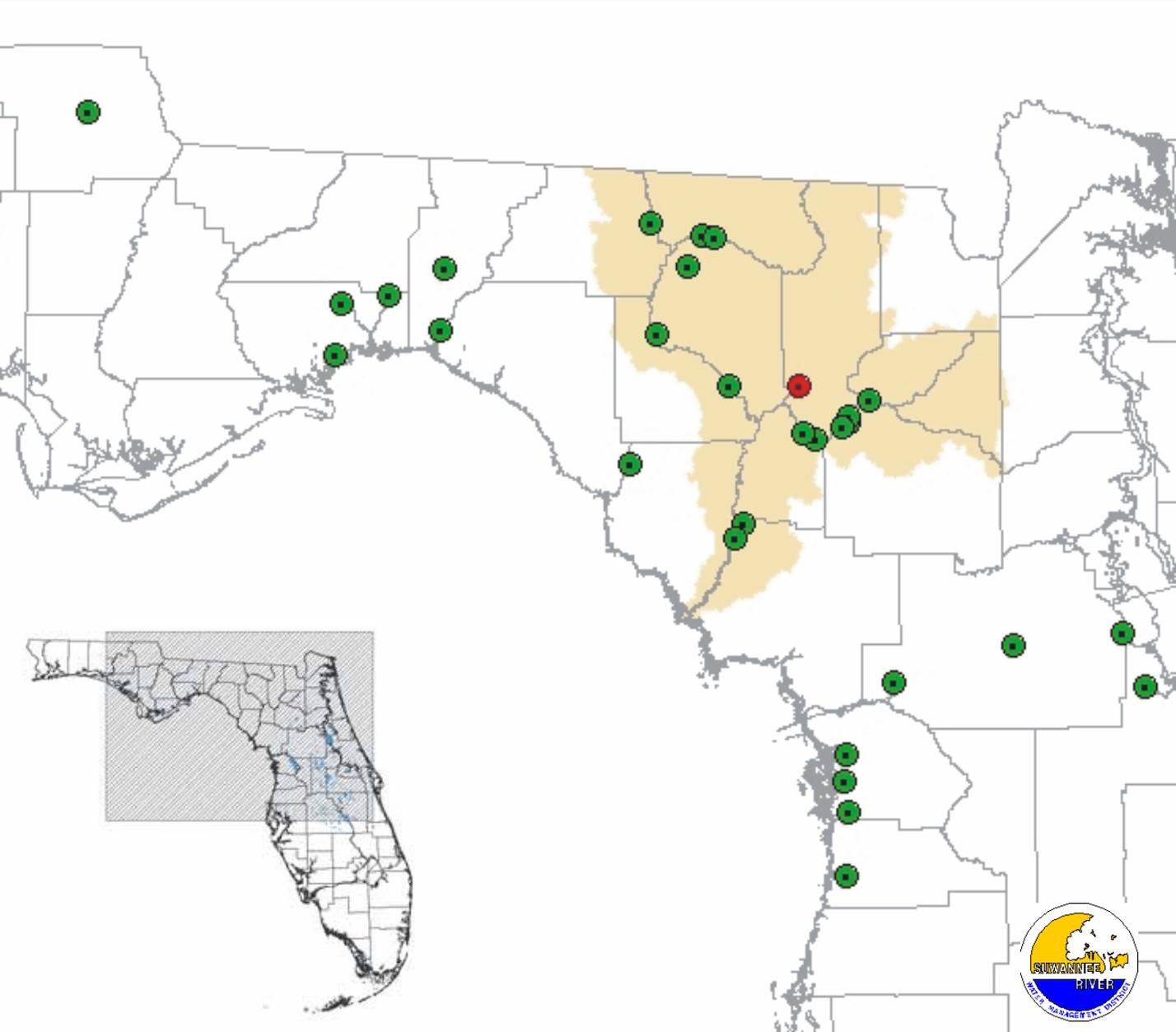


Identifying Water-Quality Domains near Ichetucknee Springs, Columbia County, Florida

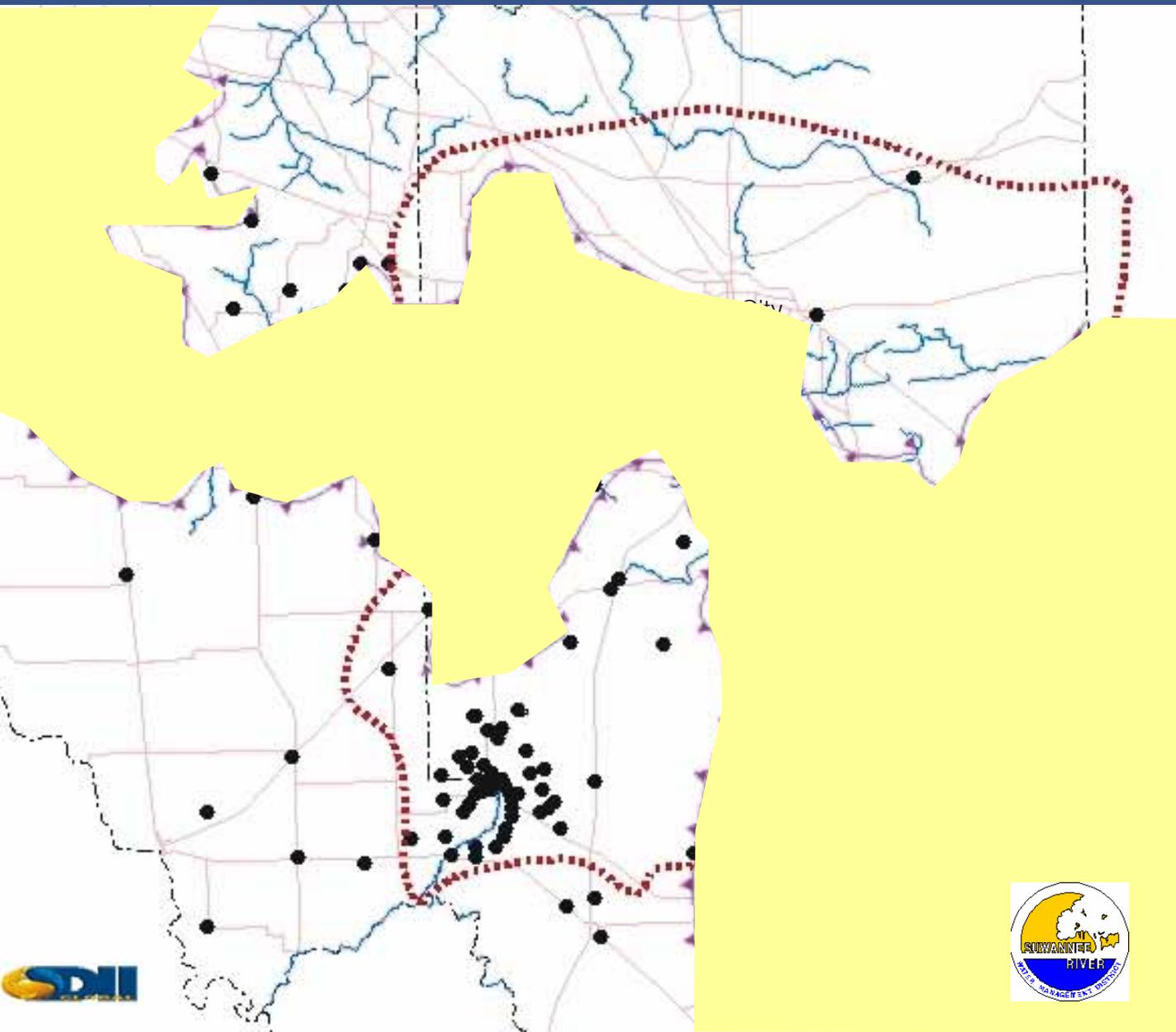
By Sam B. Upchurch, Jim Schneider,
Kyle M. Champion, David Hornsby,
Ron Ceryak, and Warren Zwanka



