EVALUATION OF REGIONAL DISSOLVED OXYGEN PATTERNS OF WADEABLE STREAMS IN TENNESSEE BASED ON DIURNAL AND DAYLIGHT MONITORING

Tennessee Department of Environment and Conservation
Division of Water Pollution Control
7th Floor L&C Annex
401 Church Street
Nashville, TN 37243-1534

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by

Deborah H. Arnwine

Gregory M. Denton

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401 Church Street
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EXECUTIVE SUMMARY

The amount of dissolved oxygen (DO) present in a stream is critical to aquatic life. Most fish and aquatic macroinvertebrates cannot obtain oxygen directly from the air and are dependent on an adequate level of oxygen dissolved in the water to survive. Oxygen gets in the water by surface air diffusion, aeration from turbulence and the photosynthesis of aquatic plants and algae. Oxygen is depleted by natural functions such as respiration and decomposition. Pollutants such as organic wastes and fertilizers can accelerate the rate of oxygen depletion.

The existing numeric dissolved oxygen criterion for non-trout streams statewide is 5 parts per million (ppm), also expressed in milligrams per liter (mg/l) with exceptions to 3 ppm for some streams. Trout streams have a more stringent criterion of 6 ppm while naturally producing trout streams must maintain a DO of 8 ppm.

According to the 2002 303(d) assessment process, 11 percent of impaired streams in Tennessee are impaired due (all or in part) to low dissolved oxygen. This includes 100 streams (949.4 stream miles) in 29 watersheds. Over half of the state's watersheds have at least 1 low DO stream. Streams assessed as impaired due to organic enrichment or nutrients, pollutants that generally affect DO levels, were not included if sufficient DO data were not available to confirm low DO levels.

An earlier study conducted by WPC, the ecoregion delineation project, divided Tennessee into 25 geographic areas called ecological subregions. Each of these subregions is a relatively homogenous area defined by similarity of climate, landform, soil, natural vegetation, hydrology and other ecological relevant variables. Reference streams, documented to represent least-impacted conditions, were identified in each of the subregions. From 1996 to 1999, these streams were intensively surveyed for multiple physical, biological, and chemical constituents including dissolved oxygen. Review of data from these reference streams indicated that, in some regions, DO levels were commonly below 5 mg/L. However, in some other regions, levels rarely fell below 8 mg/L. Clearly, in some areas of the state, the statewide DO criterion was arguably overly-protective, while in others, perhaps under-protective.

In 2000, the Division initiated a probabilistic monitoring project in subecoregion 71i (Inner Nashville Basin). During low flow conditions, several streams had less than 5 mg/L DO, yet maintained biological integrity.

One problem with only using existing reference data to determine regional dissolved oxygen requirements is they were all obtained during daylight hours when DO levels are likely at their highest due to photosynthesis by aquatic plants and algae. Continuous monitoring probes reveal a definite fluctuation of dissolved oxygen within a 24-hour period with nighttime levels lower than daytime levels. Monitoring conducted only during daylight hours may miss significant decreases in dissolved oxygen in impaired streams.

During an earlier study, division staff experimented with the use of specialized DO probes that provided continuous monitoring for multiple days. These investigations indicated that simple excursions of DO levels below 5 mg/L were only part of the overall picture. The magnitude of diurnal swings (highest versus lowest observations each day), plus the frequency that the DO levels violate the criterion, also appeared to be significant factors in use support.

Based on these initial results, division staff decided to investigate diurnal DO levels at both reference streams and test sites selected on the basis of a previous assessment of water quality impairment due to low DO.

The primary purpose of this study was to investigate natural diurnal fluctuations of dissolved oxygen levels in 15 major ecological subregions in Tennessee. Historic daylight readings were used to supplement this information and to evaluate dissolved oxygen patterns in the other 9 subregions. This study was funded, in part, by a FY 2002 104(b)(3) grant (CP-97449702-0).

Diurnal data in conjunction with multiple daylight readings suggest that dissolved oxygen levels can be grouped by ecological subregion into 5 categories with the largest areas (92%) grouped in either group b or c (see below).

a. One ecological subregion (2% of state) where the lowest reference dissolved oxygen levels frequently reached 3 ppm with no apparent detrimental affect to the biota as long as the percent saturation was maintained at or above 30 percent.

b. Ten ecological subregions (30% of state) where minimum reference dissolved oxygen levels generally stayed above 5 ppm.

c. Ten ecological subregions (62% of state) where the minimum reference dissolved oxygen levels typically stayed above 6 ppm.

d. Three ecological regions (5% of state) where the minimum reference dissolved oxygen typically stayed above 7 ppm.

e. One ecological subregion (1% of state) where the minimum dissolved oxygen level was typically above 8 ppm.

The data obtained from this study provide an initial assessment of minimum dissolved oxygen levels and the magnitude of diurnal swings. They also provided preliminary information on how long (duration) and how often (frequency) dissolved oxygen can fall below these minimum levels and still support aquatic life. Additional diurnal monitoring will need to be conducted before duration and frequency questions can be answered with confidence.

1. INTRODUCTION

According to the 2002 303(d) assessment process, 11 percent of the impaired streams in Tennessee are impaired due (all or in part) to low dissolved oxygen. This includes 100 streams (949.4 stream miles) in 29 watersheds. Streams assessed as impaired due to organic enrichment or nutrients, pollutants that generally affect DO levels, were not included if data were not available to confirm low DO levels. Therefore, the percentage of streams impacted by low DO may be much higher. The existing numeric dissolved oxygen criterion for most streams is statewide (5 ppm with exceptions to 3 ppm).

An earlier study conducted by WPC, the ecoregion delineation project, divided Tennessee into 25 geographic areas called ecological subregions. Each of these subregions is a relatively homogenous area defined by similarity of climate, landform, soil, natural vegetation, hydrology and other ecological relevant variables. Reference streams, documented to represent least-impacted conditions, were identified in each of the subregions. From 1996 to 1999, these streams were intensively surveyed for multiple physical, biological, and chemical constituents, including dissolved oxygen.

Review of these data from reference streams indicated that in some regions, DO levels were commonly below 5 mg/L. However, in some other regions, levels rarely fell below 8 mg/L. Clearly, in some areas of the state, the statewide DO criterion was arguably overly-protective, while in others, perhaps under-protective.

DO studies continued in 2000 as part of a probabilistic monitoring study of subecoregion 71i. Results from this project as well as preliminary investigations using continuous monitoring probes in 2001, indicated that diurnal monitoring at reference streams could be used to identify patterns of daily DO fluctuations.

The primary purpose of this study was to investigate natural diurnal fluctuations of dissolved oxygen levels in 15 major ecological subregions in Tennessee. The intent was to identify the magnitude of diurnal swings, the duration of DO violations of the statewide criterion (if any), and the frequency of such violations. Historic daylight readings were used to supplement this information and to evaluate dissolved oxygen requirements in the other 9 subregions.

This study was funded, in part, by a FY 2002 104(b)(3) grant (CP-97449702-0). This report was written in partial fulfillment of the conditions of that grant.

Study results will help guide fish and aquatic life criteria decisions for the 2002 triennial review of water quality standards.

It is important for the reader to note that the work undertaken for this project is specific to wadeable streams. Any results or conclusions contained within the report have limited application to other waterbody types, such as large, nonwadeable streams, lakes and wetlands.

1.0 Factors Affecting the Amount of Dissolved Oxygen in Streams

The amount of dissolved oxygen (DO) present in a stream is critical to aquatic life. Most fish and aquatic macroinvertebrates cannot obtain oxygen directly from the air and are dependent on oxygen dissolved in the water to survive. Oxygen gets in the water by surface air diffusion, aeration from turbulence and the photosynthesis of aquatic plants and algae (Figure 1). Oxygen is depleted by both natural functions and pollution.

1.0.0 Natural Factors That Increase or Decrease Stream Oxygen Levels.

Many natural variables affect the dissolved oxygen concentration of a stream including:

a. *Algae and aquatic plants*. Oxygen is produced during photosynthesis and consumed during respiration and decomposition. Because it requires light, photosynthesis occurs only during daylight hours. At night, photosynthesis cannot counterbalance the loss of oxygen through respiration and decomposition so DO concentrations decline. Turbidity or cloud cover also decreases photosynthesis by blocking sunlight. In streams with an abundance of algae, diurnal oxygen shifts can be dramatic.

b. *Flow patterns*. Dissolved oxygen concentrations increase wherever the water flow becomes turbulent. Oxygen concentrations are much higher in air, which is approximately 21 percent oxygen, than in water, which is less than 1 percent oxygen. This difference causes oxygen molecules in air to dissolve in water until saturation is reached. More oxygen dissolves in water when turbulence caused by rocky bottoms, waterfalls, steep gradients or rapid flow brings more water into contact with the surface.

c. *Water temperature*. Cold water can hold more oxygen than can warm water. During daylight hours, especially in summer months, streams are warmer, limiting the amount of oxygen that can be dissolved in the water before saturation is reached. The lower water levels during summer also affect temperature as shallow water is heated up faster.

d. *Barometric pressure*. Decreasing barometric pressure can release oxygen out of solution. This effect is also accomplished with increasing altitude. Water at higher elevations is under less pressure and contains less dissolved oxygen. However, in higher elevations streams in Tennessee, this factor appears completely offset by the lower temperatures, increased turbulence and general absence of algae in mountain streams.

e. *Groundwater.* Surface streams may be influenced by groundwater, which is generally low in dissolved oxygen. Streams influenced by subterranean inputs may have naturally low DO levels.

1.0.1 Pollution and Depletion of Dissolved Oxygen

Pollution can cause a general decrease in stream oxygen concentrations. Depletion of dissolved oxygen can cause major shifts in the kinds of aquatic organisms found in streams. Species that cannot tolerate low levels of dissolved oxygen such as trout, darters, mayflies and stoneflies are replaced by tolerant organisms such as carp, green sunfish, midge larvae and aquatic worms.

a. *Organic Wastes:* One of the main conditions resulting in low dissolved oxygen is the buildup of organic wastes, substances that were once part of a living plant or animal. Common sources of organic wastes entering streams include inadequately treated sewage, urban runoff, crop runoff, dairies, feed lots and industrial sources such as food processing plants.

b. *Fertilizers:* Fertilizer runoff from lawns and crops in storm-water stimulate the growth of algae and aquatic plants. As the plants die, aerobic bacteria consume oxygen in the process of decomposition.

c. *Impoundments:* Many dams release water from the bottom of the reservoir where dissolved oxygen levels can be near zero due to a lack of light penetration and the decomposition of settled organic matter. Unless the water is adequately aerated in the forebay, the part of the reservoir next to the dam, the water just below the dam, or tailwater, can have depressed oxygen levels. It may take several miles before DO levels reach the water quality standard.

1.1 Percent Saturation and the Availability of Oxygen

The percent of oxygen saturation is an important component in determining whether there is an adequate supply of oxygen available to support a healthy aquatic community. Percent saturation is the measured DO divided by the maximum amount of oxygen the water can hold multiplied by 100. The percent saturation is affected by:

a. *Temperature* – Like all gases, oxygen is more soluble at lower temperatures. The colder the water the more oxygen it can hold.

b. *Elevation/Atmospheric Pressure* – The higher the air pressure the more oxygen it can hold. Water at sea level can hold more oxygen than water on top of a mountain.

Because the same dissolved oxygen reading can indicate a different percent saturation depending on such factors as temperature and elevation, it is important to look at both the dissolved oxygen and the percent saturation.

Although a minimum level of dissolved oxygen is necessary to support the aquatic community, high levels can also be dangerous. Super-saturated water, with saturation levels at or above 110% can cause a condition known as gas bubble trauma resulting in fish death. Macroinvertebrates are also known to be affected by super-saturated water, but most research has been conducted on fish.

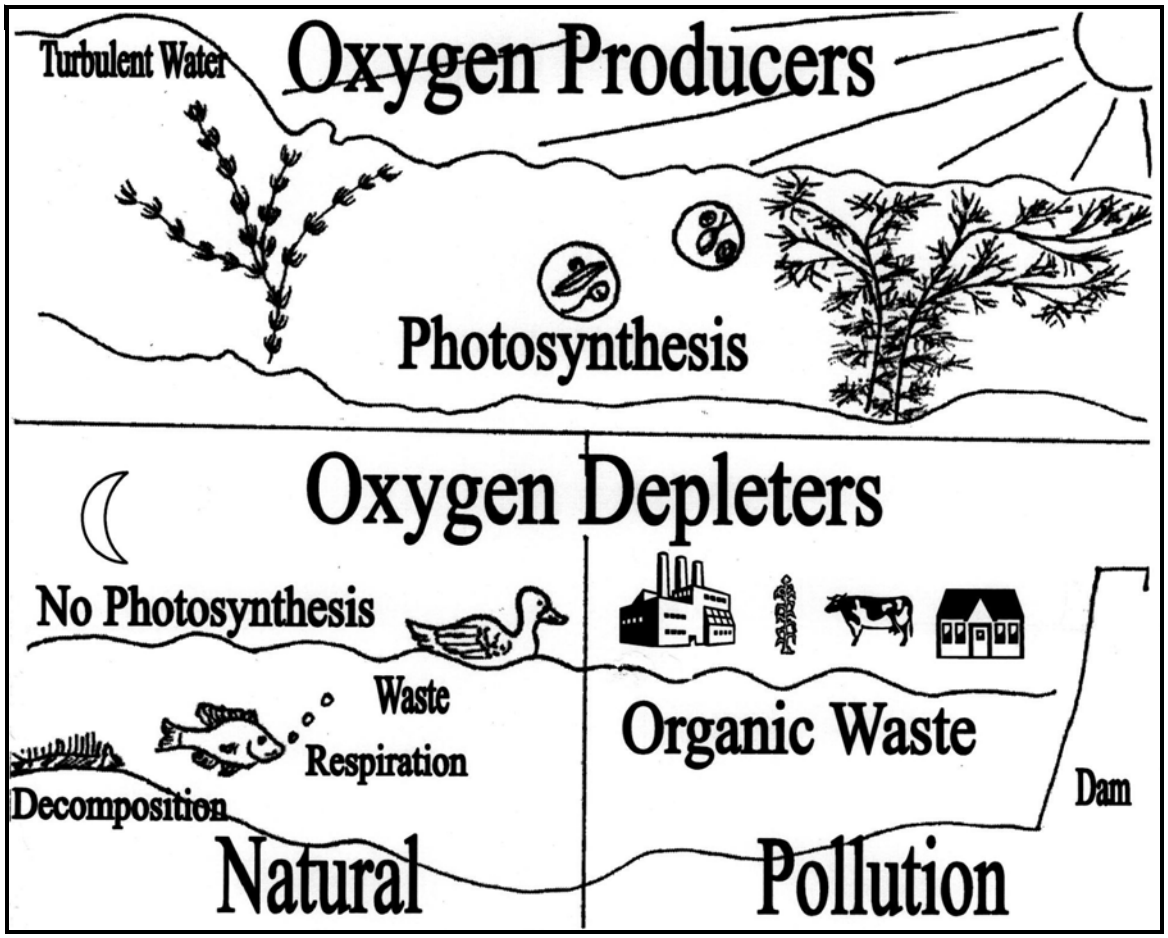


Diagram designed by Kim Sparks, WPC, TDEC

Figure 1: Factors affecting the dissolved oxygen variation in streams.

1.2 Dissolved Oxygen Criteria

Tennessee's current fish and aquatic life protection criterion for dissolved oxygen has not been revised since 1977. The criterion states that the minimum acceptable dissolved oxygen level in most streams is 5 mg/l (or ppm), although DO can drop as low as 3 mg/l. DO requirements in trout streams and naturally reproducing trout streams are 6 and 8 mg/l, respectively.

A review of dissolved oxygen data from ecoregion reference streams indicates that these criteria may be overly-protective in some cases, particularly in the Mississippi Alluvial Plain where animals are adapted to the naturally low dissolved oxygen levels in the sluggish organically-rich streams. On the other hand, the existing criteria may not be fully protective of fish and aquatic life in wadeable streams in other regions where the minimum DO levels in reference streams are consistently well above 5 mg/l.

One problem with using existing ecoregion reference data is they were all recorded during daylight hours when dissolved oxygen levels tend to be at their highest. Diurnal data indicate that regional criteria taking into account the natural fluctuations of dissolved oxygen would be more appropriate.

2. DATA COLLECTION

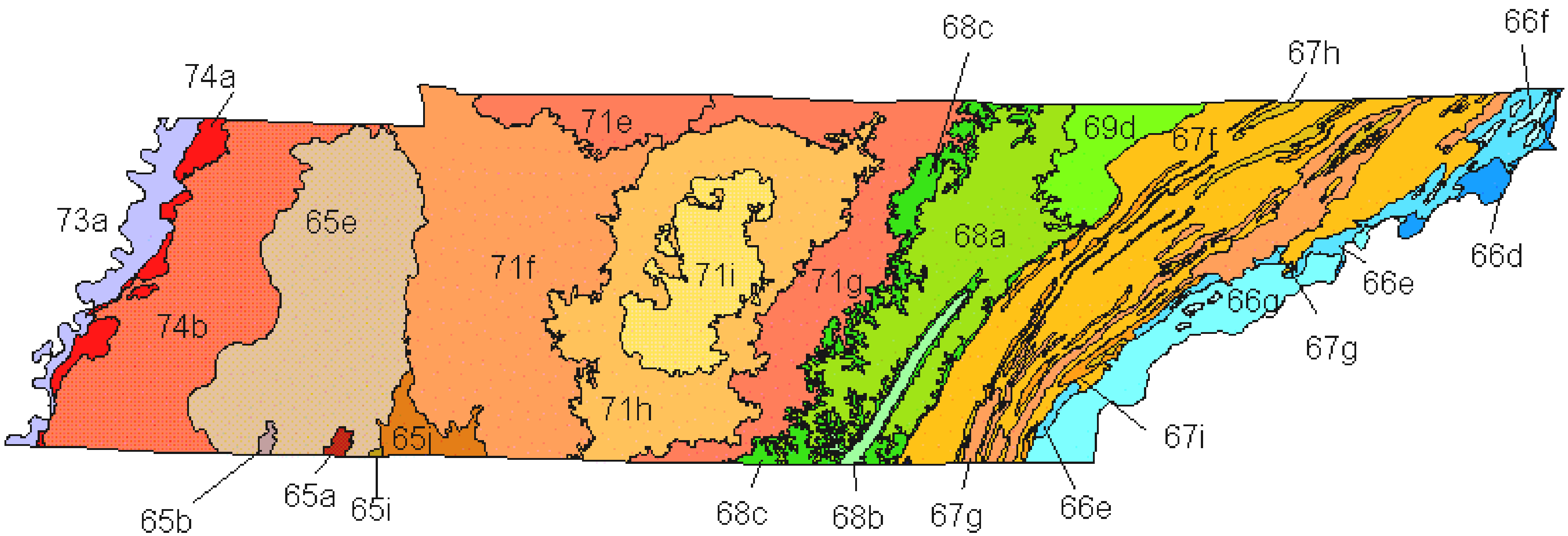
A method was needed for comparing the existing conditions found in any given stream to relatively unimpaired streams. This "reference condition" needed to be established within a similar area to avoid inappropriate comparisons. Ecoregions appeared to be the best geographic basis upon which to make this assessment. An ecoregion is a relatively homogenous area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology and other ecologically relevant variables.

In order to delineate ecoregions and isolate reference streams, the Division of Water Pollution Control initiated the Tennessee ecoregion project that began in 1993 and concluded in 1999. Details of that project, including delineation of ecoregion boundaries, descriptions of subregions, reference stream selection and monitoring protocols as well as data summaries can be found in the *Tennessee Ecoregion Project* (Arnwine et al, 2000).

After delineation, 25 ecological subregions were established in Tennessee. A map illustrating the current ecological subregion boundaries in Tennessee is presented in Figure 2.

It should be noted that recent ecoregion delineation projects conducted in surrounding states (Kentucky, North Carolina and Georgia) have resulted in the addition of 3 more Tennessee subregions. The Broad Basins (66j) in the Copper Basin area, the Pleistocene Valley Trains (73d) in Dyer County and the Cumberland Mountain Thrust Block (69e) in the eastern portion of the Central Appalachians.

Additionally, two subregion names have been changed, the Cumberland Mountains (69d) are now the Dissected Appalachian Plateau and the Northern Mississippi Alluvial Plain (73a) is now the Holocene Meander Belts. For the purpose of this study, the original 25 subregions and the already established names as presented in Figure 2 were used. The new subregions will be added once the boundary lines in Tennessee are confirmed and reference streams in these regions are established.



65a Blackland Prairie
65b Flatwoods/Alluvial Prairie Margins
65e Southeastern Plains and Hills
65i Fall Line Hills
65j Transition Hills
66d Southern Igneous Ridges and Mtns
66e Southern Sedimentary Ridges
66f Limestone Valleys and Coves
66g Southern Metasedimentary Mtns.

67f Southern Limestone/Dolomite Valleys and Low Rolling Hills
67g Southern Shale Valleys
67h Southern Sandstone Ridges
67i Southern Dissected Ridges & Knobs
68a Cumberland Plateau
68b Sequatchie Valley
68c Plateau Escarpment
69d Cumberland Mountains

71e Western Pennyroyal Karst
71f Western Highland Rim
71g Eastern Highland Rim
71h Outer Nashville Basin
71i Inner Nashville Basin
73a Northern Mississippi Alluvial Plain
74a Bluff Hills
74b Loess Plains

Figure 2: Ecological subregions of Tennessee

2.0 Reference Stream Selection

Three hundred and fifty-three potential reference sites in 25 subregions were evaluated as part of the ecoregion project. The reference sites were chosen to represent the best attainable conditions for all streams with similar characteristics in a given subregion. Reference condition represented a set of expectations for physical habitat, general water quality and the health of the biological communities in the absence of human disturbance and pollution.

Selection criteria for reference sites included least impairment and representativeness. Streams that did not flow across subregions were targeted so the distinctive characteristics of each subregion could be identified. Experienced water quality staff screened each candidate reference stream. Potential sites were rated regarding how well they met the following criteria:

a. The entire upstream watershed was contained within the ecological subregion.

b. The upstream watershed was mostly or completely forested (if forest was the natural vegetation type) or had a typical land use.

c. The geologic structure and soil pattern was typical of the region.

d. The upstream watershed did not contain a municipality, mining area, permitted discharger or any other obvious potential source(s) of pollutants, including non-regulated sources.

e. The upstream watershed was not heavily impacted by nonpoint source pollution.

f. The stream flowed in its natural channel and had not been recently channelized. There were no flow or water level modification structures such as dams, irrigation canals or field drains.

g. No power or pipelines crossed upstream of the site.

h. The upstream watershed contained few roads.

By the end of the project, 98 reference streams were selected for monitoring. Each subregion had between 1 and 8 reference streams with most having at least 3. The final number of reference streams per subregion depended on the size of the region and the availability of relatively non-impaired streams.

2.1 Dissolved Oxygen Monitoring

2.1.0 Daylight Dissolved Oxygen Monitoring

Reference dissolved oxygen readings were taken during daylight hours as part of the ecoregion project. After an initial reading in 1995 as part of the screening process, seasonal monitoring of the reference sites began fall 1996 and ended summer 1999. Since then, monitoring has followed the 5-year watershed cycle. The reference DO database included 1,135 readings recorded seasonally from 98 reference streams from 1995 to 2002 (Figure 3). A table identifying each reference site is in Appendix A.

Test data came from 4,082 readings at 837 sites representing all 25 ecoregions (Figure 4). These data were collected as part of ambient monitoring, watershed monitoring, and special studies. The data were collected from 1996 to 2002 and included both impaired and non-impaired sites. A list of the test streams is provided in Appendix B.

2.1.1 Diurnal Dissolved Oxygen Monitoring

As part of this 2002 study, continuous monitoring dissolved oxygen and temperature probes were deployed at 49 reference streams and 40 test sites in 15 ecological subregions (Figure 5 and Table 1). All test sites had been assessed as impaired due to organic enrichment and/or low dissolved oxygen according to the 2002 303(d) assessment process. The original study design was to monitor 144 streams, but 23 reference streams and 32 test streams lacked sufficient depth and/or flow. The probes must be completely submerged, which requires a minimum stream depth of 6 inches.

Probes were installed during the late summer and early fall (Late July through October) when dissolved oxygen levels should be at their lowest due to high temperatures and low flows. Each site was monitored for approximately 168 hours (7 days) with readings recorded every 30 minutes. Graphs of the diurnal data from all monitored reference and test sites are provided in Appendix C.

2.1.2 Quality Assurance

Daylight dissolved oxygen readings were taken with either calibrated Hydrolab or YSI multiparameter probes by trained field staff. Duplicate readings were taken at a minimum of 10 percent of the sites.

Stevens/Greenspan Model CS304 multi-parameter probes were used for diurnal monitoring. The accuracy of the dissolved oxygen probe was +/- 0.2 ppm. The probes were factory calibrated with pre and post calibration checks performed on each probe. Two probes were set simultaneously at 10 percent of the diurnal continuous monitoring sites.

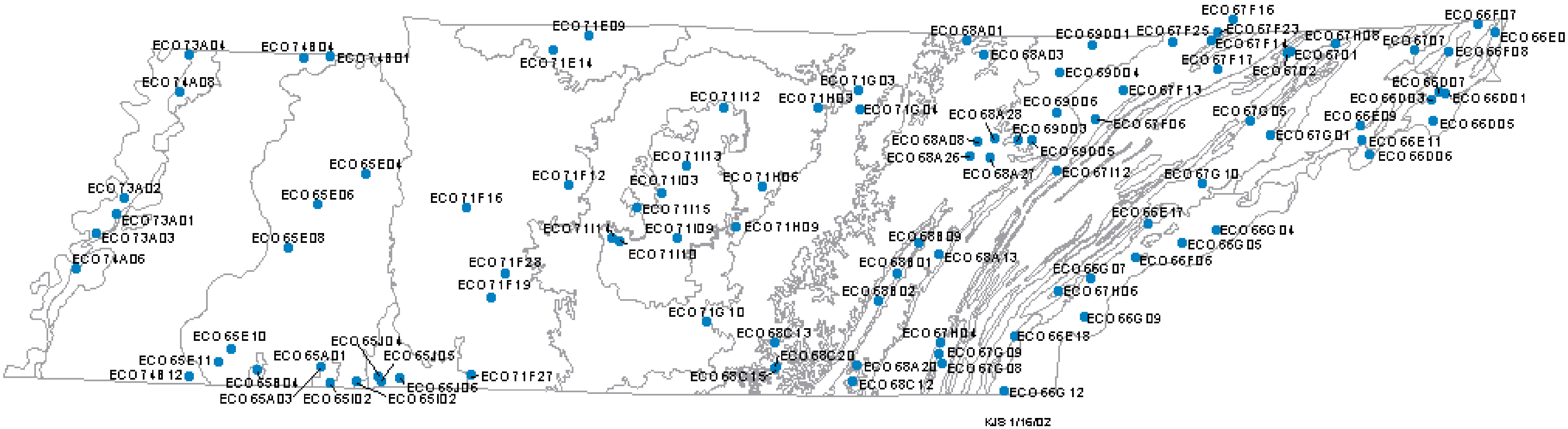


Figure 3: Location of ecoregion reference sites (1995-2002)

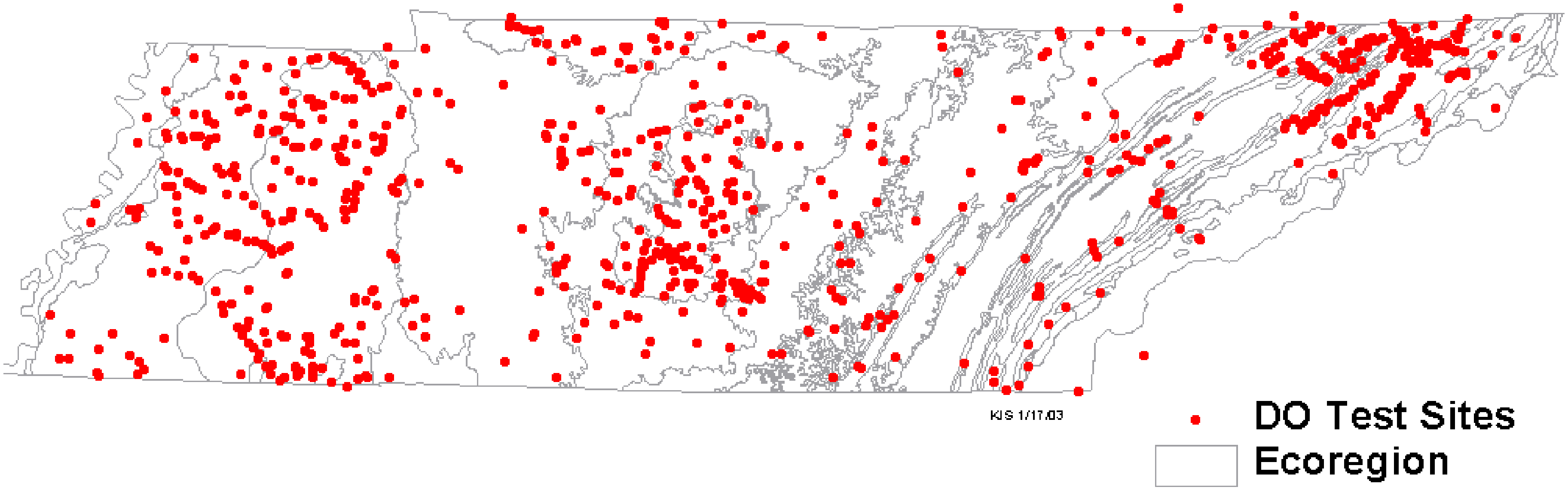


Figure 4: Location of daylight dissolved oxygen test sites (1996 – 2002). Does not include 60 additional test sites that did not have latitude and longitude information. Sites not included were in ecoregions 65b, 65e, 67f, 67g, 68a, 68c, 69d, 71f, 71g, 71h, 71i, 74a and 74b.

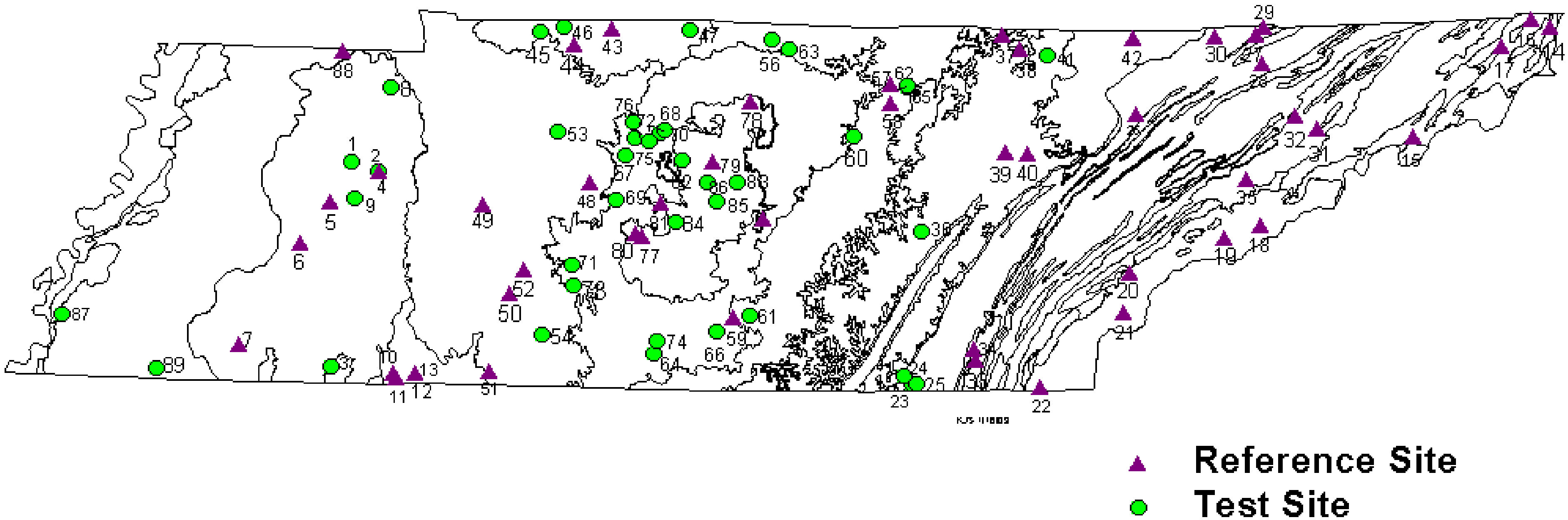


Figure 5: Location of reference sites and test sites where diurnal monitoring was conducted (August – October, 2002).

Table 1: Diurnal study site list

MAP	ECO	STATION ID	STREAM	COUNTY	TYPE
1	65e	BEAVE005.5CR	Beaver Creek	Carroll	Test
2	65e	BSAND036.4CR	Big Sandy River	Carroll	Test
3	65e	CLEAR001.2CR	Clear Creek	Carroll	Test
4	65e	ECO65E04	Blunt Creek	Carroll	Reference
5	65e	ECO65E06	Griffen Creek	Carroll	Reference
6	65e	ECO65E08	Harris Creek	Madison	Reference
7	65e	ECO65E10	Marshall Creek	Hardeman	Reference
8	65e	HFORK004.0HN	Holly Fork Creek	Henry	Test
9	65e	MUD004.7CR	Mud Creek	Carroll	Test
10	65j	ECO65J04	Pompeys Branch	Hardin	Reference
11	65j	ECO65J05	Dry Creek	Hardin	Reference
12	65j	ECO65J06	Right Fork Whites Creek	Hardin	Reference
13	65j	ECO65J11	Unnamed Trib Rt Fk Whites Cr.	Hardin	Reference
14	66e	ECO66E04	Gentry Creek	Johnson	Reference
15	66e	ECO66E11	Lower Higgens Creek	Unicoi	Reference
16	66f	ECO66F07	Beaverdam Creek	Johnson	Reference
17	66f	ECO66F08	Stoney Creek	Carter	Reference
18	66g	ECO66G04	Middle Prong Little Pigeon River	Sevier	Reference
19	66g	ECO66G05	Little River	Sevier	Reference
20	66g	ECO66G07	Citico Creek	Monroe	Reference
21	66g	ECO66G09	North River	Monroe	Reference
22	66g	ECO66G12	Sheeds Creek	Polk	Reference
23	67f	CHATT000.9HM	Chattanooga Creek	Hamilton	Test
24	67f	CITIC000.3HM	Citico Creek	Hamilton	Test
25	67f	DOBBS000.3HM	Dobbs Branch	Hamilton	Test
26	67f	ECO67F06	Clear Creek	Anderson	Reference
27	67f	ECO67F14	Powell River	Hancock	Reference
28	67f	ECO67F17	Big War Creek	Hancock	Reference
29	67f	ECO67F23	Martin Creek	Hancock	Reference
30	67f	ECO67F25	Powell River	Claiborne	Reference
31	67g	ECO67G01	Little Chucky Creek	Greene	Reference
32	67g	ECO67G05	Bent Creek	Hamblen	Reference
33	67g	ECO67G08	Brymer Creek	Bradley	Reference
34	67g	ECO67G09	Harris Creek	Bradley	Reference
35	67g	ECO67G10	Flat Creek	Sevier	Reference
36	68a	BRADD000.2BL	Bradden Creek	Bledsoe	Test

Table 1: Diurnal study site list cont.

MAP	ECO	STATION ID	STREAM	COUNTY	TYPE
37	68a	ECO68A01	Rock Creek	Morgan	Reference
38	68a	ECO68A03	Laurel Fork Station Camp Cr.	Scott	Reference
39	68a	ECO68A26	Daddys Creek	Cumberland	Reference
40	68a	ECO68A27	Island Creek	Morgan	Reference
41	68a	PINE006.0SC	Pine Creek	Scott	Test
42	69d	ECO69D01	No Business Branch	Campbell	Reference
43	71e	ECO71E09	Buzzard Creek	Robertson	Reference
44	71e	ECO71E14	Passenger Creek	Montgomery	Reference
45	71e	LWEST003.0MT	Little West Fork	Montgomery	Test
46	71e	SPRIN009.8MT	Spring Creek	Montgomery	Test
47	71e	SUMME008.6SR	Summers Branch	Sumner	Test
48	71f	ECO71F12	South Harpeth Creek	Williamson	Reference
49	71f	ECO71F16	Wolf Creek	Hickman	Reference
50	71f	ECO71F19	Brush Creek	Lewis	Reference
51	71f	ECO71F27	Swanegan Branch	Wayne	Reference
52	71f	ECO71F28	Little Swan Creek	Lewis	Reference
53	71f	JONES014.4DI	Jones Creek	Dickson	Test
54	71f	SHOAL055.4LW	Shoal Creek	Lawrence	Test
55	71g	CARR003.6OV	Carr Creek	Overton	Test
56	71g	CLEAR001.1CE	Clear Branch	Coffee	Test
57	71g	ECO71G03	Flat Creek	Overton	Reference
58	71g	ECO71G04	Spring Creek	Overton	Reference
59	71g	ECO71G10	Hurricane Creek	Moore	Reference
60	71g	MLICK014.7PU	Mine Lick Creek	Putnam	Test
61	71g	ROCK009.3FR	Rock Creek	Franklin	Test
62	71g	TOWN000.9OV	Town Creek	Overton	Test
63	71g	TOWN001.1MA	Town Creek	Macon	Test
64	71h	BROWN000.4DA	Browns Creek	Davidson	Test
65	71h	ECO71H09	Carson Creek	Cannon	Reference
66	71h	EFMUL010.4MR	East Fork Mulberry Creek	Moore	Test
67	71h	LHARP001.8WI	Little Harpeth River	Williamson	Test
68	71h	MILL003.3DA	Mill Creek	Davidson	Test
69	71h	RATTL000.2WI	Rattlesnake Branch	Williamson	Test
70	71h	SIMS000.8DA	Sims Branch	Davidson	Test
71	71h	SUGAF002.4MY	Sugar Fork	Maury	Test
72	71h	SUGAR000.1DA	Sugartree Creek	Davidson	Test

Table 1: Diurnal study site list cont.

MAP	ECO	STATION ID	STREAM	COUNTY	TYPE
73	71h	SUGAR000.2MY	Sugar Creek	Maury	Test
74	71h	SWAN008.0LI	Swan Creek	Lincoln	Test
75	71h	WFBRO000.1DA	West Fork Browns Creek	Davidson	Test
76	71h	WHITE000.7DA	Whites Creek	Davidson	Test
77	71i	ECO71I10	Flat Creek	Marshall	Reference
78	71i	ECO71I12	Cedar Creek	Wilson	Reference
79	71i	ECO71I13	Fall Creek	Rutherford	Reference
80	71i	ECO71I14	Little Flat Creek	Maury	Reference
81	71i	ECO71I15	Harpeth River	Williamson	Reference
82	71i	HURRI004.2RU	Hurricane Creek	Rutherford	Test
83	71i	JARMA000.3RU	Jarman Branch	Rutherford	Test
84	71i	KELLY000.4RU	Kelley Creek	Rutherford	Test
85	71i	LYTLE1T0.1RU	Unnamed trib to Lytle Creek	Rutherford	Test
86	71i	WFSTO008.3RU	West Fork Stones River	Rutherford	Test
87	74b	BIG1C1.0SH	Big Creek	Shelby	Test
88	74b	ECO74B01	Terrapin Creek	Henry	Reference
89	74b	STOUT000.4FA	Stout Creek	Fayette	Test

* Number in first column (MAP) refers to station location in Figure 4.

When possible, diurnal dissolved oxygen probes were set in areas with limited canopy so that diurnal swings associated with algal growth would be apparent and temperature fluctuations would be more pronounced. Data provided by the Jackson EAC staff from the Harris Creek reference site in the Southeastern Plains and Hills (65e) showed no difference between diurnal dissolved oxygen readings in canopied versus open areas of the same stream reach (Figures 6 and 7). However, the non-canopied area was in an extremely small reach of the stream and may not accurately reflect streams with larger open areas. Comparison data were not available for other regions of the state.

For the purpose of this report, monitoring sites are identified as either

a. Reference Sites – Refers to all ecoregion reference sites (both diurnal and daylight monitoring)

b. Test Sites – Refers to sites assessed as impaired due to low DO where diurnal DO readings were taken as part of the 2002 study.

c. Non-reference Sites – Refers to sites, except for ecoregion reference sites, where daylight dissolved oxygen data were available. Includes both impaired and non-impaired streams.

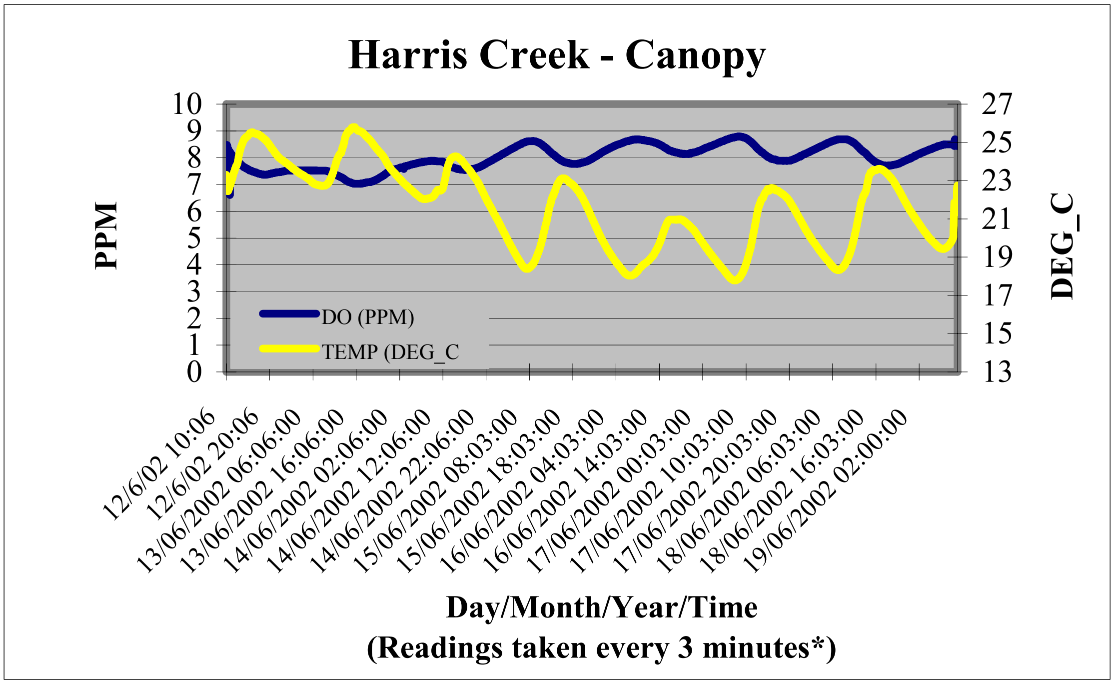


Figure 6: Diurnal dissolved oxygen and temperature data from a canopied area at the Harris Creek reference site, Southeastern Plains and Hills (65e).

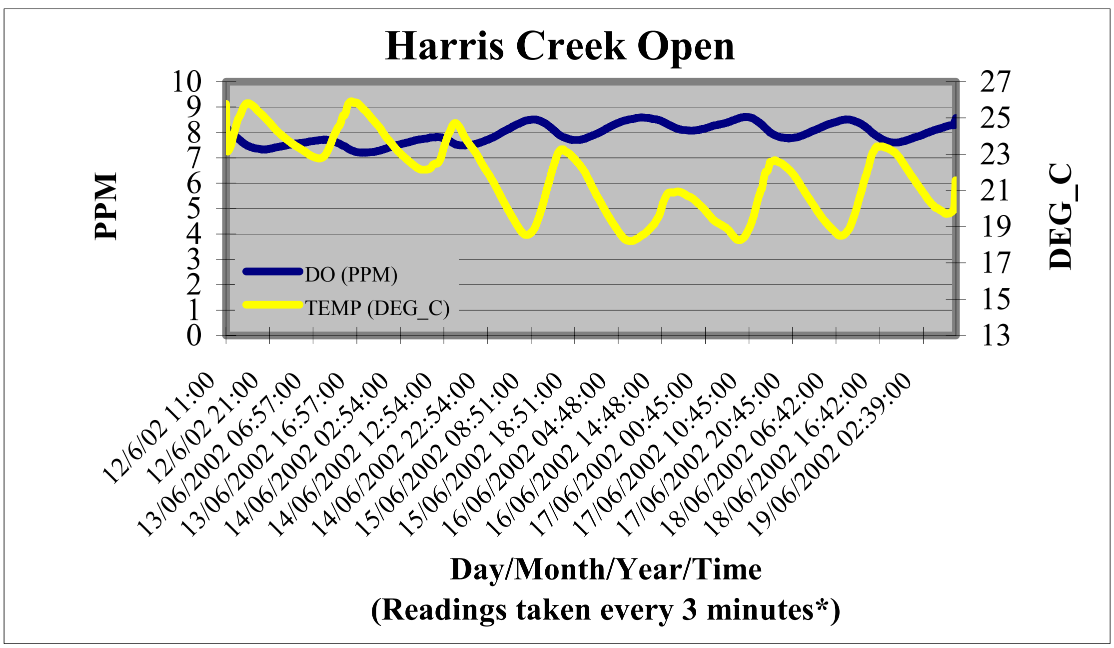


Figure 7: Diurnal dissolved oxygen and temperature data from an open area at the Harris Creek reference site, Southeastern Plains and Hills (65e).

* Readings taken every 3 minutes instead of every 30 minutes as in the August – October 2002 diurnal study.

2.2 Water Temperature

As mentioned previously, water temperature is an important determinant of dissolved oxygen levels. For the diurnal study, probes were deployed in July through October in an attempt to monitor DO patterns during the months with highest temperatures and lowest flows. Dissolved oxygen would be expected to have the lowest levels during this period. Water temperature was recorded every 30 minutes concurrent with dissolved oxygen readings.

Since the diurnal study was only conducted during a single low flow season (2002), there was some concern that this might not represent the maximum water temperatures that could occur in each region during an extremely hot year. In order to help characterize the low flow conditions in 2002, water temperatures at each reference site were compared to temperatures recorded during daylight readings taken between July and October from 1995 to 2002 (Table 2).

It should be noted that diurnal temperatures include nighttime lows while daylight monitoring were conducted between 7 am and 7 pm.

Table 2: Comparison of water temperatures recorded at ecoregion reference sites. Diurnal readings taken July–October 2002, daylight readings taken July–October, 1995-2002. Temperatures measurements are in degrees centigrade.

Ecoregion	Diurnal Study (24 hours)			Daylight Monitoring (7 am – 7 pm)				
	Min. Temp.	Max. Temp.	No. Sites	Min. Temp.	Max. Temp.	Mean Temp.	No. Sites	No. Readings
65e	15.48	24.97	4	12.15	24.58	19.68	5	28
65j	16.88	25.49	4	17.42	24.80	20.57	4	22
66e	16.32	18.81	2	7.3	19.66	17.40	3	14
66f	16.11	22.78	2	12.23	20.32	16.23	3	8
66g	17.68	26.53	5	6.07	24.72	16.25	5	23
67f	17.99	27.77	4	11.67	24.26	17.69	7	14
67g	17.70	28.65	5	18.52	24.06	20.63	4	9
68a	17.70	30.11	4	13.57	25.32	19.82	8	28
69d	19.54	33.69*	1	10.88	21.17	18.25	5	22
71e	16.93	23.09	2	9.43	23.43	18.72	2	13
71f	13.14	23.35	5	11.34	22.47	19.57	5	18
71g	18.58	24.98	3	18.3	23.50	20.50	3	14
71h	20.08	25.03	1	9.54	21.65	18.37	3	15
71i	15.86	27.54	4	10.62	26.90	19.34	7	21
74b	16.14	20.61	2	9.4	23.46	18.77	3	21

*Water levels dropped during monitoring period, probe may have been partially exposed.

Based on this information, water temperatures recorded during the 2002 diurnal study were generally higher than those previously recorded during 8 years of daylight monitoring in 12 of the 15 ecoregions studied (65e, 65j, 66f, 66g, 67f, 67g, 68a, 69d, 71f, 71g, 71h, and 71i). The diurnal data in these regions could be expected to represent low flow conditions.

In 3 regions (66e, 71e and 74b), the maximum diurnal temperatures did not reach the highest daylight temperatures recorded from 1995 to 2002. The diurnal temperatures were within the ranges recorded over the 8-year period and exceeded the mean July through October values. The diurnal monitoring results in these regions should reflect typical low flow conditions, but may not be comparable to those years when higher water temperatures are attained. This is especially true in ecoregion 74b (Loess Plains) where the high temperature recorded during the diurnal study was almost 3 degrees lower than the maximum regional daylight reading.

3. RESULTS

Diurnal data in conjunction with multiple daylight readings suggest that dissolved oxygen levels in the 25 ecological subregions can be grouped into general categories based on the lowest observed DO levels.

3.0 Dissolved Oxygen in the Mississippi Valley Loess Plains (73a)

Dissolved oxygen levels at reference streams in the Mississippi Valley Loess Plains (73a) were generally lower than the current statewide criterion of 5.0 ppm. Streams in this region are slow moving during normal flow conditions and are naturally turbid with sandy substrate providing little opportunity for oxygenation. There is abundant coarse particulate matter providing food for macroinvertebrates, but helping to deplete dissolved oxygen levels through decomposition. Many streams in the area are influenced by seasonal floods on the Mississippi River, which causes water to back up in these streams.

Due to these natural factors, the aquatic life in this region have adapted to low dissolved oxygen levels. Healthy macroinvertebrate communities are dominated by animals that would be considered tolerant in other stream types. Aquatic worms, crustaceans, odonates, beetles, midges and gilled snails are the dominant taxa in reference streams. The tolerant mayfly *Caenis* sp. is the only abundant EPT found in these streams with facultative *Baetis* and *Oecetis* spp. occurring occasionally.

Diurnal dissolved oxygen data were not collected in this region. Seasonal daytime readings taken over an 8-year period (1995-2002) at 4 reference sites were evaluated (Table 3). Dissolved oxygen values ranged from 1.9 to 10.2 ppm. The majority of readings fell between 2.5 and 8 ppm (Figure 8). Only 34% of the readings met or exceeded the current 5 ppm statewide criterion.

Table 3: Minimum dissolved oxygen levels at reference sites in ecological subregion 73a.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight DO – 90th percentile (ppm)	Daylight DO Saturation (%)	Number of Daylight Readings
73A01	NA	NA	NA	2.3	10.1	23	10
73A02	NA	NA	NA	3.2	7.6	30	8
73A03	NA	NA	NA	3.0	5.6	37	6
73A04	NA	NA	NA	2.5	7.3	31	4
All Sites	NA	NA	NA	2.5	7.9	29	28

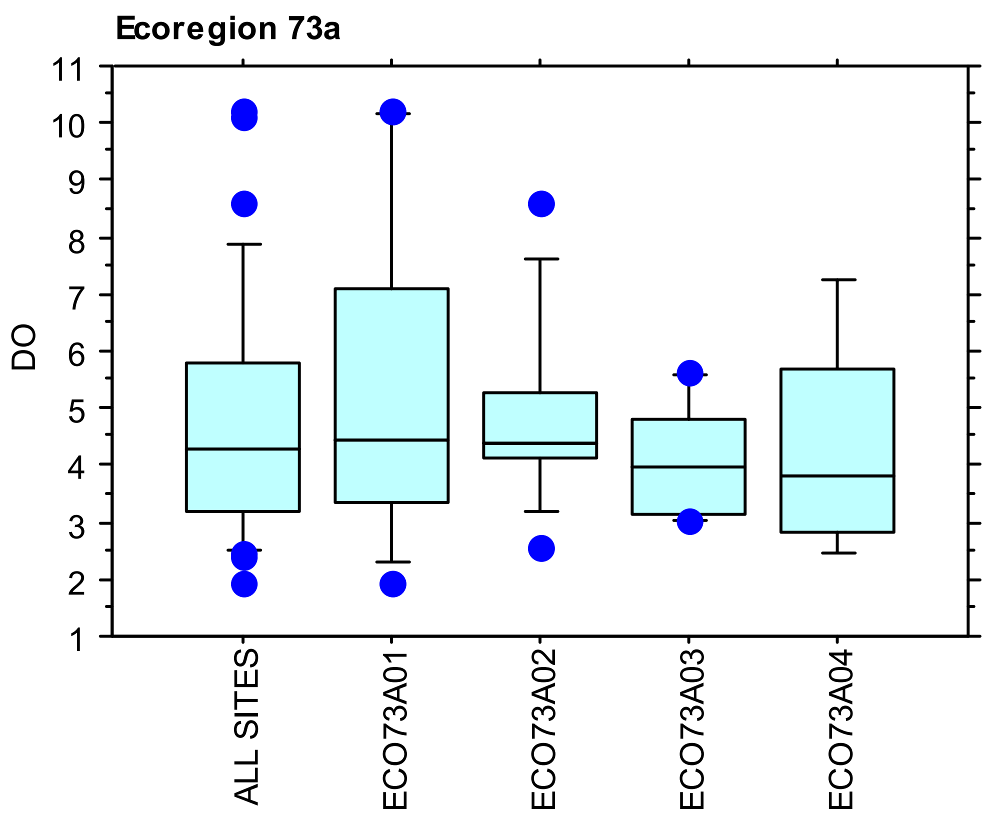


Figure 8: Dissolved oxygen ranges at 4 reference sites in the Northern Mississippi Alluvial Plain (73a). Data are based on daylight readings only.

Because of the low dissolved oxygen levels in this region, it is important that a minimum saturation level be maintained in this ecoregion. The 10th percentile of data was 30% saturation. Although 3 ppm is at least 30% saturation (depending on temperature) in the warm summer and fall months, 3 ppm may not be supportive in the winter when falling water temperatures are capable of retaining higher concentrations of oxygen.

When water temperature is at or above 16^{o}C, 3 ppm would be 30% saturation or greater. At lower water temperatures, percent saturation should be measured to ensure at least 30% saturation. For example, DO would need to be at least 4.4 ppm at 14^{o}C to maintain 30 percent saturation. Reference stream dissolved oxygen values in winter ranged between 7 and 10 ppm (Figure 9).

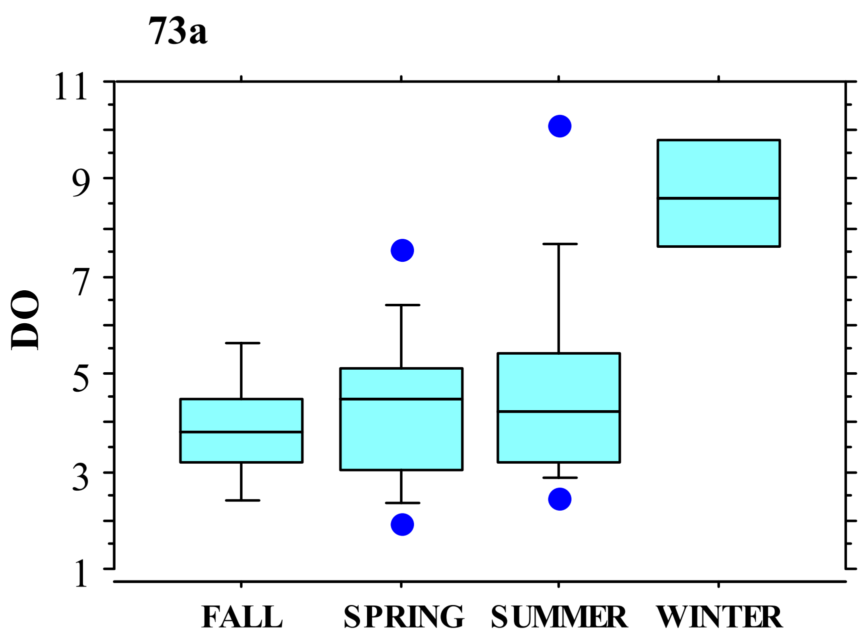


Figure 9: Seasonal variation of dissolved oxygen levels in the Northern Mississippi Alluvial Plains (73a).

3.1 Ecological Subregions Where the Minimum Reference Dissolved Oxygen Level is Generally 5 ppm

Based on a combination of diurnal and daylight monitoring at ecoregion reference stations, 10 subregions have dissolved oxygen levels regularly falling to 5 ppm (65a, 65b, 65i, 67g, 68b, 68c, 71g, 71h, 71i and 74a). These subregions comprise approximately one-third of the state.

3.1.0 Blackland Prairie (65a), Flatwoods/Alluvial Prairie Margins (65b) and Fall Line Hills (65i).

These 3 subregions located in the Southeastern Plains ecoregion comprise less than 1 percent of the state, approximately 95 square miles. Diurnal readings were not taken in these regions due to the limited geographic area. Data generated from routine monitoring of reference sites during daylight hours from 1995 to 2002 suggest that dissolved oxygen levels are generally above 5 ppm in these regions (Table 4). Reference data also indicated that dissolved oxygen levels occasionally fall to 4 ppm, in least impaired streams in the Blackland Prairie (65a).

Table 4: Minimum dissolved oxygen levels at reference sites in ecological subregions 65a, 65b and 65i.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
65A01	NA	NA	NA	4.1	47	5
65A03	NA	NA	NA	4.1	45	5
65B04	NA	NA	NA	5.7	67	14
65I02	NA	NA	NA	5.7	60	5

Non-reference test data were only available from 1 site in these 3 subregions. Chambers Creek in the Blackland Prairie (65a) has been assessed as impaired due to organic enrichment/low dissolved oxygen. Biorecon data collected in spring 2000 demonstrated a stressed benthic community based on taxa richness and the number of intolerant organisms. Dissolved oxygen readings were between 2.5 and 3.3 ppm during daylight hours.

3.1.1 Southern Shale Valleys (67g)

Dissolved oxygen levels in the Southern Shale Valleys subregion were generally lower than the rest of the Ridge and Valley ecoregion. Diurnal monitoring was conducted at 5 reference streams. Dissolved oxygen levels dropped to 5 ppm at 3 of the sites on a regular basis during the evening hours. DO dropped even lower at the other 2 reference sites for brief periods. There was typically a 2 ppm fluctuation during each 24-hour period (Figure 10).

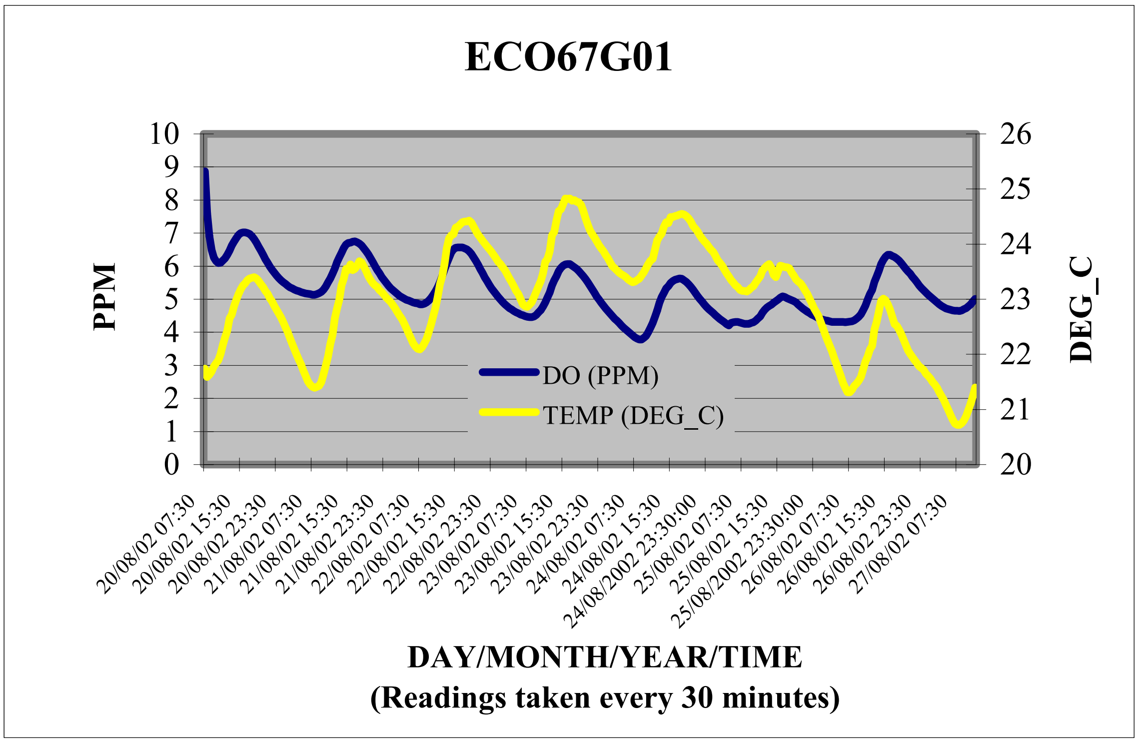


Figure 10: Diurnal dissolved oxygen and temperature data, Little Chucky reference site, Southern Shale Valleys (67g). Readings were recorded every 30 minutes for 167 hours.

Daylight dissolved oxygen values recorded seasonally at the 5 reference sites from 1995 to 2002 also suggested that lows of 5 ppm were typical in the region (Table 5). The majority of readings were above 7 ppm during daylight hours, which would mean values above 5 ppm during a typical 24-hour period assuming 2 ppm swings. Only 1 reading fell below 7 ppm (6.7) during daylight hours. The value was recorded at 10:12 am, DO probably continued to rise in the afternoon.

Table 5: Minimum dissolved oxygen levels at reference sites in ecological subregion 67g.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
67G01	3.8	44	167	8.7	88	11
67G05	4.5	53	172	7.9	78	10
67G08	5.0	52	170	8.0	84	4
67G09	5.4	63	168	8.7	89	3
67G10	5.8	69	166	NA	NA	0
All Sites	3.8	44	843	7.3	83	28

There were no streams listed as impaired due to low dissolved oxygen levels in this region. Therefore, in accordance with the study design, diurnal monitoring probes were not set up at any test sites. Daylight readings at non-reference sites yielded 9 out of 75 sites with dissolved oxygen values less than 5.0 ppm for at least 1 reading. Four of these sites had been assessed as impaired based on biology. Biological data were not available at the other sites.

Non-reference data combined with both diurnal and historic reference data indicate that a dissolved oxygen level of 5 ppm is typical of streams in this region. Occasional drops to 4 ppm during night hours are probably not detrimental to aquatic life as evidenced by diurnal data from 2 of the reference sites (Table 6).

Table 6: Frequency, magnitude and duration of reference stream diurnal dissolved oxygen readings less than 5 ppm in ecological subregion 67g. Data based on 166 – 172 hours of monitoring in August 2002.

Site	Frequency of Readings Less Than 5 ppm.	Magnitude of Lowest Reading (ppm)	Longest Duration of Readings Less Than 5 ppm (Hours).
ECO67G01	6	3.8	17
ECO67G05	2	4.5	12
ECO67G08	0	5.0	0
ECO67G09	0	5.4	0
ECOG7GIO	0	5.8	0

3.1.2 Sequatchie Valley (68b)

Diurnal monitoring was not conducted in the Sequatchie Valley since all three ecoregion reference streams had inadequate depth/flows during the targeted monitoring period. Existing daylight readings recorded seasonally at the 3 reference sites from 1995 to 2002 suggest that dissolved oxygen levels at 5 ppm support a healthy benthic community in this region (Table 7). The 10th percentile of data was 7.0 ppm during daylight hours, which allows for a 2 ppm drop to 5 ppm during the night.

There are no streams currently assessed as impaired due to low dissolved oxygen in this region. Daytime data were available from 7 non-reference streams. The lowest daylight dissolved oxygen value was 5.6 ppm at Battle Creek. The reading was taken at 7:45 in the morning so the nighttime low was probably not substantially lower.

Table7: Minimum dissolved oxygen levels at reference sites in ecological subregion 68b.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
68B01	NA	NA	NA	9.5	94	9
68B02	NA	NA	NA	7.2	81	16
68B09	NA	NA	NA	5.9	62	14
All Sites	NA	NA	NA	7.0	70	39

3.1.3 Plateau Escarpment (68c)

Diurnal probes were not set up in this region. The 10th percentile of daylight readings taken seasonally at 4 reference sites from 1995 to 2002 was 6.6 ppm (Table 8). It is likely that nighttime values are 1 to 2 ppm lower based on diurnal fluctuations at reference sites on the Cumberland Plateau. Based on this information, dissolved oxygen levels that regularly fall to 5.0 ppm in this region would probably support a healthy aquatic community.

Existing dissolved oxygen data from 7 non-reference streams were available in this region. All readings were taken during daylight hours. Dissolved oxygen readings were above 9.0 ppm at all sites except Ranger Creek, which had readings between 5.4 and 5.6 ppm. The macroinvertebrate community in this stream had been assessed as being stressed. It is likely that dissolved oxygen values fall much lower during the diurnal cycle.

Table 8: Minimum dissolved oxygen levels at reference sites in ecological subregion 68c.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
68C12	NA	NA	NA	10.0	93	4
68C13	NA	NA	NA	6.9	69	10
68C15	NA	NA	NA	6.5	67	14
68C20	NA	NA	NA	9.3	95	5
All sites	NA	NA	NA	6.6	70	33

3.1.4 Eastern Highland Rim (71g)

Diurnal probes were deployed at 3 reference stations and 7 test sites in the Eastern Highland Rim (Figure 11). Dissolved oxygen levels at 2 of the sites (Flat Creek and Hurricane Creek) stayed well above 6 ppm throughout the monitoring period. DO levels at the third site, Spring Creek, regularly fell as low as 5.5 ppm during the night (Figure 12). Typical DO fluctuations at all sites were under 2 ppm during each 24-hour period.

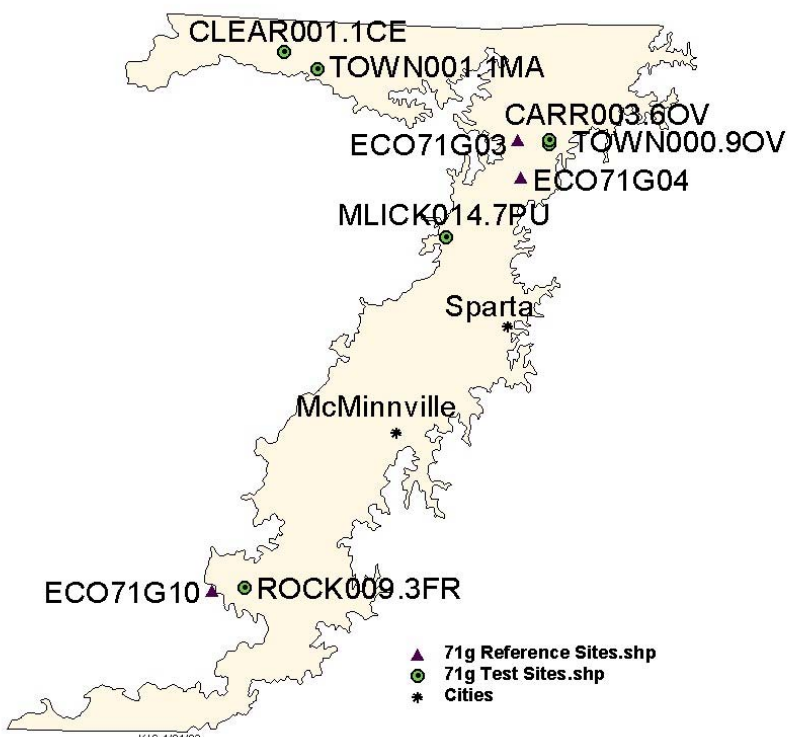


Figure 11: Location of diurnal monitoring stations in the Eastern Highland Rim (71g).

