Section 2, Chapter 1
Concerns, Goals, and Targets

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Introduction

Chapter 1 details the process of stakeholders and technical advisors identifying concerns about the watershed, goals and a vision in addressing these concerns, and tangible targets for reaching stated goals. The following Chapters in Section 2 provide guidance for meeting these goals and objectives.

Enjoyments and Concerns

Watershed planning gave participants the opportunity to come together to share their enjoyments and concerns and consider how they could collaborate toward solutions to common issues. As a past example, Lake Carroll Association helped pay for the cost share programs of upstream agricultural producers in the 1980s and 1990s, which in turn benefitted the lake. Most of the agricultural producers in the watershed interact with Lake Carroll in some capacity, whether by having homes on the lake or family within the Lake Carroll Association. As such, the group of producers and homeowners had a similar list of enjoyments within the watershed, including little car traffic, presence of wildlife, quietness, stargazing, and how the area encouraged quality time with family. In terms of the lake, stakeholders valued water clarity with visibility to about 20 feet in the lake. Other activities many stakeholders enjoyed included boating, fishing, golfing, skiing, tubing, wake surfing, ATV riding, bicycling, and horseback riding.

The group also had concerns for the watershed. For instance, stakeholders foresaw negative repercussions if no action was taken at all to filter and decrease runoff. Even if action was taken, they might still be subjected to more runoff than in the past due to seemingly more frequent, more intense storm events. They discussed obstacles to overcome, which included misinformation, apathy of Association members, and lack of funds. They identified issues of algae blooms, blue-green algae, excessive aquatic plants like milfoil, nuisance geese, pet waste, beach closings, excessive pollutants, and litter in the lake and along the trails. Other potential issues they decided to research were if cattle had stream access and what fertilizer application practices the golf course uses.

Many of these concerns were related to excess nutrients and sediment reaching the lake. Nitrogen and phosphorus naturally occur as nutrients in aquatic systems; however, human activities, both rural and agricultural, have greatly increased the amounts that occur. Too much of these nutrients causes significant jumps in algae growth, which negatively impacts water quality, reduces or eliminates oxygen within the water, harms food resources, degrades aquatic habitats, and can eventually cause algal blooms. Some algal blooms produce toxins and promote bacteria growth, which can harm humans who encounter the water (EPA, Nutrient Pollution: The Issue).

Considering these concerns, the group brainstormed practices that could improve the quality of the lake and streams. They considered cleaning boats prior to launching them, bagging and removing grass clippings and leaves, slowing water runoff rate and installing areas to settle out runoff for filtering pollutants out and reducing flooding, and lining streambanks and shorelines with filter strips and buffer strips. With each practice they considered how it would withstand 100-year and 500-year floods that seemed more common than in the past. They agreed on the importance of education and change in habit and culture.

Vision

In making the improvements, stakeholders envisioned a future watershed with reduced algae problems, managed native aquatic plants, a boat cleaning station, and partnerships and cooperation amongst the community. In doing so, they imagined protected wildlife, preserved serenity, reduced damage from dramatic storms, and a maintained recreational and residential community surrounding Lake Carroll.

Stakeholders discussed their future visions and hopes for the watershed. They voiced their desire to keep streams and lakes clean, preserve topsoil, improve the serenity and beauty of the land and water, and build a healthier ecosystem to sustain wildlife, including hunting and fishing game species. They anticipated a better understanding between the agricultural, residential, and recreational communities. The resulting vision statement captured these desires:

"Maintain and improve the agricultural, residential, and recreational community through mutual cooperation by sustaining and improving all uses of the land and water within the watershed so that all obtain the maximum benefit."

Goals

After stakeholders created the vision statement, they discussed specific goals for the watershed that could lead to the fulfillment of the vision. They wanted to take care of the land in order to take care of the water. They recognized that reducing damage from dramatic storms would in turn retain topsoil, keep water clean, and improve wildlife habitat. The resulting five goals captured the most important elements needed to achieve the vision:

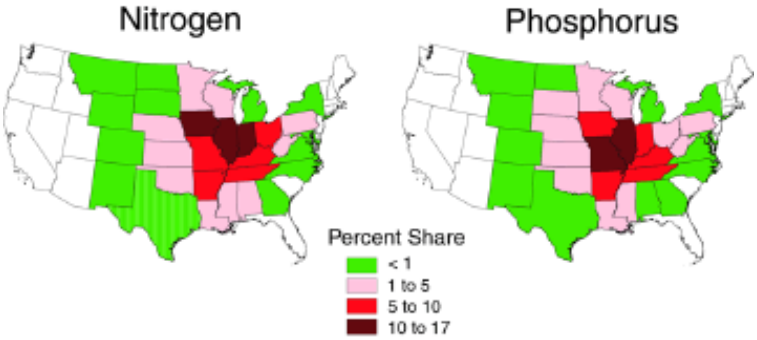
"Take care of the land to take care of the water."

