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Using Geographic Information Systems to Organize and Coordinate Holistic Watershed Resource Management

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By

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Abstract

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By John M.S. King

Thesis research explores the use of Geographic Information Systems (GIS), such as ESRI's ArcGIS and Google Earth, to organize and coordinate statewide, regional, and locally led watershed initiatives in West Virginia. Holistic Watershed Resource Management (HWRM) is an innovative collaborative approach to environmental protection designed to synchronize regional and local environmental assessment and restoration efforts. HWRM success is often attributed to an inclusive decision-making process, which seeks to build and coordinate cooperative partnerships among government agencies, private businesses, educational institutions, and non-profit organizations. A case study of the Morris Creek Watershed Association and detailed surveys of over 100 West Virginia watershed associations were conducted to give additional insight into HWRM on the local and regional scale.

Acknowledgements

This thesis would not have been possible without the support of my academic advisors, community, friends, and family. Under the direction of Dr. Tom Jones and with guidance from Dr. Ralph Taylor, Dr. Mike Little, and Mr. Pete Glass I was able to further my education in the environmental field and gain invaluable hands-on experience. Each professor stressed the importance of teamwork among students whether in the field or in the classroom, which helped foster a sense of purpose and individual responsibility.

When I first entered the Geobiophysical Modeling Graduate program, the only environmental class I had previously taken was Biology 101, which, needless to say, left my confidence shaken. Much credit for this thesis goes to the students who often went out of their way to insure I fully understood the academics being covered in both the indoor and outdoor classroom. These students include: Nicholas Adkins, Adam Cottrel, Justin Elkins, Tiffany G. Hilton III, Jeremy McComas, Brian Richards, Jim Spence, Josh Westbrook, and Casey Swecker.

Participation in the Morris Creek Watershed Association (MCWA) changed my direction in life and enabled me to learn what it means to be passionate. I witnessed first hand the amazing transformation a watershed association can have on a community. Their organized effort benefits the community as a whole and local decision-making processes help synchronize regional and statewide environmental protection efforts.

Last but not least, I am grateful for and humbled by my family's unconditional love and support. Without their encouragement (and of course finances) none of this would be possible. Also, I must give a special thanks to my fiancée Jennifer Cutlip and her sister Sarah for their critiques and encouragement.

Table of Contents

Figures and Tables

Introduction

Geographic Information Systems (GIS) are essential technological tools used in Holistic Watershed Resource Management (HWRM) to organize and coordinate local environmental protection efforts within larger regional and statewide projects. GIS is a geo-referenced computer mapping system designed to organize, model and display spatial relationships between physical, biological, economic, and social information. Geo-spatially organized information provides an invaluable comprehensive means to manage resources and enhance decision-making processes. GIS has brought cartography into a new interactive realm, giving cooperative-based partnerships within HWRM an effective way to share resources, prevent overlapping responsibilities and streamline coordinated efforts.

Natural watershed boundaries and cooperative partnerships are used in HWRM to plan, organize, and coordinate environmental restoration and protection projects. Watershed Associations and watershed project teams in West Virginia play a vital role in HWRM by providing a social and financial conduit through which public, private, and academic entities collaboratively establish and work towards common goals. These autonomous, non-profit, watershed-based, stakeholder groups build on local decision-making capacity, establish multiple cooperative partnerships and, as technology becomes available, utilize Geographical Information Systems (GIS) to compile, share, evaluate and visualize geo-spatial information.

Problem Statement

Geographic Information Systems are not being used to their full potential in West Virginia. Most colleges, universities, private entities, and government agencies use Internet accessible Geographic Information Systems to provide free public access to their GIS maps and information. However, the information is not necessarily integrated or accessible from a single cyber-location, which would greatly enhance Holistic Watershed Resource Management (Chapter 3). Google Earth could be, and to some degree already is, used as a gateway to geospatial information. In this thesis, watershed associations and local or regional watershed project teams are addressed as an efficient means to compile and generate detailed geographic information, which can then be linked to on-line Geographic Information Systems.

Research Objectives

The goal of this thesis research was to gather information on each watershed association in West Virginia, which can then be linked to Google Earth "place-marks" and website information. The Morris Creek Watershed Association's GIS cooperative with Marshall University, detailed in chapter two, serves as an example. Research was accomplished through literature reviews and communications with nearly 100 individuals using personal phone surveys, mail, and E-mail questionnaires. Attempts were made to contact all West Virginia watershed groups and their WVDEP Basin Coordinators. Surveys and research was intended to:

- Update and expand the West Virginia Watershed Network's Watershed Group Contact List
- Understand how and why individual watershed groups formed (The Spark)
- Identify what caused particular groups to become inactive
- Describe differences and similarities between political, local and broad-stakeholder based watershed groups in West Virginia.
- Identify how many groups utilize Geographic Information Systems
- Explain how watershed groups contribute to and benefit from GIS
- Use schematics to give insight into watershed associations and their projects
- Create a database of WV watershed groups, which will be organized into Marshall University's Geographic Information System and linked to Google Earth place-marks

The objective is to provide a summary of Holistic Watershed Resource Management in West Virginia and explain how watershed associations and project teams contribute to and benefit from Geographic Information Systems.

Chapter 1

1.1 Global Positioning System (GPS)

For centuries man has sought to orient himself on the Earth's surface, learn how to navigate between points of interests, and attempt to map and model practically everything on earth and in the heavens. Celestial bodies historically played a major role in land and especially sea navigation. "Early mariners relied on angular measurements to celestial bodies like the sun and stars to calculate their location" (Pace, et al, 2005). Compass and star navigation remained the dominant method for orientation until the 1920's when the use of radio waves to orient ships at sea revolutionized navigational technology and marked a colossal step in modern science.

Radionavigation was first used to orient ships out at sea with land-based transmitters (Pace, et al, 2005). Although radionavigation is more efficient than celestial methods, both rely on open-line-of-sight communication and experience similar drawbacks. Much in the same way cloudy nights limit celestial navigation, thick tree canopies and mountainous regions limit radio transmitter and receiver line-of-sight communication. Pioneers in radionavigation quickly understood transmitters would have to be positioned at higher elevations for orientation technology to expand.

In 1957, the Russian satellite Sputnik made history with its successful orbit around the planet. Visible from earth, Sputnik enticed people around the world to stare into the night sky until their necks grew stiff, waiting to catch a glimpse of the star-like object orbiting the planet. Researchers in the United States at Applied Physics Laboratory (APL) were also observing Sputnik, but with the advantage of Doppler radar technology. Sputnik's orbital path caused Doppler shifts, which APL researches tracked, measured, and modeled. They discovered that if a satellite's orbit were known, positions on earth could be determined. This discovery would take line-of-site radionavigation to new heights (Pace, et al, 2005).

Soon after the discovery, APL formed a joint venture with the United States Navy to develop "Transit." Transit was the first two-dimensional system designed to locate satellite positions using simple radio wave technology, and "laid the groundwork for a system that would later revolutionize navigation forever—the Global Positioning System" (Pace, et al, 2005). However, the viable Global Positioning System (GPS) in use today was not developed through the merits of one single military department: it required a cooperative partnership with the U.S. Navy, Air Force, and Army. Instead of working independently, the Army, Navy, and Air Force joined forces to consolidate various satellite navigational concepts into a single comprehensive Department of Defense (DoD) system (Pace, et al, 2005). The system had to be accurate, consistent, and reliable out at sea, on the land, and in the air. Collaboration made the DoD's Defense Navigation Satellite System (DNSS) possible by incorporating each military department's needs and vision.

DNSS is a 24-satellite constellation orbiting the Earth and constantly transmitting radio signals toward earth-bound GPS receivers. GPS orbiters, known as Block I and the newer Block II satellites are technologically advanced but utilize a simple mathematical equation students learn in high school: Velocity x Time = Distance (Trimble, 2006). Although there are 24 satellites in orbit, GPS units need only four to determine direction and position. At least three satellites are needed to measure or triangulate distances between the transmitter and the receiver. The fourth satellite is used to judge altitude by measuring the time it takes for the transmitters to communicate with the receiver. Thus, the GPS unit is able to record and display longitude, latitude, and altitude (Pace, et al, 2005).

Block satellites were militarily designed with both defensive and offensive applications. High above the earth, these tributes to human ingenuity reserve the capability to detect nuclear detonation, and make possible precision guided missiles [which became famous during the Desert Storm conflict] (Pace, et al, 2005). Although GPS was developed with military applications in mind, the civilian world was welcome to use GPS capabilities even before the DNSS project was completed. By the mid-1980's, a GPS market geared toward the surveying profession was established even though very few Block satellites were in orbit (Pace, et al, 2005).

The idea of having GPS technology available to the public transcends political parties. In 1995, President Bill Clinton "confirmed the government's commitment to provide GPS signals to international civil users [free of charge]," a policy that began under the Reagan administration (Pace, et al, 2005). The government benefited greatly from its generosity through user feedback and enhanced receiver technology resonating from the private sector. Presently, GPS units can be found worldwide in aircrafts, vessels, automobiles, cell phones and more. GPS satellite technology is readily available to virtually anyone for less than two hundred dollars and the price of two "AA" batteries.

1.2 Geographical Information Systems (GIS)

The ability to quickly, easily, and accurately pinpoint geographical locations has made monumental strides in modern civilization. By intertwining GPS technology with computer software and mapping programs, practically anything and everything on the

Earth can be mapped, measured, analyzed, monitored and modeled. Geographic Information Systems (GIS) are computer-based mapping programs used to compile, organize, and display geographically referenced or geo-referenced information. GIS computer software is used to view spatial relationships between points of interests and to connect data with relevant geographic locations. Map overlays or layers can be made zero to one hundred percent transparent or simply turned on and off. GIS users can present information with a seemingly unlimited array of possibilities.

Environmental Systems Research Institute (ESRI), the creators of ArcGIS, is one of the world's leading producers of GIS software. ESRI's primary network of computer programs includes ArcView, ArcEditor and ArcInfo. Arc applications enable integration with other computer programs such as Microsoft Excel, AutoCAD and Access. Software integration of tradition computer programs with ArcGIS enables graphs, charts and data sets, known as tablature data to be geo-spatially displayed. "With the right data, you can see whatever you want—land, elevation, climate zones, forests, political boundaries, population density, per capita income, land use, energy consumption, mineral resources, and a thousand other things—in whatever part of the world interests you" (Ormsby et al, 2001).

Using GIS, one can compare existing maps or customize their own interactive and comprehensive atlas. Once obscure text and numerical data can now be compiled, organized, and visualized like never before, while highlighting its geo-spatial significance (Ormsby et al, 2001). Tablature and graphical data can be assigned to points on a map (such as GPS coordinates) or in accordance with lines and polygons (such as property lines), which can be drawn to create new shapefiles. "Geographic objects have an endless variety of shapes. All of them, however, "can be represented as one of three geometrical forms—a polygon, a line, or a point…[collectively] called vector data" (Ormsby et al, 2001). New shapefiles can be joined to or related with text and numerical data then saved as a layer. GIS greatly broadens the field of communication and allows information to be shared and integrated much easier.

2.4 Sharing Geographical Information

A growing consensus claims, "substantial societal needs may be better addressed through increased sharing of geographical information" (Onsrud & Ruston, 1995). Geographic Information Systems often include pooled-information from public, private, and non-profit organizations. However, there are several barriers that can hinder information exchange and integration. "The ability and willingness to share information are affected by the behavior and needs of individuals, organizations, and institutions and are subject to technical constraints" (Onsrud & Ruston, 1995). Fortunately, technical barriers to sharing information are becoming less an issue.

Web-based Geographic Information Systems such as Google Earth (GE) reduce technical barriers to sharing information. Most web-based GIS programs provide free public access to geo-spatial information and enable users to contribute to the database. GIS web-based programs are, to some degree, clearing houses for information gathering and sharing. In addition to its free version, Google Earth offers a $400 program that allows for integration with ESRI's ArcGIS. GE upgrades give users even more capabilities to disseminate geographic information.

Research has shown obstacles to information integration and sharing have less to do with technical problems and more to do with cultural and behavioral issues (Onsrud &

Ruston, 1995). Within this obstacle lies the issue of intellectual property rights. Property rights should be taken seriously and serve a purpose, but when public information is impeded from being freely shared and displayed, the issue becomes a matter of social justice.

2.3 GIS Applications in Environmental Assessments

Geographic Information Systems have become an indispensable tool in environmental assessments. GIS is often used to integrate and compare environmental assessment data with land use data. One early example is found in a 1994 study released by the American Water Resources Association (AWRA) entitled, *Examining Land Use Influences on Stream Habitats and Macroinvertebrates: A GIS Approach*. In an attempt to understand the overall health of Lake Superior, "Geographic Information Systems (GIS) were used to assess the relationships between land use patterns and the physical habitat and macroinvertebrate fauna of streams within similar sized watersheds," which helped track pollution sources affecting the lake's health (Richards & Host, 1994). The use of GIS to compile, analyze and model environmental assessments can be found in holistic resource management strategies around the world, and is increasingly being used to coordinate global cooperatives aimed at marine conservation.

Geographic Information Systems are utilized worldwide, and help coordinate massive multi-national projects. GIS is often used to compile data, highlighting regional responsibilities, and prevent over-lapping responsibilities, thereby greatly increasing project efficiency. One example of GIS being used to decrease overlap and increase efficiency within coordinated efforts is found in a currently active global project aimed at protecting the world's largest seabird: the albatross.

The albatross is well known to marine fishermen who use them to indicate wind currents. "Its giant wings enable the albatross to stay aloft on nearly imperceptible winds, thus making it the harbinger of good sailing to mariners" (ArcNews, 2006). Unfortunately, fishing hooks have decimated the bird's population. According to ESRI's Spring 2006 issue of ArcNews, albatross are attracted to baited fishing lines, which can stretch up to 40 miles in length. Albatross are often entangled or hooked and ultimately drown. Most albatross species, according to the article, are listed as "species of concern", "threatened", or "endangered".

Due to the animal's dramatic population loss, they are considered a priority in conservation efforts, and due to their global range, this is a conservation effort that demands a holistic collaborative approach. GIS greatly enhances cooperative partnerships by helping participants coordinate their efforts. ArcNews documents a GIS based project using satellite tagged birds to track albatross movements and outline management zones. The project aimed to increase coordinated efforts and decrease overlapping responsibilities between coastal countries and fisheries.

ArcNews highlights difficulties surrounding such massive global projects and explains how GIS and satellite technology can be combined to gain a comprehensive understanding. "By overlapping albatross satellite telemetry tracks with boundaries of jurisdictional waters and fishing effort data, ArcGIS graphically highlights those fisheries and countries with responsibilities for albatross conservation" (ArcNews, 2006). Without cooperative partnerships and their willingness to compile data into a shared Geographical Information System, such comprehensive approaches would be virtually impossible.

Similar to cooperative-based projects found around the world, Geographic Information Systems are being used in West Virginia to organize and coordinate Holistic Watershed Resource Management. The Morris Creek Watershed Association (MCWA) serves as an example of how GIS can be used to support cooperative partnerships and environmental restoration projects. The MCWA, through a cooperative partnership with Marshall University, used GIS to prioritize and address local issues through spatial analysis of comprehensive environmental assessments.

Chapter 2

2.0 Background on The Morris Creek Watershed Association

Located in southern West Virginia's Upper Kanawha Valley, the Morris Creek Watershed Association Inc. (MCWA) is a community-based non-profit organization with a mission to protect and restore the local environment. For the past five years, the MCWA has used environmental assessments and GIS to physically and biologically model watershed health and measure stream restoration progress. Through data integration and comprehensive analysis, GIS has been instrumental in helping the MCWA understand the state of the local environment and make better communal decisions. Although the MCWA is an autonomous organization, it shares the same common goals as many other watershed groups throughout West Virginia. Like other watershed groups, the MCWA utilizes their mission statement as the underpinning to help guide their success.

> The MCWA is made up of citizens from the local area joining together in an effort to protect and improve the Morris Creek watershed for the benefit of all citizens…Our goals are to return the Morris Creek watershed to a safe environment for all residents while restoring the water quality to a condition capable of supporting both aquatic life and local recreational activities. (MCWA, 2001)

The MCWA owes much of its success to cooperative partnerships, government support and advice from fellow watershed groups and dedicated volunteers.

Morris Creek, a relatively small tributary in the Upper Kanawha River Valley, serves as part of the Fayette and Kanawha County line located approximately 30 miles southeast of the capital city, Charleston, WV. The five-mile stream is fed by a seven square mile watershed and supports a population of nearly 500 people. The mouth of Morris Creek cuts through the western side of Montgomery, a town of approximately

3,000 people, and divides the town into two sections, Montgomery and West Montgomery.

