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PROPOSED GROUNDWATER MONITORING PLAN

for

TOMOKA FARMS ROAD LANDFILL

VOLUSIA COUNTY

FLORIDA

OCTOBER, 1986

Briley, Wild & Associates, Inc.
Consulting Engineers & Planners
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PROPOSED GROUNDWATER MONITORING PLAN FOR
TOMOKA FARMS ROAD LANDFILL
VOLUSIA COUNTY, FLORIDA

The purpose of groundwater monitoring is to demonstrate the absence of leachate contamination of groundwater and, if leachate contamination is discovered, to provide data necessary to develop and implement a corrective control strategy. The results from the monitoring program provide assurance to the operator of the landfill, the regulatory agencies, and the general public that the groundwater resources are being protected and that they will continue to be protected from leachate contamination.

Background

The Tomoka Farms Road Landfill site has been extensively monitored since 1977. A hydrogeologic study was performed by Dr. Kelly Brooks in 1980 and the existing monitoring plan is based largely on that study. In the summer of 1986 Dr. David Gomberg performed a hydrologic study of the borrow pit area and reviewed existing monitoring data, and evaluated the existing monitoring program at the landfill site. His report on existing monitoring is the basis for this proposed groundwater monitoring plan, and is attached for reference.

Groundwater Monitoring Wells

At the present time, water quality is monitored at seven wells: B-2, B-4, B-5, B-6, FA-1, FA-2 and the deep scale house well. It is proposed to continue monitoring groundwater quality in these locations. In addition, Dr. Gomberg has recommended that groundwater quality be monitored at three new locations: B-1, B-3, and MO-5. It should be pointed out that although wells have existed at these locations in the past, the well at B-1 and MO-5 are no longer in a condition suitable for groundwater sampling, and B-3 was destroyed when the scale house was built. Consequently, three new shallow wells will be built at these approximate locations to allow proper sampling.

Dr. Gomberg has indicated that the deep Floridan Aquifer wells at FA-1 and FA-2 are too deep to serve as reliable indicators of leachate contamination. Accordingly, two new Floridan wells will be constructed at these locations in compliance with Dr. Gomberg's recommendations.

~110' collection zone

Dr. Gomberg has further recommended that three new wells; B-7, B-8 and B-9, be constructed and used for water level monitoring to assist in determining groundwater gradients and flow directions. When the landfill is expanded to the north, these wells could be used for groundwater quality monitoring at the time of expansion.

The locations of these existing and proposed wells are shown on page 46 of Dr. Gomberg's report.

Surface Water Monitoring

The present groundwater monitoring plan includes four surface water sampling points:

Pond A
Weir
Canal Pump
Canal Swamp

In addition, three groundwater sampling points are included in the EPA National Pollutant Discharge Elimination System (NPDES) permit:

NPDES-1
NPDES-2
NPDES-3

It is proposed to consolidate these seven locations into five:

SW-1 Also called NPDES-1, this location is an off-site borrow pit used to measure background surface water quality.

SW-2 Also called Canal Pump or NPDES-2, this location is in the exterior ditch near the pump that is used to discharge water from the site when such discharge is required.

SW-3 Also called NPDES-3, this location is at the confluence of the roadside ditch carrying the pumped discharge and the wetland.

SW-4 Also called Weir, this location is in the marsh, holding area just before discharge over the weir to the exterior ditch.

SW-5 This is a new sampling point on the interior ditch near where water is pumped from the interior ditch to the first of the four ponds in the leachate treatment system.

Two existing surface water sampling points are proposed to be abandoned:

Canal Swamp. This location is only a few feet from Weir and both provide a measure of the quality of water in the marshy holding area prior to discharge to the effluent ditch.

Pond A. This location provided a measure of the water quality discharged from the second pond to the third pond in the leachate treatment system. Under the proposed monitoring plan, water quality will be monitored where water enters the leachate treatment system at SW-5, and where water is discharged from the system at SW-4.

Four staff gages are proposed to be installed to assist in measuring surface water levels. These gages would be installed at SW-2, SW-3, at the borrow pit (SW-6), and in the disconnected pond west of the landfill (SW-7).

The location of these surface water monitoring points is shown on page 46 of Dr. Gomberg's report.

Sampling and Analysis Schedule

It is proposed that all sampling locations be sampled quarterly and analyzed for Cl, conductivity, TDS, Fe, pH, and COD. NPDES sampling locations are sampled and analyzed quarterly for TOC and twice yearly for COD, iron, lead, cadmium, chromium, zinc, mercury, organic scan and specific conductance.

Other parameters may also be monitored such as purgeables, volatile organics and pesticides, as required by the DER.

EVALUATION OF MONITORING AT TOMOKA LANDFILL

prepared for

Briley, Wild & Assoc., Inc.
and
Volusia County Dept. of Public Works

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July, 1986

Sept., 1986 (revised)

SUMMARY

Available data related to monitoring at Tomoka Landfill have been compiled and reviewed. These included records of well construction, water level measurements, and water quality analyses.

Water level data are accurate and relatively complete. Hydrographs illustrate that potentiometric levels in the Floridan Aquifer are always slightly lower than the water table, and that shallow groundwater levels near the active landfill area are generally higher and fluctuate less than at more distant locations. The absence of surface water gages and the small number of shallow wells precludes preparation of water table maps or the determination of groundwater flow rates.

Water from shallow wells near the old and active landfill sites contains a minor leachate component; distant shallow wells appear free from leachate. Deep wells tap too thick an interval of the Floridan Aquifer to be useful for landfill monitoring; other evidence indicates that the limestone has not been affected by landfilling activities. Surface water quality adjacent to the active fill area is exceptionally good, with only a few analyses showing a minor leachate fraction. There is no evidence for the presence or migration of hazardous chemicals.

Changes to the current monitoring program are proposed, to increase the reliability of site evaluations and to provide data relevant to future expansion. Recommendations include moderate enlargement of the well network, installation of 4 staff gages, several changes in water quality sampling locations, initiation of rainfall recordkeeping, and periodic review of collected data.

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INTRODUCTION

<u>Scope and Objectives.</u> Authorization to research and prepare this document was provided by Briley, Wild & Assoc., pursuant to the request, by Jim Griffin of the Volusia County Dept. of Public Works, that water level and water quality monitoring at Tomoka Landfill be evaluated. This request was made to insure that hydrologic impacts which may result from landfill activities are adequately yet efficiently monitored.

The specific objectives of this report are:

a) to assemble collected data and compile them in a format amenable to interpretation;

b) to evaluate, based on existing monitoring data, the impact of waste disposal on groundwater and surface water;

c) to assess the effectiveness of the current monitoring program;

d) to recommend changes, if indicated, that will improve the current monitoring program and accomodate plans for landfill expansion.

<u>Sources of Information.</u> The data presented here are mostly from files of the Volusia County Dept. of Public Works. I reviewed all water level and water quality records that could be located. Additional information, including some analyses but mostly related to well construction and subsurface conditions, was taken from the 1980 report on soils and hydrogeology prepared by Dr. H. K. Brooks, and made available to me by Briley, Wild & Assoc., Inc. Some information was obtained by site inspection and through discussions with county personnel, the engineering consultants for the county, and a local driller familiar with the site.

<u>Past and Current Monitoring.</u> To clarify the complex

history of monitoring and sampling at the landfill, Tables 1 and 2 have been prepared. These list sampling points, relevant descriptive information, and the type and timeframe of associated data collection.

Twenty-one wells have been identified as having been drilled at the landfill. These are listed in Table 1 and shown on Figure 1. Of the 21, eleven have been abandoned. Three groups of numbers reflect the construction of most wells during three separate construction episodes. Wells numbered 1 through 5 were drilled in 1977, and sampled periodically through 1979. These wells, with the exception of Well 5, which has since been renumbered as MO-5, have been abandoned.

Wells numbered MO-1 through MO-8 were drilled in 1978 (except MO-5), and used briefly for water level monitoring during the 1980 hydrologic investigation. No wells of the MO series survive, except MO-5, and there is no record of there ever having been an MO-4.

Wells B-1 through B-7 were constructed in 1980. B-2 through B-6 are included in the current DER-required monitoring program, and have been assigned DER identification numbers as noted in the Table. Well B-3 has been abandoned and, since 1983, the deep well serving the scale house has been sampled in its place, with results reported as B-3. *

Floridan Aquifer wells FA-1 and FA-2, also monitored per DER requirements, were constructed in 1980 by Bob's Well Drilling. The wells are 4" PVC, cased and pressure-grouted into limestone at approximately 90 feet depth. Written construction records are unavailable, but the driller believes each well to be about 200 feet deep.

Table 2 lists the sampling points from which surface water quality results have been obtained, and Figure 2 shows the approximate location of these sites. For several sites, results have been reported under a variety of names, as listed in the table.

Table 1. Wells at Tomoka Landfill

Well	Year Installed	Total Depth (ft)	Screened or Open Interval	Remarks
1	1977	10±	?	abandoned; Qw '77-'79
2	"	"	"	abandoned; Qw '77-'79
3	"	"	"	abandoned; Qw '78-'79
4	"	"	"	abandoned; Qw '78-'79
5 or MO-5	"	"	"	DER #64A71M05; Qw '78-'80; W.L. '80-'86
MO-1	1978	20±	"	abandoned; no data
MO-2	"	"	"	abandoned; no data
MO-3	"	"	"	abandoned; no data
MO-6	"	16.5	"	abandoned; DER #64A71M06; W.L. '80-'83
MO-7	"	20±	"	abandoned; no data
MO-8	"	"	"	abandoned; no data
B-1	1980	25	20-25	DER #64A71M16; no Qw; W.L. '80-'86
B-2	"	24	19-24	DER #64A71M01; Qw '80-'86; W.L. '80-'86
B-3	"	25	20-25	abandoned; DER #64A71M15; Qw '80-'83; W.L. '80-'83
B-4	"	25	20-25	DER #64A71M08; Qw '80-'86; W.L. '80-'86
B-5	"	23	18-23	DER #64A71M02; Qw '80-'86; W.L. '80-'86
B-6	"	30	25-30	DER #64A71M11; Qw '80-'86; W.L. '80-'86
B-7	"	25	20-25	no data
FA-1	"	200±	90-200±	DER #64A71M13; Qw '80-'86; W.L. '81-'86
FA-2	"	200±	90-200±	DER #64A71M14; Qw '80-'86; W.L. '81-'86
FA-3	"	?	?	maint. area well; no data
Scale House	1983	?	?	scale house well; no W.L.; Qw '83-'86

