

TCEQ – 21J

Calculated %-Removal

Site Description:

This site is at the RO membrane train permeate piping (RO trains 4 and 6). The analysis that was performed at this site calculated the % removal of contaminants from the RR WWTP effluent to the RO membrane permeate water.

Protocol:

TCEQ – 21J Calculated %-Removal (based on RR WWTP effluent quality and the RO membrane unit's permeate quality prior to discharge to waste Lagoon 3)									
	5-min	15-min	2-hr	4-hr	1/day	1/day or Δ	2/week	1/week	S/30/E
Nitrite removal (if detected in RO feed water)					X				
Nitrate removal					X				
TDS removal					X				
TOC removal								X	
DOC removal								X	
Removal of inorganics									X
Removal of organics									X
Removal of all radionuclides									X
Removal of secondary chemicals									X
TTHM removal								X	
HAA5 removal								X	
Bromide removal								X	

Summary Table:

TCEQ – 21J Calculated %-Removal

	Nitrite Removal %	Nitrate Removal %	TOC % Removal	DOC on-site % Removal	DOC off-site % Removal	TTHM % Removal	HAA5 % Removal	Bromide % Removal	TDS Removal %	Perchlorate (ug/L)	Arsenic (ug/L)	Barium (ug/L)
Units	%	%	%	%	%	%	%	%	%	%	%	%
Min	95.3	63.0	98.7	99.1	100.0	79.5	100.0	96.1	90.8	100	100	100
Max	99.6	99.7	99.3	100.0	100.0	90.5	100.0	98.9	99.7	100	100	100
Avg	98.1	91.6	99.0	99.6	100.0	87.5	100.0	98.0	98.7	100	100	100
95th %	99.5	95.9	99.3	100.0	100.0	90.3	100.0	98.9	99.3	100	100	100

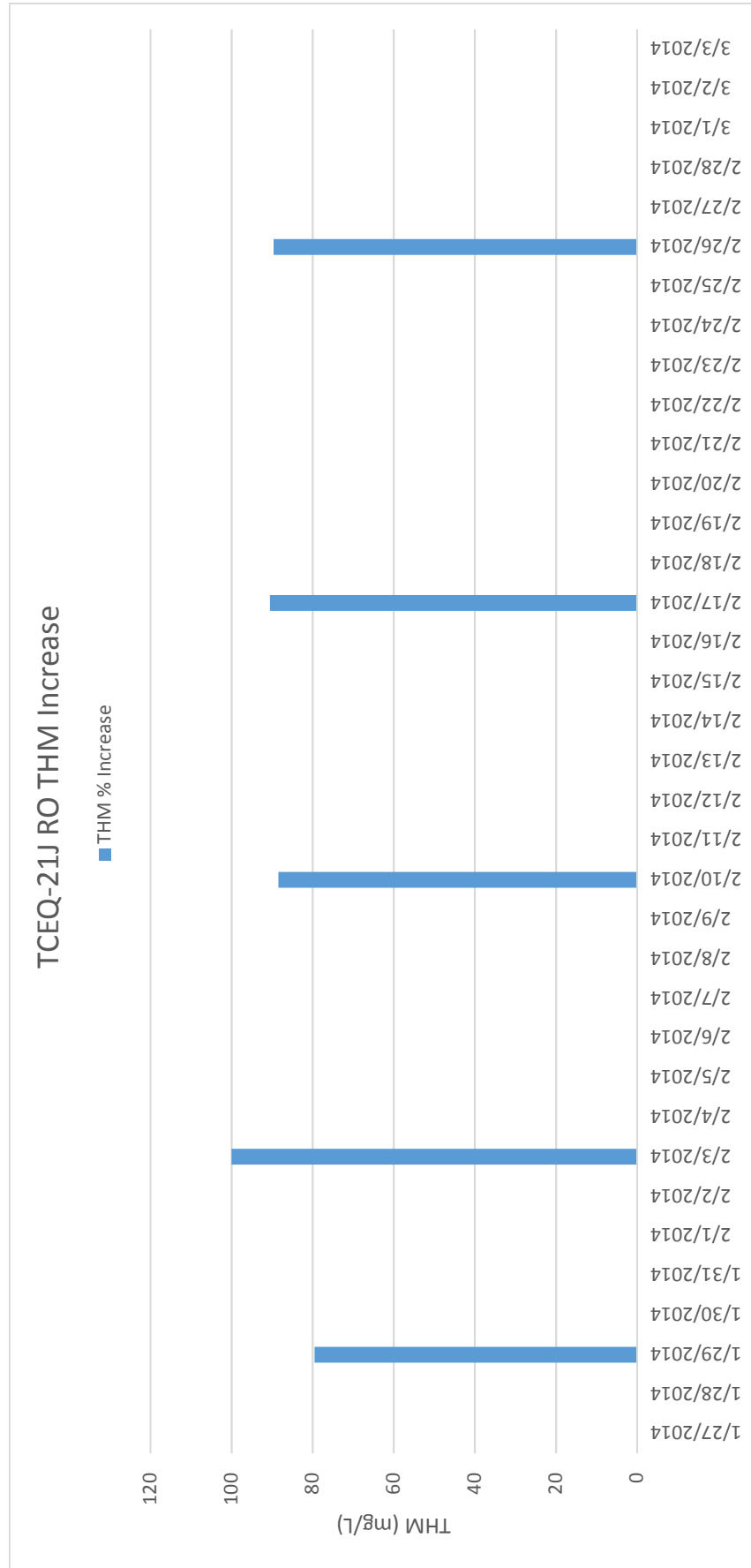
	Cyanide (mg/L)	Fluoride (mg/L)	Selenium (ug/L)	Simazine (ug/L)	Aluminum (ug/L)	Chloride (mg/L)	Copper (ug/L)	Iron (mg/L)	Radium 226 (pCi/L)	Uranium (UG/L)	Gross Beta Particle Activity (pCi/L)	Zinc (ug/L)
Units	%	%	%	%	%	%	%	%	%	%	%	%
Min	100	100	100	100	100	98.2	100	100	100	100	100	100
Max	100	100	100	100	100	98.2	100	100	100	100	100	100
Avg	100	100	100	100	100	98.2	100	100	100	100	100	100
95th %	100	100	100	100	100	98.2	100	100	100	100	100	100

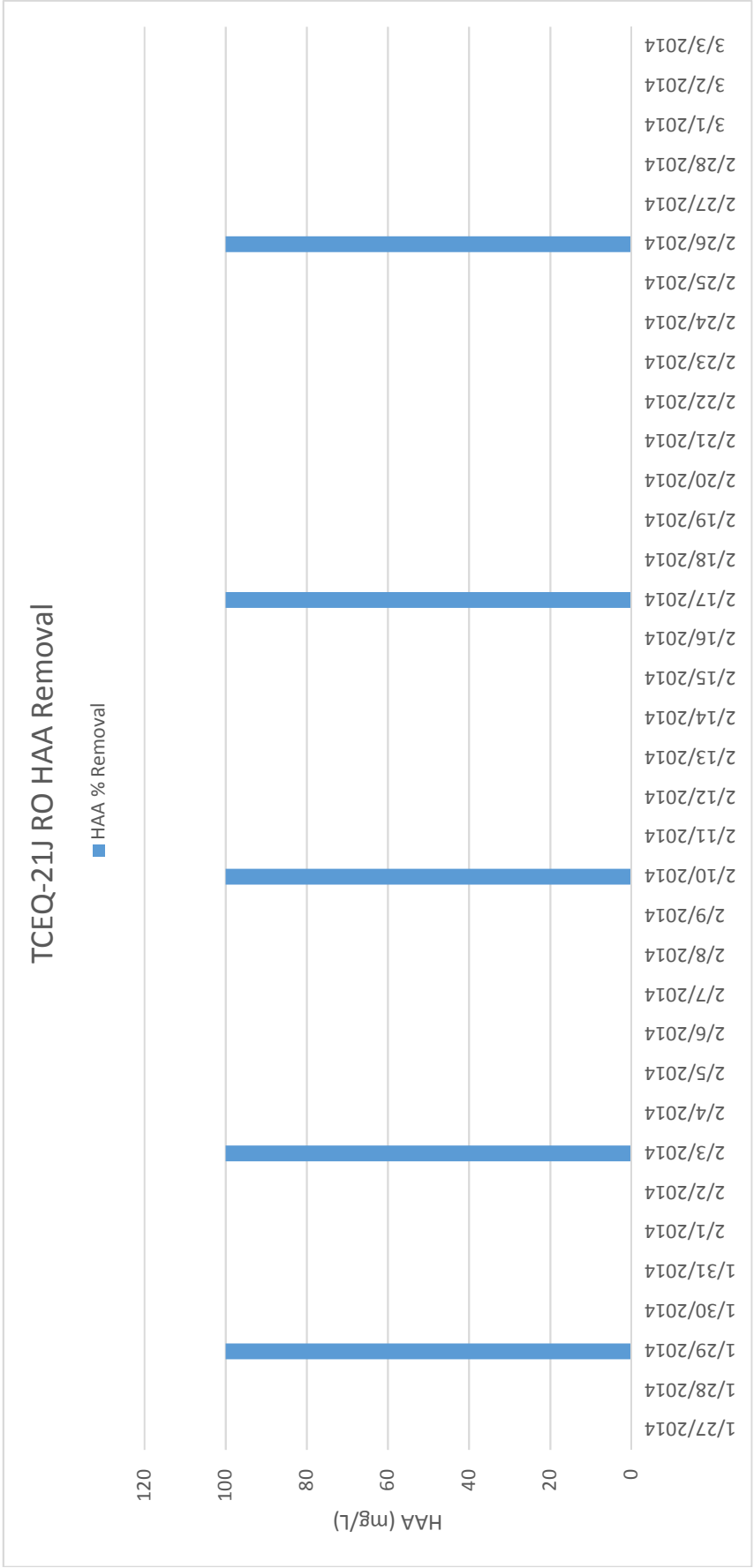
Conclusions:

