Lower Kanawha Watershed Action Plan (LKWAP)

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Introduction

Mission Statement

LKWAP's primary objective is to improve water and habitat quality to fishable and swimmable levels in the Lower Kanawha Watershed by 2040.

Goals

Goal 1: Reduce fecal bacteria concentration to normal standard

- Fecal bacteria concentration should be monitored routinely and the outcome should be made full use of.
- Feasible methods will be carried out to reduce the concentration to normal standard
- Fecal bacteria concentration goes back to acceptable standard.

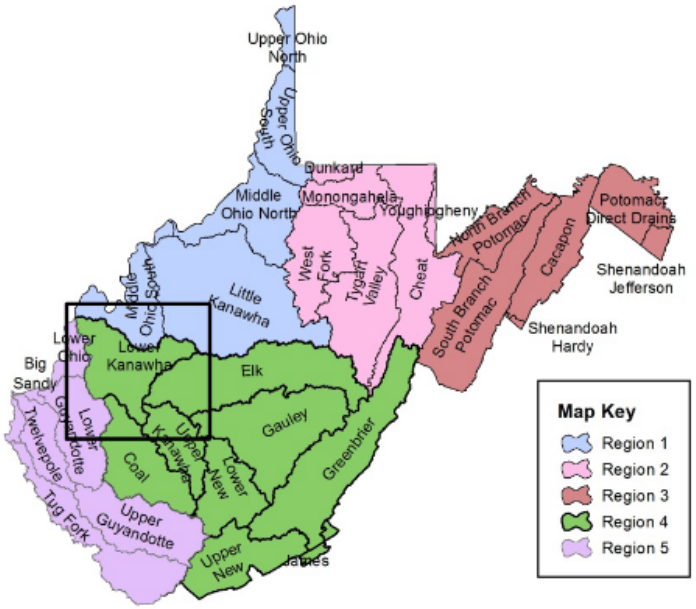
Goal 2: Industrial hazard mitigation

- Reduce the frequency and prevalence of hazardous industrial chemical spills
- Improve monitoring of industrial facilities to limit incidence of major point-source pollution events
- Ensure chemical safety protocols and standards are being met and enforced

Goal 3: Improve protection of stream habitat

- Conduction of routinely scheduled water quality and habitat monitoring tests
- Evaluate potential need to establish a protected area for vulnerable flora and fauna
- Repair degraded streams and waterways
- Implement Low Impact Development (LID) strategies in order to utilize natural systems to control and filter stormwater runoff

Background & Historical Information



Map of West Virginia Watersheds & Regions, Source: WVDEP, 2013.

Watershed Characteristics

Located in central West Virginia, the Lower Kanawha watershed is part of Region 4 in the state, as managed by the WV Department of Environmental Protection (DEP). The watershed covers an estimated 924 square miles across the six counties of Cabell, Jackson, Roane, Mason, Kanawha and Putnam. Containing most of the lower portion of the Kanawha River, it features

1,965 miles of streams and rivers across a state park (Tu-Endie-Wei), a state forest (Kanawha State Forest), and three wildlife management areas (Woodrum Lake, Amherst/Plymouth, and Chief Cornstalk) (WVDEP, 2013). The major tributaries are the Pocatalico River, Davis Creek, Hurricane Creek, and Eighteenmile Creek. To the northwest through the city of Charleston, the Kanawha River converges with the larger Ohio River.

There are two primary ecoregions found in the Lower Kanawha watershed, which consists of both rocky terrain and fertile valleys. The WVDEP (1997) further defines the area, "the Permian Hills and Monongahela Transition Zone sub-ecoregions of the Western Allegheny Plateau ecoregion. The headwaters of Davis Creek are in the Cumberland Mountains of the Central Appalachian ecoregion" (WVDEP, p.4). In these respective areas, one may find agricultural lands or havens of biological diversity. Temperatures are mild in the region with the annual average ranging from 53 to 55 degrees Fahrenheit; annual average precipitation is approximately 42 inches per year (WVDEP, 2013).

Demographics

As of 2013, the population of the entire Lower Kanawha watershed was estimated to be 162,000 (WVDEP, 2013). A major city in this area is defined as having more than 9,000 people, of which there are four that make up an estimated 30 percent of the watershed's population: South Charleston, Teays Valley, St. Albans, and Cross Lanes. See Figure 1 for population data from each city with comparable data provided from the state level, as found in the 2010 United States Census Bureau.

