

ANNUAL REPORT
ON
WATER MONITORING AT THE PRESERVE GOLF CLUB

*

REPORT PREPARED BY:

LAM HO, Ph.D.

Consulting and Research on the Environment, Ltd.

678 Winding Ridge Lane - Sidney, OH 45365

Telephone : (937) 498 - 9350 - Fax : (937) 498 - 9677

e-mail : LamHo_CARE@hotmail.com

web site : www.LHoCARE.com

REPORT SUBMITTED TO:

CRAIG PASKVAN

Paskvan Consulting

Route 1, Box 77A - Akeley, MN 56433

Telephone: (218) 652-3542

&

PRESERVE GOLF CLUB

134 South Nokomis Ave. - Nisswa, MN 56468

Annual Report
On Water Monitoring
At The Preserve Golf Club

Table of Contents

Executive Summary.....	Page 1
Introduction.....	Page 1
Water Monitoring Activities in the year 2001.....	Page 2
Assessment of Monitoring Data.....	Page 3
Leachates from Woods.....	Page 4
Well Water Monitoring.....	Page 4
Surface Water Monitoring.....	Page 4
Conclusion.....	Page 5
References.....	Page 5

Data and Tables

Table 1 Rainfall Records and Leachate Monitoring.....	Page 6
Total Water Input Table.....	Page 7
Data on Green # 4.....	Page 8
Data on Green # 10.....	Page 9
Data on Green # 13.....	Page 10
Data on Green # 13g.....	Page 11
Data on Green # 15.....	Page 12
Data on Fairway # 4.....	Page 13
Data on Fairway # 10.....	Page 14
Data on Fairway # 13.....	Page 15
Data on Fairway # 15.....	Page 16
Leachate Monitoring of Woods Data.....	Page 17
Wells Data.....	Page 18
Wetland Data.....	Page 19
Wetland Data	Page 20
Baseline Data.....	Page 21
Lysimeter Data.....	Page 22
Factors Affecting High Concentrations in Lysimeters.....	Page 23
Water Quality Data.....	Page 24

November 26, 2001

ANNUAL REPORT ON WATER MONITORING AT THE PRESERVE GOLF CLUB

EXECUTIVE SUMMARY

Leachate monitoring at the Preserve Golf Club was conducted from May through October, 2001. Water samples were collected from 3 wells, 3 wetland locations and 13 lysimeters which were previously installed at strategic locations in the Golf Club. Parameters tested in this project included Ammonium-Nitrogen, Nitrate-Nitrogen, Total Kjeldahl Nitrogen, Phosphorus, Potassium, pH and Electrical Conductivity. Water samples were preserved at the time of collection and shipped to Brookside Laboratories for analysis.

Test results suggested that the fertilizer application program at the Preserve GC generally does not increase level of nutrients in the leachates beyond the baseline concentration ranges. However, when collecting leachate samples immediately after fertilizer application, ones may expect to see elevated levels of nutrients in the samples. Leachate's Nitrogen and Potassium were found in the normal range for irrigation water. Phosphorus is the only nutrient that was found at concentrations that could cause eutrophication to lakes and wetlands if the leachates reach these surface water bodies.

INTRODUCTION

While it is a normal management practice to apply fertilizer on golf courses, the public seems always interested in knowing whether or not the application adversely affects the quality of surface and ground water which flow through or flow close to the site. To address this concern as well as to comply with county/state requirements, water samples were collected from strategic locations throughout the Preserve Golf Club from May through October, 2001. Since nutrients such as Nitrogen (N), phosphorus (P) and Potassium (K) in fertilizer application are the main parameters of interest, water samples are tested for Ammonium-Nitrogen (NH₄), Nitrate-Nitrogen (NO₃), Total Kjeldahl Nitrogen (TKN), Phosphorus (P) and Potassium (K). Electrical Conductivity (EC) and pH are also analyzed. Laboratory results from the testing of these samples are used to assess the potential release of nutrients to surface and sub-surface waters.

WATER MONITORING ACTIVITIES IN THE YEAR 2001

In 2001, water monitoring was conducted from May to October. During the monitoring period, four sampling events were performed at strategic locations on Greens and Fairways and three sampling events took place at the Beaver Dam, Wetlands, the Preserve GC's wells and the Woods near Holes 4, 10, 13 and 15. Due to the availability of water in the lysimeters at the time of sampling, for each sampling event, we were not able to collect samples from all lysimeters, and for each sample, we may not be able to analyze all test parameters listed above.

Water samples were preserved at the time of collection, as recommended by the US EPA, and shipped to Brookside Laboratories Inc. in New Knoxville, Ohio for analysis. Data from the laboratory analyses, record of fertilizer applications, rainfall and water irrigation were compiled and evaluated. Results of our assessment are presented in Tables 1 through 16 and accompanying graphs, as follows:

Table 1: Daily record of rainfalls at the Preserve GC during the monitoring period (i.e., may through October, 2001) are presented along with sampling events. The shaded blocks represented water sample collection activities at a given location on a specified date. Lysimeters at Greens and Fairways at Holes 4, 10, 13 and 15 were sampled 4 times, except Fairway 15 and Green 13 which were sampled 3 times. Woods near the aforementioned Holes, Beaver Dam, Wetlands and the Preserve GC's wells were sampled 3 times, except Woods 10 and 15 (2 times).

Table 2: Monthly data for rainfalls and irrigations are used to calculate the Total Water Input at each monitoring site. Results of the calculations are presented in number of gallons and liters per monitoring site. The latter will be used to calculate Nutrient Loadings in milligrams per liter (mg/L) which is the same concentration unit used by analytical laboratories to report nutrient concentrations in leachates.

Tables 3 to 10: These Tables document information relevant to the Greens and Fairways sites. Each Table presents data for one specific monitoring site. The information include date, amount and source of fertilizer used, rainfall and irrigation data. Calculated data are: Nutrient Loadings in pounds and in milligrams, and Loading Concentrations in mg/L. Leachate Concentration, as reported by Brookside Laboratories are also shown. Finally, the two main components of the mass balance for plant nutrients at each monitoring site, namely, the nutrients applied to the site (i.e., Loading Concentration) and the nutrients that left the site as a leachate (Leachate Concentration) are illustrated in a bar graph.

Table 11 to 13: Analytical results on the chemical analysis of water samples from the 4, 10, 13 and 15 Woods; the three Preserve GC's wells, the Wetlands and the Beaver Dam (as reported by Brookside Laboratories) are presented. Bar graphs comparing month to month fluctuation of monitoring parameters are used to illustrate the dynamic characteristics of surface and ground water.

Table 14: As ones can expected, even if no fertilizer is applied in a given month, nutrients such as N, P and K are still present in the leachates. These nutrient

P₂O₅ and 1.83 lbs/1,000 sq.ft. K₂O) and no elevation or contamination was observed . With regard to the 08/09/01 leachate monitoring, high K concentration in the leachate sample collected from Green 15 could simply be a case of sampling and/or lab contamination. There was no fertilizer application between August 1 and August 9 and the July applications were well within application ranges recorded during the water monitoring months. Rainfall and irrigation in July was 1.4 acre-inch and 6,592,239 gallons, respectively. There was also light rain and irrigation on the day of the sampling. Assuming leachate collected on 08/09/01 was predominantly derived from the July fertilization, loading concentration was calculated and compared with similar loadings. Data obtained from this assessment did not support the reported concentration of K in Greens 15' s leachate (61.6 mg/L).

In summary, monthly application rates of fertilizer for the Preserve GC normally do not elevate concentration of nutrients in lysimeter samples beyond the baseline concentration ranges. It is important to recognize, however, the timing affect on leachate sampling in relation to fertilization, rainfall and water irrigation. Since our goal is to monitor the potential of over-application of fertilizer, leachate sampling should be made at least one week after fertilization. The leachate sampling would be more representative after applied-nutrients reach their equilibria. At equilibrium, the nutrients would be distributed through out the soil's top layers, adsorbed on soil matrix , up-taken by plant roots and leach out the surplus.

Leachates from Woods.- Water samples collected from Woods 4, 10, 13 and 15 shows relatively low concentrations of nutrients and dissolved solids (i.e., Electrical Conductivity or EC), please see Table 11. There was one N reading that was uncharacteristically high (Total N in the Wood 13 sample, collected on 08/09/01). Over 83% of this N was organic nitrogen, indicating that the high N concentration did not come from the Preserve GC's fertilizer application program.

Well Water Monitoring.- Clubhouse and the two Irrigation wells were monitored three times between May and October. Chemical analysis shows a fairly consistent water quality over time, please see Table 12. All wells present good water quality as tested although Total N in the 20 HP irrigation well was higher than Total N in the other two wells. Ninety three to 99% of Nitrogen in the well water samples are in organic form.

Surface Water Monitoring.- Water samples were collected from three Wetlands and the Beaver Dam, please see Table 13. The water contains relatively low soluble solids (i.e., Electrical Conductivity or EC) and nutrients. Normal pH, ranges from 6.36 to 6.78, was also observed in the leachates. Total Nitrogen are essentially within the baseline concentration range, except two which are out of range. Median concentration of Total Nitrogen in Wetland and Beaver Dam leachates is 6.17 mg/L. In most cases, the nitrogen is organic, except the Nitrogen in Wetland 1 sample, collected on 10/01/01 where 82% of the nitrogen was nitrate and ammonia.

CONCLUSION

Leachate monitoring data in 2001 suggested that the fertilizer application program at the Preserve GC generally does not increase level of nutrients in the leachates beyond the baseline concentration ranges. However, when collecting leachate sample immediately after fertilizer application, ones may expect to see elevated concentration of nutrients in the leachates. Leachate's Nitrogen and Potassium were found in the normal range for irrigation water. Phosphorus is the only nutrient that was found at concentrations that could cause eutrophication to lakes and wetlands if the leachates reach these surface water bodies.

REFERENCES

Duncan, R. R. et al. *Understanding Water Quality and Guidelines to Management*. USGA Green Section Record. Sep/Oct 2000, pp 14 - 24.