1st magnitude springs in the Suwannee Basin



Location of wells and springs within the study area



Methods of Investigation

Factor Analysis

Hierarchical Analysis

Star Diagrams

WATEQ4F

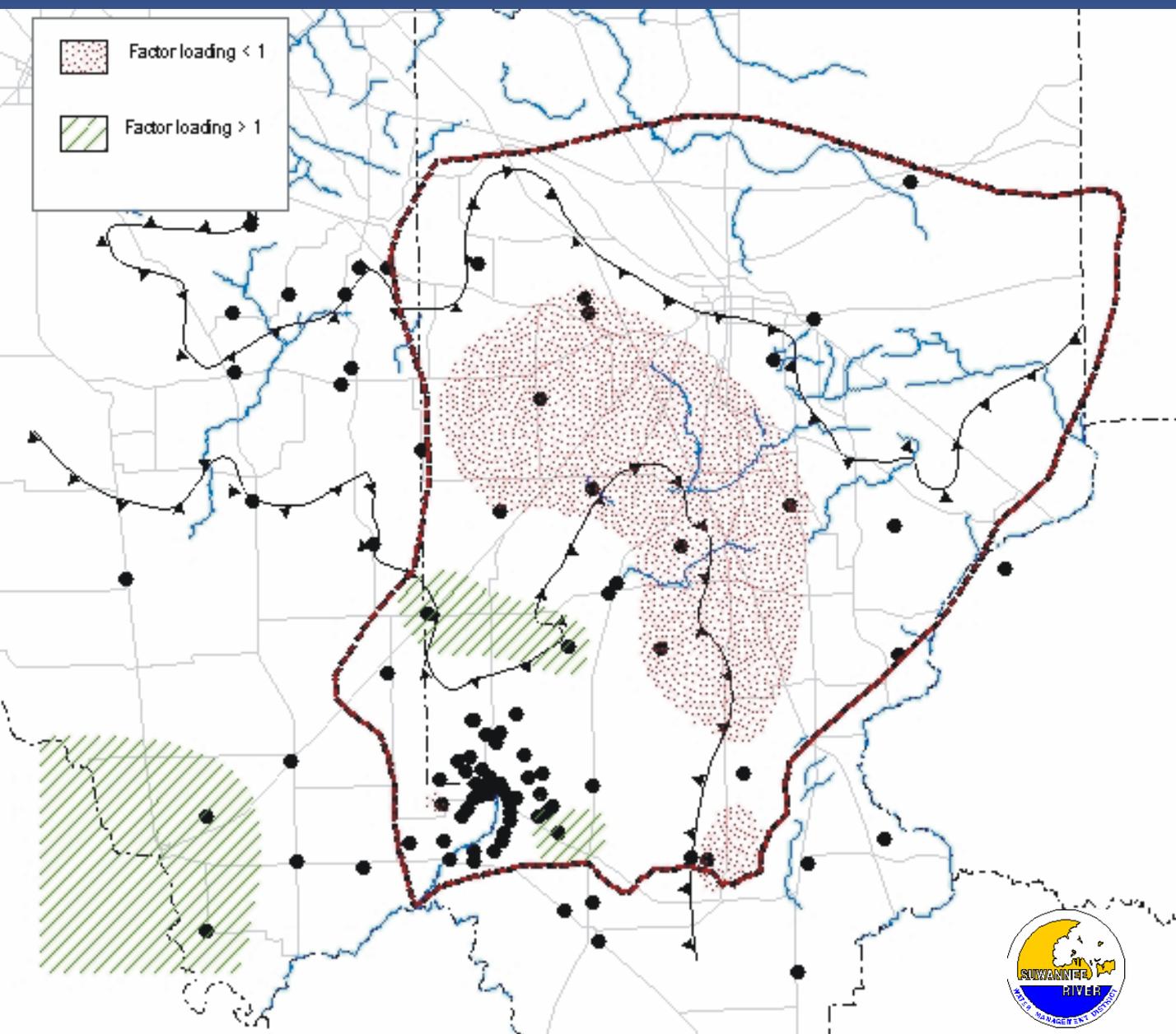
Factor Analysis

- Six factors explain ~ 76% of total variance.
- Factor I - Alkalinity, Spec. Cond., Calcium, & TDS (dissolution of calcite)
- Factor II – Silica, Magnesium, Fluoride, & Sodium (weathering of Hawthorn Group clays)
- Factor III- Ammonia & TOC (organic-rich recharge)

