Appendix A: Data

A subset of grab sample data was compiled from the California Department of Water Resources (DWR) Water Data Library and other sources to characterize the relationships between salinity constituents in each geographic grouping and to test the accuracy of the proposed methodology. The stations that contribute grab sample data to each of the geographic groupings are listed in this Appendix. All data were downloaded from the DWR Water Data Library unless otherwise noted. Dates are in calendar years.

A-1 Boundary Regions

Table A-1 identifies data used to characterize the Boundary Regions.

Table A-1. *Data and Data Sources for the Boundary Regions.*

BOUNDARY REGIONS		
Seawater	Sacramento River @ Mallard Island – D10A	1986 – 2019
	San Joaquin River @ Jersey Point – D15	1990 – 1995
	D10 – Sacramento River @ Chipps Island	2019 – 2019
	D10 Sacramento River at Chipps Island [1]	1975 – 1977
	D6A – Sacramento River @ Martinez	1957 – 1966
	SUISUN BAY A BENICIA (END-PIER)	1962 – 1969
	SAN PABLO BAY A PT DAVIS	1962 – 1970
	SF BAY A FORT PT	1964 – 1969
	D6 – Suisun Bay @ Bulls Head nr. Martinez	1968 – 1984
	SAN PABLO BAY NR RODEO	1971 – 1979
	D41 – San Pablo Bay near Pinole Point	1971 – 1984
Freshwater	Sacramento River @ Hood – C3A	1982 – 2020
	C3 – Sacramento River @ Greene’s Landing	1983 – 1998
San Joaquin River	San Joaquin River near Vernalis – C10	1982 – 2005
	San Joaquin R. @ Maze Rd. Bridge	1988 – 1994
	C10A – San Joaquin River near Vernalis @ SJR Club	2005 – 2020

[1] Data from IEP

A-2 Interior Delta Region

Table A-2 identifies data used to characterize the Interior Delta Region and the range of years during which grab sample data was collected. To preserve the seasonal and hydrodynamic nuances, no testability or data screening criteria were imposed on the Interior Delta Region datasets.

Table A-2. *Data and Data Sources for the Interior Delta Region.*

INTERIOR DELTA REGION		
Old-Middle River Export Corridor Subregion	OLD R A HOLLAND TRACT	1955 – 1974
	Old River near Rock Slough	1959 – 1959
	Old River South of Rock Slough (St 5A)	1972 – 1991
	Clifton Court Intake	1983 – 1994
	Rock Slough @ Old River	1983 – 1994
	Old River North of Rock Slough (St 4b)	1988 – 1994
	Middle River at Bacon Island Bridge	1989 – 1994
	Contra Costa PP Number 01	1990 – 2009
	Middle River @ Union Point - P10A	2006 – 2019
	Rock Slough at Delta Road Bridge	2011 – 2011
San Joaquin River Corridor Subregion	P8 - San Joaquin River @ Buckley Cove	1968 – 1984
	Little Connection Sl. @ Empire Tr.	1985 – 1994
	San Joaquin River @ Mossdale Bridge - C7A	1989 – 2010
	San Joaquin River at Prisoner's Point	2008 – 2010
	SAN JOAQUIN R A BRANDT BR	2009 – 2010
	San Joaquin River at Holt Rd.	2011 – 2011
South Delta Subregion	Old River @ Middle River	1970 – 2009
	Middle R @ Tracy Rd Bdg	1989 – 1991
	Grant Ln Can @ Tracy Rd Bdg	1989 – 1994
	Grant Line/Fabian/Bell Canals nr Old R.	1989 – 1994
	Old River nr Tracy	1989 – 1994
	Middle River at Howard Road	2002 – 2021
	Middle River @ Union Point - P10A	2006 – 2019
	Old River @ Tracy Road Bridge - P12	2008 – 2009

A-3 Location-Specific Urban Diversions

Table A-3 identifies data used to characterize key urban diversion locations within the study area. These locations are generally located within the Old-Middle River Export Corridor subregion of the Interior Delta Region. Except for the Barker Slough diversion, these urban diversions exhibited characteristics of the region in which they are geographically located. For example, the regression relationships developed for the Old-Middle River Export Corridor subregion can be accurately applied to estimate salinity constituent concentrations at Banks and Jones Pumping Plants, Old River at Bacon Island, Old River at Highway 4, and Victoria Canal. Similarly, the regression relationships developed for the Seawater Boundary Region can be accurately applied to estimate salinity constituent concentrations at Antioch.

The salinity characteristics of Barker Slough showed little agreement with the Freshwater Boundary region, presumably due to local watershed conditions. Thus, a unique set of regression constants was developed to characterize the salinity constituent relationships for Barker Slough.

Table A-3. *Data and Data Sources for the location-specific Urban Diversions.*

LOCATION-SPECIFIC URBAN DIVERSIONS		
Banks Pumping Plant	Delta P.P. Headworks at H.O. Banks PP	1960 – 2021
Jones Pumping Plant	DELTA-MENDOTA IT CA A BRYON RD	1952 – 1968
	DELTA MENDOTA CA – TRACY PUMP-STA	1956 – 1964
	DMC Intake @ Lindemann Rd.	1983 – 1999
	Canal Water Delivery in WQ cage in Jones PP	2009 – 2009
	Eastside Delta Mendota Canal intake at Jones PP	2012 – 2021
Bacon Island	Old River at Bacon Island	1994 – 2019
	CCWD Rock Slough Intake (1)	2000 – 2020
Highway 4	Old R. nr. Byron (St 9) (NEAR HWY 4 BRIDGE)	1957 – 2020
	Old River at Highway 4 (USGS)	2009 – 2010
	CCWD Old River Intake (1)	2000 – 2020
Victoria Canal (2)	CCWD Victoria Canal Intake	2014 – 2020
	CCWD Middle River Intake	2010 – 2020
Antioch	D12A – San Joaquin River @ Antioch	1951 – 2976
	SAN JOAQUIN R BY ANTIOCH	1962 – 1968
Barker Slough	Cache Slough @ Vallejo P.P	1950 – 1992
	Lindsey Slough near Rio Vista	1952 – 1982
	Lindsey Slough @ Hastings Cut	1980 – 1996
	Barker Slough Near Pumping Plant	1987 – 1988
	North Bay Aqueduct at Barker Slough Pumping Plant	1988 – 2013
	Barker Sl @ North Bay PP	1988 – 2013

(1) These grab sample data sets, which were used for validation in Appendix D, combine two datasets provided by CCWD. The first includes a suite of constituents (including EC, chloride, sodium, sulfate, bromide, and alkalinity) measured approximately monthly between 2014 and 2020. The second includes EC and chloride measured daily between 2000 and 2020.

(2) The grab sample data set for Victoria Canal comprises two sources of data. CCWD Victoria Canal Intake includes grab samples that report a suite of constituents (including EC, chloride, sodium, sulfate, bromide, alkalinity, and hardness), measured approximately monthly. This data set was used to develop regression constants in Section 6 of the user guide. CCWD Middle River Intake includes EC and chloride measured daily between 2010 and 2020 and was used for validation in Appendix D.

Appendix B: Regression Equation Parameter Uncertainties

This Appendix reports parameter uncertainties associated with the regression constants (A, B, and C) developed for the Freshwater and San Joaquin River Boundary Regions – see Tables B-1 through B-4. Parameter uncertainties are also reported for regression constants developed to characterize the Indeterminate Influence (see Tables B-5 and B-6), the Jones Pumping Plant location (see Tables B-7 and B-8), and the Barker Slough Urban Diversion location (see Tables B-9 and B-10).

Table B-1. *Parameter uncertainties for the Freshwater Boundary Region regression equations (when X = EC). This region had 643 "testable" samples.*

$Y = AX^2 + BX + C$	*TDS*	*Br*	*Cl⁻*	SO_4^{2-}	*Alkalinity*	Na^+	Ca^{2+}	Mg^{2+}	K^+
Number of Data Points Post-Screen	**600**	**377**	**598**	**595**	**591**	**594**	**596**	**596**	**591**
50 ≤ [EC] < 250 µS/cm	A = ± 1.5E-4 B = ± 0.05 C = ± 4	A = ± 6E-8 B = ± 1E-5 C = 0	A = ± 8E-6 B = ± 1.3E-3 C = 0	A = ± 1.1E-5 B = ± 1.9E-3 C = 0	A = ± 2.7E-5 B = ± 0.005 C = 0	A = ± 7E-6 B = ± 1.2E-3 C = 0	A = ± 6E-6 B = ± 1.1E-3 C = 0	A = ± 4E-6 B = ± 7E-4 C = 0	A = ± 2E-6 B = ± 3.5E-4 C = 0

Table B-2. *Parameter uncertainties for the Freshwater Boundary Region regression equations (when X = TDS). This region had 643 "testable" samples.*

$Y = AX^2 + BX + C$	*EC*	*Br*	*Cl⁻*	SO_4^{2-}	*Alkalinity*	Na^+	Ca^{2+}	Mg^{2+}	K^+
Number of Data Points Post-Screen	**598**	**376**	**595**	**592**	**588**	**591**	**593**	**593**	**588**
45 ≤ [TDS] < 150 mg/L	A = ± 8E-4 B = ± 0.16 C = ± 8	A = ± 1.7E-7 B = ± 1.8E-5 C = 0	A = ± 2.5E-5 B = ± 2.6E-3 C = 0	A = ± 3.2E-5 B = ± 3.3E-3 C = 0	A = ± 1.1E-4 B = ± 0.011 C = 0	A = ± 2.7E-5 B = ± 2.8E-3 C = 0	A = ± 2.2E-5 B = ± 2.3E-3 C = 0	A = ± 1.4E-5 B = ± 1.4E-3 C = 0	A = ± 6E-6 B = ± 6E-4 C = 0

Table B-3. *Parameter uncertainties for the San Joaquin River Boundary Region regression equations (when X = EC). This region had 611 "testable" samples.*

$Y = AX^2 + BX + C$	*TDS*	*Br*	*Cl⁻*	SO_4^{2-}	*Alkalinity*	Na^+	Ca^{2+}	Mg^{2+}	K^+
Number of Data Points Post-Screen	**541**	**457**	**539**	**540**	**539**	**535**	**532**	**537**	**528**
100 ≤ [EC] < 1,600 µS/cm	A = ± 4E-6 B = ± 0.005 C = ± 1.9	A = ± 1.5E-8 B = ± 2.1E-5 C = ± 0.007	A = ± 1.7E-6 B = ± 0.0026 C = ± 0.9	A = ± 3.1E-6 B = ± 0.005 C = ± 1.6	A = ± 2.6E-6 B = ± 0.004 C = ± 1.4	A = ± 1.2E-6 B = ± 1.8E-3 C = ± 0.6	A = ± 7E-7 B = ± 1.1E-3 C = ± 0.4	A = ± 4E-7 B = ± 5E-4 C = ± 0.18	A = ± 1.5E-7 B = ± 2.3E-4 C = ± 0.08

Table B-4. *Parameter uncertainties for the San Joaquin River Boundary Region regression equations (when X = TDS). This region had 611 "testable" samples.*

$Y = AX^2 + BX + C$	*TDS*	*Br*	Cl^-	SO_4^{2-}	*Alkalinity*	Na^+	Ca^{2+}	Mg^{2+}	K^+
Number of Data Points Post-Screen	**541**	**457**	**539**	**540**	**539**	**535**	**532**	**537**	**528**
60 ≤ [TDS] < 1,000 mg/L	A = ± 1.5E-5 B = ± 0.014 C = ± 3	A = ± 4E-8 B = ± 4E-5 C = ± 0.007	A = ± 5E-6 B = ± 0.005 C = ± 1	A = ± 7E-6 B = ± 0.007 C = ± 1.5	A = ± 7E-6 B = ± 0.007 C = ± 1.4	A = ± 3.3E-6 B = ± 3.1E-3 C = ± 0.6	A = ± 1.8E-6 B = ± 1.6E-3 C = ± 0.34	A = ± 1E-6 B = ± 9E-4 C = ± 0.18	A = ± 4E-7 B = ± 4E-4 C = ± 0.07

Table B-5. *Parameter uncertainties for the Indeterminate Influence regression equations (when X = EC).*

$Y = AX^2 + BX + C$	*TDS*	*Br*	Cl^-	SO_4^{2-}	*Alkalinity*	Na^+	Ca^{2+}	Mg^{2+}	K^+
Number of Data Points Post-Screen	**188**	**192**	**242**	**155**	**174**	**198**	**188**	**188**	**157**
150 ≤ [EC] < 1,300 µS/cm	A = ± 1.3E-5 B = ± 0.018 C = ± 6	A = ± 6E-8 B = ± 8E-5 C = ± 0.023	A = ± 9E-6 B = ± 0.013 C = ± 4	A = ± 1.4E-5 B = ± 0.020 C = ± 6	A = ± 8E-6 B = ± 0.012 C = ± 4	A = ± 3.1E-6 B = ± 0.004 C = ± 1.3	A = ± 3.3E-6 B = ± 0.005 C = ± 1.4	A = ± 1E-6 B = ± 1.4E-3 C = ± 0.4	A = ± 6E-7 B = ± 9E-4 C = ± 0.27

Table B-6. *Parameter uncertainties for the Indeterminate Influence regression equations (when X = TDS).*

$Y = AX^2 + BX + C$	*EC*	*Br*	Cl^-	SO_4^{2-}	*Alkalinity*	Na^+	Ca^{2+}	Mg^{2+}	K^+
Number of Data Points Post-Screen	**188**	**150**	**189**	**155**	**173**	**155**	**155**	**155**	**150**
100 ≤ [TDS] < 800 mg/L	A = ± 6E-5 B = ± 0.05 C = ± 9	A = ± 1.9E-7 B = ± 1.5E-4 C = ± 0.026	A = ± 4E-5 B = ± 0.030 C = ± 6	A = ± 3.5E-5 B = ± 0.029 C = ± 5	A = ± 2.5E-5 B = ± 0.021 C = ± 4	A = ± 1.2E-5 B = ± 0.010 C = ± 1.8	A = ± 9E-6 B = ± 0.007 C = ± 1.3	A = ± 4E-6 B = ± 3.1E-3 C = ± 0.5	A = ± 1.8E-6 B = ± 1.5E-3 C = ± 0.27

Table B-7. *Parameter uncertainties for the Jones Pumping Plant regression equations (when X = EC).*

$Y = AX^2 + BX + C$	*TDS*	*Br*	Cl^-	SO_4^{2-}	*Alkalinity*	Na^+	Ca^{2+}	Mg^{2+}	K^+
Number of Data Points Post-Screen	**5**	**6**	**9**	**8**	**5**	**6**	**5**	**5**	**5**
100 ≤ [EC] < 250 µS/cm	A = ± 0.004 B = ± 1.6 C = ± 150	A = ± 3E-6 B = ± 0.0012 C = ± 0.11	A = ± 0.0012 B = ± 0.5 C = ± 50	A = ± 0.0025 B = ± 1 C = ± 100	A = ± 0.008 B = ± 3.2 C = ± 300	A = ± 0.001 B = ± 0.4 C = ± 40	A = ± 0.0018 B = ± 0.7 C = ± 70	A = ± 0.0008 B = ± 0.33 C = ± 31	A = ± 0.0004 B = ± 0.14 C = ± 13
Number of Data Points Post-Screen	**167**	**225**	**457**	**307**	**216**	**318**	**209**	**209**	**189**
250 ≤ [EC] < 1,440 µS/cm	A = ± 1.5E-5 B = ± 0.022 C = ± 7	A = ± 9E-8 B = ± 0.0011 C = ± 0.035	A = ± 1E-5 B = ± 0.015 C = ± 5	A = ± 1.4E-5 B = ± 0.02 C = ± 6	A = ± 1.2E-5 B = ± 0.018 C = ± 6	A = ± 5E-6 B = ± 0.007 C = ± 2.2	A = ± 5E-6 B = ± 0.008 C = ± 2.5	A = ± 1.6E-6 B = ± 0.0023 C = ± 0.8	A = ± 7E-7 B = ± 0.001 C = ± 0.35

Table B-8. *Parameter uncertainties for the Jones Pumping Plant regression equations (when X = TDS).*

$Y = AX^2 + BX + C$	*EC*	*Br*	*Cl⁻*	SO_4^{2-}	*Alkalinity*	Na^+	Ca^{2+}	Mg^{2+}	K^+
Number of Data Points Post-Screen	**170**	**53**	**167**	**168**	**169**	**169**	**169**	**169**	**167**
145 ≤ [TDS] < 830 mg/L	A = ± 7E-5 B = ± 0.06 C = ± 11	A = ± 7E-7 B = ± 0.0005 C = ± 0.09	A = ± 5E-5 B = ± 0.04 C = ± 8	A = ± 4E-5 B = ± 0.032 C = ± 6	A = ± 4E-5 B = ± 0.034 C = ± 7	A = ± 2.2E-5 B = ± 0.019 C = ± 4	A = ± 1.4E-5 B = ± 0.012 C = ± 2.3	A = ± 5E-6 B = ± 0.004 C = ± 0.8	A = ± 2E-6 B = ± 0.0017 C = ± 0.34

Table B-9. *Parameter uncertainties for the Barker Slough regression equations (when X = EC). This region had 534 "testable" samples.*

$Y = AX^2 + BX + C$	*TDS*	*Br*	*Cl⁻*	SO_4^{2-}	*Alkalinity*	Na^+	Ca^{2+}	Mg^{2+}	K^+
Number of Data Points Post-Screen	**462**	**400**	**461**	**453**	**462**	**456**	**459**	**460**	**204**
100 ≤ [EC] < 800 µS/cm	A = ± 1.6E-5 B = ± 0.013 C = ± 2.5	A = ± 5E-8 B = ± 3.4E-5 C = ± 0.006	A = ± 7E-6 B = ± 0.006 C = ± 1.1	A = ± 6E-6 B = ± 0.005 C = ± 0.9	A = ± 1.7E-5 B = ± 0.014 C = ± 2.6	A = ± 6E-6 B = ± 0.005 C = ± 0.9	A = ± 3.3E-6 B = ± 2.7E-3 C = ± 0.5	A = ± 2.2E-6 B = ± 1.8E-3 C = ± 0.35	A = ± 9E-7 B = ± 0.0008 C = ± 0.17

Table B-10. *Parameter uncertainties for the Barker Slough regression equations (when X = TDS). This region had 534 "testable" samples.*

$Y = AX^2 + BX + C$	*EC*	*Br*	*Cl⁻*	SO_4^{2-}	*Alkalinity*	Na^+	Ca^{2+}	Mg^{2+}	K^+
Number of Data Points Post-Screen	**462**	**400**	**461**	**453**	**462**	**456**	**459**	**460**	**204**
50 ≤ [TDS] < 450 mg/L	A = ± 7E-5 B = ± 0.04 C = ± 4	A = ± 1.4E-7 B = ± 6E-5 C = ± 0.006	A = ± 2E-5 B = ± 0.01 C = ± 1.1	A = ± 1.8E-5 B = ± 0.009 C = ± 1.0	A = ± 5E-5 B = ± 0.024 C = ± 2.8	A = ± 1.5E-5 B = ± 0.008 C = ± 0.9	A = ± 1E-5 B = ± 0.005 C = ± 0.6	A = ± 7E-6 B = ± 3.5E-3 C = ± 0.4	A = ± 2.4E-6 B = ± 0.0014 C = ± 0.17

Appendix C: Scatter Plots

The figures in this Appendix illustrate the observed data distributions and regression fits. These figures include computed statistics such as R^2 and Standard Error.

For the Boundary Regions (Section C-1), where polynomial equations were developed to characterize the relationships between constituents for a specific range of EC and TDS, each graph depicts an estimating curve corresponding to a given constituent relationship. The curve is overlaid on the observed data and the equation for the curve and the statistics associated with it are also displayed.

For the Interior Delta Region (Section C-2), the *Decision Tree* was used to find the most appropriate set of regression constants which estimate the salinity constituents of interest. An EC or TDS value associated with the Interior Delta Region can be converted to a salinity constituent concentration by applying the logic shown in Branch 2 of the *Decision Tree;* this more complicated logic attempts to account for seasonal changes in the relative contributions to water quality from different sources through proxy inputs. The figures associated with the Interior Delta Region in this Appendix show the distribution of the observed data and the corresponding estimations that were calculating by following the logic of Branch 2 of the *Decision Tree.* Supporting statistics, R^2 and Standard Error, were computed by relating each observed data point to its estimated value.

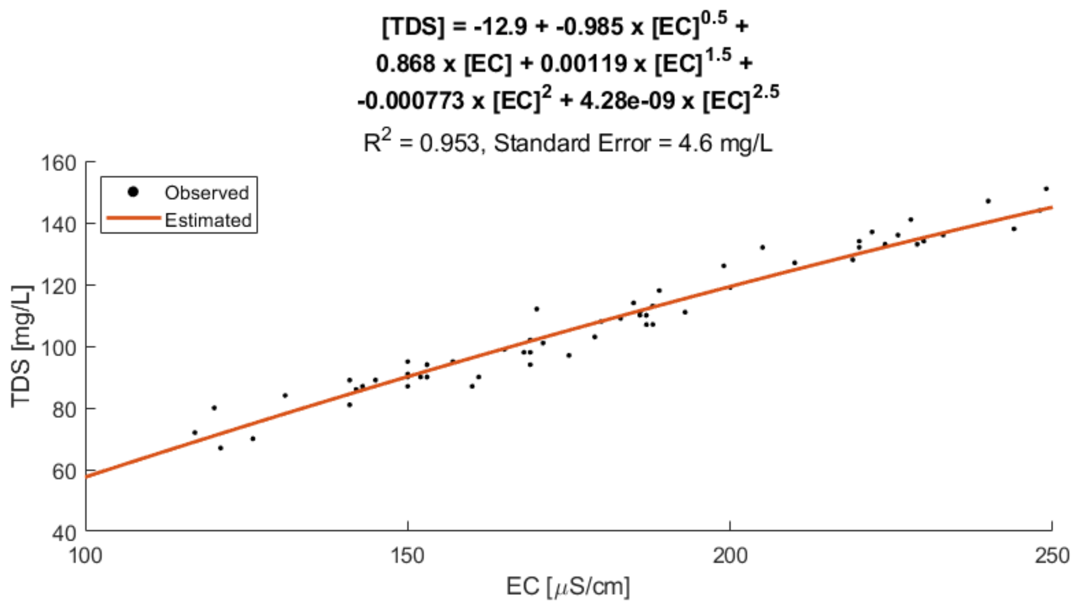
For the location-specific Urban Diversions (Section C-3), Branch 3 of the *Decision Tree* was similarly used to convert an EC or TDS value to a salinity constituent concentration. The figures supporting the estimation methodology used for the location-specific Urban Diversion within the Interior Delta Region follow a similar format as above. For the Antioch diversion, the Seawater Boundary Region relationships are recommended to compute the salinity constituent concentrations. In this Appendix, these estimations are shown in relation to the observed data distributions along with the fitting statistics. For the Jones Pumping Plant and the Barker Slough Urban Diversions, unique sets of regression constants were developed to characterize the salinity constituent relationships for the specific range of EC and TDS observed at each location. (For Jones Pumping Plant, unique constants are limited to conditions classified as seawater dominant according to Tables 11 and 12.) All graphs in this appendix depict an estimating curve corresponding to a given constituent relationship. The curve is overlaid on the observed data and the equation for the curve and the statistics associated with it are also displayed.

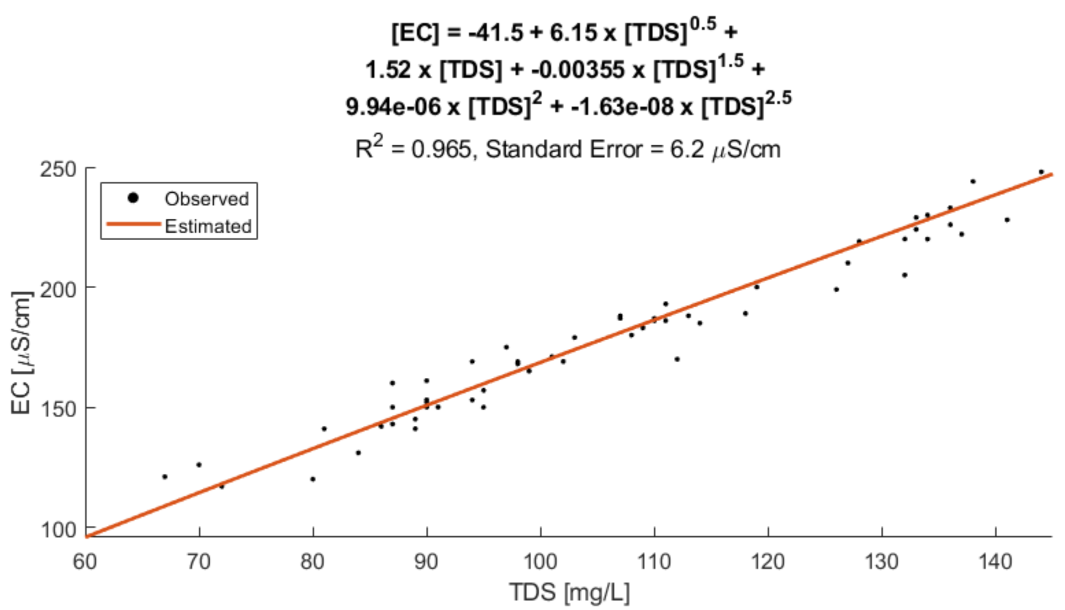
C-1. Boundary Regions

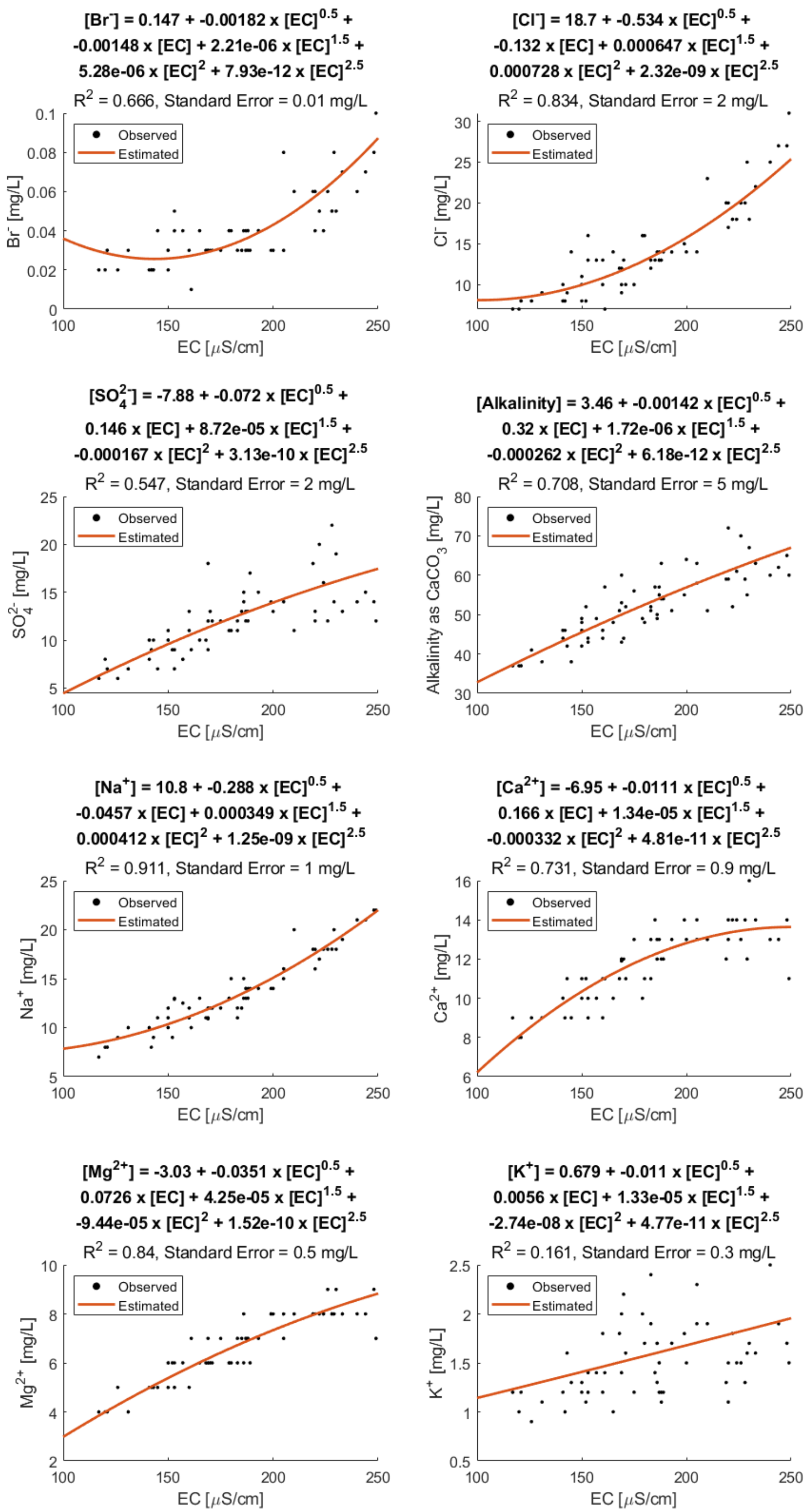
C-1.1 Seawater Boundary Region

C-1.1.1 Low Salinity

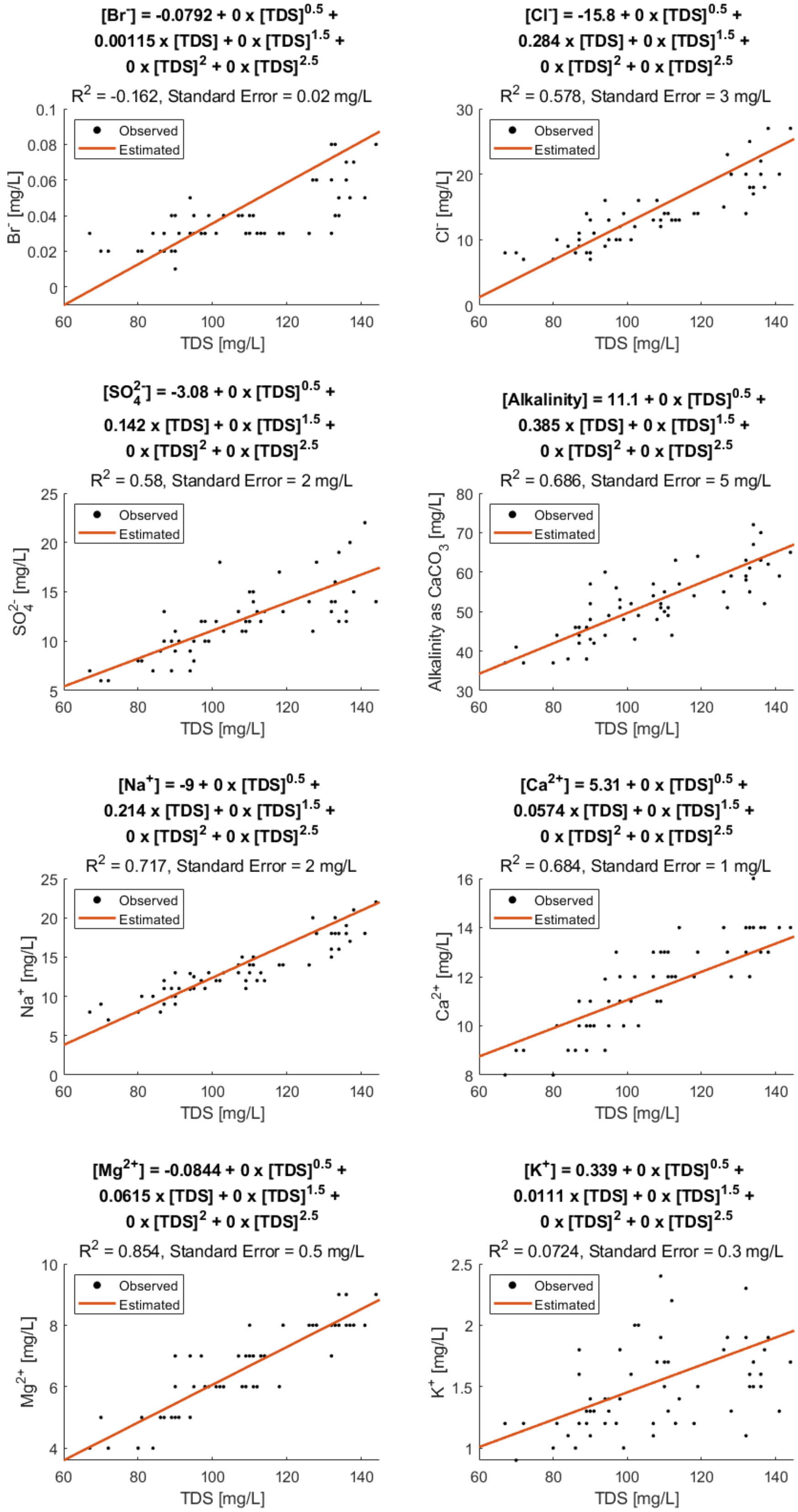
***Figure Group 1**. Model fits for the Seawater Boundary Region when salinity is low; i.e. when 100 ≤ EC < 250 µS/cm or 60 ≤ TDS < 145 mg/L. The first two graphs show the observed data used to develop the relationships between EC and TDS. The estimating equation is supported with statistics, R^2 and Standard Error, as reported in the user guide. The graphs thereafter show the observed data and fits for the relationships between EC, TDS, and each of the constituents of interest along with the estimating equation, R^2, and Standard Error.*







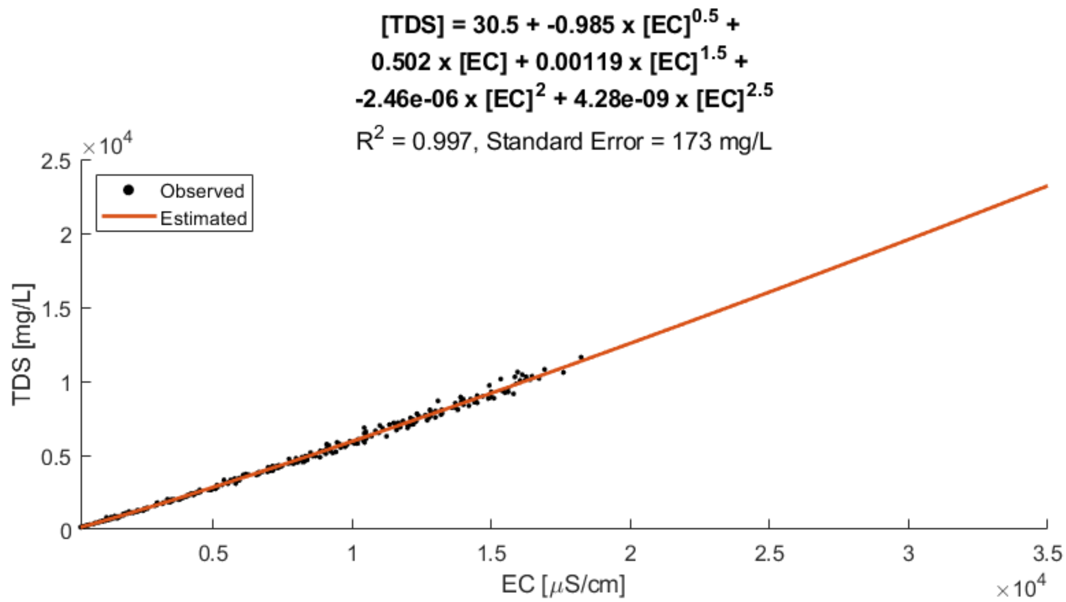
when EC < 105 µS/cm, set Br⁻ to 0.03 mg/L