According to a report written for the MCWA's Historical Committee by Jeff Davis, WV Cultural Center's Historical Preservation Office, Morris Creek is named after the first permanent settler in Fayette County: Levi Morris. In 1793, Morris built a log cabin at the mouth of what is now known as Morris Creek with the help of store bought nails he had purchased in Richmond Virginia (Davis, 2005). Less than 100 years later, coal operations brought thousands of workers and their families from all over the country and around the world to the Appalachian coalfields.

The culturally diverse community founded in the Morris Creek valley was known as Donwood, West Virginia. Presently, the area is more commonly known as Morris Drive. Davis's report shows two established post office dates for the area. One date was for Kanawha County on the western or left bank side in 1911 and the other in Fayette County, eastern or right bank side, in 1933. However, Davis notes coal operations were well known in the area long before Donwood was established.

> The West Virginia Department of Mines first published report (C. 1883) notes several mines within the valley. These operations most likely pre-date this time period as no mine reports were made prior to 1883 (Davis, 2005).

By the mid 1980's, the last coal truck rolled out of the hollow and left behind an economically depressed area riddled with mine-scarred lands. Environmental degradations or impairments from mining, such as Acid Mine Drainage (AMD) and gob piles (mine waste) reminded the community of their shared history. Their concern for the local environment and a desire to leave it in a better condition for future generations prompted the Donwood community to form the Morris Creek Watershed Association.

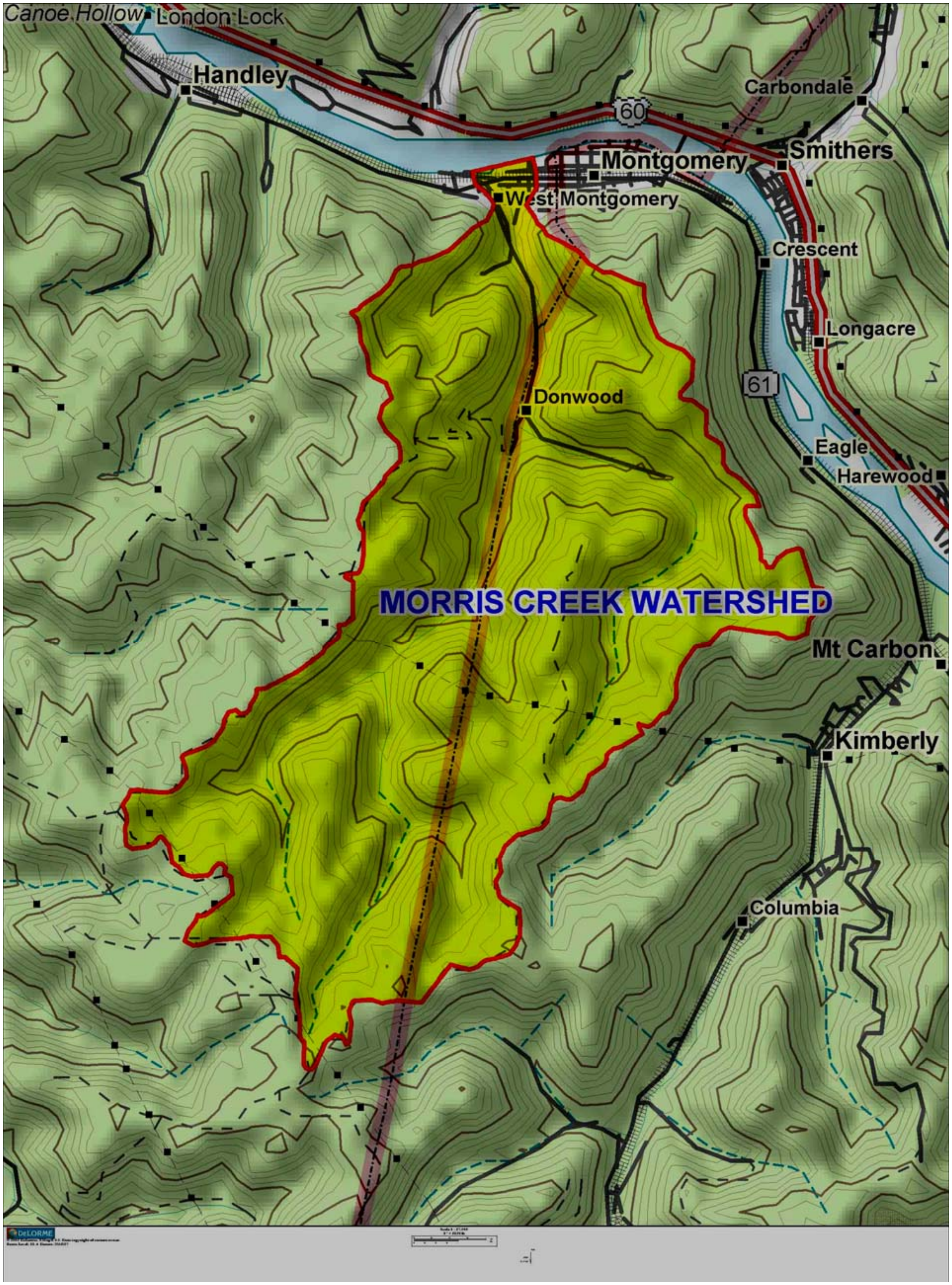

Fig.1, Morris Creek Catchment in the Upper Kanawha Watershed Basin

Outside Montgomery city limits, Donwood, now known now as Morris Drive, historically had no formal local representation or economic recognition. The community was unincorporated and had no official means to make local decisions or communicate with outside stakeholders such as government agencies and absentee landowners. In 2001, after severe flooding, the citizens of Donwood formed a non-profit organization known as the Morris Creek Watershed Association (MCWA) to cooperatively deal with complex environmental issues, which were difficult for members to approach single handedly.

With a formal organization, MCWA participants were able to organize monthly meetings, identify common goals, and build cooperative partnerships. Open communication between local and broad-based stakeholders helped strengthen the integrity of locally made decisions and increased the community's access to technical and financial resources. Multiple cooperative partnerships were established in order to pool public and private resources and guide restoration projects. MCWA's list of partnerships includes: the West Virginia Department of Environmental Protection (WVDEP), WV Department of Natural Resources (WVDNR), Soil Conservation Agency, WV Cultural Center, Office of Surface Mining Reclamation and Enforcement (OSMRE), the City of Montgomery, Canaan Valley Institute (CVI), Appalachian Electric Power Company (donated property and a building for meeting space), absentee landowner Pardee Resources, West Virginia University Institute of Technology (WVUIT), Marshall University, the National Hummer Club Inc., and the Mountaineer 4X4 Club Inc.

In 2002, the Morris Creek Watershed Association applied through the Internal Revenue Service (IRS) to incorporate the organization. This worked to strengthen the

MCWA's administration and made the 501C3 non-profit organization more formal. The first elected board members included:

- President, Mr. James Grey, engineer with Chesapeake Energy
- Vice President, Mr. Raleigh L. Collins, retired coal miner
- Treasurer, Mrs. Wanda King, ICU nurse at Charleston Area Medical Center
- Secretary, Mr. Michael L. Neese, Vice President of WVU Institute of Technology (MCWA, 2002)

Under Article 3 of incorporation, the group listed their primary goals as: flood prevention and protection, stream bank stabilization, maintenance, and water quality. In order to tackle these goals, the group initiated a comprehensive environmental assessment of the watershed and prioritized projects to address sources of pollution.

The MCWA membership is occupationally diverse. Many are retired persons from the coal mining, timber, and railroad industries, while others currently serve as homemakers, electricians, engineers, pastors etc. Very few members have a scientific or business background. Therefore, the MCWA relied heavily on technical support from the West Virginia Department of Environmental Protection (WVDEP) and the Canaan Valley Institute (CVI) to assess the watershed's environmental condition, identify sources of pollution, and facilitate restorative project planning. MCWA members were not content to sit back and let others do all the work. Local volunteers may not have known how to monitor a stream or evaluate an entire watershed. However, they knew how to pick up trash, gather historical information, and restore two cemeteries.

The MCWA's first major project was a stream cleanup in April 2002. At the time under WVDNR, now under WVDEP, the West Virginia Make It Shine program provide volunteers with trash bags, gloves and waste removal.

> The WV Make It Shine Program is a comprehensive program aimed at making WV one of the cleanest states in the nation through volunteerism. Throughout the state, groups of volunteers, businesses, community organizations and local governments are working to accomplish this goal. It is the responsibility of the WV Make It Shine Program to coordinate the effort of these people to make our state shine. (WVDEP, 2006a)

At the end of the MCWA's first weekend project, the group had removed 1,440 cubic yards (74.5 tons) of solid waste, which included over 500 tires, 27 appliances and two cars. Cooperative clean-up efforts created an immediate tangible difference within the community and the Make It Shine program became an annual MCWA project. To date the group has cleaned over 150 tons of solid waste.

2.1b Environmental Issues

Solid waste clean-ups have been a huge success for the MCWA, but Morris Creek is not only impaired because of garbage, it is biologically impaired due to Acid Mine Drainage (AMD) (Tetra Tech, 2004). Most of the mining operations in the Morris Creek Watershed were done prior to the 1977 Surface Mining Reclamation & Control Act (SMRCA). Before SMRCA coal companies were allowed to abandon mine sites when finished. Requirements on how to seal open portals and regulations to control mine drainage had yet to be declared. Since operations took place before the law, or expos facto, companies and landowners are not liable for environmental degradations or human health risks. These areas are known as Abandon Mine Lands (AML) and currently the responsibility of WVDEP's Abandon Mine Land program, which is funded by a coal severance tax (WVDEP, 2006b). The MCWA worked closely with the AML program and the federal Office of Surface Mining Reclamation and Enforcement (OSMRE) to direct funds and contract out restoration construction projects.

In order to plan and prioritize stream restoration projects, the MCWA formed partnerships with WVDEP's 319 program (attends to non-point pollution), AML Stream Restoration Group, Save Our Streams Program (WVSOS) and the Canaan Valley Institute. These groups were instrumental not only in helping the MCWA assess and monitor the watershed but also asked watershed members to be involved in the process. This hands-on approach helped members better understand where environmental problems were, which sites caused the most damage and what needed to be done to restore the stream. By 2004, the MCWA had assessed the entire watershed basin, established 17 stream monitoring sites, identified four major AML sites causing the most damage to the stream, and prioritized non-point sources of pollution in an official document called *the Watershed Based Plan*.

With help from Marshall University (MU), sources of pollution, project areas and monitoring information were complied into a Geographic Information System. The MCWA has a "place-mark" on Google Earth, which is visible to GE users worldwide. When the place-mark is clicked, it displays a link to the MCWA website (www.MorrisCreekWatershed.org). Visitors can then navigate to the MCWA's GIS map by clicking on another web-link on the MCWA webpage, which sends users to MU's online GIS server. MU's GIS support enables viewing of all 17 MCWA monitoring sites and accompanying information such as monitoring dates and results. Before the map was created, the information was either non-existent or tucked away into multiple data banks inside various state and federal agencies.

Geographic Information Systems enhanced the MCWA's data integration efforts and greatly improved local decision making capacity. For example, data analysts supported by GIS enabled participants to observe spatial relationships between pH levels and stream monitoring stations.

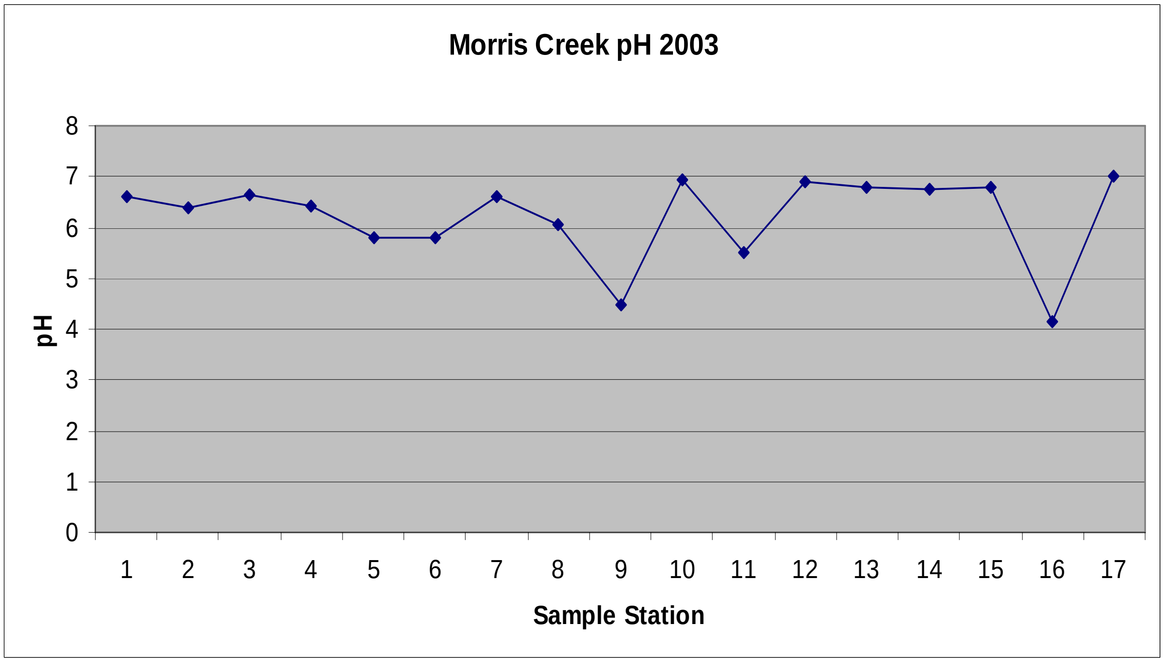

Fig.2, pH levels from all 17 MCWA monitoring stations; a drop in pH gives clues to the location of near by AMD sites.

When a drop in pH was observed between sample sites, for example, the MCWA Stream Restoration Committee knew which particular stream reach or section contained an environmental problem. GIS support greatly enhanced the MCWA's decision-making capacity. Through comprehensive watershed assessment analysis, the MCWA was able to efficiently focus resources toward sites that caused the greatest amount of damage to Morris Creek's over all health.

<u>2.1c Using GIS to Model and Address Morris Creek's Environmental Issues</u>

In order to model and holistically address environmental problems on Morris Creek, the MCWA used GIS to build a base-map or framework from which existing geo-spatially oriented data or shapefiles could be compiled and compared with locally generated shapefiles. The MCWA's Geographic Information System was provided by Marshall University as an in-kind service and maintained by a graduate student. The base-map (see fig 4) was created using surface layers to represent the watershed's natural features such as elevation, hillshade or relief, and topography. Existing shapefiles were then added to the base-map to highlight what was already known about the area. Professionals who had previously identified referenced features or vector data within the watershed, such as Abandon Mine Land sites, WVDEP stream sampling locations, and USGS Hydrologic Unit Codes or HUC, developed the existing shapefiles and provided free public access to the information on their agency's website.

Watershed volunteers and their professional partners (WVDEP, CVI, & Tetra Tech) generated their own geographic information during watershed assessments, project planning, and project implantations. Locally generated GIS data included the locations of illegal open dumps, sections of Morris Creek cleaned up through the WV Make It Shine program, previously unknown or unmapped environmental hazards (additional AML sites, an EPA Superfund site, and an old city dump), and MCWA stream-monitoring stations along with sampling results. The raw data generated during the local projects were given to the graduate student who then made the obscure data into shapefiles, put them into GIS, and highlighted spatial relationships between existing shapefiles and local project information.

