00BREAK00

1) COUNTY: TUSCOLA

2) STUDY NAME: CITY OF VASSAR

3) WATERCOURSE: CASS RIVER

4) DOCUMENT TYPE: FIS

00BREAK00

*** INPUT CARD PRINTOUT ***

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   4  6000  200   4  6115  300   5  6180  350   4  6200  400   5  6273
   4  6000
   1  2 000 040   1  2 100 100   1  2 040 040   1  2 070 070
   3  615    11000   1   3
   1  6078  -400   1  6340  -284   1  6323  -56   1  6291  -39   1  6282
   1  6075    40   1  6273    82   2  6257  100   2  6205  148   2  6175
   2  6083   100   2  6079   188   2  6082  208   2  6084  228   2  6154
   2  6088   200   2  6064   280   2  6071  308   2  6114  328   2  6103
   4  6091   300   3  6081   423   3  6278  455   3  6276  455   3  6310
   7  6094   500   3  6266   617   3  6259  677   3  6186  745   3  6225
      6093   700   3  6306   767   3  6310  850   3  6270
      2 040 040   1  2 100 100
   3  615    12100   1   3
   1  6085  -400   1  6360  -550   1  6335  -450   1  6325  -350   1  6177
   1  6084  -200   2  6230  -150   2  6205  -118   2  6195  -87   2  6220
   1  6081   -42   2  6141   -42   2  6170  -20   2  6180  -20   2  6205
   1  6080    56   3  6205   100   3  6293  200   3  6280  280   3  6265
   7  6080   500   3  6328   600   3  6350          3  6401
   1  2 070 070   1  2 050 050
   3  615    12300   1   3
   1  6080  -430   1  6360  -554   1  6335  -536   1  6332  -468   1  6317
   1  6072  -225   2  6200  -204   2  6155  -144      6143  -134   1  6134
   1  6100  -164   2  6117  -154   2  6117  -144      6105  -134   2  6113
   1  6096  -114   2  6107  -104   2  6110  -74   2  6114  -54   2  6174
   1  6096   -71   2  6155   -42   2  6206  -52   2  6261  -34   3  6241
   1  6098    20   3  6284    64   3  6249  118   3  6243  182   3  6272
   1  6097   224   3  6266   270   3  6266  338   3  6271  422   3  6430
   1  6097   430   3  6297   440   3  6309  500   3  6341  [illegible]   3
   1  2 035 035   1  2 050 050
   3  615    12500   1   3
   1  6070  -600   1  6362  -503   1  6344  -47   1  6330  -403   1  6324
   1  6066  -377   1  6400  -277   1  6330  -241   1  6133  -235   2  6134
   1  6066  -195   2  6139  -175   2  6124  -145   2  6118  -155   2  6121
   1  6060  -135   2  6121  -125   2  6115  -115   2  6113  -105   2  6156
   1  6061   -65   2  6110   -75   2  6120  -45   2  6132  -30      6000
   1     0   3  6301    50   3  6300  [illegible]   3  6299  [illegible]
   1  2 035 035   1  2 030 030
   1  615    12600      0      3
   1  6060  -[illegible]   1  6132  -150   1  6170  -140   1  6158  -130   1  6143
   1  6060  -[illegible]   1  6130  -100   1  6304  -161  -4  6310  -136   1  6111
   1  6060  -[illegible]   1  6146  -90   1  6127  -80   1  6125  -70   1  6299
   1  6062  -50   1  6110  -45   1  6300  -106  -4  6304  -52   1  6141
   1  6060  -40   1  6106  -30   1  6132  -20   1  6149  -10   1
   1     0   1  6000  -32  -4  6099
   1  6060      1  8      1  1      3
   1  6060  4100   1  6000  -232   1  6345  -358   1  6339  -292   1  6339
   1  6060  -40   1  6000  -4   1  6345  30   2  6344  114   2  6339
   1  6062  202   2  6102  202   2  6400
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X: 11370

