Section V. Areas of Concern

As noted in Section 2.02, public meetings were held and surveys were conducted to identify stakeholder concerns. These concerns included:

- Streambank erosion, log-jams and debris, flooding
- Storm sewers, municipal sewer systems
- Dumping, illegal scrap yards
- Acid mine drainage, gob piles, slurry ponds
- Surface soil erosion, farm nutrients, farm herbicides and pesticides, cattle in streams, loss of ag lands
- Chemigation / fertigation, use of surface water in irrigation
- Land-clearing in riparian areas, merging of small farm fields (loss of wind breaks)
- Surface coal operations, construction of oil & gas wells
- Loss of property tax associated with managed lands and lands associated with mining operations
- Recreational value of lands, fishery health, wildlife habitat
- Invasive plant and animal (fish) species
- Gob piles, acid mine drainage
- Methamphetamine labs, anhydrous ammonia thefts / associated leaks
- Lack of funding, economic well-being of the community, poverty levels
- Lack of private septic inspections, day-lighted septic systems
- Lack of ditch easements, county road conditions, lack of road buffers
- Poor drainage class of soils
- Property rights

These concerns were used to identify primary water quality concerns which were typically associated with land uses and practices. Additional areas and practices of concern were identified during the initial monitoring phases of this project. These following concerns occur within the Busseron Creek Watershed and are summarized in alphabetical order.

5.01 Abandoned Mine Lands

As noted in Section IIIg, the residual effects of pre-SMCRA and abandoned mine lands have severely impacted surface water quality as a source of acid mine discharge, through topographic and hydrologic changes. These “stressed” areas have also provided a foothold for invasive plant species, further degrading their ecological health.

(a) Acid Mine Discharge (AMD)

Problem

AMD enters surface waters, lowering pH levels and raising metals contents, severely diminishing water quality and aquatic habitat.

Discussion

Sulfuric acid is created by oxidation of pyrites through exposure to water or air. The pyrite deposits have either been exposed by mining activities or are contained in deposits placed at or above the water table. As contaminants are diluted with cleaner downstream surface waters, pH rises and metals precipitate out of solution, contaminating stream beds.

Support

Indiana Department of Natural Resources – Division of Reclamation data has shown pH levels as low as 2.39 at current test locations throughout the Friar Tuck AML sites. Sites with low pH were also found to have high sulfate concentrations – further confirming the presence of sulfuric acid contamination of surface waters. In addition, those sites showed elevated levels of dissolved aluminum, iron, manganese, and total dissolved solids. See Section 4.02 – Abandoned Mine Lands Benchmark Assessment and Appendix D(a) IDNR – Division of Reclamation data for TMDL sites 7, 8, 12, and 16.

Visual observations of both small and large-scale AML sites often show a lack of vegetative cover and "rusting" of soils and stream beds. Downstream locations are often streaked with rust (Fe) or white (Al) precipitates. See *Figure III-13 – Lands Designated as Abandoned Mine Lands,* page 43 for illustration of documented AML sites.

(b) Topography and Hydrology Alteration

<u>Problem</u>

Historic pre-law practices and early post-law practices have harshly altered surface topography, severely distorting surface water run-off.

<u>Discussion</u>

East-central areas of the watershed, commonly associated with AML sites are scarred with a series of ridges that typically drain to land-locked "lakes" created by abandoned mining pits. These lakes are often very deep with steep drop-offs that are not conducive to native aquatic species.

Streams have been redirected and channelized, increasing stream bank erosion and sedimentation. In some areas, headwater streams have been completely eliminated, reducing their *"ability to hold and store water which can result in increased frequency and intensity of downstream flooding as well as lower base flows." (Dunne and Leopold 1978)*

Subsidence, or the lowering of the Earth's surface due to collapse of bedrock and unconsolidated materials into underground mine areas, provides an entry of surface water (or anecdotally – grey water and/or septic effluent). These liquids can contribute to the creation of AMD. They may also pose a concern for groundwater contamination.

<u>Support</u>

- Documented acreage of AML sites from Division of Reclamation combined with visual observations of hogback / lake complexes.
- GIS documentation of "unnaturally straight" streams in the Mud Creek watershed. (See *Figure IV-4 – Mud Creek-Big Branch Tree Canopy and Habitat Evaluation,* page 77)
- Man-made lake complexes combined with oral history of stream removal (See *Figure IV-7 – Buttermilk Creek Tree Canopy and Habitat Evaluation*, page 80)
- Documented subsidence areas combined with anecdotal evidence of grey-water disbursal. (See *Figure III-15 – Closed Underground Mines,* page 45)

(c) Problem Statement - Invasive Plant Species

<u>Problem</u>

Introduction of invasive species contributes to water quality degradation decline of native habitat.

<u>Discussion</u>

The EPA defines an invasive species as:

> *"a species whose presence in the environment causes economic or environmental harm or harm to human health. Native species or non-native species may show invasive traits, although this is rare for native species and relatively common for non-native species."*

Invasive species effects on water resources can be direct, as in the case of Eurasian watermilfoil, or indirect, as in land-based species that change water tables, runoff dynamics, and other conditions that can alter surface water quality.

