

MEMORANDUM

F.O.R. 94-1514

DATE: August 21, 1997

TO: Jeff Elledge, Director *JE*
Resource Management DepartmentTHROUGH: Charles A. Padera, Director *CP*
Water Resources Department*For* Edgar F. Lowe, Ph.D., Director *EFL*
Environmental Sciences DivisionGreenville B. (Sonny) Hall, Ph.D., Technical Program Manager
Environmental Sciences Division *GBH*Clifford P. Neubauer, Ph.D., Supervising Environmental Specialist
Environmental Sciences DivisionFROM: Ric Hupalo, Environmental Specialist IV *RH*
Environmental Sciences DivisionRE: Minimum Surface Water Levels determined for Prevatt Lake, Orange County
(Project # 01-43-00-5161-10900)

The purpose of this memorandum is to forward recommended minimum lake levels and hydroperiod categories determined for Prevatt Lake to the Department of Resource Management (Table 1). Prevatt Lake was selected for investigation because it is a priority lake identified in the Minimum Flows and Levels Project Plan. The lake is located in the Wekiva basin where projected (year 2010) declines of the Floridan and surficial aquifers are five feet and less than one foot, respectively. The lake hydrograph and potentiometric surface isopleths suggest that this lake is well connected with the Floridan aquifer.

Table 1. Recommended minimum surface water levels for Prevatt Lake. Terminology is defined in 40C-8.021, F.A.C.

MINIMUM LEVEL	ELEVATION (ft NGVD)	HYDROPERIOD CATEGORY
Minimum Frequent High Level	56.0	Seasonally Flooded
Minimum Average Level	53.0	Typically Saturated
Minimum Frequent Low Level	50.9	Semipermanently Flooded

Prevatt Lake is located in Orange County, two miles north of Apopka in Wekiwa Springs State Park (Figure 1). Moderate rates of recharge (4-8 in/yr) to the Floridan aquifer occur from lands near the lake (Boniol et al. 1993). Prevatt Lake is within the Apopka Hills Physiographic Division of the Central Lakes District, a sand hills area modified by karst processes (Brooks 1982). Active consumptive use allocations do not exist from the lake or in the land sections (26, 27, 34, and 35) adjacent to the lake (personal communication, Division of Permit Data Services).

Hydrology

Prevatt Lake is a 99 acre water body when the lake level is approximately 56 ft NGVD. The elongated lake basin is comprised of shallow solution basins. The water level of Prevatt Lake has a history of rising and falling rapidly (Figure 2). This pattern appears to be related to two factors; a large drainage basin and a high rate of leakage to the Floridan aquifer. Prevatt Lake is the downstream lake in a series of lakes and ponds that drain an area known as the Lakes McCoy, Coroni, and Prevatt drainage basin. The drainage basin of Prevatt Lake is 1,090 acres, however, runoff from an additional 2,322 acres can result from hydraulic connections to Lake Coroni (PEC 1997). A flowage way from Prevatt Lake (Carpenter Branch to Mill Creek) drains to the Rock Springs Run - Wekiwa River floodplain (Figure 1). The outfall elevation from Prevatt Lake is approximately 56.6 ft NGVD (PEC 1997).

A stormwater assessment (PEC 1997) of the McCoy, Coroni, and Prevatt lakes drainage basin was recently completed. This study forms the basis for a stormwater management plan, evaluates various drainage improvements, and delimits lake flood elevations. The report describes the hydrologic characteristics of the basin, however, modeling results have little bearing on determining minimum levels. A hydrologic stormwater routing model (Interconnected Channel and Pond Routing Model) was calibrated to simulate single storm events. The model generated lake levels for a worst case flooding scenario where little storage was available prior to a large storm. Simulations indicate if rain events occur when the lakes are full (0.5 ft above the respective outfall elevations) then the peak water elevations of Prevatt Lake for mean annual, 10-year, 25-year, and 100-year rain events are 58.23, 59.35, 59.77, and 60.47 ft NGVD, respectively (PEC 1997). However, the lakes fluctuate greatly and most of the time water levels are well below their respective outfall elevations (PEC 1997).

A monthly record of water elevations for Prevatt Lake exists from January 1960 (Figure 2). Measurements prior to 1981 were collected on an irregular basis. Table 2 lists the relative standing of the values by percentile rankings, sorted to reflect percent exceedance. The data only approximate the true lake level-duration relationship because the data are monthly and long periods (years) prior to 1981 lack data. The median water level was 53.71 ft NGVD, after correcting for 30 observations when the lake bed was dry (explained below). The average of 205 measurements is 54.05 ft NGVD, however, this average is positively skewed because 30 extremely low values are unknown. If a value of 47.0 ft NGVD is assumed (explained below) for the 30 missing low values then the average lake level is 53.17 ft NGVD. Lake levels have ranged over 10.5 feet, from 47.45 ft NGVD (1981) to 57.91 ft NGVD (1994).

