



FLORIDA DEPARTMENT OF Environmental Protection

Bob Martinez Center
2600 Blair Stone Road
Tallahassee, FL 32399-2400 Bob Martinez Center

Ron DeSantis
Governor

Jeanette Nuñez
Lt. Governor

Shawn Hamilton
Secretary

Memorandum

TO: Michael Lynch, Director, Division of Water Resource Management
Elizabeth Orr, Director, Northwest District
Greg Strong, Director, Northeast District
Aaron Watkins, Director, Central District
Kelley Boatwright, Director, Southwest District
Jon Iglehart, Director, South District
Jason Andreotta, Director, Southeast District

FROM: Nia Wellendorf, Water Quality Standards Program *NW*

SUBJECT: Amended final order for statewide alternative method approval for reagent-less in-line chlorine meters

DATE: March 11, 2022

On December 8, 2020, the Division of Environmental Assessment and Restoration issued a Final Order, pursuant to Rule 62-160.220, Florida Administrative Code (F.A.C.), that approved as a statewide alternative method the use of certain reagent-less amperometric meters for continuous in-line residual chlorine measurements. This approval only applies to monitoring conducted to comply with continuous monitoring requirements in Rule 62-600.660 and Chapter 62-610, Florida Administrative Code (F.A.C.), at domestic wastewater facilities, except where reclaimed water is directly discharged to surface waters of the state or is intentionally used as drinking water supply or to augment a drinking water supply. That approval was specifically for in-line chlorine meters with an amperometric, 3-electrode sensor immersed in an electrolytic medium with a permeable membrane selective to chlorine. Since this approval, we have learned that amperometric sensors that are not immersed in an electrolytic solution and do not have a membrane represent the same essential technology and are as effective at monitoring chlorine. Therefore, we issued an Amended Final Order on March 9, 2022, for the alternative method approval to be inclusive of both varieties of meters. Because this is a statewide alternative method approval, these meters will be added to DEP-SOP-001/01 FT 2000, Field Measurement of Residual Chlorine, during the next rulemaking for Chapter 62-160, F.A.C. Data and analyses regarding comparability of these meters to the currently accepted meters are available upon request.

Basis of Approval of Statewide Alternative Method for Reagent-less In-line Chlorine Meters

*FDEP Aquatic Ecology and Quality Assurance Section
November 2020*

Introduction

Rule 62-600.660 and Chapter 62-610, Florida Administrative Code (F.A.C.), require domestic wastewater facilities to continuously monitor total residual chlorine of reclaimed water, and Chapter 62-160, F.A.C., requires that the meters must conform to the requirements in the Florida Department of Environmental Protection (DEP) SOPs. DEP SOP FT 2000 lists the types of meters that are approved for reading chlorine, and the only technology approved for continuous monitoring in domestic wastewater is a titrimetric method using an amperometric detector from Standard Methods 4500-Cl D (FT 2030). Standard Methods requires the use of reagents, even when the titration is performed by a meter and not by hand. Newer instruments can read chlorine directly, without reagents, but they are not yet approved for use in domestic wastewater.

Between 2015 and 2019, the DEP Aquatic Ecology and Quality Assurance Section (AEQAS) received alternative method approval requests from five domestic wastewater treatment facilities to allow the limited use of reagent-less amperometric meters at their individual facilities. DEP approved these individual requests, prompting the interest in a statewide alternative method approval.

This document describes the criteria and references used to evaluate reagent-less amperometric meters as a statewide alternative method and determine if approval is warranted, as required in Rule 62-160.220(4) and (6)(b), F.A.C. The bases for the approvals or disapprovals of alternative methods are described in DEP SOP FA 1000, subparts FA 2210 – FA 2230 (revision date, January 2017).

Scope of Approval

Reagent-less amperometric meters for continuous in-line residual chlorine measurements are approved for statewide use in accordance with the requirements of subparagraph 62-160.220(6)(b), F.A.C. This approval is limited to use of the meters for meeting the continuous monitoring requirements for reuse of reclaimed water in Rule 62-600.660 and Chapter 62-610, F.A.C. Use of the meters is not approved for monitoring of reclaimed water that is directly discharged to surface waters of the state or is intentionally used as a drinking water supply or to augment a drinking water supply.

Approval implementation

The associated final order of approval will be published in the Florida Administrative Register and shared via the Quality of Science E-Newsletter. It will also be available on DEP's website. Once this statewide alternative method is in full force and effect, use of the type of meter described in this document will be

allowed for reporting data to DEP in the circumstances described in the Scope of Approval. The elements of this approval will be incorporated into the next revision of DEP's SOPs (DEP-SOP-001/01, incorporated by reference in Rule 62-160.700(1)(a)).

