Traders Point Lake Dam

Investigation Report

State ID 49-5

January 31, 2008

Submitted by

Fink Roberts & Petrie, Inc.
4040 Vincennes Circle
Suite 300
Indianapolis, Indiana 46268
317-872-8400

Executive Summary

An investigation was performed on the Traders Point Lake dam on January 23, 2008. The dam is owned by Lakeside Improvement Association. It is classified by the DNR as a low hazard dam, but has several serious deficiencies as defined by the DNR. The dam is 18 feet high and 300 feet long with a crest width of 5 feet and impounds a 10 acre lake at normal pool.

On the date of the investigation, the weather was cold and dry. There had been a recent light snowfall preceding the inspection. The level of the lake was right at the crest of the principal spillway.

The embankment is generally in good condition and the investigation centered on the structural condition of the concrete spillway, which has serious concrete failure problems.

It is recommended that the Owner give consideration to upgrading this structure to comply with current DNR standards of dams of this size and repair or replace the spillway as funding permits. Several options are presented in the report.

Dam Investigation

Data Reviewed

Prior to the field investigation on January 23, 2008, the immediate past DNR inspection report was reviewed.

Scope of Investigation

This investigation was to evaluate the structural condition of the principal spillway of the Traders Point Lake. It was limited to a visual observation of the field conditions, and an office review of those observations in order to provide a preliminary estimate for the cost of repairs. Extensive concrete and foundation sampling was not performed. This evaluation does not provide any guarantee of future safety or integrity of the dam beyond the investigation date.

Investigation Conditions

The spillway was field inspected on January 23, 2008 at approximately 1:30 pm. The conditions were cold and dry. The temperature was approximately 20degrees. There had been a recent snowfall, but it did not obstruct a clear view of the spillway. The water level was slightly above the crest of the principal spillway. Ice was observed at the left side of the spillway, both at the crest and on the wall.

Description of Dam and Spillway

This dam is located in Marion County, Indiana at the Traders Point Lake near 71st Street and Lafayette Road. It is a private dam and serves as an amenity for the development surrounding the lake. It appears in Section 27, T17N, R2E of the Zionsville USGS Quadrangle Map. Descriptive data for the dam and spillway is taken from the DNR Earth Dam Visual Inspection Report.

The dam is an earth filled structure, not approved by the DNR. The earthen embankment is approximately 18 feet high, 300 feet long and has slopes of approximately 1.5V:1H upstream and 3V:1H downstream. The principal spillway is a broad crested weir 2 feet thick, 30 feet wide, and 13.5 feet high. It has abutment walls on both sides and a wing wall on the left side. A wing wall probably existed on the right side but failed and no longer exists. The discharge is to a concrete impact slab and then a discharge channel.

The dam has an upstream drainage area of approximately 1.63 square miles and the permanent pool surface area is approximately 10 acres. The normal pool is 4.5 feet below the dam crest. There is approximately 4.5 feet of freeboard between the crest elevation and the spillway elevation.

Summary of Investigation

The spillway is spalled on the crest and downstream face. This spalling is repairable by chipping the remaining material down to sound concrete and rebuilding the crest and wall to the original dimensions. The right side abutment wall has spalled areas that are repairable by chipping the remaining material down to sound concrete and rebuilding the wall to the original dimensions. Please note that in some situations, sound concrete is never found during the chipping process and walls may need to be replaced. The center divider wall is also spalled and eroded and can be repaired by removing the deteriorated concrete and reconstructing the wall to the original dimensions. The left side abutment wall is in serious structural condition.

The left side abutment wall has an extensive crack that is not repairable. This wall also has several leaks. These leaks were defined by the evidence of water leaking through the wall and freezing, leaving significant ice formations. This wall also probably had a downstream wing wall that failed and is no longer present. There was some evidence that the wing wall remains are partially buried in the downstream stream bank. While efforts to repair this wall could be made, total replacement is the only repair that will likely be permanent.

The impact slab also has deteriorated concrete as a result of years of wear, but this damage can be repaired by removing the spalled and weak material and constructing an overlay.

Cost of Repairs

An estimate of the cost of repairs as identified was made. The cost is approximately $150,000, if no hidden defects are discovered during the excavation, spalled concrete repair, and demolition. The repair will also require the draining of the lake during construction. The lake will be lost for approximately one year. If there are fish in the lake, it will take another three years after restocking for fingerlings to reach a size that would allow them to be caught.