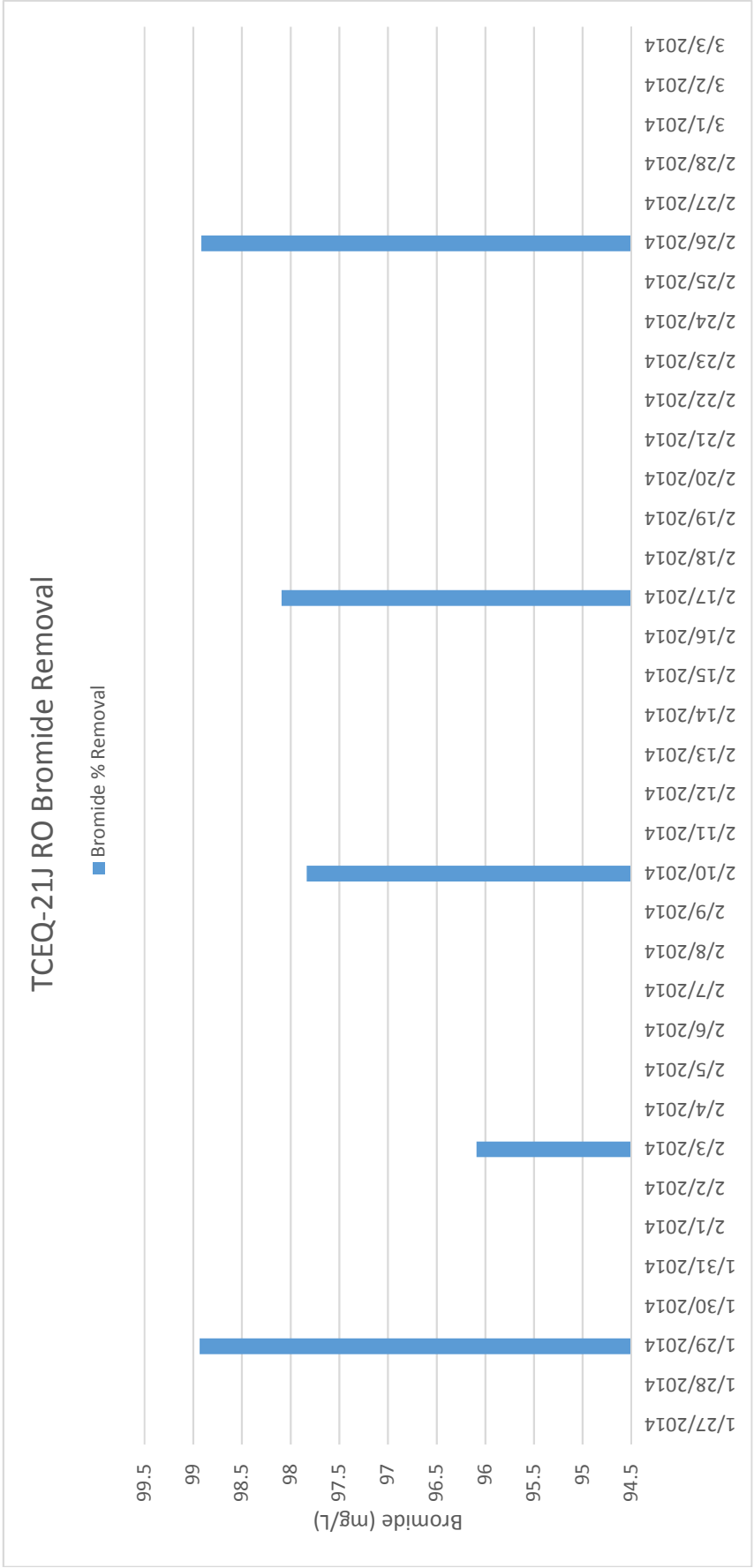
When the City submitted the “Concept Paper for the Emergency Reuse of Wastewater Effluent as a Source for Direct Potable Reuse in Wichita Falls”, it used the low end range of removal efficiencies to determine whether or not the Reverse Osmosis process could get the Nitrate and Trihalomethanes below regulatory levels.

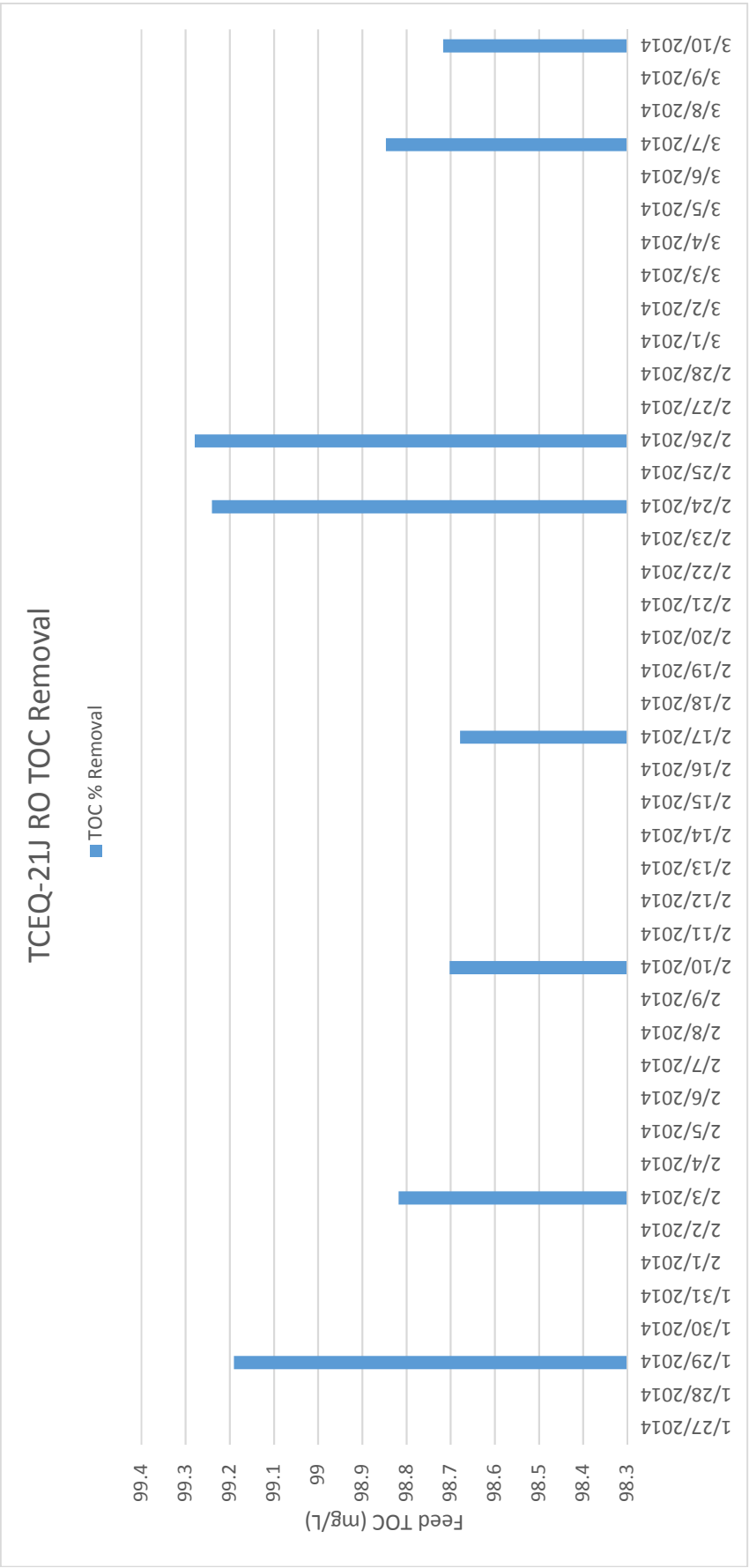
The % reductions that were calculated during the Full Scale Verification demonstrate that the Reverse Osmosis performed at the high end of the removal efficiencies, thereby performing better than the City had anticipated. The City had assumed a 90% removal of Chloride and achieved an average of 98.2%, an assumption of 80% removal of Nitrate and achieved an average of 91.6%, an assumption of 50% removal of Trihalomethanes and Haloacetic Acids and achieved an average of 87.5% and 100%, respectively.