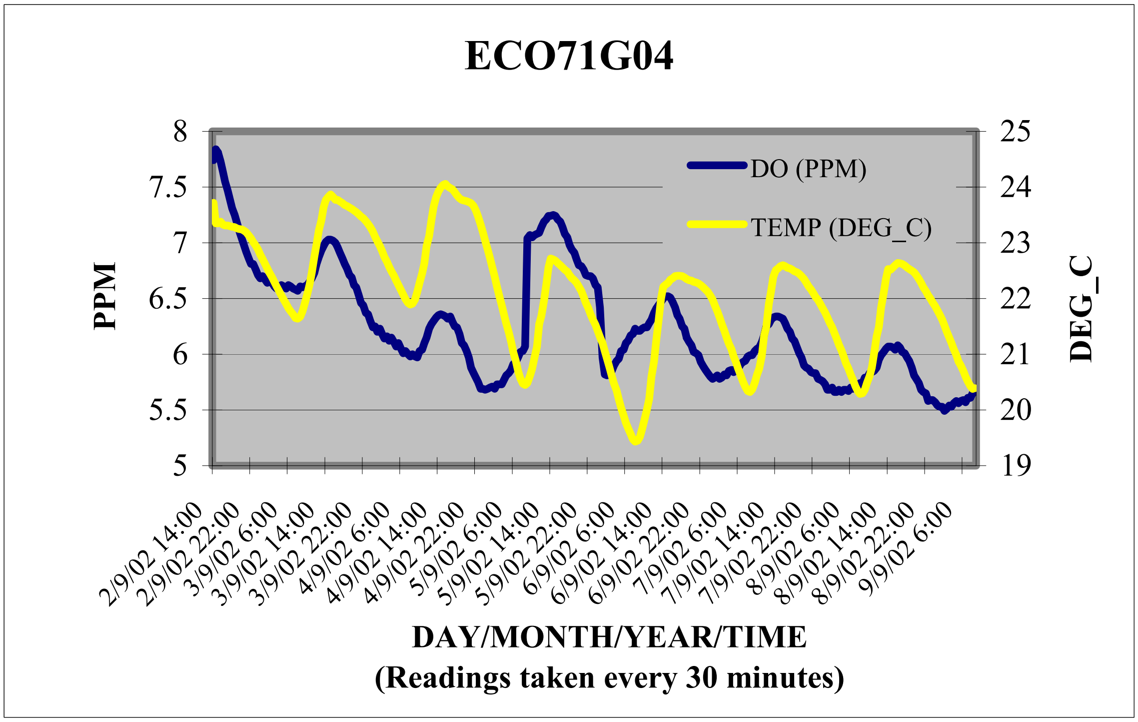


Figure 12: Diurnal dissolved oxygen and temperature data, Spring Creek reference site, Eastern Highland Rim (71g). Readings every 30 minutes for 163 hours.

Historic daylight reference data also suggest 5 ppm dissolved oxygen as the typical minimum in this region (Table 9). Ninety-eight percent of the DO values recorded seasonally from the 3 reference sites over a 7-year period were above 7 ppm. This would allow for a 2 ppm drop during the diurnal cycle while still maintaining 5 ppm as a minimum level.

Table 9: Minimum dissolved oxygen levels at reference site in ecological subregion 71g.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
71G03	6.6	74	168	8.9	94	15
71G04	5.5	62	163	7.3	71	13
71G10	6.8	74	164	8.8	88	16
All Sites	5.5	62	495	8.1	82	44

Diurnal monitoring was also conducted at 7 test sites as part of the study. Six of the sites were assessed as impaired due to organic enrichment/low DO while the 7th site was upstream of a point source. At 4 of the sites, dissolved oxygen levels regularly dropped below 5 ppm. Rock Creek fell below 5 ppm during the evening hours although daytime highs were consistently above 5 ppm (Figure 13).

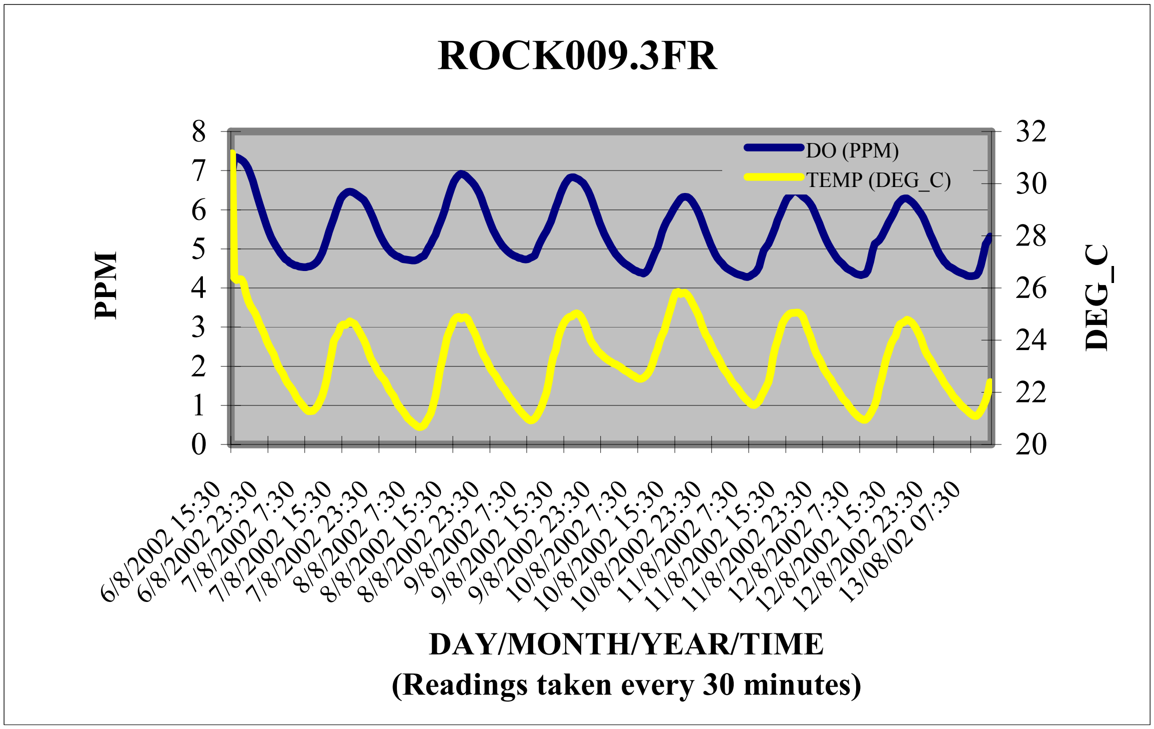


Figure 13: Diurnal dissolved oxygen and temperature data, Rock Creek test site, Eastern Highland Rim (71g). Readings every 30 minutes for 164 hours.

Daytime dissolved oxygen data from 23 non-reference sites (97 readings) collected from 1996 to 2002 were reviewed to further evaluate the dissolved oxygen patterns in this region. Only 1 site, Clear Branch, had observed DO levels less than 5 ppm. This stream had been assessed as not supporting aquatic life according to the 2002 303(d) assessment.

Four sites had daytime values above 5 ppm, but less than 7 ppm. All readings were taken after 11 am. Based on the 2 ppm fluctuation in the diurnal patterns generally observed at reference sites in this region, it is possible that DO levels fall below 5 ppm during evening hours at these sites. Based on biorecon data, all 4 streams exhibited stressed biological populations.

3.1.5 Outer Nashville Basin (71h)

Diurnal monitoring probes were deployed at 1 reference site and twelve test sites in the Outer Nashville Basin (Figure 14). Three ecoregion reference sites are established in this subregion, however, 2 sites had inadequate depth/flows for diurnal monitoring during the study period. Carson Fork was the only reference site where probes could be deployed (Figure 15). DO regularly dropped to 5 ppm during each diurnal cycle. Toward the end of the week, dissolved oxygen levels fell to 3 ppm. The probe was picked up at 3:00 pm, the reading at that time was 3.2 ppm. A Hydrolab reading taken at the same site during pickup was 7.6 ppm.

Although the diurnal probe has a 1 hour lag from stream change to actual measurement while the Hydrolab measurement is instantaneous, it is unlikely that the DO would change 4 ppm in a 1 hour period since the typical fluctuation was no more than 3 ppm in each diurnal cycle. However, field notes did not indicate any observable conditions that would affect the diurnal probe and the same probe recorded normally at the next station. Additional diurnal monitoring will need to be conducted at reference sites in this region to determine if periodic dissolved oxygen levels at 3 ppm are typical.

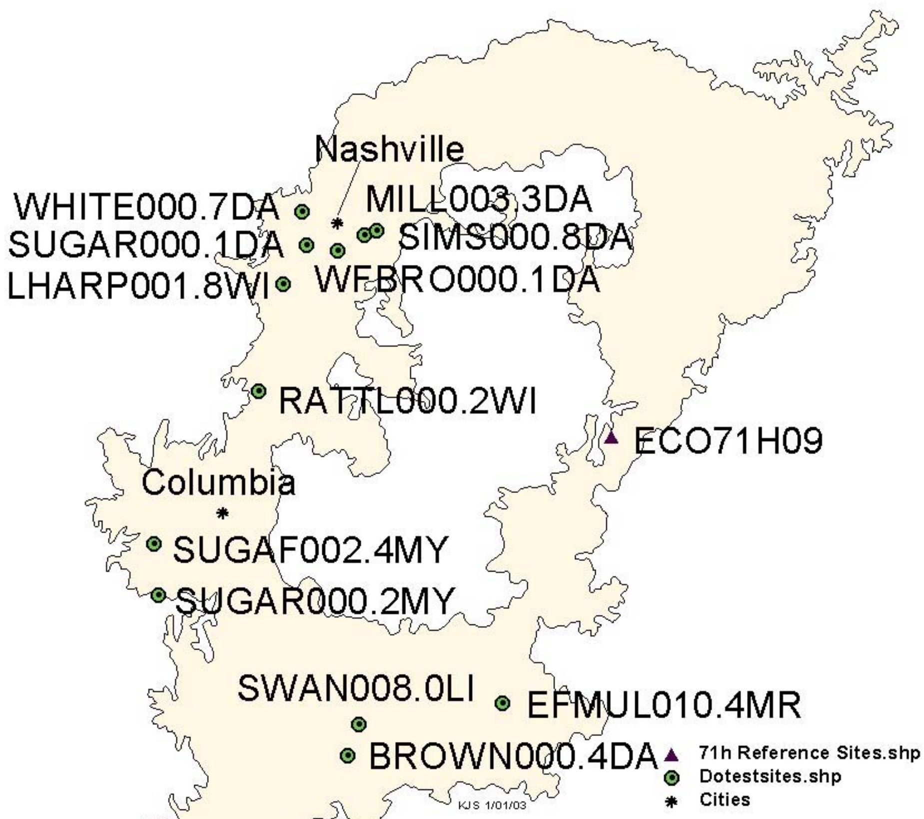


Figure 14: Location of diurnal monitoring stations in the Outer Nashville Basin (71h).

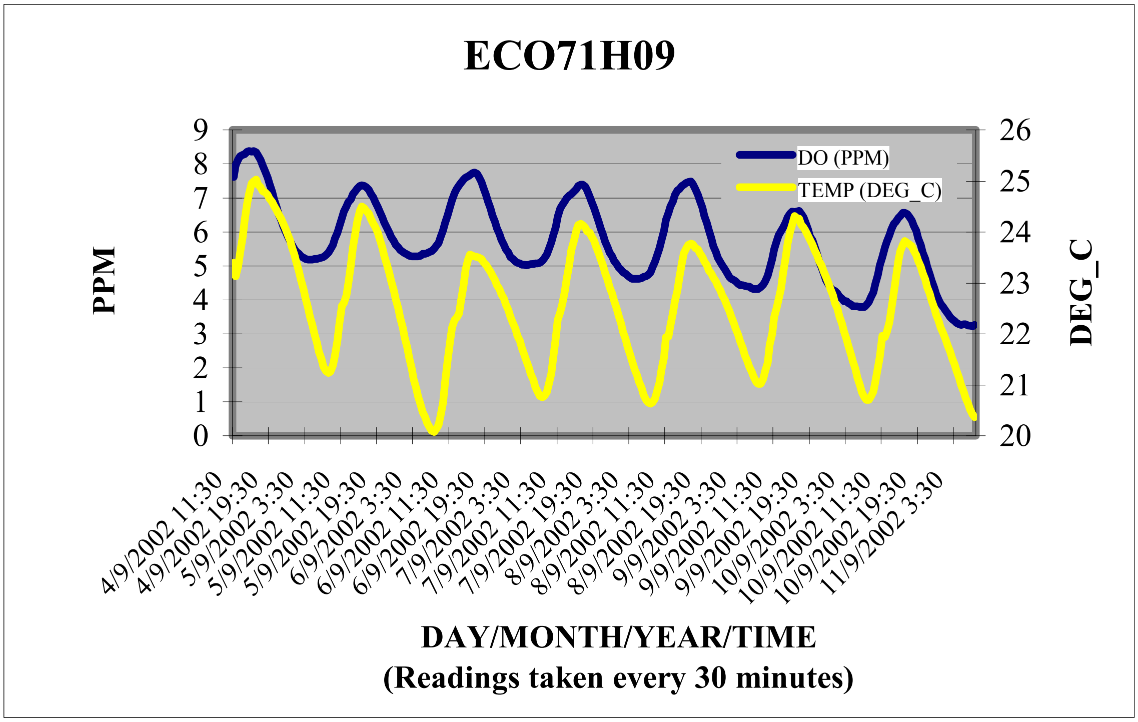


Figure 15: Diurnal dissolved oxygen and temperature data, Carson Fork reference site, Outer Nashville Basin (71h). Readings every 30 minutes for 165 hours.

The lowest daylight reading from any of the 3 reference sites (44 readings seasonally over a 7 year period) was 7.2 ppm (Table 10). The reading was taken at 10 am during the summer and probably does not reflect the highest value during that 24-hour period. The 10th percentile of data was 9.0 ppm. If the 3 ppm diurnal swing observed at Carson Fork was typical for this region, it is possible that dissolved oxygen levels at these sites did not fall below 5 ppm.

Table 10: Minimum dissolved oxygen levels at reference sites in ecological subregion 71h.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
71H03	NA	NA	NA	8.8	95	15
71H06	NA	NA	NA	9.9	98	16
71H09	3.2*	36*	163	9.0	94	19
All Sites	3.2*	36*	NA	9.0	95	50

*Questionable data: Possible diurnal probe malfunction.

Many streams in this subregion have been assessed as impaired due to organic enrichment/low dissolved oxygen. Diurnal probes were set up at 12 of these impaired sites. Dissolved oxygen levels at Brown Creek (BROWN000.4DA) dropped to near 0 ppm. East Fork Mulberry Creek (EFMUL010.4MR) cycled steadily between 4 ppm and 6 ppm. Dissolved oxygen levels at the Little Harpeth (LHARP001.8WI) never fell below 6.9 ppm. At Mill Creek (MILL003.3DA) readings were around 5 ppm at the bottom of each cycle. Fluctuations were extremely high at this site with dissolved oxygen levels varying as much as 5 ppm from day to night (Figure 16). Fluctuations at the reference site did not exceed 3 ppm.

Despite abundant algal growth, DO levels at Rattlesnake Branch (RATTL000.2WI) never fell below 6.5 ppm. Sims Branch (SIMS000.8DA) had an unusual pattern and dropped to almost 0 ppm over the weekend before returning to a more natural pattern. Sugartree Creek (SUGAR000.1DA) showed little cycling - staying near 5 ppm before dropping below 1 ppm. Sugar Creek (SUGAR000.2MY) and Sugar Fork (SUGAR002.4MY) did not fall below 6.5 ppm.

Swan Creek dropped below 5 ppm every night and only exceeded 5 ppm for about 10 hours during each cycle (Figure 17). Dissolved oxygen levels had a normal pattern and never fell below 7 ppm at West Fork Brown Creek. White Creek had an atypical pattern with fairly high dissolved oxygen levels for 2 days, then levels that cycled between 3 and 5 ppm for 2 days, before rising back to previous levels.

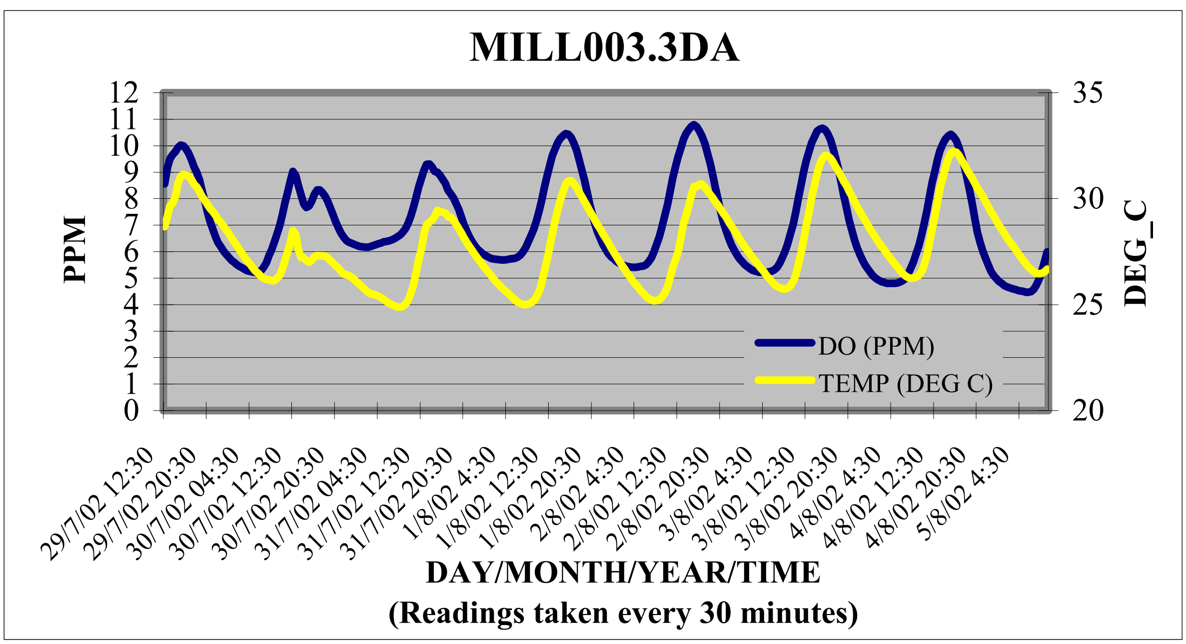


Figure 16: Diurnal dissolved oxygen and temperature data, Mill Creek test site, Outer Nashville Basin (71h). Readings every 30 minutes for 166 hours.

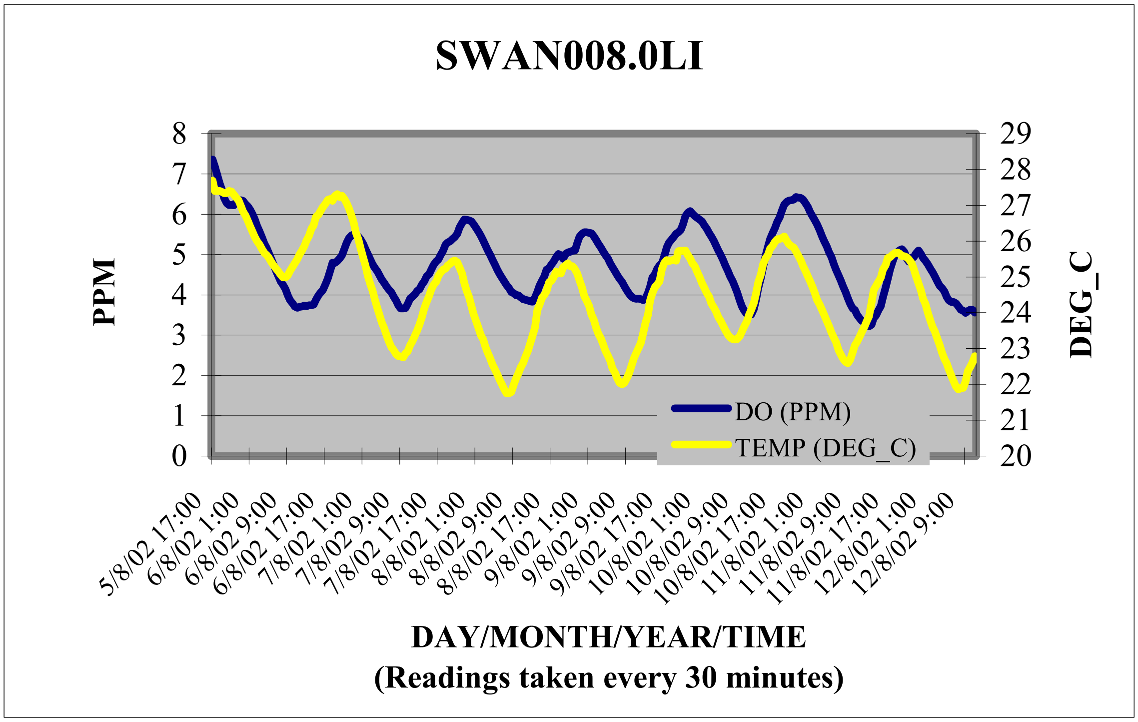


Figure 17: Diurnal dissolved oxygen and temperature data, Swan Creek test site, Outer Nashville Basin (71h). Readings every 30 minutes for 162 hours.

Based on existing 71h reference data, test data and the limited diurnal data, it appears likely that dissolved oxygen levels of at least 5 ppm are necessary to support a diverse aquatic community. While it is possible that infrequent drops to lower DOs do not have a substantial affect on biological integrity, additional diurnal studies would be needed to make this determination with confidence.

3.1.6 Inner Nashville Basin (71i)

Diurnal monitoring probes were deployed at 4 reference sites and 5 test sites as part of this study (Figure 18). Three other reference sites had inadequate depths and flows during the monitoring period. Additionally, diurnal data were available from 1 of these sites, Cedar Creek, from a 4-day study conducted in August 2001. No diurnal data are available for the other 2 reference sites, Stewart Creek and West Fork Stones River.

Dissolved oxygen fell below 5 ppm for 8 hours at 1 reference site (Table 11). Reference site diurnal DO cycles in the Inner Nashville Basin were more extreme than any other region with levels sometimes fluctuating by as much as 4 ppm (Figure 19).

Figure 18: Location of diurnal monitoring stations in the Inner Nashville Basin (71i).

Table 11: Frequency, magnitude and duration of reference stream diurnal dissolved oxygen readings less than 5 ppm in ecological subregion 71i. Data based on 165–169 hours of monitoring in August and October, 2002.

Site	Frequency of Readings Less Than 5 ppm.	Magnitude of Lowest Reading (ppm)	Longest Duration of Readings Less Than 5 ppm (Hours).
ECO71I10	0	6.1	0
ECO71I12	0	5.2	0
ECO71I13	2	3.9	8
ECO71I14	0	5.6	0
EC071I15	0	5.1	0

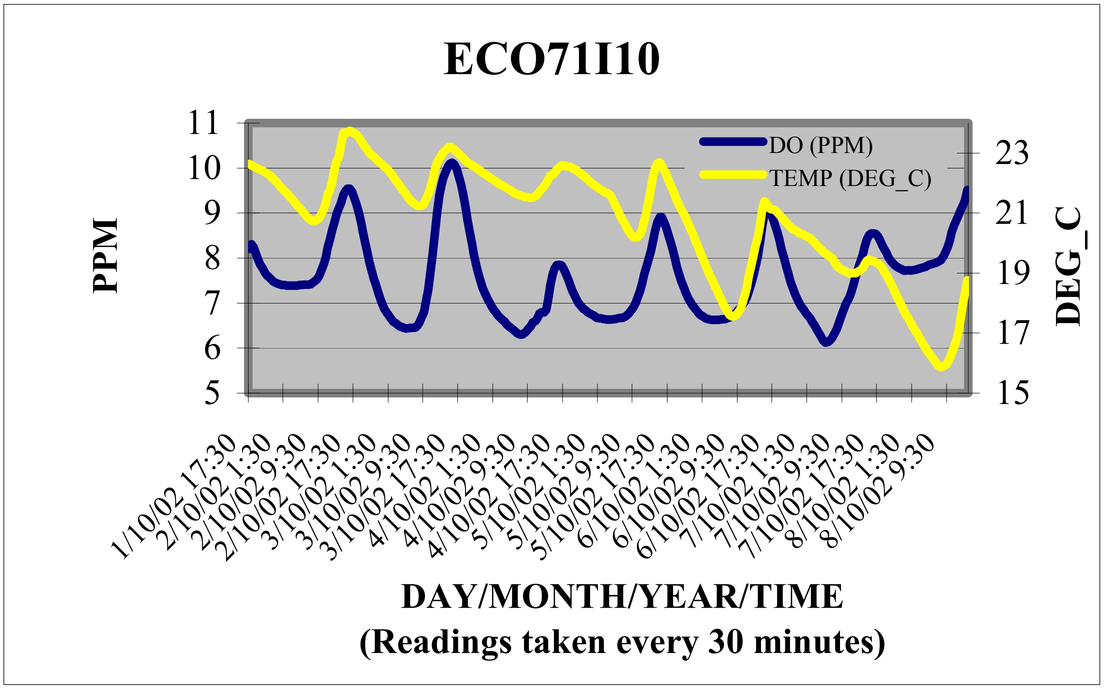


Figure 19: Diurnal dissolved oxygen and temperature data, Flat Creek reference site, Inner Nashville Basin (71i). Readings every 30 minutes for 165 hours.

Cedar Creek is one of the reference sites used to determine natural dissolved oxygen cycles in the Inner Nashville Basin (71i). *Photo provided by Aquatic Biology Section, TDH.*

Daylight readings from all 7 reference sites collected in various seasons since 1995 support 5 ppm as the minimum dissolved oxygen level typically observed in this region (Table 12). The 10th percentile of data (95 readings) was 5.2 ppm. Three sites had minimum values less than 5.0 ppm during daylight hours. This may be reflective of times when the streams had extremely reduced flow, but raises the question of whether streams in this region can withstand DO fluctuations for limited periods without a loss of biological integrity.

Additional diurnal monitoring over a longer period of time is needed in this subregion to determine the frequency and duration of values less than 5 ppm that would still support aquatic life. The amount of fluctuation within each 24-hour cycle seems to be an important factor since impaired sites had much wider diurnal swings than did reference sites.

Table 12: Minimum dissolved oxygen levels at reference sites in ecological subregion71i.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
71I03	NA	NA	NA	6.4	66	16
71I09	NA	NA	NA	4.0	44	24
71I10	6.1	67	165	7.6	84	19
71I12	5.2	NA	101	2.3	24	4
71I13	3.9	46	164	7.7	71	13
71I14	5.6	63	168	3.4	41	5
71I15	5.1	58	169	6.6	78	14
All Sites	3.9	46	767	5.2	57	95

Similar to the Outer Nashville Basin ecoregion, many sites in the Inner Nashville Basin have been assessed as impaired due to organic enrichment/low dissolved oxygen. Diurnal monitoring probes were set up at 5 of these sites. All 5 had dissolved oxygen levels falling below 5 ppm during the evening hours (Figure 20).

Changes in the dissolved oxygen levels during each cycle were much more substantial in test sites than in reference sites. Some test sites had diurnal fluctuations as much as 7 ppm. All except Kelly Creek had acceptable dissolved oxygen levels during the daylight hours. As has been indicated previously in other regions, the Inner Nashville Basin is an area where daytime DO monitoring alone may miss substantial problems affecting aquatic life.

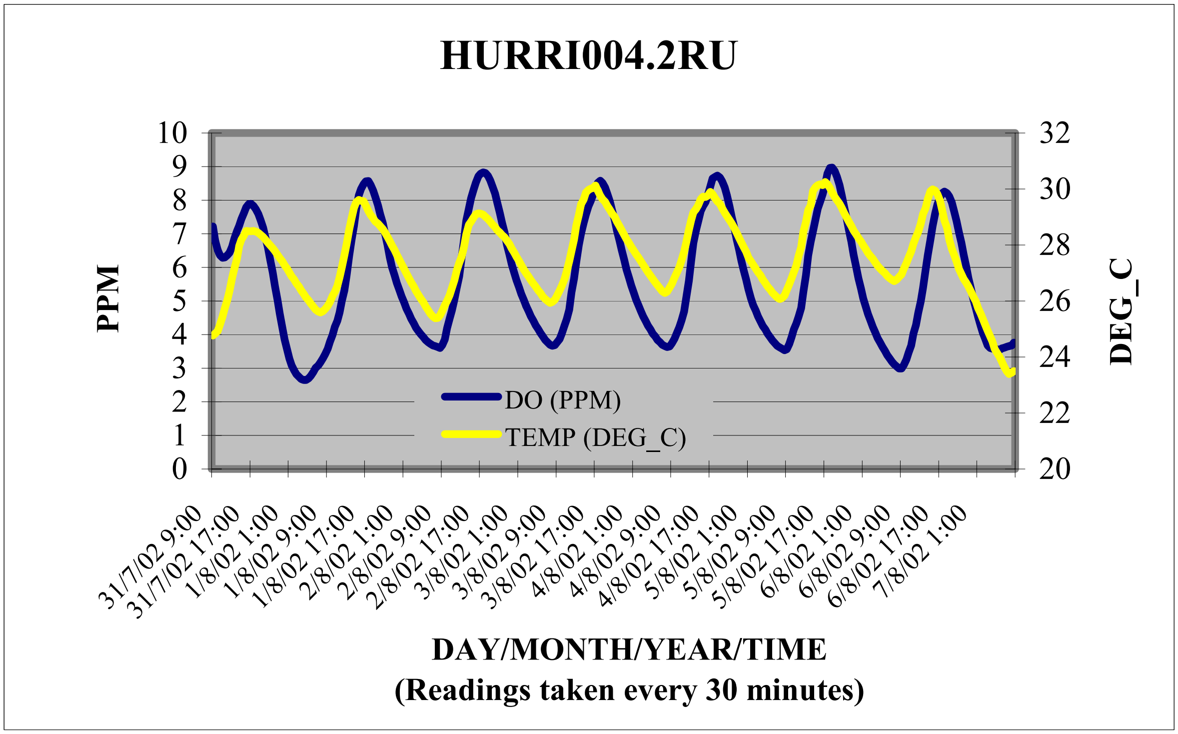


Figure 20: Diurnal dissolved oxygen and temperature data, Hurricane Creek test site, Inner Nashville Basin (71i). Readings every 30 minutes for 168 hours.

3.1.7 Bluff Hills (74a)

Diurnal monitoring probes were not used in this subregion. Forty-one seasonal daytime readings from 2 reference sites were reviewed to determine typical dissolved oxygen levels in this region (Table 13). Ninety-three percent of the values were above 7 ppm. However, without data to substantiate the extent of diurnal swings at reference sites in this region, it can only be speculated that a minimum dissolved oxygen level of 5 ppm is maintained in these streams. Additional study is needed in this region.

Table 13: Minimum dissolved oxygen levels at reference sites in ecological subregion 74a.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
74A06	NA	NA	NA	6.2	75	20
74A08	NA	NA	NA	7.7	83	22
All Sites	NA	NA	NA	7.2	79	42

There were no streams in this subregion that had been assessed as impaired due to low dissolved oxygen based on the 2002 303(d) assessment. Multiple readings from 4 non-reference sites were available in the water quality database. Only 1 site, Hyde Creek, had daytime readings less than 7 ppm with values as low as 2.8 ppm. This creek has been assessed as not supporting aquatic life due to historical industrial sources.

3.2 Ecological Subregions Where the Minimum Reference Dissolved Oxygen Level is Generally 6 ppm

Ten subregions had reference dissolved oxygen levels that were generally at or above 6 ppm (65e, 65j, 67f, 67h, 67i, 68a, 69d, 71e, 71f, 74b). This is the largest group of regions in area, comprising 62 percent of the state.

3.2.0 Southeastern Plains and Hills (65e)

Diurnal monitoring was conducted at 4 reference sites and 6 test sites in the Southeastern Plains and Hills (Figure 21). Dissolved oxygen levels generally stayed above 6 ppm during low flow conditions (Figure 22). Values fell slightly below 6.0 ppm (5.9 ppm) for 2 hours at Blunt Creek (ECO65E04) in one 24-hour cycle during the 168-hour monitoring period (Figure 23).

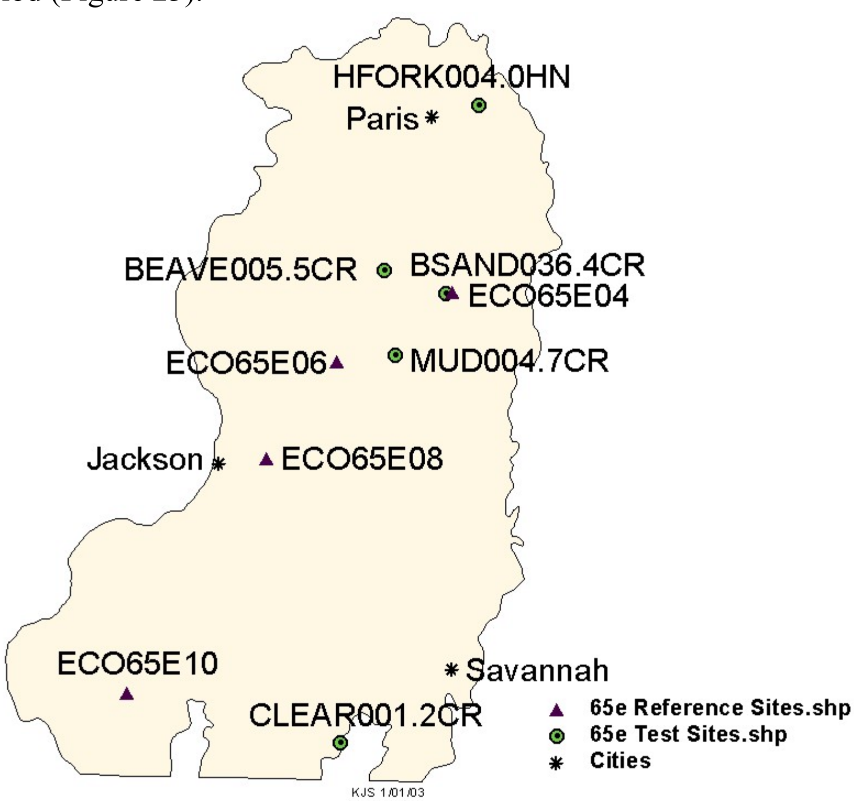


Figure 21: Location of diurnal monitoring stations in the Southeastern Plains and Hills (65e).

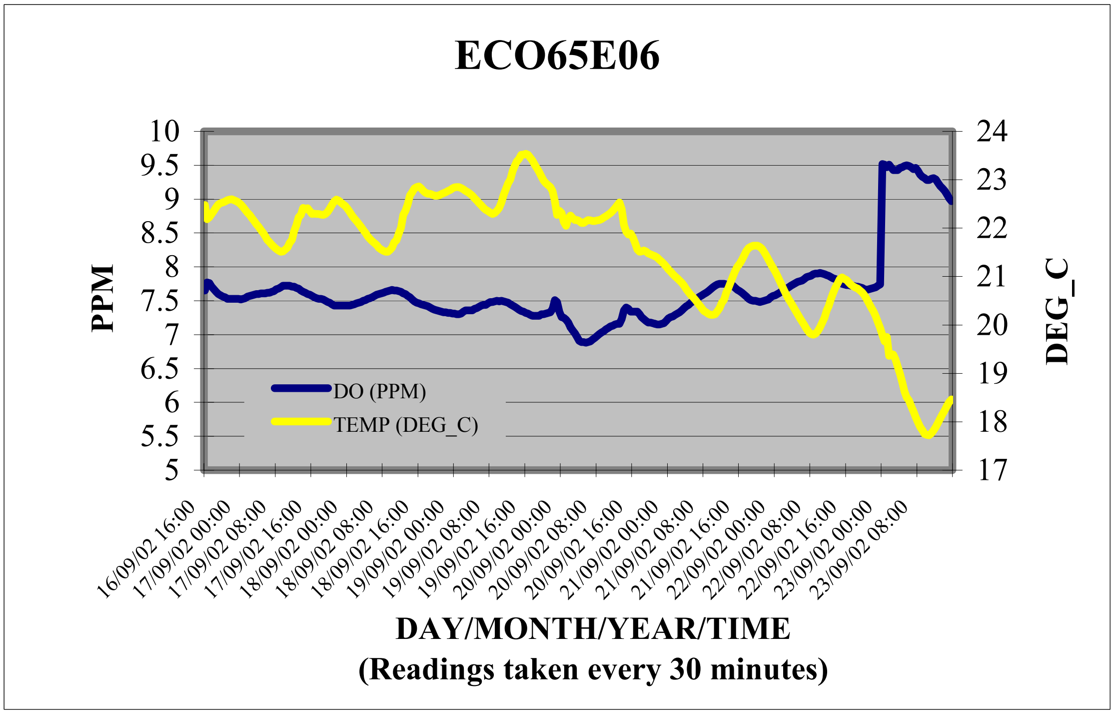


Figure 22: Diurnal dissolved oxygen and temperature data, Griffin Creek reference site, Southeastern Plains and Hills (65e). Readings every 30 minutes for 168 hours.

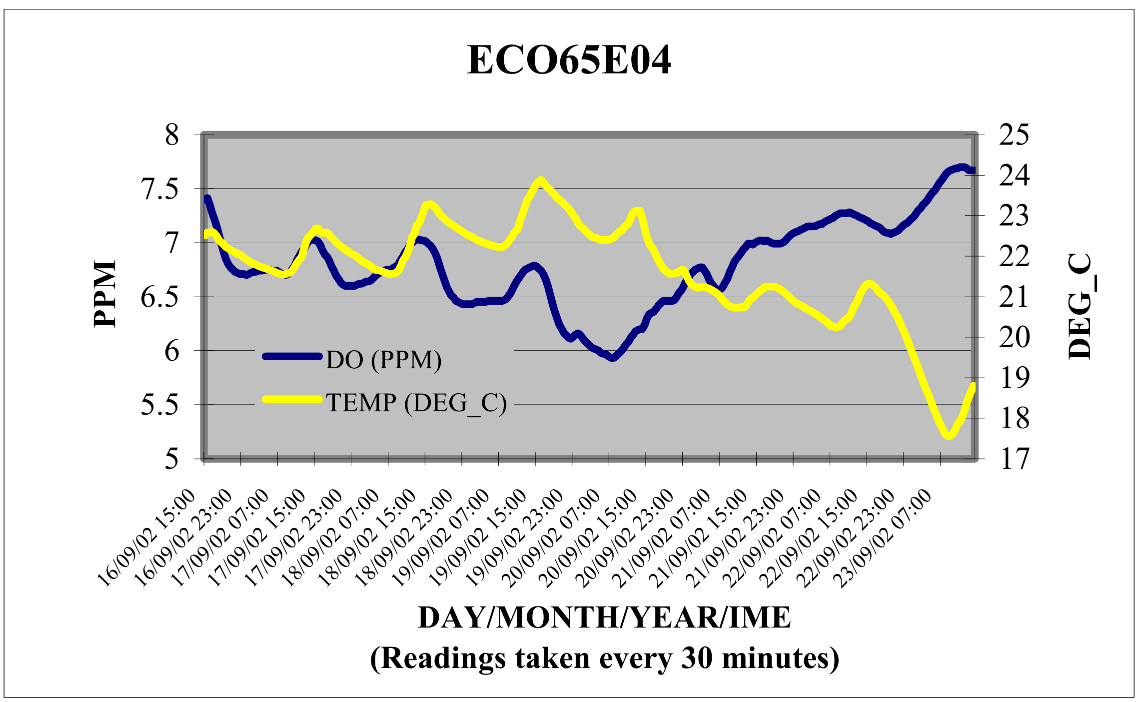


Figure 23: Diurnal dissolved oxygen and temperature data, Blunt Creek reference site, Southeastern Plains and Hills (65e). Readings every 30 minutes for 168 hours.

Table 14: Frequency, magnitude and duration of reference stream diurnal dissolved oxygen readings less than 6 ppm in ecological subregion 65e. Data based on 163–168 hours of monitoring in September 2002.

Site	Frequency of Readings Less Than 6 ppm.	Magnitude of Lowest Reading (ppm)	Longest Duration of Readings Less Than 6 ppm (Hours).
ECO65E04	1	5.9	2
ECO65E06	0	6.9	0
ECO65E08	0	6.3	0
EC065E10	1	5.3	14

The only other site to fall below 6 ppm was Marshall Creek (ECO65E10). Dissolved oxygen readings fell to 5.3 for 13 hours during a storm event when high water levels and increased turbidity were observed (Table 14). DO did not change by more than 2 ppm during any diurnal period and fluctuation was generally less than 1 ppm.

Results from seasonal daylight sampling from 1995 to 2002 are similar to the diurnal data for subregion 65e. Eighty readings were taken from 5 reference sites during this period (Table 15). No readings fell below 6 ppm. Only 8 readings were below 8 ppm. Most observations were in the morning and probably do not reflect the highest DO level attained during the day. Therefore, based on the 1-2 ppm fluctuations observed in this region, it is suggested that DO values stayed above 6 ppm.

Table 15: Minimum dissolved oxygen levels at reference sites in ecological subregion 65e.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
65E04	5.9	68	168	8.4	90	12
65E06	6.9	79	168	7.1	80	10
65E08	6.3	73	163	8.2	87	18
65E10	5.3	58	166	7.6	78	19
65E11	NA	NA	NA	7.2	77	22
All Sites	5.3	58	665	7.9	81	81

Diurnal dissolved oxygen readings were taken at 6 test sites in this region. All 6 sites have been assessed as impaired due to organic enrichment and/or low DO. Three of the sites had DO readings less than 6 ppm while only one, Clear Creek, had dissolved oxygen readings lower than 5 ppm (Figure 24). All these sites were documented as having stressed biological communities.

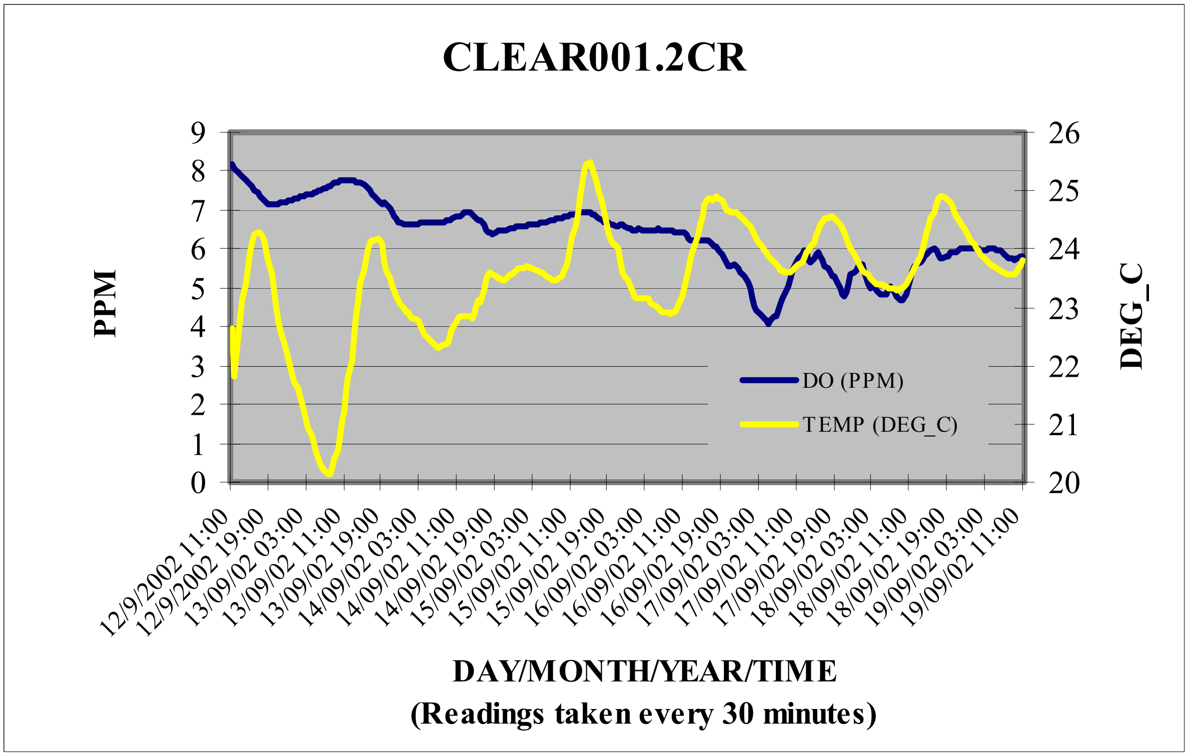


Figure 24: Diurnal dissolved oxygen and temperature data, Clear Creek, test site, Southeastern Plains and Hills (65e). Readings every 30 minutes for 168 hours.

Daylight readings were evaluated from 176 test sites on 131 streams in this region. These sites included both impaired and non-impaired streams. Over 500 readings were recorded from 1996 to 2002.

Only 12 streams (9%) had dissolved oxygen readings higher than 5 ppm, but less than 6 ppm. Six of these streams demonstrated an impaired biological community based on biorecon data while a seventh stream had ambiguous results. Three supported a healthy biological community based on either biocriteria (1 site) or biorecons. The site passing biocriteria only had 1 reading out of 10 falling below 6 ppm (5.0 ppm). The other 2 sites had one lower DO reading each, 5.6 and 5.1 ppm, based on only 2 or 3 readings. There were no biological data available for 2 sites.

Evaluation of the combination of diurnal and daylight data from both reference and test sites suggests that dissolved oxygen levels are generally at or above 6 ppm in ecoregion 65e, the Southeastern Plains and Hills. However, limited periodic drops to 5 ppm for 14 hours or less during a 7-day period did not appear to have a negative effect on the biota.

3.2.1 Transition Hills (65j)

Streams in the Transition Hills subregion are higher gradient than the other regions in the Southeastern Plains. The increased gradient, coupled with shallow depth and cobble substrate, provides more opportunity for oxygenation. Diurnal dissolved oxygen readings were taken for 7 consecutive days at 4 reference sites in this subregion. DO levels never fell below 7 ppm during this period (Figure 25). Dissolved oxygen values did not change more than 1 ppm during each diurnal cycle.

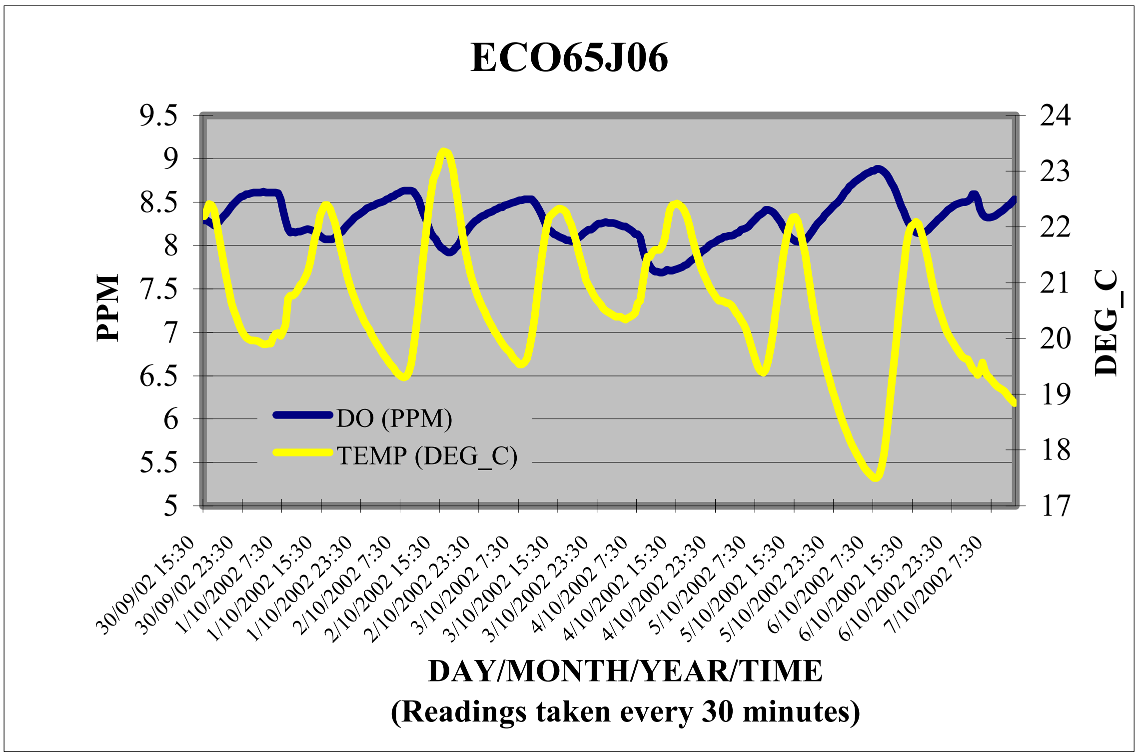


Figure 25: Diurnal dissolved oxygen and temperature data, Right Fork Whites Creek reference site, Transition Hills (65j). Readings every 30 minutes for 165 hours.

Although diurnal monitoring indicated 7 ppm was the minimum DO at reference sites in this region, daylight readings from the 4 reference sites from 1995 to 2002 indicate that DO levels of 6 ppm may occur during evening hours somewhat regularly (Table 16). The 10^{th} percentile of readings taken during daylight hours was 7 ppm. Assuming the 1 ppm diurnal fluctuation observed in this region, DO levels at reference sites may drop to at least 6 ppm at night. Approximately one third of the readings were taken in the afternoon when DO levels should be near peak.

Table 16: Minimum dissolved oxygen levels at reference sites in ecological subregion 65j.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
65J04	7.6	83	162	7.1	76	17
65J05	7.2	82	163	8.7	87	15
65J06	7.5	86	165	7.3	74	20
65J11	7.3	81	165	6.5	69	15
All Sites	7.2	81	505	7.0	69	67

There are no streams currently assessed as impaired due to low dissolved oxygen in this region, therefore, diurnal data were not collected at any test sites. A search of existing data provided only a single reading from Dry Creek. Dissolved oxygen was 9.0 ppm at this site, which supported a healthy biological community.

3.2.2 Southern Limestone/Dolomite Valleys and Low Rolling Hills (67f)

Diurnal readings were taken at 3 reference streams and 3 test streams in the Southern Limestone/Dolomite Valleys and Low Rolling Hills (Figure 26). The remaining 4 sites had insufficient flow during the monitoring period. Diurnal readings did not fall below 6.3 ppm at any site. There was typically a 2 ppm fluctuation within each 24 hour period (Figure 27).

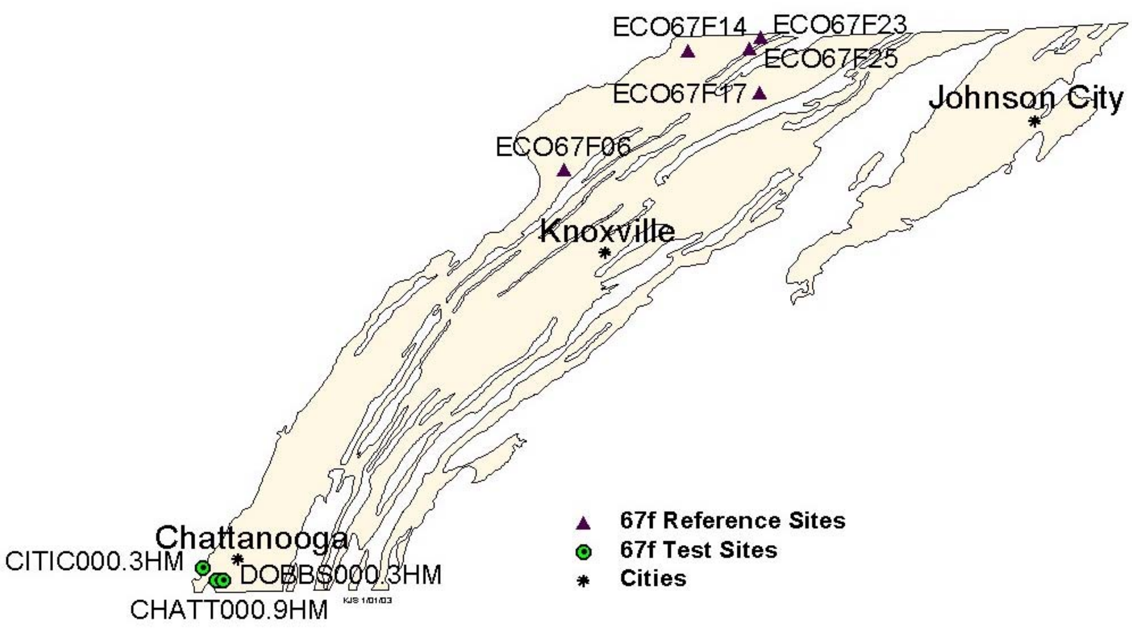


Figure 26: Location of diurnal monitoring stations in the Southern Limestone/Dolomite Valleys and Low Rolling Hills (67f).

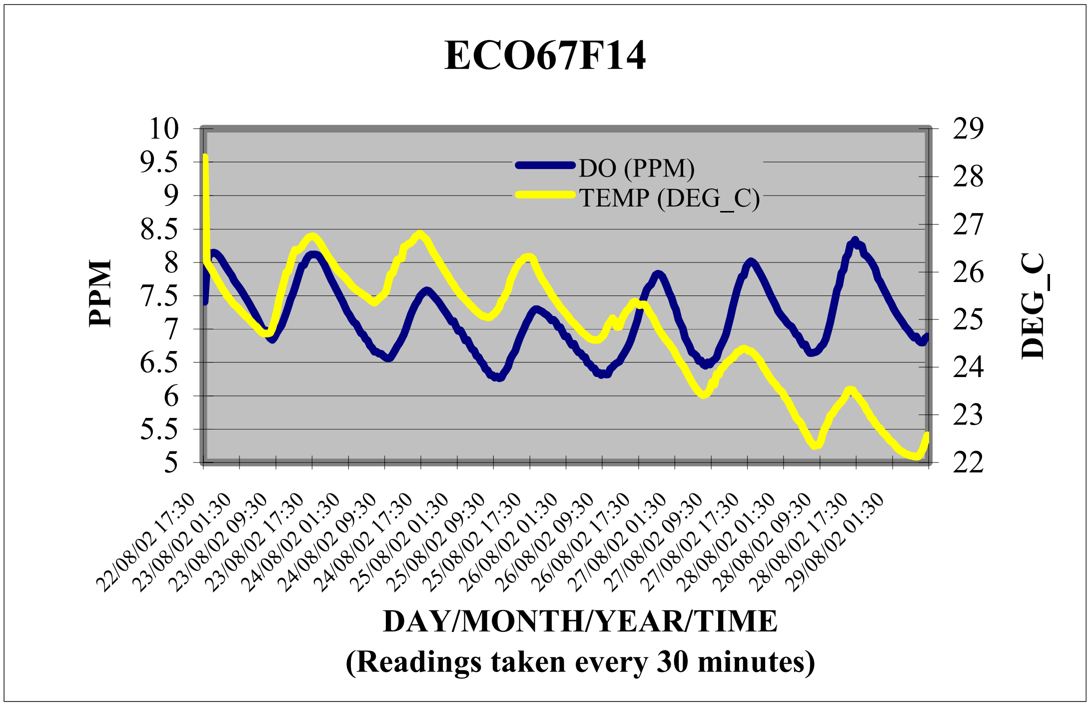


Figure 27: Diurnal dissolved oxygen and temperature data, Powell River reference site, Southern Limestone/Dolomite Valleys and Low Rolling Hills (67F). Readings were every 30 minutes for 160 hours.

Seasonal daylight dissolved oxygen levels recorded over an 8-year period from reference sites in 67f also generally remained in this range (Table 17). Only 1 reading out of 70 from 7 reference sites was below 8 ppm (6.9 ppm) during daylight hours. This reading was taken at 11:40 am and probably does not reflect the maximum DO reached that day. Assuming a swing of 2ppm as suggested by diurnal monitoring, reference sites may not fall below 6 ppm within a 24-hour period.

Table 17: Minimum dissolved oxygen levels at reference sites in ecological subregion 67f.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
67F06	NA	NA	NA	8.1	80	7
67F13	NA	NA	NA	9.6	88	15
67F14	6.3	76	160	8.7	78	9
67F16	NA	NA	NA	9.7	79	8
67F17	6.4	77	177	9.9	97	15
67F23	7.6	86	160	9.9	84	9
67F25	NA	NA	NA	10.4	89	7
All Sites	6.3	77	497	8.8	85	70

Diurnal monitoring probes were also set up at 3 test sites in subregion 67f that had been assessed as impaired due, in part, to low dissolved oxygen levels. All 3 sites showed peaks of up to 5 ppm during daylight hours, but generally stayed below 3 ppm and sometimes fell to near 0 ppm at night (Figure 28).

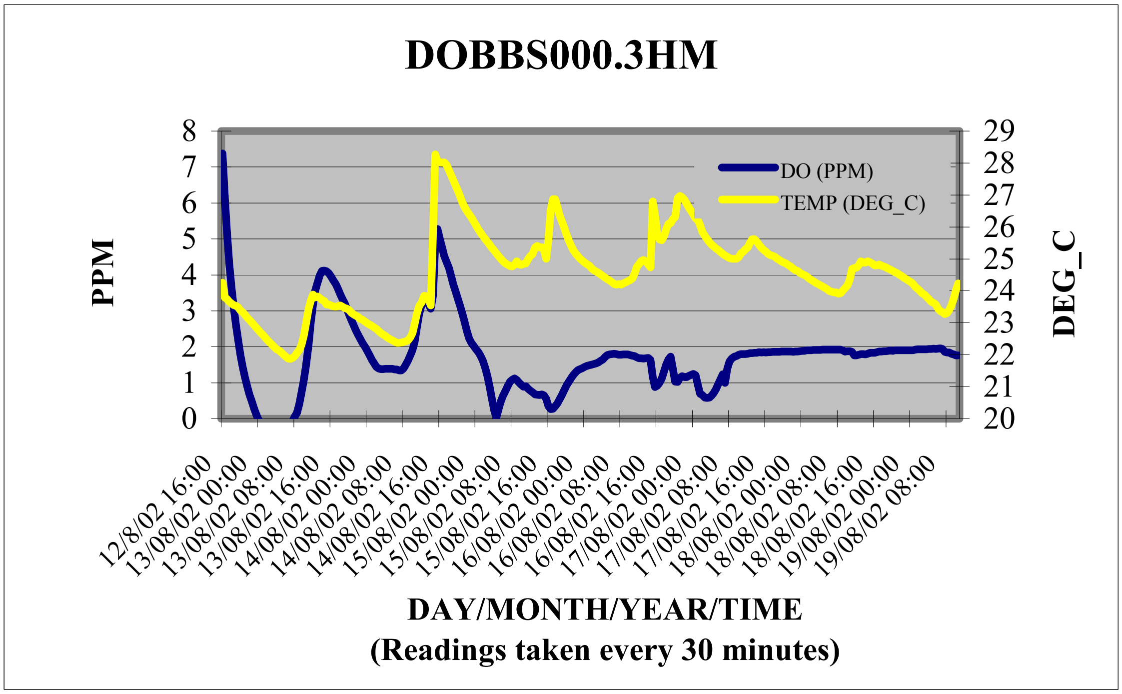


Figure 28: Diurnal dissolved oxygen and temperature data, Dobbs Branch test site, Southern Limestone/Dolomite Valleys and Low Rolling Hills (67f). Readings every 30 minutes for 162 hours.

Dissolved oxygen data from 170 non-reference sites were available in this region. Data were collected during daylight hours from 1996 to 2002 providing 907 readings. Only 11 sites had dissolved oxygen levels below 6 ppm. Of these, 5 streams were assessed as impaired for low DO while 2 were impaired from other causes.

Of the 4 remaining sites, 3 had stressed biological communities based on either biorecon or semi-quantitative surveys. Biological data were not available for the remaining site.

3.2.3 Southern Sandstone Ridges (67h) and Southern Dissected Ridges and Knobs (67i).

These 2 regions comprise a very small area of the state (2.2%). Due to the small area and lack of impaired streams in these regions, diurnal dissolved oxygen cycles were not monitored for this study. However, it is likely that diurnal patterns in these regions are similar to the surrounding 67f (Southern Limestone/Dolomite Valleys and Low Rolling Hills) discussed previously.

Seasonal reference data collected from 1995 to 2002 showed the lowest dissolved oxygen value was 7.7 ppm while most of the readings were well above 8 ppm (Table 18). Assuming a 2 ppm diurnal swing, it appears that a minimum DO level of 6 ppm is typical in least impaired streams in these regions.

Dissolved oxygen readings from 14 non-reference sites were well above 6 ppm. Biorecon data were available at 10 sites. Seven exhibited stressed biological communities while the other 3 had ambiguous results even though daytime dissolved oxygen levels were above 9 ppm at all sites. It is possible that diurnal swings at these sites are greater than reference sites since abundant algae was observed.

Table 18: Minimum dissolved oxygen levels at reference sites in ecological subregion 67h and 67i.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
67H04	NA	NA	NA	8.9	96	4
67H06	NA	NA	NA	8.6	87	4
67H08	NA	NA	NA	8.1	81	3
67I12	NA	NA	NA	8.4	82	3
All Sites	NA	NA	NA	7.8	81	14

3.2.4 Cumberland Plateau (68a)

Dissolved oxygen levels in reference streams on the Cumberland Plateau generally stay at 6 ppm or higher during the diurnal cycle although values did fall slightly lower for a few hours during the night. Continuous monitoring probes were deployed at 4 reference streams and 2 test streams in this subregion (Figure 29). DO values at 2 sites (Rock Creek and Laurel Fork of Station Camp Creek) never fell below 6 ppm and were generally above 7 ppm (Figure 30). DO levels fell as low as 5.7 ppm each evening at Island Creek with daytime highs below 7 ppm (Figure 31). Daddy’s Creek fell slightly below 6 ppm for 1 hour during the 7-day monitoring period (Table 19). Diurnal fluctuations were generally less than 1.0 ppm at all reference sites.

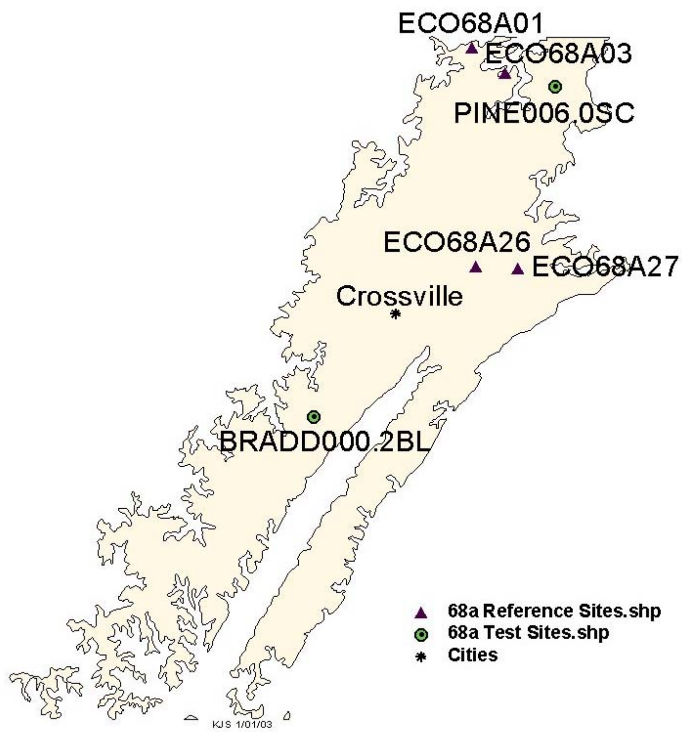


Figure 29: Location of diurnal monitoring stations in the Cumberland Plateau (68a).

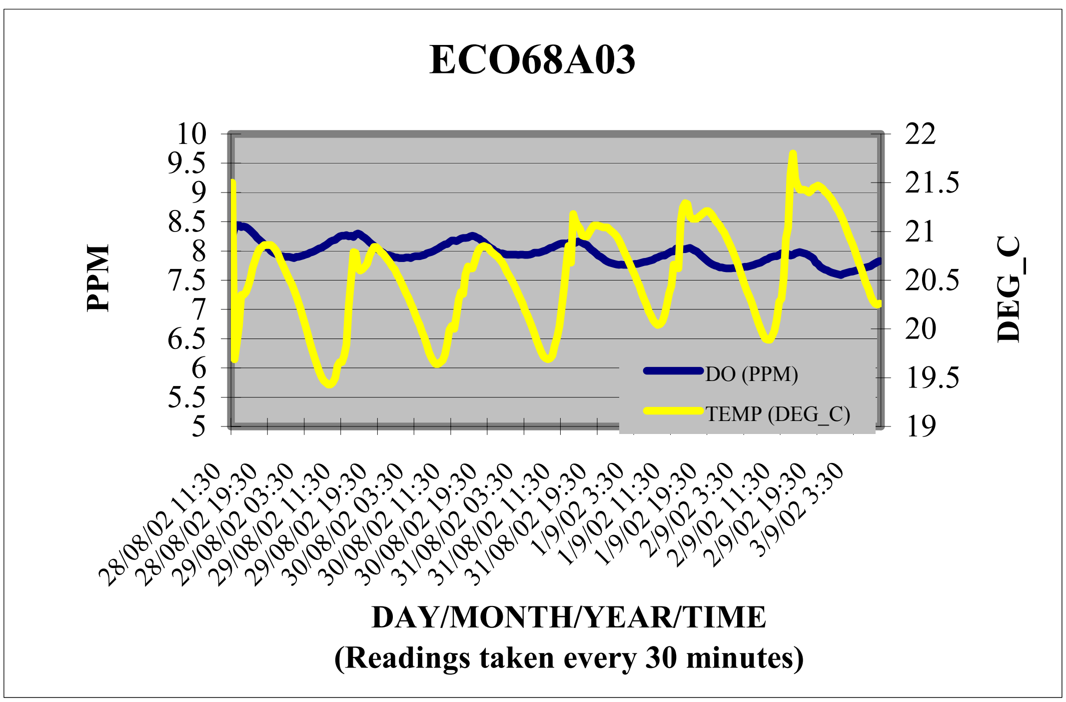


Figure 30: Diurnal dissolved oxygen and temperature data at Laurel Fork of Station Camp Creek reference site, Cumberland Plateau (68a). Readings every 30 minutes for 142 hours.

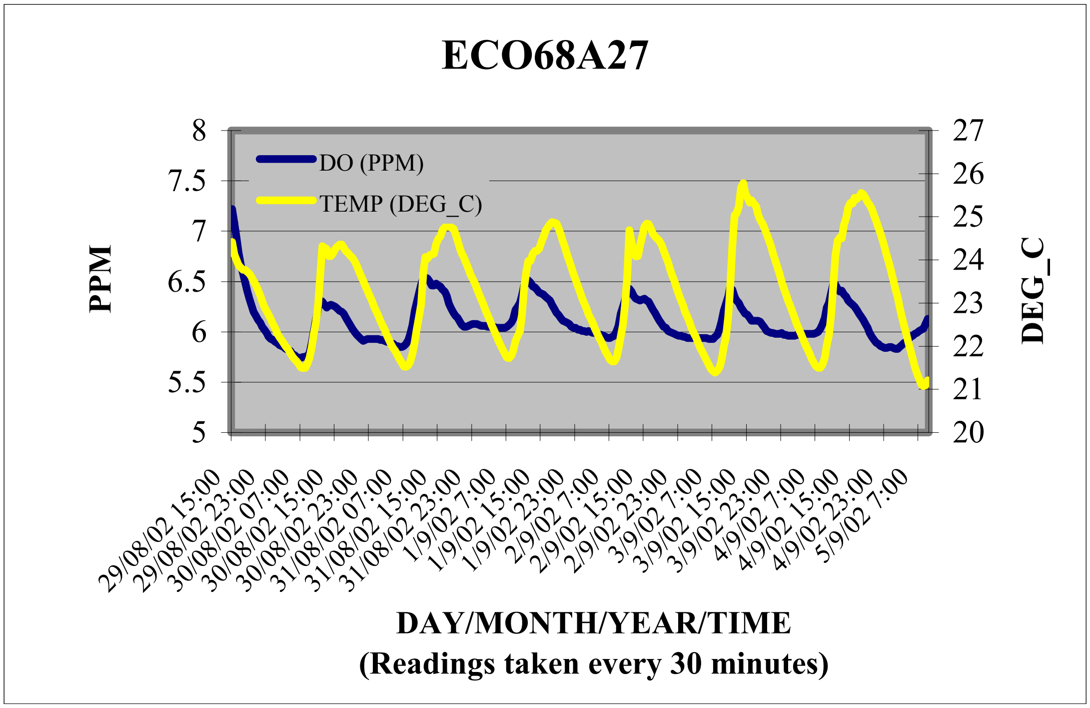


Figure 31: Diurnal dissolved oxygen and temperature data, Island Creek reference site, Cumberland Plateau (68a). Readings every 30 minutes for 162 hours.

Table 19: Frequency, magnitude and duration of reference stream diurnal dissolved oxygen readings less than 6 ppm in ecological subregion 68a. Based on 142 – 162 hours of monitoring during August and September, 2002).

Site	Frequency of Readings Less Than 6 ppm.	Magnitude of Lowest Reading (ppm)	Longest Duration of Readings Less Than 6 ppm (Hours).
ECO68A01	0	7.0	0
ECO68A03	0	7.6	0
ECO68A26	1	5.9	1
ECO68A27	5	5.7	11

Daylight readings taken seasonally at all 8 ecoregion reference streams over an 8-year period also indicated dissolved oxygen levels above 6 ppm were typical of unimpaired streams in this region (Table 20). Only 4 percent of the 93 daylight readings fell below 7 ppm. Using the 1 ppm diurnal swing observed in reference streams in this area, it is unlikely that dissolved oxygen values fell below 6 ppm during the cycle.

