HYDRAULIC & SCOUR ANALYSIS
51st AVENUE BRIDGE
at
SKUNK CREEK
BR-885806

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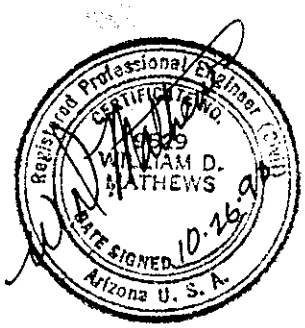

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1. PURPOSE OF STUDY

The City of Phoenix has retained Mathews Kessler & Associates, Inc. (MKA) to design a new bridge over Skunk Creek at 51st Avenue. As part of the bridge construction project, approximately 1000 feet of Skunk Creek will be channelized. This new channel will extend about 500 feet downstream, and 500 feet upstream, of the proposed bridge centerline.

As part of the design process, a hydraulic and scour analysis was required to:

1) develop water surface profiles for use in designing the new channel;

2) develop water surface profiles through the proposed bridge in order to establish minimum low-chord elevations; and

3) quantify scour depths for the design of the bridge piers and bridge abutments.

The remainder of this report documents the engineering analysis that was performed to accomplish these objectives.

2. DATA SOURCES

2.1 Design Criteria

In accordance with criteria established by the City of Phoenix and the Flood Control District of Maricopa County, the following parameters were used for the design of the channel and bridge improvements (Reference: Flood Plain Study For Channelization of Skunk Creek at 51st Avenue Crossing, RGA Engineering Corporation, June 14, 1989).

Channel Freeboard & Discharge

- 1.0 foot (minimum) for present development, 100-year discharge of 8,750 cfs.
- 0.5 feet (minimum) for future development, 100-year discharge of 10,400 cfs.

Bridge Freeboard & Discharge

- 2.0 feet (minimum) for present development, 100-year discharge of 8,750 cfs.
- 1.5 feet (minimum) for future development, 100-year discharge of 10,400 cfs.

2.2 Soils

A geotechnical engineering report, dated December 26, 1989, was prepared for the proposed bridge location by Thomas-Hartig & Associates, Inc. This report included sieve analyses at five locations near the proposed bridge site. Sample No.1 provided gradation information for material from the surface to a depth of 10 feet, while Sample No. 2 was representative of material lying 4 to 9 feet below the surface.

Based on graphic plot of these gradations, Sample No. 1 had a D50 of 4.8 mm and a gradation coefficient of 4.4. Sample No. 2 had a D50 of 2.7 mm and a gradation coefficient of 4.9.

An independent field inspection of the site indicated that the existing channel bed through this reach of Skunk Creek is very cobbly and undoubtedly armored, for certain flow conditions. However, the new channel alignment will be excavated slightly south of the existing channel alignment. Due to the manmade excavation of this new channel, it will not incorporate a natural armor layer. Accordingly, the bed-material in the new channel will probably be typical of the coarse sand and gravel that is representative of the gradation results at sample locations 1 and 2. A sand-bed channel was assumed for the purpose of conducting pier scour calculations.

2.3 Topography

A surveyed grid of spot elevations was previously obtained by RGA Engineering Corporation for the project site. This grid area included the approaches to the bridge, as well as the proposed channel alignment. The spot elevations from this surveyed grid were input to a computer program to generate a topographic map of the area. The grid elevations were used by MKA to establish invert elevations for the proposed channel.

For the purpose of HEC-2 modeling, the survey grid was supplemented with April 1990 topographic maps (1"=200', 2' C.I.) prepared by Aerial Mapping Company (AMC). These maps were compiled for use by Coe & Van Loo in preparing a new floodplain delineation for Skunk Creek.

The AMC maps, which were verified as being on the same elevation datum as the MKA survey grid, were used to develop additional HEC-2 cross-sections downstream of the proposed channelization limits associated with the new 51st Avenue bridge. These maps were also used to examine the existing bed profile of Skunk Creek from 57th Drive to 43rd Avenue.

3. HYDRAULIC ANALYSIS

A hydraulic analysis of the proposed channel was conducted with the Corps of Engineers "Water Surface Profiles" program, HEC-2. The purpose of this analysis was to develop 100-year water surface elevations for the design of both the channel and bridge. The following subsections describe the input parameters that were used to create the HEC-2 model.

3.1 Channel Geometry & Alignment

The proposed channel will consist of a trapezoidal section with a bottom width varying from 110 feet downstream of, and through the bridge, to 210 feet upstream of the bridge. The channel side-slopes will vary from 2:1 to 3:1, with the 2:1 slopes being used through the bridge area. Beneath the actual bridge structure, the 2:1 side-slopes intersect the vertical sides of the bridge abutments, i.e., when flow depths through the bridge exceed 7.0 feet, they will encounter the vertical abutment wall.

The channel banks, into and out of the bridge, will reflect a smooth transition of the side-slopes from 3:1 to 2:1 and back to 3:1.

Plate 1 illustrates the proposed channel alignment and changes in bottomwidth.

3.2 Hydraulic Roughness & Energy Loss Coefficients

Manning's "n" values were selected on the basis of engineering judgement, site inspections, and photographic references presented in Roughness Coefficients for Stream Channels in Arizona, USGS (Aldridge & Garrett) 1973.

Substantial portions of Skunk Creek have already been channelized both upstream and downstream of 51st Avenue. Significant stands of natural vegetation were observed in the channel near 59th Avenue. This existing vegetation is probably typical of how the new channel would be maintained at 51st Avenue.

The manmade channels upstream of 51st Avenue were artificially landscaped with native desert trees and bushes. Discussions with representatives from Coe & Van Loo (CVL) indicated that agreement had been reached with the Flood Control District of Maricopa County to model these landscaped channels with an "n" value of 0.035 for use in the new Skunk Creek floodplain delineation.

Although it is presently unknown as to what level of vegetation density will ultimately be allowed in the proposed channel at 51st Avenue, it is reasonable to assume that it will probably be similar to what presently exists near 59th Avenue and 43rd Avenue.

For discharges in the range of 8,750 to 10,400 cfs, an "n" value of 0.035 to 0.040 should be reasonable to simulate comparable levels of vegetation at 51st Avenue. In order to provide compatibility with the ongoing CVL Flood Insurance Study, the lower end of this range (n=.035) was adopted for use with the sub-critical water surface profile analysis. An "n" value of 0.025 was used for the super-critical water surface profile analysis. This lower, super-critical "n" value maximizes flow velocities for use in scour calculations.

The City of Phoenix should monitor this channel very closely and make a dedicated effort to periodically remove any vegetation that may naturally accumulate in the channel. Any future plans to artificially vegetate the channel should be coordinated with a river mechanics engineer to insure that the vegetation density will not create a rougher channel than that associated with the assumed "n" value of 0.035.

As a matter of technical comparison, it should be noted that the previously referenced 1989 RGA report used a channel "n" value of 0.030 for the proposed Skunk Creek channel at 51st Avenue.

Energy losses due to flow expansion and contraction were simulated by varying the loss coefficients at different locations along the channel. For the sub-critical models, loss coefficients of 0.2/0.4 (contraction/expansion) were used for all reaches of the channel except at the bridge, where the coefficients were increased to 0.3/0.5.

The super-critical models used coefficients of 0.1/0.3 through the entire channel reach, including the bridge. These lower values were used to maximize velocities for use in scour calculations.

3.3 Bridge Parameters

The proposed 51st Avenue bridge has been designed with a single group of circular piers placed along the channel centerline. This pier configuration consists of five, 5-foot diameter concrete cylinders spaced at 21 feet, 6 inches, on-center.

The hydraulic impact of the piers was simulated in the HEC-2 model by simply blocking out the pier diameter on the GR cards. Experimental models were also created using the Special Bridge routine in HEC-2.

The Special Bridge option was found to produce slightly lower water surface elevations, through and upstream of the bridge, than those obtained by modeling the piers with GR cards. Accordingly, to enhance the safety factor in the water surface profile evaluation, the Special Bridge routine was not used in the final hydraulic analysis.

The pier width used in the HEC-2 models was varied from 5 feet to 10 feet. The 5-foot diameter pier width was used with the sub-critical water surface profile to establish the channel and bridge freeboard requirements.

The pier scour and abutment scour calculations were based on both sub-critical and super-critical models that used a pier width of 10 feet. The 10-foot pier width represents the actual pier diameter of 5 feet plus an additional 2.5 feet of debris on each side of the pier. For the sub-critical models, the additional 5 feet of debris blockage increases the water surface elevation by a maximum of 0.24 feet through the bridge during a peak discharge of 10,400 cfs.

The vertical abutment walls under the bridge may create some non-effective flow areas into and out of the bridge opening. To simulate this possibility, encroachment stations were included in the model to reflect a 1:1 contraction ratio into the bridge and a 4:1 expansion ratio out of the bridge. The effective flow boundaries were extended from the upstream and downstream ends of the vertical abutment walls.

3.4 Results of Hydraulic Analysis

As indicated previously the purpose of this study is to develop both a 100-year water surface profile for the channel design and to develop hydraulic data for the analysis of pier scour and abutment scour.

Accordingly, it is prudent it investigate flow regimes that will maximize both depth of flow and velocity of flow.

To accomplish this objective, a sub-critical model was used to define the maximum water surface profile for the channel design, while a super-critical profile was used to investigate the maximum mean velocities that might occur in the channel. With the proposed channel gradients, the majority of the channel downstream of the bridge tends to be super-critical, especially when the low "n" value of 0.025 is used. Conversely, the flatter channel slope and wider bottomwidth, upstream of the bridge, promotes sub-critical flow.

Appendix A contains input and output from four HEC-2 models that were developed for this study. These models are described as follows:

1. Model SK2E.IN/.OT - Sub-critical model with n=0.035 and 5-foot diameter pier obstruction (no debris) at 51st Avenue bridge.

2. Model SK3D.IN/.OT - Super-critical model with n=0.025 and 5-foot diameter pier obstruction (no debris) at 51st Avenue bridge.

3. Model SK2F.IN/.OT - Sub-critical model with n=0.035 and 10-foot diameter pier obstruction (with debris) at 51st Avenue bridge.

4. Model SK3E.IN/.OT - Super-critical model with n=0.025 and 10-foot diameter pier obstruction (with debris) at 51st Avenue bridge.

Table 3.1 presents a summary of the water surface elevations and associated mean channel velocities that result from the sub-critical HEC-2 model (SK2E.IN/.OT) with 5-foot pier diameters. The data in Table 3.1 was used for the channel design and to meet the freeboard requirements for both the channel and bridge.

Table 3.1
Summary of Sub–Critical Water Surface Profile Elevations & Velocities
Skunk Creek at 51st Avenue
HEC–2 Model SK2E.OT

Channel XSEC	Channel Invert Elevation (MSL)	Q=8,750 cfs		Q=10,400 cfs	
		Water Surface Elevation (MSL)	Velocity (fps)	Water Surface Elevation (MSL)	Velocity (fps)
0.0	1277.60	1284.42	6.72	1285.05	7.19
150.0	1277.00	1285.18	3.40	1285.90	3.69
310.0	1278.00	1284.87	7.79	1285.52	8.43
535.0	1280.00	1285.50	12.59	1286.13	13.22
595.0	1280.80	1286.30	12.57	1286.94	13.20
655.0	1281.60	1287.10	12.57	1287.73	13.20
715.0	1282.40	1287.90	12.57	1288.53	13.20
775.0	1283.21	1288.71	12.57	1289.34	13.20
835.0	1284.01	1289.51	12.57	1290.14	13.20
900.0	1284.60	1290.84	10.95	1291.48	11.64
925.0	1284.88	1290.92	11.57	1291.55	12.31
957.0	1285.23	1290.98	12.90	1291.64	13.59
970.0	1285.37	1291.13	13.04	1291.80	13.71
1000.0	1285.70	1292.30	11.24	1293.04	11.86
1030.0	1286.03	1292.49	11.49	1293.22	12.11
1043.0	1286.17	1292.76	11.11	1293.55	11.63
1075.0	1286.53	1293.46	9.93	1294.31	10.35
1100.0	1286.80	1293.62	9.84	1294.50	10.14
1200.0	1287.90	1294.51	8.56	1295.38	8.84
1300.0	1288.65	1295.40	6.31	1296.28	6.55
1400.0	1289.20	1295.69	5.87	1296.56	6.09
1500.0	1289.75	1295.84	6.30	1296.70	6.48
1545.0	1290.00	1295.92	6.48	1296.77	6.66

File: TAB31.WK1

Table 3.2
Summary of Super-Critical Water Surface Profile Elevations & Velocities
Skunk Creek at 51st Avenue
HEC-2 Model SK3E.OT

Channel XSEC	Channel Invert Elevation (MSL)	Q=8,750 cfs		Q=10,400 cfs	
		Water Surface Elevation (MSL)	Velocity (fps)	Water Surface Elevation (MSL)	Velocity (fps)
0.0	1277.60	1282.30	10.76	1282.73	11.39
150.0	1277.00	1279.51	13.34	1279.66	14.78
310.0	1278.00	1281.44	15.91	1281.77	17.21
535.0	1280.00	1284.28	16.67	1284.76	17.66
595.0	1280.80	1285.09	16.60	1285.58	17.57
655.0	1281.60	1285.94	16.45	1286.41	17.43
715.0	1282.40	1286.79	16.25	1287.26	17.23
775.0	1283.21	1287.69	15.87	1288.16	16.87
835.0	1284.01	1288.66	15.23	1289.11	16.34
900.0	1284.60	1288.86	16.77	1289.34	17.72
925.0	1284.88	1289.20	16.75	1289.71	17.64
957.0	1285.23	1290.36	15.28	1290.99	16.01
970.0	1285.37	1290.68	14.90	1291.34	15.57
1000.0	1285.70	1291.17	14.43	1291.83	15.10
1030.0	1286.03	1291.90	13.33	1292.64	13.87
1043.0	1286.17	1292.07	13.13	1292.76	13.79
1075.0	1286.53	1292.04	12.86	1292.71	13.41
1100.0	1286.80	1292.31	12.56	1292.94	13.19
1200.0	1287.90	1292.77	12.02	1293.34	12.64
1300.0	1288.65	1292.66	11.08	1293.13	11.69
1400.0	1289.20	1292.90	10.70	1293.34	11.29
1500.0	1289.75	1293.45	10.70	1293.89	11.29
1545.0	1290.00	1293.70	10.70	1294.14	11.28

File: TAB32.WK1

Table 3.2 presents similar data for the super-critical model (SK3E.IN/.OT) with 10-feet of effective pier blockage. The mean velocities in Table 3.2 would be recommended for use in any future bank stabilization design that the City of Phoenix might consider for the entire channel.

In reviewing the velocity data in Tables 3.1 and 3.2, it should be noted that erosive velocities can be expected during the 100-year event, throughout the length of the proposed channel. Using an "n" value of 0.035 and a sub-critical flow model, Table 3.1 lists mean channel velocities ranging from 6.09 fps to 13.71 fps, for a discharge of 10,400 cfs. The approximate 6 fps velocities upstream of cross-section 1300 are borderline as to whether they would create substantial bank erosion during a single flood. However, the 10-13 fps velocities, through and downstream of the bridge, are definitely erosive.

When reviewing the data in Table 3.2, the assumptions of super-critical flow and an "n" value of 0.025, result in erosive velocities throughout the channel during the 100-year flood.

A hydraulic analysis for lesser flow events was not conducted as part of this study. Accordingly, the potential for bank erosion at smaller flow events is not known.

The Scope of Work for this project includes provisions for providing bank protection through the bridge structure, but not for the entire channel. It is recommended as part of this project, that the bank protection for the bridge abutments be extended upstream to channel STA 12+00 and downstream to STA 8+60. The downstream extension to STA 8+60 will insure that two storm drain outlets, on the north and south banks, will be protected from bank erosion. The upstream extension to STA 12+00 will insure a stable angle-point in the channel contraction at this location. Protection for the south bank should also be carried through to STA 12+00 in order to preclude accelerated erosion of this bank that could be induced when the sediment supply is cut-off from the opposite bank.

