

# DERIVATION OF THE WQBEL FOR PHOSPHORUS IN DISCHARGES TO THE EVERGLADES PROTECTION AREA

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# Water Quality Standards

- ◆ Classifications (Designated Uses)
- ◆ Narrative & Numeric Criteria\*
- ◆ Antidegradation Provision
- ◆ Moderating Provisions

\*derived to protect Designated Use

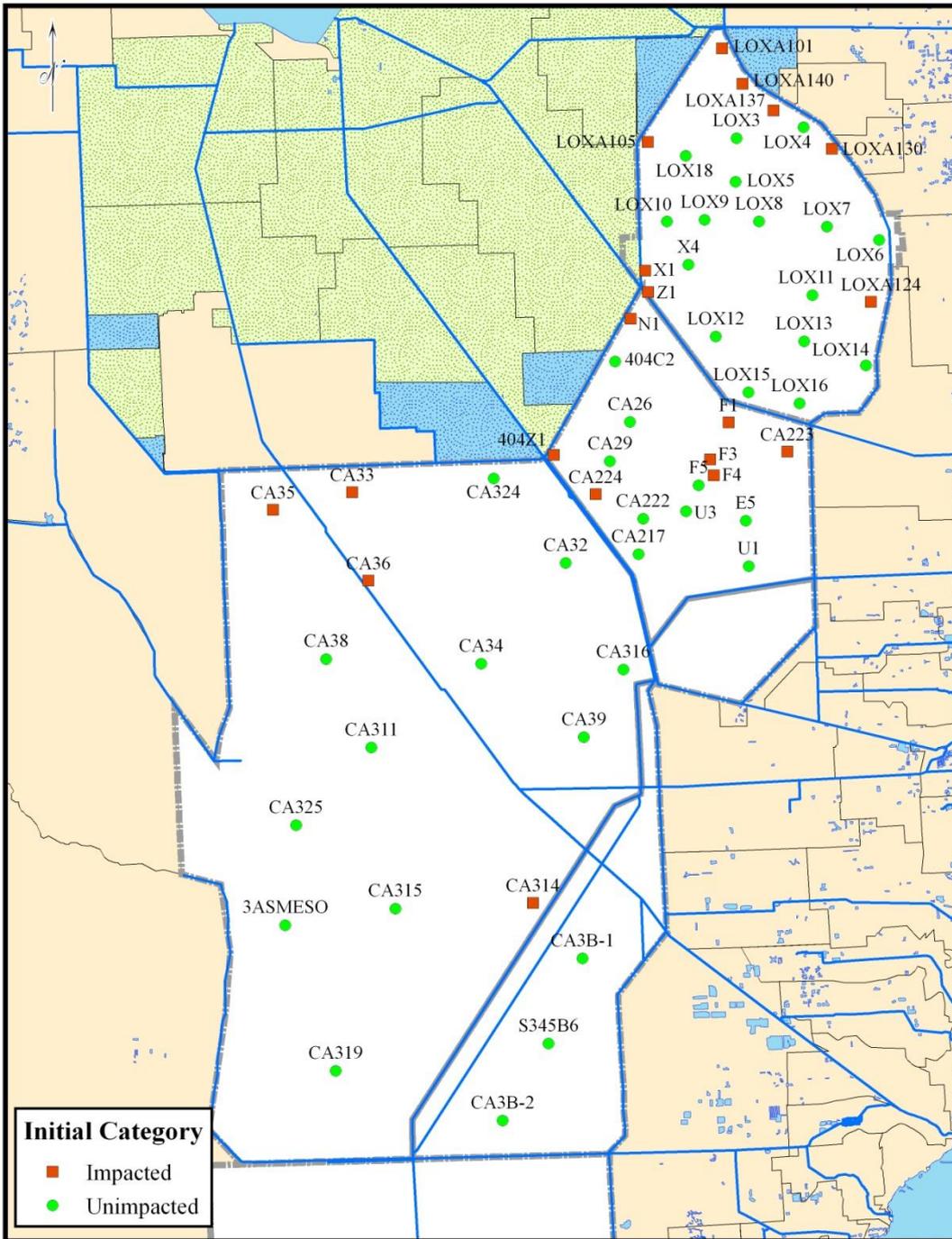
Everglades P criterion -part of the State's water quality standards - specifically derived to protect the Everglades against adverse effects from P enrichment.

