Winter Park Chain-of-Lakes Groundwater / Sediment Study

Final Report

Prepared for:

City of Winter Park, Florida

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SECTION 1

INTRODUCTION

The Winter Park Chain-of-Lakes consists of four interconnected waterbodies, located in the Cities of Winter Park and Maitland, which includes Lake Virginia, Lake Mizell, Lake Osceola, and Lake Maitland. These four lakes are part of an interconnected system of 21 lakes that begins with Lake Dot in Orlando and ends with the outflow from Lake Maitland into Howell Branch Creek. The total drainage area for the 21-lake interconnected system is approximately 17 square miles. An overview of the Winter Park Chain-of-Lakes is given in Figure 1-1.

Watershed areas around the Winter Park Chain-of-Lakes are highly urbanized, with residential, commercial, and institutional land uses. The lakes are a significant recreational resource that provide opportunities for boating, fishing, swimming, and other aquatic activities, as well as providing scenic settings for lakeside homes and the surrounding communities.

During the period from 1989-1992, the U.S. Geological Survey (USGS) performed a detailed study of the Winter Park Chain-of-Lakes in cooperation with the City of Winter Park and the St. Johns River Water Management District (SJRWMD) to quantify hydrologic budgets for each of the four lakes, to evaluate the chemical characteristics of runoff related inputs into the Chain-of-Lakes, and to determine the principle sources of nutrient loadings to the lakes. Hydrologic and nutrient budgets were developed by USGS which included surface inflow from upstream basins, direct rainfall onto the lake surfaces, stormwater inflow from surrounding drainage basin areas, groundwater inflow, evaporation, surface water outflow, and groundwater outflow. The results of these investigations were published in USGS Water Resources

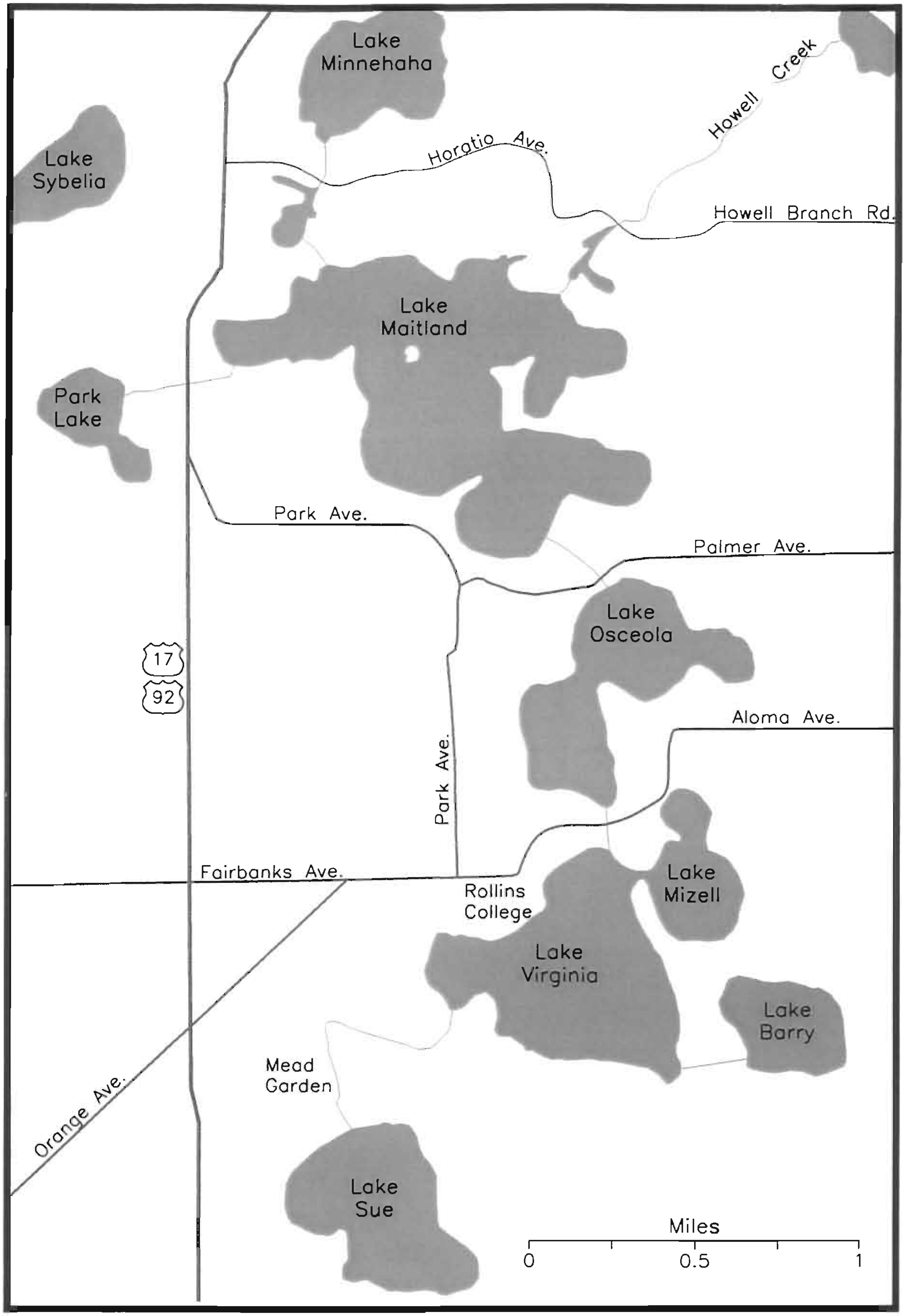


Figure 1-1. Overview of the Winter Park Chain-of-Lakes.

Investigation Report No. 95-4108 titled "Water Budgets, Water Quality, and Analysis of Nutrient Loading of the Winter Park Chain-of-Lakes, Central Florida, 1989-92."

Components of the hydrologic and nutrient budgets developed by USGS were determined using a variety of methods. Estimates of tributary inflow and outflow from the Chain-of-Lakes was computed based upon field discharge measurements combined with measured water quality characteristics. Runoff inflow from surrounding watersheds was evaluated based upon lake-stage relationships immediately before and after storm events. The chemical characteristics of stormwater inflow were determined based upon actual field monitoring. Groundwater outflow from the Chain-of-Lakes was calculated by analyzing lake-stage hydrograph recession during dry periods, with groundwater inflow calculated as the residual of the hydrologic budget. The chemical characteristics of groundwater inflow were estimated based upon shallow groundwater monitoring wells installed at 20 separate locations around the perimeter of the four lakes. Each of the surficial monitoring wells was sampled on one occasion. Estimates of nutrients inputs from internal recycling within the four lakes were not included in the work efforts performed by USGS.

1.1 Physical Characteristics

Water depth contour maps for the Winter Park Chain-of-Lakes were also developed by USGS as part of the 1995 study. Bathymetric contours were derived from color fathometer surveys of the lakes performed in February and March 1992. Modified versions of the USGS bathymetric maps for Lake Virginia, Lake Mizell, Lake Osceola, and Lake Maitland are provided in Figures 1-2 through 1-5, respectively. The Winter Park lakes are relatively deep for lakes in the Central Florida area, with maximum water depths of approximately 20-30 ft in each of the four lakes.

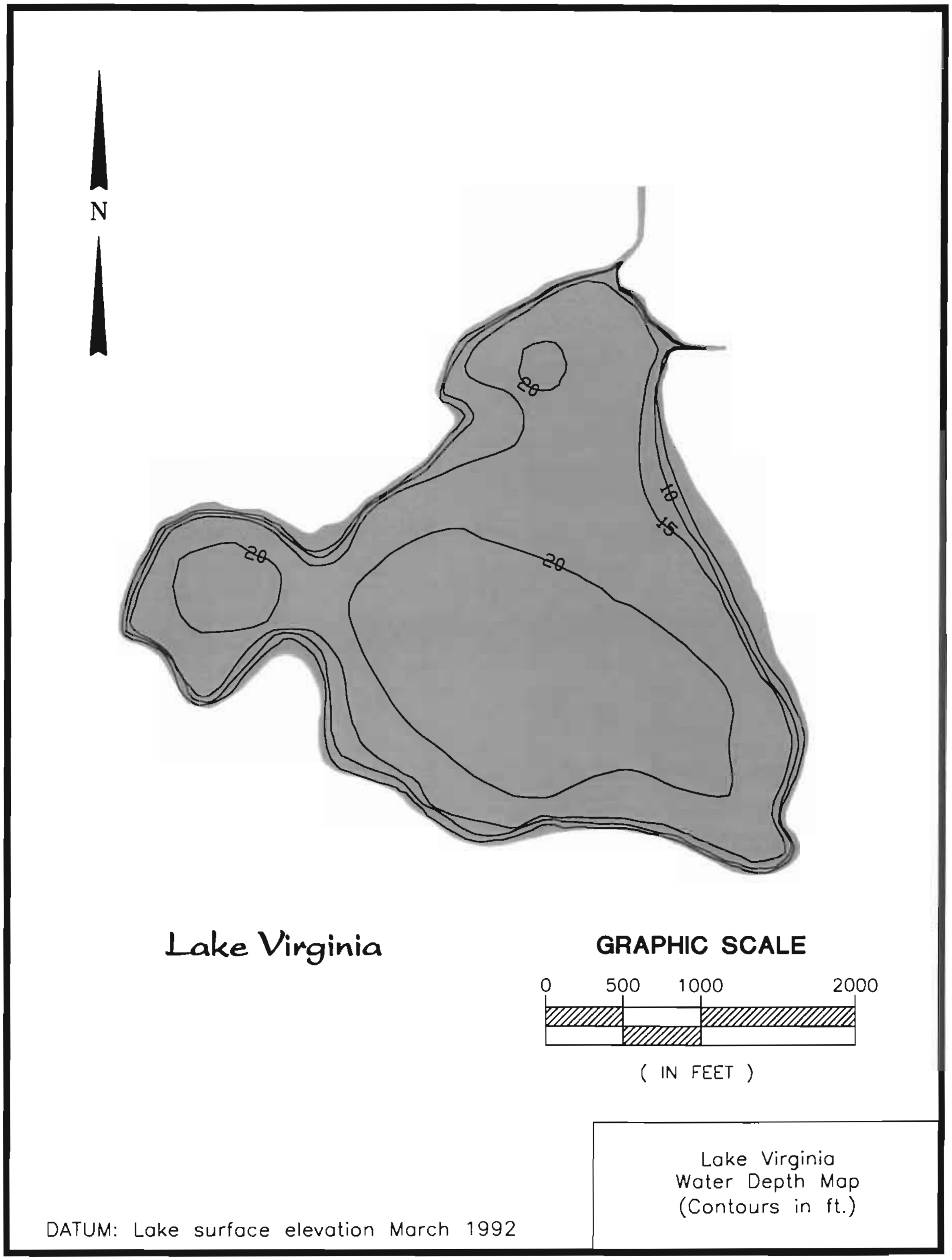


Figure 1-2. Bathymetric Map for Lake Virginia.

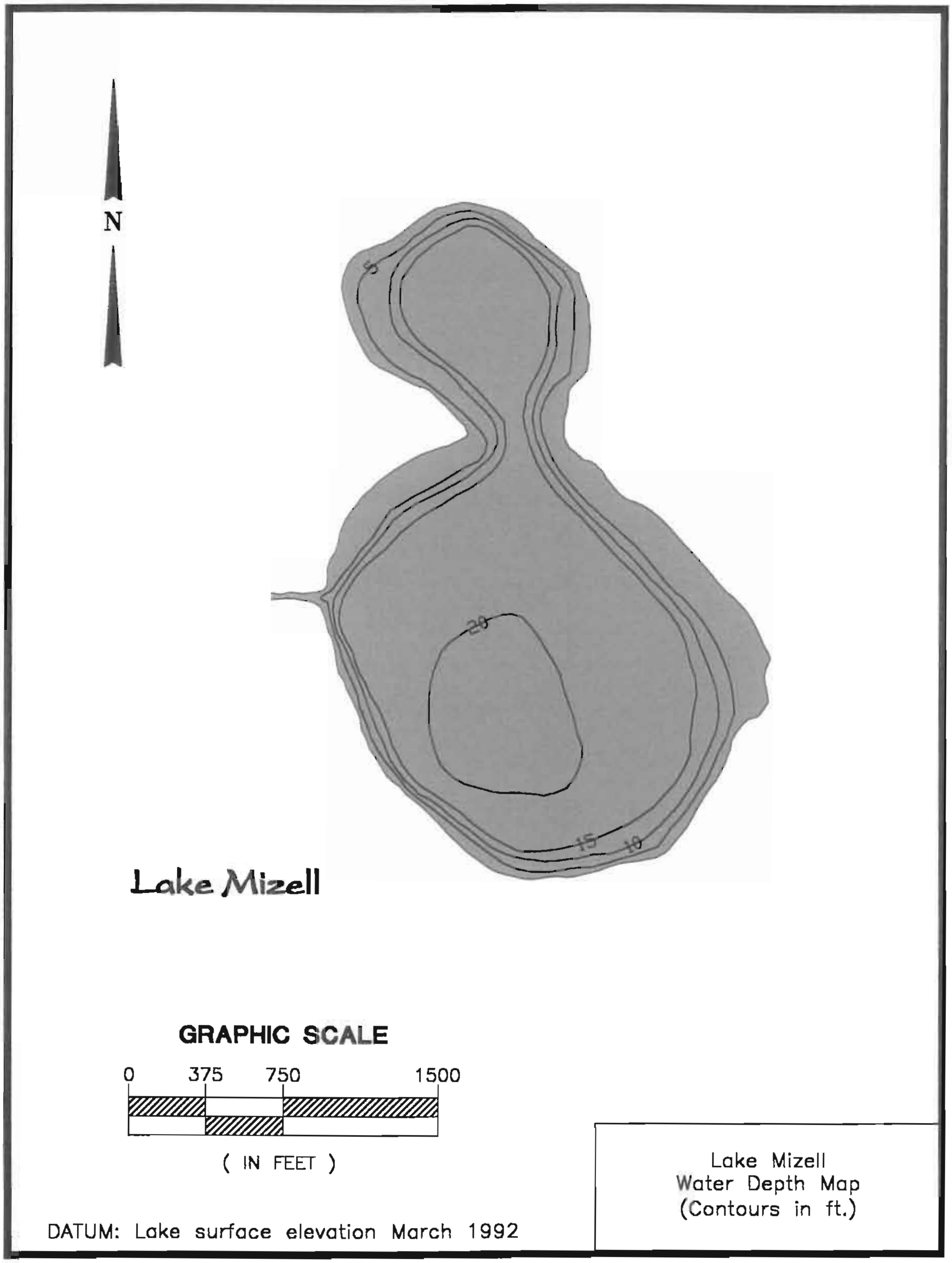


Figure 1-3. Bathymetric Map for Lake Mizell.

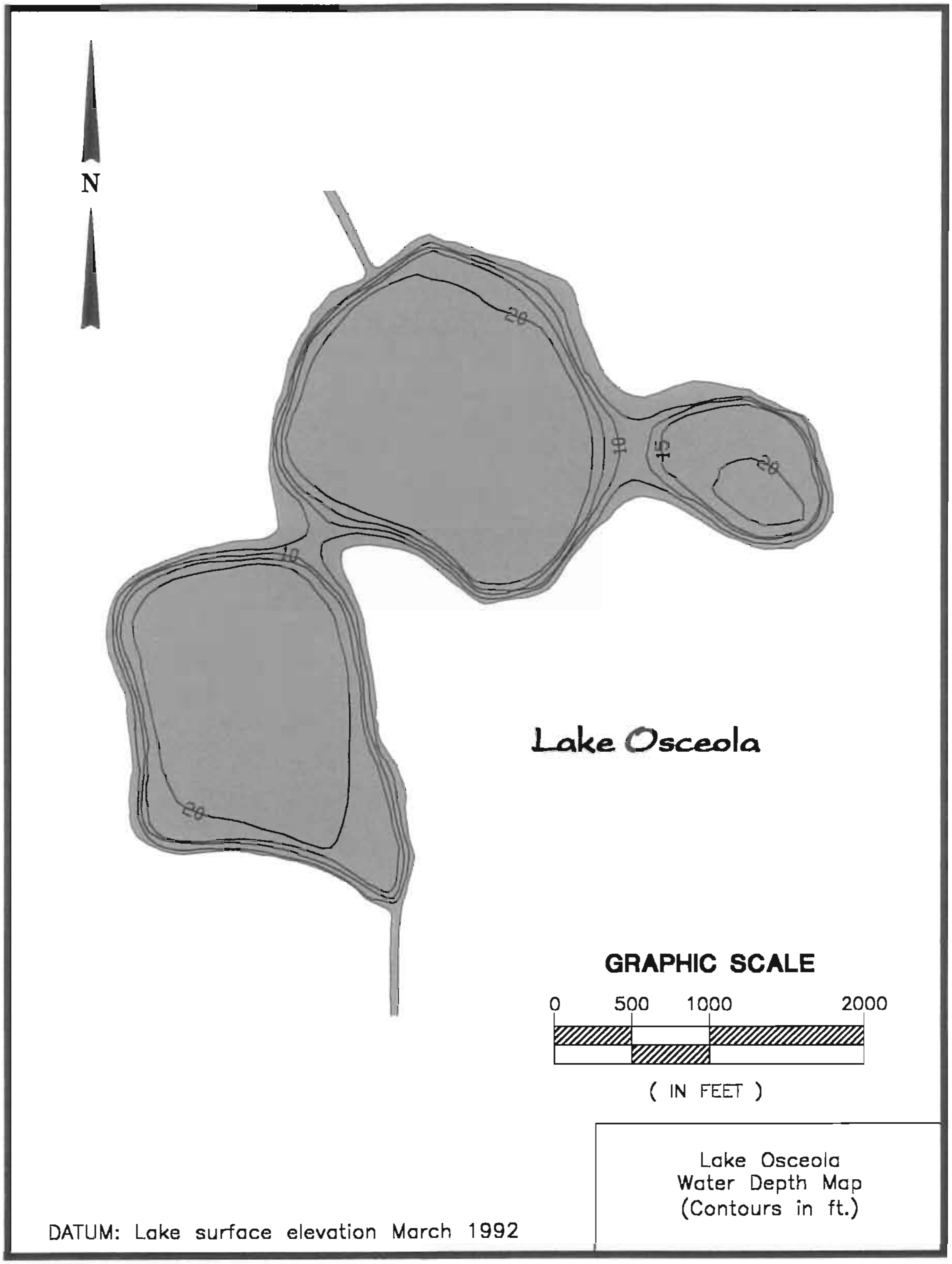


Figure 1-4. Bathymetric Map for Lake Osceola.

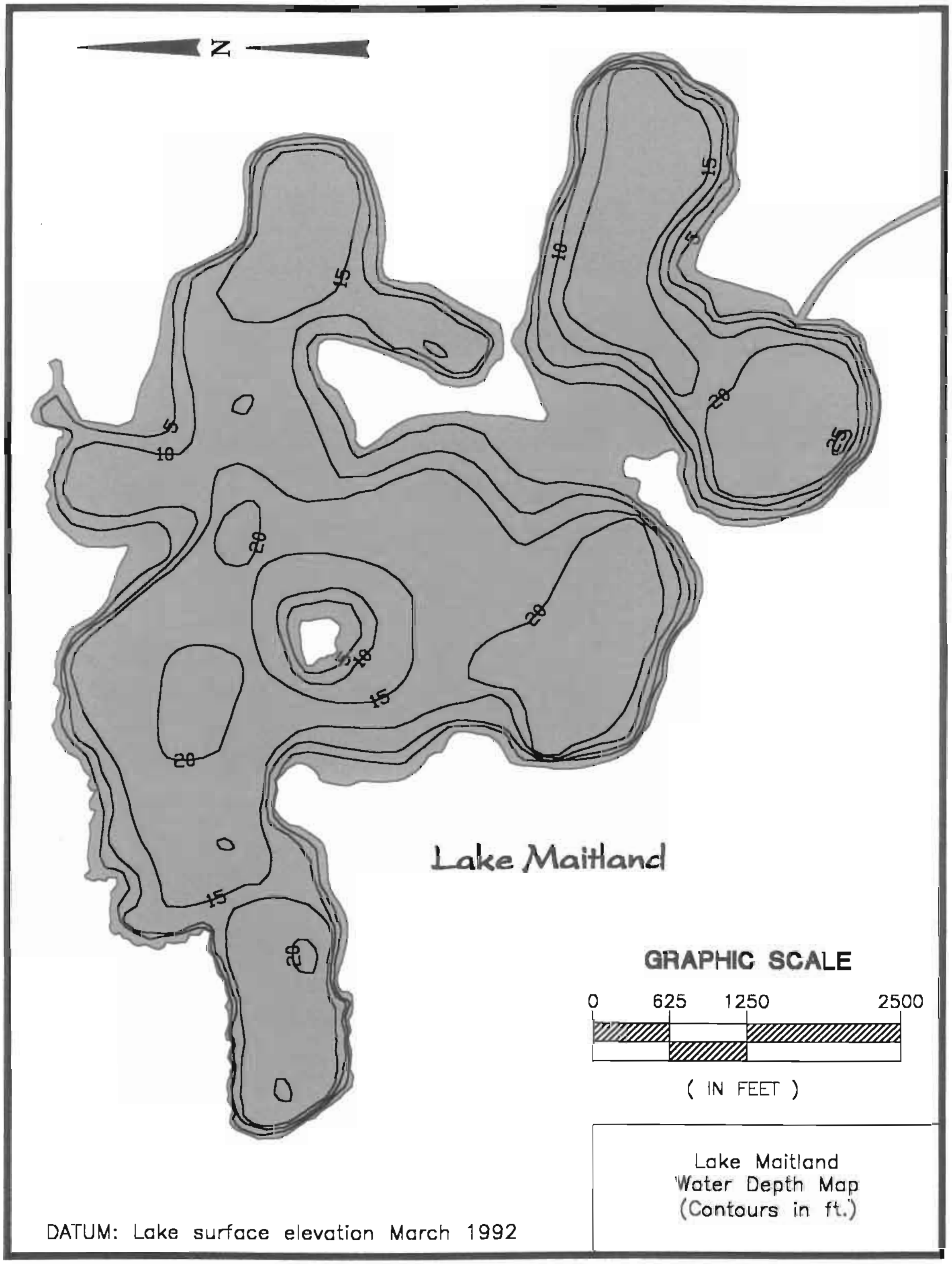


Figure 1-5. Bathymetric Map for Lake Maitland.

Physical characteristics of the Winter Park Chain-of-Lakes are summarized in Table 1-1. Surface area and volume calculations were performed by USGS based upon a lake-stage of 66.09 ft (MSL) in March 1992. The area contained within drainage sub-basins discharging to each of the four lakes was obtained primarily from a report prepared by Professional Engineering Consultants (PEC) in 1987 for the City of Winter Park, although several of the values listed in Table 1-1 were modified to reflect more recent studies and evaluations. Mean depth for the lakes is calculated as the lake volume divided by the lake surface area. The physical characteristics listed in Table 1-1 are utilized in numerous calculations throughout this report.

TABLE 1-1

PHYSICAL CHARACTERISTICS OF THE WINTER PARK CHAIN-OF-LAKES

LAKE	DRAINAGE AREA (ac)	SURFACE AREA (ac)	VOLUME (ac-ft)	SHORELINE LENGTH (miles)	MAXIMUM DEPTH (ft)	MEAN DEPTH (ft)
Maitland	1374	470	5349	6.2	30	11.4
Virginia	944	224	3398	2.9	23	15.1
Osceola	567	156	1653	2.8	23	10.7
Mizell	219	66	712	1.4	21	10.7
TOTAL:	3104	916	11,112	13.3	--	--

1.2 Scope of Work

The work efforts outlined in this report were performed as partial fulfillment of Contract No. RFP-7-98 titled "Winter Park Chain-of-Lakes Groundwater and Sediment Study" between the City of Winter Park and Environmental Research & Design, Inc. (ERD) executed on July 9, 1998. The primary objective of this study is to update the nutrient and hydrologic budgets for the Chain-of-Lakes prepared by USGS to include direct measurements, rather than the estimated values presented by USGS, of the impact of groundwater seepage on both the hydrologic and nutrient budgets of the four lakes. In addition, estimates of internal nutrient recycling, which were not included in the USGS study, are also included. The scope of services includes field monitoring and laboratory analyses necessary to identify the annual nutrient contribution from groundwater seepage as well as internal recycling of phosphorus, under both oxic and anoxic conditions. The significance of internal phosphorus recycling was evaluated by direct measurement of phosphorus release from large diameter lake sediment core samples incubated under a range of redox conditions. Historical field data collected in the four lakes by ERD was used to evaluate the areal extent of anoxic conditions in the lakes on a seasonal basis. Modified annualized hydrologic and nutrient budgets were developed by ERD utilizing information provided in the USGS report as well as new information developed for this project by ERD.

This report has been divided into five separate sections for presentation of results. Section 1 contains an introduction to the report and summarizes work efforts performed by ERD. Section 2 provides a detailed discussion of the methodology and results obtained in field monitoring activities utilized to evaluate the significance of groundwater seepage and internal recycling within the lakes. Section 3 provides a detailed description of the revised hydrologic budgets for the Chain-of-Lakes, with the revised nutrient budgets outlined in Section 4. A list of conclusions and recommendations from this study is provided in Section 5.

1.3 Units of Measurement

Work efforts outlined in this report are described using a combination of metric and English units. In general, all data, measurements and descriptions given in this report related to chemical concentrations and mass are given in metric units. Due to the popularity and common use of certain English units, particularly with respect to units of length, area, discharge, and volume, English units such as feet, acres, ac-ft, and cfs are utilized for these parameters.

SECTION 2

EVALUATION OF SEEPAGE AND SEDIMENT IMPACTS

Extensive field and laboratory activities were performed by ERD during 1998-1999 to quantify the annual hydrologic and nutrient inputs from groundwater seepage into the Winter Park Chain-of-Lakes as well as to quantify phosphorus release resulting from internal recycling of phosphorus from the sediments to the overlying water column under both aerobic and anoxic conditions. The significance of groundwater seepage inputs were evaluated by installation and monitoring of 31 groundwater seepage meters in Lake Virginia, Lake Osceola, Lake Mizell, and Lake Maitland. The significance of internal phosphorus recycling was evaluated by direct measurement of phosphorus release from large diameter lake sediment core samples from the four lakes incubated under aerobic and anoxic conditions. A detailed discussion of these activities is given in the following sections.

2.1 Groundwater Seepage

Field investigations were performed by ERD to evaluate the quantity and quality of shallow groundwater seepage entering Lake Virginia, Lake Mizell, Lake Osceola, and Lake Maitland under both wet season and dry season conditions. Groundwater seepage was quantified using a series of seepage meters installed at various locations throughout each lake. Seepage meters provide a mechanism for direct measurement of groundwater inflow into a lake by isolating a portion of the lake bottom so that groundwater seeping up through the bottom sediments into the lake can be collected and characterized. Use of the direct seepage meter measurement technique avoids errors, assumptions and extensive input data required when indirect techniques, such as the Gross Water Budget or Subtraction Method, are used as well as computer modeling and flow net analyses.

The seepage meter technique has been recommended by the U.S. Environmental Protection Agency (EPA) and has been established as an accurate and reliable technique in field and tank test studies (Lee, 1977; Erickson, 1981; Cherkauer and McBride, 1988; Belanger and Montgomery, 1992). With installation of adequate numbers of seepage meters and proper placement, seepage meters are a very effective tool to estimate groundwater-surface water interactions. One distinct advantage of seepage meters is that seepage meters can provide estimates of both water quantity and quality entering a lake system, whereas calculated methods can only provide information on water quantity.

2.1.1 Field Procedures

2.1.1.1 Seepage Meter Construction and Locations

A schematic of a typical seepage meter installation used in the four lakes is given in Figure 2-1. Seepage meters were constructed from a 2.0 ft diameter aluminum container with a closed top and open bottom. Each seepage meter isolated a sediment area of approximately 3.14 ft^2. Seepage meters were inserted into the lake sediments to a depth of approximately 8-12 inches, isolating a portion of the lake bottom. Approximately 1-3 inches of water was trapped inside the seepage meter above the lake bottom.

A 0.75-inch PVC 90° elbow fitting was threaded into the top of each aluminum container. The 0.75-inch PVC fitting was attached to a female quick-disconnect PVC camlock fitting. A flexible polyethylene bag, with an approximate volume of 40 gallons was attached to

Typical Seepage Meter Installation

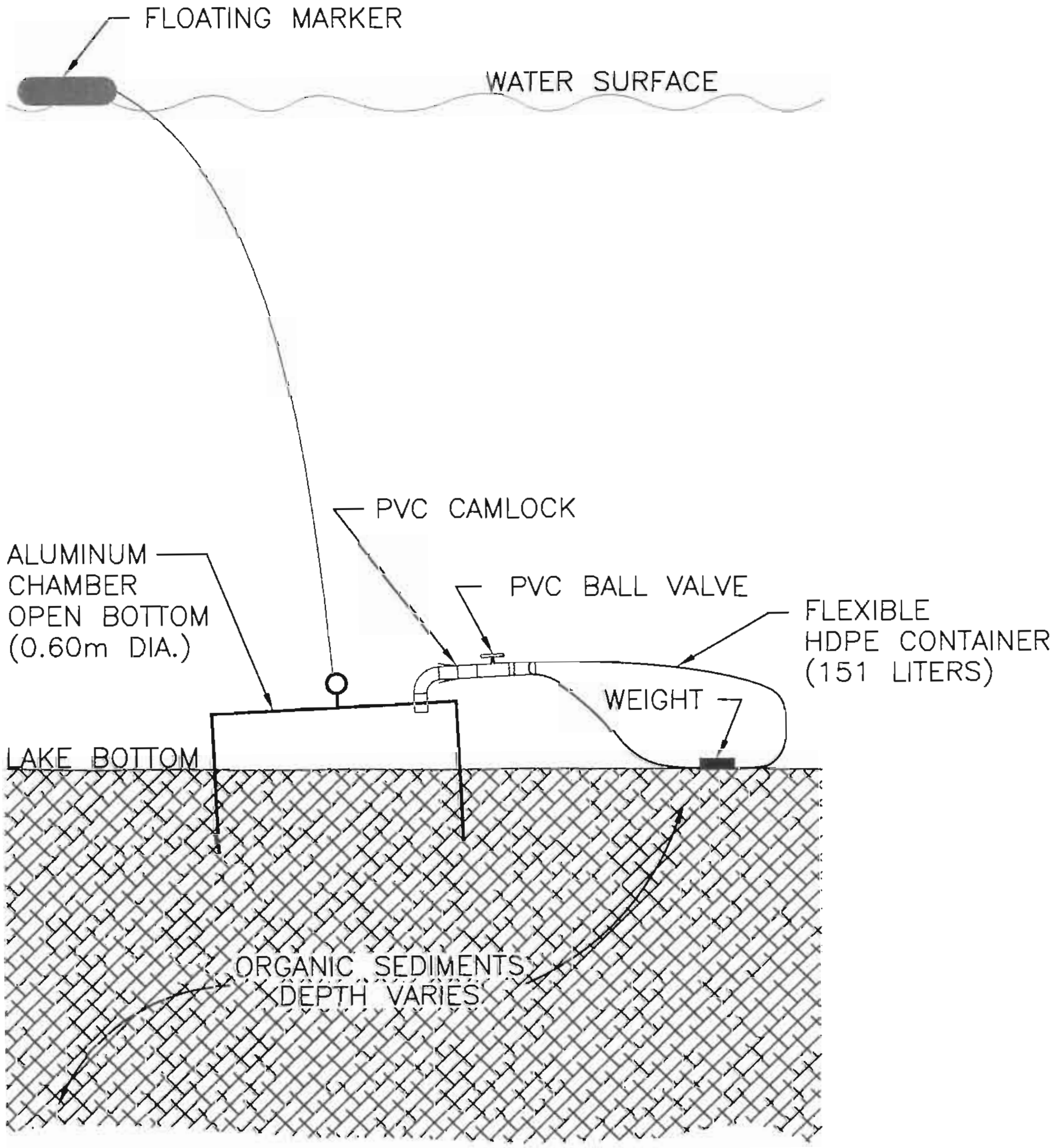


Figure 2-1. Typical Seepage Meter Installation.

the seepage meters using a quick-disconnect PVC male camlock fitting with a terminal ball valve. Each of the collection bags was constructed of black polyethylene to prevent light penetration into the bag which could potentially stimulate photosynthetic activity within the sample prior to collection, resulting in an undesirable alteration of the chemical characteristics of the sample.

Prior to attachment to the seepage meter, all air was removed from inside the polyethylene collection bag, and the PVC ball valve was closed so that lake water would not enter the collection container prior to attachment. A diver then connected the collection bag to the seepage meter using the PVC camlock fitting. After attaching the collection bag to the seepage meter, the PVC ball valve was then opened. As groundwater influx occurs into the open bottom of the seepage meter, it is collected inside the flexible polyethylene bag.

Each seepage meter was installed with a slight tilt toward the outlet point so that any gases which may be generated inside the seepage meter would exit into the collection container. A plastic-coated fishing weight was placed inside each of the collection bags to prevent the bags from floating up towards the water surface as a result of trapped gases. The location of each seepage meter was indicated by a floating marker in the lake which was attached to the seepage meter using a coated wire cable.

A total of 31 seepage meters were installed in the four lakes during 1998, with seven meters installed in Lake Virginia, five in Lake Mizell, nine in Lake Osceola, and ten in Lake Maitland. Locations for seepage meters installed in the four lakes are indicated on Figure 2-2. Since seepage inflow typically exhibits the greatest degree of variability around the perimeter of a lake, the majority of the seepage meters were installed around the lake perimeter at a uniform water depth of approximately 4-5 ft. Seepage meters were also installed near the center of each lake in areas of maximum water depth.

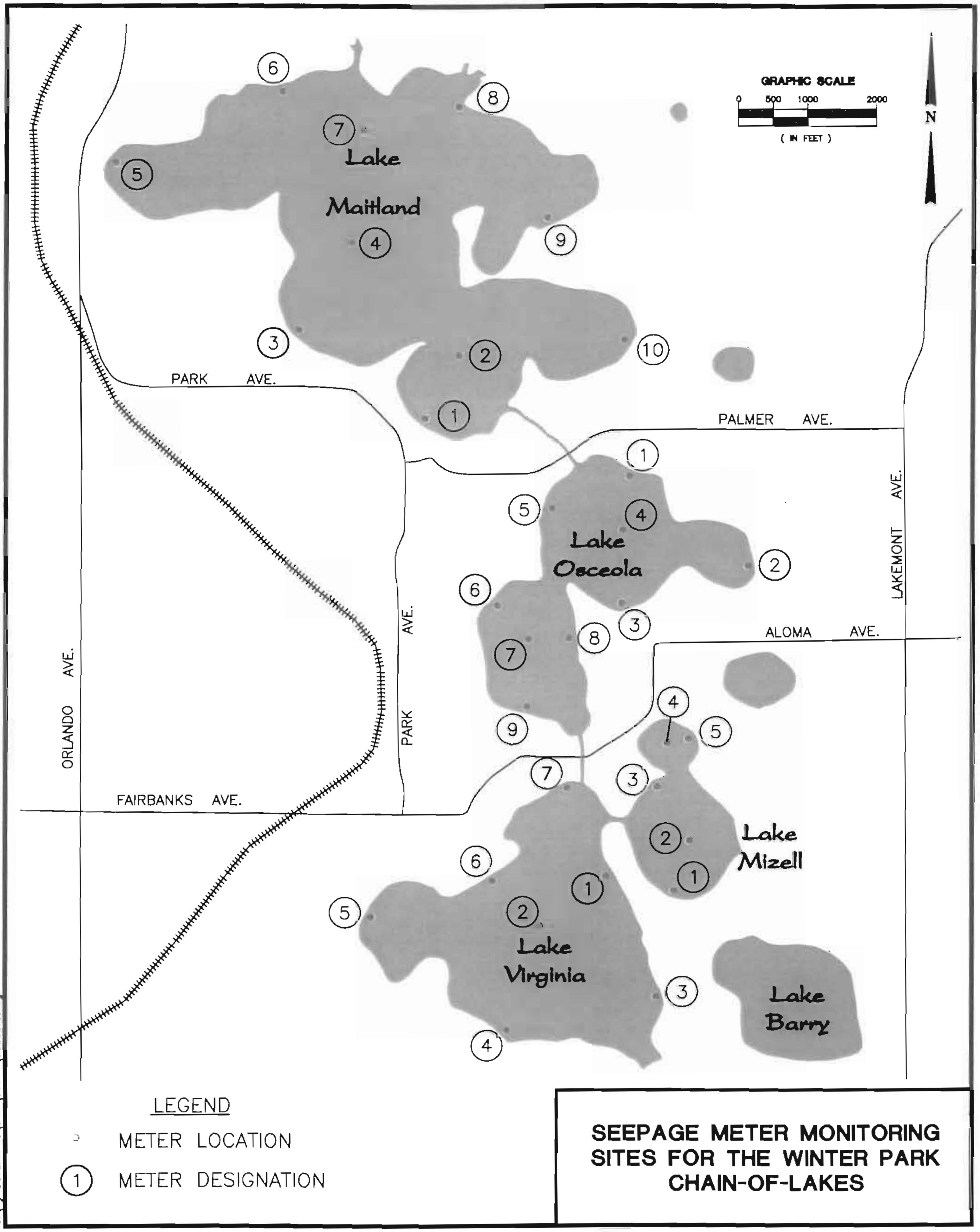


Figure 2-2. Seepage Meter Monitoring Sites for the Winter Park Chain-of-Lakes.

Each of the 20 seepage meters was monitored on approximately a 3-6 week basis from September 1998 to March 1999. A total of six separate seepage monitoring events were conducted for evaluation of seepage quantity and quality at each of the 30 sites during this monitoring period, comprising a total of 176 samples collected between the four lakes.

2.1.1.2 <u>Seepage Meter Sampling Procedures</u>

Following installation of all seepage meters, a period of four weeks was allowed for each seepage meter to reach equilibrium with the water column and groundwater prior to installing the flexible collection bag. After initial installation of the collection bags, site visits were performed on a 3-6 week basis to collect groundwater samples.

During the collection process, a diver was used to close the PVC ball valve and remove the collection bag from the seepage meter using the quick-disconnect camlock fitting. The collection bag was placed onto the boat and the volume of seepage collected in the container was measured using a 4-liter graduated cylinder. Seepage samples which contained larger volumes of water were measured using a graduated polyethylene bucket.

Following the initial purging, seepage meter samples were collected for return to the laboratory for chemical analysis. Many of the collected seepage meter samples were found to contain turbidity originating from the sediments isolated within the seepage meter, particularly during the first month of seepage collection. As a result, seepage meter samples collected for chemical analyses were field-filtered using a 0.45 micron disposable glass fiber filter typically used for filtration of groundwater samples. Seepage samples were filtered immediately following collection using a battery operated peristaltic pump at a flow rate of approximately 0.25 liter/minute. The filtered seepage sample was placed on ice for return to the ERD laboratory for further chemical analyses.

2.1.2 Evaluation of Hydraulic Inputs from Seepage

A summary of field measurements of collected seepage volumes and calculated inflow rates entering Lake Virginia, Lake Mizell, Lake Osceola, and Lake Maitland over the monitoring period is given in Appendix A.1. During collection of groundwater seepage, information was recorded on the time of sample collection, the total volume of seepage collected at each site, and general observations regarding the condition of the seepage collection bags and sample filtration details. The seepage flow rate at each location is calculated by dividing the total collected seepage volume by the area of the seepage meter and the time over which the seepage sample was collected.

Variations in overall mean groundwater seepage rates into the four lakes for each monitoring date are summarized in Figure 2-3. Mean values represented in this figure reflect the mean of shallow perimeter seepage meters which are most likely to exhibit seasonal trends. In contrast, seepage in deep areas of lakes is more uniform throughout the year.

As seen in Figure 2-3, seepage inflow into the Chain-of-Lakes appears to exhibit two distinct trends. Groundwater seepage measured in the four lakes during the period from September through November 1998 appears to be higher in value than seepage measured from December 1998 to March 1999. Seepage measurements collected during September and October were performed at the end of the annual rainy season and reflect seepage inflow which is influenced by periods of routine rainfall. For purposes of this evaluation, mean seepage characteristics measured during September and October in the Chain-of-Lakes are used to reflect "wet" season seepage inputs into the lakes. In contrast, seepage inflow into the Chain-of-Lakes measured from December 1998-March 1999 reflects seepage inflow which is characteristic of relatively dry conditions with infrequent rain events. For purposes of this evaluation, seepage inflow measured during this period is assumed to reflect "dry" season conditions.

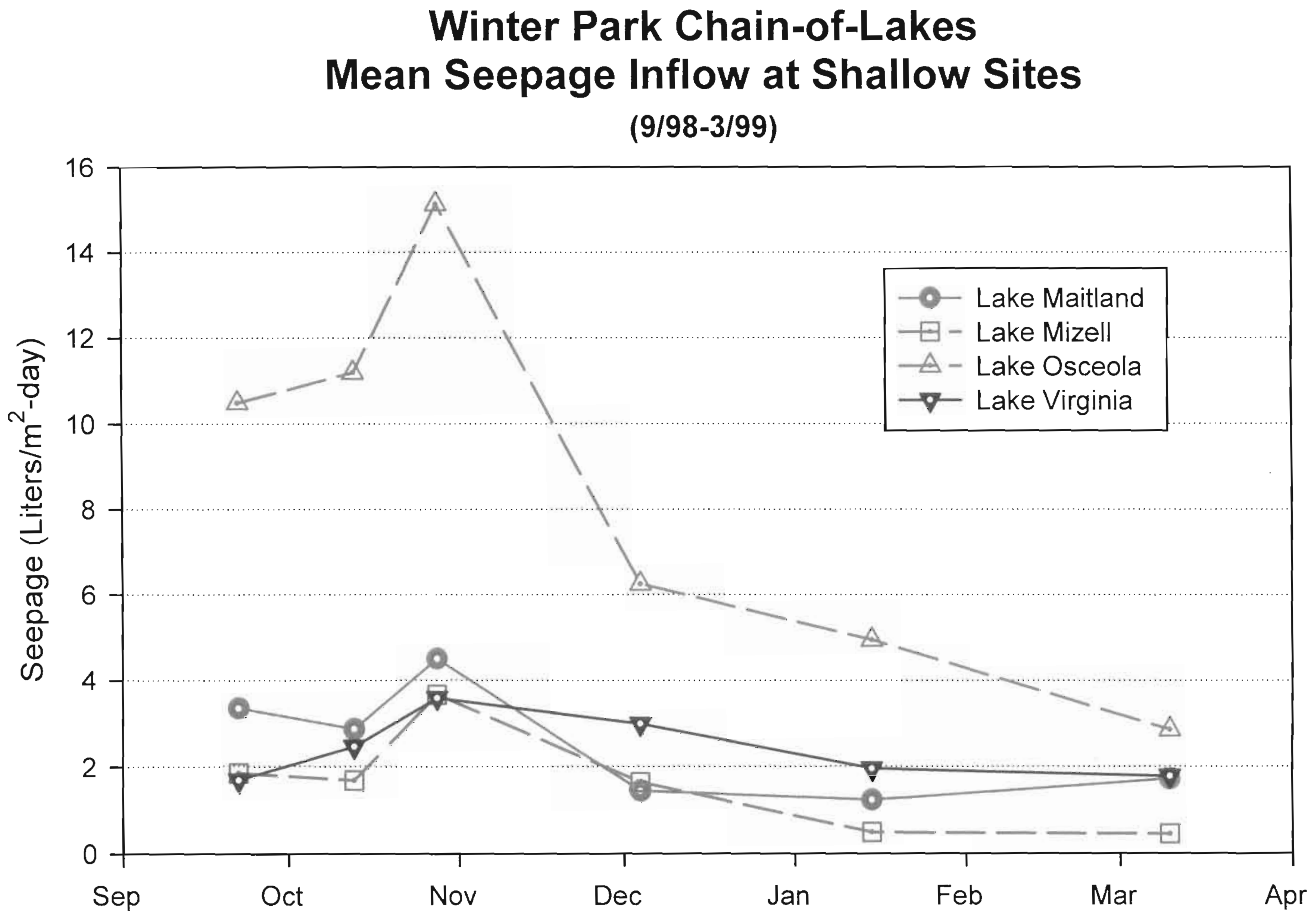


Figure 2-3. Variations in Mean Groundwater Seepage Rates Entering the Winter Park Chain-of-Lakes.

As seen in Figure 2-3, seepage inflow entering Lake Mizell, Lake Virginia, and Lake Maitland is relatively similar in value during both wet season and dry season conditions. However, seepage inflow entering Lake Osceola appears to be substantially higher than the remaining lakes during both wet season and dry season conditions. Mean seepage inflow entering Lake Osceola under wet season conditions is approximately 3-4 times greater than values measured in the remaining lakes, while seepage inflow during dry season conditions is approximately 1.5-3 times greater than seepage observed in the remaining lakes.

The increased seepage observed in Lake Osceola may be largely related to the relatively steep topography surrounding the shoreline of Lake Osceola, compared with the substantially milder topography surrounding the remaining lakes. Steep topography often results in an elevated gradient between the groundwater table and the lake surface which, all other factors being equal, results in a corresponding increase in seepage inflow rates.

A summary of mean seepage inflow rates in the Winter Park Chain-of-Lakes during wet and dry season conditions is given in Table 2-1. In general, seepage inflow in shallow shoreline areas appears to be substantially greater than seepage measured in deeper areas of the four lakes. In addition, mean seepage inflow under wet season conditions appears to be greater in shallow shoreline areas than observed under dry season conditions. Seepage inflow in deeper areas of the Chain-of-Lakes also appears to increase under wet season conditions in Lake Virginia and Lake Maitland. However, seepage inflow rates in deep areas of Lake Mizell and Lake Osceola are virtually identical under wet season and dry season conditions.

Seepage inflow isopleth maps were developed for each of the four lakes to describe the measured seepage patterns in each lake under wet season and dry season conditions. Mean wet season and dry season seepage rates were calculated for each of the monitoring locations and used to generate seepage inflow contour maps for each of the four lakes under wet season and dry season conditions. A statistical summary of mean seasonal seepage values measured at each site in the four lakes is given in Appendix A.2.

TABLE 2-1

SUMMARY OF MEAN SEEPAGE INFLOW RATES TO THE WINTER PARK CHAIN-OF-LAKES UNDER WET AND DRY SEASON CONDITIONS

LAKE	WET SEASON INFLOW (liters/m^2-day)		DRY SEASON INFLOW (liters/m^2-day)	
	SHALLOW	DEEP	SHALLOW	DEEP
Virginia	2.57	0.34	2.19	0.11
Mizell	2.45	1.35	0.76	1.37
Osceola	14.8	0.51	4.67	0.50
Maitland	3.56	1.99	1.46	0.45

Estimated seepage inflow isopleths for Lake Virginia under wet season and dry season conditions, based upon the seasonal seepage values presented in Appendix A.2, are shown in Figures 2-4 and 2-5, respectively. In general, groundwater seepage entering Lake Virginia under both wet season and dry season conditions appears to be greatest in the shallow perimeter areas, decreasing rapidly with increasing water depth. An area of elevated seepage was observed under both wet season and dry season conditions along the northwest side of Lake Virginia adjacent to the Rollins College Campus.

Seepage inflow isopleths for Lake Mizell under wet season and dry season conditions, based upon the mean seasonal seepage values presented in Appendix A.2, are shown in Figures 2-6 and 2-7, respectively. Under wet season conditions, seepage inflow was observed to be

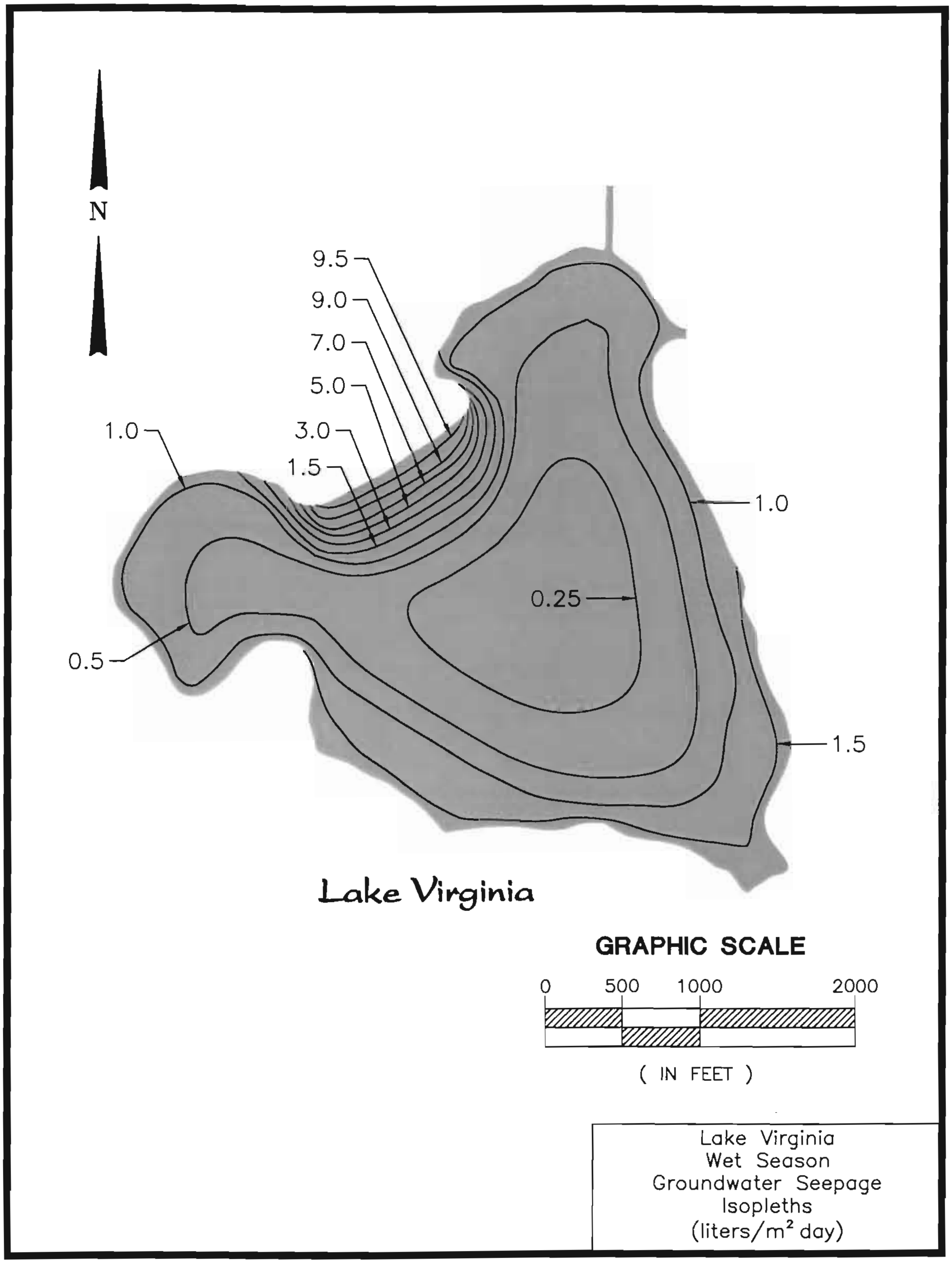


Figure 2-4. Wet Season Groundwater Seepage Isopleths for Lake Virginia.

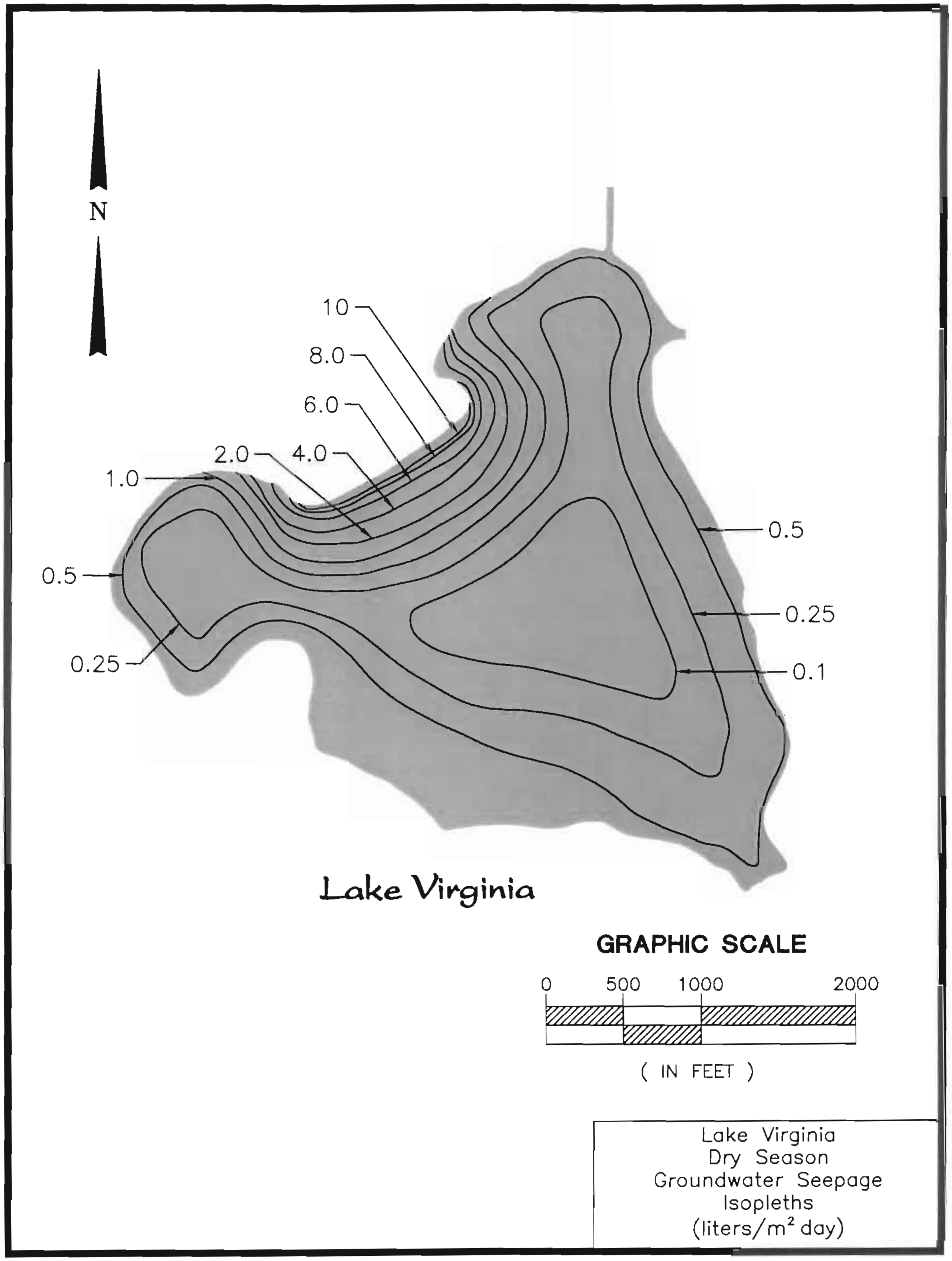


Figure 2-5. Dry Season Groundwater Seepage Isopleths for Lake Virginia.

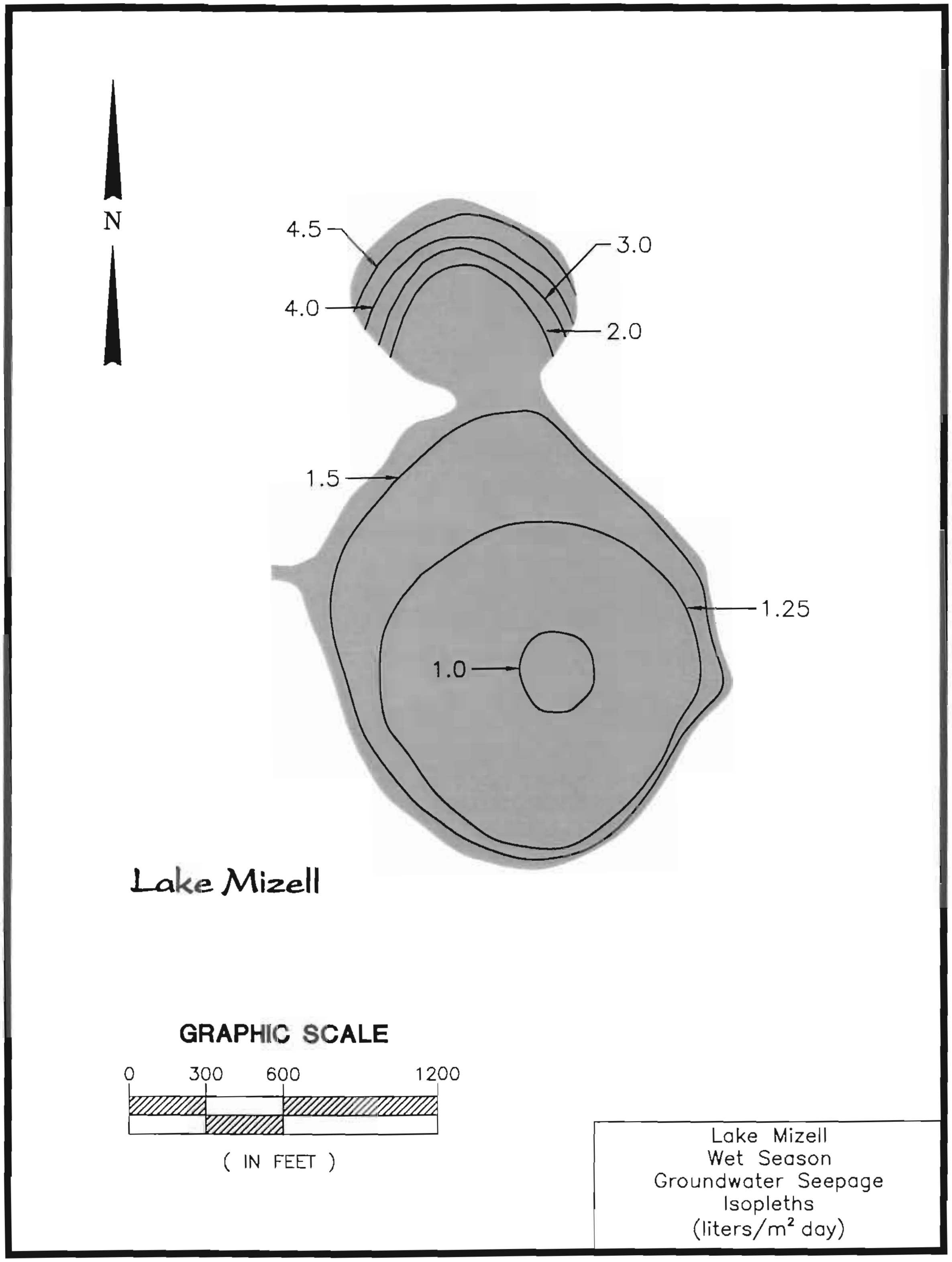


Figure 2-6. Wet Season Groundwater Seepage Isopleths for Lake Mizell.

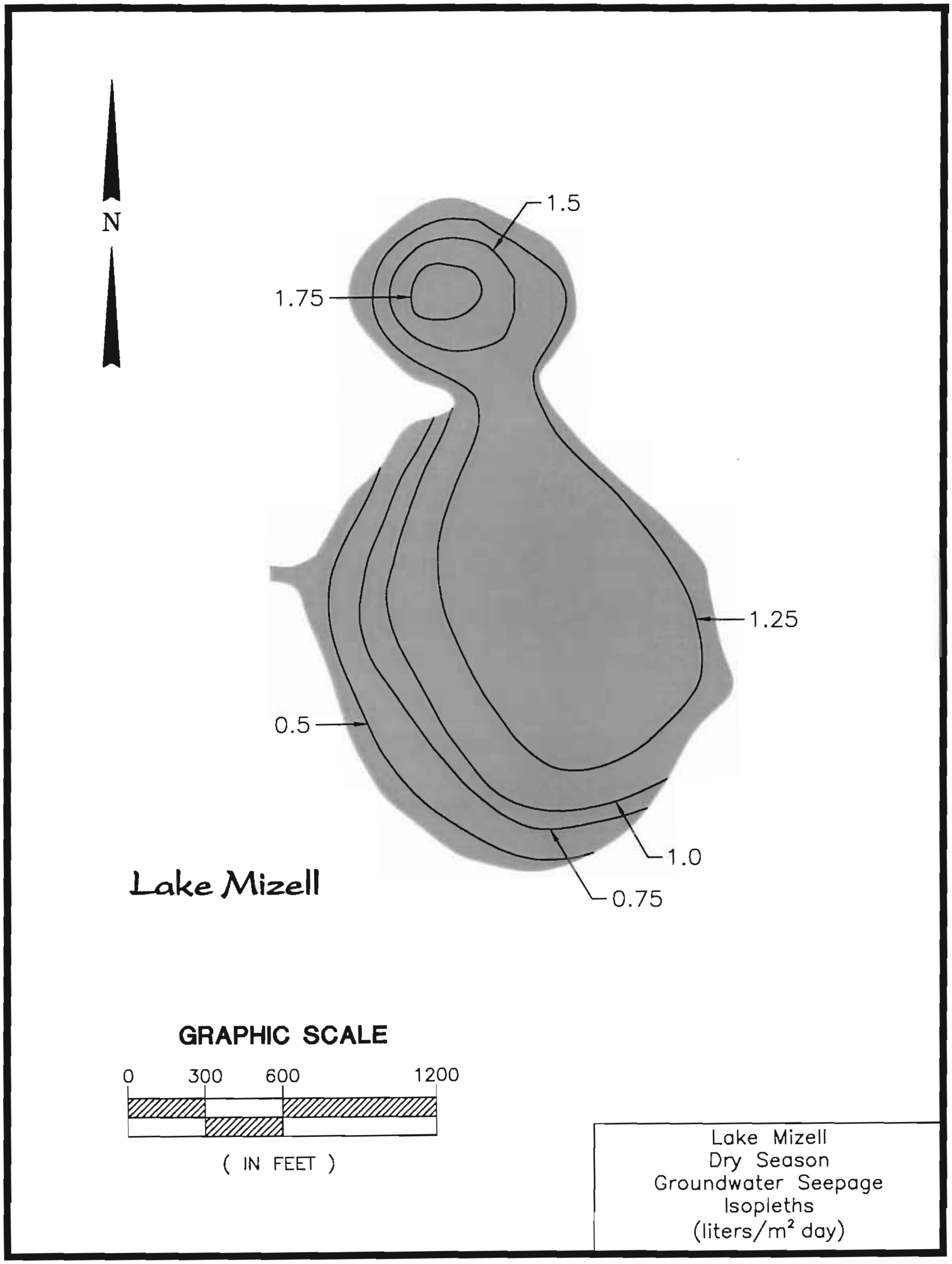


Figure 2-7. Dry Season Groundwater Seepage Isopleths for Lake Mizell.

higher in value around the perimeter of the lake, with decreasing seepage inflow with increasing water depth. The highest seepage inflow appears to occur around the northern lobe of the lake. However, under dry season conditions, seepage inflow was observed to be higher near the center of the lake, with lower values observed around the shoreline perimeter. The highest measured seepage inflow values still appear to be concentrated in the northern lobe of the lake.

Seepage inflow isopleths for Lake Osceola under wet season and dry season conditions, based upon the mean seasonal seepage values presented in Appendix A.2, are shown in Figures 2-8 and 2-9, respectively. In general, seepage inflow into Lake Osceola appears to be concentrated primarily around the perimeter of the lake, under both wet season and dry season conditions, with rapidly decreasing seepage inflow with increasing water depth. Areas of elevated seepage inflow were observed along the northern and northwestern edges of Lake Osceola. As discussed previously, seepage inflow into Lake Osceola appears to be substantially higher in value than inflow observed in the remaining Chain-of-Lakes, under both dry season and wet season conditions.

Seepage inflow isopleths for Lake Maitland under wet season and dry season conditions, based upon mean seasonal seepage values presented in Appendix A.2, are presented in Figures 2-10 and 2-11, respectively. Similar to the trends observed in the remaining lakes, seepage inflow entering Lake Maitland appears to be greatest around the perimeter of the lake, with decreasing seepage inflow observed at increasing water depths. Areas of relatively elevated seepage inflow were observed along the southeast and southwest lobes of Lake Maitland under both dry season and wet season conditions. Seepage inflow in the remaining areas of the lake was found to be relatively low.