In consideration of the erosive velocities presented in Tables 3.1 and 3.2, the City of Phoenix should consider bank protection for additional sections of the channel, other than those in the immediate vicinity of the new bridge.

That portion of the channel immediately upstream and downstream of the bridge would be constructed to its specified cross-sectional geometry as part of this contract, the remaining portions would only be graded to the specified bottomwidth and invert elevation, i.e., the bank geometry and freeboard requirements would not be established by this project.

The bank-slope and freeboard specifications would be constructed as part of future development projects.

This partial construction of the downstream channel geometry should not create any significant adverse change to the water surface profile through the bridge, as long as the full channel cross-section is extended to channel STA 8+35, as part of the bridge construction contract. This conclusion is based on the fact that cross-section 835 defaults to critical depth during the sub-critical run. This section still assumes critical depth even when the remaining improved channel cross-section at XSEC 535, 595, 655, and 715 are removed from the model. Accordingly, any partial construction of these four cross-sections should not increase the water surface profile upstream of channel STA 8+35 beyond that which was computed with the four sections modeled with their final geometry.

4. SCOUR ANALYSIS

A scour analysis was performed to identify anticipated scour depths for use in designing the bridge piers and establishing toe-down elevations for the bank protection around the bridge abutments.

Vertical movement (scour) of a riverbed can occur in response to the following processes:

1. Long-term aggradation/degradation
2. General scour
3. Local scour
4. Bedform troughs
5. Bend scour
6. Low-flow incisement

Due to the complex interaction of river system variables that control these processes, it is not possible to quantify the impact that the variables may have on each other. Accordingly, each process is evaluated independently of the other five. The total estimated bed movement is then taken as the sum of all six components. The complexity of sediment transport and scour analyses justifies the application of a safety factor to the sum of the six scour processes.

The proposed channel alignment, and contracting channel geometry, will subject the bridge piers to five of the six listed scour components. Bend scour will not be applicable to this site because of the absence of any channel curvature.

The following subsections present a discussion of the five applicable scour components and a summary section describes the manner in which each component was applied for use in the pier and abutment design.

4.1 Long-Term Degradation

This process occurs over a long period of time in response to an imbalance between the sediment transport capacity of the channel and the dominant sediment supply to the channel. When such imbalances occur, the channel will naturally adjust its slope to restore equilibrium between the transport capacity and incoming supply of sediment. If the transport capacity of the channel exceeds the sediment supply, the channel will flatten its

slope (degrade). However, should the sediment supply exceed the transport capacity of the channel, the channel slope will increase (aggrade) in order to generate higher velocities that are capable of moving the sediment inflows.

Long-term degradation is very difficult to quantify because of the many complex variables that drive the process. Accordingly, numerous assumptions have to be made on the basis of engineering judgment.

The magnitude of long-term degradation is usually established through an equilibrium slope analysis. Such analyses are very lengthy and require substantial data in order to be meaningful. Although the Scope of Work for this project did not require the performance of an equilibrium slope analysis, an effort was made to include this process in the total scour depth that the bridge piers might be subjected to.

The importance of addressing this phenomenon was magnified by the fact that this location on Skunk Creek lies only a short distance below Adobe Dam. Long-term channel degradation is a documented fact below dams. The depth of degradation at Willow Beach, which is located on the Colorado River about 12 miles below Hoover Dam, amounted to 14 feet between 1935 and 1949. Such degradation occurs because dams cut-off the sediment supply to downstream channels. The equilibrium response of the channel is to degrade in an effort to flatten it's slope to decrease its sediment transport capacity to match the reduced sediment supply.

Adobe Dam intercepts approximately 90 square miles of the Skunk Creek drainage area. Although Scatter Wash joins Skunk Creek below Adobe Dam, the Scatter Wash drainage area, below the CAP, is reported as less than 10 square miles. Considering that Skunk Creek only drains an additional 0.9 square miles below Adobe Dam, at the confluence with Scatter Wash, it is obvious that nearly 85 percent of the Skunk Creek watershed, at 51st Avenue, is intercepted by Adobe Dam. Over the long-term, this interception of the sediment supply is bound to induce degradation in those reaches of Skunk Creek lying below Adobe Dam. Since Adobe Dam has only been in-place since 1982, there probably has not been sufficient time for noticeable degradation to have occurred. This is especially true in arid environments where flow events are very infrequent. Under such conditions long-term degradation may take many years to fully develop.

Based on a review of the existing bed profile for this reach of Skunk Creek, and on sediment continuity calculations using the manmade, upstream channels as a stable sediment supply reach, a long-term degradation depth of 4-feet was used for this project.

This number is based on substantial engineering judgement and should not be regarded as the product of a detailed sediment study of the Skunk Creek watershed.

Tables 4.1 and 4.2 summarize the sediment transport calculations that were performed to analyze the potential for long-term degradation through the proposed 51st Avenue channel. It must be emphasized that these calculations are very approximate and should only be used in a qualitative manner.

These calculations are based on an assumption that the manmade channels upstream of Havasupi Drive are set at a stable slope which is in equilibrium with the reduced sediment supply created by Adobe Dam. Discussions with representatives from Coe & Van Loo confirmed that these channel slopes were set to create non-eroding channel velocities, and were not based on an equilibrium slope analysis. However, for the purpose of this analysis, they are assumed to control the supply of sediment to the 51st Avenue channel.

Based on normal depth assumptions, Table 4.1 summarizes the hydraulic parameters and sediment transport rates that are predicted for the existing channel between Havasupi Drive and 47th Avenue, as well as for two reaches of the proposed 51st Avenue channel. These calculations show the variation in sediment transport rate (Qs) as a function of different gradation coefficients and D50 particle size. Referring to the last column (Qs) in Table 4.1, it can be seen that a large imbalance in sediment transport capacity occurs between the upstream sediment supply reach and the proposed channel at 51st Avenue, i.e., the 51st Avenue channel is capable of transporting much more sediment than is being supplied to it. This will cause degradation through the 51st Avenue bridge as the new channel flattens its slope to decrease its sediment transport capacity to match that of the supply reach.

Table 4.2 lists the equilibrium slope calculations that indicate the magnitude of slope adjustment that would be required through 51st Avenue to match the incoming sediment supply from the upstream channel reach. The last column ("Target Qs") in Table 4.2 lists the rate at which sediment is being supplied to the 51st Avenue channel. This value is taken from Table 4.1 for a gradation coefficient of 4.4 and a D50 of 4.8 mm. The "Equilibrium Bed Slope" column in Table 4.2 is that which would be required to produce the sediment transport rate listed under the column labeled "Sediment Transport Rate". An equilibrium slope occurs when the "Sediment Transport Rate" is at, or very near, the value under "Target Qs".

Table 4.1
Sediment Transport Calculations
For Equilibrium Slope Analysis
Skunk Creek at 51st Avenue

File: SKDEG.WK1

Q100 (cfs)	BW (ft)	Slope (ft/ft)	n	z	Flow Depth (ft)	Hydraulic Depth (ft)	Velocity (fps)	Gradation Coefficient	D50 (mm)	q_s (cfs/ft)	Q_s (cfs)
New Channel Between Havasupai Drive & 47th Avenue											
8750	250	0.0011	0.035	3.75	6.74	6.17	4.72	4.9	2.7	0.009	2.233
8750	250	0.0011	0.035	3.75	6.74	6.17	4.72	4.4	4.8	0.006	1.498
8750	250	0.0011	0.035	3.75	6.74	6.17	4.72	4.5	10	0.004	0.967
10400	250	0.0011	0.035	3.75	7.45	6.77	5.02	4.9	2.7	0.011	2.834
10400	250	0.0011	0.035	3.75	7.45	6.77	5.02	4.4	4.8	0.008	1.901
10400	250	0.0011	0.035	3.75	7.45	6.77	5.02	4.5	10	0.005	1.227
8750	250	0.0040	0.035	3.75	4.61	4.33	7.11	4.9	2.7	0.058	14.578
8750	250	0.0040	0.035	3.75	4.61	4.33	7.11	4.4	4.8	0.039	9.778
8750	250	0.0040	0.035	3.75	4.61	4.33	7.11	4.5	10	0.025	6.312
10400	250	0.0040	0.035	3.75	5.10	4.76	7.58	4.9	2.7	0.075	18.684
10400	250	0.0040	0.035	3.75	5.10	4.76	7.58	4.4	4.8	0.050	12.532
10400	250	0.0040	0.035	3.75	5.10	4.76	7.58	4.5	10	0.032	8.090
51st Avenue, Proposed Channel, STA 5+35 to 8+35											
8750	110	0.0134	0.035	3	5.17	4.60	13.49	4.9	2.7	0.911	100.197
8750	110	0.0134	0.035	3	5.17	4.60	13.49	4.4	4.8	0.611	67.204
8750	110	0.0134	0.035	3	5.17	4.60	13.49	4.5	10	0.394	43.385
10400	110	0.0134	0.035	3	5.71	5.04	14.32	4.9	2.7	1.147	126.175
10400	110	0.0134	0.035	3	5.71	5.04	14.32	4.4	4.8	0.769	84.628
10400	110	0.0134	0.035	3	5.71	5.04	14.32	4.5	10	0.497	54.634
51st Avenue, Proposed Channel, STA 8+35 to 11+00											
8750	110	0.0105	0.035	3	5.55	4.90	12.45	4.9	2.7	0.632	69.519
8750	110	0.0105	0.035	3	5.55	4.90	12.45	4.4	4.8	0.424	46.628
8750	110	0.0105	0.035	3	5.55	4.90	12.45	4.5	10	0.274	30.102
10400	110	0.0105	0.035	3	6.13	5.36	13.21	4.9	2.7	0.795	87.414
10400	110	0.0105	0.035	3	6.13	5.36	13.21	4.4	4.8	0.533	58.630
10400	110	0.0105	0.035	3	6.13	5.36	13.21	4.5	10	0.344	37.850

Table 4.2

51st Avenue Bridge at Skunk Creek

Proposed Channel

Equilibrium Slope Analysis

100-Year Event

D50 Sediment Size (mm): 4.80

Sediment Gradation Coefficient: 4.40

Channel Reach	Discharge (cfs)	Equilibrium Bed Slope (ft/ft)	Manning's Roughness	Horizontal Component of Side-slope	Flow Depth (ft)	Bottom Width (ft)	Velocity (fps)	Froude Number	Hydraulic Depth (ft)	Sediment Transport Capacity (cfs)	Target Qs (cfs)
Slope of Sediment Supply Reach is 0.0011 ft/ft											
STA 535+00 to STA 11+00	8,750	0.00094	0.035	3.00	11.03	110.0	5.54	0.33	8.96	1.533	1.498
STA 535+00 to STA 11+00	10,400	0.00093	0.035	3.00	12.18	110.0	5.83	0.33	9.75	1.900	1.901
Slope of Sediment Supply Reach is 0.0040 ft/ft											
STA 535+00 to STA 11+00	8,750	0.00327	0.035	3.00	7.76	110.0	8.46	0.58	6.61	9.723	9.778
STA 535+00 to STA 11+00	10,400	0.00332	0.035	3.00	8.53	110.0	9.00	0.59	7.17	12.596	12.532

File: SKEQ.WK1

The results of Table 4.2 indicate that a slope of 0.00094 to 0.00093 ft/ft would be required to bring the 51st Avenue channel into equilibrium with the assumed upstream sediment supply during the peak discharge of the 100-year flood. This equilibrium slope is substantially flatter than the proposed channel slope of 0.0105 to 0.0134 ft/ft shown in Table 4.1. Accordingly, this analysis indicates a significant potential for long-term degradation through the proposed 51st Avenue channel.

It is recommended that the City of Phoenix periodically inspect the 51st Avenue bridge site and monitor the stream-bed profile. If long-term degradation in excess of 4-feet is ultimately detected, corrective measures should be pursued to prevent any structural instability in the bridge piers during flooding conditions.

4.2 General Scour

This scour process occurs in response to changes in channel geometry from one reach of a channel to the next. As a channel contracts and expands, its flow velocity (and thus sediment transport capacity) will change. General scour will occur when a channel contracts (in the downstream direction) and causes an increase in velocity through the contracted section. The increase in sediment transport capacity through the contraction will begin to remove more sediment from the bed of the contracted reach than is being delivered to the contraction by the wider, upstream reach. The result is a lowering (general scour) of the channel bed through the contracted reach. When the channel geometry expands in the downstream direction, the opposite effect can occur, i.e., sediment deposition will take place in the wider channel section.

General scour and sediment deposition is usually quantified with a mobile-boundary sediment routing model. Such models are capable of predicting scour and deposition patterns as a function of bed-material size, channel geometry, and changes in discharge that occur during passage of a specific flood hydrograph.

However, for a uniform channel section, with a simple contraction as is proposed immediately upstream of the 51st Avenue bridge, the magnitude of general scour can be estimated with a contraction scour formula developed by Laursen (1962).

The contraction scour formula is of the following form:

$$\frac{d_s}{y_1} = \left(\frac{B_1}{B_2}\right)^x - 1 \qquad (Eq.\ 4.1)$$

Where d_s = scour depth through contraction (ft)

y_1 = flow depth in uncontracted, upstream cross-section (ft)

B_1 = channel bottomwidth in uncontracted, upstream cross-section (ft)

B_2 = channel bottomwidth in contracted cross-section (ft)

x = an exponent that varies as a function of y, friction slope, sediment fall velocity, and gravitational constant (an exponent of 0.59 was used for this site)

Using data from the sub-critical HEC-2 model (this will maximize y1) and taking XSEC 1500 as the uncontracted upstream section and XSEC 1000 as the contracted section, the depth of contraction scour was computed as 2.88 feet for Q=8,750 cfs and 3.30 feet for Q=10,400 cfs.

4.3 Local Scour

Local scour will occur in response to objects being placed in the path of flowing water. The most common form of local scour is that occurring at bridge piers, protruding bridge abutments, and spur dikes.

Objects, such as bridge piers, deflect the velocity vectors down towards the bottom of the pier and around the sides of the pier. Local scour then occurs when these deflected currents create a capacity to remove bed-material around the pier at a rate greater than that at which upstream bed-material can be supplied to the scour hole.

Numerous scour prediction formulas are published in the technical literature. Some formulas only address the case of clear-water scour (i.e., upstream flows are at or below the threshold of incipient motion for the bed-materials), while others focus on "live-bed" scour, which occurs when upstream bed-material is being transported into the scour hole.

Due to the large number of methods available to compute local scour, it is prudent to use more than one method for this computation in order to explore the variation in results that such methods may produce.

Three methods were used in this study to develop estimates of local scour. Two of the methods use formulas for a direct computation of local scour, while the third method employs a design curve that relates the ratio of flow depth to pier width to the ratio of scour depth to pier width. This graphical relationship was developed by Laursen and Toch and is published in Scour Around Bridge Piers and Abutments, Bulletin No. 4, Iowa Highway Research Board, 1956.

