SOUTH FLORIDA WATER MANAGEMENT DISTRICT

WELCOME

Caloosahatchee Minimum Flow and Level Rule Development Workshop

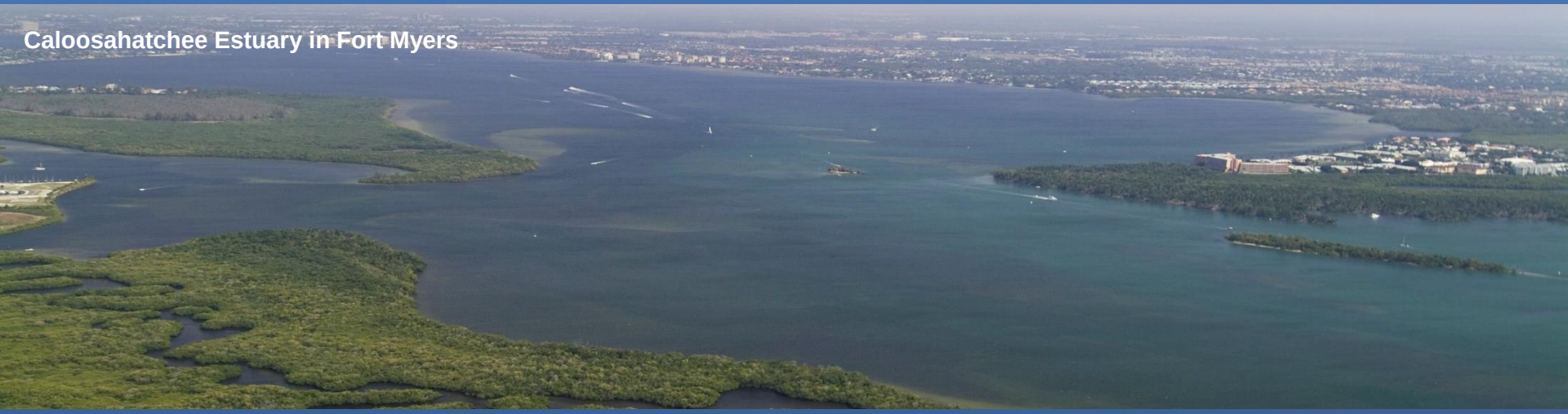
June 20, 2019

sfwmd.gov

Workshop Objectives

- Engage with stakeholders
- Discuss all flow options derived from various supplemental statistical or mathematical options
- With each flow target/range show the percent of time the recovery strategy (C-43 Reservoir) can meet the minimum flows

