2018

ENGLISH RIVER WATERSHED

SUBWATERSHED TOOLKITS

UPPER SOUTH ENGLISH RIVER

HUC-12: 070802090502

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Funding for development and printing of this plan was provided by the Iowa Watershed Approach.

The Iowa Watershed Approach is a collaborative program that brings together local, state, federal, and private organizations to work together to address factors that contribute to floods and nutrient flows. Iowans will enjoy improvements in quality of life and health resulting from upstream watershed investments tied to community resilience activities. This adaptive model, supported by U.S. Housing and Urban Development (HUD) dollars, will leverage the principles of Iowa's innovative Nutrient Reduction Strategy to make our communities more resilient to flooding and help improve water quality.

SECTION 1: PLANNING PROCESS

The English River Watershed (ERW) completed "Phase 1" comprehensive watershed planning in 2015. The goal of this project was to take an inventory of the physical environment, complete hydrologic modeling on the basin scale (HUC-8), collect baseline water quality data, engage landowners in the planning process, and formulate watershed improvement recommendations based on data public input. The entire plan, titled the *English River Watershed Improvement and Resiliency Plan*, can be found on the English River Watershed website.

PHASE 2 KEY QUESTIONS & OUTCOMES

Beginning in Fall 2017, the English River Watershed began the "Phase 2" subwatershed planning process, which was completed in December of 2018. The goal of this phase was to discover priority areas on the subwatershed level (HUC-12) for targeted implementation of cost-share funds. The plans are intended to introduce many of the tools and analyses that can be used by municipalities, SWCDs, the WMA, and other organizations when considering watershed improvement projects.

The ERW consists of 20 HUC-12 subwatersheds. Due to limitations on where funding could be spent for this project, if the majority of the subwatershed's area overlapped Washington County it was not included and a Phase 2 plan was not created. Thus, 14 total subwatershed plans were developed. Table 1 shown below highlights the differences between the 9-step planning process in Phases 1 and 2.

Table 1. The 9-Step Planning Process for Phase 1 and Phase 2. *Source: ERW*

Planning Step	Phase 1 Outcomes	Phase 2 Key Questions	Phase 2 Outcomes
1. Engage the Public	Determined of the community's concerns and perceived threats to water quality and quantity.	What concerns are specific to the HUC-12 subwatershed?	Completed a mail survey to all 14 subwatersheds and gained input at various meetings and events.
2. Inventory Resources	Determined the broad land uses, environmental characteristics, and history of the watershed.	What data exists on the subwatershed level and can be analyzed in comparison between subwatersheds?	Compiled data on soil erosion, flooding and social risks, water quality, and detailed urban land uses.
3. Develop Problem Statements	Determined the broad causes and sources of impairments in the watershed.	What tools can be developed to provide support for watershed entities seeking grant or cost share funding?	Designed a "toolbox" of resources for watershed entities that address problems specific to each subwatershed.
4. Identify Target Conditions	Identified recommendations for HUC-8 scale watershed improvements to water quality and quantity.	What are the HUC-12 level specific water quality and quantity conditions?	Analyzed historical erosion data, developed erosion potential maps, and completed 2 seasons of water quality monitoring.
5. Develop Restoration Targets	Determined priority issues throughout the watershed through public participation.	What is the potential for conservation practices (amount or type)?	Completed the Agricultural Conservation Planning Framework (ACPF) and urban modeling.
6. Evaluate Alternatives	Prepared BMP benefits table with associated reductions in contaminants or flood volumes.	What do the recommended practices achieve?	Matrix for cost/benefits of urban/rural practices and risk analysis based on community assets.
7. Prepare the Implementation Plan	Assigned responsibility to the WMA for continued research and pursuit of cost share funding.	Who is responsible for implementing programs? Who can provide technical assistance?	Matrix for responsible parties, funding opportunities, and resources provided by ERW.
8. Implement the Plan	Physical and digital copies of the plan were delivered to watershed entities.	How will the results and recommendations of the plan be communicated to the public?	Physical and digital copies of the plan delivered to watershed entities and interactive webmaps.
9. Evaluate the Plan	Determined a routine for updating the plan and monitoring implementation goals.	How will practices be measured and who will update the plan?	Developed a monitoring plan, including metrics for success.

ABOUT THE SUBWATERSHED

The Upper South English River subwatershed is located in the north central region of the ERW. It overlaps three counties (Poweshiek, Keokuk, and Iowa). The City of Montezuma (population 1,462), Barnes City (population 176), and Gibson (population 61) are incorporated area sthat overlaps the subwatershed. The Upper South English River subwatershed primarily consists of Mississippian soils and, in comparison to the entire ERW, features average depth to bedrock. The mean Corn Suitability Rating for the subwatershed is between 54-56.

Figure 1 is a location map of the subwatershed. The subwatershed encompasses 18,411 acres (28.7 square miles) of land, which is predominately row crops (corn and soybeans). The South English River stretches approximately 13.71 miles through the subwatershed in northwest to southeast direction, which meets an unnamed creek about 2 miles northeast of Gibson.

It was determined in Phase 1 planning that the primary resource concern in in the subwatershed is nitrate and nitrite contamination. Additionally, the Upper South English River subwatershed ranked average in comparison to all subwatersheds for annual flood risks. Watershed stakeholders also expressed their desire for routine water quality monitoring in all subwatersheds.

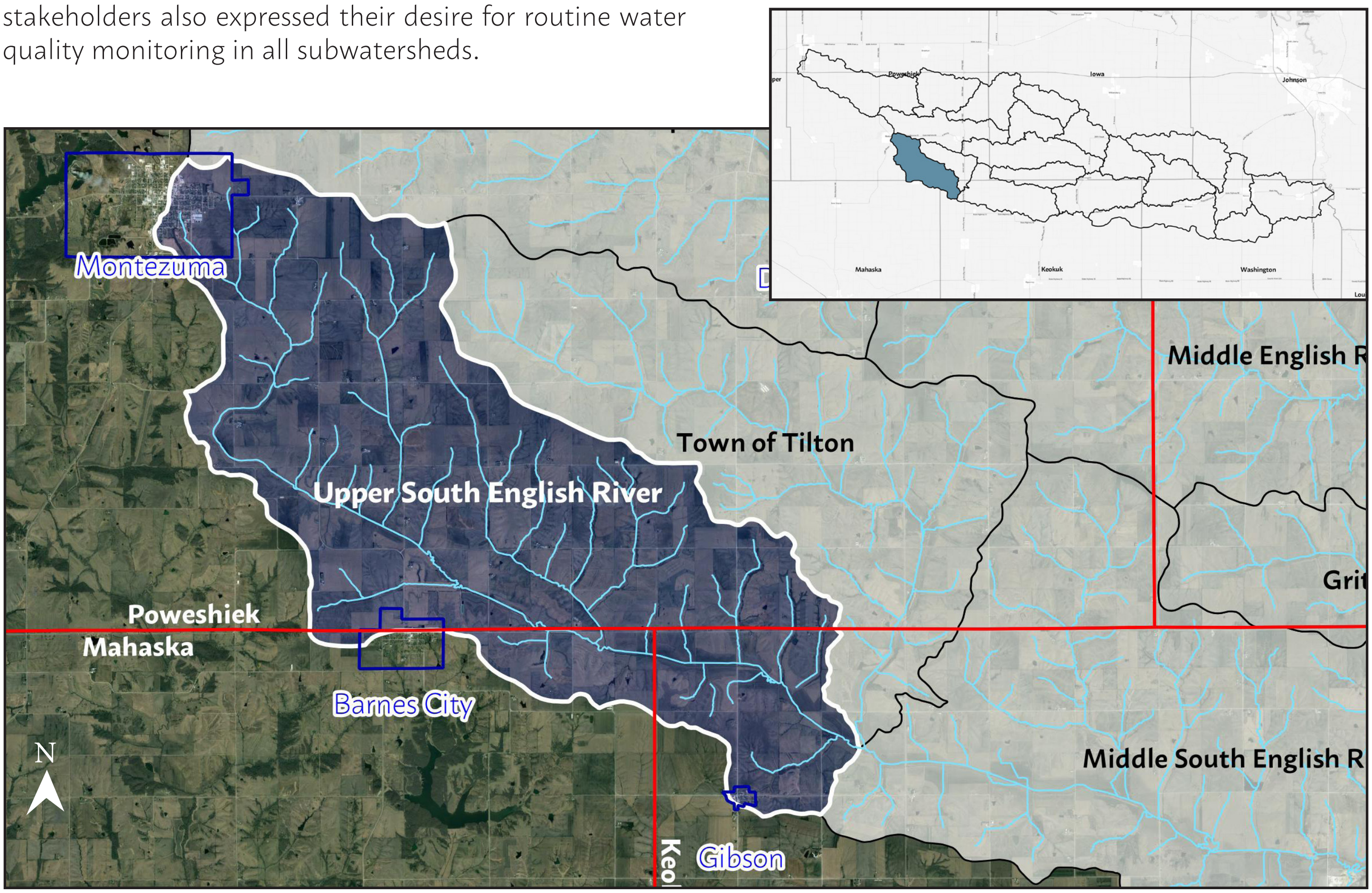

Figure 1. Upper South English River Subwatershed Boundary Map. *Source: ERW*

SECTION 2: 2018 CONSERVATION SURVEY

The English River Watershed completed the "2018 Conservation Survey" in the spring of 2018. The survey builds upon the landowner survey completed in Phase 1 and seeks to better understand the barriers farmers face when considering adoption of conservation practices.

A random sample of agricultural properties of at least 10 acres in size in the watershed were sampled via mail. The sample totaled 986 properties in Iowa, Poweshiek, Johnson, and Keokuk Counties. 264 surveys were completed, which is a response rate of 26.8 percent.

Among the entire sample, the majority of respondents indentified in the age group of 55 - 64 years old (27.7%). Table 2 shows the breakdown of farm size in the survey. Table 3 shows the breakdown of type of farm operations in the survey.

