INVENTORY AND INPECTION REPORT
FOR WATER QUALITY DETENTION BASINS
(Project No. 2411.0192)

May 5, 1995

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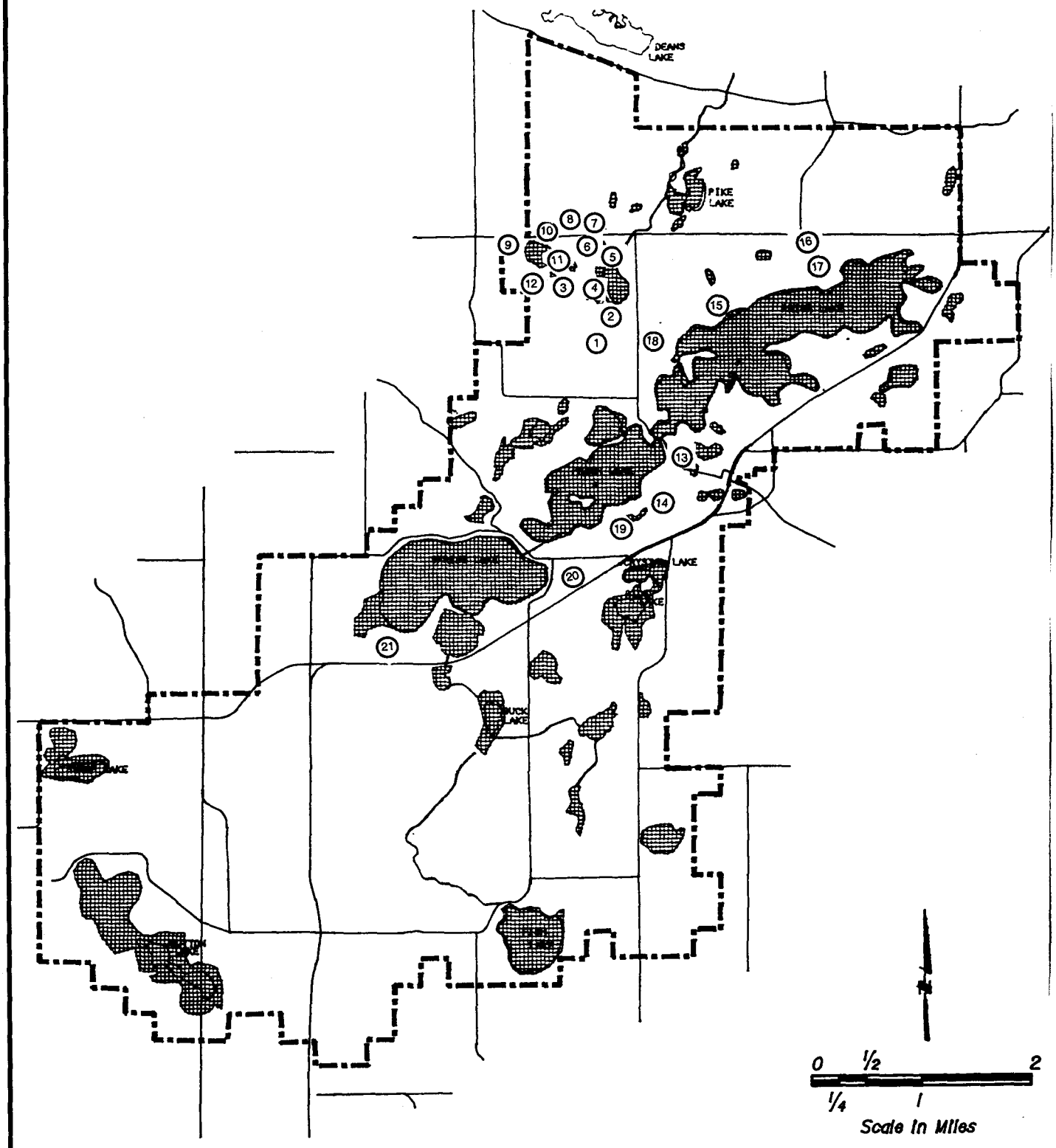
INTRODUCTION

Wet detention basins (stormwater ponds) are one of the most common and effective stormwater Best Management Practices (BMPs). Well designed wet detention basins can typically remove 80-90% of suspended particulates and particulate phase pollutants. Many municipalities and watershed organizations require the construction of stormwater basins for new developments to mitigate increased peak flows and pollutant runoff. The US Environmental Protection Agency sponsored a national study of urban runoff; the National Urban Runoff Program (NURP). The results of this study have been used to develop design criteria for wet detention basins (Walker 1988; Pitt 1993). Although wet detention basins are gaining wide acceptance and have been proven effective, they require maintenance and cannot simply be neglected after initial construction. To address future maintenance requirements the Prior Lake/Spring Lake Watershed District (PLSLWD) has directed an inventory and evaluation of the wet detention basins in the watershed.

An inventory of twenty-one wet detention basins within the PLSLWD was conducted during the month of October , 1994. The parameters that were inventoried included basin surface area, average water depth, average sediment accumulation, the number, size, and condition of inlets, condition and size of the outlet, the condition of the surrounding sideslope, and overall basin condition. A photo record was kept for each basin and data sheets were recorded during inspection. This report presents the results of the inventory and discusses specific and general maintenance requirements, general maintenance costs, and suggested design requirements.

INVENTORY RESULTS

This section presents the results of the inventory and the site-specific maintenance requirements. The first twelve basins are located in The Wilds development and golf course area. The remaining nine basins are scattered throughout the watershed, primarily in single family residential areas. Figure 1 shows the approximate locations of these basins. Table 1 lists the basins and provides their general physical characteristics.



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Prior Lake / Spring Lake Watershed District

Approximate Location of Water Quality Basins

Figure 1

TABLE 1
WATER QUALITY BASINS

No.	Name	Surface Area (ac)	Water Depth (ft)	Drainage Area (ac)	Sediment Depth (ft)	Year Built
1	NP-1S	0.29	3.5	63.0	1.0	1994
2	NP-2	0.64	4.0	10.3	0.3	1994
3	NP-3	0.20	2.0	42.5	0.8	1994
4	NP-3S	0.16	3.0	45.0	0.2	1994
5	NP-5	0.15	5.0	21.0	0.8	1994
6	NP-7	0.21	4.5	12.9	1.0	1994
7	NP-8	0.16	2.5	60.3	1.5	1993
8	NP-8S	1.1	4.5	63.3	0.5	1993
9	NP-9	0.27	4.5	13.9	0.2	1993
10	NP-10	0.17	4.5	15.8	0.3	1993
11	NP-11	0.16	4.0	13.0	0.8	1993
12	NP-12	0.39	3.0	45.0	2.0	1992
13	City Hall	1.7	4.5	18.5	0.3	NA
14	Cates Street	2.0	2.5	347	NA	NA
15	Beach Street	0.18	0.0	38.1	0.0	1986
16	Sand Point 1	0.24	0.0	17.4	0.0	1984
17	Sand Point 2	0.22	0.0	17.4	0.0	1984
18	Carriage Hills	0.85	4.5	38.9	0.5	1993
19	Willow Lane	0.22	4.0	2.5 *	0.2	1993
20	Sunset Hills II	1.5	2.5	23.2	NA	NA
21	Desilt Pond	3.3	4.5	5,310	0.5	1976

* Drainage area will be 15.0 acres at full development

Basin 1

Basin 1 (NP-1S) is located on the southeastern corner of the Wilds. The current basin size is approximately 0.29 acres. The basin has about 1 foot of sediment accumulated across the basin floor and current water depth is 3.5 feet. The outlet is situated about 3 feet above the current water level. This will make the basin over 6 feet deep when it finally reaches normal water level. The current side slopes of this basin are a 2:1 ratio. This area is still under construction and there are currently no outlets and three small PVC inlets. There are three inlets; a 2 inch PVC, a 4 inch PVC, and an 8 inch PVC that are currently flowing into basin 1. The 8 inch PVC pipe was installed to act as an emergency outlet to flow into basin 2, but due to high water levels in basin 2, the pipe is flowing in reverse.

The southwest end of the basin is showing signs of major erosion. The slope on the southwest side of basin should be regraded and stabilized. The slope should be seeded with a grass mixture and a nylon erosion barrier should be installed to stop erosion until the grass germinates. Additionally the 1 foot of sediment that has accumulated in the basin should be excavated. However, unless this basin fills substantially before completion of construction, excavation is not recommended until all construction is finished in the area. This will minimize the cost of cleaning this basin before its operation and maintenance is turned over to the City of Prior Lake.

Basin 2

Basin 2 (NP-2) is located just north of basin 1 and acts as a secondary pond for treating water coming from basin 1. This basin is approximately 0.64 acres and has an average water depth of 4 feet. The average amount of sediment accumulated in the basin is 0.3 feet and is mainly composed of clay material. This pond has 3 inlets, two 4 inch PVC inlets that drain greens and sandtraps, and one 12 inch PVC which drains a considerable area along the number 15 fairway. A delta has formed at the outfall of this pipe which measures 12 feet wide by 15 feet long by 2 feet deep.

The outlet structure was either improperly designed or improperly constructed. The plan shows an outlet pipe connected to a sewer trunk line from basin 1 that would flow into Jeffers Pond. The current outlet was an earthen spillway on the north end that was 10.5 feet wide, possibly as a result of the berm settling. This outlet is carrying water and

sediment into an adjacent jurisdictional wetland to the north. This is causing some sediment deposition into this wetland. The outlet should be diverted away from the wetland, stopping additional filling of the wetland area. This basin would benefit from a skimmer system and an outlet pipe directing flow into Jeffers Pond. Erosion of the unvegetated northwest slope is causing considerable sediment accumulation and stabilization should be addressed immediately. The slope on the northwest end needs to be regraded and some type of vegetative cover needs to be established to minimize the amount of erosion. This basin also needs to be dredged when the other maintenance needs are met.

Basin 3

Basin 3 (NP-3) is located on the 16th green and the southwest side of Jeffers Pond. This basin is 0.20 acres and has an average water depth of 2 feet. The amount of sedimentation on the basin floor is 0.8 feet deep. The sediment is coming in from side slope erosion on the west bank and through a 12 inch PVC inlet pipe. There is a large delta located at the outfall of this pipe near the southwest corner of the basin. This delta is 30 feet long by 8 feet wide by 2.3 feet deep. The outlet of basin 3 flows into basin 4 and consists of a 30 inch RCP with an apron. This pipe acts as an equalizer between basin 3 and basin 4.

This basin requires several maintenance tasks. First, the 12 inch PVC inlet needs to be stabilized with rip rap and the scour below the pipe should be repaired. Second, the basin needs side slope stabilization on the west bank, where there is currently no vegetation growing and moderate slope erosion is taking place. Finally, the basin needs to be excavated to remove the delta and the 0.8 feet of sediment that is accumulated. The excavation should not be performed until the inlet pipe and bank erosion issues are corrected.

Basin 4

Basin 4 (NP-3S) is located just to the north of basin 3 and is connected to basin 3 by a 30 inch RCP stabilizer pipe. This is the only inlet to basin 4 . This basin serves as a secondary settling pond before water is discharged into Jeffers Pond. The basin is approximately 0.16 acres in size and has an average water depth of 3 feet. The amount of sediment at this time was a minimal 0.2 feet and it was composed of fine clay particles. The basin is equipped with a 27 inch RCP outlet pipe and a 48 inch RCP skimmer. This basin was in generally good condition.

Basin 5

Basin 5 (NP-5) is located just south of the number 7 fairway. This basin is 0.15 acres and has an average water depth of 5 feet. The amount of accumulated sediment was 0.8 feet deep. The outlet for this pond is a 24 inch RCP that has a 54 inch RCP skimmer. During high flow events, this pond will discharge via a low spot along the berm located on the north end. Discharge from this spillway would be directed to an adjacent wetland.

Much of the accumulated sediment is coming from side slope erosion and the 24 inch RCP inlet at the south end of the basin. The delta formed at the 24 inch inlet was composed of gravel and sand deposits. This delta was approximately 2 feet deep. The immediate drainage area for basin 5 was currently under construction for single family homes. This construction area is also contributing large amounts of sediment. The berm was either improperly designed or improperly constructed by not building it to the proper height. Currently this portion of the berm is lower than the top outlet of the skimmer. The berm needs to be reconstructed to prevent it from overtopping and washing into the adjacent jurisdictional wetland. Additional maintenance items include side slope stabilization and sediment removal.

Basin 6

Basin 6 (NP-7) is located just northeast of fairway number 6. It has a surface area of 0.21 acres and an average water depth of 4.5 feet. There is one 21 inch RCP inlet located on the southeast end of basin. This inlet is about 6 feet higher than the current water level in pond. The water level is approximately 5 feet below the normal water level, making the normal average water depth of the basin at least 9.5 feet deep. The outlet for the basin is an 18 inch RCP with a 48 inch RCP skimmer.

The berm on the east side of the basin is about 1 foot lower than the top outlet of the skimmer. This may cause the berm to wash out during periods of high water. The berm on the east side should be built higher to direct flow through the skimmer, rather than over the berm. The side slopes are a standard 3:1 ratio, but currently they are not vegetated and are eroding rapidly. Additionally, the basin needs to have about 1 foot of sediment removed after the other maintenance requirements are met.

Basin 7

Basin 7 (NP-8) is located just north of the Wilds golf course number 6 teebox. The surface area of this pond is 0.16 acres and the average water depth is 2.5 feet. The current basin had a range of sediment depth of 1 to 2 feet. This basin has only one inlet which is a 36 inch RCP located on the northwest side. The outlet is a 36 inch RCP with a 60 inch RCP skimmer and it flows into basin 8. This structure also serves as the emergency overflow device with high flow events discharging over the top of the skimmer.

The inlet and it's adjacent uphill drainage area has serious erosion problems. The area immediately uphill from this basin is under single family home construction causing erosion of the slope. There is a delta at the base of the inlet that measures 115 feet long by 20 feet wide by 2 feet deep. This slope erosion should be repaired with bank stabilization methods such as vegetative seeding. The 2 feet of accumulated sediment should also be removed before the City takes over operation and maintenance of this stormwater pond.

Basin 8

Basin 8 (NP-8S) is located just east of basin 7. The basin covers a 1.1 acre surface area and has an average water depth of 4.5 to 5 feet. This basin has an average sediment depth of 0.5 feet and has side slopes at 3:1. There is only one inlet for this site which is a 36 inch RCP that flows from basin 7. The outlet is a 15 inch RCP with a 60 inch RCP skimmer and flows into the nearby lake.

This basin is in good condition and has only a few maintenance requirements. The slopes were in very good condition and vegetated except for a small area on the north end of the basin that is causing some minor erosion problems. The inlet pipe is not stabilized with rip rap and the sides of the pipe are showing major erosion problems. The apron is extending out about 3 feet over the edge of the pond since the underlying soil has eroded. Another maintenance problem is the berm on the southeast end of basin is lower than the emergency overflow (the top outlet of the skimmer), thus causing possible erosion problems under periods of high water. If this berm would give out during high water it could seriously affect the water quality going into the adjacent wetland.

Basin 9

Basin 9 (NP-9) is located near the entry way to the Wilds development on the east side of Mystic Lake Drive. The approximate surface area is 0.27 acres and the average water depth was 4.5 feet. There was a minimal sediment depth of 0.2 feet. There are three inlets and all were clean and secured in place by concrete. The 24 inch PVC inlet was connected to a basin on the north side of the road and it was currently flowing into basin 9. The other two inlets were collecting mainly street runoff. The outlet structure was made from a 30 inch RCP with a 60 inch skimmer, and it flows directly into Mystic Lake.

This basin and surrounding slopes are in good condition and should not require any immediate maintenance. This basin is aesthetically pleasing with the rock waterfalls and beautifully landscaped pine filled side hills. Basin 9 is also supposed to serve as a wet detention basin, but with the recirculating pumps that are installed, suspended solids may not settle properly. The recirculating pumps are used for the rock waterfalls. The small amount of sediment accumulation suggests that the solids are not being settled out in the basin.

Basin 10

Basin 10 (NP-10) is located just to the south of the golf course's number 4 teebox. The surface area is 0.17 acres and the average water depth was 4.5 to 5 feet. The average accumulated sediment across the basin floor was 0.3 feet. There is only one inlet and one outlet for this basin. Both are made of 27 inch RCP pipes, are stabilized, and have trash guards installed. The skimmer was made from a 54 inch RCP pipe. This basin flows into a natural wetland that is immediately located to the west. The side slopes were relatively steep at a ratio of 2:1 but were well vegetated with a grass seed mixture. This basin was in good condition and should not require any immediate maintenance.

Basin 11

Basin 11 (NP-11) is located to the southeast of the number 3 fairway. This basin has a surface area of 0.16 acres and it has an average water depth of 4 feet. The current level of sediment found in the basin was 0.8 feet. There is one inlet, an 18 inch RCP, located on the south end of pond. The outlet was comprised of a 24 inch RCP with a 60 inch RCP skimmer. The outlet flows into Mystic Lake to the west.

This basin is in good condition and should require very little maintenance once adjacent housing construction is finished on the east side of the basin. The surrounding side slopes were vegetated and any additional slope erosion should be minimal. In front of the inlet was a small 8 foot by 10 foot delta. This delta should be excavated along with the 0.8 feet of sediment generally accumulated across the basin after construction in the drainage area is complete.

Basin 12

Basin 12 (NP-12) is located just to the south of the golf course's number 1 green. This basin has a surface area of 0.39 acres and an average water depth of 3 feet. The elevation difference between the normal water level and the emergency spillway was approximately 3.2 feet. There was about 2 feet of sediment accumulated in the pond. There were two inlets coming in, one 27 inch RCP and one 12 inch PVC. The outlet structure was a 27 inch RCP with a 54 inch skimmer. This outlet flows directly into Mystic Lake.

A large amount of this sediment appeared to come from slope erosion along the west berm and south bank. These two areas were not well vegetated and need some maintenance for stabilization. The 27 inch RCP inlet had a small delta accumulated in front of it, but the 12 inch PVC inlet was clean and in excellent condition. There are two maintenance requirements for this basin. First, the unstable banks should be regraded and the slopes should be vegetated with a grass seed mix. Second, the 2 feet of accumulated sediment should be excavated.

Basins 1-12 were all located in the ongoing construction area of the Wilds Golf Course and Executive home sites. The maintenance issues for these basins will be addressed by the City of Prior Lake before acceptance by the City.

Basin 13

Basin 13 is located near the Prior Lake City Hall just to the east of County Road 21. It has a surface area of 1.70 acres and an average water depth of 4.5 feet. County Road 21 acts as an emergency spillway and the distance between the normal water level and the emergency spillway was 5 feet. This basin had very little sediment accumulation with only 0.3 feet. The sediment was comprised of black muck that was very high in organic material.

According to the City records there are two inlets entering the basin. Only one of those inlets could be located on the northeast side. This inlet was a 15 inch RCP with a trash guard and rip rap for stabilization. The outlet was located on the northwest side and consisted of a 24 inch RCP flared end pipe.

There was some vegetated growth in the outlet that was partially obstructing the outflow. This should not significantly affect the performance of the outlet, but occasional vegetative clearing is warranted to prevent future problems. Overall this basin was in very good condition. The surrounding areas are well developed and the pond has an established buffer strip of vegetation surrounding the perimeter. This basin currently requires little maintenance.

Basin 14

Basin 14 is located near Cates Street. This "basin" is a natural wetland. It has a surface area of approximately 2 acres of open water. The normal water level should be around 2.5 feet , but at the time of inspection on October 12, 1994 the water level was only 0.5 feet. The surrounding side slopes were very gradual at 6:1 and the perimeter was well vegetated. There was emergent vegetation coming to the water surface in about 60% of the pond. The normal water level had about a 0.5 foot cushion before it reached the emergency spillway. This spillway was a 3.5 foot wide channel that ran along side the berm. The ponds outlet was a 6 inch ductile iron pipe (DIP) that flowed through the berm. This 6 inch DIP serves as a water level control structure for draw down purposes.

Since this is a natural wetland, it maybe subject to applicable federal, state, and local wetland regulations. These regulations as well as potential water quality improvements and wildlife impacts should be considered before dredging or altering this basin.

Basin 15

Basin 15 is an established basin located on Beach Street. During inspection there was very little water in the basin, less than a half inch. The approximate bottom surface area is 0.18. Two inlets were located, one on the southeast corner and one on the west end. The inlet on the west end is a 12 inch PVC with no trash guard but is stabilized with rip rap. The second inlet is an 18 inch RCP that is not stabilized with rip rap but has a trash guard located on its apron. The basin is over 90% covered with emergent vegetation. Side slopes are at 3:1 and

are well vegetated and stable. The outlet is constructed from an 8 inch DIP that has a gate valve in it for controlling water level. There is an 18 inch RCP located 4 feet higher than the 8 inch DIP that serves as an emergency overflow.

There was no buildup of sediment and no excavation is required. This inlet has a buildup of some sediment in it that appears to be sand washing of off the street. The valve on the 8 inch DIP outlet should be closed to provide a permanent pool and better pollutant removal. The predominant surrounding land use is open space with heavily wooded areas at this time. Although in the near future, there are plans for developing this area into single family homes. This basin will receive more stormwater runoff as its drainage area is developed. This basin should be reevaluated after development occurs to ensure that it provides the necessary ponding time. This basin should not require any immediate maintenance and is in good condition, although this basin needs the valve closed to establish a permanent water level.

Basin 16

Basin 16 is the first of a two basin series located in Sand Point Park. Both basins were originally designed as wet detention basins, but currently are functioning as dry detention basins. This basin has a surface area of 0.24 acres. This basin is serving as a wetland and has a wetland plant community associated with it. This plant community was dominated by narrow leaf cattail, black willow, and some marsh grasses. There are three inlets to basin 16. The first is a 12 inch corrugated metal pipe (CMP) on the southwest corner, the second is a 12 inch CMP on the northwest corner, and the third inlet is a 42 inch RCP with a concrete flow deflector about 5 feet in front of the pipes discharge point. The basin's outlet is a 42 inch RCP and is set at a low enough elevation that no water is permanently ponded. The pond has no identifiable emergency overflow.

This basin is in good condition, but its dry basin design does not provide significant pollutant removal benefits. The NURP study demonstrated that the majority of the pollutant removal benefits from stormwater detention ponds were derived from the volume of the permanent water pool. The pollutant removal efficiency of this basin could be significantly improved by installing a controlled outlet structure that would maintain a permanent pool of water. However, the steep side slopes and location in a public park present additional safety issues that need to be considered prior to establishment of a permanent pool.

Basin 17

Basin 17 is located in the Sand Point Park just downstream of basin 16. Basin size is approximately 0.22 acres. This basin was originally constructed to maintain a permanent pool, but it's cleanout pipe is open, which maintains it as a dry pond. Dry ponds such as this one, serve primarily to attenuate peak storm flows and are not highly effective for pollutant removal. It is fully vegetated with wetland plants at the inlet and manicured grasses throughout the basin. The inlet for this basin is a 42 inch RCP that serves as the outlet for basin 16. The outlet is located in the bottom of the basin about 30 feet away from the emergency overflow structure. The outlet is constructed from a 10 inch DIP. The emergency overflow is a cement block structure 8 feet by 8 feet. The outlet pipe is a 36 inch RCP that spills directly into Prior Lake. There is about a 5 foot difference between the normal water level and the emergency overflow structure.

This basin could also be converted into a wet basin. This can be accomplished by placing a standpipe on the 10 inch DIP outlet. Installation of a standpipe that ponds 1 foot or more of water would significantly benefit the ponds function with respect to pollutant removal. However, the steep sideslopes and location within a public park present additional safety issues that need to be addressed prior to establishment of a permanent pool.

Basin 18

Basin 18 is located in the Carriage Hills development. The basin is 0.85 acres in size and has an average depth of 4.5 feet. This basin has two inlets. The 32 inch RCP inlet is located on the northeast end of basin and the 15 inch RCP is located on the southeast side of basin. The average amount of sediment deposits in the basin is 0.5 feet, which is coming from erosion associated with construction and poor bank stabilization. The outlet is located on the northwest end of the basin and is constructed from a 12" PVC pipe. The outlet flows under a proposed roadway, discharging into a neighboring cornfield.

On the south and west end the banks are stabilized and the housing construction is completed. Both inlets were partially filled with sediment at the time of inspection. On the east side, single family homes are still under construction and accordingly the side slopes are showing signs of severe erosion. This sediment problem is undoubtedly caused by the heavy amount of construction that is occurring at the site. The silt fence along the east and

north sides of basin are filled with sediment and are not functioning properly. During inspection, the outlet was flowing and the cornfield was saturated. The only other future maintenance consideration is dredging the 0.5 ft of sediment that is in the bottom of the basin.

Basin 19

Basin 19 is located near Willow Lane in the Westbury Ponds housing development. The basin is 0.22 acres and has an average water depth of 4 feet. The average amount of sediment accumulated in the basin is around 2 inches and the sediment appeared to be largely composed of organic material. There was only one inlet identified at this pond. It was a 27 inch RCP that was grouted in place. The outlet was a 36 foot rock weir that flowed into another basin. This basin does not have a separate emergency outlet, but the normal outlet should have the capacity to handle very large flow events.

This pond is in good condition with no immediate maintenance requirements. The grout around the inlet extended into the pond about 25 feet making the inlet very stable. Care should be taken to avoid digging up the grout during any future pond dredging activity.

