PINE TREE WATER CONTROL DISTRICT

WATER CONTROL PLAN

PREPARED BY

WILLIAM C WALLACE INC

GENERAL INTRODUCTION

This report deals with the drainage of a site known as the Pine Tree Water Control District which is located within Palm Beach County, Florida, approximately 18 miles West of the Atlantic Ocean and contiguous to and having its Northerly boundary along Southern Boulevard.

The Pine Tree Water Control District contains in all approximately 4,022 acres. The district has as its Northern boundary Canal C-51 and is bounded on the West by L-40, with the Southerly tip being approximately 4 miles South of C-51. See Exhibit 1 and Exhibit 1A (legal description). There are in existance several canals and major drainage structures that have an effect upon the Pine Tree Water Control District. North of Southern Boulevard we have Levee L-8 and its accompanying canal which runs in a Northerly direction and then proceeds in a Westerly direction where it connects to the Eastern shore of Lake Okeechobee. Along the Southerly edge of Southern Boulevard (State Road 80), we have the West Palm Beach Canal (C-51) with its ultimate discharge into Lake Worth and consequently the Atlantic Ocean. Heading in a Southerly direction from Southern Boulevard and also forming the Westerly limits of our project is Levee L-40 and its accompanying canal. L-40 has as its discharge point the Hillsborough Canal.

Our entire Western border is contiguous to a portion of Conservation Area #1, containing approximately 220 square miles. The various control structures that are located near the junctions of L-8, L-40, and the West Palm Beach Canal in conjunction with Pumping Station S-5A allows the control and diversion of overland flows and in the routing of major floods. Normal water elevation

within the conservation area is approximately 16 feet with the maximum elevation not to exceed 19.5 feet. Seepage from the conservation area into the Pine Tree Water Control District has been kept to a minimum by running our canals parallel to and no closer than 1300 feet of the L-40 levee and for the most part will be in the range of 2600 feet, between Levee L-40 and our primary canals.

The Pine Tree Water Control District property ranges in elevation from 13 feet to 16 feet above MSL, and in general slopes in a Southwesterly direction. (See Exhibit 2.) The surface soils consist of sands and organics with the latter covering the larger portion of the district. These organics range in a thickness from 1 foot to 8 feet with some local areas having pockets up to 13 feet in depth. (See Exhibit 3.)

The vast majority of the site is under agricultural control with sugar cane being the major crop. The remainder of the District is being developed as 5 acre minimum home sites.

Drainage facilities that are in existance within the Pine Tree Water Control District consist of several pumping stations, 2 major and 2 rehandling pumps. Both of the major pumping stations have as their discharge points the C-51 Drainage Canal. The existing pumping stations have a present capacity of 25,000 GPM (2 in Sec. 14) and an intake capacity of 15,000 GPM at the old site. There are also in existance several canals that drain a portion of the district but are inadequate to serve the entire district.

The Westerly pump station consists of 1 electric pump of 30,000 GPM and a diesel auxiliary pump of 30,000 GPM.

Access to the property is by an old wooden bridge across C-51 in line with the extension of the District's Easterly property line in a Northerly Direction. The District also has a new concrete bridge 3 miles to the West of the above referenced bridge. These bridges provide 2 connections into the District across C-51.

DESIGN CRITERIA

We have chosen as our storm duration a ten year storm. The five day rainfall intensity for a ten year storm derived from the Central and Southern Florida Flood Control records is in the following quantities:

First day	.31 inches
Second day	.48 inches
Third day	.74 inches
Fourth day	1.35 inches
Fifth day	5.87 inches

It has been stated in a report prepared by Gee & Jensen, Consulting Engineers for this district, that up to five inches of rainfall in any one day will be absorbed by ground storage and surface storage in undeveloped areas or by evaporation and transpiration. The one inch of remaining rainfall represents runoff for which we have designed our canal cross sections to carry. This is the maximum amount of discharge as allowed by Central and Southern Florida Flood Control for any 24 hour period. We can see from the above mentioned rainfall records for a ten year storm that if we were to discharge an average of one inch per day, that we would, in fact, be lowering the general water table within the area and have no requirements for holding basins. For the above stated reasons, we have not prepared synthetic unit hydrographs and/or flood hydrographs for this district, but have rather based the canal cross sections and the pumping station designs based upon the one inch per day maximum discharge.

Because of the consistent nature of this property, the runoff will not vary significantly within the drainage district. Each section will yield approximately $Q = 640 \text{ acres } (43560 \text{ ft}^2/\text{acre})(.082 \text{ ft/day}) = 26.46 \text{ cfs}$. This reflects the 1"/day allowable discharge.

The total runoff @ 1" day for the 4,022 acres would equate as follows:

Q = 4022 acres (43560 sq.ft./acre)(.082'/day) = $1.437 \times 10^7 \times ft^3$/day or 166.28 cfs or 74626 GPM

For a check, we may use the Lake Worth Drainage District recommended allowable runoff for areas West of Jog Road and discharging into the West Palm Beach Canal (C-51), as given by the formula.

$$Q = \left(\frac{16.8}{\sqrt{A}} + 23.4\right)A \qquad \text{100 acres or greater}$$

Where A = Area in square miles

$$Q = \left(\frac{16.8}{\sqrt{6.28}} + 23.4\right)6.28$$

$$= \left(\frac{16.8}{2.51} + 23.4\right)6.28$$

$$= (6.69 + 23.4)6.28$$

$$= 188.97 \text{ cfs}$$

It can be seen from the check provided by the Lake Worth Drainage District formula that our total runoff is a reasonable figure. A more detailed runoff per section breakdown would be as follows using the allowable discharge of one inch per day.