Table1	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	
1	Table 1.- Records of Rainfalls and Leachate Monitoring at The Preserve Golf Club																						
2	Date	Rainfall Total (inches)	Collection of Water Samples (Shaded)																				
3			Fairway No.				Green No.					Wood No.				Wetland No.			Beaver	Well			
4			4	10	13	15	4	10	13	13	15	4	10	13	15	1	2	3	Dam	Clubhouse	Irrigation	Irrigation	
5										(Tank)													
6			05/06/01	0.30																			
7	05/07/01	0.25																					
8	05/09/01	0.00																					
9	05/15/01	0.10																					
10	05/21/01	1.60																					
11	05/23/01	1.20																					
12	05/26/01	0.60																					
13	May Total	4.05																					
14	06/09/01	0.40																					
15	06/10/01	0.20																					
16	06/12/01	0.90																					
17	06/13/01	0.20																					
18	06/14/01	2.10																					
19	06/18/01	0.40																					
20	06/19/01	0.20																					
21	06/21/01	0.50																					
22	06/26/01	0.80																					
23	06/27/01	0.00																					
24	Jun. Total	5.70																					
25	07/02/01	0.10																					
26	07/18/01	0.20																					
27	07/11/01	0.00																					
28	07/28/01	1.10																					
29	Jul. Total	1.40																					
30	08/09/01	0.20																					
31	08/15/01	0.20																					
32	08/17/01	0.30																					
33	08/29/01	0.10																					
34	08/30/01	0.40																					
35	Aug. Total	1.20																					
36	09/02/01	0.10																					
37	09/07/01	0.60																					
38	09/08/01	0.25																					
39	09/23/01	0.25																					
40	Sep. Total	1.20																					
41	10/01/01	0.00																					
42	10/10/01	0.60																					
43	10/11/01	0.70																					
44	10/14/01	0.40																					
45	10/15/01	0.10																					
46	10/23/01	0.20																					
47	10/24/01	0.15																					
48	Oct. Total	2.15																					

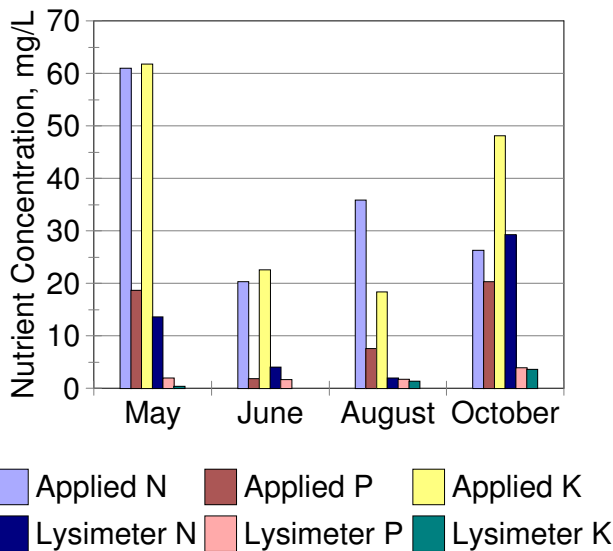
Table 1

WaterInput	A	B	C	D	E	F	G	H	I	J	K
1	Table 2.- Total Water Inputs										
2											
3	Month	Rainfall (inch)	Irrigation (gallon)	Total Amount of Water Input at Monitoring Sites, Liters/site							
4				Green 4	Green 10	Green 13	Green 15	Fairway 4	Fairway 10	Fairway 13	Fairway 15
5				(6,000 sf)	(5,000 sf)	(4,500 sf)	(6,000 sf)	(44,000 sf)	(60,000 sf)	(2,000 sf)	(44,000 sf)
6	May	4.05	2,403,281	66,973	55,811	50,230	66,973	491,138	669,734	22,324	491,138
7	June	5.70	1,822,063	88,001	73,334	66,001	88,001	645,343	880,013	29,334	645,343
8	July	1.40	6,592,379	46,258	38,548	34,693	46,258	339,222	462,576	15,419	339,222
9	August	1.20	6,479,981	42,975	35,813	32,232	42,975	315,153	429,754	14,325	315,153
10	September	1.20	3,371,379	30,509	25,424	22,882	30,509	223,731	305,088	10,170	223,731
11	October	2.15	1,434,467	36,190	30,158	27,143	36,190	265,393	361,900	12,063	265,393
12											
13											
14	Month	Rainfall (inch)	Irrigation (gallon)	Total Amount of WaterInput at Monitoring Sites, gallons/site							
15				Green 4	Green 10	Green 13	Green 15	Fairway 4	Fairway 10	Fairway 13	Fairway 15
16				(6,000 sf)	(5,000 sf)	(4,500 sf)	(6,000 sf)	(44,000 sf)	(60,000 sf)	(2,000 sf)	(44,000 sf)
17	May	4.05	2,403,281	17,694	14,745	13,271	17,694	129,759	176,944	5,898	129,759
18	June	5.70	1,822,063	23,250	19,375	17,438	23,250	170,500	232,500	7,750	170,500
19	July	1.40	6,592,379	12,221	10,184	9,166	12,221	89,623	122,213	4,074	89,623
20	August	1.20	6,479,981	11,354	9,462	8,516	11,354	83,264	113,541	3,785	83,264
21	September	1.20	3,371,379	8,060	6,717	6,045	8,060	59,110	80,604	2,687	59,110
22	October	2.15	1,434,467	9,561	7,968	7,171	9,561	70,117	95,614	3,187	70,117
23											
24											
25	Total Amount of Water Input at the Preserve GC										
26	Month	Rainfall			Irrigation			Total Amount of Water			
27		acre-inch	gal/ac	L/ac	gal., Tot.	gal/ac	L/ac	gal/ac	L/ac	gal/1000sf	L/1000 sf
28	May	4.05	109,975	416,254	2,403,281	18,487	69,972	128,461	486,227	2,949	11,162
29	June	5.70	154,779	585,839	1,822,063	14,016	53,050	168,795	638,889	3,875	14,667
30	July	1.40	38,016	143,890	6,592,379	50,711	191,940	88,727	335,830	2,037	7,710
31	August	1.20	32,585	123,335	6,479,981	49,846	188,667	82,431	312,002	1,892	7,163
32	September	1.20	32,585	123,335	3,371,379	25,934	98,159	58,519	221,494	1,343	5,085
33	October	2.15	58,382	220,974	1,434,467	11,034	41,765	69,416	262,740	1,594	6,032

Table 2

Green4	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Green 4												
2													
3	Table 3a.- Nutrient Applications (lbs/1000 sq.ft)												
4	Month	Date of Application	N	P2O5	P	K2O	K	Fertilizers applied					
5													
6	May	05/03/01	0.5	0.90	0.39	1.05	0.87	Par Ex (10-18-21)					
7		12/30/99	0	0.00375	0.00	0.02	0.02	Stand Up (0-2-12)					
8		05/30/01	0.5	0.07	0.03	0.38	0.32	Par Ex (21-3-16)					
9		05/31/01	0.5	0.07	0.03	0.38	0.32	Par Ex (21-3-16)					
10		May Total	1.5	1.05	0.46	1.83	1.52						
11	June	06/08/01	0	0.00	0.00	0.55	0.46						
12		06/22/01	0.156	0.04	0.02	0.08	0.06	Country Club (28-7-14)					
13		06/28/01	0.5	0.10	0.04	0.25	0.21	Gro Power (10-2-5)					
14		June Tot.	0.656	0.14	0.06	0.88	0.73						
15	July	07/04/01	0.156	0.04	0.02	0.08	0.06	Country Club (28-7-14)					
16		07/31/01	0.25	0.06	0.03	0.17	0.14	Green Pro (12-3-8)					
17		July Total	0.406	0.10	0.04	0.24	0.20						
18	August	08/17/01	0.067	0.17	0.08	0.08	0.06	Nutraculture (12-31-14)					
19		08/30/01	0.5	0.10	0.04	0.27	0.22	Roots 123 (15-3-8)					
20		Aug. Total	0.567	0.27	0.12	0.34	0.29						
21	October	10/01/01	0.35	0.63	0.27	0.77	0.64	Par Ex (10-18-22)					

23	Table 3b.- Loadings for green 4												
24	Month	Rainfall (acre-inch)	Irrigation (gallon)	Total Water Received		Loadings (pounds)			Loadings (milligrams)			pH	EC
25				(gallon)	(Liter)	Total N	Total P	Total K	Total N	Total P	Total K		
26	May	4.05	2,403,281	17,694	66,972	9.00	2.76	9.12	4,082,332	1,251,915	4,136,763		
27	June	5.70	1,822,063	23,250	88,001	3.94	0.36	4.38	1,787,154	163,293	1,986,735		
28	July	1.40	6,592,379	12,221	46,256	2.44	0.24	1.20	1,106,765	108,862	544,311		
29	August	1.20	6,479,981	11,354	42,975	3.40	0.72	1.74	1,542,214	326,587	789,251		
30	September	1.20	3,371,379	8,060	30,507	0	0	0	0	0	0		
31	October	2.15	1,434,467	9,561	36,188	2.10	1.62	3.84	952,544	734,820	1,741,795		
32	Month	Loading Concentration*			Leachate Concentration*								
33		Total N	Total P	Total K	TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K		
34	May	60.96	18.69	61.77	4.02	9.58	2.44	13.60	1.99	0.40	11.00	5.96	181
35	June	20.31	1.86	22.58	3.05	1.00	2.14	4.05	1.68	**	8.41	**	**
36	August	35.89	7.60	18.37	1.78	0.16	1.31	1.94	1.75	1.35	7.12	**	634
37	October	26.32	20.31	48.13	28.61	0.69	5.69	29.30	3.95	3.65	33.02	**	991
38	Total	143.47	48.45	150.84	37.46	11.43	11.58	48.89	9.37	5.40	59.55	NA	NA
39	Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.												
40	** Not enough sample to complete analysis.												
41	NA = Not applicable												

