KEY CONCEPTS

1. Key pollutants of concern have been identified
   Nitrogen, phosphorus, sediment and pathogens have been identified as the most important pollutants to address with this plan. These pollutants pose risks to human health and the environment, which are outlined within this chapter in greater detail. Strategies to prevent increases in stormwater rates and volumes also need to be considered, as stormwater tile flow and runoff are the largest carriers of these pollutants to the receiving streams. Local flooding has also caused damage to private property and infrastructure.

2. Water quality monitoring data is valuable
   Data collected by the Iowa Soybean Association / Agriculture’s Clean Water Alliance (ISA/CWA) and the IOWATER volunteer monitoring program has been valuable to identify pollutant loads and their potential sources.

3. Nutrient levels appear higher in rural areas
   Monitoring data has demonstrated that levels of nitrogen and phosphorus compounds are usually seen at higher levels in the rural areas within this watershed.

4. Bacteria levels appear higher in urban areas
   Observed levels of E.coli bacteria have been much higher within the urban landscape, although levels all across the watershed were consistently above the state’s water quality standard.

5. Key sources of sediment loading
   Streambank erosion, construction sites and gully erosion are projected to be the leading current sources of sediment loading to Walnut Creek. Almost 30,000 tons of sediment per year are estimated to be delivered from the Walnut Creek watershed to the Raccoon River.

6. Small footprint, big impact
   Construction sites make up only 0.1% of the watershed on average each year, but contribute significantly to the overall sediment load.

HOW DO THESE CONCEPTS INFLUENCE DEVELOPMENT OF THE PLAN?
To develop targeted, effective solutions, the key pollutants posing the greatest risk need to be identified. The likely sources of these pollutants need to be identified so that effective practices can be implemented to achieve the desired load reductions.
Key Pollutants and Sources
**Pollutant Sources By Land Use**

<table>
<thead>
<tr>
<th>Land Use</th>
<th>N</th>
<th>P</th>
<th>Sediment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>14%</td>
<td>26%</td>
<td>7%</td>
</tr>
<tr>
<td>Cropland</td>
<td>81%</td>
<td>49%</td>
<td>10%</td>
</tr>
<tr>
<td>Pastureland</td>
<td>2%</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Forest</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Grasslands</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Gully</td>
<td>1%</td>
<td>5%</td>
<td>19%</td>
</tr>
<tr>
<td>Streambank</td>
<td>2%</td>
<td>10%</td>
<td>38%</td>
</tr>
<tr>
<td>Construction Site</td>
<td>1%</td>
<td>8%</td>
<td>25%</td>
</tr>
</tbody>
</table>

**Key Pollutants of Concern**

- Nitrogen
- Phosphorus
- Sediment
- Pathogens *(bacteria and viruses)*
- Runoff rates and volumes

8 loading reduction goals are outlined within this chapter.

**Agricultural Areas**

Nitrogen and phosphorus compounds have been measured at higher levels.

**Urban Areas**

Levels of bacteria have been at higher concentrations.

**Nitrates**

Highest measured concentration

\[
22.9 \text{ mg/L}
\]

More than twice the Raccoon River Total Maximum Daily Load (TMDL) standard of 9.5 mg/L.

(from Iowa Soybean Association monitoring data)

77,010 orgs./100mL was observed to be the maximum level of E.coli (indicator bacteria), which is more than 330 times the state’s allowable average concentration of 235 orgs./100mL.

Water Quality Monitoring Samples

- Collected by Iowa Soybean Association/Agriculture’s Clean Water Alliance and IOWATER volunteers
- Collected at two sites along Walnut Creek, every other week, throughout spring and summer
- IOWATER completed sampling at over 30 locations within the watershed, but more infrequently

Source: Results of STEPL modeling performed by RDG
Available monitoring data within the Walnut Creek watershed was reviewed to aid in the identification of pollutants of concern, potential sources of pollution and to help inform and calibrate watershed water quality models. Several sources of information were reviewed.

Pollutants of Concern

Key pollutants of concern within the Walnut Creek watershed have been defined by considering the following information gathered through development of this plan:

2. Review of past local and municipal watershed assessments and storm water infrastructure studies.
3. Collection of stakeholder input at WMA meetings, open houses and individual conversations.
4. An overview of the available water quality monitoring information collected from sites within the watershed.

Potential Impacts of the Identified Pollutants of Concern

This document identifies key sources of pollution and determines methods to reduce their impacts, both in this watershed and the downstream receiving waters. Reducing pollutant loads will require policy changes and implementation of practices requiring significant investment. To understand why such investments are necessary, it is important to realize the impact these pollutants have on health, the environment and local economic interests. (1)

Nutrients (Nitrogen and Phosphorus)

Nutrients like nitrogen and phosphorus exist in both surface and ground water under natural conditions. Their presence supports the growth of algae and aquatic plants, providing food and habitat for fish and other aquatic life within streams and lakes. Excessive algal growth can occur when the levels of these nutrients are too high. Algal blooms can block sunlight below the surface, clog fish gills, reduce habitat quality and diminish habitat. The death and decay of algae can lead to diminished oxygen levels, known as hypoxia. Oxygen levels can fall to a range where fish and other wildlife may be sickened or killed. As of 2013, there were 166 of these hypoxic “dead zones” that had been identified in and around the United States. The largest

<table>
<thead>
<tr>
<th>Pollutant of Concern</th>
<th>Reasons</th>
</tr>
</thead>
</table>
| Nitrate (Nitrogen)   | • The Raccoon River is listed as impaired by high nitrate levels, one of the reasons for development of the Raccoon River TMDL.  
• Nitrogen is one of the two key pollutants of concern listed within Iowa’s Nutrient Reduction Strategy.  
• Levels of nitrate have routinely been observed at monitoring sites within the watershed above the State’s water quality standard for the streams intended uses and above those levels established within the Raccoon River TMDL. |
| Phosphorus           | • Phosphorus is one of the two key pollutants of concern listed within Iowa’s Nutrient Reduction Strategy.  
• Levels of phosphorus have occasionally been observed at monitoring sites within the watershed above the State’s water quality standard for the streams intended uses and above those levels established within the Raccoon River TMDL. |
| Sediment             | • Insufficient construction site erosion control has been observed to be a significant source of sediment loading in certain locations.  
• Significant sediment deposition has been observed within channel areas of Walnut Creek and its tributaries.  
• Sediment loading has impacted the water quality and storage capacity of many ponds and lakes throughout the watershed, including Country Club Lake and Southfork Pond.  
• Depositing sediment has deflected and narrowed low flow paths, accelerating the horizontal movement of streams. This is leading to more significant streambank erosion, generating even higher sediment loads. |
| Pathogens            | • The Raccoon River and lower Walnut Creek are listed as impaired by high bacteria levels, one of the reasons for development of the Raccoon River TMDL.  
• Levels of indicator bacteria at monitoring sites within the watershed have almost always been observed above the State’s water quality standard for the stream’s intended uses and above those levels established within the Raccoon River TMDL. In many cases, these levels have been well above the established standards, indicating a potential risk to public health. |
| Stormwater Quantity (Runoff Volume) | • While not considered a pollutant directly, volumes and rates of stormwater runoff are observed to be well above those which would have been expected prior to agricultural and urban development. These changes to the hydrology of the watershed increase the risk of flooding, streambank erosion and act as a carrier for larger pollutant loads being delivered through and out of the watershed. |