Basin 20

Basin 20 is located on the east side of Spring Lake just to the north of County Road 13. The single family development area of Sunset Hills II is situated just north of the basin. This basin is a naturally occurring wetland, surrounded by mature forest. The pond had emergent vegetation covering about 15 % of it's surface area. There was also a very large amount of *Lemna sp.* and other submerged aquatic plant growth. The surface area of this basin was approximately 1.5 acres and the average water depth was 2.5 feet. The basin had about 1 foot of accumulated organic material present. Much of this material was coming from leaf litter from the neighboring forest. The surrounding sideslopes are 4:1 and are showing no signs of erosion.

This wetland collects a large percentage of its drainage from overland flow. There is only one storm sewer inlet entering this pond. This inlet collects water from the Sunset Hills II neighborhood. The inlet is an 18 inch RCP that has a flow deflector about 4 feet away from the end of the pipe. It is constructed about 1.5 feet above the normal water level of the pond and there is a 30 foot long channel that carries the storm water into the pond. This channel

could possibly have some erosion problems during periods of extremely high flow, but during this inspection period there were no signs of erosion. The ponds outlet is on the west side. It is constructed from an earthen channel that was 4.5 feet wide. This channel meanders it way down a valley and eventually enters Spring Lake. There was no control structure present and the channel appears to be natural. The entrance of the outlet was partially filled with dead tree branches and leaves. This was causing partial damming of flow, but it should not cause any serious problems. This basin should require very little maintenance in the future.

Basin 21

Basin 21 is located on Scott County Ditch 13. The basin has an approximate surface area of 3.2 acres and an average water depth of 4.5 feet. Basin 21 has one inlet, County Ditch 13, which has a 5310 acre contributing watershed. Much of the land use in the contributing watershed is agricultural. Agricultural activity in the watershed likely contributes to the sediment loading to this basin. This basin has about a half of a foot of accumulated sediment fairly evenly distributed across its floor, except for a small area near the northeast corner that has about 1.5 feet of accumulated sediment. Because of large contributing watershed this basin will likely need frequent excavation to prevent large storms from resuspending accumulated sediment. The normal water level outlet is controlled by three pipes cemented into a 32 foot wide weir. The surrounding side slopes are a 4:1 ratio and are well vegetated with Reed Canary Grass and Smooth Brome Grass.

The outlet pipes are partially plugged, which results in the outlet weir regularly being overtopped. If the outlet pipes were cleared the water level in the basin would fluctuate with incoming flows and the level of Spring Lake. Cleaning the outlet pipes would allow for more attenuation of peak storm flows, but would decrease the pollutant removal efficiency of the pond.

BASIN MAINTENANCE REQUIREMENTS

Table 2 summarizes the maintenance needs of the inventoried basins and presents an approximate cost estimate for meeting these needs. The purpose of this cost estimating is to determine, for planning purposes, operation and maintenance (O&M) costs and frequency. The cost estimates were based on $10/cubic-yard for sediment excavation with off-site disposal, $2000/acre for regrading, seeding, fertilizer, and mulch stabilization, $30/linear-foot for repairing berms (assuming berms only need to be elevated by an average of 3 feet), and $25/cubic-yard for rip rap. Excavation costs were calculated only for ponds having more than half a foot of accumulated sediment. The basins in the Wilds should be repaired by developer prior to turning over O&M to the City of Prior Lake.

The costs for required maintenance range from $0 to $13,600, with an average cost of about $2,660 for the 17 wet basins (not counting 2 natural wetlands or 2 dry basins). Most of these basins have been recently built and the maintenance requirements are typically associated with incomplete or improper construction. Potential cost of maintenance can be lowered by requiring the developer to meet minimum requirements before turning over the operation and maintenance of these basins. The basins within the city limits of Prior Lake will be maintained by the City. The City requires developers to clean the basins prior to takeover. These basins should be inspected to insure side slope stabilization, proper berm construction, and final excavation of construction related sediment. Requiring an escrow from developers to cover these initial costs would be one way of ensuring that all new basins meet the minimum criteria.

Since most of the basins that were inventoried were recently built, there is little data on what the long-term maintenance requirements will be. Well constructed and established ponds will probably not have significant erosion problems. Outlet structures should be inspected and cleared of debris and vegetation once a year in the spring. Some ponds may benefit from occasional mowing to maintain the health of the vegetative buffer strip and to improve pond aesthetics. Mowing should probably be done once a year in the fall, being careful not to cut to close to the shore or blow excessive amounts of grass clipping into the pond. The total annual operational cost of inspections, outlet clearing, and mowing are estimated to be $200-$400/year for each basin.

TABLE 2
BASIN MAINTENANCE SUMMARY

No.	Name	Sediment Excavation (yd^3)	Side Slopes Stabilization Needed	Other Maintenance	Estimated Costs ($)
1	NP-1S	468	partial		5,000
2	NP-2	0	partial	repair berm	1,400
3	NP-3	258	partial	rip rap inlet	3,200
4	NP-3S	0	no		0
5	NP-5	194	yes	repair berm	4,800
6	NP-7	339	yes	repair berm	10,800
7	NP-8	387	partial		400
8	NP-8S	887	no	rip rap inlet repair berm	13,600
9	NP-9	0	no		0
10	NP-10	0	no		0
11	NP-11	207	no		2,100
12	NP-12	1258	partial		13,400
13	City Hall	0	no	clear vegetation	300
14	Cates Street	NA	no		0
15	Beach Street	0	no	close valve	0
16	Sand Point 1	0	no		0
17	Sand Point 2	0	no		0
18	Carriage Hills	686	no	clean silt fence	500
19	Willow Lane	0	no		0
20	Sunset Hills II	NA	no		0
21	County Ditch 13		no	clean outlet	300

If wet detention basins are functioning properly they will accumulate sediment and occasionally require cleaning or dredging. Literature data on wet detention basins conforming to NURP criteria give a typical sedimentation rate of about 1/2 inch per year. For NURP ponds this means that excavation will be required approximately every 20 to 30 years. The costs for dredging will vary significantly from basin to basin depending mostly upon the size of the basin. The basins inspected ranged from 0.15 acres to 3.2 acres. The

costs for excavating a foot of accumulated sediment will range from $2,500 to $32,300 for basins 0.15 ac. to 3.2 ac.. Using a 5% inflation rate and a twenty year lifetime, these costs annualize to $200/year and $2,600/year. Other studies (DCRPC, 1992) estimate the annual O&M for detention basins as $2,400/year per acre of basin. Assuming maintenance once during a 20 year period at a 1995 cost of $1,400/ac-yr and 5% interest, $28,000/ac would need to be escrowed to cover the twenty year period.

There are several possible options for handling long term operation and maintenance (O&M). The City of Prior Lake will assume responsibility for basins within the city limits. Basins created by County road improvement projects will be the responsibility of the County for O&M. For basins outside of the City, and not created by road improvement projects, the Watershed District or township could choose to assume O&M responsibility. Costs to the District could be reduced by identifying potential regional ponding facilities to reduce the number of sites to maintain. As outlying areas develop, developers could make cash contributions (i.e., pond dedication fee) to construct regional ponds rather than smaller on-site ponding facilities.

DESIGN REQUIREMENTS

The most important design characteristic of wet detention basins in determining their pollutant removal efficiency is the size of the permanent pool relative to the amount of runoff that passes through the basin. Walker (1987) uses the criteria that the permanent pool of a wet detention basin should be large enough to hold the volume of runoff generated from a 2.5 inch storm. In the Twin Cities Metropolitan Area this sizing rule provides an average hydraulic detention time of about 15 days.

Typical design mean depth for wet detention basins is about 4 feet. Maximum depths greater than 10 feet can lead to low dissolved oxygen conditions in the bottom waters with subsequent phosphorus recycling problems. Assuming a typical runoff coefficient for a single family residential watershed of 0.30, the ratio of basin surface area to watershed area of a basin with a 4 foot mean depth would be 0.016. Table 3 compares the inventoried basins to these sizing criteria. The wetland at Cates Street and the two dry basins at Sand Point Park were not compared to NURP criteria because such a comparison is not appropriate for dry detention basins and shallow wetlands.

Seven out of 18 evaluated basins meet the NURP criteria for basin surface area to watershed area ratio for single family residential developments. Some of the basins in the Wilds may meet the NURP sizing criteria because much of their drainage area will be from the golf course and not residential development and will therefore have a smaller runoff coefficient. Also basins 3 and 7 serve as pretreatment basins for basins 4 and 8. The combination of basins 7 and 8 meet the NURP criteria, while the combination of basins 3 and 4 are still undersized with respect to the NURP criteria. Basin number 19 had a basin area to watershed area ratio of 0.015, which was just slightly below the NURP criteria and probably within the range of error of the inventory. Eleven out of 18 evaluated basins meet the NURP criteria for mean depth. The current District basin standards are not the same as NURP basin standards. The District should consider reevaluating their current standards to meet NURP criteria for regulatory purposes and standardization of basin design throughout the watershed.

TABLE 3
COMPARISON OF INVENTORIED BASINS TO NURP BASIN DESIGN CHARACTERISTICS

No.	Name	Meets NURP Area Ratio Criteria > 0.016	Meets NURP Mean Depth Criteria = 4 ft
1	NP-1S	N	N
2	NP-2	Y	Y
3	NP-3	N	N
4	NP-3S	N	N
5	NP-5	N	Y
6	NP-7	Y	Y
7	NP-8	N	N
8	NP-8S	Y	Y
9	NP-9	Y	Y
10	NP-10	N	Y
11	NP-11	N	Y
12	NP-12	N	N
13	City Hall	Y	Y
14	Cates Street	NA	NA
15	Beach Street	N	N
16	Sand Point 1	NA	NA
17	Sand Point 2	NA	NA
18	Carriage Hills	Y	Y
19	Willow Lane	N	Y
20	Sunset Hills II	Y	N
21	County Ditch 13	N	Y

SUMMARY AND RECOMMENDATIONS

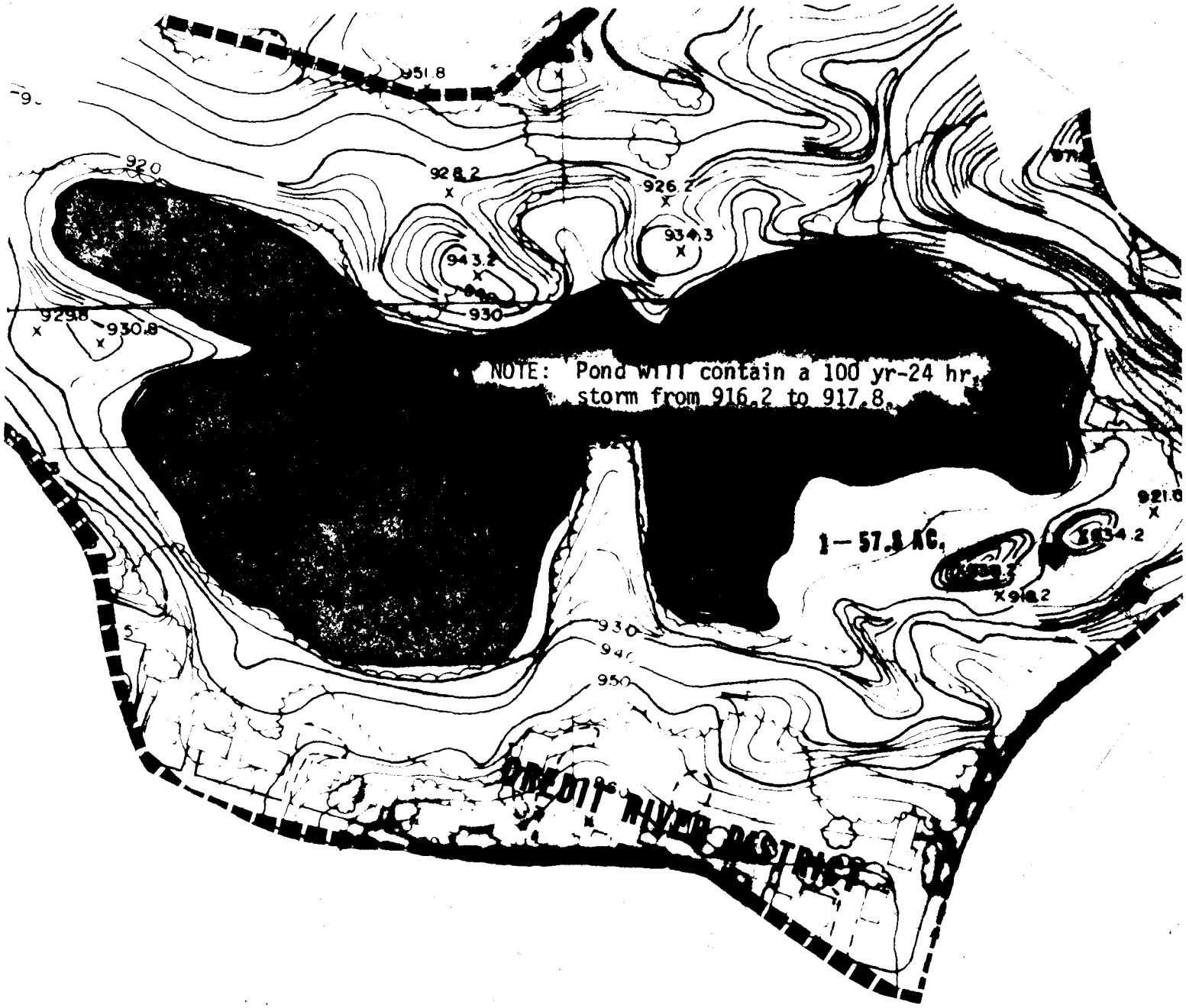
Wet detention basins (stormwater ponds) are one of the most common and effective stormwater BMPs and can typically remove 80-90% of suspended particulates and particulate phase pollutants. Many municipalities and watershed organizations require the construction of stormwater basins for new developments to mitigate increased peak flows and pollutant runoff. Although wet basins have proven effective, many cities and watershed organizations have also begun to recognize that these basins are not simply a one time cost, and that maintenance is required in order for them to remain effective. To begin to address these requirements the Prior Lake/Spring Lake Watershed District (PLSLWD) has directed an inventory and evaluation of the wet detention basins in the watershed and their maintenance needs.

An inventory of twenty-one wet detention basins within the PLSLWD was conducted during the month of October, 1994. The parameters that were inventoried included basin surface area, average water depth, average sediment accumulation, the number, size, and condition of inlets, condition and size of the outlet, the condition of the surrounding sideslope, and overall basin condition. This report presents the results of this inventory and discusses specific and general maintenance requirements, general maintenance costs, and suggested design requirements.

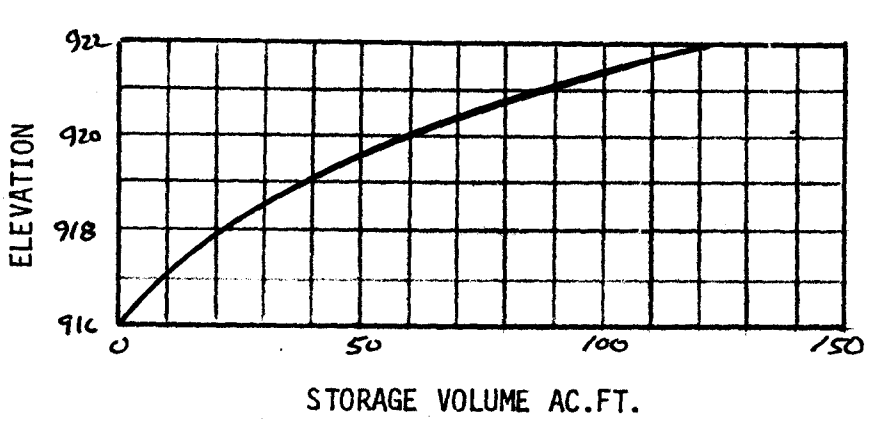
The first twelve basins are located in The Wilds development and golf course area. The remaining nine basins are scattered throughout the watershed, primarily in single family residential areas. The Cates Street basin is a natural wetland and should be managed as such. The two Sand Point Park basins are functioning as dry detention ponds. There were nine basins with a half of a foot or more of accumulated sediment, eight of which were in the Wilds. Problems at the Wilds are due to ongoing construction and use of the basins as sediment traps during construction. During construction, basin inpections should be conducted to insure their efficient operation as a sediment basin in accordance with their construction erosion control plans. However, general maintenance of these basins should wait until construction is complete. There were seven basins with at least some side slope erosion, four basins that need berm repairs, and two basins needing inlet stabilization. All of these basins were located in the Wilds. Basins outside of the Wilds needed only relatively minor maintenance.

About half of the basins inventoried meet the NURP criteria for basin size. At a minimum, it is recommended that the District and the City of Prior Lake require basins meeting NURP criteria for all new developments greater than 1 acre impervious area and that these basins be inspected for compliance with these criteria upon completion of the project. It may be necessary to require an escrow from the developer to ensure that these criteria are met.

The City of Prior Lake will have O&M responsibility for basins within the city limits. For basins outside of the City, the developer, roadway authority, Watershed District or township could assume O&M responsibility. As outlying areas develop, it will become increasingly important to have a plan for siting, design, and maintenance of ponds in these areas. The estimated range of annualized O&M costs is from $200 to $2,600/ac. Planning for these future costs should consider use of design standards and inspection by the responsible party prior to acceptance of maintenance responsibility. Costs could also be reduced by identifying potential regional ponding facilities to reduce the number of sites to maintain. Developers could be required to make cash contributions to construct these regional ponds rather than smaller on-site ponding facilities.



ELEV.	Σ V(AF)
916.2	0
918	22.46
920	60.10
922	110.87



POND NO. C-1

ODMP SHT. NO. 3-0

STORAGE INFORMATION

ELEV.	Σ V(AF)
916.2	
918	
920	
922	

ELEVATION

STORAGE VOLUME AC.FT.

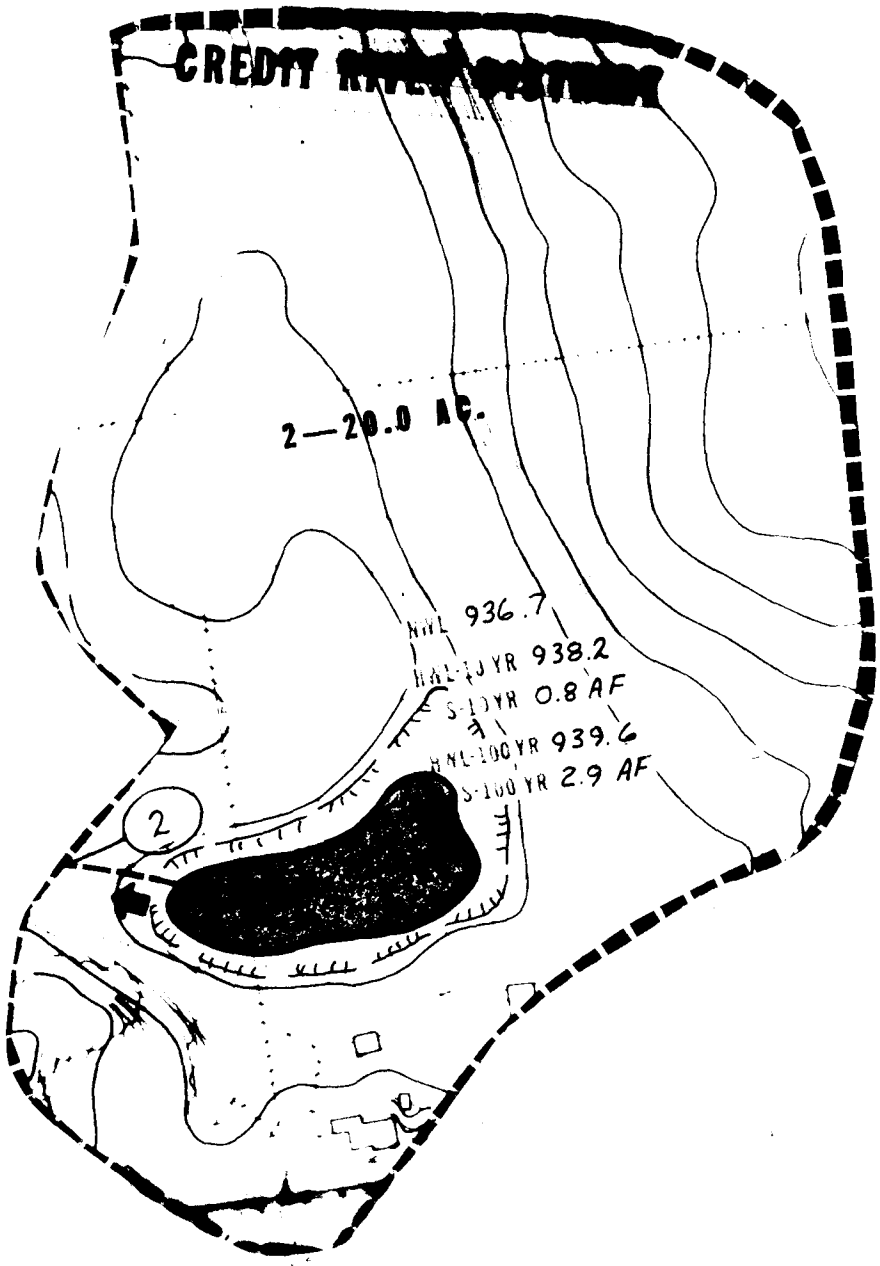
POND NO. C-1

ODMP SHT. NO. 30

STORAGE INFORMATION

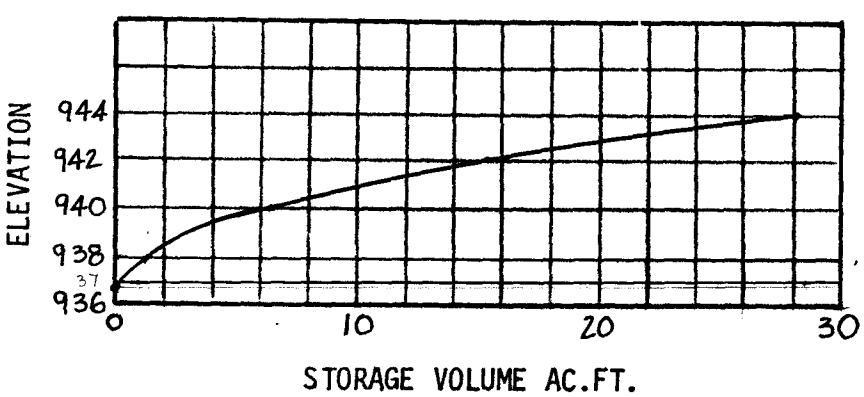
ELEV	SQ IN.	AC
916.2	12.52	11.54
918	14.42	13.24
920	26.57	29.40
922	28.72	26.37

AVG. AC	INT.	VOL (AC FT)	Σ VOL AC FT
12.48	1.8	22.46	22.46
18.82	2	37.64	60.10
25.385	2	50.77	110.87



C-2

ELEV.	Σ V(AF)
936.7	0
938	1.40
940	6.38
942	15.49
944	28.13

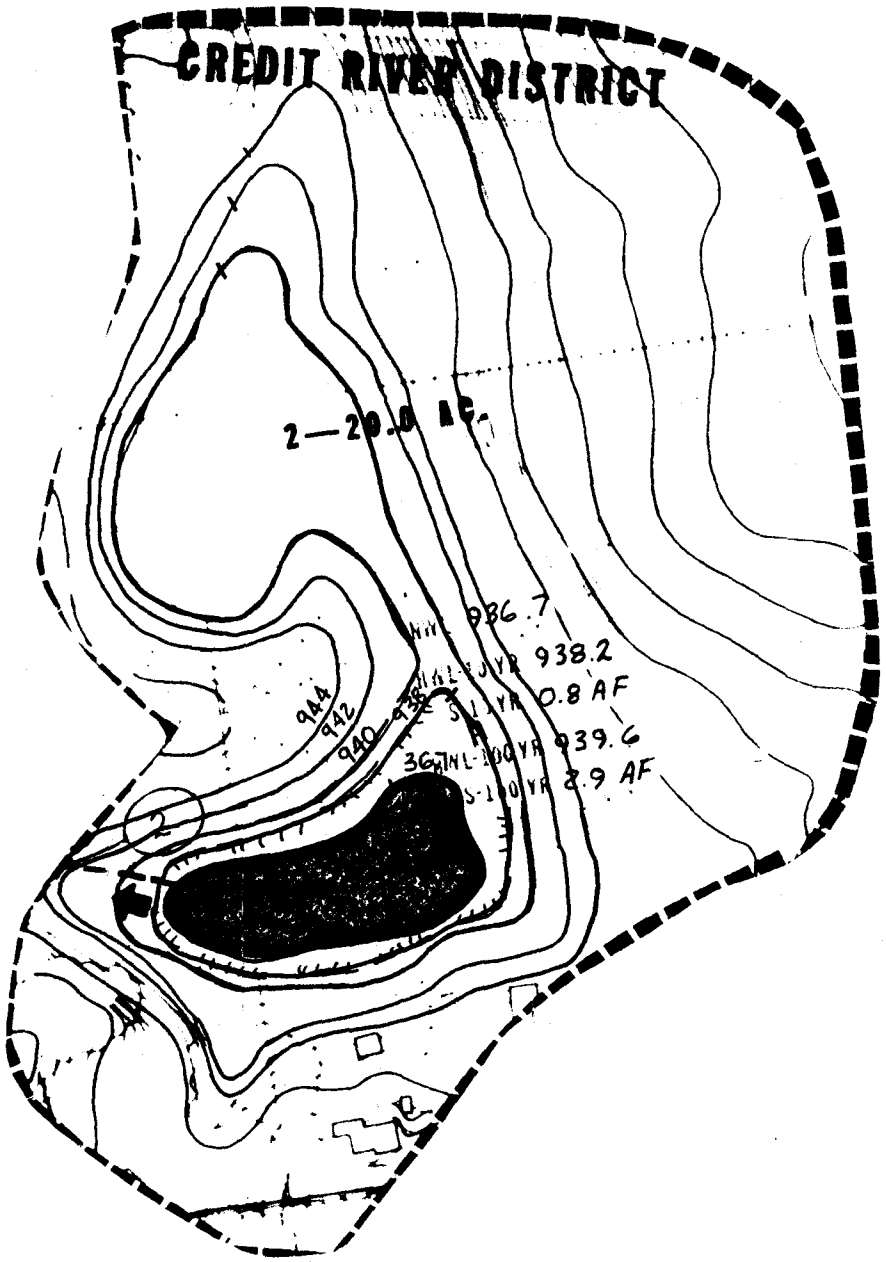


POND NO. C-2

ODMP SHT. NO. 16 H

STORAGE INFORMATION

936.7	0.41 x 2 =	0.82
938	0.76 x 2 =	1.52
940	1.95 x 2 =	3.90
942	3.01 x 2 =	6.02
944	3.87 x 2 =	7.74



C-2

ELEV.	Σ V(AF)

ELEVATION

STORAGE VOLUME AC.FT.