As the current DNR inspection report also requested a hydraulic evaluation, a preliminary hydraulic model was constructed. The results of this study are reported below and have an impact on repair costs.

The principal spillway system is capable of handling less than 20 percent of the PMF. As a low hazard structure, the DNR requires the spillway system to be capable of passing 50 percent. In order to accomplish this capability, the current 30 feet wide spillway need to be increased to 93 feet, or the dam needs to be raised approximately 15.5 feet. There are numerous combinations of these two dimensions that could be considered.

The cost of increasing the spillway to 93 feet is approximately $650,000. The cost of raising the dam 15.5 feet is approximately $1,000,000. Raising the dam by 15.5 feet must be carefully evaluated. Checking the relative elevations of home entry points in

comparison to a raised dam height was not part of this study. It is possible that an increased dam height could cause water to enter some homes during large storm events.

Another alternative is to repair the current spillway and armor the embankment to allow overtopping. The cost of armoring the embankment is approximately $450,000.

Summary of Cost Alternatives and Recommendations

Cost to repair existing spillway - $150,000
(Will not meet DNR 50% PMF criteria)

Cost to upgrade spillway by widening - $650,000

Cost to upgrade system by raising the dam - $1,000,000

Cost to upgrade the system by armoring the dam - $600,000

All of the alternatives will result in a temporary loss of the lake for up to one year and loss of fishing, if allowed, for up to three years.

The Department of Natural Resources has taken an inconsistent approach to both public and private dam repairs in the past. Currently they are in the process of upgrading their dams, so at some point they most likely will take a more active approach to requiring private dams to be upgraded. However, low hazard dams most likely will remain a low priority as high and significant hazard dams pose a greater threat to the public.

Other factors to consider include the following:

The possibility that downstream development may some day cause a reclassification of your dam to a higher risk rating.

Choosing the do nothing alternative or the repair only alternative could subject you to future action by the DNR.

Electing one of the upgrades could become obsolete if the dam is reclassified in the future, requiring a higher spillway system rating.

The repair only cost estimate is based on what could be seen and hidden costs could increase the cost substantially. The repair only cost should be considered a minimum, not a maximum, cost.

Based on the visual investigation, the dam and spillway system do not appear to be in danger of imminent failure. However, that is no guarantee that failure could not happen immediately. Hidden defects or an intense storm event could result in failure.

We recommend that your organization begin a discussion with the DNR to determine

We recommend that your organization begin a discussion with the DNR to determine the extent of repairs or upgrading that are acceptable to them and a time frame for the work that meets the financial ability of your organization.

BASE RUN

EXISTING CONDITIONS

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

            1       ID   HYDROLOGIC MODEL FOR TRADERS POINT LAKE
            2       ID   USING SCS METHOD FOR LOSS RATE AND DIMENSIONLESS UNIT HYDROGRAPH
            3       ID
            4       ID   ******ESTIMATING % OF PMP RUNOFF DAM CAN CONTROL WITHOUT OVERTOPPING******
            5       ID   CHECKING ONLY 6-HOUR STORM WHICH CONTROLS
            6       ID
            7       ID   HUFF 2ND QUARTILE DISTRIBUTION USED FOR 6-HOUR DURATION STORM
            8       ID
*** FREE ***
            9       IT     18 01JAN02       0     250                    2000
           10       IO      4
           11       JR   FLOW      .1      .2      .3      .4      .5      .6      .7      .8     1.0

           12       KK    STA1
           13       KM   TRADERS POINT LAKE 6-HOUR HYDROGRAPH
           14       BA   1.63        0
           15       PB   27.05
           16       PC    0.0    .0280   .0660   .1170   .1813   .2699   .3585   .4440   .5294   .6040
           17       PC   .6786   .7219   .7652   .8017   .8381   .8724   .9067   .9328   .9589   .9795
           18       PC   1.0
           19       LS      0      93
           20       UD    2.7

           21       KK    STA2
           22       KM   ROUTE 6-HR STORM THROUGH LAKE
           23       RS      1    ELEV     100       0
           24       SA     10      11
           25       SE    100   104.5
           26       SQ      0      32      87     153     227     305     385     465     544     619
           27       SE    100   100.5     101   101.5     102   102.5     103   103.5     104   104.5
           28       SS    100       0    3.09     1.5
           29       ST  104.5     300    3.09     1.5
           30       ZZ
```