Table 2 shows a percentile ranking of the water level record of Prevatt Lake (n= 235, where 30 missing low values are assumed to be 47 ft NGVD). The values were sorted to express percent exceedance. Extreme high and low values are likely to be under-represented because the lake level is only recorded on a monthly basis. Only several values per year occur prior to 1981 and none were recorded in 1962-64, 1969-70, 1974, and 1977. A value of 47 ft NGVD was used to account for and replace 30 occasions when the lake level was too low to record, the record having the annotation "dry". A value of 47 ft NGVD was chosen because the lowest recorded lake level was 47.45 ft NGVD. Musser (1995) also made this assumption in his hydrological analysis of the lake. Given that 30 monthly water levels were too low to record, water elevations of the lake below the 88th percent exceedance are unknown, but assumed to be less than 47.45 ft NGVD.

Table 2. Estimated percent exceedance for water levels of Prevatt Lake. See paragraph above for an explanation. Units for Elev. are ft NGVD.

Percentile	Elev.	Percentile	Elev.
0	57.94	50	53.71
1	57.86	60	52.92
5	57.08	70	52.19
10	56.80	80	50.92
20	55.93	85	49.84
30	55.11	90	< 47
40	54.38	100	< 47

Water levels of Prevatt Lake tend to fall rapidly (Figure 2). These declines are likely caused by rapid leakage to the Florida aquifer. The location of Prevatt Lake was overlain on isopleths of the potentiometric surface of the upper Florida aquifer with ARCVIEW using digital coverages from the District's GIS library. The typical bottom elevation (49.5 ft NGVD) of the southern basin of the lake was only ten feet above the potentiometric surface of the Floridan aquifer (40 ft NGVD) in May 1990. It seems likely that the depth of overburden between the lake bottom and the potentiometric surface of the Florida aquifer is small. Orange County annotated the record of Prevatt Lake as "dry" in May 1990, indicating the lake level was likely below 47 ft NGVD (explained below). Potentiometric surface maps of the upper Floridan aquifer also exist for September 1994 and May 1995. Potentiometric surface and lake levels in September 1994 were 25 ft NGVD and 56.09 ft NGVD, respectively. In May 1995, potentiometric surface and lake levels were 30 ft NGVD and 56.66 ft NGVD, respectively. The large vertical difference between lake and potentiometric surfaces during these periods would likely lead to a high rate of recharge from the lake to the Floridan aquifer. This would explain the rapid decline of lake levels that has occurred over the last year. The water level of the lake fell nine feet, from 56.92 ft NGVD in July 1996 to 47.97 ft NGVD in July of 1997.

Hydric Soils

Much of Prevatt Lake was mapped by SCS (1989) as a Basinger fine sand, depressional soil (Mapping Unit ID 3). The SCS survey was based on 1981 base photography (Figure 3).

Basinger fine sand, depressional occurs in shallow depressions and along the edges of freshwater marshes and swamps. Undrained areas are ponded for 6 to 9 months or more each year and the water table is within 12 inches of the surface for the rest of the year. In some places a variation of this soil has a surface layer of muck or mucky fine sand less than 16 inches deep (SCS 1989). A transect of the southern subbasin (XS-1, Figure 1) was located to collect elevation, soil, and vegetation information. The transect traversed a sloping area of the lake littoral zone that was mapped as Basinger fine sand, depressional. Stations on the transect between elevations 55.6 and 50.9 indicated hydric vegetation and mineral soil or shallow muck (Figure 5). Soil probing along XS-1 indicated that the open water area shown in Figure 3, labeled Prevatt Lake, has a bottom consisting of muck from one foot to more than three feet deep (Figure 5). Muck greater than one foot deep occurred from 50.9 to 48.9 ft NGVD. The average and median elevations of all stations (n= 75) on Transect 1 where muck occurred were 50.9 and 50.0 ft NGVD, respectively (Table 3).

Wetlands and Littoral Zone Vegetation

Wetlands were classified by the USBS National Wetland Inventory (NWI) in 1987 using 1983 CIR aerial photography. This information is a digitized coverage in the District's GIS library. The NWI coverage was overlain on a digitized orthoquad (1995 imagery) of the area using ARCVIEW (Figure 4). Two wetland habitats encompass the lake basin and are shown on Figure 4: Lacustrine Littoral Aquatic Bed Rooted Vascular, permanently flooded (L2AB3H, 81 acres); and Lacustrine Limnetic Unconsolidated Bottom, permanently flooded (L1UBH, 18 acres). The polygon labeled PFO1C (Palustrine Forested, seasonally flooded) is an intermittent inflow tributary. No open water habitats were delimited by the NWI.

The transect XS-1 extended across live oak hammock, shrub marsh, and aquatic bed communities (Figure 5). Shoreline vegetation (57.2 - 56.0 ft NGVD) consisted of wax myrtle, eastern baccharis, and inkberry. The dominant plant species of the shrub marsh was buttonbush. Common associates of buttonbush were smartweed, warty panicum, maidencane, and foxtail. An aquatic bed of emergent species occurred from 52.0 ft NGVD to 50.4 ft NGVD and was characterized by a mixture of maidencane, jungle-grass, and baldrush. The dewatered lake bottom to an elevation of 49.7 ft NGVD was covered with fragrant flatsedge and slender fimbriatylis. Sedges and grasses had germinated but contributed little cover below 49.7 ft NGVD, the area was mostly bare muck and scattered spatter-dock rhizomes. The southern basin is generally flooded to a depth of seven feet or less when the lake level is 56 ft NGVD. On the date of our field survey (July 30, 1997), water in the southern basin had receded to 48.0 ft NGVD and was reduced to an area of approximately 0.25 acres. A fish kill had recently occurred; dead fish (largemouth bass, sunfish, and lake chubsucker) were prolific around the perimeter of the small pond. A second small pond of several acres existed in the northern basin of the lake but it was not surveyed because a benchmark does not occur nearby.

