Watershed Resiliency Plan

A 20 Year Strategic Plan to Increase the Hydrologic Function & Resiliency of the Turkey River Watershed

Developed for the TRWMA by Northeast Iowa RC&D Inc. with funding provided by HUD/CDBG and the Iowa Departmemt of Natural Resources




Turkey River Watershed Management Authority

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Definitions

AND ACRONYMS

Turkey River

CDBG: Community Development Block Grant Program
CDI: Conservation Districts of Iowa
CRP: Conservation Reserve Program
DC: District Conservationist
EPA: Environmental Protection Agency
EWP: Emergency Watershed Protection
EWRP: Emergency Wetland Reserve Program
FEMA: Federal Emergency Management Agency
GIS: Geographic Information System
HUC: Hydrologic Unit Code
HUD: Housing & Urban Development
IACAN: Iowa Conservation Action Network
IDALS: Iowa Department of Agriculture & Land Stewardship
IEDA: Iowa Economic Development Authority
IFC/IIHR: Iowa Flood Center
Iowa DNR: Iowa Department of Natural Resources
IRVM: Integrated Roadside Vegetation Management
ISA: Iowa Soybean Association
MLRA: Major Land Resource Area
NASS: National Agricultural Statistics Service
Northeast Iowa RC&D: Northeast Iowa Resource Conservation and Development
NRCS: Natural Resource Conservation Service
NRCS RWA: Rapid Watershed Assessment
PFI: Practical Farmers of Iowa
PF: Pheasants Forever
RCPP: Regional Conservation Partnership Program
SMART: Specific, Measurable, Achievable, Realistic, Timely
SWCD: Soil and Water Conservation District
TRWMA: Turkey River Watershed Management Authority
TRW: Turkey River Watershed
USDA: United States Department of Agriculture
USGS: United States Geological Survey
WRP: Wetlands Reserve Program

Partners

AND RECOGNITION

Partner 1: TRWMA Member Cities, Counties, and SWCDs. TRWMA members each appointed one representative who served on the 35 member Turkey River WMA Board of Directors, meeting quarterly as a full Board and more frequently in committees to review information, develop recommendations, and finalize plan components.

Partner 2: TRWMA Committees. Dozens of public and private partners served on TRWMA committees considering research, best management practices, economics, social factors and discussing local lessons learned. This plan is a direct reflection of their input and recommendations and would not have been possible without them. A full description of the committees is included in the Local Leadership section of this plan. The committees included: Executive, Techical, Community, Commissioners, County Infrastructure, Producer Groups, Education, Emergency Management, Fisheries, and RCPP.

Partner 3: Iowa Economic Development Authority. Administered HUD CDBG funding for the Turkey River WMA to develop this plan, including funding to contract professional facilitators, researchers and planners to help with development of this plan. They also administered HUD CDBG funding for the Iowa Flood Center and IIHR to model and test their models in the Turkey River Watershed and Otter Creek Watershed.

Partner 4: Clayton County. Clayton County Board of Supervisors served as the applicant for the IEDA funds. They and the Clayton County Auditor provided fiscal leadership and accounting for the IEDA and other grants on behalf of the TRWMA.

Partner 5: Iowa Flood Center. Provided state-of-the-art, in-depth analysis, research, and modeling that helped all the partners better understand the TRW and how specific actions could reduce flooding. They also provided equipment and monitoring throughout the TRW, and funding for specific projects in Otter Creek Watershed including five rain gauge/soil moisture probes, two stream gauging stations, and 3 real time nitrate monitors in Otter Creek Watershed. They have two additional nitrate monitors in the Turkey River and are partners in the placement and use of over 23 rain gauge/soil moisture probes throughout the TRW. They presented information to the TRWMA Board and committees regularly and maintain access to real-time, rainfall, soil moisture, river stage, and other monitoring online. They partnered with other TRW partners to secure funding for increased analysis, outreach, and monitoring. They expanded their assistance to work more in depth with specific TRW committees including the County Infrastructure Committee, Technical Committee, and Emergency Management Committee. They have partnered with the TRWMA and TRWMA partners to submit federal grants and secure funding for future work in the TRW.

Partner 6: Northeast Iowa RC&D. Northeast Iowa RC&D helped the TRWMA form and secured planning, research project, and outreach grants. As the contracted planning entity they provided planning, facilitation, research, grant writing, GIS analysis, design, marketing, and communication, as well as outreach and education at the local and state level to the TRWMA Board and partners. In addition, as a partnering organization, the RC&D provided grant writing assistance, coordinated and funded watershed wide water quality monitoring and analysis, partner and pubic outreach and education, and developed and maintained public communications and information distribution through the www.turkeyriver.org website. They funded and placed rain gauges and soil moisture probes throughout the TRW. They secured funding from several private and public grantors for complementary work in the watershed including a Rapid Land Cover Analysis of the TRW and a conservation outreach and marketing campaign.

Partner 7: Iowa Natural Resources Conservation Service. Completed a rapid watershed assessment of the TRW, assisted with project design and implementation in Otter Creek (Iowa Flood Center Phase II Project), delivered educational presentations to the TRWMA Board and served on committees during the planning process.

Partner 8: Iowa Department of Natural Resources. Section 319 of the DNR also provided funding for the creation for this plan. Iowa DNR staff assisted with collection of water samples from throughout the TRW and assisted with funding for analysis of those samples. The water monitoring and analysis provided baseline data for the project in terms of water quality and nutrient and soil transport. They also provided technical assistance and input throughout the planning process by serving on committees including the Technical Committee and the Fisheries Committee, by providing technical assistance to the planning staff and TRWMA members as needed, and providing information for use in GIS analysis. The Big Spring Report completed by the Iowa Geological Survey Bureau was used for background information regarding the TRW geology, karst features, and provided a better understanding of springsheds. IADNR also provided an additional planning grant to the TRWMA to add nutrient reduction.

Partner 9: McKnight Foundation. Provided funding for water quality monitoring in the TRW, GIS analysis, development of the TRW website and technical assistance to the TRW Alliance, more recent funding to engage landowners through tile outlet monitoring, and rain gauge/soil moisture/temperature probes to be installed throughout the TRW. Monitoring and gauging provided a baseline of water quality information and extensive tools for producers and residents of the TRW to participate in project research and promotion..

strategies to this plan, which is scheduled to be completed by December 2015.

Partner 11: County Farm Bureau Chapters in the TRW. Iowa Farm Bureau County Boards in the Turkey River Watershed provided input for the planning process, time for presentations and discussion at their meetings, and encouraged members to attend public planning meetings. Three counties, Winneshiek, Howard and Chickasaw, also, with assistance from the Regional 6 Manager, submitted and secured state grants for Rain Gauge Monitors and Soil Moisture Probes that will be used to help producers better understand the hydrology of the watershed and how it relates to soil moisture and rainfall. The Iowa Farm Bureau Federation Region 6 Manager. The Region 6 Manager also assisted with producer outreach and served on the Producer Group Committee, providing additional input and guidance.

Partner 12: Iowa Soybean Association. ISA assisted with producer outreach and education, on-farm conservation planning through the Iowa Conservation Action Network, and on-farm tile-line monitoring. They met with producers and with other producer groups to provide input and make recommendations. An ISA staff member served on the Producer Group Committee providing input and guidance for the project. ISA was also a partner organization on a grant submitted to the McKnight Foundation by Northeast Iowa RC&D. The ISA agreed to provide assistance with tile-line monitoring and outreach components for the proposal.

Partner 13: Iowa Corn Growers Association. Assisted with producer outreach and education as well as on farm planning through the Iowa Conservation Action Network. They met with producers and with other producer groups to provide input and make recommendations. A representative also served on the Producer Group Committee providing input and guidance.

Section ONE

Goals, Vision Statement & Objectives

Goals, Vision Statement, & Objectives

SECTION ONE A

Coldwater Stream

1.A Goal #1: The first goal of this twenty-year plan is to increase the hydrologic function and resiliency of the Turkey River Watershed (TRW) so as to measurably reduce peak discharge in the Turkey River Watershed by 10% near the mouth of the river at Garber, Iowa during a 5.5 inch rainfall across the entire watershed. The partners recognize that a 5.5 inch rainfall across the entire watershed in twenty-four hours is unlikely to occur and that irregular rainfall is a truer representation of actual rainfall patterns, but have used this scenario as a standard that can be modeled by partners, specifically the Iowa Flood Center and IIHR. The reduction in peak discharge, which will only be accomplished through a complex system of actions taken by a diverse group of partners, will save millions of dollars in damage to public and private infrastructure throughout the Turkey River Watershed (TRW). It is dependent on watershed-wide implementation of flow reduction practices that result in a reduction in storm water discharge of between 20% and 40% from any given tributary to the Turkey River. The Turkey River Watershed Management Authority (TRWMA) believes that the conservation work and best management practices that will be utilized to reach this goal will have a multitude of other benefits, including helping the TRW be more resilient during episodes of low rainfall that would otherwise lead to extreme drought conditions, improving water quality in TRW streams and the river, and creating and diversifying wildlife habitat throughout the TRW.

Goal #2: The second goal of this plan is to ensure clean water for drinking, agriculture, wildlife, recreation, and other aspects of life in the Turkey River Watershed. The TRWMA recognizes that water resources in the TRW face challenges from primarily nutrient loading, sedimentation, and bacteria. Each pollutant has multiple sources and poses different problems for water resources in the TRW. Therefore, a multifaceted approach must be used to improve and protect the long term health of the water resources in the watershed. Efforts to address specific water resource issues can be geographically focused based on data collected through water sampling at 50 sites across the watershed, which began in 2011. To achieve the goal of this plan requires a reduction of all three primary issues; nutrient loading, sedimentation, and bacteria levels in the Turkey River main stem and at each sampling site in the TRW. Additionally, strategies should address both the annual mean and annual maximum levels for each parameter. Like the flood reduction portion of this plan, the conservation work and best management practices that will be utilized to reach this goal will have a multitude of other benefits.

1.B Vision statement:

The Vision of the TRWMA is that the TRW will be a high functioning hydrologic system that has increased resiliency in the face of changing precipitation patterns. Increased landscape resiliency will be achieved through the efforts of many partners working independently and collectively to increase the capacity of the watershed to slow and hold water for longer periods of time during heavy precipitation events, and consistently increase groundwater infiltration throughout the watershed to reduce drought during extended periods of decreased rainfall. Benchmarks can and will be quantitatively measured through analysis of data from gauging stations throughout the TRW and other research and monitoring detailed in this plan.

1.C Objectives:

Plan objectives are as follows:

Objective 1: Develop a team of flood mitigation and water resource improvement professionals.

Objective 2: Implement conservation practices and innovative cropping systems that stop or slow rainwater where it falls or increase rainwater infiltration so that stormwater runoff is reduced.

Objective 3: Permanently protect and/or enhance highly sensitive, priority properties adjacent to and near streams and rivers to increase the floodplain capacity.

Objective 4: Slow down rainwater runoff and reduce the frequency and intensity of heavy flash flows into streams and rivers, thereby protecting aquatic and riparian habitat, streambanks, stream and river substrate, conservation practices, and private and public infrastructure.

Objective 5: Restore and protect streams, the river, and near stream ecosystems to increase their capacity, hold storm water runoff, increase stability/resiliency during rainfall/runoff events.

Objective 6: Work with TRW Communities to implement SMART Planning practices (Specific, Measurable, Achievable, Realistic Informed, Timely Planning practices).

Objective 7: Expand management of bacteria including fecal coliform, E-coli, and other forms of bacteria that are contributed by human and non-human sources.

Objective 8: Maximize in-field management of applied nutrients to increase productivity and reduce nutrient loss from agricultural lands.

Objective 9: Work with agricultural producers to explore technological opportunities for improved water resource and nutrient management that maximizes productivity and return of investment.

Objective 10: Reduce or capture nutrient movement through subsurface drainage.

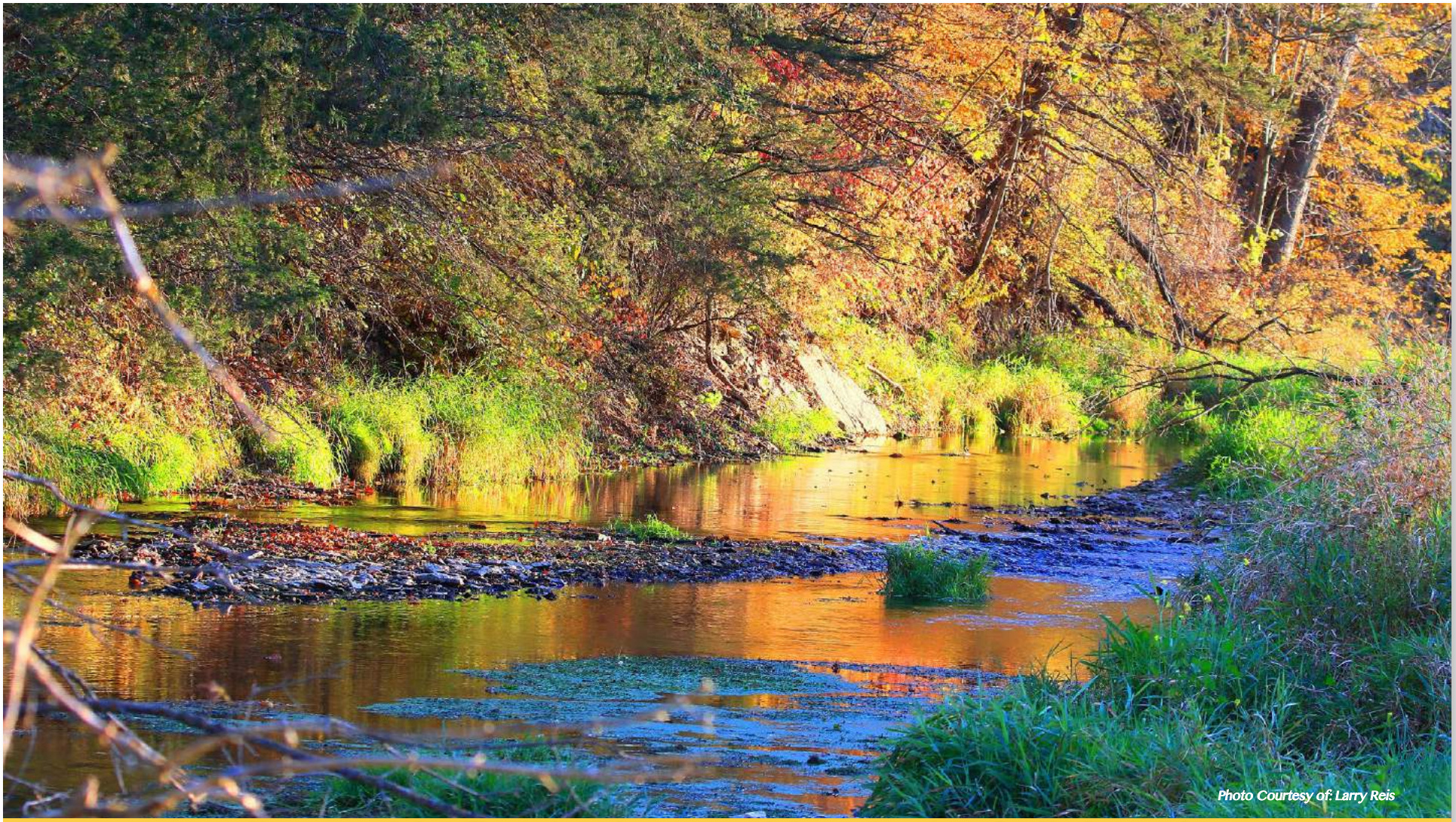
Objective 11: Work with agricultural producers to explore technological opportunities for improved water resource and nutrient management that maximizes productivity and return of investment.

Objective 12: Use existing and new education and outreach methods to engage producers and community members in all aspects of flood protection.

Objective 13: Work with TRWMA members and partners to develop and implement policy that supports a hydrologically resilient TRW: i.e. policies that help decrease stormwater runoff, lower peak flows during heavy rainfall events, and develop a landscape that is more resistant to drought.

Objective 14: Quantitatively document the hydrological, water quality, social, and policy impacts and changes that result from the implementation of this plan.

Objective 15: Research, identify, and enter into partnerships and that provide opportunities that help us understand, adapt to, and address social, structural, technological, industrial, and infrastructural changes and trends.



Coldwater streams in the Driftless Region are home to trout and other aquatic species not found in other parts of Iowa

Photo Courtesy of: Larry Reis

Section TWO

Watershed Characteristics & Demographics

Water Resources

SECTION TWO A

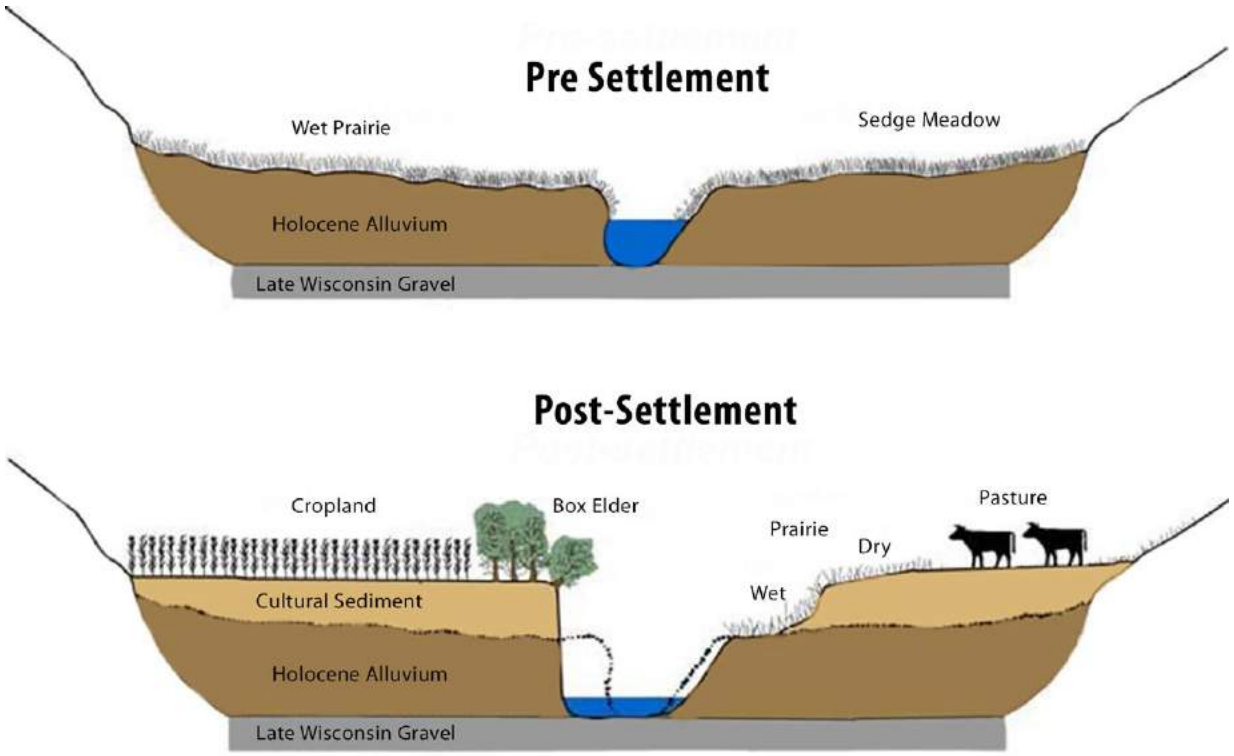
Sink Hole on Roberts Creek

2.A Water Resources: The water resources in the TRW are primarily flowing streams and rivers as opposed to lakes and reservoirs. The tributaries feeding the Turkey River are a mix of warm and cold water streams. Twenty-two such stream segments in the TRW have been designated as cold water streams by the Iowa DNR, yet each tributary type provides unique ecosystem services that become threatened by water quality issues.

Warm water tributaries in the TRW are primarily fed by surface water and subsurface agricultural drainage. These tend to be shallow, slower moving, and less meandering than cold water streams allowing more silt and sediment to deposit on the streambed. Warm water tributaries may become intermittent or lose all flow during dry periods of the year. Coldwater streams are fed by surface and subsurface agricultural drainage but are also fed by one or many coldwater springs. According to the Iowa DNR's Cold Water Use Designation Assessment Protocol, water temperatures must not exceed 75 degrees Fahrenheit under normal stream conditions between mid-May and mid-September to be designated a coldwater stream. Coldwater streams typically maintain more consistent flow throughout the year.

The Turkey River is a warm water environment for most of its length, although some coldwater species are present in certain locations. There are 84 fish species alone present in the Turkey River and its tributaries making it a very diverse fishery and ecological resource. The Turkey River, the Volga River, and the coldwater trout streams make for excellent fishing opportunities for not only residents but many visitors to the watershed.

As documented in Section 2.E of this plan, the TRW is positioned over two major landforms of Iowa, the Iowan Surface and the Paleozoic Plateau and the landscapes over these two landform regions are markedly different. The western half of the TRW, which lies over the Iowan Surface, is primarily gently rolling hills and dominated by row crop agricultural fields. The western half of the watershed is where



Incised Stream Channels Exacerbate Flooding and Water Quality Concerns

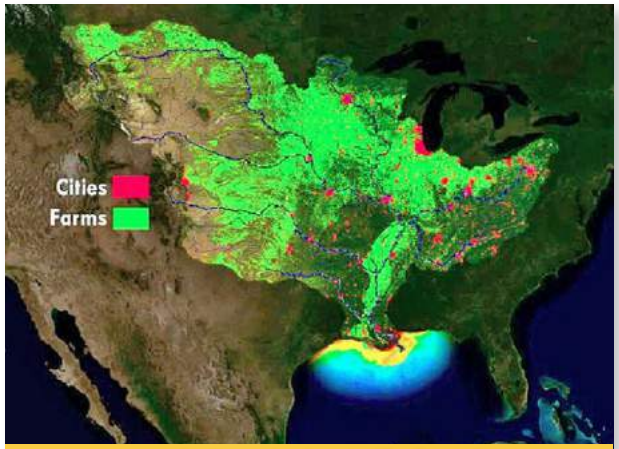
the upper reaches of many tributaries and the main stem of the Turkey River begin. Most of the surface waters in this part of the watershed are warm water environments. Sedimentation and nutrient loading are the primary concerns in this part of the watershed.

The eastern half the watershed is defined by karst topography which includes shallow depth to bedrock, sinkholes, springs and other physical features that allow for a close connection between surface water and groundwater. The Jordan aquifer provides the majority of drinking water to the eastern half of the watershed. According to State Geologist Bob Libra, "A lot of the private wells that were drilled into the Galena limestone have been replaced by wells that tap into the St. Peter Sandstone, which most view as part of the Jordan Aquifer, along with the underlying Prairie du Chien Dolomite and then the Jordan Sandstone itself." Libra also noted that most municipal wells go to deeper portions of the Jordan Aquifer to access higher yields of water. Shallow source water wells are replaced because of contamination nutrients or bacteria from surface waters. The close connection between surface waters and groundwater in this part of the watershed make source water aquifers more vulnerable to contamination than other regions.

History of Flooding & Nutrient Transport

SECTION TWO B

Fayette County Bridge Destroyed in Flood Event



Hypoxia Zone in the Gulf of Mexico

Fayette County Bridge Damaged in Flood Event

2.B History of flooding & nutrient transport:

Flooding and water quality issues in the TRW have been documented by local, state, and federal public and private entities and have been directly experienced by TRW residents, businesses, and communities. Flooding has devastated several communities in the TRW. Those most impacted by flooding have been those along the Turkey River in Clayton County but communities along the Volga River, which is a major tributary to the Turkey River, have also been impacted, as have river communities in Fayette and Chickasaw counties. Several federal disasters have been declared in the watershed counties but the flood of 2008 was especially destructive. County engineers also report flood damage to roads and bridges throughout the watershed.

In response to the 2008 Hypoxia Action Plan, Iowa officials and scientists developed the Iowa Nutrient Reduction Strategy (INRS) in 2010. The focus of the INRS is a "45% reduction in riverine Nitrogen (N) and Phosphorous (P) load", which has been determined as the primary cause for hypoxia in the Gulf of Mexico at the mouth of the Mississippi River. Iowa is the number one contributor of N and P causing the hypoxia. According to the 2014 INRS document, 93% of N and 79% of P are contributed to surface waters via non-point sources. For the TRW, the non-point sources of N and P impacting surface waters are applied fertilizer from agricultural fields and residential areas

In 2015, a poll was conducted to summarize the flood damage inflicted on the TRW counties and communities for the twenty years prior to 2015. Three communities reported no flood damage. Six communities and one county reported a total of $20.7 million damages, 105 homes lost, 79 businesses damaged or lost, and 1,518 road segments, bridges, or culverts damaged or destroyed. These figures represent only a fraction of the actual cost given that only one county, one fourth of the TRW communities reported and no agricultural loss was reported. These numbers also do not include the millions of dollars in federal FEMA funding spent on property buyouts or recovery.

Volga Bridge Washed Away in Flood Event

In 1999, the community of Volga lost 36 houses to a FEMA buyout, which covered 20 acres. All of the businesses in the main downtown district (Washington Street) were impacted. Roads and sidewalks were damaged. The town's only grocery store, restaurant, and bar never reopened. The flooding impacted the community so severely that the downtown district was declared a blighted area because many businesses remained damaged and vacant years after the flooding occurred. The dike system along the Turkey River had to be rebuilt, sewer and water lines repaired or replaced, and city property was washed away. Although the FEMA buyout helped, the resulting reduction of the property tax base due to residents relocating crippled the town's ability to repair public infrastructure or move forward with community projects.

Elkader, Iowa Flood of 2008

The TRW community of Elkader experienced severe flooding in 2008. The community spent millions of dollars in local, state, and federal funding to deal with damages. $1.8 million was invested to repair flood-damaged community infrastructure, including water and sewer lines under the river and the sewer lift station; $1.2 million was spent to replace the flood destroyed fire station; $2.2 million to buy-out flooded properties (not including redevelopment costs). The cost to private businesses and homeowners in historic Elkader, where the town's only grocery store and twenty-seven other businesses were severely damaged or destroyed, was estimated at $2 million. Flooding impacted the community again in 2014 causing another $200,000 in damage to community infrastructure, for which the city could obtain no assistance from FEMA.

Garber, Iowa Flood of 2008

Turkey River flooding has devastated several Clayton County communities, including Littleport, Elkport, and Garber, which did not have the private capital to rebuild. In some cases, last minute warnings about the rising river upstream gave residents just enough time to evacuate their homes. Many of the residents were forced to leave everything behind, and had planned to return in the morning. When they returned to Littleport, the entire town was under water with the Volga River, a tributary to the Turkey River, raging through the town. Eventually, the river receded and residents returned, but the sediment laden river water had filled most of the homes in the town with ten feet of mud.

County Road Infrastructure Damage

Flood damage to county infrastructure including roads, bridges, and culverts has occurred throughout the watershed. Clayton and Fayette County have documented the most loss and most severe damage to bridges and miles of road infrastructure. During one flood event in 2008, Fayette County resorted to removing a road that was acting as a levee in an effort to save the community of Elgin. In 2014, storm water runoff from one event impacted five hundred and thirty road segments and closed fifty-four sections of secondary roads in Fayette County. This not only caused extensive infrastructure damage to both secondary and primary roads, but also severely impacted travel in that county for several days.

Sediment Laden Turkey River Below Elkader

According to the Iowa Department of Natural Resources, water quality monitoring conducted in seven eastern Iowa rivers during 2008 floods revealed the TRW contributed the highest nitrogen and sediment yield per square mile of watershed to the Mississippi River of all seven rivers. The study compared the Turkey River and its watershed to the Maquoketa, Cedar, Iowa, Wapsipinicon, Skunk and Des Moines rivers and their watersheds. Another Iowa Department of Natural Resources study of seventy-six Iowa streams found that the Turkey River was the fourth highest contributor of sediment to the Mississippi River during normal flow.

Water Monitoring in the TRW

TRW Partners have been monitoring for N and P as well as seven additional parameters that have a direct impact on water resources. Monitoring efforts began in 2011 and 2015 marked the fifth complete year of monitoring. The samples were collected during a nine-hour span on the same day each month by professional partners from throughout the watershed. The results from 2011 through 2014 were analyzed for use in this plan. In 2015, Northeast Iowa RC&D monitored 13 subsurface tile outlets in the TRW for Total Nitrogen and Dissolved Phosphorous. The Iowa Flood Center has 5 real-time Nitrogen gauges placed in the TRW and USGS has 1 additional gauge located near Garber.

Land Ownership, Use & Major Features

SECTION TWO C

2.C Land Ownership, Use, & Major Features:

The 1,083,520-acre TRW is a very rural watershed, with no large municipality. The watershed land area extends into portions of eight counties, comprising between 24% and 70% of five of those counties. Clayton and Fayette counties are dominated by the TRW with seventy percent and sixty-nine percent of their county land areas included in the TRW respectively (Figure 2.B.1). The vast majority of the land in the TRW, 91%, is privately owned; 3.8% of the watershed is owned by county, state, or federal public entities, railroads, and unincorporated areas.

Approximately 2.6% of the land area in the TRW is within the boundaries of forty small communities (Figure 2.B.2). According to NRCS, the Turkey River Watershed is included in two Major Land Resource Areas (MLRA), 104 and 105. A MLRA is defined by NRCS as *"an area of land that has similar dominant physical characteristics including physiography, geology, climate, water, soils, biological resources, and land use."* NRCS describes MLRA 104, which encompasses the western portion of the TRW as, "covered with glacial till and outwash deposits." NRCS notes MLRA 105 has undergone only limited landscape formation by glacial ice. In their description of this MLRA they note, *"The area consists mostly of gently sloping to rolling summits with steep valley walls that join small to very large flood plains. Deep valleys, abundant rock outcrops, high bluffs, caves, crevices and sinkholes are abundant. Valleys commonly take abrupt, sharp-angled turns, indicating the local drainage network is controlled by joint patterns in the underlying bedrock."*

The land use in MLRA 104 was historically dominated by wetlands and tallgrass prairie, but is now predominantly row crop agriculture with a light mix of pasture, timber, and grassland. Tiling in this portion of the watershed has been extensively used to increase crop suitability and to maximize productivity. MLRA 105 has a higher frequency of sinkholes, sharp gullies and valleys, steep, highly erodible hillsides, and cold water streams. There are also fewer naturally occurring wetlands, a higher percentage of trees, tiling is less common, shallow soils over fractured bedrock are more prominent and there is more natural drainage.

There are an estimated 3,404 active farms in this watershed, which utilize over 52% of the watershed acres for cropping. Based on the 2012 US Census of Agriculture total crop acres per county, the majority of the crop acre in the TRW are in annual row crops of corn and soybeans. Typically these crops are grown in a set rotation of corn-beans or corn-corn-beans. The data from the 2012 US Census of Agriculture also details ownership and other cropping characteristics, including that a majority of farmland with harvested crop was cropped and harvested by the land owner or partial owner of the land. Most of the farmed land in the TRW grows only one crop for harvest per season because of climate limitations. Corn and soybeans, the most commonly grown crops, are typically planted in May-June and harvested in October-November. Some corn acres are harvested in late August and September for silage. A majority of row crop agriculture producers use conventional tillage prior to planting. Although all county Soil and Water Conservation Districts (SWCDs) in the TRW report use of no till practices in their counties, the total number of acres varies annually and there is currently no estimate of total no till acres in the TRW. Since corn and soybeans are planted in May-June, conventionally tilled fields are most vulnerable to runoff and erosion directly before and after planting before crops have become established. This intense tillage and planting period coincides with the months that have the highest mean average of precipitation for the year, typically May and June. Land use in the TRW, calculated from NASS Cropland Data layer at a thirty meter resolution is provided in more detail in Figure 2.B.3.