Approval matrix

Alternative method procedures and data have only been evaluated by DEP for use of these meters by domestic wastewater treatment facilities (WWTFs) as part of their reclaimed water monitoring activities. Thus, the only approved matrix for reagent-less in-line chlorine meters is domestic wastewater, and the application is for monitoring of reclaimed water at domestic WWTFs for the portions reused. The approval does not apply to monitoring of reclaimed water that is discharged to surface waters of the state or is intentionally used as a drinking water supply or used to augment a drinking water supply.

Approval range

The department evaluated the use of these meters for a limited range of values. Therefore, the approved range for these meters is between 0.5 and 5 ppm.

Specific description of technology

This evaluation and approval applies to in-line chlorine meters that contain an amperometric, 3-electrode sensor immersed in an electrolytic medium with a permeable membrane that is selective to chlorine separating it from the sample. Chlorine passes through the membrane and reacts with the sensing electrode to generate a signal proportional to the chlorine concentration, which allows the meter to measure total or residual chlorine directly, without the need for chemical reagents. The sensor must be equipped with an automatic pH and temperature-compensating device.

Basis for Approval

AEQAS evaluated data from limited use alternative method approvals for five different domestic WWTFs to approve this state-wide limited use alternative method. The WWTFs used in this approval were the City of Oviedo Water Reclamation Facility (FLA011074), South Central Regional Wastewater Treatment Plant (FL0102679), City of Tavares Woodlea Wastewater Treatment Plant (FLA010509), Pennbrooke Wastewater Treatment Facility (FLA010509), and Lake Groves Wastewater Treatment Plant (FLA010630). Two in-line reagent-less meters, the Hach CL 10 Amperometric Chlorine Analyzer and the ATI Q46 Residual Chlorine Monitor, were proposed for alternative use by the WWTFs. Approved in-line meters used for comparison by the facilities included the HACH CL17 in-line and the Wallace and Tiernan 2000 analyzer. The data from these meters were compared to data produced with approved laboratory methods, Standard Methods 4500-CL G, or an approved handheld meter (HACH pocket colorimeter 2). The individual alternative method approval information for the listed facilities are available upon request.

Data Review Methods

AEQAS used criteria from DEP SOP FT 1900 and EPA Method 334.0 to determine whether results generated by the reagent-less amperometric in-line chlorine meters were comparable to the results generated from a grab sample analyzed by approved N,N-diethyl-p-phenylenediamine (DPD) colorimetric methods. DEP SOP FT 1900, which currently applies to in-line chlorine monitoring at WWTFs, requires that the in-line meter result be within 20 % of the grab sample result. EPA 334.0 requires that the in-line meter result be within ± 0.1 mg/L or 15 % of the grab result, whichever is

greater. While EPA 334.0 does not currently apply to WWTF monitoring, it serves as an appropriate example of the comparison of in-line and grab sample chlorine results.

Comparison Results

In total, there were 201 pairs of data from the five facilities. The department calculated the absolute difference between the approved DPD colorimetric method (grab samples) and the alternative method (amperometric meter), and compared them to 20 % and 15 % of the grab sample value to determine if the alternative method met criteria of DEP SOP 1900 and EPA 334.0, respectively. Ninety-six percent (194) of the data pairs met the 20 % criterion and 89 % (179) met the 15 % criterion. Results generated with approved methods were generally similar to results generated with the proposed alternative meters, without any apparent bias (Figure 1). The Hach CL 10 Amperometric Chlorine Analyzer and the ATI Q46 Residual Chlorine Monitor compared equally when reviewed against approved methods. The complete comparison dataset is provided in Appendix A.