# Discharge Limits

- ◆ Associated with permits
- ◆ Derived to achieve criteria
- ◆ Normally expressed as Water Quality Based Effluent Limits (WQBELs) -derived in accordance with Chapter 62-650, Florida Administrative Code.

# What's the difference?

- ◆ In some cases discharge limit & criterion are one in the same (where no translation is necessary to derive the discharge limit from the criterion).
- ◆ That is not the case with the 10 ppb Everglades phosphorus criterion.



# Everglades P Criterion

- ◆ Derived & expressed in rule as **Long-Term Geometric Mean**
- ◆ Rule sets forth how tested on short-term basis
  - ◆ 5-year network GM  $\leq 10$  ppb
  - ◆ 1-year network GM  $\leq 10$  ppb 3 out of 5 years
  - ◆ 1-year network GM  $\leq 11$  ppb
  - ◆ Single station AGM  $\leq 15$  ppb
- ◆ Report results annually in SFER

# Discharge Limits

- ◆ Discharge limits normally expressed as discrete term limits (typically monthly or annually)
- ◆ State's STA permits use Annual Limit
- ◆ Discharge limit not normally expressed as GM of concentrations – more typical as Flow-Weighted Mean
- ◆ FWM more accurately represents effect of variability in flow on concentration of P in discharge

# FWM Equation

$$\text{FWM} = \frac{Q_1 C_1 + Q_2 C_2 + Q_3 C_3 \dots Q_n C_n}{Q_1 + Q_2 + Q_3 \dots Q_n}$$

