English River Historical Water Quality

The Iowa Department of Natural Resources has tested the water quality of the English River near Riverside, Iowa, since 1986. The site is located south of Riverside where Riverside Road crosses the river, and is near the mouth of the river upstream from where it joins the Iowa River in Washington County. Monitoring on the English River by DNR has focused on nutrients (such as ammonia, nitrate, total phosphorus and dissolved phosphorus); sediment (total suspended solids and turbidity); bacteria (E. coli); and other basic water chemistry measurements (dissolved oxygen, pH and total dissolved solids).

Nutrients

Ammonia levels in the English River have fluctuated during the 28 years of monitoring and range from below detection (the ability of the laboratory instruments to detect the compound of interest) to 2.68 parts per million (Figure XX). Under certain temperature and pH conditions, ammonia can become toxic to fish (see Iowa Administrative Code for specific criteria[1]). Based on the data from the English River at Riverside, none of the samples exceed levels of ammonia that would have an acute toxicity to fish, but the potential for chronic or long-term impacts exist. The long-term trend for ammonia appears to be downward, however the lower detection limit beginning in 2001 artificially pulls the trend line down and the changes in ammonia from 2001 to 2014 are not statistically significant.

Nitrate and nitrite are inorganic forms of nitrogen and sources include fertilizer, soil mineralization, atmospheric deposition and human and animal wastes. Nitrate plus nitrite measurements are shown in Figure XX. For purposes of laboratory measurement, nitrite (NO2) is converted to nitrate (NO3) before the test is conducted. Since levels of nitrite are generally low in Iowa streams, the conversion of nitrite to nitrate generally does not impact the overall measurement. Data from the English River are typical of southern Iowa with nitrate levels generally below the EPA drinking water standard of 10 mg/L or 10 parts per million. The statewide median (50th percentile) is roughly 5.4 mg/L, while the median nitrate levels in the English River are only 4.1 mg/L. The long-term trend appears to be decreasing for nitrate, although the trend line is not statistically significant.

[1] Iowa Water Quality Standards: Iowa Administrative Code, http://water.epa.gov/scitech/swguidance/standards/upload/iawqs_chapter61.pdf

Figure XX. Historic Ammonia Levels in the English River (1986 – 2015)

