LONG-TERM TREATMENT PERFORMANCE OF CONSTRUCTED WETLANDS BUILT FOR EVERGLADES RESTORATION

Michael J. Chimney

Applied Sciences Bureau, South Florida Water Management District, West Palm Beach, FL

1. INTRODUCTION & OBJECTIVE

The Florida Everglades is a vast oligotrophic wetland that dominates the landscape of south Florida. Portions of the Everglades have undergone eutrophication due to inputs of nutrient-rich runoff coming primarily from the Everglades Agricultural Area (EAA) (**Fig. 1**). The Everglades Stormwater Treatment Areas (STAs) are a complex of large constructed treatment wetlands (23,085 ha [57,045 ac] surface area) operated by the South Florida Water Management District (District) that are integral components of State and Federal efforts to reduce these nutrient inflows. The objective of this presentation is to evaluate the treatment performance of the STAs for phosphorus (P), nitrogen (N) and other water quality constituents that have been monitored over the STA's 23-year operational period of record (POR).

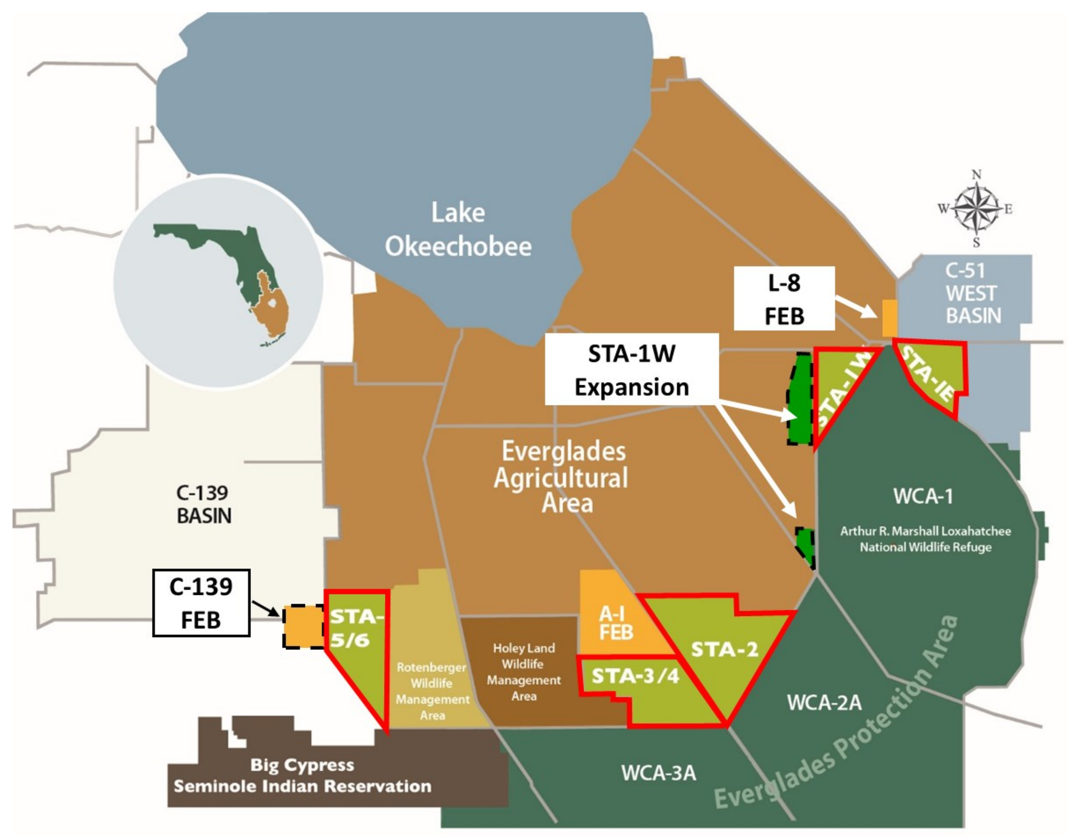

Figure 1. Location of the Everglades STAs in relation to major landscape features in south Florida.