According to the TRW Assessment conducted by Iowa NRCS (RWA) in March 2012, in addition to the cropland, 27.3% of the watershed is in pasture or hayland, 14.4% is in woodland or natural areas, 5.3% is developed urban land use, 0.2% is water and 0.5 percent is in wetlands. The majority of the pasture and hay/meadow acres recorded by NRCS are found in the eastern half of the watershed, which has traditionally been a holdout for

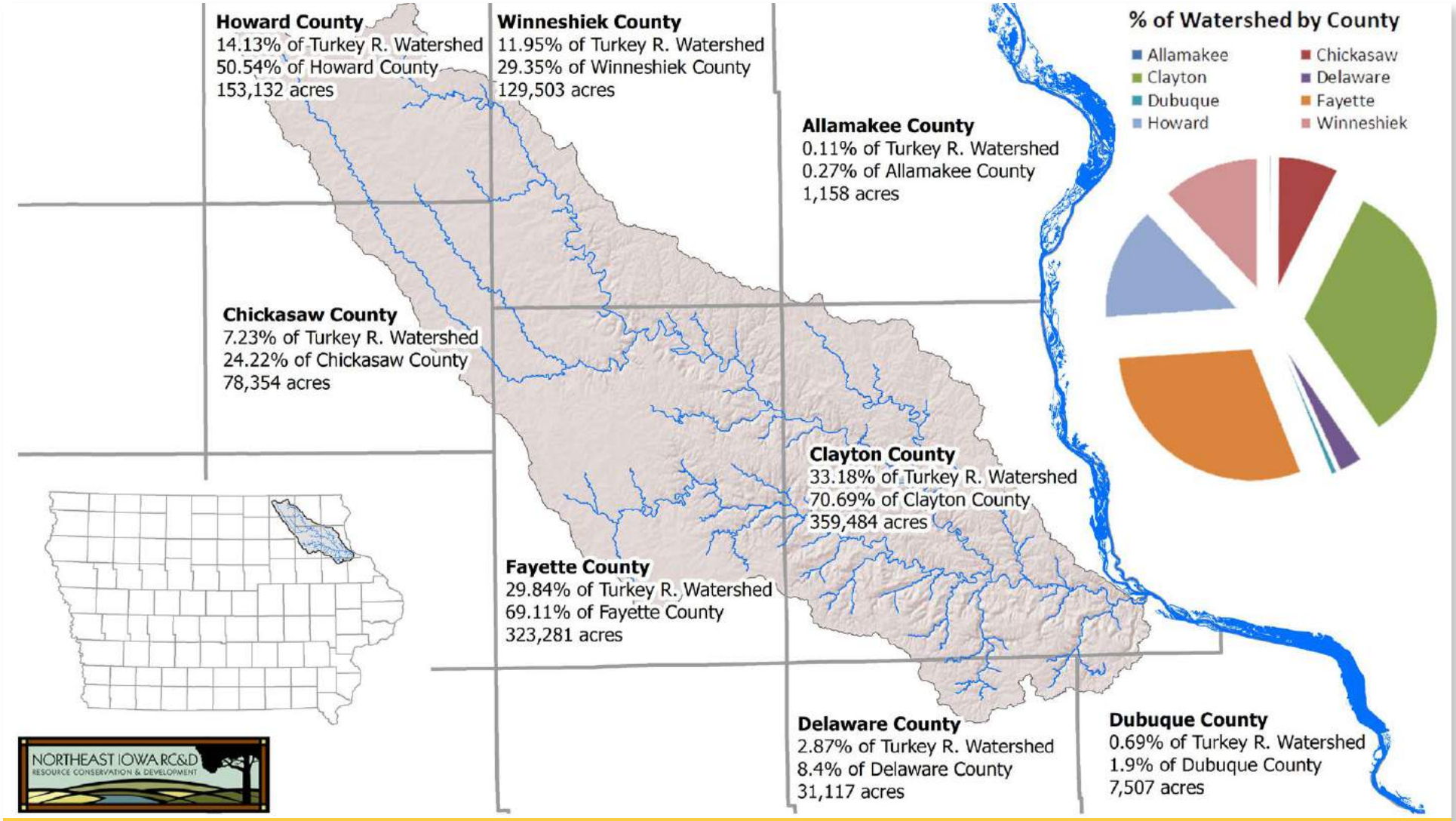


Figure 2.C.1 Turkey River Watershed: Land Area by County

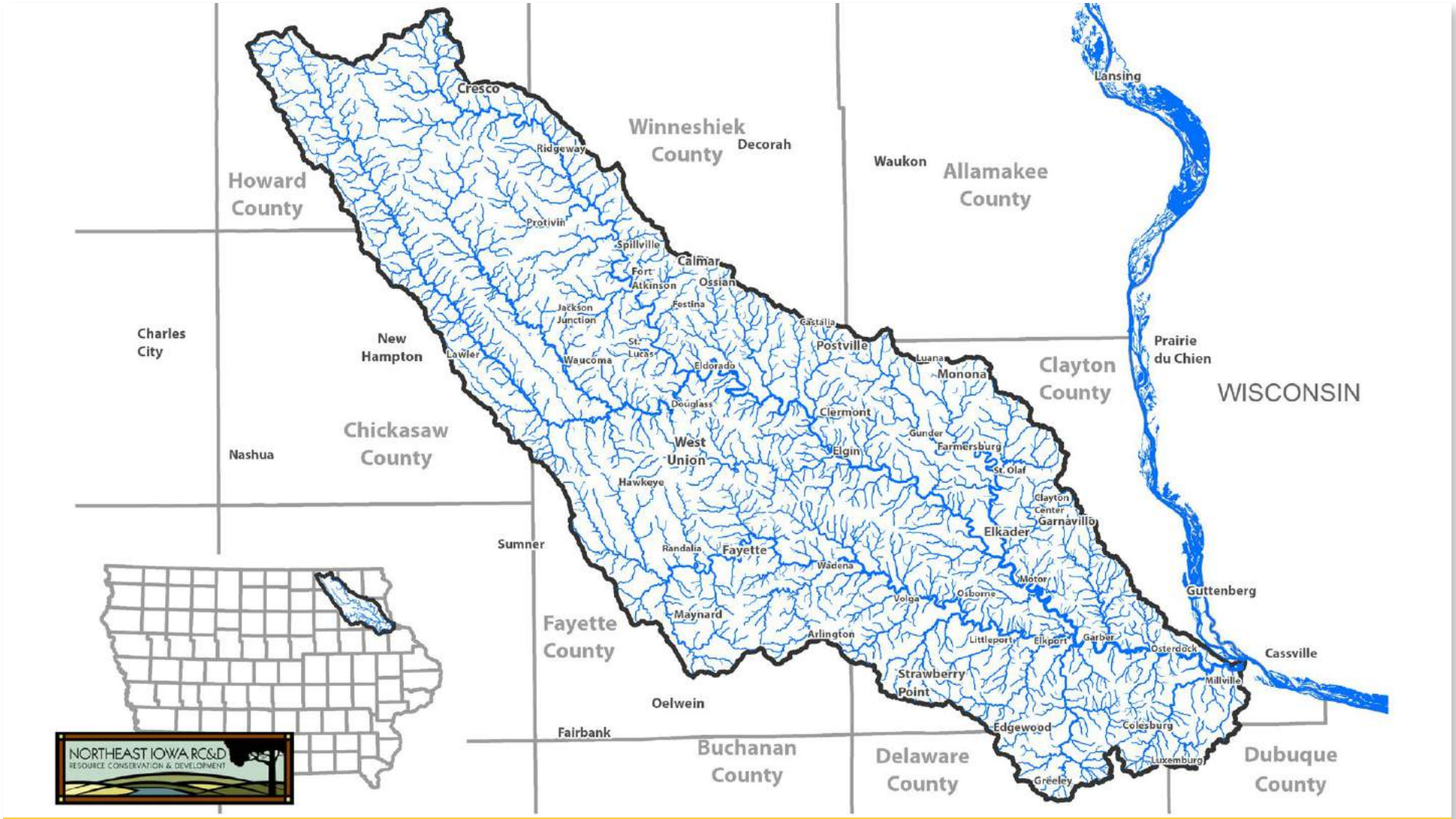


Figure 2.C.2 Turkey River Watershed: Communities

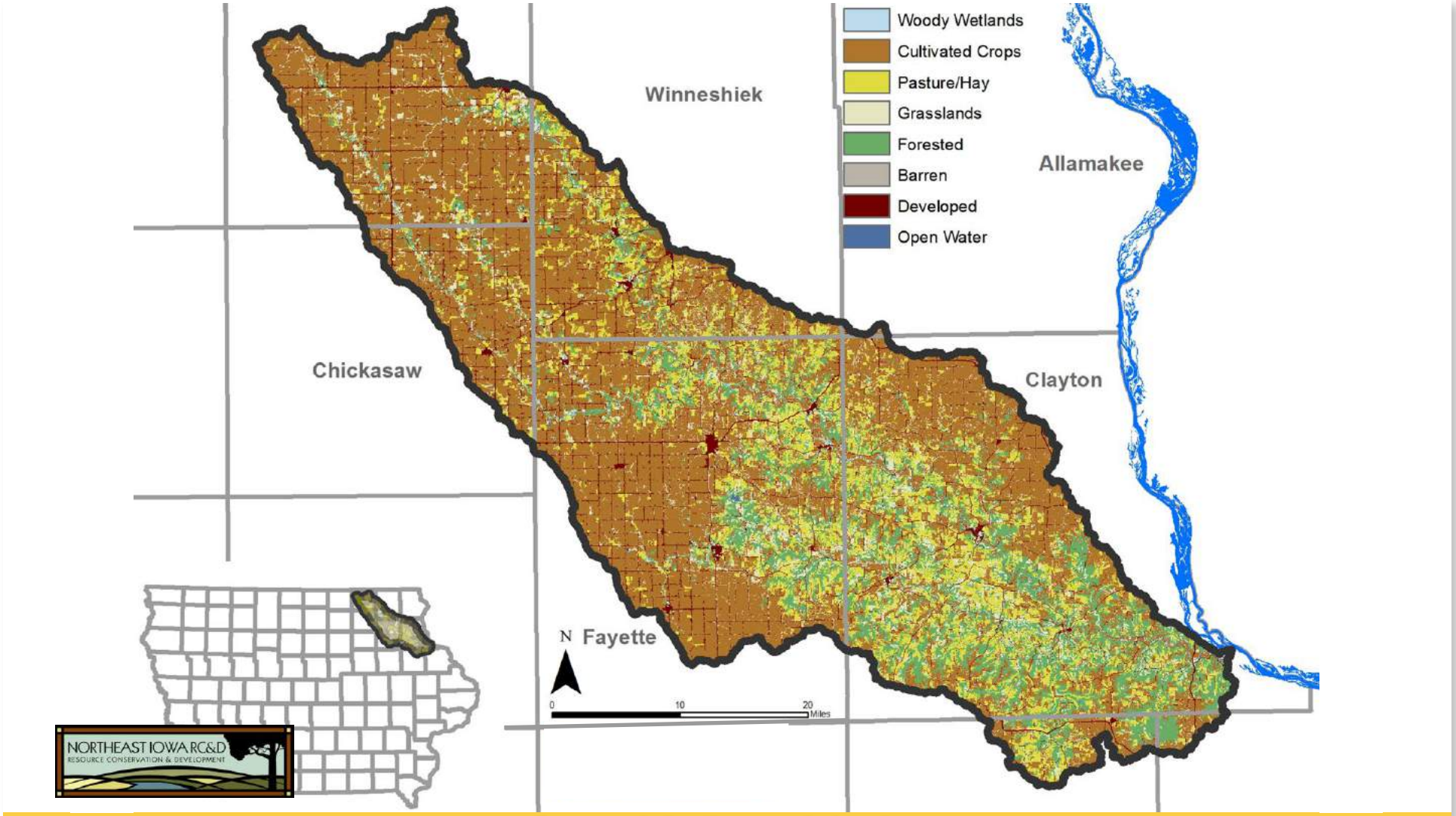


Figure 2.C.3 Turkey River Watershed: Land Use

dairy and cattle producers. However, as commodity crop prices have increased and dairy and beef prices have fluctuated, more acres, including some of the steep slopes, that were historically converted from woodland to pasture and hay, have been converted to row crop, creating a significant shift in percentage acres of hay/meadow to soybean and corn production in the watershed over the past decade. The conversion of acres of grassland/wetland/shrubland between 2008 and 2011 in the two dominant TRW counties, Fayette and Clayton, was at some of the highest levels of any county in Iowa. This conversion can been seen in relation to the conversion of acres in other Iowa counties in the *Figure 2.B.4, Acres Converted from Grassland, Wetland and Shrubland Converted (2008-2011)* developed by the Iowa Environmental Working Group. The increase in corn acres in the watershed is illustrated in a map of *Corn Production Increases in Iowa, Change in Corn Acres by County in Iowa 2000-2010,* found in Appendix 1: Additional Maps, Figures and Charts.

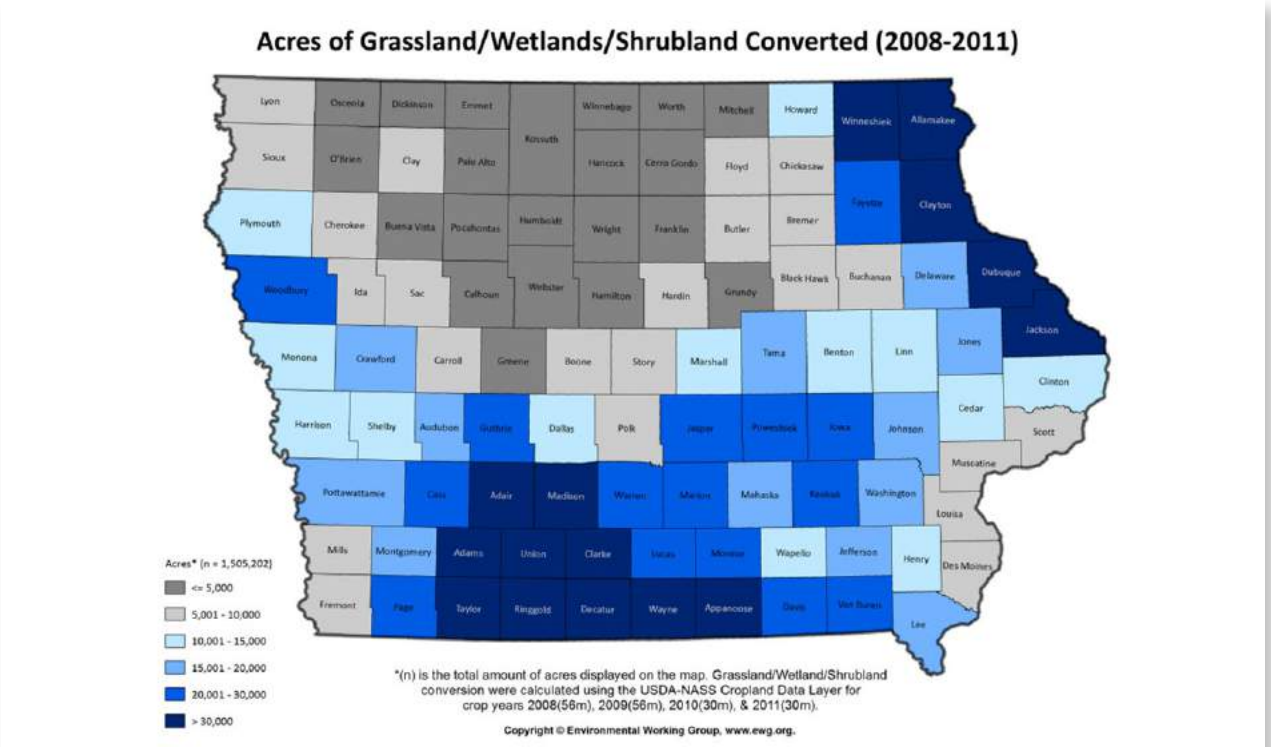


Figure 2.C.4 Acres Converted from Grassland, Wetlands and Shrubland (2008-2011) (Map by IEWG)

SWCD offices in the TRW report increased interest in, and use of, cover crops. Clayton County SWCD reports an increase in cover crop acres from 1,500 acres in 2012 to 5,500 acres in 2013. This management trend mirrors the use of cover crops in Iowa, which, according to Practical Farmers of Iowa (PFI), saw a huge statewide increase in total acres of cover crops, from less than 10,000 acres in 2009 to as many as 300,000 acres in 2013. PFI reports on their website,. "*In the 2012 Census Iowa farmers planted 379,614 acres of cover crops. Considering that the timing of the Census of Ag survey reached Iowa farmers prior to the most recent cost share program from the Iowa Department of Ag and Land Stewardship it's safe to estimate that total cover crops planted during the fall of 2013-2014 was closer to 450,000 acres in Iowa.*" Cover crops planted in the TRW include small grains, legumes, brassicas, and other plants that are planted between cash crop seasons to keep a living cover on the landscape. Several studies have shown these plants improve soil health, build

topsoil, increase infiltration, protect soil, and improve water quality. According to PFI, they have also been shown to reduce chemical input costs, improve farm resiliency, boost yields, increase forage availability, and improve wildlife habitat.

Although woodlands and natural area acres cover 14.4% of the TRW, similar to the hay/meadow acres, the woodland acres are more prevalent in the eastern third of the watershed where there is a higher concentration of highly erodible lands (D and E slopes) with fragile forest formed soils. Northeast Iowa, including eastern portions of the TRW, is known for its hardwood tree production, particularly walnut trees, which are considered by many buyers as being of the highest quality in the world. The high prices these trees command have historically encouraged both tree harvest and planting. Direct seeding, a popular planting method that spreads a diverse mix of nuts across the field, and tree seedling planting, have been used by landowners in isolated instances throughout the watershed for over twenty years. The majority of the mature woodland acres are incorporated into the landscape at strategic positions, historically influenced by soils, depth to bedrock, slope, and other topographic and landscape factors. Common woodland landscape positions in the TRW include riparian areas, steep hillsides and gullys, and areas with poor soil and/or shallow depth to bedrock.

Common Forest Landscape in the Turkey River Watershed

The RWA found that trees in the bottomland floodplains of the TRW "*are being severely impacted from scour erosion, river meandering, and extreme sand and silt depositions from frequent flooding (probably ranging from 3 to 6 year intervals between floods that are so severe they could almost be called, "stand replacing disturbances").*"

The RWA noted that, as flooding has devastated cropland and riparian areas, producers have worked with USDA/NRCS to take cropland out of production. The NRCS Watershed Assessment identified 41 USDA/NRCS conservation easements totaling 2,460 acres including Emergency Watershed Protection (EWP) program, Wetlands Reserve Program (WRP), and Emergency Wetlands Reserve Program (EWRP). They also noted that easement acres are divided across the watershed as follows: 54% of the easements acres are in Fayette County, 36% in Clayton County, 6% in Howard County, 3.1% in Winneshiek County, and the remaining 0.9% in Chickasaw County.

Local resource professionals report a need for, and producers have expressed interest in, additional enrollments in these programs. Unfortunately, local natural resource professionals report that USDA/NRCS program funding allocations and timing for these programs have limited landowner participation in the TRW. The specific location of the easements in the TRW can be seen in the Iowa Rapid Watershed Assessment Turkey River - NRCS Conservation Easement Map.

The TRW has three of the most effective Pheasants Forever (PF) chapters in the United States. Clayton, Fayette, and Winneshiek county PF chapters consistently rank among the top ten and frequently in the top five chapters in the nation for habitat development. These PF chapters have partnered with dedicated producers, local SWCDs, and USDA to enroll tens of thousands of highly erodible cropland acres into the Conservation Reserve Program over the past two decades. In recent years, a high percentage of CRP acres have been native grass and/or forb plantings, varying in diversity from a limited number of native grasses to diverse pollinator mixes. When commodity crop prices have spiked, some CRP acres have been converted back to row crop in the TRW. However, in 2014 the trend reversed and Clayton, Fayette, and Winneshiek county PF chapters ranked 4th, 5th, and 6th in the nation for 2014 habitat restoration, the majority of which were CRP acres.

The majority of public roadsides in the TRW are managed by county government, specifically county engineers and their staff. There are 2,729 miles of county roads in the TRW and 178 miles of roads located within TRW communities. The county gravel roads have varying widths of right of way of 66 feet, 33 feet from center of road to edge of right of way per side being the most common. Paved county roads, in general, have wider right of way, ranging from 80-100 feet (or greater) rather than 66 feet. These acres constitute significant public land holdings for a limited number of land managers, i.e. the TRW county engineers/roadside managers. The TRW has diverse native and restored plant communities in many of these public roadsides, which are documented to have water retention and erosion control benefits. Fayette County has the oldest and one of the most active Integrated Roadside Vegetation Management (IRVM) programs in the nation and is know for its use of deep-rooted, native plants. The Fayette County GIS Manager, Joe Biver, estimates that in the Fayette County portion of the TRW, 3,800 acres of county right of way are under the jurisdiction of Fayette County, increasing the county's infiltration and flood control.

County roads in the TRW intersect with 1,638 natural flow paths, requiring county engineers to plan and manage for surface water and storm water runoff throughout the watershed. Although *Figure 2.B.5 Stream Intersection Points with County Roads Map* illustrates the relationship of county roads to natural flow paths, the intersection of roads and flow paths does not necessarily indicate the exact locations of culverts, bridges, or other structures. Some County Engineers have paper documentation of location and size of culvert and bridges and some have begun digitizing this information. However, there is currently no digital database for the TRW that details this specific information.

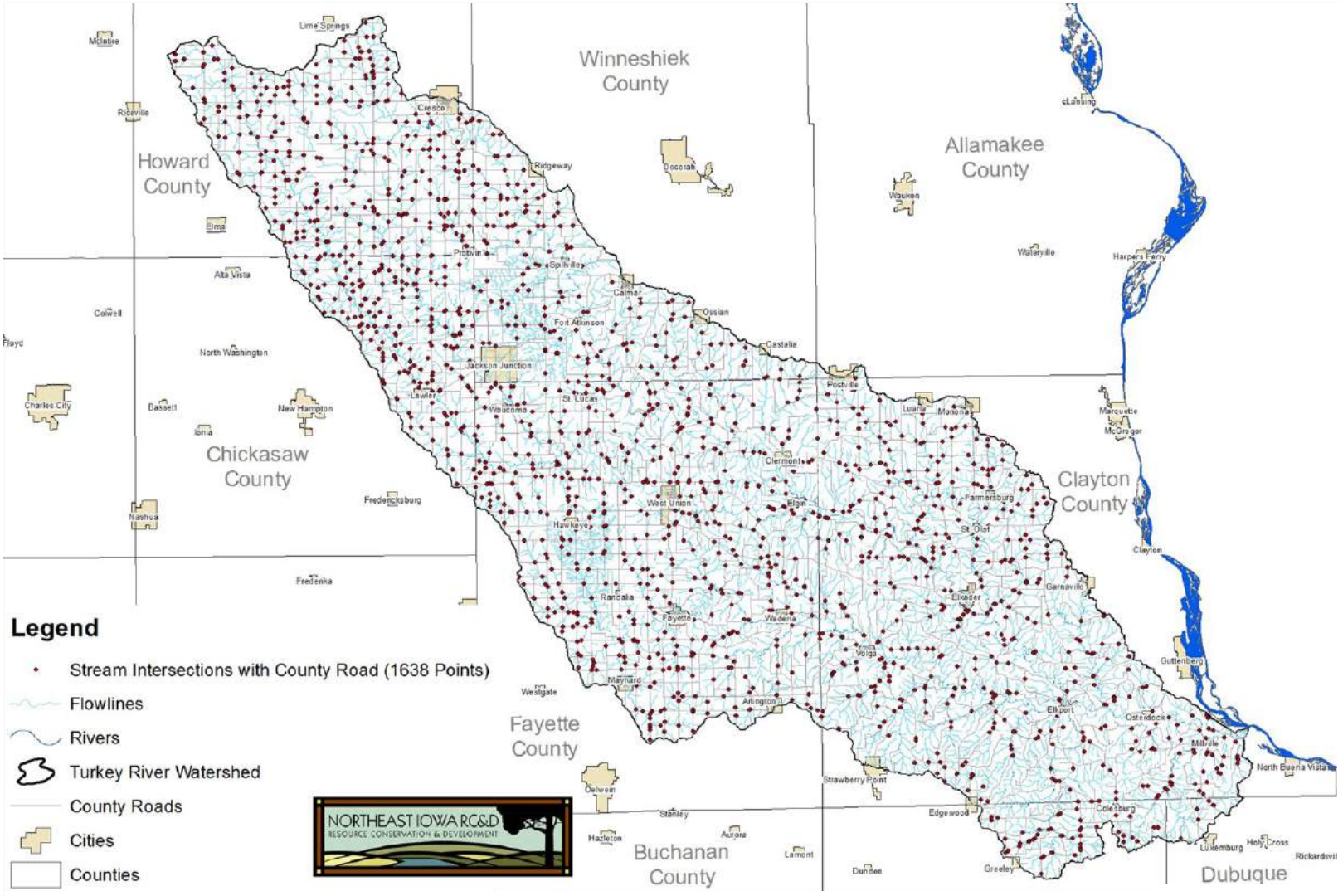
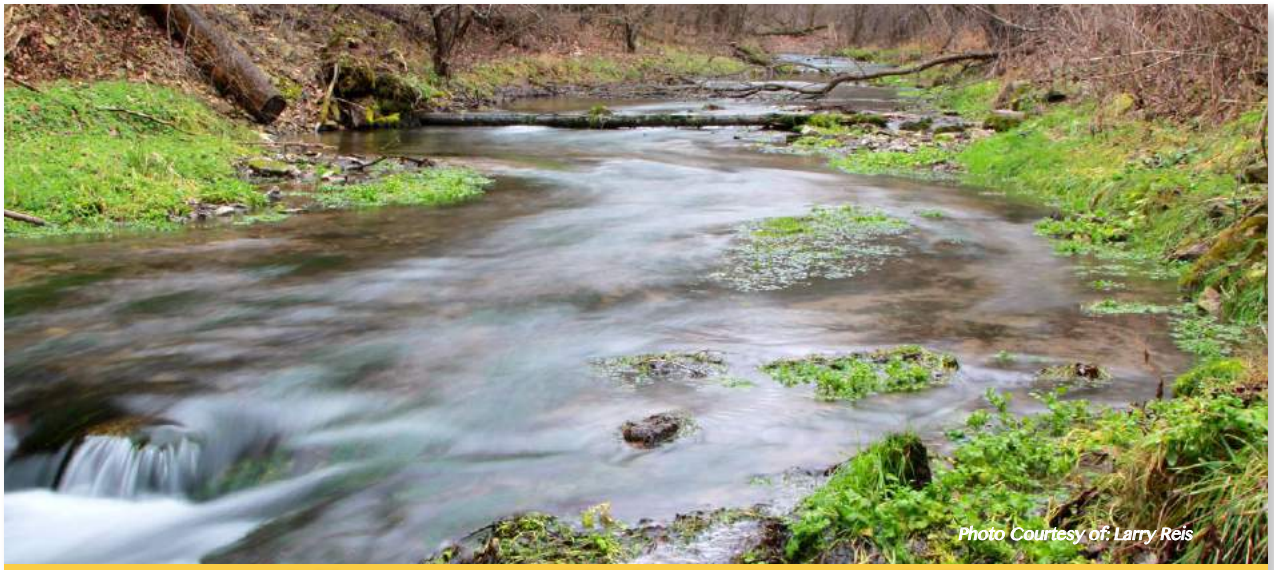


Figure 2.C.5 Stream Intersection Points with County Roads Map

Water Resource Concerns

SECTION TWO D



Coldwater Streams are High Value Water Resources in the TRW

2.D Water Resource Concerns:

1. Nitrogen: In regards to water resource improvement, reducing excess Nitrogen is the highest priority in the State of Iowa and in the TRW. Nitrogen is typically found in water as Nitrate, Nitrite, and in an organic form. Water sampling results in the TRW measured total Nitrogen (Nitrate + Nitrite). The primary source of N is from fertilizer used for plant stimulation in agricultural and residential settings. Nitrogen is a particularly effective fertilizer for growing corn and Iowa is the leading state in the United States in corn production. Nitrogen is also used as fertilizer for residential lawns and gardens.

Nitrogen is also highly soluble in water which makes it highly mobile in the ecosphere. Excess N not taken up by plants or N that dissolves into rain water before it can be used by plants becomes a water pollutant. Nitrogen has a similar effect on plants in water as on land by stimulating plant growth. This can lead to eutrophication in inland waters and hypoxic conditions in coastal waters such as the Gulf of Mexico. Nitrogen and Phosphorous are the primary contributors to eutrophication and hypoxia in the US. Because of its mobility, N can also contaminate drinking water sources and this is particularly concerning in the TRW where surface and groundwater are closely connected. According to the Environmental Protection Agency (EPA) "EPA has set an enforceable regulation for nitrate, called a maximum contaminant level (MCL), at 10 mg/L or 10 ppm. MCLs are set as close to the health goals as possible, considering cost, benefits and the ability of public water systems to detect and remove contaminants using suitable treatment technologies. In this case, the MCL equals the MCLG, because analytical methods or treatment technology do not pose any limitation."

Water sampling in the TRW at 50 sites indicates that N levels are on the rise since 2011. For all sites sampled, mean concentrations of N have risen from 6.4 mg/L to 7.3 mg/L. Mean N has also increased in all testing sites of the main stem of the Turkey River. Nitrogen concentrations are generally higher in the upper reaches of the Turkey River and western part of the watershed. Major tributaries such as Crane Creek and the Little Turkey River have also shown increased N concentrations since 2011. Of 50 sites, 35 sites averaged N levels higher than the statewide average of 5.8 mg/L. Mean N concentrations in Dry Mill Creek in Clayton County and Rogers Creek in Winneshiek County were higher than the drinking standard of 10 mg/L over four years of sampling.

Mean N levels from these sampling results are skewed low because of very low levels tested in 2012 which was a drought year for the TRW and actual averages would be slightly higher with this data removed. Sub-watersheds with the highest N levels corresponded with areas with the most intensively agricultural areas of land use.

Subsurface tile outlet monitoring conducted in the TRW indicates that agricultural tile outlets are major contributors of N to surface waters. Of sites tested in the TRW, the total range of N concentration values was .2 – 75 mg/L with a mean value for all sites of 18 mg/L. Results indicate ag tile outlets are contributing N to surface waters at a much higher concentration than exists in the stream in normal conditions.

2. Phosphorous: Phosphorous is another important nutrient listed as a priority in the State of Iowa and for the TRWMA. Like N, Phosphorous occurs naturally and is relied on by animals and plants but it is typically found in very low concentrations. Even small increases in P concentrations in an aquatic environment can send the system into production over drive causing booms in aquatic plant and algal growth. When this happens, the excess plants and algae eventually die which depletes dissolved oxygen in the system. According to EPA, "phosphorus usually exists as part of a phosphate molecule (PO_4). Phosphorus in aquatic systems occurs as organic phosphate and inorganic phosphate. Organic phosphate consists of a phosphate molecule associated with a carbon-based molecule, as in plant or animal tissue. Phosphate that is not associated with organic material is inorganic. Inorganic phosphorus is the form required by plants. Animals can use either organic or inorganic phosphate. Both organic and inorganic phosphorus can either be dissolved in the water or suspended (attached to particles in the water column)."

Similar to N, sources of P are generally associated with fertilizers for agriculture or residential settings. Other sources of P are wastewater treatment facilities, septic systems, commercial industry, and from animal manure storage areas. Sediment deposited on streambeds or in riparian areas can be a source of P if sediment particles are picked up by moving water. This can make P testing tricky because it is not always clear whether P measurements are newly introduced to the system by runoff or have been present in deposited sediment and have been mobilized. More research is necessary to determine this relationship.

The typical range for Total P in Iowa Rivers is .11-.34 mg/L with an average of .2 mg/L. Total P levels in the TRW for all sites tested is .18 mg/L and falls within the typical range for Iowa Rivers and slightly below the statewide average. Three sites had a mean value higher than the typical statewide range; Silver Creek in Clayton County and two Unnamed Stream sites in Clayton County. It should be noted that Silver Creek tested much lower in 2014 than in 2012 and 2013 which may indicate improvement of Total P loss in this watershed.

Total P levels trend higher from 2011 to 2014 in the Turkey River main stem and across all sites tested. Levels of Total P also trend higher from west to east which is inverse to the geographic patterns of Nitrogen concentrations. This is likely explainable by N concentrations being diluted as it moves through the TRW system whereas Total P becomes more concentrated from higher sediment loads being carried by the lower reaches of the Turkey River and major tributaries.

Subsurface agricultural tile outlet monitoring was also conducted in the TRW for Dissolved Phosphorous. Of sites tested in the TRW, the total range of N concentration values was .1 – 1.2 mg/L with a mean value for all sites of .23 mg/L. Many tile outlets did not register measurable Dissolved P values consistently between testing periods making it difficult to determine patterns and causes of high contributions of Dissolved P from ag tile outlets.

3. Ammonia: Ammonia is another form of Nitrogen that can be present in aquatic environments and is primarily sourced from commercial fertilizers, concentrated animal or human waste, and industrial applications. Ammonia is a toxin to aquatic life when reaching high concentrations. What is considered high concentration varies based on PH levels and temperature. As PH levels and water temperature decrease, the toxicity of Ammonia to aquatic life increases. EPA recommends "a chronic criterion magnitude of 1.9 mg TAN/L at pH 7 and 20 degrees C for a 30-day average duration, not to be exceeded more than once every three years on average", however sensitive fish species, such as rainbow trout, may begin to die when concentrations reach .2 mg/L.

Water sampling in the TRW included testing for ammonia from 2011 to 2013. In 2011, 25 of 46 of sites tested, including the Turkey River main stem, resulted in levels of ammonia too low to detect (less than .05 mg/L). The number of sites not registering measurable amounts of ammonia in 2012 decreased slightly from 2011, 21/46 sites. In 2013, nearly all (45/48) sites registered measurable amounts of ammonia and the mean value for all sites tested was .13 mg/L. Although it is a small sample size, results indicate ammonia levels are rising across the TRW and nearing levels of toxicity to aquatic life. Five sub-watersheds had a mean value of .1 mg/L between the three years tested.

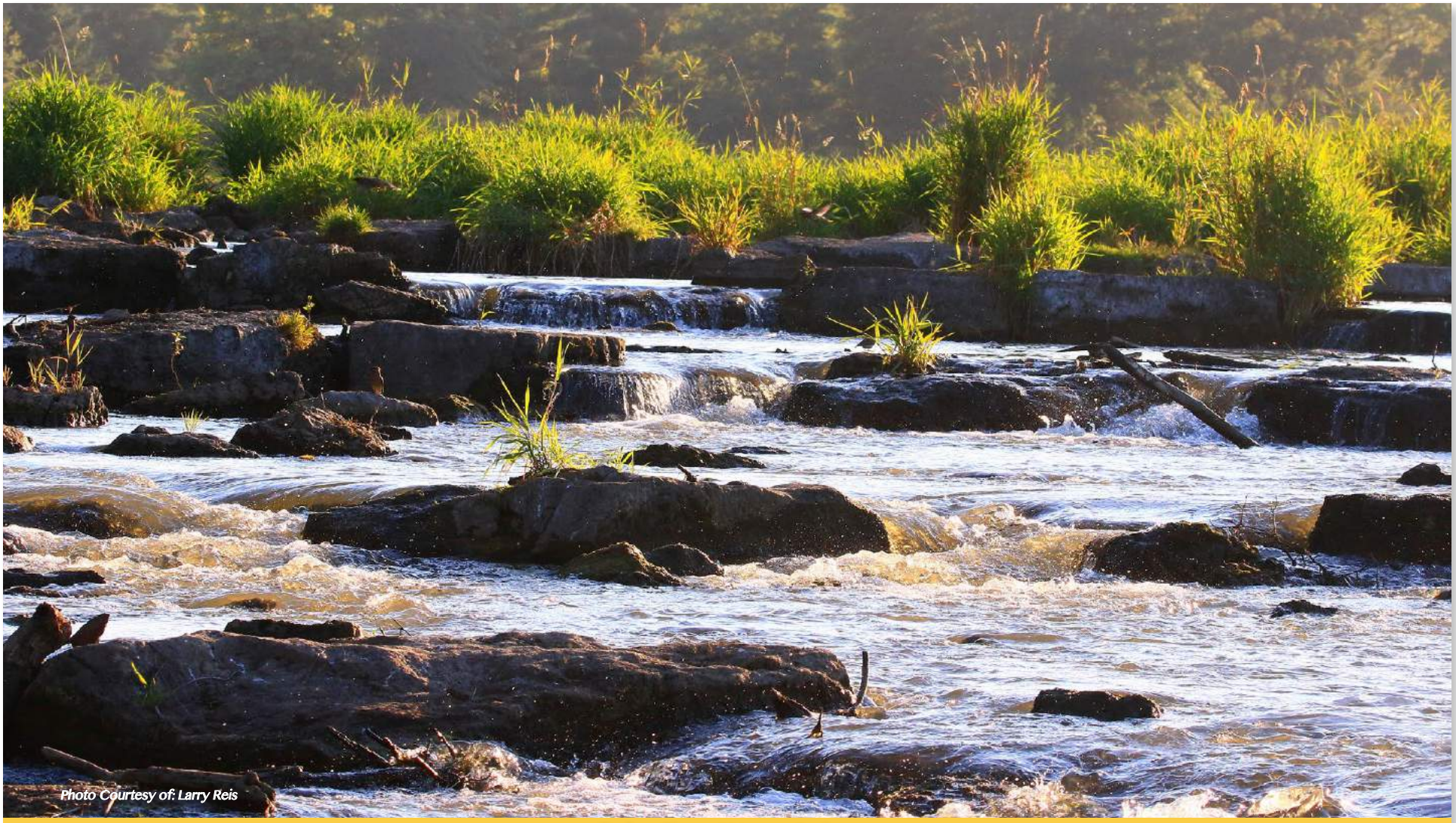
4. Chloride: Most surface and groundwater naturally contains some level of chloride in variable concentrations. chloride becomes a problem if found in very high concentrations (greater than 250 mg/L). Primary unnatural sources of chloride in aquatic systems include point and non-point sources such as wastewater from industry and municipalities, road salt, and agricultural runoff.

Water sampling for chloride in the TRW was conducted from 2011 to 2014. Results from chloride testing indicate very low to unmeasurable concentrations in all sites and all years tested. While this indicates chloride is not a primary concern in the TRW, continued monitoring is recommended.

5. Dissolved Oxygen: In terms of oxygen production, aquatic systems function similarly to terrestrial systems in that oxygen is produced by living plants and consumed by living organisms. Healthy aquatic systems produce more oxygen than is consumed. Oxygen in aquatic systems is measured through the dissolved form (DO). Similar to terrestrial systems, aquatic systems experience diurnal variations in DO levels from the nighttime respiration of plants. Dissolved Oxygen levels are also affected by water temperature. As water temperatures increase, DO levels decrease. Dissolved Oxygen levels do not necessarily have a significant direct impact on human uses for water, such as for drinking, they are extremely important for aquatic life.

6. Turbidity/Transparency: The measure of water clarity is called turbidity or transparency and indicates the amount of light that is passing through the water. Turbidity levels are typically driven by the amount of suspended sediment particles are present in the water column. High turbidity is caused by increased sediment in the water such as after a heavy rainfall event or in areas with high erosion. Sediment deposited on stream beds can also be disturbed by bottom feeding fish (carp) which leads to increased turbidity. Waters with high turbidity are typically warmer and depress the growth of vegetation leading to increased water temperatures and lower DO levels.

Turbidity measured in the TRW from 2011 to 2014 did not trend one way or another. 2013 had the lowest mean turbidity level which corresponds with the highest precipitation levels of the years tested. Higher turbidity levels in periods of heavy rains indicates high levels of erosion and sediment entering surface waters. Smaller tributaries were more likely to average lower turbidity. The Turkey River main stem averaged 60+ cm of transparency in the upper reaches to as low as 29 cm at the most downstream sampling location. This pattern is true in most stream environments.



Turkey River at Vernon Springs

7. pH: The measure of acidity or alkalinity of water is known as pH. pH is measured on a scale of 1.0 (highly acidic) to 14 (highly alkaline) with neutral value of 7.0. Most aquatic ecosystems function best with pH values of 6.5-8.0 according to EPA and levels outside of this range can stress organisms living in the system. Levels of pH are impacted by atmospheric deposition, surrounding rock, and wastewater discharges.

From 2011 to 2014, pH levels in the TRW showed very little variance between sites with mean values between 8.0 and 8.5 or between years with values between 8.2 and 8.3. The pH values in the TRW are slightly more alkaline than the 'typical' expected range because the surrounding bedrock of streams in the TRW is primarily limestone which is an alkaline rock.

Fish Presence Can Indicate Clean Water

8. Fecal Bacteria: There are many different forms of bacteria and pathogens that carry health risks for people and animals. However, it is very time consuming and expensive to test for all possible known pathogens. Therefore, indicator tests are conducted to measure the likelihood of contracting a sickness from contacting or ingesting water. According to EPA, E-coli is the most accurate test to determine correlation between bacterial indicators and occurrence of digestive system illness. The State of Iowa has a standard for E-coli of 126 CFU (colony forming units)/100mL (colony forming units per 100 milliliters of water) for a geometric mean (minimum of 5 samples per year) and a one test standard of 235 CFU/mL. These water quality standards are based on acceptable risk levels to human health. The primary sources for contamination from bacteria include wastewater treatment plants, septic systems, and animal waste (wild and domestic).

Bacteria in the TRW is measured in MPN(most probable number)/100mL which is considered the equivalent of CFU/100mL by most sources. E-coli testing in the TRW data from 2011 through 2014 indicate levels of bacteria higher than the Iowa standard for geometric mean of 126 CFU/mL for all but three sampling locations. Results indicate that 2013 was a particularly bad year for bacteria which is related to the high amounts of precipitation and runoff during the sampling season. Seven sampling sites averaged higher than 1,000 MPN/100 mL over four years which indicates a significant bacteria source in those sub-watersheds. Two sub-watersheds tested with mean values over 1,000 MPN/100 mL in three out of four years tested, Brockamp Creek in Winneshiek County and Bohemian Creek in Howard and Winneshiek Counties. These two watersheds receive top priority for identifying and implementing bacteria reduction practices.