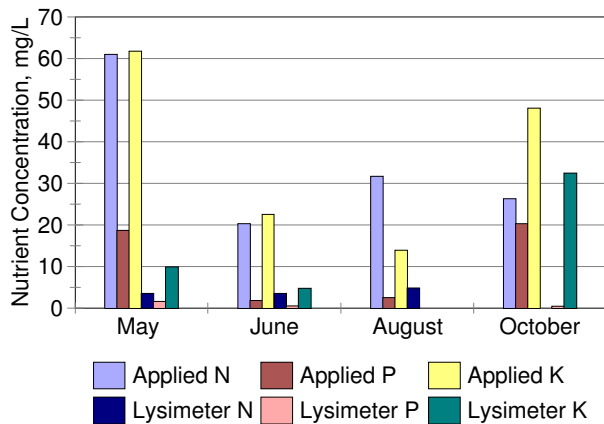


Data for Green #4

Month	Green 4 - Nutrient Concentration, mg/L					
	Applied N	Applied P	Applied K	Lysimeter N	Lysimeter P	Lysimeter K
May	60.96	18.69	61.77	13.6	1.99	0.4
June	20.31	1.86	22.58	4.05	1.68	
August	35.89	7.60	18.37	1.94	1.75	1.35
October	26.32	20.31	48.13	29.3	3.95	3.65

Green10	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Green 10												
2													
3	Table 4a.- Nutrient Applications (lbs/1000 sq.ft)												
4	Month	Date of Application	N	P2O5	P	K2O	K	Fertilizers applied					
5													
6	May	05/03/01	0.5	0.90	0.39	1.05	0.87	Par Ex (10-18-21)					
7		12/30/99	0	0.00375	0.00	0.02	0.02	Stand Up (0-2-12)					
8		05/30/01	0.5	0.07	0.03	0.38	0.32	Par Ex (21-3-16)					
9		05/31/01	0.5	0.07	0.03	0.38	0.32	Par Ex (21-3-16)					
10		May Total	1.5	1.05	0.46	1.83	1.52						
11	June	06/08/01	0	0.00	0.00	0.55	0.46						
12		06/22/01	0.156	0.04	0.02	0.08	0.06	Country Club (28-7-14)					
13		06/28/01	0.5	0.10	0.04	0.25	0.21	Gro Power (10-2-5)					
14		June Tot.	0.656	0.14	0.06	0.88	0.73						
15	July	07/04/01	0.156	0.04	0.02	0.08	0.06	Country Club (28-7-14)					
16		07/31/01	0.25	0.06	0.03	0.17	0.14	Green Pro (12-3-8)					
17		July Total	0.406	0.10	0.04	0.24	0.20						
18	August	08/30/01	0.5	0.10	0.04	0.27	0.22	Roots 123 (15-3-8)					
19	October	10/01/01	0.35	0.63	0.27	0.77	0.64	Par Ex (10-18-22)					
20													

21	Table 4b.- Loadings for Green 10												
22	Month	Rainfall (acre-inch)	Irrigation (gallon)	Total Water Received		Loadings (pounds)			Loadings (milligrams)			pH	EC
23				(gallon)	(Liter)	Total N	Total P	Total K	Total N	Total P	Total K		
24	May	4.05	2,403,281	14,745	55,810	7.50	2.30	7.60	3,401,943	1,043,263	3,447,302		
25	June	5.70	1,822,063	19,375	73,334	3.28	0.30	3.65	1,487,783	136,078	1,655,612		
26	July	1.40	6,592,379	10,184	38,546	2.03	0.20	1.00	920,793	90,718	453,592		
27	August	1.20	6,479,981	9,462	35,814	2.50	0.20	1.10	1,133,981	90,718	498,952		
28	September	1.20	3,371,379	6,717	25,424	0	0	0	0	0	0		
29	October	2.15	1,434,467	7,968	30,159	1.75	1.35	3.20	793,787	612,350	1,451,496		
30	Month	Loading Concentration*				Leachate Concentration*							
31		Total N	Total P	Total K	TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K	pH	EC
32	May	60.96	18.69	61.77	2.31	1.26	1.82	3.57	1.62	0.70	9.93	5.88	65
33	June	20.29	1.86	22.58	3.32	0.26	1.24	3.58	0.57	**	4.77	**	**
34	August	31.66	2.53	13.93	2.13	2.70	BDL	4.83	**	0.30	**	6.46	288
35	October	26.32	20.30	48.13	**	**	**	**	0.45	0.11	32.47	6.60	395
36	Total	139.23	43.39	146.41	7.76	4.22	3.06	11.98	2.64	1.11	47.17	NA	NA
37	Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.												
38	** Not enough sample to complete analysis.												
39	BDL = Below Detection Limit												
40	NA = Not applicable												



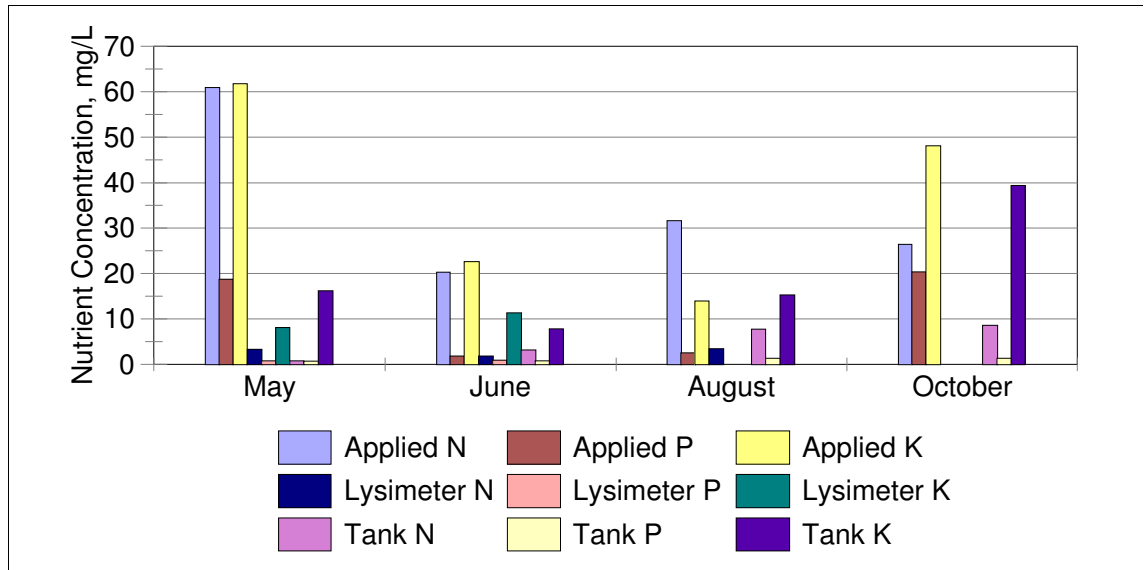
Month	Green 10 - Nutrient Concentration, mg/L					
	Applied N	Applied P	Applied K	Lysimeter N	Lysimeter P	Lysimeter K
May	60.96	18.69	61.77	3.57	1.62	9.93
June	20.29	1.86	22.58	3.58	0.57	4.77
August	31.66	2.53	13.93	4.83	NA	NA
October	26.32	20.30	48.13	NA	0.45	32.47

Data for Green #10

Green13	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Green 13												
2													
3	Table 5a.- Nutrient Applications (lbs/1000 sq.ft)												
4	Month	Date of Application	N	P2O5	P	K2O	K	Fertilizers applied					
5													
6	May	05/03/01	0.5	0.90	0.39	1.05	0.87	Par Ex (10-18-21)					
7		12/30/99	0	0.00375	0.00	0.02	0.02	Stand Up (0-2-12)					
8		05/30/01	0.5	0.07	0.03	0.38	0.32	Par Ex (21-3-16)					
9		05/31/01	0.5	0.07	0.03	0.38	0.32	Par Ex (21-3-16)					
10		May Total	1.5	1.05	0.46	1.83	1.52						
11	June	06/08/01	0	0.00	0.00	0.55	0.46						
12		06/22/01	0.156	0.04	0.02	0.08	0.06	Country Club (28-7-14)					
13		06/28/01	0.5	0.10	0.04	0.25	0.21	Gro Power (10-2-5)					
14		June Tot.	0.656	0.14	0.06	0.88	0.73						
15	July	07/04/01	0.156	0.04	0.02	0.08	0.06	Country Club (28-7-14)					
16		07/31/01	0.25	0.06	0.03	0.17	0.14	Green Pro (12-3-8)					
17		July Total	0.406	0.10	0.04	0.24	0.20						
18	August	08/30/01	0.5	0.10	0.04	0.27	0.22	Roots 123 (15-3-8)					
19	October	10/01/01	0.35	0.63	0.27	0.77	0.64	Par Ex (10-18-22)					
20													
21	Table 5b.- Loadings for Green 13 (and Green 13's Lysimeter Data)												
22	Month	Rainfall (acre-inch)	Irrigation (gallon)	Total Water Received (gallon) (Liter)		Loadings (pounds)			Loadings (milligrams)				
23						Total N	Total P	Total K	Total N	Total P	Total K		
24	May	4.05	2,403,281	13,271	50,231	6.75	2.07	6.84	3,061,749	938,936	3,102,572		
25	June	5.70	1,822,063	17,438	66,003	2.95	0.27	3.29	1,338,098	122,470	1,492,319		
26	July	1.40	6,592,379	9,166	34,693	1.83	0.18	0.90	830,074	81,647	408,233		
27	August	1.20	6,479,981	8,516	32,233	2.25	0.18	0.99	1,020,583	81,647	449,056		
28	September	1.20	3,371,379	6,045	22,880	0	0	0	0	0	0		
29	October	2.15	1,434,467	7,171	27,142	1.58	1.22	2.88	716,676	553,383	1,306,346		
30	Month	Loading Concentration*				Leachate Concentration*							
31		Total N	Total P	Total K	TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K	pH	EC
32	May	60.95	18.69	61.77	2.48	0.81	BDL	3.29	0.73	0.50	8.11	6.67	146
33	June	20.27	1.86	22.61	1.86	0.03	0.74	1.89	0.94	**	11.30	**	**
34	August	31.66	2.53	13.93	3.42	**	**	3.42	**	0.07	**	6.87	113
35	Total	112.89	23.08	98.31	7.76	0.84	0.74	8.60	1.67	0.57	19.41	NA	NA
36	Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.												
37	** Not enough sample to complete analysis.												
38	BDL = Below Detection Limit												
39	NA = Not applicable												
40													
41	Table 5c.- Loadings for Green 13 (and Green 13's Retention Tank Data)												
42	Month	Rainfall (acre-inch)	Irrigation (gallon)	Total Water Received (gallon) (Liter)		Loadings (pounds)			Loadings (milligrams)				
43						Total N	Total P	Total K	Total N	Total P	Total K		
44	May	4.05	2,403,281	13,271	50,231	6.75	2.07	6.84	3,061,749	938,936	3,102,572		
45	June	5.70	1,822,063	17,438	66,003	2.95	0.27	3.29	1,338,098	122,470	1,492,319		
46	July	1.40	6,592,379	9,166	34,693	1.83	0.18	0.90	830,074	81,647	408,233		
47	August	1.20	6,479,981	8,516	32,233	2.25	0.18	0.99	1,020,583	81,647	449,056		
48	September	1.20	3,371,379	6,045	22,880	0.00	0.00	0.00	0	0	0		
49	October	2.15	1,434,467	7,171	27,142	1.58	1.22	2.88	716,676	553,383	1,306,346		
50	Month	Loading Concentration*				Leachate Concentration*							
51		Total N	Total P	Total K	TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K	pH	EC
52	May	60.95	18.69	61.77	0.54	0.23	BDL	0.77	0.69	0.20	16.20	6.63	198
53	June	20.27	1.86	22.61	3.19	BDL	0.50	3.19	0.80	**	7.83	**	**
54	August	31.66	2.53	13.93	7.71	0.03	1.84	7.74	1.32	0.97	15.31	6.59	155
55	May-Aug Tot	112.89	23.08	98.31	11.44	0.26	2.34	11.70	2.81	1.17	39.34	NA	NA
56	October	26.40	20.39	48.13	8.57	0.04	2.42	8.61	1.37	1.22	19.33	6.8	265
57	May-Oct Tot	139.29	43.47	146.44	20.01	0.30	4.76	20.31	4.18	2.39	58.67	NA	NA
58	Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.												
59	** Not enough sample to complete analysis.												
60	BDL = Below Detection Limit												
61	NA = Not applicable												