CONSERVATION ADOPTION AND WILLINGNESS

The survey first sought to understand which conservation practices are currently being implemented and which practices, dependent on availability of cost-share funding, are in demand. This information allows conservation organizations to provide more relevant information to landowners. Figure 2 shows the number of respondents that have tried a specific practice (green bars) and the number of respondents who would try specific practices with the availability of 75 percent cost-share (blue bars).

Table 2. Farm size in survey sample. *Source: ERW*

Farm Size	% of Respondents
Less than 25 acres	7%
25 - 75 acres	14%
75 - 250 acres	32%
250 - 500 acres	21%
500 - 1,000 acres	13%
More than 1,000 acre	13%

Table 3. Type of farm operation in survey sample. *Source: ERW*

Crops/Livestock	Number of Respondents / % of Sample
Corn	211 / (35.2%)
Soybeans	210 / (35.1%)
Hogs	30 / (5.0%)
Beef Cattle	68 / (11.4%)
Dairy Cattle	11 / (1.8%)
Other	69 / (11.5%)

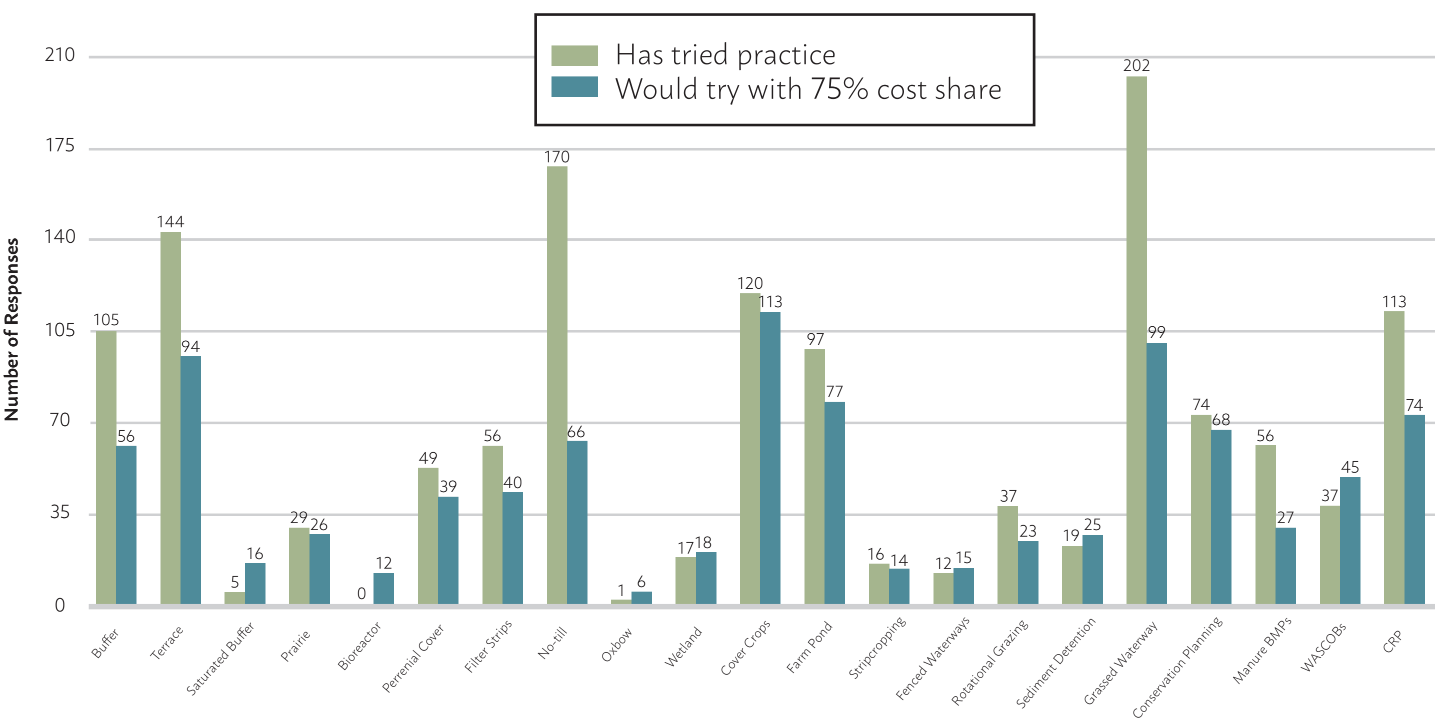

Figure 2. Conservation adoption and willingness to adopt conservation practices with cost share among survey sample. *Source: ERW*

CONSERVATION ORGANIZATIONS

Farmers face a plethora of options when seeking information about conservation. This situation can lead to confusion among various conservation organizations and produce conflicting information. Table 4 shows survey respondent's familiarity with the purpose of each group and how respondents are interacting with various groups in Iowa.

Table 4. Familiarity with organizational purposes and groups distributing conservation information among survey sample. *Source: ERW*

Organization	Mean Familiarity with Mission or Purpose (5 = Very Familiar)	Distribution of Conservation Information (Total # of Responses)
Natural Resource Conservation Service	3.21	140
Iowa Department of Natural Resources	3.16	67
County Conservation	2.99	71
Iowa State University Extension and Outreach	2.81	83
Iowa Department of Agriculture and Land Stewardship	2.70	57
Soil and Water Conservation District	2.67	84
English River Watershed	2.40	61
Iowa Flood Center	1.49	N/A
Crop Advisor	N/A	22
Growers or Producers Associations	N/A	33
Fertilizer or Agricultural Products Dealer	N/A	35

BARRIERS TO CONSERVATION

Finally, the survey attempted to uncover barriers to conservation according to farmers in the watershed. Figure 5 displays the respondent's level of agreement with various statements related to conservation and Table 5 shows some of the barriers that exist for farmers considering adopting conservation practices. Data specific to Iowa and Keokuk Counties can be found in the full report at the link below.

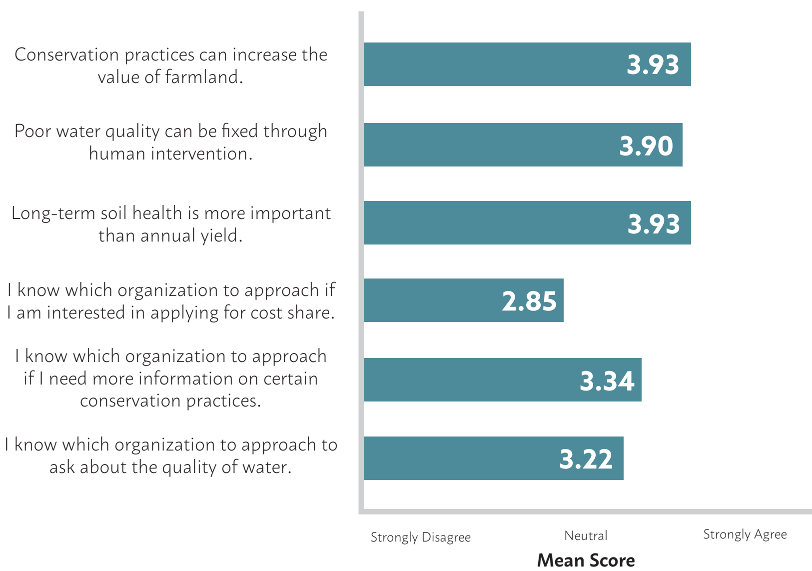

Figure 5. Mean level of agreement among conservation statements. *Source: ERW*

Table 5. Top barriers to conservation identified by survey sample. *Source: ERW*

Rank	Barrier	# of Responses
1	Cost of practice	142
2	Too many "strings attached" with state/federal programs	116
3	Loss of productive land / impact on yields	74
4	Uncertainty of crop values year to year	52
5	Maintenance plans are too strict or confusing	38
6	Unsure of actual environmental benefits	28
7	Other	14

VIEW ENTIRE "2018 CONSERVATION SURVEY" REPORT:
http://www.englishriverwma.org/subwatershed-plans/survey

SECTION 3: WATER QUALITY MONITORING

Stakeholders in the ERW identified continued water quality monitoring as the organization's number one priority during the Phase 1 comprehensive planning process. Long-term water quality monitoring is essential in the establishment of reliable water quality baselines and changes over time and in assessing the effectiveness of targeted implementation projects.

Sampling Site 18 is near the outlet of the Upper South English River subwatershed. The sampling site is located on the 120th Avenue bridge over the upper portion of the South English River, just NE of the City of Gibson.

Water quality snapshots, 5 samples in total, were conducted in 2014 during Phase 1 planning. Samples were collected and analyzed by the Iowa Soybean Association. Samples taken in 2017 and 2018 were collected by ERW staff and analyzed at the State Hygenic Laboratory. Both the 2017 and 2018 monitoring season were funded through the Iowa Watershed Approach.

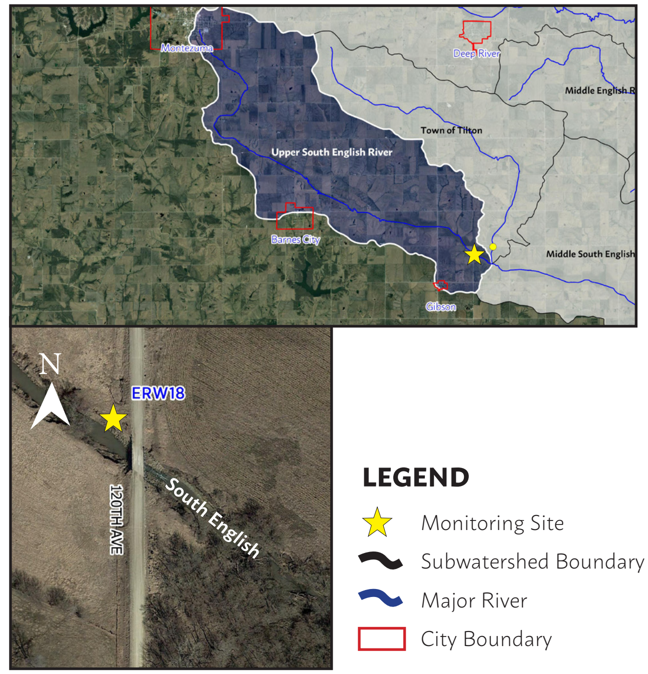

Figure 4. Water quality monitoring location for Upper South English River subwatershed. *Source: ERW*

MONITORING RESULTS

Tables 6, 7, 8, and 9 shown on the following page display monthly concentration minimums, maximums, and averages for E.Coli, orthophosphate, total phosphorus, and nitrate and nitrate, respectively, at the Deep River sampling location. An overabundance of these contaminants in the watershed is a resource concern because of their ability to negatively impact plants, wildlife, and human health through poor water quality. Values in red exceed standards for freshwater streams as defined by the Environmental Protection Agency (EPA). A more detailed explanation on standards for each of the contaminants can be found on the English River Watershed website.