Using GIS to Model and Address Morris Creek's Environmental Issues				
Surface	**Referenced Features/ Shape Files**	**MCWA Project Shape Files**	**Tablature Data**	**Interpretive Analysis**
Elevation & Hillshade	Watershed Boundaries 10 & 8 digit HUC	Open Dump Locations & Stream Reaches w/ solid waste problems	Tons of Solid Waste Collected	Identify recurring problem areas & highlight sites for future clean-ups
Topographical Map (75% Transparent)	Known AML Sites	Biologically Impaired Stream Reaches	TMDL Data	Stream Restoration Priority Sites
DOQQ files	2003 911 Arial photos	Discovered AML sites & Stream Monitoring Stations	WVDEP & WVSOS Monitoring Data	Stream Restoration Progress

Fig.3 MCWA's GIS framework

Existing data on Morris Creek before MCWA completed watershed assessments

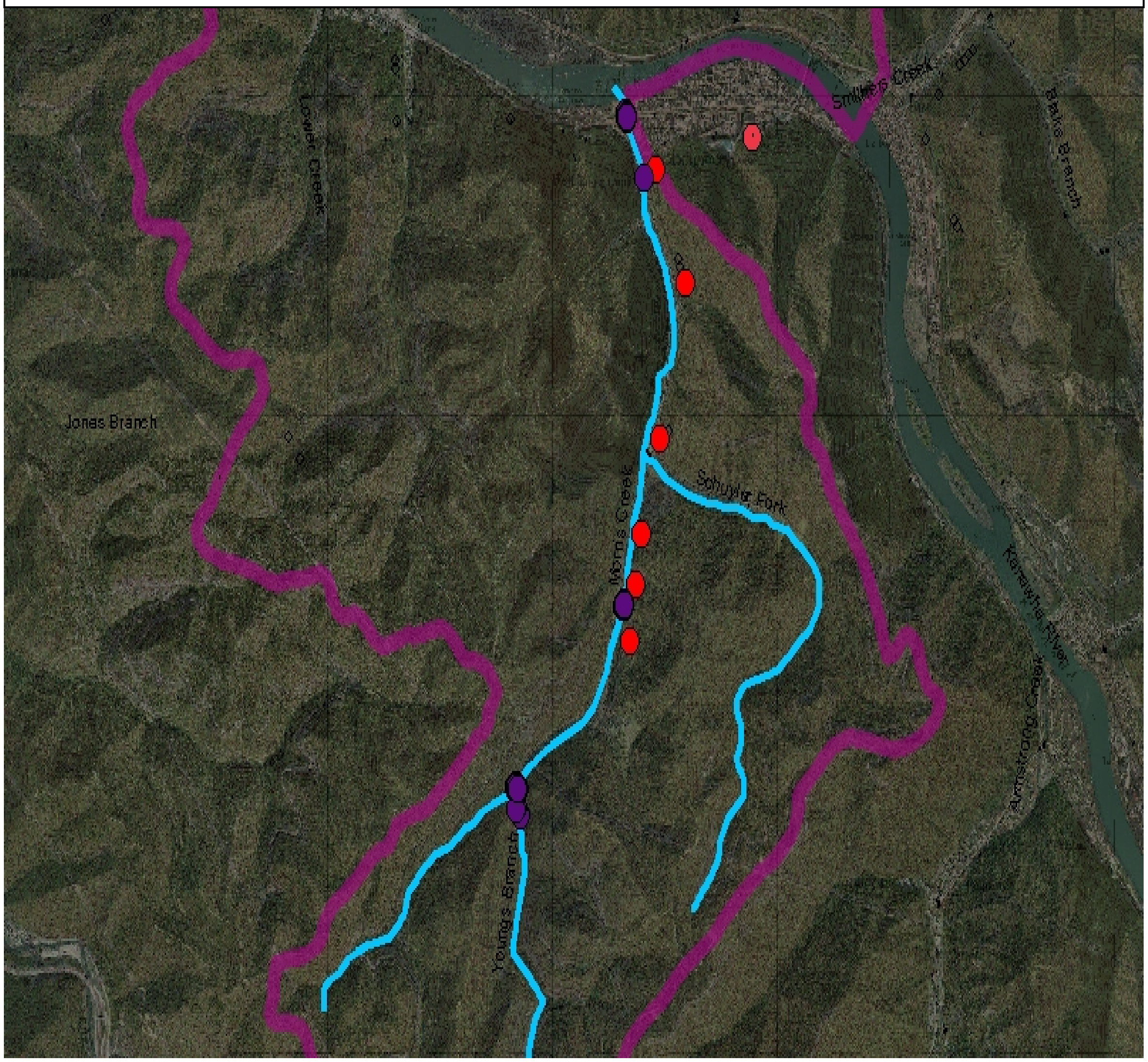

Fig.4, USGS Watershed Boundaries or HUC, Abandon Mine Land sites (red dots), WVDEP Stream Sampling Sites (purple dots), 911 Arial Photograph, Transparent County Boundary and Topographic map

Locally Generated GIS Data on Morris Creek, Map1:
Watershed assessments helped locate sources of pollution

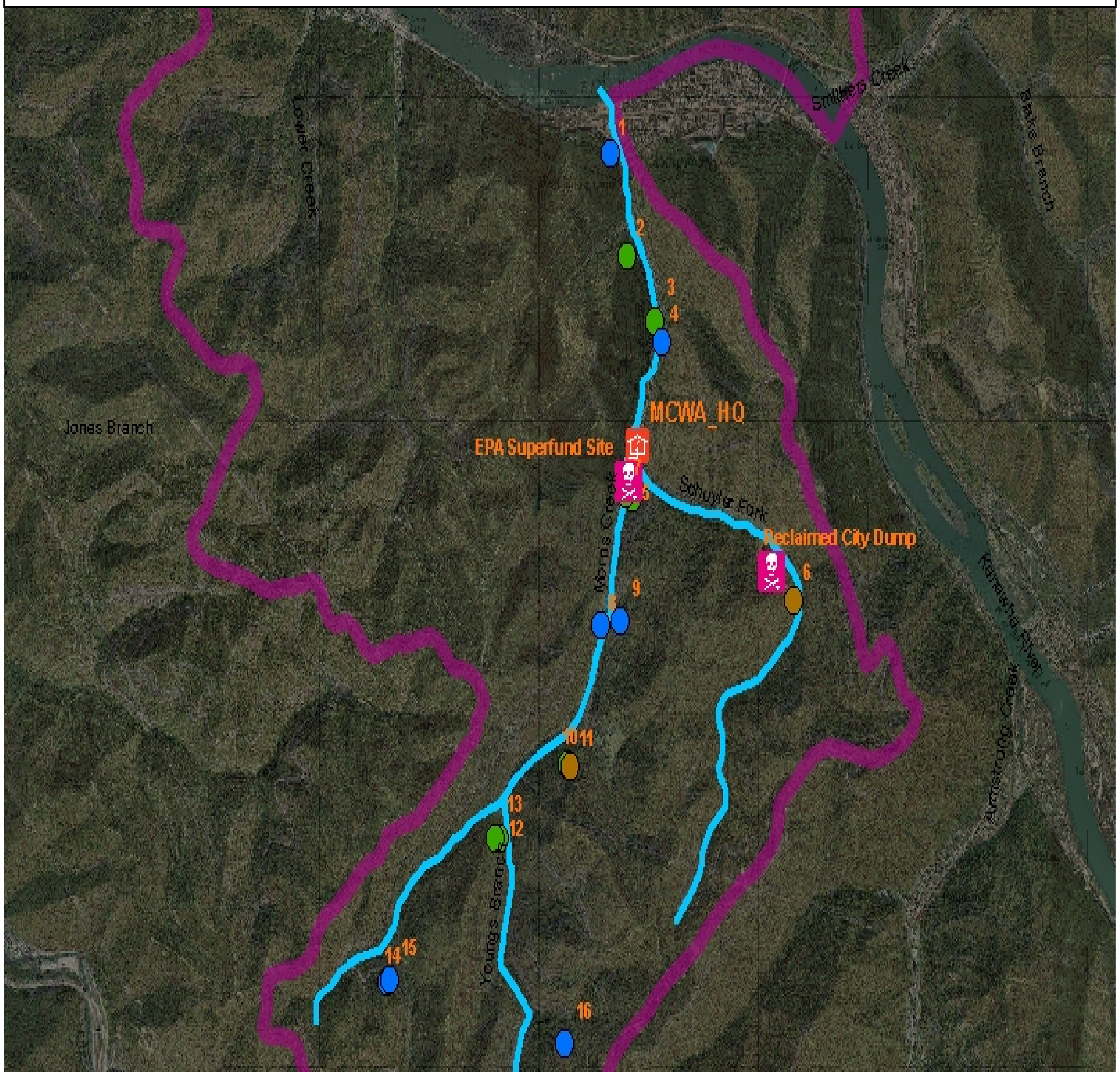

Fig.5, MCWA Stream Monitoring Stations, Reclaimed City Dump (no liner), EPA Superfund Site, and MCWA Headquarters

Locally Generated GIS Data on Morris Creek, Map2:
Locally generated project shapefiles provided participants with a holistic perspective and helped to communicate the MCWA's goals and objectives to the general public

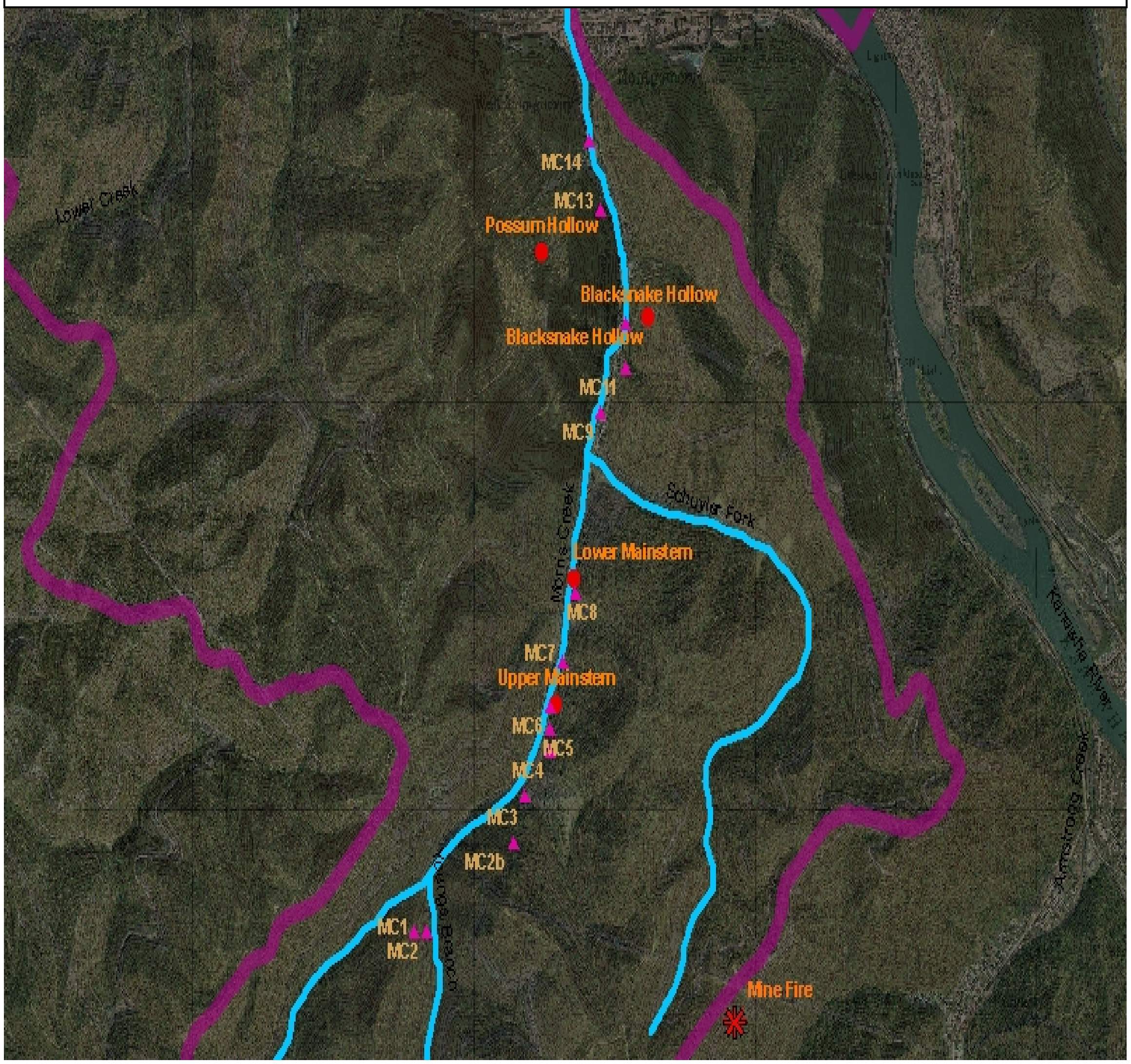

Fig.6, Morris Creek's Erosion Sites (pink triangles), AMD Remediation Sites (red dots), and Underground Mine Fire Site (red X)

Locally Generated GIS Data on Morris Creek, Map3:
MCWA projects completed through the West Virginia Make It Shine program

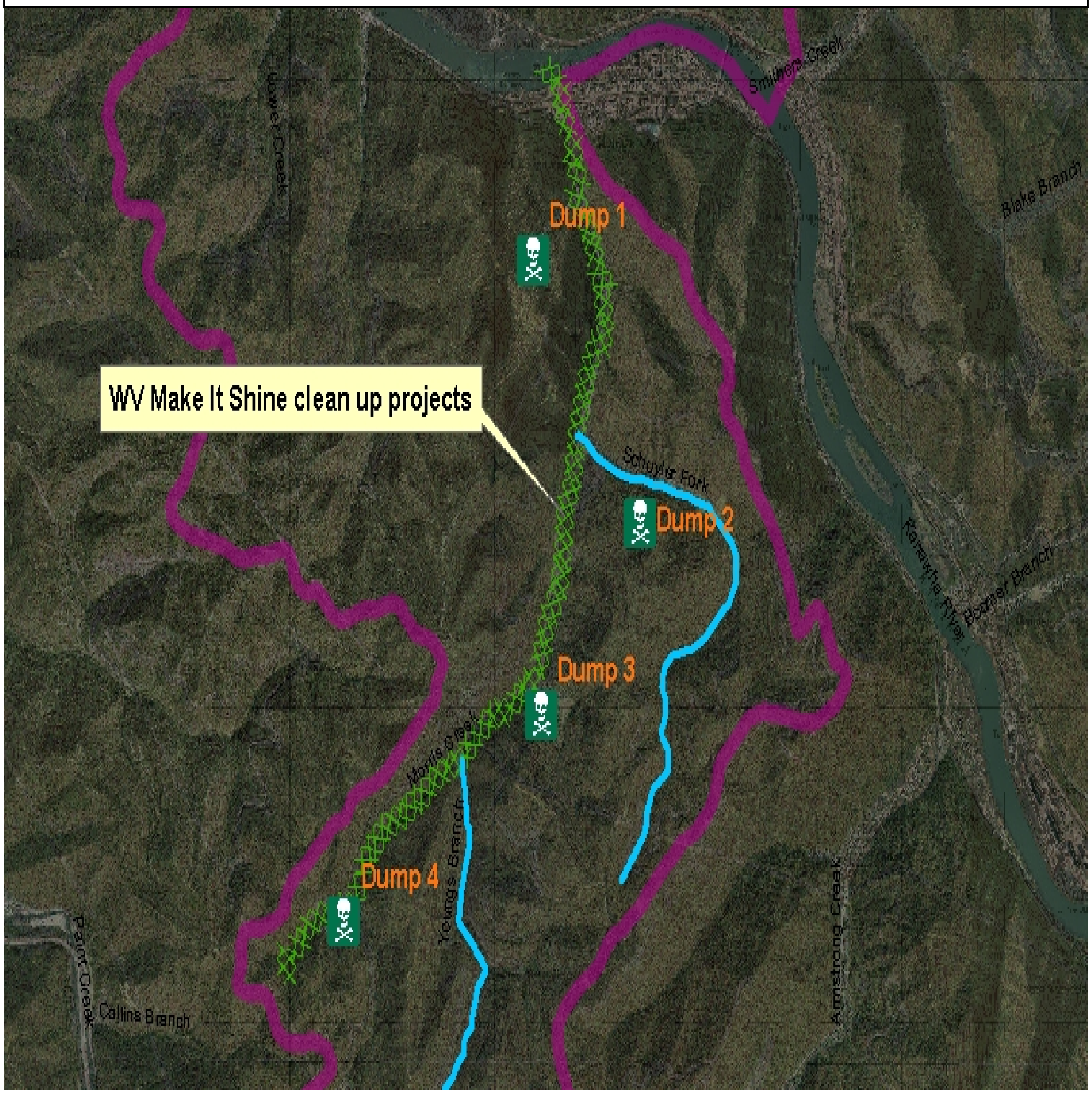

Fig.7, Section of stream and illegal open dumps cleaned up 2002-2007 (over 150 tons)

With a comprehensive GIS map, professionals and volunteers were better equipped to collaboratively identify problem areas, prioritize restoration efforts, track progression, and develop an interpretive analysis to explain project success or failure. Equally important, locally generated project shapefiles were used as an outreach and education tool to express the MCWA's goals and objectives. Shapefiles helped the MCWA visually communicate where, when, and why projects were implemented, which helped garner additional public support.

2.1d Projects and Results

Matching grants and funneling resources toward worthy projects represents a niche many watershed groups and other non-profit organizations are uniquely designed to fill. The MCWA tackled four prioritized Acid Mine Drainage (AMD) sites when it matched a federally funded grant with a state grant. OSMRE's Watershed Cooperative Agreement Program (WCAP) funded 40% of the project and the West Virginia's Department of Environmental Protection's 319 program funded the remaining 60% bringing the total project cost to $1.56 million. Construction on all four projects, Possum Hollow, Blacksnake, Upper Mainstem and Lower Mainstem began in the Spring of 2006 and were completed before winter.

Two months after project completion, the creek aesthetically changed from AMD orange to a more natural (although still impacted by sediment) brownish hue, signifying that the projects are reducing the amount of iron oxide (found in AMD) entering the stream. In addition to aesthetical change, Morris Creek is now showing signs of biological recovery according to a recent WV Save Our Streams survey (fig. 8).

