west virginia dep department of environmental protection

STATE OF THE ENVIRONMENT

Fourth Edition

Greetings from the Governor:

After reviewing sites in 28 states, the Boy Scouts of America picked West Virginia for its National Scouting Center, due to open in 2014. The Boys Scouts' decision to bring its high-adventure base and summer camp to a 10,600-acre location in Fayette County is a perfect example of the great potential our beautiful state has to attract not only visitors, but new businesses and jobs. It also underscores the importance of protecting our air, land and water. Our scenic views, rolling hills and miles of streams and rivers would not be as inviting without safeguards to protect the environment.

This fourth edition of the State of the Environment Report shows the progress our state has made in reducing air pollution, preserving our water quality, reclaiming mined lands and removing unsightly litter and waste from our state's landscape with the help of thousands of volunteers. All of these efforts not only improve the lives of West Virginians today, but set a course for a healthier environment that future generations of West Virginians will enjoy for years to come. As the Mountain State seeks new energy opportunities, such as the abundant natural gas reserves of the Marcellus Shale, we cannot underestimate the importance of being good stewards of the environment. As a state with a robust energy sector tied to our natural resources, we must find balance between industry and the environment. West Virginia continues to set a course where our natural resources provide our people jobs and our nation energy in an environmentally friendly manner.

I'm hopeful that each of you reading this report makes a concerted effort to promote a healthy environment and keep West Virginia wild and wonderful.

Very truly yours,

Earl Ray Tomblin
Governor

Letter from the Secretary:

Much has changed in the three years since the West Virginia Department of Environmental Protection released its last State of the Environment Report. The federal Environmental Protection Agency's increased involvement in the state's permitting process for coal mining and the natural gas industry's rush to tap into the lucrative Marcellus Shale, for example, have created new chapters in environmental regulation.

As we present the fourth edition of the State of the Environment Report, I can assure you one thing hasn't changed. The DEP remains steadfast in its mission of promoting a healthy environment.

In the last year, our agency has produced a guidance document to assist DEP personnel in developing water pollution control permits for the coal mining industry. The document is intended to advance water quality and maintain that surface mining operations can be conducted in ways that protect the state's narrative water quality standards. Developed in response to the EPA's stepped-up oversight of permitting activities in Appalachia, the guidance document satisfies requirements outlined in the federal Clean Water Act.

Also in the past year, the DEP began an unprecedented review of its Office of Oil and Gas to determine what changes were needed to better regulate the state's growing natural gas industry and to answer the environmental challenges brought on by new drilling techniques being used in the Marcellus Shale formation. From that comprehensive review, we crafted legislation that did not pass in the 2011 State Legislature, but will still be a valuable tool as we continue regulating the industry.

Those are just two examples of our strong commitment to protecting the state's environment. More than ever, society is focused on how the nation's growing energy needs will be met in environmentally responsible ways. The DEP is in position to take the lead, but we cannot do it alone. State regulators, business leaders, elected officials and citizens must work together to protect our resources and influence others to do the same.

I hope you find the information provided in this report useful, as we continue to set a baseline against which future changes may be compared. We welcome all comments and suggestions. Thank you for all your efforts in promoting a healthy environment.

Randy C. Huffman
Cabinet Secretary, DEP

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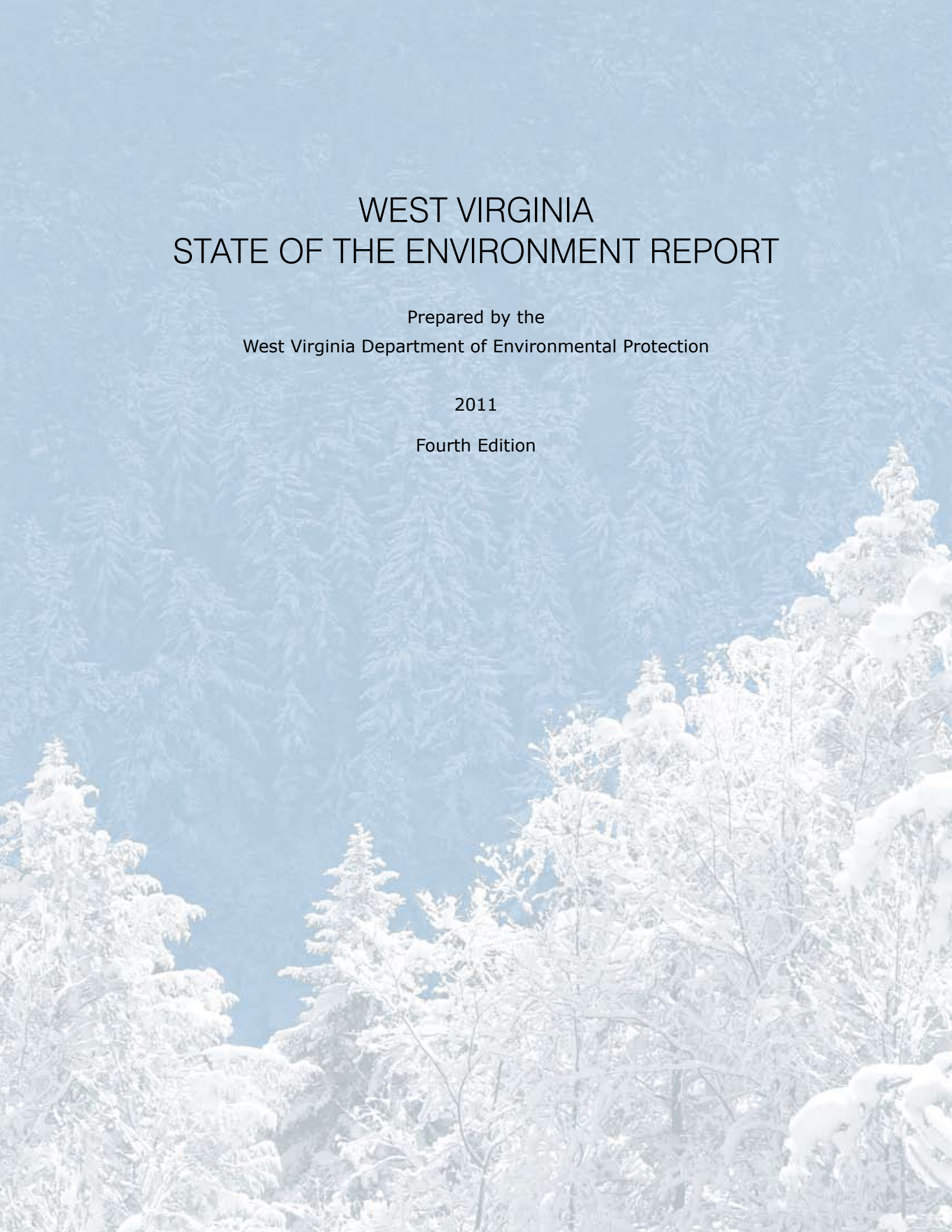
WEST VIRGINIA
STATE OF THE ENVIRONMENT REPORT

Prepared by the

West Virginia Department of Environmental Protection

2011

Fourth Edition



Purpose of this report

The report presents a numerical view of the air we breathe, the quality of our waters, and the land we live on.

The fourth edition of West Virginia's State of the Environment Report is based on a scientific approach to describing elements of environmental quality. To the extent possible, the report presents a numerical view of the air we breathe, the quality of our waters, and the land we live on. It shifts the focus from reporting about activities that are conducted to protect the environment to the results those activities achieve in improving environmental quality. In some instances, environmental impacts of human activity cannot be measured directly. For those cases, indirect measures such as regulatory and non-regulatory program activities may be used.

The report does not draw conclusions about the quality of West Virginia's environment. It simply presents a common base of data and trends, where possible, for others to interpret and analyze. Furthermore, this report continues what will be a long-term process to identify and track changes in the environment resulting from human activities. It also provides a basis for evaluating the success of regulatory and non-regulatory programs designed to improve environmental quality.

In this report, information about environmental quality is presented through the use of environmental indicators. These are measures of physical, chemical, biological, or socioeconomic factors that represent the key elements of complex ecosystems or environmental issues.

Indicators are powerful tools in a results-based environmental management system.

In the same way economic and social indicators are used to evaluate the health of our economy and the welfare of our citizens, environmental indicators can provide an objective, scientific-based representation of the state of the environment.

They can be used to communicate information to the public about the condition of the environment statewide and locally where they live and work. They also can help improve understanding of how different components of the environment interact and how environmental quality is affected by human activity.

The indicators used to describe the status and trends of the state's air, water and land resources were chosen based on data that was readily available within the Department of Environmental Protection (DEP) and other state and federal agencies.

Framework for indicators

Environmental indicators are scientifically-based measures of air, water and land quality. They measure pressures caused by human activities, as well as natural phenomena, on ecosystems and public health.

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Indicators are powerful tools in a results-based environmental management system. They focus on outcomes of environmental protection programs, such as cleaner air or water, rather than on administrative actions, such as the number of permits issued.

Most environmental indicator systems are based on a "pressure-state-effects-response" model. This report follows a variation of the model originally developed by the International Organization for Economic Cooperation and Development (OECD). The OECD model has been adapted, modified and used by several states and by the U.S. Environmental Protection Agency to report environmental initiatives. It offers a useful perspective on how indicators may be developed and used. The version used in this report is borrowed from Environmental Protection Indicators for California, published jointly by the California Environmental Protection Agency and California Resources Agency in April 2002.

The model looks at environmental quality from five aspects:

- The driving forces which are the human activities or aspects that exert pressures on the environment, that are the underlying cause or causes of a problem. Examples of driving forces include population growth, economic expansion, and energy use.

Many factors can influence change in the environment, and care must be taken to investigate all possible influences before attributing change to a particular program activity.

- The pressures on the environment resulting from the driving forces. These are physical, biological and chemical stresses on the environment such as pollution emissions and discharges, waste generation, and land use patterns.
- The state variable which describes some physical measurable characteristic of the environment that results from the pressure. Examples include indicators that monitor aspects such as water and air quality, waste generation, and existence and quality of habitats.
- The effects variable which evaluates the impact of the stresses on the environment on human health and ecosystem health.
- The response variable which measures to what degree society is responding to environmental changes and concerns. This includes policies, regulatory actions, or investments that are made to address an issue.

Indicators can be developed for each of the five aspects of this model. Typically, state environment reports have focused on indicators of pressure, state, and response.

For this report, the recommended environmental indicators include pressure and state indicators only. Response indicators will continue to be reported separately in DEP's annual activity report.

As helpful as they are in planning and decision-making, indicators must be viewed with caution because they vary widely in their ability to provide useful information. At best, indicators provide direct measures of environmental, human and ecological health. However, definitive measures are available in only a relatively few areas. Caution must be used in any attempts to establish a cause and effect relationship between an activity and a change in the environment.

Many factors can influence a single change in the environment, and care must be taken to investigate all possible influences before attributing the change to a particular program activity, for example.

How the indicators were developed

This report was developed in conjunction with the National Institute for Chemical Studies (NICS). NICS is a nonprofit research and education organization and has collaborated with the DEP on numerous projects.

Ten criteria guided the selection of the environmental indicators:

1. The indicator should be results-based, to the extent possible; that is, it should provide a measure of actual changes in environmental conditions.
2. The indicator should have a relatively high level of significance to the health of West Virginia citizens and/or its ecosystems.
3. The indicator should be based on scientifically accepted data collection methods.
4. The indicator should be able to distinguish meaningful differences in environmental conditions with an acceptable degree of resolution.
5. The indicator should provide information useful for making policy decisions.
6. The indicator should provide an early warning of changes in the environment or part thereof.
7. The indicator should be useful for making comparisons to indicators in other states, regions or nations.
8. Data collection that produces the type and amount of information needed to support an indicator should be carried out at a reasonable cost.
9. The indicator should be stated in a manner that allows comparison to a benchmark value or point of reference so that users can assess its significance.
10. The indicator should relate to the DEP mission and available data should be used to support the indicator.

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Air

Air Quality

This report examines two aspects of air quality: (1) current levels of criteria pollutants in West Virginia and (2) reported emissions of toxic air pollutants into the atmosphere.

Exposure to air pollution is associated with numerous effects on human health. These include respiratory problems, heart and lung disease, and even premature death. Children are at greater risk because they are generally more active outdoors and their lungs are still developing. Elderly people and people with heart or lung diseases are more sensitive to some types of air pollution.

Air pollutants can also significantly affect ecosystems. According to the United States Environmental Protection Agency (EPA), ground-level ozone has been associated with reduced agricultural and commercial forest yields. Airborne releases of nitrogen oxide have contributed to nitrogen pollution, which can decrease a water supply's ability to support habitat, and deposition of mercury compounds resulting in statewide fish consumption advisories is a contributing factor to impaired water quality.

Unlike a watershed where rivers, streams and runoff flow into a specific body of water, air has few natural or manmade boundaries that constrain its flow. Air movement is affected by complex relationships between the sun, oceans, the jet stream and high and low pressure systems. The synergy between these systems moves air across large regions of the Earth. The states located east of the Mississippi River may be thought of as a regional area that shares air patterns and movement. Contributors to the eastern states' regional air quality are large stationary sources (factories and power plants); smaller sources (dry cleaners and degreasing operations); mobile sources (automobiles, airplanes, and trains); and natural sources (wind-blown dust and forest fires).

Criteria Air Pollutants

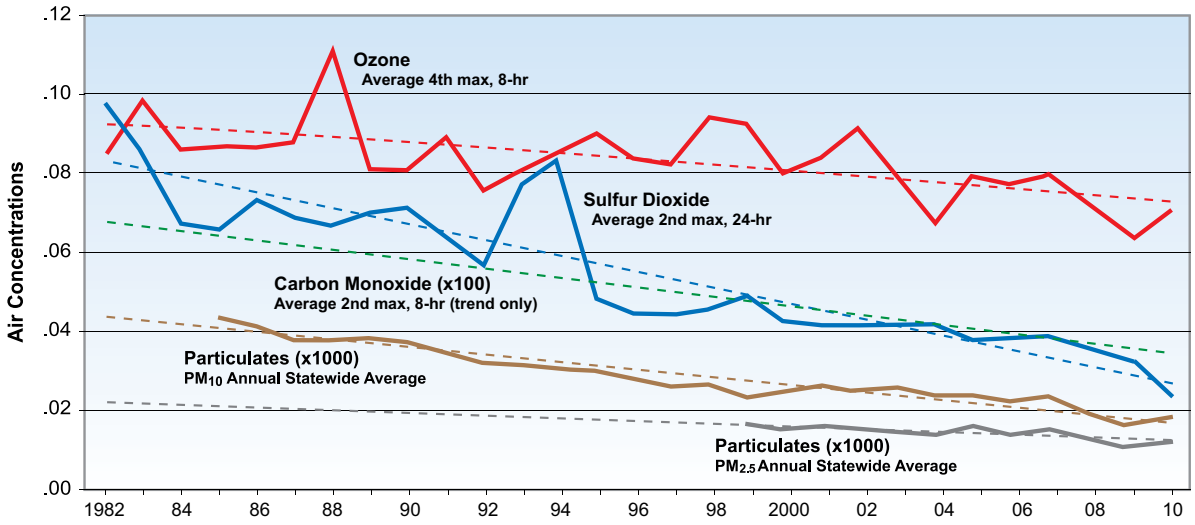
Under the federal Clean Air Act, standards were set by the EPA for six common criteria pollutants that have adverse effects on human health and the environment: carbon monoxide (CO); lead; nitrogen dioxide (NO_2); ground level ozone; particulate matter; and sulfur dioxide (SO_2). Known as National Ambient Air Quality Standards (NAAQS), these standards established acceptable concentrations of these pollutants in the ambient (outdoor) air. The Clean Air Act established two sets of standards. Primary standards are limits set to protect the health of people, including sensitive population groups. Secondary standards set limits that protect physical structures, plants and animals. This report focuses on the primary standards only.

