City of Massillon
Sippo Reservoir Dam
Hydrologic and Hydraulic Study

January 1998

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INTRODUCTION

The City of Massillon authorized **ms consultants inc**. to perform a hydraulic and hydrologic study for the Sippo Reservoir. The reservoir is located along Hankins Road and Wales Road, just north of Lincoln Way. The intent of the study is to determine if the dam is capable of meeting the Ohio Department of Natural Resources (ODNR) criteria for passing a design year storm. The study will also identify environmental concerns and necessary environmental permits that would be needed for any improvement for the project.

ODNR has classified Sippo Reservoir as a Class 1 structure (the highest classification) since failure of the dam could result in the loss of life. This classification requires that the spillway be capable of passing the Probable Maximum Flood (PMF). For this watershed basin, the Probable Maximum Precipitation (PMP) is 34.5" of rainfall over a 72 hour period. This storm event is equivalent to a 1,000 year storm. For reference, most storm drainage structures are designed for a 25 year storm, and bridges are designed for a 100 year storm.

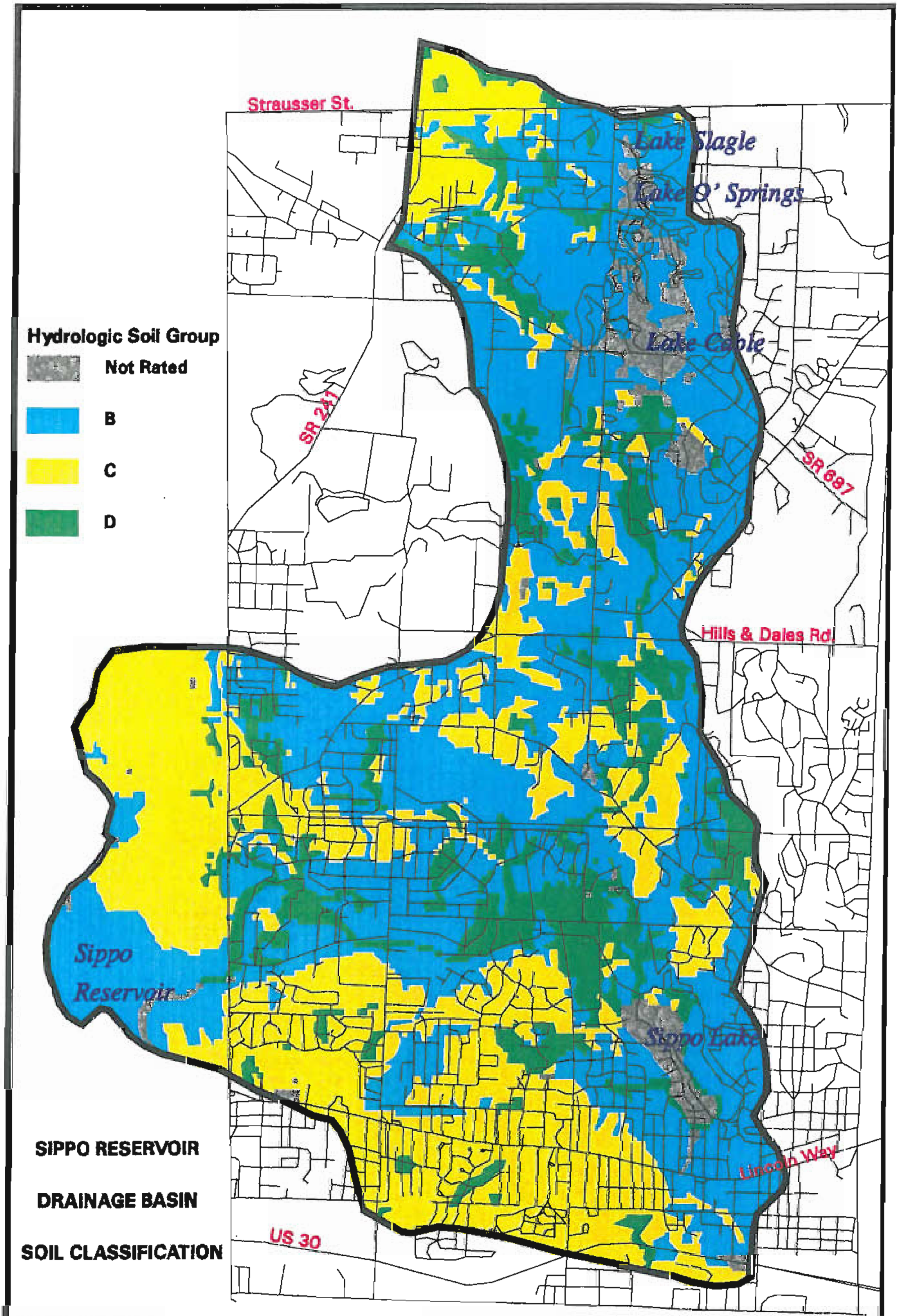
This study will utilize previous ODNR Dam Inspection Reports as historical data. An analysis of the present spillway capacity will be generated along with possible improvements to the dam to meet the ODNR criteria for the Class 1 dam.

WATERSHED DRAINAGE BASIN

Sippo Reservoir consists of a 14.9 square mile drainage basin as shown in Figure 1. The drainage basin extends from Lincoln Way on the southerly end to Strausser Street in Jackson Township on the northern end. Two series of lakes feed Sippo Creek. The lake series feeding Sippo Creek from the north is Lake Slagle which flows into Lake O'Springs which flows into Lake Cable. The lake feeding Sippo Creek from the south is Sippo Lake.

A total watershed area of 2.51 square miles flows into Lake Cable. ~~For~~ The Sippo Lake~~, the~~ watershed area is 3.10 squares miles. Thus, these two drainage basins total 5.61 square miles, which is nearly 40 percent of the total watershed. These basins are sufficiently large enough to be included in the hydraulic model for the total Sippo Reservoir basin.

Figure 1 also shows the Soils Classification for the entire 14.9 square mile basin. Areas shown in cyan consist of the "B" type soils, in yellow the "C" type soils, and in green the "D" type soils. The "B" type soils exhibit good soils permeability and absorb storm water runoff more readily than the "C" or "D" type. "D" type soils have poor permeability and storm water runoff is very high. This information was gathered from the ODNR Ohio Capability Analysis Program (OCAP).



SIPPO RESERVOIR

DRAINAGE BASIN

SOIL CLASSIFICATION

HYDRAULIC AND HYDROLOGIC MODELING

To perform the hydraulic modeling for the Sippo Reservoir, ODNR Dam Inspection Reports for Lake Cable and Sippo Lake from 1992 were used to obtain watershed information and spillway dimensions. This information was then inputted into the U.S. Army Corps of Engineers HEC-1 computer program to simulate the major flood events through the lakes.

For determining flood hydrographs, the Probable Maximum Precipitation was obtained from the HMR-52 computer program. This program generates a 6 hour unit hydrograph along with an expected peak flowtime. The computer output also generates the predicted hourly rainfall for the 72 hour period. This hourly rainfall is inputted into the HEC-1 computer program to simulate the Probable Maximum flood. As mentioned earlier, the 72 hour rainfall totals 34.5 inches of rain.

Routings were performed for the 10%, 20%, 25%, 50% and 100% Probable Maximum Flood (PMF). The 10% PMF is roughly equivalent to the 100 year storm. The 100 year storm event is typically used to set the elevation for an emergency spillway. The summary of the HEC-1 computer printout for the existing spillway is shown. This table shows that the existing spillway can safely pass the 100 year storm. However, the 100% PMF will overtop the dam which is unacceptable for ODNR criteria.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS
1.00	1001.94	1.34	128.	12485.
0.50	1001.73	1.13	121.	5907.
0.25	1001.63	1.03	117.	2637.
0.20	1001.61	1.01	116.	2097.
0.10	1000.88	0.28	91.	1097.