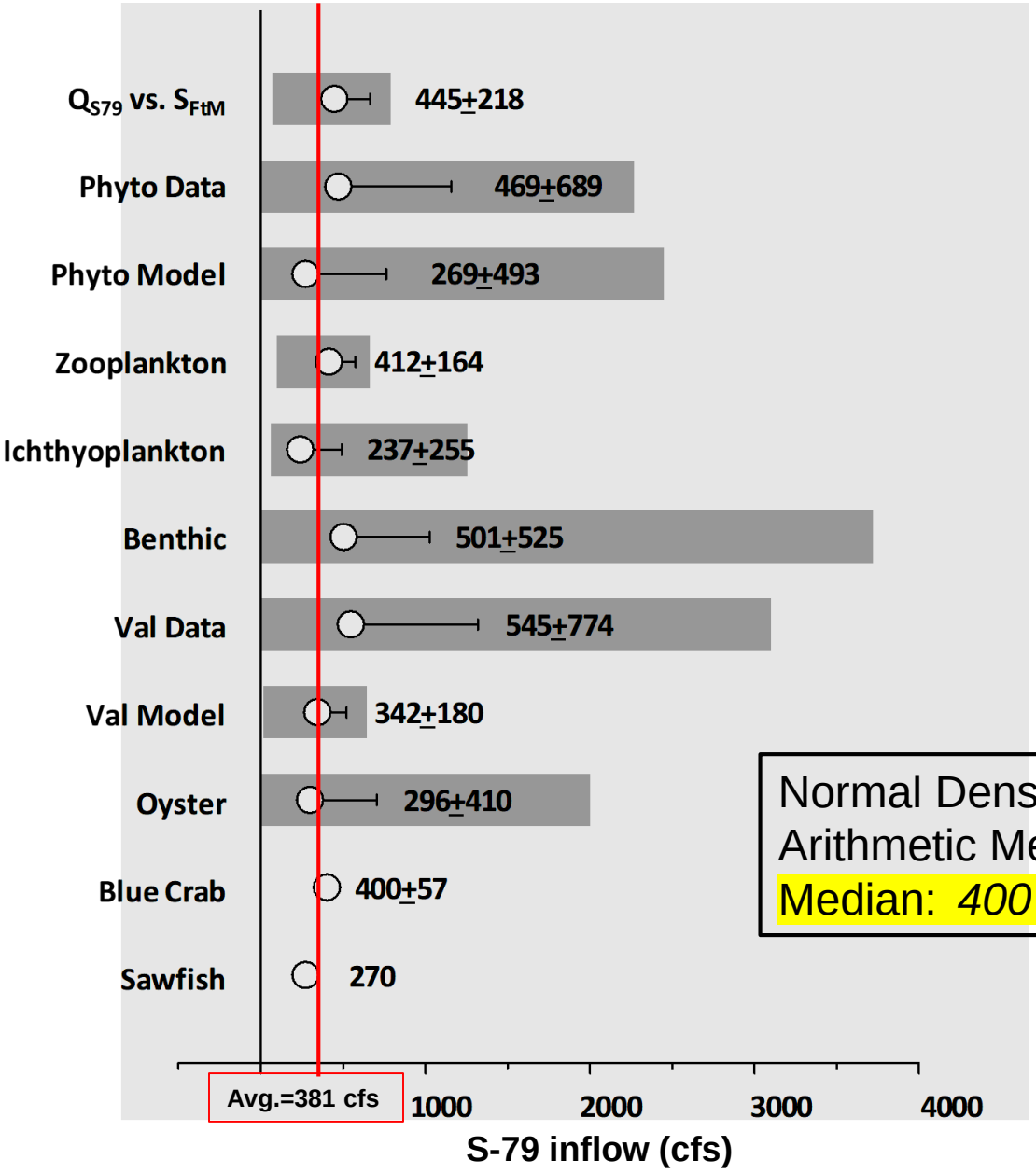
SOUTH FLORIDA WATER MANAGEMENT DISTRICT


Caloosahatchee Estuary in Fort Myers

Flow Target Options for the Caloosahatchee MFL

Cassondra Armstrong, Ph.D.
Section Administrator
June 20, 2019

Original Approach



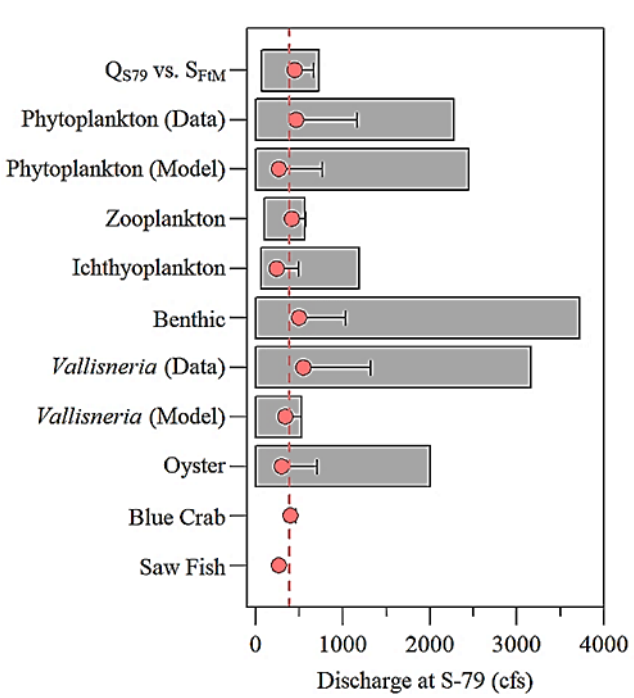
Normal Density: 365 cfs
Arithmetic Mean: 381 cfs
Median: *400 cfs*

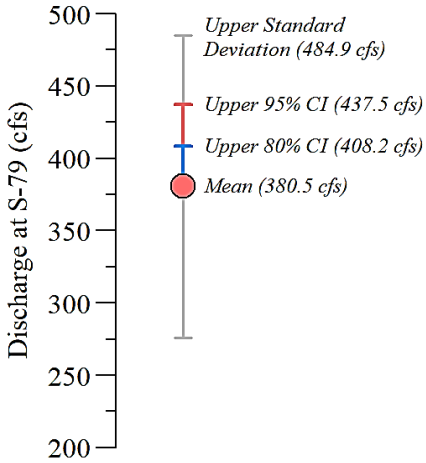
Confidence Interval Approach (P. Julian, FDEP)