Table 20: Minimum dissolved oxygen levels at reference sites in ecological subregion 68a.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
68A01	7.0	80	161	7.9	72	17
68A03	7.6	85	142	7.6	74	17
68A08	NA	NA	NA	6.7	74	17
68A13	NA	NA	NA	9.1	87	2
68A20	NA	NA	NA	8.5	86	12
68A26	5.9	70	160	7.5	88	16
68A27	5.7	65	162	7.9	72	6
68A28	NA	NA	NA	6.5	65	6
All Sites	5.7	65	625	7.5	73	93

Segments of 3 streams in this region have been assessed as impaired due to low dissolved oxygen or organic enrichment/low DO. Diurnal probes were set up at 2 of these stream segments, Pine Creek and Bradden Creek. Dissolved oxygen levels at Pine Creek stayed above 6.5 ppm while Bradden Creek fell to 5.3 ppm. Although minimum DO levels were similar to reference sites, the diurnal swings were greater with values at Pine Creek fluctuating as much as 3 ppm during a 24-hour period (Figure 32).

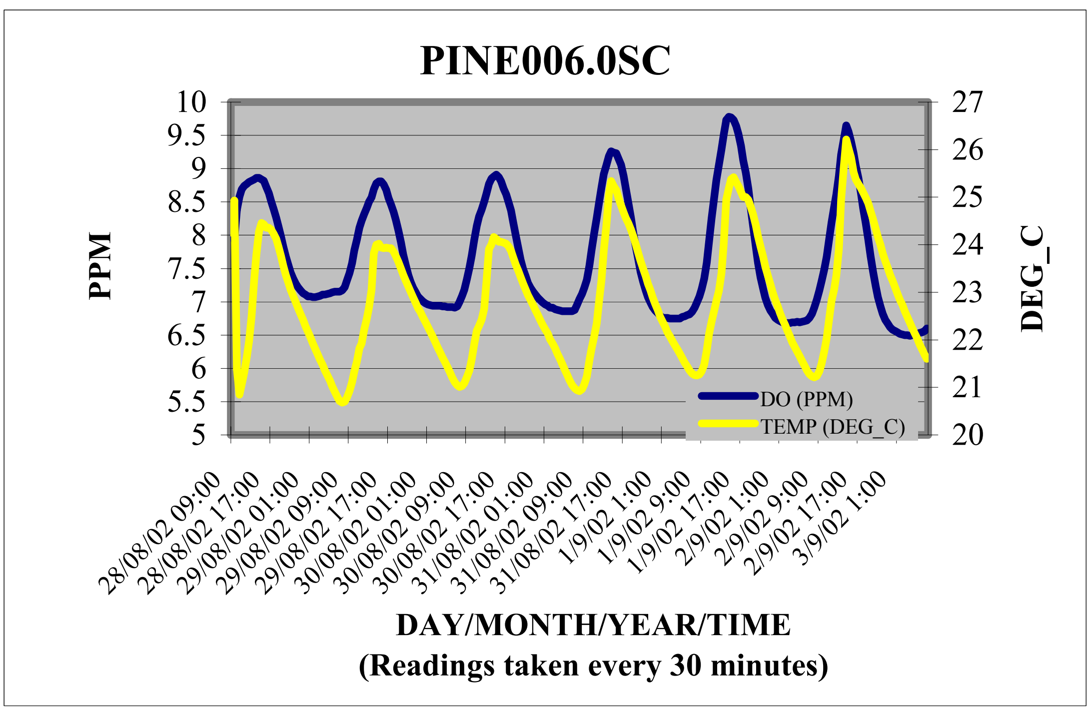


Figure 32: Diurnal dissolved oxygen and temperature data, Pine Creek test site, Cumberland Plateau (68a). Readings every 30 minutes for 142 hours.

Two hundred daylight readings were reviewed from 37 test sites on 28 streams to determine typical dissolved oxygen readings at non-reference streams. Values were below 6 ppm at only 7 sites on 4 streams. Three sites had been assessed as having stressed biological communities while the other 4 sites had not been assessed for fish and aquatic life. All 7 sites were located on impaired stream segments.

3.2.5 Cumberland Mountains (69d)

Streams in the Cumberland Mountains often go dry during the summer. Water depth and flow were only adequate in a single reference stream, No Business Branch, to perform diurnal monitoring during the study period (Figure 33). The minimum dissolved oxygen reading was 6.5 ppm. Daytime highs generally exceeded 8 ppm during this period. The greatest diurnal swing was 2 ppm. However, this may not reflect a typical pattern. Water levels dropped at this site during the monitoring period and the probe may have been partially exposed. Water temperatures during the latter half of the week were more than 10 degrees higher then previously recorded at reference sites in this region and may reflect sunlight hitting the probe in extremely shallow water.

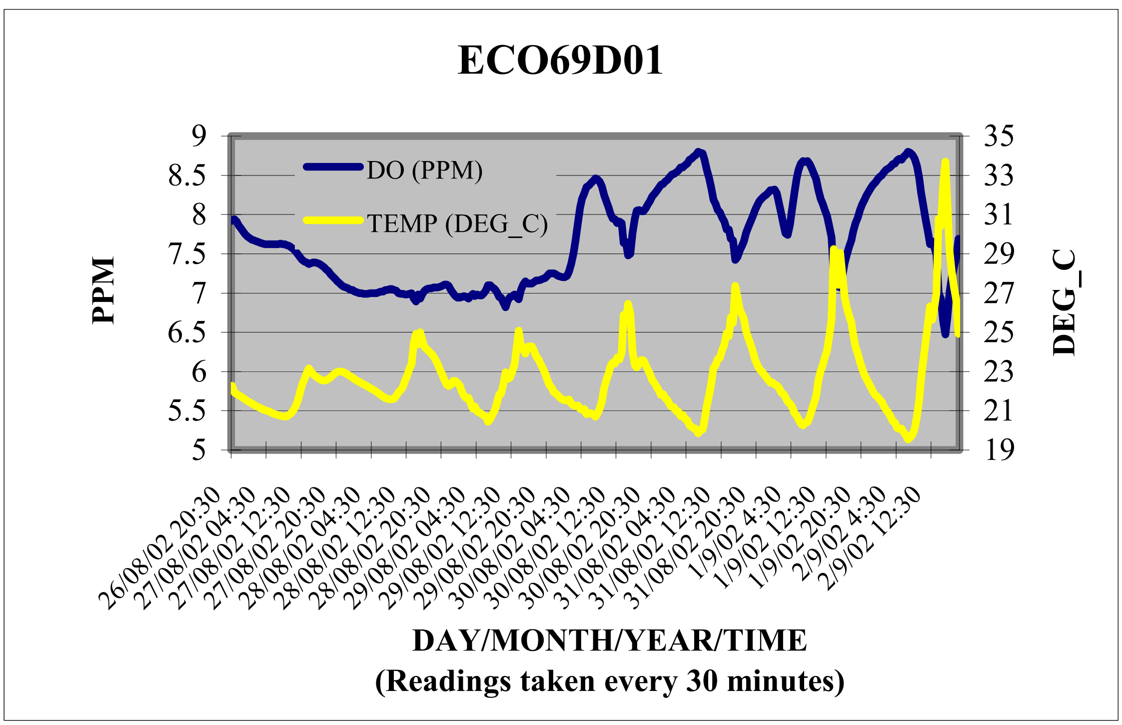


Figure 33: Diurnal dissolved oxygen and temperature data at No Business Branch reference site in the Cumberland Mountains (69d). Readings taken every 30 minutes for 166 hours.

Daylight readings over an 8-year period at 5 reference sites indicate a minimum DO of 6 ppm is typical of minimally impaired streams in this region (Table 21). Only 3 percent of readings fell below 6 ppm. The majority of daylight readings, 92 percent, were above 8 ppm indicating values probably remained above 6 ppm based on the diurnal study results, which indicated a 2 ppm diurnal fluctuation.

Table 21: Minimum dissolved oxygen levels at reference sites in ecological subregion 69d.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
69D01	6.5	78	166	8.5	87	17
69D03	NA	NA	NA	5.1	55	13
69D04	NA	NA	NA	8.4	81	18
69D05	NA	NA	NA	6.8	71	8
69D06	NA	NA	NA	8.5	77	8
All Sites	6.5	78	166	7.5	73	64

There are no streams currently assessed as impaired due to low dissolved oxygen levels in this region. Data were available from 8 non-reference streams. Daytime dissolved oxygen readings in these streams were at or above 8.9 ppm.

3.2.6 Western Pennyroyal Karst (71e)

Diurnal dissolved oxygen probes were set up at 2 reference sites and 3 test sites in this subregion (Figure 34).

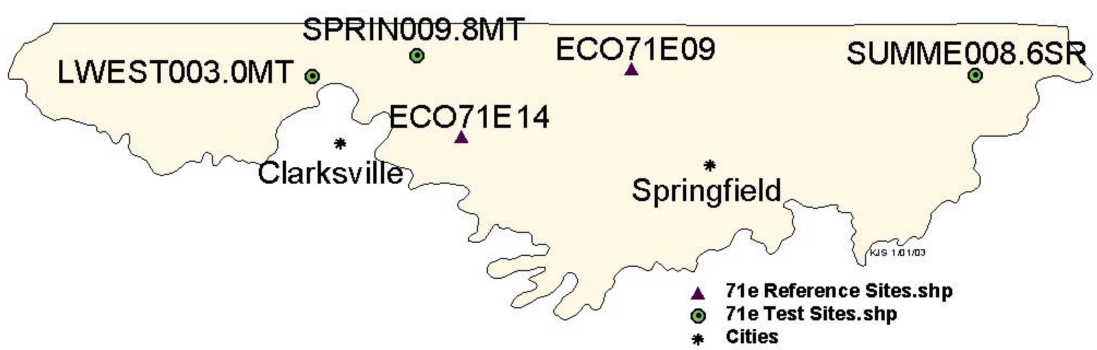


Figure 34: Location of diurnal monitoring stations in the Western Pennyroyal Karst (71e).

The minimum dissolved oxygen reading was 6.4 ppm. Diurnal swings were more pronounced at the Passenger Creek reference site, fluctuating almost 3 ppm during some 24-hour cycles (Figure 35). Buzzard Creek fluctuated less than 2 ppm during each cycle.

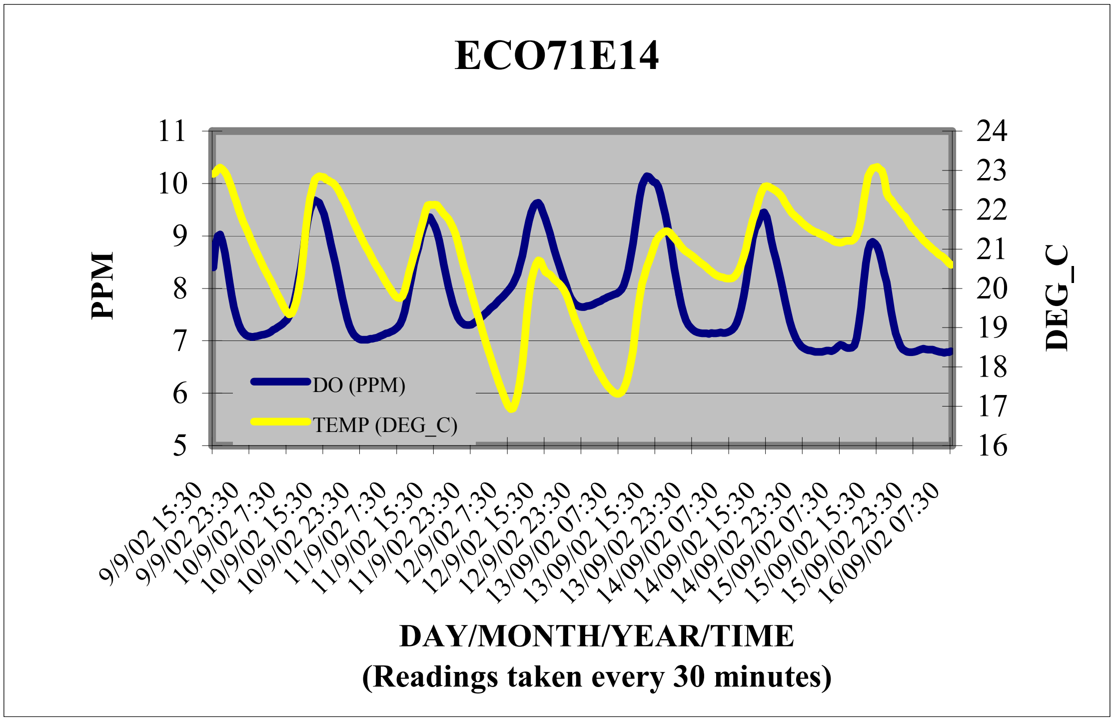


Figure 35: Diurnal dissolved oxygen and temperature data, Passenger Creek reference site, Western Pennyroyal Karst (71e). Readings every 30 minutes for 160 hours.

The maximum water temperature recorded during the 2002 diurnal study (23.1 ^{o}C) was 0.3 degrees lower than the maximum recorded during daylight monitoring from 1995 to 2002. Therefore, the diurnal monitoring may not reflect the lowest DO levels reached during extremely hot years although temperatures were above the mean value recorded during the 8-year period.

Daylight readings recorded seasonally at both reference streams also indicated 6 ppm was the minimum dissolved oxygen level naturally occurring in this region (Table 22). The 10th percentile of daylight dissolved oxygen values was 8.7 ppm. Assuming a maximum 3 ppm diurnal fluctuation, DO values should stay near 6 ppm. The 5 readings falling below 9 ppm were all recorded before 1:20 pm and probably do not reflect the peak reading which generally occurred 1 to 2 hours later based on the 2002 diurnal study.

Table 22: Minimum dissolved oxygen levels at reference sites in ecological subregion 71e.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
71E09	6.4	72	165	8.4	88	21
71E14	6.8	76	160	8.7	87	16
All Sites	6.4	72	325	8.6	87	37

Diurnal probes were deployed at 3 test sites that were listed as impaired due to low dissolved oxygen levels in this region. Dissolved oxygen levels stayed above 6 ppm at 2 of the sites, Little West Fork and Spring Creek. However, DO levels were below 6 ppm at Summers Branch for all but 2 four-hour periods during the 165 hours of continuous monitoring (Figure 36). Diurnal monitoring at a second location 6 miles upstream of the 2002 Little West Fork site was conducted a year earlier in August 2001. At that location, the highest daytime reading was 5.8 ppm and DO levels fell as low as 3 ppm during evening hours.

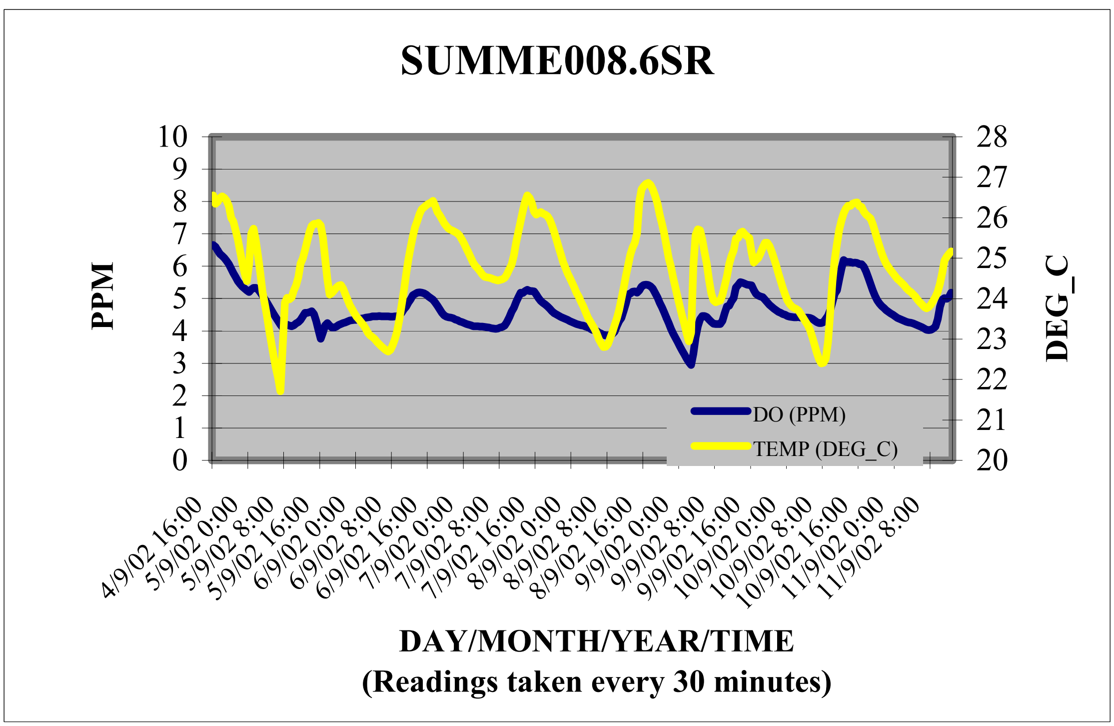


Figure 36: Diurnal dissolved oxygen and temperature data, Summers Branch test site, Western Pennyroyal Karst (71e). Readings every 30 minutes for 165 hours.

In addition to diurnal data, 62 daylight readings were available from 22 test sites. All dissolved oxygen values were above 6.0 ppm. Due to the possibility of a natural 3 ppm fluctuation in diurnal DO values, it is feasible that daytime readings could drop below 6 ppm during the night if highs of 9 ppm are not attained during the afternoon. Two sites, Carr Creek and Seven Springs Branch, had afternoon readings of 7.3 ppm and 7.5 ppm. Both sites failed biocriteria. Seven other sites had readings between 6 and 9 ppm, but these were all recorded during morning hours and it is less likely that DO fell below 6 ppm overnight.

3.2.7 Western Highland Rim (71f)

Continuous monitoring probes were set up at 5 reference sites and 2 test sites in the Western Highland Rim subregion (Figure 37). Reference dissolved oxygen levels stayed well above 6 ppm, with the lowest reading being 6.8 ppm at Swanegan Branch (Figure 38). The other 4 sites stayed above 7 ppm. Diurnal fluctuations were typically less than 2 ppm although the South Harpeth Creek reference site varied by 3 ppm within a 24-hour period during a storm event.

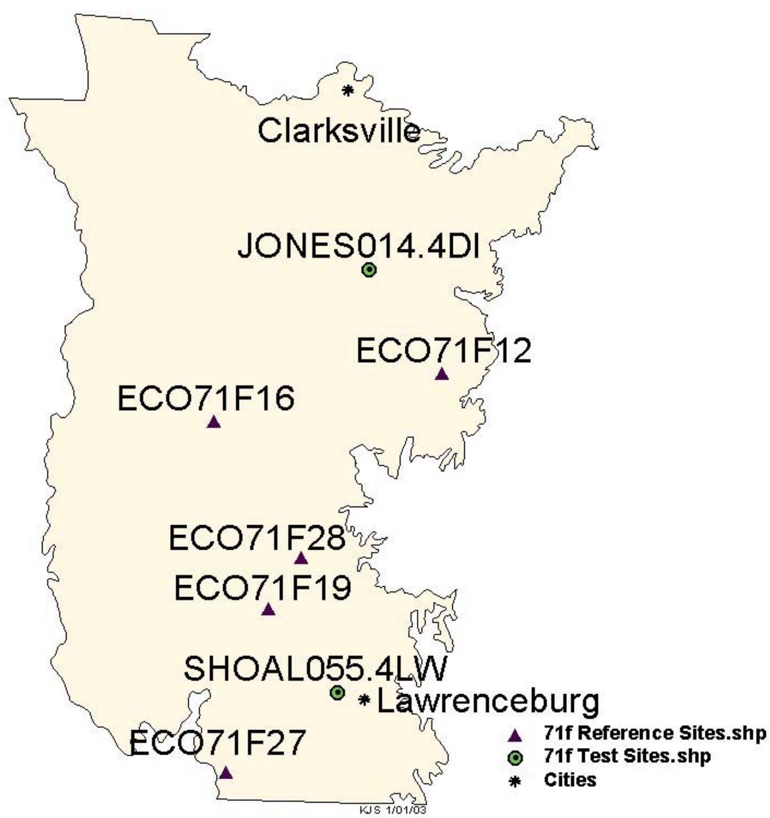


Figure 37: Location of diurnal monitoring stations in the Western Highland Rim (71f).

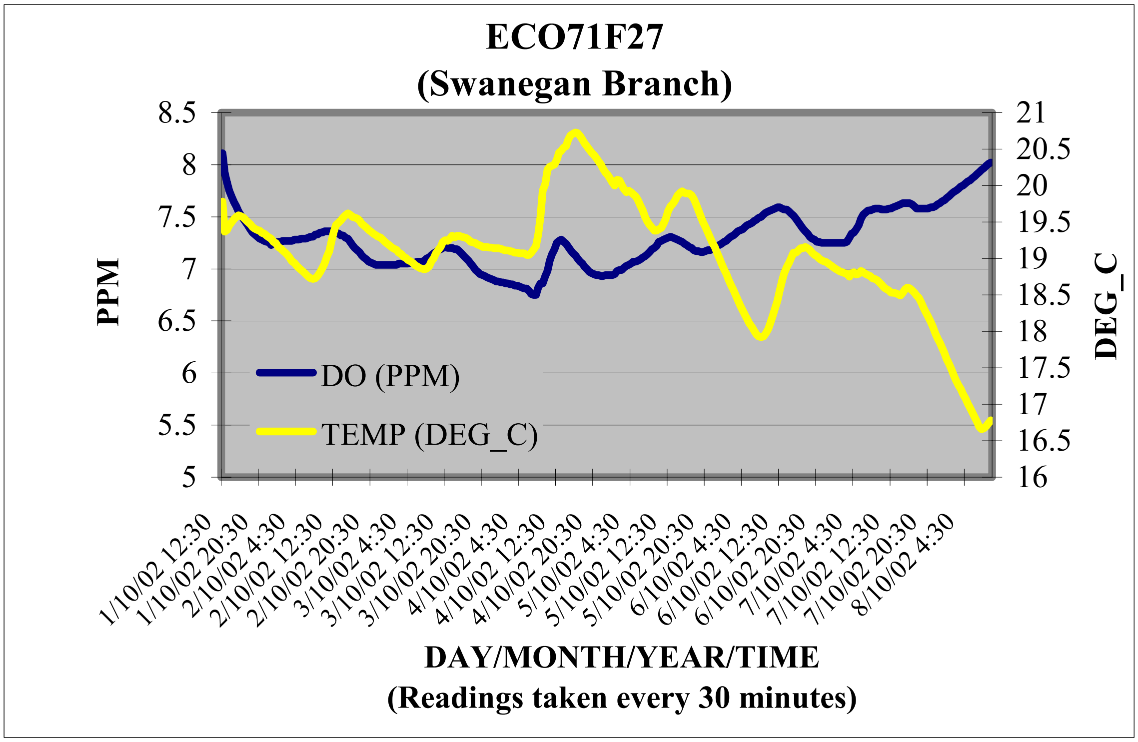


Figure 38: Diurnal dissolved oxygen and temperature data, Swanegan Branch reference site, Western Highland Rim (71f). Readings every 30 minutes for 166 hours.

Seasonal daylight readings taken over an 8-year period at the same 5 reference sites also suggest that 6 ppm is the minimum dissolved oxygen typical of natural systems in this region (Table 23). Out of 75 readings, none were less than 7 ppm. Ninety-two percent of the readings were above 8 ppm. Even allowing for a 2 ppm diurnal drop, DO values should not fall below 6 ppm in these streams.

Table 23: Minimum dissolved oxygen levels at reference sites in ecological subregion 71f.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
71F12	7.7	86	168	8.0	87	18
71F16	7.1	77	166	8.4	81	9
71F19	6.9	75	170	8.5	91	19
71F27	6.8	73	166	7.0	75	13
71F28	7.4	81	170	7.9	85	16
All Sites	6.8	73	840	8.1	85	915

Thirteen streams in this region have been assessed as impaired due to organic enrichment/low DO. Continuous monitoring probes were deployed at 2 of these sites as part of the diurnal dissolved oxygen study. Jones Creek dropped below 6 ppm during the evening hours of each diurnal cycle (Figure 39). Shoal Creek did not fall below 7 ppm either during this study or during diurnal monitoring conducted in 2001.

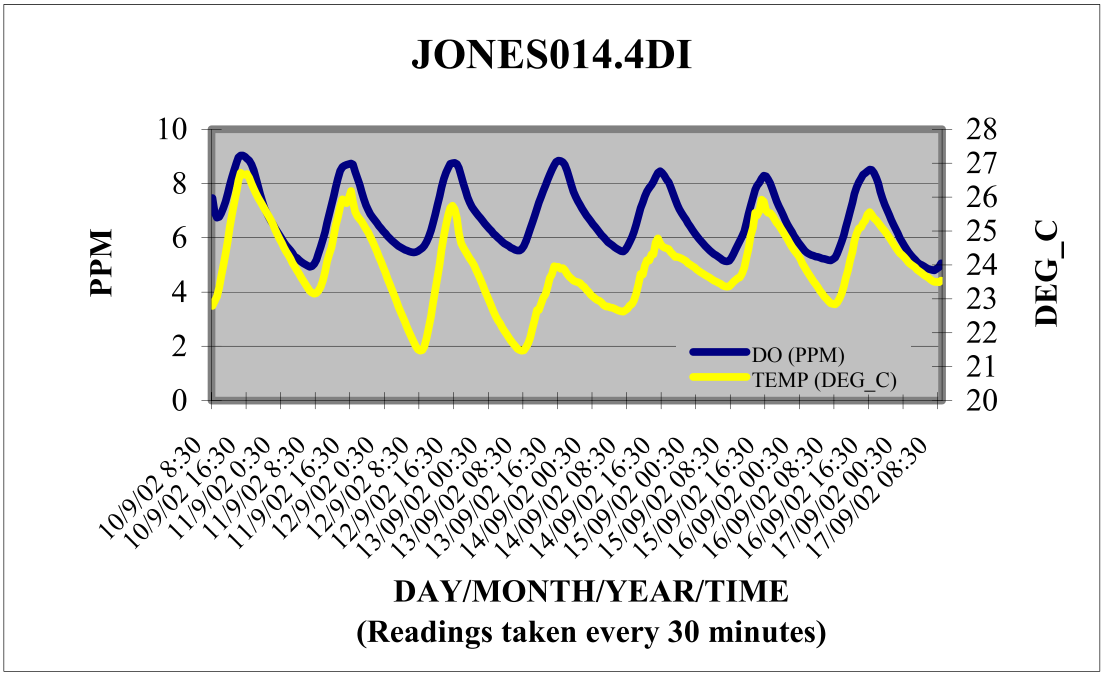


Figure 39: Diurnal dissolved oxygen and temperature data, Jones Creek test site, Western Highland Rim (71f). Readings every 30 minutes for 165 hours.

Seasonal daylight data were available from 30 test streams (250 readings). Ninety-six percent of the daylight readings were 8 ppm or above. Values between 6 ppm and 8 ppm tended to be collected during morning hours while dissolved oxygen levels are still rising. Only 2 sites had dissolved oxygen values less than 6 ppm, Eagle Creek (5.5 and 5.9 ppm) and Pryor Creek (5.4 and 5.5 ppm) each out of 11 readings. Eagle Creek has a stressed biological community based on recent biorecon data while Pryor Creek exhibits an unstable population based on semi-quantitative data.

The combination of reference and test data indicate that dissolved oxygen levels in unimpaired streams in this region typically remain above 6 ppm.

3.2.8 Loess Plains (74b)

Diurnal monitoring was conducted at 1 reference site and 2 test sites in the Loess Plains (Figure 40). Although 3 reference sites are established in this region, 2 had inadequate flow or depth. Therefore, diurnal monitoring was only conducted at 1 reference site, Terrapin Creek (Figure 41). Only 94 hours of low flow data are available due to heavy rains at the site the last 3 days of monitoring. Dissolved oxygen did not fall below 6.5 ppm and generally fluctuated by less than 2 ppm during each diurnal period.

The maximum water temperature of 20.6 ^{o}C recorded during the first 94 hours was 2.8^{o}C lower than the maximum daylight reading from 1995 to 2002. However, it was higher than the mean value recorded between July and October during the 8-year period (18.8^{o}C). It is possible that dissolved oxygen levels would be lower with higher water temperatures.

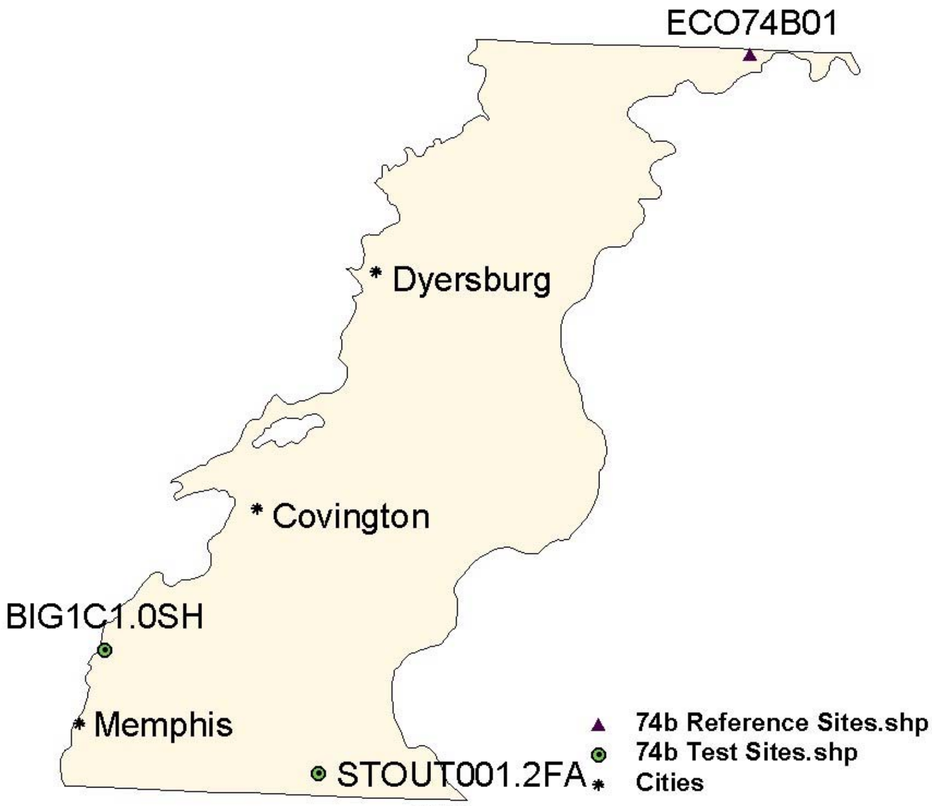


Figure 40: Location of diurnal monitoring stations in the Loess Plains (74b).

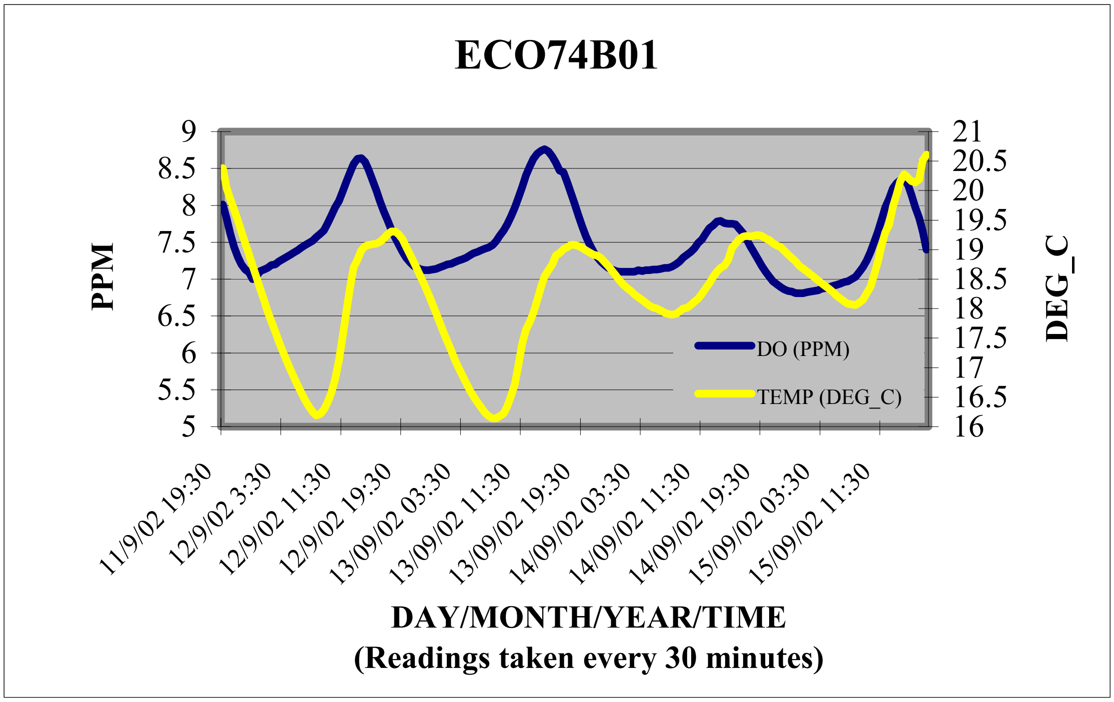


Figure 41: Diurnal dissolved oxygen and temperature data, Terrapin Creek reference site, Loess Plains (74b). Readings every 30 minutes for 94 hours.

Only 1 of 68 daylight readings taken seasonally at all 3 reference sites in this subregion was below 6 ppm (Table 24). Eighty percent were above 8 ppm allowing for a drop of 2 ppm during the 24-hour cycle. Most of the other readings were taken during morning hours so, based on existing diurnal data, it is unlikely the dissolved oxygen levels had already reached their maximum indicating evening values would not fall below 6 ppm.

Table 24: Minimum dissolved oxygen levels at reference sites in ecological subregion 74b.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
74B01	6.8	56	94	8.1	82	23
74B04	NA	NA	NA	8.4	86	25
74B06	NA	NA	NA	3.9	43	2
74B12	NA	NA	NA	7.4	76	18
All Sites	6.8	56	94	7.5	79	68

Diurnal probes were deployed at 2 impaired test sites in this subregion. Big Creek dropped to 0 ppm for 3 days before climbing back above 5 ppm. Dissolved oxygen levels at Stout Creek generally stayed above 5 ppm but were often less than 6 ppm (Figure 42). This stream did not appear to follow a typical diurnal cycle. A second probe was set during the same time for QC purposes and displayed a similar pattern although DO generally stayed slightly above 6 ppm with the second probe.

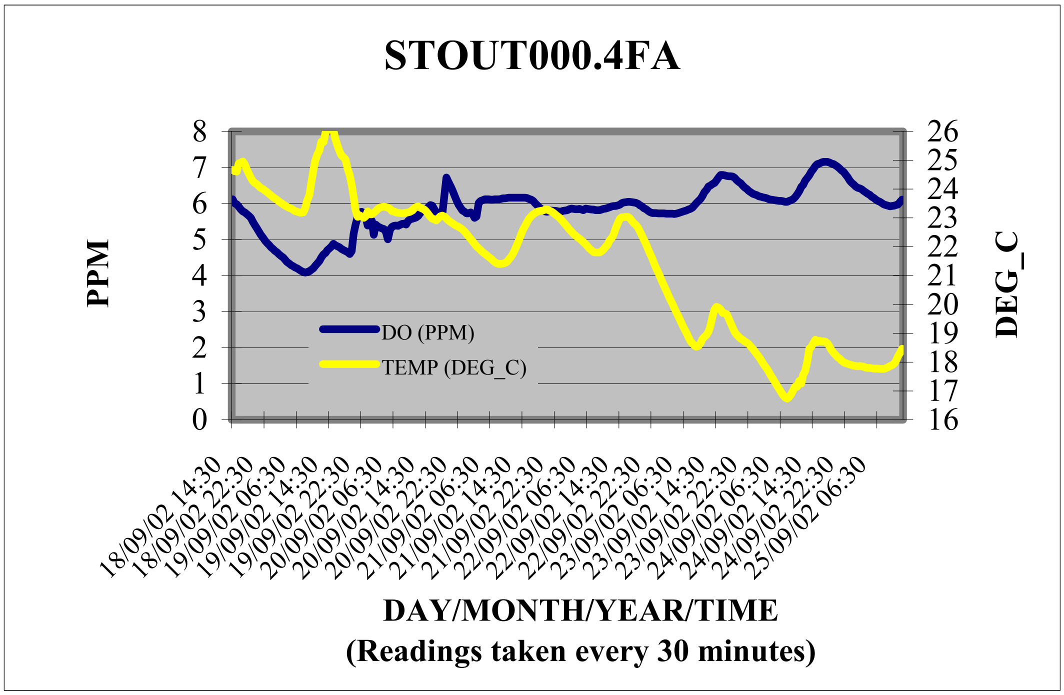


Figure 42: Diurnal dissolved oxygen and temperature data, Stout Creek test site, Loess Plains (74b). Readings every 30 minutes for 136 hours. A second probe set up at the same site yielded similar results.

Multiple dissolved oxygen readings were available from 87 test sites in this region. Thirty-one of the sites had daytime dissolved oxygen readings less than 6 ppm. Twenty of these readings were less than the current criterion of 5 ppm. Of the 11 sites that had DO readings between 5 and 6 ppm, 8 exhibited stressed biological communities while the other 3 did not have biological data available for assessment.

3.3 Dissolved Oxygen Levels in the Blue Ridge Mountains

Dissolved oxygen levels in the Blue Ridge Mountains are higher than any other ecoregion in Tennessee. The steep gradients, cold water temperatures and rocky substrates facilitate oxygenation. Nutrient levels are low in these regions, so algae and aquatic plants are not abundant. Diurnal fluctuations are minimal, less than 2 ppm in most subregions, likely because photosynthesis is not the primary source of oxygen.

Three subregions of the Blue Ridge Mountains had minimum dissolved oxygen levels of 7 ppm. These 3 subregions comprise 5% of the area of the state. One subregion, the Southern Igneous Ridges and Mountains comprising 0.6% of the state, had minimum DO levels of 8 ppm. Aquatic life in the Blue Ridge has adapted to the consistently high dissolved oxygen and is dependent on its availability.

3.3.0 Limestone Valleys and Coves (66f)

Diurnal dissolved oxygen measurements were recorded at 2 reference sites in the Limestone Valleys and Coves (66f). Both sites revealed similar diurnal patterns. Dissolved oxygen levels were relatively stable and did not vary by more than 1.5 ppm within any 24 hour period (Figure 43). The lowest value at either site was 7.5 ppm with the maximum value reaching above 9 ppm.

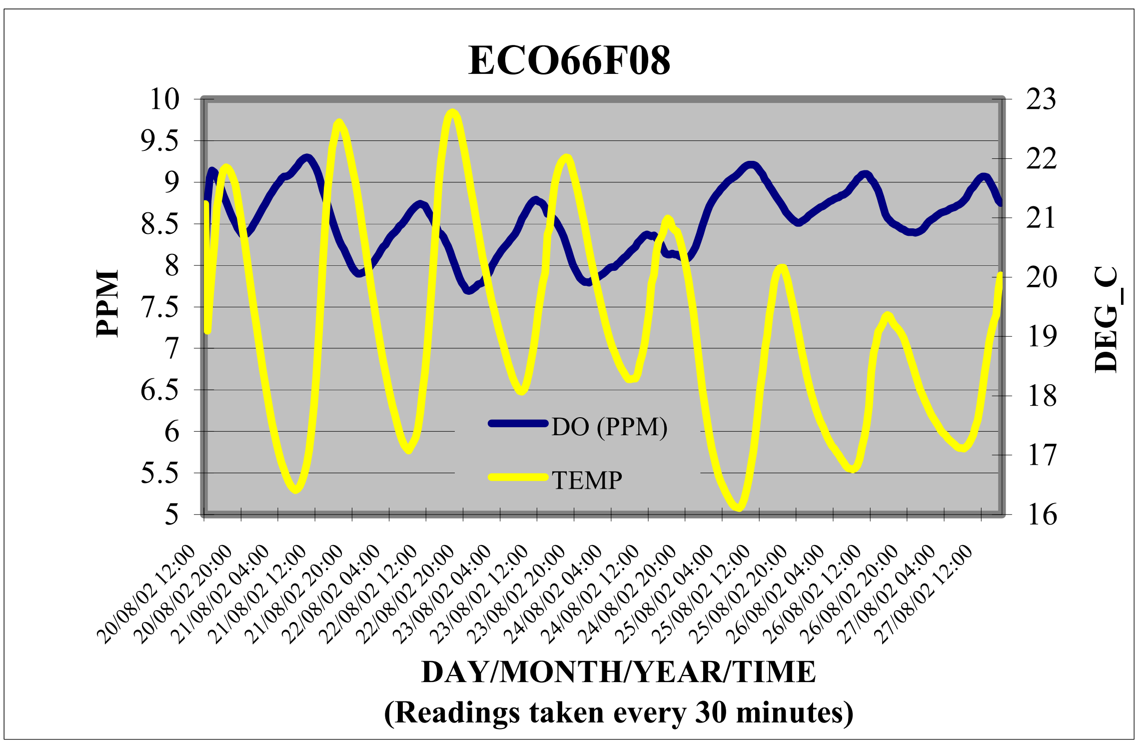


Figure 43: Diurnal dissolved oxygen and temperature data, Stoney Creek reference site, Limestone Valleys and Coves (66f). Readings every 30 minutes for 172 hours.

Only 2 of 28 dissolved oxygen readings recorded from 3 reference sites from 1995 to 2002 were below 8 ppm. The 10^{th} percentile was 8.1 ppm (Table 25). Saturation levels were higher than other regions, not falling below 86 percent. Historic dissolved oxygen data at non-reference sites were not available for comparison.

Table 25: Minimum dissolved oxygen levels at reference sites in ecological subregion 66f.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10^{TH} percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
66F06	NA	NA	NA	8.0	78	16
66F07	7.5	85	176	8.1	85	8
66F08	7.7	86	172	9.5	89	4
All Sites	7.5	85	348	8.1	80	28

Steep gradients, low temperatures and rocky substrates facilitate high dissolved oxygen levels in Blue Ridge Mountain streams such as this reference site on the Little River. *Photo provided by Aquatic Biology, TDH.*

3.3.1 Southern Metasedimentary Mountains (66g)

Minimum dissolved oxygen values of 7 ppm also appear to typify another Blue Ridge subregion, the Southern Metasedimentary Mountains (66g). Diurnal monitoring was conducted at 5 reference sites in this subregion. The lowest diurnal reading recorded at any site was 7.3 ppm. Generally levels stayed above 8 ppm. There was very little diurnal fluctuation at any reference site with most readings staying within 1 ppm over each 24-hour period (Figure 44).

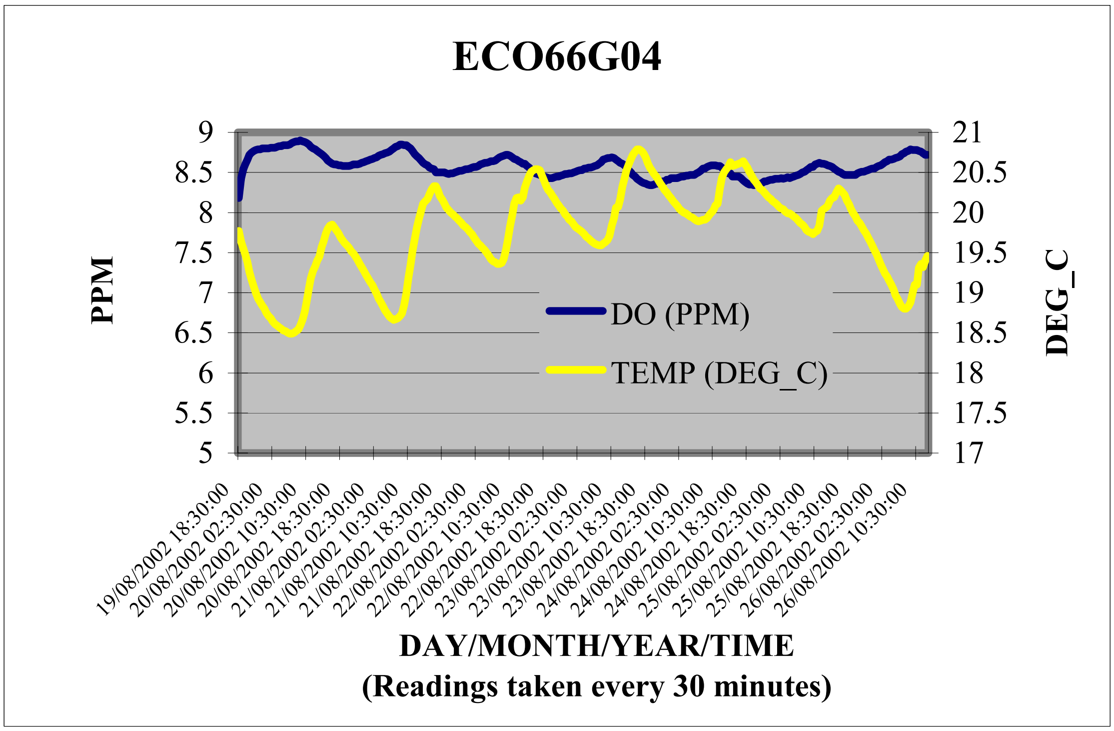


Figure 44: Diurnal dissolved oxygen and temperature data, Middle Prong Little Pigeon River reference site, Southern Metasedimentary Mountains (66g). Readings every 30 minutes for 163 hours.

Daylight monitoring also suggested that dissolved oxygen levels of 7 ppm or higher are typical of streams in this region (Table 26). Only 1 out of 60 readings at ecoregions reference sites over an 8-year period yielded a value less than 8 ppm (7.9 ppm). Since diurnal data indicate less than 1 ppm daily fluctuation, it is unlikely that dissolved oxygen readings fall below 7 ppm during the night at any of these sites.

Table 26: Minimum dissolved oxygen levels at reference sites in ecological subregion 66g.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
66G04	8.2	90	163	9.1	88	10
66G05	7.3	79	162	9.0	86	18
66G07	7.3	88	168	7.9	89	10
66G09	8.2	91	169	8.7	89	9
66G12	7.4	85	171	8.2	88	13
All Sites	7.3	85	833	8.3	86	60

There are no streams currently assessed as impaired due to low dissolved oxygen in this region. Therefore, diurnal probes were not deployed at non-reference streams in accordance with study design. Daylight readings from 5 non-reference sites were evaluated. None of the sites had DO values less than 7.0 ppm during daylight hours. Tellico River was the only stream with levels between 7 ppm and 8 ppm. However, all readings were in the morning and it is unlikely they represent the peak levels. Therefore, given the 1 ppm diurnal cycle, it is probable that all test streams maintained nocturnal DO levels of 7 ppm or greater.

3.3.2 Southern Sedimentary Ridges (66e)

Diurnal dissolved oxygen monitoring was conducted at 2 reference sites in this subregion. DO levels stayed above 7.7 ppm and did not fluctuate by more than 1 ppm during each diurnal period (Figure 45). However, it should be noted that the maximum water temperature during the 2002 diurnal study (19.81^{o}C) was 0.8 degrees lower than the maximum value recorded from 1995 to 2002. It is possible that dissolved oxygen levels would be lower when water temperatures are higher.

Despite the slightly lower temperature recoded during the 2002 study, seasonal daytime DO monitoring over an 8-year period at 5 reference sites supported the diurnal results (Table 27). The lowest DO reading was 8.1 ppm with the 10th percentile at 8.6 ppm. Even allowing for the full 1 ppm diurnal drop suggested by the diurnal monitoring, dissolved oxygen levels could be expected to remain above 7 ppm.

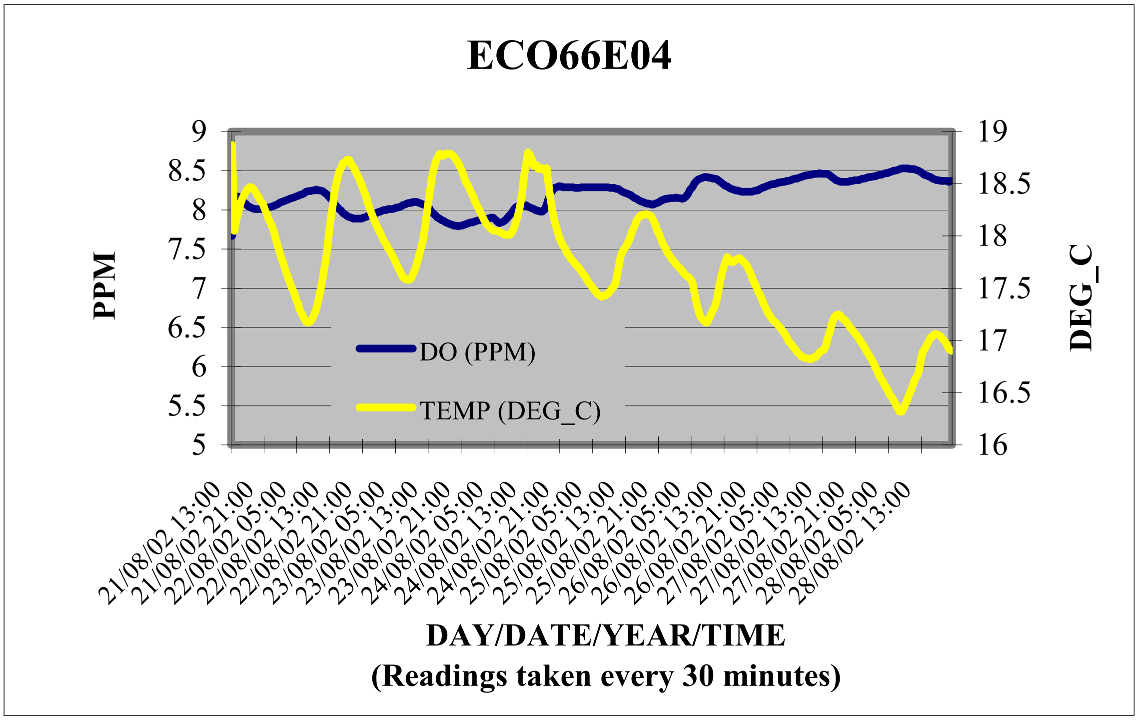


Figure 45: Diurnal dissolved oxygen and temperature data, Gentry Creek reference site, Southern Sedimentary Mountains (66e). Readings every 30 minutes for 163 hours.

Table 27: Minimum dissolved oxygen levels at reference sites in ecological subregion 66g.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
66E04	7.7	82	176	11.9	90	1
66E09	NA	NA	NA	8.4	95	13
66E11	8.0	86	173	8.6	83	12
66E17	NA	NA	NA	8.9	79	3
66E18	NA	NA	NA	8.6	94	8
All sites	7.7	82	349	8.6	84	37

There are no streams in this region currently assessed as impaired due to low dissolved oxygen levels. Data were available from 9 non-reference sites. None had DO levels below 8 ppm during the day. Therefore, based on existing diurnal data, it is unlikely that values fell below 7 ppm during the night.

3.3.3 Southern Igneous Ridges and Mountains (66d)

Aquatic life in this subregion of the Blue Ridge Mountains has adapted to the unique environment of these high elevations. Dissolved oxygen levels were the highest of any region studied. Diurnal dissolved oxygen readings were not taken in this region since oxygen levels are naturally high and are not expected to change significantly through a 24-hour period due to a scarcity of algae and aquatic plants in streams of this region.

Daylight dissolved oxygen readings were taken at 5 reference sites from 1995 to 2002 (Table 28). Dissolved oxygen did not fall below 8.6 ppm at any reference site during the 8-year period. The 10th percentile of data was 8.9 ppm. Diurnal fluctuations in the other high elevation subregions of the Blue Ridge did not exceed 1.0 ppm. It is unlikely that diurnal DO fluctuations in this region would be greater. Since the 10th percentile of daylight readings was 8.9 ppm and the majority of those readings were taken in the morning before oxygen levels had reached their peak, it is reasonable to assume that levels do not fall below 8.0 ppm during the night. Percent saturation is high in this region, typically staying at 89% or above.

Table 28: Minimum dissolved oxygen levels at reference sites in ecological subregion 66d.

Site (ECO)	Diurnal Minimum DO (ppm)	Diurnal Minimum Saturation (%)	Diurnal Monitoring Time (hours)	Daylight DO 10TH percentile (ppm)	Daylight Reading Saturation (%)	Number of Daylight Readings
66D01	NA	NA	NA	9.0	89	17
66D03	NA	NA	NA	8.8	88	15
66D05	NA	NA	NA	8.9	90	9
66D06	NA	NA	NA	9.5	99	1
66D07	NA	NA	NA	8.9	90	3
All Sites	NA	NA	NA	8.9	89	45

There are currently no sites assessed as impaired due to low dissolved oxygen in this subregion. Fifty-four dissolved oxygen readings from 21 test sites were compared to the minimum reference level to determine if dissolved oxygen readings of 8 ppm were typical of non-reference sites. Four sites had dissolved oxygen reading less than 8 ppm (7.5 to 7.8). Biorecon data were available at each site, but gave ambiguous results. It is not possible with this level of monitoring to determine if the biological community is healthy. Two of the sites had degraded habitat making it even more difficult to determine if dissolved oxygen had an affect on the biota.

Based on these data, it is clear that dissolved oxygen levels of 8 ppm or greater are supportive of a healthy biological community in these areas. No site with dissolved oxygen levels less than 8 ppm clearly maintained the aquatic community expected in this region. However, more rigorous biological testing would be needed to confirm the affect of dissolved oxygen concentrations between 7 and 8 ppm. Based on these observations, it is likely that periodic, short drops to 7 ppm would have no adverse effect on the biota. Data are not available to determine if lower values would have an adverse effect since none of the test sites fell below this value.

SUMMARY

Analysis of diurnal and historic daylight dissolved oxygen monitoring at reference stations indicate that dissolved oxygen levels vary in different regions. Tennessee's 25 ecological subregions can be divided into 5 regions based on the minimum DO levels generally found in least impaired wadeable streams (Figure 46).

Streams in one region, the Northern Mississippi Alluvial Plain (73a) have naturally low dissolved oxygen levels with non-impaired streams generally having dissolved oxygen levels of 3 ppm or higher. Ten subregions, representing 30 percent of the state, had dissolved oxygen that generally stayed above 5 ppm. Ten other regions, comprising over 60 percent of the state typically maintained DO levels at or above 6 ppm. Ecological subregions in the Blue Ridge mountains have the highest dissolved oxygen levels with 3 regions having minimum reference values of 7 ppm and 1 region having minimum reference levels of 8 ppm.

It is important that diurnal dissolved oxygen patterns be considered when determining whether a stream is meeting water quality criteria for DO. Readings during daylight hours alone may be inadequate since the lowest readings typically occur at night. Diurnal patterns observed during this study can be used as tools for predicting probable diurnal fluctuations in test streams when only daylight data are available.

Streams in most ecoregions had a diurnal fluctuation of 2 ppm dissolved oxygen although cycles in mountainous regions only varied by 1 ppm. Reference streams in some regions in middle Tennessee varied as much as 4 ppm (Table 29). Dramatic daily flucutations in dissolved oxygen levels may affect aquatic life even if minimum levels are maintained. Diurnal fluctuations at impaired test sites were generally greater than reference sites.

Percent saturation is an important consideration in some regions, especially those with lower dissolved oxygen patterns such as the Northern Mississippi Alluvial Plain (73a). In cold weather, a higher dissolved oxygen levels may be required to maintain an adequate concentration to support aquatic life.

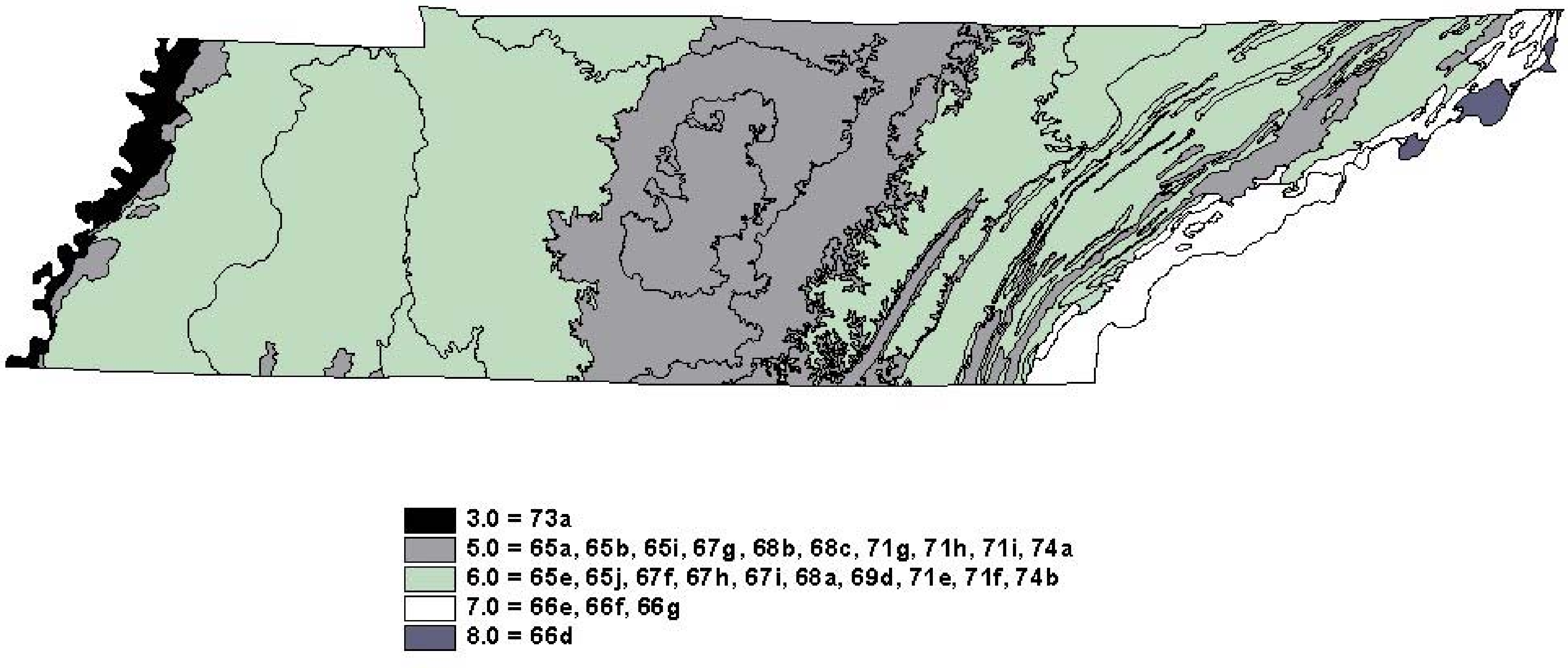


Figure 46: Minimum dissolved oxygen levels generally expected in wadeable streams based on diurnal and daylight ecoregion reference data (1995 – 2002).

Table 29: Dissolved oxygen patterns by ecological subregion including minimum values, diurnal fluctuations and percent saturation information. Data based on 7-day diurnal monitoring conducted August – October 2002, and daylight readings 1995 – 2002.

Ecoregion	Minimum DO (ppm)	Magnitude of DO Below Minimum (ppm)	Frequency of DO Below Minimum (Over 7 days)	Duration of DO Below Minimum Within 24 Hours. (Hours)	Maximum Diurnal Fluctuation (ppm)	Percent Saturation (10^{th} percentile)
73a	3.0	NA	NA	NA	NA	30
65a	5.0	NA	NA	NA	NA	50
65b	5.0	NA	NA	NA	NA	50
65i	5.0	NA	NA	NA	NA	60
67g	5.0	4.0	6	17	2	40
68b	5.0	NA	NA	NA	NA	60
68c	5.0	NA	NA	NA	NA	60
71g	5.0	5.0	0	0	2	60
71h	5.0	3.0	4	11	3	40
71i	5.0	4.0	2	8	4	40
74a	5.0	NA	NA	NA	NA	70
65e	6.0	5.0	1	14	2	60
65j	6.0	6.0	0	0	1	50
67f	6.0	6.0	0	0	2	80
67h	6.0	NA	NA	NA	NA	80
67i	6.0	NA	NA	NA	NA	80
68a	6.0	5.5	5	11	1	70
69d	6.0	6.0	0	0	2	60
71e	6.0	6.0	0	0	3	70
71f	6.0	6.0	0	0	2	70
74b	6.0	6.0	0	0	2	60
66f	7.0	7.0	0	0	2	70
66g	7.0	70	0	0	1	80
66e	7.0	7.0	0	0	1	70
66d	8.0	NA	NA	NA	NA	90

LITERATURE CITED

Arnwine, D.H., J.I. Broach, L.K. Cartwright and G.M. Denton. 2000. *Tennessee Ecoregion Project.* Tennessee Department of Environment and Conservation, Division of Water Pollution Control. Nashville, TN.

Denton, G.M., A.D. Vann and S.H. Wang. 2000. *The Status of Water Quality in Tennessee: Year 2000 305(b) Report. Tennessee Department of Environment and Conservation,* Division of Water Pollution Control. Nashville, TN

Griffith, G.E., J.M. Omernik and S. Azevedo. 1997. *Ecoregions of Tennessee.* EPA/600/R-97/022. NHREEL, Western Ecological Division, U.S. Environmental Protection Agency, Corvallis, Oregon.

