WINTER PARK CHAIN-OF-LAKES
SEDIMENT AND GROUNDWATER STUDY

EXHIBIT A: SCOPE OF SERVICES

The Engineer shall, at a minimum, perform the following specific tasks:

A. Attend a project start-up meeting with the City of Winter Park to review the project objectives, the Engineer's Scope of Services, and the project schedule. Copies of previous studies conducted on the Winter Park Chain-of-Lakes by the City of Winter Park or other entities will be provided to the Engineer.

B. Review available hydrologic and nutrient information for Lake Virginia, Lake Osceola, Lake Mizell, and Lake Maitland. This information will include any reports or data provided by the City of Winter Park at the start-up meeting, and the report titled "Water Budgets, Water Quality and Analysis of Nutrient Loading of the Winter Park Chain-of-Lakes, Central Florida, 1989-1992" prepared by the US Geological Survey.

C. Install a total of 30 seepage meters in the four lakes to determine the quantity and quality of seepage entering Lake Virginia, Lake Osceola, Lake Mizell, and Lake Maitland. The seepage meters in each lake will be installed in shallow and deep areas and will include a wide range of land use and topographic characteristics in upland areas adjacent to seepage meters. An equilibration period of at least two weeks will be allowed following installation to purge trapped lake water from the seepage meters prior to collection of samples for analysis.

D. Estimate seepage volume and collect samples from each of the seepage meters every 2 weeks for a period of 16 weeks. Eight sampling events will be conducted at each of the 30 seepage meters, for a total of 240 measurements and samples collected for analysis. Four of these sampling events will occur during the wet seasons from mid-July to mid-September, and the remaining four sampling events will occur during the dry months from mid-September to mid-November. ERD may modify the monitoring schedule and/or add additional sample collection events to ensure that both wet and dry periods are considered in the evaluation. Water samples collected from the seepage meters will be analyzed for the following parameters:

1. pH
2. Specific Conductivity
3. Alkalinity
4. Ammonia Nitrogen
5. NO_x
6. Organic Nitrogen
7. Total Nitrogen
8. Orthophosphorus
9. Total Phosphorus

E. Direct measurements of internal recycling of phosphorus under oxic and anoxic conditions will be performed in each of the four lakes by collection of large diameter ($\sim$ 10 cm) sediment core samples from each lake. Four separate core samples will be collected from each lake (16 samples total) from a variety of water depths and sediment characteristics. The core samples will be returned to the ERD laboratory and incubated under both oxic and anoxic conditions. Sediment release of phosphorus will be measured in each core sample over time. For purposes of this proposal, a total of 5 total phosphorus tests are assumed per core sample under both oxic and anoxic conditions (160 samples total). The release rate information will be combined with historical dissolved oxygen measurements in the four lakes, performed by ERD, to evaluate phosphorus recycling on a seasonal basis based on the percentage of oxic and anoxic zones within the lake.

A standard lake bottom sediment core sample will also be collected at each of the 16 sites selected for collection of large diameter core samples. Visual characteristics of each sediment core will be recorded, and the 0-10 cm layer of the sediment core will be sectioned off and collected. Each core sample will be placed into a separate sample container and returned to the ERD research laboratory for analysis. Triplicate samples will be collected at each of the 16 sites and combined to form a composite for each sampling site. A total of 16 separate sediment samples will be generated during this process. Sediment core samples will be returned to the ERD research laboratory and analyzed for the following parameters:

1. Moisture Content
2. Organic Content
3. Sediment Density
4. Total Phosphorus
5. Total Nitrogen
6. Total Aluminum
7. Total Iron
8. pH

Each of the 16 core samples will also be tested using the Chang and Jackson phosphorus speciation technique. This technique divides sediment phosphorus associations into the following categories:

1. Saloid Phosphorus
2. Iron-Bound Phosphorus
3. Aluminum-Bound Phosphorus

The results of the sediment analyses and speciation procedure will be used to estimate the potential for internal recycling of nutrients from the sediments to the water column in Lake Virginia, Lake Osceola, Lake Mizell, and Lake Maitland.

F. Utilizing available hydrologic information including the USGS report from 1992, and the results of the seepage meter analyses, develop annualized hydrologic budgets for Lake Virginia, Lake Osceola, and Lake Maitland. The budgets will include inputs from precipitation, stormwater runoff, and baseflow, as outlined in the USGS report, and groundwater seepage determined by ERD.

G. Utilizing the hydrologic budgets, nutrient concentrations from the literature and from previous samples collected by ERD in the City of Winter Park, and nutrient concentrations from the seepage meter analyses and sediment analyses, develop annualized nutrient budgets for each lake. The nutrient budgets will include inputs from bulk precipitation, stormwater runoff, baseflow, groundwater seepage, and sediment internal recycling. Annualized nutrient budgets will be prepared for total phosphorus and total nitrogen for Lake Virginia, Lake Osceola, and Lake Maitland.