9. Impaired Waters: There are 56 segments of the Turkey River or tributaries that are listed on the Iowa DNR's 2014 303d list. Thirty six of the listed segments have bacteria listed as the cause for listing. Other listed impairments include: mercury in fish, pH, biological (low biotic index), organic enrichment/low Dissolved Oxygen, Ammonia, thermal modifications, and biological (fish kill from ammonia).

10. Temperature: Water temperature in streams is an important limiting factor for aquatic life. Water temperature is one of the determining factors of what sort of ecosystem a given stream is and the suite of species that make up that ecosystem. Temperature is highly variable based on natural and unnatural factors. Natural factors impacting water

temperature in a stream would be seasonal and daily air temperature changes, current speed and circulation, stream bed type, water clarity, runoff, and riparian vegetation. Unnatural factors impacting water temperature include eutrophication from nutrients, inhibited flow (i.e. dam or levy stopping flow), warm water discharge, subsurface ag tile outlets, and runoff in urban environments.

Because temperature and dissolved oxygen are closely related, they are analyzed together here. Water temperatures sampled in the TRW are nearly uniformly higher in 2011 and particularly 2012 than in 2013 and 2014 sampling seasons. This is largely explainable by higher mean air temperatures and lower rainfall totals than in 2013 and 2014. Because Dissolved Oxygen is limited by water temperature, it is logical for DO levels to follow a similar pattern over the same period of testing. In actuality, the opposite is true with DO levels trending down slightly across when comparing the mean values of all sites tested. Clear patterns were not evident when investigating individual sampling sites. This is largely due to the many factors impacting these two parameters. Dissolved Oxygen levels varied between 7.2 and 10.8 mg/L which is above Iowa's Water Quality Minimum Standard of 5 mg/L for warm water streams but below the overall Iowa average of 10.5 mg/L.

Temperature (C)	DO (mg/l)	Temperature (C)	DO (mg/l)
0	14.60	23	8.56
1	14.19	24	8.40
2	13.81	25	8.24
3	13.44	26	8.09
4	13.09	27	7.95
5	12.75	28	7.81
6	12.43	29	7.67
7	12.12	30	7.54
8	11.83	31	7.41
9	11.55	32	7.28
10	11.27	33	7.16
11	11.01	34	7.16
12	10.76	35	6.93
13	10.52	36	6.82
14	10.29	37	6.71
15	10.07	38	6.93
16	9.85	39	6.51
17	9.65	40	6.41
18	9.45	41	6.41
19	9.26	42	6.22
20	9.07	43	6.13
21	8.90	44	6.04
22	8.72	45	5.95

Table 5.10

Maximum dissolved oxygen concentrates vary with temperature

Soils

SECTION TWO E

Increasing Organic Matter, Reducing Tillage & Improving Soil Health Can Reduce Infiltration & Runoff

2.E Soils: Soils are an important component of the TRW that must be considered in watershed planning and hydrologic considerations. The landscape position and parent materials in which soils are formed are among several factors that impact soils type and drainage characteristics in the TRW. Land use and the use of artificial drainage has impacted drainage characteristics and are themselves influenced by soil type, which vary greatly across the 1,080,000 acre TRW. Soil type, organic matter, and soil health, which is tied to all the aforementioned and other factors, also greatly impact water holding capacity, infiltration, and runoff.

Iowa NRCS State Soils Scientist, Rick Bednarek presented to the TRWMA Board about the importance of soil quality and organic matter noting that whereas poor quality, compacted soils can hold a minimum amount of rainfall, healthy soils act as a sponge. He explained that, "*The more organic matter in the soil, the more water holding capacity you have in the soil and in the watershed. Healthy soils may hold 16,000 and 20,000 gallons/acre per percent of organic matter. Infiltration is another soil characteristic that can be improved with organic matter and other factors. Soil quality refers to the inherent qualities of the soils, whereas, soil health is related to the more dynamic properties of the soil that change due to management including microbiology, organic matter etc.*"

He also noted that the plow pan, which can be from 6-7 inches in depth, is a compacted layer that forms from soil disturbance. The plow pan restricts water movement into the soil and increases runoff. Decreased disturbance and the resulting increased soil health can break down the plow pan and increase infiltration. Bednarek stated, "*The use of cover crops helps break up the plow pan at a faster rate than the use of no-till alone.*" He also recommended the use of the principles of soil health as detailed in the USDA/NRCS national campaign for soil health including the following:

1. The physical properties of the soil, including bulk density, infiltration, soil structure and macropores, soil depth, and water holding capacity influence retention and transport of water and nutrients; habitat for soil microbes; estimate of crop productivity potential; compaction, plow pan, water movement; porosity; and workability.

2. Residue year round - Year round residue will decrease the direct impact of the raindrop USDA/ NRCS provides guidelines for soil health assessment in a publication "Guidelines for Soil Quality Assessment in Conservation Planning", which also provides the following indicator examples and relationship to soil health.

Healthy Soil

3. Little or no disturbance - No till or strip till increase infiltration, help build organic matter levels, increase pore space, and help aggregate stability. Conversely when fields are tilled the microbial balance is decreased as is organic matter and pore space. Moving the soil breaks down the aggregate stability. This seems counter intuitive to some producers who think that if they plow and disturb the soil it will make the field more absorbent but that is not the case.

4. Chemical properties such as electrical conductivity, reactive carbon, soil nitrate, oil pH, and extractable phosphorus and potassium influence biological and chemical activity thresholds; plant and microbial activity thresholds; and plant available nutrients and potential for nitrogen and phosphorous loss.

5. Biological factors such as earthworms, microbial biomass carbon and nitrogen, particulate organic matter, potentially mineralizable N, soil enzymes, soil respiration, and total organic carbon influence microbial catalytic potential and repository for carbon and nitrogen; soil productivity and nitrogen supplying potential; and microbial activity measure.

6. Living roots year round - Living roots are the most active source in the soil for microbes, where they get their food, making them an important component of healthy soils.

7. Diverse Crop Rotation and/or Cover Crops - Corn and soybeans rotations are not diverse in their own right. However, cover crop mixtures can help producers add 6-8 or more species/cover crop, providing food for microbes year round and protection for the living armor of the soil. Cover Crops should be left to decompose so they can be most effective rather than plowed up before planting of the commodity crop.

8. Soil organic matter influences nutrient retention; soil fertility; soil structure; soil stability and decreased soil erosion.

These relationships and indicators provide general information regarding the potential for soil infiltration and water holding capacity in the TRW. NRCS's publication "Guidelines for Soil Quality Assessment in Conservation Planning" goes on to detail the inherent quality and dynamic qualities of soil providing insight into the relevance of soil quality and health to planning in the TRW.

Soils vary naturally in their capacity to function, therefore, quality is specific to each kind of soil. This concept encompasses two distinct but interconnected parts: inherent quality and dynamic quality. Characteristics, such as texture, mineralogy, etc., are innate soil properties determined by the factors of soil formation: climate, topography, vegetation, parent material, and time.

Cover Crops Can Provide Food for Microbes Year Round and Protection for the Living Armor of the Soil

Collectively, these properties determine the inherent quality of a soil. They help compare one soil to another and evaluate soils for specific uses. For example, all else being equal, a loamy soil will have a higher water holding capacity than a sandy soil; thus, the loamy soil has a higher inherent soil quality. This concept is generally referred to as soil capability. Map unit descriptions in soil survey reports are based on differences in the inherent properties of soils. The publication goes on to note the influence that human use and management can have on soil quality.

More recently, soil quality has come to refer to the dynamic quality of soils, defined as the changing nature of soil properties resulting from human use and management. Some management practices, such as the use of cover crops, increase organic matter and can have a positive effect on soil quality. Other management practices, such as tilling the soil when wet, adversely affect soil quality by increasing compaction.

Although there have not been any widespread studies of soil health in the TRW, it is assumed that an unknown percentage of individual producers in the watershed understand the importance of soil health, monitor soil health, and incorporate practices that improve soil health into their operation. Basic information about the TRW soils, their drainage and water holding capacity is included in Figure 2C-1.

In the TRW, loams and silt loams dominate the uplands. Loamy soils in the upstream portions of the watershed, which formed in shallow till, include Kenyon, Riceville, and Racine Series whereas soils near the mouth of the watershed, in Clayton County, contain silt loams of the Fayette, Downs, and Tama Series. The upstream soils are typically tiled and in row crop production. The three downstream soil series were formed in loess, are well-drained and, although tiling on these slopes is becoming more common, they are less likely to be tiled than the upstream soils. Additional information on soils and their influence on land use and hydrology follows.

According to the NRCS Soil Survey, silt loam soils are common on the lower slopes but vary depending on the parent material. The silt loam soils on the lower slopes in the Winneshiek County portion of the watershed include the Marlean and Nordness Series, which were formed in shallow to bedrock conditions. These soils are generally well drained soils with slopes ranging from 2 to as high as 80 % for Marlean and 2-40 % for Nordness. However, the silt loam soils found in Howard County portion of the watershed are form ed in shallow to till conditions and are in the Floyd Series. The Floyd Series consists of very deep, somewhat poorly drained soils with slopes ranging from 0-5%. The soils formed in loess found in the Fayette and Clayton County portions of the watershed are commonly in the Fayette series. Generally speaking, the loams and silt loams derived from variable materials dominate throughout the Turkey River Valley. The Fayette series consists of very deep, well drained soils and slopes range from 0-60%.

In upstream portions of the watershed (Howard, Winneshiek, and Fayette counties) soils of the Colo, Spillville, and Caneek Series are common in the stream valleys, floodplains, upstream drainageways and nearly level gently sloping footslopes. Slopes for Colo Series range from 0-5 % and the soils are very deep, poorly drained and formed in alluvium. The Spillville Series range from 0-5% and vary from moderately well drained to somewhat poorly drained soils. The Caneek Series is very deep, somewhat poorly drained and poorly drained soils will 0-2 % slopes.

In downstream portions of the watershed (primarily Clayton County) soils from the Dorchester Series are more common. They have slopes ranging from 0-5 % and are very deep, well drained and moderately well drained soils found on narrow flood plains of small streams that have limestone bluffs and outcroppings nearby. Caneek Series, which is somewhat poorly to poorly drained are also found in the valleys located in the downstream portions of the watershed.

Textural Group		Textural Classes	Water Holding Capacity Inches/foot of soil
Sandy	Coarse	Sand Loamy Sand	0.25 - 0.75 1.10 - 1.20
Loamy	Moderately Course	Sandy Loam	1.25 - 1.40
	Medium	Loam Silt Loam Silt	1.50 - 1.70
	Moderately Fine	Clay Loam Sandy Clay Loam Silty Clay Loam	1.80 - 2.00
Clayey	Fine	Sandy Clay Silty Clay Clay	1.50 - 1.70 1.20 - 1.50

Figure 2.E.1 Silt Loam Soils

Climate and Hydrology

SECTION TWO F

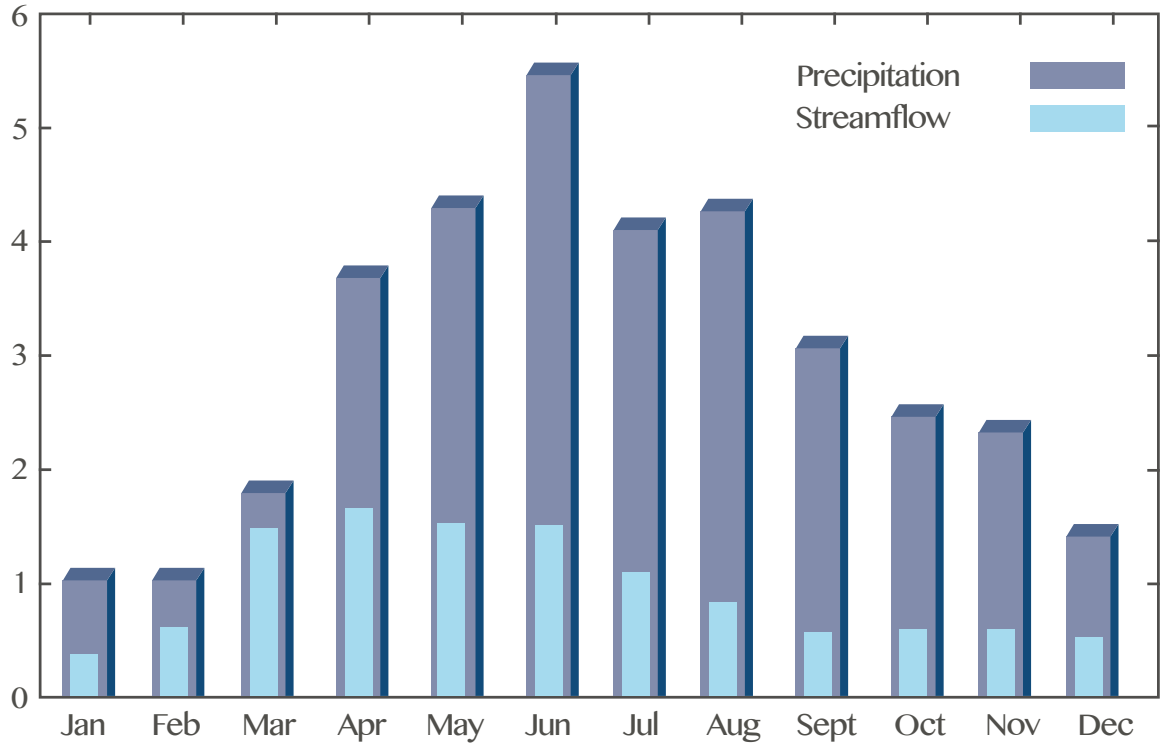


Figure 2.F.1 Turkey River at Garber - © *Iowa Flood Center*

2.F Climate and hydrology: According to the NRCS Watershed Assessment, the annual precipitation in this watershed is between 29-37 inches with most of the rainfall occurring as high-intensity, convective thunderstorms during the summer months. The Iowa Flood Center/IIHR looked more closely at the monthly water cycle and rainfall characteristics of the TRW in their Hydrologic Assessment of the Turkey River Watershed. They identified the month of June as have the highest average monthly estimate for precipitation between 1981 and 2010. They also noted that in the TRW, "*Spring is marked by an increase in precipitation, the melting of any accumulated winter snow, and low evaporation before the growing season begins: these factors combine to produce high springtime streamflows.*" In regard to flood climatology, the Iowa Flood Center's Hydrologic Assessment of the Turkey River Watershed noted that in the TRW, the "*annual maximum flows occur in March or April but the largest single annual maximums occurred in May and June.*"

Even more relevant to flood prevention and planning, IFC notes that, "*Annual mean precipitation levels are relatively unchanged in the Midwest US yet rainfall events are less frequent but of higher intensity in recent years.*" If these trends continue, it will increase the frequency flash and large scale floods.

Personnel from the IFC note that these rainfall patterns may also increase the likelihood of severe and extended periods of drought. The same strategies recommended in this plan will make the TRW landscape more resistent to both drought and flooding.

Additional information regarding the hydrology of the TRW can be found in the Iowa Flood Center's Hydrologic Assessment of the Turkey River Watershed attached to this plan in Appendix 4.

Geology of the Watershed

SECTION TWO G

Limestone Outcropping and Trout Stream in TRW - Otter Creek

2.G Geology of the Watershed: The geology of the TRW influences the topography, soil type, land use, and hydrology of the watershed, making it an important factor in watershed planning. It also creates opportunities for flood reduction and water quality improvement that other watersheds may not have. The NRCS Watershed Assessment describes the geologic formations and bedrock of the TRW noting the following. The soils and landforms of the TRW formed in isolated deposits of glacial drift laid down by ice and water over the last two million years during the Pleistocene and Holocene Epochs. Beneath the unconsolidated deposits is Paleozoic bedrock, which becomes generally older from northeast to southwest. In Howard County, underlying bedrock consists mainly of Devonian dolomite and limestone. Chickasaw and Winneshiek counties are underlain by Devonian dolomite and limestone, and Ordovician shale and dolomite. Fayette County bedrock consists of Devonian dolomite and limestone, Silurian limestone, and Ordovician shale and dolomite. Clayton County bedrock consists primarily of Silurian limestone and Ordovician shale and dolomite.

The landscape of the TRW area falls primarily within two of Iowa's seven landform regions, which are closely aligned with the NRCS MLRAs mentioned under the land use section of this plan. Elevations from the head to the mouth of the watershed range from about 1,330 feet to 605 feet. Although the average watershed slope is 6.6%, the slope varies greatly depending on the land surface and location within the watershed.

The western portions of the watershed are in the Iowan Erosion Surface including portions within Howard, Chickasaw, western Winneshiek, and Fayette counties. The associated topography is described as nearly level topography, generally open, or gently rolling. According to the NWA, this area was *"developed on Pre-Illinoian till as a result of the intense periglacial conditions and strong winds associated with the Late Wisconsinan glacial advance that formed the Des Moines Lobe to the west. In many places, the erosion left behind a lag deposit called*

a "stone line," which is covered by loamy sediments of variable thickness. Loess mantles the till on isolated topographic highs that survived the widespread erosion." Given the topography and the clay-dominated soils, obstruction of water flow in this portion of the watershed can back up water onto many acres.

The eastern portion of the watershed is within the Paleozoic Plateau, including southern portions of Winneshiek County, eastern Fayette, and all of Clayton County. The soluable limestone bedrock in the eastern portion of the watershed is closer to the surface and has a dominating influence on the resulting terrain known as karst topography. Karst topography is defined as a landscape formed from the dissolution of soluble rocks. Over time rivers have cut down into the limestone creating valleys with steep hillslopes. The underlying soluble limestone bedrock also has well developed fissures and cracks, many of which have dissolved and/or collapsed to leave sinkholes and cave systems that move water quickly through the system to emerge miles away in springs.

Because the TRW is an active karst system, dissolution of the limestone continues to influence and alter the hydrology of the watershed and the dynamics of land use. Karst surface features, including steep highly erodible hills, sinkholes, springs, losing streams, and limestone outcroppings, affect land management and cropping system decisions (Figure 2.E.3 Sinkholes, Cold Water Trout Streams and Depth to Bedrock). This creates a need for more deliberate use of conservation practices including terraces, no-till, waterways, and cover crops that help hold the soil and nutrients in place. Underground karst features influence the hydrology, changing the way surface water moves through the system and the speed with which it moves. Sinkholes and losing streams provide direct conduits for surface water into an extensive underground system of actively eroding fissures and caves that move water quickly under traditional topographic watershed boundaries to coldwater springs and streams miles away. These coldwater springs feed 22 Iowa DNR designated coldwater streams within the TRW. Coldwater streams are not common in Iowa, as they are primarily found in karst watersheds in Northeast Iowa. The coldwater streams and other warm water tributaries in the TRW are severely impacted by flooding. A Rapid Watershed Assessment of the TRW conducted by Iowa NRCS noted, *"The change in hydrology due to stream channel straightening, subsurface drainage systems, wetland destruction, and lack of perennial groundcover has resulted in flashy stream flows, thus contributing to stream down cutting and increased stream bank instability."* The TRW streams provide significant aquatic and terrestrial habitat that is important to endangered and listed aquatic and terrestrial species. Many of these species are in-stream and near-stream species that are severely impacted during their life cycle or reproductive cycle by the flashy stream flows, stream down cutting, and increased stream bank instability associated with flooding.

One of the most prominent karst features found in Iowa, the largest spring in the State, Big Spring, is found in the TRW adjacent to the Turkey River in Clayton County. Big Spring Hatchery, an Iowa DNR facility that provides stocked rainbow, brown, and brook trout for cold water trout streams, is located near this spring. The facility has suffered major damage due to flooding on several occasions. Because of its significance to the State of Iowa and the region, Big Spring and its

In-Stream Sinkhole

'springshed' was the focus of extensive dye tracing and water quality studies over several decades (Appendix 4). The study documented the transport of surface water from sinkholes and losing streams miles underground to the spring within hours. Dye tracing revealed that the basin feeding Big Spring does not follow surficial watershed boundaries but actually crosses the boundaries of six different HUC 12 and two different HUC 8 surficial watersheds. Surficial and groundwater basin boundaries match where valleys follow joint trends in the underlying bedrock. Water passes into the Big Spring underground basin through sinkholes, caves, and fissures vertically before moving horizontally along arterial conduits through a layer of Galena carbonate from north to south until emerging to the surface at Big Spring.

Big Spring is merely one example of thousands of springs in the Driftless Region of Iowa. In some parts of the TRW, much of the surface drainage actually ends up underground for a period of time before emerging again through springs. The study of the Big Spring watershed tells us the land area draining to the TRW is actually larger than formerly realized because of underground basins crossing HUC 8 boundaries (Figure 2.E.3. HUC 12 Watersheds in the TRW and Big Spring Springshed). Further study of springsheds is necessary to understand the full hydrologic impact of karst features on flooding and runoff.

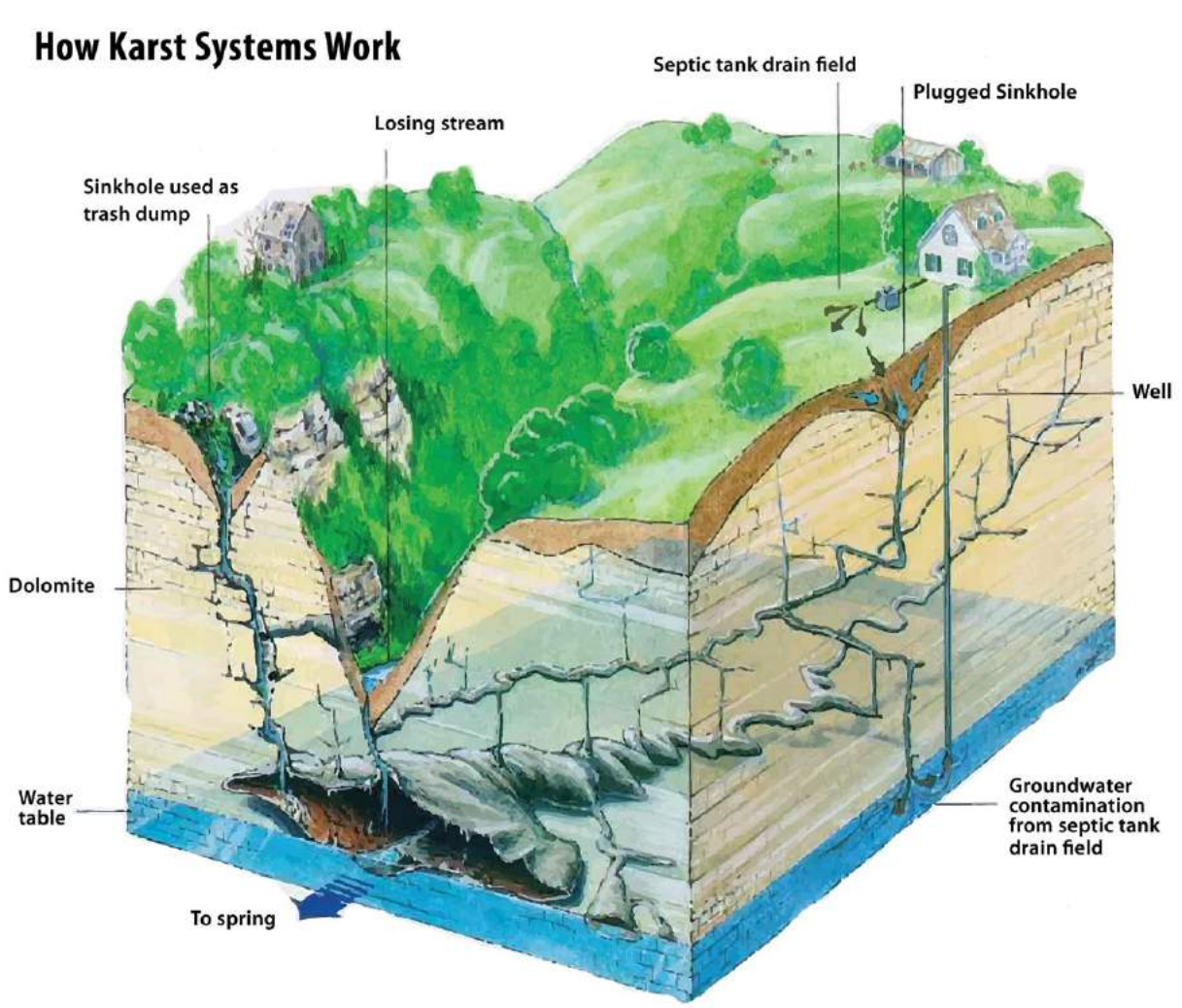


Figure 2.G.1 How Karst Systems Work

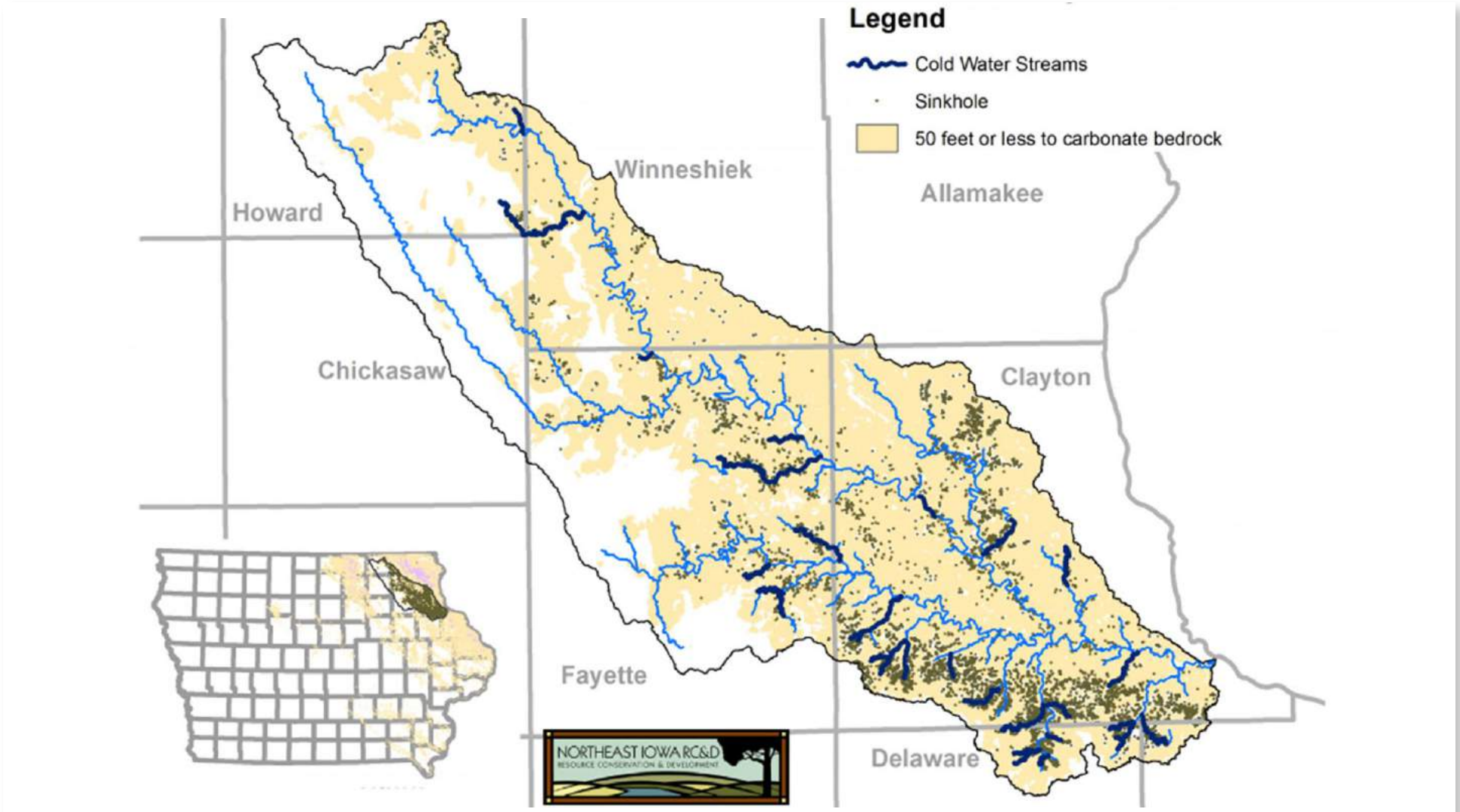


Figure 2.G.2 Sinkholes, Coldwater Trout Streams and Depth to Bedrock

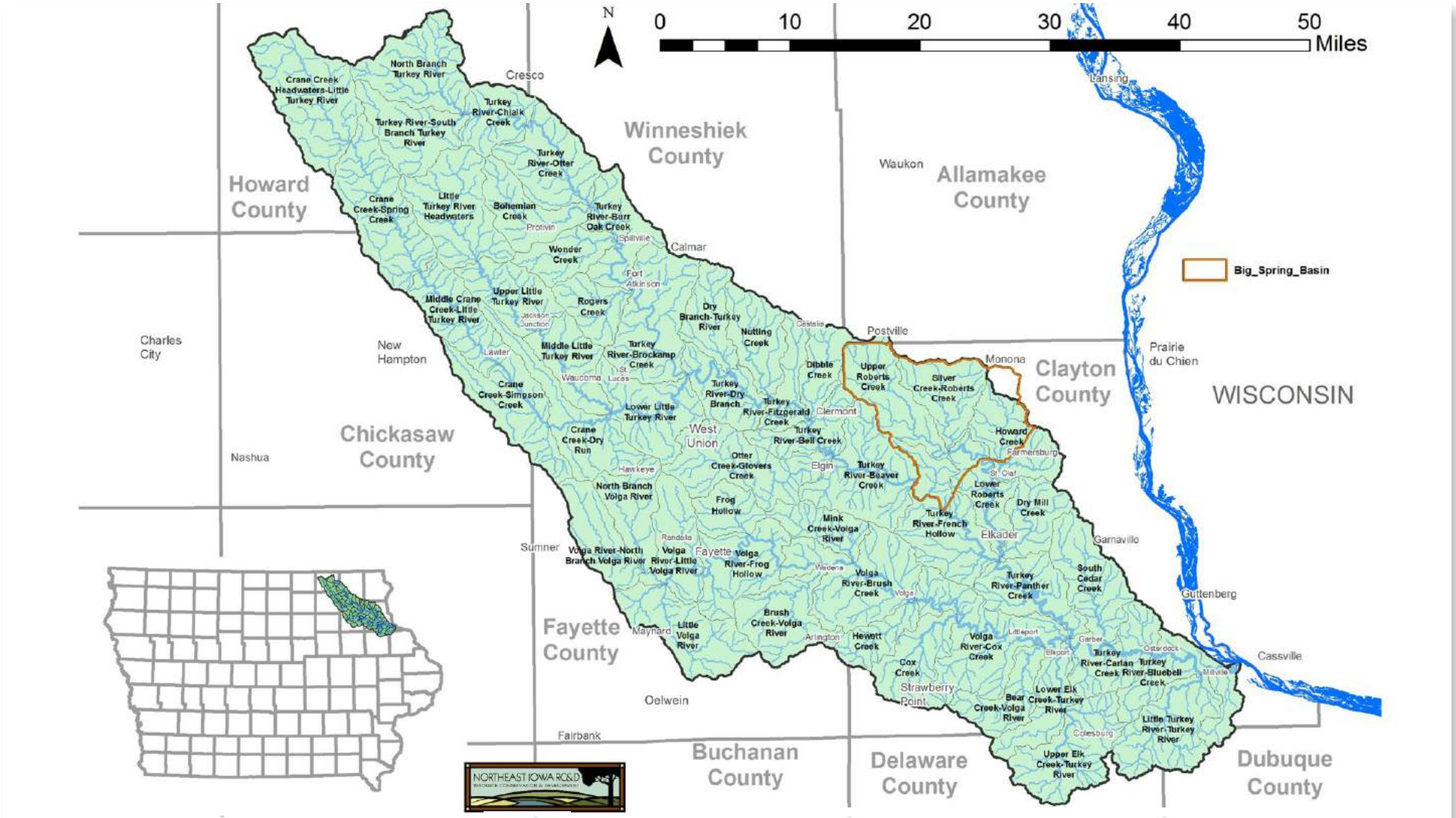


Figure 2.G.3 HUC 12 Watersheds in the TRW and Big Spring Springshed

Demographics

SECTION TWO H

2.H Demographics: The TRW is a very rural watershed, populated by farmers/producers and small town residents. As part of RWA, Iowa NRCS conducted an analysis of the census blocks provided by the US Census Bureau to calculate the population, which they estimated at 32,332 residents. This analysis considered the percentage of any census block, community or rural, within the TRW so only the percentage of the population equivalent to the percentage of the census block that is included in the physical TRW boundary is included in the calculation. The analysis accounted for the fact that the TRW boundary dissects thirteen of the forty incorporated communities in the TRW. It also considered the dissection of rural census blocks. According to the RWA, there are an estimated 5,090 total farm operators in the watershed and these operators manage 3,404 farms that range from one acre to over 1,000 acres.

The size of farms in the TRW varies, but is generally smaller than those found in other areas of Iowa. The RWA found that 8% are 1-9 acres, 19% are 10-49 acres, 30% are 50-179 acres, 28% are 180-499 acres, 10% are 500-999 acres, and 5% are over 1,000 acres. The Census of Agriculture is authorized under Public Law 105-113 and uses the definition of a farm as any place from which $1,000 or more of agricultural products are produced and sold, or normally would have been sold, during the census year.

Although the NRCS estimate of population in the TRW is useful, the TRWMA Board felt that given the small size of the TRW communities (only seven have greater than 1000 residents and the largest is less than 4,000 residents) and given the condition of the storm water runoff systems (aging or limited systems that have unknown or compromised boundaries) and given the undelineated boundaries of springsheds, the entire area and population of each TRWMA community should be invited to participate in plan development. Therefore, all participating TRWMA communities are included in this plan in their entirety. An estimated 24,685 residents live within the municipal boundaries of the forty incorporated communities. Twenty-three of the forty communities joined the TRWMA. The total population of the participating TRWMA communities is 20,641. The watershed is dominated by caucasian residents. Approximately 14% of residents in the participating TRWMA communities registered as something other than white during the last census.

The financial capacity of TRW residents, communities, and counties to deal with water quantity and water quality issues is limited. Clayton County, which is the last county in the watershed before the Turkey River empties into the Mississippi River and the county most severely impacted by flooding, has historically been one of the poorer counties in the state of Iowa, with higher unemployment and lower median income levels than a majority of Iowa. According to the USDA Economic Research Service, only 12 counties had a higher unemployment rate in 2010 than Clayton County and the median income of the county was in the bottom third of Iowa counties. Fayette County, which is also severely impacted by Turkey River flooding, suffers from median income levels in the bottom fifth of Iowa's counties and has unemployment rates higher than all but 18 counties in Iowa. FEMA buyouts and continued private and public costs for flood recovery have severely impacted the tax base of many of the small communities along the Turkey River. County funding for roads and bridges is so limited in this rural watershed that county engineers estimate *"Dozens of bridge will deteriorate to the point of being unable to support the traveling public in the next five years."*

TRW Producer

Storm Water Runoff & Smart Planning

SECTION TWO I

Photo Courtesy of: Corey Meyer

Monona Storm Water Runoff Project Dedication

2.1 Storm Water Runoff & Smart Planning:

A series of research and planning meetings were held for the 23 TRWMA communities. Each community was invited to bring a team of community leaders that could include city council members, the city administrator, the mayor, city facilities personnel, and/or other community members interested in SMART Planning and/or flood prevention. Participants learned about SMART Planning and shared information about existing community planning efforts and their community stormwater infrastructure. Northeast Iowa RC&D planning personnel provided large-scale maps for each community showing the watershed area that drains into each community and the flow and extent of the natural community runoff/drainage areas within and through the communities. Participants used the maps to locate existing stormwater infrastructure and existing or ongoing SMART planning/practices. They were also asked to take the maps back to their communities to gather additional input about which SMART practices their community may be interested in implementing and specific practice locations. Northeast Iowa RC&D planning personnel also presented to city councils on request, explaining the TRWMA goals, SMART planning, and opportunities for the communities to implement SMART planning practices.

Community meeting participants were also provided with opportunities for sharing, brainstorming, and collaboration. Discussions lead to proposed collaborations between multiple communities. Community leaders from four TRWMA communities also met with Northeast Iowa RC&D planning personnel, the Iowa Department

of Agriculture and Land Stewardship (IDALS) Urban Conservationist, and local private engineers to review projects and tour their community to further develop ideas for improved community storm water management. Some communities worked with Northeast Iowa RC&D planning personnel and/or their local Watershed Specialist to explore opportunities and determine how their community projects could help slow water and improve water quality in local streams and tributaries to the Turkey River.