During the 2017 sampling season (June 7 – December 18), the site was sampled 3 times for Nitrate+Nitrite as N, 3 times for E. coli Bacteria, 2 times for ortho-Phosphate as P, and 3 times for Total Phosphorus as P. During the 2018 sampling season (March 23 – September 4), Site 18 was sampled 3 times for Nitrate+Nitrite as N, 3 times for E. coli Bacteria, 2 times for ortho-Phosphate as P, and 3 times for Total Phosphorus as P. 2017 sampling events occurred at regular intervals between June 7 – December 18. Sampling events in 2018 occurred at regular intervals between March 23 – September 17.

In 2017, Site 18 ranked 12th of the English River's 20 subwatersheds for its seasonal average E. coli Bacteria values. In 2018, Site 18 ranked 20th (the lowest). Values in red exceed the Iowa beach advisory standards of 235 CFUs/100mL.

In 2017, Site 18 ranked 19th (nearly the lowest) of the English River's 20 subwatersheds for its seasonal average ortho-Phosphate as P values. In 2018, Site 18 ranked 20th (the lowest).

In 2017, Site 18 ranked 13th of the English River's 20 subwatersheds for its seasonal average Total Phosphorus as P values. In 2018, Site 18 ranked 19th (nearly the lowest). Values in red exceed EPA standard of 0.075 mg/L for freshwater streams.

In 2017, Site 18 ranked 2nd (nearly the highest) of the English River's 20 subwatersheds for its seasonal average Nitrate+Nitrite as N values. In 2018, Site 18 ranked 9th. Values in red exceed EPA drinking water standard of 10 mg/L.

Table 6. E.Coli ([CFUs]/100mL) monitoring results by monthly averages at ERW 18 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	360	1,000	780
2018	300	840	570

Table 7. Ortho-Phosphate as P (mg/L) monitoring results by monthly averages at ERW 18 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.00	0.05	0.03
2018	0.02	0.04	0.03

Table 8. Total Phosphorus as P (mg/L) monitoring results by monthly averages at ERW 18 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.14	0.20	0.17
2018	0.09	0.13	0.11

Table 9. Nitrate + nitrite as N (mg/L) monitoring results by monthly averages at ERW 18 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.0	14.0	4.7
2018	2.9	8.3	4.7

DATA AVAILABILITY

All water quality monitoring data collected during Phase 1 and Phase 2 is publicly available and accessible on the English River Watershed website. Watershed staff are able to create graphs and charts upon request that can be used to support grant applications or other funding opportunities. Figure 5 shown below is an example of how water quality monitoring results can be reproduced for the various contaminants tested shown above, including results from transparency field tests.

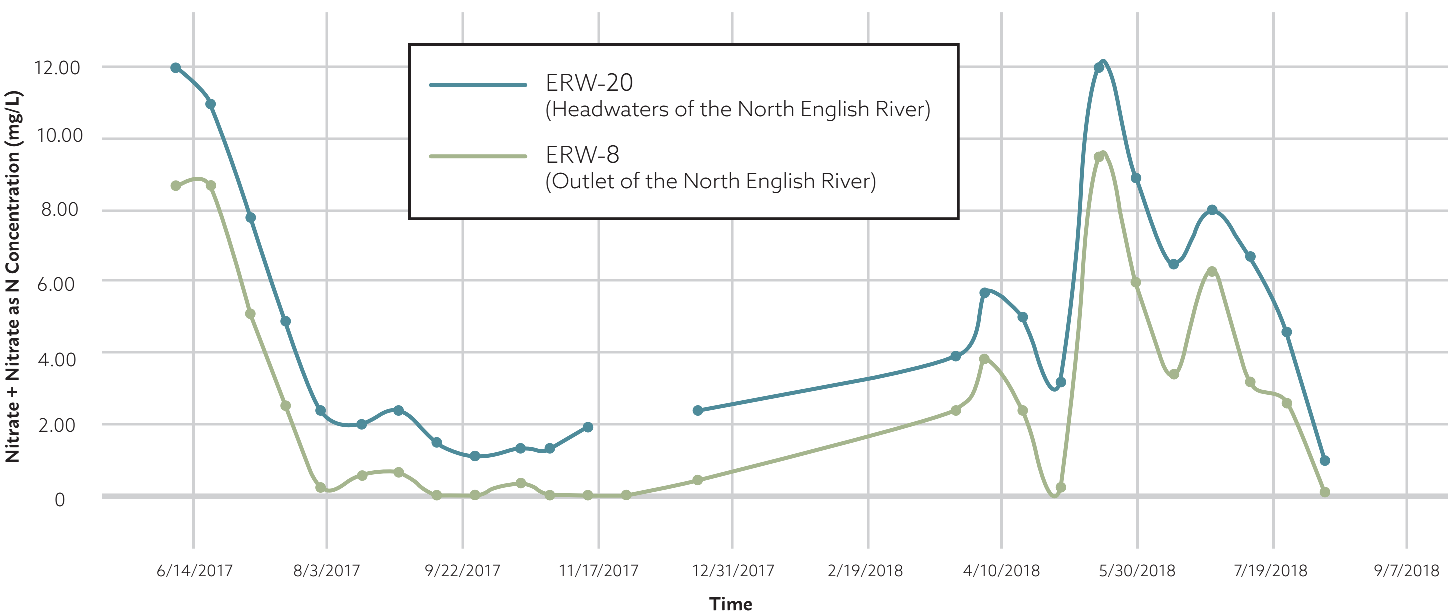

Figure 5. Example graph of Nitrate + Nitrite as N monitoring results for Sites 20 and 8 in the ERW. (2017-2018). *Source: ERW*

VIEW INTERACTIVE WATER QUALITY MONITORING MAP:
http://www.englishriverwma.org/water-quality-monitoring-1

SECTION 4: SOIL EROSION

The ERW *Resiliency and Improvement Plan* seeks to reduce soil loss from farm fields, urban areas, and construction sites through best management practices that promote soil retention and stability. In order to target specific areas of concern where practices would be most beneficial, a deeper understanding of soil erosion on the subwatershed level is necessary. Data presented in the following analysis was provided by the Iowa State University Daily Erosion Project (DEP), at https://dailyerosion.org/map. The illustration below shows what is modeled by the DEP in comparison to visible gulley erosion.

SOIL EROSION

One method for estimating erosion is to calculate the average amount of water that left the hillslopes by above ground transport. Figure 6 shown below portrays monthly variation in average erosion in the Upper South English River subwatershed. As indicated by the linear treadline, estimated erosion from 2008 to 2016 appears to be increasing. Flooding in April of 2013 generated over 7 times the total erosion (109.21 mm) than Upper South English River's average monthly erosion of 12.75 mm (0.50 inches).

Subwatersheds are identified by the last 3 digits of their 12-digit hydrologic unit code (HUC) in Table 10. For example, Upper South English River's HUC is "070802090502"; see 502 Table 10 below.

Table 10. Estimated Average Monthly Soil Runoff and Average Monthly Precipitation (2008-2016). *Source: DEP*

	405	404	402	302	401	501	403	**502**	301	406	408	407	503	504
Average Monthly Soil Runoff (mm)	13.43	13.42	13.28	13.05	13.02	12.89	12.76	**12.75**	12.59	12.26	12.24	12.23	11.78	10.80
Average Monthly Precipitation (mm)	82.68	81.97	80.54	83.21	79.25	82.04	81.65	**82.23**	83.68	82.65	83.17	84.61	82.92	82.29