A summary of the HEC-1 computer run is included in the Appendix. Two computer runs are provided in the Appendix. The first run uses the height of the dam as shown in the ODNR report, which shows the 10% PMF will overtop the dam slightly. The second run shows that the embankment needs to be raised 3' to the elevation of 1002.5 to safely pass the 100% PMF. This elevation is 5.5' above the existing spillway elevation, and 0.5' below the top of the abutment wingwall at its highest point.

SIPPO RESERVOIR

It is believed that the reservoir was constructed in 1886 for the Massillon Water Company. The existing dam consists of a 36' wide rock weir (breadth of 3') located near the center of the embankment. An additional 78' of earthen embankment exists to the west of the spillway, as well as 101' to the east, brings the total length of dam to 215'. The height of the spillway is 18.9'.

Photo 1 Existing Earthen Embankment and Spillway for Sippo Reservoir

Photo 1 shows the present embankment. Notice the presence of trees on the upstream face of the dam. These trees should be removed for safety reasons. If the tree falls during a storm event, it is possible that the root structure could be undermined. Erosion of the embankment could continue and a breach of the dam could occur. It is possible that the entire earthen embankment could fail within a very short time frame.

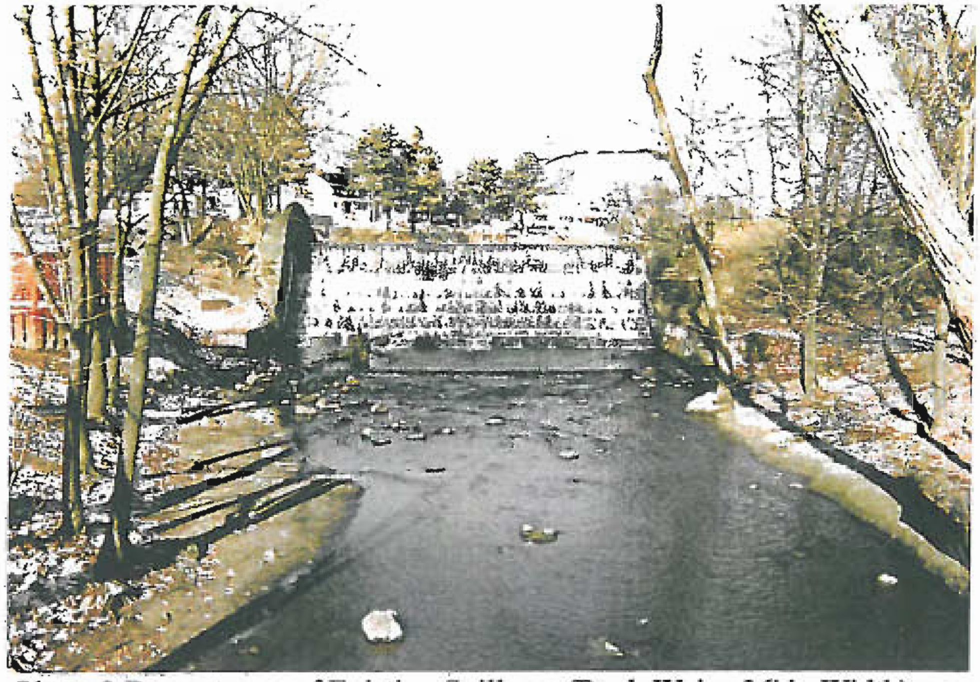


Photo 2 Downstream of Existing Spillway (Rock Weir - 36' in Width)

The overall condition of the spillway is good. There are two areas where a rock has fallen from the wall which allows erosion to occur. The two locations are along the eastern abutment wall, one at the downstream side and the other at the upstream side.

Photo 3 Close-up of spillway showing "steps" which dissipates energy

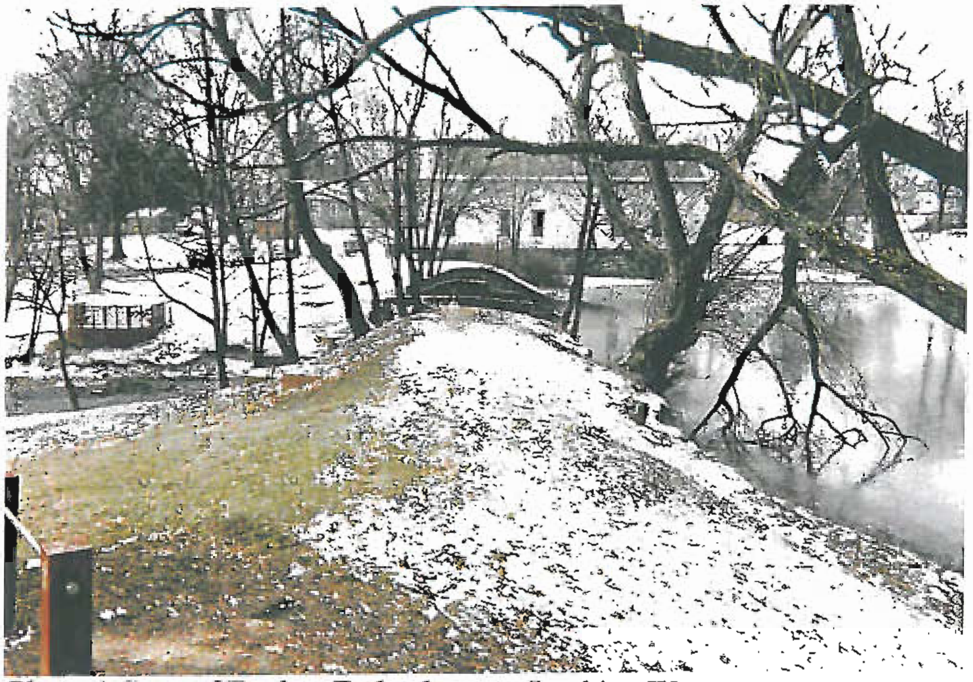


Photo 4 Crest of Earthen Embankment - Looking West

On Photo 4, notice the trees that are also present on the south side of the embankment. These trees should be removed for safety reasons as discussed previously. Also, note the present wingwall extends 30" higher than top of the embankment.

Photo 5 Eastern embankment, note trees and presence of brick wall

Photo 5 shows the presence of a 1' wide brick wall. This wall is exposed on both sides of the spillway for approximately 15'. The top of the brick wall is what ODNR used as the top of the dam. It should be determined if the wall extends for the entire length of the embankment. The embankment should also be raised above the wall since it is now possible that the water could flow over the wall, cause scour and erode the left and right sides of the spillway. This could lead to possible failure of the dam.

RESERVOIR CONDITIONS

The surface area of the reservoir is approximately 6 acres. The reservoir has the potential of being 18' depth, but the reservoir has been silted up over the years. Approximately 1/3 of the reservoir is less than 1' deep, and the majority of the reservoir being only 2' to 3' from visual observations.

The ideal water depths for reservoirs this size is a minimum of 6', with deeper pools between 10' to 12' needed for optimum reservoir conditions. Providing depths exceeding 10' will provide healthier fish habitat and control excess aquatic vegetation.

