Efficiency of Current Stormwater Rules

The Proposed Statewide Stormwater Rule: How We Got There

At a Meeting of the

AMERICAN ACADEMY OF ENVIRONMENTAL ENGINEERS®

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a program from the

University of Central Florida Stormwater Management Academy
"Managed Stormwater is Good Water"

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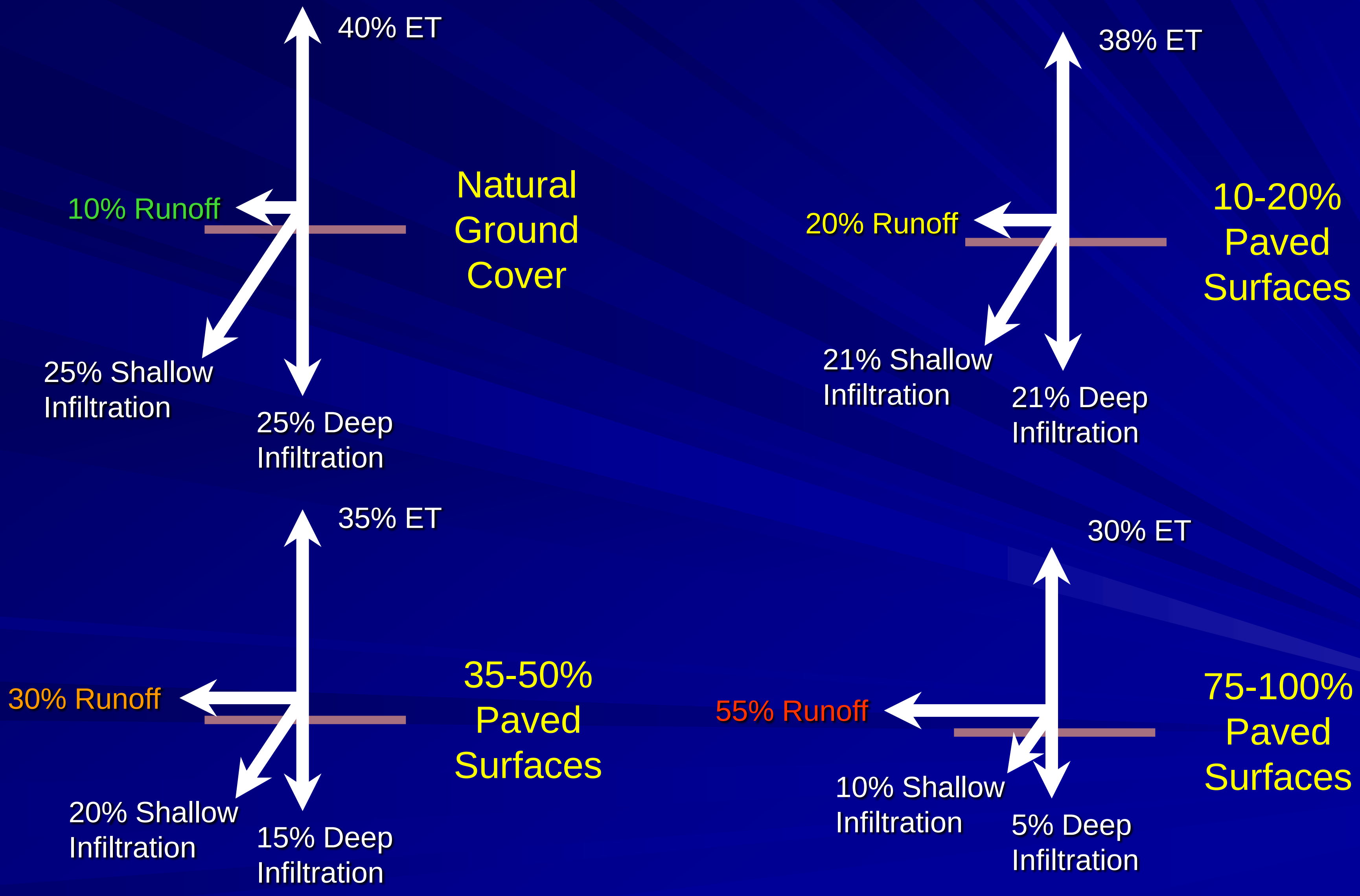
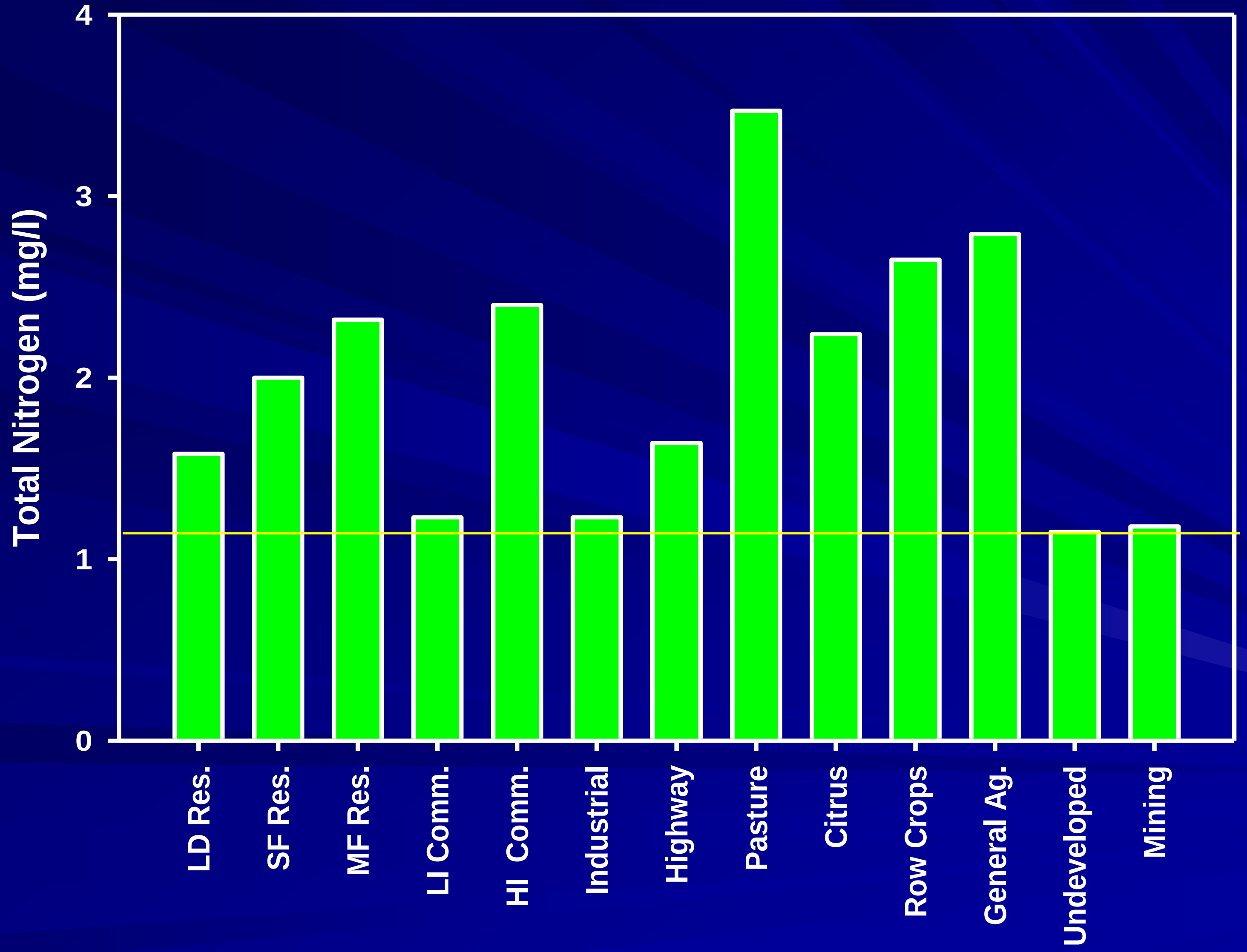
Work Efforts

- Evaluate performance efficiency of current stormwater water quality design criteria
- Update database for typical runoff characteristics
- If current design criteria fail to meet treatment goals, then develop design criteria to achieve treatment goal
  - 80% removal
  - 95% removal
  - Post $\leq$ pre-development loadings