		Q(cfs)
Section 33, Township 44 South, Range 40 East	230 acres	9.51
Section 34, Township 43 South, Range 40 East; Section 3, Township 44 South, Range 40 East	100 acres	4.13
Section 4, Township 44 South, Range 40 East	480 acres	19.85
Section 9, Township 44 South, Range 40 East	140 acres	5.79
Section 10, Township 44 South, Range 40 East	638 acres	26.38
Section 15, Township 44 South, Range 40 East	307 acres	12.69
Section 14, Township 44 South, Range 40 East	658 acres	27.20

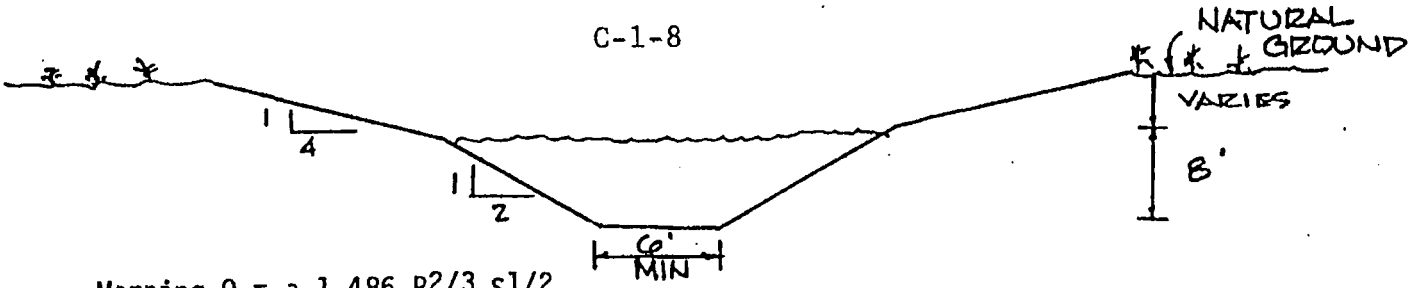
Section 13, Township 44 South, Range 40 East	658 acres	27.20
Section 23, Township 44 South, Range 40 East	211 acres	8.72
Section 24, Township 44 South, Range 40 East	600 acres	24.81
	4022 acres	166.28 cfs

DRAINAGE AREA MAP

We have prepared a drainage area map (See Exhibit 4) that labels the Sections, shows the general canal profiles, direction of flow, area contained within each section, and the runoff express in cubic feet per second. We have also shown on this same exhibit the time of concentration for the district.

We have four basic elements within our drainage plan. The first element that we considered was the overland flow from the center of any parcel to what we have labeled a C-3 swale. We have anticipated that the entire district will be developed into an area that has the same sheet flow character as dense grass. The C-3 swale design was chosen to permit the operation of farm equipment across the C-3 swale. The C-3 swale is of sufficient size and located at sufficient intervals (1320 feet swale centerline to swale centerline) to carry the runoff into our secondary canals which we have labeled C-2's. The C-2 cross sections, its related areas and corresponding velocites are shown in the calculations that follow in each particular case. The C-2's carry the runoff and eventually meet with our fourth and final element, the C-1 canals. As mentioned, the C-1 canals with its cross section areas and related velocites for the given hydraulic slope with the pump on of .00008 '/' leading to and terminating at the pump station previously mentioned in our report.

In the design of the Pine Tree Water Drainage System, we have chosen to use the Manning formula with the coefficient shown under each of the three basic designs. They are labeled and have the following configuration.



Manning $Q = a \frac{1.486}{n} R^{2/3} S^{1/2}$

Where Q = Discharge (steady uniform flow) cfs

a = area in square feet

n = roughness coefficient

R = hydraulic radius

S = hydraulic slope

a = 176 sq. ft.

n = .030

R = 4.21'

$S = .000\ 08 \frac{2'}{25{,}000''}$

$R^{2/3} = 2.61$

$S^{1/2} = .00894$

8' depth $Q = 176 \frac{1.486}{.030} (2.61)(.00894)$

Q = 203.51 cfs

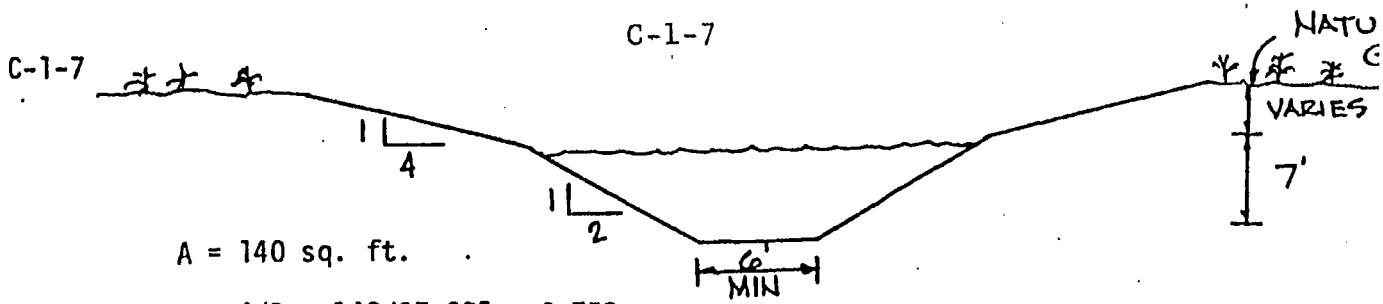
Q = VA, therefore

V = Q/A = 203.51/176

V = 1.16 ft./sec.

V = 4176 ft/hr

C-1-7



A = 140 sq. ft.

R = A/P = 140/37.305 = 3.753

$R^{2/3}$ = 2.413

$S^{1/2}$ = .008 94

$Q = 140 \left(\frac{1.486}{.030}\right)(2.413)(.008\ 94)$

Q = 149.58 cfs

Q = VA, therefore

V = Q/A

V = 149.58/140

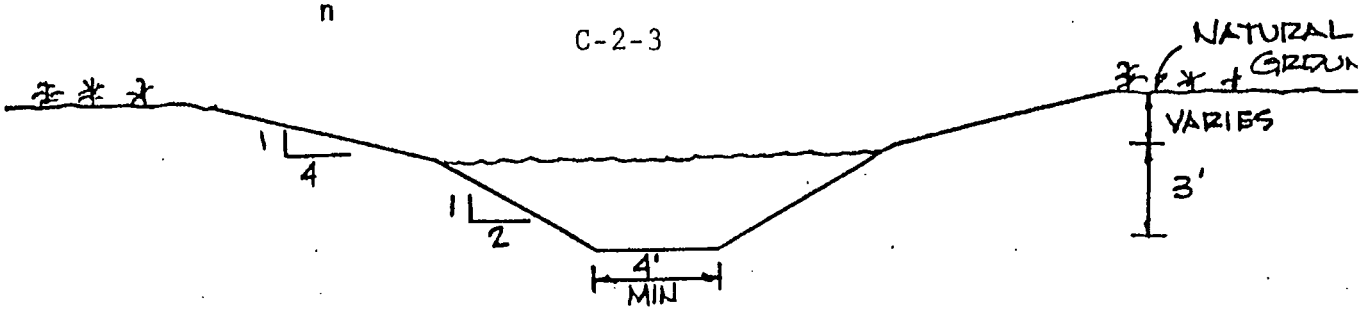
V = 1.07 ft./sec.

V = 3846 ft./hr.