- Goal 1: Reduce sediment loading from all sources in the watershed.
- Goal 2: Reduce nutrient loading from all sources in the watershed.
- Goal 3: Utilize practices that protect and/or enhance wildlife habitat.
- Goal 4: Address volume and velocity of water runoff to enhance water quality.
- Goal 5: Educate the watershed community about land and water conservation and this plan.

These overarching goals encompass the concerns for the watershed, facilitate enhancement of East Fork Creek water quality, and compliment the goals of the Illinois Nutrient Loss Reduction Strategy, which calls on Illinois to address the concerns associated with algal blooms and other negative water quality issues resulting from excess nutrients within the Mississippi River Basin, of which Illinois is a part.

Illinois is one of 12 states in the Mississippi River Basin included in the U.S. EPA's 2008 Gulf Hypoxia Action Plan. This plan calls on the 12 states to develop a strategy to reduce the amount of phosphorus and nitrogen carried to the Gulf of Mexico. Excess nutrients from these states have led to an aquatic life "dead zone" that stretches for thousands of miles. The goals of the Gulf Hypoxia Action Plan are to reduce the amount of total phosphorus and nitrogen by 45%, reduce nutrient loading to the Gulf of Mexico, and reduce the Gulf of Mexico hypoxic zone to 1,930 square miles. Illinois is one of the primary contributors of nitrogen and phosphorous to the Gulf of Mexico by contributing a 10-17 percent share (see *Figure 1.1)*.

Figure 1.1 State Percentage Share of Nitrogen and Phosphorous Contribution to Gulf of Mexico



(USGS, https://water.usgs.gov/nawqa/sparrow/gulf_findings/faq.html)

As a response to the U.S EPA's Gulf Hypoxia Action Plan and an overall concern for Illinois' water quality, Illinois EPA developed the Nutrient Loss Reduction Strategy, or NLRS. The NLRS outlines best management practices to reduce nutrient losses from point sources, urban stormwater, and agricultural nonpoint sources. It uses scientific assessments to target the most critical watersheds and to build upon existing state and industry programs. The goal is to reduce the amount of total phosphorus and nitrate-nitrogen reaching Illinois waters by 45% while also considering land uses and cost-efficiency. A NLRS Report was adopted and publicly released on July 21, 2015, and established 2025 interim milestone goals of reducing phosphorous loads by 25% and nitrogen loads by 15%. The 2015-2017 Biennial Report documents NLRS progress, including the tracking of staff and funding, outreach, land use changes and facility updates, and load reductions (*Nutrient Loss Reduction Strategy-NLRS: past, present, and future)*. In comparing numbers from eight major Illinois rivers from 1980-1996 to data from 2011-2015, Illinois has reduced nitrate-nitrogen by 10% and increased phosphorous by 17% (Drs. Mark David, Greg McIsaac, Corey Mitchell, University of Illinois at Urbana-Champaign in *Nutrient Loss Reduction Strategy-NLRS: past, present, and future*).

> "The Illinois Farm Bureau supports the NLRS because it relies on education, outreach and voluntary incentive-based practices to fulfill agriculture's role in reducing nutrient losses."
>
> ~Lauren Lurkins, Director of Natural and Environmental Resources- Illinois Farm Bureau.

In order to reach sediment and nutrient reduction goals, stakeholders would need to meet the targets outlined below.

Targets

We wish to decrease levels of nutrients and sediment within Lake Carroll and East Fork Creek. When applicable, these targets were correlated to the Illinois Nutrient Loss Reduction Strategy, Illinois Environmental Protection Agency General Use Water Quality Standards (IEPA, 2018) and the nearby TMDL study of the Pecatonica River (Tetra Tech and Fluid Clarity, 2014).

We identified reduction targets specific to nutrients and sediment as described below.

