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NAS WHITING FIELD
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PROPOSED MONITORING PROGRAM REPORT FOR BATTERY SHOP NAS WHITING FIELD FL

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GERAGHTY & MILLER, INC.

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Geraghty & Miller, Inc.

PROPOSED MONITORING PROGRAM FOR BATTERY SHOP NAS WHITING FIELD, FLORIDA

Prepared for

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION, NAVAL FACILITIES ENGINEERING COMMAND
Charleston, South Carolina

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INTRODUCTION

Whiting Field Naval Air Station is a pilot training facility located 5 miles north of Milton, Florida. Wastes generated at the station have been disposed at a number of locations on base including a battery repair site (Figure 1). A meeting held November 20, 1984 with representatives of the United States Navy, the Department of Environmental Regulation, and Geraghty & Miller, Inc., discussed a procedure to detect contaminants which may be present in the soil and ground waters surrounding the disposal area. Representatives agreed that a detection program would provide necessary data to evaluate the need for an assessment program should the detection program support further study. Presented herein is the hydrologic setting of the battery repair site, the proposed location and construction details of proposed monitor wells, and water-quality and soil-sampling analysis plans compiled from suggestions made at the November 20th meeting.

BACKGROUND

The battery shop has been the site of waste acid or electrolyte solution disposal from 1967 until 1984 (Figure 2). Waste solutions were poured down a sink drain which discharged to a dry well west of the building. The dry well consists of a section of 60-inch-diameter concrete culvert set vertically in the ground and filled with gravel. This disposal method has since been discontinued. This site is of

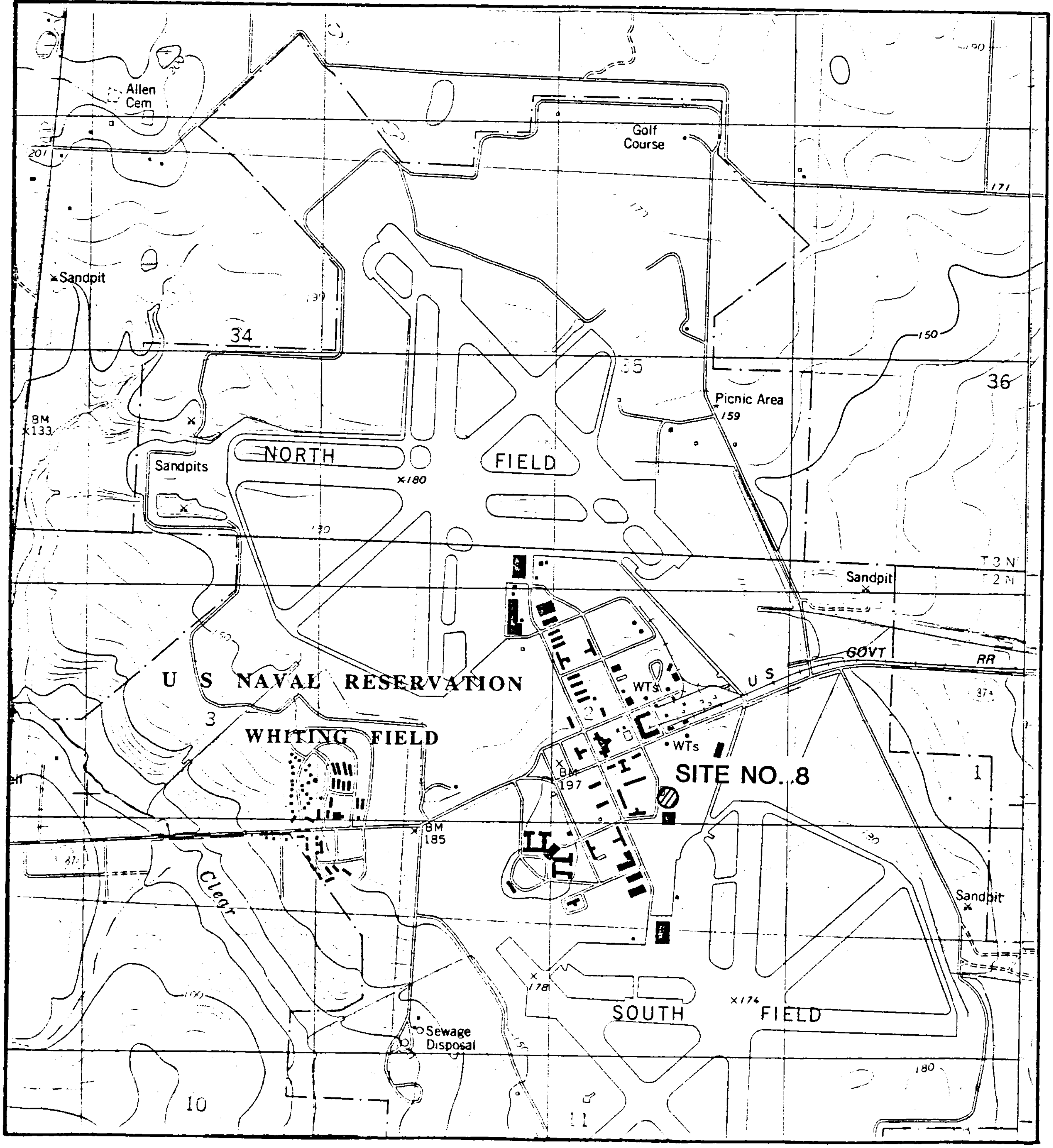


Figure 1. Regional Map Showing the Location of the Battery Shop (Site No. 8).

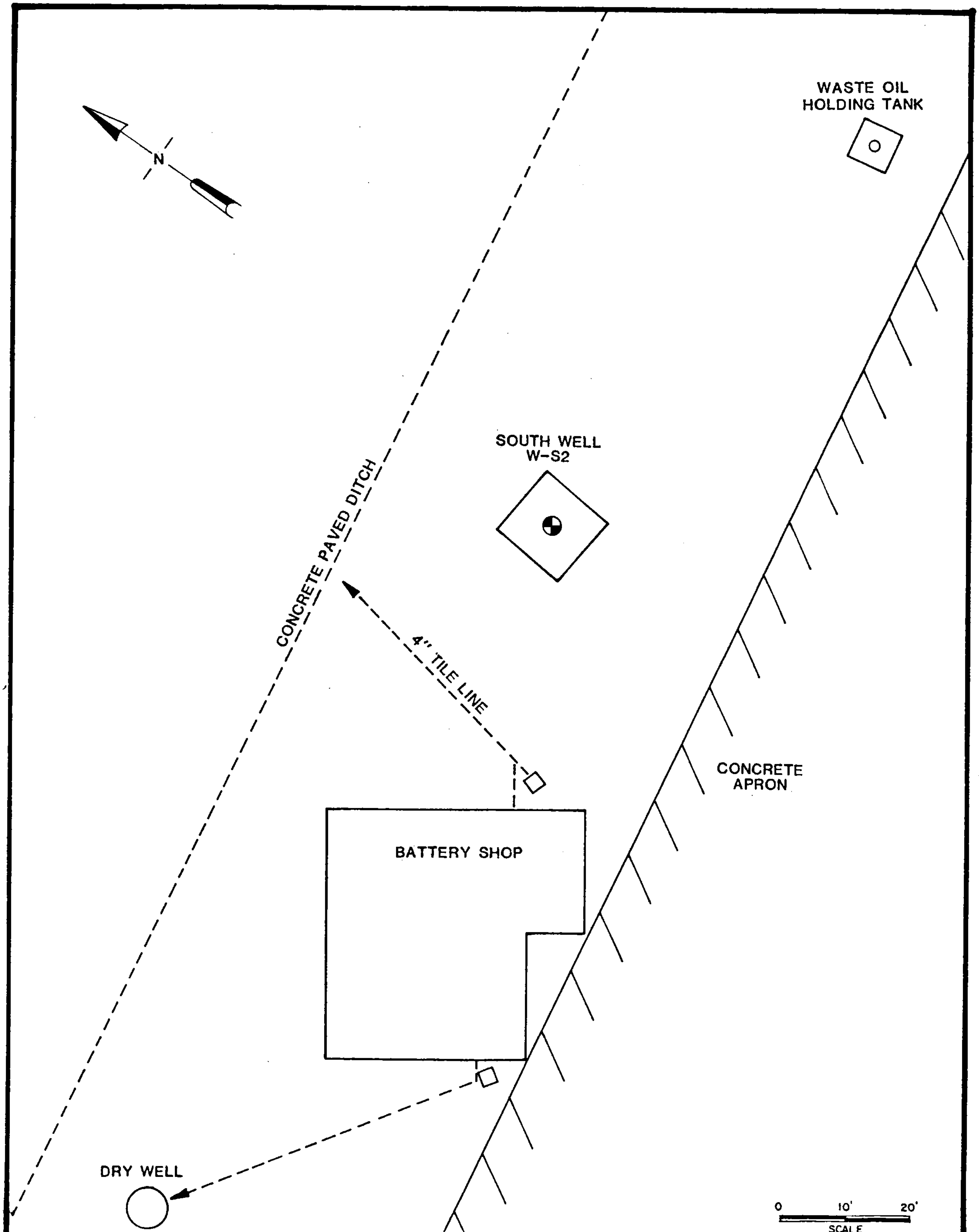


Figure 2. Detailed Location of Battery Shop.

particular concern because the dry well is located only 110 ft (feet) from the south production well (W-S2). Water from the south well has been recently sampled for primary drinking water standards (Appendix B, Table B-1) and show metal concentrations below primary drinking water standards.

WELL INVENTORY

Essentially, all potable and industrial water supplies in the Whiting Field vicinity are obtained from surficial sands known collectively as the sand and gravel aquifer, which extends from the surface to an approximate elevation of -150 ft msl (feet mean sea level). Screen settings are at depths of about 150 to 350 ft depending on surface elevation and the occurrence of clay lenses which lie at somewhat erratic depths. An inventory of wells within one mile of the waste disposal sites is presented in Table 1 and the locations of the wells are shown in Figure 3. The area includes most of Whiting Field and small residential neighborhoods south and east of the base.

Potable water on base is currently supplied by 3 wells, the north (W-N4), south (W-S2), and west (W-W3) wells; however, these are only the latest in a sequence of wells which have been replaced because of insufficient capacity or poor water quality. When the base was built in 1943, 3 wells were drilled, the original north (W-N1), south (W-S1), and west (W-W1) wells. In 1951 these wells were abandoned and replaced by new wells (W-N2, W-S2, and W-W2, respectively)

Table 1. Inventory of Wells Within One Mile of Disposal Sites.

