Stormwater Compliance Case Study: Load Duration Analysis

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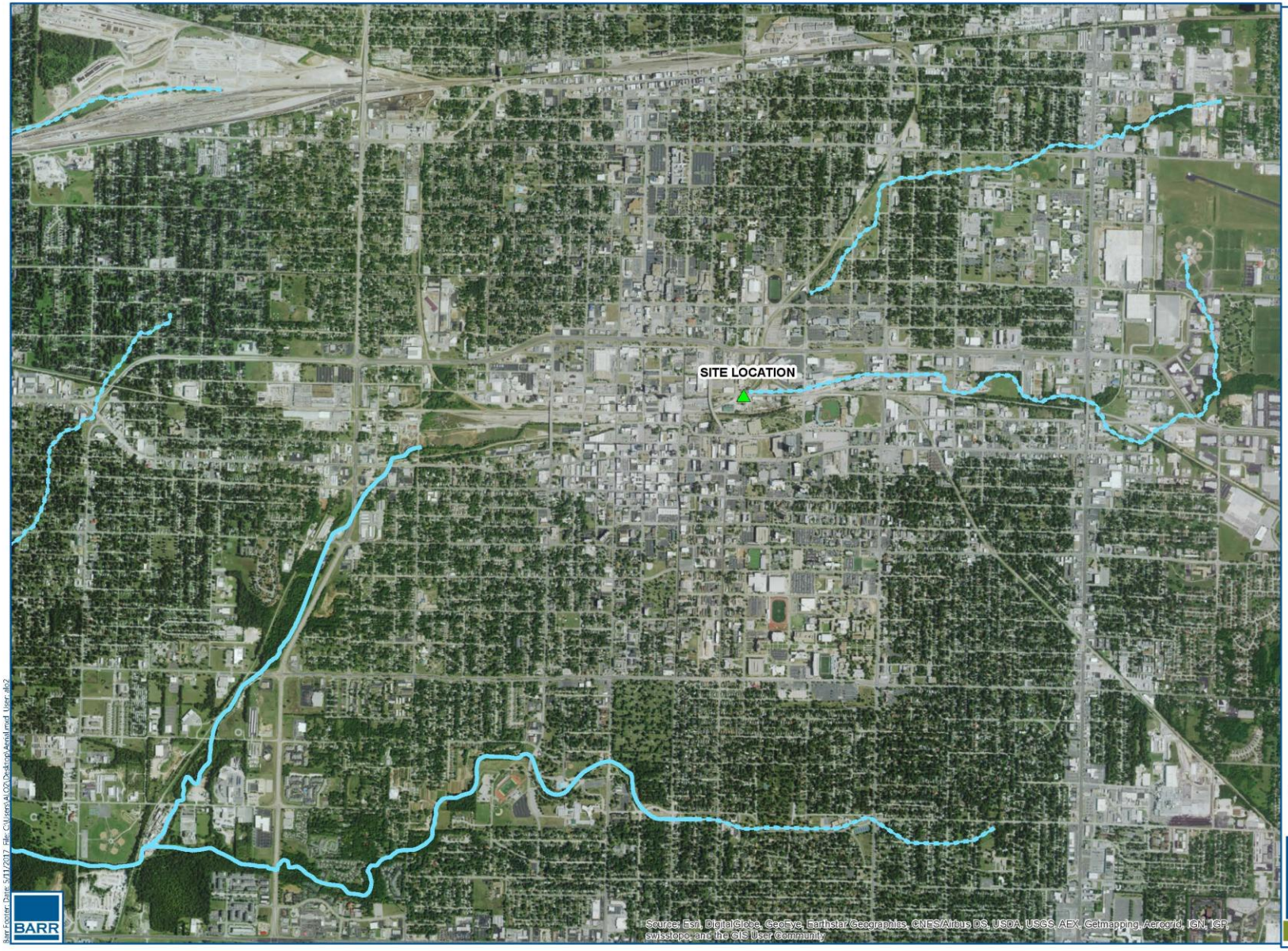

Legend

- Streams That May Cease Flow in Dry Periods
- Streams That Maintain Permanent Flow
- Standing Water
- Reaches of P Class Streams