Through the community meetings, planners were able to determine that because they are small and have limited resources, the twenty-three communities participating in the TRWMA have relatively simple stormwater runoff systems. Many have curb and gutter infrastructure that is old and aging, with limited capacity and/or system flaws. Several have no curb and gutter, instead relying on slope and overland flow. When this project started, although the communities of Elkader, Volga, Garber, and Littleport had sustained major floods that resulted in FEMA buyouts and community parks, only three TRW communities had incorporated any SMART planning/practices into their community storm water plan or infrastructure: West Union, Calmar, and Postville. The projects in West Union and Calmar were both components of larger Soil and Water Conservation District watershed projects in Otter Creek and Lake Meyer, respectively. Postville's projects were small scale localized runoff projects.

Since the TRWMA was formed, two additional communities (and one county) have implemented SMART planning/practices: Monona, Elgin, and Fayette County. Several continue the process of developing plans for incorporation of SMART practices into community projects.

Figure 2.I.1 Community Flow Map

1. West Union Downtown Streetscape

2. State Revolving Loan Sponsored Project Demo

3. Calmar Wetland

1. West Union – West Union, population 2,444, is a national model for small community, SMART planning/community infrastructure. In 2008, when it was time to replace streets, sidewalks, utilities, and stormwater management systems, West union City leaders championed the practices of sustainable urban design and were designated as a Green Pilot Program by the Iowa Department of Economic Development. Since then, they have worked to implement green infrastructure throughout a six block area of their historic downtown. They have installed a diverse suite of practices that complement their community and create a dynamic, aesthetically pleasing, modern system of stormwater management including permeable pavers, bioswales, rain gardens, green roof, native plantings, and retention ponds.

3. Monona – Monona, population 1,518, was the first Iowa community approved for a State Revolving Loan Fund Sponsored Projects Program, which they used to install permeable pavers for improved water quality and reduced stormwater runoff. (They were approved for a second project in 2015). Both projects are adjacent to an unnamed tributary and complement existing community natural areas. Monona is also in the process of investing millions of dollars to separate sewer and stormwater and to educate residents about how the community can use SMART planning/practices to improve their systems and reduce costs. Existing practices include permeable pavers in parking areas and streets, natural areas, rain gardens and bioswales, and encouragement of pond/wetland development on farms outside the city.

2. Calmar – Calmar, population 965, has developed a diverse small community storm water runoff system, incorporating complementary and affordable natural plantings and community policies and ordinances to create an aesthetically pleasing system that fosters clean water and minimizes storm water runoff. They have developed bioswales, stormwater runoff wetlands, butterfly gardens, shelterbelts, and native prairie/oak savanna plantings. They also lead the region in adoption and implementation of city policies that support clean water. City ordinances and antidegradation ordinances exclude grass clippings and other harmful materials from being deposited into the storm sewer system, reduce phosphorous applications, and encourage turf grass management.

4. Elgin Permeable Pavers

5. Postville Native Planting

6. St Lucas 2008 Flood

4. Elgin – Elgin, population 665, is located in a precarious position in the TRW at the confluence of Otter Creek and the Turkey River near the Fayette County and the Clayton County line. This small community recently completed a downtown revitalization project that incorporated permeable pavers into parking components on either side of their main street. Elgin also has two riparian wetlands that provide storage for storm water runoff and enhance water quality. In 2015, they completed a bottomland hardwood planting and work closely with the Fayette County Conservation Board, who has a nature center and an extensive county natural area just across the Turkey River, to provide conservation educational opportunities for residents and travelers.

5. Postville - Postville, population 2,176, has a history of using native vegetation to develop natural runoff areas in parks. They recently began seeking ways to use other SMART planning/practices. They worked with Northeast Iowa RC&D to submit a proposal to develop of a wetland/pond area near their high school as a storm water runoff measure to slow and filter agricultural runoff that flows through their town. Because Postville is a culturally diverse community, they proposed incorporating multilingual educational kiosks and signage. Although the proposal was not funded, the city is continuing to explore their options for that project, as well as other public and private partnerships that propose the use of permeable pavers in city and private business parking areas and city streets.

6. St.Lucas - The small community of St. Lucas, population 140, is rethinking storm water runoff and community infrastructure. Stormwater runoff from nearby farm fields and natural areas converge on this community. In the past, community leaders and residents have tried to move storm water runoff through the town as quickly as possible by using a series of culverts. In 2015, after considering the deterioration of the culverts and the cost of replacement, community leaders decided that instead of spending hundreds of thousands of dollars to increase the size of their culverts, they would explore working with upstream landowners and partners to identify options for holding water on the land and install storm water retention basins, bioswales, and raingardens at a fraction of the cost.

Public & Private Outreach Organizations

SECTION TWO J

TRWMA Technical Committee Meeting - Iowa NRCS, Iowa DNR, IDALS, SWCD Personnel and County Engineers

2.J Existing Public & Private Outreach Organizations: In the TRW Survey of Landowners, 60% of respondents said they would be willing to take action to improve water quality or decrease flooding. Unfortunately, there is currently no single entity that is providing technical assistance in the TRW to specifically help those landowners implement practices that reduce flooding. Personnel that work in county, state, and federal positions that are assumed to be responsible for this task are currently hired to focus on other related priorities, including water quality projects, wildlife habitat restoration, and emergency response. The work these employees accomplish may help reduce or in some cases increase storm water runoff. However, even the number of county, state, and federal employees in the TRW that are focused on implementing practices that improve water quality, which can by their inherent nature also reduce storm water runoff, has decreased in recent years as federal and state conservation technical assistance and program budgets have been reduced.

Seven county and one regional United States Department of Agriculture (USDA), Natural Resource Conservation Service (NRCS) offices are charged with implementing and providing technical assistance for USDA/NRCS federal soil conservation and water quality programs in the TRW. NRCS's mission is to *"provide resources to farmers and landowners to aid them with conservation." "Ensuring productive lands in harmony with a healthy environment"* is their priority. NRCS has the ability and federal authority to address any resource concern or combination of resource concerns during the conservation planning process at any scale. That includes resource concerns related to water retention and storm water runoff reduction. Unfortunately, in recent years they lack the funding to go with the authority. The PL-566 program, which was an important funding source to address water retention and storm water runoff, was last funded in 2010 and there is no ongoing PL-566 in the TRW. Currently funded NRCS programs are focused on farm-scale projects and other resource concerns (water quality, wildlife habitat, etc.).

Each USDA/NRCS county office in Iowa has traditionally had a federal NRCS District Conservationist assigned to provide leadership and implement NRCS programs in their county. Some county offices have also been assigned NRCS Soil Conservationists, Soil Technicians, Engineers, and other federal personnel, depending on their workload or approval of competitive special projects. Regional, multi-county, NRCS offices, called Area Offices, have historically provided oversight and highly specialized personnel, including a Wetland Specialist, Soil Scientist, Grazing Specialist, engineers, and other technical support to assist county offices. The TRW is served by an NRCS Area Office that provides oversight to, and serves, a 22-county area.

In recent years, as USDA/NRCS budgets have been cut, NRCS county and regional offices serving the TRW have lost personnel and experience. District Conservationists in two of the TRW counties now oversee two counties each, in what is known as a "shared management unit." Retiring or transferred county personnel positions have been left vacant or eliminated in Fayette County, Chickasaw County, and Clayton County. Retiring or transferred federal regional personnel have also been lost including the region's only Soil Scientist and the only Grazing Specialist. Fayette County and Howard County have both lost full time State Technicians. The remaining federal employees in USDA/NRCS offices are required to work on and charge their time to specific programs, so they rarely seek out landowners to encourage them to participate in conservation practices.

State agencies also assign personnel to county NRCS offices to provide technical support and oversee special projects, typically watershed/water quality projects. Howard County recently lost a State Environmental Specialist that had been assigned to work on watershed projects. The Iowa DNR has a Private Lands Wildlife Biologist that conducts outreach to an eighteen-county area of Northeast Iowa and provides technical assistance to SWCDs in the area. This employee is stationed at the NRCS Area Office in West Union. They also have a Private Lands Wildlife Technician stationed in Elkader. Pheasants Forever has a Farm Bill Biologist stationed in Delaware County.

The seven county SWCDs in the TRW are uniquely positioned to provide direct outreach and technical assistance to producers and community members. Because SWCDs are county organizations, they have the flexibility to work on projects as funding and time allows. They also have the experience, partnerships, training, and equipment needed to successfully provide one-on-one assistance and outreach to producers. Producers are typically comfortable working with and trust SWCD employees as these employees are generally local residents or producers themselves. Each SWCD in the TRW is governed by an elected county board of SWCD Commissioners. The majority of the personnel hired by SWCDs are hired for temporary positions when the SWCD secures a competative grant for a watershed project in a HUC 12 watershed. HUC 12 watersheds are typically between 10,000 and 35,000 acres and would be considered sub-watersheds of the TRW.

The majority of the TRW has never been the focus of any SWCD HUC 12 watershed project. Focused watershed projects in the TRW in the past fifteen years, before the development of the TRWMA, encompassed a total of only 85,125 acres or 8% of the total watershed, as compared to the Upper Iowa River Watershed where focused watershed projects have targeted over 90% of the 640,000 acre watershed during that same time period. It is also notable that none of the projects in the TRW have been related to flood prevention. All were focused on improving water quality.

Since the formation of the TRWMA, SWCDs in Fayette, Clayton, and Winneshiek counties have implemented new state funded projects in the TRW. The success of these SWCDs in securing the funding for these projects was greatly improved by their participation in the TRWMA, which was in some cases a requirement (being in a WMA area). In the other instances, the TRW was selected by the state of Iowa as a targeted watershed for Nutrient Reduction Strategy

demonstration project funding. HUC 12 SWCD projects that were pre-TRWMA and post-TRWMA formation, are shown in Figure 2.H.1 Current and Past Watershed Projects in the TRW. The post TRWMA projects, shown as current projects, include the Central Turkey River Nutrient Reduction Demonstration Project (Winneshiek County), Upper Rogers and Silver Creek Project-Demonstration of Targeted Nutrient Reduction Systems for Clayton County (Clayton and Allamakee Counties), and Upper Otter Creek Watershed and Otter Creek Flood Reduction IFC Phase II Project (Fayette County). These projects have helped SWCD develop relationships with producers in targeted watersheds. However, because of project funding restrictions, all but one of the projects (Otter Creek) is water quality focused rather than flood prevention. Although these new projects have increased outreach, they are all limited in scope and geographic area. The Upper Otter Creek Project encompasses only 16,740 acres of the TRW in Fayette County. Past and current projects collectively only encompass a combined total of 20% of the TRW, reaching only a fraction of the TRW landowners that want to implement practices. At the time of this plan development, Chickasaw, Howard, Dubuque, Delaware, and Allamakee County portions of the TRW have no employee charged with outreach to landowners in the TRW.

The TRWMA SWCD Commissioner Committee met several times to provide input for this plan. SWCD, IDALS, DSC and NRCS employees were also invited to give input through the TRWMA Technical Committee, at meetings and through one on one discussions with Northeast Iowa RC&D planning staff. The SWCD Commissioners noted that although they have not been tasked with reducing flooding, many of the same practices they have been promoting to improve water quality can also be used to reduce flooding. To that end, the TRWMA SWCD Commissioners, led by the Fayette County SWCD with technical assistance from the TRWMA, drafted a resolution for the SWCD state organization, Conservation Districts of Iowa (CDI), which requested that CDI make flood mitigation an SWCD long term goal and that CDI support state legislation to "*provide funding and technical assistance through SWCDs for the express purpose of reducing flooding and the resulting damage to public and private infrastructure.*" The full resolution reads as follows:

"Changes in rainfall patterns combined with land use changes have resulted in devastating flooding alternating with periods of drought in Iowa. Although flooding and drought are natural occurrences in riverine environments, the devastation caused by excessive rainfall and periods of drought can be reduced through improved water management and increased landscape resilience. Water management efforts can reduce flooding, protect private and public infrastructure, reduce erosion, and improve wildlife habitat in and along Iowa's rivers and streams.

CDI makes flood mitigation an SWCD long term goal with equal priority to water quality improvement and soil conservation. CDI supports legislation to provide funding and technical assistance through SWCDs for the express purpose of reducing flooding and the resulting damage to public and private infrastructure.

Explanation: SWCDs have long been tasked with water quality improvement and soil conservation, but have never been asked to reduce flooding or mitigate the effects of drought. It is our belief that in addition to water quality improvement and soil conservation, water management to reduce flooding and the impacts of drought should be given equal priority by CDI, SWCDs, and funders. SWCDs have experienced staff, tools, and technology, partnerships, and relationships with landowners in place to help implement flood mitigation and drought reduction techniques to protect lives and property."

Although there are County Emergency Managers in every TRWMA county, they are not tasked with flood prevention. Instead they are tasked with being prepared to respond to flooding and other disasters after they occur, as noted by Clayton County, *"The duty of the Emergency Management Director is to administer disaster services programs such as severe weather warning and assist the federal and state agencies in disasters."*

Northeast Iowa RC&D Inc., a regional, private, 501c3 nonprofit, has been working independently and with partners in the TRW for over a decade. Much of the RC&D's work in the TRW has been direct outreach to producers qualified to enroll in specific USDA and State programs related to woodland establishment and timber stand improvement, more specifically providing information to producers that qualify to enroll acres in the federal CP31, a program to increase hardwood forest acres along rivers. The RC&D has also conducted one-on-one outreach to landowners that have timber enrolled in Iowa's Forest Reserve Program. The RC&D established and coordinated water quality monitoring at over 50 sites in the TRW from 2012-2014. They established the TRW Alliance and were instrumental in establishment of the TRWMA. They are currently assisting the TRWMA with research, grant writing, and development of this plan and have secured funding to conduct additional research for the TRWMA, to work with producers throughout the watershed on rainfall and soil moisture research, and to implement major public education and outreach projects in the TRW.

The Iowa Conservation Action Network (IACAN) is a partnership formed by the Iowa Corn Growers Association, Iowa Soybean Association, and Iowa Land Improvement Contractors Association. The IACAN website notes the following work in the TRW. *"The IACAN network is a private sector initiative to demonstrate technology-based conservation practice planning to accelerate implementation of Iowa's Nutrient Reduction Strategy. ICAN is offering free conservation planning assistance to ICGA and ISA members in five priority watersheds: Floyd, Turkey, Middle Cedar, and East and West Nishnabotna. Members in these watersheds can call, email, or attend meetings to get free planning assistance for grassed waterways, wetlands, ponds, sediment basins, and soil loss assessments. Network participants will receive a map and cost estimate with multiple options for each conservation practice. In addition, one LICA contractor in each watershed will use the same technology to provide conservation planning. The planning assistance relies on a suite of conservation practice planning software developed by Iowa-based small-business, Agren."*

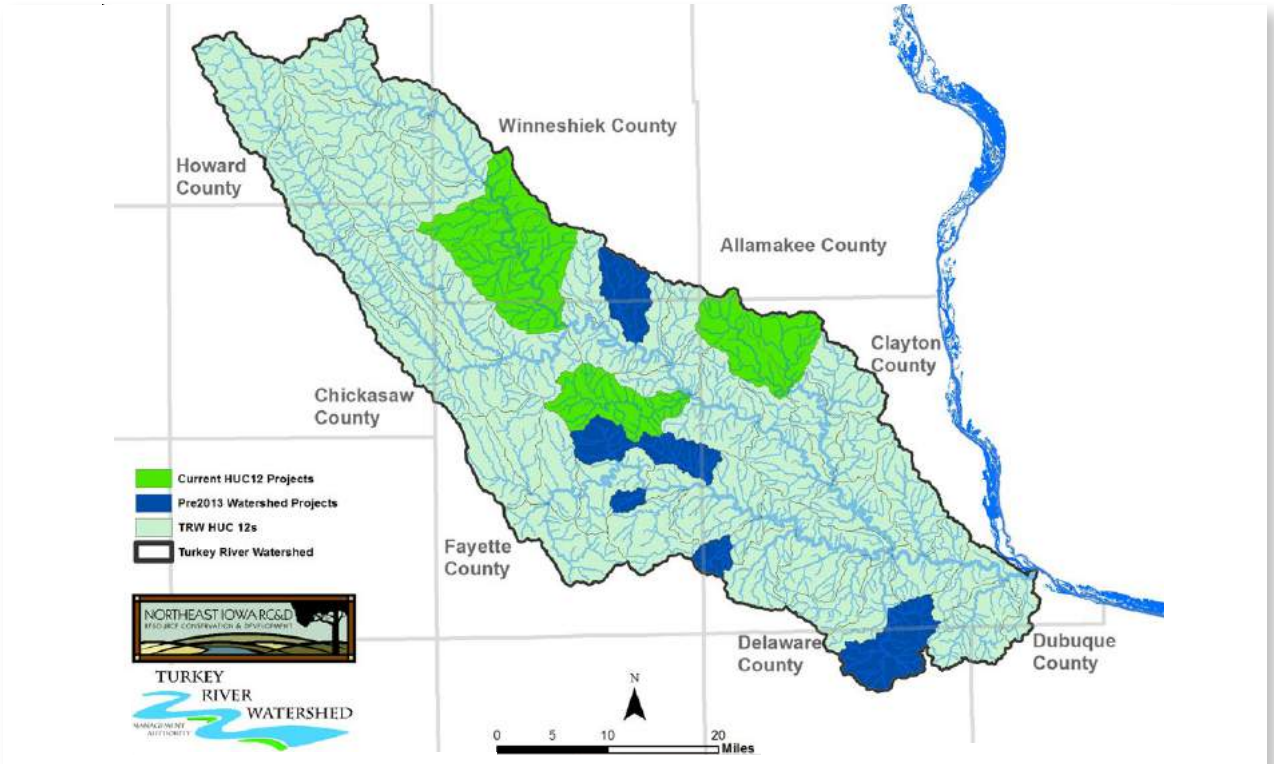


Figure 2.J.1 Current and Past Watershed Projects in the Turkey River Watershed

Section THREE

Community Based Planning

Local Leadership: TRWMA

SECTION THREE A

Turkey River Watershed Management Authority Board Meeting

3.A Local Leadership: TRWMA (Turkey River Watershed Management Authority): The most prominent formal planning entity focusing on the Turkey River Watershed as a hydrologic system is the TRWMA. The TRWMA Board provides a diverse, inclusive voice for watershed residents. The TRWMA structure and participation is defined by the Iowa Code, Chapter 466B (2011), which provides that *two or more political subdivisions (defined as including cities, counties and/or soil and water conservation districts located within the same United States Geological Survey Hydrologic Unit Code 8 watershed), may enter into agreement under Chapter 28E of the Code of Iowa to establish a Watershed Management Authority to enable cooperation in supporting watershed planning and improvements for the mutual advantage of the political subdivisions involved.* The TRWMA has a 28e agreement, as well as bylaws, which together establish the organizational structure and ensure the partnership is managed professionally and serves as a communications link with participating political subdivisions.

The TRWMA was established as follows. In 2010, Northeast Iowa RC&D, a regional 501c3 nonprofit sponsored by SWCDs and Boards of Supervisors from a seven-county region, secured a grant from the McKnight Foundation to foster partnership and collaboration in the TRW. As a result, county, state, and federal partners joined together informally as the TRW Alliance. The TRW Alliance partners began meeting quarterly, monitoring water quality each month at 50 sites in the TRW, conducting a GIS analysis, and completing a Rapid Watershed Assessment to understand water quality and water quantity issues in the TRW. TRW Alliance participants included SWCD personnel and NRCS District Conservationists, county engineers, county conservation board directors, IDALS, US Fish and Wildlife Service, Iowa NRCS, Iowa DNR Fisheries, Iowa DNR Hatchery and Northeast Iowa RC&D personnel. Northeast Iowa RC&D developed the www.turkeyriver.org website to share project information with partners and the public. The work that the TRW Alliance accomplished set the stage for the formation of the TRWMA, which has a more formal structure and is directed by local policy makers rather than natural resource technical personnel.

The formation of the TRWMA was made possible by a grant that the Clayton County Board of Supervisors secured from the Iowa Economic Development Authority. Clayton County invited all municipalities, counties, and SWCDs in the TRW to participate in discussions about formation of the TRWMA. Invitations were delivered via US Postal Service, email, by phone, and in person at City Council meetings, County Board of Supervisor meetings, and SWCD Commissioner meetings. Governmental entities that responded were included in discussions and decisions regarding the TRWMA structure, membership commitment and responsibilities, contents of the TRWMA 28e agreement, and the development of TRWMA Bylaws.

A total of thirty-five public entities, including twenty-three communities, five counties, and seven SWCDs, ultimately signed the final draft of the 28e agreement and developed and approved bylaws. Each participating governmental body appointed one representative and one alternate to serve on the TRWMA Board of Directors.

Unlike the TRW Alliance, the TRWMA is a *formal* partnership of *political jurisdictions* that have political authority within some portion of the physical boundary of TRW. The members of the TRWMA recognized that, because of the size and scope of the TRW, the extensive flooding and degraded water quality would be difficult to address without a coordinated effort of multiple jurisdictions and partnerships who can cross political boundaries, coordinate policies, develop programs and projects, and add value to watershed management.

According to the TRWMA Bylaws, the purpose of the TRWMA shall be *"enable cooperation in supporting watershed planning and improvements in the TRW for the mutual advantage of the Members."* The TRWMA Bylaws also note that, as outlined in Iowa Code Section 466B.23, a Watershed Management Authority may perform all of the following:

- Develop Assess the flood risks in the watershed.
- Assess the water quality in the watershed.
- Assess options for reducing flood risk and improving water quality in the watershed.
- Monitor federal flood risk planning and activities.
- Educate residents of the watershed area regarding water quality and flood risks.
- Allocate monies made available to the authority for purposes of water quality and flood mitigation.

The TRWMA has pursued strategies to accomplish their goals, including pursuing advantageous partnerships. Existing TRWMA partnerships include the following:

- Partner 1: Partner with the Clayton County Supervisors to secure grant funding needed to develop a TRW Plan to reduce flooding & improve water quality.
- Partner 2: Partner with the Iowa Flood Center to model flood reduction and nutrient reduction strategies.
- Partner 3: Partner with the Iowa Economic Development Authority and the Iowa DNR 319 Program to develop a TRW Plan that is a comprehensive working document that has local buy-in, provides expert guidance for the partners and provide regular updates and reports so others may learn from their efforts.
- Partner 4: Partner with the IFC, Fayette County, Fayette County SWCD to test modeling in the Otter Creek Sub-watershed.

The Turkey River Watershed Management Authority Board has also agreed to the following:

- Encourage a comprehensive, multi-objective planning approach to watershed management that values both water quality and flood prevention, while fostering an understanding and use of SMART Planning Principles.
- Foster exceptional communication to build partnerships and engagement that will result in long-term commitment and sustainability beyond planning through implementation.
- Leverage professional, social, and financial resources to maximize planning and ensure implementation
- Help partners secure funding for projects, especially funding that is directed through partners rather than through the TRWMA.

The TRWMA is comprised of thirty-five participating political subdivisions or member organizations, including twenty-three communities, seven soil and water conservation districts and five county boards of supervisors. Each of these entities has one representative (and one alternate) on the TRWMA Board of Directors. The board representative and alternate must be appointed by a vote of the member board or council.

Current TRWMA participating political subdivisions including the following:

- County Board of Supervisors: Chickasaw, Clayton, Fayette, Howard and Winneshiek.
- Soil and Water Conservation Districts: Allamakee, Chickasaw, Clayton, Delaware, Fayette, Howard and Winneshiek.
- Communities: Arlington, Calmar, Clermont, Cresco, Elgin, Elkader, Farmersburg, Fayette, Fort Atkinson, Garnavillo, Hawkeye, Lawler, Maynard, Monona, Postville, Spillville, St Lucas, St Olaf, Strawberry Point, Volga, Wadena, Waucoma and West Union.

The TRWMA Board has an Executive Committee elected from the Board of Directors, which consists of a Chair, Vice Chair, Treasurer/Secretary, and four at large appointments. The Executive Committee includes at least one representative from a county, at least one representative from a city, and at least one representative from a SWCD.

TRWMA Board members agreed they would like their plans and initiatives to be developed with input from watershed residents. Because the size and population of the watershed could inhibit communication, they encouraged formation of committees. These TRWMA committees function within independently established guidelines determined by the committee members themselves. They meet at their convenience to review and discuss the issues that most directly impact them. They were asked to develop a consensus on recommendations and make those recommendations to the TRWMA for review for inclusion in this and other TRWMA plans. Some committees provide research, technical insight and more detailed analysis and planning recommendations. Committees that provided input for this plan include the Community Committee, Producer Group Committee, Technical Committee, SWCD Commissioners Committee, County Infrastructure Committee, Education Committee, and Emergency Management Committee. These committees are detailed in the Public Engagement section of this plan.

By the nature of the organization, all the TRWMA Board meetings were public meetings and, as such, agendas for TRWMA Board meetings were posted by each of the thirty-five participating entities. Persons other than TRWMA Board members that attended TRWMA Board meetings were invited to make comment either at the meeting or at a public comment page on the www.turkeyriver.org website.

To build the collective knowledge of the TRW as a system, the hydrology of the watershed, and the opportunities for collaborative and individual action, the TRWMA Board invited local, state, and federal public and private partners and experts to present information at their meetings. This included presentations on several different topics by the Iowa Flood Center and IIHR staff and graduate students, as well as speakers from communities that had previously implemented SMART planning and practices, including Charles City, Dubuque, and West Union. The USDA/NRCS State Conservationist and Area Conservationists provided information on the relationship between perennial vegetation, soil health, and infiltration. Northeast Iowa RC&D provided presentations related to various potential funding sources and SWCD employees presented information regarding specific relevant county projects, programs and watershed efforts.

Public Engagement

SECTION THREE B

Public Meeting in Cresco

3.B Public Engagement **1. The TRWMA Board of Directors** held, and continues to hold, quarterly public meetings at the Postville YMCA. Each of the thirty-five participating member entities is responsible for posting a meeting notice as required by the TRWMA 28e agreement, by local policy, and by state law that governs open meetings. Each of the TRWMA Board meetings began with an informative presentation and included opportunities for public comment and engagement. Community members other than TRWMA Board members attended every meeting. The TRWMA Board also used several other methods to engage the public in planning.

2. Public and Private Local Meetings: Open public meetings and field days were held at various times and locations and presentations were given to private organizations in the watershed on request. The meetings were used to disseminate information and gather input through facilitated small and large group discussion. Attendance at the meetings varied from twenty to sixty persons and typically included representation from the Boards of Supervisors, community leaders and farmers/producers. Presentations included information about the TRW, the economic and environmental cost of flooding in the TRW, hydrology, storm water runoff practices, SMART planning, and other more specific topics like what is a WMA and soil health. Discussions following the presentations included opportunities for participants to brainstorm ideas and solutions and to provide input on any issue to the TRWMA Board of Directors.

3. State and Regional Meetings: TRWMA Board members and Northeast Iowa RC&D planners presented at statewide meetings, state and regional conferences and to a legislative committee. These meetings provided additional learning opportunities, technical input, as well as regional and statewide perspectives.

4. Turkey River Website: The www.turkeyriver.org website was established and maintained to foster communication and provide information to the

TRWMA Board and the public. The website includes meeting agendas and minutes, watershed happenings, past power point and videos of presentations, maps, research, the results of surveys, informative links, and a public comments section.

5. Local Research: The TRWMA Board and Northeast Iowa RC&D planning staff worked with partners, including the Iowa Soybean Association, the Iowa Corn Growers, the Iowa Flood Center and IIHR, the McKnight Foundation, the Iowa DNR, local SWCDs, and other private and public partners, to directly engage producers in research, planning, and education. As a result, producers across the watershed are engaged in on-farm tile-outflow monitoring, water quality monitoring, rain and soil moisture monitoring, and promotion of conservation practices. Their direct participation is an invaluable form of outreach, not only to those that participate, but also to all the producers in the watershed.

6. TRWMA Committees: The TRWMA engaged hundreds of citizens in planning through the development of committees. Each committee included TRWMA Board members and other relevant watershed residents, advisors, and experts. These committees met on their own schedule to learn, share information, brainstorm, and develop plan recommendations. Educational presentations were given by experts and advisors at several of the meetings when requested by committee members. For example, the Mayor from the City of Calmar presented to the Community Committee about the SMART practices his community has already implemented. Each of the major committees is described below.

Executive Committee: The Executive Committee is the only formal committee of the TRWMA Board. The TRWMA Board members elect Executive Committee members annually. They met as needed as a committee. As members of this committee, they were also notified of all other committee meetings.

Technical Committee (aka TRW Alliance): The TRW Alliance was formed in the fall of 2010. The participants continued to meet as the TRWMA Technical Committee after the formation of the TRWMA, providing technical assistance and guidance to the TRWMA Board and partner organizations including the Iowa Flood Center and IIHR. Whereas the TRWMA is a formal partnership, the Technical Committee has always been an informal partnership of agencies, organizations and conservation professionals concerned about water quality and water quantity (flooding) issues in the TRW. The local, state, and federal partners involved in the Technical Committee have been working together to evaluate and understand the TRW through scientific analysis of water quality and the watershed. Their goal is to help gather and share information, conduct scientific analysis, and better understand the watershed. They work collectively to conduct water and watershed monitoring and analysis. They strive to help TRW SWCDs and other TRW partners secure funding for implementation of projects that target technical assistance and conservation dollars to specific areas of the watershed and provide maximum water quality and flood prevention benefits for all TRW residents.

During the planning process Technical Committee members attended and/or presented at the TRWMA meetings. They provided feedback to the Iowa Flood Center and IIHR regarding complex modeling. They conducted water monitoring throughout the watershed and worked with the TRWMA to identify priority subwatersheds.

Community Committee: The TRWMA communities were invited to join a Community Committee to better understand SMART Planning and policies, identify potential practices that could be implemented in their community, identify and secure potential funding sources, and work with other communities to better

understand opportunities for partnership. City Council members, Mayors, City Administrators, and interested citizens attended the meetings. Northeast Iowa RC&D planners provided community drainage maps for each community and worked with participants to help them understand how they could incorporate SMART practices into their public and private spaces.

Participants shared information about past and proposed community projects and funding opportunities. After sharing the information with community members, most of these committee members identified specific practices their communities would like to implement and provided them to the TRWMA Board. Some mapped specific locations for those practices and provided those to the TRWMA Board; others met with local and state planning personnel and engineers to develop site-specific plans and specifications and then began the process of submitting applications for grant funding to implement specific practices and projects.

Commissioners Committee: All SWCD Commissioners and Assistant Commissioners from every participating TRWMA SWCD were invited to be part of the Commissioners Committee. During night and daytime meetings, these commissioners discussed current conditions, programs, challenges, and special projects and then made recommendations based on their knowledge and expertise. Most of the participating commissioners were also active producers from the TRW; many had been serving as elected commissioners for decades. The Commissioners Committee, with input from NRCS District Conservationists, was also instrumental in calculating and recommending specific and realistic practice quantities for individual counties and the TRW as a system.

County Infrastructure Committee: County Engineers from each of the participating TRWMA Board of Supervisor counties met as a committee to discuss and evaluate the impact and frequency of flooding to county infrastructure, with an emphasis on county roads and bridges and the potential for on-road structures. They also discussed and developed related existing and potential policy that could slow storm water runoff without increasing any county's liability. County Supervisors and SWCD Commissioners were invited to attend these meetings and several joined periodically because interest in this committee's work was high. Northeast Iowa RC&D planners completed GIS analysis of potential on-road structures and provided insight into processes. The engineers garnered advice regarding policy development and maintenance from County Attorneys, SWCDs and Boards of Supervisors. The Fayette County Engineer provided updates and information regarding development of on-road structures in Fayette County where Phase II of the Iowa Flood Center Project was underway in Otter Creek, a subwatershed of the TRW. He also provided information regarding interactions with EPA in regard to policy and on-road structures. Northeast Iowa RC&D personnel also met with Iowa Homeland Security and Emergency Management personnel to further investigate options.

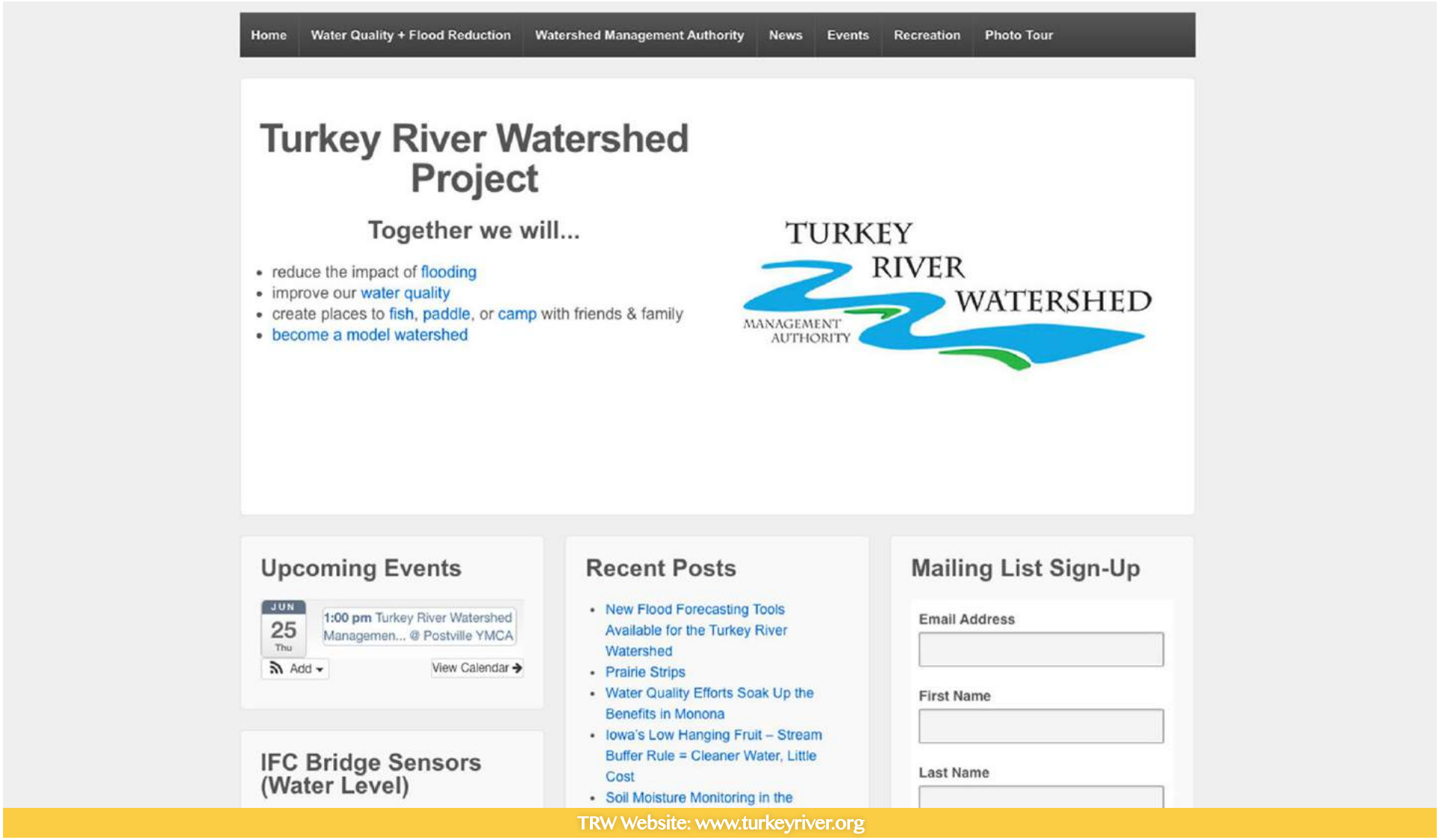
Some county engineering departments, as staff time and budgets permitted, followed up committee meetings by completing culvert inventories to help inform the planning process. This committee also hosted engineers and partners from throughout the four-state Driftless Area to discuss ideas and policy for infrastructure development. The ideas and policy developed by this committee were ultimately presented to the TRWMA Board for inclusion in this plan as well as to each county Board of Supervisors and a six-county regional Supervisor group. Every participating TRWMA Board of Supervisor ultimately adopted the policy developed through this committee.

Producer Group Committee: Producers from throughout the TRW were engaged in the planning process in several ways. Small and large group public meetings, where the majority of the participants were

producers, were held in Clayton, Fayette, Winneshiek and Howard counties. Input was also gathered from producers at County Farm Bureau meetings. A special meeting for TRW producers was held at the Dairy Center in Winneshiek County and the Iowa Corn Growers, Iowa Soybean Association, and Iowa Farm Bureau county offices helped promote the meeting to their respective producer groups. A written survey was sent to 1,500 watershed residents, including 1,000 producers, to gather opinions and attitudes.

The Producer Group Committee was formed after input had been gathered from individual producers. Several different local, county, and state producer groups were invited to participate including the Iowa Soybean Association, Iowa Corn Growers Association, Iowa Pork Producers Association, Practical Farmers of Iowa, Iowa Cattlemen's Association, Iowa Dairy Association, and the Iowa Farm Bureau. Pheasants Forever and Clayton County Conservation Awareness Network representatives were also invited to join this committee. This committee shared information about their current initiatives and outreach, and communication strategies. They reviewed input from TRW producers and developed a set of recommendations for the TRWMA Board regarding this plan. They also provided match and committed to outreach and communication for grants and

Field Day In Otter Creek, Hosted by Fayette County SWCD, Discussion Regarding Retention Basins



TRW Website: www.turkeyriver.org

proposals that will help implement portions of this plan. Farm Bureau provided funding for producer involvement in soil moisture and rainfall monitoring in three TRW counties.