see p. 2

Qw = water quality analyses
W.L. = water levels

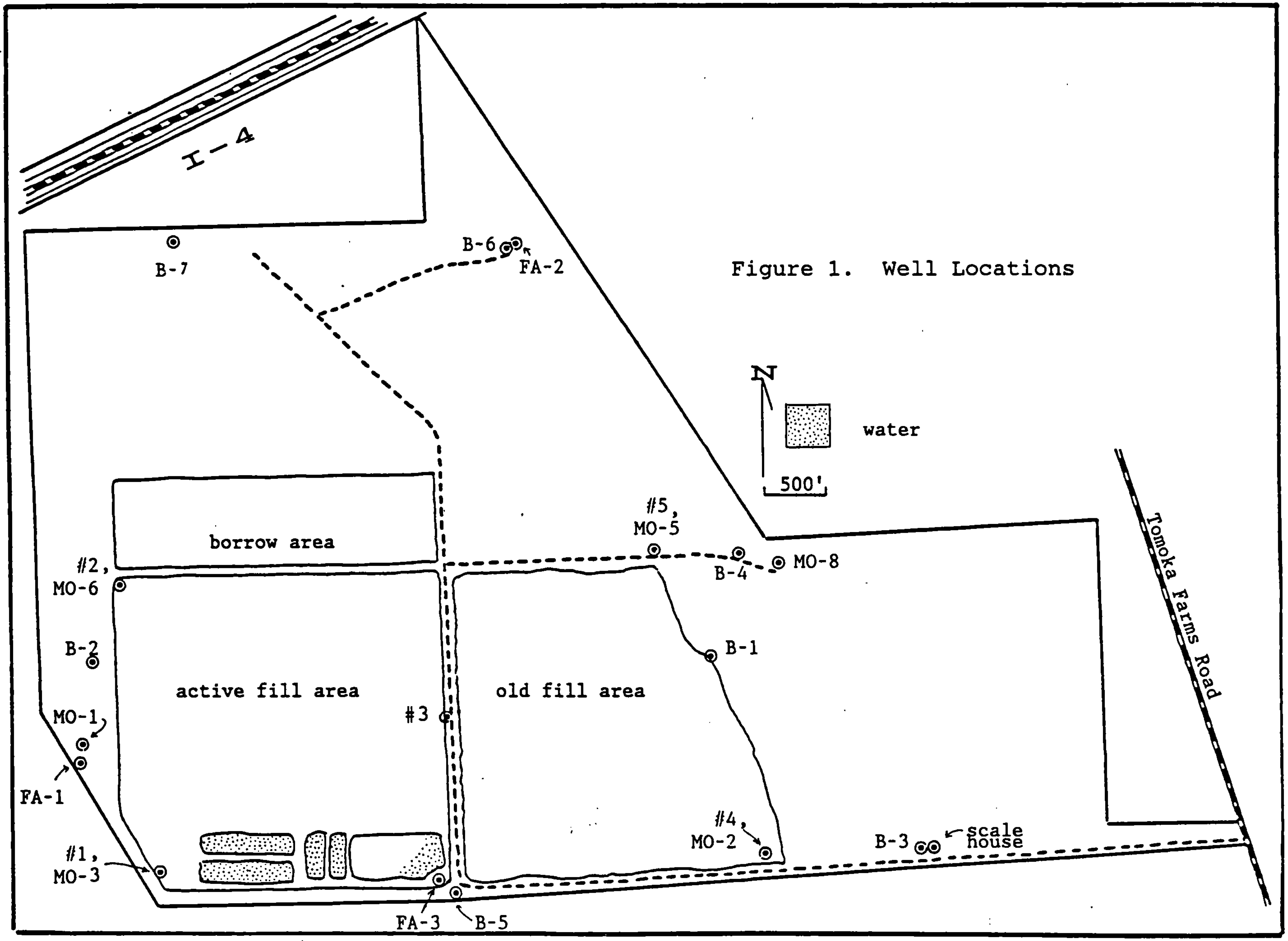

Figure 1. Well Locations

Table 2. Surface Water Sampling Points

Name	DER#	NPDES#	Water Quality Records
Pond A Pond 1 South Pond	64A71S02	-	'83-'86
Canal Pump	64A71S03	-	'83-'86
Weir Outfall Ditch	64A71S04	2	'79-'86
Canal Swamp Holding Pond	64A71S08	-	'77-'85
Pond B Pond 2	-	-	'83-'86
-	-	1	'85
-	-	3	'85

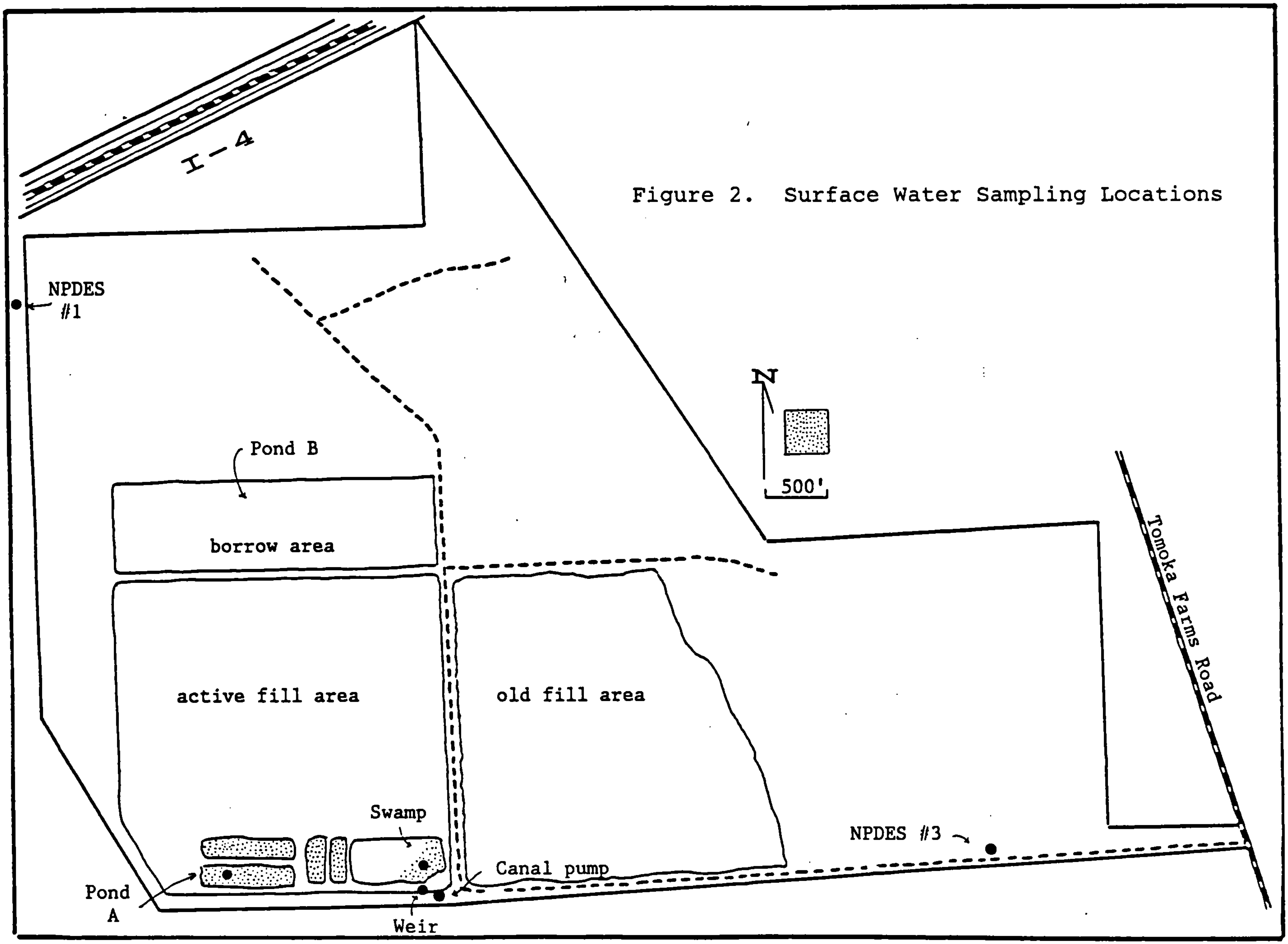

Figure 2. Surface Water Sampling Locations

Acknowledgements. Jim Griffin, Assistant Director of Public Works, supplied much information, through a diligent file search and patient discussion. Wayne Cribbs, of the county, was promptly responsive to my requests for supplemental data. Bert Reilly and Lee Powell, of Briley, Wild & Assoc., Inc., were helpful in many ways, most particularly by furnishing historical information, site data, and critical discussions. Sandra Morris, of Envirolab, reviewed parts of the draft manuscript and suggested improvements. Bob Fout, of Bob's Well Drilling, assisted in a site visit and well inspection.

WATER LEVELS

Hydrographs. Water levels in currently-monitored wells are shown in Figures 3-8. Also shown is the approximate ground elevation at the well site and, by difference, the distance below ground of the water table.

Figure 3, hydrographs of shallow well B-2 and deep well FA-1, illustrates natural differences between the water table and Floridan aquifers. Most prominent are the heads or potentiometric levels in the aquifers, with the Floridan Aquifer consistently lower than the water table. Over the 5-year period of record, this difference has varied between 1.2 and 2.3 feet at the site of wells B-2 and FA-1, and between 4.8 and 9.2 feet at the location of wells B-6 and FA-2 (Fig. 4). This head difference, or vertical gradient, is one of three factors, the others being the permeability and thickness of intervening sediments, controlling the rate and direction of flow between aquifers.

Comparison of hydrographs of B-series wells reveals a striking similarity in the shape of the curves, though not in the magnitude of water table oscillations. The similarity in curve shape suggests two things, the first being an accuracy in the collection of water level data, and the second that landfilling activities, including the operation of drainage ditches, a leachate collection system, and off-site discharge facilities, have not altered substantially the regional pattern of water table flow.

Differences in the range of water table fluctuations are illustrated by Table 3, which includes 1982-1986 data. Wells B-1 and B-4 show the greatest fluctuations, while wells B-2 and B-5, adjacent to the active landfill, show the least fluctuation and the highest water levels - during both dry and wet seasons. This response of wells B-2 and B-5 is a likely consequence of their position on the upgradient side of the property (per Brooks' work), and their proximity to the landfill perimeter ditches, where higher and more stable water levels would be expected.

Table 3. Water Table Fluctuations

Well	high (ft. MSL)	low (ft. MSL)	range (ft.)
B-1	23.5	18.7	4.8
B-2	28.0	25.2	2.8
B-4	22.0	16.5	5.5
B-5	27.1	24.2	2.9
B-6	22.9	19.1	3.8
MO-5	24.3	20.5	3.8

Water Table Contour Maps. Each month, water levels in six shallow wells are measured (see Table 3). No surface water elevations are determined. The distribution of wells is irregular, and there are no wells over large portions of the site. If the property were undrained and unused, these deficiencies might be overlooked and the attempt made to construct a water table map and determine groundwater flow directions. With current site conditions, however, data are inadequate for these purposes. Remedies are proposed in the final section of this document.

Tabulated water level data are given in Table 4. Additional information related to site hydrogeology and groundwater flow is contained in a report, nearing completion, entitled, "Hydrologic Evaluation of a 53-Acre Section of Tomoka Landfill."