Well Designation	Owner	Date Installed	Casing Diameter (inches)	Surface Elevation (ft msl)	Total Depth (ft msl)	Screened Interval (ft msl)	Gravel Pack Interval (ft msl)	Status
W-N1	Navy	1943						Abandoned 1951
W-N2	Navy	1951	16	168.1	(-256.4)	(-1.4)- (-31.4)	60- (-31)	Not in use
W-N3	Navy	1975		171.5	(-58.5)	36.5- (-23.5)		Abandoned 1975
W-N4	Navy	1975	16/12	180.0	(-38)			In use
W-W1	Navy	1943						Abandoned 1951
W-W2	Navy	1951		197.6	(-157.4)	14.1- (-47.0)		Abandoned 1965
W-W3	Navy	1965		180.0	(-35.0)	10.0- (-30.0)	80- (-30)	In use
W-S1	Navy	1943						Abandoned 1951
W-S2	Navy	1951		181.5	(-159.5)	12.0- (-33.0)	17- (-33)*	In use
P-3	Point Baker Water System	1978		200**	(-20)**			In use
P-4	Point Baker Water System	1983						In use
USGS	U.S. Geological Survey	1974	6	125.0	(-1165)	Cased to (-860)		Monitor well

* Assumed
** Estimated

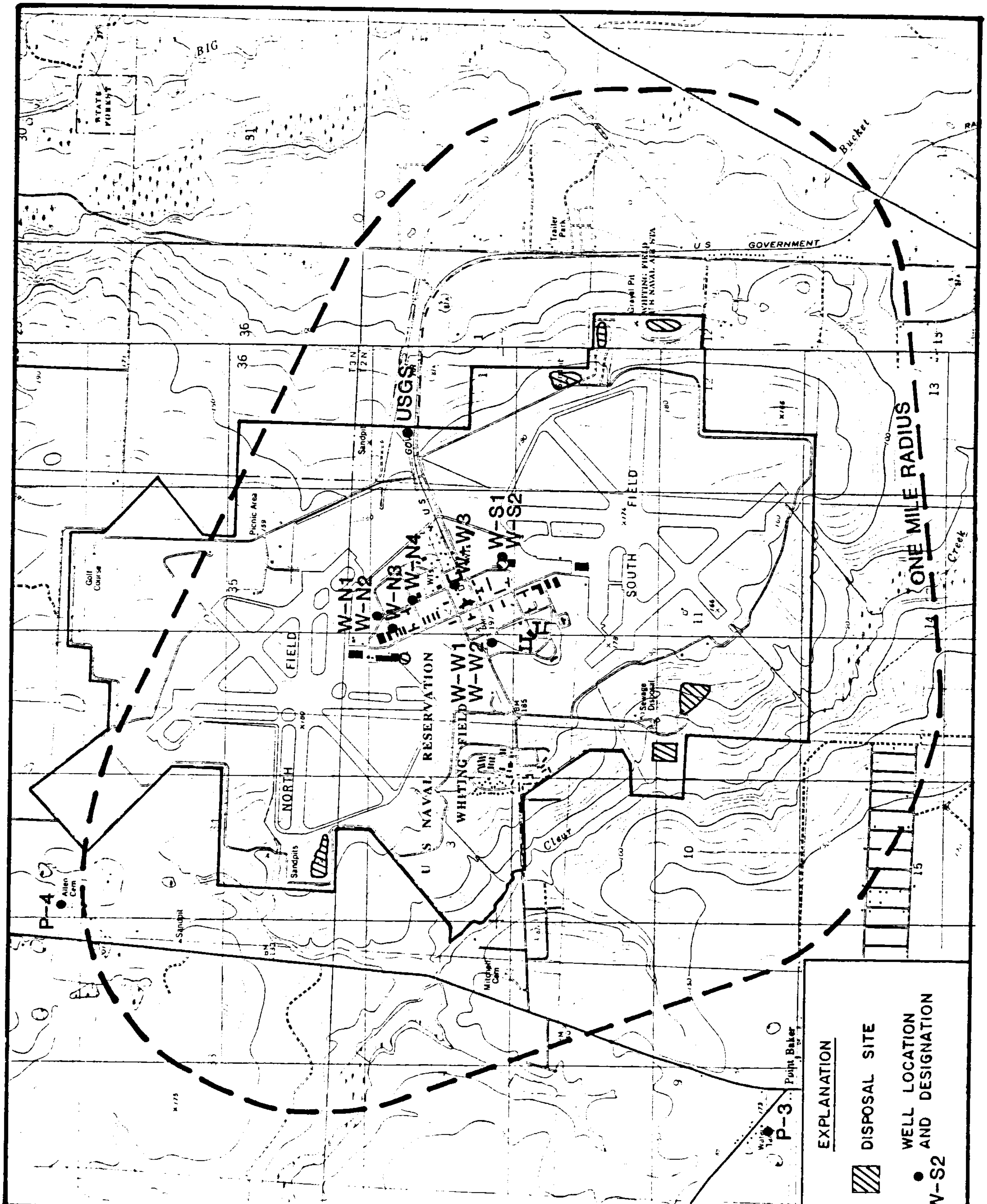
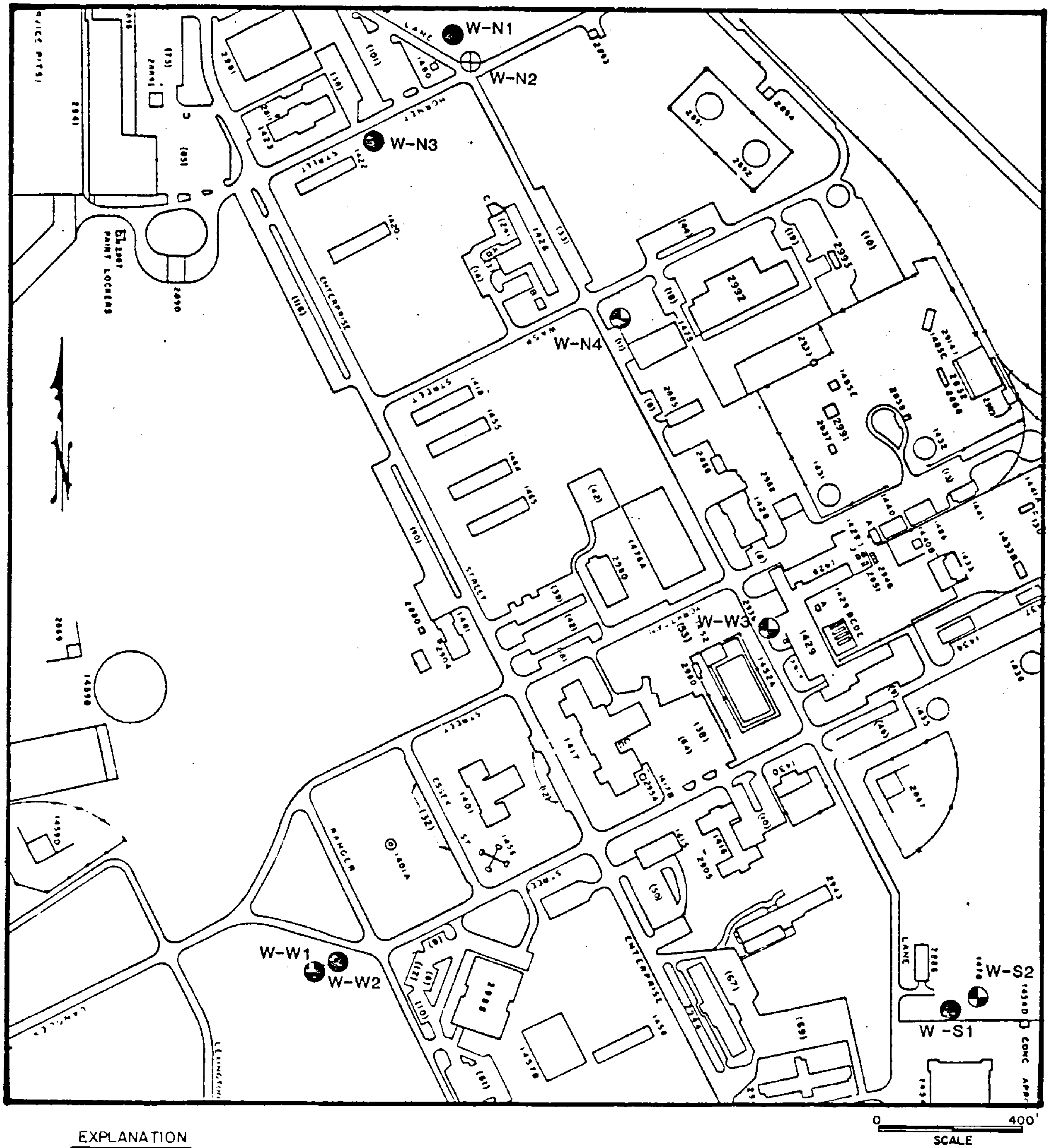


Figure 3. Locations of Wells Within One Mile of Battery Shop.

within 75 ft of the original wells. The new wells were probably constructed to deliver increased yields. The west and north wells, however, contained objectionable levels of iron and were replaced by W-W3 in 1965 and W-N3 in 1975, respectively. The replacement north well, which was drilled as a test well, was also found to have an unacceptable iron concentration and was subsequently abandoned and replaced by the currently used north well (W-N4). Locations of the Navy wells are shown in Figure 4. Current average pumpage from the wells at Whiting Field is: North well, 438 gpm (gallons per minute); West well, 479 gpm; and South well, 474 gpm. Flow from the three (3) active supply wells is combined before entering the distribution system.

Water for the City of Milton is supplied by five (5) wells, for East Milton by two (2) wells, and for the Point Baker-Allentown area by three (3) wells, all of which are screened in the sand and gravel aquifer and all of which are outside of the one-mile radius; however, two of the Point Baker wells (P-3 and P-4) are so close that they are included in the inventory. Average pumpage from these two wells is: P-3, 500 gpm; and P-4, 200 gpm. Water from the Point Baker system is available to residences west and north of Whiting Field, and water from the Milton system is available to those east and south of Whiting Field. It is believed that few if any private wells in these areas are still used.



EXPLANATION

SUPPLY WELLS

ACTIVE

INACTIVE

ABANDONED

Figure 4. Locations of NAS Supply Wells

HYDROGEOLOGIC SETTING

Topography and Drainage

Whiting Field is located on an upland area isolated on three sides by the erosion of the deep valleys of Clear Creek on the south and west, and Big Coldwater Creek on the east, both of which are tributary to Blackwater River to the south. Topographic relief from the highest part of Whiting Field to Blackwater River is almost 200 ft. Ancient marine terraces can be seen in the nearly level upland surface and on the valley slopes southeast of the base at elevations of 70 and 30 ft msl.

Because of the relatively steep valley walls, erosion became a serious problem when the land was disturbed for construction of the base. Soil conservation measures in the form of extensive contouring and construction of large paved ditches were instituted to transmit surface runoff down the slopes with minimal erosion. A system of ditches and storm sewers was also constructed to drain the upland area of the base. These and other surface-water drainage lines are shown in Figure 5.

Geologic Framework

The geologic sequence of layers underlying Whiting Field is illustrated in Figure 6, a composite geologic column constructed from published data and logs of wells in the