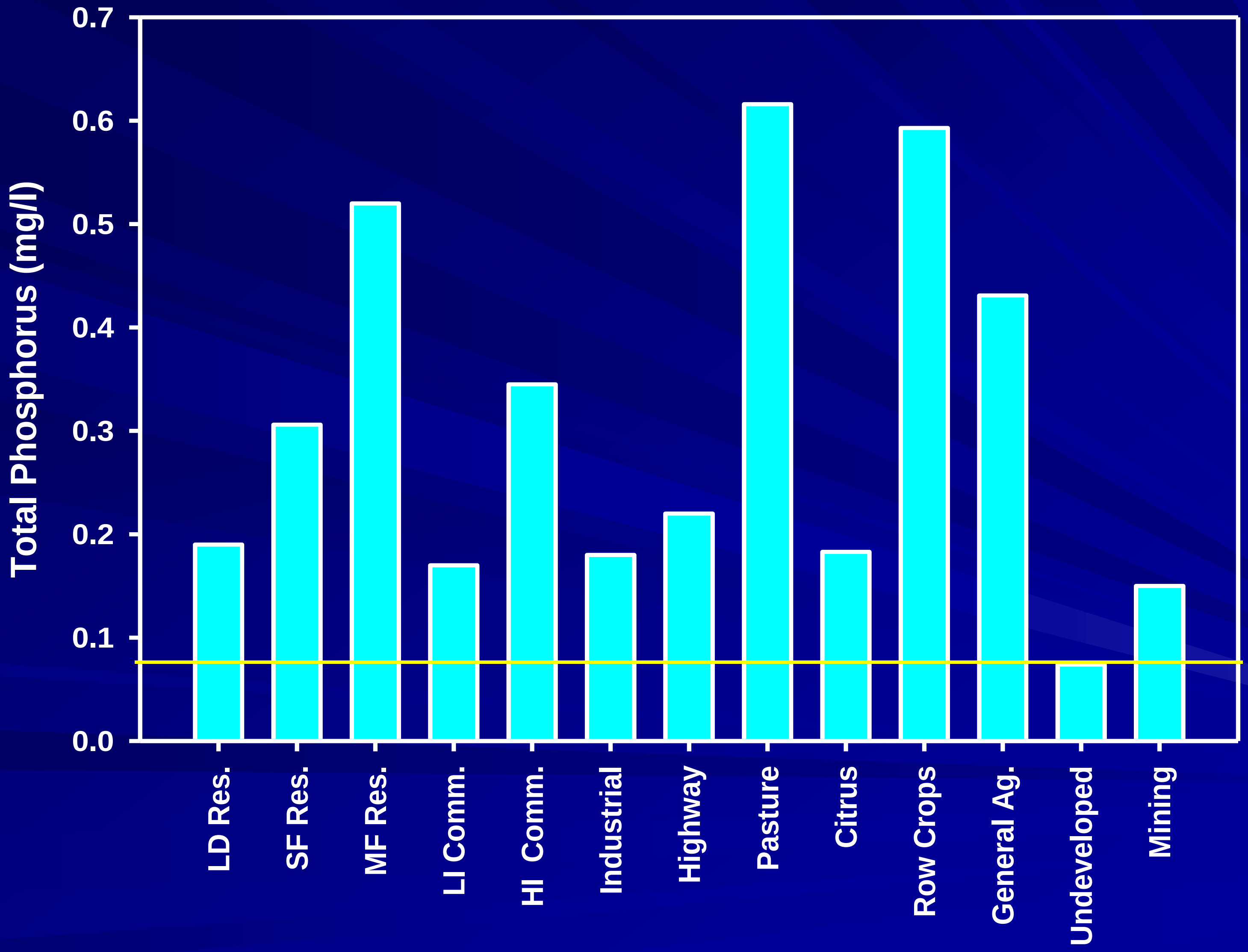
Typical Hydrologic Changes Resulting From Development



Comparison of Typical Nitrogen Concentrations in Stormwater



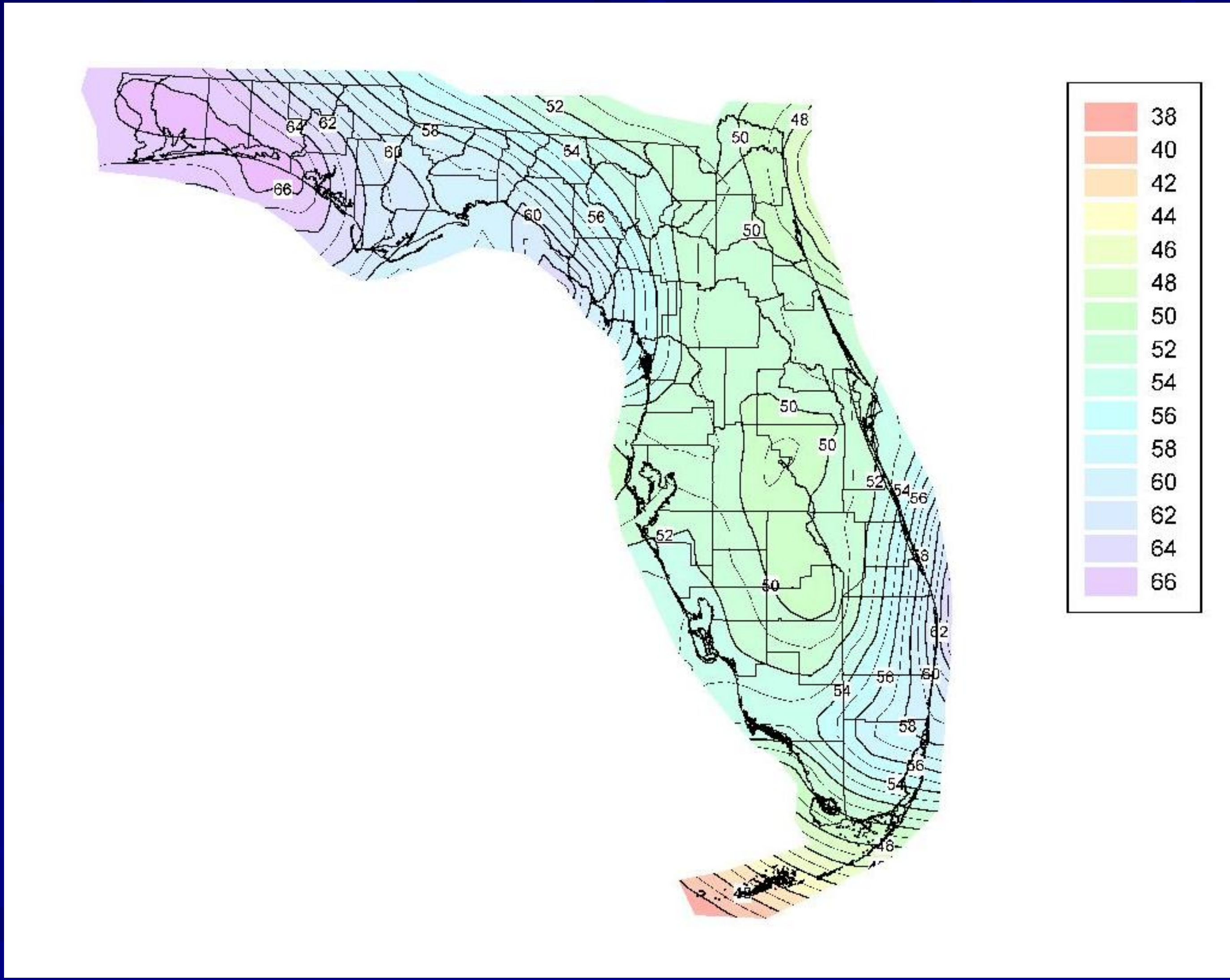
Comparison of Typical Phosphorus Concentrations in Stormwater



Meteorological Monitoring Sites Used to Generate Rainfall Isopleths

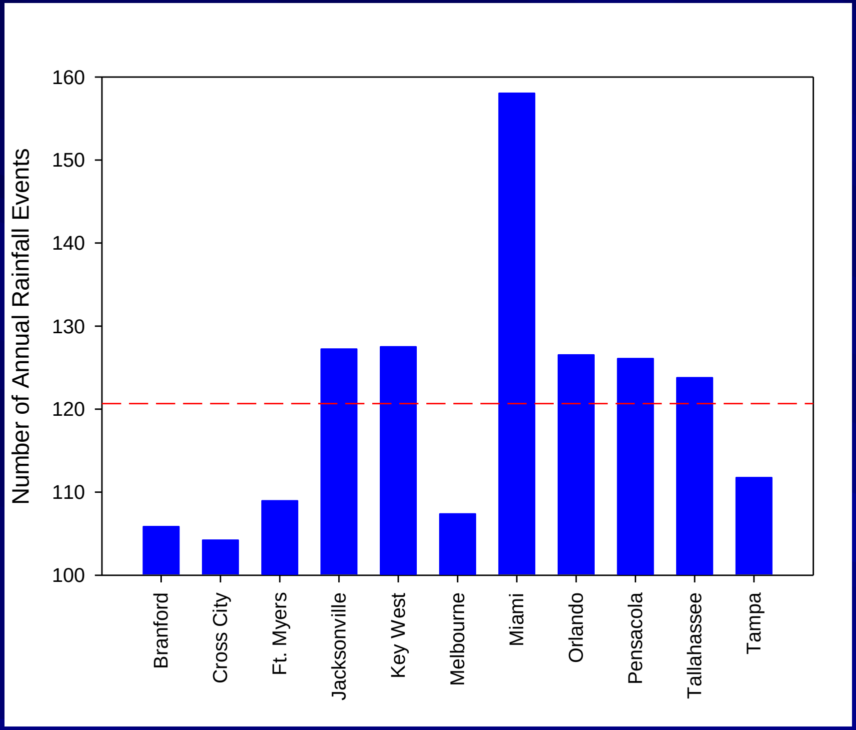
- 160 sites
- data obtained for 1971-2000