C - 2

Manning $Q = a \frac{1.486}{n} R^{2/3} S^{1/2}$

C-2-3



C-2-3 3' depth

a = 30 sq. ft.

n = .030

R = A/P = 30/17.42 = 1.72

S = .00008

$R^{2/3}$ = 1.437

$S^{1/2}$ = .00894

$Q = 30 \left(\frac{1.486}{.030}\right)(1.437)(.00894) = 19$ cfs

Q = VA , therefore

V = Q/A

V = 19/30

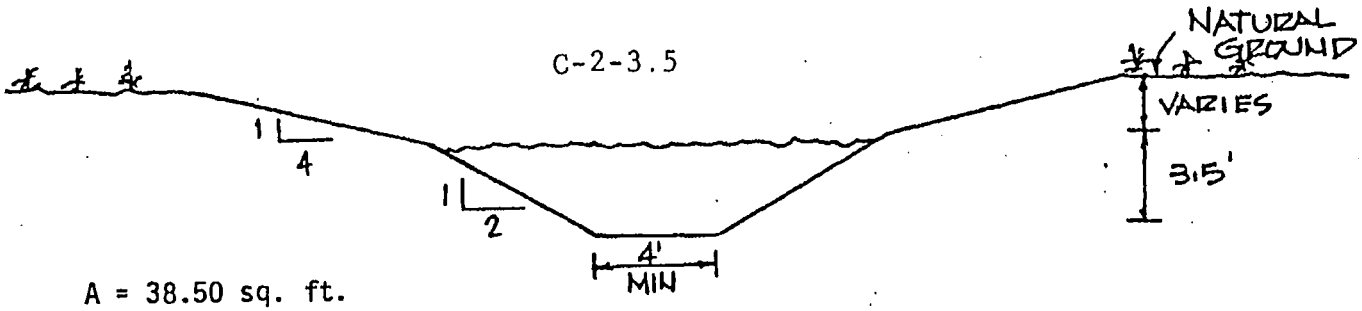
V = .63 ft./sec.

V = 2268 ft./hr.

10

C-2-3.5

Manning $Q = a \frac{1.486}{n} R^{2/3} S^{1/2}$



A = 38.50 sq. ft.

R = A/P = 38.50/19.65 = 1.96

$R^{2/3}$ = 1.57

$S^{1/2}$ = .00894

$Q = 38.50 \frac{(1.486)}{.030}(1.57)(.00894)$

Q = 26.77 cfs

Q = V/A

V = Q/A

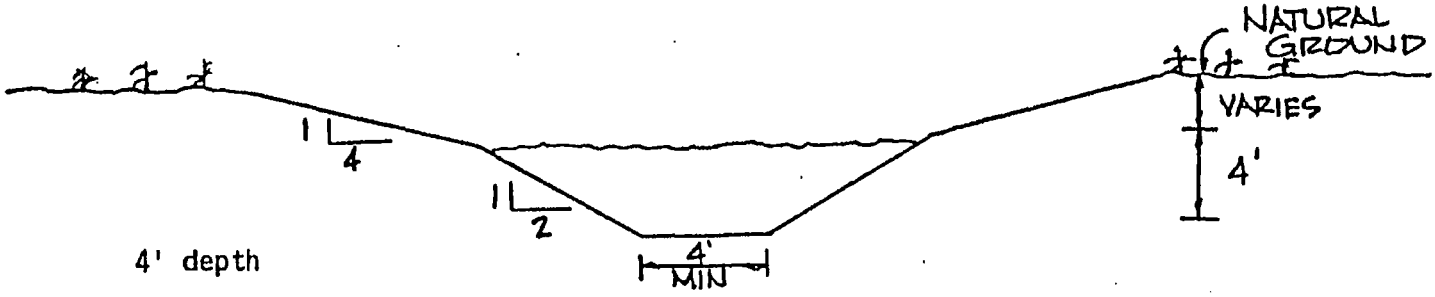
V = 26.77/38.90

V = .69 ft./sec.

= 2503'/hr

C-2-4

Manning $Q = a \frac{1.486}{n} R^{2/3} S^{1/2}$



4' depth

A = 48 sq. ft.

n = .030

R = A/P = 48/21.89 = 2.19

S = .00008

$R^{2/3}$ = 1.687

$S^{1/2}$ = .00894

$Q = 48 \left(\frac{1.486}{.030}\right)(1.687)(.00894) = 35.86$ cfs

Q = VA, therefore

V = Q/A

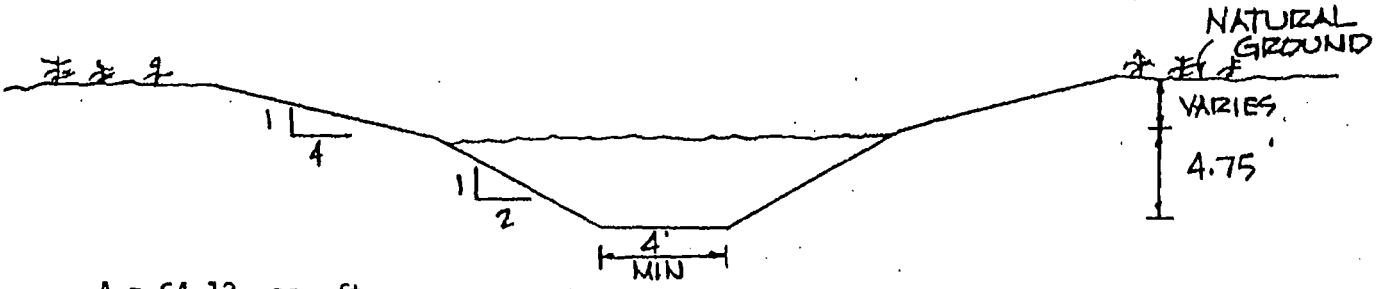
V = 35.86/48

V = .75 ft./sec.

V = 2700 ft./hr.

C-2-4.75

Manning $Q = a \frac{1.486}{n} R^{2/3} S^{1/2}$



A = 64.13 sq. ft.