Figure 1: Comparison Results from the Proposed Meters and Accepted Methods

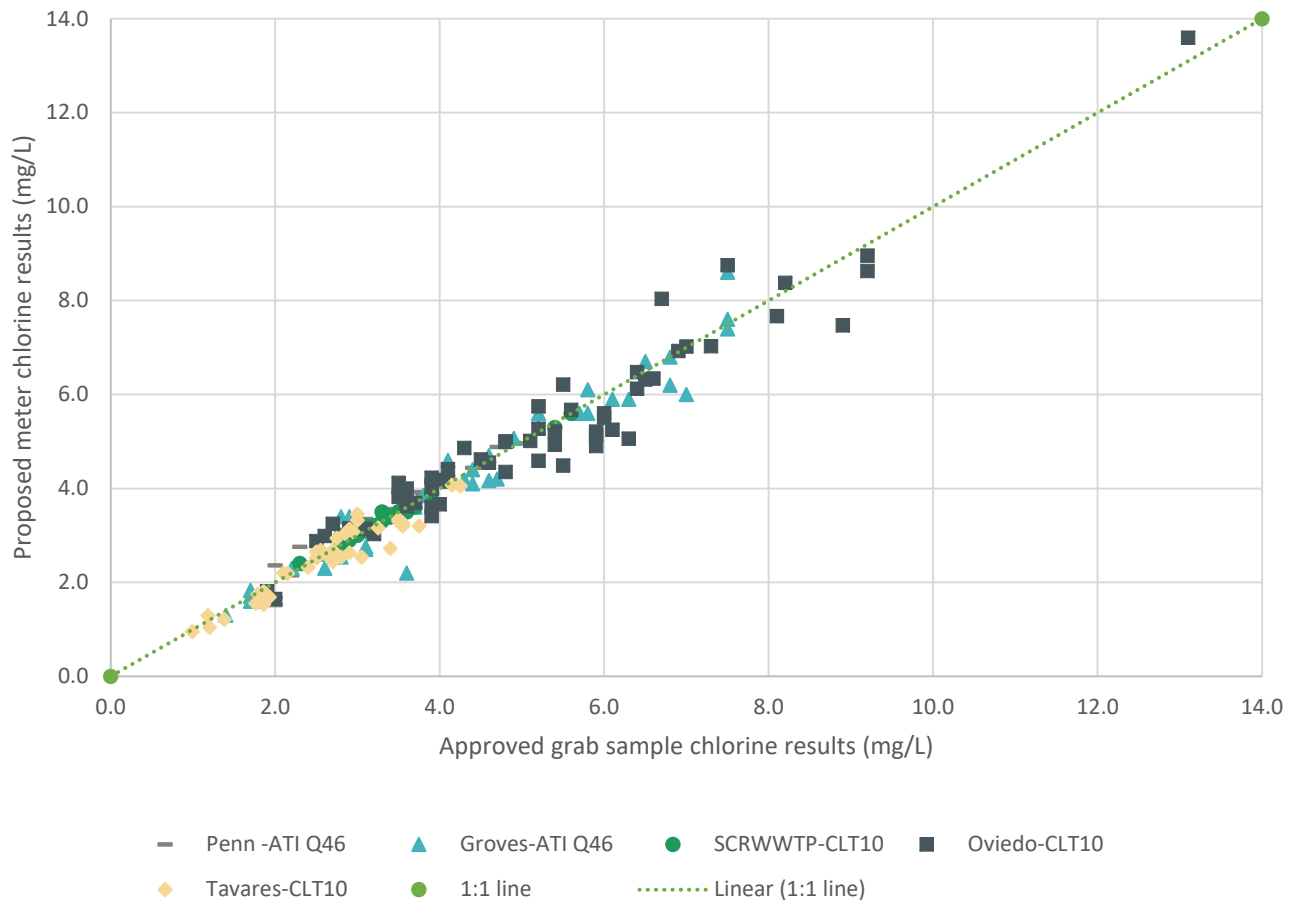


Figure 1. Results from approved DPD colorimetric grab samples compared to results from alternative reagent-less amperometric in-line chlorine meters. Points are labeled by WWTF name and meter name.

Minimum Specifications for Meter Use

Initial demonstration of capability

The initial demonstration of capability (IDC) for the use of an in-line chlorine meter at a given WWTF can be demonstrated using historical operating data if the meter demonstrates the following criterion is being met on an on-going basis: in-line chlorine meter result is within ± 0.1 mg/L or $\pm 15\%$ (whichever is larger) of the grab sample result. Historical data must show that the meter remains in agreement with the grab sample method over two consecutive weeks without meter maintenance or calibration adjustment.

If such historical data are not available, WWTF staff must conduct an IDC by comparing the concentration determined by the in-line chlorine meter with grab sample analyses collected at least

daily for 14 days, or 14 consecutive business days. During the 14-day period, grab samples collected should be representative of the range of concentrations expected at the facility.

The meter reading must be within ± 0.1 mg/L or ± 15 % (whichever is larger) of the grab sample measurement for each data pair. If this criterion is not met, staff should determine the source of the problem, take corrective action, and continue collecting daily grab samples. Once 14 days of consecutive data pairs meet the comparison criterion, the meter can be put into service for compliance monitoring.

After the IDC, DEP SOP FT 1900 must be followed for ongoing compliance monitoring.