```
*************************************                    *************************************
*                                   *                    *                                   *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1) *                  *   U.S. ARMY CORPS OF ENGINEERS    *
*           SEPTEMBER 1990          *                    *   HYDROLOGIC ENGINEERING CENTER   *
*            VERSION 4.0            *                    *       609 SECOND STREET           *
*                                   *                    *    DAVIS, CALIFORNIA 95616        *
*  RUN DATE  01/25/2008  TIME  13:30:39 *                *        (916) 756-1104             *
*                                   *                    *                                   *
*************************************                    *************************************


                    HYDROLOGIC MODEL FOR TRADERS POINT LAKE
                    USING SCS METHOD FOR LOSS RATE AND DIMENSIONLESS UNIT HYDROGRAPH

                    ******ESTIMATING % OF PMP RUNOFF DAM CAN CONTROL WITHOUT OVERTOPPING******
                    CHECKING ONLY 6-HOUR STORM WHICH CONTROLS

                    HUFF 2ND QUARTILE DISTRIBUTION USED FOR 6-HOUR DURATION STORM

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

     IT        HYDROGRAPH TIME DATA
                      NMIN         18  MINUTES IN COMPUTATION INTERVAL
                     IDATE     1JAN 2  STARTING DATE
                     ITIME       0000  STARTING TIME
                        NQ        250  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE     4JAN 2  ENDING DATE
                    NDTIME       0242  ENDING TIME
                     ICENT         20  CENTURY MARK

                COMPUTATION INTERVAL     .30 HOURS
                     TOTAL TIME BASE   74.70 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
                    .10      .20      .30      .40      .50      .60      .70      .80     1.00

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

             *************
             *           *
  12 KK      *   STA1    *
             *           *
             *************
                    TRADERS POINT LAKE 6-HOUR HYDROGRAPH

              SUBBASIN RUNOFF DATA

  14 BA        SUBBASIN CHARACTERISTICS
                     TAREA       1.63  SUBBASIN AREA

               PRECIPITATION DATA

  15 PB              STORM      27.05  BASIN TOTAL PRECIPITATION

  16 PI          INCREMENTAL PRECIPITATION PATTERN
                       .03      .04      .05      .06      .09      .09      .09      .09      .07      .07
                       .04      .04      .04      .04      .03      .03      .03      .03      .02      .02

  19 LS        SCS LOSS RATE
                    STRTL         .15  INITIAL ABSTRACTION
                   CRVNBR       93.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

  20 UD        SCS DIMENSIONLESS UNITGRAPH
                     TLAG        2.70  LAG

                                                  ***
```

UNIT HYDROGRAPH
47 END-OF-PERIOD ORDINATES

9.	30.	58.	95.	144.	197.	238.	264.	275.	275.
264.	245.	223.	195.	162.	132.	110.	92.	77.	67.
56.	48.	40.	34.	28.	24.	20.	17.	14.	12.
10.	9.	7.	6.	5.	4.	4.	3.	3.	2.
2.	2.	1.	1.	1.	0.	0.			

*** ***

