Testing Restoration Strategies Modeling Assumptions against STA-2 & STA-34 Data   Best Prototypes for STAs Operating in WQBEL Range

Assumptions = All Parameters Specified in SFWMD's DMSTA Input File (Calibrations, Areas, Hydraulics, Flow Distrib., Seepage, Etc)   Duty Cycle =   1
Symbols = Observed, Lines = 80% Prediction Interval (10th to 90th Percentiles)   Inflow & Outflow Data from Permit Monitoring Stations
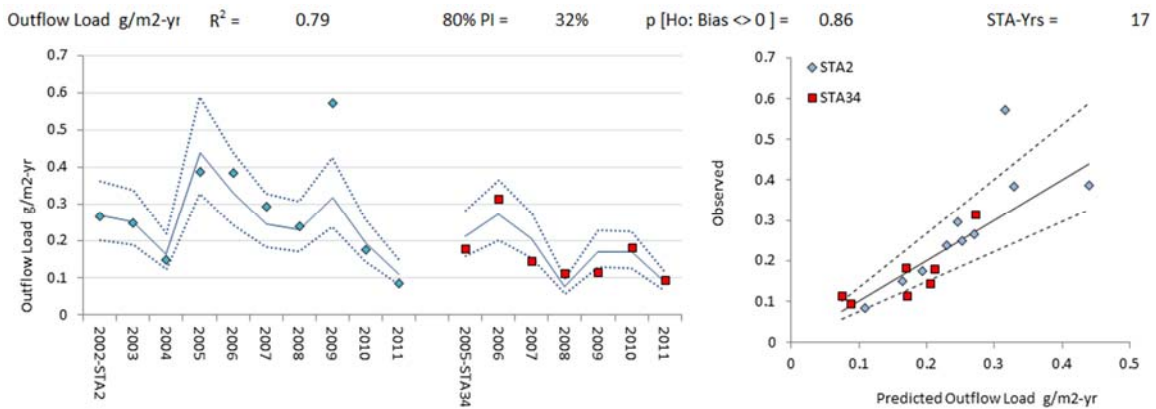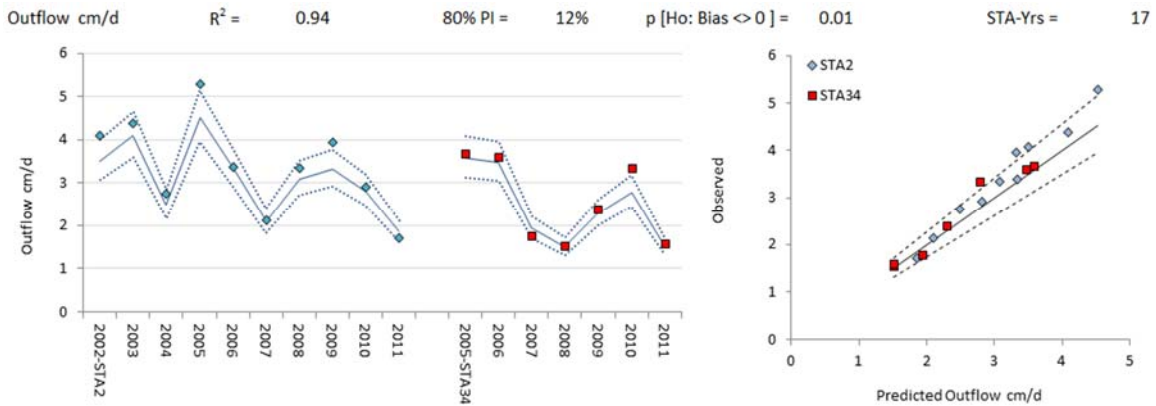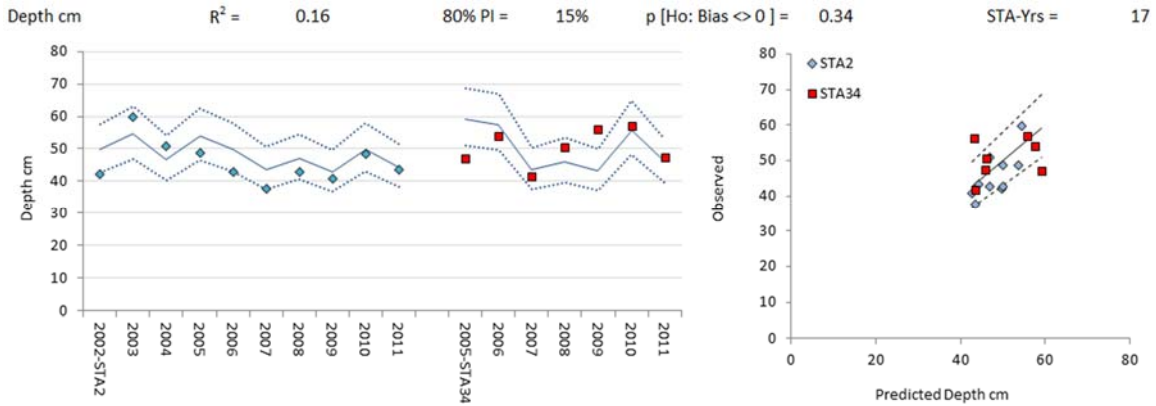X - Axis = Approximate Water Year, 360-Day Averages Ending in April Computed from 30-Day Model Output