WVSOS Results for MCWA Sample Site7	
2005	**2006**
Ph: 5.6	Ph: 7.04
Conductivity: 619	Conductivity: 422
Total stream score: 46.6	Total stream score: 53

(Fig.8)

Stream health is scored using a combination of water quality, habitat and biological indicators (macroinvertebrates) in accordance with the West Virginia Save Our Stream's Standard Operation Procedures and measured against WV's water quality standards.

The monitoring project was completed through a cooperative effort that involved the West Virginia Save Our Streams Program (citizen based monitoring program administered by WVDEP) and West Virginia University Institute of Technology (WVUIT) students. This project served as a prime example of the benefits that can be derived from university involvement with watershed groups. The students received hands-on experience and the watershed association gained valuable information.

The MCWA plans to continue such cooperatives with WVUIT, Marshall University and local schools. Experiential learning activities coupled with public outreach and education will be the group's next long-term project. The MCWA hopes educational recreational opportunities will expand understanding of local environmental conditions and perhaps, rejuvenate the local economy through eco-tourism. Other future projects will include road restoration to reduce habitat fracturing and sediment control, community-wide solid waste reduction and energy conservation, flood protection and prevention, etc.

The MCWA was recently awarded top honors at the WV Watershed Network's Watershed Celebration Day as the 2006 Watershed of the Year. The MCWA received a $5,000 award (donated by Dominion Power Co.), a plaque and several large metal signs created by the WV Department of Highways to mark the Morris Creek Watershed boundaries and acknowledge local efforts. Success in the Morris Creek watershed was the result of public participation in local restoration efforts, which were supported and coordinated within a statewide and regional watershed management framework.

Chapter 3

3.1 **<u>Holistic Watershed Resource Management</u>**

Holistic Watershed Resource Management (HWRM) utilizes a comprehensive approach to environmental protection and restoration. Watershed management develops a holistic perspective on the local ecosystem and its stressors, "Emphasizing the importance of the whole and the interdependence of its parts" (Webster's II, 1995), by compiling and analyzing environmental data along with other natural, cultural, and historical information. Traditional methods address only specific problems and often ignore the broader picture. "Pollution from a sewage treatment plant might be reduced significantly after a new technology is installed, and yet the local river may still suffer if other factors in the watershed, such as habitat destruction or polluted runoff, go unaddressed" (EPA, 1996a). Drainage-wide management requires a holistic or comprehensive approach due to inevitable upstream effects on downstream environments.

Holistic Watershed Resource Management is found to increase project efficiency and provide dramatic reductions in project costs. "Besides the environmental pay-off, watershed approaches can have the added benefit of saving time and money…a watershed framework offers many opportunities to simplify and streamline the workload" (EPA, 1996a). When water quality is the focal point or common goal of collaboration, public and private interests become more inclined to work in concert with one another, which in turn increases efficiency and saves taxpayer dollars.

Watershed management structure consists of four key elements, according to the U.S. Environmental Protection Agency (EPA). Stakeholder involvement, geographic management units, coordinated management activities, and a management schedule are the four key elements listed in the EPA's report, *Watershed Approach Framework*. HWRM can "build a sense of community, reduce conflicts, increase commitment to the actions necessary to meet societal goals and, ultimately, improve the likelihood of sustaining long-term environmental improvements" (EPA, 1996b). This "sense of community" which the watershed approach can build is important to society in many ways beyond environmental protection.

3.1a Coordinated Management Activities

Holistic Watershed Resource Management enhances decision-making processes through stakeholder cooperation within local or regional coordinated management activities. HWRM does not attempt to increase or reduce an agency or local government's responsibilities by attempting to dictate management activities nor is it an additional level of supervision (EPA, 1996b). The goal is synchronization of current or active programs. A proper watershed approach "should constitute improvements in coordination of current programs, processes and procedures to increase efficiency and efficacy" (EPA, 1996b). The aim is to increase cooperation, not start from scratch or increase the workload on already stressed government resources.

To implement a holistic watershed-based approach to environmental protection and restoration the state of West Virginia formed a Watershed Management Framework (WVWMF) with the help of approximately 30 state and federal agency and program directors. At a meeting on May 29, 1996 the group agreed in writing, "many of the natural resource, administrative, and communication challenges they will face in the future could be better met through a cooperative watershed approach" (WVWMF, 2003).

The watershed initiative made environmental protection holistically driven so that one agency's project does not interfere or duplicate another's. Ultimately, the WVWF provides a framework to synchronize multi-agency cooperation and focus.

A fundamental principle in sustaining local watershed initiatives is that groups or project teams must be, "embedded within a supportive institutional framework that identifies realistic roles for private landowners, local organizations and regional planning bodies" (Curtis et. al., 2002). The WV Department of Environmental Protection organized West Virginia into five coordinated regions (Fig 10). Each region is supported by a basin coordinator who helps organize project teams in priority watershed basins and supports local Watershed Associations. The WVWMF and basin coordinators also provide necessary institutional support.

A watershed project team's focus typically includes six defined steps:

1) Assessment and Characterization of Aquatic Resources, Problems, their Causes and Sources-- accomplished through watershed assessments

2) Goal setting-- identified through cooperative partnerships among local and broad-based stakeholders

3) Problem Prioritization and Resource Targeting-- Often utilize GIS to see geo-spatial relationships

4) Management Option Development and Watershed Plans-- documents local issues, such as point and non-point sources of pollution, and group strategies to address those issues

5) Project Implementation

6) Monitoring and Evaluation-- to determine if strategies are working and common goals are being met

(Fig.9, Modified from EPA, 1996b)

.

West Virginia's Five Coordinated Watershed Regions

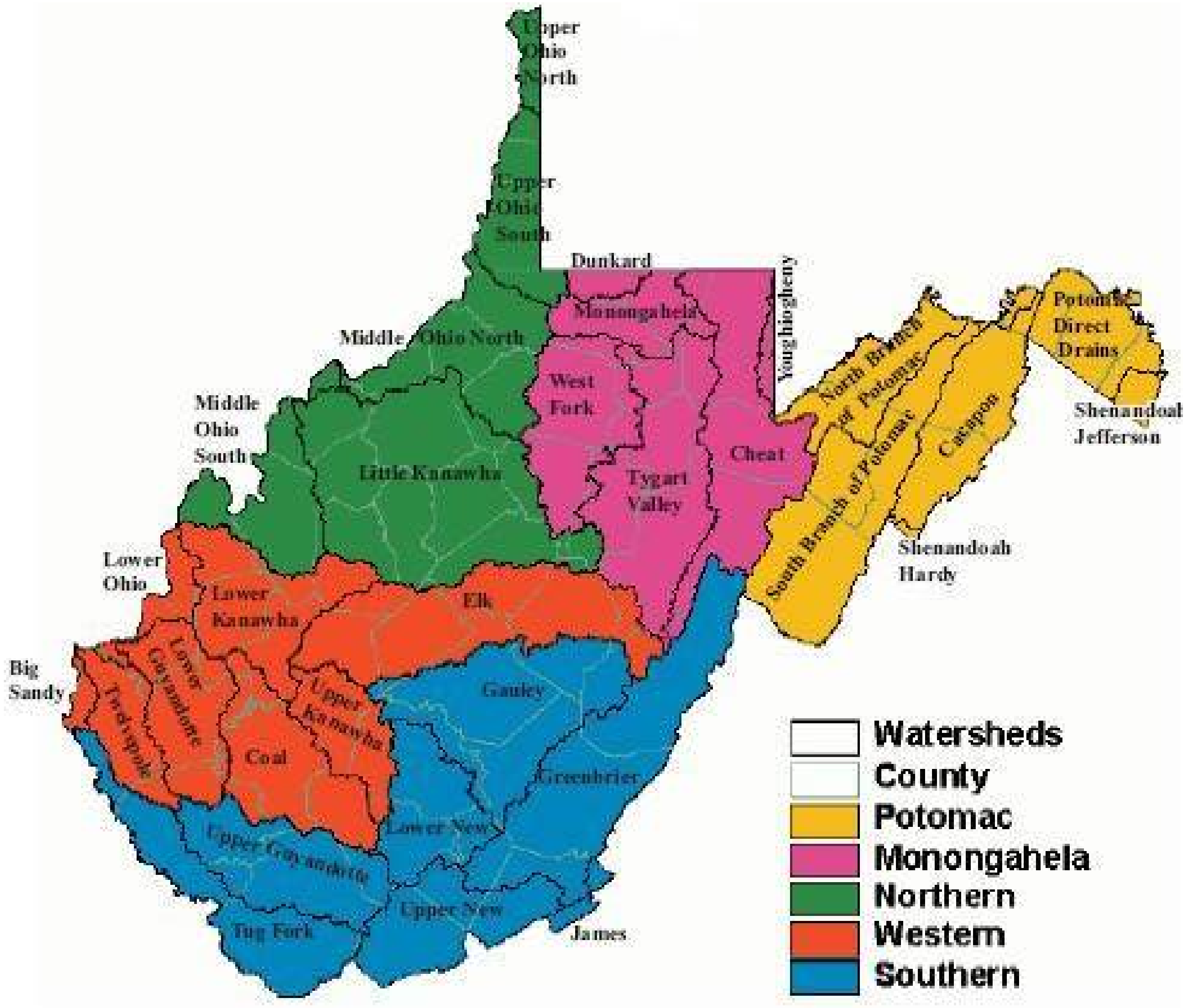

Fig.10

The West Virginia Watershed Network (WVWN) is an additional layer of institutional support loosely established by stakeholders as a means to enhance collaboration and recognize volunteer efforts. WVWN support is delivered in three forms: through an annual Watershed Celebration Day, a website, and an e-mal listserve on "Yahoo Groups." During the celebration day, watershed groups and project teams are recognized for their efforts through an awards ceremony funded by government agencies and private sponsors. The WVWN website and listserve allows participants to easily disseminate information, such as available grants and workshops, through mass e-mailings and website postings. Participants can use one e-mail address (WVWN@yahoogroups.com) to instantly send information to hundreds of individuals signed on to the WVWN Yahoo group list serve.

3.1b Management Schedule

A management schedule or cycle is an important component in Holistic Watershed Resource Management. The schedule provides a "long-term program for maintaining, restoring, and protecting water resources and provides other interested parties an opportunity to plan for their involvement" (EPA, 1996b). The schedule provides a fair and balanced approach by insuring each major catchment or river basin receives attention within a given five-year period (fig 11).

Management cycles provide stakeholders with an idea of when their particular buy-in or contribution should come into play, which helps create a synergistic atmosphere among participants.

> The essence of high synergy is that the goals of individual components are in harmony with the goals of the system as a whole. As a result there is minimal conflict between components, as well as between these components and the overall system (Russell, 1995).

The WV Watershed Management Framework uses the management cycle to select project areas within priority watersheds and synchronize restoration efforts. Prioritization is based on five key considerations: 1) Extent and severity of identified water quality impairments 2) Watershed restoration 3) Watershed protection 4) Agency interest and funding opportunities 5) Stakeholder participation (WVWMF, 2003). For example, in 2001, the Upper Kanawha River Basin was scheduled as a priority watershed. Since the Morris Creek Watershed is a sub-basin in the Upper Kanawha Valley, listed by the WVDEP as an impaired stream, and has an organized group of concerned citizens willing to participate in restoration efforts, the MCWA had a better opportunity to attract government resources.

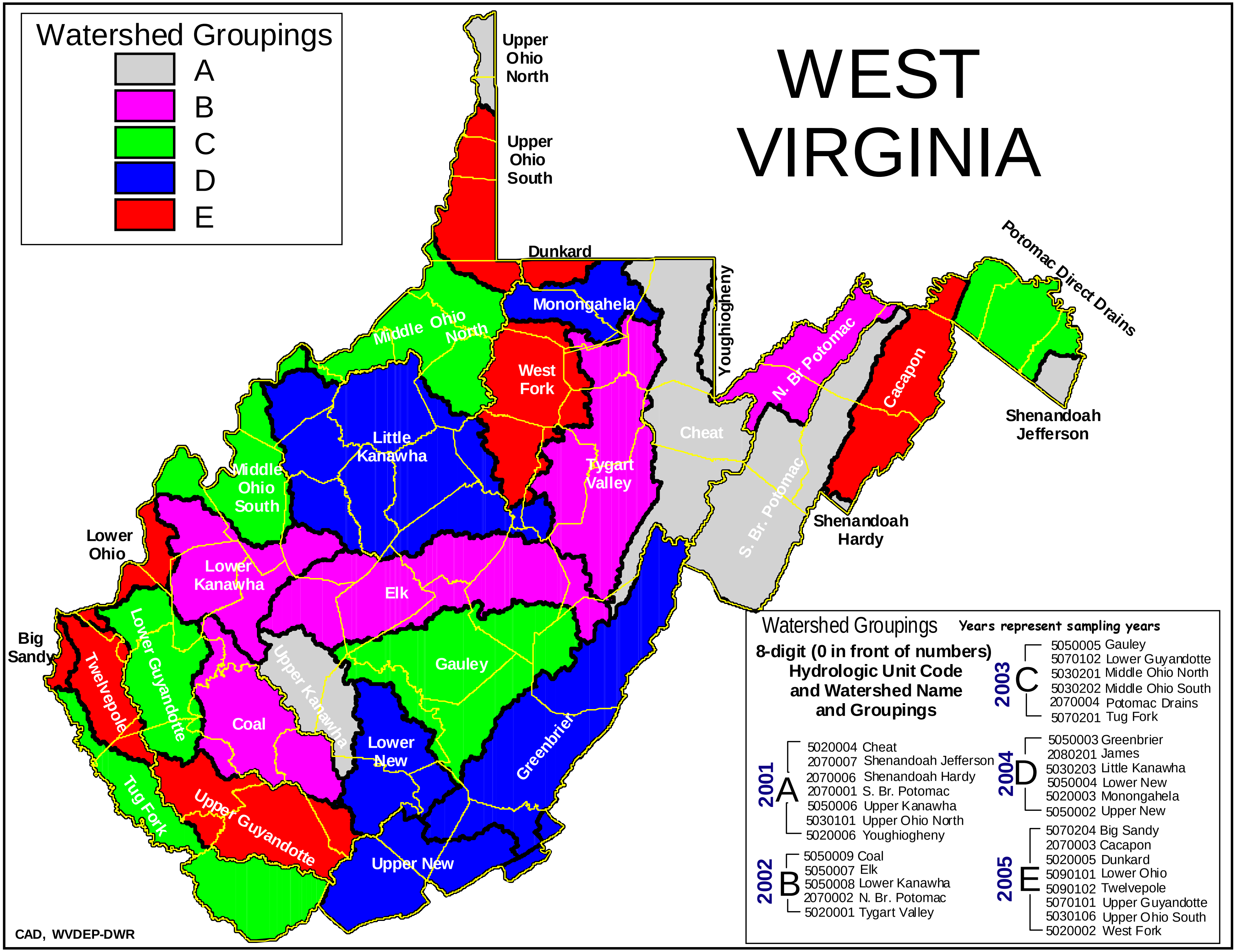

Fig.11, W.V. Watershed Framework and Total Maximum Daily Load Five Year Cycle.

3.1c Geographic Management Units

Participants in local or regional watershed approaches, such as watershed associations or project teams, need to identify a particular drainage basin or geographic management unit to focus their attention. Focus can be on a large drainage basin that takes in thousands of acres, or a small catchment draining only a few square miles. Watershed initiatives are organized using both social and natural boundaries (Curtis, et al, 2002). Watershed associations are non-profit organizations often formed by concerned citizens and communities who wish to address an existing environmental problem or by outdoor clubs and recreationalist, who wish to protect a certain area. Groups can also be formed by city and county entities (for example Piney Creek WA) seeking collaborative public/private partnerships in order to work around political boundaries, which often create barriers to cooperation and make no ecological sense.

Most Watershed Associations in West Virginia are non-profit organizations, also known as non-governmental organizations (NGOs), created by stakeholders to officially recognize local efforts and funnel resources. Organizations formed to focus on water quality issues often name their group after the drainage basin they intend to address for example, the Morris Creek Watershed Association, Friends of the Cacapon River, Baker’s Run Watershed Conservation Society, etc. Watershed groups often become incorporated along with their 501C3 non-profit status. The 501C3 non-profit status gives the group economic recognition and incorporation of the group strengthens administrational structure. Groups can also form a cooperative partnership with an existing non-profit organization and use it as an economic pass-through agent.

Comparable with Adopt-A-Highway initiatives, watershed groups essentially adopt an entire drainage basin as a sensible means to protect their streams, rivers and quality of life. Adopting the entire watershed, as opposed to merely adopting the stream, gives the group a much broader focus. However, working within a large watershed basin compared to focusing on a small sub-basin may require a different administrational approach.