	Population (2010)	**Housing Units (2010)**	**Owner Occupied Housing Unit Rate (2011-2015)**	**Median Household Income (2011-2015)**	**Percent of Persons in Poverty (2011-2015)**
South Charleston	13,450	6,819	69.9%	$46,390	14.1%
Teays Valley	13,175	5,438	82.5%	$70,419	6.8%
St. Albans	11,044	5,436	69.4%	$44,758	13.3%
Cross Lanes	9,995	4,580	70.9%	$55,773	11.8%
West Virginia	1,853,000	881,917	72.5%	$41,751	17.9%

Figure 1. Source: UCSB, 2010.

Industry & Land Use

One of the advantages of the Lower Kanawha Watershed is its abundant forests and canopy coverage. It is estimated that 77% of the land area is covered by trees, and less than 5% is impervious surfaces (WVDEP, 2013). A report produced by the United States Environmental Protection Agency (USEPA) Region III further specifies that the space is, "dominated by forest land uses (82.7%) with some pasture and grassland (9.7%), urban/residential land (7.1%), and barren/mining land (0.1%)" (USEPA Region III, 2006). Even though the watershed benefits from being largely covered by deciduous trees, water quality is undoubtedly impacted by the local economy.

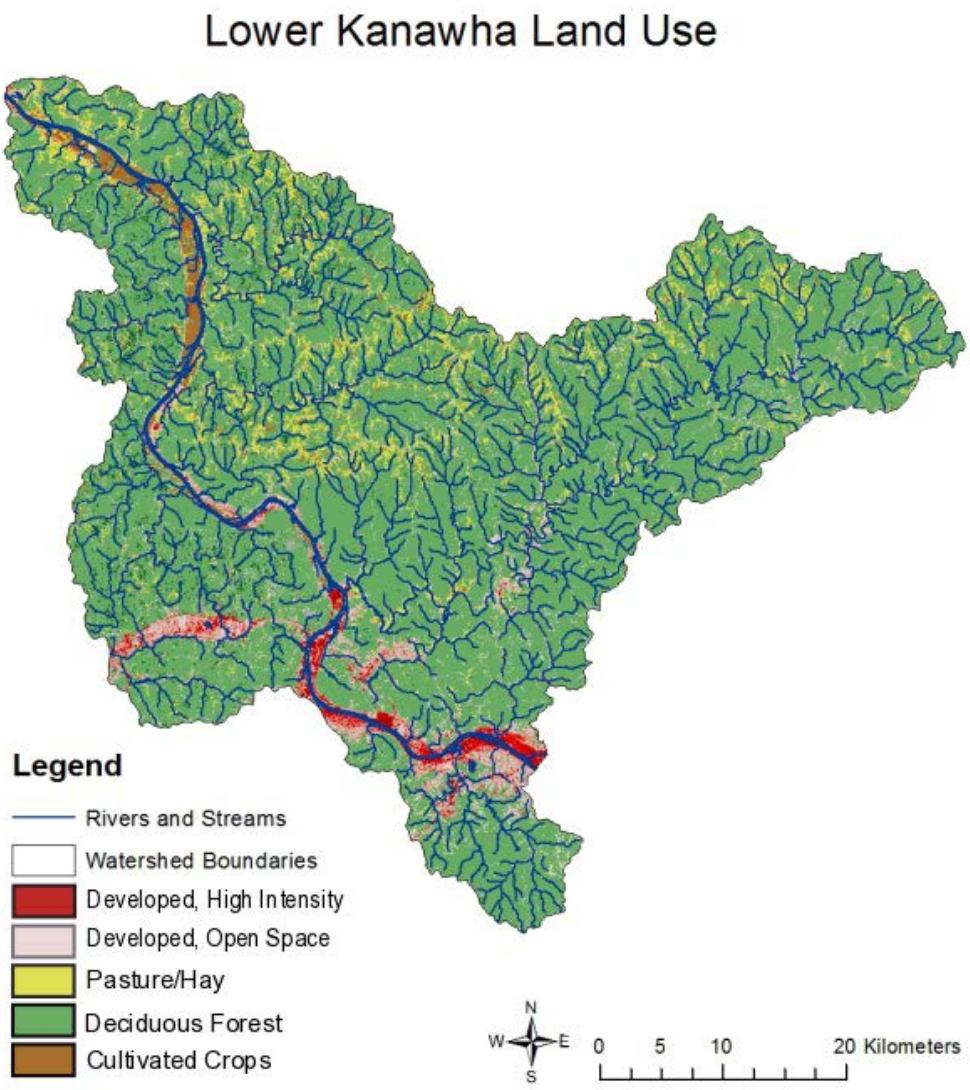


Figure 2. Land use in the Lower Kanawha Watershed

Industry in the Lower Kanawha Watershed is dominated by coal production and agriculture. Paybins et al. (2000) estimates that 7 percent of the nation's coal is sourced from its same region. Coal mining and processing can impact the acidity of the water due to chemical reactions between natural and applied chemicals, such as iron, sulfates, and ammonia (Paybins et al., 2000). Particularly if there are failures in the wastewater treatment process, certain synthetic substances are commonly traced since their concentrations decrease slowly over time. Beyond coal production, agriculture is the other primary industry. One of the major problems faced by this area is runoff pollution from farming, which has been linked to high concentrations of fecal bacteria in the water.

Total Maximum Daily Loads (TMDL) Summary

A Total Maximum Daily Load (TMDL) establishes the maximum amount of pollution allowed in a body of water in order to meet water quality standards. The Clean Water Act section 303 (d) created a system for states to list their impaired water bodies and develop a TMDL (WVDEP, 2006). The goal of TMDLs is to reduce pollution and restore water quality. A TMDL was developed in 2006 for the Lower Kanawha Watershed by the WVDEP. As previously stated, the majority of the watershed is forested, though high density industrial activity and urban/residential growth are present along the Kanawha River. Point and nonpoint sources of pollution include abandoned mines, agriculture, discharge of untreated sewage, oil and gas operations, urban land disturbance, and stormwater runoff (WVDEP, 2006). The primary impairments the WVDEP identified in 2006 were caused by exceedance in levels of iron, aluminium, pH, sediment, biological, and fecal coliform.