Source:
1. http://www2.epa.gov/nutrientpollution/problem
of these areas was a 5,840 square mile area (approximately 10% of the size of the entire state of Iowa) in the Gulf of Mexico, largely attributed to nutrient polluted runoff received from the Mississippi River watershed (which includes the entire state of Iowa).

Excessive algal growth can also increase growth of bacteria and other human pathogens. In some cases, algae can form toxins which can cause rashes, stomach/liver illness, respiratory and neurological effects in humans. Direct exposure to this algae affects fish and other wildlife, with the toxic impacts being carried up the food chain if they are consumed by other animals. If toxic algae enter into the water supply stream, they can be converted into dioxins through the use of chemical disinfectants in the water treatment process. Risks to human health from dioxins include cancers, reproductive and developmental issues. (1)

Nitrate has been observed at elevated levels in stream flows within the Walnut Creek watershed. Des Moines Water Works’ main intake point for surface water from the Raccoon River is located just downstream of where Walnut Creek flows into that river. Nitrates have been known to cause illness and death of human infants when at high levels.

Blue baby syndrome can affect the elderly and bottle-fed infants, with those younger than three months being most at risk. High nitrate levels in drinking water supplies can be converted by the human body into nitrite. These react with red blood cells, reducing their ability to carry enough oxygen throughout the body. The mouth, hands or feet of the affected person may appear blue. Complications can include trouble breathing, diarrhea, vomiting, lethargy, loss of consciousness and seizures. Extreme cases may be fatal. (2)

For this reason, Water Works employs a state of the art nitrate removal system, which is used when elevated levels of nitrate are detected in the source water. This system is expensive to operate and maintain, costing $7,000 per day to operate. From December 2014 to July of 2015, DMWW spent more than $1,500,000 to remove nitrate from the water. The cost of this operation is being transferred to residents and local businesses through annual water use rate increases.

Sources:
1. World Health Organization (www.who.int/water_sanitation_health/diseases/cyanobacteria/en/)

### Possible Sources of Nutrient Pollution

<table>
<thead>
<tr>
<th>Possible Sources of Nutrient Pollution</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wastewater Treatment Plant</td>
<td>Dallas Center’s wastewater treatment facility is located within this watershed. Point sources such as these are permitted through the Iowa Department of Natural Resources and are required to provide treatment of wastewater to lower pollutant loads to acceptable levels.</td>
</tr>
<tr>
<td>Leaking Sanitary Sewer Systems</td>
<td>Untreated wastewater can exfiltrate, or leak out from gaps or cracks in sanitary sewer mains, structures and connection points. This most commonly occurs in older systems, if they are not regularly inspected or maintained. Communities often have a program of regular inspections to address this issue.</td>
</tr>
<tr>
<td>Septic Systems</td>
<td>System failures related to improper design, age or lack of maintenance can lead to overflows or leakage into shallow groundwater layers.</td>
</tr>
<tr>
<td>Confined Animal Feeding Operations</td>
<td>These are point sources and require operation permits by the State. Wastewater is collected in lagoons and applied in the surrounding area following a manure management plan.</td>
</tr>
<tr>
<td>Pastures</td>
<td>Loading can be higher where livestock has direct access to streams, or there is little buffer between the pastureland and the stream.</td>
</tr>
<tr>
<td>Fertilizer and Manure Applications</td>
<td>Pollutant loadings can be affected by application rates, season, timing of rainfall events and application close to streams where adequate buffers are absent.</td>
</tr>
<tr>
<td>Legume Fixation</td>
<td>Process where crops such as soybeans convert nitrogen in the atmosphere to nitrogen compounds. A portion of the amount converted often remains in the soil and can be transported into groundwater or tile drainage.</td>
</tr>
<tr>
<td>Tile Drainage</td>
<td>More efficiently drains shallow groundwater from agricultural fields. This groundwater often contains elevated levels of nutrients.</td>
</tr>
<tr>
<td>Lawn Fertilizer Applications</td>
<td>Nutrient content, irrigation, overspray onto paved surfaces or streams and rainfall events following application can influence the amount of nutrient loading from this source.</td>
</tr>
<tr>
<td>Pet and Yard Waste</td>
<td>Fecal matter from pets and decomposing yard waste such as lawn clippings, leaves and garden waste. These materials are sometimes not collected appropriately, or in some cases are dumped directly into the storm sewer system or streams.</td>
</tr>
<tr>
<td>Wildlife</td>
<td>Sources include fecal matter from ducks, geese, other birds, deer, raccoons, other rodents, feral cats and dogs.</td>
</tr>
<tr>
<td>Car wash detergents</td>
<td>Car wash detergents contain high levels of phosphates. Most commercial car washes have systems which collect polluted wash water, however washing of vehicles in parking lots and driveways could allow these detergents to be washed into the storm sewer system.</td>
</tr>
<tr>
<td>Atmospheric deposition</td>
<td>Nitrogen gas is the most common compound in our atmosphere. Deposition of nitrogen can be increased by elevated levels of air pollution, usually attributed to the burning of fossil fuels.</td>
</tr>
</tbody>
</table>

Source:
1. Adapted with information from http://www2.epa.gov/nutrientpollution/problem.
With information adapted from Handbook for Developing Watershed Plans to Restore and Protect Our Waters (March 2008).
**Pathogens**

Pathogens are the most common cause for **water quality impairment** in the United States, with nearly 11,000 waterbodies listed as impaired for this cause in 2014. Pathogens are microscopic organisms which can cause disease in humans or animals. These include viruses, bacteria, protozoa and parasitic worms. The likely presence of pathogens is typically identified by measuring levels of **fecal indicator bacteria** (FIB) such as *Escherichia coli* (E. coli) or *fecal coliform*. Elevated levels of these indicator species demonstrate that conditions are favorable for pathogens at a level which could impact human health when exposures occur.