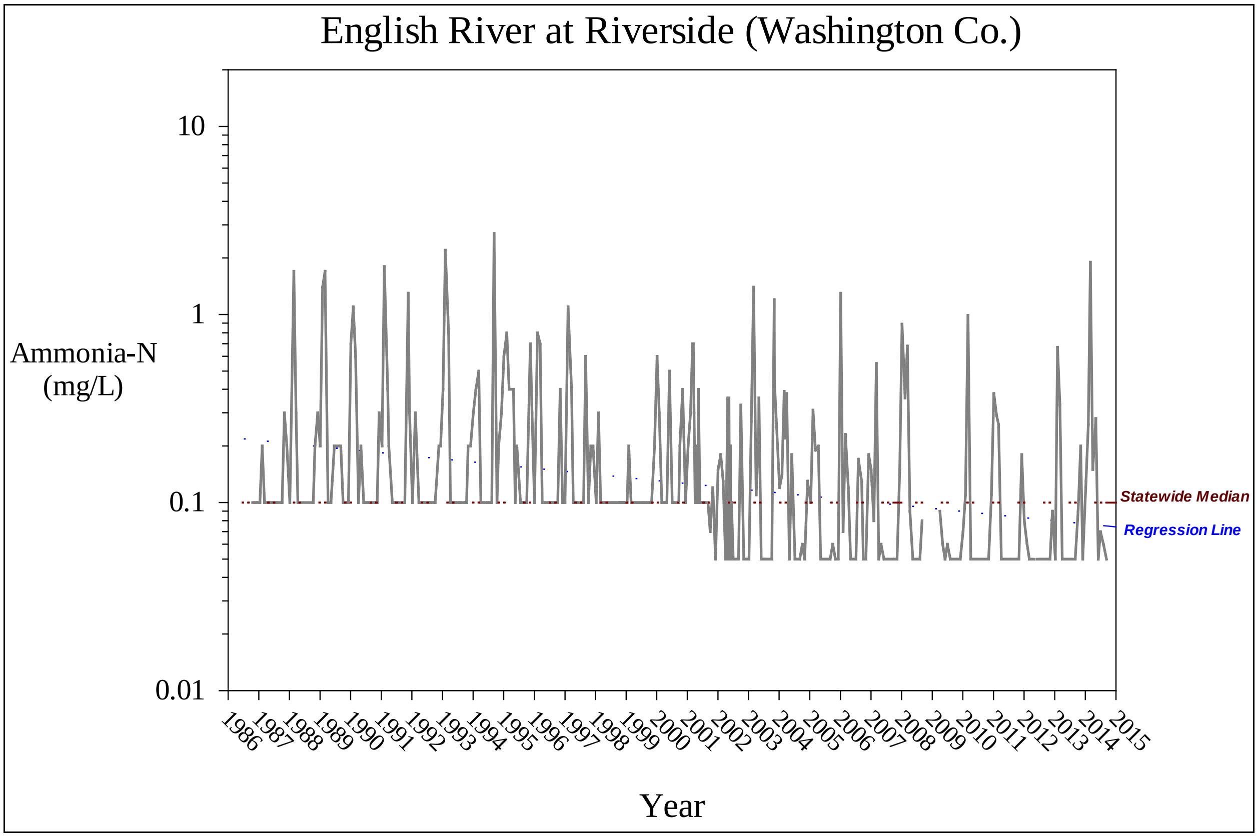
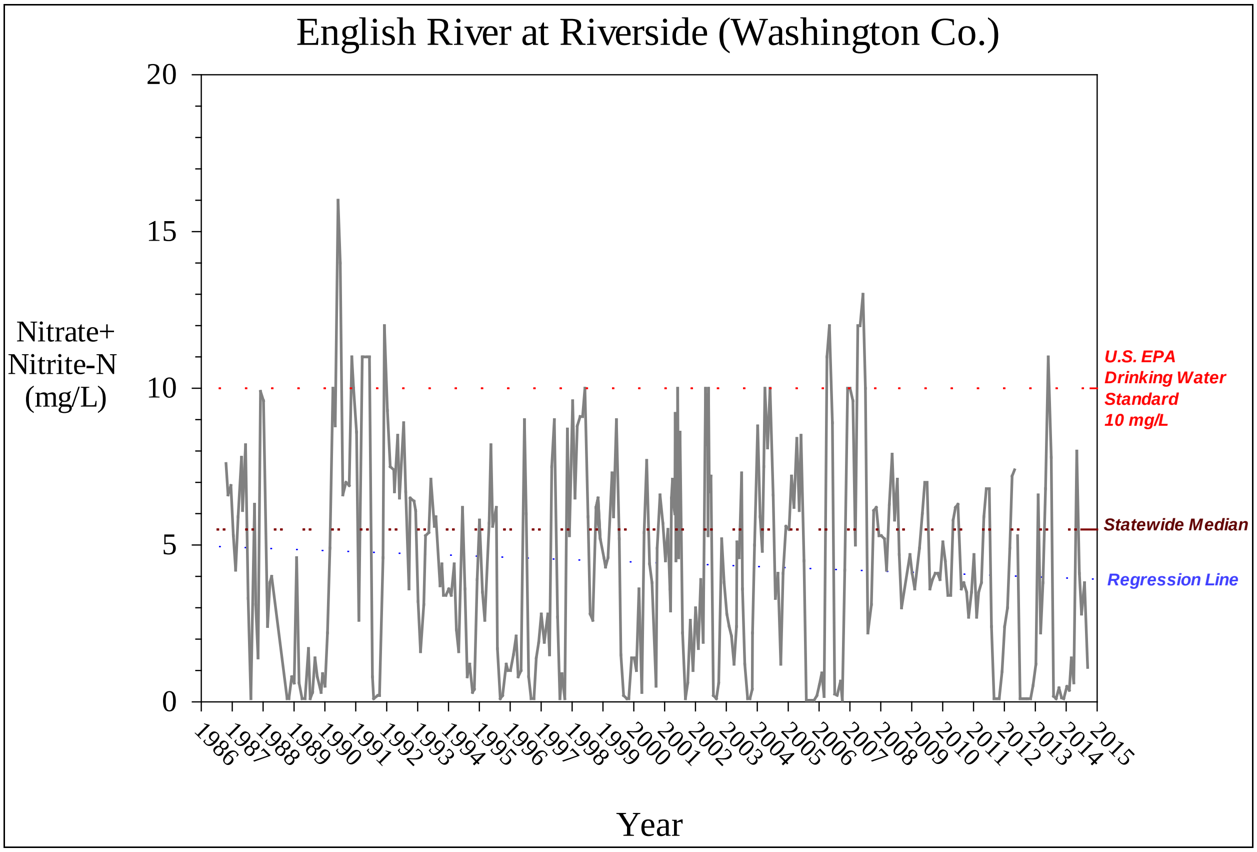