Aquatic-based invasives like Eurasian watermilfoil (typically associated with recreation - *not* abandoned mine lands) smothers native plants by forming thick, tangled stands of stems underwater and vast mats of vegetation on the surface of the water. Decomposition of mats lower dissolved oxygen levels and accelerated filling of lakes and ponds.

Shallow-rooted terrestrial invasives, such as Japanese knotweed contribute to erosion and stream bank collapse by out-competing deeper-rooted native species.

Species such as Amur bush honeysuckle can almost stop tree regeneration, eliminating the next generation of forest – and critical riparian areas. In addition, their leaf out and leaf drop dates reduce light penetration, thus shading out native grasses and forbs. The resulting bare ground has a higher run-off potential.

Support

- Documented infestations of invasive species, including Eurasian watermilfoil, Amur bush honeysuckle, and Japanese knotweed.
- Information from Invasive species groups and taskforces, including the Midwest Invasive Plant network, The Nature Conservancy, and IN-DNR Invasive Species Task Force, and Southern Indiana Cooperative Weed Management Area.

5.02 Active Mineral Extraction

(a) Surface Coal Mines

Problem

Reclaimed surface coal mine areas are very susceptible to soil erosion and elevated surface water temperatures.

Discussion

Although post-Surface Mining Control and Reclamation Act (SMCRA) coal mining operations are required to restore lands to pre-mined condition, the final soil placements are extremely fragile and susceptible to surface erosion.

Re-establishment of healthy subsoil ecosystems that help stabilize soil structure (including root mass, microscopic organisms, annelid and insect populations) can take decades to re-establish. The establishment phase of vegetative/forested stream canopies leaves surface waters more susceptible to extreme temperature variation and stream bank erosion, which result in degraded aquatic habitat.

The settling of disturbed soils directly affects the long-term stability of county roads by exacerbating normal freeze-thaw cycle damages.

Support

- Well-established soil fragility issues documented by the coal mining industry and regulatory agencies.
- On-going county road settling.
- BCWP documentation of surface water temperatures in the West Fork Busseron and Chowning Creek Watersheds combined with GIS overlay of tree cover in areas of active mining (*Figure IV-1 – Chowning Creek Tree Canopy and Habitat Evaluation Figure IV-2 – West Fork Busseron Tree Canopy and Habitat Evaluation*, pages 74-75.

Contributing Factors

- Landowners and tenants may not understand the need to treat post-mined soils as fragile ecosystems.
- Increased maintenance requirements of post-mined county road systems are beyond municipalities' capabilities.

(b) Oil & Gas Wells

Problem

New oil and gas well construction damages surface soil structure and pose a threat to vegetation and aquatic life.

Discussion

Construction of new well sites on reclaimed coal ground severely damages already unstable county roads and surface soils. New well sites have left areas of the county pock-marked with barren pads of crushed limestone and equipment.

Large volumes of water produced in the early stages of well production typically have high saline levels that pose a threat to vegetative and aquatic life if handled improperly. There is anecdotal evidence of past brine spills and fish kills in local waters.

Support
- Anecdotal evidence of brine spills.
- Visual documentation of construction methods.

Contributing Factors
- Construction methods are approved and regulated by Indiana Department of Natural Resources – Oil & Gas Division.
- Mineral rights are typically no longer owned by landowners.
- Sensitive area mitigation sites as required by regulatory permitting procedures may be located outside of the HUC12 or HUC10 watershed area.

5.03 Agriculture

As the largest land use in the Busseron Creek Watershed (57%), the impacts of agriculture are widespread. As summarized in Section IIIf, the majority of agriculture production acreage is dedicated to corn-soybean rotations in a conventional tillage system.

(a) Commodity Crops

(i) Soil Erosion

Problem
Soil erosion resulting from cropping practices contributes heavily to increased sedimentation, turbidity, nutrient and pesticide loads.

Discussion
Tillage practices, lack of cover crops, and low crop residue (especially following soybean crops) leave production acreage soils exposed and highly susceptible to sheet erosion. Soil migrates through sheet run-off and channeled erosion directly to surface streams or via field tile systems (entering through stand-pipes). In addition, studies have shown that areas lacking residue or cover have lower rates of precipitation absorption and higher rates of surface run-off volume and speed than in areas with high residue content or planted to cover crops during fallow seasons

Encroachment and elimination of riparian buffers adjacent to agricultural fields allows soil to move unimpeded into streams and contributes heavily to stream bank destabilization and collapse. Lack of grassed waterways and filter strips in natural drainage channels promote gully erosion. Even where these practices have been established in the fragile soils of reclaimed mine lands, anecdotal evidence indicates a large percentage are removed by growers/landowners once bonds have been released.