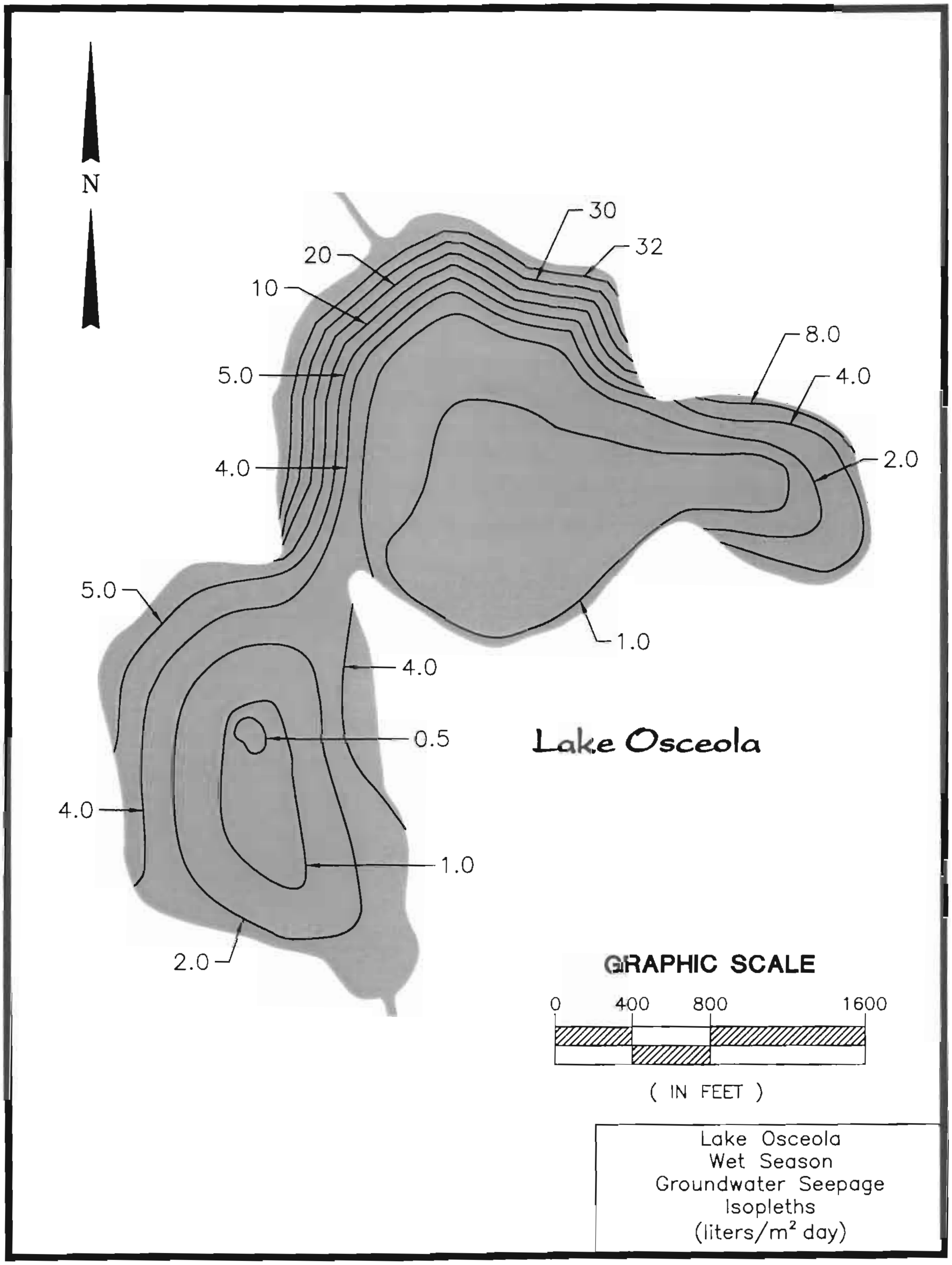


Figure 2-8. Wet Season Groundwater Seepage Isopleths for Lake Osceola.

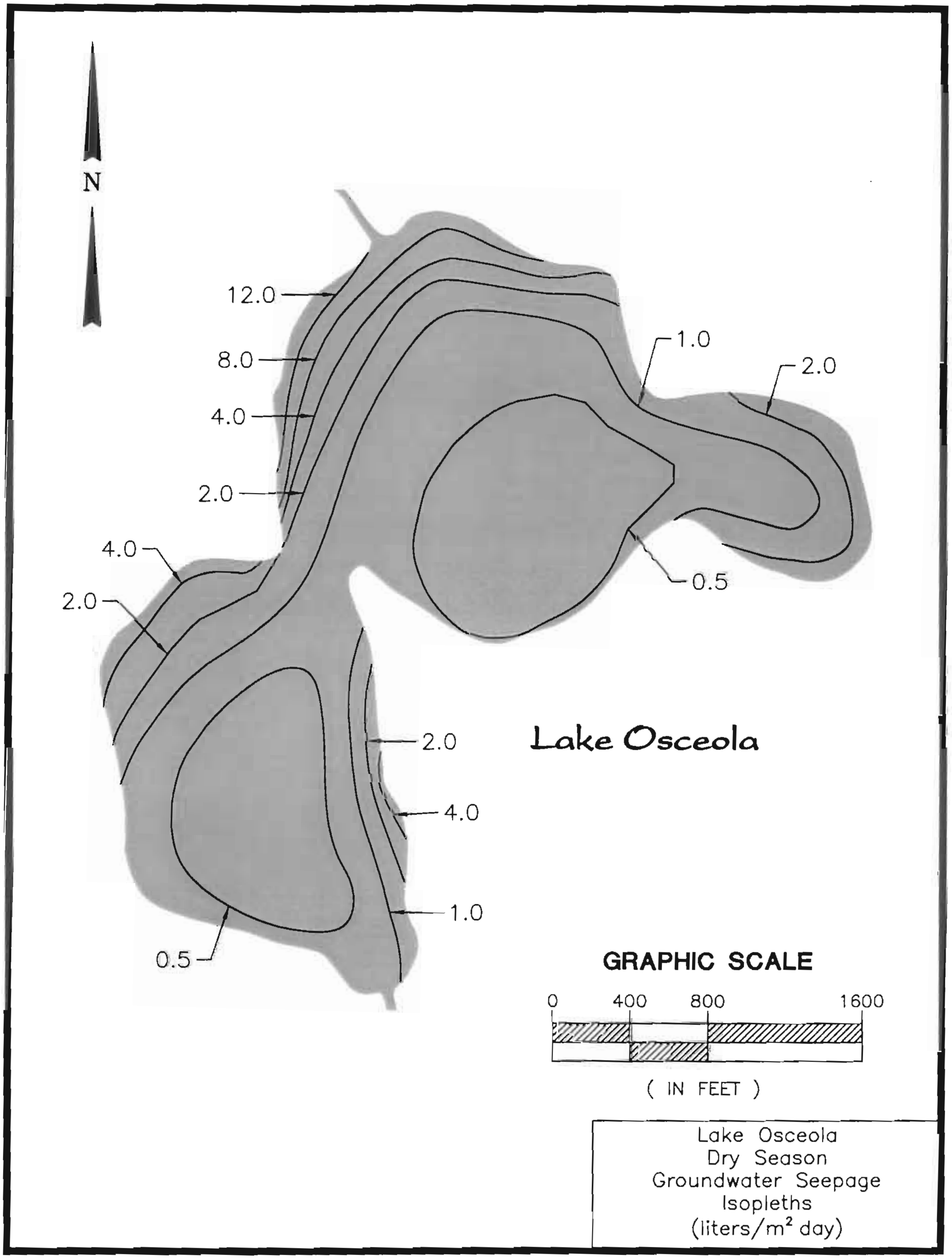


Figure 2-9. Dry Season Groundwater Seepage Isopleths for Lake Osceola.

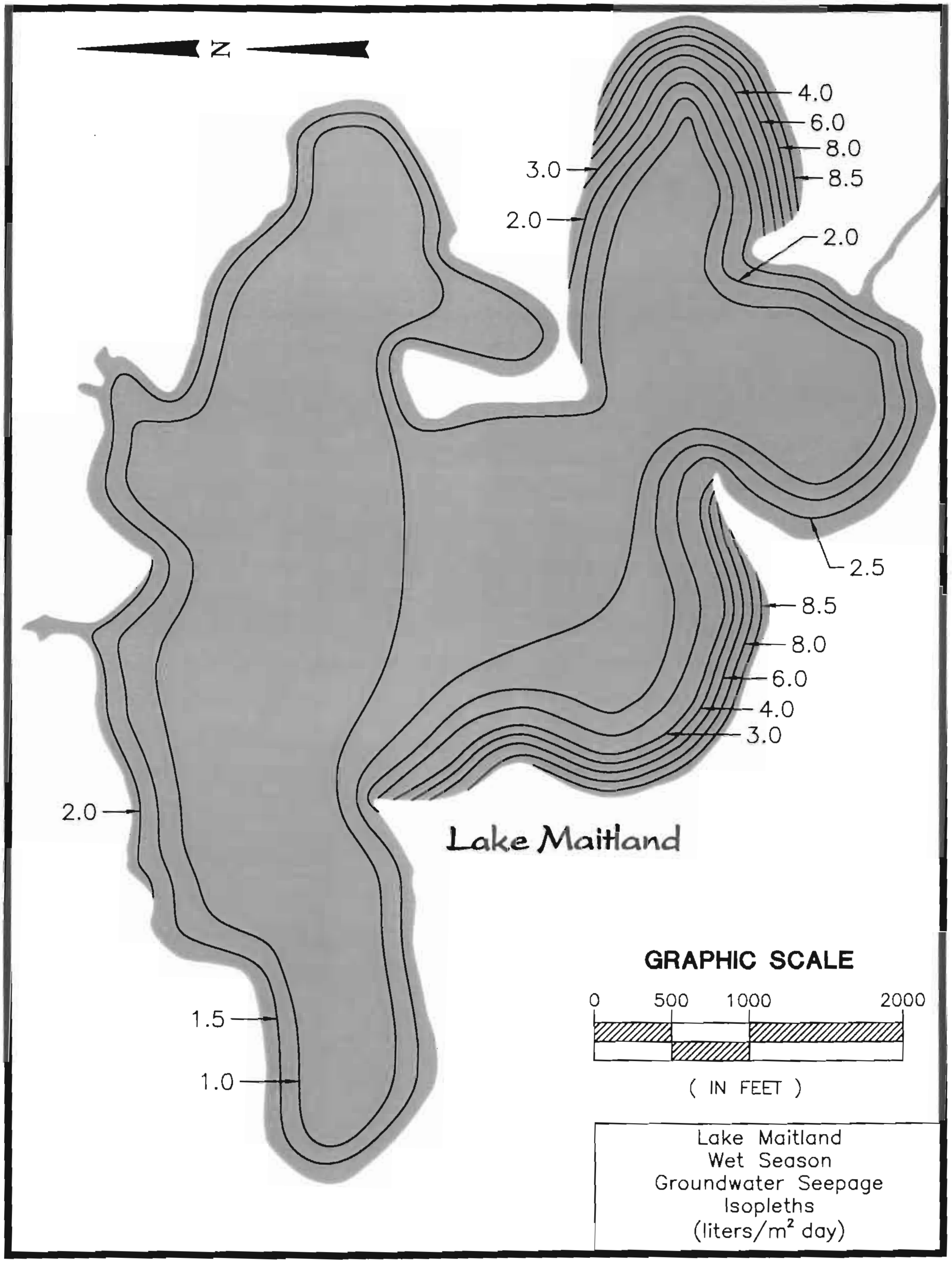


Figure 2-10. Wet Season Groundwater Seepage Isopleths for Lake Maitland.

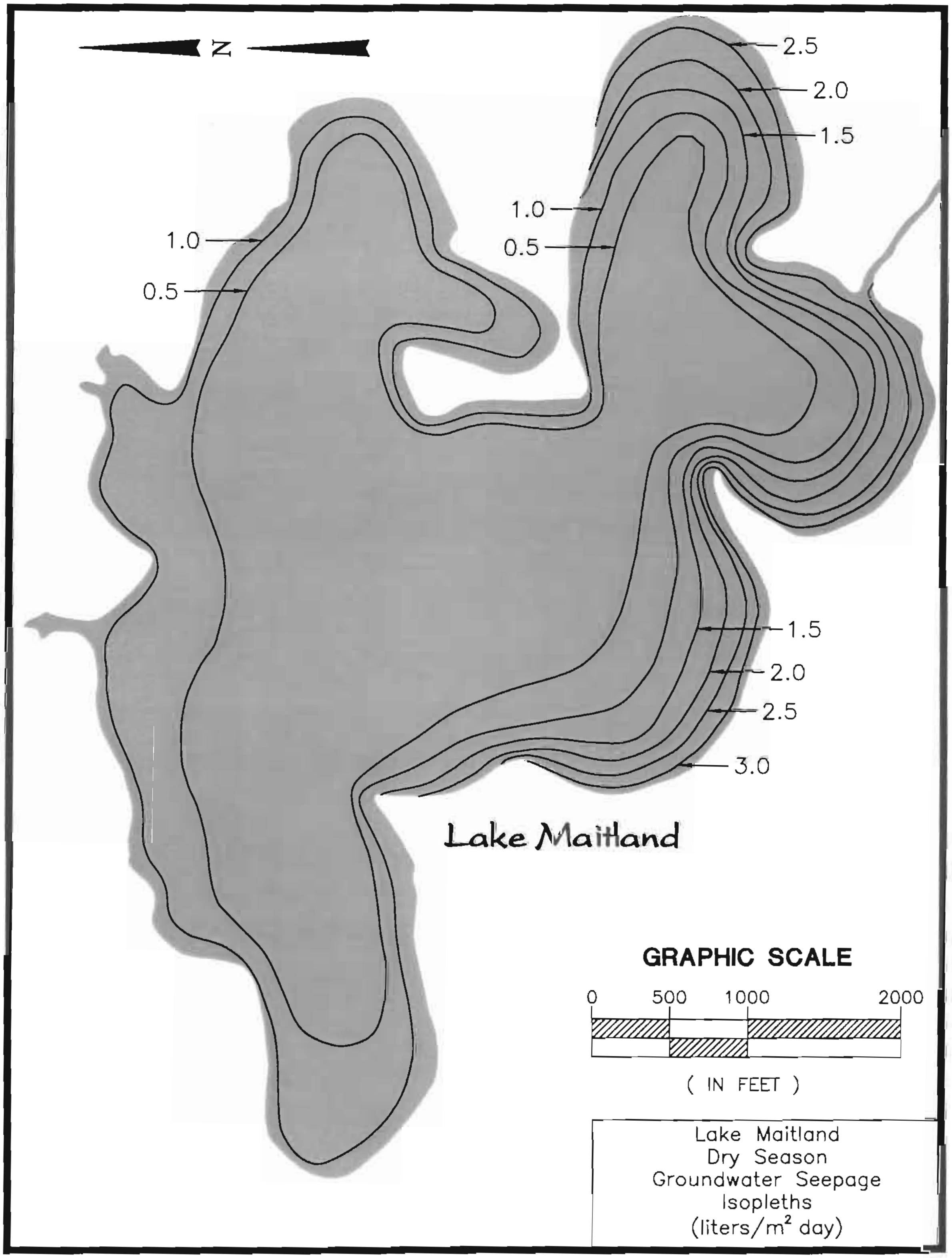


Figure 2-11. Dry Season Groundwater Seepage Isopleths for Lake Maitland.

Estimates of the mean daily inflow into each of the four lakes were obtained by integrating the wet and dry season isopleths indicated on Figures 2-4 through 2-11. For purposes of this evalution, wet season seepage inflow characteristics are assumed to occur during the period from July-November, representing 153 days of the year. Dry season seepage inflow characteristics are assumed to occur during the period from December-June, representing 212 days of the year. Daily wet season and dry season seepage inflow values were multiplied by the number of days of wet season and dry season conditions to obtain estimates of the annual seepage inputs entering each of the four lakes.

A summary of estimated annual groundwater seepage inputs into the Winter Park Chain-of-Lakes is given in Table 2-2. Seepage inflow during wet season and dry season conditions appears to be approximately equal in both Lake Mizell and Lake Virginia. However, wet season seepage inflow appears to be substantially greater than dry season inflow in Lake Osceola and Lake Maitland. Estimates of total annual seepage inflow were obtained by adding the estimated dry season inflow to the estimated wet season inflow. The values listed in Table 2-2 under the "Annual Total" column are utilized in subsequent sections for generation of hydrologic budgets for each of the four lakes.

Seepage to surface area ratios are also provided in Table 2-2 for each of the four lakes. On an areal loading basis, Lake Osceola has the largest seepage inflow per unit area of any of the Chain-of-Lakes. Seepage inflow per unit area is approximately equal in Lake Mizell and Lake Maitland at values approximately 50% less than seepage inflow observed in Lake Osceola. The lowest seepage inflow per unit area appears to occur in Lake Virginia, with approximately 70% less seepage than observed in Lake Osceola.

TABLE 2-2

ESTIMATED ANNUAL GROUNDWATER SEEPAGE INPUTS INTO THE WINTER PARK CHAIN-OF-LAKES

LAKE	GROUNDWATER SEEPAGE			
	DRY SEASON[1] (ac-ft)	WET SEASON[2] (ac-ft)	ANNUAL TOTAL (ac-ft/yr)	SEEPAGE/SURFACE AREA RATIO
Mizell	50.1	48.9	99.0	1.50
Virginia	122	117	239	1.07
Osceola	182	394	576	3.74
Maitland	303	424	727	1.59

1. Includes the period from December-June (212 days)
2. Includes the period from July-November (153 days)

2.1.3 Evaluation of Nutrient Inputs from Seepage

2.1.3.1 Chemical Characteristics of Groundwater Seepage

In addition to direct measurement of seepage volume, groundwater seepage samples were also returned to the ERD laboratory for chemical analysis of pH, conductivity, alkalinity, and nitrogen and phosphorus species. All collected seepage samples were filtered in the field using a 0.45-micron groundwater filter to remove particulate matter which may be present in the collected sample.

A complete listing of chemical analyses conducted on groundwater seepage samples collected in the Winter park Chain-of-Lakes is given in Appendix A.3. This appendix contains a listing of individual laboratory analyses for each seepage sample collected on each individual sample date. A total of six separate seepage samples was collected at each of the 31 monitoring locations during the monitoring period. A statistical summary of laboratory analyses on seepage samples is included in Appendix A.2.

A comparison of mean chemical characteristics of wet season and dry season seepage samples collected in the four lakes is given in Table 2-3. Seepage inflow entering the Winter Park Chain-of-Lakes appears to be approximately neutral in pH, with mean measured seepage inflow values during wet season and dry season conditions ranging from 7.1-7.7 within the four lakes. In general, it appears that measured pH levels were slightly higher in value during wet season conditions than observed during dry season conditions.

Measured specific conductivity in groundwater seepage was similar to values normally observed in urban runoff, ranging from approximately 280-350 μmho/cm. With the exception of Lake Virginia, specific conductivity in groundwater seepage appears to be somewhat higher during wet season conditions than observed during dry season conditions.

TABLE 2-3

MEAN CHEMICAL CHARACTERISTICS OF SEEPAGE INFLOW TO THE WINTER PARK CHAIN-OF-LAKES UNDER WET AND DRY SEASON CONDITIONS

PARAMETER	UNITS	LAKE VIRGINIA		LAKE MIZELL		LAKE OSCEOLA		LAKE MAITLAND	
		WET SEASON	DRY SEASON	WET SEASON	DRY SEASON	WET SEASON	DRY SEASON	WET SEASON	DRY SEASON
pH	s.u.	7.71	7.64	7.62	7.37	7.20	7.13	7.72	7.59
Conductivity	μmho/cm	339	340	316	306	352	279	331	325
Alkalinity	mg/l	104	82.5	44.8	39.0	42.8	27.9	109	85.7
NH_3-N	μg/l	4063	1063	2343	478	2455	517	2854	1034
NO_x-N	μg/l	2689	4486	715	1809	1166	820	1340	2056
Organic N	μg/l	1097	1064	1597	1076	897	639	524	911
Total N	μg/l	7849	6613	4655	3363	4554	1976	4718	4001
Ortho-P	μg/l	346	302	33	27	53	25	215	141
Total P	μg/l	396	337	46	42	61	38	232	179

Measured alkalinity values in groundwater seepage appear to be low to moderate in value, ranging from approximately 28-109 mg/l. Similar to the trends observed for specific conductivity, alkalinity concentrations appear to be somewhat higher during wet season conditions than during dry season conditions.

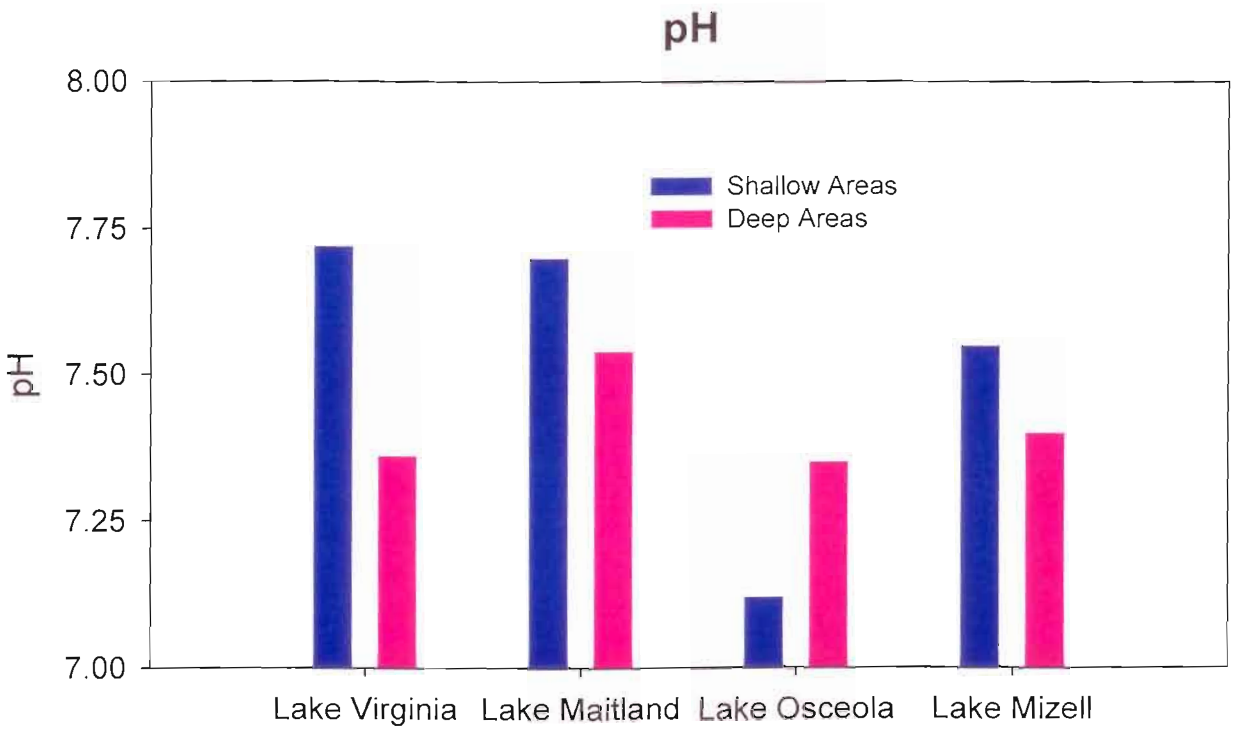
As seen in Table 2-3, elevated concentrations of nitrogen species were observed in many of the Chain-of-Lakes during both wet season and dry season conditions. Mean measured concentrations of total nitrogen in groundwater seepage averaged approximately 2-5 times total nitrogen concentrations normally observed in the water column of the lakes. The dominant nitrogen species in groundwater seepage is inorganic nitrogen, comprised of NH_3-N and NO_x-N, which accounted for more than 50% of the total nitrogen measured at each of the individual sites. Similar to the trends discussed previously, measured total nitrogen concentrations appear to be somewhat greater during wet season conditions than during dry season conditions. In addition, total nitrogen concentrations measured in groundwater seepage entering Lake Virginia were found to be approximately 50% greater than values measured in the remaining lakes.

Measured concentrations of phosphorus species in groundwater seepage were found to be highly variable between the four lakes. Relatively low concentrations of total phosphorus were observed in groundwater seepage entering Lake Mizell and Lake Osceola, each of which have been impacted by inputs of alum floc from treatment of stormwater runoff and, in the case of Lake Mizell, several surface applications. It appears that the residual aluminum remaining in the sediments of these lakes may be responsible for absorbing phosphorus as it migrates with the seepage flow through the sediments into the lake. Substantially higher values of phosphorus species were observed in Lake Virginia and Lake Maitland at values ranging from 5-10 times higher than concentrations typically observed in the water column of these lakes. The dominant phosphorus species is clearly dissolved orthophosphorus which comprises the vast majority of total phosphorus measured in groundwater seepage. Similar to the trend exhibited by total nitrogen, phosphorus concentrations in groundwater seepage appear to be somewhat greater during wet season conditions than during dry season conditions.

A graphical comparison of seepage concentrations of pH and conductivity in shallow and deep areas of the Winter Park Chain-of-Lakes is given in Figure 2-12. For purposes of this evaluation, seepage meters located around the perimeter of each lake are designated as "shallow" sites. Seepage meters installed in deeper areas of each of the four lakes are designated as "deep" sites.

As seen in Figure 2-12, measured pH values, with the exception of Lake Osceola, appear to be greater in shallow areas than measured in deeper areas of the lakes. A similar trend is apparent for specific conductivity which, with the exception of Lake Mizell, appears to be greater in shallow shoreline areas than in deeper portions of the lake. This trend appears to suggest that measured values for pH and conductivity are influenced by watershed activities around the perimeter of the lakes.

A graphical comparison of nitrogen species in shallow and deep areas of the Winter Park Chain-of-Lakes is given in Figure 2-13. Elevated concentrations of inorganic nitrogen species (NH_3 + NO_x) were observed in groundwater seepage entering each of the four lakes from both shallow and deep areas. Substantially higher inputs of inorganic nitrogen were observed in shallow areas surrounding Lake Virginia and Lake Maitland, compared to deep areas. In contrast, inorganic nitrogen concentrations in shallow areas were found to be lower in value in Lake Osceola and Lake Mizell than concentrations observed in deep areas. Trends in total nitrogen concentrations appear to mimic the trends previously discussed for inorganic nitrogen, since inorganic nitrogen comprises the majority of nitrogen present in groundwater seepage.



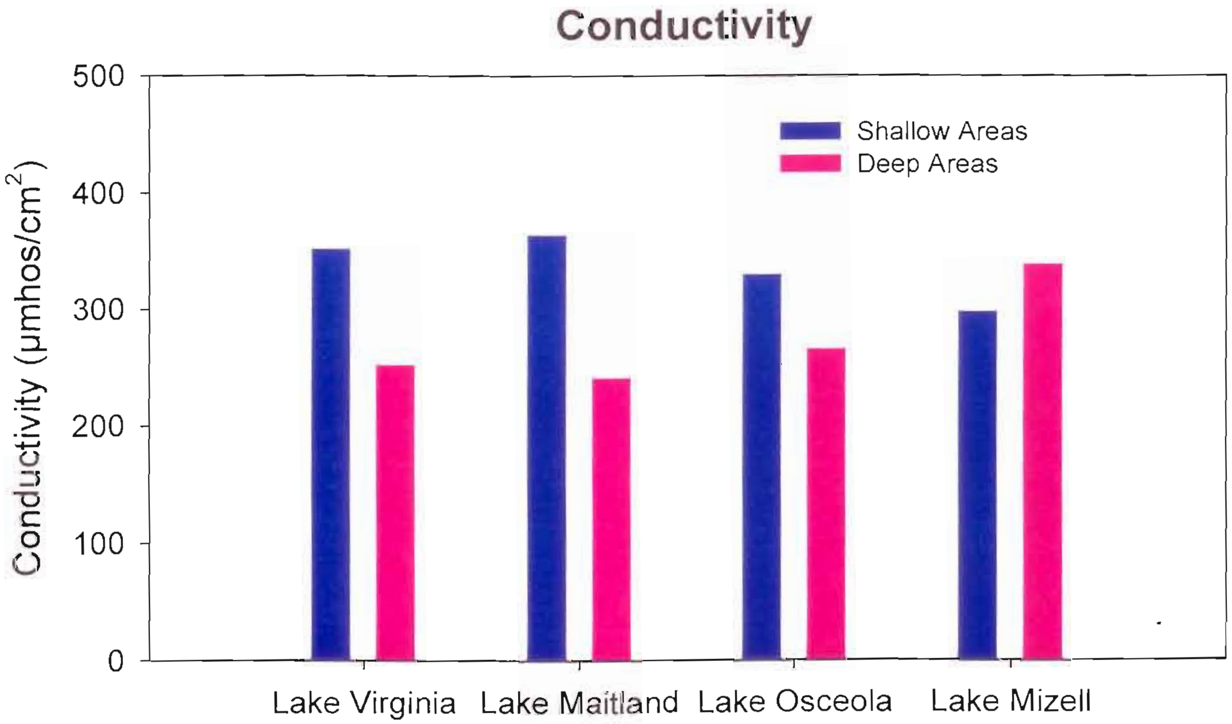
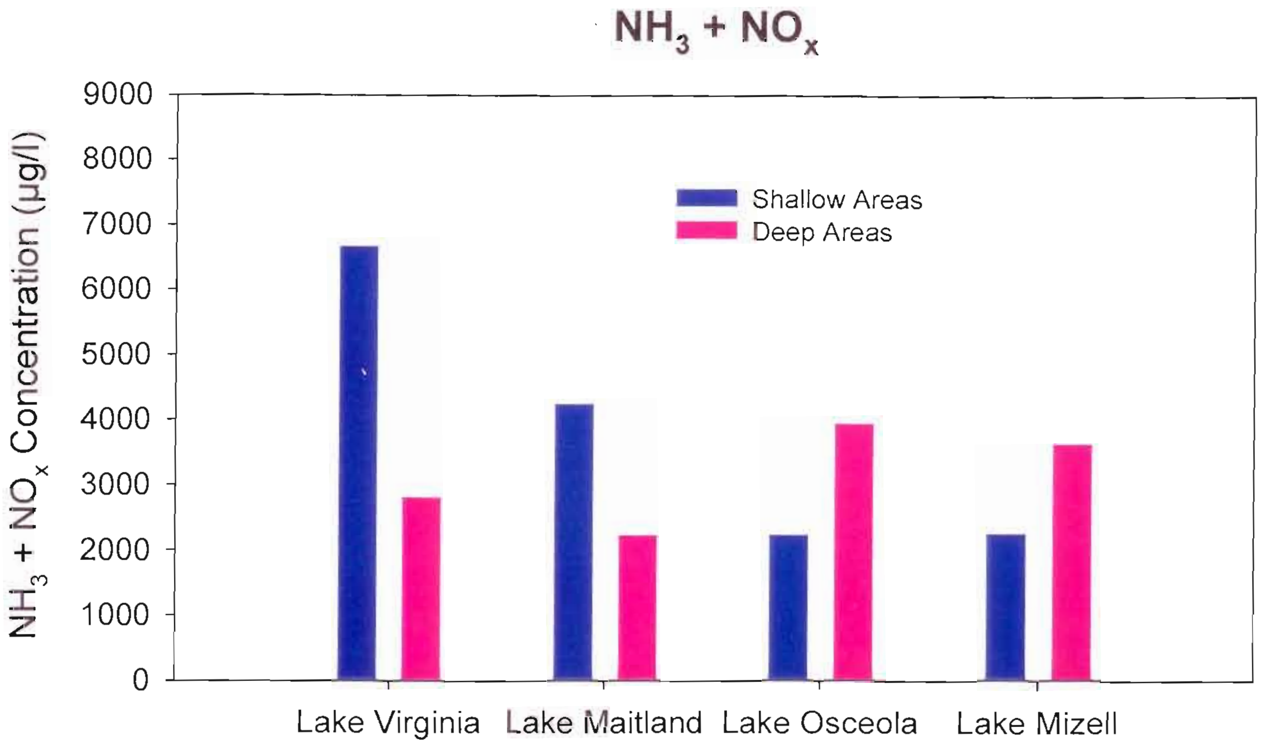


Figure 2-12. Comparison of Seepage pH and Conductivity in Shallow and Deep Areas of the Winter Park Chain-of Lakes.



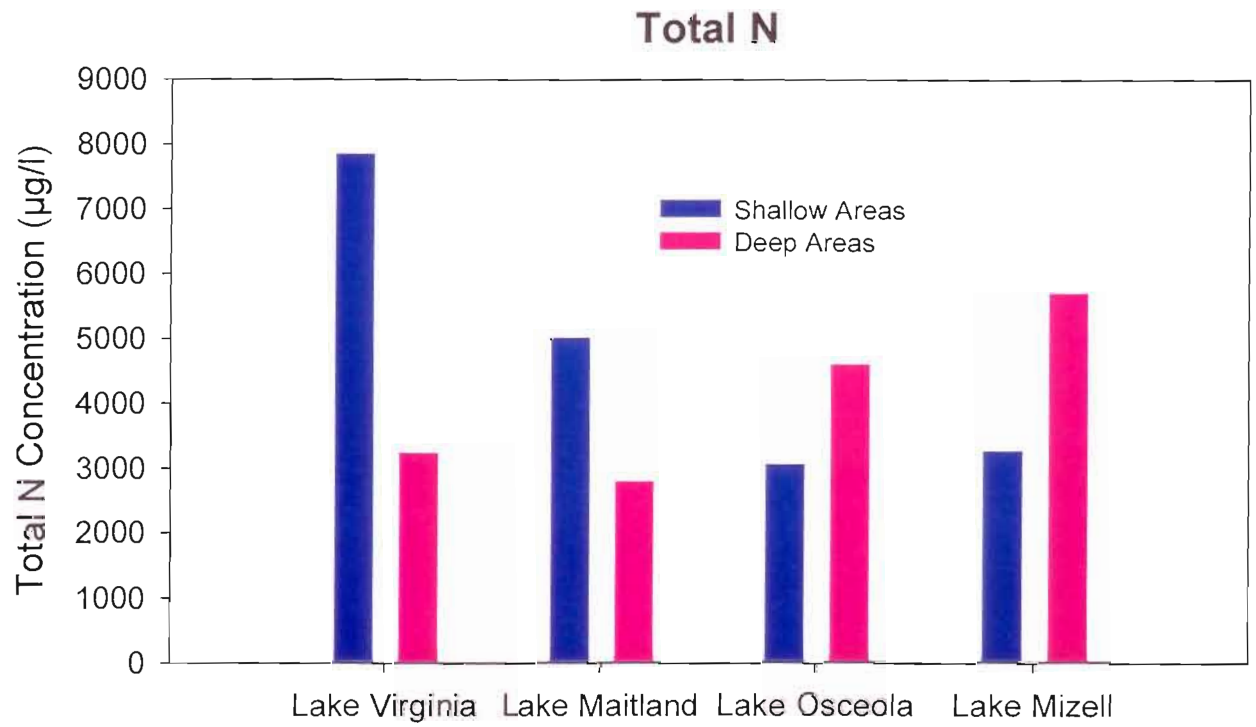


Figure 2-13. Comparison of Seepage Concentrations of Nitrogen Species in Shallow and Deep Areas of the Winter Park Chain-of Lakes.

A comparison of concentrations of phosphorus species in groundwater seepage from shallow and deep areas of the Chain-of-Lakes is given in Figure 2-14. Measured concentrations of both orthophosphorus and total phosphorus were found to be higher in shallow shoreline areas than observed in deeper areas of the lake. This trend provides further evidence that the concentrations of phosphorus in groundwater seepage are heavily impacted by watershed activities adjacent to each lake. As mentioned previously, seepage concentrations of both orthophosphorus and total phosphorus in Lake Osceola and Lake Mizell were found to be substantially lower than concentrations measured in the remaining lakes.

Mean water quality characteristics at each of the seepage monitoring sites were used to develop estimated wet season and dry season seepage isopleths for total nitrogen and total phosphorus entering each of the four evaluated lakes. Estimated wet season total nitrogen seepage isopleths for the Winter Park Chain-of-Lakes are presented in Figure 2-15. In general, wet season concentrations of total nitrogen in groundwater seepage appear to be greatest near the deeper areas of the four lakes, with lower total nitrogen concentrations measured around the perimeter of the lakes. However, substantially elevated seepage concentrations of total nitrogen were observed on the southeast lobe of Lake Virginia, the south side of the northern lobe of Lake Osceola, and the northwest lobe of Lake Maitland. Total nitrogen concentrations in wet season seepage range from approximately 1-10 times greater than nitrogen concentrations observed in the water columns of the four lakes.

Dry season seepage isopleths of total nitrogen entering the Winter Park Chain-of-Lakes are summarized in Figure 2-16. However, in contrast to the trends observed under wet season conditions, total nitrogen concentrations under dry season conditions appear to be greater in shoreline areas, with lower concentrations measured near the center of the lakes. Elevated levels

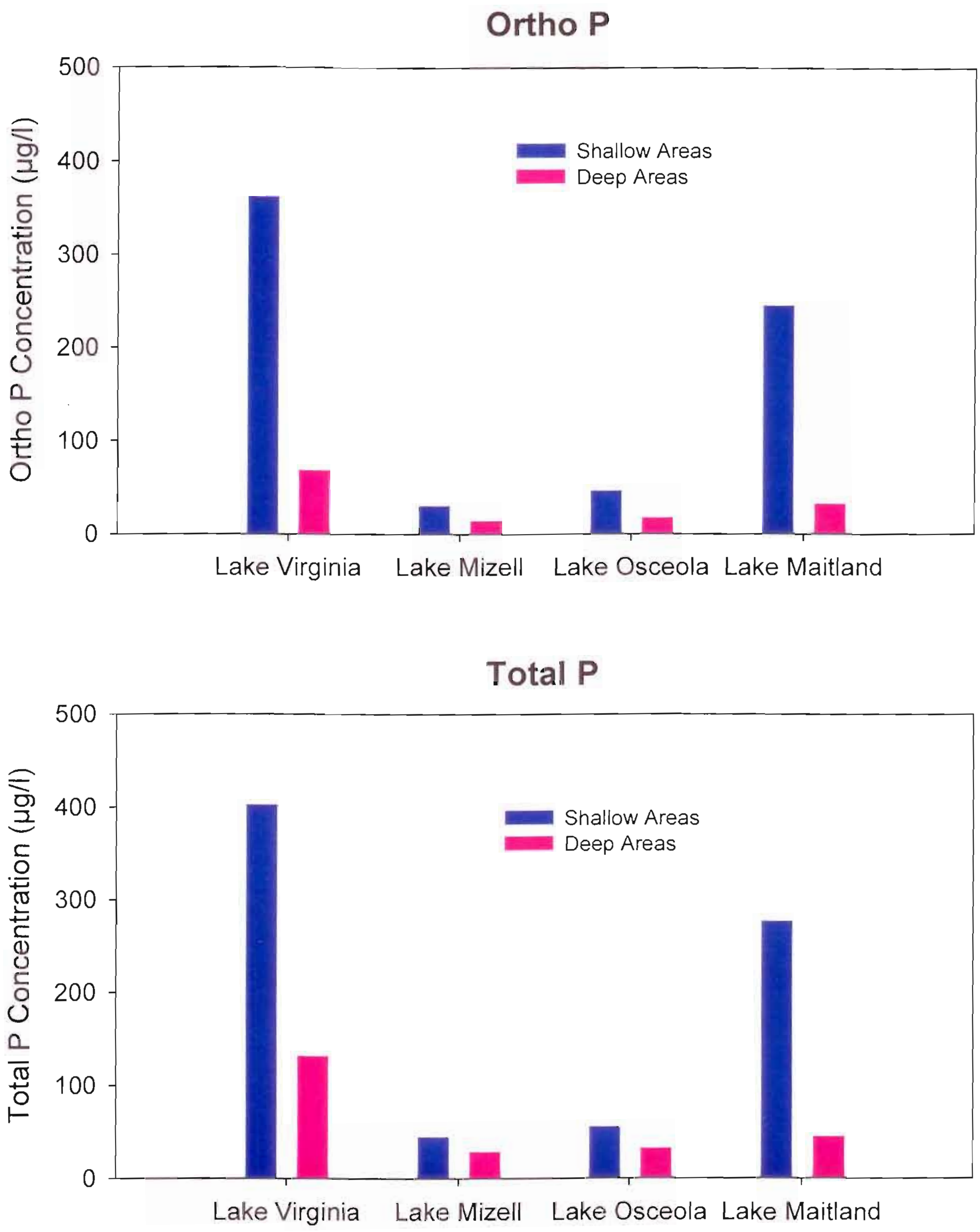
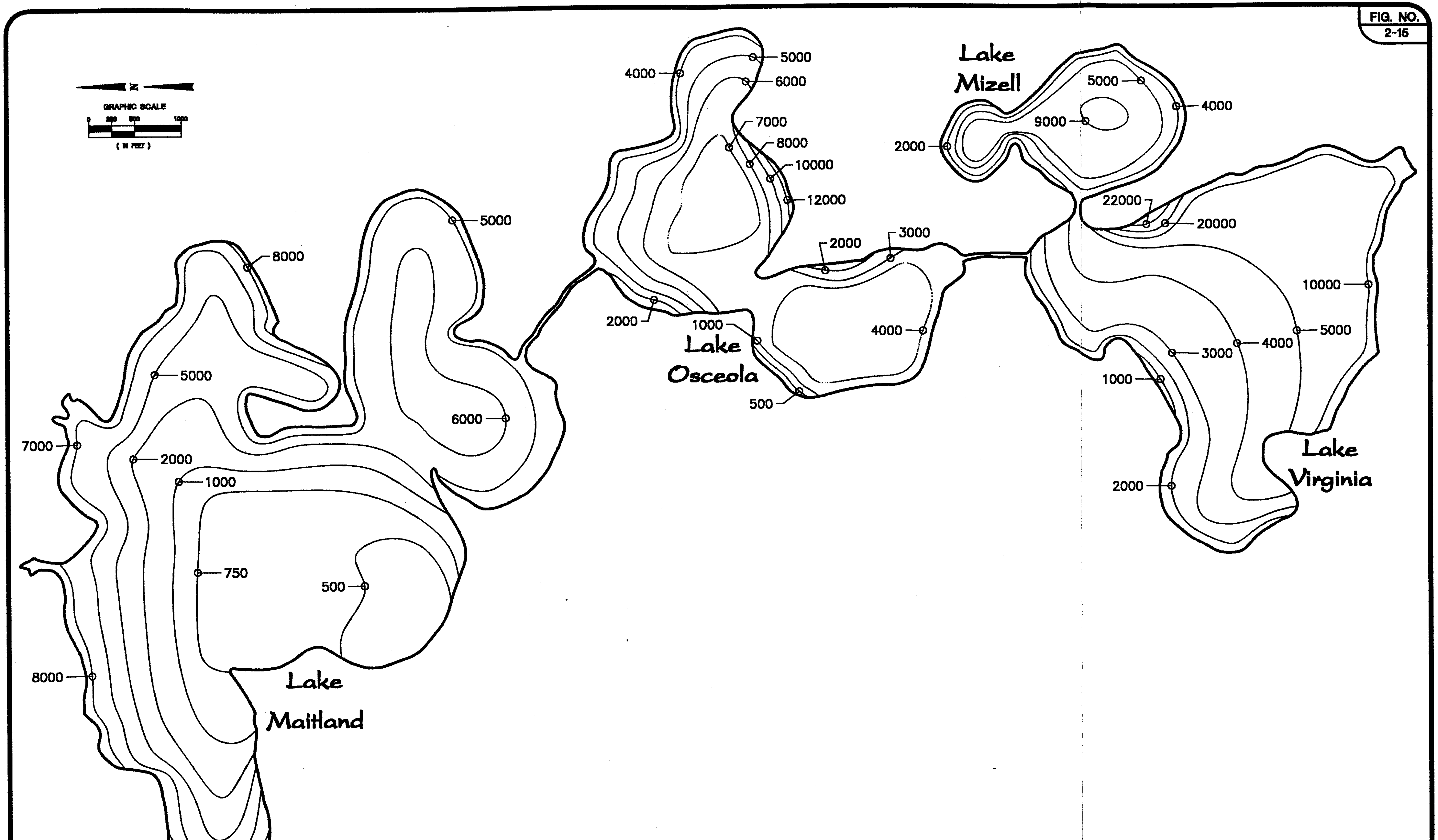


Figure 2-14. Comparison of Seepage Concentrations of Phosphorus Species in Shallow and Deep Areas of the Winter Park Chain-of Lakes.

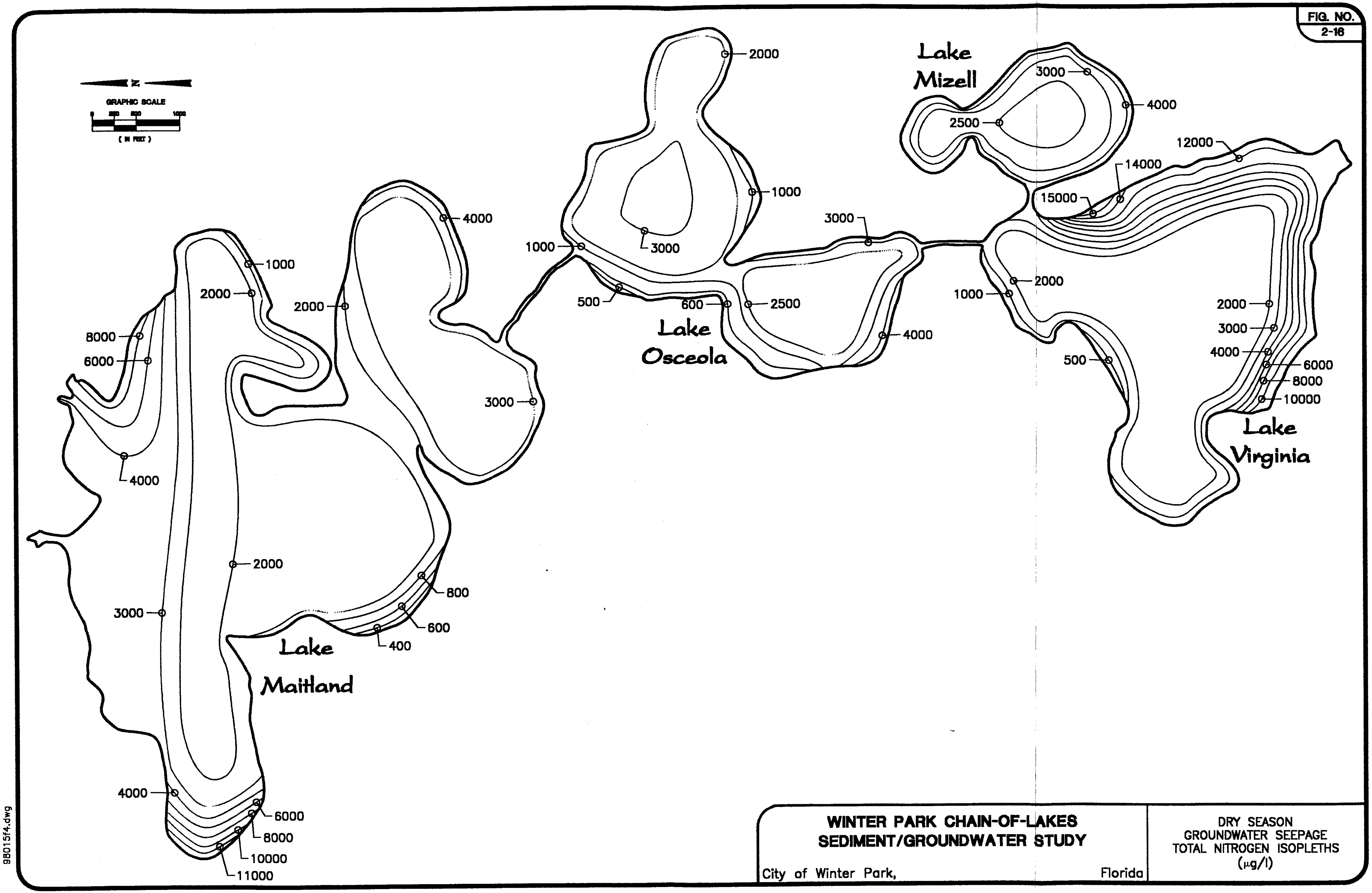


WINTER PARK CHAIN-OF-LAKES
SEDIMENT/GROUNDWATER STUDY

City of Winter Park, Florida

WET SEASON
GROUNDWATER SEEPAGE
TOTAL NITROGEN ISOPLETHS
(μg/l)

FIG. NO. 2-16



WINTER PARK CHAIN-OF-LAKES
SEDIMENT/GROUNDWATER STUDY

City of Winter Park, Florida

DRY SEASON
GROUNDWATER SEEPAGE
TOTAL NITROGEN ISOPLETHS
(μg/l)

of total nitrogen inputs under dry season conditions were observed along the southern and eastern sides of Lake Virginia, along with the west lobe of Lake Maitland. It is interesting to note that the highest total nitrogen concentrations observed in any of the four evaluated lakes were found in predominantly undeveloped areas along the east side of Lake Virginia. This area is utilized heavily by aquatic waterfowl for roosting and nesting purposes. Large amounts of waste products from waterfowl are visible on the vegetation and soil in these areas. It appears that the nutrients contained in this waste may be leaching into the shallow groundwater and entering Lake Virginia as groundwater seepage. ERD has performed several previous studies throughout Florida which have demonstrated that waterfowl can often be significant contributors of nutrient loadings to lakes.

Estimated wet season total phosphorus seepage isopleths for the Winter Park Chain-of-Lakes are summarized in Figure 2-17. Areas of elevated total phosphorus inputs are also apparent along the east side of Lake Virginia which may also reflect impacts from waterfowl in this area. Total phosphorus isopleths in Lake Mizell and the south lobe of Lake Osceola appear to be lower than isopleths measured in the other lakes, presumably due to uptake of phosphorus by the alum floc which has been deposited in these areas. An elevated level of total phosphorus inputs is also apparent along the west lobe of Lake Maitland. Total phosphorus concentrations in groundwater seepage under wet season conditions ranged from approximately 1-100 times greater than phosphorus concentrations typically observed in the water columns of the four lakes.

Estimated dry season total phosphorus seepage isopleths for the Winter Park Chain-of-Lakes are summarized in Figure 2-18. Elevated levels of total phosphorus under dry season conditions were observed along the east shore of Lake Virginia and the west lobe of Lake Maitland. Seepage inputs in other areas of the Chain-of-Lakes appear to be relatively low in value under dry season conditions.

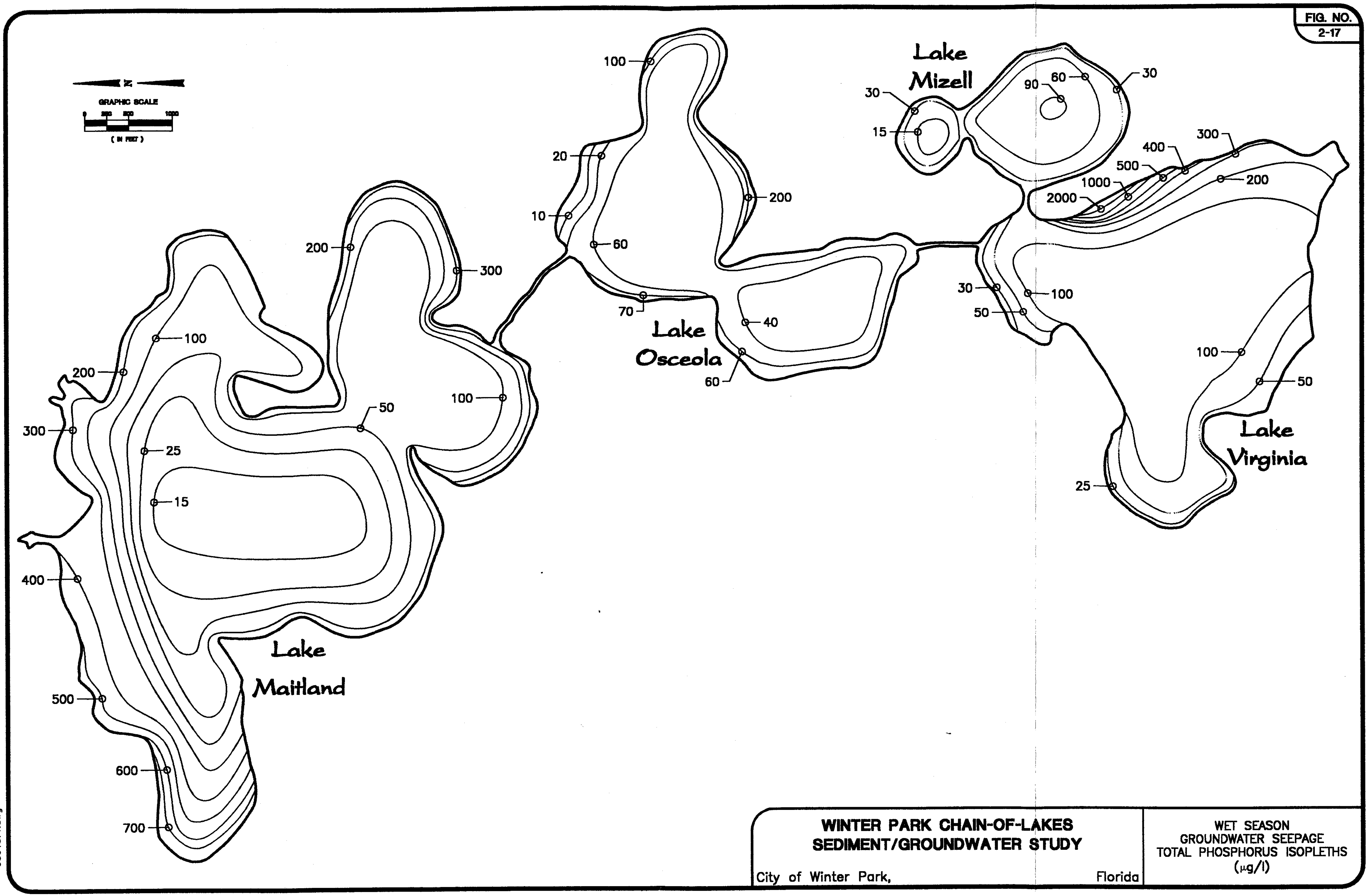
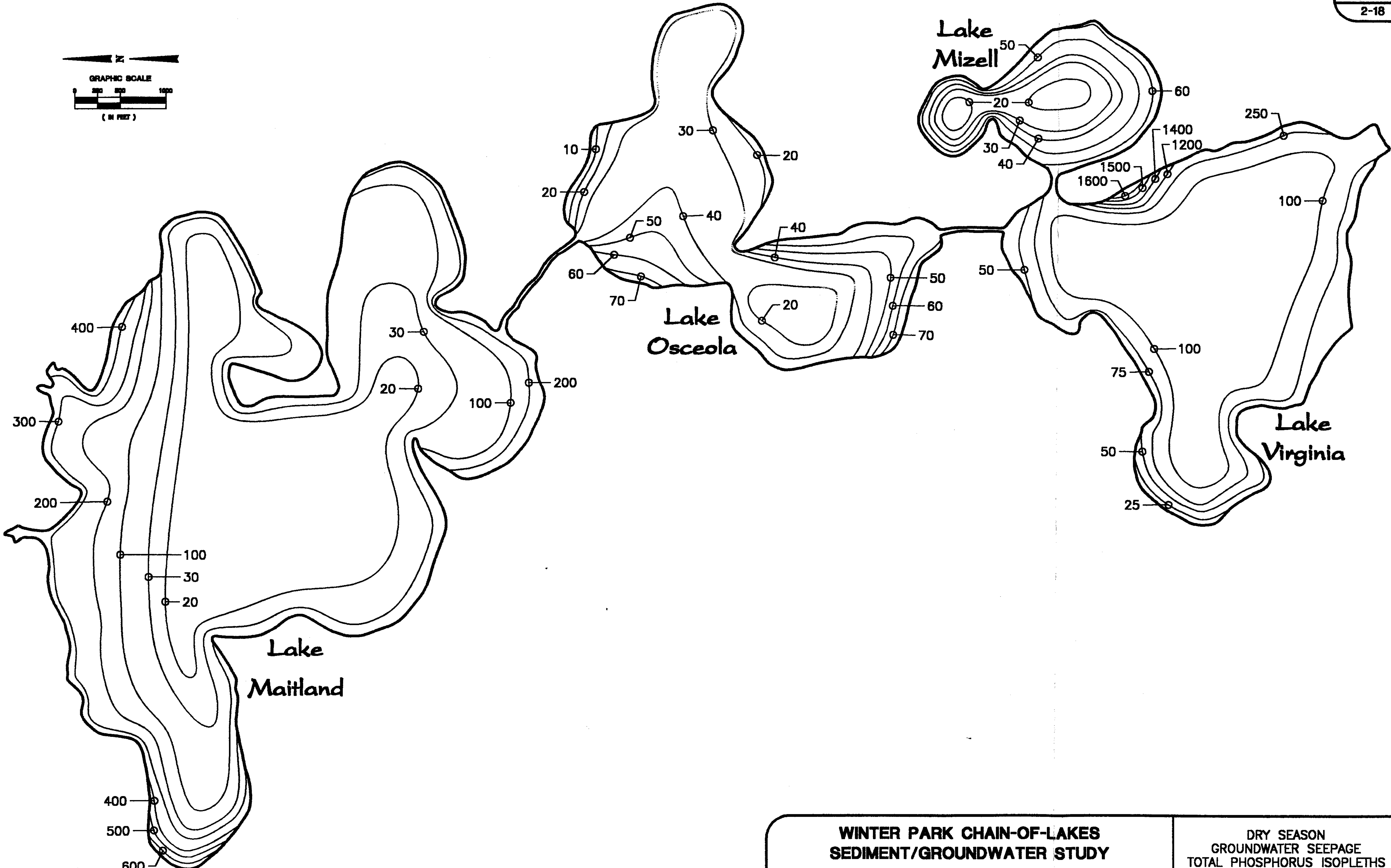


FIG. NO.
2-17
GRAPHIC SCALE
(IN FEET)
Lake Maitland
Lake Osceola
Lake Mizell
Lake Virginia
100
200
300
400
500
600
700
25
15
50
100
200
300
20
10
60
70
60
40
200
100
30
15
90
60
30
300
400
500
1000
2000
200
30
50
100
100
50
25
98015f4.dwg
WINTER PARK CHAIN-OF-LAKES
SEDIMENT/GROUNDWATER STUDY
City of Winter Park, Florida
WET SEASON
GROUNDWATER SEEPAGE
TOTAL PHOSPHORUS ISOPLETHS
(µg/l)

FIG. NO. 2-18



WINTER PARK CHAIN-OF-LAKES
SEDIMENT/GROUNDWATER STUDY

City of Winter Park, Florida

DRY SEASON
GROUNDWATER SEEPAGE
TOTAL PHOSPHORUS ISOPLETHS
(μg/l)

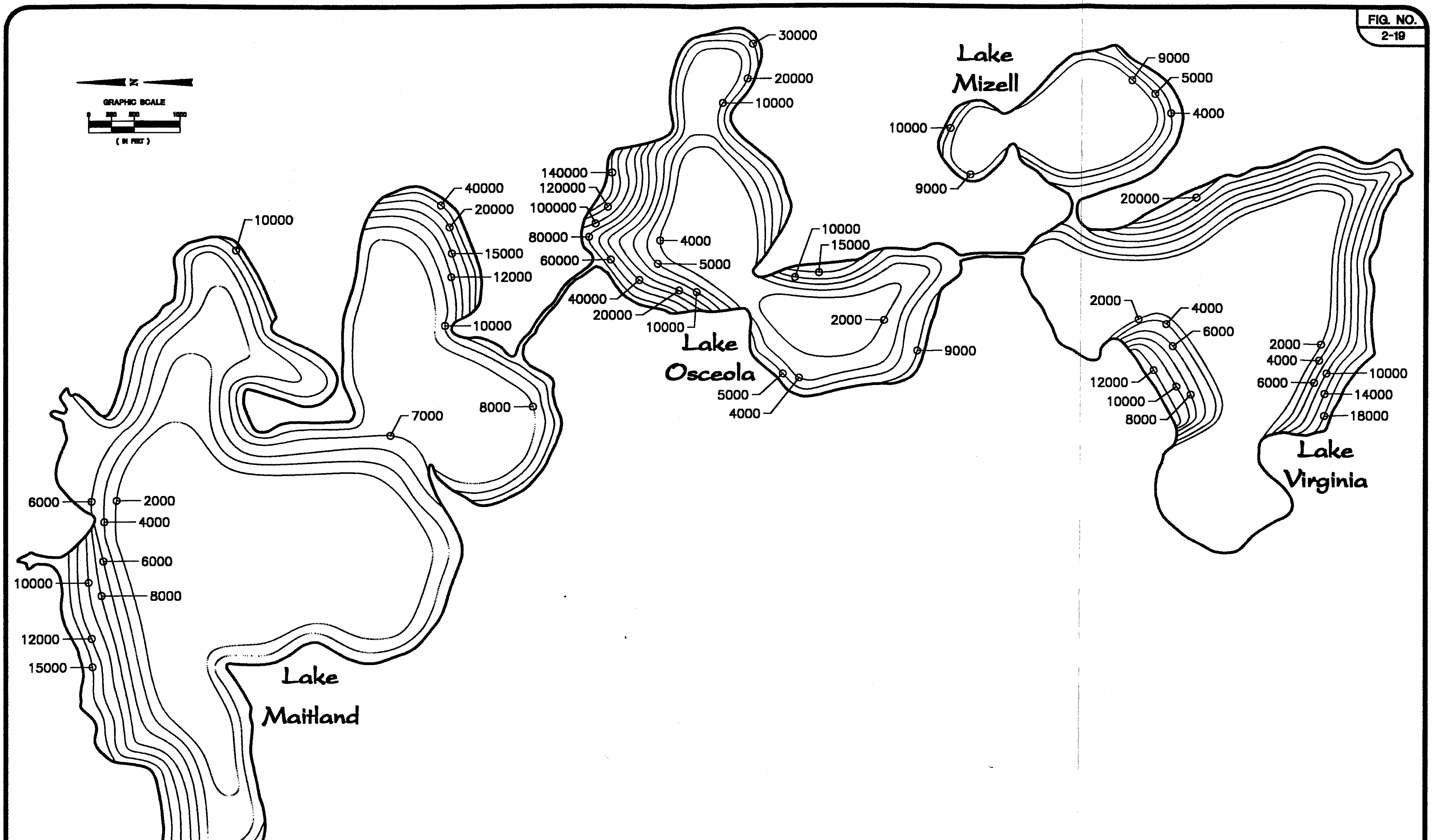
98015f4.dwg

2.1.3.2 Estimated Mass Loadings from Groundwater Seepage

Estimated mass loading isopleths for total nitrogen and total phosphorus were generated for each of the four evaluated lakes under wet season and dry season conditions by combining the concentration-based characteristics presented in the previous section with the hydraulic inputs from groundwater seepage outlined in Section 2.1.2. This procedure generated isopleths which predict inputs of nitrogen and phosphorus in terms of micrograms per square meter of lake area per day ($\mu g/m^2$-day). These estimated mass loading isopleths consider the impact of both hydraulic inflow rates as well as chemical characteristics to provide an estimate of overall mass inputs entering the four lakes.

Mass loading isopleths for total nitrogen in groundwater seepage under wet season conditions are summarized in Figure 2-19. Total nitrogen influx under wet season conditions ranges from approximately 2000 to more than 140,000 mg/m^2-day. In general, nitrogen influx appears to be greatest around the perimeter of the lakes, with lower influx rates observed near the central portions of the lakes. Nitrogen influx values in excess of 20,000 mg/m^2-day were observed along the west shore of Lake Virginia, the northern side of the north lobe of Lake Osceola, and the southeast lobe of Lake Maitland. The highest area of nitrogen influx into the Winter Park Chain-of-Lakes occurs along the northern side of the north lobe of Lake Osceola. Although nitrogen concentrations in this area were relatively low, the area was characterized by extremely high flow rates which result in elevated mass loadings.

