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# Drivers Of Macroinvertebrate Community Integrity Within Mixed Urban And Agricultural Dominated Mississippi Tributary Watersheds



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## Introduction

The "urban stream syndrome" refers to a multitude of impacts caused by urbanization including flashier hydrograph, elevated concentrations of nutrients and contaminants, altered channel morphology and stability, reduced biotic richness, with increased dominance of tolerant species, reduced base flow and increased suspended solids.<sup>1</sup> The drivers of these "symptoms" include impervious surfaces, piping in storm water drainages, habitat and forest loss, water supply and sewer leaking, and direct alterations to channel morphology and flow. The goal of this study was to assess the integrity of the macroinvertebrate community and determine the most significant drivers of such integrity at the catchment, riparian zone, and reach scales. Macroinvertebrates have been used to measure the overall health of the ecosystem and have been shown to be important in overall health in aquatic systems.<sup>2</sup> A higher species diversity of macroinvertebrates increase the health of the stream, a poor FBI for a stream can indicate that an impairment has occurred and further planning, management and restorative processes would be necessary.<sup>3</sup>

We used the Family Biotic Index (FBI) to assess the health of our sites. The family biotic index (FBI), a measure of integrity in relation to organic pollution tolerance was calculated. The FBI value is assigned based on the macroinvertebrate tolerance to pollution. The figure below illustrates FBI values and characterizes whether the aquatic system health is poor, fair, good or excellent.<sup>4</sup>

Family Biotic Index	Water Quality	Degree of Organic pollution
0.00-3.75	Excellent	Organic pollution unlikely
3.76-4.25	Very Good	Possible slight organic pollution
4.26-5.00	Good	Some organic pollution probable
5.01-5.75	Fair	Fairly substantial pollution likely
5.76-6.50	Fairly poor	Substantial pollution likely
6.51-7.25	Poor	Very substantial pollution likely
7.26-10.00	Very poor	Severe organic pollution likely

Note: low values of FBI indicate high water quality and high values of FBI indicate low quality

### Research Question:

What are the most significant drivers of macroinvertebrate integrity in urban and agricultural dominated watersheds?

## Methods

- The study area included eight mixed land use (urban & agricultural) watersheds in Rock Island County, IL and Scott County, IA, which were delineated using Arc-GIS.
- Forty-one sampling sites were identified to capture the maximum variation in hypothesized drivers of invertebrate diversity and quality.
- Sub-catchment basins above each sampling site were delineated and upstream landscape characteristics quantified in GIS including land cover and total impervious surface within a 5m buffer of streams.
- Water quality data included: total suspended solids (TSS) dissolved oxygen (DO), pH, phosphate, Nitrate, Ammonia, and Chloride (YSI Pro-Plus sonde, and Seal AQ 300 discrete auto analyzer). Geomorphic data included discharge, Sinuosity, entrenchment ratio, and substrate diversity/type.
- Sub-catchment basins above each sampling site were delineated and upstream landscape characteristics quantified in GIS including land cover and total impervious surface within a 5m buffer of streams.
- Macroinvertebrates were sampled using standard dip-netting techniques, with samples apportioned to different in-stream habitats weighted by habitat abundance.

## Results

A total of 68 macroinvertebrate families were identified. The integrity of the macroinvertebrate community differed across the watersheds and was highest in Crow Creek (Average FBI 4.1) and lowest in Rock Island (Average FBI = 8.7). Across all the watersheds, FBI was negatively correlated with dissolved oxygen levels ( $r^2 = 0.351$ ,  $F=16.18$ ,  $P<.000$ ), and positively correlated with total impervious surfaces within 5m of stream ( $r^2 = 0.213$ ,  $F=7.835$ ,  $P<.009$ ).