0 0.25 0.5 0.75

Miles

STUDY AREA & MUDD FLOWLINES

FIGURE 1

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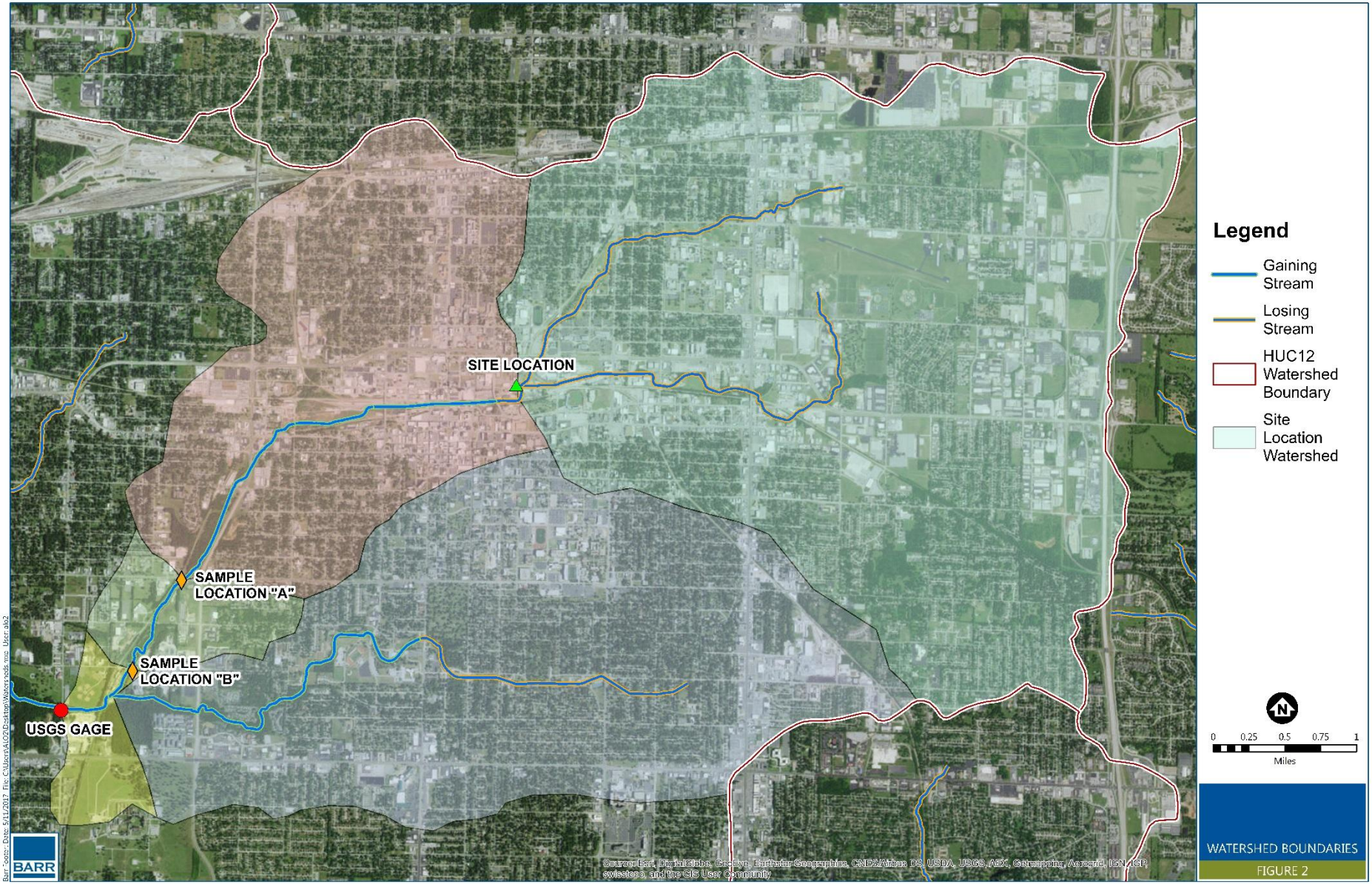

WATERSHED BOUNDARIES

FIGURE 2

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Outfall 001/002

Outfall 003 Discharge into Receiving Water Box Culvert

Storm Sewer System near Facility

Step 1 - Estimating Flow in Receiving Water, Drainage-Area Ratio (DAR) Method

- Assumes streamflow at *ungaged* location is proportional to flow at *gaged* location using ratio of their drainage areas
- $Q_u = \left[\frac{DA_u}{DA_g}\right] Q_g$