Tennessee Department of Environment and Conservation. 1999. *Rules of the Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Chapter 1200-4-3, General Water Quality Criteria.* Tennessee Water Quality Control Board, Nashville, TN

APPENDIX A

LIST OF ECOREGION REFERENCE SITES

TENNESSEE ECOREGION REFERENCE SITES

SITE #	STREAM	USGS HUC	COUNTY
ECO65A01	UT. TO MUDDY CREEK	08010207 UPPER HATCHIE	MCNAIRY
ECO65A03	WARDLOW CREEK	06040001 TN WESTERN VALLEY	MCNAIRY
ECO65B04	CYPRESS CREEK	08010207 UPPER HATCHIE	HARDEMAN
ECO65E04	BLUNT CREEK	06040005 TN WESTERN VALLEY	CARROLL
ECO65E06	GRIFFIN CREEK	08010204 S FORK FORKED DEER	HENDERSON
ECO65E08	HARRIS CREEK	08010201 N FK FORKED DEER	MADISON
ECO65E10	MARSHALL CREEK	08010208 LOWER HATCHIE	HARDEMAN
ECO65E11	WEST FORK SPRING CREEK	08010208 LOWER HATCHIE	HARDEMAN
ECO65I02	BATTLES BRANCH	06030005 TN PICKWICK LAKE	HARDIN
ECO65J04	POMPEYS BRANCH	06030005 TN PICKWICK LAKE	HARDIN
ECO65J05	DRY CREEK	06030005 TN PICKWICK LAKE	HARDIN
ECO65J06	RIGHT FORK WHITES CREEK	06040001 TN WESTERN VALLEY	HARDIN
ECO65J11	UT RT FORK WHITES CR	06040001 TN WESTERN VALLEY	HARDIN
ECO66D01	BLACK BRANCH	06010103 WATAUGA	CARTER
ECO66D03	LAUREL FORK	06010103 WATAUGA	CARTER
ECO66D05	DOE RIVER	06010103 WATAUGA	CARTER
ECO66D06	TUMBLING CREEK	06010108 NOLICHUCKY	CARTER
ECO66D07	LITTLE STONEY CREEK	06010103 WATAUGA	CARTER
ECO66E04	GENTRY CREEK	06010102 SOUTH FORK HOLSTON	JOHNSON
ECO66E09	CLARK CREEK	06010108 NOLICHUCKY	UNICOI
ECO66E11	LOWER HIGGENS CREEK	06010108 NOLICHUCKY	UNICOI

SITE #	STREAM	USGS HUC	COUNTY
ECO66E17	DOUBLE BRANCH	06010201 FORT LOUDOUN	BLOUNT
ECO66E18	GEE CREEK	06020002 HIWASSEE	POLK
ECO66F06	ABRAMS CREEK	06010204 LITTLE TENNESSEE	BLOUNT
ECO66F07	BEAVERDAM CREEK	06010102 SOUTH FORK HOLSTON	JOHNSON
ECO66F08	STONY CREEK	06010103 WATAUGA	CARTER
ECO66G04	MIDDLE PRONG LITTLE PIGEON RIVER	06010107 LOWER FRENCH BROAD	SEVIER
ECO66G05	LITTLE RIVER	06010201 FT LOUDOUN/LITTLE R	SEVIER
ECO66G07	CITICO CREEK	06010204 LITTLE TENNESSEE	MONROE
ECO66G09	NORTH RIVER	06010204 LITTLE TENNESSEE	MONROE
ECO66G12	SHEEDS CREEK	03150101 CONASAUGA	POLK
ECO67F06	CLEAR CREEK	06010207 LOWER CLINCH	ANDERSON
ECO67F13	WHITE CREEK	06010205 UPPER CLINCH	UNION
ECO67F14	POWELL RIVER	06010206 POWELL	HANCOCK
ECO67F16	HARDY CREEK	06010206 POWELL	LEE COUNTY, VA
ECO67F17	BIG WAR CREEK	06010205 UPPER CLINCH	HANCOCK
ECO67F23	MARTIN CREEK	06010206 POWELL	HANCOCK
ECO67F25	POWELL RIVER	06010206 POWELL	CLAIBORNE
ECO67G01	LITTLE CHUCKY	06010108 NOLICHUCKY	GREENE
ECO67G05	BENT CREEK	06010108 NOLICHUCKY	HAMBLEN
ECO67G08	BRYMER CREEK	06020002 HIWASSEE	BRADLEY
ECO67G09	HARRIS CREEK	06020002 HIWASSEE	BRADLEY
ECO67G10	FLAT CREEK	06010107 LOWER FRENCH BROAD	SEVIER

SITE #	STREAM	USGS HUC	COUNTY
ECO67H04	BLACKBURN CREEK	06020002 HIWASSEE	BRADLEY
ECO67H06	LAUREL CREEK	06010204 LITTLE TENNESSEE	MONROE
ECO67H08	PARKER BRANCH	06010104 HOLSTON	HAWKINS
ECO67I12	MILL CREEK	06010207 LOWER CLINCH	ANDERSON
ECO6701	BIG CREEK	06010104 HOLSTON	HAWKINS
ECO6702	FISHER CREEK	06010104 HOLSTON	HAWKINS
ECO6707	POSSUM CREEK	06010102 SOUTH FORK HOLSTON	SULLIVAN
ECO68A01	ROCK CREEK	05130104 S FORK CUMBERLAND	PICKETT
ECO68A03	LAUREL FORK OF STATION CAMP CR	05130104 S FORK CUMBERLAND	SCOTT
ECO68A08	CLEAR CREEK	06010208 EMORY	MORGAN
ECO68A13	PINEY CREEK	06010201 WATTS BAR LAKE	RHEA
ECO68A20	MULLENS CREEK	06020001 TENNESSEE	MARION
ECO68A26	DADDY’S CREEK	06010208 EMORY	CUMBERLAND
ECO68A27	ISLAND CREEK	06010208 EMORY	MORGAN
ECO68A28	ROCK CREEK	06010208 EMORY	MORGAN
ECO68B01	CRYSTAL CREEK	06020004 SEQUATCHIE	BLEDSOE
ECO68B02	MCWILLIAMS CREEK	06020004 SEQUATCHIE	SEQUATCHIE
ECO68B09	MILL BRANCH	06020004 SEQUATCHIE	BLEDSOE
ECO68C12	ELLIS GAP BRANCH	06020001 TENNESSEE	MARION
ECO68C13	MUD CREEK	06030003 UPPER ELK	FRANKLIN
ECO68C15	CROW CREEK	06030001 GUNTERSVILLE LAKE	FRANKLIN
ECO68C20	CROW CREEK	06030001 GUNTERSVILLE LAKE	FRANKLIN

SITE #	STREAM	USGS HUC	COUNTY
ECO69D01	NO BUSINESS BRANCH	05130101 UPPER CUMBERLAND	CAMPBELL
ECO69D03	FLAT FORK	06010208 EMORY	MORGAN
ECO69D04	STINKING CREEK	05130101 UPPER CUMBERLAND	CAMPBELL
ECO69D05	NEW RIVER	05140104 S FORK CUMBERLAND	MORGAN
ECO69D06	ROUND ROCK CREEK	05130104 S FORK CUMBERLAND	CAMPBELL
ECO71E09	BUZZARD CREEK	05130206 RED	ROBERTSON
ECO71E14	PASSENGER CREEK	05130206 RED	MONTGOMERY
ECO71F12	SOUTH HARPETH RIVER	05130204 HARPETH	WILLIAMSON
ECO71F16	WOLF CREEK	06040003 LOWER DUCK	HICKMAN
ECO71F19	BRUSH CREEK	06040004 BUFFALO	LEWIS
ECO71F27	SWANEGAN BRANCH	06030005 PICKWICK LAKE	WAYNE
ECO71F28	LITTLE SWAN CREEK	06040003 LOWER DUCK	LEWIS
ECO71G03	FLAT CREEK	05130106 UPPER CUMBERLAND	OVERTON
ECO71G04	SPRING CREEK	05130106 UPPER CUMBERLAND	OVERTON
ECO71G10	HURRICANE CREEK	06030003 UPPER ELK	MOORE
ECO71H03	FLYNN CREEK	05130106 UPPER CUMBERLAND	JACKSON
ECO71H06	CLEAR FORK	05130108 CANEY FORK	DEKALB
ECO71H09	CARSON FORK	05130203 STONES	CANNON
ECO71I03	STEWART CREEK	05130203 STONES	RUTHERFORD
ECO71I09	WEST FORK STONES RIVER	05130203 STONES	RUTHERFORD
ECO71I10	FLAT CREEK	06040002 UPPER DUCK	MARSHALL
ECO71I12	CEDAR CREEK	05130201 CUMBERLAND	WILSON

SITE #	STREAM	USGS HUC	COUNTY
ECO71I13	FALL CREEK	05130203 STONES	RUTHERFORD
ECO71I14	LITTLE FLAT CREEK	06040002 UPPER DUCK	MAURY
ECO71I15	HARPETH RIVER	05130204 HARPETH	WILLIAMSON
ECO73A01	COLD CREEK	08010100 MISSISSIPPI	LAUDERDALE
ECO73A02	MIDDLE FORK FORKED DEER	08010100 MISSISSIPPI	LAUDERDALE
ECO73A03	COLD CREEK	08010100 MISSISSIPPI	LAUDERDALE
ECO73A04	BAYOU DU CHIEN	08010202 OBION	LAKE
ECO74A06	SUGAR CREEK	08010100 MISSISSIPPI	TIPTON
ECO74A08	PAWPAW CREEK	08010202 OBION	OBION
ECO74B01	TERRAPIN CREEK	08010202 OBION	HENRY
ECO74B04	POWELL CREEK	08010202 OBION	WEAKLEY
ECO74B12	WOLF RIVER	08010210 WOLF	FAYETTE

APPENDIX B

LIST OF DAYLIGHT MONITORING TEST SITES

ECO	STATION ID	NAME	ECO	STATION ID	NAME
65A	CHAMB018.1MC	CHAMBERS CREEK	65E	CLEAR001.2CR	CLEAR CREEK
65B	MAGBE001.8HR	MAGBEE BRANCH	65E	CLEAR001.2HN	CLEAR CREEK
65B	MUDDY001.1HR	MUDDY CREEK	65E	CLEAR002.7MC	CLEAR CREEK
65B	PRAIR001.8HR	PRAIRIE BRANCH	65E	CLEAR003.4HR	CLEAR CREEK
65B	HATCH1T0.5HR	UT HATCHIE RIVER	65E	CLIFT002.1HN	CLIFTY CREEK
65E	AMMON000.6BN	AMMON CREEK	65E	CLOVE002.1HR	CLOVER CREEK
65E	ANDER00.55MN	ANDERSON BRANCH	65E	CLOVE008.0HR	CLOVER CK S. CH.
65E	BACON002.5CR	BACON CREEK	65E	COTTN000.8WY	COTTNELL BRANCH
65E	BAILE005.1HN	BAILEY FORK CREEK	65E	CROOK002.6CR	CROOKED CREEK
65E	BEAR000.9HN	BEAR CREEK	65E	CROOK005.6CR	CROOKED CREEK
65E	BEAR001.0MN	BEAR CREEK	65E	CROOK009.0CR	CROOKED CREEK
65E	BEASO000.2HD	BEASON CREEK	65E	CUB001.5HR	CUB CREEK
65E	BEAVE004.4CR	BEAVER CREEK	65E	CYPRE002.6MC	CYPRESS CREEK
65E	BEAVE004.5CR	BEAVER CREEK	65E	CYPRE003.8WY	CYPRESS CREEK
65E	BEAVE005.5CR	BEAVER CREEK	65E	CYPRE006.9MC	CYPRESS CREEK
65E	BEAVE006.1CR	BEAVER CREEK	65E	CYPRE014.0MC	CYPRESS CREEK
65E	BEAVE007.0CR	BEAVER CREEK	65E	CYPRE018.8MC	CYPRESS CREEK
65E	BEAVE001.5HN	BEAVERDAM CREEK	65E	DABBS001.3HE	DABBS CREEK
65E	BEAVE002.2HN	BEAVERDAM CREEK	65E	DEMOS001.0CR	DEMOSS CREEK
65E	BBEAV000.8HE	BIG BEAVER CREEK	65E	DOLAN001.6GI	DOLAN CREEK
65E	BSAND015.3BN	BIG SANDY RIVER	65E	DRY000.3HN	DRY CREEK
65E	BSAND029.7CR	BIG SANDY RIVER	65E	DRY000.3MN	DRY CREEK
65E	BSAND036.4CR	BIG SANDY RIVER	65E	DRY000.7BN	DRY CREEK
65E	BSAND045.2CR	BIG SANDY RIVER	65E	DYER001.3MN	DYER CREEK
65E	BSAND052.9HE	BIG SANDY RIVER	65E	EAGLE011.3BN	EAGLE CREEK
65E	BINGH001.0HD	BINGHAM CREEK	65E	EPDOE001.8DE	E. PRONG DOE CR.
65E	BIRDS001.8HN	BIRDS CREEK	65E	GILME00.42MN	GILME CREEK
65E	BIRDS007.4BN	BIRDSONG CREEK	65E	GHOLL000.7CR	GRASSY HOL. CR
65E	BIRDS013.9BN	BIRDSONG CREEK	65E	GUINS002.7CR	GUINS CREEK
65E	BRITT001.2BN	BRITTON CREEK	65E	GURLE0.001HE	GURLEY CREEK
65E	BROWN000.7MN	BROWNS CREEK	65E	HARRI001.4MN	HARRIS CREEK
65E	CANE000.4WY	CANE BRANCH	65E	HATCH122.1HR	HATCHIE RIVER
65E	CANE002.3HE	CANE CREEK	65E	HATCH145.5HR	HATCHIE RIVER
65E	CANE002.4HE	CANE CREEK	65E	HATCH184.8MC	HATCHIE RIVER
65E	CANEY003.7MC	CANEY CREEK	65E	HICKO001.7HR	HICKORY CREEK
65E	CARTE001.1HR	CARTER BRANCH	65E	HICKS000.1MN	HICKS CREEK
65E	CHALK001.3HD	CHALK CREEK	65E	HICKS000.8MN	HICKS CREEK
65E	CHAMB006.2HD	CHAMBERS CREEK	65E	HICKS000.9MN	HICKS CREEK

ECO	STATION ID	NAME	ECO	STATION ID	NAME
65E	CHERR000.9CR	CHERRY CREEK	65E	HFORK004.0HN	HOLLEY FORK CR.
65E	HOOVE000.1HD	HOOVER BRANCH	65E	NFSFF001.4MN	N FK S FK FKED DR
65E	HUNTI003.2CR	HUNTING CREEK	65E	NFFDE036.5GI	N FK FORKED DEER
65E	HURRI002.6WY	HURRICANE CREEK	65E	OTOWN002.2HN	OLD TOWN CREEK
65E	JOHNS001.4CR	JOHNS CREEK	65E	OXFOR003.1MC	OXFORD CREEK
65E	JOHNS001.4MN	JOHNSON CREEK	65E	PINEY002.0HR	PINEY CREEK
65E	KISE001.0MC	KISE CREEK	65E	PINEY008.0HR	PINEY CREEK
65E	LAWRE000.1HN	LAWRENCE CREEK	65E	PINEY009.6HR	PINEY CREEK
65E	LICK001.0BN	LICK CREEK	65E	PRUN001.0HR	PLEASANT RUN CR
65E	LICK001.4GI	LICK CREEK	65E	POPLA000.7MN	POPLAR CREEK
65E	LICK002.1HD	LICK CREEK	65E	PORTE004.4HR	PORTERS CREEK
65E	LICK002.7BN	LICK CREEK	65E	PORTE014.0HR	PORTERS CREEK
65E	LICK003.4GI	LICK CREEK	65E	RAMBL001.0BN	RAMBLING CREEK
65E	LICK2.0MC	LICK CREEK	65E	REEDY000.7MC	REEDY BRANCH
65E	LICK1T0.2GI	LICK CR.-UT WEST	65E	REEDY001.3CR	REEDY CREEK
65E	LBACO001.5CR	LITTLE BACON CR.	65E	ROAN002.7CR	ROAN CREEK
65E	LBEAV001.3HE	LITTLE BEAVER CR.	65E	ROBIN002.1HD	ROBINSON CREEK
65E	LBIRD001.9BN	L. BIRDSONG CR.	65E	ROLAN002.0MC	ROLAND CREEK
65E	LHATC003.1HR	LITTLE HATCHIE	65E	ROSE001.5MC	ROSE CREEK
65E	LHATC010.8MC	LITTLE HATCHIE CR.	65E	ROWE000.9HN	ROWE CREEK
65E	LINDI009.0MC	LITTLE INDIAN CR.	65E	RUSHI005.8DE	RUSHING CREEK
65E	LMUDD001.8MC	LITTLE MUDDY CR.	65E	RFOBI024.4GI	R FK OBION V
65E	MAPLE000.6CR	MAPLE CREEK	65E	RFOBI029.9GI	R FK OBION RV
65E	MARTI002.5CR	MARTIN CREEK	65E	SANDY000.8MC	SANDY CREEK
65E	MERID001.0MN	MERIDIAN CREEK	65E	SCARC001.0HE	SCARCE CREEK
65E	MFOBI1C22.5WY	M FK OBION RV (CAN)	65E	SEVEN000.4BN	SEVENTEEN CREEK
65E	MFFDE037.0MN	M FK FORKED DEER	65E	SHORT004.7HR	SHORT CREEK
65E	MFFDE051.2HE	M FK FORKED DEER	65E	SLICK000.9HN	SLICKUP CREEK
65E	MFOBI014.6WY	M FK OBION RIVER	65E	SNAKE002.0HD	SNAKE CREEK
65E	MIDDL002.1HD	MIDDLETON CREEK	65E	SNAKE009.8MC	SNAKE CREEK
65E	MIDDL002.5HD	MIDDLETON CREEK	65E	SFFDE065.6MN	S FK FKED DEER RV
65E	MILL000.9HN	MILL CREEK	65E	SFOBI025.0CR	S FK OBION RV
65E	MORRI001.1WY	MORRIS BRANCH	65E	SPRIN00.73MN	SPRING CREEK
65E	MOSEL000.7WY	MOSELEY BRANCH	65E	SPRIN00.75HE	SPRING CREEK
65E	MOSSE001.8MC	MOSSES CREEK	65E	SPRIN004.0HR	SPRING CREEK
65E	MOSSE010.8MC	MOSSES CREEK	65E	SPRIN008.7WY	SPRING CREEK
65E	MUD001.0HD	MUD CREEK	65E	SPRIN016.2WY	SPRING CREEK
65E	MUD004.7CR	MUD CREEK	65E	SPRIN018.0WY	SPRING CREEK

ECO	STATION ID	NAME	ECO	STATION ID	NAME
65E	MUDDY002.0MC	MUDDY CREEK	65E	SHILL001.5HN	SPRING HILL CREEK
65E	MUDDY006.2MC	MUDDY CREEK	65E	STANL001.0MC	STANLEY CREEK
65E	STEEL000.7WY	STEEL BRANCH	66G	TELLI022.0MO	TELLICO RIVER
65E	SUMME001.3WY	SUMMER CREEK	66G	TELLI028.5MO	TELLICO RIVER
65E	SYCAM001.4BN	SYCAMORE CREEK	67F	ALEXA000.6HS	ALEXANDER CREEK
65E	THOMP000.1WY	THOMPSON CREEK	67F	ALEXA001.4HS	ALEXANDER CREEK
65E	THOMP003.0CR	THOMPSON CREEK	67F	BACK000.5SU	BACK CREEK
65E	THREE000.1HN	THREEMILE BRANCH	67F	BAT008.1MO	BAT CREEK
65E	TRAIN000.4HN	TRAINER CREEK	67F	BEAVE000.2SU	BEAVER CREEK
65E	TUMBL002.0WY	TUMBLING CREEK	67F	BEAVE001.0SU	BEAVER CREEK
65E	TURKE00.74MN	TURKEY CREEK	67F	BEAVE003.5KN	BEAVER CREEK
65E	TURKE000.3MC	TURKEY CREEK	67F	BEAVE010.1KN	BEAVER CREEK
65E	TURKE000.8BN	TURKEY CREEK	67F	BEAVE011.0SU	BEAVER CREEK
65E	TURKE001.1DE	TURKEY CREEK	67F	BEAVE012.5KN	BEAVER CREEK
65E	TUSCU008.4MC	TUSCUMBIA RIVER	67F	BEAVE015.3SU	BEAVER CREEK
65E	BEAR1T0.5WY	UT BEAR CREEK	67F	BEAVE023.5KN	BEAVER CREEK
65E	CYPRES1T0.1BN	UT CYPRESS CREEK	67F	BEAVE023.6KN	BEAVER CREEK
65E	SPRIN1T0.4WY	UT SPRING CREEK	67F	BEAVE031.8KN	BEAVER CREEK
65E	WADE002.2HR	WADE CREEK	67F	BEAVE036.7KN	BEAVER CREEK
65E	WALDR001.7HD	WALDROP CREEK	67F	BEAVE040.2KN	BEAVER CREEK
65E	WATSO000.9BN	WATSON CREEK	67F	SFHOL1T1.0SU	BEULAH CHURCH CR
65E	WATSO000.9BN	WATSON CREEK	67F	BIG000.1HK	BIG CREEK
65E	WPDOE003.9HE	W. PRONG DOE CR	67F	BIG002.0HS	BIG CREEK
65E	WOAK002.0HD	WHITE OAK CREEK	67F	BLIME000.5GE	BIG LIMESTONE CR.
65E	WOAK017.0MC	WHITE OAK CREEK	67F	BLIME002.9WN	BIG LIMESTONE CR
65E	WOLF001.3BN	WOLF CREEK	67F	BLIME004.0WN	BIG LIMESTONE CR
65E	WOLF001.4BN	WOLF CREEK	67F	BWAR007.4HK	BIG WAR CREEK
65I	ROBIN003.4HD	ROBINSON CREEK	67F	BLACK029.9MM	BLACK CREEK TRIB
65J	DRY002.0HD	DRY CREEK	67F	BLACK000.1HK	BLACK WATER CR
66D	BUCK000.5CT	BUCK CREEK	67F	BLACK005.7HK	BLACK WATER CR
66E	FBROA095.9CO	FRENCH BROAD RV.	67F	BLACK000.1WN	BLACKLEY CR.
66E	LITTL020.3BT	LITTLE RIVER	67F	BOOHE000.3SU	BOOHER CREEK
66E	NOLIC094.4UC	NOLICHUCKY RIVER	67F	BOOZY000.1SU	BOOZY CREEK
66E	NOLIC097.5UC	NOLICHUCKY RIVER	67F	BRADL001.4HS	BRADLEY CREEK
66F	JWRIG001.1JO	JIM WRIGHT BRANCH	67F	BRIER000.1HK	BRIER CREEK
66F	STONY008.5CT	STONY CREEK	67F	BULLR005.2KN	BULLRUN CREEK
66G	FIGHT000.6_GA	FIGHTINGTOWN CR	67F	CANEY002.6HS	CANEY CREEK
66G	LITTL027.0BT	LITTLE RIVER	67F	CANEY009.1HS	CANEY CREEK

ECO	STATION ID	NAME	ECO	STATION ID	NAME
66G	LITTL029.0BT	LITTLE RIVER	67F	CANEY000.8HS	CANEY FORK
66G	LITTL035.6BT	LITTLE RIVER	67F	CANEY000.8HS	CANEY FORK
66G	MPLIT000.7BT	MIDDLE PRONG L. RV.	67F	CANOE000.5CL	CANOE BRANCH
67F	CARSO000.1WN	CARSON CR.	67F	INDIA001.0SU	INDIAN CREEK
67F	CAWOO000.2CL	CAWOOD BRANCH	67F	INDIA003.5CL	INDIAN CREEK
67F	CEDAR000.3SU	CEDAR CREEK	67F	JOCKE000.1WN	JOCKEY CR.
67F	CEDAR000.4GE	CEDAR CREEK	67F	JOCKE003.2GE	JOCKEY CREEK
67F	CEDAR002.1WN	CEDAR CREEK	67F	KENDR000.2SU	KENDRICK CREEK
67F	CEDAR003.9WN	CEDAR CREEK	67F	KENDR003.3SU	KENDRICK CREEK
67F	CSPRI026.6MM	CEDAR SPRINGS TRIB	67F	KENDR005.3SU	KENDRICK CREEK
67F	CHATT000.9HM	CHATTANOOGA CR	67F	LWAR000.1HK	LITTLE WAR CR.
67F	CITIC000.3HM	CITICO CREEK	67F	LITTL008.0BT	LITTLE CREEK
67F	CLINC159.7CL	CLINCH RIVER	67F	LMUDD006.7HY	LITTLE MUDDY CR.
67F	CLINC189.9HK	CLINCH RIVER	67F	LPVAL000.9HS	L. POOR VALLEY CR.
67F	CLOUD002.7HS	CLOUD CREEK	67F	LITTL017.4BT	LITTLE RIVER
67F	COAL001.2AN	COAL CREEK	67F	MEADO000.4GE	MEADOW CREEK
67F	CONAS009.8MM	CONASAUGA CREEK	67F	MILL000.1BR	MILL CREEK
67F	CROOK001.1BT	CROOKED CREEK	67F	MILL000.1HK	MILL CREEK
67F	DAVIS011.6CL	DAVIS CREEK	67F	MILL000.5SU	MILL CREEK
67F	DAVIS014.6CL	DAVIS CREEK	67F	MUDDY000.7SU	MUDDY CREEK
67F	DAVIS016.2CL	DAVIS CREEK	67F	NOLIC038.5GE	NOLICHUCKY RV.
67F	DAVIS018.0CL	DAVIS CREEK	67F	NOLIC041.8GE	NOLICHUCKY RV.
67F	DAVIS020.5CL	DAVIS CREEK	67F	NOLIC057.2GE	NOLICHUCKY RV.
67F	DAVIS022.6CL	DAVIS CREEK	67F	NOLIC063.0GE	NOLICHUCKY RV.
67F	DAVIS024.1CL	DAVIS CREEK	67F	NOLIC066.8GE	NOLICHUCKY RV.
67F	DOE001.1CT	DOE RIVER	67F	NOLIC068.0GE	NOLICHUCKY RV.
67F	DRY000.7GE	DRY CR.	67F	NOLIC069.0GE	NOLICHUCKY RV.
67F	DRY001.0SU	DRY CREEK	67F	NOLIC085.9WN	NOLICHUCKY RV.
67F	EFPAN000.1HK	E. FK PANTHER CR	67F	NOLIC089.0WN	NOLICHUCKY RV.
67F	FALL000.5SU	FALL CREEK	67F	NFCLI000.1HK	N. FK CLINCH RV.
67F	FALL003.6SU	FALL CREEK	67F	NFHOL004.6SU	N. FK HOLSTON RV.
67F	FORK004.6MO	FORK CREEK	67F	OCOEE001.0PO	OCOEE RIVER
67F	FMILE000.1HK	FOUR MILE CREEK	67F	OCOEE011.9PO	OCOEE RIVER
67F	FBROA077.5CO	FRENCH BROAD RV	67F	OOSTA026.6MM	OOSTANAULA CR.
67F	GAMMO000.7SU	GAMMON CREEK	67F	OOSTA027.6MM	OOSTANAULA CR.
67F	GFORK000.6HS	GRASSY FORK CR.	67F	OOSTA028.1MM	OOSTANAULA CR.
67F	GROCK000.1HK	GREASY ROCK CR.	67F	OOSTA029.1MM	OOSTANAULA CR.
67F	HINDS000.7AN	HINDS CREEK	67F	OOSTA029.6MM	OOSTANAULA CR.

ECO	STATION ID	NAME	ECO	STATION ID	NAME
67F	HOLST001.8KN	HOLSTON RIVER	67F	OOSTA030.1MM	OOSTANAULA CR.
67F	HOLST051.9JE	HOLSTON RIVER	67F	OOSTA030.0MM	OOSTANAULA CR.
67F	HOLST097.5HS	HOLSTON RIVER	67F	OOSTA028.6MM	OOSTANULA CR.
67F	HORD000.2HS	HORD CREEK	67F	PANTH000.1HK	PANTHER CR.
67F	PIGEO001.0GE	PIGEON CREEK	67F	SFHOL033.0SU	S. FK HOLSTON RV.
67F	PISTO000.2BT	PISTOL CREEK	67F	SFLSE001.7MM	S. FK L. SEWEE CR.
67F	PVALL006.3HS	POOR VALLEY CR.	67F	STANL000.1HS	STANLEY CREEK
67F	PVALL013.2HS	POOR VALLEY CR.	67F	STOCK001.1HS	STOCK CREEK
67F	POPLA009.8RO	POPLAR CREEK	67F	STOCK002.0KN	STOCK CREEK
67F	POSSU000.5WN	POSSUM CREEK	67F	STONY000.1HK	STONEY FORK
67F	POWEL065.3CL	POWELL RIVER	67F	STRAI000.2SU	STRAIGHT BRANCH
67F	POWEL115.7HK	POWELL RIVER	67F	SUTTO000.1HK	SUTTON BRANCH
67F	RED000.2WN	RED RIVER	67F	SWAN000.5HK	SWAN CREEK
67F	REEDY001.8WN	REEDY CREEK	67F	SWEET001.1HS	SWEET CREEK
67F	REEDY015.5SU	REEDY CREEK	67F	TRANS000.7SU	TRANSBARGER BR.
67F	RENFR000.1HS	RENFRO CREEK	67F	TURKE000.5HK	TURKEY CREEK
67F	RENFR000.2HS	RENFRO CREEK	67F	WAGNE001.9SU	WAGNER CREEK
67F	RICHA000.7HK	RICHARDSON CREEK	67F	WAR000.6HK	WAR CREEK
67F	RICHL000.6GE	RICHLAND CREEK	67F	WATAU020.1CT	WATAUGA RIVER
67F	RICHL001.5GE	RICHLAND CREEK	67F	WATAU025.1CT	WATAUGA RIVER
67F	RICHL003.5GE	RICHLAND CREEK	67F	WATAU025.9CT	WATAUGA RIVER
67F	RICHL003.6GE	RICHLAND CREEK	67F	WATAU026.9CT	WATAUGA RIVER
67F	RICHL004.2GE	RICHLAND CREEK	67F	WEAVE000.7SU	WEAVER BRANCH
67F	RICHL006.0GE	RICHLAND CREEK	67F	WFPAN000.1HK	W. FK PANTHER CR.
67F	RILEY000.1HK	RILEY CREEK	67F	WHITE000.5SU	WHITETOP CREEK
67F	ROBER000.7HS	ROBERTSON CREEK	67F	WOODS000.5SU	WOODS BRANCH
67F	ROCKS000.4SU	ROCK SPRINGS BR.	67G	ARNOT000.1HS	ARNOTT BRANCH
67F	ROGER000.9HM	ROGERS BRANCH	67G	BAKER008.9LO	BAKER CREEK
67F	RUSSE000.3CL	RUSSELL BRANCH	67G	BEAR000.2SU	BEAR CREEK
67F	RUSSE000.9BT	RUSSELL BRANCH	67G	BEECH003.8HS	BEECH CREEK
67F	RUSSE000.5CL	RUSSELL CREEK	67G	BEECH010.7HS	BEECH CREEK
67F	RUSSE000.7SU	RUSSELL CREEK	67G	BLIME007.7WN	BIG LIMESTONE CR.
67F	SINKI000.2GE	SINKING CREEK	67G	BLACK000.5GE	BLACK CREEK
67F	SINKI000.6CT	SINKING CREEK	67G	CARSO001.8WN	CARSON CREEK
67F	SINKI001.0SU	SINKING CREEK	67G	CLEAR000.5GE	CLEAR CREEK
67F	SINKI001.1CT	SINKING CREEK	67G	CLEAR000.5WN	CLEAR FORK
67F	SINKI001.1HS	SINKING CREEK	67G	CLEAR003.7WN	CLEAR FORK
67F	SINKI003.2GE	SINKING CREEK	67G	COAHU033.3BR	COAHULLA CR.

ECO	STATION ID	NAME	ECO	STATION ID	NAME
67F	SINKI004.5GE	SINKING CREEK	67G	COAHU039.4BR	COAHULLA CR.
67F	SINKI005.0WN	SINKING CREEK	67G	CROCK001.8HS	CROCKETT CR.
67F	SFHOL007.7SU	S. FK HOLSTON RV.	67G	DODSO000.5HS	DODSON CREEK
67F	SFHOL018.5SU	S. FK HOLSTON RV.	67G	DODSO002.6HS	DODSON CREEK
67F	SFHOL028.2SU	S. FK HOLSTON RV.	67G	FISHD000.3HA	FISHDAM CREEK
67G	FLAT000.1HA	FLAT CR.	67G	NOLIC005.3HA	NOLICHUCKY RV.
67G	FORGE000.8HS	FORGEY CREEK	67G	NOLIC015.5GE	NOLICHUCKY RV.
67G	GAINS000.1SU	GAINS BRANCH	67G	NOLIC020.8GE	NOLICHUCKY RV.
67G	GAP000.2GE	GAP CR.	67G	POTTE000.3GE	POTTER CREEK
67G	GRASS000.2GE	GRASSY CR.	67G	PUNCH000.5GE	PUNCHEONCAMP CR.
67G	HOLST109.9HS	HOLSTON RIVER	67G	PYBOR000.1GE	PYBORN CREEK
67G	HOLST131.5HS	HOLSTON RIVER	67G	REEDY000.1SU	REEDY CREEK
67G	HONEY001.4HS	HONEYCUTT CR.	67G	REEDY002.2SU	REEDY CREEK
67G	HONEY001.7HS	HONEYCUTT CR.	67G	REEDY008.0SU	REEDY CREEK
67G	HORSE000.9SU	HORSE CREEK	67G	REEDY008.0SU	REEDY CREEK
67G	HORSE004.0SU	HORSE CREEK	67G	ROARI001.0GE	ROARING FORK
67G	HORSE007.3SU	HORSE CREEK	67G	SAYLO000.3GE	SAYLOR CREEK
67G	HORSE009.5SU	HORSE CREEK	67G	SINKI003.0GE	SINKING CREEK
67G	HORSE010.6SU	HORSE CREEK	67G	SLATE001.5CO	SLATE CREEK
67G	HORSE000.5GE	HORSE FORK	67G	SMITH000.9HS	SMITH CREEK
67G	HUNT001.0HS	HUNT CREEK	67G	SFHOL001.1SU	S. FK HOLSTON RV.
67G	ISLAN003.2MO	ISLAND CREEK	67G	SFHOL005.5SU	S. FK HOLSTON RV.
67G	LICK003.8GE	LICK CR.	67G	SPOIN000.1HS	STONEY POINT
67G	LICK006.5GE	LICK CR.	67G	SURGO000.1HS	SURGOINSVILLE CR.
67G	LICK001.0GE	LICK CREEK	67G	TERRI000.8HS	TERRILL CREEK
67G	LICK011.9GE	LICK CREEK	67G	THOMA000.1SU	THOMAS CREEK
67G	LICK015.5GE	LICK CREEK	67G	WALKE000.1SU	WALKER FORK
67G	LICK020.5GE	LICK CREEK	67H	LHOLL000.3GR	LAUREL HOL. BR.
67G	LICK024.2GE	LICK CREEK	67H	LOOLT002.2BR	L. OOLTEWAH CR.
67G	LICK033.6GE	LICK CREEK	67H	NORTH000.1HS	NORTH FORK
67G	LICK040.8GE	LICK CREEK	67I	BPLAY000.3PO	BALL PLAY CREEK
67G	LICK045.2GE	LICK CREEK	67I	NOTCH002.5MO	NOTCHY CREEK
67G	LICK047.2GE	LICK CREEK	67I	STEEL000.3SU	STEELE CREEK
67G	LICK052.3GE	LICK CREEK	67I	THOMP000.6MM	THOMPSON BRANCH
67G	LICK061.0GE	LICK CREEK	68A	BIG007.2GY	BIG CREEK
67G	LHORS000.5SU	LITTLE HORSE CR.	68A	BSFOR070.0SC	BIG S. FK. CUMB. RV.
67G	LITTL019.3BT	LITTLE RIVER	68A	BWOLF000.1MG	BLACK WOLF CREEK
67G	LONG001.5GE	LONG FORK	68A	BCAMP002.2MG	BONE CAMP CREEK

ECO	STATION ID	NAME	ECO	STATION ID	NAME
67G	LOUDE000.6HS	LOUDERBACK CR.	68A	BROWN000.4DA	BROWNS CREEK
67G	MADD001.2SU	MADD BRANCH	68A	CFORK003.8SC	CLEAR FORK RIVER
67G	MINK001.0GE	MINK CR.	68A	CORCH000.2MG	CRAB ORCHARD CR.
67G	MUDDY000.4WN	MUDDY FORK	68A	CORCH003.1MG	CRAB ORCHARD CR.
67G	MUDDY005.1WN	MUDDY FORK	68A	CORCH007.1MG	CRAB ORCHARD CR.
67G	MUDDY007.1WN	MUDDY FORK	68A	CORCH010.3MG	CRAB ORCHARD CR.
68A	DADDY037.5CU	DADDYS CREEK	68C	GRIFF006.0MI	GRIFFITH CREEK
68A	FMILL000.2MG	FAGAN MILL CREEK	68C	NSUCK000.1MI	NORTH SUCK CREEK
68A	FIRES004.1GY	FIRESCALD CREEK	68C	RANGE003.0GY	RANGER CREEK
68A	GOLLI000.1MG	GOLLIHER CREEK	68C	RICHL006.0RH	RICHLAND CREEK
68A	KELLE002.2SE	KELLEY CREEK	69D	CAPUC001.9CA	CAPUCHIN CREEK
68A	LAURE000.1MG	LAUREL BRANCH	69D	CAPUC010.3CA	CAPUCHIN CREEK
68A	LLAUR000.2MG	LITTLE LAUREL CR.	69D	CLEAR019.4CA	CLEAR FORK
68A	LITTO000.2SC	LITTON FORK	69D	COAL005.4AN	COAL CREEK
68A	MILL000.5MG	MILL CREEK	69D	HICKO001.5CA	HICKORY CREEK
68A	NEW008.8SC	NEW RIVER	69D	NEW048.0AN	NEW RIVER
68A	NFPIN000.3SC	N. FK. PINE CR.	69D	STINK001.0CA	STINKING CREEK
68A	PINE000.1SC	PINE CREEK	69D	TACKE001.0CL	TACKETT CREEK
68A	PINE003.6SC	PINE CREEK	69D	WOAK000.7CA	WHITE OAK CREEK
68A	PINE006.0SC	PINE CREEK	71E	CARR010.0RN	CARR CREEK
68A	PINE008.3SC	PINE CREEK	71E	DFORK005.9MT	DRY FORK CREEK
68A	PINE010.6SC	PINE CREEK	71E	FLETC000.1MT	FLETCHERS FORK
68A	PINE011.4SC	PINE CREEK	71E	FREY000.1RN	FREY BRANCH
68A	PINEY005.4CU	PINEY CREEK	71E	HTOWN000.2SR	HALL TOWN CREEK
68A	RPAUN015.7SC	ROARING PAUNCH	71E	HONEY000.4RN	HONEY RUN
68A	ROCKY012.9VA	ROCKY RIVER	71E	LWEST003.0MT	LITTLE WEST FORK
68A	SMITH000.2MG	SMITH BRANCH	71E	LWFRE010.5MT	L. WEST FK RED RV.
68A	SFPIN000.3SC	SOUTH FK PINE CR.	71E	MILLE000.6RN	MILLERS CREEK
68A	JONES1T0.1SC	UT JONES BRANCH	71E	NSPRI000.3MT	NOAHS SPRING BR.
68A	JONES1T0.4SC	UT JONES BRANCH	71E	PEPPE000.4RN	PEPPER'S BRANCH
68A	LFGIZ2T0.2GY	UT L. FIERY GIZZARD	71E	PINEY000.4MT	PINEY FORK
68A	WOAK015.7MG	WHITE OAK CREEK	71E	PHOUS000.7RN	POOR HOUSE BR.
68A	WOODC006.0SE	WOODCOCK CREEK	71E	PORT1T0.4SR	UT-PORTLAND
68B	BATTL005.4MI	BATTLE CREEK	71E	RED024.7MT	RED RIVER
68B	CSPRI001.2MI	CLEAR SPRING BR.	71E	RED025.5MT	RED RIVER
68B	HICKS001.4SE	HICKS CREEK	71E	RED080.0RN	RED RIVER
68B	LSEQU000.5MI	L. SEQUATCHIE RV.	71E	RED082.3RN	RED RIVER
68B	SEQUA041.5SE	SEQUATCHIE RIVER	71E	RONEY000.2SR	RONEY CREEK

ECO	STATION ID	NAME	ECO	STATION ID	NAME
68B	SEQUA065.6BL	SEQUATCHIE RIVER	71E	SSPRI000.2MT	SEVEN SPRINGS BR
68B	SKILL000.5BL	SKILLERN CREEK	71E	SFRED022.7RN	SOUTH FORK RED R
68B	STONE001.5SE	STONE CREEK	71E	SPRIN000.1RN	SPRING CREEK
68C	BRIDG000.2WH	BRIDGE CREEK	71E	SPRIN000.6MT	SPRING CREEK
68C	DRY002.1WA	DRY CREEK	71E	SULPH031.0RN	SULPHUR FORK
68C	GILLI001.4GY	GILLIAM CREEK	71E	SULPH032.2RN	SULPHUR FORK
68C	GILLI001.7GY	GILLIAM CREEK	71E	SFORK042.6RN	SULPHUR FORK
71E	SUMME000.8RN	SUMMERS BRANCH	71F	WHITE006.7HO	WHITEOAK CREEK
71E	CARR1T0.6RN	UT CARR CR	71F	YELLO009.0MT	YELLOW CREEK
71F	ARKAN000.1WI	ARKANSAS CREEK	71G	BFORK010.1FR	BOILING FORK
71F	BEAVE000.3DI	BEAVERDAM CREEK	71G	CALFK002.9WH	CALFKILLER RIVER
71F	BMCAD004.7MT	BIG MCADOO	71G	CHERR003.8WH	CHERRY CREEK
71F	BSWAN005.7HI	BIG SWAN CREEK	71G	CLEAR001.1CE	CLEAR BRANCH
71F	BTURN019.1DI	BIG TURNBULL CR.	71G	CLEAR001.8CE	CLEAR BRANCH
71F	BLOOD015.5HN	BLOOD RIVER	71G	CLIFT000.1MA	CLIFTY CREEK
71F	BLUE001.4HU	BLUE CREEK	71G	COLLI013.6WA	COLLINS RIVER
71F	CANE002.5HO	CANE CREEK	71G	COLLI028.8WA	COLLINS RIVER
71F	DUNBA000.3MT	DUNBAR CREEK	71G	EFOBE012.6FE	EAST FORK OBEY
71F	EAGLE002.9HN	EAGLE CREEK	71G	FALL005.5DB	FALL CREEK
71F	EAGLE004.1BN	EAGLE CREEK	71G	HILLS0001.8WA	HILLS CREEK
71F	EFSUG002.0LW	EAST FK SUGAR CR.	71G	HILLS0001.8WA	HILLS CREEK
71F	EFSUG002.0LW	EAST FK SUGAR CR.	71G	HUDGE000.7PU	HUDGENS CREEK
71F	GREEN010.5WE	GREEN RIVER	71G	LDUCK001.3CE	LITTLE DUCK RIVER
71F	HARDI004.6HD	HARDIN CREEK	71G	MFDRA022.0SR	M. FK DRAKES CR.
71F	HARDI013.9WE	HARDIN CREEK	71G	MLICK015.5PU	MINE LICK CREEK
71F	HARPE016.5CH	HARPETH RIVER	71G	MOUNT015.2WA	MOUNTAIN CREEK
71F	HURRI004.5HU	HURRICANE CREEK	71G	PROOS002.3PU	PIGEON ROOST CR.
71F	INDIA016.4HD	INDIAN CREEK	71G	ROCK011.6CE	ROCK CREEK
71F	INDIA026.3WE	INDIAN CREEK	71G	ROCKY009.2VA	ROCKY RIVER
71F	JONES010.1DI	JONES CREEK	71G	SINK006.1DB	SINK CREEK
71F	JONES019.6DI	JONES CREEK	71G	SPBAR004.6WA	S. PR. BARREN FK
71F	LICK001.0HI	LICK CREEK	71G	TOWN000.1PI	TOWN BRANCH
71F	LJONE000.8DI	LITTLE JONES CR.	71G	TOWN001.1MA	TOWN CREEK
71F	LTURN000.6DI	L. TURNBULL CR.	71G	TRACE002.3CY	TRACE CREEK
71F	NFSAW000.3LW	NORTH FK SAW CR.	71G	WFLON004.0MA	WEST FK LONG CR.
71F	PANTH003.6ST	PANTHER CREEK	71G	WOAK011.5MA	WHITE OAK CREEK
71F	PRYOR002.0ST	PRYOR CREEK	71H	ANDER000.2BE	ANDERTON BRANCH
71F	RED000.2MT	RED RIVER	71H	BASHA000.1CE	BASHAW CREEK

ECO	STATION ID	NAME	ECO	STATION ID	NAME
71F	SHOAL032.2LW	SHOAL CREEK	71H	BBUCK001.0BE	BELL BUCKLE CR.
71F	SHOAL053.5LW	SHOAL CREEK	71H	BBUCK001.3BE	BELL BUCKLE CR.
71F	SHOAL055.7LW	SHOAL CREEK	71H	BENNE000.1BE	BENNETT BRANCH
71F	SHARP003.0CH	SOUTH HARPETH RV.	71H	BBIGB008.5MY	BIG BIGBY CREEK
71F	TOWNB003.4DI	TOWN BRANCH	71H	BBIGB014.0MY	BIG BIGBY CREEK
71F	TRACE003.5DI	TRACE CREEK	71H	BBIGB016.3MY	BIG BIGBY CREEK
71F	TURNB013.1DI	TURNBULL CREEK	71H	BIG003.4GS	BIG CREEK
71F	WFBRU000.8CH	WEST FK BRUSH CR.	71H	BOBO001.6CE	BOBO CREEK
71H	BFORK014.6FR	BOILING FORK CR.	71H	RICHL055.5GS	RICHLAND CREEK
71H	BRADL002.0RU	BRADLEY CREEK	71H	RILEY000.6CE	RILEY CR. EMBAY.
71H	CARRO003.2CE	CARROLL CREEK	71H	ROBER005.5GS	ROBERTSON FORK
71H	CARRO000.8CE	CARROLL. EMBAY.	71H	SILVE001.5MY	SILVER CREEK
71H	CASCA000.7BE	CASCADE BRANCH	71H	SIMS000.8DA	SIMS BRANCH
71H	CATHE001.8MY	CATHEYS CREEK	71H	SMITH008.8DB	SMITH FORK
71H	COFFE000.1ML	COFFEE BRANCH	71H	STONR001.1DA	STONERS CREEK
71H	COFFE000.5ML	COFFEE BRANCH	71H	SUGAR000.1MY	SUGAR CREEK
71H	CRIPP003.0RU	CRIPPLE CREEK	71H	SUGAF002.4MY	SUGAR FORK CREEK
71H	CRUMP002.9CE	CRUMPTON CREEK	71H	SWAN008.0LI	SWAN CREEK
71H	CRUMP000.4CE	CRUMPTON EMBAY.	71H	THOMP001.4BE	THOMPSON CREEK
71H	DODDY000.7BE	DODDY CREEK	71H	THOMP006.5BE	THOMPSON CREEK
71H	DUCK252.0CE	DUCK R - NORMANDY	71H	TOWN000.3SR	TOWN CREEK
71H	DUCK237.0BE	DUCK RIVER	71H	TOWN000.8ML	TOWN CREEK
71H	DUCK248.5CE	DUCK RIVER	71H	TOWN000.9ML	TOWN CREEK
71H	DUCK253.0CE	DUCK RIVER	71H	WARTR001.2BE	WARTRACE CREEK
71H	DUCK255.1CE	DUCK RIVER	71H	WEAKL000.6GS	WEAKLEY CREEK
71H	DUCK265.5CE	DUCK RIVER	71H	WFBRO000.1DA	W. FK BROWNS CK
71H	DUCK267.7CE	DUCK RIVER	71H	WFMUL001.9LI	W. FK MULBERRY C
71H	DUCK240.0BE	DUCK RIVER	71H	WFSTO008.3RU	WEST FK STONES RV.
71H	DUCK259.6CE	DUCK RV. EMBAY.	71H	WHARP000.3WI	WEST HARPETH RV.
71H	EFGLO000.1ML	EAST FK GLOBE CR.	71H	WHARP002.3WI	WEST HARPETH RV.
71H	ELK133.0FR	ELK RIVER	71H	WHARP017.7WI	WEST HARPETH RV.
71H	FIVEM001.4WI	FIVE MILE CREEK	71I	ALEXA004.0BE	ALEXANDER CR.
71H	FOUNT000.3MY	FOUNTAIN CREEK	71I	BARTO017.6WS	BARTONS CREEK
71H	FOUNT013.2MY	FOUNTAIN CREEK	71I	BROCK001.4ML	BIG ROCK CREEK
71H	GARRI004.3BE	GARRISON FORK	71I	BROCK005.2ML	BIG ROCK CREEK
71H	GLOBE001.6MY	GLOBE CREEK	71I	BROCK006.0ML	BIG ROCK CREEK
71H	GLOBE001.7MY	GLOBE CREEK	71I	BROCK009.4ML	BIG ROCK CREEK
71H	HARPE079.8WI	HARPETH RIVER	71I	BROCK015.8ML	BIG ROCK CREEK

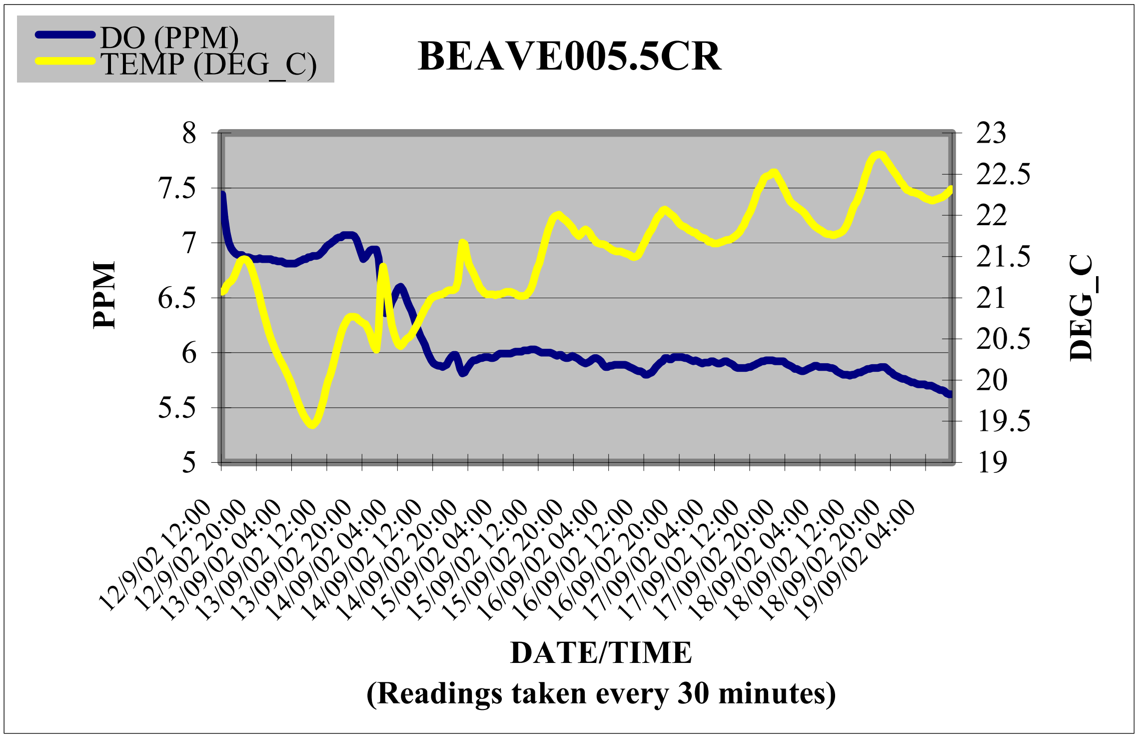
ECO	STATION ID	NAME	ECO	STATION ID	NAME
71H	HARPE092.4WI	HARPETH RIVER	71I	BROCK016.7ML	BIG ROCK CREEK
71H	HICKM013.0SM	HICKMAN CREEK	71I	BROCK019.5ML	BIG ROCK CREEK
71H	HICKM013.7DB	HICKMAN CREEK	71I	BOMAR001.0BE	BOMAR CREEK
71H	LEIPE003.0WI	LEIPERS FORK	71I	BRADL003.8RU	BRADLEY CREEK
71H	LHARP001.0WI	LITTLE HARPETH RV.	71I	BUSHM002.2RU	BUSHMAN CREEK
71H	MCCRO001.5DA	MCCRORY CREEK	71I	CANEY002.6ML	CANEY CREEK
71H	MILL003.3DA	MILL CREEK	71I	CARSO000.3CN	CARSON FORK
71H	MURFR003.9WI	MURFREES FORK	71I	CEDAR002.2MY	CEDAR CREEK
71H	OTTER002.0DA	OTTER CREEK	71I	CEDAR011.8WS	CEDAR CREEK
71I	CHEAT000.1RU	CHEATHAM BRANCH	71I	NFORK004.7BE	NORTH FORK CREEK
71I	CHRIS000.7RU	CHRISTMAS CREEK	71I	NFORK007.7BE	NORTH FORK CREEK
71I	CLEM000.4BE	CLEM CREEK	71I	NFORK016.4BE	NORTH FORK CREEK
71I	CONCO001.1RU	CONCORD CREEK	71I	OLIVE000.4RU	OLIVE BRANCH
71I	CRIPP000.4RU	CRIPPLE CREEK	71I	OVERA000.6WI	OVERALL CREEK
71I	CROOK000.2MY	CROOKED CREEK	71I	OVERA000.7RU	OVERALL CREEK
71I	DAVIS000.2BE	DAVIS BRANCH	71I	OVERA009.4RU	OVERALL CREEK
71I	DUCK216.2BE	DUCK RIVER	71I	PUCKE000.9RU	PUCKETT BRANCH
71I	DUCK219.7BE	DUCK RIVER	71I	RICH000.5ML	RICH CREEK
71I	EFSTO026.6RU	EAST FK STONES RV.	71I	ROCKY001.4RU	ROCKY FORK CREEK
71I	EFSTO044.3CN	EAST FK STONES RV.	71I	RLICK018.7WS	ROUND LICK CREEK
71I	EROCK001.8ML	EAST ROCK CR.	71I	RLICK019.1WS	ROUND LICK CREEK
71I	EROCK020.8BE	EAST ROCK CR.	71I	RLICK019.8WS	ROUND LICK CREEK
71I	FALL001.2BE	FALL CREEK	71I	SINKI000.2RU	SINKING CREEK
71I	FALL003.0BE	FALL CREEK	71I	SINKI001.2BE	SINKING CREEK
71I	FALL006.1BE	FALL CREEK	71I	SINKI004.0WS	SINKING CREEK
71I	FALL018.8WS	FALL CREEK	71I	SINKI008.9BE	SINKING CREEK
71I	FINCH001.4RU	FINCH BRANCH	71I	SNELL000.3ML	SNELL BRANCH
71I	FLAT001.1MY	FLAT CREEK	71I	SPENC005.0WS	SPENCER CREEK
71I	FLORI002.4WS	FLORIDA CREEK	71I	SPRIN003.2ML	SPRING CREEK
71I	HARTS000.1RU	HARTS BRANCH	71I	SPRIN004.4WS	SPRING CREEK
71I	HENRY001.5RU	HENRY CREEK	71I	SPRIN016.0WS	SPRING CREEK
71I	HURRI000.2WI	HURRICANE BR.	71I	SPRIN027.0WS	SPRING CREEK
71I	HURRI001.0BE	HURRICANE CR.	71I	STEWA005.3RU	STEWART CREEK
71I	HURRI002.0RU	HURRICANE CR.	71I	STEWA006.0RU	STEWART CREEK
71I	HURRI004.2BE	HURRICANE CR.	71I	STEWA018.2RU	STEWART CREEK
71I	JOHNS000.4WS	JOHNSON BR.	71I	SUGAR000.4BE	SUGAR CREEK
71I	KELLE000.4RU	KELLEY CREEK	71I	SUGAR002.7BE	SUGAR CREEK
71I	LICK001.8ML	LICK CREEK	71I	SUGGS007.7WS	SUGGS CREEK

ECO	STATION ID	NAME	ECO	STATION ID	NAME
71I	LITTL001.8WS	LITTLE CREEK	71I	THICK002.0ML	THICK CREEK
71I	LSINK001.0BE	LITTLE SINKING CR.	71I	LYTLE1T0.1RU	UT LYTLE CREEK
71I	LYTLE000.6RU	LYTLE CREEK	71I	WALLA000.8WI	WALLACE BRANCH
71I	LYTLE001.1RU	LYTLE CREEK	71I	WEAKL001.7BE	WEAKLEY CREEK
71I	LYTLE008.7RU	LYTLE CREEK	71I	WEAKL005.2BE	WEAKLEY CREEK
71I	MCKNI001.2RU	MCKNIGHT BR.	71I	WFSTO006.2RU	WEST FK STONES RV.
71I	MFSTO005.2RU	M. FK STONES RV.	71I	WFSTO022.9RU	WEST FK STONES RV.
71I	MILL012.4DA	MILL CREEK	71I	WFSTO023.2RU	WEST FK STONES RV.
71I	MILL021.2DA	MILL CREEK	71I	WILSO000.7ML	WILSON CREEK
71I	NFORK003.5BE	NORTH FORK CREEK	71I	WILSO002.9BE	WILSON CREEK
71I	WILSO005.2BE	WILSON CREEK	74B	HARRI001.8SH	HARRINGTON CREEK
73A	COLD004.7LE	COLD CREEK	74B	HARRI001.9DY	HARRIS CREEK
73A	OBION020.9DY	OBION RIVER	74B	HFORK003.6OB	HARRIS FORK CREEK
73A	RREEL003.7DY	RUN. REELFOOT BY.	74B	HURRI000.3WY	HURRICANE CREEK
74A	HYDE001.6LE	HYDE CREEK	74B	JACOB004.1HY	JACOBS CREEK
74A	KNOB006.0LE	KNOB CREEK	74B	JOHNS000.5SH	JOHNS CREEK
74A	ROCK000.8OB	ROCK BRANCH	74B	JOHNS001.4MN	JOHNSON CREEK
74A	SREEL001.7OB	S. REELFOOT CR.	74B	JONES001.2DY	JONES CREEK
74B	BEAR008.6HY	BEAR CREEK	74B	JONES003.8DY	JONES CREEK
74B	BETHE001.8DY	BETHEL BRANCH	74B	LAGOO002.8LE	LAGOON CREEK
74B	BETHE004.2GI	BETHEL BRANCH	74B	LEWIS000.3DY	LEWIS CREEK
74B	BETHE004.2GI	BETHEL BRANCH	74B	LEWIS007.9DY	LEWIS CREEK
74B	BETHE006.1GI	BETHEL BRANCH	74B	LEWIS002.5DY	LEWIS CR DITCH
74B	BIG001.0SH	BIG CREEK	74B	LIGHT002.2DY	LIGHT CREEK
74B	BMUDD004.3HY	BIG MUDDY CREEK	74B	LNIXO002.9HY	LITTLE NIXON CR.
74B	BMUDD007.0HY	BIG MUDDY CREEK	74B	MARYS001.0SH	MARYS CREEK
74B	BIGGS000.7WY	BIGGS CREEK	74B	MERID001.7HY	MERIDIAN CREEK
74B	BLACK001.6CK	BLACK CREEK	74B	MFFDE014.6CK	M. FK FKED DEER R
74B	BUCK001.2GI	BUCK CREEK	74B	MFFDE021.5GI	M. FK FKED DEER R
74B	BUCK007.7GI	BUCK CREEK S	74B	MFOBI004.5WY	M. FK OBION RV.
74B	CANE012.5LE	CANE CREEK	74B	MUD001.3HY	MUD CREEK
74B	CANE014.8LE	CANE CREEK	74B	MUD002.2OB	MUD CREEK
74B	CANE015.5LE	CANE CREEK	74B	MUD016.2WY	MUD CREEK
74B	CANE017.4LE	CANE CREEK	74B	NIXON002.2HY	NIXON CREEK
74B	CENTR00.44MN	CENTRAL CREEK	74B	NONCO2T0.3SH	UT-NONCONNAH CR.
74B	CSPRI002.4DY	COOL SPRINGS BR.	74B	NONCO3T1.4SH	UT-NONCONNAH CR.
74B	CUB001.6MN	CUB CREEK	74B	NFOBI005.9OB	NORTH FK OBION R
74B	CYPRE000.9CK	CYPRESS CREEK	74B	NFOBI018.0WY	NORTH FK OBION R

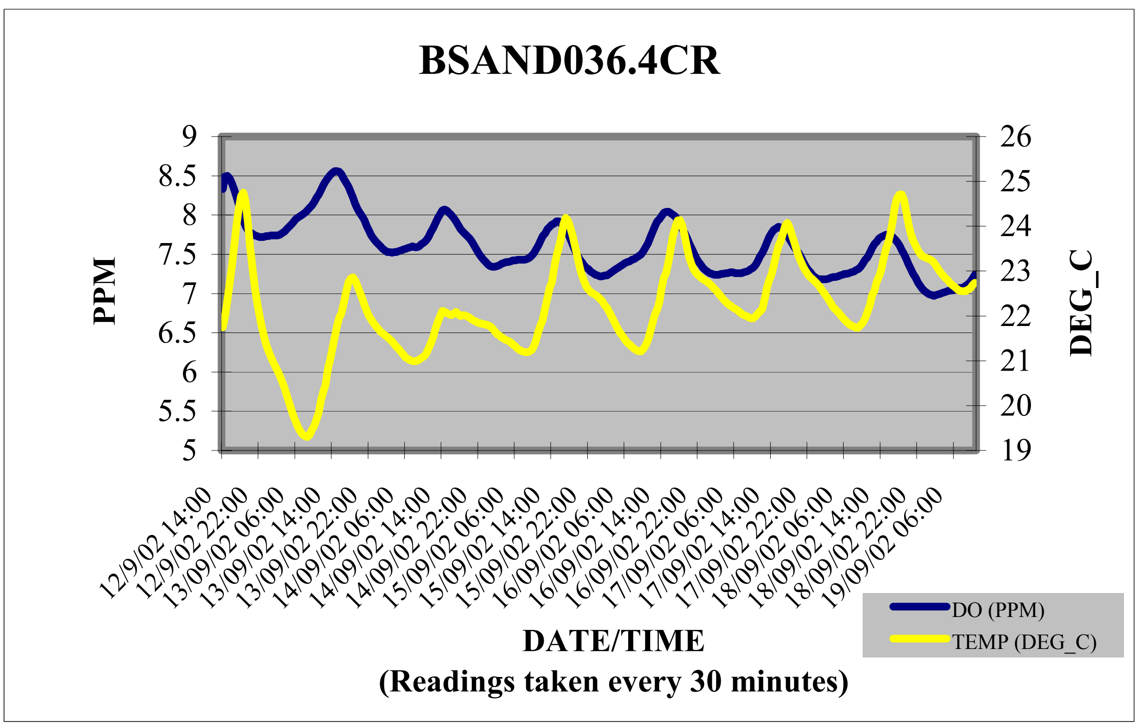
ECO	STATION ID	NAME	ECO	STATION ID	NAME
74B	CYPRE002.0MN	CYPRESS CREEK	74B	NFOBI026.5WY	N. FK OBION RV.
74B	CYPRE002.7OB	CYPRESS CREEK	74B	NFOBI040.6HN	N. FK OBION RV.
74B	CYPRE004.3HY	CYPRESS CREEK	74B	OBION044.3DY	OBION RIVER
74B	DAVIS000.9GI	DAVIS CREEK	74B	OBION071.2OB	OBION RIVER
74B	DAVIS001.0GI	DAVIS CREEK	74B	PANTH001.9MN	PANTHER CREEK
74B	DAVIS002.5GI	DAVIS CREEK	74B	PARKE000.8GI	PARKER BRANCH
74B	DOAKV005.4DY	DOAKVILLE CREEK	74B	POND001.1DY	POND CREEK
74B	GRAYS005.8SH	GRAY'S CREEK	74B	POND007.4DY	POND CREEK
74B	GRAYS010.0SH	GRAY'S CREEK	74B	POND011.3DY	POND CREEK
74B	GRISS004.7FA	GRISSUM CREEK	74B	POND012.9CK	POND CREEK
74B	HALLS001.2LE	HALLS CREEK	74B	POND014.9CK	POND CREEK
74B	POND11.11CK	POND CREEK			
74B	POPLA006.9HY	POPLAR CREEK			
74B	PRAIR001.3HY	PRAIRIE CREEK			
74B	REAGA000.4GI	REAGAN CREEK			
74B	REEDS001.6DY	REEDS CREEK			
74B	REEDS006.7DY	REEDS CREEK			
74B	RFOBI004.9OB	R. FK OBION RV CAN.			
74B	SANDY00.55MN	SANDY CREEK			
74B	SHAWS007.2FA	SHAWS CREEK			
74B	SFFDE009.5DY	S. FK FKED DEER RV.			
74B	SFFDE030.6HY	S. FK FKED DEER RV.			
74B	SFFDE036.7HY	S. FK FKED DEER RV.			
74B	SFFDE052.7MN	S. FK FKED DEER RV.			
74B	SFFDE011.2DY	S. FK FKED DEER RV.			
74B	SFFDE043.2MN	S. FK FKED DEER RV.			
74B	SFOBI006.0OB	S. FK OBION RV.			
74B	SFOBI009.7WY	S FK OBION RV.			
74B	SPRIN002.3WY	SPRING CREEK			
74B	STOUT000.4FA	STOUT CREEK			
74B	SUGAR001.5HY	SUGAR CREEK			
74B	SUMRO00.87LE	SUMROW CREEK			
74B	TENMI000.1SH	TENMILE CREEK			
74B	TUCKE000.4CK	TUCKER CREEK			
74B	HYDE1T0.3LE	UT HYDE CREEK			
74B	ONELS1T0.6LE	UT NELSON CR			

APPENDIX C

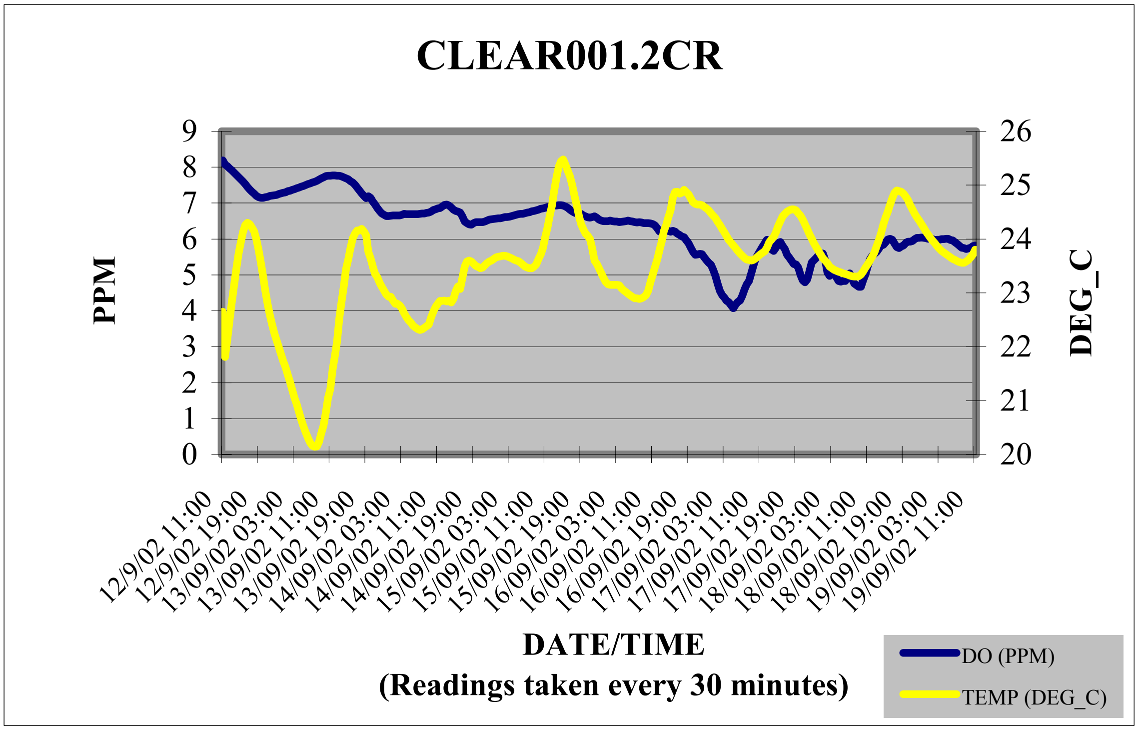
DIURNAL DISSOLVED OXYGEN DATA



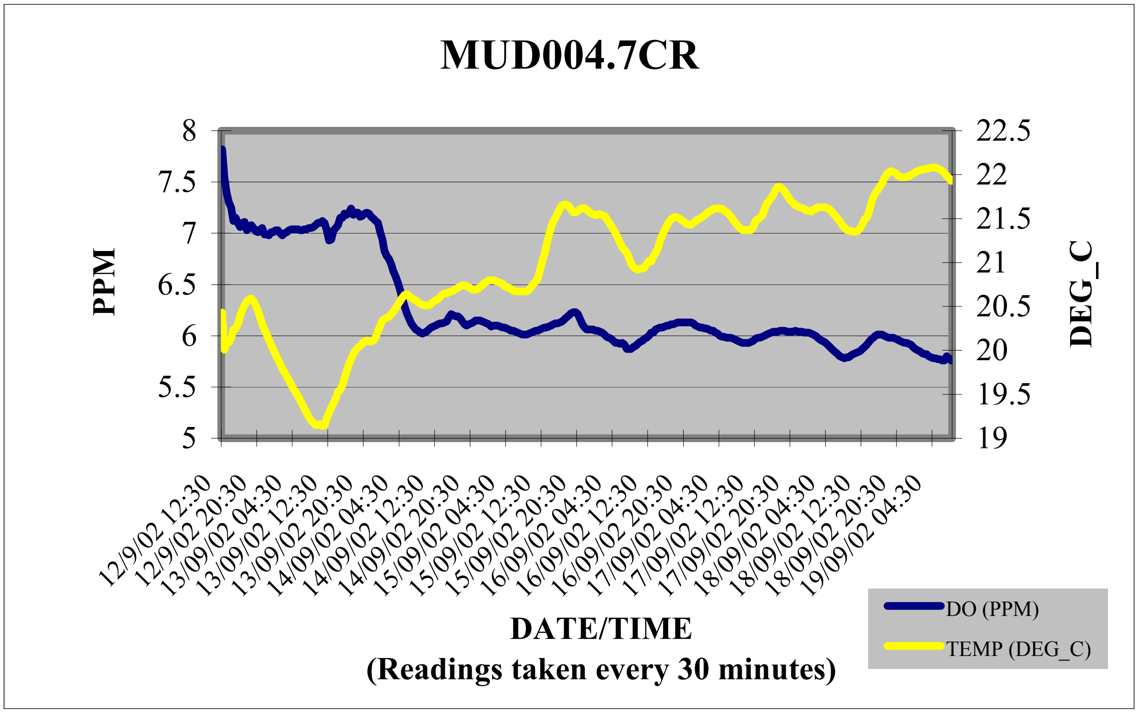
Field Notes: Rain during monitoring week, water slightly up.



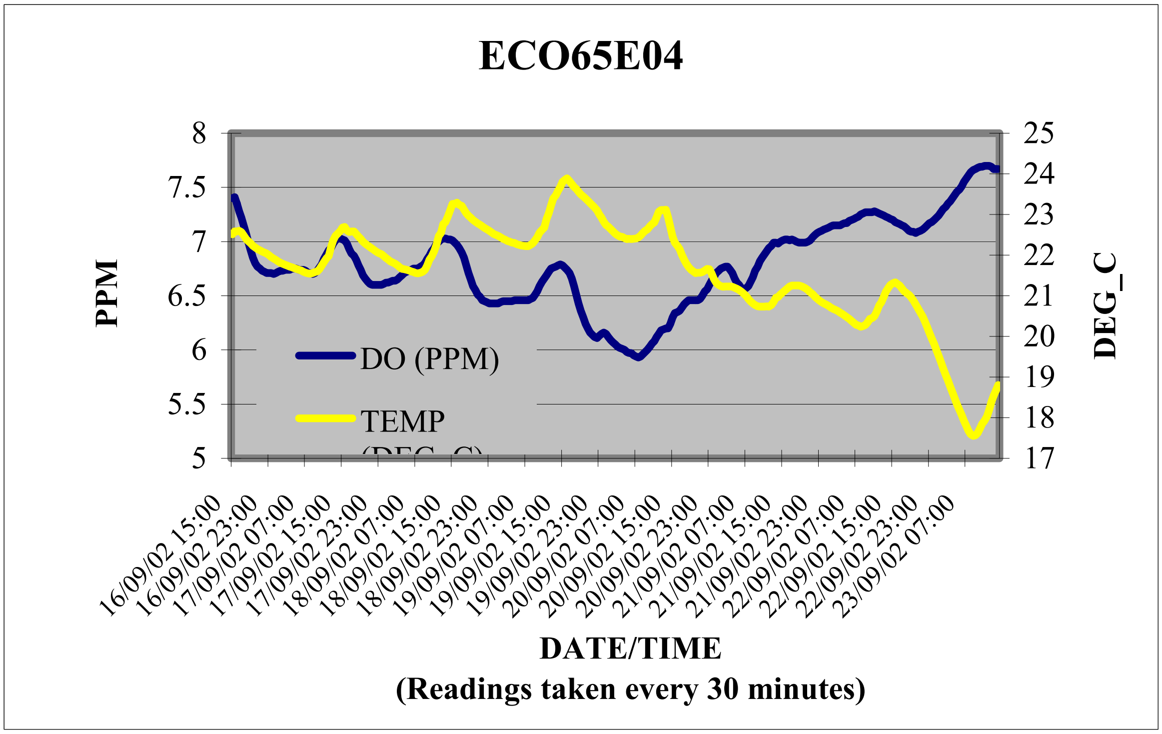
Field Notes: Rain during monitoring week.



Field Notes: Rain during monitoring week, water slightly up.



Field Notes: Rain during monitoring week, water up.