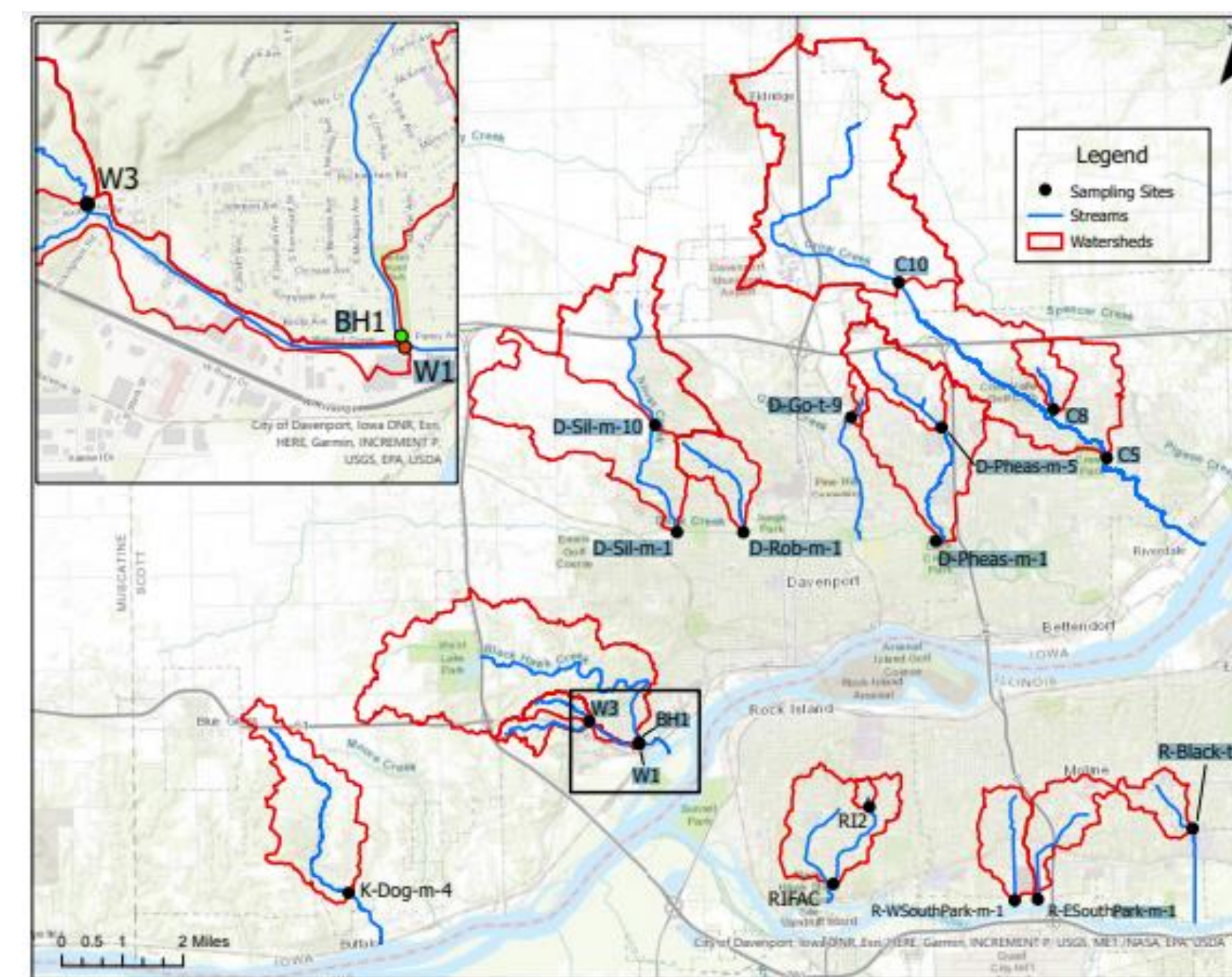


Figure 1. Map illustrating this studies watersheds, sites, and streams in mixed urban and agriculturally dominated areas.

