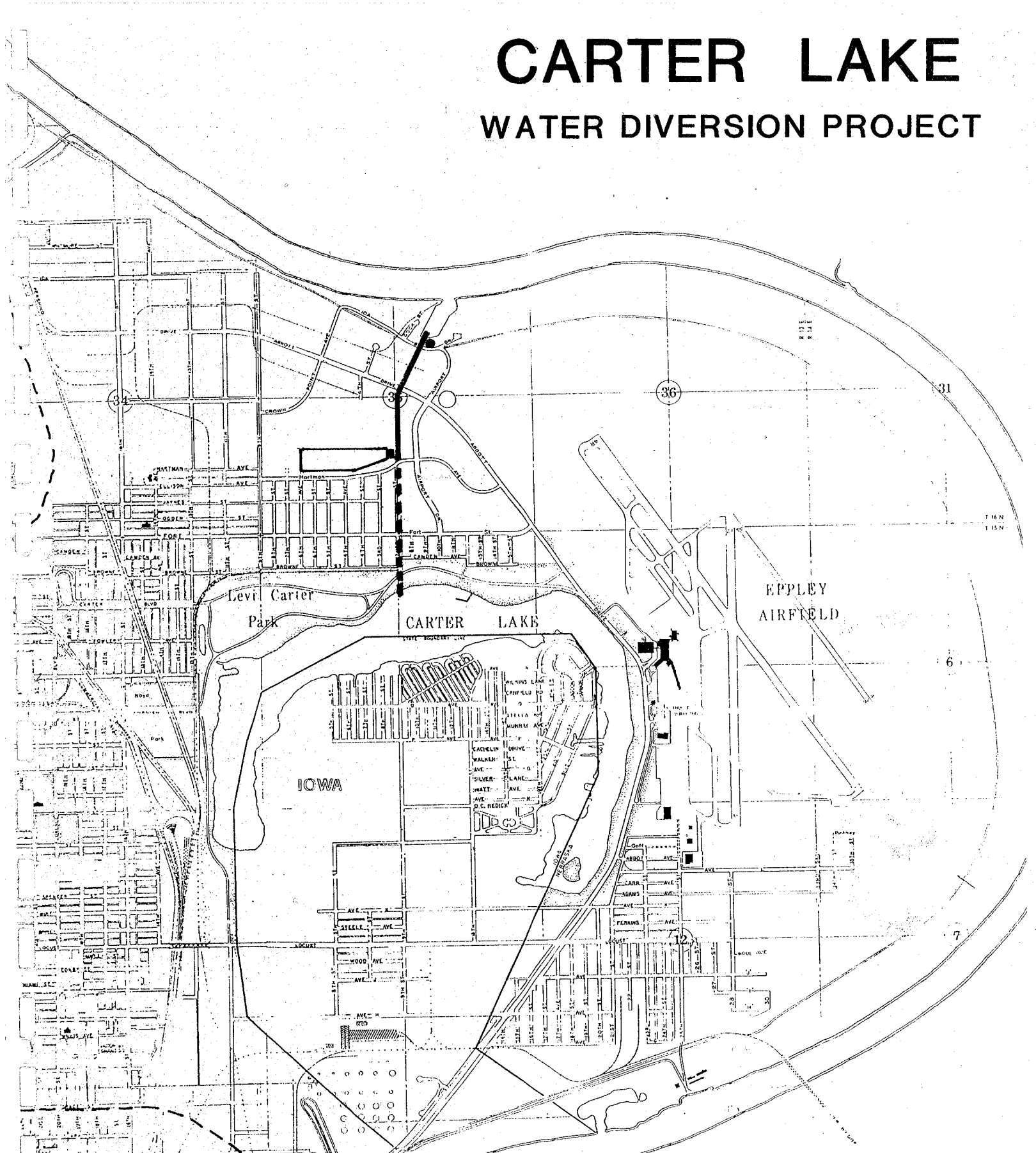
CARTER LAKE

WATER DIVERSION PROJECT



Technical Report

Assembled by

Omaha Public Works Department

August 1986

INDEX

CARTER LAKE WATER DIVERSION PROJECT

BACKGROUND AND EXECUTIVE SUMMARY:

A problem of high water level in Carter Lake has resulted in property damage along the Lake's frontage. In the past, the City of Omaha has, on an emergency basis, lowered the water level of the lake by pumping lake water into the City's sewer system.

The Carter Lake Intergovernmental Task Force was commissioned in May of 1984, under the auspices of MAPA, to study the water level problems of Carter Lake and to explore alternative solutions available to the City of Omaha, Nebraska and Carter Lake, Iowa. The City of Omaha has been ordered by the Nebraska Department of Environmental Control (NDEC) to cease pumping lake water through the sewer system by January, 1987 (Administrative Order Case No. 808).

The intent of the Task Force was to develop solutions to the water level problem while maintaining an active concern for erosion control and the wildlife and recreational uses of the lake.

Toward this end, the U.S. Army Corps of Engineers lent their expertise in assisting with the charge to the Task Force. Two studies were produced by the Corps: "Evaluation of Lake Levels for Carter Lake, Iowa and Nebraska," under Section 22 Authority, and "Carter Lake, Iowa and Nebraska: Streambank Erosion Control Technical Assistance," under Section 55 Authority.

The combined findings of these studies suggested that a relatively constant level is critical to preventing flooding and subsequent property damage at too high of a level and to minimize shoreline erosion and adverse effects on the fish population if the level drops too low. Maintaining Carter Lake at a level of 970.3 feet with a fluctuation of .5 feet (969.8 - 970.8 feet) has been determined by the Task Force to be optimal and was their recommendation.

The next step was to determine the optimal alternative for maintaining this level. A Technical Committee comprised of staff members representing: the City of Carter Lake; the City of Omaha, Department of Planning, Public Works, and Parks, Recreation and Property Management; Papio Natural Resources District; Nebraska Natural Resources Commission; Iowa Department of Water, Air and Waste Management; Iowa Conservation Commission; Soil Conservation Service; Golden Hills Resource Conservation and Development District; Nebraska Department of Environmental Control; Corps of Engineers; and MAPA, met on a regular basis to review possible solutions.

It was the recommendation of the Technical Committee and the Task Force that the water level will best be controlled by using a gravity sewer/force main system that would convey water from Carter Lake to the Storz Expressway Pump Station for discharge into the Missouri River, when the lake level requires reduction and by pumping water from the Barge Channel at Ida Street back into the Storz Expressway 54-inch diameter force main to a point that 2nd Street and Hartman Avenue where it would connect to a force main in 3rd Street and

improving Levi Carter Park until 1948 when the F. Ellwood Allen Organization prepared for the City of Omaha a comprehensive plan for the ultimate development of the area. This plan included facilities for boating, water sports, fishing, golf, baseball, and other recreational sports, and it constitutes the local interest master plan presented at a public hearing conducted by the Corps of Engineers. During the past years, construction of park facilities has been limited to three lighted ballfields, two new toilet facilities, rebuilding the boat docks, and the installation of playground equipment, picnic tables and Kiwanis Park and Fountain. Park improvements are confined to the Nebraska side from the east leg around to about a third of the way down the western leg. The remainder of the park, including all public lands on the Iowa side, still await improvement. The City of Carter Lake has acquired approximately 160 acres for development of a golf course on the west leg of Carter Lake in Iowa.

PRESENT AND PROSPECTIVE LAKE USE

PRESENT USE

Although Omaha has parks scattered throughout the city providing picnicing facilities, Carter Lake is the only lake within the metropolitan limits providing boating, skiing, and fishing. See attached map. The only comparable nearby area is Lake Manawa in Iowa about a mile south of Council Bluffs. Activities at other public and private lakes within commuting distance of Omaha are confined to swimming, fishing and no-wake boating, thereby increasing the boating pressures on the few available sites. Stabilization of the Missouri River channel and flows has encouraged river use by the larger inboard motor craft, but the river is still too dangerous for smaller outboards and waterskiing. These sports are confined to Carter Lake.

POTENTIAL PLANS OF IMPROVEMENT

Omaha's Park System is part of an overall regional network. This regional system is buttressed by state parks and recreation areas in the eastern part of the state. However, while the Omaha and Lincoln metropolitan areas contain nearly 40% of the Nebraska population, they have a disproportionately small share of the state's major park resources - The appendix to this report contains visual aids excerpts from the SCORP report dealing with user surveys.