- To account for variability around the mean S-79 flow across indicators, upper and lower limits can be derived
- To find the minimum protective flow, the upper confidence interval can be used
- A weighted average can also be used to estimate the upper confidence level by weighting indicators with high variation about the mean less than those with less variability around the mean

Confidence Interval Approach

Description	Statistic	Upper 95%	Upper 80%
Arithmetic Mean of Indicator Q_{S79}, (m) :	*Mean*	380.5	
Standard deviation of Indicator Q_{S79}, (s) :	*StDev*	104.3	
Number of Indicators used in the analysis, N :	*N*	11	
Deg. Of Freedom (DOF) = N-1 :	*Df*	10	
Probability for Prediction Interval :	*1-tail Prob*	0.95	0.80
Student-t Statistic (tp) :	*Tp*	1.81	0.88
Limit = $m + s \times \frac{t_p}{\sqrt{N}}$:	*Discharge Limit*	**437 cfs**	**408 cfs**



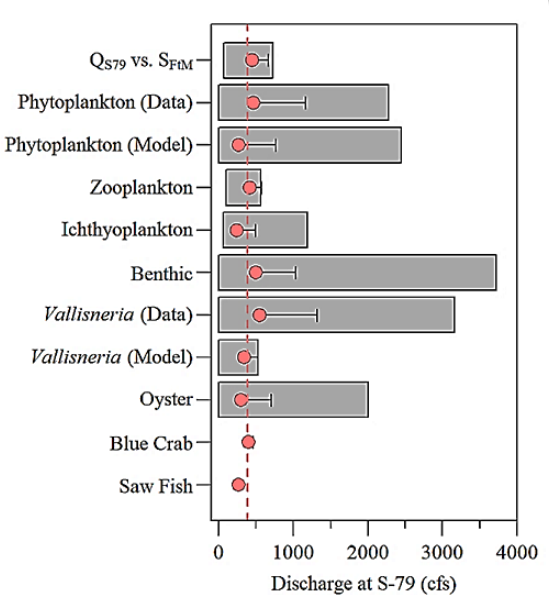


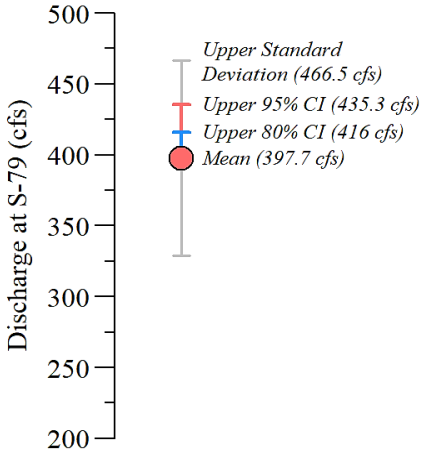
A 95% or 80% Confidence Interval could be applied.

Adapted from power point from: Dr. Paul Julian (FDEP)

Weighted Mean Confidence Interval Approach

Description	Statistic	Upper 95%	Upper 80%
Weighted Mean of Indicator Q_{S79}, (m) :	*Mean*	397.7	
Weight Standard deviation of Indicator Q_{S79}, (s) :	*StDev*	68.8	
Number of Indicators used in the analysis, N :	*N*	10	
Deg. Of Freedom (DOF) = N-1 :	*Df*	9	
Probability for Prediction Interval :	*1-tail Prob*	0.95	0.80
Student-t Statistic (tp) :	*Tp*	1.83	0.88
Limit = $m + s \times \frac{t_p}{\sqrt{N}}$:	*Discharge Limit*	**437 cfs**	**417 cfs**





- Weighting done using the inverse coefficient of variation (1/CV). Where:
  - High CV = weighted less
  - Low CV = weighted more

Adapted from power point from: Dr. Paul Julian (FDEP)

City of Sanibel / Environmental Science Associates Approach

- Relationship between monthly average flow at S-79 and average monthly salinity at Ft. Myers
  - Method – Evaluate data by month to assess what flow is required to meet a salinity of 10 at Ft. Myers 80% of the time

- Model the relationship between monthly average flow at S-79 vs monthly average salinity at Ft. Myers
  - Method – solve the derived regression equation for $S_{FtM} = 10$