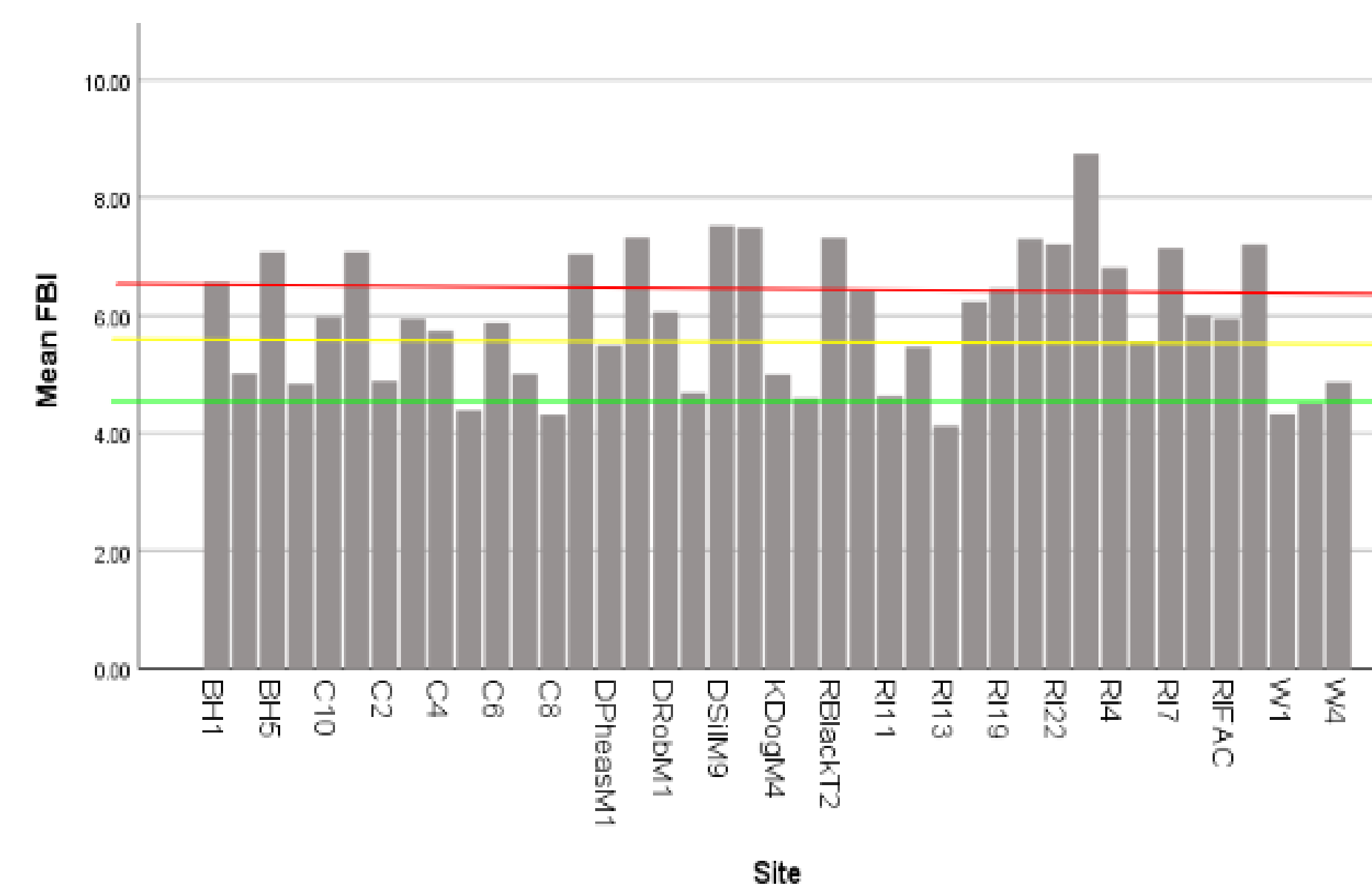


Figure 2. Graph representing mean FBI across all individual sites in this study. Green line (bottom line) represents good water quality, yellow (middle line) represents fair water quality, and red (top line) represents poor water quality.