During 2010, the DEP had monitoring stations in 13 counties to monitor for one or more of the criteria pollutants.

Health effects from air pollution vary greatly depending on the exposure level, duration of exposure, and the nature of the pollutant. Air quality standards for the criteria pollutants are expressed as an average concentration over a specific period of time (hour, day, year) because the concentration of a pollutant in air varies over time. The standards also specify whether the limit applies to an annual average concentration, a specific percentile, or the number of times the level may be exceeded during the calendar year.

The DEP measures the ambient levels of the criteria pollutants through a statewide network of monitoring stations. During 2010, the DEP had monitoring stations in 13 counties to monitor for one or more of the criteria pollutants. These counties were Berkeley, Brooke, Cabell, Greenbrier, Hancock, Harrison, Kanawha, Marion, Marshall, Monongalia, Ohio, Raleigh, and Wood. Sulfur dioxide and particulate matter had the greatest number of monitoring sites.

Carbon monoxide (CO) is formed any time a carbon-containing compound such as coal, oil or natural gas is burned and is not completely oxidized. Vehicular traffic is usually a leading source of carbon monoxide emissions, although CO levels may also be impacted by certain man-



Historical Trends of Air Concentrations in West Virginia
(Values are in parts per million except particulates which are micrograms per cubic meter; dotted lines represent trends)

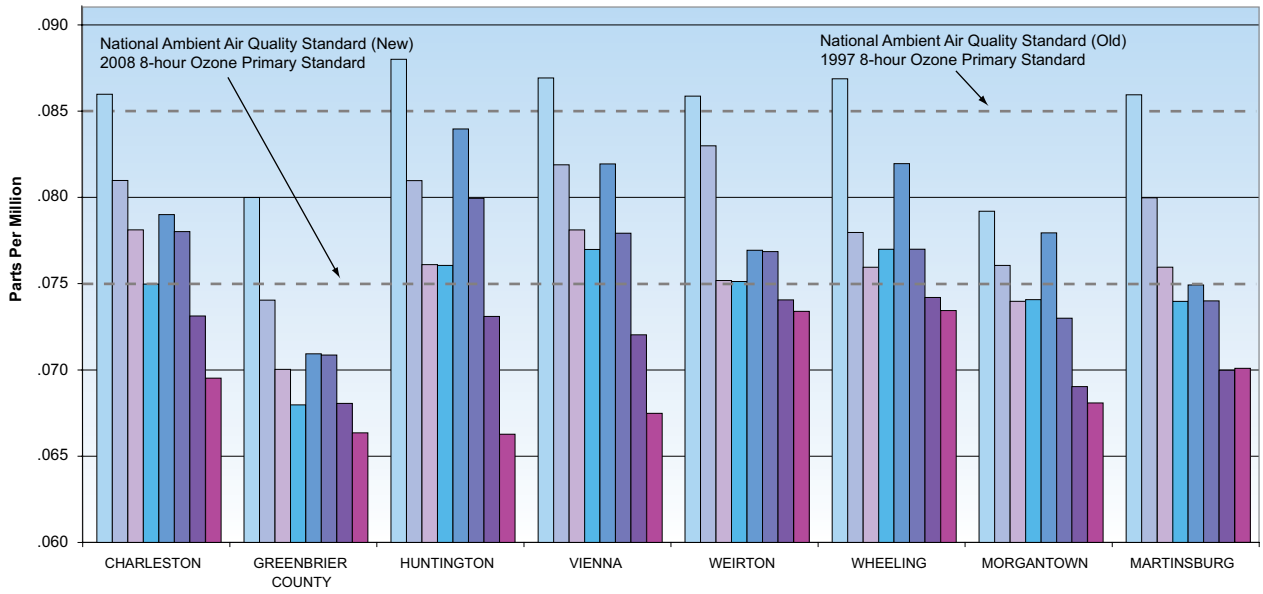
The DEP no longer monitors ambient CO in parts of the state other than a local industrial emission source in the area of Hancock and Brooke counties due to historically low concentrations.

ufacturing activities. When the standard is exceeded for this colorless and odorless gas, it can cause dizziness and sluggish reflexes. At higher concentrations it is considered a poison and may be fatal. The standard for this pollutant is 9.0 parts per million (8-hour average) and 35 parts per million (1-hour average). CO is only monitored in West Virginia near a local industrial emission source in the area of Hancock and Brooke counties. Since this is a neighborhood-scale monitor, the data would not be considered either a regional or statewide environmental indicator. The DEP no longer monitors ambient CO in other parts of the state due to historically low concentrations.

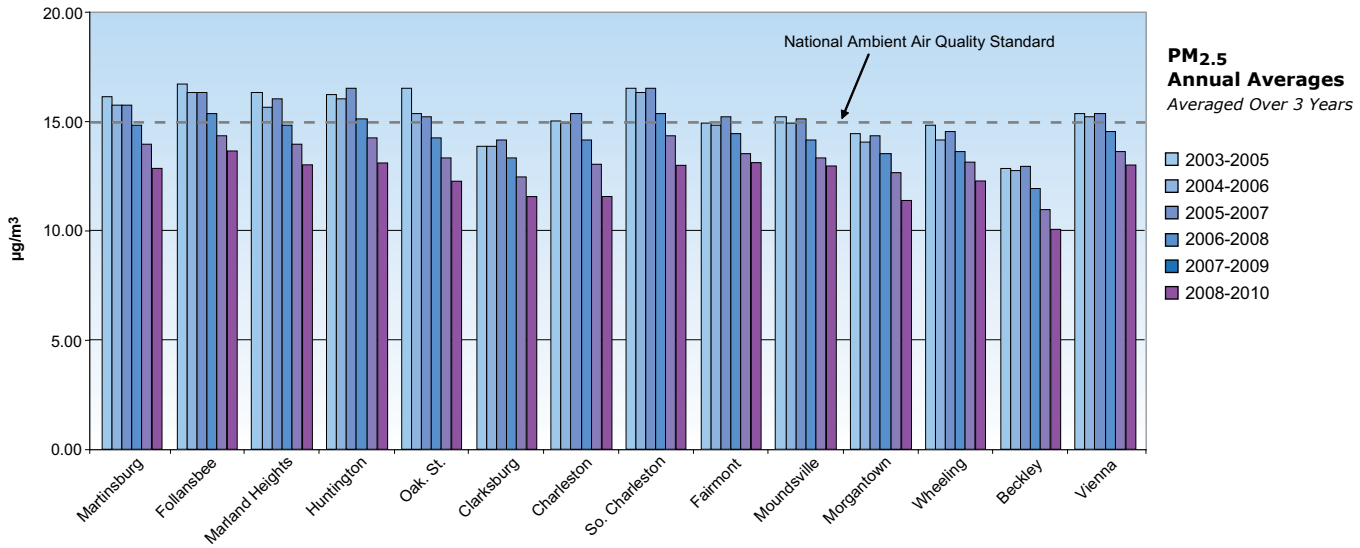
Lead was once used as an additive to gasoline to improve fuel efficiency. Before the use of lead was phased out between 1975 and 1986, vehicular traffic was the leading source of lead emissions. Lead exposure is known to cause mental retardation, behavioral disorders and seizures. Even exposure at low levels can cause developmental problems and lowered IQ in children. Due to new information on the health effects of lead emissions from industrial sources, the standard for lead was strengthened in 2008 to 0.15 micrograms per cubic meter (rolling three month average).

Nitrogen dioxide (NO_2) is formed from the combustion of fossil fuels such as coal, oil and natural gas. The leading sources of nitrogen dioxide emissions are power plants and vehicular traffic. NO_2 is a brownish gas that can react with a variety of compounds in the air to form other pollutants.

NO_2 and the pollutants it forms have the ability to negatively affect human health if levels exceed the standard. It is also a precursor to acid rain by reacting with water to form nitrous acid and nitric acid.



Ozone 4th Highest Daily Maximum 8 Hour Concentrations
Averaged Over 3 Years



In January 2010, the EPA established a new 1-hour NO_2 standard at the level of 100 parts per billion (ppb). The new standard will protect public health, including the health of sensitive populations — people with asthma, children and the elderly. In addition to establishing an average time and level, the EPA also set a new "form" for the standard. The form is the air quality statistic used to determine if an area meets the standard. The form for the 1-hour NO_2 standard, is the 3-year average of the 98th percentile of the annual distribution of daily maximum 1-hour average concentrations. The EPA is also retaining, with no change, the current annual average NO_2 standard of 53 ppb.

In 2008, the EPA strengthened the primary and secondary ozone standards to 0.75 parts per million. Current monitoring data indicates that our metropolitan areas meet the new standards.

Ground-level ozone is formed in a complex series of sunlight-driven reactions involving nitrogen oxides (NO_X) and a class of compounds called volatile organic compounds (VOCs). VOCs come from a variety of sources including vehicular traffic and industrial plants. Since sunlight is needed to generate these reactions, ozone levels are usually higher during the day than at night, and higher in the summer than during the winter. Ozone is the main constituent in smog. Ozone levels above the standard can cause difficulty breathing and are especially dangerous for those with existing lung diseases such as asthma or emphysema.

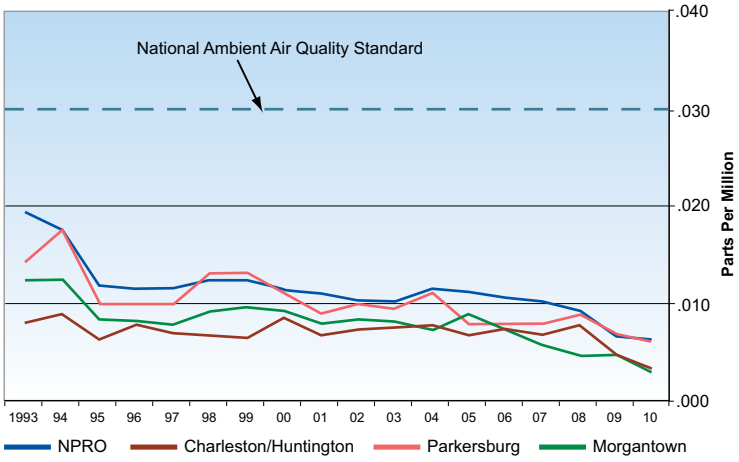
Particulate Matter (PM) consists of solid particles or liquid droplets found in the air. These particles come from a variety of sources and are commonly thought of as dust, soot or mist. At levels above the standard, particulates can cause respiratory problems especially for those individuals with existing lung diseases such as asthma or emphysema. Particulate matter is also a major cause of reduced visibility, or haze. There are two standards for particulates: one for coarse particles less than 10 micrometers (0.01 millimeters) in size; and one for fine particles less than 2.5 micrometers (0.0025 millimeters). Particles greater than 10 micrometers are likely to be captured and removed by the body's natural defense systems. Particles less than 10 micrometers have a tendency to enter and remain in the respiratory system. The annual standard for PM_{10} was revoked by the EPA in 2006. The short-term, 24-hour PM_{10} standard remains at 150 micrograms per cubic meter.

This NO_2 standard will protect public health by limiting people's exposures to short-term peak concentrations—which primarily occur near major roads.

The annual standard for $PM_{2.5}$ is 15 micrograms per cubic meter. Particulate matter was monitored in 12 counties in 2010.

Sulfur dioxide (SO_2) is formed when sulfur-containing compounds are burned. The leading source of sulfur dioxide emissions is coal-fired power plants. SO_2 is a colorless gas with a harsh odor. At levels above the standard, sulfur dioxide causes respiratory problems especially for those individuals with existing lung diseases. Sulfur dioxide, like nitrogen dioxide, is a precursor for acid rain, combining with water to form sulfuric acid. It is also known to damage vegetation.

Sulfur Dioxide Annual Average Concentration



It is anticipated that CAIR will reduce SO_2 emissions in the eastern United States by 70%, and NO_X emissions by 60%, much of this from coal-fired electric generating utilities.

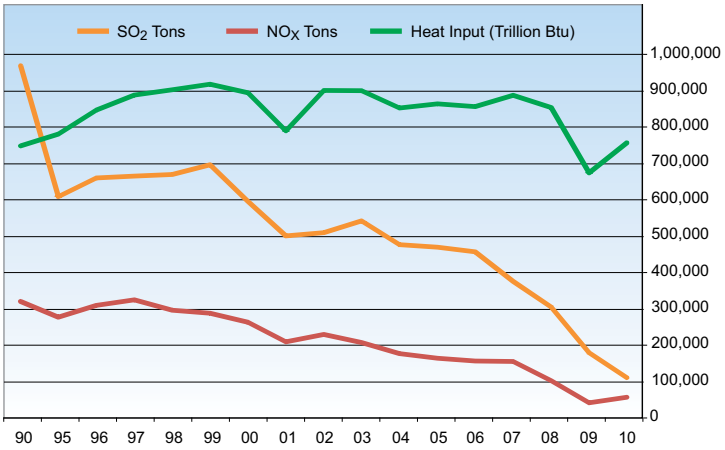
In June 2010, the EPA revised the primary SO_2 standard to a level of 75 parts per billion (ppb) measured over a 1-hour period. Adverse respiratory effects include narrowing of the airways, which can cause difficulty breathing (bronchoconstriction) and increased asthma symptoms. These effects are particularly important for asthmatics during periods of faster or deeper breathing (e.g., while exercising or playing). Studies also show an association between short term SO_2 exposure and increased visits to emergency departments and hospital admissions for respiratory illnesses — particularly in at-risk populations including children, the elderly and asthmatics.

West Virginia Power Plant Emissions

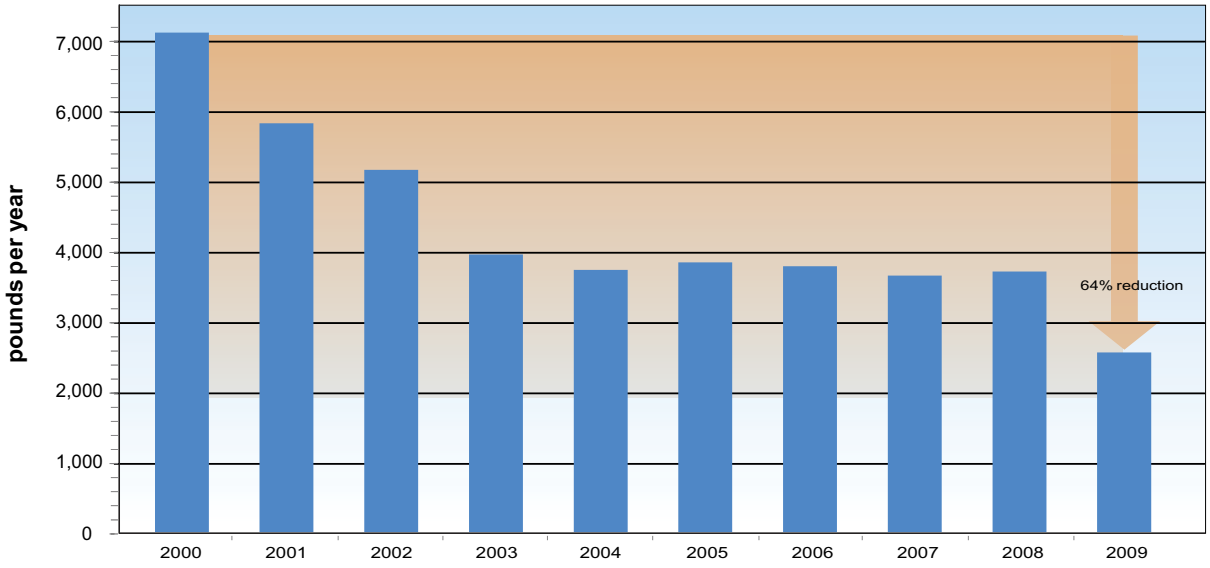
Traditionally, coal-fired electric generating utilities, or power plants, had the highest emissions of nitrogen oxides (NOx) and sulfur dioxides (SO_2), but their emissions of these pollutants have been cut by more than 80 percent in the past two decades. The first major reduction in NO_X and SO_2 emissions from power plants resulted during Phase I of the EPA's Acid Rain Program, promulgated in 1990. Phase I required reductions of these emissions from the nation's largest power plants by 1995. The implementation of Phase II of the Acid Rain Program in 2000 affected the remaining power plants and further reduced emissions of these pollutants.