Education Committee: The Education Committee was comprised of a diverse group of experts from each of the other committees, including persons of various backgrounds such as farmers/producers, landowners, community members, biologists, county conservation personnel, SWCD Commissioners and staff, elected officials, and local educators. They collectively worked to consider, combine, and recommend education and outreach ideas from the various committees, TRWMA Board members and partners. They also proposed and considered new ideas. The Education Committee made the final recommendations for TRWMA education and outreach to the TRWMA Board. Some of their recommendations were also included in grants and proposals that were submitted to or by partners to foster successful implementation of this plan.

Emergency Management Committee: This committee was comprised of city and county personnel that formally or informally respond to or deal with flooding issues as they relate to public health and/or city or county infrastructure and other related issues. County emergency managers were invited to participate in this committee along with County Supervisors were interested supervisors, city fire department personnel, county engineers, city administrators, and county conservation board directors if they were known to be actively involved in emergency planning, management and/or response. This committee was formed at the request of the TRWMA Board, who wanted their input but also felt these entities could benefit from research underway in the TRW and the flood prevention modeling in progress at the Iowa Flood Center and IIHR. Personnel from the Iowa Flood Center and IIHR presented information regarding new flood forecasting tools that will soon be available to the public. Committee members provided feedback and input on the modeling and the related website.

Fisheries Committee: The Fisheries Committee was comprised primarily of the regional Iowa DNR fisheries personnel and NRCS District Conservationists serving the TRW counties. The Trout Unlimited Project Manager for the Driftless Area Restoration Effort and a Fisheries Biologist with the US Fish and Wildlife Service were also invited. These entities work with local groups to complete the majority of the in-stream and near-stream restoration and enhancement work in the TRW. Recommendations from this committee were general, regarding practices that should be used throughout the TRW, and specific, regarding targeted projects and subwatersheds. The group also provided input regarding related recommendations that had been made by other committees, very notably endorsing the recommendations from the Commissioners Committee.

RCPP Committee: The Regional Conservation Partnership Program Committee (RCPP Committee) was comprised of members of several other committees, including the County Infrastructure Committee, Commissioners Committee, TRWMA Executive Committee, and Fisheries Committee as well as new outside groups and partners including Trout Unlimited, the League of Women Voters, Iowa Natural Heritage Foundation representatives, Pheasants Forever, engineers from others states, and other partners. This committee considered how the TRWMA partners could work with public and private entities in the four-state Driftless Area of Iowa, Minnesota, Illinois and Wisconsin. They developed recommendations for a Driftless Area watershed initiative that clearly defined and prioritized implementation of practices, and documented available local funding for projects in the TRW over the next five years. After approval of the TRWMA Board, the majority of the recommendations from this committee were incorporated into this plan.

Survey of Residents

SECTION THREE C

3.C Survey of Residents A 2013 survey of 1,500 rural and urban watershed residents revealed that thousands of watershed residents have been impacted by flooding in the TRW and watershed residents feel that not enough is being done to prevent flooding. The survey was conducted by Northeast Iowa RC&D on behalf of the TRWMA Board. Major findings from the survey results include the following. (The full results of this survey are included as *Appendix 6* and available to the public at www.turkeyriver.org.)

Result 1: 3 out of 4 people that were impacted by flooding in the TRW were impacted more than once.

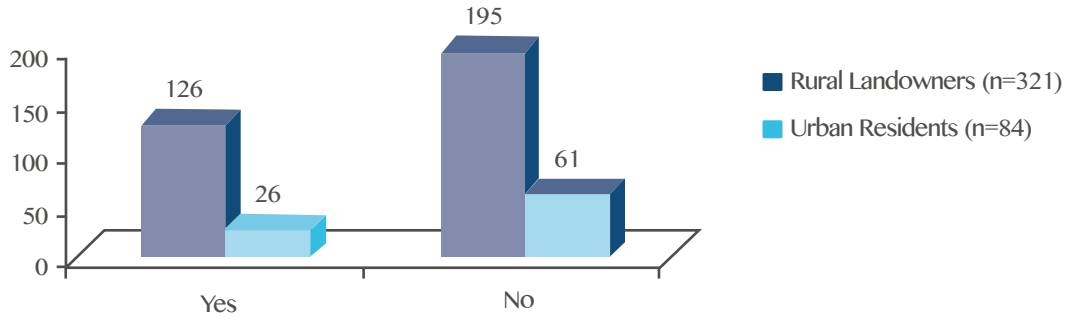
Result 2: Approximately 30% of rural landowners and 18% of urban landowners in the watershed report having been impacted by flooding in the past five years.

Result 3: 75% of TRW residents report they knew someone else who was impacted by flooding in the past five years.

Result 4: 59% of rural landowners and 70% of urban felt that not enough is being done to prevent flooding in the TRW.

Result 5: 60% of respondents said they would be willing to take action to improve water quality or decrease flooding.

Question 3: Have you impacted by flooding in the past 5 years?



Question 4: If you answered 'Yes' to question #3, how often have you been impacted by flooding in the past 5 years?

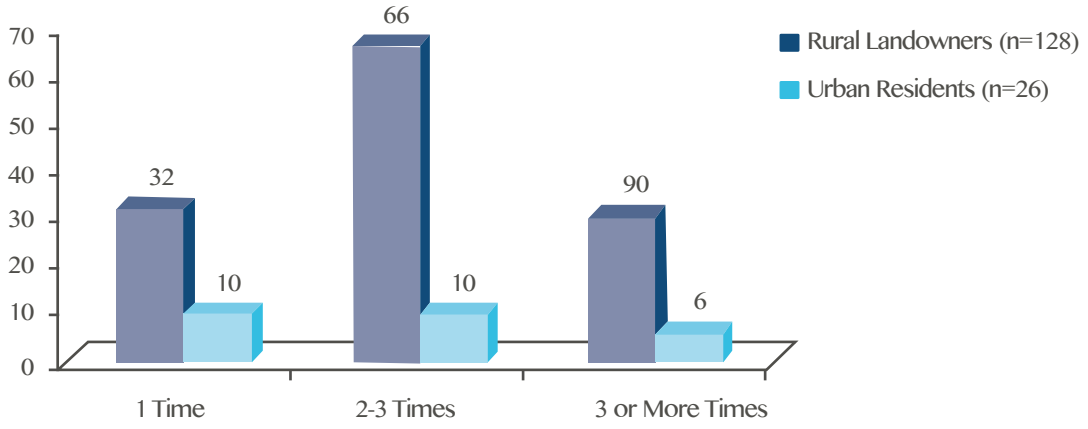


Figure 3.C.1 The Majority of Respondents Have Been Impacted By Flooding

Question 12: Are you interested in learning more about what you could do to reduce flooding or improve quality in the Turkey River Watershed?

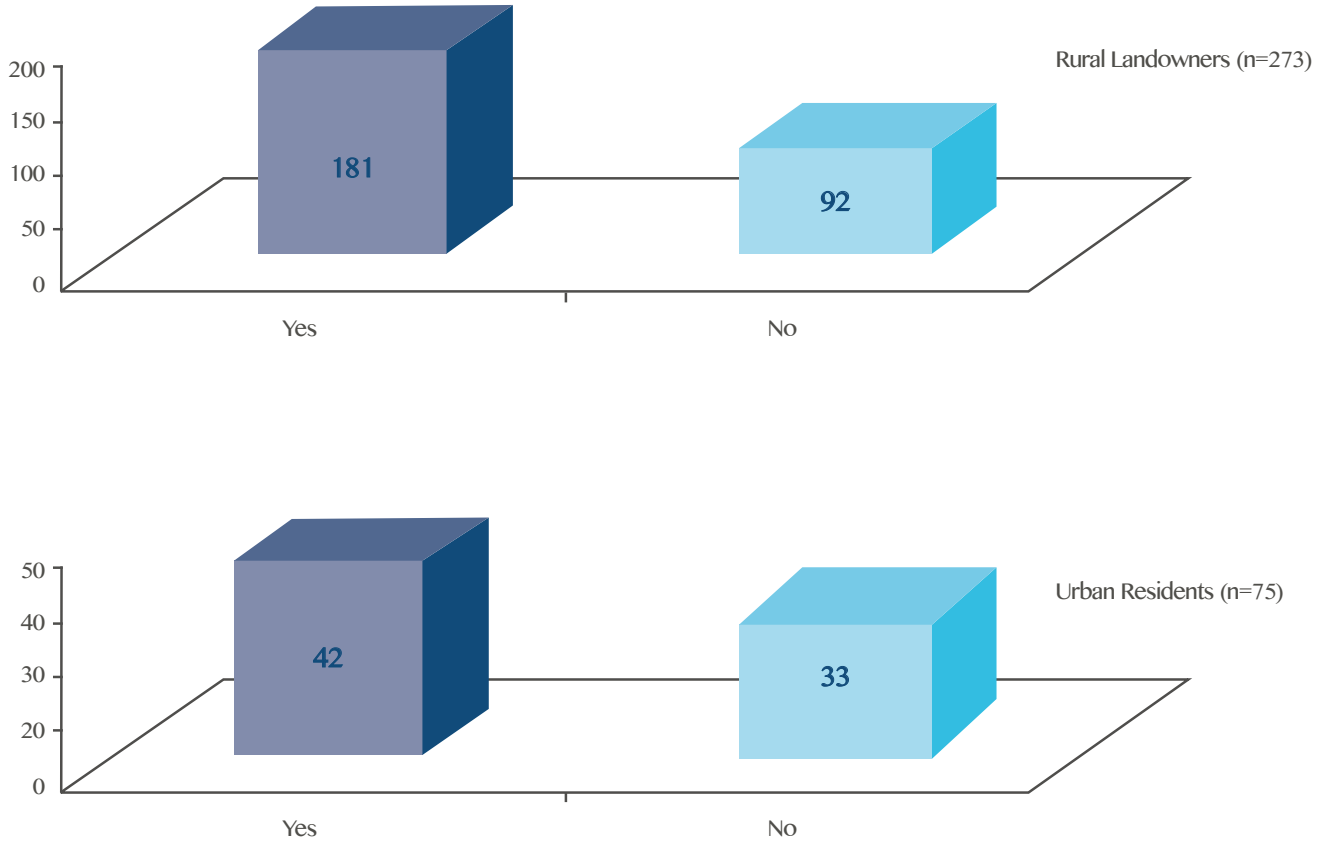


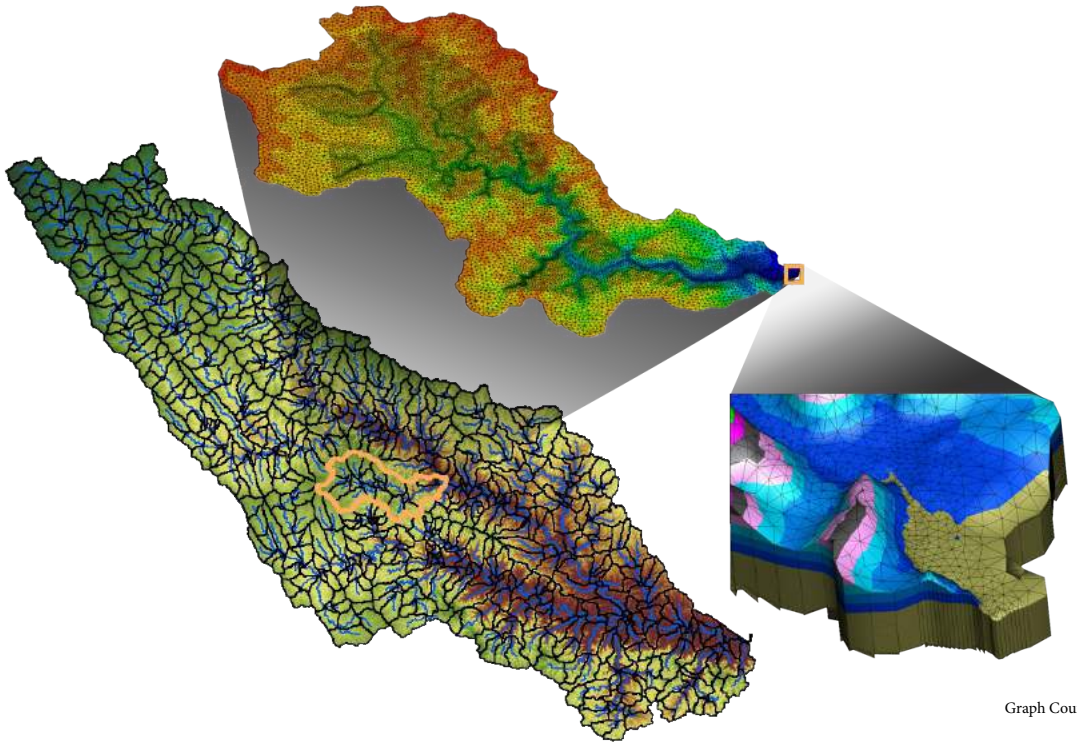
Figure 3.C.2 Survey Results Indicate the Majority of Respondents Are Interested in Learning More About What They Can Do

Section FOUR

Watershed Research, Analysis and Modeling

Watershed Research & Assessment

SECTION FOUR A



Graph Courtesy IFC

Figure 4.A.1 IFC Models Were Used to Measure Flood Reduction in Otter Creek Watershed and the TRW

Research, data analysis and modeling were used to inform and educate the TRWMA Board and subcommittee members throughout the planning process. Information from data analysis, research, and modeling provided a means to make informed decisions about the watershed based on existing conditions and set realistic goals for plan implementation. Much of the data analysis for this plan was completed by NRCS, the Iowa Flood Center/IIHR, and Northeast Iowa RC&D, although each received input from other organizations and individuals. Background geologic research conducted by the Iowa DNR through the Big Springs Project, flow monitoring conducted by USGS, and water quality monitoring and analysis conducted by the TRW Alliance/Technical Committee was also useful. To maximize the efficiency of the implementation, GIS data should be updated periodically as new data layers become available and conditions change throughout the implementation period of this plan. Below is a summary of data collection, research, and modeling done in conjunction with the planning process.

4.A Rapid Watershed Assessment

The Iowa Natural Resource Conservation Service (NRCS) completed a Rapid Watershed Assessment (RWA) on the Turkey River Watershed in 2012. According to NRCS, the purpose of a RWA is to "*provide initial estimates of where conservation investments would best address the resource concerns of landowners, conservation districts, and other community organizations and stakeholders.*" The RWA is a summary of the physical characteristics, water quality, threatened and endangered species, census and social data and resource concerns of the TRW. The RWA also has a summary of hydrologic modeling done in the Otter Creek Watershed to simulate the effects of flood management structures on the landscape. The Turkey River Watershed RWA is included in Appendix 3.

Watershed Analysis & Modeling

SECTION FOUR B & C

4.B GIS Analysis

Additional GIS data and analysis not included as part of the NRCS RWA was completed by Northeast Iowa RC&D. RC&D gathered existing GIS layers from a number of public sources including the Iowa Geological Survey, Iowa Department of Natural Resources, Iowa Department of Transportation, 2010 Census Data, and others and organized and catalogued the existing data. Northeast Iowa RC&D created and analyzed new GIS data layers as needed including flow patterns, community drainage patterns, community watersheds, potential pond locations, and others. Analysis of GIS data was performed as needed based on input from the TRWMA Board and subcommittees.

4.C IIHR/Iowa Flood Center Hydrologic Analysis and Modeling

Hydrologic modeling was conducted by the Iowa Flood Center and IIHR to quantify the results of flood mitigation efforts on stream discharges. Two hydrologic models were used to complete the modelling assessments. A surface model, HEC HMS, was used to assess current and proposed landscape conditions and the effects from large rainfall events. A more sophisticated model, Hydrogeosphere, was used to simulate hydrologic responses to flood mitigation efforts in the Otter Creek Watershed which is a sub-watershed of the TRW.

1. Turkey River Watershed (HEC HMS) - Hydrologic modeling in the TRW was done by the Iowa Flood Center for Phase I of the Iowa Watersheds Project using the Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS). This modeling system is designed to "simulate the precipitation-runoff processes of a watershed." These processes include precipitation, infiltration, transpiration, evapotranspiration, and sublimation as well as groundwater and overland flow. HEC-HMS combines two main components, basin conditions and meteorological models, and uses mathematical equations to simulate the hydrologic processes. When the input basin conditions are changed, such as flood mitigation practices are added, the output results then change reflect those changes. For the TRW, several scenarios were modeled including adding 402 flood management structures (ponds) into the existing basin conditions. Adding the 402 flood management structures into the TRW resulted in a 4.6% decrease in discharge at the USGS gauge in Garber. The results prove that flood management practices strategically placed in a large scale watershed can have a tremendous effect on stream discharge. The full report for the TRW using the HEC-HMS model is included as Appendix 2S.

2. Otter Creek Sub-watershed (Hydrogeosphere Modeling) - Otter Creek is a HUC 12 scale watershed of approximately 30,000 acres in the central portion of the TRW. Otter Creek was chosen for Phase II of hydrologic assessments by the Iowa Flood center as part of the Iowa Watersheds Project. The goal of Phase II is to couple intensive hydrologic modeling with implemented flood mitigation practices. Construction of the flood reduction ponds will occur in 2015 and the designs and storage capacities of these structures will be incorporated into the Hydrogeosphere model. Hydrogeosphere is able to model the entire hydrologic cycle and take into account interactions between surface and subsurface flow regimes. Hydrogeosphere requires a large amount of input data and intense CPU capabilities and is more suitable to smaller watersheds like Otter Creek. The Otter Creek Watershed was chosen because it is a good representation of the diversity of land cover and land use to that of the TRW.

Rain Gauge Installation in the TRW

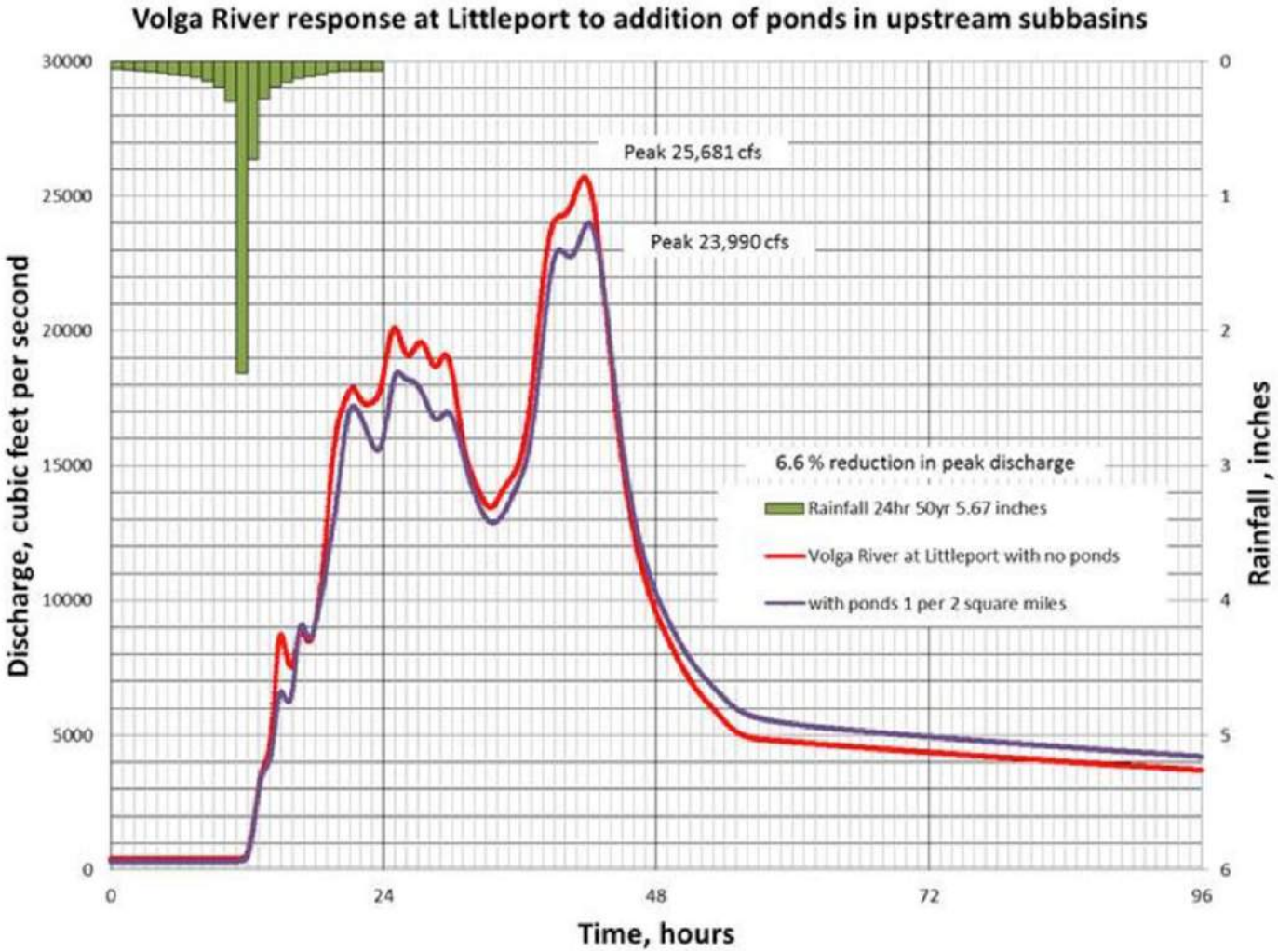


Figure 4.C.1 Volga River Response at Littleport to the Addition of Ponds in Upstream Subbasins

Section Five

Proposed Strategies

Summary of Strategies

SECTION FIVE A

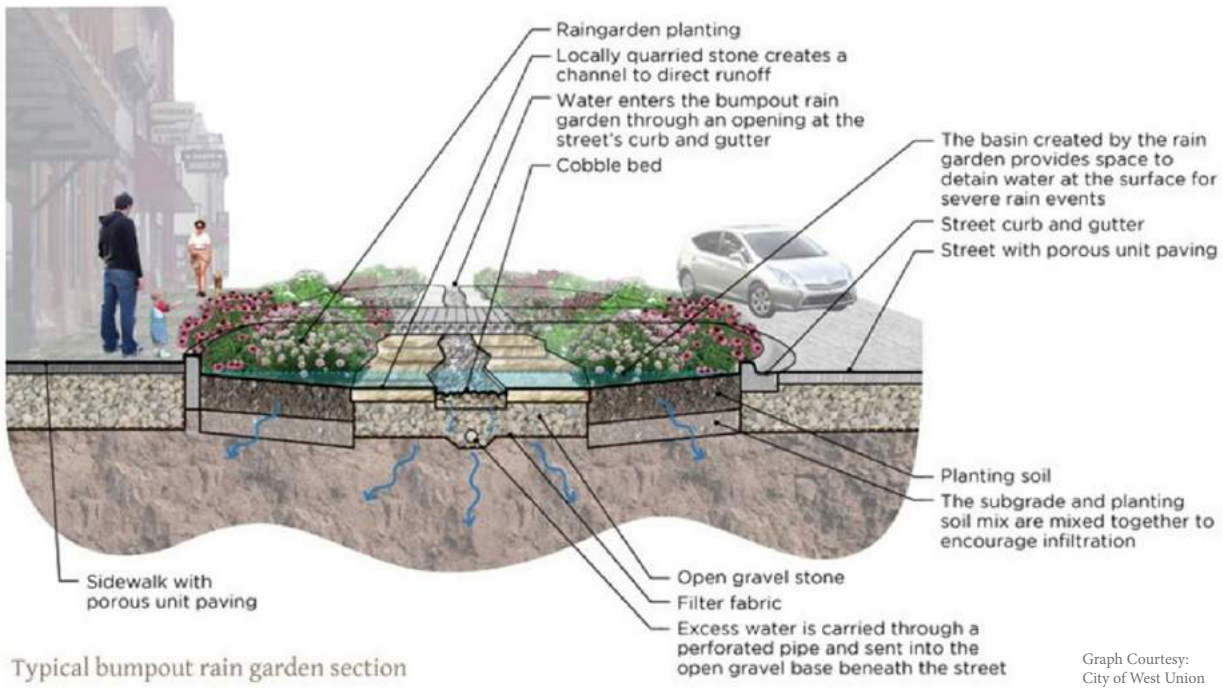


Figure 5.A.1 Rain Garden Cross Section

5.A Summary of Strategies

The proposed strategies for this plan are to occur over a 20-year period beginning in 2015 and will be spread across the entire TRW unless otherwise stated or prioritized to specific subwatersheds or landscape positions. The strategies proposed in this plan are presented by objective and are designed to address excess runoff from the top of the watershed down to the lowest reaches. They are not intended to stop rainwater runoff but rather to strategically slow runoff so that maximum stream and river levels can be decreased and moderated to reduce incidence of flash flows, catastrophic flooding and the associated resulting economic, environmental and ecosystem damage.

The most efficient and cost effective ways to slow and capture runoff are implemented to maximize the amount of precipitation absorbed and held where it falls. Once precipitation becomes runoff, it is much more challenging to slow or stop and the practices required to do so tend to be higher cost. Some proposed practices for flood reduction, such as detention structures, have an immediate, tangible impact on reducing runoff and can be implemented quickly. Practices such as no-till and soil health improvement take longer to effectively reduce runoff but are more affordable to implement, remain effective as long as the practice is in place and do not require extensive effort or funding to maintain.

Many of the strategies have multiple economic and environmental benefits for the producer/landowner and the watershed residents. For those reasons a multifaceted approach for implementation is necessary over the entire planning period to successfully reduce flooding.

The practices described in this plan are proven to effectively prevent, reduce, slow, or capture runoff before they become intense floods. The proposed practices vary in popularity and depth of supporting research, but all should be considered by watershed residence looking for how they may contribute to the hydrologic system management.

1. Technical Assistance

SECTION FIVE B

Clayton County Supervisors and Engineer Meet with Landowner and Producer to Discuss On-Road Structure

Over the next twenty years, it is likely that technology will allow for more efficient ways to prevent flooding. Therefore, this document is intended to be a guide for flood reduction with the current strategies known for reducing runoff and should be a working document that changes over time to adapt to new information and technology. As new technology is available, it should be added to the practices proposed in this document to complement existing techniques or replace ineffective practices. This should be a working document that changes and adapts as technology or watershed needs require.

5.B Objective 1: Develop a team of flood mitigation professionals

The TRWMA believes that, because of the decline in existing conservation technical assistance at all levels, the urgency associated with flood prevention and the number of producers and community members (over 60% of the 5,090 producers on approximately 3,400 farms and 60% of community members from 23 communities) that are interested in implementing practices for which they would need technical assistance, there should be increased technical assistance in the Turkey River Watershed. This should include county, regional and community technical assistance to ensure that practices can be installed in a timely manner.

1. Flood Mitigation Technicians. TRW plan goal: A minimum of 5 Flood Mitigation Technicians will be assigned to the TRW for education and outreach and landowner engagement. The five flood mitigation technicians (FMTs) should coordinate activities with each other, TRWMA and TRWMA Coordinator, TRW Engineers, and SWCD watershed personnel to ensure efficiency and maximize their efforts. FMTs should work with landowners to provide information and education, conduct face to face outreach, and assist with conservation planning and layout. They should assist engineers with project placement, survey,

design, and implementation as well as gathering all necessary state and federal permits. FMTs should also assist with gathering data and GIS analysis as the TRW Plan is implemented. FMTs will be assigned regions within the watershed to concentrate their efforts for landowner outreach.

2. Civil Engineers. TRW plan goal: A minimum of 3 Civil Engineers will be assigned to the TRW to work with landowners, counties, and SWCDs on project designs. Engineers will provide expertise in planning, survey, design, and implementation of structural projects throughout the TRW. They will work closely with the Flood Mitigation Technicians, County Engineers, and SWCDs to plan and design projects to maximize flood reduction potential.

3. Urban Conservationist. TRW plan goal: A minimum of 1 Urban Conservationist that will work with community leaders and residents throughout the TRW to coordinate design and maximize implementation of SMART Planning Practices to reduce runoff from urban areas. The twenty-three TRWMA participating communities are small communities with limited resources including access to trained professionals to assist with storm water management practices. Iowa Department of Agriculture and Land Stewardship (IDALS) has 4 urban conservationists to assist communities across the state and are a great resource for communities. However, because of the demand of a large geographic region, the IDALS urban conservationists have limited time to commit to the TRW communities. An urban conservationist in the TRW would be able to focus their efforts across the watershed. They should coordinate their efforts with the TRWMA, FMTs, TRWMA Coordinator, and IDALS Urban Conservationists to maximize efficiency and to avoid duplicating efforts. The TRW urban Conservationist will assist communities with implementing storm water best management practices, including design and planning, as well as storm water policy development.

4. Liaison & Outreach Coordinator for Private Organizations. TRW plan goal: *1 Private Lands Liaison and Outreach Specialist.* The L&O Coordinator will work with private organizations such as ducks unlimited, pheasants forever, wild turkey federation, trout unlimited, and whitetails unlimited to develop projects on private land that satisfy the objectives of this plan for reducing runoff. The L&O Coordinator will facilitate efforts between organizations as well as between organizations and private landowners.

5. TRWMA Coordinator. TRW plan goal: *1 TRWMA Coordinator.* Provide assistance to the TRWMA Board of Directors to insure the TRWMA functions at the highest level throughout implementation of this plan including but not limited to administration, coordination, facilitation, grant writing, policy development, outreach, communications, education, partnership building and other technical assistance as needed by the TRWMA Board of Directors. This person will also oversee the reporting, documentation, research and analysis associated with the implementation of this plan.

ICAN Planners Meeting with Producer

2. Increase Infiltration

SECTION FIVE C

Cover Crops Improve Dynamic Soil Properties and Increase Infiltration

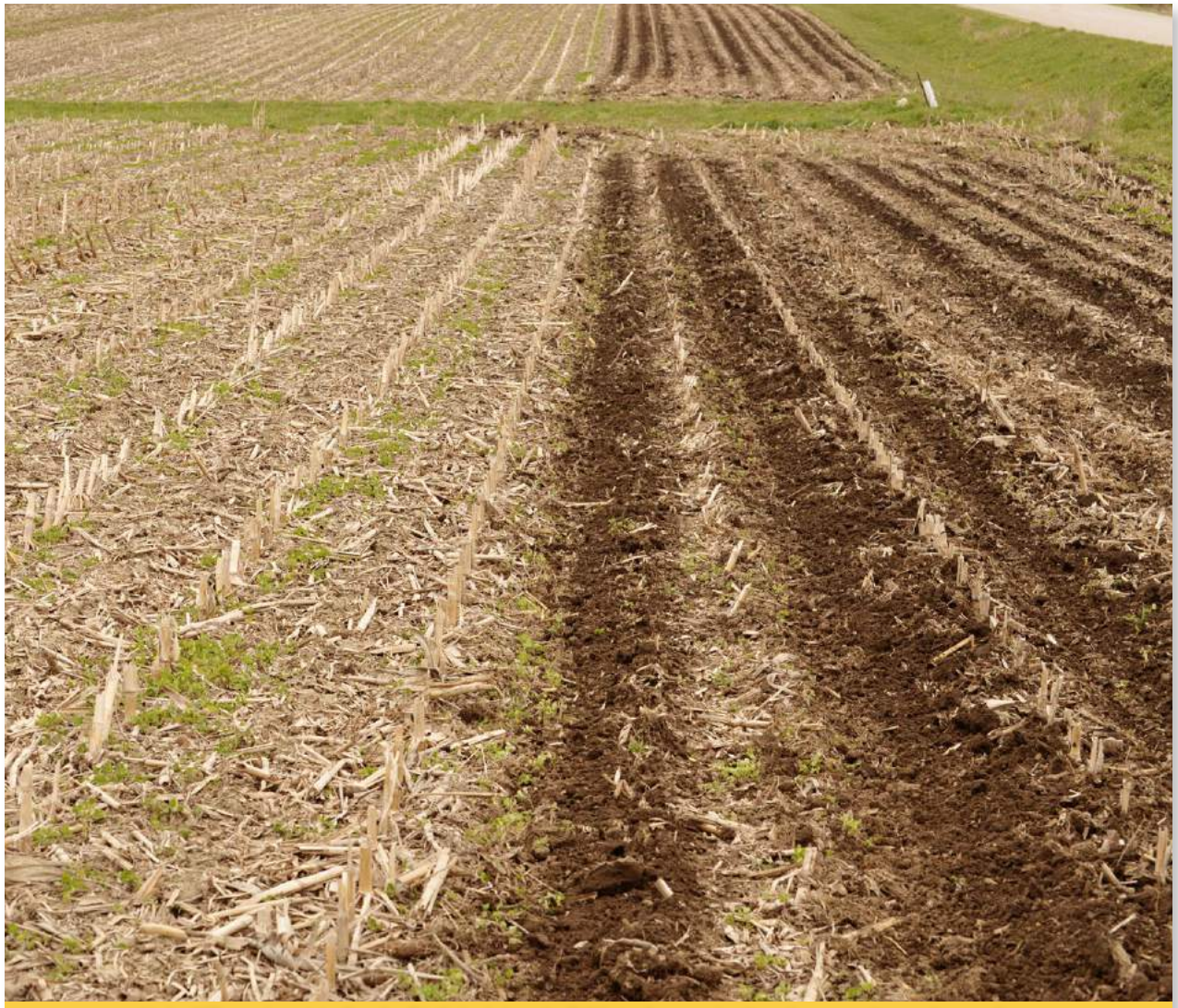
5.C Objective 2: Implement conservation practices that stop or slow rainwater where it falls or increase rainwater infiltration so that storm water runoff is reduced. The first landscape position that will most effectively reduce flooding is in the upper reaches and highest elevations of the TRW. The most common land use type found in these areas is productive agricultural land. With altered management strategies, rainfall and storm water runoff can be better infiltrated into the soil, soil can be held on the land, and water can be managed where it falls if the land in the upper reaches of the TRW. Capturing precipitation before it becomes runoff is critical to reducing flooding by reducing the total volume of stormwater that reaches surface streams and rivers. The highest percentage of the TRW area falls into this landscape position category and therefore represents is capable of holding the greatest amount of stormwater runoff. Since the majority of the TRW, 52%, is in row crop production, as opposed to hay or small grains, the first opportunity to slow rainwater where it falls is in crop fields. As discussed earlier in this plan, the dynamic soil properties have a direct impact on the amount of microbes, fungi and bacteria that are found in healthy soil and allow soils to function as intended. The following practices representing objective 1 are intended to improve the dynamic soil properties and therefore increase infiltration and reduce runoff.

Practices: Reduced Tillage or No-Till, Cover Crops, Contour Buffer Strip, Grassed Waterway, Strip Cropping, Tree and Shrub Establishment, Prairie Strips, Rotational Grazing, Conservation Reserve Program (CRP)

Supporting practices: Fencing, Livestock Pipeline, Watering Facility, Water Well

1. Reduced tillage and no till systems. TRW plan goal: 281,715 acres or 50% of cropped acres with permanently reduced tillage or no-till systems. Soil disturbance is a major cause for soil health degradation. Reduced tillage or no-till systems are highly recommended practices for reducing soil disturbance by many of the TRWMA Board, TRWMA Committees, the Iowa Flood Center, and Producer Groups. Reduced tillage and no-till systems are used by many producers statewide in Iowa but a limited number of producers are using reduced tillage on all of their cropped acres every year. Technological advances in equipment and nutrient application methods have made these methods much more feasible and economical to producers, even those growing continuous corn. The number of acres currently in a reduced tillage system is difficult to estimate given the variability of use between years and producers.

While there is little cost typically associated with this practice outside of equipment purchase, a monetary per acre incentive would increase the use of this practice across the watershed. The key to this practice being successful for the producer and for runoff reduction is long term adoption. Incentives for no-till are typically short term and therefore those receiving the incentive revert to traditional tillage when the incentive period is over. For this reason,



Strip Tillage is a Method of Minimizing Soil Disturbance in Continuous Corn Operations

it is recommended that incentives for reduced tillage systems are contingent on long-term adoption (such as a minimum of five years).

2. Cover crops. TRW plan goal: 281,715 acres permanently incorporating cover crop systems (100,000 acres after 5 year cost share program). Cover crops are becoming more commonly incorporated for regular use on Iowa cropland. Clayton County alone reported an increase of 4,000 acres in cover crops from 2012 to 2013. Cover crops have a number of important benefits that contribute to improved water quality but also reducing runoff. Cover crops keep living roots in the soil during the periods before and after corn or beans are present. This helps keep soil from being compacted, increases organic matter in the soil, and builds the microfauna community. All of these factors improve soil health and increase the soil's ability to infiltrate and hold water. The increased surface residue from cover crops also protects soil from eroding and prevents the formation of rills and gullies during heavy rains.