In 2012, the TMDL for Lower Kanawha River Watershed was updated. In the Lower Kanawha Watershed, 22 subwatersheds were identified as possessing impaired streams (WVDEP, 2012). Within the 22 subwatersheds, 221 streams were listed as impaired (WVDEP, 2012). Most stream impairments are result of an exceedance in iron, fecal coliform, and biological levels. Several sites had impairments from aluminium and pH. Exceedance of aluminium and pH levels are from abandoned mining operations. The 2012 TMDL developed Wasteload Allocations (WLAs) and Load Allocations (LAs) for point and nonpoint sources. WLAs were created for point sources permitted to discharge including active mining operations, construction stormwater, municipal storm sewer systems, and sewer treatment plants (WVDEP, 2012). WLAs were not created for aluminium and pH since there were no point source locations in the watershed. LAs were developed for oil and gas operations, abandoned mine sites, agriculture, urban/residential waste, and septic systems.

Major Policies & Developments

US Clean Water Act (1972) & US Safe Drinking Water Act (1974)

Congress and the executive branch worked to pass a series of amendments to address water pollution during the early 1970s, including the Clean Water Act (CWA) of 1972 and the Safe Drinking Water Act (SDWA) of 1974. The CWA targeted primary point sources of pollution, like factories and wastewater facilities. Cooper (2000) asserts that the policy's chief objective was to "eliminate all discharges of pollutants into the nation's surface waters by 1985" (Cooper, p. 964). Both bills addressed various concerns associated with water quality, including mandating industrial wastewater treatment; restoring the ability to swim and fish in natural waterways; and improving the overall quality of drinking water.

Ultimately the CWA was mostly successful at reducing the pollution produced by factories and sewage treatment plants, but neglected to address the indirect sources, i.e. runoff from cities, agriculture, and livestock production. It similarly failed to include any stipulations about the safety of groundwater (Cooper, 2000). Weeks' (2010) research affirms the general successes of the CWA and, specifically, the SDWA, stating that "in 1969, only 60 percent of the nation's public water supplies met all federal health guidelines; by 2006, the total had risen to 93 percent"

(Weeks, p. 531). These landmark federal policies served to generally improve the status quo for water quality in the United States, while providing critical support to state-level environmental initiatives. Other relevant legislation from this era includes the Toxic Substance Control Act (1976) and the Surface Mining Control and Reclamation Act (1977).