Additional reductions in the emissions of NO_X and SO_2 from coal-fired power plants have been achieved as a result of the EPA's Clean Air Interstate Rule (CAIR), promulgated in 2005. CAIR resulted in significant reductions, even when 2008 and 2009 economic downturn reductions are considered. Emissions of SO_2 continued to decease in 2010, even though heat input increased as the economy started to improve. Emissions of SO_2 and NO_X in 2010 decreased 89 and 84 percent respectively from 1990 levels, while heat input remained relatively consistent. CAIR reductions helped West Virginia to monitor attainment of the 1997 ozone and $PM_{2.5}$ standards.

A December 2008 court decision, while keeping the requirements of CAIR in place temporarily, directed the EPA to issue a new rule to implement the Clean Air Act requirements concerning the transport of air pollution across state boundaries. CAIR ultimately will be replaced by the EPA's proposed Transport Rule. When finalized, it is anticipated to reduce SO_2 emissions in the eastern United States to 71 percent below 2005 levels by 2014, and NO_X emissions to 52 percent below 2005 levels, much of this from coal-fired power plants. Additionally, the Transport Rule will continue to help West Virginia



West Virginia Power Plant Emissions Sulfur Dioxide and Nitrogen Oxides: **1990-2010**



West Virginia Mercury Air Releases from Power Plants compiled from certified emissions inventory reporting to the Division of Air Quality

meet and maintain the standards for ground-level ozone and fine particulate.

In 2006, the DEP adopted federal mercury emissions control requirements for coal-fired power plants, referred to as the Clean Air Mercury Rules (CAMR). It affected all coal-fired power plants nationally, established caps on mercury emissions in two phases, and allowed emissions trading to achieve the caps.

In 2008, the federal Clean Air Mercury Rule was vacated by the D.C. Circuit Court of Appeals. Nevertheless, the reductions expected by 2010 have occurred in West Virginia because the affected plants remain subject to the EPA's Clean Air Interstate Rule.

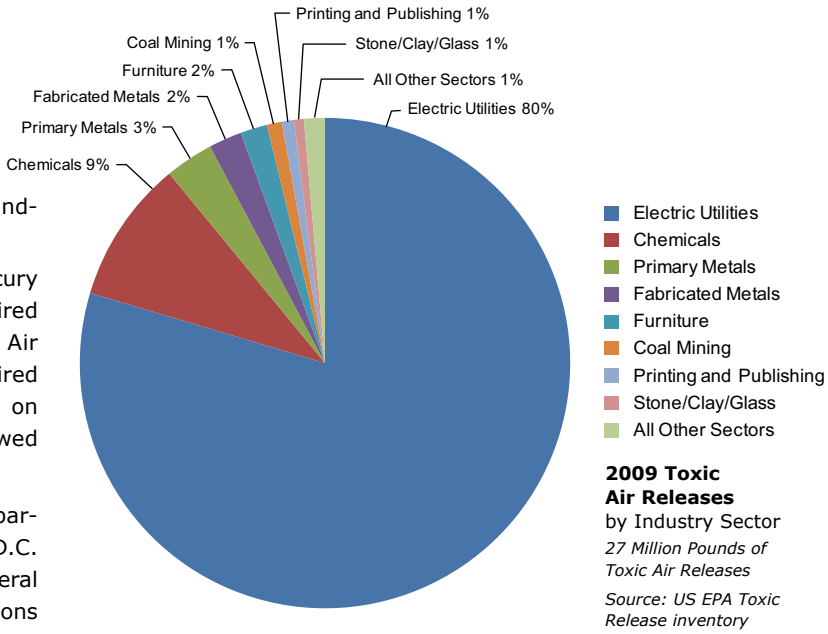
After several states and other interested parties challenged it in February 2008, the D.C. Circuit Court of Appeals vacated the federal mercury rule. Nevertheless, mercury reductions expected by 2010 under the first phase of CAMR have occurred in West Virginia because the affected plants remain subject to CAIR.

CAIR requires reductions of sulfur dioxide and nitrogen oxides in a similar two-phase approach. CAIR will transition into the federal Transport Rule which will ensure continued reductions.

Control devices used to achieve these pollutant reductions also have a co-benefit effect of significantly reducing mercury emissions. In West Virginia, facilities have installed control devices that obtained the same mercury reductions CAMR would have required by the year 2010.

Toxic Air Releases

The EPA established the Toxic Release Inventory (TRI) under the federal Emergency Planning and Community Right to Know Act of 1986. The TRI tracks releases of more than 650 different toxic chemicals into the air, water and soil. Toxic chemicals are those that may present a serious hazard to human health or the environment.



2009 Toxic Air Releases
by Industry Sector
27 Million Pounds of Toxic Air Releases
Source: US EPA Toxic Release inventory January 2011

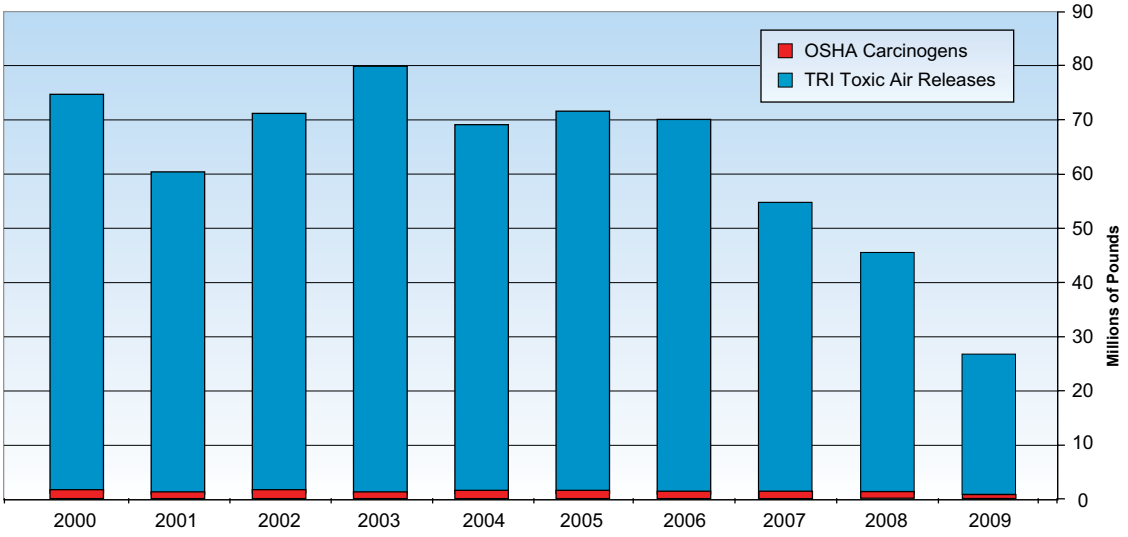
These compounds include those known to cause cancer and to have other life-threatening health effects. In 1998, the EPA added electric utilities, mining operations, hazardous waste facilities, and chemical wholesalers to the list of industries required to report under TRI. The adoption of these industries, as well as the periodic addition and deletion of chemicals from the reportable list, makes trend analysis difficult.

The graph (below) shows total statewide toxic air releases from 2000 through 2009. During that time, the reporting industries and reportable quantities have remained fairly consistent as air emissions have decreased. The pie chart (above) shows toxic air releases in 2009 by industry sector. Several factors affecting the trends in toxic air releases are changing demands on power output from the electric utilities sector; variability in coal composition; changing emission estimation factors; increased awareness of reporting; and the installation of air pollution control devices on coal-fired power plants. As

From 2000 to 2009, power plants in West Virginia reduced mercury emissions by 4,500 pounds, or 64 percent.

Toxic Air Releases in West Virginia
in Millions of Pounds

Source: US EPA Toxic Release Inventory; National Institute for Chemical Studies January 2011



discussed in the Power Plant Emissions section, mercury emissions have decreased significantly over the past several years, in large part due to actions taken by coal-fired power plants.

Most small businesses would fall below the threshold and are not required to report GHG emissions to the EPA.

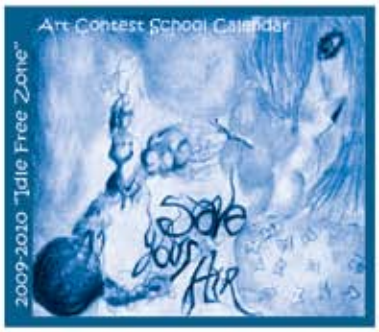
Greenhouse Gas Emissions

In the previous *State of the Environment* report, we noted that the DEP had begun collecting data on Greenhouse Gas (GHG) emissions within the state. Subsequently, the EPA adopted a national GHG mandatory reporting rule in September 2009. This nationwide reporting requirement will provide accurate and timely GHG emissions data from facilities that emit 25,000 metric tons or more of carbon dioxide equivalent (CO_2e) per year.

Publicly available data will allow the reporters to track their own emissions, compare them to similar facilities, and aid in identifying cost-effective opportunities to reduce emissions in the future. The DEP will accept the federal GHG data being collected rather than requiring sources to double-report data to West Virginia, as well as to the EPA. Sources are still encouraged, however, to voluntarily report GHGs when completing their annual emissions inventory.

Idle Free Zones

In March 2007, the DAQ began a collaborative project with the WV Department of Education to help promote State Board of Education Policy 4336 to reduce engine idling on school grounds by posting Idle Free Zone signs. These signs were made available to school administrators at no cost (the DAQ funded the signs through settlement monies), and serve to remind school bus drivers, delivery vehicles and parents to turn off their engines, thereby saving energy, reducing fuel costs and improving air quality. Currently, 54 of the state's 55 county public school systems have received these signs.



13 winning drawings were chosen from the 239 entries submitted.

Children are more susceptible to air pollution than healthy adults. Their respiratory systems are still developing and they have a faster breathing rate. Diesel exhaust can aggravate respiratory and cardiovascular disease and existing asthma. In an effort to focus on the importance of not idling vehicles while on school property, Kanawha County Schools and DAQ promoted an Idle Free Zone sign concept with a children's calendar art contest.

If the 3,700 school buses in West Virginia only idled one-half hour less per school day, they could save nearly $685,000 in fuel cost per year.

Art teachers from across the county had their students create original artwork depicting various aspects of the air quality benefits of not idling vehicle engines. Any school in Kanawha County that had even one student participating in this contest received these calendars for all students at that school. Nearly 6,000 calendars were delivered for each student in the 13 participating Kanawha County schools by the first day of the 2009-2010 school year. The students with winning entries were recognized and prizes awarded at the April 2009 Kanawha County Schools' K-12 Art Exhibit Awards Ceremony held at the Charleston Civic Center.

Water

Water Quality

West Virginia has many miles of high-quality streams that support healthy communities of aquatic organisms.

The DEP implemented the Watershed Management Framework in 1996, creating a five-year cycle to collect comprehensive water quality data. The agency uses the framework as a tool to, not only assess waters, but also to implement water quality improvement plans on each of the state's 32 watersheds.

West Virginia's Aquatic Integrity

West Virginia has many miles of high-quality streams that support healthy communities of aquatic organisms. Many of these streams are the raw water sources for the state's drinking water suppliers, as well as for the construction, manufacturing, chemical, power generation, mineral extraction, and agricultural industries. Recreation in and around West Virginia's waters contributes significantly to the state's economy. However, many stream miles are impaired by a variety of pollutants. Leading causes of impairment include mine drainage constituents (like acid and iron), sewage and livestock waste (like nutrients and pathogens), sediment, and streamside habitat destruction.

Water Resources Information - West Virginia

2010 est. state population (U.S. census)	1,859,815
WV Land surface area (sq. mi.) (U.S. Census).	24,078
Number of major watersheds	32
Total river & stream miles (1:100K scale USGS)	32,278
Perennial stream miles (flow year round)	21,114
Intermittent stream miles (may dry)	11,164
Stream miles on state border	619
Number of public lakes, reservoirs, & ponds	108
Total wetland acres	102,000

Ecological Assessments of Aquatic Integrity

In 1997, the DEP's Watershed Assessment Branch began sampling sites selected through the Environmental Protection Agency's random stratified procedure in order to better assess the ecological health of watersheds and ecoregions within the state. The data generated from this random stratified (also known as probabilistic) sampling effort allows the DEP and the EPA to make statistically valid comparisons of aquatic integrity between watersheds and ecoregions. The data also assists in monitoring long-term trends in watershed and ecoregion health.

Sites are assessed using three broad categories of aquatic integrity indicators

The probabilistically selected sites are assessed using three broad categories of aquatic integrity indicators: biological community quality; water quality; and habitat quality. From these, several individual indicators were chosen to help illustrate the condition of West Virginia's rivers and streams during the periods of interest in this report. They are presented for statewide and the three 'ecoregions' in the figure below:

Biological

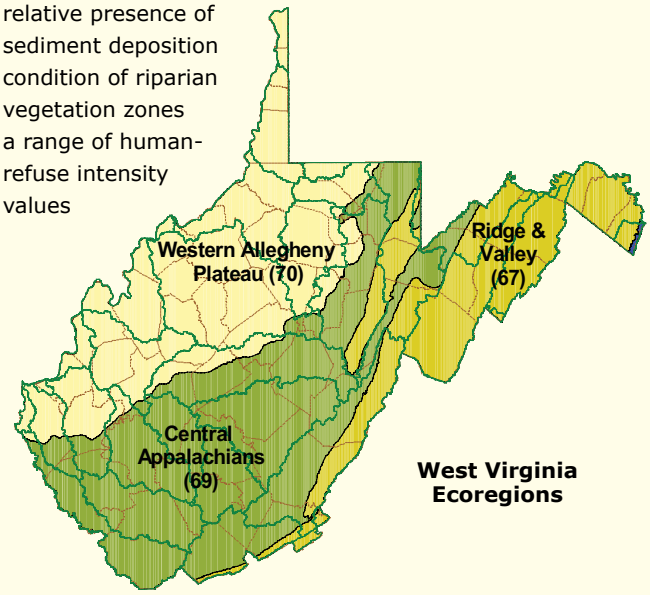
- West Virginia Stream Condition Index (WVSCI)

Water Quality Indicators

- pH less than 6.0 standard units
- Sulfate greater than 50 mg/L
- fecal coliform bacteria greater than 400 colonies/100mL

Habitat Quality Indicators

- relative presence of sediment deposition
- condition of riparian vegetation zones
- a range of human-refuse intensity values



With the exception of the Designated Use Support Section, the data used to create the charts presented in this report are from the last five years of available probabilistic data (2005–2009) and are described in terms of ecoregions. It should be noted that these estimates of condition are descriptive of smaller wadeable streams where our probabilistic monitoring efforts are focused.