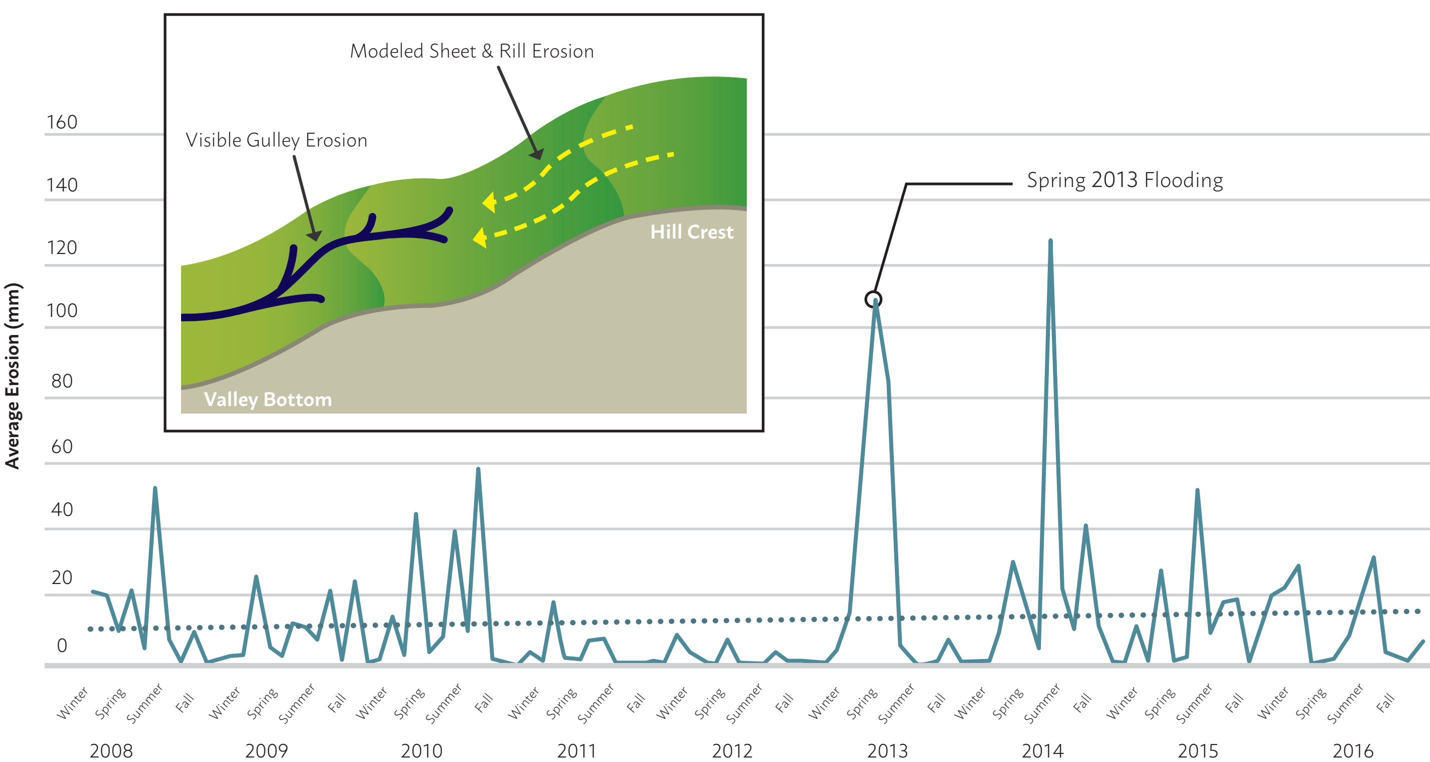

Figure 6. Soil Erosion in Upper South English River (2008-2016). *Source: DEP*

SOIL DETACHMENT & DELIVERY

Detachment is the amount of soil that is disturbed on the hillslopes during various rain events. For this analysis, historic flooding in 2013 was utilized for comparison among subwatersheds regarding their ability to hold soil. The Upper South English River subwatershed experienced an average of 4.83 tons per acre of disturbed soil during the given flood period. By comparison, the average soil detachment among the 14 subwatersheds was 6.47 tons per acre. This data is shown below (Figure 7) as light green bars.

Soil delivery is the average amount of soil transported to the bottom of hillslopes. Blue bars in the bar graph shown below (Figure 7) display average soil delivery from 2008 to 2016. The Upper South English River subwatershed ranks near the middle of all subwatersheds for soil delivery at 5.60 tons per acre per year. It is estimated that erosion rates in Iowa are about 5.1 tons per acre per year (Mike Duffy, 2012). Based on this average, soil loss in the Upper South English River subwatershed is slightly above the state average and below the average (7.00 tons per acre per year) of all subwatersheds in the English River Watershed.

All data presented in this section is publicly available via an interactive webmap hosted by the DEP. Visit the link below to access soil erosion data specifically for the Upper South English River subwatershed.

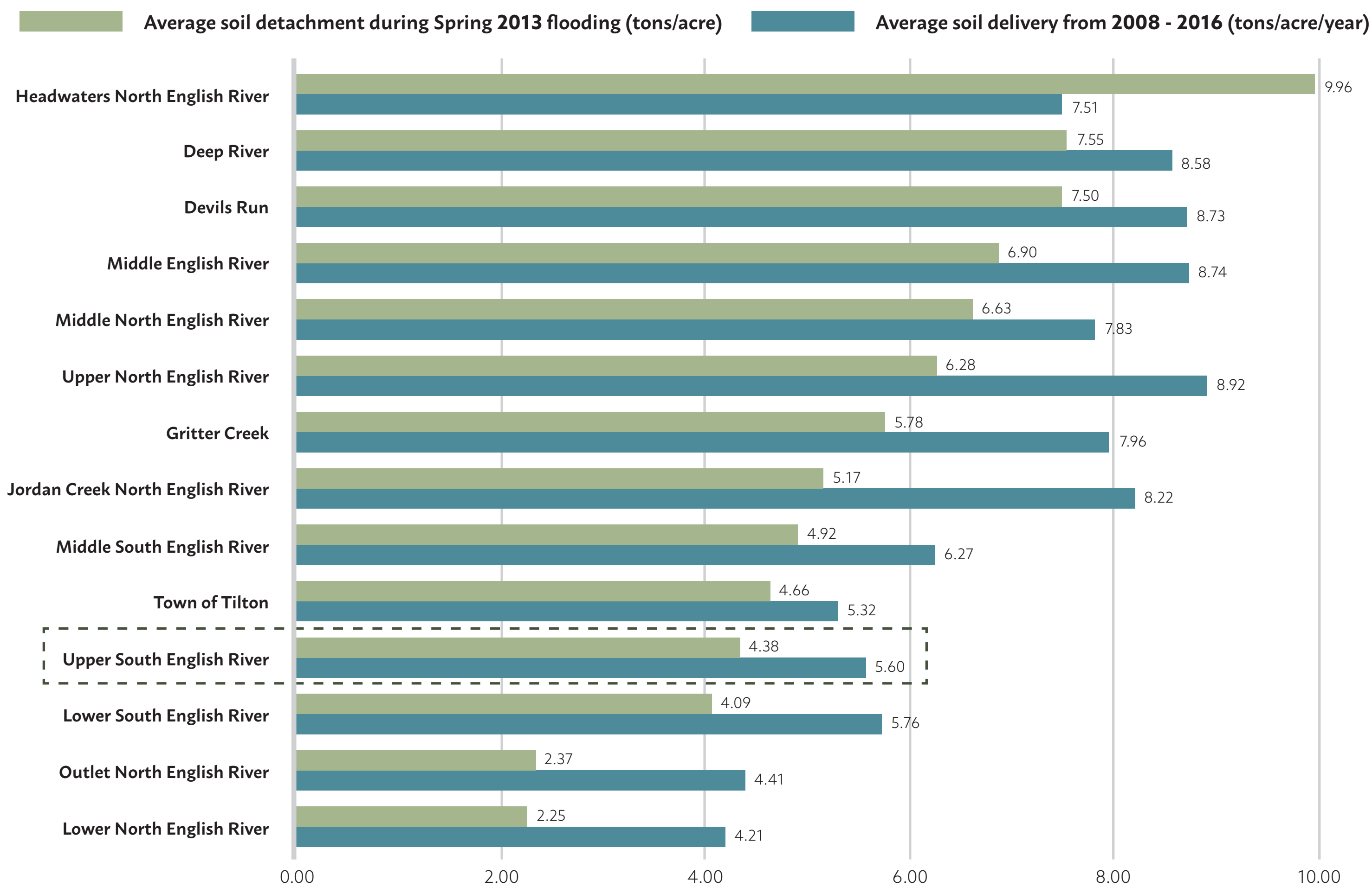

Figure 7. Soil Delivery and Detachment in Upper South English River (2008-2016). *Source: DEP*

VIEW DAILY EROSION PROJECT FOR UPPER SOUTH ENGLISH RIVER:
https://bit.ly/2OCf8Vy

Source: Duffy, Mike. Value of Soil Erosion to the Land Owner, August 2012. https://www.extension.iastate.edu/agdm/crops/pdf/a1-75.pdf

SOIL EROSION POTENTIAL

The following analysis uses the Natural Resource Conservation Service's (NRCS), formerly the Soil Conservation Service (SCS), curve number (CN) runoff equation to spatially illustrate the potential for soil erosion in the subwatershed. The equation examines the interaction between land cover type and hydrologic soil type to estimate runoff from a specific storm event. This analysis was completed by a group of graduate students through a partnership University of Iowa Urban and Regional Planning Department.

For this analysis, a 2-year storm event is assumed, which equals 1.41 inches of rain in 1 hour. This analysis *predicts* soil erosion and is merely a model that uses the best available data. Such data may still be outdated or contain inaccuracies. The model also assumes specific runoff percentages that may not truly represent all storm scenarios. The goal of this assessment is to highlight "problem areas" in the subwatershed where BMPs would likely have the most impact.

Figure 8 shows "High" runoff potential in dark orange colors and "Low" runoff potential in lighter shades. In the Upper South English River subwatershed, the higher areas of runoff potential are located primarily along the banks of upstream tributaries. An interactive webmap of this data is available on the ERW website. Click the link below to view the map.