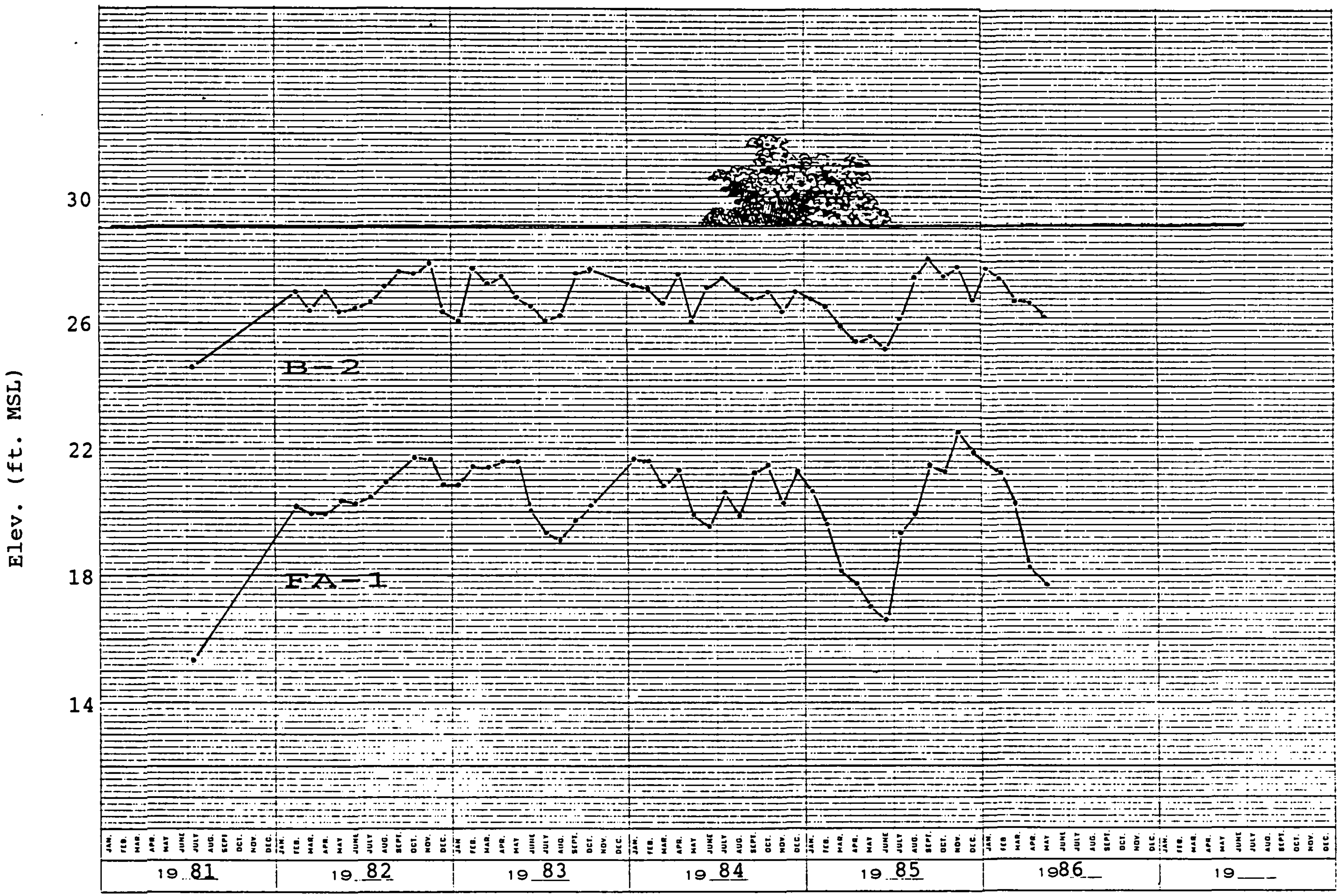

Figure 3. Water Levels, Wells FA-1, B-2

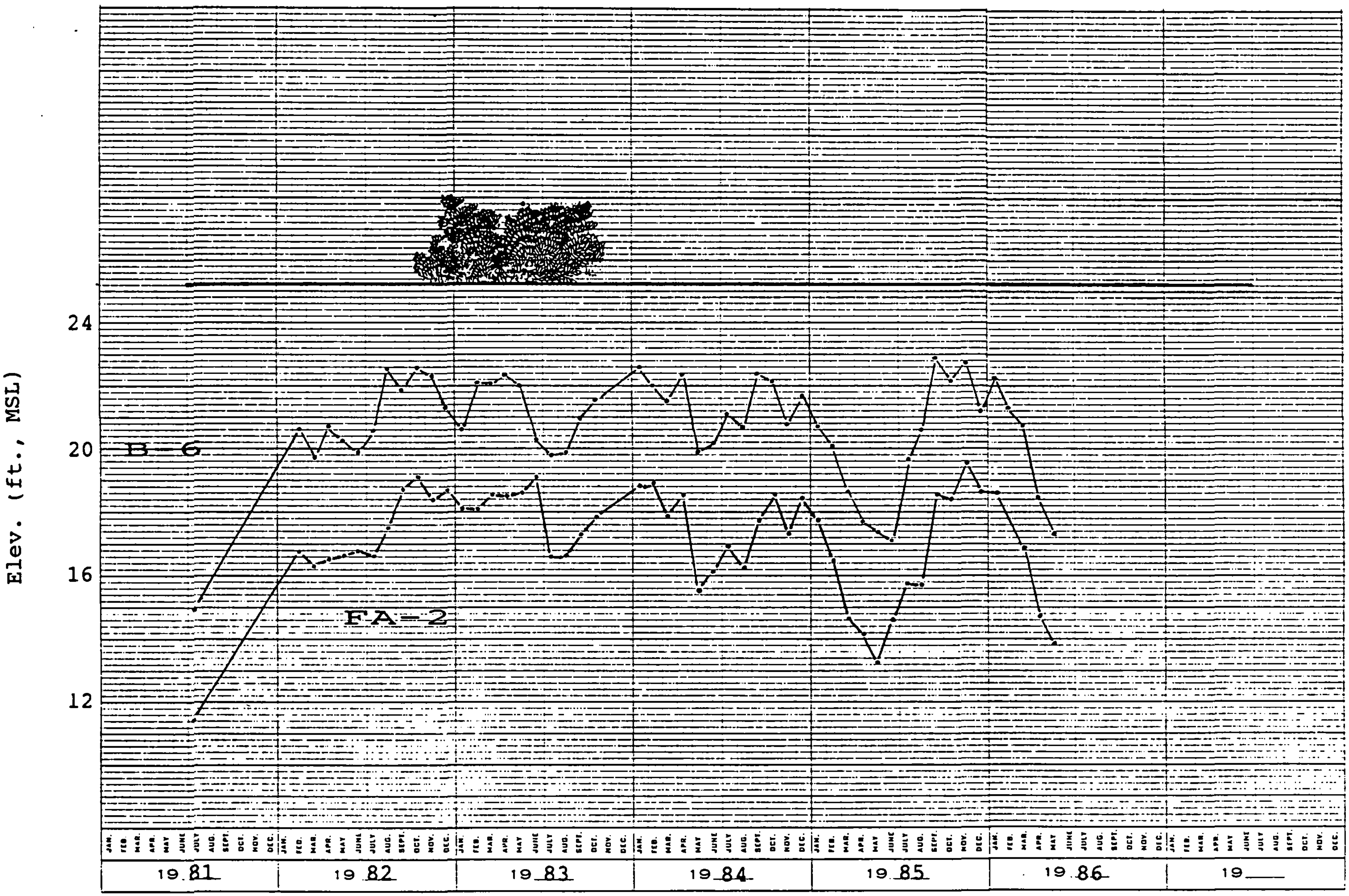

Figure 4. Water Levels, Wells FA-2, B-6

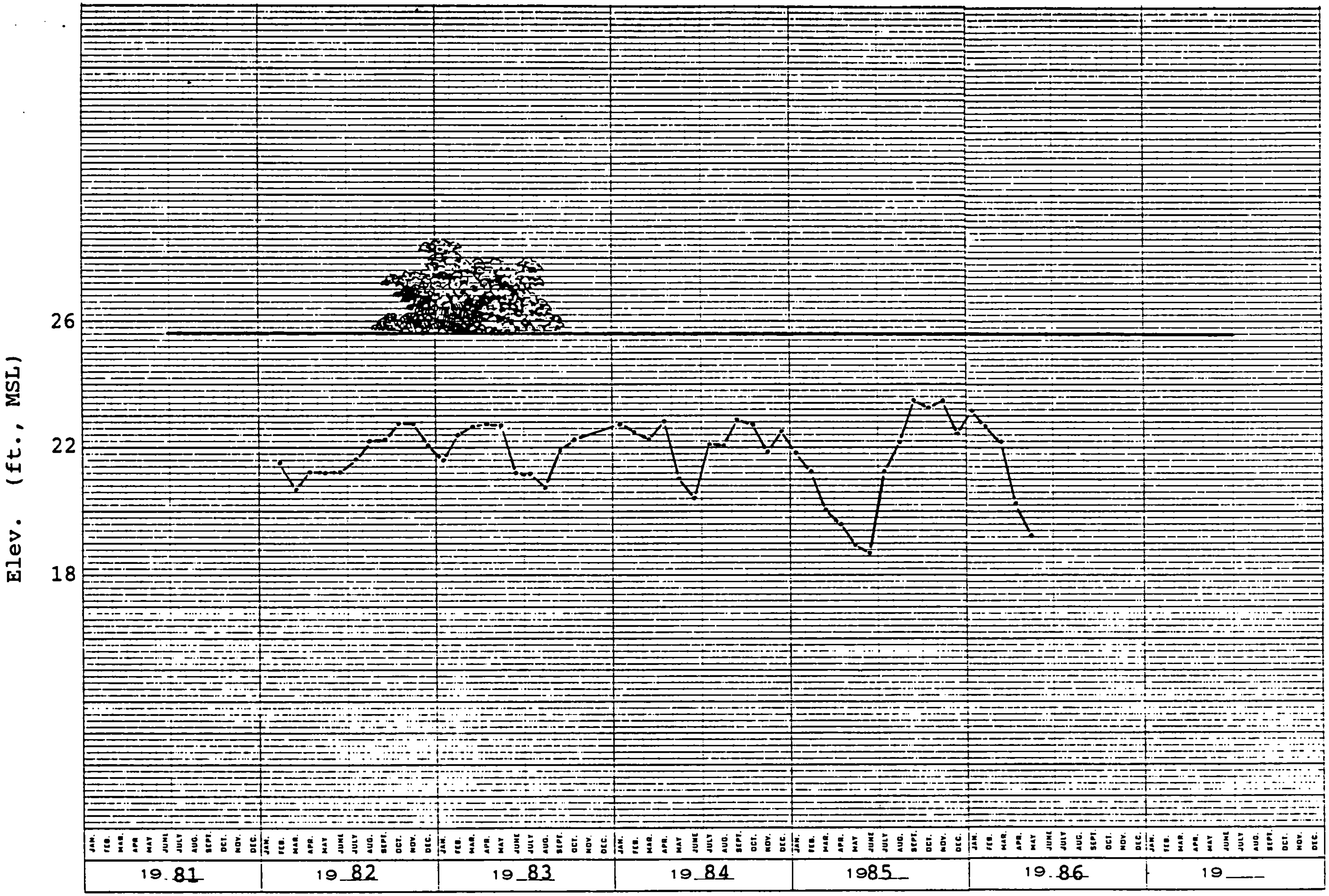

Figure 5. Water Levels, Well B-1

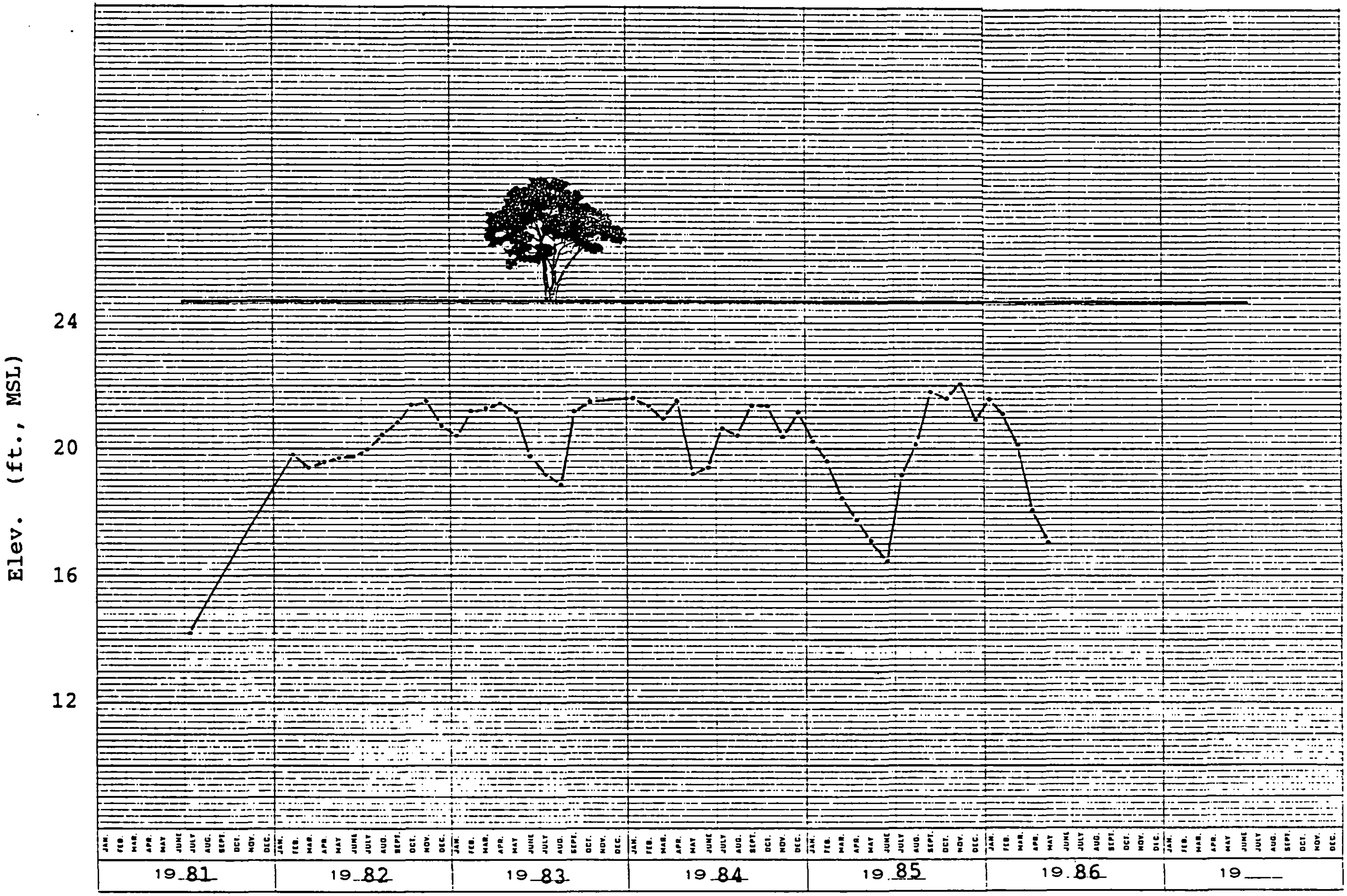

Figure 6. Water Levels, Well B-4

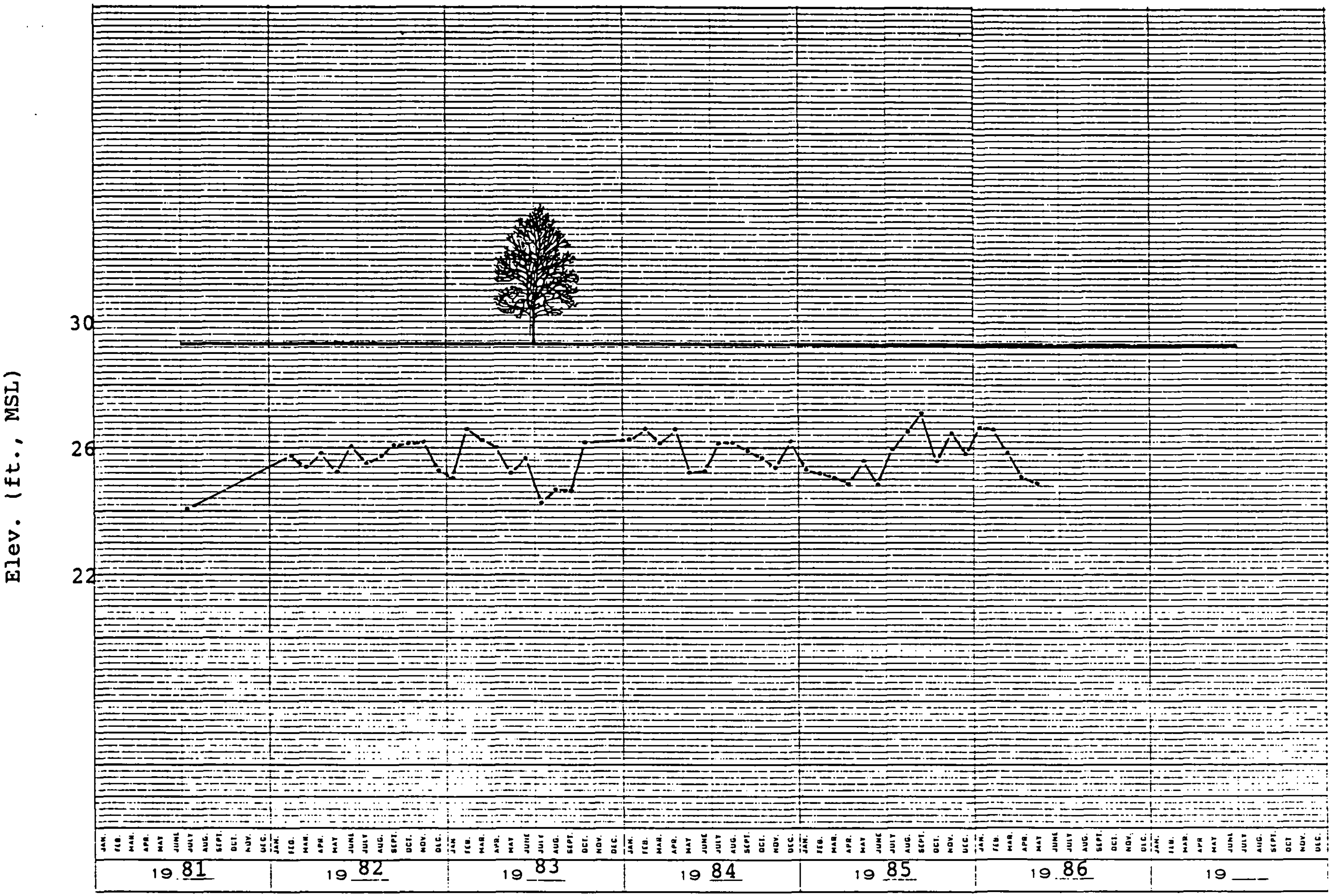

Figure 7. Water Levels, Well B-5

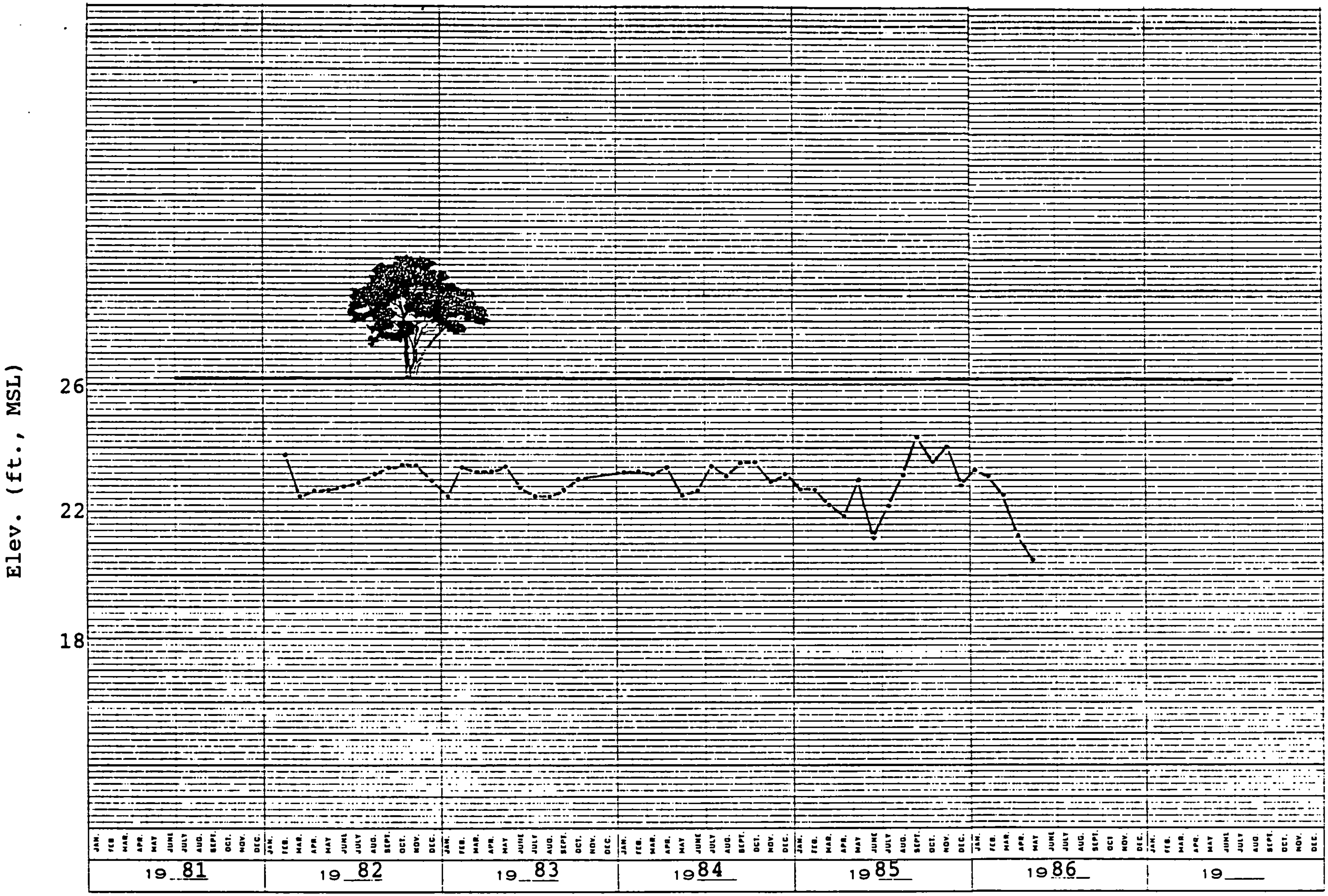

Figure 8. Water Levels, Well MO-5

Table 4. Tomoka Landfill Water Levels

DATE	FA-1	FA-2	B-1	B-2	B-3	B-4	B-5	B-6	MO-5	MO-6
4/1/80	-	-	21.3	25.5	19.8	19.7	24.6	20.4	23.1	[illegible]2.4
7/2/81	15.4	11.5	-	24.6	15.0	14.2	24.0	14.9	-	-
2/2/82	20.2	16.8	21.5	27.0	20.0	19.8	25.7	20.6	23.8	26.5
3/2/82	20.0	16.3	20.7	26.4	19.6	19.4	25.4	19.7	22.5	26.3
4/6/82	20.0	16.5	21.2	27.0	20.0	19.6	25.8	20.7	22.7	26.8
5/4/82	20.4	16.7	21.2	26.4	19.6	19.7	25.2	20.3	22.7	25.8
6/2/82	20.3	16.8	21.2	26.5	19.7	19.7	26.0	19.9	22.8	26.0
7/2/82	20.5	16.6	21.6	26.7	19.8	19.9	25.5	20.6	22.9	25.9
8/4/82	21.0	17.5	22.2	27.2	20.5	20.4	25.8	22.5	23.2	26.0
9/1/82	-	18.7	22.2	27.6	20.7	20.8	26.0	21.9	23.4	26.4
10/82	21.8	19.1	22.7	27.6	21.3	21.4	26.1	22.6	23.5	26.1
11/82	21.7	18.4	22.7	27.9	21.2	21.5	26.2	22.3	23.5	26.4
12/82	20.9	18.7	22.0	26.4	20.6	20.7	25.3	21.3	23.0	25.0
1/4/83	20.9	18.1	21.6	26.0	20.2	20.4	25.0	20.6	22.5	25.3
2/2/83	21.5	18.1	22.4	27.7	21.0	21.2	26.6	22.1	23.4	26.5
3/3/83	21.5	18.6	22.6	27.2	21.0	21.3	26.3	22.1	23.3	26.3

Table 4 (cont.)

DATE	FA-1	FA-2	B-1	B-2	B-3	B-4	B-5	B-6	MO-5	MO-6
4/5/83	21.7	18.6	22.7	27.5	21.0	21.4	26.0	22.3	23.3	25.3
5/4/83	21.7	18.6	22.7	26.8	20.8	21.1	25.2	22.0	23.5	25.2
6/6/83	20.1	17.1	21.2	26.5	19.6	19.7	25.7	20.3	22.8	24.7
7/7/83	19.4	16.6	21.2	26.1	19.0	19.2	24.2	19.8	22.5	24.6
8/3/83	19.2	16.7	20.7	26.2	19.0	18.8	24.7	19.9	22.5	25.0
9/21/83	19.8	17.3	21.9	27.5	-	21.1	24.6	21.0	22.7	25.8
10/4/83	20.3	17.9	22.2	27.7	-	21.5	26.2	21.6	23.0	25.9
11/83	-	-	-	-	-	-	-	-	-	-
12/83	-	-	-	-	-	-	-	-	-	-
1/4/84	21.7	18.9	22.7	27.2	-	21.6	26.3	22.5	23.3	25.6
2/7/84	21.6	18.9	22.5	27.1	-	21.3	26.6	22.0	23.3	26.1
3/16/84	20.8	17.9	22.2	26.6	-	20.9	26.1	21.5	23.2	25.3