R = A/P = 64.13/25.24 = 2.54

$R^{2/3}$ = 1.86

$S^{1/2}$ = .00894

$Q = 64.13 \frac{(1.486)}{.030}(1.86)(.00894)$

Q = 52.82 cfs

Q = VA, therefore

V = Q/A

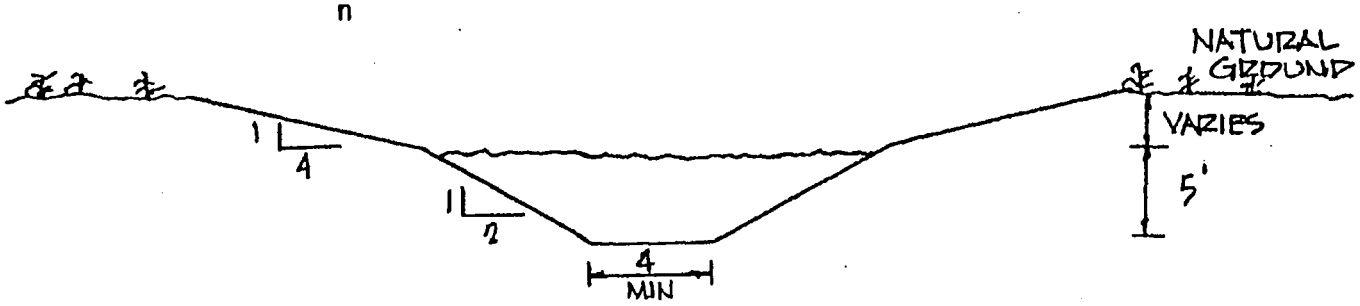
V = 52.82/64.13

V = .824 ft./sec.

V = 2966 ft./hr.

C-2-5

Manning $Q = a \frac{1.486}{n} R^{2/3} S^{1/2}$



A = 70 sq. ft.

R = 70/26.36 = 2.66

$R^{2/3}$ = 1.916

$S^{1/2}$ = .00894

$Q = 70\left(\frac{1.486}{.030}\right)(1.916)(.00894) = 59.39$ cfs

Q = VA, therefore

V = Q/A

V = 59.39/70

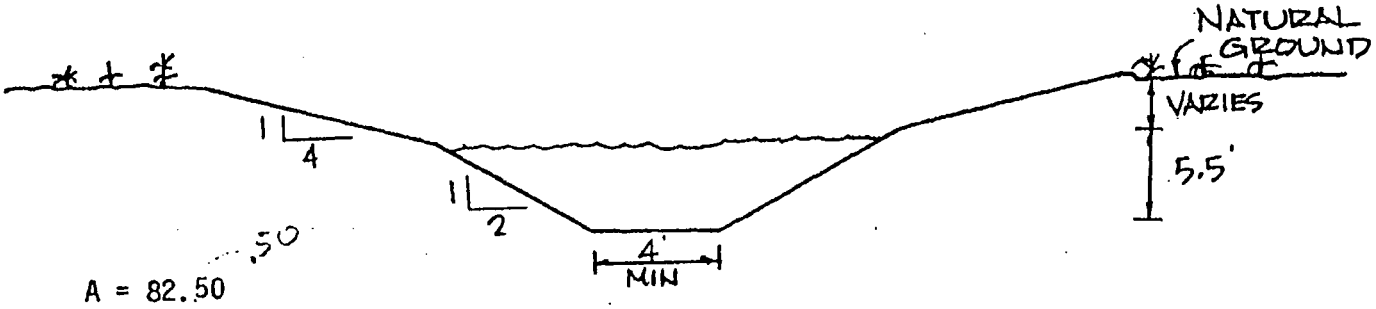
V = .85 ft./sec.

V = 3060 ft./hr.

14

C-2-5.5

Manning $Q = a \frac{1.486}{n} R^{2/3} S^{1/2}$



A = 82.50

R = A/P = 82.50/28.60 = 2.89

$R^{2/3}$ = 2.025

$S^{1/2}$ = .00894

$Q = 82.50 \frac{(1.486)}{.030}(2.025)(.00894)$

Q = 73.98 cfs

Q = VA, therefore

V = Q/A =

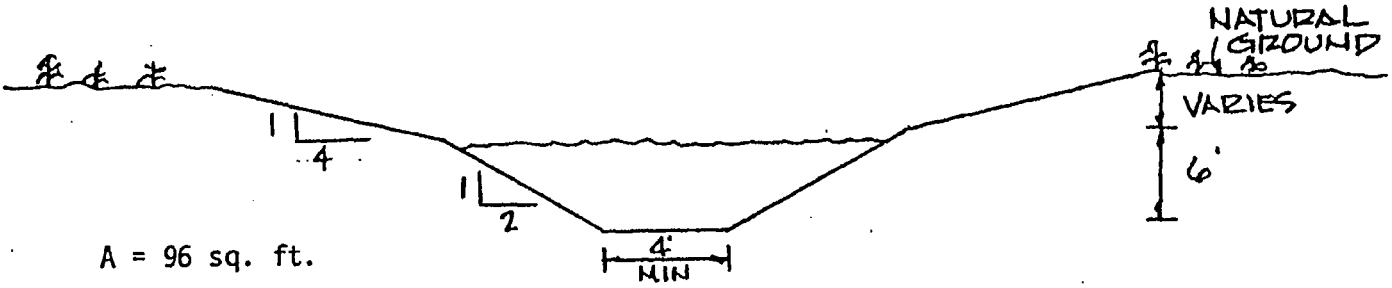
V = 72.98/82.50

V = .90 ft./sec.

V = 3228 ft./hr.

C-2-6

Manning $Q = a \frac{1.486}{n} R^{2/3} S^{1/2}$



A = 96 sq. ft.

n = .030

R = A/P = 96/30.833 - 3.114

$R^{2/3}$ = 2.132

$S^{1/2}$ = .00894

$Q = 96 \frac{(1.486)}{.030}(2.132)(.00894) = 90.63$ cfs

Q = VA, therefore

V = Q/A

V = 90.63/96

V = .94 ft./sec.

V = 3384 ft./hr.

The erosion of the canal bank will be only a slight problem if we do not exceed a maximum velocity of 2 fps. This is below a recommended safe velocity of 2.5 fps for sandy and sandy loam soil. Our maximum velocity is 1.16 ft./sec.; therefore we anticipate no erosion to our banks due to the velocity of our storm water runoff.

TIME OF CONCENTRATION

The time of concentration for the Pine Tree Water Control District will break down as follows (See Exhibits 4 and 6):

The overland flow from the center of a parcel to a created swale (of the C-3 configuration) along the property line would traverse a distance of approximately 660 feet with the slope being approximately .001, then the average turf time for this overland flow is 1.1 hours (see Exhibit 5). The distance traveled within the C-3 swale is approximately 1320 feet, the slope of the C-3 swale is approximately .001. This would yield a velocity of .49 feet per second or 1764 feet per hour. Therefore, dividing the 1320 feet traversed distance by our velocity of 1764 feet per hour, we find we have .75 hours flow time within C-3 canal profile. The C-3 swale then connects to our main canal system.

The main canal cross sections, their respective length, correspoding velocities, and therefore, the T.O.C. for each cross section is as follows (See Exhibit 4).