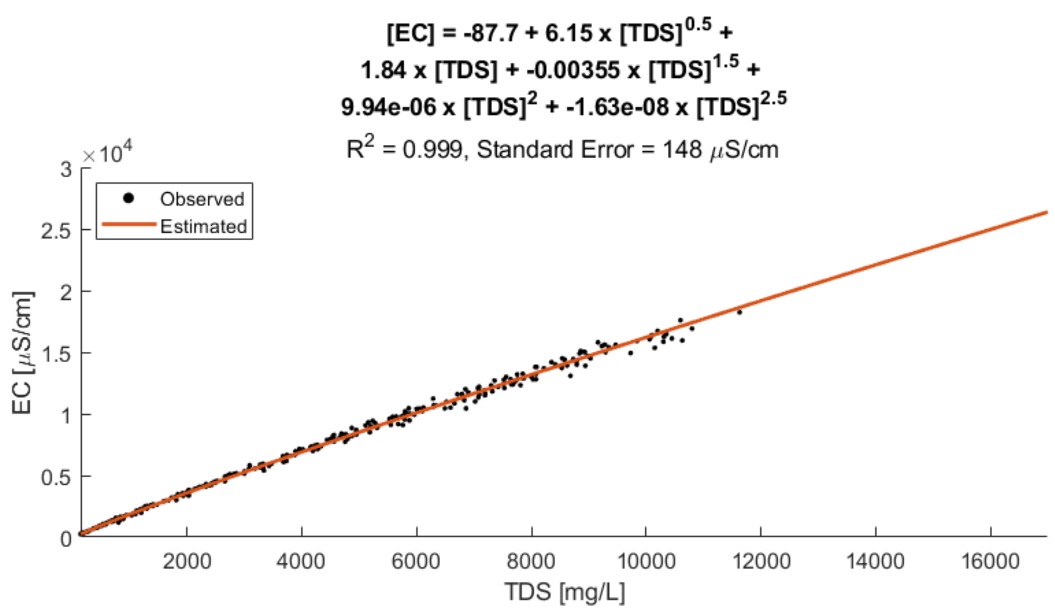


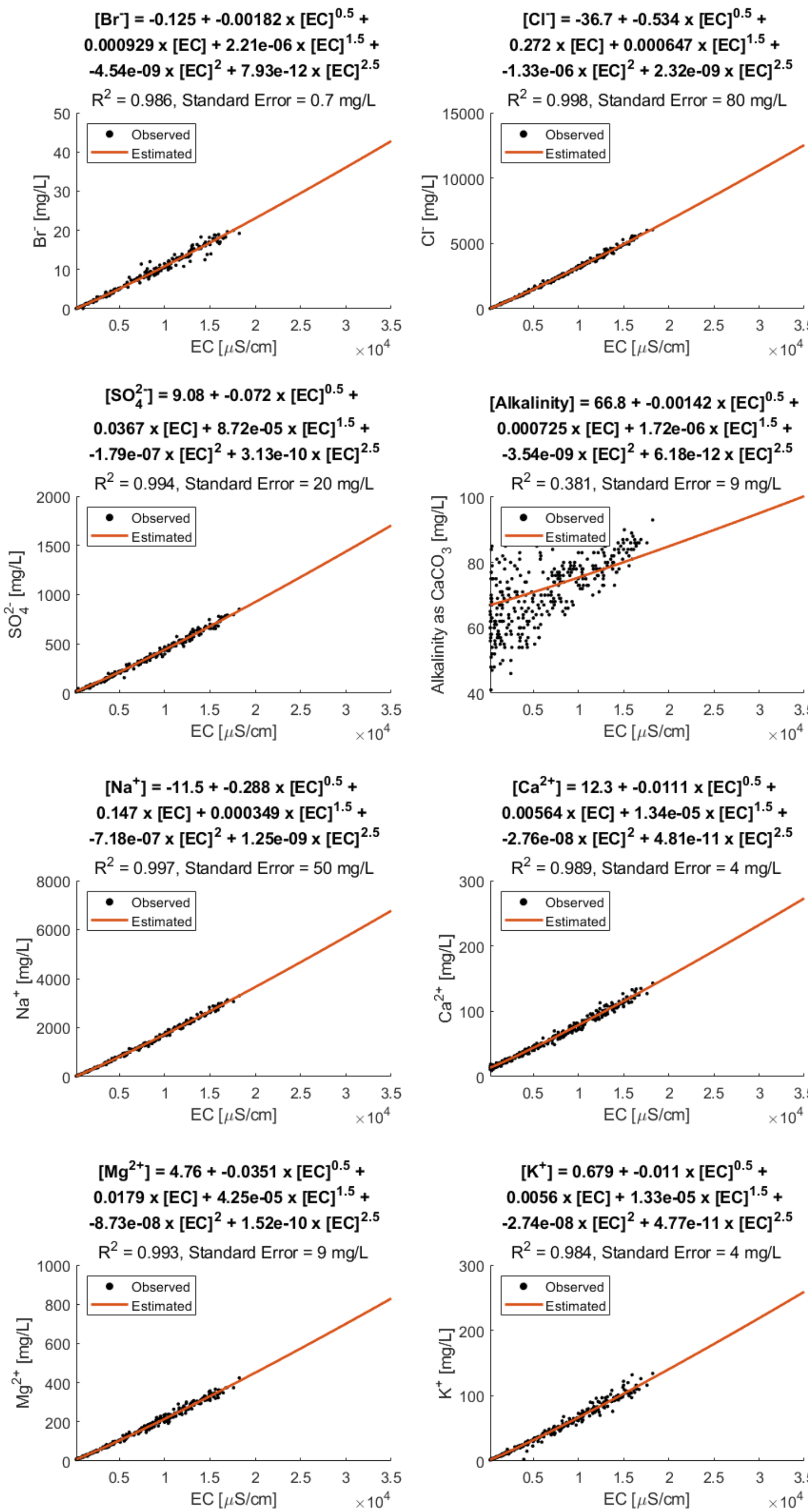
when Br^- is estimated as < 0.03 mg/L, set Br^- to 0.03 mg/L

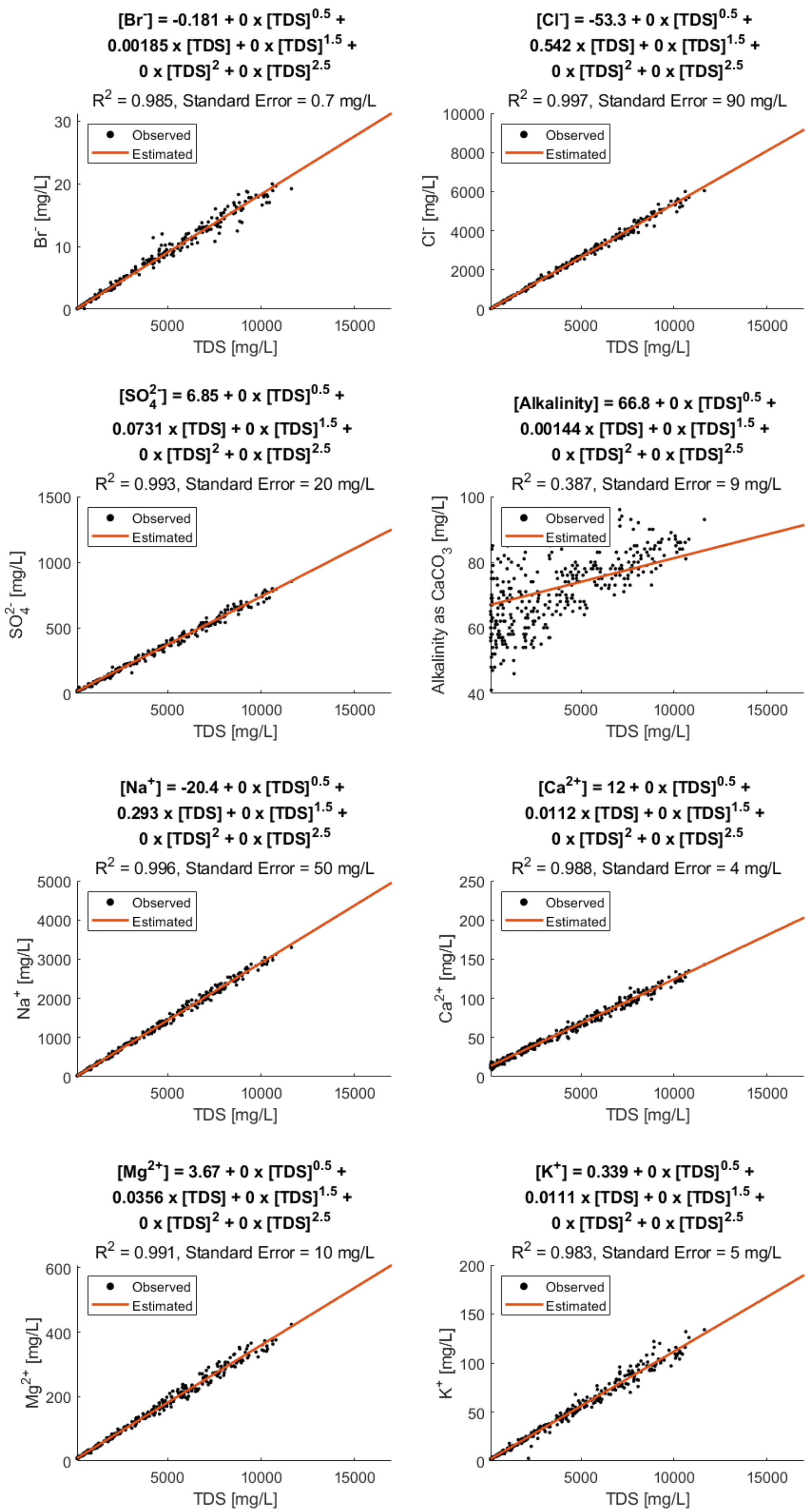
C-1.1.2 High Salinity

***Figure Group 2**. Model fits for the Seawater Boundary Region when salinity is high; i.e. when EC ≥ 250 ≤ µS/cm or TDS ≥ 145 mg/L. The first two graphs show the observed data used to develop the relationships between EC and TDS. The estimating equation is supported with statistics, R^2 and Standard Error, as reported in the user guide. The graphs thereafter show the observed data and fits for the relationships between EC, TDS, and each of the constituents of interest along with the estimating equation, R^2, and Standard Error.*



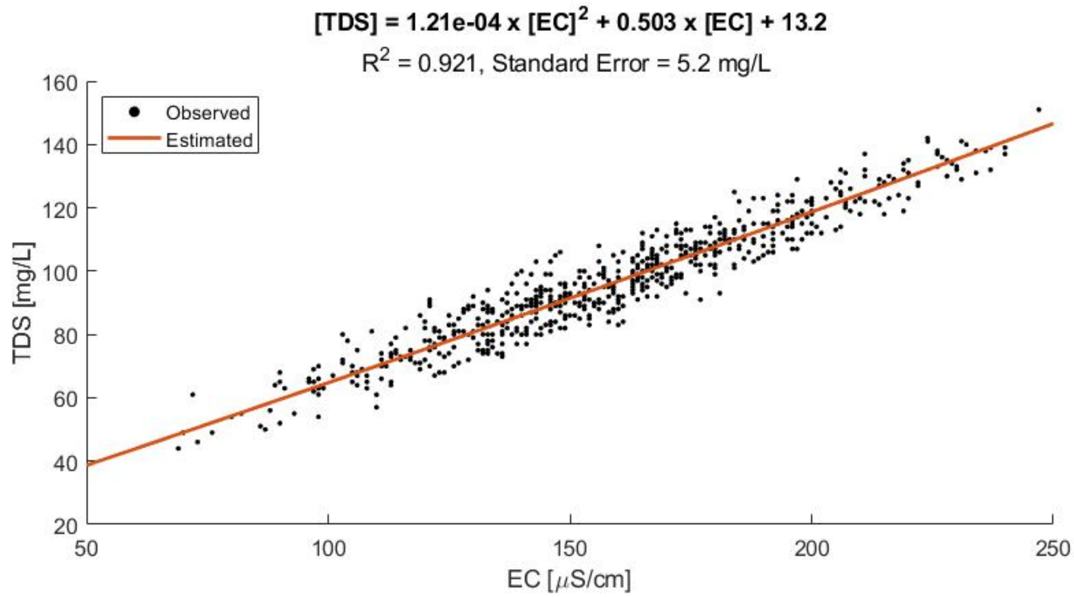


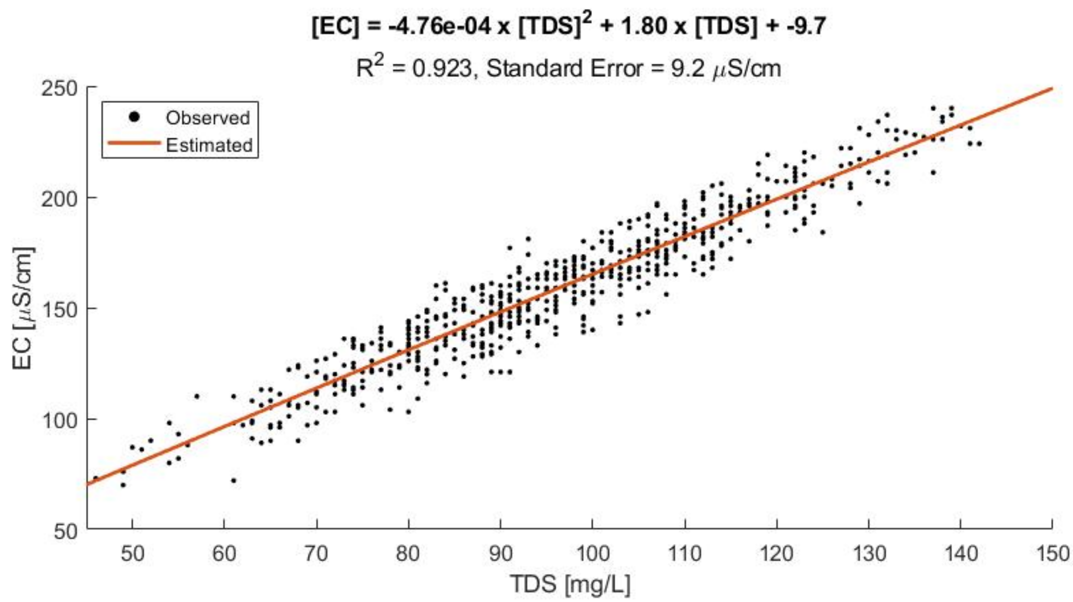

[Br-] = -0.125 + -0.00182 x [EC]^0.5 + 0.000929 x [EC] + 2.21e-06 x [EC]^1.5 + -4.54e-09 x [EC]^2 + 7.93e-12 x [EC]^2.5
R^2 = 0.986, Standard Error = 0.7 mg/L
Observed
Estimated
Br- [mg/L]
EC [μS/cm]
×10^4
[Cl-] = -36.7 + -0.534 x [EC]^0.5 + 0.272 x [EC] + 0.000647 x [EC]^1.5 + -1.33e-06 x [EC]^2 + 2.32e-09 x [EC]^2.5
R^2 = 0.998, Standard Error = 80 mg/L
Cl- [mg/L]
[SO4 2-] = 9.08 + -0.072 x [EC]^0.5 + 0.0367 x [EC] + 8.72e-05 x [EC]^1.5 + -1.79e-07 x [EC]^2 + 3.13e-10 x [EC]^2.5
R^2 = 0.994, Standard Error = 20 mg/L
SO4 2- [mg/L]
[Alkalinity] = 66.8 + -0.00142 x [EC]^0.5 + 0.000725 x [EC] + 1.72e-06 x [EC]^1.5 + -3.54e-09 x [EC]^2 + 6.18e-12 x [EC]^2.5
R^2 = 0.381, Standard Error = 9 mg/L
Alkalinity as CaCO3 [mg/L]
[Na+] = -11.5 + -0.288 x [EC]^0.5 + 0.147 x [EC] + 0.000349 x [EC]^1.5 + -7.18e-07 x [EC]^2 + 1.25e-09 x [EC]^2.5
R^2 = 0.997, Standard Error = 50 mg/L
Na+ [mg/L]
[Ca2+] = 12.3 + -0.0111 x [EC]^0.5 + 0.00564 x [EC] + 1.34e-05 x [EC]^1.5 + -2.76e-08 x [EC]^2 + 4.81e-11 x [EC]^2.5
R^2 = 0.989, Standard Error = 4 mg/L
Ca2+ [mg/L]
[Mg2+] = 4.76 + -0.0351 x [EC]^0.5 + 0.0179 x [EC] + 4.25e-05 x [EC]^1.5 + -8.73e-08 x [EC]^2 + 1.52e-10 x [EC]^2.5
R^2 = 0.993, Standard Error = 9 mg/L
Mg2+ [mg/L]
[K+] = 0.679 + -0.011 x [EC]^0.5 + 0.0056 x [EC] + 1.33e-05 x [EC]^1.5 + -2.74e-08 x [EC]^2 + 4.77e-11 x [EC]^2.5
R^2 = 0.984, Standard Error = 4 mg/L
K+ [mg/L]

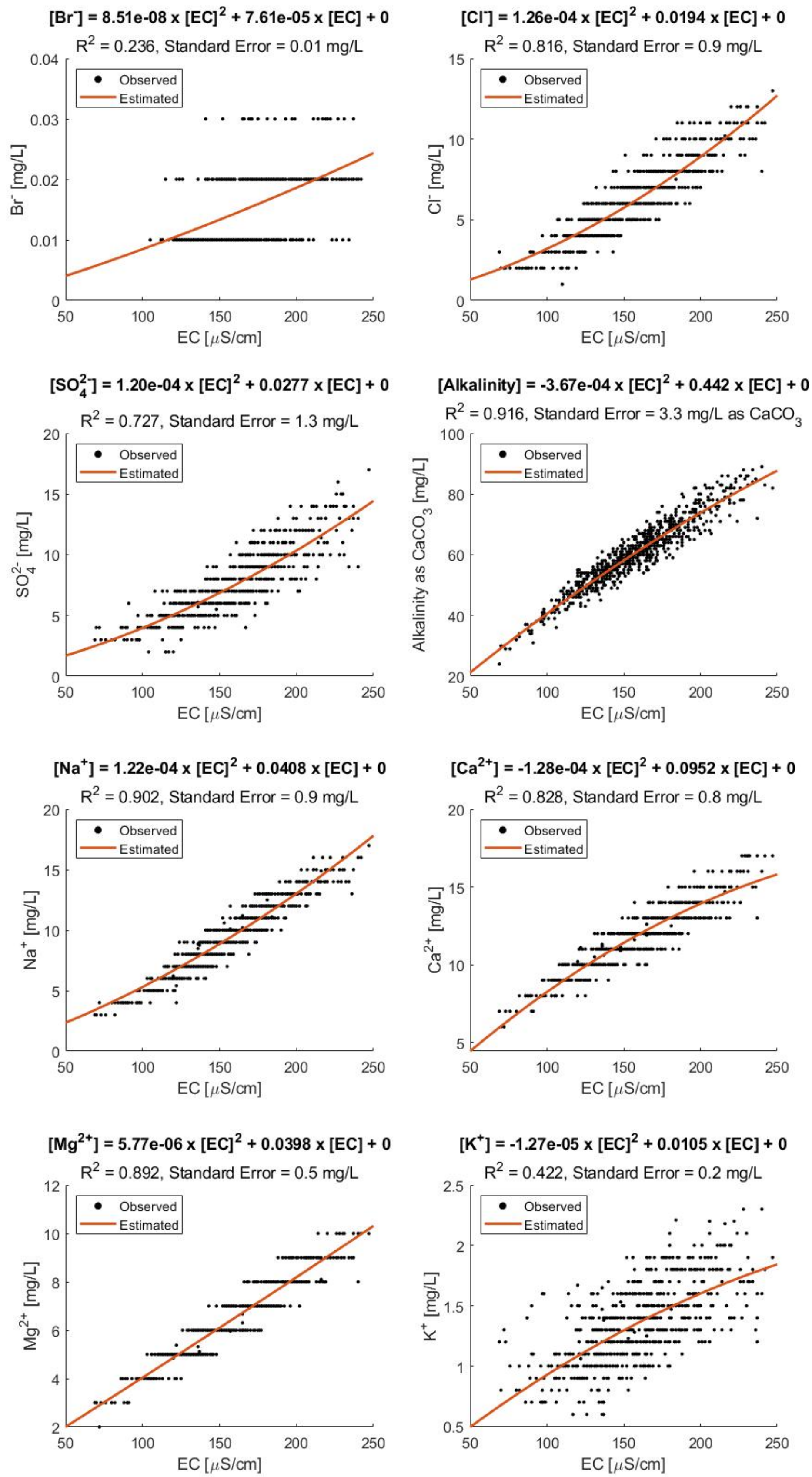

[Br-] = -0.181 + 0 x [TDS]0.5 + 0.00185 x [TDS] + 0 x [TDS]1.5 + 0 x [TDS]2 + 0 x [TDS]2.5
R2 = 0.985, Standard Error = 0.7 mg/L
Observed
Estimated
Br- [mg/L]
TDS [mg/L]
[Cl-] = -53.3 + 0 x [TDS]0.5 + 0.542 x [TDS] + 0 x [TDS]1.5 + 0 x [TDS]2 + 0 x [TDS]2.5
R2 = 0.997, Standard Error = 90 mg/L
Cl- [mg/L]
[SO42-] = 6.85 + 0 x [TDS]0.5 + 0.0731 x [TDS] + 0 x [TDS]1.5 + 0 x [TDS]2 + 0 x [TDS]2.5
R2 = 0.993, Standard Error = 20 mg/L
SO42- [mg/L]
[Alkalinity] = 66.8 + 0 x [TDS]0.5 + 0.00144 x [TDS] + 0 x [TDS]1.5 + 0 x [TDS]2 + 0 x [TDS]2.5
R2 = 0.387, Standard Error = 9 mg/L
Alkalinity as CaCO3 [mg/L]
[Na+] = -20.4 + 0 x [TDS]0.5 + 0.293 x [TDS] + 0 x [TDS]1.5 + 0 x [TDS]2 + 0 x [TDS]2.5
R2 = 0.996, Standard Error = 50 mg/L
Na+ [mg/L]
[Ca2+] = 12 + 0 x [TDS]0.5 + 0.0112 x [TDS] + 0 x [TDS]1.5 + 0 x [TDS]2 + 0 x [TDS]2.5
R2 = 0.988, Standard Error = 4 mg/L
Ca2+ [mg/L]
[Mg2+] = 3.67 + 0 x [TDS]0.5 + 0.0356 x [TDS] + 0 x [TDS]1.5 + 0 x [TDS]2 + 0 x [TDS]2.5
R2 = 0.991, Standard Error = 10 mg/L
Mg2+ [mg/L]
[K+] = 0.339 + 0 x [TDS]0.5 + 0.0111 x [TDS] + 0 x [TDS]1.5 + 0 x [TDS]2 + 0 x [TDS]2.5
R2 = 0.983, Standard Error = 5 mg/L
K+ [mg/L]

C-1.2 Freshwater Boundary Region

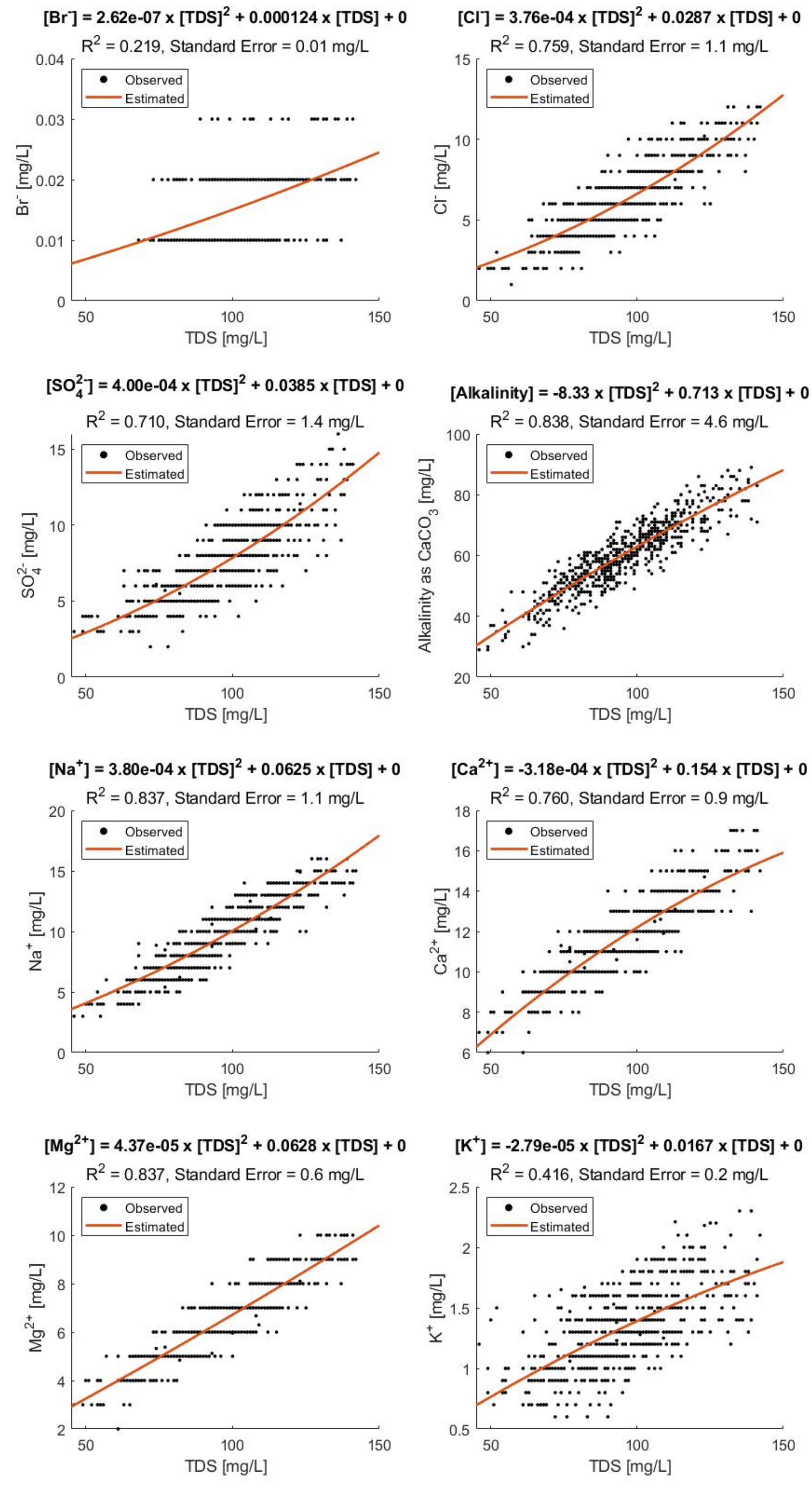
***Figure Group 3**. Regression fits for the Freshwater Boundary Region when 50 ≤ EC < 250 µS/cm or 45 ≤ TDS < 150 mg/L. The first two graphs show the observed data used to develop the regression relationships between EC and TDS. The estimating quadratic equation is supported with statistics, R^2 and Standard Error, as reported in the user guide. The graphs thereafter show the observed data and quadratic fits for the relationships between EC, TDS, and each of the constituents of interest along with the estimating quadratic equation, R^2, and Standard Error.*





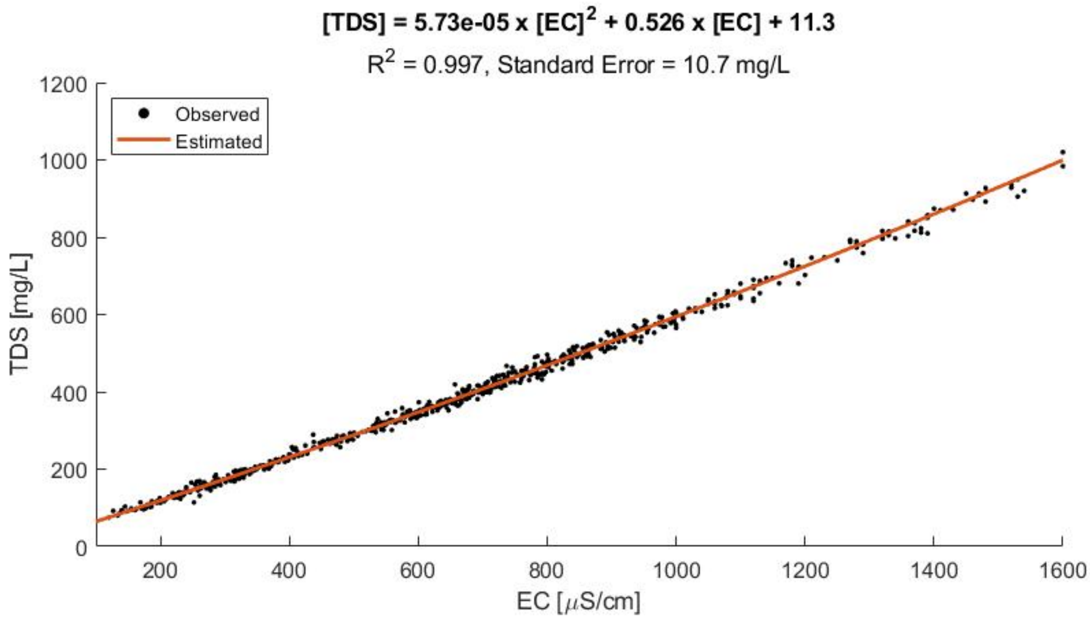


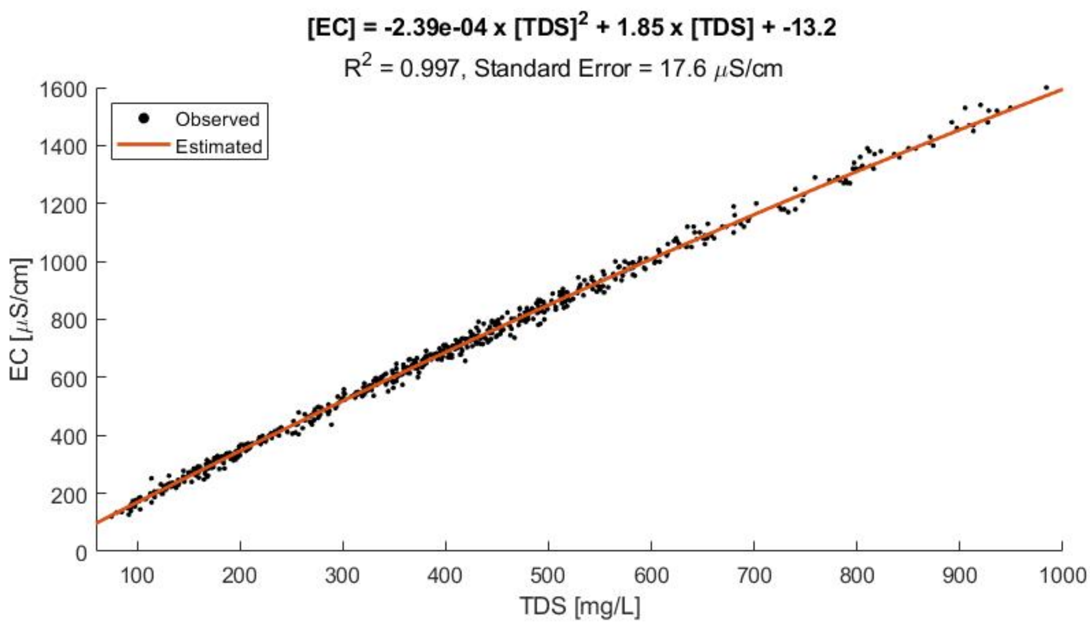
[Br⁻] = 8.51e-08 x [EC]² + 7.61e-05 x [EC] + 0
R² = 0.236, Standard Error = 0.01 mg/L
Observed
Estimated
Br⁻ [mg/L]
0.04
0.03
0.02
0.01
0
50
100
150
200
250
EC [μS/cm]
[Cl⁻] = 1.26e-04 x [EC]² + 0.0194 x [EC] + 0
R² = 0.816, Standard Error = 0.9 mg/L
Observed
Estimated
Cl⁻ [mg/L]
15
10
5
0
EC [μS/cm]
[SO4²⁻] = 1.20e-04 x [EC]² + 0.0277 x [EC] + 0
R² = 0.727, Standard Error = 1.3 mg/L
Observed
Estimated
SO4²⁻ [mg/L]
20
15
10
5
0
EC [μS/cm]
[Alkalinity] = -3.67e-04 x [EC]² + 0.442 x [EC] + 0
R² = 0.916, Standard Error = 3.3 mg/L as CaCO3
Observed
Estimated
Alkalinity as CaCO3 [mg/L]
100
80
60
40
20
EC [μS/cm]
[Na⁺] = 1.22e-04 x [EC]² + 0.0408 x [EC] + 0
R² = 0.902, Standard Error = 0.9 mg/L
Observed
Estimated
Na⁺ [mg/L]
20
15
10
5
0
EC [μS/cm]
[Ca²⁺] = -1.28e-04 x [EC]² + 0.0952 x [EC] + 0
R² = 0.828, Standard Error = 0.8 mg/L
Observed
Estimated
Ca²⁺ [mg/L]
20
15
10
5
EC [μS/cm]
[Mg²⁺] = 5.77e-06 x [EC]² + 0.0398 x [EC] + 0
R² = 0.892, Standard Error = 0.5 mg/L
Observed
Estimated
Mg²⁺ [mg/L]
12
10
8
6
4
2
EC [μS/cm]
[K⁺] = -1.27e-05 x [EC]² + 0.0105 x [EC] + 0
R² = 0.422, Standard Error = 0.2 mg/L
Observed
Estimated
K⁺ [mg/L]
2.5
2
1.5
1
0.5
EC [μS/cm]

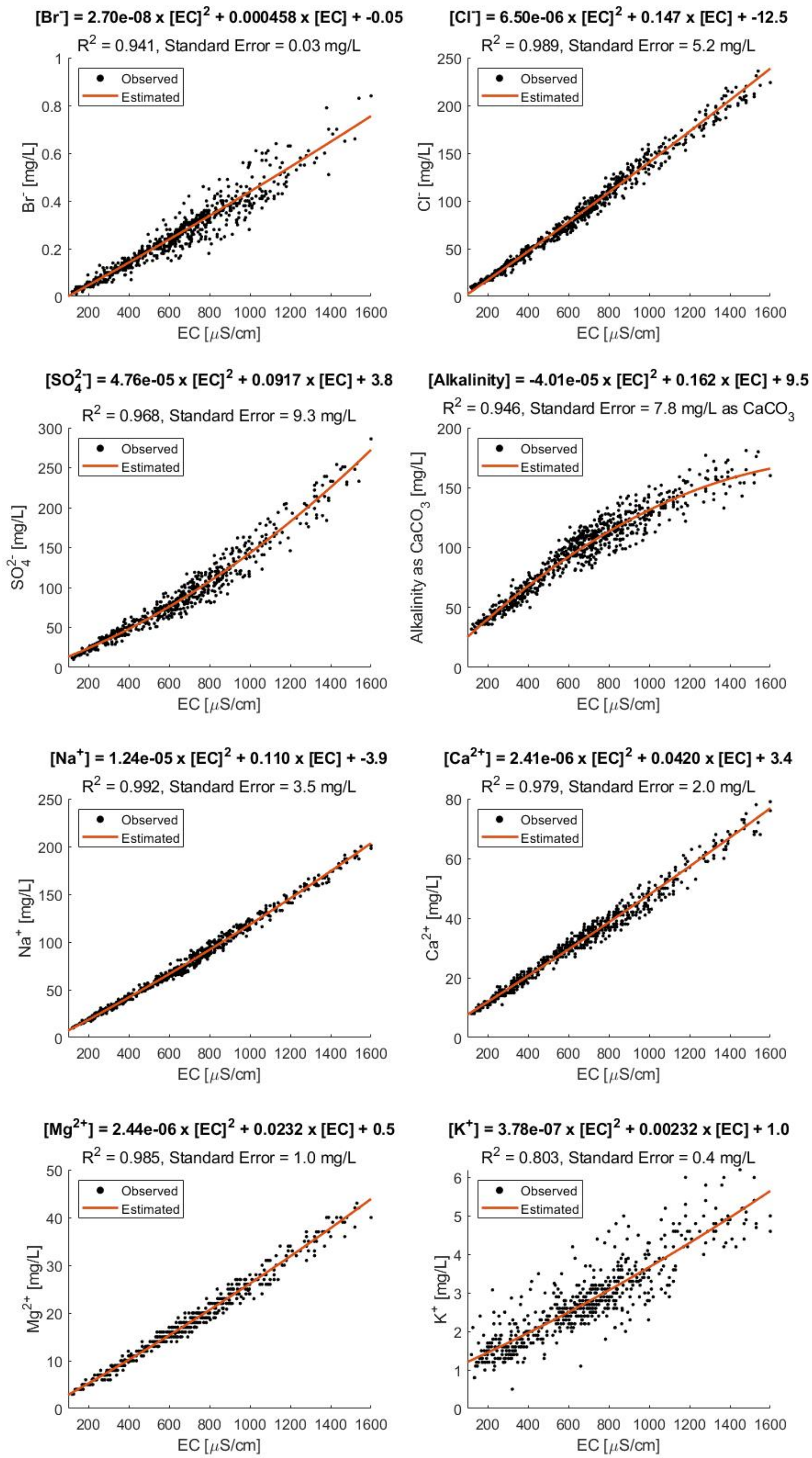

[Br$^-$] = 2.62e-07 x [TDS]^2 + 0.000124 x [TDS] + 0
R^2 = 0.219, Standard Error = 0.01 mg/L
Observed
Estimated
Br$^-$ [mg/L]
TDS [mg/L]
[Cl$^-$] = 3.76e-04 x [TDS]^2 + 0.0287 x [TDS] + 0
R^2 = 0.759, Standard Error = 1.1 mg/L
Cl$^-$ [mg/L]
[SO_4^{2-}] = 4.00e-04 x [TDS]^2 + 0.0385 x [TDS] + 0
R^2 = 0.710, Standard Error = 1.4 mg/L
SO_4^{2-} [mg/L]
[Alkalinity] = -8.33 x [TDS]^2 + 0.713 x [TDS] + 0
R^2 = 0.838, Standard Error = 4.6 mg/L
Alkalinity as $CaCO_3$ [mg/L]
[Na^+] = 3.80e-04 x [TDS]^2 + 0.0625 x [TDS] + 0
R^2 = 0.837, Standard Error = 1.1 mg/L
Na^+ [mg/L]
[Ca^{2+}] = -3.18e-04 x [TDS]^2 + 0.154 x [TDS] + 0
R^2 = 0.760, Standard Error = 0.9 mg/L
Ca^{2+} [mg/L]
[Mg^{2+}] = 4.37e-05 x [TDS]^2 + 0.0628 x [TDS] + 0
R^2 = 0.837, Standard Error = 0.6 mg/L
Mg^{2+} [mg/L]
[K^+] = -2.79e-05 x [TDS]^2 + 0.0167 x [TDS] + 0
R^2 = 0.416, Standard Error = 0.2 mg/L
K^+ [mg/L]