Mass loadings for total nitrogen entering the Winter Park Chain-of-Lakes under dry season conditions are summarized in Figure 2-20. In general, mass loading isopleths under dry season conditions appear to be substantially lower than values measured under wet season conditions. This decrease is due, at least in part, to substantially lower flows observed during



WINTER PARK CHAIN-OF-LAKES
SEDIMENT/GROUNDWATER STUDY

City of Winter Park, Florida

WET SEASON
GROUNDWATER SEEPAGE
TOTAL NITROGEN
MASS INFLUX ISOPLETHS
($\mu g/m^2$ –day)

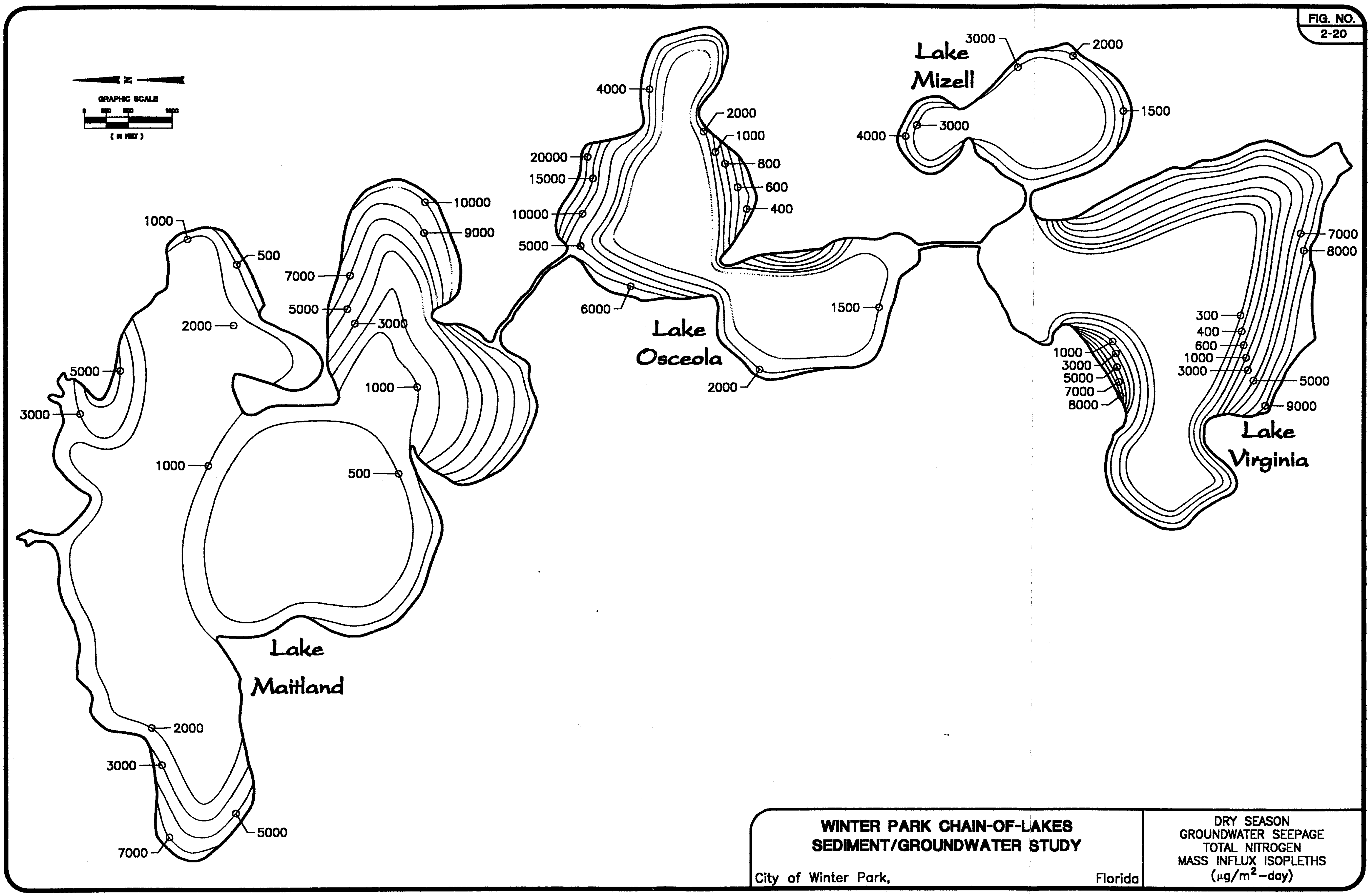


FIG. NO.
2-20
N
GRAPHIC SCALE
(IN FEET)
Lake Maitland
Lake Osceola
Lake Mizell
Lake Virginia
1000
500
2000
5000
3000
1000
500
2000
3000
5000
7000
10000
9000
7000
5000
3000
1000
4000
20000
15000
10000
5000
6000
2000
1000
800
600
400
1500
2000
3000
2000
1500
4000
3000
7000
8000
300
400
600
1000
3000
5000
9000
1000
3000
5000
7000
8000
WINTER PARK CHAIN-OF-LAKES
SEDIMENT/GROUNDWATER STUDY
City of Winter Park, Florida
DRY SEASON
GROUNDWATER SEEPAGE
TOTAL NITROGEN
MASS INFLUX ISOPLETHS
(μg/m²–day)

98015f4.dwg

dry season conditions. Total nitrogen influx rates under dry season conditions range from approximately 300-20,000 $\mu g/m^2$-day. However, similar to the trends observed under wet season conditions, elevated levels of nitrogen influx area apparent along the east side of Lake Virginia, the north side of the north lobe of Lake Osceola, the southeast lobe of Lake Maitland, and the western lobe of Lake Maitland.

Mass loading isopleths for total phosphorus in groundwater seepage under wet season conditions are presented in Figure 2-21. Mass influx of total phosphorus in the Winter Park Chain-of-Lakes ranges from approximately 10-3000 $\mu g/m^2$-day. The lowest mass influx rates for total phosphorus appear to occur in the southern lobe of Lake Osceola and in Lake Mizell, both of which have received inputs of alum floc. Elevated levels of phosphorus mass influx under wet season conditions are apparent along the east side of Lake Virginia, the northwest edge of the north lobe of Lake Osceola, and the southeast lobe of Lake Maitland.

Mass loading isopleths for total phosphorus entering the Winter Park Chain-of-Lakes under dry season conditions are summarized in Figure 2-22. In general, mass influx rates under dry season conditions are substantially lower than mass influx under wet season conditions. Under dry season conditions, mass influx ranges from approximately 10-800 $\mu g/m^2$-day. Elevated levels of total phosphorus influx under dry season conditions were observed along the east and northwest sides of Lake Virginia, the northwest edge of the north lobe of Lake Osceola, the south lobe of Lake Maitland, and the western lobe of Lake Maitland. Similar to the trend observed under wet season conditions, mass influx of total phosphorus appears to be lower in Lake Mizell and in the south lobe of Lake Osceola than in the remaining lakes.

Estimates of the daily mass influx of total nitrogen and total phosphorus under wet season and dry season conditions were calculated for each of the four evaluated lakes by integrating the

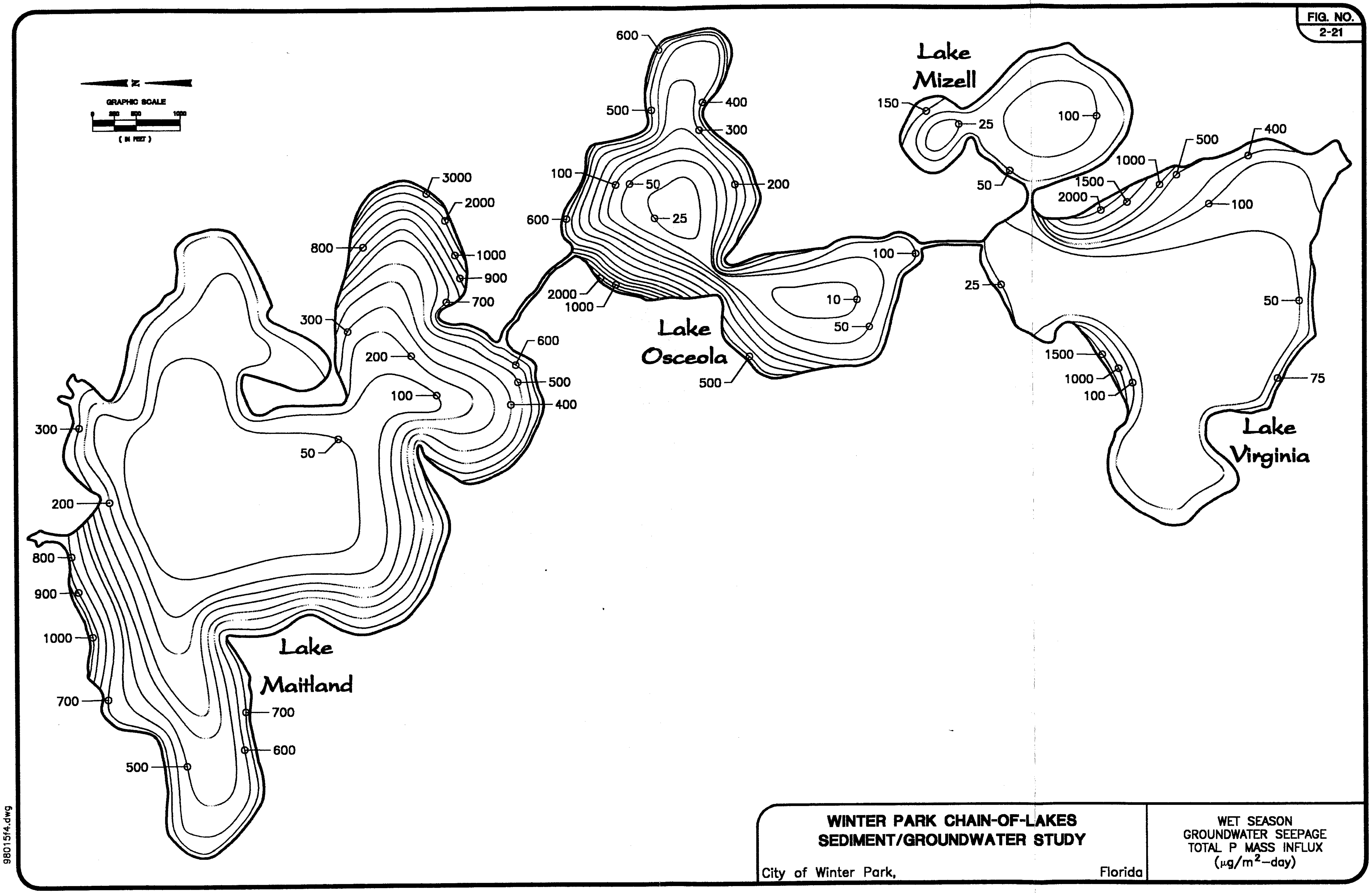
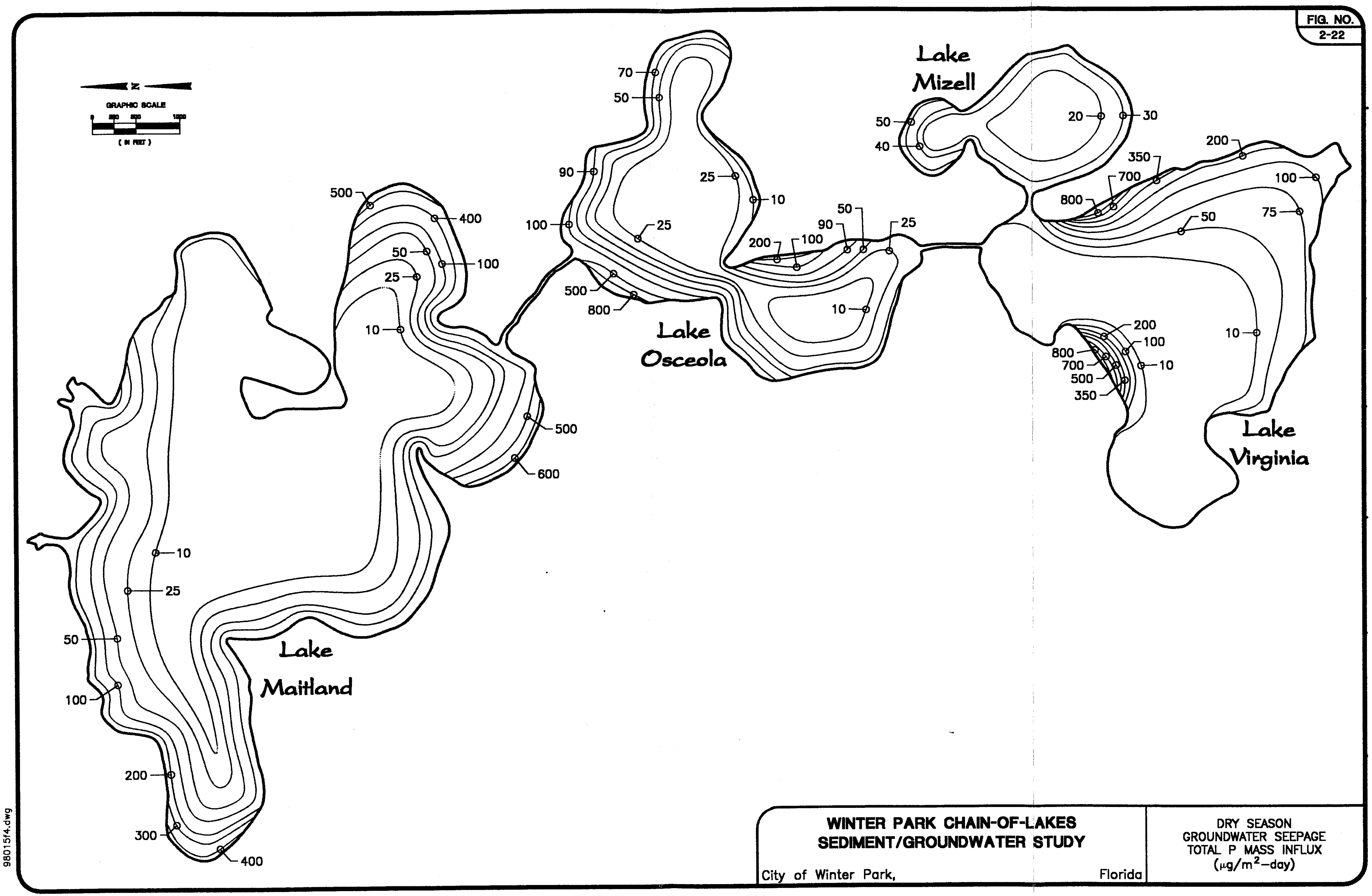


FIG. NO. 2-21

WINTER PARK CHAIN-OF-LAKES SEDIMENT/GROUNDWATER STUDY

City of Winter Park, Florida

WET SEASON GROUNDWATER SEEPAGE TOTAL P MASS INFLUX ($\mu g/m^2$–day)



WINTER PARK CHAIN-OF-LAKES
SEDIMENT/GROUNDWATER STUDY

City of Winter Park, Florida

DRY SEASON
GROUNDWATER SEEPAGE
TOTAL P MASS INFLUX
($\mu g/m^2$-day)

isopleths presented in Figures 2-19 through 2-22. Estimates of total mass inflow under wet season and dry season conditions were obtained by multiplying the daily wet season inputs by 153 days, assuming that the wet season conditions occur during the period from July-November. Estimates of total mass influx under dry season conditions were obtained by multiplying the daily dry season mass influx by 212 days, assuming that dry season conditions occur from December-June.

A summary of estimated wet season and dry season seepage inputs of total nitrogen and total phosphorus to the Winter Park Chain-of-Lakes is given in Table 2-4. Wet season inputs of total nitrogen are substantially greater in each of the four lakes than loadings under dry season conditions, in spite of the fact that wet season conditions occur for a smaller portion of the year. Estimated total annual inputs of total nitrogen from groundwater seepage appear to be similar in Lake Virginia, Lake Osceola, and Lake Maitland, ranging from approximately 1100-1250 kg/yr. In contrast, inputs of total nitrogen into Lake Mizell from groundwater seepage contributed approximately 485 kg/yr.

TABLE 2-4

SUMMARY OF ESTIMATED WET SEASON AND DRY SEASON SEEPAGE INPUTS OF TOTAL NITROGEN AND TOTAL PHOSPHORUS TO THE WINTER PARK CHAIN-OF-LAKES

LAKE	TOTAL NITROGEN LOADING (kg)			TOTAL PHOSPHORUS LOADING (kg)		
	WET	DRY	TOTAL	WET	DRY	TOTAL
Virginia	954	301	1255	31.1	4.93	36.1
Mizell	378	107	485	3.47	1.06	4.53
Osceola	1075	147	1222	4.44	3.98	8.43
Maitland	750	364	1114	25.0	20.1	45.1

As seen in Table 2-4, a high degree of variability appears to exist in seasonal and annual inputs of total phosphorus from groundwater seepage into the Chain-of-Lakes. Similar to the trend observed for total nitrogen, seepage inputs of total phosphorus appear to be greater under wet season conditions than dry season conditions in spite of the fact that the wet season occupies a smaller portion of the year. Inputs of total phosphorus into Lake Mizell and Lake Osceola from groundwater seepage appear to be relatively similar, ranging from 4.5-8.4 kg/yr. Inputs of total phosphorus from groundwater seepage entering Lake Virginia and Lake Maitland also appear to be similar, ranging from 36-45 kg/yr. The estimated inputs of total nitrogen and total phosphorus listed in Table 2-4 are utilized in a subsequent section for completion of nutrient budgets for the Winter Park Chain-of-Lakes.

2.2 Internal Recycling

Field and laboratory investigations were performed by ERD to quantify the mass of phosphorus released as a result of internal recycling from the sediments to the overlying water column in each of the four lakes under both aerobic and anoxic conditions. Large diameter lake sediment core samples were collected at multiple locations in each of the four lakes and incubated under anoxic and aerobic conditions. Periodic measurements of orthophosphorus and other water quality parameters were used to estimate sediment phosphorus release under the evaluated conditions. This information is utilized to provide an estimate of the significance of mass loadings of phosphorus from lake sediments as part of the overall nutrient budget for the Chain-of-Lakes.

2.2.1 Field and Laboratory Procedures

Multiple sediment core samples were collected in each of the four lakes using 4-inch diameter clear acrylic core tubes. Each of the acrylic tubes was driven into the sediments to the maximum possible depth using a large sledge hammer. A 4-inch x 4-inch wooden beam was placed on top of the acrylic core tube to evenly distribute the force of each sledge hammer blow and to prevent direct contact between the sledge hammer and the acrylic tube. Separate core samples were collected in each of the four evaluated lakes, at water depths of 5, 10, 15, and 20 ft, comprising a total of 16 separate large diameter core samples collected for this evaluation.

Each of the acrylic tubes was penetrated into the sediments to depths ranging from approximately 2-6 ft, depending upon the physical characteristics of the sediments at each of the selected monitoring sites, until a firm bottom material was encountered. Each of the core tubes was retrieved intact, along with the overlying water column present at each of the collection sites. Upon retrieval, a rubber cap was attached to the bottom of each core tube to prevent loss of sediments. The collected water volume above the trapped sediments was carefully siphoned off until a water depth of 18 inches remained in each of the collected columns above the sediment-water interface. Each of the acrylic core tubes was then cut at a height of 6 inches above the water level, leaving a 6-inch space between the water level and the top of the column. A 4-inch PVC cap was then placed on the top of each collected core tube. Each of the collected core tubes was then returned to the ERD laboratory for incubation experimentation. All samples were transported to the ERD laboratory in a vertical position so that mixing of the sediment layers did not occur during transport.

After return to the laboratory, each of the 16 collected core samples was attached to a laboratory work bench in a vertical position. Two separate ¼-inch diameter holes were then drilled into the PVC cap attached to the top of each core sample. A ¼-inch diameter semi-rigid polyethylene tube was inserted through one of the holes to a depth of approximately 2-3 inches above the sediment surface. An air stone diffuser was attached to the end of the tubing inside each core tube. This system was used to introduce selected gases into the core tubes to encourage aerobic and anoxic conditions.

A separate piece of polyethylene tubing was inserted into the second hole in the top of each core tube, approximately 1 inch below the level of the cap, but well above the water level contained in each tube. The other end of the tubing was connected to a water trap to minimize loss of water from each column as a result of evaporation. This tubing also provided a point of exit for gases which were bubbled into each core tube. A schematic of the sediment incubation apparatus is given in Figure 2-23.

After initial set-up of the incubation apparatus, compressed air was introduced into each of the core tubes, through the individual diffusers, using a compressed air source. This process quickly created aerobic conditions within each of the 16 core tubes. This aeration process was continued in each of the core tubes for a period of approximately 60 days. During the aeration process, the water within each of the core tubes was well mixed, so that phosphorus released from the sediments could be quantified as a function of changes in phosphorus concentrations within the water column of each core tube. On approximately a 1-2 day interval, 15 ml of water was withdrawn from each of the columns using a ¼-inch polyethylene tube and a plastic laboratory syringe. Each of the collected samples was immediately filtered using a 0.45 micron syringe type membrane filter and analyzed for orthophosphorus along with other significant laboratory parameters for research purposes. However, only the results of the orthophosphorus analyses are utilized in this report for purposes of estimating sediment phosphorus release rates.

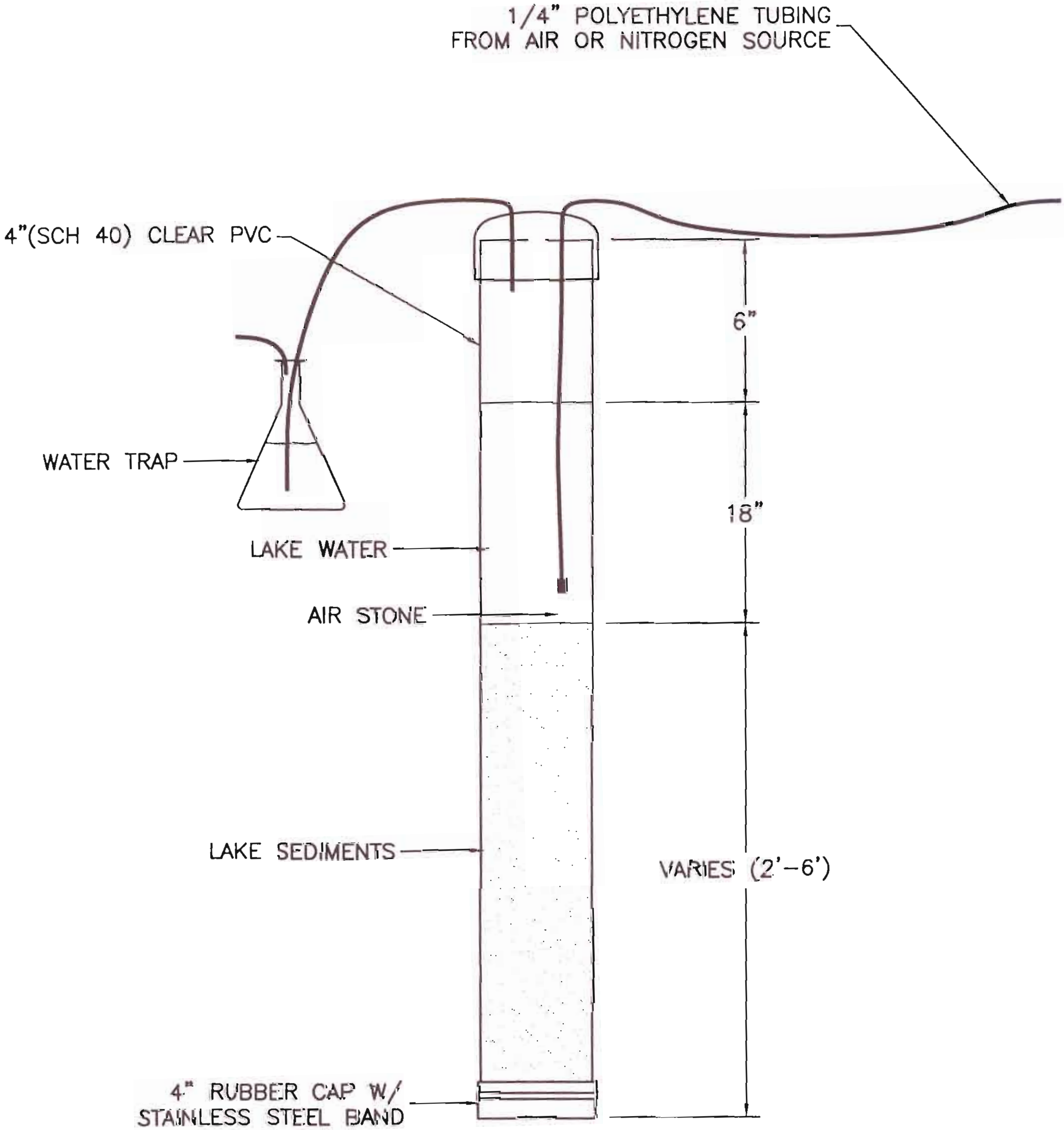


Figure 2-23. Schematic of Sediment Incubation Apparatus.

At the conclusion of the experimentation under aerobic conditions, the compressed air source was replaced with a pure nitrogen source. Nitrogen gas was gently bubbled through each of the 16 columns to remove existing dissolved oxygen and create anoxic conditions within each tube. In general, creation of anoxic conditions, as indicated by measurements of redox potential (< 200 mv) within each of the columns, occurred after approximately 5-7 days. At the onset of anoxic conditions, sample collection was conducted on a 1-2 day basis from each of the 16 columns using the method previously outlined for aerobic conditions. Incubation of samples under anoxic conditions was continued for approximately 90 days.

At the time of sample collection for the 4-inch sediment core samples, 2-inch diameter sediment core samples were also collected at each site using a stainless steel split spoon core collection device, to evaluate the physical and chemical characteristics of sediments in the vicinity of the core samples collected for the isolation experiments. Triplicate samples were collected at each site and the 0-10 cm layer from each sample was combined together to form a single composite 0-10 cm layer for each of the 16 monitored sites. The 0-10 cm layer was collected since sediment phosphorus release is typically regulated by the physical and chemical characteristics of this zone. Each of these collected samples was evaluated in the laboratory for moisture content, organic content, total nitrogen, total phosphorus, total iron, total aluminum, saloid-bound phosphorus, iron-bound phosphorus, aluminum-bound phosphorus, and wet density. The chemical characteristics of each of the collected samples is assumed to be similar to sediment characteristics present in the large diameter sediment core samples collected at each of the monitoring sites.

Collection of the large diameter (4-inch) and smaller diameter (2-inch) sediment core samples was performed during February and March 1999. Experimentation under aerobic conditions was initiated in April 1999, with anoxic experimentation initiated during July 1999.

2.2.2 Results of Field and Laboratory Procedures

2.2.2.1 Sediment Characteristics

A summary of characteristics of core samples collected in the Winter Park Chain-of-Lakes is given in Table 2-5. Characteristics presented in this table reflect the results of laboratory analyses on the small diameter samples collected simultaneously with the large-diameter core samples.

Several general trends are apparent in the sediment characteristics presented in Table 2-5. In general, measured values for moisture content, organic content, total nitrogen, and total phosphorus are higher in the shallow shoreline areas and deep central portions of each lake than was observed in sediments collected from intermediate water depths ranging from 10-15 ft. Elevated levels of moisture content, organic content, and nutrients are often indicative of areas where organic matter and detritus may be accumulating at relatively high rates. The data in Table 2-5 suggest that organic matter and detritus is primarily accumulating in the shallow shoreline areas and deeper areas of the Chain-of-Lakes, with substantially lower accumulation rates in the intermediate water depths. The apparent accumulation of organic matter in shallow areas of the lakes (5 ft deep or less) may be related to entrapment of organic matter by shoreline vegetation which exists around the perimeter of most of the lakes. Accumulation of organic matter near the center of each lake is a natural process driven by wave action and continual migration of particulate matter toward deeper areas of the lake.

Mean values of moisture content and organic content in the collected core samples appear to be relatively similar in Lake Virginia, Lake Osceola, and Lake Maitland. However, Lake Mizell appears to have somewhat higher levels for both moisture content and organic content, suggesting that the accumulation of organic matter is more advanced in Lake Mizell than in the

TABLE 2-5

CHARACTERISTICS OF CORE SAMPLES COLLECTED IN THE WINTER PARK CHAIN-OF-LAKES DURING 1999

LAKE	SITE	LAYER (cm)	MOISTURE CONTENT (%)	ORGANIC CONTENT (%)	SEDIMENT NUTRIENT CONTENT ($\mu g/cm^3$)		TOTAL Fe ($\mu g/cm^3$)	TOTAL Al ($\mu g/cm^3$)	SEDIMENT P SPECIATION ($\mu g/cm^3$)				WET DENSITY (g/cm^3)
					TOTAL N	TOTAL P			SALOID -P	Fe-BOUND P	Al-BOUND	TOTAL AVAILABLE P	
Mizell	5 ft	0-10	95.4	68.9	1885	296	471	1299	2.4	44	70	46	1.02
	10 ft	0-10	27.1	0.9	427	55	108	393	0.1	18	10	18	2.08
	15 ft	0-10	26.4	1.4	685	359	226	1835	1.8	87	42	89	2.09
	20 ft	0-10	90.7	46.2	1740	253	544	1550	2.4	45	60	47	1.08
	Mean	--	59.9	29.4	1354	341	337	1269	1.7	49	46	50	1.57
Virginia	5 ft	0-10	50.9	6.4	1670	945	639	5920	2.0	274	394	276	1.69
	10 ft	0-10	27.4	2.0	1042	841	555	5523	5.7	155	388	161	2.07
	15 ft	0-10	23.6	0.7	495	226	83	1220	2.5	48	52	51	2.14
	20 ft	0-10	94.0	50.8	2973	438	916	2610	4.4	68	86	72	1.04
	Mean	--	49.0	15.0	1545	613	548	3818	3.7	136	230	140	1.74
Osceola	5 ft	0-10	39.6	3.4	1325	533	517	2653	0.1	159	71	159	1.88
	10 ft	0-10	20.4	0.8	374	283	100	1291	0.5	89	32	90	2.18
	15 ft	0-10	27.2	1.0	573	312	137	1231	0.8	59	24	60	2.08
	20 ft	0-10	90.0	42.8	2736	597	788	3539	4.2	125	124	129	1.09
	Mean	--	44.3	12.0	1252	431	386	2178	1.4	108	63	120	1.81
Maitland	5 ft	0-10	56.3	5.8	1597	448	651	2062	1.5	128	41	130	1.62
	10 ft	0-10	26.7	2.0	893	155	335	936	0.6	62	20	63	2.08
	15 ft	0-10	25.5	0.8	474	184	224	1106	1.7	79	21	81	2.11
	20 ft	0-10	88.3	43.3	1853	819	1035	4991	6.3	264	114	270	1.10
	Mean	--	49.2	13.0	1204	402	561	2274	2.5	133	49	136	1.73

remaining lakes. Differences in sediment characteristics are also observed in measured wet densities which are relatively similar for Lake Virginia, Lake Osceola, and Lake Maitland, but somewhat lower in value for Lake Mizell. Lower values of wet density are also indicative of a higher degree of organic matter within the sediments. In terms of nutrient content, sediments collected in Lake Mizell, Lake Osceola, and Lake Maitland appear to have similar concentrations of total nitrogen and total phosphorus, while somewhat elevated levels of these parameters appear to exist in Lake Virginia.

The results of sediment phosphorus speciation procedures on the collected sediment core samples are also presented in Table 2-5. Under this speciation scheme, both saloid-bound phosphorus (comprised of soluble plus easily exchangeable phosphorus) and iron-bound phosphorus (consisting of phosphorus bound with various associations with iron) are considered potentially available for release into the overlying water column. Saloid-bound phosphorus is continually available as a result of diffusion processes, while iron-bound phosphorus is available under reduced conditions in the sediments. The magnitude of the sum of these sources is an indication of the potential for recycling within a particular area of sediments. Aluminum-bound phosphorus is generally considered to be unavailable for release regardless of changes in redox potential or pH.

A comparison of total available sediment phosphorus in the Winter Park Chain-of-Lakes is given in Figure 2-24. Mean concentrations of total available phosphorus within the sediments of the four lakes are compared based upon the 1999 monitoring event. In addition, phosphorus speciation is also provided for Lake Mizell based upon sediment samples collected in December 1996 prior to the surface applications of alum performed to Lake Mizell during 1997 and 1998. Total available phosphorus concentrations in the sediments of Lake Virginia and Lake Maitland

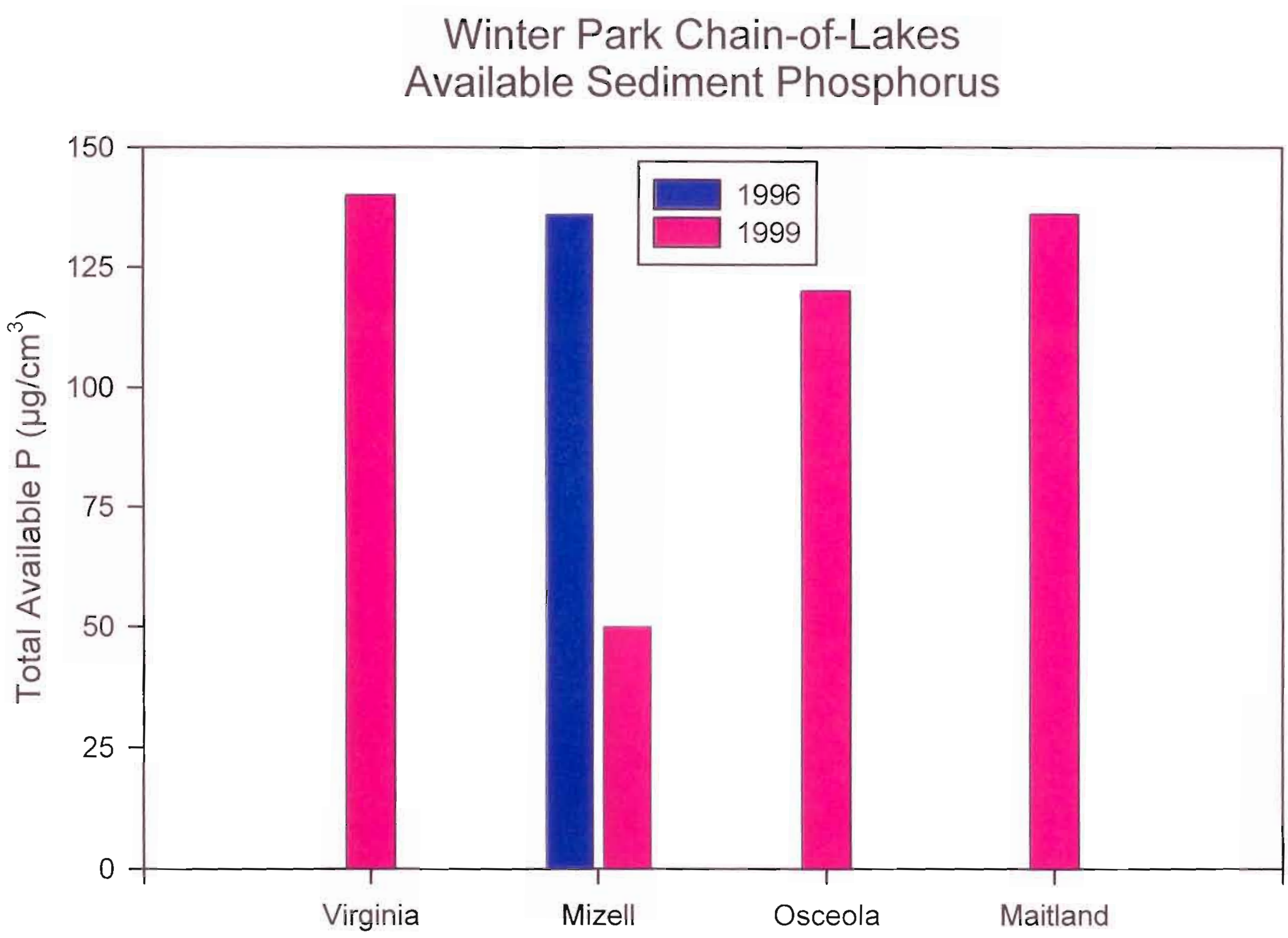


Figure 2-24. Comparison of Total Available Sediment Phosphorus in the Winter Park Chain-of-Lakes.

appear to be relatively similar, with values ranging from 136-140 $\mu g/cm^3$. A slightly lower value of 120 $\mu g/cm^3$ was observed in Lake Osceola. However, total available phosphorus in Lake Mizell, based on the 1999 monitoring event, is substantially lower than available phosphorus measured in the sediments of the remaining lakes. Lake Mizell received multiple surface applications of alum during 1997-1998 to inactivate available phosphorus within the sediments. Although it has been several years since the final alum surface treatment performed in Lake Mizell, the sediments within the lake still exhibit substantially lower levels of total available phosphorus than the remaining lakes. Based on pre-alum treatment monitoring performed in Lake Mizell in December 1996, total available phosphorus within the lake prior to the alum surface treatments was similar to values measured in Lake Virginia and Lake Maitland.

2.2.2.2 Results of Sediment Release Experiments

A complete listing of the chemical characteristics of isolation experiments performed on core samples incubated under aerobic conditions is provided in Appendix B.1. A complete listing of chemical characteristics of isolation experiments performed under anoxic conditions is given in Appendix B.2. Laboratory analyses were performed on each of the collected isolation chamber samples for alkalinity, nitrogen species, phosphorus species, color, sulfate, and dissolved aluminum. However, for purposes of this evaluation, only the orthophosphorus measurements are presented for purposes of estimating phosphorus release from lake sediments.

A graphical summary of sediment release of orthophosphorus in Lake Virginia under aerobic and anoxic conditions is given in Figure 2-25. Separate plots are provided for phosphorus release measured in sediment core samples collected from water depths of 5 ft, 10

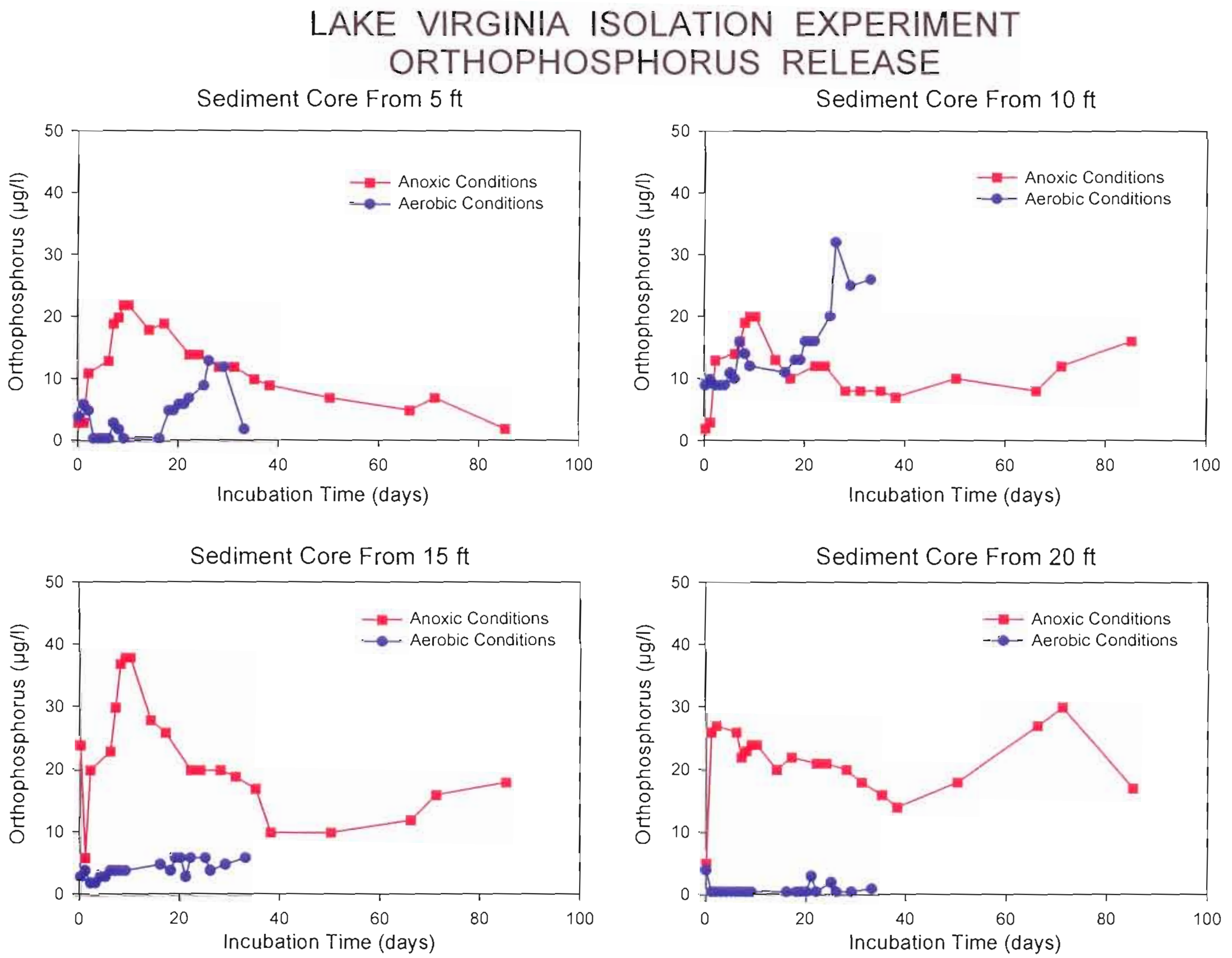


Figure 2-25. Sediment Release of Orthophosphorus in Lake Virginia Under Aerobic and Anoxic Conditions.

ft, 15 ft, and 20 ft. With the exception of the sediment core collected in Lake Virginia at a depth of 10 ft, release of orthophosphorus from the lake sediment core samples appears to be substantially greater under anoxic conditions than observed under aerobic conditions. Low rates of phosphorus release were observed under aerobic conditions in sediment core samples collected from depths of 5 ft, 15 ft, and 20 ft. In contrast, substantially greater levels of orthophosphorus releases were observed in the same samples under anoxic conditions. This trend is consistent with the current theoretical belief that sediment iron-phosphorus associations are relatively stable under aerobic conditions but become unstable under anoxic conditions, allowing phosphorus to be released from the sediments into the overlying water column.

A graphical comparison of orthophosphorus release from isolation chamber sediments in Lake Mizell under aerobic and anoxic conditions is given in Figure 2-26. Phosphorus release in Lake Mizell sediments under aerobic conditions was found to be extremely low in value. Phosphorus release was observed to increase under anoxic conditions, although not to the extent observed in Lake Virginia, particularly in sediment core samples collected from deeper areas of each lake (15 ft and 20 ft). As discussed previously, Lake Mizell has received several surface alum applications to inactivate phosphorus release under anoxic conditions. These applications appear to have substantially reduced phosphorus release in Lake Mizell under anoxic conditions compared with phosphorus release observed in Lake Virginia which has not received sediment inactivation with alum. It is interesting to note that the highest level of orthophosphorus release in Lake Mizell under anoxic conditions was observed in the shallow shoreline areas which were not included in the surface applications of alum performed on the lake.

A graphical comparison of orthophosphorus release from Lake Osceola sediments under aerobic and anoxic conditions is given in Figure 2-27. The sediment core samples in Lake

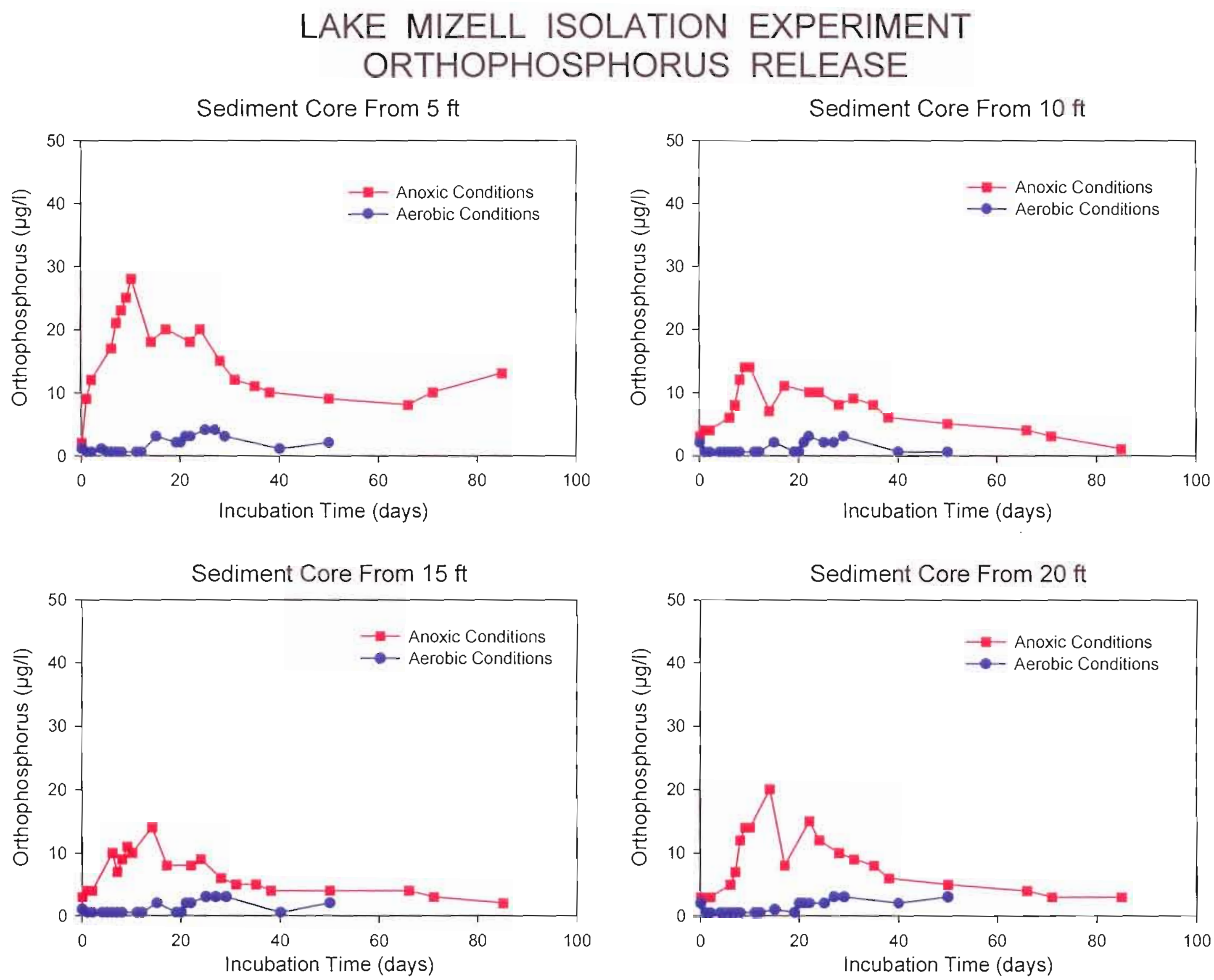


Figure 2-26. Sediment Release of Orthophosphorus in Lake Mizell Under Aerobic and Anoxic Conditions.

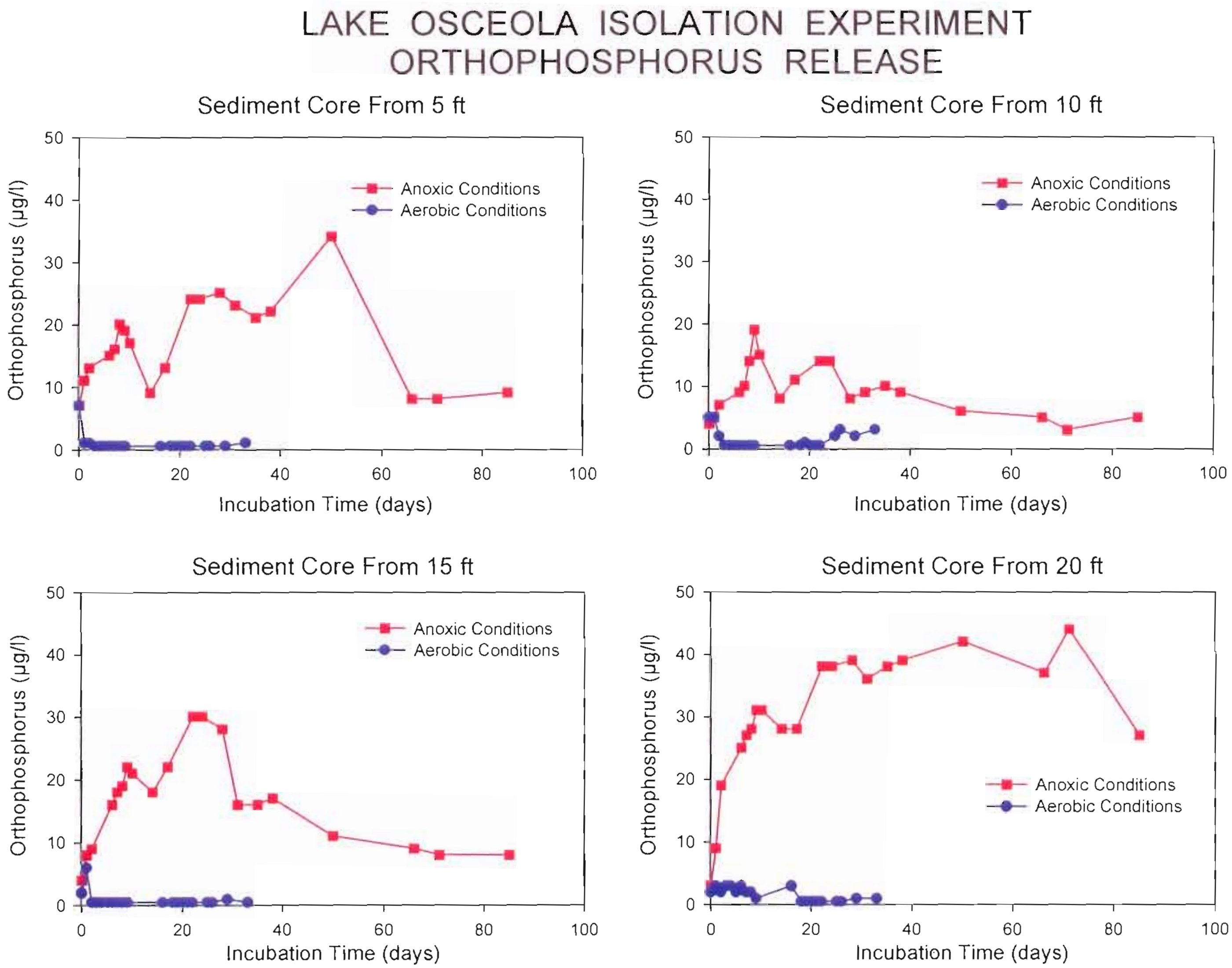


Figure 2-27. Sediment Release of Orthophosphorus in Lake Osceola Under Aerobic and Anoxic Conditions.

Osceola were collected from the northern lobe of the lake which had not been impacted by inputs of alum floc from the existing alum stormwater treatment systems. Similar to the trends observed in Lake Mizell, virtually no release of orthophosphorus was observed in the isolation experiments under aerobic conditions. However, under anoxic conditions, release of phosphorus from Lake Osceola sediments increased substantially, exhibiting values equal to or greater than release rates observed in Lake Virginia. Extremely high levels of orthophosphorus release were observed near the shoreline areas of Lake Osceola (5 ft) and from deep areas within the lake (20 ft).

A graphical comparison of orthophosphorus release from Lake Maitland sediments is given in Figure 2-28. Similar to the trends observed in the previous lakes, relatively little orthophosphorus release was observed from Lake Maitland sediments under aerobic conditions, with the possible exception of the sediment cores collected at a depth of 20 ft. Sediments collected at this depth exhibited a moderate level of orthophosphorus release even under aerobic conditions. A relatively high degree of orthophosphorus release was observed in Lake Maitland sediments which were incubated under anoxic conditions. Orthophosphorus release rates in Lake Maitland are similar to those observed in Lake Osceola. Release rates in both Lake Osceola and Lake Maitland under anoxic conditions are approximately 2-5 times greater than release rates measured in Lake Mizell under the same conditions.

Estimated orthophosphorus release rates for the Chain-of-Lakes under aerobic and anoxic conditions were calculated by integrating the anoxic and aerobic plots for the four lakes presented in Figures 2-25 through 2-28. This process resulted in estimated orthophosphorus release rates, in terms of $\mu g/ft^2$-day, under aerobic and anoxic conditions in sediment samples collected at each of the four water column depths. A summary of estimated orthophosphorus

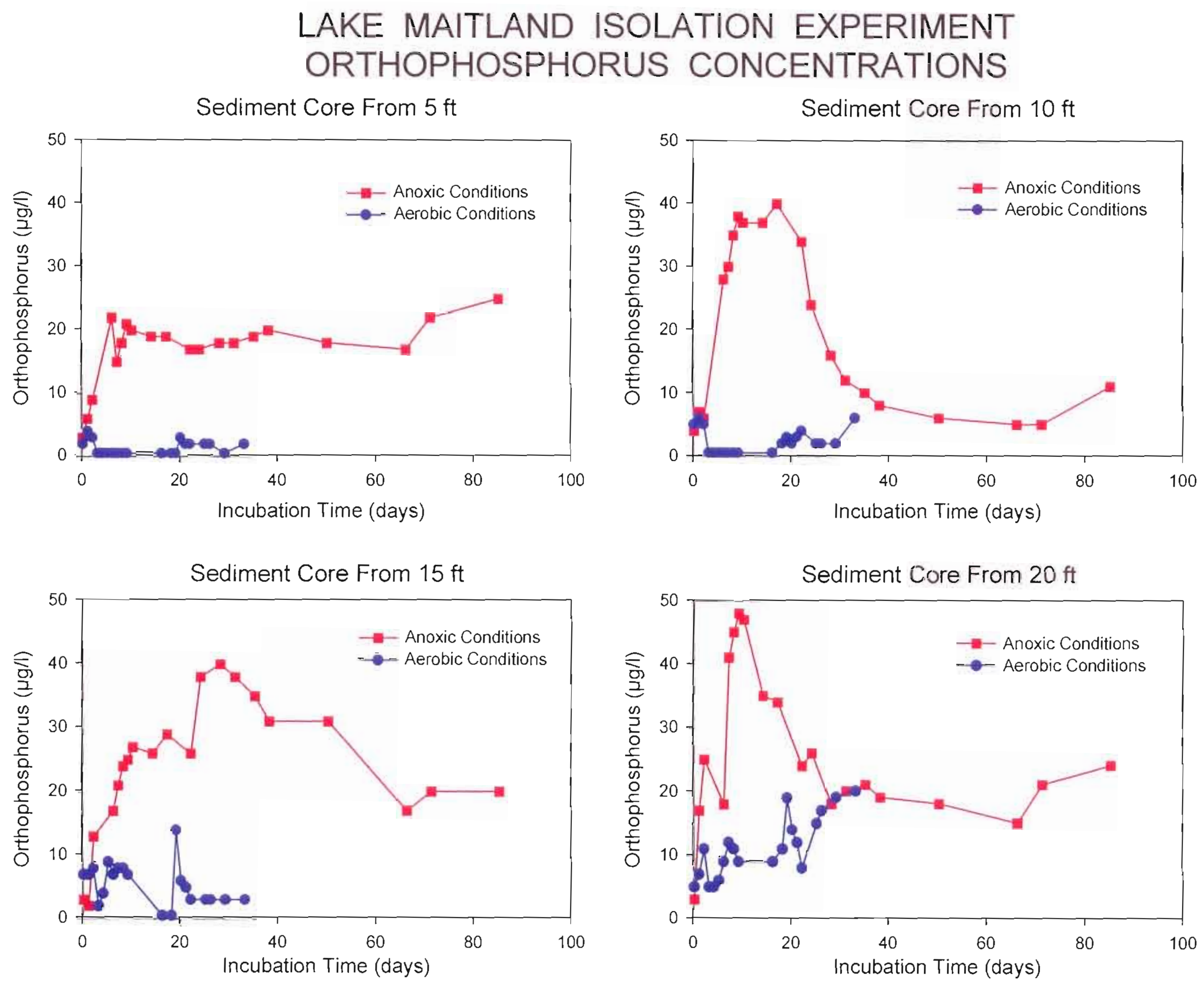


Figure 2-28. Sediment Release of Orthophosphorus in Lake Maitland Under Aerobic and Anoxic Conditions.

release rates based upon this procedure is given in Table 2-6. Estimated orthophosphorus release rates presented in this table are utilized in the following section to predict annual mass loadings of orthophosphorus from internal recycling in each of the four lakes.

TABLE 2-6

ESTIMATED ORTHOPHOSPHORUS RELEASE RATES FOR THE CHAIN-OF-LAKES UNDER AEROBIC AND ANOXIC CONDITIONS

LAKE	ORTHOPHOSPHORUS RELEASE ($\mu g/ft^2$-day)							
	AEROBIC CONDITIONS				ANOXIC CONDITIONS			
	5 ft	10 ft	15 ft	20 ft	5 ft	10 ft	15 ft	20 ft
Virginia	1.30	5.10	11.89	29.45	78.6	88.3	103	467
Mizell	0.72	1.70	2.25	2.34	32.7	47.6	53.9	45.6
Osceola	0.00	0.00	0.23	3.06	51.8	56.5	77.7	117
Maitland	0.28	1.59	9.06	18.69	68.0	80.7	101	174

2.2.3 <u>Estimated Mass Inputs of Phosphorus from Internal Recycling</u>

Before the information provided in Section 2.2.2 can be utilized to predict mass loadings of phosphorus resulting from internal recycling in each of the evaluated lakes, information must also be considered regarding the extent of aerobic and anoxic conditions as a function of water depth in the four lakes. It is commonly assumed that anoxic conditions begin to develop in the surficial sediment layers when water column concentrations of dissolved oxygen at the water-sediment interface decrease to less than 2 mg/l. These low levels of dissolved oxygen initiate development of a reduced environment which solubilizes previously insoluble iron-phosphorus associations, allowing orthophosphorus to be released into the overlying water column.

To evaluate the extent of anoxic conditions within the Chain-of-Lakes, a statistical evaluation was performed on historical field measurements of dissolved oxygen performed by ERD in Lake Virginia, Lake Mizell and Lake Osceola during the 1990s. ERD has performed monthly vertical profiles of dissolved oxygen, along with several other field parameters, at multiple locations in Lake Mizell since April 1994, in Lake Osceola since June 1991, and in Lake Virginia since April 1996. Surface monitoring in Lake Maitland has not been performed by ERD.

A statistical evaluation of dissolved oxygen concentrations in the Chain-of-Lakes was performed based on the available ERD monitoring data. The estimated frequency of measured dissolved oxygen concentrations less than 2 mg/l were calculated for each 1-ft water depth interval from the surface to the bottom of each lake. The percentage of overall dissolved oxygen readings with values less than 2 mg/l were calculated for each 1-ft depth interval.

A summary of dissolved oxygen characteristics in the Chain-of-Lakes based on the ERD monitoring data is given in Table 2-7. Dissolved oxygen concentrations less than 2 mg/l were not observed in Lake Osceola, Lake Virginia, or Lake Mizell on any occasion at water depths less than 7-8 ft. However, at depths in excess of this value, the occurrence of dissolved oxygen conditions less than 2 mg/l increased rapidly with increasing water depth. Since dissolved oxygen profiles are not available for Lake Maitland, dissolved oxygen conditions are assumed to be similar to those exhibited by Lake Virginia, which has water quality characteristics similar to those commonly found in Lake Maitland. In general, dissolved oxygen regimes within the Chain-of-Lakes appear to be relatively similar, although the occurrence of low dissolved oxygen conditions appears to be less in Lake Mizell than in the remaining lakes, particularly at water depths of 15 ft or less. The calculated areas of each lake associated with a particular water depth contour are also listed in Table 2-7.

TABLE 2-7

SUMMARY OF DISSOLVED OXYGEN CHARACTERISTICS IN THE CHAIN-OF-LAKES BASED ON ERD MONITORING DATA

WATER DEPTH (ft)	LAKE OSCEOLA		LAKE MAITLAND		LAKE VIRGINIA		LAKE MIZELL	
	Percent < 2 mg/l (%)	Contour Area (ac)	Percent < 2 mg/l (%)	Contour Area (ac)	Percent < 2 mg/l (%)	Contour Area (ac)	Percent < 2 mg/l (%)	Contour Area (ac)
0	0.0	2.4	0.0	9.7	0.0	2.4	0.0	1.9
1	0.0	4.8	0.0	19.4	0.0	4.8	0.0	3.7
2	0.0	5.2	0.0	20.0	0.0	5.0	0.0	3.4
3	0.0	2.4	0.0	10.0	0.0	1.8	0.0	2.4
4	0.0	1.5	0.0	0.5	0.0	1.3	0.0	0.8
5	0.0	2.0	0.0	8.7	0.0	1.2	0.0	1.5
6	0.0	3.8	0.0	16.7	0.0	3.7	0.0	2.3
7	0.0	4.0	0.0	17.8	0.0	3.7	0.0	2.2
8	0.0	2.1	0.5	8.3	0.5	1.3	0.0	1.3
9	1.6	1.1	0.6	12.5	0.6	1.1	0.6	0.8
10	3.7	1.5	1.4	14.3	1.4	2.7	1.8	1.3
11	6.6	3.3	5.5	32.8	5.5	6.6	5.4	2.1
12	12.5	3.1	13.3	33.0	13.3	7.4	9.7	2.0
13	21.1	1.6	24.5	16.6	24.5	3.7	14.9	1.0
14	30.4	3.7	35.5	19.4	35.5	5.6	21.9	2.6
15	38.7	3.7	45.1	31.6	45.1	16.2	29.8	9.5
16	43.3	11.3	50.3	62.1	50.3	43.7	39.8	12.2
17	47.6	7.0	60.6	32.0	60.6	23.0	56.9	5.3
18	51.8	3.5	74.4	15.3	74.4	11.5	79.0	2.5
19	53.9	8.8	89.6	69.1	89.6	77.7	89.8	7.3
20	56.9	26.5	100.0	6.2				
21	62.3	17.6	100.0	12.4				
22	70.6	17.6	100.0	0.8				
23	80.4	4.4	100.0	0.4				
24	92.6	8.8	100.0	0.3				
25	100.0	4.4	100.0	0.1				
	TOTAL:	156		470		224		66

Estimates of annual orthophosphorus release from sediments within the Chain-of-Lakes were performed based upon the percentages of aerobic and anoxic conditions presented in Table 2-7, along with the contour areas also presented in Table 2-7, and the estimated aerobic and anoxic release rates for each of the four lakes summarized in Table 2-6. For calculation purposes, areas from the shoreline to a depth of 5 ft are assumed to have release rates similar to those measured within the sediment core samples collected at a depth of 5 ft. Orthophosphorus release rates in areas of the lake between water depths of 5-10 ft are iterated based on release rates measured at a depth of 5 ft and 10 ft. Release rates for areas between 10-15 ft are iterated based on release rates measured at depths of 10 ft and 15 ft, with release rates for areas between 15 and 20 ft iterated based on release rates measured at depths of 15 ft and 20 ft. Areas in excess of 20 ft are assumed to have release rates similar to those measured at a depth of 20 ft. A weighted release rate is calculated for each water depth interval by multiplying the aerobic release rates times the percentage of time in which the water column exhibits aerobic conditions and by multiplying the anoxic release rates times the percentage of time during which the water depth exhibits anoxic conditions. The calculated release rate values in terms of μg/day are then multiplied by 365 days to obtain estimates of the mass of orthophosphorus released on an annual basis. Details of these calculations are provided in Appendix B.3.

A summary of calculated phosphorus inputs to the Chain-of-Lakes from internal recycling, based upon the calculations presented in Appendix B.3., is given in Table 2-8. Phosphorus release from internal recycling contributes approximately 419 kg/yr to Lake Virginia, 6.4 kg/yr to Lake Mizell, 90.1 kg/yr to Lake Osceola, and 145.4 kg/yr to Lake Maitland.

TABLE 2-8

CALCULATED PHOSPHORUS INPUTS TO THE CHAIN-OF-LAKES FROM INTERNAL RECYCLING

LAKE	PHOSPHORUS INPUTS FROM INTERNAL RECYCLING	
	(kg/yr)	(kg/ac-yr)
Virginia	419.2	1.87
Mizell	6.4	0.10
Osceola	90.1	0.58
Maitland	145.4	0.31

Calculated areal phosphorus loadings from internal recycling, in terms of kg/ac-yr, are also provided in Table 2-8. The lowest degree of internal recycling per unit of lake area is observed in Lake Mizell which has received multiple alum surface treatments for sediment inactivation. Phosphorus release rates per unit area in Lake Maitland and Lake Osceola are approximately 3-6 times greater than those observed in Lake Mizell. An extremely large rate of phosphorus release appears to exist in Lake Virginia, with a release rate per unit area approximately 20 times greater than that observed in Lake Mizell. Based on this analysis, internal recycling and release of phosphorus appears to be more significant in Lake Virginia than in any of the evaluated lakes. The calculated phosphorus inputs presented in Table 2-8 are utilized in Section 4 to prepare nutrient budgets for each of the four lakes.