ECO65E04
PPM
DEG_C
DO (PPM)
TEMP
DATE/TIME
(Readings taken every 30 minutes)
8
7.5
7
6.5
6
5.5
5
25
24
23
22
21
20
19
18
17
16/09/02 15:00
16/09/02 23:00
17/09/02 07:00
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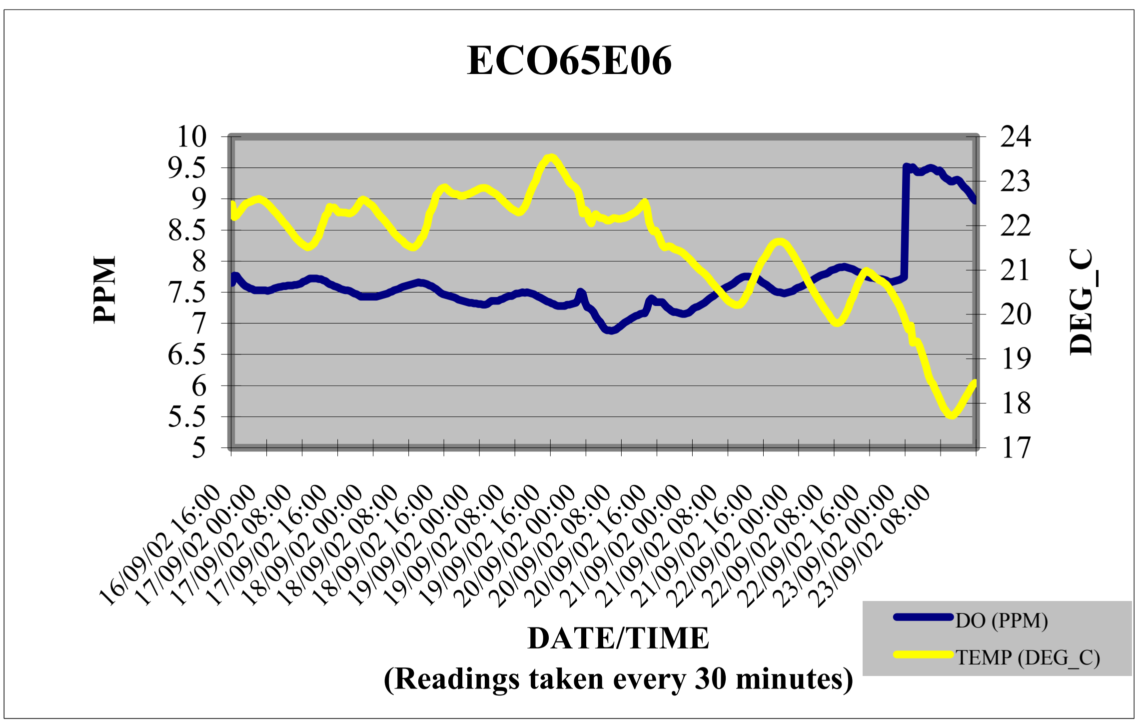
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DEG_C
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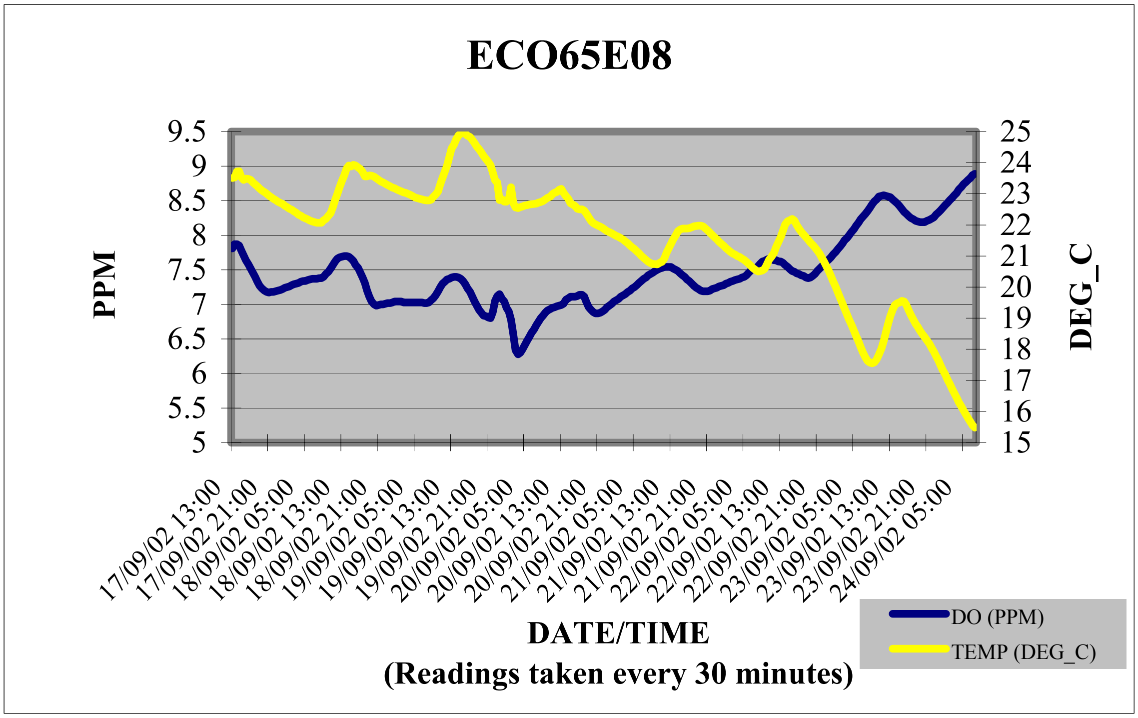
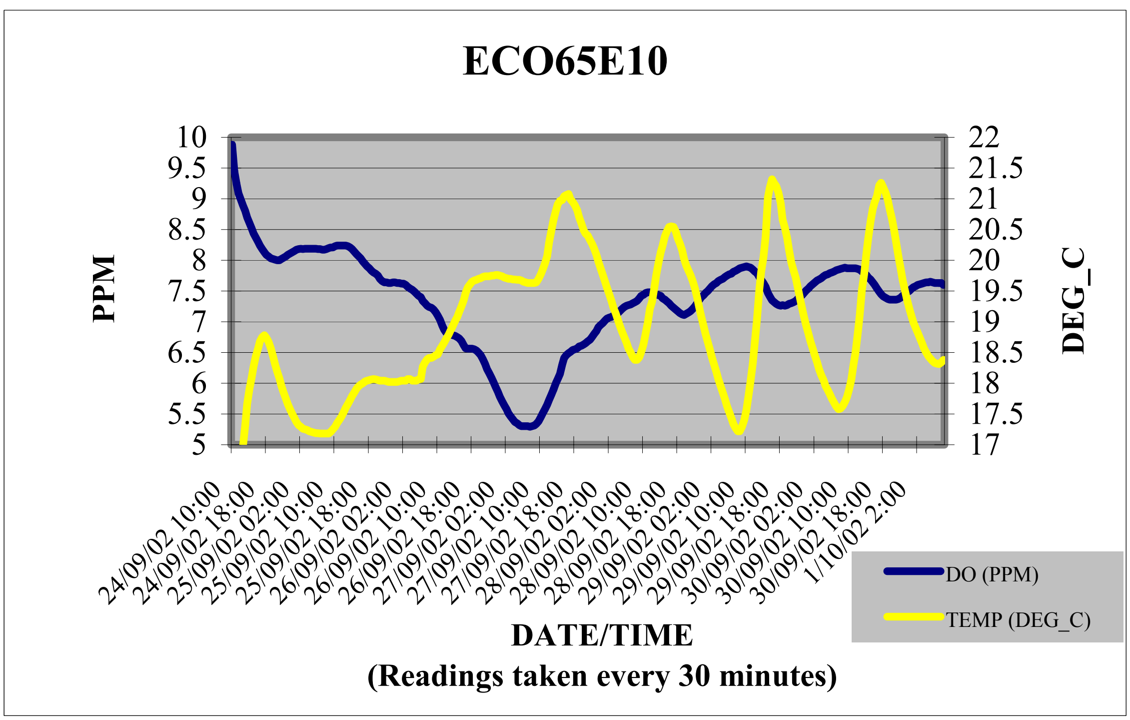
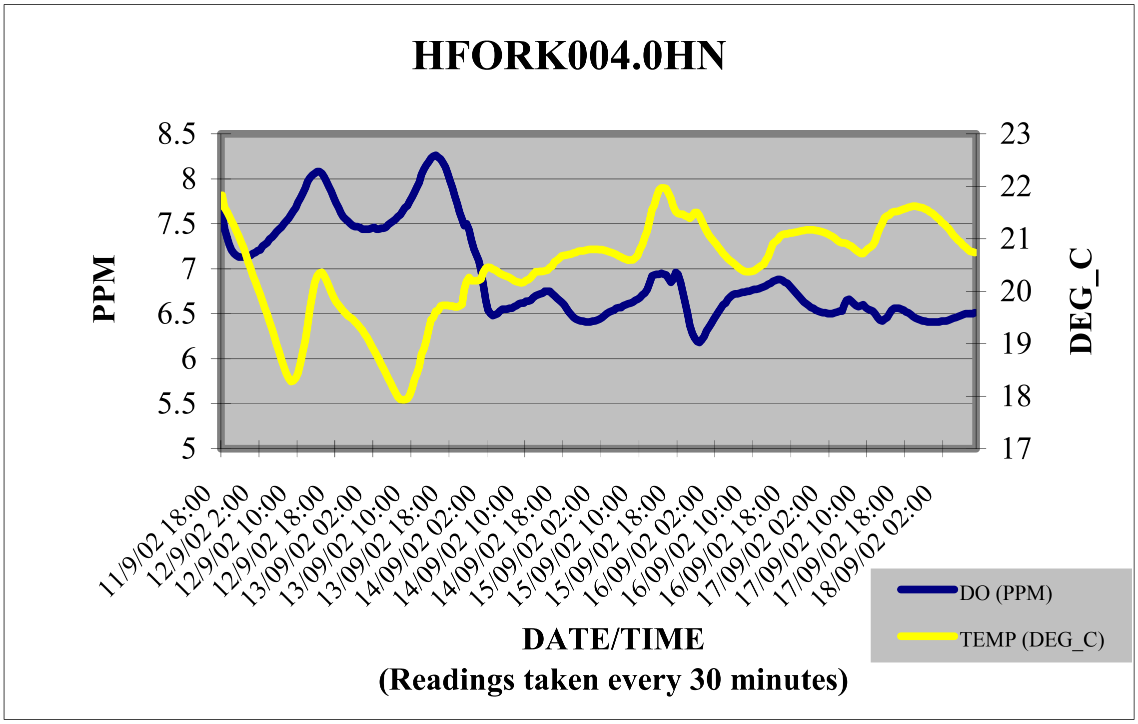
TEMP (DEG_C)
DATE/TIME
(Readings taken every 30 minutes)

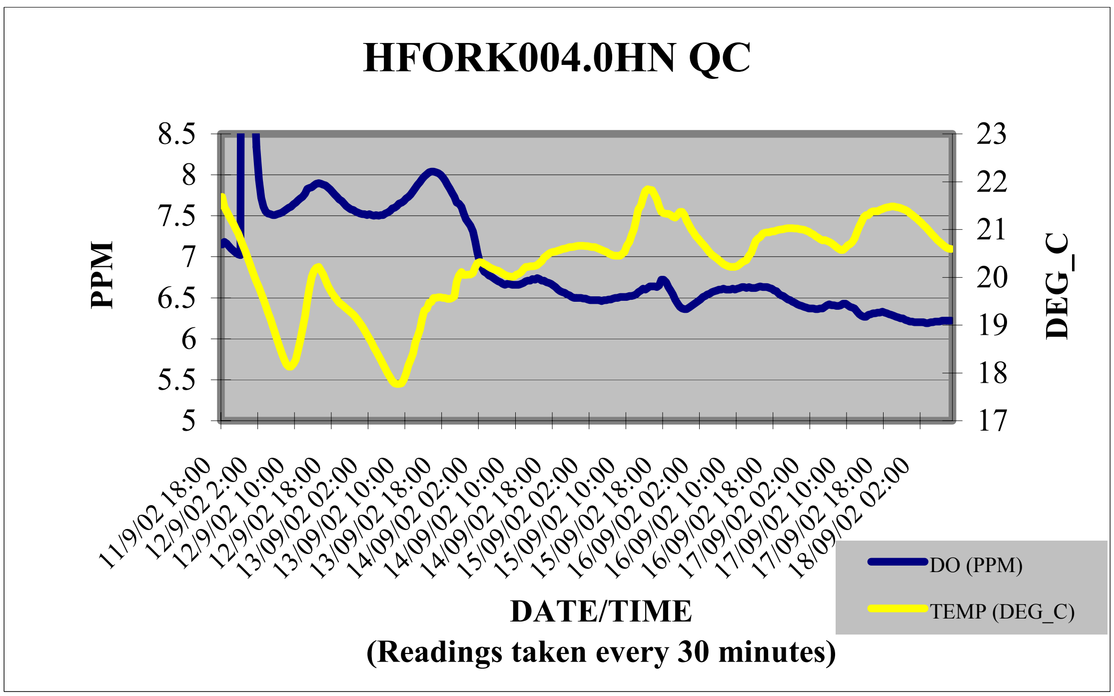


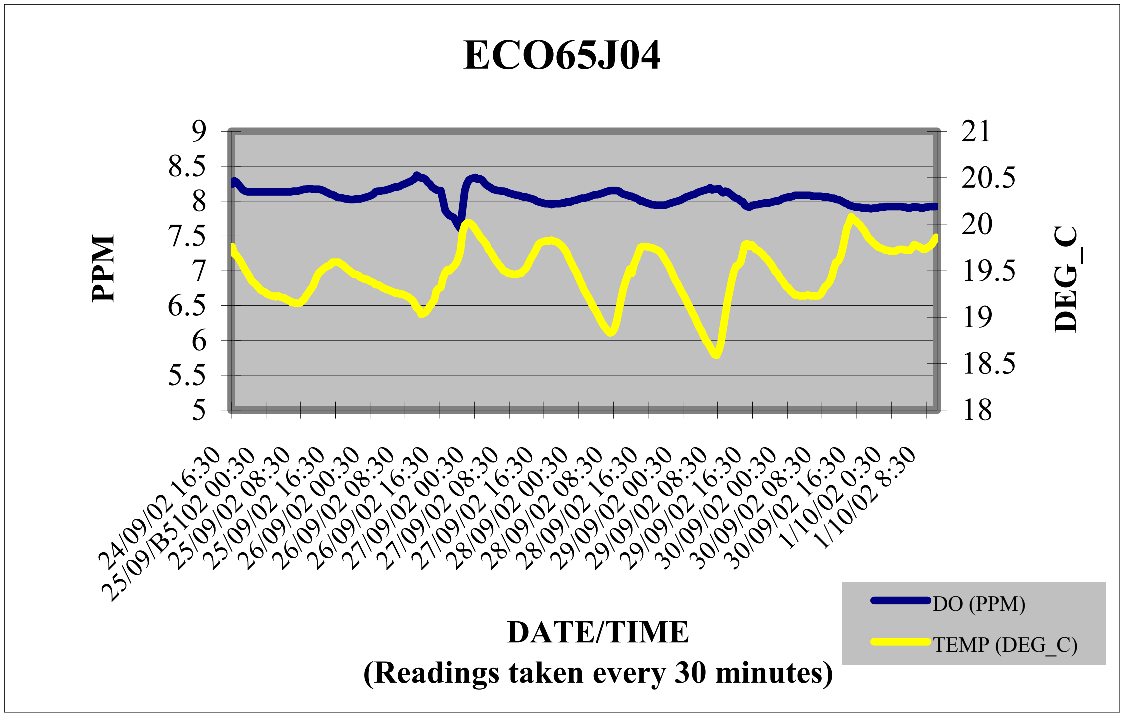


Field Notes: Heavy rain while probe was out. Water turbid at pickup.



Field Notes: Rain during monitoring week, water up.

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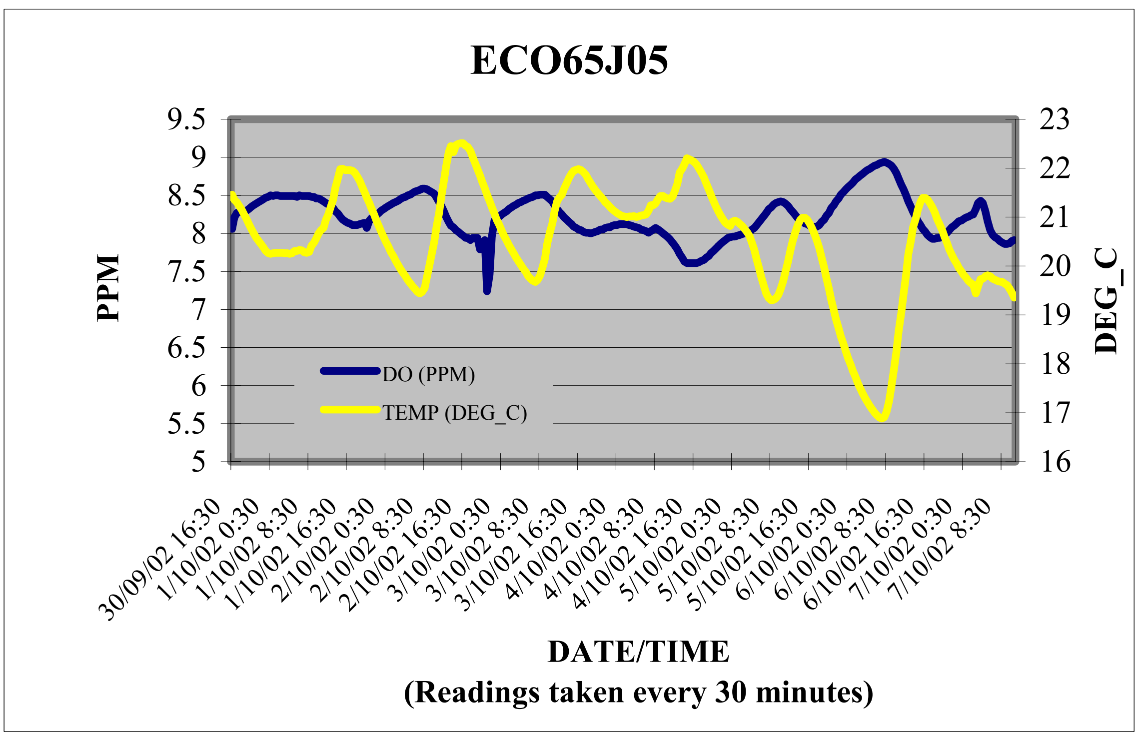
DO (PPM)
TEMP (DEG_C)
DATE/TIME
(Readings taken every 30 minutes)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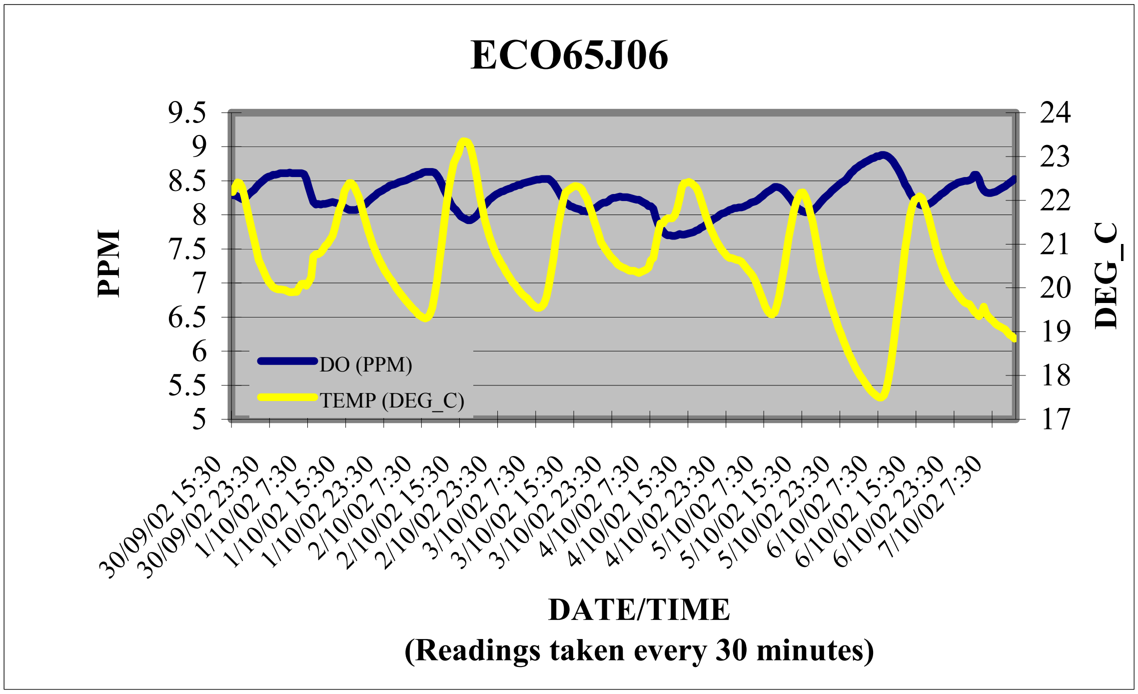
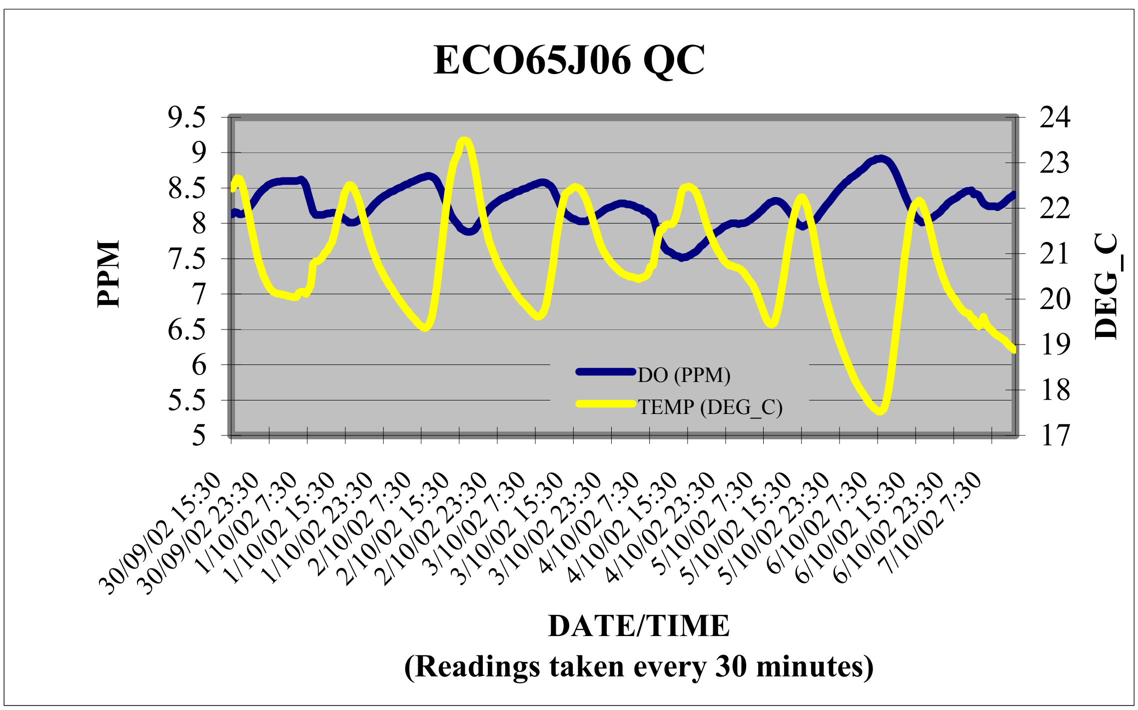
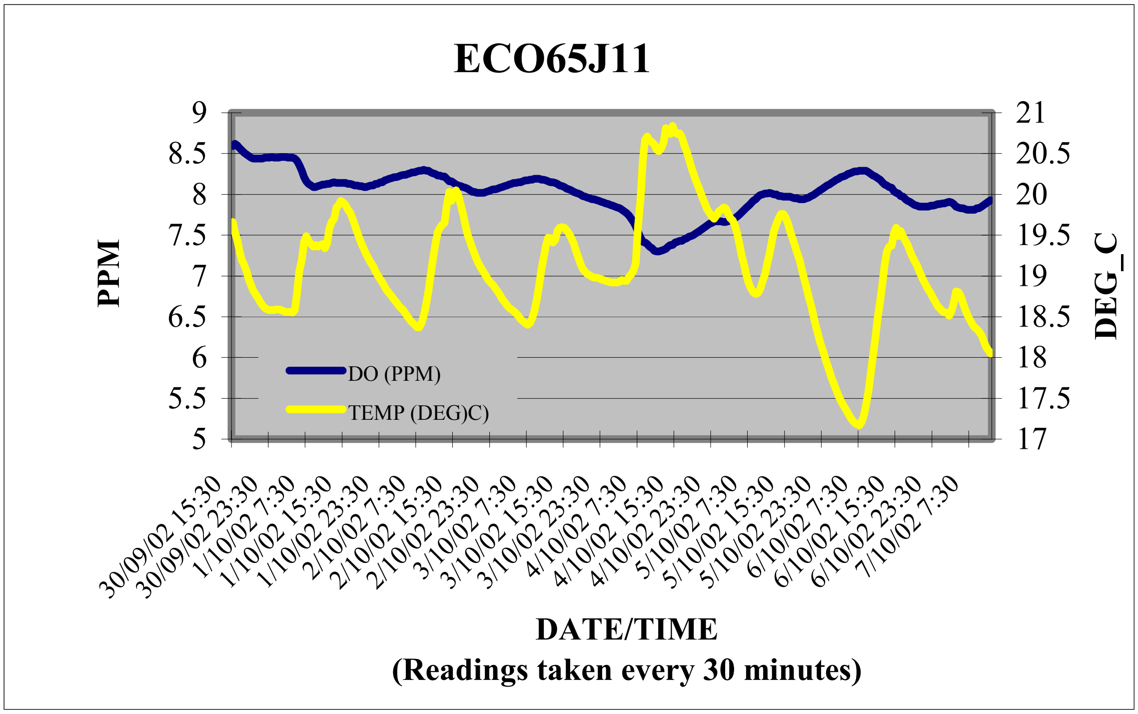
DATE/TIME
(Readings taken every 30 minutes)

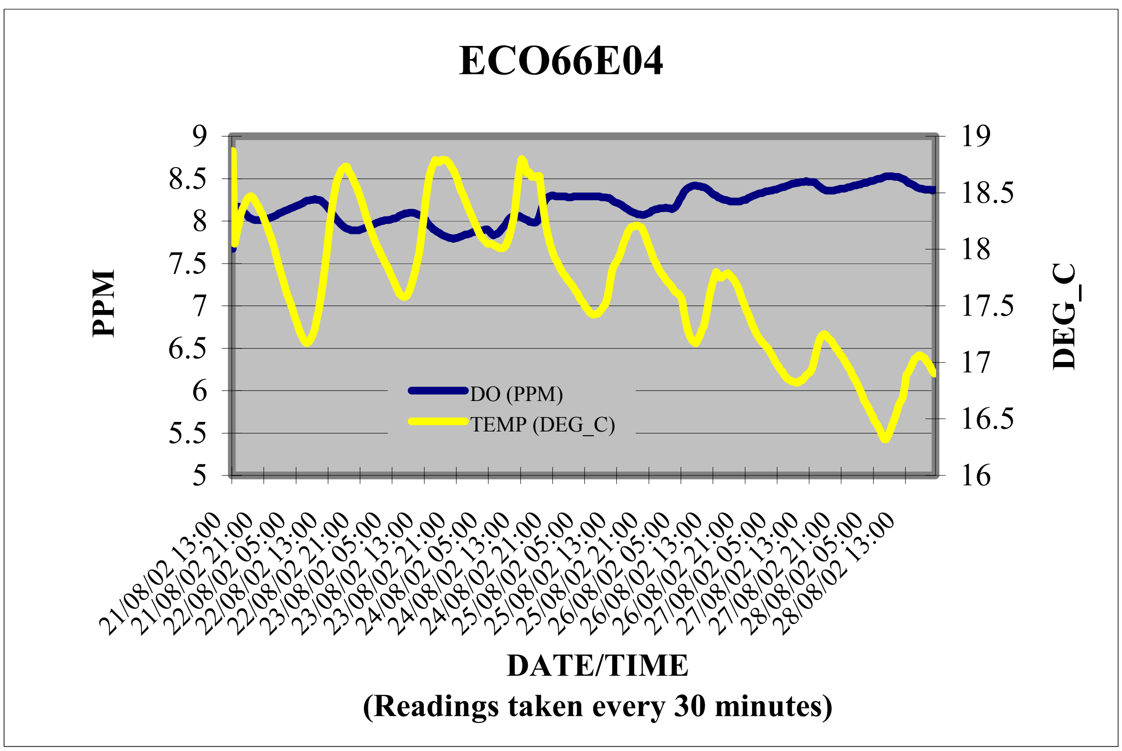


Field Notes: Rain during monitoring week, evidence of water up during week, but down at pickup.

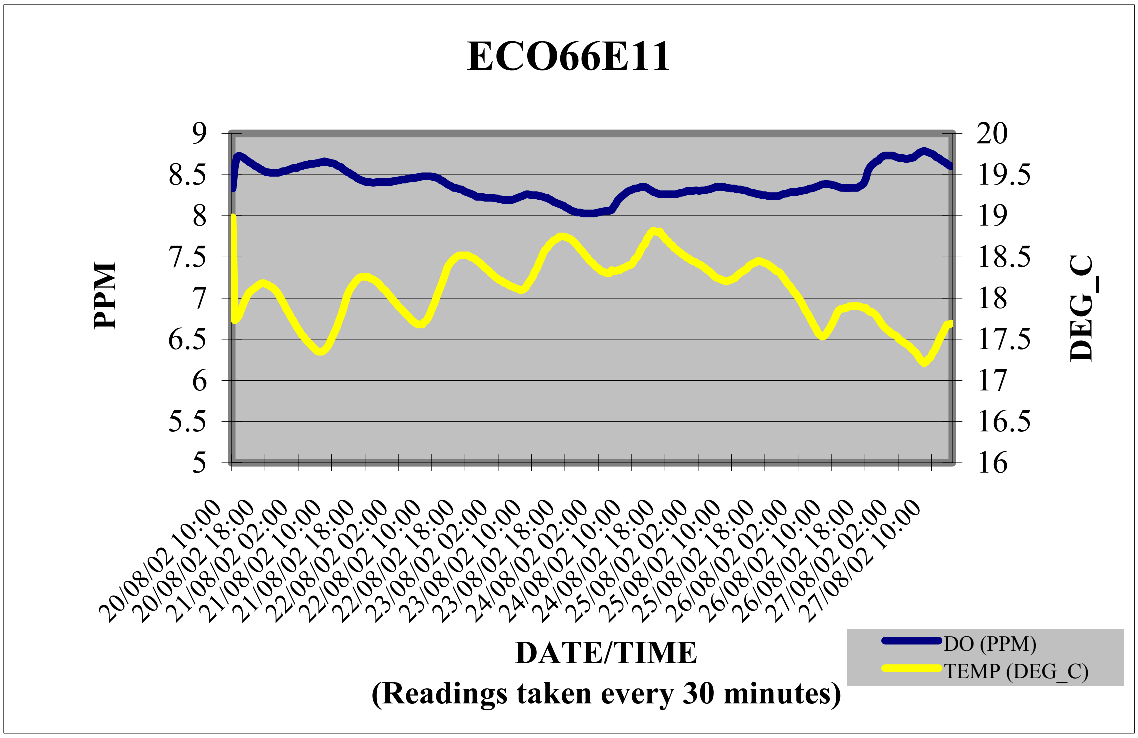


Field Notes: Rain during monitoring week, water up during week but down at pickup.





Field Notes: Rain during monitoring week, water up.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DATE/TIME
(Readings taken every 30 minutes)
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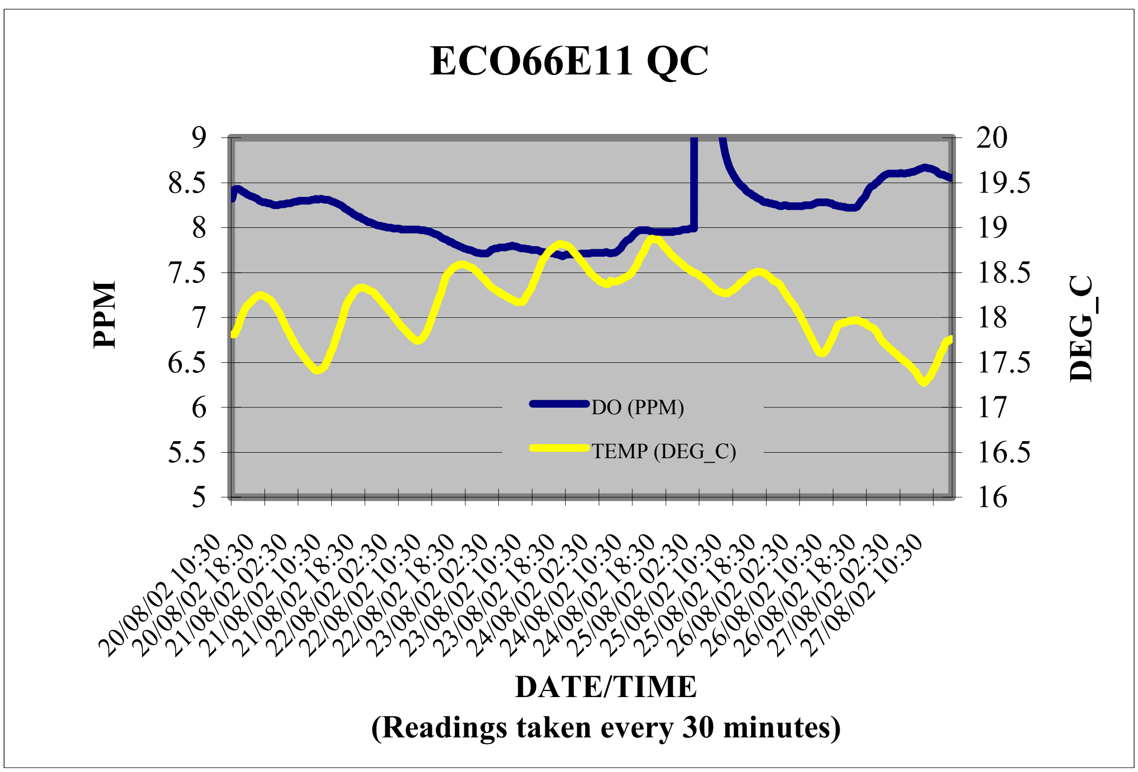
TEMP (DEG_C)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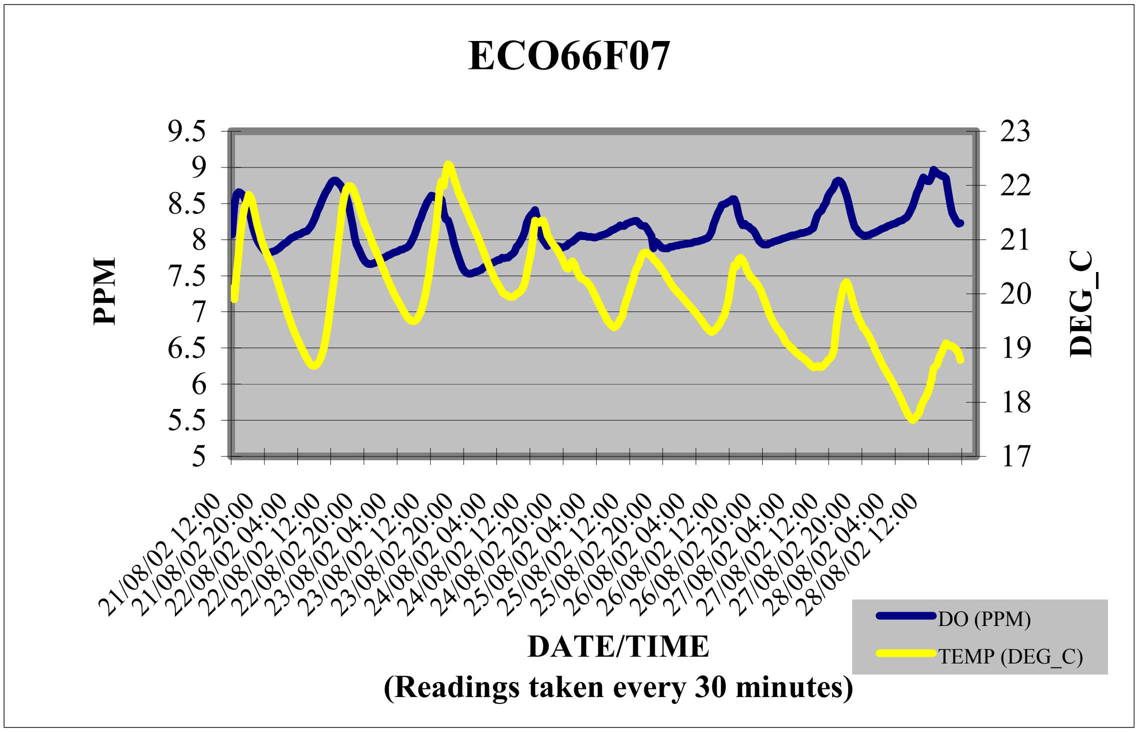
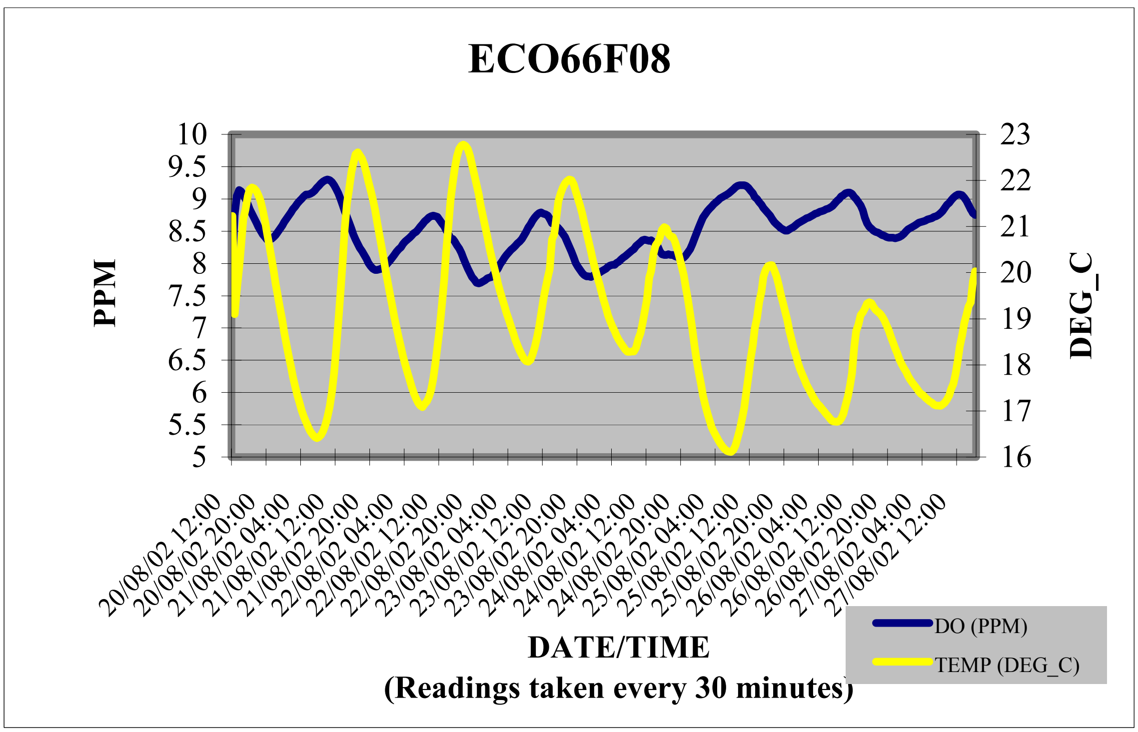
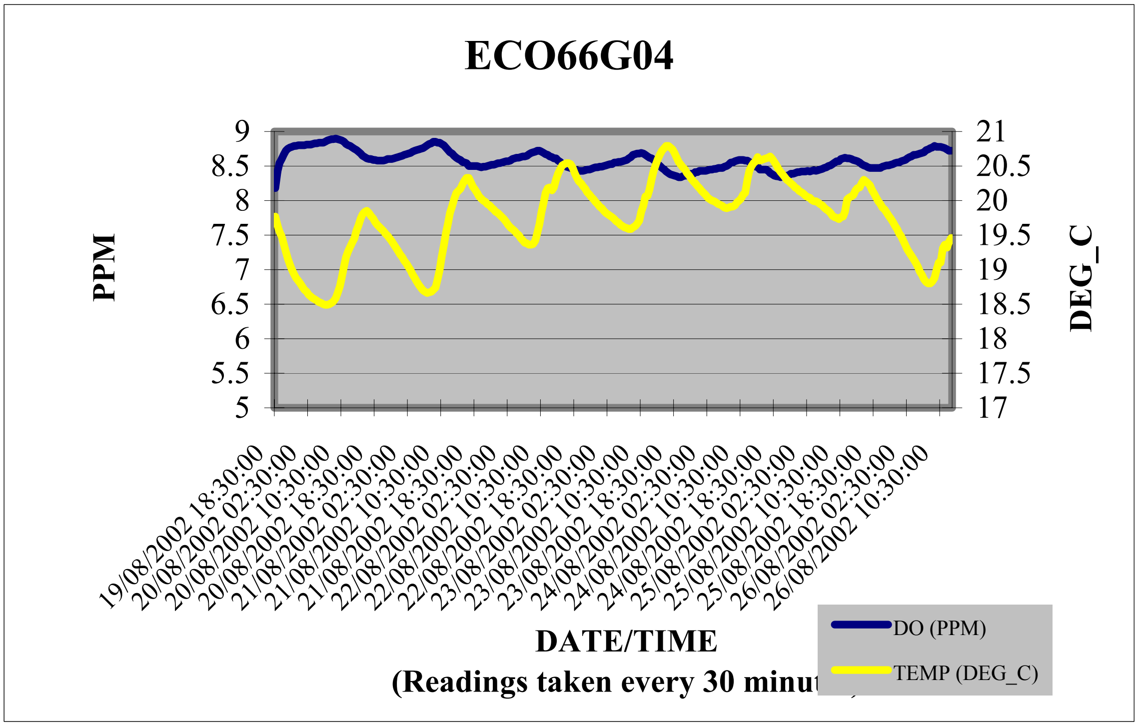
DATE/TIME
(Readings taken every 30 minutes)



Field Notes: Rain during monitoring week, water up.

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DATE/TIME
(Readings taken every 30 minut
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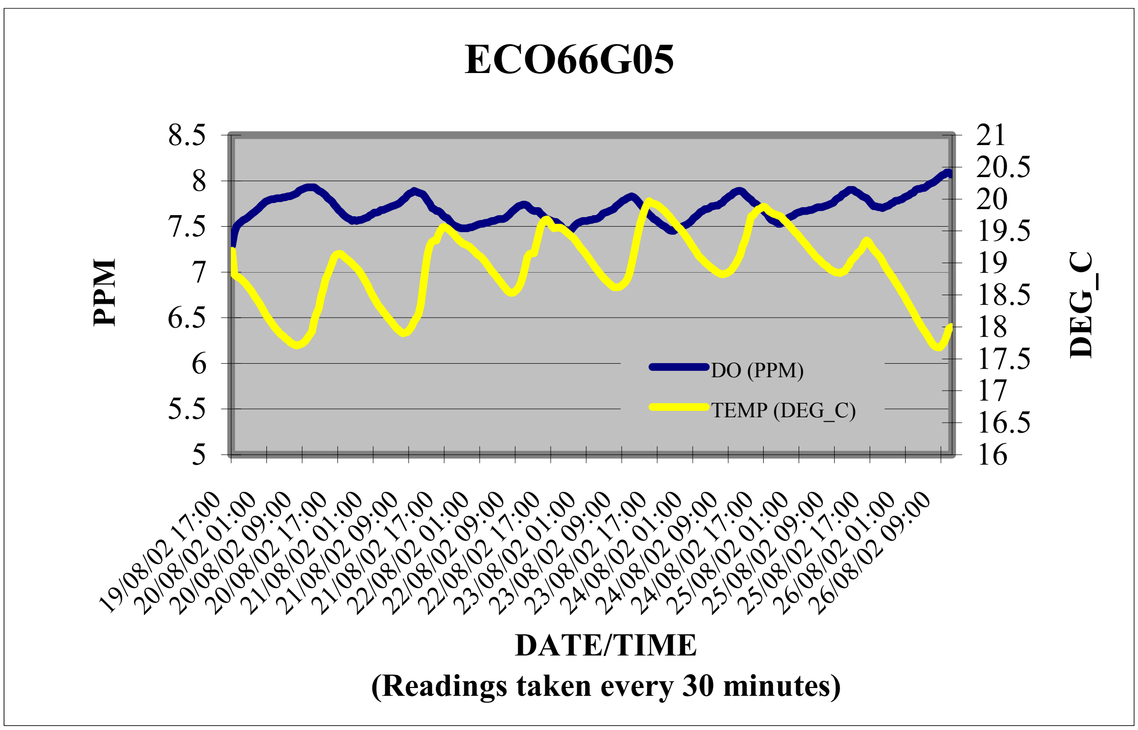
TEMP (DEG_C)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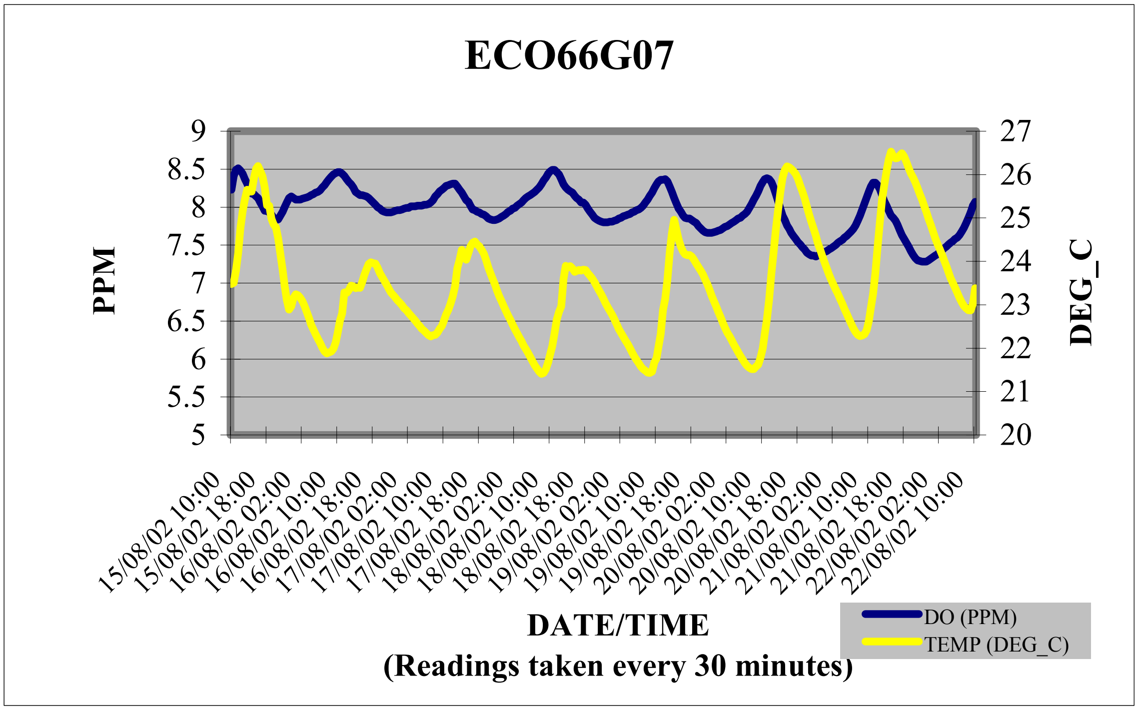
DATE/TIME
(Readings taken every 30 minutes)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DATE/TIME
(Readings taken every 30 minutes)
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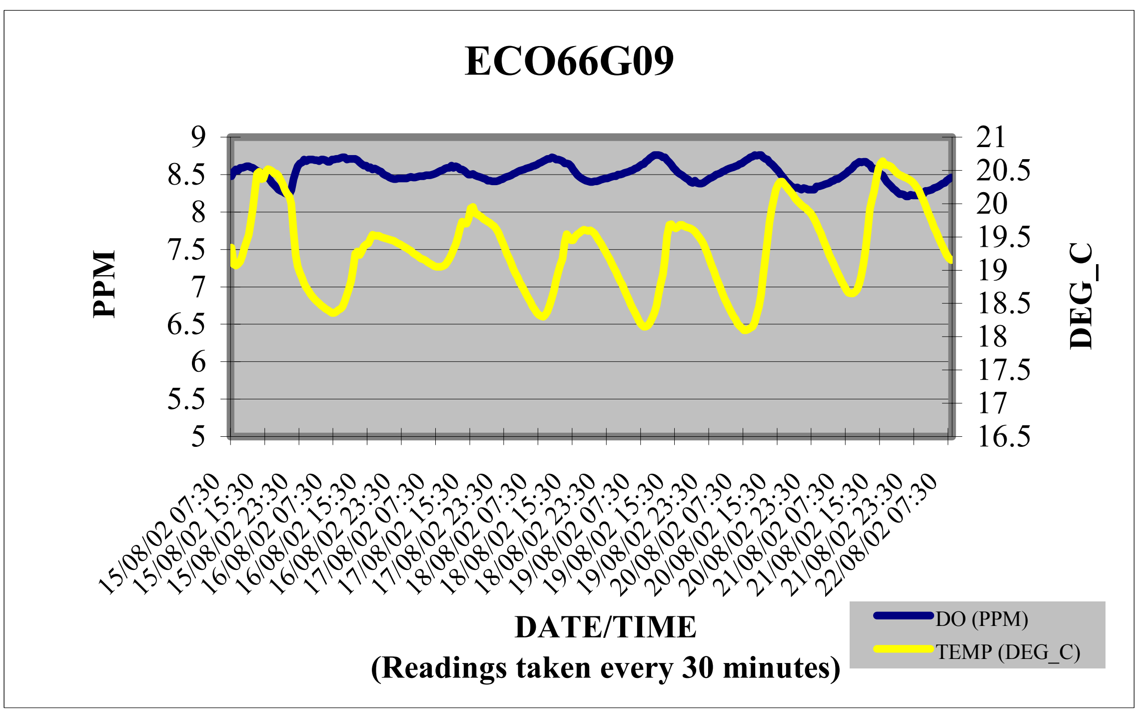
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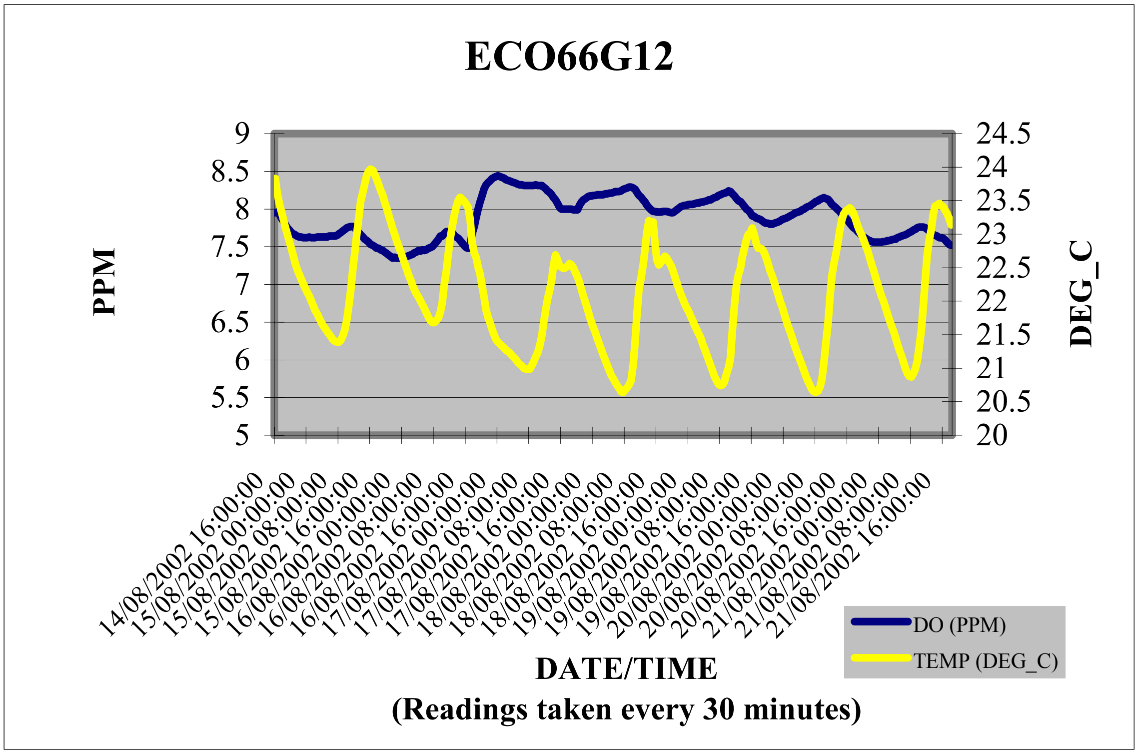
DATE/TIME
(Readings taken every 30 minutes)
DO (PPM)
TEMP (DEG_C)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DATE/TIME
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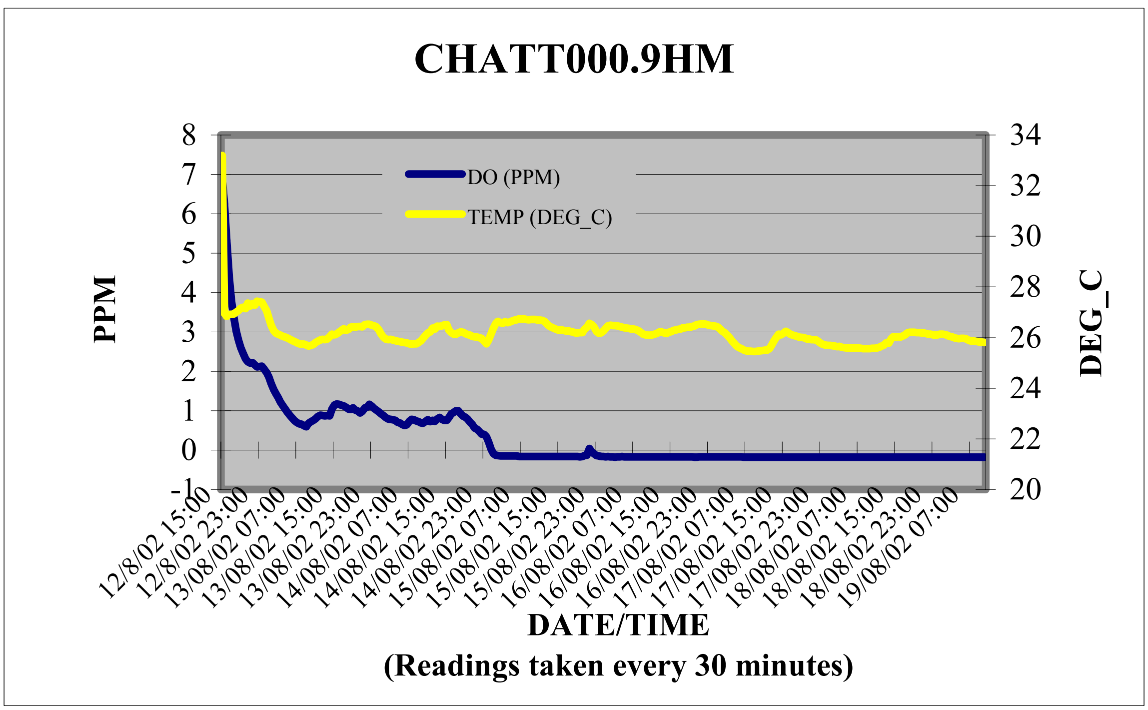
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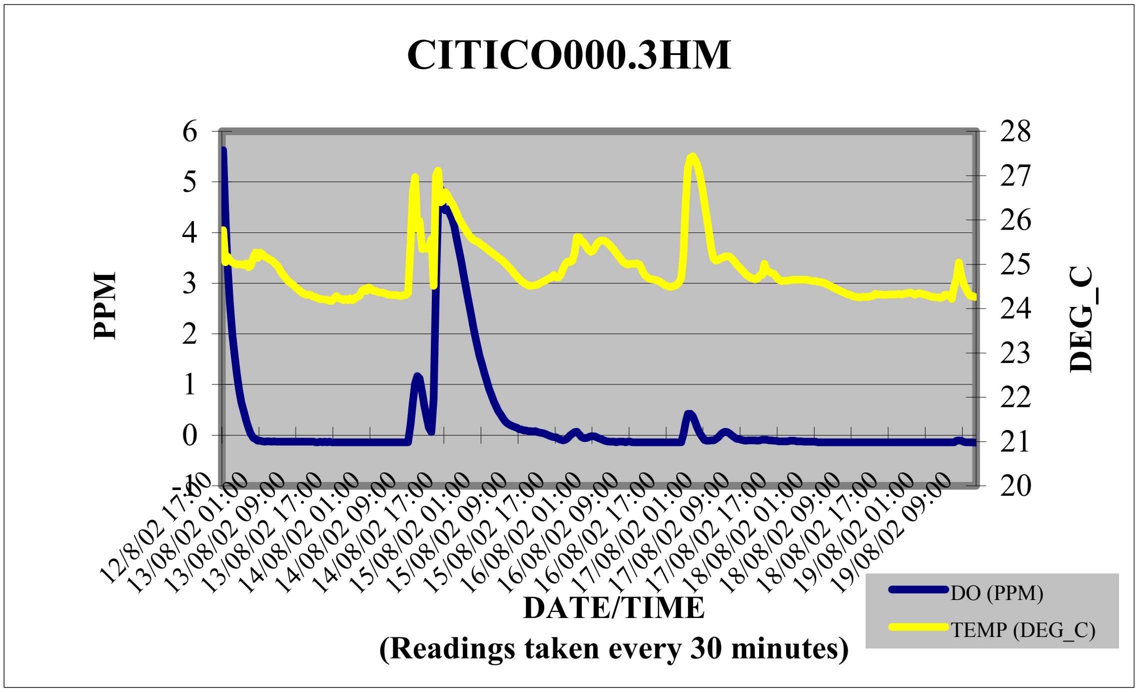
(Readings taken every 30 minutes)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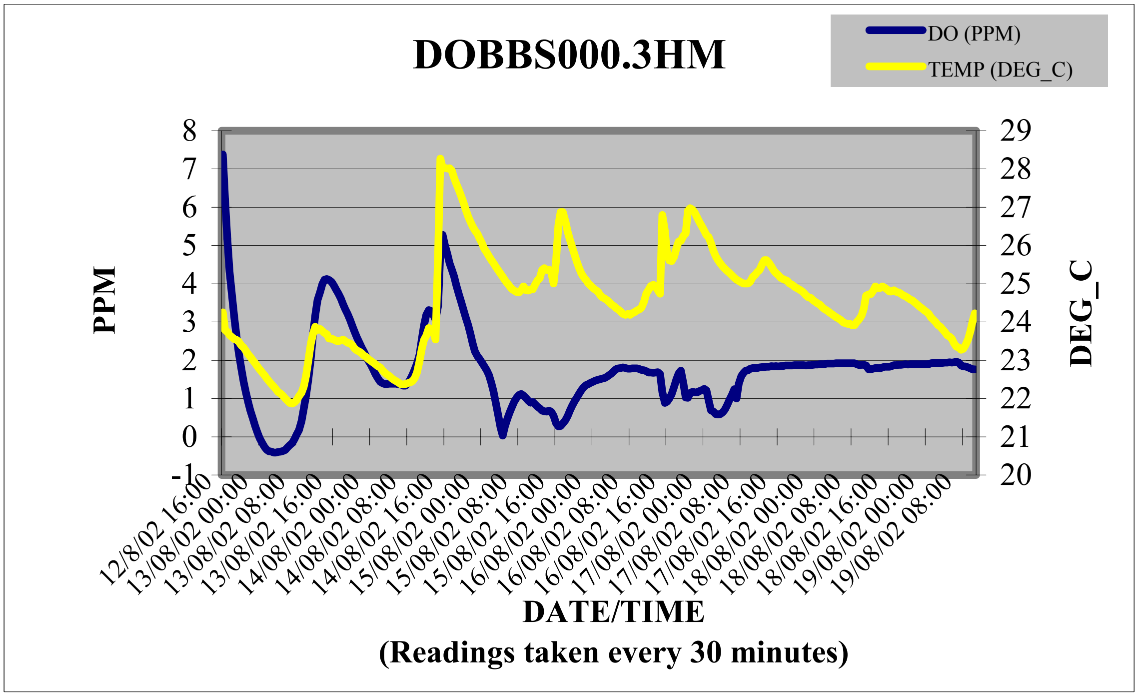
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PPM
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DATE/TIME
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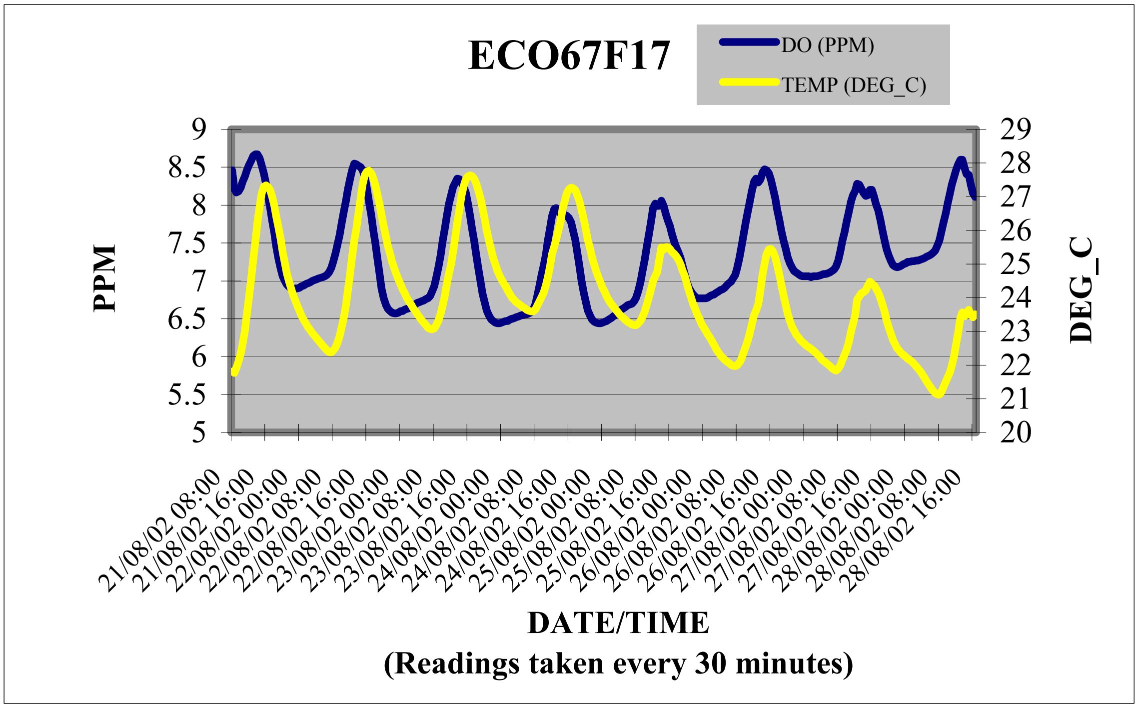
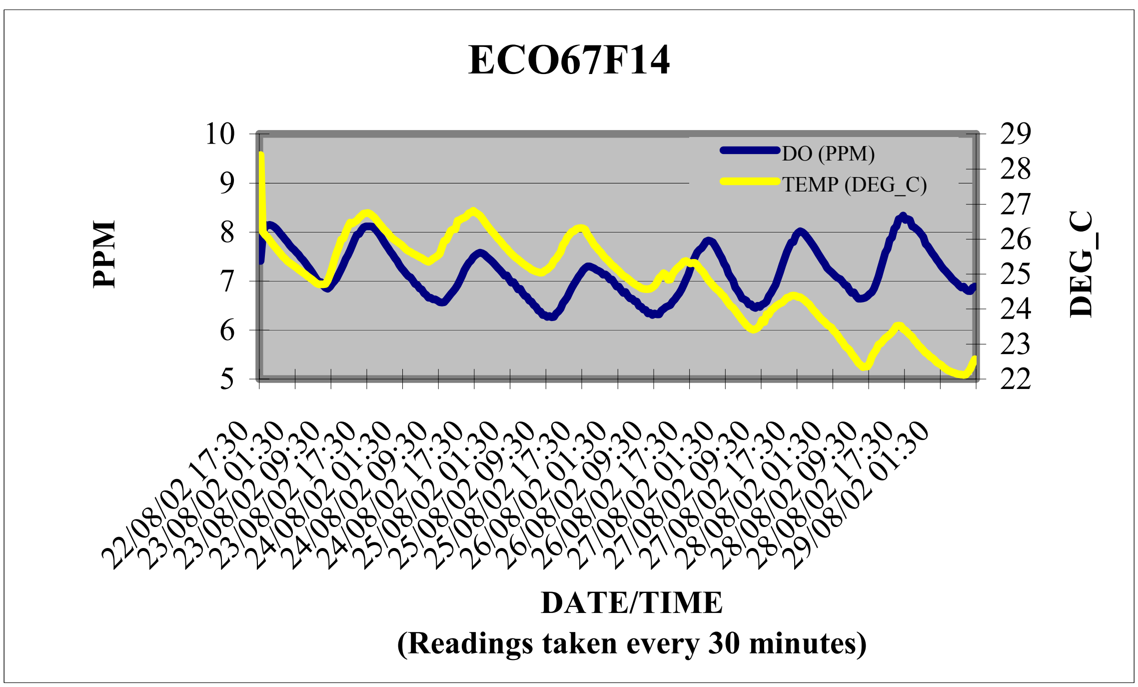
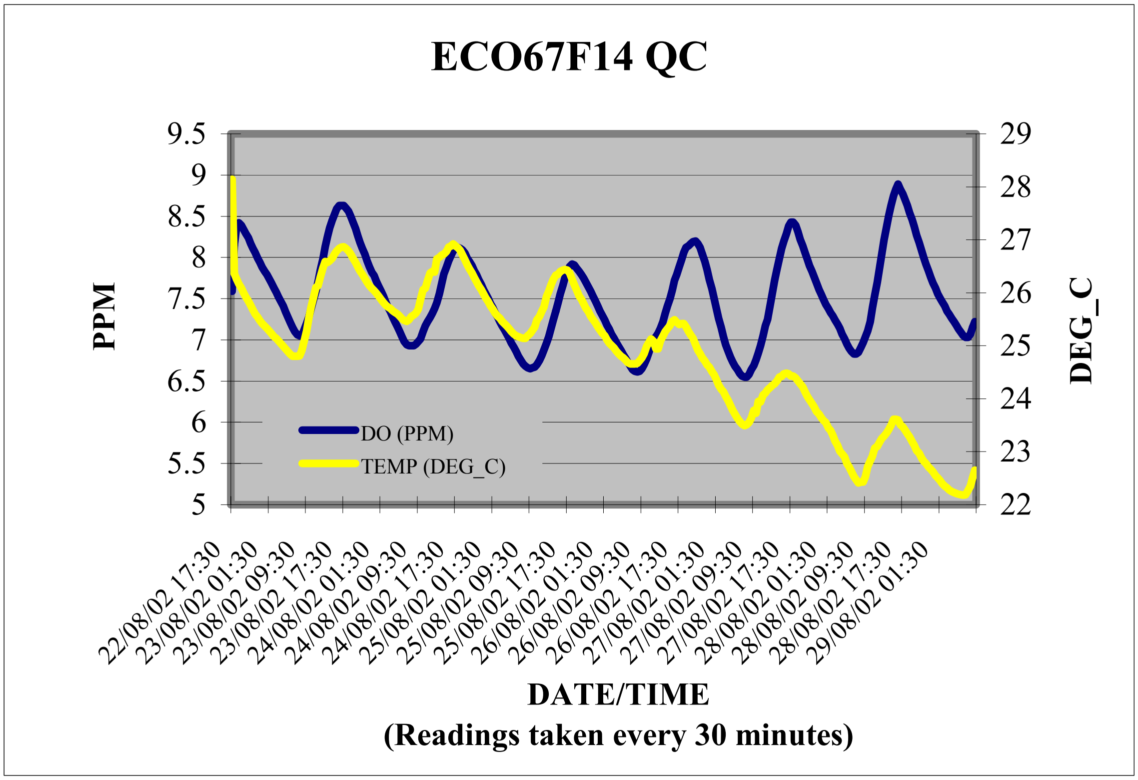


Field Notes: Rain during week, water up.