  Where $Q_u = flow\ at\ ungaged\ location, Q_g = flow\ at\ gaged\ location, DA_u = ungaged\ drainage\ area, DA_g = gaged\ drainage\ area$
- DAR method limited to sites with ratio between 0.4 to 1.5 (ratio of facility watershed to USGS gage watershed = 0.475)
- Technical Reference: USGS Scientific Investigations Report 2013-5090, prepared in cooperation with MDNR

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Step 2 - Estimating Load Capacity in Receiving Water Downstream

- Load duration curves allow water quality criteria to be plotted across variety of flow regimes, allowing for visualization of a loading target at all flow rates
- Load capacity curves developed by multiplying stream flow x numeric water quality criteria x conversion factor
- Instantaneous loadings plotted by multiplying stream flow on day of sampling x concentration of POC x conversion factor
- Background loading was accounted for using available water quality data from the watershed

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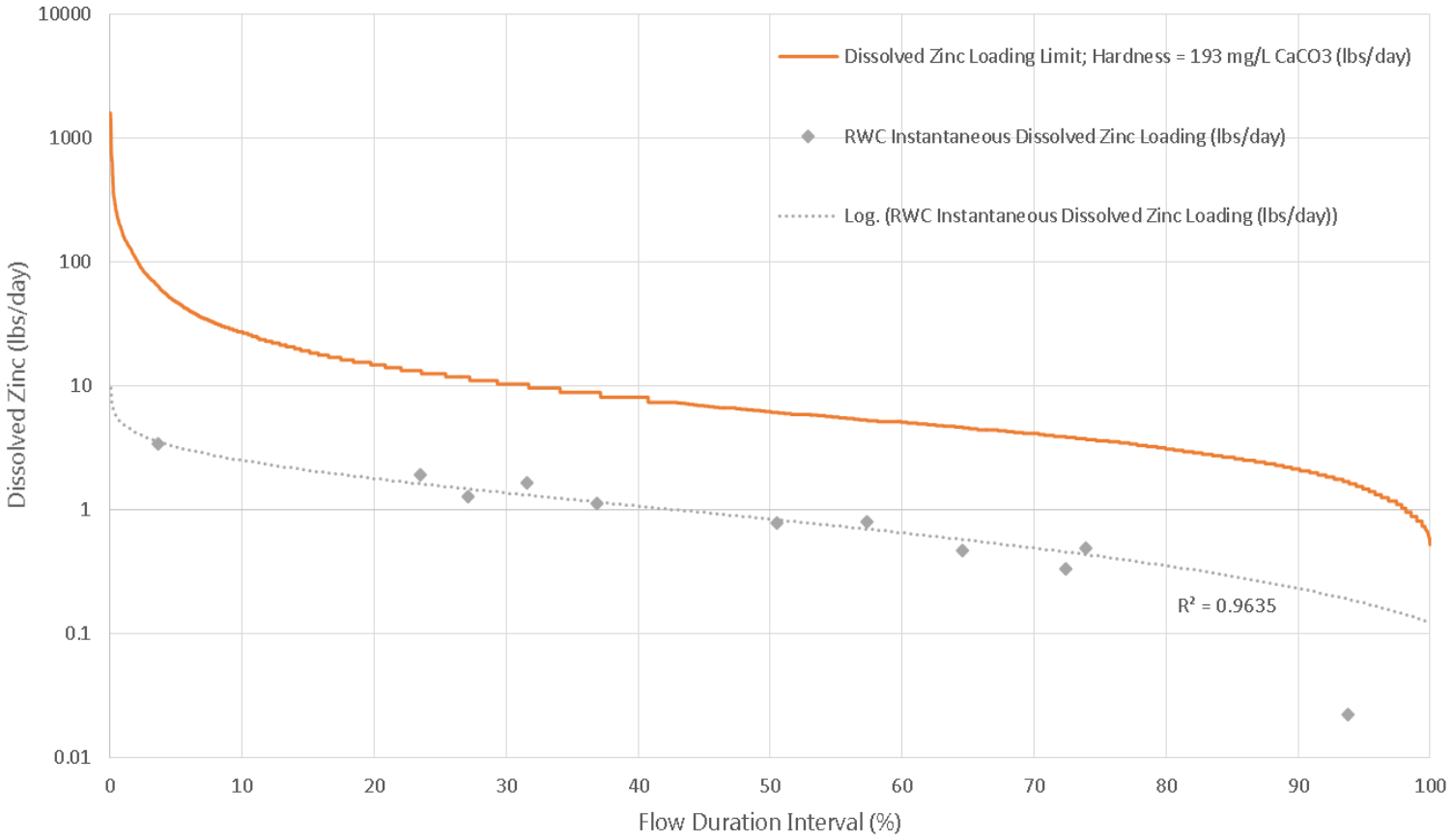
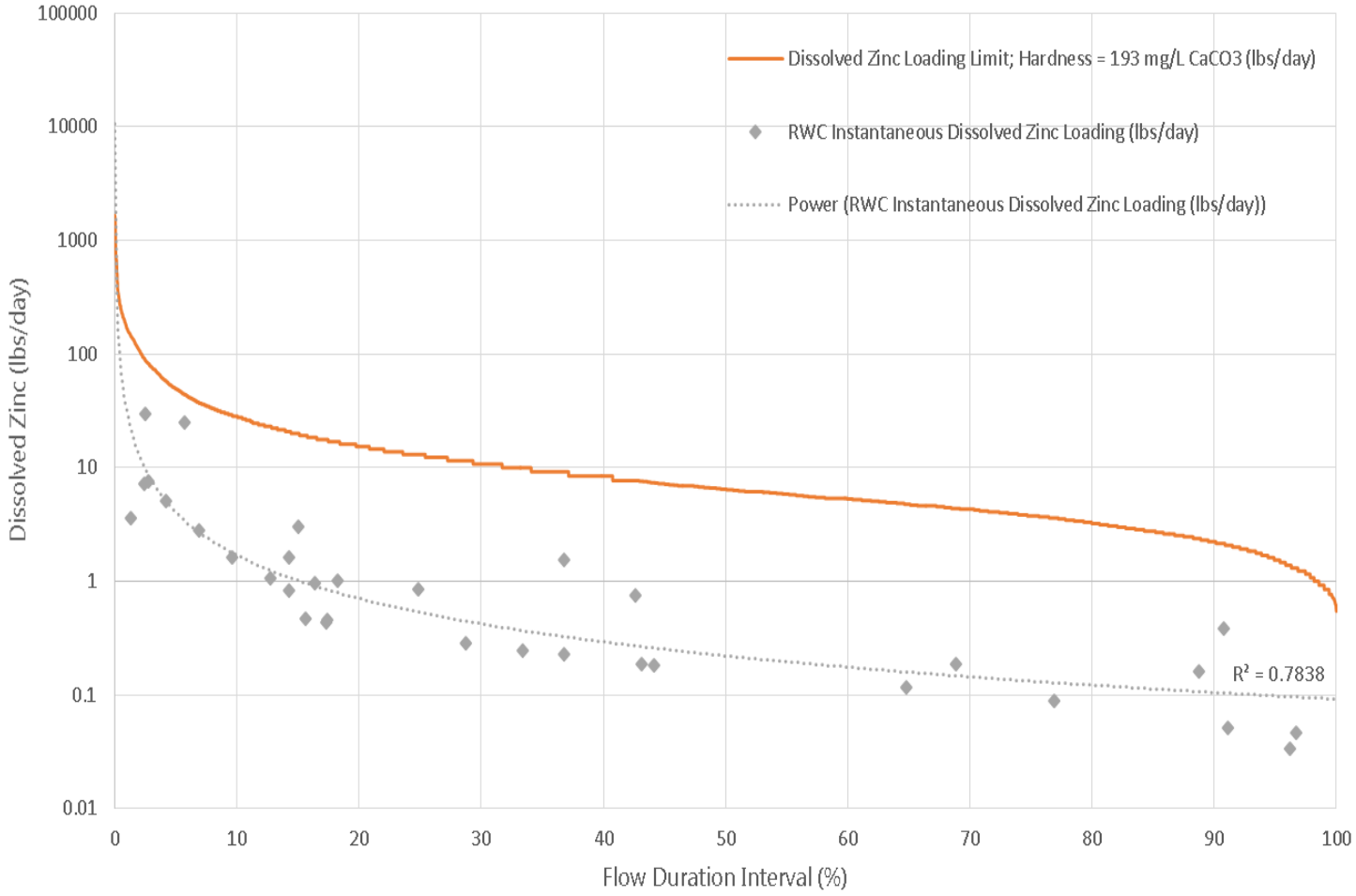
Receiving Water Load Duration Curve – Dissolved Zinc Sample Location A (2.9 miles downstream)