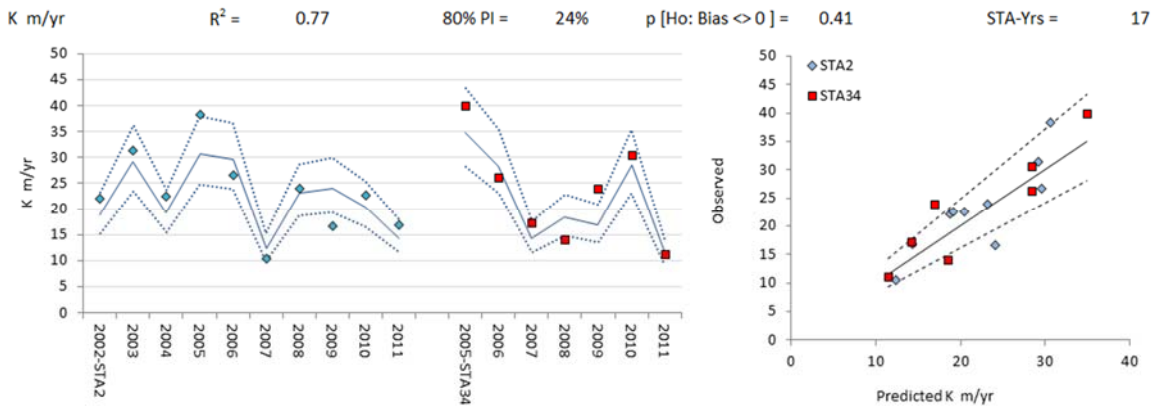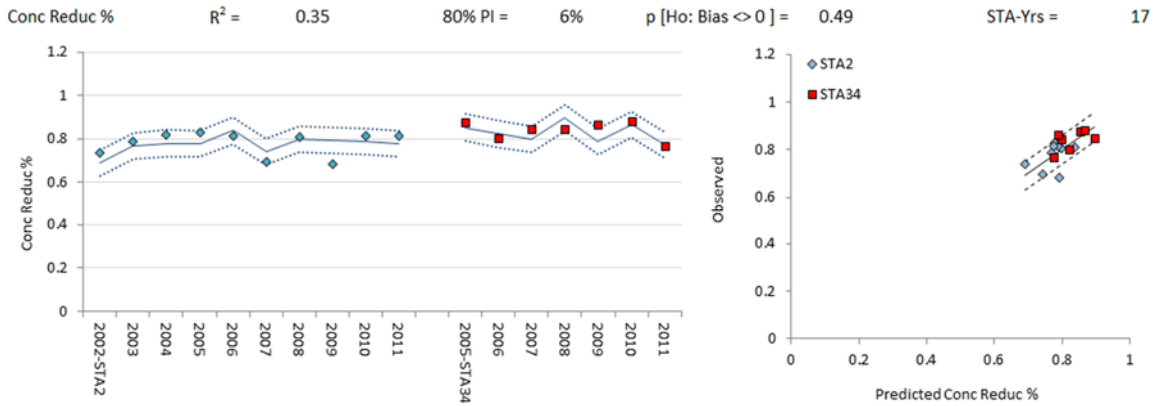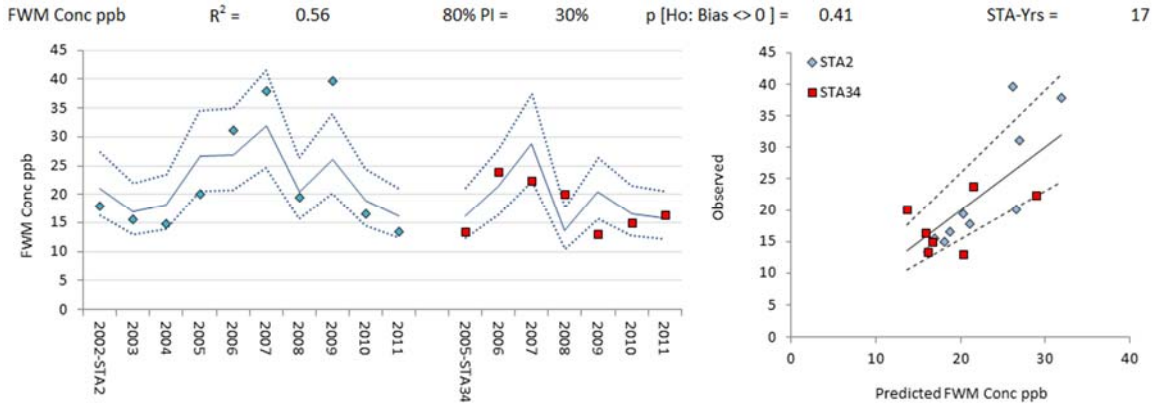Data from STA-34 provide a powerful test of assumptions because they were not used in calibrating DMSTA. Calibration of hydraulic parameters may improve the fit.
With the exception of flow, there is no evidence of bias in the long-term means and the model explains considerable variance (79% for load, 56% for concentration).
Results for flow (under-estimation in wet years) would trigger further investigation of water budget components, hydraulic calibrations, and measurements.
Outliers can be explored with reference to operational records and other variables to identify potential causal factors.