The primary concern is incidental human ingestion during recreational contact, resulting in illness. In addition, respiratory, skin, ear and eye infections are also possible. Those most at risk are the very young, those with compromised immune systems and those with no prior exposure to the pathogen. The level of exposure required to cause illness varies with each type of pathogen.

### Possible Sources of Pathogens

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viruses</td>
<td>Main symptoms from most common viruses may include diarrhea, vomiting, headache, fever and abdominal cramps.</td>
</tr>
<tr>
<td>Bacteria Salmonella</td>
<td>May cause diarrhea in humans.</td>
</tr>
<tr>
<td>Bacteria Campylobacter</td>
<td>Known to cause diarrhea, abdominal cramping, pain, fever, nausea and vomiting.</td>
</tr>
<tr>
<td>Bacteria E. coli</td>
<td>Most strains are harmless. A few specific strains can result in hemorrhagic colitis. Approximately 10% of cases of this disease lead to hemolytic uremic syndrome, a leading cause of kidney failure in children.</td>
</tr>
<tr>
<td>Other Bacteria</td>
<td>Other water related bacterial diseases include pneumonia, kidney infections and skin / wound infections.</td>
</tr>
<tr>
<td>Protozoa Cryptosporidium</td>
<td>This is one of the most significant causes of waterborne illness today, able to persist in the environment for months at a time in some cases. The dose required to cause infection is small. The disease is usually self-limiting, however it can be chronic and life threatening for those with compromised immune systems.</td>
</tr>
<tr>
<td>Protozoa Giardia</td>
<td>The dose required to cause infection is small. The disease is usually self-limiting, however it can be chronic and debilitating for those with compromised immune systems.</td>
</tr>
</tbody>
</table>

Source: Adapted from “Pathogens in Urban Stormwater Systems,” Urban Water Resources Research Council, August 2014
**Sediment**

A certain amount of sediment is naturally present and transported in streams. However, the excessive loadings observed within this watershed can have significant impacts on water quality and stream structure.

High sediment loads directly impact watershed ecology through habitat loss, reduced wetland functions and impaired water quality in ponds and lakes. Sediment impacts the physical characteristics of waterbodies through decreased floodplain volumes (increases flood risk), higher stream velocities, accelerated streambank erosion, and reduced storage in ponds and lakes. Water quality is also directly affected, as some pollutants are able to bind to sediment particles and be carried downstream.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat Loss</td>
<td>• In-stream structures, such as pools and gravel beds (which are important habitat for fish and other aquatic life) can be lost when filled with sediment. • Sediment laden waters can keep fish from finding food and can interrupt spawning.</td>
</tr>
<tr>
<td>Deposition</td>
<td>• Sediment is more quickly deposited in lower velocity flow zones, such as inside bends of streams or near bridge columns. As sediment builds up in these areas, it can push more water outward in higher velocity zones toward banks of the stream, accelerating bank erosion and creating even higher sediment loads. • In some locations sediment deposition can reduce channel floodplain storage and clog stormwater infrastructure such as inlets, pipes and culverts. • Deposited sediment can fill wetlands, ponds and lakes; diminishing their storage depth, affecting habitat and impacting water quality within and downstream of these waterbodies.</td>
</tr>
<tr>
<td>Other Pollutants</td>
<td>• Sediment particles act as transport vehicles for certain pollutants, such as phosphorus and metals. • Sediments can provide refuge for pathogens from sunlight and predators, extending their lifespan and in some cases creating a medium for their reproduction.</td>
</tr>
<tr>
<td>Drinking Water</td>
<td>• Taste and odor problems can be developed in drinking water sources.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Possible Sources of Sediment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tilled Agricultural Landscapes</td>
</tr>
<tr>
<td>Paved Surfaces</td>
</tr>
<tr>
<td>Construction Sites</td>
</tr>
<tr>
<td>Gully and Ravine Formation</td>
</tr>
<tr>
<td>Streambank Erosion</td>
</tr>
<tr>
<td>Wind Erosion</td>
</tr>
</tbody>
</table>


**Runoff Rates and Volume**

Hydrology is the study of how water moves through and over the landscape. Stormwater runoff caused by rain, snowmelt and groundwater movement are the main ways that pollutants are carried from the landscape to receiving waters. As volumes of surface and subsurface runoff increase, a larger load of nutrients, pathogens and sediments are likely to be driven to the stream. Understanding the activities that increase the rates and flows of runoff can help us identify potential sources of such increases to address.

Activities that reduce the soil’s ability to soak up water (infiltration) or restrict its ability to move through the soil (percolation) lead to increases in stormwater runoff volume. Both infiltration and percolation are decreased when soils are compacted. In rural areas, compaction can occur when large equipment is driven over or through the soil during agricultural activities. Tilling, fertilizing, harvesting and tile installations are all activities which can compact soils. In urban areas,
soil compaction primarily occurs by use of heavy equipment during grading and construction operations as part of land development. Installation of impervious surfaces such as roofs, driveways, parking lots and streets can virtually eliminate infiltration which increases runoff volume.

Runoff volume is also increased when native plants, trees and other vegetation are removed. Plants use water in photosynthesis, changing air and water into sugars for growth. They also distribute water to their leaves and release it back into the atmosphere using a process called transpiration. Their root structures dig deep into the soil, helping to keep it loose and porous. They provide habitat for worms, insects and burrowing animals which also increase void spaces within the soil.

As landscapes are developed, many changes also effect the speed at which runoff is funneled to streams. This decreases the time of concentration, or the longest time it takes for runoff to reach the most downstream point from the extents of a given area. In agricultural areas, many ditches and tiles were constructed to drain wetlands and low lying areas. In some areas, the alignments of larger streams were straightened. Roads were installed with ditches and culverts. In urban areas, impervious areas collect runoff and quickly funnel it into gutters and storm sewers. The pipe network very quickly routes this runoff to the nearest pond or stream.

The combination of these effects results in a system which has been significantly altered from natural conditions. By modeling a case study of a developing area, the effects of these changes can be seen. Runoff volumes in both the agricultural watershed and suburban environments are likely to be several times higher than pre-settlement conditions. The proportion of increases are highest during the smaller, most frequently occurring storms. It should be noted that this comparison is based on suburban conditions (primarily single-family with some commercial growth, with a total of 40-45% impervious cover). More intense development scenarios would be expected to generate even higher runoff volumes.

Shortened time of concentrations magnify the effects of increased runoff volume. In rural areas, peak rates of flow may be nearly 20 times higher than pre-settlement levels during the most frequently occurring storms. In the suburban environment, peak rates for these events are expected to be 20-45 times more than the natural conditions. These drastic changes demonstrate how storm events of less than three inches of rain can cause rapid rises in stream levels and flash flooding. These effects are likely most dramatic in smaller streams in urban developed areas. These quick bounces account for a significant amount of streambank erosion on an annual basis, leaving the streambanks weakened and vulnerable for more significant impacts from the more rarely occurring larger events.