The two pier scour equations used in this study are listed as follows:

Laursen (1958 & 1962):

$$\frac{b}{y_0} = 5.5 d_s \left\{ \left[\left(\frac{1}{11.5} \right) \left(\frac{d_s}{y_o} \right) + 1 \right]^{1.7} - 1 \right\} \qquad (Eq.\ 4.2)$$

Where b = pier width (ft)

y_0 = upstream flow depth (ft)

d_s = equilibrium scour depth (ft)

Colorado State University (CSU, 1975):

$$\frac{d_s}{b} = 2.2 \left(\frac{y_0}{b} \right)^{0.35} F^{0.43} \qquad (Eq.\ 4.3)$$

Where b = pier width (ft)

y_0 = upstream flow depth (ft)

d_s = equilibrium scour depth (ft)

F = Froude Number

As previously referenced in Section 3.3, an additional 5 feet of debris obstruction was added to the pier diameter for use in computing local scour. It is interesting to note that both Laursen's methods and the CSU equation are dependent upon flow depth and pier width, while the CSU equation includes Froude Number as a third variable. As a result of this difference, Laursen's methods produce the deepest scour depths during sub-critical flow when flow depths are greatest. The addition of Froude Number in the CSU equation introduces flow velocity as a variable, which for this particular site creates a slightly more severe scour depth during super-critical flow than for sub-critical flow.

Even though the proposed pier design will consist of circular piers, the addition of a debris load on the pier nose may cause the piers to present a more rectangular shape to oncoming flows. Accordingly, methods were included in the analysis to simulate both rectangular and circular pier shapes.

Table 4.3 presents the results of the local scour computations for discharges of both 8,750 and 10,400 cfs.

Table 4.3
Summary of Local Scour Computations
Skunk Creek At 51st Avenue

Method	Assumed Pier Shape	* Effective Pier Diameter (ft)	** Calculated Base Value (ft)	
			Q=8,750 cfs	Q=10,400 cfs
Laursen (1956)	Rectangular	10	13.75	14.20
Laursen (1962)	Rectangular	10	9.40	10.00
CSU (1975)	Rectangular	10	18.00	18.70
CSU (1975)	Circular	10	16.40	17.00

* 5 foot concrete cylinder with 5 feet of debris

** Base value is added to other scour components to arrive at a total scour depth for the pier design

File: TAB43.WK1
(REVISED 03/03/91)

4.4 Bedform Troughs

Sand and gravel-bed streams, such as Skunk Creek, are subject to the formation of dune shaped bedforms. The troughs of these bedforms extend below the natural riverbed and are additive to other scour processes. For sand-bed channels, the depths of these troughs can be estimated with the following equation, (ADWR/SLA, 1985):

$$\Delta Z_{AD} = 0.0135 V^2 \qquad (Eq.\ 4.4)$$

Where ΔZ_{AD} = depth of trough below natural streambed (ft)

V = flow velocity (fps)

The highest mean, super-critical channel velocity through the bridge section occurs at STA 9+57 (XSEC 957). Based on data published by Blodgett (1984), the maximum velocity through a bridge with piers is 1.5 times the mean velocity. Accordingly, the bedform trough depth calculation should be based on the maximum velocity, rather than the mean velocity.

However, since the trough depth cannot exceed 1/2 the depth of flow, the flow depth is a controlling factor in this case. Accordingly, the trough depths will be based on 1/2 the flow depth at XSEC 957. The bedform trough depth calculations are summarized in Table 4.4.

Table 4.4

Summary of Bedform Trough Depths

Q (cfs)	V_{AVG} (fps)	V_{max} ($1.5xV_{AVG}$) (fps)	ΔZ_{AD} (ft)	y/2 (ft)
8,750	15.28	22.92	7.09	2.57
10,400	16.01	24.01	7.79	2.88

4.5 Low-Flow Incisement

Manmade channels with large width to depth ratios are very vulnerable to the formation of low-flow channels. When trapezoidal channels, designed to carry large events such as the 100-year flood, are exposed to smaller, more frequent flows (2 to 5 year floods), the wide channel bottomwidths may cause a shallow sheetflow condition to exist. Rather than transporting these smaller flows in this manner, the channel will develop a low-flow channel that provides a more efficient conveyance of these small discharges.

Low-flow channels will meander across the bottom of the larger, parent channel, thus randomly coming into contact with the channel bank. Accordingly, it is important to acknowledge low-flow incisement when computing the total scour depth for bank-lining design. For the purpose of this study, 1-foot of low-flow incisement is included in the total scour depth for use at the bridge piers and abutments.

4.6 Summary of Scour Analysis

Because of the numerous assumptions that must be made in conducting scour analyses, it is useful to define an envelope of high and low scour estimates. Engineering judgment can then be used to arrive at a design recommendation within this envelope.

The total scour depth is the sum of all the previously discussed scour processes. Tables 4.5, 4.6, and 4.7 summarize the magnitude of all scour components that were used to define the low envelope, high envelope, and design recommendation, respectively. Table 4.8 is a summary table of the total scour depths for both the pier and abutment locations. The total abutment scour depth includes all the scour components except the local scour that occurs at the bridge pier.

Correction factors for bedforms are included in Tables 4.5, 4.6, and 4.7. The Laursen and CSU equations are based on an equilibrium scour depth, which fluctuates in response to the passage of bed-forms (i.e., dunes and antidunes). The technical literature provides different recommendations on how large this correction factor should be. The 1.3 factor was chosen for this study on the basis of recommendations in "Highways in the River Environment," (1987).

Table 4.5
Summary of Calculations for Low Scour Envelope at Bridge Pier
Skunk Creek at 51st Avenue

Scour Component	8,750 cfs				10,400 cfs			
	Base Value	Adjustment for Bedforms	Adjustment for Skew	Total Depth (ft)	Base Value	Adjustment for Bedforms	Adjustment for Skew	Total Depth (ft)
Long-Term Degradation	4.00	n/a	n/a	4.00	4.00	n/a	n/a	4.00
General Scour (contraction)	2.88	n/a	n/a	2.88	3.30	n/a	n/a	3.30
Local Scour	9.40	n/a	n/a	9.40	10.00	n/a	n/a	10.00
Bedform Troughs	2.57	n/a	n/a	2.57	2.88	n/a	n/a	2.88
Low-Flow Incisement	1.00	n/a	n/a	1.00	1.00	n/a	n/a	1.00
Bend Scour	0.00	n/a	n/a	0.00	0.00	n/a	n/a	0.00
			sub-total:	19.85			sub-total:	21.18
			x Safety Factor	1.30			x Safety Factor	1.30
			Total:	25.81			Total:	27.53
			Rounded To:	**26.00**			**Rounded To:**	**27.50**

File: TAB45.WK1

Table 4.6
Summary of Calculations for High Scour Envelope at Bridge Pier
Skunk Creek at 51st Avenue

Scour Component	8,750 cfs				10,400 cfs			
	Base Value	Adjustment for Bedforms	Adjustment for Skew	Total Depth (ft)	Base Value	Adjustment for Bedforms	Adjustment for Skew	Total Depth (ft)
Long-Term Degradation	4.00	n/a	n/a	4.00	4.00	n/a	n/a	4.00
General Scour (contraction)	2.88	n/a	n/a	2.88	3.30	n/a	n/a	3.30
Local Scour	15.10	x 1.3	x 1.1	21.59	16.20	x 1.3	x 1.1	23.17
Bedform Troughs	2.57	n/a	n/a	2.57	2.88	n/a	n/a	2.88
Low-Flow Incisement	1.00	n/a	n/a	1.00	1.00	n/a	n/a	1.00
Bend Scour	0.00	n/a	n/a	0.00	0.00	n/a	n/a	0.00
			sub-total:	32.04			sub-total:	34.35
			x Safety Factor	1.30			x Safety Factor	1.30
			Total:	41.65			Total:	44.66
			Rounded To:	**41.50**			**Rounded To:**	**44.50**

File: TAB46.WK1

Table 4.7
Summary of Calculations for Recommended Scour Design at Bridge Pier
Skunk Creek at 51st Avenue

Scour Component	8,750 cfs				10,400 cfs			
	Base Value	Adjustment for Bedforms	Adjustment for Skew	Total Depth (ft)	Base Value	Adjustment for Bedforms	Adjustment for Skew	Total Depth (ft)
Long-Term Degradation	4.00	n/a	n/a	4.00	4.00	n/a	n/a	4.00
General Scour (contraction)	2.88	n/a	n/a	2.88	3.30	n/a	n/a	3.30
Local Scour	13.70	n/a	n/a	13.70	14.70	n/a	n/a	14.70
Bedform Troughs	2.57	n/a	n/a	2.57	2.88	n/a	n/a	2.88
Low-Flow Incisement	1.00	n/a	n/a	1.00	1.00	n/a	n/a	1.00
Bend Scour	0.00	n/a	n/a	0.00	0.00	n/a	n/a	0.00
			sub-total:	24.15			sub-total:	25.88
			x Safety Factor	1.30			x Safety Factor	1.30
			Total:	31.40			Total:	33.64
			Rounded To:	**31.50**			**Rounded To:**	**33.50**

File: TAB47.WK1

Table 4.8
Summary of Total Scour Depths for Low Envelope, High Envelope, & Design Recommendation
Skunk Creek at 51st Avenue
(all depths are feet below channel invert)

Location	Low Envelope		Design Recommendation		High Envelope	
	8,750 cfs	10,400 cfs	8,750 cfs	10,400 cfs	8,750 cfs	10,400 cfs
Bridge Pier Design	26.0	27.5	31.5	33.5	41.5	44.5
Bridge Abutment Design	n/a	n/a	13.6	14.5	n/a	n/a

File: TAB48.WK1

Tables 4.5 and 4.7 do not apply a bedform adjustment factor to the local scour component. Instead, a bedform depth is listed as a separate component. For the depths of flow predicted at this site, a 30 percent adjustment to local scour, for bedforms, is probably excessive. Accordingly, the separate computation for bedforms in Tables 4.5 and 4.7 was considered more realistic for arriving at a design recommendation.

The high envelope in Table 4.6 includes an adjustment factor to the local scour component to account for skewed flow angles approaching the piers. Although the proposed channel alignment through the 51st Avenue bridge is straight, the upstream contraction geometry is not symmetrical (see Plate 1). This may create a small amount of skew to the velocity vectors as they approach the bridge. Even though circular piers are being used for the bridge design, research indicates that groups of closely spaced circular piers can still experience an increase in scour depth when exposed to skewed flow patterns (Raudkivi 1986).

5. RECOMMENDATIONS

Based on the engineering analysis presented in this study, the following recommendations are made regarding the channel and bridge design at 51st Avenue and Skunk Creek.

1. The channel should be excavated to its final slope and bottomwidth, as part of the bridge construction contract, from channel STA 5+35 to STA 15+45.

2. The channel should be constructed to its final, full cross-sectional geometry (including specified freeboard) from channel STA 8+35 to STA 13+00.

3. The channel should include bank protection, as part of the bridge construction contract, from channel STA 8+60 to STA 12+50. Bank protection for the entire channel should be considered as a future project.

4. The bridge piers should be designed for a total scour depth of 31.5 feet for a discharge of 8,750 cfs, and a depth of 33.5 feet for a discharge of 10,400 cfs.

5. The bridge abutments should be designed for a total scour depth of 13.6 feet for a discharge of 8,750 cfs, and 14.5 feet for a discharge of 10,400 cfs.

6. The structural design of the bridge piers should consider the possibility of increasing the mean channel velocities by a factor of 1.5 to acknowledge the potential for maximum velocity vectors that might exist through the bridge. Based on super-critical flow conditions, maximum velocities of 22.92 fps and 24.01 fps could occur for discharges of 8,750 cfs and 10,400 cfs, respectively.

7. The City of Phoenix should pursue a periodic maintenance and inspection program for both the proposed bridge and channel. This program should be used to keep the channel free of vegetation densities that would exceed the assumed Manning's roughness value of 0.035. The inspection program should also monitor the bed profile in order to detect any excessive channel degradation near the bridge piers.

8. Coe & Van Loo is presently conducting a new floodplain delineation for this reach of Skunk Creek. This work is being done for the Flood Control District of Maricopa County. This new delineation is based on the existing topography of Skunk Creek, i.e., it will not reflect the proposed channel and bridge construction that has been addressed in this report. Accordingly, it is recommended that the sub-critical HEC-2 model (SK2E.IN) included in this report be provided to the District for inclusion in the new Skunk Creek floodplain delineation. Model SK2F.IN should be provided to the District if they prefer a sub-critical model with debris loading on the bridge piers at 51st Avenue. Either of these models should be completely compatible with the CVL model, since all models are on the same vertical elevation datum and use similar "n" values.

REFERENCES

Arizona Department of Water Resources, (ADWR), "Design Manual for Engineering Analysis of Fluvial Systems", prepared by Simons, Li & Associates, Inc., 1985

Blodgett, J.C., "Effect of Bridge Piers on Streamflow and Channel Geometry", TRB 950, Second Bridge Conference, Vol.2, 1984

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Laursen, E.M., "Scour At Bridge Crossings", Iowa Highway Research Board, Bulletin No. 8, 1958

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Laursen, E.M., and Toch, A., "Scour Around Bridge Piers and Abutments", Bulletin No. 4, Iowa Highway Research Board, 1956

Raudkivi, A.J., "Functional Trends of Scour at Bridge Piers", Journal of Hydraulic Engineering, ASCE, Vol.112, January 1986

APPENDIX A

HEC-2 Models

Skunk Creek at 51st Avenue

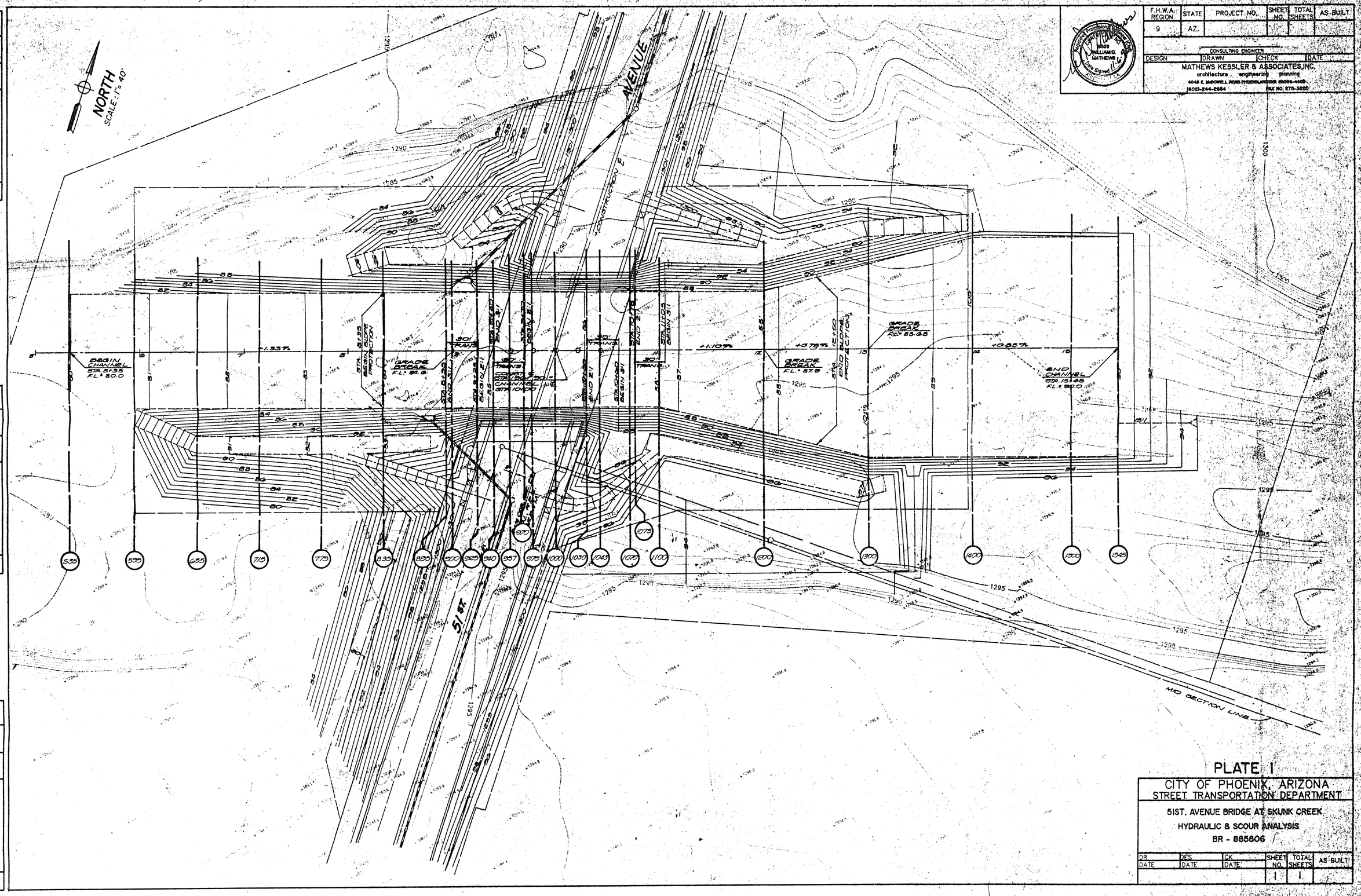
Model SK2E.IN/.OT - Sub-Critical With No Pier Debris
Model SK3D.IN/.OT - Super-Critical With No Pier Debris
Model SK2F.IN/.OT - Sub-Critical With Pier Debris
Model SK3E.IN/.OT - Super-Critical With Pier Debris

APPENDIX A

HEC-2 Models

Skunk Creek at 51st Avenue

Model SK2E.IN/.OT - Sub-Critical With No Pier Debris
Model SK3D.IN/.OT - Super-Critical With No Pier Debris
Model SK2F.IN/.OT - Sub-Critical With Pier Debris
Model SK3E.IN/.OT - Super-Critical With Pier Debris



REVISION BY CITY OF PHOENIX				
NO.	DISCRIPTION	REV. BY	CHK. BY	DATE

REVISION BY CITY OF PHOENIX				
NO.	DISCRIPTION	REV. BY	CHK. BY	DATE

REVISION BY CITY OF PHOENIX				
NO.	DISCRIPTION	REV. BY	CHK. BY	DATE

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ.				

