derived “nrs\_fonly” 30 meter grid that was snapped to the West Virginia 30 meter snap grid, the square meters of forest cover in each county of the state was determined. The county shapefile was used as “zone” input using the “fips” code as the zone value in a “tabulate area” spatial analyst function. The resulting table was converted from square meters to acres and table joined to the county shapefile to capture forested acres. These acreages were calculated against each county’s total acres to derive the percent area forested in each county. This percentage calculation was used to establish HML reclassifications and associated values of “3”, “2” and “1” for each county. Reclassification values were captured in the county shapefile to be used in a priority county summary.

**Input layer 3: Large saw timber estimates** (board feet per acre)

**Data Source:** U.S. Forest Service. n.d. FIA data online. Washington, DC: U.S. Department of Agriculture, Forest Service, Forest Inventory and Analysis Program. <http://fiatools.fs.fed.us>. Accessed July 2009.

**Description and GIS process:** A table with county summary of estimated board feet per acre of large saw timber downloaded from FIA was joined to the WV county shapefile. Estimates by county were HML reclassified using natural breaks algorithm and assigned values of “3”, “2” and “1” respectively. Reclassification values were captured in the county shapefile to be used in a priority county summary.

**Input layer 4: Above ground carbon estimates** (metric tons per hectare)

**Data Source:** USDA. Forest Service. 2006. Carbon Estimator (<http://ncasi.uml.edu/COLE/cole.html>).

**Description and GIS process:** A table with county summaries of above ground carbon estimates for metric tons per hectare downloaded from FIA was joined to the West Virginia county shapefile. Estimates by county were HML reclassified using natural breaks algorithm and



assigned values of “3, “2” and “1” respectively. Reclassification values were captured in the county shapefile to be used in a priority county summary.

#### **Input layer 5: Percent of county in large 1,000 acre tax parcels (Percent area of county 2009)**

**Data Source:** Foreman, James. WV Tax Department, Personal communications regarding information on large tax parcels by county to Steve Harouff, fall 2009.

**Description and GIS process:** A table with a county summary of 1,000 acre and greater tax parcels provided by the West Virginia Tax Department was joined to the WV county shapefile. Large parcel acreages by county were calculated against county total acreage to derive percentage of county in large parcel ownership. County percentages were HML reclassified using natural breaks algorithm and assigned values of “3, “2” and “1” respectively. Reclassification values were captured in the county shapefile to be used in a priority county summary.

#### **Input layer 6: Percent Harvested 2005-2009 (Percent area of county harvested)**

**Data Source:** WVDOF GIS. 2009. Harvest Locations 2005-2009. *Note: This is point data not available by polygon, so these acreages may not be exactly correct for each county; but do indicate the general area in which timber was harvested.*

**Description and GIS process:** Using a point shapefile of harvest locations with acres harvested associated with each point, a “spatial join” was used to calculate the total harvest acres by county. The resulting shapefile was table joined to the county base shapefile, so that harvest acres by county could be carried over and used to calculate the percentage of land area harvested. Once percentages were calculated, they were reclassified using a natural breaks algorithm and assigned values of “3”, “2”, and “1”, respectively. Reclassification values were captured in the county shapefile and used in a priority county summary.

#### **Input layer 7: Primary Mill Production (Annual MBF 2005)**

**Data Source:** Luppold, W. J. 2009. USDA Forest Service. Personal communications regarding information on sawmill production in WV fall 2009.

**Description and GIS process:** A table with a county summary of primary mill production in million board feet for 2005 provided by the USDA Forest Service was joined to the WV county shapefile. County production was HML reclassified using natural breaks algorithm and assigned values of “3, “2” and “1” respectively. Reclassification values were captured in the county shapefile and used in a priority county summary.



## **Issue 8: Priority Area Determinations**

### **Retention of Forest Industry**

Using the seven input layers described above, a composite score was derived by adding the reclassified values. Scores were then broken up into HML classifications using a natural breaks algorithm. The HML classes represent priorities for forest industry retention as shown in Map 8.7 on page 323.

### **Expansion of the Primary Forest Industry**

Expanding on the priority counties for forest industry retention, an analysis of counties where primary forest industry expansion could occur was explored. Using input layer 7 “Primary Mill Production” described above, but reversing the reclassification so that low primary mill production would then have the highest priority expressed through reclassified values of “3”. Then using the reversed reclassification values combined with the priority counties from the retention of industry analysis, resulted in an expansion of primary industry score. The process involved reclassifying the High and Medium identified priority retention counties to values of “1” and the remainder as “0”. These newly classified retention counties were combined with input layer 7, with low primary mill production given priority, resulting in combined scores where the highest scores indicate counties with forest industry potential and potential primary mill expansion. The resulting combined scores were given HML classifications using a natural breaks algorithm. The HML classes represent priorities for primary forest industry expansion shown in Map 8.8 on page 324.

### **Expansion of the Secondary Forest Industry**

Expansion of secondary manufacturing was also explored and used the identified “High” and “Medium” priority retention counties reclassified to values of “1” and the remainder as “0”. It was assumed secondary manufacturing is highly influenced and dependent on primary mill production represented in input layer 7. Using input layer 7 described above, with original classifications prioritizing high primary mill production, and then combined with the priority counties from the retention of industry analysis, resulted in a score for priority counties where expansion of secondary industry would be associated. The resulting combined score indicates counties with forest industry potential and where high primary mill production exists to support potential secondary forest industry expansion. The resulting combined scores were given HML classifications using a natural breaks algorithm. The HML classes represent priorities for secondary forest industry expansion shown in Map 8.9 on page 325.

**3. Data Gaps**

<b>WVDOF and WVDA Identified Data Gaps</b>
<b>Issue 1</b>
Tax parcel GIS data (Land Ownership).
Better data on wind farm potential.
<b>Issue 2</b>
Better and more consistent conservation education data collection within the WVDOF.
Information from colleges/teachers/schools on how to better disseminate forestry information.
Determine how to correlate WVDOF conservation education activities into the state's CSO's.
<b>Issue 3</b>
Continue to collect and utilize more current FIA data and NWOS data for all aspects of sub-issue 1 for the 2015 Assessment/Strategy revision.
Need spatial locations of Tree Farms and Managed Timber acres.
Need tax parcel location data for all counties in the state. This will help determine number of "managed" forest acres in the state, and will also help us to more accurately locate NIPF lands on a state map.
More scientific information about specific impacts of non-native invasive species.
Better spatial information on the location of specific potential planting sites on previously mined lands.
Better public lands GIS data and acreage figures.
Gather specific information on the causes and locations of forest regeneration problems.
<b>Issue 4</b>
Polygon or area data on logging operations.
Well defined perennial/intermittent streams data layer.
Better soils data.
<b>Issue 5</b>
A complete list of Volunteer Fire Department locations, wildfire responsibilities, and coverage areas.
An up-to-date and representative fuel model map, usually produced by Landfire. (Multi-state data gap).
Locations of potential high risk wildfire fuels areas.
<b>Issue 6</b>
Better data on recreation potential.
Better urban area boundary delineation.
More current and higher resolution canopy cover data and maps.

<b>Issue 7</b>
Detailed resource location identification.
Lack of private landowner involvement.
Funding / Co-op money for private land protection / treatments.
Better information on the extent of invasive plant infestations.
Higher resolution raster data from USFS NIDRM.
More information in regard to the various hardwood declines.
<b>Issue 8</b>
More accurate information on climate change, biomass potential, and carbon sequestration.
Tax parcel data.
Secondary industry data base (economic potential).



Photo courtesy of Barb Breshock, WVDOF.



#### 4. Collaboration Timeline

The following table is a chronological list of meetings and conference calls held or attended by WVDOF staff, as well as personal communications with various coordinating agencies, stakeholders, committees and individuals involved with the Statewide Assessment and Strategy. The coordinating efforts listed below provided much of the data, stakeholder input, feedback, and discussion on collaboration that supports the Statewide Assessment and Strategy. This information is a more detailed listing of collaboration efforts over the last year that expands on Section 6: Collaboration with Others of this Assessment and provides initial input for in the development of the State Strategy.

West Virginia Division of Forestry State-Wide Assessment Stakeholder Coordination and Collaboration Timeline (Note: Committees with “*” have a list of members in separate tables that follow this timeline).			
Date	Meeting type	Agency / Attendees (Title)	Purpose
4/2/2009	Meeting	WVDA / Clark Haynes (Assistant Director), Shawn McCauley (GIS Specialist), Jill Rose (Forest Pathologist), Tim Tomon (Forest Entomologist) - USDA FS / Dan Twardus (Group Leader Forest Health Management) - State of WV / Tony Simental (State GIS Coordinator)	<b>Forest Resource Assessment and Strategy (FRAS)</b> overview / review NA guidance documents / explore potential forest health issues / data available.
4/21/2009	Meeting	WVDOF / Assessment Committee* (Program Managers and WVDA Staff)	Inform newly formed Assessment Committee. Kick-off meeting on FRAS overview / review NA guidance documents / explore potential issues / data available.
5/3/2009	Meeting	USDA NRCS / Tim Prescott (GIS analyst)	FRAS overview/ availability and quality of soils data state-wide.
5/4/2009	Meeting	The Nature Conservancy / Beth Wheatley (Director of Government Relations), Keith Fisher (Director of Conservation), Amy Cimarillo (Director of Science and Stewardship), Allison Jones (GIS Specialist)	FRAS overview and background; explore potential issues and data available. Sought input.
5/4/2009	Meeting	WVDNR / Mike Daughtery (GIS Specialist)	FRAS overview and background; explore potential issues and data available.
05/11-14/09	FRPC Meeting, Portland Maine	USFS personnel and NA-wide 20 State DOF Planners and GIS staff – Kincaid and Harouff WVDOF	FRAS update meeting with collaboration efforts etc. including GIS data availability and potential regional Multi-state issues identified.
5/21/2009	Meeting	WVDOF / Assessment Committee*	Update committee on NA FRPC meeting in Maine. Issue identification refined.
5/26/2009	Meeting	MNF / Sam Lammie (GIS Coordinator), Jack Tribble (Ecosystems Staff Officer) and Glen Juergens (Forest Silviculturist)	FRAS overview, explore potential issues and data available. Sought input.
6/2/2009	Phone Conference	WVDO / John McGarity (Senior Planner)	FRAS overview, explore potential issues and data available / SCORP Plan.
6/5/2009	Phone Conference	USFWS Ohio River Islands NWR / Patricia Morrison (Wildlife Biologist) and Laura Hill (Biologist/Ecologist)	FRAS overview, explore potential issues and data available. Sought input.