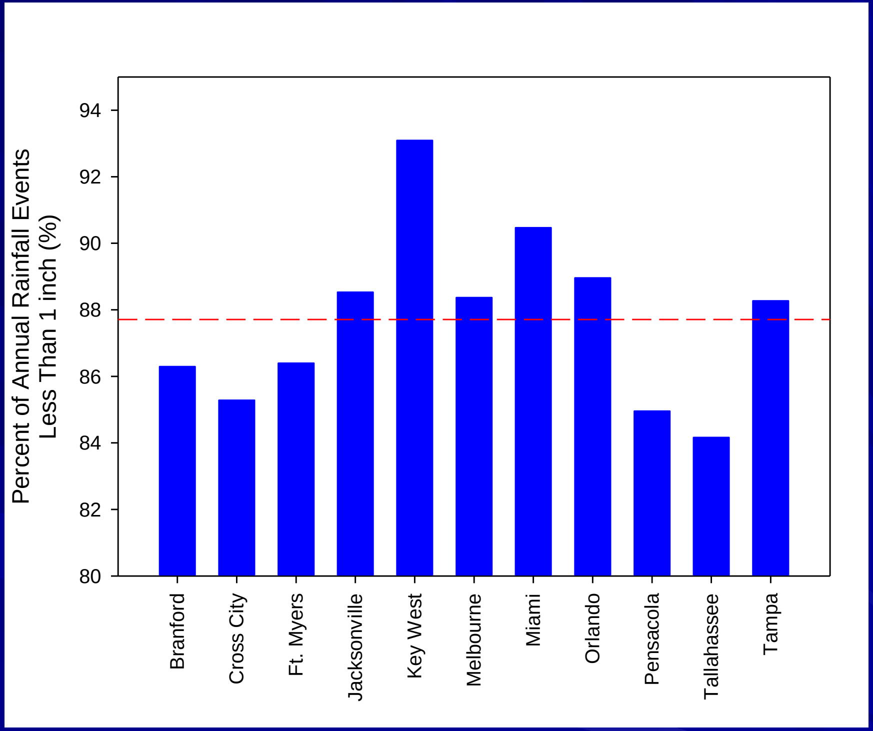
Average Annual Florida Precipitation 1971 – 2000



Florida rainfall is highly variable ranging from ~ 38 – 66 in/yr, depending on location

Characteristics of Rainfall Events at Selected Meteorological Sites

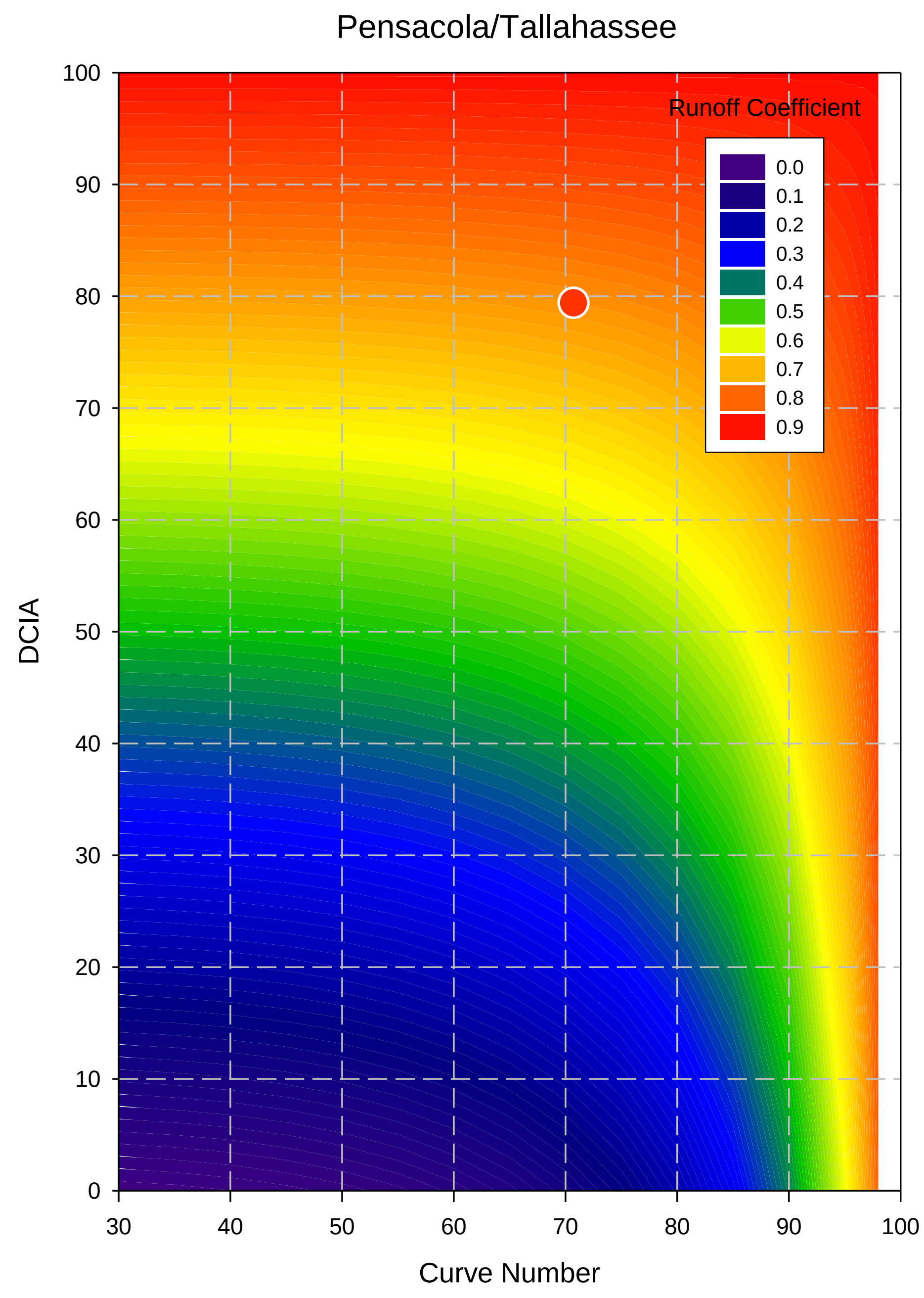


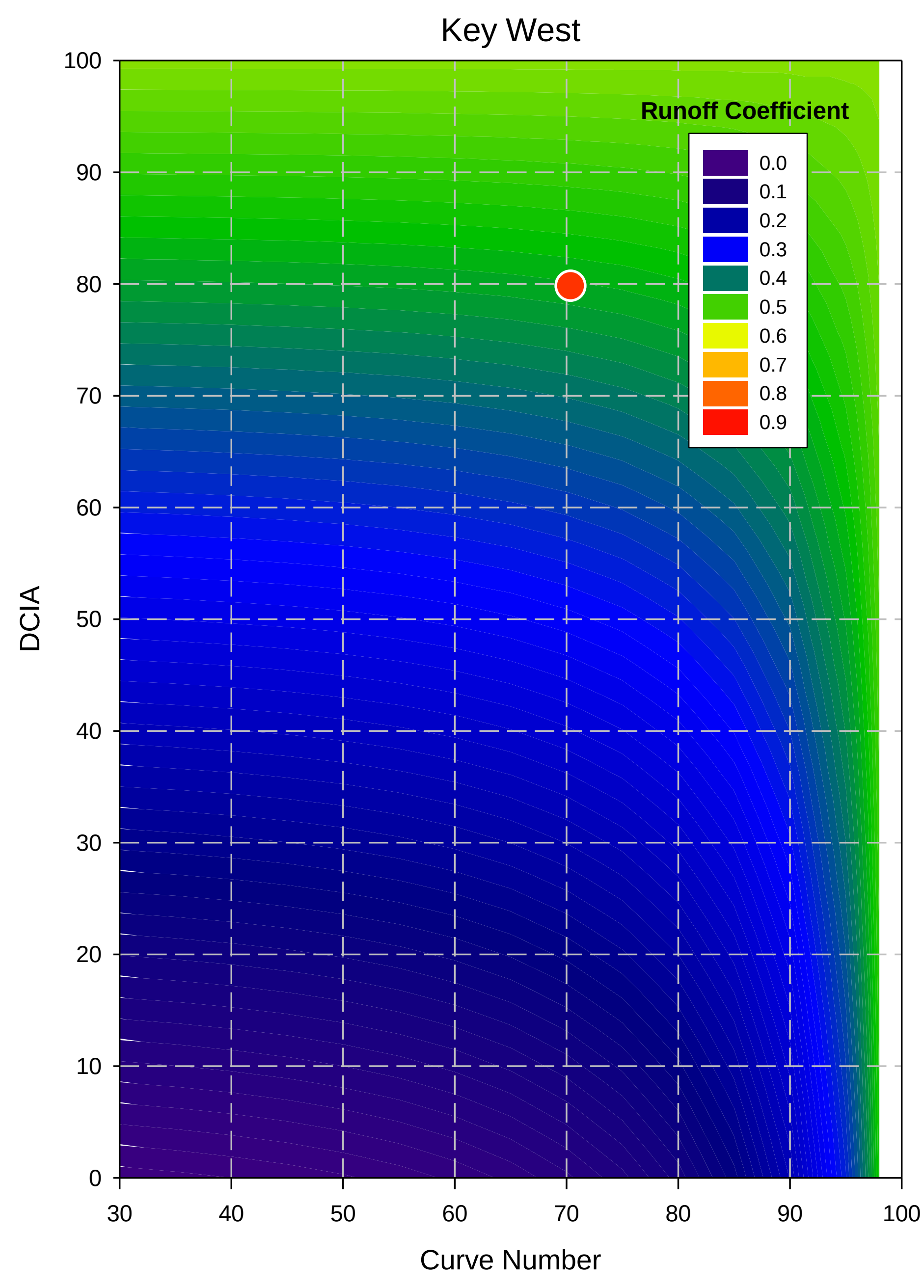


- Rainfall is highly variable in the number of “small” and “large” events at sites around the state