2. METHODS

Constituent mass-balance budgets were computed by STA and water year (WY = May 1 to April 30). Inflow and outflow loads for each constituent then were aggregated across STAs within water years to generate budgets for all STAs combined, i.e., the "STA complex". Cumulative double-mass curves (cumulative inflow load vs. cumulative load retained expressed on a unit area basis) were generated from the STA complex budgets.

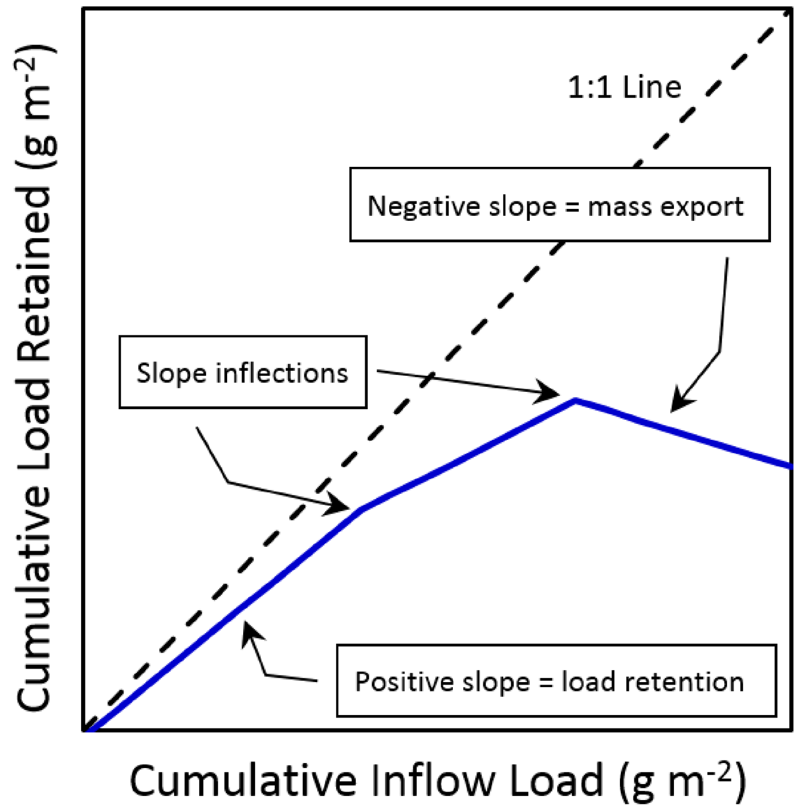

Figure 2. A hypothetical cumulative double-mass curve. A positive slope indicates load retention; the steeper the slope, the greater the treatment efficiency. A negative slope indicates mass export. An inflection in the curve indicates a change in treatment efficiency. The curve will fall along a 1:1 line with 100% load retention.