Cross Section	Distance	Velocity	T.O.C.
C-2-3	5160'	2268'/hr	2.28
C-2-3.5	2640'	2503'/hr	1.05
C-2-4.0	2640'	2700'/hr	.98
C-2-4.75	1320'	2966'/hr	.45
C-2-5.50	1320'	3228'/hr	.41
C-2-6.0	3840'	3384'/hr	1.13
C-1-7.0	6060'	3846'/hr	1.58
C-1-8.0	7920'	4176'/hr	1.90
			9.78

If we add the overland flow from the center of a parcel to the C-3-1, we have and additional 1.10 hours. Then the flow within the C-3-1 cross section is equal to.75 hours. Adding these two elements to the above elements, we come up with a total time of concentration of 11.63 hours.

Canal Flow	9.78 hours
Overland	1.10
C-3 Swale	.75
	11.63 hours T.O.C.

It is obvious that for a storm frequency greater than a ten year storm, some form of a holding basin or basins must be provided.

It would appear that the most economical and practical method for providing the holding basins would be to coordinate the construction of individual lakes within the parcels with the land owners. These lakes would be beneficial to the individual parcel owners in that the fill could be utilized to raise the local areas for building pads and entrance roads, provide readily available water for livestock and/or crops.

When the S.F.W.M.D. implements its back pumping plan, Pine Tree Water Control District will be allowed to discharge 2"/day into C-51. The effect of a 2"/day discharge is to reduce the holding basin which must be provided,

The design water elevation within the district will range from between 8.5+ MSL to 11.00+ MSL, while the property ranges in elevation from 13+ to 16+. This should provide for a minimum storage of 2' at any lake location.

The maximum rainfall likely to occur during any 24 hour period as compiled by the Water Survey and Research Division of Florida State Board of Conservation is slightly in excess of nine inches. As previously shown, five inches could be allocated to ground storage and evapotranspiration.

One inch may be discharged into the West Palm Beach Canal (C-51).

Three inches must go into some form of holding basins, being held in these basins until the excess could be discharged at the allowable rate of one inch per day into the West Palm Beach Canal. With a minimum storage height available of two feet and with the three inches or .25 feet excess rainfall, then each square foot of

holding basins at a 2' depth could hold 8 square feet of runoff; therefore, approximately 1/8 or 12% of the land surface should be in the form of a holding basin to allow for rentention of the maximum storm without occurring damage to crops and livestock. Buildings would not be endangered if their finished floors are constructed at the recommended elevations with or without the holding basins.

Culverts have not been sized because a final road layout has not been chosen. Upon selection of a road layout, the culvert and/or bridges will be sized to prevent upstream ponding and the resulting risk of flooding and damage to property upstream.

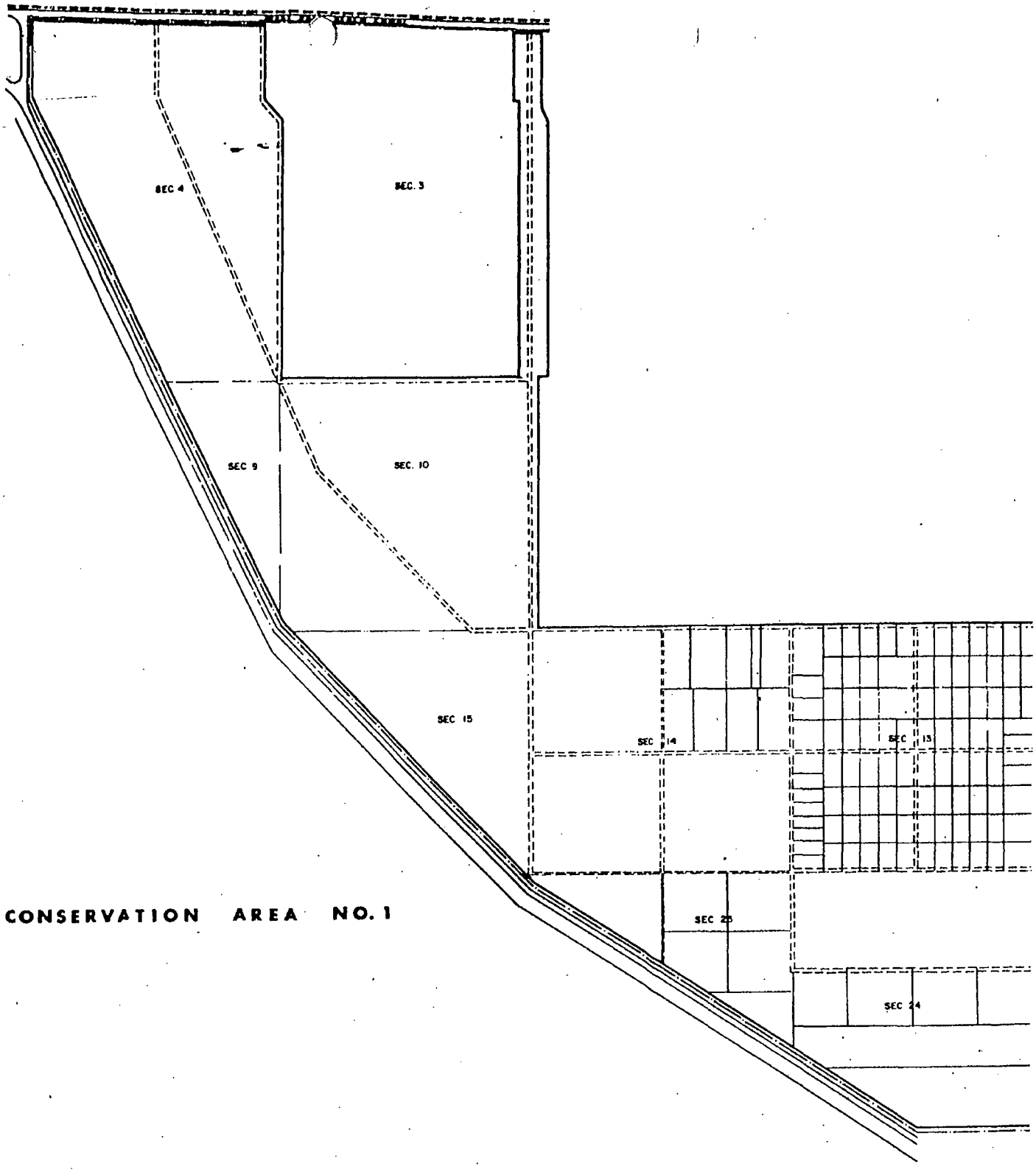
It is our recommendation that the finished floor be set at not less than 17' above MSL and/or 12" above the surrounding natural grade, whichever is greater.