Data for Green #13 -cont'd

Green 13



Month	Green 13 - Nutrient Concentration. mg/L								
	Applied N	Applied P	Applied K	Lysimeter N	Lysimeter P	Lysimeter K	Tank N	Tank P	Tank K
May	60.95	18.69	61.77	3.29	0.73	8.11	0.77	0.69	16.20
June	20.27	1.86	22.61	1.89	0.94	11.30	3.19	0.80	7.83
August	31.66	2.53	13.93	3.42	NA	NA	7.74	1.32	15.31
October	26.40	20.39	48.13	NA	NA	NA	8.61	1.37	39.34

Data for Green #13

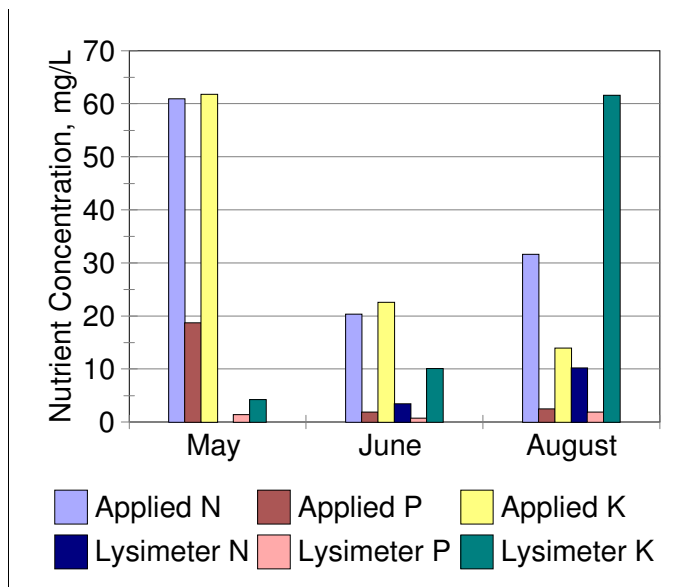
Green 15

Table 6a.- Nutrient Applications (lbs/1000 sq.ft)							
Month	Date of Application	N	P2O5	P	K2O	K	Fertilizers applied
May	05/03/01	0.5	0.90	0.39	1.05	0.87	Par Ex (10-18-21)
	12/30/99	0	0.00375	0.00	0.02	0.02	Stand Up (0-2-12)
	05/30/01	0.5	0.07	0.03	0.38	0.32	Par Ex (21-3-16)
	05/31/01	0.5	0.07	0.03	0.38	0.32	Par Ex (21-3-16)
	May Total	1.5	1.05	0.46	1.83	1.52	
June	06/08/01	0	0.00	0.00	0.55	0.46	
	06/22/01	0.156	0.04	0.02	0.08	0.06	Country Club (28-7-14)
	06/28/01	0.5	0.10	0.04	0.25	0.21	Gro Power (10-2-5)
		June Tot.	0.656	0.14	0.06	0.88	0.73
July	07/04/01	0.156	0.04	0.02	0.08	0.06	Country Club (28-7-14)
	07/31/01	0.25	0.06	0.03	0.17	0.14	Green Pro (12-3-8)
		July Total	0.406	0.10	0.04	0.24	0.20
August	08/30/01	0.5	0.10	0.04	0.27	0.22	Roots 123 (15-3-8)
October	10/01/01	0.35	0.63	0.27	0.77	0.64	Par Ex (10-18-22)

Table 6b.- Loadings for Green 15												
Month	Rainfall (acre-inch)	Irrigation (gallon)	Total Water Received		Loadings (pounds)			Loadings, in milligrams			pH	EC
			(gallon)	(Liter)	Total N	Total P	Total K	Total N	Total P	Total K		
May	4.05	2,403,281	17,694	66,972	9.00	2.76	9.12	4,082,332	1,251,915	4,136,763		
June	5.70	1,822,063	23,250	88,001	3.94	0.36	4.38	1,787,154	163,293	1,986,735		
July	1.40	6,592,379	12,221	46,256	2.44	0.24	1.20	1,106,765	108,862	544,311		
August	1.20	6,479,981	11,354	42,975	3.00	0.24	1.32	1,360,777	108,862	598,742		
September	1.20	3,371,379	8,060	30,507	0	0	0	0	0	0		
October	2.15	1,434,467	9,561	36,188	2.10	1.62	3.84	952,544	734,820	1,741,795		

Month	Loading Concentration*				Leachate Concentration*							
	Total N	Total P	Total K	TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K	pH	EC
May	60.96	18.69	61.77	**	**	**	**	1.41	**	4.25	**	**
June	20.31	1.86	22.58	3.36	0.10	1.91	3.46	0.73	**	10.10	**	**
August	31.66	2.53	13.93	9.71	0.52	6.32	10.23	1.89	1.81	61.60	6.91	495
Total	112.93	23.08	98.28	13.07	0.62	8.23	13.69	4.03	1.81	75.95	NA	NA

Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.
 ** Not enough sample to complete analysis.
 BDL = Below Detection Limit
 NA = Not applicable



Month	Green 15 - Nutrient Concentration, mg/L					
	Applied N	Applied P	Applied K	Lysimeter N	Lysimeter P	Lysimeter K
May	60.96	18.69	61.77	NA	1.41	4.25
June	20.31	1.86	22.58	3.46	0.73	10.10
August	31.66	2.53	13.93	10.23	1.89	61.60

Fairway 4

1
2

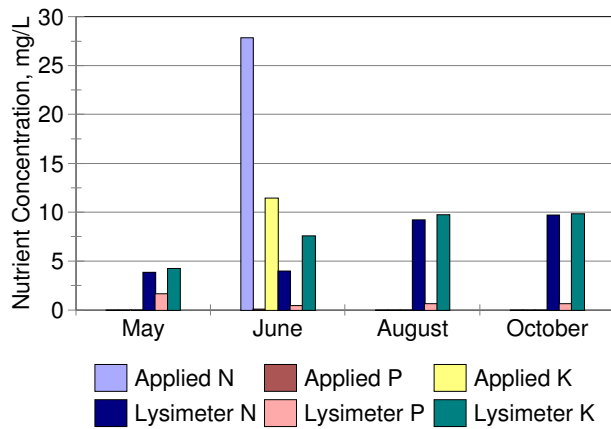
Table 7a.- Nutrient Applications (lbs per 1000 sq. ft.)