Calibration and Verification Requirements

A 2-point initial calibration is required before use of new or refurbished sensors received from the factory, and whenever the sensor is disconnected from power or removed from water for more than 15 minutes. Samplers should check with the manufacturer to determine the details of performing a 2-point calibration for a specific instrument. A comparison grab sample must be taken immediately following initial calibration to verify equipment function. When taking a grab sample, ensure it is taken near or as near as possible to the same location as the in-line meter as described in FT 1900, section 2.2.

On a daily basis, samplers must measure a grab sample and compare the result to the in-line meter's reading as described in FT 1900, section 2.3. If the in-line meter fails to meet the acceptance criteria, then a 1-point calibration must be conducted. A 1-point calibration should be conducted on at least a monthly basis to ensure the meter's accuracy. Calibration frequency can be extended if it is documented the instrument is stable over a longer period of time.

A permit or program may require more frequent calibration. An instrument should be returned to the manufacturer for maintenance when consecutive or repeated failed verifications show the meter will no longer hold a calibration or a general mechanical failure occurs that cannot be corrected by the operator.

Maintenance requirements

Maintenance requirements vary depending on the meter. Check with the manufacturer to determine recommended maintenance for your meter. Examples of potential needed maintenance include, but are not limited to, polishing the electrode, replacing the membrane or membrane cap, and replacing the sensor.

Documentation

Record all relevant information specified in documentation sections of DEP SOPs FT 2000 section 5, FT 1900 section 5, and FD 4100.

Conclusions

From this data analysis, DEP has determined that the reagent-less amperometric in-line meter technology for measuring total residual chlorine is acceptable for reclaimed domestic wastewater if samplers follow the minimum specifications for meter use. Use of the meters is not approved for monitoring of reclaimed water that is discharged to surface waters of the state or is intentionally used as a drinking water supply or used to augment a drinking water supply, as described in the Scope of Approval section of this document.

References

Chapter 62-160.220(4), Florida Administrative Code F.A.C. (DEP. 4/16/2018). Sections 6b, 7b, and 8. Quality Assurance.

Chapter 62-610, Florida Administrative Code (F.A.C.). Reuse of Reclaimed Water and Land Application.

Florida Department of Environmental Protection. *Department of Environmental Protection Standard Operating Procedures for Field Activities, DEP-SOP-001/01* (Revision date, January 2017). FA1000, Subparts FA2210 - 2230. Florida Department of Environmental Protection, 2600 Blair Stone Road, MS 6511, Tallahassee, FL 32399.

Florida Department of Environmental Protection. *Department of Environmental Protection Standard Operating Procedures for Field Activities, DEP-SOP-001/01* (Revision date, January 2017). FT 1900 and FT2000, Subpart FT2030. Florida Department of Environmental Protection, 2600 Blair Stone Road, MS 6511, Tallahassee, FL 32399.

Rule 62-600.660, Florida Administrative Code (F.A.C.). Domestic Water Facilities.

Standard methods for the examination of water and wastewater, 23rd. Washington, DC, New York: American Public Health Association; 2017. 4500-CL G.

Wendelken, S. C., Losh, D.E., Fair, P.S. *EPA Method 334.0: Determination of Residual Chlorine in Drinking Water Using An On-Line Chlorine Analyzer, EPA 815-B-09-013* (September 2009). Office of Groundwater and Drinking Water. U.S. Environmental Protection Agency. Cincinnati, Ohio 45268.

Appendix A. Table of all data from WWTFs used for statistical comparison.

Table A1. City of Oviedo Water Reclamation Facility. DEP Facility ID FLA011074.