Figure XX. Historic Total Nitrate (NO2 + NO3) Levels in the English River (1986 – 2015)



Phosphorus is measured in two different forms: Total Phosphorus and Dissolved Orthophosphorus. Phosphorus tends to bind to sediment and is incorporated in the cell walls of plant materials. Phosphorus that is dissolved in the water and not bound to sediment is called Dissolved Orthophosphorus. This form of phosphorus is easily taken up by plant material and contributes to algae blooms. Sources of Dissolved Orthophosphorus include animal and human wastes and decomposition of plant materials. Total phosphorus, on the other hand, measures all sources of phosphorus in the water including the dissolved components as well as the phosphorus bound to sediment and in plant materials. While higher levels of Total Phosphorus are associated with algae blooms, it is important to note that less of the Total Phosphorus is available for the plants to utilize. Total Phosphorus is strongly correlated to rainfall since the erosion of sediment is the major mode of phosphorus delivery to the stream.

Currently, the State of Iowa does not have water quality standards for either Total Phosphorus (TP) or Dissolved Orthophosphorus (OP), however EPA has established a benchmark value of 0.075 parts per million for Total Phosphorus for streams such as the English River. Few samples in the English River would meet this benchmark value; based on 28 years of data, fewer than 5% of samples were below the EPA benchmark value for Total Phosphorus (Figure XX). The median value of TP in the English River is 0.2 mg/L, which is more than double the benchmark value and is higher than median values of TP for streams statewide. Maximum levels of TP in the English River approach 20 mg/L, which is extremely high. A trend analysis for TP shows little change during the monitoring record. The levels of Orthophosphorus are similar for the English River to streams statewide (median level of 0.1 mg/L; Figure XX); however OP has only been measured in the English River since late 1998. There appears to be a slight downward trend in OP during the past 16 years, but the change is not statistically significant and may be a result of changing detection limits during the monitoring time frame. The proportion of Dissolved Orthophosphorus to the overall Total Phosphorus found in the English River ranges from 2% to nearly 100% with a median of 40%, which suggests that that the majority of phosphorus found in the stream is coming from sediment eroded from the uplands or stream bed/banks. The data also suggest that at the times when OP comprises 40% or more of the TP concentration, sources such as animal and human waste may be impacting the English River, particularly during times of low stream flow.

Figure XX. Historic Total Phosphorus (TP) Levels in the English River (1988 – 2015)