The water elevation in West Palm Beach Canal during flood periods will be approximately 17.00'; therefore, our pumps must be capable of discharging against a 8' head.

There is an existing pumping station with 3 bays located at the intersection of the East line of Section 34 and C-51. The concrete sub-base is in fairly good shape but with some repair required. The wooden framing that supports the weight of the pumps has been replaced and a new floor installed.

This Easterly pump station has a 25,000 GPM pump.

The Westerly pump station has two 30,000 GPM pumps, one electric and one diesel.



CONSERVATION AREA NO. 1

property outline

NO. SCALE

EXHIBIT 1

BOUNDARY DESCRIPTION

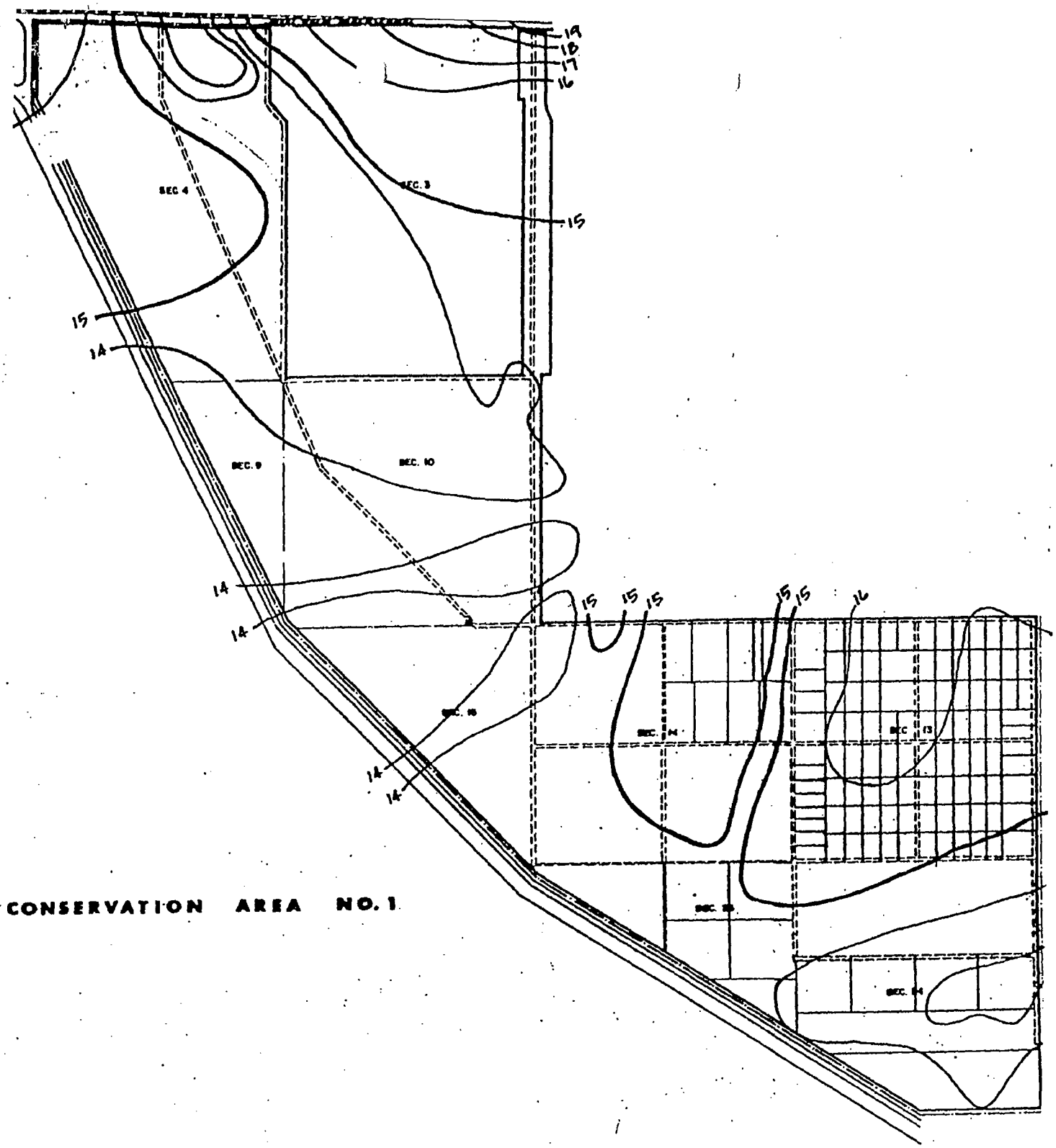
PINE TREE WATER CONTROL DISTRICT

Beginning at the Southeast corner of Section 24, Township 44 South, Range 40 East, run South 89° 43' 08" West, along the South line of said Section 24 a distance of 2,674.64 feet to the Northerly right of way of Canal L-40; thence North 56° 54' 19" West along said right of way of Canal L-40, a distance of 9,479.62 feet; thence North 42° 15' 14" West and continuing along said Canal right of way 7,363.27 feet to the West line of Section 10, Township 44 South, Range 40 East; thence South 01° 16' 05" West, along said West line of said Section 10, a distance of 57.57 feet; thence North 25° 11' 01" West along the aforementioned Northerly right of way of Canal L-40, a distance of 12,185.26 feet to the West line of Hiatus Lot 4; thence North 01° 14' 08" East along the West line of Hiatus Lot 4 a distance of 113.66 feet to the Southwest corner of Section 33, Township 43 South, Range 40 East; thence North 01° 14' 08" East along the West line of said Section 33, a distance of 1,532.34 feet to the South right of way line of the West Palm Beach Canal; thence South 88° 23' 22" East along said Canal right of way 4,981.18 feet; thence South 01° 04' 07" West 1,541 feet to the South line of Section 33, Township 43 South, Range 40 East; thence South 42° 09' 30" East 643.43 feet to the Northeast corner of Section 4, Township 44 South, Range 40 East; thence South 01° 16' 05" West along the East line of said Section 4 a distance of 5,314.41 feet to the Southeast corner of said Section 4; thence North 89° 44' 30" East along the North line of Section 10, Township 44 South, Range 40 East, 4,875.18 feet; thence run North 01° 15' 49" East 5,304.15 feet to a point on the South line of Hiatus Lot 3; thence North 01° 25' 51" East 515.41 feet; thence North 87° 27' 20" West 106.75 feet; thence North 00° 51' 10" East 1,336.85 feet to the South right of way line of West Palm