Date	Meeting type	Agency / Attendees (Title)	Purpose
6/10/2009	Meeting	State of WV / Tony Simental (State GIS Coordinator)	Review WV county Tax parcel Data and GIS copy was provided.
6/17/2009	Phone Conference	The Nature Conservancy / Beth Wheatley (Director of Government Relations)	Sought feedback and discuss State Issue input / FMRC input and TNC data use for the Assessment.
7/15/2009	Phone Conference	Monongahela National Forest / Sam Lammie (GIS Coordinator)	Sent latest State Issues list to Sam Lammie to share and discuss potential input/data.
7/16/2009	Meeting	Forest Stewardship Committee**	FRAS overview, explore potential issues and data available.
7/20/2009	Personal Communication	USFWS Canaan Valley NWR / Ken Sturm (Wildlife Biologist) and Marquette Crocket (Wildlife Biologist)	Provided information and shared GIS data. Sought input.
7/20/2009	Meeting / Phone Conference	WVU / Shawn Grushecky (Research Associate and Assistant Director, Appalachian Hardwood Center)	Discuss WVU's role in development of the FRAS.
7/28/2009	Meeting	WVDOF / Assessment Committee*	Update committee on FRAS progress / latest NA guidance/ Data available/Analytics needed.
7/30/2009	Meeting	State Tree Farm Committee****	Share FRAS overview and background / sought input on issues and data available.
7/31/2009	Phone Conference	WVDA / Shawn McCauley (GIS Specialist)	Share and review of MNF and USFWS Canaan Valley NWR data.
8/1/2009	Personal Communication	Project Learning Tree (National Level) / Vanessa Bullwinkle (Director of Communications) and Jackie Stallard (Manager, Education Programs)	FRAS overview and background, explore potential information on PLT and No Child Left Inside.
8/5/2009	Meeting	WVFA / Cinda Francis (SFI Forester) and Dave Posca (Tree Farm Chairman)	Explored the availability of Tree Farm data and PLT accomplishments.
8/11/2009	Phone Conference	WVDEP / Dave Montali (TMDL Program Manager) and Jim Summers (Environmental Resource Specialist III)	Discussed potential use of TMDL data / Chesapeake Bay Initiative / shared latest 303d impaired streams GIS data. Sought input.
8/12/2009	Phone Conference	WVFA / Cinda Francis (SFI Forester)	Discussed Tree Farm acreage by county list provided by WVFA.
8/20/2009	Personal Communication	WVDE / Jason Hughes (Coordinator of Agriculture, Science and Natural Resources)	Provided information on forestry in public schools.
8/25/2009	Phone Conference	Monongahela National Forest / Sam Lammie (GIS Specialist)	Discussed and worked on list of total number of acres under management on the forest.
8/26/2009	Phone Conference	WV Tax Department / James Foreman (Database Specialist)	Discussed and reviewed Managed Timber Account database provided by WV Tax Department.
9/1/2009	Personal Communication	WVDNR / Art Shomo (Project Wild Coordinator)	FRAS overview and background, explore potential information on Project Wild.
9/2/2009	Meeting	WVU / Shawn Grushecky (Research Associate and Assistant Director, Appalachian Hardwood Center)	Reviewed and discussed potential GIS data available and Assessment narrative format.



Date	Meeting type	Agency / Attendees (Title)	Purpose
9/3/2009	Meeting / Phone Conference	WVU / Shawn Grushecky (Research Associate and Assistant Director, Appalachian Hardwood Center)	Reviewed and discussed Assessment narrative drafts and formats.
9/4/2009	Personal Communication	Ted Harriman Forest Industries Camp / Al Miller (Camp Director)	FRAS overview and background explore, potential information on educational programs offered.
9/7/2009	Meeting	WVU / Shawn Grushecky (Research Associate and Assistant Director, Appalachian Hardwood Center)	Continued reviewed and discussion of Assessment narrative format.
9/9/2009	Meeting	WVDOF / Assessment Committee*	Assessment Committee update meeting to review the current draft Assessment issues, timetable, planned multi-state issues, and next steps.
9/15/2009	Meeting	State GIS Steering Committee	Inform committee of FRAS, provided background overview, share identified issues; explore potential data available and collaboration.
9/16/2009	Meeting	State Urban and Community Forestry Council*****	WVDOF informed council of FRAS, provided background overview and Urban Sustainability Issue results. Sought input.
9/22/2009	Personal Communications	USFS, Chesapeake Bay Program /Sally Clagget (Program Coordinator) and Judy Okay (Riparian Forest Buffer Specialist)	Provided information on the Chesapeake Bay Program.
9/24/2009	Phone Conference	TNC Conservation Planning Committee	WVDOF informed committee of FRAS, provided background overview, explored potential issue input, and data available and collaboration.
9/28/2009	Personal Communication	WVDNR Wildlife Section /Gary Foster (Supervisor of Game Management)	FRAS overview and background, discuss Project Wild accomplishments.
10/1/2009	Personal Communication	Auburn University / Tommy Futral (Extension Coordinator)	FRAS overview and background, explore potential information on the National 4-H Invitational.
10/2/2009	Personal Communication	WV Conservation Agency / Amy Belcher (Conservation Outreach Specialist) and Carla Hardy (Watershed Program Specialist)	FRAS overview and background, explore potential information on Envirothon and Chesapeake Bay Programs.
10/2/2009	Personal Communication	Pennsylvania State University / Dave Jackson (Forest Resources Extension Educator)	FRAS overview and background, explore potential information on National 4-H Invitational.
10/2/2009	Personal Communication	WV Environmental Education Association / Eriks Janelsin ( Director of the Schrader Environmental Education Center)	FRAS overview and background, explore potential information on WVEEA Programs.
10/2/2009	Personal Communication	WVDEP / Diana Haid (State Environmental Coordinator), Alana Hartman (Basin Coordinator) and Theresa Koon (Non-Point Source Program Manager)	FRAS overview and background, explore potential information on Jr. Conservation Camps, Youth Conservation Program, and Chesapeake Bay Programs.
10/5/2009	Personal Communication	WVDEP / Rose Long (Project WET Coordinator)	FRAS overview and background, explore Project WET program information.



Date	Meeting type	Agency / Attendees (Title)	Purpose
10/6/2009	Personal Communication	Monongahela National Forest / Cindy Sandeno (Ecologist)	FRAS overview and background, discuss and share information on the Potomac Highlands Cooperative Weed and Pest Management Area.
10/10/2009	Personal Communication	Plum Creek	FRAS overview and background and explore potential GIS data available.
10/10/2009	Personal Communication	The Forest Land Group	FRAS overview and background and explore potential GIS data available.
10/10/2009	Personal Communication	MeadWestvaco	FRAS overview and background and explore potential GIS data available.
10/10/2009	Personal Communication	Pardee / Curtin	FRAS overview and background and explore potential GIS data available.
10/11/2009	Personal Communication	Allegheny Wood Products	FRAS overview and background and explore potential GIS data available.
10/11/2009	Personal Communication	Sun Lumber	FRAS overview and background and explore potential GIS data available.
10/19/2009	Phone Conference	WVDNR / Mike Daughtery (GIS Specialist)	Discussed and reviewed WVDNR GIS data, including Landscape Integrity and Natural Heritage Database; RTE species data from the WWCAP.
10/21/2009	Meeting	Forest Stewardship Committee***	WVDOF presented an update on the FRAS to the Forest Stewardship Committee.
10/23/2009	Personal Communication	USDA NRCS / Barb McWhorter (Staff Forester) and FSA / Kevin Hinkle (FSA Program Specialist)	Inquired about and discussed NRCS and FSA program accomplishments in EQIP, WRP, CRP and CREP.
10/28/2009	Meeting	WV Green Infrastructure Committee	WVDOF informed committee of FRAS and provided background overview, shared identified issues, explore potential data available, and collaboration.
10/30/2009	Meeting	WVDOF / Assessment Committee*	Update committee on FRAS progress / latest NA guidance. Resolve concerns / set timetables.
11/2/2009	Personal Communication	USDA FS / Devin Wanner (Public Relations) and Chuck Reger (Information Management & Analysis Group Leader)	Discussed and provided information on No Child Left Inside, PLT, Environmental Literacy Plans and MACE.
11/2/2009	Phone Conference	WVDA / Shawn McCauley (GIS Specialist)	Discussed Forest Health section revisions.
11/9/2009	Meeting	WVU / Shawn Grushecky (Research Associate and Assistant Director, Appalachian Hardwood Center)	Discussed work on Utilization, Marketing and Workforce Development section – Issue 8.
11/10/2009	Meeting	West Virginia Invasive Species Working Group	WVDOF provided background overview of FRAS; sought input.
11/12/2009	Personal Communication	WV Tax Department / James Foreman (Database Specialist)	Reviewed and discussed latest Tax parcel GIS data and its use for the State Assessment.
11/13/2009	Personal Communication	USDA FSA / Kevin Hinkle (FSA Program Specialist)	Provided CRP and CREP accomplishments in WV; sought input.



Date	Meeting type	Agency / Attendees (Title)	Purpose
11/13/2009	Personal Communication	WVGES / Susan Kite	Reviewed and discussed Oil and Gas well GIS data and its use for the State Assessment.
11/16-19/09	Meeting	USDA S&PF National Meeting for FRAS in Colorado, Harouff attended (WVDOF)	Participated in FRAS update meeting with other State's Forest planners and GIS staff, as well as USDA staff and various speakers.
11/23/2009	Personal Communication	WV Army National Guard / Mike Plevich (Natural Resource Specialist)	Provided information on acreages and management plans for forested lands within Camp Dawson.
11/30/2009	Personal Communication	USFWS Canaan Valley NWR / Ken Sturm (Wildlife Biologist)	Provided information on acreages and management plans for forested lands.
11/30/2009	Personal Communication	USACE (Pittsburgh, PA District) / Sheliah Harlan (Manager)	Provided information on acreages and management plans for forested lands on USACE properties in WV.
12/2/2009	Personal Communication	WVDNR Wildlife Section /Gary Foster (Supervisor of Game Management)	Provided information on Wildlife Management Area acreage breakdowns
12/3/2009	Personal Communication	USDA NRCS / Barb McWhorter (Staff Forester)	Provided EQIP, CRP and CREP accomplishments in WV.
12/4/2009	Personal Communication	USFWS Ohio River Islands NWR /Patricia Morrison (Wildlife Biologist)	Provided information on acreages and management plans for forested lands.
12/9/2009	Personal Communication	NPS /John Perez (Biologist)	Provided information on acreages and management plans for forested lands for the New River Gorge National River, Gauley River Recreation Area and The Bluestone National Scenic River.
12/11/2009	Personal Communication	WVDO / John McGarity (Senior Planner)	Discussed and provided latest information on SCORP and web link.
12/14/2009	Personal Communication	WVDEP / Richard Darnell (Program Manager Planning)	Provided latest data on mine breaks (burning coal seams) in the state.
12/15/2009	Meeting	Monongahela National Forest / Clyde Thompson (Forest Supervisor), Kate Goodrich-Arling (Public Affairs), Sam Lammie (GIS Program Manager), David Ede (Forest Planner), Nadine Pollock (Natural Resources Group Leader)	WVDOF provided a briefing on the initial draft of the Statewide Assessment with members of the Monongahela National Forest for potential feedback and input.
12/15/2009	Personal Communication	George Washington and Jefferson N. F. / Karen Overcash (Planning Team leader) and Ken Landgraf (Planning Staff Officer)	Provided acreages and management prescription data for the WV portions of the George Washington and Jefferson National Forests.
12/20/2009	Personal Communication	WVDNR Wildlife Resources Section / Terry Jones (Staff Forester)	Provided information on forest timber sales on WMAs and USACE properties.
1/4/2010	Personal Communication	WVDNR Land & Streams / Chris Cook, and Steve Rauch (District Wildlife Biologist)	Provided acreages and management prescription data for the WV Wildlife Management Areas.