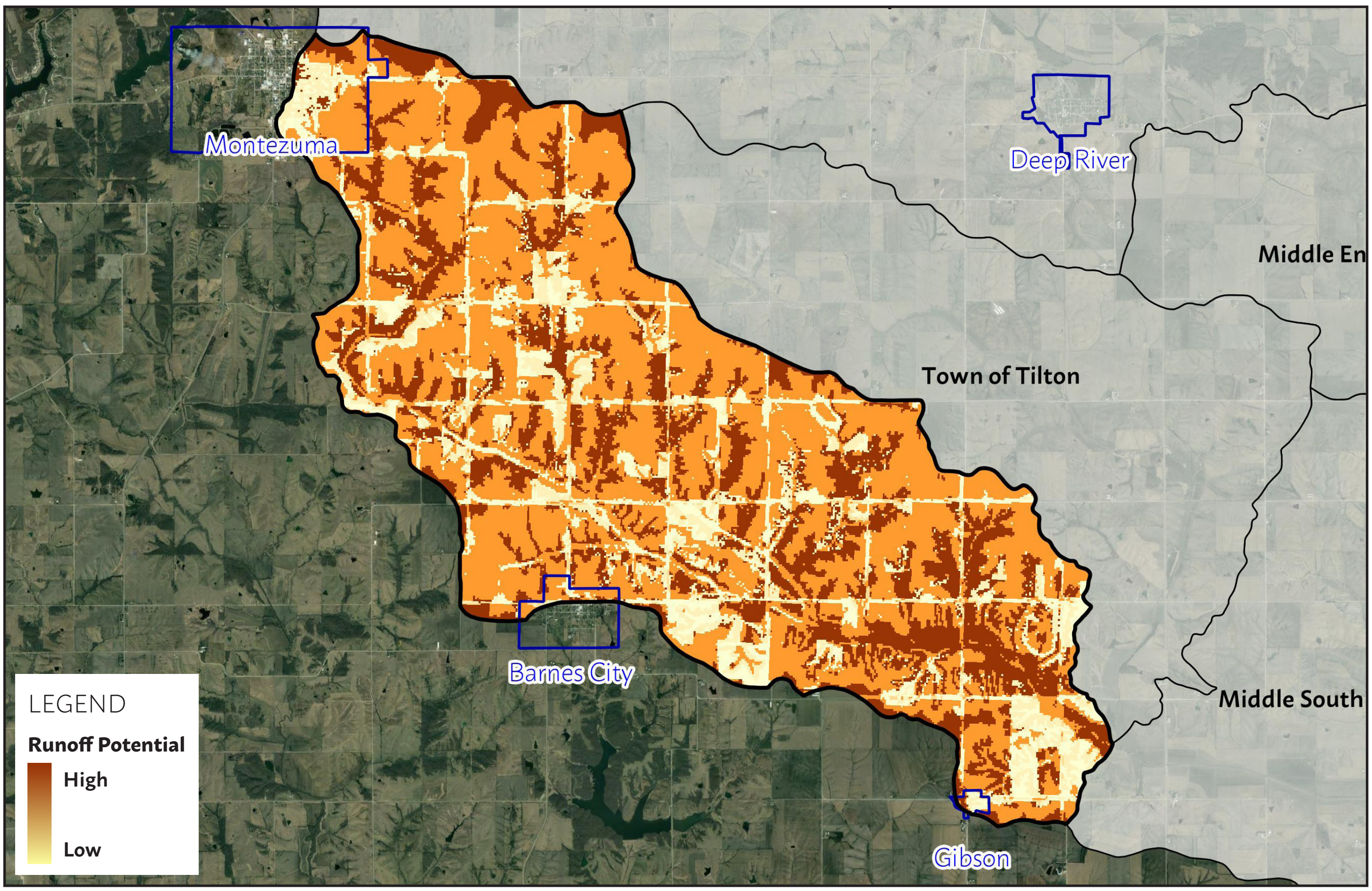

Figure 8. SCS-CN Runoff Potential Model for Upper South English River Subwatershed. *Source: ERW*

VIEW SOIL EROSION POTENTIAL WEBMAP FOR UPPER SOUTH ENGLISH RIVER:
http://www.englishriverwma.org/subwatershed-plans/erosion

SECTION 5: AGRICULTURAL CONSERVATION PLANNING FRAMEWORK

The Agricultural Conservation Planning Framework (ACPF) is a digital toolbox watershed planning and research. Utilizing a geographic information system (GIS), ACPF processes topographic data for terrain in the watershed. These data can determine land and agricultural fields within a watershed that are most prone to contribute runoff to streams. Furthermore, ACPF can identify where in-field and edge-of-field practices could be installed throughout the watershed. Such practices include surface intake filters, restored wetland, grassed waterways, buffer strips, water and sediment control basins (WASCOBs), bioreactors, saturated buffers, and floodplain reconnections. The Iowa Flood Center executed the ACPF for all subwatersheds in the English River Watershed as part of the Phase II planning project.

POTENTIAL BEST MANAGEMENT PRACTICES

According to the ACPF results, there exists the potential for 414.42 miles of contour buffer strips, 33 bioreactors, 444 WASCOBs, 18 nutrient-removal wetlands, a total of 3,699.51acres of drainage area for the wetlands, and 148.87 miles of grassed waterways in the Upper South English River subwatershed (Table 11). If all 18 wetlands were installed in the subwatershed, roughly 20.1 percent of the subwatershed drainage area would be treated. These practices are spatially depicted in Figure 9. In order to see the map in greater detail and to locate the exact position of potential practices, access the ACPF webmap via the link on the following page. Locations for BMPs are not prioritized in this analysis. Further analysis is needed to determine which practices present the highest potential.

Actual implementation of practices in the subwatershed was also analyzed in comparison to potential practices identified by the ACPF tool. Refer to the Iowa Flood Center's full report for a complete analysis, which can be found on the English River WMA website.

Table 11. Count of Potential Best Management Practices as identified by ACPF in the ERW by subwatershed. *Source: Iowa Flood Center*

HUC-12	Area (acres)	CBS (miles)	Bio-reactors	WASCOBs	Nutrient Removal-Wetlands	Wetland Drainage (Acres)	% of HUC-12	Grassed Waterways (miles)
301	14,836	389.52	23	255	7	1,728.87	11.7 %	35.18
302	29,845	693.60	53	464	14	2,520.01	8.5 %	104.88
401	36,075	885.55	80	826	39	8,608.98	23.8 %	313.86
402	19,076	381.94	49	245	2	348.79	1.8 %	58.52
403	26,535	579.03	65	393	5	1,156.23	4.4 %	91.17
404	19,540	328.89	36	195	5	903.01	4.6 %	137.75
405	13,007	155.69	8	113	1	226.90	1.7 %	57.89
406	12,841	79.46	27	65	0	0	0.0 %	120.80
407	12,611	107.77	20	66	1	183.03	1.5 %	28.28
408	14,193	185.31	12	89	5	1,004.06	7.1 %	43.37
501	11,016	271.67	18	246	6	1,106.28	10.0 %	101.12
502	**18,411**	**414.42**	**33**	**444**	**18**	**3,699.51**	**20.1 %**	**148.87**
503	27,397	615.76	37	451	8	1,687.15	6.2 %	190.94
504	25,728	533.86	49	291	1	158.05	0.6 %	98.27

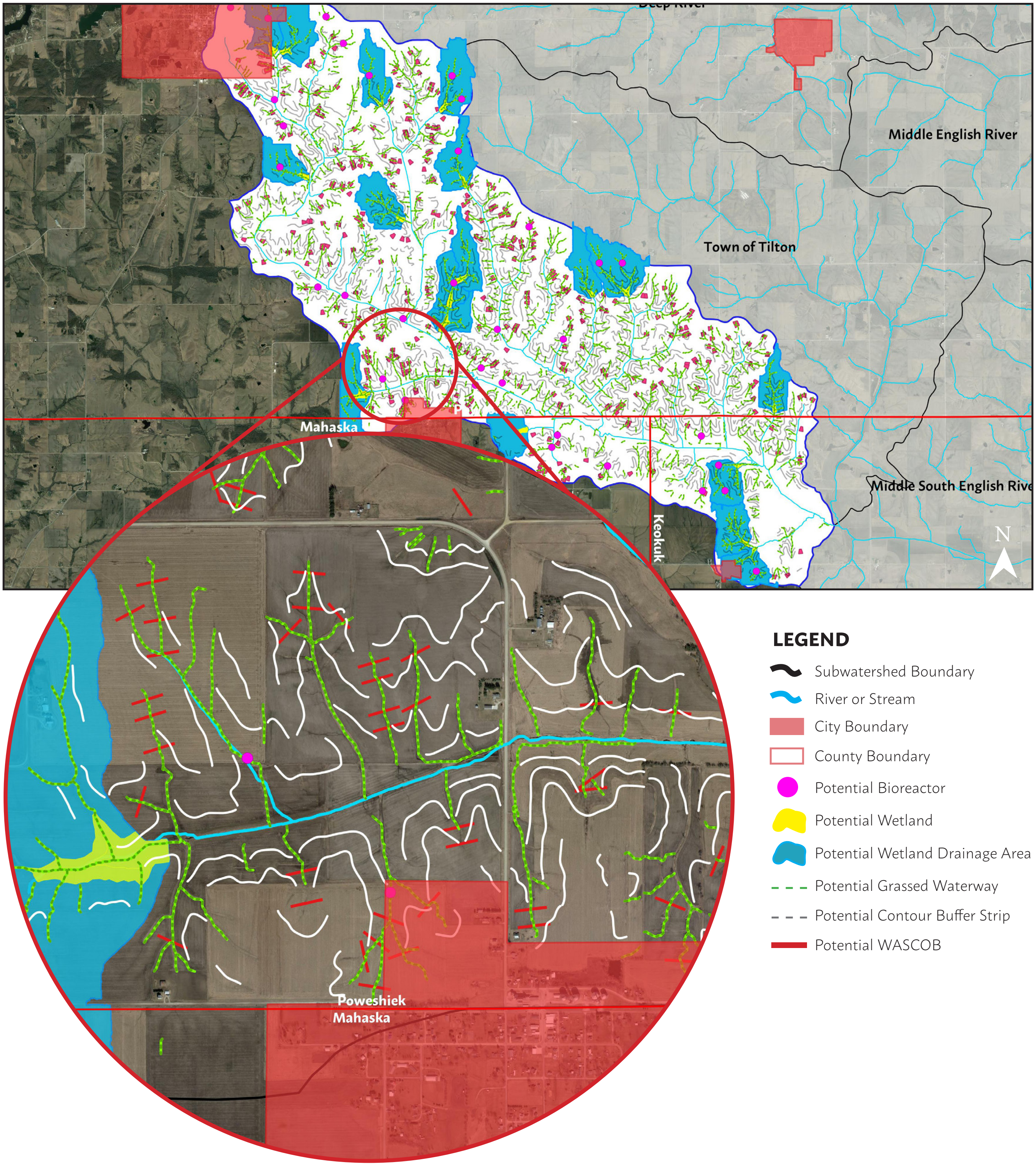

Figure 9. ACPF Model Results for Upper South English River Subwatershed. *Source: Iowa Flood Center*

VIEW ACPF WEBMAP FOR UPPER SOUTH ENGLISH RIVER:
http://www.englishriverwma.org/subwatershed-plans/acpf

SECTION 6: URBAN ASSESSMENT

The purpose of the following assessment was to quantify stormwater runoff per catchment area and to calculate pollutant loads, which provides data that can indicate higher runoff and pollutant contributing areas or "hot spots". The analysis improves the understanding of where urban best management practices (BMPs) can provide the most benefit. These results are critical in securing grant funds and can help communities and public or private organizations better plan for utilizing limited funding.