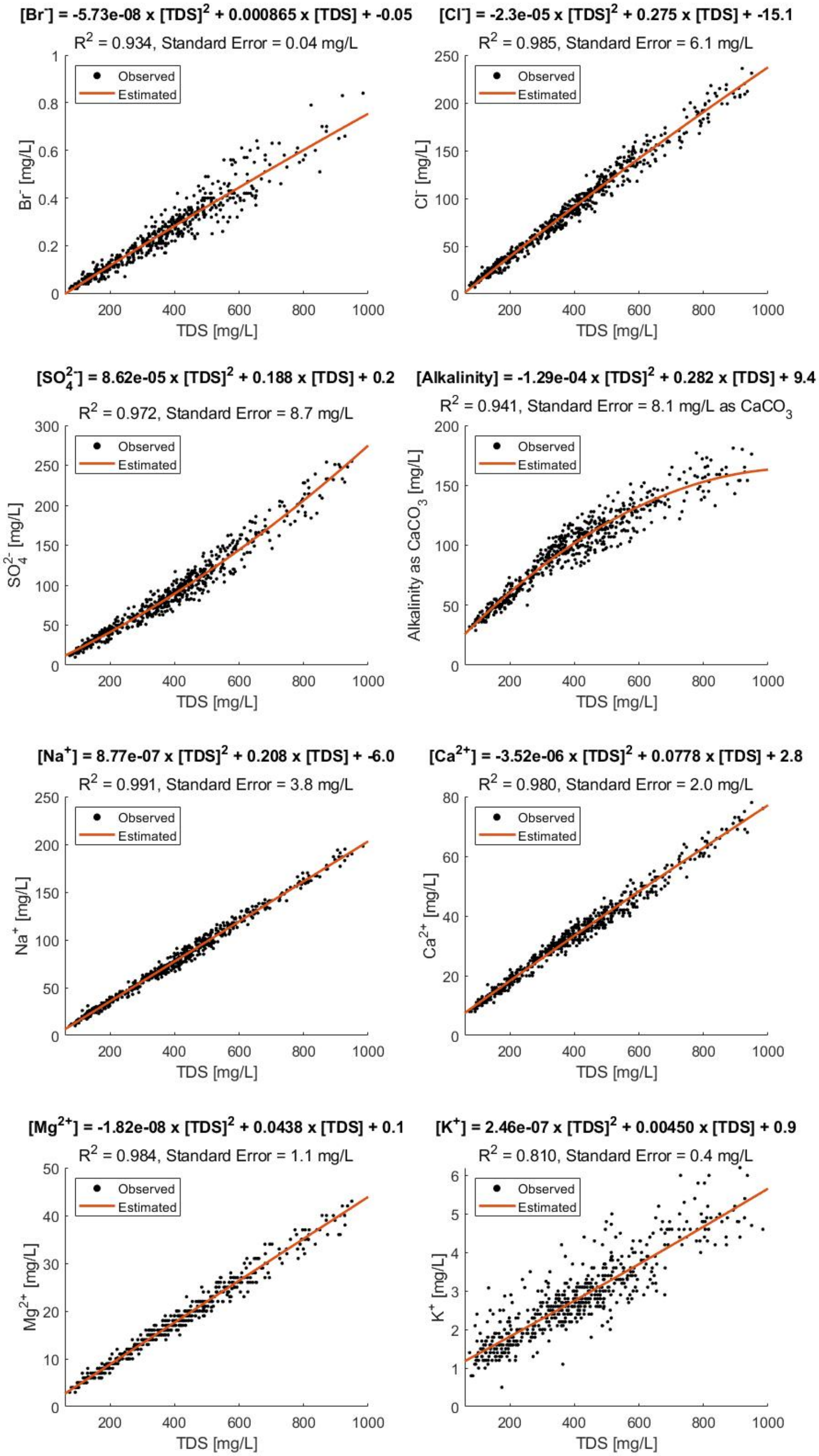
C-1.3 San Joaquin River Boundary Region

Figure Group 4*. Regression fits for the San Joaquin River Boundary Region when 100 ≤ EC < 1,600 µS/cm or 60 ≤ TDS < 1,000 mg/L. The first two graphs show the observed data used to develop the regression relationships between EC and TDS. The estimating quadratic equation is supported with statistics,* R^2 *and Standard Error, as reported in the user guide. The graphs thereafter show the observed data and quadratic fits for the relationships between EC, TDS, and each of the constituents of interest along with the estimating quadratic equation,* R^2*, and Standard Error.*





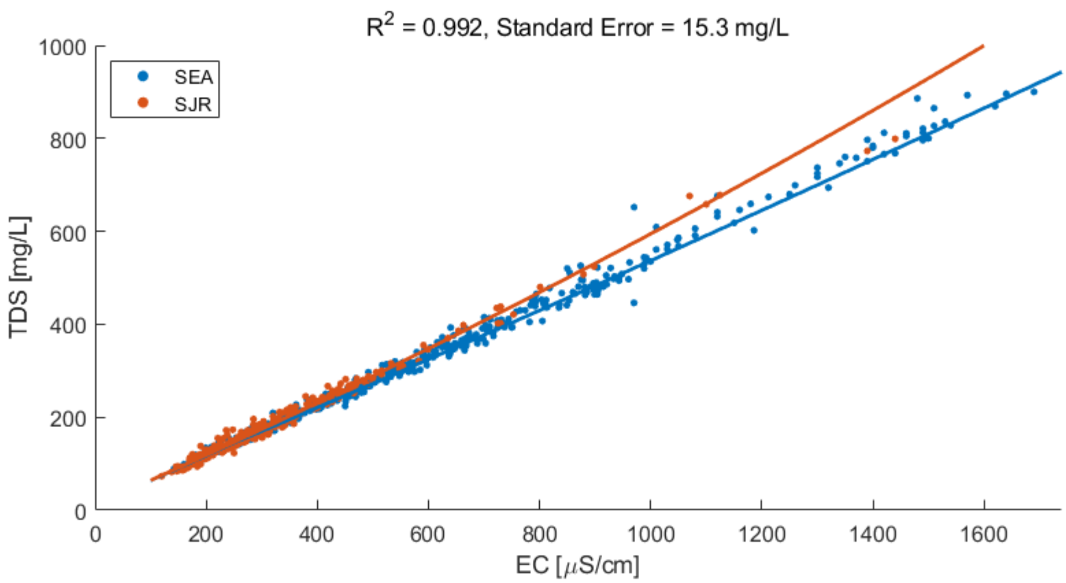

[Br⁻] = 2.70e-08 x [EC]^2 + 0.000458 x [EC] + -0.05
R^2 = 0.941, Standard Error = 0.03 mg/L
Observed
Estimated
Br⁻ [mg/L]
EC [μS/cm]
[Cl⁻] = 6.50e-06 x [EC]^2 + 0.147 x [EC] + -12.5
R^2 = 0.989, Standard Error = 5.2 mg/L
Observed
Estimated
Cl⁻ [mg/L]
EC [μS/cm]
[SO4^2-] = 4.76e-05 x [EC]^2 + 0.0917 x [EC] + 3.8
R^2 = 0.968, Standard Error = 9.3 mg/L
Observed
Estimated
SO4^2- [mg/L]
EC [μS/cm]
[Alkalinity] = -4.01e-05 x [EC]^2 + 0.162 x [EC] + 9.5
R^2 = 0.946, Standard Error = 7.8 mg/L as CaCO3
Observed
Estimated
Alkalinity as CaCO3 [mg/L]
EC [μS/cm]
[Na⁺] = 1.24e-05 x [EC]^2 + 0.110 x [EC] + -3.9
R^2 = 0.992, Standard Error = 3.5 mg/L
Observed
Estimated
Na⁺ [mg/L]
EC [μS/cm]
[Ca^2+] = 2.41e-06 x [EC]^2 + 0.0420 x [EC] + 3.4
R^2 = 0.979, Standard Error = 2.0 mg/L
Observed
Estimated
Ca^2+ [mg/L]
EC [μS/cm]
[Mg^2+] = 2.44e-06 x [EC]^2 + 0.0232 x [EC] + 0.5
R^2 = 0.985, Standard Error = 1.0 mg/L
Observed
Estimated
Mg^2+ [mg/L]
EC [μS/cm]
[K⁺] = 3.78e-07 x [EC]^2 + 0.00232 x [EC] + 1.0
R^2 = 0.803, Standard Error = 0.4 mg/L
Observed
Estimated
K⁺ [mg/L]
EC [μS/cm]

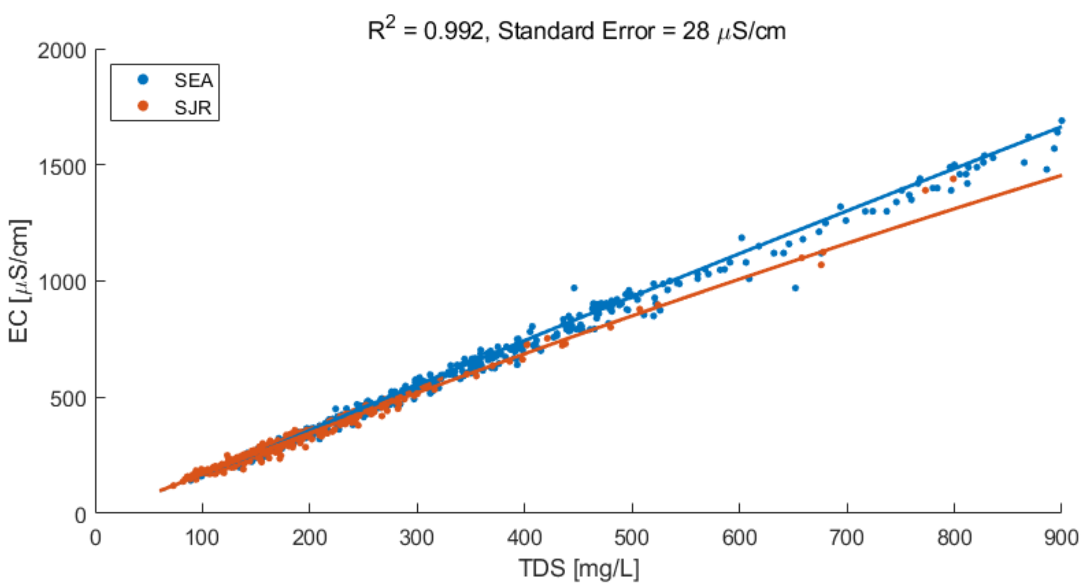

[Br-] = -5.73e-08 x [TDS]^2 + 0.000865 x [TDS] + -0.05
R^2 = 0.934, Standard Error = 0.04 mg/L
Observed
Estimated
Br- [mg/L]
TDS [mg/L]
[Cl-] = -2.3e-05 x [TDS]^2 + 0.275 x [TDS] + -15.1
R^2 = 0.985, Standard Error = 6.1 mg/L
Cl- [mg/L]
[SO4 2-] = 8.62e-05 x [TDS]^2 + 0.188 x [TDS] + 0.2
R^2 = 0.972, Standard Error = 8.7 mg/L
SO4 2- [mg/L]
[Alkalinity] = -1.29e-04 x [TDS]^2 + 0.282 x [TDS] + 9.4
R^2 = 0.941, Standard Error = 8.1 mg/L as CaCO3
Alkalinity as CaCO3 [mg/L]
[Na+] = 8.77e-07 x [TDS]^2 + 0.208 x [TDS] + -6.0
R^2 = 0.991, Standard Error = 3.8 mg/L
Na+ [mg/L]
[Ca2+] = -3.52e-06 x [TDS]^2 + 0.0778 x [TDS] + 2.8
R^2 = 0.980, Standard Error = 2.0 mg/L
Ca2+ [mg/L]
[Mg2+] = -1.82e-08 x [TDS]^2 + 0.0438 x [TDS] + 0.1
R^2 = 0.984, Standard Error = 1.1 mg/L
Mg2+ [mg/L]
[K+] = 2.46e-07 x [TDS]^2 + 0.00450 x [TDS] + 0.9
R^2 = 0.810, Standard Error = 0.4 mg/L
K+ [mg/L]

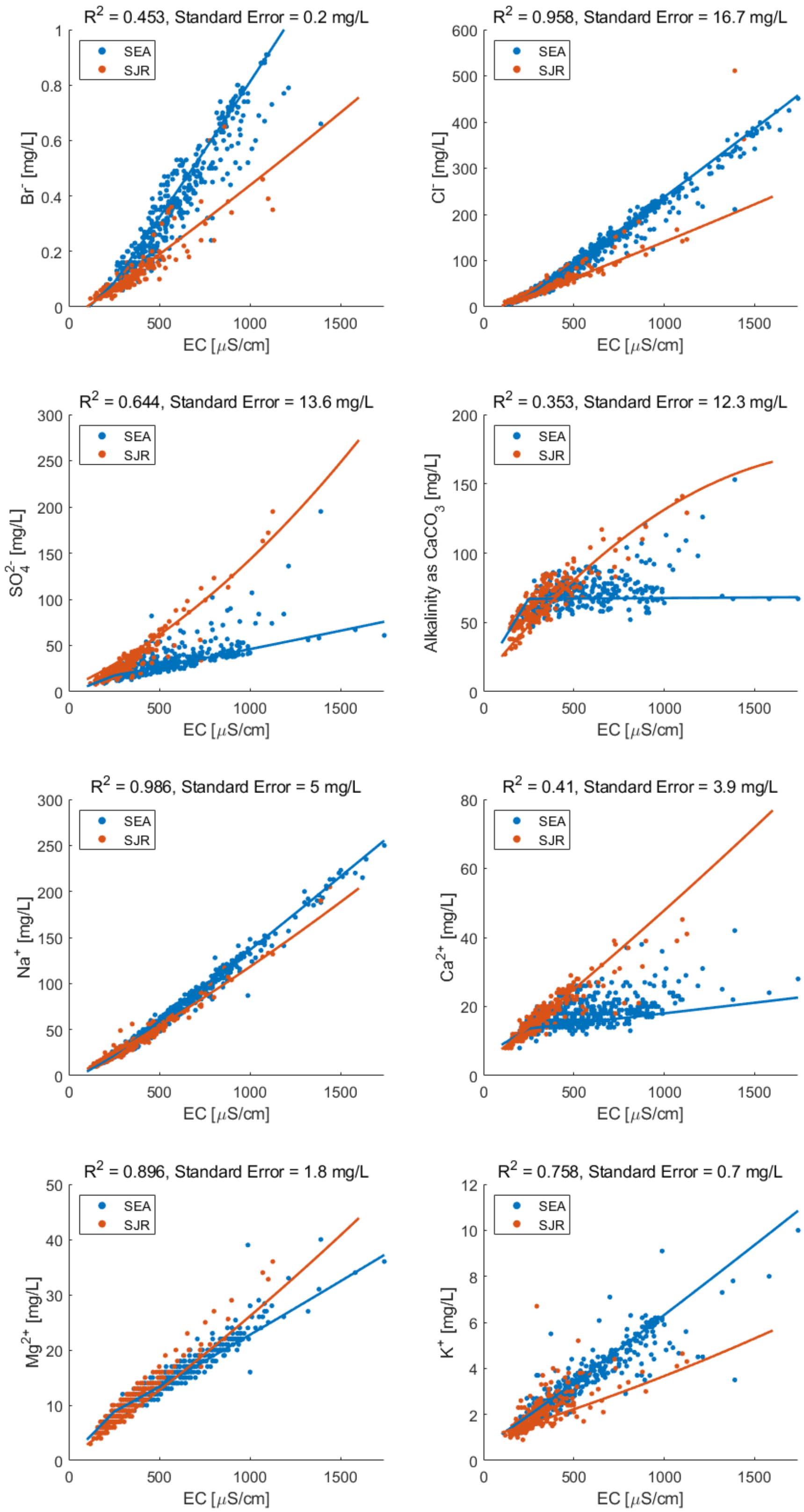
C-2 Interior Delta Region

C-2.1 Old-Middle River Export Corridor Subregion

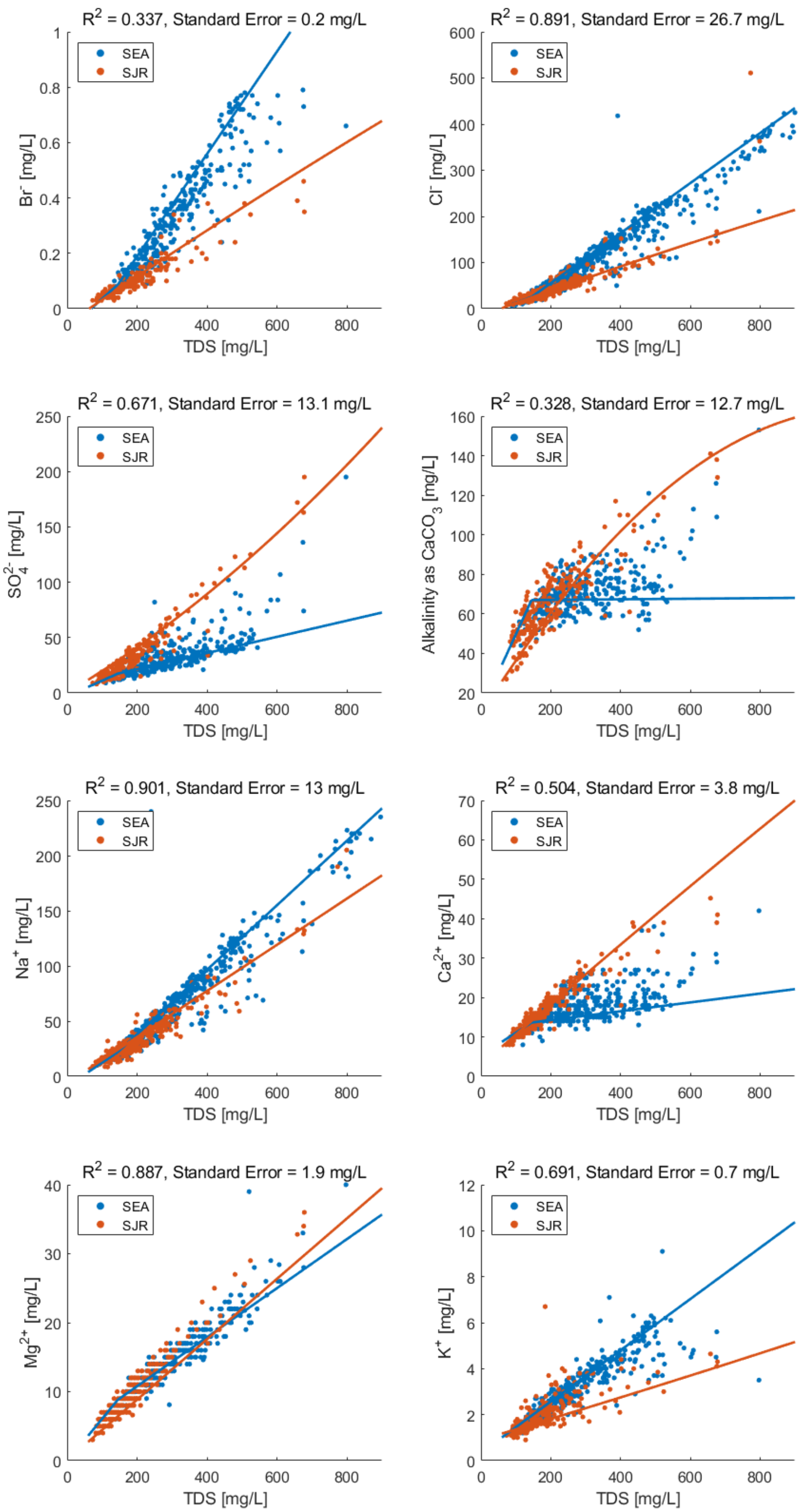
Figure Group 5*. Observed and estimated salinity constituent concentrations within the Old-Middle River Export Corridor Subregion using known EC or TDS values and following the methodology in Branch 2 of the Decision Tree. The first two graphs show the observed data and the estimations for EC as a function of TDS and vice versa. The estimation is supported with statistics, R^2 and Standard Error, as reported in the user guide. The graphs thereafter show the observed data and regression equations of other salinity constituents of interest as a function of EC or TDS, along with the overall R^2 and Standard Error associated with the estimation.*







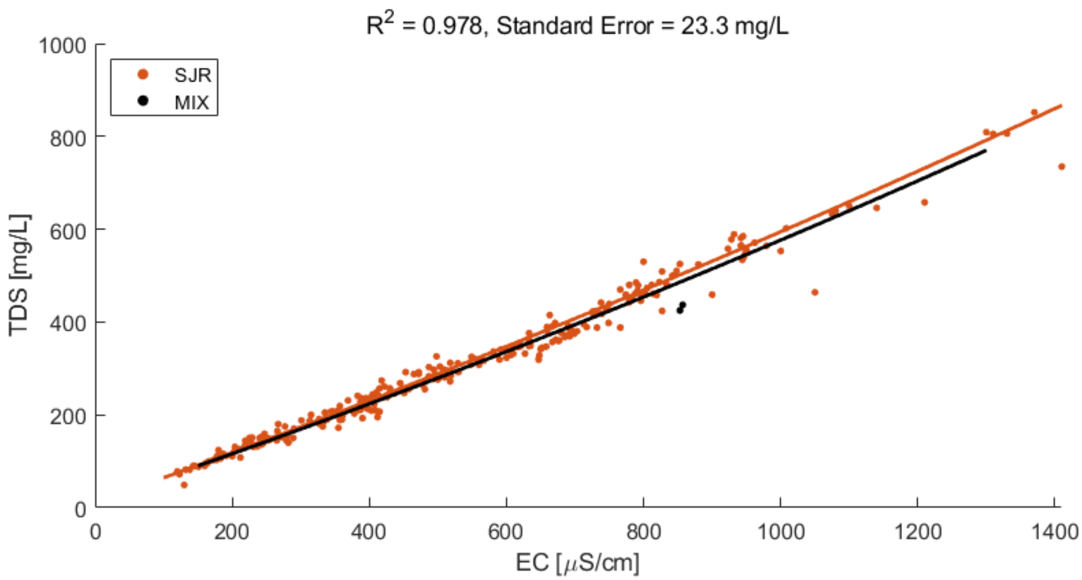
y-axis scaled to exclude a single data point where bromide concentration exceeds 1 mg/L; however, the associated statistics still incorporate this data point.

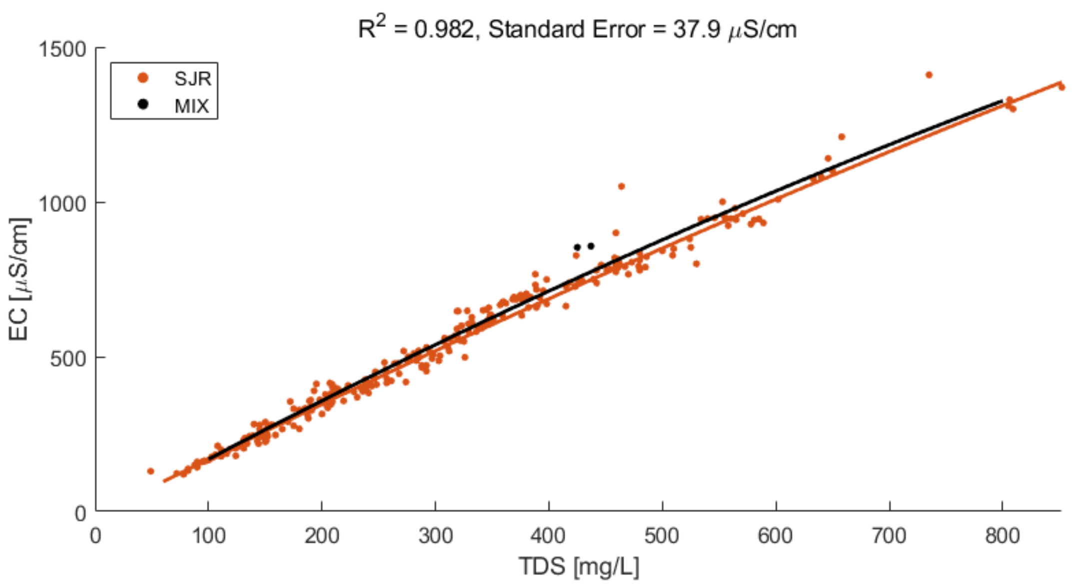


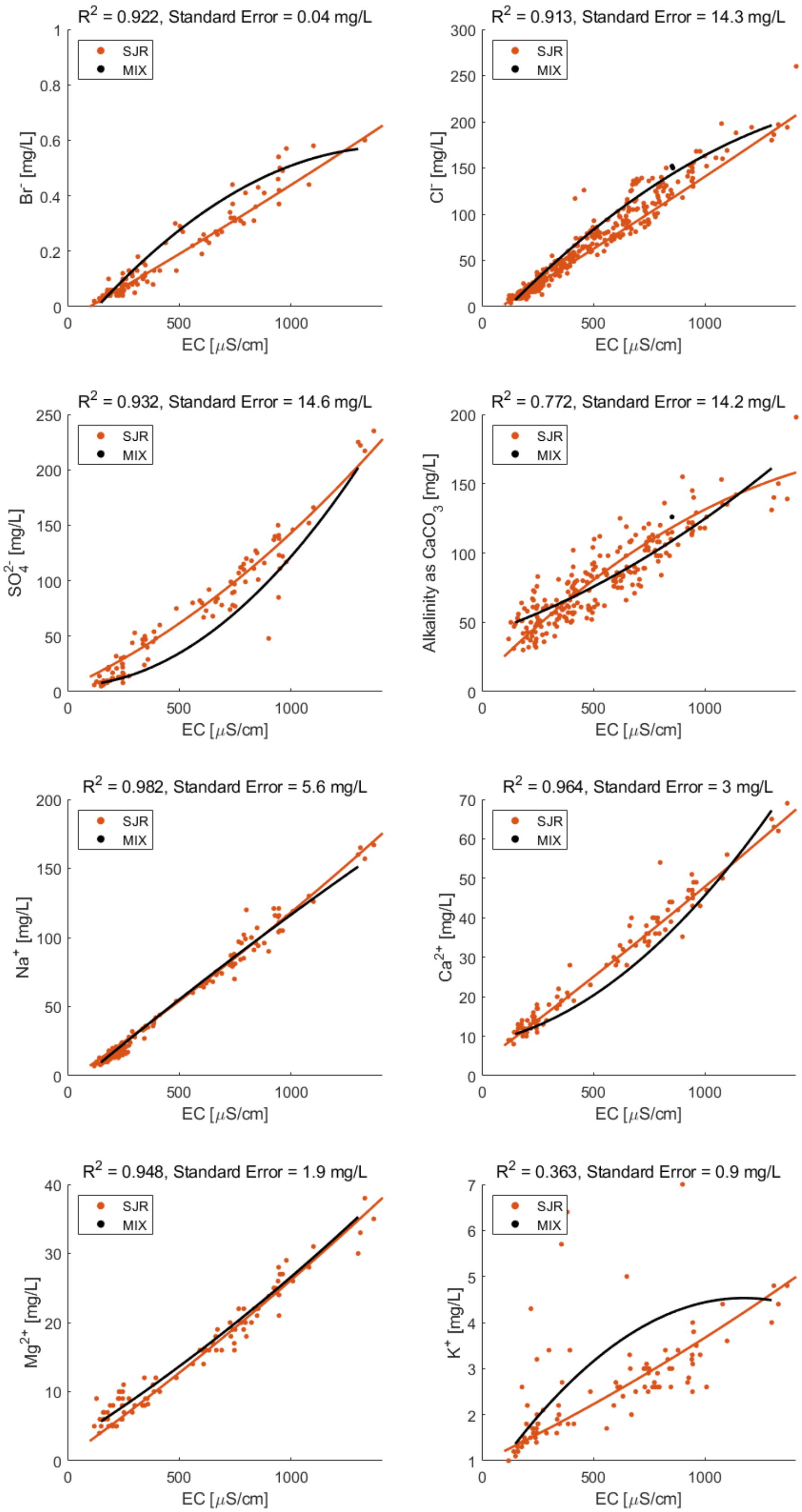
y-axis scaled to exclude a single data point where bromide concentration exceeds 1 mg/L; however, the associated statistics still incorporate this data point.

C-2.2 San Joaquin River Corridor Subregion

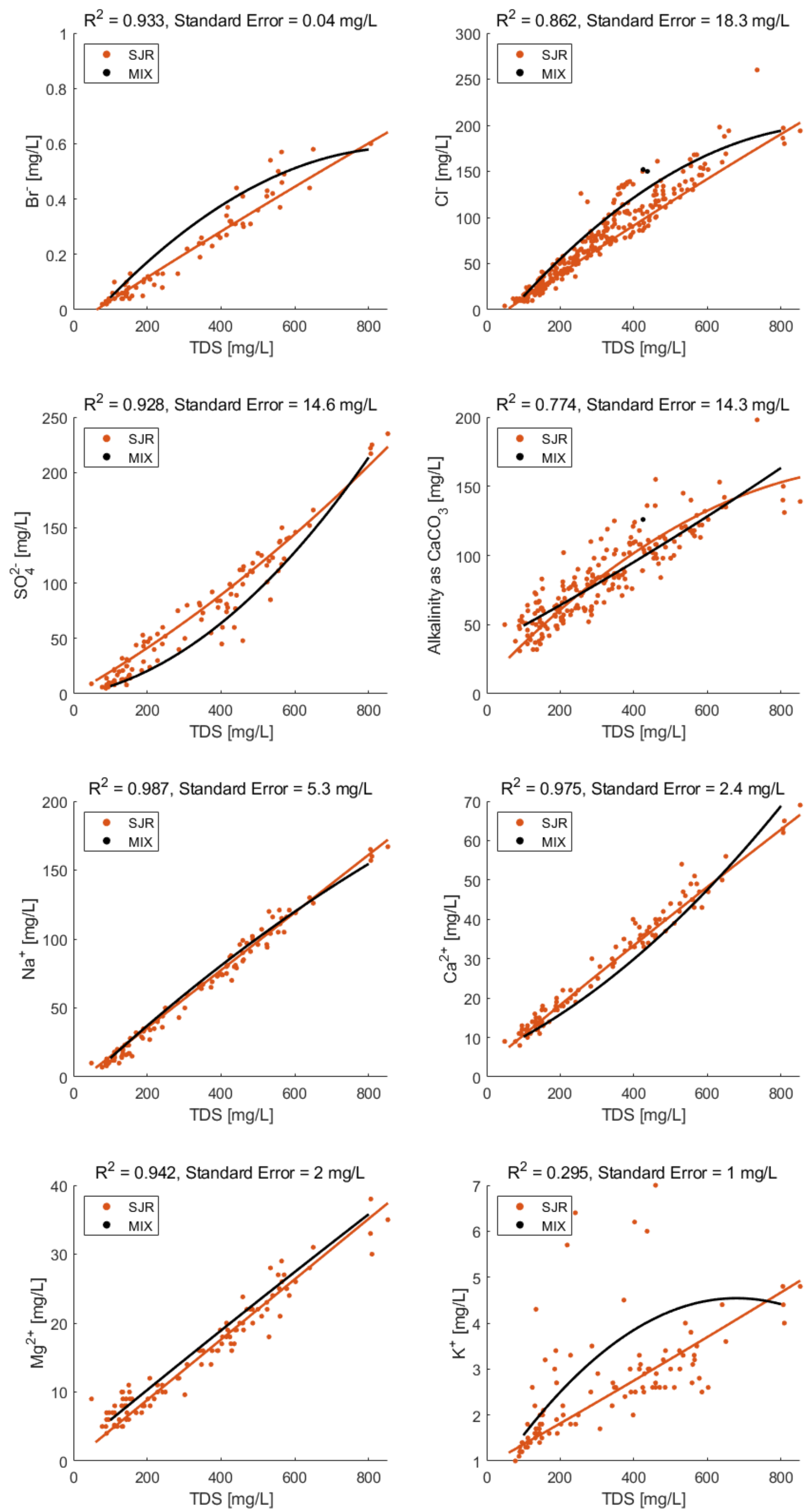
Figure Group 6. *Observed and estimated salinity constituent concentrations within the San Joaquin River Corridor Subregion using known EC or TDS values and following the methodology in Branch 2 of the Decision Tree. The first two graphs show the observed data and the estimations for EC as a function of TDS and vice versa. The estimation is supported with statistics, R^2 and Standard Error, as reported in the user guide. The graphs thereafter show the observed data and regression equations of other salinity constituents of interest as a function of EC or TDS, along with the overall R^2 and Standard Error associated with the estimation.*





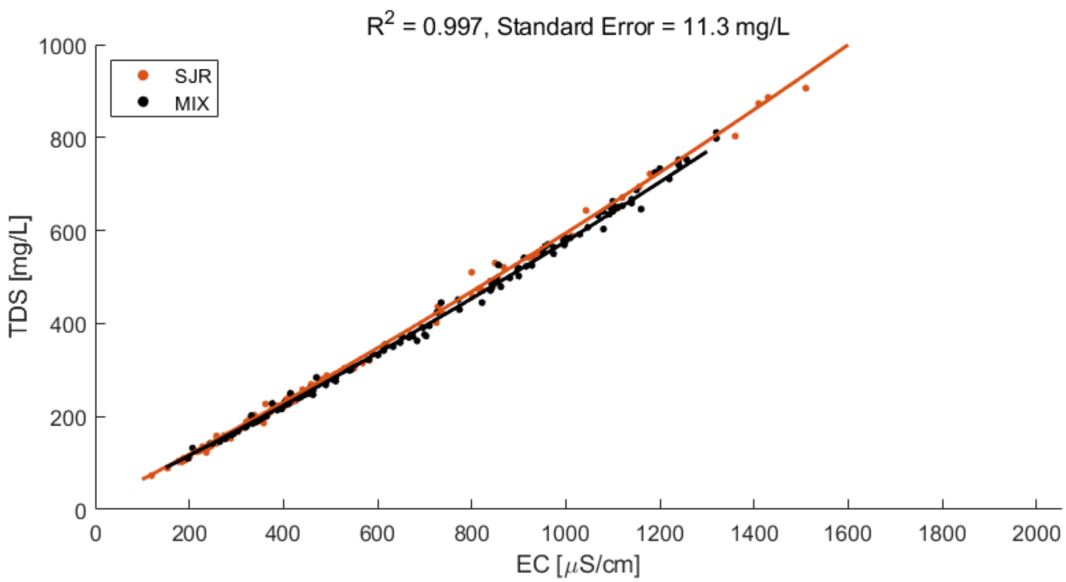


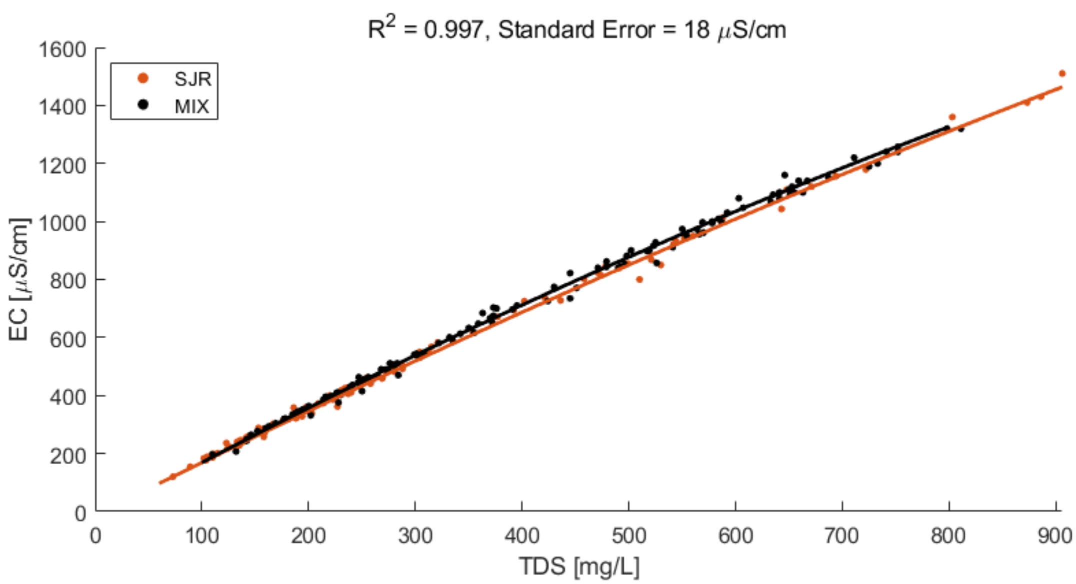
R2 = 0.922, Standard Error = 0.04 mg/L
SJR
MIX
Br- [mg/L]
EC [μS/cm]
R2 = 0.913, Standard Error = 14.3 mg/L
SJR
MIX
Cl- [mg/L]
EC [μS/cm]
R2 = 0.932, Standard Error = 14.6 mg/L
SJR
MIX
SO42- [mg/L]
EC [μS/cm]
R2 = 0.772, Standard Error = 14.2 mg/L
SJR
MIX
Alkalinity as CaCO3 [mg/L]
EC [μS/cm]
R2 = 0.982, Standard Error = 5.6 mg/L
SJR
MIX
Na+ [mg/L]
EC [μS/cm]
R2 = 0.964, Standard Error = 3 mg/L
SJR
MIX
Ca2+ [mg/L]
EC [μS/cm]
R2 = 0.948, Standard Error = 1.9 mg/L
SJR
MIX
Mg2+ [mg/L]
EC [μS/cm]
R2 = 0.363, Standard Error = 0.9 mg/L
SJR
MIX
K+ [mg/L]
EC [μS/cm]