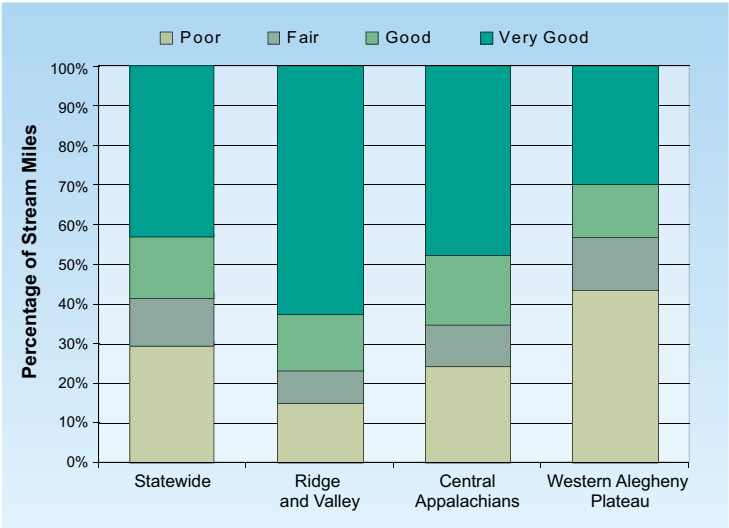
West Virginia Stream Condition Index

Benthic macroinvertebrates are bottom-dwelling organisms with no backbones, and are visible with the naked eye.

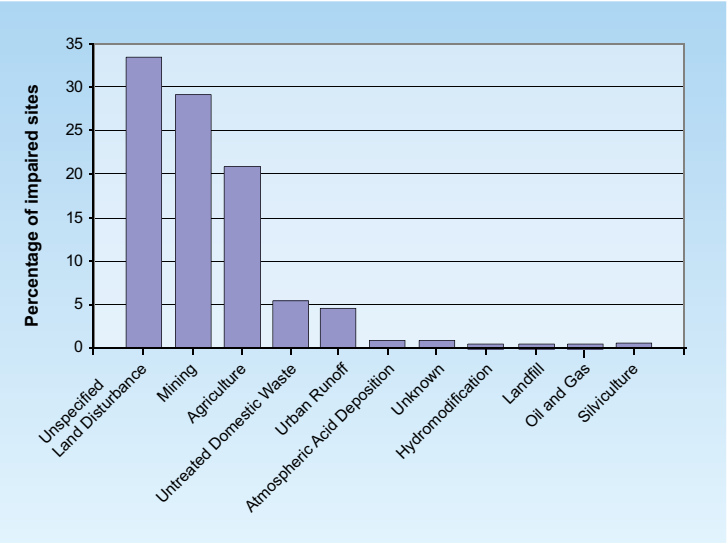
Biological impairment is defined by a low score on the West Virginia Stream Condition Index (WVSCI). The WVSCI is a scoring system that integrates the results of six measures of benthic macroinvertebrate community health. Benthic macroinvertebrates are bottom-dwelling organisms with no backbones, and are visible with the naked eye. Typically, aquatic insects (e.g. mayflies and stoneflies) comprise the largest diversity of these animals, but snails, mussels, aquatic worms, and crayfish are also members of the benthic community.

These animals are important in the processing and cycling of nutrients, and are major food sources for fish and other aquatic animals. Communities of such organisms are excellent indicators of water quality because they reflect overall ecological condition, by integrating the combined effects of water quality and habitat quality.

Stream biological condition *based on benthic macroinvertebrate community*



The percentages of stream miles in four WVSCI categories for the data generated in 2005-2009 are shown in the bar chart titled "Stream biological condition based on benthic macroinvertebrate community." The chart compares the results for the three ecoregions and includes statewide estimates. The individual and combined influences of pollution and stream habitat alterations are the causes of fair and poor WVSCI scores.



Biological Impairment Sources *based on 2005-2009 probabilistically sampled sites with WVSCI < 60.6 (n=146)*

Sources of Bio-impairment

The results of the 2005-2009 probabilistic sampling revealed that 146 out of 530 samples received a WVSCI score of 60.6 or less. Benthic macroinvertebrate communities that score within this range are considered impaired, and the DEP would describe them as not supporting their aquatic life use designation.

Twelve categories of major sources of biological impairment were determined using water chemistry analyses, narrative descriptions by sampling personnel, benthic community characteristics, and several Geographic Information System data layers depicting landuse activities. Each of the 146 sites was assigned a primary source of impairment from one of the 12 categories. For sites with possibly more than one source of impairment, the most obvious source was listed.

Of the 146 bio-impaired sites, "Unspecified Land Use" affected over 33 percent. These were sites that had field notes indicating excessive stream sediment associated with dirt roads, poor riparian zones, and highly erodable areas. The next highest sources of impairment are the broad categories of mining and agriculture.

Water Quality Indicators of Aquatic Integrity

The top right graph summarizes the results of three parameters that are indicators of different sources of impairment.

The Watershed Assessment Branch analyzes over 20 different water quality parameters at each of the sites sampled as part of the probabilistic monitoring program. Fecal coliform bacteria analysis provides an indication of whether human or animal wastes are present in waterbodies.

Sulfates are typically fairly low unless there are large land disturbances (such as surface mining and road construction) that allow rainwater to percolate through fractured rock.

Low pH or acidic conditions are found in areas that are vulnerable to the affects of acidic precipitation as well areas with untreated mine drainage. Ecoregion 69 has the highest percentage of acidic waters (17.6 percent), this region includes the poorly buffered headwaters of the Gauley, Little Kanawha, Elk, Tygart, and Cheat River watersheds.

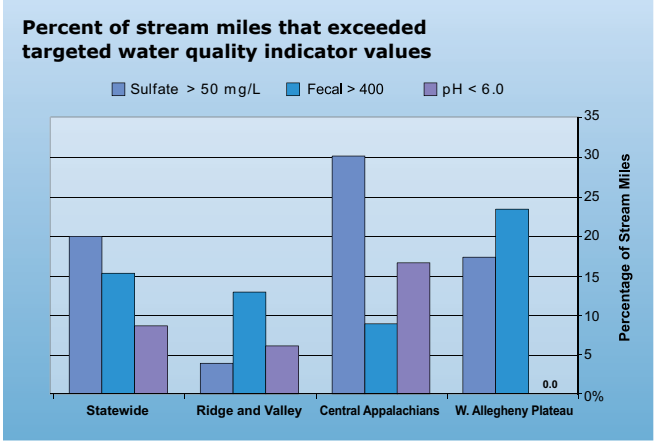
Habitat Indicators of Aquatic Integrity

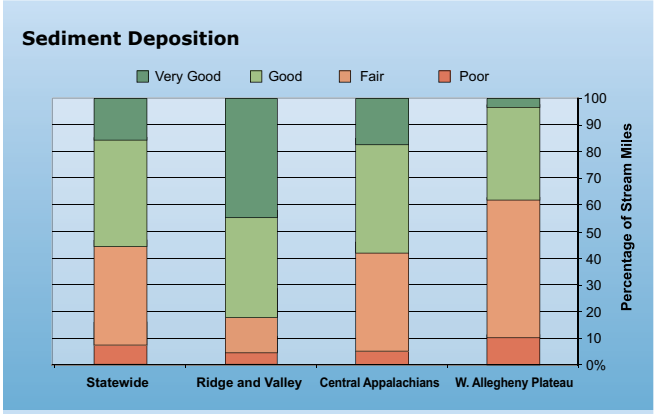
The charts on the right show percentage of stream miles in very good, good, fair, and poor categories for three habitat indicators of aquatic integrity.

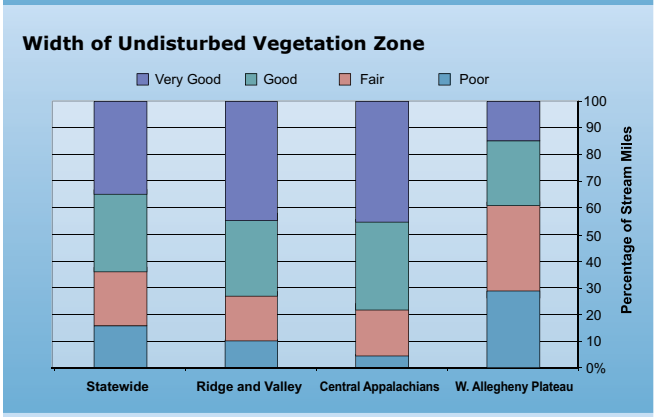
The chart titled "Sediment Deposition" shows the percentages of stream miles impacted by the amount of sand and silt deposited instream. Excess sedimentation is often considered the most widespread stressor to stream health in West Virginia and throughout much of the country. Ecoregion 70 had a much higher percentage of streams with poor and fair ratings of sediment deposition. This is likely because this region has slower, low-gradient streams, has more erodable soils, and more land-disturbing activities than in other areas.

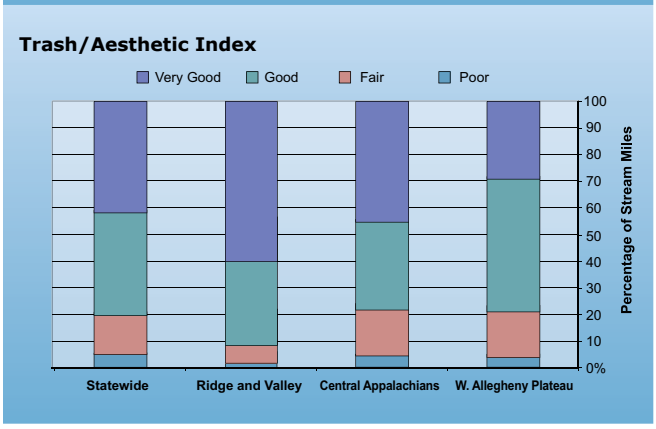
Ecoregion 69, the Central Appalachians, had the highest percentage of wide undisturbed riparian zones. This indicator rates streamside zones on the amount of undisturbed vegetation present, which is desirable for minimizing the amount of sediment, excess nutrients, and other pollutants entering the stream.

The "Trash/Aesthetic Index" is a measure of the amount of human refuse that is in and around the stream (including that which could be washed into the stream at high flows). Ecoregion 67, the Ridge and Valley Ecoregion, has the highest percentage of "clean" streams, with over 60 percent of stream miles in the very good category.









The scale showing three underwater stream photographs helps illustrate the range of RBP Embeddedness impacts encountered across the state.

Embeddedness Index

Poor: Gravel, cobble and boulder particles are over 75% surrounded by fine sediment.

Fair: Gravel, cobble and boulder particles are between 50 and 75% surrounded by fine sediment.

Good: Gravel, cobble, and boulder particles are between 25 and 50% surrounded by fine sediment.

Very Good: Gravel, cobble and boulder particles are between 0 and 25% surrounded by fine sediment; layering of cobble provides a diversity of niche space.

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Mud River/Guyandotte Watershed (WVOGM) Embeddedness Score = 5 (Poor)

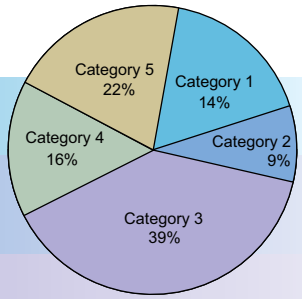
Big Horse Creek/Coal Watershed (WVKC-10-I) Embeddedness Score = 10 (Fair)

Big Run/Souh Branch Potomac Watershed (WVPSB-28-EE) Embeddedness Score = 19 (Very Good)

Designated Use Support

Designated uses refer to those stream uses outlined in Title 47CSR2, Requirements Governing Water Quality Standards. Examples include warm water fishery, public water supply, and water contact recreation, including swimming and skiing, etc.

Waterbodies fall into five categories of support for their designated uses



Category 1 fully supporting all designated uses.

Category 2 fully supporting some designated uses, without sufficient data to assess other designated uses.

Category 3 insufficient data to determine if any of the uses are met.

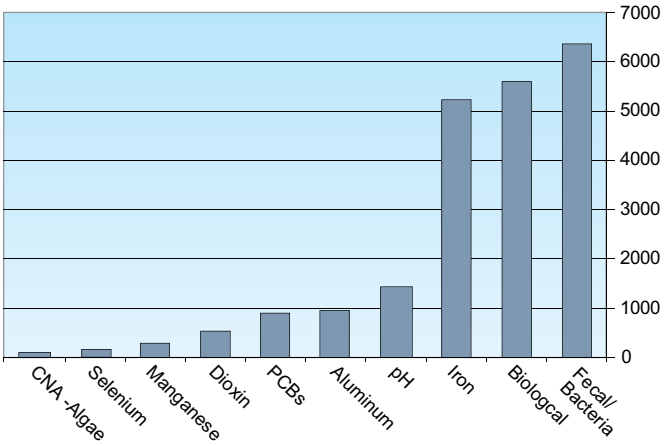
Category 4 waters that are impaired or threatened, but do not need a TMDL plan developed.

- **Subcategory 4a** waters that already have an approved TMDL plan, but still do not meet designated uses.
- **Subcategory 4b** waters with control mechanisms in place that are expected to restore the waters to designated uses.

Category 5 impaired waters expected to need a TMDL plan developed.

Data source - Preliminary Draft 2010 Integrated Report

Section 303(d) of the federal Clean Water Act required the compilation of streams and other bodies of water that do not meet their designated uses due to impairments by various causes. The primary reason for developing 303(d) lists is to formulate plans to restore impaired waters to their designated uses.



Stream Miles Impaired by Reason for Listing

includes Category 4 & Category 5 (Impaired) Streams

Such plans include the determination of total maximum daily loads of pollutants allowed in the impaired waters.

Leading Sources of Impairment

The chart titled "Stream Miles Impaired by Reason for Listing" shows bio-impairment as the most extensive reason for listing streams as impaired. Biological impairment reflects a low score (< 60.6) on the West Virginia Stream Condition Index (see the discussion under the section titled Ecological Assessments of Aquatic Integrity).

