MEMORANDUM

TO: Melvin O. Hinson Jr., Division Manager
Environmental Resource Management Division

Steve Stecher, P.E., Section Manager
Water Research and Evaluation

FROM: Joan Balogh, Environmental Quality Specialist
Watershed Regulation and Management Section

DATE: December 6, 1993

SUBJECT: Results of soil survey and recommendations for sludge ponds at the future Spikerush Golf Course

Results of soil sample analyses from the decommissioned sludge ponds at the future Spikerush Golf Course site were reported to ECSD on November 23, 1993. The soil analyses data indicate high levels of total Kjeldahl nitrogen (TKN = organic-nitrogen + ammonia-nitrogen) and total organic carbon (TOC) throughout much of the upper 6 to 12 inches of soil in all three ponds. Elevated concentrations of nitrate-N (NO_3-N) were also found in surface and subsurface soils of all three ponds. The highest concentrations of TKN, NO_3-N and TOC were found in Pond 7. Table 1 (see attached data table) gives the results of soil analyses for each soil pit sampled. The total nitrogen (TN) values given in Table 1 are from the addition of TKN and NO_3-N values. Figure 1 shows the approximate location of sampling sites within the decommissioned sludge ponds.

The data presented in Table 2 gives a comparison of selected constituents in surface weathered sludge/soils and typical Altoga and Frio soils. Prior to installation of the sludge ponds, Altoga and Frio soils were present; modified versions of these soil types are now present due to alterations caused by the grading operations in the ponds and accumulations of sludge. These data indicate that the surface soils in Pond 7 have TOC values two to six times greater than comparable Altoga and Frio soils, and TN values two to eight times greater than these reference soils. Pond 8 surface soils have TOC and TN concentrations up to three times greater than that found in comparable soils, and Pond 9 surface soils have TOC and TN values up to five times greater than that of reference soils. Table 3 (see attached data table) presents TN and TOC data for a complete soil profile of typical Altoga and Frio soils.

Table 2. Comparison of Selected Sludge Pond Soils Data with Typical Frio and Altoga Soil Characteristics

Depth	Pond 7 Pit 7-7	Pond 7 Pit 7-12	Pond 8 Pit 8-2	Pond 9 Pit 9-2	Typical Altoga and Frio soils
			Total Nitrogen (mg/kg)		
surface					
3" to 6"	7424.2	16131.0	5300.3	8114.8	1,100 - 1,800
			Total Organic Carbon (mg/kg)		
surface					
3" to 6"	46,200	120,000	64,500	115,000	12,000 - 21,000

The primary reason for the elevated nitrogen concentrations in the ponds' soils is that residual sewage sludge accumulated in the ponds prior to the wastewater treatment plant being decommissioned in 1986. Even though disking the sludge into the bottom of the ponds was an approved remediation effort, the continued presence of high organic-N, NH_3-N, and NO_3-N concentrations in the weathered sludge/soil in this vicinity remains a point of concern today.

The soil test data (Table 1) indicate that the TKN fraction (organic-N + NH_3-N) is the largest component of total nitrogen in the weathered sludge/soils mixture of the ponds. As the soil organic-N compounds are mineralized or biologically decomposed, the decomposition by-product, NH_3-N, undergoes nitrification to the stable NO_3-N form in aerated soils. Nitrate-N is normally a very transient form of nitrogen in the soil; it is either assimilated by plants for nutrition or easily transported to the local groundwater system via percolating water.

Nitrate contamination of soils in the decommissioned sludge ponds is evident, notably in Pond 7. Pits 7-4, 7-5, 7-6, and 7-12 (see Table 1 and Figure 1), where high NO_3-N concentrations are found below depths of 6 to 12 inches illustrate this finding. Continued leaching of NO_3-N through soils in the bottom of the ponds can be expected to cause further contamination of the local groundwater systems which feed nearby springs and seeps into Williamson Creek and Onion Creek. The quantity of nitrates that have leached over time through the soil is difficult to predict, and is dependent on several factors, such as: (1) total amount of soil organic-N present and relative amount of NO_3-N present; (2) amount, duration, and intensity of rainfall; (3) soil infiltration and percolation rates; (4) evapotranspiration; (5) soil water holding capacity; and (6) plant uptake of NO_3-N from shallow soil horizons.