City of Sanibel / Environmental Science Associates Approach

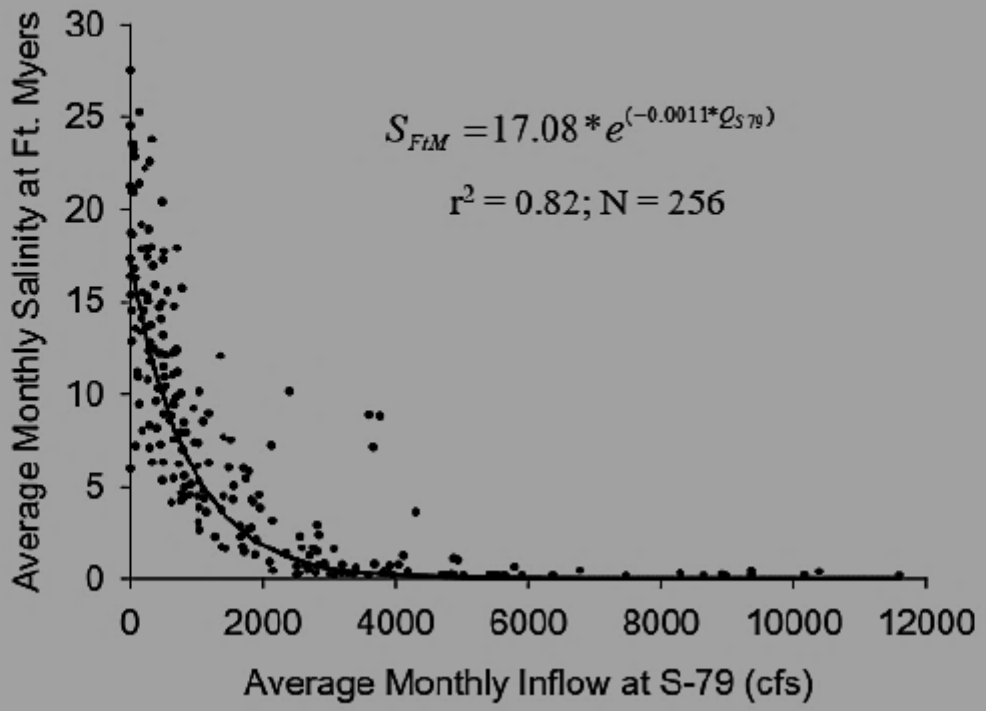
Table 3 – Approximate flow thresholds (in units of 100 cfs) that would result in at least an 80% probability of producing monthly average salinities of 10 ppt or lower.

Month	Approximate flow threshold (cfs)
Jan	700
Feb	500 to 600
Mar	400
Apr	500
May	600 to 700
Jun	400
Jul	400
Aug	400
Sept	400
Oct	400
Nov	400
Dec	500 to 600

Taken from 6/12/19 Memorandum from: Dr. David Tomasko (ESA) & James Evans (City of Sanibel), pg. 7