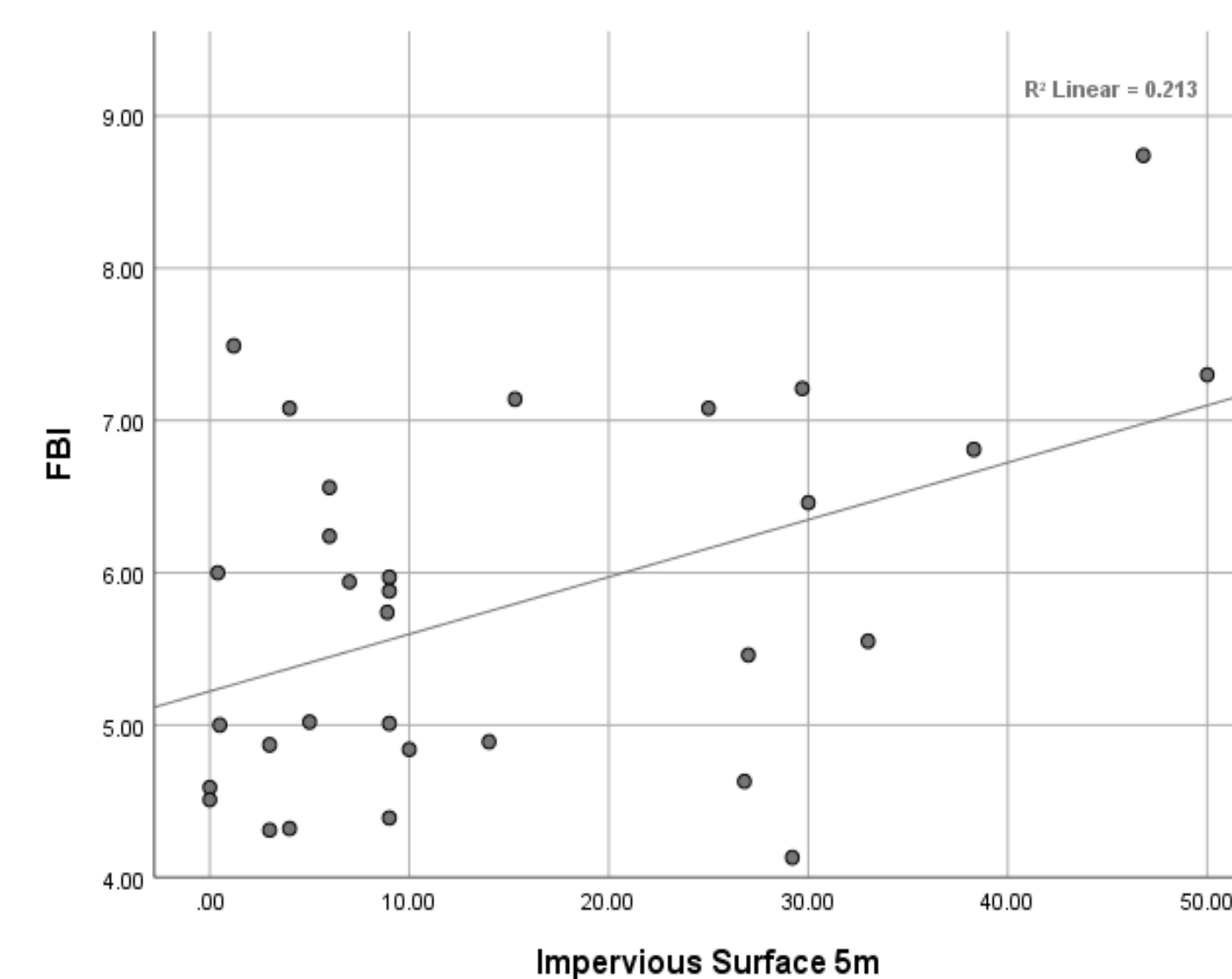


Figure 3. Graph showing a weak correlation between FBI values and Impervious surfaces within 5m of a stream. Sites with greater impervious surfaces within 5m of a stream tend to have a higher FBI value. High FBI values indicate low quality