Agriculture-related soil erosion contributes heavily to:
- Sedimentation, resulting in stream bed smothering
- Increased turbidity, resulting in an increase of heat absorption, and a decrease of photosynthetic activity – which combine to reduce dissolved oxygen levels.
- Increased soil-attached phosphorus loads, particularly during the spring season, contributing to algal blooms which decreases light penetration. Decay of algal blooms severely depletes available oxygen.
- Transport of chemicals to surface waters.

Support
- Visual evidence of heavy stream bed sedimentation and smothering during sampling events and CQHEI assessments.

- Impaired / highly impaired Subwatersheds (for sediment) correlate with areas of concentrated agricultural activity (See *Table VI-2 – Parameter-based Critical Watersheds,* page 197 *and Figure III-9 – Cultivated Areas,* page 35)
- Elevated TSS & turbidity during periods of heavy tillage and planting. See Appendix A – BCWP Sampling Data.
- Studies showing elevated N & P levels during spring.

Contributing Factors
Contributors to the slow adoption of conservation tillage practices and planting of cover crops include:

- High cost of equipment conversion.
- Skills required, especially in production of no-till corn.
- Studies that have shown possible yield decrease in no-till cropping systems.
- Lack of information about fuel and time reduction, especially in no-till cropping systems.
- Cost and time factors of cover crop establishment.

Contributors to removal of riparian buffers and filter strips include:

- Economic pressures to increase cropped acreage.
- Large pieces of agricultural equipment are difficult to maneuver in areas constricted by multiple filter strips and buffers.
- Mid-field filter strips often result in point rows – areas of higher plant density and lower yields.

(ii) Farm Chemicals

Problem
Farmers of the Busseron Creek Watershed use chemicals which have the potential to enter creeks, possibly degrading water quality.

Discussion
After peaking in the late 1970's pesticide use by U.S. farmers steadily declined through the 1990's and has held steady since that time. Use of genetically-modified crops (GMOs) has been credited with that decline, especially the decrease of insecticide use.

According to a 1996 USDA study, a variety of pesticides were commonly found in streams throughout the White River Basin. Concentrations of individual pesticides were generally greatest in areas where their use was the greatest.

Glyphosate (Round-up©), one of the most commonly used farm chemicals, enters surface water through three routes: direct application to aquatic vegetation, binding to soil that washes off treated terrestrial sites, or through drift from treated areas that are near water. This is due to the chemical's tendency to attach to soil particles. Other chemicals that have high adsorption rates, such as Treflan© (Trifularlin) or Prowl© (Pendimethalin) are likely to be delivered to surface waters in a similar manner.

Other chemicals with low soil adsorption rates and high water solubility, such as Banvel© (Dicamba) and Lannate (Methomyl) are more likely to leach through soils and be transported to surface waters through drainage tiles.

Hazards and toxicity levels of these chemicals vary greatly.

Support

- Studies by agencies, and universities such as USGS, EPA, Purdue, and University of Illinois.
- According to the USGS publication "Occurrence of Pesticides in the White River", the total amount of herbicides transported by the river is about 1 percent or less.
- Based on 2001 treated acreage and rates from USDA - National Agricultural Statistics Service, and combined with information from the USGS study (1% runoff, above) the following commonly used pesticide loads may be expected in the Busseron Creek Watershed as a result of corn and soybean cultivation:
    - Atrazine – 491 lbs

  - Metoachlor, S-Metoachlor – 240 lbs
  - Glyphosate (bound to soils) – 496 lbs
  - Acetochlor – 183 lbs
  - 2-4, D – 50 lbs
- Note: Due to cost constraints, the presence of commonly used farm chemicals were not included as part of the water quality testing parameters.

<u>Contributing Factors</u>

- Lack of market opportunities severely inhibit the addition of crops in a rotation. Those additional crops would help break pest cycles.
- Adoption of precision agriculture technology such as swath control and variable rate application to reduce application rates and overlap can be extremely expensive – especially for small to medium sized operations.

(iii) Fertility Programs

<u>Problem</u>

Surface water concentrations of phosphorus and nitrogen exceed State standards in areas of heavy agricultural activity.

<u>Discussion</u>

Soybean rotations reduce the amount of nitrogen applications required for the following corn crops. However, corn is a "heavy feeder", requiring high amounts of available nutrients to produce viable yields.

- Late fall applications of nitrogen as anhydrous ammonia (NH_3) are susceptible to nitration (conversion to NO_3) during warm, wet weather, including the following spring. The resulting nitrates are more easily moved through the soil, and enter surface waters through field tile systems.
- Spring applications of nitrogen, including starter fertilizer and side dress of applications are also susceptible to denitrification losses during periods of warm, wet weather.
- Phosphates are typically applied during winter months while soils are frozen. They tend to attach to soil particles and are more typically lost through surface run-off and resulting soil erosion.
- Most nitrogen and phosphate loads from agricultural practices will occur during spring seasons.

In addition, theft of anhydrous ammonia for the production of methamphetamine is a well-known and documented hazard for rural communities, including the Busseron Creek Watershed.