SECTION 3

HYDROLOGIC BUDGETS FOR THE CHAIN-OF-LAKES

Individual hydrologic budgets were prepared for Lake Virginia, Lake Mizell, Lake Osceola, and Lake Maitland to evaluate water movement through the lakes and to assist in developing the nutrient budgets outlined in Section 4. Hydrologic budgets were generated using a combination of data generated by ERD during this project, data collected and generated by ERD as a result of previous water quality monitoring and watershed projects performed for the City of Winter Park, and information provided in the 1995 USGS report. In general, when specific information concerning hydrologic components was available based upon previous work efforts performed by ERD, this information was utilized in preparation of the hydrologic budgets. When previous information had not been directly generated by ERD, information contained in the 1995 USGS report was used.

A summary of hydrologic sources and sinks included in the modeled hydrologic budgets for the Chain-of-Lakes is given in Table 3-1. Hydrologic inputs into the four lake systems were evaluated for direct precipitation, stormwater runoff, dry weather baseflow, streamflow, groundwater seepage, and interconnected lakes. Hydrologic losses were evaluated for evaporation, deep groundwater recharge, and surface outflow. A discussion of the magnitude and significance of these sources and sinks is given in the following sections.

TABLE 3-1

HYDROLOGIC SOURCES AND SINKS INCLUDED IN MODELED HYDROLOGIC BUDGETS

HYDROLOGIC SOURCES	HYDROLOGIC SINKS
Direct Precipitation Stormwater Runoff Dry Weather Baseflow Streamflow Groundwater Seepage Interconnected Lakes	Evaporation Deep Groundwater Recharge Surface Outflow

3.1 Hydrologic Inputs (Sources)

3.1.1 Direct Precipitation

Estimates of mean monthly precipitation in the Central Florida area were generated by ERD based upon a statistical evaluation of historical rainfall over a 47-year period from 1950-1996. The historical rainfall data was obtained in digital format from the U.S. Climatological Data Center (CDC). A summary of mean monthly rainfall in the Central Florida area over the 47-year period is given in Table 3-2. Mean monthly rainfall depths range from a low of 1.85 inches during December to a high of 7.08 inches during July. The mean annual total rainfall is approximately 49.54 inches. The mean monthly rainfall presented in Table 3-2 is assumed to occur as a direct input onto the total surface area of each of the four lakes.

TABLE 3-2

SUMMARY OF MEAN MONTHLY RAINFALL IN THE CENTRAL FLORIDA AREA FROM 1950-1996

MONTH	RAINFALL DEPTH (inches)
January	2.45
February	2.41
March	3.96
April	3.18
May	3.15
June	6.83
July	7.08
August	6.54
September	5.98
October	3.11
November	3.00
December	1.85
TOTAL:	49.54

3.1.2 Stormwater Runoff

Estimates of annual inputs of stormwater runoff from drainage sub-basin areas were generated for each of the four evaluated lakes. This information is based upon a combination of sources, including: (1) recent watershed studies performed by ERD during evaluation of the alum stormwater treatment system designs for Lake Virginia, Lake Mizell, and Lake Osceola; and (2) information provided in the 1995 USGS report. The USGS report indicated an overall runoff coefficient of 0.353 for the Winter Park Chain-of-Lakes based upon changes in water surface elevations in the lakes following rain events. Runoff coefficients are defined as the percentage of annual rainfall occurring within a drainage basin which ultimately discharges into the receiving waterbody as stormwater runoff. A runoff coefficient of 0.353 suggests that approximately 35.3% of the annual rainfall deposited within the watershed area is discharged to the lakes by way of stormwater runoff. The remaining rainfall amounts are lost due to a combination of groundwater infiltration and evaporation. However, the value reported by USGS reflects the combined drainage discharging into the four lakes and does not address watershed contributions for each of the lakes individually.

During 1991, ERD performed a detailed study of the hydrologic characteristics of runoff inputs entering the south lobe of Lake Osceola as part of the feasibility evaluation for the Lake Osceola alum stormwater treatment system. During 1996, ERD performed a second study, as part of the feasibility evaluation for the Webster Avenue alum stormwater treatment system, which addressed runoff inputs entering the north lobe of Lake Osceola. The overall weighted runoff coefficient generated during these two studies is 0.456. For purposes of this study, the runoff coefficient of 0.456 is utilized to reflect the annual contribution of runoff inputs to Lake Osceola.

During 1996, ERD performed a study of the hydrologic characteristics of the Lake Mizell watershed as part of the feasibility evaluation for the Lake Mizell alum stormwater treatment system. This study included all sub-basin areas discharging to Lake Mizell and suggested a weighted runoff coefficient of 0.186 for the Lake Mizell basin. The runoff coefficient for the Lake Mizell basin is lower than values calculated for the other lakes due to the large amount of undeveloped areas in the basin. This value is utilized for purposes of estimating runoff inputs to Lake Mizell as part of this report.

During 1995, ERD performed a study of the hydrologic characteristics of Lake Virginia sub-basin areas as part of the feasibility evaluation for the Lake Virginia North alum stormwater treatment system. Modeling presented in this report indicated a runoff coefficient of 0.381 for the Lake Virginia sub-basin. This value is utilized in this report for hydrologic budget calculations.

No previous studies are available which address hydrologic characteristics of the Lake Maitland sub-basin other than the 1995 USGS study which addresses combined characteristics of sub-basin areas discharging into the Winter Park Chain-of-Lakes. As indicated previously, the USGS study suggested that a runoff coefficient of 0.353 is appropriate for the overall combined sub-basin area. Using the previously discussed runoff coefficients for Lake Virginia, Lake Mizell, and Lake Osceola, a runoff coefficient was calculated for Lake Maitland such that, utilizing the previously stated runoff coefficients for Lake Virginia, Lake Mizell, and Lake Osceola, the weighted average of the runoff coefficients for the four lakes equals the value of 0.353 calculated by the USGS. Based on this procedure, the calculated runoff coefficient for the Lake Maitland basin is 0.319.

A summary of estimated annual runoff coefficients for contributing watershed areas for the Winter Park Chain-of-Lakes is given in Table 3-3. In general, the estimated annual runoff coefficients reflect land use characteristics within each of the lake basins. Higher runoff coefficients are typically associated with higher degrees of imperviousness within a watershed, while lower runoff coefficients are often associated with reduced impervious areas and large expanses of lawns or natural areas.

A summary of estimated annual runoff inputs to the Winter Park Chain-of-Lakes is given in Table 3-4. Annual runoff inputs were calculated by multiplying the mean annual rainfall volume of 49.54 inches (4.13 ft) times the drainage basin area and the assumed runoff coefficient. Based upon this procedure, annual runoff inputs into the four lakes ranges from 168 ac-ft/yr entering Lake Mizell to 1809 ac-ft/yr entering Lake Maitland.

TABLE 3-3

ESTIMATED ANNUAL RUNOFF COEFFICIENTS FOR CONTRIBUTING WATER AREAS FOR THE WINTER PARK CHAIN-OF-LAKES

LAKE	ASSUMED RUNOFF COEFFICIENT	REFERENCE
Virginia	0.381	1. 1995 ERD Study: "Lake Virginia North Alum Treatment System Feasibility Study"
Mizell	0.186	1. 1996 ERD Study: "Lake Mizell Alum Treatment System Feasibility Study"
Osceola	0.456	1. 1991 ERD Study: "Lake Osceola Alum Treatment System Feasibility Study" 2. 1996 ERD Study: "Webster Avenue Alum Treatment System Feasibility Study"
Maitland	0.319	1. Calculated by difference

TABLE 3-4

ESTIMATED ANNUAL RUNOFF INPUTS TO THE WINTER PARK CHAIN-OF-LAKES

LAKE	DRAINAGE AREA (acres)	RUNOFF COEFFICIENT	ANNUAL RUNOFF VOLUME (ac-ft/yr)
Virginia	944	0.381	1485
Mizell	219	0.186	168
Osceola	567	0.456	1067
Maitland	1374	0.319	1809

3.1.3 Dry Weather Baseflow

ERD has performed numerous stormsewer monitoring projects since 1991 in stormsewer systems discharging into Lake Virginia, Lake Mizell, and Lake Osceola. The majority of these projects have been performed as part of feasibility and characterization studies associated with implementation of alum stormwater treatment systems for these lakes. Each of these studies included direct measurement of flow rates discharging through stormsewer lines for continuous periods ranging from 2-6 months, along with flow-weighted collection of stormwater runoff for laboratory characterization.

The studies performed by ERD suggest that dry weather baseflow is not a significant hydrologic component in the overall water budgets for Lake Virginia, Lake Mizell, or Lake Osceola. Although many stormsewer lines were observed to have a continuous flow of water during dry weather conditions, virtually all of these inputs represented extremely low flow rates, and a relatively insignificant volumetric contribution on an annual basis. As a result, dry weather baseflow inputs into Lake Virginia, Lake Mizell, and Lake Osceola between storm events are considered to be negligible. Although direct studies have not been performed by ERD in the Lake Maitland drainage basin, the surrounding watershed characteristics are similar to those entering the other lakes. Therefore, inputs of dry weather baseflow are also considered to be negligible in Lake Maitland.

3.1.4 Streamflow

In addition to direct inputs of stormwater runoff and dry weather baseflow, continuous inflow also occurs into Lake Virginia and Lake Maitland through several small streams. These streams originate primarily as discharges from upstream lakes, although inputs from other sources (primarily untreated stormwater runoff) also occur along the lengths of the streams.

Streamflow into Lake Virginia occurs through a partially natural channelized conveyance known as Howell Branch Creek. This inflow occurs into the south lobe of Lake Virginia and includes discharges from Lake Sue, along with direct inputs of stormwater runoff during storm events. As a result, inflow through this source consists of a combination of dry weather baseflow, stormwater runoff, and lake overflow.

Inflows into Lake Virginia from Howell Branch Creek were measured on a continuous basis during 1990, 1991, and 1992 by the USGS. Continuous measurements of water stage were performed and used to compute mean daily discharges. The measured mean daily inflows from Howell Branch Creek into Lake Virginia, based upon measurements performed by USGS, are summarized in Table 3-5. Measured mean daily inflow rates appear to be relatively consistent over the 3-year period, ranging from 4.8-6.2 cfs, with an overall mean of 5.6 cfs. Estimates of annual inflow volumes are also provided in Table 3-5, ranging from 3475-4489 ac-ft/yr. For purposes of this evaluation, a mean annual inflow of 4078 ac-ft/yr is assumed from Howell Branch Creek into the north lobe of Lake Virginia based on the overall mean flow rate of 5.6 cfs.

TABLE 3-5

MEAN DAILY STREAM INFLOWS ENTERING THE WINTER PARK CHAIN-OF-LAKES FROM 1990-1992[1]

YEAR	HOWELL BRANCH CREEK		PARK LAKE		LAKE MINNEHAHA	
	MEAN DAILY INFLOW (cfs)	MEAN ANNUAL INFLOW (ac-ft/yr)	MEAN DAILY INFLOW (cfs)	MEAN ANNUAL INFLOW (ac-ft/yr)	MEAN DAILY INFLOW (cfs)	MEAN ANNUAL INFLOW (ac-ft/yr)
1990	4.8	3475	0.8	579	1.0	724
1991	6.2	4489	1.3	941	1.2	869
1992	5.9	4271	1.0	724	1.1	796
MEAN:	5.6	4078	1.0	748	1.1	796

A summary of mean daily inflow to Lake Maitland from Park Lake and Lake Minnehaha is also given in Table 3-5. Measured inputs from these sources also appear to be relatively consistent in value, ranging from 0.8-1.3 cfs for Park Lake and 1.0-1.2 cfs for Lake Minnehaha. Estimates of mean annual inflow are also provided in Table 3-5, ranging from 748 ac-ft/yr for Park Lake to 796 ac-ft/yr for Lake Minnehaha. For purposes of this evaluation, the mean annual inflows listed at the bottom of Table 3-5 are assumed for these sources.

3.1.5 Groundwater Seepage

Estimates of hydrologic inputs from groundwater seepage are summarized in Section 2.1. Estimated seepage inputs contained in this section are utilized for preparation of hydrologic budgets for each of the four lakes.

3.2 Hydrologic Sinks

3.2.1 Evaporation

Estimates of monthly evaporation rates from the lake surfaces were generated based upon mean monthly evaporation data collected at the Lake Alfred experiment station over the 27-year period from 1953-1979. This evaporation data is the closest long-term evaporation station to the Winter Park sites.

A summary of mean monthly evaporation assumed for the Winter Park area is given in Table 3-6. Mean monthly surface evaporation ranges from a low of 2.29 inches/month in December to a high of 6.28 inches/month in May. The estimated total annual evaporation within the Winter Park lakes is assumed to be 53.07 inches.

TABLE 3-6

SUMMARY OF MEAN MONTHLY EVAPORATION AT THE LAKE ALFRED EXPERIMENTAL STATION FROM 1966-1994

MONTH	MEAN PAN EVAPORATION (inches)	ESTIMATED LAKE SURFACE EVAPORATION[1] (inches)
January	3.47	2.43
February	4.21	2.95
March	6.26	4.38
April	7.60	5.32
May	8.47	5.93
June	7.65	5.36
July	7.57	5.30
August	7.16	5.01
September	6.28	4.40
October	5.51	3.86
November	3.98	2.79
December	3.22	2.25
TOTAL:	71.38	49.98

1. Based on a pan coefficient of 0.70

3.2.2 Deep Groundwater Recharge

Direct estimates of direct groundwater recharge were not performed by ERD as part of this project. Therefore, information for this output is obtained solely from information provided in the 1995 USGS report. Based on this report, groundwater losses to deep recharge within the Chain-of-Lakes accounts for approximately 33 inches of water over the entire surface area of the lakes on an annual basis. No specific information is provided for each lake individually, since the water and nutrient budgets prepared by USGS consider the Chain-of-Lakes on a collective basis. Therefore, the estimated deep groundwater recharge loss of 33 inches/year is assumed to be distributed evenly over each of the four lakes. These losses occur primarily through areas of the lake bottom which may have relatively permeable connections with deep aquifer zones.

A summary of estimated annual deep groundwater recharge losses for the Winter Park Chain-of-Lakes is given in Table 3-7. Values presented in this table were obtained by multiplying the lake surface area (in acres) times the estimated groundwater recharge loss of 33 inches (2.75 ft) per year. Values presented in Table 3-7 are utilized in Section 3.3 for preparation of hydrologic budgets for the Chain-of-Lakes.

TABLE 3-7

ESTIMATED ANNUAL DEEP GROUNDWATER RECHARGE FOR THE WINTER PARK CHAIN-OF-LAKES

LAKE	ANNUAL DEEP GROUNDWATER RECHARGE (ac-ft/yr)
Virginia	616
Mizell	182
Osceola	429
Maitland	1293

3.2.3 Surface Outflow

Surface outflow from each of the four lakes was calculated as the difference between the five identified hydrologic inputs and the previously estimated hydrologic losses resulting from evaporation and deep groundwater recharge. For purposes of this evaluation, lake water level elevations are assumed to be relatively constant, with surface outflow calculated so that hydrologic inputs and losses are balanced.

3.3 Estimated Hydrologic Budgets for the Chain-of-Lakes

Separate hydrologic budgets were developed for Lake Virginia, Lake Mizell, Lake Osceola, and Lake Maitland based upon the hydrologic inputs and losses summarized in Table 3-1. Each of the hydrologic budgets was prepared on a monthly basis, with inputs from direct precipitation and stormwater runoff assumed to be proportional to the amount of rainfall which occurs during each individual month. Inputs from Lake Sue through Howell Branch Creek are also assumed to be proportional to rainfall inputs. Seepage inputs are assumed to vary depending upon whether dry season or wet seasons exist during a certain time of the year. However, seepage inputs are assumed to be constant on a daily basis during each wet season and dry season period.

Hydrologic losses are also assumed to vary depending upon rainfall conditions and the number of days contained within a given month. Deep groundwater recharge losses are assumed to occur on a constant basis throughout the year, and are calculated based upon the number of days contained within each month. Losses due to lake surface evaporation are assumed to be equal to the values listed in Table 3-6. Outflow discharges from each lake are calculated as the difference between inputs and outputs. Complete monthly hydrologic budgets for each of the four lakes, based upon the parameters outlined previously, are included in Appendix C.

A summary of estimated hydrologic budgets for the Winter Park Chain-of-Lakes, based upon the information contained in Appendix C, is presented in Table 3-8. Inflow from adjacent lakes and canals comprises the largest annual hydrologic inputs to Lake Virginia, Lake Osceola, and Lake Maitland. In contrast, the primary hydrologic input to Lake Mizell, which receives no significant lake or canal inflow, is direct precipitation. The second most significant input into the Chain-of-Lakes is stormwater runoff, although direct precipitation generates more inputs into Lake Maitland than stormwater runoff. The smallest contributor into the lakes on a volumetric basis appears to be groundwater seepage.

TABLE 3-8

ESTIMATED HYDROLOGIC BUDGETS FOR THE WINTER PARK CHAIN-OF-LAKES

LAKE	HYDROLOGIC INPUTS (ac-ft/yr)						HYDROLOGIC LOSSES (ac-ft/yr)			
	Direct Precip.	Runoff	Stream-flow	Inter-connected Lakes	Ground-water Seepage	Total	Evap.	Deep Recharge	Lake Outflow	Total
Virginia	925	1485	4078	83.0	239	6810	933	616	5261	6810
Mizell	272	168	0	0	99	539	275	182	83	539
Osceola	644	1067	0	5261	576	7548	650	429	6470	7548
Maitland	1940	1809	1544	6470	727	12,490	1957	1293	9241	12,490

The largest hydrologic output from Lake Virginia, Lake Osceola, and Lake Maitland consists of discharges through the outfall structures for these lakes. In contrast, the largest hydrologic loss in Lake Mizell is evaporation. Evaporation ranks second in terms of hydrologic losses in Lake Virginia, Lake Osceola, and Lake Maitland. Losses due to deep groundwater recharge represent the smallest hydrologic loss component in each of the four lakes. A graphical comparison of hydrologic inputs and losses to Lake Virginia, Lake Mizell, Lake Osceola, and Lake Maitland is given in Figures 3-1, 3-2, 3-3, and 3-4, respectively.

Calculated residence times for each of the four lakes are also provided in the monthly hydrologic budgets presented in Appendix C. A summary of mean calculated residence times is given in Table 3-9. Lake Osceola appears to have the shortest residence time, with a mean value of approximately 102 days. As seen in Table 3-9, this short residence time is driven primarily by the continuous inflow from Lake Virginia. Calculated mean residence times in Lake Maitland and Lake Virginia are approximately equal, ranging from 197-220 days. The longest mean residence time occurs in Lake Mizell, with a calculated value of 550 days.

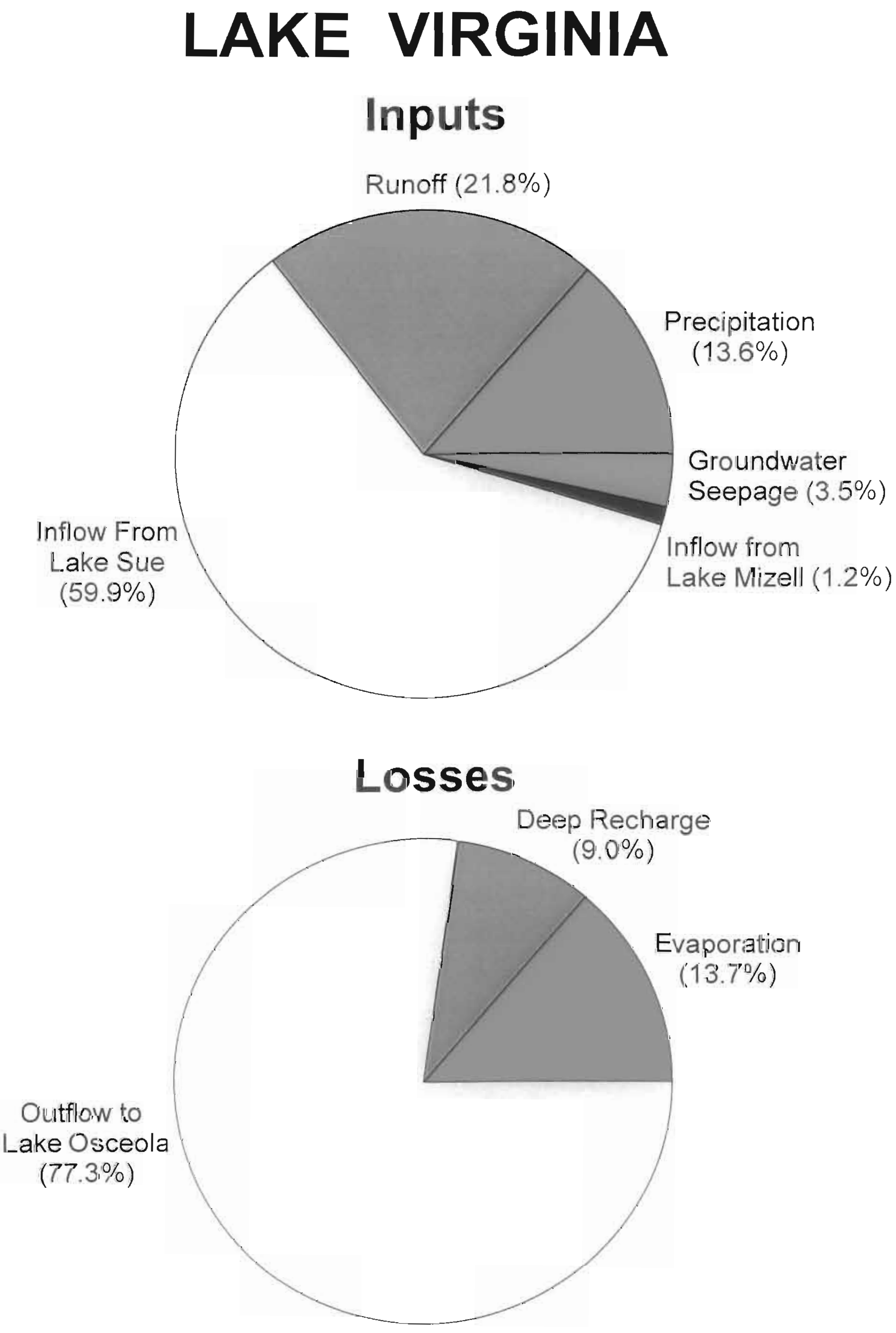


Figure 3-1. Estimated Mean Annual Hydrologic Budget for Lake Virginia.

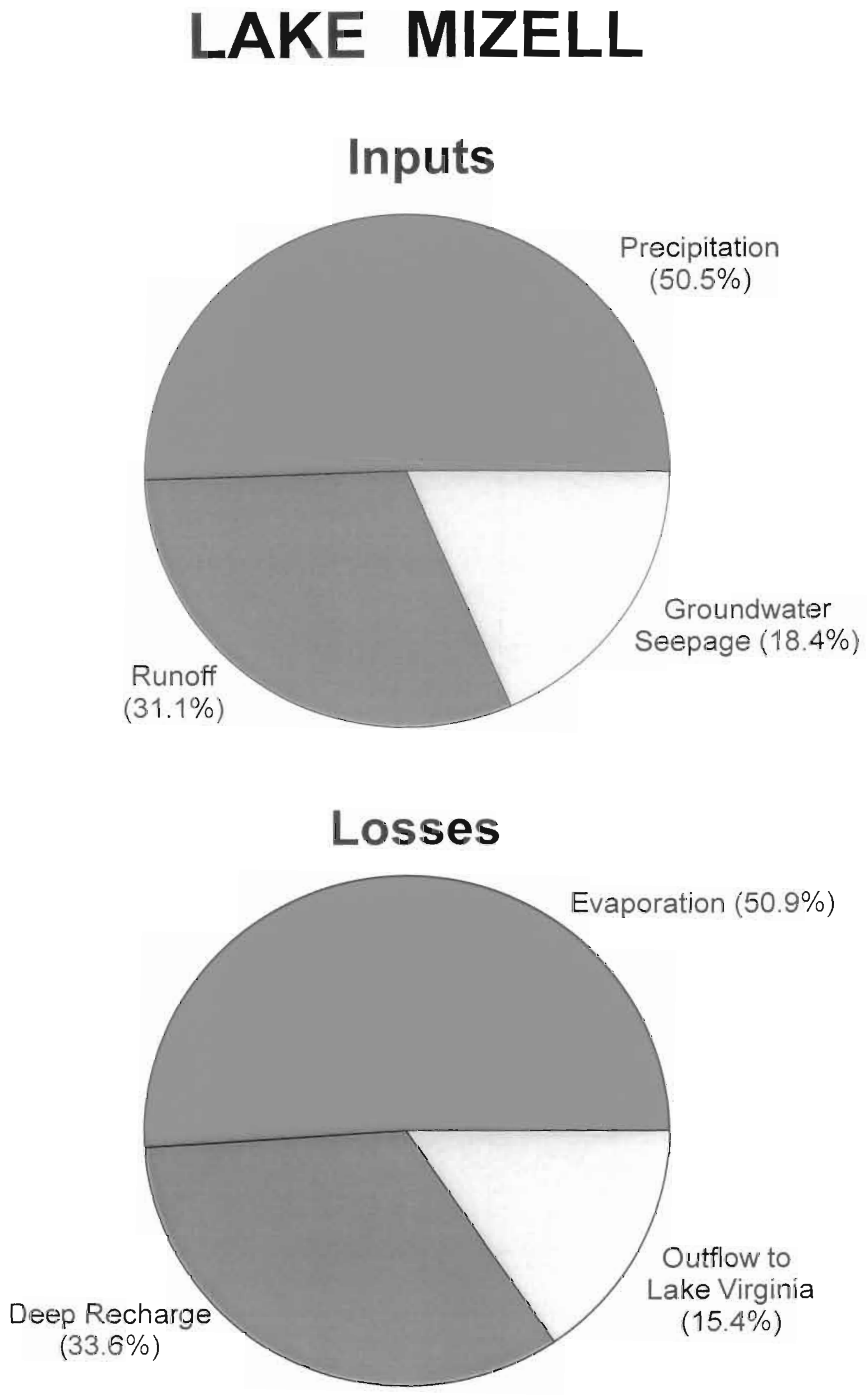
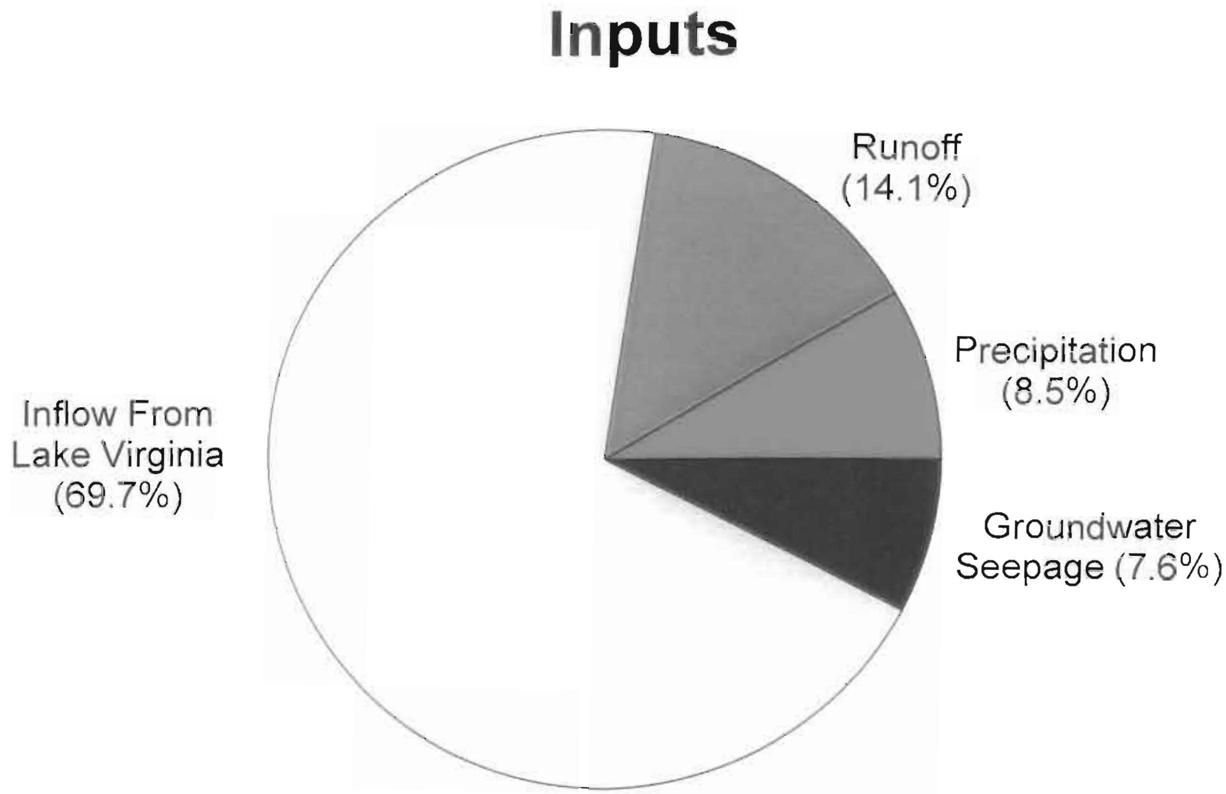


Figure 3-2. Estimated Mean Annual Hydrologic Budget for Lake Mizell.

LAKE OSCEOLA



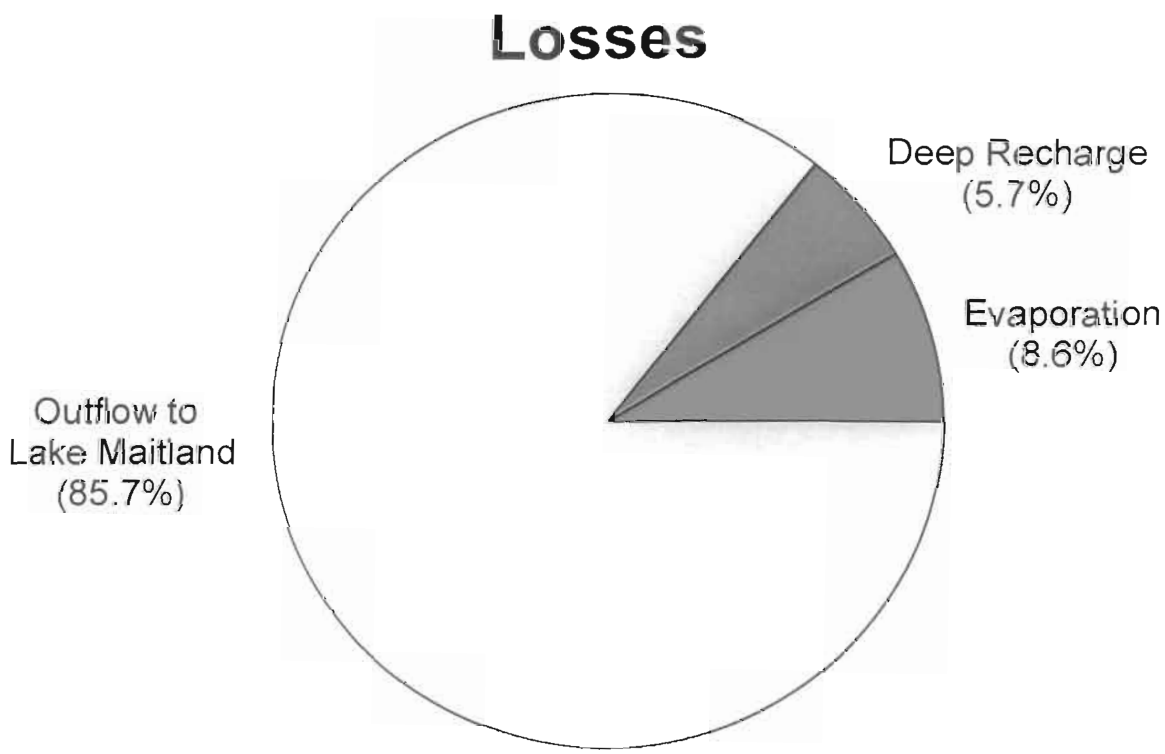


Figure 3-3. Estimated Mean Annual Hydrologic Budget for Lake Osceola.

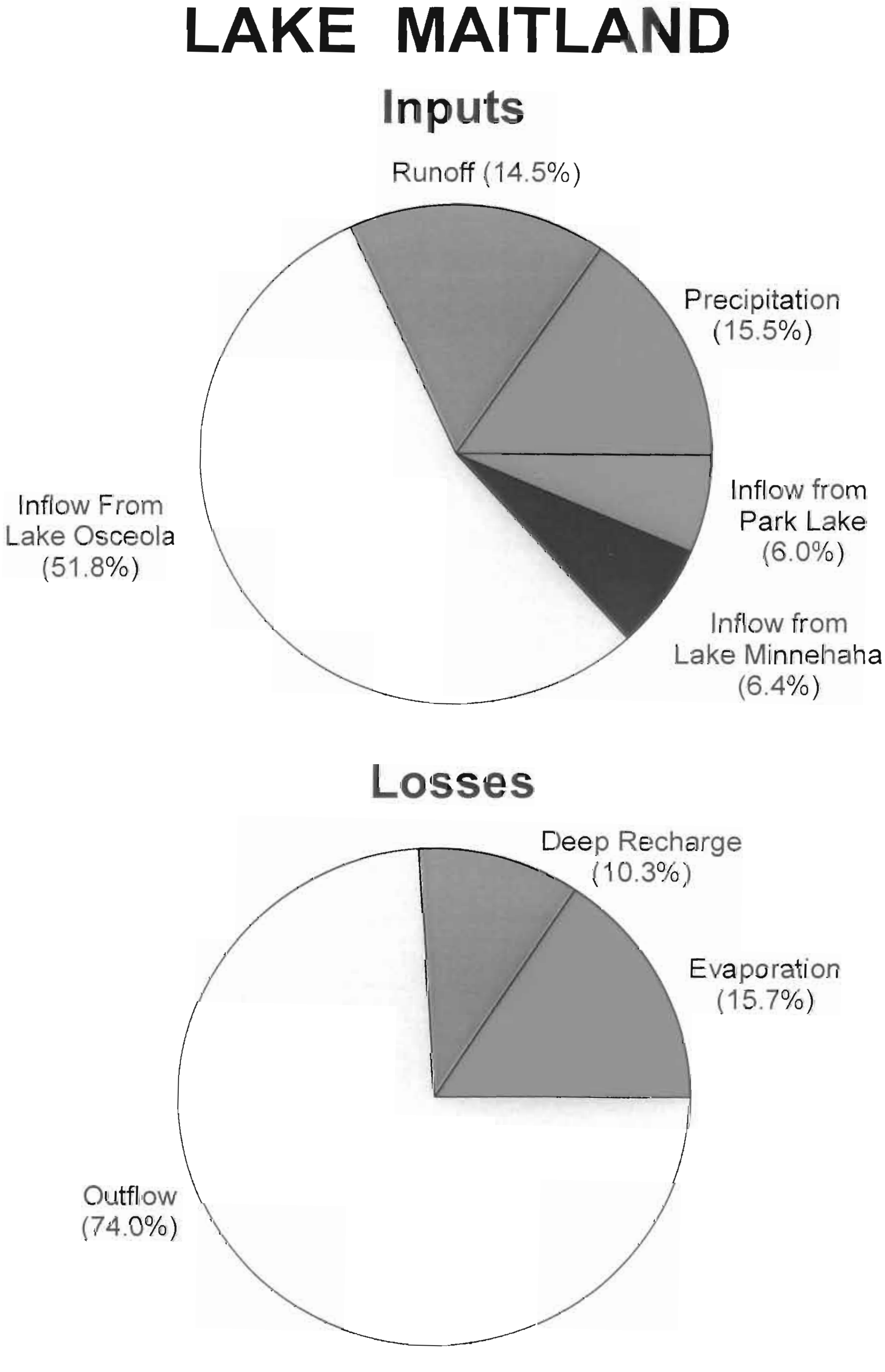


Figure 3-4. Estimated Mean Annual Hydrologic Budget for Lake Maitland.

TABLE 3-9

CALCULATED RESIDENCE TIMES FOR THE WINTER PARK CHAIN-OF-LAKES

LAKE	MEAN RESIDENCE TIME (days)
Virginia	220
Mizell	550
Osceola	102
Maitland	197

SECTION 4

CALCULATED NUTRIENT BUDGETS FOR THE CHAIN-OF-LAKES

Detailed nutrient budgets were calculated for inputs of nitrogen and phosphorus into Lake Virginia, Lake Mizell, Lake Osceola, and Lake Maitland from a variety of sources and sinks. A listing of nutrient sources and sinks included in the modeled nutrient budgets is given in Table 4-1. Nutrient inputs into the Chain-of-Lakes are calculated for direct precipitation, stormwater runoff, streamflow, groundwater seepage, internal recycling, and interconnected lakes. Nutrient losses or sinks are calculated for surface outflow and deep recharge/sediments.

TABLE 4-1

NUTRIENT SOURCES AND SINKS INCLUDED IN THE MODELED NUTRIENT BUDGETS

NUTRIENT SOURCES	NUTRIENT SINKS
Direct Precipitation Stormwater Runoff Streamflow Groundwater Seepage Internal Recycling Interconnected Lakes	Surface Outflow Deep Recharge/Sediments

The nutrient budgets discussed in this section are generated primarily from data collected by ERD during this project as well as other projects performed in the City of Winter Park and in the Central Florida area. Much of this information has been collected more recently than information contained in the study performed by USGS from 1990-1992 and are indicative of more current water quality and watershed characteristics. A discussion of assumptions utilized in generating nutrient budgets for the Chain-of-Lakes is given in the following sections.

4.1 Nutrient Sources

4.1.1 Bulk Precipitation

ERD has performed numerous evaluations of the characteristics of bulk precipitation in the Central Florida area as a part of research projects conducted for the St. Johns River Water Management District and the Florida Department of Environmental Protection. Bulk precipitation includes the combined inputs from direct precipitation and dry fallout. A summary of typical characteristics of total nitrogen and total phosphorus in bulk precipitation measured in the Central Florida area by ERD is given in Table 4-2. These values represent a total of 17 bulk precipitation samples collected during the period from June-November 1992 in a combined residential/commercial/highway land use area in north Central Florida.

TABLE 4-2

TYPICAL CHARACTERISTICS OF BULK PRECIPITATION MEASURED IN CENTRAL FLORIDA[1]

PARAMETER	UNITS	MEAN CONCENTRATION
Total Phosphorus	µg/l	45
Total Nitrogen	µg/l	671

1. Harper, H.H., and Herr, J.L. (August 1993). "Treatment Efficiencies of Detention with Filtration Systems." Final Report for the St. Johns River Water Management District, Contract No. 90B103.

For purposes of this evaluation, it is assumed that the bulk precipitation characteristics in Table 4-2 are similar to bulk precipitation which occurs in the Winter Park area. Estimates of annual mass loadings from bulk precipitation into the lakes were calculated for total nitrogen and total phosphorus based upon the typical characteristics listed in Table 4-2 and the mean monthly rainfall volumes listed in Table 3-2. A summary of estimated annual mass loadings from bulk precipitation to the Winter Park Chain-of-Lakes is given in Table 4-3. In general, estimated monthly loadings of total nitrogen and total phosphorus were calculated by multiplying the typical bulk precipitation concentrations listed in Table 4-2 times the mean monthly rainfall depth and the surface area of each lake. This information is used to generate the nutrient budgets presented in Section 4.3.

TABLE 4-3

ESTIMATED ANNUAL MASS LOADINGS FROM BULK PRECIPITATION TO THE WINTER PARK CHAIN-OF-LAKES

LAKE	ANNUAL LOADING (kg/yr)	
	TOTAL N	TOTAL P
Mizell	225	15.1
Virginia	765	51.3
Osceola	533	35.7
Maitland	1605	108

4.1.2 <u>Stormwater Runoff</u>

A number of previous studies and evaluations have been performed which characterize concentrations of runoff-related constituents entering the Winter Park Chain-of-Lakes in the form of stormwater runoff. The USGS report provides water quality analyses for 17 separate stormwater events entering Lake Osceola at the Webster Avenue outfall from March 1991 to June 1992. An additional 16 stormwater runoff samples were collected by USGS in the stormsewer line along Elizabeth Drive, which also enters Lake Osceola, from June 1991 to June 1992. In addition, 11 separate runoff events were monitored by ERD during 1991 and 1996 in a variety of sub-basin areas discharging to Lake Osceola.

A total of six runoff samples were collected by ERD during 1995 from sub-basin areas discharging into Lake Virginia. These basin areas included urban land use as well as a significant portion of land located within the Rollins College campus which was monitored as part of the evalution phase for the Lake Virginia Alum Stormwater Treatment System. A total of 12 separate runoff samples were collected from four sub-basin areas discharging into Lake Mizell during 1996 as part of the evaluation phase for the Lake Mizell Alum Stormwater Treatment System.

A summary of mean concentrations of total nitrogen and total phosphorus in runoff characterization studies performed on the Winter Park Chain-of-Lakes is given in Table 4-4. Mean concentrations of total nitrogen and total phosphorus in runoff inputs to Lake Osceola are very similar in the studies performed by USGS and ERD. Mean concentrations of total nitrogen in the two studies differ by only 10%, with a 4% difference in estimated concentrations of total phosphorus. Measured concentrations of total nitrogen and total phosphorus in runoff inputs to Lake Mizell are also similar to values measured in Lake Osceola, based upon monitoring performed in Lake Mizell by ERD during 1996.

In contrast to the relatively similar values observed in Lake Mizell and Lake Osceola, substantially lower concentrations were observed for total nitrogen and total phosphorus in runoff inputs entering Lake Virginia, based upon the 1995 ERD study. Much of the sub-basin area included in this monitoring program was located within the Rollins College campus where watershed activities are substantially less intense than more typical urban and residential areas which discharge into the Chain-of-Lakes. As a result, the measured runoff concentrations of total nitrogen and total phosphorus in the Lake Virginia evaluation may under-estimate concentrations which occur in the remaining portions of the Lake Virginia basin. Therefore, for purposes of this evalution, runoff characteristics of total nitrogen and total phosphorus entering Lake Virginia are assumed to be similar to runoff characteristics entering Lake Mizell and Lake Osceola.

TABLE 4-4

MEAN CONCENTRATIONS OF TOTAL NITROGEN AND TOTAL PHOSPHORUS IN RUNOFF CHARACTERIZATION STUDIES PERFORMED ON THE WINTER PARK CHAIN-OF-LAKES

LAKE	NUMBER OF SAMPLES	REFERENCE	MEAN MEASURED CONCENTRATION (μg/l)	
			TOTAL NITROGEN	TOTAL PHOSPHORUS
Virginia	6	ERD (1995)	1393	246
Mizell	12	ERD (1996)	2260	366
Osceola	a. 11 b. 33	a. ERD (1991/1996) b. USGS (1995)	a. 2416 b. 2645	a. 387 b. 370
Mean[1]	--		2395	372

1. Mean of concentrations measured in Lake Mizell and Lake Osceola

An estimate of typical concentrations of total nitrogen and total phosphorus in untreated stormwater runoff entering Lake Virginia, Lake Mizell, and Lake Osceola was obtained by averaging the overall mean runoff characteristics observed in Lake Osceola with the listed mean concentrations measured in Lake Mizell. These values are summarized at the bottom of Table 4-4. The overall mean total nitrogen concentration of 2395 μg/l and the overall mean total phosphorus concentration of 372 μg/l are assumed to be typical of mean annual concentrations of untreated stormwater runoff entering Lake Virginia, Lake Mizell, and Lake Osceola.

Although significant runoff characterization studies have not been performed in the Lake Maitland basin, land use characteristics in this basin are similar to land uses which currently exist in sub-basin areas for the other three lakes. Therefore, for purposes of this evaluation, runoff characteristics entering Lake Maitland are also assumed to be similar to the overall mean runoff concentrations listed at the bottom of Table 4-4.

The mean estimated concentrations of total nitrogen and total phosphorus listed at the bottom of Table 4-4 reflect the characteristics of untreated stormwater runoff entering the Chain-of-Lakes. However, over the past 10 years, a number of significant stormwater retrofit projects have been constructed by the City of Winter Park on Lake Virginia, Lake Mizell, and Lake Osceola. Each of these projects provides varying levels of attenuation for runoff generated loadings of total nitrogen and total phosphorus which must be considered in evaluating runoff related mass inputs actually reaching the Winter Park Chain-of-Lakes.

A summary of existing significant stormwater retrofit projects is given in Table 4-5. Alum stormwater treatment systems have been constructed on Lake Virginia and Lake Mizell, with two separate systems constructed on Lake Osceola. In addition, a wet detention pond, known as the Ninth Grade Center Treatment Pond, has been constructed to provide treatment for a 60-acre basin area entering Lake Virginia. An additional alum treatment system has been constructed by the City of Winter Park to treat the streamflow discharging through Howell Branch Creek into Lake Virginia. The impacts of this treatment system are considered in Section 4.1.3.

TABLE 4-5

SUMMARY OF EXISTING SIGNIFICANT STORMWATER RETROFIT PROJECTS ON THE WINTER PARK CHAIN-OF-LAKES

LAKE	DRAINAGE BASIN AREA (acres)	SUMMARY OF EXISTING SIGNIFICANT RETROFIT PROJECTS			
		PROJECT NAME	WATERSHED AREA TREATED (acres)	TYPE OF SYSTEM	ESTIMATED MASS REMOVAL
Virginia	944	Lake Virginia North Alum Treatment System	63.0	Alum Injection	TN: 50% TP: 90%
		9th Grade Center Treatment Pond	60.0	Wet Detention Pond	TN: 60% TP: 65%
Mizell	219	Lake Mizell Alum Treatment System	75.1	Alum Injection	TN: 50% TP: 90%
Osceola	567	Lake Osceola Alum Treatment System	64.4	Alum Injection	TN: 25% TP: 88%
		Webster Avenue Alum Treatment System	75.3	Alum Injection	TN: 75% TP: 95%

Estimated mass removal efficiencies for the listed stormwater retrofit projects are also provided in Table 4-5. Estimated mass removal efficiencies for the alum stormwater treatment systems were obtained from the associated evaluation studies performed by ERD as part of the design phase for these systems. Estimated treatment efficiencies for the Ninth Grade Center wet detention pond are based upon a performance evalution of this facility performed for the City of Winter Park by ERD during 1992-1993.

An estimate of runoff related mass inputs of total nitrogen and total phosphorus reaching the Winter Park Chain-of-Lakes is given in Table 4-6. Estimates of generated loadings of total nitrogen and total phosphorus in raw stormwater runoff were obtained for each of the four lakes by multiplying the estimated annual runoff inputs to each of the four lakes, as summarized in Table 3-4, times the mean total nitrogen and total phosphorus concentrations for raw runoff listed at the bottom of Table 4-4.

TABLE 4-6

ESTIMATED RUNOFF RELATED MASS INPUTS REACHING THE WINTER PARK CHAIN-OF-LAKES

LAKE	GENERATED LOADING (kg/yr)		MASS REMOVAL BY TREATMENT SYSTEMS (kg/yr)		LOADING ENTERING LAKE (kg/yr)	
	TOTAL N	TOTAL P	TOTAL N	TOTAL P	TOTAL N	TOTAL P
Virginia	4844	681	346	69.0	4498	612
Mizell	496	77.1	85.0	23.8	411	53.3
Osceola	3152	490	403	111	2749	379
Maitland	5343	830	0	0	5343	830

Estimates of mass removal achieved in the existing stormwater treatment systems are also provided in Table 4-6. These estimates were generated using a two-step process. First, the estimated annual mass of untreated stormwater constituents reaching each of the treatment systems was calculated by multiplying the percentage of the overall drainage basin area treated by each project times the generated raw loading calculated previously. Estimated mass removal in each system was then calculated by multiplying the mass removal efficiencies listed in the final column of Table 4-5 times the overall mass loading entering each of the treatment systems. The resulting mass removal estimates are summarized in the middle columns of Table 4-6. The estimated loading entering each of the lakes is then calculated by subtracting the mass removal achieved by the treatment systems from the initial generated loading from raw runoff. These values are summarized in the final two columns of Table 4-6 and reflect the estimated annual inputs of total nitrogen and total phosphorus into the four lakes from both treated and untreated runoff sources. The values listed in the final two columns of Table 4-6 are utilized for estimation of nutrient budgets for each of the four lakes, as presented in Section 4.3.

4.1.3 Streamflow

4.1.3.1 Howell Branch Creek Inflow

As discussed in Section 3.1.4, streamflow through Howell Branch Creek contributes a mean annual inflow of 4078 ac-ft/yr into Lake Virginia, based upon measurements performed for the 1995 USGS study. In addition to virtually continuous discharges from Lake Sue, Howell Branch Creek inflow also receives inputs of untreated runoff during rain events from numerous stormsewers prior to reaching Lake Virginia.

Water quality characteristics of streamflow entering Lake Virginia through Howell Branch Creek has been monitored on a monthly basis by ERD since April 1996. A summary of mean water quality characteristics for total nitrogen, total phosphorus, and fecal coliform bacteria from April 1996 to April 1999 are summarized in Table 4-7. The mean total nitrogen concentration of 937 μg/l measured in Howell Branch Creek inflow over this period is similar to total nitrogen concentrations measured in open water areas of Lake Virginia. However, the mean total phosphorus concentration of 56 μg/l measured in the canal is substantially higher than the average value of 30 μg/l typically measured in open water areas of Lake Virginia. The 1995 USGS report stated that this inflow is the largest single contributor of phosphorus loadings to the overall Chain-of-Lakes system. In addition, elevated levels of fecal coliform bacteria have also been observed in samples collected in the canal inflow. The mean fecal coliform concentration of 253 organisms/100 ml is approximately 10 times greater than fecal coliform levels measured in other areas of Lake Virginia.

During 1998, the City of Winter Park completed a stormwater retrofit project on Howell Branch Creek to reduce loadings of total phosphorus from this input into the Chain-of-Lakes. An off-line alum stormwater treatment system was constructed at Mead Gardens which provides continuous alum treatment of baseflow and runoff from ordinary storm events in an off-line treatment system and settling pond. Larger storm events bypass the system directly without treatment. The system became fully operational in May 1999.

TABLE 4-7

WATER QUALITY CHARACTERISTICS OF STREAMFLOW ENTERING LAKE VIRGINIA THROUGH HOWELL BRANCH CREEK

PARAMETER	UNITS	PRE-TREATMENT (4/96-4/99)[1]	POST-TREATMENT (5/99-3/00)[2]	PERCENT CHANGE
Total N	μg/l	937	806	-14
Total P	μg/l	56	36	-36
Fecal Coliform	No./100 ml	253	198	-22

1. n = 37 samples
2. n = 12 samples

A summary of post-treatment water quality monitoring results in Howell Branch Creek from May 1999 to March 2000 is also provided in Table 4-7. During this time, concentrations of total nitrogen discharging through the canal were reduced by approximately 14%, compared with pre-treatment water quality characteristics. A 36% reduction was observed for total phosphorus, with a 22% reduction in fecal coliform bacteria. However, it should be noted that the treatment system was not operational during the entire monitoring period from May 1999 to March 2000. The system was inoperative on several occasions due to problems with the flow monitoring equipment and excessive build-up of floc within the settling pond. As a result, future post-treatment monitoring may indicate a higher degree of water quality improvement than the initial post-treatment monitoring results presented in Table 4-7. However, for purposes of this evaluation, water quality characteristics of streamflow entering Lake Virginia through Howell

Branch Creek are assumed to be similar to the post-treatment values listed in Table 4-7, with an overall mean of 806 μg/l for total nitrogen and 36 μg/l for total phosphorus.

A summary of estimated mass loadings of total nitrogen and total phosphorus entering Lake Virginia from Howell Branch Creek inflow is given in Table 4-8. Estimates of annual mass inputs were obtained by multiplying the mean annual inflow of 4078 ac-ft/yr times the post-treatment water quality characteristics for total nitrogen and total phosphorus listed in Table 4-7. The estimated annual mass loadings summarized in Table 4-8 are utilized for preparation of the nutrient budgets presented in Section 4.3.

TABLE 4-8

ESTIMATED MASS LOADINGS OF TOTAL NITROGEN AND TOTAL PHOSPHORUS ENTERING LAKE VIRGINIA FROM HOWELL BRANCH CREEK INFLOW

PARAMETER	ESTIMATED ANNUAL MASS LOADING (kg/yr)
Total N	4054
Total P	181

4.1.3.2 Lake Minnehaha and Park Lake

As discussed in Section 3.1.4, Lake Maitland receives sporadic inflow from both Lake Minnehaha and Park Lake, depending primarily on antecedent rainfall conditions. Mean daily inflows from each of these two lakes into Lake Maitland, based upon estimates provided by USGS (1995), are approximately equal, with a mean daily inflow of 1.0 cfs from Park Lake and a mean daily inflow of approximately 1.1 cfs from Lake Minnehaha.

A summary of ambient water quality characteristics of Lake Minnehaha and Park Lake is provided in Table 4-9, based upon Florida LAKEWATCH data. A total of 61 sampling dates were performed in Lake Minnehaha from July 1989 to December 1996, with 44 sampling dates conducted in Park Lake from January 1991 to December 1996. During this period, Lake Minnehaha was characterized by a mean total nitrogen concentration of 781 μg/l, with a mean total phosphorus concentration of 35 μg/l. Park Lake was characterized by a mean total nitrogen concentration of 661 μg/l, with a mean total phosphorus concentration of 50 μg/l. For purposes of this evaluation, water quality characteristics of inflows from these lakes into Lake Maitland are assumed to be similar to the ambient lake water quality characteristics listed in Table 4-9.

TABLE 4-9

AMBIENT WATER QUALITY CHARACTERISTICS OF LAKE MINNEHAHA AND PARK LAKE

PARAMETER	UNITS	LAKE MINNEHAHA[1] (7/89-12/96)	PARK LAKE[2] (1/91-12/96)
Total N	μg/l	781	661
Total P	μg/l	35	50

1. Florida LAKEWATCH data - 61 sampling dates
2. Florida LAKEWATCH data - 44 sampling dates

A summary of estimated mass loadings of total nitrogen and total phosphorus entering Lake Maitland from Lake Minnehaha and Park Lake is given in Table 4-10. Mass loadings presented in this table were obtained by multiplying the estimated mean annual inflow for these sources (summarized in Table 3-5) times the ambient water quality characteristics summarized in Table 4-9. On an annual basis, inflow from Lake Minnehaha contributes a larger loading of total nitrogen, while inflow from Park Lake contributes a larger loading of total phosphorus into Lake Maitland on an annual basis.

TABLE 4-10

ESTIMATED MASS LOADINGS OF TOTAL NITROGEN AND TOTAL PHOSPHORUS ENTERING LAKE MAITLAND FROM LAKE MINNEHAHA AND PARK LAKE

PARAMETER	ESTIMATED ANNUAL LOAD (kg/yr)	
	LAKE MINNEHAHA	PARK LAKE
Total N	720	649
Total P	32.3	49.1

4.1.4 Groundwater Seepage

Estimated mass loadings of total nitrogen and total phosphorus entering the Winter Park Chain-of-Lakes from groundwater seepage are provided in Section 2.1.3.2. The estimated wet season and dry season seepage inputs of total nitrogen and total phosphorus to the Winter Park Chain-of-Lakes (summarized in Table 2-4) are utilized in Section 4.3 for generation of nutrient budgets for the lakes.

4.1.5 Internal Recycling

Estimated mass inputs of total phosphorus into the Winter Park Chain-of-Lakes from internal recycling are summarized in Section 2.2.3. The calculated phosphorus inputs (summarized in Table 2-8) are utilized for preparation of the overall nutrient budgets summarized in Section 4.3.

4.1.6 Interconnected Lakes

Movement of nitrogen and phosphorus within the Winter Park Chain-of-Lakes also occurs as a result of surface water flow between interconnected lake systems. For purposes of this evaluation, interconnected surface water flow is assumed to occur from Lake Mizell to Lake Virginia, Lake Virginia to Lake Osceola, Lake Osceola to Lake Maitland, and from Lake Maitland to Howell Branch Creek. Mass transfer through these exchanges is calculated as the annual estimated volume of interconnected lake flow (summarized in Table 3-8) times ambient mean concentrations of total nitrogen and total phosphorus in each of the four waterbodies.

A summary of mean water quality characteristics in Lake Virginia, Lake Mizell, Lake Osceola, and Lake Maitland is given in Table 4-11 based upon water quality monitoring performed by ERD in Lake Virginia, Lake Mizell, and Lake Osceola, combined with LAKEWATCH data for Lake Maitland. Mean total phosphorus concentrations in the four lakes range from a low of 20 μg/l in Lake Mizell to a high of 30 μg/l in Lake Virginia. Mean measured total nitrogen concentrations range from a low of 724 μg/l in Lake Mizell to a high of 924 μg/l in Lake Maitland. Similarly, mean chlorophyll-a concentrations in the Chain-of-Lakes have ranged from 14.5 mg/m^3 in Lake Mizell to 26.0 mg/m^3 in Lake Virginia. Mean water quality transparency ranges from 0.9 m in Lake Virginia to 1.8 m in Lake Mizell.

A summary of estimated annual mass exchange of total nitrogen and total phosphorus resulting from interconnected lake flow is given in Table 4-12. Discharges from Lake Mizell to Lake Virginia contribute relatively small amounts of total nitrogen and total phosphorus to the lake. However, discharges from Lake Virginia to Lake Osceola contribute approximately 6000 kg/yr of total nitrogen and almost 200 kg/yr of total phosphorus to Lake Osceola. Discharges from Lake Osceola to Lake Maitland contribute almost 6800 kg/yr of total nitrogen and more than 200 kg/yr of total phosphorus to Lake Maitland. Lake Maitland discharges approximately 10,500 kg/yr of total nitrogen and almost 300 kg/yr of total phosphorus downstream to Howell Branch Creek. The values summarized in Table 4-12 are utilized in Section 4.3 for preparation of nutrient budgets for the Chain-of-Lakes.

TABLE 4-11

MEAN WATER QUALITY CHARACTERISTICS IN LAKE VIRGINIA, LAKE MIZELL, LAKE OSCEOLA, AND LAKE MAITLAND

LAKE	TOTAL N (μg/l)	TOTAL P (μg/l)	CHYL-A (mg/m^3)	SECCHI DISK (m)	REFERENCE
Virginia	914	30	26.0	0.9	ERD (1994-2000)
Mizell	724	20	14.5	1.8	ERD (1994-2000)
Osceola	852	26	21.9	1.1	ERD (1991-2000)
Maitland	924	26	21.0	1.3	LAKEWATCH (1986-1996)

TABLE 4-12

ESTIMATED ANNUAL MASS EXCHANGE OF TOTAL NITROGEN AND TOTAL PHOSPHORUS RESULTING FROM INTERCONNECTED LAKE FLOW

SOURCE	ESTIMATED ANNUAL MASS EXCHANGE (kg/yr)	
	TOTAL N	TOTAL P
Mizell to Virginia	74.1	2.1
Virginia to Osceola	5930	195
Osceola to Maitland	6798	207
Maitland to Howell Branch Creek	10,530	296

4.2 Nutrient Sinks

Losses of nutrients within the Chain-of-Lakes occur as a result of surface outflow from each lake and sedimentation of nitrogen and phosphorus into the bottom sediments of each lake. A brief discussion of these sinks is given in the following sections.

4.2.1 Surface Outflow

Estimates of mass loss as a result of surface water discharges from each of the four lakes were calculated based upon the information provided in Table 4-12. A summary of estimated annual mass loss from each lake resulting from surface water discharges is given in Table 4-13. This information is used to generate the nutrient budgets outlined in Section 4.3.

TABLE 4-13

ESTIMATED ANNUAL MASS LOSSES FROM THE CHAIN-OF-LAKES RESULTING FROM LAKE OUTFLOW DISCHARGES

LAKE	ESTIMATED ANNUAL MASS DISCHARGE (kg/yr)	
	TOTAL N	TOTAL P
Virginia	5930	195
Mizell	74.1	2.1
Osceola	6798	207
Maitland	10,530	296

4.2.2 Sediment Storage

Estimates of annual storage of nitrogen and phosphorus in the sediments of the four lakes was obtained by comparing the sum of inputs and losses for the four lakes summarized in Table 4-1. Sediment storage was calculated as the difference between quantified nutrient inputs (direct precipitation + stormwater runoff + streamflow + groundwater seepage + internal recycling + interconnected lake flow), and the estimated surface outflow losses summarized in Table 4-13. These estimated sediment storage values are utilized in Section 4.3 for preparation of nutrient budgets for the Chain-of-Lakes.

4.3 Estimated Annual Mass Budgets

Estimated annual mass budgets were developed for total nitrogen and total phosphorus in the Winter Park Chain-of-Lakes based upon the analyses previously presented in Sections 2, 3, and 4. A discussion of the estimated nutrient budgets for total nitrogen and total phosphorus is given in the following sections.

4.3.1 Total Nitrogen

A summary of estimated annual mass budgets for total nitrogen in the Winter Park Chain-of-Lakes is given in Table 4-14. Information provided in this table is based upon discussions and analyses presented in the previous sections. Stormwater runoff is the single largest contributor of nitrogen to Lake Virginia, followed by streamflow through Howell Branch Creek, groundwater seepage, direct precipitation, and inflow from Lake Mizell. The most significant source of total nitrogen in Lake Mizell is groundwater seepage, followed by stormwater runoff and direct precipitation. Interconnected lake flow from Lake Virginia is the single largest source of total nitrogen to Lake Osceola, followed by stormwater runoff, groundwater seepage, and direct precipitation. Similarly, interconnected lake flow is the largest contributor of total nitrogen to Lake Maitland, followed by stormwater runoff, direct precipitation, interconnected streamflow, and groundwater seepage.

With the exception of Lake Mizell, nitrogen losses from the Winter Park Chain-of-Lakes occur primarily as a result of surface outflow from each lake. However, in Lake Mizell, sediment storage is the primary fate of nitrogen inputs. Graphical representations of total nitrogen budgets in the Winter Park Chain-of-Lakes are summarized for Lake Virginia, Lake Mizell, Lake Osceola, and Lake Maitland in Figures 4-1, 4-2, 4-3, and 4-4, respectively. Percentage contributions of evaluated sources to the annual total nitrogen budgets for the Winter Park Chain-of-Lakes are summarized in Table 4-15.

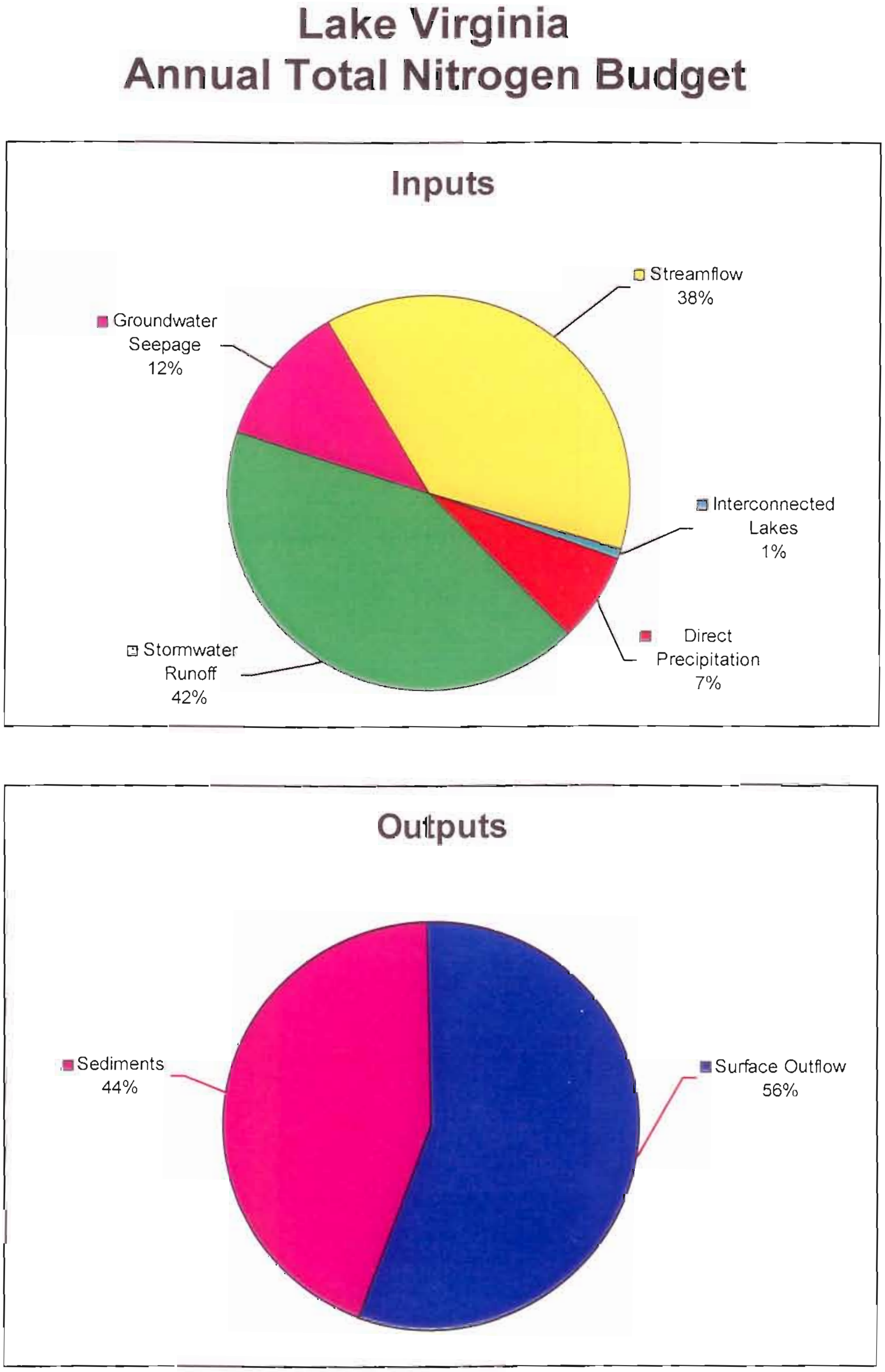


Figure 4-1. Estimated Annual Total Nitrogen Budget for Lake Virginia.

