**Jewett Brook Watershed Tile Drainage Project**

**Associations with land use/ag management**

Land use variables were taken from the report *Characterization of Tile Drainage Systems in the Jewett Brook Watershed*, primarily from Tables 1 and 2. The following independent variables were evaluated:

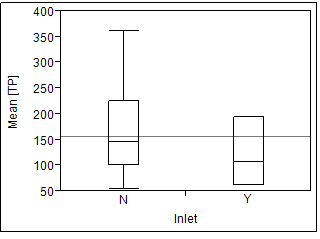
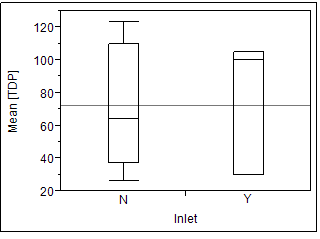
* Surface inlet: Y or N
* 2017 crop: soybeans (SB), corn silage (C), hay (H), and alfalfa (ALF) and corn (C) vs. other (O)
* 2017 manure: Y or N (manure application data not detailed enough to use rate or method)
* 2017 cover crop: Y or N (corn cropland only)
* Soil: clay (Cl) or loam (Lo) based on majority of field soil
* Size: field area (ha), assuming that field area ~= area drained by tile outlet

Dependent variables evaluated were:

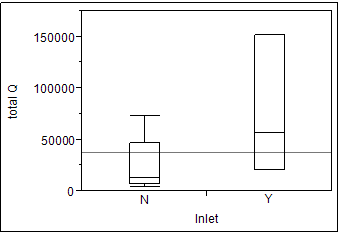
* [TP]: mean TP concentration (g/L), anti-log of logmean of monthly concentrations
* [TDP]: mean TDP concentration (g/L), anti-log of logmean of monthly concentrations
* Q: total discharge (sum of monthly discharge) (m3)
* TPx: total TP export over monitoring period (kg)
* TDPx: total TDP export over monitoring period (kg)
* Areal TPx: total TP export/field area (kg/ha)
* Areal TDPx: total TDP export/field area (kg/ha)
* %TDP: percentage of TPx as TDPx, based on total annual TP and TDP export

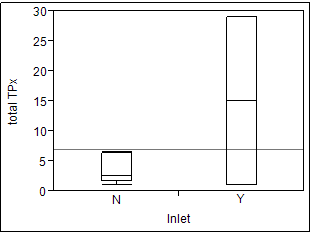
**Presence of surface inlet(s)**

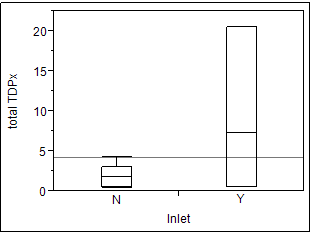
Mean TP and TDP concentrations were not significantly associated with the presence of surface inlet(s), *P*< 0.10. There appeared to be a slight tendency for higher P concentrations in tile drainage from fields without surface inlet(s).



Total tile discharge was significantly higher from fields with surface inlet(s), *P*=0.067.



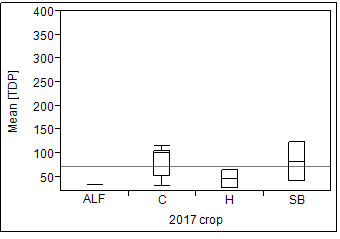
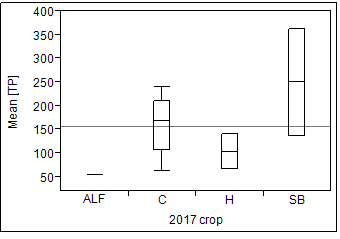
Driven by the flow differences, both TPx and TDPx were significantly higher from fields with surface inlet(s), *P*=0.053 and *P*=0.089, respectively.



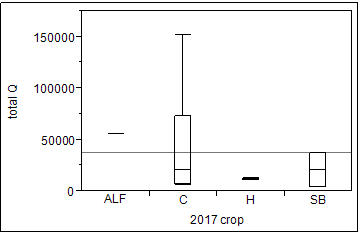
A similar pattern was shown for areal TPx and TDPx, although the difference was nonsignificant for TPx. There was no significant difference in mean %TDP between fields with and without surface inlets.