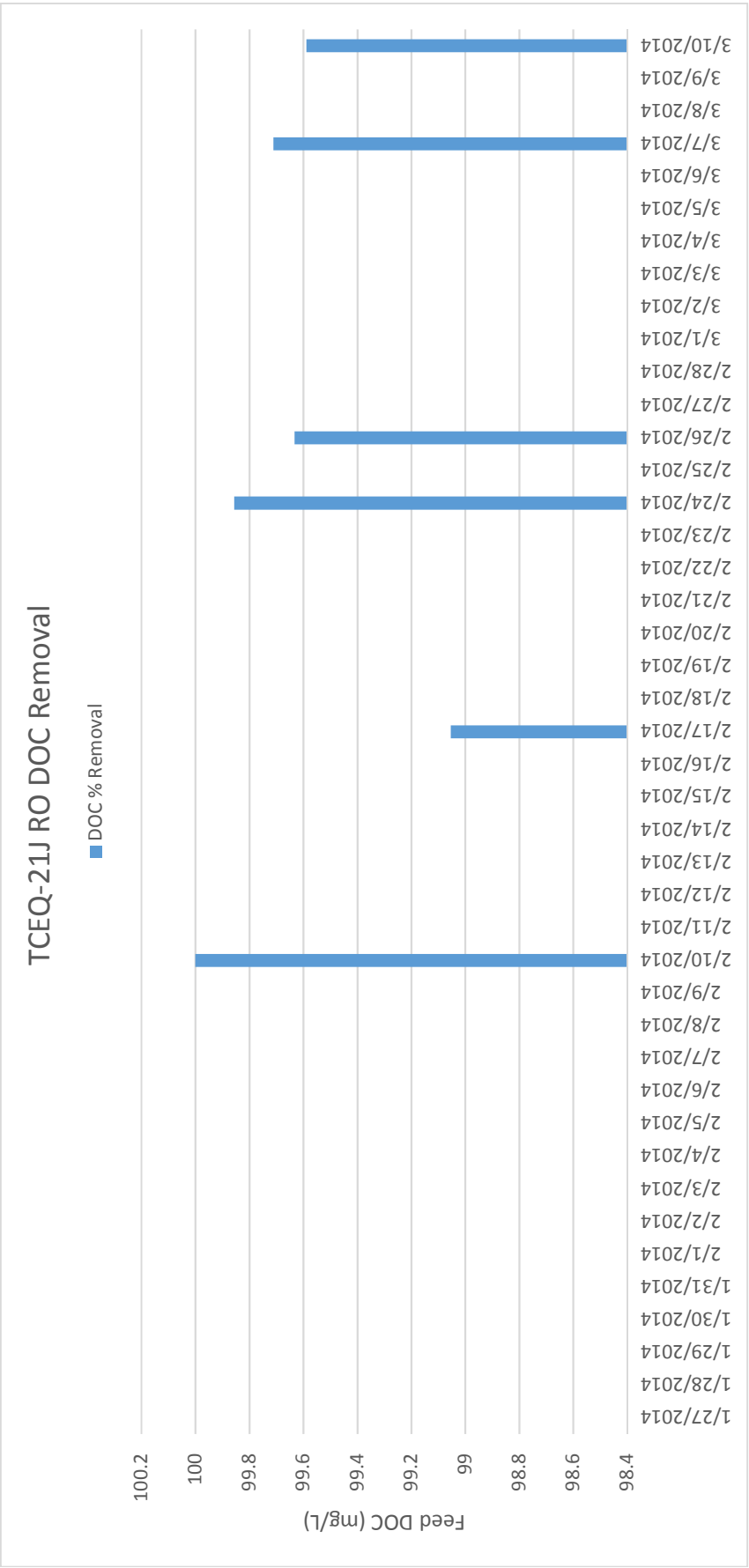
Additional constituents required by the TCEQ for % reduction monitoring all showed to be reduced at levels ranging on average from 98% to 100%.