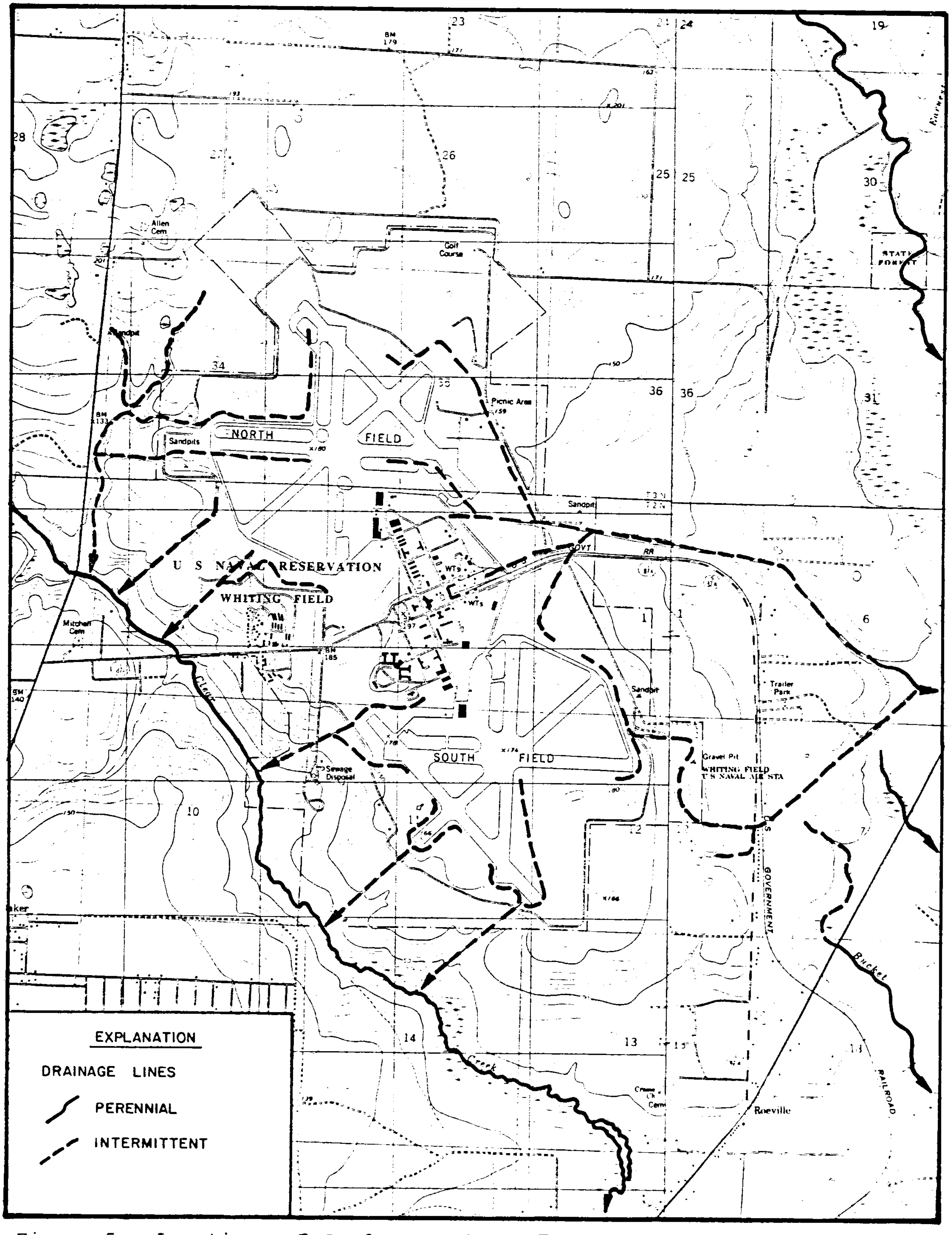


Figure 5. Locations of Surface Drainage Features.

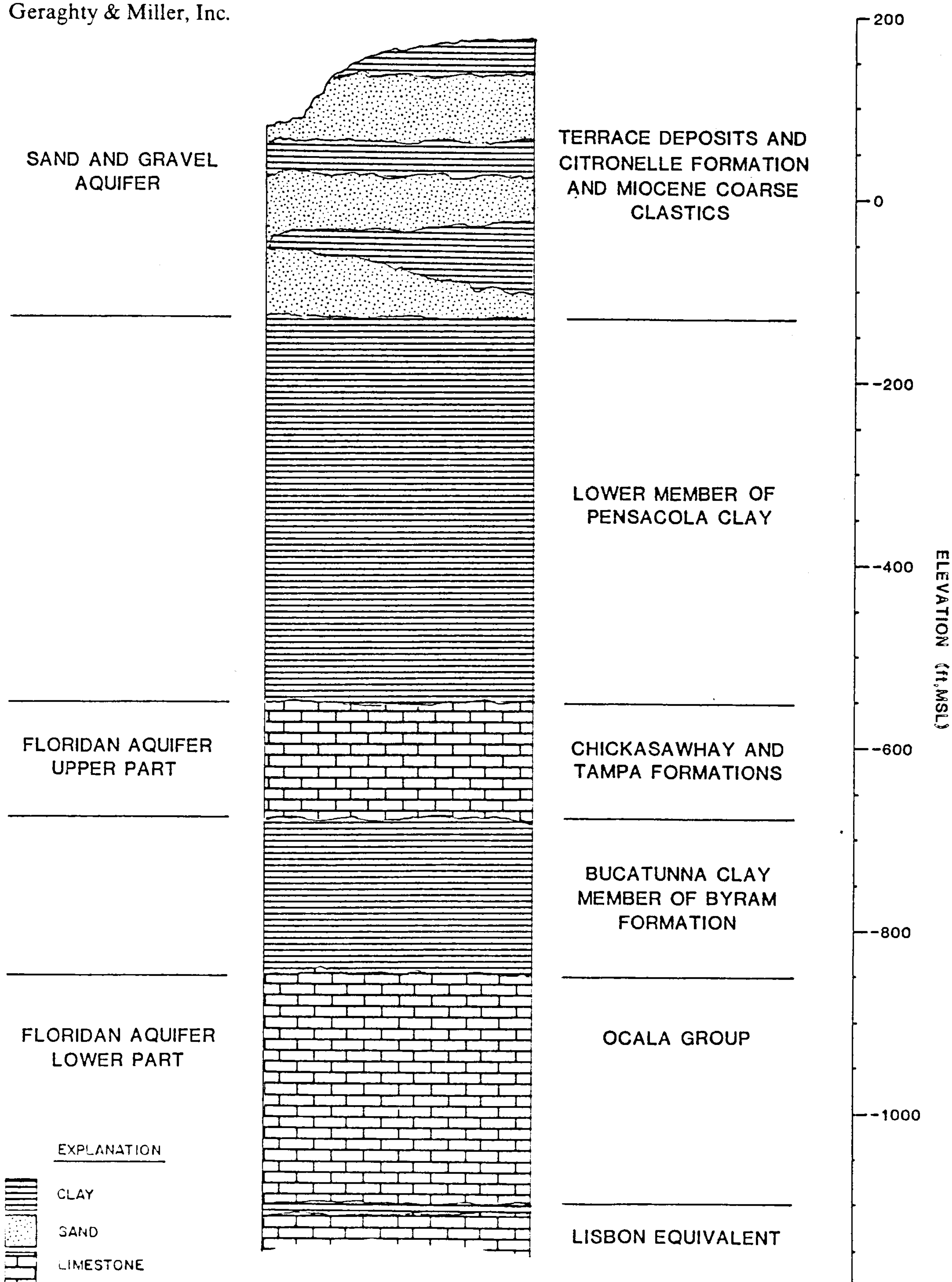


Figure 6. Generalized Geologic Column Representative of the Whiting Field Area.

area. Lithologic logs of borings and wells in the Whiting Field area and their locations are included in Appendix A.

The uppermost sediments extending to a depth of about 350 ft comprise the so-called sand and gravel aquifer. It is underlain by the relatively impermeable Pensacola clay, below which are thick layers of limestone and shale to a depth of nearly 2,000 ft.

Sand and Gravel Aquifer

The sand and gravel aquifer includes the upper Miocene coarse clastics, the Citronelle formation, and marine terrace deposits, three units which have similar hydraulic properties and sometimes are indistinguishable. The aquifer consists of poorly-sorted, fine to coarse sands with gravel and lenses of clay which may be as much as 60 ft thick. In some areas, the formation also contains wood fragments of all sizes, including whole tree trunks, occurring mostly in layers which may be as much as 25 feet thick (Marsh, 1966); however, logs of wells drilled on base do not indicate the presence of wood fragments in the immediate area.

The formation contains lensatic zones within the sand which are cemented by iron oxide minerals. These lenses, known locally as "hardpan", have low permeabilities, and along with the clay lenses, are responsible for the occurrence of perched water tables and artesian conditions in the aquifer. In the Whiting Field area, major clay lenses occur in the uppermost 30 ft and in the depth interval of approximately 110 to 170 ft (elevation 10-70 ft msl). The vertical positions of these clay lenses in relation to the screened intervals of the NAS supply wells is shown in Figure 7. Although the clays appear to be continuous, they may contain permeable zones.

Floridan Aquifer

The limestone layers constitute the regionally extensive Floridan aquifer, which in this area is divided into an upper and lower part separated by the Bucatunna clay. The upper Floridan aquifer is an important source of water in areas east of Santa Rosa County; however, toward the west, it is increasingly mineralized and is generally not used as a water supply. The lower Floridan aquifer is highly mineralized in the Whiting Field area and is, in fact, designated for use as a waste-disposal injection zone. Chemical analyses of water from the upper and lower parts of the Floridan aquifer are included in Appendix B, Table B-2.

Subsurface Hydrology

The potentiometric surface of the upper Floridan aquifer at Whiting Field is approximately 50 ft msl and has been declining because of heavy pumpage from the aquifer at Fort Walton Beach. Ground-water movement in the aquifer is toward the southeast as can be seen in the potentiometric surface map of Figure 8. The potentiometric surface of the lower

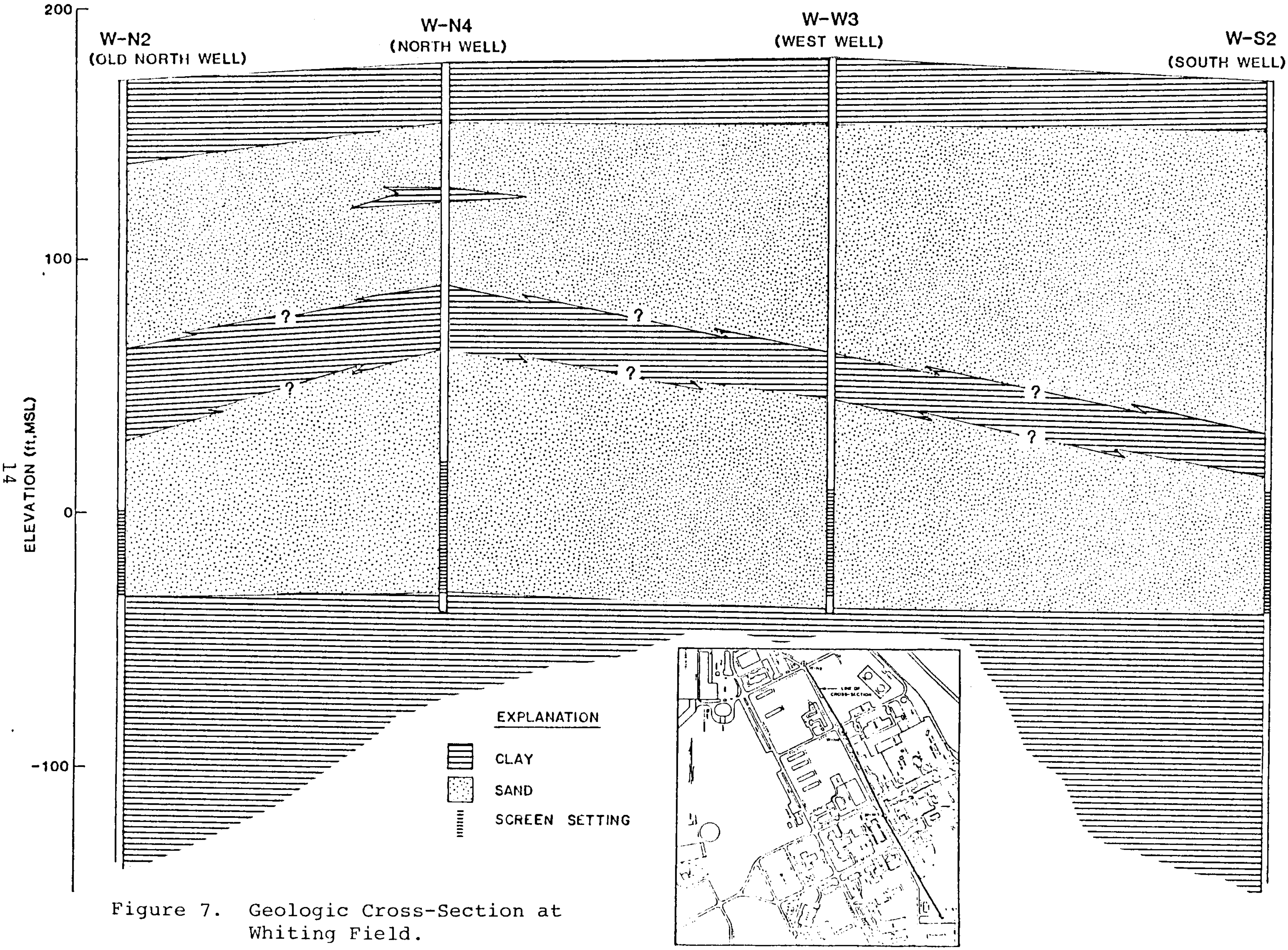


Figure 7. Geologic Cross-Section at Whiting Field.