Oveido Data Points	CL10 In-line Result	Hach DR 3900result	CL17 In-line Result	Absolute Difference (CL 10 vs. Hach)	20 % grab sample	Is difference <20 %?	15 % grab sample	Is difference <15 %?	Is difference < 0.1 mg/L (if 15 % is < 0.1)
1	7.02	7.0	5.00	0.02	1.4	yes	1.05	yes	yes
2	6.34	6.6	5.00	0.26	1.32	yes	0.99	yes	no
3	7.67	8.1	5.00	0.43	1.62	yes	1.215	yes	no
4	13.60	13.1	5.00	0.5	2.62	yes	1.965	yes	no
5	3.15	2.9	2.73	0.25	0.58	yes	0.435	yes	no
6	3.25	2.7	2.62	0.55	0.54	no	0.405	no	no
7	5.27	5.2	4.64	0.07	1.04	yes	0.78	yes	yes
8	8.04	6.7	5.00	1.34	1.34	no	1.005	no	no
9	8.75	7.5	5.00	1.25	1.5	yes	1.125	no	no
10	6.12	6.4	5.00	0.28	1.28	yes	0.96	yes	no
11	6.93	6.9	5.00	0.03	1.38	yes	1.035	yes	yes
12	5.51	6.0	5.00	0.49	1.2	yes	0.9	yes	no
13	5.13	5.9	5.00	0.77	1.18	yes	0.885	yes	no
14	5.21	5.4	5.00	0.19	1.08	yes	0.81	yes	no
15	3.73	3.6	3.63	0.13	0.72	yes	0.54	yes	no
16	3.61	3.9	3.90	0.29	0.78	yes	0.585	yes	no
17	3.82	3.5	4.19	0.32	0.7	yes	0.525	yes	no
18	4.93	5.4	5.00	0.47	1.08	yes	0.81	yes	no
19	4.90	5.9	5.00	1	1.18	yes	0.885	no	no
20	4.62	4.5	5.00	0.12	0.9	yes	0.675	yes	no
21	5.25	6.1	5.00	0.85	1.22	yes	0.915	yes	no
22	4.15	4.1	4.42	0.05	0.82	yes	0.615	yes	yes
23	4.12	3.5	4.26	0.62	0.7	yes	0.525	no	no
24	4.41	4.1	4.30	0.31	0.82	yes	0.615	yes	no
25	4.55	4.6	4.15	0.05	0.92	yes	0.69	yes	yes
26	5.21	5.9	5.00	0.69	1.18	yes	0.885	yes	no
27	5.60	6.0	5.00	0.4	1.2	yes	0.9	yes	no
28	4.35	4.8	4.65	0.45	0.96	yes	0.72	yes	no
29	4.00	3.6	4.04	0.4	0.72	yes	0.54	yes	no
30	3.99	3.9	4.20	0.09	0.78	yes	0.585	yes	yes
31	2.88	2.5	2.98	0.38	0.5	yes	0.375	no	no
32	5.01	5.10	5.00	0.09	1.02	yes	0.765	yes	yes
33	3.14	3.10	3.69	0.04	0.62	yes	0.465	yes	yes
34	1.65	2.00	2.21	0.35	0.4	yes	0.3	no	no
35	1.81	1.90	2.23	0.09	0.38	yes	0.285	yes	yes

36	3.66	4.00	4.03	0.34	0.8	yes	0.6	yes	no
37	3.41	3.90	4.26	0.49	0.78	yes	0.585	yes	no
38	2.99	2.60	3.01	0.39	0.52	yes	0.39	no	no
39	4.49	5.50	5.00	1.01	1.1	yes	0.825	no	no
40	4.23	3.90	3.69	0.33	0.78	yes	0.585	yes	no
41	8.38	8.20	5.00	0.18	1.64	yes	1.23	yes	no
42	8.96	9.20	5.00	0.24	1.84	yes	1.38	yes	no
43	7.47	8.90	5.00	1.43	1.78	yes	1.335	no	no
44	7.03	7.30	5.00	0.27	1.46	yes	1.095	yes	no
45	6.21	5.50	5.00	0.71	1.1	yes	0.825	yes	no
46	5.67	5.60	5.00	0.07	1.12	yes	0.84	yes	yes
47	5.75	5.20	5.00	0.55	1.04	yes	0.78	yes	no
48	5.00	4.80	5.00	0.2	0.96	yes	0.72	yes	no
49	6.32	6.50	5.00	0.18	1.3	yes	0.975	yes	no
50	5.00	4.80	4.95	0.2	0.96	yes	0.72	yes	no
51	3.03	3.20	2.97	0.17	0.64	yes	0.48	yes	no
52	3.62	3.60	3.62	0.02	0.72	yes	0.54	yes	yes
53	4.86	4.30	5.00	0.56	0.86	yes	0.645	yes	no
54	4.18	4.00	4.11	0.18	0.8	yes	0.6	yes	no
55	4.59	5.20	4.92	0.61	1.04	yes	0.78	yes	no
56	5.06	6.30	5.00	1.24	1.26	yes	0.945	no	no
57	8.63	9.20	5.00	0.57	1.84	yes	1.38	yes	no
58	6.48	6.40	5.00	0.08	1.28	yes	0.96	yes	yes
59	3.69	3.70	5.00	0.01	0.74	yes	0.555	yes	yes

*Table A2. South Central Regional Wastewater Treatment Plant & Disposal Board.
DEP Facility ID FL0102679.*