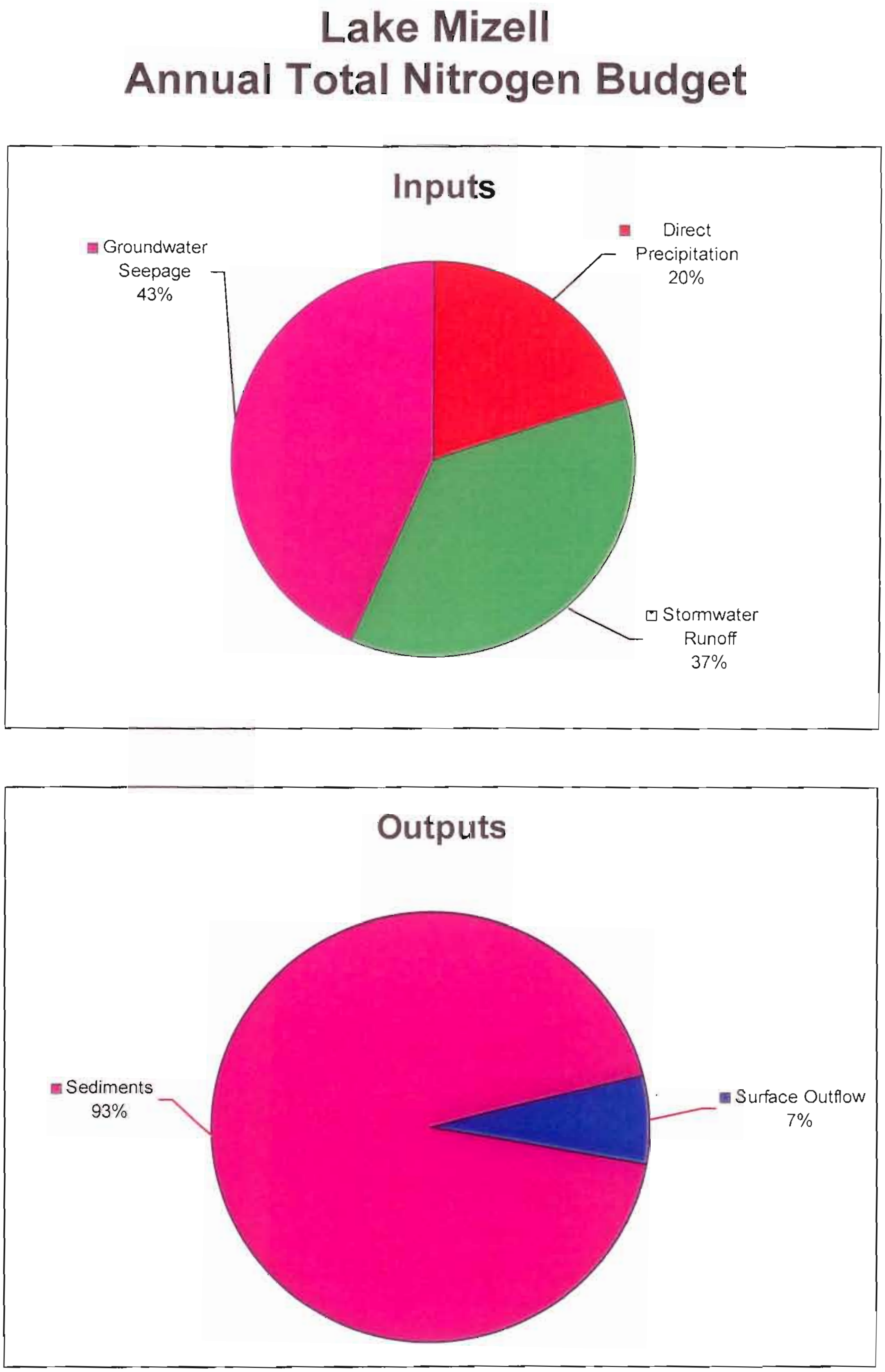
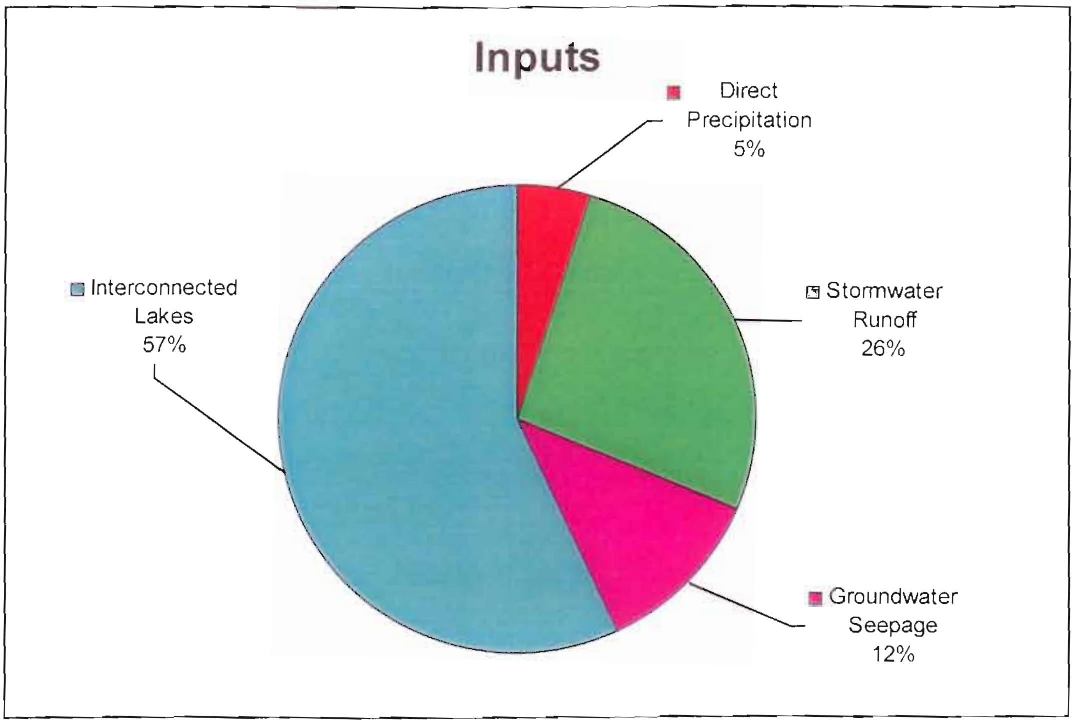


Figure 4-2. Estimated Annual Total Nitrogen Budget for Lake Mizell.

Lake Osceola
Annual Total Nitrogen Budget



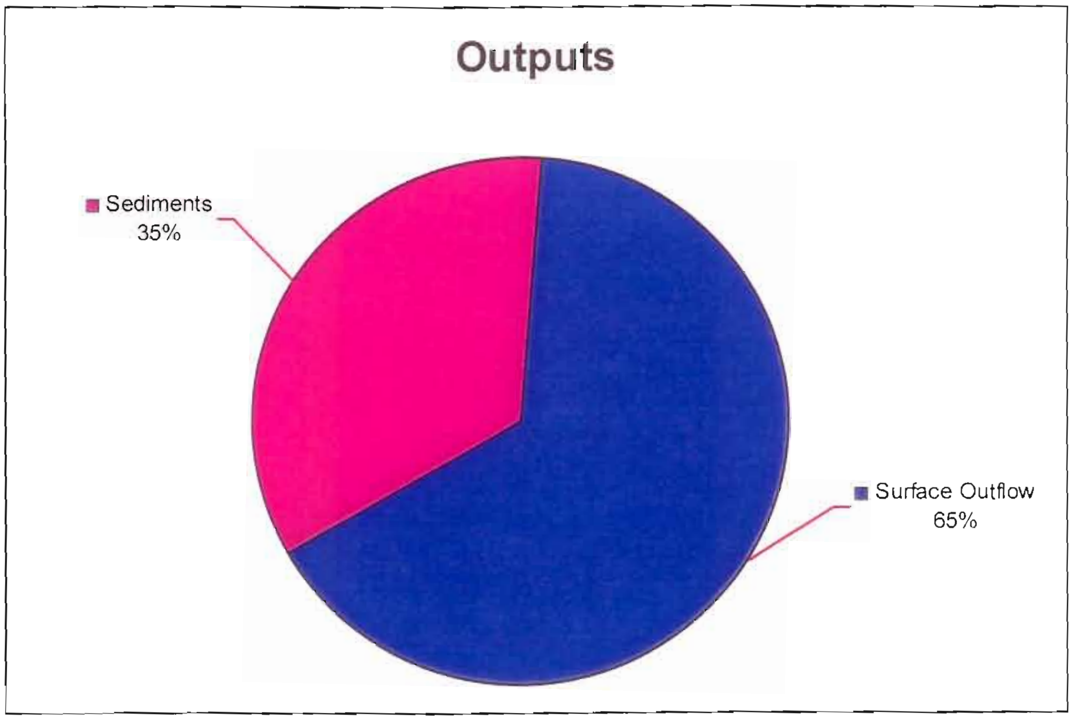
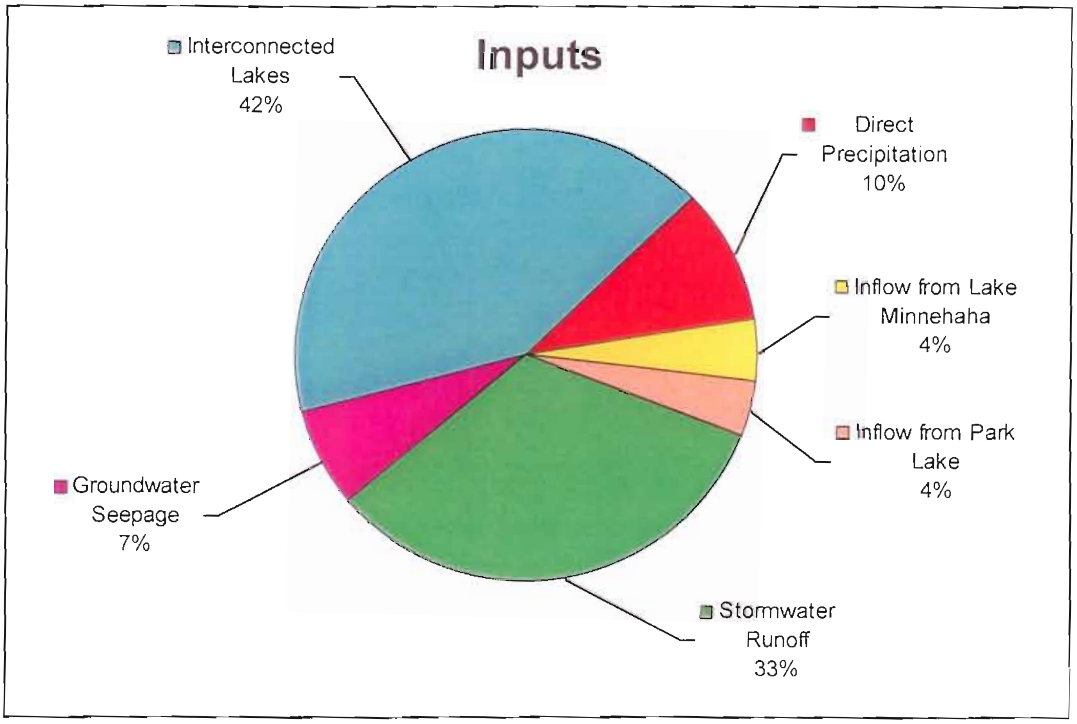


Figure 4-3. Estimated Annual Total Nitrogen Budget for Lake Osceola.

Lake Maitland
Annual Total Nitrogen Budget



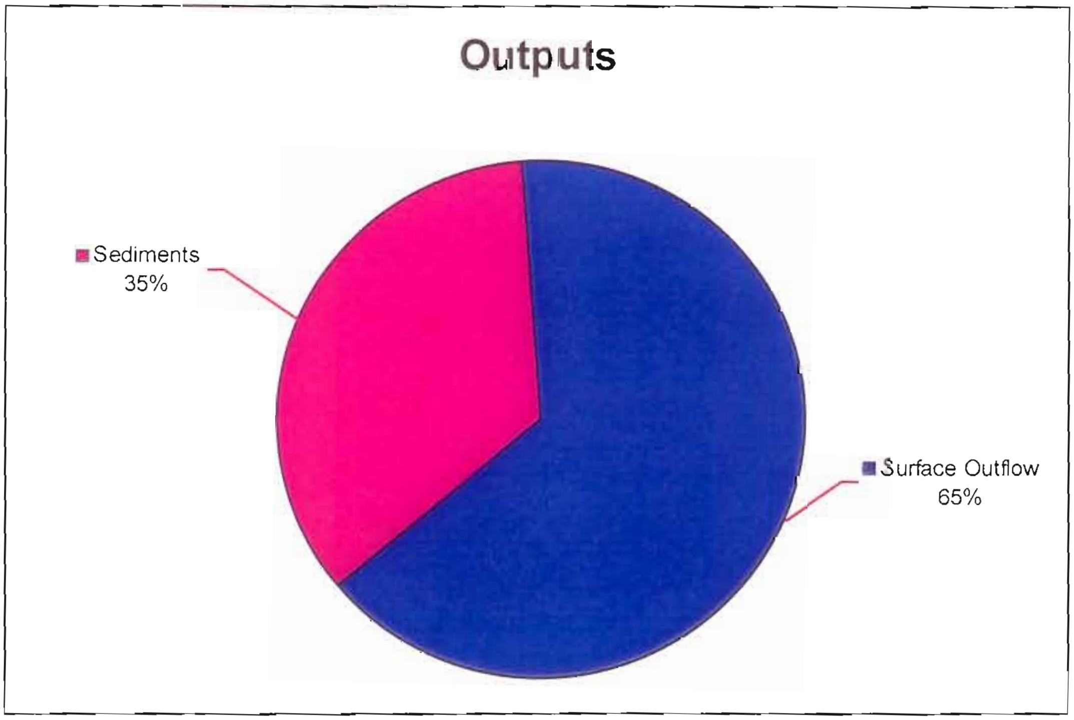


Figure 4-4. Estimated Annual Total Nitrogen Budget for Lake Maitland.

TABLE 4-14

ESTIMATED ANNUAL MASS BUDGETS FOR TOTAL NITROGEN IN THE WINTER PARK CHAIN-OF-LAKES

LAKE	NITROGEN INPUTS (kg/yr)					NITROGEN LOSSES (kg/yr)	
	Direct Precipitation	Stormwater Runoff	Streamflow	Groundwater Seepage	Interconnected Lakes	Surface Outflow	Sediments
Virginia	765	4498	4054	1255	74.1	5930	4716
Mizell	225	411	0	485	0	74.1	1047
Osceola	533	2749	0	1222	5930	6798	3636
Maitland	1605	5343	720/649[1]	1114	6798	10,530	5699

1. Inflow from Lake Minnehaha/Park Lake

TABLE 4-15

ESTIMATED PERCENTAGE CONTRIBUTIONS OF EVALUATED SOURCES TO ANNUAL MASS BUDGETS FOR TOTAL NITROGEN IN THE WINTER PARK CHAIN-OF-LAKES

LAKE	NITROGEN INPUTS					NITROGEN LOSSES	
	Direct Precipitation	Stormwater Runoff	Streamflow	Groundwater Seepage	Interconnected Lakes	Surface Outflow	Sediment Storage
Virginia	7	42	38	12	1	56	44
Mizell	20	37	0	43	0	7	93
Osceola	5	26	0	12	57	65	35
Maitland	10	33	4/4[1]	7	42	65	35

1. Inflow from Lake Minnehaha/Park Lake

4.3.2 Total Phosphorus

Estimated annual mass budgets for total phosphorus in the Winter Park Chain-of-Lakes are summarized in Table 4-16, with percentage contributions of evaluated sources of total phosphorus presented in Table 4-17. Stormwater runoff is the primary phosphorus source to

Lake Virginia, followed closely by internal recycling. The remaining inputs, such as streamflow, direct precipitation, groundwater seepage, and interconnected lake flow, represent relatively small portions of the overall phosphorus budget. Similarly, the most significant phosphorus input to Lake Mizell is stormwater runoff, followed by direct precipitation. Inputs from groundwater seepage and internal recycling are minimal in Lake Mizell, presumably due to the repeated alum applications to this lake in previous years.

TABLE 4-16

ESTIMATED ANNUAL MASS BUDGETS FOR TOTAL PHOSPHORUS IN THE WINTER PARK CHAIN-OF-LAKES

LAKE	PHOSPHORUS INPUTS (kg/yr)						PHOSPHORUS LOSSES (kg/yr)	
	Direct Precipitation	Stormwater Runoff	Streamflow	Groundwater Seepage	Internal Recycling	Interconnected Lakes	Surface Outflow	Sediments
Virginia	51.3	612 *	181	36.1	419	2.1	195	1107
Mizell	15.1	53.3 **	0	4.5	6.4	0	2.1	77.2
Osceola	35.7	379	0	8.4	90.1	195	207	501
Maitland	108	830	32.3/49.1[1]	45.1	145	207	296	1121

1. Inflow from Lake Minnehaha/Park Lake

* 2.7 kgs/acre (surface area)
** 0.2 kg/acre

5.2 kg/ac Total
(3.9 w/out sed.)

1.2 kg/ac total

TABLE 4-17

ESTIMATED PERCENTAGE CONTRIBUTIONS OF EVALUATED SOURCES TO ANNUAL MASS BUDGETS FOR TOTAL PHOSPHORUS IN THE WINTER PARK CHAIN-OF-LAKES

LAKE	PHOSPHORUS INPUTS						PHOSPHORUS LOSSES	
	Direct Precipitation	Stormwater Runoff	Streamflow	Groundwater Seepage	Internal Recycling	Interconnected Lakes	Surface Outflow	Sediments
Virginia	4	47	14	3	32	1	15	85
Mizell	19	67	0	6	8	0	3	97
Osceola	5	53	0	1	13	28	29	71
Maitland	8	59	2/3[1]	3	10	15	21	79

1. Inflow from Lake Minnehaha/Park Lake

Stormwater runoff is also the primary phosphorus source to Lake Osceola, followed by inflow from Lake Virginia, internal recycling, and direct precipitation. Groundwater seepage appears to introduce a relatively small portion of the annual phosphorus loading to this lake. Stormwater runoff is also the primary source of phosphorus to Lake Maitland, followed by inflow from Lake Osceola, internal recycling, and direct precipitation. Phosphorus loadings from streamflow and groundwater seepage appear to be relatively minimal in Lake Maitland. A graphical comparison of annual phosphorus budgets for Lake Virginia, Lake Mizell, Lake Osceola, and Lake Maitland are given in Figures 4-5, 4-6, 4-7, and 4-8, respectively.

In contrast to the trend exhibited for total nitrogen in the Winter Park Chain-of-Lakes, the primary loss of phosphorus within the Chain-of-Lakes occurs as a result of sediment storage. Approximately 71-97% of phosphorus inputs into the Chain-of-Lakes remains as stored phosphorus within the lake sediments.

4.4 Management Implications of the Developed Nutrient Budgets

Previous studies performed by ERD have suggested that water quality in the Winter Park Chain-of-Lakes can be effectively controlled by reducing inputs of total phosphorus into the lakes. Future restoration for stormwater management projects should target significant phosphorus inputs into the lakes, based upon the information provided in Table 4-16. For example, future restoration efforts in Lake Virginia should emphasize primarily treatment of stormwater runoff as well as internal recycling, both of which are significant sources of phosphorus to the lake system. Future restoration efforts in Lake Mizell should primarily emphasize treatment of additional untreated runoff sources. Restoration efforts in Lake Osceola should primarily emphasize untreated runoff sources and, to a lesser degree, internal recycling. Inflow of total

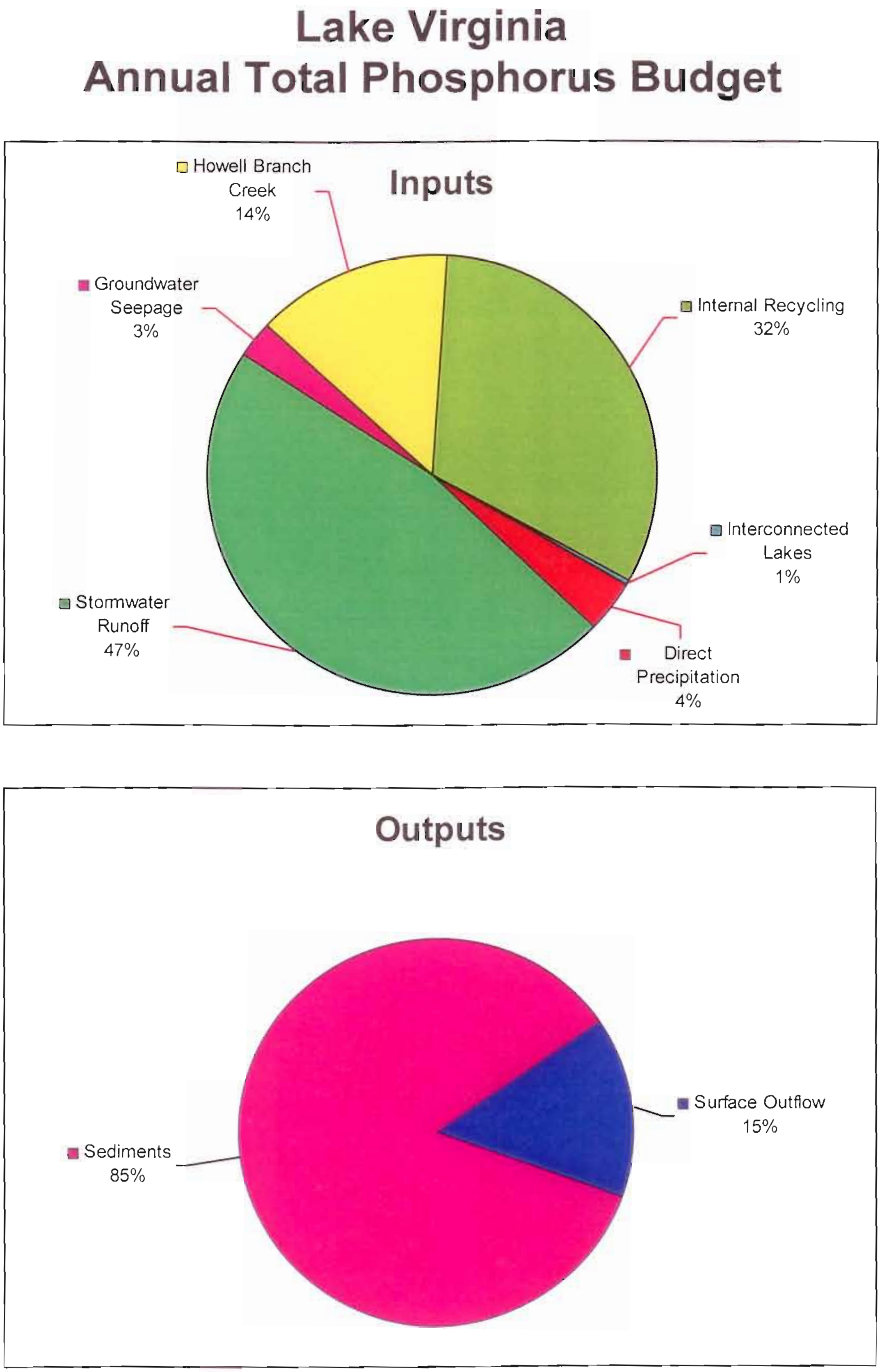


Figure 4-5. Estimated Annual Total Phosphorus Budget for Lake Virginia.

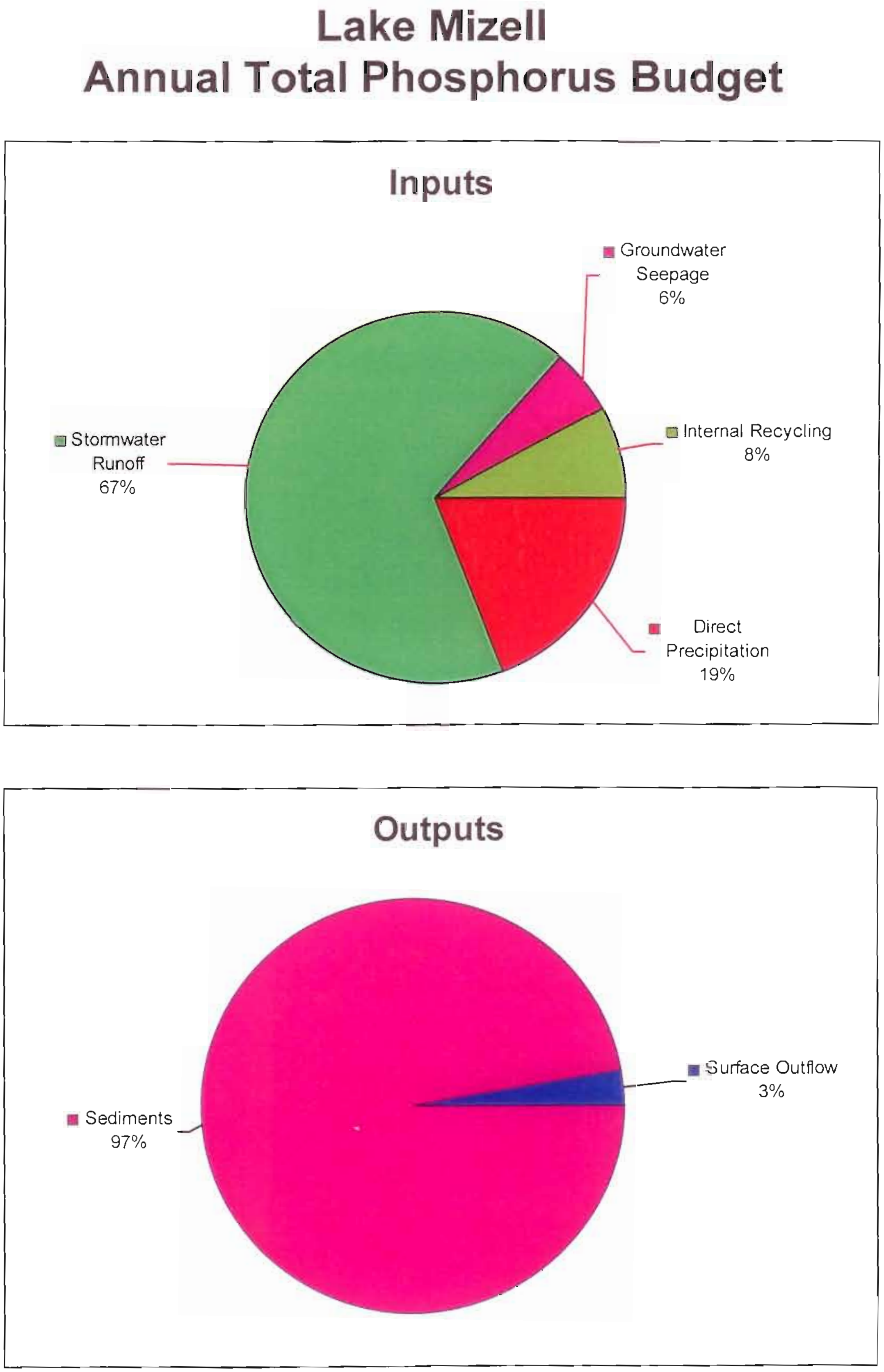
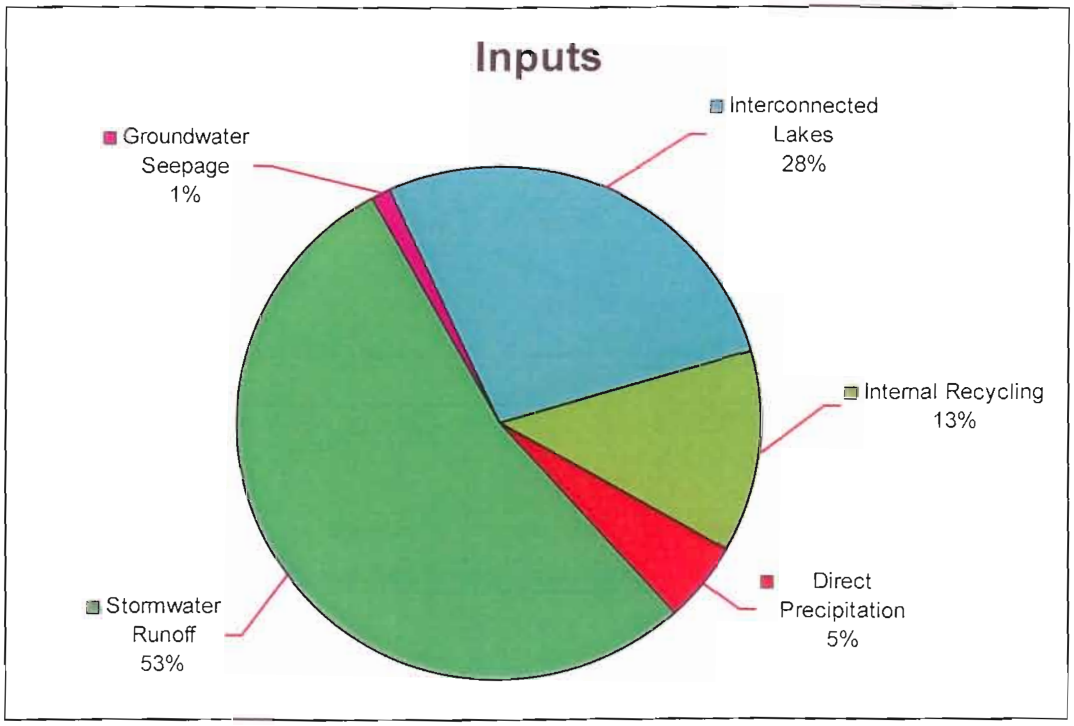


Figure 4-6. Estimated Annual Total Phosphorus Budget for Lake Mizell.

Lake Osceola
Annual Total Phosphorus Budget



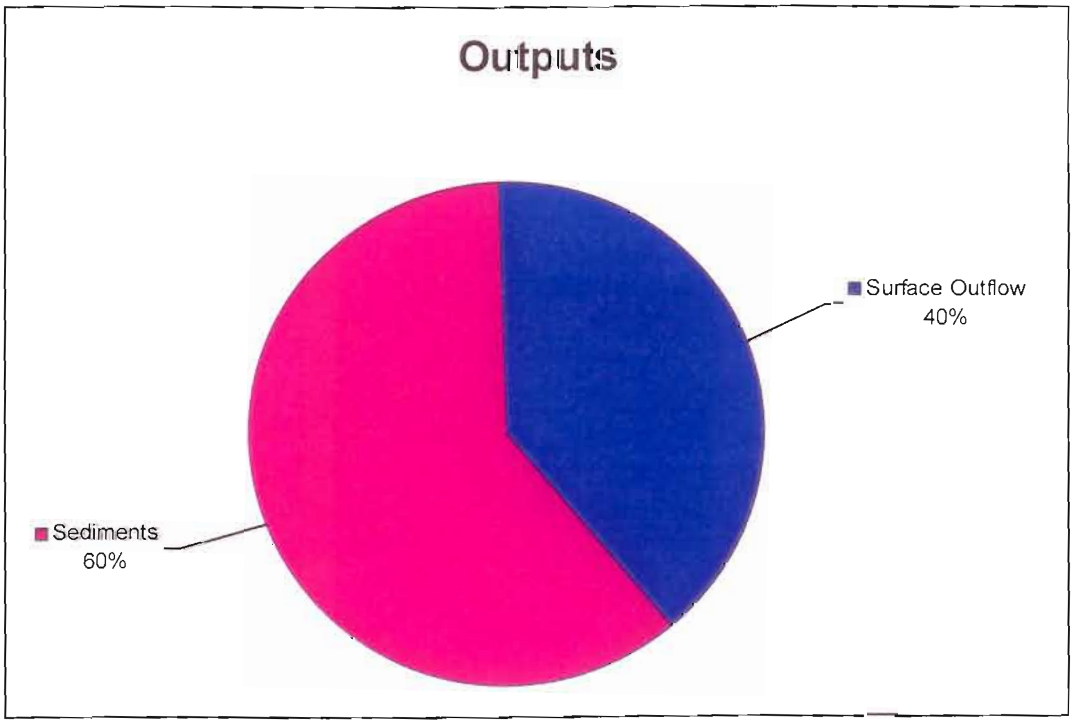
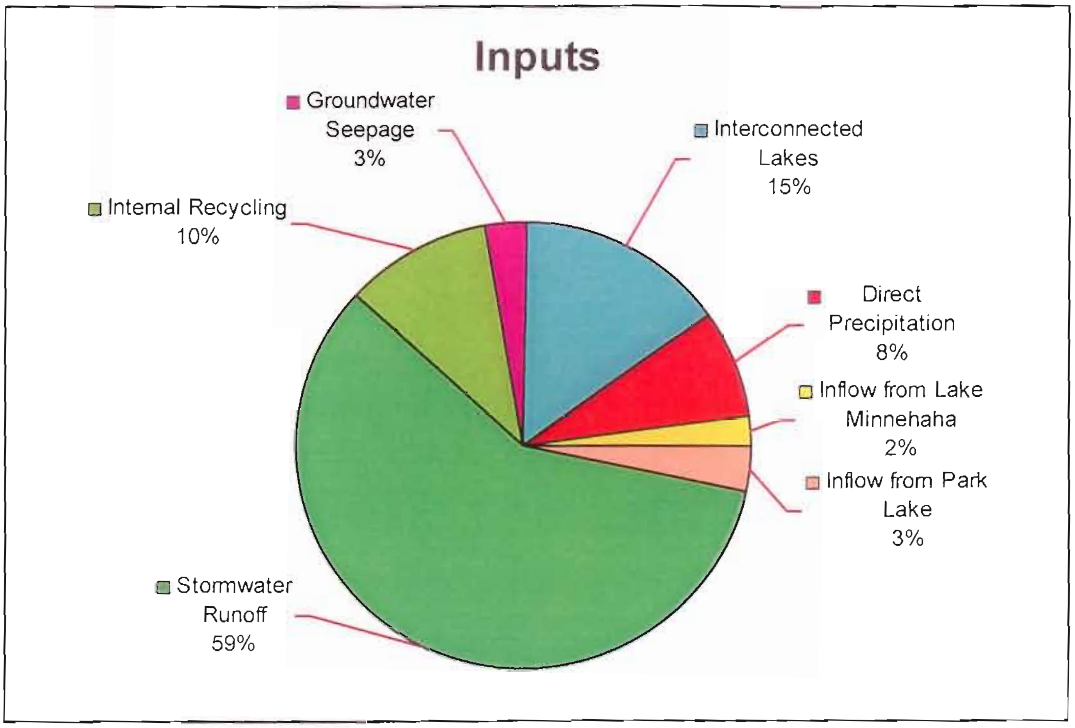


Figure 4-7. Estimated Annual Total Phosphorus Budget for Lake Osceola.

Lake Maitland
Annual Total Phosphorus Budget



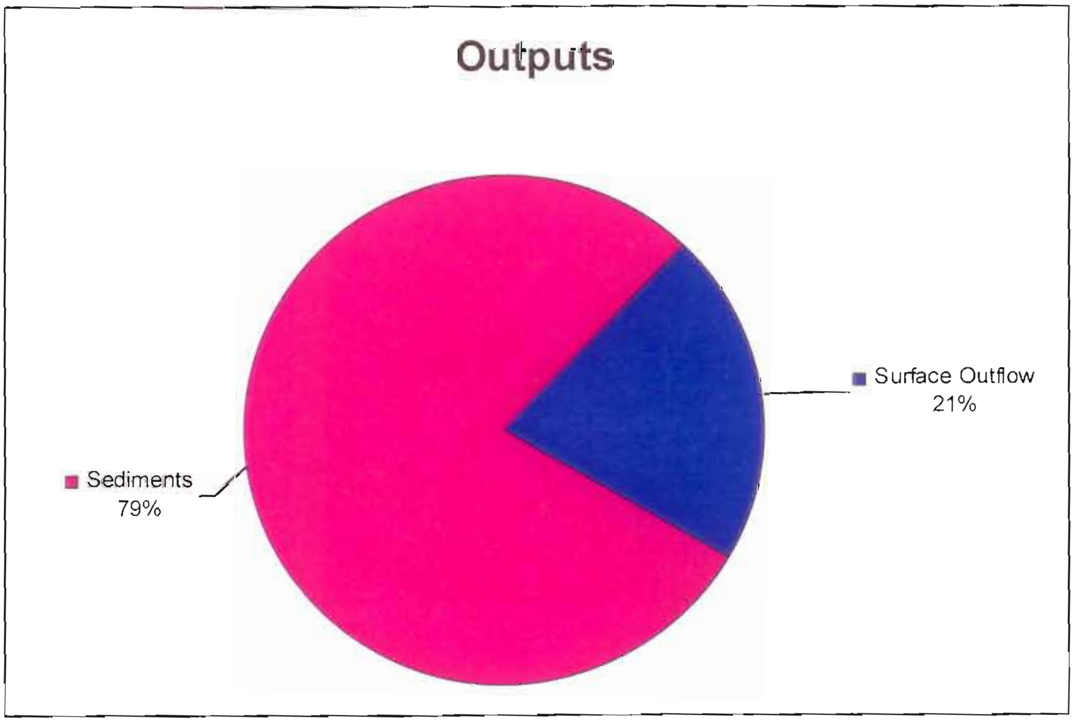


Figure 4-8. Estimated Annual Total Phosphorus Budget for Lake Maitland.

phosphorus into Lake Osceola from Lake Virginia can be best controlled by improving water quality characteristics in Lake Virginia as a result of either treatment of stormwater runoff or reduction of internal recycling. Similarly, water quality improvements can best be achieved in Lake Maitland by additional stormwater treatment projects and, to a lesser extent, internal recycling. Reductions in total phosphorus loadings discharging into Lake Maitland from Lake Osceola, which represents 15% of the phosphorus inputs into Lake Maitland on an annual basis, can best be achieved by improving water quality characteristics in Lake Osceola.

SECTION 5

SUMMARY AND CONCLUSIONS

Detailed hydrologic and nutrient budgets were prepared for the Winter Park Chain-of-Lakes based upon a combination of direct data collection by ERD and information contained in the 1995 USGS report. The primary purpose of this study is to update the information presented in the USGS report and also to provide direct measurements of the impact of groundwater seepage on both the hydrologic and nutrient budgets of the four lakes. In addition, estimates of internal nutrient recycling of phosphorus, which were not included in the USGS study, are also included in this study.

Extensive field and laboratory activities were performed by ERD during 1998-1999 to quantify the annual hydrologic and nutrient inputs from groundwater seepage into the Winter Park Chain-of-Lakes, as well as to quantify phosphorus release resulting from internal recycling of phosphorus from the sediments to the overlying water column under both aerobic and anoxic conditions. The significance of groundwater seepage inputs were evaluated by installation and monitoring of 31 groundwater seepage meters in Lake Virginia, Lake Osceola, Lake Mizell, and Lake Maitland. The significance of internal phosphorus recycling was evaluated by direct measurement of phosphorus release from large diameter lake sediment core samples from the four lakes incubated under aerobic and anoxic conditions.

Estimates of annual inputs into the lakes from bulk precipitation were calculated based upon a mean annual rainfall of 49.54 inches and typical characteristics of bulk precipitation measured in Central Florida by ERD. Inputs from stormwater runoff were calculated using a combination of monitoring performed by ERD and USGS. Consideration was given to existing significant retrofit projects on the Chain-of-Lakes to obtain estimates of runoff related loadings actually reaching the four lakes. Estimated mass loadings from streamflow were calculated by multiplying the mean daily flow rates, provided by USGS, with surface water quality data obtained from a variety of sources.

The most significant hydrologic input to Lake Virginia is streamflow through Howell Branch Creek, followed by stormwater runoff, direct precipitation, and groundwater seepage. Direct precipitation is the most significant hydrologic input to Lake Mizell, followed by stormwater runoff and groundwater seepage. Interconnected lake inflow represents the largest single hydrologic inputs to both Lake Osceola and Lake Maitland, contributing approximately 3-4 times more on an annual basis than inputs from direct precipitation, stormwater runoff, or groundwater seepage.

The most significant nitrogen source to Lake Virginia is stormwater runoff, followed closely by streamflow through Howell Branch Creek inflow, with smaller contributions from direct precipitation and groundwater seepage. In contrast, groundwater seepage is the single most significant source of total nitrogen to Lake Mizell, followed by stormwater runoff and direct precipitation. Flow between interconnected lakes is the largest source of total nitrogen inputs to both Lake Osceola and Lake Maitland, followed by stormwater runoff, groundwater seepage, and direct precipitation.

The most significant phosphorus inputs to Lake Virginia consist of stormwater runoff and internal recycling. The remaining phosphorus inputs to Lake Virginia are relatively small in comparison to these sources. Further improvements to water quality in Lake Virginia can most readily be achieved by further treatment of stormwater runoff and/or a project which addresses internal recycling, such as a whole-lake alum treatment to Lake Virginia. Of these two sources, internal recycling is the easiest and least expensive phosphorus source to target in Lake Virginia due to the relatively low cost of an alum surface treatment of the lake compared with substantially higher costs associated with stormwater treatment projects.

The single largest phosphorus source to Lake Mizell is stormwater runoff, primarily from existing untreated basin areas. Further improvements in water quality in Lake Mizell could be achieved by additional stormwater treatment projects. Phosphorus inputs from groundwater seepage and internal recycling do not appear to be significant at this time. Input values for both groundwater seepage and internal recycling are substantially lower in Lake Mizell than in the remaining Chain-of-Lakes, presumably due to the alum applications which have been performed on Lake Mizell that inactivates phosphorus both in the sediments and in groundwater seepage migrating upward through the lake. Alum surface treatments to Lake Mizell should be repeated approximately every 3-5 years to maintain the existing control of phosphorus from internal recycling and groundwater seepage.

The single largest source of phosphorus to Lake Osceola is stormwater runoff. Additional improvements in water quality characteristics in Lake Osceola can best be achieved by providing additional stormwater treatment for currently untreated areas. Interconnected lake flow from Lake Virginia also contributes a relatively large phosphorus loading to Lake Osceola each year. However, the best management strategy for this source appears to be water quality projects which improve Lake Virginia, reducing nutrient concentrations in discharges into Lake Osceola.

Inputs of stormwater runoff also appear to be the dominant source of phosphorus entering Lake Maitland. Further efforts toward water quality improvements in this waterbody should target untreated stormwater runoff sources. Internal recycling is also a relatively large component of the phosphorus budget in Lake Maitland which should be further evaluated after implementation of additional stormwater management systems for the lake.

The vast majority of phosphorus inputs into the Chain-of-Lakes is stored within each of the lakes as sediment. This represents a significant phosphorus pool which is subject to release and recycling into the overlying water column under poor water quality conditions and low dissolved oxygen concentrations. Therefore, efforts should be undertaken to maximize water quality characteristics within each lake to maintain this large pool of phosphorus in an unavailable state and to prevent further degradation of water quality characteristics within the lakes.

APPENDICES

APPENDIX A

GROUNDWATER SEEPAGE MONITORING

A.1 Field Measurements of Seepage Inflow to the Winter Park Chain-of-Lakes from September 1998-March 1999

A.2 Statistical Summary of Seepage Characteristics by Lake and Site

A.3 Chemical Characteristics of Seepage Inflow to the Winter Park Chain-of-Lakes from September 1998-March 1999

A.1 Field Measurements of Seepage Inflow to the Winter Park Chain-of-Lakes from September 1998-March 1999

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Virginia   Date: 8/24/98

Date Installed: 7/23/98   Chamber Diameter: 0.58 m   Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	14:55	--	--	--	--	--	Bag installed, no sample
2	15:07	--	--	--	--	--	Bag installed, no sample
3	15:13	--	--	--	--	--	Bag installed, no sample
4	15:22	--	--	--	--	--	Bag installed, no sample
5	15:34	--	--	--	--	--	Bag installed, no sample
6	15:41	--	--	--	--	--	Bag installed, no sample
7	15:55	--	--	--	--	--	Bag installed, no sample

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Virginia Date: 9/23/98

Date Installed: 7/23/98 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	19:10	5.5	8/24/98	14:55	30.18	0.68	Sample collected, bag in good condition
2	19:25	3.2	8/24/98	15:07	30.18	0.39	Sample collected, bag in good condition
3	19:35	9.3	8/24/98	15:13	30.18	1.14	Sample collected, bag in good condition
4	19:41	8.3	8/24/98	15:22	30.18	1.02	Sample collected, bag in good condition
5	19:47	7.0	8/24/98	15:34	30.18	0.86	Sample collected, bag in good condition
6	19:55	34.0	8/24/98	15:41	30.18	4.17	Sample collected, bag in good condition
7	20:04	18.0	8/24/98	15:55	30.17	2.21	Sample collected, bag replaced

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Virginia　　Date: 10/13-14/98

Date Installed: 7/23/98　　Chamber Diameter: 0.58 m　　Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	16:16[1]	6.2	9/23/98	19:10	20.88	1.10	Sample collected; bag in good condition
2	16:22[1]	1.1	9/23/98	19:25	20.87	0.20	Sample collected; bag in good condition
3	16:35[1]	9.0	9/23/98	19:35	20.88	1.60	Sample collected; bag in good condition
4	16:41[1]	8.8	9/23/98	19:41	20.88	1.56	Sample collected; bag in good condition
5	16:48[1]	4.2	9/23/98	19:47	20.88	0.74	Sample collected; bag in good condition
6	16:56[1]	52.5	9/23/98	19:55	20.88	9.31	Sample collected; bag in good condition
7	15:40[2]	2.0	9/23/98	20:04	19.82	0.37	Sample collected; bag in good condition

1. Sample collected on 10/14/98
2. Sample collected on 10/13/98

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Virginia   Date: 10/28/98

Date Installed: 7/23/98   Chamber Diameter: 0.58 m   Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	14:25	4.4	10/14/98	16:16	13.92	1.17	Sample collected; bag in good condition
2	14:35	1.6	10/14/98	16:22	13.93	0.43	Sample collected; bag in good condition
3	14:43	6.3	10/14/98	16:35	13.92	1.68	Sample collected; bag in good condition
4	14:48	7.5	10/14/98	16:41	13.92	2.00	Sample collected; bag in good condition
5	14:56	3.2	10/14/98	16:48	13.92	0.85	Sample collected; bag in good condition
6	15:08	58.0	10/14/98	16:56	13.93	15.4	Sample collected; bag in good condition
7	15:15	1.6	10/13/98	15:40	14.98	0.40	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Virginia   Date: 12/5/98

Date Installed: 7/23/98   Chamber Diameter: 0.58 m   Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	12:53	6.4	10/28/98	14:25	37.94	0.62	Sample collected; bag in good condition
2	13:00	1.2	10/28/98	14:35	37.93	0.12	Sample collected; bag in good condition
3	13:08	9.4	10/28/98	14:43	37.93	0.92	Sample collected; bag in good condition
4	13:15	12.5	10/28/98	14:48	37.94	1.22	Sample collected; bag in good condition
5	13:25	--	10/28/98	14:56	37.94	--	Bag damaged; no sample; bag replaced
6	13:35	123	10/28/98	15:08	37.94	12.0	Sample collected; bag in good condition
7	13:45	1.6	10/28/98	15:15	37.94	0.16	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Virginia

Date: 1/16/99

Date Installed: 7/23/98

Chamber Diameter: 0.58 m

Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	10:48	4.9	12/5/98	12:53	41.91	0.43	Sample collected, bag in good condition
2	10:55	1.1	12/5/98	13:00	41.91	0.10	Sample collected, bag in good condition
3	11:06	5.9	12/5/98	13:08	41.92	0.52	Sample collected, bag in good condition
4	11:20	12.0	12/5/98	13:15	41.92	1.06	Sample collected, bag in good condition
5	11:31	2.6	12/5/98	13:25	41.92	0.23	Sample collected, bag in good condition
6	11:44	105	12/5/98	13:35	41.92	9.28	Sample collected, bag in good condition
7	11:56	2.0	12/5/98	13:45	41.92	0.18	Sample collected, bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Virginia

Date: 3/13/99

Date Installed: 7/23/98

Chamber Diameter: 0.58 m

Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	10:50	6.0	1/16/99	10:48	53.00	0.42	Sample collected, meter removed
2	11:05	--	1/16/99	10:55	53.01	--	Meter missing
3	11:10	8.6	1/16/99	11:06	53.00	0.60	Sample collected, meter removed
4	11:25	9.5	1/16/99	11:20	53.00	0.66	Sample collected, meter removed
5	11:40	2.4	1/16/99	11:31	53.01	0.17	Sample collected, meter removed
6	11:58	124	1/16/99	11:44	53.01	8.66	Sample collected, meter removed
7	12:15	2.0	1/16/99	11:56	53.01	0.14	Sample collected, meter removed

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Mizell Date: 8/24/98

Date Installed: 7/23/98 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	16:14	--	--	--	--	--	Bag installed, no sample
2	16:21	--	--	--	--	--	Bag installed, no sample
3	16:29	--	--	--	--	--	Bag installed, no sample
4	16:37	--	--	--	--	--	Bag installed, no sample
5	16:45	--	--	--	--	--	Bag installed, no sample

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Mizell Date: 9/23/98

Date Installed: 7/23/98 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	18:28	9.9	8/24/98	16:14	30.09	1.22	Sample collected, bag replaced
2	18:38	2.0	8/24/98	16:21	30.10	0.25	Sample collected, bag in good condition
3	--	--	8/24/98	16:29	--	--	Meter missing
4	18:50	8.3	8/24/98	16:37	30.09	1.02	Sample collected, bag in good condition
5	19:05	20.0	8/24/98	16:45	30.10	2.46	Sample collected, bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Mizell   Date: 10/14/98

Date Installed: 7/23/98   Chamber Diameter: 0.58 m   Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	17:38	4.4	9/23/98	18:28	19.97	0.82	Sample collected; bag in good condition
2	12:20[1]	1.5	9/23/98	16:21	11.83	0.47	Sample collected; meter replaced
3	17:55	4.4	10/5/98	12:20	9.23	1.77	Sample collected; bag in good condition
4	13:10[1]	8.5	9/23/98	16:37	11.86	2.66	Sample collected; bag in good condition
5	18:05	13.0	9/23/98	19:05	19.96	2.41	Sample collected; bag in good condition

1. Sample collected on 10/5/98

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Mizell Date: 10/28/98

Date Installed: 7/23/98 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	13:45	6.3	10/14/98	17:38	13.84	1.69	Sample collected; bag in good condition
2	13:51	8.7	10/14/98	17:45	13.84	2.33	Sample collected; bag in good condition
3	14:00	4.6	10/14/98	17:55	13.84	1.23	Sample collected; bag in good condition
4	--	--	--	--	--	--	Meter missing
5	14:12	30.0	10/14/98	18:05	13.84	8.03	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Mizell   Date: 12/4/98

Date Installed: 7/23/98   Chamber Diameter: 0.58 m   Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	14:05	--	10/28/98	13:45	37.01	--	Bag damaged; no sample; bag replaced
2	14:15	17.6	10/28/98	13:51	37.02	1.76	Sample collected; bag in good condition
3	13:42	10.6	10/28/98	14:00	36.99	1.06	Sample collected; bag in good condition
4	--	--	--	--	--	--	Meter missing
5	13:35	22.0	10/28/98	14:12	36.97	2.20	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Mizell   Date: 1/16/99

Date Installed: 7/23/98   Chamber Diameter: 0.58 m   Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	10:05	5.6	12/4/98	14:05	42.83	0.48	Sample collected, bag in good condition
2	10:13	18.1	12/4/98	14:15	42.83	1.57	Sample collected, bag in good condition
3	10:29	4.0	12/4/98	13:42	42.87	0.35	Sample collected, bag in good condition
4	--	--	12/4/98	--	--	--	Meter missing
5	10:40	7.1	12/4/98	13:35	42.88	0.61	Sample collected, bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Mizell　　Date: 3/13/99

Date Installed: 7/23/98　　Chamber Diameter: 0.58 m　　Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	9:45	6.0	1/16/99	10:05	52.99	0.42	Sample collected, meter removed
2	10:00	11.0	1/16/99	10:13	52.99	0.77	Sample collected, meter removed
3	10:15	6.3	1/16/99	10:29	52.99	0.44	Sample collected, meter removed
4	--	--	--	--	--	--	Meter missing
5	10:30	6.9	1/16/99	10:40	52.99	0.48	Sample collected, meter removed

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Osceola   Date: 8/24/98

Date Installed: 7/23/98   Chamber Diameter: 0.58 m   Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	13:33	--	--	--	--	--	Bag installed, no sample
2	13:40	--	--	--	--	--	Bag installed, no sample
3	13:45	--	--	--	--	--	Bag installed, no sample
4	13:52	--	--	--	--	--	Bag installed, no sample
5	14:02	--	--	--	--	--	Bag installed, no sample
6	14:16	--	--	--	--	--	Bag installed, no sample
7	14:56	--	--	--	--	--	Bag installed, no sample
8	14:31	--	--	--	--	--	Bag installed, no sample
9	--	--	--	--	--	--	Meter missing

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Osceola

Date: 9/22/98

Date Installed: 7/23/98

Chamber Diameter: 0.58 m

Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	15:17	154	8/24/98	13:33	29.07	19.62	Sample collected, bag in good condition
2	15:29	60.0	8/24/98	13:40	29.08	7.64	Sample collected, bag in good condition
3	15:40	5.8	8/24/98	13:45	29.08	0.74	Sample collected, bag in good condition
4	15:47	3.4	8/24/98	13:52	29.08	0.43	Sample collected, bag in good condition
5	16:05	142	8/24/98	14:02	29.09	18.08	Sample collected, bag replaced
6	16:40	66.0	8/24/98	14:16	29.10	8.40	Sample collected, bag in good condition
7	16:30	2.5	8/24/98	14:56	29.07	0.32	Sample collected, bag in good condition
8	16:16	66.0	8/24/98	14:31	29.07	8.41	Sample collected, bag in good condition
9	--	--	--	--	--	--	Meter missing, replaced

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Osceola Date: 10/13-14/98

Date Installed: 7/23/98 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	14:35[1]	163	9/22/98	15:17	20.97	28.8	Sample collected; bag replaced
2	14:45[1]	42.0	9/22/98	15:29	20.97	7.42	Sample collected; bag in good condition
3	14:51[1]	18.0	9/22/98	15:40	20.97	3.18	Sample collected; bag in good condition
4	15:05[1]	3.1	9/22/98	15:47	20.97	0.55	Sample collected; bag in good condition
5	14:10[1]	155	9/22/98	16:05	20.92	27.4	Sample collected; bag replaced
6	15:15[1]	27.5	9/22/98	16:40	20.94	4.86	Sample collected; bag in good condition
7	17:17[2]	2.0	9/22/98	16:30	22.01	0.34	Sample collected; bag in good condition
8	15:25[1]	21.0	9/22/98	16:16	20.96	3.71	Sample collected; bag in good condition
9	17:25[2]	11.0	9/30/98	16:30	14.04	2.90	Sample collected; bag in good condition

1. Sample collected on 10/13/98
2. Sample collected on 10/14/98

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Osceola   Date: 10/28/98

Date Installed: 7/23/98   Chamber Diameter: 0.58 m   Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	12:15	176	10/13/98	14:35	14.90	43.8	Sample collected; bag in good condition
2	12:25	13.8	10/13/98	14:45	14.90	3.43	Sample collected; bag in good condition
3	12:35	4.6	10/13/98	14:51	14.91	1.14	Sample collected; bag in good condition
4	12:41	3.5	10/13/98	15:05	14.90	0.87	Sample collected; bag in good condition
5	12:47	165	10/13/98	14:10	14.94	40.9	Sample collected; bag in good condition
6	13:01	40.0	10/13/98	15:15	14.91	9.94	Sample collected; bag in good condition
7	13:12	2.0	10/14/98	17:17	13.83	0.54	Sample collected; bag in good condition
8	13:22	20.0	10/13/98	15:25	14.91	4.97	Sample collected; bag in good condition
9	13:27	5.9	10/14/98	17:25	13.83	1.58	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Osceola Date: 11/3/98

Date Installed: 7/23/98 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	12:03	63.0	10/28/98	12:15	5.99	39.0	Sample collected; bag in good condition
2	--	--	--	--	--	--	--
3	--	--	--	--	--	--	--
4	--	--	--	--	--	--	--
5	12:12	62.5	10/28/98	12:47	5.98	38.7	Sample collected; bag in good condition
6	--	--	--	--	--	--	--
7	--	--	--	--	--	--	--
8	--	--	--	--	--	--	--
9	--	--	--	--	--	--	--

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Osceola Date: 12/4/98-12/5/98

Date Installed: 7/23/98 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	17:00	145	10/28/98	12:15	37.20	14.4	Sample collected; bag in good condition
2	11:25	34.0	10/28/98	12:25	37.96	3.32	Sample collected; bag in good condition
3	11:35	4.8	10/28/98	12:35	37.96	0.47	Sample collected; bag in good condition
4	11:43	6.0	10/28/98	12:41	37.96	0.59	Sample collected; bag in good condition
5	11:55	160	10/28/98	12:47	37.96	15.6	Sample collected; bag in good condition
6	12:15	38.0	10/28/98	13:01	37.96	3.71	Sample collected; bag in good condition
7	12:25	2.0	10/28/98	13:12	37.97	0.20	Sample collected; bag in good condition
8	12:36	56.0	10/18/98	13:22	37.97	5.46	Sample collected; bag in good condition
9	12:41	7.5	10/28/98	13:27	37.97	0.73	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Osceola   Date: 1/15-16/99

Date Installed: 7/23/98   Chamber Diameter: 0.58 m   Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	11:18[1]	130	12/4/98	17:00	41.76	11.5	Sample collected, bag in good condition
2	11:29[1]	29.0	12/5/98	11:25	41.00	2.62	Sample collected, bag in good condition
3	8:50[2]	3.3	12/5/98	11:35	41.89	0.29	Sample collected, bag in good condition
4	9:01[2]	--	12/5/98	11:43	41.89	--	Meter missing, no sample
5	9:12[2]	146	12/5/98	11:55	41.89	12.9	Sample collected, bag in good condition
6	9:25[2]	61	12/5/98	12:15	41.88	5.39	Sample collected, bag in good condition
7	9:37[2]	4.0	12/5/98	12:25	41.88	0.35	Sample collected, bag in good condition
8	9:46[2]	14.2	12/5/98	12:36	41.88	1.26	Sample collected, bag in good condition
9	9:55[2]	5.9	12/5/98	12:41	41.88	0.52	Sample collected, bag in good condition

1. Samples collected on 1/15/99
2. Samples collected on 1/16/99

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Osceola　　　　Date: 3/10/99

Date Installed: 7/23/98　　　　Chamber Diameter: 0.58 m　　　　Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	15:20	41.5	1/15/99	11:18	54.17	2.84	Sample collected, meter removed
2	15:30	8.4	1/15/99	11:29	54.17	0.57	Sample collected, meter removed
3	15:42	3.6	1/16/99	8:50	53.29	0.25	Sample collected, meter removed
4	--	--	1/16/99	9:01	--	--	Meter missing
5	16:00	145	1/16/99	9:12	53.28	10.1	Sample collected, meter removed
6	16:20	23.0	1/16/99	9:25	53.29	1.60	Sample collected, meter removed
7	16:30	12.5	1/16/99	9:37	53.29	0.87	Sample collected, meter removed
8	16:45	65	1/16/99	9:46	53.29	4.52	Sample collected, meter removed
9	16:58	1.0	1/16/99	9:55	53.29	0.07	Sample collected, meter removed

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Maitland   Date: 8/24/98

Date Installed: 7/23/98   Chamber Diameter: 0.58 m   Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	11:15	--	--	--	--	--	Bag installed, no sample
2	--	--	--	--	--	--	Meter missing
3	11:50	--	--	--	--	--	Bag installed, no sample
4	--	--	--	--	--	--	Meter missing
5	12:25	--	--	--	--	--	Bag installed, no sample
6	12:32	--	--	--	--	--	Bag installed, no sample
7	--	--	--	--	--	--	Meter missing
8	12:41	--	--	--	--	--	Bag installed, no sample
9	12:52	--	--	--	--	--	Bag installed, no sample
10	13:14	--	--	--	--	--	Bag installed, no sample

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Maitland Date: 9/22/98

Date Installed: 7/23/98 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	' TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	12:37	29.0	8/24/98	11:15	29.06	3.70	Sample collected, bag in good condition
2	12:58	3.8	9/15/98	15:25	6.90	2.04	Sample collected, bag in good condition
3	13:30	81.0	8/24/98	11:50	29.07	10.32	Sample collected, bag in good condition
4	13:17	2.8	9/15/98	14:50	6.94	1.50	Sample collected, bag in good condition
5	13:46	8.4	8/24/98	12:25	29.06	1.07	Sample collected, bag in good condition
6	14:05	7.9	8/24/98	12:32	29.06	1.01	Sample collected, bag replaced
7	14:13	6.9	9/15/98	14:00	29.01	0.88	Sample collected, bag in good condition
8	14:20	8.0	8/24/98	12:41	29.07	1.02	Sample collected, bag in good condition
9	14:25	7.0	8/24/98	12:52	29.06	0.89	Sample collected, bag in good condition
10	14:40	42.0	8/24/98	13:14	29.06	5.35	Sample collected, bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Maitland Date: 10/13/98

Date Installed: 7/23/98 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	' TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	11:15	6.0	9/22/98	12:37	20.94	1.06	Sample collected; bag in good condition
2	11:05	6.1	9/22/98	12:58	20.92	1.08	Sample collected; bag in good condition
3	11:31	27.0	9/22/98	13:30	20.92	4.78	Sample collected; bag in good condition
4	11:25	7.8	9/22/98	13:17	20.92	1.38	Sample collected; bag in good condition
5	11:42	4.8	9/22/98	13:46	20.91	0.85	Sample collected; bag in good condition
6	11:50	8.9	9/22/98	14:05	20.91	1.58	Sample collected; bag in good condition
7	11:56	10.8	9/22/98	14:13	20.90	1.91	Sample collected; bag in good condition
8	12:08	7.6	9/22/98	14:20	20.91	1.35	Sample collected; bag in good condition
9	12:13	8.6	9/22/98	14:25	20.91	1.52	Sample collected; bag in good condition
10	12:22	50.0	9/22/98	14:40	20.90	8.86	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Maitland   Date: 10/28/98

Date Installed: 7/23/98   Chamber Diameter: 0.58 m   Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	10:38	10.1	10/13/98	11:15	14.97	2.50	Sample collected; bag in good condition
2	10:27	4.4	10/13/98	11:05	14.97	1.09	Sample collected; bag in good condition
3	11:05	44.0	10/13/98	11:31	14.98	10.88	Sample collected; bag in good condition
4	10:47	23.0	10/13/98	11:25	14.97	5.69	Sample collected; bag replaced
5	11:13	4.9	10/13/98	11:42	14.98	1.21	Sample collected; bag in good condition
6	11:25	13.5	10/13/98	11:50	14.98	3.34	Sample collected; bag in good condition
7	11:33	9.6	10/13/98	11:56	14.98	2.37	Sample collected; bag in good condition
8	11:38	3.9	10/13/98	12:08	14.98	0.96	Sample collected; bag in good condition
9	11:43	4.8	10/13/98	12:13	14.98	1.19	Sample collected; bag in good condition
10	11:52	46.0	10/13/98	12:22	14.98	11.37	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Maitland   Date: 12/4/98