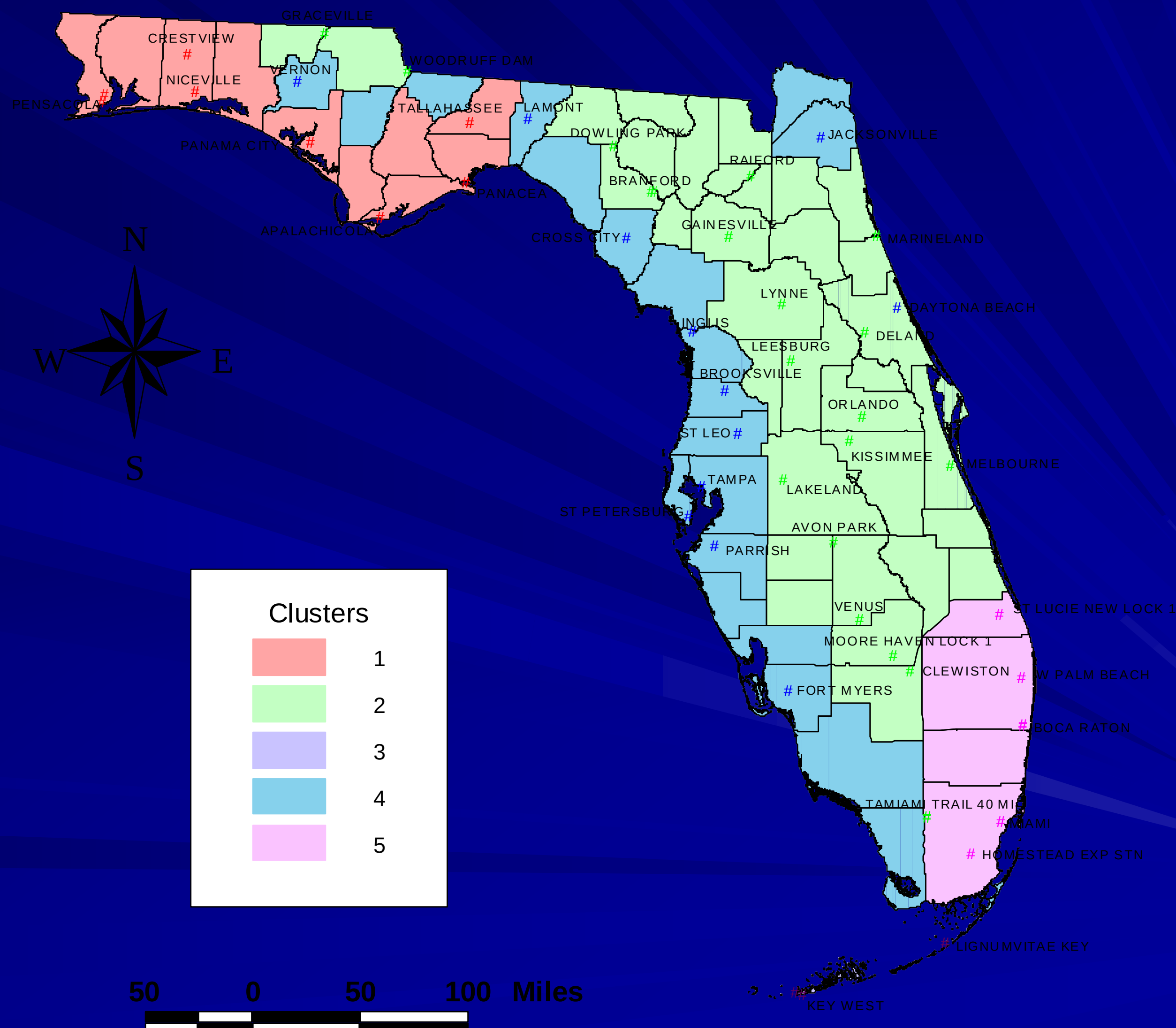
-This impacts both runoff generation as well as treatment system performance efficiency

Annual C Values as a Function of DCIA and non-DCIA Curve Number





Similar Meteorological Zones



-Clusters represent areas with similar runoff generation potential

- Analysis is dependent on rainfall distribution rather than annual rainfall

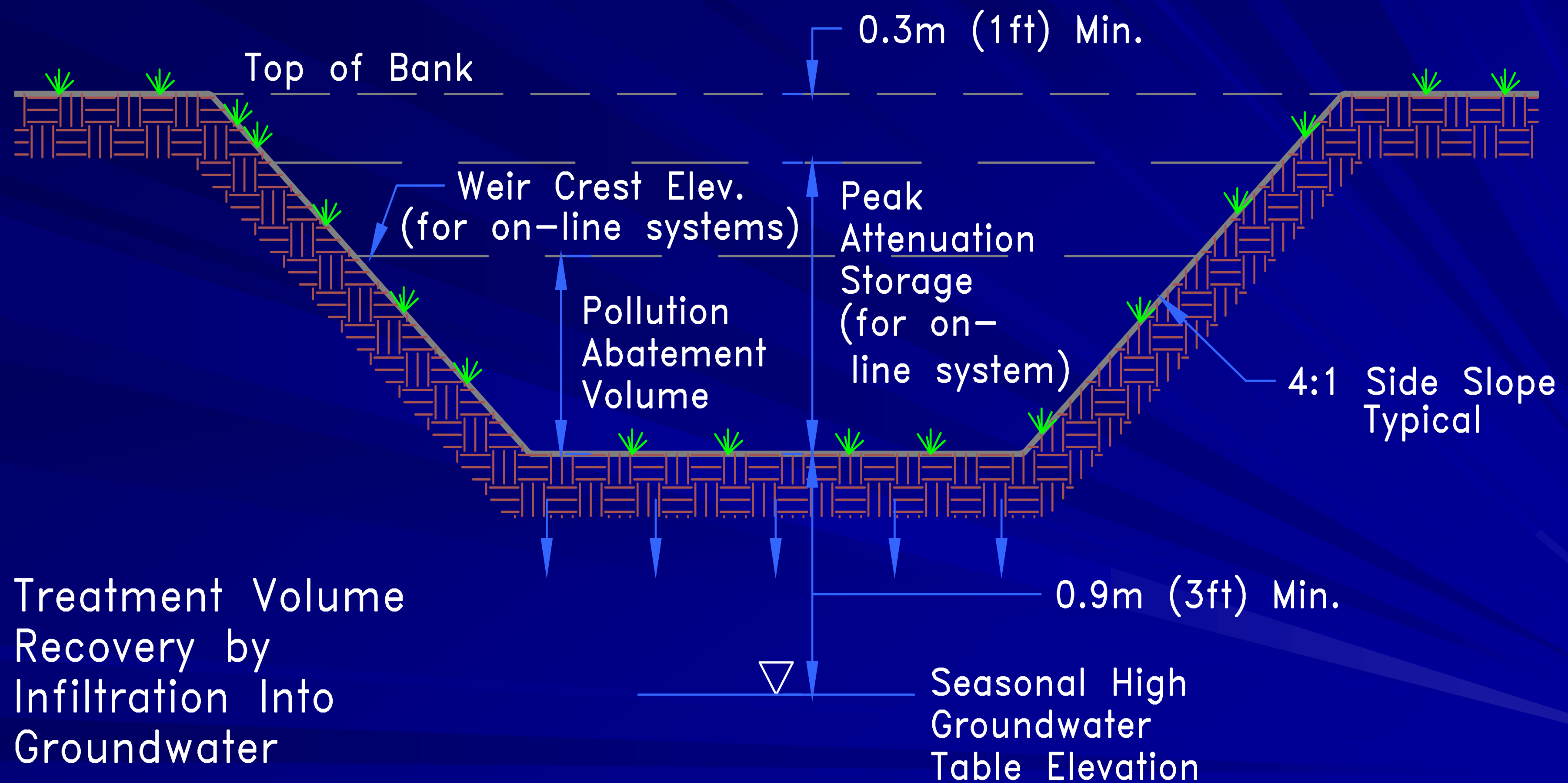
Runoff Characteristics

- Literature survey conducted for common land use categories:
  - Pre-Development
    - Agriculture (pasture, citrus, row crops)
    - Open Space / Forests
    - Mining
  - Post-Development
    - Low-Density Residential
    - Single-Family Residential
    - Multi-Family Residential
    - Low-Intensity Commercial
    - High-Intensity Commercial
    - Light Industrial
    - Highway