In 1973 Nebraska State Comprehensive Outdoor Recreation Plan (SCORP) documented this deficiency. SCORP stated that in 1972 the Omaha metropolitan region had 9,525 acres of easily accessible park land, including City parks. Yet, the metropolitan area needed 37,212 acres, a shortage of 27,717 acres. SCORP projected a 1980 demand at over 67,000 acres.

The plan noted a shortage of facilities for picnicing, camping, water recreation, hiking and biking. It stated that while the Papio flood control program around Omaha would produce major recreational sites in the metropolitan area, there would still be a major park shortage in the area. Thus, SCORP proposed acquisition and development of the state parks near Omaha; and expanded use of floodplains for linear parks; and development of

then south to Carter Lake, when the level of the lake water needs to be increased. The existing Barge Channel is proposed to be used as a detention lagoon for removing Missouri River sediment prior to its entrance into Carter Lake. The U.S. Corps of Engineers has estimated annual accumulation of sediment to be approximately 116 cubic yards. The project cost estimates are as follows:

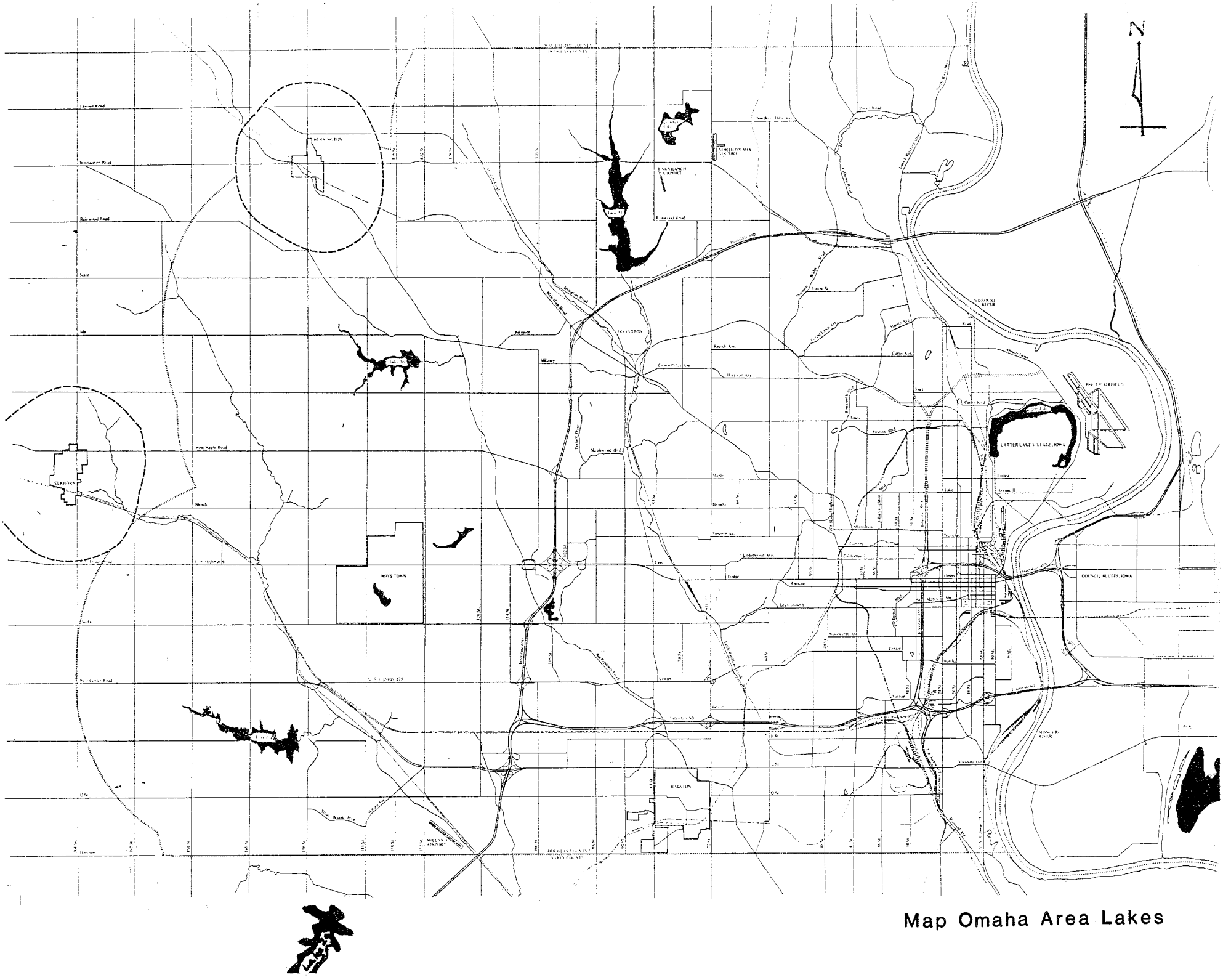
Project Cost	$951,651.00
Operation and Maintenance Cost Per Year	14,500.00

These estimates are based in 1985 dollars, and do not represent a detailed engineering study.

It was also the recommendation of the Task Force that the Cities of Omaha and Carter Lake investigate potential funding sources to implement the above mentioned solution. Those suggested by the Task Force would involve exploring the propriety and legal precedence of each city issuing a general obligation bond and for setting up a Special Improvement District to generate construction and operation and maintenance cost, either in total or as a match for possible federal and/or state funds. It was further recommended that the appropriate congressional representatives and state legislators be requested to assist in obtaining funds, due to the bi-state nature of this existing problem.

PARK DEVELOPMENT HISTORY

In 1903, Mrs. Levi Carter donated $120,000 to create a park along the lake shore in memory of her husband. The original gift provided $50,000 to purchase 303 acres of land, $20,000 for a dredge, and $10,000 annually for five years to operate the dredge for filling and improving the land. Subsequent donations eventually increased the gift to over $400,000. Administration of the area was undertaken by the City of Omaha, but interest in improving the recreational potential of the area lagged until the middle of the 1920's when the deterioration of the lake forced the establishment of a dredging and pumping program. Shore facilities continued to be neglected until 1935 when revived public interest resulted in development of a new plan of development. To permit utilization of federal funds for improvement in both Nebraska and Iowa, administration of the area was turned over to the Carter Lake Development Society, a non-profit organization incorporated under special authorization of the State of Nebraska, controlling all except one-third of a mile of shoreline. From 1935 through 1937 federal funds through the Civilian Conservation Corps and Works Progress Administration were expended for the development of recreational facilities and improvement of the park area including the construction of stone bath houses, picnic facilities and new park roads, removal of undesirable obstructions from the lake and shore area, improvement of the beaches, installation of water and sewer lines, landscaping picnic and recreational areas, and remodeling the boat docks and landing facility. With the termination of these programs in 1937, development again reverted to local interest. The Carter Lake Development Society, which was dependent upon local contributions, ceased operation and turned its rights over to Omaha and the town of Carter Lake. Little was accomplished towards



Map Omaha Area Lakes

the Missouri River environment. Attached is a proposed City of Omaha Bond Issue in which monies, $300,000, are designated for improvements in Carter Lake Park. This is in addition to the annual operation and maintenance of the upkeep of Carter Lake Park.

PREVIOUS STUDIES

The National Park Service in a report dated February 25, 1957, estimated that Carter Lake is primarily of local significance and does not attract visitors beyond approximately a ten mile radius. This is roughly the metropolitan area of Omaha-Council Bluffs, including the suburban towns of Bellevue, Ralston, Irvington and Papillion in Nebraska. The preliminary 1960 census figures indicated the population about 456,500 for this area. The 1980 census figures indicated the population is now 569,614 for this area.

In the above mentioned report, the National Park Service also estimated that 314,000 persons enjoyed the recreation, boating and fishing facilities of the lake during 1956. Similarly, in a report dated October 27, 1959, the Bureau of Sport Fisheries and Wildlife estimated lake fishing at approximately 10,000 fisherman-days annually. Use of the area is quite heavy, especially on weekends and is rapidly approaching the limit of the present facility. Little has changed in the park use and no recent studies are available except for a very cursory study conducted by the City of Omaha park caretaker that indicates the park area and Lake are still actively used. See Appendix.

Studies by the National Park Service indicate that even with full development this project would remain of local significance and would not attract visitors from beyond the present limits. However, development of the recreational potential would encourage a greater percentage of the Omaha-Council Bluffs residents to use the facilities at present. The National Park Service estimates that with full development the park could double its capacity visitor-days annually. The Bureau of Sport Fisheries and Wildlife has indicated that reserving area for fishing only and adding fish at tractors could increase the fisherman-days by 8,000 annually. Pleasure boating in the future would probably be a continuation of the present trend and would be confined to high speed outboard motorboats adaptable to towing water skiers.