Month	Date of Application	N	P2O5	P	K2O	K	Fertilizers applied
May	NA	0	0	0	0	0	Luxacote (20-2-10)
June	06/07/01	0.9	0.09	0.04	0.45	0.37	
July	07/17/01	0.92	0.09	0.04	0.46	0.38	
August	NA	0	0	0	0	0	Green Pro (12-2-6)
September	09/11/01	0.8	0.13	0.06	0.40	0.33	
October	NA	0	0	0	0	0	

Table 7b.- Loadings for Fairway 4

Month	Rainfall (acre-inch)	Irrigation (gallon)	Total Water Received		Loadings (pounds)			Loadings (milligrams)			pH	EC
			(gallon)	(Liter)	Total N	Total P	Total K	Total N	Total P	Total K		
May	4.05	2,403,281	129,759	491,138	0	0	0	0	0	0		
June	5.70	1,822,063	170,500	645,343	39.60	0.13	16.28	17,962,259	58,967	7,384,484		
July	1.40	6,592,379	89,623	339,223	40.48	1.76	8.80	18,361,420	798,323	3,991,613		
August	1.20	6,479,981	83,264	315,154	0	0	0	0	0	0		
September	1.20	3,371,379	59,110	223,731	35.20	2.64	14.52	15,966,452	1,197,484	6,586,162		
October	2.15	1,434,467	70,117	265,393	0	0	0	0	0	0		
Month	Loading Concentration*				Leachate Concentration*							
	Total N	Total P	Total K	TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K	pH	EC
May	0	0	0	2.79	1.07	1.29	3.86	1.67	0.10	4.25	6.03	144
June	27.83	0.09	11.44	3.14	0.85	1.30	3.99	0.47	**	7.58	**	**
August	0	0	0	4.52	4.69	2.28	9.21	0.64	0.30	9.73	5.75	183
October	0	0	0	3.72	6.00	BDL	9.72	0.64	0.34	9.82	5.40	191
<i>Total</i>	27.83	0.09	11.44	14.17	12.61	4.87	26.78	3.42	0.74	31.38	NA	NA

Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.
 ** Not enough sample to complete analysis.
 BDL = Below Detection Limit
 NA = Not applicable

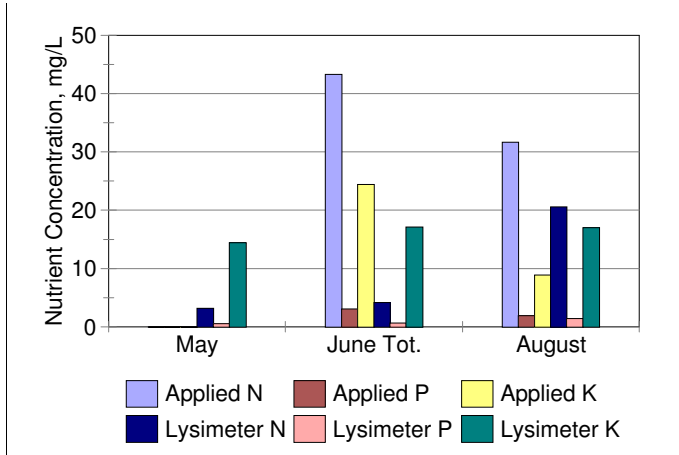


Month	Fairway 4 -- Nutrient Concentration, mg/L					
	Applied N	Applied P	Applied K	Lysimeter N	Lysimeter P	Lysimeter K
May	0	0	0	3.86	1.67	4.25
June	27.83	0.09	11.44	3.99	0.47	7.58
August	0	0	0	9.21	0.64	9.73
October	0	0	0	9.72	0.64	9.82

Data for Fairway #4

Fairway10	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Fairway 10												
2													
3	Table 8a.- Nutrient Applications (lbs per1000 sq.ft.)												
4	Month	Date of Application	N	P2O5	P	K2O	K	Fertilizers applied					
5													
6	May	NA	0	0	0	0	0						
7	June	06/04/01	0.5	0.08	0.04	0.5	0.42	Green Pro (12-2-12)					
8		06/07/01	0.9	0.09	0.04	0.45	0.37	Luxacote (20-2-10)					
9		June Tot.	1.4	0.17	0.08	0.95	0.79						
10	July	07/10/01	0.5	0.07	0.03	0.17	0.14	Superior Turf (15-2-5)					
11		07/17/01	0.92	0.09	0.04	0.46	0.38	Luxacote (20-2-10)					
12		July Total	1.42	0.16	0.07	0.63	0.52						
13	August	08/17/01	0.5	0.07	0.03	0.17	0.14	Superior Turf (15-2-5)					
14	September	09/11/01	0.8	0.13	0.06	0.4	0.33	Green Pro (12-2-6)					
15	October	NA	0	0	0	0	0						

18	Table 8b.- Loadings for Fairway 10													
19	Month	Rainfall (acre-inch)	Irrigation (gallon)	Total Water Received (gallon) (Liter)		Loadings (pounds) Total N Total P Total K			Loadings (milligrams) Total N Total P Total K					
20	May	4.05	2,403,281	176,944	669,733	0	0	0	0	0	0			
21	June	5.70	1,822,063	232,500	880,013	84.00	6.00	47.40	38,101,762	2,721,554	21,500,280			
22	July	1.40	6,592,379	122,213	462,576	85.20	4.20	31.20	38,646,072	1,905,088	14,152,083			
23	August	1.20	6,479,981	113,541	429,753	30.00	1.80	8.40	13,607,772	816,466	3,810,176			
24	September	1.20	3,371,379	80,604	305,086	48.00	3.60	19.80	21,772,435	1,632,933	8,981,130			
25	October	2.15	1,434,467	95,614	361,899	0	0	0	0	0	0			
26														
27	Month	Loading Concentration*			Leachate Concentration*									
28		Total N	Total P	Total K	TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K	pH	EC	
29	May	0	0	0	0.40	2.75	BDL	3.15	0.53	0.30	14.40	5.82	147	
30	June	43.30	3.09	24.43	1.50	2.65	0.86	4.15	0.62	**	17.10	**	**	
31	August	31.66	1.90	8.87	7.53	13.07	3.12	20.60	1.41	1.55	17.02	5.89	305	
32	October	0	0	0	**	**	**	**	**	0.62	**	7.80	440	
33	Total	74.96	4.99	33.30	9.03	15.72	3.98	24.75	2.03	2.17	34.12	NA	NA	
34	Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.													
35	** Not enough sample to complete analysis.													
36	BDL = Below Detection Limit													
37	NA = Not applicable													



Month	Nutrient Concentration, mg/L					
	Applied N	Applied P	Applied K	Lysimeter N	Lysimeter P	Lysimeter K
May	0	0	0	3.15	0.53	14.4
June Tot.	43.30	3.09	24.43	4.15	0.62	17.1
August	31.66	1.90	8.87	20.6	1.41	17.02

Data for Fairway #10

Fairway 13

Table 9a.- Nutrient Applications (lbs per 1000 sq.ft.)

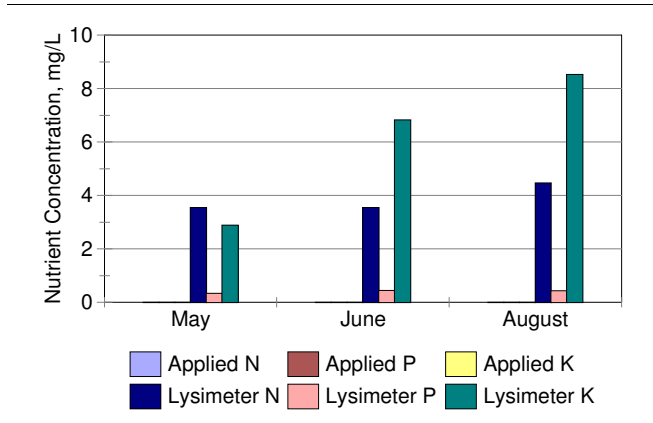
Month	Date of Application	N	P2O5	P	K2O	K	Fertilizers applied
May	NA	0	0	0	0	0	Green Pro (12-2-6)
June	NA	0	0	0	0	0	
July	NA	0	0	0	0	0	
August	NA	0	0	0	0	0	
September	09/11/01	0.8	0.13	0.06	0.4	0.33	
October	NA	0	0	0	0	0	

Table 9b.- Loadings for Fairway 13

Month	Rainfall (acre-inch)	Irrigation (gallon)	Total Water Received		Loadings (pounds)			Loadings (milligrams)		
			(gallon)	(Liter)	Total N	Total P	Total K	Total N	Total P	Total K
May	4.05	2,403,281	5,898	22,324	0	0	0	0	0	0
June	5.70	1,822,063	7,750	29,334	0	0	0	0	0	0
July	1.40	6,592,379	4,074	15,420	0	0	0	0	0	0
August	1.20	6,479,981	3,785	14,326	0	0	0	0	0	0
September	1.20	3,371,379	2,687	10,170	1.60	0.12	0.66	725,748	54,431	299,371
October	2.15	1,434,467	3,187	12,063	0	0	0	0	0	0

Month	Loading Concentration*			Leachate Concentration*							pH	EC
	Total N	Total P	Total K	TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K		
May	0	0	0	3.13	0.42	BDL	3.55	0.33	0.20	2.89	5.90	303
June	0	0	0	3.16	0.38	0.73	3.54	0.44	**	6.83	**	**
August	0	0	0	2.53	1.94	1.43	4.47	0.43	**	8.53	**	**
May-Aug Tot.	0	0	0	8.82	2.74	2.16	11.56	1.20	0.20	18.25	NA	NA
October	0	0	0	**	**	**	**	**	0.37	**	6.80	78

Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.
 ** Not enough sample to complete analysis.
 BDL = Below Detection Limit
 NA = Not applicable



Month	Nutrient Concentration, mg/L					
	Applied N	Applied P	Applied K	Lysimeter N	Lysimeter P	Lysimeter K
May	0	0	0	3.55	0.33	2.89
June	0	0	0	3.54	0.44	6.83
August	0	0	0	4.47	0.43	8.53

Data for Fairway #13

Fairway 15

Table 10a.- Nutrient Applications (lbs per 1000 sq.ft.)