SCRWWTP Data Points	CL10 In-line Result	Hach Colorimeter Result	Wallace & Tiernan 2000 In- line Result	Absolute Difference (CL10 vs. Hach)	20 % grab sample	Is difference <20 %?	15 % grab sample	Is difference <15 %?	Is difference < 0.1 mg/L (if 15 % is < 0.1)
1	3.0	3.0	3.0	0	0.6	yes	0.45	yes	yes
2	2.9	2.8	2.9	0.1	0.56	yes	0.42	yes	no
3	2.9	2.8	2.9	0.1	0.56	yes	0.42	yes	no
4	3.3	3.3	3.5	0	0.66	yes	0.495	yes	yes
5	2.4	2.3	2.6	0.1	0.46	yes	0.345	yes	no
6	2.8	2.8	3.0	0	0.56	yes	0.42	yes	yes
7	3.5	3.3	3.4	0.2	0.66	yes	0.495	yes	no
8	2.9	2.9	2.8	0	0.58	yes	0.435	yes	yes
9	3.4	3.4	3.4	0	0.68	yes	0.51	yes	yes
10	3.1	3.1	3.0	0	0.62	yes	0.465	yes	yes
11	5.6	5.6	5.6	0	1.12	yes	0.84	yes	yes
12	3.0	2.8	2.7	0.2	0.56	yes	0.42	yes	no
13	3.2	3.1	2.9	0.1	0.62	yes	0.465	yes	no
14	3.2	3.2	3.2	0	0.64	yes	0.48	yes	yes
15	3.9	3.9	4.0	0	0.78	yes	0.585	yes	yes
16	3.0	2.9	2.8	0.1	0.58	yes	0.435	yes	no
17	5.3	5.4	5.5	0.1	1.08	yes	0.81	yes	no
18	3.5	3.5	3.3	0	0.7	yes	0.525	yes	yes
19	3.4	3.4	3.5	0	0.68	yes	0.51	yes	yes
20	3.2	3.1	3.0	0.1	0.62	yes	0.465	yes	no
21	3.2	3.2	2.9	0	0.64	yes	0.48	yes	yes
22	3.6	3.7	3.5	0.1	0.74	yes	0.555	yes	no
23	3.0	2.9	2.5	0.1	0.58	yes	0.435	yes	no
24	3.1	3.1	3.7	0	0.62	yes	0.465	yes	yes
25	3.5	3.5	3.0	0	0.7	yes	0.525	yes	yes
26	3.5	3.6	3.5	0.1	0.72	yes	0.54	yes	no
27	3.1	3.0	2.8	0.1	0.6	yes	0.45	yes	no
28	3.1	3.0	2.9	0.1	0.6	yes	0.45	yes	no
29	3.4	3.4	3.4	0	0.68	yes	0.51	yes	yes
30	3.5	3.5	3.3	0	0.7	yes	0.525	yes	yes
31	3.6	3.6	3.8	0	0.72	yes	0.54	yes	yes

Table A3. City of Tavares Woodlea Wastewater Treatment Plant. DEP Facility ID FLA010509.