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CARTER LAKE TASK FORCE STUDY
ALTERNATIVES FOR CONTROLLING WATER LEVEL IN CARTER LAKE

After careful review of the area and existing facilities and after several discussions with the Public Works Department, Design Division Engineers, it would appear there are five possible alternatives for controlling the water level in Carter Lake.

It was the opinion and recommendation of the Technical Committee of the Carter Lake Task Force Committee that any alternative considered must address both the problem of low and high water levels in Carter Lake.

The following is a very brief explanation of each alternative and the estimated cost in 1985 dollars.

Please remember these are very preliminary figures and do not represent a detailed engineering investigation or study of each alternative.

All five (5) alternatives are feasible and have the ability to be phased into operation to allow for on-going evaluation.

ALTERNATIVES

There are five alternatives, and these are made up of various options. Some options are for removing water from Carter Lake while the other options involve bringing water into Carter Lake.

The three options for removing water from Carter Lake are designated by a suffix "o", i.e. Option Ao, Bo and Co.

Option Ao is a gravity sewer that would convey water from Carter Lake to the Storz Expressway Pump Station for discharge to the Missouri River.

Option Bo involves a pump station at Carter Lake and forcemain to convey water from Carter Lake to the O.I.F. (Riverfront Park) Pump Station which in turn is then pumped to the Missouri River.

Option Co involves constructing a 54 inch diameter gravity line to the existing Eppley airfield South Pump Station where it would connect to new proposed 54 inch drainage line to be constructed as part of Phase I work by 1987 as part of the Airport's plan to divert all drainage water from Carter Lake to the Missouri River.

NOTE:

The present method of pumping water from Carter Lake into the City Sewer System is not a viable option to be considered since by Administrative Order from the Nebraska Department Environmental Control the City of Omaha is to discontinue this practice by January, 1987.

There are several options for bringing water to Carter Lake and these will be designated by the Suffix "i".

Option Ai, Option Bi and Option Ci.

Option Ai. This option involves pumping water, from the Missouri River at 16th Street extended, into an existing storm sewer system, which ultimately would flow by gravity to an existing Lagoon in the northwest corner of Carter Lake. This option has previously been used in the past (1960) as a method for bringing water into Carter Lake using a portable pump and irrigation piping.

Some modifications would need to be made for present use, including a new pump station 600 lineal feet of forcemain, a diversion and gate structure at the Storz Expressway drainage line and rehabilitation of the existing lagoon in the northwest corner of Carter Lake.

Option Bi. This option is similar to Option Ai except the river water would be diverted to the existing Storz Expressway East Detention Cell and then pumped to Carter Lake via a new 54" diameter forcemain, south along 3rd Street, to Carter Lake. This Option Bi proposes to use the Detention Cell as a sedimentation lagoon during dry weather and would require approval of other agencies such as the Nebraska State Highway Department and the Federal Highway Administration.

A plan of operation would need to be developed to eliminate any conflict of use and assure availability of the Detention Cell during wet weather events for drainage of storm water falling on the expressway.

Option Ci. This option involves pumping water from the Barge Channel at Ida Street back into the Storz Expressway 54" diameter discharge forcemain to a point at 2nd Street and Hartman Avenue where it would connect to a new 54" forcemain in 3rd Street and thence south to Carter Lake. This Option proposes to use the existing barge channel as a detention lagoon for removing sediment from the river water prior to pumping to Carter Lake and would involve rehabilitation and modification of this barge channel for use as a lagoon.

ALTERNATIVES - COST ESTIMATES

ALTERNATIVE 1 - Ao & Ai (See attached drawing Alternative 1)

Option Ao - Construct a 54 inch diameter gravity line from Carter Lake north to the Storz Expressway Pump Station at 2nd and Hartman Avenue and use the Storz Pump Station to pump water to the Missouri River.

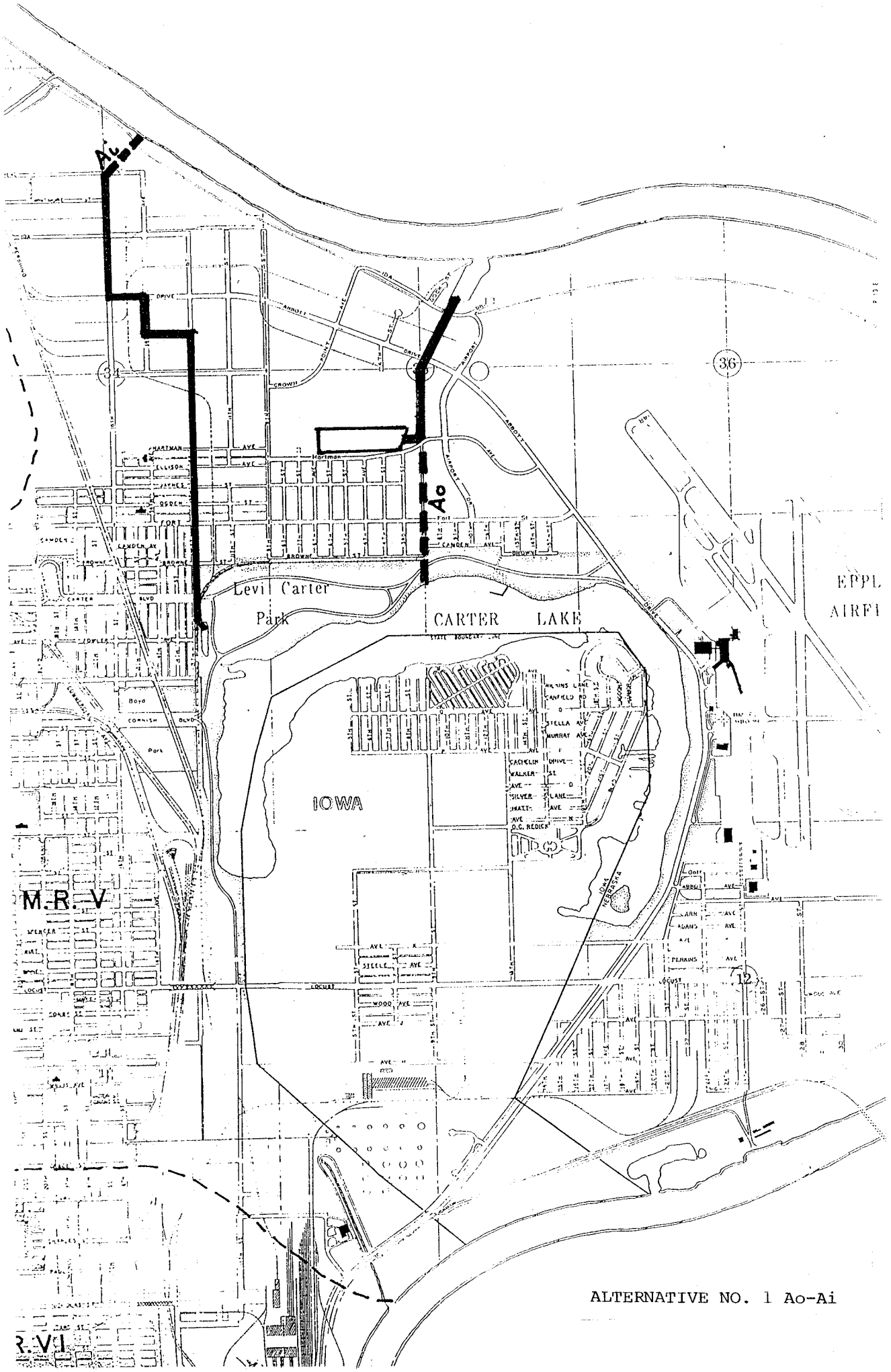
54 inch diameter forcemain -- 2800 lineal feet from Carter Lake to point at 2nd Street and Hartman Avenue and thence to Storz Pump Station	
2800 L.F. x $150.00 per L.F. =	$420,000.00
Carter Lake Inlet and Outlet Structure and Gate In Storz Pump Station	25,000.00
Estimated Cost Gravity Line	445,000.00
Contingency 10%	44,500.00
Estimated Total Capital Cost	$489,500.00
Operation and Maintenance (Storz Pump Staton)	
Electric	$ 2,150.00
Contract Maintenance	1,250.00
Labor - 250 hours x $15.40 per hour	3,850.00
	$ 7,250.00 per year

Option Ai. Construct a pump station on the bank of the Missouri River at 16th Street extended and pump water to the northwest Lagoon in Carter Lake using the existing storm sewer system. The quantity of water pumped is limited by the existing 36" diameter CMP in the system to 3800 GPM. At the intersection with the new Storz Highway Drainage System, a new diversion and gate structure would be needed to permit uninterrupted flow to Carter Lake from the Missouri River Pump Station as well as storm drainage from the Storz Highway Drainage System itself.