The City of North English is the only urbanized, incorporated area in the Upper South English River subwatershed. English River Watershed boundaries encompass the entirety of North English. However, the Upper South English River subwatershed only spans a portion of northwest North English, which is primarily residential land uses. The majority of urbanized area lies in the Lower South English River subwatershed.

Urbanization increases the amount of impermeable surfaces in a watershed. Rainfall can water contaminants over urban areas, into storm sewer system, and consequently into waterbodies. Nitrogen, phosphorus, and sediment are of primary concern if they exceed natural levels in streams and rivers, and are the principal contaminants prioritized by the Iowa Nutrient Reduction Strategy (NRS).

Runoff volume and pollutant models take into account a variety of environmental and physical conditions, including land use and impervious surfaces, soil types, and slope. Modeling was provided by the University of Northern Iowa GeoInformatics Training Research Education and Extension (GeoTREE) Center.

RUNOFF VOLUME

Comprehensive watershed planning completed in 2015 identified that runoff and flooding are primary resource concerns in the Upper South English River subwatershed. Figures 11-13 represents the stormwater runoff volume for each catchment area within the city limits of North English where orange and red portray higher runoff volumes. These "hot spots" would be suitable locations for BMPs that capture and retain water. The Iowa Stormwater Management Manual (ISWMM), a guide for the design and installation of stormwater BMPs in urban and rural areas, recommends wet ponds, wetlands, and infiltration basins for the purpose of water retention and flood control.

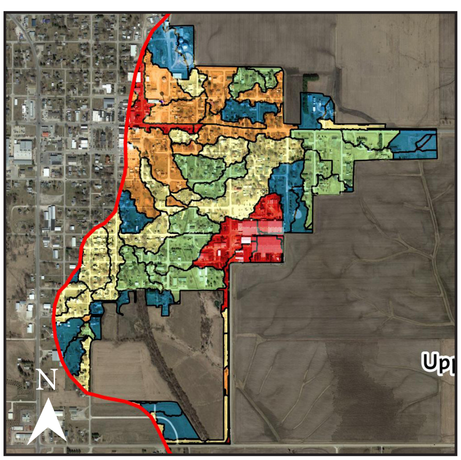

Figure 11. Modeled Runoff Volume in Montezuma, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

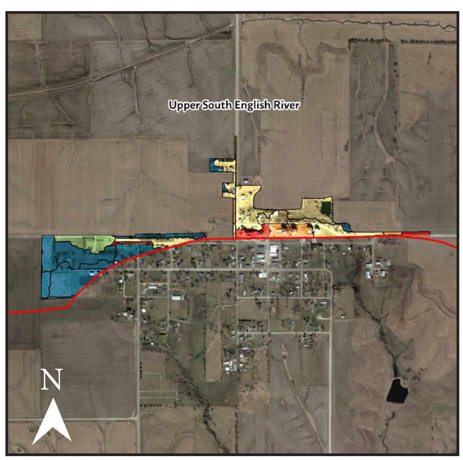

Figure 12. Modeled Runoff Volume in Barnes City, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Figure 13. Modeled Runoff Volume in Gibson, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Runoff Volume (Cubic feet/acre/year)
- 5,741 - 13,819
- 13,918 - 19,751
- 19,751 - 26,169
- 26,169 - 43,357
- 43,357 - 88,749

NITRATE, PHOSPHORUS, & SEDIMENT LOADING LOADING

Figures 14-16 displays total nitrate loads for each of the catchment areas where darker shades of red portray higher loads. These "hot spots" would be suitable locations for structural BMPs such as porous paver systems, bioretention areas, and infiltrating trenches. According to the ISWMM, these practices are proven to provide total nitrogen reductions between 60 and 80 percent. Figures 17-19 and Figures 20-22 display total phosphorus loads and total sediment loads, respectively, for catchment areas where darker shades of red portray higher loads. These "hot spots" would be suitable locations for best management practices such as bioswales or rain gardens.

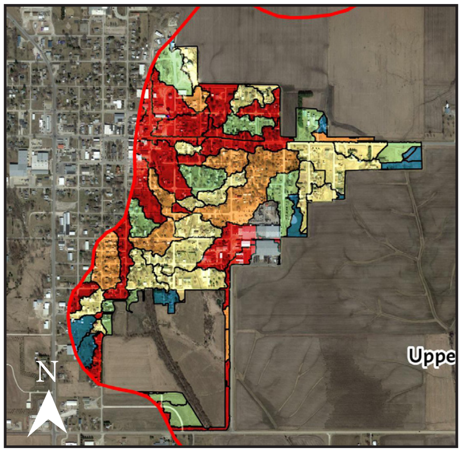

Figure 14. Modeled Nitrate Load in Montezuma, IA (lbs/acre/year). *Source: UNI GeoTREE*

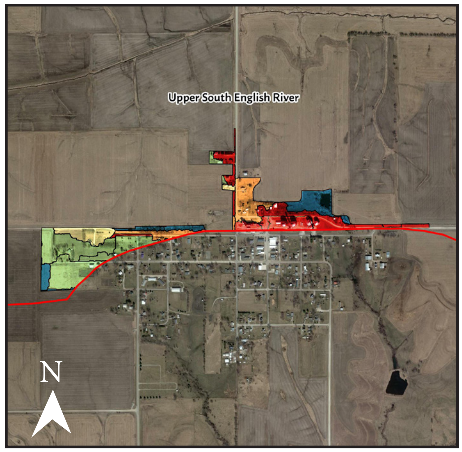

Figure 15. Modeled Nitrate Load in Barnes City, IA (lbs/acre/year). *Source: UNI GeoTREE*

Figure 16. Modeled Nitrate Load in Gibson, IA (lbs/acre/year). *Source: UNI GeoTREE*

Total Nitrate Load (lbs/acre/year)
- 0.000 - 0.201
- 0.201 - 0.331
- 0.331 - 0.469
- 0.469 - 0.549
- 0.549 - 2.000

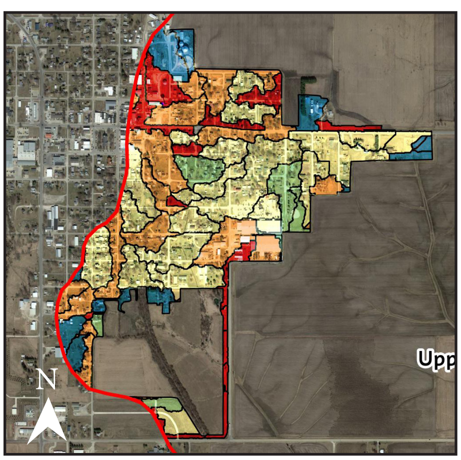

Figure 17. Modeled Phosphorus Load in Montezuma, IA (lbs/acre/year). *Source: UNI GeoTREE*

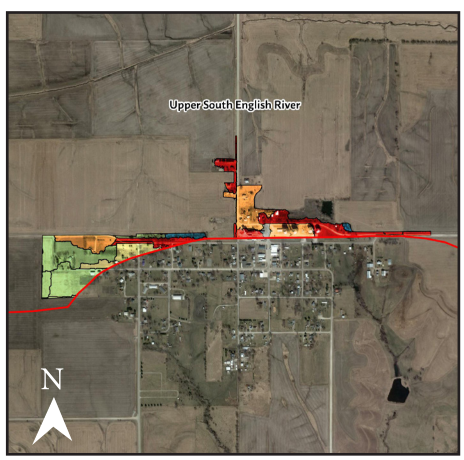

Figure 18. Modeled Phosphorus Load in Barnes City, IA (lbs/acre/year). *Source: UNI GeoTREE*

Figure 19. Modeled Phosphorus Load in Gibson, IA (lbs/acre/year). *Source: UNI GeoTREE*

Total Phosphorus Load (lbs/acre/year)
- 0.525 - 0.646
- 0.646 - 0.828
- 0.828 - 1.128
- 1.128 - 1.424
- 1.424 - 3.035

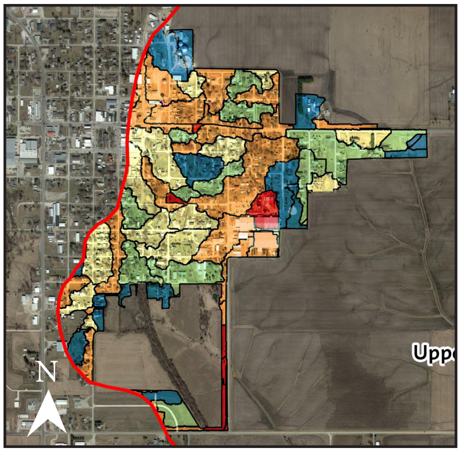

Figure 20. Modeled Sediment Load in Montezuma, IA (lbs/acre/year). *Source: UNI GeoTREE*

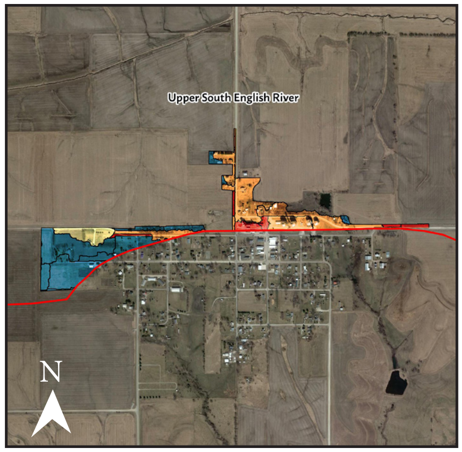

Figure 21. Modeled Sediment Load in Barnes City, IA (lbs/acre/year). *Source: UNI GeoTREE*

Figure 22. Modeled Sediment Load in Gibson, IA (lbs/acre/year). *Source: UNI GeoTREE*

Total Sediment Load (lbs/acre/year)

- 124 - 276
- 276 - 376
- 376 - 483
- 483 - 799
- 799 - 3143

BMP SCENARIOS

These data allow for modeling the impacts of BMP introduction in various catchment areas in urban areas in the ERW. For example, a bioretention cell (roughly 21,000 square feet in area) was introduced near English Valley's High School to gauge the potential impacts of this practice. The results of modeling suggest implementation of this practice would result in a 81.1 percent reduction in runoff and a 79.6 percent reduction in particulate solids in the catchment area. This scenario is hypothetical and likely would not represent actual implementation locally, but provides an example of the impact urban conservation practices can make to both runoff volume and water quality.