Date	Meeting type	Agency / Attendees (Title)	Purpose
1/4/2010	Personal Communication	USACE (Huntington, WV District) / Kimberly Barnett (Natural Resource Specialist)	Provided information on acreages and management plans for forested lands on USACE properties in WV.
1/5/2010	Personal Communication	Monongahela National Forest / David Ede (Forest planner)	Provided information on forest timber sales.
1/6/2010	Meeting	State Technical Committee****	WVDOF presented an update on the FRAS to the State Technical Committee, solicited input.
1/14/2010	Meeting	WVDOF / Assessment Committee*	FRAS progress reports, identify data gaps, and discuss summary section; identify other information needed.
1/15/2010	Conference Call	USFS NA / Sherri Wormstead, Tom Luther and Bob Lueckel with Harouff/Kincaid WVDOF	Informal review of the State Assessment draft with members of the USFS.
1/19/2010	Personal Communication	WVDNR Wildlife Section / Jim Crum (Wildlife Biologist)	FRAS overview and background explore potential deer density data available and a map was provided.
1/20/2010	Meeting	Forest Stewardship Committee**	WVDOF presented an update on the FRAS to the Forest Stewardship Committee, solicited input.
1/29/2010	Meeting	USFWS / Ken Sturm (Wildlife Biologist), Patricia Morrison (Wildlife Biologist) - USACE /Shekinah Bailey (Manager), Lea Bodmer (Reality Specialist) - WVU Division of Forestry/ Joe McNeel (Director) - WVDNR / Bob Beanblossom (District Administrator), Curtis Taylor (Chief of the Wildlife Resources Section), Steve Brown (Wildlife Conservation Action Plan Coordinator) - NPS / John Perez (Biologist)	WVDOF shared latest draft of the State Assessment with state and federal land managers, as well as the Director of the WVU Division of Forestry for feedback and input.
2/10/2010	Meeting	AB Brooks Symposium - Charleston, WV	Kincaid presented WV FRAS overview and background.
2/22/2010	Conference Call	Forest Resource Planning Committee (USFS and State Agency Forestry Planners)	Review / discuss progress of FRAS /Share Multi-state Issues.
2/22/2010	Conference Call	NAASF/ State Foresters /USFS / Ian McFarland (Staff Liaison)	Review / discuss progress of FRAS /Share Multi-state Issues
2/24/2010	Meeting	State Urban and Community Forestry Council*****	WVDOF presented an update on the FRAS.
3/1/2010	Personal Communication	KYDOF / Leah MacSwords (Director / State Forester)	Shared information on Multi-State Priority Areas.
3/4/2010	Conference Call	Forest Resource Planning Committee	Input on integrating grant narratives with FRAS / Update on FRAS.
3/12/2010	Meeting	USFS/ Bob Lueckel and Karen Sykes	Preliminary discussions on upcoming changes to Forest Stewardship Program and its incorporation into the FRAS.
3/12/2010	Meeting	Retired Director of WVDOF / Bill Gillespie (Consulting Forester)	Reviewed comments and suggested edits to current Assessment draft.



Date	Meeting type	Agency / Attendees (Title)	Purpose
4/20/2010	Meeting (Grant County, WV)	Members of the CWPMA and local land owners	Gather input for implementing projects for the CWPMA program.
4/22/2010	Meeting (Pendleton County, WV)	Members of the CWPMA and local land owners	Gather input for implementing projects for the CWPMA program.
4/21/2010	Meeting	State Technical Committee Meeting****	WVDOF provided an update on FRAS.
4/22/2010	Meeting	Forest Stewardship Committee Meeting**	WVDOF provided an update on FRAS.
4/28/2010	Conference Call	USFS/ Bob Lueckel Tom Luther, Sherri Wormstead and Karen Sykes	Informal review of the State Strategy draft to date with members of the USFS.
5/3-7/2010	Edit	WVU / Shawn Grushecky and staff (Research Associate and Assistant Director, Appalachian Hardwood Center)	Edit review of the Assessment.
5/13-14/2010	Meeting	Monongahela National Forest	Update of the FRAS; discuss ideas for strategies and implementation.
5/25/2010	Meeting	WVHAZ-Wood Industries Summit	Kincaid shared State Assessment and Strategy information with attendees.
6/1-2/2010	Meeting	Appalachian Fire Learning Network participants, WV/VA border project	Discuss strategies for implementing prescribed fire and fire adaptive ecosystems for (Sub-Issue 5.7-8).
6/8/2010	Meeting	Monongahela National Forest / Nadine Pollock, Glen Juergens, Cindy Sandeno, Jane Bard, Evan Burk	Meet at Clements State Tree Nursery to discuss future planting needs for potential partnership projects.



AB Brooks Forestry Symposium Legislative Reception. (Photo courtesy of Cinda Francis; WVFA).



## Committee Member Lists

<b>* Assessment Committee Member List</b>		
<b>Agency / Organization</b>	<b>Contact</b>	<b>Title</b>
West Virginia Division of Forestry (WVDOP)	Randy Dye	Director/State Forester
	Dan Kincaid	Assistant State Forester - Planning
	Greg Cook	Deputy State Forester
	Ben Webster	Assistant State Forester - Forest Protection
	Jeremy McGill	Assistant State Forester - LSCA & Water Quality
	Bob Hannah	Urban Forestry Coordinator
	John Rowe	Forest Legacy Forester
	Barb Breshock	State Lands Manager
	Linda Carnell	Forestry Specialist - Logging
	Steve Harouff	GIS Specialist
West Virginia Department of Agriculture (WVDA)	Clark Haynes	Plant Industries Division Assistant Director (Forest Health Specialist)
	Jill Rose	CFHP Coordinator/Forest Pathologist
	Tim Tomon	Forest Entomologist
	Shawn McCauley	GIS Analyst
(Contributions to Issue 8) WVU-Appalachian Hardwood Center	Shawn Grushecky	Research Associate and Assistant Director



<b>** Stewardship Committee Member List</b>		
<b>Agency / Organization</b>	<b>Contact</b>	<b>Title</b>
West Virginia Division of Forestry (WVD OF)	Randy Dye	Committee Chairman - Director / State Forester
	Dan Kincaid	Committee Liaison - Assistant State Forester – Stewardship / Forest Management
	John Rowe	Sub-Committee Liaison - Forest Legacy Program Coordinator
USDA NRCS	Barb McWhorter	Staff Forester
USDA FSA	Kevin Hinkle	FSA Program Specialist
TNC	Beth Wheatley	Director of Government Relations
WVDNR Parks & Recreation	Bob Beanblossom	District Administrator
WVU Division of Forestry	Dave McGill	Forest Resources Extension Specialist
WV Farm Bureau, Inc	Don Michael	Director of Government Affairs
Christmas Tree Growers Association	Ed Grafton	President
Non-Industrial Private Forest Landowners	French Armstrong	Land owner
WVDNR Wildlife	Gary Foster	Supervisor of Game Management
WV Woodland Owners Association	Russ Richardson	Registered Forester
Canaan Valley Institute (CVI)	Jennifer Newland	Stakeholder Services & Assessment Director
WV Association of Conservation Districts	Joe Gumm	President
Consulting foresters	John Bell	Consulting Forester
USDA Forest Service	Karen Sykes	Forest Resources Group Leader
WV Conservation Agency	Larry Layman	Area Director
WVFA	Dick Waybright	Executive Director
WV Department of Agriculture	Steve Hannah	Deputy Commissioner
Association of Consulting Foresters	Bill Gillespie	Retired Director of WVD OF / Consulting Forester



<b>*** State Technical Committee Member List</b>		
<b>Agency / Organization</b>	<b>Contact</b>	<b>Title</b>
Beef Cattlemen's Association	Jim Bostic	Executive Secretary
COE-Huntington Dist.	Ginger Mullins	Acting
WVU College of Agriculture, Forestry & Consumer Sciences	Dr. David W. McGill	Extension Specialist Forest Resources Management
Department of Agriculture	Honorable Gus Douglass	Commissioner of Agriculture
DEP-Division of Water & Waste Management	Scott Mandirola	Director
DEP-Division of Water & Waste Management	Teresa Koon	Assistant Director
WVDOP	Dan Kincaid	Assistant State Forester
WVDNR	Roger Anderson	Program Administrator
Farm Bureau	Jamie Kinsey	Secretary/Treasurer
USDA Farm Service Agency	Kevin S. Hinkle	Supervisory Agriculture Program Specialist
	Doug Cyphers	Acting State Executive Director
FSA State Committee	Clair Cottrill	Chairperson
Izaak Walton League	Gary Meade	President
NRCS	Kevin Wickey	State Conservationist
	Pam Yost	Assistant State Conservationist-Programs
Poultry Association	Dale Walker	President
Rivers Coalition	Liz Garland	Executive Director
Shepherds Foundation	Ron Fletcher	President
USFWS	John Schmidt	Fish & Wildlife Biologist
USDA Forest Service	Karen Sykes	Forest Resource Group Leader
	Chuck Reger	Tech Transfer Specialist
WV Association of Conservation Districts	Joe Gumm	President
WV Conservation Agency	Truman Wolfe	Executive Director
WVU Extension Service	Tom Basden	Extension Specialist
	Jennifer Williams	Director, Agriculture & Natural Resources
US EPA	Hank Zygmunt	Agricultural Advisor
Trout Unlimited	Bryan K. Moore	Program Director