Option Ai.

Pump Station (3800 GPM)	$ 50,000.00
36" diameter forcemain 600 L.F. x $125.00 per L.F.	75,000.00
Inlet Structure	25,000.00
Estimated Forcemain and Pump Station	$150,000.00
Diversion and Gate Structure at Storz Highway	50,000.00
Renovation of Lagoon at Carter Lake	
800 x 120,000 square feet = 2.75 acres	
5.50 x 45,000 cubic yards =	$247,500.00
Estimated Capital Cost	$447,500.00
10% Contingency	45,000.00
Total Capital Cost	$492,500.00
Operation & Maintenance	$ 7,250.00 per year

An allowance should be made for annual maintenance and repair of the storm sewer system from 16th Street and Perry Street South to Carter Lake since this sewer is a corrugated metal pipe and in existence for approximately thirty (30) years. I would estimate annual maintenance at $2,000.00 per year.



ALTERNATIVE NO. 1 Ao-Ai

Advantages - Alternative No. 1 Ao - Ai

The gravity overflow line provides an automatic level control for high water. When the lake reaches a predetermined level, the lake water will overflow into this 54" line and flow to the Storz Expressway Pump Station. High water level in the wet well of the Storz Pump Station activates the pumps.

Using existing pumping facilities reduces capital costs.

Large capacity pumps in the Storz Pump Station permits rapid removal of water during severe wet weather events.

Water is only pumped one time in either direction.

Water is available in unlimited quantities and is available at all times.

Water from the Lagoon (Barge Channel) would be a high quality water.

Disadvantages - Alternative No. 1 Ao - Ai

The existing storm sewer system is more than thirty years old and would eventually need to be replaced or be involved in high maintenance. The 36" diameter CMP restricts the amount of flow to the lake to 3800 GPM's.

The existing lagoon in the northwest corner of Carter Lake would need rehabilitated and enlarged.

A new pump station needs to be built on the Missouri River at 16th Street extended and a 600 lineal foot ± forcemain. Rights-of-way would be needed for the station and forcemain.

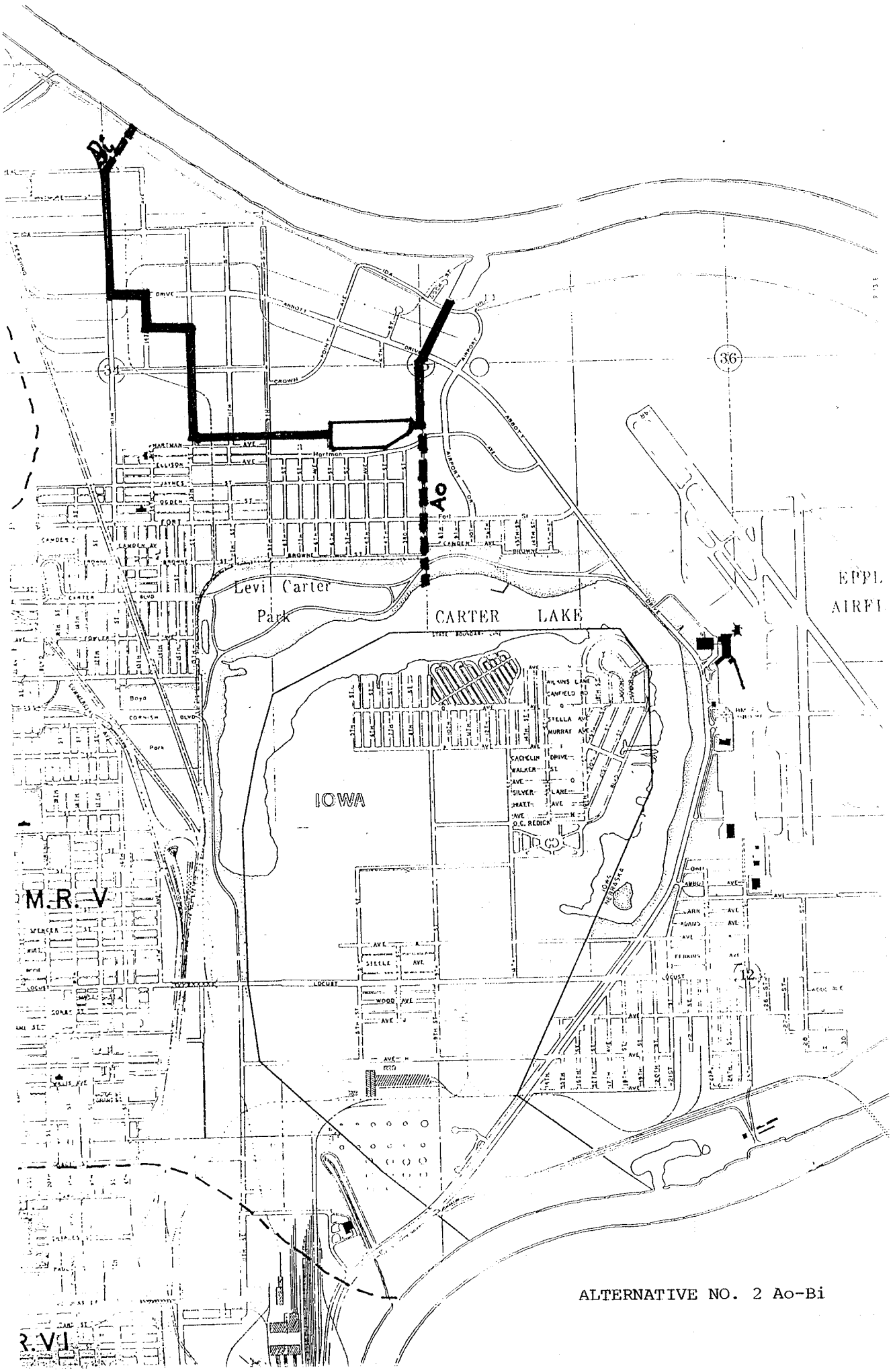
A permit also would be required from the U. S. Corps of Engineers for the pump station on the river bank. Easements through the park area for the 54" force main sewer also would be required from the Parks Department.

A diversion and gate structure is needed at the Storz Expressway drainage line to redirect the flow of water to Carter Lake.

Periodic maintenance of the lagoon would be required.

ALTERNATIVE NO. 2 - Ao - Bi (See Attached Drawing)

Option Ao - construct a 54" diameter forcemain line from Carter Lake to the Storz Expressway Pump Station at 3rd Street and Hartman Avenue. This line would function both as a gravity line to take water from Carter Lake and also as a forcemain to bring water into Carter Lake.



ALTERNATIVE NO. 2 Ao-Bi

54" Diameter Forcemain - 2800 lineal feet from Carter Lake to a point at 2nd Street and Hartman Avenue and thence to Storz Pump Station.

2800 L.F. x $150.00 per lineal foot	$420,000.00	
Inlet and Outlet Structure and Gate in Storz Pump Station	25,000.00	
Estimated Forcemain-Gravity Line Cost	$445,000.00	
Contingency - 10%	44,500.00	
Total Estimated Capital Cost	$489,500.00	
Operation and Maintenance Storz Pump Station		
Electric	2,150.00	
Contract Maintenance	1,250.00	
Labor - 250 hours at $8.00 per hour	3,850.00	
	$ 7,250.00	per year

Option Bi - Construct a pump station on the bank of the Missouri River at 16th Street extended and pump water to Carter Lake using the existing storm sewer system. The quantity of water pumped is limited by the existing 36" diameter CMP in the system to 3800 GPM. The flow would go to the Storz Expressway East Detention Cell where sediment would be removed prior to pumping the water to Carter Lake via a new 54" diameter Force South to Carter Lake.