Elevation data from plant communities, common plant species, and other significant features that were located on XS-1 are summarized in Figure 5 and Table 3. Scientific names for plant species are provided in Table 4. Data were collected by ES and Surveying staff using Orange

County Benchmark W-520-008 as the elevation datum. The recommended minimum levels are based upon consideration of biological features associated with long-term typical water levels. Three levels with corresponding hydroperiod categories (adapted from Cowardin et al. 1979) are recommended below. A short description of the functions of each minimum level and some of the related data used in the determination follows.

Table 3. Elevation Summary from survey of Prevatt Lake. Unit is ft NGVD.

Feature	Max	Mean	Median	Min	N
Live oak hammock	58.2	57.6	57.6	57.0	3
Shoreline	57.2	56.5	56.4	56.0	8
Shrub Marsh	56.0	53.9	53.9	52.0	27
Emergent Aquatic Bed	52.0	51.2	51.2	50.4	13
Muck presence (muck depth 0.1 ft or greater)	55.6	50.9	50.0	48.9	75
Lake Bottom - dense cover of sedges	50.2	49.9	49.9	49.7	15
Muck depth 1 ft or greater	50.9	49.6	49.4	48.9	46
Lake Bottom - total (irrespective of cover)	50.2	49.5	49.4	48.9	41
Lake Bottom - little vegetative cover	49.5	49.2	49.2	48.9	26

MINIMUM FREQUENT HIGH LEVEL

The recommended Minimum Frequent High level is 56.0 ft NGVD with an associated hydroperiod category of Seasonally Flooded. This minimum level conserves the structure and functions of the marsh and littoral aquatic beds. The Minimum Frequent High level was based on maintaining inundation of the shrub marsh, a seasonally flooded wetland fringing the lake (Figure 5). The recommended minimum level corresponds to the elevation of the shrub marsh - shoreline shrub fringe ecotone at XS-1. The average water depth in the shrub marsh would be 2.1 feet (Table 3). Frequent, prolonged flooding to this level provides water depths on the marsh which enable fish and other aquatic organisms to feed or spawn, and maintains the present plant species and soil ecotone between wetland and upland communities. Musser (1995) measured the elevations of 16 slash pine >10" DBH (*Pinus elliotti*, DEP-UPL) and 17 wax myrtle (Table 4) around the shoreline of Lake Prevatt and found that all the slash pine and 13 wax myrtle grew at elevations above 56 ft NGVD. Muck was measured on XS-1 to 55.6 ft NGVD (Figure 5).

The water level 56.0 ft NGVD ranks near the 20th percentile (55.9 ft NGVD) in the record of monthly values (Table 2). The water level 56.0 ft NGVD is 1.1 ft below the normal high water level of Lake Prevatt (57.1 ft NGVD) according to Orange County normal high water level setting guidelines (PEC 1997).

MINIMUM AVERAGE LEVEL

The recommended Minimum Average Level is 53.0 ft NGVD with an associated hydroperiod category of Typically Saturated. The Minimum Average level and the hydroperiod category Typically Saturated approximates a "typical" lake level that is less than the long-term median and average water levels while still protecting the water resource. The recommended minimum

average level was determined by allowing for 3.5 feet of flooding over the bottom of the southern basin measured at XS-1 (49.5 ft NGVD, Table 3). Water depths of 3 - 4 ft and a surface area large enough to intercept prevailing winds are necessary to maintain a fishery in shallow lakes (personal communication, Dale Jones - FL Game and Fresh Water Fish Commission). The median water level of the lake is 53.71 ft NGVD (Table 2). The survey at XS-1 indicates that vast areas of the lake are nearly dewatered at 49.5 ft. Presumably, water depths in the southern basin, and over much of Prevatt Lake, are less than or equal to 4.2 ft (53.7 - 49.5) approximately 50 percent of the time. Therefore, the water depth of Prevatt Lake is often more typical of a marsh than a lake. This ecological feature is reflected in the recommended Minimum Average Level.

The water elevation exceeded by 60 percent of the values in the record is 52.92 ft NGVD (Table 2). The ecological rationale for the Minimum Average level for Lake Prevatt is atypical compared with previous lakes. Typically, the average elevation of organic soil minus 0.25 ft or, the correlation of this elevation with the water level exceeded 60 percent of the time are used as criteria to maintain soil anaerobiosis (Hall 1987). At Prevatt Lake, organic soil of substantial depths is located lower than 50.9 ft NGVD, water levels have exceeded this elevation for 80 percent of the record. These atypical circumstances occur because the lake tends to be high or low, seldom staying near "central tendency". The average water level and one standard deviation for 205 measurements and 30 "dry" annotations set to 47.0 ft NGVD equals 53.17 ft NGVD +/- 3.1 ft.