<b>*** State Technical Committee Member List (cont.)</b>		
<b>Agency / Organization</b>	<b>Contact</b>	<b>Title</b>
WVU Extension Service	Tom Brand	Special Assistant to the Director
Rural Development	Bobby Lewis	State Director
WV DHHR	Rick Hertges	Onsite Sewage Program Coordinator
USDA Forest Service	Bob Lueckel	Field Representative
Trout Unlimited	Gary Berti	Potomac Headwaters Director
WV Poultry Association	Emily Funk	Executive Secretary
Division of Forestry	Randy Dye	State Forester
Environmental Defense	Suzy Friedman	Agriculture Policy Analyst & Organizer
WV Rivers Coalition	Evan Hansen	Science Advisor
Mountain State Organic Growers and Buyers Association	Scott Snyder	President
WV Resource Conservation & Development Association	James L. McClelland	President
WV Department of Agriculture	Steve Hannah	Deputy Commissioner
Southern States Cooperative, Inc.	John McCallister	American Society of Agronomy / Certified Crop Adviser
University of Maryland	Mark Dubin	Agriculture Technical Coordinator
The Nature Conservancy	Beth Wheatley	Land Protection Specialist
WV Agriculture and Farmland Protection Board	Gregory L. Carnill	Chairman
WVDNR	Dave Truban	DNR Commissioner
Monongahela Conservation District	Jean Conley	Supervisor
WV Department of Agriculture	Bob Tabb	Assistant Commissioner



<b>**** State Tree Farm Committee Member List</b>		
<b>Agency / Organization</b>	<b>Contact</b>	<b>Title</b>
WVDOF	Kevin Arnold	Regional Forester
Private Landowner	Buck Chestnut	Land owner
WVDOF	Tom Cover	Regional Forester
NewPage	Carl DeFazio	Forester
WVDOF	Randy Dye	Director/State Forester
WV Forestry Association	Cinda Francis	SFI Forester
Glatfelter	Joseph Garrett	Forestry Technician
WVDOF	Dan Kincaid	Assistant State Forester - Stewardship
Weyerhaeuser	Larry Matheny	Forester
WVDOF	Steve McAnarney	LOA Specialist
WVDOF	Robert L. McBride	LOA Specialist
Appalachian Hardwood Center/WVU	Dave McGill	Forest Resources Extension Specialist
WVU, Division of Forestry and Natural Resources	Dr. Joseph McNeel	Director
MeadWestvaco	Charles McNeel	Forester
USDA-NRCS, WV State Office	Barbara McWhorter	Staff Forester
Mountaineer Forestry Services	Mark Metz	Consulting Forester
Consulting Forester	Jim Mitchell	Consulting Forester
MeadWestvaco	Rick Persinger	Forester
Greenwood Forestry LLC	David L. Posca	Chairman/Forester
Tree Farmer/Consulting Forester	Russell H. Richardson	Consulting Forester
USDA Forest Service	Karen J. Sykes	Forest Resources Group Leader
MeadWestvaco	John F. Vallelonga	Forester (retired)
WV Forestry Association	Dick Waybright	Executive Director
WVDOF	Gerald W. Waybright	Retired
WV Christmas Tree Growers Association	Robert Whipkey	Forester
WVDOF	Juergen Wildman	LOA Specialist/Forester
WVDOF	L. R. "Rudy" Williams, II	Regional Forester



<b>***** State Urban and Community Forestry Council Member List</b>		
<b>Agency / Organization</b>	<b>Contact</b>	<b>Title</b>
West Virginia Division of Forestry (WVDOF)	Director Randy Dye	State Forester
	Jennifer Hammer	Urban Forestry Tech Specialist
	Bob Hannah	Urban Forestry Coordinator
	Andy Sheetz	Partnership Coordinator
City of Phillippi	Karen Weaver	City Manager
Forcon	Matt Groves	Forester
American Electric Power	Phil Ross	Regional Forestry Supervisor
Allegheny Power	Chip Brown	Forestry Manager
	Todd Revello	Forester
City of Parkersburg	Rickie Yeager	Planning Administrator
West Virginia University	Dan Brown	Trades Specialist Lead II
City of Charles Town	Scott Coyle	Floodplain Manager
USDA Forest Service	Donna Murphy	Coordinator, Mid-Atlantic Center for Urban & Community Forestry
	Anne Cumming	Urban Forester
Parkersburg Tree Commission	Turner Sharp	Chairman/Forester
Appalachian Power	Stan Wagman	Forester



## **5. Multi-State Background Briefing Papers**

The following section presents three briefing papers that were written by the NA Morgantown Field Office of the USDA Forest Service in October, 2009 for the WVDOF to use as background documents to assist with the development of potential multi-state projects:

### **1. Chesapeake Bay Watershed: Multi-State Priority Area Forestry Considerations**

#### **Overview**

Assessing the location and condition of forests in the Chesapeake Bay watershed allows for meaningful priorities and defined results. Water quality and watershed functioning remain the largest emphasis areas of the work in the Chesapeake. Forestry plays a critical role. This paper is a subset of the great deal of resource information (e.g., data, assessments, models, maps) that has been amassed at the Chesapeake Bay Program ([www.chesapeakebay.net](http://www.chesapeakebay.net)) regarding water quality and land use.

#### **Background**

The Chesapeake Bay is the largest and most productive estuary in North America. More than 64,000 square miles of land drain into the Chesapeake Bay, including parts of six states – New York, Pennsylvania, Maryland, Delaware, West Virginia, and Virginia -- and the District of Columbia. It is home to over 3,600 species of plants, fish and wildlife. The Bay has struggled for more than 100 years against pressures such as pollutants, overfishing, and development. But it is the way in which humans use the land that is the primary threat to the water quality and healthy functioning of the Chesapeake watershed.

Many Chesapeake landscapes with ecological, historical, and cultural importance are vulnerable to the effects of land development and climate change. Development trends place enormous pressure on valuable ecological and cultural landscapes, tearing at the very fabric that defines the region and supports our way of life. Humans are taking up more space on the landscape, converting open green spaces into paved and developed environments that will not return to their original state. For example, the region's population grew by 8.2 percent between 1990 and 2000, but the conversion of farms and forest land to development grew at three times that rate—roughly 25 percent.

By the end of this century, the water level in the Bay region may rise between 21 and 48 inches, about double the predicted global average (Wu et al. 2009). In the coming decades, water will cover many valuable low-lying areas—including islands, forests, wetlands, and beaches—that were not submerged before. Erosion will claim others. Land managers must modify land protection strategies, possibly by conserving areas that will support the upward migration of tidal wetlands and habitats. With these major forces at work, many of the Bay region's most important landscapes may soon be irreversibly altered or lost.



## Value of Watershed Forests

Forests are the most abundant, and the most beneficial land cover to the health of the Bay. Currently, 58 percent of the watershed is forested, down from 95 percent prior to European settlement. Between 1982 and 1997, the Bay watershed lost over 750,000 acres of forest land to development—a rate of about 100 acres per day. From 1997-2006, forests have continued to be subject to the highest land use conversion.

Forests are most valued because of the suite of ecological services they provide human communities—by protecting the quality and quantity of our drinking water; promoting air quality; combating global warming; and reducing the pollution, erosion, and flood events related to storm water runoff. Essentially, forests mitigate the effects of development, and give back in many ways:

- Forests yield high-quality, clean water, with streams from forested watersheds averaging less than 1 mg/l of nitrate (Binkley et al. 2004).
- A 10 percent loss of forest land disproportionately increases the loading of nutrients discharged into the Bay by 40 percent (Pan et al. 2005).
- Forests retain more than 85 percent of the atmospheric N deposited (Pan et al., 2004).
- Forests are capable of storing and filtering 6 times more rainfall than grass alone and 20 times more than a parking lot (Capiella et al. 2005).
- Riparian forest buffers reduce N from upland uses by 70-90 percent (Mayer et al. 2005).
- The majority of the population relies on surface reservoirs for drinking water, and cleaner water means lower treatment costs.
- Forests are a water quality BMP that gains in effectiveness for decades.

The best indicator of watershed health is impervious cover--- the healthiest watersheds have less than 4 percent. The next best land use indicator is the amount of forest cover and the amount of riparian forest (Goetz 2003). A healthy watershed has over 70 percent forest cover. Riparian forest cover is especially important on agricultural-dominated landscapes.



The following geographic features help maintain forest water quality functions over time:

- porous soils
- vegetation height (taller is better)
- shallow soils and flatter slopes (entire floodplain and land that is at or near water table should be forested)
- contiguous forest

### **Importance of Location**

While all forests are valuable to water quality, some forests are more valuable than others. Assessing the location and condition of forests in the watershed allows for meaningful priorities and defined results. These locations often combine habitat value with significant value to people providing essential watershed services such as flood control, storm water management, base flow, carbon sinks, and water quality treatment. Notable examples are:

- forested areas of contiguous natural habitat with significant interior size, and
- low-lying landscapes such as forested wetlands and riparian habitat
- areas close to drinking water sources and/or containing headwater streams
- landscapes of ecological and social importance sometimes referred to as “green infrastructure” by virtue of the crucial ecosystem services they provide for human communities and wildlife.

Because forests are the most beneficial land cover for watershed services, if these landscapes are not forested, they should be priority areas for reforestation and conservation wherever possible.

This prioritization was the focus of the Chesapeake Forest Conservation Directive ([http://www.chesapeakebay.net/content/publications/cbp\\_27761.pdf](http://www.chesapeakebay.net/content/publications/cbp_27761.pdf)). See associated map on Forest Conservation in the Chesapeake Bay.

### **Urban Forests**

With over 17 million citizens, the Chesapeake watershed is heavily populated, especially along the Baltimore-Washington-Richmond (I-95) corridor. Urban forestry is a vital component to livable, well-planned communities, which are also important to open space conservation. Chesapeake urban areas are expected to grow (see map on Forecasted Forest Loss).

An urban tree canopy reduces storm water runoff, particularly during the smaller rains that are most frequent and often carry high concentrations of pollutants. Based on current models, trees that overlap impervious areas tend to have greater ability to mitigate storm water. Urban tree canopy also has the side benefit of decreasing air temperatures to improve air quality. Increasing urban tree canopy includes a variety of techniques from street trees to greenways to pocket parks



to brownfields restoration, and can be practiced in different ways across even an already developed landscape, that are more appealing and cost-effective than other storm water retrofits. Forestry in urban areas is a priority because of politics: more people will reap the benefits of work done in urban areas.