Pump Station (3800 gallon per minute)	$175,000.00	
600 L.F. Forcemain	90,000.00	
Inlet Structure	25,000.00	
Total Estimated Capital Cost	$290,000.00	
Operation and Maintenance - Storz Pump Station	7,250.00	per year
Missouri River Pump Station	3,400.00	
Total Estimated O & M	$ 10,650.00	per year

Lagoon Maintenance		
1 Track Loader	$1.40	per cu. yd.
12 Yard Dump Truck - 3 mile haul	$2.50	per cu. yd.
	$3.90	per cu. yd.
Use $4.00 per cubic yard		
$4.00 per cubic yard x Est. 300 cubic yards per year =	$1,200.00	per year

Advantages - Alternative No. 2 - Ao - Bi

The gravity line provides positive method of controlling Carter Lake high water level.

Use of existing Storz Pump Station - reduces capital costs.

The existing use of the Storz Pump Station for both in and out needs is the most efficient use of existing pumping facilities and in addition will mean lower O and M costs.

Use of existing Detention Cell as a Lagoon to remove suspended matter.

Disadvantages - Alternative No. 2 Ao - Bi

Existing storm sewer is old and may require high maintenance or replacement.

A 36' diameter section restricts the quantity of flow to 3800 GPM.

Using Detention Cell committed to another purpose may present a conflict of use.

May need federal and state approval.

It would be necessary to pump water two times to get water into lake.

ALTERNATIVE NO. 3 Ao & Ci (See Attached Drawing)

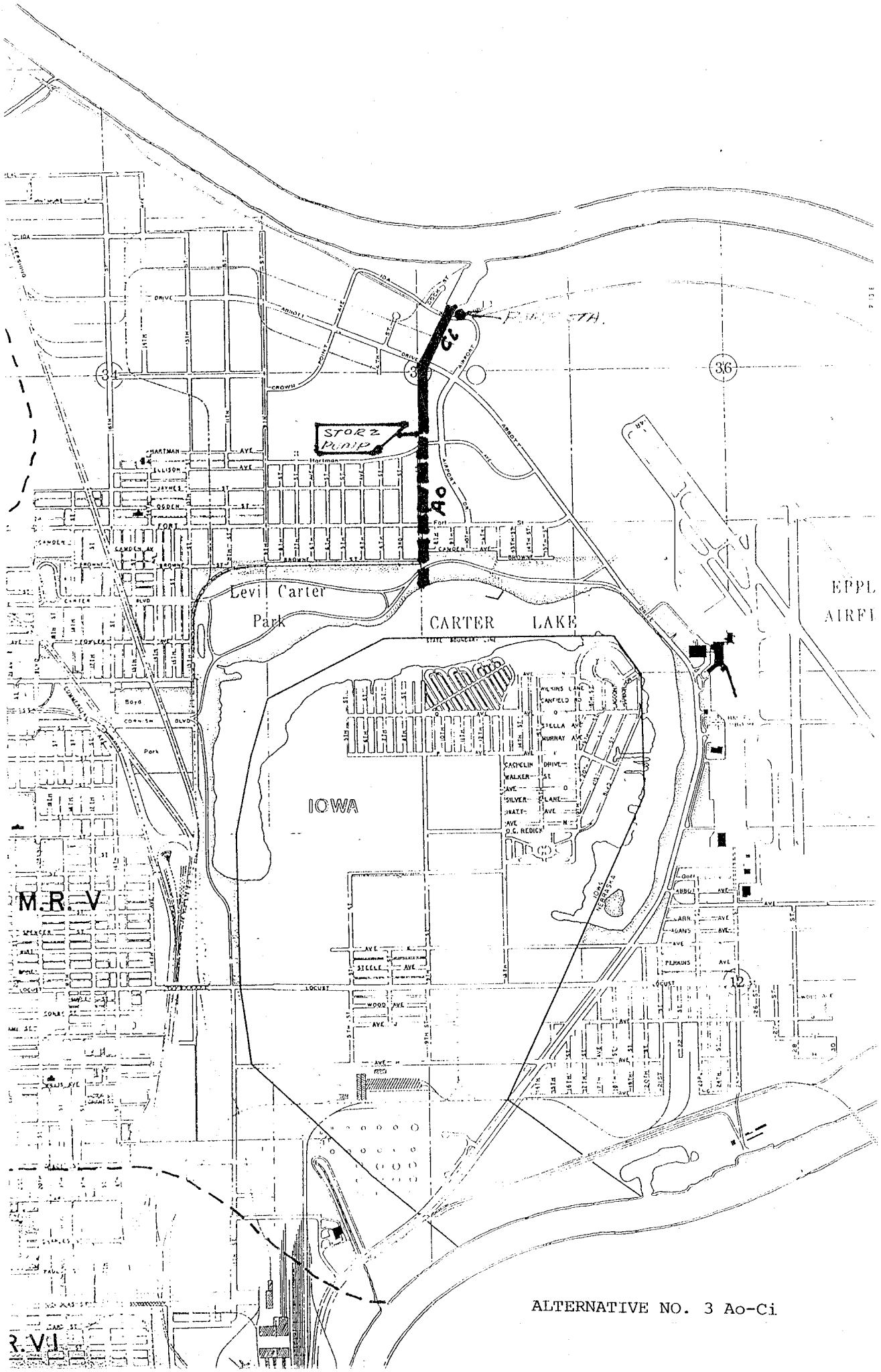
Option Ao - construct a 54" diameter gravity line from Carter Lake North to the Storz Expressway Pump Station at 3rd Street and Hartman Avenue. This line while functioning as a gravity line to take water out of Carter Lake would be constructed as a forcemain in the event water had to be pumpted into Carter Lake.

54" Diameter Forcemain - 2800 lineal feet from Carter Lake to point at 2nd Street and Hartman Avenue and thence to Storz Pump Station.

2800 lineal feet x $150.00 per L.F. =	$420,000.00
Inlet and Outlet Structure and Gate in Storz Pump Station	25,000.00
Estimated Cost Forcemain-Gravity Line	$445,000.00
Contingency - 10%	44,500.00
Total Forcemain - Gravity Line Cost	$489,500.00

Oeration and Maintenance	
Storz Pump Station - Electric	$ 2,150.00
Contract Maintenance	1,250.00
Labor - 250 hours at $8.00 per hour	3,850.00
	$ 7,250.00 per yr.

Option Ci - Use of existing O.I.F. (Riverfront Park) Pump Station on the bank of the Missouri River at the Barge Channel and pump river water into Carter Lake using as a common forcemain, the Storz Expressway Drainage Pump Station Forcemain to a point approximately located at 2nd Street and Hartman Avenue where it would be connected to the Option Ao Forcemain - a total distance of approximately 5,400 lineal feet.



ALTERNATIVE NO. 3 Ao-Ci

Barge Channel Inlet Structure and Pipe	$ 75,000.00
Three Control Valves	45,000.00
	$120,000.00

Lagoon for Sedimendation - O.I.F. Barge Channel

$\frac{100 \text{ sq. ft.} \times 5 \text{ ft.}}{27}$ = 18,500 cu. yds.

18,500 cu. yds. x $5.50 per cu. yd. =	$221,850.00
Construct Barge Channel Dike at Missouri River	52 500.00
Total Estimated Capital Cost	$274,350.00

Operation and Maintenance Pump Station + Lagoon (Annual Est. Grit Settlement from River Water=116 cu. yds.)	$ 7,250.00

Advantages - Alternative No. 3 Ao - Ci

The maximum economical uses of existing pumping facilities.

Limited amount of new piping - 2600 lineal feet forcemain.

100 lineal feet Intake.

Unlimited quantities of water available at all times.

Water in the lake can be drawn down quickly.

Water to the lake is relatively clear.