EXHIBIT 1A

Beach Canal; thence South 88° 21' 18" East along the South right of way of said Canal 363.94 feet; thence continue along the South line of said Canal right of way South 88° 28' 22" East 200.02 feet; thence South 00° 56' 00" West 1,544.21 feet to the South line of Section 35, Township 43 South, Range 40 East; thence South 24° 36' 48" East 325 feet to the North line of Section 2, Township 44 South, Range 40 East, said line also being the South line of Hiatus Lot 2; thence South 01° 15' 44" West 5,302.88 feet to the South line of Section 2; thence South 89° 44' 30" West along the South line of said Section 2 a distance of 200.07 feet to the Southwest corner of said Section 2; thence South 01°15'44" West along the West line of Section 11, Township 44 South, Range 40 East 5278.18 feet to the Southwest corner of said Section 11; thence North 89° 43' 57" East along the North lines of Sections 14 and 13, Township 44 South, Range 40 East, 10,536.48 feet to the Northeast corner of said Section 13; thence South 01°17'26" West along the East line of said Section 13 a distance of 5,276.29 feet to the Southeast corner of said Section 13, thence South 01° 20' 00" West along the East line of Section 24, Township 44 South, Range 40 East 5,279.90 feet to the Southeast corner of Section 24 and the Point of Beginning.

Containing 4,022 acres, more or less.