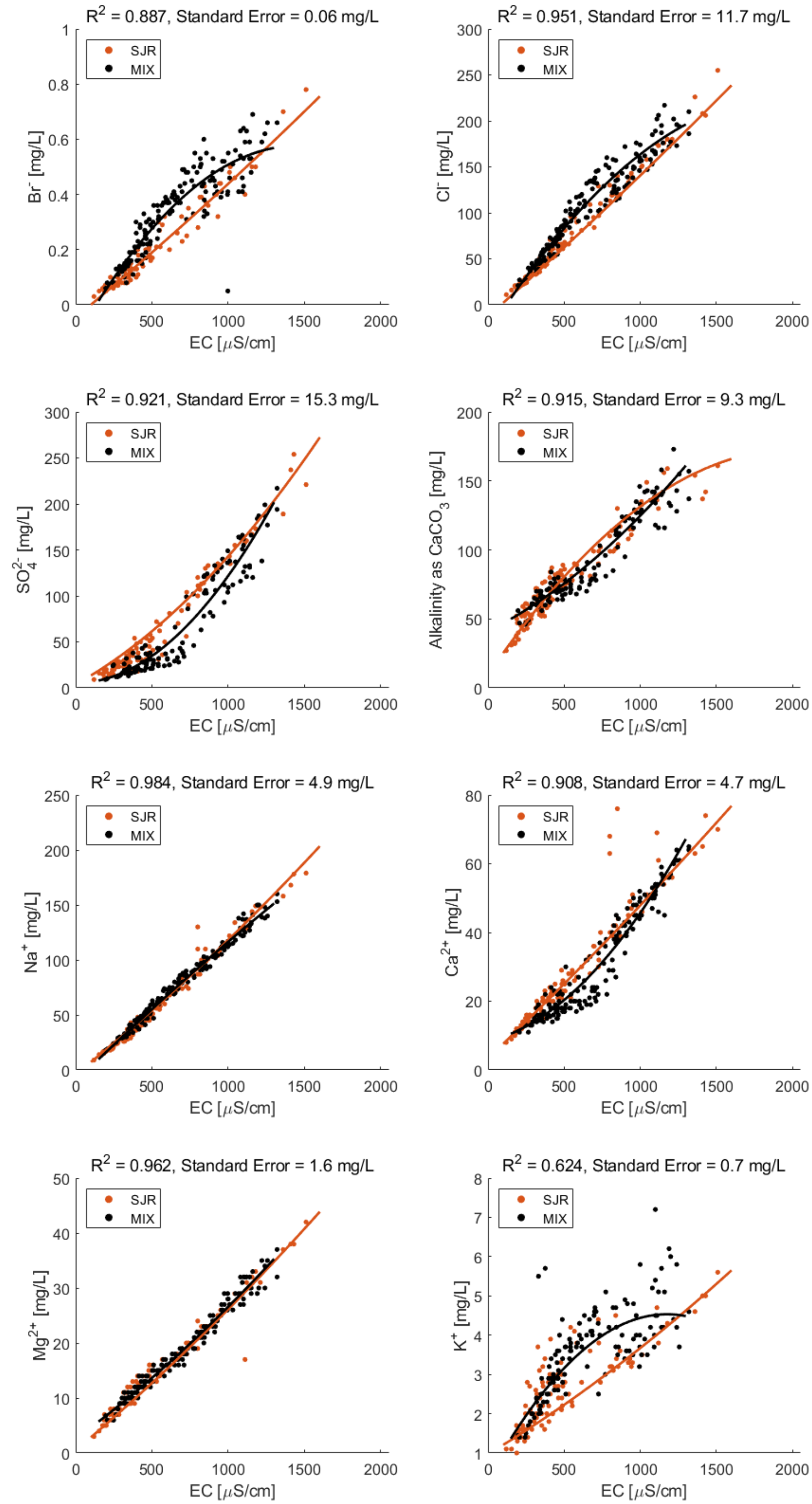

R2 = 0.933, Standard Error = 0.04 mg/L
SJR
MIX
Br- [mg/L]
TDS [mg/L]
R2 = 0.862, Standard Error = 18.3 mg/L
SJR
MIX
Cl- [mg/L]
TDS [mg/L]
R2 = 0.928, Standard Error = 14.6 mg/L
SJR
MIX
SO42- [mg/L]
TDS [mg/L]
R2 = 0.774, Standard Error = 14.3 mg/L
SJR
MIX
Alkalinity as CaCO3 [mg/L]
TDS [mg/L]
R2 = 0.987, Standard Error = 5.3 mg/L
SJR
MIX
Na+ [mg/L]
TDS [mg/L]
R2 = 0.975, Standard Error = 2.4 mg/L
SJR
MIX
Ca2+ [mg/L]
TDS [mg/L]
R2 = 0.942, Standard Error = 2 mg/L
SJR
MIX
Mg2+ [mg/L]
TDS [mg/L]
R2 = 0.295, Standard Error = 1 mg/L
SJR
MIX
K+ [mg/L]
TDS [mg/L]

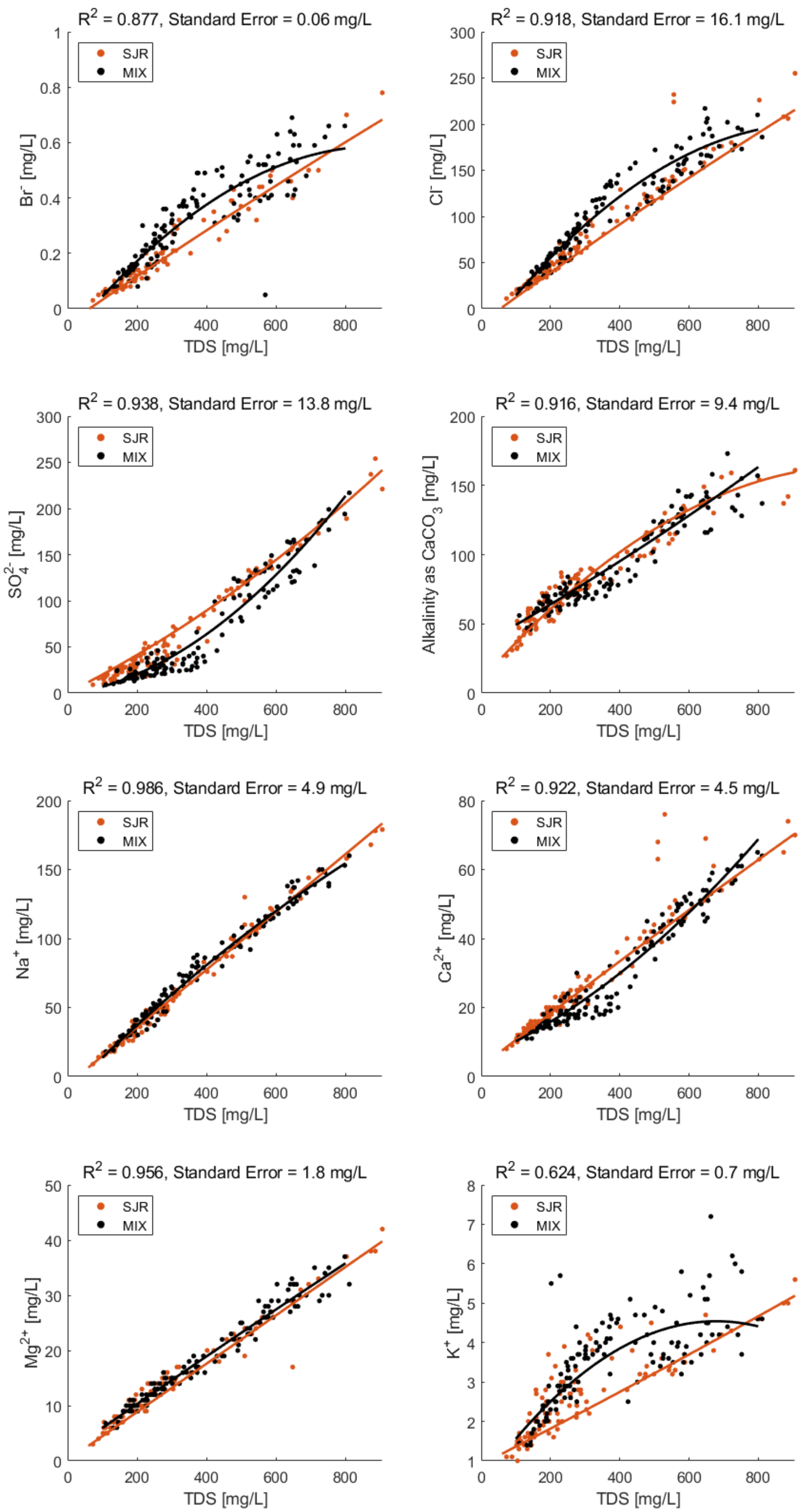
C-2.3 South Delta Subregion

Figure Group 7*. Observed and estimated salinity constituent concentrations within the South Delta Subregion using known EC or TDS values and following the methodology in Branch 2 of the Decision Tree. The first two graphs show the observed data and the estimations for EC as a function of TDS and vice versa. The estimation is supported with statistics, R^2 and Standard Error, as reported in the user guide. The graphs thereafter show the observed data and regression equations of other salinity constituents of interest as a function of EC or TDS, along with the overall R^2 and Standard Error associated with the estimation.*






R2 = 0.887, Standard Error = 0.06 mg/L
SJR
MIX
Br- [mg/L]
EC [μS/cm]
R2 = 0.951, Standard Error = 11.7 mg/L
Cl- [mg/L]
R2 = 0.921, Standard Error = 15.3 mg/L
SO42- [mg/L]
R2 = 0.915, Standard Error = 9.3 mg/L
Alkalinity as CaCO3 [mg/L]
R2 = 0.984, Standard Error = 4.9 mg/L
Na+ [mg/L]
R2 = 0.908, Standard Error = 4.7 mg/L
Ca2+ [mg/L]
R2 = 0.962, Standard Error = 1.6 mg/L
Mg2+ [mg/L]
R2 = 0.624, Standard Error = 0.7 mg/L
K+ [mg/L]

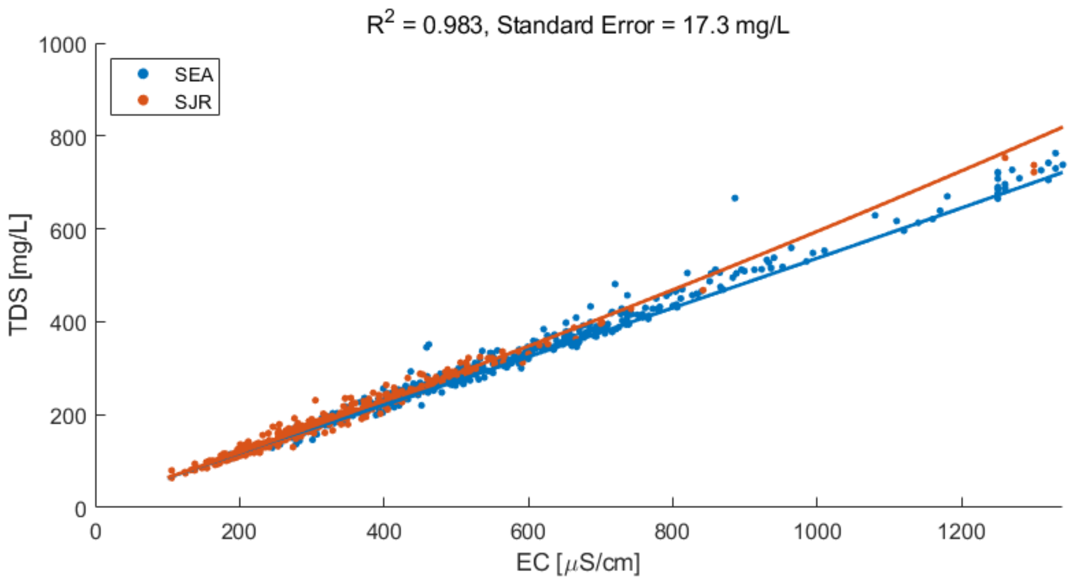


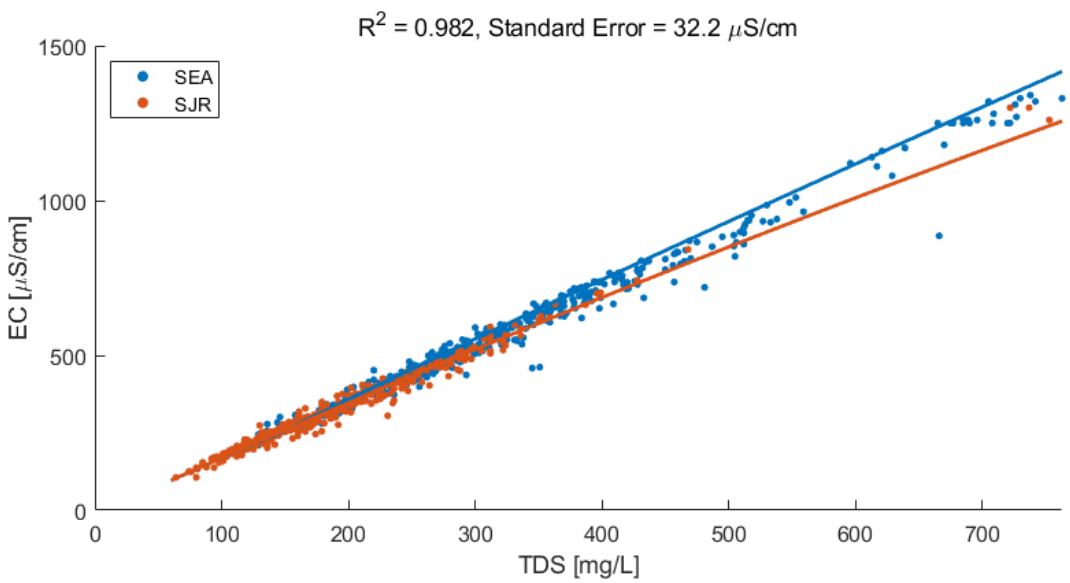
R² = 0.877, Standard Error = 0.06 mg/L
SJR
MIX
Br⁻ [mg/L]
TDS [mg/L]
R² = 0.918, Standard Error = 16.1 mg/L
SJR
MIX
Cl⁻ [mg/L]
TDS [mg/L]
R² = 0.938, Standard Error = 13.8 mg/L
SJR
MIX
SO4 2- [mg/L]
TDS [mg/L]
R² = 0.916, Standard Error = 9.4 mg/L
SJR
MIX
Alkalinity as CaCO3 [mg/L]
TDS [mg/L]
R² = 0.986, Standard Error = 4.9 mg/L
SJR
MIX
Na⁺ [mg/L]
TDS [mg/L]
R² = 0.922, Standard Error = 4.5 mg/L
SJR
MIX
Ca²⁺ [mg/L]
TDS [mg/L]
R² = 0.956, Standard Error = 1.8 mg/L
SJR
MIX
Mg²⁺ [mg/L]
TDS [mg/L]
R² = 0.624, Standard Error = 0.7 mg/L
SJR
MIX
K⁺ [mg/L]
TDS [mg/L]

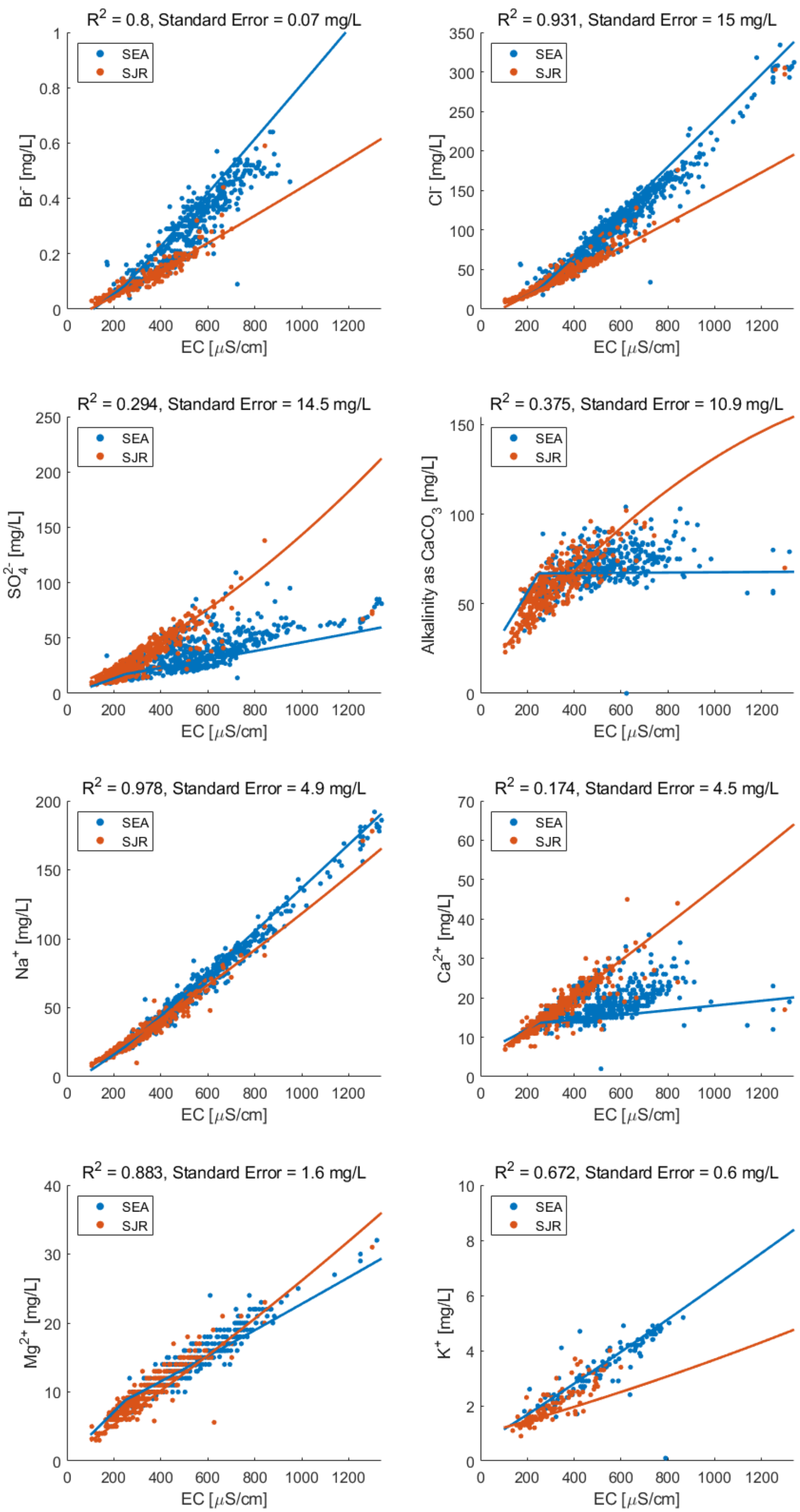
C-3 Location-Specific Urban Diversions

C-3.1 Banks Pumping Plant

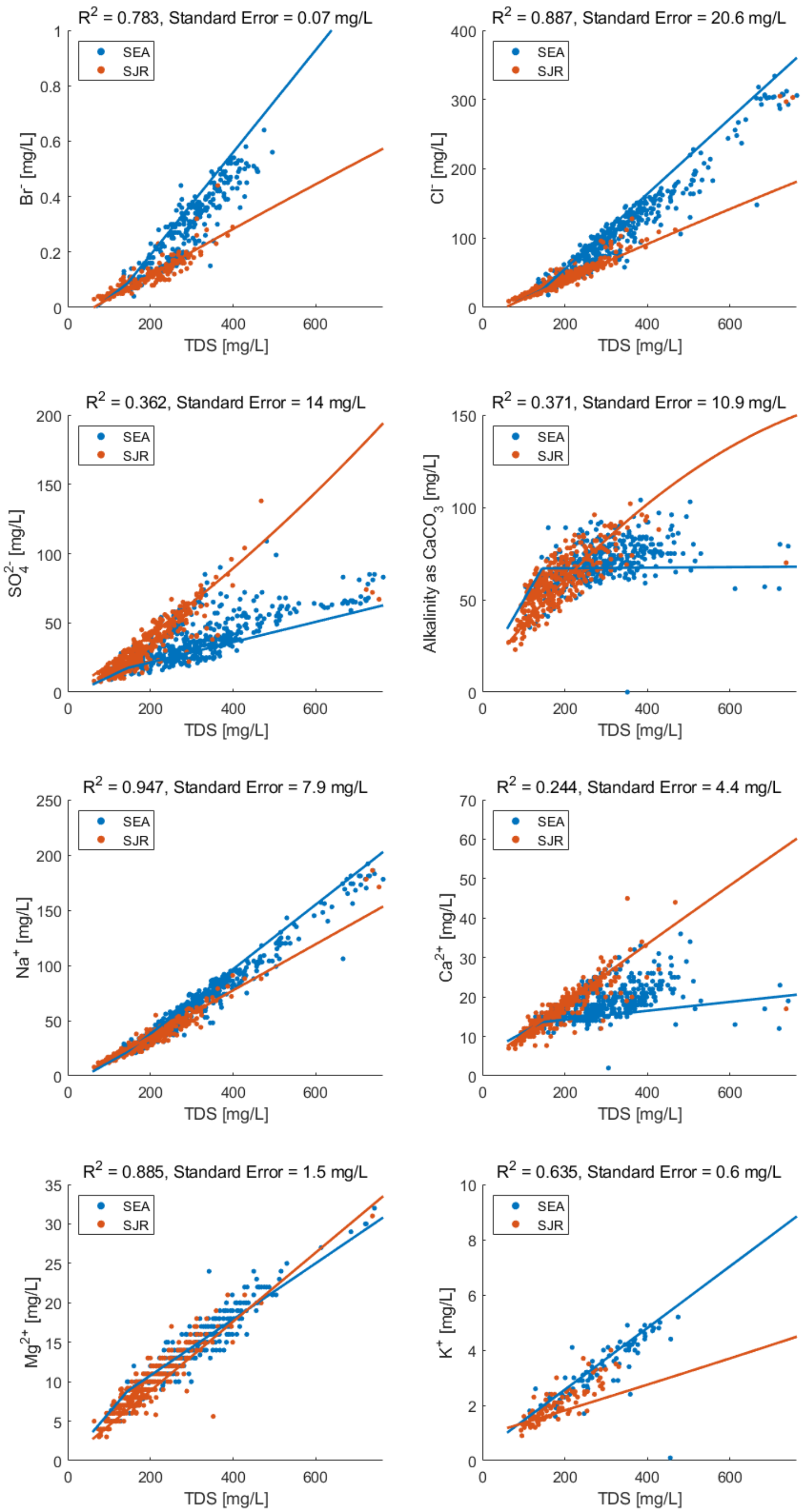
***Figure Group 8**. Observed and estimated salinity constituent concentrations at the Banks Pumping Plant using known EC or TDS values and following the methodology in Branch 3 of the Decision Tree. The first two graphs show the observed data and the estimations for EC as a function of TDS and vice versa. The estimation is supported with statistics, R^2 and Standard Error, as reported in the user guide. The graphs thereafter show the observed data and regression equations of other salinity constituents of interest as a function of EC or TDS, along with the overall R^2 and Standard Error associated with the estimation.*







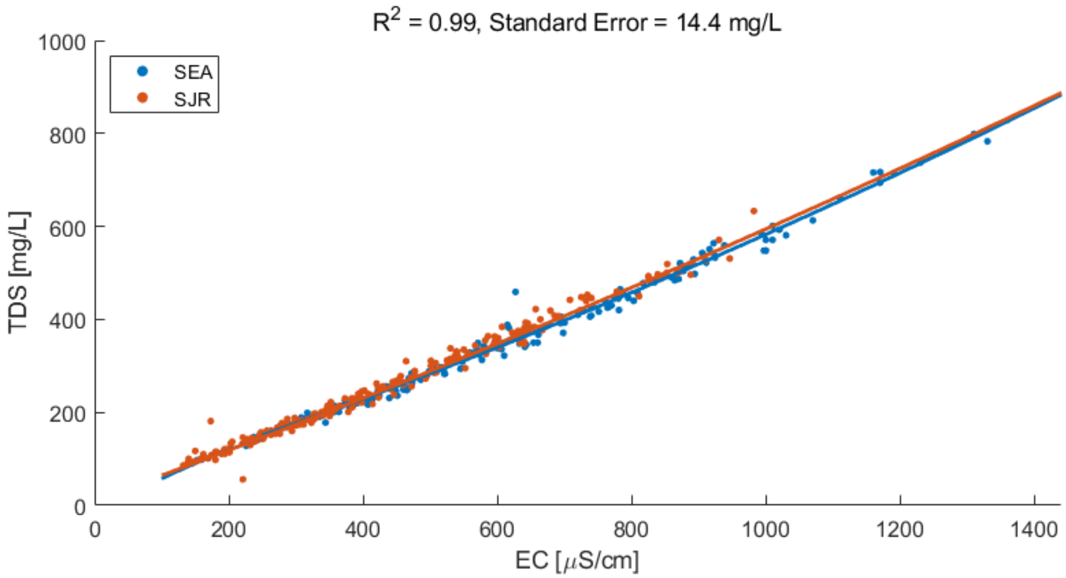
R^2 = 0.8, Standard Error = 0.07 mg/L
SEA
SJR
Br^- [mg/L]
EC [μS/cm]
R^2 = 0.931, Standard Error = 15 mg/L
SEA
SJR
Cl^- [mg/L]
EC [μS/cm]
R^2 = 0.294, Standard Error = 14.5 mg/L
SEA
SJR
SO_4^{2-} [mg/L]
EC [μS/cm]
R^2 = 0.375, Standard Error = 10.9 mg/L
SEA
SJR
Alkalinity as $CaCO_3$ [mg/L]
EC [μS/cm]
R^2 = 0.978, Standard Error = 4.9 mg/L
SEA
SJR
Na^+ [mg/L]
EC [μS/cm]
R^2 = 0.174, Standard Error = 4.5 mg/L
SEA
SJR
Ca^{2+} [mg/L]
EC [μS/cm]
R^2 = 0.883, Standard Error = 1.6 mg/L
SEA
SJR
Mg^{2+} [mg/L]
EC [μS/cm]
R^2 = 0.672, Standard Error = 0.6 mg/L
SEA
SJR
K^+ [mg/L]
EC [μS/cm]

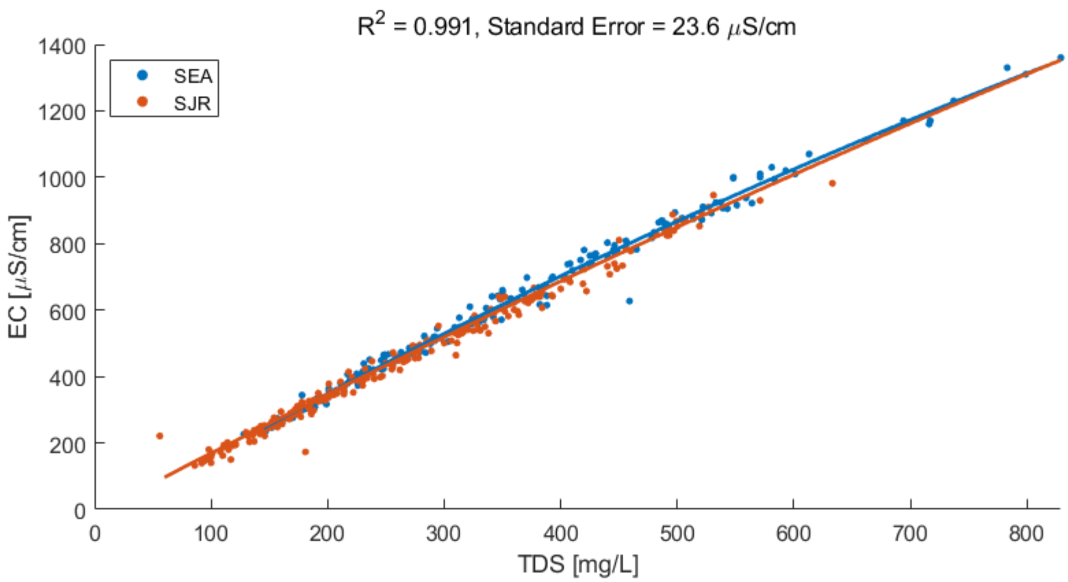


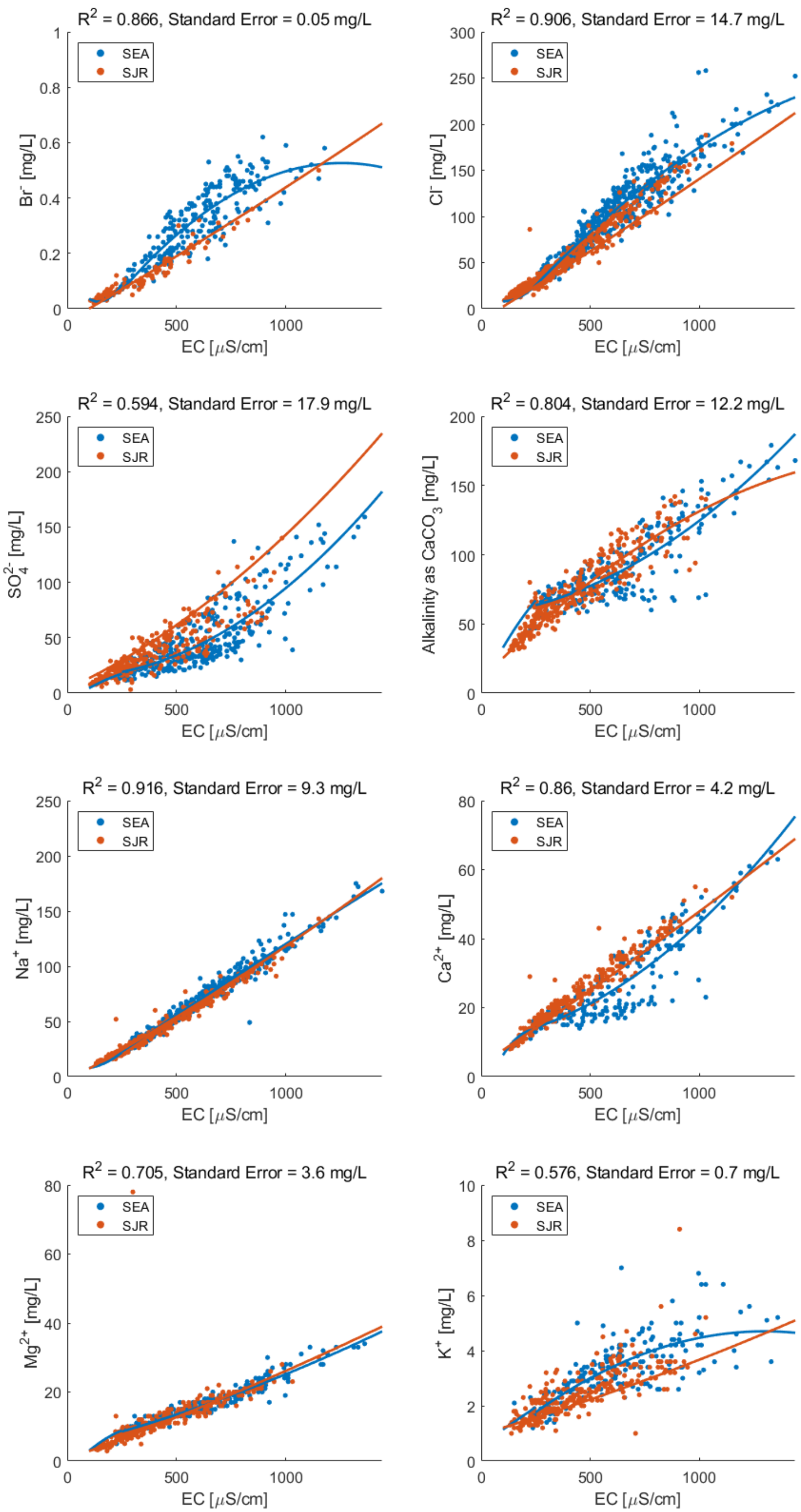
R2 = 0.783, Standard Error = 0.07 mg/L
SEA
SJR
Br- [mg/L]
TDS [mg/L]
R2 = 0.887, Standard Error = 20.6 mg/L
SEA
SJR
Cl- [mg/L]
TDS [mg/L]
R2 = 0.362, Standard Error = 14 mg/L
SEA
SJR
SO42- [mg/L]
TDS [mg/L]
R2 = 0.371, Standard Error = 10.9 mg/L
SEA
SJR
Alkalinity as CaCO3 [mg/L]
TDS [mg/L]
R2 = 0.947, Standard Error = 7.9 mg/L
SEA
SJR
Na+ [mg/L]
TDS [mg/L]
R2 = 0.244, Standard Error = 4.4 mg/L
SEA
SJR
Ca2+ [mg/L]
TDS [mg/L]
R2 = 0.885, Standard Error = 1.5 mg/L
SEA
SJR
Mg2+ [mg/L]
TDS [mg/L]
R2 = 0.635, Standard Error = 0.6 mg/L
SEA
SJR
K+ [mg/L]
TDS [mg/L]

C-3.2 Jones Pumping Plant

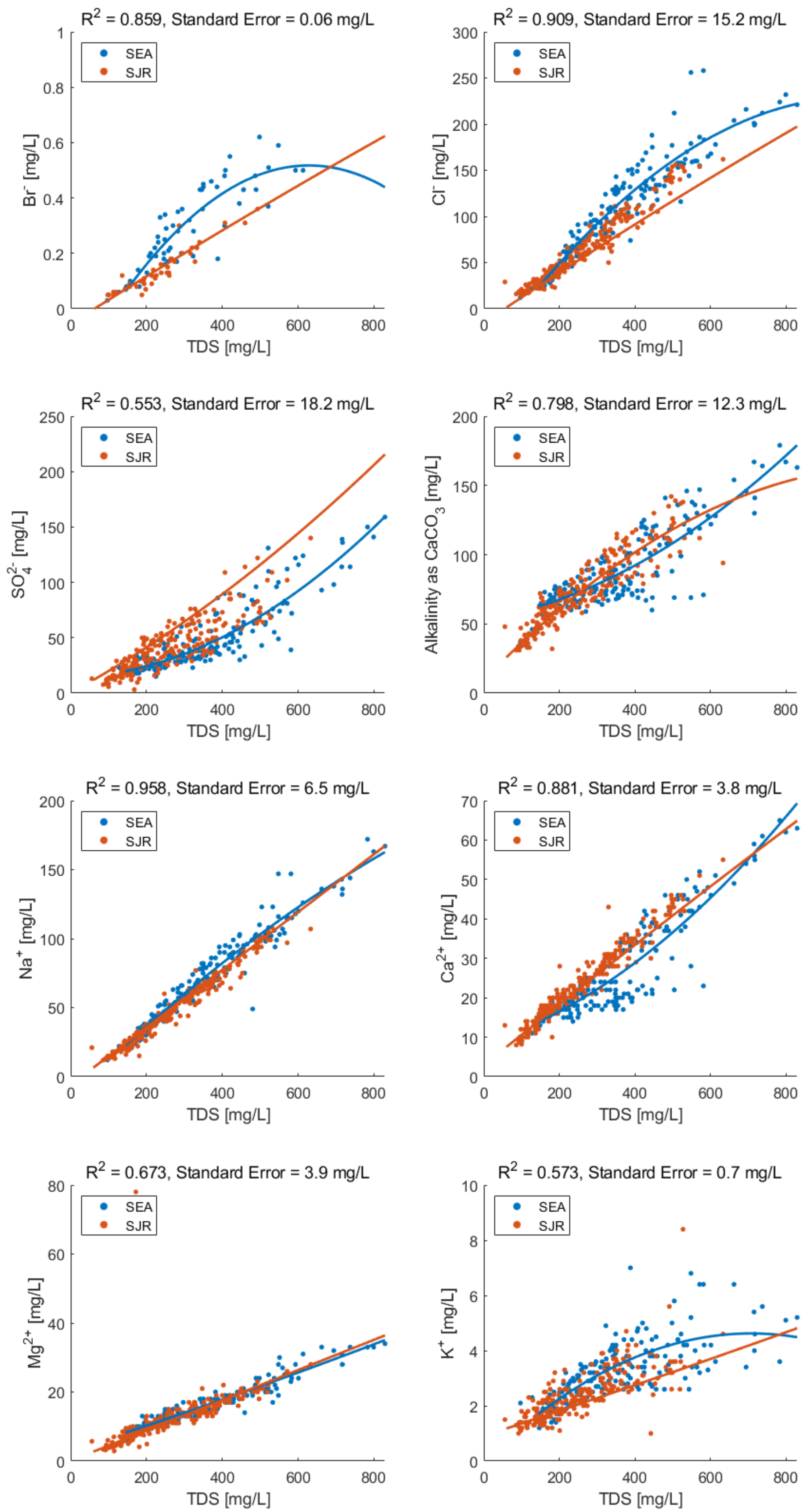
***Figure Group 9**. Model fits are shown for Jones Pumping Plant when 100 ≤ EC < 1,440 µS/cm or 55 ≤ TDS < 830 mg/L. Unique regression equations are used under seawater dominant conditions, while San Joaquin River Boundary regression equations are used under SJR dominant conditions. The first two graphs show the observed data used to develop the regression relationships between EC and TDS. The estimating equations are supported with statistics, R^2 and Standard Error, as reported in the user guide. The graphs thereafter show the observed data and model fits for the relationships between EC, TDS, and each of the constituents of interest along with statistics R^2, and Standard Error.*