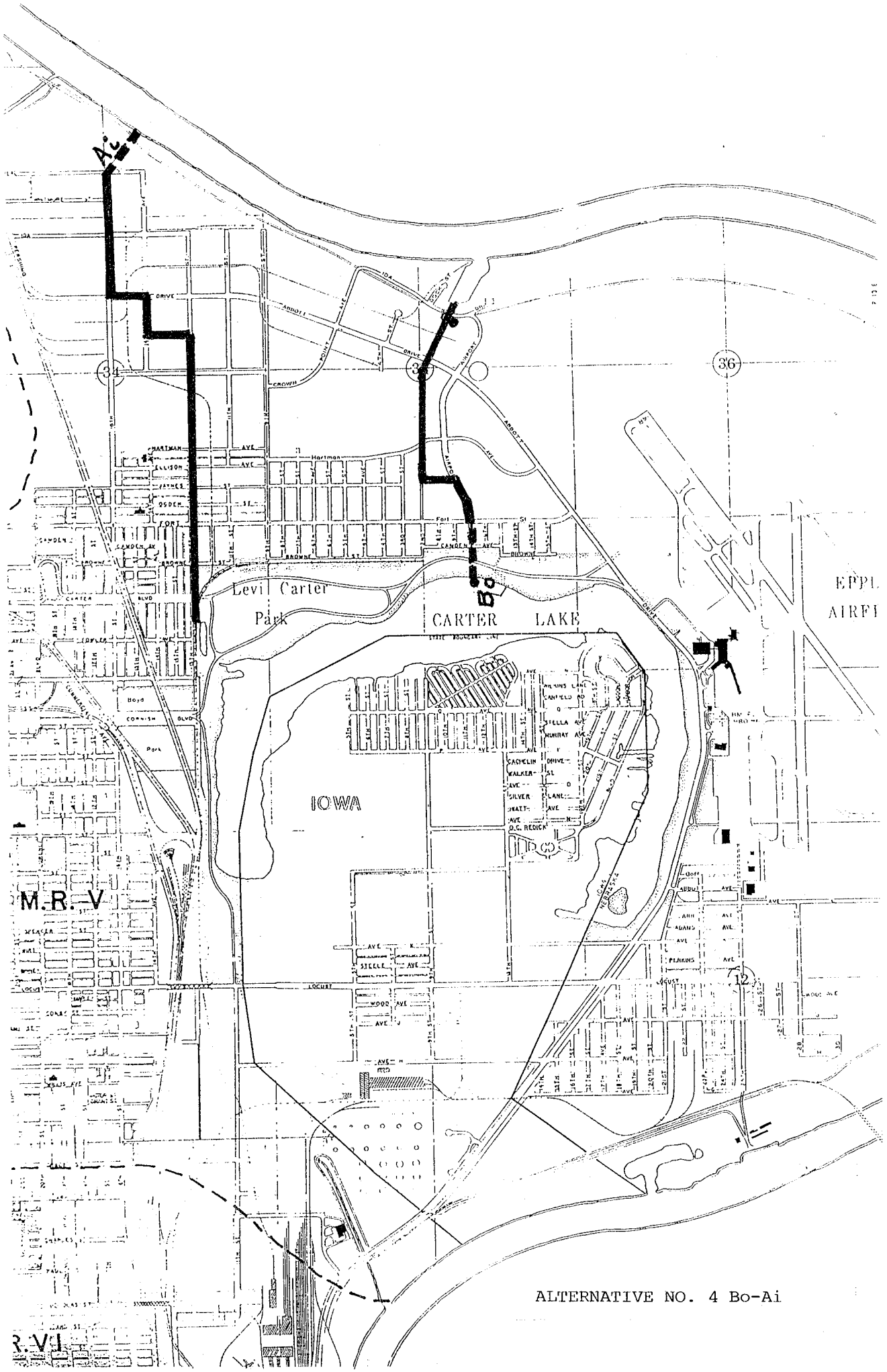
The O.I.F. Barge Channel is available as a lagoon for sedimentation purposes.

Positive control of lake level.

Disadvantages - Alternative No. 3 Ao - Ci

Use of facilities must be approved by federal and state authorities.

ALTERNATIVE NO. 4 Bo - Ai (See attached drawing)



ALTERNATIVE NO. 4 Bo-Ai

OPTION Bo - construct a 48" forcemain from Carter Lake 850 lineal feet North to Fort Street and Airport Drive and discharge into an existing 48" storm sewer system which flows to the riverfront Industrial park pump station at Ida Street and thence into the Missouri River.

Pump Station at Carter Lake (20,000 G.P.M.)	$275,000.00
Inlet Structure	25,000.00
	$300,000.00
Forcemain - 850 lineal feet	
850 lineal feet x $150.00 per lineal feet =	$127,500.00
Manhole Structure	5,000.00
Estimated Forcemain Cost	$132,500.00
	$432,500.00
Contingency - 10%	43,250.00
Total Estimated Capital Cost	$475,750.00
Operation and Maintenance	
OIF Pump Station	$ 5,400.00 per year
Carter Lake Pump Station	2,600.00
Estimated Annual O & M Costs	$ 8,000.00 per year

Option Ai - Construct a pump station on the bank of the Missouri River at 16th Street extended and pump water to the Northwest lagoon in Carter Lake using the existing storm sewer system. The quantity of water pumped is limited by an existing 36" diameter CMP in the system to 3800 GPM. At the intersection with the new Storz Expressway Drainage System, a new diversion and gate structure would be needed to permit unterrupted flow to Carter Lake from the Missouri River Pump Station as well as storm drainage from the Storz Expressway Drainage System. Water would flow to the existing lagoon in the northwest corner of Carter Lake.

Missouri River (16th Street) Pump Station (3800 GPM)	$ 50,000.00
36" Diameter Forcemain	
600 lineal feet x $150.00 per lineal foot	75,000.00
Inlet Structure	25,000.00
Estimated Pump Station and Forcemain Cost	$150,000.00
Diversion Structure at Storz Expressway	50,000.00
Renovation of Lagoon	
800 lineal ft x $150.00 = 120,000 sq. ft. = 2.75 acres	
45,000 cu. yds. x $5.50 per cu. yd. =	$247,500.00
Estimated Capital cost	$447,500.00
10% Contingency	45,000.00
Estimated Capital Cost	$492,500.00
Option Ci - Operation Maintnance	7,250.00
Pump Station	
Allowance for Sewer Maintenance Per Year	2,000.00 per year
Estimated Annual O & M Cost	9,250.00

Advantages - Alternative No. 4 Bo - Ai

Use existing Storz Pump Station and Forcemain and the existing riverfront park storm sewer system.

Disadvantages - Alternative No. 4 Bo - Ai

Pumping water twice out of Carter Lake.

Need to construct two pump stations.

Use of existing storm sewer would require renovation and high replacement cost at later date.

Quantity of flow is restricted in the 36" diameter to 3800 GPM.

Need to renovate the existing lagoon.

Need to construct additional diversion and gate structure at Storz Drainage System pipe.

Need right-of-way for 600 feet ± and pump station at 16th Street extended.

Need right-of-way for forcemain through Carter Lake Park.

Option has high operation and maintenance cost.

ALTERNATIVE NO. 5 - Bo + Ai (See Attached Drawing)

Option Co

Construct a 54 inch diameter gravity line from Carter Lake shore east across Abbott Drive to the Eppley Airport South Pump Station a distance of 500 L.F.±. By 1987 Eppley Airfield Phase I project for controlling storm drainage runoff should be completed which involves removing all connections to this pump station and diverting them by gravity to a proposed new pump station (Locust Street Pump Station). All water would flow by gravity from Carter Lake above elevation 970.0 to the new Locust Street Pump Station and be pumped to the Missouri River.

500 L.F. x $100.00/L.F. =	$50,000.00
Inlet Structure	5,000.00
Manhole Gate Structure at South Pump Station	10,000.00
	$65,000.00
Contingency 10%	6,500.00
Estimated Capital cost	$71,500.00

Operation and Maintenance

From HD&R report, estimated Operation and Maintenance for Locust Station is $40,000 per year. $5,400.00 would approximate 13% and is comparable to estimated operation and maintenance cost of other stations in various alternatives.

Option Ai = Construct a pump station on the bank of the Missouri River at 16th Street extended and pump water to the northwest Lagoon in Carter Lake using the existing storm sewer. The quantity of water pumped is limited by the existing 36 inch drain

C.M.P. in the system to 3800 GPM. At the intersection with the new Storz Highway Drainage System a new diversion and gate structure would be needed to permit uninterrupted flow to Carter Lake from the Missouri River Pump Station as well as storm drainage from the Storz Highway Drainage System.

Pump Station (3800 gpm)	$ 50,000.00
36 inch diameter forcemain - 600 L.F. x $125.00	75,000.00
Inlet Structure at Missouri River	25,000.00
	$150,000.00
Diversion Structure at Storz Line	50,000.00
Renovation of Lagoon	
45,000 C.Y. x $5.50-cu. yd. =	247,500.00
	$447,500.00
	45,000.00
Total Estimated Capital Cost	$492,500.00
Operation and Maintenance	
Missouri River Pump Station	$ 7,250.00 per year

Advantages - Alternative No. 5 - Co - Ai

Maximum use of existing facilities

Low operation and maintenance costs

Low capital cost.

Positive control of Lake water levels.