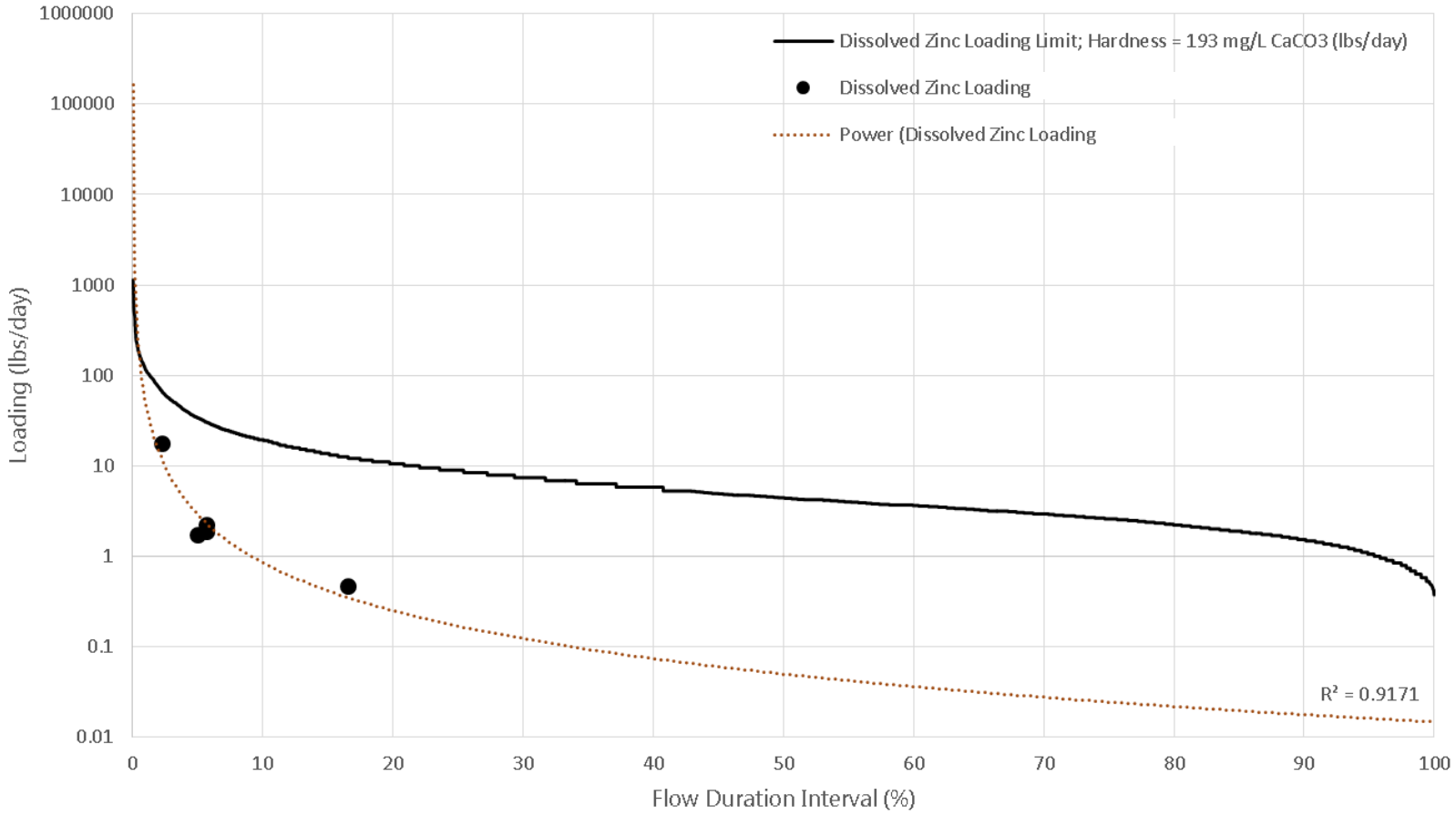
Receiving Water Load Duration Curve – Dissolved Zinc Sample Location B (3.7 miles downstream)