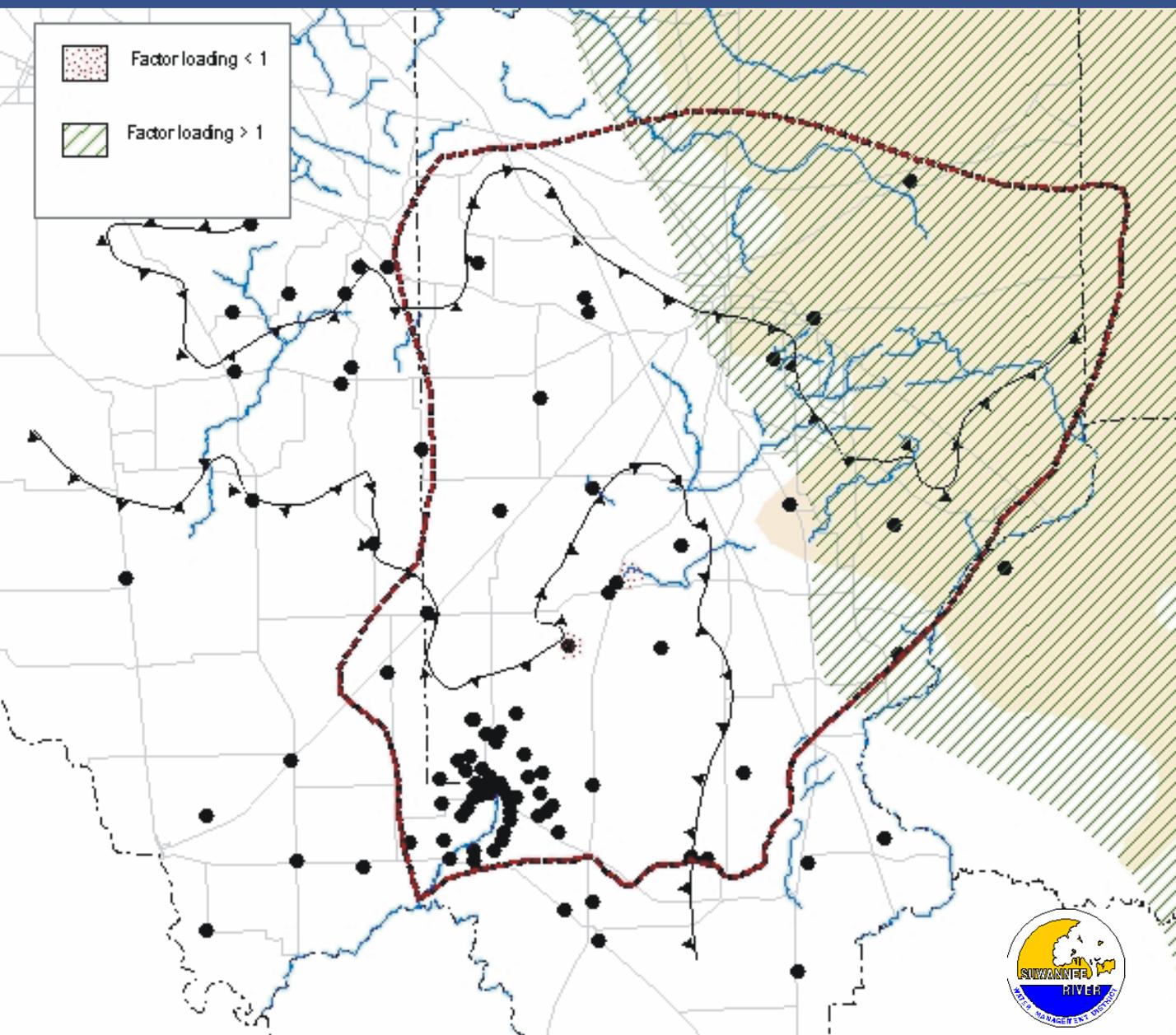
Factor Analysis

- Factor IV – Chloride, Sulfate, & Potassium (deep flow)
- Factor V – Phosphorus, (-pH), & Sodium (well construction?)
- Factor VI – Iron, (-Nitrate) & Temperature (shallow/deep flow or recharge)

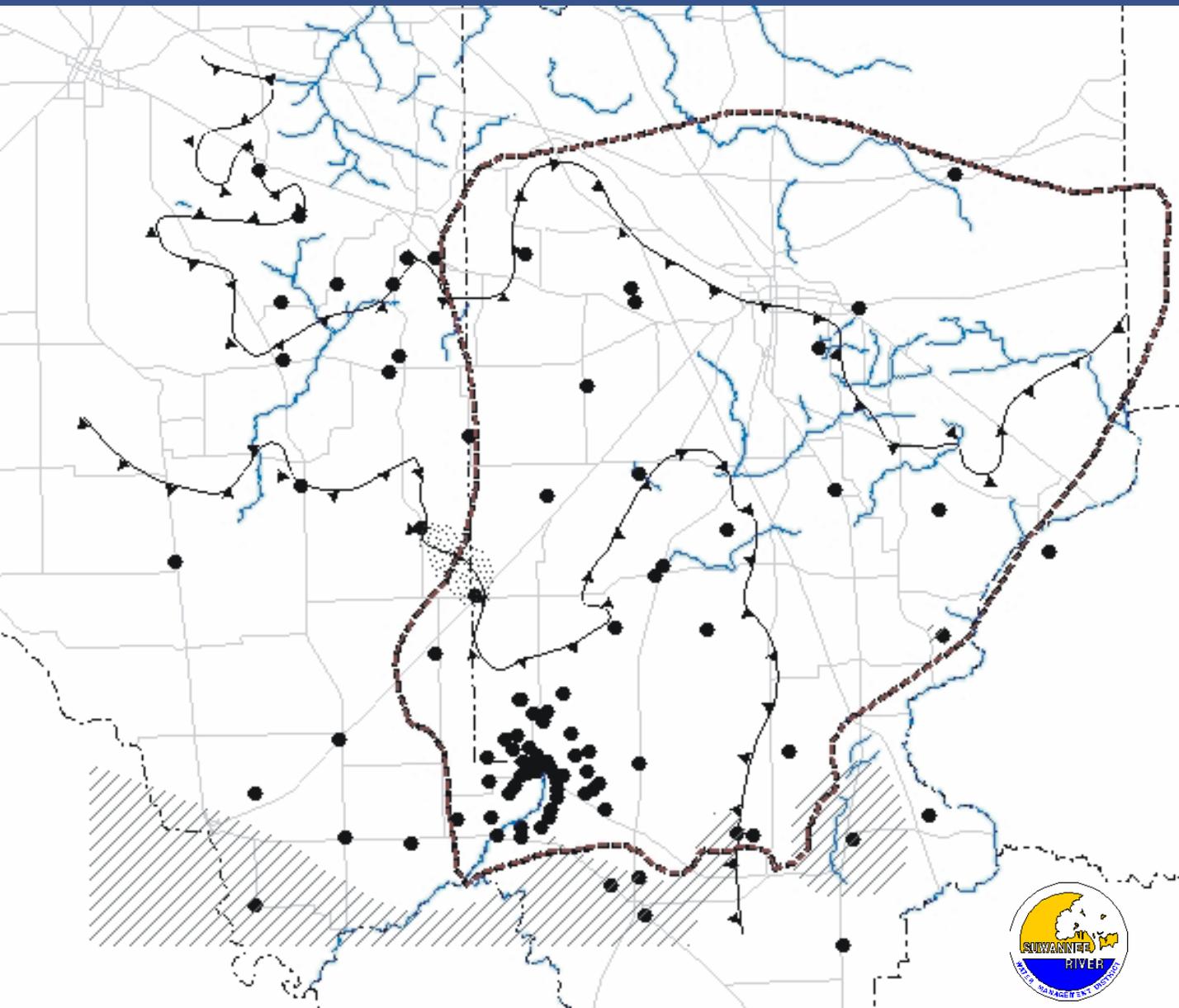
Factor I – Alkalinity, Calcium, Spec. Cond., & TDS