*** INPUT / APPLICATION ***

5	1413		296	2	6103	306	2	6105	31[illegible]	2	5111	32[illegible]	2	6121	336	2	7130						
5	1414		351	2	6156	376	3	[illegible]	[illegible]	3	6241	572	4	6261	506	4	6384						
5	1415		694	4	6285	718	4	6241	7[illegible]	4	[illegible]	[illegible]	4	6257	918	4	6773						
5	1416		908	4	6280	1010	4	6[illegible]															
5	1400	1	2 140 100	1	2 040 040	1	2	[illegible]	1	2	[illegible]												
5	1402	3	1 0	32	4	415	14110	2	6														
																							SAMPLE CASE
5	1410		-560	1	6400	-104	1	6112	-39	1	[illegible]	0	1	[illegible]	34[illegible]	1	[illegible]						
5	1411		136	1	6400	216	3	6400	216	1	6241	214		[illegible]	216	2	6305						
5	1412		266	2	6144	256	2	6132	266	2	6124	274	2	6113	2[illegible]	2	6707						
5	1413		296	2	6103	306	2	6105	310	2	6111	32[illegible]	2	6121	336	2	6140						
5	1414		351	2	6155	376	3	6[illegible]	4[illegible]		62[illegible]	572	4	62[illegible]	185	4	6344						
5	1415		694	4	6285	718	4	[illegible]	7[illegible]	4	6258	[illegible]	4	[illegible]	918	4	6571						
5	1416		908	4	6280	1010	4	6[illegible]															
5	1400	1	2 140 100	1	2 040 040	1	2	[illegible]	1	2	[illegible]												
5	1404	4	4 0	36	3	615	14700	1	3														
5	1510		-143	1	6472	-46	1	6403		1	6402		1	640	231	1	6450						
5	1511		200	1	6341	242	1	6266	13[illegible]	2	[illegible]	[illegible]	2	61[illegible]	173	1	[illegible]						
5	1512		3[illegible]	2	6114	341		6124	43[illegible]		[illegible]	411	2	61[illegible]	421	2	[illegible]						
5	1513		433	2	6131	443	2	6111	45[illegible]	2	[illegible]	13[illegible]	1	134	5[illegible]	2	[illegible]						
5	1514		463	2	6137	443	2	[illegible]	[illegible]	2	6137			614[illegible]	71[illegible]	1	[illegible]						
5	1515		530	3	6270	5[illegible]	1	5117	7[illegible]	1	[illegible]	[illegible]	1	[illegible]	515	1	[illegible]						
5	1516		1028	3	6414	1[illegible]	1	6[illegible]	1[illegible]		[illegible]	[illegible]	1	[illegible]	[illegible]	3	5[illegible]						
5	1517		1400	3	6420																		
5	1520	1	2 140 120	2	2 040	4[illegible]	1	2 1[illegible]	1[illegible]														
5	1400	1	1 0	32	4	415	1[illegible]	1	3														
5	1610		0	1	543	182	1	5[illegible]	2[illegible]	1	312	274	1	[illegible]	1[illegible]	2	6[illegible]						
5	1611		406	2	6141	416	2	6119	42[illegible]	2	[illegible]	4[illegible]	2	6123	4[illegible]	2	[illegible]						
5	1612		456	2	6124	466	2	6124	47[illegible]	2	61[illegible]	[illegible]	2	61[illegible]	4[illegible]	2	[illegible]						
5	1613		506	2	6118	516	2	6117	5[illegible]	2	61[illegible]	[illegible]	2	[illegible]	46	2	3131						
5	1614		553	2	6150	574	3	62[illegible]	7[illegible]	4	[illegible]	8[illegible]	4	311	[illegible]	4	6[illegible]						
5	1615		1032	4	6333	1172	4	6[illegible]	[illegible]	4	33	[illegible]	4	6[illegible]	10[illegible]	4	[illegible]						
5	[illegible]		1600	4	6376	2000	4	6420															
5	1620	1	2 120 120	3	2 040 [illegible]	1	2 1[illegible]	1[illegible]	1	2	[illegible]												
5	1700		1 0	32	3	[illegible]	[illegible]	1	3														
5	1710		-46	1	6400	[illegible]	1	632	15[illegible]	1	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]						
5	1711		125	2	6144	135	2	6143	14[illegible]	2	61[illegible]	[illegible]		[illegible]	[illegible]	2	[illegible]						
5	1712		175	2	6132	3[illegible]	2	[illegible]	32[illegible]	2	611[illegible]	[illegible]	2	[illegible]	41[illegible]	2	[illegible]						
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5	1715		491	1	6325	10[illegible]	1	6[illegible]	1147	3	[illegible]	1[illegible]		[illegible]	[illegible]	1	6[illegible]						
5	1716		1811	3	6394	2010	3	[illegible]															
5	1700	1	2 120 120	4	2 040 [illegible]	1	[illegible]	1[illegible]															
5	1704		0 0	24	3	415	17250	1	3														
5	20		-46	1	6432	[illegible]	1	634	[illegible]	1	[illegible]	[illegible]	1	[illegible]	30	2	[illegible]						
5	21		120	2	6155	150	2	6146	140	2	[illegible]	[illegible]	2	[illegible]	[illegible]	2	[illegible]						
5	[illegible]		170	2	6126	180	2	6128	190		[illegible]	[illegible]		[illegible]	210	2	[illegible]						
5	[illegible]		[illegible]	3	6219	268	3	6232	33[illegible]	3	[illegible]	36[illegible]	3	[illegible]	[illegible]	1	[illegible]						
5	[illegible]		[illegible]	3	6304	534	1	6362	[illegible]	3	[illegible]	[illegible]	3	[illegible]	[illegible]		[illegible]						
5	[illegible]		[illegible]	3	6420																		
5	[illegible]		2 140 140	1	2 045 045	1	2 1[illegible]	10															