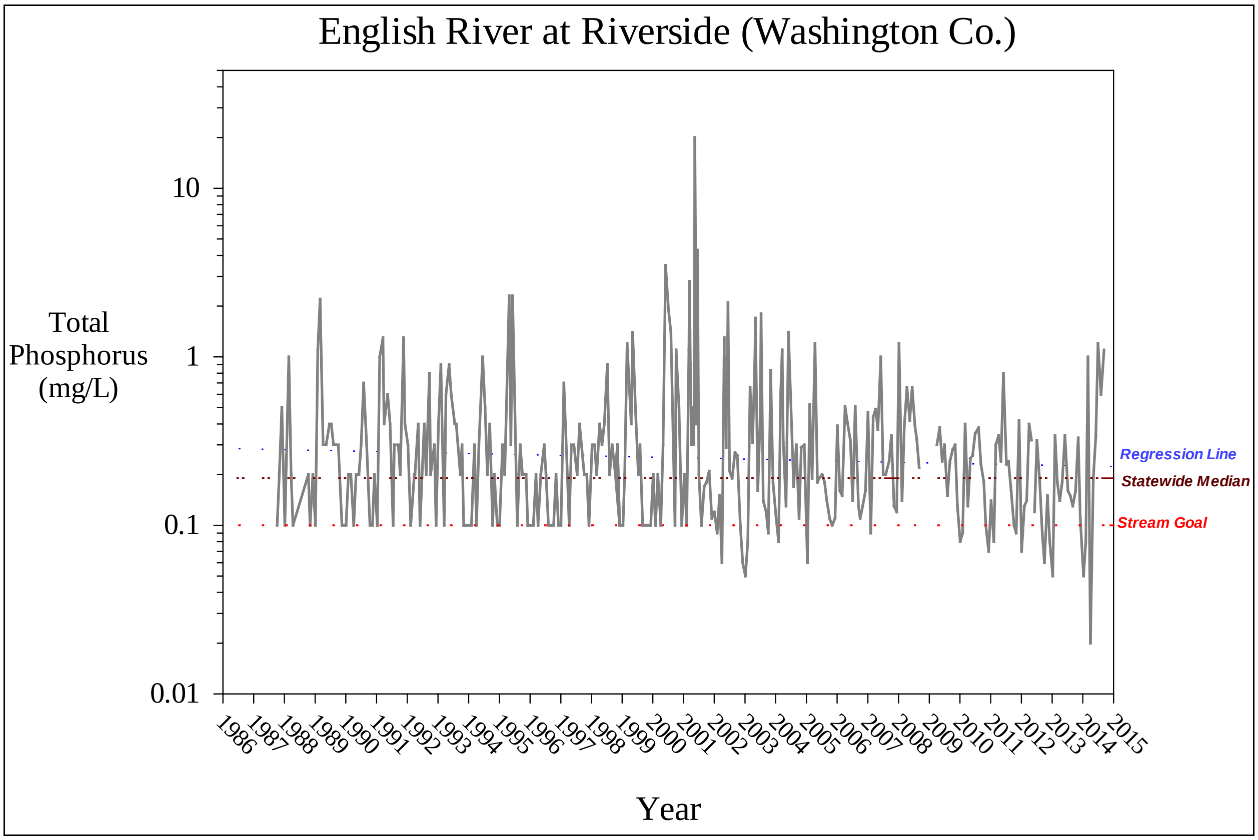
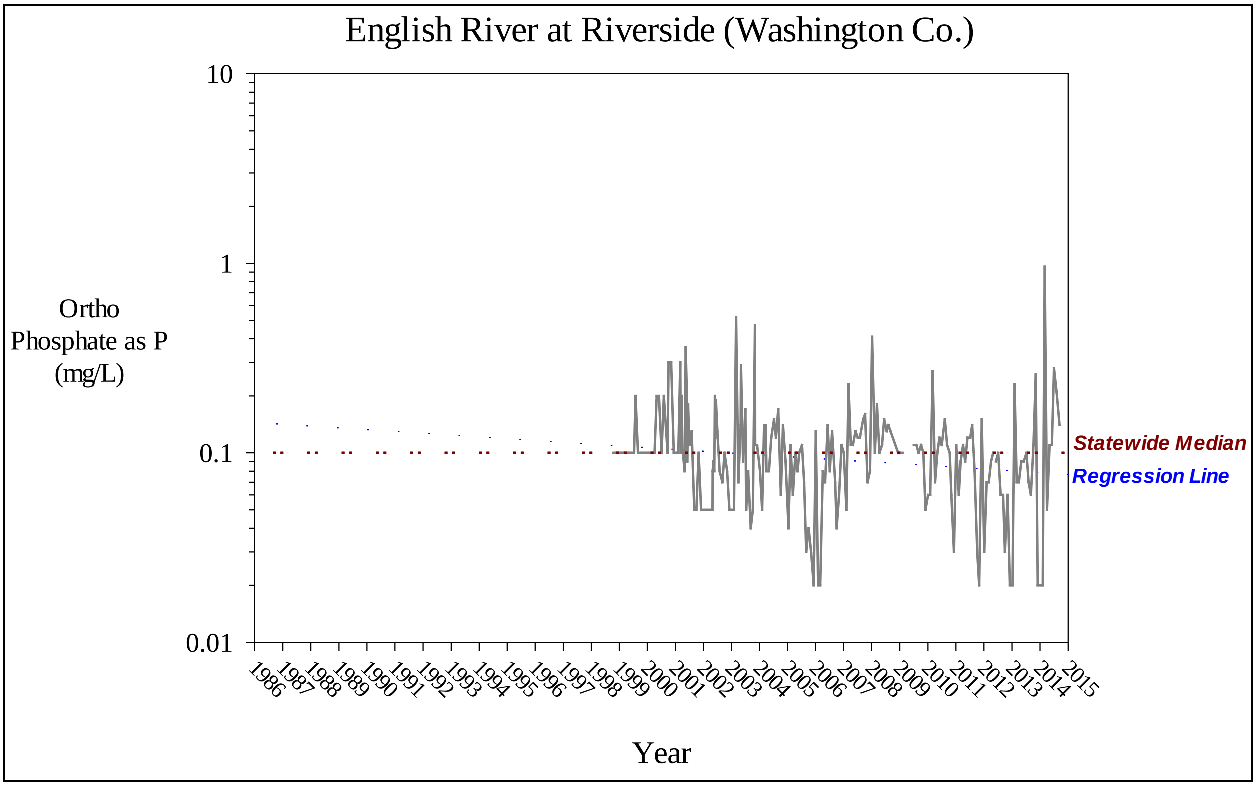