3. RESULTS

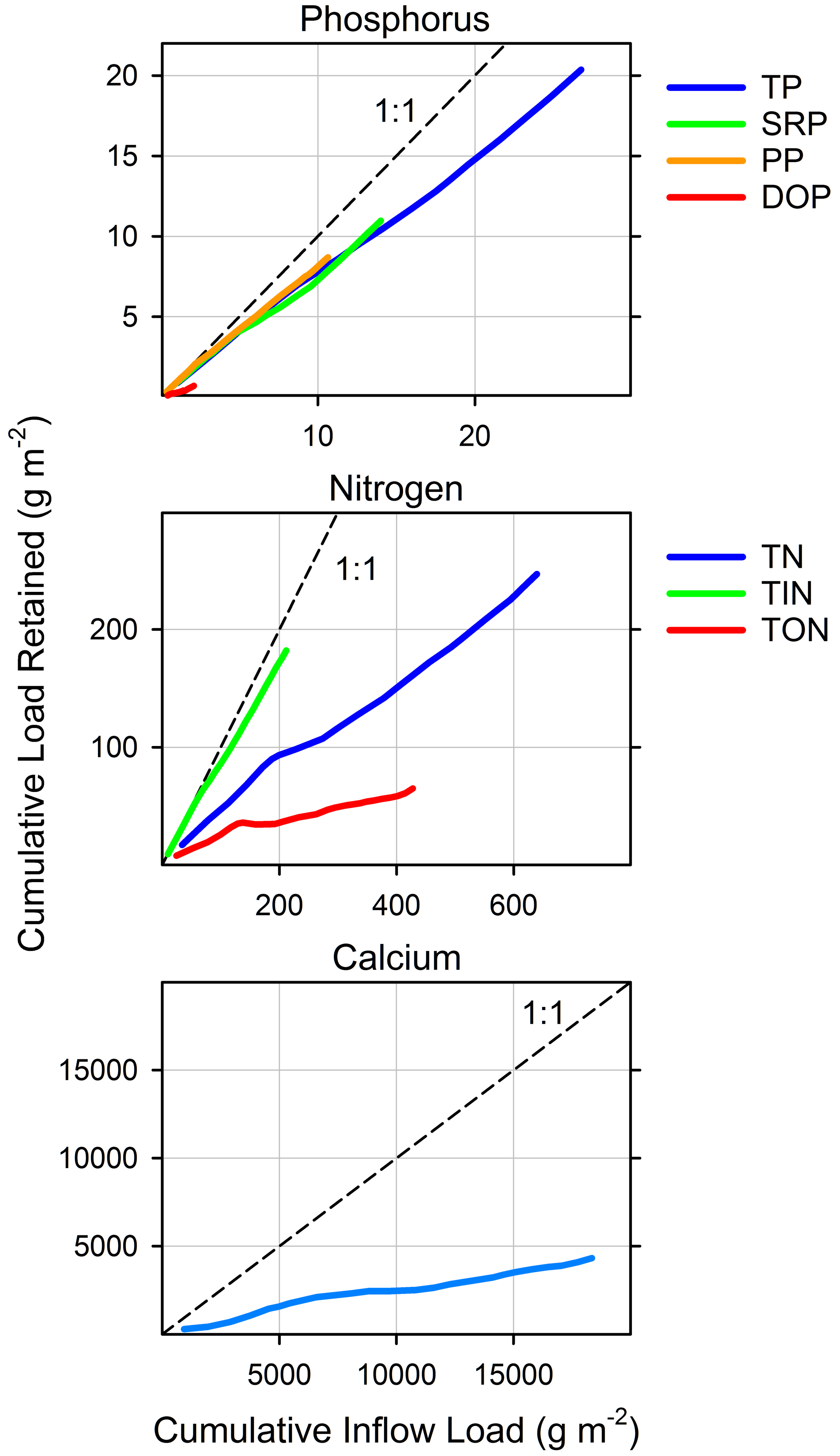

Figure 3. Cumulative double-mass curves for phosphorus & nitrogen fractions and calcium over the POR in the STA complex. Dashed lines are the 1:1 lines. Note the marked differences in treatment efficiency among the N fractions compared to the similarity in treatment efficiency for the P fractions.

3. RESULTS (cont.)

Table 1. Summary of constituent load retention over the POR by the STA Complex.

	Load Retention		Load Retention
Calcium (CA)	21%	P, dissolved organic (DOP)	38%
Chloride (CL)	2%	P, particulate (PP)	80%
N, total (TN)	38%	P, soluble reactive (SRP)	80%
N, total inorganic (TIN)	85%	Potassium (K)	-2%
N, total organic (TON)	13%	Sulfate (SO4)	8%
P, total (TP)	77%	Total Suspended Solids (TSS)	68%