Factor II – Silica, Magnesium, Fluoride, & Sodium



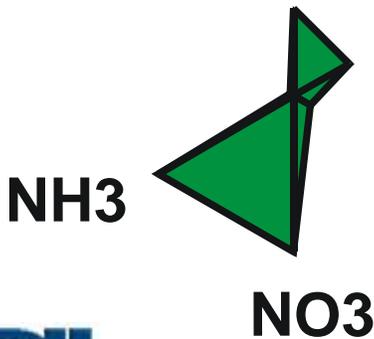
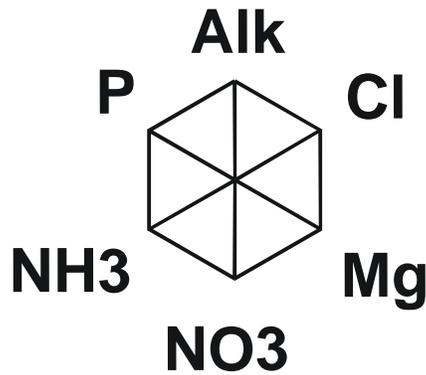
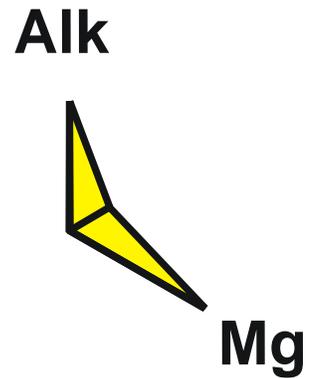
Factor IV – Chloride, Sulfate Potassium, & TDS



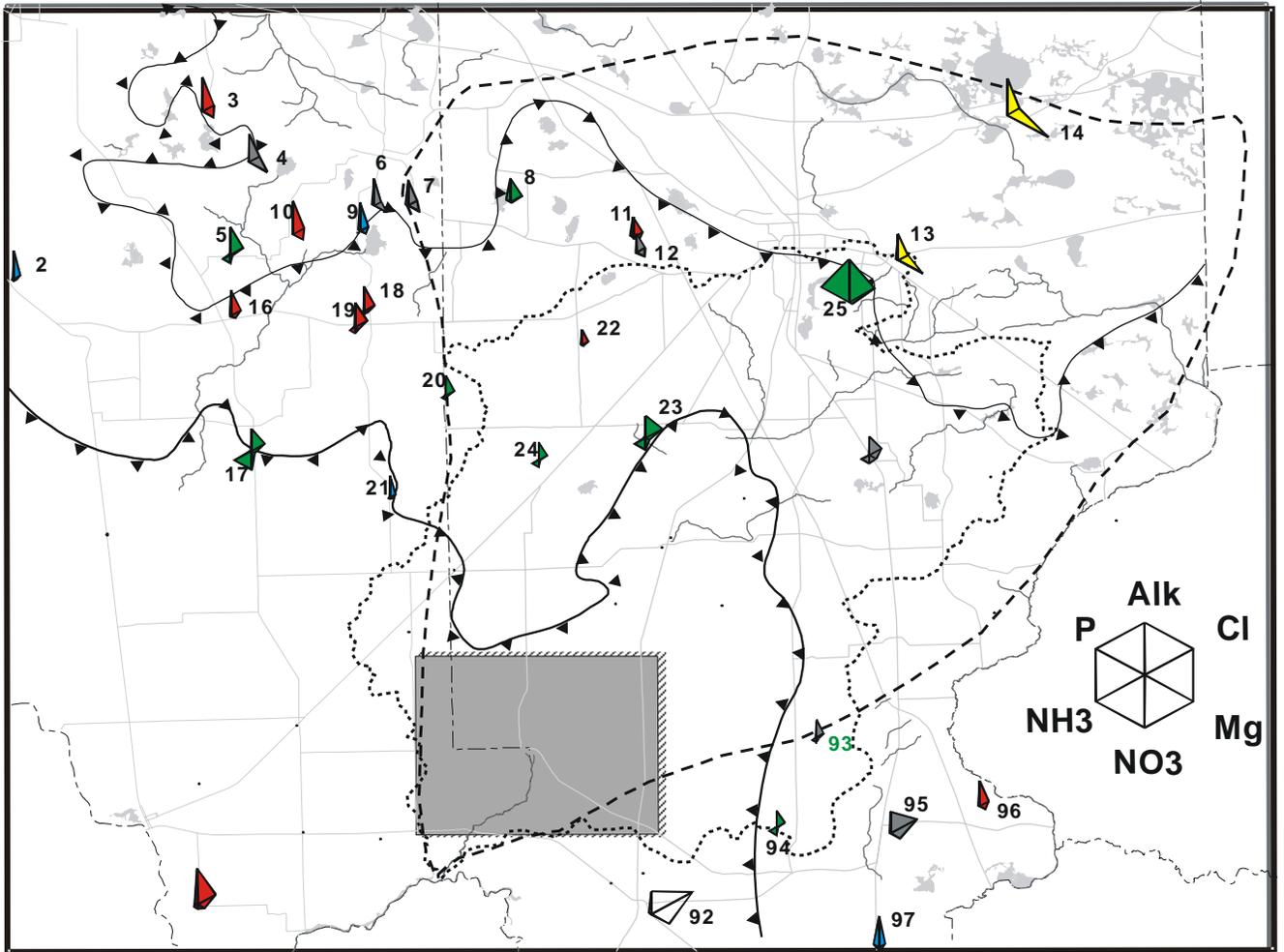
Star Diagrams

- Graphic representation of six water-quality factors.
- Three water-quality domains
 - 1) Northern Highlands
 - 2) Discharge zones along major streams/rivers
 - 3) Gulf Coast Lowlands