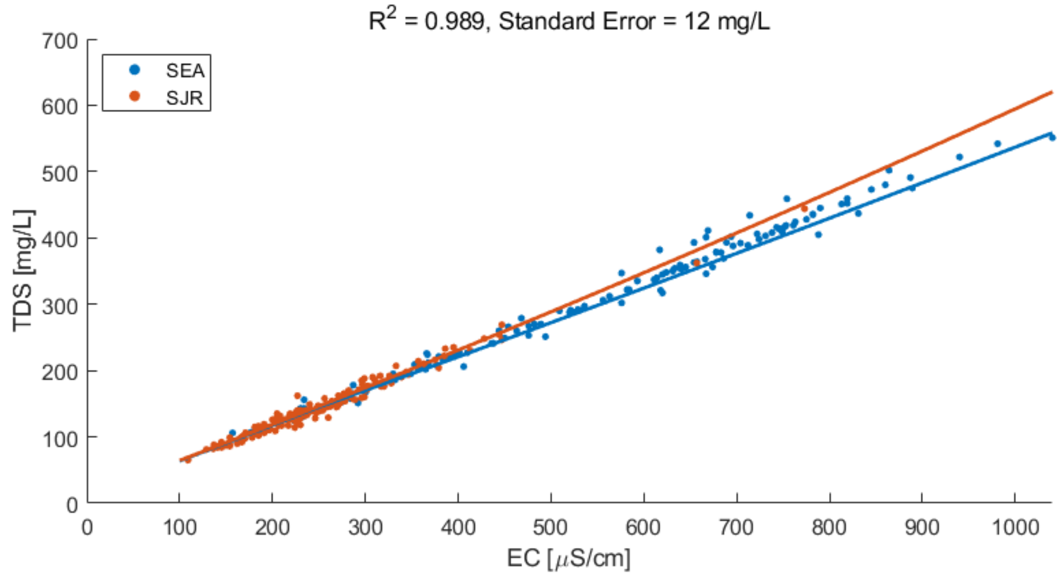
R2 = 0.866, Standard Error = 0.05 mg/L
Br- [mg/L]
R2 = 0.906, Standard Error = 14.7 mg/L
Cl- [mg/L]
R2 = 0.594, Standard Error = 17.9 mg/L
SO42- [mg/L]
R2 = 0.804, Standard Error = 12.2 mg/L
Alkalinity as CaCO3 [mg/L]
R2 = 0.916, Standard Error = 9.3 mg/L
Na+ [mg/L]
R2 = 0.86, Standard Error = 4.2 mg/L
Ca2+ [mg/L]
R2 = 0.705, Standard Error = 3.6 mg/L
Mg2+ [mg/L]
R2 = 0.576, Standard Error = 0.7 mg/L
K+ [mg/L]
EC [μS/cm]
SEA
SJR

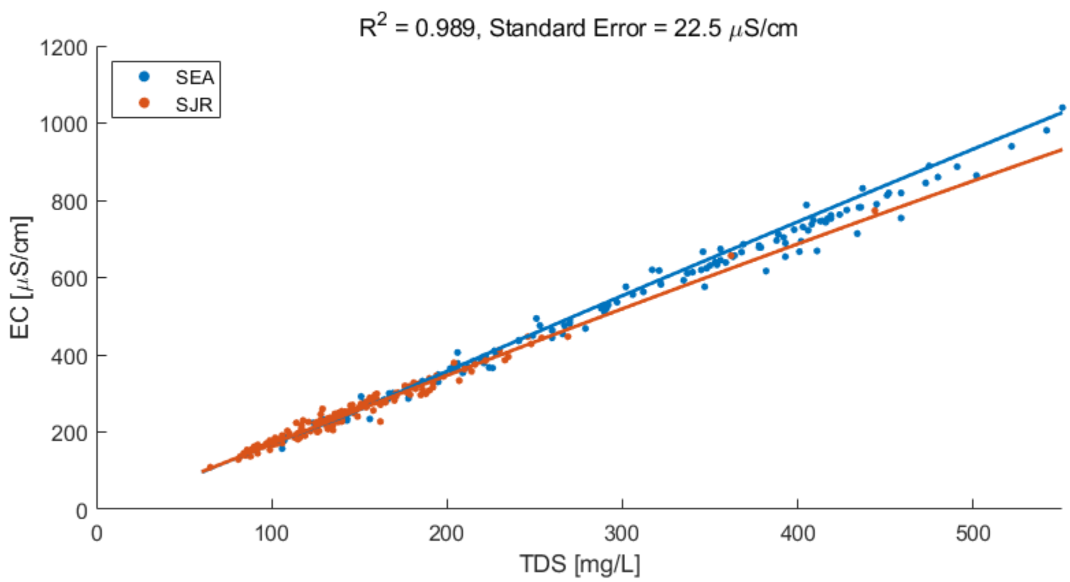


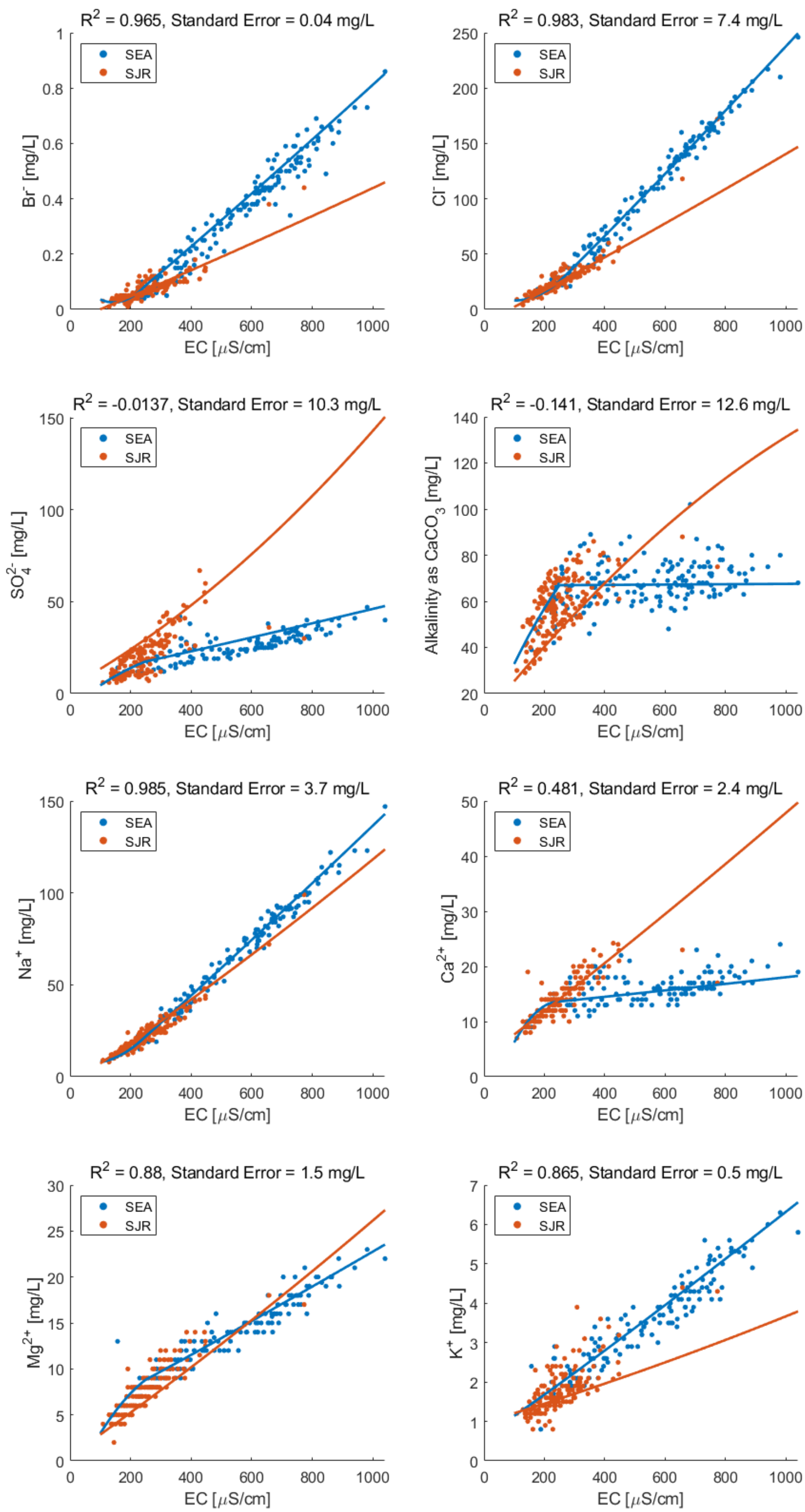
R2 = 0.859, Standard Error = 0.06 mg/L
Br- [mg/L]
R2 = 0.909, Standard Error = 15.2 mg/L
Cl- [mg/L]
R2 = 0.553, Standard Error = 18.2 mg/L
SO42- [mg/L]
R2 = 0.798, Standard Error = 12.3 mg/L
Alkalinity as CaCO3 [mg/L]
R2 = 0.958, Standard Error = 6.5 mg/L
Na+ [mg/L]
R2 = 0.881, Standard Error = 3.8 mg/L
Ca2+ [mg/L]
R2 = 0.673, Standard Error = 3.9 mg/L
Mg2+ [mg/L]
R2 = 0.573, Standard Error = 0.7 mg/L
K+ [mg/L]
SEA
SJR
TDS [mg/L]

C-3.3 Old River at Bacon Island

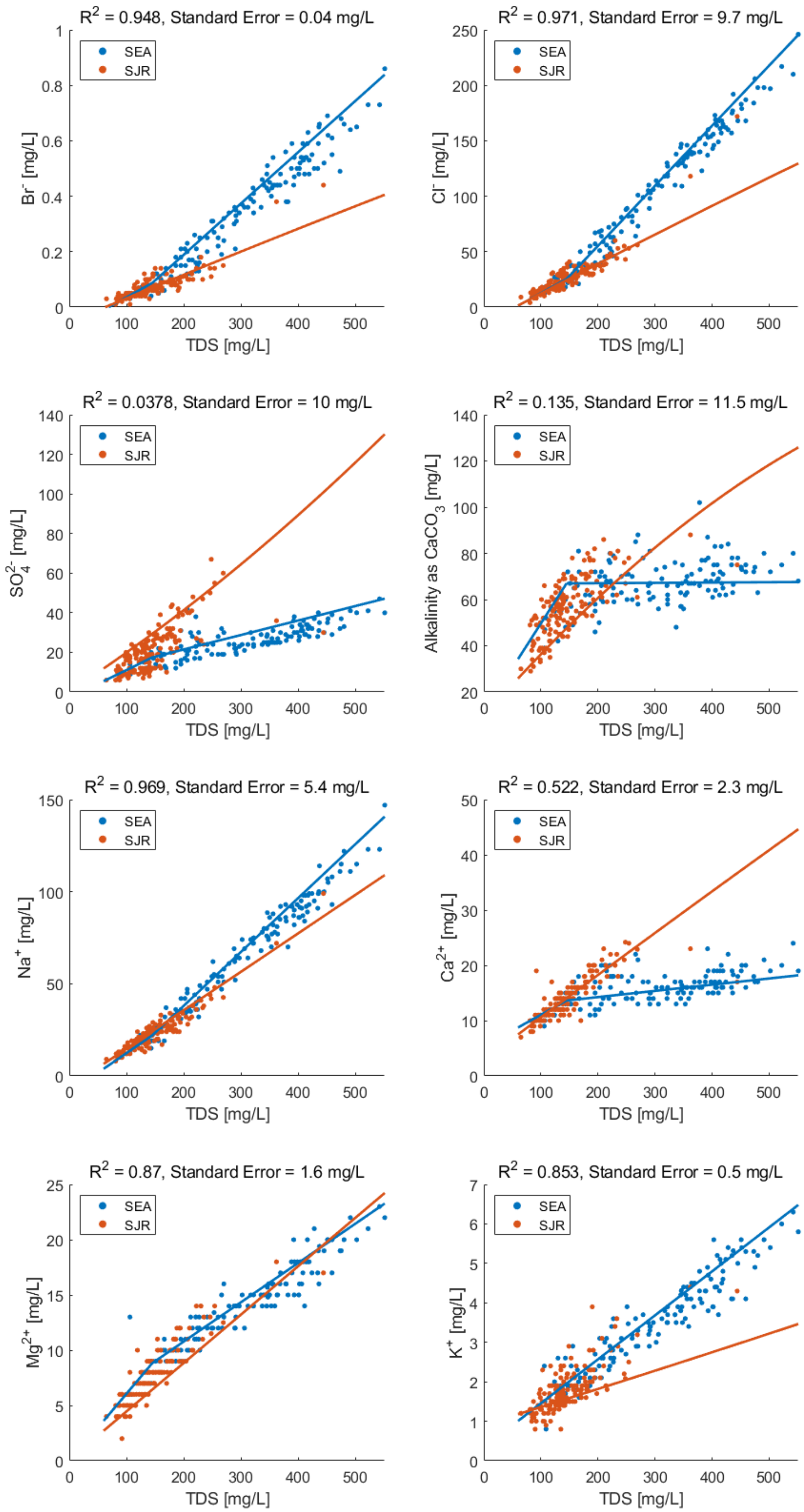
Figure Group 10. *Observed and estimated salinity constituent concentrations at Old River at Bacon Island using known EC or TDS values and following the methodology in Branch 3 of the Decision Tree. The first two graphs show the observed data and the estimations for EC as a function of TDS and vice versa. The estimation is supported with statistics, R^2 and Standard Error, as reported in the user guide. The graphs thereafter show the observed data and regression equations of other salinity constituents of interest as a function of EC or TDS, along with the overall R^2 and Standard Error associated with the estimation.*





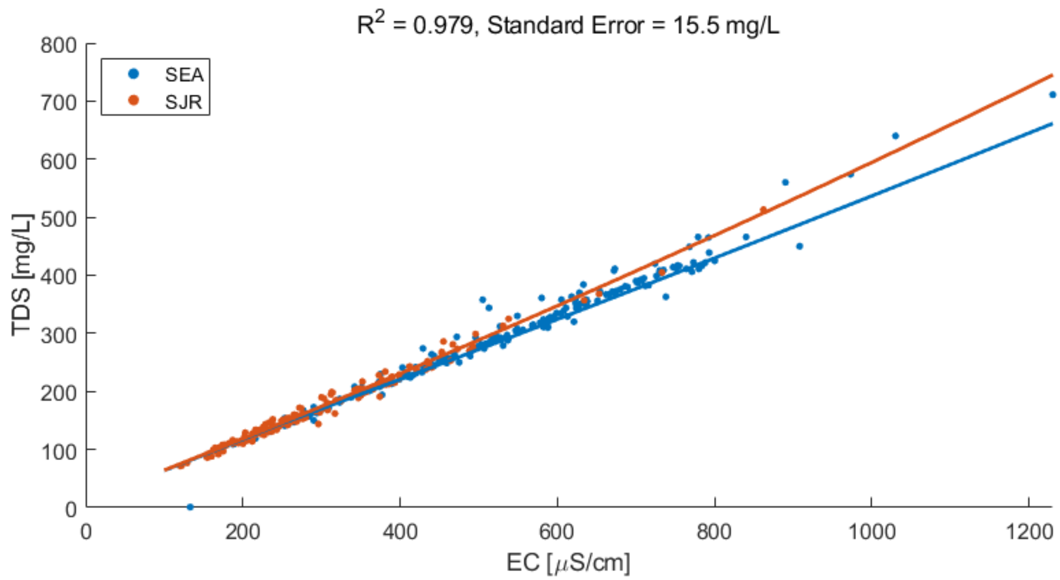


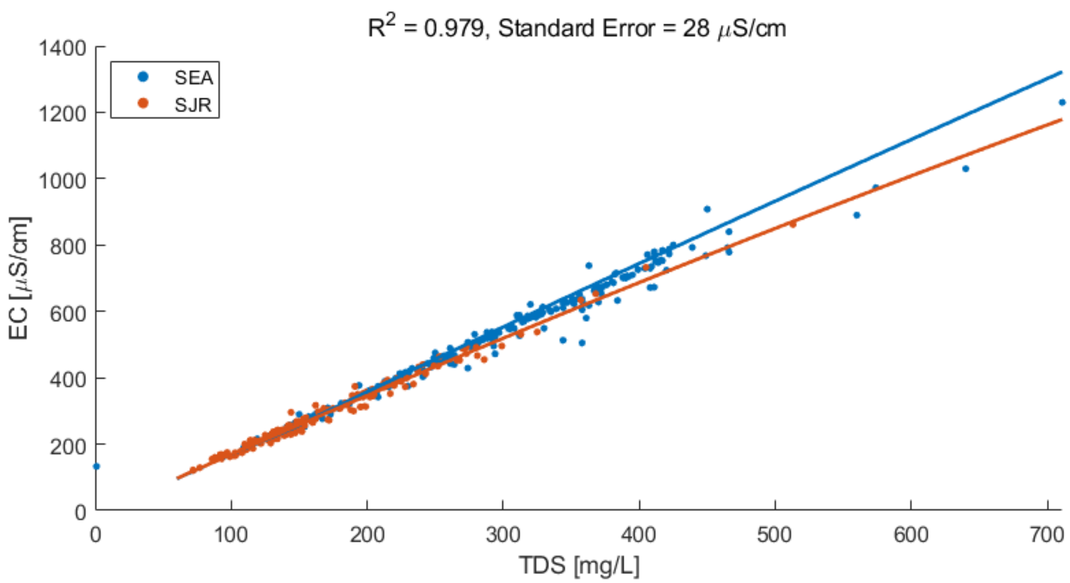
R2 = 0.965, Standard Error = 0.04 mg/L
Br- [mg/L]
EC [μS/cm]
SEA
SJR
R2 = 0.983, Standard Error = 7.4 mg/L
Cl- [mg/L]
EC [μS/cm]
SEA
SJR
R2 = -0.0137, Standard Error = 10.3 mg/L
SO42- [mg/L]
EC [μS/cm]
SEA
SJR
R2 = -0.141, Standard Error = 12.6 mg/L
Alkalinity as CaCO3 [mg/L]
EC [μS/cm]
SEA
SJR
R2 = 0.985, Standard Error = 3.7 mg/L
Na+ [mg/L]
EC [μS/cm]
SEA
SJR
R2 = 0.481, Standard Error = 2.4 mg/L
Ca2+ [mg/L]
EC [μS/cm]
SEA
SJR
R2 = 0.88, Standard Error = 1.5 mg/L
Mg2+ [mg/L]
EC [μS/cm]
SEA
SJR
R2 = 0.865, Standard Error = 0.5 mg/L
K+ [mg/L]
EC [μS/cm]
SEA
SJR

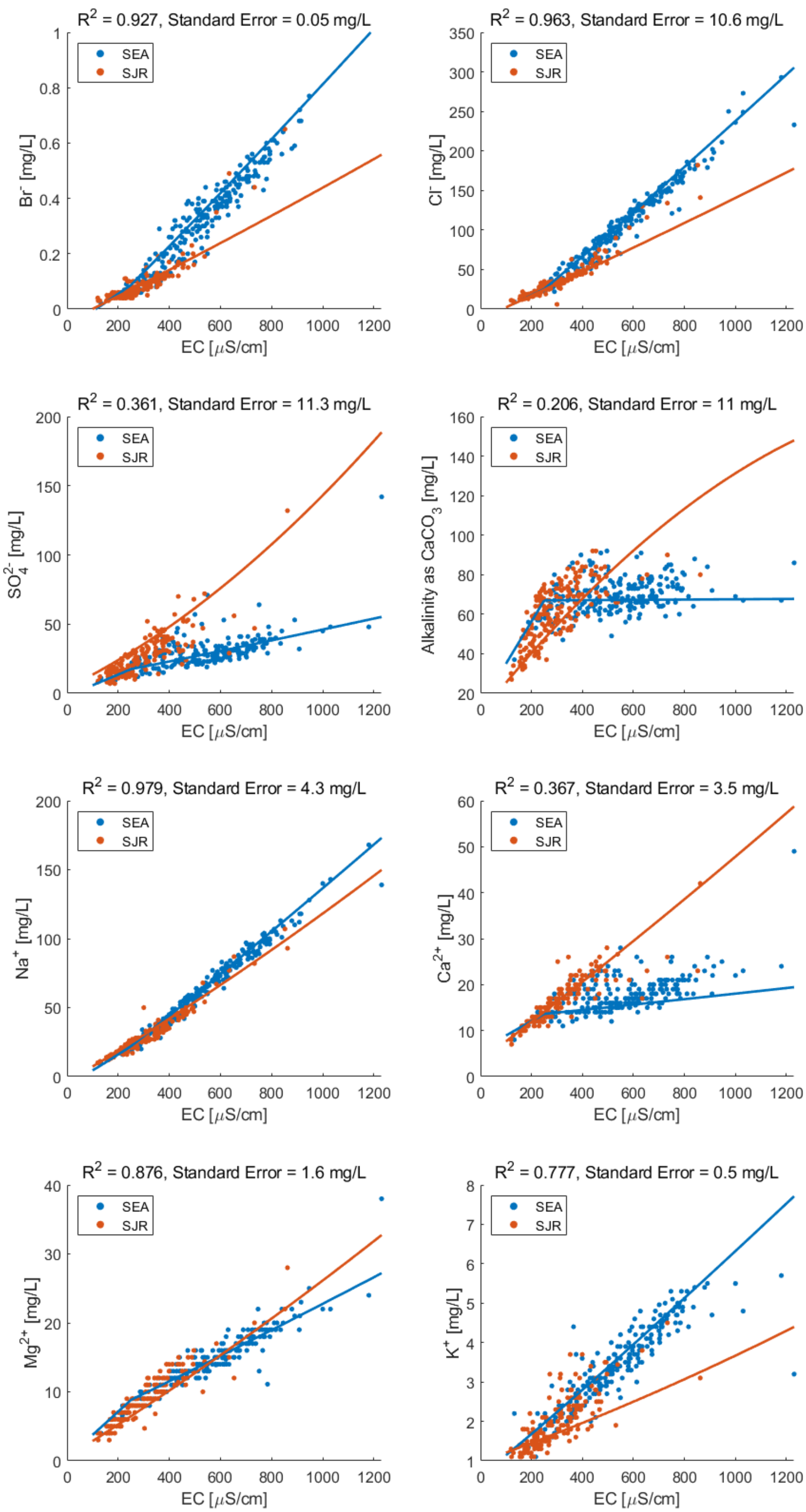

R2 = 0.948, Standard Error = 0.04 mg/L
SEA
SJR
Br- [mg/L]
TDS [mg/L]
R2 = 0.971, Standard Error = 9.7 mg/L
SEA
SJR
Cl- [mg/L]
TDS [mg/L]
R2 = 0.0378, Standard Error = 10 mg/L
SEA
SJR
SO42- [mg/L]
TDS [mg/L]
R2 = 0.135, Standard Error = 11.5 mg/L
SEA
SJR
Alkalinity as CaCO3 [mg/L]
TDS [mg/L]
R2 = 0.969, Standard Error = 5.4 mg/L
SEA
SJR
Na+ [mg/L]
TDS [mg/L]
R2 = 0.522, Standard Error = 2.3 mg/L
SEA
SJR
Ca2+ [mg/L]
TDS [mg/L]
R2 = 0.87, Standard Error = 1.6 mg/L
SEA
SJR
Mg2+ [mg/L]
TDS [mg/L]
R2 = 0.853, Standard Error = 0.5 mg/L
SEA
SJR
K+ [mg/L]
TDS [mg/L]

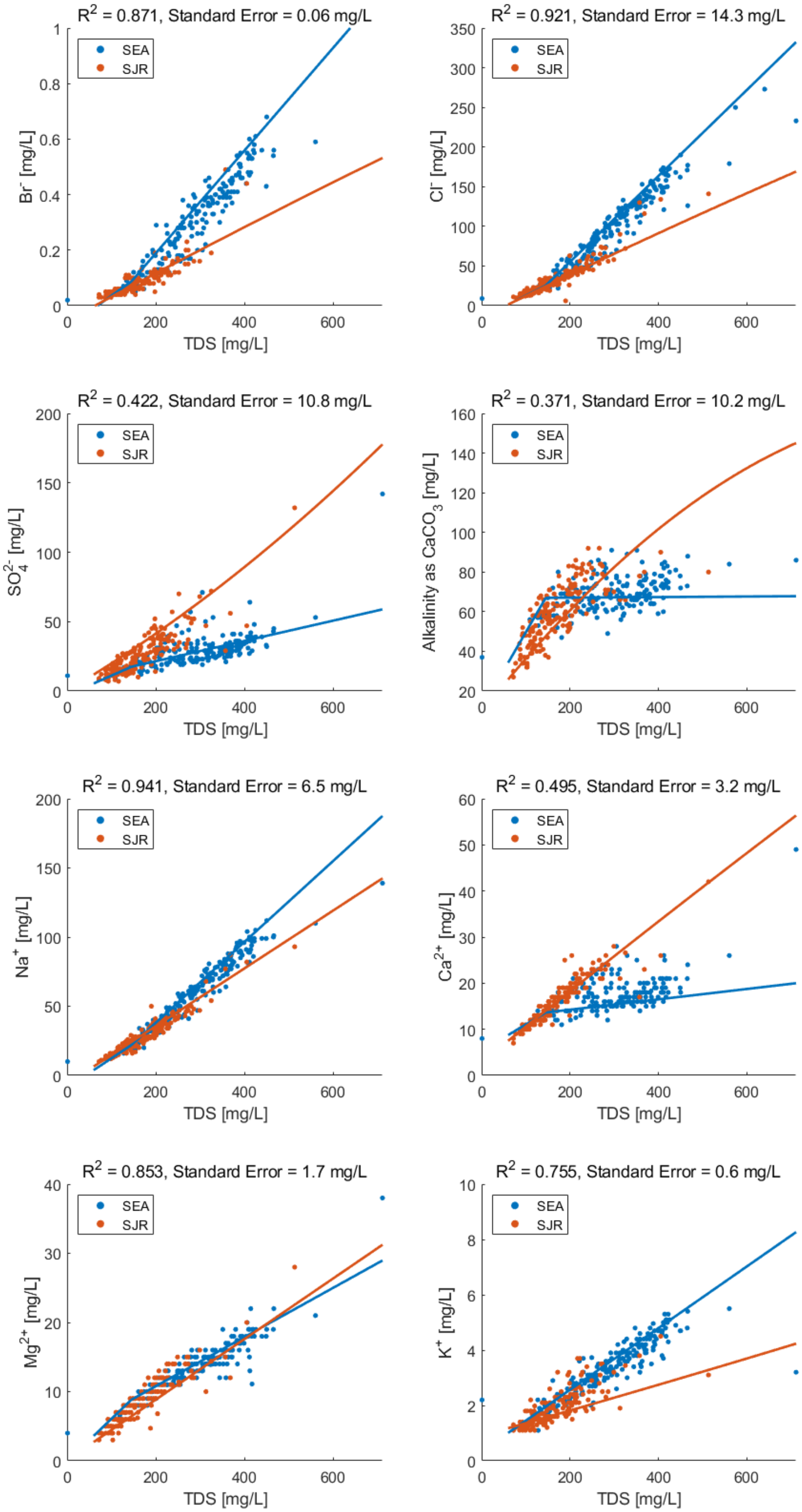
C-3.4 Old River at Highway 4

Figure Group 11. *Observed and estimated salinity constituent concentrations at Old River at Highway 4 using known EC or TDS values and following the methodology in Branch 3 of the Decision Tree. The first two graphs show the observed data and the estimations for EC as a function of TDS and vice versa. The estimation is supported with statistics,* R^2 *and Standard Error, as reported in the user guide. The graphs thereafter show the observed data and regression equations of other salinity constituents of interest as a function of EC or TDS, along with the overall* R^2 *and Standard Error associated with the estimation.*



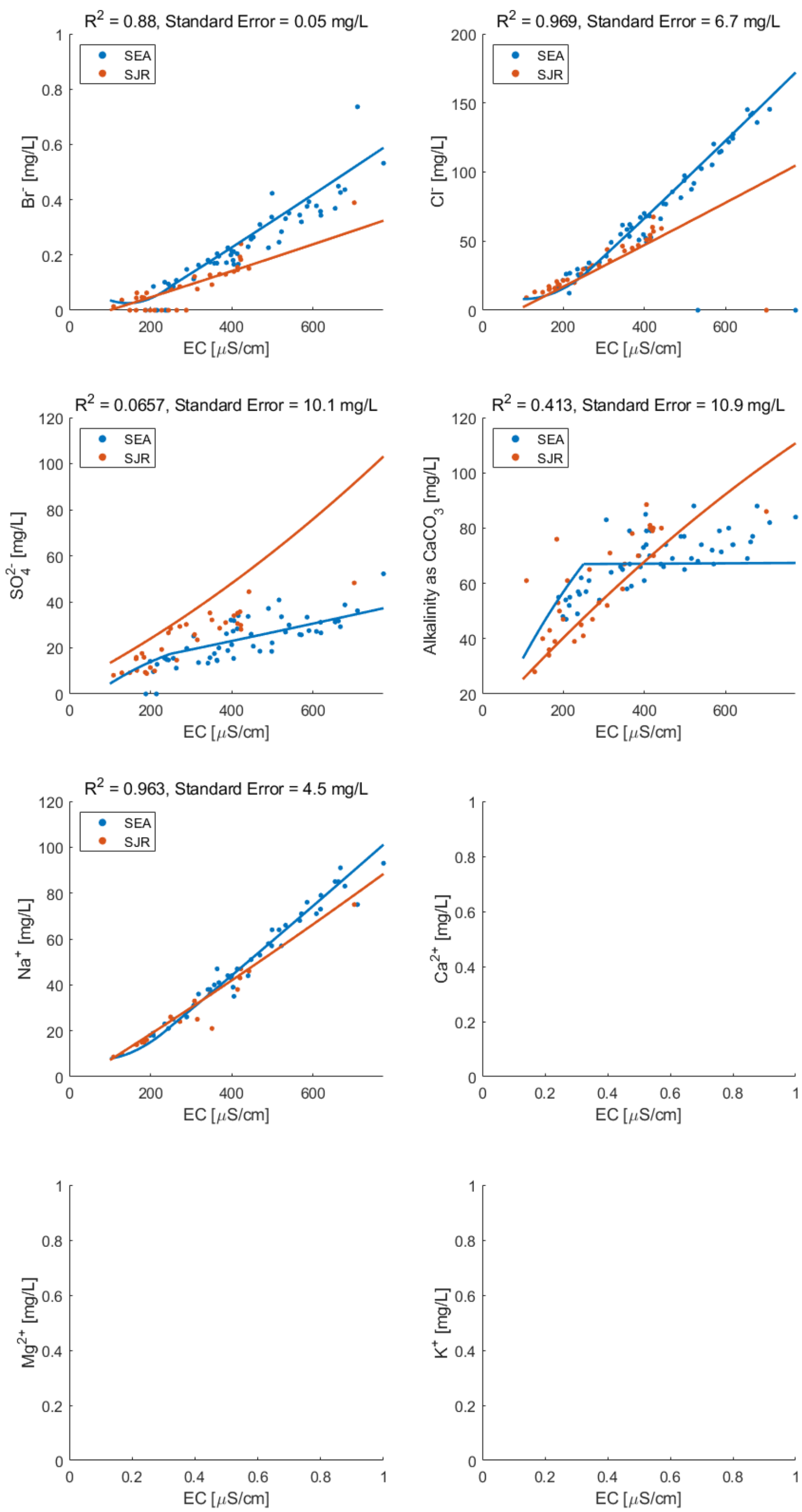



R2 = 0.927, Standard Error = 0.05 mg/L
Br- [mg/L]
R2 = 0.963, Standard Error = 10.6 mg/L
Cl- [mg/L]
R2 = 0.361, Standard Error = 11.3 mg/L
SO42- [mg/L]
R2 = 0.206, Standard Error = 11 mg/L
Alkalinity as CaCO3 [mg/L]
R2 = 0.979, Standard Error = 4.3 mg/L
Na+ [mg/L]
R2 = 0.367, Standard Error = 3.5 mg/L
Ca2+ [mg/L]
R2 = 0.876, Standard Error = 1.6 mg/L
Mg2+ [mg/L]
R2 = 0.777, Standard Error = 0.5 mg/L
K+ [mg/L]
SEA
SJR
EC [μS/cm]


R2 = 0.871, Standard Error = 0.06 mg/L
Br- [mg/L]
R2 = 0.921, Standard Error = 14.3 mg/L
Cl- [mg/L]
R2 = 0.422, Standard Error = 10.8 mg/L
SO42- [mg/L]
R2 = 0.371, Standard Error = 10.2 mg/L
Alkalinity as CaCO3 [mg/L]
R2 = 0.941, Standard Error = 6.5 mg/L
Na+ [mg/L]
R2 = 0.495, Standard Error = 3.2 mg/L
Ca2+ [mg/L]
R2 = 0.853, Standard Error = 1.7 mg/L
Mg2+ [mg/L]
R2 = 0.755, Standard Error = 0.6 mg/L
K+ [mg/L]
SEA
SJR
TDS [mg/L]

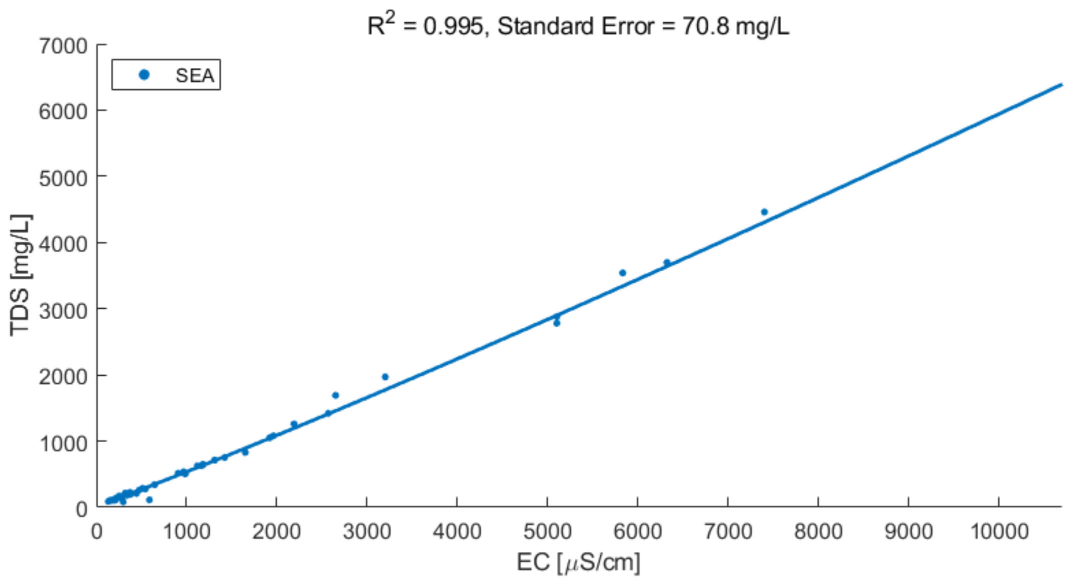
C-3.5 Victoria Canal

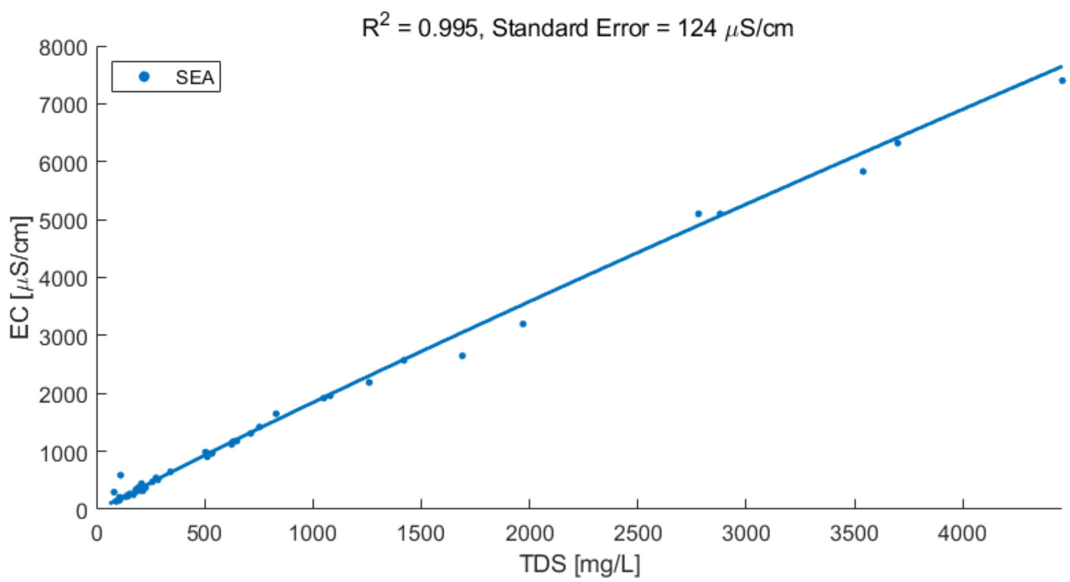
***Figure Group 12**. Observed and estimated salinity constituent concentrations at Victoria Canal using known EC or TDS values and following the methodology in Branch 3 of the Decision Tree. The graphs show the observed data and regression equations of other salinity constituents of interest as a function of EC, along with the overall R^2 and Standard Error associated with the estimation, as reported in the user guide.*