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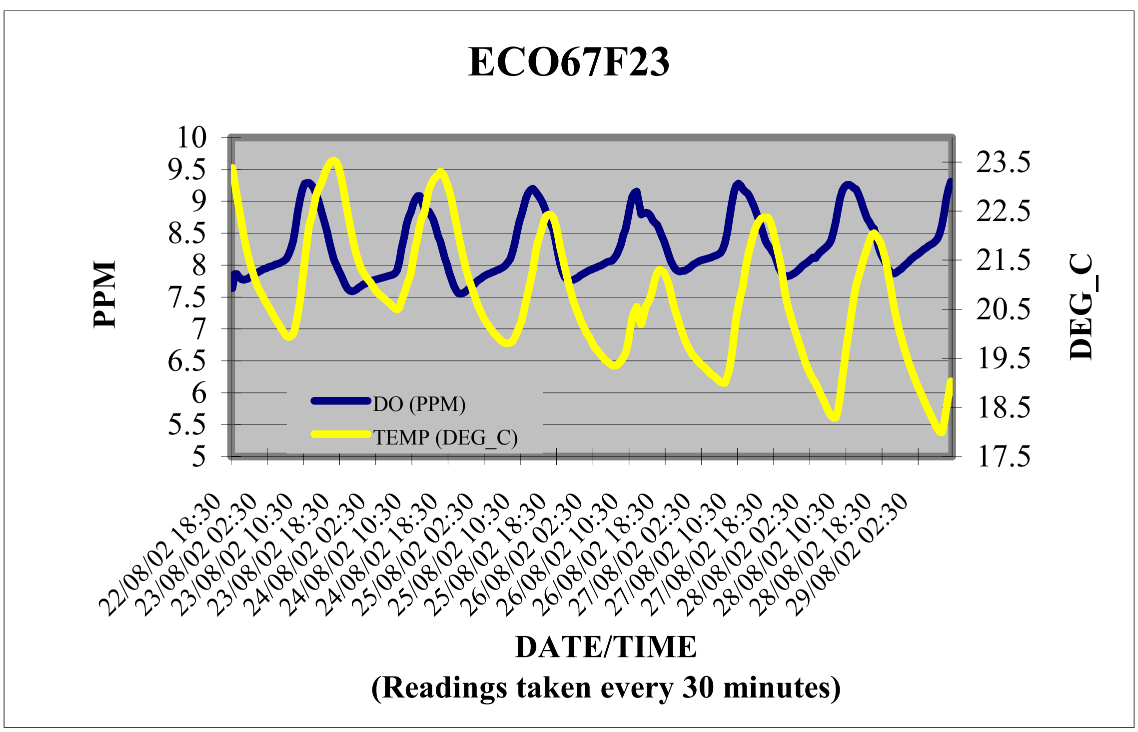
DATE/TIME
(Readings taken every 30 minutes)



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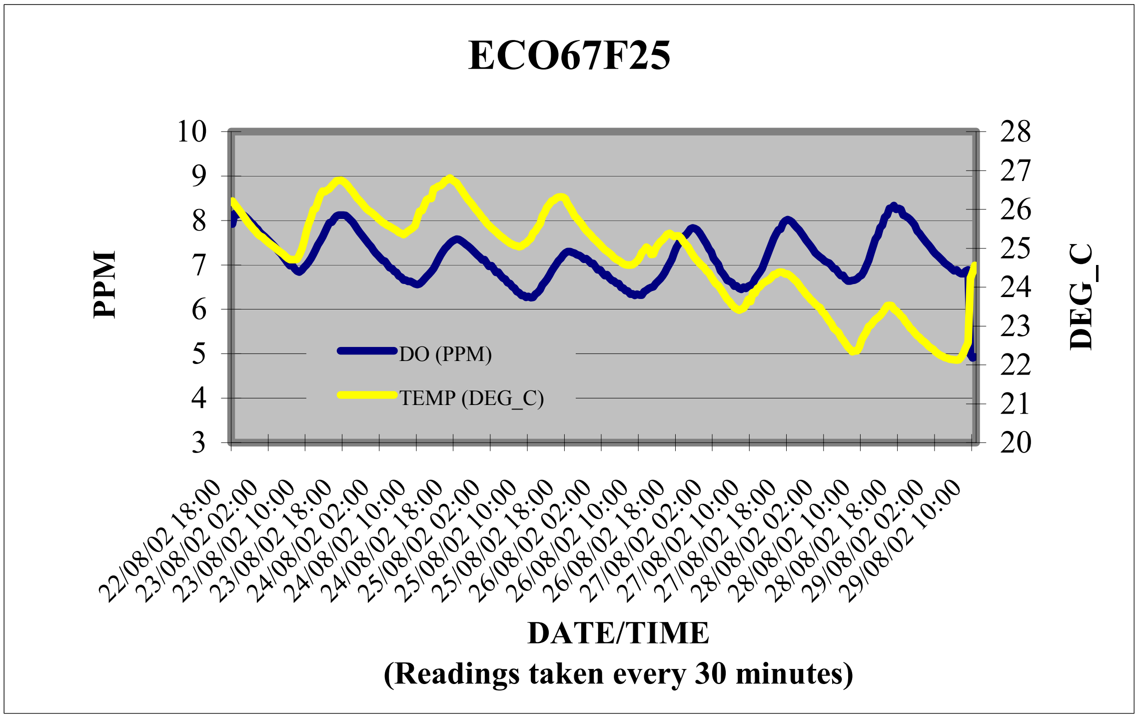
DATE/TIME
(Readings taken every 30 minutes)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DEG_C
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TEMP (DEG_C)
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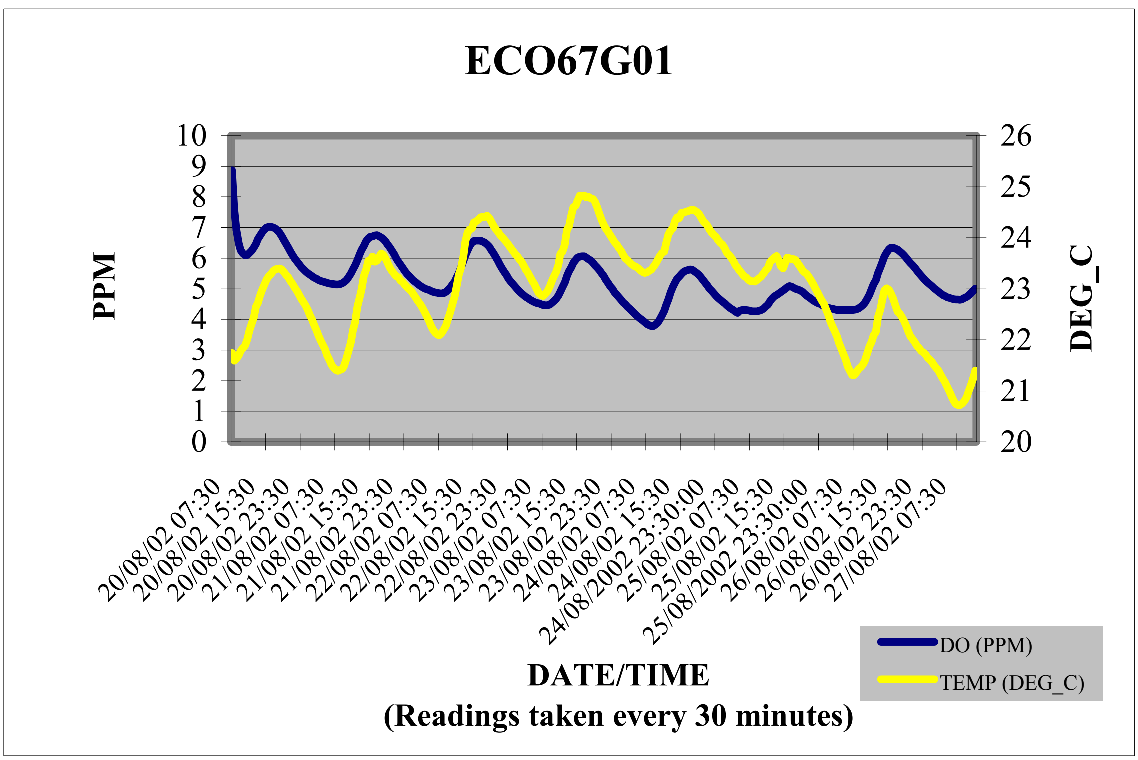
DATE/TIME
(Readings taken every 30 minutes)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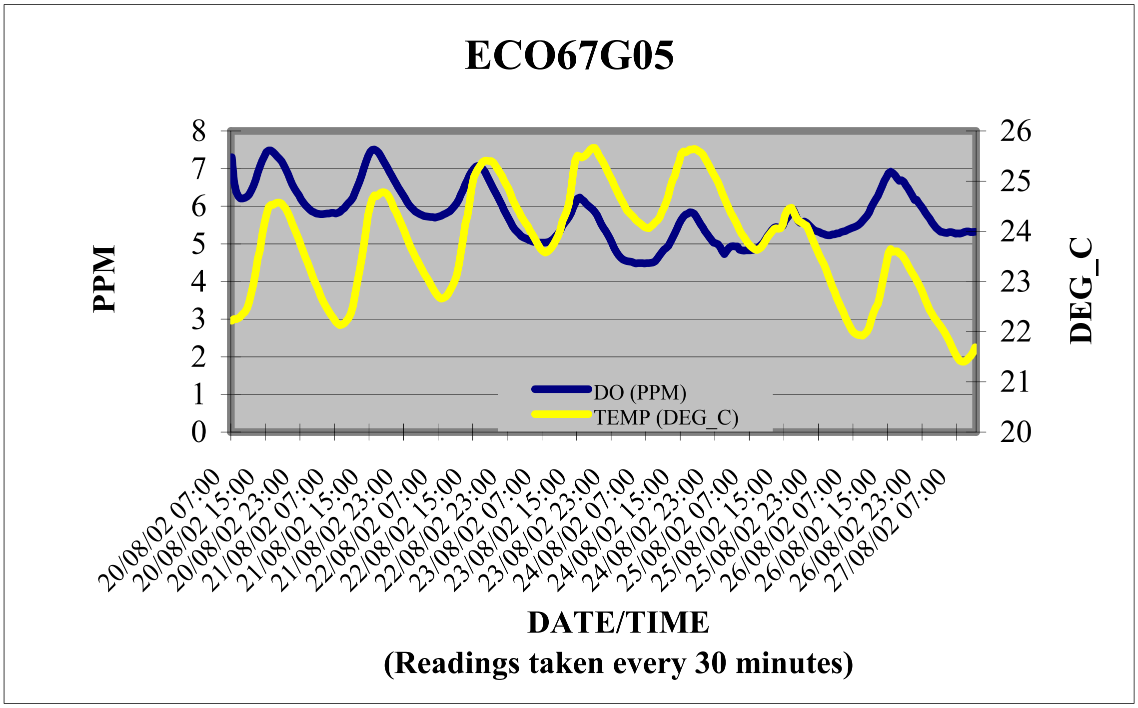
DATE/TIME
(Readings taken every 30 minutes)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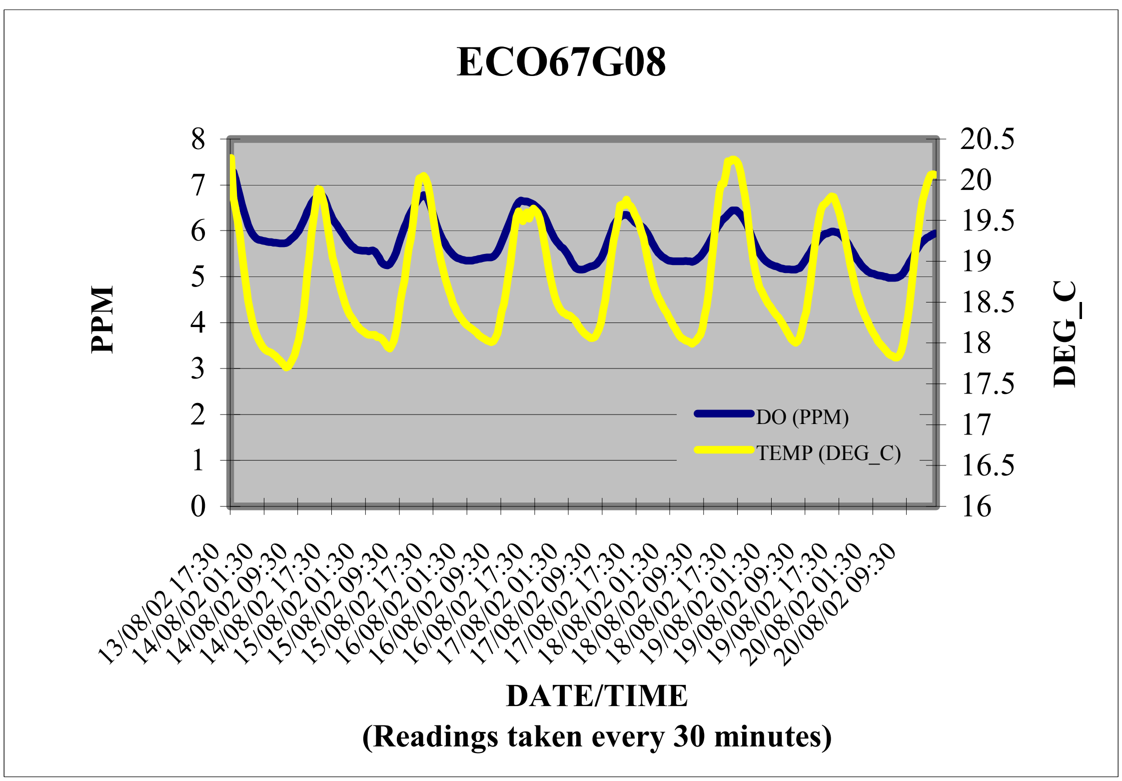
(Readings taken every 30 minutes)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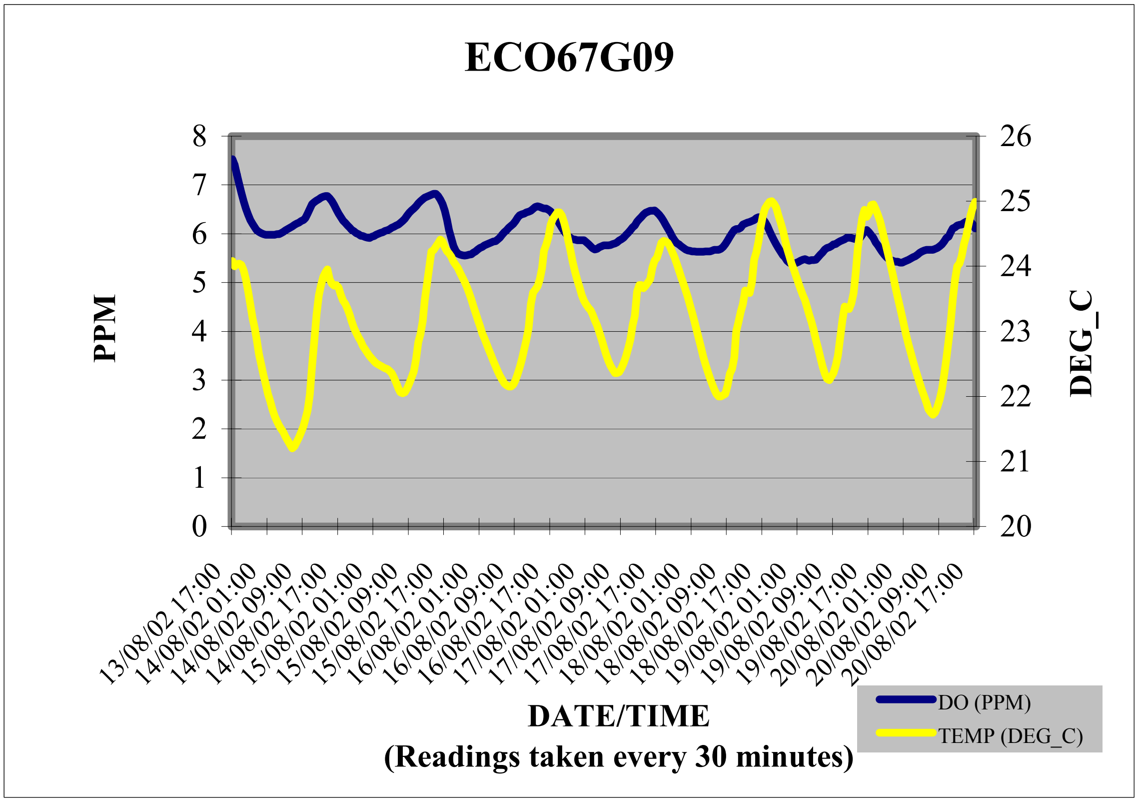
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DATE/TIME
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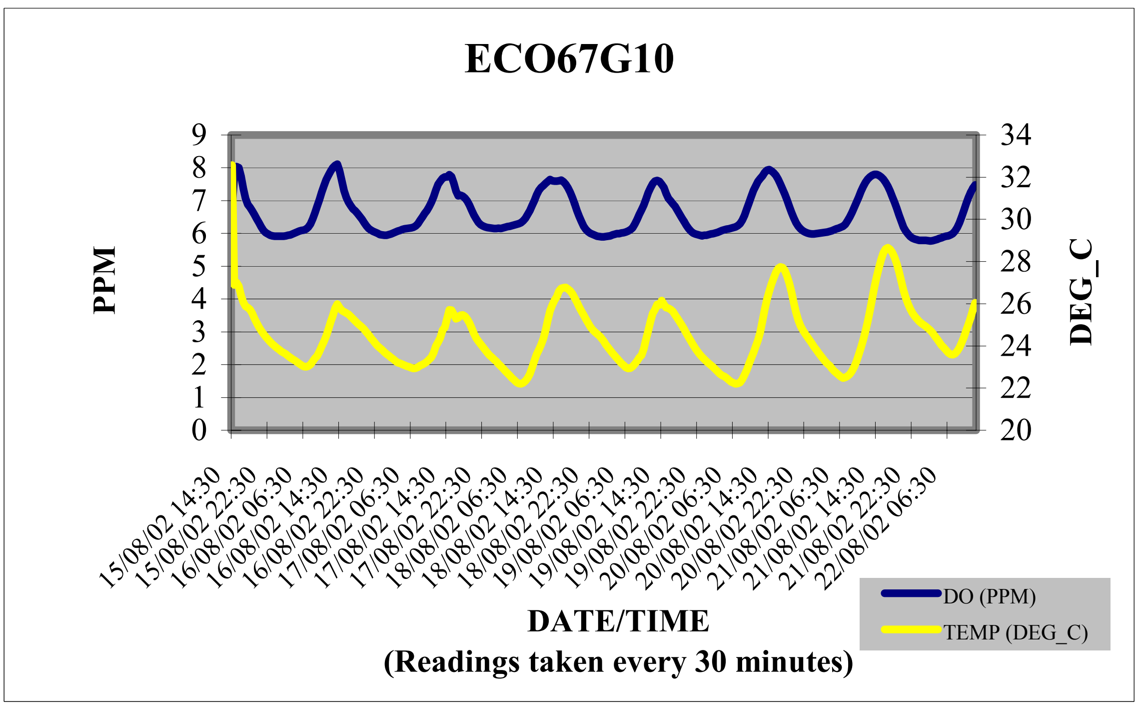
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DATE/TIME
(Readings taken every 30 minutes)
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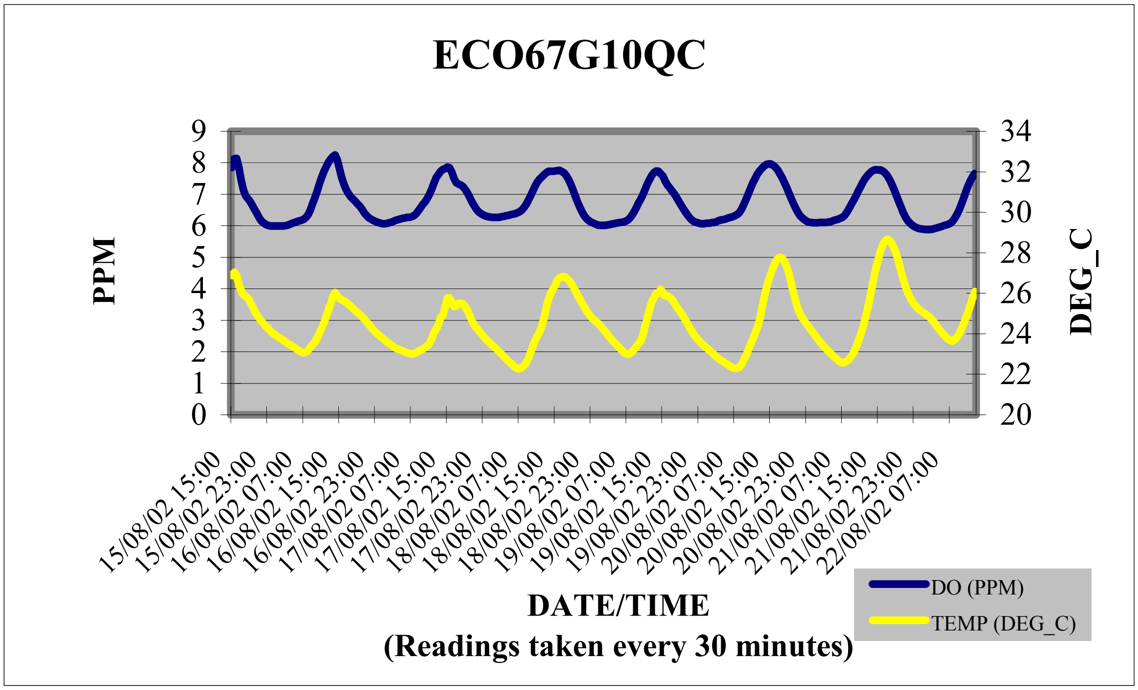
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DATE/TIME
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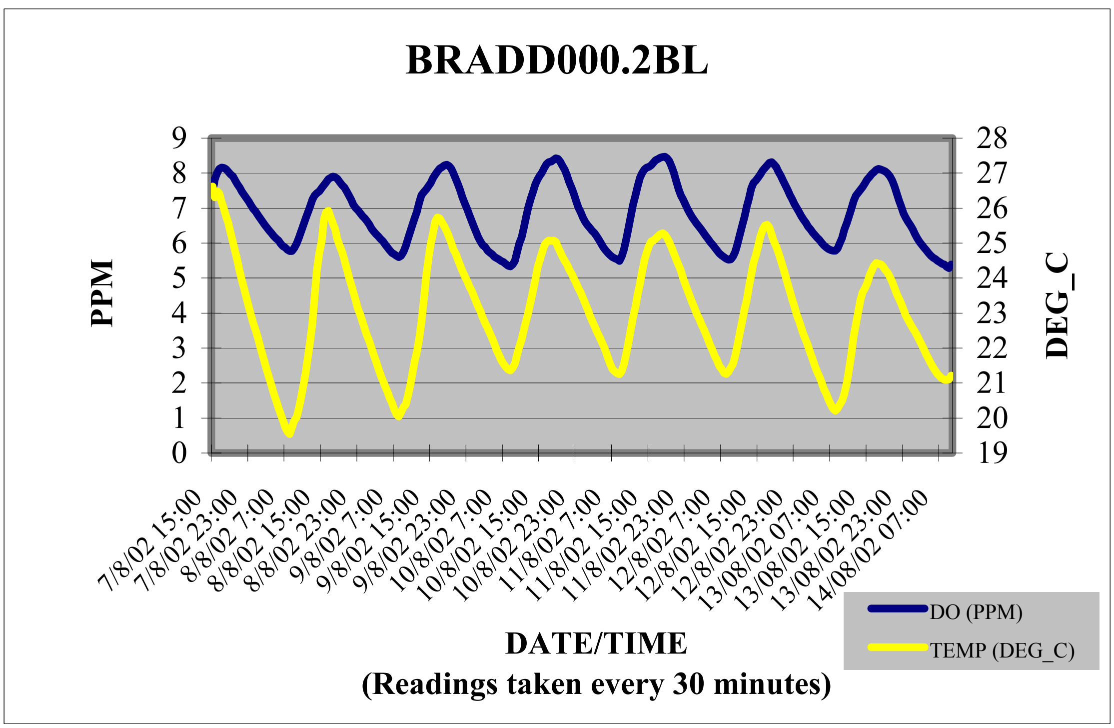
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DATE/TIME
(Readings taken every 30 minutes)
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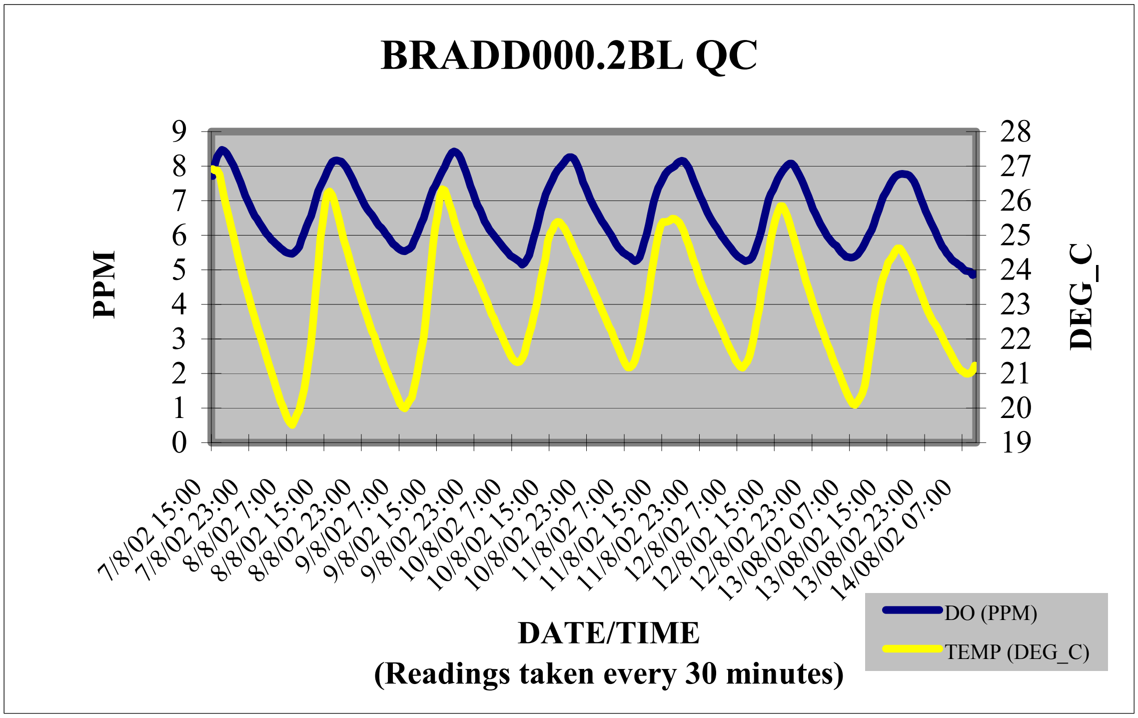
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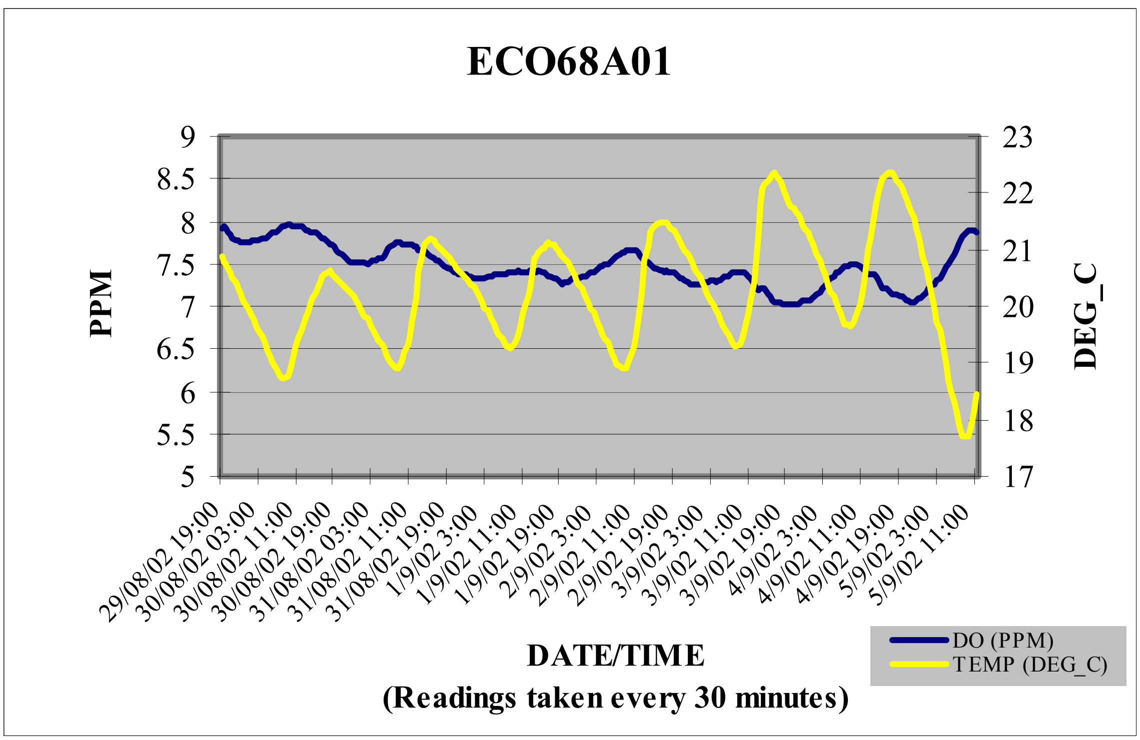
DATE/TIME
(Readings taken every 30 minutes)
DO (PPM)
TEMP (DEG_C)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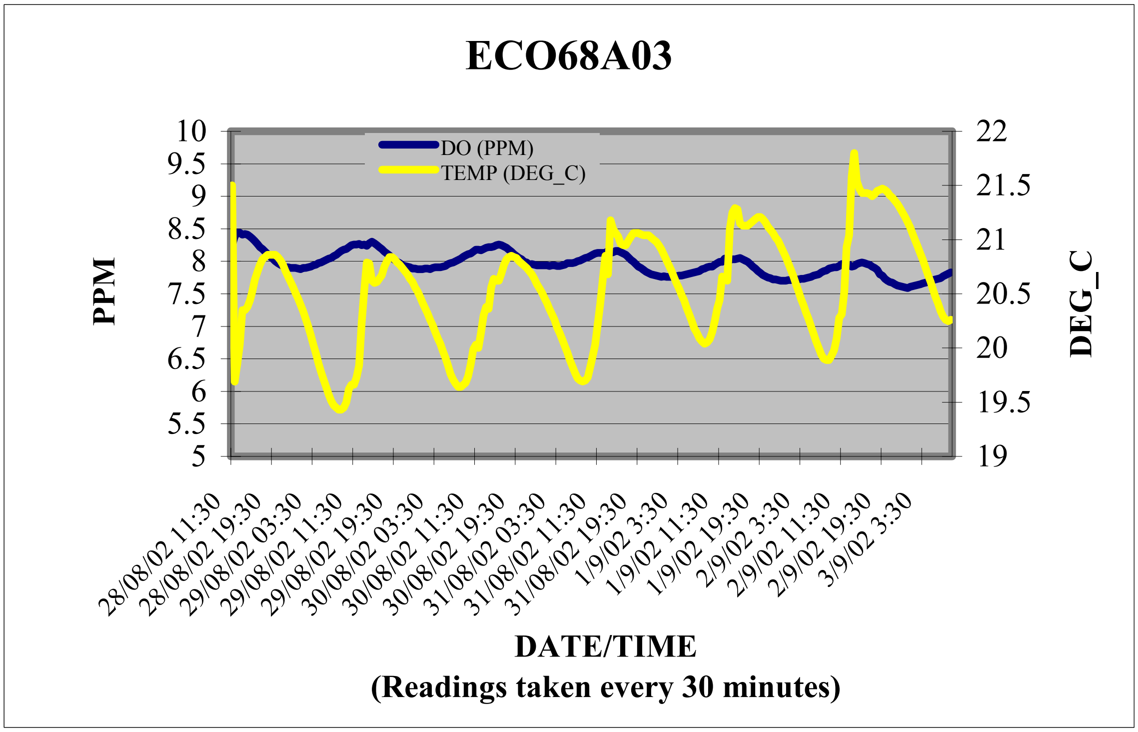
5/9/02 11:00
DATE/TIME
(Readings taken every 30 minutes)
DO (PPM)
TEMP (DEG_C)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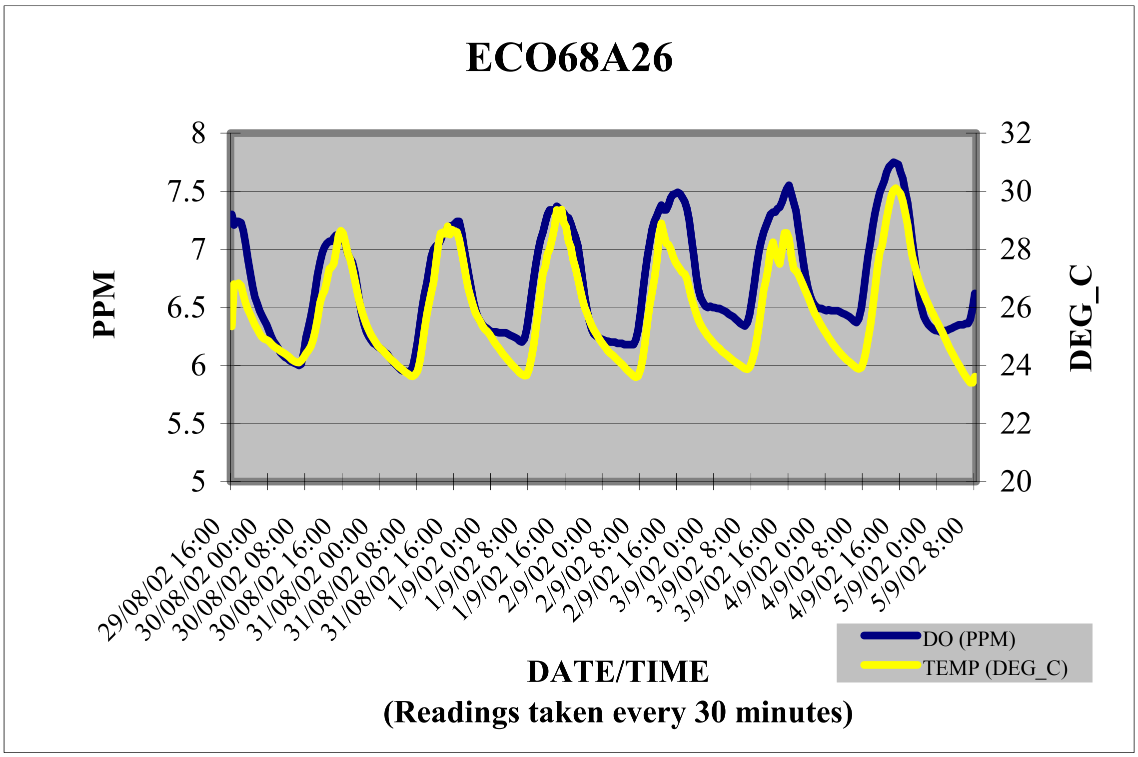
DATE/TIME
(Readings taken every 30 minutes)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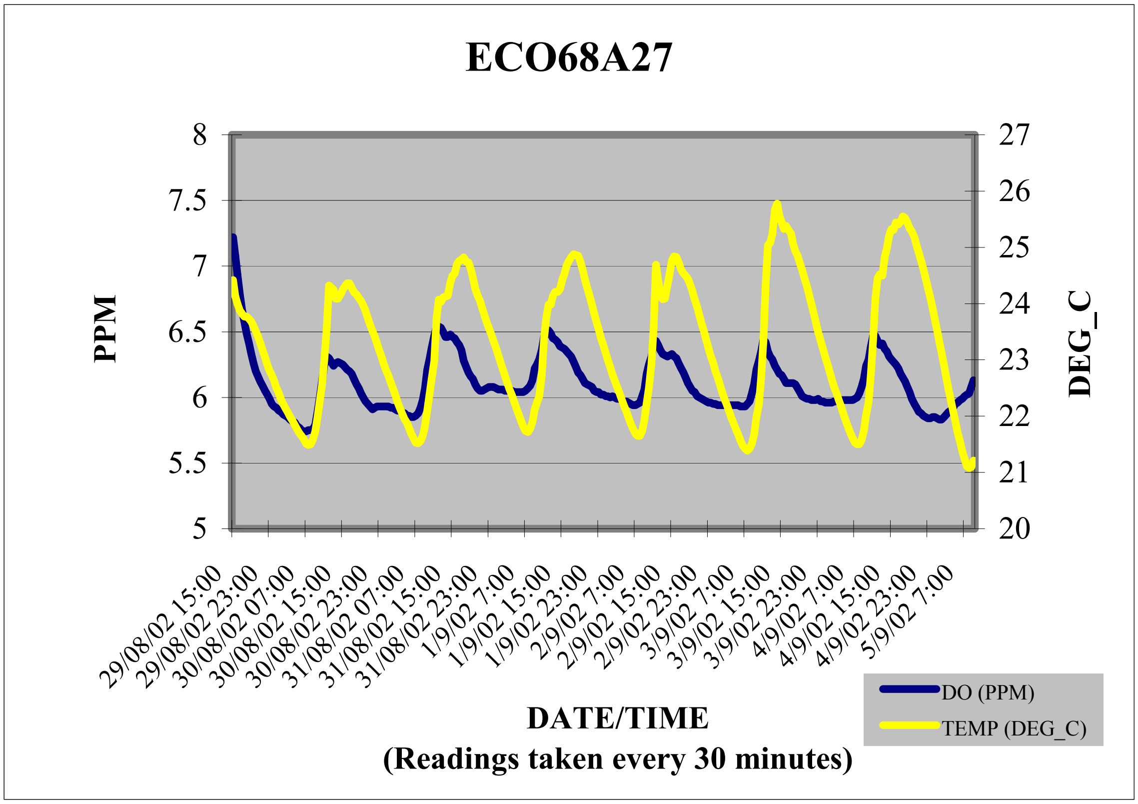
TEMP (DEG_C)
DATE/TIME
(Readings taken every 30 minutes)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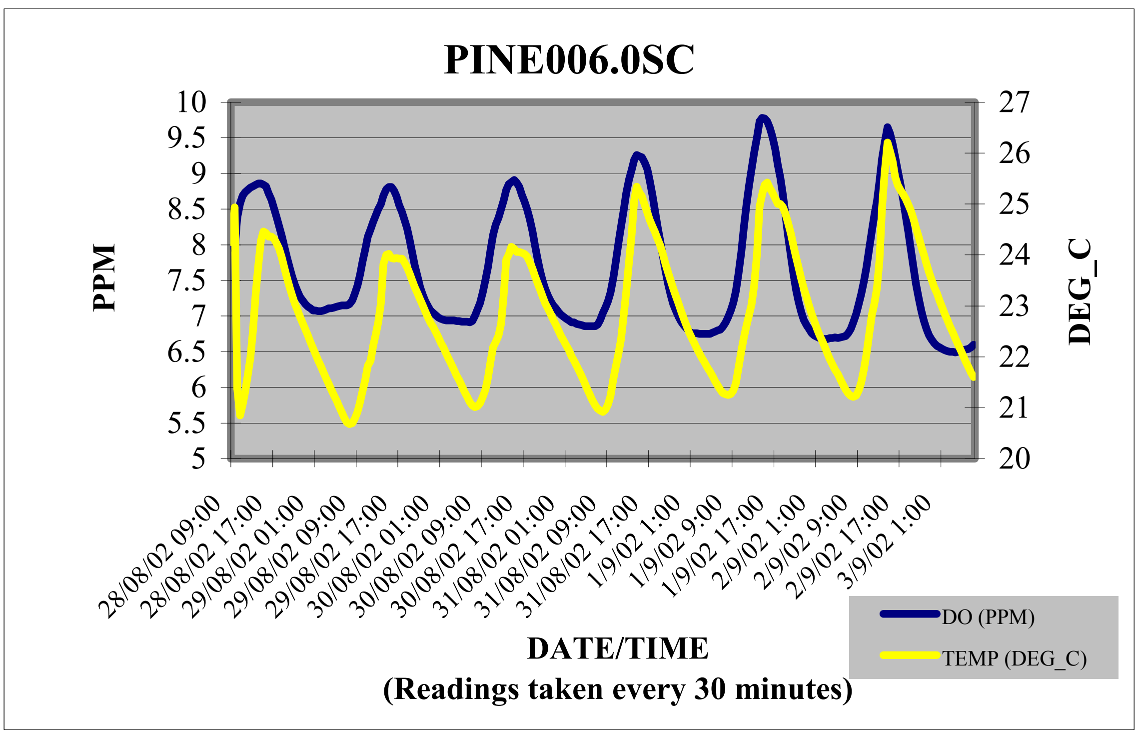
DO (PPM)
TEMP (DEG_C)
DATE/TIME
(Readings taken every 30 minutes)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28/08/02 09:00
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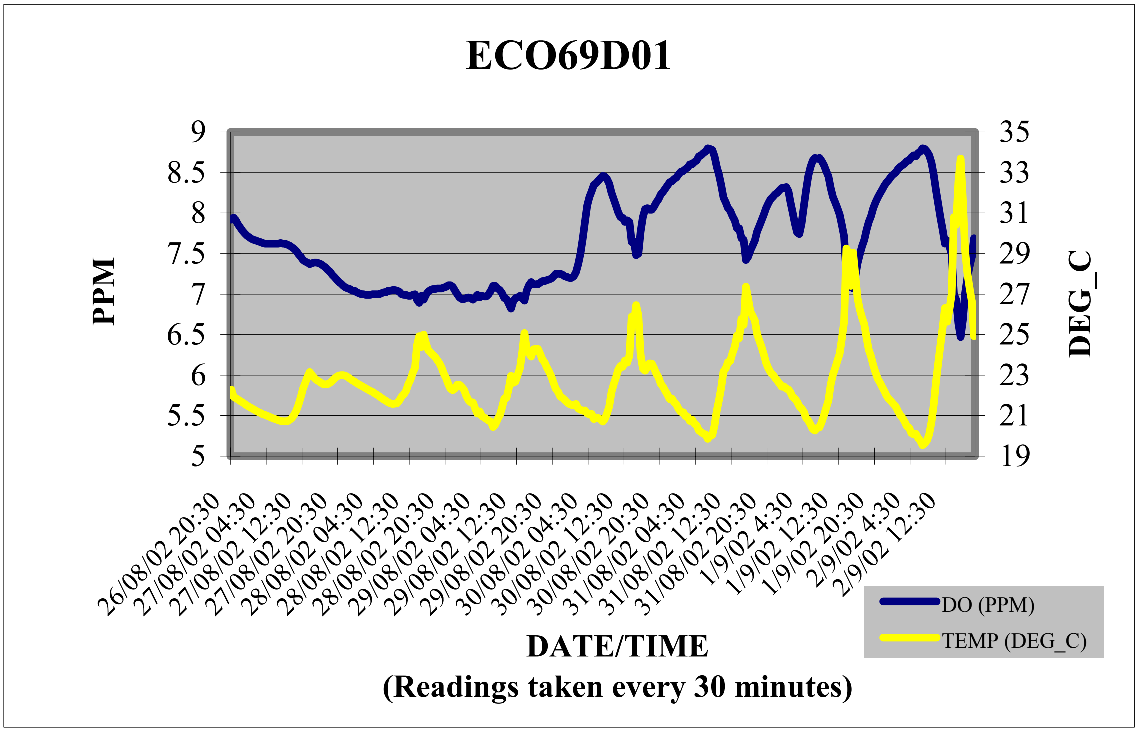
3/9/02 1:00
DO (PPM)
TEMP (DEG_C)
DATE/TIME
(Readings taken every 30 minutes)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TEMP (DEG_C)
DATE/TIME
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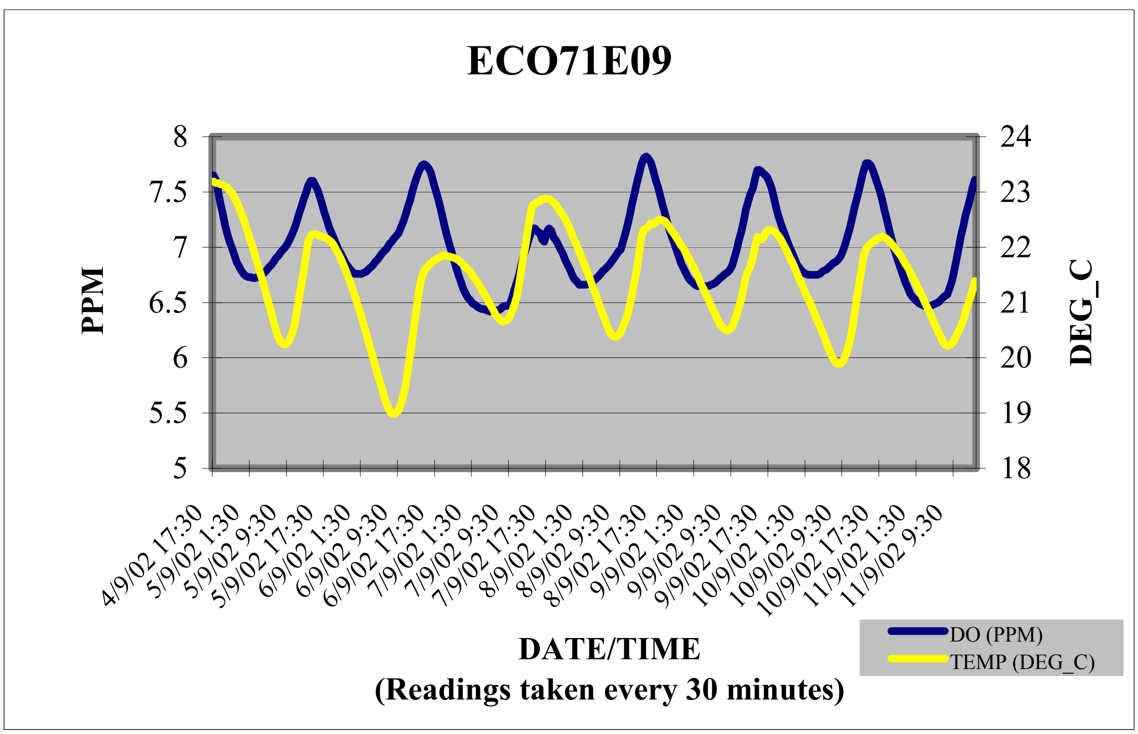
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TEMP (DEG_C)
DATE/TIME
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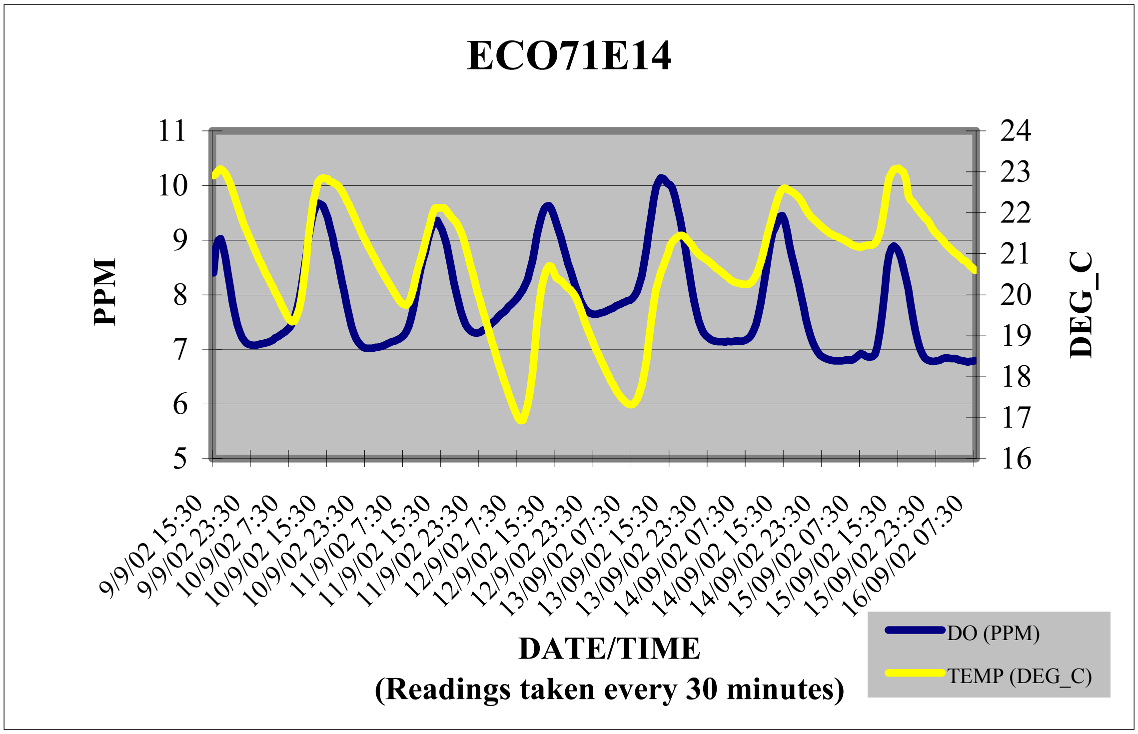
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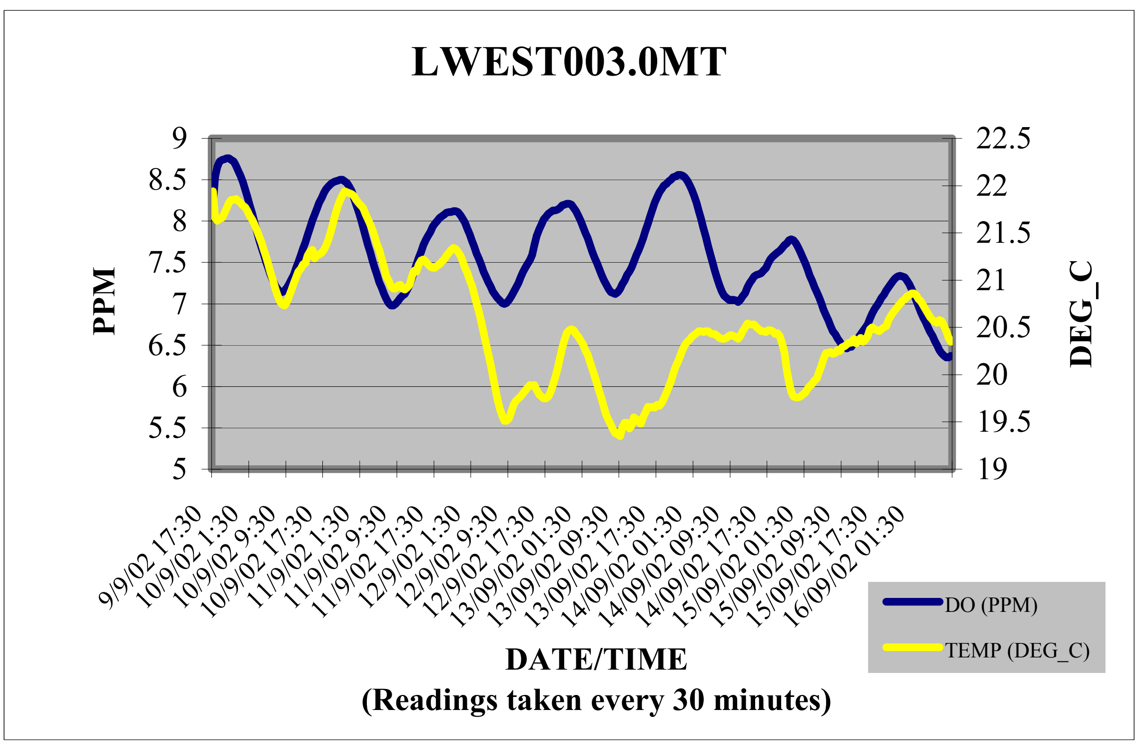
DATE/TIME
(Readings taken every 30 minutes)
DO (PPM)
TEMP (DEG_C)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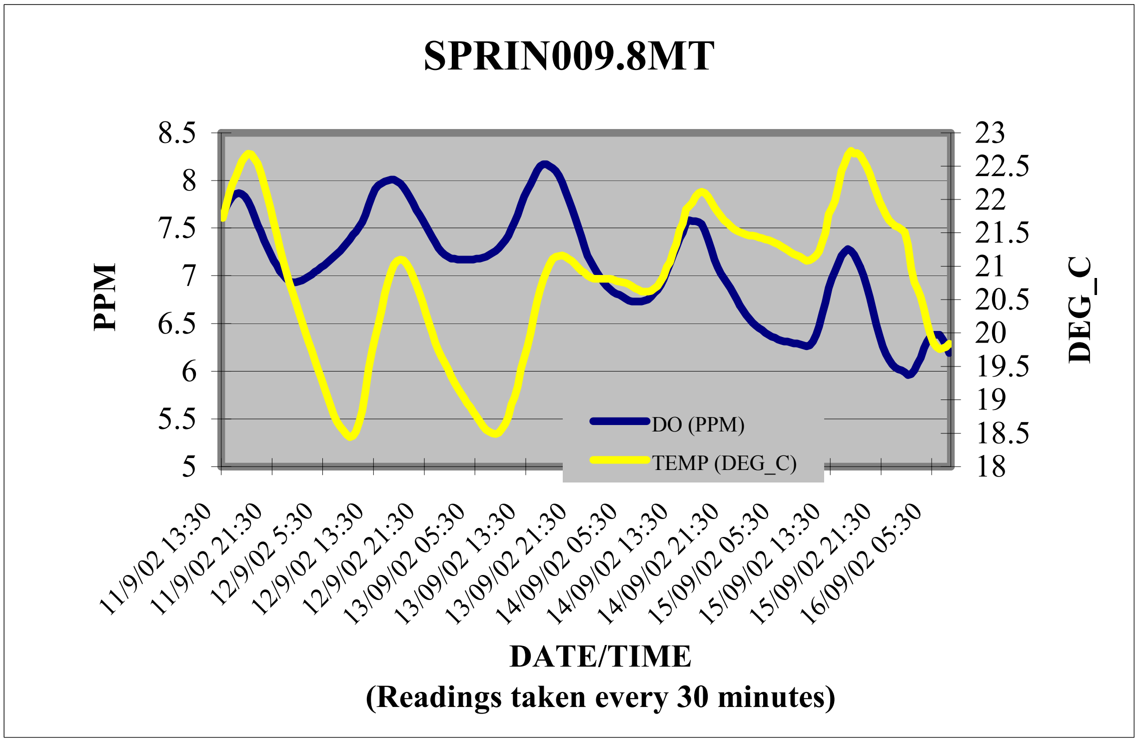
DATE/TIME
(Readings taken every 30 minutes)
DO (PPM)
TEMP (DEG_C)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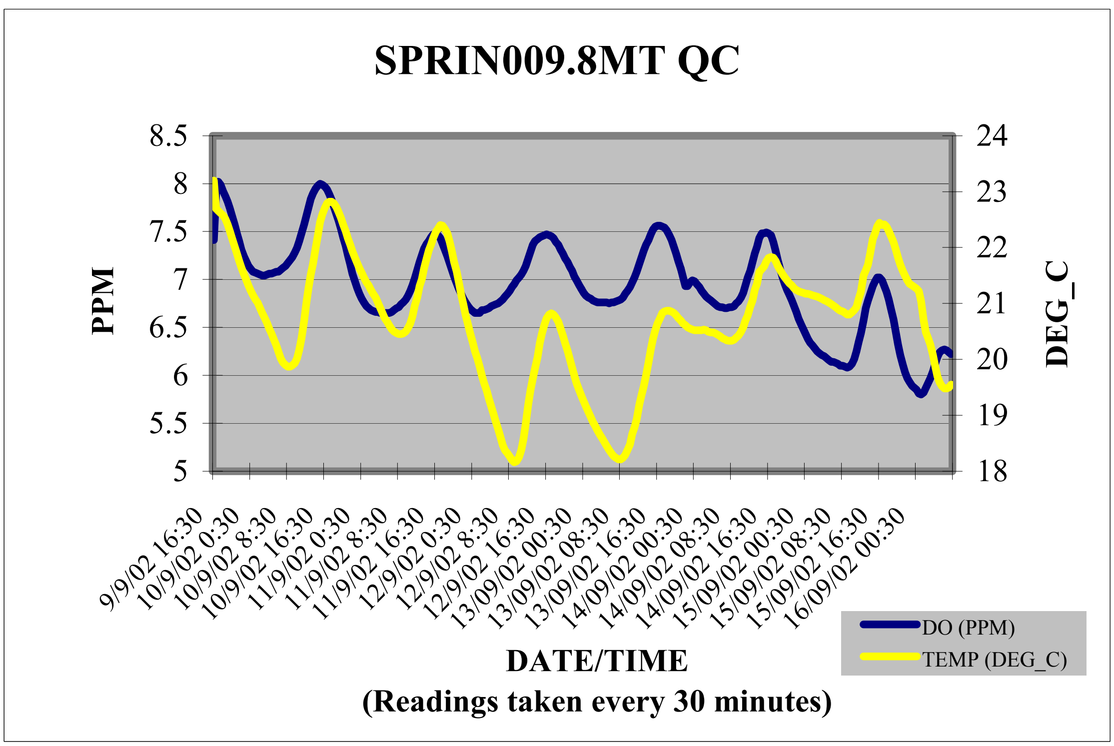
DATE/TIME
(Readings taken every 30 minutes)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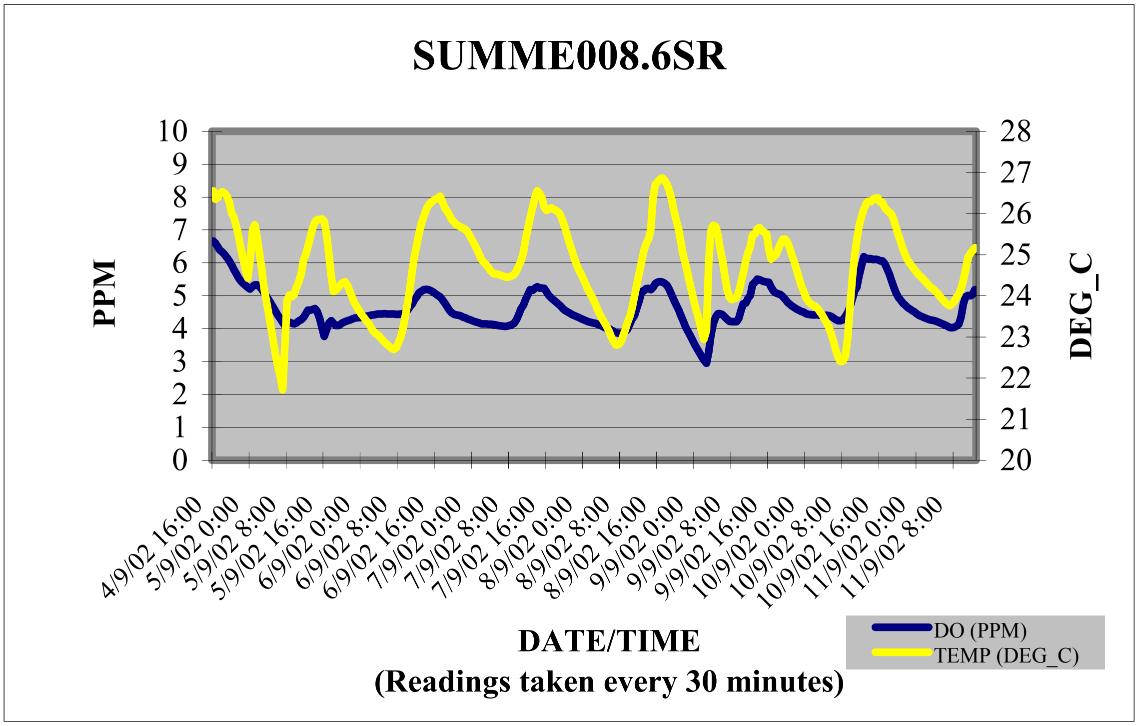
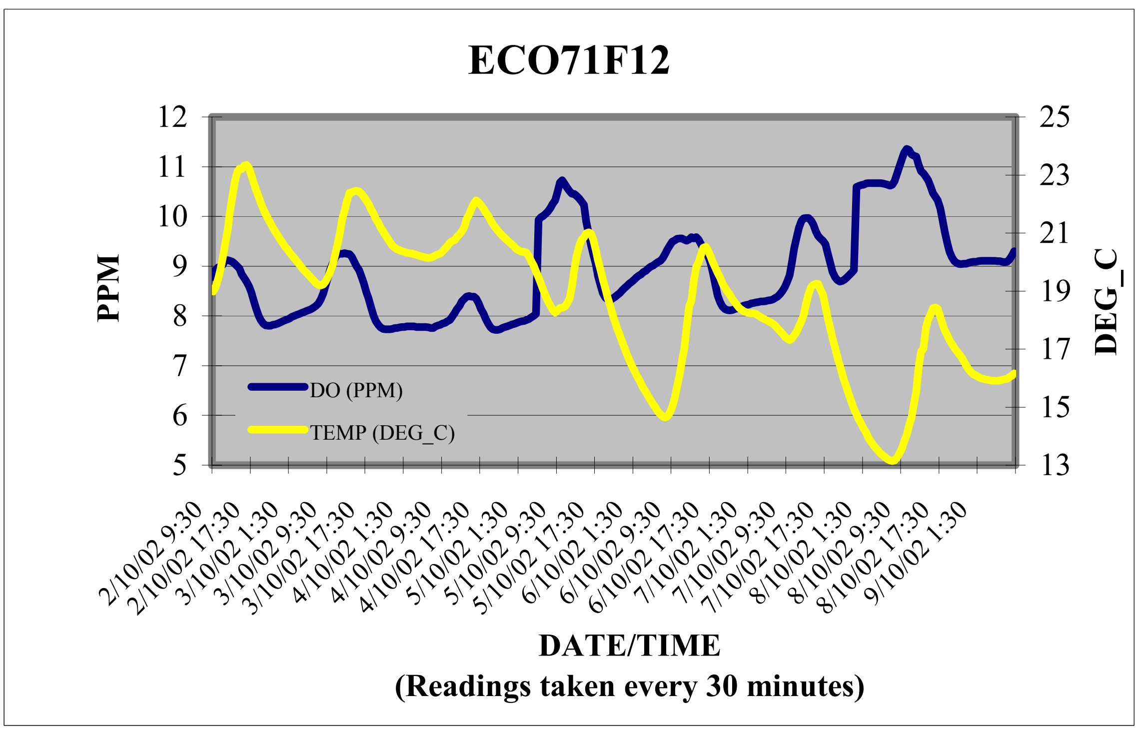
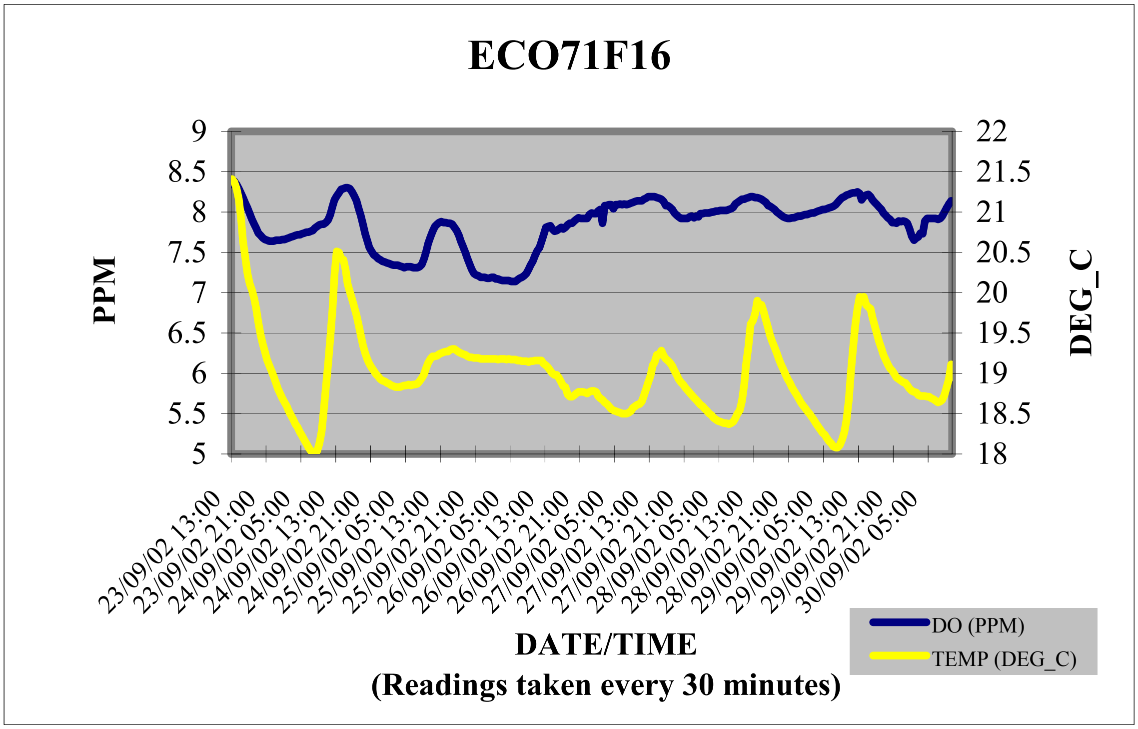
DO (PPM)
TEMP (DEG_C)
DATE/TIME
(Readings taken every 30 minutes)