Please contact staff at the ERW if you are interested in having these types of scenarios completed in your watershed community. All data presented in Section 6 is available via an interactive webmap produced by the UNI GeoTree Center, and can be accessed at the link below.

VIEW MONTEZUMA INTERACTIVE WEBMAP:
https://arcg.is/0Da4nb

VIEW BARNES CITY INTERACTIVE WEBMAP:
https://arcg.is/0THq81

VIEW GIBSON INTERACTIVE WEBMAP:
https://arcg.is/rSSPP

SECTION 7: HAZARD MITIGATION

Hazard mitigation planning is defined as the effort to reduce loss of life and property by lessening the impact of disasters. Most counties in Iowa are required to complete a county-wide Hazard Mitigation Plan, which makes the county and its cities eligible for federal funding for emergency and non-emergency disaster assistance programs. English River Watershed stakeholders identified in Phase 1 Comprehensive Planning that reducing flood severity is a priority for watershed improvement. A brief analysis of flooding hazards is included in this plan as supplemental information and support for county Hazard Mitigation Plans. The Poweshiek County Multi-Jurisdictional Hazard Mitigation Plan was adopted in 2016 and expires in 2021.

EXTENT OF HAZARDS

As determined by the Federal Emergency Management Agency (FEMA), Figure 23 shown below represents the flood hazards that exist in the Upper South English River subwatershed. The flood hazard area accounts for roughly 8.2 percent of the subwatershed area. Riverine flooding can cause damage to crops, roads, homes, and businesses when river levels rise and overflow their banks. Urban areas, such as the cities of Montezuma, Barnes City, and Gibson, are also subject to impacts from flash flooding, or flooding that develops within 6 hours of the immediate storm.

Tables 12 and 13 show previous flooding events in the county from 2008 to present (August 2018) and public assistance costs per flood event. Not all assistance costs were incurred directly within the subwatershed because data is only available on the county level. The subwatershed covers about 4.9 percent of Poweshiek County's area. By contrast, the English River Watershed overlaps about 45 percent of Poweshiek County. Figures presented are not exhaustive; many flash flood events do not meet the threshold to trigger public assistance.

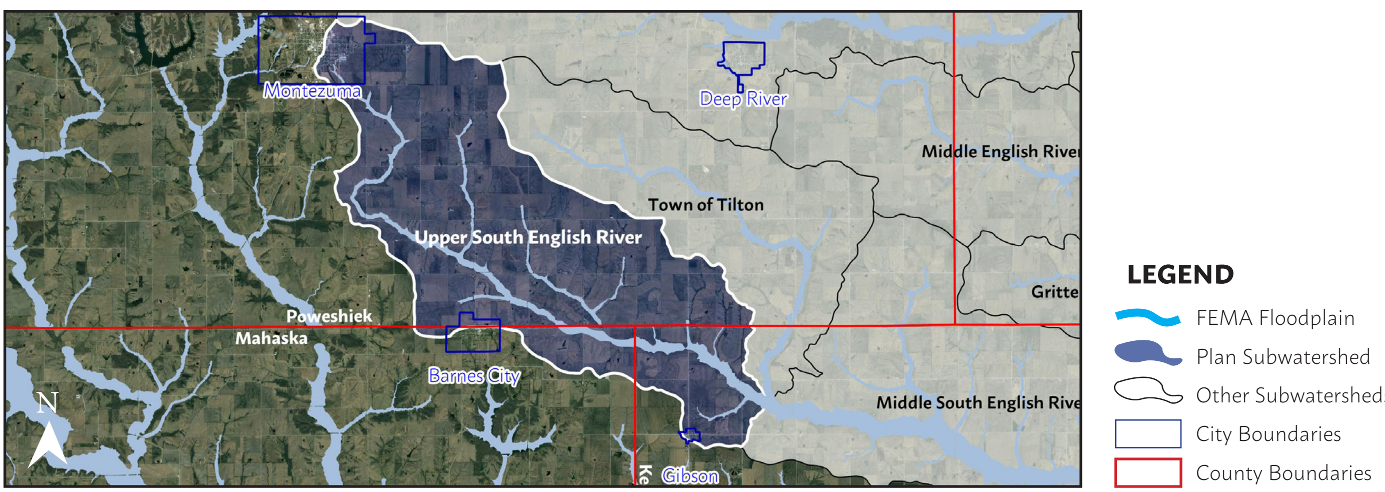

Figure 23. Flood hazard boundary areas for Upper South English River Subwatershed. *Source: FEMA*

Table 12. 10-Year Disaster Assistance Funding by Type of Work in Poweshiek County. *Source: HSEM*

Type of Work	Assistance Costs
Roads/Culverts	$623,826.13
Debris Removal	$133,878.41
Emergency Procedures	$40,166.52
Total	**$797,171.06**

Table 13. 10-Year Disaster Assistance Funding by Flood Event in Poweshiek County. *Source: Iowa Homeland Security & Emergency Management (HSEM)*

Flood Event Period	Assistance Cost	Flood Height at Deep River Monitoring Gauge
May 25 - August 13, 2008	$249,331.52	No historic data available
May 19 - June 1, 2013	$352,811.41	81.53' (6th Highest)
June 26 - July 8, 2014	$195,728.13	81.94' (7th Highest)
Total	**$797,171.06**	

POTENTIAL LOSSES

Hazards United States (HAZUS) is a nationally-applicable, standardized method for estimating potential losses from floods and other hazards. Table 14 provides estimations of building and content damage from flooding events in ERW counties. There exists 1 structure vulnerable to losses from the 1 percent annual chance flood (red dots) and 10 structures vulnerable to the 0.2 percent annual chance flood (green dots) in the subwatershed (Figure 15).

Table 14. Estimated Losses from Flood Hazards by County in the ERW. *Source: HSEM*

County	Building Count	Estimated Building Cost	Estimated Content Cost	Estimated Building Damage	Estimated Content Damage	Combined Estimated Loss
Average Annual Loss Vulnerability						
Iowa	20	$1,374,100.00	$1,000,000.00	$2,921.00	$1,379.00	$4,300.00
Poweshiek	5	$407,220.00	$203,610.00	$5,274.00	$2,563.00	$7,837.00
Keokuk	2	$11,620.00	$5,810.00	$484.00	$268.00	$752.00
100-Year Loss Vulnerability (1% Annual Chance Flood)						
Iowa	10	$1,002,150.00	$814,025.00	$82,248.00	$35,149.00	$117,397.00
Poweshiek	4	$372,360.00	$186,180.00	$60,882.00	$34,394.00	$95,276.00
Keokuk	2	$11,620.00	$5,810.00	$5,653.00	$3,117.00	$8,770.00
500-Year Loss Vulnerability (0.2% Annual Chance Flood)						
Iowa	20	$1,374,100.00	$1,000,000.00	$183,065.00	$100,204.00	$283,269.00
Poweshiek	5	$407,220.00	$203,610.00	$83,011.00	$50,406.00	$133,417.00
Keokuk	2	$11,620.00	$5,810.00	$5,997.00	$3,289.00	$9,286.00

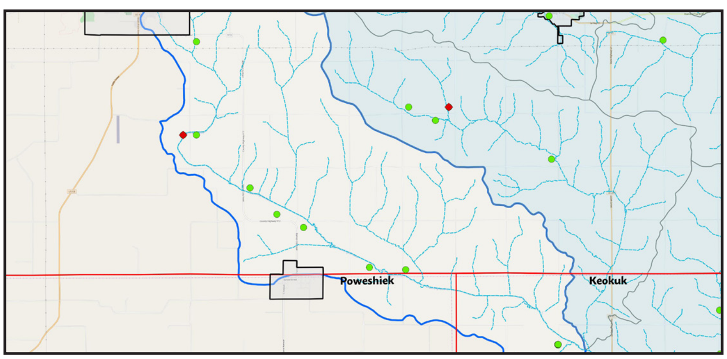

Figure 15. Vulnerable structures for flood hazards in the Upper South English River Subwatershed. *Source: HSEM*

VIEW INTERACTIVE HAZUS DATA:
http://www.englishriverwma.org/subwatershed-plans/hazus

The National Flood Insurance Program (NFIP) is a federal program that provides flood insurance for residential and commercial landowners in participating communities and counties (Table 15).

VIEW NORTH ENGLISH NFIP FLOOD MAP:
http://arcg.is/SLfjH

Table 15. City or County Participation in NFIP. *Source: FEMA*

Municipality/Entity	Participation in NFIP
Grinnell	Yes
Guernsey	Yes
Montezuma	**Yes**
Webster	Yes
Kinross	Yes
Johnson County	Yes
Keokuk County	**Yes**
Iowa County	Yes
Poweshiek County	**Yes**
Barnes City	**No**
Deep River	No
Gibson	**No**
Keswick	No
Millersburg	No
Parnell	No
North English	No

SOCIAL VULNERABILITY

Community disaster resilience is the ability of people living in a subwatershed to plan and act collectively, using local capacities to mitigate, prepare for, respond to, and recover from hazards like flooding. Understanding the social barriers present in a subwatershed may aid in targeting specific actions that watershed residents can utilize when preparing for or responding to a flood event.

The Iowa Flood Center Resilience Program conducted social vulnerability research as part of the Iowa Watershed Approach in 2018. The social vulnerability (SVI) is a combined metric of 12 indicators: African American, language barrier, renters, unemployed, poverty, children, elderly, Hispanic or Latino, low education, female head of household, disabled, and no vehicle access. They represent a percent of the population at the census tract level.