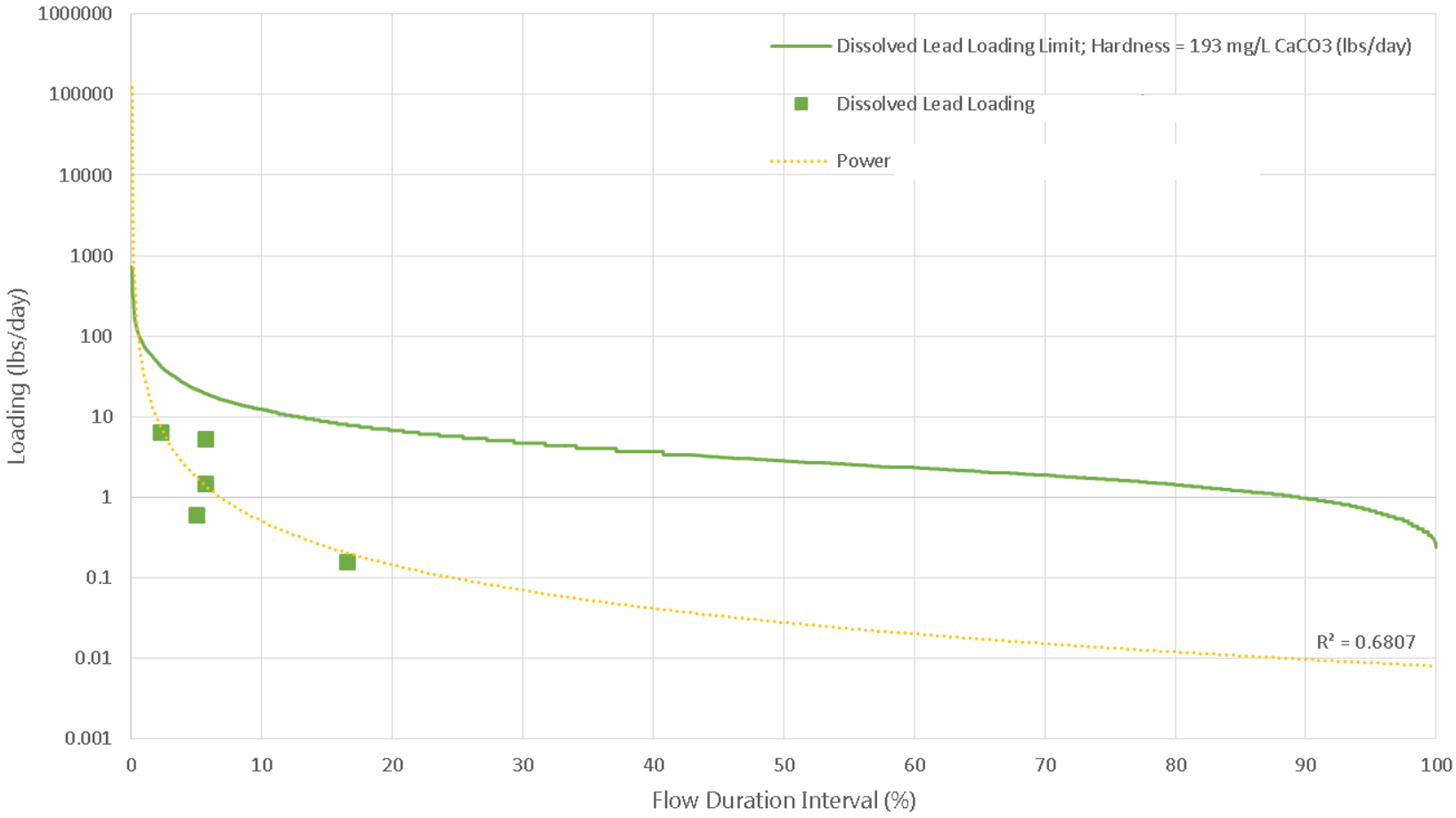
Step 3 - Estimating Loading at Facility Location

- Sample results from facility outfall used to estimate loading from site at different flow regimes
- Using precipitation data from nearby weather station and USDA-NRCS TR-55 method for estimating runoff volume, calculated conservative estimates of POC loads
- Background loading was accounted for using available water quality data from the watershed
- Assumptions:
  - Curve number of 98 (representing highly impervious surfaces)
  - POC concentrations remain constant throughout rainfall event
  - Loading capacity represents acute AQL WQC; assumed hardness = 193 mg/L $CaCO_3$