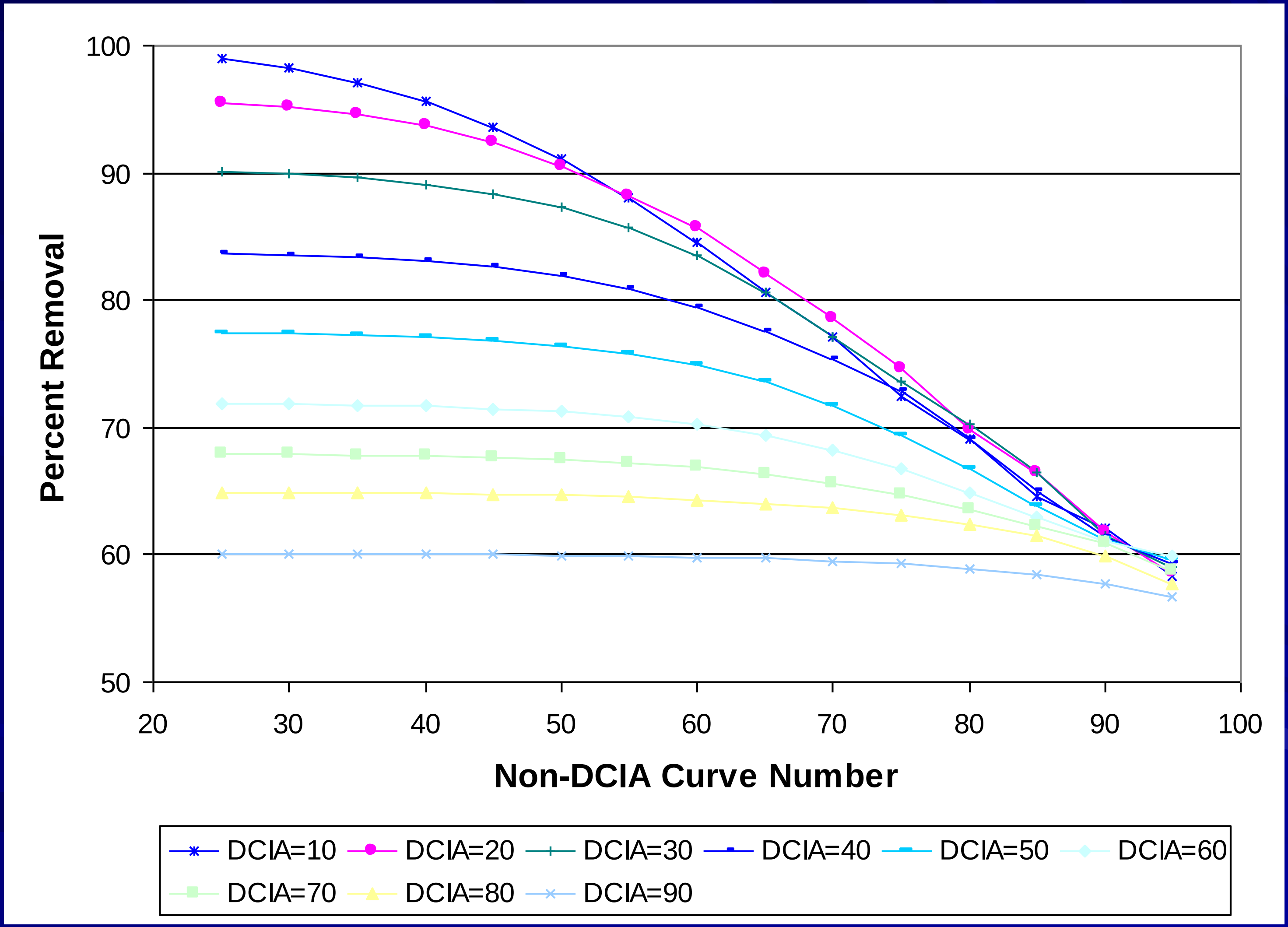
Summary of Literature-Based Runoff Concentrations For Selected Land Use Categories in Florida

Land Use Category	Typical Runoff Concentration (mg/l)						
	TN	TP	BOD	TSS	Cu	Pb	Zn
1. Low-Density Residential	1.61	0.191	4.7	23.0	0.008	0.002	0.031
2. Single-Family Resid.	2.07	0.327	7.9	37.5	0.016	0.004	0.062
3. Multi-Family Residential	2.32	0.520	11.3	77.8	0.009	0.006	0.086
4. Low-Intensity Comm.	1.18	0.179	7.7	57.5	0.018	0.005	0.094
5. High-Intensity Comm.	2.40	0.345	11.3	69.7	0.015	--	0.160
6. Light Industrial	1.20	0.260	7.6	60.0	0.003	0.002	0.057
7. Highway	1.64	0.220	5.2	37.3	0.032	0.011	0.126
8. Agricultural							
a. Pasture	3.47	0.616	5.1	94.3	--	--	--
b. Citrus	2.24	0.183	2.55	15.5	0.003	0.001	0.012
c. Row Crops	2.65	0.593	--	19.8	0.022	0.004	0.030
d. General Ag.	2.79	0.431	3.8	43.2	0.013	0.003	0.021
9. Undeveloped/Rangeland/ Forest	1.15	0.055	1.4	8.4	--	--	--
10. Mining	1.18	0.15	7.6	60.0	0.003	0.002	0.057

Dry Retention

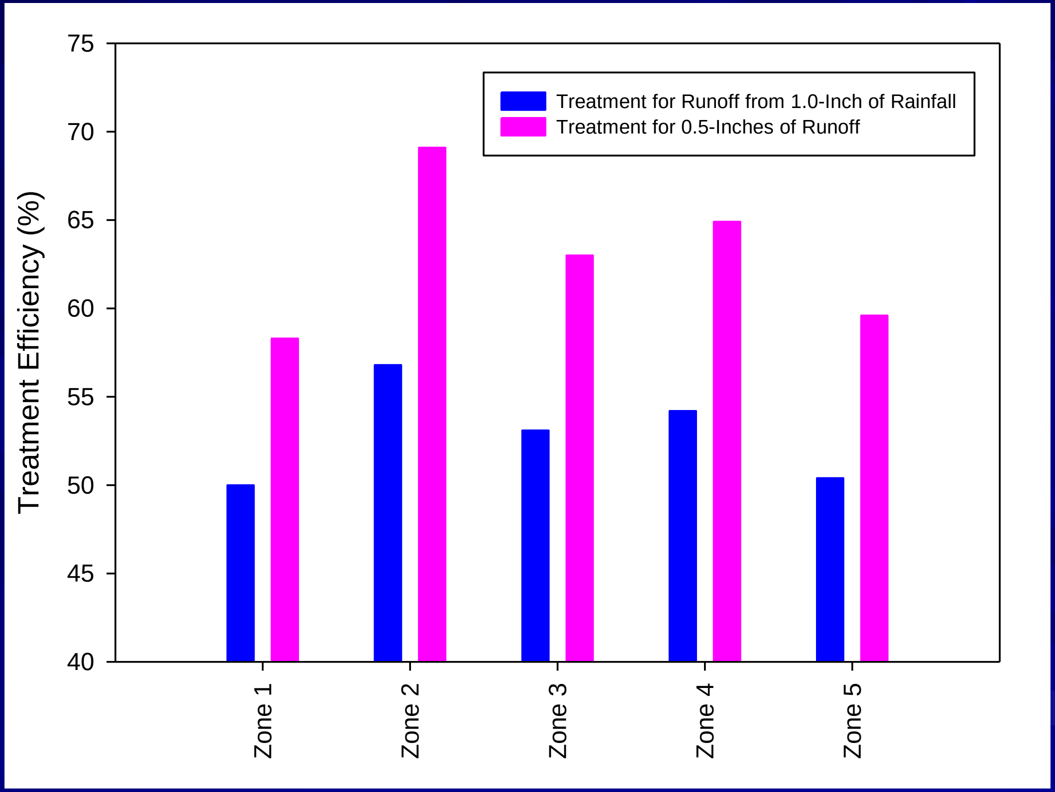


On-Line Retention (0.50 Inch Retention)



Regional Variability in Treatment Efficiency of Dry Retention

Treatment of 0.5 inch Runoff vs. Treatment of 1 inch of Runoff
(40% DCIA and non-DCIA CN of 70)

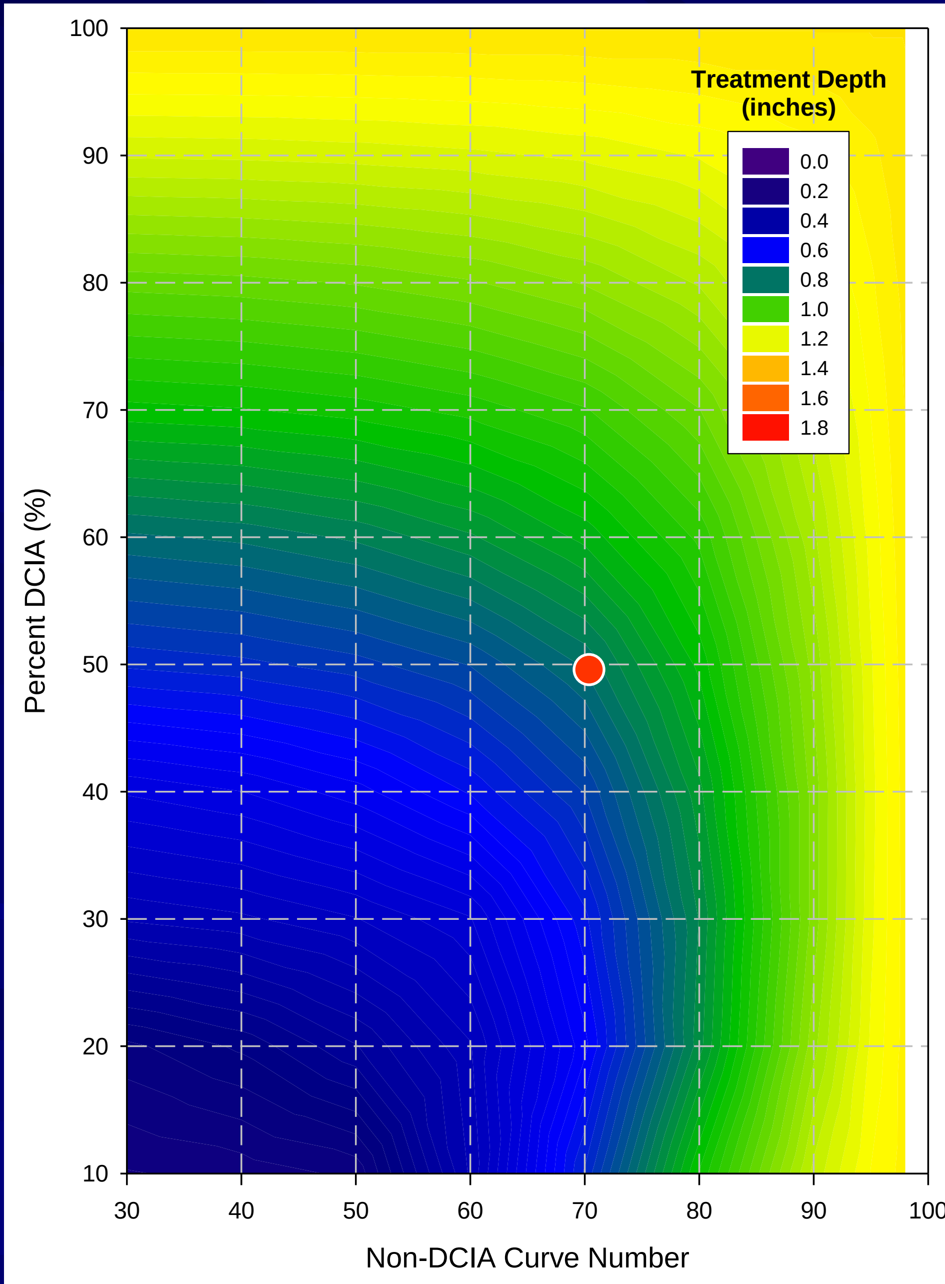


Design criteria based on treatment of 0.5 inch of runoff provide better annual mass removal than treatment of 1 inch of rainfall