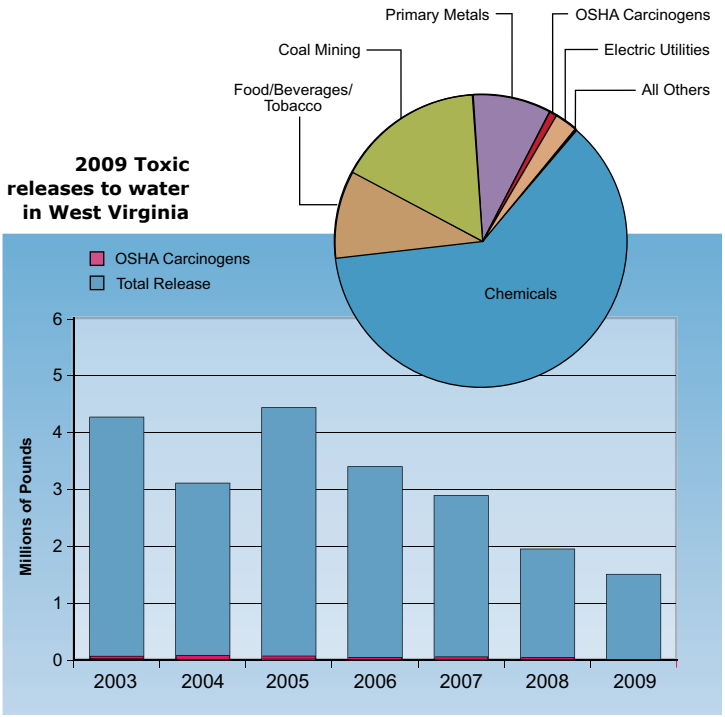
Toxic Releases to Surface Water

The chart below represents toxic chemical releases to surface water. This information is tracked by the EPA through the Toxic Release Inventory that was established in 1986. Electronic fact sheets with TRI data are available for each state at http://www.epa.gov/triexplorer/.

Toxic Releases to surface water by Industry Sector (in pounds)

Industry	2003	2004	2005	2006	2007	2008	2009
Chemicals	3,453,484	2,211,710	3,723,306	2,713,137	2,367,156	1,065,550	880,032
Food/Beverage/Tobacco	192,901	281,030	220,754	214,802	207,472	238,365	188,777
Coal Mining	181,547	165,626	175,818	167,293	78,237	450,870	246,965
Primary Metals	156,991	238,845	142,837	164,281	181,107	139,312	137,048
OSHA Carcinogens	23,923	43,851	36,664	26,309	23,243	14,322	12,231
Electric Utilities	94,564	88,922	95,922	79,795	89,062	76,765	47,210
Plastics and Rubber	71,957	18,633	1	2	1	11	11
Machinery	34,561	46,703	22,669	No Data	No Data	0	0
Petroleum	24	20	20	522	14	9	5
Stone/Clay/Glass	74	120	126	139	137	120	138
Fabricated Metals	7,859	435	890	1,533	373	67	57
Petroleum Bulk Terminals	304	285	285	40	20	295	290
Wood Products	5	162	21	18	34	39	54
Electrical Equipment	50	0	0	10	1	2	2

2009 Toxic releases to water in West Virginia



Comparison to OSHA Carcinogenic Releases to Total Toxic Water Releases in WV

Wastewater Treatment

The availability of publicly owned wastewater collection and treatment facilities is a key determinant in defining the health and water quality of a community. Residents without access to public sewer systems either rely on individual sewage systems or pipe the untreated sewage directly into streams. Inadequate or untreated sewage can have severe environmental and health implications and can impair water quality with disease-causing bacteria, metals and nutrient-laden effluent. Reducing or eliminating these risks through development of publicly owned wastewater collection and treatment systems is a fundamental part of the federal Clean Water Act and state environmental law.

The DEP's Clean Water State Revolving Fund plays a major part in this effort by supplying low interest loans to West Virginia entities for the planning, design and construction of wastewater treatment works.

Many West Virginia municipalities are also struggling with problems associated with combined sewer systems and wet weather overflows. After a heavy rain or snow melt, excess water entering combined systems can easily exceed the capacity of these lines and, mixed with sewage, exits the system through overflows directly into streams. In addition, wastewater treatment plants can be burdened to the point where sewage bypasses may occur at the plant and inadequately treated sewage is discharged.

The funding of publicly owned wastewater projects in West Virginia is facilitated through the coordination of the Infrastructure and Jobs Development Council (IJDC), on which DEP is a member. The IJDC is close to completing a statewide, comprehensive planning study for existing water, wastewater and storm water facilities and future needs. This study will include the development of a Geographic Information System and project prioritization and management tools.

An additional 5.5 million pounds of pollutants is estimated to have been removed from West Virginia waters over the past three years (2008 –2010). Twenty communities have provided sewer service for the first time to 5,395 customers, who previously relied on septic tanks, direct pipes into streams, or other inadequate means of treatment as a means of sewage disposal.

Summary of Needs

Sewer
40% of population not connected to centralized public wastewater system

Needs include treatment, collection, extension and compliance with federal and state Clean Water Acts

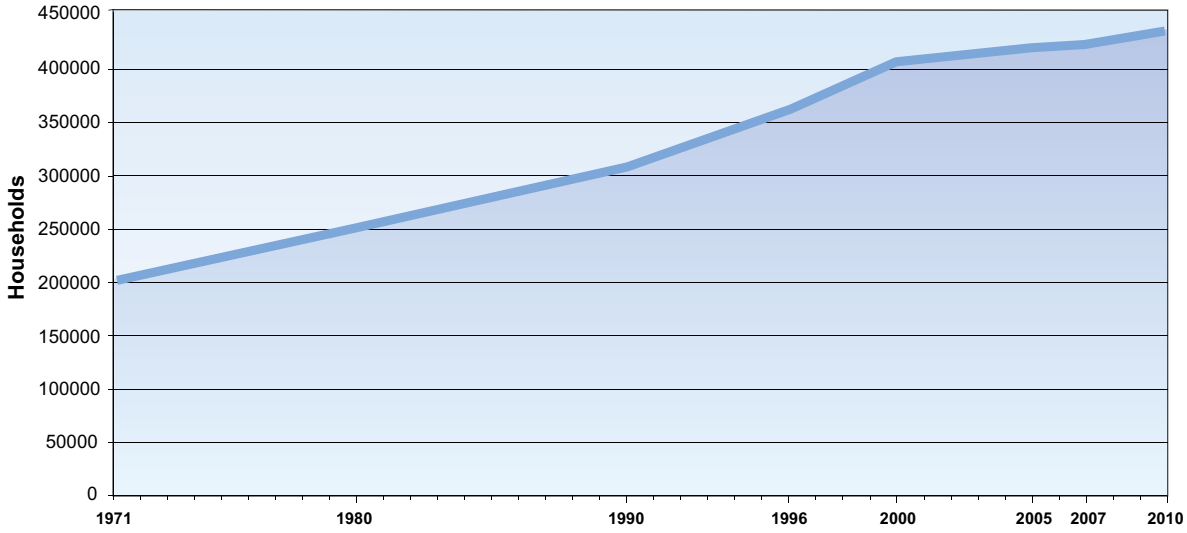
Needs exceed $1.4 billion

Combined Sewer Overflow
58 communities have identified CSO corrections

Upgrades needed to achieve compliance

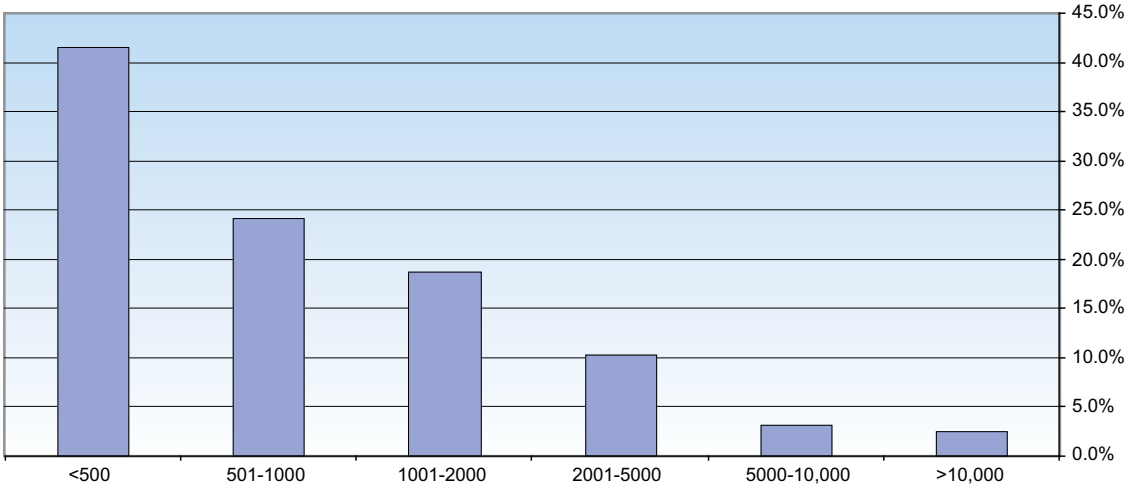
Needs exceed $1.5 billion

West Virginia Households served by a Public Sewer System



The graphs here and on the next page summarize the progress being made toward providing adequate wastewater service to our citizens and also describe the tremendous future needs that still must be met.

Wastewater Systems
by number of customers served



Sewage facilities built 2008-2010

- 20 new facilities built serving 5,395 new customers
- 32 existing facilities upgraded serving 151,622 existing customers
- Over 5.5 million pounds of additional pollutants removed annually from WV waters from 2008 – 2010

Thirty-two other communities serving 151,622 customers have upgraded their facilities providing for a better degree of treatment which has reduced the amount of pollutants discharged to receiving streams.

The chart (above) on existing sewer systems indicates that the vast majority of wastewater systems serve a very small customer base. It is estimated that 441,820 households or customers are now currently served by a public sewer system. This equates to approximately 1.1 million of our citizens, or 60 percent of the population. Over 40 percent of the systems serve fewer than 500 customers, 65 percent serve fewer than 1,000 customers and over 94 percent serve fewer than 5,000 customers. This is really a true indication of the rural makeup of our communities in our state and the inherent challenges of providing adequate wastewater collection and treatment to our residents.

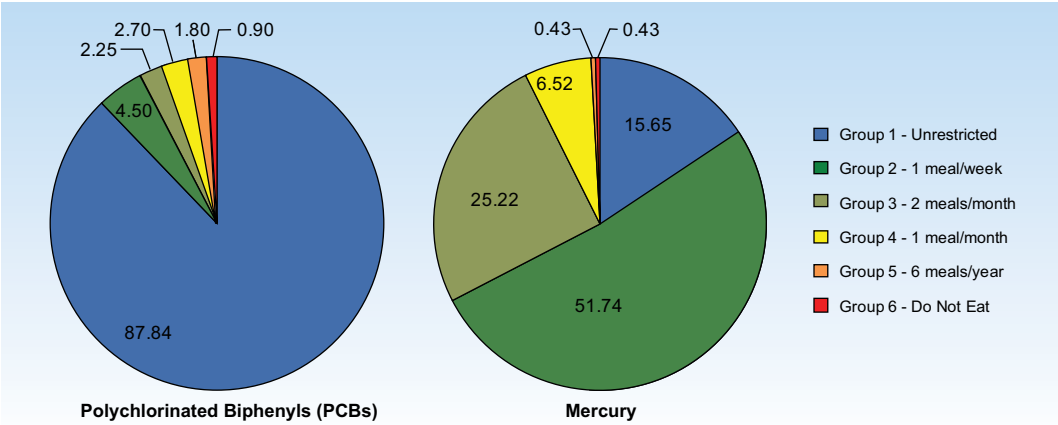
Fish Consumption

The narrative water quality criterion of 47CSR2-3.2.e prohibits the presence of materials in concentrations that are harmful, hazardous, or toxic to man, animal, or aquatic life in state waters. Fish consumption advisories are used to inform the public about potential health risks associated with eating fish from West Virginia's streams. These advisories are developed and issued in accordance with an interagency agreement between the DEP, Division of Natural Resources, and the Bureau for Public Health.

West Virginia's fish consumption advisories include guidelines on the number of meals to eat and information on proper fish preparation to further minimize risk. There are currently waterbody-specific fish consumption advisories on 16 state streams and six lakes for a variety of fish species and contaminants. The risk-based approach estimates the probability of adverse health effects and provides a statement on the health risk facing the angler and high-risk groups including women of childbearing age and children. There is a general statewide advisory that recommends limiting the consumption of sport-caught fish from all West Virginia waters in relation to low-level mercury and/or polychlorinated biphenyl (PCB) contamination. The

West Virginia's fish consumption advisories include guidelines on the number of meals to eat and information on proper fish preparation to further minimize risk.

Fish Consumption Advisories
Percent of samples in each meal category



statewide advisory provides species-specific recommendations ranging from one meal per week to one meal per month. The pie charts on page 13 represent a summary of all fish tissue data collected and used to generate statewide advisories and waterbody specific advisories. For a comprehensive fish advisory list, visit the Department of Health and Human Resources online at www.wvdhhr.org/fish.

Water Quantity

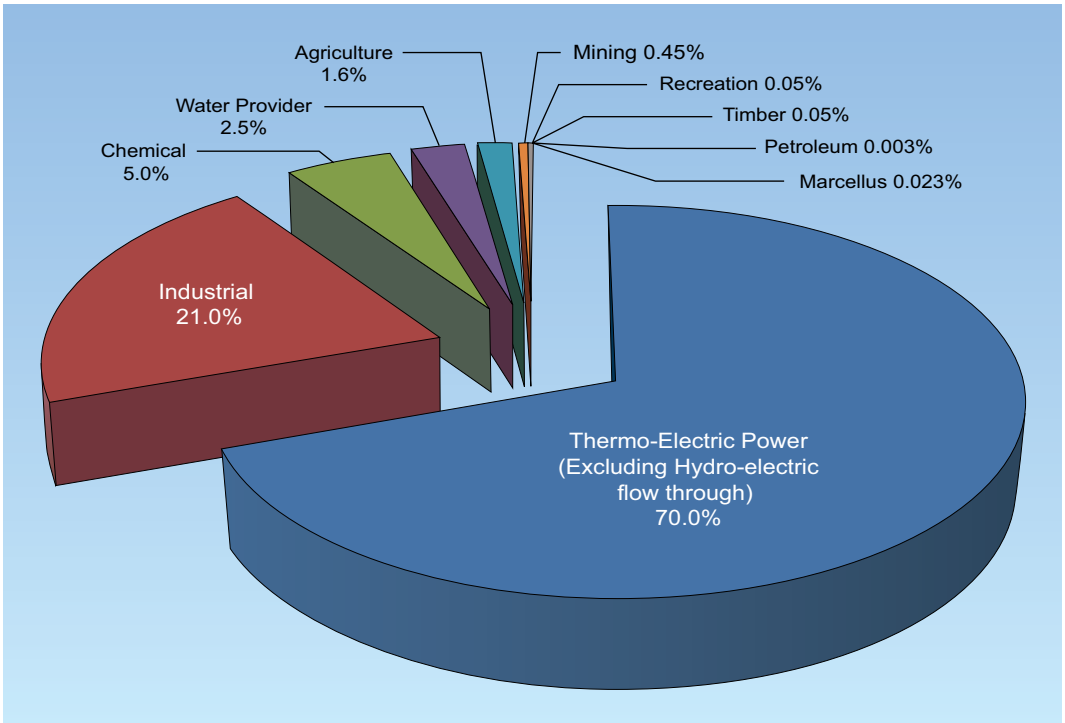
For the first time, the state has assembled water use data allowing informed decisions on water quantity management. The data, collected under the authority of the Water Resources Protection and Management Act, provides the basis for the state Water Management Plan, scheduled for completion in 2013. Each year, large-quantity water users, defined as any person who withdraws over 750,000 gallons from state waters in a calendar month, must report their use to the DEP.

Although the citizens of West Virginia currently enjoy the benefits of plentiful, high-quality water, there are challenges dimly visible on the horizon. The Mountain State is the birthplace of, or a major contributor to, the Ohio and Potomac rivers, which many other states rely upon for their own water needs. Increasingly, the demand for more water to meet development needs in neighboring states will impact how we are able to manage our waters regarding both quality and quantity. Future, unforeseen demands will be placed on our water resources by industry, with the development of the Marcellus Shale gas play being the most recent example. It is essential for the state's future environmental and economic well being to be able to intelligently manage our water resources to meet these needs.