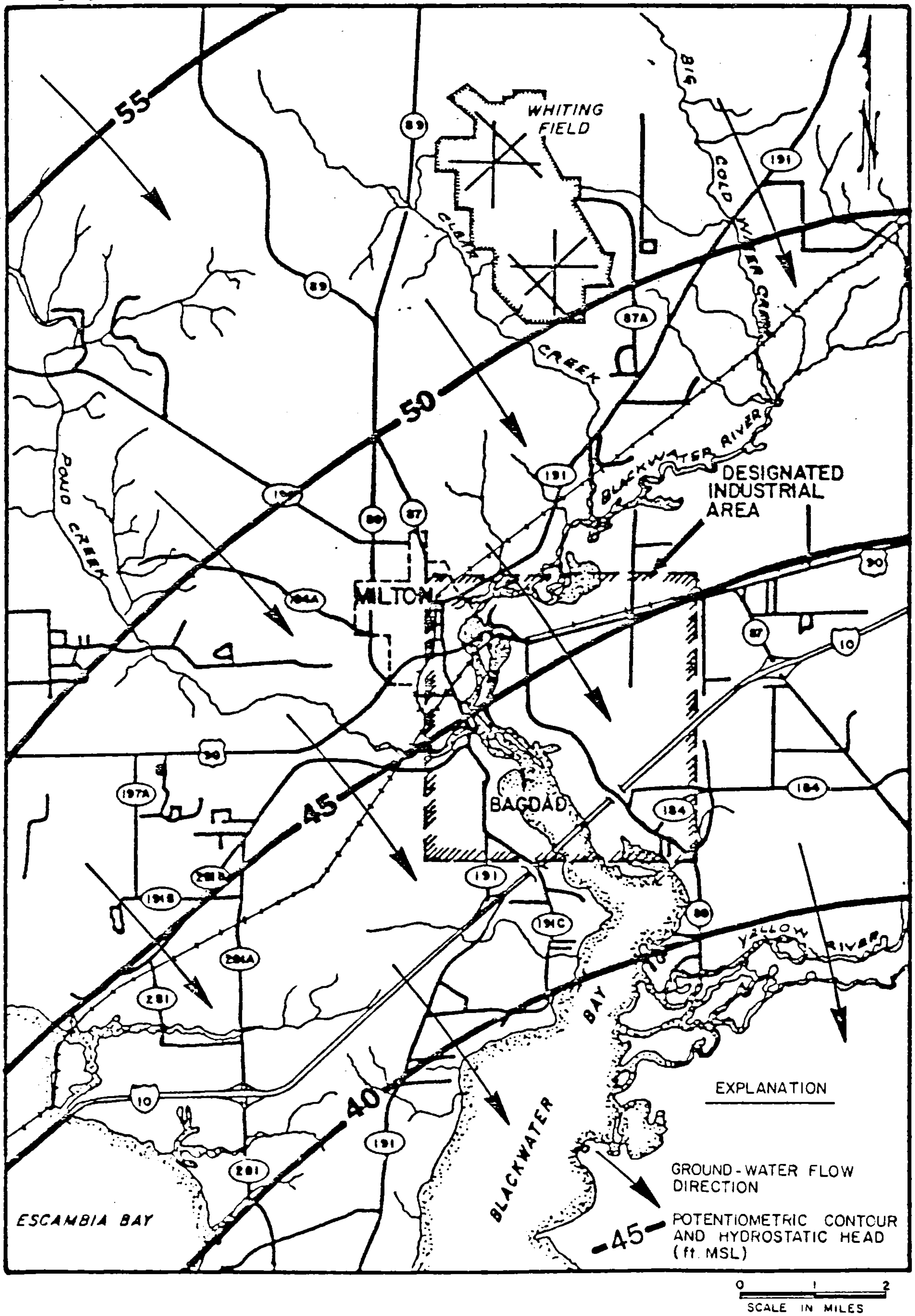


Figure 8. Contour Map of the Potentiometric Surface of the Upper Floridan Aquifer in the Whiting Field Area, 1980.

Floridan aquifer has increased by several feet to approximately 130 ft msl since 1974 because of waste injection at nearby industrial plants (J.B. Martin, USGS, 1984, oral communication). There is, therefore, a potential for upward movement of water from the lower to the upper Floridan; however, the intervening Bucatunna clay has a low permeability and allows essentially no flow between the two aquifers. Recharge to the upper Floridan occurs primarily in northern Santa Rosa County and southern Alabama, where the aquifer is at or near the surface.

In the sand and gravel aquifer, static water levels at Whiting Field range from approximately 70 ft msl in the center of the station to about 30 ft msl along Clear Creek and Big Coldwater Creek. This, along with the low permeability of the confining deposits (Pensacola clay), indicates little potential for movement of ground water vertically between the Floridan and the sand and gravel aquifers.

Ground-water flow in the saturated portion of the sand and gravel aquifer is nearly horizontal. Shallow ground water normally moves from topographic highs to areas of discharge, such as streams. Figure 9, which was prepared using the surface topography, shows inferred directions of ground-water flow within the sand and gravel aquifer. These flow lines do not, however, reflect the influence of cones of

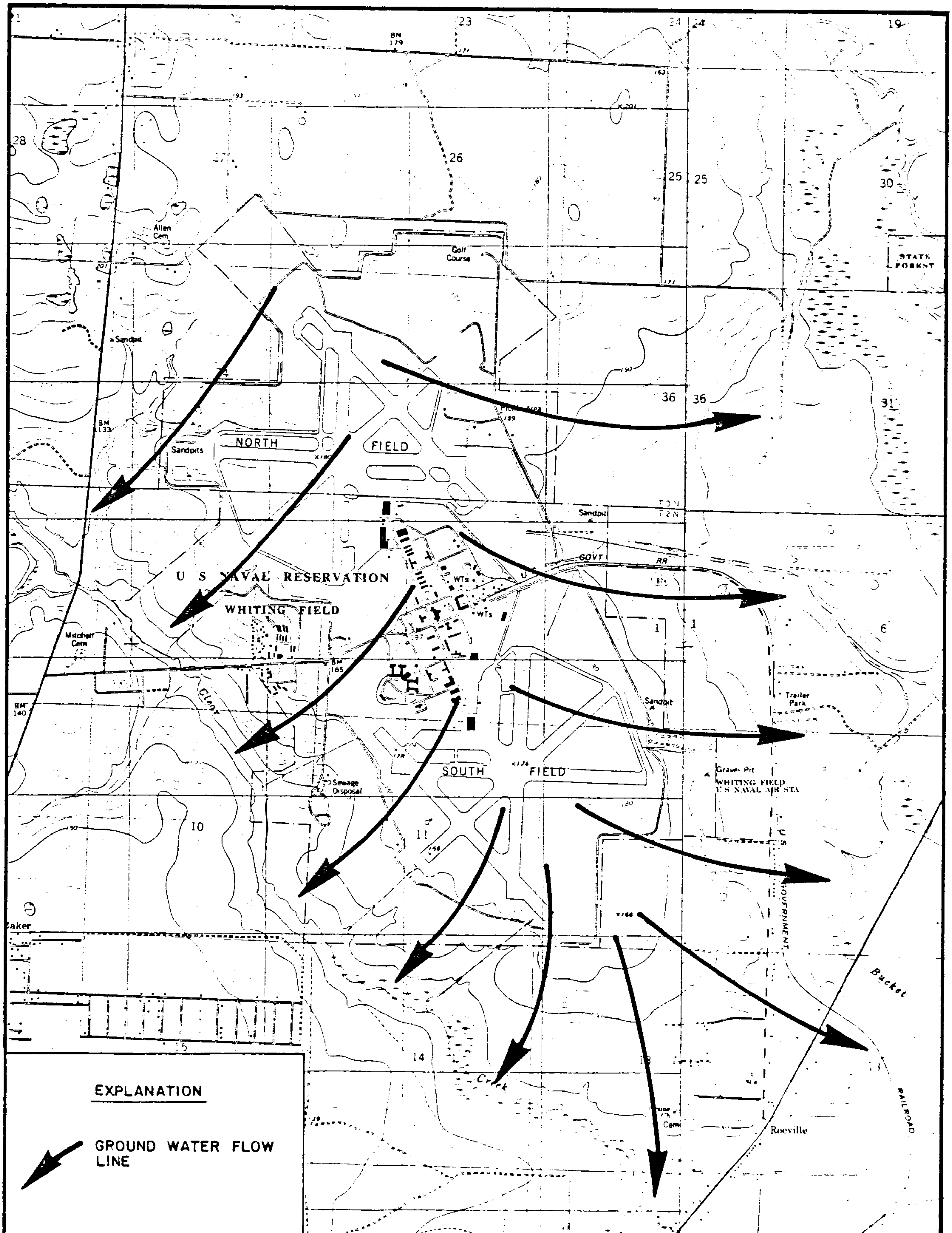


Figure 9. Inferred Directions of Ground-Water Movement in the Sand and Gravel Aquifer.

depression which occur around the three Navy production wells.

The sand and gravel aquifer is recharged by infiltration of rainwater at the surface. The downward movement of water through the unsaturated zone is interrupted at clay layers, above which perched water tables may exist. Flow in the perched saturated zones is primarily horizontal with some downward leakage through the clay, depending upon its vertical permeability.

The following specific capacities were determined from test pumping of the 1951 NAS wells:

W-N2	16.7 gpm/ft (gallons per minute per foot of drawdown)
W-W2	23.0 gpm/ft
W-S2	21.7 gpm/ft

From these values, an average transmissivity for the pumped zone of the sand and gravel aquifer is estimated to be about 37,000 gpd/ft (gallons per day per foot). This agrees rather well with a transmissivity of 54,600 gpd/ft determined from a pumping test at Milton (NWFWMD, 1980).

WATER QUALITY

As noted above, the upper and lower Floridan aquifers are highly mineralized whereas the sand and gravel aquifer contains water of generally good quality, as do Big Coldwater Creek and Blackwater River, the baseflows of which are maintained by discharge from the sand and gravel aquifer.

Total dissolved solids and total hardness of water in the sand and gravel aquifer generally are less than 50 ppm (parts per million) and nitrate is about 1 ppm. However, because of high levels of dissolved carbon dioxide, the water is acidic with a pH of 5.0 to 5.5 and locally high concentrations of iron are found. Results of chemical analyses of ground water and surface water are contained in Appendix B.

PROPOSED MONITORING PROGRAM

The following program is proposed to evaluate the impact that disposal of fluids from the battery shop may have had on soils and ground waters. The program consists of the drilling of soil borings and installation of monitor wells from which water-quality analyses will be performed. These data will then be used to assess whether or not soils and ground waters in the vicinity of the dry well have been adversely affected.

Soil Boring and Monitor-Well Program

A soil-boring program will be undertaken to define the subsurface geology in the vicinity of the dry well and to collect core samples for chemical analyses. Initially, a soil boring will be drilled adjacent to the dry well (see Figure 10) to the top of the first confining unit (± 120 ft).

Shelby tube or split-spoon samples will be collected on 5-ft centers during the drilling and the core samples of the surficial clayey sediments will be submitted to a water-quality laboratory for chemical analysis. After this boring has reached its total depth, it will be converted to a temporary monitor well in order to determine the depth to water. Thereafter, the boring will be redrilled to its total depth and cemented back to land surface with a neat cement grout.