4/11/84	21.3	18.5	22.8	27.5	-	21.5	26.6	22.3	23.4	25.4
5/17/84	19.9	15.5	21.0	26.0	-	19.1	25.2	19.9	22.5	25.5
6/19/84	19.5	16.0	20.4	27.1	-	19.4	25.2	20.1	22.7	-
7/11/84	20.6	16.9	22.1	27.4	-	20.7	26.1	21.1	23.4	-

Table 4 (cont.)

DATE	FA-1	FA-2	B-1	B-2	B-3	B-4	B-5	B-6	MO-5	MO-6
8/9/84	19.9	16.2	22.0	27.1	-	20.4	26.2	20.6	23.1	-
9/18/84	21.2	17.7	22.8	26.8	-	21.3	25.9	22.3	23.5	-
10/16/84	21.5	18.5	22.7	27.0	-	21.4	25.7	22.1	23.5	-
11/16/84	20.3	17.3	21.8	26.4	-	20.4	25.4	20.7	22.9	-
12/12/84	21.3	18.4	22.5	27.0	-	21.1	26.2	21.7	23.2	-
1/15/85	20.6	17.7	21.8	26.8	-	20.2	25.3	20.7	22.7	-
2/6/85	19.6	16.4	21.2	26.5	-	19.6	25.2	20.0	22.7	-
3/8/85	18.1	14.6	20.0	25.9	-	18.4	25.0	18.6	22.2	-
4/2/85	17.7	14.1	19.6	25.5	-	17.7	24.9	17.8	21.9	-
5/21/85	17.0	13.3	18.9	25.6	-	17.1	25.6	17.3	23.0	-
6/7/85	16.6	14.5	18.7	25.2	-	16.5	24.9	17.1	21.1	-
7/18/85	19.3	15.7	21.2	26.1	-	19.1	26.0	19.7	22.2	-
8/7/85	19.9	15.7	22.1	27.5	-	20.1	26.5	20.5	23.1	-
9/4/85	21.5	18.5	23.5	28.0	-	21.8	27.1	22.9	24.3	-
10/8/85	21.3	18.4	23.2	27.5	-	21.6	25.6	22.1	23.5	-
11/5/85	22.5	19.5	23.4	27.8	-	22.0	26.5	22.7	24.0	-

Table 4 (cont.)

DATE	FA-1	FA-2	B-1	B-2	B-3	B-4	B-5	B-6	MO-5	MO-6
12/10/85	21.9	18.6	22.4	26.7	-	20.9	25.8	21.2	22.8	-
1/21/86	21.6	18.6	23.1	27.8	-	21.6	26.6	22.2	23.3	-
2/18/86	21.3	18.0	22.7	27.5	-	21.1	26.6	21.3	23.1	-
3/12/86	20.3	16.9	22.1	26.7	-	20.1	25.9	20.7	22.5	-
4/24/86	18.3	14.7	20.2	26.7	-	18.0	25.1	18.4	21.2	-
5/15/86	17.7	13.9	19.2	26.2	-	17.0	24.9	17.3	20.5	-

WATER QUALITY

Tabular Data. Results of analyses are given, by sampling point, in Tables 5-22. Because of the large volumes of analyses, I limited examination to parameters most likely to be indicative of water quality conditions. These are Chloride, Conductivity, Total Dissolved Solids, Iron, Nitrate, pH, TOC and COD. Analytical reports were also reviewed for extraordinary results (e.g. high trace metal concentrations) that might be important, but neither these nor ordinary data other than indicator parameters are tabulated here.