Disadvantages - Alternative No. 5 - Co - Ai

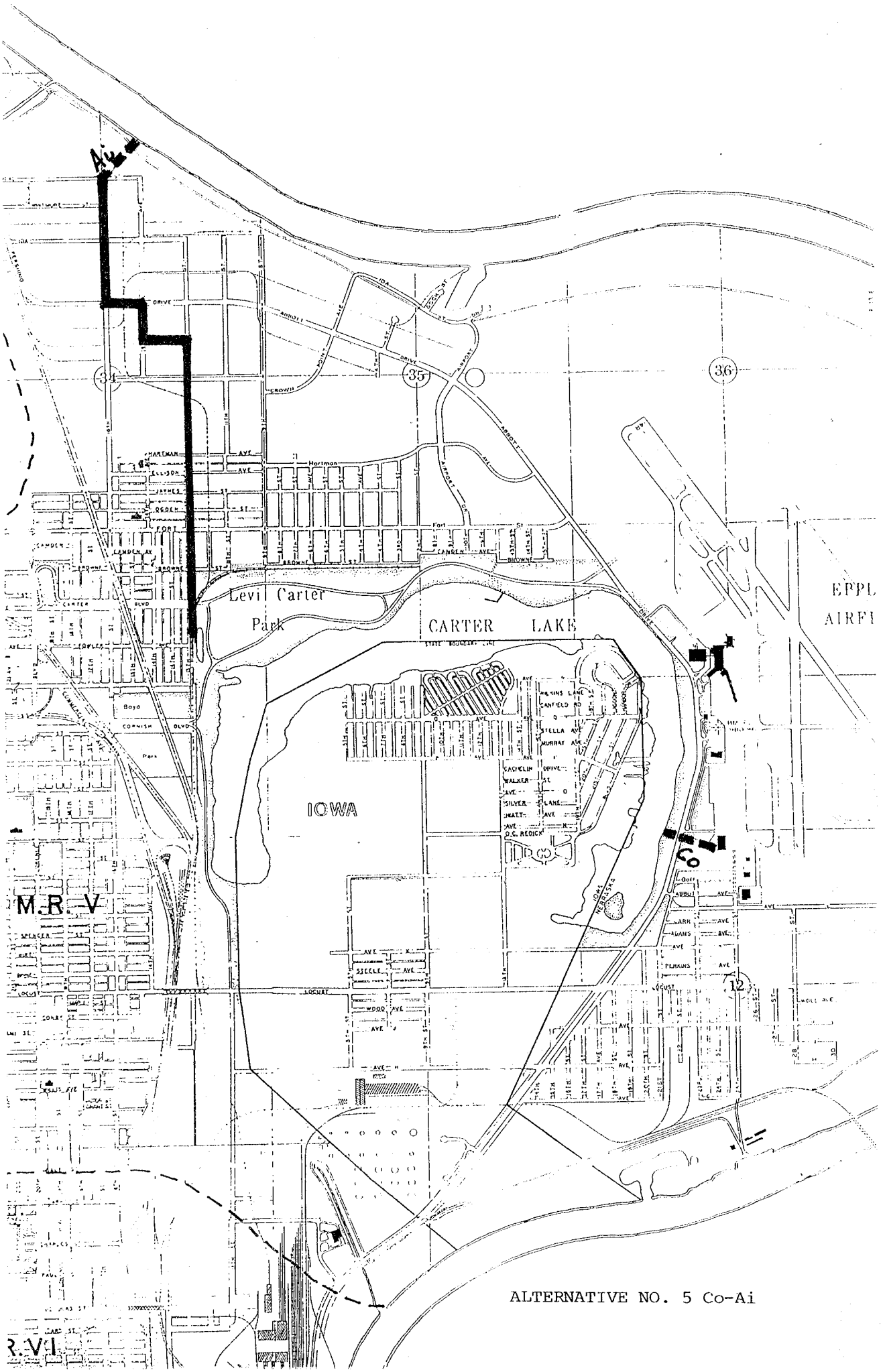
Existing 36 inch storm sewer restricts river water flow to lake.

Solution to high water problem not immediate.

Will require agreements with other agency Airports.

Will require rights-of-way at Airport.

0120w:sap



ALTERNATIVE NO. 5 Co-Ai

COST EFFECTIVENESS ANALYSIS SUMMARY
WATER LEVEL CONTROL OF CARTER LAKE

ALTERNATIVES	1	2	3	4	5	6
Item	Option Ao Option Ai	Option Ao Option Bi	Option Ao Option Ci	Option Bo Option Ai	Option Co Option Ai	
Capital Cost	Ao= 489,500 Ai= 492,500 982,000	Ao= 489,500 Bi= 290,000 779,500	Ao= 489,500 Ci= 274,350 763,850	Bo= 475,750 Ai= 492,600 968,250	Co= 71,500 Ai= 492,500 564,000	
O & M Cost 1985	9,250	10,650	7,250	10,000	7,250	
2004 Future Worth Em Pv x (1+.06)	29,666	34,156	23,252	32,071	23,252	

PRESENT WORTH COSTS

Capital Cost	982,000	779,500	763,850	968,250	564,000	
O & M Cost @ 8%	79,350	91,360	62,193	85,784	62,193	
Total Present Worth 1985	1,061,350	870,860	826,043	1,054,034	626,193	

OPTIONS

Ao Gravity Line to Storz Station and thence to Mo. River
Bo Forcemain to OIF (Riverfront Park) Pump Station and thence to Mo. River
Ai Pump Station at 16th St. & Mo. River plus Forcemain-Gravity Flow to N.W. Cor Lagoon Carter Lake
Bi Pump Station at 16th St. & Mo. River plus Forcemain-Gravity Flow to Storz Detention Cell and Pumped to Lake
Ci Riverfront Pump Station back to Carter Lake via Forcemain
Co Gravity Line to Eppley Airfield So. Pump Sta.

PROPOSED FUNDING

For purposes of comparison, capital costs as well as operation and maintenance costs are presented in summary form using present worth costs.

As previously stated, after due consideration the Carter Lake Task Force recommended alternative three as the alternative meeting all prerequisites and constraints.

PROJECT SUMMARY

Estimated Construction Cost	757,225.00
Engineering & Construction Management	75,722.00
Rights of Way	6,625.00
Present worth O+M (14,500/yr.)	112,079.00
Total Estimated Project Cost	951,651.00

Because of the Bi State nature of the facility, the following distribution graph for funding is proposed.

CARTER LAKE
WATER DIVISION
PROPOSED FUNDING OPTIONS

	WITH FEDERAL PARTICIPATION		WITHOUT FEDERAL PARTICIPATION
	(50% Federal)	(75% Federal)	(0% Federal)
1. Federal Government	$420,000	$630,000	$ -0-
2. State of Nebraska and City of Omaha	210,000	105,000	420,000
3. State of Iowa and City of Carter Lake	210,000	105,000	420,000
Total Construction Cost (Includes Construction, Easements, and Engineering Costs)	$840,000	$840,000	$840,000

APPENDIX

Section 22 Study

Planning Assistance to States

Evaluation of Lake Levels for Carter Lake, Iowa and Nebraska

Hydrology Analysis

August 1985

HYDROLOGY ANALYSIS

Table of Contents

Authority and Purpose

This report presents the results of the hydrologic study of Carter Lake, Iowa and Nebraska, which was done under the authority of Section 22 of Public Law 93-251, Water Resources Development Act of 1974, Planning Assistance to States. The hydrologic analysis was conducted by the Omaha District Corps of Engineers during the period from 1984 to 1985 at the request of the States of Iowa and Nebraska. Section 22 provides the authority for the Corps of Engineers to cooperate with a state and provide assistance in preparing comprehensive state water plans for the development, use, and conservation of available water resources.

The purpose of the hydrology study was to determine the cause of fluctuating water surface levels in Carter Lake, which have had an adverse impact on recreation and have caused some property damage due to bank erosion in the area. The effects on future Carter Lake levels caused by the Storz Freeway, which is under construction, and the planned diversion of the Eppley Airfield runoff into the Missouri River were investigated. Finally, a strategy for controlling the level of Carter Lake in the future is discussed.

Climate

The Carter Lake drainage basin is located in a typical subhumid climate. Average annual precipitation is about 30 inches per year and average lake evaporation is about 40 inches per year, as shown in Table 1.

