Point Source and Non-Point Source Phosphorus Loading to Lake St. Clair from the Clinton River, Southeast Michigan, USA

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Blue Ribbon Commission, Audit Committee Scientific Question:

What are the relative magnitudes of point source and non-point source phosphorus inputs?

Relevant Theory → Mass Balance

Total P Load = Point Source (WWTPs) + Non-Point Source (all else)

Data Sources

- River fluvial discharge: USGS National Water Information System: http://nwis.waterdata.usgs.gov/usa/nwis/discharge
- River nutrient chemistry from the Lake St. Clair study of 2004 to 2005: http://www.lakestclairdata.net
- WWTP daily discharge: MI DEQ, Water Bureau: Hae-Jin Yoon, District Supervisor, Southeast Michigan District Office, personal communication 30 Jan 2008.

Time Periods for Calculations

2004: September to November

2005: April to October

Reference drainages designated “non-point source”:

- Belle River
- Black River
- Pine River

Drainage designated “point source PLUS non-point source”:

- Clinton River

Drainage Characteristics

- Runoff averaged 0.275 meters per year
- 72% of annual runoff occurred from December to March in Belle, Black, and Pine
- 57% of annual runoff occurred from December to March in Clinton

TP concentration (mg per Liter).

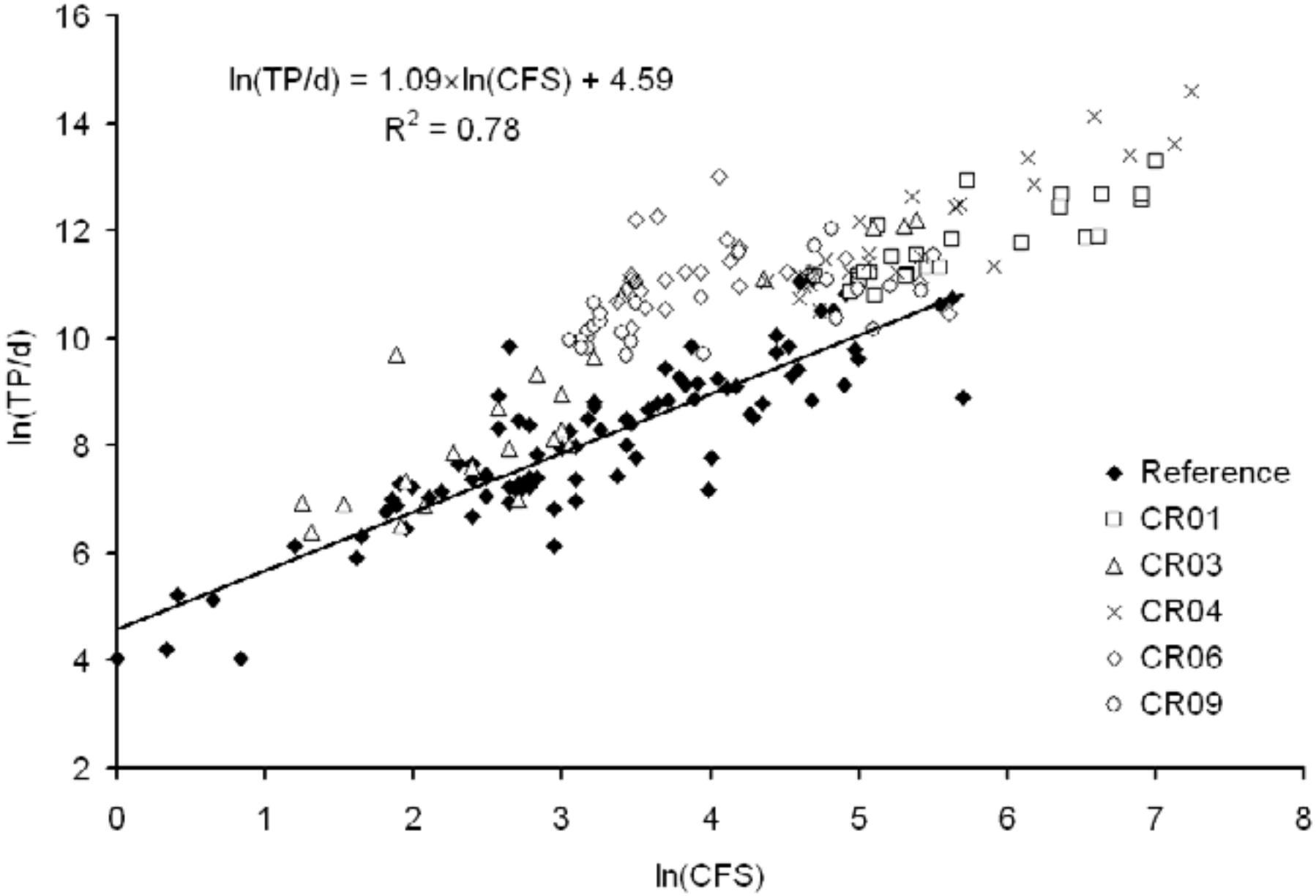
WWTP	Median	Minimum	Maximum
Armada	0.58	0.06	1.39
Mt. Clemens	0.74	0.03	2.40
New Baltimore	0.56	0.21	1.10
Pontiac	0.63	0.13	1.14
Richmond	0.69	0.03	1.86
Romeo	0.5	0.1	2.1
Warren	0.7	0.2	4.2

Daily discharge of TP (kg per day) by the Clinton River downstream of Mt. Clemens during 2004 (Sept to Nov) and 2005 (Apr to Oct).

	2004	2005
Clinton River	178.4	199.3
WWTPs (point)	85.8	95.8
% point source	48	48

Second Method:

Compare TP load of Clinton River with TP load of “non-point source” streams, accounting for differences in water volume.


ln(TP/d) = 1.09×ln(CFS) + 4.59
R2 = 0.78
ln(TP/d)
ln(CFS)
Reference
CR01
CR03
CR04
CR06
CR09

Assuming that the excess TP in the Clinton River comes from point sources, what fraction of the total must that be?

Answer: 58%

The two methods give answers ranging from 48% to 58% for the point source TP.

Conclusion

Total P Load (100%) = Point Source (48% to 58%) + Non-Point Source (42% to 52%)

Caveat

Water quality data are not available for the rivers from December to March, when runoff is the greatest.

It is possible, therefore, that non-point source TP is underestimated.

Management Implications

From April to October (growing season) → point sources and non-point sources in the Clinton River drainage seem equal.

Prudent management calls for aggressive abatement of the more cost effective, identifiable, and practicable of the two.

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