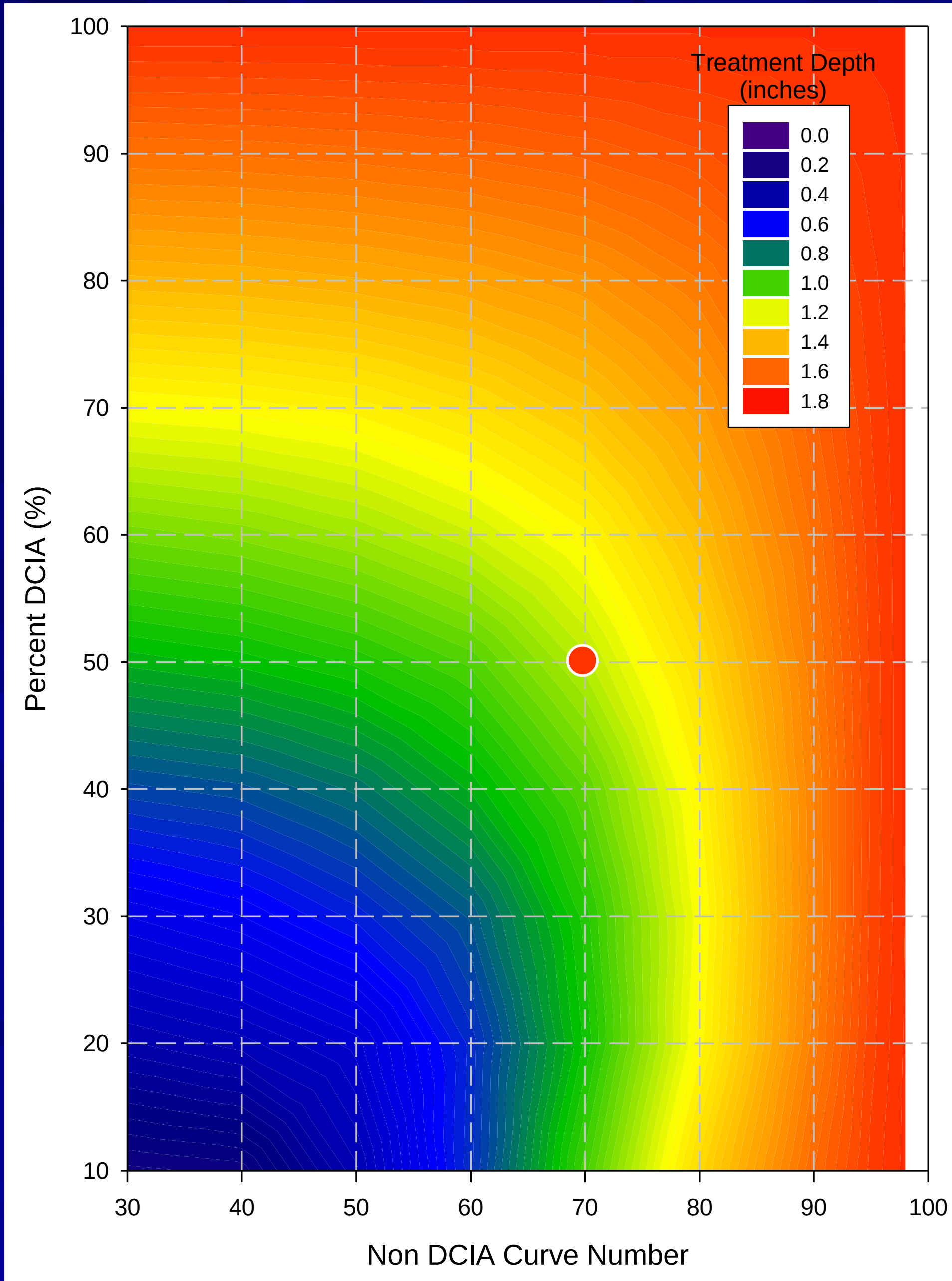
Conclusion: Current dry retention designs fail to meet the 80% design standard