Nutrient Load Reduction Targets

Limiting phosphorus and nitrogen will improve the overall health of the lake and streams and reduce nuisance algae blooms. Although phosphorous and nitrogen are essential components of the aquatic food web, through development, agriculture, and lawn care, humans have greatly increased the amount of phosphorous and nitrogen input into water systems. In fresh waters and in the right conditions, even a miniscule jump in phosphorous can cause a negative ripple effect on many other factors, including algae blooms, enhanced plant growth, decreased levels in dissolved oxygen, and the death of certain fish, invertebrates, and other aquatic animals (USEPA, 2012). Specifically, we wish to keep inorganic nitrogen concentration levels at or below 0.3 mg/l and orthophosphate concentration levels consistently at or below 0.01 mg/l but only propose a target related to orthophosphate. See Nitrogen Reduction Targets section below for explanation on why no nitrogen targets are proposed at this time.

Phosphorus Reduction Targets

To determine targets for phosphorus reduction, we referenced a TMDL (Total Maximum Daily Load) report, IEPA standards, and the Illinois Nutrient Loss Reduction Strategy to adopt total phosphorus load targets and general guidelines for orthophosphate load reductions for nearby lakes and streams.

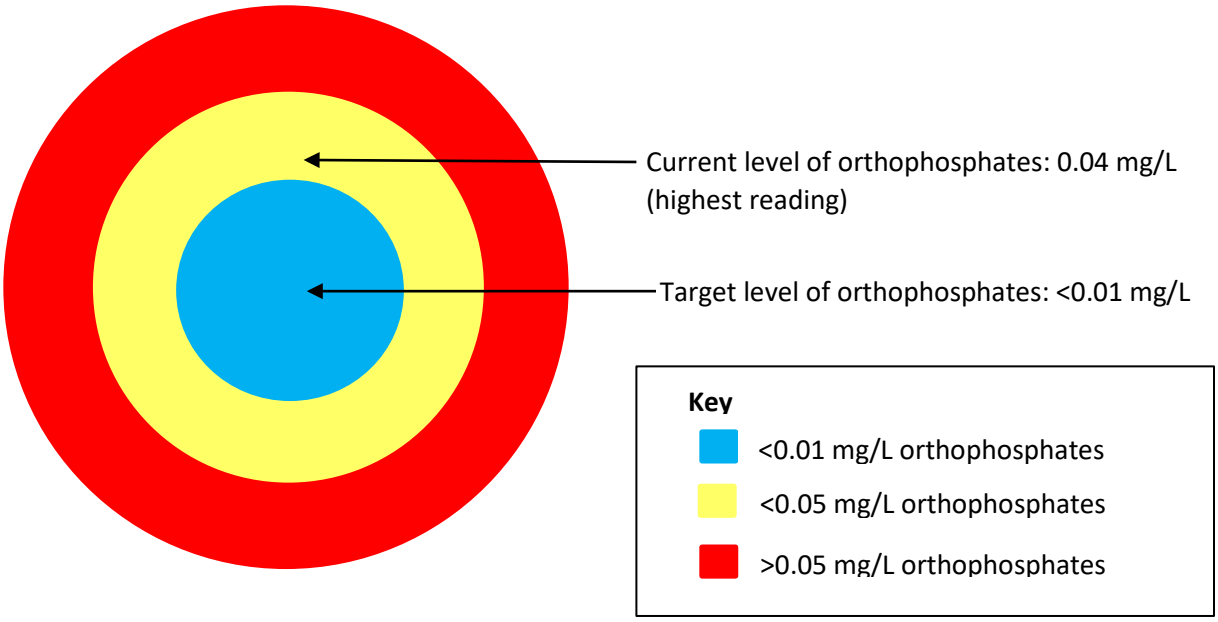
For total phosphorus, stakeholders already maintain a target of 0.05 mg/L for lakes according to the General Use Water Quality Standard (IEPA, 2018). The Pecatonica River TMDL for Ecoregion 54 recommended a stream water quality target of 0.0725 mg/L (Tetra Tech and Fluid Clarity, 2014). Over long-term study involving 14 total phosphorus samples between 1995 and 2016, Lake Carroll consistently met the 0.05 mg/L state standard. No baseline monitoring was conducted on East Fork Creek.