The DEP is not waiting on finalization of the plan to implement good water management practices when either the need presents itself, or funding materializes. In the past two years, the groundwater monitoring network has been expanded four-fold, a water withdrawal guidance tool was developed to help safeguard our streams during the driest months, abandoned underground mines are being evaluated for their capacity to store and supply water, flood control and other reservoirs are being evaluated to ensure the state derives maximum benefit from those waters, and methods to warn of impending flooding are being investigated.

Water's importance as a commodity is expected to increase in the 21st century. Work initiated by the Water Resources Protection and Management Act will ensure West Virginians will be able to manage the benefits of plentiful, clean water to their best advantage.

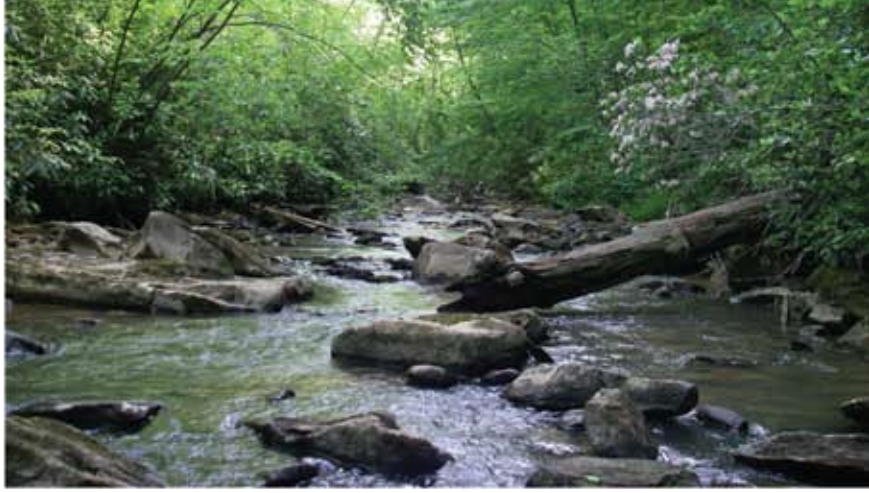
2009 West Virginia Water Use
by percent excluding hydroelectric flowthrough



Examples of High Quality West Virginia Streams

These streams are considered examples of high-quality streams because they have a high West Virginia Stream Condition Index (WVSCI) score and because they have an overall high physical habitat quality score.

The WVSCI denotes the overall health of a stream based on the presence of benthic macroinvertebrates.



Whiteday Creek/Monongahela Watershed Score 91.36

Waites Run/Potomac Watershed Score 90.35

West Virginia Watersheds

Back Fork/Elk Watershed Score 88.89

Hoffman Hollow
Upper Kanawha Watershed
Score 87.32

Land

Since the late 19th Century, West Virginia's economy has been based largely on manufacturing and natural resource industries that contributed significantly to the nation's growth. As a result, a legacy of environmental problems from these past practices has led to the creation of multiple cleanup programs. The DEP has continued efforts in coordinating cleanup programs to provide sound, effective remedies using the best available scientific and technical approaches. The goal is to eliminate separate, redundant, and potentially inconsistent cleanup standards and procedures for cleanup projects conducted under different regulatory programs.

The DEP continues to pursue steps to ensure safe and protective cleanup efforts, having adopted provisions of the West Virginia Uniform Environmental Covenant Act, continuing the participation in the One Call utility notification program as a member of MISS Utility of West Virginia, and continuing to develop measures to establish a long-term stewardship program to help ensure compliance with applicable land use restrictions.

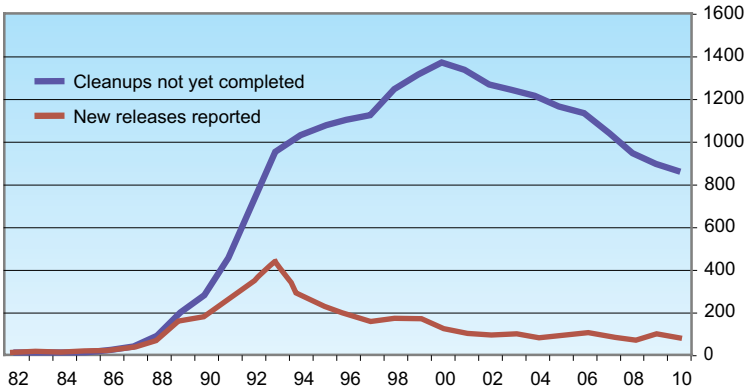
The DEP maintains an extensive list of sites with potential contamination requiring remediation. The list includes sites in the federal Superfund program, including those with enough contamination to be designated as ***National Priority List sites***

WV National Priority List Sites	City	County
Allegany Ballistics Lab	Short Gap	Mineral
Big John Salvage - Hoult Rd Site	Fairmont	Marion
Fike Chemical, Inc	Nitro	Kanawha
Hanlin-Allied-Olin	Moundsville	Marshall
Ordnance Works Disposal Area	Morgantown	Monongalia
Sharon Steel Corporation (Fairmont Coke Works)	Fairmont	Marion
Vienna Tetrachloroethene	Vienna	Wood
West Virginia Ordnance	Pt. Pleasant	Mason
Ravenswood PCE	Ravenswood	Jackson

Leaking Underground Storage Tanks

Leaking underground fuel tanks can act as point sources for shallow groundwater contamination. Until the mid 1980s, many underground storage tank (UST) systems were made of bare steel that corroded and then leaked. Faulty installation and inadequate operating and maintenance procedures can also result in tank system leaks. Depending on the amount of fuel released, the hydro-geologic properties of the aquifer impacted by the release, and the location of nearby public drinking water sources, public water supplies can be threatened or directly impacted. According to 2010 data, West Virginia had 4,887 active underground storage tanks as of Dec. 31, 2010 and more than 19,255 tanks have been closed, either by being removed from the ground or properly filled in place with an inert solid.

Total Leaks from Underground Storage Tanks



Historical trends in confirmed releases in the state awaiting final cleanup between 1982 and 2010, and trends in new releases reported by year.

More than 2,400 of the leaking UST system cleanups have been completed during this period, with 888 yet to be completely remediated and the files closed. During the past decade, the number of new releases from UST systems has remained below 100 per year, and because of the required leak detection monitoring of the UST systems, the impacts from new leaks have tended to be less severe. Recent changes in gasoline formulation and the increased use of ethanol, has caused concerns for compatibility with existing UST system components, as well as the fate and transport of contamination when increased ethanol-formulated gasoline re-

Since 1982, there have been 3,289 confirmed releases from underground storage tank systems, with 11 emergency responses related to underground tank leaks.

leases occur. Vigilant leak detection monitoring and aggressive clean-up responses to new releases will be necessary with the higher ethanol blends, to protect ground water resources.

Voluntary Remediation Sites

The abandonment or under-use of contaminated or potentially contaminated industrial sites results in inefficient use of public facilities and services and increases the pressure for development of uncontaminated pristine land. Because existing industrial areas frequently have transportation networks, utilities, and an existing infrastructure, it can be less costly to society to redevelop existing industrial areas than to relocate amenities for industrial facilities at pristine sites. The Voluntary Remediation Program was established to facilitate voluntary remediation activities and Brownfield revitalization. The DEP Brownfield and Voluntary Remediation programs have matured as structured and predictable mechanisms to achieve compliance with applicable state and federal environmental requirements, while promoting the reuse and redevelopment of former industrial and mine-scarred properties. The DEP has promoted an active partnership with the Southern and Northern Brownfield Assistance Centers located at Marshall University and West Virginia University, respectively. The Assistance Centers empower communities to plan and implement Brownfields redevelopment projects by conducting general citizen and local government education efforts, and by providing assistance to specific local communities interested in the reuse of Brownfields in their communities. Support can be provided to help groups solicit grants and low-interest loans for site assessments, clean-ups, and environmental job training, as well as provide support for preliminary legal and planning work. The assistance centers' support to communities in developing competitive grant applications for submittal to EPA has resulted in the award of assessment and clean-up grants totaling well in excess of $1 million for West Virginia communities. The DEP and the assistance centers have jointly participated in annual West Virginia Brownfield Conferences and have conducted informational workshops for banking, economic development and real estate agents.

RCRA Corrective Action

The DEP continues to work collaboratively with the U.S. Environmental Protection Agency to implement the Resource Conservation and Recovery Act's Corrective Action Program, which requires the investigation and cleanup of releases of hazardous wastes and hazardous constituents that pose an unacceptable risk at RCRA hazardous waste treatment, storage and disposal facilities. Facility evaluations are based on human health and environmental risks posed by actual or potential releases to the environment, potential migration pathways, target receptors, and waste characteristics.

Two environmental indicators have been established that focus on preventing unacceptable exposure to humans and preventing the continued migration of contaminated ground water. Human health indicators have been demonstrated at 37 of the 42 sites in West Virginia, and the five sites remaining are being evaluated. Similarly, ground water migration control has been demonstrated at 33 sites, with five sites being evaluated and additional information needed for four other sites.

Landfill Closure Assistance Program

The Solid Waste Landfill Closure Assistance Program, Chapter 22, Article 16 (LCAP Act) was adopted to provide assistance to landfill permittees to facilitate closure of sub-standard landfills in a timely and environmentally sound manner. Landfill permittees who stopped receiving waste before June 2, 1996 must close their facility in accordance with the terms and conditions of their solid waste permit, order, and/or the laws, rules, and regulations in place on May 1, 1990.

Assistance provided by DEP under LCAP, covers the costs of closure projects and may include:

- Closure design, including analysis of the effect of the facility on groundwater and design measures necessary to protect and monitor groundwater;
- Construction of closure-related structures to provide leachate management, sediment and erosion control, gas management, groundwater monitoring, and final cover and capping to meet the Solid Waste Management Act, §22-15;
- Monitoring of surface and groundwater required by the Water Pollution Control Act, §22-11 and the Solid Waste Management Act, §22-15;
- Remedial actions to protect groundwater and surface water, other natural resources, and the health and safety of West Virginians to the extent that funds are available;
- Post-closure monitoring and maintenance, which includes leachate management during the 30-year post closure monitoring period.

Landfill Closure Assistance Program Projects Status

Projected closure construction date

Group 1		Group 3		Group 4		Group 5	
Marion County*	2018	Big Bear Lake**	2011	ERO		Berkeley County	
Moundsville**	2011	Capon Springs & Farm	2011	Fayette County		Buckhannon	
Group 2		Clarksburg	2012	Kanawha Western		Central WV Refuse	
Morgan County	2011	Kingwood	2012	Montgomery		Don's Disposal	
		South Charleston	2014	Morgantown		Fleming	
		Wheeling/North Park	2012	Wyoming County		Hampshire County	
						Jackson County	
						Jefferson County	
						McDowell County	
						Mideast	
						Mingo County	
						Monongalia County	
						Petersburg	
						Preston/Rehe	
						Pine Creek/Omar	

- Facility has engineering contract to design its closure.
- Facility connected to sanitary sewer
- Federal Subtitle D Soil Cap
- State Regulated Cap

** Marion County will be downgraded to priority group 3 once a sewer line for leachate control and treatment is constructed. It's design is currently under permit review and the closure plan will be submitted for review in 2011.*

*** Moundsville is currently being capped and Big Bear should be remediated during the current year.*

Green shaded facilities have been capped as of June 30, 2010 and are in 'Post-closure monitoring and maintenance'

Twenty-eight landfills were initially accepted into the program, and two others have subsequently been added by legislation. Twenty-one facilities are in the post-closure monitoring and maintenance phase and the nine remaining landfills are scheduled to be closed, with all construction projected to be completed by 2018.

2009 Ranking	NAICS	Description	Tons Generated
1	3251	Basic Chemical Manufacturing	58,538
2	3339	Other General Purpose Machinery Manufacturing	13,165
3	3311	Iron and Steel Mills and Ferroalloy Manufacturing	5,904
4	3252	Resin, Synthetic Rubber, & Artificial Synthetic Fibers and Filaments	2,104
5	5629	Remediation and Other Waste Management Services	2,062
6	3328	Coating, Engraving, Heat Treating, & Allied Activities	1,738
7	3314	Nonferrous Metal	1,412
8	3261	Plastics Product Manufacturing	1,119
9	3241	Petroleum and Coal Products Manufacturing	1,063
10	3364	Aerospace Product and Parts Manufacturing	922
Total			**88,027**

Hazardous Waste
Top Ten Quantities of Waste Generated in WV in 2009
By North American Industry Classification System (NAICS) Code

Hazardous Waste Generation

Hazardous waste has the potential to cause health and environmental threats when improperly treated, stored, transported, or disposed of.

Hazardous wastes are regulated under the Federal Resource Conservation and Recovery Act of 1976 (RCRA) and state law. Under these regulations, the wastes are to be managed safely and tracked from the time they are generated until their final disposition ("cradle to grave").

The wastes can be liquids, solids, gases, or sludges. They can be discarded commercial products, like cleaning fluids or pesticides, or the by-products of manufacturing processes. A waste may be classified as hazardous if it exhibits certain characteristics (ignitable, corrosive, reactive, or toxic). In addition to the "characteristic" wastes, there are over 500 specific hazardous wastes identified under RCRA and termed "listed" wastes.

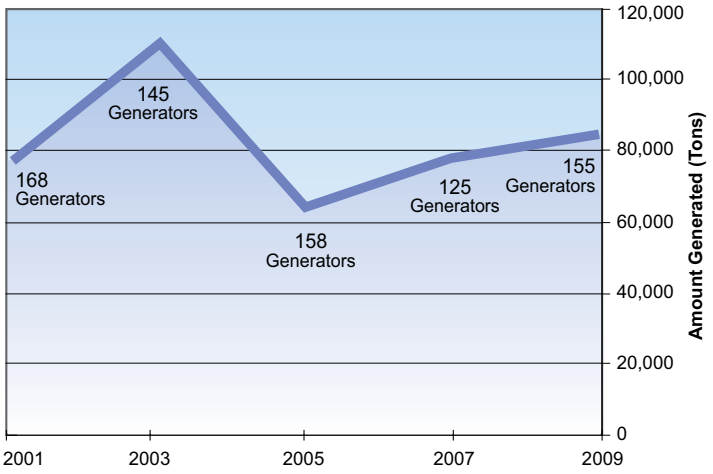
In 2009, West Virginia ranked 25th in the nation for quantity of hazardous waste generated.

Solid Waste Generation

The use of materials, both raw and manufactured, leads to the generation of solid waste. The illegal disposal of solid waste creates pressure on the environment in terms of the loss of land and other resources necessary for solid waste disposal and treatment, and the potential for adverse health effects resulting from illegal disposal practices.

National data reveals that Americans continue to generate increasing amounts of municipal solid waste. The amount for Americans has increased from 2.7 pounds per person in 1960 to 4.4 pounds per person currently. For West Virginians that number is believed to be about four pounds per day. Municipal solid waste includes garbage, paper, litter, refuse, cans and bottles, resulting from industrial, residential, commercial, mining, agricultural operations, and similar community activities.