CONSULTING ENGINEER

DESIGN	DRAWN	CHECK	DATE

MATHEWS KESSLER & ASSOCIATES, INC.
architecture . engineering planning
4048 E. McDOWELL ROAD PHOENIX, ARIZONA 85008-4409
(602) 244-2664 FAX NO. 275-3220

PLATE 1

CITY OF PHOENIX, ARIZONA
STREET TRANSPORTATION DEPARTMENT

51ST. AVENUE BRIDGE AT SKUNK CREEK

HYDRAULIC & SCOUR ANALYSIS

BR - 885806

DR. DATE	DES. DATE	CK. DATE	SHEET NO.	TOTAL SHEETS	AS BUILT
			1	1	

THIS RUN EXECUTED 10-01-90

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  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
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Model SK2E.IN/.OT

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*  VERSION OF NOVEMBER 1976                         *
*  UPDATED MAY 1984                                 *
*  IBM-PC-XT VERSION AUGUST 1985                    *
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*  THE HYDROLOGIC ENGINEERING CENTER
*  609 SECOND STREET, SUITE D
*  DAVIS, CALIFORNIA 95616
*  (916) 440-2105 (FTS) 448-2105
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X     X  X        X     X            X     X
X     X  X        X                        X
XXXXXXX  XXXX     X         XXXXX    XXXXX
X     X  X        X                  X
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X     X  XXXXXXX   XXXXX             XXXXXXX
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THIS RUN EXECUTED 10-01-90

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HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
ERROR CORR -  01,02,03,04,05,06
MODIFICATION -  50,51,52,53,54,55,56
IBM-PC-XT VERSION AUGUST 1985
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T1      HYDRAULIC & SCOUR ANALYSIS FOR 51st AVENUE BRIDGE AT SKUNK CREEK
T2      IMPROVED CHANNEL WITH THE NEW BRIDGE IN-PLACE, MODEL SK2E.IN, NO DEBRIS
T3      SKUNK CREEK AT 51st AVE         SUB-CRITICAL, EXISTING 100-YEAR EVENT

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

     0.        2.        0.        0.   .002650      .00       .0        0.   285.000      .000

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

    .000      .000    -1.000      .000      .000      .000    -1.000      .000      .000      .000

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

   38.000    43.000     1.000     2.000     8.000    42.000    53.000    54.000     4.000    26.000


    .000    38.000    17.000    33.000     5.000    39.000    25.000    14.000    27.000    28.000

J5  LPRNT    NUMSEC                    ********REQUESTED SECTION NUMBERS********

  -10.000   -10.000      .000      .000      .000      .000      .000      .000      .000      .000

NC      .045      .045      .035      .200      .400      .000      .000      .000      .000      .000
QT     2.000  8750.000 10400.000      .000      .000      .000      .000      .000      .000      .000
1       .000     8.000  9782.000 10135.000      .000      .000      .000      .000      .000      .000
3       .000      .000      .000  9869.000      .000 10100.000      .000      .000      .000      .000
GR    290.000  9782.000   280.000  9848.000   278.000  9858.000   277.600  9880.000   278.000  9950.000
GR    279.000 10000.000   280.000 10075.000   282.000 10135.000      .000      .000      .000      .000

X1    150.000     7.000  9870.000 10280.000   150.000   150.000   150.000      .000      .000      .000
X3       .000      .000      .000  9920.000      .000      .000      .000      .000      .000      .000
GR    290.000  9870.000   280.000  9919.000   278.000  9920.000   277.000 10221.000   278.000 10242.000
GR    280.000 10252.000   290.000 10280.000      .000      .000      .000      .000      .000      .000

X1    310.000     7.000  9745.000 10145.000   160.000   160.000   160.000      .000      .000      .000
3       .000      .000      .000  9950.000      .000 10188.000      .000      .000      .000      .000
GR    290.000  9745.000   280.000  9769.000   278.000  9780.000   278.000 10105.000   280.000 10111.000
GR    290.000 10129.000   292.000 10145.000      .000      .000      .000      .000      .000      .000

X1    535.000     4.000  9885.000 10115.000   225.000   225.000   225.000      .000      .000      .000
GR    300.000  9885.000   280.000  9945.000   280.000 10055.000   300.000 10115.000      .000      .000
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X1	595.000	.000	.000	.000	60.000	60.000	60.000	.000	.830	.000
X1	655.000	.000	.000	.000	60.000	60.000	60.000	.000	.890	.000
X1	715.000	.000	.000	.000	60.000	60.000	60.000	.000	.800	.000
X1	775.000	.000	.000	.000	60.000	60.000	60.000	.000	.810	.000
X3	.000	.000	.000	9893.000	.000	.000	.000	.000	.000	.000
X1	835.000	.000	.000	.000	60.000	60.000	60.000	.000	.800	.000
X3	.000	.000	.000	9908.000	.000	10104.000	.000	.000	.000	.000
NC	.000	.000	.000	.300	.500	.000	.000	.000	.000	.000
X1	900.000	4.000	9889.000	10115.000	65.000	65.000	65.000	.000	-.200	.000
X3	.000	.000	.000	9924.000	.000	10087.000	.000	.000	.000	.000
GR	304.800	9889.000	284.800	9945.000	284.800	10055.000	304.800	10115.000	.000	.000
X1	925.000	5.000	9931.000	10115.000	25.000	25.000	25.000	.000	-1.870	.000
X3	.000	.000	.000	.000	.000	10081.000	.000	.000	.000	.000
GR	306.750	9931.000	293.750	9931.000	286.750	9945.000	286.750	10055.000	306.750	10115.000
X1	957.000	9.000	9931.000	10105.000	32.000	32.000	32.000	.000	-1.610	.000
X3	.000	.000	.000	.000	.000	10072.000	.000	.000	.000	.000
GR	306.840	9931.000	293.840	9931.000	286.840	9945.000	286.840	9997.500	306.840	9997.500
GR	306.840	10002.500	286.840	10002.500	286.840	10055.000	306.840	10105.000	.000	.000
X1	970.000	10.000	9931.000	10069.000	13.000	13.000	13.000	.000	-1.560	.000
GR	306.930	9931.000	293.930	9931.000	286.930	9945.000	286.930	9997.500	306.930	9997.500
GR	306.930	10002.500	286.930	10002.500	286.930	10055.000	293.930	10069.000	306.930	10069.000
X1	1000.000	.000	.000	.000	30.000	30.000	30.000	.000	.330	.000
X1	1030.000	.000	.000	.000	30.000	30.000	30.000	.000	.330	.000
X1	1043.000	9.000	9897.000	10069.000	13.000	13.000	13.000	.000	-.200	.000
X3	.000	.000	.000	9918.000	.000	.000	.000	.000	.000	.000
GR	306.370	9897.000	286.370	9945.000	286.370	9997.500	306.370	9997.500	306.370	10002.500
GR	286.370	10002.500	286.370	10055.000	293.370	10069.000	306.370	10069.000	.000	.000
X1	1075.000	5.000	9885.000	10069.000	32.000	32.000	32.000	.000	-.870	.000
GR	307.400	9885.000	287.400	9945.000	287.400	10055.000	294.400	10069.000	307.400	10069.000
NC	.000	.000	.000	.200	.400	.000	.000	.000	.000	.000
X1	1100.000	4.000	9885.000	10115.000	25.000	25.000	25.000	.000	-.750	.000
GR	307.550	9885.000	287.550	9945.000	287.550	10055.000	307.550	10115.000	.000	.000
X1	1200.000	4.000	9860.000	10115.000	100.000	100.000	100.000	.000	-.200	.000
GR	308.100	9860.000	288.100	9920.000	288.100	10055.000	308.100	10115.000	.000	.000

X1	1300.000	4.000	9835.000	10140.000	100.000	100.000	100.000	.000	.000	.000
GR	308.650	9835.000	288.650	9895.000	288.650	10080.000	308.650	10140.000	.000	.000
X1	1400.000	4.000	9835.000	10165.000	100.000	100.000	100.000	.000	.000	.000
GR	309.200	9835.000	289.200	9895.000	289.200	10105.000	309.200	10165.000	.000	.000
X1	1500.000	4.000	9835.000	10165.000	100.000	100.000	100.000	.000	.000	.000
GR	309.750	9835.000	289.750	9895.000	289.750	10105.000	309.750	10165.000	.000	.000
X1	1545.000	.000	.000	.000	45.000	45.000	45.000	.000	.250	.000
EJ	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

THIS RUN EXECUTED 10-01-90

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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
**************************************************
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T1      HYDRAULIC & SCOUR ANALYSIS FOR 51st AVENUE BRIDGE AT SKUNK CREEK
T2      IMPROVED CHANNEL WITH THE NEW BRIDGE IN-PLACE,  MODEL SK2E.IN, NO DEBRIS
T3      SKUNK CREEK AT 51st AVE         SUB-CRITICAL, FUTURE 100-YEAR EVENT

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

      0.        3.        0.        0.   .002650      .00        .0        0.   286.000     .000

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLOC     IBW       CHNIM     ITRACE