<u>Support</u>

Under normal spring conditions, sampling should show higher levels of phosphorus from surface run-off and nitrogen from tile systems. However, 2009 planting delays caused by cool, wet weather resulted in a conversion from the longer-season, high-nutrient consuming corn crops to the shorter-seasoned, lower nutrient-consuming soybean crops. Expected levels of nutrient loads were calculated using proven models (STEP-L and Center for Watershed Protection Watershed Treatment models). See *Table VI-3 – Loads and Suggested Reductions,* page *226.*

<u>Contributing Factors</u>

Factors influencing fertility programs include:

- Reduced yields due to nutrient deficiencies
- Lodging caused by nutrient imbalances or deficiencies can reduce yields by 25%
- Plants stressed by nutrient deficiencies are more susceptible to plant and disease infestation

(iv) Irrigation

<u>Problem</u>

Irrigation systems can contribute to high levels of surface run-off and associated soil erosion.

<u>Discussion</u>

Center-pivot irrigation systems, such as those found in the Western regions of the Busseron Creek Watershed are typically sited on light, sandy soils that are susceptible to soil erosion. These irrigated fields are typically managed to produce high yielding commodity crops or high-value crops such as seed corn, seed wheat, green bean, tomato, or melon crops. Very few, if any of the tracts are no-tilled.

The force of irrigation droplets hitting the ground breaks down surface soil structure, forming a thin compacted layer that greatly reduces water infiltration. Soil surface sealing continues to develop with each additional irrigation. In addition, high application rates, especially on the outer pivot sections, exceed the infiltration rate of most soils.

These conditions combine to increase surface run-off and surface soil erosion on irrigated fields.

Support

- Studies by USDA, University of Idaho, University of Michigan, Purdue.
- Visual evidence of erosion in irrigated fields – Rogers Ditch and Tanyard Branch Subwatersheds.

Contributing Factors

- Increased production of specialty crops in area.
- 30% increase in irrigated acres from 2002 – 2007.
- Seed crop contracts typically require intensive tillage practices.

(v) Lack of Riparian Buffer Zones

Problem

Encroachment of agricultural fields into riparian buffer zones have severely diminished natural cooling and filtering systems.

Discussion

Sediment and sediment-associated pollutants, such as phosphorus, bacteria, and some pesticides move to surface waters by surface run-off. Riparian buffer zones can effectively slow surface water movement, allowing sediment to settle out before reaching streams and creeks.

Nitrogen from agricultural fields typically moves as nitrates through groundwater. To remove nitrate from groundwater before it reaches surface water, the groundwater must enter a zone where plant roots are or have been active. Riparian forest buffers reduce nitrogen under most conditions. (Studies have shown 18 – 55 pounds of nitrogen per acre per year)

Shade provided by vegetation during summer months maintains cooler, more even temperature, especially on smaller streams. Cooler water holds more oxygen and reduces stress on fish and other aquatic organisms. A few degrees temperature can have a major effect on their survival.

Support

- Various studies demonstrating the positive impact of forest buffer zones in reducing the influence of agricultural nutrients and chemicals on surface stream waters.
- Elevated temperature, turbidity, and loads of nutrients downstream from areas devoid or nearly devoid of riparian buffer zones in the Busseron Creek Watershed.
- Note lack of tree cover upstream from temperature-impaired BCWP sites 14, 15, and *16: Figure IV-1 – Chowning Creek Tree Canopy and Habitat Evaluation* and *Figure IV-2 – West Fork Busseron Tree Canopy and Habitat Evaluation,* pages 74-75.

Contributing Factors

Contributors to removal of riparian buffers and filter strips include:

- Economic pressures to increase cropped acreage.
- Wooded buffers, reduce soil-available moisture and shade crops, resulting in reduced yields in areas 30-50 feet from tree lines.
- Large pieces of agricultural equipment are difficult to maneuver in areas constricted by multiple filter strips and buffers.
- Mid-field filter strips often result in point rows – areas of higher plant density and lower yields.

- Damage of expensive agriculture equipment by overhanging branches and downed trees/tree limbs in areas adjacent to wooded buffers.

(b) Livestock

Confined livestock operations are a minimal concern in the Busseron Creek Watershed. Water quality concerns for these and other livestock operations revolve around manure applications and unrestricted stream access.

(i) Manure Applications

Problem
Winter applications of manure can contribute to nutrient loading of surface waters.

Discussion
Manure applications in the area are mostly of turkey litter and are typically made during winter months while ground is frozen to limit wheel ruts. This also coincides with a season in which run-off is more likely – frozen soils can be nearly as impervious as parking lots.

- Studies in Vermont, Minnesota, and Iowa recorded losses of 20-30% of applied nitrogen and phosphorus from winter-applied manure.
- Winter application of manure can result in runoff concentrations of nitrogen and phosphorus from two to 15 times higher than those from summer applications.
- In winter, when manure rests on the soil surface, interaction with soil is minimal and manure organisms are more readily carried away in run-off.
- Cool temperatures and moist conditions in winter favor longer survival of microorganisms on the land. In warm weather, most manure pathogens are killed or immobilized in soils by physical filtration, adsorption or predation by native soil microorganisms.