Table 1
Carter Lake Average Monthly Precipitation and Evaporation

	Avg. Precip. (inches)	Avg. Lake Evap. (inches)	Avg. Carter Lake Volume Loss Due to Evaporation (acre-feet)
Jan	0.77	0.89	24
Feb	0.91	1.04	28
Mar	1.91	1.56	42
Apr	2.94	2.08	75
May	4.33	5.58	149
Jun	4.08	6.26	167
Jul	3.62	6.47	172
Aug	4.10	5.58	149
Sep	3.50	4.10	110
Oct	2.09	3.35	90
Nov	1.32	1.73	46
Dec	0.84	1.12	30

Description of Carter Lake Drainage Basin

Carter Lake, a horseshoe-shaped oxbow of the Missouri River, is bounded by the Missouri River on three sides. It is located in northeast Omaha adjacent to Eppley Airfield and is primarily used for recreational purposes. No streams contribute to Carter Lake; however, Carter Lake drains approximately 1,925 acres (not including 320 acres of lake) of both urbanized and undeveloped land. Before the addition of the Omaha north interceptor sewer, Carter Lake also drained land situated along the high bluffs located just west of its present drainage basin.

Present Conditions. The soil type is part of the Albaton-Haynie association which consists of a deep, poorly drained, nearly level clayey and silty soil. Land use classification within the basin has been divided into four different categories with each land use consisting of one or several different soil series. The land uses along with their respective soil series is shown in Table 2 below.

Table 2
Carter Lake Land Use and Soil Types

		Approximate Area (acres)	Percent Impervious (%)
1.	Undeveloped Lands		
	a. Albaton (Ab)	192	10
	b. Albaton (Ac)	403	10
	c. Sarpy (Sp)	223	10
2.	Residential Lands		
	a. Albaton (Ab)	143	30
	b. Carr (CA)	283	35
3.	Airport		
	a. Cut and fill	626	60
4.	Commercial		
	a. Cut and fill	55	40
		1,925	Basin avg. 32.5 %

Planned Development. The future conditions within the drainage basin consist of the addition of the Storz Freeway and the proposed diversion by Eppley Airfield of storm runoff from Carter Lake to the Missouri River. The proposed diversion by the Airfield would eliminate item No. 3 in the table shown above. This would decrease the contributing drainage area to 1,299 acres and would also decrease the percent impervious to 18.9 percent.

Hydrologic Analysis

The hydrologic analysis conducted by the Corps of Engineers consisted of two parts: (1) determination of the causes leading to high and low water conditions and (2) the future effects that the construction of the Storz Freeway and the proposed diversion of Eppley Airfield storm runoff from Carter Lake into the Missouri River would have on lake levels. In order to try to delineate the causes of high water conditions in the lake, lake level data were obtained from the City of Omaha, so that a time history plot showing lake levels, Missouri River stages, and precipitation could be constructed. In addition, readings from Corps of Engineers piezometers located along Ninth Street north of Carter Lake were superimposed on this plot. Data were available for the years 1980 and 1981. The results of this analysis show that Carter Lake levels are very slow in responding to river stages; however, it was noted that lake levels were sensitive to rainfall runoff from the drainage basin. The plot showed several periods of rapidly increasing river stages with no effect and even perhaps a decrease in lake levels. Periods of heavy rainfall showed a sharp increase in lake level and, consequently, the need to pump water out of the lake by the City of Omaha during three periods in the year 1980. The conclusion that can be drawn from a comparison of these data is that Carter Lake responds slowly to changes in Missouri River stages. A report published in 1960 by the Corps of Engineers entitled Review Report on Navigation and Other Purposes, Carter Lake, Iowa and Nebraska, November 1960 supports this conclusion. It was concluded in that report that there is a silt layer on the bottom of the lake that varies in thickness from 3 to 19 feet. This silt layer consists of a fat clay material that is relatively impervious to seepage and overlays a poorly graded, pervious silty sand layer. Laboratory results from soil samples taken from bore holes in the lake reveal that the material is a fat clay (CH) with a liquid limit of 61 and a

plastic index of 41, which is relatively impervious to seepage flows. The report goes on to state that "the effect of any seepage inflow into the lake is partially offset by other losses and therefore results in only minor increases in lake level."

It was determined that the Storz Freeway, which is under construction and located just north of Carter Lake, will have a minor impact on future lake levels. The land situated north of the freeway does not contribute runoff to Carter Lake because it is situated in a topographical depression.

On the other hand, Eppley Airfield storm runoff is a major contributor to lake levels. The Storage Treatment Overflow Runoff Model (STORM) developed at the Hydrologic Engineering Center (HEC) in Davis, California, was used to model the Carter Lake drainage basin. The model was used to simulate the runoff characteristics of the basin during a 21-year time interval in order to analyze present and future lake level conditions. Runoff is determined by an hourly application of the Soil Conservation Service (SCS) runoff equation allowing for antecedent moisture conditions. Factors used in the program deal with soil infiltration rate, deep percolation rate, detention storage, and soil moisture capacity. Initial values for these factors were obtained from the Soil Survey of Douglas and Sarpy Counties, Nebraska (published by the United States Department of Agriculture SCS). The STORM model was calibrated using lake level readings along with precipitation input for several periods in 1980 and 1981. Generally, maximum infiltration rates ranged from 2 to 4 inches per hour, deep percolation rates were .02 inch per hour, maximum soil moisture storage capacities ranged from 5 to 10 inches, and depression storages were 1 inch.

Groundwater seepage into and out of Carter Lake was determined by using a water balance for the years 1980 and 1981 and the figures are as follows in Table 3.

Table 3
Carter Lake Monthly Groundwater Seepage

Month	Average Seepage (acre-feet)*
Jan	- 110
Feb	- 150
Mar	- 150
Apr	0
May	+ 75
Jun	+ 75
Jul	+ 75
Aug	+ 75
Sep	0
Oct	0
Nov	0
Dec	- 110
TOTAL	- 220

*A plus sign denotes seepage into the lake while a minus sign denotes seepage out of the lake.

The percent impervious ranged from 32.5 percent of the watershed for the present conditions to only 18.9 percent for the future conditions with all of the airport runoff diverted. This reduction of 13.6 percent in impervious area is due to the large percent of impervious areas on the Eppley Airfield grounds from which drainage will be redirected.

Planned Development Impacts

In order to project Carter Lake water levels, a long period of precipitation records was required as input to the STORM program. Precipitation data for the years 1949 through 1969 which was already available on magnetic tape was used for this period of record. The STORM program was run with both the present and two future conditions for this time period. The future conditions consisted of two cases: the first was with all of the airport storm runoff diverted, and the second was with the south half of the airport storm runoff diverted and the north half still contributing to Carter Lake. This will be the case when Eppley Airport completes the first phase of

its planned diversion of runoff from Carter Lake into the Missouri River. The results of the three computer runs were as follows. Under the present conditions, there is an excess volume of runoff into Carter Lake which necessitates periodic pumping from the lake to avoid flooding. With the contribution of the entire airport drainage area to Carter Lake eliminated, a low water problem would exist which would necessitate pumping water in from an outside source, most likely the Missouri River. Under this condition, it would also be necessary to make emergency provisions to be able to pump water out of the lake in the event of a large runoff event. With only the southern half of the airport area eliminated from contributing to Carter Lake, a minor high water problem would exist necessitating pumping from Carter Lake on a more limited basis than with present conditions.

Evaluation of Methodology

The analysis presented here is based on the calibration of the STORM program to hydrologic records for the years 1980 and 1981. These years were selected primarily because of data availability and the limited pumping requirements. In the calibration studies, all leftover quantities of water not measured were assumed to be representative of the seepage factor. This factor was then used for the model simulation for the period of record from 1949 to 1969.

When, however, data from the years 1983 and 1984 were examined, it was seen that a much larger amount of apparent seepage into the lake had occurred. It can logically be assumed from a water budget developed for each of these years that much of the water pumped out of Carter Lake by the City of Omaha to control basement flooding was seepage into the lake from an apparent high groundwater table. The exact cause of the high groundwater table is not known, but it is evident from the Carter Lake pumping records and lake level records that pumping continued during periods of low precipitation without

lowering the lake level significantly. Under this condition, even if the airport storm runoff were diverted, pumping would still be required to maintain the lake at desirable levels.

Conclusion

It has been shown that either a high water or a low water problem could exist after the airport drainage area is eliminated as a contributor to Carter Lake, depending on the data used in the analysis. These two seemingly conflicting results are both valid. The differences arises because the data used in each case were obtained from years which had different groundwater conditions. The lack of sufficient data to carry out a hydrologic analysis for other years prohibits any conclusions as to which groundwater situation is most likely to occur. Therefore, the final conclusion as to what measures will be necessary to control future water levels in Carter Lake is that the proposed pumping system should be able to both bring water into Carter Lake as well as take water out of the lake.