Retention Depth Required for 80% Removal

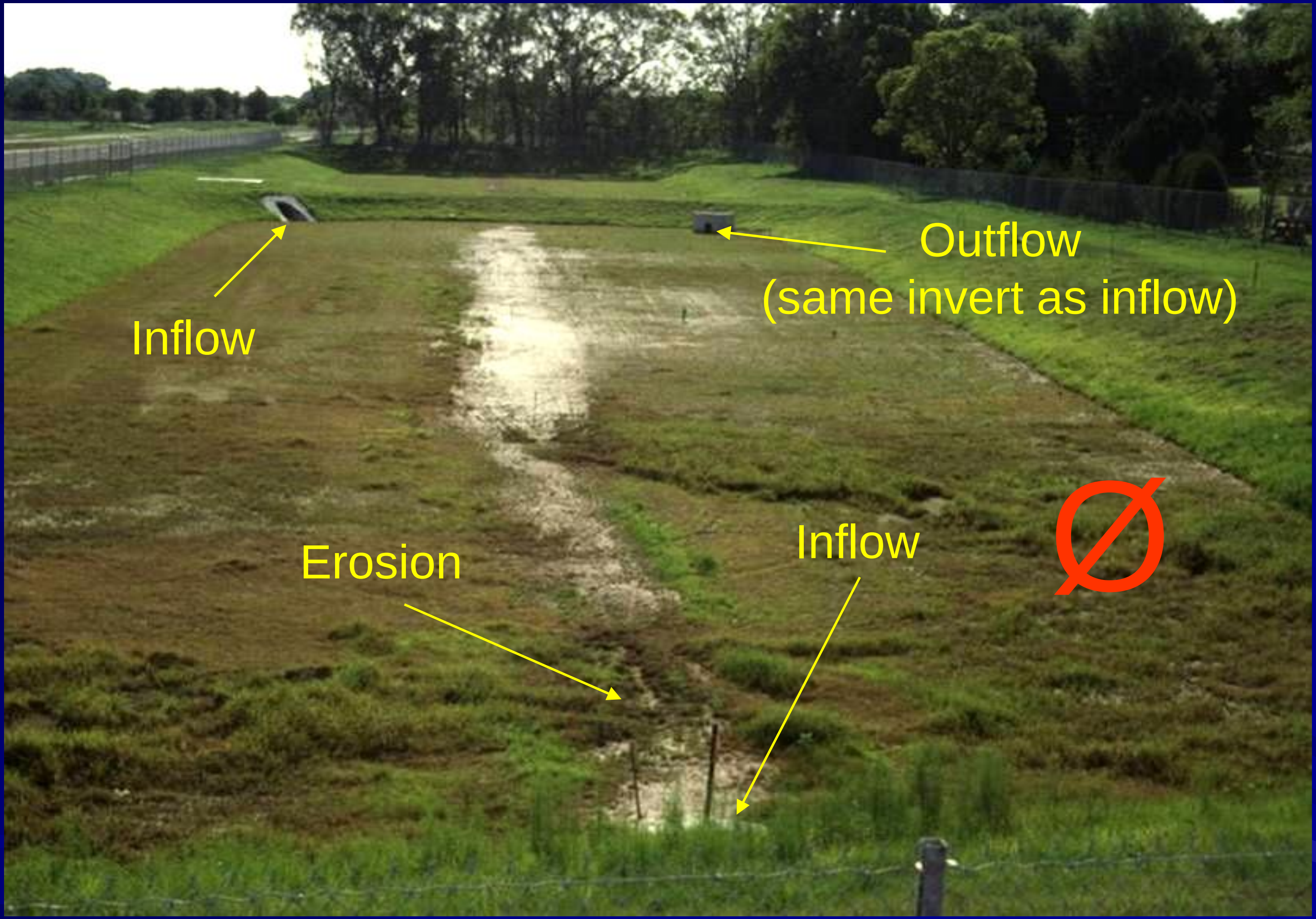
Melbourne



Pensacola

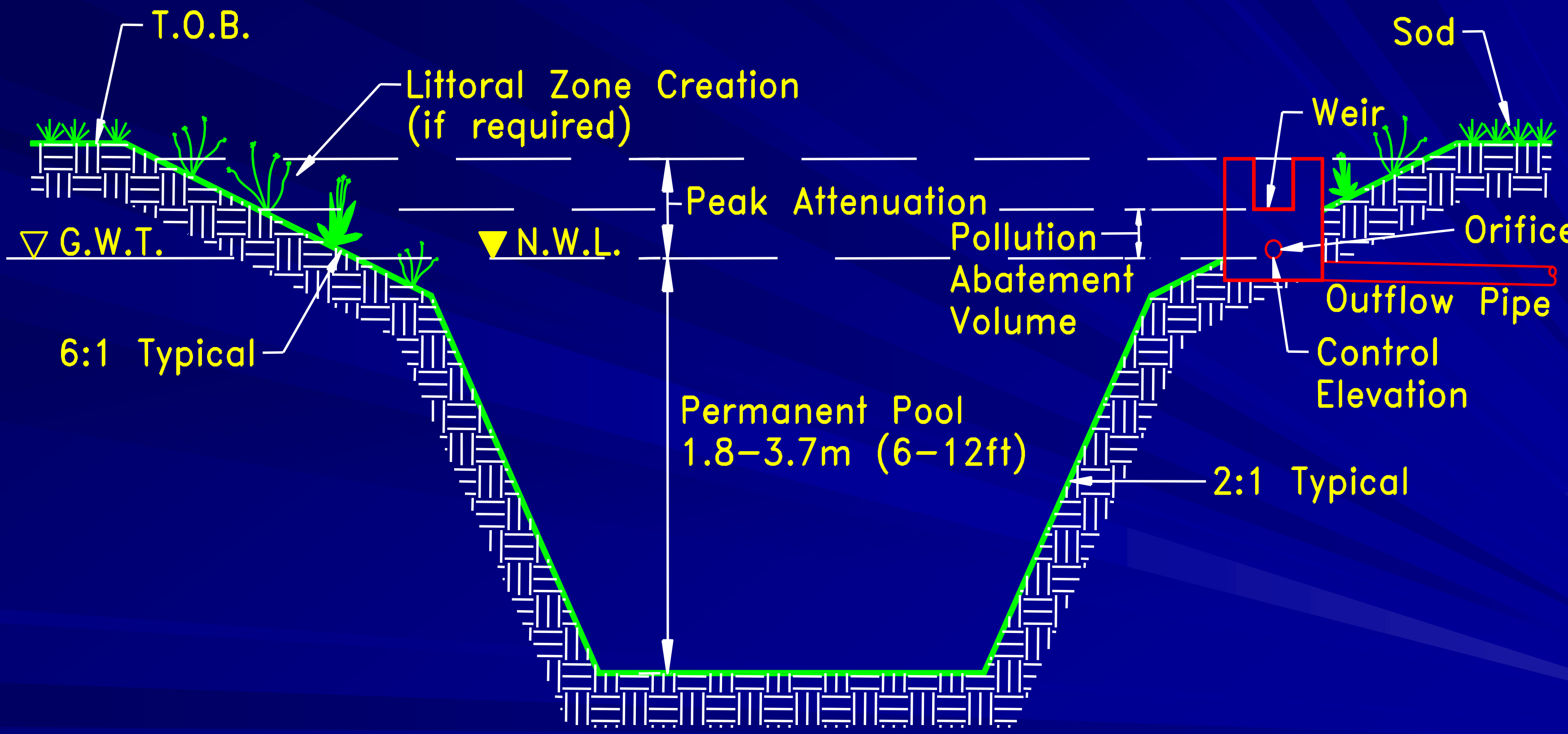


Dry Detention Basin



- Systems only detain runoff for a short time
- No permanent water pool, biological uptake minimal
- Good TSS removal for larger particles
- Poor nutrient removal

Wet Detention

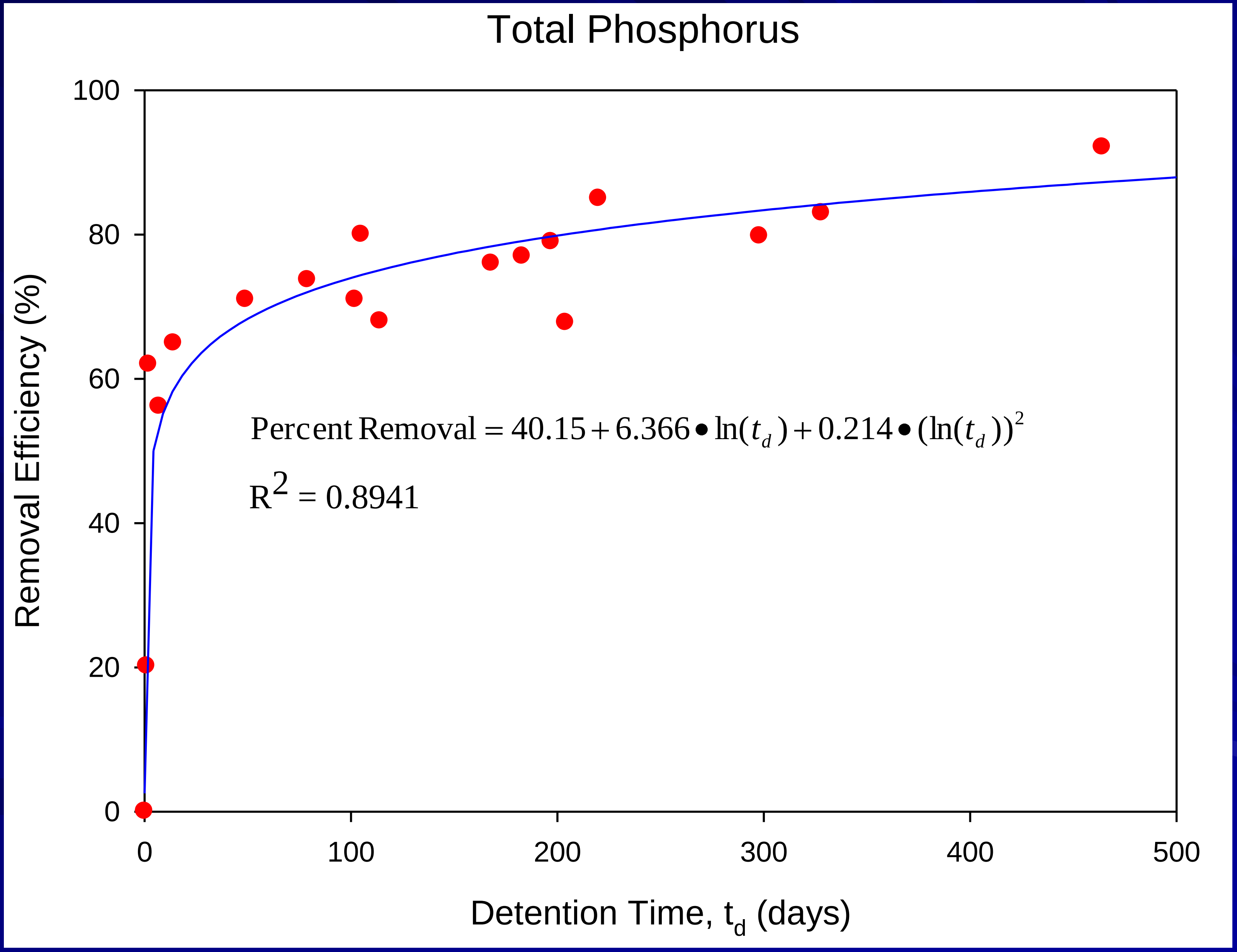


Wet Detention Systems

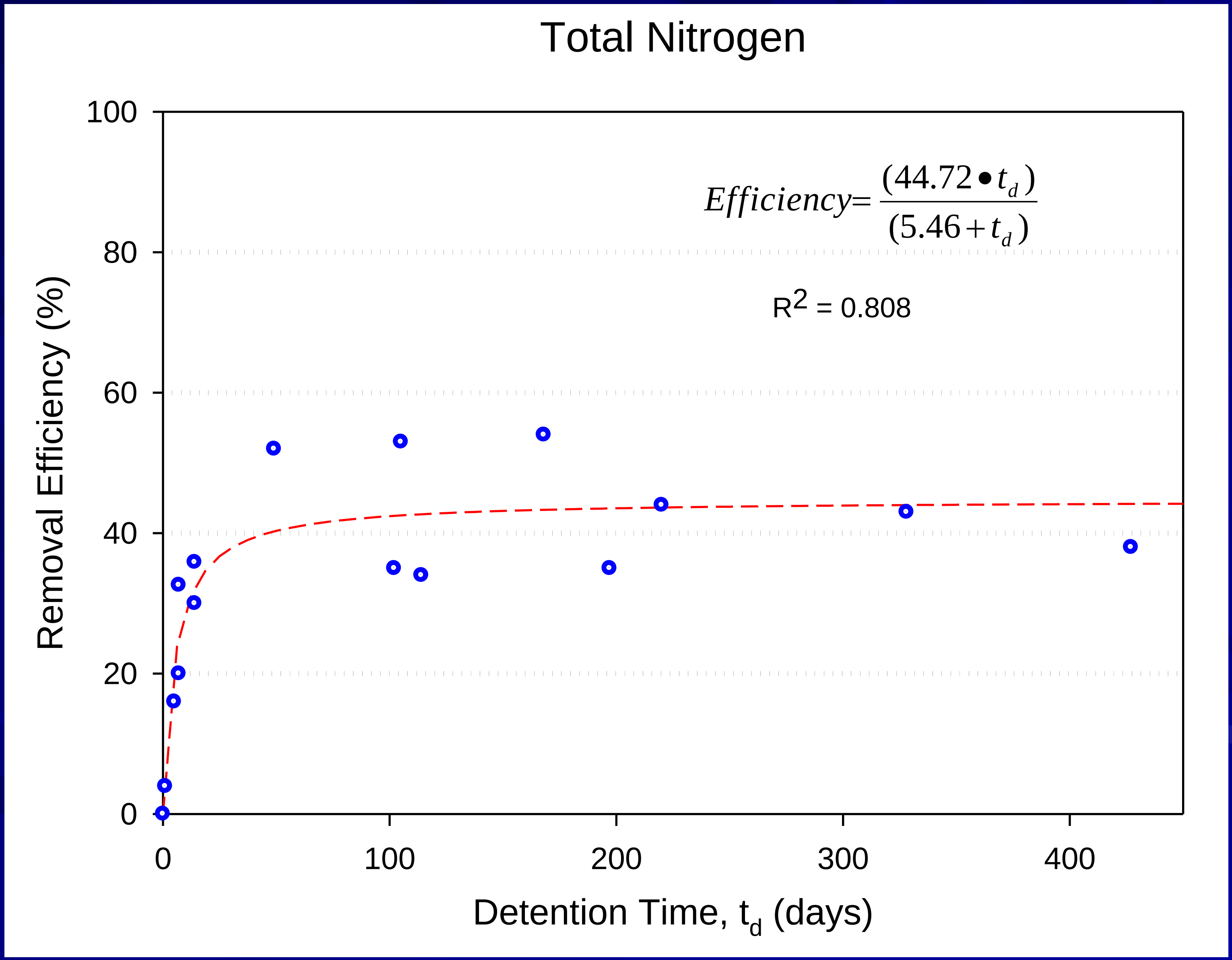
Wet Detention Ponds Can Be Constructed as Amenities