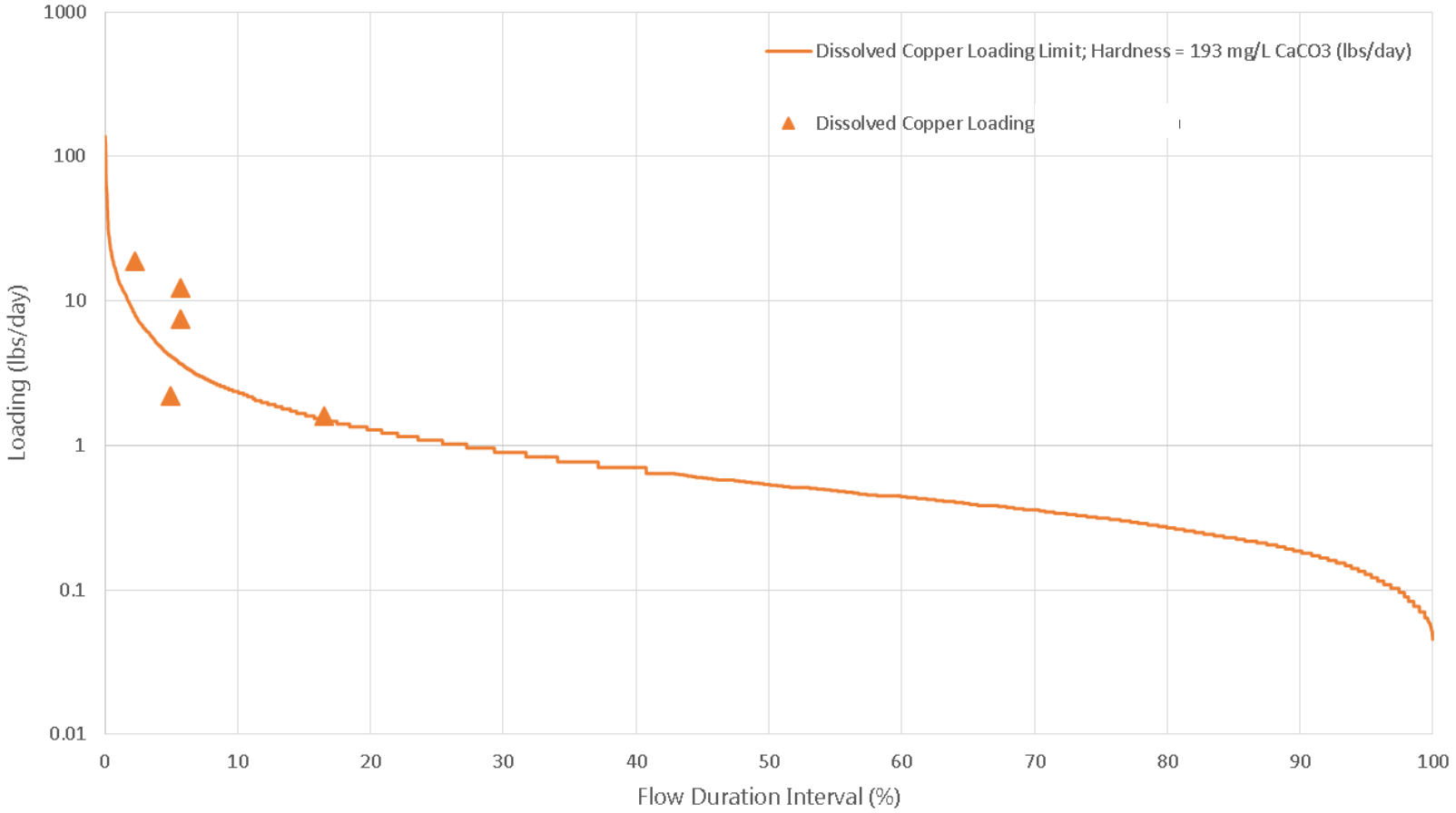
Receiving Water Load Duration Curves at Facility Location – Dissolved Zinc



Receiving Water Load Duration Curves at Facility Location – Dissolved Lead



Receiving Water Load Duration Curves at Facility Location – Dissolved Copper



Note: Trendline not shown due to poor statistical fit.

Conclusions

- Load duration analysis indicates that stormwater discharges from facility are not causing or contributing to exceedances of acute aquatic life criteria for all of POCs evaluated except copper
- Conservative estimates of copper load exceed the load capacity at certain design storm events. Further effort to quantify and mitigate actual copper loading from facility may be warranted
- Best Management Practices (BMPs) may be design to help meet stormwater benchmarks
- Understand your receiving water and facility watershed

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