> "Nesting" smaller watersheds areas within larger watershed or river basins allows those involved at every level to scale their efforts up or down to address specific concerns and still maintain consistency with related efforts. (EPA, 1996b)

Holistic Watershed Resource Management is extremely pliable. HWRM's flexibility encourages stakeholders to customize administrational structure to fit their watershed group or project team's specific needs.

The USEPA encourages state, federal and local governments to utilize HWRM to better coordinate projects and departmental programs. The EPA promotes watershed boundaries as the best way to coordinate public and private interests and point to cooperative partnerships as an efficient means to develop common goals and a comprehensive focus. The EPA does not enforce watershed management methods or require subordinates to direct funds away from current programs in order to comply. Voluntary participation is extremely important in watershed management, which strives for success through cooperation not coercion.

3.1d Stakeholder Involvement

Stakeholder participation is an essential component in the watershed approach and "without broad stakeholder representation, the perceived benefits of participation are quickly forfeited" (Curtis, et al, 2002). The common thread between broad and local interests is the realization of their shared dependence on water resources and the desire to cooperatively and comprehensively preserve, clean, protect and restore one of the Earth's most precious natural resource. Collaborative decision-making and cooperative public private partnerships among broad and local stakeholders are essential social components in Holistic Watershed Resource Management.

Public participation is an important element written into several U.S. legislative acts. "Statutes like the Clean Air Act, the Clean Water Act, and the Endangered Species Act were designed to both protect the environment and strengthen our democracy. They made government and industry more transparent on the local level" (Kennedy, 2001). In West Virginia, most watershed associations were formed by rural communities to help facilitate and coordinate local public participation and to give the community a voice in managing resources important to them. Watershed association members have a direct vested interest in the health of their drainage basin, and their cooperative participation provides collaborative partnerships with an essential social component (Gorder, 2001).

Watershed groups and project teams are formed by stakeholders who join together to maximize efforts toward common goals and often form what is known as public private partnerships. The EPA believes, "partnerships that promote the active participation of concerned parties from all levels of government and from across the public and private sectors is essential to the watershed approach" (EPA 1996b). Stakeholders pool resources in order to form better decisions and effectively implement watershed projects which are comprehensive and efficient.

Chapter 4

4.1 Research Methods

Research methods for this thesis includes investigation of 72 active (highlighted green in appendix A) and 43 non-active (highlighted blue) watershed associations and their five regional WVDEP watershed-basin coordinators through mailed questionnaires, E-mail and telephone surveys. The mailed questionnaire had poor results with only nine replies out of 72 sent. Therefore, E-mail and personal phone surveys were the primary method for gathering information. The nine watershed groups who responded to the mailed questionnaire were also contacted by phone or E-mail.

Survey results were compiled in a Microsoft Excel format and are included in appendix A. The original Excel format was developed for the West Virginia Watershed Network by Jennifer Pauer and borrowed from the West Virginia Department of Environmental Protection's Division of Water Resources. Original questions included: organization's name, contact person, mailing address, phone, fax, website address, E-mail address, county area, WV's watershed grouping code, name of watershed, sub-watershed, type of project, environmental problems, type of group, number of members, meeting dates, funding resources, partnerships, committees, educational institutions, map ID and year established.

Thesis research objectives were to identify groups that utilize Geographic Information Systems and update and expand the original watershed group database. An attempt was made to contact 120 individuals either by telephone or through E-mail. Five of the contacts were basin coordinators and the rest were watershed association members. How and why groups were started, listed as "the Spark," was an additional question added to create greater insight and to measure long-term success. There were a few new groups added to the list and some from the original list were reclassified as being active or inactive based on individual responses (new groups added to the list do not have a map ID). Attempts were made to contact non-active groups to gain a comprehensive understanding of the issues facing watershed associations and reasons why they entered inactive status.

4.2 Study Results

The Appalachian Mountains, stretching from Newfoundland, Canada to Georgia, USA are recognized as the world's second oldest mountain chain. Many scientists believe that at one time the Appalachians were taller than the Himalayans, but the weathering process over millions of years turned steep rocky cliffs into rounded hilltops, now sheltered by dense temperate forests. West Virginia is the only state completely encased in the Appalachian Mountains and its rugged terrain leaves no short supply of watersheds. Nicknamed the Mountain State, West Virginia reflects its ancient past through a wrinkled landscape formed by thirty-two major watershed basins carved by 32,278 miles of stream (WVDEP, 2004).

West Virginia has 72 autonomous watershed associations, organized under 32 major watershed basins and regionally divided into five coordinated areas (See Appendix B for Research Schematics). A WVDEP Watershed Basin Coordinator supports each region. According to the WV Watershed Management Framework's Guidance Manual, Basin Coordinator responsibilities include:

1) Facilitate Watershed Management Framework meetings at all levels
2) Serve as liaison between Project Teams and Partners on program and project status
3) Assist partner agencies with database development to support consistent

hydrologic coding,

4) Assist with the organization, planning, and reporting of the local project teams
5) Work to improve agency communication and understanding of the WMF process
6) Develop a watershed project database including a GIS map on a website
7) Assist with public outreach and education (WVDEP, 2003)

Basin coordinated regions include: The Potomac, Monongahela, Eastern, Western, and Northern Watershed Basins.

The Potomac Basin Coordinator has fourteen active and six non-active watershed associations, and the regional district is devoted to land areas that drain into the Potomac River Watershed. The Potomac region is divided into six major watershed basins—North and South Branch of the Potomac, Shenandoah Hardy, Cacapon, Shenandoah Jefferson, and Potomac Direct Drains. Watershed groups for this area are numbered three – 22 in appendix A.

The Monongahela Basin has five major basins which are part of the Monongahela River drainage system—Tygart Valley, West Fork, Cheat, Monongahela and Dunkard. In this region there are 18 active and twelve inactive groups numbered 24 – 53 in appendix A.

The Western Basin contains eight major watershed basins—Elk, Upper Kanawha, Lower Kanawha, Lower Ohio, Big Sandy, Twelvepole, Lower Guyandotte and Coal. There are a total of 19 active and eleven inactive groups in this area, which are numbered 55 – 84 in appendix A.

The Eastern Basin takes in all of southern West Virginia and contains seven catchments—Gauley, Greenbrier, Upper New, Lower New, Upper Guyandotte and the Tug. There are 18 active and six inactive groups, numbered 86 – 109 in appendix A.

The Northern Basin has five major basins—Upper Ohio North, Upper Ohio South, Mid Ohio North, Mid Ohio South and the Little Kanawha. This area, by far, has the least amount of watershed groups with only two active groups and eight inactive groups.

4.3 Discussion

West Virginia's 72 Watershed Associations help bring a local focus and comprehensive approach to environmental protection through which better Geographic Information Systems can be built and better decisions made. Thesis research has helped to define three types of watershed groups: 1) Community or local stakeholder-based, 2) Broad stakeholder-based and 3) Politically-based stakeholder groups. The majority of WV watershed groups are community or local stakeholder-based. This is most likely due, to the rural culture found throughout West Virginia and the people's strong sense of community. Most community-based and broad-based groups form to deal with existing environmental degradations such as Acid Mine Drainage, fecal contamination, and flood prevention. Local stakeholder groups typically focus on smaller sub-watersheds, whereas broad-based groups usually work with entire drainage systems (for example, the Morris Creek Watershed Association verses the Greenbrier River Watershed Association).

Local and broad-based groups normally do not limit themselves to one or two projects and often work on multiple projects throughout the year. Projects can include litter clean-ups, outreach and education, development of recreational opportunities, community revitalization and more. Thesis research, "The Spark," indicates groups who initiate multiple projects opposed to working toward only one issue, were more likely to maintain active status.

Groups who focus on only one project are more likely to fall into inactive status whether the project fails or succeeds. An example of this can be found in the New Creek Valley Watershed Association (Group # 17, Appendix A) located in the Potomac Watershed Basin. The New Creek group was formed after a major flood and worked to generate support to build a floodwall. After the project was declared a success, the group saw no reason to meet any longer since it accomplished the goal.

Although local and broad-based groups share many of the same goals and work on similar projects, there is at least one major difference according to thesis research. In general, community groups appear to be better at generating local participation but have difficulties finding outside support. Broad-based groups typically have outside support but have few local participants. Friends of the Cacapon River Inc (group #1, Appendix A) serves as a good example of this situation. According to their interview response, the group has 300 members but 99% live outside the area. The group is able to organize more support than smaller community-based groups through a widely circulated newsletter, membership dues, and donations but have difficulties organizing local participation.

Lack of local participation is an issue that plagues both broad and locally-based groups and represents the number one reason for watershed groups falling inactive. Nearly every watershed group reported their number one need was to find “new blood” and specifically the need for more young people to be involved. Most watershed members are over the age of fifty and will not be able to sustain the organization long-term if new members are not found.

The majority of watershed groups are found in two main areas of West Virginia: 1) the Eastern Panhandle where urban sprawl is creating over-development issues, and 2) within the West Virginia Coal Belt, which runs north to south through the center of the state. This evidence shows that most groups are pro-active and are usually formed to address existing environmental degradations, not as a preventive measure. There are however, a few groups that initially formed to prevent problems rather than address existing issues. Two examples of this situation can be found with Friends of Laurel Mountain Watershed, which formed to stop a rock quarry and Friends of the Cacapon River Inc that formed to prevent a ski resort from being developed. Eventually both groups developed other projects such as stream clean-ups and bank stabilization to address existing problems. The additional projects helped both groups remain active.

Environmental degradations or impairments are often tied to economic activities such as timber extraction, mining operations and commercial development. According to thesis research, most watershed groups in West Virginia form to address degraded environments caused by such economic development. However, this research uncovered a group formed specifically to reduce environmental protections. This is the role of politically based watershed associations or pseudo watershed groups.

In West Virginia there was only one political group found. The politically focused group, Blackwater River Watershed Association Inc. (Group #44, Appendix A) was located in the Monongahela Basin, and established by developers to loosen regulations in the highly profitable Canaan Valley area. Some argue the term watershed association was used to misinform and misdirect the public. These actions are known as propaganda. The group did not intend to protect or restore water quality. Instead, they (along with other private entities) sued the West Virginia Department of Environmental Protection over the Blackwater River's designation as a cold-water stream. However, on January 2002, the Blackwater River watershed group, along with several private entities, lost their case before the West Virginia Supreme Court of Appeals (WVSCA, 2002). The WVDEP's decision was upheld and the Blackwater River Watershed Association promptly disbanded.

Thesis research schematics (Appendix B) identify the number of watershed groups in each regional basin and gives insight into common projects. Results show that the Western Watershed Basin has 19 active groups with a total of 765 participants. The Eastern and Monongahela Watershed Basins each have a total of 18 active groups and a larger membership base than their western counterpart; the Eastern Basin with 1,072 and Monongahela basin with 847.

Most watershed associations in the Western and Monongahela basins are community-based groups, which may explain the lower number of participants. For example, the Potomac Watershed Basin has 14 active groups and 1,022 participants, which is similar to the Eastern Basin. The Eastern and Potomac regional basins encompass a larger portion of broad-based stakeholder groups, which typically contain higher memberships. The Northern Basin has the fewest groups with three active associations and a total of 25 participants. Thesis research did not indicate why the Northern Basin's numbers were much lower than the other regions.

Research results show a large majority of watershed groups prefer to be recognized as non-profit organizations and rarely use economic pass-through agents. Autonomy is important to watershed associations considering that 49% formed their own non-profit organization, while only 11% use pass-through agents. A group's decision to hold monthly meetings represents the largest discrepancy among regional basins. The Western Basin holds the same amount of monthly meetings as the other regions combined. Out of 19 active groups in the Western Basin, 11 hold monthly meetings.

Regular monthly meetings, common in the Western Basin, may be contributed to the areas close-nit community atmosphere and the fact many watershed groups in the area are formed by neighbors or community members who live in close proximity to one another. Groups that focus on large watershed basins, such as the Greenbrier River Watershed Association, Friends of the Cheat and Friends of the Cacapon River, may have difficulties getting people to drive long distances to attend monthly meetings. However, monthly meetings are not always necessary and should be made to fit an organization's individual needs. Groups who forego monthly gatherings convene every six weeks, quarterly, or as needed.

Although watershed associations engage in many unique and innovative projects, thesis research has identified five major categories including: open dump/litter clean-ups, stream monitoring, stream restoration, recreational opportunity development, and outreach and education. According to interview results, 55% of watershed groups participate in litter clean ups and stream monitoring projects. Often groups that monitor their stream and participate in clean ups, also intend to restore their stream to its natural beauty. Therefore, 52% of watershed groups engage in stream restoration projects. Outreach an education projects are tied closely to but not dependant upon websites as 44% promote outreach and education and 36% maintain websites.

Partnerships with educational institutions are highly sought after by watershed associations and exhibit many reciprocal benefits. Research indicates 54% of watershed groups have formed partnerships with one or more educational institution. Several groups, such as the Upper Paint Creek Watershed Association (UPCWA), utilize educational partnerships to help teachers promote watershed conservation in the classroom. The UPCWA developed a puppet show for elementary students and often travel to schools outside the Paint Creek area.

Other groups, such as the Morris Creek Watershed Association, form multiple educational partnerships (Marshall University and WVUIT) and encourage the use of their watershed as an outdoor classroom. Through such educational partnerships, students gain experiential learning opportunities, while their projects provide watershed groups with valuable information.

The use of GIS enables watershed groups and their partners to compile information and geo-spatially visualize their individual contributions and responsibilities. However, only 18% of responding watershed groups utilizes GIS. This number may be higher or lower due to questionnaire difficulties. The GIS information was gathered using an E-mail questionnaire, which received a poor response. Out of 72 e-mails sent, only 20 replied: 13 used GIS and 7 did not. Also, 25 e-mails were returned due to wrong addresses and others who failed to reply may not have known enough about Geographical Information Systems to comment.

Conclusion

Cooperative public-private partnerships are essential to efficiently build comprehensive Geographic Information Systems through which better decisions can be made. Using GIS to make better decisions is not only found in Holistic Watershed Resource Management, but in practically every corner of society. "Geographical information is used by practically everyone. Government agency members, state and local planners, industry, businesses and the general public all utilize geographical information for practical decision making on a daily basis" (Onsrud & Rushton, 1995). GIS maps created through HWRM usually contain more than just environmental data and often include layers with pertinent infrastructure and population census information. Interactive HWRM GIS maps made free to the public and accessible on the internet can benefit all levels of society by allowing individuals to use and manipulate geographical information in a variety of ways to suit their needs.

The Morris Creek Watershed Association's GIS cooperative with Marshall University should be seen as a pilot project and duplicated within watershed associations and project teams throughout West Virginia. Google Earth should be used as a focal point to help coordinate and network watershed initiatives. GE place-marks and KMZ files with links to additional website and contact information will greatly enhance local, regional, and statewide collaborative efforts.

GIS support in Holistic Watershed Resource Management helps decrease the risk of overlapping efforts and increases broad and local support thereby amplifying project efficiency, success, and long-term effectiveness. Environmental Systems Research Institute (ESRI) was established in 1969 with the concept that Geographic Information

Systems would be used to help organizations and individuals gain and share additional quantitative insights into environmental issues (ArcNews, 2006). Through GIS stakeholders can organize information along geographic management units, and build integrative and interactive maps to visualize and communicate where and when particular contributions are needed. GIS can greatly enhance local and regional HWRM project synchronization and expand decision-making capacity.

Holistic Watershed Resource Management and Geographical Information Systems are extremely versatile and are often used to increase the efficiency of collaborative approaches by supporting a project's technical, financial, scientific, and social needs. GIS is designed to "provide a bridge between technology, science, and social responsibility" (ArcNews, 2006). HWRM is based on local volunteerism, collective reasoning, and democratic processes that bridge communicative gaps between researchers, educators, policy makers, agency members, and the public and private sectors. Through GIS and cooperative watershed-focused partnerships, HWRM is able to organize and coordinate a comprehensive collaborative approach to environmental protection.