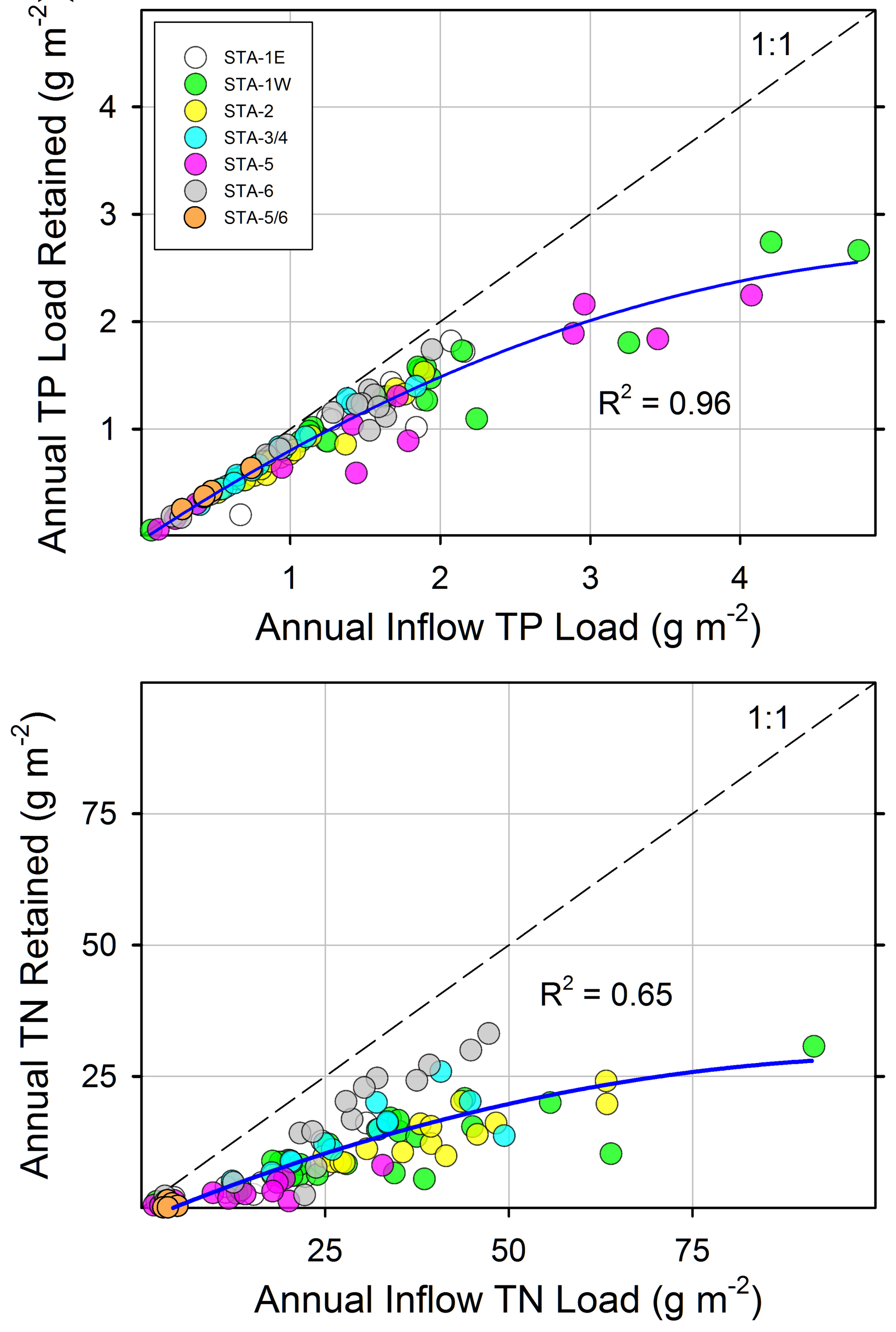

Figure 4. Relationship of annual TP and TN inflow loads with annual TP and TN loads retained in individual STAs. Dashed lines are the 1:1 lines. Solid blue lines are quadratic regression fits to the data. The TP regression suggests that retention began to approach an asymptote at TP inflow loadings > 2 g m^{-2}. The TN regression provides less evidence for an asymptote in TN retention .