There are two methods for removing materials from the reservoir bottom, either dredging or excavation of the basin. Dredging is performed by mechanically removing material by a hydraulic dredge and pumping this material to a disposal area. Excavation of the basin requires the reservoir to be drained and the bottom is allowed to sufficiently dry to allow heavy equipment to physically remove and haul out the material. A major problem with trying to excavate this basin is the fact that the reservoir services a large watershed. The probability of removing all material in a sufficient amount of time before a large rainfall event occurs is very small. Therefore it could take a minimum of three months to excavate the bottom, however nine months to one year is more realistic for this to occur.

By dredging the reservoir bottom, the existing reservoir elevation can be maintained while the material is removed. Presently, two large dredging operations are being undertaken at Lake Cable and Sippo Lake. The procedure for dredging at these lakes is similar, but the discharged material is being handled differently. At Lake Cable, the material is being diverted into large settling basins. The basins are allowed to dry before the material is removed. This method requires a large amount of land for the settling basins.

At Sippo Lake, the discharged material is mixed with an organic polymer in a giant rotary mixer. The polymer binds the suspended solids and the effluent water enters a final polishing pond. The solids are then pumped to a basin area for final drying and disposal. For either type of dredging, the final product is a very good organic material that can be used like topsoil.

PRELIMINARY WETLAND FINDINGS AND PERMIT REQUIREMENTS

A field walk was made with the US Army Corps of Engineers (Huntington District) on November 11, 1997, to discuss the overall project and get some ideas regarding permit requirements. The field walk identified some small areas at the upstream end of the reservoir as possible wetland areas. These are at the small island in the reservoir and at a small area on the northwest side of the stream. A wetland delineation will probably be needed for this area. Since the area is below headwaters, any wetland encroachment (regardless of size) becomes a permit issue.

Generally, individual permits will be needed for whatever the City may do. ~~This~~ Their permits shouldn't be a big problem for most solutions that could be undertaken. Regulated activities include the following:

- Substantial modifications to the dam or other control structures (minor modifications could be a Nationwide permit)
- Dredging or excavation of basin
- In-lake sediment collection area
- On-stream sediment basins

Besides the Corps of Engineers permit, a 401 Water Quality Certification from OEPA will be required. For projects of this type, OEPA requirements can be more stringent than the Corps. A permit from ODNR will also be required for any work on the dam or other control structures.

SEDIMENT BASINS

Sediment basins are devices used normally upstream to reduce the amount of siltation entering into the reservoir. The material transported can include a variety of soil materials, small stones or road grit, and rocks. It is impractical to expect to design a system where all solids will be collected and a clean effluent from storm water runoff will be entering the lake. The main idea for a sediment basin would be to try to minimize the amount of material entering the lake. Res.

As mentioned previously, two large dredging projects are being undertaken at Sippo Lake and Lake Cable. Over ½ million cubic yards of material are expected to be removed from these two lakes. A benefit of this removal is the fact that there will be new areas for material to accumulate in these lakes before it can enter Sippo Reservoir. These two lakes have nearly 40% of the drainage basin passing through their spillways.

With new construction activities, soil and erosion control plans are required to minimize the amount of sediment leaving the site and entering downstream watercourses. This practice has a beneficial effect on Sippo Reservoir since there will be less sediment entering the lake, in comparison to prior construction practices.

Reviewing topographic maps of the Sippo Reservoir drainage basin, there is no apparent location for a sediment basin to be conveniently located on Sippo Creek. A basin could be constructed, but this would require a large amount of material to be excavated along the stream for future storage areas. This can get quite costly and require additional environmental permits.

For the size of Sippo Reservoir, it is more prudent to implement a clean street maintenance program and keep culverts and catch basins cleaned periodically. This will further enhance the longevity of the reservoir. However, it should be expected to need to dredge the reservoir every 30 years or so.

SIPPO CREEK - DOWNSTREAM OF THE DAM

The US Army Corps of Engineers was contacted to discuss the storm sewer network west of Third Street. This system was installed to minimize flooding from the Tuscarawas River. Basically, there are two separate systems for handling storm drainage in this area of the City. First, there is a large pressure conduit that Sippo Creek enters before it exits into the Tuscarawas River. With this conduit being a pressure conduit, it is designed to contain water for a period of time before it will be released into the river. The design of the pressure conduit is less than a 100 year storm, so the elimination of the Sippo Reservoir would have a significant impact on flooding downstream.

The second system consists of the storm drainage network for the city streets. These pipes gravity flow into a pumping station. The pumping station then discharges the storm water into the pressure conduit. Inside the pressure conduit are a series of flap gates on storm pipe outlets to prevent water from surcharging or backing into the pipe. It is important to note that the pumping station has no real relationship from water flowing through Sippo Creek.

As discussed in the previous section, Sippo Reservoir will contain silt. If the reservoir was removed, then this silt could settle in the pressure conduit. It could be much more expensive to clean this conduit than it would be to remove the silt in the reservoir.

SPILLWAY IMPROVEMENT ALTERNATIVES

The breaching of the dam is the first alternative to be discussed. If the dam is breached and the reservoir is permanently eliminated, the downstream pressure conduit will be negatively impacted. Elimination of the reservoir would adversely affect the aesthetic quality and recreational value of Reservoir Park, and would eliminate aquatic habitat. Elimination of the lake would probably involve extensive OEPA and COE permit requirements. Based on these factors, breaching of the dam is considered to be the most environmentally damaging alternative, and would require considerable environmental analysis before it could be eliminated. The cost of breaching the dam itself is estimated at $25,000. Site restoration, including possible wetland mitigation, would probably increase project costs to at least $75,000.

The second alternative is the placement of embankment protection on the downstream side of the dam. The width of the earthen embankment is 78' and 101', which totals 179'. For embankment protection, a length of 50' is needed. Typically, a concrete material is used on embankments that will be overtopped during the Probable Maximum Flood. The preliminary cost of this material is $60 per square yard. The protection cost is estimated at $60,000. Additional earthwork and tree removal is estimated at $20,000. Engineering design, permitting preparation and construction administration would bring this alternative to $100,000.

The next alternative would be raising of the embankment approximately 3' to contain the full Probable Maximum Flood. It is estimated that to raise the embankment would cost $15,000, with and an additional $10,000 for miscellaneous earthwork and tree removal. Engineering design, permitting preparation and construction administration would bring this alternative to $35,000.

The last alternative to discuss is the option of constructing an additional spillway. Preliminary calculations show that an additional spillway 30' in width is needed to safely pass the Probable Maximum Flood. Ideally, the emergency spillway should be cut into an area of original ground. One such area could be near the building at the western side of the spillway. The eastern embankment appears to be all fill. Without having any plans of the dam, the only way of determining fill and cut areas would be through soils exploration. The length of the emergency spillway is estimated at 60'. The estimated cost of the concrete spillway, earthwork and tree removal is $50,000. Soils exploration, engineering design, permitting preparation and construction administration would bring this alternative to $70,000.

Alternative Description	Estimated Cost
Breaching the Dam	$ 75,000
Embankment Protection	$100,000
Raising Embankment	$ 35,000
Additional Spillway	$ 70,000

The most economical method for bringing the dam into ODNR compliance is the raising of the embankment 3'.

DREDGING COSTS

The surface area of the reservoir is approximately 6 acres. The actual depth of the reservoir is unknown and can only be obtained by field surveying. If the reservoir surface became frozen, it is possible that holes can be drilled through the ice to obtain reservoir depths. However, determining the reservoir bottom contours is outside the scope of this project.