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Organization Name	City	State	Web-site	County Area	Watershed	subwatershed	Type of Project
Potomac Basin Coordinator			www.wvdep.org/item.cfm?ssid=11&ss1id=835				
Friends of the Cacapon River Inc.	Great Cacapon	WV	http://www.cacaponriver.org	Hampshire and Morgan	Cacapon	(Lost River becomes the Cacapon) Cacapon River	WV Make It Shine, Made home owners packet (Enviro dues and don'ts), WVSave Our Streams (WVSOS), Stream Bank Restoration, One of two Rivers in State with Harperella (endangered plant species), Monitors Hydrilla (invasive plant species) with plans to eradicate. River has native Freshwater mussel populations. News Letter,
Friends of the North River	Capon Bridge	WV		Hampshire	Cacapon	North River	Outreach - Edu "North River Mills/ ICE Mountain Day" & bike rides with local church group, best management practices, WV Make It Shine, Monitor stream w/ Cacapon Inst.
Bakers Run Watershed Conservation Society	Baker	WV		Hardy	Cacapon	Lost River (140)	WVSOS (started with Izacc Walton League), Adopt-a-Highway, Stream Clean ups, WV Make It Shine, Out Reach and Education (on Chesapeake Bay), Build Nature Trails
Cacapon and Lost Rivers Trust Inc	High View	WV		Hardy, Hampshire, Morgan	Potomac DD & Cacapon	Cacapon and Lost River watershed	
Blue Heron Environmental Network Inc	Hedgesville	WV	http://www.blue-heron.org/	Berkeley	Potomac Dir. Drains	Back Creek	Back Creek Water Quality Initiative (A Wild and Scenic River designation) = "This program has included many educational and research projects ranging from water quality analysis, wetland education, stream/watershed cleanups, wildlife and endangered species inventories, as well as historical documentation" (BHEN). WVSOS, Annual
Opequon Watershed, Inc.	Winchester	VA		Berkeley/Jeff	Potomac Dir. Drains	Opequon Creek	focus on tribs that run through cities, VA Save Our Streams, Spruce up Program - get rid of invasive species. Helped city build environmental recreation park around wetland
Opequon Watershed Project Team	Romney	WV			Potomac Dir. Drains	Opequon Creek	BMPs for nutrients, sediment, fecal coliform, also trash cleanups, monitoring, and landowner outreach
Sleepy Creek Watershed Association	Berkley Springs	WV		Morgan	Potomac Dir. Drains	Sleepy Creek	sustainable development, sediment, and Watershed Assessment, Stream Clean Ups, Stream Bank Restoration
Friends of Spring Run's Wild Trout	Petersburg	WV	N/A	Grant	S. Branch Potomac	North and South Mill Creek (Spring Run)	Restoring Trout habitat destroyed in 1996 and 1985 floods, erosion and sediment control, conservation education, Stream Monitoring
North Fork Watershed Association	Riverton	WV		Pendleton	S. Branch Potomac	North Fork	Reduction Non-Point Source Pollution Through BMPs
Upper So. Branch Watershed Association Inc	Petersburg	WV		Hardy/Grant	S. Branch Potomac	Lunice Cr, N Fk, S Fk, S Br, N & S Mill Cr	Watershed assessment, outreach- Education with local schools in three counties
Jefferson County Watershed Coalition	Shephardstown	WV		Jefferson	Shenandoah Jefferson	Shenandoah River	Annual Potomac Solid waste cleanup, WVSOS, Bacteria monitoring using IDEX
Creekside Anglers							
Rocky Marsh Run Network	Shepherdstown	WV		Jefferson/Berkeley County		Rockymarsh Run	Educational Outreach
New Creek Valley Watershed Association	Keyser	WV		Mineral	N. Branch Potomac	New Creek	Flooding, monitoring, cleanup, outreach
Back Creek Conservation Improvements	Charles Town	WV		Jefferson	Potomac Dir. Drains	Sir John's Run	Trash, habitat, education
Thorn Creek Watershed Association	Moyers	WV		Pendleton	S. Branch Potomac	South Branch (Thorn Cr)	Wetlands restoration, outreach
Lower New Creek Watershed Association	Keyser	WV		Mineral	N. Branch Potomac	New Creek	
South Branch Watershed Association of Hampshire County	Springfield	WV			S. Branch Potomac		
Tuscorora Creek Watershed Association, Inc.	Martinsburg	WV		Berkeley	Potomac Dir. Drains	Opequon Creek	WV Make It Shine, WVSOS, Water quality, litter, flooding, BMP

Organization Name	City	State	Web-site	County Area	Watershed	subwatershed	Type of Project
Monongahela Basin Coordinator			www.wvdep.org/item.cfm?ssid=11&ss1id=835				
Friends of the North Fork Watershed Association	Charleston	WV	http://www.northforkwatershed.org	Tucker	Cheat	Blackwater	Protect the Canyon's ecosystem & other resources, AMD Remediation, Outreach and Edu
Laurel Mountain/Fellowsville Area Clean WSA, Inc	Moatsville	WV		Preston	Tygart Valley	Left Fork of Sandy Creek	AMD being treated in cooperation w/DEP. Look at the effects of treatment, WVSOS monitoring by local 4-H group (Friends of Laurel Mountain Watershed)
Friends of Laurel Mountain Watershed	Tunnelton	WV	no	Preston	Cheat	Cheat R. Dir. Drains (watkins run)	WVSOS Monitoring on watkins run & with a 4-H group on the left fork of sandy creek for another watershed group (Fellowsville W.A.), fund raising
Friends of the Cheat Inc.	Kingwood	WV	www.cheat.org	Preston	Cheat	Big Sandy Cr, Cheat R. Drains, Horseshoe Run, Little Sandy Cr, Saltlick Cr	AMD Remediation, Cheat River Festival, Environmental Edu, SOS monitoring twice a year 17 sites. GIS mapping, News Letter
Shavers Fork Coalition Inc	Snow Shoe	WV	www.shaversfork.org	Randolph	Cheat	Shaver's Fork	Outreach, cleanup, monitoring
Cheat Lake Environment and Recreation Association	Morgantown	WV		Monongalia	Cheat	Cheat R. Dir. Drains (Cheat Lake)	Recreation, conservation, Water Quality Monitoring - use data collected by other groups of near by tributaries
Downstream Alliance (Preston County)	Morgantown	WV		Monongalia	Cheat & Monongahela		Stream quality survey, training
Dunkard Creek Watershed Association Inc	Morgantown	WV	DunkardCreek.org	Monongalia	Dunkard Creek	Dunkard Creek	Water quality, erosion, boat access project completed, Adopt a highway, Stream Monitoring, EDU& Outreach- want to take a program to schools, WVU college of engineering- in stream video and data collection plus a weather monitoring station, Work w/ Purple Martin Conservation Association-Take care of purple martin colony (Land
Buffalo Creek Dream Makers	Mannington	WV	(no www) busibyson.tripod.com	Marion	Monongahela	Lower Buffalo Creek	Clean Streams American Dream (Stream monitoring-a community service project for 4H), Trout Stocking, Habitat improvement, WV Make It Shine Day, Outreach and EDU, Fishing contest, AMD Remediation, built two parks
Friends of Deckers Creek	Dellslow	WV	http://www.deckerscreek.org/index.html	Monongalia	Monongahela	Lower Deckers Creek	"Friends of Deckers Creek takes care of a three-mile stretch of Route 7 between Pioneer Rocks and Cascade three times a year through the state's Adopt-a-Highway program, at the same time making sure the parallel section of the Deckers Creek rail-trail is litter-free. We participate each April in Monongalia County's Project Pride. Ar
4-H Road Community Association Inc.	Morgantown	WV		Monongalia	Monongahela	Monongahela Direct Drains	non-official Litter clean ups , worked with OMEGA Mine Project -water treatment from bond forfeiture, Worked with DOH to pave some roads
West Run Watershed Association	Morgantown	WV		Monongalia	Monongahela	West Run	Storm water mgt, development
People Against Littering Streams of WV	Montrose	WV		Barbour	Tygart Valley	Tygart River	WV Make It Shine, National Make a difference Day
Buckhannon River Watershed Association Inc.	Buckhannon	WV		Upshur	Tygart Valley	Buckhannon River	Monitored with WV Wesleyan College, and WVDEP over 100 sites, Trout habitat studies, four Liming stations, Recreational development, News Letter
Save the Tygart Watershed Association Inc	Grafton	WV		Tayler	Tygart Valley River	Three Fork Creek	Spring Clean Up, AMD monitoring on AML, Stream sampling (15 miles worth), applied for reclamation project and working on a study project, WVSOS, work with city on waste treatment plants, Public Outreach and Edu, setting up a small lab to help with their testing
Guardians of the West Fork Inc	Fairmont	WV		Marion	West Fork	Lower West Fork River	Water Quality, looking at TMDLs
Simpson Creek Watershed Association Inc.	Bridgeport	WV		Harrison	West Fork	Simpson Creek	Water quality, sewage, flooding
White Day Creek Watershed Association Inc	Fairmont	WV		Mon./Marion	Monongahela	White Day Creek	"Our watershed group organizes tree plantings to stabilize the streambanks, cleans up illegal dump sites, and builds trails and bridges to enhance recreation….We also participate in stream quality monitoring" (Moran, 2005).
Laurel Run of Big Sandy Watershed Association	Morgantown	WV		Preston Mon	Cheat	Big Sandy, Laurel Run	AMD, sediment, trash
Blackwater River Watershed Association Inc	Davis	WV		Tucker	Cheat	Blackwater River	Water desalinations issues (the group thought the river should be a warm water stream)
Big Sandy Creek Watershed Association	Bruceton Mills	WV		Preston	Cheat River	Big Sandy Creek (150)	Sustainable growth, water quality, amd, solid waste, sediment
Friends for the Restoration of Guyses	Fairmont	WV		Marion	Tygart Valley	Tygart Valley R. Drains	AMD
Helvetia Restoration & Development Organization	Helvetia	WV		Upshur/Ran.	Tygart Valley	Upper Buckhannon River	Habitat
Stalnaker Run Watershed Association	Elkins	WV		Tucker	Tygart Valley	Leading Creek	
Teeter Creek Lake Neighborhood Watch	Montrose	WV		Kanawha	Tygart Valley	Teeter Creek	Recreation area
Lower West Fork Watershed Association	Worthington	WV		Harrison and Marion	West Fork	Lower West Fork River	Monitoring, outreach, recreation, flood management, erosion control, and AMD
Elk Creek Watershed Association	Clarksburg	WV		Harrison	West Fork	ElkCreek	
Elk Creek Water Pollution Control				Harrison	West Fork	Elk Creek	Water quality, trash
Harrison County ECO (Environmental Citizens Org)	Salem	WV		Harrison	West Fork	Salem Fork	AMD, siltation, erosion, recreation, habitat, water quality
Tygart Valley River Watershed Association	Philippi	WV		9 counties	Tygart Valley		Flooding, water quality, trash

Organization Name	City	State	Web-site	County Area	Watershed	subwatershed	Type of Project
Western Basin Coordinator			www.wvdep.org/item.cfm?ssid=11&ss1id=835				
North Sand Branch Watershed Association Inc.	Mt. Hope	WV		Raleigh	Upper Kanawha		USACE doing a cost benefit study, Out-reach and Education about local issues with political figures
Big Coal River Watershed Association	Whitesville	WV		Boone	Coal River	Coal River (040)	WV Make It Shine, Adopt-a-Highway Program, Community Upgrade Project-Fixing up buildings & sidewalks, Stream Banks stabilization, WVSOS Monitoring, Enviro-edu/outreach "Butterflies in the classroom" Quail & frog releases.
Heizer Manila Watershed Organization, Inc.	Poca	WV		Putnam	Lower Kanawha	Lower Pocatalico River	WV Make It Shine, Great Kanawha Clean Up, and WVDEP's PPOD program. Sewage issues, flood warning systems, AMD remediation with 3 cell wetlands, Out-reach w/ newsletter, & Info booth at poca heritage day, SOS program, Adopt a Highway
Davis Creek Watershed Association Inc	Charleston	WV	www.daviscreekwv.org	Kanawha	Lower Kanawha	Davis Creek	WV Make It Shine, Adopt-a-Highway Program, Adopt-Stream-Pilot-Program, WVSOS-(1st time was in 1990), World Monitoring Day, Habitat improvement, Quarterly News Letter
Twelvepole Watershed Association	Dunlow	WV	www.twelvepole.org	Wayne	Twelvepole	East Fork/West Fork Twelvepole	Stream Monitoring with help from Argus Energy, Rock springs Coal Foundation, & Rock Labs out of Beckley WV, WV Make it Shine, Edu out-reach, Stream Restoration projects in Cabwaylingo State forest - Erosion and Habitat destruction,
Fields Creek Watershed Association	Winifrede	WV		Kanawha	Upper Kanawha	Fields Creek	Adopt-a-highway, Trash, would like to start a WVSOS program, Sewer System
Cabin Creek Watershed Association Inc	Dawaes	WV		Kanawha	Upper Kanawha	Cabin Creek	WV Make It Shine, Adopt-a-Highway, Stream Restoration-Team Project, WVSOS
Hughes Creek Watershed Association	Hugeston	WV		Kanawha	Upper Kanawha	Kanawha River	Adopt a Highway, Watershed Based Plan (In lieu Mitigation & USACE 404), Flood prevention project (Safe Community Project), working to increase law enforcement
Kelly's Creek Communities Association, Inc.	Glasgow	WV		Kanawha	Upper Kanawha	Kellys Creek	WV Make it Shine, Adopt a highway, AMD working towards WCAP, sewage project, Browns Field, Out-reach, Puppet Show (with over 2,000 kids), Navigating through History on the Kanawha, Annual Volunteer Appreciation Dinner. Rick Prichard Award-person that brings most volunteers to clean ups
Loop Creek Watershed Inc	Page	WV		Fayette	Upper Kanawha	Loop Creek	Save Our Streams, WV Make It Shine, Solid Waste Authority in Fayetteville paid for Clean Ups, Trout Unlimited Stocks Trout Work w/ mitigation money from Open Fork Mining Co & Trout Unlimited,
Lower Paint Creek Association Inc	Gallagher	WV	N/A	Kanawha	Upper Kanawha	Lower Paint Creek	WV Make It Shine, SOS, outreach, recreation- Rails to Trails, Highways-ByWays w/ Upper Paint Creek WA, and the Kanawha, Raleigh, and Fayette county commissions, Work w/ Trout Unlimited to stock trout and habitat reconstruction, Built fishing peers and pick nick settlers , walking paths. Adopt-a Highway , AMD remediation on Ten-
Morris Creek Watershed Association, Inc.	Montgomery	WV	www.MorrisCreekWatershed.org	Fayette Kanawha	Upper Kanawha	Morris Creek	Remediation of 4 AML sites. Stream Monitoring w/ SOS program, Marshall University, and AML Stream Restoration Group. 319 Watershed Based Plan, Edu Out-reach, Grave Yard Restoration. WV Make it Shine, Local History, develop recreational opportunities.
Upper Paint Creek Watershed Association	Pax	WV	www.paxflood.com	Fayette	Upper Kanawha	Upper Paint Creek	Byway-backway project, acquired land for hiking trails, overlook, fishing peers, RV park, puppet play. Bike-a-thon for St. Jude Hospital.
Clear Fork Watershed Association		WV		Raleigh & Boon	Big Coal River	Clear Fork Creek	WVSOS
Elk Headwaters Watershed Association Inc	Slatyfork	WV	www.elkheadwaterswatershedassociation.org	Pocahontas, Randolph	Elk	Elk	WVSOS, Adopt-a-highway, Following sewage treatment proposals, has a VISTA
Friends of the Elk Inc	Williamstown	WV	www.friendsofelk.org	Burgoo up stream	Elk	Elk	Annual Clean ups, WVSOS
Blue Creek Watershed Association	Clendenin	WV		Kanawha	Elk	Blue Creek	WV Make It Shine, Adopt-a-highway, AMD, sediment, flooding
Little Sandy Creek Watershed Association	Elkview	WV	www.littlesandy.org	Kanawha	Elk	Little Sandy Creek	Flood protection, sewage, WV Make it Shine, Public Out-reach, development of a community park.
Buffalo Creek Watershed Association	Charleston	WV		Clay	Elk River	Buffalo Creek	Acid mine drainage, water quality monitoring
Simmons Creek Watershed Association Inc	Belle	WV		Kanawha	Upper Kanawha	Kanawha River (Simmons Cr)	Flooding, trash, sediment
Buffalo Restoration Group	Clay	WV		Clay	Elk	Buffalo Creek	
Lens Creek Watershed Association	Hernshaw	WV		Kanawha	Upper Kanawha	Loop Creek	
Tyler Mountain Community Association	Charleston	WV		Kanawha	Lower Kanawha	Kanawha River (Tyler Cr)	Flooding, trash
Friends of Trace Fork	Nitro	WV		Kanawha	Lower Kanawha	Davis Creek	Recreation
Upper Mud River Water Association	Hamlin	WV		Lincoln	Lower Guyandotte	Upper Mud River	Recreation area
Pond Fork Watershed Association	Wharton	WV			Coal	Upper Pond Fork	
Little Coal River Coalition	Nitro	WV		Lincoln	Coal	Little Coal River	Water quality, land use, erosion, litter
Trap Hill Watershed Association	Fairdale	WV		Raleigh	Coal	Lower Marsh Forks	Flooding, trash, habitat, sewage
Friends of Mud River Watershed	Sod	WV		Lincoln	Coal	Parsner Creek/Mud River (Upper Mud R.)	Recreation, habitat, flooding
Upper Kanawha Valley Citizens Action Network	Gallagher	WV		Kanawha, Fayette, Raleigh	Upper Kanawha		