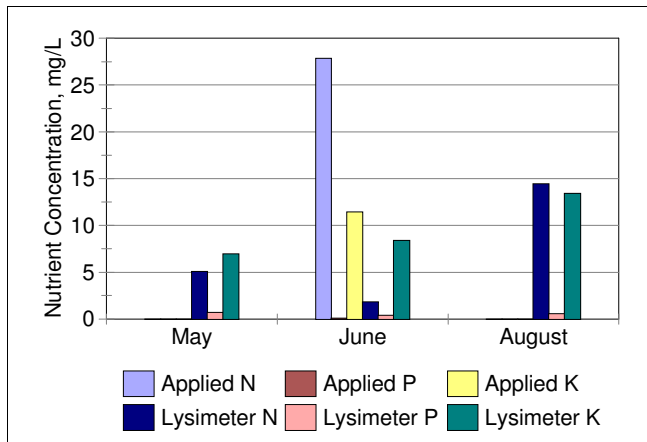
Month	Date of Application	N	P2O5	P	K2O	K	Fertilizers applied
May	NA	0	0	0	0	0	
June	06/07/01	0.9	0.09	0.04	0.45	0.37	Luxacote (20-2-10)
July	07/17/01	0.92	0.09	0.04	0.46	0.38	Luxacote (20-2-10)
August	NA	0	0	0	0	0	
September	09/11/01	0.8	0.13	0.06	0.40	0.33	Green Pro (12-2-6)
October	NA	0	0	0	0	0	

Table 10b.- Loadings for Fairway 15

Month	Rainfall (acre-inch)	Irrigation (gallon)	Total Water Received		Loadings (pounds)			Loadings (milligrams)		
			(gallon)	(Liter)	Total N	Total P	Total K	Total N	Total P	Total K
May	4.05	2,403,281	129,759	491,138	0	0	0	0	0	0
June	5.70	1,822,063	170,500	645,343	39.60	0.13	16.28	17,962,259	58,967	7,384,484
July	1.40	6,592,379	89,623	339,223	40.48	1.76	8.80	18,361,420	798,323	3,991,613
August	1.20	6,479,981	83,264	315,154	0	0	0	0	0	0
September	1.20	3,371,379	59,110	223,731	35.20	2.64	14.52	15,966,452	1,197,484	6,586,162
October	2.15	1,434,467	70,117	265,393	0	0	0	0	0	0

Month	Loading Concentration*			Leachate Concentration*								
	Total N	Total P	Total K	TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K	pH	EC
May	0	0	0	2.93	2.15	BDL	5.08	0.72	0.20	6.95	**	**
June	27.83	0.09	11.44	1.00	0.82	1.35	1.82	0.39	**	8.41	**	**
August	0	0	0	5.36	9.11	2.25	14.47	0.56	0.22	13.43	6.25	207.00
Total	27.83	0.09	11.44	9.29	12.08	3.60	21.37	1.67	0.42	28.79	NA	NA

Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.
 ** Not enough sample to complete analysis.
 BDL = Below Detection Limit
 NA = Not applicable



Month	Nutrient Concentration, mg/L					
	Applied N	Applied P	Applied K	Lysimeter N	Lysimeter P	Lysimeter K
May	0	0	0	5.08	0.72	6.95
June	27.83	0.09	11.44	1.82	0.39	8.41
August	0	0	0	14.47	0.56	13.43

Data for Fairway #15

Woods

Table 11a.- Leachate Monitoring - Wood 4

Month	Date of Sampling	Leachate Concentration*								
		TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K	pH	EC
May	05/21/01	0.67	0.05	0.40	0.72	0.28	0.03	0.19	5.57	56.00
June	06/27/01	0.98	0.01	0.69	0.99	0.20	**	0.22	**	**
August	08/06/01	**	**	**	**	**	0.05	**	6.97	**

Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.
 ** Not enough sample to complete analysis.

Table 11b.- Leachate Monitoring - Wood 10

Month	Date of Sampling	Leachate Concentration*								
		TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K	pH	EC
June	06/27/01	1.83	BDL	0.50	1.83	**	**	**	**	**
August	08/09/01	**	**	**	**	**	0.64	**	6.65	**

Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.
 ** Not enough sample to complete analysis.
 BDL = Below Detection Limit

Table 11c.- Leachate Monitoring - Wood 13

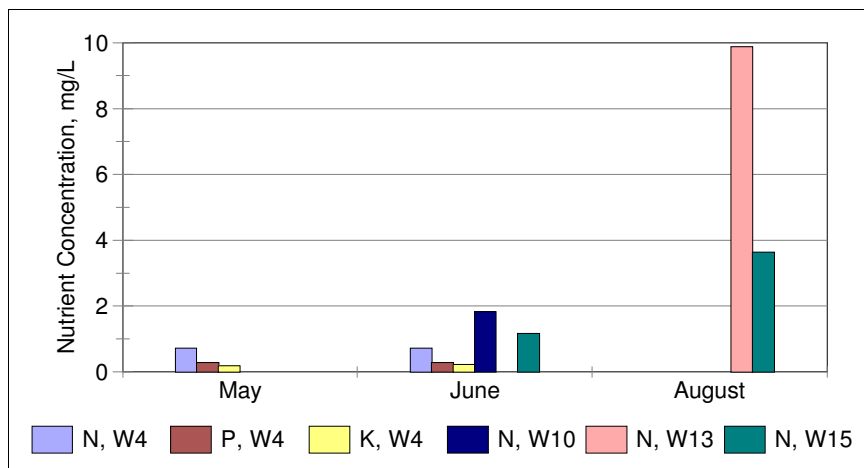
Month	Date of Sampling	Leachate Concentration*								
		TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K	pH	EC
June	06/27/01	**	**	**	**	0.31	**	0.87	**	**
August	08/09/01	9.35	0.53	1.13	9.88	**	**	**	**	**

Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.
 ** Not enough sample to complete analysis.
 BDL = Below Detection Limit

Table 11d.- Leachate Monitoring - Wood 15

Month	Date of Sampling	Leachate Concentration*								
		TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K	pH	EC
June	06/27/01	1.15	0.02	0.50	1.17	**	**	**	**	**
August	08/09/01	3.61	0.03	BDL	3.64	**	**	**	**	**

Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.
 ** Not enough sample to complete analysis.
 BDL = Below Detection Limit



Month	Nutrient Concentration, mg/L											
	N, W4	P, W4	K, W4	N, W10	P, W10	K, W10	N, W13	P, W13	K, W13	N, W15	P, W15	K, W15
May	0.72	0.28	0.19	NA	NA	NA	NA	NA	NA	NA	NA	NA
June	0.72	0.28	0.22	1.83	NA	NA	NA	NA	NA	1.17	NA	NA
August	NA	NA	NA	NA	NA	NA	9.88	NA	NA	3.64	NA	NA

Wells	A	B	C	D	E	F	G	H	I	J	K	L
-------	---	---	---	---	---	---	---	---	---	---	---	---

Wells

Table 12a.- Water Monitoring - Club-house Well

Month	Date of Sampling	Leachate Concentration*								
		TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K	pH	EC
May	05/09/01	BDL	0.02	BDL	BDL	0.18	0.04	1.20	7.32	360
July	07/11/01	0.78	0.25	BDL	1.03	0.22	0.09	1.05	7.83	360
October	10/01/01	3.94	0.02	BDL	3.96	BDL	0.09	1.12	7.70	369

Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.
BDL = Below Detection Limit

Table 12b.- Water Monitoring - 20 HP Irrigation Well

Month	Date of Sampling	Leachate Concentration*								
		TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K	pH	EC
May	05/09/01	2.74	0.12	BDL	2.86	0.18	0.05	0.96	7.46	350
July	07/11/01	0.37	0.14	BDL	0.51	0.15	0.06	0.78	7.70	369
October	10/01/01	7.88	0.21	BDL	8.09	BDL	0.04	0.85	7.88	392

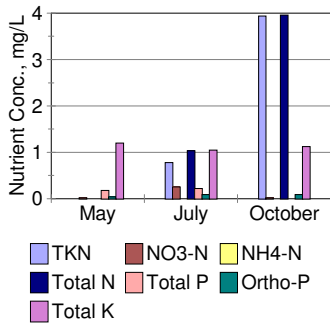
Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.
BDL = Below Detection Limit

Table 12c.- Water Monitoring - 60 HP Irrigation Well

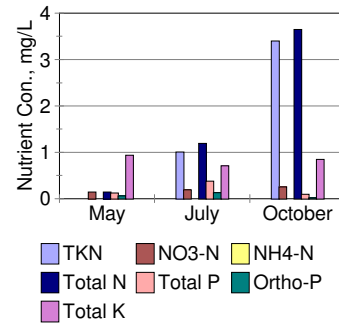
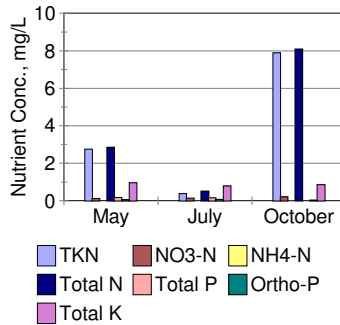
Month	Date of Sampling	Leachate Concentration*								
		TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K	pH	EC
May	05/09/01	BDL	0.14	BDL	0.14	0.12	0.06	0.94	7.65	330
July	07/11/01	1.00	0.19	BDL	1.19	0.38	0.13	0.71	7.82	308
October	10/01/01	3.40	0.25	BDL	3.65	0.10	0.02	0.85	7.50	316

Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.
BDL = Below Detection Limit