As mentioned previously, the ideal water depths for reservoirs this size is a minimum of 6', with deeper pools between 10' to 12' needed for optimum reservoir conditions. Assuming that a total quantity of 20,000 cubic yards of material is excavated (4 acres x 3 feet x 43560 sq.ft/acre /27), at an estimated cost of $10 per cubic yard, the dredging cost is projected at $200,000. This cost would include all disposal costs. The above discussion shows that to get a realistic estimate a field survey has to be performed on the reservoir.

SUMMARY

This study performed a hydraulic and hydrologic analysis on the 14.9 square mile watershed. It was determined that the present spillway is unable to meet current ODNR criteria for a Class 1 dam. This criteria is that the spillway be capable of safely containing a Probable Maximum Flood. For this drainage basin, the Probable Maximum Flood results from a rainfall of 34.5" over a 72 hour period. This rainfall is greater than a once in one thousand years storm event.

The reservoir was found to harbor wetlands. Individual permits from the Corps of Engineers, Ohio EPA, and ODNR will be needed for whatever the City may do. These permits shouldn't be a big problem for most solutions that could be undertaken.

Several alternatives for bringing the dam into ODNR compliance were discussed. The most economical and environmentally accepted method for bringing the dam into ODNR compliance is the raising of the embankment 3'.

Alternative Description	Estimated Cost
Breaching the Dam	$ 75,000
Embankment Protection	$100,000
Raising Embankment	$ 35,000
Additional Spillway	$ 70,000

The estimated costs include all engineering, permitting preparation and construction administration costs.

The cost of dredging the reservoir is estimated at $200,000 if the projected 20,000 cubic yards of material needs to be removed. This figure could be reduced once quantities are more accurately determined by field surveying.

In conclusion, there are feasible alternatives for restoring the dam and reservoir. The estimated construction costs presented in this study can be further refined during the engineering of the projects.

APPENDIX A

CALCULATIONS AS IS

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1***************************************
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 *                                       *                                              *
         *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                              *   U.S. ARMY CORPS OF
ENGINEERS     *
 *             MAY   1991                *                                              *   HYDROLOGIC ENGINEERING
CENTER    *
 *          VERSION 4.0.1E               *                                              *        609 SECOND
STREET        *
 *    Lahey F77L-EM/32 version 5.01      *                                              *     DAVIS, CALIFORNIA
95616       *
 *      Dodson & Associates, Inc.        *                                              *       (916) 551-1748
         *
 *  RUN DATE  01/15/98  TIME  10:55:54   *                                              *
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                                                   X     X  X        X     X       XX
                                                   X     X  X        X              X
                                                   XXXXXXX  XXXX     X       XXXXX  X
                                                   X     X  X        X              X
                                                   X     X  X        X     X        X
                                                   X     X  XXXXXXX   XXXXX        XXX


            THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

            THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT
STRUCTURE.
            THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77
VERSION
            NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
            DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL    LOSS RATE:GREEN AND AMPT INFILTRATION
            KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID   LAKE CABLE DAM
  2           IT      10       0       0     500
  3           IN      60
  4           IO       5       0
  5           JR    FLOW     1.0     .50     .25     .20     .10

  6           KK   ERIC 1
  7           KM   INFLOW HYDROGRAPH TO LAKE ERIC 72 HOUR
  8           BA    .135
  9           PB   34.50
 10           PI   0.050   0.060   0.050   0.060   0.050   0.060   0.070   0.070   0.070   0.060
 11           PI   0.070   0.060   0.090   0.080   0.090   0.080   0.090   0.080   0.120   0.120
 12           PI   0.120   0.110   0.120   0.120   0.170   0.170   0.190   0.190   0.210   0.220
 13           PI   0.390   0.430   0.490   0.560   0.660   0.770   1.340   2.300   6.310   9.960
 14           PI   2.600   1.620   0.360   0.310   0.290   0.260   0.250   0.230   0.150   0.140
 15           PI   0.150   0.150   0.140   0.150   0.100   0.090   0.100   0.100   0.100   0.100
 16           PI   0.070   0.080   0.070   0.008   0.070   0.080   0.050   0.060   0.060   0.060
 17           PI   0.060   0.060
 18           LS       0      75
 19           UD    1.78

 20           KK   L.ERIC 1
 21           KM   ROUTE THROUGH LAKE ERIC
 22           RS       1    ELEV  1116.5
 23           SA       0     3.7     3.9     4.2     8.1
 24           SE  1109.1  1116.5  1118.0  1120.0  1130.0
 25           SQ       0       3      17      40      69    1130    3586
 26           SE  1116.5  1117.0  1118.0  1119.0  1120.0  1121.0  1122.0
 27           SS  1116.5
 28           ST  1120.0

 29           KK   A.O'SPRINGS 2
 30           KM   INFLOW HYDROGRAPH TO LAKE O'SPRINGS
 31           BA    .358
 32           PB    34.5
 33           PI   0.050   0.060   0.050   0.060   0.050   0.060   0.070   0.070   0.070   0.060
 34           PI   0.070   0.060   0.090   0.080   0.090   0.080   0.090   0.080   0.120   0.120
 35           PI   0.120   0.110   0.120   0.120   0.170   0.170   0.190   0.190   0.210   0.220
 36           PI   0.390   0.430   0.490   0.560   0.660   0.770   1.340   2.300   6.310   9.960
 37           PI   2.600   1.620   0.360   0.310   0.290   0.260   0.250   0.230   0.150   0.140
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38          PI   0.150    0.150    0.140    0.150    0.100    0.090    0.100    0.100    0.100    0.100
39          PI   0.070    0.080    0.070    0.080    0.070    0.080    0.050    0.060    0.060    0.060
40          PI   0.060    0.060
41          LS       0       75
42          UD    2.56

43          KK   L.O'SPRINGS 2
44          KM   COMBINE HYDROGRAPHS (1 & 2)
45          HC       2
1                                          HEC-1 INPUT                                                  PAGE  2

LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


46          KK   L.O'SPRINGS 2
47          KM   ROUTE THROUGH LAKE O'SPRINGS
48          RS       1     ELEV  1106.0
49          SA       0       27       30      40       44
50          SE  1104.2  1106.0   1108.7 1110.0   1112.9
51          SS  1106.0
52          ST  1108.7

53          KK   A.CABLE 3
54          KM  INFLOW HYDROGRAPH TO LAKE CABLE
55          BA    2.02
56          PB    34.5
57          PI   0.050    0.060    0.050    0.060    0.050    0.060    0.070    0.070    0.070    0.060
58          PI   0.070    0.060    0.090    0.080    0.090    0.080    0.090    0.080    0.120    0.120
59          PI   0.120    0.110    0.120    0.120    0.170    0.170    0.190    0.190    0.210    0.220
60          PI   0.390    0.430    0.490    0.560    0.660    0.770    1.340    2.300    6.310    9.960
61          PI   2.600    1.620    0.360    0.310    0.290    0.260    0.250    0.230    0.150    0.140
62          PI   0.150    0.150    0.140    0.150    0.100    0.090    0.100    0.100    0.100    0.100
63          PI   0.070    0.080    0.070    0.080    0.070    0.080    0.050    0.060    0.060    0.060
64          PI   0.060    0.060
65          LS       0       75
66          UD    5.82