Source: Results from runoff analysis completed as part of Developing Case Study completed by RDG as part of this plan (see Chapter 8 and appendix resources).
Overview of Available Monitoring Data

Iowa Soybean Association / Agriculture’s Clean Water Alliance (ISA/ACWA)

The Iowa Soybean Association in collaboration with Agriculture’s Clean Water Alliance and the Des Moines Water Works has collected data at four separate locations along the main stem of Walnut Creek. Regular sampling at these sites offers the ability to evaluate conditions during a variety of flow conditions through most of the year. The limitations of this data are the small number of sites (no more than two for each year) and a lack of data during the winter, early spring and fall months of the year.

Site 40—Located near Valley Drive Bridge over Walnut Creek (Des Moines)
Data collection at this site began in April 1999 with weekly sampling through mid-November of that year. Beginning in 2000, sampling was usually conducted every other week from April through August. Data through 2014 was reviewed with the development of this plan.

This location is located less than one mile downstream of the USGS gaging station referred to in Chapter 2. Walnut Creek has received runoff from over 98% of its watershed at this location. The combination of these two factors makes this location valuable in estimating overall watershed loading and watershed scale model calibration.

Note: Water Quality data provided by the Iowa Soybean Association, the Agriculture’s Clean Water Alliance and the Des Moines Water Works, supported by various grants and contracts assisting watershed management implementation in Iowa. For more information contact Roger Wolf, Director of Environmental Programs; Executive Director, Agriculture’s Clean Water Alliance; Iowa Soybean Association; 1255 SW Prairie Trail Parkway; Ankeny, Iowa 50023; Tel: 515-251-8640 Fax: 515-251-8657

Information about eleven parameters was collected at this location. Not all parameters were measured during each sampling.

- Chloride
- Discharge
- E.coli
- pH
- Fluoride
- Nitrate as N
- Nitrite as N
- Turbidity
- Orthophosphate as P
- Sulfate
- Total Coliform

Site 70.0—Located near 156th Street Bridge over Walnut Creek (Urbandale)
Data collection at this site began in April 2005 with sampling occurring every other week through August of that same year.

Information about ten parameters was collected at this location. Not all parameters were measured during each sampling.

- Chloride
- Fluoride
- Nitrate as N
- Nitrite as N
- Sulfate
- Total Coliform
- Ecoli
- pH
- Orthophosphate as P
- Turbidity

Site 70.1—Located near Douglas Parkway Bridge over Walnut Creek (Urbandale)
Data collection at this site began in April 2002 with sampling occurring every other week through August of 2003. Both years, sampling ended in late August.

Information about nine parameters was collected at this location. Not all parameters were measured during each sampling.

- Chloride
- Nitrate as N
- Total Phosphorus
- Conductivity
- Turbidity
- Orthophosphate as P
- Nitrate as N
- pH

Site 70.2—Located near Meredith Drive Bridge over Walnut Creek (Urbandale)
Data collection at this site began in April 2004 with sampling occurring every other week through August of that same year.

Information about four parameters was collected at this location. Not all parameters were measured during each sampling.

- Chloride
- Nitrate as N
- Nitrite as N
- Orthophosphate as P

Snapshot Monitoring Data
Water quality data was collected at 31 sites across the Walnut Creek watershed through the Polk County, Raccoon River Watershed and Walnut Creek snapshot monitoring events. These events were typically conducted twice annually (a spring and fall date each year) by volunteers using IDNR IOWATER field test kits. These kits contain test strips and other measurement methods of making a quick evaluation of water quality conditions in the field. During these events, some samples were also taken for laboratory testing. The laboratory samples measure pollutants more precisely than the test kits, which only indicate the likely concentration range for a given pollutant. Data collected and reviewed as part of this study extends from June 2004 through October 2014.
Data gathered using field test kits included the following parameters:

- Chloride
- Dissolved Oxygen
- Nitrate as N
- Water Temperature
- Transparency
- Secchi Depth (measures turbidity)

Laboratory analysis included the following parameters:

- Bromide
- Chloride
- Chlorophyll
- Nitrate + Nitrite
- Nitrite
- Nitrogen, Ammonia
- Solids, Total Suspended (TSS)
- Solids, Total Volatile Susp. (TVSS)
- Chlrophyll
- Nitrogen, Kjeldahl
- Orthophosphate
- Solids, Dissolved
- Sulfate
- Total Coliform
- Turbidity

Data was not collected at every site during each snapshot event. Also, not all of the parameters above were analyzed for each sample collected. Since sampling was conducted less frequently, this data is less effective at measuring the patterns of pollutant loading on a monthly or seasonal basis. It is also more difficult to evaluate the effects of different flow conditions on these pollutant levels, as detailed flow data is not recorded when samples are taken. However, this data is beneficial because it has been collected over a broader area than that collected by the Iowa Soybean Association, with a greater number of pollutants measured. More data was also collected in the later months of the year than at the ISA sites. Using this information with that collected by ISA/ACWA, allows a broader evaluation into the possible sources of certain types of pollution. This provides opportunities to validate outcomes from water quality modeling at a subwatershed level.

USGS Water Quality Data

Water quality data was collected at USGS gaging station 05484800 located near the 1st Street / 63rd Street Bridge over Walnut Creek on the border between Des Moines and West Des Moines (same location referred to in Chapter 3). Data was collected on roughly a monthly basis between December 1971 and August 1975; October 1983 and January 2002. Over these periods, data on the following parameters was collected:

- Discharge
- Suspended Sediment Discharge
- Gage Height
- Suspended Sediment Conc.
- Temperature, Water
- Specific Conductance
- pH
- Temperature, Air

Des Moines Water Works

Des Moines Water Works collects nearly continuous water quality information from their intake site on the Raccoon River. This site is located less than one mile downstream of the confluence of Walnut Creek with the Raccoon River. The continuous nature of the data available makes it a valuable resource to review. However at the point of measurement, streamflow from Walnut Creek has mixed with flow from the much larger Raccoon River watershed. Given the other data sources available, it can be difficult to separate out the influence of the Walnut Creek watershed from water samples collected at this location.