Orthophosphate is the inorganic form of phosphorus in a form ready for uptake by plants and algae (USEPA, 2012). Orthophosphate typically represents 60% to 70% of total phosphorus, with the remaining portion mostly being organically bound phosphorus. This organically bound phosphorus can be converted to orthophosphate by biological processes (Commonwealth Engineers, 2017). During a five-year study with five samples, Lake Carroll exhibited orthophosphate levels of 0.04 mg/L twice, once in 2009 and again in 2011, with levels less than 0.01 mg/L during the other three years (ILM, 2016). Issues with algae blooms would decrease if orthophosphate levels in the lake were less than 0.01 mg/L (ILM, 2016) a guideline not consistently met at Lake Carroll. If orthophosphates in the waterways decreased, total phosphorus levels would also decrease.

Stakeholders recognized the need to reduce orthophosphate in order to diminish the frequency and intensity of algae blooms in Lake Carroll. Due to the availability of predictive models for total phosphorus plus the relationship between total phosphorus and orthophosphate, we chose to focus

targets for total phosphorus only. Doing so would result in the reduction of both total phosphorus and orthophosphate. *Figure 1.2* depicts current levels and target levels of phosphorous in Lake Carroll.

Figure 1.2 Phosphorous Targets for Lake Carroll



Stakeholders adopted to maintain the total phosphorus general use standards of 0.05 mg/L for lakes and 0.0725 mg/L for streams and to reduce total phosphorus by 25% in order to more consistently meet the guideline of 0.01 mg/L of orthophosphates for lakes. This reduction target is also the interim phosphorus reduction target of the Nutrient Loss Reduction Strategy for Illinois. This percent reduction target represents what can reasonably be expected by this community's effort within the next ten years. *Table 1.1* outlines these water quality targets for phosphorous and orthophosphates.

We propose to decrease total phosphorus by 25%, which will also result in reduction of orthophosphate.

Table 1.1 Lake Carroll Stream and Lake Water Quality Targets for Phosphorous and Orthophosphate

Load Reduction Parameter	**Stream Water Quality Targets**	**Lake Water Quality Targets**
Total Phosphorus	0.0725 mg/L	0.05 mg/L
Orthophosphate	N/A	0.01 mg/L

Nitrogen Reduction Targets

To determine targets for nitrogen reduction for nearby lakes and streams, we referenced the same resources used for phosphorus (TMDL report, IEPA standards, and the Illinois Nutrient Loss Reduction Strategy). We considered total nitrogen and inorganic nitrogen, which is most readily available to plants and algae. Total nitrogen in Lake Carroll consistently fell under the 15 mg/L General Use Water Quality Standard for total ammonia nitrogen (IEPA, 2018) when measured over a period of five years from 2009 to 2016 (ILM, 2016).

Inorganic nitrogen in the form of nitrate (NO3-N) and nitrite (NO2-N) above 0.30 mg/L can promote algae blooms (ILM, 2016). The inorganic nitrogen concentration at Lake Carroll was highly variable from one sample to the next. Six samples taken between 2007 and 2016 averaged 3.47 mg/L of nitrate-nitrite, which is much higher than the level that could cause an algae bloom. However, during the same sampling period, the algae growth in Lake Carroll was known to be limited by phosphorus, so higher nitrate-nitrite levels would not affect algae growth so long as this remains true. At this time, we recommend focusing on phosphorus load reductions, which will also result in nitrogen load reductions. If at any point the lake switches to a nitrogen-limited system, we recommend revisiting reduction targets for nitrogen. While focusing on reducing phosphorus loads, we can expect to also see a reduction in total nitrogen of 15%, which is the interim standard of the Nutrient Loss Reduction Strategy for Illinois.

We expect to see a reduction of 15% total nitrogen complimentary to phosphorus load reductions, which will also result in reduction of inorganic nitrogen.

Sediment Reduction Targets

Sedimentation, siltation, and total suspended solids were all known causes of impairments to the Plum River, downstream of East Fork Creek (IEPA, 2018). As of 2018, there were 94,000 cubic yards of sediment collected in Lake Carroll (Lake Carroll Association, 2018) hindering the enjoyment of the lake. Contrary to this, water clarity is very good, given the depth of the lake and other factors of lake health putting it in a mesotrophic state. While the Lake Carroll Association works on removing sediment from the lake, the objective of this plan is to prevent sediment from entering the lake. There were no General Use Water Quality Standards for total suspended solids or sediment (IEPA, 2018) and no sediment-related targets in the Nutrient Loss Reduction Strategy. The Pecatonica River TMDL Study recognized a target of a median surface concentration less than 3 mg/L of nonvolatile suspended solids to address aesthetic quality impairments (Tetra Tech and Fluid Clarity, 2014). An objective of this plan is to reduce sediment loading to the extent practicable in order to lessen the need for future dredging and improve

We anticipate reasonable efforts to relieve 25% of the sediment loading into Lake Carroll and East Fork Creek.

aesthetic enjoyment of the lake. We anticipate that reasonable efforts taken within the next ten years will reduce sediment loading into streams, ponds, and the lake by 25%.