3. RESULTS (cont.)

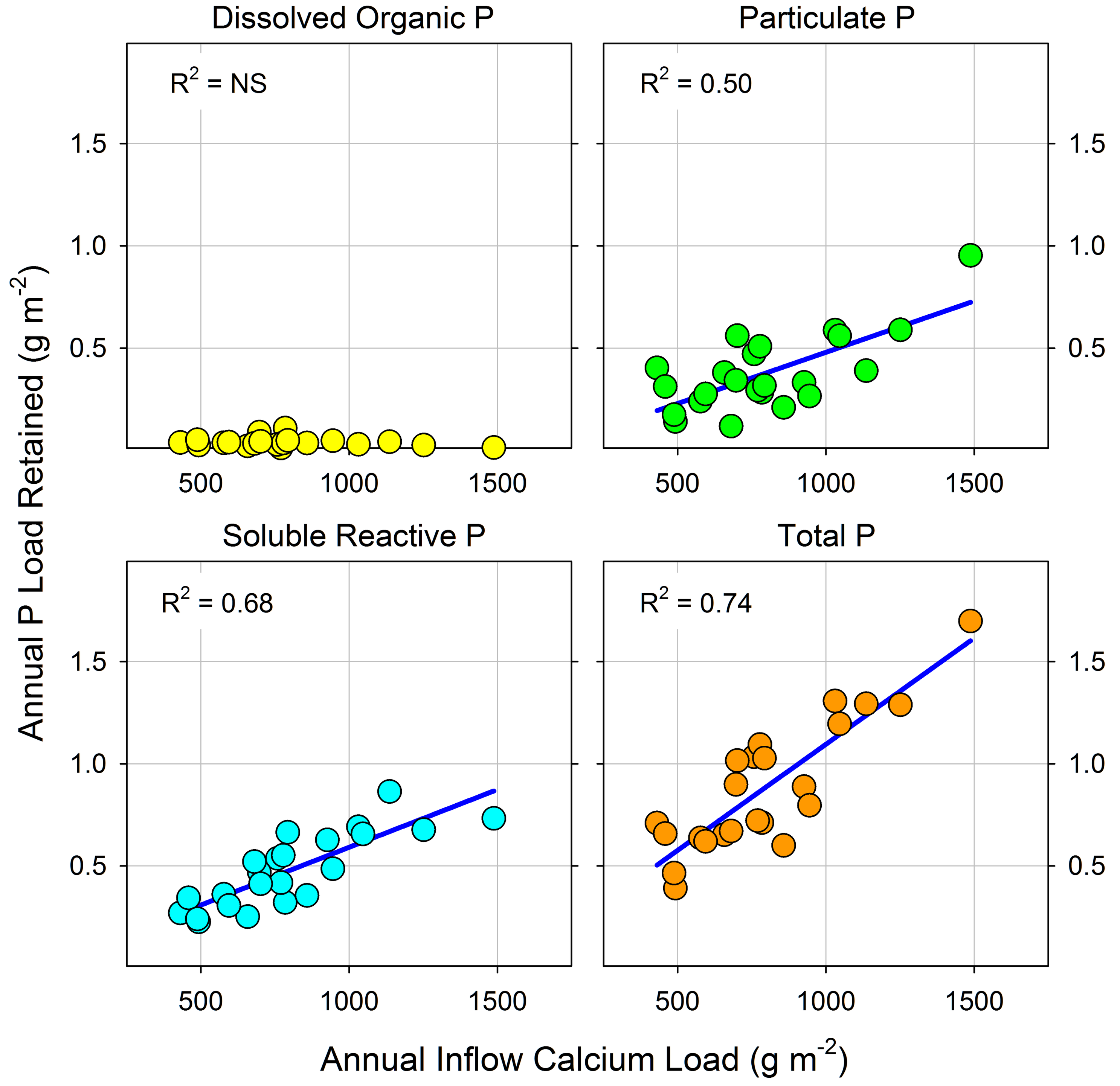

Figure 5. Relationship of annual calcium inflow load with annual P loads retained by the STA complex. Solid lines are linear regressions through the data.

4. SUMMARY

- The STA complex was relatively efficient at retaining TP, particles and inorganic P & N over the POR, but not so for TN and organic P and N (**Table 1**). The STA complex retained 81 to 86% of the annual inflow TP load in recent years (WY2012 to WY2017).
- There is no indication from the cumulative double-mass curves that the STA complex is losing its ability to act as a sink for P and N (**Fig 3**).
- Annual data for individual STAs suggested that TP retention approached an asymptote at inflow TP loads > 2 g m^{-2}. There is less evidence for a TN asymptote (**Fig 4**).
- Coprecipitation of P with CA from the water column has been proposed as an important P removal mechanism in the STAs. There were moderate linear relationships between annual inflow CA load to the STA complex and the annual load retained for PP, SRP and TP (**Fig. 5**).

Michael J. Chimney, Ph.D.
mchimney@sfwmd.gov
561.682.6523

sfwmd.gov