Organization Name	City	State	Web-site	County Area	Watershed	subwatershed	Type of Project
Southern Basin Coordinator	Charleston	WV	www.wvdep.org/item.cfm?ssid=11&ss1id=835				
Upper Guyandotte Watershed Association Inc	Mullens	WV	http://www.railwv.org/	Eastern Wyoming Southern Raleigh	Guyandotte	Upper Guyandotte	WV Make It Shine, Annual Scrap Metal collection, Flooding, sewage
Friends of Lower Guyandotte Watershed Association	Logan	WV			Guyandotte	Lower Guyandotte	
Elkhorn Creek Watershed Association Inc	Gary	WV		McDowell	Tug Fork	Elkhorn Creek	Trash, water quality, stream access, environmental education
Pigeon Creek Watershed Association	Delbarton	WV		Mingo	Tug Fork	Pigeon Creek	AMD , Trash
Indian Ridge Watershed Association, Inc	Welch	WV		McDowell , Wyoming line	Guyandotte / Tug	Indian Creek	WV Make It Shine, Stream Assessment, Want to map water course changes, Strategic Pond placements to protect from flooding, Plant propagation
Webster County Watershed Association	Webster Springs	WV		Webster	Elk & Gauley	Laurel & Williams	bank stabilization, trash, monitoring, outreach
Plateau Action Network Inc.	Fayetteville	WV	http://www.plateauactionnetwork.org/	Fayette	New River	Lower Meadow River	WV Make It Shine, WVSOS, AMD projects and wetlands restoration on Wolf Creek, , outreach Education, News Letter, Fayette County waste water treatment
Concerned Citizens of Pond Gap	Pond Gap	WV		Nicholas	Gauley	Twentymile Creek	WV Make It Shine, Adopt-A-Highway
Friends of Lower Greenbrier River, Inc.	Alderson	WV	www.Lowergreenbrierriver.org	Greenbrier, Monroe, Summers	Greenbrier	Greenbrier River	Adopt-a-highway, WV Make It Shine, Edu river workshops, Public Out Reach events, However this group does not facilitate public event due to liability concerns
Greenbrier River Watershed Association	Hillsboro. Office: Lewisburg	WV	http://www.greenbrier.org	Greenbrier, Pocahontas, Monroe, Summers	Greenbrier	Greenbrier River	Outreach, cleanup, baseline study
Upper Knapps Creek Watershed Association Inc	Buckeye	WV		Pocahontas	Greenbrier	Knapp Creek	Flooding, Stream Restoration Work, Bank Stabilization, Stream Assessment of 17 miles
Dunloup Creek Watershed Association Inc.	Glen Jean	WV	http://dcwa.blogspot.com	Fayette/Raleigh	Lower New	Dunloup Creek	WV Make It Shine, Flood control- work with NRCS volunteer buy out, AMD, sewage, Stewardship of our streams program, Reforestation in Glen Jean
Sewell Creek Watershed Beautification and Imp. Inc	Rainelle	WV		Fayette	Lower New	Upper Meadow Creek	WV Make It Shine
Piney Creek Watershed Association	Beckley	WV		Raleigh	New River	Piney Creek	WV Make it Shine, Storm Drain marking program
Laurel Creek Watershed Association	Oceana	WV					
Friends of the Second Creek	Second Creek	WV		Monroe	Greenbrier	Second Creek	Habitat
Indian Creek Watershed Association	Union	WV		Summers	Upper New	Indian Creek	Watershed survey, restoration
Hominy Creek Preservation Association	Quinwood	WV					
People Who Care About Brush Creek	Pipestem	WV		Mercer	Upper New	Brush Creek	
Moncove Lake Foundation, Inc	Gap Mills	WV		Monroe	Greenbrier & James	Second Creek & Potts Creek (Moncove Lake)	Habitat
Main Island Creek Partners	Omar	WV		Logan	Upper Guyandotte	Island Creek	AMD, flooding, litter, sewage, beautification
Cape Coalwood Restoration	Welch	WV		McDowell	Tug Fork	Clear Fork Creek	Trash, recreation/tourism
Little Buffalo Creek Watershed Association	Logan	WV		Logan	Upper Guyandotte	Buffalo Creek	Water quality, erosion, AMD
Bluestone River Environmental Restoration	Princeton	WV		Mercer	Upper New	Bluestone River	Water quality, recreation, trash
Northern Basin Coordinator	Charleston	WV	www.wvdep.org/item.cfm?ssid=11&ss1id=835				
Gilmer Watershed Coalition	Glenville	WV		Gilmer	Little Kanawha	All Gilmer, parts of Braxton Calhoun,, Doddridge and Lewis Counties	Flood Mapping with LiDAR Hydrology models and GIS, Stream Monitoring with SOS, Watershed Assessment (as of 2005, 40 miles of stream),
Little Grave Creek Inc	Glen Dale	WV		Marshall County			"We are attempting to restore the stream bank with riparian barriers, j-hooks, and plantings. We are also attempting to have a new bridge built into a major subdivision." (Smith, 2006)
Middle Island Creek Cons. Group	Sistersville	WV			Mid Ohio North	Lower Middle Island Creek	Recreation area - Initially and specifically, "The Jug" area within Tyler County, a unique loop of the stream which takes a sharp southerly bend, travels approx. 3.6 miles, and returns to within 100 ft. of the loop's beginning
Briscoe Run Watershed Association	Parkersburg	WV		Wood	Middle Ohio River 2		Ohio River Sweep, Flooding, erosion, education, solid waste, sustainable development, stream restoration, sewer project
Northern Panhandle Watershed Council Inc	Moundsville	WV		Northern Pan.	Upper Ohio		
Carter Run Watershed Improvement Association	Wheeling	WV		Marshall	Upper Ohio South	Wheeling Creek	Flood reduction, Bank stabilization
Wheeling Environmental Conservation Association	Wheeling	WV		Ohio/Marshall	Upper Ohio South	Wheeling Creek	Monitoring, plantings
Calhoun & Gilmer Careers Center	Grantsville	WV					
Bonds Creek Watershed Improvement Association					?		
Cedarville Community Association Inc	Cedarville	WV		Gilmer Braxton	Little Kanawha	Cedar Creek	Water quality, str bank stabilization, education
Friends of the Little Kanawha	Rock Cave	WV		Upshur	Little Kanawha	Upper Little Kanawha	

Environmental Problems	Type of Group	# of Members	Meeting Date	Funding Resources
In evasive plant Hydrilla, Sedimentation, *Cacapon is one of two rivers (other is south branch) that have inter-sex fish (found at the forks of the cacapon).	WSA, 501C3	300 (aprox 99% of members do not live in area)	Annual	Apple Butter Festival, Red Bud Festival, Stream Partners, donations
Fecal	WSA, Not a 501C3	2		No Grants
Nitrogen (non-point), Sediment, Development	WSA, 501C3	20	As needed	Stream Partners Grant, and smaller grants
Urban Sprawl	Land Trust	540	4 times a year	Membership, foundations, federal and state agencies and mitigation
	WSA		Monthly	
Stream is Impaired for Nutrients and Sediment, development, storm water run-off	WSA, 501C3	20	As needed	A foundation
nutrients, sediment, fecal coliform, trash - also side effects of rampant development	Uses Opequon Watershed Inc. as a Pass through Agent	8-12 usually attend, running list is about 25-30.	soon will be more consistent and will be 2nd Tues of ea month	Chesapeake Bay Program (through DEP), possibly Stream Partners, possibly Chesapeake Bay small watershed grant, possibly Chesapeake Bay Targeted Watershed Grant
Fecal	WSA	45		Stream Partners Grant $5,000. WV Conservation Agency Grant $1700. Yearly Dues. Money-raising projects
Flooding affects on the areas naturally reproducing rainbow trout	WSA	8	No meetings, annual letter about the group and the stream's situation	WV Stream Partners Grant, Canaan Valley Institute grant, local businesses
Fecal coliform, Nitrogen Phosphorous and sedimentation.	WSA, not a 501C3	25	As needed	NRCS
Nitrogen	WSA	5	no meetings	
Water Quality, would like to learn more about ground water	WSA, 501C3	12	3rd Tues every month at Sheppard College	Stream Partners Grant
Development pressures	WSA, 501C3	15	as needed	Stream Partners
	Boy Scouts / SOS			
	WSA/Foundation			
	WSA			

Environmental Problems	Type of Group	# of Members	Meeting Date	Funding Resources
AMD	WSA, 501C3 (through friends of Black Water)			
AMD	WSA, 501C3	50	Annual public meeting, Board meets every six months	Laurel Mountain F&M Trust Fund
Mining, logging, trash, development	WSA, have used Friends of the Cheat as a pass-through	10	as needed, will setup annual meetings in near future	Fund raisers -make apple butter, cater dinners, bake sales, raffle sales
AMD, Timbering issues	WSA, 501C3	325	Every 6 weeks, not open to public	Stream Partners Grant, WCAP, CWA 319, private donations, basic membership dues $20 (4 donation/membership levels)
	WSA			
	non-typical, WSA	10	4 meetings a year with one public meeting	County Commission, WVDEP- Stream Partners Grant, Membership dues, 1980s grant from Gov Caperton, Allegheny Energy
	WSA		Meetings on hold	
Erosion, subsidence	WSA, 501C3, Inc	20	as needed, will setup annual meetings	Stream Partners, donations
Solid Waste, AMD (small amount), abnormal chemical imbalances	WSA, Kept up by busy bison 4H-club	32	Incorporated into 4H club meetings	Raise money, Stream Partners, 4H Club
AMD	WSA, 501C3	200	third Thursday every month	Stream Partners, WCAP, 319 Grant, CVI, funding from city and county. Membership dues
AMD	WSA, Not a 501C3	5	As needed	OMEGA Law Suit settlement
Flooding, Development	WSA	10	4th Tues. every other month. Meet at WVU Poultry farm	
Acid Mine Drainage	WSA, AB College is a Pass Through Agent	15 to 30, Most members are students and faculty at AB college	As needed	Stream Partners, Local county grant,
Sediment, AMD, Acid Rain, Nitrogen, Mining, Logging, Septic Tanks	WSA, 501C3	30	1 or 2 public meetings a year, Board members meet once a month	Stream Partners, in-Kind services
AMD, fecal coliform	WSA, 501C3	20	3rd Tue every month at 7:00pm	Stream Partner Grant, fund raising
AMD, sediment	WSA, 501C3	25	3rd Tues every Month at local EMS center	Stream Partners, WCAP, 319 Grant
Sewage	WSA, 501C3	30	As needed	
Erosion due to timbering	501C3 WSA	50	We hold quarterly meetings in the Smithtown community center.	Donations from members
They say river is not being polluted	WSA (not a typical watershed group)	25	once a month	CVI
	WSA			
	5 families			
	WSA			
	Residential			
	WSA			
	WSA			
	Chamber of Comm.			

Environmental Problems	Type of Group	# of Members	Meeting Date	Funding Resources
Flooding, Development near and around Cross-Roads Mall, sediment	WAS	25	As needed	
Flooding, Mining and Timbering, Open dumps, AMD, economic diversity	WSA, working on 501C3	15	Meet w/ rotary club every Thursday	Stream Partners, OSMRE, Cooperate & private donations
AMD, Flooding, 2 toxic waste dumps-Super fund sites, erosion.	WSA, 501C3	42	3rd Tues.	Stream Partners, Verizon Employee program $500
Flooding (major event 2003), Development, Mountain Top Mining, Solid Waist, Sediment	WSA, 501C3	300	As needed	Stream Partners, Private & public contributions, CVI, OSMRE
Flooding, Siltation, Riparian disturbances, unpaved roads, improper solid waist disposal, sewage pollution.	WAS, Pass-through, Big Sandy River Basin Coalition Inc., 501C3, based in Prestonsburg, Ky cover WV KY & Va ties to ORSANCO,	35	once a month	Stream Partners, in-Kind services,
WQ, need a sewer system	WSA, 501C3	20	2nd tues every month	Stream Partner Grant, Kanawha Eagle Coal Company
AMD, Need additional Sewer System, Erosion, Sediment	WSA, 501C3	20	3rd Thur. every month 6:00pm, Meet in Cabin Creek medical center Administration Building at Sharon	Stream Partner Grant, Fund raising, Out side Donations
Flooding, Mine Fire, Logging Roads, sediment, slight AMD, Hydrogen Sulfides from AML	WSA	25	3rd Thr	Donations from members
AMD, Sewage, Flooding, Sediment, Stream Bank Erosion near Glasgow sewage plant	WSA	30	3rd Tues.	Stream Partners, Browns Field, CVI, Kanawha County Commission,
100 year Flooding	WSA, 510C3	8	2 or 3 times a year	Stream Partners, CVI, $15000 Fayette County Solid Waist Authority,
AMD, sediment, Flooding, Kingston Strip Jobs putting coal dust in creek, gas well people from Hamlin dumped oil in creek at standard. Timbering jobs causing sediment.	WSA, 501C3	20	4th Tuesday	Stream Partners, Roth & Hamilton, AEP, CVI
AMD, Timbering issues, sediment loads from logging roads, stream bank erosion, and improper reclamation near a gob pile (Jones Hollow Slip). Illegal dumping	WAS, 501C3	30	2nd Monday	Stream Partners, in-Kind services, WCAP
Down trees in creek, flooding, sediment, bank erosion, small amounts of AMD (not major problem) Fecal problems from up stream treatment plant.	WSA, 501C3	55	2nd Mon.	Stream Partners, NRCS (byway-backway), CVI, Fayette County commissions
WQ, concerned about slurry impoundments, Solid waste	WAS	12		
Fecal, Maintaining health of River for reproducing trout, sediment load	WSA, 501C3	50	Forth Thursday of every month	Stream Partners, CVI, Mountain RC&D, Share a VISTA with WV Nature Conservancy
Solid Waste, Sediment, Fecal	Sportsmen Club	43	As needed, mostly communicate through E-mails	membership dues
Flooding, AMD, Fecal, AMD	WSA	10	Second Tuesday every month, at the Quick Community Center	Stream Partners
Gas, oil, & logging roads. Straight piping, Flooding	WSA, 501C3	25	1st Tues. 7:30 p.m at the Elk River Community Center.	Stream Partners Grant
	WSA			
	WSA			
	WSA			
	Trails Coalition			
	WSA			
	WSA			
	Hunting Club			

Environmental Problems	Type of Group	# of Members	Meeting Date	Funding Resources
Sewage, Impaired streams from metals, sedimentation	WSA, 501C3	140	second Monday every month at Mullins opportunity center.	Stream Partners, CVI, 319 grant, Resource Conservation Council
	WSA	8	2nd Tues	Grants, local in-kind services
	WSA			
Flooding, Air Quality, Chemical pollution, Timber with no BMP, Coal mining diverting water, want early warning system	WAS, Inc (not 501C3)	was 1,000. Now 10	As needed	
AMD, Fecal, development, flooding	WSA, 501C3	400	1st Tuesday of the month 6:00 pm, at Gregg Studios, in Fayetteville	Stream Partners, Donations, Paid membership, Patagonia Grants, Wolf creek trust fund (Summer Lee mine site)
Logging and Mining, Illegal Dumping	WAS	10	as needed	
Forestry Management, Development, proper maintenance and operations of Waste treatment plants	WSA, 501c3 non-profit	250	two times a year	Stream Partners Grant
agricultural runoff; fecal coliform; flooding; urban runoff and lack of urban sprawl policy. karst-associated problems with difficulty in tracking pollution sources and underground mapping.	WSA, 501C3			
Stream Bank erosion	WSA, 501C3	10	As needed	Stream Partners, CVI, NRCS, Fish and Wildlife
Flooding, AMD, Sewage	WSA, 501C3	200	3rd Monday ever Month	NRCS, Stream Partners Grant, PAN
Flooding	WSA, 501C3	12	2 a year	Stream Partners
Storm Water, Fecal	WSA Not yet official	32	TBA	N/A
	WSA		Meet at local Hardeys	
	WSA			
	WSA			
	WSA			
	WSA			
	Community/WSA			
	WSA			
	WSA		2nd Fri.	
Flooding	WAS, a sub-committee of the Gilmer County Family Resource Network (pass-through agent)	5	Monthly, at FRN Community Show Case building	CVI (intern work on stream Assessment), Stream Partners grant, River Festival, Supported by the FRN which is funded by a yearly grant from the Governor's Cabinet on Children & Families.
Sediment, Fecal	WSA, 501c3	20	once a month	Stream Partners Grant $5,000 – County Commission match of $1,000 6,000 WV DEP/Conservation 12,000 Northern Panhandle Soil Conservation District 12,000 Total
	WSA, pass-through Tyler County Development Authority			
Flooding, urban watershed problems	WSA.	25	as needed	Stream Partners Grant, Rural community development
Flooding	WSA			
	College class			
	Community/WSA			