Limitations of Reduction Targets

Some issues within the watershed were considered yet not chosen as targets for this plan: reducing fecal coliform, improving dissolved oxygen, and controlling zebra mussels within Lake Carroll. Improving dissolved oxygen levels so that they measure at or above 5 mg/l near the lake bottom would aid in overall lake health and ecological function related to nutrients and organic material, although not addressed by this plan. We acknowledge a zebra mussel infestation, although we did not address zebra mussel control in this plan. The Lake Carroll Association is taking efforts to control zebra mussels by replenishing mussel-eating fish, such as pumpkinseed sunfish reared in their hatchery pond, a project that already has five years longevity. Fecal coliform is a known cause of impairment to the Plum River downstream of East Fork Creek. The Illinois General Use Standard for fecal coliform stated that the mean of five samples taken within 30 days was not to exceed 200 counts per 100 ml (IEPA, 2018). There was no known monitoring of fecal coliform within the East Fork Creek Watershed. Fecal coliform reduction also could not be estimated using predictive models. Since we do not have a method of tracking fecal coliform levels, although we know that fecal coliform will be reduced with recommended best management practices, we have not set a target for fecal coliform reduction.

Agricultural Runoff versus Residential Runoff

It is a common misconception that agricultural production is the main cause of water quality degradation. This is probably due to the visibility of both the vast expanses of agriculture in the Midwest and the significant degradation of streams and lakes. However, it is well documented that impervious cover like roads, rooftops, driveways, and sidewalks have more of a negative impact on water quality than agriculture. All of these impervious surfaces are found in much greater abundance within residential areas. Even watersheds with as little as 6% of impervious cover can start to show measurable degradation of the biological, hydrologic, and geomorphic conditions of its streams, although various studies have found that this minimum can be as high as 20% based on site-specific variables (EPA, 2011).

It is also well known that acre for acre, residential and commercial development have the highest pollutant runoff, with agricultural production as a close second, as indicated by the Event Mean Concentration (EMC) values documented by the EPA and other sources and used in our pollutant load reduction modeling estimates. As watersheds undergo urbanization, developers convert previously vegetated areas to impervious surfaces, i.e. driveways, roadways, parking lots, homes, and corporate/industrial buildings. Impervious surfaces do not allow precipitation to infiltrate into the soil and therefore cause runoff accumulation and flooding. Areas with residential, commercial, and industrial development have more impervious surfaces than agricultural areas, and these impervious surfaces result in more runoff traveling in a concentrated flow. When water quickly runs off impervious surfaces into lower drainages areas or storm drains, it not only causes flooding but also does not allow slow infiltration through the soil. One of nature's ways of filtering out pollutants in precipitation is through soil infiltration. Humans are removing this natural step of filtration by increasingly utilizing impervious surfaces. Moreover, more development results in more pollutant accumulation onto these impervious surfaces. When stormwater flows over these surfaces, it collects pollutants like automobile petroleum by-products, deicing salts, fertilizers, pesticides, pet waste, metals, and sediment and then empties it into the nearest stream, lake, or other waterway. Even areas that are left undeveloped and vegetated may have compacted soils from surrounding development activities. Compacted soils make it difficult for precipitation to infiltrate soil.

Although agricultural areas do have runoff and erosion problems, generally the amount of runoff will be less on agricultural lands than on developed, residential lands. Although agricultural lands may have bare soil or compacted soil at times (especially if conventional till and no cover crop practices are used), they have much less impervious surfaces and concentrated water flows. Although there may be agricultural erosion and runoff concerns, there are more opportunities for precipitation to infiltrate into the soil.