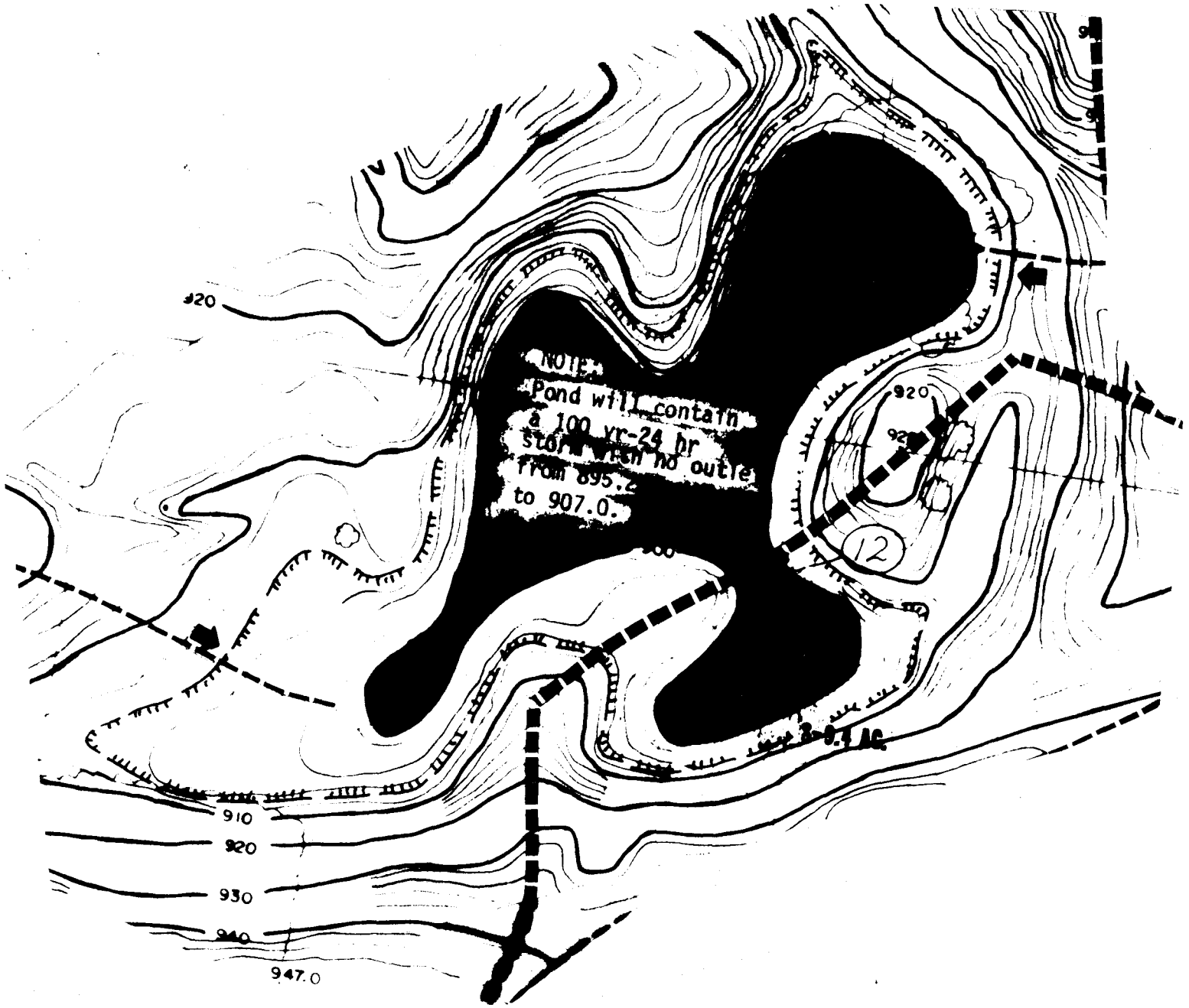
POND NO. [redacted]

ODMP SHT. NO. 16 H

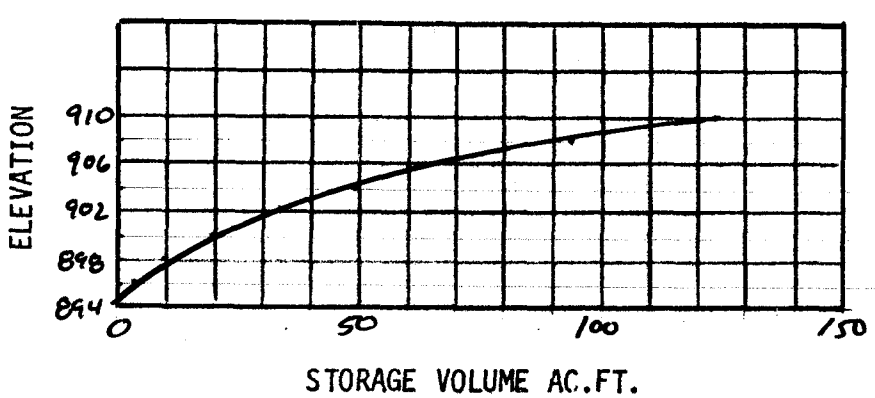
STORAGE INFORMATI

ELEV	SQ IN.	AC
936.7	0.82	0.75
938	1.52	1.40
940	3.90	3.58
942	6.02	5.53
944	7.74	7.11

AVG. AC	INT.	VOL (AC-FT)	Σ VOL AC-FT
1.075	1.3	1.40	1.40
2.49	2	4.98	6.38
4.555	2	9.11	15.49
6.32	2	12.64	28.13



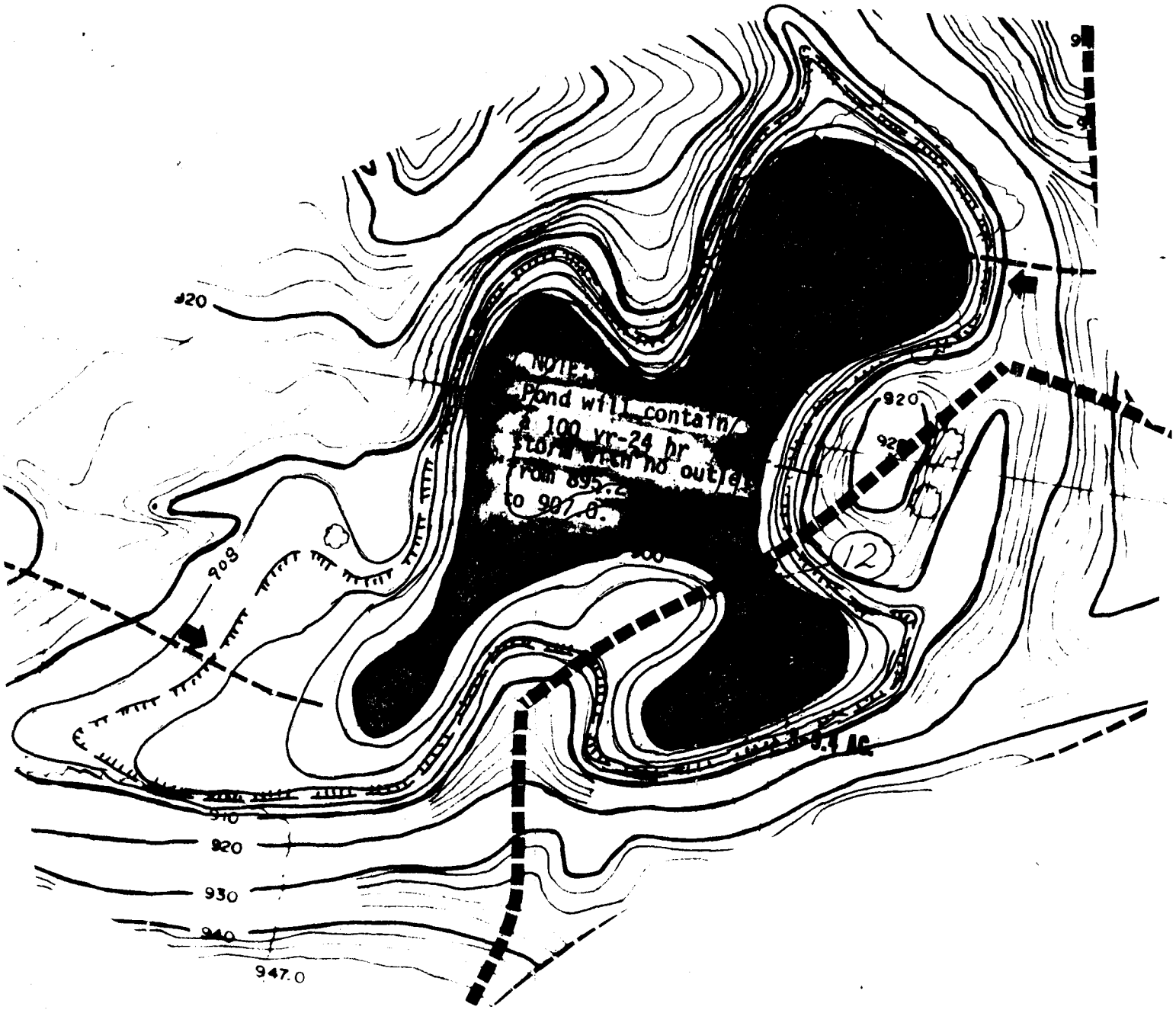
ELEV.	Σ V(AF)
894	0
896	2.63
898	9.22
900	19.67
902	33.46
904	49.26
906	68.65
907	93.40
910	123.59



POND NO. C-7 & 8

ODMP SHT. NO. P-4

STORAGE INFORMATION



ELEV.	Σ V(AF)

ELEVATION

STORAGE VOLUME AC.FT.

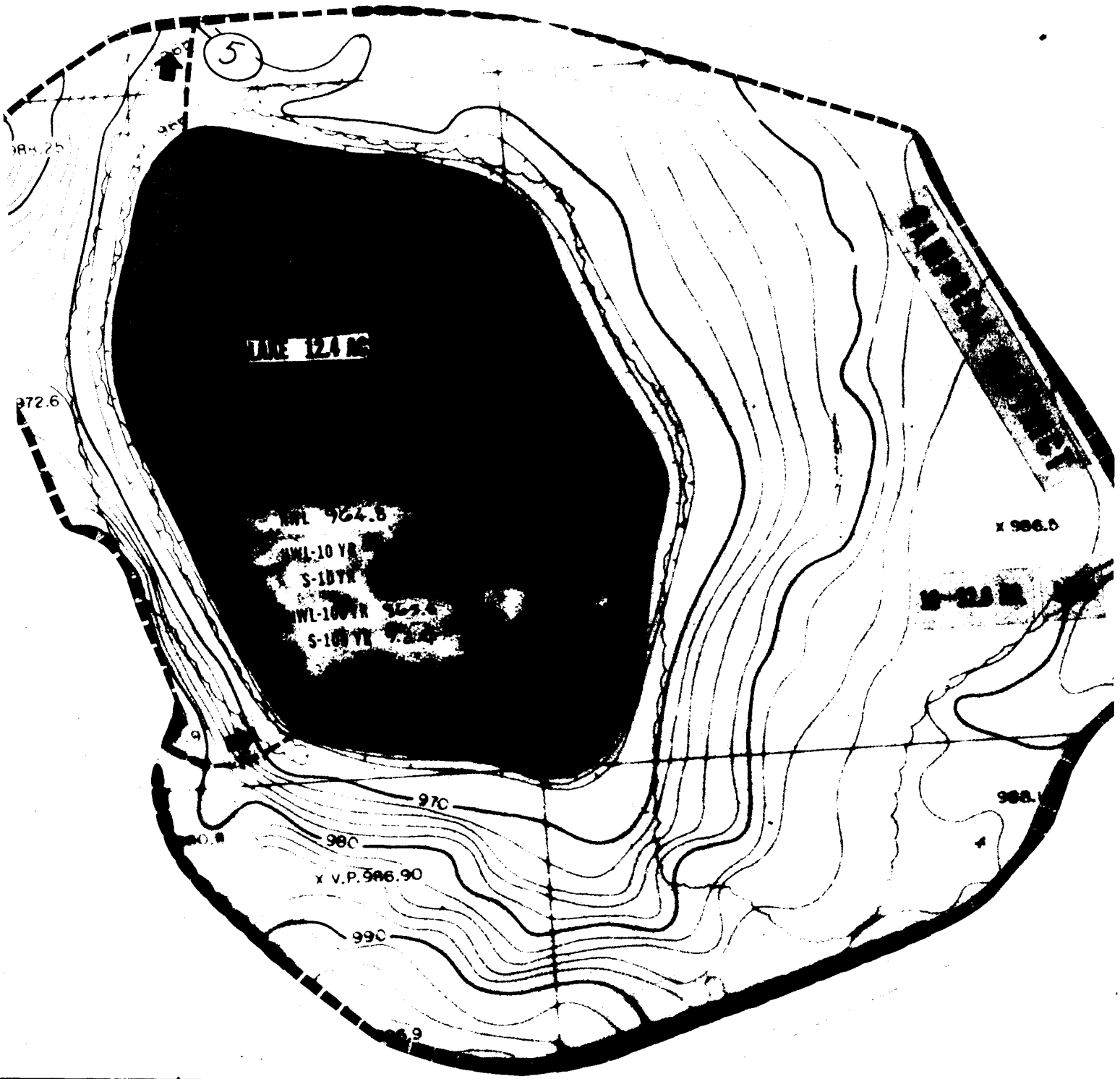
POND NO. C-7 & 8

ODMP SHT. NO. P-4

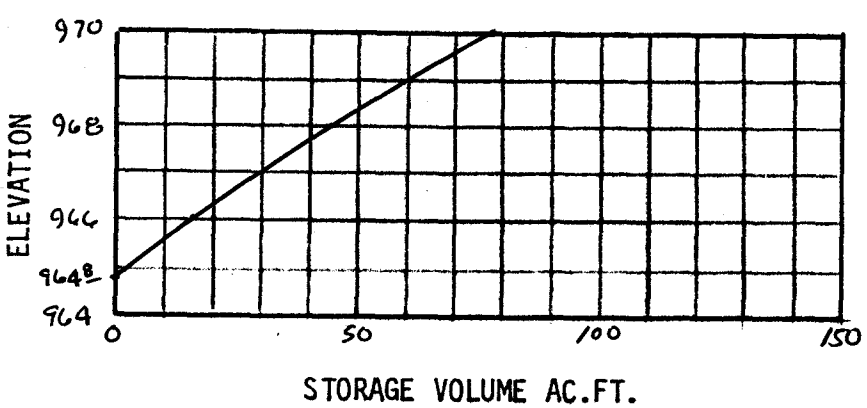
STORAGE INFORMATION

ELEV	SQ IN.	AC
894	0.15	0.14
896	2.71	2.49
898	4.46	4.10
900	6.92	6.35
902	8.10	7.44
904	9.10	8.36
906	12.01	11.03
908	14.94	13.72
910	17.93	16.47

AVG. AC	INT.	VOL (AC FT)	Σ VOL AC FT
1.315	2	2.63	2.63
3.295	2	6.59	9.22
5.225	2	10.45	19.67
6.895	2	13.79	33.46
7.90	2	15.80	49.26
9.695	2	19.39	68.65
12.375	2	24.75	93.40
15.095	2	30.19	123.59



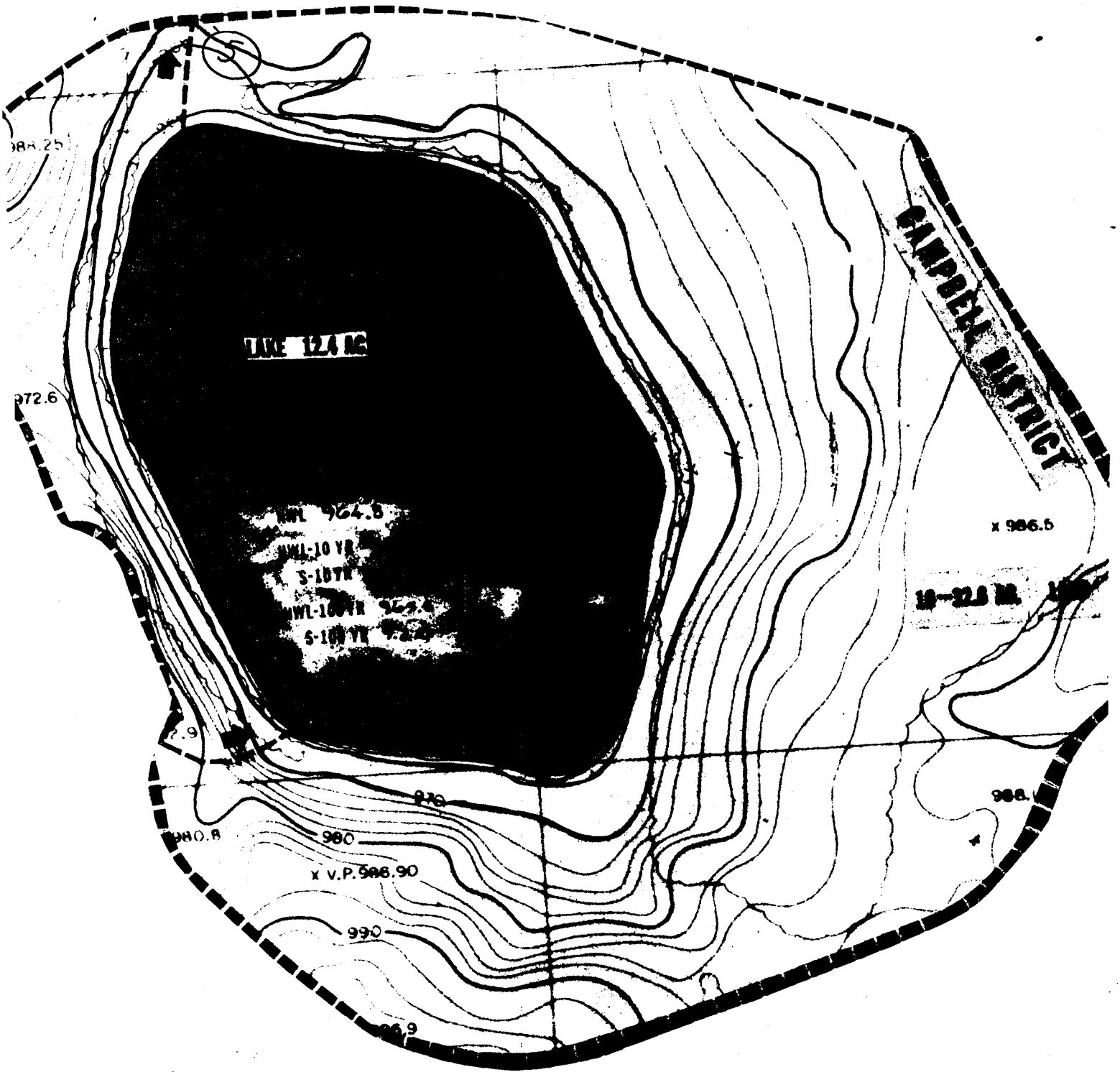
EI.EV.	Σ V(AF)
964.8	
966	
968	
970	



POND NO. C 10

ODMP SHT. NO. 64

STORAGE INFORMATION



ELEV.	Σ V(AF)

ELEVATION

STORAGE VOLUME AC.FT.