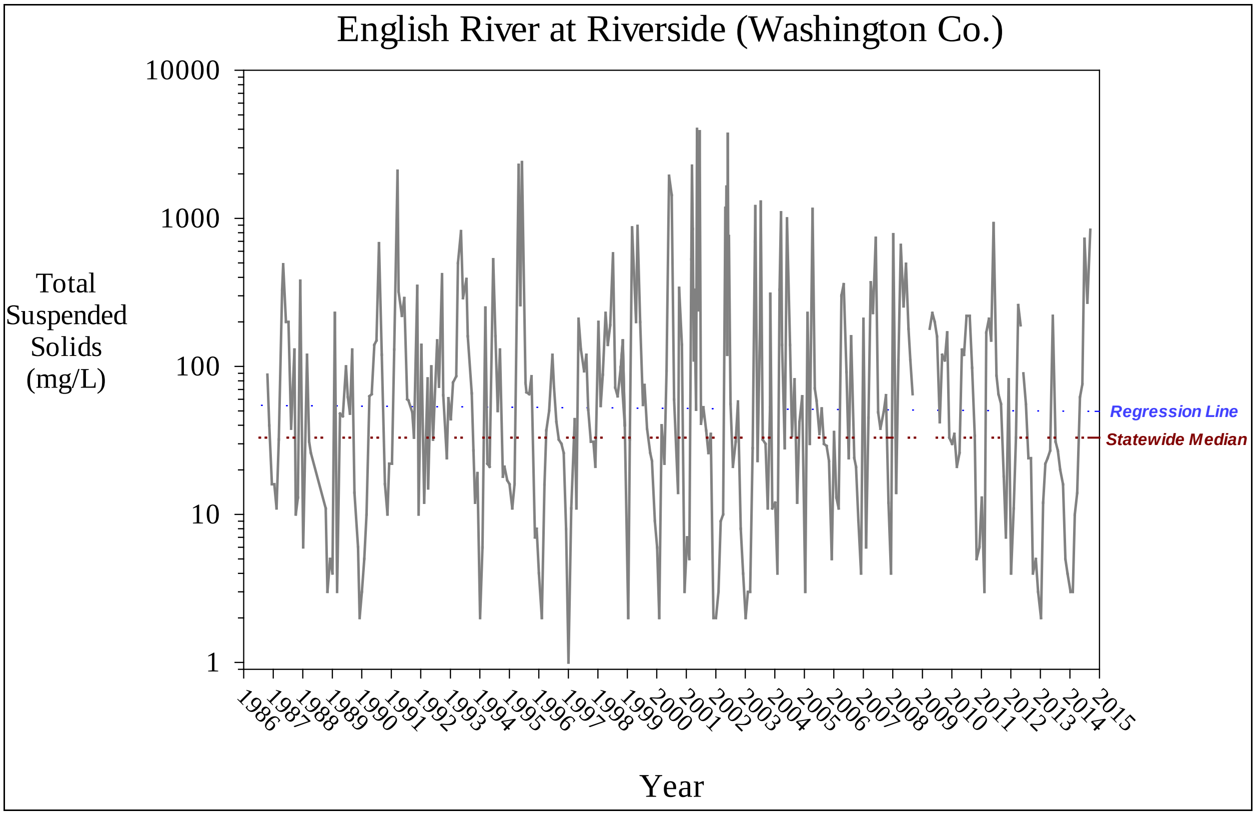
Figure XX. Historic Orthophosphate (OP) Levels in the English River (1998 – 2015)



Sediment

Total suspended solids are a measurement of the concentration of solid particles in the water column. Total suspended solids or TSS can be comprised of inorganic sediment (silt, clay, etc.) or may also be a product of organic particles such as decomposing plant material or algae. The impact of TSS on a stream is that it decreases the ability of light to penetrate the water, which impacts aquatic plant growth. Sediment in the stream can smother fish spawning beds, cause damage to fish gills and impact the type and diversity of fish and aquatic life found in a stream. Sediment also carries nutrients (particularly phosphorus), bacteria, and organic compounds (pesticides), metals, and oil and grease. Excessive levels of TSS indicate that erosion of sediment from uplands and the bed and/or bank of the stream is occurring. Measurements of TSS in the English River show a wide variability ranging from 1 part per million to more than 3600 parts per million (Figure XX). Iowa does not have a standard for TSS, but levels above 40 parts per million (mg/L) are considered aesthetically unpleasing. For comparison, South Dakota sets a sample maximum of 158 mg/L for warm water streams such as the English River. The median TSS value for the English River is 43 mg/L and more than 25% of the values exceed 197 mg/L.