The volume of municipal solid waste disposed in West Virginia is more of an indicator of opportunities for reuse, recycling, materials recovery, and waste reduction than of direct stress on the

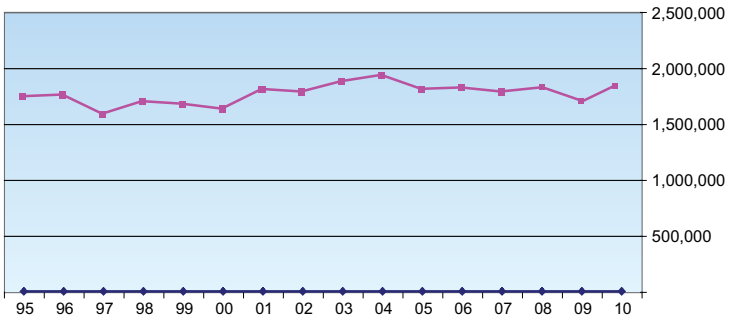


Hazardous Waste Generated in WV
Source: USEPA, National Biennial Hazardous Waste Report; Documents and Data from http://www.epa.gov/osw/inforesources/data/biennialreport/

The amount of municipal solid waste per person has increased from 2.7 pounds in 1960 to 4.4 pounds per person currently.

environment, because properly managed municipal solid waste landfills pose little direct risk to human health and the environment.

Solid waste landfills construct approximately 30 acres of composite lined area per year to ensure the disposal needs of the state are met. For the purposes of this report, the indicator chosen to reflect the disposal of solid waste is the trend of solid waste disposed during the period from fiscal year 1992 through FY 2010. As shown on the chart at right, there has been only a slight increase in recent totals.

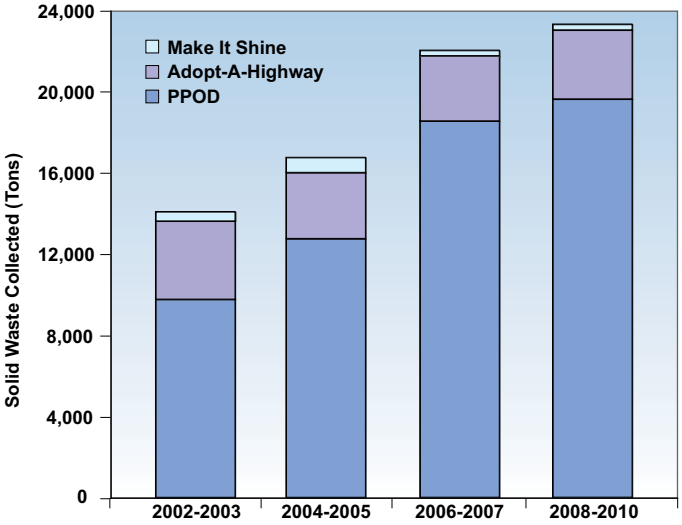


Solid Waste Disposal Tonnage
(tons per year)
Source: Solid Waste Management Board and Department of Tax and Revenue validated receipts, reports and monthly tonnage reports submitted by commercial solid waste landfills in WV.

REAP

In July of 2005, the Rehabilitation Environmental Action Plan (REAP) was re-established as an arm of the DEP. Charged with the task of cleaning up the state, REAP combines existing elements of the DEP with those formally housed under the Division of Natural Resources (DNR) into a more effective and streamlined system for the direction of environmental remediation programs. Bringing all of the state's cleanup programs under one umbrella, the program provides oversight of litter removal, statewide recycling, and open dump cleanups.

REAP Programs
Total Solid Waste Collected
(2002-2010)



Three cleanup programs exist under REAP: the Pollution Prevention Open Dump, the West Virginia Make It Shine and the Adopt-A-Highway/Adopt-A-Spot programs. For the years 2008-2010, these three programs removed 23,167 tons of solid waste, 1,344 tons of recyclable scrap metal, 6,080 appliances and 1,173,778 waste tires from our state's roadsides, streams and public lands. Much of the success of these programs relies on the participation of volunteers. Since 2008, 89,762 West Virginians have participated in REAP cleanup programs.

The effect that these three programs have on our environment cannot be measured by the tonnages associated with their cleanup efforts alone. Their success can also be seen in the wide variety of geographic settings that these cleanups affect. Since 2008, PPOD has eradicated 3,503 illegal dumps throughout the state. PPOD and Make It Shine have been responsible for the reclamation of 2,954 acres of our state's public lands. Volunteers of the Adopt-A-Highway/Adopt-A-Spot programs have cleaned 11,900 miles of roadway since 2008. Make It Shine and PPOD have recently joined together in offering assistance to volunteer groups wishing to conduct stream cleanups. Since 2008, volunteers working for the West Virginia Clean Streams program have cleaned 709 miles of stream bank, removed 1,572 tons of litter and recyclables, as well as 61,787 tires from our state's waterways.

REAP works to educate West Virginians about the merits of pollution prevention and recycling while encouraging volunteerism in cleanup efforts.

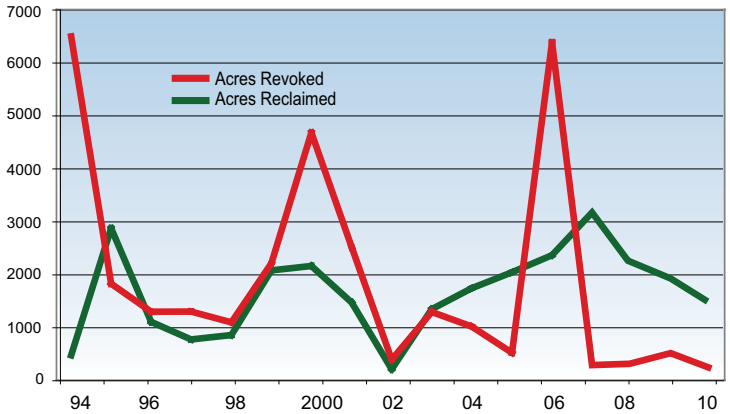
Another of REAP's programs working toward the preservation of our environment is the Statewide Recycling Program. This program has four components: Recycling Assistance Grant Program, Litter Control Grant Program, Covered Electronics Grant Program, and the State Employees Office Paper Recycling Program. The Recycling Grant Program has awarded $3,991,071.89 since 2008. During that same period, the Litter Control Grant Program issued awards totaling $163,869.33. The Covered Electronic Devices Program was established in 2008. The CED Program ensures that manufacturers register their brands with the state, and allows counties and municipalities to apply for grants to conduct electronic collection events. Since its inception, the CED Program has awarded $273,291. The total amount that has been awarded among the three grant programs since 2008 is $4,428,232.22.

Abandoned Mine Lands

A significant increase in Abandoned Mine Lands (AML) grant funding is being realized due

to the 2006 amendment to the Surface Mine Control and Reclamation Act (SMCRA). The DEP has received $190 million in AML grant funds in the four grant years from 2008 to 2011. West Virginia is projected to receive an additional $180 million in the following three grant years from 2012 to 2014. The grant funds are distributed into four distinct program areas. Those areas are abatement and reclamation of health and safety problems; emergency health and safety; construction of waterline extension projects; and treatment of acid mine drainage. The health and safety issues that are abated consist of dangerous highwalls, landslides, mine subsidence, drainage issues and portal closures. The DEP has an uncompleted inventory of priority health and safety sites that exceeds $940 million. Emergency projects are health and safety projects that are abated through expedited contract procurement procedures. These projects are sudden occurrences of an AML hazard that pose an immediate threat to public health and safety. The third area of funding involves providing clean drinking water by extending waterlines to those areas that were impacted by pre-law mining activities. The DEP has approved and is committed to approximately 50 additional waterline extension projects at an AML share of nearly $100 million. These projects will be completed as matching funds become available and as the local entities prepare the projects for construction. The fourth area that funds are used is the treatment of acid mine drainage. The 2006 amendment to SMCRA allowed states to set aside 30 percent of eligible grant funds in an interest-bearing state account. The DEP intends to set aside these funds with the intention that interest from the fund will allow for the operation and maintenance for perpetual water treatment once the fee collection ends in 2022.

OSR Acres Revoked and Reclaimed
as of 12-31-10



OSR Water Treatment Progress
as of 12-31-10

548	**Revoked Permits**
386	Reclaimed Projects
79	Permits in Progress
83	Permits to be Reclaimed
270	**Water Treatment Permits**
126	Water Treatment Sites
107	Sites Under Construction
37	Sites to be Constructed

AML will, by the spring of 2011, have constructed and have nine in-stream treatment dosers operational. These dosers are located in the Tygart, Blackwater and Potomac watersheds. AML and Water Resources are jointly monitoring and evaluating the success at these treatment locations. All construction and operational costs for these dosers are paid from the set aside account.

The AML grant expenditures reclaims mined lands to a more beneficial use, removes and abates health and safety hazards, extends water service to communities and restores impaired streams, providing a major contribution to an improved quality of life for the citizens of West Virginia.

Special Reclamation

Mandated by the SMCRA, the Office of Special Reclamation (OSR) is charged with protecting public health, safety and property by reclaiming land and treating water on all bond-forfeited coal mining permits in West Virginia.

Bond-forfeited coal mine permits in West Virginia may be comprised of any combination of dangerous highwalls, unsealed underground mine portals, shafts, boreholes, leaking impoundments, ponds, refuse piles, abandoned preparation plants and other infrastructure, debris, extensive unvegetated areas, and acid mine drainage (AMD). OSR eliminates these hazards.

Funding for the program comes from bond-forfeitures, civil penalties and the Special Reclamation Tax on mined coal.

Prior to passage of WV Enrolled Senate Bill 5003 in 2001, OSR was hindered in discharging its duties fully due to limited funding. Since then, the increase in the Special Reclamation Tax has allowed OSR to increase staff, equipment and funding to reclaim land and treat water on bond-forfeited permits in 46 coal-mining counties in West Virginia. Since its inception, OSR has reclaimed over 44,000 acres on 1,718 permits and as of Dec. 31, 2010, treats water on 126 permits.

Energy

Energy production *requires permitting by DEP to ensure environmental impacts are minimized.*

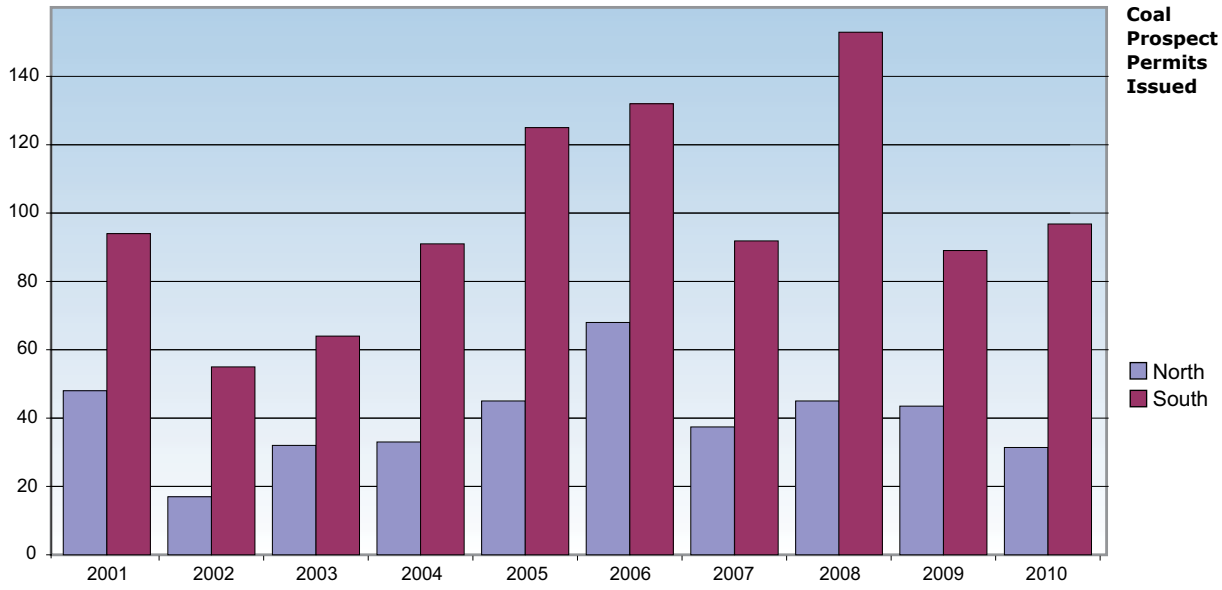
West Virginia is well known as a leading energy producer in the United States. Although most of this production is from mining bituminous coal, the state has a burgeoning natural gas industry that is poised to take advantage of the gas-rich Marcellus Shale using new drilling techniques. The rock formation is found about a mile or more beneath much of West Virginia, Pennsylvania, Ohio and New York and could contain as much as 500 trillion cubic feet of natural gas.

This energy production requires permitting by the DEP to ensure that environmental impacts are minimized. Permitting actions in the coal mining arena shed some light on recent trends. Fluctuations in the coal market generally affect the number of coal prospect permits issued for both the state's southern and northern coalfields. More prospect permits were issued for the south in 2008 than any other time in the last 10 years. Prospect permits for the north fell off slightly in 2009 and 2010 and dropped by nearly 50 percent in the south in 2009.

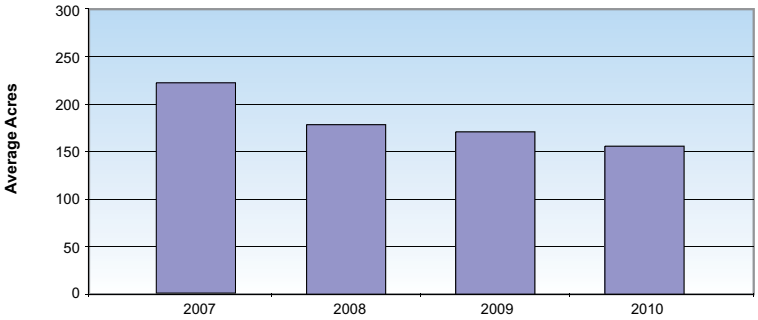
As shown in the accompanying charts, West Virginia coal production has remained steady for several years, while crude oil production in 2010 reached its highest level in the past 10 years of 1.9 million barrels.

West Virginia's natural gas production has been on an upward swing since 2003, due, in part, to the industry's ability to reach large, previously untapped reserves such as the Marcellus Shale. Since Jan. 1, 2006, the DEP's Office of Oil and Gas has issued over 1,200 permits for Marcellus drilling.

All in all, West Virginia's energy production picture remains bright. The state will continue to be a leader in energy production. In May of 2010, ground was broken on a TransGas coal-to-gas facility in southern West Virginia that could create thousands of jobs, while turning 7,500 tons of coal per day into gasoline that will fuel West Virginia trucks, cars and machinery. As more innovations emerge in energy production, the DEP stands committed to ensuring that the environment is protected.