Date Installed: 7/23/98   Chamber Diameter: 0.58 m   Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	15:15	17.6	10/28/98	10:38	37.19	1.75	Sample collected; bag in good condition
2	15:25	10.0	10/28/98	10:27	37.21	1.00	Sample collected; bag in good condition
3	15:36	30.0	10/28/98	11:05	37.19	2.99	Sample collected; bag in good condition
4	15:45	5.1	10/28/98	10:47	37.21	0.51	Sample collected; bag in good condition
5	15:53	7.2	10/28/98	11:13	37.19	0.72	Sample collected; bag in good condition
6	16:03	9.6	10/28/98	11:25	37.19	0.96	Sample collected; bag in good condition
7	16:11	--	10/28/98	11:33	37.19	--	No sample; bag damaged; replaced
8	16:25	6.4	10/28/98	11:38	37.20	0.64	Sample collected; bag in good condition
9	16:35	6.8	10/28/98	11:43	37.20	0.68	Sample collected; bag in good condition
10	16:48	22.5	10/28/98	11:52	37.21	2.24	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Maitland Date: 1/15/99

Date Installed: 7/23/98 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	'TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	9:10	11.0	12/4/98	15:15	41.75	0.98	Sample collected; bag in good condition
2	9:30	2.9	12/4/98	15:25	41.75	0.26	Sample collected; bag replaced
3	9:45	29.0	12/4/98	15:36	41.76	2.57	Sample collected; bag in good condition
4	9:55	5.0	12/4/98	15:45	41.76	0.44	Sample collected; bag in good condition
5	10:08	6.1	12/4/98	15:53	41.76	0.54	Sample collected; bag in good condition
6	10:16	8.0	12/4/98	16:03	41.76	0.71	Sample collected; bag in good condition
7	10:25	5.0	12/4/98	16:11	41.76	0.44	Sample collected; bag in good condition
8	10:40	7.0	12/4/98	16:25	41.76	0.62	Sample collected; bag in good condition
9	10:55	7.8	12/4/98	16:35	41.76	0.69	Sample collected; bag in good condition
10	11:10	27.9	12/4/98	16:48	41.77	2.47	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Maitland　　Date: 3/10/99

Date Installed: 7/23/98　　Chamber Diameter: 0.58 m　　Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	12:00	79.5	1/15/99	9:10	54.12	5.44	Sample collected; meter removed
2	12:28	2.8	1/15/99	9:30	54.12	0.19	Sample collected; meter removed
3	12:43	42.0	1/15/99	9:45	54.12	2.87	Sample collected; meter removed
4	13:05	2.7	1/15/99	9:55	54.13	0.18	Sample collected; meter removed
5	13:14	8.9	1/15/99	10:08	54.13	0.61	Sample collected; meter removed
6	13:40	2.5	1/15/99	10:16	54.14	0.17	Sample collected; meter removed
7	14:02	8.0	1/15/99	10:25	54.15	0.55	Sample collected; meter removed
8	14:15	6.8	1/15/99	10:40	54.15	0.47	Sample collected; meter removed
9	14:30	4.2	1/15/99	10:55	54.15	0.29	Sample collected; meter removed
10	14:45	32.5	1/15/99	11:10	54.15	2.22	Sample collected; meter removed

APPENDICES

APPENDIX A

GROUNDWATER SEEPAGE MONITORING

A.1 Field Measurements of Seepage Inflow to the Winter Park Chain-of-Lakes from September 1998-March 1999

A.2 Statistical Summary of Seepage Characteristics by Lake and Site

A.3 Chemical Characteristics of Seepage Inflow to the Winter Park Chain-of-Lakes from September 1998-March 1999

A.1 Field Measurements of Seepage Inflow to the Winter Park Chain-of-Lakes from September 1998-March 1999

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Virginia   Date: 8/24/98

Date Installed: 7/23/98   Chamber Diameter: 0.58 m   Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	14:55	--	--	--	--	--	Bag installed, no sample
2	15:07	--	--	--	--	--	Bag installed, no sample
3	15:13	--	--	--	--	--	Bag installed, no sample
4	15:22	--	--	--	--	--	Bag installed, no sample
5	15:34	--	--	--	--	--	Bag installed, no sample
6	15:41	--	--	--	--	--	Bag installed, no sample
7	15:55	--	--	--	--	--	Bag installed, no sample

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Virginia　　Date: 9/23/98

Date Installed: 7/23/98　　Chamber Diameter: 0.58 m　　Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	19:10	5.5	8/24/98	14:55	30.18	0.68	Sample collected, bag in good condition
2	19:25	3.2	8/24/98	15:07	30.18	0.39	Sample collected, bag in good condition
3	19:35	9.3	8/24/98	15:13	30.18	1.14	Sample collected, bag in good condition
4	19:41	8.3	8/24/98	15:22	30.18	1.02	Sample collected, bag in good condition
5	19:47	7.0	8/24/98	15:34	30.18	0.86	Sample collected, bag in good condition
6	19:55	34.0	8/24/98	15:41	30.18	4.17	Sample collected, bag in good condition
7	20:04	18.0	8/24/98	15:55	30.17	2.21	Sample collected, bag replaced

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Virginia — Date: 10/13-14/98

Date Installed: 7/23/98 — Chamber Diameter: 0.58 m — Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	16:16[1]	6.2	9/23/98	19:10	20.88	1.10	Sample collected; bag in good condition
2	16:22[1]	1.1	9/23/98	19:25	20.87	0.20	Sample collected; bag in good condition
3	16:35[1]	9.0	9/23/98	19:35	20.88	1.60	Sample collected; bag in good condition
4	16:41[1]	8.8	9/23/98	19:41	20.88	1.56	Sample collected; bag in good condition
5	16:48[1]	4.2	9/23/98	19:47	20.88	0.74	Sample collected; bag in good condition
6	16:56[1]	52.5	9/23/98	19:55	20.88	9.31	Sample collected; bag in good condition
7	15:40[2]	2.0	9/23/98	20:04	19.82	0.37	Sample collected; bag in good condition

1. Sample collected on 10/14/98
2. Sample collected on 10/13/98

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Virginia

Date: 10/28/98

Date Installed: 7/23/98

Chamber Diameter: 0.58 m

Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	14:25	4.4	10/14/98	16:16	13.92	1.17	Sample collected; bag in good condition
2	14:35	1.6	10/14/98	16:22	13.93	0.43	Sample collected; bag in good condition
3	14:43	6.3	10/14/98	16:35	13.92	1.68	Sample collected; bag in good condition
4	14:48	7.5	10/14/98	16:41	13.92	2.00	Sample collected; bag in good condition
5	14:56	3.2	10/14/98	16:48	13.92	0.85	Sample collected; bag in good condition
6	15:08	58.0	10/14/98	16:56	13.93	15.4	Sample collected; bag in good condition
7	15:15	1.6	10/13/98	15:40	14.98	0.40	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Virginia Date: 12/5/98

Date Installed: 7/23/98 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	12:53	6.4	10/28/98	14:25	37.94	0.62	Sample collected; bag in good condition
2	13:00	1.2	10/28/98	14:35	37.93	0.12	Sample collected; bag in good condition
3	13:08	9.4	10/28/98	14:43	37.93	0.92	Sample collected; bag in good condition
4	13:15	12.5	10/28/98	14:48	37.94	1.22	Sample collected; bag in good condition
5	13:25	--	10/28/98	14:56	37.94	--	Bag damaged; no sample; bag replaced
6	13:35	123	10/28/98	15:08	37.94	12.0	Sample collected; bag in good condition
7	13:45	1.6	10/28/98	15:15	37.94	0.16	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Virginia

Date: 1/16/99

Date Installed: 7/23/98

Chamber Diameter: 0.58 m

Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	10:48	4.9	12/5/98	12:53	41.91	0.43	Sample collected, bag in good condition
2	10:55	1.1	12/5/98	13:00	41.91	0.10	Sample collected, bag in good condition
3	11:06	5.9	12/5/98	13:08	41.92	0.52	Sample collected, bag in good condition
4	11:20	12.0	12/5/98	13:15	41.92	1.06	Sample collected, bag in good condition
5	11:31	2.6	12/5/98	13:25	41.92	0.23	Sample collected, bag in good condition
6	11:44	105	12/5/98	13:35	41.92	9.28	Sample collected, bag in good condition
7	11:56	2.0	12/5/98	13:45	41.92	0.18	Sample collected, bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Virginia　　　　Date: 3/13/99

Date Installed: 7/23/98　　Chamber Diameter: 0.58 m　　Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	10:50	6.0	1/16/99	10:48	53.00	0.42	Sample collected, meter removed
2	11:05	--	1/16/99	10:55	53.01	--	Meter missing
3	11:10	8.6	1/16/99	11:06	53.00	0.60	Sample collected, meter removed
4	11:25	9.5	1/16/99	11:20	53.00	0.66	Sample collected, meter removed
5	11:40	2.4	1/16/99	11:31	53.01	0.17	Sample collected, meter removed
6	11:58	124	1/16/99	11:44	53.01	8.66	Sample collected, meter removed
7	12:15	2.0	1/16/99	11:56	53.01	0.14	Sample collected, meter removed

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Mizell Date: 8/24/98

Date Installed: 7/23/98 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	16:14	--	--	--	--	--	Bag installed, no sample
2	16:21	--	--	--	--	--	Bag installed, no sample
3	16:29	--	--	--	--	--	Bag installed, no sample
4	16:37	--	--	--	--	--	Bag installed, no sample
5	16:45	--	--	--	--	--	Bag installed, no sample

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Mizell　　　　Date: 9/23/98

Date Installed: 7/23/98　　　　Chamber Diameter: 0.58 m　　　　Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	18:28	9.9	8/24/98	16:14	30.09	1.22	Sample collected, bag replaced
2	18:38	2.0	8/24/98	16:21	30.10	0.25	Sample collected, bag in good condition
3	--	--	8/24/98	16:29	--	--	Meter missing
4	18:50	8.3	8/24/98	16:37	30.09	1.02	Sample collected, bag in good condition
5	19:05	20.0	8/24/98	16:45	30.10	2.46	Sample collected, bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Mizell Date: 10/14/98

Date Installed: 7/23/98 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	17:38	4.4	9/23/98	18:28	19.97	0.82	Sample collected; bag in good condition
2	12:20[1]	1.5	9/23/98	16:21	11.83	0.47	Sample collected; meter replaced
3	17:55	4.4	10/5/98	12:20	9.23	1.77	Sample collected; bag in good condition
4	13:10[1]	8.5	9/23/98	16:37	11.86	2.66	Sample collected; bag in good condition
5	18:05	13.0	9/23/98	19:05	19.96	2.41	Sample collected; bag in good condition

1. Sample collected on 10/5/98

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Mizell

Date: 10/28/98

Date Installed: 7/23/98

Chamber Diameter: 0.58 m

Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	13:45	6.3	10/14/98	17:38	13.84	1.69	Sample collected; bag in good condition
2	13:51	8.7	10/14/98	17:45	13.84	2.33	Sample collected; bag in good condition
3	14:00	4.6	10/14/98	17:55	13.84	1.23	Sample collected; bag in good condition
4	--	--	--	--	--	--	Meter missing
5	14:12	30.0	10/14/98	18:05	13.84	8.03	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Mizell

Date: 12/4/98

Date Installed: 7/23/98

Chamber Diameter: 0.58 m

Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	14:05	--	10/28/98	13:45	37.01	--	Bag damaged; no sample; bag replaced
2	14:15	17.6	10/28/98	13:51	37.02	1.76	Sample collected; bag in good condition
3	13:42	10.6	10/28/98	14:00	36.99	1.06	Sample collected; bag in good condition
4	--	--	--	--	--	--	Meter missing
5	13:35	22.0	10/28/98	14:12	36.97	2.20	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Mizell — Date: 1/16/99

Date Installed: 7/23/98 — Chamber Diameter: 0.58 m — Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	10:05	5.6	12/4/98	14:05	42.83	0.48	Sample collected, bag in good condition
2	10:13	18.1	12/4/98	14:15	42.83	1.57	Sample collected, bag in good condition
3	10:29	4.0	12/4/98	13:42	42.87	0.35	Sample collected, bag in good condition
4	--	--	12/4/98	--	--	--	Meter missing
5	10:40	7.1	12/4/98	13:35	42.88	0.61	Sample collected, bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Mizell   Date: 3/13/99

Date Installed: 7/23/98   Chamber Diameter: 0.58 m   Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	9:45	6.0	1/16/99	10:05	52.99	0.42	Sample collected, meter removed
2	10:00	11.0	1/16/99	10:13	52.99	0.77	Sample collected, meter removed
3	10:15	6.3	1/16/99	10:29	52.99	0.44	Sample collected, meter removed
4	--	--	--	--	--	--	Meter missing
5	10:30	6.9	1/16/99	10:40	52.99	0.48	Sample collected, meter removed

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Osceola　　Date: 8/24/98

Date Installed: 7/23/98　　Chamber Diameter: 0.58 m　　Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	13:33	--	--	--	--	--	Bag installed, no sample
2	13:40	--	--	--	--	--	Bag installed, no sample
3	13:45	--	--	--	--	--	Bag installed, no sample
4	13:52	--	--	--	--	--	Bag installed, no sample
5	14:02	--	--	--	--	--	Bag installed, no sample
6	14:16	--	--	--	--	--	Bag installed, no sample
7	14:56	--	--	--	--	--	Bag installed, no sample
8	14:31	--	--	--	--	--	Bag installed, no sample
9	--	--	--	--	--	--	Meter missing

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Osceola　　　　Date: 9/22/98

Date Installed: 7/23/98　　Chamber Diameter: 0.58 m　　Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	15:17	154	8/24/98	13:33	29.07	19.62	Sample collected, bag in good condition
2	15:29	60.0	8/24/98	13:40	29.08	7.64	Sample collected, bag in good condition
3	15:40	5.8	8/24/98	13:45	29.08	0.74	Sample collected, bag in good condition
4	15:47	3.4	8/24/98	13:52	29.08	0.43	Sample collected, bag in good condition
5	16:05	142	8/24/98	14:02	29.09	18.08	Sample collected, bag replaced
6	16:40	66.0	8/24/98	14:16	29.10	8.40	Sample collected, bag in good condition
7	16:30	2.5	8/24/98	14:56	29.07	0.32	Sample collected, bag in good condition
8	16:16	66.0	8/24/98	14:31	29.07	8.41	Sample collected, bag in good condition
9	--	--	--	--	--	--	Meter missing, replaced

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Osceola　　　　Date: 10/13-14/98

Date Installed: 7/23/98　　Chamber Diameter: 0.58 m　　Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	14:35[1]	163	9/22/98	15:17	20.97	28.8	Sample collected; bag replaced
2	14:45[1]	42.0	9/22/98	15:29	20.97	7.42	Sample collected; bag in good condition
3	14:51[1]	18.0	9/22/98	15:40	20.97	3.18	Sample collected; bag in good condition
4	15:05[1]	3.1	9/22/98	15:47	20.97	0.55	Sample collected; bag in good condition
5	14:10[1]	155	9/22/98	16:05	20.92	27.4	Sample collected; bag replaced
6	15:15[1]	27.5	9/22/98	16:40	20.94	4.86	Sample collected; bag in good condition
7	17:17[2]	2.0	9/22/98	16:30	22.01	0.34	Sample collected; bag in good condition
8	15:25[1]	21.0	9/22/98	16:16	20.96	3.71	Sample collected; bag in good condition
9	17:25[2]	11.0	9/30/98	16:30	14.04	2.90	Sample collected; bag in good condition

1. Sample collected on 10/13/98
2. Sample collected on 10/14/98

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Osceola Date: 10/28/98

Date Installed: 7/23/98 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	12:15	176	10/13/98	14:35	14.90	43.8	Sample collected; bag in good condition
2	12:25	13.8	10/13/98	14:45	14.90	3.43	Sample collected; bag in good condition
3	12:35	4.6	10/13/98	14:51	14.91	1.14	Sample collected; bag in good condition
4	12:41	3.5	10/13/98	15:05	14.90	0.87	Sample collected; bag in good condition
5	12:47	165	10/13/98	14:10	14.94	40.9	Sample collected; bag in good condition
6	13:01	40.0	10/13/98	15:15	14.91	9.94	Sample collected; bag in good condition
7	13:12	2.0	10/14/98	17:17	13.83	0.54	Sample collected; bag in good condition
8	13:22	20.0	10/13/98	15:25	14.91	4.97	Sample collected; bag in good condition
9	13:27	5.9	10/14/98	17:25	13.83	1.58	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Osceola　　　　Date: 11/3/98

Date Installed: 7/23/98　　　　Chamber Diameter: 0.58 m　　　　Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	12:03	63.0	10/28/98	12:15	5.99	39.0	Sample collected; bag in good condition
2	--	--	--	--	--	--	--
3	--	--	--	--	--	--	--
4	--	--	--	--	--	--	--
5	12:12	62.5	10/28/98	12:47	5.98	38.7	Sample collected; bag in good condition
6	--	--	--	--	--	--	--
7	--	--	--	--	--	--	--
8	--	--	--	--	--	--	--
9	--	--	--	--	--	--	--

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Osceola　　Date: 12/4/98-12/5/98

Date Installed: 7/23/98　　Chamber Diameter: 0.58 m　　Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	17:00	145	10/28/98	12:15	37.20	14.4	Sample collected; bag in good condition
2	11:25	34.0	10/28/98	12:25	37.96	3.32	Sample collected; bag in good condition
3	11:35	4.8	10/28/98	12:35	37.96	0.47	Sample collected; bag in good condition
4	11:43	6.0	10/28/98	12:41	37.96	0.59	Sample collected; bag in good condition
5	11:55	160	10/28/98	12:47	37.96	15.6	Sample collected; bag in good condition
6	12:15	38.0	10/28/98	13:01	37.96	3.71	Sample collected; bag in good condition
7	12:25	2.0	10/28/98	13:12	37.97	0.20	Sample collected; bag in good condition
8	12:36	56.0	10/18/98	13:22	37.97	5.46	Sample collected; bag in good condition
9	12:41	7.5	10/28/98	13:27	37.97	0.73	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Osceola   Date: 1/15-16/99

Date Installed: 7/23/98   Chamber Diameter: 0.58 m   Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	11:18[1]	130	12/4/98	17:00	41.76	11.5	Sample collected, bag in good condition
2	11:29[1]	29.0	12/5/98	11:25	41.00	2.62	Sample collected, bag in good condition
3	8:50[2]	3.3	12/5/98	11:35	41.89	0.29	Sample collected, bag in good condition
4	9:01[2]	--	12/5/98	11:43	41.89	--	Meter missing, no sample
5	9:12[2]	146	12/5/98	11:55	41.89	12.9	Sample collected, bag in good condition
6	9:25[2]	61	12/5/98	12:15	41.88	5.39	Sample collected, bag in good condition
7	9:37[2]	4.0	12/5/98	12:25	41.88	0.35	Sample collected, bag in good condition
8	9:46[2]	14.2	12/5/98	12:36	41.88	1.26	Sample collected, bag in good condition
9	9:55[2]	5.9	12/5/98	12:41	41.88	0.52	Sample collected, bag in good condition

1. Samples collected on 1/15/99
2. Samples collected on 1/16/99

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Osceola

Date: 3/10/99

Date Installed: 7/23/98

Chamber Diameter: 0.58 m

Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	15:20	41.5	1/15/99	11:18	54.17	2.84	Sample collected, meter removed
2	15:30	8.4	1/15/99	11:29	54.17	0.57	Sample collected, meter removed
3	15:42	3.6	1/16/99	8:50	53.29	0.25	Sample collected, meter removed
4	--	--	1/16/99	9:01	--	--	Meter missing
5	16:00	145	1/16/99	9:12	53.28	10.1	Sample collected, meter removed
6	16:20	23.0	1/16/99	9:25	53.29	1.60	Sample collected, meter removed
7	16:30	12.5	1/16/99	9:37	53.29	0.87	Sample collected, meter removed
8	16:45	65	1/16/99	9:46	53.29	4.52	Sample collected, meter removed
9	16:58	1.0	1/16/99	9:55	53.29	0.07	Sample collected, meter removed

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Maitland

Date: 8/24/98

Date Installed: 7/23/98

Chamber Diameter: 0.58 m

Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	11:15	--	--	--	--	--	Bag installed, no sample
2	--	--	--	--	--	--	Meter missing
3	11:50	--	--	--	--	--	Bag installed, no sample
4	--	--	--	--	--	--	Meter missing
5	12:25	--	--	--	--	--	Bag installed, no sample
6	12:32	--	--	--	--	--	Bag installed, no sample
7	--	--	--	--	--	--	Meter missing
8	12:41	--	--	--	--	--	Bag installed, no sample
9	12:52	--	--	--	--	--	Bag installed, no sample
10	13:14	--	--	--	--	--	Bag installed, no sample

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Maitland　　Date: 9/22/98

Date Installed: 7/23/98　　Chamber Diameter: 0.58 m　　Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	12:37	29.0	8/24/98	11:15	29.06	3.70	Sample collected, bag in good condition
2	12:58	3.8	9/15/98	15:25	6.90	2.04	Sample collected, bag in good condition
3	13:30	81.0	8/24/98	11:50	29.07	10.32	Sample collected, bag in good condition
4	13:17	2.8	9/15/98	14:50	6.94	1.50	Sample collected, bag in good condition
5	13:46	8.4	8/24/98	12:25	29.06	1.07	Sample collected, bag in good condition
6	14:05	7.9	8/24/98	12:32	29.06	1.01	Sample collected, bag replaced
7	14:13	6.9	9/15/98	14:00	29.01	0.88	Sample collected, bag in good condition
8	14:20	8.0	8/24/98	12:41	29.07	1.02	Sample collected, bag in good condition
9	14:25	7.0	8/24/98	12:52	29.06	0.89	Sample collected, bag in good condition
10	14:40	42.0	8/24/98	13:14	29.06	5.35	Sample collected, bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Maitland Date: 10/13/98

Date Installed: 7/23/98 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	' TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	11:15	6.0	9/22/98	12:37	20.94	1.06	Sample collected; bag in good condition
2	11:05	6.1	9/22/98	12:58	20.92	1.08	Sample collected; bag in good condition
3	11:31	27.0	9/22/98	13:30	20.92	4.78	Sample collected; bag in good condition
4	11:25	7.8	9/22/98	13:17	20.92	1.38	Sample collected; bag in good condition
5	11:42	4.8	9/22/98	13:46	20.91	0.85	Sample collected; bag in good condition
6	11:50	8.9	9/22/98	14:05	20.91	1.58	Sample collected; bag in good condition
7	11:56	10.8	9/22/98	14:13	20.90	1.91	Sample collected; bag in good condition
8	12:08	7.6	9/22/98	14:20	20.91	1.35	Sample collected; bag in good condition
9	12:13	8.6	9/22/98	14:25	20.91	1.52	Sample collected; bag in good condition
10	12:22	50.0	9/22/98	14:40	20.90	8.86	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Maitland　　Date: 10/28/98

Date Installed: 7/23/98　　Chamber Diameter: 0.58 m　　Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	10:38	10.1	10/13/98	11:15	14.97	2.50	Sample collected; bag in good condition
2	10:27	4.4	10/13/98	11:05	14.97	1.09	Sample collected; bag in good condition
3	11:05	44.0	10/13/98	11:31	14.98	10.88	Sample collected; bag in good condition
4	10:47	23.0	10/13/98	11:25	14.97	5.69	Sample collected; bag replaced
5	11:13	4.9	10/13/98	11:42	14.98	1.21	Sample collected; bag in good condition
6	11:25	13.5	10/13/98	11:50	14.98	3.34	Sample collected; bag in good condition
7	11:33	9.6	10/13/98	11:56	14.98	2.37	Sample collected; bag in good condition
8	11:38	3.9	10/13/98	12:08	14.98	0.96	Sample collected; bag in good condition
9	11:43	4.8	10/13/98	12:13	14.98	1.19	Sample collected; bag in good condition
10	11:52	46.0	10/13/98	12:22	14.98	11.37	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Maitland　　Date: 12/4/98

Date Installed: 7/23/98　　Chamber Diameter: 0.58 m　　Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	15:15	17.6	10/28/98	10:38	37.19	1.75	Sample collected; bag in good condition
2	15:25	10.0	10/28/98	10:27	37.21	1.00	Sample collected; bag in good condition
3	15:36	30.0	10/28/98	11:05	37.19	2.99	Sample collected; bag in good condition
4	15:45	5.1	10/28/98	10:47	37.21	0.51	Sample collected; bag in good condition
5	15:53	7.2	10/28/98	11:13	37.19	0.72	Sample collected; bag in good condition
6	16:03	9.6	10/28/98	11:25	37.19	0.96	Sample collected; bag in good condition
7	16:11	--	10/28/98	11:33	37.19	--	No sample; bag damaged; replaced
8	16:25	6.4	10/28/98	11:38	37.20	0.64	Sample collected; bag in good condition
9	16:35	6.8	10/28/98	11:43	37.20	0.68	Sample collected; bag in good condition
10	16:48	22.5	10/28/98	11:52	37.21	2.24	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Maitland | Date: 1/15/99

Date Installed: 7/23/98 | Chamber Diameter: 0.58 m | Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	9:10	11.0	12/4/98	15:15	41.75	0.98	Sample collected; bag in good condition
2	9:30	2.9	12/4/98	15:25	41.75	0.26	Sample collected; bag replaced
3	9:45	29.0	12/4/98	15:36	41.76	2.57	Sample collected; bag in good condition
4	9:55	5.0	12/4/98	15:45	41.76	0.44	Sample collected; bag in good condition
5	10:08	6.1	12/4/98	15:53	41.76	0.54	Sample collected; bag in good condition
6	10:16	8.0	12/4/98	16:03	41.76	0.71	Sample collected; bag in good condition
7	10:25	5.0	12/4/98	16:11	41.76	0.44	Sample collected; bag in good condition
8	10:40	7.0	12/4/98	16:25	41.76	0.62	Sample collected; bag in good condition
9	10:55	7.8	12/4/98	16:35	41.76	0.69	Sample collected; bag in good condition
10	11:10	27.9	12/4/98	16:48	41.77	2.47	Sample collected; bag in good condition

SEEPAGE METER FIELD MEASUREMENTS

Location: Lake Maitland　　Date: 3/10/99

Date Installed: 7/23/98　　Chamber Diameter: 0.58 m　　Sediment Area Covered: 0.27 m^2

SITE/ LOCATION	TIME COLLECTED	VOLUME COLLECTED (liters)	PREVIOUS COLLECTION EVENT		SEEPAGE TIME (days)	SEEPAGE (L/m^2-day)	COMMENTS / OBSERVATIONS
			DATE	TIME			
1	12:00	79.5	1/15/99	9:10	54.12	5.44	Sample collected; meter removed
2	12:28	2.8	1/15/99	9:30	54.12	0.19	Sample collected; meter removed
3	12:43	42.0	1/15/99	9:45	54.12	2.87	Sample collected; meter removed
4	13:05	2.7	1/15/99	9:55	54.13	0.18	Sample collected; meter removed
5	13:14	8.9	1/15/99	10:08	54.13	0.61	Sample collected; meter removed
6	13:40	2.5	1/15/99	10:16	54.14	0.17	Sample collected; meter removed
7	14:02	8.0	1/15/99	10:25	54.15	0.55	Sample collected; meter removed
8	14:15	6.8	1/15/99	10:40	54.15	0.47	Sample collected; meter removed
9	14:30	4.2	1/15/99	10:55	54.15	0.29	Sample collected; meter removed
10	14:45	32.5	1/15/99	11:10	54.15	2.22	Sample collected; meter removed

A.2 Statistical Summary of Seepage Characteristics by Lake and Site

Winter Park Lakes Seepage Data from 9/98-3/99

OBS	LAKE	MONTH	DAY	YEAR	SITE	DEPTH	SEEPAGE	PH	COND	ALK
1	MIZELL	09	23	98	1	S	1.22	7.58	294	25.1
2	MIZELL	09	23	98	2	D	0.25	7.29	452	56.6
3	MIZELL	09	23	98	3	S	.	.	.	.
4	MIZELL	09	23	98	4	D	1.02	7.46	331	34.2
5	MIZELL	09	23	98	5	S	2.46	7.48	266	30.6
6	MIZELL	10	14	98	1	S	0.82	7.86	342	80.0
7	MIZELL	10	14	98	2	D	0.47	7.76	440	127.0
8	MIZELL	10	14	98	3	S	1.77	7.82	273	15.9
9	MIZELL	10	14	98	4	D	2.66	7.59	299	42.3
10	MIZELL	10	14	98	5	S	2.41	7.85	265	40.0
11	MIZELL	10	28	98	1	S	1.69	7.62	286	30.0
12	MIZELL	10	28	98	2	D	2.33	7.46	298	26.7
13	MIZELL	10	28	98	3	S	1.23	7.57	295	36.9
14	MIZELL	10	28	98	4	D	.	.	.	.
15	MIZELL	10	28	98	5	S	8.03	7.66	271	37.4
16	MIZELL	12	04	98	1	S	.	.	.	.
17	MIZELL	12	04	98	2	D	1.76	7.31	283	15.4
18	MIZELL	12	04	98	3	S	1.06	7.26	307	26.7
19	MIZELL	12	04	98	4	D	.	.	.	.
20	MIZELL	12	04	98	5	S	2.20	7.27	272	51.9
21	MIZELL	01	16	99	1	S	0.48	7.42	332	48.5
22	MIZELL	01	16	99	2	D	1.57	7.09	304	19.0
23	MIZELL	01	16	99	3	S	0.35	6.90	289	16.1
24	MIZELL	01	16	99	4	D	.	.	.	.

OBS	NH3	NOX	ORGANICN	TOTALN	ORTHOP	TOTALP	PERIOD
1	1456	841	208	2505	21	40	wet
2	9493	25	1297	10815	13	53	wet
3	.	.	.	.	.	.	wet
4	4583	539	124	5246	3	12	wet
5	267	1387	151	1805	23	34	wet
6	4174	304	1093	5571	17	29	wet
7	1843	162	11740	13745	193	223	wet
8	1532	4	446	1982	4	16	wet
9	4245	413	190	4848	5	12	wet
10	5	293	2390	2688	16	23	wet
11	50	1650	777	2477	17	32	wet
12	1851	821	939	3611	5	9	wet
13	346	2002	524	2872	70	72	wet
14	.	.	.	.	.	.	wet
15	614	854	888	2356	41	44	wet
16	.	.	.	.	.	.	dry
17	876	113	1190	2179	2	8	dry
18	52	2226	1124	3402	35	47	dry
19	.	.	.	.	.	.	dry
20	697	1092	4962	6751	40	62	dry
21	474	3432	42	3948	3	46	dry
22	1521	602	558	2681	25	10	dry
23	25	1146	216	1387	30	33	dry
24	.	.	.	.	.	.	dry

Winter Park Lakes Seepage Data from 9/98-3/99

OBS	LAKE	MONTH	DAY	YEAR	SITE	DEPTH	SEEPAGE	PH	COND	ALK
25	MIZELL	01	16	99	5	S	0.61	7.60	275	36.5
26	MIZELL	03	13	99	1	S	0.42	7.52	322	62.9
27	MIZELL	03	13	99	2	D	0.77	7.24	306	10.3
28	MIZELL	03	13	99	3	S	0.44	7.79	398	83.8
29	MIZELL	03	13	99	4	D	.	.	.	.
30	MIZELL	03	13	99	5	S	0.48	7.65	278	56.7
31	VIRGINIA	09	23	98	1	S	0.68	7.74	535	187.0
32	VIRGINIA	09	23	98	2	D	0.39	7.43	265	56.2
33	VIRGINIA	09	23	98	3	S	1.14	7.85	418	160.0
34	VIRGINIA	09	23	98	4	S	1.02	8.11	499	203.0
35	VIRGINIA	09	23	98	5	S	0.86	7.66	223	43.4
36	VIRGINIA	09	23	98	6	S	4.17	7.40	198	33.9
37	VIRGINIA	09	23	98	7	S	2.21	7.50	194	25.0
38	VIRGINIA	10	13	98	1	S	1.10	7.90	498	167.0
39	VIRGINIA	10	13	98	2	D	0.20	7.28	266	66.0
40	VIRGINIA	10	13	98	3	S	1.60	7.98	438	177.0
41	VIRGINIA	10	13	98	4	S	1.56	8.06	462	172.0
42	VIRGINIA	10	13	98	5	S	0.74	7.97	252	66.4
43	VIRGINIA	10	13	98	6	S	9.31	7.86	206	32.4
44	VIRGINIA	10	13	98	7	S	0.37	7.80	256	67.9
45	VIRGINIA	10	28	98	1	S	1.17	7.11	437	134.0
46	VIRGINIA	10	28	98	2	D	0.43	7.21	238	47.7
47	VIRGINIA	10	28	98	3	S	1.68	7.99	471	185.0
48	VIRGINIA	10	28	98	4	S	2.00	8.17	488	161.0

OBS	NH3	NOX	ORGANICN	TOTALN	ORTHOP	TOTALP	PERIOD
25	674.0	838	1757	3269	20	25	dry
26	93.0	2563	950	3606	58	86	dry
27	716.0	1212	397	2325	4	26	dry
28	75.0	5185	482	5742	52	76	dry
29	.	.	.	.	.	.	dry
30	55.0	1489	157	1701	28	47	dry
31	14330.0	11	1234	15575	2054	2097	wet
32	3697.0	151	142	3990	31	64	wet
33	7280.0	4	1323	8607	215	230	wet
34	9452.0	4	954	10410	11	21	wet
35	702.0	4	360	1066	2	17	wet
36	1021.0	4	184	1209	98	108	wet
37	118.0	4	333	455	5	14	wet
38	13692.0	12317	1138	27147	1501	1729	wet
39	3748.0	50	1240	5038	84	272	wet
40	9787.0	30	3712	13529	212	281	wet
41	275.0	11520	1302	13097	6	22	wet
42	1738.0	102	1054	2894	51	52	wet
43	360.0	142	874	1376	114	129	wet
44	1033.0	82	1505	2620	9	21	wet
45	3345.0	19214	951	23510	2210	2535	wet
46	1354.0	839	458	2651	82	96	wet
47	10136.0	686	2412	13234	342	364	wet
48	177.0	11133	63	11373	77	81	wet

Winter Park Lakes Seepage Data from 9/98-3/99

OBS	LAKE	MONTH	DAY	YEAR	SITE	DEPTH	SEEPAGE	PH	COND	ALK
49	VIRGINIA	10	28	98	5	S	0.85	7.73	268	70.3
50	VIRGINIA	10	28	98	6	S	15.40	7.29	208	35.7
51	VIRGINIA	10	28	98	7	S	0.40	7.83	297	88.8
52	VIRGINIA	12	05	98	1	S	0.62	7.35	446	58.3
53	VIRGINIA	12	05	98	2	D	0.12	7.33	237	25.5
54	VIRGINIA	12	05	98	3	S	0.92	7.87	481	181.0
55	VIRGINIA	12	05	98	4	S	1.22	8.11	517	172.0
56	VIRGINIA	12	05	98	5	S	.	.	.	.
57	VIRGINIA	12	05	98	6	S	12.00	7.28	222	33.0
58	VIRGINIA	12	05	98	7	S	0.16	7.75	364	123.0
59	VIRGINIA	01	16	99	1	S	0.43	7.49	422	39.3
60	VIRGINIA	01	16	99	2	D	0.10	7.56	254	14.0
61	VIRGINIA	01	16	99	3	S	0.52	7.81	404	103.0
62	VIRGINIA	01	16	99	4	S	1.06	8.12	513	179.0
63	VIRGINIA	01	16	99	5	S	0.23	7.61	351	120.0
64	VIRGINIA	01	16	99	6	S	9.28	7.14	218	23.5
65	VIRGINIA	01	16	99	7	S	0.18	7.32	214	20.2
66	VIRGINIA	03	13	99	1	S	0.42	7.54	224	40.0
67	VIRGINIA	03	13	99	2	D	.	.	.	.
68	VIRGINIA	03	13	99	3	S	0.60	7.90	438	140.0
69	VIRGINIA	03	13	99	4	S	0.66	8.14	508	183.0
70	VIRGINIA	03	13	99	5	S	0.17	7.74	260	56.3
71	VIRGINIA	03	13	99	6	S	8.66	7.47	207	31.5
72	VIRGINIA	03	13	99	7	S	0.14	7.61	174	25.4

OBS	NH3	NOX	ORGANICN	TOTALN	ORTHOP	TOTALP	PERIOD
49	1705.0	128	1024	2857	17	27	wet
50	965.0	4	278	1247	110	118	wet
51	402.0	38	2501	2941	39	45	wet
52	137.0	18566	4725	23428	2380	2658	dry
53	588.0	960	194	1742	39	98	dry
54	8868.0	3705	4271	16844	328	358	dry
55	158.0	9786	2632	12576	35	60	dry
56	.	.	.	.	.	.	dry
57	57.0	588	439	1084	76	96	dry
58	304.0	1622	1273	3199	62	91	dry
59	29.0	17737	900	18666	2005	2002	dry
60	2019.0	600	100	2719	103	125	dry
61	163.0	7998	456	8617	223	237	dry
62	2306.0	5388	870	8564	62	68	dry
63	4061.0	954	245	5260	5	20	dry
64	28.0	41	542	611	48	60	dry
65	2.5	122	341	466	4	15	dry
66	48.0	720	477	1245	36	56	dry
67	.	.	.	.	.	.	dry
68	78.0	9609	877	10564	235	268	dry
69	1194.0	5879	792	7865	43	62	dry
70	97.0	380	424	901	10	32	dry
71	40.0	463	145	648	42	65	dry
72	25.0	113	511	649	7	33	dry

Winter Park Lakes Seepage Data from 9/98-3/99

OBS	LAKE	MONTH	DAY	YEAR	SITE	DEPTH	SEEPAGE	PH	COND	ALK
73	OSCEOLA	09	22	98	1	S	19.62	6.56	887	47.1
74	OSCEOLA	09	22	98	2	S	7.64	6.87	203	2.6
75	OSCEOLA	09	22	98	3	S	0.74	7.26	306	91.6
76	OSCEOLA	09	22	98	4	D	0.43	7.44	296	92.4
77	OSCEOLA	09	22	98	5	S	18.08	7.01	198	24.0
78	OSCEOLA	09	22	98	6	S	8.40	7.09	173	4.9
79	OSCEOLA	09	22	98	7	D	0.32	7.07	256	73.8
80	OSCEOLA	09	22	98	8	S	8.41	7.08	709	51.8
81	OSCEOLA	09	22	98	9	S	.	.	.	.
82	OSCEOLA	10	13	98	1	S	28.80	7.09	818	6.7
83	OSCEOLA	10	13	98	2	S	7.42	7.28	212	13.5
84	OSCEOLA	10	13	98	3	S	3.18	7.94	418	148.0
85	OSCEOLA	10	13	98	4	D	0.55	7.68	291	83.9
86	OSCEOLA	10	13	98	5	S	27.40	7.66	193	15.9
87	OSCEOLA	10	13	98	6	S	4.86	7.57	172	3.5
88	OSCEOLA	10	13	98	7	D	0.34	7.37	241	66.4
89	OSCEOLA	10	13	98	8	S	3.71	7.52	552	42.6
90	OSCEOLA	10	13	98	9	S	2.90	7.55	264	56.4
91	OSCEOLA	10	28	98	1	S	43.80	6.33	612	7.2
92	OSCEOLA	10	28	98	2	S	3.43	6.86	201	4.1
93	OSCEOLA	10	28	98	3	S	1.14	7.79	387	84.6
94	OSCEOLA	10	28	98	4	D	0.87	7.73	321	87.8
95	OSCEOLA	10	28	98	5	S	40.90	7.15	198	14.9
96	OSCEOLA	10	28	98	6	S	9.94	6.78	175	2.4

OBS	NH3	NOX	ORGANICN	TOTALN	ORTHOP	TOTALP	PERIOD
73	1698	1245	454	3397	2	7	wet
74	3006	13	2111	5130	69	81	wet
75	1048	2580	219	3847	7	24	wet
76	5355	20	468	5843	2	19	wet
77	407	26	5283	5716	50	65	wet
78	49	499	116	664	47	56	wet
79	3325	4	273	3602	6	22	wet
80	2097	30	48	2175	25	35	wet
81	.	.	.	.	.	.	wet
82	3090	1142	1280	5512	3	4	wet
83	3820	64	346	4230	84	88	wet
84	7998	13272	793	22063	216	235	wet
85	6373	108	693	7174	8	41	wet
86	142	40	1587	1769	52	56	wet
87	5	592	421	1018	43	51	wet
88	4279	15	1193	5487	12	33	wet
89	1853	94	567	2514	37	44	wet
90	2640	90	1124	3854	11	15	wet
91	111	897	2760	4768	8	15	wet
92	3127	4	836	3967	111	112	wet
93	324	9507	694	10525	296	312	wet
94	7567	201	67	7835	63	63	wet
95	300	14	471	785	85	86	wet
96	98	84	344	526	48	48	wet

OBS	LAKE	MONTH	DAY	YEAR	SITE	DEPTH	SEEPAGE	PH	COND
97	OSCEOLA	10	28	98	7	D	0.54	7.28	258
98	OSCEOLA	10	28	98	8	S	4.97	7.43	563
99	OSCEOLA	10	28	98	9	S	1.58	7.46	241
100	OSCEOLA	11	03	98	1	S	39.00	5.93	516
101	OSCEOLA	11	03	98	5	S	38.70	6.72	208
102	OSCEOLA	12	04	98	1	S	14.40	7.10	508
103	OSCEOLA	12	04	98	2	S	3.32	6.72	205
104	OSCEOLA	12	04	98	3	S	0.47	7.28	224
105	OSCEOLA	12	04	98	4	D	0.59	7.21	276
106	OSCEOLA	12	04	98	5	S	15.60	7.13	196
107	OSCEOLA	12	04	98	6	S	3.71	6.91	179
108	OSCEOLA	12	04	98	7	D	0.20	7.21	236
109	OSCEOLA	12	04	98	8	S	5.46	7.28	544
110	OSCEOLA	12	04	98	9	S	0.73	7.41	268
111	OSCEOLA	01	15	98	1	S	11.50	6.43	363
112	OSCEOLA	01	15	98	2	S	2.62	7.04	207
113	OSCEOLA	01	15	98	3	S	0.29	7.40	226
114	OSCEOLA	01	15	98	4	D	.	.	.
115	OSCEOLA	01	15	98	5	S	12.90	7.20	189
116	OSCEOLA	01	15	98	6	S	5.39	7.11	184
117	OSCEOLA	01	15	98	7	D	0.35	7.25	228
118	OSCEOLA	01	15	98	8	S	1.26	7.34	519
119	OSCEOLA	01	15	98	9	S	0.52	7.53	283
120	OSCEOLA	03	10	99	1	S	2.84	6.31	382

OBS	ALK	NH3	NOX	ORGANICN	TOTALN	ORTHOP	TOTALP	PERIOD
97	38.1	4290	4	59	4353	5	14	wet
98	41.4	1633	301	831	2765	71	73	wet
99	66.6	3186	539	503	4228	49	50	wet
100	4.9	664	1263	1415	3342	7	8	wet
101	20.7	267	4	148	419	62	64	wet
102	2.9	515	1224	930	2669	5	6	dry
103	3.8	1206	110	2321	3637	25	47	dry
104	32.2	5	613	595	1213	7	20	dry
105	43.4	1194	760	975	2929	26	44	dry
106	85.1	148	46	174	368	52	59	dry
107	5.1	12	135	152	299	6	14	dry
108	37.6	2486	8	830	3324	1	7	dry
109	38.8	1530	461	617	2608	51	58	dry
110	45.7	215	1954	2850	5019	61	77	dry
111	8.9	202	1550	32	1784	3	6	dry
112	8.5	145	583	377	1105	4	14	dry
113	20.2	86	897	462	1445	13	26	dry
114	.	.	.	.	.	.	.	dry
115	7.6	362	48	188	598	56	67	dry
116	14.5	34	441	854	1329	17	25	dry
117	25.6	1532	647	1334	3513	6	14	dry
118	21.9	68	1951	823	2842	48	55	dry
119	38.1	515	2657	257	3429	57	73	dry
120	3.3	35	2189	189	2413	1	16	dry

Winter Park Lakes Seepage Data from 9/98-3/99

OBS	LAKE	MONTH	DAY	YEAR	SITE	DEPTH	SEEPAGE	PH	COND
121	OSCEOLA	03	10	99	2	S	0.57	6.51	198
122	OSCEOLA	03	10	99	3	S	0.25	7.27	222
123	OSCEOLA	03	10	99	4	D	.	.	.
124	OSCEOLA	03	10	99	5	S	10.10	7.11	184
125	OSCEOLA	03	10	99	6	S	1.60	7.09	191
126	OSCEOLA	03	10	99	7	D	0.87	7.26	222
127	OSCEOLA	03	10	99	8	S	4.52	7.48	451
128	OSCEOLA	03	10	99	9	S	0.07	7.65	278
129	MAITLAND	09	22	98	1	S	3.70	7.34	276
130	MAITLAND	09	22	98	2	D	2.04	7.33	302
131	MAITLAND	09	22	98	3	S	10.32	7.33	196
132	MAITLAND	09	22	98	4	D	1.50	7.37	197
133	MAITLAND	09	22	98	5	S	1.07	7.94	550
134	MAITLAND	09	22	98	6	S	1.01	7.55	360
135	MAITLAND	09	22	98	7	D	0.88	7.67	202
136	MAITLAND	09	22	98	8	S	1.02	7.89	368
137	MAITLAND	09	22	98	9	S	0.89	7.77	284
138	MAITLAND	09	22	98	10	S	5.35	7.98	284
139	MAITLAND	10	13	98	1	S	1.06	7.27	279
140	MAITLAND	10	13	98	2	D	1.08	7.28	331
141	MAITLAND	10	13	98	3	S	4.78	7.40	210
142	MAITLAND	10	13	98	4	D	1.38	7.39	190
143	MAITLAND	10	13	98	5	S	0.85	8.03	613
144	MAITLAND	10	13	98	6	S	1.58	7.95	423

OBS	ALK	NH3	NOX	ORGANICN	TOTALN	ORTHOP	TOTALP	PERIOD
121	10.3	326	413	188	927	9.0	30	dry
122	38.6	48	352	319	719	7.0	27	dry
123	.	.	.	.	.	.	.	dry
124	27.5	21	273	119	413	52.0	70	dry
125	24.4	48	133	46	227	17.0	33	dry
126	45.7	1023	147	667	1837	7.0	25	dry
127	41.0	330	1432	179	1941	47.0	58	dry
128	65.6	848	1478	503	2829	46.0	75	dry
129	91.1	4748	360	246	5354	314.0	314	wet
130	111.0	3754	4	650	4408	4.0	27	wet
131	17.3	335	56	57	448	55.0	68	wet
132	45.6	75	4	480	559	2.0	8	wet
133	221.0	7339	166	591	8096	551.0	576	wet
134	133.0	6186	380	565	7131	375.0	381	wet
135	40.0	333	8	323	664	2.0	19	wet
136	146.0	4431	173	426	5030	88.0	103	wet
137	80.8	607	3685	108	4400	192.0	210	wet
138	198.0	4709	20	318	5047	386.0	399	wet
139	57.3	3313	892	98	4303	202.0	223	wet
140	129.0	7302	21	1401	8724	70.0	115	wet
141	9.3	166	11	342	519	42.0	53	wet
142	24.2	229	21	683	933	5.0	22	wet
143	259.0	5331	7610	209	13150	753.0	755	wet
144	144.0	2675	3035	1252	6962	385.0	450	wet

Winter Park Lakes Seepage Data from 9/98-3/99

OBS	LAKE	MONTH	DAY	YEAR	SITE	DEPTH	SEEPAGE	PH	COND
145	MAITLAND	10	13	98	7	D	1.91	8.01	223
146	MAITLAND	10	13	98	8	S	1.35	7.99	459
147	MAITLAND	10	13	98	9	S	1.52	8.03	258
148	MAITLAND	10	13	98	10	S	8.86	8.10	452
149	MAITLAND	10	28	98	1	S	2.50	7.56	280
150	MAITLAND	10	28	98	2	D	1.09	7.78	270
151	MAITLAND	10	28	98	3	S	10.88	6.90	208
152	MAITLAND	10	28	98	4	D	5.69	7.62	200
153	MAITLAND	10	28	98	5	S	1.21	8.16	685
154	MAITLAND	10	28	98	6	S	3.34	7.91	446
155	MAITLAND	10	28	98	7	D	2.37	7.98	239
156	MAITLAND	10	28	98	8	S	0.96	8.02	503
157	MAITLAND	10	28	98	9	S	1.19	7.74	213
158	MAITLAND	10	28	98	10	S	11.37	8.23	442
159	MAITLAND	12	04	98	1	S	1.75	7.38	275
160	MAITLAND	12	04	98	2	D	1.00	7.40	230
161	MAITLAND	12	04	98	3	S	2.99	7.01	214
162	MAITLAND	12	04	98	4	D	0.51	7.47	212
163	MAITLAND	12	04	98	5	S	0.72	8.09	672
164	MAITLAND	12	04	98	6	S	0.96	7.95	322
165	MAITLAND	12	04	98	7	D	.	.	.
166	MAITLAND	12	04	98	8	S	0.64	7.99	533
167	MAITLAND	12	04	98	9	S	0.68	7.65	217
168	MAITLAND	12	04	98	10	S	2.24	8.12	442

OBS	ALK	NH3	NOX	ORGANICN	TOTALN	ORTHOP	TOTALP	PERIOD
145	49.6	34	1076	813	1923	20.0	34	wet
146	184.0	6753	225	708	7716	136.0	162	wet
147	61.4	54	2240	972	3226	121.0	141	wet
148	191.0	4374	147	434	4955	314.0	325	wet
149	68.1	3033	974	769	4776	283.0	305	wet
150	67.4	335	3910	621	4866	47.0	47	wet
151	17.8	109	31	337	477	57.0	61	wet
152	31.6	97	73	524	694	3.0	12	wet
153	307.0	7277	5776	398	13450	863.0	872	wet
154	139.0	2253	5939	305	8497	512.0	580	wet
155	52.8	26	1836	645	2507	15.0	16	wet
156	195.0	7108	1180	53	8341	344.0	355	wet
157	34.1	23	35	840	898	38.0	41	wet
158	173.0	2617	314	562	3493	281.0	285	wet
159	53.2	2134	1410	983	4527	220.0	244	dry
160	34.5	94	82	379	555	7.0	13	dry
161	12.9	62	119	242	423	20.0	32	dry
162	37.3	482	57	688	1227	0.5	14	dry
163	238.0	4436	7911	2969	15316	653.0	678	dry
164	65.2	56	4485	843	5384	300.0	629	dry
165	.	.	.	.	.	.	.	dry
166	193.0	2700	203	6818	9721	272.0	582	dry
167	32.6	49	252	719	1020	5.0	14	dry
168	177.0	1737	1100	3155	5992	217.0	244	dry

OBS	LAKE	MONTH	DAY	YEAR	SITE	DEPTH	SEEPAGE	PH	COND
169	MAITLAND	01	15	99	1	S	0.98	7.44	265
170	MAITLAND	01	15	99	2	D	0.26	7.48	238
171	MAITLAND	01	15	99	3	S	2.57	6.83	203
172	MAITLAND	01	15	99	4	D	0.44	7.17	211
173	MAITLAND	01	15	99	5	S	0.54	7.97	529
174	MAITLAND	01	15	99	6	S	0.71	7.71	261
175	MAITLAND	01	15	99	7	D	0.44	7.92	261
176	MAITLAND	01	15	99	8	S	0.62	7.73	484
177	MAITLAND	01	15	99	9	S	0.69	7.43	217
178	MAITLAND	01	15	99	10	S	2.47	8.16	447
179	MAITLAND	03	10	99	1	S	5.44	7.27	258
180	MAITLAND	03	10	99	2	D	0.19	7.41	367
181	MAITLAND	03	10	99	3	S	2.87	6.99	207
182	MAITLAND	03	10	99	4	D	0.18	7.41	217
183	MAITLAND	03	10	99	5	S	0.61	7.88	547
184	MAITLAND	03	10	99	6	S	0.17	7.42	241
185	MAITLAND	03	10	99	7	D	0.55	7.41	214
186	MAITLAND	03	10	99	8	S	0.47	7.94	488
187	MAITLAND	03	10	99	9	S	0.29	7.47	230
188	MAITLAND	03	10	99	10	S	2.22	7.99	437

OBS	ALK	NH3	NOX	ORGANICN	TOTALN	ORTHOP	TOTALP	PERIOD
169	44.0	269	2708	324	3301	222.0	241	dry
170	18.2	87	56	713	856	13.0	18	dry
171	6.7	162	303	15	487	27.0	34	dry
172	16.9	242	723	119	1084	2.0	12	dry
173	177.0	333	8008	989	9330	536.0	540	dry
174	38.9	217	2107	257	2581	98.0	112	dry
175	63.7	2129	4137	209	6475	8.0	24	dry
176	161.0	2973	3805	105	6883	224.0	252	dry
177	20.2	107	410	994	1511	18.0	28	dry
178	171.0	2328	588	1586	4502	184.0	188	dry
179	57.2	1360	250	627	2237	164.0	175	dry
180	95.2	991	8200	476	9667	28.0	54	dry
181	22.0	97	48	142	287	24.0	44	dry
182	42.1	188	378	334	900	4.0	29	dry
183	220.0	1729	6902	486	9117	430.0	447	dry
184	39.7	62	294	468	824	7.0	35	dry
185	34.9	19	726	589	1334	48.0	75	dry
186	193.0	3351	3660	263	7274	199.0	230	dry
187	38.4	70	435	361	866	9.0	25	dry
188	181.0	1509	264	578	2351	159.0	174	dry

LAKE=MAITLAND SITE=1 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.98	5.44	2.72	87.54
	PH	7.27	7.44	7.36	1.17
	COND	258.00	275.00	266.00	3.21
	ALK	44.00	57.20	51.47	13.15
	NH3	269.00	2134.00	1254.33	74.70
	NOX	250.00	2708.00	1456.00	84.45
	ORGANICN	324.00	983.00	644.67	51.17
	TOTALN	2237.00	4527.00	3355.00	34.16
	ORTHOP	164.00	222.00	202.00	16.30
	TOTALP	175.00	244.00	220.00	17.73

LAKE=MAITLAND SITE=1 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	1.06	3.70	2.42	54.62
	PH	7.27	7.56	7.39	2.05
	COND	276.00	280.00	278.33	0.75
	ALK	57.30	91.10	72.17	23.92
	NH3	3033.00	4748.00	3698.00	24.88
	NOX	360.00	974.00	742.00	44.93
	ORGANICN	98.00	769.00	371.00	95.02
	TOTALN	4303.00	5354.00	4811.00	10.94
	ORTHOP	202.00	314.00	266.33	21.71
	TOTALP	223.00	314.00	280.67	17.87

LAKE=MAITLAND SITE=10 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	2.22	2.47	2.31	6.01
	PH	7.99	8.16	8.09	1.10
	COND	437.00	447.00	442.00	1.13
	ALK	171.00	181.00	176.33	2.85
	NH3	1509.00	2328.00	1858.00	22.75
	NOX	264.00	1100.00	650.67	64.78
	ORGANICN	578.00	3155.00	1773.00	73.25
	TOTALN	2351.00	5992.00	4281.67	42.75
	ORTHOP	159.00	217.00	186.67	15.58
	TOTALP	174.00	244.00	202.00	18.34

LAKE=MAITLAND SITE=10 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	5.35	11.37	8.53	35.46
	PH	7.98	8.23	8.10	1.54
	COND	284.00	452.00	392.67	24.00
	ALK	173.00	198.00	187.33	6.88
	NH3	2617.00	4709.00	3900.00	28.81
	NOX	20.00	314.00	160.33	91.97
	ORGANICN	318.00	562.00	438.00	27.87
	TOTALN	3493.00	5047.00	4498.33	19.38
	ORTHOP	281.00	386.00	327.00	16.42
	TOTALP	285.00	399.00	336.33	17.20

LAKE=MAITLAND SITE=2 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.19	1.00	0.48	92.86
	PH	7.40	7.48	7.43	0.59
	COND	230.00	367.00	278.33	27.63
	ALK	18.20	95.20	49.30	82.31
	NH3	87.00	991.00	390.67	133.08
	NOX	56.00	8200.00	2779.33	168.91
	ORGANICN	379.00	713.00	522.67	32.87
	TOTALN	555.00	9667.00	3692.67	140.17
	ORTHOP	7.00	28.00	16.00	67.50
	TOTALP	13.00	54.00	28.33	78.95

LAKE=MAITLAND SITE=2 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	1.08	2.04	1.40	39.29
	PH	7.28	7.78	7.46	3.69
	COND	270.00	331.00	301.00	10.14
	ALK	67.40	129.00	102.47	30.91
	NH3	335.00	7302.00	3797.00	91.75
	NOX	4.00	3910.00	1311.67	171.56
	ORGANICN	621.00	1401.00	890.67	49.65
	TOTALN	4408.00	8724.00	5999.33	39.52
	ORTHOP	4.00	70.00	40.33	83.06
	TOTALP	27.00	115.00	63.00	73.22

LAKE=MAITLAND SITE=3 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	2.57	2.99	2.81	7.70
	PH	6.83	7.01	6.94	1.42
	COND	203.00	214.00	208.00	2.68
	ALK	6.70	22.00	13.87	55.50
	NH3	62.00	162.00	107.00	47.42
	NOX	48.00	303.00	156.67	84.00
	ORGANICN	15.00	242.00	133.00	85.54
	TOTALN	287.00	487.00	399.00	25.60
	ORTHOP	20.00	27.00	23.67	14.84
	TOTALP	32.00	44.00	36.67	17.53

LAKE=MAITLAND SITE=3 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	4.78	10.88	8.66	38.94
	PH	6.90	7.40	7.21	3.76
	COND	196.00	210.00	204.67	3.70
	ALK	9.30	17.80	14.80	32.23
	NH3	109.00	335.00	203.33	57.80
	NOX	11.00	56.00	32.67	69.02
	ORGANICN	57.00	342.00	245.33	66.49
	TOTALN	448.00	519.00	481.33	7.42
	ORTHOP	42.00	57.00	51.33	15.87
	TOTALP	53.00	68.00	60.67	12.37

LAKE=MAITLAND SITE=4 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.18	0.51	0.38	46.16
	PH	7.17	7.47	7.35	2.16
	COND	211.00	217.00	213.33	1.51
	ALK	16.90	42.10	32.10	41.68
	NH3	188.00	482.00	304.00	51.48
	NOX	57.00	723.00	386.00	86.29
	ORGANICN	119.00	688.00	380.33	75.54
	TOTALN	900.00	1227.00	1070.33	15.32
	ORTHOP	0.50	4.00	2.17	81.04
	TOTALP	12.00	29.00	18.33	50.68

LAKE=MAITLAND SITE=4 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	1.38	5.69	2.86	85.92
	PH	7.37	7.62	7.46	1.86
	COND	190.00	200.00	195.67	2.62
	ALK	24.20	45.60	33.80	32.15
	NH3	75.00	229.00	133.67	62.31
	NOX	4.00	73.00	32.67	110.05
	ORGANICN	480.00	683.00	562.33	18.99
	TOTALN	559.00	933.00	728.67	25.99
	ORTHOP	2.00	5.00	3.33	45.83
	TOTALP	8.00	22.00	14.00	51.51

LAKE=MAITLAND SITE=5 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.54	0.72	0.62	14.56
	PH	7.88	8.09	7.98	1.32
	COND	529.00	672.00	582.67	13.37
	ALK	177.00	238.00	211.67	14.81
	NH3	333.00	4436.00	2166.00	96.31
	NOX	6902.00	8008.00	7607.00	8.05
	ORGANICN	486.00	2969.00	1481.33	88.61
	TOTALN	9117.00	15316.00	11254.33	31.27
	ORTHOP	430.00	653.00	539.67	20.67
	TOTALP	447.00	678.00	555.00	20.94

LAKE=MAITLAND SITE=5 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.85	1.21	1.04	17.39
	PH	7.94	8.16	8.04	1.38
	COND	550.00	685.00	616.00	10.97
	ALK	221.00	307.00	262.33	16.43
	NH3	5331.00	7339.00	6649.00	17.17
	NOX	166.00	7610.00	4517.33	85.85
	ORGANICN	209.00	591.00	399.33	47.83
	TOTALN	8096.00	13450.00	11565.33	26.01
	ORTHOP	551.00	863.00	722.33	21.91
	TOTALP	576.00	872.00	734.33	20.30

LAKE=MAITLAND SITE=6 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.17	0.96	0.61	65.83
	PH	7.42	7.95	7.69	3.45
	COND	241.00	322.00	274.67	15.36
	ALK	38.90	65.20	47.93	31.21
	NH3	56.00	217.00	111.67	81.73
	NOX	294.00	4485.00	2295.33	91.57
	ORGANICN	257.00	843.00	522.67	56.79
	TOTALN	824.00	5384.00	2929.67	78.50
	ORTHOP	7.00	300.00	135.00	111.08
	TOTALP	35.00	629.00	258.67	124.88

LAKE=MAITLAND SITE=6 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	1.01	3.34	1.98	61.45
	PH	7.55	7.95	7.80	2.82
	COND	360.00	446.00	409.67	10.87
	ALK	133.00	144.00	138.67	3.97
	NH3	2253.00	6186.00	3704.67	58.28
	NOX	380.00	5939.00	3118.00	89.17
	ORGANICN	305.00	1252.00	707.33	69.17
	TOTALN	6962.00	8497.00	7530.00	11.18
	ORTHOP	375.00	512.00	424.00	18.01
	TOTALP	381.00	580.00	470.33	21.48

LAKE=MAITLAND SITE=7 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.44	0.55	0.50	15.71
	PH	7.41	7.92	7.66	4.70
	COND	214.00	261.00	237.50	13.99
	ALK	34.90	63.70	49.30	41.31
	NH3	19.00	2129.00	1074.00	138.92
	NOX	726.00	4137.00	2431.50	99.20
	ORGANICN	209.00	589.00	399.00	67.34
	TOTALN	1334.00	6475.00	3904.50	93.10
	ORTHOP	8.00	48.00	28.00	101.02
	TOTALP	24.00	75.00	49.50	72.85

LAKE=MAITLAND SITE=7 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.88	2.37	1.72	44.36
	PH	7.67	8.01	7.89	2.39
	COND	202.00	239.00	221.33	8.38
	ALK	40.00	52.80	47.47	14.03
	NH3	26.00	333.00	131.00	133.57
	NOX	8.00	1836.00	973.33	94.35
	ORGANICN	323.00	813.00	593.67	41.94
	TOTALN	664.00	2507.00	1698.00	55.47
	ORTHOP	2.00	20.00	12.33	75.34
	TOTALP	16.00	34.00	23.00	41.93

LAKE=MAITLAND SITE=8 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.47	0.64	0.58	16.11
	PH	7.73	7.99	7.89	1.75
	COND	484.00	533.00	501.67	5.42
	ALK	161.00	193.00	182.33	10.13
	NH3	2700.00	3351.00	3008.00	10.87
	NOX	203.00	3805.00	2556.00	79.77
	ORGANICN	105.00	6818.00	2395.33	159.93
	TOTALN	6883.00	9721.00	7959.33	19.32
	ORTHOP	199.00	272.00	231.67	16.01
	TOTALP	230.00	582.00	354.67	55.60

LAKE=MAITLAND SITE=8 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.96	1.35	1.11	18.92
	PH	7.89	8.02	7.97	0.85
	COND	368.00	503.00	443.33	15.53
	ALK	146.00	195.00	175.00	14.69
	NH3	4431.00	7108.00	6097.33	23.85
	NOX	173.00	1180.00	526.00	107.79
	ORGANICN	53.00	708.00	395.67	83.04
	TOTALN	5030.00	8341.00	7029.00	25.03
	ORTHOP	88.00	344.00	189.33	71.87
	TOTALP	103.00	355.00	206.67	63.78

LAKE=MAITLAND SITE=9 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.29	0.69	0.55	41.22
	PH	7.43	7.65	7.52	1.56
	COND	217.00	230.00	221.33	3.39
	ALK	20.20	38.40	30.40	30.58
	NH3	49.00	107.00	75.33	38.98
	NOX	252.00	435.00	365.67	27.14
	ORGANICN	361.00	994.00	691.33	45.91
	TOTALN	866.00	1511.00	1132.33	29.75
	ORTHOP	5.00	18.00	10.67	62.42
	TOTALP	14.00	28.00	22.33	33.00

LAKE=MAITLAND SITE=9 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.89	1.52	1.20	26.26
	PH	7.74	8.03	7.85	2.03
	COND	213.00	284.00	251.67	14.27
	ALK	34.10	80.80	58.77	39.92
	NH3	23.00	607.00	228.00	144.12
	NOX	35.00	3685.00	1986.67	92.52
	ORGANICN	108.00	972.00	640.00	72.72
	TOTALN	898.00	4400.00	2841.33	62.73
	ORTHOP	38.00	192.00	117.00	65.88
	TOTALP	41.00	210.00	130.67	65.03

LAKE=MIZELL SITE=1 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.42	0.48	0.45	9.43
	PH	7.42	7.52	7.47	0.95
	COND	322.00	332.00	327.00	2.16
	ALK	48.50	62.90	55.70	18.28
	NH3	93.00	474.00	283.50	95.03
	NOX	2563.00	3432.00	2997.50	20.50
	ORGANICN	42.00	950.00	496.00	129.45
	TOTALN	3606.00	3948.00	3777.00	6.40
	ORTHOP	3.00	58.00	30.50	127.51
	TOTALP	46.00	86.00	66.00	42.85

LAKE=MIZELL SITE=1 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.82	1.69	1.24	35.02
	PH	7.58	7.86	7.69	1.97
	COND	286.00	342.00	307.33	9.85
	ALK	25.10	80.00	45.03	67.46
	NH3	50.00	4174.00	1893.33	110.73
	NOX	304.00	1650.00	931.67	72.73
	ORGANICN	208.00	1093.00	692.67	64.75
	TOTALN	2477.00	5571.00	3517.67	50.55
	ORTHOP	17.00	21.00	18.33	12.60
	TOTALP	29.00	40.00	33.67	16.89

LAKE=MIZELL SITE=2 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.77	1.76	1.37	38.44
	PH	7.09	7.31	7.21	1.56
	COND	283.00	306.00	297.67	4.28
	ALK	10.30	19.00	14.90	29.34
	NH3	716.00	1521.00	1037.67	41.07
	NOX	113.00	1212.00	642.33	85.72
	ORGANICN	397.00	1190.00	715.00	58.62
	TOTALN	2179.00	2681.00	2395.00	10.78
	ORTHOP	2.00	25.00	10.33	123.30
	TOTALP	8.00	26.00	14.67	67.27

LAKE=MIZELL SITE=2 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.25	2.33	1.02	112.40
	PH	7.29	7.76	7.50	3.17
	COND	298.00	452.00	396.67	21.59
	ALK	26.70	127.00	70.10	73.46
	NH3	1843.00	9493.00	4395.67	100.43
	NOX	25.00	821.00	336.00	126.66
	ORGANICN	939.00	11740.00	4658.67	131.69
	TOTALN	3611.00	13745.00	9390.33	55.54
	ORTHOP	5.00	193.00	70.33	151.15
	TOTALP	9.00	223.00	95.00	118.96

LAKE=MIZELL SITE=3 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.35	1.06	0.62	62.69
	PH	6.90	7.79	7.32	6.12
	COND	289.00	398.00	331.33	17.64
	ALK	16.10	83.80	42.20	86.29
	NH3	25.00	75.00	50.67	49.39
	NOX	1146.00	5185.00	2852.33	73.31
	ORGANICN	216.00	1124.00	607.33	76.86
	TOTALN	1387.00	5742.00	3510.33	62.09
	ORTHOP	30.00	52.00	39.00	29.57
	TOTALP	33.00	76.00	52.00	42.18

LAKE=MIZELL SITE=3 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	1.23	1.77	1.50	25.46
	PH	7.57	7.82	7.70	2.30
	COND	273.00	295.00	284.00	5.48
	ALK	15.90	36.90	26.40	56.25
	NH3	346.00	1532.00	939.00	89.31
	NOX	4.00	2002.00	1003.00	140.86
	ORGANICN	446.00	524.00	485.00	11.37
	TOTALN	1982.00	2872.00	2427.00	25.93
	ORTHOP	4.00	70.00	37.00	126.13
	TOTALP	16.00	72.00	44.00	90.00

LAKE=MIZELL SITE=4 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	.	.	.	.
	PH	.	.	.	.
	COND	.	.	.	.
	ALK	.	.	.	.
	NH3	.	.	.	.
	NOX	.	.	.	.
	ORGANICN	.	.	.	.
	TOTALN	.	.	.	.
	ORTHOP	.	.	.	.
	TOTALP	.	.	.	.