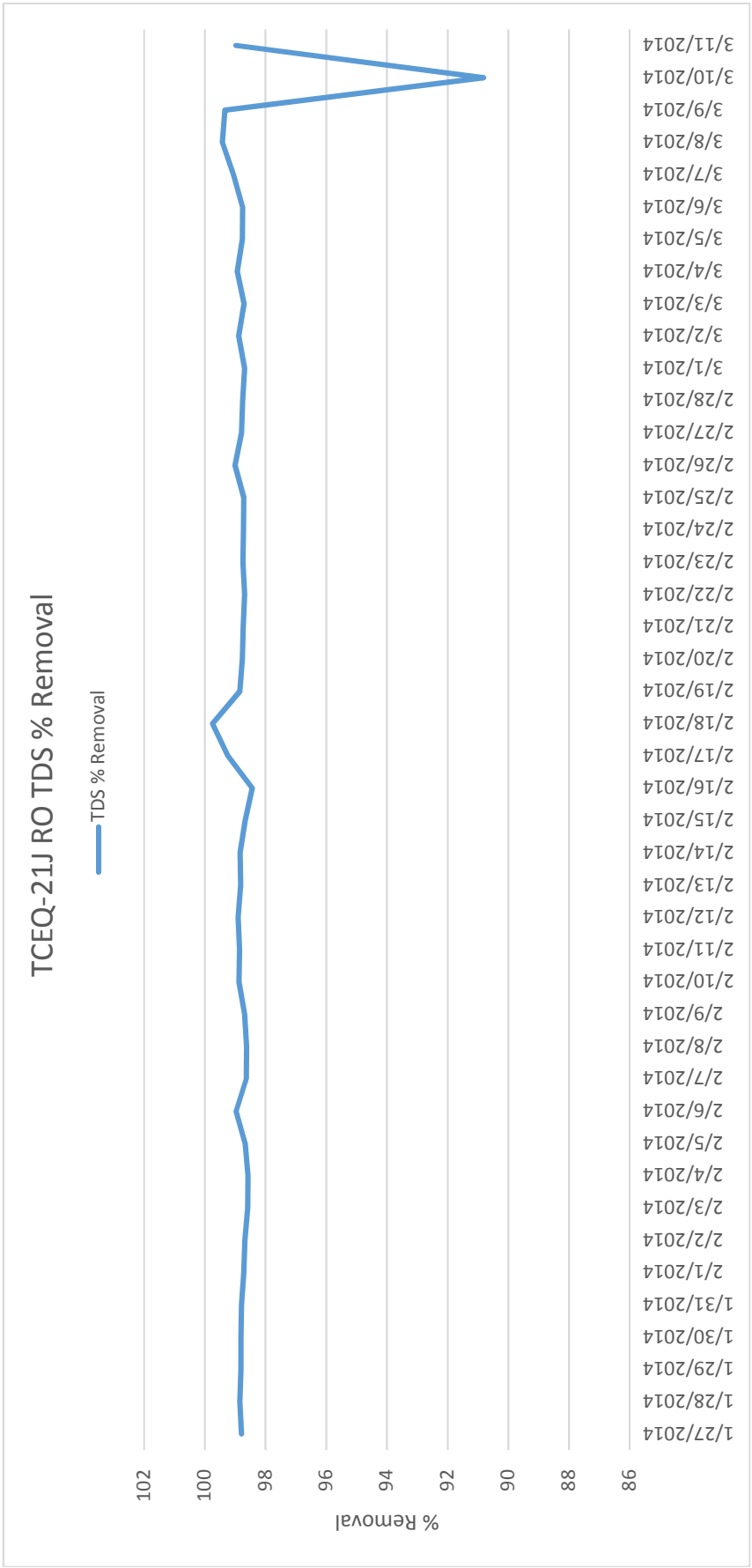




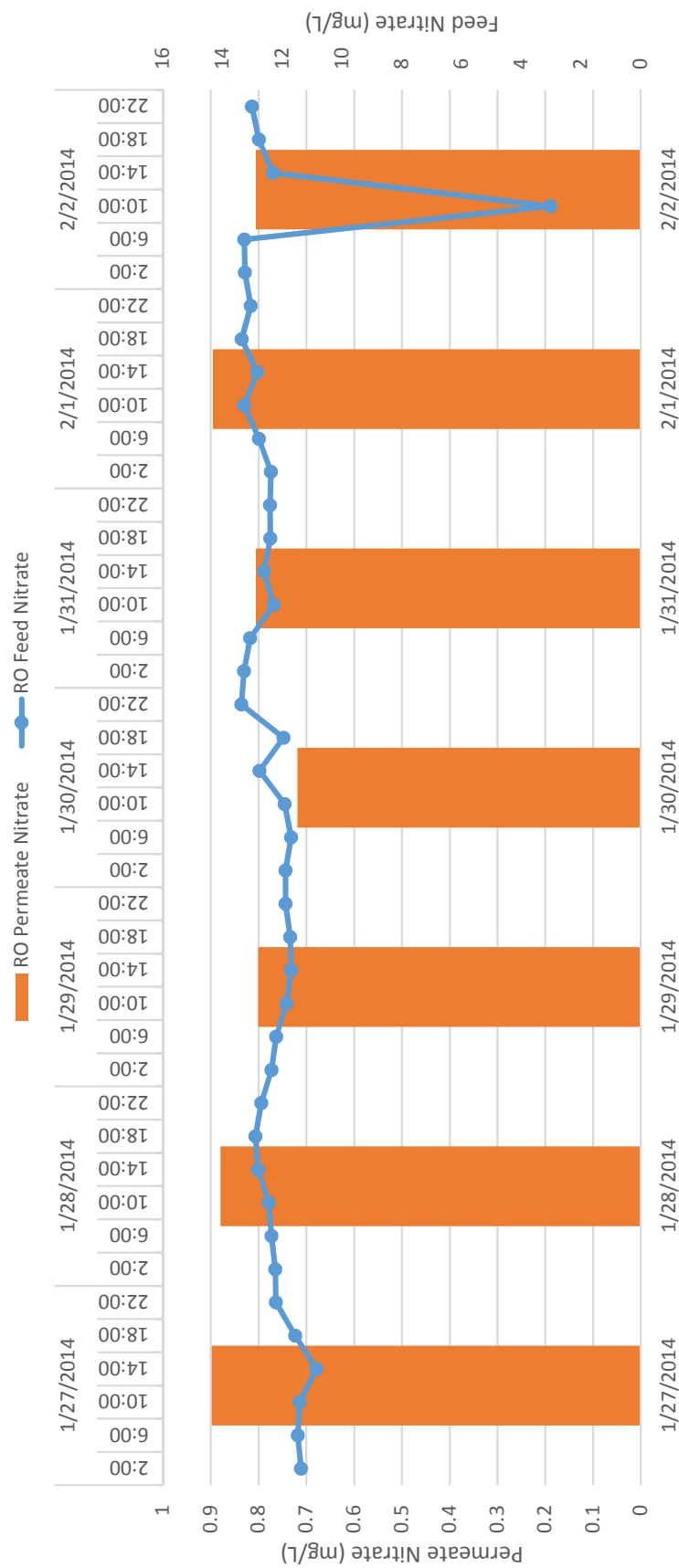




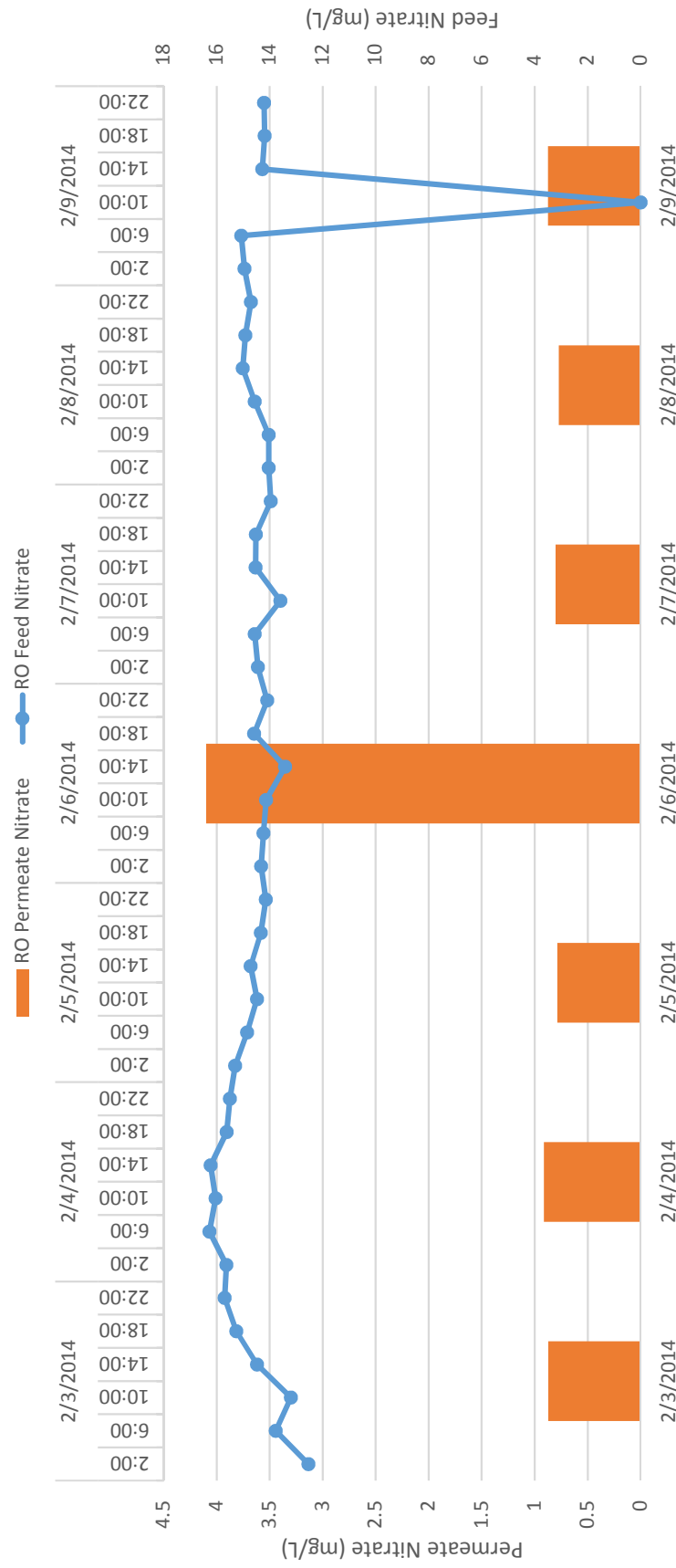




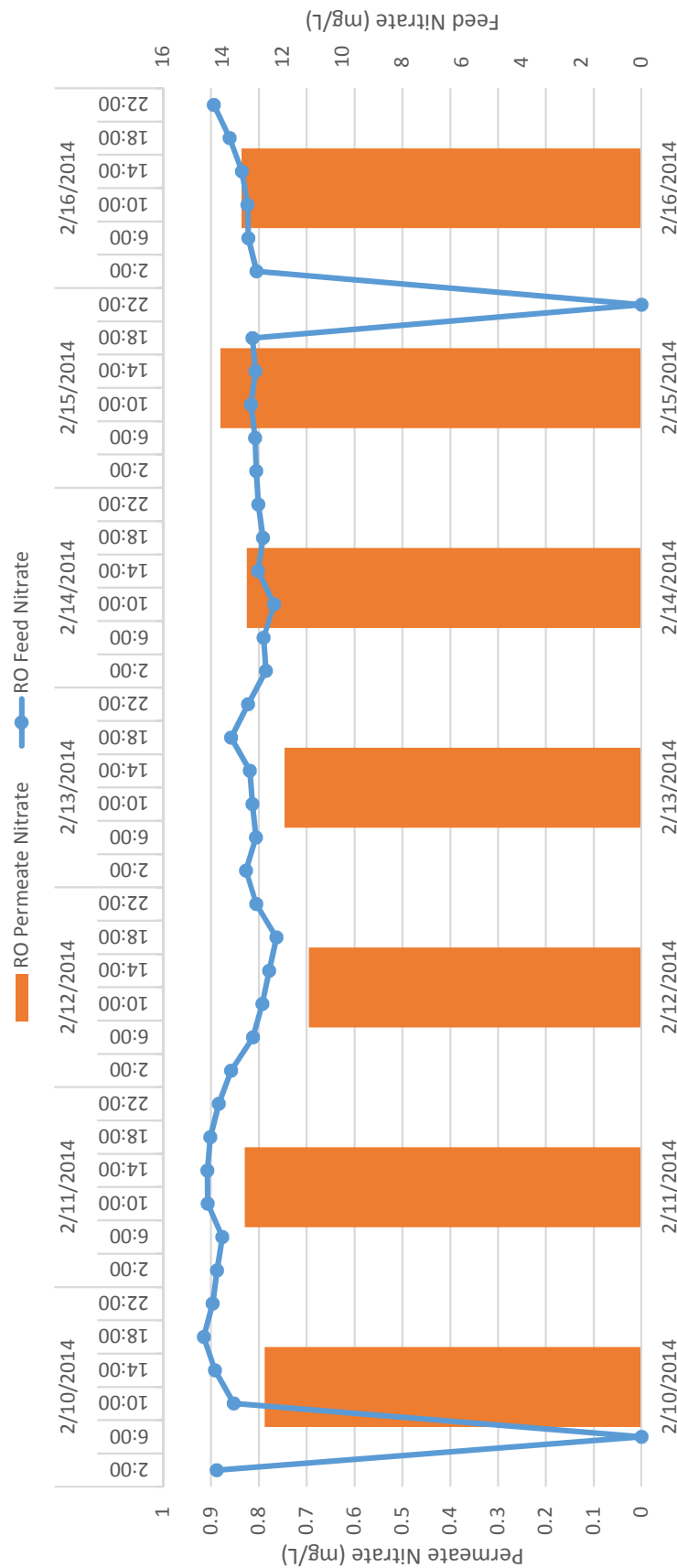
TCEQ-21J RO Nitrate Removal



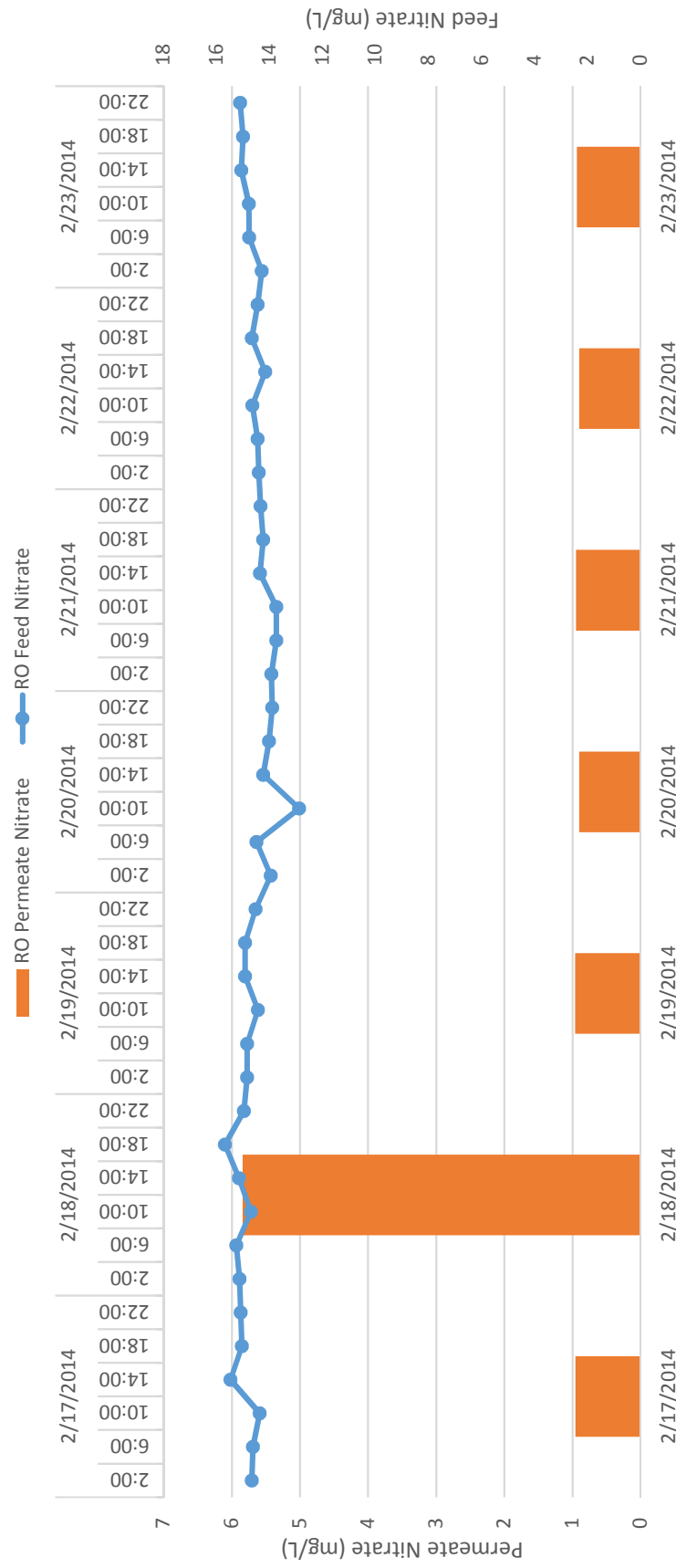
TCEQ-21J RO Nitrate Removal



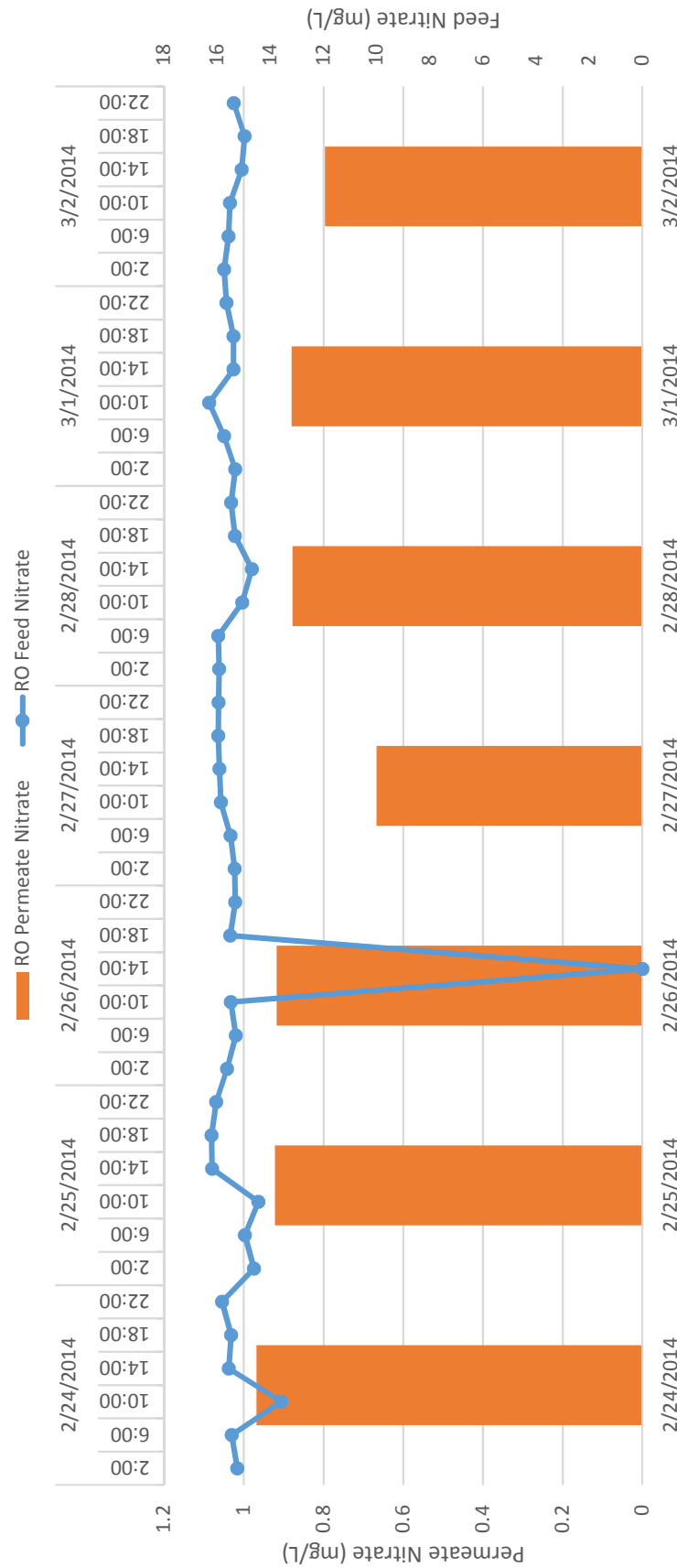
TCEQ-21J RO Nitrate Removal



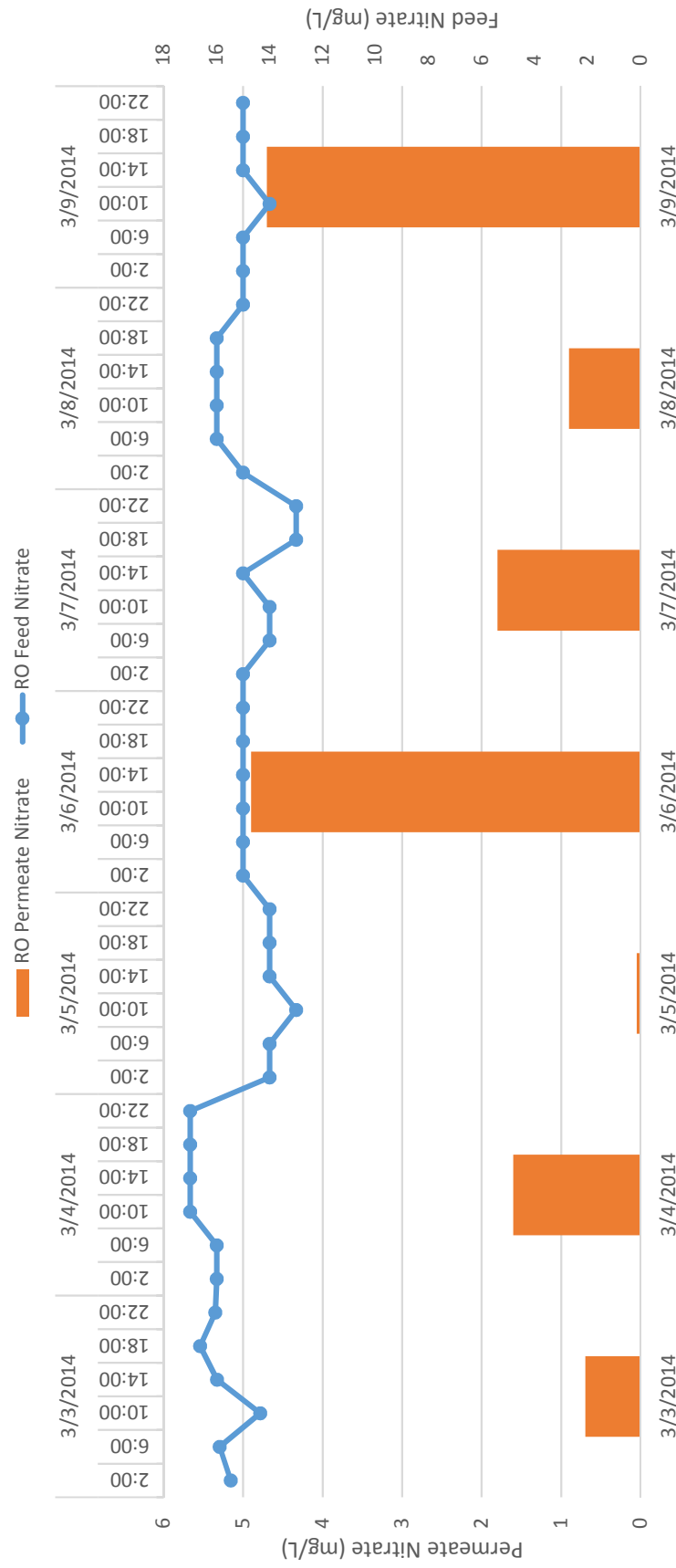
TCEQ-21J RO Nitrate Removal



TCEQ-21J RO Nitrate Removal

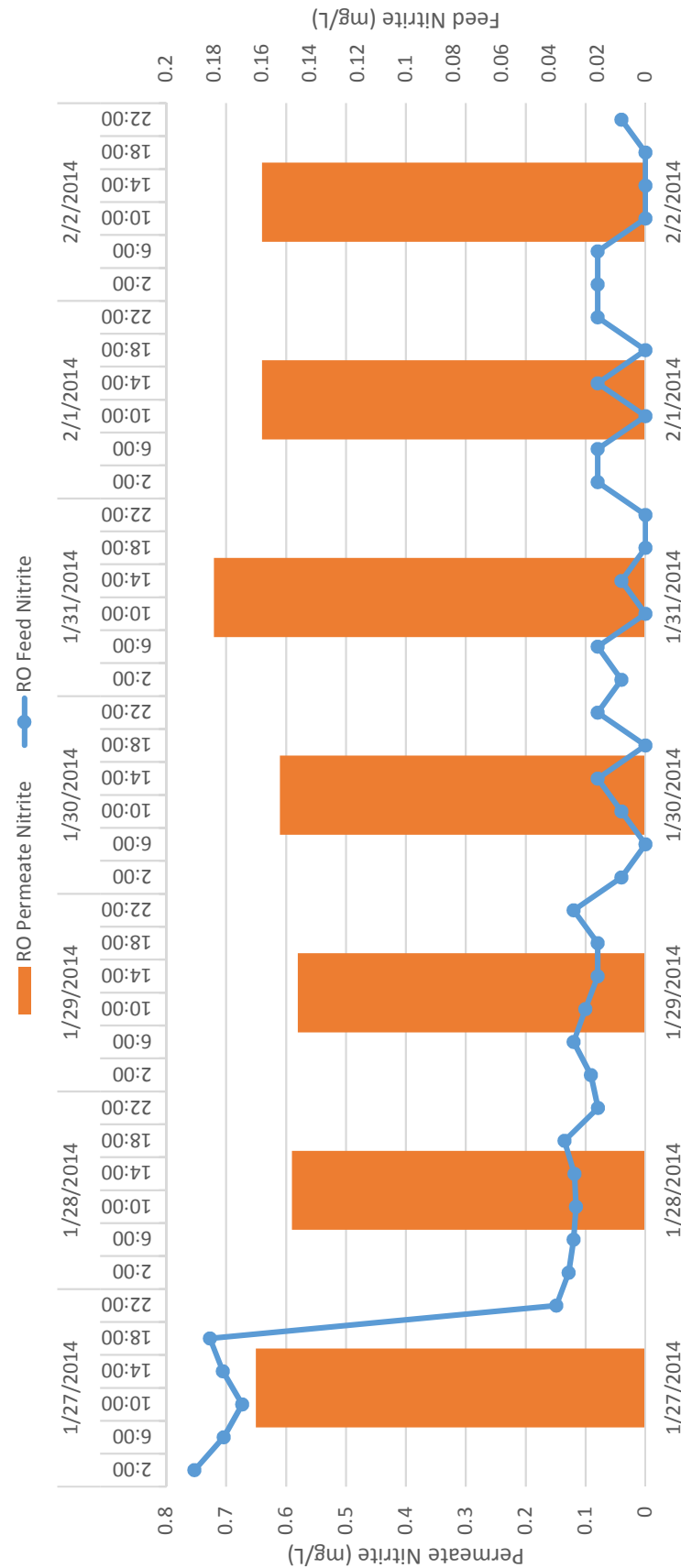


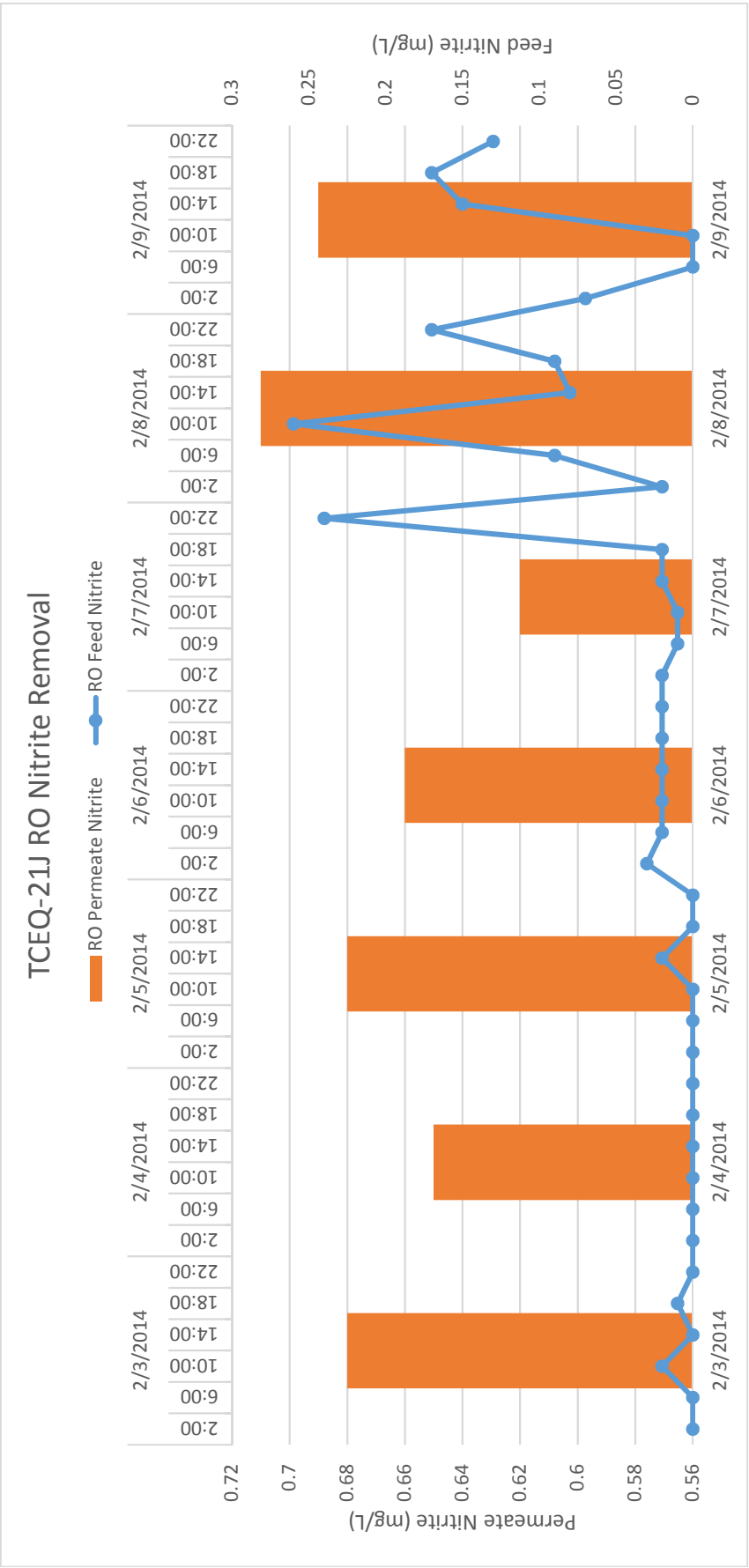
TCEQ-21J RO Nitrate Removal



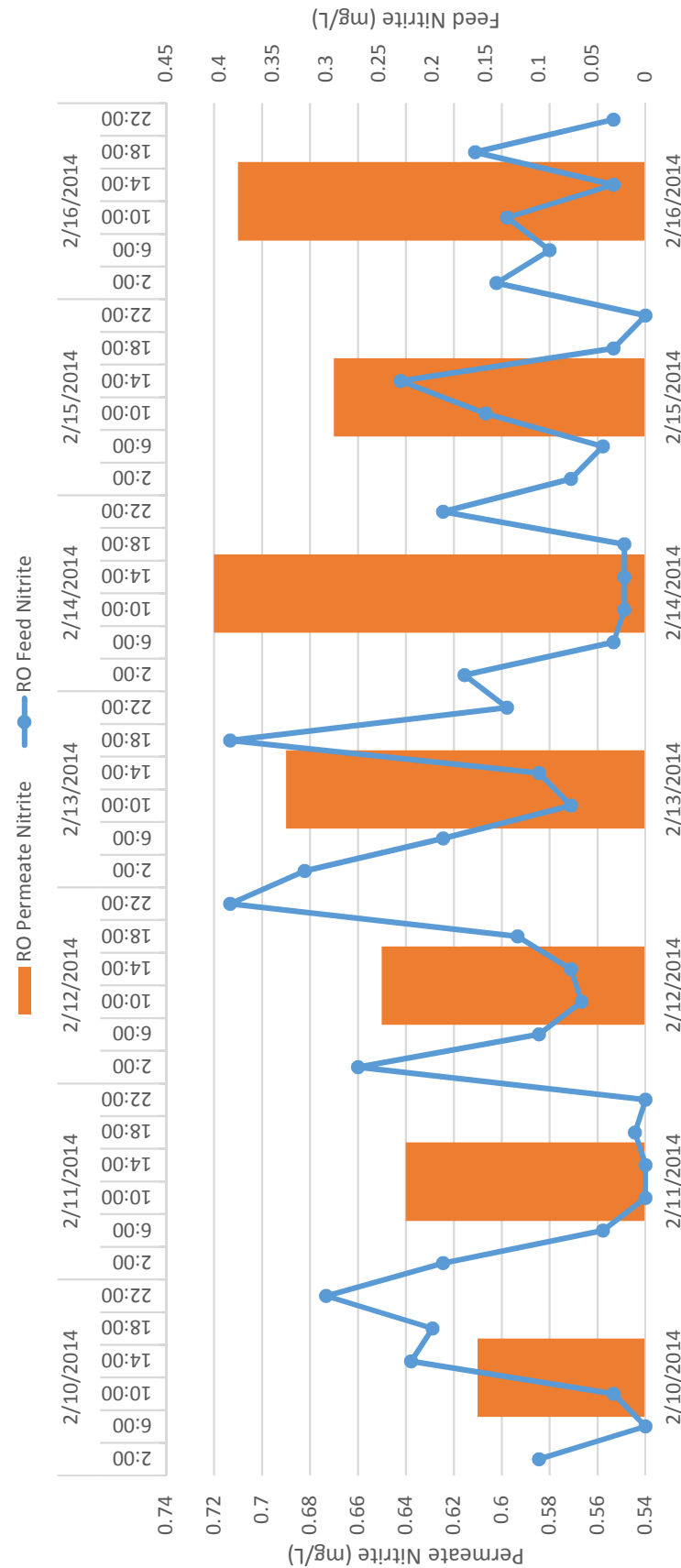


TCEQ-21J RO Nitrite Removal

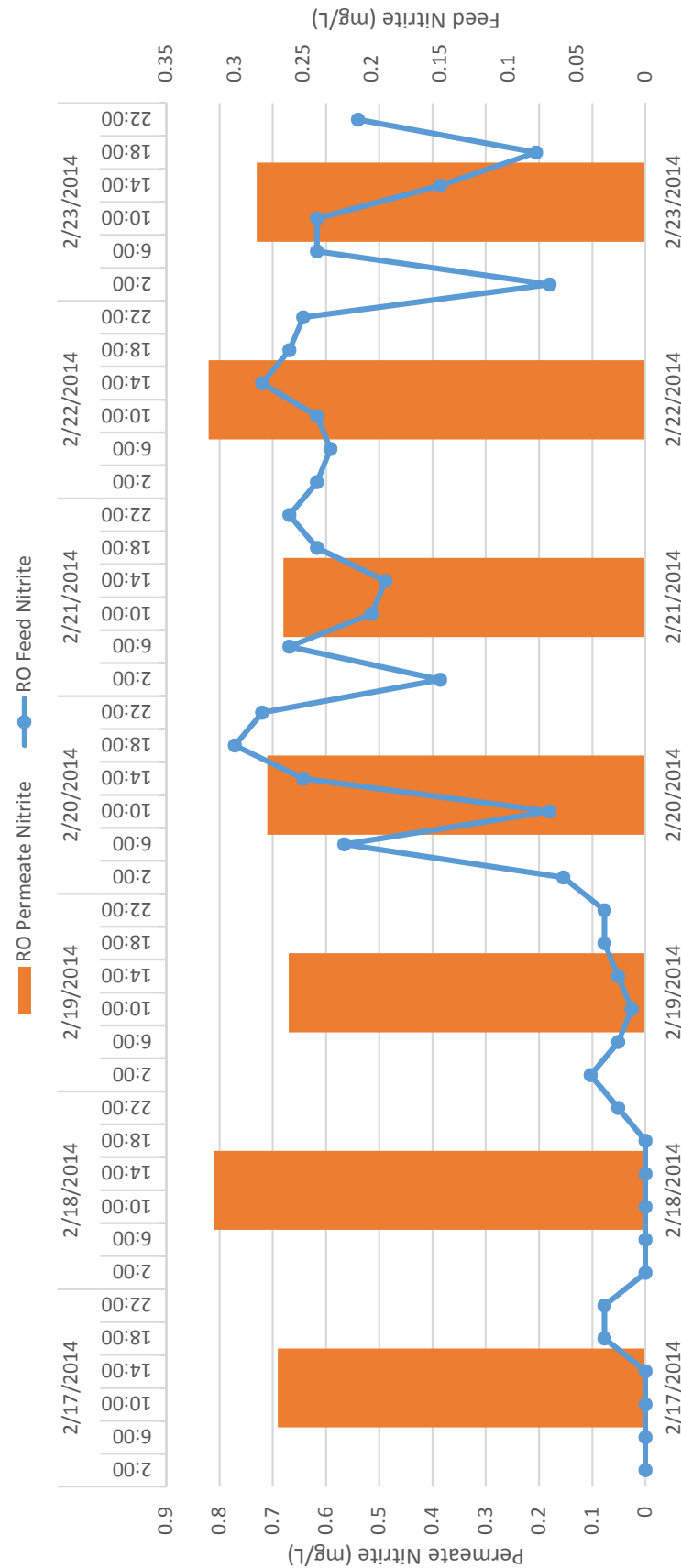




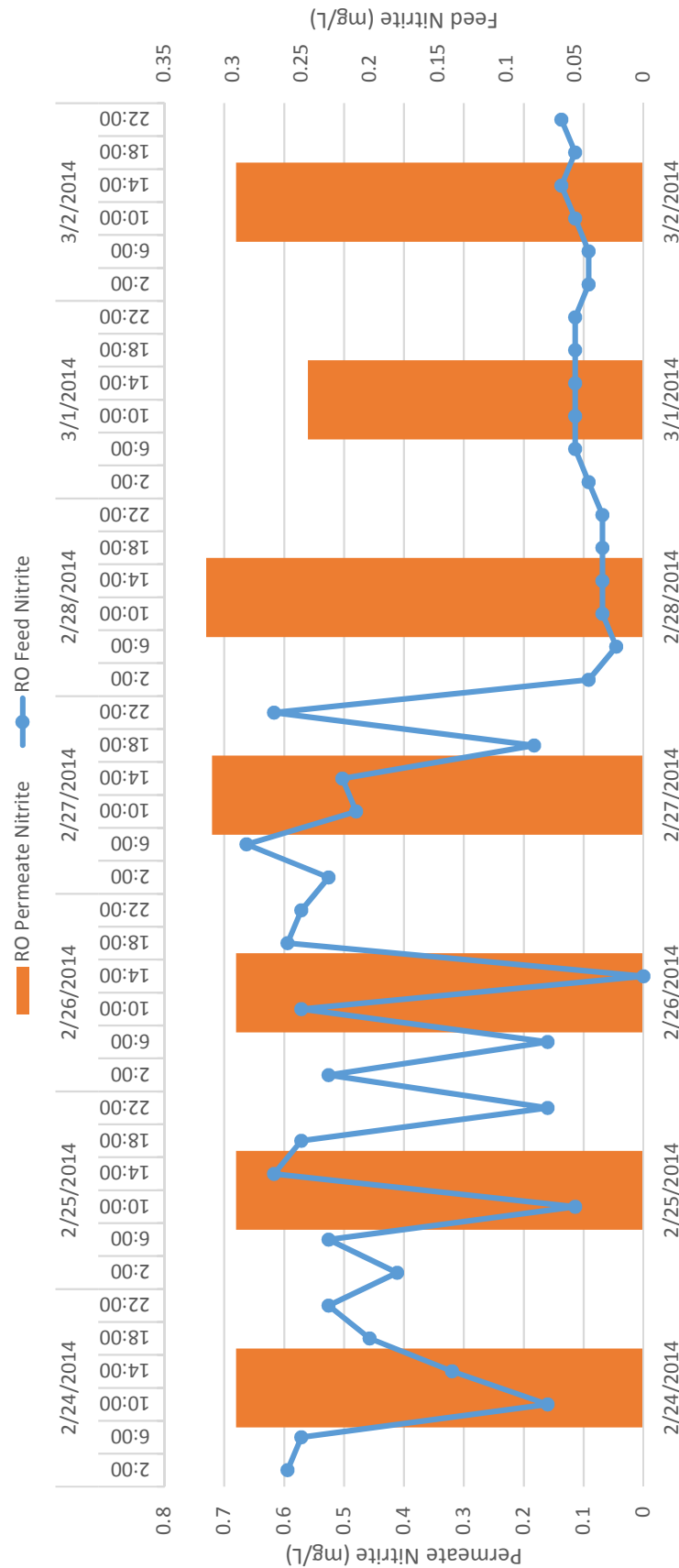
TCEQ-21J RO Nitrite Removal



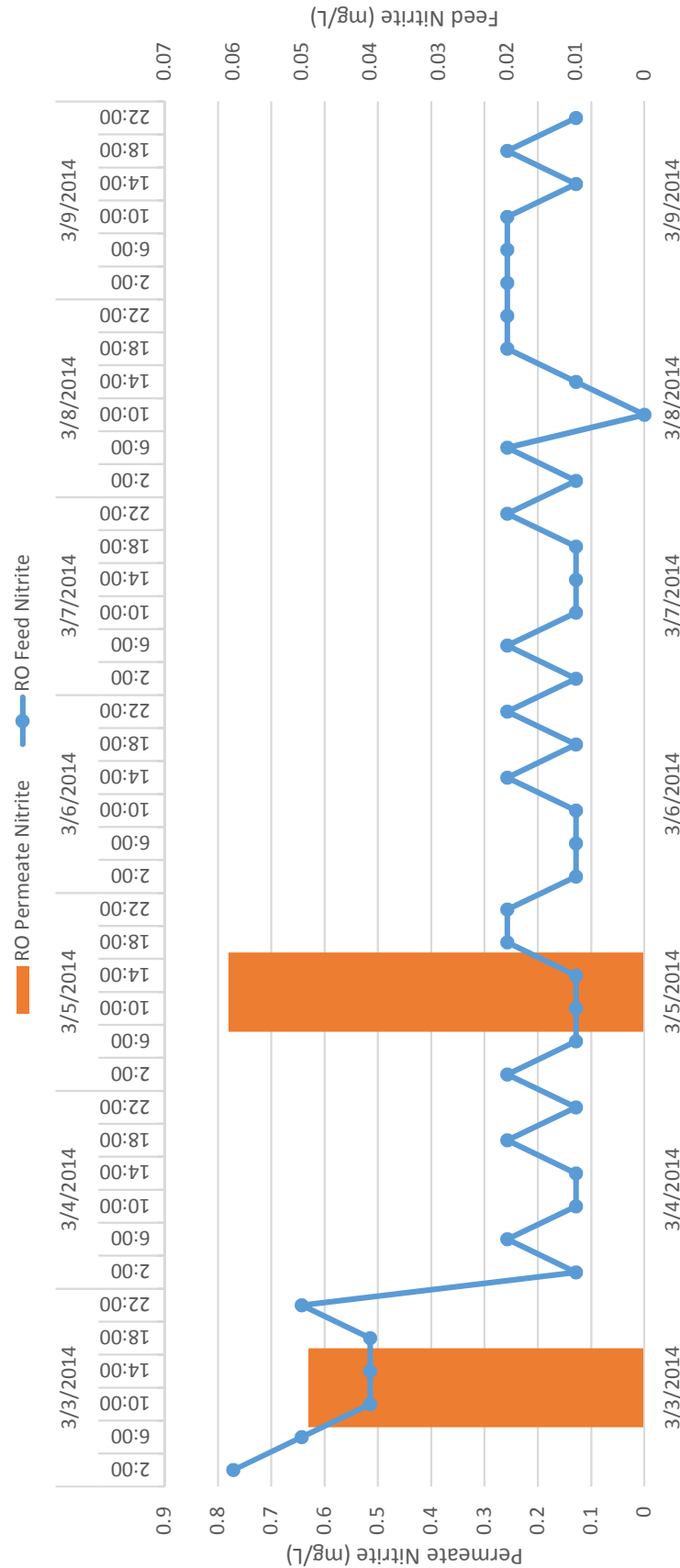
TCEQ-21J RO Nitrite Removal



TCEQ-21J RO Nitrite Removal