### **Chesapeake Forest Health Issues**

- Parcelization is the breakup of larger land ownerships into smaller parcels. Over the past 10 years, the number of family forest owners in the Bay watershed increased by nearly 25 percent, or 23,000 new family forest land owners per year. Nearly 70 percent of all family forest owners hold less than 10 acres. Forest parcelization often corresponds with a decline in the percentage of forest land under sustainable management plans. This restricts access to residents and increases the risk of fragmentation and conversion to other uses.
- Inaccessibility to mills and other forest industry infrastructure means that stewardship plans do not get implemented (see map on Forest Economics).
- White-tailed deer have become one of the greatest threats to many of the Bay watershed's forests. As forests have become fragmented and surrounded by farms and suburban gardens, deer have more plentiful and nutritious food sources. Fragments also provide refuges for deer where hunting is prohibited. Locally high deer populations:
  - Eat large amounts of tree seedlings and young trees, keeping forests from regenerating.
  - Selectively browse for food, which changes forest composition and depletes species diversity.
- Japanese barberry, Japanese honeysuckle, kudzu, Canada thistle, English ivy and other invasive plants have become permanent residents of Chesapeake forests. Invasive plants:
  - Grow and reproduce rapidly, killing and out-competing other species in the process.
  - Lower the quality of food and shelter for wildlife.
  - Eliminate host plants of insects.
  - Compete with native plants for pollinators.
- Invasive pests and diseases have also altered forest conditions in the Bay watershed. Some, such as gypsy moth, chestnut blight, beech bark disease and Dutch elm disease, have had long-term, devastating impacts. Others, such as emerald ash borer, also have potential to further & severely degrade ecosystems.

### **Opportunities and Potential Strategies**

- 1) Support ecosystem markets and land registries to generate additional incentive for continued forest conservation and restoration;
- 2) Work closely with NRCS to prioritize forestry projects under the Chesapeake Bay Watershed Initiative in the 2008 Farm Bill;
- 3) Develop a sustainable forestry incentives & policies to stimulate improved forest conservation through:
  - a) tax incentives, such as:
    - i) income tax credit for developing a forest stewardship plan;



- ii) expanded property tax rebate for having a forest stewardship plan;
  - b) effective and equitable regulations, particularly related to forest harvesting;
  - c) forest enterprise zones to support healthy forest product markets and technical innovation for new markets;
  - d) forest health reserve fund to improve response to forest health threats; and
  - e) family forest revolving loan fund to support intact intergenerational transfer of forest land;
- 4) Link forests, storm water, and water supply through Comprehensive Plan elements like Sensitive Areas, Water Resources, and Land Protection Plans, and new requirements for prioritized environmental site design for storm water;
  - 5) Support dedicated land conservation funding through state, and especially through local ballot measures;
  - 6) Adopt a transferable and/or refundable tax credit program for donated conservation easements similar to the one Virginia has;
  - 7) Support effective Transferable and Purchase of Development Rights programs in local jurisdictions;
  - 8) Work with other federal, state, and local organizations to improve technical assistance provided to forest landowners.

Invest in ongoing conservation education, outreach, and technical assistance to local jurisdiction planners and landowners to improve forest conservation and management, and to schools. The ultimate outcome is greater integration of the benefits of forest cover, forestry, and natural resource conservation into public education and public policy decisions. The need for public understanding of the importance of forests, and the trade-offs involved when forest cover is degraded or removed is a critical.



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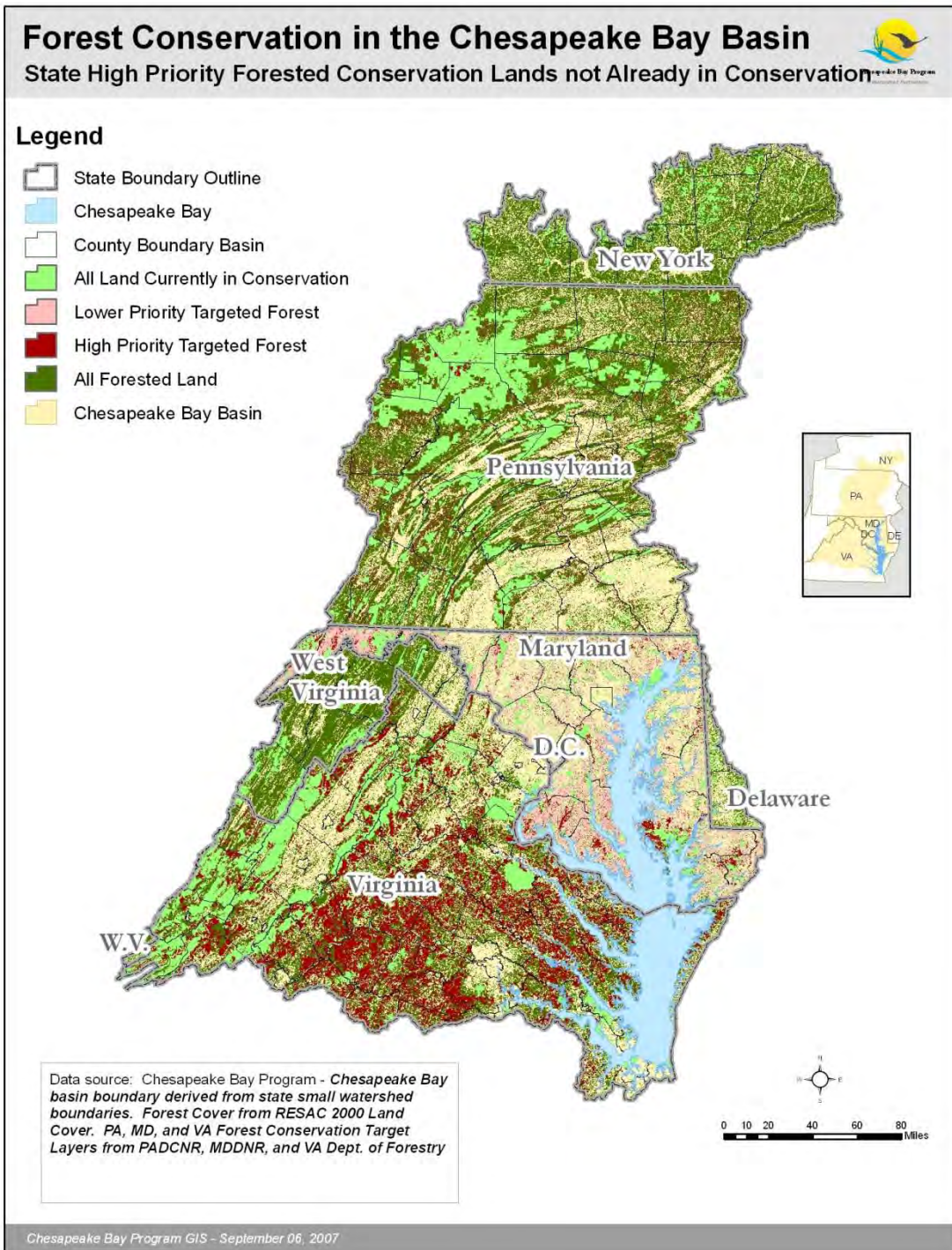
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## 2. The Ohio River Basin: Multi-State Priority Area



October 16, 2009

### Location

The Ohio River is 981 miles (1582 km) long, starting at the confluence of the Allegheny and the Monongahela Rivers in Pittsburgh, Pennsylvania, and ending in Cairo, Illinois, where it flows into the Mississippi River<sup>1</sup> and eventually the Gulf of Mexico. The Ohio River passes through or is adjacent to the states of Illinois, Indiana, Kentucky, Ohio, West Virginia, and Pennsylvania.<sup>2</sup> Portions of New York, Virginia, Maryland, Tennessee, North Carolina, Georgia, Alabama, and Mississippi are also within the Ohio River Basin. Major tributaries flowing into the Ohio include (from upstream to downstream) the Muskingum, Kanawha, Guyandotte, Big Sandy, Scioto, Licking, Great Miami, Kentucky, Green, and Wabash Rivers.<sup>3</sup> A complete list of tributaries is available at <http://www.orsanco.org/images/stories/files/orrg/Tribs.pdf>.

### Physical Geography

<sup>1</sup> <http://www.orsanco.org/index.php/river-facts>

<sup>2</sup> <http://creekconnections.allegheny.edu/Modules/On-LineActivities/Watersheds/OhioRiverWatershed.pdf>

<sup>3</sup> <http://www.fws.gov/orve/stratplan.html>



The land in the Ohio Basin can be divided into essentially three basic parts, corresponding to the Basin's three major physiographic provinces. The Appalachian Plateau in the eastern portion is characterized by rugged topography resulting largely from the erosion of flat-lying rocks. The permeable sand and gravel deposits in the valleys of the drainage system provide moderate groundwater supplies. The area has extensive forest cover, generally poor quality soils, narrow valleys, steep stream gradients, flash floods during the rainy season, and low stream flows during dry seasons.<sup>4</sup>

The Central Lowlands physiographic province occupies the northwestern third of the Basin and is the result of several glaciations. Glaciers covered most of the area in recent geologic history, and left soil deposits which are now some of the richest agricultural lands in the Basin. The topography is flat to slightly rolling and the drainage pattern has been significantly altered from its condition prior to glaciation. In some instances, buried pre-glacial streams provide extensive groundwater resources.<sup>5</sup>

The Interior Low Plateau physiographic province in the southwestern third of the Basin is dominated by limestone rock which covers most of this region. This has resulted in the rolling terrain forming the Lexington Plains and Bluegrass regions where farming dominates. Areas of local rugged relief are forested, their soils thin. Groundwater has the typical variability of limestone areas.<sup>6</sup>

## Biological Resources

The Ohio River ecosystem bisects three regions of the Deciduous Forest Formation of eastern North America: the Mixed Mesophytic Forest Region (upper basin, roughly upstream of Portsmouth, Ohio), the Western Mesophytic Forest Region (lower basin from Portsmouth, Ohio, to Paducah, Kentucky), and the Mississippi Alluvial Plain Section of the Southeastern Evergreen Forest Region (lowermost portion of the basin from Paducah, Kentucky, to Cairo, Illinois).<sup>7</sup>

The mixed mesophytic and western mesophytic forests have been classified broadly as a tulip poplar-oak region. The dense, mixed mesophytic forest contains a fair abundance of two indicator species, white basswood and yellow buckeye, in a total group of 15 to 20 dominant species. The western mesophytic forest is marked by a transition from extensive mixed mesophytic communities in the east to extensive oak and oak-hickory communities in the west. The western mesophytic forest is less dense, has few dominants, and usually lacks the two indicator species of the mixed mesophytic forest.<sup>8</sup>

The rich flora and fauna of the ecosystem reflect its diverse physiography and unique geologic past. The Fish and Wildlife Service has identified many "Trust Resources" in the Ohio River basin, including many federally listed endangered and threatened plants, mussels, fishes, birds and mammals; waterfowl and other migratory water birds; and neotropical migratory land birds.<sup>9</sup>

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<sup>4</sup> <http://www.fws.gov/orve/stratplan.html>

<sup>5</sup> <http://www.fws.gov/orve/stratplan.html>

<sup>6</sup> <http://www.fws.gov/orve/stratplan.html>

<sup>7</sup> <http://www.fws.gov/orve/stratplan.html>

<sup>8</sup> <http://www.fws.gov/orve/stratplan.html>

<sup>9</sup> <http://www.fws.gov/orve/stratplan.html>



Examples can be found at

[http://www.kwalliance.org/Portals/3/Evans\\_Ohio%20R%20summit\\_1Aug2008.Part2.pdf](http://www.kwalliance.org/Portals/3/Evans_Ohio%20R%20summit_1Aug2008.Part2.pdf).