Depth cm R^2 =   0.16   80% PI =   15%   p [Ho: Bias <> 0] =   0.34   STA-Yrs =   17

Outflow cm/d R^2 =   0.94   80% PI =   12%   p [Ho: Bias <> 0] =   0.01   STA-Yrs =   17

Outflow Load g/m2-yr R^2 =   0.79   80% PI =   32%   p [Ho: Bias <> 0] =   0.86   STA-Yrs =   17

FWM Conc ppb R^2 =   0.56   80% PI =   30%   p [Ho: Bias <> 0] =   0.41   STA-Yrs =   17

Conc Reduc % R^2 =   0.35   80% PI =   6%   p [Ho: Bias <> 0] =   0.49   STA-Yrs =   17

K m/yr R^2 =   0.77   80% PI =   24%   p [Ho: Bias <> 0] =   0.41   STA-Yrs =   17

Tracking STA Performance Relative to Restoration Strategies Modeling Assumptions   Variable: FWM Conc ppb
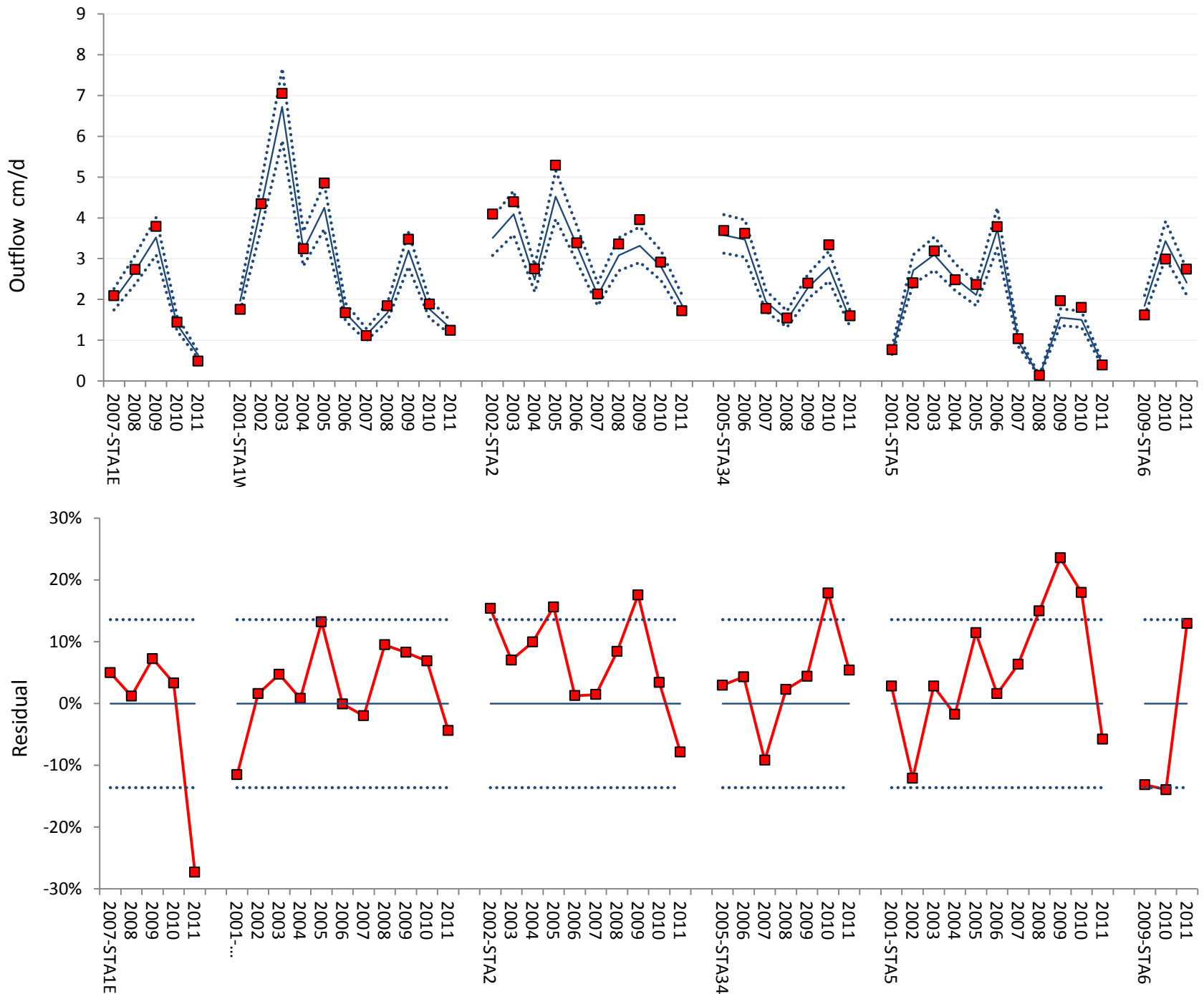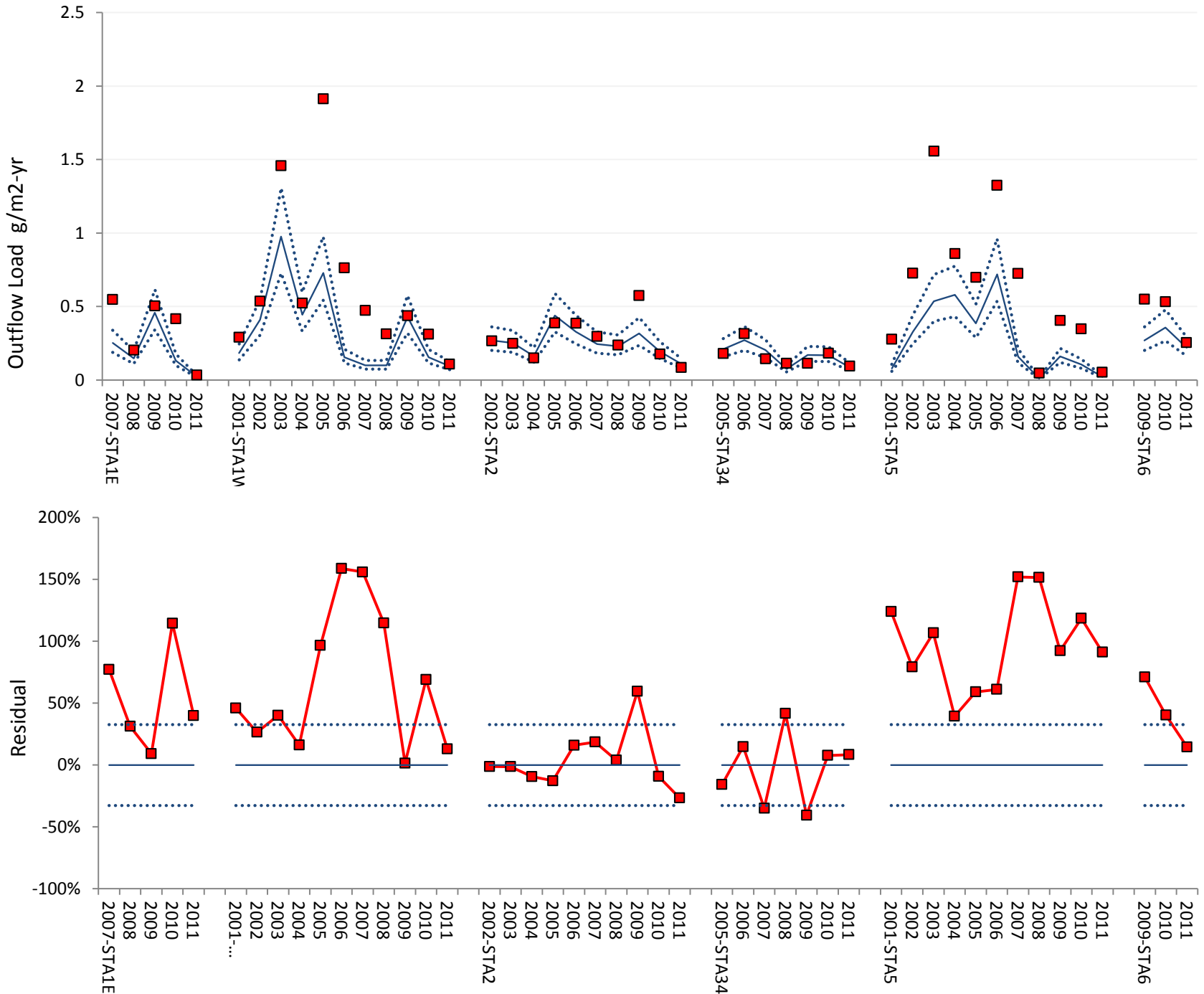