Support
Visual observation of winter-applied turkey litter, especially in the Rogers Ditch, Tanyard Branch, and Middle Fork Subwatesheds.

Contributing Factors
Contributors of winter applications of manure include:

- Seasonal nature of agriculture – with exception of winter wheat, manure is not spread in fields with growing crops.
- Concerns about soil compaction and/or rutting during warmer, wetter months.

(ii) Pasture Management

Problem
Poor pasture management contributes to increased run-off of nutrients, E. coli, and erosion.

Discussion
Overgrazed pastures result in compacted soils and degradation of vegetative cover. The compacted soils are unable to absorb precipitation and the resulting run-off flow to streams is relatively unimpeded by surface vegetation.

- Surface run-off can carry high levels of E. coli and nutrients into streams and creeks.
- Overgrazed areas lack appropriate vegetative cover to control soil erosion or filter surface run-off.
- Small pastures often effectively become dry lots which lack filter strips. Waste and surface soils wash into surface creeks and streams.
- Livestock prefer new plant growth and re-graze portions of pastures repeatedly until the area is near barren.

Support
Visual observations of overgrazed lots, especially for small acreage hobby-farms or recreation animals.

Contributing Factors

- Lack of education on pasture acreage required for animals, particularly those kept for recreation purposes.

(iii) Unlimited Stream Access

Problem

Unrestricted stream access by domestic animals such as horses, cattle, and goats destabilizes stream banks.

Discussion

Uncontrolled livestock access to streams can result in bank erosion, damage streamside vegetation and degrade water quality with solid waste pollution.

- Midstream "loafing" during hot weather churns stream beds and contribute to solid waste loads.
- Common access points are heavily compacted by livestock traffic and devoid of surface vegetation.
- Collapse of stream banks (gully-ing) in historically grazed areas are common.

Support

Visual observations of stream bank destabilization and compaction of heavy use areas.

Contributing Factors

- Large deer populations also contribute to stream bank erosion
- Fencing out livestock can be cost-prohibitive
- Cost to replace streams and creeks as a source of water to livestock.

5.04 Logging / Land Clearing

Problem

Poorly planned and conducted logging or land clearing activities contribute to stream bank destabilization, stream turbidity, and elevated water temperatures.

Discussion

Some logging operations within the watershed are conducted without implementation of best management practices or logging plans. They leave surface soils rutted and compacted. They also remove mast-bearing trees, eliminating wildlife feed and seed for re-growth. The long-term health of forested areas is reduced because smaller trees are not allowed to fully mature and deeply harvested areas are not replanted.

Land clearing close to surface waters, including ephemeral streams leads to stream bank erosion or collapse and increased turbidity of downstream waters. As noted in the agricultural section, riparian buffer zones can effectively slow surface water movement, allowing sediment to settle out before reaching streams and creeks. In addition surface water that is no longer slowed by riparian vegetation, contributes to flooding episodes, increased erosion by fast-moving water, and channelization of streams.

Shade provided by vegetation during summer months maintains cooler, more even temperature, especially on smaller streams. Cooler water holds more oxygen and reduces stress on fish and other aquatic organisms. As a few degrees temperature can have a major effect on their survival, removal of stream-side forested canopies can severely impact surface water health.

Support

- Visual evidence of heavy stream bed sedimentation and smothering downstream from cleared lands.
- Elevated stream temperatures and turbidity documented by BCWP in areas downstream from cleared lands.

Contributing Factors

- Landowners view sales of standing timber to sales of mineral rights, but are less educated about what shape their land will be left in.
- Landowners are often unprepared or unequipped to replant and/or restore post-timbered lands.
- Note lack of tree cover upstream from temperature-impaired BCWP sites 14, 15, and *16: Figure IV-1 – Chowning Creek Tree Canopy and Habitat Evaluation* and *Figure IV-2 – West Fork Busseron Tree Canopy and Habitat Evaluation,* pages 74-75.

5.05 Lawn / Landscaping

Problem

Lawn and/or landscaping chemicals and fertilizers can enter streams and creeks through surface run-off

Discussion

A quest for the perfect lawn or landscape often results in applications of chemicals as a matter of course, rather than need. The consequences of these treatments can include:

- An over-application of fertilizers which enter streams through surface run-off.
- Broadcast of chemicals onto impervious areas such as sidewalks and driveways. If these chemicals are not swept and disposed of properly, they can wash into surface drainage systems – and into surface streams.
- Lack of riparian buffers on urban creeks. Although turf does absorb some precipitation, manicured lawns do not sufficiently slow run-off to filter contaminants.
- Maintenance of area golf course and parks follows a similar pattern to residential care: applications of fertilizers and chemicals as a matter of course and lack of riparian buffers.
- In addition to contamination of streams and creeks, highly-maintained lawns lack diversity of plant life required for beneficial insects.