WV Water Resources Protection & Management Act (2004)

Initially passed in 2004 and amended in 2008, the WV Water Resources Protection and Management Act (WRPMA) places all ground and surface water resources under the ownership and management of the WVDEP. The 2008 modifications renewed requirements for annual water use surveys and quality testing, and mandated that a State Water Resources Management Plan be developed by 2013 with its stated purpose is "to protect and define the state's valuable water resources while promoting its availability for the public, tourism, and industry" (WVDEP, 2013). Procedures for determining current and future water consumption budgets, availability, and area planning are described in the 2013 plan.

Environmental Concerns & Proposed Solutions

Fecal Bacteria in Streams

Questions

Fecal bacteria in Lower Kanawha Watershed were found higher than State contact standard of 200 col/100 ml (West Virginia Department of Natural Resources) and 400 colonies/100ml established by the Environmental Quality Board.

Fecal coliform bacteria sources are point sources, including individual sources covered under the NPDES program such as wastewater treatment plants, combined sewer overflows (CSOs), municipal separate storm sewers (MS4s), and general sewage permits; and unpermitted sources, including on-site treatment systems, storm water runoff and agriculture. Also, wild and domestic animals and increased urbanization, improperly designed and maintained septic systems are sources.

Fecal contamination of water can influence human health such as ear infection, dysentery, typhoid fever, and can be harmful to environment by reducing dissolved oxygen levels due to aerobic decomposition of this material.

Goals

The TMDLs include a total allowable load as well as individual wasteload allocations (WLAs) and load allocations (LAs). WLAs were developed for all facilities permitted to discharge fecal coliform bacteria, including: sewage treatment plants, MS4s and CSOs. Sources mentioned above are regulated by NPDES permits that require effluent disinfection and compliance with strict fecal coliform effluent limitations (200 counts/100 ml)(WVDEP, 2012).

Our goal is to reduce and prevent influx into streams in which way helping achieve the goal of swimmable and fishable in 2040. Concretely, by 2040, the fecal bacteria can meet the numeric standards of WV Department of Natural Resources and NPDES permits, which is 200 col/100ml.

Solutions

As required by Clean Water Act, best management practices (BMP) should be carried out, which should include with regards to fecal contamination.

- Actions: as to different pollution sources, different measures and actions should be carried out. On one hand, under NPDES program, the standards of discharge permits can be set higher to reduce the *discharge* of pollutions. On the other hand, other measures to prevent or reduce *pollution* of these discharges can be done even though the pollutions have been generated. Regarding to increased urbanization and stormwater runoff, actions should be taken to reduce impervious cover, to build bioretention covers or to build drainage swales. As to wild and domestic animals, fences can be built along water edge to prevent them. As to household sewage, education should be carried out to individuals and families. Besides, a good septic systems can be designed and maintained.
- Technology side: In the Lower Kanawha River watershed, there are two publicly owned treatment works (POTW) that treats effluent and 231 general sewage treatment plants. New disposal systems can be built to dispose sewage before they run into the rivers.
- Monitor: an agency who takes charge of monitor should be established to guarantee the enforcement of these measures proposed above.
- Review and revise: these measures and outcomes should be reviewed every year and revisions should be made accordingly.

Industrial Pollution

Chemical Spills

The Lower Kanawha River Watershed has the highest density of industrial operations in West Virginia.The large quantity of chemical, oil and gas, and industrial companies have led to the Kanawha River being nicknamed “Chemical Valley.” Chemical spills and leaks occur approximately every two years along the Kanawha River. Spills along the Kanawha River travel into the tributaries of the Lower Kanawha Watershed. The largest recent chemical spill occurred in 2014 by Freedom Industries when 10,000 gallons of MCHM, a chemical used in coal washing, was dumped into Elk River within the Lower Kanawha Watershed (New York Times, 2014). The spill caused 300,000 people to lose water, with some areas having no water for over a month (New York Times, 2014). Large chemical companies like Bayer and DuPont have also had recent accidents along the Kanawha River, which resulted in the death of three workers. The frequency of chemical spills within the Lower Kanawha Watershed threatens human and environmental health.