LAKE=MIZELL SITE=4 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	1.02	2.66	1.84	63.02
	PH	7.46	7.59	7.53	1.22
	COND	299.00	331.00	315.00	7.18
	ALK	34.20	42.30	38.25	14.97
	NH3	4245.00	4583.00	4414.00	5.41
	NOX	413.00	539.00	476.00	18.72
	ORGANICN	124.00	190.00	157.00	29.73
	TOTALN	4848.00	5246.00	5047.00	5.58
	ORTHOP	3.00	5.00	4.00	35.36
	TOTALP	12.00	12.00	12.00	0.00

LAKE=MIZELL SITE=5 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.48	2.20	1.10	87.33
	PH	7.27	7.65	7.51	2.75
	COND	272.00	278.00	275.00	1.09
	ALK	36.50	56.70	48.37	21.82
	NH3	55.00	697.00	475.33	76.62
	NOX	838.00	1489.00	1139.67	28.79
	ORGANICN	157.00	4962.00	2292.00	106.75
	TOTALN	1701.00	6751.00	3907.00	66.16
	ORTHOP	20.00	40.00	29.33	34.32
	TOTALP	25.00	62.00	44.67	41.66

LAKE=MIZELL SITE=5 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	2.41	8.03	4.30	75.12
	PH	7.48	7.85	7.66	2.41
	COND	265.00	271.00	267.33	1.20
	ALK	30.60	40.00	36.00	13.48
	NH3	5.00	614.00	295.33	103.44
	NOX	293.00	1387.00	844.67	64.77
	ORGANICN	151.00	2390.00	1143.00	99.83
	TOTALN	1805.00	2688.00	2283.00	19.54
	ORTHOP	16.00	41.00	26.67	48.36
	TOTALP	23.00	44.00	33.67	31.20

LAKE=OSCEOLA SITE=1 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	2.84	14.40	9.58	62.78
	PH	6.31	7.10	6.61	6.44
	COND	363.00	508.00	417.67	18.87
	ALK	2.90	8.90	5.03	66.65
	NH3	35.00	515.00	250.67	97.21
	NOX	1224.00	2189.00	1654.33	29.67
	ORGANICN	32.00	930.00	383.67	125.01
	TOTALN	1784.00	2669.00	2288.67	19.90
	ORTHOP	1.00	5.00	3.00	66.67
	TOTALP	6.00	16.00	9.33	61.86

LAKE=OSCEOLA SITE=1 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
4	SEEPAGE	19.62	43.80	32.81	32.89
	PH	5.93	7.09	6.48	7.48
	COND	516.00	887.00	708.25	24.49
	ALK	4.90	47.10	16.48	124.07
	NH3	111.00	3090.00	1390.75	94.19
	NOX	897.00	1263.00	1136.75	14.82
	ORGANICN	454.00	2760.00	1477.25	64.64
	TOTALN	3342.00	5512.00	4254.75	25.07
	ORTHOP	2.00	8.00	5.00	58.88
	TOTALP	4.00	15.00	8.50	54.76

LAKE=OSCEOLA SITE=2 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.57	3.32	2.17	65.86
	PH	6.51	7.04	6.76	3.95
	COND	198.00	207.00	203.33	2.32
	ALK	3.80	10.30	7.53	44.55
	NH3	145.00	1206.00	559.00	101.53
	NOX	110.00	583.00	368.67	64.99
	ORGANICN	188.00	2321.00	962.00	122.74
	TOTALN	927.00	3637.00	1889.67	80.22
	ORTHOP	4.00	25.00	12.67	86.60
	TOTALP	14.00	47.00	30.33	54.40

LAKE=OSCEOLA SITE=2 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	3.43	7.64	6.16	38.45
	PH	6.86	7.28	7.00	3.42
	COND	201.00	212.00	205.33	2.85
	ALK	2.60	13.50	6.73	87.74
	NH3	3006.00	3820.00	3317.67	13.24
	NOX	4.00	64.00	27.00	119.84
	ORGANICN	346.00	2111.00	1097.67	83.01
	TOTALN	3967.00	5130.00	4442.33	13.73
	ORTHOP	69.00	111.00	88.00	24.19
	TOTALP	81.00	112.00	93.67	17.36

LAKE=OSCEOLA SITE=3 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.25	0.47	0.34	34.81
	PH	7.27	7.40	7.32	0.99
	COND	222.00	226.00	224.00	0.89
	ALK	20.20	38.60	30.33	30.79
	NH3	5.00	86.00	46.33	87.47
	NOX	352.00	897.00	620.67	43.92
	ORGANICN	319.00	595.00	458.67	30.09
	TOTALN	719.00	1445.00	1125.67	32.94
	ORTHOP	7.00	13.00	9.00	38.49
	TOTALP	20.00	27.00	24.33	15.56

LAKE=OSCEOLA SITE=3 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.74	3.18	1.69	77.59
	PH	7.26	7.94	7.66	4.66
	COND	306.00	418.00	370.33	15.62
	ALK	84.60	148.00	108.07	32.17
	NH3	324.00	7998.00	3123.33	135.66
	NOX	2580.00	13272.00	8453.00	64.16
	ORGANICN	219.00	793.00	568.67	53.96
	TOTALN	3847.00	22063.00	12145.00	75.88
	ORTHOP	7.00	296.00	173.00	86.26
	TOTALP	24.00	312.00	190.33	78.34

LAKE=OSCEOLA SITE=4 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.59	0.59	0.59	.
	PH	7.21	7.21	7.21	.
	COND	276.00	276.00	276.00	.
	ALK	43.40	43.40	43.40	.
	NH3	1194.00	1194.00	1194.00	.
	NOX	760.00	760.00	760.00	.
	ORGANICN	975.00	975.00	975.00	.
	TOTALN	2929.00	2929.00	2929.00	.
	ORTHOP	26.00	26.00	26.00	.
	TOTALP	44.00	44.00	44.00	.

LAKE=OSCEOLA SITE=4 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.43	0.87	0.62	36.88
	PH	7.44	7.73	7.62	2.04
	COND	291.00	321.00	302.67	5.31
	ALK	83.90	92.40	88.03	4.83
	NH3	5355.00	7567.00	6431.67	17.21
	NOX	20.00	201.00	109.67	82.53
	ORGANICN	67.00	693.00	409.33	77.47
	TOTALN	5843.00	7835.00	6950.67	14.60
	ORTHOP	2.00	63.00	24.33	138.17
	TOTALP	19.00	63.00	41.00	53.66

LAKE=OSCEOLA SITE=5 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	10.10	15.60	12.87	21.37
	PH	7.11	7.20	7.15	0.66
	COND	184.00	196.00	189.67	3.18
	ALK	7.60	85.10	40.07	100.46
	NH3	21.00	362.00	177.00	97.37
	NOX	46.00	273.00	122.33	106.66
	ORGANICN	119.00	188.00	160.33	22.75
	TOTALN	368.00	598.00	459.67	26.52
	ORTHOP	52.00	56.00	53.33	4.33
	TOTALP	59.00	70.00	65.33	8.70

LAKE=OSCEOLA SITE=5 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
4	SEEPAGE	18.08	40.90	31.27	33.89
	PH	6.72	7.66	7.13	5.51
	COND	193.00	208.00	199.25	3.16
	ALK	14.90	24.00	18.87	22.53
	NH3	142.00	407.00	279.00	39.12
	NOX	4.00	40.00	21.00	73.98
	ORGANICN	148.00	5283.00	1872.25	125.83
	TOTALN	419.00	5716.00	2172.25	111.88
	ORTHOP	50.00	85.00	62.25	25.78
	TOTALP	56.00	86.00	67.75	18.92

LAKE=OSCEOLA SITE=6 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	1.60	5.39	3.57	53.24
	PH	6.91	7.11	7.04	1.57
	COND	179.00	191.00	184.67	3.26
	ALK	5.10	24.40	14.67	65.80
	NH3	12.00	48.00	31.33	57.92
	NOX	133.00	441.00	236.33	75.00
	ORGANICN	46.00	854.00	350.67	125.22
	TOTALN	227.00	1329.00	618.33	99.70
	ORTHOP	6.00	17.00	13.33	47.63
	TOTALP	14.00	33.00	24.00	39.75

LAKE=OSCEOLA SITE=6 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	4.86	9.94	7.73	33.68
	PH	6.78	7.57	7.15	5.57
	COND	172.00	175.00	173.33	0.88
	ALK	2.40	4.90	3.60	34.81
	NH3	5.00	98.00	50.67	91.82
	NOX	84.00	592.00	391.67	69.06
	ORGANICN	116.00	421.00	293.67	54.01
	TOTALN	526.00	1018.00	736.00	34.48
	ORTHOP	43.00	48.00	46.00	5.75
	TOTALP	48.00	56.00	51.67	7.82

LAKE=OSCEOLA SITE=7 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.20	0.87	0.47	74.28
	PH	7.21	7.26	7.24	0.37
	COND	222.00	236.00	228.67	3.07
	ALK	25.60	45.70	36.30	27.86
	NH3	1023.00	2486.00	1680.33	44.20
	NOX	8.00	647.00	267.33	125.71
	ORGANICN	667.00	1334.00	943.67	36.85
	TOTALN	1837.00	3513.00	2891.33	31.75
	ORTHOP	1.00	7.00	4.67	68.88
	TOTALP	7.00	25.00	15.33	59.18

LAKE=OSCEOLA SITE=7 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.32	0.54	0.40	30.41
	PH	7.07	7.37	7.24	2.13
	COND	241.00	258.00	251.67	3.69
	ALK	38.10	73.80	59.43	31.70
	NH3	3325.00	4290.00	3964.67	13.97
	NOX	4.00	15.00	7.67	82.84
	ORGANICN	59.00	1193.00	508.33	118.53
	TOTALN	3602.00	5487.00	4480.67	21.18
	ORTHOP	5.00	12.00	7.67	49.38
	TOTALP	14.00	33.00	23.00	41.48

LAKE=OSCEOLA SITE=8 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	1.26	5.46	3.75	58.83
	PH	7.28	7.48	7.37	1.39
	COND	451.00	544.00	504.67	9.54
	ALK	21.90	41.00	33.90	30.83
	NH3	68.00	1530.00	642.67	121.30
	NOX	461.00	1951.00	1281.33	59.03
	ORGANICN	179.00	823.00	539.67	60.94
	TOTALN	1941.00	2842.00	2463.67	18.98
	ORTHOP	47.00	51.00	48.67	4.28
	TOTALP	55.00	58.00	57.00	3.04

LAKE=OSCEOLA SITE=8 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	3.71	8.41	5.70	42.71
	PH	7.08	7.52	7.34	3.17
	COND	552.00	709.00	608.00	14.41
	ALK	41.40	51.80	45.27	12.57
	NH3	1633.00	2097.00	1861.00	12.47
	NOX	30.00	301.00	141.67	99.99
	ORGANICN	48.00	831.00	482.00	82.65
	TOTALN	2175.00	2765.00	2484.67	11.92
	ORTHOP	25.00	71.00	44.33	53.82
	TOTALP	35.00	73.00	50.67	39.19

LAKE=OSCEOLA SITE=9 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.07	0.73	0.44	76.64
	PH	7.41	7.65	7.53	1.59
	COND	268.00	283.00	276.33	2.76
	ALK	38.10	65.60	49.80	28.52
	NH3	215.00	848.00	526.00	60.20
	NOX	1478.00	2657.00	2029.67	29.22
	ORGANICN	257.00	2850.00	1203.33	118.95
	TOTALN	2829.00	5019.00	3759.00	30.11
	ORTHOP	46.00	61.00	54.67	14.21
	TOTALP	73.00	77.00	75.00	2.67

LAKE=OSCEOLA SITE=9 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	1.58	2.90	2.24	41.67
	PH	7.46	7.55	7.50	0.85
	COND	241.00	264.00	252.50	6.44
	ALK	56.40	66.60	61.50	11.73
	NH3	2640.00	3186.00	2913.00	13.25
	NOX	90.00	539.00	314.50	100.95
	ORGANICN	503.00	1124.00	813.50	53.98
	TOTALN	3854.00	4228.00	4041.00	6.54
	ORTHOP	11.00	49.00	30.00	89.57
	TOTALP	15.00	50.00	32.50	76.15

LAKE=VIRGINIA SITE=1 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.42	0.62	0.49	23.00
	PH	7.35	7.54	7.46	1.32
	COND	224.00	446.00	364.00	33.47
	ALK	39.30	58.30	45.87	23.49
	NH3	29.00	137.00	71.33	80.83
	NOX	720.00	18566.00	12341.00	81.62
	ORGANICN	477.00	4725.00	2034.00	115.05
	TOTALN	1245.00	23428.00	14446.33	80.84
	ORTHOP	36.00	2380.00	1473.67	85.44
	TOTALP	56.00	2658.00	1572.00	86.08

LAKE=VIRGINIA SITE=1 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.68	1.17	0.98	26.95
	PH	7.11	7.90	7.58	5.51
	COND	437.00	535.00	490.00	10.10
	ALK	134.00	187.00	162.67	16.45
	NH3	3345.00	14330.00	10455.67	58.98
	NOX	11.00	19214.00	10514.00	92.52
	ORGANICN	951.00	1234.00	1107.67	12.99
	TOTALN	15575.00	27147.00	22077.33	26.80
	ORTHOP	1501.00	2210.00	1921.67	19.39
	TOTALP	1729.00	2535.00	2120.33	19.03

LAKE=VIRGINIA SITE=2 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.10	0.12	0.11	12.86
	PH	7.33	7.56	7.45	2.18
	COND	237.00	254.00	245.50	4.90
	ALK	14.00	25.50	19.75	41.17
	NH3	588.00	2019.00	1303.50	77.63
	NOX	600.00	960.00	780.00	32.64
	ORGANICN	100.00	194.00	147.00	45.22
	TOTALN	1742.00	2719.00	2230.50	30.97
	ORTHOP	39.00	103.00	71.00	63.74
	TOTALP	98.00	125.00	111.50	17.12

LAKE=VIRGINIA SITE=2 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.20	0.43	0.34	36.14
	PH	7.21	7.43	7.31	1.54
	COND	238.00	266.00	256.33	6.20
	ALK	47.70	66.00	56.63	16.17
	NH3	1354.00	3748.00	2933.00	46.63
	NOX	50.00	839.00	346.67	123.85
	ORGANICN	142.00	1240.00	613.33	92.16
	TOTALN	2651.00	5038.00	3893.00	30.73
	ORTHOP	31.00	84.00	65.67	45.74
	TOTALP	64.00	272.00	144.00	77.78

LAKE=VIRGINIA SITE=3 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.52	0.92	0.68	31.13
	PH	7.81	7.90	7.86	0.58
	COND	404.00	481.00	441.00	8.75
	ALK	103.00	181.00	141.33	27.61
	NH3	78.00	8868.00	3036.33	166.34
	NOX	3705.00	9609.00	7104.00	42.96
	ORGANICN	456.00	4271.00	1868.00	111.97
	TOTALN	8617.00	16844.00	12008.33	35.80
	ORTHOP	223.00	328.00	262.00	21.94
	TOTALP	237.00	358.00	287.67	21.85

LAKE=VIRGINIA SITE=3 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	1.14	1.68	1.47	19.78
	PH	7.85	7.99	7.94	0.98
	COND	418.00	471.00	442.33	6.05
	ALK	160.00	185.00	174.00	7.34
	NH3	7280.00	10136.00	9067.67	17.18
	NOX	4.00	686.00	240.00	161.03
	ORGANICN	1323.00	3712.00	2482.33	48.18
	TOTALN	8607.00	13529.00	11790.00	23.41
	ORTHOP	212.00	342.00	256.33	28.95
	TOTALP	230.00	364.00	291.67	23.19

LAKE=VIRGINIA SITE=4 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.66	1.22	0.98	29.43
	PH	8.11	8.14	8.12	0.19
	COND	508.00	517.00	512.67	0.88
	ALK	172.00	183.00	178.00	3.13
	NH3	158.00	2306.00	1219.33	88.10
	NOX	5388.00	9786.00	7017.67	34.34
	ORGANICN	792.00	2632.00	1431.33	72.70
	TOTALN	7865.00	12576.00	9668.33	26.29
	ORTHOP	35.00	62.00	46.67	29.72
	TOTALP	60.00	68.00	63.33	6.57

LAKE=VIRGINIA SITE=4 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	1.02	2.00	1.53	32.15
	PH	8.06	8.17	8.11	0.68
	COND	462.00	499.00	483.00	3.93
	ALK	161.00	203.00	178.67	12.19
	NH3	177.00	9452.00	3301.33	161.35
	NOX	4.00	11520.00	7552.33	86.59
	ORGANICN	63.00	1302.00	773.00	82.67
	TOTALN	10410.00	13097.00	11626.67	11.71
	ORTHOP	6.00	77.00	31.33	126.47
	TOTALP	21.00	81.00	41.33	83.12

LAKE=VIRGINIA SITE=5 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.17	0.23	0.20	21.21
	PH	7.61	7.74	7.68	1.20
	COND	260.00	351.00	305.50	21.06
	ALK	56.30	120.00	88.15	51.10
	NH3	97.00	4061.00	2079.00	134.82
	NOX	380.00	954.00	667.00	60.85
	ORGANICN	245.00	424.00	334.50	37.84
	TOTALN	901.00	5260.00	3080.50	100.06
	ORTHOP	5.00	10.00	7.50	47.14
	TOTALP	20.00	32.00	26.00	32.64

LAKE=VIRGINIA SITE=5 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.74	0.86	0.82	8.15
	PH	7.66	7.97	7.79	2.09
	COND	223.00	268.00	247.67	9.21
	ALK	43.40	70.30	60.03	24.21
	NH3	702.00	1738.00	1381.67	42.62
	NOX	4.00	128.00	78.00	83.83
	ORGANICN	360.00	1054.00	812.67	48.27
	TOTALN	1066.00	2894.00	2272.33	45.98
	ORTHOP	2.00	51.00	23.33	107.60
	TOTALP	17.00	52.00	32.00	56.34

LAKE=VIRGINIA SITE=6 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	8.66	12.00	9.98	17.80
	PH	7.14	7.47	7.30	2.27
	COND	207.00	222.00	215.67	3.60
	ALK	23.50	33.00	29.33	17.41
	NH3	28.00	57.00	41.67	34.97
	NOX	41.00	588.00	364.00	78.74
	ORGANICN	145.00	542.00	375.33	54.89
	TOTALN	611.00	1084.00	781.00	33.68
	ORTHOP	42.00	76.00	55.33	32.80
	TOTALP	60.00	96.00	73.67	26.47

LAKE=VIRGINIA SITE=6 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	4.17	15.40	9.63	58.40
	PH	7.29	7.86	7.52	4.02
	COND	198.00	208.00	204.00	2.59
	ALK	32.40	35.70	34.00	4.86
	NH3	360.00	1021.00	782.00	46.87
	NOX	4.00	142.00	50.00	159.35
	ORGANICN	184.00	874.00	445.33	84.03
	TOTALN	1209.00	1376.00	1277.33	6.85
	ORTHOP	98.00	114.00	107.33	7.76
	TOTALP	108.00	129.00	118.33	8.88

LAKE=VIRGINIA SITE=7 PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.14	0.18	0.16	12.50
	PH	7.32	7.75	7.56	2.90
	COND	174.00	364.00	250.67	39.96
	ALK	20.20	123.00	56.20	103.04
	NH3	2.50	304.00	110.50	151.99
	NOX	113.00	1622.00	619.00	140.33
	ORGANICN	341.00	1273.00	708.33	70.07
	TOTALN	466.00	3199.00	1438.00	106.25
	ORTHOP	4.00	62.00	24.33	134.20
	TOTALP	15.00	91.00	46.33	85.72

LAKE=VIRGINIA SITE=7 PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
3	SEEPAGE	0.37	2.21	0.99	106.08
	PH	7.50	7.83	7.71	2.37
	COND	194.00	297.00	249.00	20.83
	ALK	25.00	88.80	60.57	53.70
	NH3	118.00	1033.00	517.67	90.47
	NOX	4.00	82.00	41.33	94.61
	ORGANICN	333.00	2501.00	1446.33	75.03
	TOTALN	455.00	2941.00	2005.33	67.43
	ORTHOP	5.00	39.00	17.67	105.19
	TOTALP	14.00	45.00	26.67	60.97

LAKE=MAITLAND PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
30	SEEPAGE	0.17	5.44	1.18	101.19
	PH	6.83	8.16	7.59	4.76
	COND	203.00	672.00	325.48	41.67
	ALK	6.70	238.00	85.68	86.99
	NH3	19.00	4436.00	1033.55	118.95
	NOX	48.00	8200.00	2055.90	130.46
	ORGANICN	15.00	6818.00	911.41	148.59
	TOTALN	287.00	15316.00	4001.10	96.33
	ORTHOP	0.50	653.00	141.33	121.02
	TOTALP	12.00	678.00	178.86	114.67

LAKE=MAITLAND PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
30	SEEPAGE	0.85	11.37	3.09	103.66
	PH	6.90	8.23	7.72	4.35
	COND	190.00	685.00	331.43	40.63
	ALK	9.30	307.00	109.28	72.27
	NH3	23.00	7339.00	2854.20	95.66
	NOX	4.00	7610.00	1340.07	154.27
	ORGANICN	53.00	1401.00	524.33	61.90
	TOTALN	448.00	13450.00	4718.23	75.93
	ORTHOP	2.00	863.00	215.33	106.83
	TOTALP	8.00	872.00	231.97	100.55

LAKE=MIZELL PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
15	SEEPAGE	0.35	2.20	0.92	69.44
	PH	6.90	7.79	7.37	3.52
	COND	272.00	398.00	306.00	11.84
	ALK	10.30	83.80	38.89	60.91
	NH3	25.00	1521.00	478.00	99.58
	NOX	113.00	5185.00	1808.91	80.99
	ORGANICN	42.00	4962.00	1075.91	129.23
	TOTALN	1387.00	6751.00	3362.82	49.01
	ORTHOP	2.00	58.00	27.00	70.39
	TOTALP	8.00	86.00	42.36	59.54

LAKE=MIZELL PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
15	SEEPAGE	0.25	8.03	2.03	96.96
	PH	7.29	7.86	7.62	2.26
	COND	265.00	452.00	316.31	19.61
	ALK	15.90	127.00	44.82	65.57
	NH3	5.00	9493.00	2343.00	114.96
	NOX	4.00	2002.00	715.00	88.32
	ORGANICN	124.00	11740.00	1597.46	194.72
	TOTALN	1805.00	13745.00	4655.46	78.40
	ORTHOP	3.00	193.00	32.92	156.33
	TOTALP	9.00	223.00	46.08	121.86

LAKE=OSCEOLA PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
27	SEEPAGE	0.07	15.60	4.01	122.34
	PH	6.31	7.65	7.13	4.65
	COND	179.00	544.00	278.52	40.97
	ALK	2.90	85.10	27.85	74.28
	NH3	5.00	2486.00	517.36	123.82
	NOX	8.00	2657.00	820.08	93.68
	ORGANICN	32.00	2850.00	639.24	106.63
	TOTALN	227.00	5019.00	1976.68	64.77
	ORTHOP	1.00	61.00	24.96	87.96
	TOTALP	6.00	77.00	37.84	63.52

LAKE=OSCEOLA PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
29	SEEPAGE	0.32	43.80	11.70	122.18
	PH	5.93	7.94	7.20	6.39
	COND	172.00	887.00	352.46	58.03
	ALK	2.40	148.00	42.78	88.50
	NH3	5.00	7998.00	2455.43	94.36
	NOX	4.00	13272.00	1166.14	256.42
	ORGANICN	48.00	5283.00	896.57	119.72
	TOTALN	419.00	22063.00	4553.86	91.25
	ORTHOP	2.00	296.00	52.82	124.57
	TOTALP	4.00	312.00	61.46	108.67

LAKE=VIRGINIA PERIOD=dry

N Obs	Variable	Minimum	Maximum	Mean	CV
21	SEEPAGE	0.10	12.00	1.97	183.74
	PH	7.14	8.14	7.64	3.91
	COND	174.00	517.00	339.68	36.02
	ALK	14.00	183.00	82.53	76.88
	NH3	2.50	8868.00	1063.29	204.38
	NOX	41.00	18566.00	4485.84	130.03
	ORGANICN	100.00	4725.00	1063.89	125.68
	TOTALN	466.00	23428.00	6613.05	105.89
	ORTHOP	4.00	2380.00	302.26	223.23
	TOTALP	15.00	2658.00	337.05	212.56

LAKE=VIRGINIA PERIOD=wet

N Obs	Variable	Minimum	Maximum	Mean	CV
21	SEEPAGE	0.20	15.40	2.25	160.00
	PH	7.11	8.17	7.71	4.11
	COND	194.00	535.00	338.90	36.21
	ALK	25.00	203.00	103.80	60.96
	NH3	118.00	14330.00	4062.71	115.14
	NOX	4.00	19214.00	2688.90	208.22
	ORGANICN	63.00	3712.00	1097.24	81.41
	TOTALN	455.00	27147.00	7848.86	97.31
	ORTHOP	2.00	2210.00	346.19	194.92
	TOTALP	14.00	2535.00	396.33	186.46

A.3 Chemical Characteristics of Seepage Inflow to the Winter Park Chain-of-Lakes from September 1998-March 1999

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE VIRGINIA ON SEPTEMBER 23, 1998

PARAMETER	UNITS	LOCATION/SITE						
		1	2	3	4	5	6	7
pH	s.u.	7.74	7.43	7.85	8.11	7.66	7.40	7.50
Spec. Conductivity	μmho/cm	535	265	418	499	223	198	194
Alkalinity	mg/l	187	56.2	160	203	43.4	33.9	25.0
NH_3-N	μg/l	14,330	3697	7280	9452	702	1021	118
NO_x-N	μg/l	11	151	< 8	< 8	< 8	< 8	< 8
Organic N	μg/l	1234	142	1323	954	360	184	333
Total N	μg/l	15,575	3990	8607	10,410	1066	1209	455
Ortho-P	μg/l	2054	31	215	11	2	98	5
Total P	μg/l	2097	64	230	21	17	108	14
Seepage Flow	L/m^2-day	0.68	0.39	1.14	1.02	0.86	4.17	2.21

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE VIRGINIA ON OCTOBER 14, 1998

PARAMETER	UNITS	LOCATION/SITE						
		1	2	3	4	5	6	7
pH	s.u.	7.90	7.28	7.98	8.06	7.97	7.86	7.80
Spec. Conductivity	μmho/cm	498	266	438	462	252	206	256
Alkalinity	mg/l	167	66.0	177	172	66.4	32.4	67.9
NH_3-N	μg/l	13,692	3748	9787	275	1738	360	1033
NO_x-N	μg/l	12,317	50	30	11,520	102	142	82
Organic N	μg/l	1138	1240	3712	1302	1054	874	1505
Total N	μg/l	27,147	5038	13,529	13,097	2894	1376	2620
Ortho-P	μg/l	1501	84	212	6	51	114	9
Total P	μg/l	1729	272	281	22	52	129	21
Seepage Flow	L/m^2-day	1.10	0.20	1.60	1.56	0.74	9.31	0.37

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE VIRGINIA ON OCTOBER 28, 1998

PARAMETER	UNITS	LOCATION/SITE						
		1	2	3	4	5	6	7
pH	s.u.	7.11	7.21	7.99	8.17	7.73	7.29	7.83
Spec. Conductivity	μmho/cm	437	238	471	488	268	208	297
Alkalinity	mg/l	134	47.7	185	161	70.3	35.7	88.8
NH_3-N	μg/l	3345	1354	10,136	177	1705	965	402
NO_x-N	μg/l	19,214	839	686	11,133	128	< 8	38
Organic N	μg/l	951	458	2412	63	1024	278	2501
Total N	μg/l	23,510	2651	13,234	11,373	2857	1247	2941
Ortho-P	μg/l	2210	82	342	77	17	110	39
Total P	μg/l	2535	96	364	81	27	118	45
Seepage Flow	L/m^2-day	1.17	0.43	1.68	2.00	0.85	15.4	0.40

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE VIRGINIA ON DECEMBER 5, 1998

PARAMETER	UNITS	LOCATION/SITE						
		1	2	3	4	5	6	7
pH	s.u.	7.35	7.33	7.87	8.11	--	7.28	7.75
Spec. Conductivity	μmho/cm	446	237	481	517	--	222	364
Alkalinity	mg/l	58.3	25.5	181	172	--	33.0	123
NH_3-N	μg/l	137	588	8868	158	--	57	304
NO_x-N	μg/l	18,566	960	3705	9786	--	588	1622
Organic N	μg/l	4725	194	4271	2632	--	439	1273
Total N	μg/l	23,428	1742	16,844	12,576	--	1084	3199
Ortho-P	μg/l	2380	39	328	35	--	76	62
Total P	μg/l	2658	98	358	60	--	96	91
Seepage Flow	L/m^2-day	0.62	0.12	0.92	1.22	--	12.0	0.16

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CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE VIRGINIA ON JANUARY 16, 1999

PARAMETER	UNITS	LOCATION/SITE						
		1	2	3	4	5	6	7
pH	s.u.	7.49	7.56	7.81	8.12	7.61	7.14	7.32
Spec. Conductivity	μmho/cm	422	254	404	513	351	218	214
Alkalinity	mg/l	39.3	14.0	103	179	120	23.5	20.2
NH_3-N	μg/l	29	2019	163	2306	4061	28	< 5
NO_x-N	μg/l	17,737	600	7998	5388	954	41	122
Organic N	μg/l	900	100	456	870	245	542	341
Total N	μg/l	18,666	2719	8617	8564	5260	611	466
Ortho-P	μg/l	2005	103	223	62	5	48	4
Total P	μg/l	2002	125	237	68	20	60	15
Seepage Flow	L/m^2-day	0.43	0.10	0.52	1.06	0.23	9.28	0.18

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE VIRGINIA ON MARCH 13, 1999

PARAMETER	UNITS	LOCATION/SITE						
		1	2	3	4	5	6	7
pH	s.u.	7.54	--	7.90	8.14	7.74	7.47	7.61
Spec. Conductivity	μmho/cm	224	--	438	508	260	207	174
Alkalinity	40.0	40.0	--	140	183	56.3	31.5	25.4
NH_3-N	μg/l	48	--	78	1194	97	40	25
NO_x-N	μg/l	720	--	9609	5879	380	463	113
Organic N	μg/l	477	--	877	792	424	145	511
Total N	μg/l	1245	--	10,564	7865	901	648	649
Ortho-P	μg/l	36	--	235	43	10	42	7
Total P	μg/l	56	--	268	62	32	65	33
Seepage Flow	L/m^2-day	0.42	--	0.60	0.66	0.17	8.66	0.14

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE MIZELL ON SEPTEMBER 23, 1998

PARAMETER	UNITS	LOCATION/SITE				
		1	2	3	4	5
pH	s.u.	7.58	7.29	--	7.46	7.48
Spec. Conductivity	μmho/cm	294	452	--	331	266
Alkalinity	mg/l	25.1	56.6	--	34.2	30.6
NH_3-N	μg/l	1456	9493	--	4583	267
NO_x-N	μg/l	841	25	--	539	1387
Organic N	μg/l	208	1297	--	124	151
Total N	μg/l	2505	10,815	--	5246	1805
Ortho-P	μg/l	21	13	--	3	23
Total P	μg/l	40	53	--	12	34
Seepage Flow	L/m^2-day	1.22	0.25	--	1.02	2.46

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE MIZELL ON OCTOBER 14, 1998

PARAMETER	UNITS	LOCATION/SITE				
		1	2[1]	3	4[1]	5
pH	s.u.	7.86	7.76	7.82	7.59	7.85
Spec. Conductivity	μmho/cm	342	440	273	299	265
Alkalinity	mg/l	80.0	127	15.9	42.3	40.0
NH_3-N	μg/l	4174	1843	1532	4245	< 10
NO_x-N	μg/l	304	162	< 8	413	293
Organic N	μg/l	1093	11,740	446	190	2390
Total N	μg/l	5571	13,745	1982	4848	2688
Ortho-P	μg/l	17	193	4	5	16
Total P	μg/l	29	223	16	12	23
Seepage Flow	L/m^2-day	0.82	0.47	1.77	2.66	2.41

1. Samples collected on October 6, 1998

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE MIZELL ON OCTOBER 28, 1998

PARAMETER	UNITS	LOCATION/SITE				
		1	2	3	4	5
pH	s.u.	7.62	7.46	7.57	--	7.66
Spec. Conductivity	μmho/cm	286	298	295	--	271
Alkalinity	mg/l	30.0	26.7	36.9	--	37.4
NH_3-N	μg/l	50	1851	346	--	614
NO_x-N	μg/l	1650	821	2002	--	854
Organic N	μg/l	777	939	524	--	888
Total N	μg/l	2477	3611	2872	--	2356
Ortho-P	μg/l	17	5	70	--	41
Total P	μg/l	32	9	72	--	44
Seepage Flow	L/m^2-day	1.69	2.33	1.23	--	8.03

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CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE MIZELL ON DECEMBER 4, 1998

PARAMETER	UNITS	LOCATION/SITE				
		1	2	3	4	5
pH	s.u.	--	7.31	7.26	--	7.27
Spec. Conductivity	μmho/cm	--	283	307	--	272
Alkalinity	mg/l	--	15.4	26.7	--	51.9
NH_3-N	μg/l	--	876	52	--	697
NO_x-N	μg/l	--	113	2226	--	1092
Organic N	μg/l	--	1190	1124	--	4962
Total N	μg/l	--	2179	3402	--	6751
Ortho-P	μg/l	--	2	35	--	40
Total P	μg/l	--	8	47	--	62
Seepage Flow	L/m^2-day	--	1.76	1.06	--	2.20

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE MIZELL ON JANUARY 16, 1999

PARAMETER	UNITS	LOCATION/SITE				
		1	2	3	4	5
pH	s.u.	7.42	7.09	6.90	--	7.60
Spec. Conductivity	μmho/cm	332	304	289	--	275
Alkalinity	mg/l	48.5	19.0	16.1	--	36.5
NH_3-N	μg/l	474	1521	25	--	674
NO_x-N	μg/l	3432	602	1146	--	838
Organic N	μg/l	42	558	216	--	1757
Total N	μg/l	3948	2681	1387	--	3269
Ortho-P	μg/l	3	25	30	--	20
Total P	μg/l	46	10	33	--	25
Seepage Flow	L/m^2-day	0.48	1.57	0.35	--	0.61

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE MIZELL ON MARCH 13, 1999

PARAMETER	UNITS	LOCATION/SITE				
		1	2	3	4	5
pH	s.u.	7.52	7.24	7.79	--	7.65
Spec. Conductivity	μmho/cm	322	306	398	--	278
Alkalinity	mg/l	62.9	10.3	83.8	--	56.7
NH_3-N	μg/l	93	716	75	--	55
NO_x-N	μg/l	2563	1212	5185	--	1489
Organic N	μg/l	950	397	482	--	157
Total N	μg/l	3606	2325	5742	--	1701
Ortho-P	μg/l	58	4	52	--	28
Total P	μg/l	86	26	76	--	47
Seepage Flow	L/m^2-day	0.42	0.77	0.44	--	0.48

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE OSCEOLA ON SEPTEMBER 22, 1998

PARAMETER	UNITS	LOCATION/SITE								
		1	2	3	4	5	6	7	8	9
pH	s.u.	6.56	6.87	7.26	7.44	7.01	7.09	7.07	7.08	--
Spec. Conductivity	μmho/cm	887	203	306	296	198	173	256	709	--
Alkalinity	mg/l	47.1	2.6	91.6	92.4	24.0	4.9	73.8	51.8	--
NH_3-N	μg/l	1698	3006	1048	5355	407	49	3325	2097	--
NO_x-N	μg/l	1245	13	2580	20	26	499	< 8	30	--
Organic N	μg/l	454	2111	219	468	5283	116	273	48	--
Total N	μg/l	3397	5130	3847	5843	5716	664	3602	2175	--
Ortho-P	μg/l	2	69	7	2	50	47	6	25	--
Total P	μg/l	7	81	24	19	65	56	22	35	--
Seepage Flow	L/m^2-day	19.62	7.64	0.74	0.43	18.08	8.40	0.32	8.41	--

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE OSCEOLA ON OCTOBER 14, 1998

PARAMETER	UNITS	LOCATION/SITE								
		1	2	3	4	5	6	7	8	9
pH	s.u.	7.09	7.28	7.94	7.68	7.66	7.57	7.37	7.52	7.55
Spec. Conductivity	μmho/cm	818	212	418	291	193	172	241	552	264
Alkalinity	mg/l	6.7	13.5	148	83.9	15.9	3.5	66.4	42.6	56.4
NH_3-N	μg/l	3090	3820	7998	6373	142	< 10	4279	1853	2640
NO_x-N	μg/l	1142	64	13,272	108	40	592	15	94	90
Organic N	μg/l	1280	346	793	693	1587	421	1193	567	1124
Total N	μg/l	5512	4230	22,063	7174	1769	1018	5487	2514	3854
Ortho-P	μg/l	3	84	216	8	52	43	12	37	11
Total P	μg/l	4	88	235	41	56	51	33	44	15
Seepage Flow	L/m^2-day	28.8	7.42	3.18	0.55	27.4	4.86	0.34	3.71	2.90

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE OSCEOLA ON OCTOBER 28, 1998

PARAMETER	UNITS	LOCATION/SITE								
		1	2	3	4	5	6	7	8	9
pH	s.u.	6.33	6.86	7.79	7.73	7.15	6.78	7.28	7.43	7.46
Spec. Conductivity	μmho/cm	612	201	387	321	198	175	258	563	241
Alkalinity	mg/l	7.2	4.1	84.6	87.8	14.9	2.4	38.1	41.4	66.6
NH_3-N	μg/l	111	3127	324	7567	300	98	4290	1633	3186
NO_x-N	μg/l	897	< 8	9507	201	14	84	< 8	301	539
Organic N	μg/l	2760	836	694	67	471	344	59	831	503
Total N	μg/l	4768	3967	10,525	7835	785	526	4353	2765	4228
Ortho-P	μg/l	8	111	296	63	85	48	5	71	49
Total P	μg/l	15	112	312	63	86	48	14	73	50
Seepage Flow	L/m^2-day	43.8	3.43	1.14	0.87	40.9	9.94	0.54	4.97	1.58

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE OSCEOLA ON NOVEMBER 3, 1998

PARAMETER	UNITS	LOCATION/SITE								
		1	2	3	4	5	6	7	8	9
pH	s.u.	5.93	--	--	--	6.72	--	--	--	--
Spec. Conductivity	μmho/cm	516	--	--	--	208	--	--	--	--
Alkalinity	mg/l	4.9	--	--	--	20.7	--	--	--	--
NH_3-N	μg/l	664	--	--	--	267	--	--	--	--
NO_x-N	μg/l	1263	--	--	--	< 8	--	--	--	--
Organic N	μg/l	1415	--	--	--	148	--	--	--	--
Total N	μg/l	3342	--	--	--	419	--	--	--	--
Ortho-P	μg/l	7	--	--	--	62	--	--	--	--
Total P	μg/l	8	--	--	--	64	--	--	--	--
Seepage Flow	L/m^2-day	39.0	--	--	--	38.7	--	--	--	--

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE OSCEOLA ON DECEMBER 4-5, 1998

PARAMETER[1]	UNITS	LOCATION/SITE								
		1	2	3	4	5	6	7	8	9
pH	s.u.	7.10	6.72	7.28	7.21	7.13	6.91	7.21	7.28	7.41
Spec. Conductivity	μmho/cm	508	205	224	276	196	179	236	544	268
Alkalinity	mg/l	2.9	3.8	32.2	43.4	85.1	5.1	37.6	38.8	45.7
NH_3-N	μg/l	515	1206	< 10	1194	148	12	2486	1530	215
NO_x-N	μg/l	1224	110	613	760	46	135	8	461	1954
Organic N	μg/l	930	2321	595	975	174	152	830	617	2850
Total N	μg/l	2669	3637	1213	2929	368	299	3324	2608	5019
Ortho-P	μg/l	5	25	7	26	52	6	1	51	61
Total P	μg/l	6	47	20	44	59	14	7	58	77
Seepage Flow	L/m^2-day	14.4	3.32	0.47	0.59	15.6	3.71	0.20	5.46	0.73

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE OSCEOLA ON JANUARY 15-16, 1999

PARAMETER	UNITS	LOCATION/SITE								
		1[1]	2[1]	3[2]	4[2]	5[2]	6[2]	7[2]	8[2]	9[2]
pH	s.u.	6.43	7.04	7.40	--	7.20	7.11	7.25	7.34	7.53
Spec. Conductivity	μmho/cm	363	207	226	--	189	184	228	519	283
Alkalinity	mg/l	8.9	8.5	20.2	--	7.6	14.5	25.6	21.9	38.1
NH_3-N	μg/l	202	145	86	--	362	34	1532	68	515
NO_x-N	μg/l	1550	583	897	--	48	441	647	1951	2657
Organic N	μg/l	32	377	462	--	188	854	1334	823	257
Total N	μg/l	1784	1105	1445	--	598	1329	3513	2842	3429
Ortho-P	μg/l	3	4	13	--	56	17	6	48	57
Total P	μg/l	6	14	26	--	67	25	14	55	73
Seepage Flow	L/m^2-day	11.5	2.62	0.29	--	12.9	5.39	0.35	1.26	0.52

1. Samples collected on January 15, 1999
2. Samples collected on January 16, 1999

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE OSCEOLA ON MARCH 10, 1999

PARAMETER	UNITS	LOCATION/SITE								
		1	2	3	4	5	6	7	8	9
pH	s.u.	6.31	6.51	7.27	--	7.11	7.09	7.26	7.48	7.65
Spec. Conductivity	μmho/cm	382	198	222	--	184	191	222	451	278
Alkalinity	mg/l	3.3	10.3	38.6	--	27.5	24.4	45.7	41.0	65.6
NH_3-N	μg/l	35	326	48	--	21	48	1023	330	848
NO_x-N	μg/l	2189	413	352	--	273	133	147	1432	1478
Organic N	μg/l	189	188	319	--	119	46	667	179	503
Total N	μg/l	2413	927	719	--	413	227	1837	1941	2829
Ortho-P	μg/l	1	9	7	--	52	17	7	47	46
Total P	μg/l	16	30	27	--	70	33	25	58	75
Seepage Flow	L/m^2-day	2.84	0.57	0.25	--	10.1	1.60	0.87	4.52	0.07

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE MAITLAND ON SEPTEMBER 22, 1998

PARAMETER	UNITS	LOCATION/SITE									
		1	2	3	4	5	6	7	8	9	10
pH	s.u.	7.34	7.33	7.33	7.37	7.94	7.55	7.67	7.89	7.77	7.98
Spec. Conductivity	μmho/cm	276	302	196	197	550	360	202	368	284	284
Alkalinity	mg/l	91.1	111	17.3	45.6	221	133	40.0	146	80.8	198
NH_3-N	μg/l	4748	3754	335	75	7339	6186	333	4431	607	4709
NO_x-N	μg/l	360	< 8	56	< 8	166	380	8	173	3685	20
Organic N	μg/l	246	650	57	480	591	565	323	426	108	318
Total N	μg/l	5354	4408	448	559	8096	7131	664	5030	4400	5047
Ortho-P	μg/l	314	4	55	2	551	375	2	88	192	386
Total P	μg/l	314	27	68	8	576	381	19	103	210	399
Seepage Flow	L/m^2-day	3.70	2.04	10.3	1.50	1.07	1.01	0.88	1.02	0.89	5.35

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE MAITLAND ON OCTOBER 13, 1998

PARAMETER	UNITS	LOCATION/SITE									
		1	2	3	4	5	6	7	8	9	10
pH	s.u.	7.27	7.28	7.40	7.39	8.03	7.95	8.01	7.99	8.03	8.10
Spec. Conductivity	μmho/cm	279	331	210	190	613	423	223	459	258	452
Alkalinity	mg/l	57.3	129	9.3	24.2	259	144	49.6	184	61.4	191
NH_3-N	μg/l	3313	7302	166	229	5331	2675	34	6753	54	4374
NO_x-N	μg/l	892	21	11	21	7610	3035	1076	225	2240	147
Organic N	μg/l	98	1401	342	683	209	1252	813	708	972	434
Total N	μg/l	4303	8724	519	933	13,150	6962	1923	7716	3226	4955
Ortho-P	μg/l	202	70	42	5	753	385	20	136	121	314
Total P	μg/l	223	115	53	22	755	450	34	162	141	325
Seepage Flow	L/m^2-day	1.06	1.08	4.78	1.38	0.85	1.58	1.91	1.35	1.52	8.86

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE MAITLAND ON OCTOBER 28, 1998

PARAMETER	UNITS	LOCATION/SITE									
		1	2	3	4	5	6	7	8	9	10
pH	s.u.	7.56	7.78	6.90	7.62	8.16	7.91	7.98	8.02	7.74	8.23
Spec. Conductivity	μmho/cm	280	270	208	200	685	446	239	503	213	442
Alkalinity	mg/l	68.1	67.4	17.8	31.6	307	139	52.8	195	34.1	173
NH_3-N	μg/l	3033	335	109	97	7277	2253	26	7108	23	2617
NO_x-N	μg/l	974	3910	31	73	5775	5939	1836	1180	35	314
Organic N	μg/l	769	621	337	524	398	305	645	53	840	562
Total N	μg/l	4776	4866	477	694	13,450	8497	2507	8341	898	3493
Ortho-P	μg/l	283	47	57	3	863	512	15	344	38	281
Total P	μg/l	305	47	61	12	872	580	16	355	41	285
Seepage Flow	L/m^2-day	2.50	1.09	10.9	5.69	1.21	3.34	2.37	0.96	1.19	11.4

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE MAITLAND ON DECEMBER 4, 1998

PARAMETER	UNITS	LOCATION/SITE									
		1	2	3	4	5	6	7	8	9	10
pH	s.u.	7.38	7.40	7.01	7.47	8.09	7.95	--	7.99	7.65	8.12
Spec. Conductivity	μmho/cm	275	230	214	212	672	322	--	533	217	442
Alkalinity	mg/l	53.2	34.5	12.9	37.3	238	65.2	--	193	32.6	177
NH_3-N	μg/l	2134	94	62	482	4436	56	--	2700	49	1737
NO_x-N	μg/l	1410	82	119	57	7911	4485	--	203	252	1100
Organic N	μg/l	983	379	242	688	2969	843	--	6818	719	3155
Total N	μg/l	4527	555	423	1227	15,316	5384	--	9721	1020	5992
Ortho-P	μg/l	220	7	20	< 1	653	300	--	272	5	217
Total P	μg/l	244	13	32	14	678	629	--	582	14	244
Seepage Flow	L/m^2-day	1.75	1.00	2.99	0.51	0.72	0.96	--	0.64	0.68	2.24

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE MAITLAND ON JANUARY 15, 1999

PARAMETER	UNITS	LOCATION/SITE									
		1	2	3	4	5	6	7	8	9	10
pH	s.u.	7.44	7.48	6.83	7.17	7.97	7.71	7.92	7.73	7.43	8.16
Spec. Conductivity	μmho/cm	265	238	203	211	529	261	261	484	217	447
Alkalinity	mg/l	44.0	18.2	6.7	16.9	177	38.9	63.7	161	20.2	171
NH_3-N	μg/l	269	87	162	242	333	217	2129	2973	107	2328
NO_x-N	μg/l	2708	56	303	723	8008	2107	4137	3805	410	588
Organic N	μg/l	324	713	< 30	119	989	257	209	105	994	1586
Total N	μg/l	3301	856	487	1084	9330	2581	6475	6883	1511	4502
Ortho-P	μg/l	222	13	27	2	536	98	8	224	18	184
Total P	μg/l	241	18	34	12	540	112	24	252	28	188
Seepage Flow	L/m^2-day	0.98	0.26	2.57	0.44	0.54	0.71	0.44	0.62	0.69	2.47

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE MEASURED AT LAKE MAITLAND ON MARCH 10, 1999

PARAMETER	UNITS	LOCATION/SITE									
		1	2	3	4	5	6	7	8	9	10
pH	s.u.	7.27	7.41	6.99	7.41	7.88	7.42	7.41	7.94	7.47	7.99
Spec. Conductivity	μmho/cm	258	367	207	217	547	241	214	488	230	437
Alkalinity	mg/l	57.2	95.2	22.0	42.1	220	39.7	34.9	193	38.4	181
NH_3-N	μg/l	1360	991	97	188	1729	62	19	3351	70	1509
NO_x-N	μg/l	250	8200	48	378	6902	294	726	3660	435	264
Organic N	μg/l	627	476	142	334	486	468	589	263	361	578
Total N	μg/l	2237	9667	287	900	9117	824	1334	7274	866	2351
Ortho-P	μg/l	164	28	24	4	430	7	48	199	9	159
Total P	μg/l	175	54	44	29	447	35	75	230	25	174
Seepage Flow	L/m^2-day	5.44	0.19	2.87	0.18	0.61	0.17	0.55	0.47	0.29	2.22

APPENDIX B

SEDIMENT RELEASE EXPERIMENTS

B.1 Chemical Characteristics of Isolation Experiments Conducted Under Aerobic Conditions