Water Quality Monitoring

Water quality monitoring allows the presence of pollutants in streams to be evaluated. However, results can be effected by collection methods, timing, weather conditions, flow levels, sampling, testing methods and sampler training. Monitoring efforts rely on developing and following quality assurance plans to reduce these factors which can skew data collection. To improve the quality of collected data submitted to the state for recording, volunteer efforts must comply with requirements of Iowa Administrative Code Section 567.61.
Review of Existing Monitoring Data for Key Pollutants

Now that we have identified the key pollutants of concern, it is important to review the available monitoring data for these pollutants in greater detail.

Data collected by the ISA/ACWA offers the highest number of samples, typically collected every other week. Site 40 is also located just downstream of a USGS gaging station, and is less than two miles from the weather station located at the Des Moines Airport. Collectively, this information offers opportunities to understand how pollutant concentrations vary with time, streamflow and climate patterns.

IOWATER data collection does not have as many samples at each site, but has more sites distributed throughout the watershed. This data can be used in determining where higher pollutant concentrations are most likely located.

Nitrate (Nitrogen)

ISA/ACWA Monitoring

A total of 168 samples were collected and analyzed for nitrate from the ISA/ACWA site 40 between 1999 and 2014. At sites 70.0, 70.1 and 70.2; a total of 131 samples were collected between 2002 and 2014. Reviewing this data indicates that nitrate concentrations appear to be significantly higher in streams within the rural landscapes. (The site 70 locations were positioned in a primarily rural watershed, whereas site 40 received runoff from both urban and rural sources.) It appears that nitrate concentrations in urban runoff is lower, diluting nitrate concentrations as those flows enter the stream.

At both sites, concentrations were highest during the months of April through July, with peak levels occurring in May and June. This trend seems to follow the times after spring fertilization has occurred and when rainfall patterns are near their highest levels. It should be noted that concentration levels were noted to drop significantly in August, although average precipitation remains high during this month. Concentrations remained

<table>
<thead>
<tr>
<th>ISA/ACWA Monitoring</th>
<th>Site 40</th>
<th>Site 70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Nitrate Concentration</td>
<td>5.83 mg/L</td>
<td>9.95 mg/L</td>
</tr>
<tr>
<td>% Above Water Quality Standard</td>
<td>26%</td>
<td>49%</td>
</tr>
<tr>
<td>Maximum Recorded Level</td>
<td>17.6 mg/L</td>
<td>22.9 mg/L</td>
</tr>
<tr>
<td>Date of Maximum Recorded Level</td>
<td>5/20/2004</td>
<td>5/16/2013</td>
</tr>
</tbody>
</table>

Several IOWATER sites had average lab results for nitrate concentrations which exceeded the state standard.

Several IOWATER sites had average lab results for nitrate concentrations which exceeded the state standard.

Test kit data also indicated elevated nitrate concentrations in rural areas.

Nitrate concentrations were 78% higher on average in rural areas; 49% of all samples taken at the rural ISA/ACWA site were above the state’s water quality standard.

Several IOWATER sites had average lab results for nitrate concentrations which exceeded the state standard.

Several IOWATER sites had average lab results for nitrate concentrations which exceeded the state standard.

Test kit data also indicated elevated nitrate concentrations in rural areas.
low from September to November, although very few samples were collected during each of these months (only 5 total samples were collected in the months of Sept-Oct-Nov at site 40, and only 2 samples during those months at site 70).

At site 40, nitrate concentrations appear to be lowest during low flows, noticeably so when streamflows are in the lowest 20% of observed flow rates. They appear highest when flows are in the highest 10–50% of observed flow rates. This distribution pattern indicates that nitrate loading is most likely from non-point sources, being moved off the landscape or out of tile flows primarily during and after measurable rainfall events. In contrast, if concentrations remained high at low flow, or had spikes that appeared outside of larger rainfall events, that would indicate that the source of the pollutant was from one or more point sources, which have more constant outflows between rainfall events.

### Snapshot Monitoring (Lab Samples)

IOWATER has collected data from 31 separate sampling sites in the Walnut Creek watershed. Nitrate was measured by 233 laboratory samples from these sites. Laboratory samples were also collected for Nitrate + Nitrite, with 189 collected for that parameter (nitrite levels when measured alone were typically low, so nitrate + nitrite may still be a good measure to approximate and compare nitrate levels).

Since significant seasonal patterns were seen at the ISA/ACWA sites, analysis of IOWATER samples has been divided into three periods: spring (April-June), summer (July-August) and fall (September-November). The sites with the highest average levels of nitrates are listed below.

Since there are fewer data points at each site, it is difficult to draw specific conclusions about each location. However, this data seems to follow the pattern of the ISA/ACWA monitoring, indicating elevated levels of nitrate in the spring months, especially where runoff is being received from rural landscapes.

The IOWATER data does seem to lend some support to possibilities of spikes in nitrate concentrations in the fall. Some higher concentrations...
were noted on a few dates. In reviewing USGS streamflow data, it appears that these elevated values may coincide with above average flow rates. Regularly occurring late season monitoring would be needed to determine if elevated nitrate levels in the fall are a normal pattern or caused by more unique sets of circumstances.

**Snapshot Monitoring (Test Kits)**

IOWATER test kits use strips that read nitrate levels by changes in color. This means that readings are estimates of concentration within a given range around that number. Of the 521 samples taken, no reading above 20 mg/L was recorded. This measurement on the strip is intended to represent a range between 20 and 50 mg/L. The table on the previous page notes the different locations and dates where readings of 20 were recorded. Most of these dates coincide with elevated flow volumes measured at the USGS gaging station within the Walnut Creek watershed.

**Phosphorus**

**ISA/ACWA Monitoring**

A total of 136 samples were collected and analyzed for phosphorus from the ISA/ACWA site 40 between 2001 and 2014. At sites 70.0, 70.1 and 70.2; a total of 127 samples were collected between 2002 and 2014. This indicates that phosphorus concentrations may be higher in streams within the rural landscapes.

At site 70, average concentrations were elevated above 0.12 mg/L during all months sampled, except for August, with peak levels occurring in May and June. At site 40, highest concentrations were observed in April, with concentrations wavering after that. Seasonal trendlines are present, but do not appear as strong as those seen for nitrate concentrations. Also in contrast to nitrate levels, there appears to be much less correlation between high flow levels and elevated phosphorus concentrations. This appears to indicate that phosphorus concentrations may be more influenced by individual site actions, such as fertilizer applied soon before a storm event, which could lead to a sudden spike in phosphorus concentrations.