Support

- Visual documentation and anecdotal evidence of typical residential lawn and landscaping care.
- SCPL and Elks Country Club golf course maintenance practices.
- Elevated phosphorus loads downstream from residential areas (BCWP sites 7 & 8)

Contributing Factors

- Perception of a neatly maintained lawn as one species of lush green grass.

5.06 Municipal Infrastructure

(a) Impervious Surfaces

Problem

Imperviousness of parking lots, roofs, streets, and sidewalks does not allow absorption of rain or melting snow, increasing run-off which results in negative impacts on surface water and habitat quality.

Discussion

Structures and paving prohibit absorption of rain or melting snow. A 1,000 square foot area of roof, parking lot, or street will produce 623 gallons of run-off in a 1-inch rain. Even lawns, sloped to encourage run-off, do not rapidly absorb precipitation.

From an Ohio State University Fact Sheet:

> *In many places, as little as 10% impervious cover has been linked to stream impacts, which increases in severity as impervious cover increases (Schueler, 1995). The amount of impervious cover in the watershed can be used as an indicator to predict how severe these impacts might be. Research has shown that as the amount of impervious surface increases, the amount of runoff generated increases. This leads to increased amounts of water flowing in the stream, especially during heavy rainfalls; less ground water flowing through the soil (base flow); and more erosion of the stream bed because of faster*

flowing water. These changes to stream flow result in flooding; habitat loss; erosion, which widens the stream channel; and physical changes in how the stream looks and functions.

Impacts from Increases in Impervious Surface Coverage (USEPA, 1997).

Increased Imperviousness Leads to:	Resulting Impacts				
	Flooding	Habitat Loss	Erosion	Channel Widening	Stream Alteration
• Increased Amount of Flow	X	X	X	X	X
• Increased Peak Flow	X	X	X	X	X
• Increased Peak Duration	X	X	X	X	X
• Decreased Base Flow		X			
• Sediment Loading	X	X	X	X	X

The effects of urbanization on riparian habitat, and macroinvertebrate and fish communities can generally be classified into three categories: low, moderate, and high (USEPA, 1993). At low levels of urban development, the riparian zone has lots of vegetation and no erosion from the stream banks; there are lots of different species of fish and macroinvertebrates in the stream. At moderate levels of urban development, some of the riparian plants have been removed and there is some erosion of the stream banks; there is less of a variety of macroinvertebrate and fish species in the stream. At high levels of urban development, the riparian area is nearly gone and the stream banks are completely bare, which increases erosion of the stream banks; there are just a few different species of fish and macroinvertebrates in the stream because habitats within the stream were destroyed and the pollution intolerant species have either left or died.

<u>Support</u>
- Visual documentation
- Habitat assessments of streams, in particular BCWP Site 8.

(b) Road and Ditch Maintenance

<u>Problem</u>
Gravel roads and ditches are often severely degraded, contributing to impaired surface water run-off and stream sedimentation.

<u>Discussion</u>
Unpaved roads are considered to be the largest source of particulate air pollution in the country. According to the Environmental Protection Agency, unpaved roads produce almost five times as much particulate matter as construction activities and wind erosion (the next two largest sources) combined. Dust coats roadside vegetation and structures from where it can be washed by rains and into ditches and streams as surface run-off.

When the smaller components of paving materials (road fines) are lost as dust, it deteriorates the gravel surface. Larger aggregate pieces become exposed and are then scattered by vehicles or washed away. In many areas of the watershed, pit-run gravel is typically used for surfacing. The rounded shape of the material is easily displaced rather than compacted into a more durable road bed. The unstable road becomes rough, developing potholes and washboarding. These damages hold water which then infiltrate and damage the road base. In addition, the eroded material damages ditches and drainage systems.

These issues are compounded by grading activities that remove crowns and sometimes *add* washboarding. The grading often does not extend to shoulders, resulting in a drop *from* the shoulder to the road – surface road water cannot reach ditches and flows down the road, further damaging the road surface and base.

In areas of prior surface mining, roads are inherently unstable due to settling – again, further compounding damages.

Ditches are not only heavily sedimented by fines from damaged roads, but also from agricultural practices which encroach upon easements. Filter strips that may have existed in easements are no longer present and surface soil erosion freely enters the ditch system. In areas of steep roadside to field slopes, easement encroachment contributes significantly to ditch bank collapse.

Current ditch sediment removal methods leave steep, bare banks that are more susceptible to erosion. Road shoulders may not be graded to improve drainage into ditches.

Support

- Visual documentation.
- Known contributors to gravel road degradation.
- Known fragility of reclaimed surface mine ground.

Contributing Factors

- Lack of tax base – and municipal funds.
- Lack of training for county employees.
- A joy of “mudding” on county roads.

(c) Sanitary Sewer Systems

Problem

Combined Sanitary and Storm Sewer systems in urban areas cannot handle current population densities, and release pollutants, including E. coli, chlorine, and suspended solids into surface waters.

Discussion

In urban areas within the watershed, storm water run-off from roofs, parking lots, and streets empties into the same system that carries household wastewater to sewage treatment plants.