67          KK   L.E&O 3
68          KM   COMBINE HYDROGRAPHS (2 & 3)
69          HC       2

70          KK   L.CABLE 3
71          KM   ROUTE THROUGH LAKE CABLE: FLASHBOARDS IN PLACE
72          RS       1     ELEV  1097.4
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```
 73          SA       0   220.0   296.0   316.7     405     500
 74          SE  1080.0  1097.4  1099.5  1100.0  1103.0  1104.0
 75          SQ       0     6.5    14.0    70.5   242.2   261.8   346.6  1298.6 10961.4 27165.9
 76          SQ   49064   74924  103009
 77          SE  1096.4  1097.0  1097.4  1098.0  1099.0  1099.1  1099.5  1100.0  1102.0  1104.0
 78          SE  1106.0  1108.0  1110.0
 79          SS  1097.4
 80          ST  1099.5

 81          KK  A.SIPPO 4
 82          KM  ROUTE SEPARATE HYDROGRAPH THROUGH SIPPO LAKE
 83          HC       2
 84          BA    3.01
 85          PB    34.5
 86          PI   0.050   0.060   0.050   0.060   0.050   0.060   0.070   0.070   0.070   0.060
 87          PI   0.070   0.060   0.090   0.080   0.090   0.080   0.090   0.080   0.120   0.120
 88          PI   0.120   0.110   0.120   0.120   0.170   0.170   0.190   0.190   0.210   0.220
 89          PI   0.390   0.430   0.490   0.560   0.660   0.770   1.340   2.300   6.310   9.960
 90          PI   2.600   1.620   0.360   0.310   0.290   0.260   0.250   0.230   0.150   0.140
 91          PI   0.150   0.150   0.140   0.150   0.100   0.090   0.100   0.100   0.100   0.100
 92          PI   0.070   0.080   0.070   0.080   0.070   0.080   0.050   0.060   0.060   0.060
 93          PI   0.060   0.060
 94          LS       0      75
 95          UD    5.82
```



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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 96          KK  L.SIPPO C
 97          KM  ROUTE THROUGH SIPPO LAKE
 98          RS       1    ELEV  1027.0
 99          SA       0      88   106.0
100          SE    1022  1027.0  1029.3
101          SQ       0     346    1375    7145
102          SE    1027  1029.3  1030.3  1032.3
103          SS  1027.0
104          ST  1029.3

105          KK  A.SIP RES 5
106          KM  ROUTE THROUGH SIPPO LAKE RESERVOIR
107          BA    9.38
108          PB   34.50
109          PI   0.050   0.060   0.050   0.060   0.050   0.060   0.070   0.070   0.070   0.060
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 110           PI   0.070   0.060   0.090   0.080   0.090   0.080   0.090   0.080   0.120   0.120
 111           PI   0.120   0.110   0.120   0.120   0.170   0.170   0.190   0.190   0.210   0.220
 112           PI   0.390   0.430   0.490   0.560   0.660   0.770   1.340   2.300   6.310   9.960
 113           PI   2.600   1.620   0.360   0.310   0.290   0.260   0.250   0.230   0.150   0.140
 114           PI   0.150   0.150   0.140   0.150   0.100   0.090   0.100   0.100   0.100   0.100
 115           PI   0.070   0.080   0.070   0.080   0.070   0.080   0.050   0.060   0.060   0.060
 116           PI   0.060   0.060
 117           LS       0      75
 118           UD    16.4

 119           KK   L.C&SIP 5
 120           KM   COMBINE HYDROGRAPHS (3 &4)
 121           HC       3

 122           KK   SIP RES 5
 123           KM   ROUTE THROUGH RESERVOIR
 124           RS       1    ELEV   997.0
 125           SA       0     4.4    34.0   40.0
 126           SE     983   997.0  1000.6 1004.0
 127           SQ       0     828    1800   3300     5150
 128           SE     997  1000.6  1001.6 1002.6   1003.6
 129           SS     997
 130           ST  1000.6
 131           ZZ
1*****************************************
***************************************
 *                                       *                                                   *
        *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                                   *    U.S. ARMY CORPS OF
ENGINEERS    *
 *             MAY   1991                *                                                   *    HYDROLOGIC ENGINEERING
CENTER    *
 *          VERSION 4.0.1E               *                                                   *          609 SECOND
STREET          *
 *     Lahey F77L-EM/32 version 5.01     *                                                   *       DAVIS, CALIFORNIA
95616     *
 *       Dodson & Associates, Inc.       *                                                   *          (916) 551-1748
        *
 *  RUN DATE  01/15/98  TIME  10:55:54   *                                                   *
        *
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```
                   LAKE CABLE DAM

4 IO          OUTPUT CONTROL VARIABLES
                    IPRNT            5  PRINT CONTROL
                    IPLOT            0  PLOT CONTROL
                    QSCAL           0.  HYDROGRAPH PLOT SCALE

  IT          HYDROGRAPH TIME DATA
                     NMIN           10  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1     0  STARTING DATE
                    ITIME         0000  STARTING TIME
                       NQ          500  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      4     0  ENDING DATE
                   NDTIME         1110  ENDING TIME
                    ICENT           19  CENTURY MARK

               COMPUTATION INTERVAL    0.17 HOURS
                    TOTAL TIME BASE   83.17 HOURS

       ENGLISH UNITS
            DRAINAGE AREA          SQUARE MILES
            PRECIPITATION DEPTH    INCHES
            LENGTH, ELEVATION      FEET
            FLOW                   CUBIC FEET PER SECOND
            STORAGE VOLUME         ACRE-FEET
            SURFACE AREA           ACRES
            TEMPERATURE            DEGREES FAHRENHEIT

  JP           MULTI-PLAN OPTION
                    NPLAN            1  NUMBER OF PLANS

  JR           MULTI-RATIO OPTION
                  RATIOS OF RUNOFF
                 1.00      0.50      0.25      0.20      0.10

 *** WARNING ***   UNIT HYDROGRAPH TRUNCATED FROM 494 TO 300 INTERVALS
1

          PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
                           FLOWS IN CUBIC FEET PER SECOND,  AREA IN SQUARE MILES
                                           TIME TO PEAK IN HOURS
```