I recommend that during construction of the City's new Spikerush Golf Course, further opportunities for remediation of the decommissioned sludge

ponds be sought, as follows:

- The weathered sludge/soil deposits should be removed and stockpiled for future use as a soil supplement, top dressing and/or fertilizer on the new golf course. Silt fences shall be constructed at the perimeter of the stockpiles to intercept sediment; the fence shall remain in place until the stockpiles are entirely redistributed.

- The deepest sludge/soil deposits are found in the north-northwest portions of Pond 7. The top one-foot of surface soil in this region needs to be removed. The removal of only six inches of surficial soils over the remainder of Pond 7 and for the entire areas of Ponds 8 and 9 is needed. (See Figure 1.)

- Compact the soil surface under the area where the stockpiled sludge/soil materials are to be placed, in order to promote complete removal of the stored materials. Cover the stock piles with plastic sheeting.

- Since transformations or losses of NO_3-N in percolating groundwater is minimal, continue to monitor local groundwater seeps. If elevated nitrate levels persist, install groundwater pumps and/or underdrains which could intercept localized groundwater flows. Use this water for fertigation.

I have set up a meeting with Gene Faulk to discuss these test results and project recommendations for Wednesday, December 8, at 9:00 in conference room 16.119, Two Commodore Plaza. Grading work has begun at the Spikerush site, so we need to implement the mitigation recommendations soon. Please let me know if you can attend this meeting. If you have any further suggestions or questions regarding this investigation, please contact me at 499-2746.

Joan Balogh

Joan Balogh
Watershed Regulation and Management
Environmental and Conservation Services Department

JB/jb

cc: Mike Lyday
Nancy McClintock
Scott Hiers
Randy Russell, PARD
Gene Faulk, PARD
Bill Stout, Water and Wastewater Department
Charles Schoening, Water and Wastewater Department
Maureen McReynolds, Water and Wastewater Department