X - Axis = approximate water year (360 day averages computed from 30-day model output)   SFWMD data thru Water Year 2011
Red Symbols = observed values for combined STA outflow measured at permit structures.   STA mean depths are area-weighted means across cells.
Blue Lines = DMSTA simulations with Restoration Strategies assumptions (calibrations, hydraulics, area, flow distribution, seepage, etc..). Duty Cycle = 1.0
Dashed Lines = 80% prediction interval based upon residual error distribution for prototype datasets (STA-2 & STA34) =   30% R^2 =   0.56
Active flow paths: STA1E (C&W)   STA1W (All)   STA2 (Cells 1,2,3)   STA34 (All)   STA5 (Cells 1-2)   STA6 (Cells 2,3,5)
Top: observed & predicted time series.
Bottom: Residuals = ln (observed / predicted Value) ~ error as a percentage of predicted.   [observed - predicted for Conc Reduction]

Residuals filter out variations driven by factors considered in DMSTA (inflow volume, load, rainfall, etc). Enables focus on long-term mean & trends.
Residual variance reflects some combination of (1) random measurement error in the observed input & output data, (2) bias in model parameter estimates,
(3) factors not considered in the model structure; (4) artifacts related to atypical operation; (5) deviation from RS design assumptions.
Investigation of outliers and systematic patterns in the residuals can help to partion the variance components and test hypotheses.
Recalibration of DMSTA P cycle and hydraulic parameters may reduce residual variance.   Restructuring the model can also be explored.
This analysis tracks the net overall performance based upon data from inflow and outflow structures used for permit compliance.
The individual flow path data are of lower quality will be analyzed and used in updating the model calibrations and structure, as appropriate.
Simulations assume a Duty Cycle of 1.0.   Predicted values of concentration & load would be slightly higher with a Duty Cycle of 0.95 (RS assumption).
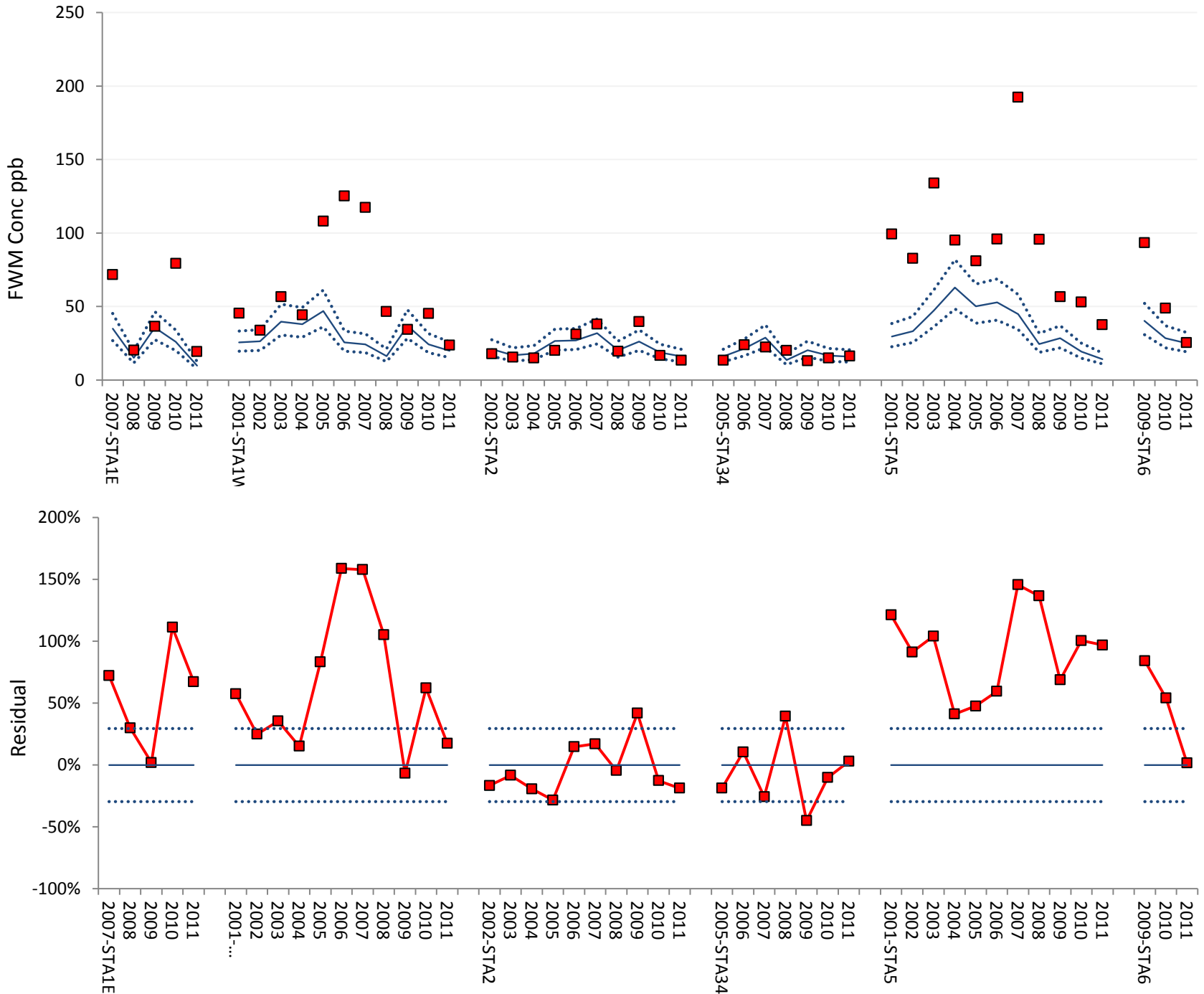
DMSTA, RS design simulations, and compliance measurements assume long-term operation with all features in place and stabilized.
STA-2 & STA-34 are the best prototypes for evaluating design assumptions because of ~steady operation in low concentration ranges (13 - 40 ppb).
Results indicate that the RS design assumptions are consistent with the STA-2+34 data (17 STA-years) for depth, flow, load, and FWM concentration.
Performance of the other STAs has been impaired by partial operation, construction, vegetation conversion, damage repair, overloading, etc.
We do not expect agreement between observed and predicted values until they are in more or less steady operation for a few years.
Convergence would be expected as the STAs stabilize if their performance is consistent with DMSTA calibrations & other RS design assumptions.
DMSTA input files can be adjusted each year to reflect the RS plan features that have been implemented.
Performance inconsistent with design assumptions can be identified well before all of the RS projects are in place and stabilized.
Persistent excursions may indicate a need to revise performance projections and make appropriate adjustments to the design using an updated model.
The tracking mechanism can be refined in the future with improvements to the model and recalibration of hydraulic and P cycling input parameters.
Since most of the observed concentrations are >15 ppb, DMSTA will be used within its 2005 calibration envelope until concentrations decrease significantly.
As additional data below 15 ppb are accumulated and Science Plan research results are available, the model and performance forecasts can be updated.

11/01/12   WWW   DRAFT

Tracking STA Performance Relative to Restoration Strategies Modeling Assumptions   Variable: Outflow cm/d

X - Axis = approximate water year (360 day averages computed from 30-day model output)   SFWMD data thru Water Year 2011
Red Symbols = observed values for combined STA outflow measured at permit structures. STA mean depths are area-weighted means across cells.
Blue Lines = DMSTA simulations with Restoration Strategies assumptions (calibrations, hydraulics, area, flow distribution, seepage, etc..). Duty Cycle = 1.0
Dashed Lines = 80% prediction interval based upon residual error distribution for prototype datasets (STA-2 & STA34) =   14% R^2 =   0.92
Active flow paths: STA1E (C&W)   STA1W (All)   STA2 (Cells 1,2,3)   STA34 (All)   STA5 (Cells 1-2)   STA6 (Cells 2,3,5)
Top: observed & predicted time series.
Bottom: Residuals = ln (observed / predicted Value) ~ error as a percentage of predicted. [observed - predicted for Conc Reduction]