```
            **************
            *            *
21 KK       *     STA2   *
            *            *
            **************
```

ROUTE 6-HR STORM THROUGH LAKE

HYDROGRAPH ROUTING DATA

23 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	ELEV	TYPE OF INITIAL CONDITION
RSVRIC	100.00	INITIAL CONDITION
X	.00	WORKING R AND D COEFFICIENT

24 SA	AREA	10.0	11.0							
25 SE	ELEVATION	100.00	104.50							
26 SQ	DISCHARGE	0.	32.	87.	153.	227.	305.	385.	465.	544.	619.
27 SE	ELEVATION	100.00	100.50	101.00	101.50	102.00	102.50	103.00	103.50	104.00	104.50

28 SS SPILLWAY

CREL	100.00	SPILLWAY CREST ELEVATION
SPWID	.00	SPILLWAY WIDTH
COOW	.00	WEIR COEFFICIENT
EXPW	1.50	EXPONENT OF HEAD

29 ST TOP OF DAM

TOPEL	104.50	ELEVATION AT TOP OF DAM
DAMWID	300.00	DAM WIDTH
COOD	3.09	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED STORAGE-ELEVATION DATA

STORAGE	.00	47.23
ELEVATION	100.00	104.50

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	5.03	10.11	15.25	20.44	25.68	30.99	36.35	41.76	47.23
OUTFLOW	.00	32.00	87.00	153.00	227.00	305.00	385.00	465.00	544.00	619.00
ELEVATION	100.00	100.50	101.00	101.50	102.00	102.50	103.00	103.50	104.00	104.50

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		RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .20	RATIO 3 .30	RATIO 4 .40	RATIO 5 .50	RATIO 6 .60	RATIO 7 .70	RATIO 8 .80	RATIO 9 1.00
HYDROGRAPH AT													
+	STA1	1.63	1	FLOW	495.	991.	1486.	1981.	2477.	2972.	3467.	3963.	4953.
				TIME	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10
ROUTED TO													
+	STA2	1.63	1	FLOW	462.	988.	1483.	1977.	2471.	2965.	3459.	3954.	4943.
				TIME	6.00	5.40	5.40	5.40	5.40	5.40	5.40	5.10	5.10
			** PEAK STAGES IN FEET **										
			1	STAGE	103.48	104.97	105.36	105.68	105.96	106.22	106.46	106.69	107.12
				TIME	6.00	5.40	5.40	5.40	5.40	5.40	5.40	5.10	5.10

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION STA2
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	100.00	100.00	104.50
STORAGE	0.	0.	47.
OUTFLOW	0.	0.	619.

	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
	.10	103.48	.00	36.	462.	.00	6.00	.00
	.20	104.97	.47	52.	988.	3.60	5.40	.00
	.30	105.36	.86	57.	1483.	5.10	5.40	.00
	.40	105.68	1.18	60.	1977.	6.30	5.40	.00
→	.50	105.96	1.46	64.	2471.	6.90	5.40	.00
	.60	106.22	1.72	66.	2965.	7.50	5.40	.00
	.70	106.46	1.96	69.	3459.	7.80	5.40	.00
	.80	106.69	2.19	72.	3954.	8.10	5.10	.00
	1.00	107.12	2.62	77.	4943.	8.70	5.10	.00

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

EXPANDED SPILLWAY

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

            1       ID   HYDROLOGIC MODEL FOR TRADERS POINT LAKE
            2       ID   USING SCS METHOD FOR LOSS RATE AND DIMENSIONLESS UNIT HYDROGRAPH
            3       ID
            4       ID   ******ESTIMATING % OF PMP RUNOFF DAM CAN CONTROL WITHOUT OVERTOPPING******
            5       ID   CHECKING ONLY 6-HOUR STORM WHICH CONTROLS
            6       ID
            7       ID   HUFF 2ND QUARTILE DISTRIBUTION USED FOR 6-HOUR DURATION STORM
            8       ID
*** FREE ***
            9       IT     18 01JAN02       0     250                    2000
           10       IO      4
           11       JR   FLOW      .1      .2      .3      .4      .5      .6      .7      .8     1.0

           12       KK    STA1
           13       KM   TRADERS POINT LAKE 6-HOUR HYDROGRAPH
           14       BA    1.63       0
           15       PB   27.05
           16       PC     0.0    .0280   .0660   .1170   .1813   .2699   .3585   .4440   .5294   .6040
           17       PC    .6786   .7219   .7652   .8017   .8381   .8724   .9067   .9328   .9589   .9795
           18       PC    1.0
           19       LS      0      93
           20       UD    2.7

           21       KK    STA2
           22       KM   ROUTE 6-HR STORM THROUGH LAKE
           23       RS       1    ELEV     100       0
           24       SA      10      11
           25       SE     100   104.5
           26       SQ       0     100     281     511     778    1075    1397    1740    2101    2478
           27       SE     100   100.5     101   101.5     102   102.5     103   103.5     104   104.5
           28       SS     100       0    3.09     1.5
           29       ST   104.5     300    3.09     1.5
           30       ZZ
```

```
*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*           SEPTEMBER 1990              *
*            VERSION 4.0                *
*                                       *
*  RUN DATE  01/25/2008  TIME  13:37:10 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

HYDROLOGIC MODEL FOR TRADERS POINT LAKE
USING SCS METHOD FOR LOSS RATE AND DIMENSIONLESS UNIT HYDROGRAPH

******ESTIMATING % OF PMP RUNOFF DAM CAN CONTROL WITHOUT OVERTOPPING******
CHECKING ONLY 6-HOUR STORM WHICH CONTROLS

HUFF 2ND QUARTILE DISTRIBUTION USED FOR 6-HOUR DURATION STORM

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

   IT          HYDROGRAPH TIME DATA
                   NMIN          18  MINUTES IN COMPUTATION INTERVAL
                   IDATE      1JAN 2  STARTING DATE
                   ITIME        0000  STARTING TIME
                     NQ         250  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE      4JAN 2  ENDING DATE
                  NDTIME        0242  ENDING TIME
                  ICENT          20  CENTURY MARK

                COMPUTATION INTERVAL      .30 HOURS
                    TOTAL TIME BASE   74.70 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
                    .10       .20       .30       .40       .50       .60       .70       .80      1.00
```