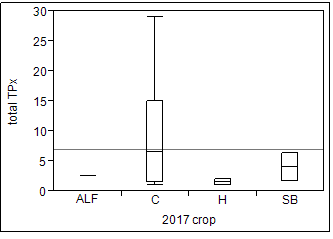
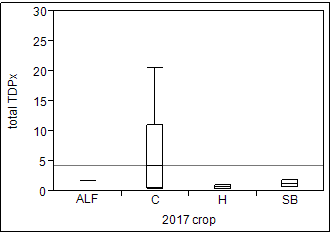
**2017 crop**

No significant associations were observed between specific 2017 crop and P concentration, discharge, or P load in tile flow. This is not surprising, as the number of fields in hay (n=2), soybeans (n=2), and alfalfa (n=1) was too small for reliable statistical inference. Mean P concentrations in tile discharge tended to be ordered: SB>C>H>ALF.



Annual tile discharge tended to be higher in fields in corn silage than those in other crops, although the differences were nonsignificant. This relationship was probably influenced by the fact that corn tended to be grown on the larger fields.

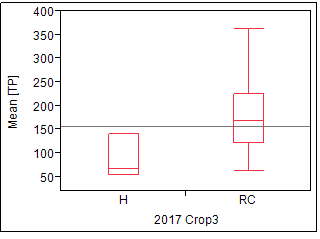
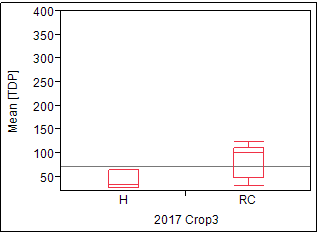


This difference in tile flow drove a similar pattern for TPx and TDPx, although differences were nonsignificant.

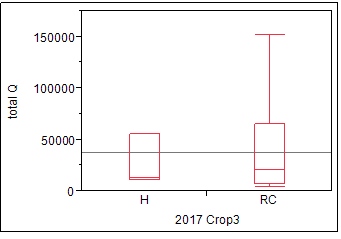
Differences among crop types with respect to %TDP were also nonsignificant, but %TDP was considerably more variable among fields in corn.

When crop was recoded to Corn vs. Other, differences were again nonsignificant. There was a slight tendency for discharge and P export to be higher and more variable from fields in corn, but this was likely due to the large difference in field size for corn (mean = 16.2 ha) vs. fields in other crops (mean = 8.2 ha).

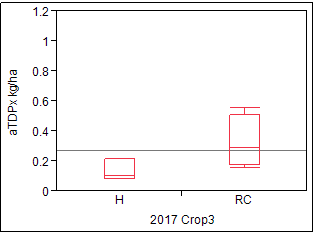
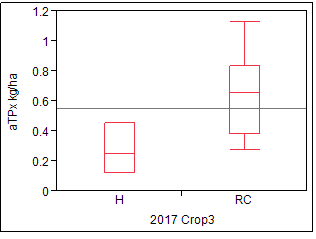
Crop data were recoded a third way: Row Crop (RC): corn and soybeans and Hay (H): hay and alfalfa. In this case, the groups were not confounded by field size – there was no significant difference (*P* = 0.64) between RC and H fields with respect to size. Mean TP and TDP concentrations tended to be higher from RC fields, although the difference was significant only for TDP (*P* = 0.08).



There was no significant difference between RC and H for annual tile discharge, although discharge tended to be somewhat higher and more variable from RC land.



Although differences in annual total TP and TDP loads between H and RC crop groups were not statistically significant, differences with respect to areal P loads were significant.

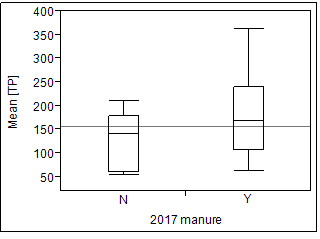
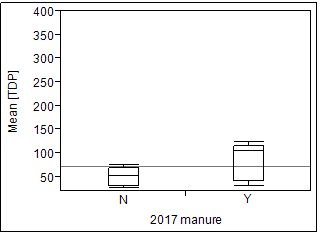


Both TP and TDP areal loads were significantly higher from row crop land compared to grassland.

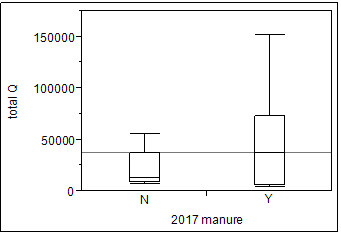
No significant difference in %TDP between RC and H crop types were observed (*P* = 0.89).