## Results

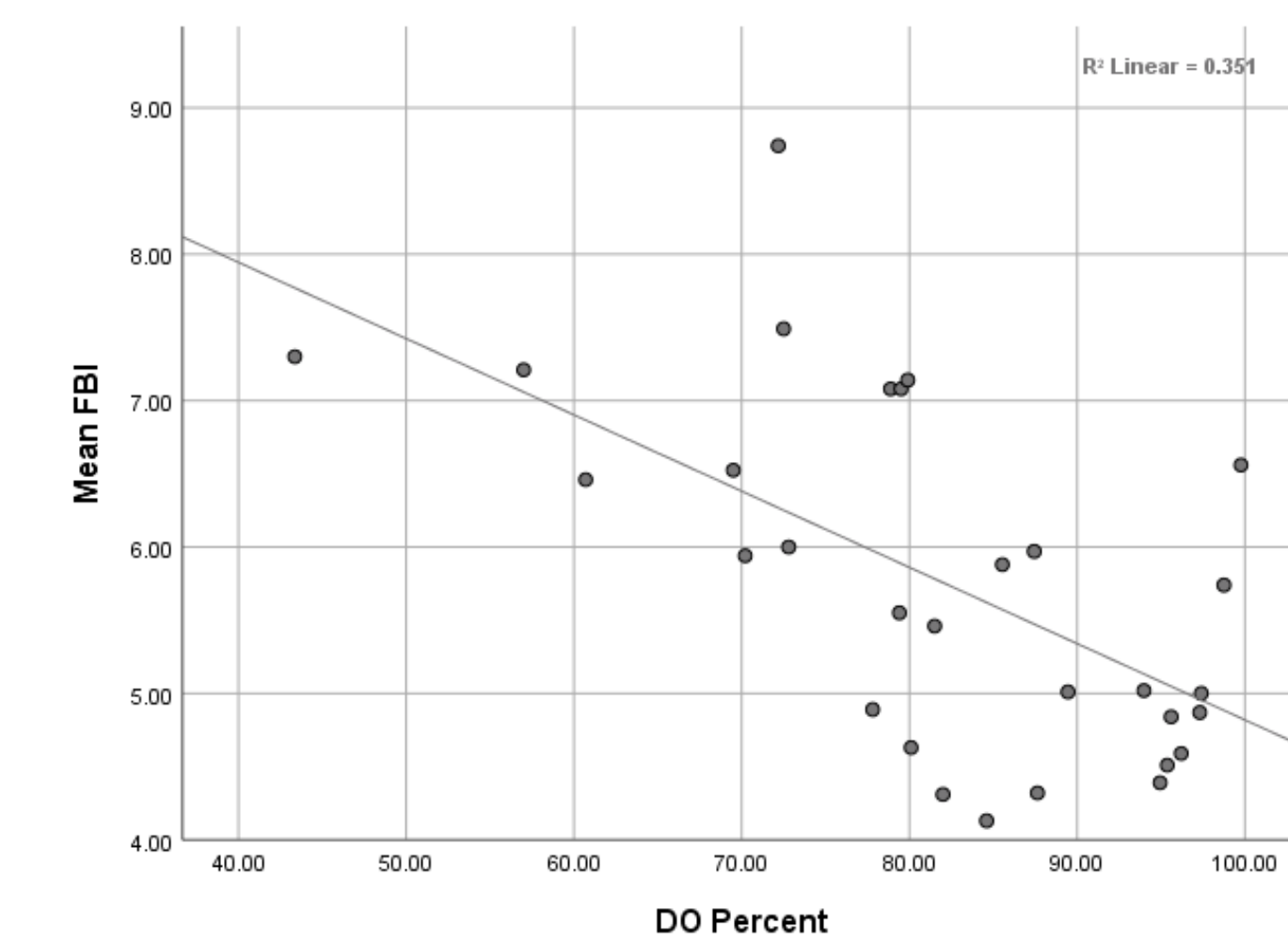


Figure 5. Graph showing strong correlation between mean FBI and DO percent across all sites. Sites with a low DO percent tend to have a high FBI value. High FBI indicates low quality.

- Found weak correlations between macroinvertebrate integrity and phosphorus, pool diversity, riparian grass cover, riparian forest cover, total flood prone area, frequency and quality of riffles, total inundated habitat, 5m impervious surfaces, discharge, total in channel habitat, and substrate embeddedness.

## Discussion

- Across the quad cities, macroinvertebrate community integrity ranged from very poor to very good, with most sampled sites in the fairly poor-fair range.
- Macroinvertebrate community integrity was most closely related to dissolved oxygen. Since low dissolved oxygen can be a proxy for other environmental problems such as sewage or agricultural nutrient pollution, this makes sense.
- Did not find correlations between macroinvertebrate integrity and Chloride, Nitrates, or Ammonia and only weak relationships with other predictive variables. It may that these variables are not significant drivers in these watersheds, but it may also be due to the low observed range in many of these variables in this data set. Our limited sample size of sites where fish were also assessed prevents us from looking at relationships between fish and macroinvertebrate assemblages.

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