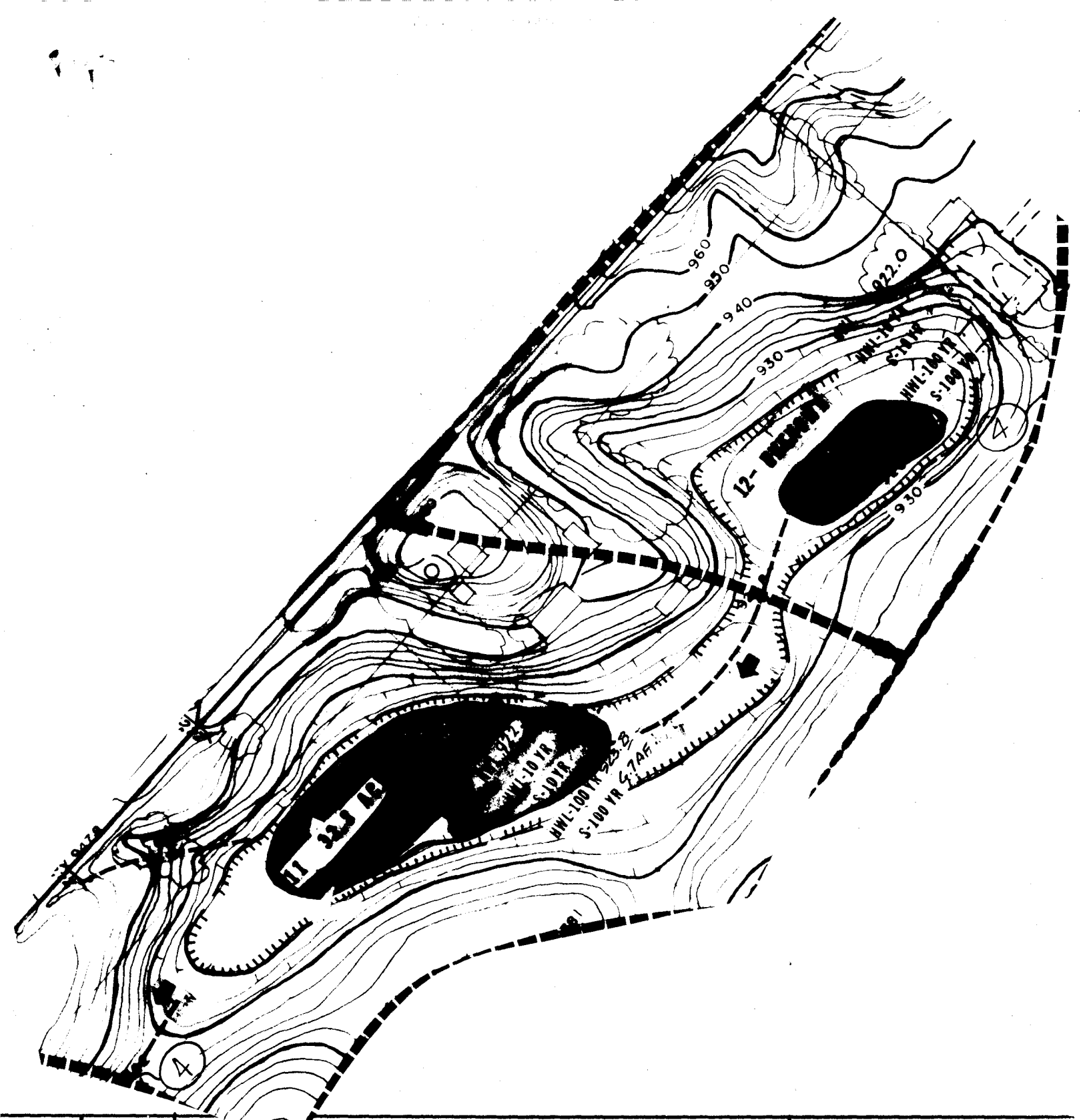
POND NO. C 10

ODMP SHT. NO. 64

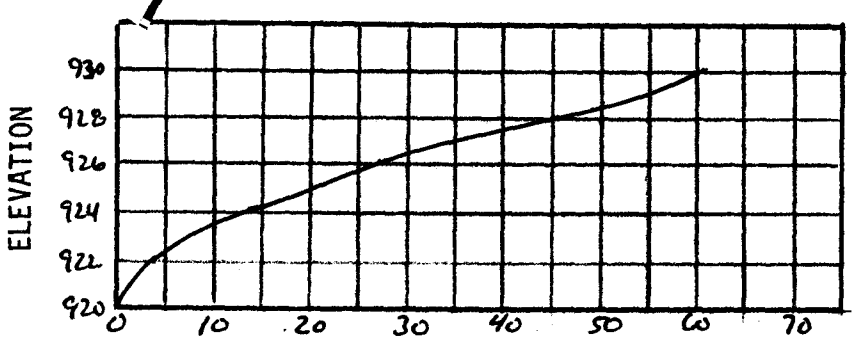
STORAGE INFORMATION

ELEV	SQ IN.	AC
964.8	14.00	12.86
966.0	14.78	13.57
968.0	16.40	15.06
970.0	19.64	18.05

AVG. AC	INT.	VOL (AC FT)	Σ VOL AC FT
13.215	1.2	15.86	15.86
14.315	2	28.63	44.49
16.555	2	33.11	77.60



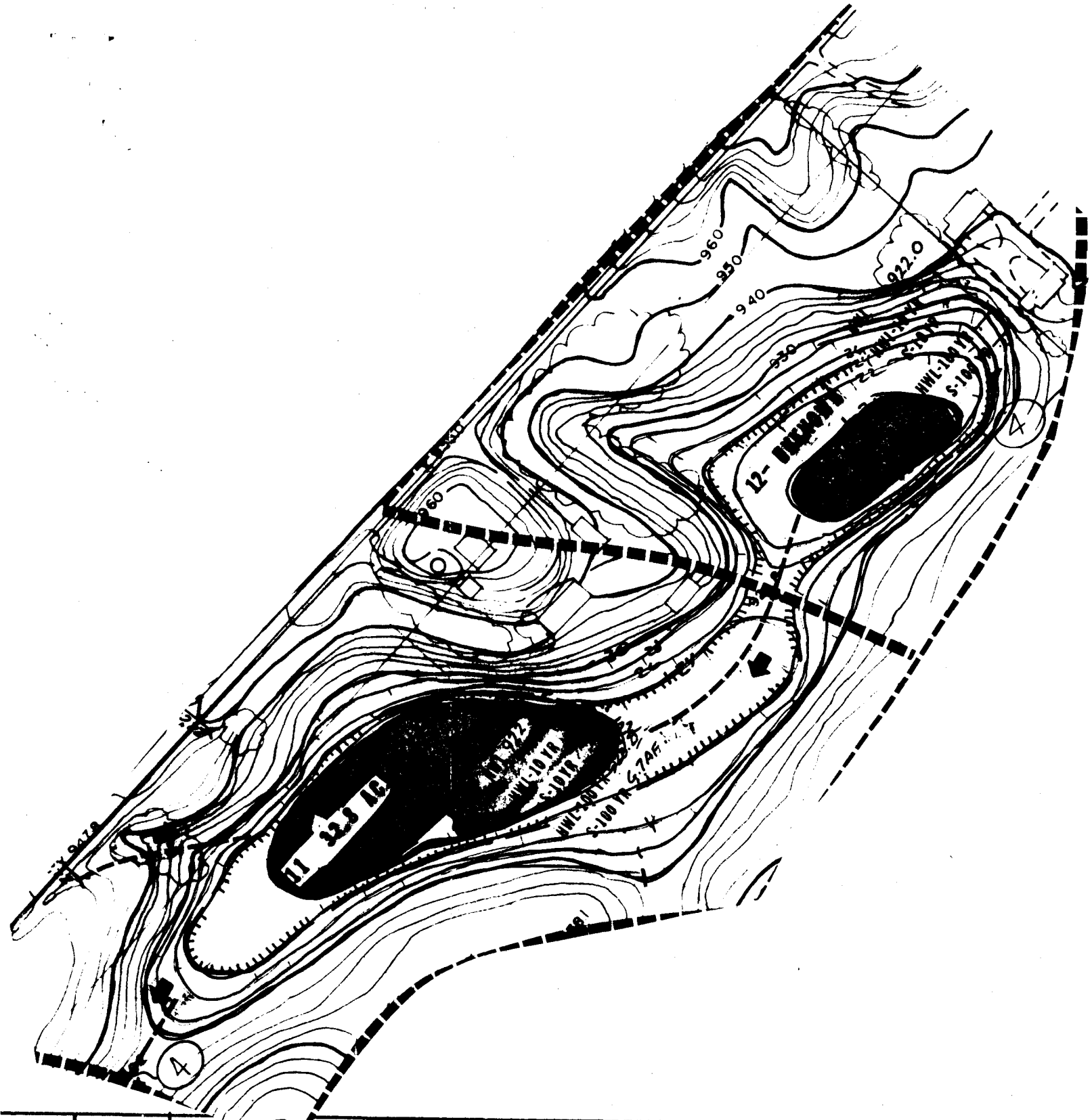
EI.EV.	Σ V(A.F)
920	0
922	3.96
924	13.87
926	27.38
928	45.24
930	65.65



POND NO. C-11 & 12

ODMP SHT. NO. P-9

STORAGE INFORMATION



ELEV.	Σ V(A.F)

ELEVATION

STORAGE VOLUME AC. FT.

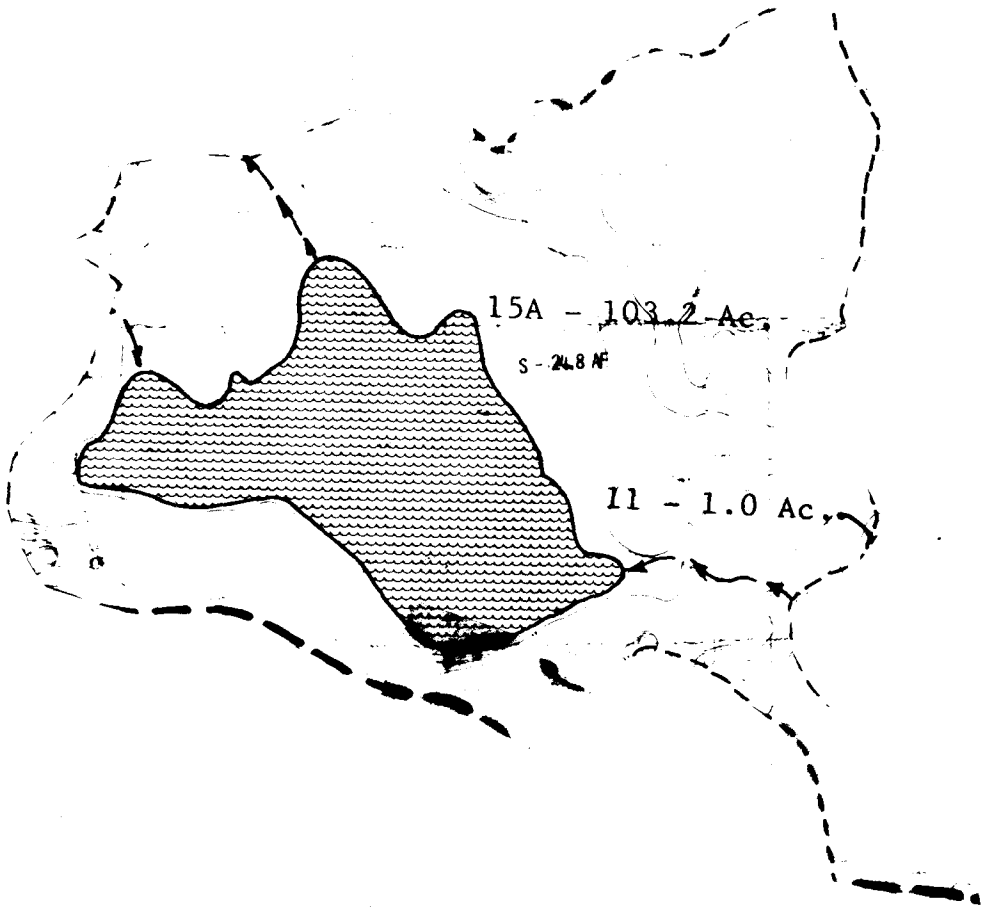
POND NO. C-11 & 12

ODMP SHT. NO. P-4

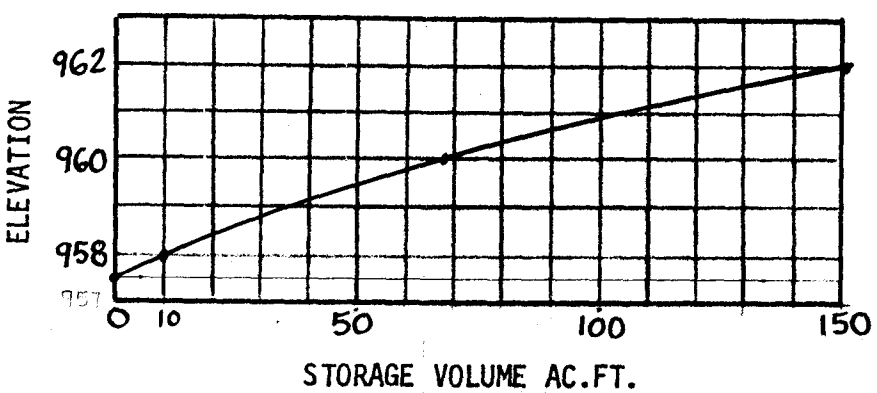
STORAGE INFORMATION

ELEV	SQ IN.	AC
920	0.23	0.21
922	4.08	3.75
924	6.71	6.16
926	8.55	7.85
928	10.36	9.51
930	11.87	10.90

AVG. AC	INT.	VOL (AC FT)	Σ VOL AC FT
1.98	2	3.96	3.96
4.955	2	9.91	13.87
7.005	2	14.01	27.88
8.68	2	17.36	45.24
10.205	2	20.41	65.65



ELEV.	Σ V(AF)
957.5	0
958	10.02
960	68.61
962	150.87



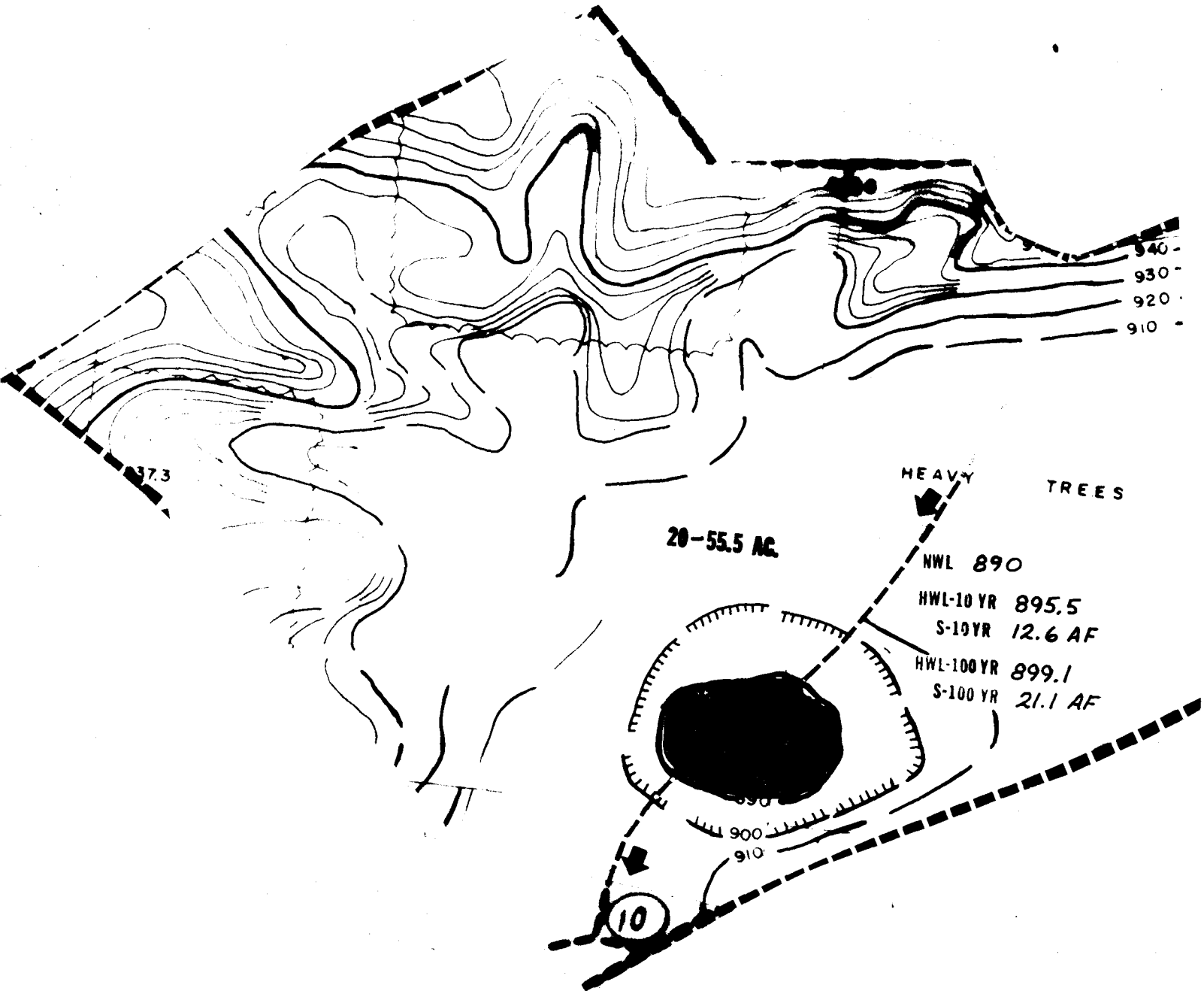
POND NO. C 15A

ODMP SHT. NO. 7K

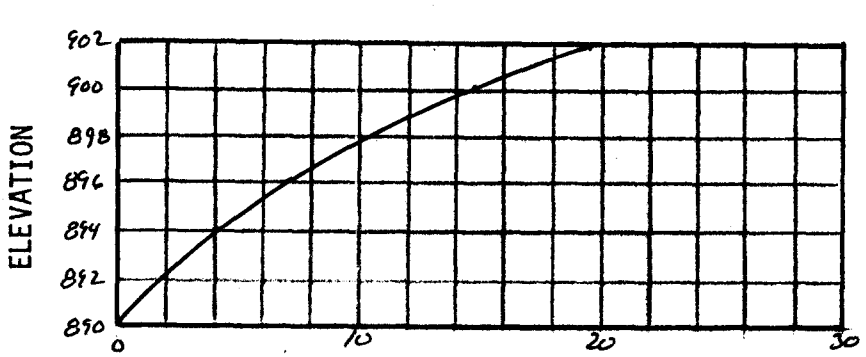
STORAGE INFORMATION

ELEV	SQ IN.	AC
957.5	20.96	19.25
958	22.68	20.83
960	41.12	37.76
962	48.46	44.50

AVG. AC	INT.	VOL (AC FT)	Σ VOL AC FT
20.04	0.5	10.02	10.02
29.295	2	58.59	68.61
41.13	2	82.26	150.87



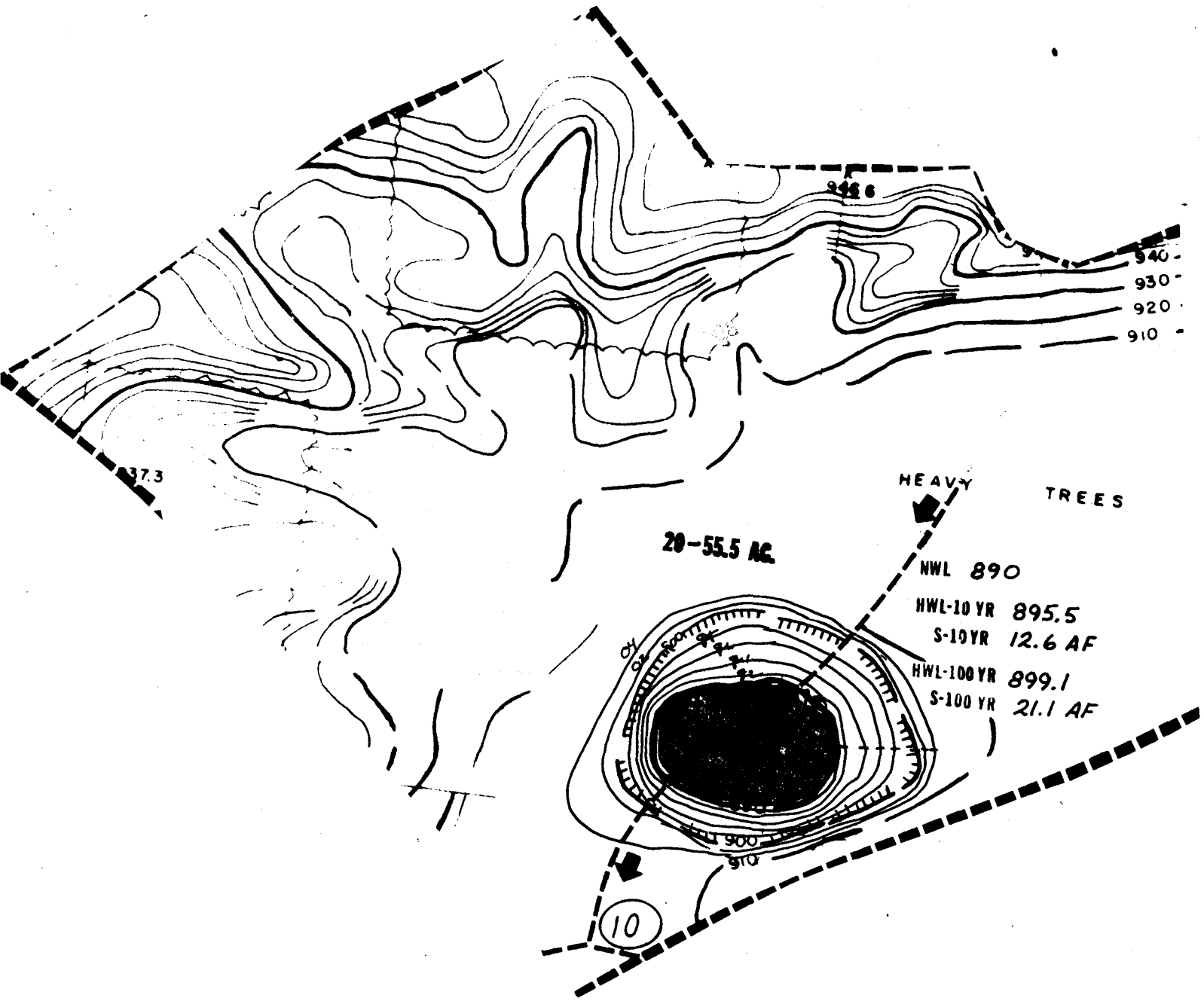
ELEV.	Σ V(AF)
890	0
892	1.87
894	4.22
896	7.10
898	10.59
900	14.71
902	19.50
904	24.68



POND NO. C-20

ODMP SHT. NO. 4-C

STORAGE INFORMATION



ELEV.	Σ V(AF)

ELEVATION

STORAGE VOLUME AC.FT.

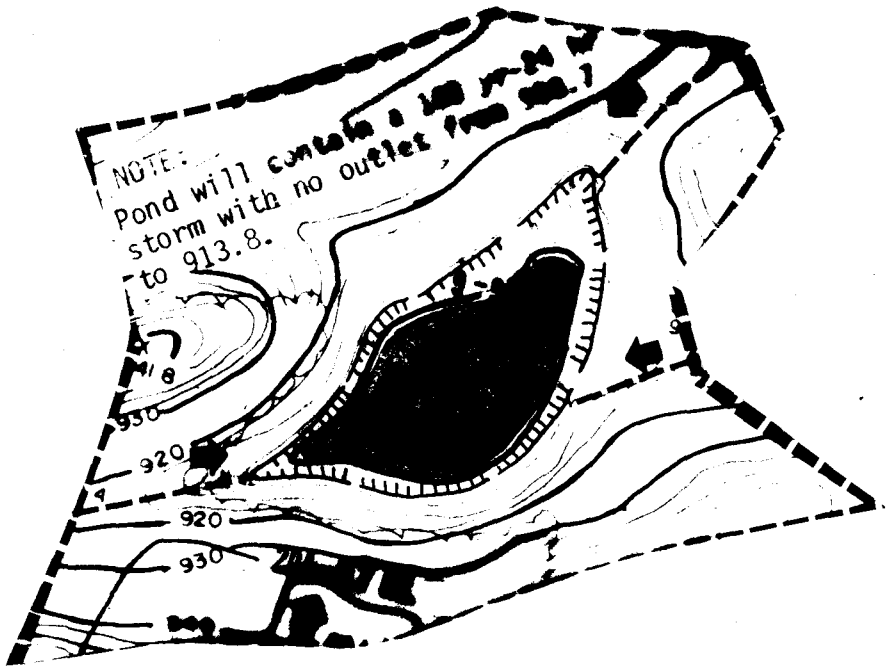
POND NO. C-20

ODMP SHT. NO. 4-C

STORAGE INFORMATION

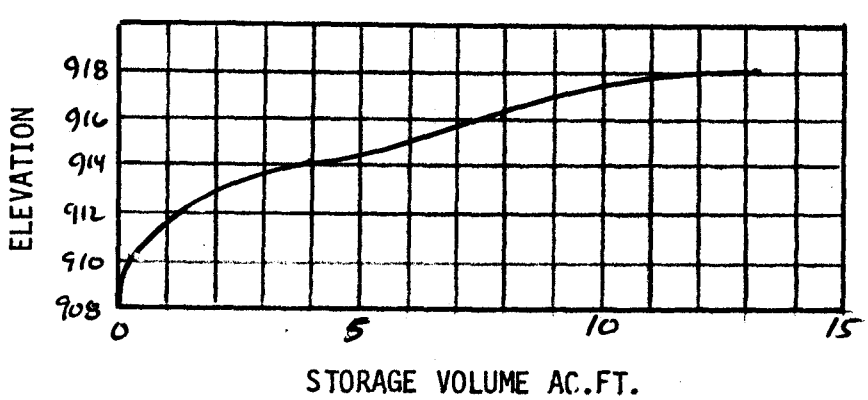
ELEV	SQ IN.	AC
890	0.87	0.80
892	1.16	1.07
894	1.39	1.28
896	1.74	1.60
898	2.06	1.89
900	2.43	2.23
902	2.79	2.56
904	2.85	2.62

AVG. AC	INT.	VOL (AC FT)	Σ VOL AC FT
0.935	2	1.87	1.87
1.175	2	2.35	4.22
1.44	2	2.88	7.10
1.745	2	3.49	10.59
2.06	2	4.12	14.71
2.395	2	4.79	19.50
2.59	2	5.18	24.68



C-9

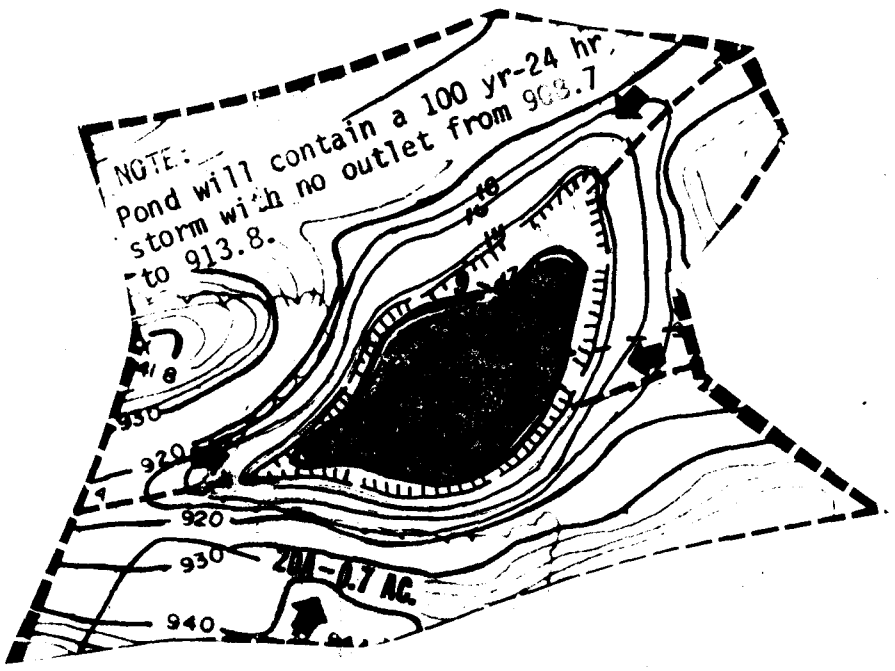
ELEV.	Σ V(AF)
908.7	0
910	0.18
912	1.36
914	3.94
916	7.94
918	13.25



POND NO. C-20A

ODMP SHT. NO. 4-P

STORAGE INFORMATION



ELEV.	Σ V(AF)

ELEVATION

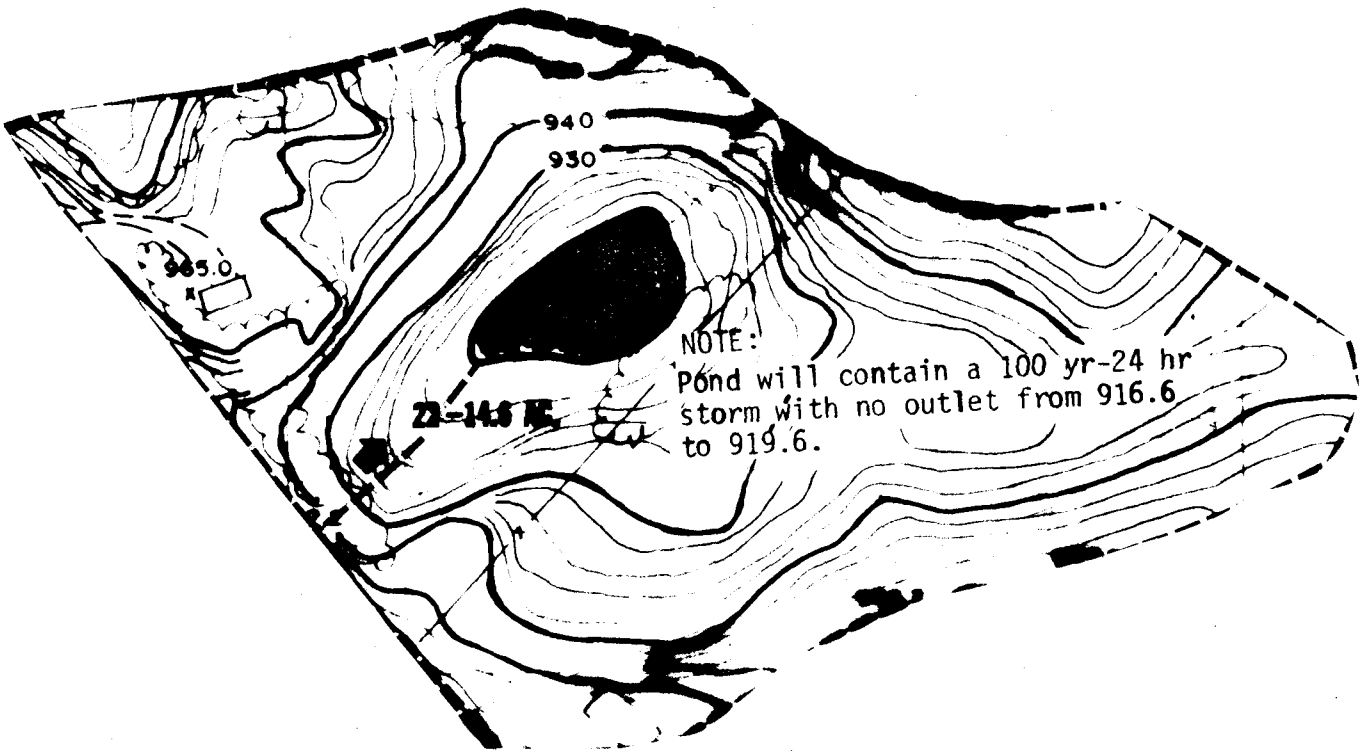
STORAGE VOLUME AC.FT.