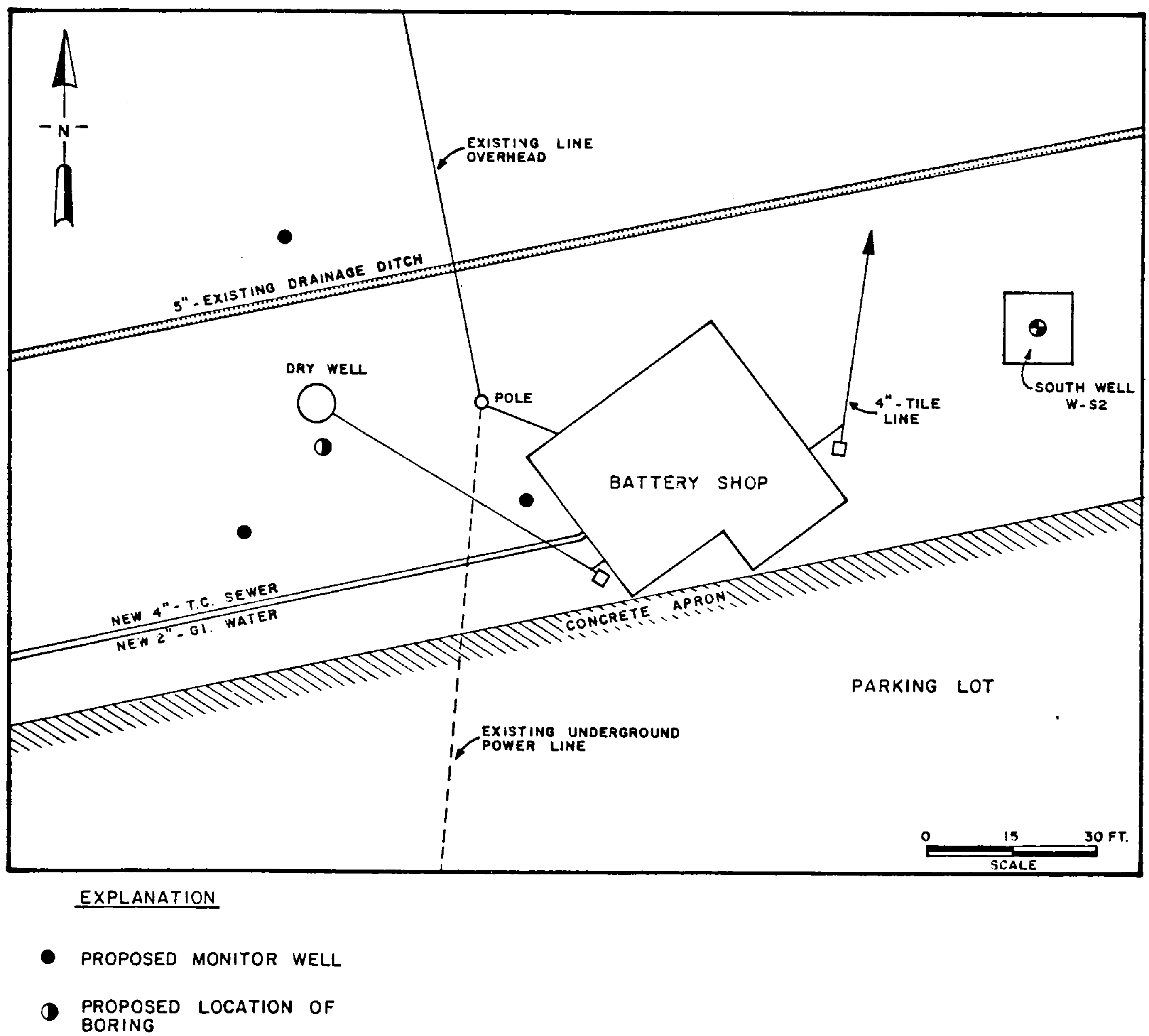


Figure 10. Map Showing the Proposed Locations of Soil Borings and Monitor Wells at the Battery Shop.

Based on the data collected, three additional soil borings will be drilled at the monitor-well locations shown in Figure 10. During the drilling of these borings, Shelby-tube samples will be collected on 5-ft centers of the surficial clays and these will be preserved for possible future chemical analyses. During the drilling of all borings, a representative from Geraghty & Miller, Inc., will be present to describe the physical and mineral characteristics of the sediments encountered.

The monitor wells will tap the first saturated zone and will be constructed by the mud-rotary method of drilling. After the borehole is drilled to its total depth, the well casing and attached well screen will be inserted into the borehole and the annulus around the well screen will be gravel packed by the tremie method. The annulus above the gravel pack will be grouted, using a neat cement grout by the tremie method, up to land surface. Upon completion, each monitor well will be adequately developed and will be protected at land surface by a metal protective casing. Sections of casing and screen will be joined by threaded couplings without the use of PVC bonding cement and the drilling equipment will be thoroughly cleaned before drilling each well in order to avoid cross contamination. Presented in Figure 11 is a diagram showing the typical construction details of the monitor wells.

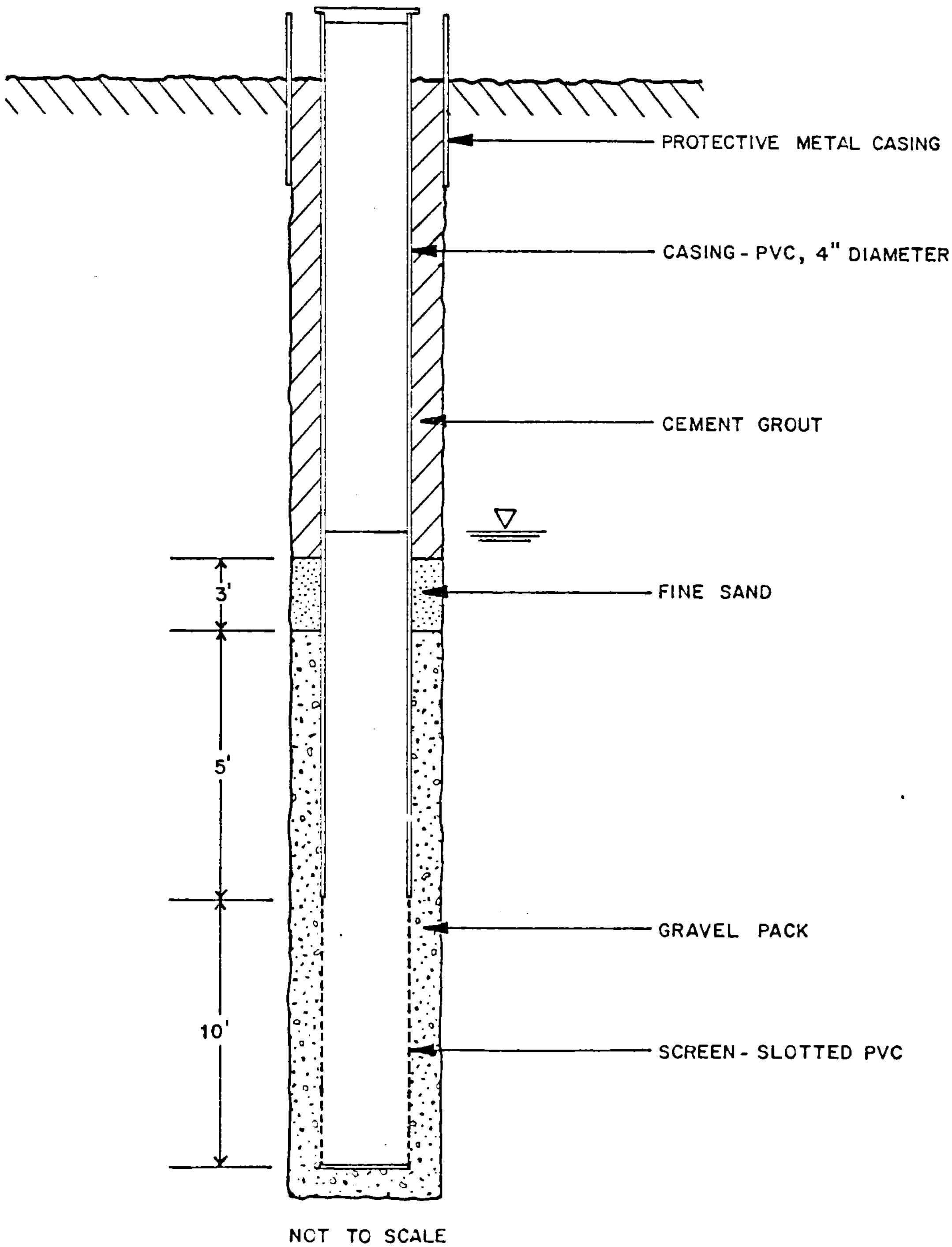


Figure 11. Schematic Diagram Showing the Typical Construction Details of the Monitor Wells.

After completion of the monitor wells, the elevations of tops of the well casing will be determined by a certified surveyor and water-level measurements will be collected in order to determine ground-water flow directions. Water-level elevations will also be collected in the south supply well (W-S2).

Sampling and Analysis Program

Soils

The Shelby-tube samples of the surficial clays (depth ± 30 ft) collected on 5-ft centers in the soil boring will be analyzed for pH and for EP toxicity for cadmium, zinc, lead, and nickel. These parameters were selected because two types of batteries have historically been used in the facility including nickel-cadmium, and lead-zinc batteries. In addition, destructive analyses will also be performed on the soils to determine total concentrations of these metals. If the analyses show that any of the four metals exceed the standards set forth in 40 CFR 261.24 Table 1, then the Shelby tube samples collected from the surficial clays at the monitor-well locations will be analyzed for EP toxicity for lead, zinc, nickel, and cadmium.

Ground Water

After completion of the monitor wells, water samples will be collected from each and analyzed for EPA's (Environmental Protection Agency's) priority pollutants and

FDER's (Florida Department of Environmental Regulation) primary drinking-water standards. Thereafter, quarterly samples will be collected for one year (second through fourth quarters) and analyses will be conducted for pH, specific conductance, lead, zinc, nickel, and cadmium, and for those constituents that exceeded FDER's primary drinking-water standards and any organic constituents detected during the first quarter sampling.

Yield Test

Upon construction of the three monitor wells, a yield test (pump test) will be performed on the south supply well (W-S2) to determine water-bearing characteristics of the aquifer system. Periodic water-level measurements in the monitor wells as well as the supply well will be collected during the eight-hour test. Since a water-use gauge is not installed on the supply well, the well will be pumped at its highest capacity for the duration of the test.

Reporting Schedule

Two reports will summarize the findings of the monitoring program. The first report will be submitted to the Department 120 days following the date of the Consent Order and will summarize the monitor-well construction details, results from the core-sample analyses for EP toxicity, and the results from the first round of water-quality analyses from the monitor wells. In the event that the chemical analyses show that the battery-shop operations have significantly affected soil and ground water, then this first report (as-built report) will contain a proposed ground-water and soils assessment program as outlined in Chapter 17-4.245(6)(d). The assessment program will be designed to determine the rate and extent of contaminants at the site.

If the data contained in the as-built report shows that soil and ground water has not been adversely affected, then a final report will be submitted to the Department 60 days following the final quarterly sampling results. This report will contain the results of all of the chemical analyses collected during the investigation, and will describe the need for further actions at the site, if required.