SVI scores are ranked on a scale of low/low-medium (0.000 - 0.300), medium (0.301 - 0.450), and medium-high/high (0.451-max). Table 16 displays the SVI and the top vulnerability indicators for each of the census tracts that overlap the ERW. The highlighted row(s) represent a census tract(s) that overlaps the subwatershed.

Table 16. Top Vulnerability Factors in English River Watershed by Census Tract. *Source: IFC, ACS 2016 5-Year Estimates*

Census Tract	County	Incorporated Cities	SVI	1st Indicator	2nd Indicator	3rd Indicator
3704	Poweshiek	Grinnell	0.725	2 % Black or African American	24 % Age 65 or Older	7 % Unemployed
9601	Washington	Kalona, Riverside	0.449	27 % Children	4 % Limited English	13 % No High School Diploma
3705	**Poweshiek**	**Montezuma, Guernsey, Deep River**	**0.44**	**1 % Black or African American**	**12 % Poverty**	**5 % Unemployed**
9501	**Mahaska**	**Barnes City**	**0.418**	**2 % Black or African American**	**7 % Unemployed**	**27 % Children**
9602	Washington	Wellman	0.411	1 % Black or African American	23 % Children	3 % Hispanic or Latino
802	**Keokuk**	**Gibson, Keswick, Webster**	**0.404**	**7 % Unemployed**	**15 % Poverty**	**25 % Children**
9603	Iowa	North English, Millersburg	0.401	27 % Children	11 % Poverty	0.5 % Black or African American
104	Johnson	None	0.381	2 % Black or African American	5 % Limited English	12 % No Vehicle Access
801	Keokuk	Kinross	0.375	27 % Children	13 % Poverty	4 % Unemployed
3702	Poweshiek	Grinnell	0.363	5 % Unemployed	20 % Age 65 or Older	3 % Hispanic or Latino
3701	Poweshiek	None	0.339	5% Age 65 or Older	5% Unemployed	5 % Black or African American
9604	Iowa	Parnell	0.326	0.5 % Black or African American	10 % Poverty	19 % Age 65 or Older

Social vulnerability maps are available to the public online via the Iowa Flood Center's Iowa Watershed Approach mapping application. Click the link below and then select your watershed of interest. Then, hover over the "IWA" icon within the menu on the top-right side of the page. From there, you will see a "Flood Resilience" heading and a button to turn on the social vulnerability map layer. Users can click around on the various census tracts within the English River Watershed to see more information regarding the social vulnerability, including the top three indicators of vulnerability for that particular census tract in comparison to the rest of the watershed.

VIEW FLOOD RESILIENCY MAP:
http://iwa.iowawis.org/app/

VIEW SOCIAL VULNERABILITY MAPS:
http://www.englishriverwma.org/subwatershed-plans/resilience

SECTION 8: ACTION PLAN

This plan is intended to serve as a guide in decision-making and planning by the ERW, local agencies, local government, and citizens. Mitigation actions stated in this section are the result of data obtained through the Phase 2 planning process, the 2018 Conservation Survey, and other stakeholder input. The priority mitigation actions should be re-evaluated at least every 5 years and adjusted as necessary to keep pace with accomplished projects, current policies and practice, and availability of funding.

Mitigation actions presented in this plan (Table 17) supplement recommendations stated in Iowa County's Hazard Mitigation Plan. The following recommendations for the Upper South English River subwatershed are based on a comparative analysis among all 14 subwatershed analyzed in this planning project.

As the uppermost subwatershed in the South English River basin, it is imperative to treat runoff for water quality and quantity prior to sediment and excess nutrient entering the waterway. The subwatershed presents the second highest potential to treat 20 percent of the drainage area in the watershed through implementation of nutrient-removal wetlands, which can also slow rainwater velocities. Contour buffer strips, WASCBOs, and grassed waterways are suitable throughout the subwatershed and can aid in protecting vulnerable structures in rural areas. See Section 4 for locations prone to higher runoff rates, which would be effective locations for such practices. Urban areas (Gibson, Montezuma, and Barnes City) should consider implementation of BMPs designed to treat stormwater runoff locally before entering the storm sewer or waterway (also known as green stornwater infrastructure).

FUNDING SOURCES

Mitigation actions can be financially supported through a variety of state and federal programs (Table 17). Examples of BMPs that can be funded by each program are shown in Table 18. More information on each program can be found on by accessing the links shown for each program. The following table is not exhaustive.

Table 17. State and Federal Conservation Programs. *Source: ERW*

Program	Eligible Applicants	Funding	Notes
Hazard Mitigation Grant Program (HMGP) *https://bit.ly/2wiKqq7*	Individuals, state agencies, tribal agencies, private non-profits, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Non-profits must partner with municipality or county
Pre-Disaster Mitigation Program (PDM) *https://bit.ly/2wiKqq7*	State agencies, U.S. territories, tribal agencies, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Funded annually by Congressional action and subject to a national competition
Iowa Watershed Approach (IWA) *https://bit.ly/2P7ibSi*	Individuals, municipalities, counties, private non-profits	75% cost share, no max as funds are available	• Project must be within eligible area defined by HUD • Funding period closes December 2022
Water Quality Initiative (WQI) *https://bit.ly/2BSCjWG*	SWCDs, counties, county conservation boards, municipalities, private non-profits, public water utilities, WMAs	Grants vary; Typical range: $100-$300K	• Established in 2013 to help implement Nutrient Reduction Strategy • Funding is steered toward priority watershed projects across the state
EPA 319 Non-Point Source Program *https://bit.ly/2BTXTtS*	WMAs, SWCDs	Grants vary; Typical range: $100-$300K	• Funding includes technical assistance, financial assistance, demonstration projects, training • Funding decisions are made by states; states receive annual allocation from EPA

Table 18. Mitigation Action Plan for the Upper South English River subwatershed. *Source: ERW*

Plan Objective	Action Number	Mitigation Action	Recommended Practices	Recommended Sites for Implementation	Timeframe	Potential Funding Source	Potential Partners	Jurisdiction Benefitting from Action	Action Priority
1	1.1	Flood protection of critical facilities along Upper South English River in Incorporated areas	None	None	N/A	N/A	N/A	N/A	None
	1.2	Flood protection of bridges in Upper South English River subwatershed	Perrenial Cover, Floodplain Restoration	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM	Secondary Roads, Poweshiek/Keokuk/ Mahaska SWCD, NRCS	Poweshiek/ Keokuk/Mahaska Counties, Montezuma, Barnes City, Gibson	Medium/ High
	1.3	Flood protection for population safety in Upper South English River subwatershed	Detention Basins, Ponds	See Urban Analysis (Section 6)	1-3 Years	PDM	Montezuma, Barnes City, Gibson, ERW	Montezuma, Barnes City, Gibson	Low
2	2.2	Acquire property at risk of flooding near Upper South English River; convert to open space	None	None	N/A	N/A	N/A	N/A	N/A
	2.3	Elevation of structures at risk to flooding in in Incorporated areas	None	N/A	N/A	N/A	N/A	N/A	N/A
3	3.1	Improve water quality in urban areas in Upper South English River subwatershed	Perennial Cover, Grass, Stormwater Detetion Basin, Urban BMPs	See Urban Analysis (Section 6)	5-7 Years	WQI	Poweshiek/Keokuk/ Mahaska SWCD, NRCS, ERW	Montezuma, Barnes City, Gibson	Medium/ High
	3.2	Improve water quality in rural areas in Upper South English River subwatershed	Saturated Buffers, Bioreactors, Wetlands, Sediment Detention Basins	See Soil Erosion and ACPF Analysis (Sections 4 & 5)	1-3 Years	319	Poweshiek/Keokuk/ Mahaska SWCD, NRCS, ERW	Poweshiek/ Keokuk/Mahaska Counties	High
4	4.1	Provide flood protection for roads and in Upper South English River subwatershed	Floodplain Restoration, Perennial Cover	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM	Secondary Roads, Poweshiek/Keokuk/ Mahaska SWCD, NRCS	Poweshiek/ Keokuk/Mahaska Counties, Montezuma, Barnes City, Gibson	Low

ACRONYMS

ACPF	Agriculture Conservation Planning Framework
BMP	Best Management Practice
DEP	Daily Erosion Project
EPA	Environmental Protection Agency
ERW	English River Watershed
FEMA	Federal Emergency Management Agency
HSEM	Homeland Security & Emergency Management
HUC	Hydrologic Unit Code
ISWMM	Iowa Stormwater Management Manual
IWA	Iowa Watershed Approach
NFIP	National Flood Insurance Program
NRCS	Natural Resource Conservation Service
NRS	Nutrient Reduction Strategy
SCS-CN	Soil Conservation Service - Curve Number
SWCD	Soil & Water Conservation District
WMA	Watershed Management Authority

ACKNOWLEDGEMENTS

This report is one of fourteen subwatershed plans developed as part of Phase 2 planning in the English River Watershed. These plans would not have been possible without the hardwork by the Iowa Flood Center and their participation in the National Disaster Resiliency program, a federal grant administered by the Housing and Urban Development department. The following is a list of project partners that were instrumental in providing data, technical assistance, and support through the planning process.

The Iowa Flood Center

Iowa County, Iowa

The University of Northern Iowa's GeoTREE Center

The Iowa Department of Natural Resources

Iowa Homeland Security & Emergency Management

The Iowa Water Center & The Daily Erosion Project

Center for Evaluation and Assessment

The State Hygenic Laboratory

Iowa Department of Agriculture & Land Stewardship

Eldon C. Stutsman, Inc.

CONTACT INFORMATION

All of the data, assessments, and tools highlighted in this plan are available to the public. Please contact staff at the English River Watershed to discuss how we can assist you in conservation planning and implementation.

The English River Watershed organization operates out of the Kalona City Hall offices. Our team is available by email, phone, or via our website: (http://englishriverwma.org/contact).

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