*** ***

```
           *************
           *           *
12 KK      *    STA1   *
           *           *
           *************
                    TRADERS POINT LAKE 6-HOUR HYDROGRAPH

              SUBBASIN RUNOFF DATA

14 BA            SUBBASIN CHARACTERISTICS
                      TAREA       1.63  SUBBASIN AREA

                 PRECIPITATION DATA

15 PB                 STORM      27.05  BASIN TOTAL PRECIPITATION

16 PI              INCREMENTAL PRECIPITATION PATTERN
                     .03       .04       .05       .06       .09       .09       .09       .09       .07       .07
                     .04       .04       .04       .04       .03       .03       .03       .03       .02       .02

19 LS            SCS LOSS RATE
                      STRTL        .15  INITIAL ABSTRACTION
                     CRVNBR      93.00  CURVE NUMBER
                      RTIMP        .00  PERCENT IMPERVIOUS AREA

20 UD            SCS DIMENSIONLESS UNITGRAPH
                      TLAG       2.70  LAG
```

***

UNIT HYDROGRAPH
47 END-OF-PERIOD ORDINATES

9.	30.	58.	95.	144.	197.	238.	264.	275.	275.
264.	245.	223.	195.	162.	132.	110.	92.	77.	67.
56.	48.	40.	34.	28.	24.	20.	17.	14.	12.
10.	9.	7.	6.	5.	4.	4.	3.	3.	2.
2.	2.	1.	1.	1.	0.	0.			

*** ***

21 KK

```
**************
*            *
*    STA2    *
*            *
**************
```

ROUTE 6-HR STORM THROUGH LAKE

HYDROGRAPH ROUTING DATA

23 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	ELEV	TYPE OF INITIAL CONDITION
RSVRIC	100.00	INITIAL CONDITION
X	.00	WORKING R AND D COEFFICIENT

24 SA AREA 10.0 11.0

25 SE ELEVATION 100.00 104.50

26 SQ DISCHARGE 0. 100. 281. 511. 778. 1075. 1397. 1740. 2101. 2478.

27 SE ELEVATION 100.00 100.50 101.00 101.50 102.00 102.50 103.00 103.50 104.00 104.50

28 SS SPILLWAY

CREL	100.00	SPILLWAY CREST ELEVATION
SPWID	.00	SPILLWAY WIDTH
COOW	.00	WEIR COEFFICIENT
EXPW	1.50	EXPONENT OF HEAD

29 ST TOP OF DAM

TOPEL	104.50	ELEVATION AT TOP OF DAM
DAMWID	300.00	DAM WIDTH
COOD	3.09	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED STORAGE-ELEVATION DATA

STORAGE	.00	47.23
ELEVATION	100.00	104.50

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	5.03	10.11	15.25	20.44	25.68	30.99	36.35	41.76	47.23
OUTFLOW	.00	100.00	281.00	511.00	778.00	1075.00	1397.00	1740.00	2101.00	2478.00
ELEVATION	100.00	100.50	101.00	101.50	102.00	102.50	103.00	103.50	104.00	104.50

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		RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .20	RATIO 3 .30	RATIO 4 .40	RATIO 5 .50	RATIO 6 .60	RATIO 7 .70	RATIO 8 .80	RATIO 9 1.00
HYDROGRAPH AT													
+	STA1	1.63	1	FLOW	495.	991.	1486.	1981.	2477.	2972.	3467.	3963.	4953.
				TIME	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10
ROUTED TO													
+	STA2	1.63	1	FLOW	490.	986.	1481.	1975.	2463.	2966.	3460.	3953.	4943.
				TIME	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.10
			** PEAK STAGES IN FEET **										
			1	STAGE	101.46	102.35	103.12	103.83	104.48	104.87	105.15	105.40	105.85
				TIME	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.10

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION STA2
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	100.00	100.00	104.50
STORAGE	0.	0.	47.
OUTFLOW	0.	0.	2478.