EXHIBIT A: SCOPE OF SERVICES
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H. Utilizing the estimated nutrient and hydrologic budgets, an interlinked spreadsheet-type phosphorus-limitation trophic state model will be developed for the Winter Park Chain-of-Lakes. The model will be calibrated by prediction of in-lake water quality based on the estimated nutrient and hydrologic budgets for Lake Virginia, Lake Osceola, and Lake Maitland. The predicted in-lake water quality including total phosphorus, total nitrogen, chlorophyll-a and Secchi disk depths will be compared to actual data available on these three lakes. ERD has previously monitored Lake Virginia and Lake Osceola for extended periods of time and information should be available from the City of Maitland for Lake Maitland.

If the actual in-lake water quality is different than the predicted in-lake water quality, the nutrient budgets will be evaluated and adjustments made so the predicted water quality conforms to the ambient water quality for Lake Virginia, Lake Osceola, and Lake Maitland. The model will be developed so that changes in stormwater loadings resulting from retrofit projects can be input to evaluate water quality improvements within the Chain-of-Lakes.

I. Prepare a Draft Report summarizing the project objectives, procedures, data, and results. Six copies of the Draft Report will be submitted to the City of Winter Park for review.

J. Once the City of Winter Park has had an opportunity to review the Draft Report, the Engineer will attend a review meeting to discuss any comments.

K: Based on the review comments received during the meeting with the City of Winter Park, a Final Report will be prepared incorporating any review comments. One unbound copy and six bound copies will be submitted to the City for their use.

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EXHIBIT B: MAN-HOUR / FEE SUMMARY

I. LABOR	MAN-HOURS*						COST ($)
TASK	PM	SE	T	CH	FT	CL	
A. Conduct project start-up meeting	2	--	--	--	--	--	
B. Review available hydrologic and nutrient information for Lake Virginia, Lake Osceola, Lake Mizell, and Lake Maitland	8	4	--	--	--	--	
C. Prepare and install a total of 30 seepage meters in the four lakes	16	16	--	--	24	--	
D. Collect seepage meter samples once every 3 weeks for 16 weeks (2 wet and 2 dry months) (6 sample events, 180 samples total)	60	--	--	--	60	8	
E. Collect 4 large diameter sediment core samples from each lake (16 core samples total) and incubate in lab under both oxic and anoxic conditions; collect 4 standard core samples in each lake (16 samples total)	16	--	--	32	16	4	
F. Utilizing available hydrologic information and the results of the seepage meter analyses, develop a revised hydrologic budget for each lake	6	12	--	--	--	4	
G. Utilizing available nutrient information and the results of the seepage meter and sediment analyses, develop a revised nutrient budget for each lake	12	12	--	--	--	4	
H. Prepare an interlinked trophic state model for the 4 lakes	40	--	--	--	--	--	
I. Prepare a Draft Report summarizing the project procedures, data and results; submit 6 copies for review	32	8	16	--	--	16	
J. Attend a review meeting to discuss review comments	4	--	--	--	--	--	
K. Prepare a Final Report incorporating review comments; submit 1 unbound and 6 bound copies	8	4	4	--	--	4	
LABOR TOTAL:	204	56	20	32	100	40	$26,060.00

II. LABORATORY EXPENSES		
A. Seepage Water Analysis:	180 samples x $75/sample	$13,500.00
B. Core Sample Phosphorus Analysis:	160 samples x $10/sample	1,600.00
C. Sediment Analyses:	16 samples x $77.50/sample	1,240.00
	LABORATORY EXPENSES TOTAL:	$16,340.00

III. REIMBURSABLE EXPENSES		
A. Seepage Meter Construction	30 meters x $100/meter	$ 3,000.00
B. Expendable Field Supplies		
1. Seepage Meter Sampling	$225/event x 8 events	1,800.00
2. Large Diameter Core Tubes		500.00
C. Copies	5000 copies x $0.06/copy	300.00
	REIMBURSABLE EXPENSES TOTAL:	$ 5,600.00
	PROJECT TOTAL:	**$48,000.00**

LEGEND:

PM:	Project Manager ($80/hr)	CH:	Chemist ($45/hr)
SE:	Senior Engineer ($50/hr)	FT:	Field Technician ($35/hr)
T:	Technician ($40/hr)	CL:	Clerical ($30/hr)

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EXHIBIT C: SCHEDULE

TASK	1998						1999		
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
A. Conduct project start-up meeting	*								
B. Review available hydrologic and nutrient information for Lake Virginia, Lake Osceola, Lake Mizell, and Lake Maitland									
C. Prepare and install a total of 30 seepage meters in the four lakes									
D. Collect seepage meter samples once every 3 weeks for 16 weeks (2 wet and 2 dry months) (6 sample events, 180 samples total)									
E. Collect 4 large diameter sediment core samples from each lake (16 core samples total) and incubate in lab under both oxic and anoxic conditions; collect 4 standard core samples in each lake (16 samples total)									
F. Utilizing available hydrologic information and the results of the seepage meter analyses, develop a revised hydrologic budget for each lake									
G. Utilizing available nutrient information and the results of the seepage meter and sediment analyses, develop a revised nutrient budget for each lake									
H. Prepare an interlinked trophic state model for the 4 lakes									
I. Prepare a Draft Report summarizing the project procedures, data and results; submit 6 copies for review									
J. Attend a review meeting to discuss review comments									*
K. Prepare a Final Report incorporating review comments; submit 1 unbound and 6 bound copies									