The unusually rich and diverse fauna found in the ecosystem is the product of a multitude of biotic and abiotic factors which have evolved over time. Throughout geologic time, changes in such factors as topography, climate, and geomorphology have formed, modified, and eliminated habitats and consequently have had a profound effect upon the distribution of the faunal assemblages in the ecosystem. Due to the ecosystem's central geographical location in the eastern United States, some species with northern affinities and others with southern affinities occur in the ecosystem in addition to those common to the central region of the country.<sup>10</sup>

### **Land Use Patterns**

Land use in the Ohio River Basin is a mix of urban/industrial, row crops/intensive agriculture, pasture and forested. These patterns are graphically portrayed at

<http://www.orsanco.org/images/stories/files/orrg/BasinlandusemapUSGS.pdf>.

### **Economic Influence**

The Ohio River plays an important role in the economic fabric of the region. There are over 1,000 manufacturing facilities, terminals, and docks in the Ohio River Basin that shipped and received tonnage in 1998. The Port of Pittsburgh includes 41 miles of the Ohio River, 91 miles of the Monongahela River, and the entire 72 navigable miles of the Allegheny River. The port shipped and received almost 53 million tons of commodities in 1998, making it the largest port in the Ohio River Basin and the largest inland port in the United States. The port of Huntington is the next busiest in the basin and ranks 3<sup>rd</sup> among the nation's inland ports.<sup>11</sup>

### **Major Highway Systems**

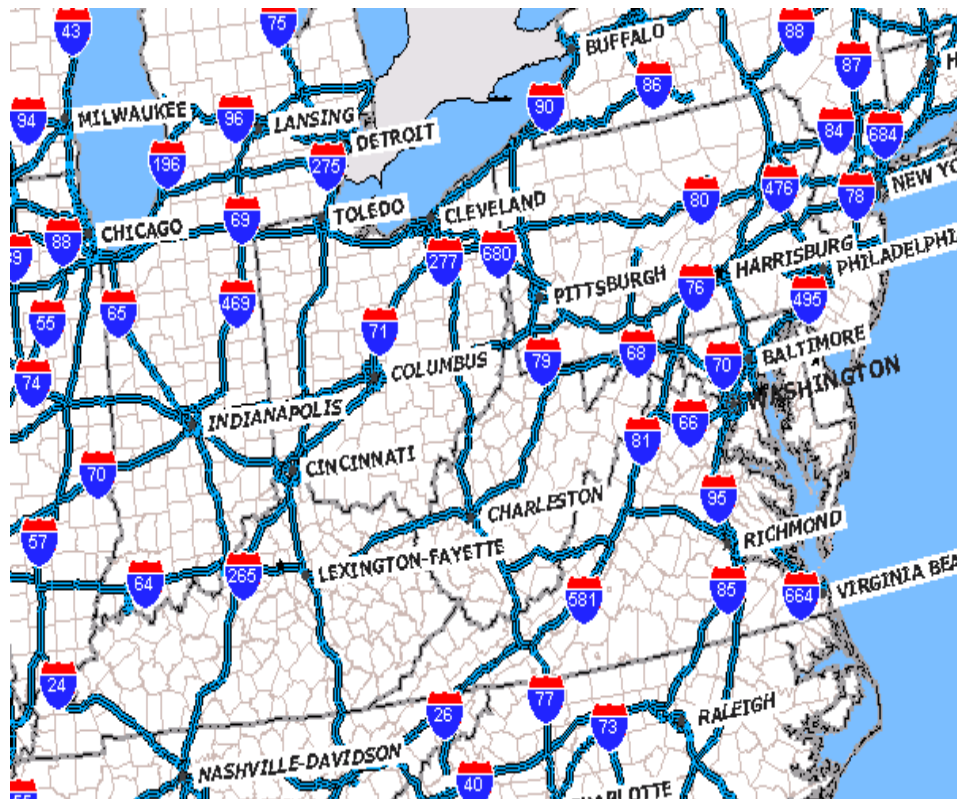
The Ohio River Basin, and the states served by the Northeastern Area S&PF have, generally speaking, access to well-developed major highway systems (Figure 1).<sup>12</sup>

<sup>10</sup> <http://www.fws.gov/orve/stratplan.html>

<sup>11</sup> <http://www.ccpa-ohioriver.com/> Ohio River Basin Profile

<sup>12</sup> [http://hepgis.fhwa.dot.gov/hepgis\\_v2/Highway/Map.aspx](http://hepgis.fhwa.dot.gov/hepgis_v2/Highway/Map.aspx)

**Figure 1. Interstate Highways**



## Population Dynamics

Approximately 25 million people, or nearly 10 percent of the U.S. population, live in the Ohio River Basin.<sup>13</sup> A detailed, state by state description population dynamics within the Ohio River Basin was developed by the Ohio River Sanitation Commission and is available at [Basin Population](http://www.orsanco.org/index.php/basin-population).<sup>14</sup>

<sup>13</sup> <http://creekconnections.alleghey.edu/Modules/On-LineActivities/Watersheds/OhioRiverWatershed.pdf>

<sup>14</sup> <http://www.orsanco.org/index.php/basin-population>

**Table 1. Cities and Towns along the Ohio River<sup>15</sup>**

<b>Metro area</b>	<b>Population</b>
Pittsburgh	2.3 million
Cincinnati	2.2 million
Louisville	1.8 million
Evansville	350,000
Huntington	290,000
Parkersburg	160,000
Wheeling	145,000
Weirton-Steubenville	132,000
Owensboro	112,000

The U.S. Census Bureau uses definitions of metropolitan and micropolitan statistical areas developed by the U.S. Office of Management and Budget to describe population centers. The term “Core Based Statistical Area” (CBSA) is a collective term for both metro and micro areas. A metro area contains a core urban area of 50,000 or more population, and a micro area contains an urban core of at least 10,000 (but less than 50,000) population. Each metro or micro area consists of one or more counties and includes the counties containing the core urban area, as well as any adjacent counties that have a high degree of social and economic integration (as measured by commuting to work) with the urban core. Maps of metro and micro areas are available for all states, including OH, WV, and PA.<sup>16</sup>

Population densities are highly variable within the Ohio River Basin reflecting the broad range of uses. Maps portraying population densities for forested and non-forested for all states can be obtained at <http://www.fs.fed.us/ne/fia/studies/LDS/index.html>.

The Ohio River Basin population is expected to grow, with housing density increases expected to be moderate throughout a good deal of the region.<sup>17</sup> Concomitant with increases in housing and population are demand for energy resources, water and improved infrastructure, as well as the diminishment of ecosystem services.

<sup>15</sup> [http://en.wikipedia.org/wiki/Ohio\\_River#Cities\\_and\\_towns\\_along\\_the\\_river](http://en.wikipedia.org/wiki/Ohio_River#Cities_and_towns_along_the_river)

<sup>16</sup> Ohio [http://ftp2.census.gov/geo/maps/metroarea/stcbsa\\_pg/Nov2004/cbsa2004\\_OH.pdf](http://ftp2.census.gov/geo/maps/metroarea/stcbsa_pg/Nov2004/cbsa2004_OH.pdf)  
West Virginia [http://ftp2.census.gov/geo/maps/metroarea/stcbsa\\_pg/Nov2004/cbsa2004\\_WV.pdf](http://ftp2.census.gov/geo/maps/metroarea/stcbsa_pg/Nov2004/cbsa2004_WV.pdf)  
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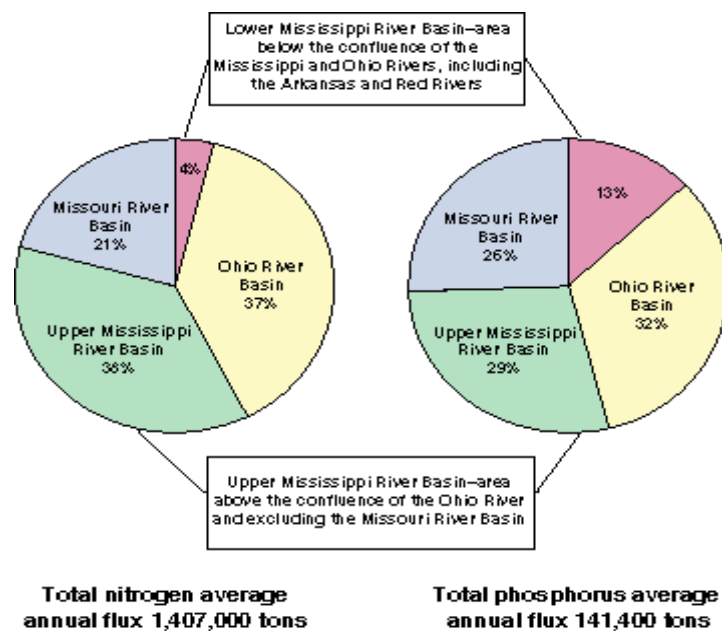
<sup>17</sup> <http://www.fs.fed.us/projects/fote/reports/fote-6-9-05.pdf>

## Water Resources & Issues

The Ohio River is a direct source of drinking water for more than three million people.<sup>18</sup> A number of issues have been identified relating to water quality issues in the basin. Issues identified by Ohio River Basin Consortium for Research and Education (ORBCRE) are mostly pollution-oriented and include effluent from municipal waste water treatment plants, combined sewage and storm water overflows, coal mine drainage and resulting sedimentation, urban storm water, agricultural and forest runoff, toxic pollutants, problems from oil and gas recovery brines, reservoir eutrophication, ground water pollution, and drinking water contamination. The region has a number of hazardous waste disposal sites (Karl et al. 1996).<sup>19</sup>

Agricultural activities in the Ohio River Basin region are a major contributor to nitrogen and phosphorous loadings in the Mississippi watershed (Figure 2).<sup>20</sup> These pollutants, coupled with other water quality issues such as sedimentation are believed to be the primary drivers for a large hypoxic “dead zone” in the Gulf of Mexico.