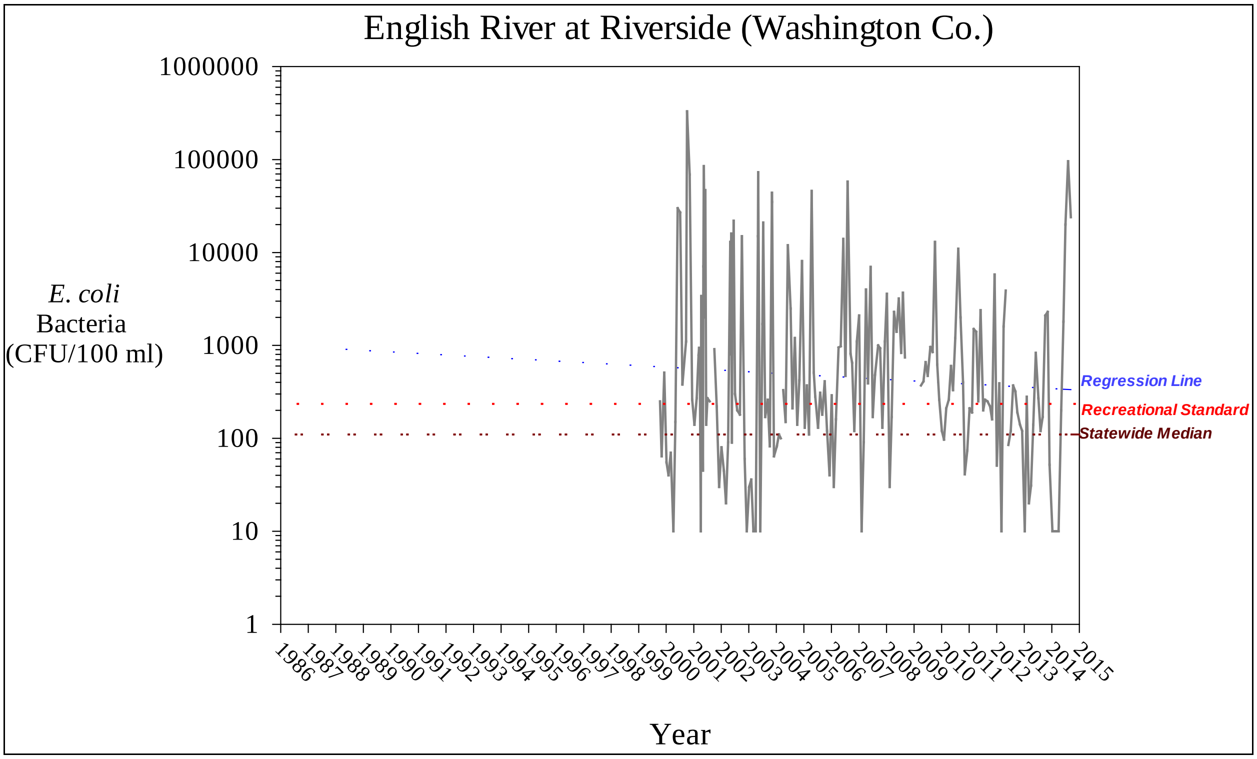
Figure XX. Historic Total Suspended Solids (TSS) Levels in the English River (1986 – 2015)



Bacteria

The presence of *E. coli* bacteria indicates that sources of human and/or animal waste are present in the water. Levels above 235 colony forming units per 100 milliliters of water (235 CFU/100ml) are associated with increased risk of illness (see Iowa Administrative Code). Monitoring for *E. coli* bacteria in the English River began in 1999 and data show that the water in the English River exceeds the 235 CFU/100ml standard more than 50% of the time. As is typical with bacteria, values of bacteria range from below detection to more than 250,000 CFU/100ml in the English River. *E. coli* values show a strong seasonal pattern with higher values occurring during times of rainfall and runoff from the land surface and are correlated with sediment transport as bacteria stick to sediment particles. Figure XX shows that bacteria levels in the English River are higher than is typical for streams statewide, but that a significant downward trend has occurred from 1999 through 2014.