POND NO. C-20 A

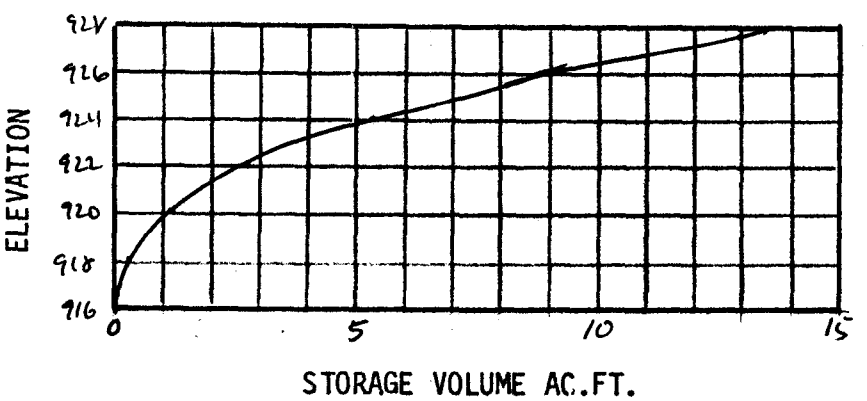
ODMP SHT. NO. 4-P

STORAGE INFORMATION

ELEV	SQ IN.	AC	AVG. AC	INT.	VOL (AC-FT)	Σ VOL AC-FT
908.7	0	0				
910	0.30	0.28	0.14	1.3	0.18	0.18
912	0.98	0.90	0.59	2	1.18	1.36
914	1.83	1.68	1.29	2	2.58	3.94
916	2.53	2.32	2.0	2	4.0	7.94
918	3.26	2.99	2.655	2	5.31	13.25



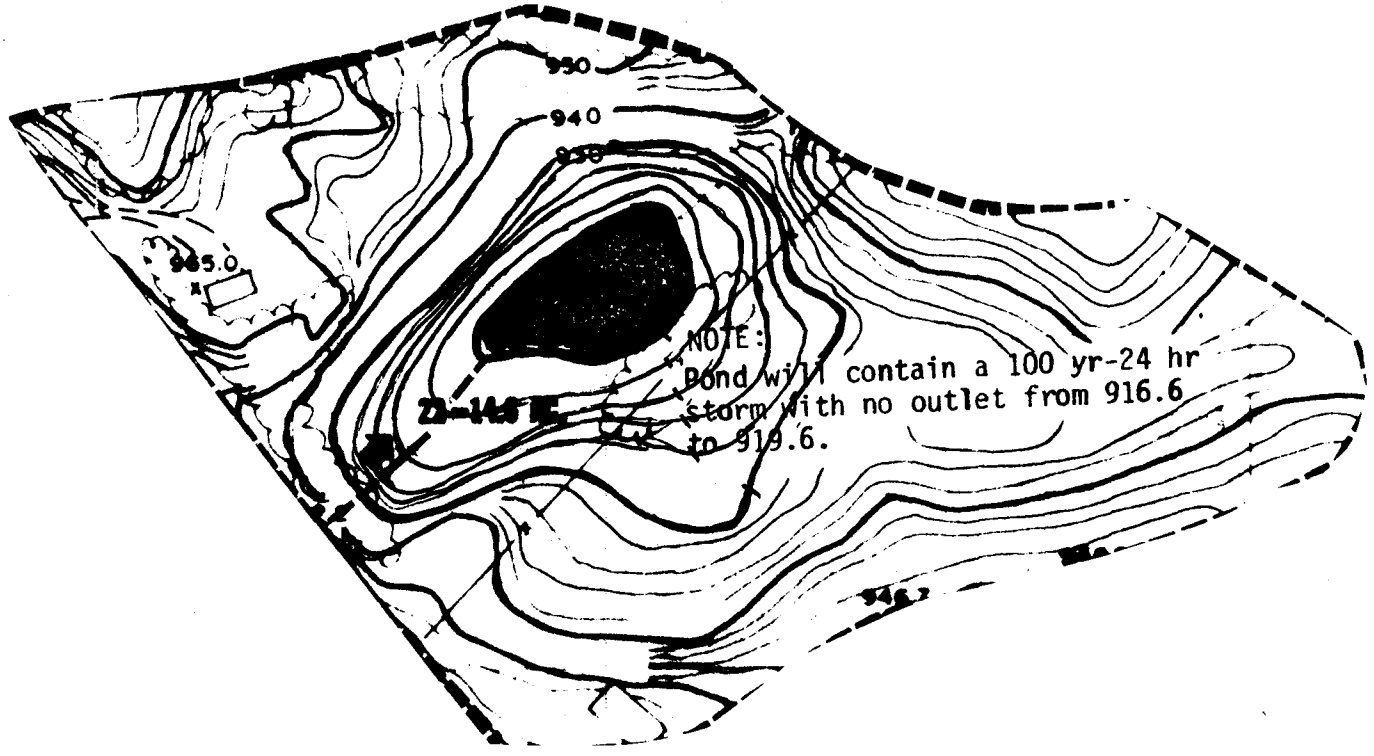
ELEV.	Σ V(AF)
916.6	0
918	0.25
920	1.15
922	2.70
924	5.30
926	8.95
928	13.48
930	19.25



POND NO. C-22

ODMP SHT. NO. 4-P

STORAGE INFORMATION



ELEV.	Σ V(AF)

ELEVATION

STORAGE VOLUME AC.FT.

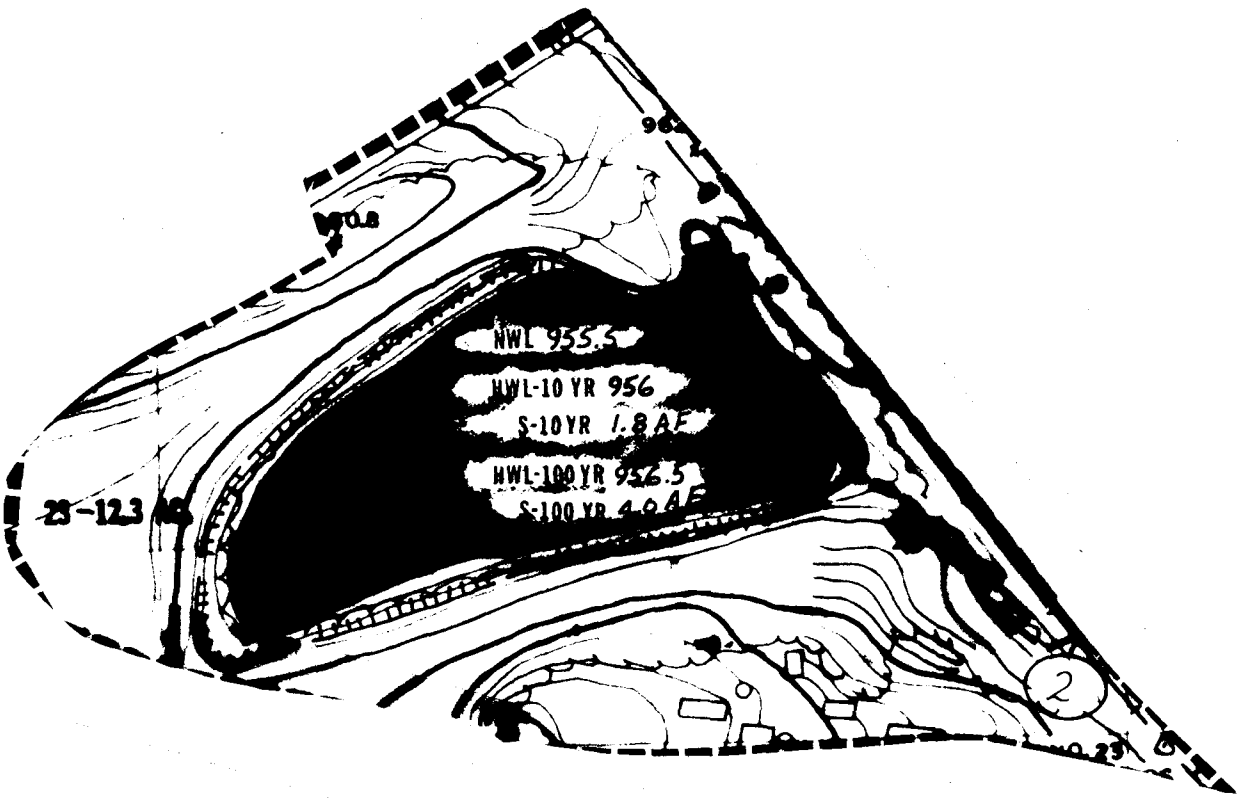
POND NO. C-22

ODMP SHT. NO. 4-5

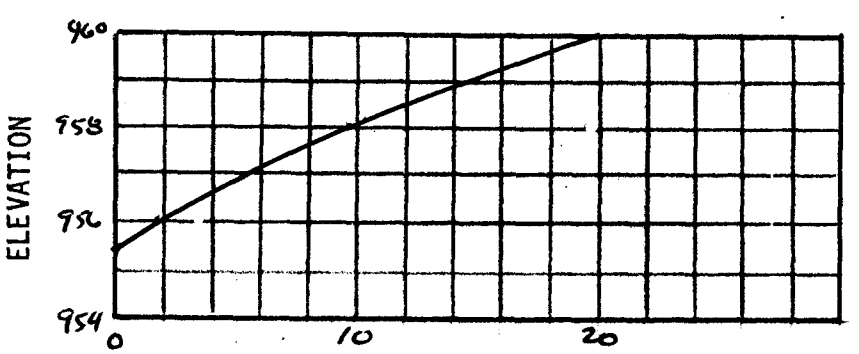
STORAGE INFORMATION

ELEV	SQ IN.	AC
916.6	0	0
918	0.38	0.35
920	0.60	0.55
922	1.09	1.00
924	1.74	1.60
926	2.23	2.05
928	2.70	2.48
930	3.57	3.28

AVG. AC	INT.	VOL (AC FT)	Σ VOL AC FT
0175	1.4	0.25	0.25
0.45	2	0.90	1.15
0.775	2	1.55	2.70
1.30	2	2.60	5.30
1.825	2	3.65	8.95
2.265	2	4.53	13.48
2.88	2	5.76	19.24



ELEV.	Σ V(AF)
955.5	0
	1.70
958	9.74
960	19.86



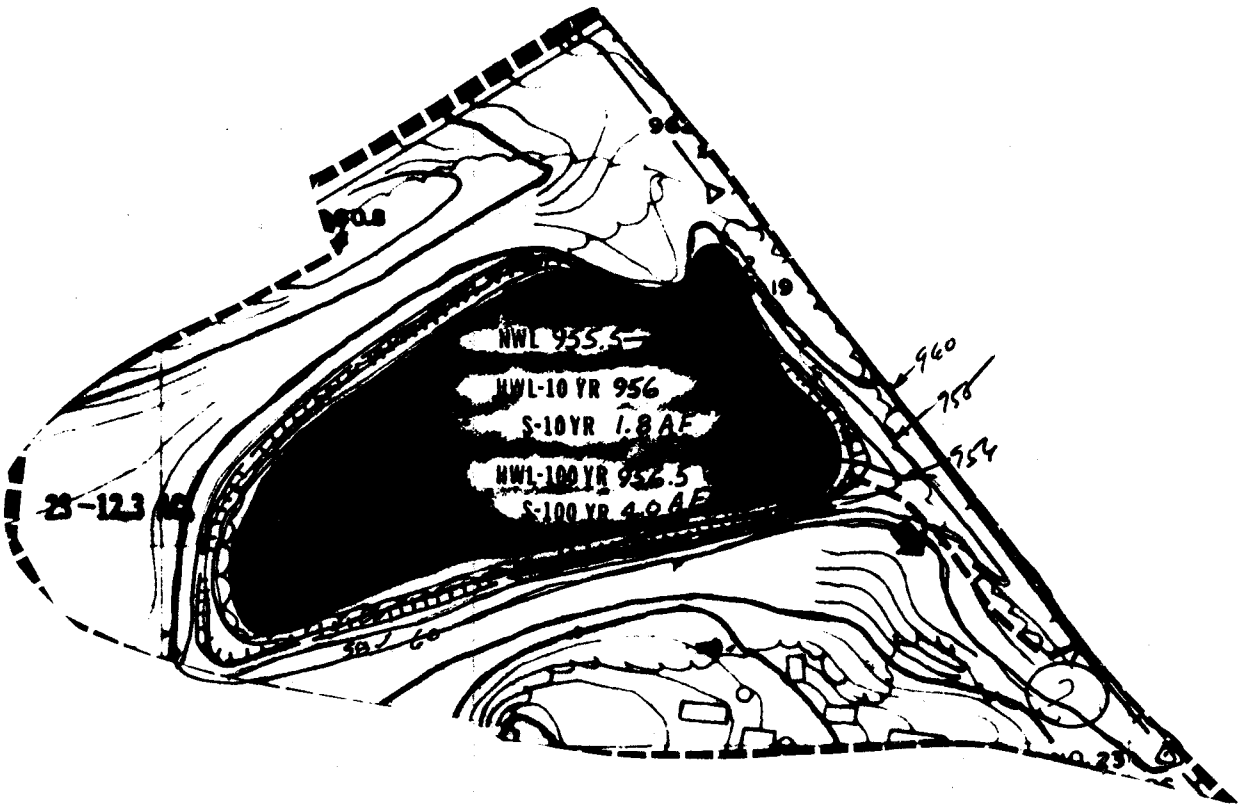
POND NO. C-23

ODMP SHT. NO. 4-P

STORAGE INFORMATION

32.2 FT/sec

17.08 Sec



ELEV.	Σ V(AF)

ELEVATION

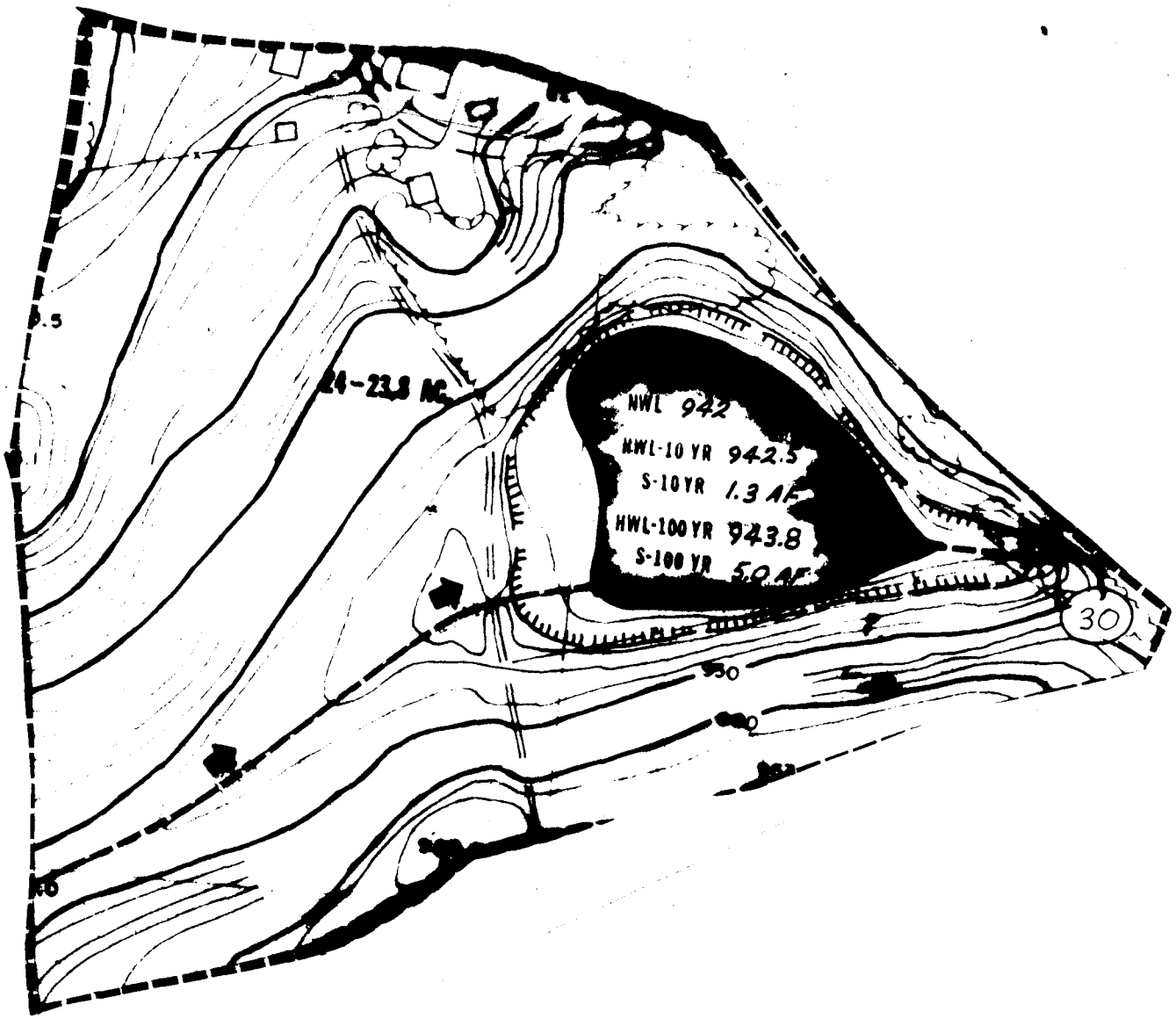
STORAGE VOLUME AC.FT.

POND NO. C-23

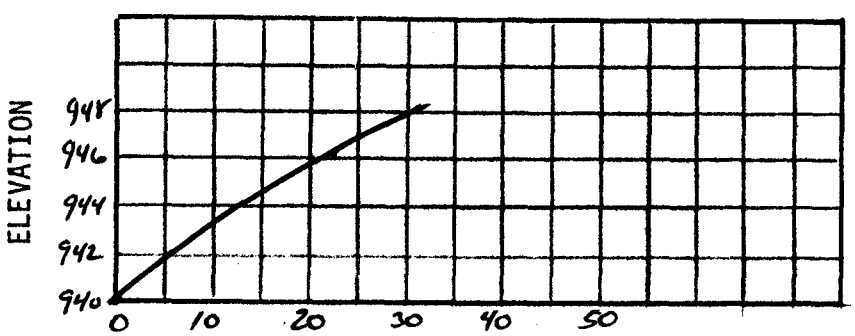
ODMP SHT. NO. 4-P

STORAGE INFORMATION

ELEV	SQ IN.	AC	AVG. AC	INT.	VOL (AC-FT)	Σ VOL AC-FT
955.5	3.48	3.19				
956.0	3.92	3.60	3.395	0.5	1.70	1.70
958.0	4.84	4.44	4.02	2	8.04	9.74
960.0	6.18	5.68	5.06	2	10.12	19.86



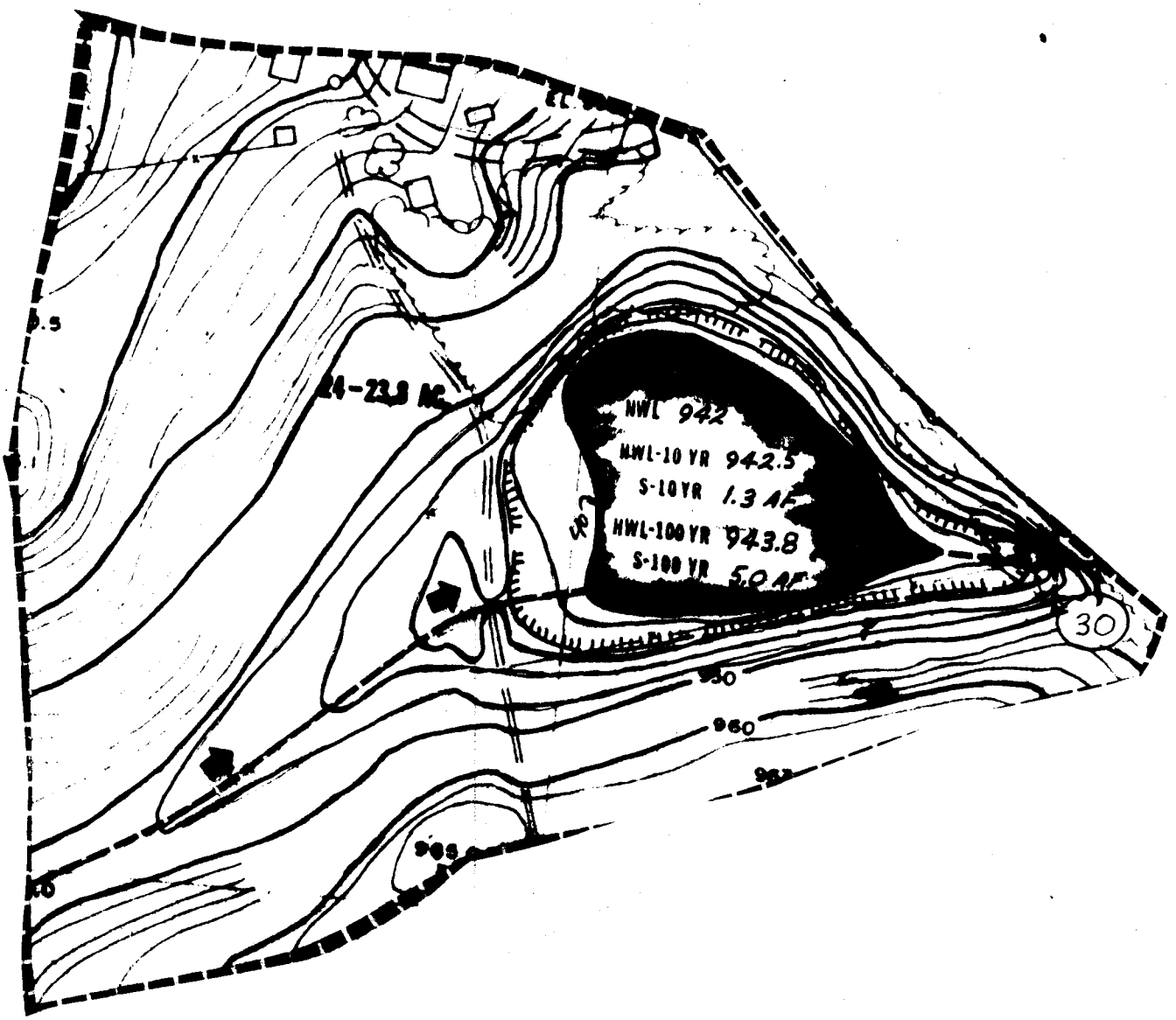
ELEV.	Σ V(AF)
940	0
942	6.44
944	12.75
946	22.40
948	34.37



POND NO. C-24

ODMP SHT. NO. 4-P

STORAGE INFORMATION



ELEV.	Σ V(AF)

ELEVATION

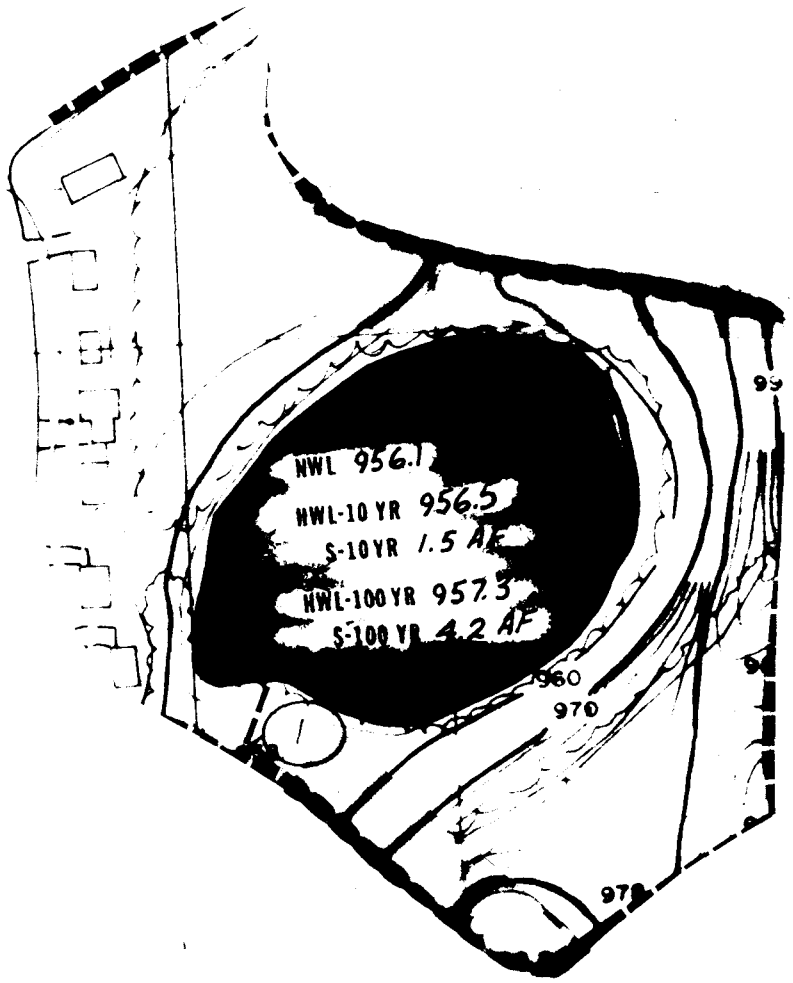
STORAGE VOLUME AC.FT.