**Figure 2. Sources of Nitrogen and Phosphorus Loadings in the Mississippi River**



The combined effects of industrial pollutants, urbanization, agriculture, mining and other land uses are increasingly threatening clean water supplies. Forested landscapes play a key role in

<sup>18</sup> <http://www.orsanco.org/index.php/river-factsconditions>

<sup>19</sup> <http://www.colorado.edu/research/cires/banff/pubpapers/140/>

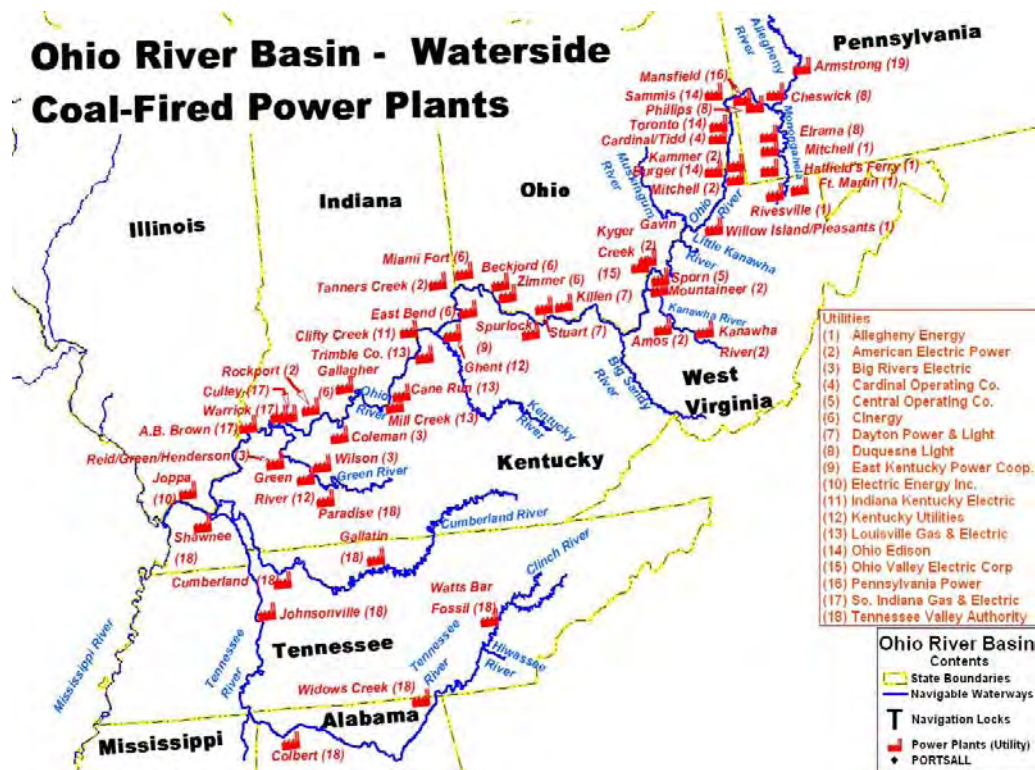
<sup>20</sup> <http://water.usgs.gov/nasqan/docs/missfact/missfactsheet.html>

providing a broad range of ecosystem services, including clean water. Paradoxically, the high degree of amenity values associated with forests makes them highly desirable as housing development sites, which often results in significant diminishment of their ability to produce clean water. The USDA Forest Service, Northeastern Area State and Private Forestry has utilized geographic information systems to map areas (including OH, PA, and WV within the Ohio River Basin<sup>21</sup>) and to identify those watersheds that are have a high ability to produce clean water and are threatened by development, located on private lands and which many people rely on for their drinking water. A number of areas in West Virginia and particularly southeastern Ohio have been identified as highly significant sources of clean water.<sup>22</sup>

### The Ohio River Basin & Energy Production

Energy generators in the Ohio River Basin produce 6 percent of the nation’s energy. While a small proportion of that is hydropower, the majority is fueled from the region’s coal resources. Figure 3 depicts the number of coal fired power plants in the Ohio River Basin. The Ohio River plays an important role in the transportation of coal resources to these power generators. State economies in the region, including WV, PA, and OH have traditionally been dependent both on jobs related to coal production and the inexpensive energy produced.

Figure 3.



<sup>21</sup> Ohio - [http://www.na.fs.fed.us/watershed/factsheets/fwap/FWAP\\_state\\_sheet\\_OH.pdf](http://www.na.fs.fed.us/watershed/factsheets/fwap/FWAP_state_sheet_OH.pdf)  
 Pennsylvania - [http://www.na.fs.fed.us/watershed/factsheets/fwap/FWAP\\_state\\_sheet\\_PA.pdf](http://www.na.fs.fed.us/watershed/factsheets/fwap/FWAP_state_sheet_PA.pdf)  
 West Virginia - [http://www.na.fs.fed.us/watershed/factsheets/fwap/FWAP\\_state\\_sheet\\_WV.pdf](http://www.na.fs.fed.us/watershed/factsheets/fwap/FWAP_state_sheet_WV.pdf)

<sup>22</sup> Forests, Water, and People. [http://www.na.fs.fed.us/watershed/fwap\\_preview.shtm](http://www.na.fs.fed.us/watershed/fwap_preview.shtm)



## Forest Conservation Challenges

As noted earlier, increasing urbanization is a significant threat to forested ecosystems. Other issues likely to affect forests within the Ohio River Basin include:

- **Climate change.** While the science available to document climate change effects on a regional or sub-regional basis are still limited, the expectation is that changes in weather patterns already observed will intensify in future years. While not all changes will necessarily negatively affect forest health, it is expected that there will be changes in species composition, tree vigor, etc. as trees attempt to adapt. As changes occur, climatic conditions may often favor the further dispersion of invasive plants and pests.
- **Forests - adaption and mitigation responses.** Humans and trees have highly interdependent relationships. In response to changes in forest health, society is likely to implement a number of adaptive and mitigative responses which will likely have an impact on forest resources.
- **Energy development.** Projections indicate that America's demand for energy will continue to increase in future years. If America becomes a "carbon constrained society" as many expect, the search for energy resources with a lower carbon intensity will accelerate. While carbon capture and sequestration technologies may eventually enable electrical energy to be produced from coal with zero carbon emissions, the availability of that technology is still speculative. Woody biomass and natural gas contained in Marcellus shale deposits in the region have significantly lower carbon footprints than coal, but their extraction and use have implications for forest health and water quality which must be understood. Currently, many electrical generating facilities in the Ohio River Basin (and elsewhere) are responding to state mandated requirements to increase their use of renewable energy by very actively considering the use of woody biomass either as a sole source of energy or co-fired with coal. This concept is now being actively promoted by the U.S. Environmental Protection Agency as a climate mitigation strategy. The potential demand created should only a fraction of electrical generators switch to wood would have very significant impacts on forest resources in the region, especially when added to emerging demand for woody biomass to be used in pellets, transportation fuels, etc.
- **Loss of forest products industries.** Interactions between international competition, changes in the structure and composition of forest products industries, a weak U.S. economy, and the "housing crisis" have converged resulting in a significant downturn in forest products related businesses in the Ohio River Basin region. For example, it is anticipated that more than one third of existing capacity in primary hardwood industries may be lost in the current economic downturn.
- **Conservation education.** The need for public understanding of the importance of forests, and the trade-offs involved when forest cover is degraded or removed is critical. In expanding conservation education programs across the region, the ultimate outcome is greater integration of the benefits of forest cover, forestry, and natural resource conservation into public education and public policy decisions.



## Efforts Underway

Definitions of sustainability recognize the high levels of integration between economic, ecological, and societal factors. Forests, and the many ecosystem services they provide will become increasingly acknowledged as vital, and perhaps even strategic resources as issues already acknowledged as important (water availability, energy, economic survival) take on increasing importance.

Efforts recently underway that could have implications for forest resources in the Ohio River Basin include:

1. The U.S. Army Corps of Engineers is doing an Ohio River Basin Study.<sup>23</sup> *The Ohio River Basin Comprehensive Reconnaissance Study is a collaborative effort between four Corps Districts that share the Ohio River Basin – Huntington, Nashville, Louisville and Pittsburgh, the 15 basin states and a multitude of stakeholders, project sponsors and the public. This ongoing comprehensive reconnaissance-level basin plan will feature a preliminary reinvestment plan for the existing reservoirs and local protection projects as well as identify opportunities for additional municipal and industrial water supply, hydropower facilities and restoration of damaged ecosystems. The reconnaissance study will provide a pathway for resolving not only the problems faced by Corps projects but also other federal, regional, state and local water resource problems and needs while identifying opportunities for expanded and enhanced water management through future collaborative watershed planning and decision-making. They have identified a number of water related issues which will be addressed in the study.*<sup>24</sup>
2. **Electric Power Research Institute.** In order to respond to mandates in the Clean Air Act, electrical generators will have to adopt technologies which will increase the release of nitrates and other pollutants into the Ohio River. Already a problem for the Ohio, EPRI seeks to abate pollutant levels and costs for electrical generators and other point sources of pollutants (ex. municipal wastewater treatment plants) by developing a water quality trading market for the entire Ohio River Basin. Forest landowners could potentially be suppliers of abatement credits, although there has been no significant mention of this possibility to date.<sup>25</sup>
3. **USDA efforts in the Mississippi Watershed.** In late September 2009 Secretary Vilsack announced that the Obama administration would support \$300 million in expenditures focused on cleaning up the waters of the Mississippi and addressing water quality and hypoxia issues in the Gulf of Mexico. Whether or not the sole focus of USDA efforts will be on abating agricultural pollutants is unknown at this writing.

<sup>23</sup> [http://www.orboutreach.com/pdfs/ORBC\\_Study\\_announce\\_news\\_release.pdf](http://www.orboutreach.com/pdfs/ORBC_Study_announce_news_release.pdf)

<sup>24</sup> <http://www.orboutreach.com/index.php/ohio-river-basin-issues-and-concerns/>

<sup>25</sup> <http://my.epri.com/portal/server.pt?open=512&objID=401&&PageID=226975&mode=2>



### 3. Appalachian Region Priority Area

#### 1. General Area/Boundary Description

The Appalachians are among the oldest mountains on Earth. They extend almost 2,000 mi from the Canadian provinces of Newfoundland and Labrador in the northeast, southwestward to Alabama in the U.S. They include the White Mountains in New Hampshire, the Green Mountains in Vermont, the Catskill Mountains in New York, the Allegheny Mountains primarily in Pennsylvania, the Blue Ridge Mountains in Virginia and North Carolina, the Great Smoky Mountains in North Carolina and Tennessee, and the Cumberland Plateau extending from West Virginia to Alabama. Their highest peak is Mount Mitchell in North Carolina.

The Appalachian Region discussed in this summary focuses more on the Mid-Atlantic States and south, more so than the Appalachians that extend into New England region. The region (see map below) is a 205,000-square-mile area that follows the spine of the Appalachian Mountains from southern New York to northern Mississippi. It includes all of West Virginia and parts of 13 other states including Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, and Virginia.