    15.000     .000    -1.000     .000      .000      .000    -1.000     .000      .000      .000
```

THIS RUN EXECUTED 10-01-90

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*************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
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NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SKUNK CREEK AT 51st AVE

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	CRIWS	DEPTH	ELMIN	SSTA	ENDST	TOPWID	VCH
	.000	8750.00	284.42	282.31	6.82	277.60	9869.00	10100.00	231.00	6.72
	.000	10400.00	285.05	282.73	7.45	277.60	9869.00	10100.00	231.00	7.19
	150.000	8750.00	285.18	280.33	8.18	277.00	9920.00	10266.51	346.51	3.40
	150.000	10400.00	285.90	280.64	8.90	277.00	9920.00	10268.51	348.51	3.69
	310.000	8750.00	284.87	282.54	6.87	278.00	9950.00	10119.78	169.78	7.79
	310.000	10400.00	285.52	283.10	7.52	278.00	9950.00	10120.95	170.95	8.43
*	535.000	8750.00	285.50	285.50	5.50	280.00	9928.51	10071.49	142.97	12.59
*	535.000	10400.00	286.13	286.13	6.13	280.00	9926.61	10073.39	146.77	13.22
*	595.000	8750.00	286.30	286.30	5.50	280.80	9928.49	10071.51	143.01	12.57
*	595.000	10400.00	286.94	286.94	6.14	280.80	9926.59	10073.41	146.81	13.20
*	655.000	8750.00	287.10	287.10	5.50	281.60	9928.50	10071.50	143.00	12.57
*	655.000	10400.00	287.73	287.73	6.13	281.60	9926.60	10073.40	146.80	13.20
*	715.000	8750.00	287.90	287.90	5.50	282.40	9928.50	10071.50	143.01	12.57
*	715.000	10400.00	288.53	288.53	6.13	282.40	9926.60	10073.40	146.80	13.20
*	775.000	8750.00	288.71	288.71	5.50	283.21	9928.50	10071.50	143.00	12.57
*	775.000	10400.00	289.34	289.34	6.13	283.21	9926.60	10073.40	146.80	13.20
*	835.000	8750.00	289.51	289.51	5.50	284.01	9928.50	10071.50	143.00	12.57
*	835.000	10400.00	290.14	290.14	6.13	284.01	9926.60	10073.40	146.80	13.20
	900.000	8750.00	290.84	290.11	6.24	284.60	9927.53	10073.72	146.20	10.95
	900.000	10400.00	291.48	290.75	6.88	284.60	9925.75	10075.63	149.88	11.64
	925.000	8750.00	290.92	290.43	6.04	284.88	9932.91	10073.13	140.22	11.57
	925.000	10400.00	291.55	291.07	6.67	284.88	9931.66	10075.01	143.35	12.31

	SECNO	Q	CWSEL	CRIWS	DEPTH	ELMIN	SSTA	ENDST	TOPWID	VCH
	957.000	8750.00	290.98	290.98	5.75	285.23	9933.50	10069.38	130.88	12.90
*	957.000	10400.00	291.64	291.64	6.41	285.23	9932.18	10071.02	133.84	13.59
*	970.000	8750.00	291.13	291.13	5.76	285.37	9933.49	10066.51	128.03	13.04
*	970.000	10400.00	291.80	291.80	6.43	285.37	9932.13	10067.87	130.74	13.71
	1000.000	8750.00	292.30	291.46	6.60	285.70	9931.82	10068.18	131.36	11.24
	1000.000	10400.00	293.04	292.13	7.34	285.70	9931.00	10069.00	133.00	11.86
	1030.000	8750.00	292.49	291.79	6.46	286.03	9932.08	10067.92	130.83	11.49
	1030.000	10400.00	293.22	292.46	7.19	286.03	9931.00	10069.00	133.00	12.11
	1043.000	8750.00	292.76	291.90	6.59	286.17	9929.19	10068.18	133.99	11.11
	1043.000	10400.00	293.55	292.57	7.38	286.17	9927.29	10069.00	136.71	11.63
	1075.000	8750.00	293.46	292.09	6.93	286.53	9924.23	10068.84	144.61	9.93
	1075.000	10400.00	294.31	292.74	7.78	286.53	9921.70	10069.00	147.30	10.35
	1100.000	8750.00	293.62	292.30	6.82	286.80	9924.55	10075.45	150.90	9.84
	1100.000	10400.00	294.50	292.93	7.70	286.80	9921.88	10078.12	156.23	10.14
	1200.000	8750.00	294.51	292.78	6.61	287.90	9900.18	10074.82	174.63	8.56
	1200.000	10400.00	295.38	293.34	7.48	287.90	9897.57	10077.43	179.86	8.84
	1300.000	8750.00	295.40	292.66	6.75	288.65	9874.74	10100.26	225.53	6.31
	1300.000	10400.00	296.28	293.13	7.63	288.65	9872.08	10102.92	230.84	6.55
	1400.000	8750.00	295.69	292.90	6.49	289.20	9875.52	10124.48	248.96	5.87
	1400.000	10400.00	296.56	293.34	7.36	289.20	9872.93	10127.07	254.13	6.09
	1500.000	8750.00	295.84	293.46	6.09	289.75	9876.74	10123.26	246.52	6.30
	1500.000	10400.00	296.70	293.90	6.95	289.75	9874.15	10125.85	251.70	6.48
	1545.000	8750.00	295.92	293.70	5.92	290.00	9877.22	10122.78	245.56	6.48
	1545.000	10400.00	296.77	294.14	6.77	290.00	9874.66	10125.34	250.69	6.66

SKUNK CREEK AT 51st AVE

SUMMARY PRINTOUT

	SECNO	K*XNCH	K*CHSL	10K*S	XLCH	AREA	QCH	STENCL	STENCR
	.000	35.00	.00	26.43	.00	1302.42	8750.00	9869.00	10100.00
	.000	35.00	.00	26.46	.00	1447.19	10400.00	9869.00	10100.00
	150.000	35.00	-4.00	4.57	150.00	2573.26	8750.00	9920.00	10280.00
	150.000	35.00	-4.00	4.80	150.00	2821.90	10400.00	9920.00	10280.00
	310.000	35.00	6.25	28.94	160.00	1123.06	8750.00	9950.00	10188.00
	310.000	35.00	6.25	30.38	160.00	1233.04	10400.00	9950.00	10188.00
*	535.000	35.00	8.89	108.49	225.00	695.12	8750.00	.00	.00
*	535.000	35.00	8.89	105.15	225.00	786.84	10400.00	.00	.00
*	595.000	35.00	13.33	108.03	60.00	696.10	8750.00	.00	.00
*	595.000	35.00	13.33	104.75	60.00	787.84	10400.00	.00	.00
*	655.000	35.00	13.33	108.15	60.00	695.83	8750.00	.00	.00
*	655.000	35.00	13.33	104.83	60.00	787.64	10400.00	.00	.00
*	715.000	35.00	13.33	108.13	60.00	695.88	8750.00	.00	.00
*	715.000	35.00	13.33	104.83	60.00	787.64	10400.00	.00	.00
*	775.000	35.00	13.50	108.15	60.00	695.85	8750.00	9893.00	10115.01
*	775.000	35.00	13.50	104.83	60.00	787.64	10400.00	9893.00	10115.01
*	835.000	35.00	13.33	108.15	60.00	695.85	8750.00	9908.00	10104.00
*	835.000	35.00	13.33	104.83	60.00	787.64	10400.00	9908.00	10104.00
	900.000	35.00	9.08	70.30	65.00	799.41	8750.00	9924.00	10087.00
	900.000	35.00	9.08	70.95	65.00	893.51	10400.00	9924.00	10087.00
	925.000	35.00	11.20	80.36	25.00	756.11	8750.00	.00	10081.00
	925.000	35.00	11.20	80.89	25.00	844.92	10400.00	.00	10081.00
	957.000	35.00	10.94	117.81	32.00	678.32	8750.00	.00	10072.00
*	957.000	35.00	10.94	115.99	32.00	765.34	10400.00	.00	10072.00
*	970.000	35.00	10.77	119.35	13.00	670.82	8750.00	.00	.00
*	970.000	35.00	10.77	116.62	13.00	758.41	10400.00	.00	.00
	1000.000	35.00	11.00	76.27	30.00	778.78	8750.00	.00	.00
	1000.000	35.00	11.00	75.24	30.00	876.59	10400.00	.00	.00
	1030.000	35.00	11.00	81.54	30.00	761.56	8750.00	.00	.00
	1030.000	35.00	11.00	80.17	30.00	858.85	10400.00	.00	.00
	1043.000	35.00	10.77	75.12	13.00	787.36	8750.00	9918.00	10069.00
	1043.000	35.00	10.77	72.49	13.00	894.23	10400.00	9918.00	10069.00

SECNO	K*XNCH	K*CHSL	10K*S	XLCH	AREA	QCH	STENCL	STENCR
1075.000	35.00	11.25	50.38	32.00	881.27	8750.00	.00	.00
1075.000	35.00	11.25	47.47	32.00	1004.79	10400.00	.00	.00
1100.000	35.00	10.80	51.46	25.00	889.16	8750.00	.00	.00
1100.000	35.00	10.80	47.39	25.00	1025.66	10400.00	.00	.00
1200.000	35.00	11.00	39.11	100.00	1022.60	8750.00	.00	.00
1200.000	35.00	11.00	36.01	100.00	1177.08	10400.00	.00	.00
1300.000	35.00	7.50	19.87	100.00	1386.51	8750.00	.00	.00
1300.000	35.00	7.50	18.42	100.00	1588.59	10400.00	.00	.00
1400.000	35.00	5.50	17.80	100.00	1490.18	8750.00	.00	.00
1400.000	35.00	5.50	16.45	100.00	1707.04	10400.00	.00	.00
1500.000	35.00	5.50	22.18	100.00	1389.19	8750.00	.00	.00
1500.000	35.00	5.50	19.96	100.00	1604.34	10400.00	.00	.00
1545.000	35.00	5.56	24.28	45.00	1349.81	8750.00	.00	.00
1545.000	35.00	5.56	21.69	45.00	1562.11	10400.00	.00	.00

SUMMARY OF ERRORS AND SPECIAL NOTES

```
CAUTION  SECNO=   535.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   535.000  PROFILE= 1  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=   535.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   535.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=   595.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   595.000  PROFILE= 1  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=   595.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   595.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=   655.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   655.000  PROFILE= 1  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=   655.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   655.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=   715.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   715.000  PROFILE= 1  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=   715.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   715.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=   775.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   775.000  PROFILE= 1  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=   775.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   775.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=   835.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   835.000  PROFILE= 1  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=   835.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   835.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=   957.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   957.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=   970.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   970.000  PROFILE= 1  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=   970.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   970.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY
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THIS RUN EXECUTED 10-01-90

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**************************************************
 HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
 ERROR CORR -  01,02,03,04,05,06
 MODIFICATION -  50,51,52,53,54,55,56
 IBM-PC-XT VERSION AUGUST 1985
**************************************************
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Model SK3D.IN/.OT

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*****************************************************
*  WATER SURFACE PROFILES                           *
*  VERSION OF NOVEMBER 1976                         *
*  UPDATED MAY 1984                                 *
*  IBM-PC-XT VERSION AUGUST 1985                    *
*  RUN DATE  10-01-90   TIME  19:37:33                *
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*************************************
*  U.S. ARMY CORPS OF ENGINEERS
*  THE HYDROLOGIC ENGINEERING CENTER
*  609 SECOND STREET, SUITE D
*  DAVIS, CALIFORNIA 95616
*  (916) 440-2105 (FTS) 448-2105
*************************************
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```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X       X     X            X     X
X     X  X       X                        X
XXXXXXX  XXXX    X         XXXXX    XXXXX
X     X  X       X                  X
X     X  X       X     X            X
X     X  XXXXXXX   XXXXX            XXXXXXX
```

THIS RUN EXECUTED 10-01-90

```
**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
**************************************************
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```
T1      HYDRAULIC & SCOUR ANALYSIS FOR 51st AVENUE BRIDGE AT SKUNK CREEK
T2      IMPROVED CHANNEL WITH THE NEW BRIDGE IN-PLACE,  MODEL SK3D.IN, NO DEBRIS
T3      SKUNK CREEK AT 51st AVE        SUPER-CRITICAL, EXISTING 100-YEAR EVENT

J1  ICHECK    INQ      NINV     IDIR     STRT     METRIC   HVINS    Q        WSEL     FQ

      0.       2.       0.       1. -1.000000      .00       .0       0.   295.000     .000

J2  NPROF    IPLOT    PRFVS    XSECV    XSECH     FN      ALLDC    IBW     CHNIM    ITRACE

     .000     .000   -1.000     .000     .000     .000   -1.000    .000     .000     .000

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

   38.000   43.000    1.000    2.000    8.000   42.000   53.000   54.000    4.000   26.000

     .000   38.000   17.000   33.000    5.000   39.000   25.000   14.000   27.000   28.000

J5  LPRNT   NUMSEC                 ********REQUESTED SECTION NUMBERS********

  -10.000  -10.000     .000     .000     .000     .000     .000     .000     .000     .000

NC      .025     .025     .025     .100     .300     .300     .000     .000     .000     .000
QT     2.000 8750.000 10400.000     .000     .000     .000     .000     .000     .000     .000
X1  1545.000    4.000 9835.000 10165.000   45.000   45.000   45.000     .000     .000     .000
GR   310.000 9835.000  290.000 9895.000  290.000 10105.000  310.000 10165.000     .000     .000

X1  1500.000     .000     .000     .000  100.000  100.000  100.000     .000    -.250     .000

X1  1400.000    4.000 9835.000 10165.000  100.000  100.000  100.000     .000     .000     .000
GR   309.200 9835.000  289.200 9895.000  289.200 10105.000  309.200 10165.000     .000     .000

X1  1300.000    4.000 9835.000 10140.000  100.000  100.000  100.000     .000     .000     .000
GR   308.650 9835.000  288.650 9895.000  288.650 10080.000  308.650 10140.000     .000     .000

X1  1200.000    4.000 9860.000 10115.000  100.000  100.000  100.000     .000    -.200     .000
GR   308.100 9860.000  288.100 9920.000  288.100 10055.000  308.100 10115.000     .000     .000

X1  1100.000    4.000 9885.000 10115.000   25.000   25.000   25.000     .000    -.750     .000
GR   307.550 9885.000  287.550 9945.000  287.550 10055.000  307.550 10115.000     .000     .000
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X1	1075.000	5.000	9885.000	10069.000	32.000	32.000	32.000	.000	-.870	.000
X3	.000	.000	.000	9885.000	.000	.000	.000	.000	.000	.000
GR	307.400	9885.000	287.400	9945.000	287.400	10055.000	294.400	10069.000	307.400	10069.000
X1	1043.000	9.000	9897.000	10069.000	13.000	13.000	13.000	.000	-.200	.000
X3	.000	.000	.000	9918.000	.000	.000	.000	.000	.000	.000
GR	306.370	9897.000	286.370	9945.000	286.370	9997.500	306.370	9997.500	306.370	10002.500
GR	286.370	10002.500	286.370	10055.000	293.370	10069.000	306.370	10069.000	.000	.000
X1	1030.000	10.000	9931.000	10069.000	30.000	30.000	30.000	.000	-1.170	.000
GR	307.200	9931.000	294.200	9931.000	287.200	9945.000	287.200	9997.500	307.200	9997.500
GR	307.200	10002.500	287.200	10002.500	287.200	10055.000	294.200	10069.000	307.200	10069.000
X1	1000.000	.000	.000	.000	30.000	30.000	30.000	.000	-.330	.000
X1	970.000	.000	.000	.000	13.000	13.000	13.000	.000	-.330	.000
X1	957.000	9.000	9931.000	10105.000	32.000	32.000	32.000	.000	-1.610	.000
X3	.000	.000	.000	.000	.000	10072.000	.000	.000	.000	.000
GR	306.840	9931.000	293.840	9931.000	286.840	9945.000	286.840	9997.500	306.840	9997.500
GR	306.840	10002.500	286.840	10002.500	286.840	10055.000	306.840	10105.000	.000	.000
X1	925.000	5.000	9931.000	10115.000	25.000	25.000	25.000	.000	-1.870	.000
X3	.000	.000	.000	.000	.000	10081.000	.000	.000	.000	.000
GR	306.750	9931.000	293.750	9931.000	286.750	9945.000	286.750	10055.000	306.750	10115.000
X1	900.000	4.000	9889.000	10115.000	65.000	65.000	65.000	.000	-.200	.000
X3	.000	.000	.000	9924.000	.000	10087.000	.000	.000	.000	.000
GR	304.800	9889.000	284.800	9945.000	284.800	10055.000	304.800	10115.000	.000	.000
X1	835.000	.000	.000	.000	60.000	60.000	60.000	.000	-.590	.000
X3	.000	.000	.000	9908.000	.000	10104.000	.000	.000	.000	.000
X1	775.000	.000	.000	.000	60.000	60.000	60.000	.000	-.800	.000
X3	.000	.000	.000	9893.000	.000	.000	.000	.000	.000	.000
X1	715.000	.000	.000	.000	60.000	60.000	60.000	.000	-.810	.000
X1	655.000	.000	.000	.000	60.000	60.000	60.000	.000	-.800	.000
X1	595.000	.000	.000	.000	60.000	60.000	60.000	.000	-.800	.000
X1	535.000	.000	.000	.000	225.000	225.000	225.000	.000	-.800	.000
X1	310.000	7.000	9745.000	10145.000	160.000	160.000	160.000	.000	.000	.000
X3	.000	.000	.000	9950.000	.000	10188.000	.000	.000	.000	.000
GR	290.000	9745.000	280.000	9759.000	278.000	9780.000	278.000	[illegible]	280.000	[illegible]
GR	290.000	10129.000	292.000	10145.000	.000	.000	.000	.000	.000	.000

THIS RUN EXECUTED 10-01-90

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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
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T1      HYDRAULIC & SCOUR ANALYSIS FOR 51st AVENUE BRIDGE AT SKUNK CREEK
T2      IMPROVED CHANNEL WITH THE NEW BRIDGE IN-PLACE,  MODEL SK3D.IN, NO DEBRIS
T3      SKUNK CREEK AT 51st AVE        SUPER-CRITICAL, FUTURE 100-YEAR EVENT

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

      0.        3.        0.        1. -1.000000       .00        .0        0.   296.000      .000

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

    15.000      .000    -1.000      .000      .000      .000    -1.000      .000      .000      .000
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THIS RUN EXECUTED 10-01-90

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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
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NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SKUNK CREEK AT 51st AVE

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	CRIWS	DEPTH	ELMIN	SSTA	ENDST	TOPWID	VCH
*	1545.000	8750.00	293.70	293.70	3.70	290.00	9883.90	10116.10	232.20	10.70
*	1545.000	10400.00	294.14	294.14	4.14	290.00	9882.57	10117.43	234.86	11.28
*	1500.000	8750.00	293.45	293.45	3.70	289.75	9883.90	10116.10	232.20	10.70
*	1500.000	10400.00	293.89	293.89	4.14	289.75	9882.57	10117.43	234.85	11.29
*	1400.000	8750.00	292.90	292.90	3.70	289.20	9883.90	10116.10	232.20	10.70
*	1400.000	10400.00	293.34	293.34	4.14	289.20	9882.57	10117.43	234.85	11.29
*	1300.000	8750.00	292.66	292.66	4.01	288.65	9882.98	10092.02	209.04	11.08
*	1300.000	10400.00	293.13	293.13	4.48	288.65	9881.55	10093.45	211.90	11.69
*	1200.000	8750.00	292.77	292.77	4.87	287.90	9905.40	10069.60	164.20	12.02
*	1200.000	10400.00	293.34	293.34	5.44	287.90	9903.69	10071.31	167.62	12.64
*	1100.000	8750.00	292.31	292.31	5.51	286.80	9928.48	10071.52	143.04	12.56
*	1100.000	10400.00	292.94	292.94	6.14	286.80	9926.58	10073.42	146.85	13.19
	1075.000	8750.00	292.04	292.09	5.51	286.53	9928.50	10066.00	137.50	12.86
*	1075.000	10400.00	292.71	292.73	6.18	286.53	9926.45	10067.37	140.92	13.41
*	1043.000	8750.00	291.90	291.90	5.73	286.17	9931.25	10066.46	130.21	12.98
*	1043.000	10400.00	292.57	292.57	6.40	286.17	9929.65	10067.79	133.15	13.65
	1030.000	8750.00	291.73	291.79	5.70	286.03	9933.59	10066.41	127.82	13.18
*	1030.000	10400.00	292.46	292.47	6.43	286.03	9932.13	10067.87	130.74	13.71
	1000.000	8750.00	290.99	291.47	5.29	285.70	9934.42	10065.58	126.16	14.31
	1000.000	10400.00	291.66	292.13	5.96	285.70	9933.09	10066.91	128.82	14.94
	970.000	8750.00	290.51	291.12	5.14	285.37	9934.71	10065.29	125.57	14.76
	970.000	10400.00	291.15	291.80	5.78	285.37	9933.45	10066.55	128.11	15.44