10/30/12   WWW   DRAFT

Tracking STA Performance Relative to Restoration Strategies Modeling Assumptions   Variable: Outflow Load g/m2-yr
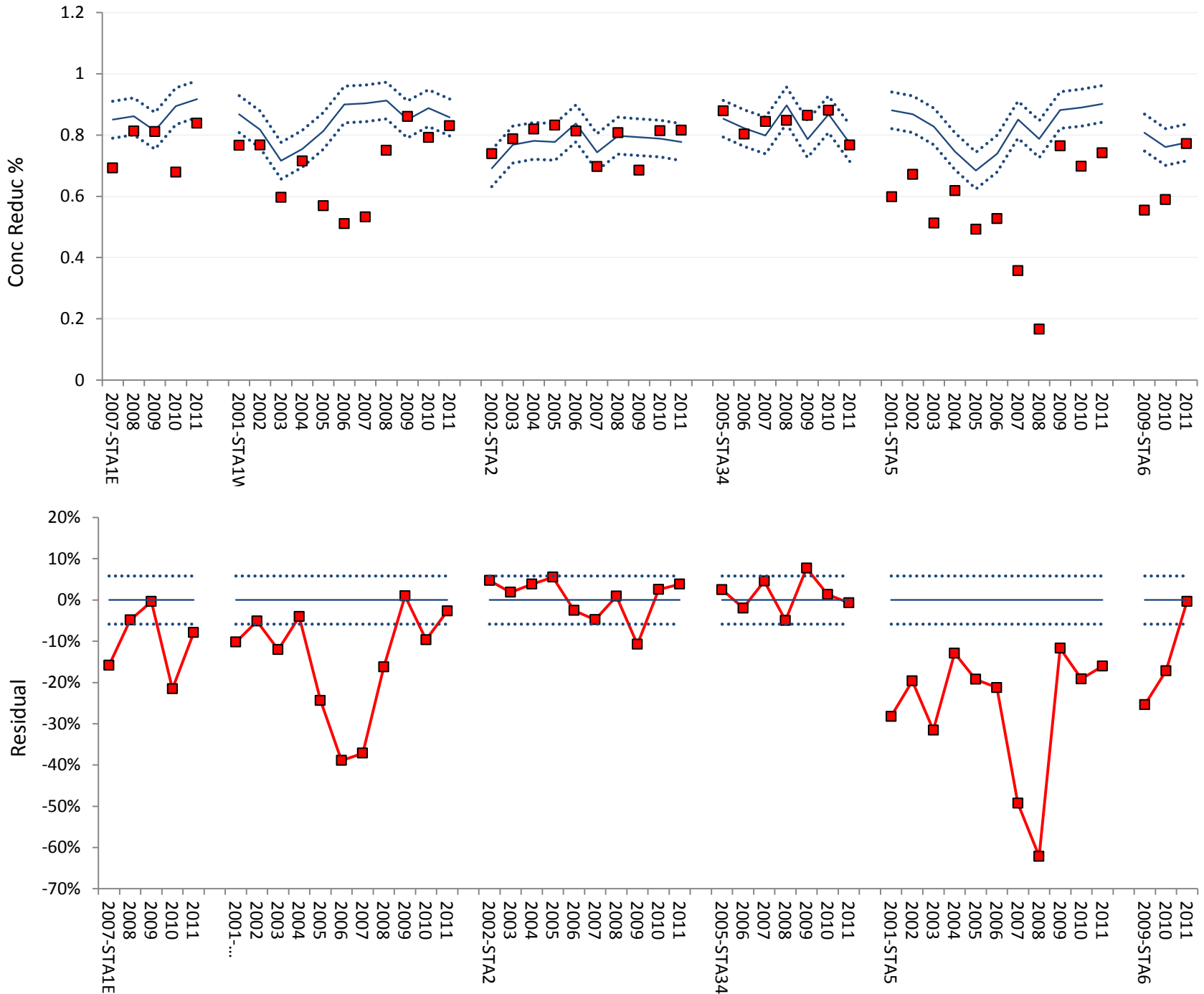

X - Axis = approximate water year (360 day averages computed from 30-day model output)   SFWMD data thru Water Year 2011

Red Symbols = observed values for combined STA outflow measured at permit structures. STA mean depths are area-weighted means across cells.

Blue Lines = DMSTA simulations with Restoration Strategies assumptions (calibrations, hydraulics, area, flow distribution, seepage, etc..). Duty Cycle = 1.0

Dashed Lines = 80% prediction interval based upon residual error distribution for prototype datasets (STA-2 & STA34) =   33% R^2 =   0.77

Active flow paths: STA1E (C&W)   STA1W (All)   STA2 (Cells 1,2,3)   STA34 (All)   STA5 (Cells 1-2)   STA6 (Cells 2,3,5)

Top: observed & predicted time series.

Bottom: Residuals = ln (observed / predicted Value) ~ error as a percentage of predicted. [observed - predicted for Conc Reduction]