MINIMUM FREQUENT LOW LEVEL

This level (50.9 ft NGVD), with the assigned hydroperiod category of Semipermanently Flooded, recognizes the benefit of low-water conditions during periods of low rainfall. The recommended minimum level was based on several factors: 1) shallow drawdown (-0.25 ft) below the average elevation (51.2 ft NGVD) of the emergent aquatic bed at XS-1; 2) the maximum elevation supporting muck depths of one foot or greater was 50.9 ft NGVD and; 3) the water elevation 50.92 ft NGVD was exceeded by 80 percent of the values in the record, note 40C8.021(15), F.A.C. Dewatering to slightly below the ground surface will stimulate the production of drawdown-type emergent wetland vegetation (Van DerValk 1981) and protect the organic substrate from oxidation and subsidence (Hall 1987, Stephens 1974). This vegetation serves as cover for fish and as a substrate for aquatic invertebrates when the area refloods. Occasional drawdowns are necessary since moist, aerobic soil conditions stimulate decomposition and promote seed germination in many wetland plants. Declining water levels also concentrate fish, thus providing a foraging area for many wetland birds (Bancroft 1990). However, excessive drawdown over prolonged periods results in oxidation or subsidence of organic soils and long-term alteration of ecosystem structure or functions.

Cyclic drawdowns of Prevatt Lake have occurred historically and are necessary to maintain a lake environment over the long-term. The lake basin is shallow and is frequently not an open water habitat. This is evident from our survey of the southern basin, the lake hydrograph, and from aerial photos dating from 1947. Water depths of the southern basin exceed approximately

6.5 ft only twenty percent of the time (Tables 2 and 3). If the water level of Lake Prevatt were stable, spatter-dock would likely cover the lake surface and accumulating biomass would lead to a marsh environment. Cyclic replacement or oscillatory fluctuations of plant communities in Hopkins Prairie, Ocala National Forest, are the consequence of repeated cycles of flooding and drawdown (Clough et al., 1992). Shifts from floating-leaved aquatic communities to sedge/grass communities occurs in a presumably cyclic manner, resulting in a dynamic but stable plant community (Clough et al., 1992). Hydrologic disturbance (drawdown or flooding) shifts the plant community and succession proceeds until the disturbance reoccurs. At Prevatt Lake, water levels fluctuate rapidly and have ranged over 10.5 feet. Drawdowns desiccate aquatic plants established during periods of high lake levels and allow a sedge and grass prairie to establish on the lake bottom. Periods of deep flooding allow regrowth from the surviving spatter-dock rhizomes and prevent woody species e.g., carolina willow (*Salix caroliniana*) from expanding from the shoreline into the lake.

Anthropogenic induced shifts away from the recommended hydroperiod categories would be detrimental to Prevatt Lake. Decreasing the duration of flooding would lead to more frequent periods that the lake emulates an old field ecosystem, rather than a prairie or lake ecosystem.

Please call me (ext. 4338) or Cliff Neubauer (4343) if you wish to discuss these minimum levels or hydroperiod definitions.

Table 4. Plant species observed at Prevatt Lake.

SPECIES	COMMON NAME	DEP	USACOE
<i>Amphicarpum muhlenbergianum</i>	blue-maidencane	FACW	FACW
<i>Baccharis halimifolia</i>	eastern baccharis	FAC	FAC
<i>Centella asiatica</i>	coinwort	FACW	FACW
<i>Cephalanthus occidentalis</i>	buttonbush	OBL	OBL
<i>Cyperus odoratus</i>	fragrant flatsedge	FACW	FACW
<i>Eichinochloa walteri</i>	jungle-grass	FACW	OBL DRA
<i>Erichites hieraciifolia</i>	fireweed	FAC	UPL
<i>Eupatorium capillifolium</i>	dog fennel	FAC	UPL
<i>Fimbristylis autumnalis</i>	slender fimbristylis	OBL	OBL
<i>Fuirena scirpoidea</i>	rush fuirena	OBL	OBL
<i>Galactia sp.</i>	milk-pea	UPL	UPL
<i>Hypericum hypericoides</i>	St. Andrew's cross	FAC	UPL
<i>Ilex glabra</i>	inkberry	UPL	FACW
<i>Ilex opaca var. opaca</i>	american holly	FAC	UPL
<i>Myrica cerifera</i>	wax myrtle	FAC	FAC+
<i>Nuphar luteum</i>	spatter-dock	OBL	OBL
<i>Panicum verrcosum</i>	warty panicum	FACW	FACW DRA
<i>Polygonum punctatum</i>	smartweed	OBL	FACW+
<i>Pontederia cordata</i>	pickerelweed	OBL	OBL
<i>Psilocarya nitens</i>	baldrush	OBL	OBL
<i>Quercus virginiana</i>	virginia live oak	UPL	UPL
<i>Serenoa repens</i>	saw palmetto	UPL	UPL
<i>Setaria magna</i>	foxtail	OBL	FACW+
<i>Vaccinium myrsinities</i>	shiny blueberry	UPL	UPL