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
.10	101.46	.00	15.	490.	.00	5.40	.00
.20	102.35	.00	24.	986.	.00	5.40	.00
.30	103.12	.00	32.	1481.	.00	5.40	.00
.40	103.83	.00	40.	1975.	.00	5.40	.00
→.50	104.48	.00	47.	2463.	.00	5.40	.00
.60	104.87	.37	51.	2966.	2.40	5.40	.00
.70	105.15	.65	54.	3460.	3.60	5.40	.00
.80	105.40	.90	57.	3953.	4.50	5.40	.00
1.00	105.85	1.35	62.	4943.	5.40	5.10	.00

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

RAISED DAM HEIGHT

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

            1       ID   HYDROLOGIC MODEL FOR TRADERS POINT LAKE
            2       ID   USING SCS METHOD FOR LOSS RATE AND DIMENSIONLESS UNIT HYDROGRAPH
            3       ID
            4       ID   ******ESTIMATING % OF PMP RUNOFF DAM CAN CONTROL WITHOUT OVERTOPPING******
            5       ID   CHECKING ONLY 6-HOUR STORM WHICH CONTROLS
            6       ID
            7       ID   HUFF 2ND QUARTILE DISTRIBUTION USED FOR 6-HOUR DURATION STORM
            8       ID
*** FREE ***
            9       IT     18 01JAN02       0     250                    2000
           10       IO      4
           11       JR   FLOW      .1      .2      .3      .4      .5      .6      .7      .8     1.0

           12       KK    STA1
           13       KM   TRADERS POINT LAKE 6-HOUR HYDROGRAPH
           14       BA    1.63       0
           15       PB   27.05
           16       PC     0.0    .0280   .0660   .1170   .1813   .2699   .3585   .4440   .5294   .6040
           17       PC   .6786    .7219   .7652   .8017   .8381   .8724   .9067   .9328   .9589   .9795
           18       PC     1.0
           19       LS       0      93
           20       UD     2.7

           21       KK    STA2
           22       KM   ROUTE 6-HR STORM THROUGH LAKE
           23       RS       1    ELEV     100       0
           24       SA      10      11      13      14
           25       SE     100   104.5     110     115
           26       SQ       0      32      87     153     227     305     385     465     544     619
           27       SE     100   100.5     101   101.5     102   102.5     103   103.5     104   104.5
           28       SS     100       0    3.09     1.5
           29       ST   116.5     300    3.09     1.5
           30       ZZ
```

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  01/25/2008  TIME  13:55:18 *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*        DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104              *
*                                       *
*****************************************
```


```
HYDROLOGIC MODEL FOR TRADERS POINT LAKE
USING SCS METHOD FOR LOSS RATE AND DIMENSIONLESS UNIT HYDROGRAPH

******ESTIMATING % OF PMP RUNOFF DAM CAN CONTROL WITHOUT OVERTOPPING******
CHECKING ONLY 6-HOUR STORM WHICH CONTROLS

HUFF 2ND QUARTILE DISTRIBUTION USED FOR 6-HOUR DURATION STORM

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

   IT         HYDROGRAPH TIME DATA
                    NMIN         18  MINUTES IN COMPUTATION INTERVAL
                   IDATE      1JAN 2  STARTING DATE
                   ITIME        0000  STARTING TIME
                      NQ         250  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE      4JAN 2  ENDING DATE
                  NDTIME        0242  ENDING TIME
                   ICENT          20  CENTURY MARK

                COMPUTATION INTERVAL      .30 HOURS
                     TOTAL TIME BASE    74.70 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
                .10       .20       .30       .40       .50       .60       .70       .80      1.00


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


         *************
         *           *
12 KK    *     STA1  *
         *           *
         *************
                  TRADERS POINT LAKE 6-HOUR HYDROGRAPH

          SUBBASIN RUNOFF DATA

14 BA       SUBBASIN CHARACTERISTICS
                 TAREA       1.63  SUBBASIN AREA

            PRECIPITATION DATA

15 PB            STORM      27.05  BASIN TOTAL PRECIPITATION

16 PI         INCREMENTAL PRECIPITATION PATTERN
                 .03       .04       .05       .06       .09       .09       .09       .09       .07       .07
                 .04       .04       .04       .04       .03       .03       .03       .03       .02       .02

19 LS       SCS LOSS RATE
                 STRTL        .15  INITIAL ABSTRACTION
                CRVNBR      93.00  CURVE NUMBER
                 RTIMP        .00  PERCENT IMPERVIOUS AREA

20 UD       SCS DIMENSIONLESS UNITGRAPH
                  TLAG       2.70  LAG

                                                    ***
```