**IS/ACWA Monitoring**

<table>
<thead>
<tr>
<th>Site/Location</th>
<th>Date</th>
<th>Max</th>
<th>Site/Location</th>
<th>Date</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>WC1</td>
<td>5/18/05</td>
<td>2.5</td>
<td>WCV1</td>
<td>10/15/14</td>
<td>0.69</td>
</tr>
<tr>
<td>WAVELAND</td>
<td>5/18/05</td>
<td>1.0</td>
<td>WCTrib</td>
<td>10/15/14</td>
<td>0.66</td>
</tr>
<tr>
<td>WAVELAND</td>
<td>10/12/05</td>
<td>1.0</td>
<td>WAVELAND</td>
<td>10/12/05</td>
<td>0.64</td>
</tr>
<tr>
<td>WAVELAND GC</td>
<td>5/24/06</td>
<td>0.68</td>
<td>LWC1</td>
<td>10/15/14</td>
<td>0.57</td>
</tr>
<tr>
<td>WAVEAND</td>
<td>5/14/06</td>
<td>0.54</td>
<td>LWC1</td>
<td>5/8/13</td>
<td>0.52</td>
</tr>
</tbody>
</table>

Some snapshot readings indicate that runoff from Waveland Golf Course could contain elevated phosphorus levels.
Snapshot Monitoring

IOWATER has collected data from 31 separate sampling sites in the Walnut Creek watershed. Phosphorus was measured by 136 laboratory samples from these sites. Laboratory samples were also collected for Orthophosphate, with 217 collected for that parameter.

Since there are fewer data points at each site, it is difficult to draw specific conclusions about each location. However, this data seems to indicate elevated levels of phosphorus may be present at various locations in both rural and urban areas.

A review of maximum phosphorus concentrations also seems to indicate that the areas near Waveland Golf Course may have significant spikes in loadings. Perhaps these are associated with fertilization coinciding with certain rainfall events. It is also worthy of note, that certain dates resulted in maximum values at multiple sites. This indicates that runoff or streamflow patterns likely do influence concentrations, but it is difficult to interpret how much with the limited data available.

Bacteria (E. coli)

Iowa Soybean Association / ACWA Monitoring

A total of 62 samples were collected and analyzed for E. coli at the ISA/ACWA site 40 between 2005 and 2011. At site 70.0, a total of 46 samples were collected between 2006 and 2011. The overall average concentration for all samples at site 40 was 3126 MPN (most probable number of organisms)/100 mL, with 73% exceeding the State of Iowa’s single sample water quality criterion of 235 MPN/100mL. The average concentration for samples collected at site 70 locations was 1333 MPN/100mL, with 66% of the samples exceeding the single sample criterion. Average values at site 40 were 135% higher than those observed at site 70. This indicates pathogens may be much more present in streams which receive more urban runoff.

At both sites, average concentrations over this period peaked in June, with average levels during that month at 8,122 orgs./100mL at site 40 and 1,602 at site 70. Average values showed a very high peak in June at site 40, where values were more consistent through all months at site 70.

At site 40, there appears to be a connection between high flow levels and elevated bacteria concentrations. Most of the highest concentrations were observed during the highest 30% of all flow conditions. At site 70, this connection was much less defined. This data provides strong evidence that there is a connection between high runoff events from urban environments and high concentrations of indicator bacteria. Other seasonal factors, such as elevated temperatures may provide better environments for these bacteria and allow them to survive and multiply.

<table>
<thead>
<tr>
<th>ISA/ACWA Monitoring</th>
<th>Site 40</th>
<th>Site 70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average E. coli Concentration</td>
<td>3,126 orgs./100mL</td>
<td>1,333 orgs./100mL</td>
</tr>
<tr>
<td>Maximum Recorded Level</td>
<td>54,700 orgs./100mL</td>
<td>14,670 orgs./100mL</td>
</tr>
<tr>
<td>Percentage of samples exceeding water quality standard</td>
<td>73%</td>
<td>66%</td>
</tr>
<tr>
<td>Date of Maximum Recorded Level</td>
<td>6/26/2008</td>
<td>7/24/2008</td>
</tr>
</tbody>
</table>

Levels of E. coli were much higher at the site receiving urban runoff.

| Average and Maximum E. coli Concentrations (Laboratory) |
|----------------|----------------|
| AVERAGE | MAXIMUM |
| SITE | COUNT | AVG | SITE | DATE | AVG |
| NWCTrib1 | 12 | 9,165 | NWCTrib1 | 10/12/2005 | 77,010 |
| WC3trib | 2 | 7,875 | WC6 | 5/8/2005 | 61,310 |
| NWCSA | 2 | 8,585 | WAVELAND | 10/12/2005 | 30,760 |
| WAVELAND | 10 | 8,585 | NWCTrib2 | 10/18/2006 | 30,760 |
| WC6 | 19 | 5,332 | NWCSA | 10/18/2006 | 16,070 |

The state’s water quality standard for E. coli is 235 orgs./100mL for a single sample. The maximum level observed was more than 300 times that level.
Snapshot Monitoring
IOWATER has collected data from 31 separate sampling sites in the Walnut Creek watershed. E. coli was measured by 298 laboratory samples from these sites.

Since there are fewer data points at each site, it is difficult to draw specific conclusions about each location. However, this data seems to follow the pattern of the ISA/ACWA monitoring, indicating elevated levels of indicator bacteria where runoff is being received from urbanized areas.

Highest concentrations appear to be in the older developed areas, lying east of I-35/80. Highest concentrations often appear in tributary streams, however high averages and maximums were noted at sites NWC5A (North Walnut Creek) and WC6 (Walnut Creek). Samples at both of these sites were collected from second or third order stream channels.

Did you know...?
E. coli levels are usually measured by finding the most probable number (MPN) of bacteria organisms (orgs.) that are present in 100mL of water.
Watershed Loading—Key Pollutants

Water quality modeling system software was used to determine the most likely sources of the key pollutants of concern. A more detailed description of this modeling effort is included as an appendix to this plan. Available GIS land use dataset information was used to determine the amount of different land uses in each of 33 subwatershed areas within the Walnut Creek watershed. The model accounts for other factors including local rainfall patterns, soil types, terrain, livestock, wildlife and management practices. Gully and streambank stability characteristics were also input into the modeling. The modeling software used did not account for construction site runoff. To account for this, separate calculations were completed to determine the amount of development that occurred on an annual basis over a recent ten year period. Modeling results were developed for each subarea, considering scenarios with and without this construction site loading.

Existing monitoring data at Iowa Soybean Association Site 40 and streamflow data from the USGS gage located nearby were used to evaluate preliminary results. The monitoring and streamflow data was used to calculate approximations of loading rates based on the data available. The water quality model was then calibrated using this information, to bring it into better agreement with real world observations.

Expected Pollutant Sources by Land Use

Modeling results demonstrate that cropland is likely the largest source of nitrogen and phosphorus loadings. This is consistent with observations from monitoring sites, which demonstrated higher phosphorus and much higher nitrate concentrations in rural areas. Over 80% of the sediment loading in the watershed is expected from three sources—streambank, construction site and gully erosion.