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RH:bs
attachments

c:	Hal Wilkening	Larry Battoe	Tommy Walters	Larry Fayard
	Jane Mace	Eric Olsen	Sandy McGee	Price Robison
	David Clapp	P. Valentine-Darby	Bob Freeman	Dale Jones
	MFL-REG			

6641 SE
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Fig. 1

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

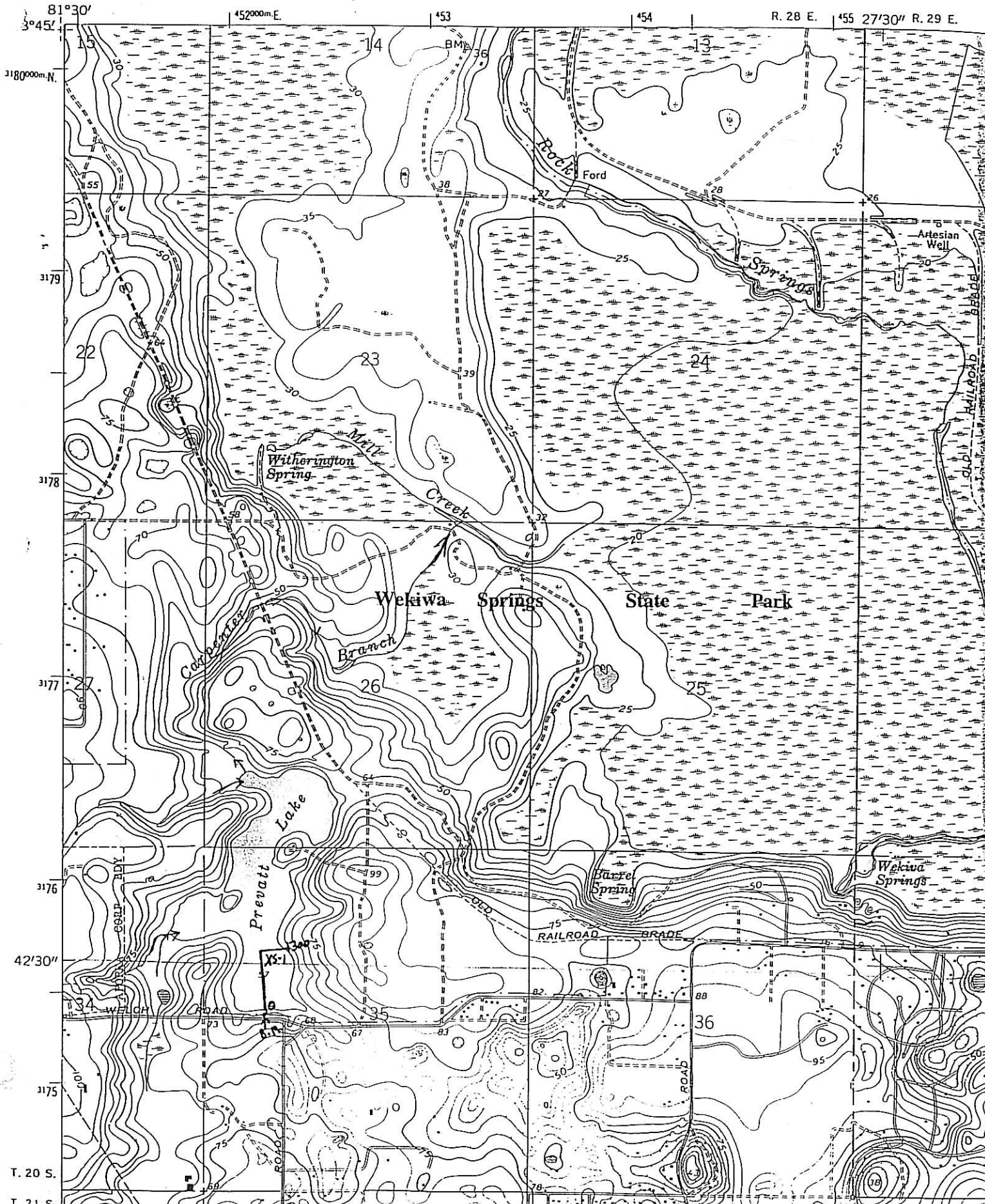
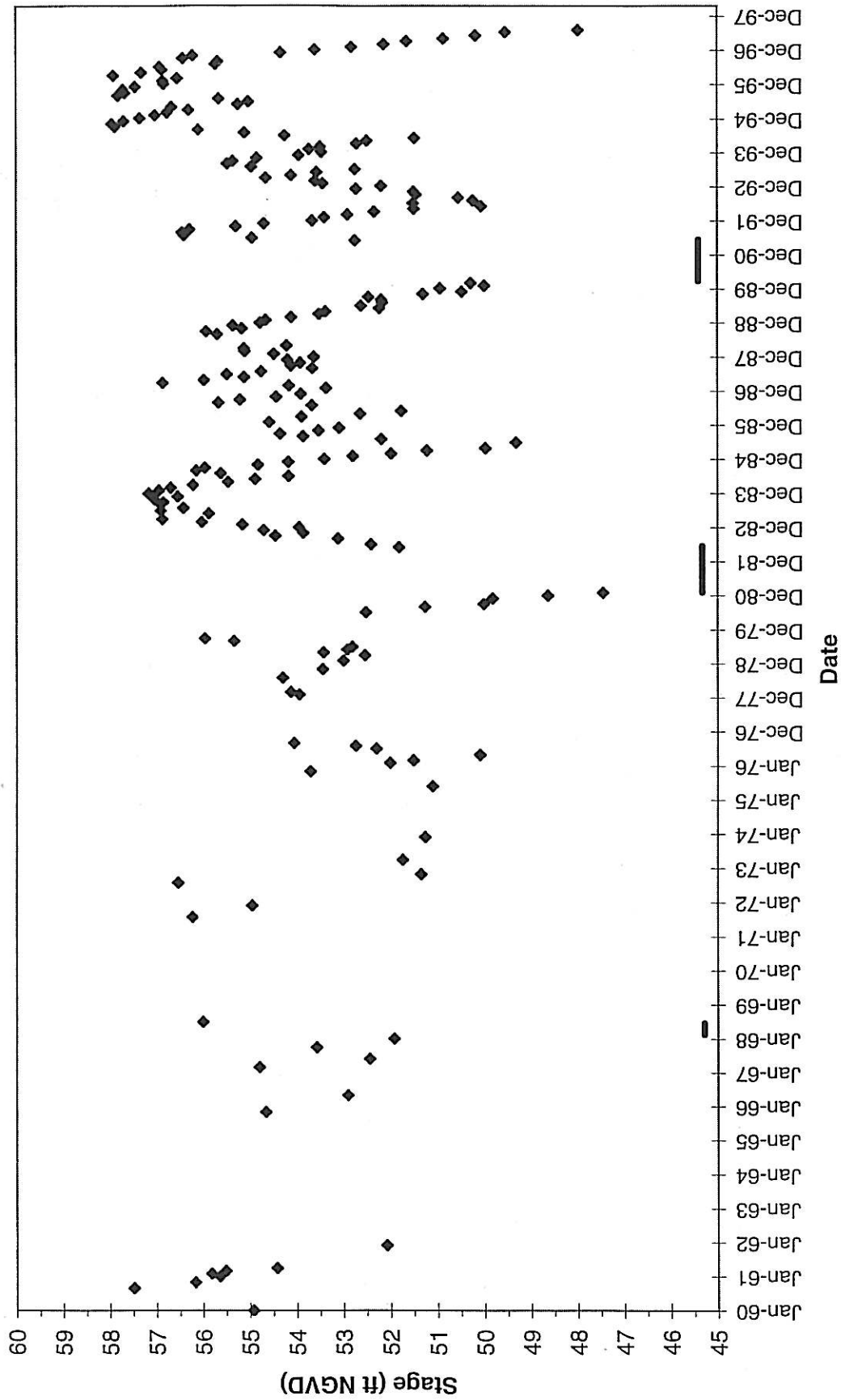
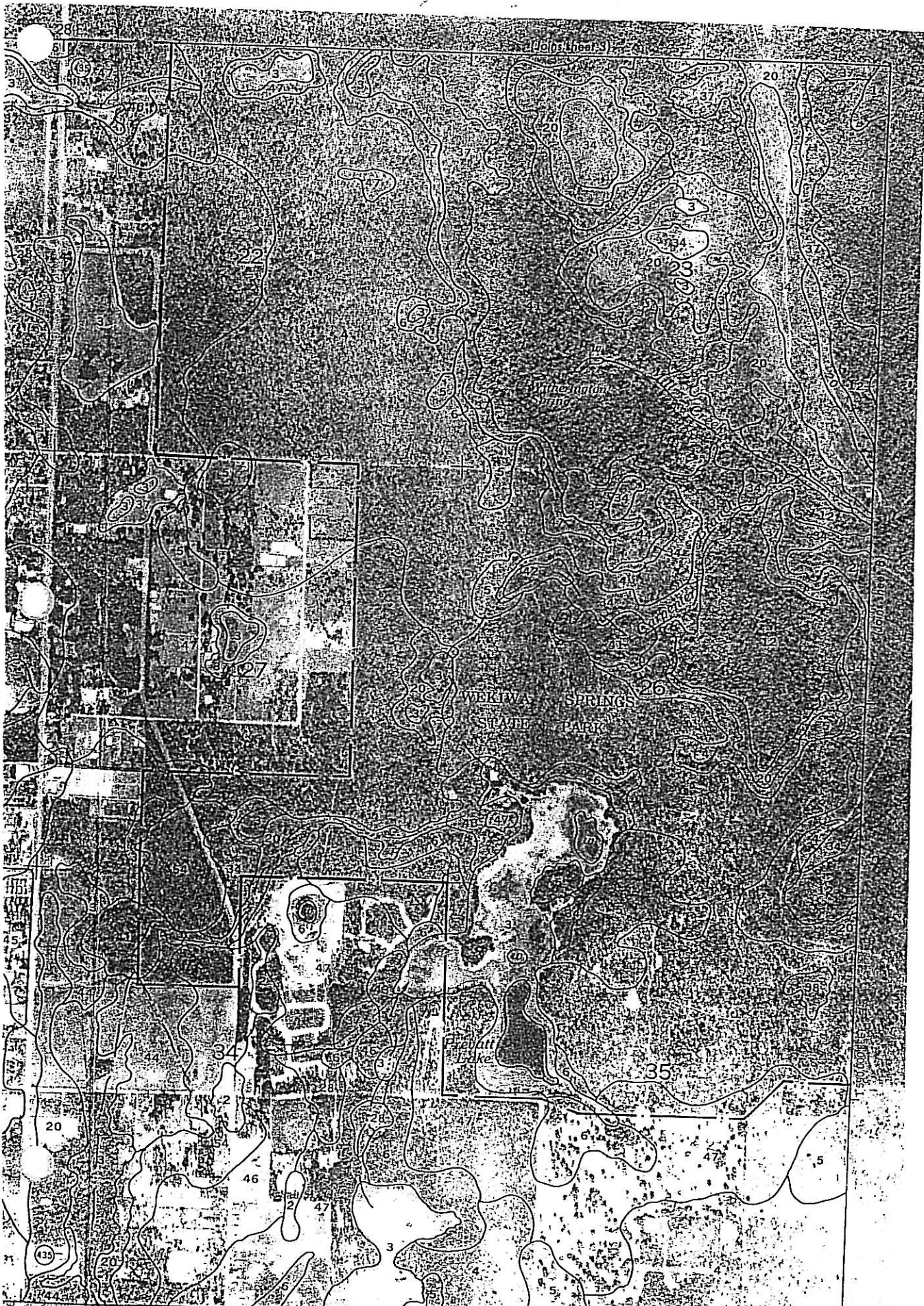