POND NO. C-24

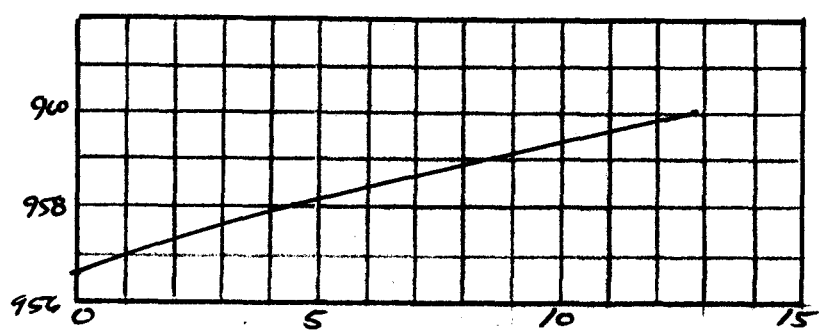
ODMP SHT. NO. 4-P

STORAGE INFORMATION

ELEV	SQ IN.	AC	AVG. AC	INT.	VOL (AC FT)	Σ VOL AC FT
940	2.54	2.33				
942	3.39	3.11	2.72	2	5.44	5.44
944	4.57	4.20	3.655	2	7.31	12.75
946	5.93	5.45	4.825	2	9.65	22.40
948	7.10	6.52	5.985	2	11.97	34.37



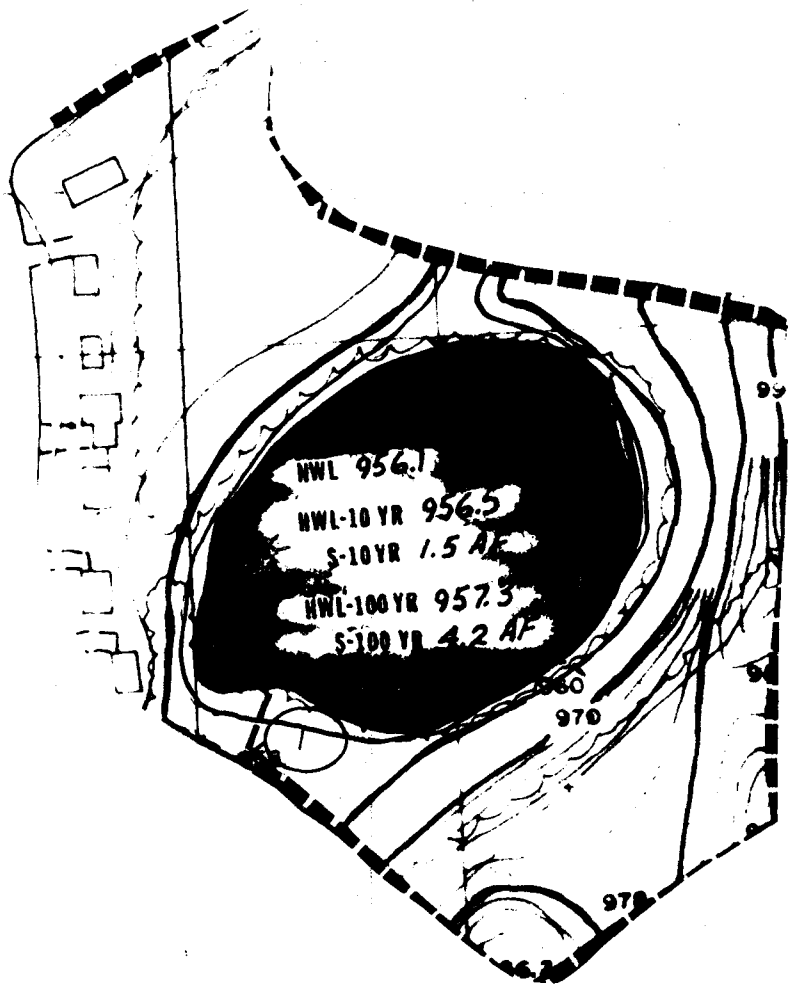
ELEV.	Σ V(AF)
956.7	0
958	4.47
960	12.79



POND NO. C-27

ODMP SHT. NO. 4-P

STORAGE INFORMATION



ELEV.	Σ V(AF)

ELEVATION

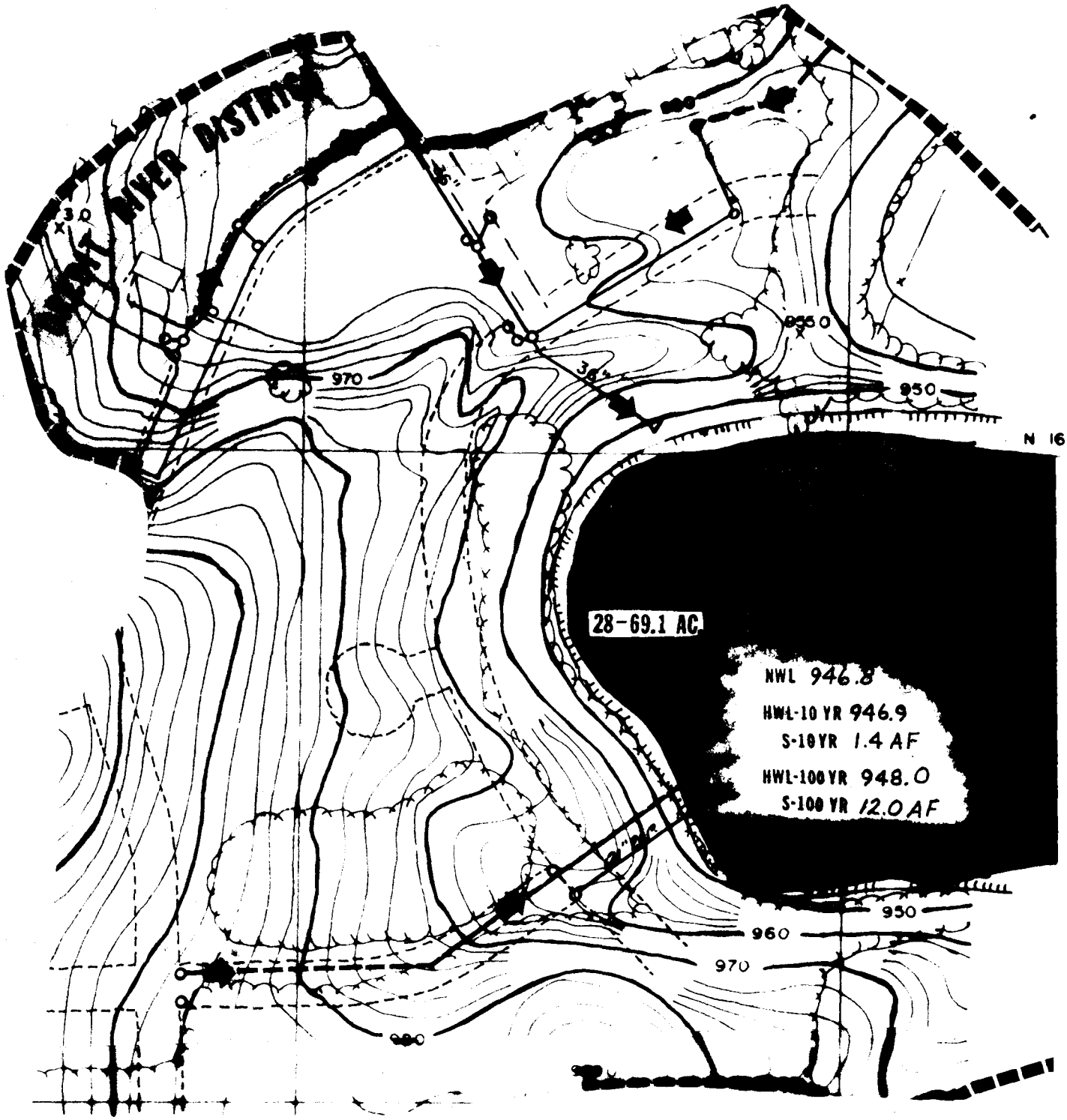
STORAGE VOLUME AC.FT.

POND NO. C-27

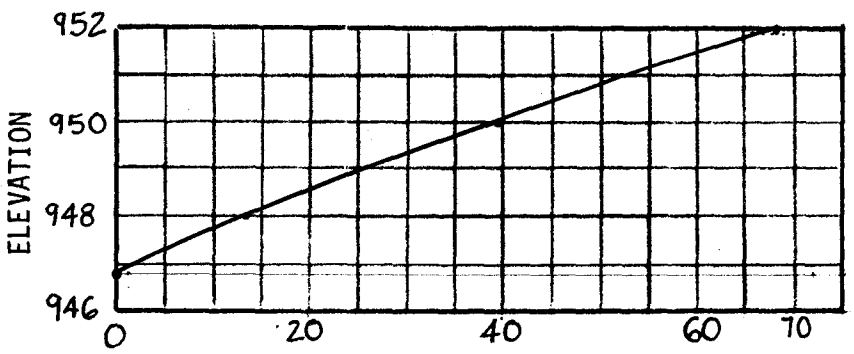
ODMP SHT. NO. 4-P

STORAGE INFORMATION

ELEV	SQ IN.	AC	AVG. AC	INT.	VOL (AC FT)	Σ VOL AC FT
956.7	3.50	3.21				
			3.435	1.3	4.47	4.47
958	3.99	3.66				
			4.16	2	8.32	12.79
960	5.07	4.66				



ELEV.	Σ V(AF)
946.8	0
948	13.52
950	39.43
952	68.13



POND NO. C 28

ODMP SHT. NO. 3-0

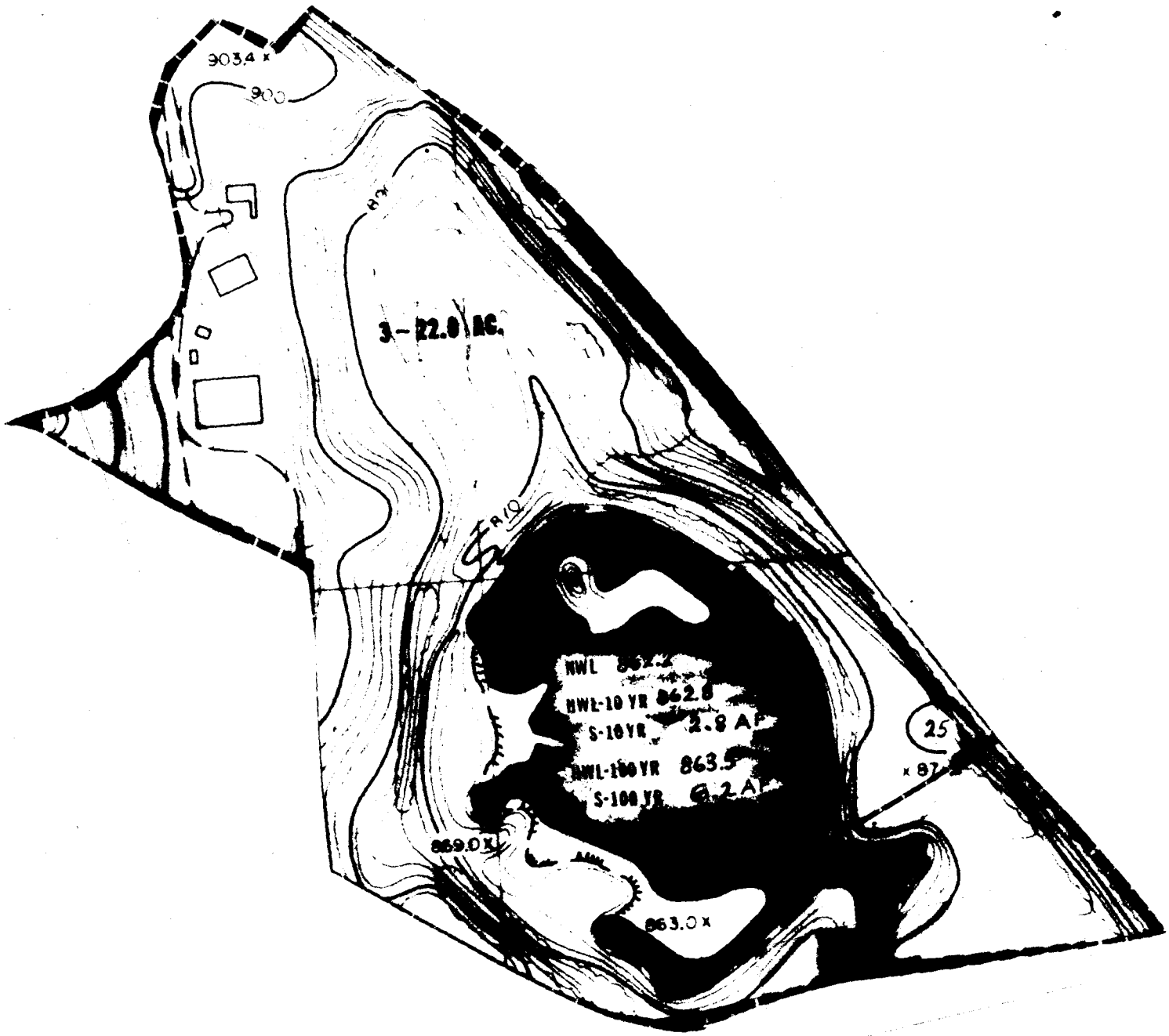
STORAGE INFORMATION

28-69.1 AC.
HWL 948.8
HWL-10 YR 946.9
S-10 YR 1.4 AF
HWL-100 YR 948.0
S-100 YR 12.0 AF
946.8 5.74 x2 = 11.48
948 6.53 x2 = 13.06
950 7.58 x2 = 15.16
952 8.05 x2 = 16.10
960.2
970
980
960
950
946
948
952
27
30
4
P

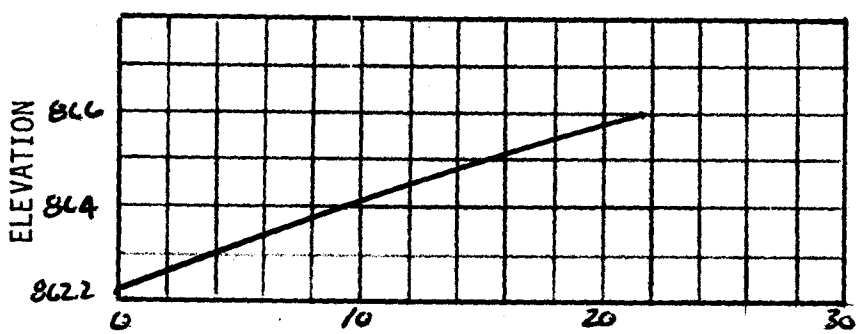
ELEV	SQ IN.	AC
946.8	11.48	10.54
948	13.06	11.99
950	15.16	13.92
952	16.10	14.78

AVG. AC	INT.	VOL (AC-FT)	Σ VOL AC-FT
11.265	1.2	13.52	13.52
12.955	2	25.91	39.43
14.35	2	28.70	68.13

٩٢١٥ [illegible]



ELEV.	Σ V(AF)
862.2	0
864.0	9.38
866.0	21.70



POND NO. PL-3

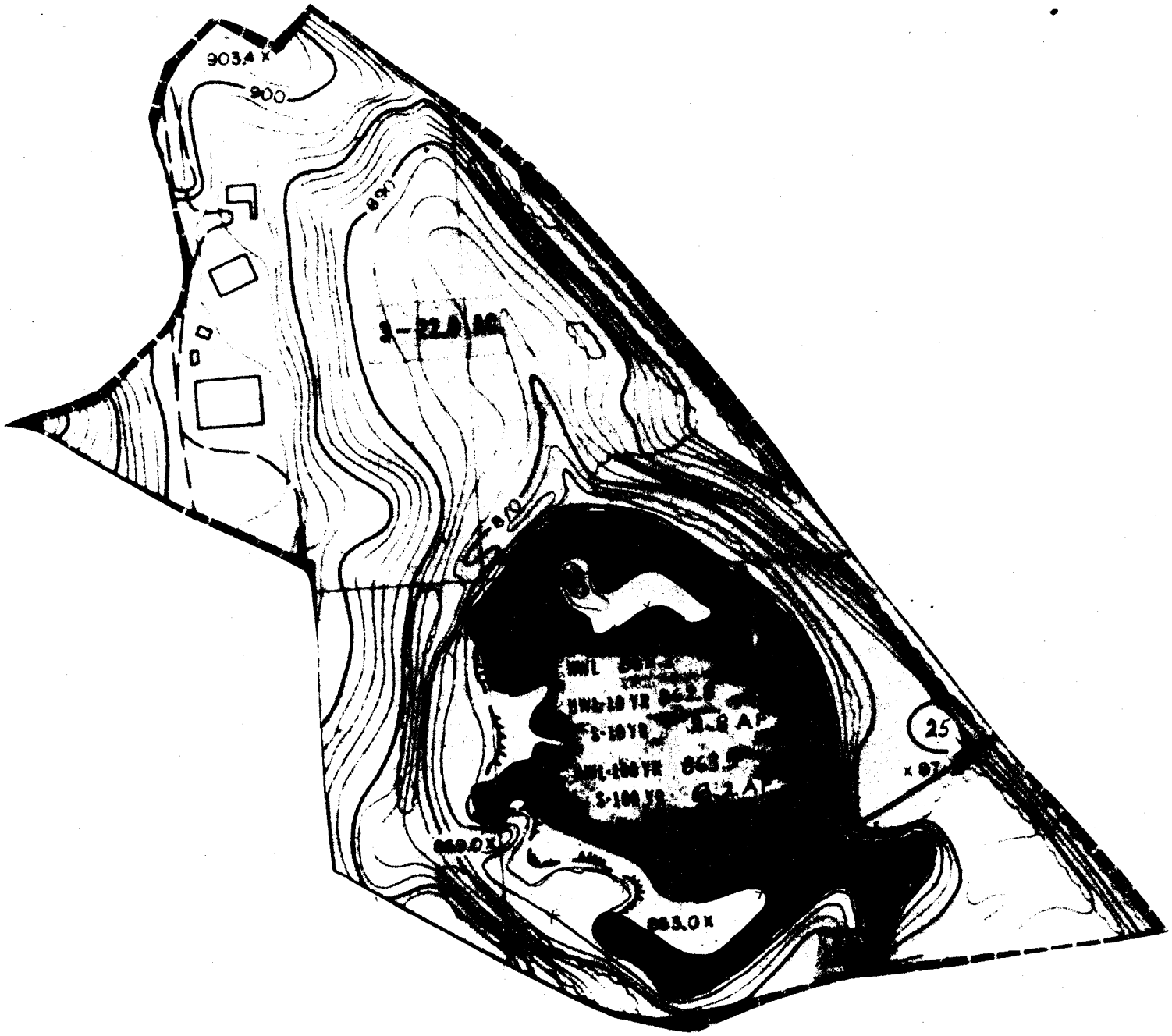
ODMP SHT. NO. 10A

STORAGE INFORMATION

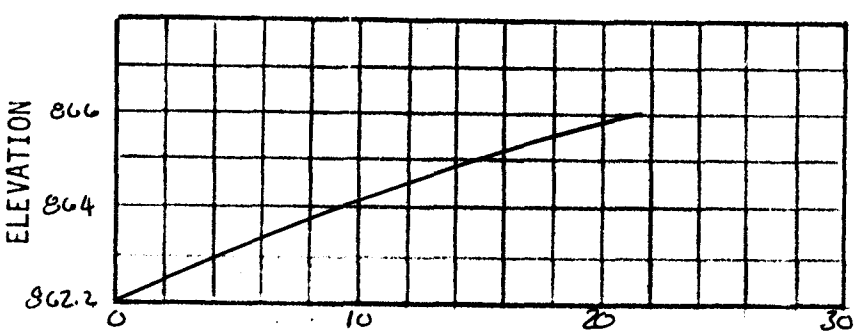
POND PC-3
SHT # 10-A.

ELEV	SQ IN.	AC
862.2	5.08	4.66
864.0	6.29	5.77
866.0	7.17	6.58

AVG. AC	INT.	VOL (AC FT)	Σ VOL AC FT
5.21	1.8	9.38	9.38
6.16	2	12.32	21.70



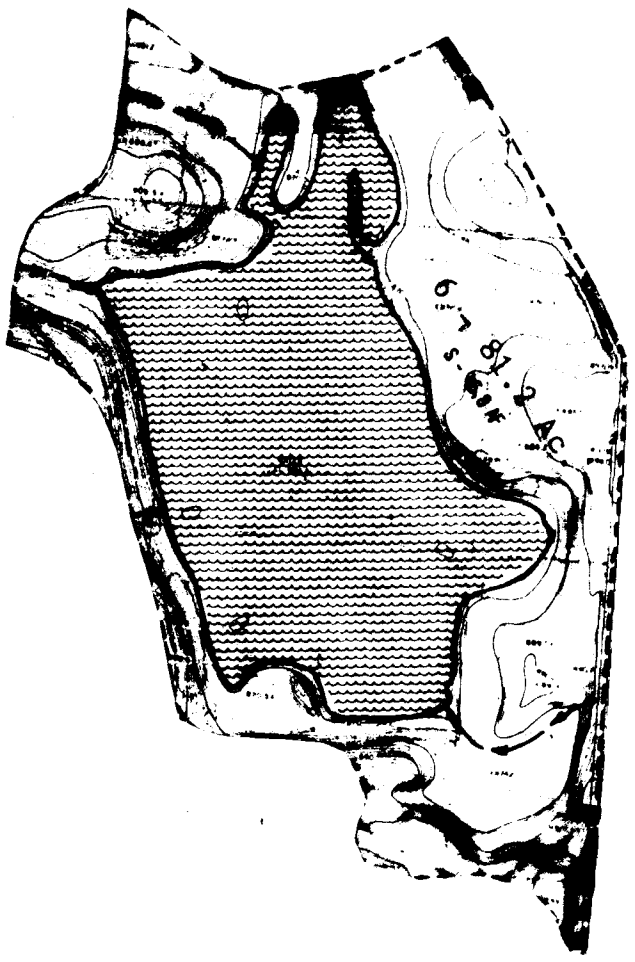
I.EV.	Σ V(AF)
862.2	0
864	9.39
866	21.75