TCEQ-21J RO Nitrite Removal





TCEQ-21J: Calculated %-Removal

(based on RR WWTP effluent quality and the RO membrane unit's permeate quality prior to discharge to waste Lagoon 3)

Daily data

Date	TCEQ-21J			
	Nitrite Removal %	Nitrate Removal %	Sulfate LRV (RO Feed to Permeate)	TDS Removal %
1/27/2014	95.6	94.3	3.04	98.8
1/28/2014	95.3	92.2	1.98	98.9
1/29/2014	96.7	94.8	2.93	98.8
1/30/2014	95.5	94	2.14	98.8
1/31/2014	97.7	94.9	2.86	98.8
2/1/2014	97	92.8	2.72	98.7
2/2/2014	97.8	95.6	2.02	98.7
2/3/2014	98	94.2	2.86	98.6
2/4/2014	98.2	92.5	2.94	98.6
2/5/2014	98.3	94.4	3.17	98.7
2/6/2014	98.8	69	1.99	99
2/7/2014	98.4	95.4	2.26	98.6
2/8/2014	98.4	94.3	3.11	98.6
2/9/2014	98.6	92.7	3.3	98.7
2/10/2014	98.5	94.8	2.83	98.9
2/11/2014	98.6	93.4	2.45	98.9
2/12/2014	97.9	94	3.2	98.9
2/13/2014	97.9	94.4	3.13	98.8
2/14/2014	97.9	93.3	2.26	98.8