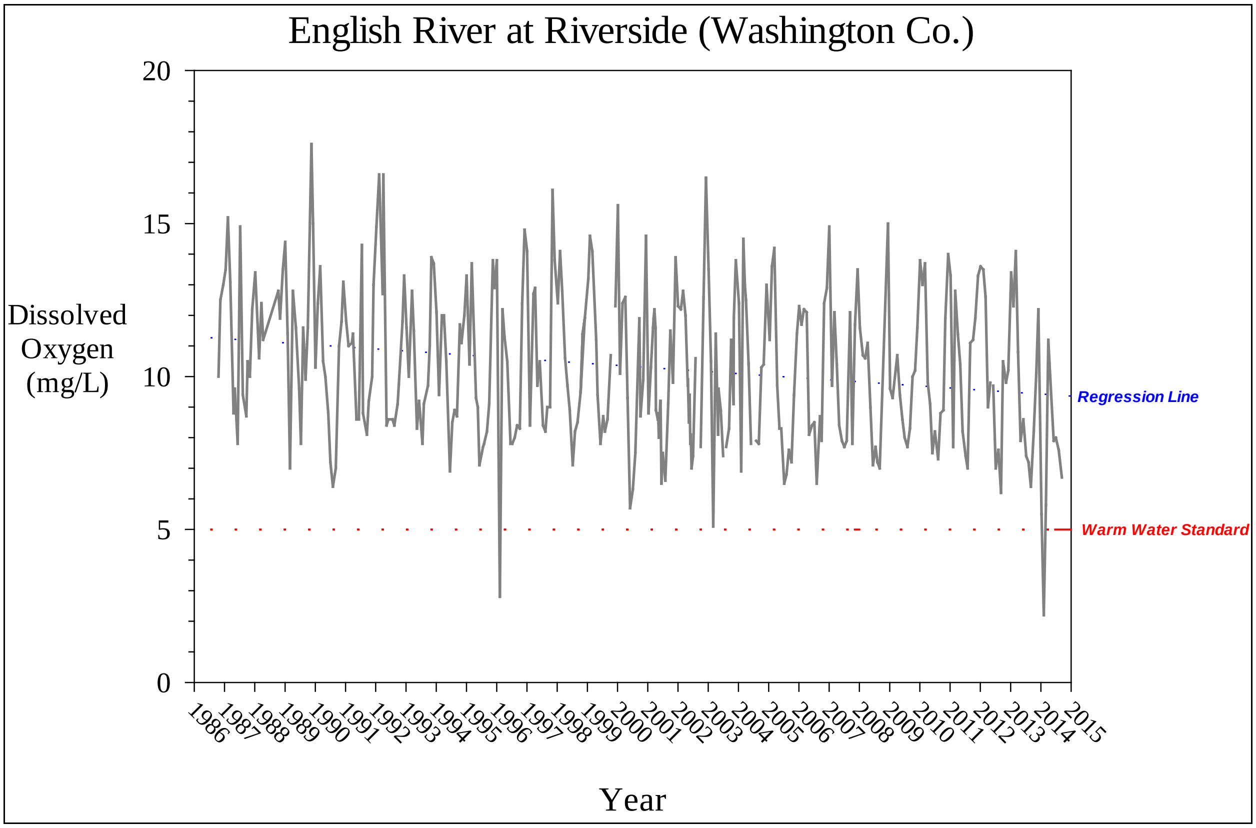
Figure XX. Historic Bacteria Levels in the English River (1999 – 2015)



Dissolved Oxygen

Dissolved Oxygen (DO) is a critical component for healthy aquatic systems and low levels of Dissolved Oxygen can indicate pollution sources such as human and/or animal waste, excessive algae growth and or decomposition of excessive organic matter. The warm water standard for Dissolved Oxygen is 5 parts per million (mg/L) and the English River violated the DO standard infrequently during the twenty-eight years of monitoring; however there appears to be downward trend in DO long-term and the winter of 2013/2014 was a time period of very low Dissolved Oxygen readings.