OPERATION	STATION	AREA	PLAN		RATIO 1 1.00	RATIO 2 0.50	RATIO 3 0.25	RATIO 4 0.20	RATIO 5 0.10
					RATIOS APPLIED TO FLOWS				
HYDROGRAPH AT									
+	ERIC	0.14	1	FLOW	531.	266.	133.	106.	53.
				TIME	41.17	41.17	41.17	41.17	41.17
ROUTED TO									
+	L.ERI	0.14	1	FLOW	531.	265.	134.	95.	33.
				TIME	41.17	41.17	41.17	41.83	42.67
			** PEAK STAGES IN FEET **						
			1	STAGE	1120.44	1120.19	1120.06	1120.02	1118.71
				TIME	41.17	41.17	41.17	41.83	42.67
HYDROGRAPH AT									
+	A.O'S	0.36	1	FLOW	1156.	578.	289.	231.	116.
				TIME	42.00	42.00	42.00	42.00	42.00
2 COMBINED AT									
+	L.O'S	0.49	1	FLOW	1644.	822.	411.	326.	147.
				TIME	41.67	41.67	41.67	41.83	42.00
ROUTED TO									
+	L.O'S	0.49	1	FLOW	0.	0.	0.	0.	0.
				TIME	0.17	0.17	0.17	0.17	0.17
			** PEAK STAGES IN FEET **						
			1	STAGE	1111.22	1110.23	1109.67	1109.49	1108.78
				TIME	80.83	79.00	77.17	77.17	80.00
HYDROGRAPH AT									
+	A.CAB	2.02	1	FLOW	3758.	1879.	939.	752.	376.
				TIME	45.17	45.17	45.17	45.17	45.17
2 COMBINED AT									
+	L.E&O	2.51	1	FLOW	3758.	1879.	939.	752.	376.
				TIME	45.17	45.17	45.17	45.17	45.17
ROUTED TO									
+	L.CAB	2.51	1	FLOW	3578.	1382.	295.	227.	98.
				TIME	46.17	48.00	51.83	52.00	52.67

```
                                    ** PEAK STAGES IN FEET **
                                    1   STAGE     1100.47  1100.02  1099.25  1098.91  1098.16
                                        TIME        46.17    48.00    51.83    52.00    52.67

 HYDROGRAPH AT
+                  A.SIP       3.01     1   FLOW        5599.    2800.    1400.    1120.     560.
                                        TIME        45.17    45.17    45.17    45.17    45.17

 ROUTED TO
+                  L.SIP       3.01     1   FLOW        5527.    2765.    1254.     969.     309.
                                        TIME        45.67    45.67    46.83    47.00    49.33

                                    ** PEAK STAGES IN FEET **
                                    1   STAGE     1031.74  1030.78  1030.18  1029.91  1029.06
                                        TIME        45.67    45.67    46.83    47.00    49.33

 HYDROGRAPH AT
+                  A.SIP       9.38     1   FLOW        7586.    3793.    1896.    1517.     759.
                                        TIME        55.67    55.67    55.67    55.67    55.67

  3 COMBINED AT
+                  L.C&S      14.90     1   FLOW       12485.    5905.    2638.    2097.    1098.
                                        TIME        46.83    48.00    49.67    49.67    53.83

 ROUTED TO
+                  SIP R      14.90     1   FLOW       12485.    5906.    2638.    2097.    1097.
                                        TIME        46.83    48.00    49.50    49.50    54.17

                                    ** PEAK STAGES IN FEET **
                                    1   STAGE     1001.94  1001.73  1001.63  1001.61  1000.88
                                        TIME        46.83    48.00    49.50    49.50    54.17
1                                 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    L.ERI

                              (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 ..............                INITIAL VALUE    SPILLWAY CREST    TOP OF DAM

                              ELEVATION       1116.50          1116.50          1120.00

                              STORAGE             9.               9.              23.
```

OUTFLOW	0.	0.	69.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1120.44	0.44	25.	531.	6.50	41.17	0.00
0.50	1120.19	0.19	24.	265.	4.33	41.17	0.00
0.25	1120.06	0.06	23.	134.	2.00	41.17	0.00
0.20	1120.02	0.02	23.	95.	0.83	41.83	0.00
0.10	1118.71	0.00	18.	33.	0.00	42.67	0.00

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION L.O'S

(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1106.00	1106.00	1108.70
STORAGE	16.	16.	93.
OUTFLOW	0.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1111.22	2.52	824.	0.	45.00	0.00	0.00
0.50	1110.23	1.53	420.	0.	43.00	0.00	0.00
0.25	1109.67	0.97	217.	0.	41.50	0.00	0.00
0.20	1109.49	0.79	176.	0.	40.83	0.00	0.00
0.10	1108.78	0.08	96.	0.	21.83	0.00	0.00

1

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION L.CAB

(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1097.40	1097.40	1099.50
STORAGE	1276.	1276.	1816.
OUTFLOW	14.	14.	347.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS

1.00	1100.47	0.97	2121.	3578.	18.00	46.17	0.00
0.50	1100.02	0.52	1974.	1382.	11.67	48.00	0.00
0.25	1099.25	0.00	1744.	295.	0.00	51.83	0.00
0.20	1098.91	0.00	1648.	227.	0.00	52.00	0.00
0.10	1098.16	0.00	1453.	98.	0.00	52.67	0.00

1

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION L.SIP

(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1027.00	1027.00	1029.30
STORAGE	147.	147.	369.
OUTFLOW	0.	0.	346.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1031.74	2.44	653.	5527.	22.83	45.67	0.00
0.50	1030.78	1.48	536.	2765.	16.33	45.67	0.00

0.25	1030.18	0.88	466.	1254.	10.83	46.83	0.00
0.20	1029.91	0.61	435.	969.	9.00	47.00	0.00
0.10	1029.06	0.00	344.	309.	0.00	49.33	0.00

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION SIP R

(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	997.00	997.00	1000.60
STORAGE	21.	21.	81.
OUTFLOW	0.	0.	828.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1001.94	1.34	128.	12485.	43.33	46.83	0.00
0.50	1001.73	1.13	121.	5906.	40.00	48.00	0.00
0.25	1001.63	1.03	117.	2638.	29.67	49.50	0.00
0.20	1001.61	1.01	116.	2097.	25.83	49.50	0.00
0.10	1000.88	0.28	91.	1097.	12.67	54.17	0.00

*** NORMAL END OF HEC-1 ***

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1*****************************************                                                   *
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 *                                       *                                                   *
        *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                                   *   U.S. ARMY CORPS OF
ENGINEERS      *
 *             MAY   1991                *                                                   *   HYDROLOGIC ENGINEERING
CENTER    *
 *          VERSION 4.0.1E               *                                                   *         609 SECOND
STREET           *
 *     Lahey F77L-EM/32 version 5.01     *                                                   *      DAVIS, CALIFORNIA
95616       *
 *       Dodson & Associates, Inc.       *                                                   *           (916) 551-1748
        *
 *  RUN DATE  01/16/98  TIME  08:08:13   *                                                   *
        *
 *****************************************
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                                        X     X  XXXXXXX   XXXXX          X
                                        X     X  X        X     X        XX
                                        X     X  X        X               X
                                        XXXXXXX  XXXX     X       XXXXX   X
                                        X     X  X        X               X
                                        X     X  X        X     X         X
                                        X     X  XXXXXXX   XXXXX         XXX


             THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

             THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT
STRUCTURE.
             THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77
VERSION
             NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
             DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
             KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM
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LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   1        ID   LAKE CABLE DAM
   2        IT      10       0       0     500
   3        IN      60
   4        IO       5       0
   5        JR    FLOW     1.0     .50     .25     .20     .10

   6        KK   ERIC 1
   7        KM   INFLOW HYDROGRAPH TO LAKE ERIC 72 HOUR
   8        BA    .135
   9        PB   34.50
  10        PI   0.050   0.060   0.050   0.060   0.050   0.060   0.070   0.070   0.070   0.060
  11        PI   0.070   0.060   0.090   0.080   0.090   0.080   0.090   0.080   0.120   0.120
  12        PI   0.120   0.110   0.120   0.120   0.170   0.170   0.190   0.190   0.210   0.220
  13        PI   0.390   0.430   0.490   0.560   0.660   0.770   1.340   2.300   6.310   9.960
  14        PI   2.600   1.620   0.360   0.310   0.290   0.260   0.250   0.230   0.150   0.140
  15        PI   0.150   0.150   0.140   0.150   0.100   0.090   0.100   0.100   0.100   0.100
  16        PI   0.070   0.080   0.070   0.008   0.070   0.080   0.050   0.060   0.060   0.060
  17        PI   0.060   0.060
  18        LS       0      75
  19        UD    1.78

  20        KK   L.ERIC 1
  21        KM   ROUTE THROUGH LAKE ERIC
  22        RS       1    ELEV  1116.5
  23        SA       0     3.7     3.9     4.2     8.1
  24        SE  1109.1  1116.5  1118.0  1120.0  1130.0
  25        SQ       0       3      17      40      69    1130    3586
  26        SE  1116.5  1117.0  1118.0  1119.0  1120.0  1121.0  1122.0
  27        SS  1116.5
  28        ST  1120.0