Pollutant Sources by Subarea

The water quality modeling completed identifies potential sources of key pollutants at a subwatershed level. For each of these areas, the expected annual load of nitrogen, phosphorus and sediment has been calculated. These loading rates were divided by the acres of land within each subwatershed to determine the annual loading rate per acre, in order to compare loading rates of subwatershed that are different in size.

Loading rates have been calculated both with and without the expected effects of construction site sediment loads. Construction site loadings were calculated based on land development patterns that occurred between 2001 and 2011. The modeling provides a good estimate of average annual construction site loadings from each subarea which would have occurred during that period of time. As development patterns change over time, the location of these sources will be different in the years ahead. Therefore, the maps included within this chapter show the expected

<table>
<thead>
<tr>
<th>Pollutant Sources By Land Use</th>
<th>N</th>
<th>P</th>
<th>Sediment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>14%</td>
<td>26%</td>
<td>7%</td>
</tr>
<tr>
<td>Cropland</td>
<td>81%</td>
<td>49%</td>
<td>10%</td>
</tr>
<tr>
<td>Pastureland</td>
<td>2%</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Forest</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Grasslands</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Gully</td>
<td>1%</td>
<td>5%</td>
<td>19%</td>
</tr>
<tr>
<td>Streambank</td>
<td>2%</td>
<td>10%</td>
<td>38%</td>
</tr>
<tr>
<td>Construction Site</td>
<td>1%</td>
<td>8%</td>
<td>25%</td>
</tr>
</tbody>
</table>

Estimated pollutant levels delivered from Walnut Creek to the Raccoon River.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Total Load (pounds)</th>
<th>Total Load (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>941,600</td>
<td>471</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>61,500</td>
<td>31</td>
</tr>
<tr>
<td>Sediment</td>
<td>59,360,000</td>
<td>29,700</td>
</tr>
</tbody>
</table>

Projected source location of each pollutant.

Source: Results of STEPL pollutant load modeling performed by RDG Planning and Design.
loading rates without construction site effects. This allows non-construction site sources to be evaluated and targeted separately. Construction site sources are best addressed with site level management techniques.

**Nitrogen**
Sources of nitrogen are expected to be highest in the agricultural lands that make up the headwaters of Walnut Creek. Areas west of Waukee and those between Dallas Center and Grimes appear to be the largest sources for nitrogen on a per acre basis. Elevated levels are also indicated to be present in the upper reaches of the North Walnut Creek subwatershed. These results appear to be consistent with available monitoring data.

**Phosphorus**
Like nitrogen, sources of phosphorus are expected to be highest in the agricultural lands in the upland areas of the watershed. However, there is less variation in phosphorus loading between the various subareas. Twenty-eight of the thirty-three subwatersheds are expected to have loading rates between 0.8-1.3 pounds per acre per year. Levels are expected to be below this range in two subwatersheds and above this range in three others. These results appear to be in agreement with available monitoring data.

**Pathogens**
This modeling software did not include detailed modeling of bacteria sources. Bacteria loading can be difficult to estimate, as they are driven by a variety of factors such as animal sources, temperature, precipitation, growth and lifespan. Available monitoring data for bacteria indicates levels are most elevated in the urban environment.

**Sediment**
Source loadings of sediment are expected to be highest in areas of steeper slopes and where more streambank and gully erosion has been observed. Highest levels are expected along lower Little Walnut Creek and along Walnut Creek upstream of its confluence with South Walnut Creek. There are many ravines, gullies and streams with significant slope in these areas. Please remember construction site loadings are not reflected in the maps included within this chapter.

---

**Average Loading per Acre by Subwatershed Without Construction Site Runoff**

<table>
<thead>
<tr>
<th>Subwatershed Site</th>
<th>N lb/ac/yr</th>
<th>P lb/ac/yr</th>
<th>Sediment lb/ac/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>4.8</td>
<td>0.7</td>
<td>967.2</td>
</tr>
<tr>
<td>102</td>
<td>6.1</td>
<td>0.9</td>
<td>895.3</td>
</tr>
<tr>
<td>111</td>
<td>5.1</td>
<td>0.6</td>
<td>489.1</td>
</tr>
<tr>
<td>112</td>
<td>6.0</td>
<td>0.9</td>
<td>729.5</td>
</tr>
<tr>
<td>201</td>
<td>6.1</td>
<td>1.0</td>
<td>1034.2</td>
</tr>
<tr>
<td>202</td>
<td>6.7</td>
<td>0.9</td>
<td>911.9</td>
</tr>
<tr>
<td>203</td>
<td>6.7</td>
<td>1.1</td>
<td>2198.1</td>
</tr>
<tr>
<td>211</td>
<td>6.4</td>
<td>0.9</td>
<td>761.7</td>
</tr>
<tr>
<td>212</td>
<td>13.3</td>
<td>0.9</td>
<td>737.5</td>
</tr>
<tr>
<td>213</td>
<td>6.3</td>
<td>0.8</td>
<td>919.7</td>
</tr>
<tr>
<td>214</td>
<td>17.3</td>
<td>1.1</td>
<td>1810.8</td>
</tr>
<tr>
<td>301</td>
<td>17.7</td>
<td>1.2</td>
<td>1923.3</td>
</tr>
<tr>
<td>311</td>
<td>28.3</td>
<td>1.3</td>
<td>1862.8</td>
</tr>
<tr>
<td>312</td>
<td>27.0</td>
<td>1.2</td>
<td>1513.8</td>
</tr>
<tr>
<td>401</td>
<td>24.0</td>
<td>1.8</td>
<td>3823.2</td>
</tr>
<tr>
<td>402</td>
<td>27.4</td>
<td>1.0</td>
<td>568.4</td>
</tr>
<tr>
<td>411</td>
<td>28.7</td>
<td>1.9</td>
<td>520.7</td>
</tr>
<tr>
<td>501</td>
<td>5.5</td>
<td>0.8</td>
<td>855.7</td>
</tr>
<tr>
<td>502</td>
<td>5.8</td>
<td>0.9</td>
<td>1081.4</td>
</tr>
<tr>
<td>503</td>
<td>9.8</td>
<td>1.0</td>
<td>1001.6</td>
</tr>
<tr>
<td>504</td>
<td>18.0</td>
<td>0.9</td>
<td>335.7</td>
</tr>
<tr>
<td>511</td>
<td>6.0</td>
<td>0.8</td>
<td>799.4</td>
</tr>
<tr>
<td>512</td>
<td>5.5</td>
<td>0.8</td>
<td>605.6</td>
</tr>
<tr>
<td>513</td>
<td>19.3</td>
<td>0.8</td>
<td>201.0</td>
</tr>
<tr>
<td>601</td>
<td>18.6</td>
<td>1.1</td>
<td>1311.7</td>
</tr>
<tr>
<td>602</td>
<td>27.4</td>
<td>0.8</td>
<td>195.6</td>
</tr>
<tr>
<td>611</td>
<td>12.3</td>
<td>1.0</td>
<td>1051.1</td>
</tr>
<tr>
<td>612</td>
<td>10.8</td>
<td>0.8</td>
<td>389.6</td>
</tr>
<tr>
<td>613</td>
<td>26.7</td>
<td>0.8</td>
<td>254.3</td>
</tr>
<tr>
<td>614</td>
<td>28.2</td>
<td>0.8</td>
<td>182.5</td>
</tr>
<tr>
<td>701</td>
<td>25.5</td>
<td>1.2</td>
<td>1757.9</td>
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<tr>
<td>702</td>
<td>29.5</td>
<td>1.8</td>
<td>153.8</td>
</tr>
<tr>
<td>711</td>
<td>28.0</td>
<td>0.8</td>
<td>184.2</td>
</tr>
<tr>
<td>Watershed Avg.</td>
<td>17.6</td>
<td>1.1</td>
<td>840.8</td>
</tr>
</tbody>
</table>