UNIT HYDROGRAPH
47 END-OF-PERIOD ORDINATES

9.	30.	58.	95.	144.	197.	238.	264.	275.	275.
264.	245.	223.	195.	162.	132.	110.	92.	77.	67.
56.	48.	40.	34.	28.	24.	20.	17.	14.	12.
10.	9.	7.	6.	5.	4.	4.	3.	3.	2.
2.	2.	1.	1.	1.	0.	0.			

*** ***

21 KK STA2

ROUTE 6-HR STORM THROUGH LAKE

HYDROGRAPH ROUTING DATA

23 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	ELEV	TYPE OF INITIAL CONDITION
RSVRIC	100.00	INITIAL CONDITION
X	.00	WORKING R AND D COEFFICIENT

24 SA	AREA	10.0	11.0	13.0	14.0					
25 SE	ELEVATION	100.00	104.50	110.00	115.00					
26 SQ	DISCHARGE	0.	32.	87.	153.	227.	305.	385.	465.	544.	619.
27 SE	ELEVATION	100.00	100.50	101.00	101.50	102.00	102.50	103.00	103.50	104.00	104.50

28 SS SPILLWAY

CREL	100.00	SPILLWAY CREST ELEVATION
SPWID	.00	SPILLWAY WIDTH
COOW	.00	WEIR COEFFICIENT
EXPW	1.50	EXPONENT OF HEAD

29 ST TOP OF DAM

TOPEL	116.50	ELEVATION AT TOP OF DAM
DAMWID	300.00	DAM WIDTH
COQD	3.09	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED STORAGE-ELEVATION DATA

STORAGE	.00	47.23	113.16	180.64
ELEVATION	100.00	104.50	110.00	115.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	5.03	10.11	15.25	20.44	25.68	30.99	36.35	41.76	47.23
OUTFLOW	.00	32.00	87.00	153.00	227.00	305.00	385.00	465.00	544.00	619.00
ELEVATION	100.00	100.50	101.00	101.50	102.00	102.50	103.00	103.50	104.00	104.50

STORAGE	113.16	180.64
OUTFLOW	1444.00	2194.00
ELEVATION	110.00	115.00

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		RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .20	RATIO 3 .30	RATIO 4 .40	RATIO 5 .50	RATIO 6 .60	RATIO 7 .70	RATIO 8 .80	RATIO 9 1.00
HYDROGRAPH AT													
+	STA1	1.63	1	FLOW	495.	991.	1486.	1981.	2477.	2972.	3467.	3963.	4953.
				TIME	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10
ROUTED TO													
+	STA2	1.63	1	FLOW	462.	914.	1359.	1800.	2236.	2904.	3492.	3956.	4942.
				TIME	6.00	6.00	6.30	6.30	6.30	5.70	5.10	5.40	5.40
			** PEAK STAGES IN FEET **										
			1	STAGE	103.48	106.46	109.43	112.37	115.28	117.07	117.50	117.78	118.31
				TIME	6.00	6.00	6.30	6.30	6.30	5.70	5.10	5.40	5.40

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION STA2
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	100.00	100.00	116.50
STORAGE	0.	0.	202.
OUTFLOW	0.	0.	2419.

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
.10	103.48	.00	36.	462.	.00	6.00	.00
.20	106.46	.00	70.	914.	.00	6.00	.00
.30	109.43	.00	106.	1359.	.00	6.30	.00
.40	112.37	.00	145.	1800.	.00	6.30	.00
→ .50	115.28	.00	185.	2236.	.00	6.30	.00
.60	117.07	.57	210.	2904.	1.80	5.70	.00
.70	117.50	1.00	216.	3492.	3.00	5.10	.00
.80	117.78	1.28	220.	3956.	3.60	5.40	.00
1.00	118.31	1.81	228.	4942.	4.50	5.40	.00

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