Effect of Landfill on Water Quality. Evaluation of the parameters listed in Tables 5-22 should provide an indication of the presence or absence of leachate, and an approximation of the magnitude of the leachate component. It would be an unexpected result, and possibly an indication of ineffective monitoring, to find no suggestion of discharge from the waste disposal site. This is not the case; leachate can be detected, with reasonalbe confidence if not certainty, in both shallow groundwater and surface water. Leachate is quite probably absent from Floridan Aquifer wells.

Analyses from shallow wells are given in Tables 5-15. Shown are results for 1980-86 from wells B-2 through B-6, 1978-80 from well MO-5, and 1977-79 from older wells 1-4. Most indicative of water quality conditions are Chlorides, Conductivity, TDS, Iron, and COD or TOC. Nitrates have never been above reasonable levels for background, pH has not varied greatly, and only once (for MO-5, 8/78, with Lead = .135 ppm and Cadmium = .047 ppm) have trace metals or chlorinated hydrocarbons exceeded regulatory levels.

A determination of what constitutes background water quality is the critical factor in recognizing the presence of leachate. Review of the analytical data, comparison with results from similar settings, and information collected during

Water Quality Data - Tomoka Landfill

Table 5 Well or Sample B-2 64A71MO1

SAMPLING DATE	Cl	Cond.	TDS	Fe	NO_3-N	TOC	COD	pH
4/2/80	50	-	-	3.0	.4	-	16	-
7/30/81	5.1 ?	514	-	31.9	.36*	-	102	-
12/30/81	37	320	-	7.5	.51	-	51.2	5.9
6/82	45	295	-	7.71	.131	-	69	6.1
12/29/82	60	271	-	.29	.34	-	16	6.5
6/6/83	50	289	-	5.8	.53	21.0	-	6.2
6/26/84	70	329	-	< .01	.06*	15	-	-
12/12/84	60	299	437	< .02	< .05	14	-	6.5
6/26/85	30	259	267	-	< .02	18	-	7.3
9/25/85	74	762	-	20	-	-	-	-
12/18/85	40	276	226	11.5	< .02	18	-	6.3
3/19/86	-	-	256	-	-	-	-	6.7

*oxidized N

Water Quality Data - Tomoka Landfill

Table 6 Well or Sample B3 64A71M15

SAMPLING DATE	Cl	Cond.	TDS	Fe	NO_3-N	TOC	COD	pH
4/2/80	45	-	-	.25	.4	-	22	-
5/28/80	-	-	-	9.1	-	-	8	-
12/2/80	-	858	-	6.25	<.01	-	39	-
7/30/81	1.0 ?	1072	-	9.71	.07*	-	30	-
12/30/81	29	1100	-	2.14	.28	-	41.6	6.8
6/82	41	1060	-	6.84	.127	-	86	6.9
12/29/82	50	817	-	.48	.23	-	12	6.9
6/6/83	60	929	-	3.6	.13	9.1	-	7.0