APPENDIX A

LITHOLOGIC LOGS

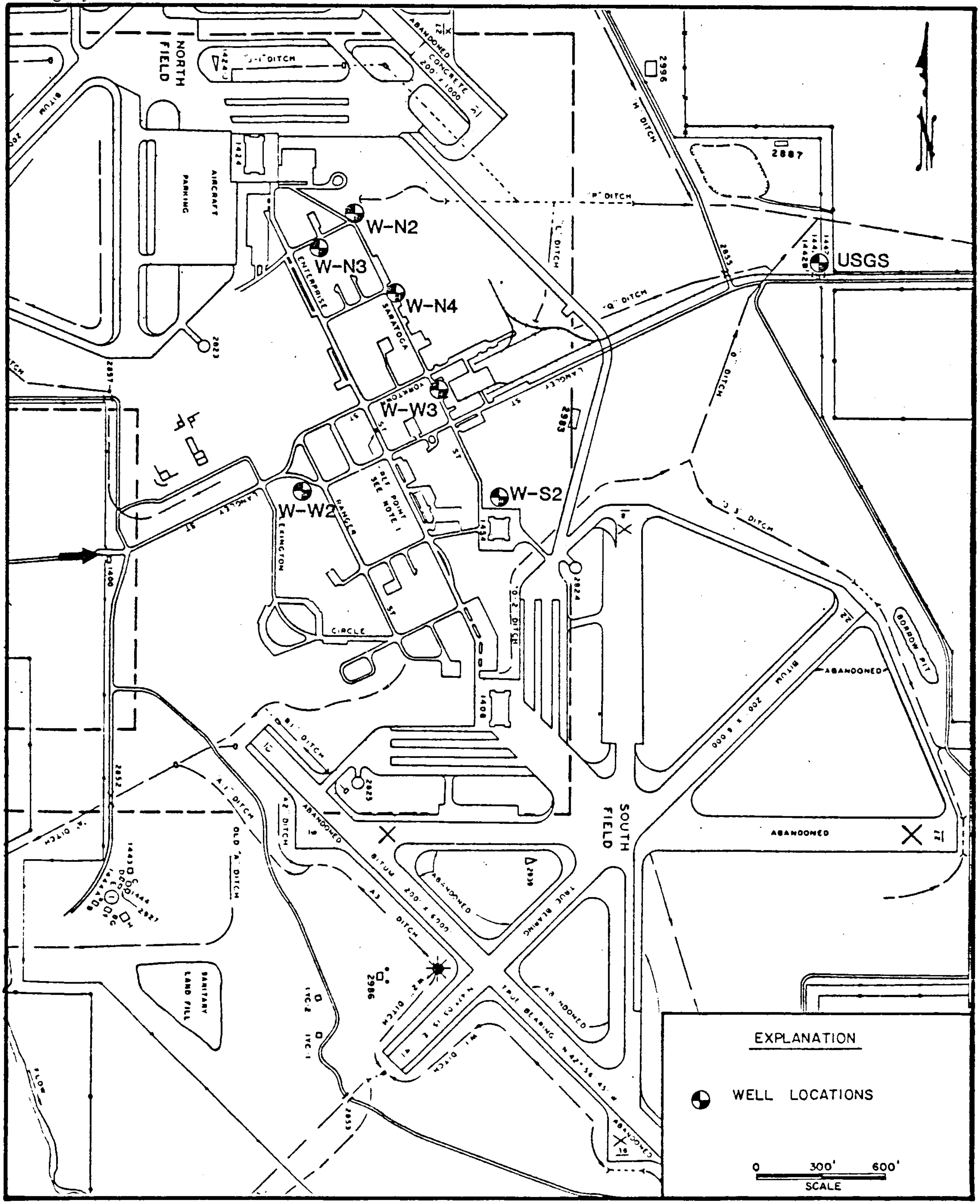


Figure A-1. Locations of Wells For Which Lithologic Logs Are Presented.

TABLE A-1. LITHOLOGIC LOG OF NAS OLD NORTH SUPPLY WELL

Well designation: W-N2
Surface Elevation: 168.1 ft msl

Depth (ft)	Description	Elevation (ft msl)
0 - 30	Sandy clay	168 - 138
30 - 44	Loose muddy sand and gravel	138 - 124
44 - 66	White sand with clay streaks	124 - 102
66 - 89	White sand with clay balls	102 - 79
89 - 102	Muddy sand	79 - 66
102 - 113	Clay	66 - 55
113 - 135	Yellow sandy clay	55 - 33
135 - 140	Clay	33 - 28
140 - 140.4	Rock	28 - 27.6
140.4 - 156	Muddy Sand	27.6 - 12
156 - 183	Pack sand, clay streaks	12 - (-15)
183 - 200	Brown pack sand with loose streaks	(-15) - (-32)
200 - 237	Sandy clay	(-32) - (-69)
237 - 254	Soft yellow clay	(-69) - (-86)
254 - 275	Muddy sand	(-86) - (-107)
275 - 304	Pack sand	(-107) - (-136)
304 - 312	Sandy shale	(-136) - (-144)
312 - 365	Hard sandy shale	(-144) - (-197)
365 - 424	Clay	(-197) - (-256)

TABLE A-2. LITHOLOGIC LOG OF NAS TEST WELL

Well designation: W-N3
Surface elevation: 171.5 ft msl

Depth (ft)	Description	Elevation (ft msl)
0 - 2	Topsoil	171 - 169
2 - 9	Sandy	169 - 162
9 - 22	Red clay to yellow chalk	162 - 149
22 - 27	Yellow sand, clay streaks	149 - 144
27 - 39	Clay	144 - 132
39 - 42	Coarse sand, clay stringers	132 - 129
42 - 52	Coarse sand, clay stringers, loose	129 - 119
52 - 62	Coarse sand, clay stringers, tight	119 - 109
62 - 75	Sand, cut well	109 - 96
75 - 80	Sand, tight	96 - 91
80 - 90	Sand, loose	91 - 81
90 - 100	Sand	81 - 71
100 - 119	Yellow clay	71 - 52
119 - 125	Sand	52 - 46
125 - 137	Muddy sand	46 - 34
137 - 145	Sand, cut well	34 - 26
145 - 165	Sand	26 - 6
165 - 176	Sand, small clay strings	6 - (-5)
176 - 198	Sand; iron minerals at 23-27 ft	(-5) - (-27)
198 - 217	Muddy sand	(-27) - (-46)
217 - 222	Black chalk	(-46) - (-51)
222 - 229	Sandy, bad looking	(-51) - (-58)

TABLE A-3. LITHOLOGIC LOG OF NAS NORTH SUPPLY WELL

Well designation: W-N4
Surface elevation: 180 ft msl

Depth (ft)	Description	Elevation (ft msl)
0 - 15	Sandy clay	180 - 165
15 - 25	Pink chalk	165 - 155
25 - 40	Fine muddy sand	155 - 140
40 - 50	Muddy sand	140 - 130
50 - 54	Clay	130 - 126
54 - 65	Muddy sand	126 - 115
65 - 85	Fine muddy sand	115 - 95
85 - 90	Fine packed sand	95 - 90
90 - 114	Clay	90 - 66
114 - 125	Muddy sand	66 - 55
125 - 137	Fine packed sand	55 - 43
137 - 157	Muddy sand with mud balls	43 - 23
157 - 167	Sand (coarse good) some gravel	23 - 13
167 - 177	Sand (good)	13 - 3
177 - 195	Sand	3 - (-15)
195 - 203	Sand (red)	(-15) - (-23)
203 - 210	Sand	(-23) - (-30)
210 - 218	Clay and mud	(-30) - (-38)

TABLE A-4. LITHOLOGIC LOG OF NAS ABANDONED WEST WELL

Well designation: W-W2
Surface elevation: 197.6 ft msl

Depth (ft)	Description	Elevation (ft msl)
0 - 9	Sand	198 - 189
9 - 22	Clay	189 - 176
22 - 32	Muddy sand	176 - 166
32 - 35	Clay	166 - 163
35 - 74	Sandy clay	163 - 124
74 - 124	Coarse pack sand	124 - 74
124 - 120	Soft yellow muddy sand	74 - 70
120 - 158	Sandy clay	70 - 40
158 - 178	Coarse pack sand	40 - 20
178 - 199	Coarse to fine pack sand	20 - (-1)
199 - 221	Coarse pack sand	(-1) - (-23)
221 - 244	Pack sand, streak	(-23) - (-46)
244 - 245	Rock	(-46) - (-47)
245 - 260	Soft sand and clay	(-47) - (-62)
260 - 270	Pack sand	(-62) - (-52)
270 - 294	Hard fine sand	(-52) - (-96)
294 - 355	Hard and soft blue sandy shale	(-96) - (-157)

TABLE A-5. LITHOLOGIC LOG OF NAS WEST SUPPLY WELL

Well designation: W-W3
Surface elevation: 180 ft msl

Depth (ft)	Description	Elevation (ft msl)
0 - 23	Red sandy clay	180 - 157
23 - 50	Fine sand and white clay	157 - 130
50 - 73	Sand and white clay balls	130 - 107
73 - 76	Sand and gravel	107 - 104
76 - 88	Fine sand	104 - 92
88 - 90	Fine sand and clay	92 - 90
90 - 105	Medium sand	90 - 75
105 - 113	Loose medium sand	75 - 67
113 - 132	Pink and yellow clay	67 - 48
132 - 150	Medium sand	48 - 30
150 - 153	Loose sand	30 - 27
153 - 156	Yellow clay	27 - 24
156 - 165	Loose sand	24 - 15
165 - 175	Medium sand	15 - 5
175 - 195	Sand and gravel	5 - (-15)
195 - 215	Loose sand and gravel	(-15) - (-35)
215 - 220	Yellow clay and iron rock	(-35) - (-40)

TABLE A-6. LITHOLOGIC LOG OF NAS SOUTH SUPPLY WELL

Well designation: W-S2
Surface elevation: 181.5 ft msl

Depth (ft)	Description	Elevation (ft msl)
0 - 27	Red sandy clay	181 - 154
27 - 66	Sand and clay balls	154 - 115
66 - 88	Sand	115 - 93
88 - 110	Pack sand	93 - 71
110 - 121	Sand and clay balls	71 - 60
121 - 133	Fine pack sand	60 - 48
133 - 146	Pack sand	48 - 35
146 - 148	Clay	35 - 33
148 - 155	Loose sand and gravel	33 - 26
155 - 173	Soft sandy clay	26 - 8
173 - 197	Pack sand and soft streaks	8 - (-16)
197 - 215	Pack sand	(-16) - (-34)
215 - 245	Yellow clay	(-34) - (-64)
245 - 251	Rock	(-64) - (-70)
251 - 255	Clay	(-70) - (-74)
255 - 273	Red sandy clay	(-74) - (-92)
273 - 340	Sandy shale	(-92) - (-159)

TABLE A-7. LITHOLOGIC LOG OF USGS DEEP MONITOR WELL.