Like reduced tillage systems, the goal of the TRWMA is for cover crops to become an established practice with producers. A challenge with this practice is it incurs more initial cost to the producer. Cost share programs have been established to help demonstrate the benefits of cover crops but they vary widely across the state. Climate variation, application method, and cover crop varieties are also variables that can impact the degree of success or failure of cover crops. Like reduced tillage and no-till systems, new technology and application methods are making it easier and more economical for producers to incorporate cover crops into their year to year operations. To encourage producers further incorporate cover crops to assist with researching improved application methods and timing as well as cover crop variety, it is recommended that an initial cost share program be established for the first 5 years of implementation.

3. Contour buffer strips, grassed waterways, prairie strips & strip cropping. TRW plan goal: In order of priority A) prairie strips, B) contour buffers, C) grassed waterways and d) strip cropping - 56,000 acres. Contour buffers, grassed waterways, and prairie strips are practices that are intended to achieve the same end through slightly different methods. Contour buffer strips and grassed waterways have been utilized by producers for many years. Grassed waterways were the most highly utilized conservation method according to the TRW survey of landowners. All of these practices are intended to capture runoff to increase infiltration and prevent the formation of rills and gullies in and around crop fields.

Traditionally used methods such as contour buffers and grassed waterways vary greatly in width and are typically mowed or cut multiple times per year. Frequent cutting and plant species typically used (such as brome grass or alfalfa) prevents the establishment of deep root systems that allow better infiltration. Prairie strips are strategically placed on contours and at the foot of slopes to intercept runoff and allow it to absorb. Prairie strips are planted with native tallgrass prairie grasses and forbs which have very deep root systems that build healthy soil, provide ideal conditions for microbes, decrease compaction, and increase the water holding capacity of the soil. Of the four practices listed, prairie strips are the most effective at reducing runoff, up to 40% in some cases. Based on Iowa State Extension research, 10% of a field planted into prairie strips can treat runoff from the remaining 90% of the field. Prairie strips are also a more cost efficient

Grassed Waterway

Rotational Grazing

Strip Cropping with Hay Filter Strips

method of reducing runoff and nutrients from fields than traditional earthen terraces.

4. Rotational grazing. TRW plan goal: 146,725 acres or 50% of TRW pastured acres permanently in rotational systems. While cropped acres make up the largest land cover type in the TRW, pasture and hay are second highest land cover type at 27% of the watershed. This estimate may be lower than the actual amount of pastured land because many of the acres designated as forest are also grazed. While pastureland is typically covered in perennial grasses for grazing, overgrazing can cause compaction of the soil in these areas. According to Historical Agriculture and Soil Erosion in the Upper Mississippi Valley Hill Country, compaction of steep slopes from overgrazing has historically been a major problem in the Driftless Region of Iowa and overly grazed pasture can have a higher runoff coefficient than agricultural land. Rotational grazing ensures that pastures are not overgrazed and grasses and vegetation have a chance to grow back, establish deeper roots and more surface cover. Supporting practices of fencing and watering practices should be used in conjunction with rotational grazing efforts.

5. CRP. TRW plan goal: Retain existing acres and install 20,000 additional acres (1,000 new acres installed per year x 20 years). CRP is an NRCS program dedicated to taking less productive agricultural ground out of production and into perennial grasses that protect soil from erosion and runoff. CRP was a very popular program in the 1990's in Iowa but has seen a significant reduction in participation in Iowa due to low rent rates and high crop prices. CRP remains a critical part of protecting vulnerable, less productive land in the TRW. With the most recent farm bill passed by US Congress, CRP payments were increased to become more competitive with rental rates per acre. CRP can be used to set aside significant portions of land for runoff reduction as nearly zero runoff comes from established grassland.

3. Reduce Rainwater Runoff & Flash Flows

SECTION FIVE D

On-Road Water Control Structures Can Capture Runoff from Small Drainages

5.D Objective 3: Slow down rainwater runoff and reduce the frequency and intensity of heavy flash flows into streams and rivers, thereby protecting aquatic and riparian habitat, streambanks, stream and river substrate, conservation practices and private and public infrastructure. During intense rainfall events when soil becomes completely saturated or precipitation is falling at a rate that exceeds the rate of infiltration, excess water will begin to run over land as runoff. This excess runoff can cause flash flooding, wash out roads and bridges, and is the eventual cause of major floods. As more runoff gathers, it becomes more powerful and thus more difficult to slow or stop. This plan proposes to create a network of small water control structures strategically placed in the mid and upper reaches of the TRW to capture and hold runoff from small drainages. Smaller control structures are relatively low cost, simple to engineer and construct and when constructed in large numbers, effective at capturing runoff. Larger flood control reservoirs take a long time to engineer and construct, are very expensive, and have limited location potential. Another important advantage to smaller control structures is the limited risk in the event of a failing structure. When larger flood control reservoirs fail, they can actually cause more damage and cost than the flood they were intended to prevent.

The water control structures referred to above are commonly called ponds, sediment detention basins, and gully blocks. Regardless of the name or whether or not the structure permanently holds water, the purpose of these structures is to create a system or network of distributed storage for runoff that is then released more slowly after the peak runoff period following heavy precipitation. Given the variation of topography from west to east in the TRW, the design of these structures will vary as the landscape and soil type demands.

In the eastern portion of the TRW, especially Clayton County, there are many ponds already in existence. Many of these structures have very little capacity to hold runoff because they have filled with sediment

over time or are permanently filled with water. Some of these structures could be restored to their former holding capacity, however it is generally more cost effective to build a new structure than to restore an existing one. One possibility for utilizing existing, aged retention structures is as a sediment trap above a newly constructed pond. Although the older structures cannot capture runoff very effectively, they are still effective at slowing runoff temporarily to allow sediment to filter out before moving downstream. Sediment buildup is the primary cause of reduced effectiveness of any control structure, small or large.

The Hydrologic Assessment of the Turkey River Watershed completed by the Iowa Flood Center/IIHR incorporated a system of distributed storage from ponds or retention structures into their hydrologic model to quantify the reduction in discharge during large scale rain events. This assessment modeled a 50 year storm (5.67 inches of rainfall) across the entire TRW with and without the presence of 402 water control structures. It is noted in the assessment that the scenario of evenly distributed rainfall across a large watershed like the TRW is extremely unlikely but is required for modeling purposes. The results of the model were quantified at locations where an existing USGS gauge exists so as to compare modeling results to past major floods. The ponds were distributed primarily in the mid and upper reaches of the TRW at a density of approximately 1 pond per every 2 square miles. Modeling results on the Turkey River at Spillville, Eldorado, Elkader, and Garber resulted in reductions of 16.5%, 5.9%, 3.8%, and 1.7% respectfully. Higher percentage discharge reductions occurred in the upper portions of the TRW because a higher acreage is controlled by retention structures than in the lower reaches yet the precipitation was distributed evenly across the entire area.

Practices: Riparian Buffers, Sediment Basin, In-field Water and Sediment Control Basin, On-road Water and Sediment Control Basins, Wetland Creation, Wetland Restoration

1. In-field water and sediment control basins, on-road water and sediment control basins, wetland creation and restoration. TRW plan goal: 300 water and sediment control basins (in-field or on-road), 50 wetlands created or restored. The TRWMA recommends using each kind of control structure to make up the distributed storage system of ponds and wetlands. Water control structures on private lands vary in design based on topography and landowner input. In addition to ponds on private land, the TRWMA County Infrastructure Committee made up of County Engineers and County Supervisors are seeking to install water retention structures using gravel county roads as the dam for retention (*Figure 2.B.5 Stream Intersection Points with County Roads Map*). These structures can be used in place of culverts and small bridges that have a tendency to wash out or receive damage during heavy flows. Wetlands are another design alternative for retaining runoff before it enters streams and rivers.

2. Riparian buffers. TRW plan goal: 10 linear miles of streambanks protected with minimum of 60 foot buffers on both sides. Riparian Buffers are strips of perennial grasses and forbs that are seeded a determined distance along the edge of a given waterway. These grass strips intercept surface runoff and allow it to infiltrate into the soil as well as stabilize riparian banks. Like contour grass strips, riparian buffers that are planted into native tallgrass prairie grasses and forbs will have a greater benefit than other species.

Riparian Buffer

4. Restore & Protect Stream Ecosystems

SECTION FIVE E

Streambank Improvement with Sloped Banks and Native Prairie Planting

5.E Objective 4: Restore and protect stream/river and near stream ecosystems to increase their capacity to hold storm water runoff and increase stability and resiliency during rainfall and runoff events. Decades of floods, erosion, and sedimentation have taken a toll on river and stream corridors. Streambeds have aggraded over time because of sedimentation while stream channels become more incised and disconnected from former floodplains. These factors reduce the volume of water that a stream channel can hold, increase flash flows, and increase the velocity of water moving downstream. The following suite of practices are intended to protect riparian areas, reconnect streams with floodplains, restore in-stream habitat to improve flow, and increase the volume capacity of stream channels.

Practices: Stream shoreline Protection, Stream Habitat Improvement, Restore Floodplain Connectivity.

Supporting Practices: Riparian Forest Buffer, Riparian Buffers, Riparian Wetlands, Fencing, Access Control, Heavy Use Protection, Stream Crossing

1. Stream Shoreline Protection. TRW plan goal: 5 linear miles of streambank protection. Stream shorelines and banks can be protected in a number of different ways to prevent further damage and erosion which cause steep cut banks. High, vertical cut banks affect the hydrology of the river by accelerating water downstream, particularly during higher levels. Stream banks can be protected using strategically placed rock or riprap, native tallgrass prairie, woody material, or tree and shrub plantings. Stream bank protection projects should include sloping of the bank to a more gradual slope along with one ore more of the listed material protection. The TRWMA Fisheries Committee recommends using a x/1 slope paired with native tallgrass prairie species and strategic rock placement for stream shoreline protection. Other options may be more appropriate where bank sloping is not possible.

Big Spring Hatchery is an Important Educational Site in the TRW

Big Spring Hatchery is situated in Clayton County and raises and stocks trout into coldwater streams in Clayton and Fayette Counties. Big Spring Hatchery is a popular destination for schools for field trips, tourists, and fisherman. The Iowa DNR owns approximately one mile of river corridor above and below the hatchery. Parts of this section of the Turkey River are very good fishing but hard for anglers to access because of the steep eroded banks.

Hatchery personnel have proposed to do stream habitat improvement and stream shoreline protection along this section of the Turkey River to improve fish habitat, protect banks from further erosion, protect hatchery facilities, increase the storage of the river channel during high water, improve angler accessibility, and to provide a demonstration for visitors to the hatchery of these practices. The hatchery is visited by hundreds of people every year and would be a perfect location for demonstration of stream restoration along the Turkey River. The TRWMA supports this demonstration project.

The listed supporting practices are included to be used as additional or complementary methods for stream shoreline or bank protection. Riparian buffers, forested or prairie, stabilize soil and prevent erosion. Riparian buffer zones also serve as a final barrier to intercept runoff before it enters streams and rivers. Riparian wetlands are found near streams and rivers in the stream or river valley. Riparian wetlands are natural occurring water retention areas that increase floodplain storage and can intercept and reduce runoff.

Fencing, livestock pipelines, watering facilities, water wells, access control, heavy use protection, and stream crossings are all supporting practiced used in pastured sections of streams or rivers. Livestock with unhampered access to a stream or river can increase erosion by compacting soils and overgrazing of riparian vegetation. The practices included in this plan are intended to limit livestock access to streams, provide alternative watering locations, and protect areas where stream access is required.

Restricted Access Watering

2. Stream Habitat Improvement. TRW plan goal: 5 linear miles of in-stream habitat improvement. Stream habitat improvement refers to in-stream improvements made between the banks of the stream or river. This can include, but is not limited to, lunker structures, strategically placed rock or boulders, riffle enhancement, and dam or obstruction removal. These projects should be done in conjunction with stream shoreline protection to maximize the benefits. In-stream improvements when combined with stream shoreline protection can increase the stream's ability to move sediment down and out of the system which deepens the channel and increases the storage capacity while also providing benefits to the aquatic community of species.

The TRWMA Fisheries Committee recommended four specific project locations for stream shoreline protection and stream habitat improvement. The Turkey River at Big Spring Hatchery, the Turkey River in Elkader, Otter Creek, and Bohemian Creek were recommended for projects. All of these are important fisheries within the TRW and because of their high usage, would make excellent demonstration sites for educating visitors about flood reduction, water quality improvement, fish habitat, and other topics. The TRWMA Fisheries also recommended that a HUC 12 watershed be selected based on analysis and be used to demonstrate these practices and benefits they provide.

3. Restore floodplain connectivity. TRW plan goal: 5 linear miles of streams. Stream channels that have become incised also have sediment built up directly along the stream channel. The sediment buildup actually acts like a levy and increases current velocity but lowers the total water volume holding capacity of the stream. In some locations, such as where riparian wetlands have been cut off from natural flooding, removing excess sediment can reconnect streams with their former floodplains. During flood events, water is more likely to naturally spread over these areas protecting more vulnerable riparian areas downstream and recharging riparian wetlands. Floodplain restoration should only be completed where it will not directly damage existing infrastructure or property.

5. Protect Properties Near Streams & Rivers

SECTION FIVE F

5.F Objective 5: Permanently protect and/or enhance highly sensitive, priority properties adjacent and near streams and rivers to increase the floodplain capacity.

Practices: Agricultural Conservation Easements, Stream Easements, Floodplain Easements

1. Protect properties near streams & rivers. TRW plan goal: 2,000 acres of agricultural conservation easements and 1,000 acres of stream easements. Landowners in the Driftless Area are passionate about their property. According to the survey of TRW landowners, more than 60% are interested in helping to reduce flooding or improve water quality on their land. How they decide to do that will vary. Some will want their lands to continue to function as working farms, others will prefer to transfer properties to conservation organizations, creating permanent habitat for wildlife. Voluntary permanent land protection through Agricultural Land Easements, fee title transfers and other conservation easements in strategic areas, including flood prone areas adjacent to streams and rivers and in hydrologically sensitive areas including side hills and bluffs are supported. ACEs and fee titles are options that help sustain public and private investments and can be measured by the number of properties and acres protected. Stream easements and floodplain easements can be used along stream corridors to take flood prone land out of production.

Land Protected by Pheasants Forever

6. Implement SMART Planning Practices

SECTION FIVE G

TRW Communites, like West Untion, are already Implementing Storm Water Best Management Practices

6.G Objective 6: Work with TRW communities to implement SMART planning practices to address stormwater & water quality concerns.

Practices: Pond, wetland, rain garden, bioswale, permeable paver, green roof, native plantings, tree and shrub plantings, rain barrels, municipal waste upgrades, separation of storm water runoff and municipal waste, private and public managed and reduced nutrient application and policy.

The 23 communities represented on the TRWMA Board control a lesser portion of the TRW than private landowners control cropped or pastured rural acres, yet the portion of the land the communities control is significant because urban areas with mostly impermeable surfaces have the highest runoff possible. The TRW communities are also among the greatest "point sources" of pollution in the TRW through their own community sewage treatment facilities and businesses within their communities.

1. SMART Planning Practices and Municipal Infrastructure Upgrades. TRW plan goal: 10% reduction in impermeable surface or 10% increase in runoff captured from impermeable surfaces and a 45% reduction in nutrient loading from communities. Since the time many of these communities were formed over a century ago, precipitation has been treated as a nuisance. The majority of community infrastructure in the TRW is designed to transport runoff to locations outside of city limits as quickly as possible. Curb and gutter systems were installed in portions of many communities; others simply straight piped it into the nearest ditch or stream. Smaller communities that have been unable to develop stormwater infrastructure have areas that are routinely inundated with stormwater causing problems for residents. Several of the communities have aging and/or failing stormwater and sewer infrastructure that dates back to the early 1900s. This aging infrastructure is compromised or

failing to different degrees depending on the communities. Many of the communities have agricultural land draining into or through residential and business districts, whether a community has existing stormwater infrastructure of none at all, nearly every community in the TRW is facing the need of replacement or installation of some type of stormwater infrastructure over the next five to ten years. This provides an opportunity for TRW member communities to maximize SMART Planning and implement practices that will reduce storm water runoff and beautify their communities. Many stormwater infrastructure practices not only reduce flooding, they also improve water quality. Ponds for example help slow storm water runoff but also help with sediment and nutrient removal in urban areas. According to the Pennsylvania Stormwater Best Mangement Practices Manual, they can remove up to 90% of the total suspended sediment and between 60 % and 70% of nutrients from urban stormwater.

Projects completed by West Union, Calmar, Monona, and Elgin, as well as examples from outside the TRW, were presented to the TRWMA Board to show that stormwater runoff best management practices (BMPs) are practical, don't adversely affect businesses, are effective at removing stormwater runoff efficiently, and can be more aesthetically

Traditional Storm Water Practices Move Water Downstream

Several TRW Communties are Planning to Install Permeable Pavers

pleasing than traditional methods. During TRWMA Community Committee meetings and City Council meetings, TRWMA Board representatives, mayors, City Council members and city staff discussed a number of practices that can be used to harvest or infiltrate stormwater runoff when replacing the existing aging infrastructure. Their discussions and decisions were related back to the TRWMA Board. Figure 6.G.1 documents the projects recommended by the TRWMA Board on the advice of the TRWMA Community Committee. The TRWMA Board recognizes that as City Councils and citizens become even more involved, additional BMPs may be added to this list for specific communities.

The goal of the TRWMA is to implement stormwater BMPs in every TRWMA community. However, to implement the practices listed in Figure 6.G.1, financial and technical assistance is needed. In some cases, the TRWMA Community Committee discussed collaboration on projects to reduce the financial burden. For example, nearly every community on the TRWMA is interested in incorporating a rain barrel program for their residents to build or purchase rain barrels. A collaborative effort would help TRW Communities share the costs of an expert to teach a rain barrel construction class, for rain barrel materials, and for purchase of pre-fabricated barrels.

Bioswale

Rain Garden

Wetland

With advice from the TRWMA Community Committee, the following projects are proposed by the TRWMA Board for collaboration:

1. Community use & construction rain barrel program
2. Public/private rain garden/bioswale program
3. Permeable pavement maintenance equipment sharing
4. Business BMP incentive program to reduce runoff
5. School property stormwater reduction program, including teacher and youth engagement

In additional to collaborative efforts, TRWMA communities are also interested in implementing projects independently or in partnership with local, state, and federal, public and private, agencies and organizations including but not limited to SWCDs, the RC&D, IDALS, Iowa DNR, IEDA, NRCS, ISU Extension and others. West Union, Monona, Postville, Elkader, Calmar, Elgin, and the other TRW communities have already implemented millions of dollars in SMART storm water runoff projects, which will change the way their communities function and benefit water quality and watershed resiliency for all TRW residents. Many of them have also proposed additional projects. This plan calls for funding for a TRW Urban Conservationist to work proactively with the communities in the TRW who are willing to maximize project opportunities. The TRW Urban Conservationist will help the communities identify specific opportunities for projects, find and secure grant and other funding to make those projects more affordable, and facilitate discussions with potential partners.

1. *Monona – Pond, wetland, or small lake; Policy/ Ordinances*

2. *Postville - Pond, wetland, or small lake; rain garden/ empty lot project; bio-swale project; downtown rainscape; policy/ordinances; business rain-scape incentive/blvd project; bank stabilization/stream meander; tree planting.*

2. Municipal Infrastructure Upgrades. TRW plan goal: Work with each TRW community to determine need and funding resources to complete water infrastructure upgrades. Community sewer systems and other point sources of pollution in the TRW are owned and maintained by municipalities and/or private entities that are regulated and managed. Unfortunately, many of the systems in the TRW communities are outdated, which is common across Iowa. The Iowa Nutrient Reduction Plan talks about how bacteria reductions are not the only nutrient reduction benefits that are realized with modifications to wastewater treatment facilities, noting "Modifications to (Iowa's) wastewater treatment facilities have the potential to reduce the plants' nitrogen discharge by 66% and phosphorus discharge by 75%. If successful, this strategy will reduce by at least 11,000 tons per year the amount of nitrogen and 2,170 tons per year the amount of phosphorus discharged annually by these facilities (statewide). These figures represent a 4% reduction in nitrogen and a 16% reduction in phosphorus in the estimated statewide nutrient loads to Iowa's streams and rivers." If those numbers are extrapolated to the TRW, they, when combined with the benefits of stormwater BMPs, could have a significant impact on water quality and help the TRWMA Board reach its 45% goal to reduce nutrient loading from communities. The Iowa Nutrient Reduction Plan notes that many nutrient removal technologies in wastewater treatment are already proven and well-established and therefore nutrient removal for Iowa's wastewater treatment facilities is technologically feasible. However, the primary mechanism IDNR uses in assessing the "reasonableness" of nutrient removal for individual facilities is the "estimated costs for improvements and the ability of end users to afford those costs" and "reasonableness or affordability of wastewater treatment improvements is dependent upon a number of factors including capital costs, existing and projected debt service, and operation and maintenance costs". Unfortunately, the TRWMA communities are small and have limited financial resources.

A SMART Planning initiative in West Union that occurred in the TRW before formation of the TRWMA has served has a model for other TRWMA communities. West Union is an Iowa Economic Development Authority Green Pilot Community. They installed new water and sewer lines while recreating their downtown, installing permeable streets and sidewalks and other SMART practices. The TRWMA member community of Elgin completed a $1.5 million upgrade to their wastewater treatment plant before the TRWMA formed and updated their downtown stormwater infrastructure and installed permeable parking during the planning process. Although they are small communities with limited resources, during the TRWMA planning process, three TRWMA member communities implemented or started major projects to upgraded their wastewater infrastructure and completed some type of sewer retrofit, repair or stormwater runoff system upgrade, Monona, Postville, and Elkader. The projects in these three communities represent an investment of nearly $15 million and their efforts, combined with previous projects in West Union and Elgin, these efforts will greatly reduce the discharge of bacteria, nitrogen and phosphorous into the streams and rivers of the TRW. The TRWMA Board applauds the efforts TRWMA member communities have made and encourages other communities to take similar actions upgrading their sewage systems and installing SMART practices. They include community initiatives and components that have been proposed but not yet funded as components of this plan and expect additions to the plan as other communities become more informed and proactive as a result of this plan.

The TRWMA Board recommends that all TRWMA member communities update their municipal wastewater and stormwater infrastructure. This recommended action recognizes the autonomy and financial limitations of the communities and encourages voluntary projects that have multiple benefits. As previously noted in this section, this plan calls for funding for a TRW Urban Conservationist to work proactively with the communities in the TRW who are willing to maximize

project opportunities. This TRW Urban Conservationist will help the communities identify specific funding opportunities for infrastructure projects, find and secure grant and other funding to make those projects more affordable, and facilitate discussions with potential private and public partners.

3. Policies, Ordinances and Education. TRW plan goal: Work with each TRW community to develop and implement storm water and water quality policies and ordinances as necessary. The TRWMA Community Committee considered policy and ordinances as part of the planning process. Policies, ordinances, and education will influence the decisions and behavior of community leaders, businesses, and residents and may or may not result in any cost to the community or citizens. Seven TRWMA communities are interested in developing and implementing some type of policy or ordinances. Each is unique and many are tied to specific actions including everything from prohibiting directing of sump pumps into sewer lines to prohibiting disposal of pet feces and/or grass clipping into the city stormwater system. This plan recommends that TRWMA member communities share effective policies and ordinances as well as educational pieces and programs with each other. Funding for development and printing of related educational and promotional materials for communities is also included in this plan.

Educational Kiosks should be Used in Conjunction with Practices

TRW Community	Pond, Wetland, or Small Lake	Rain Garden/Empty Lot Project	Rain Barrel Program	Permeable Pavers Strips of P. P.	Rain-scaped Park Revitalization	School Storm Water Runoff Program	Green Roof Project	Native Turf Project/ Native Grasses	Bio-swale Project	Lawn Nutrient Reduction & Grass Mngmt	Downtown Rain-scape	Policy/Ordinance	Business Rain-scape Incentive/ Blvd Project	Bank Stabilization/ Stream Meander	Tree Planting (edible/other)
Arlington		X	X	X				X	X	X					X
Calmar	X	X	X	X	X	X		X	X	X		X	X		X
Clermont	X	X	X	X	X	X	X	X	X	X					
Cresco			X		X			X					X		
Elgin				X											
Elkader	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Farmersburg															
Fayette	X	X	X	X	X		X	X	X	X	X	X	X		X
Fort Atkinson			X	X				X	X					X	
Garnavillo		X							X						
Hawkeye			X	X				X							
Lawler		X	X						X						
Maynard	X		X												
Monona		X	X	X	X	X		X	X	X	X				X
Postville	X		X	X	X	X		X	X	X				X	X
Strawberry Point		X	X						X						
St Lucas	X														
Volga	X	X	X		X			X	X						X
Wadena		X	X					X	X	X					
Waucoma			X		X			X				X	X		X
West Union	X	X	X	X		X	X	X	X	X		X	X		X

Community Project Ideas

4. Spotlight on 3 TRWMA member communities inspired by the planning process. Monona, Postville and Elkader.

1. **Monona:** Monona, population 1,549, has completed several major projects that will improve water quality and reduce storm water runoff in an impaired TRW tributary that has some of the highest nutrient levels of any stream in the TRW. In 2013, the City renovated the wastewater treatment facility to bring the City in compliance with the EPA clean water guidelines during normal weather conditions. In 2014, the City completed Iowa's first State Revolving Loan Fund Sponsored Project by installing permeable pavers in a large parking lot near the Unnamed Tributary. In 2016, the city will use the same program to install permeable pavers on a gravel city street that contributes directly an unnamed tributary of Silver Creek, which flows into the Turkey River. In 2016, the city will also replace, reline, and complete spot repair of areas of the sanitary sewers and sanitary manholes that have been identified as having problems with inflow and infiltration. Inflow and infiltration problems were impacting water quality because the sewer system became overwhelmed by storm water runoff during rainfall events of two or more inches. During rainfall events, the sewer system and wastewater treatment facility was inundated with storm water runoff and the wastewater treatment facility did not have the capacity to handle the extra water, forcing the City treatment facility operators to release untreated sewage into the unnamed tributary. The project will reduce bacteria, ammonia, and other pollutants entering the unnamed tributary and other downstream surface waters. Monona has also installed rain gardens and is currently implementing new education and information programs to inform citizens about the importance of keeping storm water out of sewer lines.

The City of Monona has Mulitple Storm Water Best Management Practices in Place

2. Postville: Postville, population 2,176, is planning and implementing several projects. They are in the process of a $5 million municipal sewage facility upgrade and a sewer rehabilitation project in the downtown business district. They are also rehabilitating aging sewer mains and manholes city-wide. This is important because more than half of the clay lines and brick manholes had been in service since 1915. Through the use of cured in-place polyurethane liners, as well as traditional "point repairs", the wastewater collection system is being strengthened and sealed to reduce the possibility of bypasses that could enter into streams and rivers. The community is also working to implement several SMART practices. In partnership with Northeast Iowa RC&D, they will demonstrate and interpret bioretention cells, rain garden, permeable pavers, grassed pavers, natural landscaping, soil quality restoration, rainwater harvesting, and other storm water runoff options at the RC&D facility, which is located in the downtown district. They are also acquiring stream and riparian zones so they can stabilize streambanks with native plantings, and have proposed curbcuts, bioswales, and native plantings in four locations in the community to demonstrate private participation opportunities. They have proposed permeable pavers or grassed pavers in a city street and three different parking areas/ lots. They have identified and proposed locations for native plantings, bioswales, and cubcuts in city parks and have proposed a partnership with the middle school/high school to develop a wetland in a location that will reduce runoff and nutrient loss from both rural and urban portions of the TRW. If funding can be secured, they would like to implement a citywide soil amendment project incentive and a cost share program for businesses who will put in permeable pavers, bioswales, and other urban storm water practices. Their planning considered how water flows through and from the entire community, how private and public entities could be involved, and how their community could benefit environmentally, economically, and socially from SMART Planning.

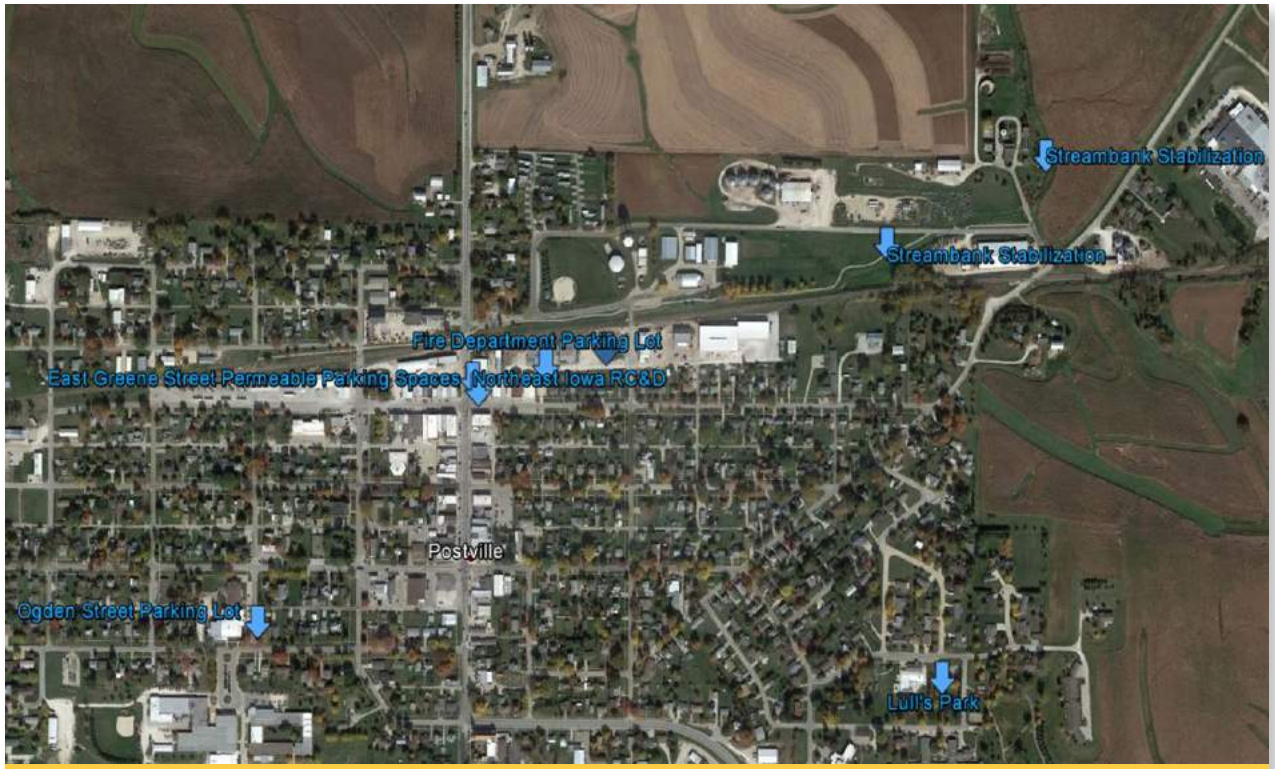
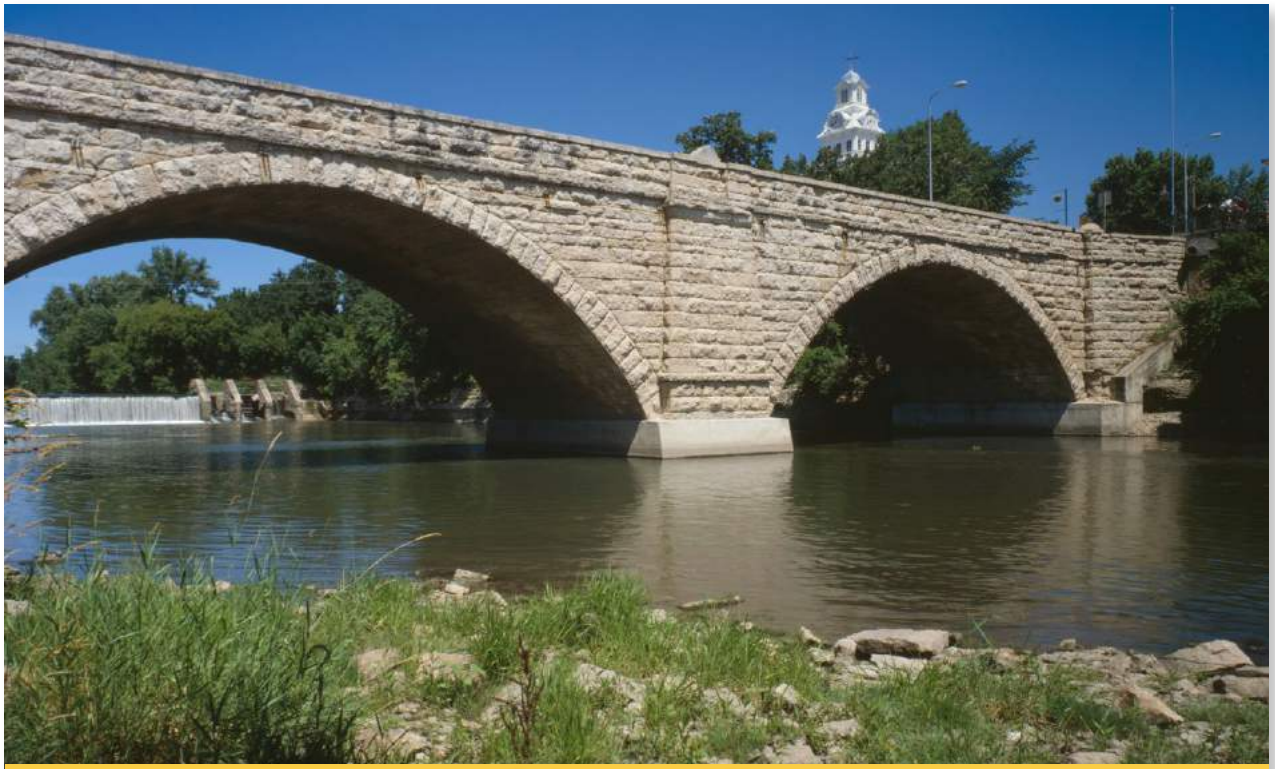


Figure 5.G.2 Proposed Projects in Postville

3. Elkader: The TRW member community of Elkader, population 1229 is located on the Turkey River and has sustained millions of dollars in private and public flood damage. They recently invested $5 million to upgrade their wastewater lagoon to a mechanical plant and implemented a sewer retrofit and repair program, which involved installing new sewer mains and manholes and upgrading existing life stations to mitigate future flooding. This was also important as they had broken sewer mains underneath buildings throughout the City. They implemented a community-wide smoke testing to determine problem areas of inflow and infiltration in their system and upgraded their capital improvement plan to reflect the areas of concern. They installed storm water mains along two streets to help alleviate basement flooding for residences in those areas and worked with a private developer to install a retention pond in the Industrial Park to address storm water run off from nearby parking lots. If funding can be secured, Elkader has plans to install permeable pavers in alleys near their downtown and in the upper part of Main Street and would like to install bioswales and add soil amendments that will increase infiltration in a strategically located city park. Elkader would also like to promote and provide cost share for rain gardens and rain barrels to the residents as a way to raise awareness about stormwater retention. Because flooding and water quality are such important issues in Elkader, they have plans to implement a stormwater ordinance and are looking for local partners to adopt a community storm sewer inlet labeling project that will make citizens more aware that storm sewers lead directly to the river. Elkader is also looking to work with landowners and entities upstream from the community to reduce the impact of storm water from those areas.



Elkader Keystone Bridge

7. Bacteria Management

SECTION FIVE.H

A Dairy Confinement Operation

7.H Objective 7: Expand management of bacteria including fecal coliform, E. coli, and other forms of bacteria that are contributed by human and non-human sources. Fecal coliform bacteria, including E.coli, found in surface and groundwater in the TRW likely comes from a variety of sources, including human, livestock, and wildlife. A previous microbial DNA source tracking study in a neighboring Northeast Iowa watershed found fecal bacteria from humans, numerous livestock types, and numerous warm-blooded wildlife species. Controlling bacteria inputs from wildlife is nearly impossible, but strategies exist to reduce or eliminate the contributions from human and livestock sources.

The following strategies and practices are targeted at primary sources of fecal bacteria in the TRW:

1. Minimize over-application of manure through expanded manure and soil testing. TRW Plan Goal: Work with 100 producers in the TRW to conduct soil testing and improve manure management.The number of confined animal feeding operations in the State of Iowa and in the TRW have continued to increase over the past decade, however the amount of crop ground available to apply the increased manure production has remained relatively the same. This could lead to heavier applications of manure to areas or to manure being applied to additional areas, both of which increase the potential of fecal bacteria reaching streams and rivers from rainfall runoff or accidental spillage. This plan recommends that manure nutrient testing and soil testing be combined to reduce the frequency of over-application based on the ability of crops to uptake available nutrients. Manure applied at rates above nutrient needs increases the amount of fecal bacteria susceptible to runoff. Timing of applications to avoid snow covered or frozen ground is also critical to minimize the risk of bacteria runoff to streams and rivers.