*oxidized N

Water Quality Data - Tomoka Landfill

Table 7 Well or Sample B4 64A71M08

SAMPLING DATE	Cl	Cond.	TDS	Fe	NO_3-N	TOC	COD	pH
4/2/80	40	-	-	.15	.4	-	26	-
5/28/80	-	-	-	3.1	-	-	26	-
12/2/80	-	592	-	3.75	<.01	-	34	-
7/30/81	6.4 ?	715	-	3.36	.03*	-	28	-
12/30/81	43	750	-	3.63	.32	-	35.2	7.0
6/82	48	722	-	3.58	.07	-	64	7.1
12/29/82	65	607	-	.4	.215	-	40	7.0
6/6/83	55	661	-	3.3	.13	10.3	-	7.1
3/28/84	70	484	426	< .2	<.05	17	-	5.8
6/26/84	70	-	289	< .01	<.05*	-	-	6.3
12/12/84	60	-	474	.2	<.02	-	-	7.1
3/19/85	62	592	432	.2	<.02	12	-	6.9
6/26/85	25	569	465	< .02	.03	-	-	6.8
9/25/85	89	762	484	4.7	<.02	11	-	-
12/18/85	57	754	478	5.6	<.02	-	-	7.0
3/19/86	50	762	496	3.7	<.02	62	-	7.1

*oxidized N

Water Quality Data - Tomoka Landfill

Table 8 Well or Sample B5 64A71MO2

SAMPLING DATE	Cl	Cond.	TDS	Fe	NO_3-N	TOC	COD	pH
4/2/80	34	-	-	1.4	.2	-	34	-
5/28/80	-	-	-	-	-	-	58	-
7/30/81	3.0?	1590	-	37.5	.04*	-	132	-
12/30/81	55	680	-	10.5	.43	-	44.8	6.6
6/82	47	562	-	10.82	.183	-	48	6.4
12/29/82	70	530	-	.68	.43	-	40	6.9
6/6/83	160	1228	-	9.5	.51	24.5	-	6.7
3/28/84	75	485	455	< .01	< .05	19	-	6.0
6/26/84	140	-	450	< .01	< .05*	-	-	7.1
12/12/84	85	788	992	.3	< .05	33	-	6.9
3/19/85	78	697	543	.2	< .02	21	-	6.9
6/25/85	20	627	496	< .02	< .02	-	-	6.9
9/25/85	-	-	445	-	< .02	24	-	6.9
12/18/85	51	775	494	21.5	< .02	19	-	7.3
3/19/86	46	848	540	21.5	< .02	20	-	7.2

*oxidized N

Water Quality Data - Tomoka Landfill

Table 9 Well or Sample B6 64A71M11

SAMPLING DATE	Cl	Cond.	TDS	Fe	NO_3-N	TOC	COD	pH
4/2/80	65	-	-	3.0	.6	-	50	-
5/28/80	-	-	-	16.6	-	-	98	-
12/2/80	-	283	-	7.50	.01	-	42	-
7/30/81	25	299	-	6.46	.11*	-	42	-
12/30/81	22	280	-	4.34	.27	-	48	6.0
6/82	13	158	-	4.03	.111	-	48	5.8
12/29/82	25	148	-	.41	.2	-	44	6.1
6/6/83	25	183	-	3.7	.32	15.3	-	6.2
3/28/84	40	77	93	1.8	<.05	20	-	5.6
6/26/84	35	153	-	<.01	<.05*	18	-	-
12/12/84	40	167	142	1.8	<.05	21	-	5.9
3/19/85	32	127	89	1.3	<.02	15	-	6.0
6/26/85	20	179	221	1.0	<.02	11	-	6.2
9/25/85	31	-	136	5.3	<.02	-	-	6.4
12/18/85	23	146	128	7.7	<.02	18	-	5.9
3/19/86	20.5	138	144	4.8	<.02	24	-	6.2

*oxidized N

Water Quality Data - Tomoka Landfill

Table 10 Well or Sample MO5 (#5)

SAMPLING DATE	Cl	Cond.	TDS	Fe	NO_3-N	TOC	COD	pH
2/16/78	21	-	-	-	0.0	-	112	-
5/24/78	135	-	-	-	0.0	-	110	
8/17/78	140	-	-	-	.3	-	120	-
11/9/78	130	-	-	-	.1	-	86	-
2/22/79	110	-	-	-	.3	-	285	-
5/29/79	20	-	-	-	.2	-	208	-
12/14/79	25	-	-	-	1.0	-	54	-
4/2/80	85	-	-	6.4	.5	-	64	-
5/28/80	-	-	-	66.0	-	-	171	-

Water Quality Data - Tomoka Landfill

Table 11 Well or Sample FA1 64A71M13

SAMPLING DATE	Cl	Cond.	TDS	Fe	NO_3-N	TOC	COD	pH
12/2/80	-	525	-	.39	<.01	-	18	-
7/30/81	10	613	-	.82	.05*	-	62	-
12/30/81	19	650	-	.3	.21	-	17.6	7.4
6/82	19	611	-	.71	.028	-	4	7.3
12/29/82	20	587	-	.06	.095	-	4	7.3
6/6/83	30	568	-	.4	<.01	5.3	-	7.1
3/28/84	30	400	321	<.01	<.05	6	-	6.5
6/26/84	30	-	89	<.01	<.05*	-	-	6.5
12/12/84	45	491	370	<.02	<.05	9	-	7.3
3/19/85	30	474	331	<.02	<.02	6.8	-	7.2
6/26/85	25	459	369	<.02	<.02	-	-	7.3
9/25/85	30	581	348	0.6	<.02	5.3	-	7.2
12/18/85	28	551	340	2.4	<.02	4.8	-	7.2
3/19/86	23.5	599	368	<.3	<.02	70	-	7.5

*oxidized N

Water Quality Data - Tomoka Landfill

Table 12 Well or Sample FA2 64A71M14

SAMPLING DATE	Cl	Cond.	TDS	Fe	NO_3-N	TOC	COD	pH
12/2/80	-	570	-	.3	< .01	-	30	-
7/30/81	2.8 ?	731	-	.47	.04*	-	16	-
12/30/81	22	680	-	.144	.15	-	17.6	7.1
6/82	31	649	-	.558	.02	-	8	7.3
12/29/82	50	553	-	.08	.1	-	20	7.4
6/6/83	55	651	-	<.01	.03	8	-	7.1
3/28/84	35	419	335	.01	< .05	7	-	6.5
6/26/84	40	599	-	.01	< .05*	4.3	-	-
12/12/84	65	654	449	<.02	< .05	11	-	7.3
3/19/85	64	591	450	<.02	.12	7.4	-	7.0
6/26/85	25	554	179	<.02	< .02	14	-	7.0
9/25/85	39	-	366	0.4	< .02	-	-	7.1
12/18/85	46	588	356	2.5	< .02	6.9	-	7.0
3/19/86	45.5	685	429	<.3	< .02	52	-	7.4

*oxidized N

Water Quality Data - Tomoka Landfill

Table 13 Well or Sample Scale House Well

SAMPLING DATE	Cl	Cond.	TDS	Fe	NO_3-N	TOC	COD	pH
3/19/85	80	568	415	<.02	< .02	7.2	-	6.9
6/25/85	25	520	878	<.02	< .02	7.3	-	7.2
9/25/85	49	-	410	1.2	< .02	-	-	7.0
12/18/85	57	706	419	1.1	< .02	5.7	-	7.1
3/19/86	-	-	435	-	-	-	-	7.3

Water Quality Data - Tomoka Landfill

Table 14 Well or Sample Well #1

SAMPLING DATE	Cl	Cond.	TDS	Fe	NO_3-N	TOC	COD	pH
1/11/77	26	-	-	-	.4	-	110	-
10/11/77	63	-	-	-	.1	-	35	-
2/16/78	24	-	-	-	0.0	-	12	-
5/24/78	60	-	-	-	0.0	-	80	-
8/17/78	70	-	-	-	.01	-	65	-
11/9/78	65	-	-	-	.3	-	150	-
2/22/79	45	-	-	-	.2	-	360	-
5/29/79	20	-	-	-	.2	-	187	-

Water Quality Data - Tomoka Landfill

Table 15 Well or Sample Well #2

SAMPLING DATE	Cl	Cond.	TDS	Fe	NO_3-N	TOC	COD	pH
10/11/77	30	-	-	-	.1	-	5	-
2/16/78	12	-	-	-	0.0	-	5	-
5/24/78	18	-	-	-	0.0	-	25	-
8/17/78	35	-	-	-	.3	-	30	-
11/9/78	40	-	-	-	0.0	-	178	-
2/22/79	50	-	-	-	.4	-	290	-
5/29/79	20	-	-	-	.3	-	184	-

Water Quality Data - Tomoka Landfill

Table 16 Well or Sample Well #3

SAMPLING DATE	Cl	Cond.	TDS	Fe	NO_3-N	TOC	COD	pH
2/16/78	27	-	-	-	0.0	-	16	-
5/24/78	111	-	-	-	0.0	-	130	-
8/17/78	280	-	-	-	.1	-	280	-
11/9/78	400	-	-	-	0.0	-	330	-
2/22/79	20	-	-	-	.3	-	385	-

Water Quality Data - Tomoka Landfill

Table 17 Well or Sample Well #4

SAMPLING DATE	Cl	Cond.	TDS	Fe	NO_3-N	TOC	COD	pH
2/16/78	24	-	-	-	0.0	-	0	-
5/24/78	45	-	-	-	0.0	-	60	-
8/17/78	60	-	-	-	.01	-	100	-
11/9/78	55	-	-	-	.3	-	160	-
2/22/79	30	-	-	-	1.1	-	315	-
5/29/79	25	-	-	-	1.4	-	199	-

Water Quality Data - Tomoka Landfill

Table 18 Well or Sample Pond A 64A71SO2

SAMPLING DATE	Cl	Cond.	TDS	Fe	NO_3-N	TOC	COD	pH
12/28/83	-	-	-	-	.81	17.5	-	-
12/12/84	110	664	711	.35	.05	24	-	7.8
3/19/85	102	568	480	<.02	.03	18	-	7.5
6/26/85	45	477	-	<.02	<.02	23	-	7.4
9/25/85	-	530	-	.7	.05	9.2	-	6.7
3/19/86	-	475	-	0.9	.07	11	-	7.7

Water Quality Data - Tomoka Landfill

Table 19 Well or Sample Pond B

SAMPLING DATE	Cl	Cond.	TDS	Fe	NO_3-N	TOC	COD	pH
12/28/83	-	-	-	-	.45	14.5	-	-
3/28/84	-	646	-	.2	-	29	-	7.2
12/12/84	60	363	439	.1	.05	16	-	7.8
3/19/85	92	448	360	.6	<.02	18	-	7.5
6/26/85	45	507	-	< .5	<.02	23	-	7.4
9/25/85	-	216	-	16	.42	9.7	-	6.7
3/19/86	-	424	-	5.9	.18	13	-	7.4