10/30/12   WWW   DRAFT

Tracking STA Performance Relative to Restoration Strategies Modeling Assumptions   Variable: FWM Conc ppb
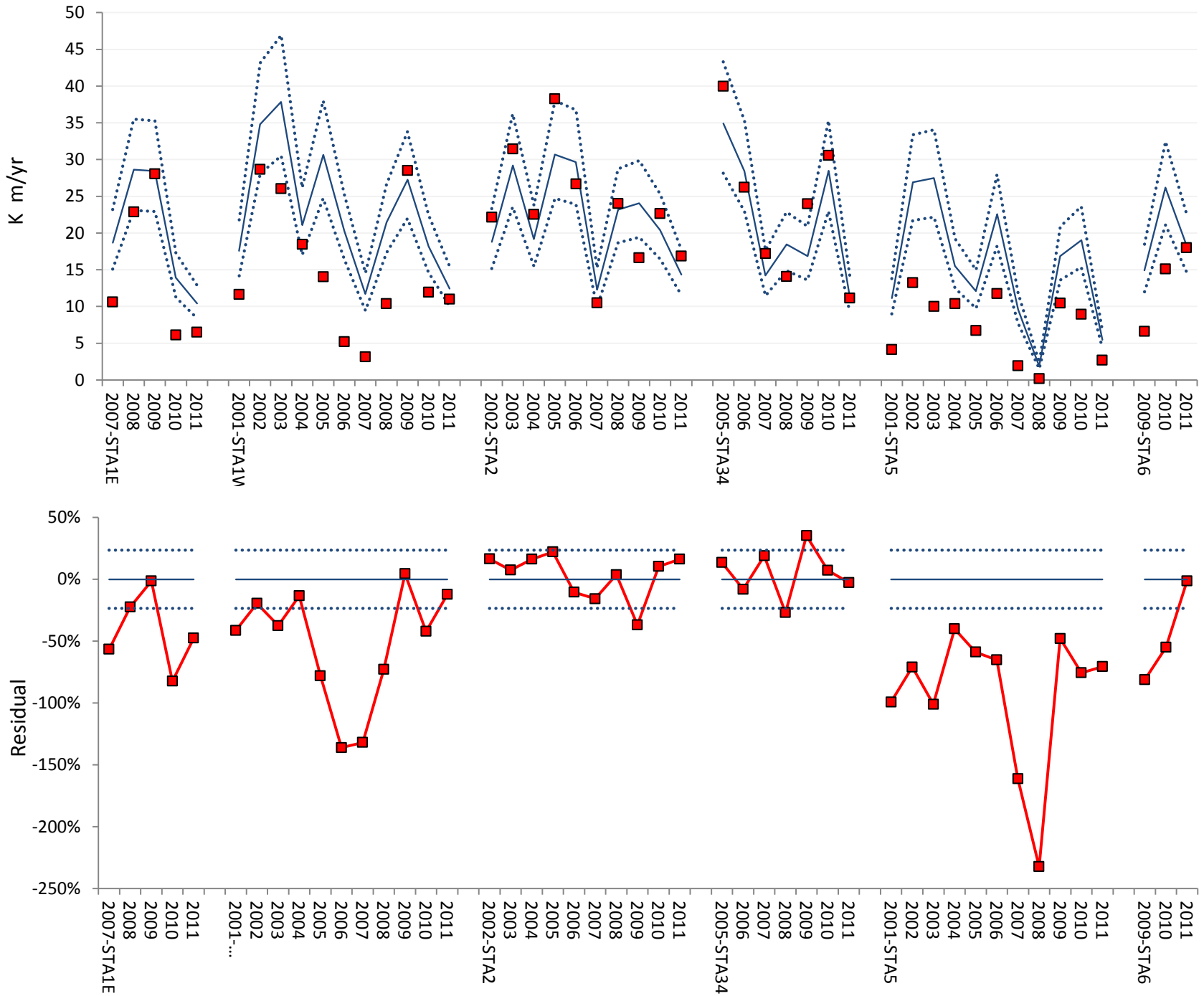

X - Axis = approximate water year (360 day averages computed from 30-day model output)   SFWMD data thru Water Year 2011
Red Symbols = observed values for combined STA outflow measured at permit structures. STA mean depths are area-weighted means across cells.
Blue Lines = DMSTA simulations with Restoration Strategies assumptions (calibrations, hydraulics, area, flow distribution, seepage, etc..). Duty Cycle = 1.0
Dashed Lines = 80% prediction interval based upon residual error distribution for prototype datasets (STA-2 & STA34) =   30% R^2 =   0.56
Active flow paths: STA1E (C&W)   STA1W (All)   STA2 (Cells 1,2,3)   STA34 (All)   STA5 (Cells 1-2)   STA6 (Cells 2,3,5)
Top: observed & predicted time series.
Bottom: Residuals = ln (observed / predicted Value) ~ error as a percentage of predicted. [observed - predicted for Conc Reduction]