Tavares Data Points	CL10 In-line Result	Lab TRC: SM 4500-CL-G	CL17 In-line Result	Absolute Difference (CL10 vs. Lab)	20 % grab sample	Is difference <20 %?	15 % grab sample	Is difference <15 %?	Is difference < 0.1 mg/L (if 15 % is < 0.1)
1	1.55	1.76	1.88	0.21	0.352	yes	0.264	yes	no
2	1.04	1.20	1.23	0.16	0.24	yes	0.18	yes	no
3	2.54	3.05	2.83	0.51	0.61	yes	0.4575	no	no
4	2.68	2.55	2.42	0.13	0.51	yes	0.3825	yes	no
5	1.69	1.93	1.90	0.24	0.386	yes	0.2895	yes	no
6	1.80	1.86	2.01	0.06	0.372	yes	0.279	yes	yes
7	4.05	4.25	4.06	0.2	0.85	yes	0.6375	yes	no
8	2.68	2.70	2.76	0.02	0.54	yes	0.405	yes	yes
9	2.72	3.40	3.05	0.68	0.68	no	0.51	no	no
10	3.20	3.55	3.05	0.35	0.71	yes	0.5325	yes	no
11	3.20	3.75	3.12	0.55	0.75	yes	0.5625	yes	no
12	2.94	2.75	2.87	0.19	0.55	yes	0.4125	yes	no
13	3.45	3.00	3.00	0.45	0.6	yes	0.45	no	no
14	3.08	2.95	2.97	0.13	0.59	yes	0.4425	yes	no
15	3.32	3.00	2.94	0.32	0.6	yes	0.45	yes	no
16	3.16	3.25	3.08	0.09	0.65	yes	0.4875	yes	yes
17	3.13	2.90	3.19	0.23	0.58	yes	0.435	yes	no
18	4.07	4.15	4.04	0.08	0.83	yes	0.6225	yes	yes
19	1.21	1.38	1.45	0.17	0.276	yes	0.207	yes	no
20	2.44	2.70	2.34	0.26	0.54	yes	0.405	yes	no
21	2.32	2.40	2.23	0.08	0.48	yes	0.36	yes	yes
22	3.30	3.50	3.26	0.2	0.7	yes	0.525	yes	no
23	2.19	2.15	2.35	0.04	0.43	yes	0.3225	yes	yes
24	1.29	1.18	1.26	0.11	0.236	yes	0.177	yes	no
25	2.65	2.50	2.63	0.15	0.5	yes	0.375	yes	no
26	2.20	2.10	2.27	0.1	0.42	yes	0.315	yes	no
27	1.53	1.86	1.73	0.33	0.372	yes	0.279	no	no
28	2.54	2.80	2.63	0.26	0.56	yes	0.42	yes	no
29	2.54	2.65	2.52	0.11	0.53	yes	0.3975	yes	no
30	0.95	0.99	0.98	0.04	0.198	yes	0.1485	yes	yes
31	1.75	1.89	1.80	0.14	0.378	yes	0.2835	yes	no
32	1.75	1.79	1.76	0.04	0.358	yes	0.2685	yes	yes
33	2.52	2.50	2.29	0.02	0.5	yes	0.375	yes	yes
34	3.04	2.85	2.90	0.19	0.57	yes	0.4275	yes	no
35	3.34	3.50	3.38	0.16	0.7	yes	0.525	yes	no

36	1.76	1.85	1.89	0.09	0.37	yes	0.2775	yes	yes
37	3.26	3.55	3.26	0.29	0.71	yes	0.5325	yes	no
38	2.63	2.90	2.74	0.27	0.58	yes	0.435	yes	no

Table A4. Pennbrooke Wastewater Treatment Facility. DEP Facility ID FLA010570.

Pennbrooke Data Points	Q46 In-line Result	Hach 2 Result	CL17 In-line Result	Absolute Difference (Q46 vs. Hach)	20 % grab sample	Is difference <20 %?	15 % grab sample	Is difference <15 %?	Is difference < 0.1 mg/L (if 15 % is < 0.1)
1	4.88	4.8	5.00	0.08	0.96	yes	0.72	yes	yes
2	4.96	5	5.00	0.04	1	yes	0.75	yes	yes
3	4.44	4.5	5.00	0.06	0.9	yes	0.675	yes	yes
4	4.89	4.8	5.00	0.09	0.96	yes	0.72	yes	yes
5	4.91	4.8	5.00	0.11	0.96	yes	0.72	yes	no
6	4.88	4.7	3.46	0.18	0.94	yes	0.705	yes	no
7	4.44	4.4	3.48	0.04	0.88	yes	0.66	yes	yes
8	4.17	3.9	3.84	0.27	0.78	yes	0.585	yes	no
9	4.15	4	3.57	0.15	0.8	yes	0.6	yes	no
10	3.85	3.8	3.56	0.05	0.76	yes	0.57	yes	yes
11	3.92	3.7	4.3	0.22	0.74	yes	0.555	yes	no
12	3.91	3.8	4.62	0.11	0.76	yes	0.57	yes	no
13	3.84	3.8	3.51	0.04	0.76	yes	0.57	yes	yes
14	3.66	3.6	3.55	0.06	0.72	yes	0.54	yes	yes
15	3.75	3.7	3.48	0.05	0.74	yes	0.555	yes	yes
16	3.65	3.6	3.84	0.05	0.72	yes	0.54	yes	yes
17	3.64	3.6	4.1	0.04	0.72	yes	0.54	yes	yes
18	3.81	3.6	4.4	0.21	0.72	yes	0.54	yes	no
19	3.71	3.6	3.56	0.11	0.72	yes	0.54	yes	no
20	3.52	3.5	3.72	0.02	0.7	yes	0.525	yes	yes
21	3.71	3.6	3.88	0.11	0.72	yes	0.54	yes	no
22	3.56	3.4	3.62	0.16	0.68	yes	0.51	yes	no
23	3.35	3.1	3.71	0.25	0.62	yes	0.465	yes	no
24	3.91	3.5	3.64	0.41	0.7	yes	0.525	yes	no
25	3.11	3	3.80	0.11	0.6	yes	0.45	yes	no
26	2.15	2.2	1.94	0.05	0.44	yes	0.33	yes	yes
27	1.68	2	2.65	0.32	0.4	yes	0.3	no	no
28	2.36	2	2.42	0.36	0.4	yes	0.3	no	no
29	2.76	2.3	2.25	0.46	0.46	no	0.345	no	no
30	1.52	2	2.50	0.48	0.4	no	0.3	no	no

Table A5. Lake Groves Wastewater Treatment Plan. DEP Facility ID FLA010630.