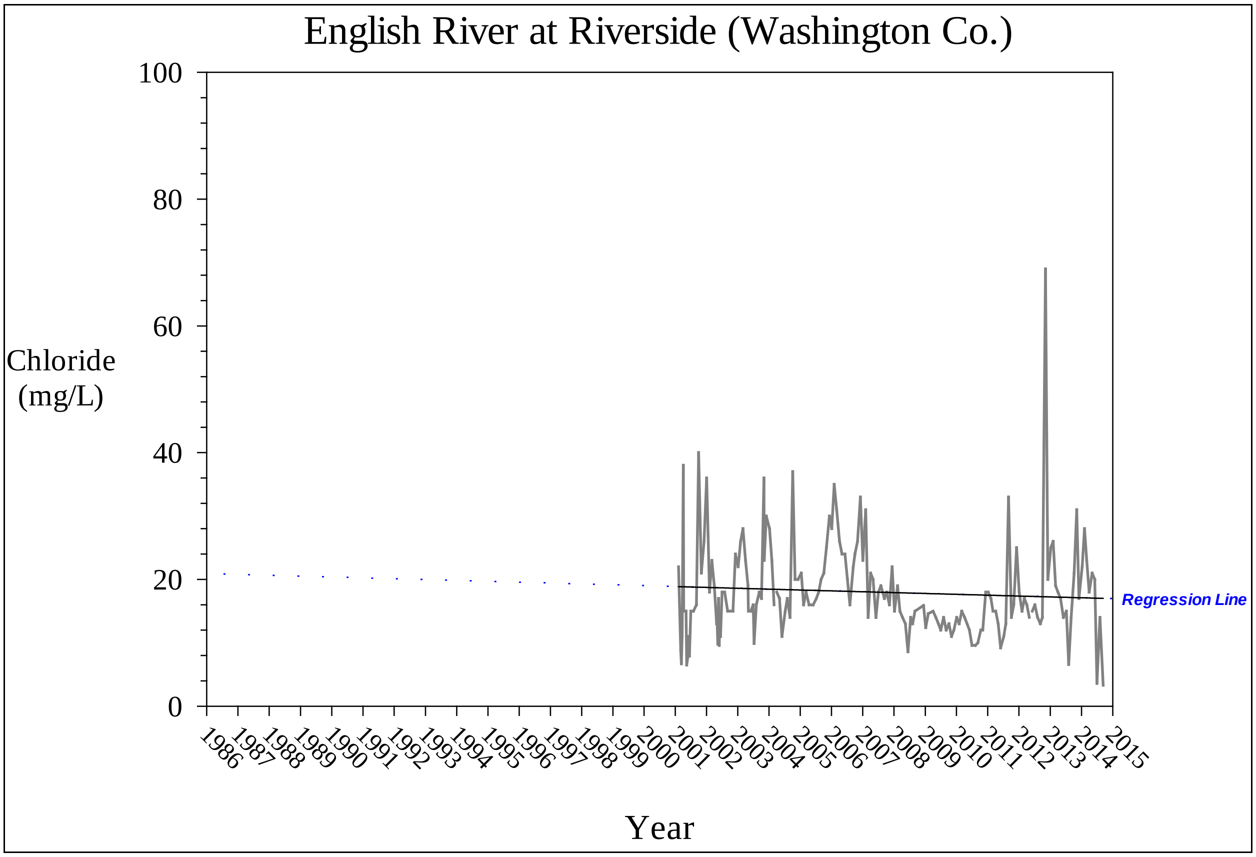
Figure XX. Historic Dissolved Oxygen (DO) Levels in the English River (1986 – 2015)



Chloride

Chloride has been measured in the English River since February of 2001 (Figure XX). Sources of chloride in the environment include road salts, human and animal waste, and some fertilizers. The standard for chloride in Iowa is based on sulfate and water hardness values, but using assumed background concentrations of these constituents, the acute toxicity level for chloride is 629 mg/L. The maximum level of chloride seen in the English River during the past thirteen years is 69 mg/L, well below the water quality standard. Levels are also significantly below the level of chloride that may create chronic, long-term impacts (389 mg/L). Trend analysis shows a statistically significant decline in chloride values in the English River during the period of record.

Figure XX. Historic Chloride Levels in the English River (1986 – 2015)



Sulfate

Sulfate is a naturally occurring compound in Iowa's waters, but high levels can cause taste and odor issues for drinking water and may be a concern for livestock. Monitoring of sulfate in the English River show a range from 4 parts per million to nearly 83 parts per million. The water quality standard for sulfate is based on water hardness and chloride levels, but the values seen in the English River are well below those of concern (EPA sets a secondary drinking water standard of 250 mg/L). Trend analyses show that sulfate levels are increasing, but are not statistically significant at this time (Figure XX).

Figure XX. Historic Sulfate Levels in the English River (2001 – 2015)