The runoff coefficient, (C), is a value ranging from zero to one that considers the relation between the amount of precipitation and the amount of resulting runoff within a watershed (Water Boards, 2011). Other factors considered and displayed in *Figure 2.1* are soil type, slope, permeability, and land use. A high runoff coefficient means higher runoff and lower infiltration, potentially resulting in flash flooding during storms. Low runoff coefficients have lower runoff rates and higher infiltration. Larger, densely vegetated areas with flat slopes and permeable soil will have the lowest runoff coefficients because they have less impervious pavement. The runoff coefficient increases as impervious surfaces increase, clay content in soil increases, and slope steepens. The different soil groups (Group A, B, C, and D) in the charts below are categorized based on U.S. Soil Conservation Service (SCS) soil identifications and soil infiltration rates. According to *Figure 1.3*, the runoff coefficient for farmland is always less than the runoff coefficient for residential areas, regardless of residential acreage, soil type, or slope.

Figure 1.3 Runoff Coefficient

	Runoff Coefficient, C					
	Soil Group A			Soil Group B		
Slope :	< 2%	2-6%	> 6%	< 2%	2-6%	> 6%
Forest	0.08	0.11	0.14	0.10	0.14	0.18
Meadow	0.14	0.22	0.30	0.20	0.28	0.37
Pasture	0.15	0.25	0.37	0.23	0.34	0.45
Farmland	0.14	0.18	0.22	0.16	0.21	0.28
Res. 1 acre	0.22	0.26	0.29	0.24	0.28	0.34
Res. 1/2 acre	0.25	0.29	0.32	0.28	0.32	0.36
Res. 1/3 acre	0.28	0.32	0.35	0.30	0.35	0.39
Res. 1/4 acre	0.30	0.34	0.37	0.33	0.37	0.42
Res. 1/8 acre	0.33	0.37	0.40	0.35	0.39	0.44
Industrial	0.85	0.85	0.86	0.85	0.86	0.86
Commercial	0.88	0.88	0.89	0.89	0.89	0.89
Streets: ROW	0.76	0.77	0.79	0.80	0.82	0.84
Parking	0.95	0.96	0.97	0.95	0.96	0.97
Disturbed Area	0.65	0.67	0.69	0.66	0.68	0.70

Rational Method Runoff Coefficients - Part I

	Runoff Coefficient, C					
	Soil Group C			Soil Group D		
Slope :	< 2%	2-6%	> 6%	< 2%	2-6%	> 6%
Forest	0.12	0.16	0.20	0.15	0.20	0.25
Meadow	0.26	0.35	0.44	0.30	0.40	0.50
Pasture	0.30	0.42	0.52	0.37	0.50	0.62
Farmland	0.20	0.25	0.34	0.24	0.29	0.41
Res. 1 acre	0.28	0.32	0.40	0.31	0.35	0.46
Res. 1/2 acre	0.31	0.35	0.42	0.34	0.38	0.46
Res. 1/3 acre	0.33	0.38	0.45	0.36	0.40	0.50
Res. 1/4 acre	0.36	0.40	0.47	0.38	0.42	0.52
Res. 1/8 acre	0.38	0.42	0.49	0.41	0.45	0.54
Industrial	0.86	0.86	0.87	0.86	0.86	0.88
Commercial	0.89	0.89	0.90	0.89	0.89	0.90
Streets: ROW	0.84	0.85	0.89	0.89	0.91	0.95
Parking	0.95	0.96	0.97	0.95	0.96	0.97
Disturbed Area	0.68	0.70	0.72	0.69	0.72	0.75

Rational Method Runoff Coefficients - Part II

Source: Knox County Tennessee Stormwater Management Manual

The projects and practices already implemented in and recommended for the East Fork Creek Watershed considered both agricultural and residential settings. With more agricultural land than residential land in the watershed, both are important in reducing sediment and nutrients in order to meet the goals of the plan. Some residential lots at Lake Carroll are greater than one acre.

This plan is conducted at the conceptual level. As such, we used readily available land use data with categories of open space, low density development, and medium density development to define the residential portions of the watershed and estimate their pollutant loading to the streams. However, some of the lots at Lake Carroll Association are five acres in size, and many have not yet been

developed. Without calculating the impervious area of each lot, it is possible that the pollutant loads reported from these areas may be overstated compared to actual, current conditions. This data was used in the Watershed Resource Inventory to compare pollutant loading from the subwatersheds and to prioritize areas of opportunity within this plan. It was not used to estimate the benefits that would be realized from implementing the recommended best management practices.

In order to achieve the chosen targets, the stakeholders of the watershed, members of Lake Carroll Association, and consultants considered best management practices that were both effective and likely to be implemented by watershed residents and producers. These best management practices are discussed within the next chapter of this plan.