2. Locate livestock facilities and apply manure in feasible locations. TRW Plan Goal: Engage all producers with livestock in close proximity to streams about facility improvement and location. A paired watershed study in the Upper Iowa River Watershed determined

that differences in fecal bacteria in water samples in two adjacent, HUC-12 watersheds was due primarily to proximity of feedlots and pastured livestock to the stream. Fecal coliform bacteria levels were higher in the watershed where livestock facilities were more concentrated near the stream than in the watershed where facilities were located farther away from the stream. Placement of new concentrated livestock facilities and open feedlots in the TRW should be prioritized to locations with substantial distance between the facility and waterways. Buffers and filter strips, along with proper maintenance of manure storage systems, will also reduce likelihood of bacteria reaching the stream or river. Fecal coliform bacteria impairments from pasturing of livestock and application of manure near streams can also be reduced through livestock exclusion from stream bank, filter strips, and proper timing and method of application.

3. Utilize analytical software program to quantify bacteria loading. TRW Plan Goal: Use analytical software whenever working with producers. While there has been significant research in Iowa evaluating nutrient levels in manure, there has not been a concerted effort to quantify the amount of fecal coliform bacteria. As a result, the actual contributions of bacteria from agricultural manure to water quality impairments have been largely implied. Computer modeling software exists to quantify bacteria runoff from open feedlots and is widely utilized in the neighboring state of Minnesota. The Minnesota Feedlot Annualized Runoff Model (MinnFARM) calculates bacteria delivery from open feedlots based on annual average rainfall and can also calculate based on a one-time storm event. A project to model the use of the technology in Iowa took place in the Upper Iowa River Watershed in between 2006-2009 and proved an effective way to estimate bacteria delivery levels in runoff and to quantify reductions based on the incorporation of practices to improve feedlot manure management. The TRWMA recommends the use of this software for evaluating feedlot runoff upon the modification of this software to account for new rainfall data. Efficient targeting of practices to reduce fecal coliform bacteria delivery to surface and groundwater resources in the TRW can be greatly improved through utilization of this technology.

4. Target feedlot fixes to maximize bacteria loading reductions to waters of the state. TRW Plan Goal: Work on 50 open feedlots to incorporate BMPs. Utilizing available technology to quantify bacteria delivery from open feedlots can improve targeting of limited funding available for conservation practice implementation. Targeting feedlot fixes to those feedlots contributing the highest levels of bacteria to streams and rivers will maximize return on investment, ultimately result in greater water quality improvement, and improve functionality and profitability of feedlots. Additionally, this plan recommends incorporation of a full suite of practices to reduce runoff from open feedlots, including low cost fixes to reduce the amount of clean water interacting with manure, such as clean water diversions and roof gutters on adjacent buildings. Best management practices for feedlot improvement also include waste storage structures, settling basins, stacking pads, filter/buffer strips, and replacement of open feedlots with deep bedded hoop buildings.

Septic System Replacement

5. Address outdated septic systems through outreach/ education efforts, funding incentives and policy changes to reduce human contributions of fecal bacteria. TRW Plan Goal: Improve or update a minimum of 50% of outdated septic systems in the TRW. The Iowa DNR estimates that more than 100,000 buildings in Iowa have a septic system that does not function adequately. County sanitarians throughout the TRW have estimated that anywhere between 50-70% of rural septic systems in their counties are outdated and not adequately treating human waste. Septic systems that are not functioning properly, i.e. without a leach field, sand filter or other secondary treatment system often dump raw sewage into a ditch or into a tile line that leads straight to a ditch or stream. These systems can contribute extremely high levels of fecal bacteria, up to 100 million most probable number (MPN) of bacteria per 100/ml, and also contribute heavy loading of organic matter leading to lower dissolved oxygen in the receiving streams and rivers. Outreach and education to efforts combined with funding incentives to encourage updating of poorly functioning or inadequate septic systems is the most effective strategy to reduce fecal bacteria contributions from septics. The TRWMA recommends targeting funding for incentive programs to help reduce costs associated with updating septic systems. The cost share program should be available to individuals, businesses, and municipalities. A current Iowa law that has been in effect since 2009 requires properties being sold to have a septic inspection completed and, if necessary, have the septic system updated. The TRWMA supports the continuation of this law as a way to reduce inadequate septic systems.

6. Research innovative manure management strategies. The TRWMA recommends continued research and strategic planning regarding manure management and the reduction of fecal coliform bacteria entering surface and groundwater in the watershed. Specifically, the plan proposes research to evaluate the economic value of manure as a fertilizer versus distribution distance for manure applications, the feasibility of anaerobic digesters, and plausibility of manure trading. The TRWMA Board recognizes that manure transportation can damage county roads and recommends research to explore alternative transportation methods.

7. Work with communities to understand the importance of separation of wastewater and stormwater. TRW Plan Goal: Work with each TRW Community to address wastewater and stormwater runoff. Many communities in the TRW have aging wastewater treatment facilities and sewer systems that may contribute significant amounts of human fecal coliform bacteria to streams and rivers in the TRW, particularly during times of high rainfall and stormwater runoff. Separation of stormwater runoff and waste water effluent are critical to maintaining the ability of wastewater treatment facilities to function during heavy rainfall events. The majority of wastewater bypasses occur during these times. Several TRW communities have recently re-lined aging sewer pipes to keep stormwater from infiltrating into the system. This plan recommends that the TRWMA continues to work with communities to understand the financial and environmental benefits of updating wastewater treatment systems through an education effort. Communities utilizing low interest loans from the State Revolving Loan Fund will also be encouraged to apply for Water Resource Restoration Sponsored Project funding to address non-point source pollution in the watershed where the wastewater system in located, thereby maximizing local return on interest payments.

8. Address uncapped water wells through incentives and education. TRW Plan Goal: Determine the number, location, and address 100% of uncapped wells in the TRW. Abandoned wells are typically drilled into aquifers and act as a direct conduit for contaminants from the surface to the aquifer. Iowa counties may offer an incentive to cap abandoned wells to prevent groundwater contamination. The TRWMA recommends promotion of this incentive to encourage its use. The board also recommends efforts to identify existing uncapped well locations so they can be addressed.

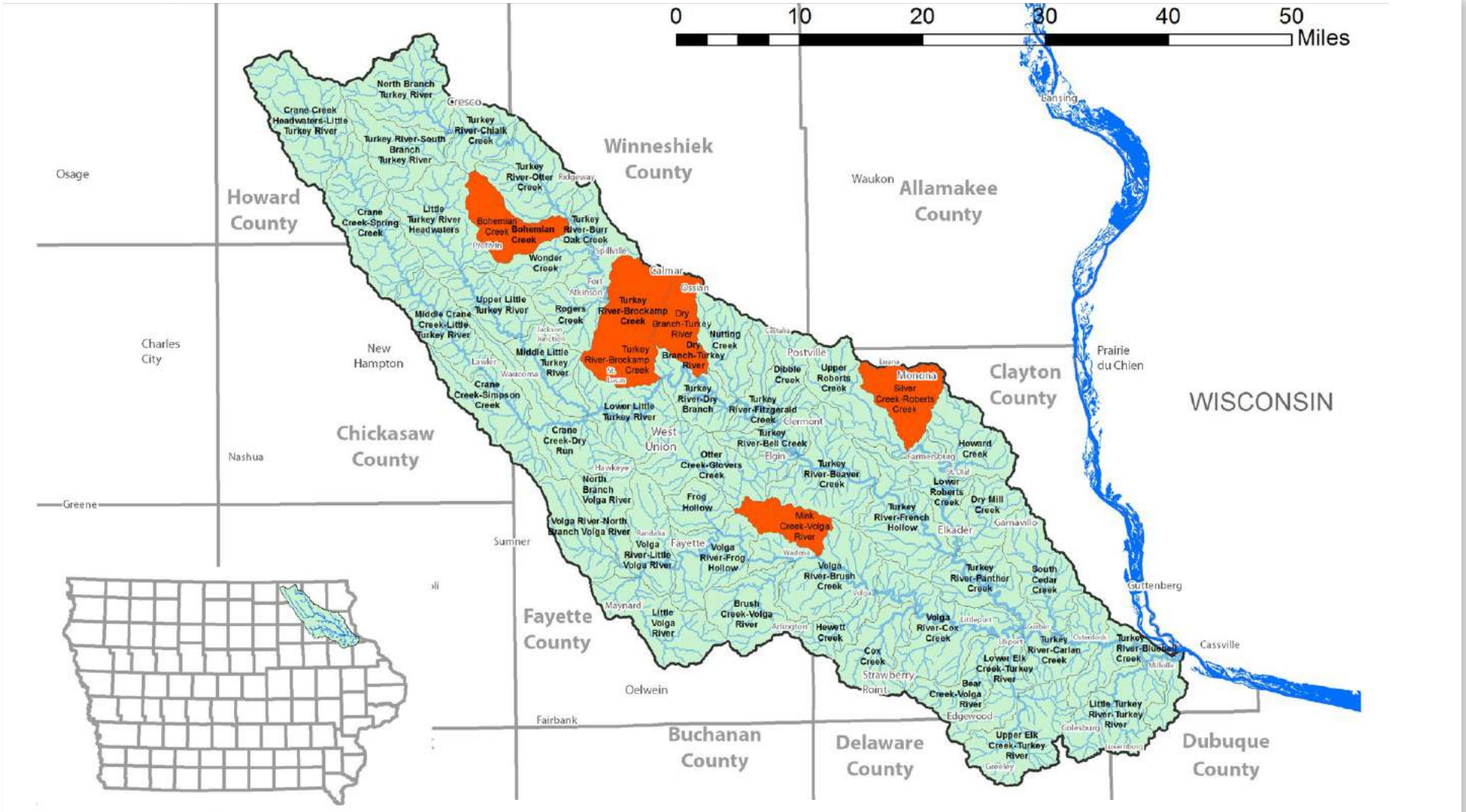


Figure 5.H.1 Priority HUC 12 Watersheds within the TRW - E - Coli

8. Management of Applied Nutrients

SECTION FIVE I

Precision Farming

5.1 Objective 8: Maximize in-field management of applied nutrients to increase productivity & reduce nutrient loss from agricultural lands. Perhaps the simplest way to reduce nutrients from entering surface waters is to adjust the rate, timing, and method of application. Although this sounds simple, there is considerable variability for methods, rates, and timing combinations producers can use. There is also conflicting information about which combination of these factors yields the most crops AND minimizes nutrient loss. Weather, soils, and topography can impact the ideal combination of rate, timing, and application method as well. Maximizing the combination of rate, timing, and method for production and nutrient reduction will not have as dramatic of decrease in nutrient reduction as some other edge of field practices. However, these practices can be incorporated on the most acres in the watershed and have a big overall impact on nutrient reduction.

1. Application Timing. TRW plan goal: 2,000 acres of altered nutrient application timing from fall application to pre or post planting. Fertilizers are generally applied to fields in spring prior to planting although some are applied in the fall following harvest. Fall applied nitrogen (N) is more likely to be transported by runoff from precipitation or snowmelt before plants begin using it in the spring. There is also substantial fertilizer loss if temperatures are not cool enough to slow the nitrification process. However, lower fall prices and the ability to spread out workload are reasons producers apply fertilizer in the fall. The TRWMA Board recommends that Water Resource Professionals work with producers in the TRW to encourage the elimination of fall applied N. This will require work with not only producers, but also fertilizer suppliers to ensure fertilizer is available to all producers in the spring. To spread the demand for fertilizer over a longer period on the spring, producers should be encouraged to sidedress crops rather than pre-planting application.

2. Application Method. TRW plan goal: 5,000 acres of improved application method and rate. Application method varies by which nutrient is being applied to the field. The primary shift in application method for Nitrogen means sidedressing or a rate reduction to lessen nutrient loss from a field. Sidedressing involves applying N to crops after emergence and the crops are ready to use the fertilizer immediately. This avoids the period of time between pre-plant application and emergence when nutrient losses are generally the highest. Sidedressing also reduces the overall amount of N applied to fields. The TRWMA Board recognizes that constraints on price and a ready supply of fertilizer is a challenge for producers during spring planting, but recommends that Water Resource Professionals work with producers to consider alternative options that reduce nutrient loss.

Another strategy for reducing N and P loss from fields is to reduce the rate of application for all or parts of fields. Many producers use spatial harvest data as guidance for application of fertilizer. However, some ground will not be profitable regardless of the rate of N applied. Similarly, Phosphorous application may be done at too high of a rate in some areas of the field and application rates should be examined to ensure excess is not being applied. The TRWMA recommends that Water Resource Professionals work with producers to identify areas where N application could be cut back to reduce the overall amount applied to a field and ultimately reduce the amount being lost to surface waters. Ultimately, changing the method of application, such as rate reduction or sidedressing will realize the best results when coupled with other nutrient reduction practices. Nutrient loss can be avoided by protecting soil in the field with cover crops and increased crop residue. Increasing soil health, which is outlined in section 5.C, will lessen the need for high rates of fertilizer application and fix existing nutrients in the ground.

3. Nutrient Sources. TRW plan goal: 5,000 acres of crops fertilized by natural fertilizers as opposed to commercially produced. Most producers in the TRW and the State of Iowa use commercially produced fertilizers when growing row crops such as corn and soybeans. Animal manure can be used as an alternative source of N and P to commercially produced fertilizer and is readily available in Iowa. Iowa ranks number one in pork production and number seven in beef production in the US which means there are a lot manure producing facilities in the state. It is advantageous for crop only producers and animal stock producers to work together in using manure more widely as fertilizer. Like commercial fertilizer, if application of manure is not done responsibly or at the wrong time it can enter surface waters and become a pollutant. The TRWMA Board recommends Water Resource Professionals work with crop and animal producers to develop economically viable solutions to connect these two kinds of producers. Further details about ways to incorporate manure as fertilizer are detailed in Objective 7.

Fine Tuning of Nutrients Helps Crops & Water Resources

9. Subsurface Drainage

SECTION FIVE J

Agricultural Subsurface Drainage is Common in the TRW

5.J Objective 9: Reduce or capture nutrient movement through subsurface drainage.

Over 50% of land in the Turkey River Watershed is in row crop agriculture and nearly all of this land has been tiled to some degree. It is difficult to determine the density, size, condition, outlet locations, and location of agricultural tile because of lost records and the proprietary nature of the data. This makes it nearly impossible to estimate how much water is contributed to surface waters via sub-surface ag drainage. However, it is well documented in scientific literature that subsurface ag drainage systems are high contributors of water soluble nutrients, particularly Nitrogen and Dissolved Phosphorous.

Testing in the TRW has shown that tile outlets contribute an average of 18 mg/L of N to surface waters. Although testing was conducted over only one season and at a limited number of sites, results are consistent with Iowa Nutrient Reduction Strategies and other documents that state the reduction in nutrients gained by incorporating conservation practices. Tile outlet sites draining from corn and soybean acres that incorporated reduced tillage systems, cover crops, and other conservation practices were consistently and significantly lower than those that did not.

The issue of sub-surface drainage has been divisive issue in the State of Iowa. In 2015, Des Moines Waterworks issued a notice of litigation against three counties in north central Iowa that control a number of drainage districts that enter the Raccoon River, which is part of the main source of drinking water for the City of Des Moines. The grounds of the litigation derive from high Nitrate levels in the Raccoon River and the cost associated with removing those Nitrates to make the water suitable for human consumption. The utility issuing the litigation is seeking to make sub-surface agricultural drainage outlets point source pollution as opposed to non-point. At the time of publication of this plan, this litigation has not yet reached court and no ruling has been made. As such, the TRWMA feels that proactively addressing water resource concerns

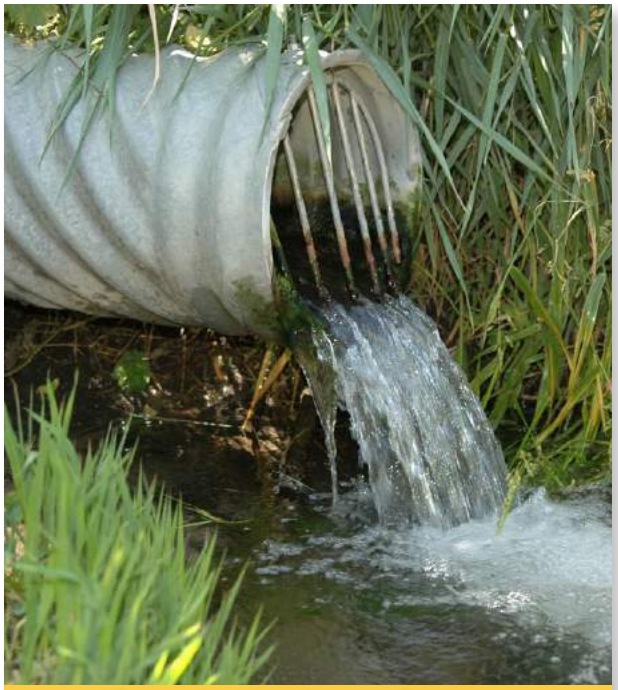
in the TRW will lessen the chance of conflict and serve as a model for other areas of the state and the nation to follow. The practices recommended for reducing nutrients from tile outlets are considered 'end-of-pipe' or 'edge-of-field' practices that are intended to remove nutrients after or as they are leaving tile outlets. These practices should be used in conjunction with additional in-field practices to reduce the amount of nutrients entering and moving through tiles in the first place.

Practices: Saturated buffers, bioreactors, wetlands and detention basins as outlet locations for tiles.

1.Bioreactors. TRW Plan Goal: 200 bioreactors installed to capture tile drainage. Woodchip bioreactors are created to capture water exiting subsurface tile outlets. Denitrifier bacteria living in the woodchips use the Nitrates carried by the water entering the bioreactor for respiration and in the process, remove it from the water. Bioreactors can remove between 15 and 60% of Nitrate load over a period of one year. Bioreactors are typically considered an edge of field practice so they're installation does not remove land from production. Bioreactors have a lifespan of up to 20 years and therefore once installed, are effective for a long period of time.

2. Saturated Buffers. TRW Plan Goal: 50 saturated buffers installed. Saturated buffers look very similar to traditional vegetative buffers on the surface. Where these practices differ is under ground. Saturated buffers created by allowing perforated tile drainage to move laterally through the root zone of perennial vegetation planted in the buffer zone. A water control structure between the lateral pipes and the tile outlet allow the landowner to maintain a water level during wet and dry periods. According to Iowa State Extension, saturated buffers remove "an average nitrate concentration of 91% for water actually passing through a buffer root zone." Saturated buffers are also a very cost effective way of removing Nitrates at an estimated cost of $1.54 per kilogram of N removed. Saturated buffers also have a high inherent value as wildlife habitat and still function like a traditional buffer in capturing some overland flow.

3. Wetlands and detention basins as outlet locations for tiles. TRW Plan Goal: Utilize at least half (150) of installed wetlands and detention basins for alternative tile outlet sites. Install an additional 50 wetlands or detention basins to specifically capture tile outlet drainage. Section 5.D of this plan details strategies for capturing overland runoff by installing wetlands and detention structures throughout the TRW. These structures will provide flood prevention and nutrient removal benefits for overland flow. Installed structures also provide the opportunity to capture and remove nutrients from tile outlets. As these structures are installed, flood mitigation and water resource professionals should work with landowners to maximize benefits as flood mitigation and nutrient reduction practices.



Tiles Outlet Directly to Surface Water

10. Technological Opportunities

SECTION FIVE K

New Ag Technologies Can Be Used for Practices such as Controlled Traffic to Make an Operation more Efficient

5.K Objective 10: Work with agricultural producers to explore technological opportunities for improved water resource and nutrient management that maximizes productivity and return of investment. Producers have more technology and data about their operations at their fingertips than ever before and these technologies are expanding exponentially. New technologies present opportunities for producers that are more efficient, economical, sustainable, and more productive. Advances in technology can also make agriculture less impactful on the environment. The TRWMA Board recognizes that new and emerging technologies should be used to improve returns on investment on working farms, work towards more continuous living cover on the landscape, more efficiently use available resources, and reduce the impact of agriculture on the natural environment.

1. Increase precision data use. TRW Plan Goal: 20,000 acres under improved management through precision technology. Precision agriculture has been expanding as GPS, yield monitors, and application rate monitors have been added to farming equipment. Precision agriculture gives producers the opportunity to maximize their return on investment by controlling cost inputs in crop production such as fuel and fertilizer, concentrate on the most productive acres and set aside those that aren't productive, and explore alternative management strategies that reduce costs and time in the field. An example of this technology is AgSolver Profit Zone Manager which uses spatially referenced input and harvest information to help producers make management decisions at the sub-field level. The TRWMA recommends flood mitigation and water resource professionals work with producers in the TRW to incorporate expanded use of precision agriculture to increase conservation and economic returns.

2.Perennial crops. TRW Plan Goal: 2,000 acres of perennial crops established. Most cropping systems in Iowa involve annual crops for grain. This poses challenges for producers because of the costs associated with growing these crops. Furthermore, the most common annuals grown in Iowa (corn and soybeans) have a limited period of growing activity of about two and a half months. This leaves soil without growing roots and overhead

cover for the remainder of the year. Agronomists are exploring new options for perennial crop species that are economical, practical, and useful. New varieties of perennial crops, such as Kernza (a form of intermediate wheatgrass), reduce the need for fertilizers, increase infiltration, improve soil health, reduce fuel costs, AND provide an economical crop. The TRWMA recommends that the use of perennial crops continue to be explored and implemented as a sustainable alternative to the current system of agriculture.

3. Controlled traffic. TRW Plan Goal: 20 farms fully utilizing controlled traffic farming. One technological phenomenon in the agricultural industry over time has been the increase in equipment size used to grow and harvest crops. Larger equipment has had many impacts, some positive and some negative, on the agricultural landscape. One of the primary concerns with larger equipment is the compaction of soil that results from repeated trips over the field. Soil compaction negatively affects crops by limiting root growth and access to nutrients and water. Soil compaction negatively affects the environment by preventing rainwater infiltration which leads to increased erosion, increased nutrient loss, and increased flooding. Controlled traffic farming (CTF) reduces the number of trips over fields and coordinates required trips over a field to minimize the area impacted by equipment. The TRWMA recommends flood mitigation and water resource professionals work with producers to explore new technologies to minimize the impact of equipment on fields. These may include simultaneous tillage and sowing, no-till, and GPS coordinated traffic lanes that planters, sprayers, and harvesters use to maximize the no-traffic areas.

4. Closed farming systems. TRW Plan Goal: search methods to improve agricultural efficiency. Natural ecosystems have evolved over time to operate on a 'closed loop system' meaning they do not require outside inputs to function. Nearly 100% of agricultural systems in Iowa are 'open systems', which require continual outside inputs to function. Nutrients are the primary inputs into Iowa cropping systems, yet nutrients are also one of the main outputs in Iowa cropping systems. Each year Iowa farmers spend millions of dollars to add fertilizers to their fields only to have millions of dollars' worth of fertilizer leave their fields. They then have to repeat the process the following year.

Closed farming systems function more like a natural ecosystem where outputs are valued and kept within the system to provide repeated benefits. The challenge keeping closed farming systems from becoming more commonly practiced is economics. Since closed farming systems operate on the principle of balance, it is difficult to remove enough outputs (i.e. harvested crop, milk, beef) from the system to maintain economic viability and still maintain the current system of productivity. As agro-technologies advance, the human population grows, and resources become scarcer, farm system loops will need to come closer to becoming closed. That is to say, farmers will have to grow more food, with fewer resources, to feed more people. The TRWMA Board recommends research and testing in the TRW to move agricultural systems toward more closed loop systems. Practices such as perennial crops, contract grazing, and other methods can help reduce inputs into farming systems from outside sources.

Sidedressing Nitrogen in Corn

11. Minimize Water Quality Impacts from PPCPs

SECTION FIVE L

Source Water Protection is Important for Rural and Urban Residents of the TRW

5.L Objective 11: Increase awareness of issues related to the disposal of pharmaceutical and personal care products (PPCPs) and implement measures to reduce their improper disposal.

Although testing for presence or absence of pharmaceutical compounds and personal care products (PPCPs) has not occurred consistently in the Turkey River Watershed, scientists have identified numerous pharmaceutical compounds at discernable concentrations in waterways nationwide. A 2008 study conducted by the Illinois-Indiana Sea Grant College Program, which works jointly with the University of Illinois Extension, estimated that 5,000 tons of pharmaceuticals and personal-care products (PPCPs) were discarded annually in the United States. "The use of prescription medicine increases and new drugs come on the market every year in this country," said Beth Hinchey Malloy, Illinois- Indiana Sea Grant (IISG) Great Lakes ecosystem specialist. "When people's prescriptions change, their drugs expire or are no longer needed, these medicines are typically flushed or thrown away." These products make their way to our local lakes and streams, posing a potential environmental concern. In 2000, the U.S. Geological Survey sampled downstream from wastewater treatment plants in 30 states and found at least one pharmaceutical in 80 percent of 139 streams.

Improper prescription medicine and PPCP disposal has other implications related to public health. According to the Iowa Governor's Office of Drug Control Policy prescription medicine abuse and prevention is a big issue. In their 2015 Iowa Drug Control strategy, they note that "Medicine cabinets are a leading source of prescription drug diversion and by removing outdated and unused medicines from homes, the risk of abuse and environmental contamination is reduced." They also recognize that "Prescription drug Take Back events and similar activities are taking place in a growing number of Iowa communities, safely removing an unused medicine that is subject to abuse. Coalitions of law enforcement, pharmacies and

others offer citizens a convenient and effective way to help reduce prescription drug abuse and protect the environment."

Although Household Hazardous Materials may be disposed of at the Floyd Mitchell Chickasaw landfill (fmclandfill.org) or at the bi-annual hazardous household collection, "Household Hazardous Materials" in Iowa as defined do not include PPCPs or medications. The Northeast Iowa Drug Task Force works with 17 agencies from Howard, Chickasaw, Winneshiek, Allamakee, Clayton, and Fayette counties, including county sheriff offices and police departments across the region, Helping Services of Northeast Iowa, and other partners, to implement a prescription drugs collection program. The program includes two National Prescription Drug Drop Off Day events that are held once or twice each year in April and September for four hours. Between 20 and 30 Northeast Iowa sites are manned by police and/or pharmacists for the program, which disposes of an average of 800 pounds of medications per year and has disposed of up to 1,000 pounds. The purpose of the program and these events is to keep medications out of the hands of people who may misuse or abuse them, especially youth. Drugs collected through the program are turned into the Drug Enforcement Agency (DEA). DEA collects the drugs nationally and then transports them for incineration at a central location that meets the requirements for disposal. Although hospitals in the region have incinerators, they are not the required four-state incinerators, which eliminate pills completely. Unfortunately, improper disposal into waterways still exist, sometimes at institutions. A nursing home employee living in the region recently reported being required to flush thousands of unused pills down the toilet weekly.

The limitations related to the cost and scope of monitoring for PPCPs and medication pollutants in the streams and rivers of the TRW currently prevents the TRW Board from quantifying the scope of the water quality degradation related to this issue or any water quality changes that could occur because of the recommendations being made in this Plan. However, the TRW Board and individual TRWMA members can influence public and private policies and actions within their cities and communities. Therefore, the TRWMA Board recommends dealing with this issue by partnering with and empowering the Northeast Iowa Drug Task Force. They can also work to find ways to better understand the related policy, program and physical issues as they relate to public and private inputs; conduct appropriate outreach and education to public and private organizations and citizens; and develop, recommendations and support for existing and new voluntary preventative measures and programs.

Ways for which the TRW Board and individual TRWMA members can influence public and private policies and actions include the following:

1. Increase Understanding of the Issues.

- Work with partners to understand the potential impacts of pharmaceuticals and PPCPs in the watershed of the TRW.
- Identify related BMPs, potential collection and disposal programs, need for additional programs, and quantify the associated costs.
- Develop and complete a Pharmaceutical and PPCP Disposal Survey of TRW public and private facilities and citizens that explores the following (survey both workers and administrators to see how different the answers are):
  a. How hospitals, long term care facilities (LTCFs), or other facilities operate with regard to this issue.
  b. Common industry disposal practices, guidance, and regulatory requirements.
  c. Which pharmaceuticals are being disposed of, in what quantities and frequencies.
  d. Existing and potential policies, estimated amounts of disposal, and frequency of disposal of unused pharmaceuticals and PPCPs.
  e. Challenges with the generation and disposal of unused, unwanted, and expired pharmaceuticals and PPCPs.
  f. What are the existing and potential options for disposing of unused pharmaceuticals?

2. Outreach and Education.

- Quantify the findings of the Pharmaceutical and PPCP Disposal Survey and work with the Northeast Iowa Drug Task Force to develop a related educational piece that summarizes those findings and makes appropriate disposal recommendations.
- Work with the Northeast Iowa Drug Task Force and other partners to distribute the educational piece to relevant local public and private facilities and the public, both those that participated in the survey and other appropriate entities, through press releases, targeted direct mailings, and social media.

3. Development, Recommendation and Support for Existing and New Voluntary Preventative Measure and Programs.

- Work with the Northeast Iowa Drug Task Force and other interested entities and partnerships to:
  a. Secure grants that will help reduce the improper disposal of drugs.
  b. Expand and publicize the multi-county disposal program.
  c. Identify new opportunities to incentivize appropriate disposal.
  d. Identify and share public and private policies that businesses and government entities could voluntarily implement to reduce improper disposal of pharmaceuticals and PPCPs.

Pharmaceuticals can Contaminate Water Resources Even in Trace Amounts

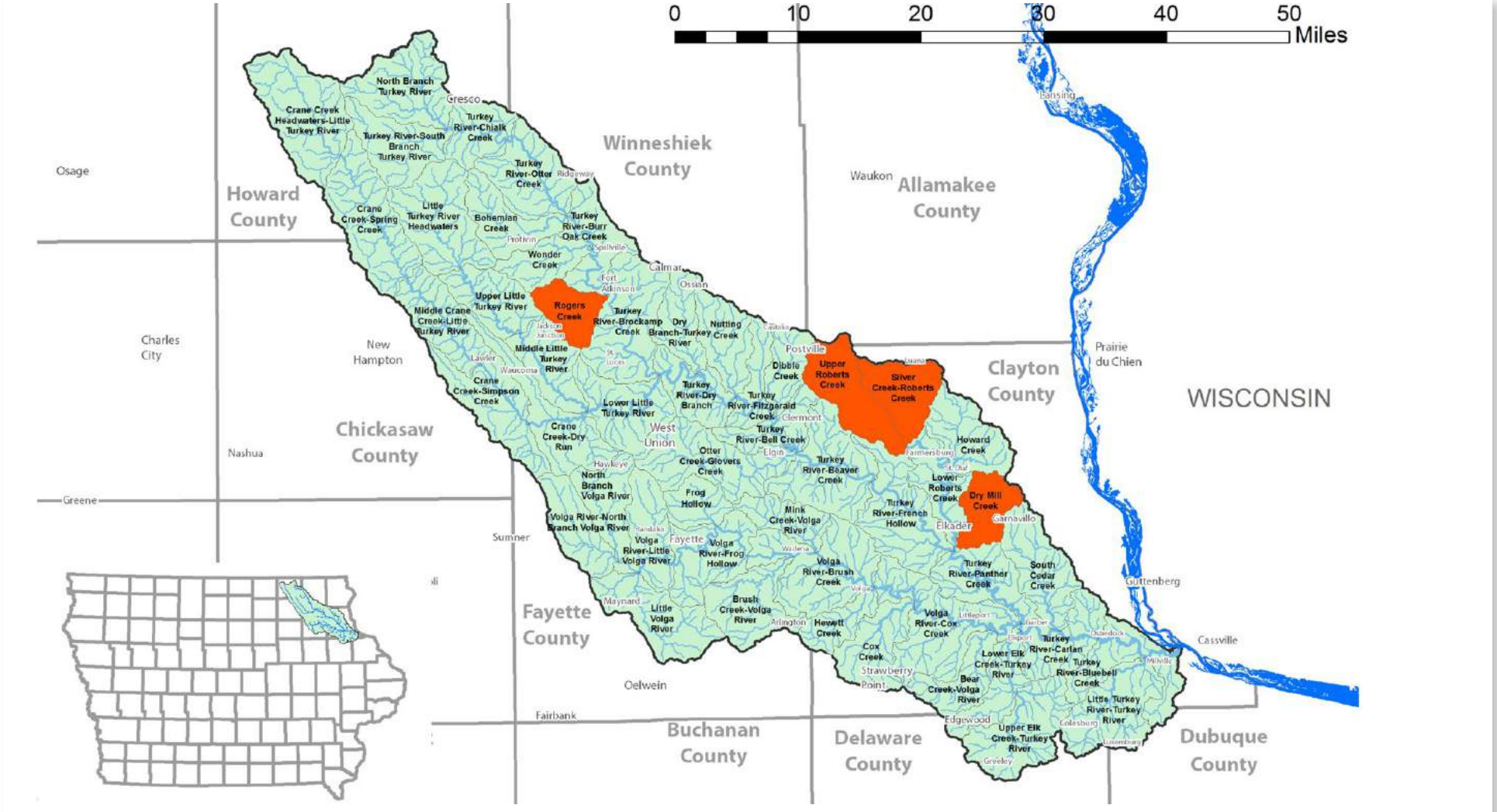


Figure 5.L.1 Priority HUC 12s for Nitrates

12. Education & Outreach

SECTION FIVE M

Education, Outreach, and Engagement are Critical for Successful Implementation

5.M Objective 12: Use existing and new education and outreach methods to engage producers and community members in all aspects of flood protection. This plan was developed with input from the TRWMA Education Committee, included persons of various backgrounds, such as farmers/producers, landowners, community members, biologists, county conservation personnel, SWCD Commissioners and staff, elected officials, and local educators. This diverse team worked to consider, combine, and recommend education and outreach ideas that had been developed by all the TRWMA committees, Board members, and partners.

The TRWMA Education Committee also proposed and considered new ideas before making final recommendations to the TRWMA Board. The TRWMA Board also considered the results of a Turkey River Watershed Landowner Survey and other implementation factors when developing this plan. The TRWMA Board feels that the following principles are important in all education and outreach efforts.

i. Respectful dialog should be used in all education and outreach efforts, as research confirms that the majority of the watershed residents care about the flooding and/or water quality issues.
ii. Engagement should include both rural and urban landowners, as the issues are the responsibility of and impact all watershed residents.
iii. Education and outreach will be most effective if rural and urban residents have been engaged in all aspects of the watershed project including research and planning, education and outreach, practice implementation, and policy development.
iv. Individual and collective action should be proposed and undertaken voluntarily.
v. Collective action should be encouraged but watershed residents and groups represented within the watershed will be more effective if they develop and implement ideas that they themselves want to see implemented rather than dictating action to other residents and groups.
vi. Dialog and discussion must recognize that not all watershed residents will agree on all issues or actions and therefore encourage diverse opportunities for engagement, planning, and action.
vii. Education and outreach can inform policy change, which can maximize local resources and effect change throughout the watershed, but should be supported by the majority of the constituents impacted by the policy.

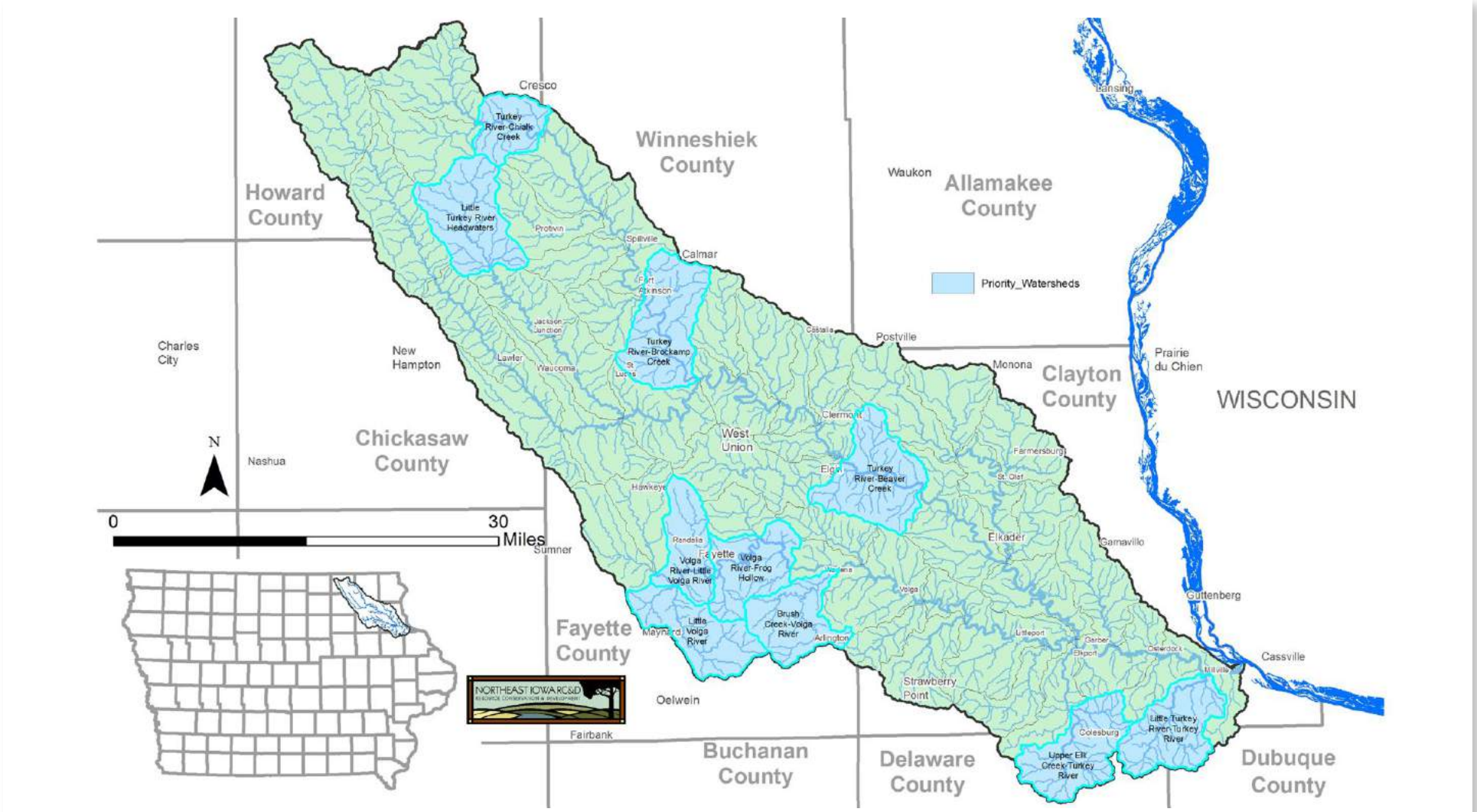


Figure 5.M.1 Priority HUC 12 Watershed Map

Practices: Flood Reduction Technical Assistance Outreach and Education in every TRW County, County Engineers Partnership to Engage Landowners, TRW Producer Engagement in Research and Promotion of Flood Reduction, Regional Outreach to Qualified Landowners in Strategic Landscape Positions, Community Outreach and Engagement.