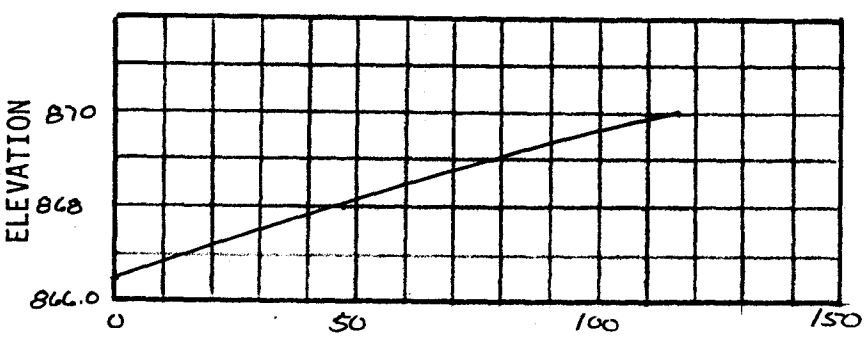
POND NO. PL-3

ODMP SHT. NO. 10A

STORAGE INFORMATION



ELEV.	Σ V(AF)
866.5	0
868.0	48.3
870.0	116.5



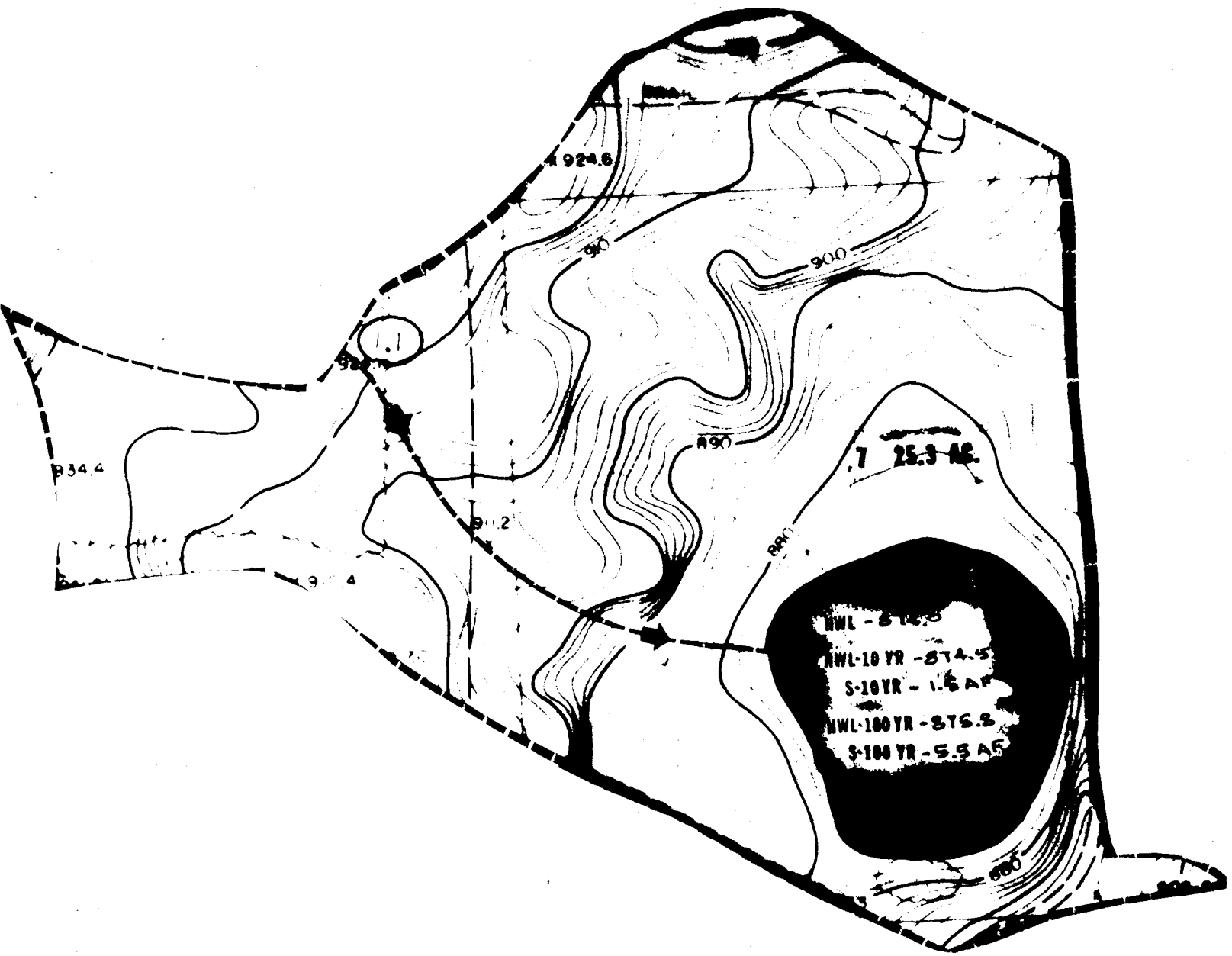
POND NO. PL-6

ODMP SHT. NO. 10A

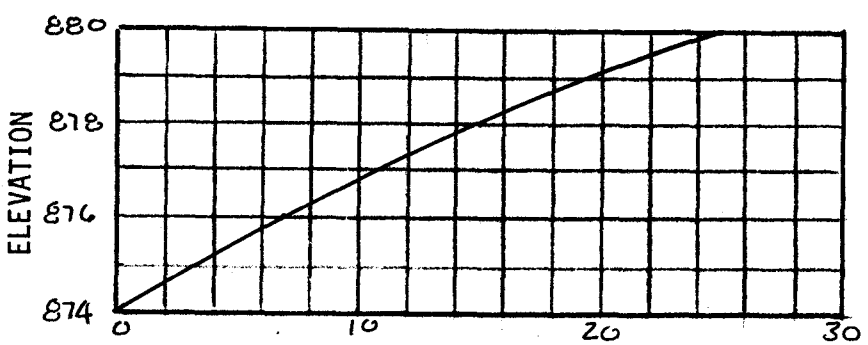
STORAGE INFORMATION

POND PL-6
SHTP 10 A.

ELEV	SQ IN.	AC	AVG. AC	INT.	VOL (AC FT)	Σ VOL AC FT
866.5	34.08	31.29				
868.0	36.06	33.11	32.2	1.5	48.3	48.3
870.0	38.26	35.13	34.12	2.0	68.24	116.5



ELEV.	Σ V(AF)
874	0
876	6.86
878	14.92
880	24.81



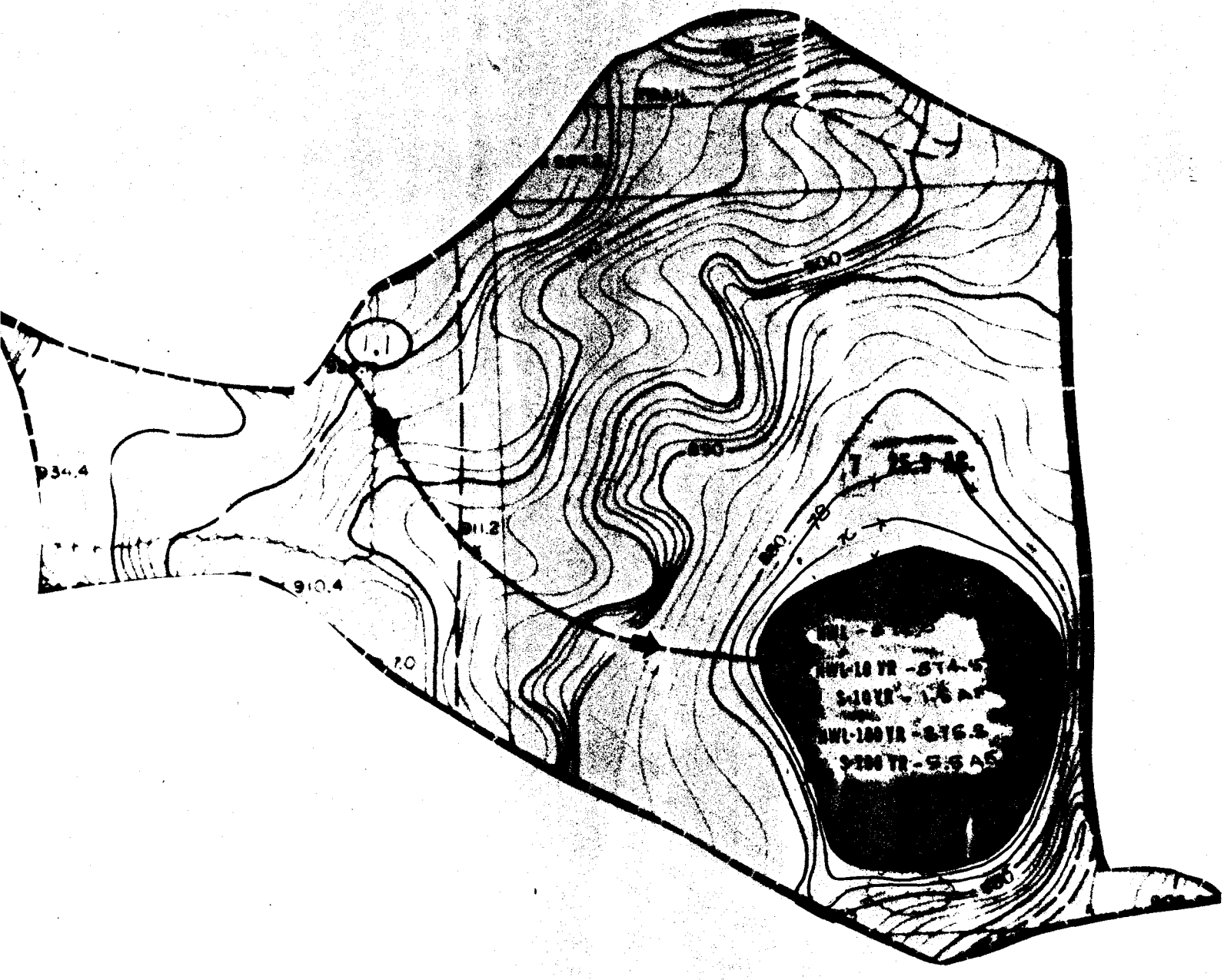
POND NO. PL - 7

ODMP SHT. NO. 10A

STORAGE INFORMATION

Pond No PL-7
Sht No 10-A.

ELEV	SQ IN.	AC	AVG. AC	INT.	VOL (AC FT)	Σ VOL AC FT
874	3.5	3.21				
876	3.98	3.65	[illegible]	2	6.86	6.86
878	4.80	4.40	4.03	2	8.06	14.92
880	5.98	5.49	4.95	2	9.89	24.81



I.EV.	Σ V(AF)

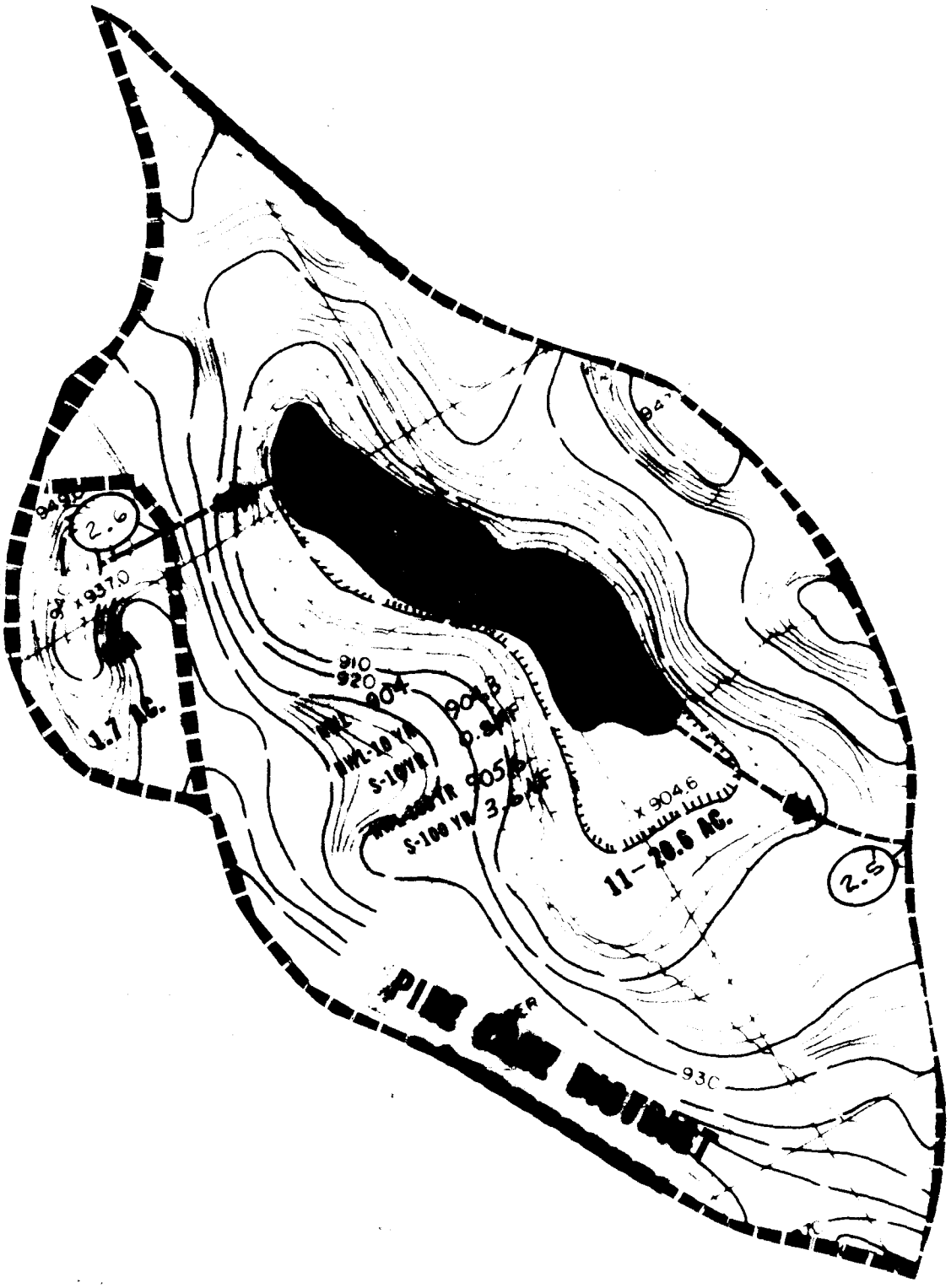
ELEVATION

STORAGE VOLUME AC FT

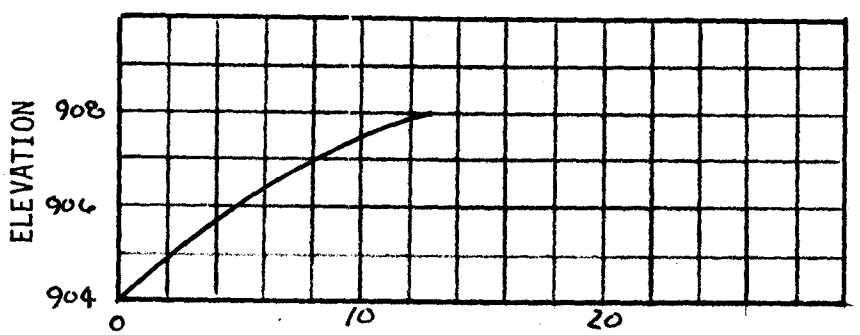
POND NO. PL-7

ODMP SHT. NO. 10A

STORAGE INFORMATION



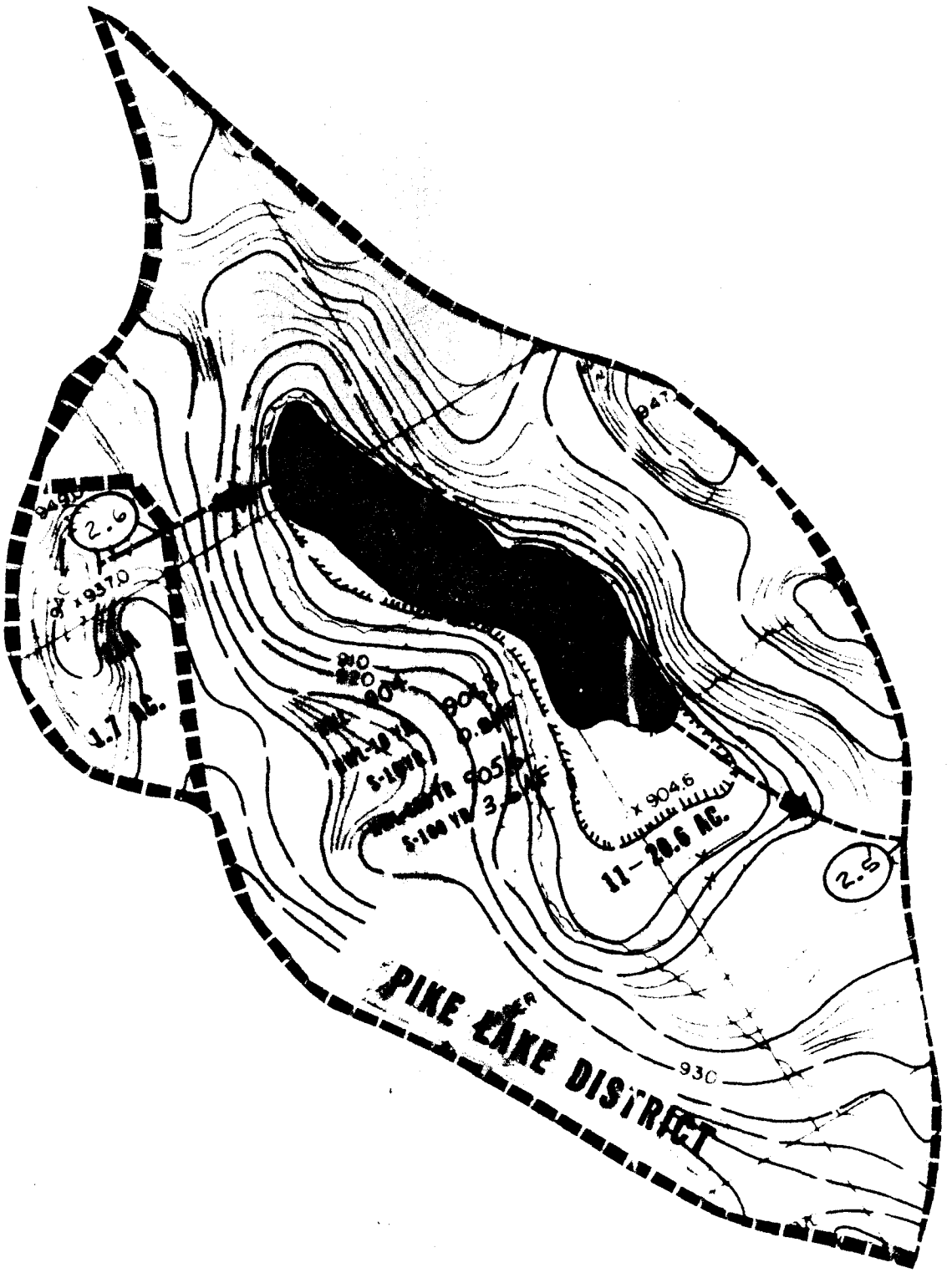
ELEV.	Σ V(AF)
904	0
906	5.12
908	12.98



POND NO. PL 11

ODMP SHT. NO. 10A

STORAGE INFORMATION



ELEV.	Σ V(AF)

ELEVATION

STORAGE VOLUME AC.FT.

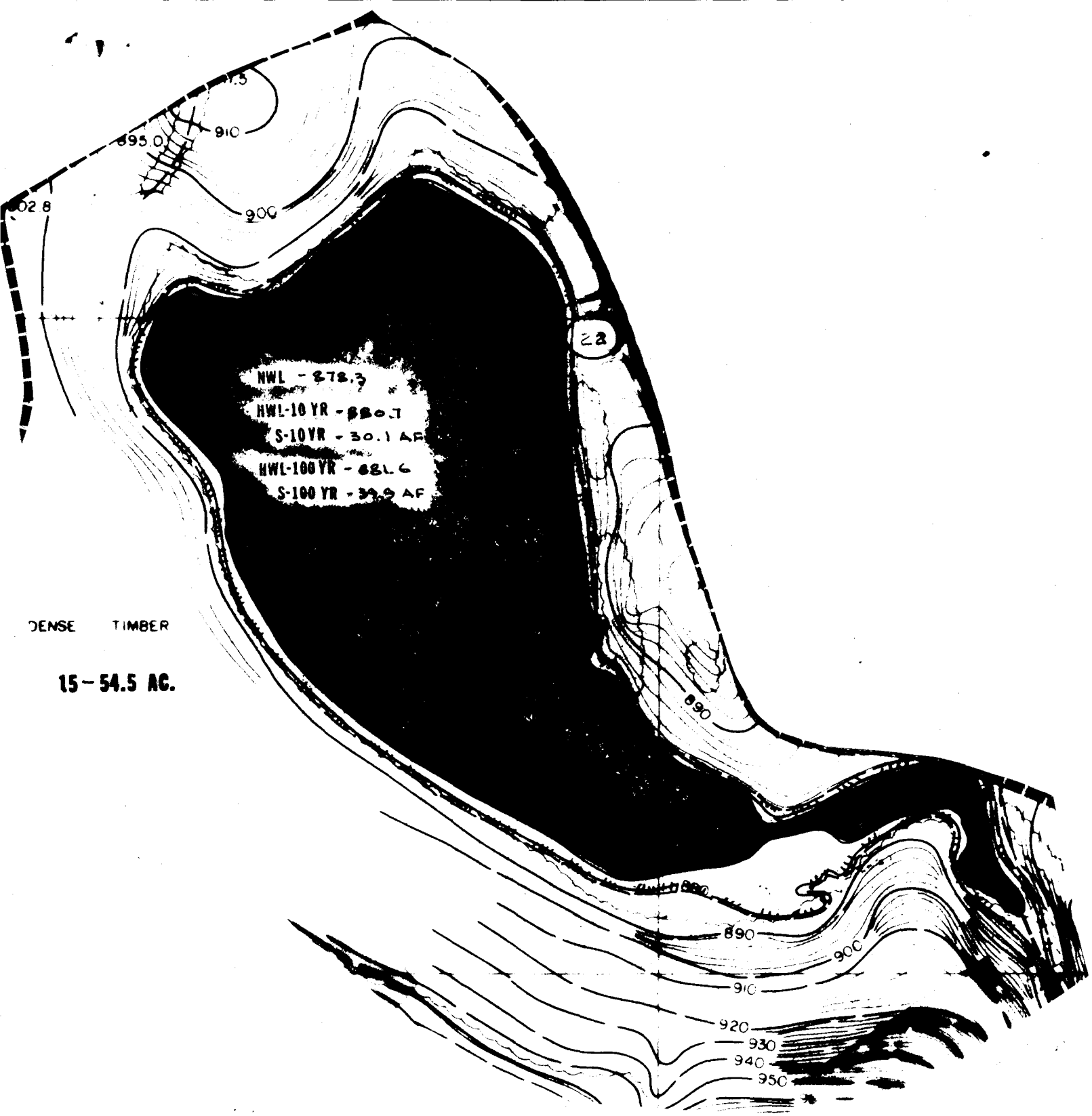
POND NO. PL 11

ODMP SHT. NO. 10A

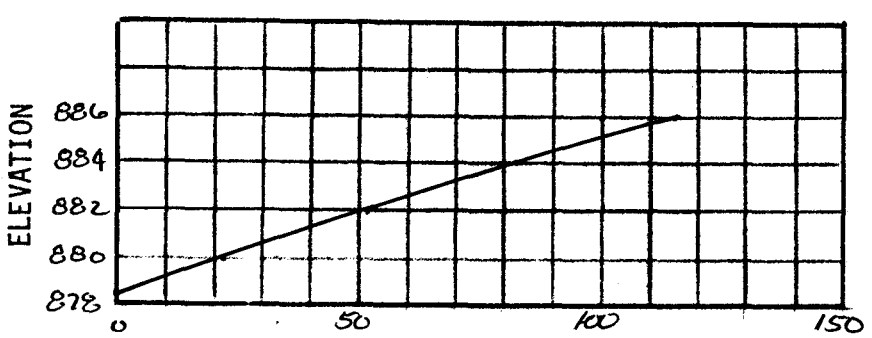
STORAGE INFORMATION

POND PL 11
SHT NO 10a

ELEV	SQ IN.	AC	AVG. AC	INT.	VOL (AC FT)	Σ VOL AC FT
904	1.74	1.59				
906	3.84	3.53	2.56	2	5.12	5.12
908	4.72	4.33	3.93	2	7.86	12.98



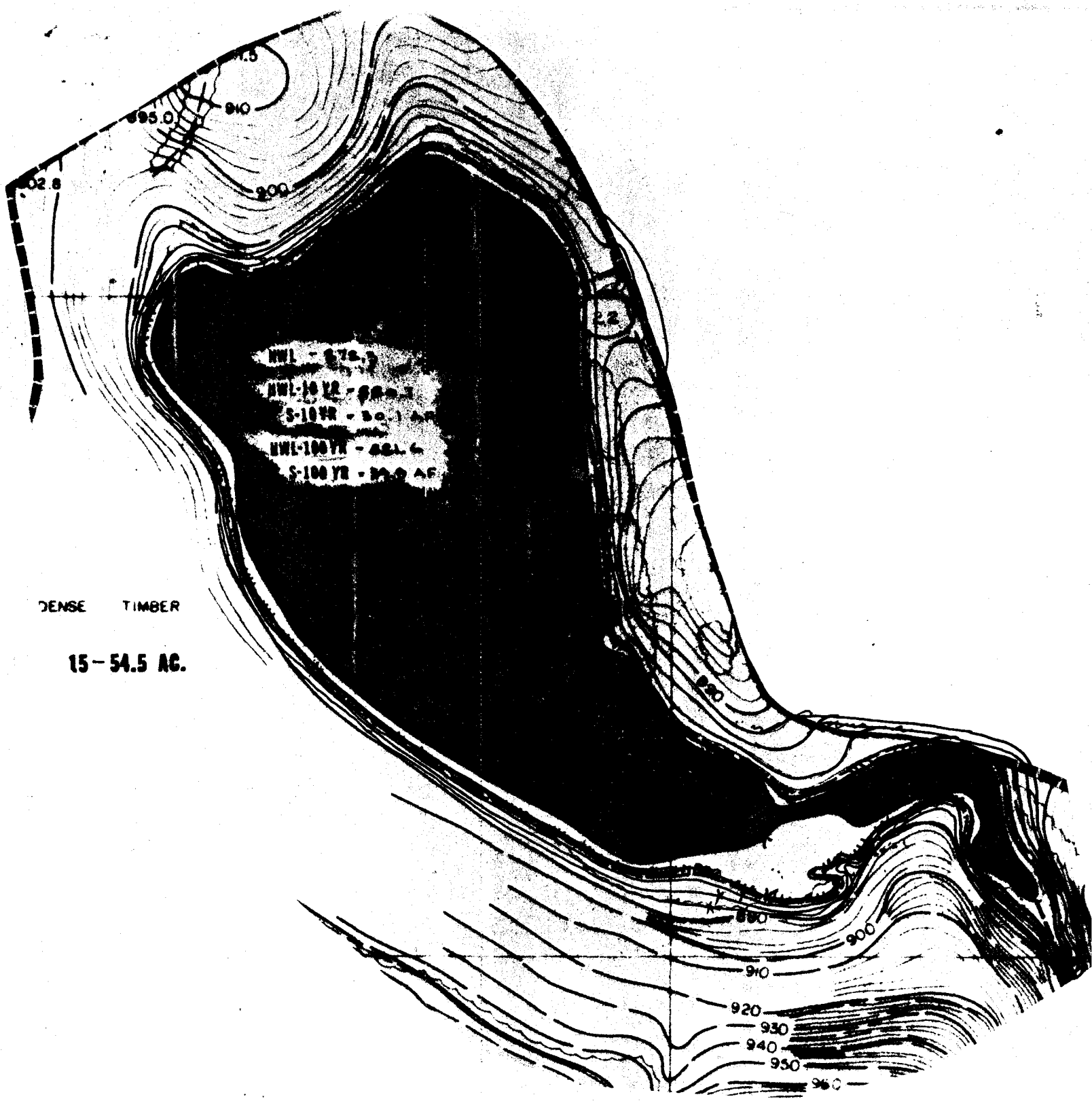
ELEV.	Σ V(AF)
878.3	0
880	22.29
882	51.28
884	82.51
886	115.70