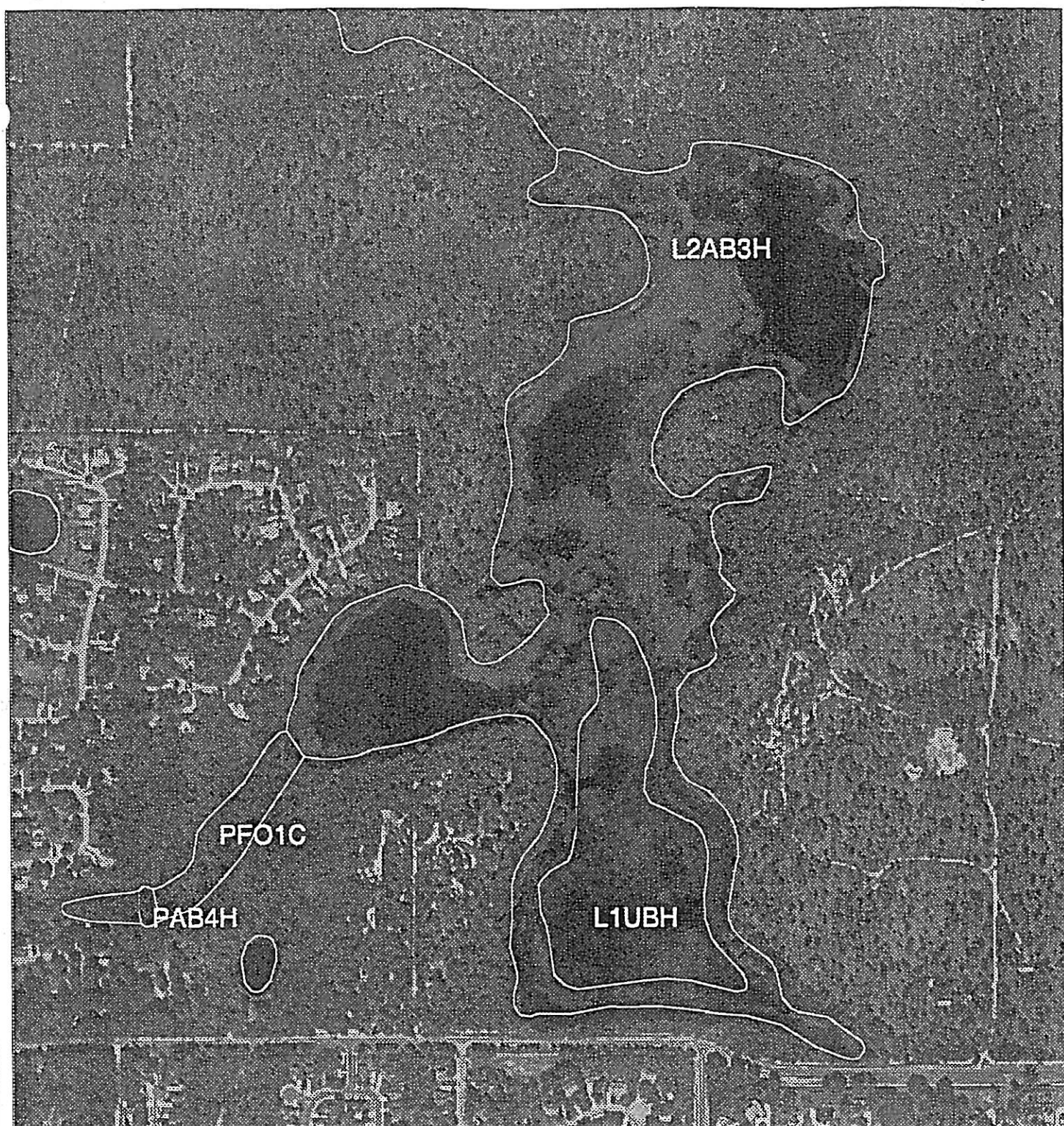
Fig. 2



Stage data collected by Orange Co. for Prevat Lake (irregular Jan-60 to Jul-97, usually monthly after 1980). The bold lines at the bottom of the figure show when readings were attempted and the record annotated with the comment "dry" (assumed to be less than 47.0 