SECNO	Q	CWSEL	CRIWS	DEPTH	ELMIN	SSTA	ENDST	TOPWID	VCH
957.000	8750.00	290.20	290.96	4.97	285.23	9935.05	10067.44	127.39	15.13
957.000	10400.00	290.81	291.63	5.58	285.23	9933.86	10068.93	130.07	15.88
925.000	8750.00	289.37	290.43	4.49	284.83	9936.02	10068.47	132.46	16.07
925.000	10400.00	289.89	291.08	5.01	284.88	9934.98	10070.03	135.05	16.94
900.000	8750.00	288.99	290.10	4.39	284.60	9932.70	10068.18	135.48	16.22
900.000	10400.00	289.43	290.74	4.88	284.60	9931.32	10069.66	138.34	17.14
835.000	8750.00	288.73	289.52	4.72	284.01	9931.77	10069.17	137.40	14.97
835.000	10400.00	289.19	290.15	5.18	284.01	9930.43	10070.56	140.08	16.04
775.000	8750.00	287.72	288.74	4.51	283.21	9932.35	10068.55	136.20	15.74
775.000	10400.00	288.21	289.35	5.00	283.21	9931.00	10070.00	139.00	16.71
715.000	8750.00	286.81	287.91	4.41	282.40	9932.66	10068.22	135.56	16.17
715.000	10400.00	287.29	288.54	4.89	282.40	9931.30	10069.67	138.37	17.12
655.000	8750.00	285.95	287.10	4.35	281.60	9932.82	10068.05	135.23	16.40
655.000	10400.00	286.43	287.74	4.83	281.60	9931.47	10069.49	138.02	17.36
595.000	8750.00	285.10	286.30	4.30	280.80	9932.93	10067.93	135.00	16.57
595.000	10400.00	285.59	286.94	4.79	280.80	9931.58	10069.37	137.79	17.52
535.000	8750.00	284.28	285.51	4.28	280.00	9932.98	10067.88	134.90	16.65
535.000	10400.00	284.77	286.14	4.77	280.00	9931.66	10069.30	137.64	17.63
310.000	8750.00	281.44	282.54	3.44	278.00	9950.00	10113.59	163.59	15.91
310.000	10400.00	281.77	283.08	3.77	278.00	9950.00	10114.19	164.19	17.22
150.000	8750.00	279.51	280.33	2.51	277.00	9920.00	10249.60	329.60	13.34
150.000	10400.00	279.66	280.67	2.66	277.00	9920.00	10250.32	330.32	14.78
.000	8750.00	282.30	282.30	4.70	277.60	9869.00	10100.00	231.00	10.76
.000	10400.00	282.73	282.73	5.13	277.60	9869.00	10100.00	231.00	11.39

SKUNK CREEK AT 51st AVE

SUMMARY PRINTOUT

	SECNO	K*XNCH	K*CHSL	10K*S	XLCH	AREA	QCH	STENCL	STENCR
*	1545.000	25.00	.00	60.83	.00	817.98	8750.00	.00	.00
*	1545.000	25.00	.00	58.66	.00	921.66	10400.00	.00	.00
*	1500.000	25.00	-5.56	60.82	45.00	818.04	8750.00	.00	.00
*	1500.000	25.00	-5.56	58.73	45.00	921.33	10400.00	.00	.00
*	1400.000	25.00	-5.50	60.81	100.00	818.06	8750.00	.00	.00
*	1400.000	25.00	-5.50	58.74	100.00	921.29	10400.00	.00	.00
*	1300.000	25.00	-5.50	59.59	100.00	789.52	8750.00	.00	.00
*	1300.000	25.00	-5.50	57.57	100.00	889.89	10400.00	.00	.00
*	1200.000	25.00	-7.50	56.81	100.00	728.15	8750.00	.00	.00
*	1200.000	25.00	-7.50	55.01	100.00	822.57	10400.00	.00	.00
*	1100.000	25.00	-11.00	54.95	100.00	696.79	8750.00	.00	.00
*	1100.000	25.00	-11.00	53.27	100.00	788.67	10400.00	.00	.00
	1075.000	25.00	-10.80	56.62	25.00	680.65	8750.00	9885.00	10069.00
*	1075.000	25.00	-10.80	53.54	25.00	775.82	10400.00	9885.00	10069.00
*	1043.000	25.00	-11.25	61.05	32.00	673.88	8750.00	9918.00	10069.00
*	1043.000	25.00	-11.25	59.75	32.00	761.76	10400.00	9918.00	10069.00
	1030.000	25.00	-10.77	62.81	13.00	663.99	8750.00	.00	.00
*	1030.000	25.00	-10.77	59.47	13.00	758.56	10400.00	.00	.00
	1000.000	25.00	-11.00	80.60	30.00	611.43	8750.00	.00	.00
	1000.000	25.00	-11.00	76.88	30.00	696.34	10400.00	.00	.00
	970.000	25.00	-11.00	88.45	30.00	593.00	8750.00	.00	.00
	970.000	25.00	-11.00	85.05	30.00	673.37	10400.00	.00	.00
	957.000	25.00	-10.77	97.30	13.00	578.25	8750.00	.00	10072.00
	957.000	25.00	-10.77	94.37	13.00	654.90	10400.00	.00	10072.00
	925.000	25.00	-10.94	112.97	32.00	544.53	8750.00	.00	10081.00
	925.000	25.00	-10.94	109.97	32.00	613.95	10400.00	.00	10081.00
	900.000	25.00	-11.20	119.81	25.00	539.31	8750.00	9924.00	10087.00
	900.000	25.00	-11.20	117.68	25.00	606.71	10400.00	9924.00	10087.00
	835.000	25.00	-9.08	93.47	65.00	584.42	8750.00	9908.00	10104.00
	835.000	25.00	-9.08	95.94	65.00	648.41	10400.00	9908.00	10104.00
	775.000	25.00	-13.33	109.00	60.00	556.04	8750.00	9893.00	10115.01
	775.000	25.00	-13.33	108.79	60.00	622.40	10400.00	9893.00	10115.01

	SECNO	K*XNCH	K*CHSL	10K*S	XLCH	AREA	QCH	STENCL	STENCR
	715.000	25.00	-13.50	118.57	60.00	541.12	8750.00	.00	.00
	715.000	25.00	-13.50	117.23	60.00	607.45	10400.00	.00	.00
	655.000	25.00	-13.33	123.91	60.00	533.47	8750.00	.00	.00
	655.000	25.00	-13.33	122.39	60.00	599.02	10400.00	.00	.00
	595.000	25.00	-13.33	127.87	60.00	528.08	8750.00	.00	.00
	595.000	25.00	-13.33	125.86	60.00	593.60	10400.00	.00	.00
	535.000	25.00	-13.33	129.74	60.00	525.62	8750.00	.00	.00
	535.000	25.00	-13.33	128.22	60.00	590.03	10400.00	.00	.00
	310.000	25.00	-8.89	147.18	225.00	549.85	8750.00	9950.00	10188.00
	310.000	25.00	-8.89	153.33	225.00	603.90	10400.00	9950.00	10188.00
	150.000	25.00	-6.25	202.35	160.00	656.15	8750.00	9920.00	10280.00
	150.000	25.00	-6.25	227.13	160.00	703.77	10400.00	9920.00	10280.00
*	.000	25.00	4.00	63.27	150.00	813.39	8750.00	9869.00	10100.00
*	.000	25.00	4.00	61.09	150.00	913.05	10400.00	9869.00	10100.00

SUMMARY OF ERRORS AND SPECIAL NOTES

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CAUTION  SECNO=  1545.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1545.000  PROFILE= 2  CRITICAL DEPTH ASSUMED

CAUTION  SECNO=  1500.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1500.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1500.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=  1500.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1500.000  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1500.000  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=  1400.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1400.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1400.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=  1400.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1400.000  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1400.000  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=  1300.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1300.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1300.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=  1300.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1300.000  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1300.000  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=  1200.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1200.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1200.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=  1200.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1200.000  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1200.000  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=  1100.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1100.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1100.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=  1100.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1100.000  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1100.000  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=  1075.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=  1043.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1043.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1043.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=  1043.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1043.000  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1043.000  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=  1030.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=      .000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=      .000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
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```
CAUTION  SECNO=      .000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=      .000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=      .000  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=      .000  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL
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THIS RUN EXECUTED 10-01-90

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*************************************************
 HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
 ERROR CORR -  01,02,03,04,05,06
 MODIFICATION -  50,51,52,53,54,55,56
 IBM-PC-XT VERSION AUGUST 1985
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Model SK2F.IN/.OT

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****************************************************
*  WATER SURFACE PROFILES                          *
*  VERSION OF NOVEMBER 1976                        *
*  UPDATED MAY 1984                                *
*  IBM-PC-XT VERSION AUGUST 1985                   *
*  RUN DATE  10-01-90   TIME  19:38:23               *
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*  U.S. ARMY CORPS OF ENGINEERS
*  THE HYDROLOGIC ENGINEERING CENTER
*  609 SECOND STREET, SUITE D
*  DAVIS, CALIFORNIA 95616
  *  (916) 440-2105 (FTS) 448-2105
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X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X            X     X
X     X  X        X                        X
XXXXXXX  XXXX     X         XXXXX    XXXXX
X     X  X        X                  X
X     X  X        X     X            X
X     X  XXXXXXX   XXXXX             XXXXXXX
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THIS RUN EXECUTED 10-01-90

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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
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T1      HYDRAULIC & SCOUR ANALYSIS FOR 51st AVENUE BRIDGE AT SKUNK CREEK
T2      IMPROVED CHANNEL WITH THE NEW BRIDGE IN-PLACE, MODEL SK2F.IN
T3      SKUNK CREEK AT 51st AVE        SUB-CRITICAL, EXISTING 100-YEAR EVENT

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

      0.        2.        0.        0.   .002650       .00        .0        0.   285.000      .000

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

     .000      .000    -1.000      .000      .000      .000    -1.000      .000      .000      .000

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

   38.000    43.000     1.000     2.000     8.000    42.000    53.000    54.000     4.000    26.000


     .000    38.000    17.000    33.000     5.000    39.000    25.000    14.000    27.000    28.000

J5  LPRNT    NUMSEC                    ********REQUESTED SECTION NUMBERS********

  -10.000   -10.000      .000      .000      .000      .000      .000      .000      .000      .000

NC      .045      .045      .035      .200      .400      .000      .000      .000      .000      .000
QT     2.000  8750.000 10400.000      .000      .000      .000      .000      .000      .000      .000
X1      .000     8.000  9782.000 10135.000      .000      .000      .000      .000      .000      .000
X3      .000      .000      .000  9869.000      .000 10100.000      .000      .000      .000      .000
GR   290.000  9782.000   280.000  9848.000   278.000  9858.000   277.600  9880.000   278.000  9950.000
GR   279.000 10000.000   280.000 10075.000   282.000 10135.000      .000      .000      .000      .000

X1   150.000     7.000  9870.000 10280.000   150.000   150.000   150.000      .000      .000      .000
X3      .000      .000      .000  9920.000      .000      .000      .000      .000      .000      .000
GR   290.000  9870.000   280.000  9919.000   278.000  9920.000   277.000 10221.000   278.000 10242.000
GR   280.000 10252.000   290.000 10280.000      .000      .000      .000      .000      .000      .000

X1   310.000     7.000  9745.000 10145.000   160.000   160.000   160.000      .000      .000      .000
X3      .000      .000      .000  9950.000      .000 10188.000      .000      .000      .000      .000
GR   290.000  9745.000   280.000  9769.000   278.000  9780.000   278.000 10105.000   280.000 10111.000
GR   290.000 10129.000   292.000 10145.000      .000      .000      .000      .000      .000      .000

X1   535.000     4.000  9885.000 10115.000   225.000   225.000   225.000      .000      .000      .000
GR   300.000  9885.000   280.000  9945.000   280.000 10055.000   300.000 10115.000      .000      .000
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X1	595.000	.000	.000	.000	60.000	60.000	60.000	.000	.300	.000
X1	655.000	.000	.000	.000	60.000	60.000	60.000	.000	.800	.000
X1	715.000	.000	.000	.000	60.000	60.000	60.000	.000	.800	.000
X1	775.000	.000	.000	.000	60.000	60.000	60.000	.000	.810	.000
X3	.000	.000	.000	9893.000	.000	.000	.000	.000	.000	.000
X1	835.000	.000	.000	.000	60.000	60.000	60.000	.000	.800	.000
X3	.000	.000	.000	9908.000	.000	10104.000	.000	.000	.000	.000
NC	.000	.000	.000	.300	.500	.000	.000	.000	.000	.000
X1	900.000	4.000	9889.000	10115.000	65.000	65.000	65.000	.000	-.200	.000
X3	.000	.000	.000	9924.000	.000	10087.000	.000	.000	.000	.000
GR	304.800	9889.000	284.800	9945.000	284.800	10055.000	304.800	10115.000	.000	.000
X1	925.000	5.000	9931.000	10115.000	25.000	25.000	25.000	.000	-1.870	.000
X3	.000	.000	.000	.000	.000	10081.000	.000	.000	.000	.000
GR	306.750	9931.000	293.750	9931.000	286.750	9945.000	286.750	10055.000	306.750	10115.000
X1	957.000	9.000	9931.000	10105.000	32.000	32.000	32.000	.000	-1.610	.000
X3	.000	.000	.000	.000	.000	10072.000	.000	.000	.000	.000
GR	306.840	9931.000	293.840	9931.000	286.840	9945.000	286.840	9995.000	306.840	9995.000
GR	306.840	10005.000	286.840	10005.000	286.840	10055.000	306.840	10105.000	.000	.000
X1	970.000	10.000	9931.000	10069.000	13.000	13.000	13.000	.000	-1.560	.000
GR	306.930	9931.000	293.930	9931.000	286.930	9945.000	286.930	9995.000	306.930	9995.000
GR	306.930	10005.000	286.930	10005.000	286.930	10055.000	293.930	10069.000	306.930	10069.000
X1	1000.000	.000	.000	.000	30.000	30.000	30.000	.000	.330	.000
X1	1030.000	.000	.000	.000	30.000	30.000	30.000	.000	.330	.000
X1	1043.000	9.000	9897.000	10069.000	13.000	13.000	13.000	.000	-.200	.000
X3	.000	.000	.000	9918.000	.000	.000	.000	.000	.000	.000
GR	306.370	9897.000	286.370	9945.000	286.370	9995.000	306.370	9995.000	306.370	10005.000
GR	286.370	10005.000	286.370	10055.000	293.370	10069.000	306.370	10069.000	.000	.000
X1	1075.000	5.000	9885.000	10069.000	32.000	32.000	32.000	.000	-.870	.000
GR	307.400	9885.000	287.400	9945.000	287.400	10055.000	294.400	10069.000	307.400	10069.000
NC	.000	.000	.000	.200	.400	.000	.000	.000	.000	.000
X1	1100.000	4.000	9885.000	10115.000	25.000	25.000	25.000	.000	-.750	.000
GR	307.550	9885.000	287.550	9945.000	287.550	10055.000	307.550	10115.000	.000	.000
X1	1200.000	4.000	9860.000	10115.000	100.000	100.000	100.000	.000	-.200	.000
GR	308.100	9860.000	288.100	9920.000	288.100	10055.000	308.100	10115.000	.000	.000