Wet Detention Lakes Can Be Integral to the Overall Development Plan

Phosphorus Removal in Wet Ponds is Primarily a Function of Detention Time



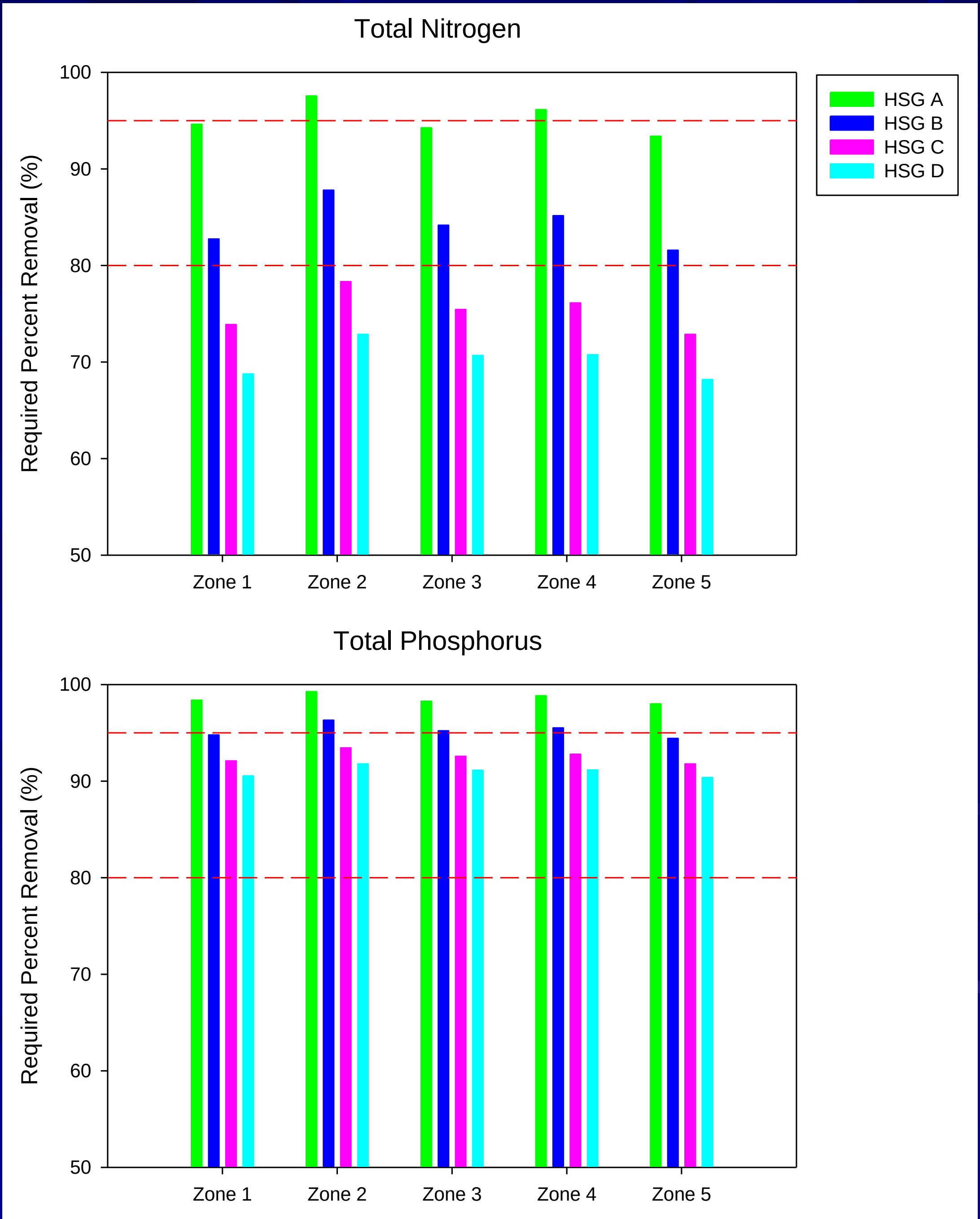
Nitrogen Removal in Wet Ponds



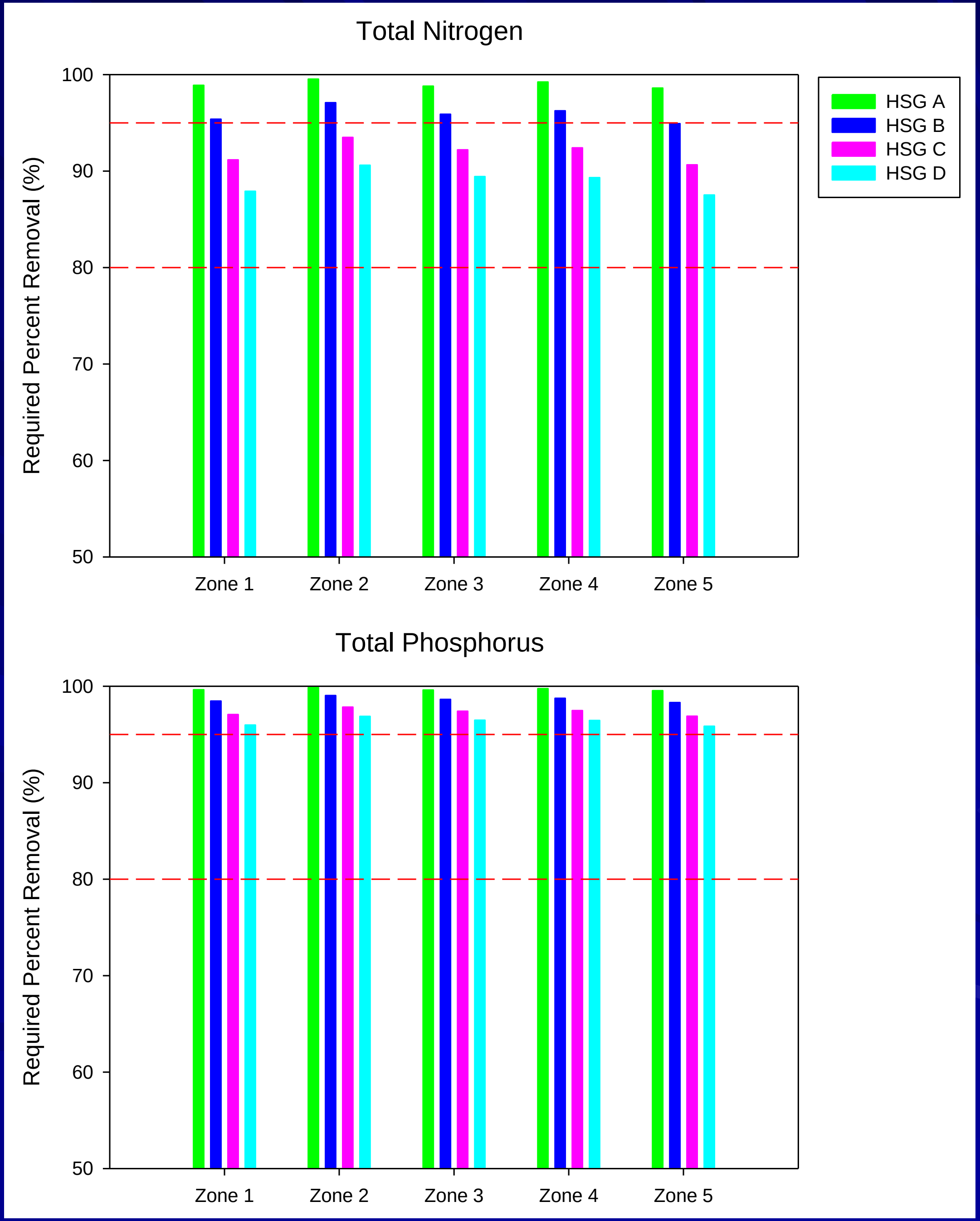
Treatment Efficiencies for Typical Stormwater Management Systems

Type of System	Estimated Annual Removal Efficiencies (%)						
	Total N	Total P	TSS	BOD	Cu	Pb	Zn
Dry Retention	Varies with region and treatment volume Generally 60-75% for existing design criteria						
Wet Detention	25	65	85	55	60	75	85
Dry Detention	Highly variable – depends on pond bottom/GWT relationship						

Required Annual Mass Removal Efficiencies To Achieve Pre<=Post Loadings for Single Family Residential (25% impervious)



Required Annual Mass Removal Efficiencies To Achieve Pre<=Post Loadings for Commercial Development



Conclusions

- Current stormwater design criteria fail to meet the 80% treatment goal
- Additional treatment is required to eliminate or reduce pollutant loadings from new developments