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE VIRGINIA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 5 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	3	4	5	6	7	8	9
Alkalinity	mg/l	48.8	49.5	50.3	51.3	50.8	49.9	51.8	51.3	51.5	49.6
NH_3-N	µg/l	481	421	258	199	96	42	21	< 5	< 5	< 5
NO_x-N	µg/l	73	156	387	542	670	657	675	658	606	607
Organic N	µg/l	319	178	339	211	271	333	382	380	451	466
Total N	µg/l	873	755	984	952	1037	1032	1078	1041	1060	1076
Ortho-P	µg/l	4	6	5	< 1	< 1	< 1	< 1	3	2	< 1
Total P	µg/l	18	22	27	23	22	23	21	20	16	14
Color	Pt-Co	14	22	17	17	16	18	18	19	19	16
Sulfate	mg/l	28	27	28	30	29	29	29	28	29	30
Diss. Al	µg/l	13	14	21	22	26	27	27	26	30	29
Collection Date		5/5/99	5/6/99	5/7/99	5/8/99	5/9/99	5/10/99	5/11/99	5/12/99	5/13/99	5/14/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE VIRGINIA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 5 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		16	18	19	20	21	22	25	26	29	33
Alkalinity	mg/l	48.5	50.1	46.2	45.9	52.6	50.9	47.3	46.2	48.3	50.8
NH_3-N	μg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	μg/l	595	588	604	612	584	578	575	579	583	582
Organic N	μg/l	431	449	436	350	353	403	478	462	481	400
Total N	μg/l	1029	1040	1043	965	940	984	1056	1044	1067	985
Ortho-P	μg/l	< 1	5	5	6	6	7	9	13	12	2
Total P	μg/l	12	12	12	10	14	14	17	14	21	23
Color	Pt-Co	16	16	15	16	17	17	15	14	16	16
Sulfate	mg/l	70	66	73	77	75	74	72	73	72	72
Diss. Al	μg/l	29	29	29	28	21	21	22	23	24	26
Collection Date		5/15/99	5/17/99	5/18/99	5/19/99	5/20/99	5/21/99	5/24/99	5/25/99	5/28/99	6/1/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE VIRGINIA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 5 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)							
		34	35	36	39	41	43	54	64
Alkalinity	mg/l	52.9	50.8	50.7	51.0	52.1	50.7	56.0	60.6
NH_3-N	µg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	µg/l	594	606	605	613	578	604	568	582
Organic N	µg/l	325	266	327	301	426	343	277	329
Total N	µg/l	922	875	935	917	1007	950	848	914
Ortho-P	µg/l	15	15	16	16	14	15	14	11
Total P	µg/l	25	22	22	24	25	24	26	22
Color	Pt-Co	22	19	20	22	21	22	22	22
Sulfate	mg/l	31	29	27	28	31	31	32	33
Diss. Al	µg/l	23	23	23	23	19	19	21	22
Collection Date		6/2/99	6/3/99	6/4/99	6/7/99	6/9/99	6/11/99	6/22/99	7/2/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE VIRGINIA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 10 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	3	4	5	6	7	8	9
Alkalinity	mg/l	44.5	44.0	46.6	47.7	45.3	48.7	46.2	50.4	48.1	43.0
NH_3-N	μg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	μg/l	670	673	733	661	673	688	698	673	631	619
Organic N	μg/l	87	124	189	65	113	368	314	355	278	271
Total N	μg/l	760	800	925	729	789	1059	1015	1031	912	893
Ortho-P	μg/l	9	10	9	9	9	11	10	16	14	12
Total P	μg/l	25	30	38	28	28	32	22	19	24	27
Color	Pt-Co	14	14	17	17	16	17	18	19	17	14
Sulfate	mg/l	30	28	29	30	30	30	30	30	30	29
Diss. Al	μg/l	13	14	17	19	20	22	22	22	23	24
Collection Date		5/5/99	5/6/99	5/7/99	5/8/99	5/9/99	5/10/99	5/11/99	5/12/99	5/13/99	5/14/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE VIRGINIA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 10 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		16	18	19	20	21	22	25	26	29	33
Alkalinity	mg/l	44.1	43.6	42.1	41.9	43.8	42.3	42.5	43.1	46.9	47.2
NH_3-N	µg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	µg/l	610	625	655	668	645	641	649	661	640	649
Organic N	µg/l	418	469	435	414	402	520	474	522	523	373
Total N	µg/l	1031	1097	1093	1085	1050	1164	1126	1186	1166	1025
Ortho-P	µg/l	11	13	13	16	16	16	20	32	25	26
Total P	µg/l	22	23	23	18	18	19	24	38	48	40
Color	Pt-Co	15	14	14	14	16	17	15	13	16	16
Sulfate	mg/l	70	66	73	77	76	74	73	74	73	74
Diss. Al	µg/l	26	28	21	21	21	21	23	24	26	29
Collection Date		5/15/99	5/17/99	5/18/99	5/19/99	5/20/99	5/21/99	5/24/99	5/25/99	5/28/99	6/1/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE VIRGINIA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 10 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)							
		34	35	36	39	41	43	54	64
Alkalinity	mg/l	48.2	47.3	47.2	47.8	49.3	49.1	50.5	55.7
NH_3-N	µg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	µg/l	655	666	668	669	586	593	527	470
Organic N	µg/l	335	309	330	308	365	378	327	484
Total N	µg/l	993	978	1001	980	954	974	857	957
Ortho-P	µg/l	27	27	28	31	22	23	24	25
Total P	µg/l	39	36	39	38	34	34	37	40
Color	Pt-Co	21	20	20	22	21	21	23	22
Sulfate	mg/l	33	29	28	29	33	33	36	35
Diss. Al	µg/l	28	35	27	25	19	20	20	20
Collection Date		6/2/99	6/3/99	6/4/99	6/7/99	6/9/99	6/11/99	6/22/99	7/2/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE VIRGINIA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 15 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	3	4	5	6	7	8	9
Alkalinity	mg/l	44.2	45.1	45.1	46.2	46.0	43.9	44.4	43.9	44.6	43.3
NH_3-N	μg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	μg/l	538	554	586	561	559	560	557	553	525	502
Organic N	μg/l	174	187	200	188	230	369	392	360	433	446
Total N	μg/l	715	744	789	752	792	932	952	916	961	951
Ortho-P	μg/l	3	4	2	2	3	3	4	4	4	4
Total P	μg/l	25	24	27	17	15	22	10	7	8	14
Color	Pt-Co	14	15	16	16	16	15	16	17	16	14
Sulfate	mg/l	30	29	29	30	30	30	30	29	30	30
Diss. Al	μg/l	13	13	15	18	19	19	18	19	20	20
Collection Date		5/5/99	5/6/99	5/7/99	5/8/99	5/9/99	5/10/99	5/11/99	5/12/99	5/13/99	5/14/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE VIRGINIA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 15 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		16	18	19	20	21	22	25	26	29	33
Alkalinity	mg/l	43.0	43.8	41.3	41.5	41.8	41.2	40.9	41.9	43.4	44.6
NH_3-N	$\mu g/l$	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	$\mu g/l$	514	518	551	563	547	545	615	573	587	690
Organic N	$\mu g/l$	497	493	420	405	382	392	419	499	580	402
Total N	$\mu g/l$	1014	1014	974	971	932	940	1037	1075	1170	1095
Ortho-P	$\mu g/l$	5	4	6	6	3	6	6	4	5	6
Total P	$\mu g/l$	13	7	18	20	19	21	22	23	28	28
Color	Pt-Co	15	14	14	14	15	15	14	14	15	16
Sulfate	mg/l	70	68	74	71	74	75	75	74	74	75
Diss. Al	$\mu g/l$	22	23	22	20	20	19	20	20	21	22
Collection Date		5/15/99	5/17/99	5/18/99	5/19/99	5/20/99	5/21/99	5/24/99	5/25/99	5/28/99	6/1/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE VIRGINIA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 15 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)							
		34	35	36	39	41	43	54	64
Alkalinity	mg/l	46.4	44.8	44.6	45.1	45.5	44.8	45.6	48.0
NH_3-N	μg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	μg/l	722	748	770	844	770	765	870	1253
Organic N	μg/l	397	356	389	426	509	461	652	587
Total N	μg/l	1122	1107	1162	1273	1282	1229	1525	1843
Ortho-P	μg/l	16	17	19	26	18	20	26	43
Total P	μg/l	31	28	31	38	35	66	63	82
Color	Pt-Co	23	20	21	22	21	22	23	23
Sulfate	mg/l	33	28	29	30	34	35	38	37
Diss. Al	μg/l	19	20	18	18	16	16	16	16
Collection Date		6/2/99	6/3/99	6/4/99	6/7/99	6/9/99	6/11/99	6/22/99	7/2/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE VIRGINIA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 20 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	3	4	5	6	7	8	9
Alkalinity	mg/l	47.3	47.0	48.5	50.3	48.3	51.2	49.3	50.3	48.3	44.2
NH_3-N	µg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	14
NO_x-N	µg/l	1062	1088	1159	850	825	800	798	732	658	662
Organic N	µg/l	< 30	< 30	< 30	125	159	362	308	351	417	603
Total N	µg/l	1071	1109	1177	978	987	1165	1109	1086	1078	1279
Ortho-P	µg/l	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Total P	µg/l	26	49	34	21	18	23	6	7	8	6
Color	Pt-Co	13	14	16	14	16	15	20	15	16	16
Sulfate	mg/l	28	27	28	29	29	28	28	28	29	29
Diss. Al	µg/l	13	16	17	20	21	22	22	20	21	22
Collection Date		5/5/99	5/6/99	5/7/99	5/8/99	5/9/99	5/10/99	5/11/99	5/12/99	5/13/99	5/14/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE VIRGINIA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 20 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		16	18	19	20	21	22	25	26	29	33
Alkalinity	mg/l	45.5	43.6	42.1	41.0	43.0	39.5	37.7	38.9	38.0	39.7
NH_3-N	µg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	µg/l	634	594	586	577	520	498	515	452	506	378
Organic N	µg/l	377	492	522	445	440	484	519	488	426	478
Total N	µg/l	1014	1089	1111	1025	963	985	1037	943	935	859
Ortho-P	µg/l	< 1	< 1	< 1	< 1	3	< 1	2	< 1	< 1	1
Total P	µg/l	4	4	8	7	3	3	3	11	13	9
Color	Pt-Co	17	17	16	17	17	17	14	15	17	17
Sulfate	mg/l	71	63	68	72	72	71	72	70	70	73
Diss. Al	µg/l	20	25	20	31	18	19	20	20	20	22
Collection Date		5/15/99	5/17/99	5/18/99	5/19/99	5/20/99	5/21/99	5/24/99	5/25/99	5/28/99	6/1/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE VIRGINIA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 20 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)							
		34	35	36	39	41	43	54	64
Alkalinity	mg/l	41.7	39.6	40.6	38.7	40.3	41.5	46.7	52.5
NH_3-N	µg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	µg/l	369	360	360	364	325	341	381	381
Organic N	µg/l	347	329	383	385	447	426	499	1420
Total N	µg/l	719	692	746	752	775	770	883	1804
Ortho-P	µg/l	1	1	3	3	3	3	3	2
Total P	µg/l	11	9	10	11	11	12	14	14
Color	Pt-Co	23	20	20	20	20	21	22	23
Sulfate	mg/l	34	29	30	31	34	35	35	40
Diss. Al	µg/l	20	21	20	19	16	17	17	17
Collection Date		6/2/99	6/3/99	6/4/99	6/7/99	6/9/99	6/11/99	6/22/99	7/2/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MIZELL SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 5 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	4	5	6	7	8	11	12
Alkalinity	mg/l	18.1	15.5	16.0	15.6	14.2	13.7	13.8	15.0	14.5	14.8
NH_3-N	μg/l	57	132	215	323	405	433	505	541	680	688
NO_x-N	μg/l	19	9	9	12	17	18	22	24	49	62
Organic N	μg/l	857	974	835	878	800	722	598	614	756	813
Total N	μg/l	933	1115	1059	1213	1222	1173	1125	1179	1485	1563
Ortho-P	μg/l	1	< 1	< 1	1	< 1	< 1	< 1	< 1	< 1	< 1
Total P	μg/l	21	23	27	13	14	9	8	6	8	14
Color	Pt-Co	17	12	12	11	12	11	12	10	6	7
Sulfate	mg/l	69	69	70	66	77	75	74	72	73	72
Diss. Al	μg/l	16	19	21	23	26	17	13	12	14	15
Collection Date		5/13/99	5/14/99	5/15/99	5/17/99	5/18/99	5/19/99	5/20/99	5/21/99	5/24/99	5/25/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MIZELL SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 5 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		15	19	20	21	22	25	27	29	40	50
Alkalinity	mg/l	16.6	16.5	16.1	13.6	13.0	12.4	14.4	15.1	12.1	10.6
NH_3-N	μg/l	452	468	361	153	73	< 5	< 5	< 5	< 5	< 5
NO_x-N	μg/l	342	422	540	653	729	856	772	717	791	672
Organic N	μg/l	733	557	496	524	583	455	593	418	392	522
Total N	μg/l	1527	1447	1397	1330	1385	1314	1368	1148	1186	1197
Ortho-P	μg/l	3	2	2	3	3	4	4	3	1	2
Total P	μg/l	26	33	28	24	26	19	17	22	28	33
Color	Pt-Co	8	9	8	4	10	10	11	11	11	11
Sulfate	mg/l	72	73	72	66	66	66	71	74	74	74
Diss. Al	μg/l	13	16	12	14	10	10	13	12	18	13
Collection Date		5/28/99	6/1/99	6/2/99	6/3/99	6/4/99	6/7/99	6/9/99	6/11/99	6/22/99	7/2/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MIZELL SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 10 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	4	5	6	7	8	11	12
Alkalinity	mg/l	16.9	13.5	15.5	15.7	12.3	12.3	13.4	11.9	11.2	10.8
NH_3-N	μg/l	15	78	159	240	278	293	319	326	338	316
NO_x-N	μg/l	7	31	65	146	208	246	275	308	458	512
Organic N	μg/l	953	876	707	648	589	518	499	577	515	576
Total N	μg/l	975	985	931	1034	1075	1057	1093	1211	1311	1404
Ortho-P	μg/l	2	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Total P	μg/l	23	15	13	8	10	15	12	11	12	13
Color	Pt-Co	16	10	11	10	7	7	11	13	5	4
Sulfate	mg/l	71	70	70	72	77	76	74	73	74	73
Diss. Al	μg/l	18	19	24	23	19	31	13	11	13	14
Collection Date		5/13/99	5/14/99	5/15/99	5/17/99	5/18/99	5/19/99	5/20/99	5/21/99	5/24/99	5/25/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MIZELL SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 10 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		15	19	20	21	22	25	27	29	40	50
Alkalinity	mg/l	9.6	12.9	11.1	10.6	11.8	12.1	12.1	10.7	12.3	12.8
NH_3-N	µg/l	215	86	86	41	44	19	21	9	10	< 5
NO_x-N	µg/l	850	856	888	914	922	992	959	926	972	775
Organic N	µg/l	413	427	478	369	399	389	517	399	201	329
Total N	µg/l	1478	1369	1452	1324	1365	1400	1497	1334	1183	1107
Ortho-P	µg/l	2	< 1	< 1	2	3	2	2	3	< 1	< 1
Total P	µg/l	14	11	10	10	12	10	10	10	10	6
Color	Pt-Co	8	5	6	7	7	7	10	12	11	11
Sulfate	mg/l	72	74	73	66	66	66	75	74	75	75
Diss. Al	µg/l	11	13	12	11	10	10	13	13	17	13
Collection Date		5/28/99	6/1/99	6/2/99	6/3/99	6/4/99	6/7/99	6/9/99	6/11/99	6/22/99	7/2/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MIZELL SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 15 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	4	5	6	7	8	11	12
Alkalinity	mg/l	22.4	19.8	18.2	16.1	14.2	15.7	15.5	16.6	15.4	15.5
NH_3-N	µg/l	48	118	231	322	413	455	555	589	761	761
NO_x-N	µg/l	9	< 5	< 5	< 5	6	6	6	6	11	11
Organic N	µg/l	889	915	810	844	871	924	782	816	856	937
Total N	µg/l	946	1036	1044	1169	1290	1385	1343	1411	1628	1709
Ortho-P	µg/l	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Total P	µg/l	16	14	19	11	14	12	15	10	14	14
Color	Pt-Co	16	12	14	11	10	9	6	9	6	5
Sulfate	mg/l	70	72	70	68	79	71	74	75	75	74
Diss. Al	µg/l	18	21	27	37	34	24	14	13	14	14
Collection Date		5/13/99	5/14/99	5/15/99	5/17/99	5/18/99	5/19/99	5/20/99	5/21/99	5/24/99	5/25/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MIZELL SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 15 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		15	19	20	21	22	25	27	29	40	50
Alkalinity	mg/l	16.3	19.0	20.4	19.2	19.7	19.9	19.6	20.6	21.0	20.7
NH_3-N	µg/l	936	1081	1185	1175	1209	1300	1332	1316	1387	1191
NO_x-N	µg/l	< 5	30	40	44	50	87	101	104	277	375
Organic N	µg/l	732	623	605	643	731	750	808	860	709	1127
Total N	µg/l	1671	1734	1830	1862	1990	2137	2241	2280	2373	2593
Ortho-P	µg/l	2	< 1	< 1	2	2	3	3	3	< 1	2
Total P	µg/l	26	23	26	27	28	31	22	27	20	18
Color	Pt-Co	9	8	7	7	7	8	10	10	14	14
Sulfate	mg/l	74	75	75	68	68	69	77	75	79	81
Diss. Al	µg/l	16	18	16	16	15	14	15	15	18	14
Collection Date		5/28/99	6/1/99	6/2/99	6/3/99	6/4/99	6/7/99	6/9/99	6/11/99	6/22/99	7/2/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MIZELL SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 20 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	4	5	6	7	8	11	12
Alkalinity	mg/l	14.7	19.1	20.8	30.0	27.7	26.2	24.7	24.0	26.5	29.3
NH_3-N	µg/l	235	330	507	1095	1393	1460	1528	1508	2054	2156
NO_x-N	µg/l	< 5	< 5	< 5	< 5	< 5	< 5	5	7	7	9
Organic N	µg/l	764	825	818	997	584	600	452	396	565	905
Total N	µg/l	1002	1158	1328	2095	1980	2063	1985	1911	2626	3070
Ortho-P	µg/l	2	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Total P	µg/l	12	14	20	7	8	7	9	10	10	18
Color	Pt-Co	18	11	11	10	8	6	7	7	4	7
Sulfate	mg/l	69	70	71	63	72	32	72	71	72	70
Diss. Al	µg/l	18	19	23	25	25	25	17	16	18	14
Collection Date		5/13/99	5/14/99	5/15/99	5/17/99	5/18/99	5/19/99	5/20/99	5/21/99	5/24/99	5/25/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MIZELL SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 20 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		15	19	20	21	22	25	27	29	40	50
Alkalinity	mg/l	29.2	29.0	31.1	25.2	26.8	28.2	29.2	27.4	24.5	23.8
NH_3-N	µg/l	2291	2147	2083	1985	1930	1616	1462	1244	648	585
NO_x-N	µg/l	< 5	44	61	55	58	95	109	129	266	252
Organic N	µg/l	618	361	391	269	357	326	453	344	260	555
Total N	µg/l	2912	2552	2535	2309	2345	2037	2024	1717	1174	1392
Ortho-P	µg/l	1	< 1	2	2	2	2	3	3	2	3
Total P	µg/l	10	8	8	4	6	7	8	10	9	7
Color	Pt-Co	7	9	10	7	8	8	10	9	13	12
Sulfate	mg/l	70	73	73	66	66	67	74	75	77	79
Diss. Al	µg/l	18	20	18	17	15	16	16	15	34	15
Collection Date		5/28/99	6/1/99	6/2/99	6/3/99	6/4/99	6/7/99	6/9/99	6/11/99	6/22/99	7/2/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE OSCEOLA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 5 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	3	4	5	6	7	8	9
Alkalinity	mg/l	51.9	50.3	51.8	52.0	51.5	51.5	53.2	52.1	50.9	47.6
NH_3-N	µg/l	559	401	349	219	158	125	51	8	5	< 5
NO_x-N	µg/l	119	192	319	432	489	531	586	594	558	564
Organic N	µg/l	294	334	153	197	359	492	468	462	625	650
Total N	µg/l	972	927	821	848	1006	1148	1105	1064	1188	1217
Ortho-P	µg/l	7	1	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Total P	µg/l	29	31	27	24	23	29	11	11	12	12
Color	Pt-Co	12	12	15	14	14	15	16	17	18	16
Sulfate	mg/l	28	27	28	28	28	28	27	26	28	27
Diss. Al	µg/l	11	13	17	21	24	25	25	21	27	27
Collection Date		5/5/99	5/6/99	5/7/99	5/8/99	5/9/99	5/10/99	5/11/99	5/12/99	5/13/99	5/14/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE OSCEOLA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 5 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		16	18	19	20	21	22	25	26	29	33
Alkalinity	mg/l	48.6	48.7	47.2	46.3	46.2	45.6	45.5	45.8	47.2	48.7
NH_3-N	μg/l	6	6	15	6	11	16	18	33	< 5	30
NO_x-N	μg/l	557	561	588	596	581	588	622	646	661	723
Organic N	μg/l	577	544	535	438	478	491	517	508	594	460
Total N	μg/l	1140	1111	1138	1040	1070	1095	1157	1187	1258	1213
Ortho-P	μg/l	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1
Total P	μg/l	15	5	8	4	1	2	3	13	15	21
Color	Pt-Co	19	16	16	15	24	23	16	15	16	18
Sulfate	mg/l	28	27	31	39	29	29	29	28	28	29
Diss. Al	μg/l	30	36	32	19	22	23	24	25	26	26
Collection Date		5/15/99	5/17/99	5/18/99	5/19/99	5/20/99	5/21/99	5/24/99	5/25/99	5/28/99	6/1/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE OSCEOLA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 5 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)							
		34	35	36	39	41	43	54	64
Alkalinity	mg/l	49.6	48.2	48.7	46.5	48.7	49.4	53.9	48.8
NH_3-N	µg/l	43	13	10	< 5	< 5	< 5	< 5	< 5
NO_x-N	µg/l	753	769	780	841	766	734	820	1283
Organic N	µg/l	416	386	413	587	525	587	626	704
Total N	µg/l	1212	1168	1203	1431	1294	1326	1449	1990
Ortho-P	µg/l	4	2	3	4	4	4	6	3
Total P	µg/l	16	13	14	14	17	23	24	57
Color	Pt-Co	23	21	21	21	22	24	23	24
Sulfate	mg/l	29	27	25	25	28	28	32	30
Diss. Al	µg/l	22	22	22	20	19	19	18	18
Collection Date		6/2/99	6/3/99	6/4/99	6/7/99	6/9/99	6/11/99	6/22/99	7/2/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE OSCEOLA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 10 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	3	4	5	6	7	8	9
Alkalinity	mg/l	43.7	44.5	44.3	44.4	44.4	44.8	43.4	43.9	43.6	41.4
NH_3-N	μg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	μg/l	462	489	526	512	492	514	503	492	468	445
Organic N	μg/l	204	293	243	267	308	365	470	331	358	434
Total N	μg/l	669	785	772	782	803	882	976	826	829	882
Ortho-P	μg/l	5	5	2	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Total P	μg/l	21	56	18	15	16	19	8	7	6	4
Color	Pt-Co	14	13	15	9	14	15	15	15	15	13
Sulfate	mg/l	30	28	29	24	30	30	30	29	30	30
Diss. Al	μg/l	11	11	13	14	16	16	17	18	17	18
Collection Date		5/5/99	5/6/99	5/7/99	5/8/99	5/9/99	5/10/99	5/11/99	5/12/99	5/13/99	5/14/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE OSCEOLA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 10 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		16	18	19	20	21	22	25	26	29	33
Alkalinity	mg/l	42.9	42.3	40.5	40.1	41.3	39.6	41.6	41.8	44.2	49.1
NH_3-N	µg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	36
NO_x-N	µg/l	447	445	476	483	458	451	446	451	452	438
Organic N	µg/l	524	568	598	549	418	432	432	441	457	315
Total N	µg/l	974	1016	1077	1035	879	886	881	895	912	789
Ortho-P	µg/l	< 1	< 1	1	< 1	< 1	< 1	2	3	2	3
Total P	µg/l	10	4	9	2	4	4	5	7	16	15
Color	Pt-Co	13	13	13	13	17	16	13	17	15	16
Sulfate	mg/l	30	29	33	36	32	31	32	32	31	32
Diss. Al	µg/l	19	21	21	23	18	19	20	21	22	25
Collection Date		5/15/99	5/17/99	5/18/99	5/19/99	5/20/99	5/21/99	5/24/99	5/25/99	5/28/99	6/1/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE OSCEOLA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 10 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)							
		34	35	36	39	41	43	54	64
Alkalinity	mg/l	48.5	47.7	49.0	49.6	50.7	53.0	54.7	59.0
NH_3-N	μg/l	9	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	μg/l	444	439	434	414	343	334	310	231
Organic N	μg/l	362	332	309	311	453	332	211	302
Total N	μg/l	815	774	746	728	799	672	524	539
Ortho-P	μg/l	8	6	7	7	3	3	3	2
Total P	μg/l	16	10	13	13	14	13	11	10
Color	Pt-Co	20	18	18	19	17	19	20	21
Sulfate	mg/l	32	28	28	27	31	32	30	32
Diss. Al	μg/l	20	21	23	22	18	19	19	19
Collection Date		6/2/99	6/3/99	6/4/99	6/7/99	6/9/99	6/11/99	6/22/99	7/2/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE OSCEOLA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 15 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	3	4	5	6	7	8	9
Alkalinity	mg/l	48.8	47.2	49.0	48.3	47.8	47.9	47.6	49.3	48.3	44.1
NH_3-N	μg/l	316	254	124	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	μg/l	163	291	523	583	532	511	479	435	393	362
Organic N	μg/l	263	352	286	368	406	385	389	391	411	619
Total N	μg/l	742	897	933	954	941	899	871	829	807	984
Ortho-P	μg/l	2	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Total P	μg/l	17	22	14	12	13	17	9	8	6	6
Color	Pt-Co	13	14	16	15	14	15	17	17	16	14
Sulfate	mg/l	28	28	30	30	30	30	30	29	30	30
Diss. Al	μg/l	13	17	15	18	18	18	18	18	20	19
Collection Date		5/5/99	5/6/99	5/7/99	5/8/99	5/9/99	5/10/99	5/11/99	5/12/99	5/13/99	5/14/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE OSCEOLA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 15 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		16	18	19	20	21	22	25	26	29	33
Alkalinity	mg/l	45.4	47.5	43.3	42.7	41.3	41.8	43.7	44.3	45.2	49.8
NH_3-N	µg/l	< 5	< 5	< 5	< 5	29	27	42	49	35	130
NO_x-N	µg/l	352	342	363	362	340	338	361	358	371	416
Organic N	µg/l	563	640	612	509	457	473	486	531	498	394
Total N	µg/l	918	985	978	874	826	838	889	938	904	940
Ortho-P	µg/l	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1	< 1
Total P	µg/l	8	6	6	12	10	11	8	12	15	12
Color	Pt-Co	14	14	14	14	20	21	15	24	15	16
Sulfate	mg/l	31	30	34	32	32	32	34	32	32	32
Diss. Al	µg/l	20	21	21	24	19	18	20	21	21	24
Collection Date		5/15/99	5/17/99	5/18/99	5/19/99	5/20/99	5/21/99	5/24/99	5/25/99	5/28/99	6/1/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE OSCEOLA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 15 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)							
		34	35	36	39	41	43	54	64
Alkalinity	mg/l	52.5	48.0	50.2	50.0	51.0	50.3	49.7	54.9
NH_3-N	µg/l	109	10	19	< 5	< 5	< 5	< 5	< 5
NO_x-N	µg/l	448	447	459	491	465	469	400	322
Organic N	µg/l	407	410	437	405	596	479	520	657
Total N	µg/l	964	867	915	899	1064	951	923	982
Ortho-P	µg/l	8	3	3	4	4	4	4	3
Total P	µg/l	15	9	13	16	12	18	20	16
Color	Pt-Co	21	17	20	21	22	21	22	22
Sulfate	mg/l	33	31	29	29	33	33	34	35
Diss. Al	µg/l	21	20	21	20	18	17	17	18
Collection Date		6/2/99	6/3/99	6/4/99	6/7/99	6/9/99	6/11/99	6/22/99	7/2/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE OSCEOLA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 20 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	3	4	5	6	7	8	9
Alkalinity	mg/l	52.3	51.4	53.7	53.2	52.1	53.0	53.5	54.8	54.6	50.7
NH_3-N	µg/l	1226	1194	1303	1299	1359	1336	1373	1376	1430	1430
NO_x-N	µg/l	< 5	< 5	14	40	92	50	74	84	102	104
Organic N	µg/l	174	486	99	239	241	430	504	497	478	463
Total N	µg/l	1403	1683	1416	1578	1692	1816	1951	1957	2010	1997
Ortho-P	µg/l	2	3	2	3	3	2	3	2	2	1
Total P	µg/l	18	30	15	13	17	12	6	7	7	6
Color	Pt-Co	13	14	15	18	17	15	17	18	18	15
Sulfate	mg/l	29	29	29	31	30	30	29	28	29	30
Diss. Al	µg/l	12	14	15	19	20	20	21	19	21	22
Collection Date		5/5/99	5/6/99	5/7/99	5/8/99	5/9/99	5/10/99	5/11/99	5/12/99	5/13/99	5/14/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE OSCEOLA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 20 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		16	18	19	20	21	22	25	26	29	33
Alkalinity	mg/l	52.5	52.7	46.9	48.5	49.2	45.0	43.7	43.8	40.5	42.5
NH_3-N	µg/l	1484	1373	1391	1360	1248	1192	877	686	258	56
NO_x-N	µg/l	140	194	277	316	370	428	760	880	1152	1272
Organic N	µg/l	431	569	562	406	384	546	481	522	588	731
Total N	µg/l	2055	2136	2230	2082	2002	2166	2118	2088	1998	2059
Ortho-P	µg/l	3	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1	1
Total P	µg/l	9	6	8	4	9	7	8	14	18	22
Color	Pt-Co	19	16	15	15	19	17	11	18	15	17
Sulfate	mg/l	34	30	33	32	32	32	32	33	33	35
Diss. Al	µg/l	24	26	24	23	20	18	21	23	22	25
Collection Date		5/15/99	5/17/99	5/18/99	5/19/99	5/20/99	5/21/99	5/24/99	5/25/99	5/28/99	6/1/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE OSCEOLA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 20 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)							
		34	35	36	39	41	43	54	64
Alkalinity	mg/l	43.5	42.0	42.9	43.9	45.6	49.6	53.0	56.1
NH_3-N	μg/l	21	8	9	< 5	< 5	< 5	< 5	< 5
NO_x-N	μg/l	1246	1288	1260	1275	1105	829	768	588
Organic N	μg/l	563	594	596	593	517	297	421	911
Total N	μg/l	1830	1890	1865	1871	1625	1126	1192	1502
Ortho-P	μg/l	1	2	2	5	4	4	4	3
Total P	μg/l	19	26	30	31	17	21	21	18
Color	Pt-Co	22	19	20	21	22	21	22	22
Sulfate	mg/l	35	31	31	32	36	36	38	39
Diss. Al	μg/l	20	21	22	20	18	18	18	18
Collection Date		6/2/99	6/3/99	6/4/99	6/7/99	6/9/99	6/11/99	6/22/99	7/2/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MAITLAND SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 5 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	3	4	5	6	7	8	9
Alkalinity	mg/l	46.9	44.6	44.7	44.2	42.2	41.9	42.0	41.4	40.5	36.8
NH_3-N	μg/l	638	629	633	580	373	347	< 5	< 5	< 5	< 5
NO_x-N	μg/l	79	46	83	202	444	545	869	866	783	802
Organic N	μg/l	538	257	287	259	350	404	320	329	442	393
Total N	μg/l	1255	932	1003	1041	1167	1296	1192	1198	1228	1198
Ortho-P	μg/l	2	4	3	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Total P	μg/l	32	22	21	22	23	17	12	6	8	9
Color	Pt-Co	14	14	13	15	14	14	16	17	17	15
Sulfate	mg/l	30	28	28	30	30	30	29	28	30	29
Diss. Al	μg/l	14	13	15	22	20	22	20	21	23	23
Collection Date		5/5/99	5/6/99	5/7/99	5/8/99	5/9/99	5/10/99	5/11/99	5/12/99	5/13/99	5/14/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MAITLAND SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 5 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		16	18	19	20	21	22	25	26	29	33
Alkalinity	mg/l	38.0	35.8	33.3	34.0	34.1	31.2	32.0	32.1	32.0	33.2
NH_3-N	µg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	µg/l	793	767	760	744	709	696	645	643	602	648
Organic N	µg/l	450	745	467	491	486	366	480	472	539	402
Total N	µg/l	1246	1515	1230	1238	1198	1065	1138	1124	1144	1063
Ortho-P	µg/l	< 1	< 1	< 1	3	2	2	2	2	< 1	2
Total P	µg/l	12	7	18	10	13	12	12	14	17	18
Color	Pt-Co	15	15	15	15	19	17	14	14	16	18
Sulfate	mg/l	29	29	33	31	31	31	31	31	31	32
Diss. Al	µg/l	26	29	26	19	18	18	19	20	20	21
Collection Date		5/15/99	5/17/99	5/18/99	5/19/99	5/20/99	5/21/99	5/24/99	5/25/99	5/28/99	6/1/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS
CONDUCTED ON LAKE MAITLAND SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 5 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)							
		34	35	36	39	41	43	54	64
Alkalinity	mg/l	33.4	32.8	31.9	33.3	34.7	36.8	38.3	38.3
NH_3-N	μg/l	68	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	μg/l	732	666	670	678	616	592	519	452
Organic N	μg/l	433	372	410	369	483	482	405	441
Total N	μg/l	1233	1041	1083	1050	1102	1077	933	896
Ortho-P	μg/l	8	5	5	6	4	4	5	4
Total P	μg/l	17	12	21	16	18	17	22	27
Color	Pt-Co	22	19	19	21	21	21	23	22
Sulfate	mg/l	31	27	27	28	33	33	35	36
Diss. Al	μg/l	18	18	15	17	16	16	17	17
Collection Date		6/2/99	6/3/99	6/4/99	6/7/99	6/9/99	6/11/99	6/22/99	7/2/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MAITLAND SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 10 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	3	4	5	6	7	8	9
Alkalinity	mg/l	52.1	52.6	53.7	52.3	52.0	51.8	51.2	52.3	51.7	50.0
NH_3-N	μg/l	861	891	819	366	13	< 5	< 5	< 5	< 5	< 5
NO_x-N	μg/l	< 5	96	214	772	1214	1223	1195	1176	1077	1116
Organic N	μg/l	472	298	324	79	< 30	339	270	365	423	383
Total N	μg/l	1336	1285	1357	1217	1229	1565	1468	1544	1503	1502
Ortho-P	μg/l	5	6	5	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Total P	μg/l	30	27	23	19	19	24	12	12	10	13
Color	Pt-Co	14	16	14	17	16	17	17	18	17	14
Sulfate	mg/l	28	28	27	29	29	29	28	28	29	28
Diss. Al	μg/l	14	15	16	16	18	18	19	19	20	20
Collection Date		5/5/99	5/6/99	5/7/99	5/8/99	5/9/99	5/10/99	5/11/99	5/12/99	5/13/99	5/14/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MAITLAND SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 10 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		16	18	19	20	21	22	25	26	29	33
Alkalinity	mg/l	50.7	48.8	45.7	46.6	46.9	46.2	46.1	46.5	49.9	53.1
NH_3-N	μg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	μg/l	1108	1067	1018	1014	978	980	964	953	899	907
Organic N	μg/l	354	444	497	430	476	444	482	535	497	491
Total N	μg/l	1465	1514	1518	1447	1457	1427	1449	1491	1399	1401
Ortho-P	μg/l	< 1	2	3	2	3	4	2	2	2	6
Total P	μg/l	13	8	9	8	11	5	6	7	8	17
Color	Pt-Co	16	15	15	15	20	24	15	13	16	18
Sulfate	mg/l	29	28	31	32	30	30	29	30	29	30
Diss. Al	μg/l	20	21	22	21	20	19	22	21	19	24
Collection Date		5/15/99	5/17/99	5/18/99	5/19/99	5/20/99	5/21/99	5/24/99	5/25/99	5/28/99	6/1/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MAITLAND SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 10 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)							
		34	35	36	39	41	43	54	64
Alkalinity	mg/l	54.3	53.2	53.3	54.8	54.0	54.7	57.3	59.1
NH_3-N	μg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	μg/l	908	922	927	944	897	886	814	717
Organic N	μg/l	327	346	381	579	484	504	280	400
Total N	μg/l	1238	1271	1311	1526	1384	1393	1097	1120
Ortho-P	μg/l	10	8	7	8	5	4	3	2
Total P	μg/l	15	18	14	16	15	14	14	17
Color	Pt-Co	22	20	20	20	22	21	21	21
Sulfate	mg/l	30	26	25	26	30	30	31	32
Diss. Al	μg/l	23	24	23	22	18	18	18	18
Collection Date		6/2/99	6/3/99	6/4/99	6/7/99	6/9/99	6/11/99	6/22/99	7/2/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MAITLAND SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 15 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	3	4	5	6	7	8	9
Alkalinity	mg/l	43.5	43.7	44.8	48.4	44.7	47.5	47.0	47.9	44.5	43.6
NH_3-N	µg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	µg/l	242	260	269	297	296	308	309	301	298	281
Organic N	µg/l	166	146	254	241	273	359	374	373	442	420
Total N	µg/l	411	409	534	579	587	699	695	677	743	704
Ortho-P	µg/l	7	7	8	2	4	9	7	8	8	7
Total P	µg/l	21	19	22	19	17	25	9	9	9	9
Color	Pt-Co	14	15	14	16	22	15	16	18	18	15
Sulfate	mg/l	29	28	28	30	31	29	30	29	30	29
Diss. Al	µg/l	12	12	13	17	17	16	17	17	19	19
Collection Date		5/5/99	5/6/99	5/7/99	5/8/99	5/9/99	5/10/99	5/11/99	5/12/99	5/13/99	5/14/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MAITLAND SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 15 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		16	18	19	20	21	22	25	26	29	33
Alkalinity	mg/l	43.7	45.6	42.2	42.4	43.4	38.1	43.0	42.3	44.3	46.9
NH_3-N	µg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	µg/l	275	292	321	329	313	317	338	318	299	330
Organic N	µg/l	398	454	401	382	418	399	546	675	526	521
Total N	µg/l	676	749	725	714	734	719	892	999	828	854
Ortho-P	µg/l	< 1	< 1	14	6	5	3	3	3	3	3
Total P	µg/l	11	8	15	6	9	5	8	9	13	19
Color	Pt-Co	15	14	14	14	19	18	13	13	16	18
Sulfate	mg/l	32	30	34	33	32	32	32	32	31	33
Diss. Al	µg/l	20	21	21	18	19	19	22	21	22	23
Collection Date		5/15/99	5/17/99	5/18/99	5/19/99	5/20/99	5/21/99	5/24/99	5/25/99	5/28/99	6/1/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MAITLAND SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 15 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)							
		34	35	36	39	41	43	54	64
Alkalinity	mg/l	47.9	46.4	45.7	46.4	47.6	48.0	50.5	54.1
NH_3-N	μg/l	< 5	< 5	< 5	15	13	6	8	6
NO_x-N	μg/l	323	327	324	318	196	164	185	112
Organic N	μg/l	321	296	390	288	454	393	238	340
Total N	μg/l	647	626	717	621	663	563	431	458
Ortho-P	μg/l	8	9	10	12	4	2	3	2
Total P	μg/l	19	16	16	16	15	11	10	9
Color	Pt-Co	21	19	19	19	19	19	19	19
Sulfate	mg/l	33	28	28	29	34	33	35	35
Diss. Al	μg/l	21	21	21	21	17	17	18	18
Collection Date		6/2/99	6/3/99	6/4/99	6/7/99	6/9/99	6/11/99	6/22/99	7/2/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MAITLAND SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 20 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	3	4	5	6	7	8	9
Alkalinity	mg/l	48.4	47.3	49.3	48.7	50.7	49.1	48.9	48.4	48.7	44.4
NH_3-N	μg/l	71	6	20	23	53	21	17	< 5	< 5	< 5
NO_x-N	μg/l	1184	1143	1174	1133	1124	1107	1109	1095	1018	999
Organic N	μg/l	35	74	248	280	264	359	273	346	434	493
Total N	μg/l	1290	1223	1442	1436	1441	1487	1399	1444	1455	1495
Ortho-P	μg/l	5	7	11	5	5	6	9	12	11	9
Total P	μg/l	30	29	34	25	30	30	14	16	14	19
Color	Pt-Co	14	17	16	15	16	17	18	18	17	15
Sulfate	mg/l	29	28	28	30	30	29	30	28	30	29
Diss. Al	μg/l	11	13	14	17	17	17	17	17	17	17
Collection Date		5/5/99	5/6/99	5/7/99	5/8/99	5/9/99	5/10/99	5/11/99	5/12/99	5/13/99	5/14/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MAITLAND SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 20 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)									
		16	18	19	20	21	22	25	26	29	33
Alkalinity	mg/l	44.9	45.4	43.8	44.4	44.1	40.4	42.7	44.1	44.5	48.0
NH_3-N	µg/l	< 5	< 5	5	< 5	< 5	< 5	< 5	< 5	< 5	34
NO_x-N	µg/l	1013	1024	1023	1041	1024	1019	1010	1007	999	918
Organic N	µg/l	469	567	524	498	572	383	477	567	530	569
Total N	µg/l	1485	1594	1550	1542	1599	1426	1495	1581	1532	1521
Ortho-P	µg/l	9	11	19	14	12	8	15	17	19	20
Total P	µg/l	20	17	31	20	18	10	16	51	40	30
Color	Pt-Co	16	16	15	14	20	17	11	12	15	17
Sulfate	mg/l	31	28	33	32	32	32	31	32	32	33
Diss. Al	µg/l	18	19	18	27	18	17	18	18	20	21
Collection Date		5/15/99	5/17/99	5/18/99	5/19/99	5/20/99	5/21/99	5/24/99	5/25/99	5/28/99	6/1/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MAITLAND SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 20 ft

Incubation Conditions: Aerobic

PARAMETER	UNITS	INCUBATION TIME (days)							
		34	35	36	39	41	43	54	64
Alkalinity	mg/l	48.1	45.2	48.0	47.5	47.0	48.2	49.1	51.0
NH_3-N	µg/l	< 5	< 5	< 5	< 5	< 5	< 5	31	17
NO_x-N	µg/l	909	927	913	931	765	752	887	805
Organic N	µg/l	411	312	411	333	504	428	356	506
Total N	µg/l	1323	1252	1334	1267	1272	1183	1274	1328
Ortho-P	µg/l	17	19	22	23	14	16	20	23
Total P	µg/l	30	27	31	32	23	30	38	37
Color	Pt-Co	22	20	18	23	22	20	22	21
Sulfate	mg/l	32	29	28	29	34	34	35	36
Diss. Al	µg/l	18	18	19	18	16	16	17	16
Collection Date		6/2/99	6/3/99	6/4/99	6/7/99	6/9/99	6/11/99	6/22/99	7/2/99

B.2 Chemical Characteristics of Isolation Experiments Conducted Under Anoxic Conditions

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE VIRGINIA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 5 ft

Incubation Conditions: Anoxic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	6	7	8	9	10	14	17
Alkalinity	mg/l	47.2	46.1	46.6	48.5	48.1	49.6	48.1	51.5	49.1	52.0
NH_3-N	μg/l	95	74	104	134	180	192	144	< 5	< 5	18
NO_x-N	μg/l	< 5	14	10	93	118	92	163	298	321	308
Organic N	μg/l	431	605	526	466	401	464	449	449	423	388
Total N	μg/l	528	693	640	694	698	748	756	750	747	714
Ortho-P	μg/l	3	3	11	13	19	20	22	22	18	19
Total P	μg/l	54	164	40	46	28	29	29	28	28	34
Color	Pt-Co	22	23	22	22	22	23	24	24	23	24
Sulfate	mg/l	27	26	26	25	26	25	26	25	26	26
Diss. Al	μg/l	16	15	16	15	14	14	13	14	14	15
Collection Date		7/13/99	7/14/99	7/15/99	7/19/99	7/20/99	7/21/99	7/22/99	7/23/99	7/27/99	7/30/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE VIRGINIA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 10 ft

Incubation Conditions: Anoxic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	6	7	8	9	10	14	17
Alkalinity	mg/l	45.6	46.3	46.7	45.2	46.4	46.4	44.7	45.4	45.5	47.7
NH_3-N	µg/l	55	57	179	21	< 5	< 5	< 5	< 5	< 5	< 5
NO_x-N	µg/l	< 5	< 5	10	86	154	173	188	202	201	172
Organic N	µg/l	453	564	525	546	463	447	491	426	406	411
Total N	µg/l	510	623	714	653	620	623	682	631	610	586
Ortho-P	µg/l	2	3	13	14	16	19	20	20	13	10
Total P	µg/l	69	69	60	41	27	26	25	24	22	31
Color	Pt-Co	22	23	24	23	23	27	23	23	25	25
Sulfate	mg/l	27	27	26	25	26	26	26	26	26	26
Diss. Al	µg/l	17	15	16	17	13	13	13	13	16	19
Collection Date		7/13/99	7/14/99	7/15/99	7/19/99	7/20/99	7/21/99	7/22/99	7/23/99	7/27/99	7/30/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE VIRGINIA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 15 ft

Incubation Conditions: Anoxic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	6	7	8	9	10	14	17
Alkalinity	mg/l	49.0	45.3	47.9	48.0	46.2	46.8	45.7	46.1	45.7	50.0
NH_3-N	μg/l	715	8	94	72	< 5	< 5	< 5	< 5	< 5	26
NO_x-N	μg/l	15	89	117	205	319	334	350	371	372	347
Organic N	μg/l	1114	633	564	482	458	445	430	421	502	398
Total N	μg/l	1844	730	775	759	780	782	783	795	877	771
Ortho-P	μg/l	24	6	20	23	30	37	38	38	28	26
Total P	μg/l	215	74	49	49	39	44	44	45	48	45
Color	Pt-Co	31	23	24	23	23	23	23	23	23	23
Sulfate	mg/l	28	26	27	26	26	26	26	26	27	26
Diss. Al	μg/l	13	14	15	15	13	13	12	13	15	15
Collection Date		7/13/99	7/14/99	7/15/99	7/19/99	7/20/99	7/21/99	7/22/99	7/23/99	7/27/99	7/30/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE VIRGINIA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 20 ft

Incubation Conditions: Anoxic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	6	7	8	9	10	14	17
Alkalinity	mg/l	49.3	47.6	50.7	49.2	47.8	48.0	47.5	47.3	46.2	48.5
NH_3-N	µg/l	336	286	464	233	< 5	7	< 5	< 5	< 5	18
NO_x-N	µg/l	10	59	61	294	323	249	333	406	245	181
Organic N	µg/l	603	780	573	488	628	653	587	408	426	411
Total N	µg/l	950	1125	1098	1015	953	909	923	817	674	610
Ortho-P	µg/l	5	26	27	26	22	23	24	24	20	22
Total P	µg/l	81	105	60	44	36	37	31	32	34	49
Color	Pt-Co	22	25	25	22	22	21	22	22	23	24
Sulfate	mg/l	26	26	26	26	26	26	25	26	26	26
Diss. Al	µg/l	16	15	15	16	12	12	12	12	14	14
Collection Date		7/13/99	7/14/99	7/15/99	7/19/99	7/20/99	7/21/99	7/22/99	7/23/99	7/27/99	7/30/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MIZELL SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 5 ft

Incubation Conditions: Anoxic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	6	7	8	9	10	14	17
Alkalinity	mg/l	46.0	43.9	44.0	43.1	44.3	42.4	43.3	43.1	41.7	42.6
NH_3-N	μg/l	47	108	157	295	333	365	379	372	207	6
NO_x-N	μg/l	< 5	8	< 5	< 5	< 5	< 5	7	21	246	433
Organic N	μg/l	555	628	558	481	468	739	689	603	495	442
Total N	μg/l	605	744	717	778	804	1107	1075	996	948	881
Ortho-P	μg/l	2	9	12	17	21	23	25	28	20	20
Total P	μg/l	86	92	54	37	57	32	33	30	27	37
Color	Pt-Co	23	26	25	21	23	24	24	23	22	23
Sulfate	mg/l	28	28	28	27	28	28	28	28	27	27
Diss. Al	μg/l	20	18	20	20	17	15	16	16	18	16
Collection Date		7/13/99	7/14/99	7/15/99	7/19/99	7/20/99	7/21/99	7/22/99	7/23/99	7/27/99	7/30/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MIZELL SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 10 ft

Incubation Conditions: Anoxic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	6	7	8	9	10	14	17
Alkalinity	mg/l	44.2	44.8	44.3	43.9	45.2	44.1	44.3	44.7	44.1	46.2
NH_3-N	μg/l	26	51	96	309	365	410	444	484	566	676
NO_x-N	μg/l	5	13	8	< 5	< 5	< 5	< 5	10	24	8
Organic N	μg/l	492	581	535	477	437	469	526	505	437	441
Total N	μg/l	522	645	640	788	805	882	973	999	1027	1125
Ortho-P	μg/l	3	4	4	6	8	12	11	10	9	10
Total P	μg/l	47	69	39	29	39	19	21	17	15	31
Color	Pt-Co	25	24	22	21	21	22	21	20	20	23
Sulfate	mg/l	29	29	28	28	27	28	31	30	28	28
Diss. Al	μg/l	19	17	19	19	18	16	18	19	19	19
Collection Date		7/13/99	7/14/99	7/15/99	7/19/99	7/20/99	7/21/99	7/22/99	7/23/99	7/27/99	7/30/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MIZELL SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 15 ft

Incubation Conditions: Anoxic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	6	7	8	9	10	14	17
Alkalinity	mg/l	45.1	45.3	45.1	43.6	43.8	43.2	43.3	43.5	42.0	45.0
NH_3-N	μg/l	134	177	242	448	524	583	604	673	836	966
NO_x-N	μg/l	23	17	13	9	< 5	< 5	< 5	< 5	23	7
Organic N	μg/l	707	601	580	496	458	457	528	525	426	470
Total N	μg/l	864	795	835	953	985	1043	1135	1201	1285	1443
Ortho-P	μg/l	3	4	4	5	7	9	11	10	14	12
Total P	μg/l	67	59	41	32	36	17	21	13	19	25
Color	Pt-Co	20	24	24	19	19	20	19	18	18	20
Sulfate	mg/l	29	29	29	30	30	30	31	31	32	31
Diss. Al	μg/l	20	19	20	21	19	18	15	14	22	22
Collection Date		7/13/99	7/14/99	7/15/99	7/19/99	7/20/99	7/21/99	7/22/99	7/23/99	7/27/99	7/30/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MIZELL SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 20 ft

Incubation Conditions: Anoxic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	6	7	8	9	10	14	17
Alkalinity	mg/l	44.8	45.0	44.1	43.1	43.5	39.7	42.1	42.2	38.4	39.7
NH_3-N	μg/l	47	115	235	385	424	477	511	504	190	158
NO_x-N	μg/l	15	10	< 5	< 5	8	10	13	41	202	363
Organic N	μg/l	543	593	537	453	431	466	506	499	671	456
Total N	μg/l	605	717	776	840	863	953	1030	1044	1063	977
Ortho-P	μg/l	3	3	3	5	7	12	14	14	20	18
Total P	μg/l	62	54	44	27	36	17	20	17	15	25
Color	Pt-Co	20	22	22	20	20	21	20	20	20	19
Sulfate	mg/l	29	29	29	30	30	31	31	30	32	31
Diss. Al	μg/l	16	17	17	19	15	14	12	12	15	17
Collection Date		7/13/99	7/14/99	7/15/99	7/19/99	7/20/99	7/21/99	7/22/99	7/23/99	7/27/99	7/30/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE OSCEOLA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 5 ft

Incubation Conditions: Anoxic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	6	7	8	9	10	14	17
Alkalinity	mg/l	46.4	47.1	47.3	48.8	47.8	49.4	48.5	48.3	50.2	52.3
NH_3-N	µg/l	243	63	139	53	21	24	20	5	< 5	104
NO_x-N	µg/l	28	77	122	137	175	173	195	203	175	80
Organic N	µg/l	848	601	547	529	501	493	496	480	468	499
Total N	µg/l	1118	741	808	720	698	690	711	688	646	683
Ortho-P	µg/l	7	11	13	15	16	20	19	17	9	13
Total P	µg/l	138	72	55	43	31	35	23	25	27	31
Color	Pt-Co	29	24	24	21	24	21	22	22	22	24
Sulfate	mg/l	27	26	26	26	25	25	26	25	24	24
Diss. Al	µg/l	14	16	16	15	12	12	14	12	14	15
Collection Date		7/13/99	7/14/99	7/15/99	7/19/99	7/20/99	7/21/99	7/22/99	7/23/99	7/27/99	7/30/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE OSCEOLA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 10 ft

Incubation Conditions: Anoxic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	6	7	8	9	10	14	17
Alkalinity	mg/l	47.6	46.3	46.8	47.7	48.3	48.1	48.0	47.3	47.4	50.6
NH_3-N	µg/l	410	68	107	152	158	176	183	186	100	129
NO_x-N	µg/l	< 5	< 5	< 5	< 5	13	17	69	20	89	78
Organic N	µg/l	1069	597	561	499	456	475	452	493	494	468
Total N	µg/l	1481	668	670	653	627	668	704	699	683	675
Ortho-P	µg/l	4	5	7	9	10	14	19	15	8	11
Total P	µg/l	176	75	63	38	21	24	25	25	25	30
Color	Pt-Co	29	24	24	23	24	25	26	26	27	36
Sulfate	mg/l	27	27	26	26	26	25	26	25	26	25
Diss. Al	µg/l	14	16	16	14	13	13	12	14	15	16
Collection Date		7/13/99	7/14/99	7/15/99	7/19/99	7/20/99	7/21/99	7/22/99	7/23/99	7/27/99	7/30/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE OSCEOLA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 15 ft

Incubation Conditions: Anoxic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	6	7	8	9	10	14	17
Alkalinity	mg/l	46.1	46.9	47.1	47.0	46.8	47.5	47.3	46.3	47.0	49.8
NH_3-N	µg/l	96	77	146	57	< 5	< 5	< 5	8	< 5	20
NO_x-N	µg/l	< 5	6	9	95	212	215	229	233	222	182
Organic N	µg/l	706	586	613	558	487	478	517	481	491	420
Total N	µg/l	805	669	767	709	702	696	749	722	716	622
Ortho-P	µg/l	4	8	9	16	18	19	22	21	18	22
Total P	µg/l	80	74	55	72	31	33	26	34	37	44
Color	Pt-Co	23	24	26	24	24	25	25	24	25	25
Sulfate	mg/l	25	27	27	26	26	26	27	26	26	26
Diss. Al	µg/l	15	15	16	14	12	12	14	12	13	14
Collection Date		7/13/99	7/14/99	7/15/99	7/19/99	7/20/99	7/21/99	7/22/99	7/23/99	7/27/99	7/30/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE OSCEOLA SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 20 ft

Incubation Conditions: Anoxic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	6	7	8	9	10	14	17
Alkalinity	mg/l	46.8	47.1	46.4	47.2	47.4	46.5	46.4	45.4	43.1	46.2
NH_3-N	µg/l	32	99	169	285	265	267	207	153	< 5	14
NO_x-N	µg/l	21	53	10	70	121	135	195	303	378	318
Organic N	µg/l	545	637	588	477	481	461	538	420	467	457
Total N	µg/l	598	788	768	832	867	863	940	876	848	789
Ortho-P	µg/l	3	9	19	25	27	28	31	31	28	28
Total P	µg/l	72	67	50	57	39	38	40	42	48	53
Color	Pt-Co	22	25	23	23	30	24	23	25	25	25
Sulfate	mg/l	27	27	27	27	27	27	27	27	27	28
Diss. Al	µg/l	16	16	15	14	14	14	16	13	15	17
Collection Date		7/13/99	7/14/99	7/15/99	7/19/99	7/20/99	7/21/99	7/22/99	7/23/99	7/27/99	7/30/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MAITLAND SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 5 ft

Incubation Conditions: Anoxic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	6	7	8	9	10	14	17
Alkalinity	mg/l	45.6	47.2	46.9	47.9	47.5	45.6	48.5	47.3	46.2	50.2
NH_3-N	µg/l	28	97	179	307	324	402	328	336	< 5	< 5
NO_x-N	µg/l	5	21	30	16	30	56	103	173	300	466
Organic N	µg/l	553	601	571	490	501	413	501	429	640	433
Total N	µg/l	587	719	780	813	855	871	932	938	943	902
Ortho-P	µg/l	3	6	9	12	15	18	21	20	19	19
Total P	µg/l	53	64	55	42	41	30	30	30	29	38
Color	Pt-Co	22	23	25	22	22	26	23	23	22	22
Sulfate	mg/l	26	27	26	25	26	26	25	25	26	26
Diss. Al	µg/l	16	15	16	14	14	14	14	13	12	12
Collection Date		7/13/99	7/14/99	7/15/99	7/19/99	7/20/99	7/21/99	7/22/99	7/23/99	7/27/99	7/30/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MAITLAND SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 10 ft

Incubation Conditions: Anoxic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	6	7	8	9	10	14	17
Alkalinity	mg/l	47.5	47.1	47.2	48.3	48.9	40.7	50.0	49.7	50.2	52.9
NH_3-N	μg/l	145	63	91	287	346	428	433	460	530	504
NO_x-N	μg/l	< 5	31	40	< 5	5	7	11	34	50	174
Organic N	μg/l	703	578	607	472	489	460	476	457	399	435
Total N	μg/l	850	672	738	761	840	895	920	951	979	1113
Ortho-P	μg/l	4	7	6	28	30	35	38	37	37	40
Total P	μg/l	88	63	53	53	51	55	56	50	46	59
Color	Pt-Co	24	24	23	23	22	24	23	23	23	24
Sulfate	mg/l	27	26	26	25	26	26	26	25	25	25
Diss. Al	μg/l	15	17	16	14	13	14	15	13	15	15
Collection Date		7/13/99	7/14/99	7/15/99	7/19/99	7/20/99	7/21/99	7/22/99	7/23/99	7/27/99	7/30/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MAITLAND SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 15 ft

Incubation Conditions: Anoxic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	6	7	8	9	10	14	17
Alkalinity	mg/l	46.7	45.0	46.6	46.8	45.7	45.6	46.0	45.1	45.8	48.6
NH_3-N	μg/l	44	39	57	119	146	144	166	201	210	239
NO_x-N	μg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	27	43
Organic N	μg/l	512	548	481	485	455	477	477	442	408	382
Total N	μg/l	559	589	541	606	604	624	646	646	645	664
Ortho-P	μg/l	3	2	13	17	21	24	25	27	26	29
Total P	μg/l	62	45	32	40	35	34	34	33	33	48
Color	Pt-Co	22	24	23	23	23	24	24	25	24	26
Sulfate	mg/l	27	27	26	26	26	26	26	25	26	25
Diss. Al	μg/l	15	15	16	14	12	15	13	15	17	18
Collection Date		7/13/99	7/14/99	7/15/99	7/19/99	7/20/99	7/21/99	7/22/99	7/23/99	7/27/99	7/30/99

CHEMICAL CHARACTERISTICS OF ISOLATION EXPERIMENTS CONDUCTED ON LAKE MAITLAND SEDIMENT CORE SAMPLES

Water Depth at Sediment Core: 20 ft

Incubation Conditions: Anoxic

PARAMETER	UNITS	INCUBATION TIME (days)									
		0	1	2	6	7	8	9	10	14	17
Alkalinity	mg/l	49.3	49.6	50.2	50.5	49.8	49.8	50.2	49.8	47.6	49.7
NH_3-N	μg/l	231	368	458	499	362	478	503	391	< 5	28
NO_x-N	μg/l	30	85	65	101	239	193	205	362	490	544
Organic N	μg/l	599	737	662	559	590	524	496	387	530	407
Total N	μg/l	860	1189	1185	1159	1191	1195	1204	1140	1023	979
Ortho-P	μg/l	3	17	18	25	41	45	48	47	35	34
Total P	μg/l	65	95	73	60	50	55	50	49	46	60
Color	Pt-Co	22	27	25	23	23	24	24	24	24	24
Sulfate	mg/l	26	26	25	25	26	26	26	25	26	26
Diss. Al	μg/l	15	15	15	15	12	12	13	12	14	14
Collection Date		7/13/99	7/14/99	7/15/99	7/19/99	7/20/99	7/21/99	7/22/99	7/23/99	7/27/99	7/30/99

B.3 Calculations for Estimation of Phosphorus Inputs from Internal Recycling

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Lake Virginia

Interval Depth (ft)	% < 2 mg/L	Contour Area (ac)	Ortho P Release Rate (µg/day-ft²)					kg/yr
			5	10	15	20	>20	
0	0.0%	2.4	1.303	---	---	---	---	0.1
1	0.0%	4.8	1.303	---	---	---	---	0.1
2	0.0%	5.0	1.303	---	---	---	---	0.1
3	0.0%	1.8	1.303	---	---	---	---	0.0
4	0.0%	1.3	1.303	---	---	---	---	0.0
5	0.0%	1.2	1.303	---	---	---	---	0.0
6	0.0%	3.7	---	0.759	---	---	---	0.0
7	0.0%	3.7	---	1.518	---	---	---	0.1
8	0.5%	1.3	---	2.296	---	---	---	0.0
9	0.6%	1.1	---	3.067	---	---	---	0.1
10	1.4%	2.7	---	3.875	---	---	---	0.2
11	5.5%	6.6	---	---	1.443	---	---	0.2
12	13.3%	7.4	---	---	3.125	---	---	0.4
13	24.5%	3.7	---	---	5.202	---	---	0.3
14	35.5%	5.6	---	---	7.609	---	---	0.7
15	45.1%	16.2	---	---	10.246	---	---	2.6
16	50.3%	43.7	---	---	---	38.411	---	26.7
17	60.6%	23.0	---	---	---	91.118	---	33.3
18	74.4%	11.5	---	---	---	165.351	---	30.2
19	89.6%	77.7	---	---	---	262.579	---	324.2
	Total	224					Total	419.2

Lake Osceola

Interval Depth (ft)	% < 2 mg/L	Contour Area (ac)	Ortho P Release Rate (µg/day-ft²)					kg/yr
			5	10	15	20	>20	
0	0.0%	2.4	0.000	---	---	---	---	0.0
1	0.0%	4.8	0.000	---	---	---	---	0.0
2	0.0%	5.2	0.000	---	---	---	---	0.0
3	0.0%	2.4	0.000	---	---	---	---	0.0
4	0.0%	1.5	0.000	---	---	---	---	0.0
5	0.0%	2.0	0.000	---	---	---	---	0.0
6	0.0%	3.8	---	0.000	---	---	---	0.0
7	0.0%	4.0	---	0.000	---	---	---	0.0
8	0.0%	2.1	---	0.000	---	---	---	0.0
9	1.6%	1.1	---	0.058	---	---	---	0.0
10	3.7%	1.5	---	0.171	---	---	---	0.0
11	6.6%	3.3	---	---	0.322	---	---	0.0
12	12.5%	3.1	---	---	1.139	---	---	0.1
13	21.1%	1.6	---	---	2.800	---	---	0.1
14	30.4%	3.7	---	---	5.296	---	---	0.3
15	38.7%	3.7	---	---	8.354	---	---	0.5
16	43.3%	11.3	---	---	---	3.738	---	0.7
17	47.6%	7.0	---	---	---	8.116	---	0.9
18	51.8%	3.5	---	---	---	13.099	---	0.7
19	53.9%	8.8	---	---	---	18.067	---	2.5
20	56.9%	26.5	---	---	---	23.693	---	10.0
21	62.3%	17.6	---	---	---	---	74.136	20.8
22	70.6%	17.6	---	---	---	---	83.641	23.5
23	80.4%	4.4	---	---	---	---	94.872	6.7
24	92.6%	8.8	---	---	---	---	108.792	15.3
25	100.0%	4.4	---	---	---	---	117.232	8.2
	Total	156					Total	90.1

Lake Mizell

Interval Depth (ft)	% < 2 mg/L	Contour Area (ac)	Ortho P Release Rate (µg/day-ft^2)					kg/yr
			5	10	15	20	>20	
0	0.0%	1.9	0.722	---	---	---	---	0.0
1	0.0%	3.7	0.722	---	---	---	---	0.0
2	0.0%	3.4	0.722	---	---	---	---	0.0
3	0.0%	2.4	0.722	---	---	---	---	0.0
4	0.0%	0.8	0.722	---	---	---	---	0.0
5	0.0%	1.5	0.722	---	---	---	---	0.0
6	0.0%	2.3	---	0.195	---	---	---	0.0
7	0.0%	2.2	---	0.391	---	---	---	0.0
8	0.0%	1.3	---	0.586	---	---	---	0.0
9	0.6%	0.8	---	0.846	---	---	---	0.0
10	1.8%	1.3	---	1.222	---	---	---	0.0
11	5.4%	2.1	---	---	0.173	---	---	0.0
12	9.7%	2.0	---	---	0.448	---	---	0.0
13	14.9%	1.0	---	---	0.850	---	---	0.0
14	21.9%	2.6	---	---	1.462	---	---	0.1
15	29.8%	9.5	---	---	2.289	---	---	0.3
16	39.8%	12.2	---	---	---	3.322	---	0.6
17	56.9%	5.3	---	---	---	9.497	---	0.8
18	79.0%	2.5	---	---	---	19.745	---	0.8
19	89.8%	7.3	---	---	---	29.902	---	3.5
	Total	**66**					**Total**	**6.4**

Lake Maitland

Interval Depth (ft)	% < 2 mg/L	Contour Area (ac)	Ortho P Release Rate (µg/day-ft^2)					kg/yr
			5	10	15	20	>20	
0	0.0%	9.7	0.283	---	---	---	---	0.0
1	0.0%	19.4	0.283	---	---	---	---	0.1
2	0.0%	20.0	0.283	---	---	---	---	0.1
3	0.0%	10.0	0.283	---	---	---	---	0.0
4	0.0%	0.5	0.283	---	---	---	---	0.0
5	0.0%	8.7	0.283	---	---	---	---	0.0
6	0.0%	16.7	---	0.261	---	---	---	0.1
7	0.0%	17.8	---	0.521	---	---	---	0.1
8	0.5%	8.3	---	0.818	---	---	---	0.1
9	0.6%	12.5	---	1.101	---	---	---	0.2
10	1.4%	14.3	---	1.457	---	---	---	0.3
11	5.5%	32.8	---	---	1.637	---	---	0.9
12	13.3%	33.0	---	---	3.677	---	---	1.9
13	24.5%	16.6	---	---	6.385	---	---	1.7
14	35.5%	19.4	---	---	9.650	---	---	3.0
15	45.1%	31.6	---	---	13.302	---	---	6.7
16	50.3%	62.1	---	---	---	8.265	---	8.2
17	60.6%	32.0	---	---	---	19.126	---	9.7
18	74.4%	15.3	---	---	---	33.896	---	8.3
19	89.6%	69.1	---	---	---	52.844	---	58.0
20	100.0%	6.2	---	---	---	72.633	---	7.2
21	100.0%	12.4	---	---	---	---	173.724	34.3
22	100.0%	0.8	---	---	---	---	173.724	2.3
23	100.0%	0.4	---	---	---	---	173.724	1.1
24	100.0%	0.3	---	---	---	---	173.724	0.8
25	100.0%	0.1	---	---	---	---	173.724	0.3
	Total	**470**					**Total**	**145.4**

APPENDIX C

MONTHLY HYDROLOGIC BUDGETS FOR THE WINTER PARK CHAIN-OF-LAKES

Estimated Monthly Hydrologic Budget for Lake Virginia

Month	Rainfall (inches)	Hydrologic Inputs (ac-ft): Direct Prec.	Runoff	Lk Sue + Mizell	Seepage	Total Inputs	Pan Evap. (inches)	Hydrologic Losses (ac-ft): Lake Evap.	Deep Recharge	Outflow to Osc.	Total	Detention Time (days)
January	2.45	45.7	73.4	202	17.8	339	3.47	45.3	52.3	241	339	311
February	2.41	45.0	72.2	196	16.1	330	4.21	55.0	47.3	227	330	289
March	3.96	73.9	118.7	329	17.8	539	6.26	81.8	52.3	405	539	195
April	3.18	59.4	95.3	253	17.3	425	7.60	99.3	50.6	275	425	240
May	3.15	58.8	94.4	247	17.8	418	8.47	110.7	52.3	255	418	252
June	6.83	127.5	204.7	586	17.3	935	7.65	100.0	50.6	785	935	109
July	7.08	132.2	212.2	611	23.7	979	7.57	98.9	52.3	828	979	108
August	6.54	122.1	196.0	563	23.7	905	7.16	93.6	52.3	759	905	116
September	5.98	111.6	179.3	516	22.9	830	6.28	82.1	50.6	697	830	123
October	3.11	58.1	93.2	257	23.7	432	5.51	72.0	52.3	308	432	244
November	3.00	56.0	89.9	253	22.9	422	3.98	52.0	50.6	319	422	242
December	1.85	34.5	55.5	148	17.8	256	3.22	42.1	52.3	162	256	411
Totals:	49.54	925	1485	4161	239	6810	71.38	933	616	5261	6810	220
Percent of Total:		13.6	21.8	61.1	3.5			13.7	9.0	77.3		

Lake Surface Area (acres):	224	Annual Runoff Volume (ac-ft\yr):	1485
Lake Sue Inflow (ac-ft\yr):	4078	Wet Season Seepage (ac-ft\day):	0.765
Dry Season Seepage (ac-ft\day):	0.575	Deep Aquifer Loss (in/yr):	33
Lake Volume (ac-ft):	3398	Pan Evaporation Coefficient:	0.7

Estimated Monthly Hydrologic Budget for Lake Mizell

Month	Rainfall (inches)	Hydrologic Inputs (ac-ft) Direct Prec.	Runoff	Baseflow	Seepage	Total Inputs	Pan Evap. (inches)	Hydrologic Losses (ac-ft) Lake Evap.	Deep Recharge	Outflow to Vir.	Total	Detention Time (days)
January	2.45	13.5	8.3	0	7.3	29	3.47	13.4	15.4	0	29	758
February	2.41	13.3	8.2	0	6.6	28	4.21	16.2	13.9	-2	28	711
March	3.96	21.8	13.4	0	7.3	43	6.26	24.1	15.4	3	43	519
April	3.18	17.5	10.8	0	7.1	35	7.60	29.3	14.9	-9	35	604
May	3.15	17.3	10.7	0	7.3	35	8.47	32.6	15.4	-13	35	625
June	6.83	37.6	23.2	0	7.1	68	7.65	29.5	14.9	23	68	315
July	7.08	38.9	24.0	0	9.9	73	7.57	29.1	15.4	28	73	303
August	6.54	36.0	22.2	0	9.9	68	7.16	27.6	15.4	25	68	324
September	5.98	32.9	20.3	0	9.6	63	6.28	24.2	14.9	24	63	340
October	3.11	17.1	10.5	0	9.9	38	5.51	21.2	15.4	1	38	587
November	3.00	16.5	10.2	0	9.6	36	3.98	15.3	14.9	6	36	589
December	1.85	10.2	6.3	0	7.3	24	3.22	12.4	15.4	-4	24	928
Totals:	49.54	272	168	0	99	539	71.38	275	182	83	539	550
Percent of Total:		50.5	31.1	0.0	18.4			50.9	33.6	15.4		

Lake Surface Area (acres):	66	Annual Runoff Volume (ac-ft\yr):	168
Annual Baseflow (ac-ft\yr):	0	Wet Season Seepage (ac-ft\day):	0.320
Dry Season Seepage (ac-ft\day):	0.236	Deep Aquifer Loss (in/yr):	33
Lake Volume (ac-ft):	712	Pan Evaporation Coefficient:	0.7

Estimated Monthly Hydrologic Budget for Lake Osceola

		Hydrologic Inputs (ac-ft)					Pan	Hydrologic Losses (ac-ft)				Detention
Month	Rainfall (inches)	Direct Prec.	Runoff	Virginia Inflow	Seepage	Total Inputs	Evap. (inches)	Lake Evap.	Deep Recharge	Outflow to Mait.	Total	Time (days)
January	2.45	31.9	52.8	241	26.6	353	3.47	31.6	36.4	285	353	145
February	2.41	31.3	51.9	227	24.0	335	4.21	38.3	32.9	263	335	138
March	3.96	51.5	85.3	405	26.6	569	6.26	57.0	36.4	475	569	90
April	3.18	41.3	68.5	275	25.7	411	7.60	69.2	35.3	306	411	121
May	3.15	41.0	67.8	255	26.6	390	8.47	77.1	36.4	277	390	131
June	6.83	88.8	147.1	785	25.7	1046	7.65	69.6	35.3	941	1046	47
July	7.08	92.0	152.5	828	79.8	1152	7.57	68.9	36.4	1047	1152	44
August	6.54	85.0	140.9	759	79.8	1065	7.16	65.2	36.4	964	1065	48
September	5.98	77.7	128.8	697	77.3	981	6.28	57.1	35.3	888	981	51
October	3.11	40.4	67.0	308	79.8	495	5.51	50.1	36.4	408	495	104
November	3.00	39.0	64.6	319	77.3	500	3.98	36.2	35.3	429	500	99
December	1.85	24.1	39.8	162	26.6	252	3.22	29.3	36.4	186	252	203
Totals:	49.54	644	1067	5261	576	7548	71.38	650	429	6470	7548	102
Percent of Total:		8.5	14.1	69.7	7.6			8.6	5.7	85.7		

Lake Surface Area (acres): 156

Annual Runoff Volume (ac-ft\yr): 1067

Annual Baseflow (ac-ft\yr): 0

Wet Season Seepage (ac-ft\day): 2.575

Dry Season Seepage (ac-ft\day): 0.858

Deep Aquifer Loss (in/yr): 33

Lake Volume (ac-ft): 1653

Pan Evaporation Coefficient: 0.7

Estimated Monthly Hydrologic Budget for Lake Maitland

Month	Rainfall (inches)	Hydrologic Inputs (ac-ft) Direct Prec.	Runoff	Lake Inflow	Seepage	Total Inputs	Pan Evap. (inches)	Hydrologic Losses (ac-ft) Lake Evap.	Deep Recharge	Lake Outflow	Total	Detention Time (days)
January	2.45	96.0	89.5	361	44.3	591	3.47	95.1	110	386	591	281
February	2.41	94.4	88.0	339	40.0	561	4.21	115.4	99	346	561	267
March	3.96	155.1	144.6	599	44.3	943	6.26	171.6	110	661	943	176
April	3.18	124.6	116.1	405	42.9	689	7.60	208.4	106	374	689	233
May	3.15	123.4	115.0	375	44.3	657	8.47	232.2	110	315	657	252
June	6.83	267.5	249.4	1154	42.9	1714	7.65	209.7	106	1398	1714	94
July	7.08	277.3	258.5	1268	85.9	1889	7.57	207.5	110	1572	1889	88
August	6.54	256.2	238.8	1167	85.9	1748	7.16	196.3	110	1442	1748	95
September	5.98	234.2	218.4	1075	83.1	1611	6.28	172.2	106	1332	1611	100
October	3.11	121.8	113.6	505	85.9	827	5.51	151.1	110	566	827	201
November	3.00	117.5	109.5	522	83.1	832	3.98	109.1	106	617	832	193
December	1.85	72.5	67.6	244	44.3	428	3.22	88.3	110	230	428	387
Totals:	49.54	1940	1809	8014	727	12490	71.38	1957	1293	9241	12490	197
Percent of Total:		15.5	14.5	64.2	5.8			15.7	10.3	74.0		

Lake Surface Area (acres):	470	Annual Runoff Volume (ac-ft\yr):	1809
Park/Minnehaha Inflow (ac-ft\yr):	1544	Wet Season Seepage (ac-ft\day):	2.771
Dry Season Seepage (ac-ft\day):	1.429	Deep Aquifer Loss (in/yr):	33
Lake Volume (ac-ft):	5349	Pan Evaporation Coefficient:	0.7