X1	1300.000	4.000	9835.000	10140.000	100.000	100.000	100.000	.000	.000	.000
GR	308.650	9835.000	288.650	9895.000	288.650	10080.000	308.650	10140.000	.000	.000
X1	1400.000	4.000	9835.000	10165.000	100.000	100.000	100.000	.000	.000	.000
GR	309.200	9835.000	289.200	9895.000	289.200	10105.000	309.200	10165.000	.000	.000
X1	1500.000	4.000	9835.000	10165.000	100.000	100.000	100.000	.000	.000	.000
GR	309.750	9835.000	289.750	9895.000	289.750	10105.000	309.750	10165.000	.000	.000
X1	1545.000	.000	.000	.000	45.000	45.000	45.000	.000	.250	.000
EJ	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

THIS RUN EXECUTED 10-01-90

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 HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
 ERROR CORR -  01,02,03,04,05,06
 MODIFICATION -  50,51,52,53,54,55,56
 IBM-PC-XT VERSION AUGUST 1985
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T1      HYDRAULIC & SCOUR ANALYSIS FOR 51st AVENUE BRIDGE AT SKUNK CREEK
T2      IMPROVED CHANNEL WITH THE NEW BRIDGE IN-PLACE,  MODEL SK2F.IN
T3      SKUNK CREEK AT 51st AVE        SUB-CRITICAL, FUTURE 100-YEAR EVENT

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

      0.        3.        0.        0.   .002650       .00        .0        0.   286.000      .000

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

    15.000      .000    -1.000      .000      .000      .000    -1.000      .000      .000      .000
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THIS RUN EXECUTED 10-01-90

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*************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
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NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SKUNK CREEK AT 51st AVE

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	CRIWS	DEPTH	ELMIN	SSTA	ENDST	TOPWID	VCH
	.000	8750.00	284.42	282.31	6.82	277.60	9869.00	10100.00	231.00	6.72
	.000	10400.00	285.05	282.73	7.45	277.60	9869.00	10100.00	231.00	7.19
	150.000	8750.00	285.18	280.33	8.18	277.00	9920.00	10266.51	346.51	3.40
	150.000	10400.00	285.90	280.64	8.90	277.00	9920.00	10268.51	348.51	3.69
	310.000	8750.00	284.87	282.54	6.87	278.00	9950.00	10119.78	169.78	7.79
	310.000	10400.00	285.52	283.10	7.52	278.00	9950.00	10120.95	170.95	8.43
*	535.000	8750.00	285.50	285.50	5.50	280.00	9928.51	10071.49	142.97	12.59
*	535.000	10400.00	286.13	286.13	6.13	280.00	9926.61	10073.39	146.77	13.22
*	595.000	8750.00	286.30	286.30	5.50	280.80	9928.49	10071.51	143.01	12.57
*	595.000	10400.00	286.94	286.94	6.14	280.80	9926.59	10073.41	146.81	13.20
*	655.000	8750.00	287.10	287.10	5.50	281.60	9928.50	10071.50	143.00	12.57
*	655.000	10400.00	287.73	287.73	6.13	281.60	9926.60	10073.40	146.80	13.20
*	715.000	8750.00	287.90	287.90	5.50	282.40	9928.50	10071.50	143.01	12.57
*	715.000	10400.00	288.53	288.53	6.13	282.40	9926.60	10073.40	146.80	13.20
*	775.000	8750.00	288.71	288.71	5.50	283.21	9928.50	10071.50	143.00	12.57
*	775.000	10400.00	289.34	289.34	6.13	283.21	9926.60	10073.40	146.80	13.20
*	835.000	8750.00	289.51	289.51	5.50	284.01	9928.50	10071.50	143.00	12.57
*	835.000	10400.00	290.14	290.14	6.13	284.01	9926.60	10073.40	146.80	13.20
	900.000	8750.00	290.84	290.11	6.24	284.60	9927.53	10073.72	146.20	10.95
	900.000	10400.00	291.48	290.75	6.88	284.60	9925.75	10075.63	149.88	11.64
	925.000	8750.00	290.92	290.43	6.04	284.88	9932.91	10073.13	140.22	11.57
	925.000	10400.00	291.55	291.07	6.67	284.88	9931.66	10075.01	143.35	12.31

	SECNO	Q	CWSEL	CRIWS	DEPTH	ELMIN	SSTA	ENDST	TOPWID	VCH
*	957.000	8750.00	291.14	291.14	5.91	285.23	9933.19	10069.76	126.57	13.08
*	957.000	10400.00	291.80	291.80	6.57	285.23	9931.86	10071.42	129.56	13.79
*	970.000	8750.00	291.30	291.30	5.93	285.37	9933.14	10066.86	123.73	13.19
*	970.000	10400.00	292.00	292.00	6.63	285.37	9931.74	10068.26	126.52	13.85
	1000.000	8750.00	292.49	291.63	6.79	285.70	9931.43	10068.57	127.13	11.36
	1000.000	10400.00	293.24	292.32	7.54	285.70	9931.00	10069.00	128.00	12.01
	1030.000	8750.00	292.68	291.96	6.65	286.03	9931.69	10063.31	126.61	11.61
	1030.000	10400.00	293.43	292.65	7.40	286.03	9931.00	10069.00	128.00	12.25
	1043.000	8750.00	292.98	292.07	6.81	286.17	9928.66	10068.62	129.95	11.18
	1043.000	10400.00	293.79	292.76	7.62	286.17	9926.73	10069.00	132.27	11.71
	1075.000	8750.00	293.99	292.07	7.46	286.53	9922.61	10069.00	146.39	9.12
	1075.000	10400.00	294.88	292.72	8.35	286.53	9919.95	10069.00	149.05	9.53
	1100.000	8750.00	294.10	292.30	7.30	286.80	9923.09	10076.91	153.82	9.08
	1100.000	10400.00	295.02	292.94	8.22	286.80	9920.35	10079.65	159.31	9.40
	1200.000	8750.00	294.76	292.77	6.86	287.90	9899.40	10075.60	176.20	8.19
	1200.000	10400.00	295.69	293.34	7.79	287.90	9896.63	10078.37	181.75	8.43
	1300.000	8750.00	295.55	292.67	6.90	288.65	9874.29	10100.71	226.43	6.16
	1300.000	10400.00	296.48	293.15	7.83	288.65	9871.50	10103.50	232.01	6.37
	1400.000	8750.00	295.82	292.90	6.61	289.20	9875.16	10124.84	249.68	5.76
	1400.000	10400.00	296.74	293.34	7.54	289.20	9872.42	10127.58	255.17	5.94
	1500.000	8750.00	295.96	293.45	6.21	289.75	9876.38	10123.62	247.23	6.17
	1500.000	10400.00	296.86	293.89	7.11	289.75	9873.67	10126.33	252.67	6.32
	1545.000	8750.00	296.03	293.70	6.03	290.00	9876.88	10123.12	246.24	6.35
	1545.000	10400.00	296.93	294.15	6.93	290.00	9874.19	10125.81	251.62	6.50

SKUNK CREEK AT 51st AVE

SUMMARY PRINTOUT

	SECNO	K*XNCH	K*CHSL	10K*S	XLCH	AREA	QCH	STENCL	STENCR
	.000	35.00	.00	26.43	.00	1302.42	8750.00	9869.00	10100.00
	.000	35.00	.00	26.46	.00	1447.19	10400.00	9869.00	10100.00
	150.000	35.00	-4.00	4.57	150.00	2573.26	8750.00	9920.00	10280.00
	150.000	35.00	-4.00	4.80	150.00	2821.90	10400.00	9920.00	10280.00
	310.000	35.00	6.25	28.94	160.00	1123.06	8750.00	9950.00	10188.00
	310.000	35.00	6.25	30.38	160.00	1233.04	10400.00	9950.00	10188.00
*	535.000	35.00	8.89	108.49	225.00	695.12	8750.00	.00	.00
*	535.000	35.00	8.89	105.15	225.00	786.84	10400.00	.00	.00
*	595.000	35.00	13.33	108.03	60.00	696.10	8750.00	.00	.00
*	595.000	35.00	13.33	104.75	60.00	787.84	10400.00	.00	.00
*	655.000	35.00	13.33	108.15	60.00	695.83	8750.00	.00	.00
*	655.000	35.00	13.33	104.83	60.00	787.64	10400.00	.00	.00
*	715.000	35.00	13.33	108.13	60.00	695.88	8750.00	.00	.00
*	715.000	35.00	13.33	104.83	60.00	787.64	10400.00	.00	.00
*	775.000	35.00	13.50	108.15	60.00	695.85	8750.00	9893.00	10115.01
*	775.000	35.00	13.50	104.83	60.00	787.64	10400.00	9893.00	10115.01
*	835.000	35.00	13.33	108.15	60.00	695.85	8750.00	9908.00	10104.00
*	835.000	35.00	13.33	104.83	60.00	787.64	10400.00	9908.00	10104.00
	900.000	35.00	9.08	70.30	65.00	799.41	8750.00	9924.00	10087.00
	900.000	35.00	9.08	70.95	65.00	893.51	10400.00	9924.00	10087.00
	925.000	35.00	11.20	80.36	25.00	756.11	8750.00	.00	10081.00
	925.000	35.00	11.20	80.89	25.00	844.92	10400.00	.00	10081.00
*	957.000	35.00	10.94	118.93	32.00	668.98	8750.00	.00	10072.00
*	957.000	35.00	10.94	117.64	32.00	754.11	10400.00	.00	10072.00
*	970.000	35.00	10.77	119.29	13.00	663.57	8750.00	.00	.00
*	970.000	35.00	10.77	116.49	13.00	750.88	10400.00	.00	.00
	1000.000	35.00	11.00	76.39	30.00	770.43	8750.00	.00	.00
	1000.000	35.00	11.00	75.53	30.00	865.81	10400.00	.00	.00
	1030.000	35.00	11.00	81.48	30.00	753.90	8750.00	.00	.00
	1030.000	35.00	11.00	80.34	30.00	848.70	10400.00	.00	.00
	1043.000	35.00	10.77	74.23	13.00	782.76	8750.00	9918.00	10069.00
	1043.000	35.00	10.77	71.78	13.00	888.26	10400.00	9918.00	10069.00

SECNO	K*XNCH	K*CHSL	10K*S	XLCH	AREA	QCH	STENCL	STENCR
1075.000	35.00	11.25	38.69	32.00	959.92	8750.00	.00	.00
1075.000	35.00	11.25	36.83	32.00	1091.22	10400.00	.00	.00
1100.000	35.00	10.80	40.46	25.00	963.35	8750.00	.00	.00
1100.000	35.00	10.80	37.80	25.00	1106.54	10400.00	.00	.00
1200.000	35.00	11.00	34.22	100.00	1068.36	8750.00	.00	.00
1200.000	35.00	11.00	31.22	100.00	1233.97	10400.00	.00	.00
1300.000	35.00	7.50	18.43	100.00	1420.40	8750.00	.00	.00
1300.000	35.00	7.50	16.90	100.00	1633.52	10400.00	.00	.00
1400.000	35.00	5.50	16.73	100.00	1519.96	8750.00	.00	.00
1400.000	35.00	5.50	15.20	100.00	1750.97	10400.00	.00	.00
1500.000	35.00	5.50	20.77	100.00	1418.58	8750.00	.00	.00
1500.000	35.00	5.50	18.46	100.00	1645.04	10400.00	.00	.00
1545.000	35.00	5.56	22.76	45.00	1377.71	8750.00	.00	.00
1545.000	35.00	5.56	20.09	45.00	1601.09	10400.00	.00	.00

SUMMARY OF ERRORS AND SPECIAL NOTES

```
CAUTION  SECNO=   535.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   535.000  PROFILE= 1  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=   535.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   535.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=   595.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   595.000  PROFILE= 1  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=   595.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   595.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=   655.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   655.000  PROFILE= 1  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=   655.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   655.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=   715.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   715.000  PROFILE= 1  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=   715.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   715.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=   775.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   775.000  PROFILE= 1  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=   775.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   775.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=   835.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   835.000  PROFILE= 1  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=   835.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   835.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=   957.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   957.000  PROFILE= 1  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=   957.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   957.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=   970.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   970.000  PROFILE= 1  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=   970.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   970.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY
```

THIS RUN EXECUTED 10-01-90

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**************************************************
 HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
 ERROR CORR -  01,02,03,04,05,06
 MODIFICATION -  50,51,52,53,54,55,56
 IBM-PC-XT VERSION AUGUST 1985
**************************************************
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Model SK3E.IN/.OT

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*****************************************************
*  WATER SURFACE PROFILES                           *
*  VERSION OF NOVEMBER 1976                         *
*  UPDATED MAY 1984                                 *
*  IBM-PC-XT VERSION AUGUST 1985                    *
*  RUN DATE  10-01-90   TIME  19:39:03                *
*****************************************************
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*************************************
*  U.S. ARMY CORPS OF ENGINEERS
*  THE HYDROLOGIC ENGINEERING CENTER
*  609 SECOND STREET, SUITE D
*  DAVIS, CALIFORNIA 95616
*  (916) 440-2105 (FTS) 448-2105
*************************************
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X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X            X     X
X     X  X        X                        X
XXXXXXX  XXXX     X         XXXXX    XXXXX
X     X  X        X                  X
X     X  X        X     X            X
X     X  XXXXXXX   XXXXX             XXXXXXX
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THIS RUN EXECUTED 10-01-90

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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
**************************************************
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T1 HYDRAULIC & SCOUR ANALYSIS FOR 51st AVENUE BRIDGE AT SKUNK CREEK
T2 IMPROVED CHANNEL WITH THE NEW BRIDGE IN-PLACE, MODEL SK3E.IN
T3 SKUNK CREEK AT 51st AVE SUPER-CRITICAL, EXISTING 100-YEAR EVENT

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0.	2.	0.	1.	-1.000000	.00	.0	0.	295.000	.000
J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLOC	IBW	CHNIM	ITRACE
	.000	.000	-1.000	.000	.000	.000	-1.000	.000	.000	.000

J3 VARIABLE CODES FOR SUMMARY PRINTOUT

38.000	43.000	1.000	2.000	8.000	42.000	53.000	54.000	4.000	26.000
.000	38.000	17.000	33.000	5.000	39.000	25.000	14.000	27.000	28.000

J5 LPRNT NUMSEC ********REQUESTED SECTION NUMBERS********

-10.000	-10.000	.000	.000	.000	.000	.000	.000	.000	.000

NC	.025	.025	.025	.100	.300	.000	.000	.000	.000	.000
QT	2.000	8750.000	10400.000	.000	.000	.000	.000	.000	.000	.000
X1	1545.000	4.000	9835.000	10165.000	45.000	45.000	45.000	.000	.000	.000
GR	310.000	9835.000	290.000	9895.000	290.000	10105.000	310.000	10165.000	.000	.000
X1	1500.000	.000	.000	.000	100.000	100.000	100.000	.000	-.250	.000
X1	1400.000	4.000	9835.000	10165.000	100.000	100.000	100.000	.000	.000	.000
GR	309.200	9835.000	289.200	9895.000	289.200	10105.000	309.200	10165.000	.000	.000
X1	1300.000	4.000	9835.000	10140.000	100.000	100.000	100.000	.000	.000	.000
GR	308.650	9835.000	288.650	9895.000	288.650	10080.000	308.650	10140.000	.000	.000
X1	1200.000	4.000	9860.000	10115.000	100.000	100.000	100.000	.000	-.200	.000
GR	308.100	9860.000	288.100	9920.000	288.100	10055.000	308.100	10115.000	.000	.000
X1	1100.000	4.000	9885.000	10115.000	25.000	25.000	25.000	.000	-.750	.000
GR	307.550	9885.000	287.550	9945.000	287.550	10055.000	307.550	10115.000	.000	.000