Water Quality Data - Tomoka Landfill

Table 20 Well or Sample Canal Swamp 64A71SO8

SAMPLING DATE	Cl	Cond.	TDS	Fe	NO_3-N	TOC	COD	pH
1/11/77	18	-	-	-	4.2	-	50	-
5/24/78	-	-	341[2]	.3	-	-	75	-
11/9/78	75	-	-	-	0.0	-	365	-
11/4/80	-	-	696[2]	.05	-	-	8	-
12/15/80	-	-	502[2]	1.0	-	-	116	-
12/29/80	-	-	520[2]	4.8	-	-	82	-
1/27/81	-	-	362[2]	.05	-	-	76	7.3
2/25/81	-	-	349[2]	0.0	-	-	60	6.9
3/30/81	-	-	359[2]	.24	-	-	54	7.8
4/23/81	-	-	202[2]	.1	-	-	72	7.5
5/22/81	-	-	190[2]	.2	-	-	82	6.8
6/23/81	-	-	172[2]	.2	-	-	44	6.8
8/24/81	-	-	222[2]	.7	-	-	86	7.4
12/28/83	80	489	-	.02	-	-	-	-
3/28/84	-	405	-	.6	-	18	-	6.8
6/26/84	-	-	-	-	.1*	16	-	-
9/25/85	-	365	-	.9	.07	14	-	6.9
3/19/86	-	435	-	.8	<.02	14	-	7.5

* oxidized N

[2] total solids - total suspended solids

Water Quality Data - Tomoka Landfill

Table 21 Well or Sample Weir 64A71SO4

SAMPLING DATE	Cl	Cond.	TDS	Fe	NO_3-N	TOC	COD	pH
12/14/79	-	-	-	-	-	-	60	-
4/2/80	-	-	-	.1	-	-	60	-
10/29/80	-	-	384*	.06	-	-	0	-
11/4/80	-	-	300*	.05	-	-	0	-
12/2/80	-	660	-	.95	.3	-	63	-
12/15/80	-	-	806*	1.2	-	-	132	-
12/29/80	-	-	440*	.3	-	-	64	-
1/27/81	-	-	798*	.02	-	-	80	7.3
2/25/81	-	-	600*	0.0	-	-	174	6.9
3/30/81	-	-	668*	3.2	-	-	114	6.9
4/23/81	-	-	632*	.4	-	-	192	7.2
5/22/81	-	-	604*	.3	-	-	166	7.4
6/23/81	-	-	582*	.25	-	-	76	6.9
8/24/81	-	-	890*	1.7	-	-	112	7.5
6/3/83	-	-	-	-	-	19.1	-	-
12/28/83	40	180	-	.02	-	-	-	-
6/26/84	225	982	-	.75	-	-	-	7.1
12/12/84	-	614	-	.3	<.05	23	-	5.7
6/26/85	35	485	-	-	-	25	99	-
9/25/85	-	365	-	.9	.03	14	-	6.9
12/18/85	-	500	-	1.5	.82	15	-	7.0
3/19/86	-	525	-	4.4	<.02	23	-	7.3

*Total Solids - Total Suspended Solids

Water Quality Data - Tomoka Landfill

Table 22 Well or Sample Canal Pump 64A71SO3

SAMPLING DATE	Cl	Cond.	TDS	Fe	NO_3-N	TOC	COD	pH
12/28/83	45	330	-	.07	.12	15.5	-	-
3/28/84	-	404	-	.6	-	18	-	6.7
12/18/85	-	428	-	1.7	.06	12	-	7.3
3/19/86	-	435	-	.8	<.02	14	-	7.5

the recent hydrologic investigation (reported elsewhere), suggest that, for shallow groundwater, about the maximum levels to be expected under natural circumstances are:

Cl	100 mg/l
Conductivity	600-800 mmhos
TDS	500-700 mg/l
Fe	15 mg/l
TOC	50 mg/l
COD	100 mg/l

It should be emphasized that background levels for indicator parameters are not subject to rigorous quantification. This is particularly the case for Fe, TOC and COD, the concentration of which may be highly dependent on seasonal seepage from shallow strata rich in organic material. On the other hand, one can draw tentative conclusions regarding the presence of leachate from a combination of related water quality factors, such as time-related fluctuations in concentration, spatial variations, and whether only one or several indicator parameters exhibit abnormal levels.

In the context of these general guidelines, analyses from active shallow wells shows the following:

a) Well B-2 - elevated FE (twice) and COD (once, slightly);

b) Well B-3 - elevated Cond. (6 times);

c) Well B-4 - elevated TOC (once, slightly);

d) Well B-5 - elevated Cl (twice), Cond. (3 times), COD (once);

e) Well B-6 - elevated Fe (once, slightly);

f) Well MO-5 - elevated Cl (5 times), Fe (once), COD (6 times).

Wells B-5 and MO-5 most clearly show evidence of a leachate component, as would be expected from their location adjacent to buried waste. (Largely on the basis of high COD concentrations, older wells 1 through 4 also indicate the presence of leachate.) Wells B-6 and B-4 appear free from leachate, while the evidence for wells B-2 and B-3 is less clear, and conclusions regarding these sites must await additional and more complete analyses.

Figure 9 shows monitoring data for Iron, from wells B-2 through B-6. In addition to differences in absolute concentrations, the greater fluctuation of Fe levels in wells B-2 and B-5 is apparent, and suggests that the periodically high levels are not natural. As can also be seen, the Fe concentration in well B-6 was near or above selected background during part of 1980. These results for B-6 are puzzling, in that, even though downgradient from the landfill, it is not readily apparent how shallow groundwater flow could have raised Fe concentrations at this distant location. In addition, only Fe and possibly one COD value are above background, raising the issue of whether the choice of background concentration is too low. Further analyses and evaluation are needed to resolve these questions.

Compelling circumstantial evidence indicates that landfill activities have had no effect on water quality in the Floridan Aquifer. This evidence, unfortunately, is not provided by water quality data given in Tables 11 (for FA-1), 12 (for FA-2), or 13 (for the scale house well). It is based, instead, on knowledge of site hydrogeology, especially the lithology and thickness of sedimentary strata underlying the landfill, particulars of which are the subject of other documents.

In their current condition, wells FA-1 and FA-2 are not useful as landfill monitoring wells. Only the most extreme contamination would be detected by sampling these wells, because of the large open interval exposed to limestone. When these wells are pumped, the fraction of water contributed by the upper part of the borehole is tiny at best. As a consequence, evidence for landfill contamination or its absence is diluted to the point of undetectability, by water from deeper in the aquifer.

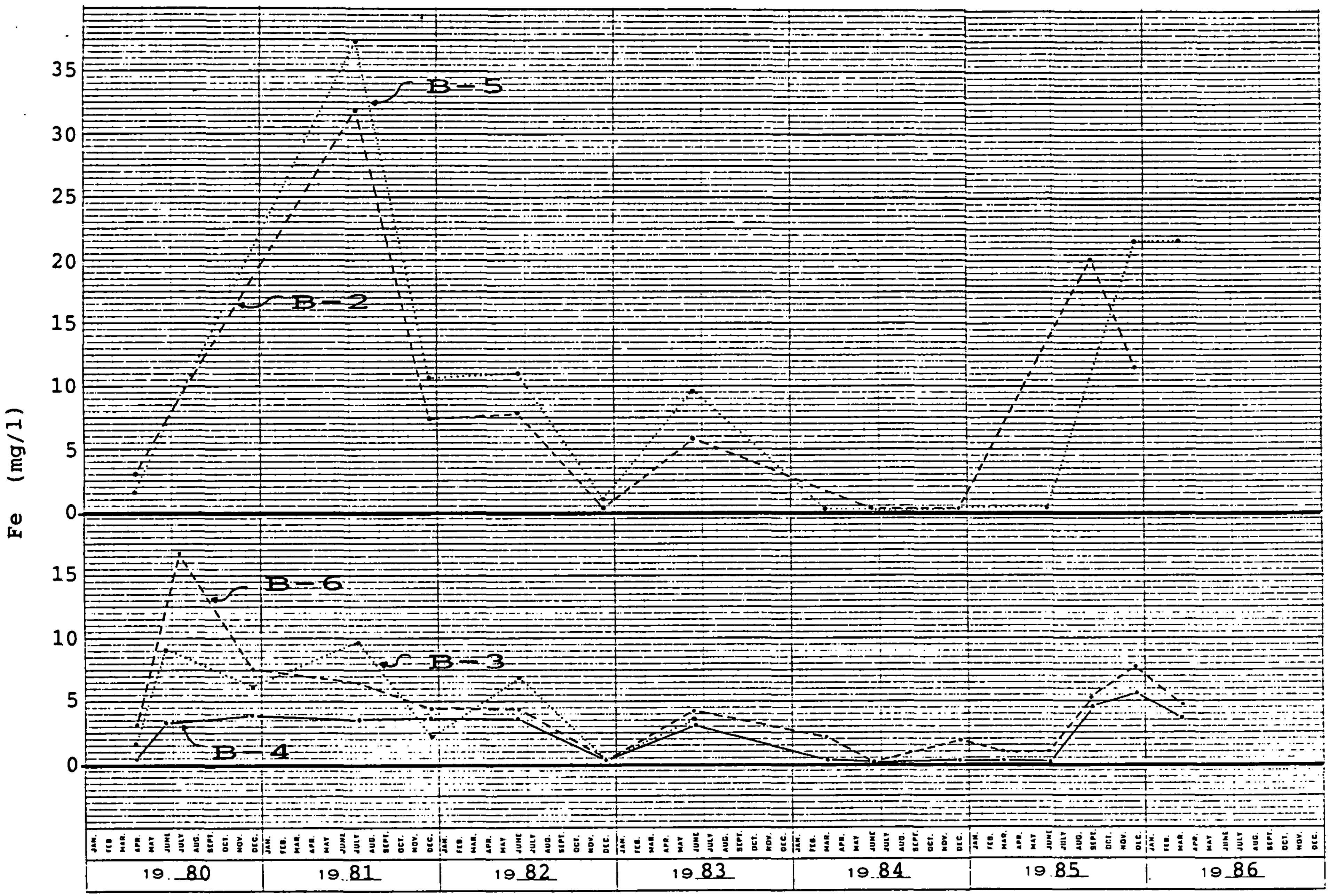

Figure 9. Iron in Monitor Wells

Recent results for FA-1 and FA-2 include unusually high levels for Fe (for both wells in 12/85) and TOC (again for both wells, in this instance in 3/86). These peculiar analyses can be attributed to a sampling or analytical problem because they appear simultaneously in deep wells separated, in distance, by more than a mile, and in time, by many years of groundwater flow. It is difficult to construct a flow scenario that would produce these water quality results.

Analyses of surface water samples are presented in Tables 18-22. The results show the following:

a) Pond A - elevated Cl (twice, slightly), TDS (once, slightly);

b) Pond B - elevated Fe (once, slightly);

c) Swamp - elevated COD (twice);

d) Weir - elevated Cl (once), cond. (once), TDS (3 times), COD (6 times);

e) Canal Pump - no elevated results.

Considering the source of most surface water samples, the quality is strikingly good, particularly from the standpoint that nitrates and trace metals (not shown in the tables) have remained low in all surface water analyses. Of special note is the fact that Canal Pump samples, which are most representative of surface water discharged from the site, show no indication of water quality deterioration.