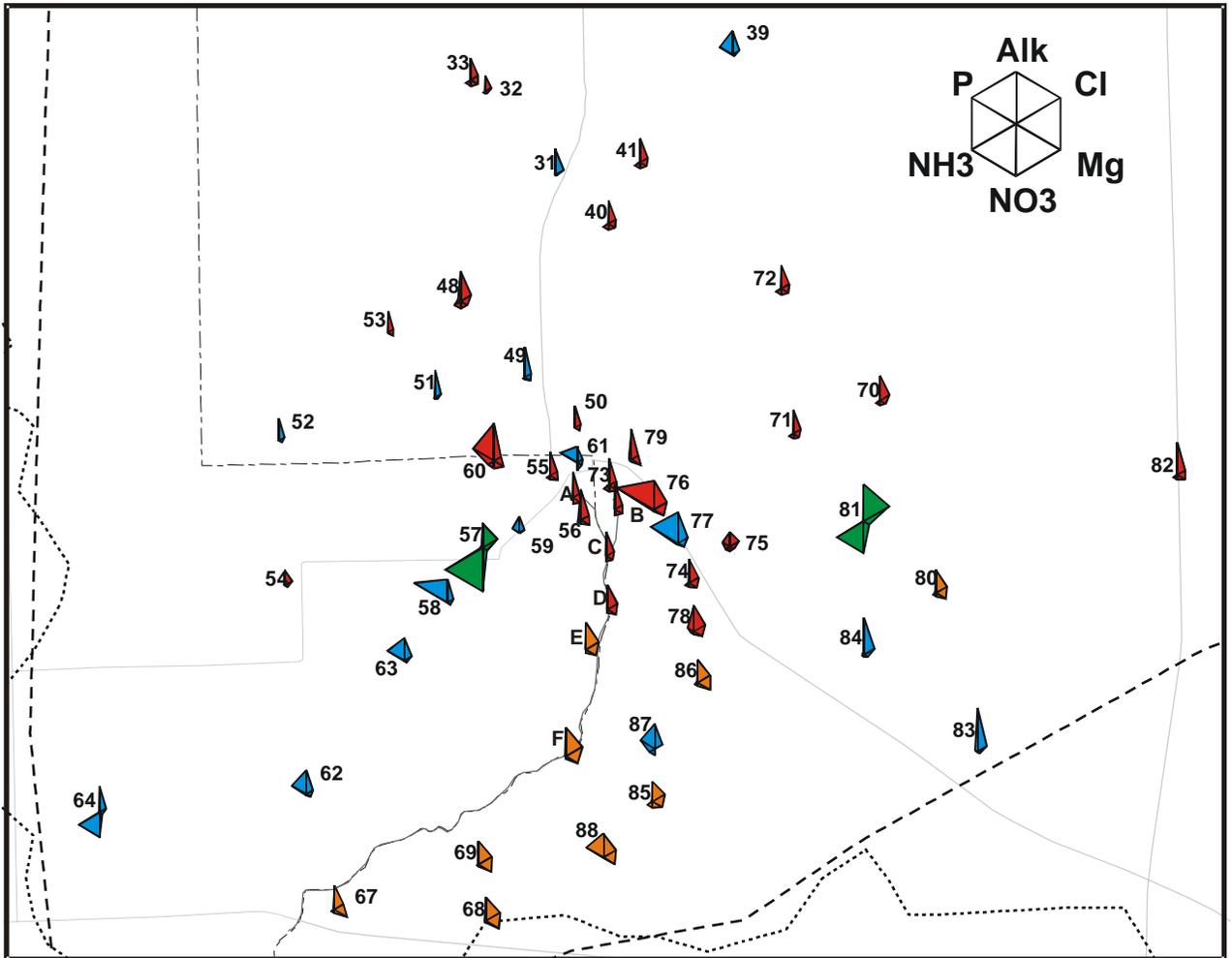
Star Diagrams



Star Diagrams



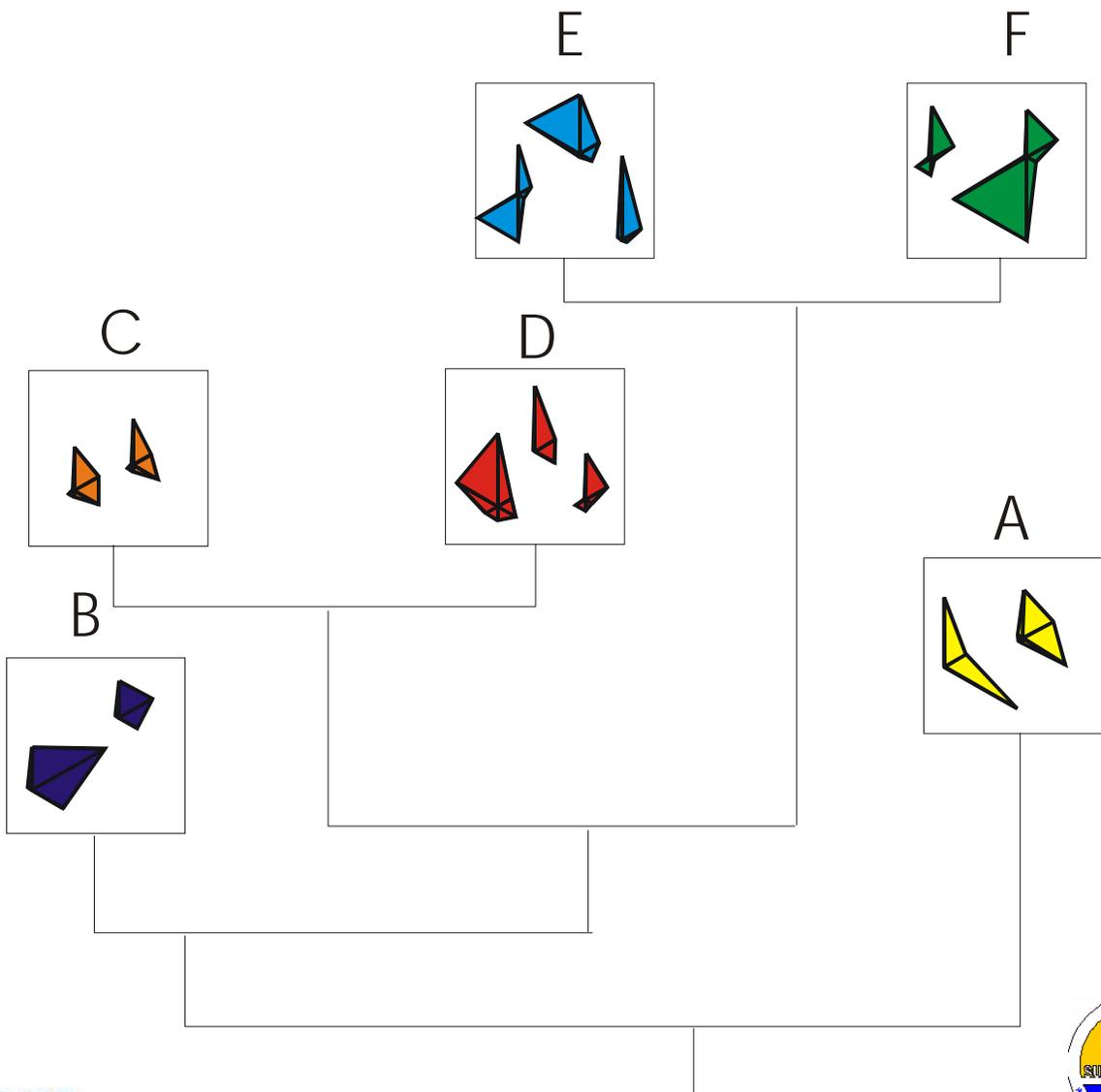
Star Diagrams



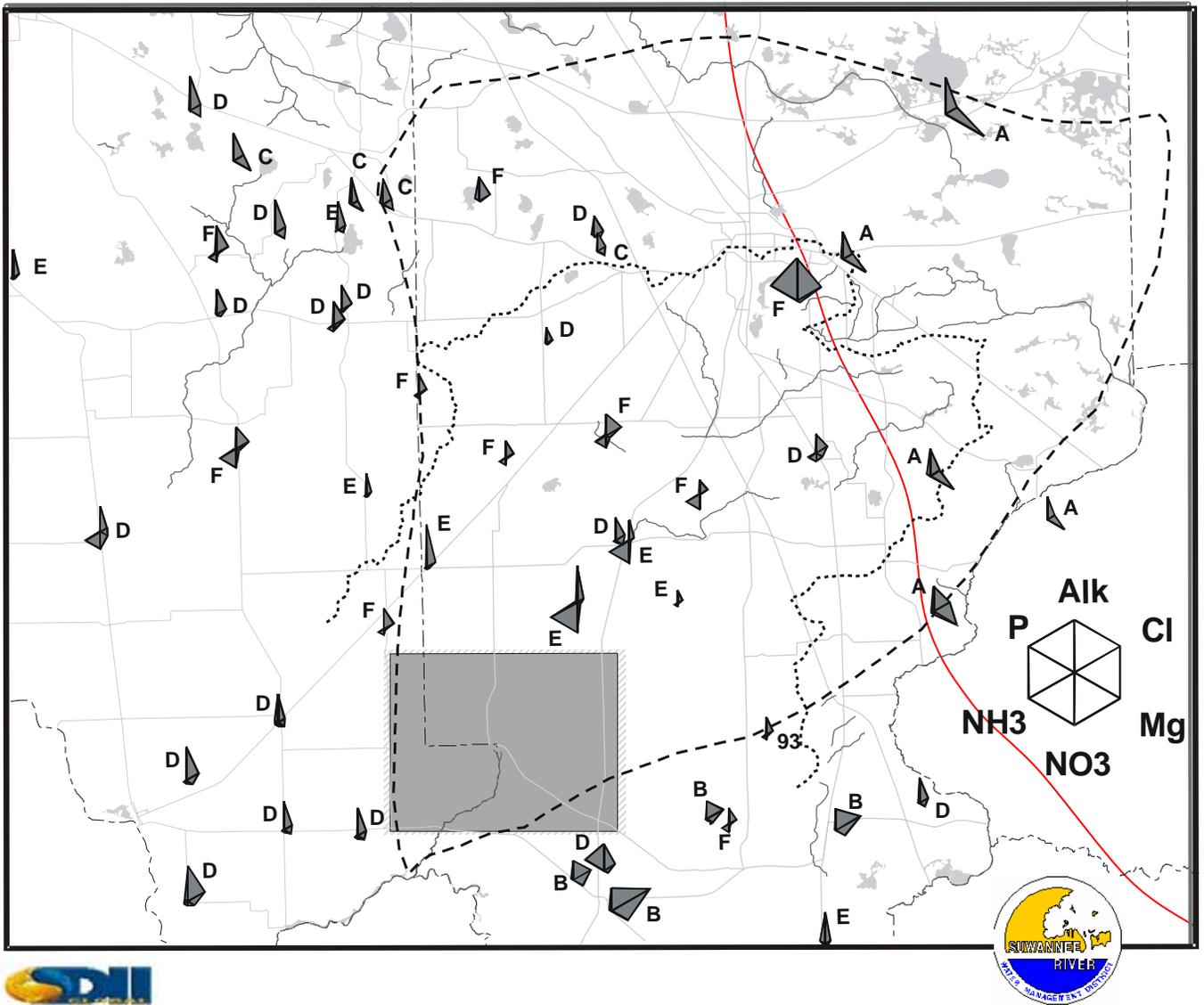
Hierarchical Analysis

- Using factor variables, cluster samples into similar groupings.
- Factor variables included:
Alkalinity, chloride, magnesium, nitrate, ammonia, and phosphorus
- Clustering suggests three distinct water-quality groupings within the study area.