2/15/2014	97.7	93.9	2.16	98.7
2/16/2014	98.4	94.5	2.68	98.4
2/17/2014	99.5	94.1	2.95	99.2
2/18/2014	99.4	63	2.01	99.7
2/19/2014	98.3	92.4	2.91	98.9
2/20/2014	97.1	93.4	3.04	98.8
2/21/2014	97.5	93.8	2.36	98.7
2/22/2014	97.3	93.6	2.86	98.7
2/23/2014	97.8	94.4	2.93	98.7
2/24/2014	98.2	94.5	3.12	98.7
2/25/2014	97.8	93.5	3.12	98.7
2/26/2014	99.3	94.7	2.21	99

TCEQ-21J: Calculated %-Removal

(based on RR WWTP effluent quality and the RO membrane unit's permeate quality prior to discharge to waste Lagoon 3)

Daily data

Date	TCEQ-21J			
	Nitrite Removal %	Nitrate Removal %	Sulfate LRV (RO Feed to Permeate)	TDS Removal %
2/27/2014	98.8	95.3	2.48	98.8
2/28/2014	97.9	94.7	2.98	98.8
3/1/2014	97.5	93.8	3.04	98.7
3/2/2014	98	96	2.83	98.9
3/3/2014	98.4	96.2	3.09	98.7
3/4/2014	98.5	90.2	1.17	98.9
3/5/2014	98.3	99.7	1.26	98.8