10/30/12   WWW   DRAFT

Tracking STA Performance Relative to Restoration Strategies Modeling Assumptions   Variable: Conc Reduc %
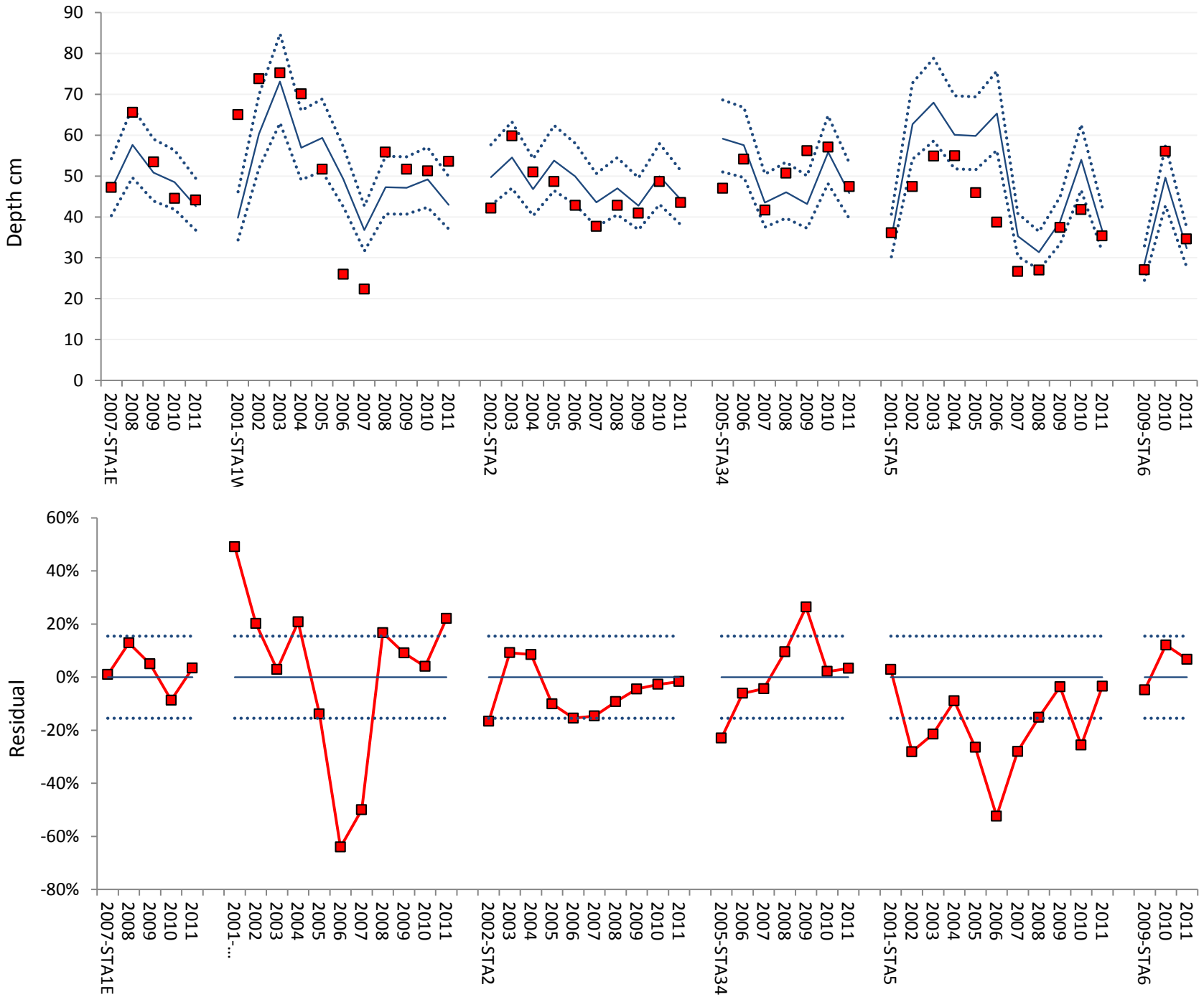

X - Axis = approximate water year (360 day averages computed from 30-day model output)   SFWMD data thru Water Year 2011
Red Symbols = observed values for combined STA outflow measured at permit structures. STA mean depths are area-weighted means across cells.
Blue Lines = DMSTA simulations with Restoration Strategies assumptions (calibrations, hydraulics, area, flow distribution, seepage, etc..). Duty Cycle = 1.0
Dashed Lines = 80% prediction interval based upon residual error distribution for prototype datasets (STA-2 & STA34) =   6% R^2 =   0.35
Active flow paths: STA1E (C&W)   STA1W (All)   STA2 (Cells 1,2,3)   STA34 (All)   STA5 (Cells 1-2)   STA6 (Cells 2,3,5)
Top: observed & predicted time series.
Bottom: Residuals = ln (observed / predicted Value) ~ error as a percentage of predicted. [observed - predicted for Conc Reduction]

10/30/12   WWW   DRAFT

Tracking STA Performance Relative to Restoration Strategies Modeling Assumptions   Variable: K m/yr

X - Axis = approximate water year (360 day averages computed from 30-day model output)   SFWMD data thru Water Year 2011
Red Symbols = observed values for combined STA outflow measured at permit structures. STA mean depths are area-weighted means across cells.
Blue Lines = DMSTA simulations with Restoration Strategies assumptions (calibrations, hydraulics, area, flow distribution, seepage, etc..). Duty Cycle = 1.0
Dashed Lines = 80% prediction interval based upon residual error distribution for prototype datasets (STA-2 & STA34) = 24% R^2 = 0.77
Active flow paths: STA1E (C&W)   STA1W (All)   STA2 (Cells 1,2,3)   STA34 (All)   STA5 (Cells 1-2)   STA6 (Cells 2,3,5)
Top: observed & predicted time series.
Bottom: Residuals = ln (observed / predicted Value) ~ error as a percentage of predicted. [observed - predicted for Conc Reduction]

10/30/12   WWW   DRAFT

Tracking STA Performance Relative to Restoration Strategies Modeling Assumptions   Variable: Depth cm

X - Axis = approximate water year (360 day averages computed from 30-day model output)   SFWMD data thru Water Year 2011
Red Symbols = observed values for combined STA outflow measured at permit structures. STA mean depths are area-weighted means across cells.
Blue Lines = DMSTA simulations with Restoration Strategies assumptions (calibrations, hydraulics, area, flow distribution, seepage, etc..). Duty Cycle = 1.0
Dashed Lines = 80% prediction interval based upon residual error distribution for prototype datasets (STA-2 & STA34) =   15% R^2 =   0.16
Active flow paths: STA1E (C&W)   STA1W (All)   STA2 (Cells 1,2,3)   STA34 (All)   STA5 (Cells 1-2)   STA6 (Cells 2,3,5)
Top: observed & predicted time series.
Bottom: Residuals = ln (observed / predicted Value) ~ error as a percentage of predicted. [observed - predicted for Conc Reduction]

10/30/12   WWW   DRAFT