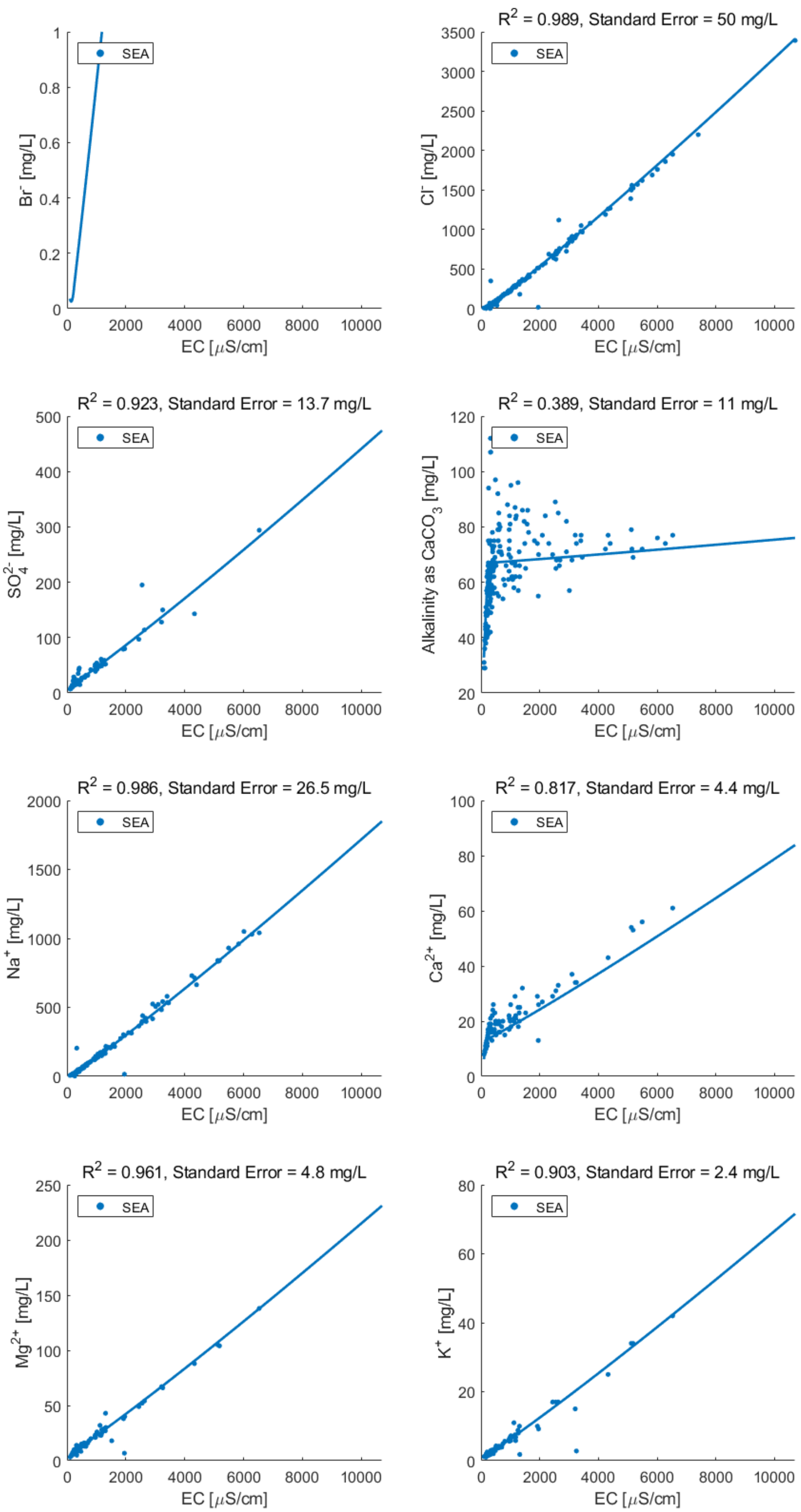


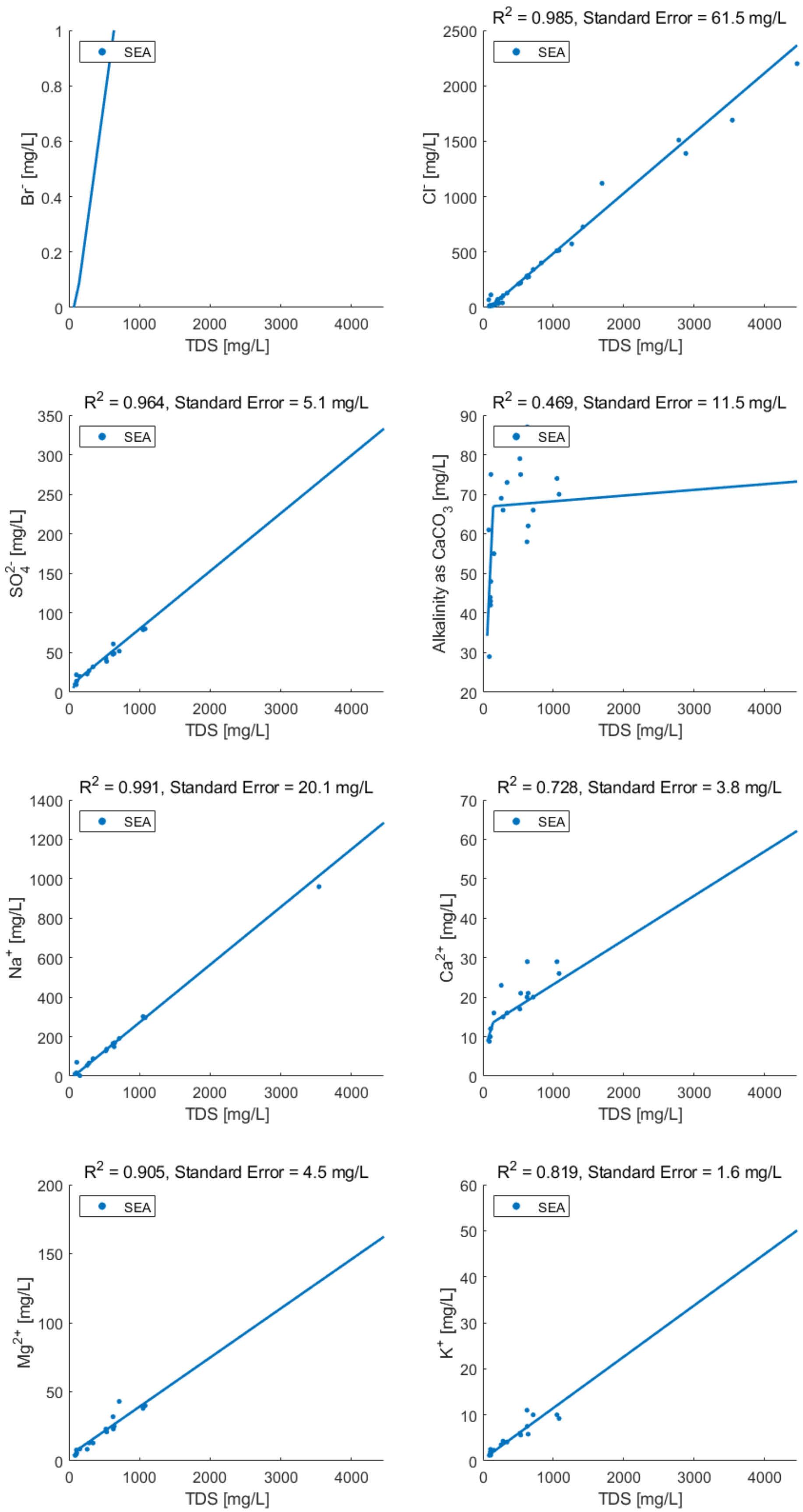
C-3.6 Antioch

Figure Group 13. *Observed and estimated salinity constituent concentrations at Antioch using known EC or TDS values and following the methodology in Branch 3 of the Decision Tree. The first two graphs show the observed data and the estimations for EC as a function of TDS and vice versa. The estimation is supported with statistics,* R^2 *and Standard Error, as reported in the user guide. The graphs thereafter show the observed data and regression equations of other salinity constituents of interest as a function of EC or TDS, along with the overall* R^2 *and Standard Error associated with the estimation.*



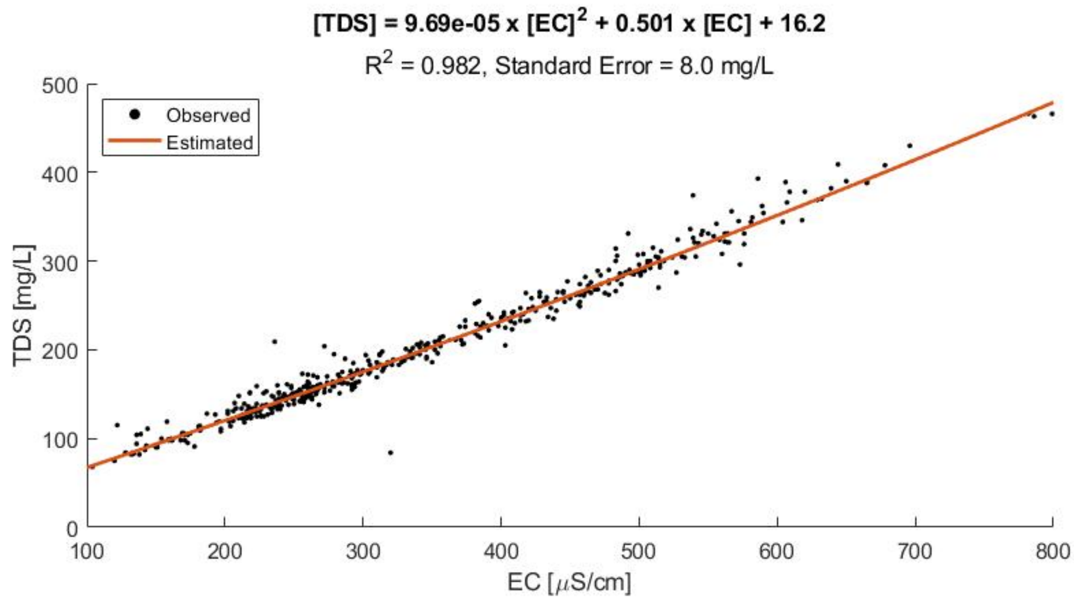


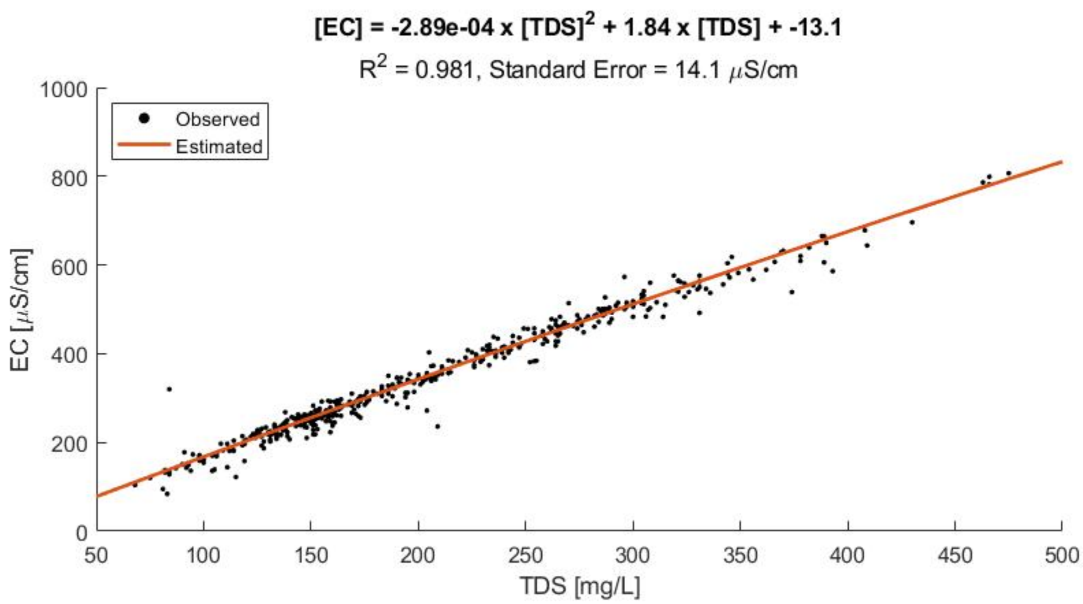

Br⁻ [mg/L]
SEA
EC [μS/cm]
R² = 0.989, Standard Error = 50 mg/L
Cl⁻ [mg/L]
SEA
EC [μS/cm]
R² = 0.923, Standard Error = 13.7 mg/L
SO4 2- [mg/L]
SEA
EC [μS/cm]
R² = 0.389, Standard Error = 11 mg/L
Alkalinity as CaCO3 [mg/L]
SEA
EC [μS/cm]
R² = 0.986, Standard Error = 26.5 mg/L
Na⁺ [mg/L]
SEA
EC [μS/cm]
R² = 0.817, Standard Error = 4.4 mg/L
Ca2+ [mg/L]
SEA
EC [μS/cm]
R² = 0.961, Standard Error = 4.8 mg/L
Mg2+ [mg/L]
SEA
EC [μS/cm]
R² = 0.903, Standard Error = 2.4 mg/L
K⁺ [mg/L]
SEA
EC [μS/cm]

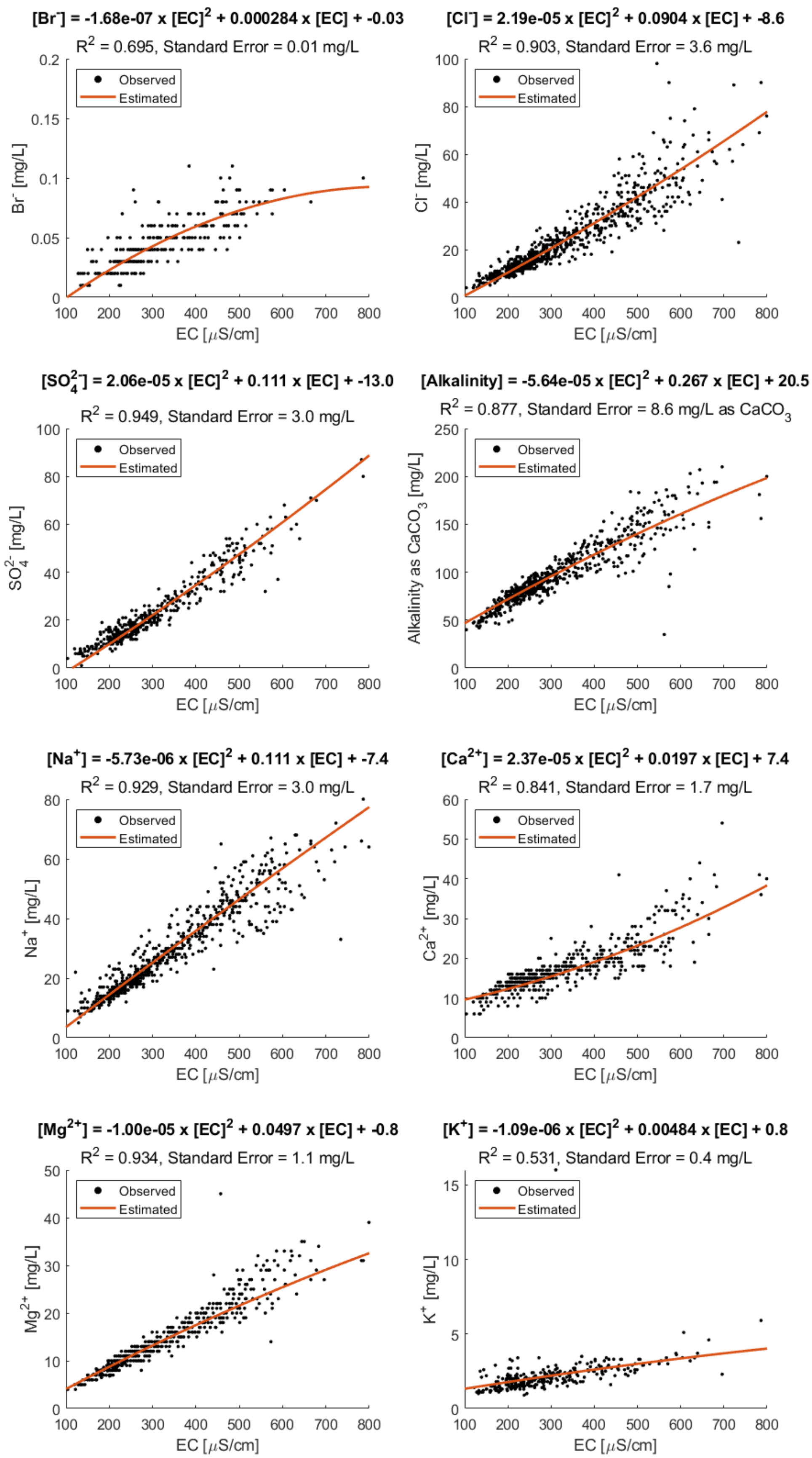

SEA
Br⁻ [mg/L]
TDS [mg/L]
R² = 0.985, Standard Error = 61.5 mg/L
SEA
Cl⁻ [mg/L]
TDS [mg/L]
R² = 0.964, Standard Error = 5.1 mg/L
SEA
SO4 2- [mg/L]
TDS [mg/L]
R² = 0.469, Standard Error = 11.5 mg/L
SEA
Alkalinity as CaCO3 [mg/L]
TDS [mg/L]
R² = 0.991, Standard Error = 20.1 mg/L
SEA
Na⁺ [mg/L]
TDS [mg/L]
R² = 0.728, Standard Error = 3.8 mg/L
SEA
Ca2+ [mg/L]
TDS [mg/L]
R² = 0.905, Standard Error = 4.5 mg/L
SEA
Mg2+ [mg/L]
TDS [mg/L]
R² = 0.819, Standard Error = 1.6 mg/L
SEA
K⁺ [mg/L]
TDS [mg/L]

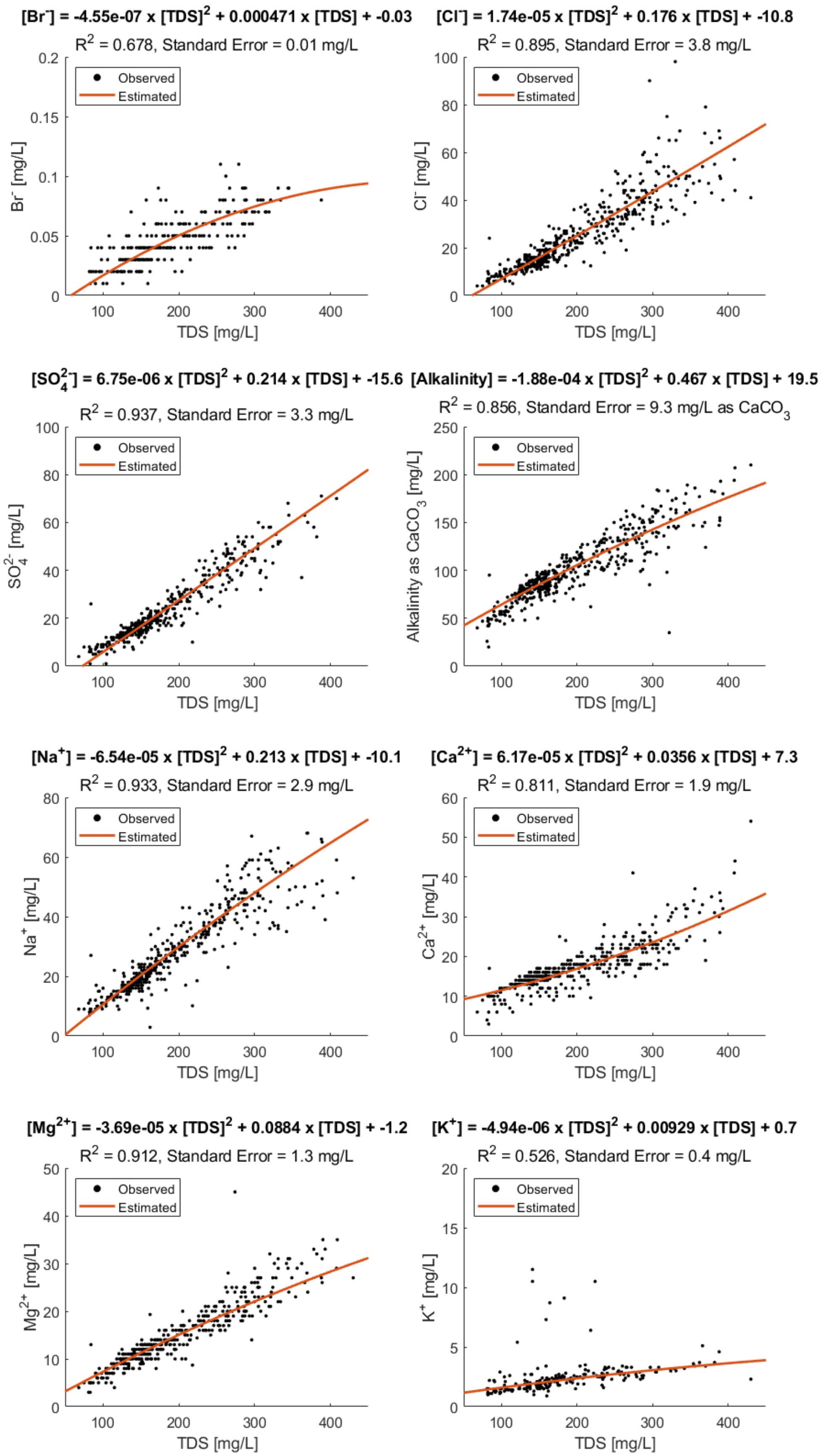
C-3.7 Barker Slough

Figure Group 14*. Regression fits for the Barker Slough Urban Diversion when 100 ≤ EC < 800 µS/cm or 50 ≤ TDS < 500 mg/L and following the methodology in Branch 3 of the Decision Tree. The first two graphs show the observed data used to develop the regression relationships between EC and TDS. The estimating quadratic equation is supported with statistics, R^2 and Standard Error, as reported in the user guide. The graphs thereafter show the observed data and quadratic fits for the relationships between EC, TDS, and each of the constituents of interest along with the estimating quadratic equation, R^2, and Standard Error.*






[Br⁻] = -1.68e-07 x [EC]² + 0.000284 x [EC] + -0.03
R² = 0.695, Standard Error = 0.01 mg/L
Observed
Estimated
Br⁻ [mg/L]
EC [μS/cm]
[Cl⁻] = 2.19e-05 x [EC]² + 0.0904 x [EC] + -8.6
R² = 0.903, Standard Error = 3.6 mg/L
Observed
Estimated
Cl⁻ [mg/L]
EC [μS/cm]
[SO₄²⁻] = 2.06e-05 x [EC]² + 0.111 x [EC] + -13.0
R² = 0.949, Standard Error = 3.0 mg/L
Observed
Estimated
SO₄²⁻ [mg/L]
EC [μS/cm]
[Alkalinity] = -5.64e-05 x [EC]² + 0.267 x [EC] + 20.5
R² = 0.877, Standard Error = 8.6 mg/L as CaCO₃
Observed
Estimated
Alkalinity as CaCO₃ [mg/L]
EC [μS/cm]
[Na⁺] = -5.73e-06 x [EC]² + 0.111 x [EC] + -7.4
R² = 0.929, Standard Error = 3.0 mg/L
Observed
Estimated
Na⁺ [mg/L]
EC [μS/cm]
[Ca²⁺] = 2.37e-05 x [EC]² + 0.0197 x [EC] + 7.4
R² = 0.841, Standard Error = 1.7 mg/L
Observed
Estimated
Ca²⁺ [mg/L]
EC [μS/cm]
[Mg²⁺] = -1.00e-05 x [EC]² + 0.0497 x [EC] + -0.8
R² = 0.934, Standard Error = 1.1 mg/L
Observed
Estimated
Mg²⁺ [mg/L]
EC [μS/cm]
[K⁺] = -1.09e-06 x [EC]² + 0.00484 x [EC] + 0.8
R² = 0.531, Standard Error = 0.4 mg/L
Observed
Estimated
K⁺ [mg/L]
EC [μS/cm]


[Br⁻] = -4.55e-07 x [TDS]^2 + 0.000471 x [TDS] + -0.03
R^2 = 0.678, Standard Error = 0.01 mg/L
Observed
Estimated
Br⁻ [mg/L]
TDS [mg/L]
[Cl⁻] = 1.74e-05 x [TDS]^2 + 0.176 x [TDS] + -10.8
R^2 = 0.895, Standard Error = 3.8 mg/L
Observed
Estimated
Cl⁻ [mg/L]
TDS [mg/L]
[SO_4^{2-}] = 6.75e-06 x [TDS]^2 + 0.214 x [TDS] + -15.6
R^2 = 0.937, Standard Error = 3.3 mg/L
Observed
Estimated
SO_4^{2-} [mg/L]
TDS [mg/L]
[Alkalinity] = -1.88e-04 x [TDS]^2 + 0.467 x [TDS] + 19.5
R^2 = 0.856, Standard Error = 9.3 mg/L as $CaCO_3$
Observed
Estimated
Alkalinity as $CaCO_3$ [mg/L]
TDS [mg/L]
[Na^+] = -6.54e-05 x [TDS]^2 + 0.213 x [TDS] + -10.1
R^2 = 0.933, Standard Error = 2.9 mg/L
Observed
Estimated
Na^+ [mg/L]
TDS [mg/L]
[Ca^{2+}] = 6.17e-05 x [TDS]^2 + 0.0356 x [TDS] + 7.3
R^2 = 0.811, Standard Error = 1.9 mg/L
Observed
Estimated
Ca^{2+} [mg/L]
TDS [mg/L]
[Mg^{2+}] = -3.69e-05 x [TDS]^2 + 0.0884 x [TDS] + -1.2
R^2 = 0.912, Standard Error = 1.3 mg/L
Observed
Estimated
Mg^{2+} [mg/L]
TDS [mg/L]
[K^+] = -4.94e-06 x [TDS]^2 + 0.00929 x [TDS] + 0.7
R^2 = 0.526, Standard Error = 0.4 mg/L
Observed
Estimated
K^+ [mg/L]
TDS [mg/L]

Appendix D: Validation Analysis

The tables and figures in this Appendix summarize evaluations of data that are independent of the observations used in Sections 4, 5 and 6 of the user guide. Statistics computed for this validation analysis include R^2, Standard Error, and Mean Bias Error; this latter statistic is the average difference between the estimated and observed values.

Data that failed the testability criteria (see Section 3), i.e. samples that did not have concurrent measurements for EC, TDS, Cl^-, SO_4^{2-}, Na^+, and Mg^{2+}, were used to validate regression fits for the Boundary Regions and the Barker Slough Urban Diversion. The development of each regression equation was associated with a specific dataset and range in EC, TDS and salinity constituent concentration. Data points that were selected for validation but that exceeded the calibration data range by more than one Standard Error were excluded from the validation test. Both the data range and Standard Error are reported in Sections 4 and 6 of the user guide. Data collected by Contra Costa Water District (CCWD) were used to validate the methodology presented in the user guide for the Location-Specific Urban Diversions. Validation results should be interpreted in the same manner as the regression results reported in the user guide. Thus, high R^2 values and low Standard Error values are favorable. Furthermore, fits are favorable when the mean bias is lower than the Standard Error.

D-1 Boundary Regions

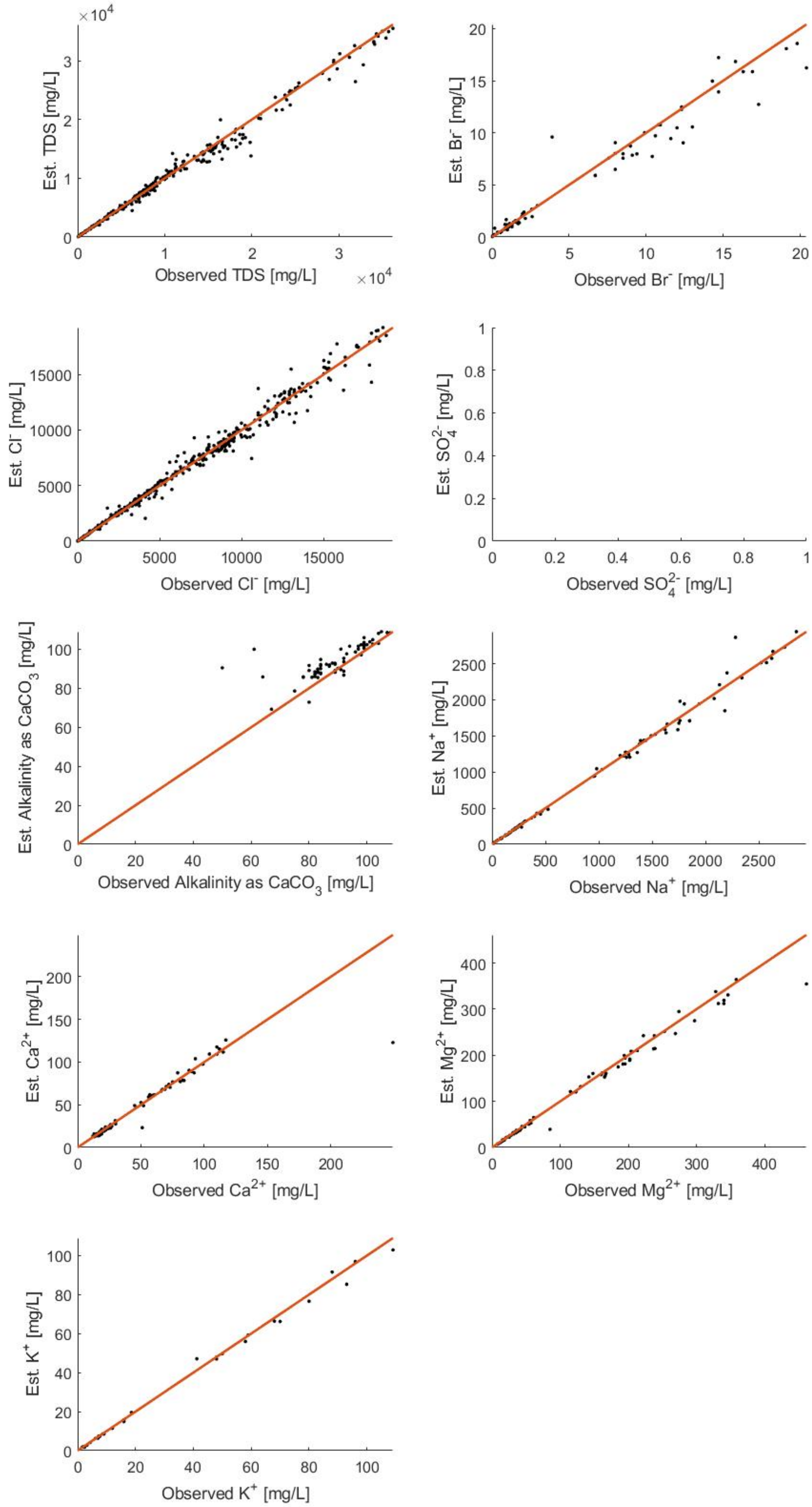
D-1.1 Seawater Boundary Region

Data used to validate the Seawater Boundary Region equations comprise the samples collected within the Seawater Boundary that failed the testability criteria, i.e. the samples that did not have concurrent measurements for EC, TDS, Cl^-, SO_4^{2-}, Na^+, and Mg^{2+}. Additionally, data points that were selected for validation but that exceeded the calibration data range by more than one Standard Error were excluded from the validation test. Both the data ranges and Standard Errors for the Seawater Boundary Region are reported in Section 4 of the user guide. These data were collected from 1975 to 2016 and are reported in Table D-1 and Figure D-1.

Table D-1*. Validation statistics computed for the Seawater Boundary Region. Standard Error (SE) and Mean Bias are expressed in the units of the dependent variable (Y). Units are mg/L for all constituents. For alkalinity, units are expressed as mg/L as $CaCO_3$. The data used for validation comprise the samples collected within the Seawater Boundary that failed the testability criteria, i.e. samples that did not have concurrent measurements for EC, TDS, Cl^-, SO_4^{2-}, Na^+, and Mg^{2+}.*

X = EC	Y	Data Points	R^2	SE	Mean Bias
100 ≤ [EC] < 52,300 µS/cm	**TDS**	355	0.991	852	-151
	Br^-	81	0.955	1.3	-0.3
	Cl^-	559	0.989	514	-0.5
	SO_4^{2-}	0	N/A	N/A	N/A
	Alkalinity	62	0.350	9	5.0
	Na^+	91	0.990	88	-0.6
	Ca^{2+}	82	0.857	15	-1.6
	Mg^{2+}	82	0.981	16	-4.4
	K^+	33	0.995	2	-0.6

Figure D-1*. Scatter plots comparing observed concentrations of salinity constituents in the Seawater Boundary Region validation dataset with the values estimated using measured EC. The red diagonal line denotes a 1:1 relationship. Points above the line are overpredicted concentrations. Points below the line are underpredicted concentrations.*



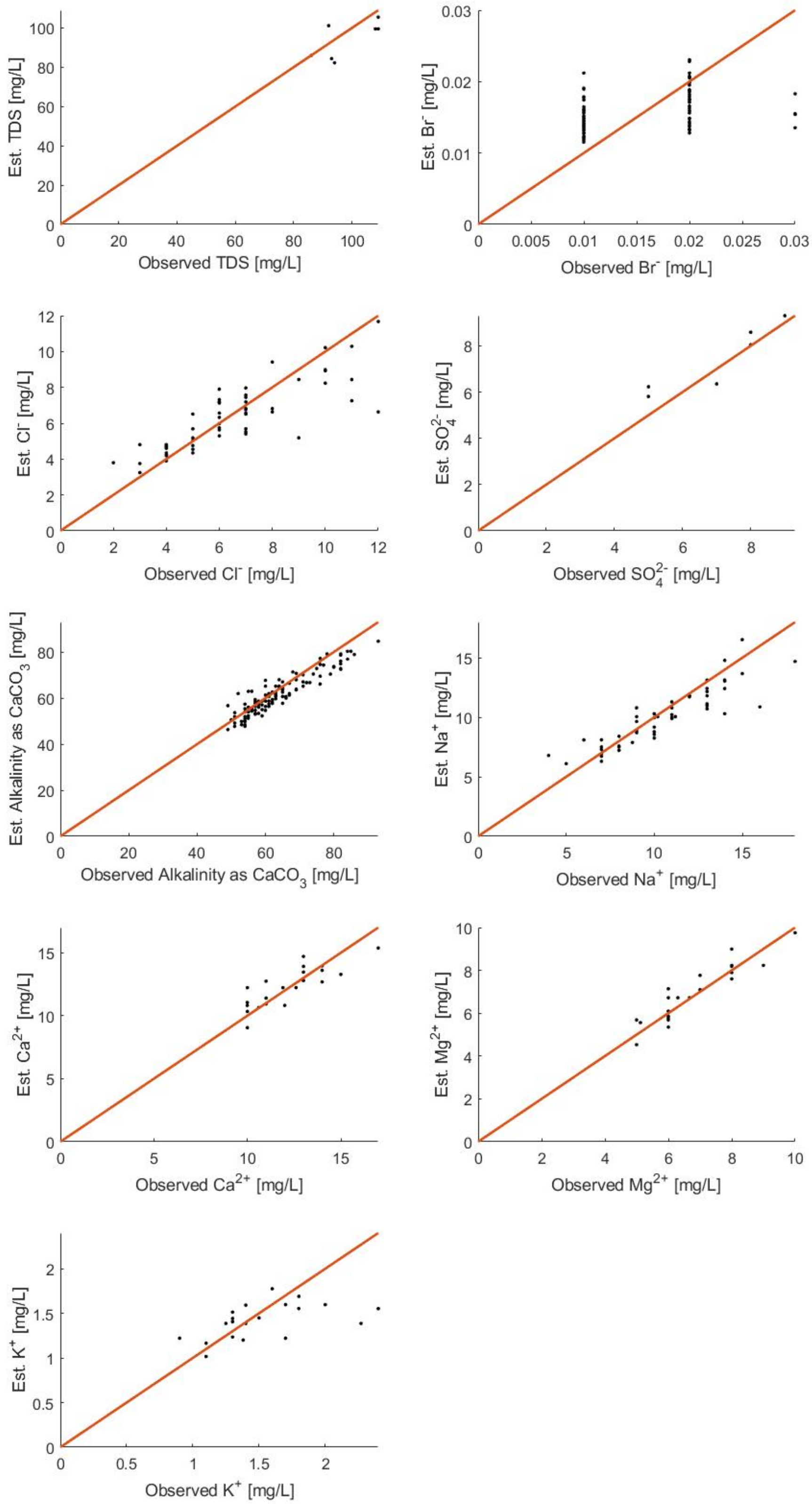
D-1.2 Freshwater Boundary Region

Data used to validate the Freshwater Boundary Region regression equations comprise the samples collected within the Freshwater Boundary that failed the testability criteria, i.e. samples that did not have concurrent measurements for EC, TDS, Cl^-, SO_4^{2-}, Na^+, and Mg^{2+}. Additionally, data points that were selected for validation but that exceeded the calibration data range by more than one Standard Error were excluded from the validation test. Both the data ranges and Standard Errors for the Freshwater Boundary Region are reported in Section 4 of the user guide. These data were collected from 1982 to 2020 and are reported in Table D-2 and Figure D-2.