X1	1075.000	5.000	9885.000	10069.000	32.000	32.000	32.000	.000	-.870	.000
X3	.000	.000	.000	9885.000	.000	.000	.000	.000	.000	.000
GR	307.400	9885.000	287.400	9945.000	287.400	10055.000	294.400	10069.000	307.400	10069.000
X1	1043.000	9.000	9897.000	10069.000	13.000	13.000	13.000	.000	-.200	.000
X3	.000	.000	.000	9918.000	.000	.000	.000	.000	.000	.000
GR	306.370	9897.000	286.370	9945.000	286.370	9995.000	306.370	9995.000	306.370	10005.000
GR	286.370	10005.000	286.370	10055.000	293.370	10069.000	306.370	10069.000	.000	.000
X1	1030.000	10.000	9931.000	10069.000	30.000	30.000	30.000	.000	-1.170	.000
GR	307.200	9931.000	294.200	9931.000	287.200	9945.000	287.200	9995.000	307.200	9995.000
GR	307.200	10005.000	287.200	10005.000	287.200	10055.000	294.200	10069.000	307.200	10069.000
X1	1000.000	.000	.000	.000	30.000	30.000	30.000	.000	-.330	.000
X1	970.000	.000	.000	.000	13.000	13.000	13.000	.000	-.330	.000
X1	957.000	9.000	9931.000	10105.000	32.000	32.000	32.000	.000	-1.610	.000
X3	.000	.000	.000	.000	.000	10072.000	.000	.000	.000	.000
GR	306.840	9931.000	293.840	9931.000	286.840	9945.000	286.840	9995.000	306.840	9995.000
GR	306.840	10005.000	286.840	10005.000	286.840	10055.000	306.840	10105.000	.000	.000
X1	925.000	5.000	9931.000	10115.000	25.000	25.000	25.000	.000	-1.870	.000
X3	.000	.000	.000	.000	.000	10081.000	.000	.000	.000	.000
GR	306.750	9931.000	293.750	9931.000	286.750	9945.000	286.750	10055.000	306.750	10115.000
X1	900.000	4.000	9889.000	10115.000	65.000	65.000	65.000	.000	-.200	.000
X3	.000	.000	.000	9924.000	.000	10087.000	.000	.000	.000	.000
GR	304.800	9889.000	284.800	9945.000	284.800	10055.000	304.800	10115.000	.000	.000
X1	835.000	.000	.000	.000	60.000	60.000	60.000	.000	-.590	.000
X3	.000	.000	.000	9908.000	.000	10104.000	.000	.000	.000	.000
X1	775.000	.000	.000	.000	60.000	60.000	60.000	.000	-.800	.000
X3	.000	.000	.000	9893.000	.000	.000	.000	.000	.000	.000
X1	715.000	.000	.000	.000	60.000	60.000	60.000	.000	-.810	.000
X1	655.000	.000	.000	.000	60.000	60.000	60.000	.000	-.800	.000
X1	595.000	.000	.000	.000	60.000	60.000	60.000	.000	-.800	.000
X1	535.000	.000	.000	.000	225.000	225.000	225.000	.000	-.800	.000
X1	310.000	7.000	9745.000	10145.000	160.000	160.000	160.000	.000	.000	.000
X3	.000	.000	.000	9950.000	.000	10188.000	.000	.000	.000	.000
GR	290.000	9745.000	280.000	9769.000	278.000	9780.000	278.000	10105.000	280.000	10111.000
GR	290.000	10129.000	292.000	10145.000	.000	.000	.000	.000	.000	.000

X1	150.000	7.000	9870.000	10280.000	150.000	150.000	150.000	.000	.000	.000
X3	.000	.000	.000	9920.000	.000	.000	.000	.000	.000	.000
GR	290.000	9870.000	280.000	9919.000	278.000	9920.000	277.000	10221.000	278.000	10242.000
GR	280.000	10252.000	290.000	10280.000	.000	.000	.000	.000	.000	.000
X1	.000	8.000	9782.000	10135.000	.000	.000	.000	.000	.000	.000
X3	.000	.000	.000	9869.000	.000	10100.000	.000	.000	.000	.000
GR	290.000	9782.000	280.000	9848.000	278.000	9858.000	277.600	9880.000	278.000	9950.000
GR	279.000	10000.000	280.000	10075.000	282.000	10135.000	.000	.000	.000	.000
EJ	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

THIS RUN EXECUTED 10-01-90

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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
**************************************************
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T1      HYDRAULIC & SCOUR ANALYSIS FOR 51st AVENUE BRIDGE AT SKUNK CREEK
T2      IMPROVED CHANNEL WITH THE NEW BRIDGE IN-PLACE,  MODEL SK3E.IN
T3      SKUNK CREEK AT 51st AVE        SUPER-CRITICAL, FUTURE 100-YEAR EVENT

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

       0.        3.        0.        1. -1.000000       .00        .0        0.   296.000      .000

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLOC     IBW       CHNIM     ITRACE

     15.000      .000    -1.000      .000      .000      .000    -1.000      .000      .000      .000
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THIS RUN EXECUTED 10-01-90

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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
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NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SKUNK CREEK AT 51st AVE

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	CRIWS	DEPTH	ELMIN	SSTA	ENDST	TOPWID	VCH
*	1545.000	8750.00	293.70	293.70	3.70	290.00	9883.90	10116.10	232.20	10.70
*	1545.000	10400.00	294.14	294.14	4.14	290.00	9882.57	10117.43	234.86	11.28
*	1500.000	8750.00	293.45	293.45	3.70	289.75	9883.90	10116.10	232.20	10.70
*	1500.000	10400.00	293.89	293.89	4.14	289.75	9882.57	[illegible]	234.85	11.29
*	1400.000	8750.00	292.90	292.90	3.70	289.20	9883.90	10116.10	232.20	10.70
*	1400.000	10400.00	293.34	293.34	4.14	289.20	9882.57	10117.43	234.85	11.29
*	1300.000	8750.00	292.66	292.66	4.01	288.65	9882.98	10092.02	209.04	11.08
*	1300.000	10400.00	293.13	293.13	4.48	288.65	9881.55	10093.45	211.90	11.69
*	1200.000	8750.00	292.77	292.77	4.87	287.90	9905.40	10069.60	164.20	12.02
*	1200.000	10400.00	293.34	293.34	5.44	287.90	9903.69	10071.31	167.62	12.64
*	1100.000	8750.00	292.31	292.31	5.51	286.80	9928.48	10071.52	143.04	12.56
*	1100.000	10400.00	292.94	292.94	6.14	286.80	9926.58	10073.42	146.85	13.19
	1075.000	8750.00	292.04	292.09	5.51	286.53	9928.50	10066.00	137.50	12.86
*	1075.000	10400.00	292.71	292.73	6.18	286.53	9926.45	10067.37	140.92	13.41
*	1043.000	8750.00	292.07	292.07	5.90	286.17	9930.84	10066.80	125.96	13.13
*	1043.000	10400.00	292.76	292.76	6.59	286.17	9929.19	10068.17	128.98	13.79
	1030.000	8750.00	291.90	291.96	5.87	286.03	9933.25	10066.75	123.49	13.33
*	1030.000	10400.00	292.64	292.66	6.61	286.03	9931.76	10068.24	126.48	13.87
	1000.000	8750.00	291.17	291.64	5.47	285.70	9934.07	10065.93	121.87	14.43
	1000.000	10400.00	291.83	292.32	6.13	285.70	9932.73	10067.27	124.54	15.10
	970.000	8750.00	290.68	291.30	5.31	285.37	9934.38	10065.62	121.24	14.90
	970.000	10400.00	291.34	291.99	5.97	285.37	9933.07	10066.93	123.87	15.57

SECNO	Q	CWSEL	CRIWS	DEPTH	ELMIN	SSTA	ENDST	TOPWID	VCH
957.000	8750.00	290.36	291.13	5.13	285.23	9934.73	10067.83	123.10	15.28
957.000	10400.00	290.99	291.82	5.76	285.23	9933.50	10069.38	125.88	16.01
925.000	8750.00	289.20	290.43	4.32	284.88	9936.35	10067.97	131.62	16.75
925.000	10400.00	289.71	291.07	4.83	284.88	9935.34	10069.49	134.14	17.64
900.000	8750.00	288.86	290.11	4.26	284.60	9933.06	10067.79	134.72	16.77
900.000	10400.00	289.34	290.74	4.74	284.60	9931.72	10069.23	137.50	17.72
835.000	8750.00	288.66	289.52	4.65	284.01	9931.97	10068.96	136.99	15.23
835.000	10400.00	289.11	290.15	5.10	284.01	9930.72	10070.30	139.59	16.34
775.000	8750.00	287.69	288.74	4.48	283.21	9932.45	10068.45	136.00	15.87
775.000	10400.00	288.16	289.35	4.95	283.21	9931.13	10069.87	138.74	16.87
715.000	8750.00	286.79	287.90	4.39	282.40	9932.71	10068.17	135.45	16.25
715.000	10400.00	287.26	288.54	4.86	282.40	9931.38	10069.59	138.21	17.23
655.000	8750.00	285.94	287.11	4.34	281.60	9932.85	10068.02	135.17	16.45
655.000	10400.00	286.41	287.74	4.81	281.60	9931.52	10069.44	137.91	17.43
595.000	8750.00	285.09	286.30	4.29	280.80	9932.95	10067.91	134.96	16.60
595.000	10400.00	285.58	286.94	4.78	280.80	9931.62	10069.34	137.72	17.57
535.000	8750.00	284.28	285.51	4.28	280.00	9932.99	10067.87	134.87	16.67
535.000	10400.00	284.76	286.14	4.76	280.00	9931.68	10069.27	137.59	17.66
310.000	8750.00	281.44	282.54	3.44	278.00	9950.00	10113.60	163.60	15.91
310.000	10400.00	281.77	283.08	3.77	278.00	9950.00	10114.19	164.19	17.21
150.000	8750.00	279.51	280.33	2.51	277.00	9920.00	10249.60	329.60	13.34
150.000	10400.00	279.66	280.67	2.66	277.00	9920.00	10250.32	330.32	14.78
* .000	8750.00	282.30	282.30	4.70	277.60	9869.00	10100.00	231.00	10.76
* .000	10400.00	282.73	282.73	5.13	277.60	9869.00	10100.00	231.00	11.39

SKUNK CREEK AT 51st AVE

SUMMARY PRINTOUT

	SECNO	K*XNCH	K*CHSL	10K*S	XLCH	AREA	QCH	STENCL	STENCR
*	1545.000	25.00	.00	60.83	.00	817.98	8750.00	.00	.00
*	1545.000	25.00	.00	58.66	.00	921.66	10400.00	.00	.00
*	1500.000	25.00	-5.56	60.82	45.00	818.04	8750.00	.00	.00
*	1500.000	25.00	-5.56	58.73	45.00	921.33	10400.00	.00	.00
*	1400.000	25.00	-5.50	60.81	100.00	818.06	8750.00	.00	.00
*	1400.000	25.00	-5.50	58.74	100.00	921.29	10400.00	.00	.00
*	1300.000	25.00	-5.50	59.59	100.00	789.52	8750.00	.00	.00
*	1300.000	25.00	-5.50	57.57	100.00	889.89	10400.00	.00	.00
*	1200.000	25.00	-7.50	56.81	100.00	728.15	8750.00	.00	.00
*	1200.000	25.00	-7.50	55.01	100.00	822.57	10400.00	.00	.00
*	1100.000	25.00	-11.00	54.95	100.00	696.79	8750.00	.00	.00
*	1100.000	25.00	-11.00	53.27	100.00	788.67	10400.00	.00	.00
	1075.000	25.00	-10.80	56.62	25.00	680.65	8750.00	9885.00	10069.00
*	1075.000	25.00	-10.80	53.54	25.00	775.82	10400.00	9885.00	10069.00
*	1043.000	25.00	-11.25	61.07	32.00	666.57	8750.00	9918.00	10069.00
*	1043.000	25.00	-11.25	59.78	32.00	753.97	10400.00	9918.00	10069.00
	1030.000	25.00	-10.77	62.89	13.00	656.37	8750.00	.00	.00
*	1030.000	25.00	-10.77	59.74	13.00	749.60	10400.00	.00	.00
	1000.000	25.00	-11.00	79.76	30.00	606.50	8750.00	.00	.00
	1000.000	25.00	-11.00	76.88	30.00	688.81	10400.00	.00	.00
	970.000	25.00	-11.00	87.86	30.00	587.39	8750.00	.00	.00
	970.000	25.00	-11.00	84.31	30.00	667.92	10400.00	.00	.00
	957.000	25.00	-10.77	96.83	13.00	572.53	8750.00	.00	10072.00
	957.000	25.00	-10.77	93.66	13.00	649.45	10400.00	.00	10072.00
	925.000	25.00	-10.94	128.56	32.00	522.40	8750.00	.00	10081.00
	925.000	25.00	-10.94	124.74	32.00	589.47	10400.00	.00	10081.00
	900.000	25.00	-11.20	132.84	25.00	521.63	8750.00	9924.00	10087.00
	900.000	25.00	-11.20	130.38	25.00	586.84	10400.00	9924.00	10087.00
	835.000	25.00	-9.08	98.51	65.00	574.56	8750.00	9908.00	10104.00
	835.000	25.00	-9.08	101.48	65.00	636.66	10400.00	9908.00	10104.00
	775.000	25.00	-13.33	111.85	60.00	551.42	8750.00	9893.00	10115.01
	775.000	25.00	-13.33	112.13	60.00	616.30	10400.00	9893.00	10115.01

	SECNO	K*XNCH	K*CHSL	10K*S	XLCH	AREA	QCH	STENCL	STENCR
	715.000	25.00	-13.50	120.32	60.00	538.57	8750.00	.00	.00
	715.000	25.00	-13.50	119.52	60.00	603.64	10400.00	.00	.00
	655.000	25.00	-13.33	125.02	60.00	531.95	8750.00	.00	.00
	655.000	25.00	-13.33	123.93	60.00	596.58	10400.00	.00	.00
	595.000	25.00	-13.33	128.55	60.00	527.18	8750.00	.00	.00
	595.000	25.00	-13.33	126.91	60.00	592.01	10400.00	.00	.00
	535.000	25.00	-13.33	130.18	60.00	525.04	8750.00	.00	.00
	535.000	25.00	-13.33	128.94	60.00	588.97	10400.00	.00	.00
	310.000	25.00	-8.89	147.00	225.00	550.05	8750.00	9950.00	10188.00
	310.000	25.00	-8.89	153.03	225.00	604.26	10400.00	9950.00	10188.00
	150.000	25.00	-6.25	202.45	160.00	656.05	8750.00	9920.00	10280.00
	150.000	25.00	-6.25	227.29	160.00	703.62	10400.00	9920.00	10280.00
*	.000	25.00	4.00	63.28	150.00	813.34	8750.00	9869.00	10100.00
*	.000	25.00	4.00	61.09	150.00	913.05	10400.00	9869.00	10100.00

SUMMARY OF ERRORS AND SPECIAL NOTES

```
CAUTION  SECNO=  1545.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1545.000  PROFILE= 2  CRITICAL DEPTH ASSUMED

CAUTION  SECNO=  1500.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1500.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1500.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=  1500.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1500.000  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1500.000  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=  1400.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1400.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1400.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=  1400.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1400.000  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1400.000  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=  1300.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1300.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1300.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=  1300.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1300.000  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1300.000  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=  1200.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1200.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1200.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=  1200.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1200.000  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1200.000  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=  1100.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1100.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1100.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=  1100.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1100.000  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1100.000  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=  1075.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=  1043.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1043.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1043.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=  1043.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  1043.000  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  1043.000  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=  1030.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=      .000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=      .000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
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CAUTION  SECNO=      .000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=      .000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=      .000  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=      .000  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL
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