**2017 manure**

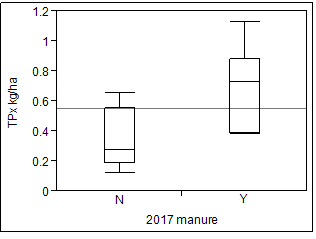
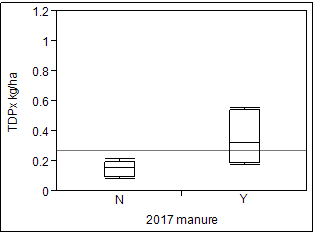
No significant associations were observed between 2017 manure application and P concentration, although there was a tendency for both mean TP and TDP concentrations to be somewhat higher from fields that had received some manure in 2017, compared to fields that were not manured.



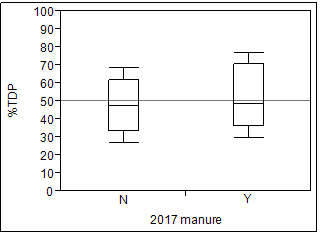
There was a nonsignificant tendecy for annual tile discharge to be higher from fields that received manure in 2017; this pattern drove a similar tendency for P export to be higher from fields that received manure.



However, because it seems unlikely that manure application alone would lead to increased tile discharge on an annual basis, the higher tile flow is more likely due to the fact that manure application favored larger fields, and fields in corn; both of these characteristics tended to show higher tile flow than did smaller fields in other crops. The higher tile flows also drove significantly higher P export (both absolute and areal) from manured fields; but this result must be viewed with some skepticism because of the confounding effects of field size and crop.



There was no significant difference in %TDP between fields that did and did not receive manure in 2017.



**Cover crop on corn**

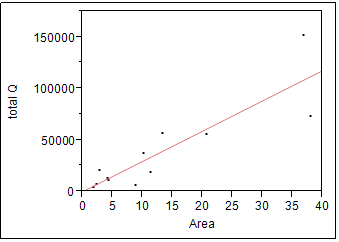
Because cover crop is applied only to corn silage in this case, only the six fields in corn were included in this analysis. The presence of a cover crop did not appear to have a significant effect on P concentrations or loads from the monitored fields. There was a slight tendency for cover cropped corn fields to exhibit higher and more variable TP and TDP concentrations and loads, but this was confounded by the observed tendency for cover crops to be applied on the larger corn fields. Also, the inclusion of only two corn fields without cover crops did not support rigorous statistical inference.

**Soils**

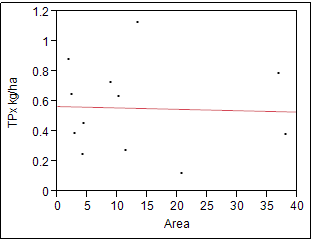
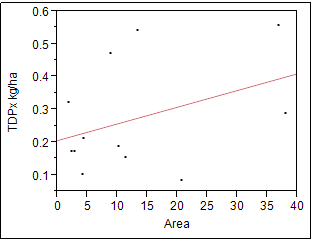
There were no significant (or even suggestive) differences in P concentration, tile discharge, or P export from fields with predominantly clay soils compared to fields with a majority of loam soils.

**Field size**

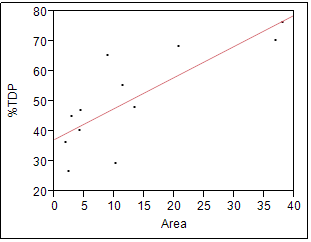
Mean P concentration in tile discharge did not vary significantly with field size. However, annual tile discharge did appear to be partially a function of field size (P < 0.001, r2=0.77):



Because of this strong relationship between field size and tile discharge, there was also a strong positive association between field size and annual TP and TDP export. However, this relationship was not evident when P export was expressed on an areal basis:



There appeared to be a positive association between field size and %TDP in tile discharge:



The reason for such a relationship is unclear, but may be related to longer travel time in tile lines in larger fields offering greater opportunities for tile flow to pick up soluble P.

Finally, it is worth noting that the relationship between field size and annual tile discharge is strong but not perfect; size explains only 77% of the variability in annual tile discharge. This suggests two important things. First, the uncertainty of the association may reflect differences between field boundaries and tile system drainage area, i.e., the field area may not exactly correspond to the drainage area. This uncertainty may add additional uncertainty to subsequent P loading estimates. Second, there are likely other factors in addition to size that influence tile system discharge, e.g., the magnitude of preferential (macropore) flow, actual soil porosity, etc.