1. Watershed-wide Outreach. The TRWMA calls for a minimum of five full-time Flood Mitigation Technicians that are systematically reaching out to, educating and engaging, and providing technical assistance to Turkey River Watershed landowners and other watershed stakeholders including agricultural organizations, custom sprayers, youth/schools, community partners, and the press. These professionals should be reaching out to stakeholders in every county as well as providing technical assistance to those urban and rural landowners that want to implement practices that reduce flooding. The TRWMA further recommends that these professionals meet regularly to encourage each other and share progress and information with each other. Some specific outreach and education that these personnel will utilize will include the following:

2. County Engineers Partnership. Given that there are 1,638 points at which roads meet with drainages in the TRW, the TRW County Boards of Supervisors have adopted policy to consider replacement of upland road culverts with on-road water control structures whenever landowners will voluntarily partner. The TRWMA Board recommends that the County Engineers work with two Regional Civil Engineer Technicians to engineer on-road water control structures and Flood Mitigation Technicians to educate and engage willing landowners. The County Engineers will provide lists and prioritization of potential sites for on-road water control structures. The Flood Mitigation Technicians will work with the County Engineers to reach out to receptive landowners to educate and help them understand cost share opportunities so they are more likely to participate. Regional TRW Civil Engineers will design the structures. The County Engineers and Flood Mitigation Technicians will work to see the projects through to completion.

3. Rural and Urban Engagement. Landowners will be recruited from throughout the TRW to participate in various aspects of project research and promotion. Landowners will be engaged through the www.turkeyriver.org website, recruited to host rain gauge/soil moisture probes, be recruited to conduct tile-line monitoring, and to appear in conservation promotional materials. Brochures, posters, billboards, signs, press releases and radio spots will be developed and distributed to promote implementation strategies in the TRW.

4. Targeted Landowner Outreach. Outreach efforts will be targeted to specific landowners that are in key landscape positions as identified through analysis. These may include but are not limited to landowners in targeted subwatersheds, landowners eligible for specific state or federal programs, landowners at locations for on-road retention structures, landowners within community drainages, and landowners within riparian zones and floodplains. All landowner projects will be completely voluntary.

Priority subwatersheds have been identified in each TRW county. These subwatersheds were selected based on criteria provided to the TRWMA SWCDs by the TRWMA as advised by the Iowa Flood Center for reduced flooding and improved water quality. Priority TRWMA subwatersheds include the following:

i. Volga River Watershed in Fayette County.
ii. Little Turkey River Watershed in Howard and Chickasaw Counties.
iii. Brownfield Creek Watershed in Delaware and Clayton Counties.
iv. Brockamp Watershed in Winneshiek & Fayette Counties.
v. North Branch Turkey River Watershed in Howard County.
vi. Beaver Creek Watershed in Clayton and Fayette Counties.

NRCS and SWCD Staff Successfully Engage Landowners in Conservation

13. Implement Policy

SECTION FIVE N

TRW Counties Passed Policy to Use On-Road Control Structures Where Possible

5.N Objective 13: Work with TRWMA members and partners to develop and implement policy that supports a hydrologically resilient TRW: i.e. policies that help the watershed have less stormwater runoff and lower peak flows during heavy rainfall events and a landscape that is more resistant to drought.

Policies or ordinances can be an important tool for communities, counties and other entities to ensure residents and developers are moving toward a goal that is for the benefit of all involved. Very few entities in the TRW currently have ordinances that serve to reduce runoff. Six of the TRW County Boards of Supervisors passed a policy in 2014 to consider on-road water control structures where possible when replacing a small bridge or culvert. The policy is shown in Appendix 7. This policy will help counties retain runoff where topography allows and landowners are willing to participate. Additionally, the policy will be recognized by FEMA in the event disaster relief funds are necessary to repair infrastructure. FEMA will recognize existing local policies when replacing infrastructure that has been damaged or destroyed and are more likely to pay for infrastructure that will help prevent future disasters then replace it with the same infrastructure that failed.

The TRWMA has reviewed several examples of policy from other areas outside of the TRW that can be adapted for use within the watershed. Communities and counties can incorporate policy that allows them to function in a manner that maximizes the economic and aesthetic benefits of SMART planning. Policies and ordinances should be implemented so as not to deter economic growth and sustainability but still achieve the desired goal of stormwater management. The TRWMA Coordinator will work with TRWMA members and TRWMA Committees, watershed personnel, community development professionals, and attorneys to adapt new or existing policies from other areas to fit their local needs. This effort will also provide opportunities for shared learning and shared policy development.

14. Document Results

SECTION FIVE O

Stream Level Gauge in the TRW

5.0 Objective 14: Quantitatively document the hydrological, water quality, social, and policy impacts and changes that result from the implementation of this plan. The TRWMA Board would like to document for themselves, their members, watershed residents, other Iowa WMAs, and the Iowa Legislature the impact that implementation of this plan has on the TRW. They want to quantify the reduction in flow, improvements in water quality, and changes in policy, attitudes, and engagement. They would like to periodically review and understand the impact and effectiveness of specific objectives and methods so that they can make adjustments and modifications to those objectives and methods in a timely and direct manner to improve the measurable impact of their work. They would also like to quantify the cost effectiveness of implementing this plan. The tools, frequency of use of those tools, and related cost for each type of monitoring and evaluation that the TRWMA proposes to use are detailed further below.

1. Land Cover. The 2013 land cover for the TRW is currently being assessed by Northeast Iowa RC&D using a new GIS tool, Rapid Land Cover Mapper (RLCM), through funding provided by USDA/NRCS Conservation Innovation Grant. The RLCM tool is an ESRI ArcGIS based tool that utilizes dot grids and high resolution aerial imagery to assign land cover to specific geographic regions. This tool was developed by the USGS at the Earth Resources Observation and Science (EROS) Center and has been used for similar land cover assessments in West Africa and the Black Hills of South Dakota. This new tool more accurately and efficiently maps land cover for select geographical areas than existing land cover datasets such as the National Land Cover Data or National Agricultural Statistics Service satellite methods. For example, ten-meter resolution land cover data will be available the same year as the imagery is released for a geographic region rather than years later. The RLCM tool will be used to quickly analyze and chronicle short-term or annual changes in practice adoption, land

cover and conservation trends. This tool will help the TRWMA track and better understand the net change in land cover as it occurs across the TRW.

2. Surface Flow. There are currently twenty-one stream/river gauging stations located in the TRW. These gauges were put in place by the IFC and USGS. In response to the 2008 floods, the IFC developed and maintains a statewide network of stream stage sensors designed to measure stream height and transmit data automatically and frequently to the Iowa Flood Information System (IFIS), where the public and TRWMA partners can view both IFC and USGS gauges in the TRW in real-time. Existing gauges should be maintained and additional gauges added as projects across the TRW are implemented to help the TRWMA, their partners and all the TRW residents understand and document the changes in flow that result from the implementation of practices within specific portions of the TRW.

3. Water Quality. Northeast Iowa RC&D and members of the TRWMA Technical Committee have been working together to monitor water quality at 50 in the TRW for three years. Beginning in May of 2011, monthly water samples were collected from April through November from several locations along the main branch of the Turkey River, and at locations along 35+ tributaries. Samples are collected during a 7-9 hour span and sent to the State Hygienic Lab for analysis. The lab analyzes the samples for concentrations of Ammonia Nitrogen as N, E. coli Bacteria, Nitrate + Nitrite Nitrogen as N, and Total Phosphate as P, while field measurements include water temperature, pH, Dissolved Oxygen, Transparency, and Chloride. Results are posted on the www.turkeyriver.org website. Six of the afore mentioned stream gauge sites also have real-time nitrate monitors in place that are automatically and frequently transmitted to IFC. This data is used by landowners, citizens, communities, and resource professionals to better understand nutrient loss in the watershed, find cost-effective ways to solve water-related problems, and make financial and technical assistance available to public and private landowners when needed. As related to this plan, this monitoring makes it possible for the TRWMA to document water quality improvements that correlate to implementation of this plan. These sites do not directly correlate water quality data to any single producer but provide baseline information for large subwatersheds of the TRW that are tens of thousands of acres in size. Continuation of this monitoring will allow the TRWMA partners to better understand and document the water quality implications of flood prevention practices.

4. Precipitation and Soil Conditions. Northeast Iowa RC&D, the McKnight Foundation, Iowa Farm Bureau (through County Farm Bureau offices) the Iowa Flood Center/IIHR and 30 landowners in the TRW have agreed to host rain gauge and soil moisture/temperature probes in the TRW. Many of these units are on farms; some are in or near communities. These stations will transmit data in real time automatically and be available in near real time on the IFIS website. The information available from these units, when coupled with real-time, in-stream nitrate monitors and gauging stations (which are already placed throughout the watershed) will help producers understand why they should adopt nutrient management and flood reduction practices. This strategy will also engage landowners in research and monitoring, creating a greater sense of project ownership. This monitoring is also watched by TRWMA Board Members, TRW communities, counties and SWCDs as well as Emergency Managers, County Engineers and others interested in how rainfall and soil moisture influence stormwater runoff. Because these units will be placed in strategic locations throughout the watershed, they will also allow the TRWMA to document changes in hydrology and stormwater runoff in relation to rainfall and soil moisture. Funding has already been secured for the units but data transmission, Internet costs and repair must be paid for over the 20-year implementation period.

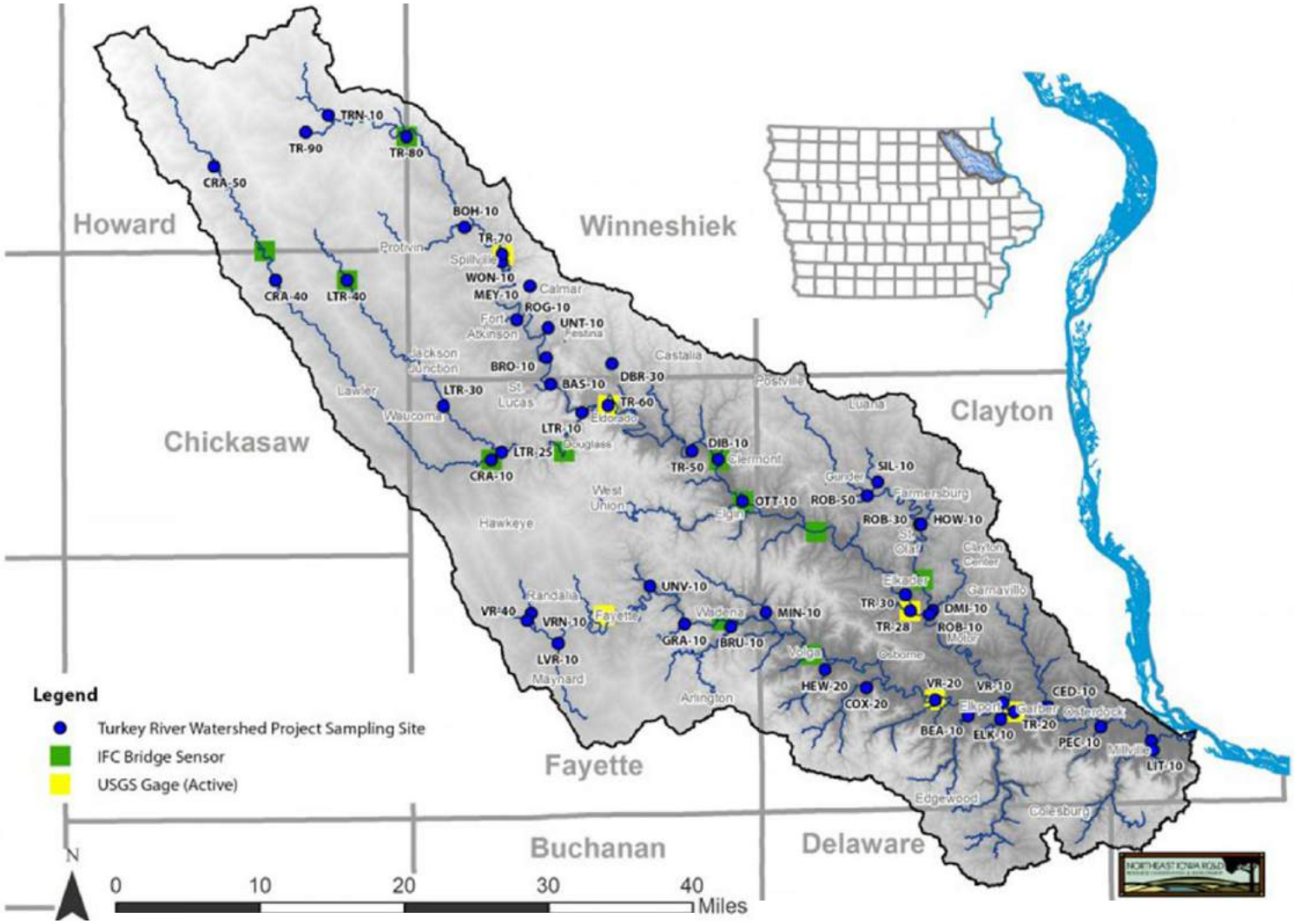


Figure 5.O.1 Gauging Stations Map

5. Social Measures. The TRWMA has completed one survey of 1,500 TRW residents including 1,000 producers and 500 community members in the watersheds. This random survey provided baseline information regarding social perceptions, attitudes, and awareness in the watershed. The TRWMA will repeat this survey at least once every five years with recipients selected from the 3,400 farms in the TRW. This direct mailing will include TRWMA updates either in the form of a letter or a newsletter and may include other outreach materials developed through this project including, but not limited to, the brochures. The www.turkeyriver.org website will also be used to track social changes including interest in the TRW over time. The website analytics will provide specific information about the number of visits per page, etc. that will help the TRWMA better understand the effectiveness of various outreach campaigns and components of this plan.

6. Springsheds. The Big Spring Study provided important information about the Big Spring springshed or capture zone that details the flow path of surface water as it is pushed through the extensive, well-developed karst system of the TRW. This analysis should be repeated for other springs of significance to ensure that the TRWMA is addressing all the land area that is contributing to the hydrology of the TRW. Analysis should include dye tracing, mapping of underlying bedrock, and other technologies to determine drainages for larger springs. The purpose of this study is to determine the subsurface watershed that is contributing runoff to the TRW which may differ considerably from the superficial drainage area.

7. Implementation Tracking. The technical personnel involved with implementation of this plan will be in a unique position to record implementation of project practices, including the number of practices applied, the GPS locations of said practices, structure size specifications, number of acres treated, length of stream treated, calculations on changes in rainfall runoff associated with specific practices, and other details that should help the TRWMA quantify the impact of the practices installed through the implementation of this plan. The technical personnel should not only document and report this information to the TRWMA Board, but they should also keep a collective GIS and descriptive database of practices. The database can be used to analyze the impact of the implementation of this plan when overlayed with other data collected through other methods including, but not limited to, flow analysis, which will allow the TRWMA to adjust objectives and methods as needed to maximize the impact of the project. Documentation of dollars expended by location will also help the TRWMA complete cost benefit analysis of practices within specific subwatersheds, targeted landscape positions and/or the entire TRW.

The TRWMA will work with the technical personnel to develop measures for practices for which there is no current information such as watershed-wide soil health improvements. The NRCS State Soil Scientist recommended that the Haney Soil Test be used to determine a soil health score when the TRWMA technical personnel are working with landowners that are willing to work to improve their soil health (including producers willing to install cover crops and/or no-till practices.) This test can help producers understand if they can improve their soil health and what, if any, measures should be taken. Organic C and N ratios can be used to determine which cover crops the producer could plant to improve soil health as measured by this index. The soil health score allows the producer to determine if soil health is improving.

8. Policy Tracking. The public and private policy information that is gathered by TRWMA technical personnel should be documented and entered into a GIS database of policies adopted by type and location in the watershed, as well as the resulting impact of those policy changes as they relate to implementation of practices and/or influence on specific subwatersheds, targeted landscape positions, downstream infrastructure, etc.

9. Economic Impact. The damage associated with flooding further reduces the lifespan of aging public roads and bridges and, if unchecked, may result in a decreased life span for culverts, roads and bridges. The University of Iowa, in partnership with Northeast Iowa RC&D, has expressed interest in analyzing the economic impact of these issues and policies. The TRWMA supports this work. The economic impact of flooding and the related county policy on public infrastructure, particularly culverts, roads and bridges is important to the TRWMA as it will be useful in understanding and evaluating future public investment in on-road structures and other partnerships.

Infrastructure Damage in the TRW

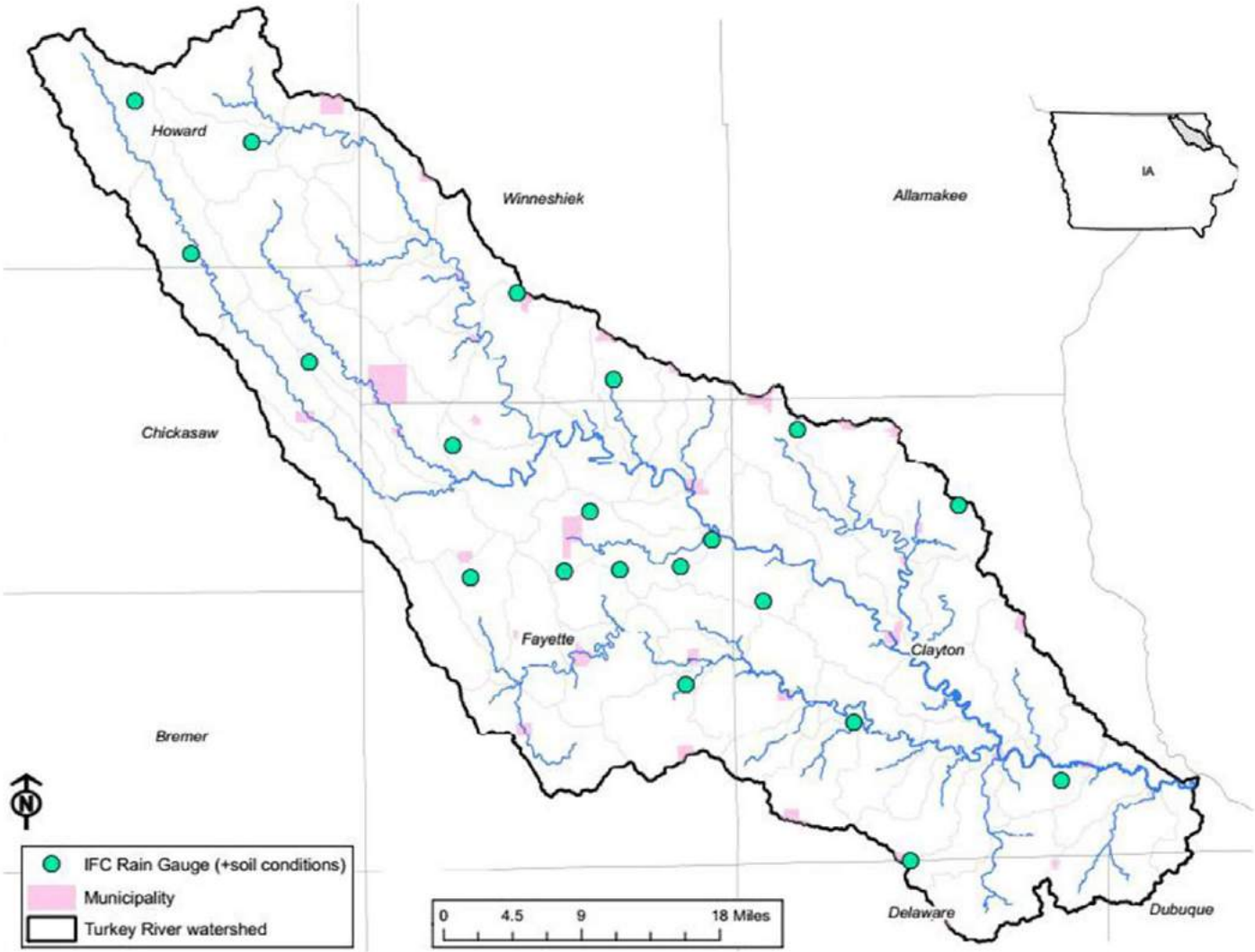


Figure 5.O.2 Rain Gauge Map

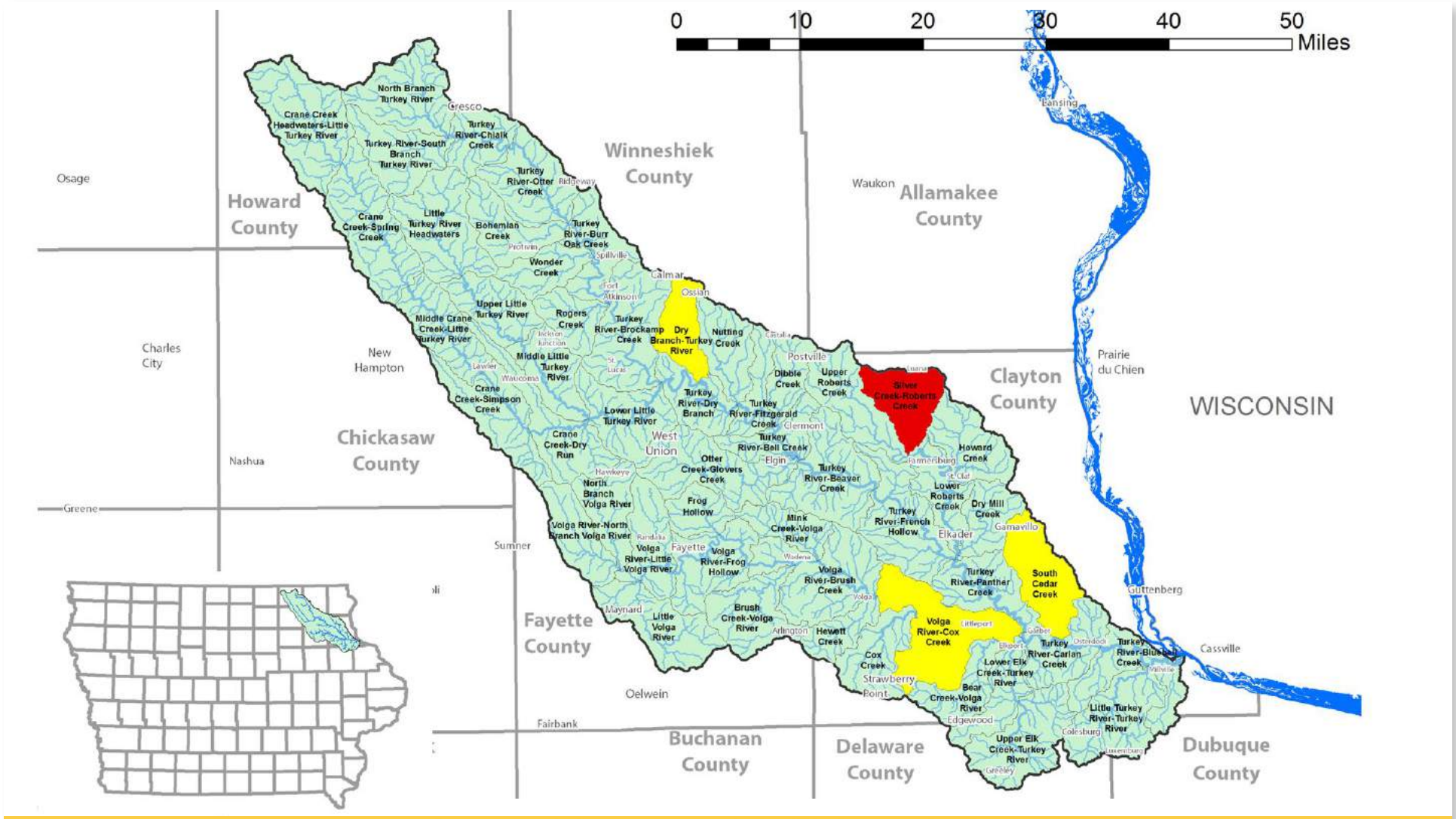
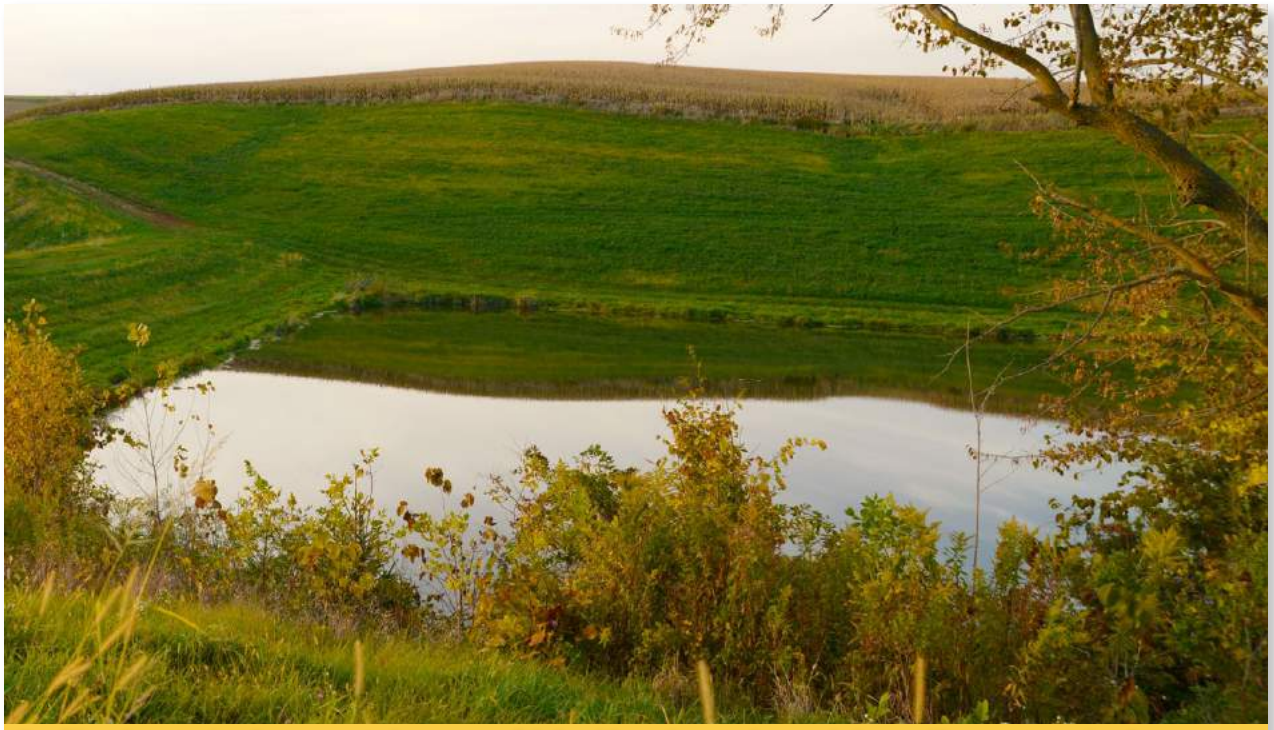


Figure 5.O.3 Priority HUC 12 Watersheds within the TRW - Phosphorous

15. Identify & Address Changes & Trends

SECTION FIVE P



Traditional strategies that prove to be successful should continue to be used along with new strategies that emerge

5.P Objective 15: Research, identify, and enter into partnerships that provide opportunities that help us understand, adapt to, and address social, economic, structural, technological, industrial, and infrastructural changes and trends. The TRWMA Board recognizes that many factors influence the decisions made by watershed residents about how to manage their land and water individually and collectively. At a recent WMA Board meeting, TRWMA Board Members discussed one of the Iowa strategies to reduce nutrient loss: moving from fall to spring pre-plant applications of fertilizer. They noted that the decisions producers make to apply fertilizer in the fall, which Iowa State University notes can also "reduce the efficiency and success in achieving corn yield potential" or even "lower corn yield," could be influenced by the travel and weather limitations that Cooperatives with heavy work loads face in the spring. The workload and schedule of Cooperatives when impacted by travel restrictions was reported by a TRW producer to potentially delay the application of fertilizer in the spring and narrow his critical planting window. Therefore, producers are balancing potential nitrogen and yield losses with planting schedules. Another TRW producer reported that although he had always implemented as many conservation practices as he could on his farm, his son, who recently took over the farm, feels like he is under social pressure to produce higher yields per acre and therefore is considering removing some of the conservation practices. Social, economic, structural, political, technological, industrial and other issues and trends must therefore be researched and addressed.

1. Survey of Producer. Conduct a written survey of 1,000 TRW producers annually that lists Iowa's Nutrient Management Strategies and provides an opportunity for the producer to provide input on their participation or lack thereof with detail on why they do or do not participate with regard to social, economic, structural, political, technological, industrial and other issues and trends.

2. Engage Producers at Trainings and Meetings. Producers have the opportunity to attend some meetings and conferences and are required to attend other trainings and meetings. These meetings should be used as another point of contact for conservation professionals to identify social, economic, structural, political, technological, industrial and other issues and trends. TRWMA representatives should work with meeting and conference organizers to develop and facilitate group discussion opportunities that provide safe, nonjudgmental opportunities for producer input regarding decision making.

3. TRWMA Producer Group Committee Annual Meetings. Meet annually with the TRWMA Producer Group Committee to gather their feedback regarding social, economic, structural, political, technological, industrial and other pressures, issues and trends. The Iowa Soybean Association, Corn Growers, Pork Producers, Cattlemen's Association, Iowa Farm Bureau, Practical Farmers of Iowa, and other producer groups should be consulted collectively to understand their perceptions and gather results from their representatives, producer group surveys and other producer group input methods. Follow-up with/at producer field days, meetings, and other methods identified by the group to confirm and address issues.

4. Consult with the Risk Management Association. Risk Management Association personnel recently noted at national conference, that implementation of conservation practices without consideration for policy guidelines, such as revision to cropping acres within a field, can void a crop insurance policy for the entire field within which the practice was implemented. This type of loss could be devastating for a producer. Reporting the installation of the practice and excluding the conservation acres in the field from the crop insurance policy is a simple way to maintain coverage. Policy changes for some of the newest and most innovative conservation techniques, may not have been determined and should be discussed in open dialog with RMA and insurance agents. There are rules regarding usage of cover crops, termination dates and double crops that can have an impact on crop insurance policies. Every effort should be made by conservation professionals and insurance agents to understand crop insurance guidelines in relation to the conservation practices and programs they are promoting to producers.

TRWMA Board Meeting

Section Six

Turkey River Watershed Budget

Budget

SECTION SIX A

	Practice	Goal	Per Unit Cost	Plan Cost	Existing Funding
Objective 1 Flood Mitigation Professionals	Flood Mitigation Technicians	5	$60,000 per year	$300,000 per year	No
	Civil Engineers	3	$80,000 per year	$240,000 per year	No
	Urban Conservationist	1	$65,000 per year	$65,000 per year	No
	Liaison & Outreach Coordinator	1	$65,000 per year	$65,000 per year	No
				Objective Total:	$735,000 per year
Objective 2 Implemen Conservation Practices	Reduced Tillage or No-Till	281,715 acres			Limited
	Cover Crops	100,000 acres	25 per acre	$2,500,000	Limited
	Contour Buffers, etc.	56,000 acres	$180-280 per acre		Yes
	Rotational Grazing	146,725 acres	25 per acre	$3,668,125	Limited
	CRP	20,000 acres	$180-280 per acre		Yes
				Objective Total:	$6,168,125
Objective 3 Reduce Rainwater Runoff & Flash Flows	Water Control Basins	300	$30,000	$9,000,000	No
	Wetlands	50	$30,000	$1,500,000	Limited
	Riparian Buffers	145 acres	$180-280 per acre		Yes
				Objective Total:	$10,500,000

Budget for Objectives 1-3

	Practice	Goal	Per Unit Cost	Plan Cost	Existing Funding
Objective 4 Restore & Protect Stream Ecosystems	Streambank Restoration	5 miles	$792,000	$9,000,000	Limited
	Stream Habitat Improvement				
	Restore Floodplain Connectivity				
				Objective Total:	**$9,000,000**
Objective 5 Protect Properties Near Streams & Rivers	Agricultural Conservation Easements	2,000 acres	$8,700		Limited
	Stream Easements (100 feet on both banks)	1,000 acres	$1,500	$1,500,000	No
				Objective Total:	**1,500,000**
Objective 6 Implement SMART Planning Practices	Treatment of 10% of Impermeable Surfaces	2,800 acres	$1,000	$2,800,000	Limited
				Objective Total:	**$2,800,000**
Objective 7 Education & Outreach	Watershed-Wide Outreach			See Objective 1	
	County Engineers Partnership			See Objective 1	
	Website Maintenance	20 Years	$1,500	$30,000	No

Budget for Objectives 4-7

Objective 7
Education & Outreach cont.

Practice	Goal	Per Unit Cost	Plan Cost	Existing Funding
Additional Rain Gauges	7	$7,000	$50,000	No
Tile Monitoring	48	$1,083	$52,000	Limited
Champion Producers	12			Limited
Outreach Materials			$50,000	Limited
RLCM Land Cover Assessment	4	$16,000	$64,000	Limited
River Gauging Stations	20 years	$60,000	$1,200,000	Limited
Water Monitoring	20 years	$28,000	$560,000	Limited
IFIS Website Maintenance	20 years	$1,250	$25,000	Limited
Surveys	4	$7,500	$30,000	No
Soil Testing & Manure Mgmt	100	$10,000	$100,000	Limited
Livestock Facility Location	20 years			Limited
Analytical Software	20 years		$200,000	Limited
Address Outdated Septics	500	$2,500	$1,250,000	Limited
Research Manure Mgmt	N/A			Limited
Wastewater Mgmt Outreach	N/A			Limited
Address Uncapped Wells	100	$2,000	$200,000	Limited
			Objective Total:	**$3,811,000**

Budget for Objective 7

	Practice	Goal	Per Unit Cost	Plan Cost	Existing Funding
Objective 8 Text needed	Altered Nutrient Application Timing	2,000 acres	N/A	N/A	No
	Change Method & Rate of Application	5,000 acres			
	Expand use of Natural Fertilizers	5,000 acres			
				Objective Total:	$0
Objective 9 Text needed	Bioreactors	200	$8,000	$1,600,000	Limited
	Saturated Buffers	50	$2,000	$100,000	Limited
	Wetlands & Detention Basin Tile Outlets	150	$2,500	$375,000	Limited
				Objective Total:	$2,075,000
Objective 10 Text needed	Precision Farming Techniques	20,000 acres	$2	$40,000	No
	Perennial Crop Establishment	2,000 acres	$250	$500,000	No
	Controlled Traffic	20 farms	N/A	N/A	No
	Closed Farming Systems	N/A	N/A	N/A	No
				Objective Total:	$540,000
Objective 1-10				Total Plan Cost:	$37,129,125

Budget for Objectives 8-10

Cedar Waxwing feeding along the Turkey River

Watershed Resiliency Plan

A 20 Year Strategic Plan to Increase the Hydrologic Function & Resiliency of the Turkey River Watershed

Developed for the TRWMA by Northeast Iowa RC&D Inc. with funding provided by HUD/CDBG and the Iowa Department of Natural Resources

February of 2016