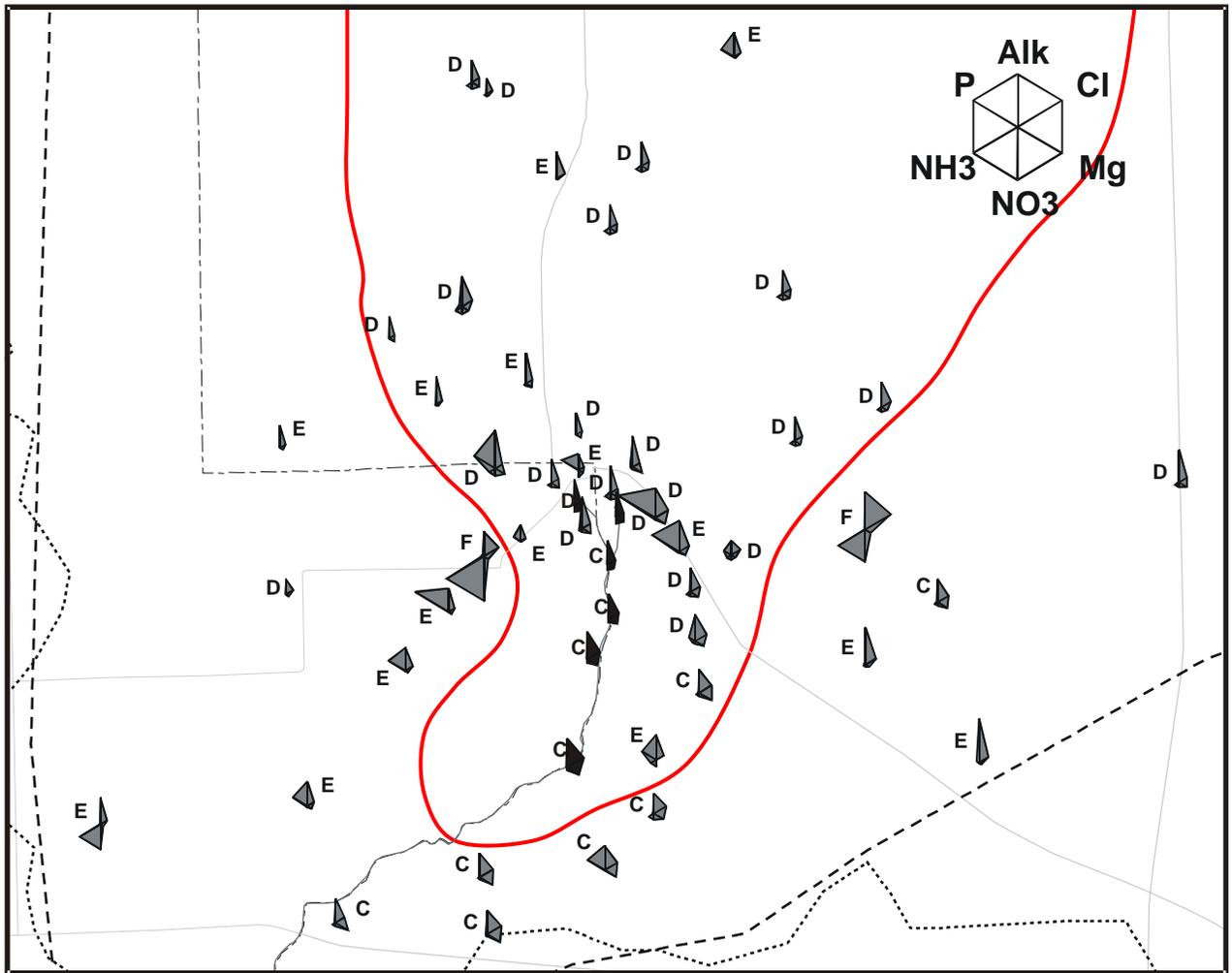
Dendrogram for water-quality data in the study area