Abandoned Mine Sites

Leaks from abandoned mine sites cause impairments to the Lower Kanawha Watershed. According to the TMDL, the source of the metal toxicity is from leakages in oil and gas and abandoned mine sites. Abandoned mine sites cause acid mine drainage (AMD), which is liquid waste that contains high metal contaminants and lowers the pH (WVDEP, 2012). AMD may enter groundwater and surface water sources. The metals resulting from abandoned mine sites in

the Lower Kanawha Watershed are aluminum and iron, which are potential components of AMD. Abandoned mine sites after are controlled under the Surface Mining Control and Reclamation Act of 1977 (SMCRA) and West Virginia's office of Abandoned Mine Lands & Reclamation (AML&R). SMCRA and AML&R possess goals to clean up abandoned mine sites. The AML&R was created in West Virginia in 1981 to address mining sites from before 1977 and is funded by a tax on coal mining (WVDEP, n.d.).

Oil and Gas Operations

Oil and gas production has increased in West Virginia due to the discovery of marcellus shale. Figure 2 shows the amount of oil and gas wells in the Lower Kanawha Watershed. The map only includes active and abandoned sites as sources for potential leakage. Oil and gas leakage can contribute to metal contamination. Over 1,150 active oil and gas wells are currently utilized in the TMDL watersheds of the Lower Kanawha Watershed (WVDEP, n.d.). The WVDEP Office of Oil and Gas oversees all drilling, extraction, plugging, and storage of well sites across West Virginia.

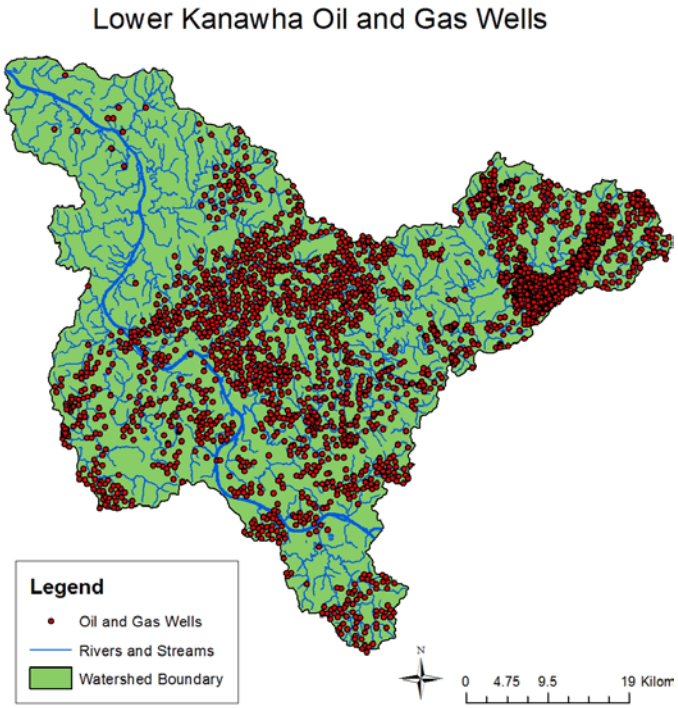


Figure 3: Active and abandoned oil and gas wells in Lower Kanawha Watershed

Goals

- Reduce prevalence and frequency of hazardous chemical spills
- Prevent leakage from abandoned mine sites and oil and gas wells
- Improve monitoring and equipment of industrial facilities to limit incidence of major point-source pollution events

Solutions

- Neutralize AMD acidity with constructed wetlands and/or lime as part of a BMP

- Increase the use of SMCRA for abandoned mine sites
- Increase the coal tax for AML&R to 50 cents per ton for surface mining and 30 cents per ton for underground mining
- Encourage industrial companies to update their equipment through tax credits or grant funding
- Educate factory workers on proper safety techniques and the risks of exposure to hazardous chemicals
- Restrict oil and gas permitting

Heavy Metals Traced in Wildlife

Problem

Non-point sources of pollution are increasingly becoming problematic for the Kanawha River and its watersheds and thus the management of water quality and waste has become difficult. Trace elements such as Iron, Nickel, Chromium, Zinc, Iron, Manganese and Lead were found in samples from the Lower Kanawha watershed's bed sediment, as well as in common carp or rock bass tissue samples. Concentrations of Iron and Manganese were found to exceed the U.S. Environmental Protection Agency's (USEPA) Secondary Maximum Contaminant Levels (SMCL), which can cause harmful effects to aquatic life, thus affecting the watershed's ecosystem. The causes found are non-point sources of pollution such as logging, energy extraction, construction or urbanization, and agriculture which cause increased storm water runoff and erosion send metals and dissolved solids into the waterways.