  29        KK   A.O'SPRINGS 2
  30        KM   INFLOW HYDROGRAPH TO LAKE O'SPRINGS
  31        BA    .358
  32        PB    34.5
  33        PI   0.050   0.060   0.050   0.060   0.050   0.060   0.070   0.070   0.070   0.060
  34        PI   0.070   0.060   0.090   0.080   0.090   0.080   0.090   0.080   0.120   0.120
  35        PI   0.120   0.110   0.120   0.120   0.170   0.170   0.190   0.190   0.210   0.220
  36        PI   0.390   0.430   0.490   0.560   0.660   0.770   1.340   2.300   6.310   9.960
  37        PI   2.600   1.620   0.360   0.310   0.290   0.260   0.250   0.230   0.150   0.140
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 38          PI   0.150   0.150   0.140   0.150   0.100   0.090   0.100   0.100   0.100   0.100
 39          PI   0.070   0.080   0.070   0.080   0.070   0.080   0.050   0.060   0.060   0.060
 40          PI   0.060   0.060
 41          LS       0      75
 42          UD    2.56

 43          KK   L.O'SPRINGS 2
 44          KM   COMBINE HYDROGRAPHS (1 & 2)
 45          HC       2
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 46          KK   L.O'SPRINGS 2
 47          KM   ROUTE THROUGH LAKE O'SPRINGS
 48          RS       1    ELEV  1106.0
 49          SA       0      27      30      40      44
 50          SE  1104.2  1106.0  1108.7 1110.0  1112.9
 51          SS  1106.0
 52          ST  1108.7

 53          KK   A.CABLE 3
 54          KM  INFLOW HYDROGRAPH TO LAKE CABLE
 55          BA    2.02
 56          PB    34.5
 57          PI   0.050   0.060   0.050   0.060   0.050   0.060   0.070   0.070   0.070   0.060
 58          PI   0.070   0.060   0.090   0.080   0.090   0.080   0.090   0.080   0.120   0.120
 59          PI   0.120   0.110   0.120   0.120   0.170   0.170   0.190   0.190   0.210   0.220
 60          PI   0.390   0.430   0.490   0.560   0.660   0.770   1.340   2.300   6.310   9.960
 61          PI   2.600   1.620   0.360   0.310   0.290   0.260   0.250   0.230   0.150   0.140
 62          PI   0.150   0.150   0.140   0.150   0.100   0.090   0.100   0.100   0.100   0.100
 63          PI   0.070   0.080   0.070   0.080   0.070   0.080   0.050   0.060   0.060   0.060
 64          PI   0.060   0.060
 65          LS       0      75
 66          UD    5.82

 67          KK   L.E&O 3
 68          KM   COMBINE HYDROGRAPHS (2 & 3)
 69          HC       2

 70          KK   L.CABLE 3
 71          KM   ROUTE THROUGH LAKE CABLE: FLASHBOARDS IN PLACE
 72          RS       1    ELEV  1097.4
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 73          SA       0   220.0   296.0   316.7     405     500
 74          SE  1080.0  1097.4  1099.5  1100.0  1103.0  1104.0
 75          SQ       0     6.5    14.0    70.5   242.2   261.8   346.6  1298.6 10961.4 27165.9
 76          SQ   49064   74924  103009
 77          SE  1096.4  1097.0  1097.4  1098.0  1099.0  1099.1  1099.5  1100.0  1102.0  1104.0
 78          SE  1106.0  1108.0  1110.0
 79          SS  1097.4
 80          ST  1099.5

 81          KK   A.SIPPO 4
 82          KM   ROUTE SEPARATE HYDROGRAPH THROUGH SIPPO LAKE
 83          HC       2
 84          BA    3.01
 85          PB    34.5
 86          PI   0.050   0.060   0.050   0.060   0.050   0.060   0.070   0.070   0.070   0.060
 87          PI   0.070   0.060   0.090   0.080   0.090   0.080   0.090   0.080   0.120   0.120
 88          PI   0.120   0.110   0.120   0.120   0.170   0.170   0.190   0.190   0.210   0.220
 89          PI   0.390   0.430   0.490   0.560   0.660   0.770   1.340   2.300   6.310   9.960
 90          PI   2.600   1.620   0.360   0.310   0.290   0.260   0.250   0.230   0.150   0.140
 91          PI   0.150   0.150   0.140   0.150   0.100   0.090   0.100   0.100   0.100   0.100
 92          PI   0.070   0.080   0.070   0.080   0.070   0.080   0.050   0.060   0.060   0.060
 93          PI   0.060   0.060
 94          LS       0      75
 95          UD    5.82
1                                           HEC-1 INPUT                                             PAGE  3

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 96          KK   L.SIPPO C
 97          KM   ROUTE THROUGH SIPPO LAKE
 98          RS       1    ELEV  1027.0
 99          SA       0      88   106.0
100          SE    1022  1027.0  1029.3
101          SQ       0     346    1375    7145
102          SE    1027  1029.3  1030.3  1032.3
103          SS  1027.0
104          ST  1029.3