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1985 STEP-BACKWATER PROGRAM - VERSION 72.339 *** PAGE COUNT=    1*DATE= 3/31/76

                                        *** INPUT CARD PRINTOUT ***

  1  1 VASSAR
  2 10 63013  63249  63327  63459  63327                                  10  5  2 99 17
  3 1000 1    A 1   37  3  615    13700  1  3
  4 1000  12000  13700  18200  21500  18200
  5 1000    -900  1  6400 -886  1  6388 -826  1  6360 -766  1  6313 -736  1  6286
  6 1011    -884  2  6286 -872  2  6164 -662  2  6148 -652  2  6140 -642  2  6128
  7 1012    -632  2  6126 -622  2  6125 -612  2  6125 -602  2  6125 -592  2  6125
  8 1013    -582  2  6129 -576  2  6149 -572  2  6150 -562  2  6156 -550  2  6182
  9 1014    -538  3  6224 -488  3  6244 -440  3  6255 -360  3  6277 -266  3  6306
 10 1015     -00  3  6338    0  3  6279  140  3  6269  284  3  6266  374  3  6291
 11 1016     450  3  6382  630  3  6308  664  3  6340  692  3  6356  760  3  6364
 12 1017     938  3  6342 1000  3  6400
 13 1018  1  2 100 100  1  2 045 045  1  2 060 060
 14 1000 ** ** 2   21  1  615    13700        0        3 0
                                                  "                                    **ERROR(5)**
 15 1020    -147  1  6322 -145  1  6185 -130  1  6154 -115  1  6130 -100  1  6125
 16 1021     -90  1  6116  -76  1  6121  -79  1  6372 -147  -9  6322  -71  1  6322
 17 1022     -71  1  6120  -60  1  6139  -40  1  6142  -30  1  6159  -20  1  6167
 18 1023     -10  1  6289   -3  1  6215   -3  1  6305    0  1  6305    0  1  6322
 19 1024     -76  -9  6322
 20 1025  1  2 035 035
 21 1026 ** 68 4   3  2   12          1  8          2 2                  1
 22 1027       0  1  6415  500  2  6415 1000  2  6415
 23 1028  J   L 5   37  4  615    14100  1  3
 24 1029    -584  1  6400 -106  1  6372  -38  1  6362    0  1  6348  136  1  6325
 25 1031     136  1  6400  216  1  6400  216  1  6323  224  2  6318  236  2  6155
 26 1032     246  2  6144  256  2  6132  266  2  6124  276  2  6115  286  2  6107
 27 1033     296  2  6103  306  2  6105  316  2  6115  326  2  6121  336  2  6133
 28 1034     351  2  6154  371  3  6244  396  3  6255  498  3  6291  572  4  6287
 29 1035     606  4  6284  698  4  6285  718  4  6293  758  4  6266  858  4  6257
 30 1036     918  4  6273  988  4  6280 1010  4  6400
 31 1037  1  2 100 100  1  2 040 040  1  2 060 060  1  2 060 060
 32 1038  J   L 0   32  4  615    14110  1  3
                                                                                  SEQUENCE FROM
 33 1039    -584  1  6400 -104  1  6372  -98  1  6362    0  1  6348  136  1  6325
 34 1040     136  1  6400  216  1  6400  216  1  6323  224  2  6318  236  2  6155
 35 1041     246  2  6144  256  2  6132  266  2  6124  276  2  6115  286  2  6107
 36 1042     296  2  6103  306  2  6105  316  2  6115  326  2  6121  336  2  6133
 37 1043     351  2  6154  376  3  6256  498  3  6291  572  4  6287  606  4  6284
 38 1044     606  4  6285  718  4  6293  758  4  6266  858  4  6257  918  4  6273
 39 1045     988  4  6280 1010  4  6400
 40 1046  1  2 100 100  1  2 040 040  1  2 060 060  1  2 060 060
 41 1047  M   N 0   36  3  615    14700  1  3
 42 1048    -140  1  6472  -46  1  6403    0  1  6403    0  1  6450  200  1  6450
 43 1049     200  1  6341  242  1  6266  338  2  6254  353  2  6150  373  2  6151
 44 1050     393  2  6133  343  2  6129  403  2  6131  413  2  6129  423  2  6129
 45 1051     433  2  6130  443  2  6131  453  2  6134  463  2  6134  473  2  6136
 46 1052     483  2  6137  493  2  6135  503  2  6133  513  2  6141  519  2  6156
 47 1053     619  3  6270  634  3  6277  746  3  6294  936  3  6320  946  3  6329
 48 1054    1024  3  6314 1206  3  6341 1322  3  6345 1448  3  6357 1534  3  6367
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USGS STEP-RACE#3754 DRAINAGE - [illegible] 72,345 000 PAGE COUNT- [illegible]