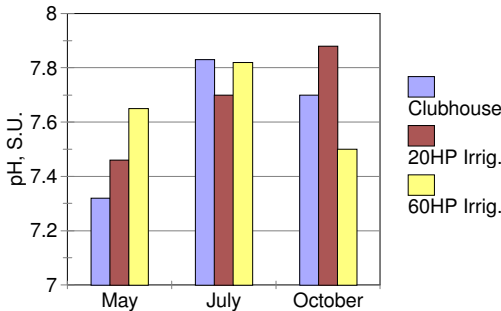
Clubhouse Well



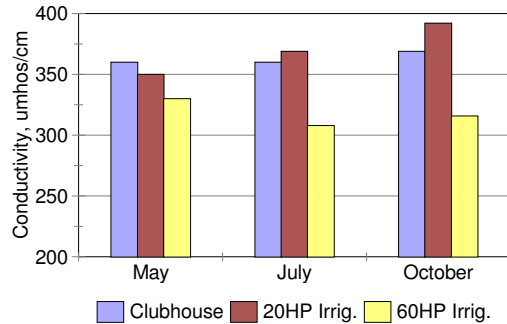
20 HP Irrigation Well 60HP Irrigation Well



pH of Well Water



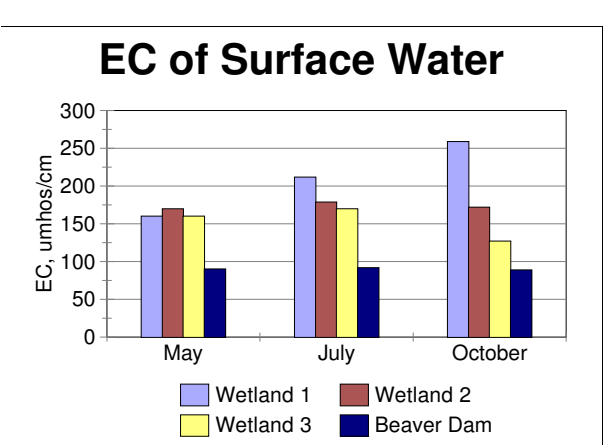
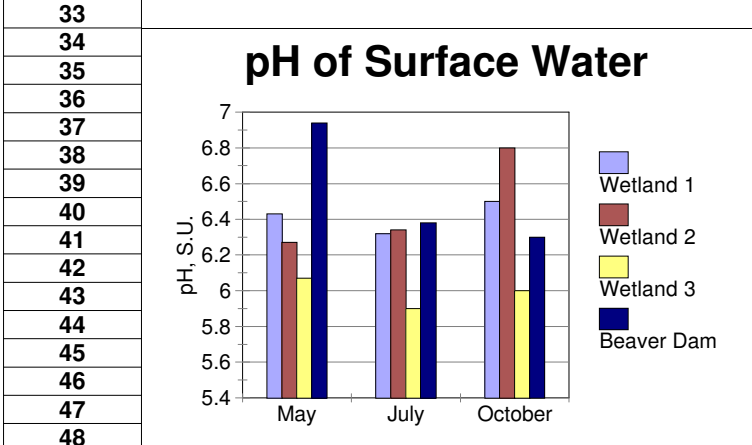
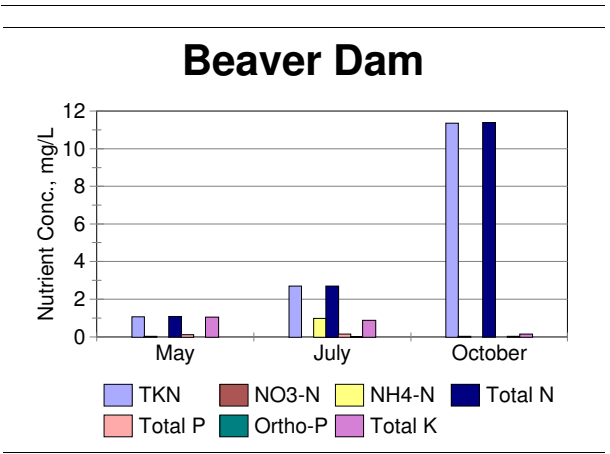
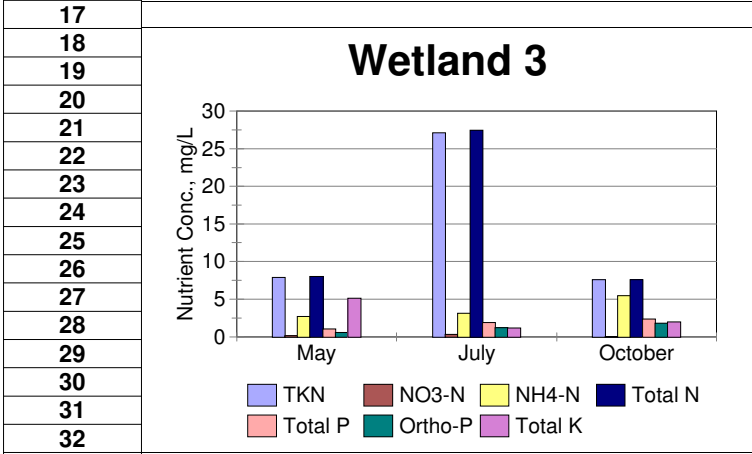
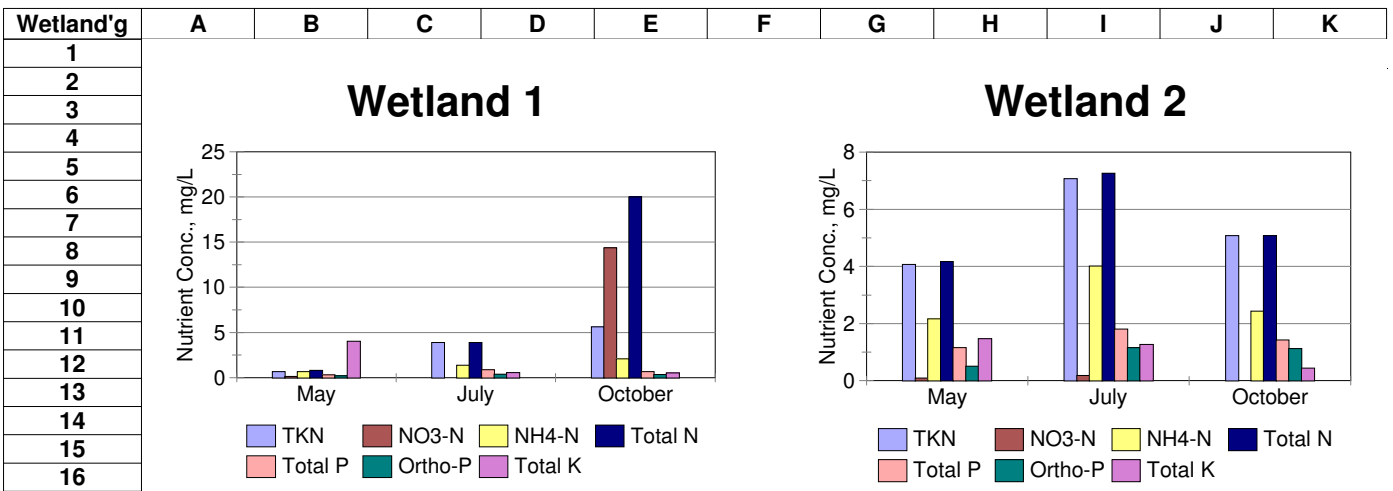
Conductivity of Well Water



Month	pH, S.U.			Conductivity, umhos/cm		
	Clubhouse	20HP Irrig.	60HP Irrig.	Clubhouse	20HP Irrig.	60HP Irrig.
May	7.32	7.46	7.65	360	350	330
July	7.83	7.70	7.82	360	369	308
October	7.70	7.88	7.50	369	392	316

Wetland	A	B	C	D	E	F	G	H	I	J	K
1	Wetlands										
2											
3	Table 13a.- Water Monitoring - Wetland 1										
4	Month	Date of Sampling	Leachate Concentration*								
5			TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K	pH	EC
6	May	05/09/01	0.68	0.12	0.68	0.80	0.30	0.20	4.04	6.43	160
7	July	07/11/01	3.89	BDL	1.39	3.89	0.86	0.40	0.56	6.32	212
8	October	10/01/01	5.63	14.39	2.08	20.02	0.67	0.36	0.52	6.50	259
9	Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.										
10	BDL = Below Detection Limit										
11											
12	Table 13b.- Water Monitoring - Wetland 2										
13	Month	Date of Sampling	Leachate Concentration*								
14			TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K	pH	EC
15	May	05/09/01	4.07	0.10	2.17	4.17	1.16	0.50	1.47	6.27	170
16	July	07/11/01	7.07	0.19	4.01	7.26	1.81	1.15	1.26	6.34	179
17	October	10/01/01	5.08	BDL	2.44	5.08	1.42	1.12	0.44	6.80	172
18	Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.										
19	BDL = Below Detection Limit										
20											
21	Table 13c.- Water Monitoring - Wetland 3										
22	Month	Date of Sampling	Leachate Concentration*								
23			TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K	pH	EC
24	May	05/09/01	7.91	0.13	2.69	8.04	1.06	0.60	5.12	6.07	160
25	July	07/11/01	27.11	0.34	3.14	27.45	1.90	1.21	1.17	5.90	170
26	October	10/01/01	7.61	0.02	5.48	7.63	2.37	1.83	1.99	6.00	127
27	Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.										
28											
29	Table 13d.- Water Monitoring - Beaver Dam										
30	Month	Date of Sampling	Leachate Concentration*								
31			TKN	NO3-N	NH4-N	Total N	Total P	Ortho-P	Total K	pH	EC
32	May	05/09/01	1.07	0.02	BDL	1.09	0.11	BDL	1.05	6.94	90
33	July	07/11/01	2.70	BDL	0.99	2.70	0.16	0.01	0.88	6.38	92
34	October	10/01/01	11.36	0.02	BDL	11.38	BDL	0.02	0.16	6.30	89
35	Footnotes: * All Concentrations are in mg/L, except pH and EC which are S.U. and micromhos/cm, respectively.										
36	BDL = Below Detection Limit										

Wetlands Data



Month	pH, S.U.				Conductivity, umhos/cm			
	Wetland 1	Wetland 2	Wetland 3	Beaver Dam	Wetland 1	Wetland 2	Wetland 3	Beaver Dam
May	6.43	6.27	6.07	6.94	160	170	160	90
July	6.32	6.34	5.90	6.38	212	179	170	92
October	6.50	6.80	6.00	6.30	259	172	127	89

