Summary of findings

What researchers found is that **there has been a large increase in average annual NO3-N concentrations since 1970 in spite of no significant change in N fertilizer use for the past 15 years.** The study also revealed that there have been **significant variations in NO3-N concentrations in the Raccoon River watershed over the past 70 years — and they have occurred alongside considerable variations in annual loading from year-to-year.**

For example, there have been three years with maximum concentrations above 18 mg L^{-1}. However, these concentration levels have occurred throughout the past 30 years and are not isolated to the recent record. **In fact, NO3-N loads from the watershed have shown a slight decrease in the past 10 years because of increased crop yields and increased removal of N in the grain.**

That means that **variations in annual NO3-N loading are probably related to annual precipitation,** since leaching into subsurface drains is the primary path that NO3-N takes from the field into streams and rivers.

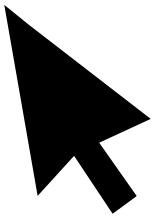
Another interesting piece of the puzzle seems to be the movement into a period of extremely variable rainfall — less frequency, yet higher intensity.

But more than anything else revealed by the research, **the increased average annual NO3-N concentration since the 1970's seems likely related to decreased planting of small grains, cover crops or hay crops, since there is a correlation between the land area used for these crops and the average annual NO3-N concentration.**

March rains recharge the groundwater supply — anything that falls after that is usually flushing the system. **That's why high levels of NO3-N occur consistently from April to June each year. Small grains, cover crops or hay crops are at their peak water use up until May, during spring rains, providing 'water tension.'** Row crops simply cannot use as much water at that time of year — they provide no water tension. **The result is that rainfall is more likely to drain off from a row crop landscape, taking N along with it.**

When viewed from that perspective, **NO3-N loading becomes more of a water management issue than a nutrient management issue. The implications of the research are that we'll probably have to look at solutions that include land use change in order to find a solution.** Perhaps it's possible to target land use practices (reintroduce small grains, cover crops or hay) in 'hot spots' to change the water balance. It definitely points to the need to experiment with new systems.

But at the end, the key issue is this: making changes in the watershed will not be easy — if we decide to do so, how are we going to manage the basin to achieve our goals?



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LEARNING FROM THE DATA | RACCOON RIVER

Flow and Nitrate-N Loading

Annual Average	1997	1998	1999	2000	2001
Flow (cfs)	19,000	36,000	31,000	4,000	19,000
Nitrate-N load (Metric Ton)	12,000	29,000	32,000	1,000	14,000
Nitrate-N concentration (ppm)	13	27	31	1	14

Interpretation: Total nitrate-N loads leaving the watershed are affected by precipitation and