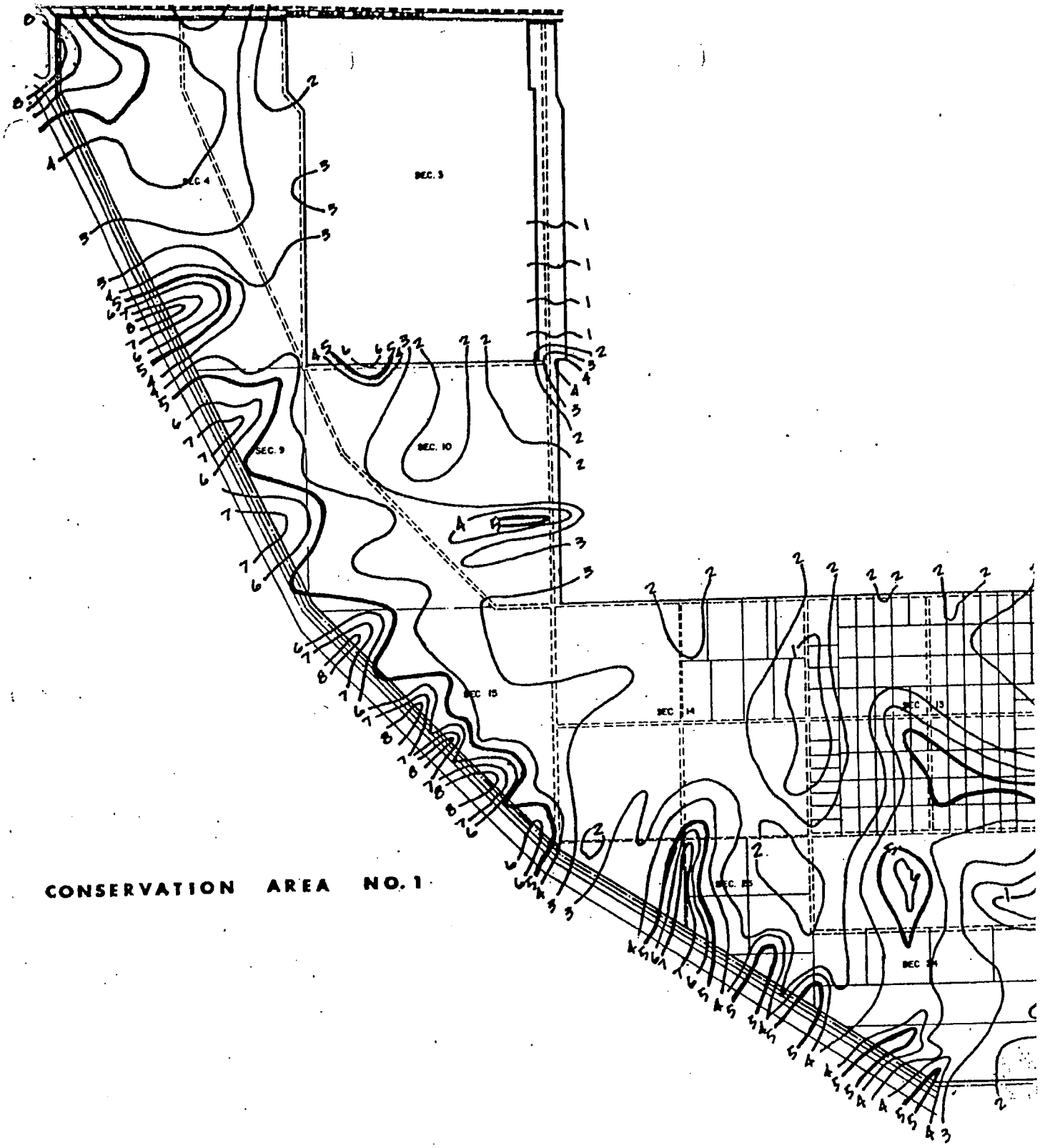


CONSERVATION AREA NO. 1

ground elevations

NO SCALE

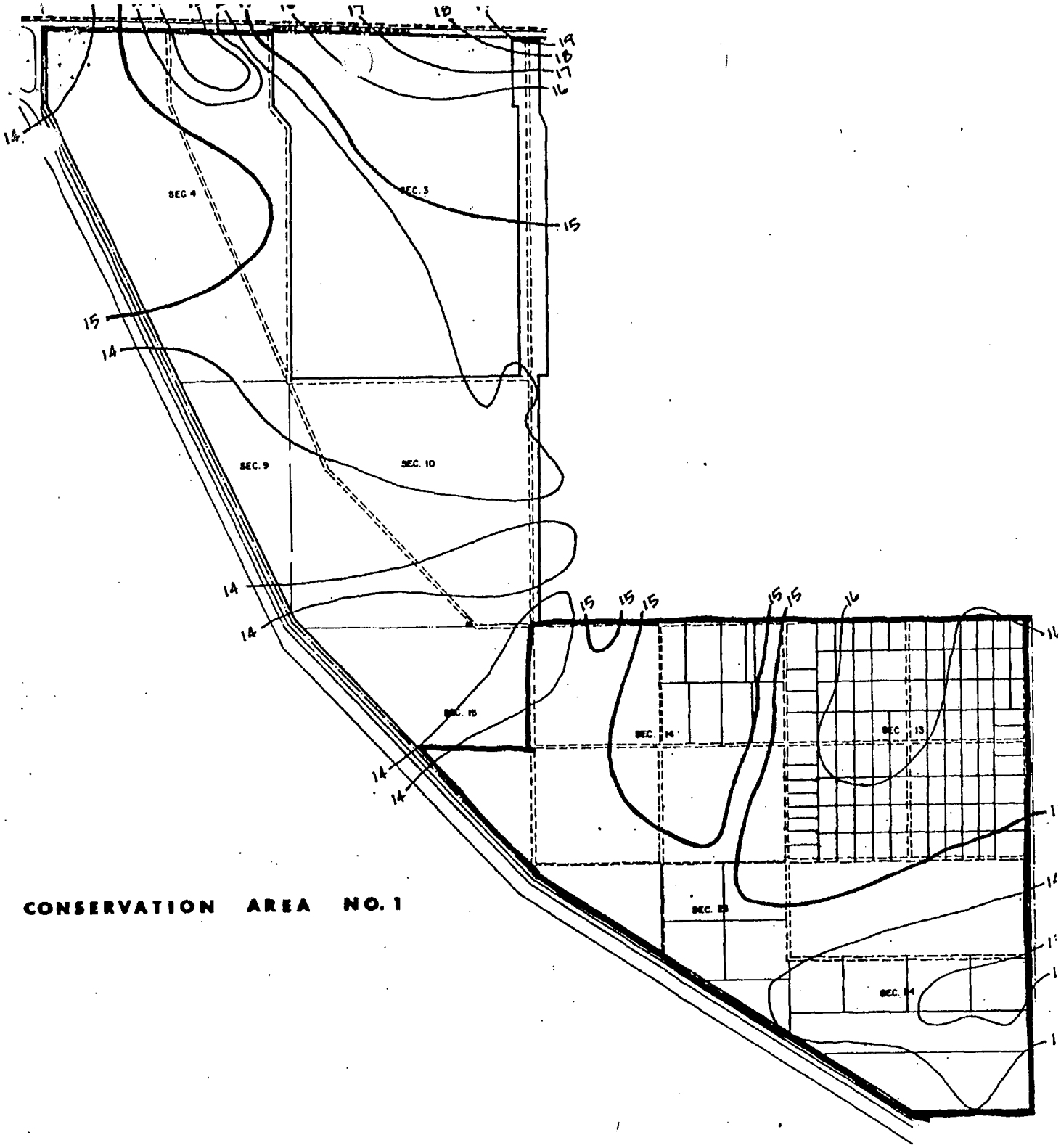
EXHIBIT 2



CONSERVATION AREA NO. 1

depth of muck
elevations
NO SCALE

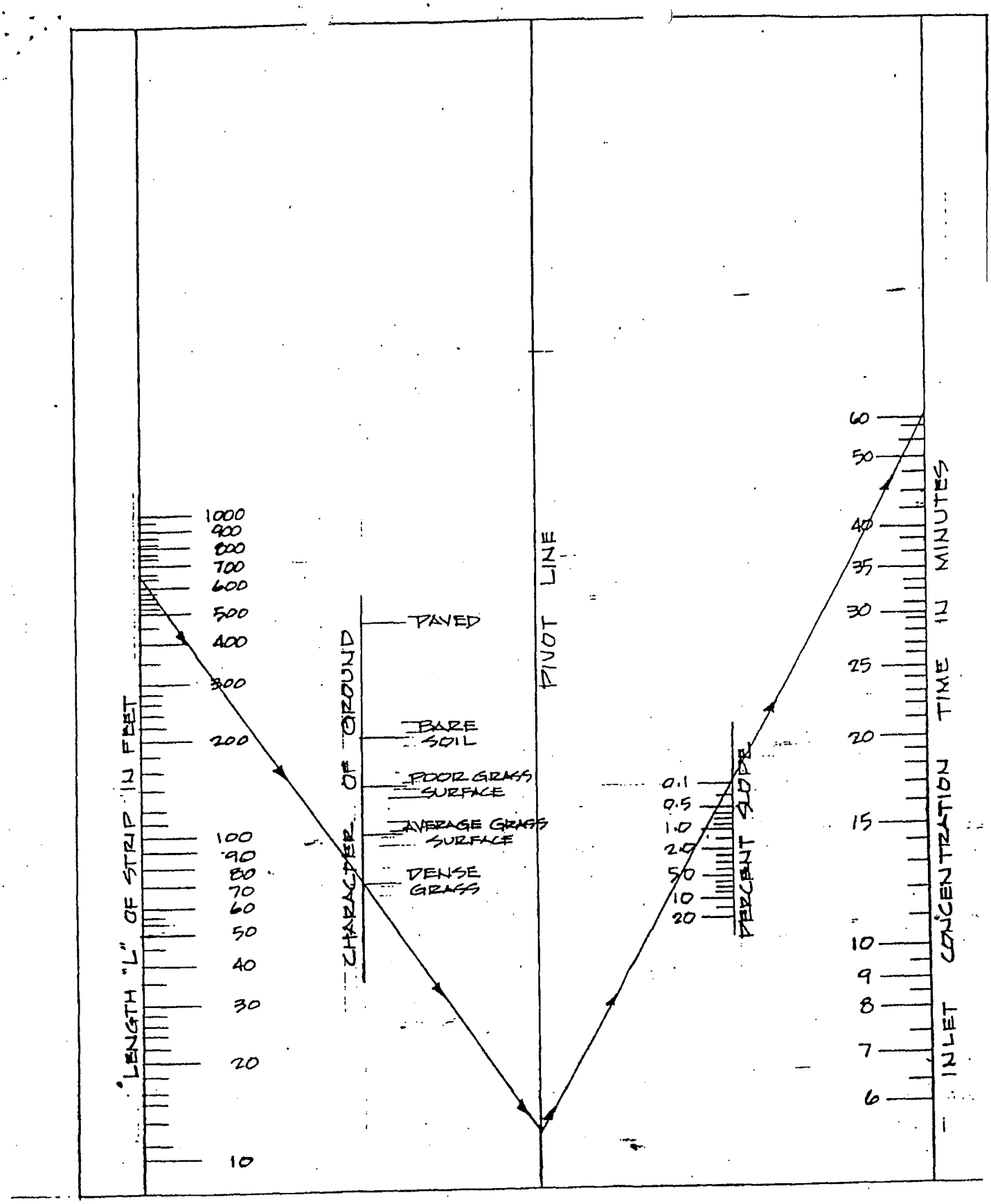
EXHIBIT 3



CONSERVATION AREA NO. 1

ground elevations

NO SCALE



OVERLAND FLOW TIME

EXHIBIT 5