105          KK   A.SIP RES 5
106          KM   ROUTE THROUGH SIPPO LAKE RESERVOIR
107          BA    9.38
108          PB   34.50
109          PI   0.050   0.060   0.050   0.060   0.050   0.060   0.070   0.070   0.070   0.060
```

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110    PI   0.070   0.060   0.090   0.080   0.090   0.080   0.090   0.080   0.120   0.120
111    PI   0.120   0.110   0.120   0.120   0.170   0.170   0.190   0.190   0.210   0.220
112    PI   0.390   0.430   0.490   0.560   0.660   0.770   1.340   2.300   6.310   9.960
113    PI   2.600   1.620   0.360   0.310   0.290   0.260   0.250   0.230   0.150   0.140
114    PI   0.150   0.150   0.140   0.150   0.100   0.090   0.100   0.100   0.100   0.100
115    PI   0.070   0.080   0.070   0.080   0.070   0.080   0.050   0.060   0.060   0.060
116    PI   0.060   0.060
117    LS       0      75
118    UD    16.4

119    KK   L.C&SIP 5
120    KM   COMBINE HYDROGRAPHS (3 &4)
121    HC       3

122    KK   SIP RES 5
123    KM   ROUTE THROUGH RESERVOIR
124    RS       1    ELEV   997.0
125    SA       0     4.4    34.0   40.0     50.0
126    SE     983   997.0  1000.6 1004.0   1006.0
127    SQ       0     828    1200   1800     2435
128    SE     997  1000.6  1001.6 1003.0   1005.0
129    SS     997
130    ST  1003.6
131    ZZ
1***************************************
***************************************
 *                                       *                                              *
        *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                              *    U.S. ARMY CORPS OF
ENGINEERS     *
 *             MAY   1991                *                                              *    HYDROLOGIC ENGINEERING
CENTER    *
 *          VERSION 4.0.1E               *                                              *          609 SECOND
STREET        *
 *     Lahey F77L-EM/32 version 5.01     *                                              *       DAVIS, CALIFORNIA
95616       *
 *       Dodson & Associates, Inc.       *                                              *          (916) 551-1748
        *
 *  RUN DATE  01/16/98  TIME  08:08:13   *                                              *
        *
 ***************************************
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                   LAKE CABLE DAM

4 IO          OUTPUT CONTROL VARIABLES
                    IPRNT            5  PRINT CONTROL
                    IPLOT            0  PLOT CONTROL
                    QSCAL           0.  HYDROGRAPH PLOT SCALE

  IT          HYDROGRAPH TIME DATA
                     NMIN           10  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1     0  STARTING DATE
                    ITIME         0000  STARTING TIME
                       NQ          500  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      4     0  ENDING DATE
                   NDTIME         1110  ENDING TIME
                    ICENT           19  CENTURY MARK

                COMPUTATION INTERVAL    0.17 HOURS
                     TOTAL TIME BASE   83.17 HOURS

      ENGLISH UNITS
           DRAINAGE AREA          SQUARE MILES
           PRECIPITATION DEPTH    INCHES
           LENGTH, ELEVATION      FEET
           FLOW                   CUBIC FEET PER SECOND
           STORAGE VOLUME         ACRE-FEET
           SURFACE AREA           ACRES
           TEMPERATURE            DEGREES FAHRENHEIT

  JP           MULTI-PLAN OPTION
                     NPLAN           1  NUMBER OF PLANS

  JR           MULTI-RATIO OPTION
                   RATIOS OF RUNOFF
                  1.00       0.50       0.25       0.20       0.10

  *** WARNING ***   UNIT HYDROGRAPH TRUNCATED FROM 494 TO 300 INTERVALS
1

          PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
                              FLOWS IN CUBIC FEET PER SECOND,  AREA IN SQUARE MILES
                                              TIME TO PEAK IN HOURS
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OPERATION	STATION	AREA	PLAN		RATIO 1 1.00	RATIO 2 0.50	RATIO 3 0.25	RATIO 4 0.20	RATIO 5 0.10
					RATIOS APPLIED TO FLOWS				
HYDROGRAPH AT									
+	ERIC	0.14	1	FLOW	531.	266.	133.	106.	53.
				TIME	41.17	41.17	41.17	41.17	41.17
ROUTED TO									
+	L.ERI	0.14	1	FLOW	531.	265.	134.	95.	33.
				TIME	41.17	41.17	41.17	41.83	42.67
			** PEAK STAGES IN FEET **						
			1	STAGE	1120.44	1120.19	1120.06	1120.02	1118.71
				TIME	41.17	41.17	41.17	41.83	42.67
HYDROGRAPH AT									
+	A.O'S	0.36	1	FLOW	1156.	578.	289.	231.	116.
				TIME	42.00	42.00	42.00	42.00	42.00
2 COMBINED AT									
+	L.O'S	0.49	1	FLOW	1644.	822.	411.	326.	147.
				TIME	41.67	41.67	41.67	41.83	42.00
ROUTED TO									
+	L.O'S	0.49	1	FLOW	0.	0.	0.	0.	0.
				TIME	0.17	0.17	0.17	0.17	0.17
			** PEAK STAGES IN FEET **						
			1	STAGE	1111.22	1110.23	1109.67	1109.49	1108.78
				TIME	80.83	79.00	77.17	77.17	80.00
HYDROGRAPH AT									
+	A.CAB	2.02	1	FLOW	3758.	1879.	939.	752.	376.
				TIME	45.17	45.17	45.17	45.17	45.17
2 COMBINED AT									
+	L.E&O	2.51	1	FLOW	3758.	1879.	939.	752.	376.
				TIME	45.17	45.17	45.17	45.17	45.17
ROUTED TO									
+	L.CAB	2.51	1	FLOW	3578.	1382.	295.	227.	98.
				TIME	46.17	48.00	51.83	52.00	52.67

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                                       ** PEAK STAGES IN FEET **
                                       1    STAGE     1100.47  1100.02  1099.25  1098.91  1098.16
                                            TIME        46.17    48.00    51.83    52.00    52.67

 HYDROGRAPH AT
+                A.SIP      3.01       1    FLOW        5599.    2800.    1400.    1120.     560.
                                            TIME        45.17    45.17    45.17    45.17    45.17

 ROUTED TO
+                L.SIP      3.01       1    FLOW        5527.    2765.    1254.     969.     309.
                                            TIME        45.67    45.67    46.83    47.00    49.33

                                       ** PEAK STAGES IN FEET **
                                       1    STAGE     1031.74  1030.78  1030.18  1029.91  1029.06
                                            TIME        45.67    45.67    46.83    47.00    49.33

 HYDROGRAPH AT
+                A.SIP      9.38       1    FLOW        7586.    3793.    1896.    1517.     759.
                                            TIME        55.67    55.67    55.67    55.67    55.67

  3 COMBINED AT
+                L.C&S     14.90       1    FLOW       12485.    5905.    2638.    2097.    1098.
                                            TIME        46.83    48.00    49.67    49.67    53.83

 ROUTED TO
+                SIP R     14.90       1    FLOW       12485.    5906.    2638.    2096.    1086.
                                            TIME        46.83    48.00    49.67    49.67    55.17

                                       ** PEAK STAGES IN FEET **
                                       1    STAGE     1002.54  1001.99  1001.72  1001.67  1001.29
                                            TIME        46.83    48.00    49.67    49.67    55.17
1                                   SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    L.ERI

                               (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 ...............                 INITIAL VALUE     SPILLWAY CREST     TOP OF DAM

                                ELEVATION        1116.50           1116.50          1120.00

                                STORAGE              9.                9.              23.
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OUTFLOW	0.	0.	69.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1120.44	0.44	25.	531.	6.50	41.17	0.00
0.50	1120.19	0.19	24.	265.	4.33	41.17	0.00
0.25	1120.06	0.06	23.	134.	2.00	41.17	0.00
0.20	1120.02	0.02	23.	95.	0.83	41.83	0.00
0.10	1118.71	0.00	18.	33.	0.00	42.67	0.00

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION L.O'S

(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1106.00	1106.00	1108.70
STORAGE	16.	16.	93.
OUTFLOW	0.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1111.22	2.52	824.	0.	45.00	0.00	0.00
0.50	1110.23	1.53	420.	0.	43.00	0.00	0.00
0.25	1109.67	0.97	217.	0.	41.50	0.00	0.00
0.20	1109.49	0.79	176.	0.	40.83	0.00	0.00
0.10	1108.78	0.08	96.	0.	21.83	0.00	0.00

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION L.CAB

(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1097.40	1097.40	1099.50
STORAGE	1276.	1276.	1816.
OUTFLOW	14.	14.	347.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS

1.00	1100.47	0.97	2121.	3578.	18.00	46.17	0.00
0.50	1100.02	0.52	1974.	1382.	11.67	48.00	0.00
0.25	1099.25	0.00	1744.	295.	0.00	51.83	0.00
0.20	1098.91	0.00	1648.	227.	0.00	52.00	0.00
0.10	1098.16	0.00	1453.	98.	0.00	52.67	0.00

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION L.SIP

(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1027.00	1027.00	1029.30
STORAGE	147.	147.	369.
OUTFLOW	0.	0.	346.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1031.74	2.44	653.	5527.	22.83	45.67	0.00
0.50	1030.78	1.48	536.	2765.	16.33	45.67	0.00
0.25	1030.18	0.88	466.	1254.	10.83	46.83	0.00

0.20	1029.91	0.61	435.	969.	9.00	47.00	0.00
0.10	1029.06	0.00	344.	309.	0.00	49.33	0.00

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION SIP R

(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	997.00	997.00	1003.60
STORAGE	21.	21.	191.
OUTFLOW	0.	0.	13331.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1002.54	0.00	151.	12485.	0.00	46.83	0.00
0.50	1001.99	0.00	130.	5906.	0.00	48.00	0.00
0.25	1001.72	0.00	120.	2638.	0.00	49.67	0.00
0.20	1001.67	0.00	119.	2096.	0.00	49.67	0.00
0.10	1001.29	0.00	105.	1086.	0.00	55.17	0.00

*** NORMAL END OF HEC-1 ***