These sewer systems were typically built before the mid-20th century and disposed of household wastewater by simply discharging it into rivers and streams. Because of concern for water quality and public health, cities built sewage treatment plants to treat wastewater before discharging it. New sewer lines were constructed to carry household wastewater to these treatment plants and diversion dams were built in old sewer lines to divert sewage into the new system and prevent it from discharging directly into streams… *except during rain.*

The old outfalls were left in place to act as “relief valves” to prevent sewage from backing up into homes during storms. Rain events increase the volume of water in the system, which then overtops the diversion dams, allowing raw sewage to flow into surface streams.

In addition, old sewage treatment plants are over-taxed, resulting in release of pollutants into surface streams. As noted in *Table IV-1 NPDES Permit Violations*, page 87, these older WWTPs have experienced exceedingly large numbers of violations. Point-source concerns in the areas near Sullivan, Dugger, Carlisle, Hymera, Farmersburg, and Shelburn should be noted.

Support

- NPDES violations for dissolved oxygen, biochemical oxygen demand, E. coli, total suspended solids, residual chlorine, and ammonia. (See *Table IV-1 NPDES Permit Violations*, page 87)
- BCWP sampling which indicated high levels of E. coli, low dissolved oxygen, and high suspended solids levels downstream from the town of Sullivan. (BCWP Site #8)

<u>Contributing Factors</u>

- Money – although municipalities have agreements with IDEM to correct sanitary sewer discharge, all are struggling to find funds for engineering and construction.
- Time – Agreements with IDEM to correct CSOs extend for decades.

(d) Stormwater Systems

<u>Problem</u>

Municipal stormwater systems cannot handle the amounts of surface run-off, resulting in flooding during heavy rain events and subsequent negative impacts on surface water and habitat quality.

<u>Discussion</u>

Imperviousness of parking lots, roofs, streets, sidewalks does not allow absorption of rain or melting snow. Even lawns, sloped to encourage run-off, do not rapidly absorb precipitation.

Stormwater systems in the watershed are not equipped to handle current volumes – streets, homes, and houses have been subject to minor flooding during 1-2" rain events. Removal of riparian corridors and wetlands contributes to water quality degradation because water that reaches surface streams through ditches and sewers is no longer slowed nor filtered by those ecosystems.

- Stream velocities are substantially amplified, increasing stream bank erosion and channelization.
- Pollutants, including road salts, oils, and chemicals are carried by run-off to streams
- Stream bank erosion and channelization contribute to turbidity and total suspended solids levels.

<u>Support</u>

- Visual documentation
- Flood-related costs incurred by municipalities.
- Storm event sampling shows increased turbidity and levels of total suspended solids. See Appendix A – BCWP Sample Data.

5.07 Private Waste Disposal

(a) Dumping of Refuse

<u>Problem</u>

Illegal dumping along roadsides and directly into waterways creates biological, environmental, and safety hazards.

<u>Discussion</u>

Household waste and animal carcasses thrown over bridges or into roadside ditches present biological hazards from decaying materials and associated rodent populations. Refuse thrown into creeks foul water supplies for wildlife.

Household chemicals and components in appliances or computers may be a source of toxic wastes. In addition, discarded methamphetamine labs are considered to be hazardous waste sites.

Dump sites become safety hazards for landowners, tenants, and others utilizing the land or cleaning up the site. Costs associated with illegal dumping are two-fold:

- Costs associated with clean-up
- Loss of property value

Support
Visual documentation.

Contributing Factors
- A common local view that mined property is wasteland owned by rich companies that have/are raping the land without recourse – and dumping of refuse is fair game.
- The practice of dumping in ditches, off bridges, etc. is cultural based: *a practice learned from parents.*
- The cost of garbage removal is either too much for poverty-stricken residents or seen as an unnecessary expense.

(b) Private Septic Systems

Problem
Raw waste emitted from failing, improperly maintained, or improperly installed private septic systems enters surface waters resulting in excessive nutrient loads and E. coli content that far exceeds State standards.

Discussion
E. coli levels exceeded the 235 MPN State of Indiana standards for recreation activity at all BCWP testing sites. Levels at some sites were over 2,400 MPN.

The overall condition of surface waters are severely degraded by septic pollution.High levels of E. coli not only make waters unsafe for wading, but can make creeks toxic to livestock and wildlife as water sources. High nutrient loads contribute to algal blooms and resulting low dissolved oxygen levels. Embeddedness resulting from deposition of solid wastes destroys habitat.

Thirty-five percent of all dwellings lie outside towns serviced with municipal septic systems. Ninety percent of those structures are over 20 years old. Private septic systems over the age of 20 years can generally be considered to be in a failing condition due to lack of maintenance. Improper installations exacerbate this problem. Some systems discharge into surface waters – and some homes “straight pipe” effluent through farm field tiles or into ditches and streams. In addition, there is much anecdotal evidence of private septic systems draining to areas of subsidence – voids left by collapse of underground mine structures. In fact, in the 1930’s, a sewage system (since closed) was installed in Shakamak Park by “drilling a well-like hole 200 feet down to connect with the old workings of an abandoned mine.