Lake Groves Data Points	Q46 In-line Result	HACH 2 Result	CL17 In-line Result	Absolute Difference (Q46 vs. Hach)	20 % grab sample	Is difference <20 %?	15 % grab sample	Is difference <15 %?	Is difference < 0.1 mg/L (if 15 % is < 0.1)
1	2.3	2.2	2.3	0.1	0.44	yes	0.33	yes	yes
2	6.1	5.8	5.0	0.3	1.16	yes	0.87	yes	no
3	8.6	7.5	5.0	1.1	1.5	yes	1.125	yes	no
4	6.7	6.5	5.0	0.2	1.3	yes	0.975	yes	no
5	5.9	6.1	5.0	0.2	1.22	yes	0.915	yes	no
6	2.4	2.3	2.5	0.1	0.46	yes	0.345	yes	no
7	1.7	1.9	2.2	0.2	0.38	yes	0.285	yes	no
8	1.6	1.8	2.0	0.2	0.36	yes	0.27	yes	no
9	2.3	2.6	2.7	0.3	0.52	yes	0.39	yes	no
10	4.7	4.6	4.6	0.1	0.92	yes	0.69	yes	no
11	5.6	5.2	5.0	0.4	1.04	yes	0.78	yes	no
12	2.6	2.6	2.9	0	0.52	yes	0.39	yes	yes
13	1.3	1.4	1.5	0.1	0.28	yes	0.21	yes	yes
14	6.8	6.8	5.0	0	1.36	yes	1.02	yes	yes
15	5.9	6.3	5.0	0.4	1.26	yes	0.945	yes	no
16	6.2	6.8	5.0	0.6	1.36	yes	1.02	yes	no
17	5.6	5.8	5.0	0.2	1.16	yes	0.87	yes	no
18	2.2	3.6	3.6	1.4	0.72	no	0.54	no	no
19	3.4	2.9	3.3	0.5	0.58	yes	0.435	no	no
20	5.3	5.2	5.0	0.1	1.04	yes	0.78	yes	yes
21	4.4	4.4	4.9	0	0.88	yes	0.66	yes	yes
22	3.6	3.7	4.4	0.1	0.74	yes	0.555	yes	no
23	7.6	7.5	5.0	0.1	1.5	yes	1.125	yes	yes
24	5.6	5.7	5.0	0.1	1.14	yes	0.855	yes	no
25	2.7	3.1	3.7	0.4	0.62	yes	0.465	yes	no
26	6.0	7.0	5.0	1	1.4	yes	1.05	yes	no
27	7.4	7.5	5.0	0.1	1.5	yes	1.125	yes	yes
28	1.6	1.7	2.0	0.1	0.34	yes	0.255	yes	yes
29	1.7	1.7	2.0	0	0.34	yes	0.255	yes	yes
30	2.9	2.8	3.3	0.1	0.56	yes	0.42	yes	no
31	3.4	2.8	3.0	0.6	0.56	no	0.42	no	no
32	4.6	4.1	5.0	0.5	0.82	yes	0.615	yes	no
33	1.83	1.7	2.3	0.13	0.34	yes	0.255	yes	no
34	1.80	1.9	2.3	0.1	0.38	yes	0.285	yes	yes

35	2.54	2.8	3.1	0.26	0.56	yes	0.42	yes	no
36	2.76	3.1	3.4	0.34	0.62	yes	0.465	yes	no
37	4.18	4.3	5.0	0.12	0.86	yes	0.645	yes	no
38	4.17	4.6	5.0	0.43	0.92	yes	0.69	yes	no
39	4.10	4.4	5.0	0.3	0.88	yes	0.66	yes	no
40	4.2	4.7	5.0	0.5	0.94	yes	0.705	yes	no
41	5.07	4.9	5.0	0.17	0.98	yes	0.735	yes	no
42	3.85	3.8	4.3	0.05	0.76	yes	0.57	yes	yes
43	3.11	2.9	3.3	0.21	0.58	yes	0.435	yes	no