Source: Results of STEPL pollutant load modeling performed by RDG Planning and Design.
Nitrogen Loading

Source: Results of STEPL pollutant load modeling performed by RDG Planning and Design.
Phosphorus Loading

Source: Results of STEPL pollutant load modeling performed by RDG Planning and Design.
Sediment Loading

Source: Results of STEPL pollutant load modeling performed by RDG Planning and Design.
Projected Reduction Targets

The reduction targets within this section are intended to be long-term goals which will likely take many decades to achieve. The Watershed Action Plan (Chapters 7-10) and Implementation Plan included (Chapters 11-14) within this document will identify how to begin progress toward these goals over the next decade.

Iowa’s Nutrient Reduction Strategy calls for reductions in nutrient loading from non-point sources in agricultural areas. These loading reductions are 41% for nitrogen and 29% for phosphorus. Using past monitoring data from the ISA/ACWA sites, loading reductions of this amount for nitrogen would be expected to limit violations of the Raccoon River watershed TMDL standard for nitrate to less than 1% of all samples collected at site 40. Many management practices which target phosphorus are also effective at reducing erosion or trapping sediment loads. Based on this, it seems reasonable to expect that sediment loadings from the agricultural areas could be reduced by a similar amount by implementing practices which aim to reduce phosphorus loading.

Did you know...?
Phosphorus is a pollutant that often binds with sediment particles.

The Nutrient Reduction Strategy does not establish reduction goals for nutrients within urban areas. The analysis within this plan identifies that pathogens, sediment loadings and runoff volumes and rates are more critical pollutants to address within the urban environment.

Loading Reduction Goal #1:
Reduce nitrogen loading from non-point sources within rural areas by at least 41%.

Loading Reduction Goal #2:
Reduce phosphorus loading from non-point sources within rural areas by at least 29%.

Loading Reduction Goal #3:
Reduce sediment loading from non-point sources within rural areas by at least 29%.

Did you know...?
This plan estimates that 25% of the sediment load from this watershed could be attributed to construction sites. These sites cover only 0.1% of the entire watershed in a typical year. Those statistics may be difficult to imagine, however the average sediment loss estimated for construction sites is equal to only about 1/8 inch of soil across the surface of all construction sites. A more detailed discussion of how construction site loadings were calculated is included within an appendix to this plan.

Levels of Stormwater Management Using ISWMM’s Unified Sizing Criteria

[Diagram showing different levels of stormwater management, including capture and treat, extended detention, overbank flood protection, and extreme flood protection.]

Source: RDG
The Raccoon River TMDL established a target single sample maximum concentration of E.coli bacteria at 200 MPN/100mL. Based on monitoring sites, load reductions of more than 99% would be necessary to meet this criterion. This appears to be an impractical goal, given the level of existing urban development throughout the watershed and the amount of retrofits that would be necessary to meet this standard. For this reason, the following load reduction goals are proposed:

**Loading Reduction Goal #4:**
In newly developing areas, employ best management practices (BMPs) to capture and treat runoff from the 1.25” rainfall event (Water Quality event). Select practices such as bioretention, wet detention ponds and constructed wetlands which have been demonstrated to be most effective at reducing bacteria loading. Refer to the International Stormwater BMP Database (bmpdatabase.org) for updated information.

**Loading Reduction Goal #5:**
In existing developed areas, develop a program to employ stormwater retrofits where practical to reduce pathogen loading to the maximum extent possible.

There is no established statewide criteria governing sediment loadings or water quantity volumes. This plan has identified that these items have a significant impact related to both water quality and stream corridor stability. Therefore, the following goals related to sediment and runoff water quantity are proposed:

**SEDIMENT**

**Loading Reduction Goal #6:**
Implement and/or enforce effective construction site pollution prevention management practices in developing areas. Controls should reduce total suspended solids (TSS) from site runoff by 80% (as compared to no controls). Could reduce watershed sediment load by 15%.

**Loading Reduction Goal #7:**
Complete streambank stabilization and restoration projects as needed to reduce sediment loading attributed to streambank erosion by 50% by 2040.

**RATES AND VOLUMES**

**Loading Reduction Goal #8:**
In developing areas, provide stormwater management practices which achieve the following:

- Capture and treat runoff from the Water Quality Event (treat 100% of runoff from precipitation events of less than 1.25 inches). 90% of all rainfall events in Central Iowa fall into this category.
- Provide extended detention of the 24-year, 1-year return period event; with slow release over a period of not less than 24 hours. This should reduce peak runoff rates from newly developing areas by more than 95% for these types of storm events.
- Limit runoff rates for events equal to or smaller than the 24-hour, 1% annual exceedance probability (100-year return period storm) to levels similar to natural (pre-settlement) conditions.

**Loading Reduction Goal #9:**
In developed areas, evaluate opportunities and implement practices to reduce runoff rates and volumes by the maximum extent possible.

- Develop education and outreach incentives to increase use of best management practices on existing developed areas.
- Install practices that are intended to maximize reduction in rates and volumes from a one-year storm event.

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Source:
1. Iowa Stormwater Management Manual
2. Iowa’s NPDES General Permit Number 2
3. Results from runoff analysis completed as part of Developing Case Study completed by RDG as part of this plan (see Chapter 8 and appendix resources)