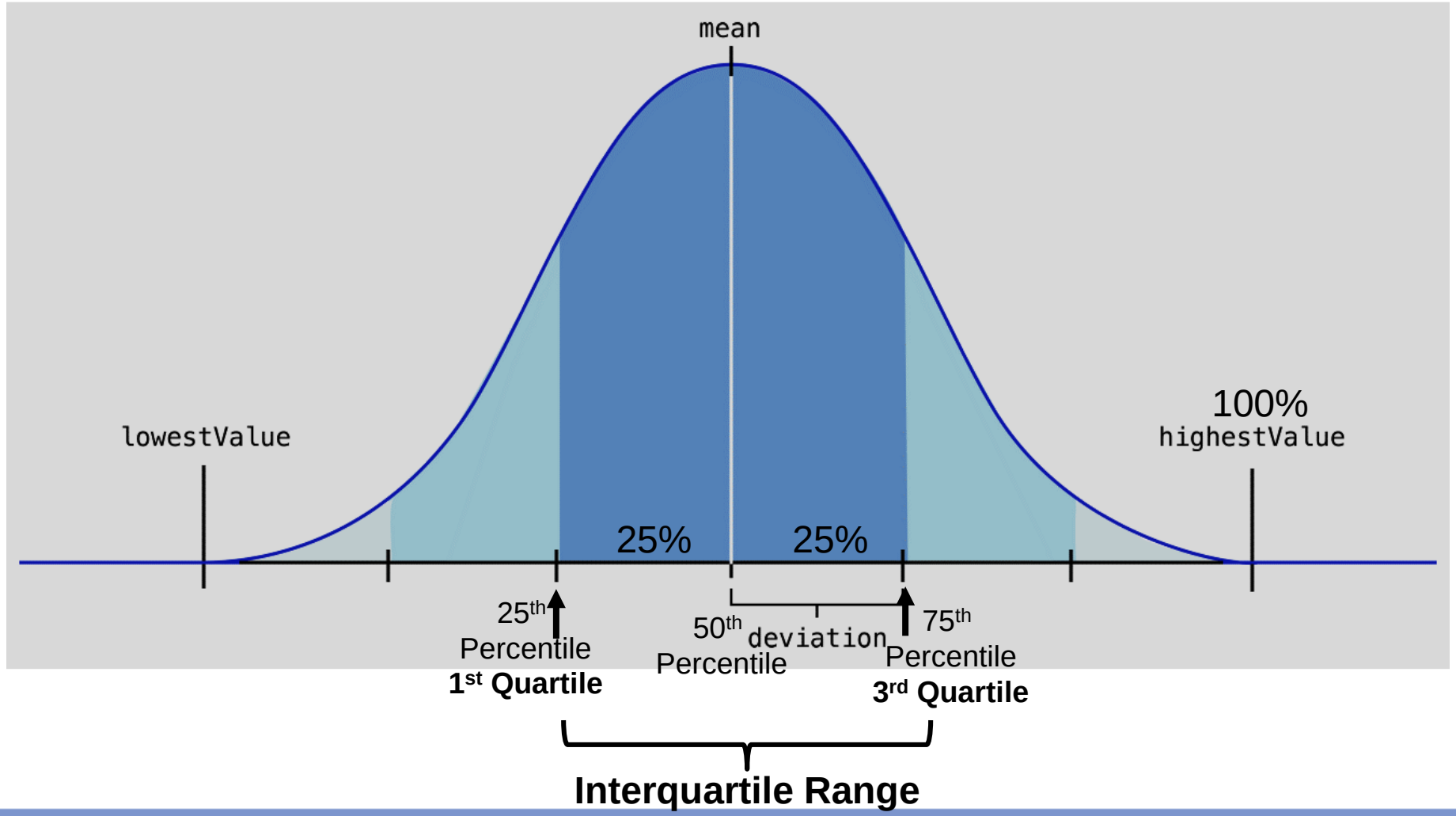
City of Sanibel / Environmental Science Associates Approach

Figure 3 – Average monthly flow at S-79 vs. average monthly salinity at Ft. Myers for the period of WY 1993 to WY2013. (Figure A-13(b) from District, 2018).



Taken from 6/12/19 Memorandum from: Dr. David Tomasko (ESA) & James Evans (City of Sanibel), pg. 8

Interquartile Range Approach



Interquartile Range Approach

- Choose the flow at S-79 at the 75th percentile

Method	25th percentile	50th percentile	75th percentile
Indicator Mean	311 cfs	381 cfs	**451 cfs**
Indicator Median	283 cfs	*400 cfs*	**457 cfs**

Tidal Basin Flow Approach

- Based on the WaSh model, calibrated and verified with 39 period-of-record data, account for relative percent contribution of tidal basin flow under given flow at S-79
- A flow-based change that considers normal dry season conditions

Tidal Basin Flow Approach

- Amend flow at S-79 to account for additional contributions from tidal basin
- Average dry-season contribution of S-79 is 82% of the total inflow

Method	S-79 (82%)	Tidal Basin (18%)	Total Flow (100%)
Indicator Mean	381 cfs	84 cfs	**465 cfs**
Indicator Median	*400 cfs*	87 cfs	**487 cfs**

Summary

Flow (cfs)	Source	Method
400	SFWMD	Median of resource-based multi indicator Approach
408	P. Julian (FDEP)	Upper 80% CI of Mean of Indicators
417	P. Julian (FDEP)	Upper 80% CI of Weighted Mean of Indicators
437	P. Julian (FDEP)	Upper 95% CI of Non & Weighted Mean of Indicators
451	SFWMD	75% Interquartile of Indicator Mean
457	SFWMD	75% Interquartile of Indicator Median
465	SFWMD	Addition of 18% tidal basin contribution to Indicator mean
487	SFWMD ESA/City of Sanibel	Addition of 18% Tidal Basin contribution to Indicator median Solve for regression of average monthly salinity at Ft. Myers and flow at S-79