Field Notes: Water up during week.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PPM
DEG_C
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DATE/TIME
(Readings taken every 30 minutes)
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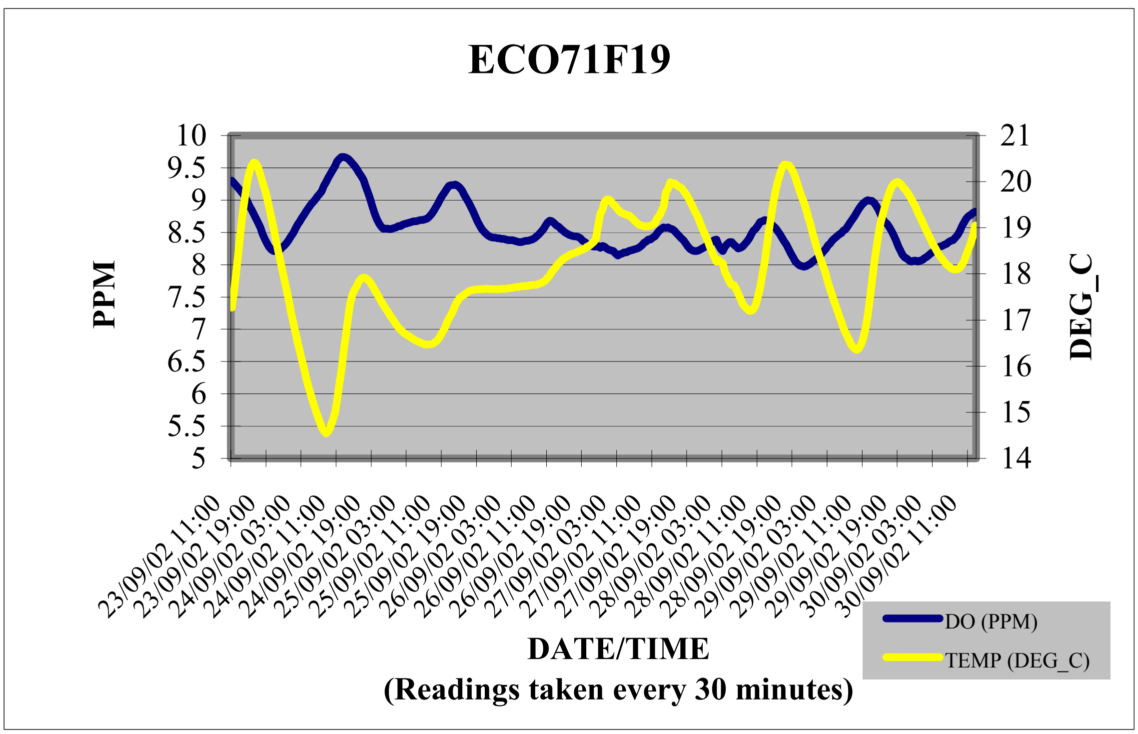
TEMP (DEG_C)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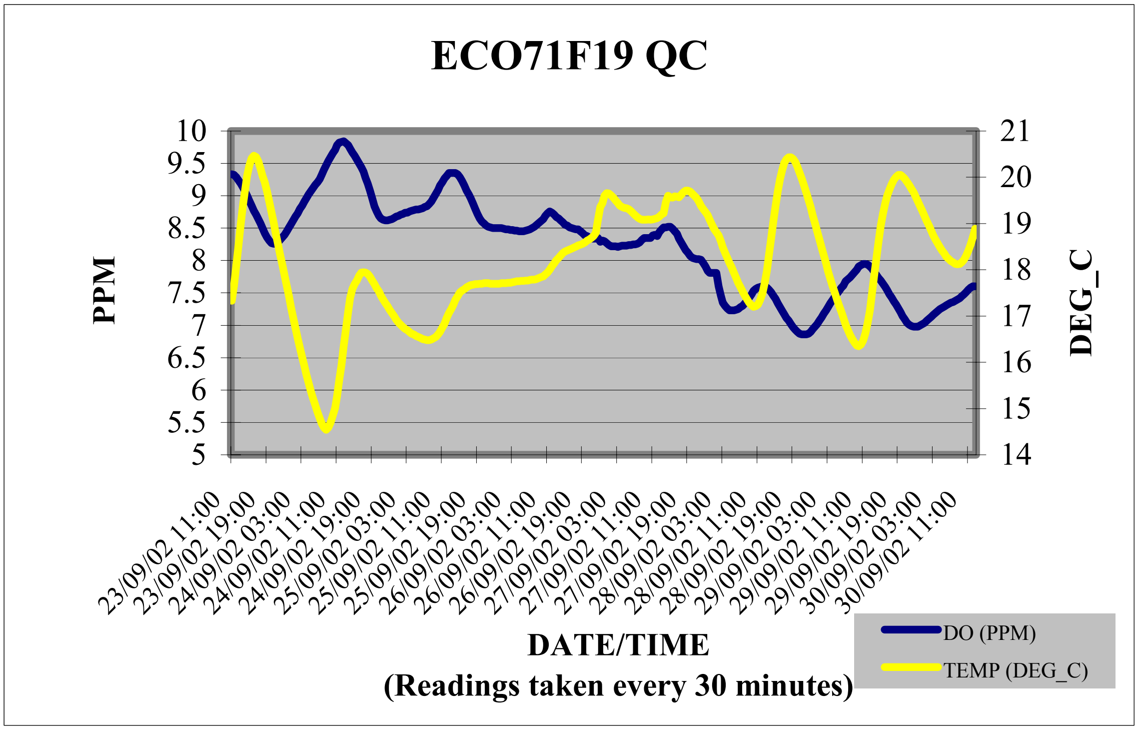
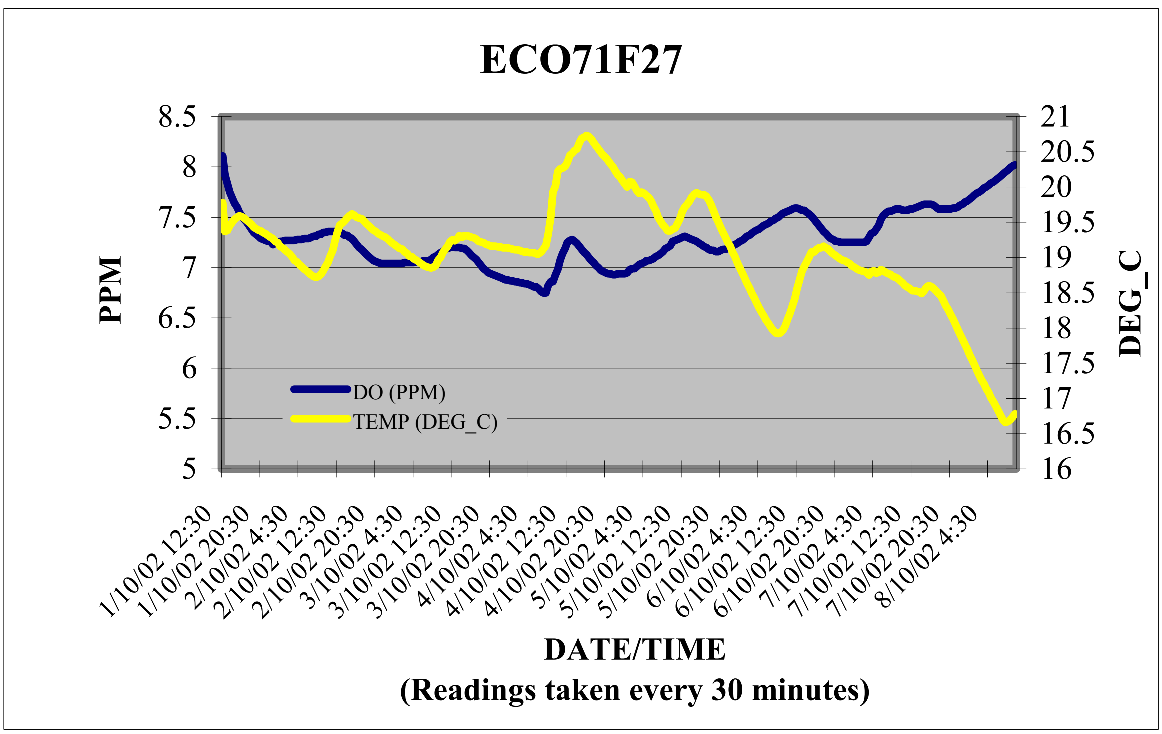
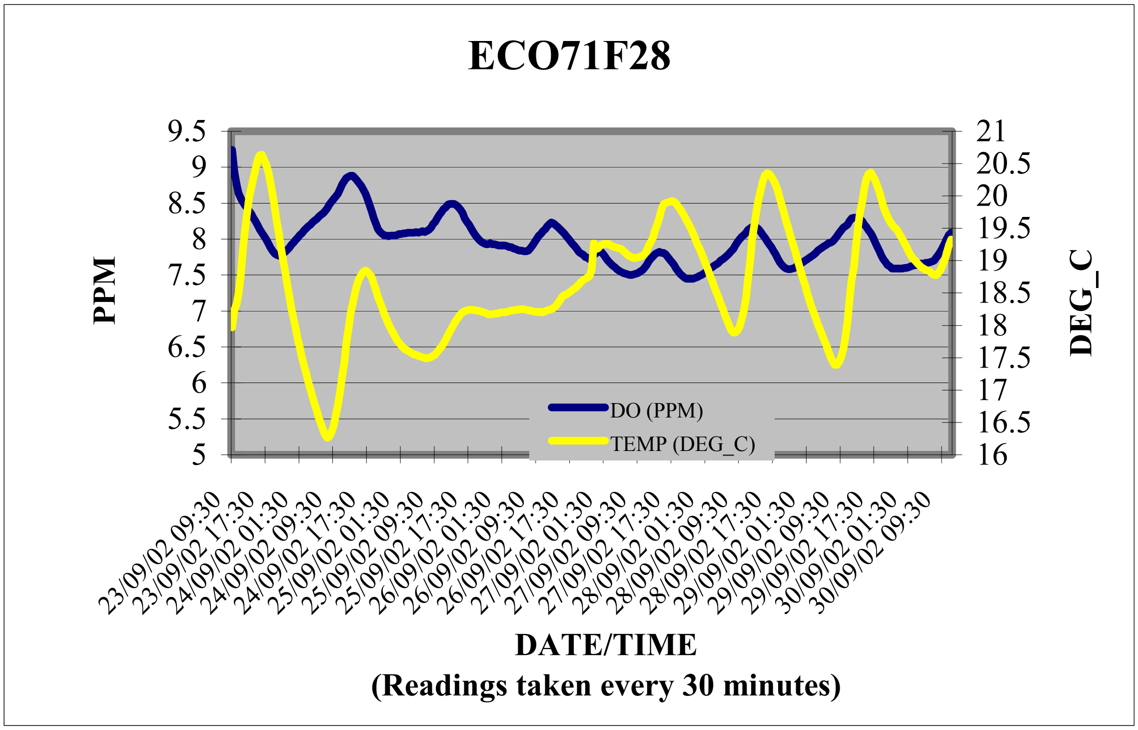
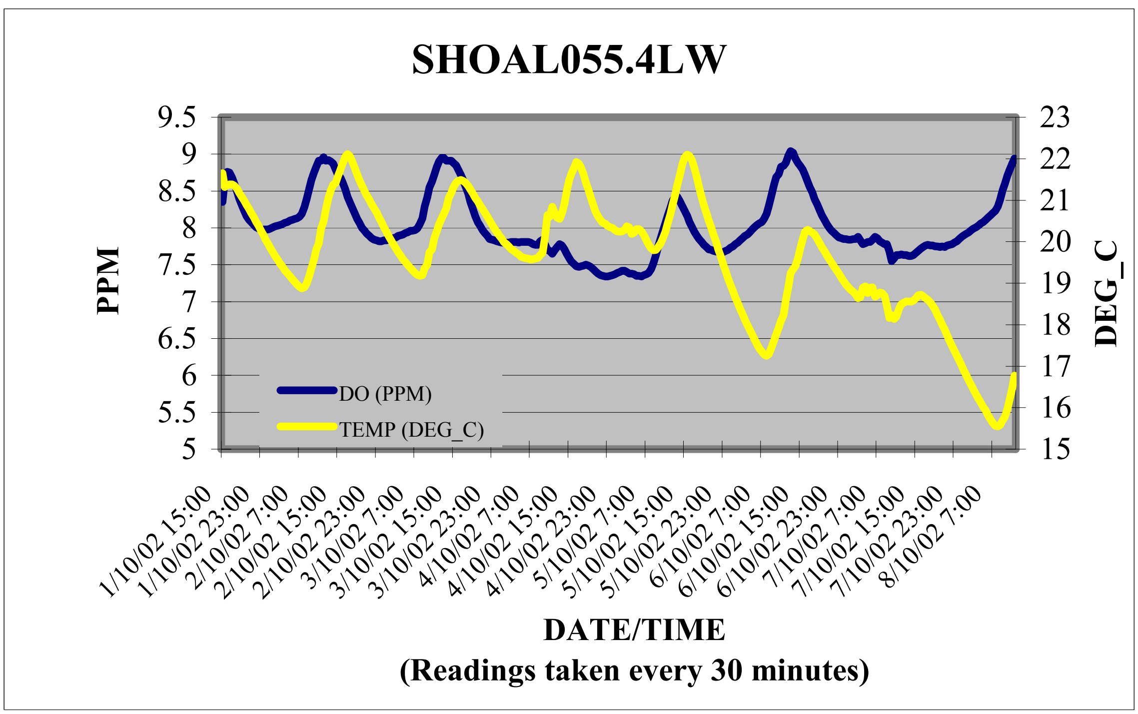
30/09/02 11:00
DATE/TIME
(Readings taken every 30 minutes)
DO (PPM)
TEMP (DEG_C)



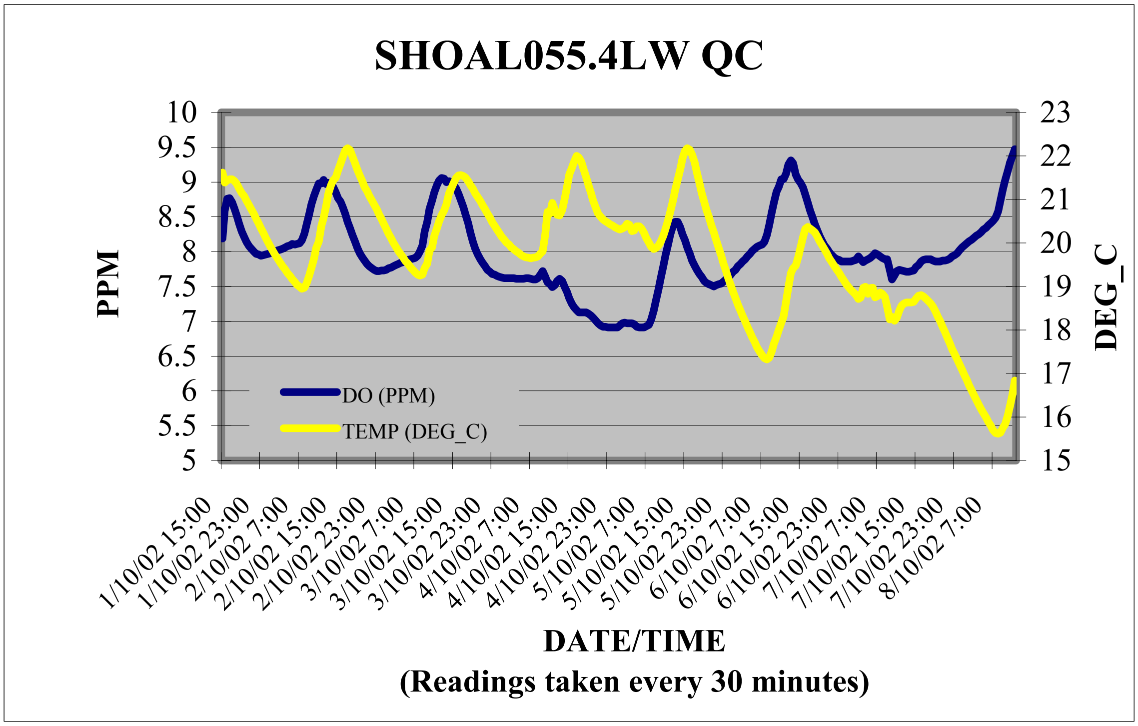


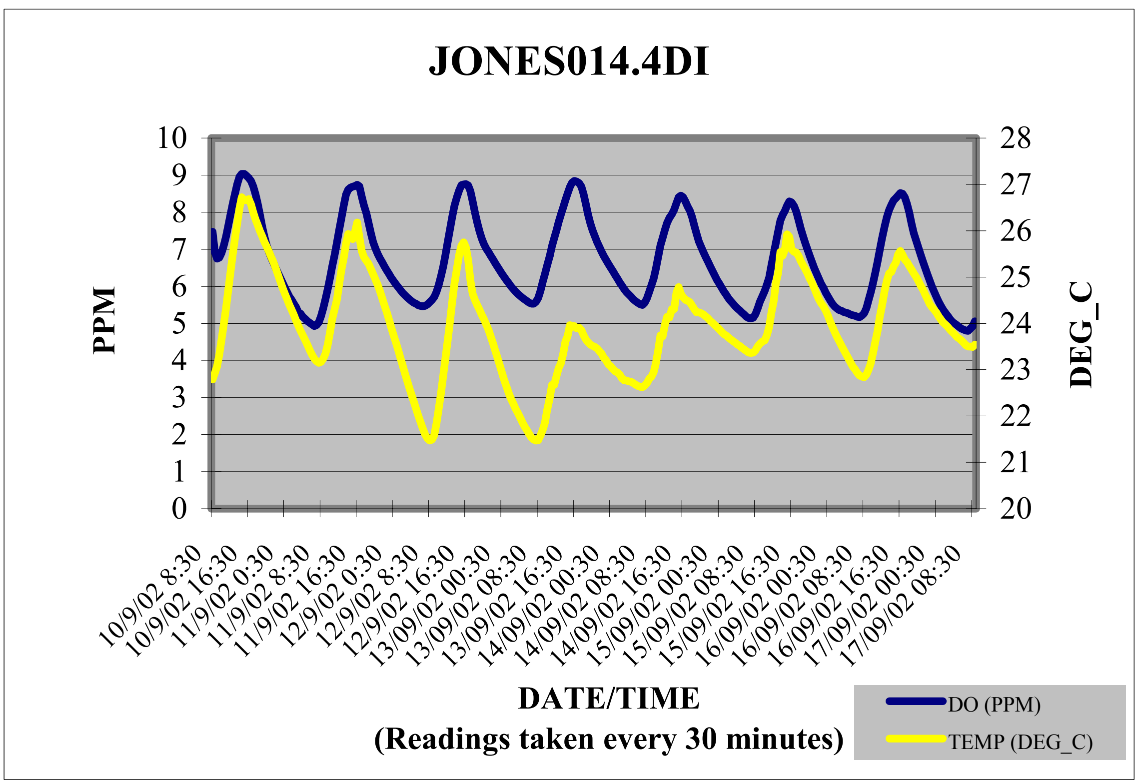
Field Notes: Construction, new riprap at bridge upstream of site.

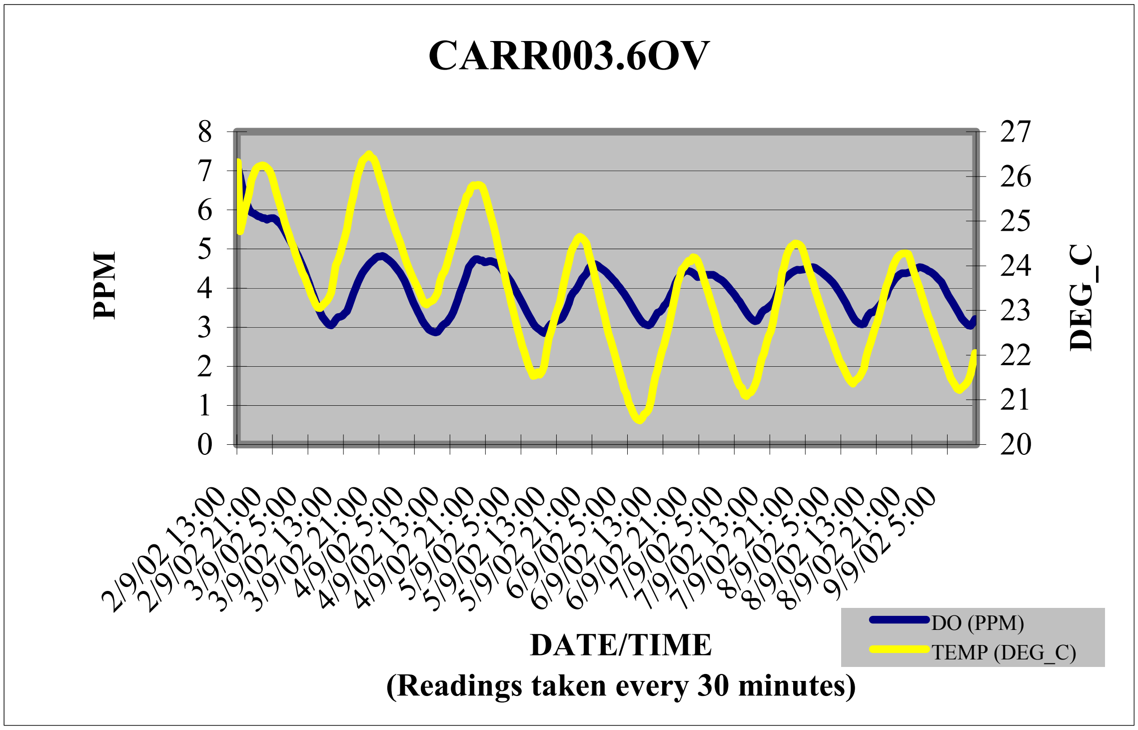


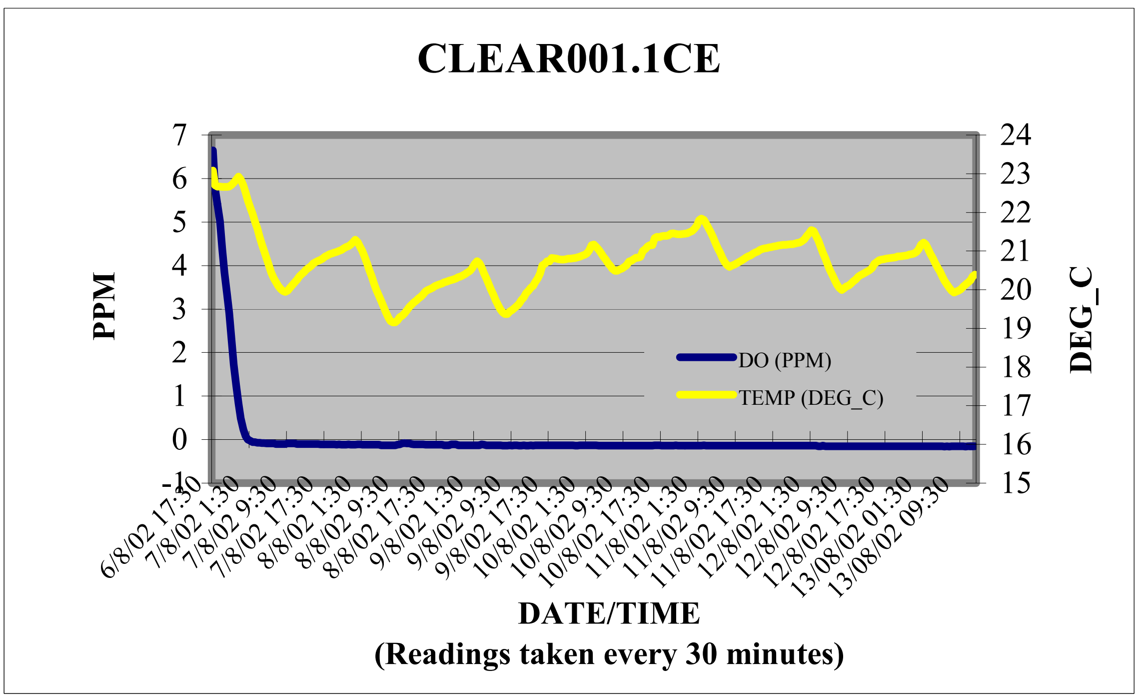


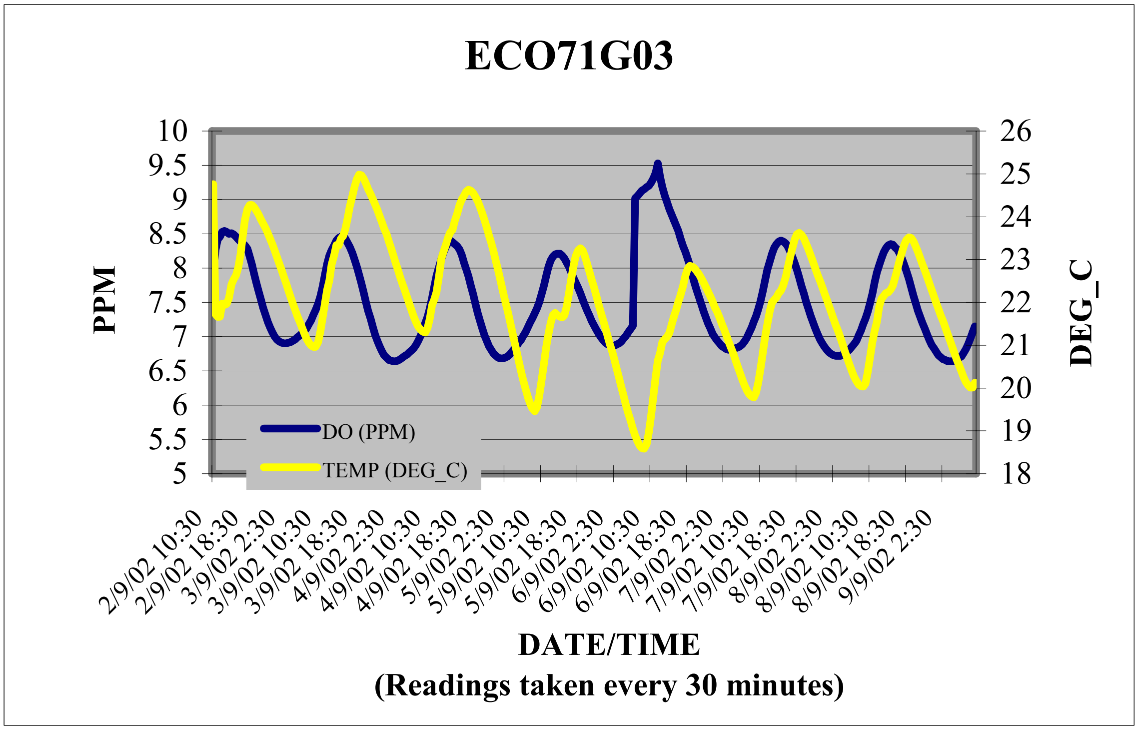
Field Notes: Water up during week

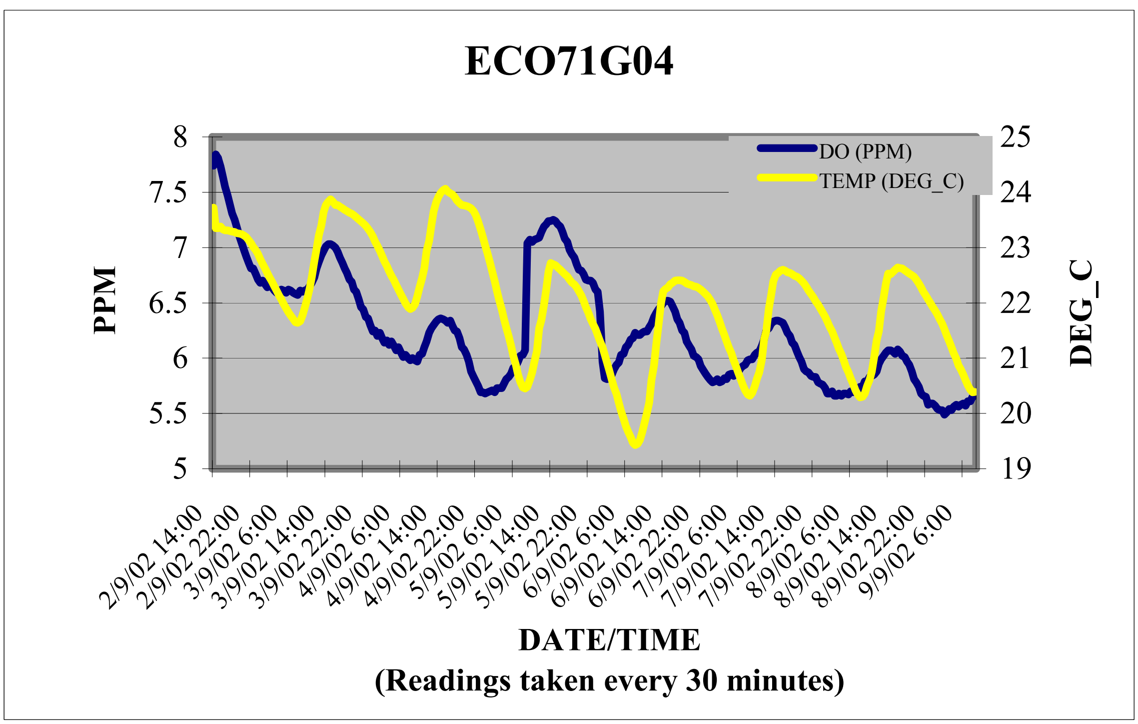

SHOAL055.4LW QC
PPM
DEG_C
DO (PPM)
TEMP (DEG_C)
1/10/02 15:00
1/10/02 23:00
2/10/02 7:00
2/10/02 15:00
2/10/02 23:00
3/10/02 7:00
3/10/02 15:00
3/10/02 23:00
4/10/02 7:00
4/10/02 15:00
4/10/02 23:00
5/10/02 7:00
5/10/02 15:00
5/10/02 23:00
6/10/02 7:00
6/10/02 15:00
6/10/02 23:00
7/10/02 7:00
7/10/02 15:00
7/10/02 23:00
8/10/02 7:00
DATE/TIME
(Readings taken every 30 minutes)

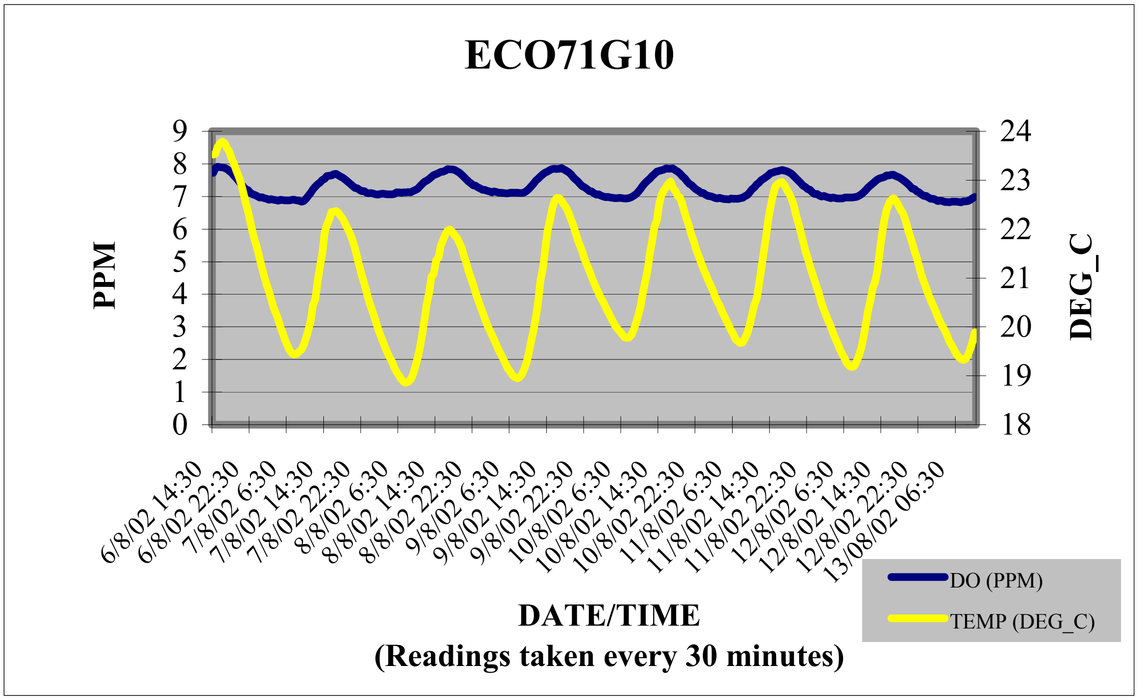

JONES014.4DI
PPM
DEG_C
10/9/02 8:30
10/9/02 16:30
11/9/02 0:30
11/9/02 8:30
11/9/02 16:30
12/9/02 0:30
12/9/02 8:30
12/9/02 16:30
13/09/02 00:30
13/09/02 08:30
13/09/02 16:30
14/09/02 00:30
14/09/02 08:30
14/09/02 16:30
15/09/02 00:30
15/09/02 08:30
15/09/02 16:30
16/09/02 00:30
16/09/02 08:30
16/09/02 16:30
17/09/02 00:30
17/09/02 08:30
DATE/TIME
(Readings taken every 30 minutes)
DO (PPM)
TEMP (DEG_C)

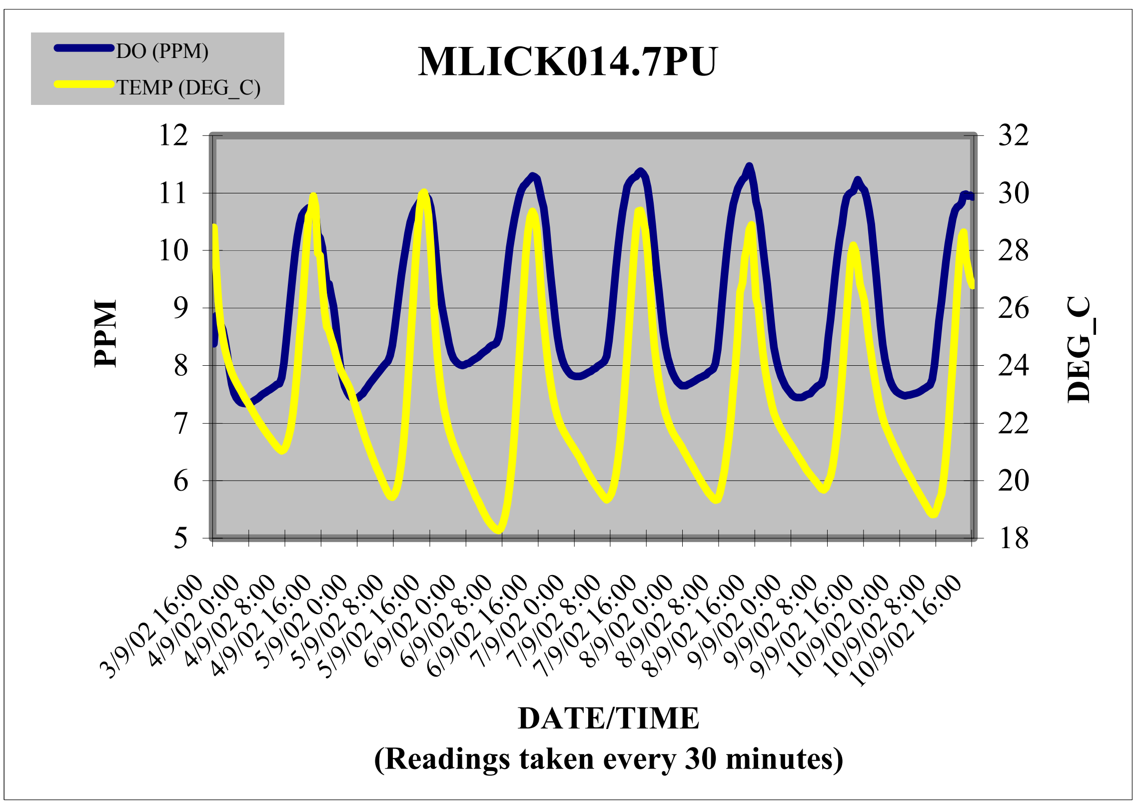

CARR003.6OV
PPM
DEG_C
8
7
6
5
4
3
2
1
0
27
26
25
24
23
22
21
20
2/9/02 13:00
2/9/02 21:00
3/9/02 5:00
3/9/02 13:00
3/9/02 21:00
4/9/02 5:00
4/9/02 13:00
4/9/02 21:00
5/9/02 5:00
5/9/02 13:00
5/9/02 21:00
6/9/02 5:00
6/9/02 13:00
6/9/02 21:00
7/9/02 5:00
7/9/02 13:00
7/9/02 21:00
8/9/02 5:00
8/9/02 13:00
8/9/02 21:00
9/9/02 5:00
DO (PPM)
TEMP (DEG_C)
DATE/TIME
(Readings taken every 30 minutes)

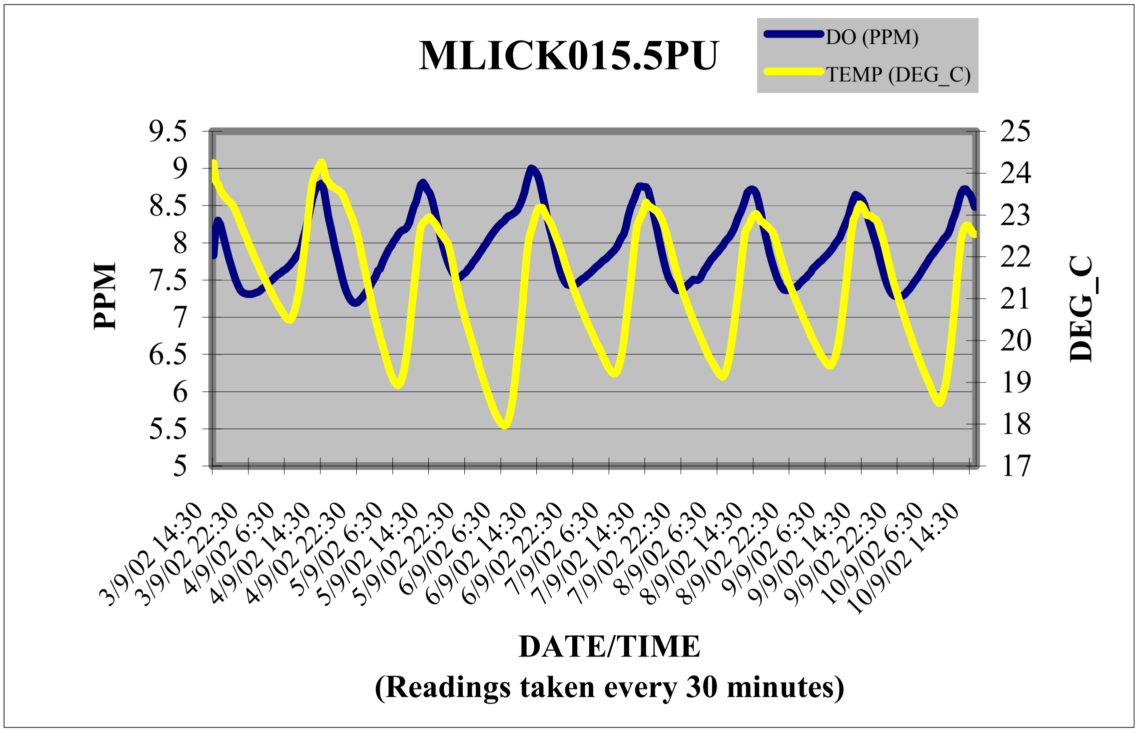

CLEAR001.1CE
PPM
DEG_C
7
6
5
4
3
2
1
0
-1
24
23
22
21
20
19
18
17
16
15
6/8/02 17:30
7/8/02 1:30
7/8/02 9:30
7/8/02 17:30
8/8/02 1:30
8/8/02 9:30
8/8/02 17:30
9/8/02 1:30
9/8/02 9:30
9/8/02 17:30
10/8/02 1:30
10/8/02 9:30
10/8/02 17:30
11/8/02 1:30
11/8/02 9:30
11/8/02 17:30
12/8/02 1:30
12/8/02 9:30
12/8/02 17:30
13/08/02 01:30
13/08/02 09:30
DO (PPM)
TEMP (DEG_C)
DATE/TIME
(Readings taken every 30 minutes)

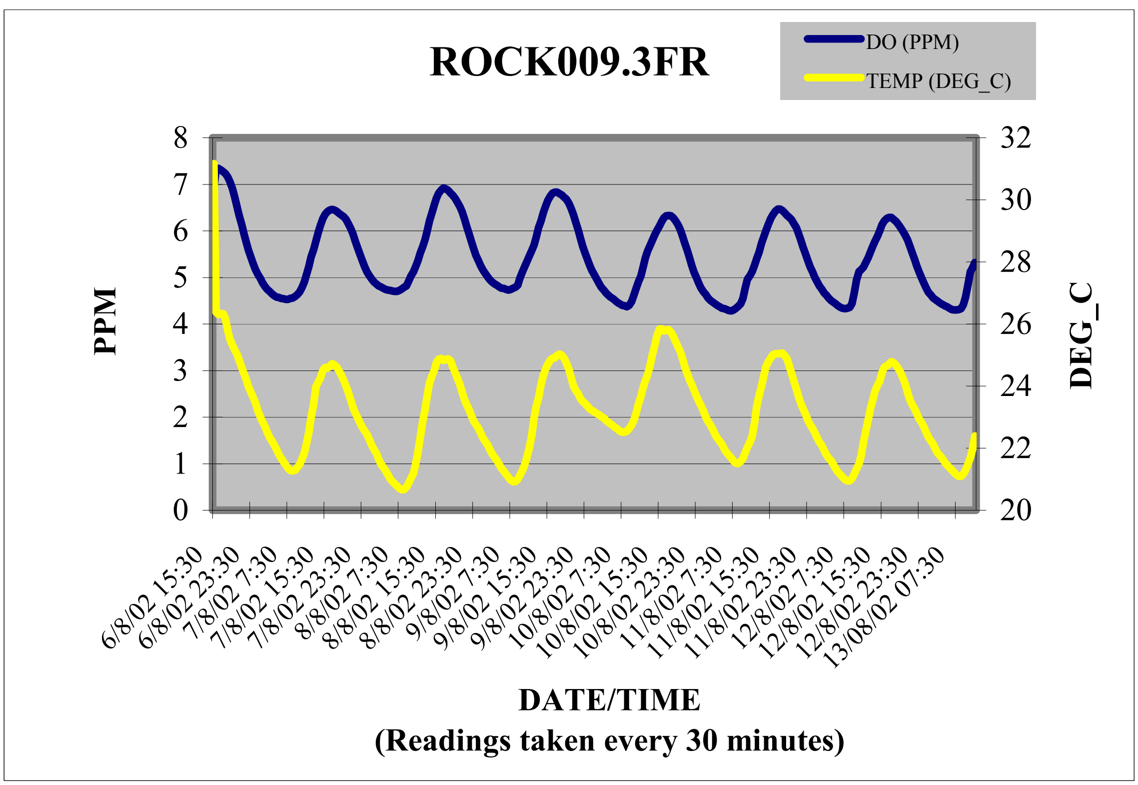

ECO71G03
PPM
DEG_C
DO (PPM)
TEMP (DEG_C)
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
26
25
24
23
22
21
20
19
18
2/9/02 10:30
2/9/02 18:30
3/9/02 2:30
3/9/02 10:30
3/9/02 18:30
4/9/02 2:30
4/9/02 10:30
4/9/02 18:30
5/9/02 2:30
5/9/02 10:30
5/9/02 18:30
6/9/02 2:30
6/9/02 10:30
6/9/02 18:30
7/9/02 2:30
7/9/02 10:30
7/9/02 18:30
8/9/02 2:30
8/9/02 10:30
8/9/02 18:30
9/9/02 2:30
DATE/TIME
(Readings taken every 30 minutes)

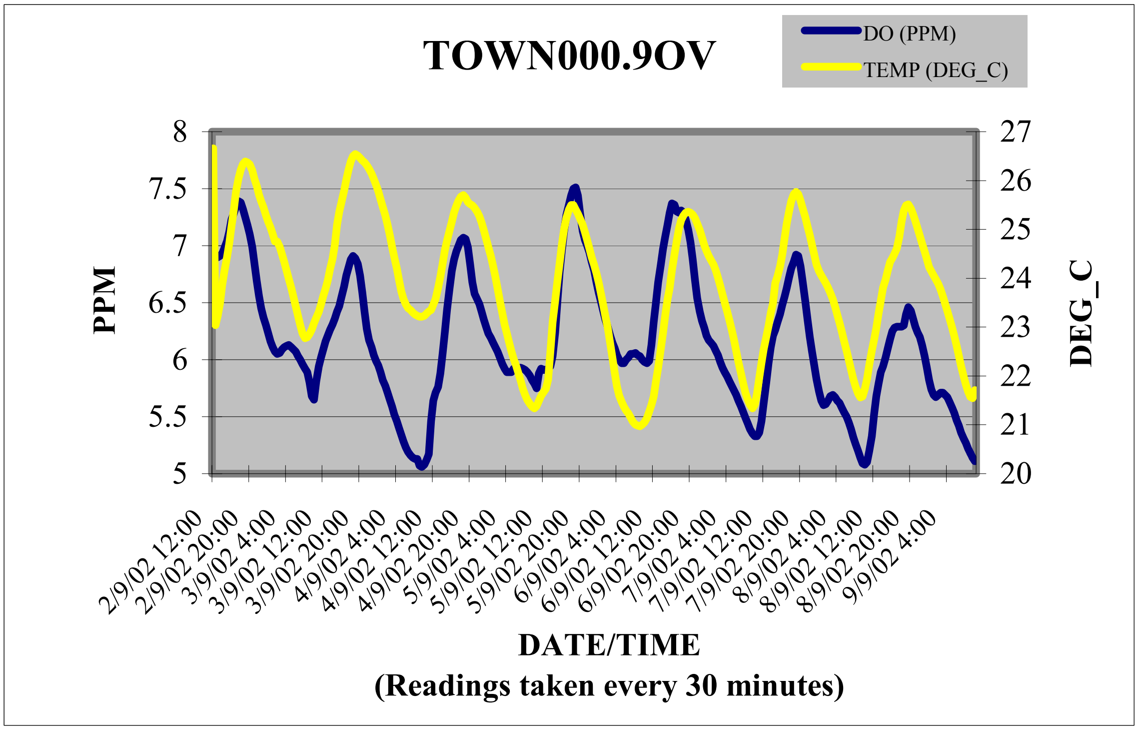

ECO71G04
PPM
DEG_C
DO (PPM)
TEMP (DEG_C)
8
7.5
7
6.5
6
5.5
5
25
24
23
22
21
20
19
2/9/02 14:00
2/9/02 22:00
3/9/02 6:00
3/9/02 14:00
3/9/02 22:00
4/9/02 6:00
4/9/02 14:00
4/9/02 22:00
5/9/02 6:00
5/9/02 14:00
5/9/02 22:00
6/9/02 6:00
6/9/02 14:00
6/9/02 22:00
7/9/02 6:00
7/9/02 14:00
7/9/02 22:00
8/9/02 6:00
8/9/02 14:00
8/9/02 22:00
9/9/02 6:00
DATE/TIME
(Readings taken every 30 minutes)

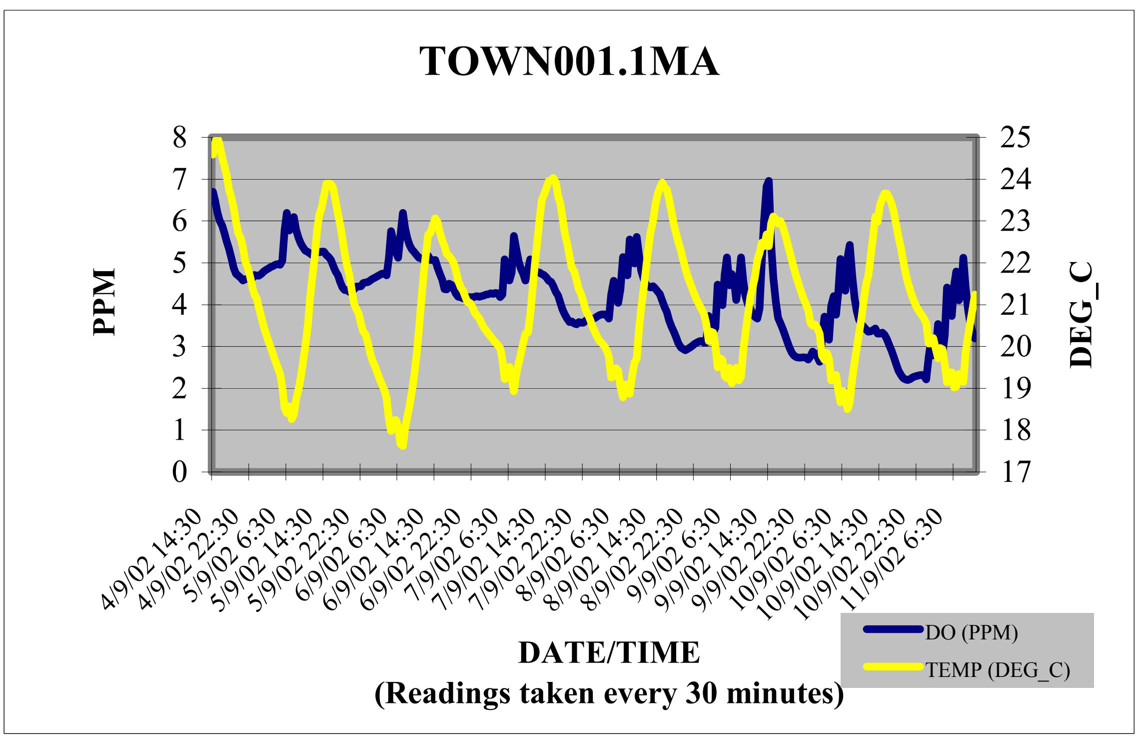

ECO71G10
PPM
DEG_C
9
8
7
6
5
4
3
2
1
0
24
23
22
21
20
19
18
6/8/02 14:30
6/8/02 22:30
7/8/02 6:30
7/8/02 14:30
7/8/02 22:30
8/8/02 6:30
8/8/02 14:30
8/8/02 22:30
9/8/02 6:30
9/8/02 14:30
9/8/02 22:30
10/8/02 6:30
10/8/02 14:30
10/8/02 22:30
11/8/02 6:30
11/8/02 14:30
11/8/02 22:30
12/8/02 6:30
12/8/02 14:30
12/8/02 22:30
13/08/02 06:30
DO (PPM)
TEMP (DEG_C)
DATE/TIME
(Readings taken every 30 minutes)

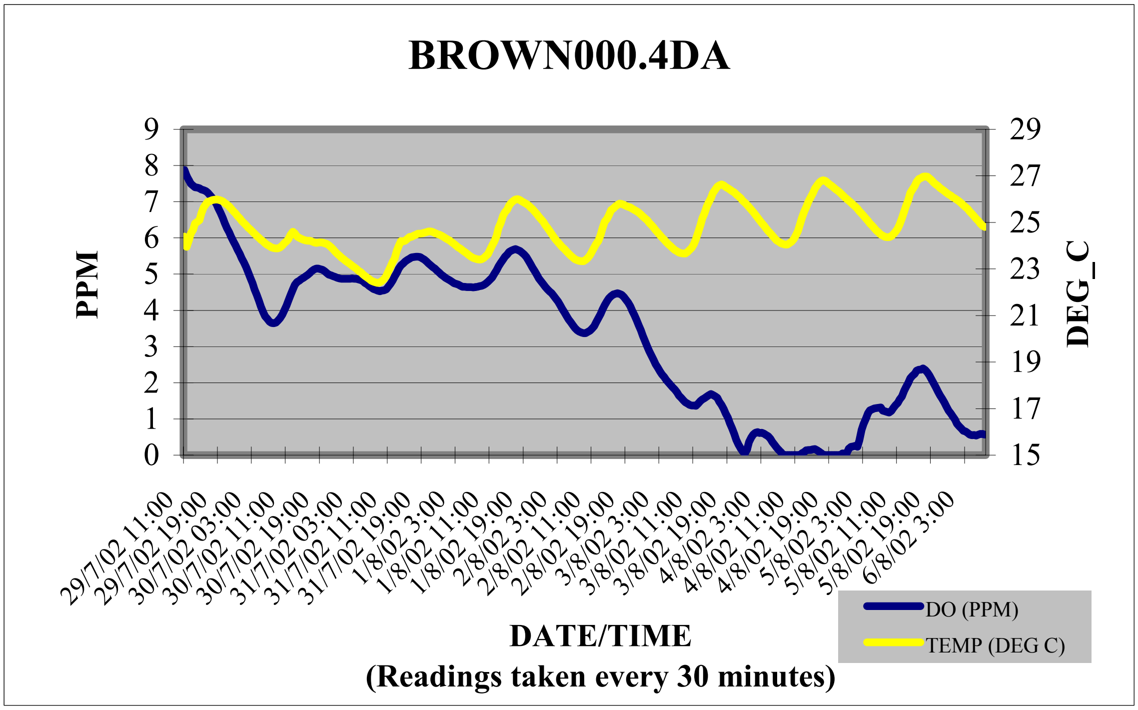

DO (PPM)
TEMP (DEG_C)
MLICK014.7PU
PPM
DEG_C
12
11
10
9
8
7
6
5
32
30
28
26
24
22
20
18
3/9/02 16:00
4/9/02 0:00
4/9/02 8:00
4/9/02 16:00
5/9/02 0:00
5/9/02 8:00
5/9/02 16:00
6/9/02 0:00
6/9/02 8:00
6/9/02 16:00
7/9/02 0:00
7/9/02 8:00
7/9/02 16:00
8/9/02 0:00
8/9/02 8:00
8/9/02 16:00
9/9/02 0:00
9/9/02 8:00
9/9/02 16:00
10/9/02 0:00
10/9/02 8:00
10/9/02 16:00
DATE/TIME
(Readings taken every 30 minutes)

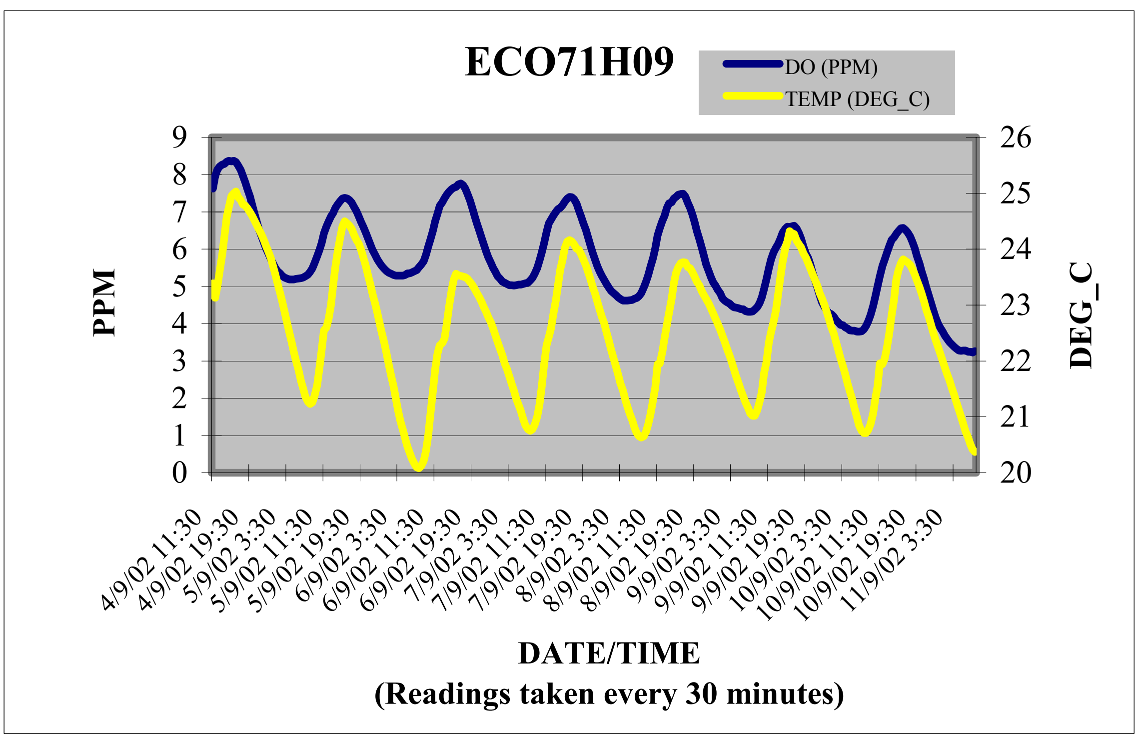

MLICK015.5PU
DO (PPM)
TEMP (DEG_C)
PPM
DEG_C
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
25
24
23
22
21
20
19
18
17
3/9/02 14:30
3/9/02 22:30
4/9/02 6:30
4/9/02 14:30
4/9/02 22:30
5/9/02 6:30
5/9/02 14:30
5/9/02 22:30
6/9/02 6:30
6/9/02 14:30
6/9/02 22:30
7/9/02 6:30
7/9/02 14:30
7/9/02 22:30
8/9/02 6:30
8/9/02 14:30
8/9/02 22:30
9/9/02 6:30
9/9/02 14:30
9/9/02 22:30
10/9/02 6:30
10/9/02 14:30
DATE/TIME
(Readings taken every 30 minutes)


ROCK009.3FR
DO (PPM)
TEMP (DEG_C)
PPM
DEG_C
8
7
6
5
4
3
2
1
0
32
30
28
26
24
22
20
6/8/02 15:30
6/8/02 23:30
7/8/02 7:30
7/8/02 15:30
7/8/02 23:30
8/8/02 7:30
8/8/02 15:30
8/8/02 23:30
9/8/02 7:30
9/8/02 15:30
9/8/02 23:30
10/8/02 7:30
10/8/02 15:30
10/8/02 23:30
11/8/02 7:30
11/8/02 15:30
11/8/02 23:30
12/8/02 7:30
12/8/02 15:30
12/8/02 23:30
13/08/02 07:30
DATE/TIME
(Readings taken every 30 minutes)

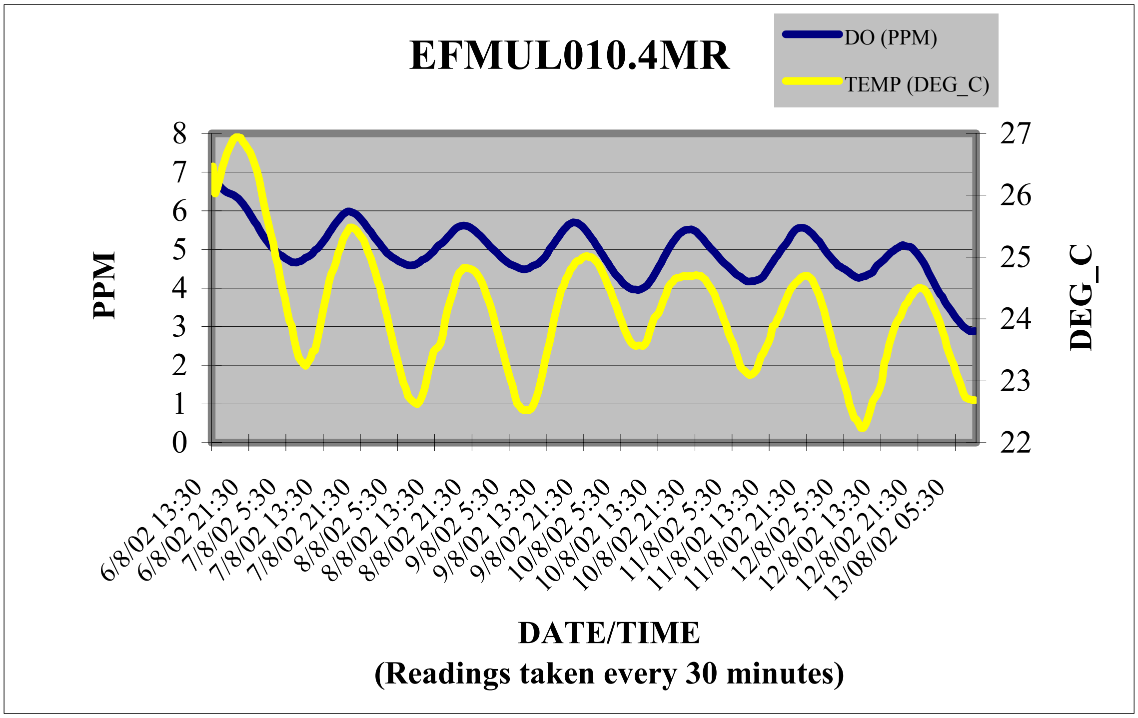

TOWN000.9OV
DO (PPM)
TEMP (DEG_C)
PPM
DEG_C
8
7.5
7
6.5
6
5.5
5
27
26
25
24
23
22
21
20
2/9/02 12:00
2/9/02 20:00
3/9/02 4:00
3/9/02 12:00
3/9/02 20:00
4/9/02 4:00
4/9/02 12:00
4/9/02 20:00
5/9/02 4:00
5/9/02 12:00
5/9/02 20:00
6/9/02 4:00
6/9/02 12:00
6/9/02 20:00
7/9/02 4:00
7/9/02 12:00
7/9/02 20:00
8/9/02 4:00
8/9/02 12:00
8/9/02 20:00
9/9/02 4:00
DATE/TIME
(Readings taken every 30 minutes)

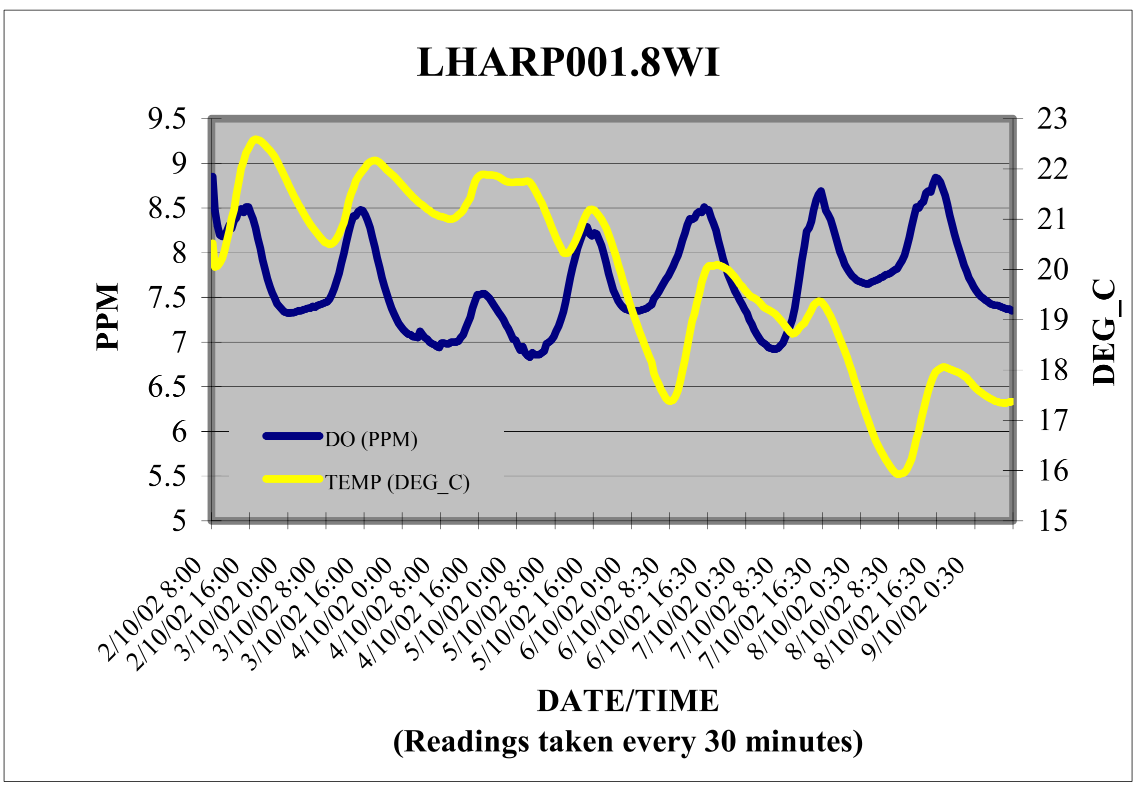

TOWN001.1MA
PPM
DEG_C
8
7
6
5
4
3
2
1
0
25
24
23
22
21
20
19
18
17
4/9/02 14:30
4/9/02 22:30
5/9/02 6:30
5/9/02 14:30
5/9/02 22:30
6/9/02 6:30
6/9/02 14:30
6/9/02 22:30
7/9/02 6:30
7/9/02 14:30
7/9/02 22:30
8/9/02 6:30
8/9/02 14:30
8/9/02 22:30
9/9/02 6:30
9/9/02 14:30
9/9/02 22:30
10/9/02 6:30
10/9/02 14:30
10/9/02 22:30
11/9/02 6:30
DATE/TIME
(Readings taken every 30 minutes)
DO (PPM)
TEMP (DEG_C)

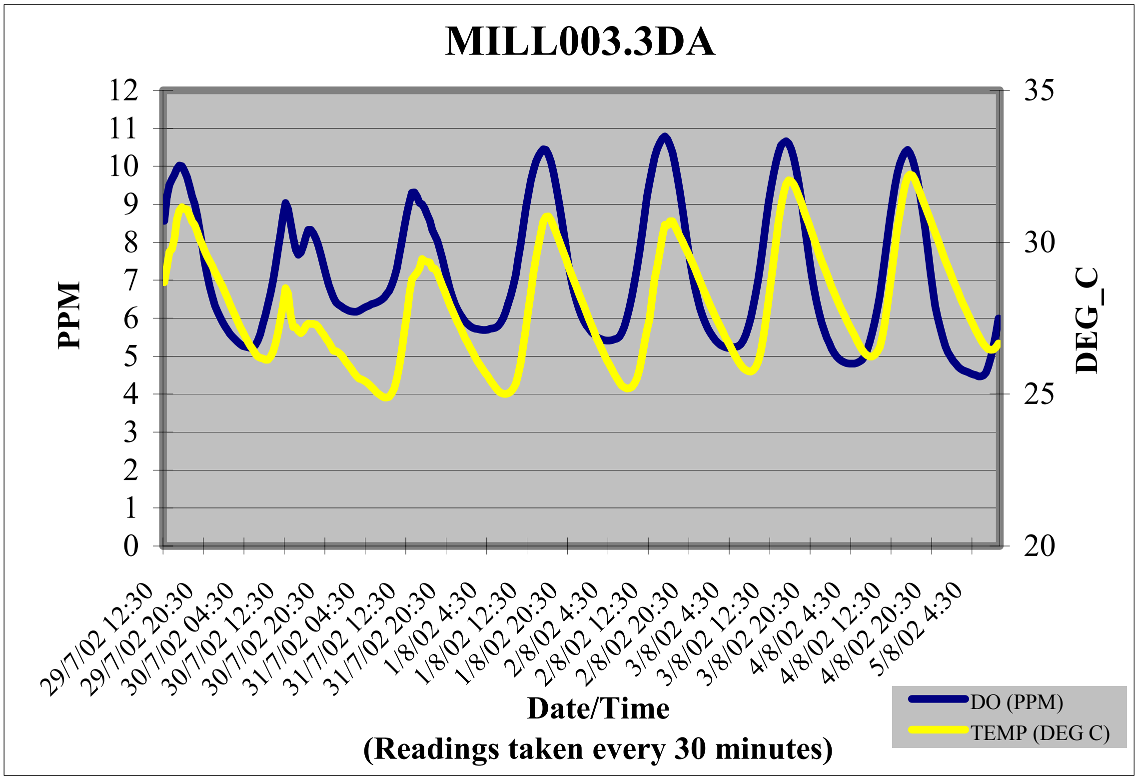


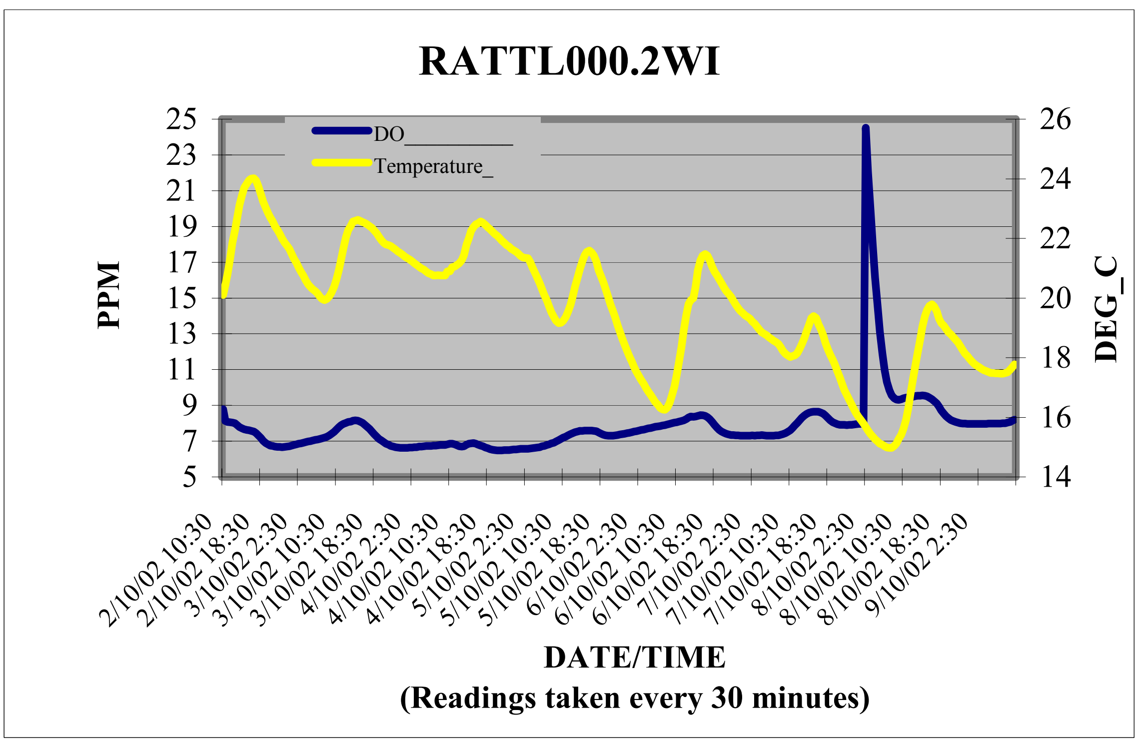


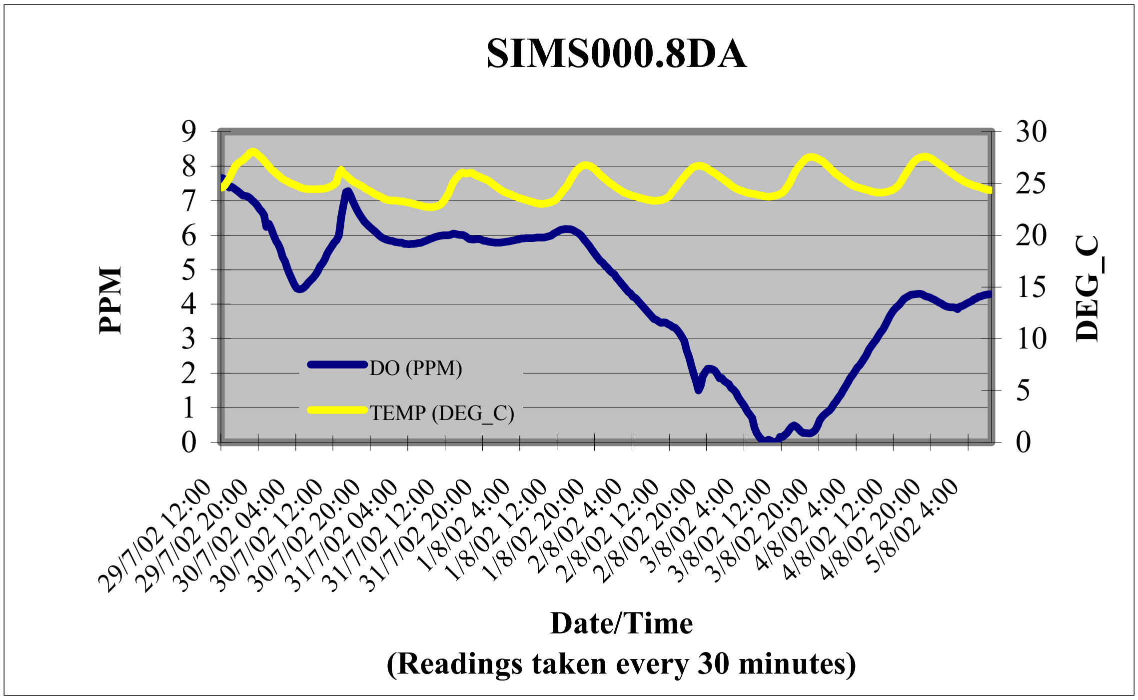
Field Notes: Data questionable, Hydrolab reading at pickup was 7.6 ppm.