POND NO. PL-15

ODMP SHT. NO. 10A

STORAGE INFORMATION



ELEV.	Σ V(AF)

ELEVATION

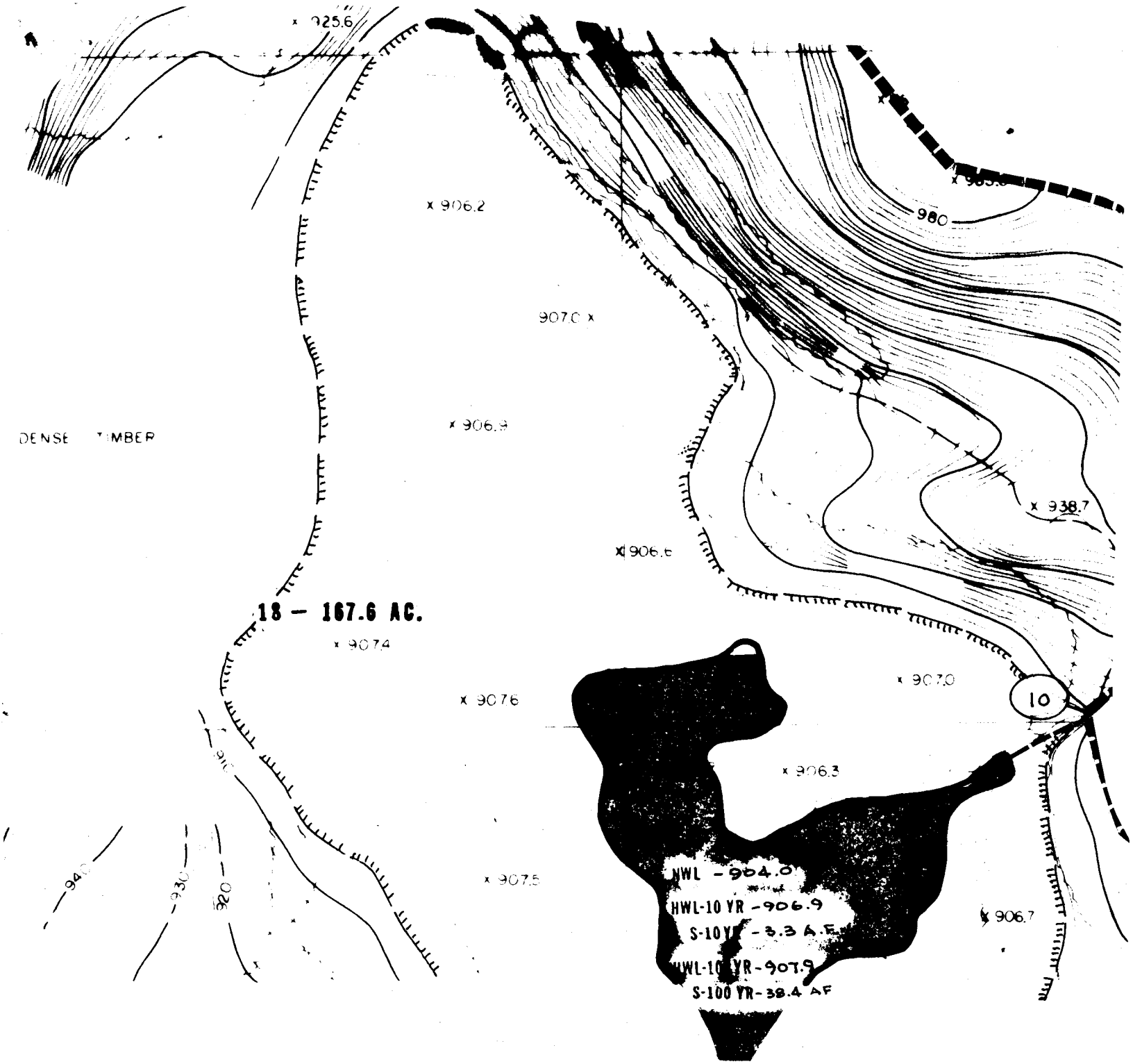
STORAGE VOLUME AC.FT.

POND NO. PL-15

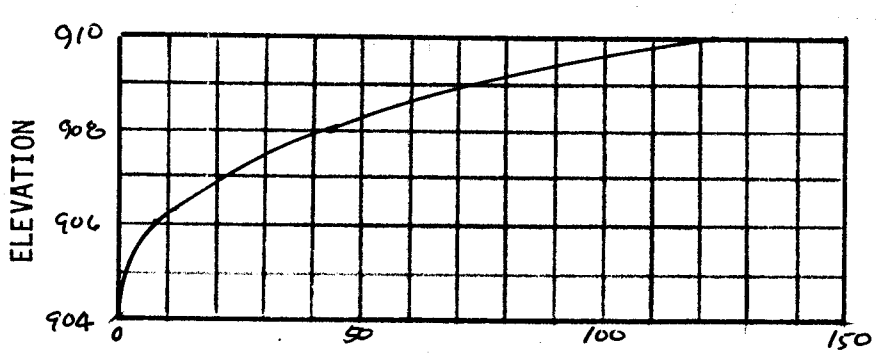
ODMP SHT. NO. 10A

STORAGE INFORMATION

ELEV	SQ IN.	AC	AVG. AC	INT.	VOL (AC FT)	Σ VOL AC FT
878.3	13.34	12.24				
880	15.24	13.99	13.11	1.7	22.29	22.29
882	16.34	15.00	14.49	2.0	28.99	51.28
884	17.68	16.23	15.61	2.0	31.23	82.51
886	18.48	16.96	16.59	2.0	33.19	115.70



ELEV.	Σ V(AF)
904	0
906	7.28
908	42.28
910	124.28



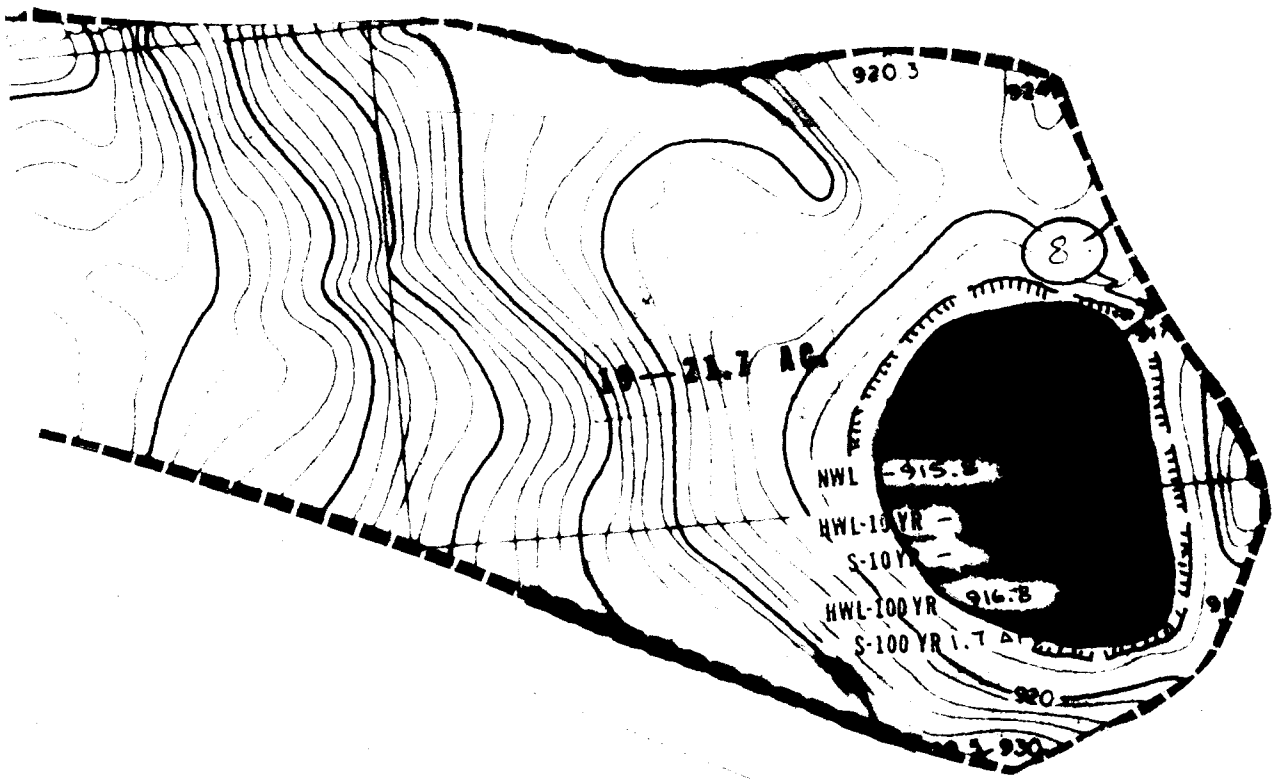
POND NO. PL-18

ODMP SHT. NO. 10 A.

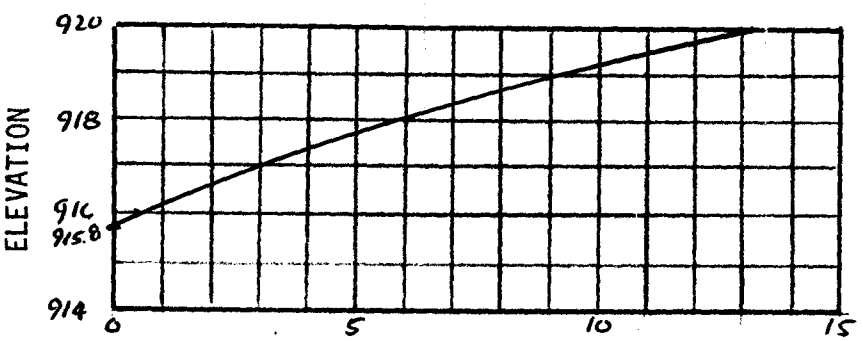
STORAGE INFORMATION

ELEV	SQ IN.	AC
904	3.50	3.21
906	4.42	4.06
908	33.68	30.93
910	52.88	48.56

AVG. AC	INT.	VOL (AC FT)	Σ VOL AC FT
3.64	2	7.28	7.28
17.50	2	35.00	42.28
39.75	2	79.50	121.78



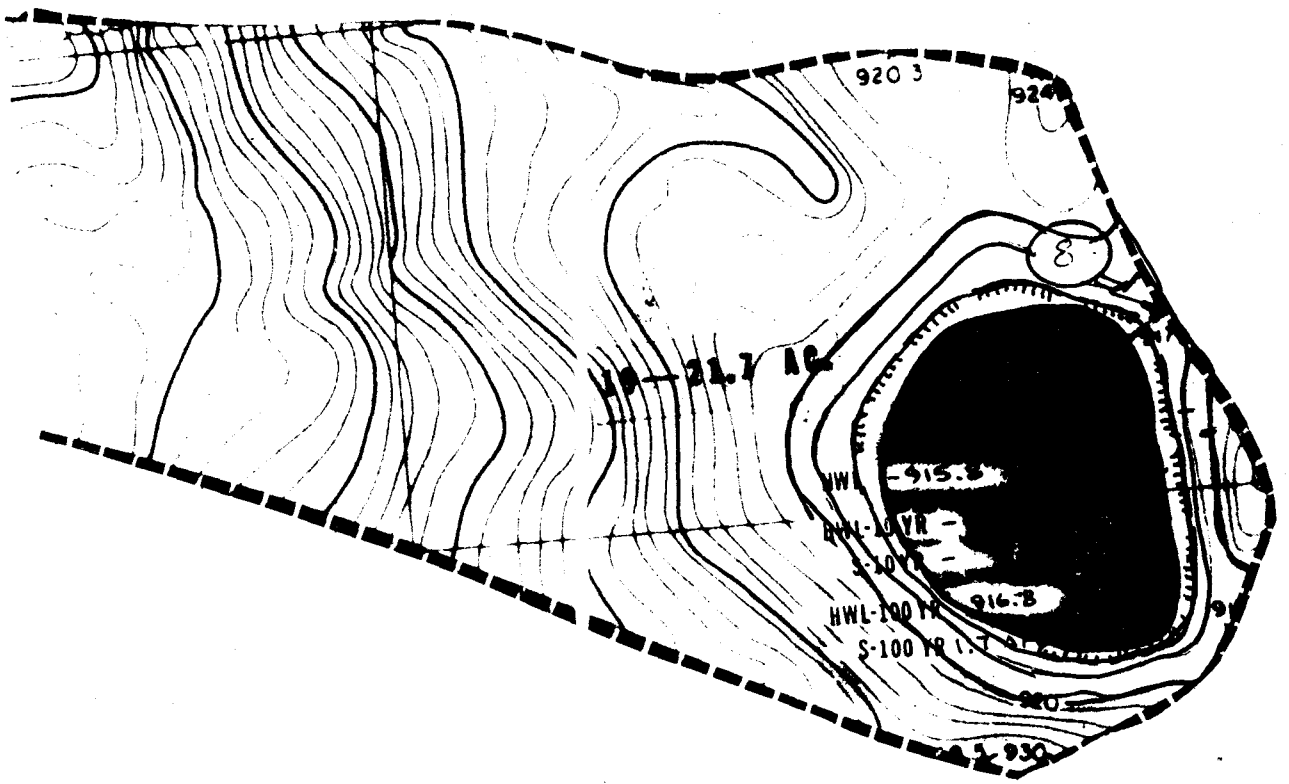
ELEV.	Σ V(AF)
915.8	-
916	0.45
918	6.07
920	13.16



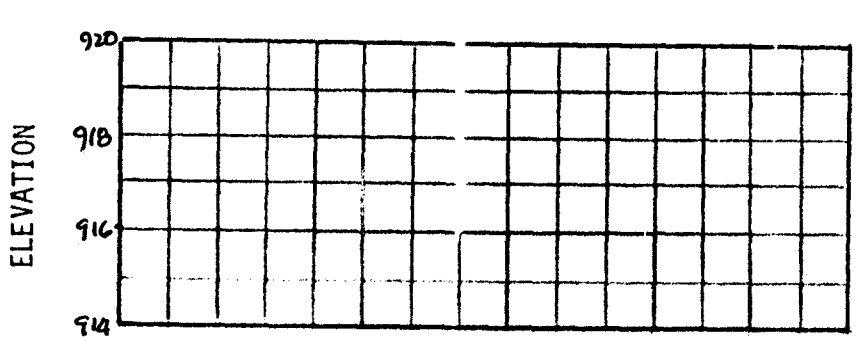
POND NO. DL-19

ODMP SHT. NO. 14 F

STORAGE INFORMATION



ELEV.	Σ V(AF)
915.8	
916	
918	
920	



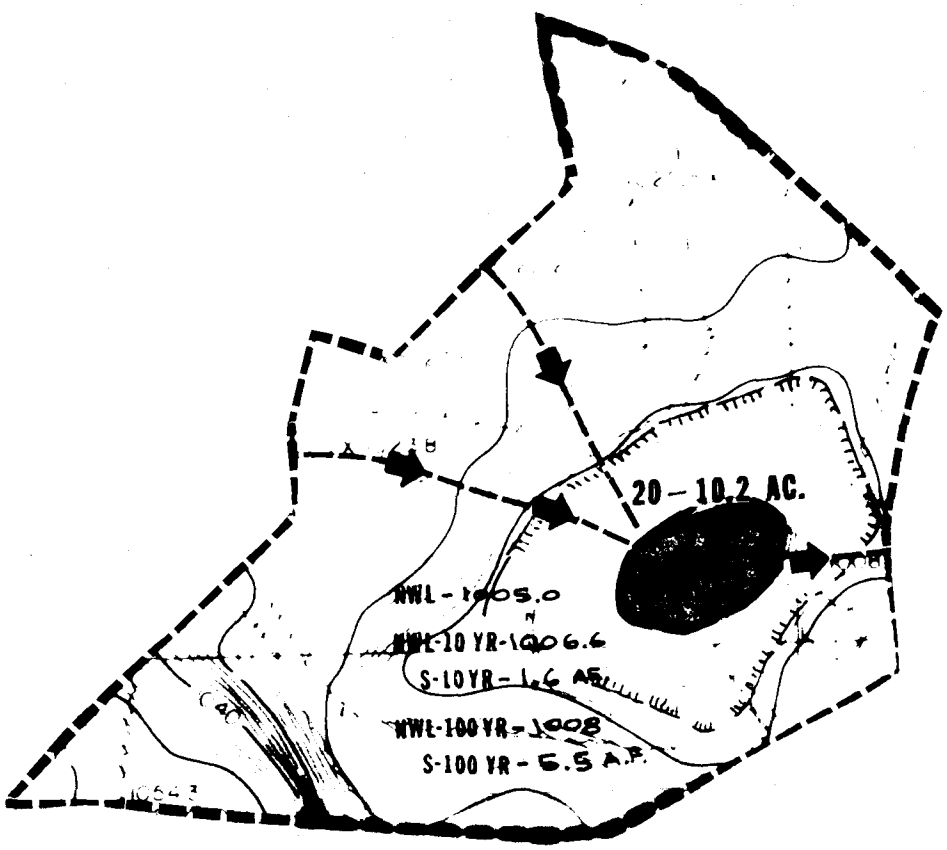
POND NO. DL-19

ODMP SHT. NO. 14 F

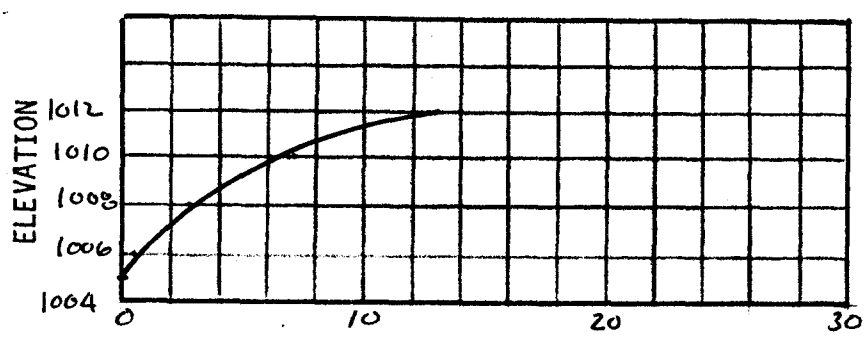
STORAGE INFORMATI

ELEV	SQ IN.	AC
915.8	2.19	2.01
916	2.70	2.48
918	3.42	3.14
920	4.30	3.95

AVG. AC	INT.	VOL (AC FT)	Σ VOL AC ET
2.245	0.2	0.45	0.45
2.81	2	5.62	6.07
3.545	2	7.09	13.16



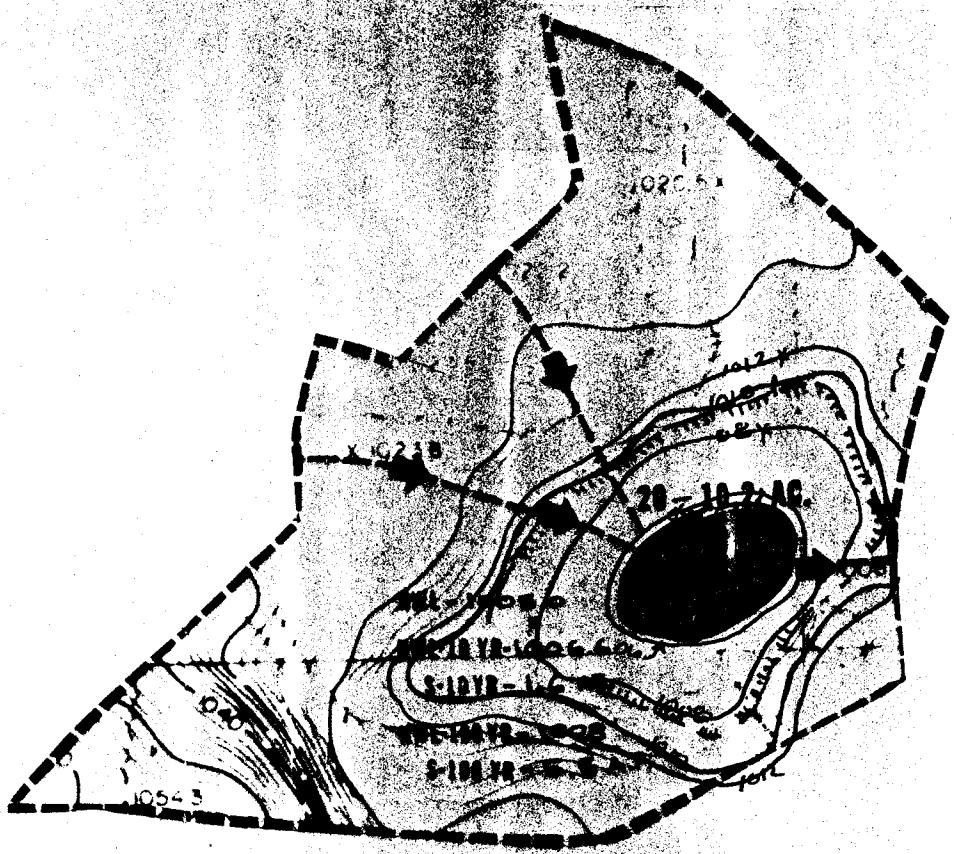
ELEV.	Σ V(AF)
[illegible]	0
[illegible]	0.53
[illegible]	2.70
[illegible]	7.03
[illegible]	13.18



POND NO. PL-20

ODMP SHT. NO. 10 A

STORAGE INFORMATION



ELEV.	Σ V(AF)

ELEVATION

STORAGE VOLUME AC.FT.

POND NO. PL-20

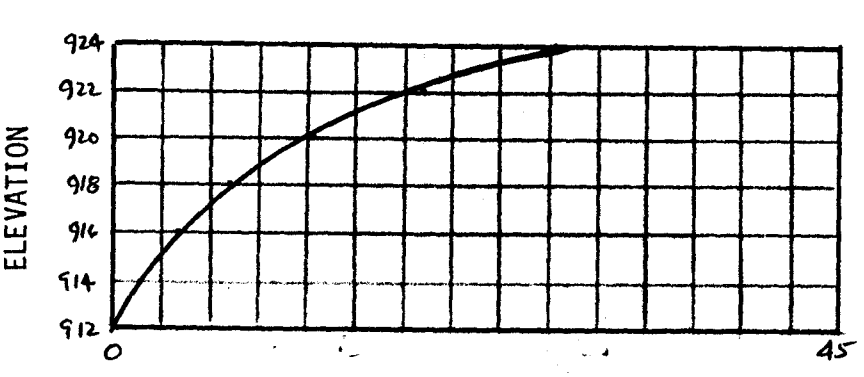
ODMP SHT. NO. 10 A

STORAGE INFORMATION

ELEV	SQ IN.	AC
1005	0.52	0.48
1006	0.64	0.59
1008	1.72	1.58
1010	3.00	2.75
1012	3.70	3.40

AVG. AC	INT.	VOL (AC FT)	Σ VOL AC FT
0.53	1	0.53	0.53
1.085	2	2.17	2.70
2.165	2	4.33	7.03
3.075	2	6.15	13.18

ELEV.	Σ V(AF)
912	0
914	1.42
916	3.86
918	7.26
920	12.36
922	18.99
924	27.35
926	38.13



POND NO. PL-23

ODMP SHT. NO. 14F

STORAGE INFORMATION

ELEV.	Σ V(AF)
912	
914	

ELEVATION

STORAGE VOLUME AC.FT.

POND NO. PL-23

ODMP SHT. NO. 14 F

STORAGE INFORMATI

ELEV	SQ IN.	AC	AVG. AC	INT.	VOL (AC-FT)	Σ VOL AC-FT
912	0.73	0.67				
914	1.03	0.95	0.81	2	1.62	1.62
916	1.40	1.29	1.12	2	2.24	3.86
918	2.30	2.11	1.70	2	3.40	7.26
920	3.24	2.99	2.55	2	5.10	12.36
922	3.96	3.64	3.315	2	6.63	18.99
924	5.14	4.72	4.18	2	8.36	27.35
926	6.60	6.06	5.39	2	10.78	38.13