***Table D-2**. Validation statistics computed for the Freshwater Boundary Region. Standard Error (SE) and Mean Bias are expressed in the units of the dependent variable (Y). Units are mg/L for all constituents. For alkalinity, units are expressed as mg/L as $CaCO_3$. The data set used for validation comprise the samples collected within the Freshwater Boundary that failed the testability criteria, i.e. samples that did not have concurrent measurements for EC, TDS, Cl^-, SO_4^{2-}, Na^+, and Mg^{2+}.*

X = EC	Y	Data Points	R^2	SE	Mean Bias
50 ≤ [EC] < 250 µS/cm	**TDS**	7	0.158	9.71	-4.7
	Br^-	92	0.175	0.02	0.00
	Cl^-	65	0.682	1.35	-0.1
	SO_4^{2-}	6	0.784	0.87	0.4
	Alkalinity	124	0.815	4.22	-2.0
	Na^+	56	0.757	1.46	-0.5
	Ca^{2+}	23	0.699	1.07	0.1
	Mg^{2+}	22	0.841	0.55	0.1
	K^+	21	-0.130	1.37	-0.2

***Figure D-2**. Scatter plots comparing observed concentrations of salinity constituents in the Freshwater validation dataset with the values estimated using measured EC. The red diagonal line denotes a 1:1 relationship. Points above the line are overpredicted concentrations. Points below the line are underpredicted concentrations.*



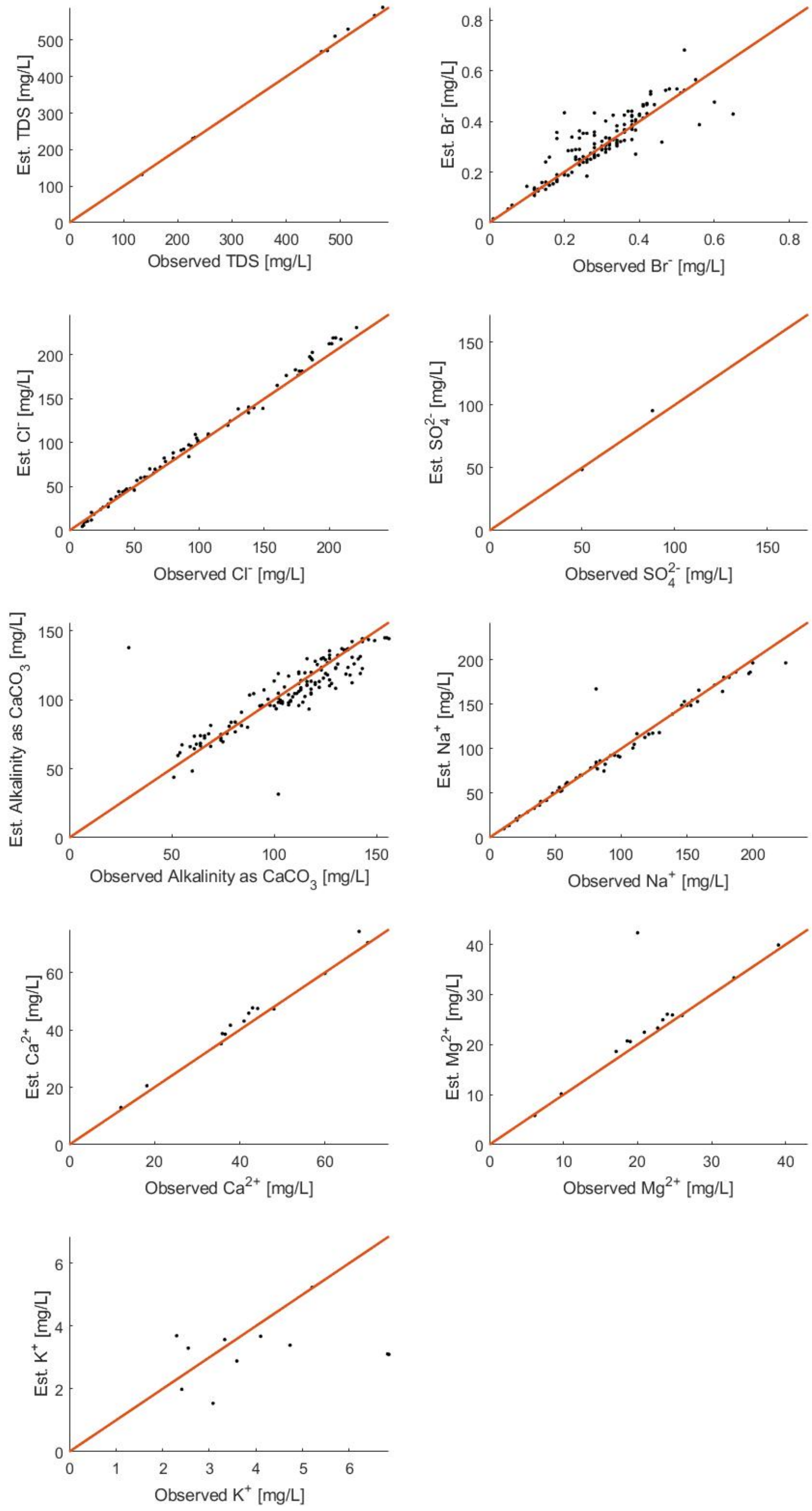
D-1.3 San Joaquin River Boundary Region

Data used to validate the San Joaquin River Boundary Region regression equations comprise the samples collected within the San Joaquin River Boundary that failed the testability criteria, i.e. samples that did not have concurrent measurements for EC, TDS, Cl^-, SO_4^{2-}, Na^+, and Mg^{2+}. Additionally, data points that were selected for validation but that exceeded the calibration data range by more than one Standard Error were excluded from the validation test. Both the data ranges and Standard Errors for the San Joaquin River Boundary Region are reported in Section 4 of the user guide. These data were collected from 1982 to 2020 and are reported in Table D-3 and Figure D-3.

Table D-3*. Validation statistics computed for the San Joaquin River Boundary Region. Standard Error (SE) and Mean Bias are expressed in the units of the dependent variable (Y). Units are mg/L for all constituents. For alkalinity, units are expressed as mg/L as* $CaCO_3$*. The data set used for validation comprise the samples collected within the San Joaquin River Boundary that failed the testability criteria, i.e. samples that did not have concurrent measurements for EC, TDS,* Cl^-*,* SO_4^{2-}*,* Na^+*, and* Mg^{2+}*.*

X = EC	Y	Data Points	R^2	SE	Mean Bias
100 ≤ [EC] < 1,600 µS/cm	**TDS**	9	0.996	11.1	5.8
	Br^-	141	0.734	0.06	0.01
	Cl^-	72	0.990	6.4	3.3
	SO_4^{2-}	2	N/A	N/A	3.0
	Alkalinity	137	0.702	14.4	-2.2
	Na^+	63	0.950	12.5	-0.6
	Ca^{2+}	14	0.964	3.2	2.2
	Mg^{2+}	14	0.417	6.6	2.6
	K^+	11	-0.315	2.0	-0.9

***Figure D-3**. Scatter plots comparing observed concentrations of salinity constituents in the San Joaquin River validation dataset with the values estimated using measured EC. The red diagonal line denotes a 1:1 relationship. Points above the line are overpredicted concentrations. Points below the line are underpredicted concentrations.*



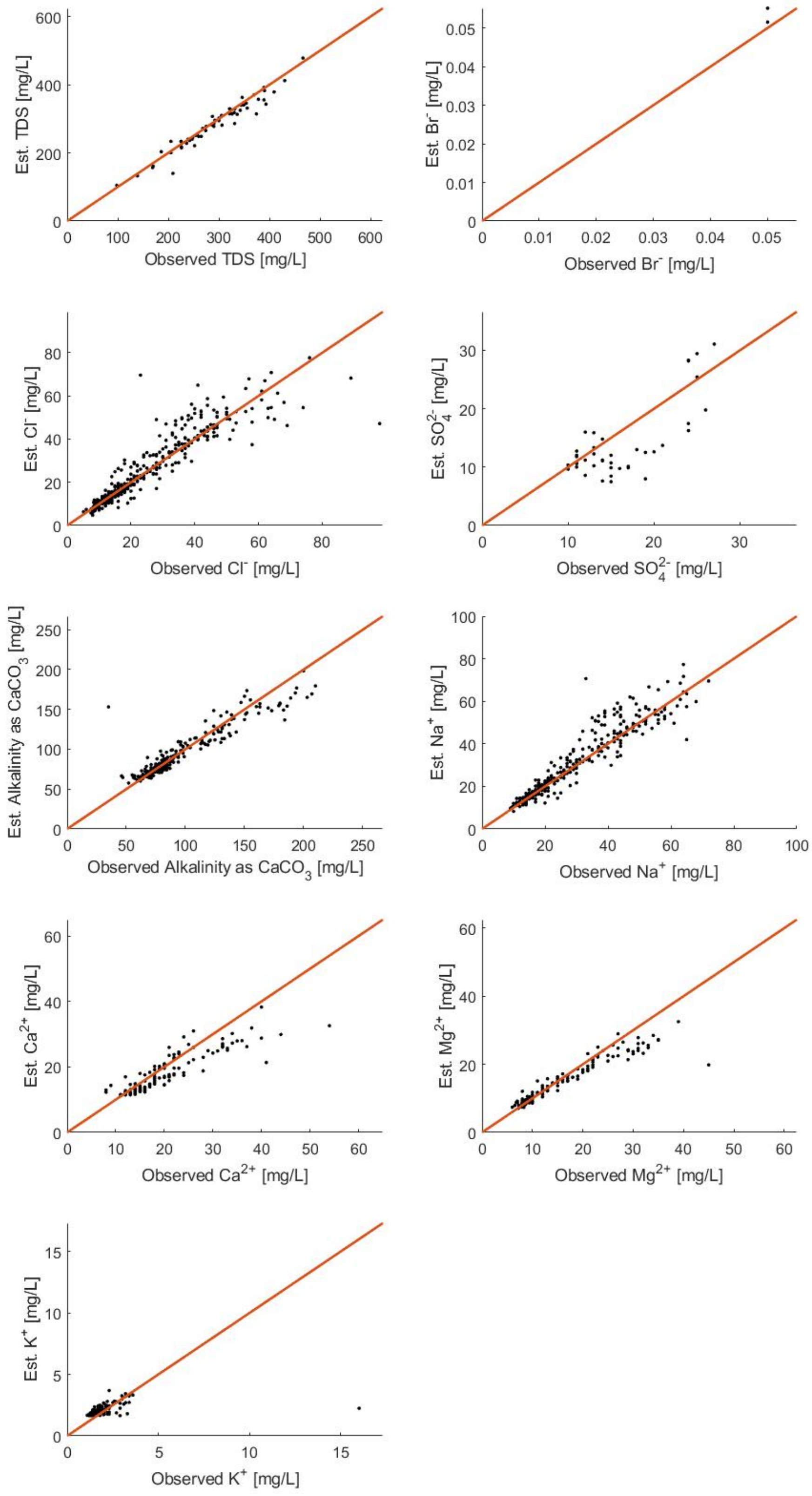
D-2 Barker Slough Urban Diversion Location

Data used to validate the Barker Slough Urban Diversion regression equations comprise the samples collected at Barker Slough that failed the testability criteria, i.e. samples that did not have concurrent measurements for EC, TDS, Cl^-, SO_4^{2-}, Na^+, and Mg^{2+}. Additionally, data points that were selected for validation but that exceeded the calibration data range by more than one Standard Error were excluded from the validation test. Both the data ranges and Standard Errors for Barker Slough are reported in Section 6 of the user guide. These data were collected from 1975 to 2016 and are reported in Table D-4 and Figure D-4.

Table D-4. *Validation statistics computed for the Barker Slough Urban Diversion. Standard Error (SE) and Mean Bias are expressed in the units of the dependent variable (Y). Units are mg/L for all constituents. For alkalinity, units are expressed as mg/L as $CaCO_3$. The data set used for validation comprise the samples collected at Barker Slough that failed the testability criteria, i.e. samples that did not have concurrent measurements for EC, TDS, Cl^-, SO_4^{2-}, Na^+, and Mg^{2+}.*

X = EC	Y	Data Points	R^2	SE	Mean Bias
100 ≤ [EC] < 800 µS/cm	**TDS**	61	0.926	19.7	-8.4
	Br^-	2	N/A	N/A	N/A
	Cl^-	357	0.829	6.6	0.6
	SO_4^{2-}	40	0.116	4.9	-2.4
	Alkalinity	235	0.864	12.9	-1.1
	Na^+	339	0.868	5.4	1.3
	Ca^{2+}	148	0.700	4.3	-2.0
	Mg^{2+}	148	0.841	3.4	-1.1
	K^+	107	0.084	1.4	0.0

Figure D-4. *Scatter plots comparing observed concentrations of salinity constituents in Barker Slough validation dataset with the values estimated using measured EC. The red diagonal line denotes a 1:1 relationship. Points above the line are overpredicted concentrations. Points below the line are underpredicted concentrations.*



D-3 Contra Costa Water District (CCWD) Urban Diversion Locations

Data collected by CCWD were used to validate goodness-of-fit of the user guide's urban diversion methodology at their Rock Slough[1], Old River[2] and Victoria Canal[3] intakes located within the Old-Middle River Export Corridor Subregion of the Interior Delta Region.

D-3.1 Daily Data at CCWD Rock Slough, Old River & Victoria Canal Intakes

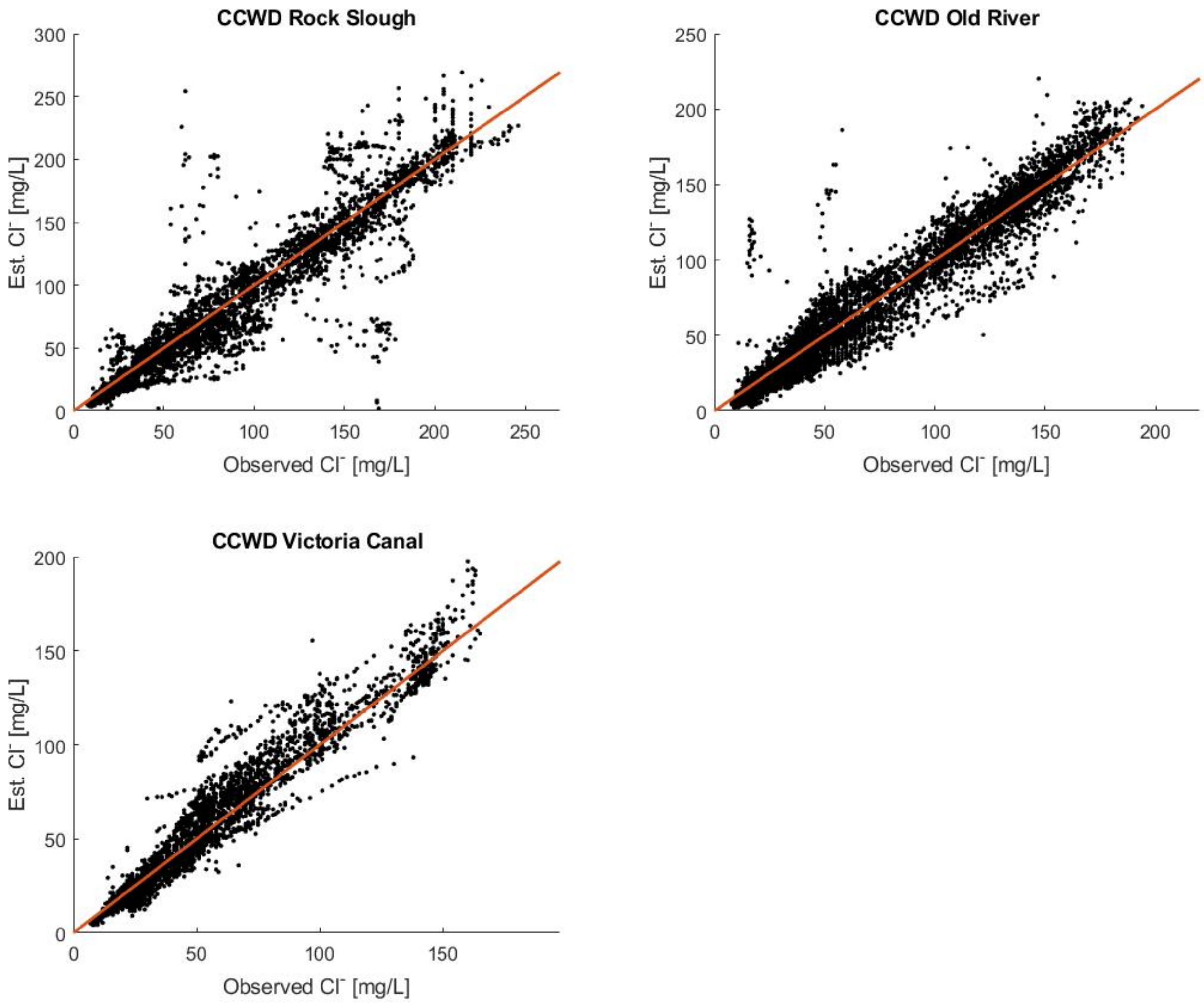
A dataset used to validate the urban diversion methodology comprise daily observations of Cl^- and EC at the Rock Slough, Old River, and Victoria Canal diversions. These data were collected from 2000 to 2020 (2014 to 2020 for Victoria Canal) and are reported in Table D-5 and Figure D-5.

Table D-5*. Validation statistics computed for the Old-Middle River Export Corridor using the daily observations at three CCWD stations. Standard Error (SE) and Mean Bias are expressed in the units of the dependent variable (Cl^-). Units are mg/L.*

X = EC	Y	Data Points	R^2	SE	Mean Bias
CCWD Rock Slough	Cl^-	5081	0.868	21.0	0.8
CCWD Old River	Cl^-	6874	0.921	13.4	2.7
CCWD Victoria Canal	Cl^-	3644	0.908	10.7	6.2

[1] This urban diversion is represented by the MWQI Old River at Bacon Island monitoring station in the user guide.
[2] This urban diversion is represented by the MWQI Old River at Highway 4 monitoring station in the user guide.
[3] This urban diversion is represented by the MWQI Victoria Canal monitoring station in the user guide.

Figure D-5. *Scatter plots comparing observed concentrations of chloride in the daily CCWD validation dataset for three stations in the Old-Middle River Export Corridor with the values approximated using measured EC. The red diagonal line denotes a 1:1 relationship. Points above the line are overpredicted concentrations. Points below the line are underpredicted concentrations.*



D-3.2 Grab Sample Data at CCWD Rock Slough Intake

Another dataset used to validate the urban diversion methodology comprise monthly grab sample observations of constituents such as TDS, Br^-, Cl^-, SO_4^{2-}, Alkalinity, and Na^+ at the CCWD Rock Slough intake. These data were collected from 2014 to 2020 and are reported in Table D-6 and Figure D-6.

To compare the reported hardness data with our methodology, we substituted the appropriate Ca^{2+} and Mg^{2+} estimates into the following equation to estimate total hardness:

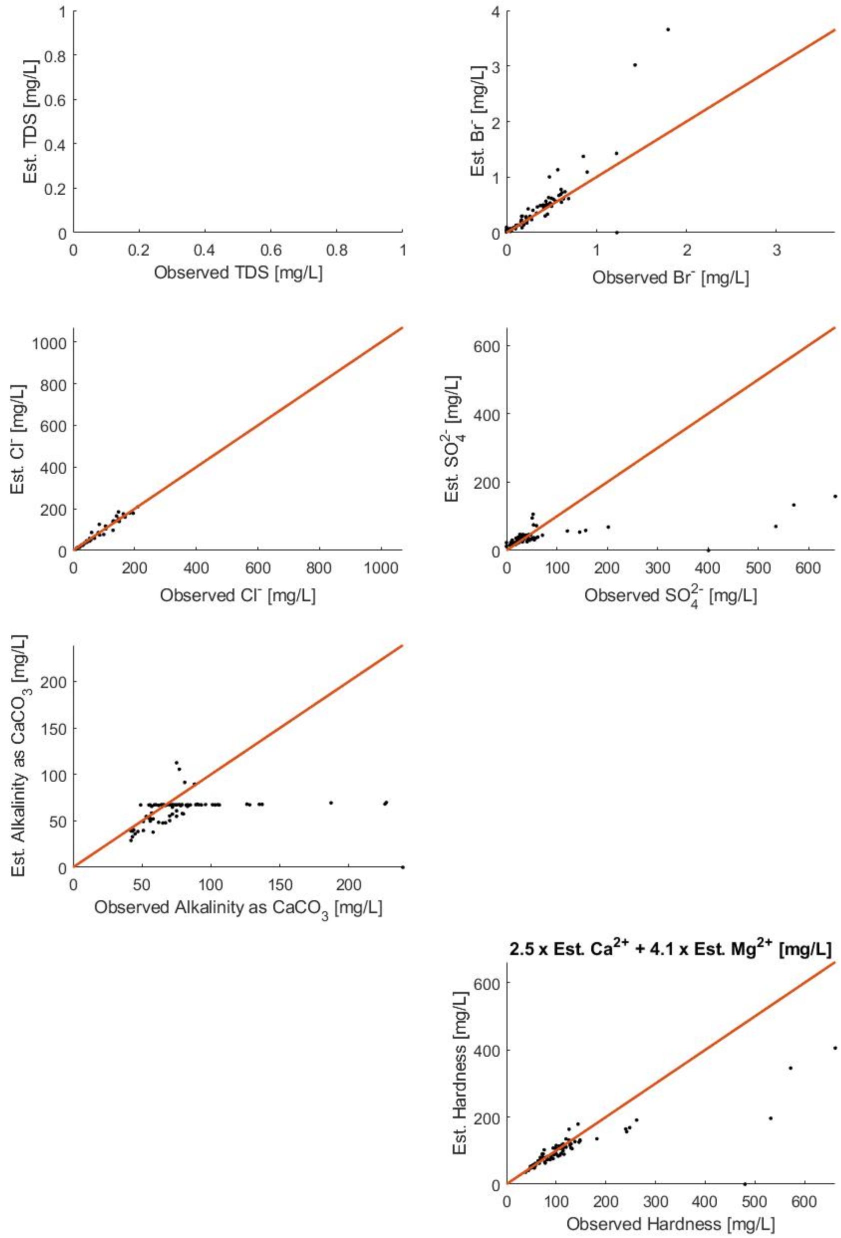
$$\text{Total Hardness [mg/L]} = 2.5 \times [Ca^{2+}] + 4.1 \times [Mg^{2+}]$$

Hardness is often underpredicted as the above approximating equation does not incorporate concentrations of additional cationic constituents that may contribute to the total hardness of a sample.

Table D-6. *Validation statistics computed for the Old-Middle River Export Corridor using the monthly observations at CCWD Rock Slough WQ Building at Fish Screen. Standard Error (SE) and Mean Bias are expressed in the units of the dependent variable (Y). Units are mg/L for all constituents. For alkalinity, units are expressed as mg/L as* $CaCO_3$.

X = EC	Y	Data Points	R^2	SE	Mean Bias
CCWD Rock Slough WQ Building at Fish Screen	**TDS**	0	N/A	N/A	N/A
	Br^-	84	0.153	0.3	0.09
	Cl^-	61	0.956	12	-0.5
	SO_4^{2-}	84	0.272	93	-17
	Alkalinity	85	-0.082	34	-15
	Na^+	59	0.926	28	-5
	Ca^{2+}	0	N/A	N/A	N/A
	Mg^{2+}	0	N/A	N/A	N/A
	K^+	0	N/A	N/A	N/A
	Hardness	85	0.689	57	-16

Figure D-6. *Scatter plots comparing observed concentrations of salinity constituents in the monthly CCWD Rock Slough WQ Building at Fish Screen validation dataset with the values estimated using measured EC. The red diagonal line denotes a 1:1 relationship. Points above the line are overpredicted concentrations. Points below the line are underpredicted concentrations.*



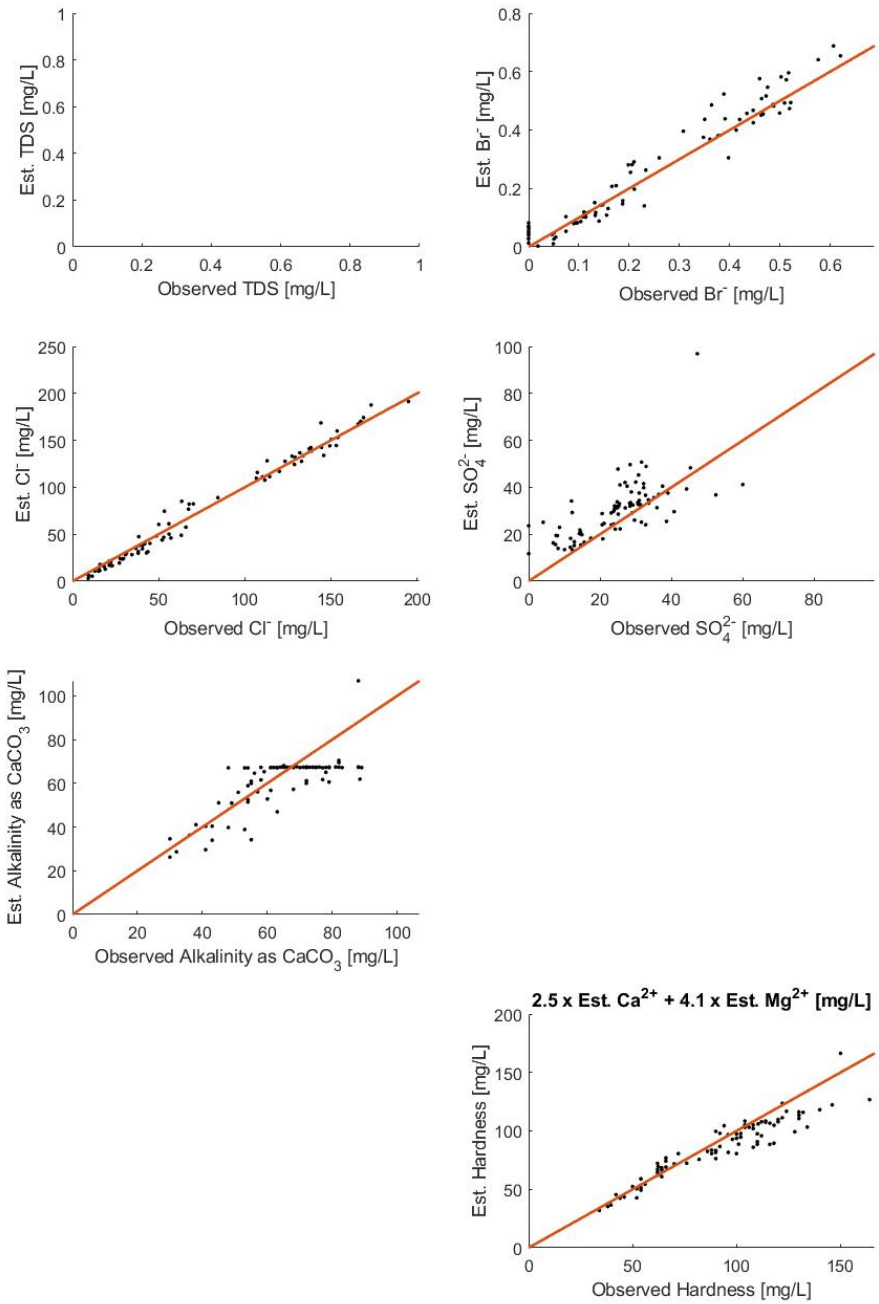
D-3.3 Grab Sample Data at CCWD Old River Intake

Another dataset used to validate the urban diversion methodology comprise monthly grab sample observations of constituents such as TDS, Br^-, Cl^-, SO_4^{2-}, Alkalinity, and Na^+ at the CCWD Old River intake. At this intake, total hardness was also recorded. These data were collected from 2014 to 2020 and are reported in Table D-7 and Figure D-7. See Section D-3.2 regarding our methodology for validating hardness data.

Table D-7*. Validation statistics computed for the Old-Middle River Export Corridor using the monthly observations at CCWD Old River Intake. Standard Error (SE) and Mean Bias are expressed in the units of the dependent variable (Y). Units are mg/L for all constituents. For alkalinity, units are expressed as mg/L as $CaCO_3$. Hardness is used to gauge the goodness-of-fit for the cations Ca^{2+} and Mg^{2+}.*

X = EC	Y	Data Points	R^2	SE	Mean Bias
CCWD Old River Intake	**TDS**	0	N/A	N/A	N/A
	Br^-	85	0.933	0.05	0.04
	Cl^-	82	0.980	8	24
	SO_4^{2-}	85	0.093	11	5
	Alkalinity	85	0.497	10	0.6
	Na^+	60	0.977	5	1
	Ca^{2+}	0	N/A	N/A	N/A
	Mg^{2+}	0	N/A	N/A	N/A
	K^+	0	N/A	N/A	N/A
	Hardness	86	0.837	12	-12

Figure D-7*. Scatter plots comparing observed concentrations of salinity constituents in the monthly CCWD Old River Intake validation dataset with the values estimated using measured EC. The red diagonal line denotes a 1:1 relationship. Points above the line are overpredicted concentrations. Points below the line are underpredicted concentrations.*



Appendix E: Alternate Least Squares Regression Fit to Seawater Boundary and Location-Specific Urban Diversion Data

This appendix summarizes an alternate approach for estimating salinity constituents from known values of EC and TDS for the Seawater Boundary and the following location-specific urban diversions: Banks Pumping Plant, Old River at Bacon Island, Old River at Highway 4, and Victoria Canal. This approach, which employs least squares regression assuming quadratic fitting, is not used in the user guide but is presented here for archival purposes.

E-1 Seawater Boundary Data

Four salinity ranges were defined to divide the spectrum of observed and expected values of the independent variables (i.e. EC and TDS) within the Seawater Boundary Region: (i) "Low", (ii) "Low-Medium", (iii) "Medium", and (iv) "High" salinity. The Seawater Boundary Region dataset was divided in such a manner because the constituent relationships were found to have unique trends in certain salinity ranges which were not adequately captured by a single quadratic regression fit. The relationships between constituents in each of the salinity ranges are captured by the constants and statistics in Tables E-1 and E-2 below. Table E-3 can be used to quickly estimate the salinity constituents of interest when the general EC range is known. Because data were generally unavailable to characterize the "High" salinity range, constants associated with this range were derived assuming a linear combination ("mix") of low salinity water and ambient seawater.[1] As the data used to derive these constants were not measured, regression statistics and parameter uncertainties were not generally calculated.[2] Parameter uncertainties associated with the regression constants are summarized in Tables E-4 and E-5.

[1] Ambient seawater was assumed to have the following properties: EC = 53,097 µS/cm, TDS = 35,000 mg/L TDS, Br^- = 65 mg/L, Cl^- = 19,284 mg/L, SO_4^{2-} = 2,710 mg/L, Alkalinity = 116 mg/L as $CaCO_3$, Na^+ = 10,693 mg/L, Ca^{2+} = 403 mg/L, Mg^{2+} = 1,298 mg/L, and K^+ = 387 mg/L. See Voutchkov (2010). Introduction to Reverse Osmosis Desalination – A SunCam Online Continuing Education Course, Technical Report, January. DOI: 10.13140/RG.2.2.13908.60801. Also see Schemel, L. and Park, M. (2001). Simplified Conversions Between Specific Conductance and Salinity Units for Use with data from Monitoring Stations, Interagency Ecological Program Newsletter, 14(1).

[2] Regression statistics (R^2 and Standard Error) were calculated and reported for EC, TDS and Cl^- in the high salinity range, as limited data were available for these constituents. Other constituents were either not observed or were not reported in the high salinity range.

***Table E-1**. This series of tables can be used to estimate salinity constituents of interest within the Seawater Boundary Region given a known value of EC. Each row represents one relationship and contains the regression constants (A, B, C) in the quadratic equation $Y = A\,[EC]^2 + B\,[EC] + C$, that are used to estimate Y, the concentration of the salinity constituent of interest. Also listed in each row are the number of data points that were used to generate the associated regression constants and statistics (R^2 and Standard Error). The Seawater Boundary Region is divided into four salinity ranges: low, low-medium, medium, and high. Each salinity range is defined by an upper and lower bound; regression constants are valid for the listed range of EC values. Units are mg/L for all constituents. For alkalinity, units are expressed as mg/L as $CaCO_3$.*

X = EC	Y	Data Points	A	B	C	R^2	SE	Data Range
"Low" Salinity 100 ≤ [EC] < 250 µS/cm	**TDS**	68	0	0.593	0.8	0.957	4.5	67 – 151
	Br^-	64	0	0.000401	-0.03	0.604	0.01	0.01 – 0.1
	Cl^-	68	0	0.139	-10.9	0.781	2.6	7 – 31
	SO_4^{2-}	68	0	0.0716	-1.0	0.544	2.3	6 – 22
	Alkalinity	68	0	0.205	15.0	0.706	4.7	37 – 72
	Na^+	68	0	0.102	-4.9	0.892	1.3	7 – 22
	Ca^{2+}	68	0	0.0422	4.0	0.665	1.1	8 – 16
	Mg^{2+}	68	0	0.0355	0.1	0.836	0.6	4 – 9
	K^+	68	0	0.00484	0.6	0.221	0.3	0.9 – 2.5

X = EC	Y	Data Points	A	B	C	R^2	SE	Data Range
"Low-Medium" Salinity 250 ≤ [EC] < 1,000 µS/cm	**TDS**	51	0	0.527	13.3	0.996	8.3	151 – 541
	Br^-	50	0	0.000869	-0.13	0.786	0.11	0.07 – 0.83
	Cl^-	51	0	0.282	-45.1	0.984	8.6	23 – 235
	SO_4^{2-}	51	0	0.0342	8.9	0.755	4.7	14 – 47
	Alkalinity	51	0	0.00280	61.9	0.004	10.2	41 – 85
	Na^+	51	0	0.155	-16.8	0.988	4.2	21 – 137
	Ca^{2+}	51	0	0.00482	12.4	0.202	2.3	9 – 21
	Mg^{2+}	51	0	0.0188	4.1	0.900	1.5	8.9 – 26
	K^+	51	0	0.00583	0.5	0.924	0.4	1.9 – 6.8

Table E-1 (contd.)

X = EC	Y	Data Points	A	B	C	R^2	SE	Data Range
"Medium" Salinity 1,000 ≤ [EC] < 17,500 µS/cm	**TDS**	308	4.84E-06	0.544	-20.9	0.996	185	532 – 10,800
	Br^-	266	3.21E-10	0.00114	-0.46	0.982	0.7	0.08 – 19.65
	Cl^-	308	2.42E-06	0.299	-72.5	0.997	89	238 – 5,704
	SO_4^{2-}	308	3.60E-07	0.0400	1.3	0.992	19	40 – 793
	Alkalinity	308	-1.13E-08	0.00168	61.5	0.449	8	46 – 96
	Na^+	308	1.16E-06	0.163	-35.0	0.997	50	138 – 3130
	Ca^{2+}	308	5.06E-08	0.00619	10.9	0.987	4	15 – 135
	Mg^{2+}	308	9.13E-08	0.0207	-0.4	0.991	10	22 – 376
	K^+	308	5.01E-08	0.0062	-0.6	0.979	5	2.6 – 132

X = EC	Y	Data Points	A	B	C	R^2	SE	Data Range
"High" Salinity [EC] ≥ 17,500 µS/cm	**TDS**	103	0	0.659	-15.8	0.936	2,460	10,200 – 36,200
	Br^-	0	0	0.00123	-0.24	N/A	N/A	N/A
	Cl^-	228	0	0.364	-67.3	0.947	910	5,400 – 18,800
	SO_4^{2-}	0	0	0.0510	4.2	N/A	N/A	N/A
	Alkalinity	70	0	0.000950	66.0	0.509	9	47 – 108
	Na^+	0	0	0.202	-22.9	N/A	N/A	N/A
	Ca^{2+}	0	0	0.00735	12.7	N/A	N/A	N/A
	Mg^{2+}	0	0	0.0244	2.9	N/A	N/A	N/A
	K^+	0	0	0.00729	0.0	N/A	N/A	N/A

Table E-2. *This series of tables can be used to estimate salinity constituents of interest within the Seawater Boundary Region given a known value of TDS. Each row represents one relationship and contains the regression constants (A, B, C) in the quadratic equation $Y = A\,[TDS]^2 + B\,[TDS] + C$, that are used to estimate Y, the concentration of the salinity constituent of interest. Also listed in each row are the number of data points that were used to generate the associated regression constants and statistics (R^2 and Standard Error). The Seawater Boundary Region is divided into four salinity ranges: low, low-medium, medium, and high. Each salinity range is defined by an upper and lower bound; regression constants are valid for the listed range of TDS values. Units are mg/L for all constituents. For alkalinity, units are expressed as mg/L as $CaCO_3$.*

X = TDS	Y	Data Points	A	B	C	R^2	SE	Data Range
"Low" Salinity 60 ≤ [TDS] < 150 mg/L	**EC**	68	0	1.62	6.3	0.954	7.4	117 – 248
	Br^-	64	0	0.000592	-0.03	0.559	0.01	0.01 – 0.08
	Cl^-	68	0	0.213	-9.0	0.745	2.6	7 – 27
	SO_4^{2-}	68	0	0.128	-1.8	0.589	2.2	6 – 22
	Alkalinity	68	0	0.334	16.1	0.651	5.1	37 – 72
	Na^+	68	0	0.163	-4.1	0.849	1.4	7 – 22
	Ca^{2+}	68	0	0.0741	3.7	0.725	1.0	8 – 16
	Mg^{2+}	68	0	0.0595	0.1	0.808	0.6	4 – 9
	K^+	68	0	0.00894	0.5	0.259	0.3	0.9 – 2.5

X = TDS	Y	Data Points	A	B	C	R^2	SE	Data Range
"Low-Medium" Salinity 150 ≤ [TDS] < 700 mg/L	**EC**	59	0	1.92	-30.3	0.996	21.5	249 – 1,299
	Br^-	58	0	0.00184	-0.20	0.884	0.11	0.07 – 1.21
	Cl^-	59	0	0.547	-54.6	0.984	11.7	23 – 321
	SO_4^{2-}	59	0	0.0674	7.2	0.864	4.5	12 – 57
	Alkalinity	59	0	0.00603	61.3	0.011	9.7	41 – 85
	Na^+	59	0	0.295	-20.8	0.986	5.9	21 – 179
	Ca^{2+}	59	0	0.00998	12.0	0.359	2.2	9 – 21
	Mg^{2+}	59	0	0.0362	3.5	0.946	1.5	7 – 29
	K^+	59	0	0.0113	0.3	0.952	0.4	1.5 – 8.4

Table E-2 (contd.)