Further compounding the issue is a high occurrence of swelling clays in the watershed. Complete saturation occurs early in swelling clays, closing pore space and minimizing penetration. Traditional septic systems are not meant to be used in these soil types – yet few alternative septic methods (mound, composting, incinerating, etc) are utilized.

New septic systems are rarely inspected and often fall below accepted standards for new construction: allowing “trickle” pipes to emit grey and black water into streams. There is anecdotal evidence of installation of “straight pipe” systems, often routed through agricultural drainage tile systems.

Support
- Results of E. coli testing by BCWP indicate 75% of all test sites (71% of rural sites) exceed State of Indiana standards for recreation.
- Documented odor of raw human waste at multiple test sites.

Contributing Factors
- New septic systems are rarely, if ever, inspected by Health Department officials.
- New homeowners are often unaware of acceptable standards – or if their systems meet those standards.
- Over 90% of houses are over 20 years old. The majority of those on private septic have never performed septic maintenance.
- Poverty levels prohibit household expenditures on septic maintenance or repair.

(c) Unlicensed Scrap Yards

Problem

Collections of vehicles and refuse on private property can be a source of surface soil and water contaminants and lower surrounding property values.

Discussion

Unlicensed scrap yards on private property are not inspected by IDEM or other regulatory agencies. Vehicles are typically not drained of fluids. Fuel, oil, antifreeze and other liquids/lubricants contaminate surface soils and may enter creeks and streams through surface run-off.

Visual impact of multiple, unfenced, and unscreened yards devalues nearby properties.

Support

Visual documentation. Repeated legal judgments against individuals.

Contributing Factors

"This is my land and I can do anything I want with it."

5.08 Other

In addition to the concerns listed above, some water quality issues have been recognized, but an associated source or practice has not been identified as of this writing.

(a) Metals Levels in Non-mining Areas

High levels of Aluminum and Iron have been found in areas in the watershed where neither high numbers of mine sites nor widespread mining has been known to exist. Source theories include:

- Soil losses from agricultural areas which have a naturally high metals content.
- The presence of undocumented AML sites with concentrated drainage into surface waters.

5.09 Summary – Areas of Concern

Each of the Areas of Concern outlined in this section leaves a "fingerprint" on surface water quality. Just as a doctor uses symptoms to identify a disease, water quality impairments can be used to identify an area of concern. *Table V-1 – Parameters Associated with Concerns* provides a key between the Areas of Concern identified in this section and their associated impairments (parameters).

For example, areas impacted by acid mine drainage are likely to exhibit poor habitat quality. Macroinvertebrates are fewer in number, less diverse and higher tolerance of pollutants than those found in healthy streams. Close to the source, pH will be low. Metal concentrations and total dissolved solids are typically high.

Table V-1 – Parameters Associated with Concerns

	Parameter																		
Concern	Habitat Quality	Macroinvertebrates	Impaired Biotic Communities	Temperature	Dissolved Oxygen	pH	Turbidity	Total Suspended Solids	Total Dissolved Solids	E. Coli	Nitrogen, as NH3	Nitrogen, as N02-N03	Total Phosphorus	Aluminum	Iron	Copper	Manganese	Large-molecule chemicals	Surface Water Run-off
Abandoned Mine Lands																			
Acid Mine Drainage	●	●	●			●			●					●	●	●	●		
Altered Topography and Hydrology	●																		●
Invasive Plant Species	●																		
Active Mineral Extraction																			
Coal Mines	●		●	●			●	●											
Oil & Gas Wells	●	●					●	●											
Agriculture - Commodity Crop Production																			
Soil Erosion	●	●	●	●	●		●	●					●	●					
Farm Chemicals	●	●	●															●	
Fertility Programs	●	●	●	●	●			●			●	●	●						
Lack of Riparian Buffer Zones	●	●	●	●	●		●	●			●	●	●					●	●
Agriculture - Livestock																			
Manure Applications	●	●	●	●	●		●	●		●	●		●						
Pasture Management	●	●	●	●	●		●	●		●	●		●						
Unlimited Stream Access	●	●	●				●	●		●	●								
Logging / Land Clearing	●	●	●	●	●		●	●					●						
Lawn / Landscaping	●	●	●	●	●		●	●			●	●	●					●	●
Municipal Infrastructure																			
Impervious Surfaces	●	●	●	●															●
Road & Ditch Maintenance	●	●	●	●	●		●	●						●					●
Sanitary Sewer Systems	●	●	●	●	●		●	●		●	●		●						
Stormwater Systems	●	●	●				●	●											●
Private Waste Disposal																			
Dumping of Refuse	●		●															●	
Private Septic Systems	●	●	●	●	●		●	●		●	●		●						
Unlicensed Scap Yards	●		●															●	
Metals in Non-Mining Areas	●	●	●						●					●	●	●	●		