ft NGVD). The value for Jul-30-97 (47.97 ft NGVD) was surveyed by SJRWMD.

Fig. 3





Lake Prevat, Wekiwa Spring SP



0.1 0 0.1 Miles

Scale 1:7437



Fig. 5

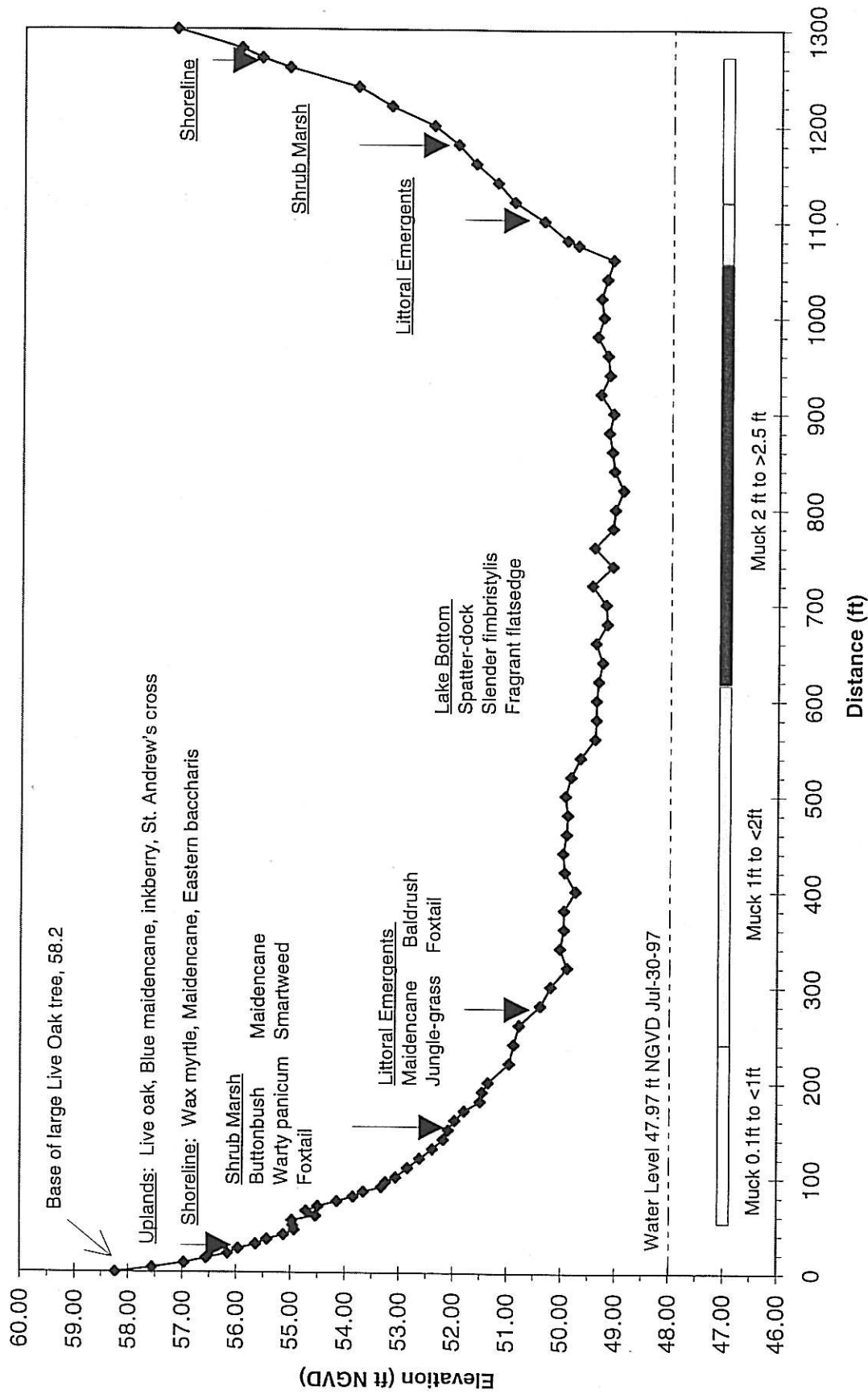


Figure 5. Elevation and environmental feature survey at Prevatt Lake. See Figure 1 for the location of the survey.