3/6/2014	98.4	67.1	1.43	98.8
3/7/2014	98.7	87	1	99.1
3/8/2014	99.6	93.3	1.38	99.4
3/9/2014	99.5	71.9	1.41	99.3
3/10/2014	99.3	94.9	1.37	90.8
3/11/2014	98.3	95.2	1.36	99

TCEQ-21J: Calculated %-Removal

(based on RR WWTP effluent quality and the RO membrane unit's permeate quality prior to discharge to waste Lagoon 3)

Weekly data

TCEQ-21J						
	TOC % Removal	DOC on-site % Change	DOC off-site % Removal	TTHM % Increase	HAA5 % Removal	Bromide % Removal
Week 1						
	99.2		100	79.5	100	98.9
Week 2	98.8			89.4	100	96.1
			100			
Week 3	98.7	100	100	88.5	100	97.8
Week 4	98.7	99.05	100	90.5	100	98.1
Week 5	99.2	99.86				
	99.3	99.63	100	89.6	100	98.9

TCEQ-21J: Calculated %-Removal

(based on RR WWTP effluent quality and the RO membrane unit's permeate quality prior to discharge to waste Lagoon 3)

Weekly data

TCEQ-21J						
	TOC % Removal	DOC on-site % Change	DOC off-site % Removal	TTHM % Increase	HAA5 % Removal	Bromide % Removal
Week 6						
	98.8	99.71				
Week 7	98.7	99.59		100		
	99.1	100	100	100	100	99.2

TCEQ-21J: Calculated %-Removal

(based on RR WWTP effluent quality and the RO membrane unit's permeate quality prior to discharge to waste Lagoon 3)

Start, Day 30, End data

	Perchlorate (ug/L)	Arsenic (ug/L)	Barium (ug/L)	Cyanide (mg/L)	Fluoride (mg/L)	Selenium (ug/L)	Simazine (ug/L)	Aluminum (ug/L)	Chloride (mg/L)	Copper (ug/L)	Iron (mg/L)
% Removal	100	100	100	100	100	100	100	100	98.2	100	100

TCEQ-21J: Calculated %-Removal

(based on RR WWTP effluent quality and the RO membrane unit's permeate quality prior to discharge to waste Lagoon 3)
Start, Day 30, End data

	Radium 226 (pCi/L)	Uranium (UG/L)	Gross Beta Particle Activity (pCi/L)	Zinc (ug/L)
% Removal	100	100	100	100