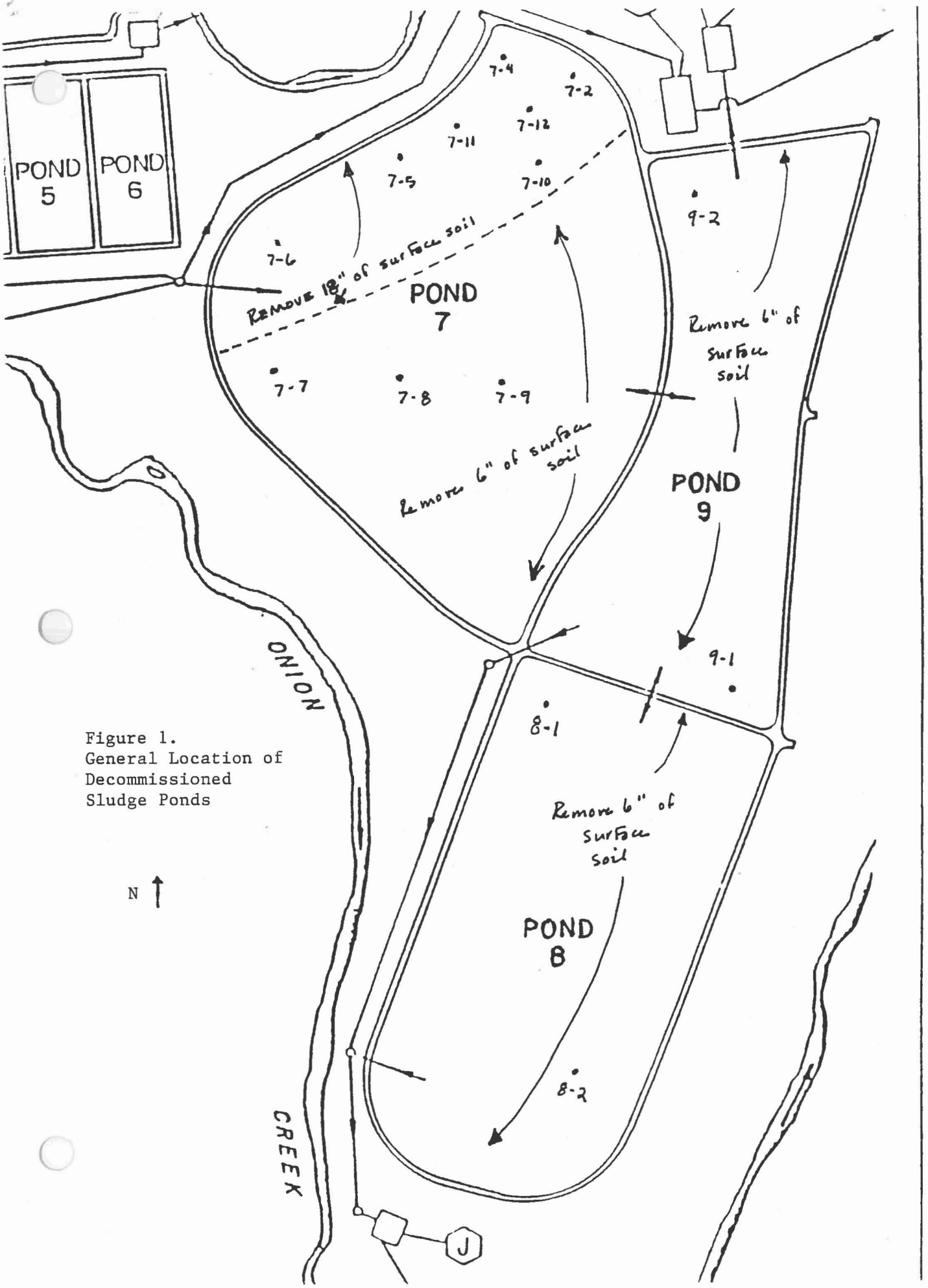

Figure 1.
General Location of
Decommissioned
Sludge Ponds

TABLE 1.
Spikerush Soil Survey

Location	Depth	NO3 + NO2 (mg/Kg)	TKN (mg/Kg)	Total Nitrogen (mg/Kg)	TOC (mg/Kg)	Total Solids %
AF*	Surface	1.98	4570	4572.0	16700	95.8
AF*	10"	11.10	1710	1721.1	13600	95.7
AF*	2'	2.63	859	861.6	9200	.
DR**	Surface	7.78	1790	1797.8	13000	92.6
DR**	14"	2.38	680	682.4	9940	92.6
DR**	3'	3.07	697	700.1	4870	94.4
7 fwy***	Surface	12.00	1210	1222.0	12900	77.8
7 fwy ***	Subsurface	6.59	923	929.6	9520	81.9
7-2	Surface	4.03	13900	13904.0	69900	94.4
7-2	4"	1.57	454	455.6	7010	95.6
7-2	10"to 12"	3.10	535	538.1	4550	96.8
7-4	Surface	110.00	6350	6460.0	79700	.
7-4	6"	11.60	600	611.6	2090	95.6
7-4	12"	10100.00	1360	11460.0	11900	92.3
7-4	4'	85.50	979	1064.5	3810	83.9
7-5	Surface	111.00	9940	10051.0	72300	92.7
7-5	3" to 5"	20.80	1290	1310.8	11800	93.1
7-5	16"	17.80	702	719.8	5470	87.8
7-6	Surface	108.00	8370	8478.0	48500	92.7
7-6	5" to 27"	7.87	1440	1447.9	6730	87.7
7-6	27"	11.30	542	553.3	2140	98.1
7-7	Surface	44.20	7380	7424.2	46200	95.2
7-7	3" to 4"	3.66	1240	1243.7	2850	98.4
7-7	3'	9.25	370	379.3	752	98.4

* Academy Field: nearby grassed field

** Driving range: nearby grassed field currently irrigated with potable water; and previously irrigated with effluent

*** Hole #7 fairway: currently irrigated with potable water, fertilized and previously irrigated with effluent

Table 1 (continued)

	Location	NO3 + NO2 (mg/Kg)	TKN (mg/Kg)	Total Nitrogen (mg/Kg)	TOC (mg/Kg)	Total Solids %
Median	Surface	25.60	5280	5305.6	59500	94.2
	Surface to12"	7.43	1110	1117.4	6445	93.7
	Over 12"	4.06	740	744.1	4875	92.6
Mean	Surface	50.73	6025.9412	6076.7	57735.294	93.1
	Surface to12"	570.94	1170.3889	1741.3	9295.5556	92.7
	Over 12"	5.31	759.5	764.8	5170	92.7

Table 3.

Background Soils Data for Typical Frio and Altoga Soils

Depth of Soil (in Inches)	Total Organic Carbon (ppm)	Total Nitrogen (ppm)
0" to 6"	12,000 to 21,000	1,100 to 1,800
6" to 12"	11,000 to 15,000	1,000 to 1,200
12" to 24"	7,500 to 11,000	650 to 850
24" to 36"	6,000 to 9,000	550 to 650
36" to 48"	3,700 to 5,700	.
48" to 60"	3,500 to 4,500	.

Source: Soil Conservation Service, James Greenwade, Temple Area Office