Well designation: USGS
Surface elevation: 125.0 ft msl

Lithology	Thickness (feet)	Depth (feet)
Clay, white to brown, sticky; sand, white to clear quartz, medium.	20	20
Sand, clear to white quartz, medium; clay, brown to red.	20	40
Sand, clear to white, medium to coarse; gravel, white to yellow, very coarse to pea size; clay, brown.	20	60
Sand, clear to white, medium to coarse, subrounded to rounded; gravel, clear to white, very coarse; clay, light brown.	90	150
Clay, yellow to brown, sticky; gravel, very coarse to small pebbles; sand, medium, clear to white.	10	160
Sand, clear to white, medium to coarse, subrounded to angular; gravel--very coarse to pebble; clay, light brown.	50	210
Clay, green-gray to red, sticky; gravel, very coarse to pea size; sand, clear to white medium.	10	220
Sand, white to clear, medium to coarse; gravel, white to clear, very coarse to pebbles; clay, yellow brown to green, sticky.	30	250

TABLE A-7. (Continued)

Lithology	Thickness (feet)	Depth (feet)
Sand, clear to purple, medium to coarse, subrounded to subangular; clay, brown; gravel, clear to rose, very coarse to pea size.	40	290
Clay, gray brown to yellow brown; sand, clear to white, medium to coarse; gravel, clear to red, very coarse; black phosphorite grains.	40	330
Clay, dark green, sticky; sand, clear to white, subangular to subrounded; shell fragments; black phosphorite grains.	120	450
Sand, clear to white, medium; clay, dark green, soft; shell fragments; black phosphorite grains.	80	530
Clay, dark gray, soft, sticky; sand, white to clear, angular to subangular; shell fragments.	110	640
Limestone, gray, finely crystalline, porous; sand, clear to white, medium; clay, dark gray, soft, sticky; black phosphorite grains; pyrite; shell fragments.	30	670

TABLE A-7 (Continued)

Lithology	Thickness (feet)	Depth (feet)
Limestone, light gray, fine; sand, clear to white, medium; clay, gray to green, brittle, soft; black phosphorite grains; pyrite; shell fragments.	120	790
Sand, clear to white, medium; limestone, gray, fine; shell fragments; black phosphorite grains.	40	830
Clay, dark green, soft, sticky; sand, white to yellow, angular to subangular; limestone, gray, fine; shell fragments.	50	880
Clay, dark green, soft, very dense, waxy; sand, clear to white, medium.	100	980
Limestone, white, finely crystalline; sand, clear to white, medium; black phosphorite grains.	30	1010
Limestone, white, finely crystalline; pyrite; green glauconite; black phosphorite grains; shell fragments.	50	1060
Limestone, white to tan, limonite stains on limestone, finely crystalline; green glauconite; sand, clear quartz.	30	1090
Clay, light gray, soft, waxy; limestone, white to tan, finely crystalline.	20	1110

TABLE A-7 (Continued)

Lithology	Thickness (feet)	Depth (feet)
Limestone, white, finely crystalline; black phosphorite grains; pyrite; trace of clay.	20	1130
Limestone, white, finely crystalline; shell fragments; phosphorite; green glauconite; sand, clear qhartz, medium.	20	1150
Limestone, white to tan to gray; shell fragments; foraminifers; limonite clay, white; clay, gray, silty.	40	1190
Sand, clear quartz; medium, subangular; limestone, white to tan, crystalline.	40	1230
Limestone, white to tan, finely crystalline; shell fragments; sand, clear quartz, medium; limonite clay.	30	1260
Limestone, white to tan; sand, clear quartz, medium; shell fragments; clay, light gray, soft; black phosphorite, black.	20	1280
Clay, gray, soft; black phosphorite grains, abundant; sand, clear quartz, medium; limestone fragments.	10	1290

APPENDIX B

WATER-QUALITY ANALYSES

Pioneer
LABORATORY, INC.

11 EAST OLIVE ROAD PHONE (904) 474-1001
PENSACOLA, FLORIDA 32514

TABLE B-1. CHEMICAL ANALYSIS OF SOUTH WELL.

DRINKING WATER CHEMICAL ANALYSIS

System Name: RCA Base Support Services NAS Whiting Field — County: Santa Rosa — Collector: ______

Address: Receiving Dept., Bldg. 2832, Milton, Florida 32570 — System I.D. No. ______ — DER District ______

Sample Site: South Well — Raw or Treated: Raw — Temperature ______

Date and Time Collected: March 2, 1984 — Field Chlorine, mg/1: ______ — Field pH ______

Circle one: 40. Community public water system 41. Non-community public water system 42. Other public water system 43. Private water system

Circle one: 1. Compliance 2. Recheck 3. Other (indicate below parameters to be tested for items 2 or 3).

PRIMARY STANDARDS

PARAMETER	METHOD	RESULT**
Arsenic as As		< 0.001
Barium as Ba		< 0.1
Cadmium as Cd		0.004
Chromium as Cr		0.004
Lead as Pb		< 0.01
Mercury as Hg		< 0.0001
Selenium as Se		< 0.001
Silver as Ag		< 0.001
Nitrate as N		0.44
Fluoride as F		0.12
Turbidity, * NTU		0.10
Endrin		
Lindane		
Methoxychlor		
Toxaphene		
2,4-D		
2,4,5-TP Silvex		
Trihalomethanes		

SECONDARY STANDARDS

PARAMETER	METHOD†	RESULT**
Chloride as Cl		
Color*		
Copper as Cu		
Corrosivity*		
Foaming Agents		
H_2S		
Iron as Fe		
Manganese as Mn		
Odor*		
pH*		
Sulfate as SO_4		
TDS		
Zinc as Zn		

DER reviewer

Action required

GENERAL

PARAMETER	RESULT**
Total Hardness as $CaCO_3$ (c)	
Total Alkalinity as $CaCO_3$	
N.C.H. as $CaCO_3$ (c)	
Bicarbonate as HCO_3	
Calcium as Ca	
Magnesium as Mg	
Carbon Dioxide as CO_2 (c)	
Bicarbonate as $CaCO_3$ (c)	
Carbonate as $CaCO_3$ (c)	
Hydroxide as $CaCO_3$ (c)	
Sodium as Na	
pHs* (c)	
Stability Index* 2pHs-pH (c)	
Saturation Index* pH-pHs (c)	
INTERPRETATION: Stable	
Corrosive	
Scale Forming	

Note: All results in mg/liter except those designated. Detection limits/methods available on request.

(c) = Calculated value

**BDL = Below detection limit (see reverse side)

Date and Time Received: March 2, 1984 — Laboratory I.D. No. 81142

Date Reported: March 13, 1984

Analysts ______

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Approved by: W. F. Bowers, Laboratory Director

TABLE B-2. CHEMICAL ANALYSES OF WATER FROM THE FLORIDAN AND SAND AND GRAVEL AQUIFERS.

	CONCENTRATIONS			
	SAND-AND-GRAVEL AQUIFER [1]	FLORIDAN AQUIFER UPPER LIMESTONE [2]	FLORIDAN AQUIFER LOWER LIMESTONE [3]	
	August 1976	July 1975	Jan. 1974	Sept. 1977
alkalinity as $CaCO_3$	2	576	323	303
*aluminum, dissolved	-	20	50	-
*arsenic, dissolved	0	0	0	-
bicarbonate HCO_3	2	613	370	368
*boron, dissolved	-	740	600	-
*cadmium, dissolved	4	-	-	-
calcium, dissolved	.08	2.2	5.0	4.1
carbon, organic total	-	3.0	2.0	-
carbonate	-	44	12	-
chemical oxygen demand	-	26	12	-
chloride, dissolved	2.7	86	330	400
*chromium, dissolved	10	0	0	-
*chromium, hexavalent	-	0	0	-
*cobalt, dissolved	-	1	1	-
color (platinum cobalt scale)	5	100	8	0
*copper, dissolved	-	-	1	-
dissolved solids, residue at 180°C	12	840	870	998
fluoride, dissolved	.0	3.8	3.0	2.2
hardness, as $CACO_3$	4	8	21	22
hardness, noncarbonate	2	0	0	0
*iron, dissolved	.00	170	100	20
*lead, dissolved	14	8	0	-
magnesium, dissolved	-	.7	2.0	2.7
*manganese, dissolved	-	0	17	-
*mercury, dissolved	.0	.0	0.0	-
nitrate, NO_3 as N	.50	.00	.00	.01
nitrite, NO_2 as N	.00	.00	.01	-
nitrogen, NH_3 as N	-	1.0	.74	.74
nitrogen, total organic as N	-	.60	.30	.08
nitrogen, total as N	-	1.6	1.0	-
pH	5.1	8.8	8.7	8.4
phosphorus, total ortho as P	.00	.00	.03	.03
phosphorus, total as P	.01	.08	.03	.03
potassium, dissolved	.4	5.6	9.7	11
silica, dissolved	6.4	14	34	34
sodium, dissolved	2.3	330	320	380
specific conductivity (umhos at 25°C)	20	1,190	1,560	1,890
*strontium, dissolved	-	60	0	350
turbidity (NTU)	1	6	8	16
water temperature (°C)	23.5	24.0	30.0	27.5
*zinc, dissolved	-	3	10.0	-

[1] Sample from Milton municipal well No. 4
[2] Sample from USGS shallow monitor well 15 miles south of Whiting Field
[3] Sample from USGS monitor well at Whiting Field.
* Concentrations in ug/l; other concentrations in mg/l

From NWFWMD, 1980

TABLE B-3. Chemical Analysis of Whiting Field Water Supply.

Pioneer LABORATORY, INC.

11 EAST OLIVE ROAD PHONE (904) 474-1001
PENSACOLA, FLORIDA 32514

To: RCA Base Support Services, NAS Whiting Dield, Receiving Dept. Bldg. 783
Milton, Florida 32570, Date of Order: 2/3/84, Lab I.D. # 204.

DRINKING WATER PRIORITY POLLUTANT ANALYSIS

Purgeables:

Acrolein	< 10
Acrylonitrile	< 10
Benzene	< 1
Bromodichloromethane	< 1
Bromoform	< 1
Bromomethane	< 1
Carbon-tetrachloride	< 1
Chlorobenzene	< 1
Chloroethane	< 1
2-Chloroethylvinyl ether	< 1
Chloroform	< 1
Chloromethane	< 1
Dibromochloromethane	< 1
Dichlorodifluoromethane	< 1
1,1-Dichloroethane	< 1
1,2-Dichloroethane	< 1
1,1-Dichloroethene	< 1
1,2-Dichloroethene	< 1
1,2-Dichloropropane	< 1
cis-1,3-Dichloropropene	< 1
trans-1,3-Dichloropropene	< 1
Ethylbenzene	< 1
Methylene Chloride	< 1
Tetrachloroethane	< 1
1,1,1-Trichloroethane	< 1
1,1,2-Trichloroethane	< 1
Trichloroethene	< 1
Trichlorofluoromethane	< 1
Toluene	< 1
Vinyl Chloride	< 1
Xylene	< 1
Styrene	< 1
Dichlorobenzene	< 1
1,2-Dibromoethane(EDB)	< 0.05
N-hexane	< 1
1,2-Dichloropropene	< 1
1,2-Dibromo-3-Chloropropane	< 1

NOTE: All results reported in parts per billion.
< = less than
Florida Certification #81142

NOTE: Sample taken from combined stream from all three supply wells.

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Approved by W. F. Bowers
W. F. Bowers
Laboratory Director

TABLE B-3 (Continued)

Pioneer LABORATORY, INC.

11 EAST OLIVE ROAD PHONE (904) 474-1001
PENSACOLA, FLORIDA 32514

To: RCA Base Support Services, NAS Whiting Field, Receiving Dept. Bldg. 2832, Milton Florida 32570, Date of Order: 2/3/84, Lab I.D. #204.

DRINKING WATER PRIORITY POLLUTANT ANALYSIS

Base Neutral Extractables:

Acenaphthene	<5
Acenaphthylene	<5
Anthracene	<5
Benzo(a)anthracene	<5
Benzo(b)fluoranthene	<5
Benzo(k)fluoranthene	<5
Benzo(a)pyrene	<5
Diethylphthalate	<5
Dimethylphthalate	<5
2,4-Dinitrotoluene	<5
2,6-Dinitrotoluene	<5
Dioctylphthalate	<5
1,2-Diphylhydrazine	<5
Fluoranthene	<5
Benzo(g,h,i)perylene	<5
Benzidine	<5
Bis(2-chloroethyl)ether	<5
Bis(2-chloroethoxy)methane	<5
Bis(2-ethylhexyl)phthalate	<5
Bis(2-chloroisopropyl)ether	<5
4-Bromophenyl phenyl ether	<5
Butyl benzyl phthalate	<5
2-Chloronaphthalene	<5
4-Chlorophenyl phenyl ether	<5
Chrysene	<5
Dibenzo(a,h)anthracene	<5
Di-n-butylphthalate	<5
1,3-Dichlorobenzene	<5
1,4-Dichlorobenzene	<5
1,2-Dichlorobenzene	<5
3,3'-Dichlorobenzidine	<5
Fluorene	<5
Hexachlorobenzene	<5
Haxachlorobutadiene	<5
Hexachloroethane	<5
Hexachlorocyclopentadiene	<5
Indeno(1,2,3-cd)pyrene	<5
Isophorone	<5
Naphthalene	<5
Nitrobenzene	<5
N-Nitrosodimethylamine	<5
N-Nitrosodi-n-propylamine	<5
N-Nitrosodiphenylamine	<5
Phenanthrene	<5
Pyrene	<5
2,3,7,8-Tetrachlorodibenzo-p-dioxin(Dioxin)	<5
1,2,4-Trichlorobenzene	<5

Approved by W. F. Bowers
W. F. Bowers
Laboratory Director

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NOTE: Results are reported in parts per billion. < = less than
Florida Certification #81142.