*** INPUT CARD PRINTOUT ***

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1409     361  2  6156  376  3  6240  440  3  6241  572  4  6247  695  4  6346
1410     488  4  6288  710  4  6293  754  4  6293  858  4  6297  912  4  6273
1411     988  4  6290 1010  4  6400
1412   1  2 100 100  1  2 040 040  1  2 000 000  1  2 000 000
1413   J  L 0  32  4  815   1413  2  4
                                                                          SEQUENCE 63304
1410    -500  1  6450 -104  1  6372  -38  1  6382    0  1  6362  136  1  6323
1411     136  1  6400  264  1  6400  216  1  6323  224  2  6314  238  2  6155
1412     246  2  6164  256  2  6132  266  2  6124  274  2  6114  288  2  6117
1413     296  2  6173  316  2  6175  316  2  6175  326  2  6121  336  2  6132
1414     361  2  6156  376  2  6236  448  3  6291  572  4  6297  695  4  6346
1415     698  4  6288  710  4  6293  754  4  6288  858  4  6297  918  4  6273
1416     988  4  6 [illegible] 1010  4  6400
1400   1  2 100 100  1  2 040 040  1  2 100 100  1  2 000 000
1409   W  M 0  96  3  815   1413  1  3
1410    -100  1  6422  -46  1  6413    0  1  6383    [illegible]  1  6[illegible]  [illegible]  1  [illegible]
1411     200  1  6383  252  1  6350  339  2  6353  353  2  6135  373  2  6171
1412     383  2  6139  393  2  6125  403  2  6131  413  2  6124  423  2  6123
1413     433  2  6131  443  2  6131  453  2  6134  463  2  6134  473  2  6139
1414     483  2  6137  493  2  6132  503  2  6133  513  2  6141  519  2  6135
1415     538  2  6270  534  3  6277  766  3  [illegible]  94  4  632  586  4  6322
1416    1063  3  6316 1208  3  6351 1322  3  6343 1414  3  6347 1534  3  6367
1417    1606  3  6429
1420   1  2 120 120  1  2  0 040  1  2 100 1 [illegible]
1400   1  M 0  42  4  [illegible]  1413  1  3
1410       0  1  6432  182  1  6427  254  1  6312  378  3  6255  336  2  6135
1411     406  2  6141  416  2  6133  426  2  6131  436  2  6[illegible]  [illegible]  2  6132
1412     456  2  6124  465  2  6123  475  2  6123  485  2  [illegible]  [illegible]  2  6123
1413     506  2  6113  516  2  6117  526  2  6133  [illegible]  2  6133  545  2  6131
1414     553  2  6133  576  3  6261  738  4  6346  [illegible]  4  [illegible]  [illegible]  4  6421
1415    1032  4  6313 1172  4  6322 1136  4  6341 1[illegible]  4  [illegible]  [illegible]  4  6397
1416    1680  4  6370 2010  4  6420
1420   1  2 120 120  1  2 040 040  1  2 100 100  1  2 000 000
1400   1  M 0  42  3  815   1[illegible]  1  3
1410     -48  1  6456  24  1  6[illegible]  136  1  6131  [illegible]  1  6[illegible]  316  1  6130
1411     325  2  6149  335  2  6165  45  2  [illegible]  [illegible]  1  6[illegible]  [illegible]  2  6134
1412     375  2  6132  385  2  6133  [illegible]  2  6132  [illegible]  2  [illegible]  [illegible]  2  6132
1413     425  2  6123  435  2  6127  [illegible]  2  6126  [illegible]  2  6126  [illegible]  2  6132
1414     473  2  6156  487  3  6[illegible]  [illegible]  2  6132  [illegible]  2  [illegible]  [illegible]  3  6344
1415     951  4  6325  [illegible]  3  6[illegible]  1107  3  [illegible]  1371  4  6371  1535  3  6[illegible]
1416    1611  3  6334  2[illegible]  3  6[illegible]
1420   1  2 120 120  1  2 140 140  1  5 12  70
1400   M  2 0  26  3  815   1[illegible]  1  3
1410     -86  1  6432  [illegible]  1  [illegible]  [illegible]  2  [illegible]  [illegible]  2  6[illegible]  174  2  [illegible]
1411     120  2  6156  130  2  [illegible]  140  2  [illegible]  150  2  6129  161  2  6121
1412     170  2  6126  180  2  6128  190  2  6131  [illegible]  2  6136  [illegible]  2  6135
1413     224  3  6219  [illegible]  3  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  3  [illegible]
1414     784  4  6324  944  3  [illegible]  1[illegible]  3  [illegible]  [illegible]  [illegible]  [illegible]  3  [illegible]
1415    1680  3  6420
1420   1  2 100 100  1  2 045 045  1  2 100 100
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USGS STEP-BACKWATER PROGRAM - VERSION 72.339 *** PAGE COUNT= P.OSIE= 3/31/76