MONITORING PROGRAM MODIFICATIONS

The evaluation of monitoring at Tomoka Landfill indicates that, as should be expected, the impact of solid waste disposal can be detected in nearby ground- and surface water. Collected data suggest, however, that the impact is confined to the margins of the disposal area, and that constituents which are hazardous or harmful to the environment are absent. The evaluation also reveals several areas where modifications to the monitoring program will improve the effectiveness of data collection, thereby increasing the reliability of subsequent site assessments and accomodating plans for future expansion of the disposal area.

Wells. The recommended network of monitoring wells is listed in Table 23, and shown in Figure 10. Explanatory remarks are as follows:

1. Wells FA-1B and FA-2B are intended as replacements for existing Floridan Aquifer monitors FA-1 and FA-2. As discussed, the small amount of water emanating from the upper part of the existing boreholes is diluted by water from deeper in the aquifer, obscuring any changes that might be observed as a result of vertical leakage. This situation could be corrected by cementing back the wells, but the cost to do this properly would nearly equal the cost of new wells, and the possibility of complications or mistakes is very real. New wells should be constructed at least 25 feet from existing wells. Only enough borehole to allow efficient sampling should be drilled (probably 10± feet). Existing wells should not be abandoned, but capped for possible future monitoring use.

2. Wells B-1 and MO-5 are downgradient and near the margins of the old disposal area. They should be included in the water quality monitoring program.

3. Well B-3B is proposed as a new well to replace Well 3B, which had to be abandoned when the scale house was constructed. This well should be located at least 200 feet from

Table 23. Proposed Monitor Well Network

Well	Type of Monitoring[1]	Remarks
FA-1B	Q_w, W.L.	new well to replace FA-1
FA-2B	Q_w, W.L.	new well to replace FA-2
B-1	Q_w, W.L.	existing; add Q_w
B-2	Q_w, W.L.	existing, no change
B-3B	Q_w, W.L.	new well to replace B-3
B-4	Q_w, W.L.	existing, no change
B-5	Q_w, W.L.	existing, no change
B-6	Q_w, W.L.	existing, no change
B-7	W.L. only	existing; currently unmonitored
B-8	W.L. only	new well
B-9	W.L. only	new well
MO-5	Q_w, W.L.	existing; add Q_w
Scale House	Q_w only	existing, no change

[1] Q_w = water quality
W.L. = water level

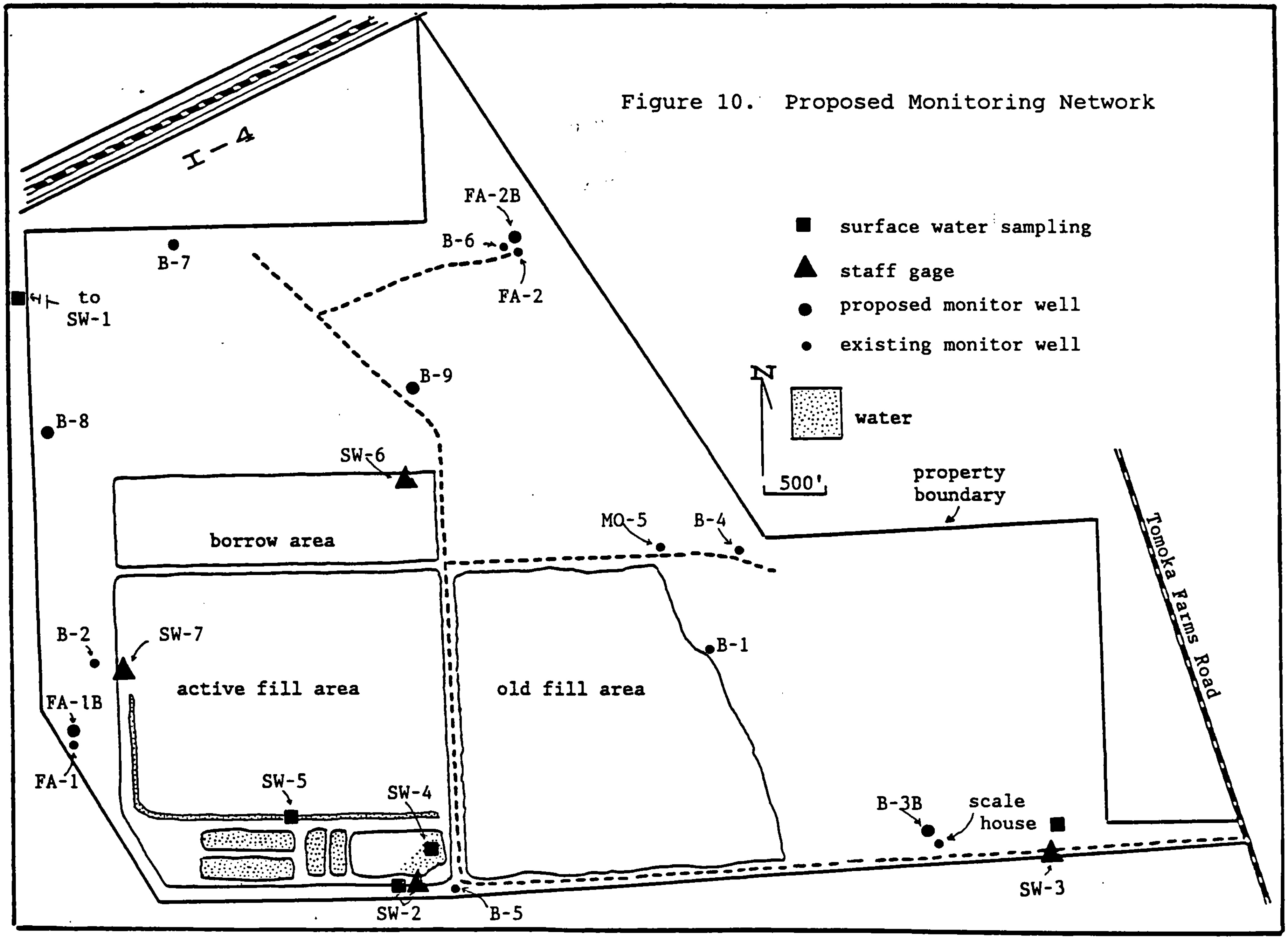

Figure 10. Proposed Monitoring Network

the drainage ditch along the south property boundary, and screened approximately 5 feet into the first permeable stratum that is 10 or more feet below ground.

4. Wells B-7, B-8, and B-9 are proposed only for water level monitoring. Locations were selected to compliment other sites and, in so doing, provide areal coverage sufficient to determine gradients and groundwater flow directions. As the waste disposal area expands in future years, one or more of these wells can be included in the water quality program. Wells B-8 and B-9 should be constructed similarly to Well B-3B (above).

5. The scale house well, which has been sampled in place of abandoned Well B-3, should continue to be sampled. Other wells that furnish water for operational purposes, whether existing or constructed in the future, should routinely be included in the water quality program.

Surface Water Sampling. Locations recommended for collection of surface water samples are shown on Figure 10. Five sites are proposed, versus four that are included in the existing approved monitoring program. This is not an increase in the number of total sites, however, as it is reccommended that NPDES sites be incorporated into the network. Relevant comments on the suggested changes are as follows:

1. The five locations are a) SW-1, an off-site borrow pit near the northwest part of the site, and co-incident with existing NPDES-1; b) SW-2, the Canal pump site (DER 64A71SO3), which is approximately co-incident with NPDES #2; c) SW-3, a site (NPDES-3) along the eastern portion of the southern, roadside drainage ditch; d) SW-4, the Canal Swamp, co-incident with existing DER site 64A71SO8; e) SW-5, the discharge end of the interior, leachate-collection ditch.

2. The Weir location (DER 64A71SO4) is proposed for elimination because it is essentially duplicated by sampling at the Canal Pump and Swamp sites.

3. Pond A (DER 64A71SO2) is proposed for elimination because it furnishes little in the way of useful information. Results from SW-2, 4 and 5 will provide a firmer basis for evaluating the effectiveness of leachate treatment than is currently supplied by data from Pond A.

4. SW-5 is proposed as a new site to monitor water quality in the interior leachate collection system of the active landfill area.

5. SW-3 (NPDES-3) is proposed for inclusion in the network because it monitors water quality near where discharge leaves the property, and also because seepage from the old fill area would be detected at this location.

Water Levels. Monthly collection of water level data has provided useful and accurate information that has aided in evaluating the behavior of the groundwater flow regime. This effort should be continued, and expanded to incorporate new or reactivated monitoring wells. In addition, the installation of 4 staff gages is proposed, at locations shown in Figure 10. Relevant comments regarding these staff gages are as follows:

1. Gage SW-6 will measure water levels in the dewatering ditch along the north side of the borrow agea. It will provide data concerning the rate and direction of groundwater flow and, should it become desirable, can be correlated with dewatering volumes removed from the area.

2. Gage SW-7 will monitor water levels in the perimeter ditch along the western side of the active fill area, providing information on groundwater flow directions in that area. It will also be useful for an assessment of the leachate containment function of the ditch, and for preliminary evaluation of design features of other potential hydraulic barriers.

3. Gage SW-2 will monitor water levels on the discharge side of the weir, for a general indication of discharge volumes and groundwater flow in that area.

4. Gage SW-3 will monitor water levels and groundwater flow near where discharge exits the site. Coupled with rainfall data and the possibility for quantitative calibration against actual discharge volumes, data from this and other staff gages will support a better understanding of site hydrology.

Water Quality. Choices regarding analytical parameters and sampling frequency for water quality monitoring are beyond the scope of this document, as they are largely specified by DER. Recommendations that will assist in landfill evaluation and management, regardless of DER specifications, are:

1. At a minimum, water samples should be analyzed for Cl, Conductivity, TDS, Fe, pH and COD, whether or not these parameters are conditioned by permit.

2. Constituents that are not specified by permit or listed above should not be determined. These may include Ca, Mg, K, NH_3, and organic N, among others. Omitting unneeded constituents will allow the budget for monitoring to be used to better advantage.

Rainfall. Rainfall data are easy, inexpensive, and enjoyable to collect, and will be useful for correlation with water levels, discharge volumes, and water budgets. A nice automatic gage that totalizes monthly and yearly rainfall can be had for about $300. A fence-post type gage ($5) will also work, but is more prone to human error, requires daily attention, and is less reliable on weekends. Whichever device is selected, it is recommended that a rainfall gage be installed and the collection of daily rainfall records begun.

Data Review. The purpose of monitoring at the landfill is to provide assurance of a contained impact or, failing that, to signal early a broader, less acceptable impact. In the latter case, the monitoring network should be sufficiently extensive to allow an understanding and predictions regarding origins, causes, and, ultimately, corrective measures. These objectives are ill-served if the monitoring network is adequate but monitoring data are not periodically reviewed. It is therefore recommended that, no less than annually, accumulated water level and water quality data be evaluated. This evaluation should include data reduction, graphical analysis, and a written summary of results and interpretations.