#### 2. Major Landforms

The Northern **Ridge and Valley Province** is a physiographic province of the larger Appalachian division and is also a belt within the Appalachian Mountains extending from southeastern New York through northwestern New Jersey, westward into Pennsylvania and southward into Maryland, West Virginia, Virginia, Tennessee, Georgia and Alabama. They form a broad arc between the Blue Ridge Mountains and the Appalachian Plateau physiographic province (the Allegheny and Cumberland Plateaus). These mountains are characterized by long, even ridges with long, continuous valleys in

between.

The **Appalachian Plateau** (or Allegheny Mountains) is the western part of the Appalachian Mountains, stretching from New York to Georgia and Alabama. From the east the escarpment that forms the edge of the plateau has the appearance of a mountain range. However, technically it is an eroded plain of sedimentary rock not mountains. A large portion of the plateau is a coalfield formed during the Pennsylvanian Period (320 to 286 million years ago). The surface of the plateau slopes gently to the northwest and merges into the Interior Plains.

The northern-most regions of both provinces were glaciated. This section is less hilly and lacks the rugged quality of the unglaciated landscape. Evidence of the region's glacial past includes bogs, kettle lakes, and a landscape marked by small hills of sand and gravel called "kames."



Today, the area is marked by smaller tracts of forests, ranging from a few acres to hundreds of acres.

A major attraction to the area is the Appalachian Trail. It is the nation's longest marked footpath, at approximately 2,178 miles and was designated in 1968 as the first national scenic trail. It crosses six national parks and numerous local state parks and forests; six national forests; and 14 states. More than 2,000 rare, threatened, endangered, and sensitive plant and animal species are located near or around the trail route. Thousands of people use the trail -- most just for short day hikes or an overnight backpacking trip. Others set out for weeks or months on the trail. Hundreds of people each year hike the entire length of the trail in one season.

### **3. Forests and other ecological attributes**

The Appalachian Region is divided into four major physiographic provinces, which will be described here. For additional information on fauna, climate, disturbance regimes and land uses, see Appendix A.

#### ***Northern Ridge and Valley (includes MD, NC, NY, PA, VA, WV, and VA)***

This section is a series of parallel, southwest to northeast trending, narrow valleys and mountain ranges (high ridges) created by erosion of tightly folded, intensely faulted bedrock. The eastern boundary is the Great Valley low land; the western boundary is a steep, high ridge, the Allegheny Front. Some of the strip-mined lands exhibit hummocky or gouged topography. Elevation ranges from 300 to 4,000 ft.

Because much of this area lies in the rain shadow of the Allegheny Mountains Section, vegetation conditions are drier. Kuchler types are mapped as Appalachian oak forest, oak-hickory-pine forest, and some northern hardwoods forest. Before arrival of the blight that decimated the chestnut, it was the dominant species in this Section. Oaks now dominate and generally red and white oaks occur on more productive, moderately moist sites. Eastern white pine can occur with white oak on the lower portions of slopes. Scarlet and black oaks are more common on drier sites. On the driest sites, oaks are mixed with pitch, table-mountain, or Virginia pines. The latter can also occur as pure stands.

#### ***The Blue Ridge Mountains (includes PA, MD, WV, VA, NC, GA, and TN)***

The **Blue Ridge** is a physiographic province of the larger Appalachian Mountains range. The northern half is narrow, about 14 miles wide but broadens to 70 miles in its southern half. The mountain range starts at its southern-most portion in Georgia, and terminates in south-central Pennsylvania. To the west of the Blue Ridge, between it and the bulk of the Appalachians, lies the Great Valley, which is bordered on the west by the Ridge and Valley province. Elevation ranges from 1,000 to over 6,000 feet. Local relief ranges from 500 to 1,000 feet. Mt. Mitchell, the highest point in eastern North America (6,684 feet) occurs here.

Within the Blue Ridge province are two distinct sections: the Shenandoah in the northern section and the Great Smoky Mountains in the southern section. The Blue Ridge also contains the Blue



Ridge Parkway, a 469-mile long scenic highway that connects the two parks and is located along the ridge crestlines along the Appalachian Trail.

Kuchler classified vegetation as Appalachian oak forest, southeastern spruce-fir forest, and northern hardwoods. Forests are dominated by oaks, consisting of black, white, and chestnut oaks that are found on dry mountain slopes; pitch pine is often a component along ridge tops. Yellow-poplar, red maple, northern red oak, and sweet birch dominate the valleys and moist slopes. Smaller sections of forests between mountains are dominated the hardwood-pine cover type of scarlet, white, blackjack, and post oaks and shortleaf and Virginia pines. Table-mountain pine, a fire-dependent species with serotinous cones, occurs on dry ridge tops where fire was historically more common. Eastern white pine dominates small areas of the Blue Ridge escarpment joining the Southern Appalachian Piedmont Section. Mesic sites at higher elevations (4,500 feet) are occupied by northern hardwoods (e.g., sugar maple, basswood, and buckeye); drier sites are dominated by northern red oak. Red spruce and Fraser fir are found above altitudes of about 5,000 to 6,000 feet.

#### ***Northern Appalachian Plateau (Allegheny Mountains – includes PA, MD, and WV)***

This Section is a dissected plateau with high, sharp ridges, low mountains, and narrow valleys. It has broad, northeast to southwest trending folds in the bedrock. Elevation ranges from 1,000 to 4,500 feet, with a few peaks higher, notably Spruce Knob (4,861 feet), the highest point in West Virginia. Local relief generally ranges from 1,000 to 2,500 feet.

The Allegheny Mountains can be placed in four broad forest type groups: red spruce, northern hardwoods, mixed mesophytic, and oaks. Red spruce is usually found above 3,500 feet and includes stands of American beech and yellow birch. The northern hardwood group features sugar maple occurring with beech and black cherry. The mixed mesophytic species are red oak, basswood, white ash, and yellow-poplar. The productive, diverse cove hardwoods are included in this group. Oak sites occur mostly on foothills, but are much less common in this Section than in the Northern Ridge and Valley Section.

#### ***Cumberland Mountains (western and eastern coalfields of WV, Black Mountain section of KY, and southern Cumberlands in KY)***

This section contains mountains and dissected uplands. Landforms are mainly low mountains where less than 20 percent of the area is gently sloping. Elevation ranges from 2,000 to 2,600 feet.

Kuchler classified vegetation as mixed mesophytic forest, Appalachian oak forest, and northern hardwoods. The predominant vegetation is hardwoods with a mixture of pine. Existing forest types consist of oak-hickory; white, black, scarlet, and blackjack oaks; and common hickories including mockernut and pignut.

#### **4. Landownership Characteristics**



The majority of the Appalachian region's timberland is privately owned, most of it in small lots of fifty acres or less. Several landowners own 1,000 or more acres throughout the region, and 5 and 10-acre tracts are becoming common and wide spread.

Agriculture, urban and suburban clusters, mining areas, and other features are interwoven into the landscape. Absentee ownership and secondary homes are prevalent with many properties owned by people who reside in the more populated eastern coast.

## **5. Population attributes**

About 24.8 million people live in the 420 counties of the Appalachian Region; 42 percent of the population is rural, compared with 20 percent of the national population. In the past, the Region's economy was based mostly on extraction of natural resources and manufacturing. The modern economy is gradually diversifying, with an emphasis on services and widespread development of tourism, especially in more remote areas where there is no other viable industry. Coal remains an important resource, but it is not a major provider of jobs, with the exception of, perhaps, West Virginia. Manufacturing is still an economic mainstay but is no longer concentrated in a few major industries.

Because of crop failures on mountain farms, grazing came to dominate the area, and its influence continues. Farmers often created open grassy areas, called sods, by cutting the timber, removing the logs, and burning the slash. From 1880 to 1920, major logging and sawmilling denuded the landscape. Fires raged throughout the forests, laying soils open to erosion. Today, extractive industries prevail, along with a traditional mountain culture. However, a more recreation-oriented lifestyle has emerged to cater to the needs of urban dwellers from East Coast metropolitan areas.

The Appalachians are crisscrossed with major interstates including I-40, I-59, I-64, I, 68, I-70, I-75, I-76 (Pennsylvania Turnpike and its northern extension I-476), I-77, I-78, I-79, I-80, I-81, I-84, I-85, I-86, I-87, and I-90. These road systems bridge the urban and rural areas of the region, posing threats to the landscapes. Major development has occurred along all of these interstates and creates problems for forest management, resulting in fragmentation and parcellation, and additional issues with forest health and invasive species. For example, emerald ash borer has spread because of the major travelways between states.

Tourism, in general, generates \$26 billion per year in direct revenue to the states within the region.

Human population growth and the demand for natural resources are impacting the landscapes. Pollution, contaminants, and landscape changes related to human activities threaten the integrity of the region's water resources.

## **6. Communities/Major Population Centers**

Georgia – Dalton, Rome



Kentucky – Berea, London, Pikesville, Williamsburg

Maryland – Cumberland

New York – Binghamton, Elmira

North Carolina – Asheville

Ohio – Athens, Zanesville

Pennsylvania – Erie, Harrisburg, Pittsburgh, Scranton-Wilkes Barre

South Carolina – Greenville

Tennessee – Chattanooga, Johnson City, Kingsport, Knoxville

Virginia – Blacksburg, Covington, Lexington

West Virginia – Beckley, Charleston, Huntington, Parkersburg, Morgantown, Wheeling

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## 7. Water Resources

The Appalachians contain tens of thousands of miles of headwater streams and are the headwaters of major, national rivers. The major rivers of the 11-state area include Allegheny, Delaware, Greenbrier, James, Kanawha, Monongahela, Muskingum, Potomac, New, Ohio, Scioto, Shenandoah, Susquehanna, and Tennessee.

Streams are most active in the spring due to frequent rainfall and snowmelt. Many smaller streams dry up in the summer and are not recharged until October to November. The **Northern Ridge and Valley Section** includes the headwaters of the Potomac and Greenbrier Rivers. Streams are generally more alkaline and productive than in the Allegheny Mountains. The **Appalachian Plateau** contains headwaters of the Cheat and Greenbrier Rivers, which eventually feed through other tributaries into the Ohio River, and the Allegheny and Monongahela Rivers which form the Ohio in Pittsburgh. Streams are generally more acidic and less productive than in the Northern Ridge and Valley Section. Wetlands are scarce in both sections.

Parts of the region have the highest rates of atmospheric acid deposition in the United States, resulting in acidic streams. This is compounded by acid mine drainage from abandoned mine lands.

Over 31 percent of the stream miles are in poor condition based on a fish Index of Biotic Integrity or aquatic insect indicators.

## 8. Major Forest Conservation Challenges

- The headwaters of the Chesapeake Bay and Ohio River were formed in the region and have major water quality issues ranging from sediment and nutrient pollution to water withdrawal for oil and gas exploration. **Stream degradation and water quality**