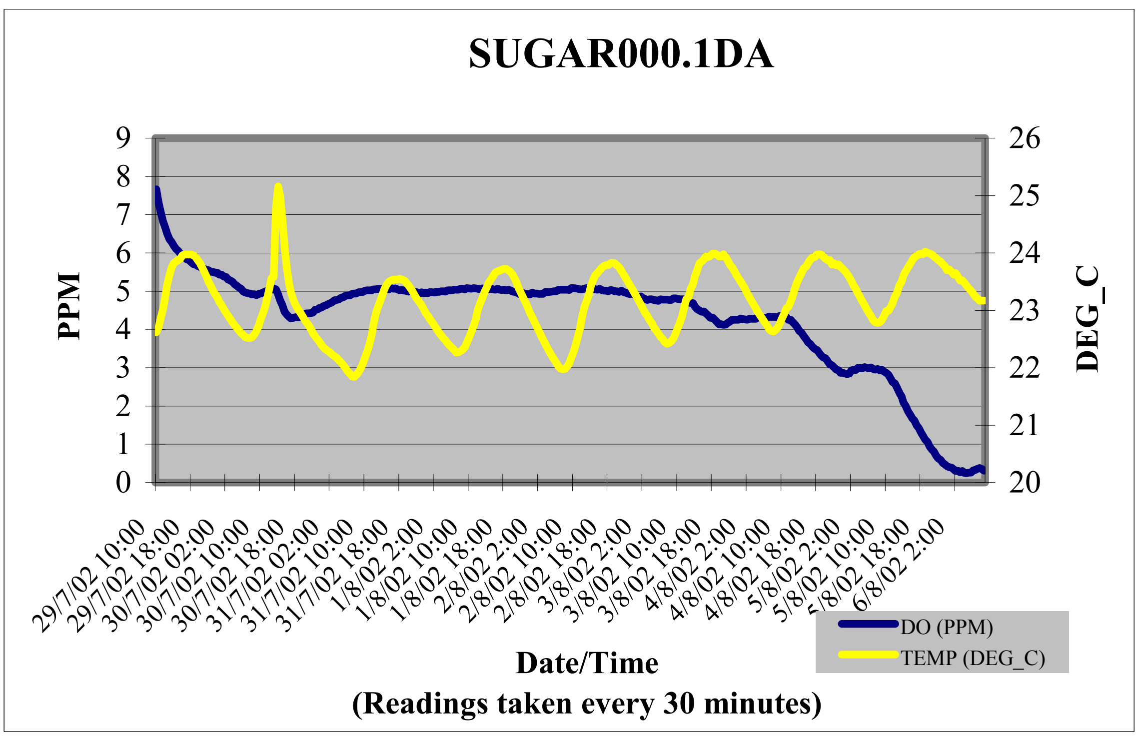

EFMUL010.4MR
DO (PPM)
TEMP (DEG_C)
PPM
DEG_C
8
7
6
5
4
3
2
1
0
27
26
25
24
23
22
6/8/02 13:30
6/8/02 21:30
7/8/02 5:30
7/8/02 13:30
7/8/02 21:30
8/8/02 5:30
8/8/02 13:30
8/8/02 21:30
9/8/02 5:30
9/8/02 13:30
9/8/02 21:30
10/8/02 5:30
10/8/02 13:30
10/8/02 21:30
11/8/02 5:30
11/8/02 13:30
11/8/02 21:30
12/8/02 5:30
12/8/02 13:30
12/8/02 21:30
13/08/02 05:30
DATE/TIME
(Readings taken every 30 minutes)


LHARP001.8WI
PPM
DEG_C
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
23
22
21
20
19
18
17
16
15
DO (PPM)
TEMP (DEG_C)
2/10/02 8:00
2/10/02 16:00
3/10/02 0:00
3/10/02 8:00
3/10/02 16:00
4/10/02 0:00
4/10/02 8:00
4/10/02 16:00
5/10/02 0:00
5/10/02 8:00
5/10/02 16:00
6/10/02 0:00
6/10/02 8:30
6/10/02 16:30
7/10/02 0:30
7/10/02 8:30
7/10/02 16:30
8/10/02 0:30
8/10/02 8:30
8/10/02 16:30
9/10/02 0:30
DATE/TIME
(Readings taken every 30 minutes)

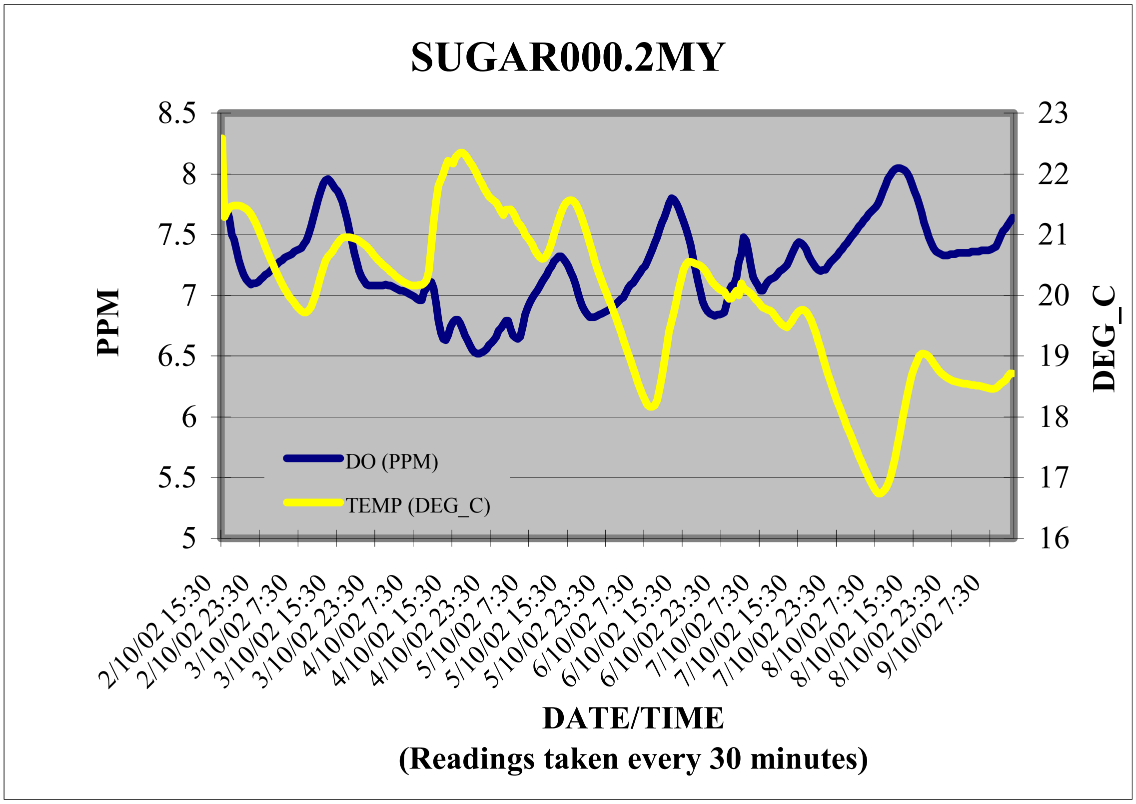

MILL003.3DA
PPM
DEG_C
29/7/02 12:30
29/7/02 20:30
30/7/02 04:30
30/7/02 12:30
30/7/02 20:30
31/7/02 04:30
31/7/02 12:30
31/7/02 20:30
1/8/02 4:30
1/8/02 12:30
1/8/02 20:30
2/8/02 4:30
2/8/02 12:30
2/8/02 20:30
3/8/02 4:30
3/8/02 12:30
3/8/02 20:30
4/8/02 4:30
4/8/02 12:30
4/8/02 20:30
5/8/02 4:30
Date/Time
(Readings taken every 30 minutes)
DO (PPM)
TEMP (DEG C)

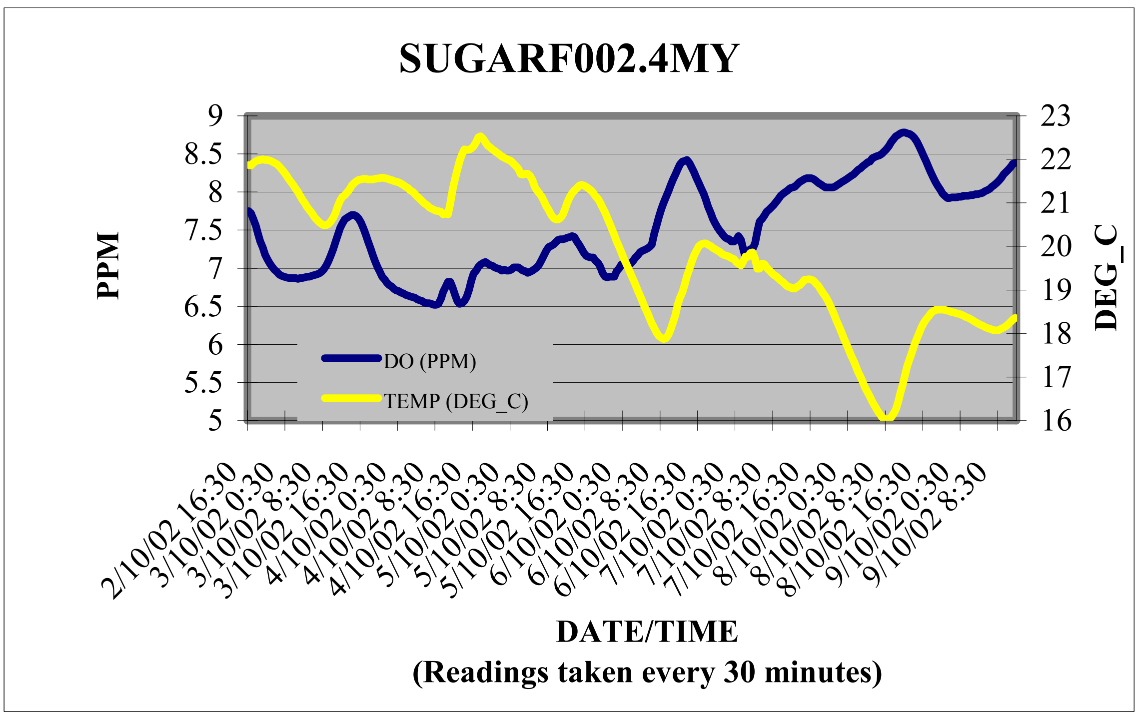

RATTL000.2WI
DO__________
Temperature_
PPM
DEG_C
2/10/02 10:30
2/10/02 18:30
3/10/02 2:30
3/10/02 10:30
3/10/02 18:30
4/10/02 2:30
4/10/02 10:30
4/10/02 18:30
5/10/02 2:30
5/10/02 10:30
5/10/02 18:30
6/10/02 2:30
6/10/02 10:30
6/10/02 18:30
7/10/02 2:30
7/10/02 10:30
7/10/02 18:30
8/10/02 2:30
8/10/02 10:30
8/10/02 18:30
9/10/02 2:30
DATE/TIME
(Readings taken every 30 minutes)

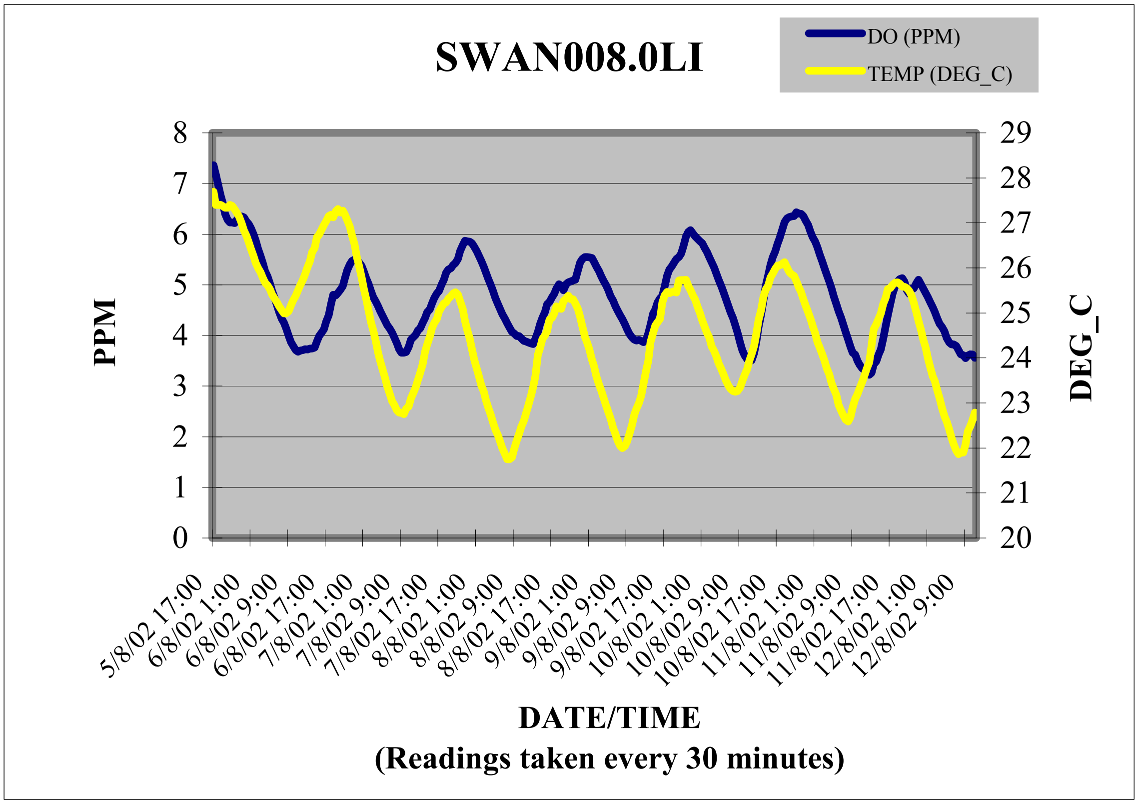


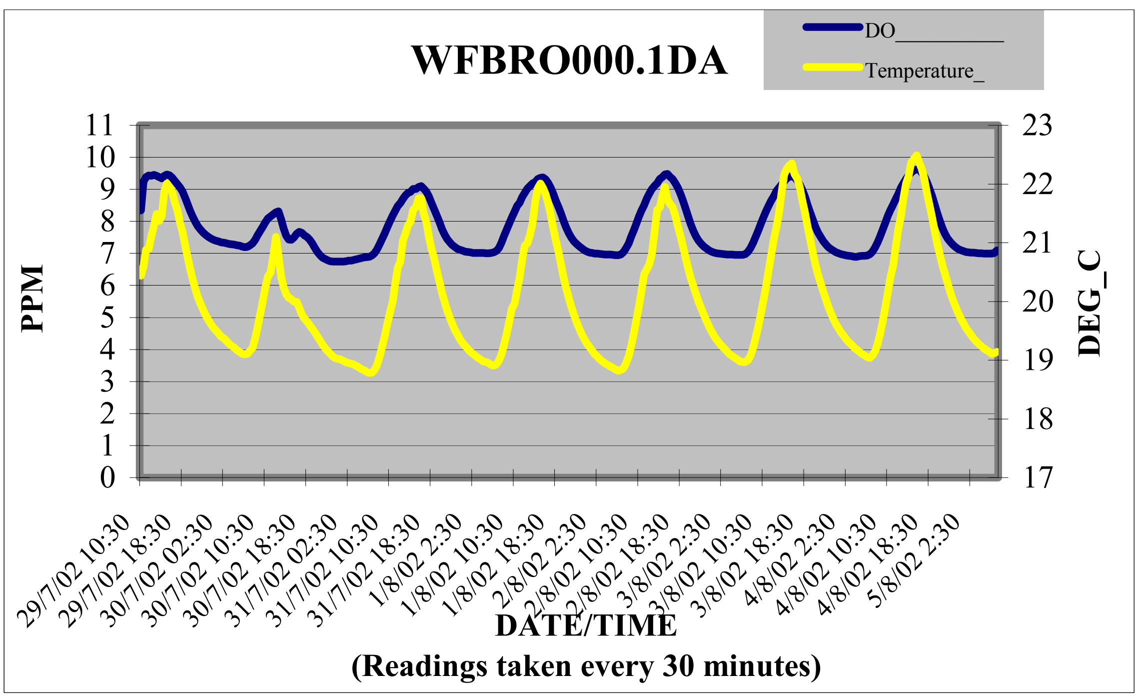


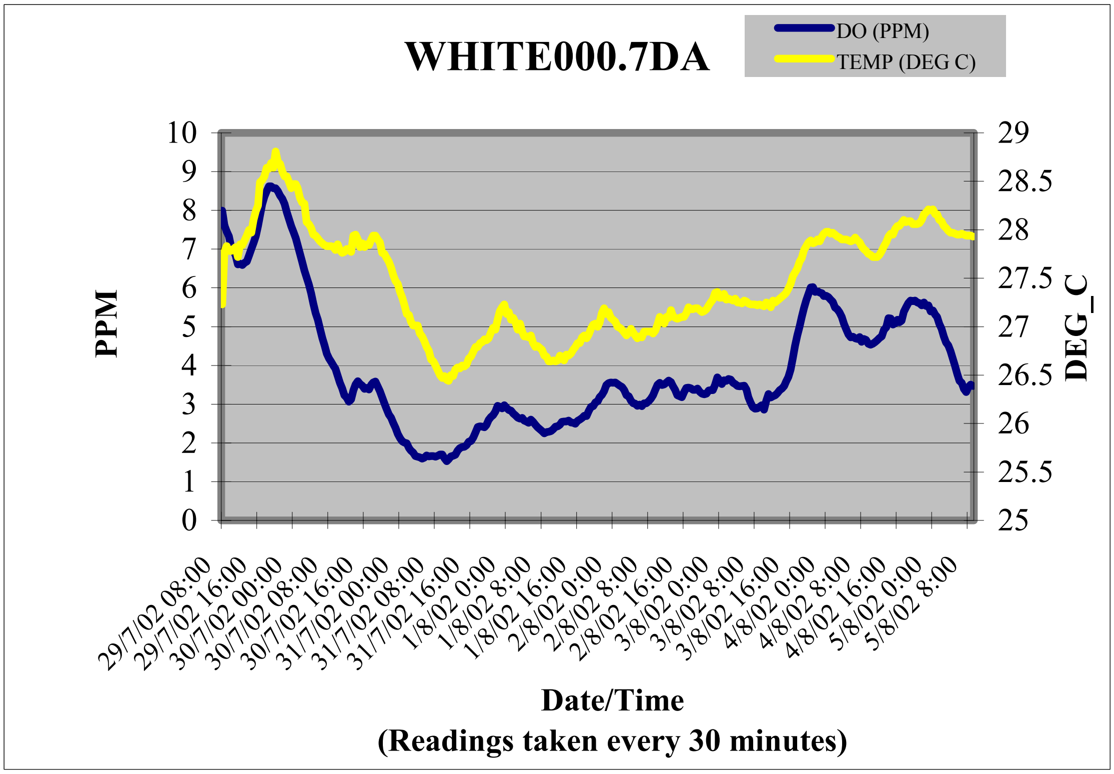
Field Notes: Water up during week.


SUGAR000.2MY
PPM
DEG_C
8.5
8
7.5
7
6.5
6
5.5
5
23
22
21
20
19
18
17
16
DO (PPM)
TEMP (DEG_C)
2/10/02 15:30
2/10/02 23:30
3/10/02 7:30
3/10/02 15:30
3/10/02 23:30
4/10/02 7:30
4/10/02 15:30
4/10/02 23:30
5/10/02 7:30
5/10/02 15:30
5/10/02 23:30
6/10/02 7:30
6/10/02 15:30
6/10/02 23:30
7/10/02 7:30
7/10/02 15:30
7/10/02 23:30
8/10/02 7:30
8/10/02 15:30
8/10/02 23:30
9/10/02 7:30
DATE/TIME
(Readings taken every 30 minutes)

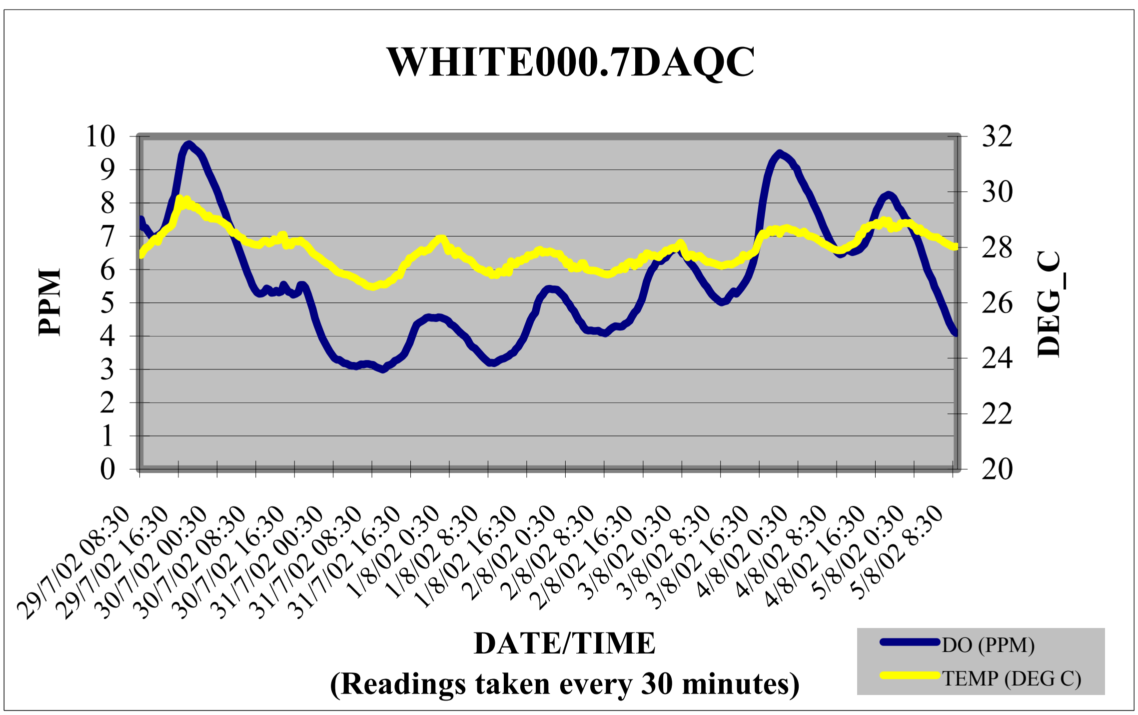

SUGARF002.4MY
PPM
DEG_C
9
8.5
8
7.5
7
6.5
6
5.5
5
23
22
21
20
19
18
17
16
DO (PPM)
TEMP (DEG_C)
2/10/02 16:30
3/10/02 0:30
3/10/02 8:30
3/10/02 16:30
4/10/02 0:30
4/10/02 8:30
4/10/02 16:30
5/10/02 0:30
5/10/02 8:30
5/10/02 16:30
6/10/02 0:30
6/10/02 8:30
6/10/02 16:30
7/10/02 0:30
7/10/02 8:30
7/10/02 16:30
8/10/02 0:30
8/10/02 8:30
8/10/02 16:30
9/10/02 0:30
9/10/02 8:30
DATE/TIME
(Readings taken every 30 minutes)


SWAN008.0LI
DO (PPM)
TEMP (DEG_C)
PPM
DEG_C
8
7
6
5
4
3
2
1
0
29
28
27
26
25
24
23
22
21
20
5/8/02 17:00
6/8/02 1:00
6/8/02 9:00
6/8/02 17:00
7/8/02 1:00
7/8/02 9:00
7/8/02 17:00
8/8/02 1:00
8/8/02 9:00
8/8/02 17:00
9/8/02 1:00
9/8/02 9:00
9/8/02 17:00
10/8/02 1:00
10/8/02 9:00
10/8/02 17:00
11/8/02 1:00
11/8/02 9:00
11/8/02 17:00
12/8/02 1:00
12/8/02 9:00
DATE/TIME
(Readings taken every 30 minutes)

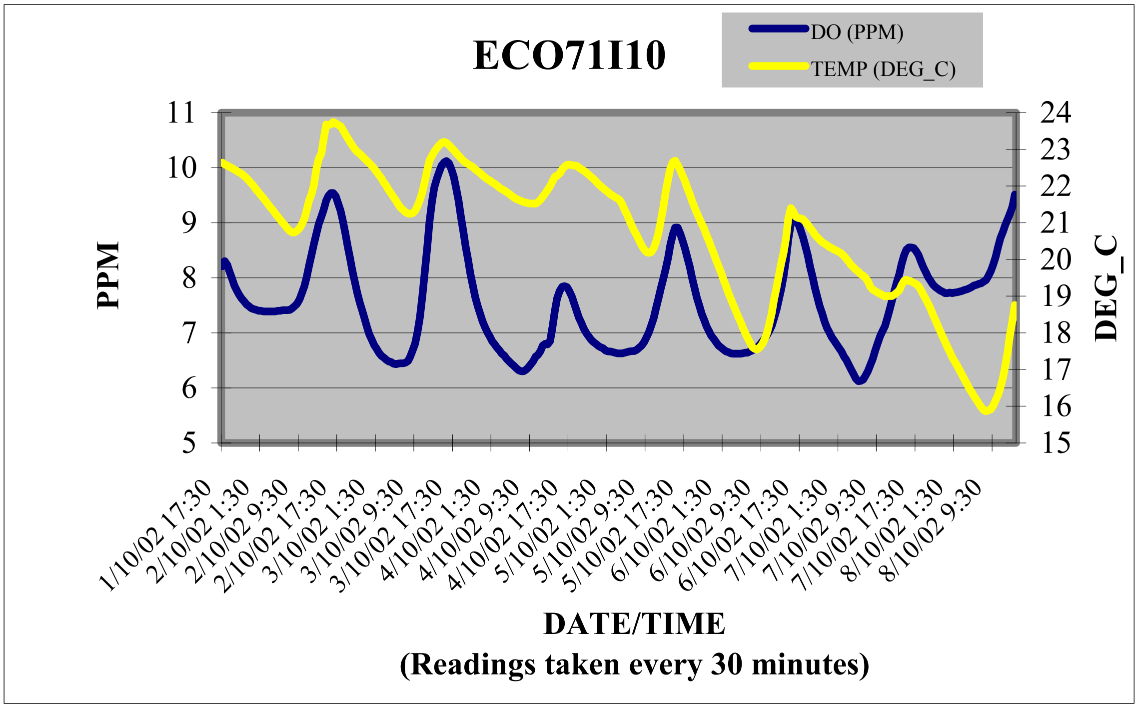

WFBRO000.1DA
DO__________
Temperature_
PPM
DEG_C
11
10
9
8
7
6
5
4
3
2
1
0
23
22
21
20
19
18
17
29/7/02 10:30
29/7/02 18:30
30/7/02 02:30
30/7/02 10:30
30/7/02 18:30
31/7/02 02:30
31/7/02 10:30
31/7/02 18:30
1/8/02 2:30
1/8/02 10:30
1/8/02 18:30
2/8/02 2:30
2/8/02 10:30
2/8/02 18:30
3/8/02 2:30
3/8/02 10:30
3/8/02 18:30
4/8/02 2:30
4/8/02 10:30
4/8/02 18:30
5/8/02 2:30
DATE/TIME
(Readings taken every 30 minutes)

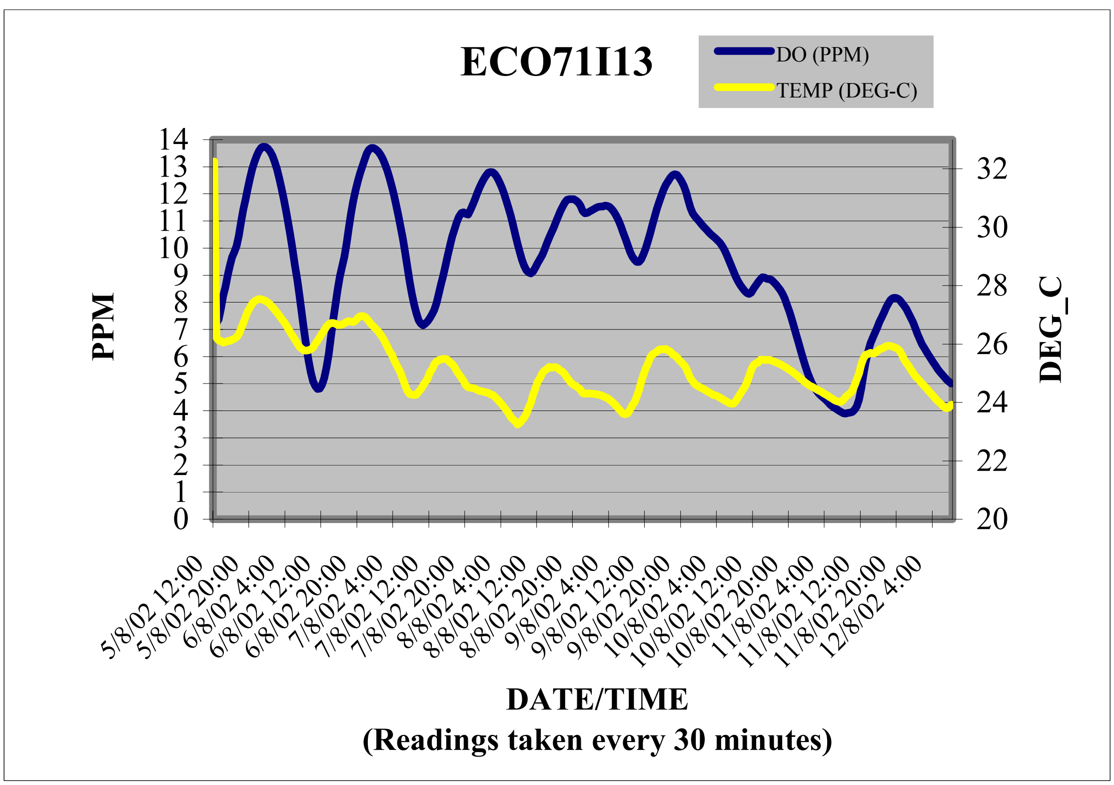


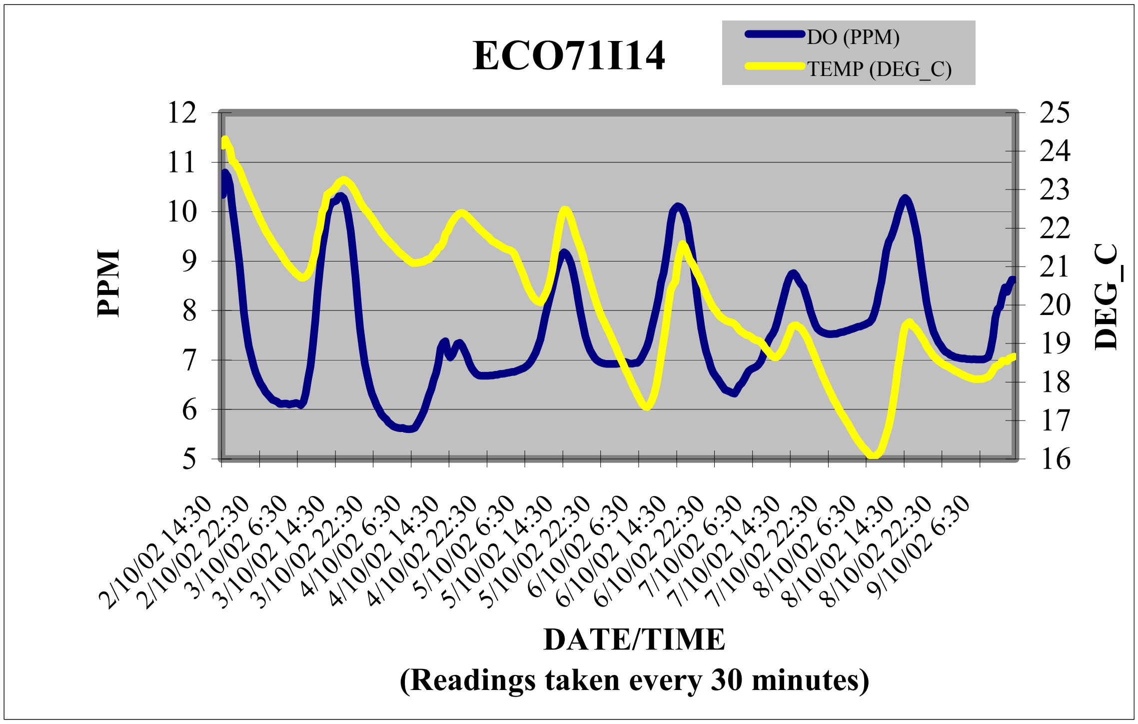
WHITE000.7DA
DO (PPM)
TEMP (DEG C)
PPM
DEG_C
10
9
8
7
6
5
4
3
2
1
0
29
28.5
28
27.5
27
26.5
26
25.5
25
29/7/02 08:00
29/7/02 16:00
30/7/02 00:00
30/7/02 08:00
30/7/02 16:00
31/7/02 00:00
31/7/02 08:00
31/7/02 16:00
1/8/02 0:00
1/8/02 8:00
1/8/02 16:00
2/8/02 0:00
2/8/02 8:00
2/8/02 16:00
3/8/02 0:00
3/8/02 8:00
3/8/02 16:00
4/8/02 0:00
4/8/02 8:00
4/8/02 16:00
5/8/02 0:00
5/8/02 8:00
Date/Time
(Readings taken every 30 minutes)



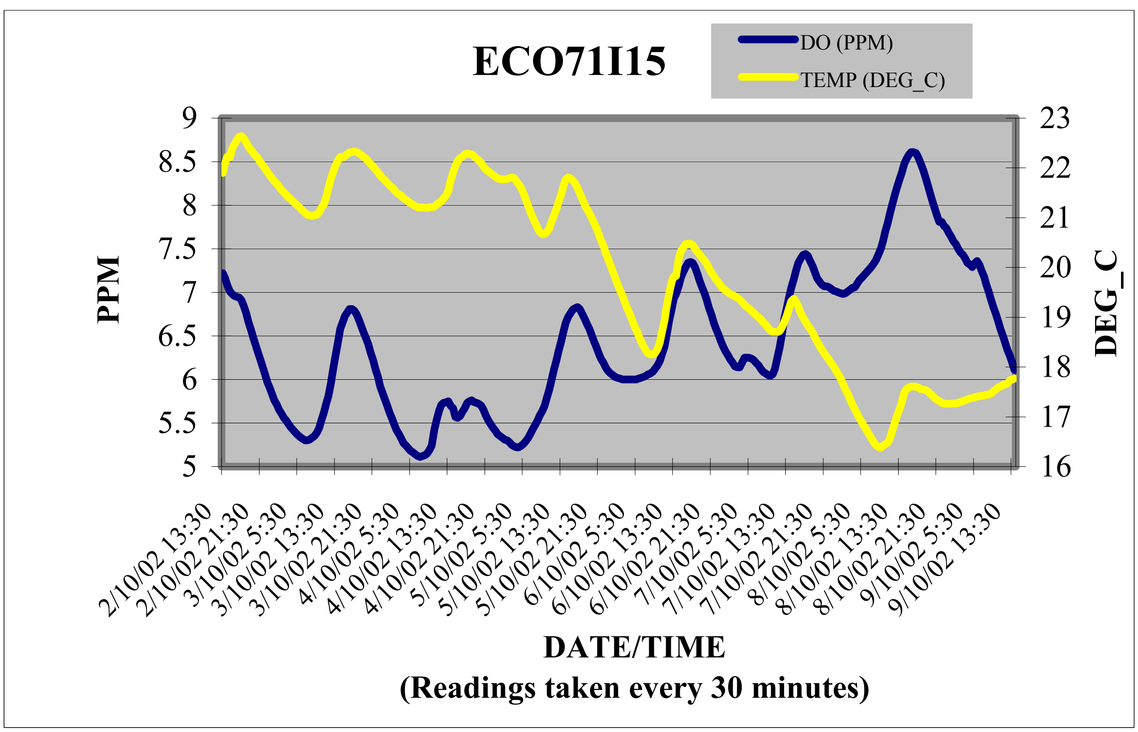
WHITE000.7DAQC
PPM
DEG_C
10
9
8
7
6
5
4
3
2
1
0
32
30
28
26
24
22
20
29/7/02 08:30
29/7/02 16:30
30/7/02 00:30
30/7/02 08:30
30/7/02 16:30
31/7/02 00:30
31/7/02 08:30
31/7/02 16:30
1/8/02 0:30
1/8/02 8:30
1/8/02 16:30
2/8/02 0:30
2/8/02 8:30
2/8/02 16:30
3/8/02 0:30
3/8/02 8:30
3/8/02 16:30
4/8/02 0:30
4/8/02 8:30
4/8/02 16:30
5/8/02 0:30
5/8/02 8:30
DATE/TIME
(Readings taken every 30 minutes)
DO (PPM)
TEMP (DEG C)


ECO71I10
DO (PPM)
TEMP (DEG_C)
PPM
DEG_C
11
10
9
8
7
6
5
24
23
22
21
20
19
18
17
16
15
1/10/02 17:30
2/10/02 1:30
2/10/02 9:30
2/10/02 17:30
3/10/02 1:30
3/10/02 9:30
3/10/02 17:30
4/10/02 1:30
4/10/02 9:30
4/10/02 17:30
5/10/02 1:30
5/10/02 9:30
5/10/02 17:30
6/10/02 1:30
6/10/02 9:30
6/10/02 17:30
7/10/02 1:30
7/10/02 9:30
7/10/02 17:30
8/10/02 1:30
8/10/02 9:30
DATE/TIME
(Readings taken every 30 minutes)

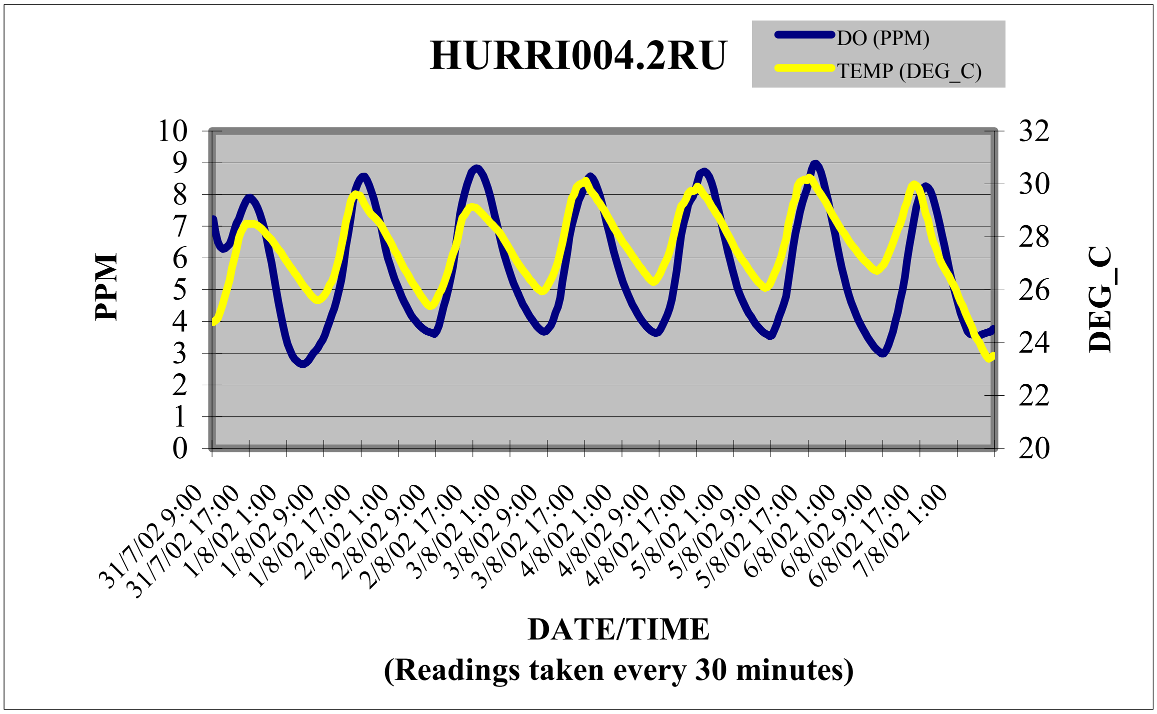

ECO71I13
DO (PPM)
TEMP (DEG-C)
PPM
DEG_C
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
32
30
28
26
24
22
20
5/8/02 12:00
5/8/02 20:00
6/8/02 4:00
6/8/02 12:00
6/8/02 20:00
7/8/02 4:00
7/8/02 12:00
7/8/02 20:00
8/8/02 4:00
8/8/02 12:00
8/8/02 20:00
9/8/02 4:00
9/8/02 12:00
9/8/02 20:00
10/8/02 4:00
10/8/02 12:00
10/8/02 20:00
11/8/02 4:00
11/8/02 12:00
11/8/02 20:00
12/8/02 4:00
DATE/TIME
(Readings taken every 30 minutes)

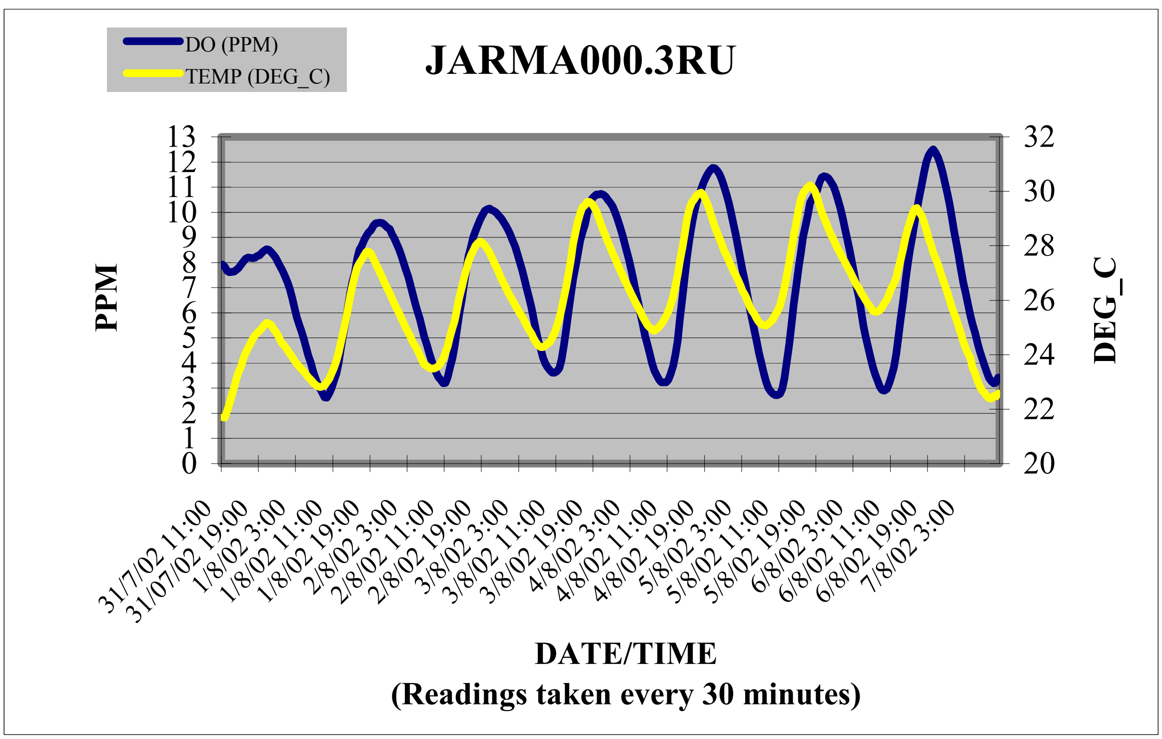


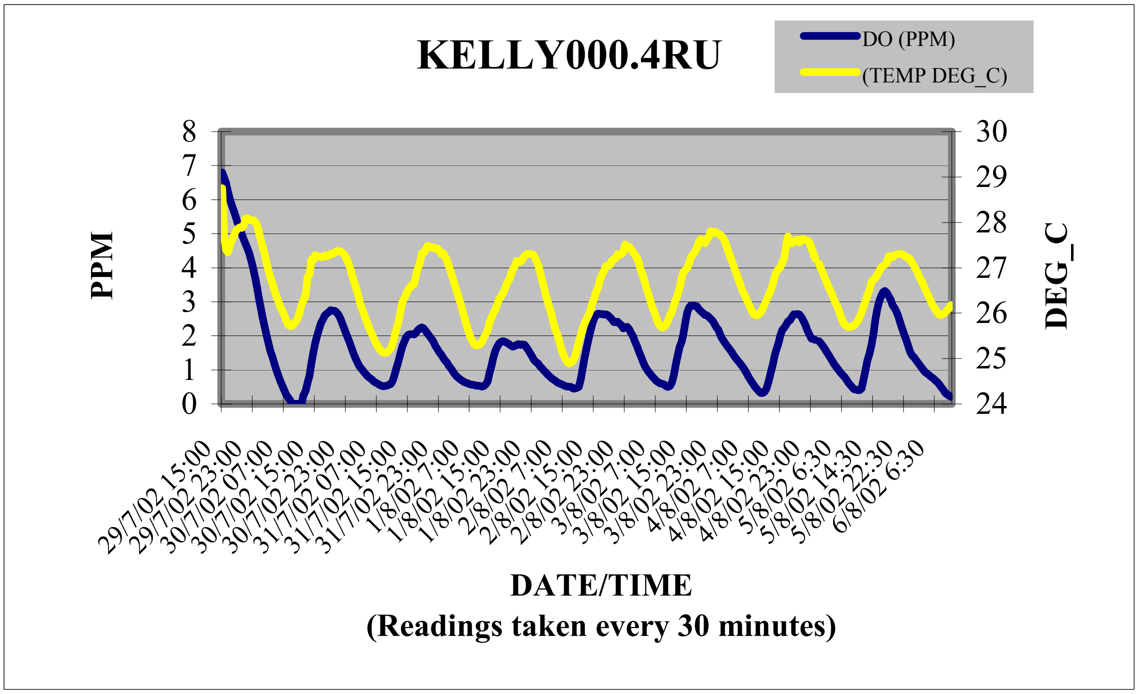
Field Notes: Water up during week.

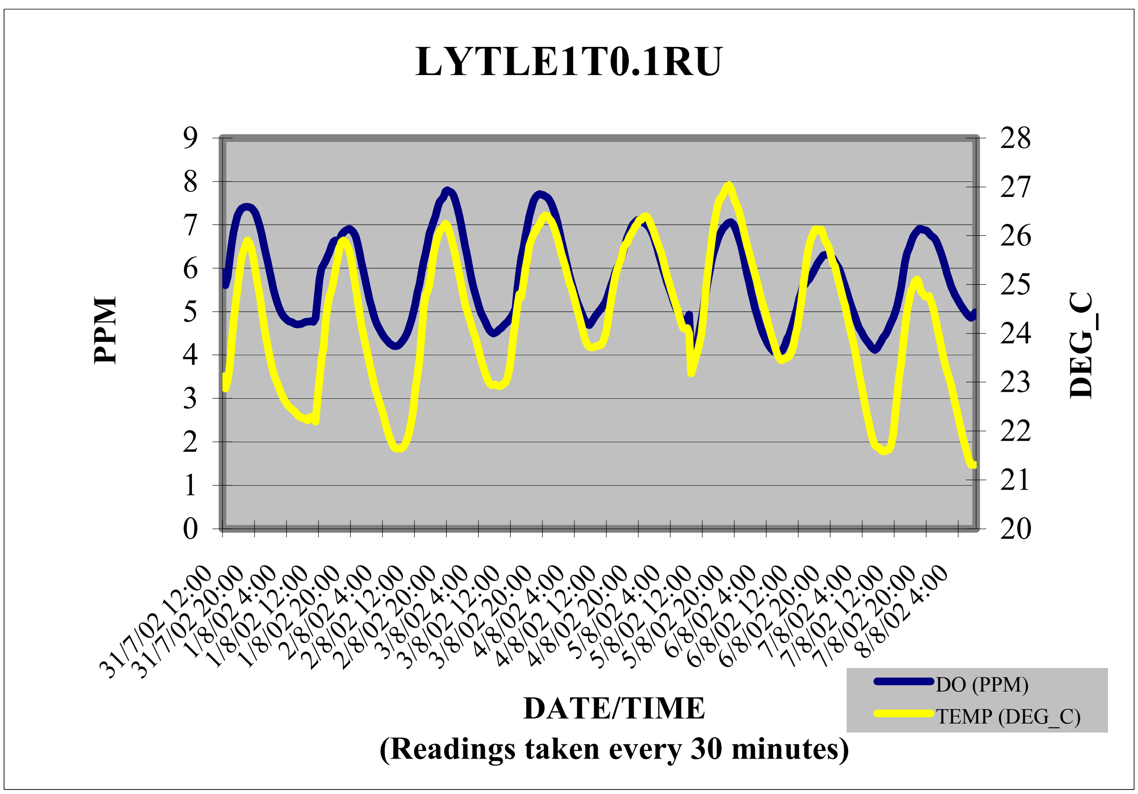


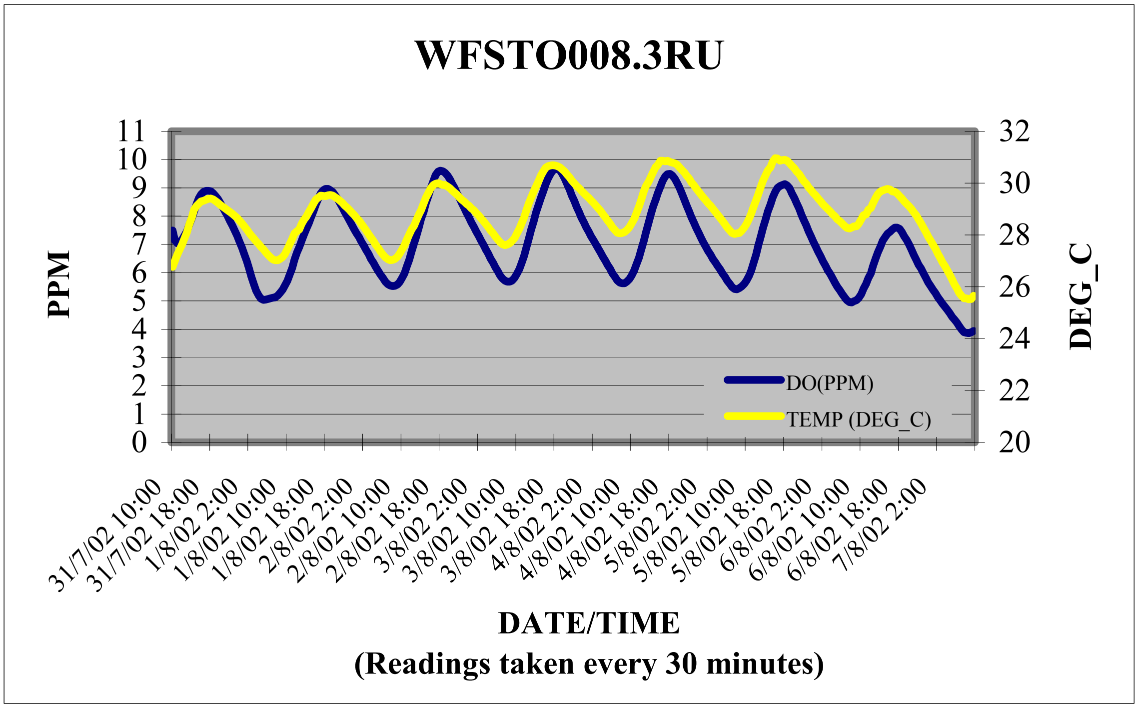
Field Notes: Water up during week.

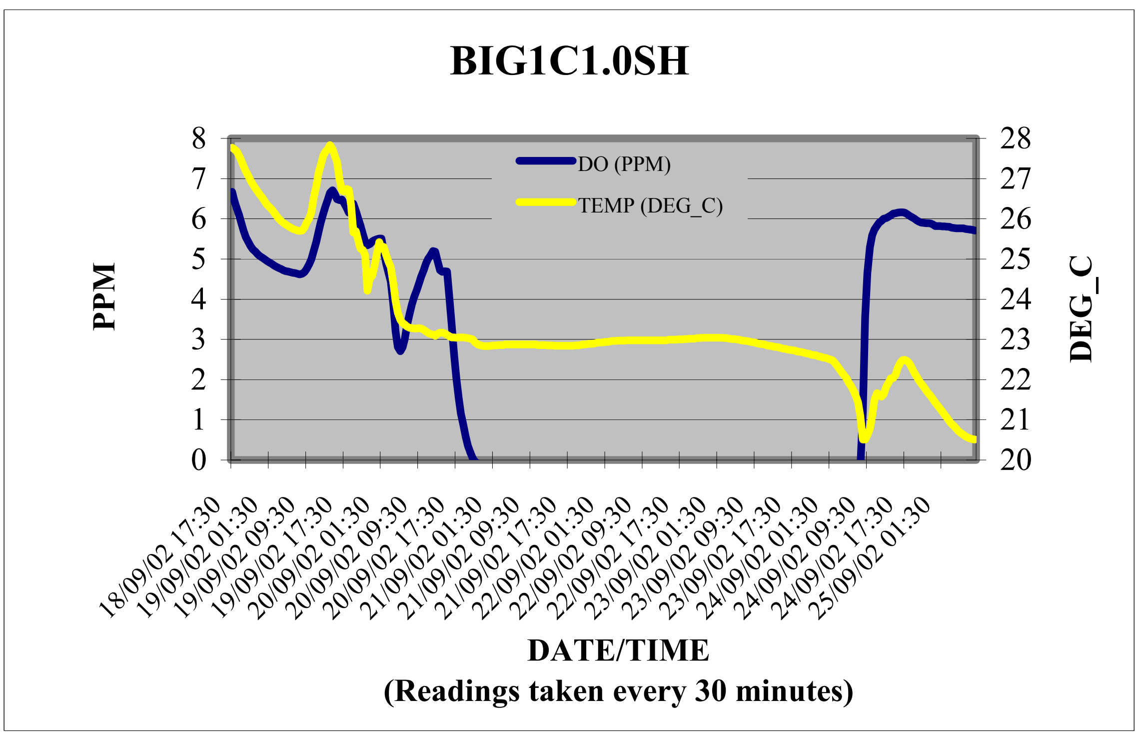

HURRI004.2RU
DO (PPM)
TEMP (DEG_C)
PPM
DEG_C
0
1
2
3
4
5
6
7
8
9
10
20
22
24
26
28
30
32
31/7/02 9:00
31/7/02 17:00
1/8/02 1:00
1/8/02 9:00
1/8/02 17:00
2/8/02 1:00
2/8/02 9:00
2/8/02 17:00
3/8/02 1:00
3/8/02 9:00
3/8/02 17:00
4/8/02 1:00
4/8/02 9:00
4/8/02 17:00
5/8/02 1:00
5/8/02 9:00
5/8/02 17:00
6/8/02 1:00
6/8/02 9:00
6/8/02 17:00
7/8/02 1:00
DATE/TIME
(Readings taken every 30 minutes)

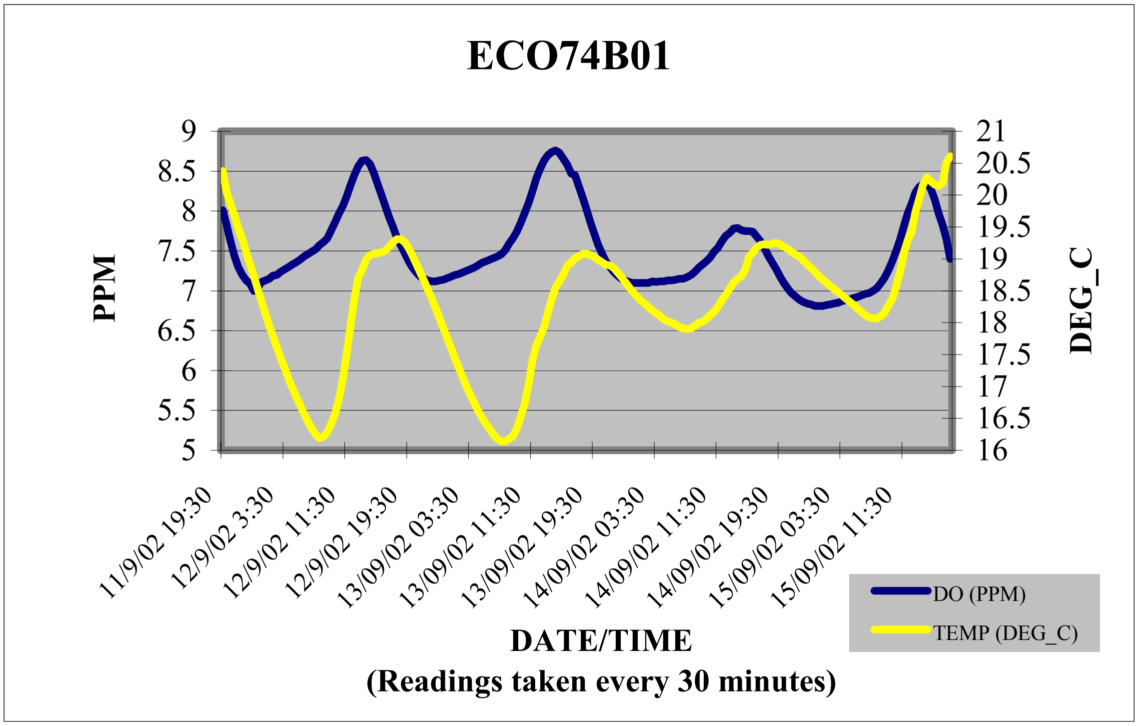

JARMA000.3RU
DO (PPM)
TEMP (DEG_C)
PPM
DEG_C
0
1
2
3
4
5
6
7
8
9
10
11
12
13
20
22
24
26
28
30
32
31/7/02 11:00
31/07/02 19:00
1/8/02 3:00
1/8/02 11:00
1/8/02 19:00
2/8/02 3:00
2/8/02 11:00
2/8/02 19:00
3/8/02 3:00
3/8/02 11:00
3/8/02 19:00
4/8/02 3:00
4/8/02 11:00
4/8/02 19:00
5/8/02 3:00
5/8/02 11:00
5/8/02 19:00
6/8/02 3:00
6/8/02 11:00
6/8/02 19:00
7/8/02 3:00
DATE/TIME
(Readings taken every 30 minutes)


KELLY000.4RU
DO (PPM)
(TEMP DEG_C)
PPM
DEG_C
8
7
6
5
4
3
2
1
0
30
29
28
27
26
25
24
29/7/02 15:00
29/7/02 23:00
30/7/02 07:00
30/7/02 15:00
30/7/02 23:00
31/7/02 07:00
31/7/02 15:00
31/7/02 23:00
1/8/02 7:00
1/8/02 15:00
1/8/02 23:00
2/8/02 7:00
2/8/02 15:00
2/8/02 23:00
3/8/02 7:00
3/8/02 15:00
3/8/02 23:00
4/8/02 7:00
4/8/02 15:00
4/8/02 23:00
5/8/02 6:30
5/8/02 14:30
5/8/02 22:30
6/8/02 6:30
DATE/TIME
(Readings taken every 30 minutes)

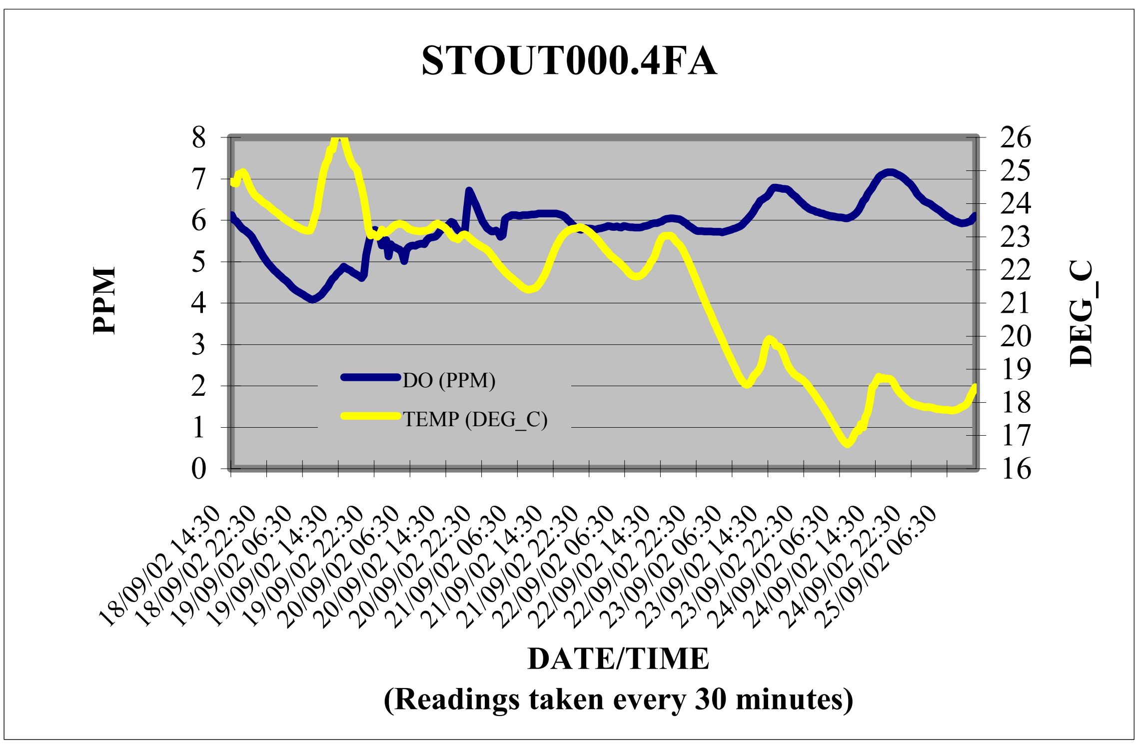

LYTLE1T0.1RU
PPM
DEG_C
9
8
7
6
5
4
3
2
1
0
28
27
26
25
24
23
22
21
20
31/7/02 12:00
31/7/02 20:00
1/8/02 4:00
1/8/02 12:00
1/8/02 20:00
2/8/02 4:00
2/8/02 12:00
2/8/02 20:00
3/8/02 4:00
3/8/02 12:00
3/8/02 20:00
4/8/02 4:00
4/8/02 12:00
4/8/02 20:00
5/8/02 4:00
5/8/02 12:00
5/8/02 20:00
6/8/02 4:00
6/8/02 12:00
6/8/02 20:00
7/8/02 4:00
7/8/02 12:00
7/8/02 20:00
8/8/02 4:00
DO (PPM)
TEMP (DEG_C)
DATE/TIME
(Readings taken every 30 minutes)

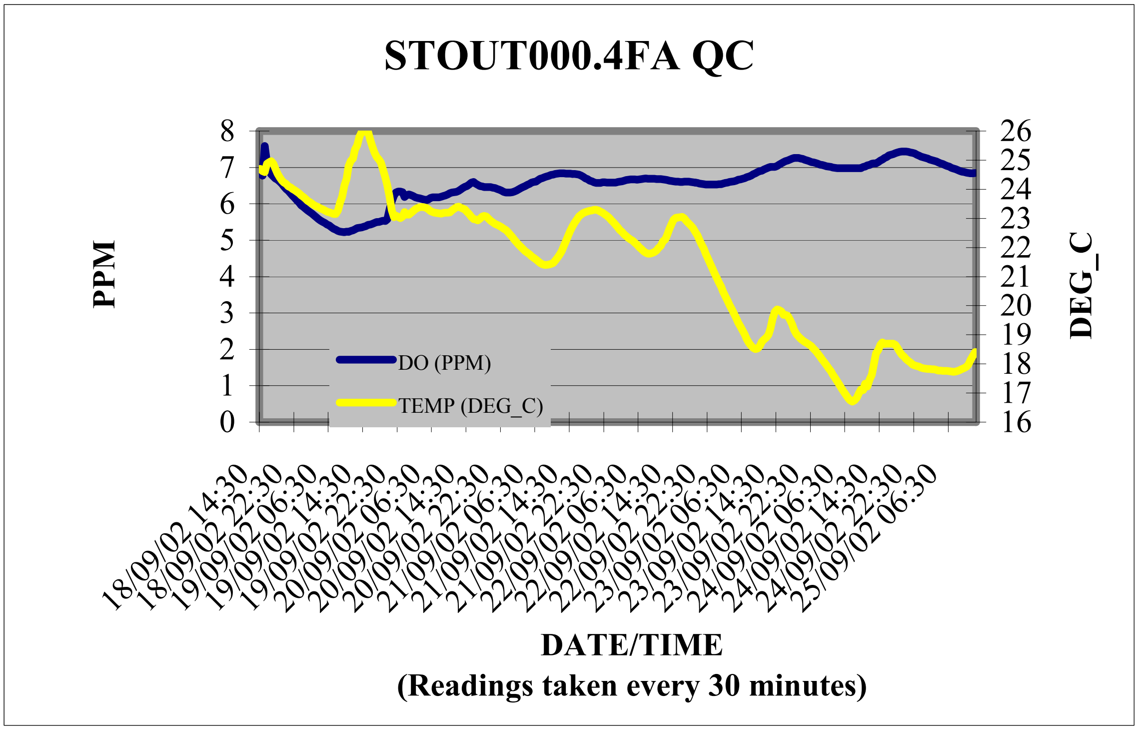

WFSTO008.3RU
PPM
DEG_C
11
10
9
8
7
6
5
4
3
2
1
0
32
30
28
26
24
22
20
DO(PPM)
TEMP (DEG_C)
31/7/02 10:00
31/7/02 18:00
1/8/02 2:00
1/8/02 10:00
1/8/02 18:00
2/8/02 2:00
2/8/02 10:00
2/8/02 18:00
3/8/02 2:00
3/8/02 10:00
3/8/02 18:00
4/8/02 2:00
4/8/02 10:00
4/8/02 18:00
5/8/02 2:00
5/8/02 10:00
5/8/02 18:00
6/8/02 2:00
6/8/02 10:00
6/8/02 18:00
7/8/02 2:00
DATE/TIME
(Readings taken every 30 minutes)


BIG1C1.0SH
PPM
DEG_C
8
7
6
5
4
3
2
1
0
28
27
26
25
24
23
22
21
20
DO (PPM)
TEMP (DEG_C)
18/09/02 17:30
19/09/02 01:30
19/09/02 09:30
19/09/02 17:30
20/09/02 01:30
20/09/02 09:30
20/09/02 17:30
21/09/02 01:30
21/09/02 09:30
21/09/02 17:30
22/09/02 01:30
22/09/02 09:30
22/09/02 17:30
23/09/02 01:30
23/09/02 09:30
23/09/02 17:30
24/09/02 01:30
24/09/02 09:30
24/09/02 17:30
25/09/02 01:30
DATE/TIME
(Readings taken every 30 minutes)



Field Notes: Heavy rains, high flow after 9/15, data not recorded.




STOUT000.4FA QC
PPM
DEG_C
DO (PPM)
TEMP (DEG_C)
8
7
6
5
4
3
2
1
0
26
25
24
23
22
21
20
19
18
17
16
18/09/02 14:30
18/09/02 22:30
19/09/02 06:30
19/09/02 14:30
19/09/02 22:30
20/09/02 06:30
20/09/02 14:30
20/09/02 22:30
21/09/02 06:30
21/09/02 14:30
21/09/02 22:30
22/09/02 06:30
22/09/02 14:30
22/09/02 22:30
23/09/02 06:30
23/09/02 14:30
23/09/02 22:30
24/09/02 06:30
24/09/02 14:30
24/09/02 22:30
25/09/02 06:30
DATE/TIME
(Readings taken every 30 minutes)