There are multiple native aquatic and riparian flora and fauna that are negatively affected by non-point source pollution. Multiple birds, reptiles, and amphibians are susceptible to feed on fish and other aquatic insects that have been contaminated by the metals that have been found in some of the carp or rock bass. It is not clear of the extent of contamination, but constant monitoring of the watershed will prevent further contamination that will cause even larger problems.

Goal

To focus on maintaining a "fishable" status for the Lower Kanawha River Watershed by managing non-point source water runoff and pollution by the year 2040. Working with Goal 1 and Goal 2, the wildlife inhabiting the watersheds wetlands, streams and river can be protected as well as provide a safe and clean water environment for fishing. In order to reach the goal, we will incorporate a number of methods.

Solutions and Objectives:

Conduction of tests

- Continue to conduct routinely scheduled water quality.
- Begin to conduct habitat monitoring that is focused on capture and recapture of migrant song birds that feed on the local watershed's fish and amphibian population.
- Use of mist netting in the spring to mid-summer method in the capture of small migratory birds such as the Alder Flycatcher (*Empidonax alnorum*) and Louisiana Waterthrush

(*Parkesia* motacilla) will include blood sampling from birds which will be conducted every five years and will incorporate graduate and undergraduate student volunteers in order to be cost effective.

Evaluate potential need to establish a protected area for vulnerable flora and fauna

- For larger birds that inhabit the river floodplains and riparian buffers, such as the Green Blue Heron (*Andrea Herodias*) and the Green Heron (*Blutorides virescens*), capture will be difficult. In order to maintain protection of the fish that inhabit the area, studies will be conducted at least once a year in the spring to better understand the habitats frequently used by these birds.

Repair degraded streams and waterways

Non-point sources are difficult to pinpoint and so protection of the waterways from runoff is important. The following will be conducted and will work in tandem with creating protected areas for vulnerable flora and fauna.

- Plant native grasses to create an edge where meadow bird species can flourish and give a buffer between the riparian buffer and the stream or wetland waterways.
- Maintain and/ or plant native canopy and understory trees along streams in protected areas to create a riparian buffer.
- By the year 2027, expansion of riparian buffers and establishment of protected areas will be implemented in order to protect the vulnerable species such as the Marbled Salamander (*Ambystoma opacum*) from non-point source pollution.

Implement Low Impact Development (LID)

LID is a fairly a land planning method and engineering design approach that is used to manage stormwater runoff. It utilizes natural systems to control and filter the runoff with an emphasis on conservation and use of on-site natural features to protect water quality.

We will urge the Lower Kanawha watershed management stakeholder to implement the following LID methods when planning the riparian buffers and protected lands, as well as in agricultural land use, in order to prevent further damage from runoff:

- Bioretention
    - Absorbs excess stormwater runoff and filter out pollutants and recharge groundwater using soil- and plant-based filtration devices.
    - Installation of one in the Kanawha valley will reduce mass amounts of heavy metals
    - Proven to reduce up to 90% of copper, zinc, and lead found in stormwater runoff
- Permeable pavements
    - Installation of paved roads and parking lots that infiltrate water such as block or grid paving, pervious asphalt, or pervious concrete

- Method decreases downstream flooding

Stakeholder Summary

The following have been identified as key stakeholders at the federal, state, and local/nonprofit levels who may require engagement during the implementation of this watershed plan:

- US Environmental Protection Agency (Federal)
- US Geological Survey (Federal)
- WV Division of Natural Resources (State)
- WV Office of Land & Streams (State)
- WV Department of Environmental Protection (State)
- WV Conservation Agency (Nonprofit)
- Coal River Group (Nonprofit)

Conclusion

Lower Kanawha Watershed Action Plan aims to protect The Lower Kanawha watershed, which is located in central West Virginia. The Lower Kanawha watershed is managed by the WV Department of Environmental Protection, however, some problems still exist. This Action tries to design a plan to help Lower Kanawha watershed to be fishable and swimmable by 2040.

High fecal bacteria concentration, industrial pollution and heavy metals traced in wildlife are the main issues. According to the project mission and TMDL standards, concrete actions to minimize and prevent the pollution are proposed in this Action plan. Monitoring activity and review processes should be carried out routinely to guarantee the compliance of the actions as they are detailed in this document.

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