TABLE B-3 (Continued)

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11 EAST OLIVE ROAD PHONE (904) 474-1001
PENSACOLA, FLORIDA 32514

To: RCA Base Support Services, NAS Whiting Field, Receiving Dept. Bldg. 2832, Milton, Florida 32570, Date of Order: 2/3/84, Lab I.D. # 204.

DRINKING WATER PRIORITY POLLUTANT ANALYSIS

Pesticides:

Aldrin	<0.05
a-BHC	<0.05
b-BHC	<0.05
g-BHC	<0.05
d-BHC	<0.05
Chlordane	<0.05
4,4'-DDD	<0.05
4,4'-DDE	<0.05
4,4'-DDT	<0.05
Dieldrin	<0.05
Endosulfan I	<0.05
Endosulfan II	<0.05
Endosulfan Sulfate	<0.05
Ethion	<0.05
Trithion	<0.05
o,p-DDT, DDE and DDD	<0.05
Tedion	<0.05
Endrin Aldehyde	<0.05
Heptachlor	<0.05
Heptachlor Epoxide	<0.05
Toxaphene	<0.3
PCB-1016	<0.2
PCB-1221	<0.2
PCB-1232	<0.2
PCB-1242	<0.2
PCB-1248	<0.2
PCB-1254	<0.2
PCB-1260	<0.2
Aldicarb (non extractable)	<25
Diazinon	<1
Malathion	<1
Parathion	<1
Guthion	<1
Kelthane (Dicofal)	<1

NOTE: All results are reported in parts per billion.
< = less than
Florida Certification #81142

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Laboratory Director

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TABLE B-3 (Continued)

Pioneer LABORATORY, INC.

11 EAST OLIVE ROAD
PENSACOLA, FLORIDA 32514
PHONE (904) 474-1001

To: RCA Base Support Services, NAS Whiting Field, Receiving Dept. Bldg. 28
Milton, Florida 32570, Date of Order: 2/3/84, Lab I.D. # 204.

DRINKING WATER PRIORITY POLLUTANT ANALYSIS

Acid Extractables:

2-Chlorophenol	<5
2,4-Dichlorophenol	<5
2,4-Dimethylphenol	<5
2,4-Dinitrophenol	<5
2-Methyl-4,6-Dinitrophenol	<5
2-Nitrophenol	<5
4-Nitrophenol	<5
Pentachlorophenol	<5
Phenol	<5
2,4,6-Trichlorophenol	<5

NOTE: All results reported in parts per billion.
< = less than
Florida Certification #81142

W. F. Bowers

Approved by W. F. Bowers
Laboratory Director

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TABLE B-4. Surface Water Chemical Analyses

RANGE OF CHEMICAL ANALYSIS FOR BLACKWATER RIVER, BIG COLDWATER CREEK, AND POND CREEK.

SITE	Range	Discharge (ft^3/s)	Specific conductance (umho/cm at 25°C)	pH (units)	Color (Platinum-Cobalt units)	Temperature (°C)	Iron (Fe) in ug/L	Alkalinity as $CaCO_3$, in mg/L	Bicarbonate (HCO_3), in mg/L	Calcium (Ca), in mg/L	Chloride (Cl), in mg/L	Fluoride (F), in mg/L	Hardness, noncarbonate, in mg/L	Hardness, total (Ca, Mg), in mg/L	Magnesium (Mg), in mg/L	Nitrate as (NO_3), in mg/L	Phosphate (PO_4), in mg/L	Potassium (K), in mg/L	Dissolved solids (sum), in mg/L	Silica (SiO_2), in mg/L	Sodium (Na), in mg/L	Sulfate (SO_4), in mg/L	Dissolved Oxygen (DO), in mg/L
Big Coldwater Creek near Milton, FL (1/59-7/75)	HIGH	2465	150	7.5	60	27.8	220	28	34	5.6	8.0	0.4	6.0	18	1.5	1.9	.05	0.7	28	34.0	21.0	2.4	9.2
	LOW	298	15	5.3	2	13.3	0	0	0	0.5	1.0	0	0	2	0.1	0	0	0	11	1.9	0.4	0	6.2
Pond Creek near Milton, FL (1/58-8/74)	HIGH	60	22	6.2	45	23.5	60	3	4	1.8	3.8	0.1	2	6	0.9	.09	.04	0.4	18	8.4	2.5	1.2	8.9
	LOW	32	15	5.2	0	11.7	10	2	2	0.4	1.8	0	0	2	0.1	.0	.01	0	10	3.7	1.6	0	6.9
Blackwater River near Baker, FL (1977 water year)	HIGH	1270	25	5.7	50	24	370	0	0	1.1	3.9	0.1	5	5	0.6	0	0	0.7	17	6.3	3.5	9.3	0
	LOW	119	21	4.6	40	20	120	0	0	1.0	2.8	0	4	4	0.4	0	0	0.3	16	5.8	1.9	0.3	0

From: NWFWMD, 1980.

Table B-5. Results of the Analyses for EPA's Organic Priority Pollutants From the North Supply Well, W-N4.

Compound	Sample ID: CAA ID:	Concentration ug/l (ppb)[2] Whiting North Well 8401255
(2v) acrolein		
(3v) acrylonitrile		
(4v) benzene		
(6v) carbon tetrachloride		
(7v) chlorobenzene		
(10v) 1,2-dichloroethane		
(11v) 1,1,1,-trichloroethane		
(13v) 1,1-dichloroethane		
(14v) 1,1,2-trichloroethane		
(15v) 1,1,2,2-tetrachloroethane		
(16v) chloroethane		
(19v) 2-chloroethylvinyl ether		
(23v) chloroform		
(29v) 1,1-dichloroethylene		
(30v) trans-1,2-dichloroethylene		
(32v) 1,2-dichloropropane		
(33v) trans-1,3-dichloropropene		
cis-1,3-dichloropropene		
(38v) ethylbenzene		
(44v) methylene chloride		
(45v) chloromethane		
(46v) bromomethane		
(47v) bromoform		
(48v) bromodichloromethane		
(49v) fluorotrichloromethane		
(50v) dichlorodifluoromethane		
(51v) chlorodibromomethane		
(85v) tetrachloroethylene		
(86v) toluene		
(87v) trichloroethylene		
(88v) vinyl chloride		
Detection Limit		1

[1]U.S. EPA. 1982. Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater. EPA 600/4-82-057. EPA/EMSL, Cincinnati, Ohio.

[2]Concentrations less than the detection limit are left blank. Concentrations between 1 and 10 times the detection limit are listed as trace levels (TR). Acrolein and acrylonitrile are 100 and 10 timex the detection limit respectively.

Table B-5 (Continued)

CAMBRIDGE ANALYTICAL ASSOCIATES, INC.

Table 3A (cont'd.). Concentration of Acid/Base/Neutral Extractables (Method 625[1])

Client: Geraghty and Miller

Report No.: 84-297

Compound		Concentration - ug/l (ppb)[2]
	Sample ID:	Whiting North Well
	CAA ID:	8401255
ACID COMPOUNDS		
(21A) 2,4,6-trichlorophenol		
(22A) p-chloro-m-cresol		
(24A) 2-chlorophenol		
(31A) 2,4-dichlorophenol		
(34A) 2,4-dimethylphenol		
(57A) 2-nitrophenol		
(58A) 4-nitrophenol		
(59A) 2,4-dinitrophenol		
(60A) 4,6-dinitro-2-methylphenol		
(64A) pentachlorophenol		
(65A) phenol		
Detection Limit		2
BASE/NEUTRAL COMPOUNDS		
(1B) acenaphthene		
(5B) benzidine		
(8B) 1,2,4-trichlorobenzene		
(9B) hexachlorobenzene		
(12B) hexachloroethane		
(18B) bis (2-chloroethyl) ether		
(20B) 2-chloronaphthalene		
(25B) 1,2-dichlorobenzene		
(26B) 1,3-dichlorobenzene		
(27B) 1,4-dichlorobenzene		
(28B) 3,3'-dichlorobenzidine		
(35B) 2,4-dinitrotoluene		
(36B) 2,6-dinitrotoluene		
(37B) 1,2-diphenylhydrazine		
(39B) fluoranthene		
(40B) 4-chlorophenyl phenyl ether		
(41B) 4-bromophenyl phenyl ether		

CAMBRIDGE ANALYTICAL ASSOCIATES, INC.

Table 3B (cont'd). Concentration of Acid/Base/Neutral Extractables (Method 625[1])

Client: Geraghty and Miller

Report No.: 84-297

Compound	Concentration - ug/l (ppb)[2]
Sample ID:	Whiting North Well
CAA ID:	8401255
BASE NEUTRAL COMPOUNDS (cont'd)	
(42B) bis (2-chloroisopropyl) ether	
(43B) bis (2-chloroethoxy) methane	
(52B) hexachlorobutadiene	
(53B) hexachlorocyclopentadiene	
(54B) isophorone	
(55B) naphthalene	
(56B) nitrobenzene	
(62B) N-nitrosodiphenylamine	
(63B) N-nitrosodipropylamine	
(66B) bis (2-ethylhexyl) phthalate	
(67B) benzyl butyl phthalate	
(68B) di-n-butyl phthalate	
(69B) di-n-octyl phthalate	
(70B) diethyl phthalate	
(71B) dimethyl phthalate	
(72B) benzo(a)anthracene	
(73B) benzo(a)pyrene	
(74B) benzo(b)fluoroanthene	
(75B) benzo(k)fluoroanthene	
(76B) chrysene	
(77B) acenaphthylene	
(78B) anthracene	
(79B) benzo(ghi)perylene	
(80B) fluorene	
(81B) phenanthrene	
(82B) dibenzo(a,h)anthracene	
(83B) ideno(1,2,3-cd)pyrene	
(84B) pyrene	
Detection Limit	2

[1] U.S. EPA, 1982. Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater. EPA 600/4-82-057. EPA/EMSL, Cincinnati, Ohio.

[2] Concentrations less than the detection limit are left blank. Concentrations between 1 and 10 times the limit of detection are listed as trace levels (TR).

Table B-5 (Continued)

CAMBRIDGE ANALYTICAL ASSOCIATES, INC.

Table 4(cont'd.). Concentration of Pesticides and PCBs (Method 608[1])

Client: Geraghty and Miller

Report No.: 84-297

		Concentration - ug/l (ppb)[2]
	Sample ID:	Whiting North Well
Compound	CAA ID:	8401255
PESTICIDES AND PCBs		
(89P) aldrin		
(90P) dieldrin		
(91P) chlordane		
(92P) 4,4'-DDT		
(93P) 4,4'-DDE		
(94P) 4,4'-DDD		
(95P) endosulfan-alpha		
(96P) endosulfan-beta		
(97P) endosulfan sulfate		
(98P) endrin		
(99P) endrin aldehyde		
(100P) heptachlor		
(101P) heptachlor epoxide		
(102P) BHC-alpha		
(103P) BHC-beta		
(104P) BHC-delta		
(105P) BHC-gamma (lindane)		
(106P) PCB - 1242		
(107P) PCB - 1254		
(108P) PCB - 1221		
(109P) PCB - 1232		
(110P) PCB - 1248		
(111P) PCB - 1260		
(112P) PCB - 1016		
(113P) toxaphene		
Detection Limit		.01

[1] U.S. EPA, 1982. Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater. EPA 600/4-82-057. EPA/EMSL, Cincinnati, Ohio.

[2] Concentrations less than the detection limit are left blank. Concentrations between 1 and 10 times detection limit are listed as trace levels (TR).