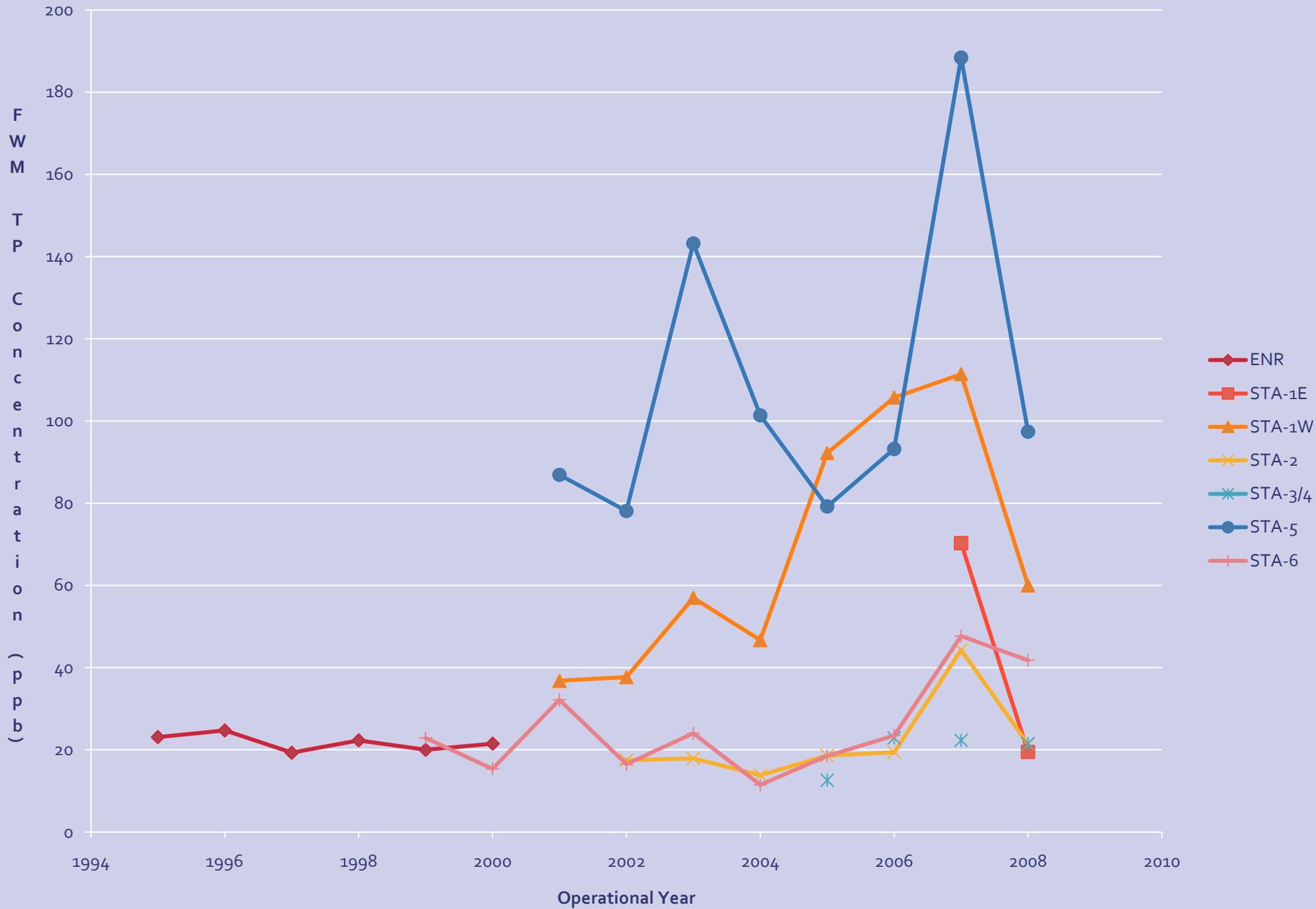
# WQBEL Development

- ◆ Used statistical properties of STA discharge data based on actual historical monitoring data
- ◆ 1995 – 2008 (Only known data set that can be used for this purpose)
- ◆ Since not achieving 10 ppb GM yet, cannot be used directly - Data must be rescaled to 10 ppb
- ◆ Method is same as used for TBEL Limit

# Rescaling Factors

- ◆ Calculated by 2 methods:
  - ◆ 1<sup>st</sup> – GM calculated over entire POR for each STA – rescaling determined as ratio of 10 ppb criterion divided by POR GM (Factors ranged from 0.55 to 0.1)
  - ◆ 2<sup>nd</sup> – calculated as ratio of 10 ppb criterion divided by arithmetic average of AGM (Factors ranged from 0.52 to 0.098)
  - ◆ Both rescaling factors applied to individual STA TP measurements