Water-quality data in the study area



Water-quality data in the study area



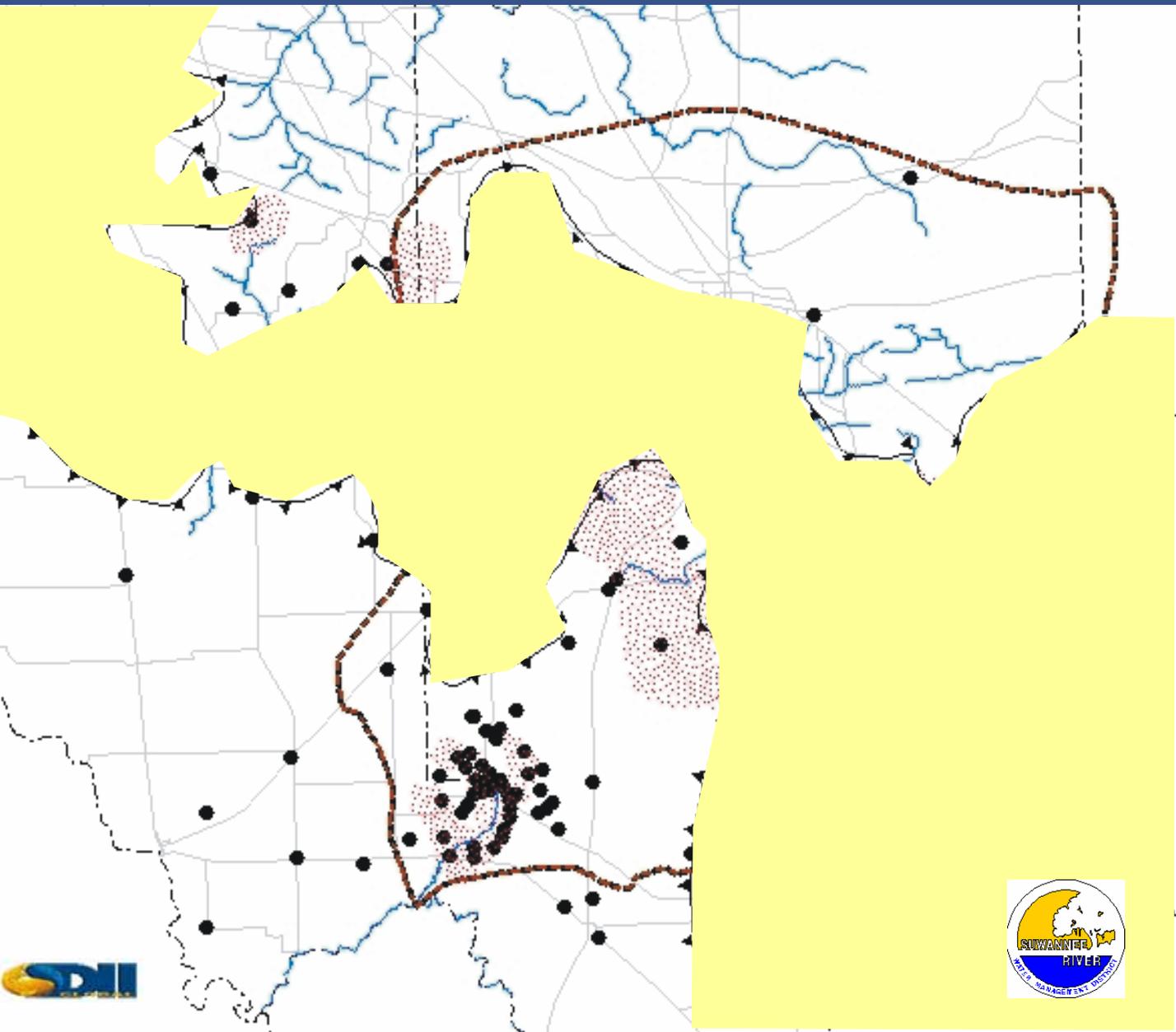
Water quality at the springs

- Factor analysis indicates similarity in ground-water chemistry
- Hierarchical analysis places springs in one major cluster.
- Similarity of star diagrams suggests local recharge origin/flowpaths

WATEQ4F Analysis

- At or near saturation w/ respect to calcite
- Undersaturated in areas of the Cody Scarp
- Greatest saturation occurs along Suwannee/Sante Fe river corridors

Saturation indices in the study area

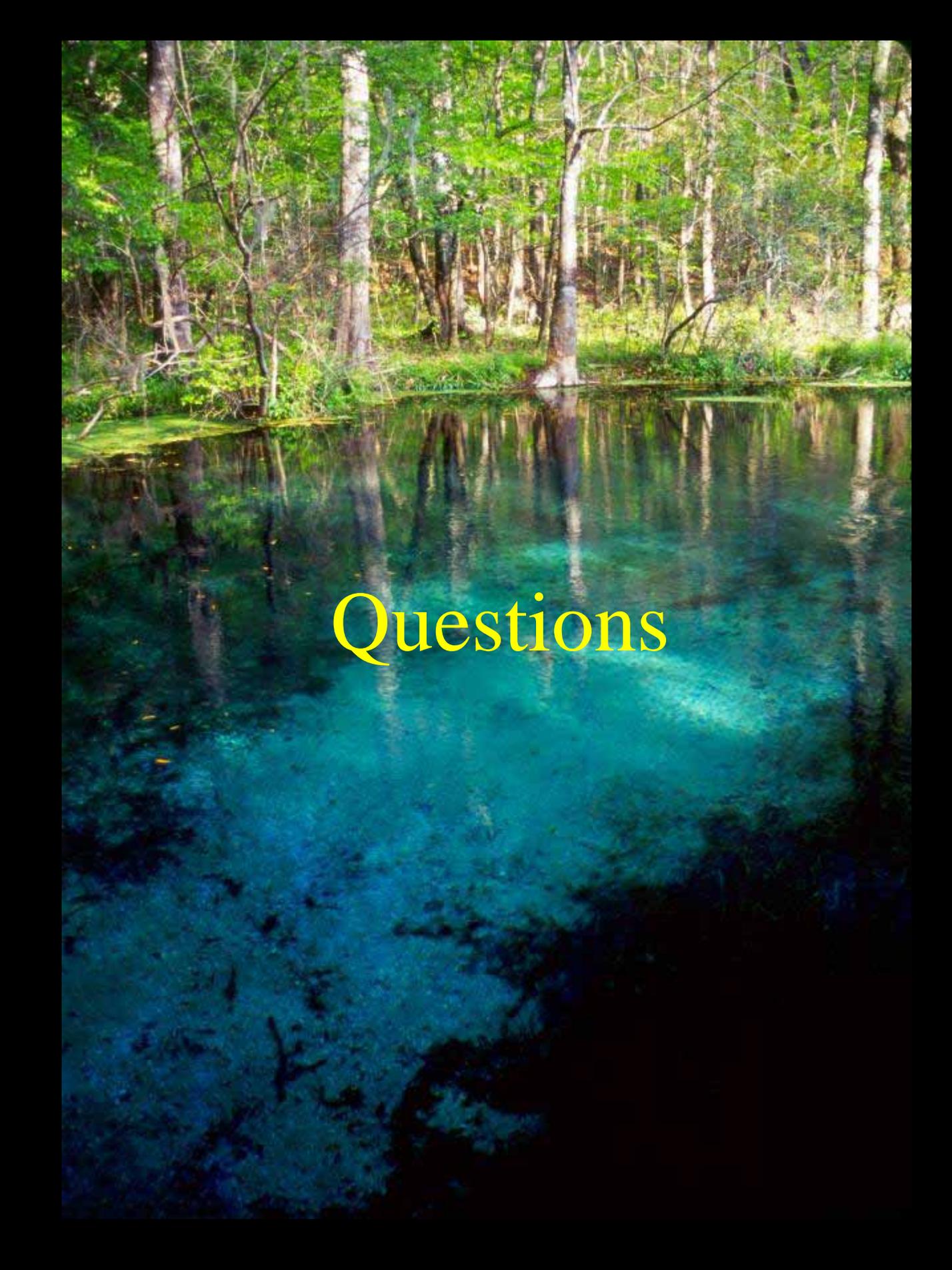


Summary

- Six factors account for more than 76% of the variability.
- Factors are tied to water-rock interactions, recharge characteristics, and flow-paths in the aquifer.
- Three major water-quality domains characterize the Ichetucknee Springs groundwater basin.

Summary

- Domains extend over a wide range and overlap to some degree.
- Using star diagrams, distinct water-quality domains are evident near the springs.
- Much of the ground-water in the region is at or near saturation, except for areas in and near the Cody Scarp.



Questions