Recovery of Caloosahatchee River MFL

- Subsection 373.0421(2), Florida Statutes.
- All options evaluated to determine the ability of the approved recovery strategy (C-43 Reservoir performance) to meet the MFL

C-43 Reservoir Performance

- **C-43 Reservoir Model with Future Condition Base simulation**
- **Percent of time (months) the flow target is met (1965-2005)**

FCB_400	FCB_408	FCB_417	FCB_437	FCB_451	FCB_457	FCB_465	FCB_487
97.2%	95.3%	94.7%	93.1%	88.8%	88.4%	87.2%	85.2%

* The future condition base (FCB) model simulation is used because Subsections 373.0421(2), F.S., and 62-40.473(5), F.A.C., require a 20-year planning horizon to determine if the MFL is met.

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Public Discussion

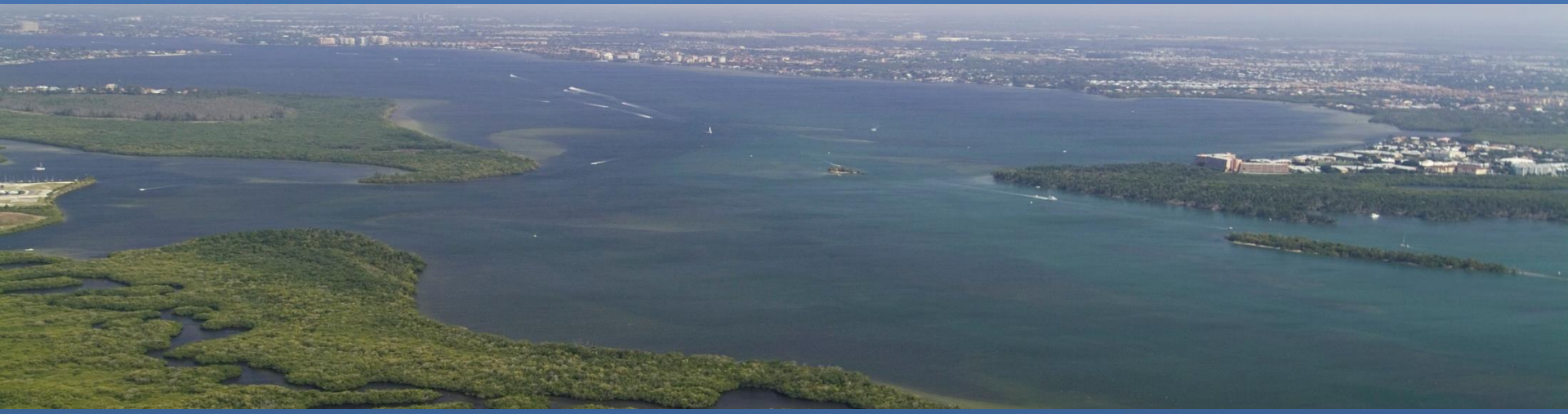
Caloosahatchee Minimum Flow and Level Rule Development Workshop

June 20, 2019

Next Steps

- June 30, 2019 – All Written Public Comments Due
  - Submit all letters or comments to:

    Don Medellin at dmedelli@sfwmd.gov
- July 11, 2019 – Governing Board Meeting



Questions

Caloosahatchee MFL Draft Rule Criteria

Proposed revision to Caloosahatchee MFL rule based on "Best Available Information", including scientific studies, modeling and peer review conducted over the past 8 years

- **Magnitude:** 30-day moving average flow of 400 cfs at S-79
- **Duration:** An MFL exceedance occurs during a 365-day period when the 30-day moving average flow at S-79 is below 400 cfs and the 30-day moving average salinity exceeds 10 at the Ft. Myers salinity monitoring station
- **Return Frequency:** An MFL violation occurs when an exceedance occurs more than once in a five-year period

Note: MFL exceedances are expected until the recovery strategy is completed and operational

Existing MFL Criteria

- MFL rule initially adopted in 2001
- Based on salinity tolerance of a single ecological indicator - tape grass (*Vallisneria*)
- Mean monthly flow of 300 cfs at S-79
- MFL exceedances are based on salinity criteria
- 2000 peer review recommendation: MFL should be set on a suite of additional indicators within the upper and lower estuary