# Original Annual FW Mean TP Concentrations



# Rescaled Annual FW Mean TP Concentrations



# Derivation of FWM from AGM

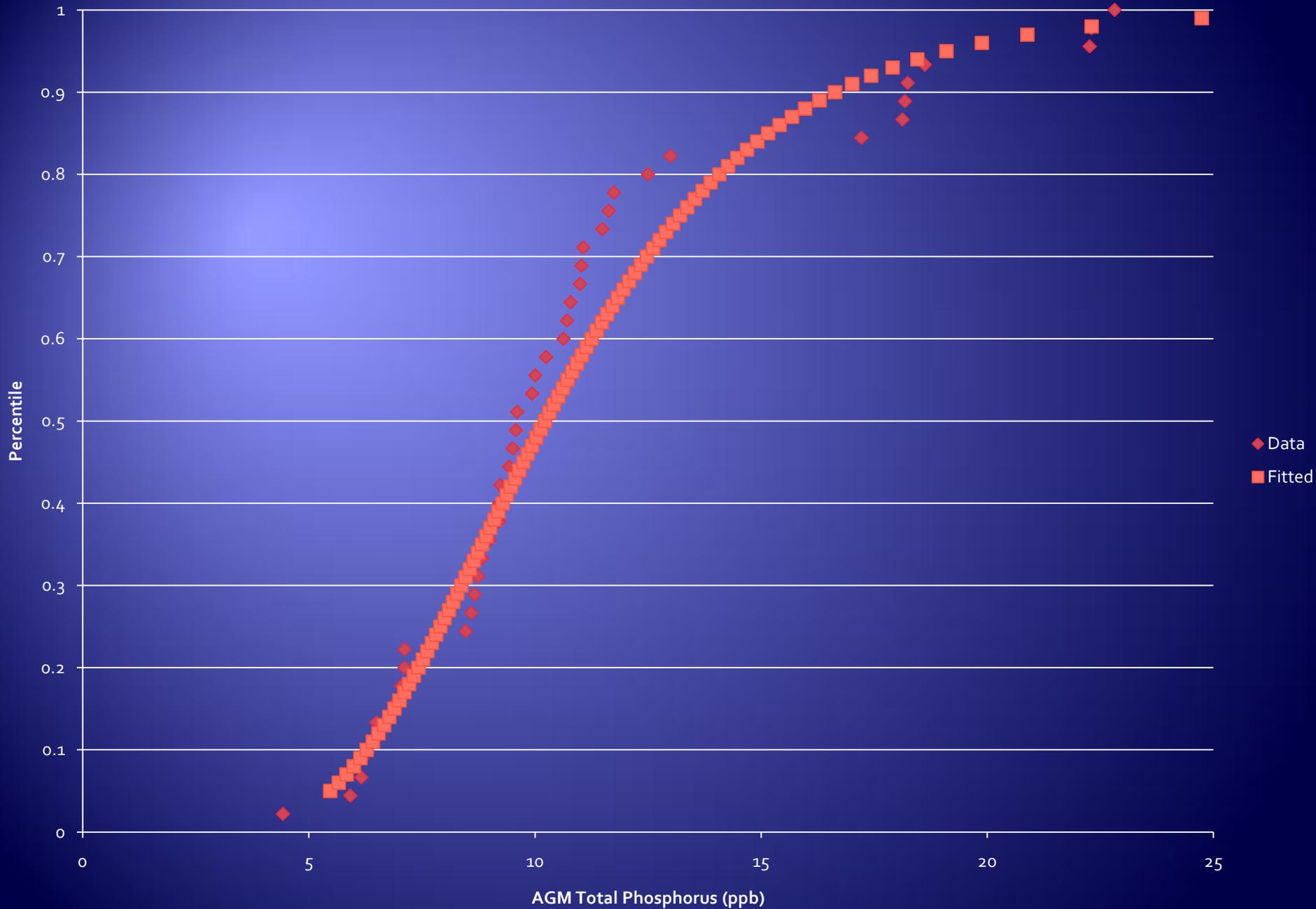
- ◆ Annual FWM calculated from rescaled TP measurements & actual flow data for STA
- ◆ Annual FWMs pooled & used to evaluate relationship between long-term GM of 10 ppb & annual FWMs\*

*\*limited data for many of STAs – necessitates pooling of data to obtain rigorous estimate of discharge under variety of conditions*