Partnerships	Committees	Educational Institutions	Est.
Chesapeake Bay Program, WV Rivers Coalition, Morgan County Rural Water Committee	Board of Directors	Morgan County High School, Paw Paw High School	1991
Nature Conservancy, United Methodist Church		Capon Ridge Middle School	1990
Mountain Institute, Cacapon Institute, NRCS, Chesapeake Bay Program, Soil Conservation District, Bake Raritan Club		Chesapeake Bay Program, East Hardy High and Middle school, Moorefield Middle	1990
			1995
			1991
City of Winchester, Sanitation Authority		Trained Teachers at Daniel Morgan Middle school with SOS, Lord Farfax Community College	1992
The Opequon Watershed, Inc., Jefferson Co. Watersheds Coalition, Berkeley Co. WVU Extension office, City of Martinsburg, Berkeley Co. Parks and Rec. Dept., Berkeley Co. Commission and Berkeley Co. Planning Commission			2005
	Stream Monitoring		2000
Trout Unlimited, Moorefield High School, WV DEP, CVI	No formal committees	Moorefield High School physical education fly fishing instruction program, and an annual on-stream conservation field day	1996
Chesapeake Bay Program, Potomac Soil Conservation Agency, WV Conservation Agency, USDA NRCS, WVDEP, WV Dept of Ag, DOH, US EPA, USFW, TU, WV Div of Forestry, US Forest Service, WVDNR, Farm service agency, USACE		WVU extension service	1996
local schools		Schools in Grant Pendleton and Hardy counties	1997
County Commission, Blue Heron Environmental Network Inc, WVDEP, Keep Jefferson Beautiful		Sheppard College Environmental Association	1997
Shepherd University, Freshwater Institute,			
			1996

Appendix A - WV Watershed Groups

Partnerships	Committees	Educational Institutions	Est.
			2002
WVDEP, Friends of Laurel Mountain Watershed	Steering committee	4-H Group	1989
Local 4-H Club, Fellowsville WA,	none	Rowlesburg Elementary and Middle school	1995
WCAP, 319 program, local businesses especially paddling companies, OSM/VISTA, CVI, Friends of Deckers Creek, Eastern Region Coal Round Table.	Board of directors, chair river of promise, funding umbrella for Preston county rails to trails.	Preston High School, Aurora Elementary, 4-H club, Boy Scouts, Bruceton 1-8th grade, South Preston Middle School	1994
			1996
WVU Dept. Economics, Dept of parks and recreation	recreation, news letter, Air Quality, Cheat canyon, Erosion	WVU	1984
WVU, Local schools, WVDEP,WVDNR, local farmers	Stocking committee, Stream Monitors, fund raising, farm land stewardship	Mason Dixon Elementary School, Clay-battelle High School grades 7th - 12	1995
4H Club	Clean Streams American Dream Committee through 4H	Boy Scouts, Barracksville Elementary and Middle	1997
WVDEP AML and NPS NRCS, Morgantown Utility Board, OSMRE, City and County	General	WVU, University High school, Cheat Lake Middle School	1995
Down Stream Alliance, WVDEP, Highlands Conservancy	informal		1983
Monongahela Soil Conservation Agency	Citizen Advisory	WVU	
AB College		AB College	1999
WVU Dept of Agriculture, WVDEP, WVDNR, CVI, OSMRE Farmers, City Water, Trout Unlimited, WCAP, Wesleyan College	Finance & Budget, Executive	Wesleyan College's Institute foe Environmental Research & Education	2001
Alterative testing Lab Inc, Lemont furnace, PA	Advertising, construction, public relations	Fairmont State College	2001
WVDEP, OSM, National Mine Lands Reclamation Center	Technical Meeting		2001
City of Bridgeport has taken over the clean ups		Bridgeport High School Key Club	1996
WV DEP, Boy Scouts	General		1998
			1998
none	none	None	1998
			1998

Partnerships	Committees	Educational Institutions	Est.
USACE			2004
Rotary Club of Whitesville & fire Dpt., Town of Whitesville, Town of Sylvester, Catenary Coal, Massey Energy Services, Libby's Dinner, WVDEP, WVDNR,OSMRE, Corporation for Community and National Service- VISTA, & many local schools and businesses	Grant writing, and clean up committees	Appalachian Council Head start, Whitesville Elementary, Sherman Jr. & Sr. (kids raise Quail and frogs at the school then release them in the watershed)	2000
	Out-reach, stream Monitoring analysis, grants	WV State's Biology, ecology, and chemistry dept. Marshall University, Out-reach presentation to Poca Elem, Middle, and High. Rock Branch Elem. 4H groups.	1997
Kanawha Sport Horse Association, DEP, Walker Machinery, Local businesses and contractors, County Commission Planning Office, Solid Waste Authority, Boy Scouts, Land Developers	Advisory committee	University of Charleston, Brownie Troup, Boy Scout, Charleston Catholic High School	1995
Marshall University (Vice President), Argus Energy, Cabwaylingo (superintendent = Treasure) and Beach Fork (Assistant Superintendent = Secretary) State Parks, WVDEP, Argus Energy (president), Rock springs Coal Foundation, & Rock Labs out of Beckley WV, WVDNR, Big Sandy River Basin Coalition	None	Marshall University	1998
Kanawha Eagle Coal Company			2000
DEP, DNR, Catenary Coal, OSM, CVI		Sharon Dawes Elementary School	1994
Nothing formal, but works a lot with USACE	N/A	N/A	2004
	Grants,	Riverside High School	1999
Trout Unlimited, WVDEP, Open Fork Coal Co., CVI, Stream Partners	N/A	Americorps working in Beards Fork came and learned about stream monitoring	1997
Kanawha, Raleigh, and Fayette county commissions, Trout Unlimited	N/A	N/A	1995
CVI, WVDEP, OSM, AML, Marshall University, National Hummer Club, WV Mountaineer 4X4, WV Soil Conservation Agency, Pardee & Curtin Land Co., City of Montgomery.	Finance, Grant, Historical, Stream Assessment Task Force, Leadership , Outreach	Marshall University, WVUTECH	2001
Lower Paint Creek WA, DEP, NRCS, CVI	Highways back ways, Paint creek restoration team	Only with Puppet Show	1996
			2002
Friends of the Elk, Trout Unlimited, CVI, WV Nature Conservancy, Forestry Industry	Action Committee-responds on a local level	Pocahontas County High School	2003
Elk Headwaters WA, WV Council Trout unlimited, WV Outdoor Sportsmen Organization.	general		2004
	general	Pinch Elementary	1998
	N/A		2000
			1994

Partnerships	Committees	Educational Institutions	Est.
Rural Appalachian Improvement League, local businesses, Trout Unlimited, Solid Water Authority, WVDEP	Waste Water project committee	WVU Water Research Institute	2002
McDowell Solid waste Auth, McDowell DOH,WVDEP,WV Make It Shine,Trout Unlimited,McDowell Parks & Rec.			1996
Lower Paint Creek Watershed Association, WV Rivers Coalition			2001
			1997
Waterstone Outdoors, Partners under MOU for wolf creek trusts		Fayetteville Elementary, St. Peter and Paul Catholic, Fayetteville High School	1997
Kenny's Machine Services, Kelley's Creek Watershed Association			1998
WV Rivers Network	Edu, clean up, Public affairs	Alderson, Talcott, Hinton	1992
CVI	general	WVU	1997
USACE, NRCS, WVDEP, PAN, Southern Conservation District	general	Mount Hope and Scarboro elementary school	1964
		Meadow Bridge High School	2003
N/A	N/A	Will work with Sherry Hunter and the Raleigh County Recycling Center	2004
			2005
Army Corps of Engineers, National Weather Service, US Geological Survey, National Resource Conservation Service, Resource Conservation & Development, WV Office of Emergency Services, WVDEP, CVI, Calhoun-Gilmer Career Center, Glenville State College, Cedar Creek WA, Down Stream Alliance, Guardians of West Fork,	River Festival and Technical committees	Glenville State College, Calhoun-Gilmer Career Center.	2002
Marshall County Commission, WVDEP, WV Conservation Agency, Department of Highways, Division of Forestry, Canaan Valley Institute. Ben Walls, WVDEP is our primary source of guidance and information.	Stream Partners Grant Membership Bridge Replacement Incorporation Publicity		2005
County, DOH, local businesses, CVI			1997
			2000

The Spark	GIS
Formed to stop a ski resort that was to be built on west face of Cacapon River. "The Friends of the Cacapon River was started in 1991 as a sub group and a "steering committee" called the Riverbank Group of the Lower Cacapon, a continuation of the Riverbank Group of the parent Cacapon River Committee. With encouragement and	Yes
Group talked w/ Dr. George Constantz	
Started as a way to help educate children.	
Protect contiguous parcels from development combined with permanent protection of restored riparian corridors.	Yes
"Blue Heron Environmental Network Inc. was organized as a 501(c) non-profit, non-political environmental/conservation education organization" (BHEN).	
Prioritized #1 of 24 subwatersheds in WV's Potomac drainage, through Potomac Tributary Strategy Implementation process. Also receiving a fecal coliform and biological impairment TMDL in 2006.	
Flooding in 1996	
Flood in January 1996, first meeting was that June to discuss flooding issues. Mike Sykes from Potomac Soil Conservation Agency told group about watershed associations. In 1998 group began to discuss BMPs and the fact that the North Fork was listed as impaired on 303d list because of fecal coliform. This group now reaches WQ	
Formed to gather data to see if there was a problem with the stream. Outside groups said it was the poultry industry that was hurting the stream, but after old data and new data was reviewed there seemed to be no consistencies. Now the group only focuses on Youth education.	
Mr. Latterell was conservation chair of the Sierra Club. He formed the Watershed Group so it could receive funds and provide a wider focus	
The Rockymarsh Run Network developed out of small and large community meetings addressing growth and development issues in Berkeley and Jefferson County. Several large parcels along the stream have changed hands in the last year and will be "growing houses" instead of crops. The Rockymarsh Run Network seeks to engage	
After a major flood. Group got a flood wall built.	
I talked with Mr. Walters who said he was with the Lightstone Foundation based out of Pendleton County. He knew little about Thorn Creek Watershed Association and said he thought it was formed by a group of farmers.	

The Spark	GIS
Formed as a group because F&M Coal company had three mining permits and degraded the stream then forfeited their bond. There was also a proposed deep mine.	
Rock quarry coming to local community and residents wanted to stop it	No
Mine blowout on Muddy Creek in 1994	Yes
Group of interested citizens who wanted a say in the Cheat lake's recreational and environmental potential the group helped the community to work with Allegheny Power	
Group taking a break	
Add in paper from WVDEP	
Adam Daft was the founding father of the group. He created the group as part of his community service project "Clean Streams American Dream" This is still a project of the local 4H Club	
Outdoor recreational group of people got together after seeing the success of Friends of the Cheat and wanted to do the same thing.	Yes
WV Sen. John Hunter helped pull his local community together to focus on community issues. First project was working on coal refuse piles and the OMEGA mine project.	
Wanted people to pay attention to the run off coming from new developments, and concerns with Rt 705 towards university stadium and Rt 68.	
Denniston family moved to the area and took notice of litter in the river and wanted to clean up the stream. Mrs. Denniston works at AB College and worked to involve students and faculty.	No
WVDEP held TMDL meetings	
Overflow from treatment plant caused local people to come together. They contacted an array of agencies to come to a public meeting. DNR directed them toward forming a stakeholder group.	
	Yes
Flooding issues and solid waste in the stream.	No
Illeagal dumping	
To negotiate with Allegheny power for access rights for fishermen (group became in active in 2001)	
To verify the water body's designation- the group (mostly made up by land developers) thought the Black Water River should be a warm water stream and the WVDEP ruled that it was a cold water stream. After the group lost the battle their meetings stopped.	
A sub-committee of the city of Philippi. No longer active.	

The Spark	GIS
Flash Flooding almost caused two people to drown. This raised awareness and encouraged local politicians and news media to get involved.	No
To address flooding and other enviro issues. Mrs. Cooper worked with Chesapeake-bay program and explained the watershed approach to the group.	
Robbert Carter (worked w/ Chesapeake Bay) caught wind of Toxic dump site, and contacted Mrs. Bonnett.	Yes
City of Charleston wanted to install a sewer line up Davis Creek and put it under the stream bed. This destroyed fish habitat. Diana Green helped organize a community meeting with DEP officials DEP asked the group, " what do you want?" Their main concern was putting Fish habitat back in the creek. The DEP gave some technical	
AARP invited Jennifer Pauer, WVDEP, to speak w/ group	
Community had no representation and wanted a voice in local decision making	
Concerned citizens wanted to improve the area. WVDEP told them about Watershed Groups.	
1st time, Flooding- C. Friddle knew about Watershed Approach because he worked as a raft guide and had contact with various non-profit groups. 2nd time- C Friddle talked with interested neighbors	
Benedum Mini-grants program, Taught them leadership skills for 6-months, after that $2,000 to community project, Lower Paint Creek introduced the group to Watershed Movement	Yes
Larry Parsons w/ DEP solid waste, met with Lower Paint Creek	
Was formed after PCWA split into two groups	
WVDEP Stream Restoration group, and the 2001 Floods	Yes
Public meeting that addressed flooding, CVI Gary Birti	
DEP had public meeting in Whitesville, Director Stephanie Timmire told Ms McVay and her brother about Watershed Associations	
Core of five or six concerned citizens wanted to involve and educate local people about the health of the elk and how to protect it.	
Wanted a group to focus on the local area and wanted to follow in the footsteps of Trout Unlimited but needed to maintain autonomy.	
Major Flooding	No
Series of public meetings w/ & encouragement from various agencies talking about improving the quality of life.	
This group broke up because of the leader's health problems and due to the fact that there was very little interest from the community. Most members were in their 70s	
No Contact info	
Number disconnected	
No local participation	

The Spark	GIS
One… Major flooding in 2001, Two… RAIL instrumental in starting group, Three… A community design team from WVU identified the formation of a Watershed Association as a way to help. Rail decided to do it and made it a project. The group is now officially a 501C3 all on its own.	Yes
	No
Floods of 2001	
The "Meadow River… Like it is!" project first centralized the community efforts into what is now PAN. In response to a proposed power line route for the hydro station at Summersville Dam. The route took the lines down into the Meadow River and ran through the typically pristine gorge for over a mile and then back out. A group of	Yes
Kenny Rucker organized community and made DEP contacts	
Group use to be called Concerned citizens of Alderson/Glen Ray. They were formed due to the development of a pressure treated wood processing plant. This group helped form the Greenbrier River Watershed Association to provide river wide protection. The group then changed their name to Lower Greenbrier River WA to	
	Yes
Couldn't get any help with their environmental issues. They were told that a watershed group could help.	
First meeting was over dredging. This evolved into current group.	
Several years of Flooding	
City of Beckley wants to facilitate the group getting started in order to help the city maintain their outreach and citizen involvement with MS4 requirements	
New group. Only had one meeting so far and currently working to develop the group. Learned about watershed groups while participating with Upper Guyandotte WA Annual Metal collection program.	
A public meeting held by the Army Corps of Engineers. Group is now having problems with their pass-through agent and activity is extreamly low.	Yes
The catalyst for creating the watershed was three 100 year floods in a few months. One of my son's friends, Frank Borsuk	Yes
Formed to facilitate grant funds that were never received. Group is working to pull back together. Longest Creek in WV	
Flooding raised concerns, Local Rural Community & Development program and WVDEP introduced the idea of watershed groups. This group did extensive mapping and culvert studies with the help of CVI. However, according to Mr. Amick the group did not succeed with major on-ground projects due to low population and lack of	
Established to receive grants to focus toward flooding. Sources of funding were not helpful and group became discouraged	

Appendix B - Research Schematics

Watershed Basins	Active Groups	Non-active	501C3 Non-Profit Organization	Use Pass-through Agent	Hold Monthly Meetiings	Solid Waste/ Litter Clean-ups	Stream Monitoring	Stream Restoration	Develop Recreational Opportunities	Outreach & Education	Website	Partnerships w/ Educational Institutions	GIS	Participants
Potomac	14	6	7	1	3	6	10	4	5	9	2	8	2	1,022
Monongahela	18	12	9	4	5	7	14	10	6	9	6	12	3	847
Western	19	11	11	1	13	15	11	14	5	8	7	11	3	765
Southern	18	6	7	0	4	12	4	9	0	5	5	7	3	1,072
Northern	3	8	1	2	1	0	1	1	1	1	0	1	2	25
Totals & Percentage	72 / 63%	43 / 37%	35 / 49%	8 / 11%	26 / 36%	40 / 55%	40 / 55%	38 / 52%	17 / 24%	32 / 44%	20 / 36%	39 / 54%	13 / 18%	3,731