X = TDS	Y	Data Points	A	B	C	R^2	SE	Data Range
"Medium" Salinity 700 ≤ [TDS] < 12,000 mg/L	**EC**	304	-2.34E-05	1.83	34.9	0.996	281	1,180 – 18,232
	Br^-	263	-2.60E-08	0.00209	-0.42	0.979	0.8	1.15 – 20
	Cl^-	304	-1.83E-06	0.560	-77.5	0.994	116	301 – 6,044
	SO_4^{2-}	304	-1.07E-07	0.0745	1.7	0.992	19	51 – 853
	Alkalinity	304	-6.26E-08	0.00303	61.5	0.442	8	46 – 96
	Na^+	304	-1.01E-06	0.302	-32.3	0.995	59	178 – 3,298
	Ca^{2+}	304	-1.83E-08	0.0114	11.1	0.987	4	16 – 143
	Mg^{2+}	304	-2.78E-07	0.0382	-0.4	0.989	11	25 – 424
	K^+	304	-3.47E-08	0.0116	-0.7	0.978	5	2.6 – 134

X = TDS	Y	Data Points	A	B	C	R^2	SE	Data Range
"High" Salinity [TDS] ≥ 12,000 mg/L	**EC**	97	0	1.52	23.9	0.947	3,200	14,600 – 50,100
	Br^-	0	0	0.00186	-0.21	N/A	N/A	N/A
	Cl^-	241	0	0.553	-58.6	0.956	941	5,680 – 18,800
	SO_4^{2-}	0	0	0.0773	5.4	N/A	N/A	N/A
	Alkalinity	129	0	0.00144	66.0	0.579	9	62 – 123
	Na^+	0	0	0.306	-25.1	N/A	N/A	N/A
	Ca^{2+}	0	0	0.0111	12.9	N/A	N/A	N/A
	Mg^{2+}	0	0	0.0370	3.5	N/A	N/A	N/A
	K^+	0	0	0.0111	0.2	N/A	N/A	N/A

Table E-3. *This look-up table can be used to estimate salinity constituents of interest in the Seawater Boundary Region given a general range of EC.*

SEAWATER BOUNDARY REGION									
EC [µS/cm]	**TDS** [mg/L]	**Br^-** [mg/L]	**Cl^-** [mg/L]	**SO_4^{2-}** [mg/L]	**Alkalinity** [mg/L as $CaCO_3$]	**Na^+** [mg/L]	**Ca^{2+}** [mg/L]	**Mg^{2+}** [mg/L]	**K^+** [mg/L]
100	60	0.01	3	6	35	5	8	4	1.1
150	90	0.03	10	10	46	10	10	5	1.3
200	119	0.05	17	13	56	15	12	7	1.6
250	149	0.07	24	17	66	21	15	9	1.8
…	…	…	…	…	…	…	…	…	…
500	277	0.30	96	26	63	61	15	14	3.4
750	409	0.52	167	35	64	99	16	18	4.9
1,000	541	0.74	237	43	65	138	17	23	6.3
…	…	…	…	…	…	…	…	…	…
2,000	1,087	1.8	534	83	65	296	24	41	12
3,000	1,655	3.0	845	125	66	465	30	62	18
4,000	2,233	4.1	1,161	167	68	636	36	84	25
5,000	2,821	5.2	1,481	211	70	810	43	105	32
…	…	…	…	…	…	…	…	…	…
10,000	5,905	11	3,156	438	77	1,712	78	215	66
15,000	9,230	17	4,951	683	84	2,674	115	330	104
20,000	13,164	24	7,213	1,024	85	4,017	160	491	146
25,000	16,459	31	9,033	1,279	90	5,027	196	613	182
30,000	19,754	37	10,853	1,534	95	6,037	233	735	219
35,000	23,049	43	12,673	1,789	99	7,047	270	857	255
40,000	26,344	49	14,493	2,044	104	8,057	307	979	292
45,000	29,639	55	16,313	2,299	109	9,067	343	1,101	328
50,000	32,934	61	18,133	2,554	114	10,077	380	1,223	365
53,097	35,000	65	19,284	2,710	116	10,693	403	1,298	387

***Table E-4**. Parameter uncertainties for the Seawater Boundary Region regression equations (when X = EC). This region had 440 "testable" samples.*

$Y = AX^2 + BX + C$	*TDS*	*Br*	*Cl^-*	*SO_4^{2-}*	*Alkalinity*	*Na^+*	*Ca^{2+}*	*Mg^{2+}*	*K^+*
Number of Data Points Post-Screen	**427**	**380**	**427**	**427**	**427**	**427**	**427**	**427**	**427**
LOW *100 ≤ [EC] < 250 µS/cm*	A = 0 B = ± 0.017 C = ± 3.1	A = 0 B = ± 4E-5 C = ± 0.008	A = 0 B = ± 0.010 C = ± 1.8	A = 0 B = ± 0.009 C = ± 1.6	A = 0 B = ± 0.017 C = ± 3.2	A = 0 B = ± 2.1E-3 C = ± 0.4	A = 0 B = ± 0.004 C = ± 0.7	A = 0 B = ± 2.1E-3 C = ± 0.4	A = 0 B = ± 1.2E-3 C = ± 0.22
LOW-MEDIUM *250 ≤ [EC] < 1,000 µS/cm*	A = 0 B = ± 0.005 C = ± 2.9	A = 0 B = ± 7E-5 C = ± 0.04	A = 0 B = ± 0.005 C = ± 3	A = 0 B = ± 2.8E-3 C = ± 1.6	A = 0 B = ± 6E-3 C = ± 4	A = 0 B = ± 9E-4 C = ± 0.5	A = 0 B = ± 1.4E-3 C = ± 0.8	A = 0 B = ± 9E-4 C = ± 0.5	A = 0 B = ± 2.4E-4 C = ± 0.14
MEDIUM *1,000 ≤ [EC] < 17,500 µS/cm*	A = ± 6E-7 B = ± 0.010 C = ± 34	A = ± 2.3E-9 B = ± 4E-5 C = ± 0.14	A = ± 2.7E-7 B = ± 5E-3 C = ± 16	A = ± 6E-8 B = ± 1E-3 C = ± 3.4	A = ± 2.3E-8 B = ± 4E-4 C = ± 1.4	A = ± 3.1E-8 B = ± 5E-4 C = ± 1.8	A = ± 1.2E-8 B = ± 2E-4 C = ± 0.7	A = ± 3.1E-8 B = ± 5E-4 C = ± 1.8	A = ± 1.4E-8 B = ± 2.4E-4 C = ± 0.9
HIGH *[EC] ≥ 17,500 µS/cm*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

***Table E-5**. Parameter uncertainties for the Seawater Boundary Region regression equations (when X = TDS). This region had 440 "testable" samples.*

$Y = AX^2 + BX + C$	*EC*	*Br*	*Cl^-*	*SO_4^{2-}*	*Alkalinity*	*Na^+*	*Ca^{2+}*	*Mg^{2+}*	*K^+*
Number of Data Points Post-Screen	**431**	**385**	**431**	**431**	**431**	**431**	**431**	**431**	**431**
LOW *65 ≤ [TDS] < 150 mg/L*	A = 0 B = ± 0.05 C = ± 5	A = 0 B = ± 7E-5 C = ± 0.008	A = 0 B = ± 0.016 C = ± 1.8	A = 0 B = ± 0.014 C = ± 1.5	A = 0 B = ± 0.032 C = ± 3.5	A = 0 B = ± 0.004 C = ± 0.4	A = 0 B = ± 0.006 C = ± 0.7	A = 0 B = ± 0.004 C = ± 0.4	A = 0 B = ± 0.002 C = ± 0.22
LOW-MEDIUM *150 ≤ [TDS] < 700 mg/L*	A = 0 B = ± 0.017 C = ± 6	A = 0 B = ± 9E-5 C = ± 0.033	A = 0 B = ± 0.009 C = ± 3.5	A = 0 B = ± 3.5E-3 C = ± 1.3	A = 0 B = ± 0.008 C = ± 2.9	A = 0 B = ± 1.2E-3 C = ± 0.4	A = 0 B = ± 1.8E-3 C = ± 0.7	A = 0 B = ± 1.2E-3 C = ± 0.4	A = 0 B = ± 3.3E-4 C = ± 0.12
MEDIUM *700 ≤ [TDS] < 12,000 mg/L*	A = ± 2.2E-6 B = ± 0.023 C = ± 50	A = ± 6E-9 B = ± 7E-5 C = ± 0.15	A = ± 9E-7 B = ± 0.010 C = ± 21	A = ± 1.5E-7 B = ± 1.6E-3 C = ± 3.5	A = ± 6E-8 B = ± 6E-4 C = ± 1.4	A = ± 9E-8 B = ± 9E-4 C = ± 2	A = ± 2.9E-8 B = ± 3.1E-4 C = ± 0.7	A = ± 9E-8 B = ± 9E-4 C = ± 2	A = ± 4E-8 B = ± 4E-4 C = ± 0.9
HIGH *[TDS] ≥ 12,000 mg/L*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

E-2 Location-Specific Urban Diversion Data

In this appendix, regression equations associated with Banks Pumping Plant, Old River at Bacon Island, Old River at Highway 4, and Victoria Canal are fit to data when the location of interest is classified as Seawater Dominant in Tables 11 and 12. Users should refer to Section 6 of the main document when the location of interest is classified as San Joaquin River Dominant in Tables 11 and 12.

E-2.1 Banks Pumping Plant

Two salinity ranges were defined to divide the spectrum of observed and expected values of the independent variables (i.e. EC and TDS) at this location. The Banks Pumping Plant dataset was divided in such a manner because the constituent relationships were found to have unique trends in certain salinity ranges which were not adequately captured by a single quadratic regression fit. The relationships between constituents in each of the salinity ranges are captured by the constants and statistics in Tables E-6 and E-7 below. Fitting statistics, provided in Table E-8 below, includes data at this location under both Seawater and San Joaquin River Dominant conditions.

E-2.2 Old River at Bacon Island

Two salinity ranges were defined to divide the spectrum of observed and expected values of the independent variables (i.e. EC and TDS) at this location. The Old River at Bacon Island dataset was divided in such a manner because the constituent relationships were found to have unique trends in certain salinity ranges which were not adequately captured by a single quadratic regression fit. The relationships between constituents in each of the salinity ranges are captured by the constants and statistics in Tables E-9 and E-10 below. Fitting statistics, provided in Table E-11 below, includes data at this location under both Seawater and San Joaquin River Dominant conditions.

E-2.3 Old River at Highway 4

Two salinity ranges were defined to divide the spectrum of observed and expected values of the independent variables (i.e. EC and TDS) at this location. The Old River at Highway 4 dataset was divided in such a manner because the constituent relationships were found to have unique trends in certain salinity ranges which were not adequately captured by a single quadratic regression fit. The relationships between constituents in each of the salinity ranges are captured by the constants and statistics in Tables E-12 and E-13 below. Fitting statistics, provided in Table E-14 below, includes data at this location under both Seawater and San Joaquin River Dominant conditions.

E-2.4 Victoria Canal

Two salinity ranges were defined to divide the spectrum of observed and expected values of the independent variable (i.e. EC) at this location. The Victoria Canal dataset was divided in such a manner because the constituent relationships were found to have unique trends in certain salinity ranges which were not adequately captured by a single quadratic regression fit. The relationships between constituents in each of the salinity ranges are captured by the constants and statistics in Table E-15 below. Fitting statistics, provided in Table E-16 below, includes data at this location under both Seawater and San Joaquin River Dominant conditions.

Table E-6. *These tables can be used to estimate salinity constituents of interest at Banks Pumping Plant, given a known value of EC, when the location is classified as Seawater Dominant per Tables 11 and 12. Each row represents one relationship and contains the regression constants (A, B, C) in the quadratic equation Y = A $[EC]^2$ + B [EC] + C, that are used to estimate Y, the concentration of the salinity constituent of interest. Also listed in each row are the number of data points that were used to generate the associated regression constants and statistics (R^2 and Standard Error). Data are divided into two salinity ranges. Each salinity range is defined by an upper and lower bound; regression constants are valid for the listed range of EC values. Units are mg/L for all constituents. For alkalinity, units are expressed as mg/L as $CaCO_3$.*

X = EC	Y	Data Points	A	B	C	R^2	SE	Data Range
80 ≤ [EC] < 250 µS/cm	**TDS**	13	-0.0023	1.50	-94.1	0.867	5.4	105 – 142
	Br^-	17	3.71E-05	-0.0159	1.8	0.365	0.03	0.04 – 0.17
	Cl^-	23	1.24E-02	-5.28	583	0.378	9.0	17 – 57
	SO_4^{2-}	22	0.0031	-1.28	149	0.084	5.9	9 – 34
	Alkalinity	13	0.0059	-2.38	288	0.260	8.2	35 – 59
	Na^+	14	-0.00080	0.444	-38.8	0.708	1.7	16 – 24
	Ca^{2+}	13	0.00044	-0.138	21.7	0.743	0.8	11 – 15
	Mg^{2+}	13	0.00041	-0.145	18.4	0.530	0.9	5 – 8
	K^+	3	N/A	N/A	N/A	N/A	N/A	1.8 – 2.6

X = EC	Y	Data Points	A	B	C	R^2	SE	Data Range
250 ≤ [EC] < 1,350 µS/cm	**TDS**	435	-5.36E-07	0.550	7.8	0.983	17.0	136 – 763
	Br^-	425	-1.45E-07	0.000949	-0.16	0.830	0.05	0.04 – 0.64
	Cl^-	680	4.13E-05	0.204	-27.7	0.954	12.1	18 – 334
	SO_4^{2-}	578	-1.98E-06	0.0533	8.0	0.479	11.5	12 – 109
	Alkalinity	393	-5.74E-05	0.0957	38.0	0.252	9.1	0 – 104
	Na^+	555	1.43E-05	0.128	-10.7	0.980	4.7	21 – 192
	Ca^{2+}	425	-1.98E-05	0.0353	6.2	0.261	3.6	2 – 36
	Mg^{2+}	425	-3.23E-07	0.0225	2.4	0.904	1.2	6 – 32
	K^+	96	-3.09E-06	0.00819	-0.00	0.576	0.6	0.1 – 5.2

Table E-7. *These tables can be used to estimate salinity constituents of interest at Banks Pumping Plant, given a known value of TDS, when the location is classified as Seawater Dominant per Tables 11 and 12. Each row represents one relationship and contains the regression constants (A, B, C) in the quadratic equation Y = A* $[TDS]^2$ *+ B [TDS] + C, that are used to estimate Y, the concentration of the salinity constituent of interest. Also listed in each row are the number of data points that were used to generate the associated regression constants and statistics (*R^2 *and Standard Error). Data are divided into two salinity ranges. Each salinity range is defined by an upper and lower bound; regression constants are valid for the listed range of TDS values. Units are mg/L for all constituents. For alkalinity, units are expressed as mg/L as* $CaCO_3$.

X = TDS	Y	Data Points	A	B	C	R^2	SE	Data Range
60 ≤ [TDS] < 145 mg/L	**EC**	16	0.0228	-3.56	309	0.819	14.5	185 – 283
	Br^-	11	7.55E-06	-0.00054	0.02	0.468	0.02	0.04 – 0.13
	Cl^-	16	0.0011	0.0961	-4.5	0.517	5.1	17 – 40.5
	SO_4^{2-}	16	-0.0184	4.67	-276	0.358	4.0	9 – 28
	Alkalinity	16	0.0398	-9.50	612	0.509	7.2	35 – 73
	Na^+	16	0.00028	0.190	-7.2	0.687	2.6	16 – 29
	Ca^{2+}	16	0.0022	-0.458	35.4	0.501	1.2	11 – 16
	Mg^{2+}	16	0.0031	-0.709	46.0	0.522	1.0	5 – 10
	K^+	3	N/A	N/A	N/A	N/A	N/A	1.8 – 2.6

X = TDS	Y	Data Points	A	B	C	R^2	SE	Data Range
145 ≤ [TDS] < 760 mg/L	**EC**	432	-2.94E-05	1.82	-9.7	0.983	30.7	253 – 1,340
	Br^-	246	-9.75E-08	0.00158	-0.16	0.825	0.05	0.04 – 0.64
	Cl^-	432	0.00012	0.378	-31.1	0.936	16.1	18 – 334
	SO_4^{2-}	432	-2.67E-05	0.115	4.6	0.546	11.0	13 – 109
	Alkalinity	388	-0.00019	0.175	36.7	0.252	9.1	0 – 104
	Na^+	431	4.34E-05	0.232	-11.9	0.961	7.0	21 – 192
	Ca^{2+}	389	-6.74E-05	0.0682	5.1	0.287	3.6	2 – 36
	Mg^{2+}	389	-4.44E-06	0.0434	1.7	0.899	1.3	6 – 32
	K^+	84	-2.55E-05	0.0242	-1.4	0.553	0.7	0.1 – 5.2

Table E-8. *This table presents fitting statistics (R^2 and Standard Error) for the Banks Pumping Plant location. As demonstrated in Figure 3 (Branch 3), given EC or TDS observations, sampling month, water year type, and (optionally) X2 position, the appropriate Water Year Type and Season Matrix (see Tables 11 and 12) can be consulted to determine the dominant boundary influence. The following statistics were computed by comparing the resultant estimations to the reported observations. Also listed in each row are the number of data points that were used to compute these statistics and the general ranges of EC and TDS. Units are mg/L for all constituents. For alkalinity, units are expressed as mg/L as $CaCO_3$.*

X = EC	Y	Data Points	R^2	SE	Data Range	X = TDS	Y	Data Points	R^2	SE	Data Range
Generally ranged from 80 to 1,350 µS/cm	**TDS**	809	0.987	14.7	64 – 763	*Generally ranged from 60 to 760 mg/L*	**EC**	809	0.988	26.1	8.3 – 1,340
	Br^-	702	0.906	0.05	0.02 – 0.64		**Br^-**	448	0.906	0.04	0.02 – 0.64
	Cl^-	1172	0.957	11.8	9 – 334		**Cl^-**	806	0.941	14.9	9 – 334
	SO_4^{2-}	1022	0.438	12.9	7.6 – 138		**SO_4^{2-}**	806	0.492	12.5	7.6 – 138
	Alkalinity	757	0.496	9.8	0 – 104		**Alkalinity**	755	0.489	9.8	0 – 104
	Na^+	978	0.983	4.3	8 – 192		**Na^+**	805	0.969	6.1	8 – 192
	Ca^{2+}	799	0.491	3.6	2 – 45		**Ca^{2+}**	759	0.537	3.4	2 – 45
	Mg^{2+}	800	0.896	1.5	3 – 32		**Mg^{2+}**	759	0.891	1.5	3 – 32
	K^+	195	0.696	0.6	0.1 – 5.2		**K^+**	177	0.693	0.6	0.1 – 5.2

Table E-9. *These tables can be used to estimate salinity constituents of interest at Old River at Bacon Island, given a known value of EC, when the location is classified as Seawater Dominant per Tables 11 and 12. Each row represents one relationship and contains the regression constants (A, B, C) in the quadratic equation $Y = A [EC]^2 + B [EC] + C$, that are used to estimate Y, the concentration of the salinity constituent of interest. Also listed in each row are the number of data points that were used to generate the associated regression constants and statistics (R^2 and Standard Error). Data are divided into two salinity ranges. Each salinity range is defined by an upper and lower bound; regression constants are valid for the listed range of EC values. Units are mg/L for all constituents. For alkalinity, units are expressed as mg/L as $CaCO_3$.*

X = EC	Y	Data Points	A	B	C	R^2	SE	Data Range
100 ≤ [EC] < 250 µS/cm	**TDS**	10	0.00881	-3.02	364	0.801	8.6	106 – 156
	Br^-	18	-3.88E-06	0.00191	-0.17	0.207	0.02	0.03 – 0.1
	Cl^-	10	0.000123	0.113	-8.2	0.677	3.7	12 – 29
	SO_4^{2-}	10	0.00333	-1.25	128	0.433	3.5	9 – 22
	Alkalinity	18	0.000789	-0.0855	36.5	0.383	8.0	39 – 70
	Na^+	10	0.000165	0.0292	4.3	0.601	2.6	13 – 23
	Ca^{2+}	10	9.01E-05	0.0223	3.3	0.674	1.3	9 – 15
	Mg^{2+}	10	0.00354	-1.44	151	0.800	1.0	6 – 13
	K^+	10	0.000922	-0.361	36.4	0.600	0.4	0.8 – 2.9

X = EC	Y	Data Points	A	B	C	R^2	SE	Data Range
250 ≤ [EC] < 1,040 µS/cm	**TDS**	121	-2.90E-05	0.57849	-1.0	0.985	12.5	147 – 551
	Br^-	146	-4.51E-08	0.00102	-0.20	0.947	0.04	0.05 – 0.86
	Cl^-	121	-2.50E-05	0.309	-53.3	0.979	7.6	21 – 246
	SO_4^{2-}	120	2.59E-05	0.000259	17.1	0.608	4.6	12 – 47
	Alkalinity	147	1.68E-05	-0.0103	68.8	0.043	8.4	46 – 102
	Na^+	121	-2.03E-06	0.152	-16.9	0.979	4.0	19 – 147
	Ca^{2+}	121	1.41E-05	-0.0102	17.1	0.244	2.2	11 – 24
	Mg^{2+}	121	2.46E-06	0.0154	4.8	0.901	1.1	8 – 23
	K^+	121	3.51E-07	0.00515	0.6	0.889	0.4	1.6 – 6.3

Table E-10. *These tables can be used to estimate salinity constituents of interest at Old River at Bacon Island, given a known value of TDS, when the location is classified as Seawater Dominant per Tables 11 and 12. Each row represents one relationship and contains the regression constants (A, B, C) in the quadratic equation $Y = A\,[TDS]^2 + B\,[TDS] + C$, that are used to estimate Y, the concentration of the salinity constituent of interest. Also listed in each row are the number of data points that were used to generate the associated regression constants and statistics (R^2 and Standard Error). Data are divided into two salinity ranges. Each salinity range is defined by an upper and lower bound; regression constants are valid for the listed range of TDS values. Units are mg/L for all constituents. For alkalinity, units are expressed as mg/L as $CaCO_3$.*

X = TDS	Y	Data Points	A	B	C	R^2	SE	Data Range
65 ≤ [TDS] < 145 mg/L	**EC**	9	-0.0762	20.69404	-1170.29	0.971	5.9	157 – 236
	Br^-	9	-7.01E-05	0.018061	-1.0912	0.588	0.01	0.03 – 0.09
	Cl^-	9	-0.0253	6.540986	-394.811	0.800	3.1	12 – 29
	SO_4^{2-}	9	0.00856	-1.93729	121.0382	0.690	2.3	9 – 20
	Alkalinity	9	-0.00749	2.091636	-92.497	0.272	7.0	39 – 60
	Na^+	9	-0.0191	4.86413	-287.688	0.846	1.7	13 – 23
	Ca^{2+}	9	-0.00077	0.303277	-13.7916	0.747	1.1	9 – 15
	Mg^{2+}	9	0.00331	-0.83491	59.97022	0.064	2.4	6 – 13
	K^+	9	-0.00015	0.052001	-2.25599	0.161	0.6	0.8 – 2.6

X = TDS	Y	Data Points	A	B	C	R^2	SE	Data Range
145 ≤ [TDS] < 550 mg/L	**EC**	122	-9.13E-05	1.872111	-16.0212	0.985	23.1	234 – 1,040
	Br^-	121	-1.69E-07	0.00186	-0.20294	0.933	0.05	0.05 – 0.86
	Cl^-	122	-9.56E-05	0.569195	-56.8416	0.967	9.6	21 – 246
	SO_4^{2-}	121	8.48E-05	0.000128	17.00369	0.609	4.6	12 – 47
	Alkalinity	122	2.08E-05	0.014658	61.19733	0.106	8.4	46 – 102
	Na^+	122	-2.16E-05	0.284872	-19.2301	0.961	5.6	19 – 147
	Ca^{2+}	122	4.33E-05	-0.01656	16.73614	0.242	2.2	11 – 24
	Mg^{2+}	122	3.91E-06	0.03069	4.222878	0.896	1.2	8 – 23
	K^+	122	1.32E-06	0.009112	0.635934	0.876	0.4	1.6 – 6.3

Table E-11. *This table presents fitting statistics (R^2 and Standard Error) for the Old River at Bacon Island location. As demonstrated in Figure 3 (Branch 3), given EC or TDS observations, sampling month, water year type, and (optionally) X2 position, the appropriate Water Year Type and Season Matrix (see Tables 11 and 12) can be consulted to determine the dominant boundary influence. The following statistics were computed by comparing the resultant estimations to the reported observations. Also listed in each row are the number of data points that were used to compute these statistics and the general ranges of EC and TDS. Units are mg/L for all constituents. For alkalinity, units are expressed as mg/L as $CaCO_3$.*

X = EC	Y	Data Points	R^2	SE	Data Range	X = TDS	Y	Data Points	R^2	SE	Data Range
Generally ranged from 100 to 1,040 µS/cm	**TDS**	281	0.993	10.0	65 – 551	*Generally ranged from 65 to 550 mg/L*	**EC**	281	0.993	17.9	109 – 1,040
	Br^-	337	0.973	0.03	0.01 – 0.86		**Br^-**	279	0.966	0.04	0.01 – 0.86
	Cl^-	281	0.984	7.3	4 – 246		**Cl^-**	281	0.977	8.6	4 – 246
	SO_4^{2-}	280	0.037	10.0	6 – 67		**SO_4^{2-}**	280	0.112	9.6	6 – 67
	Alkalinity	339	-0.116	12.5	29 – 102		**Alkalinity**	281	0.176	11.2	29 – 102
	Na^+	281	0.986	3.6	8 – 147		**Na^+**	281	0.978	4.6	8 – 147
	Ca^{2+}	281	0.517	2.3	7 – 24		**Ca^{2+}**	281	0.551	2.3	7 – 24
	Mg^{2+}	281	0.891	1.5	2 – 23		**Mg^{2+}**	281	0.881	1.5	2 – 23
	K^+	280	0.875	0.4	0.8 – 6.3		**K^+**	280	0.869	0.5	0.8 – 6.3

Table E-12. *These tables can be used to estimate salinity constituents of interest at Old River at Highway 4, given a known value of EC, when the location is classified as Seawater Dominant per Tables 11 and 12. Each row represents one relationship and contains the regression constants (A, B, C) in the quadratic equation Y = A [EC]^2 + B [EC] + C, that are used to estimate Y, the concentration of the salinity constituent of interest. Also listed in each row are the number of data points that were used to generate the associated regression constants and statistics (R^2 and Standard Error). Data are divided into two salinity ranges. Each salinity range is defined by an upper and lower bound; regression constants are valid for the listed range of EC values. Units are mg/L for all constituents. For alkalinity, units are expressed as mg/L as $CaCO_3$.*

X = EC	Y	Data Points	A	B	C	R^2	SE	Data Range
100 ≤ [EC] < 250 µS/cm	**TDS**	7	-0.0130	6.06	-573	0.993	5.0	1 – 134
	Br^-	8	-3.44E-06	0.00174	-0.15	0.732	0.01	0.02 – 0.09
	Cl^-	7	0.000747	-0.116	11.3	0.958	1.5	9 – 26
	SO_4^{2-}	7	0.000597	-0.178	23.7	0.407	2.3	9 - 17
	Alkalinity	8	-0.00045	0.383	-5.0	0.842	4.0	37 – 67
	Na^+	7	0.000306	-0.0108	6.2	0.921	1.3	10 – 21
	Ca^{2+}	7	-0.00027	0.148	-6.9	0.867	0.8	8 – 14
	Mg^{2+}	7	-0.00015	0.0898	-5.3	0.835	0.7	4 – 8
	K^+	7	0.000307	-0.115	12.1	0.550	0.3	1.1 – 2.2

X = EC	Y	Data Points	A	B	C	R^2	SE	Data Range
250 ≤ [EC] < 1,250 µS/cm	**TDS**	180	7.38E-05	0.471	25.1	0.972	15.7	141 – 711
	Br^-	236	-6.86E-08	0.00101	-0.19	0.920	0.04	0.05 – 0.77
	Cl^-	230	-7.61E-06	0.281	-48.3	0.957	10.2	22 – 293
	SO_4^{2-}	189	7.45E-05	-0.0475	31.4	0.455	9.1	12 – 142
	Alkalinity	222	-1.21E-05	0.0278	58.7	0.081	8.0	47 – 92
	Na^+	226	-1.69E-05	0.169	-21.9	0.976	4.0	19 – 168
	Ca^{2+}	225	2.24E-05	-0.0153	18.7	0.398	2.9	11 – 49
	Mg^{2+}	225	5.91E-06	0.0127	5.3	0.859	1.4	8 – 38
	K^+	199	-4.59E-06	0.0103	-0.6	0.804	0.4	1.6 – 5.7

Table E-13. *These tables can be used to estimate salinity constituents of interest at Old River at Highway 4, given a known value of TDS, when the location is classified as Seawater Dominant per Tables 11 and 12. Each row represents one relationship and contains the regression constants (A, B, C) in the quadratic equation $Y = A [TDS]^2 + B [TDS] + C$, that are used to estimate Y, the concentration of the salinity constituent of interest. Also listed in each row are the number of data points that were used to generate the associated regression constants and statistics (R^2 and Standard Error). Data are divided into two salinity ranges. Each salinity range is defined by an upper and lower bound; regression constants are valid for the listed range of TDS values. Units are mg/L for all constituents. For alkalinity, units are expressed as mg/L as $CaCO_3$.*

X = TDS	Y	Data Points	A	B	C	R^2	SE	Data Range
70 ≤ [TDS] < 145 mg/L	**EC**	9	0.00979	-0.539	133.5	0.984	5.5	133 – 258
	Br^-	9	7.51E-06	-0.00058	0.02	0.868	0.01	0.02 – 0.1
	Cl^-	9	0.00266	-0.228	9.3	0.932	2.1	9 – 32
	SO_4^{2-}	9	0.000805	-0.0823	11.0	0.410	2.2	9.2 – 17
	Alkalinity	9	-0.00071	0.248	36.8	0.944	1.9	37 – 59
	Na^+	9	0.00129	-0.0922	10.1	0.894	1.6	10 – 24
	Ca^{2+}	9	5.19E-05	0.0287	8.0	0.844	0.8	8 – 14
	Mg^{2+}	9	0.000276	-0.0101	4.0	0.922	0.4	4 – 8
	K^+	9	0.000211	-0.031	2.2	0.471	0.3	1.1 – 2.2

X = TDS	Y	Data Points	A	B	C	R^2	SE	Data Range
145 ≤ [TDS] < 750 mg/L	**EC**	178	-0.00055	2.12	-46.6	0.973	27.2	253 – 1,230
	Br^-	165	-6.32E-07	0.00201	-0.22	0.868	0.05	0.05 – 0.68
	Cl^-	178	-0.00023	0.625	-65.0	0.919	12.9	22 – 273
	SO_4^{2-}	173	0.00039	-0.171	42.9	0.555	8.4	12 – 142
	Alkalinity	173	8.24E-06	0.0358	57.7	0.184	7.6	47 – 91
	Na^+	174	-0.00019	0.380	-32.5	0.941	5.6	19 – 139
	Ca^{2+}	173	0.000111	-0.0494	21.5	0.450	2.9	11 – 49
	Mg^{2+}	173	3.63E-05	0.0128	6.6	0.837	1.4	8 – 38
	K^+	173	-2.04E-05	0.0222	-1.2	0.813	0.4	1.6 – 5.5

Table E-14. *This table presents fitting statistics (R^2 and Standard Error) for the Old River at Highway 4 location. As demonstrated in Figure 3 (Branch 3), given EC or TDS observations, sampling month, water year type, and (optionally) X2 position, the appropriate Water Year Type and Season Matrix (see Tables 11 and 12) can be consulted to determine the dominant boundary influence. The following statistics were computed by comparing the resultant estimations to the reported observations. Also listed in each row are the number of data points that were used to compute these statistics and the general ranges of EC and TDS. Units are mg/L for all constituents. For alkalinity, units are expressed as mg/L as $CaCO_3$.*

X = EC	Y	Data Points	R^2	SE	Data Range	X = TDS	Y	Data Points	R^2	SE	Data Range
Generally ranged from 100 to 1,250 µS/cm	**TDS**	352	0.987	12.5	1 – 711	*Generally ranged from 70 to 750 mg/L*	**EC**	351	0.988	21.5	120 – 1,230
	Br^-	425	0.946	0.04	0.02 – 0.77		**Br^-**	323	0.931	0.04	0.02 – 0.77
	Cl^-	413	0.969	9.7	6 – 293		**Cl^-**	351	0.954	10.8	6 – 293
	SO_4^{2-}	363	0.400	10.9	7 – 142		**SO_4^{2-}**	346	0.498	10.1	7 – 142
	Alkalinity	421	0.250	10.6	27 – 92		**Alkalinity**	345	0.427	9.7	27 – 92
	Na^+	408	0.982	4.0	10 – 168		**Na^+**	347	0.966	4.9	10 – 168
	Ca^{2+}	406	0.596	2.8	7 – 49		**Ca^{2+}**	346	0.702	2.5	7 – 49
	Mg^{2+}	406	0.879	1.6	3 – 28		**Mg^{2+}**	346	0.864	1.6	3 – 28
	K^+	373	0.827	0.5	1.1 – 5.7		**K^+**	342	0.828	0.5	1.1 – 5.7

Table E-15. *These tables can be used to estimate salinity constituents of interest at Victoria Canal, given a known value of EC, when the location is classified as Seawater Dominant per Tables 11 and 12. Each row represents one relationship and contains the regression constants (A, B, C) in the quadratic equation Y = A [EC]^2 + B [EC] + C, that are used to estimate Y, the concentration of the salinity constituent of interest. Also listed in each row are the number of data points that were used to generate the associated regression constants and statistics (R^2 and Standard Error). Data are divided into two salinity ranges. Each salinity range is defined by an upper and lower bound; regression constants are valid for the listed range of EC values. Units are mg/L for all constituents. For alkalinity, units are expressed as mg/L as $CaCO_3$.*

X = EC	Y	Data Points	A	B	C	R^2	SE	Data Range
100 ≤ [EC] < 250 µS/cm	**TDS**	0	N/A	N/A	N/A	N/A	N/A	N/A
	Br^-	9	7.56E-06	-0.00244	0.20	0.129	0.05	0 – 0.1
	Cl^-	9	-0.00142	0.765	-75.8	0.289	5.3	12 – 30
	SO_4^{2-}	9	-0.00103	0.662	-84.5	0.433	5.6	0 – 16
	Alkalinity	10	0.00728	-3.06	371	0.451	3.9	47 – 62
	Na^+	5	-0.00380	1.78	-186	0.823	1.3	18 – 23
	Ca^{2+}	0	N/A	N/A	N/A	N/A	N/A	N/A
	Mg^{2+}	0	N/A	N/A	N/A	N/A	N/A	N/A
	K^+	0	N/A	N/A	N/A	N/A	N/A	N/A

X = EC	Y	Data Points	A	B	C	R^2	SE	Data Range
250 ≤ [EC] < 775 µS/cm	**TDS**	0	N/A	N/A	N/A	N/A	N/A	N/A
	Br^-	44	6.83E-07	0.000216	0.009	0.838	0.05	0.09 – 0.7
	Cl^-	42	0.000168	0.108	-6.85	0.963	6.7	30 – 145
	SO_4^{2-}	44	1.15E-05	0.0362	5.93	0.510	6.2	11 – 52
	Alkalinity	44	-3.25E-05	0.0675	47.6	0.306	7.1	54 – 88
	Na^+	36	-3.07E-05	0.171	-18.6	0.947	4.6	25 – 93
	Ca^{2+}	0	N/A	N/A	N/A	N/A	N/A	N/A
	Mg^{2+}	0	N/A	N/A	N/A	N/A	N/A	N/A
	K^+	0	N/A	N/A	N/A	N/A	N/A	N/A

***Table E-16**. This table presents fitting statistics (R^2 and Standard Error) for the Victoria Canal location. As demonstrated in Figure 3 (Branch 3), given EC or TDS observations, sampling month, water year type, and (optionally) X2 position, the appropriate Water Year Type and Season Matrix (see Tables 11 and 12) can be consulted to determine the dominant boundary influence. The following statistics were computed by comparing the resultant estimations to the reported observations. Also listed in each row are the number of data points that were used to compute these statistics and the general ranges of EC and TDS. Units are mg/L for all constituents. For alkalinity, units are expressed as mg/L as $CaCO_3$.*

X = EC	Y	Data Points	R^2	SE	Data Range	X = TDS	Y	Data Points	R^2	SE	Data Range
Generally ranged from 100 to 775 µS/cm	**TDS**	0	N/A	N/A	N/A	*N/A*	**EC**	0	N/A		
	Br^-	85	0.901	0.05	0.01 – 0.74		**Br^-**	0			
	Cl^-	89	0.974	5.9	8 – 165		**Cl^-**	0			
	SO_4^{2-}	85	0.101	9.9	8 – 52		**SO_4^{2-}**	0			
	Alkalinity	86	0.553	9.5	28 – 89		**Alkalinity**	0			
	Na^+	60	0.970	4.2	8 – 93		**Na^+**	0			
	Ca^{2+}	0	N/A	N/A	N/A		**Ca^{2+}**	0			
	Mg^{2+}	0	N/A	N/A	N/A		**Mg^{2+}**	0			
	K^+	0	N/A	N/A	N/A		**K^+**	0			