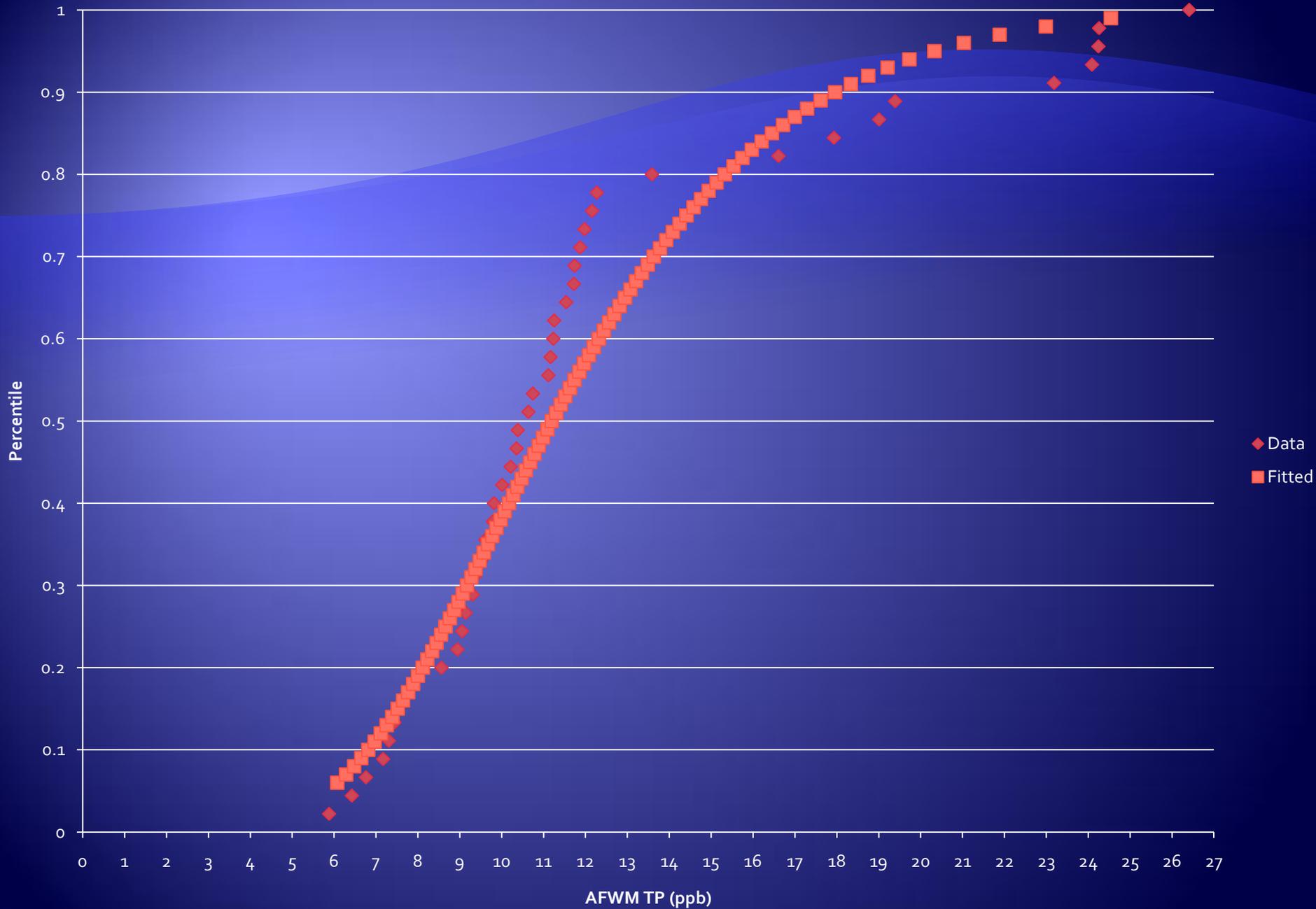
# Maximum Annual Limit Calculation

- ◆ Derived by fitting lognormal frequency distribution to rescaled annual FWM concentration data for pooled data set

# Data & Fitted Distribution (POR GM Method)



# Data & Fitted Distribution (AGM Method)



# Final Derivation

- ◆ Both methods appropriate (neither more appropriate than other)
- ◆ Mean of methods AFWM= 17.4 ppb
- ◆ Walker method 16.0 (SD 0.05)
- ◆ Rounded to 17 ppb for WQBEL

# Application

- ◆ Applied at STA Discharge Structure (multiple structures @ individual STA flow-weighted across all points)
- ◆ Exclusions
  - ◆ Low-flow water supply deliveries
  - ◆ Rainfall in excess or max annual in POR for derivation