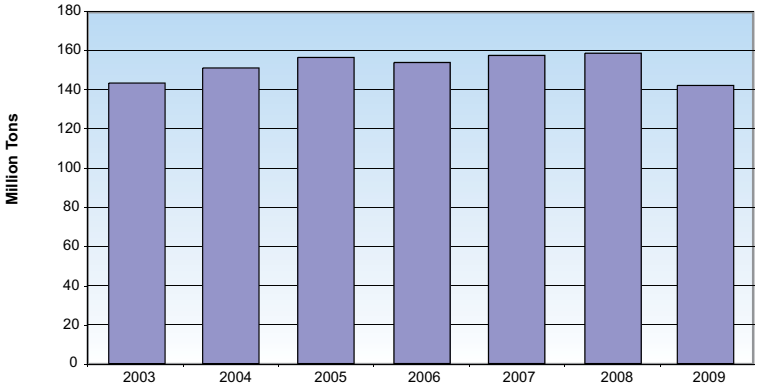


Surface Permits - Average Permit Acres

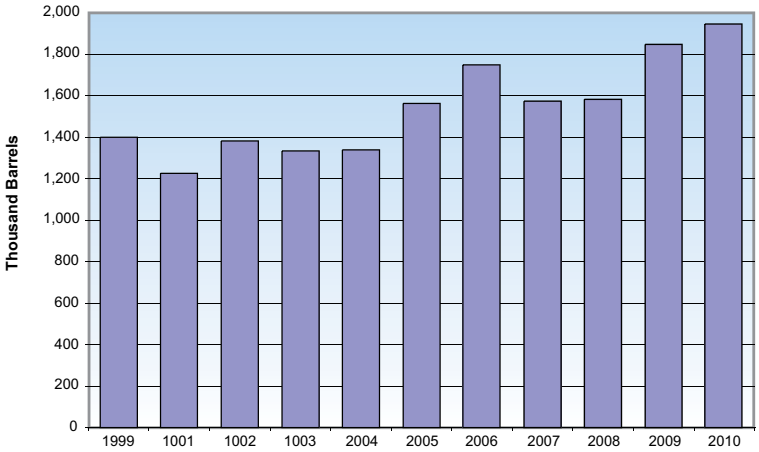


Coal Figures provided by the West Virginia Office of Miners' Health Safety and Training

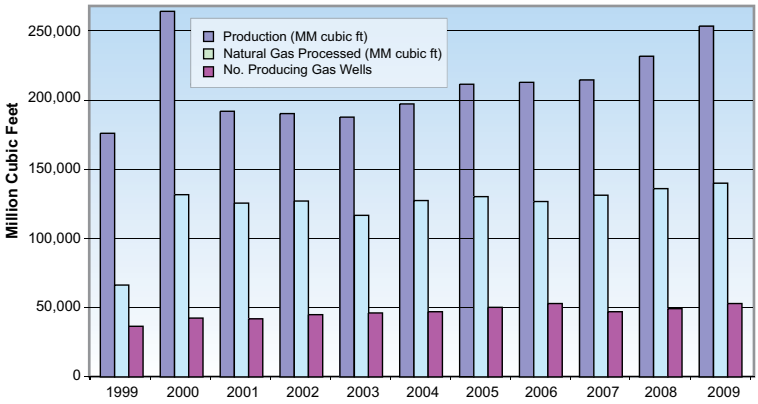
WV Coal Production



WV Crude Oil Production



WV Natural Gas Production *(does not include Transmission)*

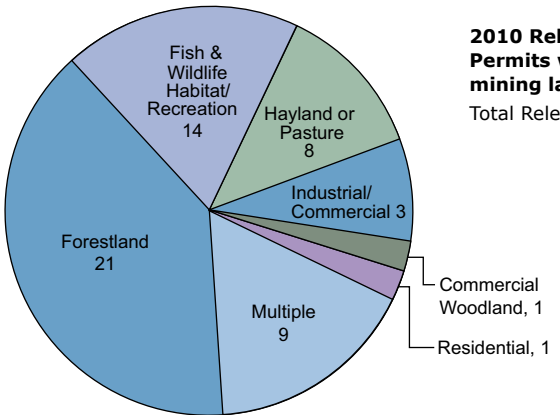


Oil and Gas Source: US Department of Energy, Energy Information Administration

Mining

A factor to consider in evaluating the state of the environment is whether activities affecting the environment are likely to continue. Coal mining activity dropped slightly in 2010. The DEP conducted close to 21,000 mining and quarry inspections on roughly 2,300 open permits in 2010.

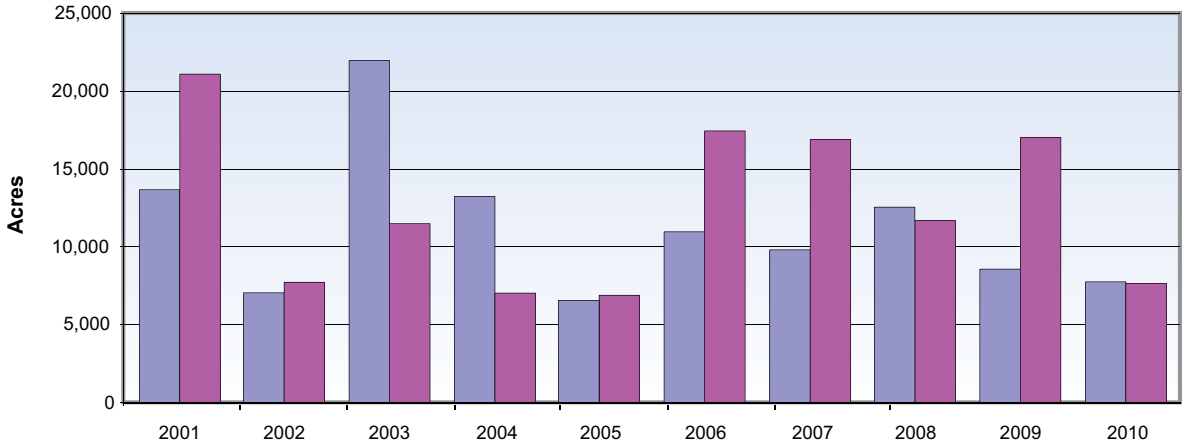
One gauge of the effectiveness of the mining program is the rate of reclamation of lands affected by coal mining operations. This can be determined by examining the number of acres meeting the bond release standards. As the accompanying chart on page 23 shows, in 2010 the acres permitted were roughly equal to the acres released. While the number of permit applications for surface mining activities has remained steady since 2007, the scope of the proposed operations has decreased. In 2007, 95 applications were submitted with an average acreage of 232. Essentially the same number of applications was submitted in 2010 with an average acreage of 151. Also in 2010, the DEP responded to the federal Environmental Protection Agency's increased oversight of the mining permitting process by establishing its own guidance document to be used in issuing water pollution control permits for coal mining. The DEP's guidance document was written to meet federal Clean Water Act requirements and to protect the state's narrative water quality standards.



2010 Released Permits with post mining land use

Total Released: 56

West Virginia coal mining permits reclaimed and released are being restored to productive postmining land uses compatible with surrounding environmental conditions. In 2010, the majority (21) of the 56 released permits were returned to forestland.



New Permit and Amendment Acres
Issued and Released Acres 2001-2010

Electronic Permitting

Electronic permitting has steadily increased since the first electronic submittal of a new permit in 2005. On Jan. 1, 2009, all permit applications were required to be submitted electronically. Now, 99 percent of mining applications are submitted electronically.

Mitigation

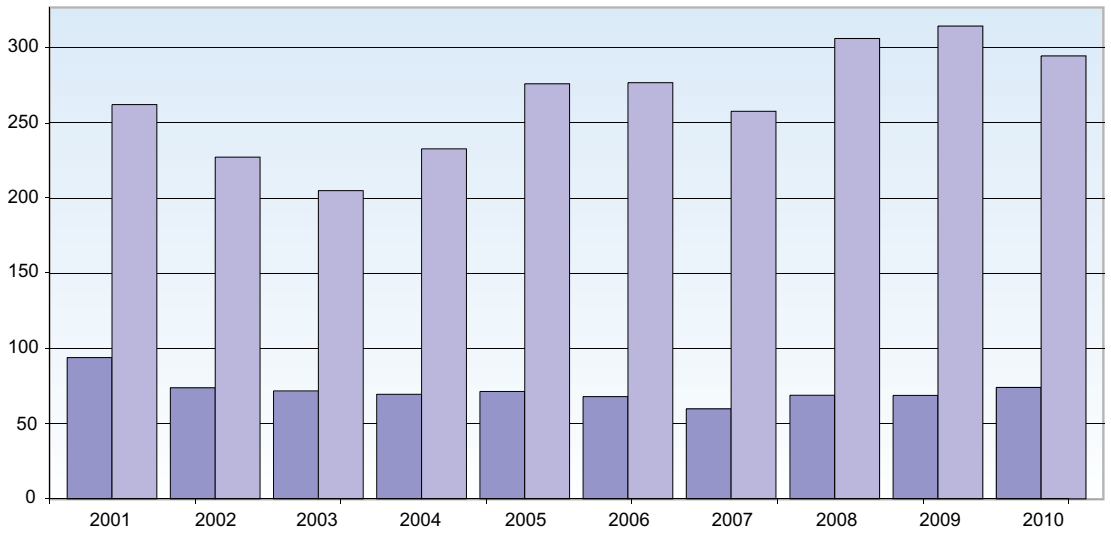
Compensatory mitigation projects continue to offset mining impacts in the coal regions of West Virginia. Numerous mitigation projects have been implemented throughout the state in response to stream impacts due to mining. Mitigation and restoration projects in the Coal River watershed are currently being monitored by West Virginia University. The DEP has extended an Interagency Agreement with WVU to produce predictive tools for mitigation success over time. Numerous mitigation structures have been constructed on the Little Coal River and this data will be used to predict potential beneficial outcomes of future mitigation efforts and provide a comprehensive assessment of a proposed mining permit/impact mitigation packet. The DEP continues to work closely with WVU in the "Continued Evaluation of Offsite Watershed Mitigation Success in the Little Coal River Watershed and Incorporating Mitigation Benefits into an Alternative Futures Modeling Systems for the Mountaintop Mining Region of West Virginia." This research will help fuel future mitigation projects on a watershed level and provide for continued mitigation success in West Virginia.

The Little Coal River mitigation project involved the construction of structures designed to reduce the stream's width/depth ratio... benefiting benthic and fish habitat by improving the river's morphology.

Oil and Gas

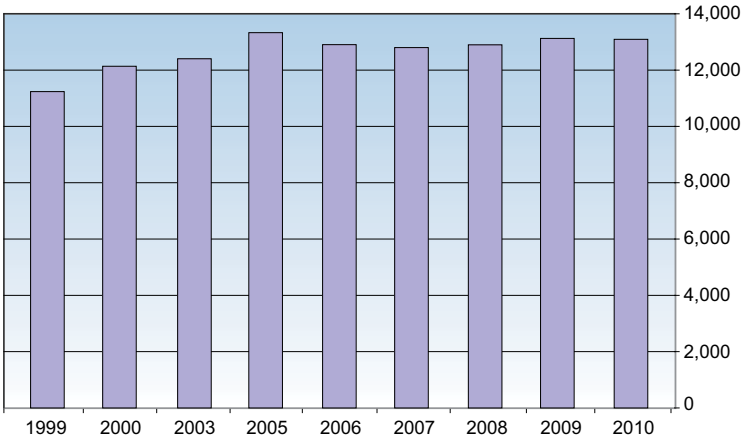
During the past three years, oil and gas activity has changed significantly, likely due largely to economic conditions and commodity prices. After experiencing steady increases in permit applications through 2007, applications leveled off in 2008 and subsequently declined in 2009 and 2010. Total well work permits issued in 2010 were down 54 percent from 2008 levels.

While overall well work permit activity was decreasing, the state began to see the beginning of what may prove to be a "sea" change in natural gas development with the Marcellus



Active Surface and Underground Coal Mines
Northern - Southern WV

Abandoned Wells Inventory



Shale. This play, and particularly the type of operations associated with it — mainly horizontal drilling combined with large-volume fracture treatments — is having a tremendous impact on how the natural gas resource is developed and consequently, the regulatory framework under which such operations are conducted. In response to this "new" activity, the Office of Oil and Gas over the past year has been reviewing the OOG program. The review prompted significant legislative changes in an effort to meet new challenges associated with such a different type of development. These proposed changes did not pass during the 2011 State Legislative session but work continues on meeting the regulatory hurdles associated with the Marcellus development.

Abandoned Wells

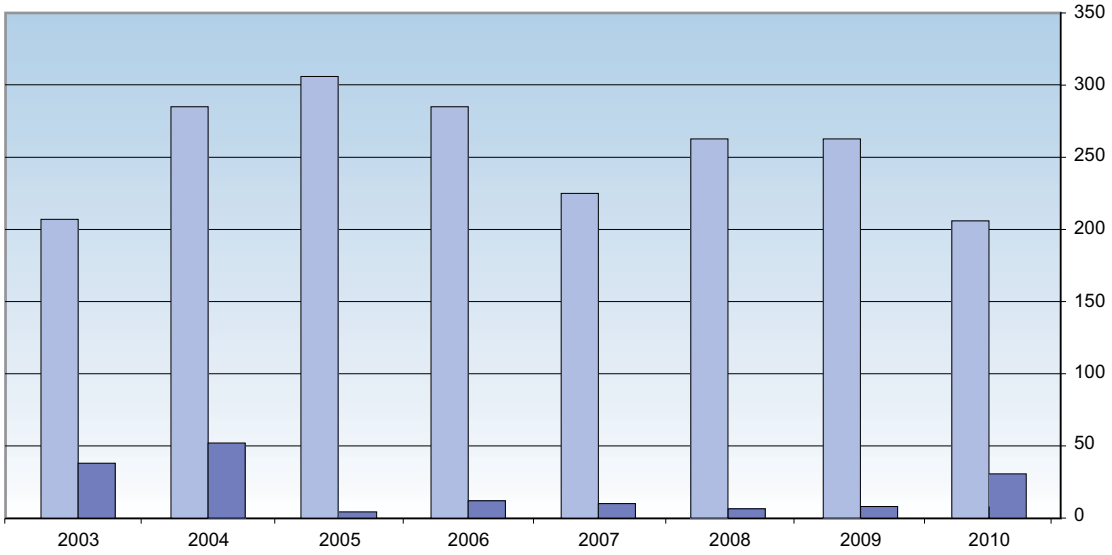
West Virginia currently has approximately 13,000 permitted wells that fall into the abandoned category.

West Virginia law defines an abandoned well as any well that is completed as a dry hole or that is not in use for a period of 12 consecutive months. Any well identified as abandoned is required to be plugged by the operator unless the operator demonstrates that the well has a bona fide future use. Due in part to the long well-drilling history and changing requirements over that period of time, West Virginia currently has approximately 13,000 permitted wells that fall into the abandoned category.

While many of these wells may actually pose little environmental threat, others are a concern. These wells may be leaking crude oil or salt water at the surface, potentially polluting nearby streams. Natural gas may also be leaking into the atmosphere. The sites themselves may also create problems due to a lack of proper reclamation, creating sediment and erosion control problems that consequently affect the state's surface waters.

Perhaps the greatest concern is the uncertainty of what may be occurring below the surface. Unplugged wells or improperly plugged wells can lead to groundwater contamination with crude oil, salt water and natural gas. The problem may go unnoticed for a period of time, resulting in potentially more damage to groundwater or hydrocarbon-bearing zones.

During the past seven years, the Office of Oil and Gas has plugged or reclaimed 252 wells and well sites at a cost of $6.2 million.

To help address the problems associated with abandoned wells, the Office of Oil and Gas administers the Oil and Gas Reclamation Fund. While the fund is limited, the resources are used to respond to the greatest environmental or safety threat. Over the past several years, the DEP has been successful in obtaining federal funding to address some of the problems associated with crude oil contamination of surface waters from abandoned wells. During the past 10 years, the Office of Oil and Gas has plugged or reclaimed 252 wells and well sites at a cost of approximately $6.2 million.

Wells Plugged