Wetlands Charts

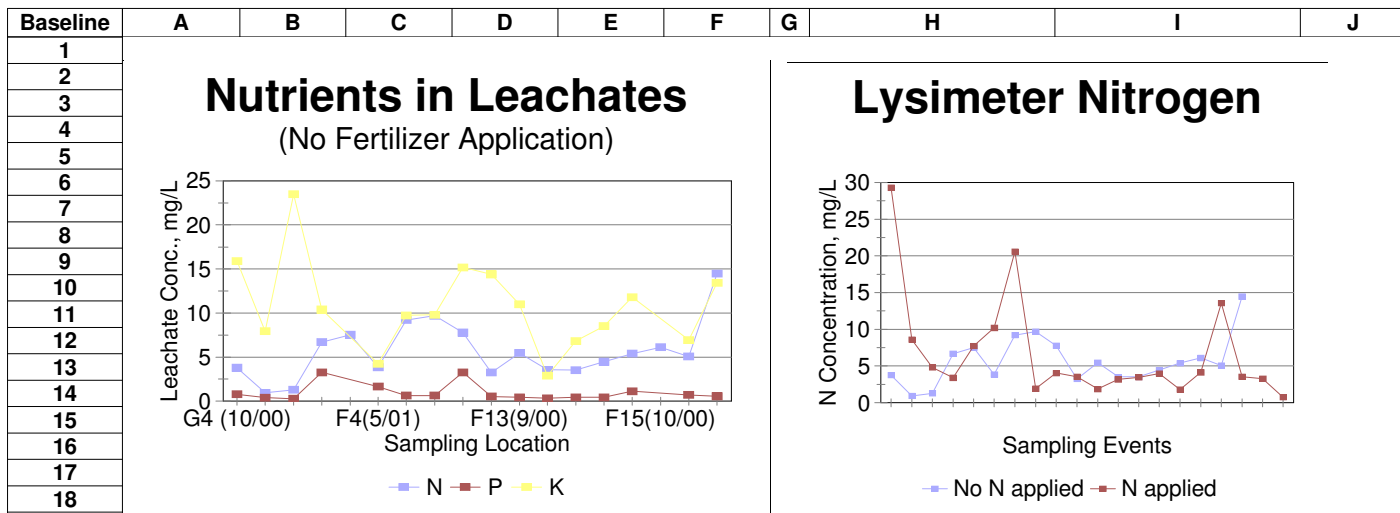


Table 14a.- Nutrients in Lysimeters' Leachates (When No Fertilizer Applied)

Sample Location	Sampling Date	Sample ID	Leachate Conc., mg/L		
			N	P	K
Green 4	10/30/00	G4 (10/00)	3.79	0.8	15.9
Green 10	10/30/00	G10(10/00)	0.95	0.4	7.93
Green13 (Tk)	10/30/00	G13(10/00)	1.3	0.28	23.5
Fairway 4	09/14/00	F4(9/00)	6.7	3.28	10.4
Fairway 4	10/30/00	F4(10/00)	7.52		
Fairway 4	05/21/01	F4(5/01)	3.86	1.67	4.25
Fairway 4	08/09/01	F4(8/01)	9.21	0.64	9.73
Fairway 4	10/01/01	F4(10/01)	9.72	0.64	9.82
Fairway 10	09/14/00	F10(9/00)	7.79	3.28	15.2
Fairway 10	05/21/01	F10(5/01)	3.26	0.53	14.4
Fairway 13	09/14/00	F13(9/00)	5.48	0.43	11
Fairway 13	05/21/01	F13(5/01)	3.55	0.33	2.89
Fairway 13	06/27/01	F13(6/01)	3.54	0.44	6.83
Fairway 13	08/09/01	F13(8/01)	4.47	0.43	8.53
Fairway 15	09/14/00	F15(9/00)	5.4	1.13	11.8
Fairway 15	10/30/00	F15(10/00)	6.12		
Fairway 15	05/21/01	F15(5/01)	5.08	0.72	6.95
Fairway 15	08/09/01	F15(8/01)	14.47	0.56	13.43

Statistical calculations:

Averages:			
. Greens		2.01	15.78
. Fairway		6.41	9.63
. Overall		5.68	10.79
Medians:			
. Greens		1.30	15.90
. Fairway		5.48	9.82
. Overall		5.24	10.11
Ranges:			
. Greens	0.95 - 3.79	0.28 - 0.80	7.93 - 23.5
. Fairway	3.26 - 14.5	0.33 - 3.28	2.89 - 15.2
. Overall	0.95 - 14.5	0.28 - 3.28	2.89 - 23.5
Std.Deviations:			
. Greens		1.26	6.36
. Fairway		2.91	3.57
. Overall		3.17	4.87

Table 14b.- Lysimeter Nitrogen (mg/L)

No N applied	N applied
3.79	29.3
0.95	8.61
1.3	4.83
6.7	3.42
7.52	7.74
3.86	10.2
9.21	20.6
9.72	1.94
7.79	4.05
3.26	3.58
5.48	1.89
3.55	3.19
3.54	3.46
4.47	3.99
5.4	1.82
6.12	4.15
5.08	13.6
14.47	3.57
	3.29
	0.77

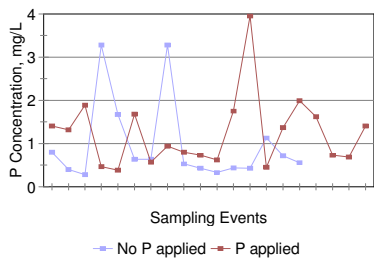
Footnotes:

1. The Leachate N readings from "No N applied" sites are collected in Aug. - Oct. 2000 and May - Oct. 2001 monitoring periods.
2. The Leachate N readings from "N applied" sites are collected in May - Oct. 2001. Amount of N applied ranges from 0.35 to 1.5 pounds per 1,000 sq.ft.

Baseline Data

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107

Lysimeter Phosphorus



Lysimeter Potassium

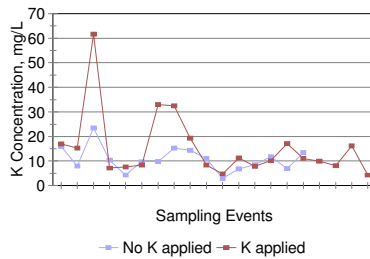


Table 14c.- Lysimeter Phosphorus (mg/L)

No P applied	P applied
0.80	1.41
0.40	1.32
0.28	1.89
3.28	0.47
1.67	0.39
0.64	1.68
0.64	0.57
3.28	0.94
0.53	0.80
0.43	0.73
0.33	0.62
0.44	1.75
0.43	3.95
1.13	0.45
0.72	1.37
0.56	1.99
	1.62
	0.73
	0.69
	1.41

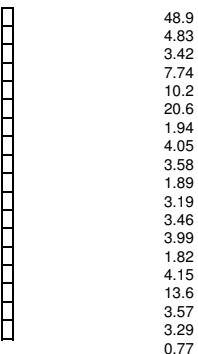
Footnotes:
 1. The Leachate P readings from "No P applied" sites are collected in Aug. - Oct. 2000 and May - Oct. 2001 monitoring periods.
 2. The Leachate P readings from "P applied" sites are collected in May - Oct. 2001.
 Amount of P₂O₅ applied ranges from 0.07 to 1.05 pounds per 1,000 sq.ft.

Table 14d.- Lysimeter Potassium (mg/L)

No K applied	K applied
15.90	17.02
7.93	15.30
23.50	61.60
10.40	7.12
4.25	7.58
9.73	8.41
9.82	33.02
15.20	32.47
14.40	19.33
11.00	8.41
2.89	4.77
6.83	11.30
8.53	7.83
11.80	10.10
6.95	17.10
13.43	11.00
	9.93
	8.11
	16.20
	4.25

Footnotes:
 1. The Leachate K readings from "No K applied" sites are collected in Aug. - Oct. 2000 and May - Oct. 2001 monitoring periods.
 2. The Leachate K readings from "K applied" sites are collected in May - Oct. 2001.
 Amount of K₂O applied ranges from 0.17 to 1.83 pounds per 1,000 sq.ft.

N applied



0.35 to 1.5 #/1000sf

Lysimeter Data

Irregularity	A	B	C	D	E	F	G	H
1								
2	Table 15.- Factors Affecting High Concentrations of Nutrients in Lysimeter Samples							
3	Date	Sampling Site	Rainfall (inch)	Irrigation (Total gallons)	Tot. Water Input (gal/site)	Fertilizer Application (lbs/1,000 sq.ft.)		
4						N	P₂O₅	K₂O
5	Jul. Total	Green 15	1.4	6,592,379	12,221	0.406	0.101	0.245
6	Jul. Total	Fairway 10	1.4	6,592,379	122,213	1.42	0.159	0.66
7	08/09/01	Green 15	0.2	175,006	933	0	0	0
8	08/09/01	Fairway 10	0.2	175,006	9,335	0	0	0
9	08/17/01	Fairway 10	0.3	273,398	14,118	0.5	0.07	0.17
10	08/30/01	Green 15	0.4	0	1,496	0.5	0.1	0.27
11	10/01/01	Green 10	0	312,246	276	0.35	0.63	0.77
12	10/01/01	Green 4	0	312,246	331	0.35	0.63	0.77
13	Date	Sampling Site	Loading Concentration (mg/L)			Leachate Concentration (mg/L)		
14			N	P	K	N	P	K
15	Jul. Total	Green 15	*	*	*	*	*	*
16	Jul. Total	Fairway 10	*	*	*	*	*	*
17	08/09/01	Green 15	22**	2**	11**	10.2	1.89	<u>61.6</u>
18	08/09/01	Fairway 10	78**	4**	30**	<u>20.6</u>	1.41	17.0
19	08/17/01	Fairway 10	*	*	*	*	*	*
20	08/30/01	Green 15	*	*	*	*	*	*
21	10/01/01	Green 10	760	597	1388	---	0.45	<u>32.5</u>
22	10/01/01	Green 4	760	597	1389	<u>29.3</u>	<u>3.95</u>	<u>33.0</u>
23	Footnotes:							
24	* Data are not available or not calculated.							
25	** Calculation based on the assumptions that loading concentration come from July fertilization. Water input is derived from July 1 - August 9 rainfall and irrigation water .							
26								

Lysimeter Factors

WaterQual	A	B	C	D	E
1					
2	Table 16.- Nutrient Guidelines in Irrigation Water, mg/L. (Duncan, R.R. et al.)				
3	Nutrient	Low	Normal	High	Very High
4	N	<1.1	1.1 - 11.3	11.3 - 22.6	>22.6
5	NO3	<5	5 - 50	50 - 100	>100
6	P	<0.01	0.1 - 0.4	0.4 - 0.8	>0.8
7	K	<5	5 - 20	20 - 30	>30

Water Quality