*** INPUT CARD PRINTOUT ***

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      406  2  6141  416  2  6139  426  2  6137  436  2  6135  446  2  6132
      456  2  6129  466  2  6128  476  2  6125  486  2  6122  496  2  6120
      506  2  6118  516  2  6117  526  2  6118  536  2  6123  546  2  6131
      553  2  6156  574  3  6261  768  4  6294  858  4  6305  902  4  6121
     1082  4  6333 1172  4  6322 1304  4  6341 1428  4  6370 1484  4  6359
     1486  4  6378 2000  4  6420
    1  2 120 120  1  2 040 040  1  2 120 120  1  2 050 050
    0 0  32  3  615   16250  1  3
      -8  1  6408   24  1  6128  142  1  6315  300  2  6267  315  2  6156
      325  2  6144  335  2  6145  345  2  6142  355  2  6133  365  2  6134
      375  2  6132  385  2  6133  395  2  6132  405  2  6132  415  2  6130
      425  2  6128  435  2  6127  445  2  6128  455  2  6126  465  2  6132
      473  2  6156  497  3  6219  531  3  6232  595  3  6258  731  3  6324
      951  3  6325 1067  3  6329 1197  3  6362 1371  3  6377 1635  3  6379
     1011  3  6399 2000  3  6420
    1  2 120 120  1  2 040 040  3  5 120 070
N   P 0  26  3  615   17250  1  3
      -86  1  6432    0  1  6396   52  2  6327   68  2  6293  106  2  6192
      120  2  6155  130  2  6144  140  2  6135  150  2  6124  160  2  6121
      170  2  6126  180  2  6128  190  2  6131  200  2  6136  210  2  6156
      224  3  6219  268  3  6232  332  3  6258  468  3  6324  698  3  6325
      704  3  6329  634  3  6362 1008  3  6377 1270  3  6379 1446  3  6399
     1600  3  6420
    1  2 100 100  1  2 045 045  1  2 100 100
D   0 0  21  4  620   18750  1  4
     -500  1  6420 -500  1  6300    0  2  6270   14  2  6163   24  2  6158
       34  2  6152   44  2  6155   54  2  6153   64  2  6155   80  3  6163
      128  3  6178  152  3  6204  206  4  6297  250  4  6329  356  4  6364
      542  4  6386  710  4  6379  896  4  6377 1160  4  6386 1190  4  6397
     2200  4  6420
    1  2 070 070  1  2 050 050  1  2 150 150  1  2 100 100
P   R 0  26  4  620   19700  1  4
        0  1  6420  200  1  6400  700  1  6350 1200  1  6300 1990  1  6260
     2016  1  6270 2044  2  6244 2052  2  6175 2060  2  6167 2070  2  6157
     2080  2  6151 2090  2  6149 2100  2  6144 2110  2  6151 2120  2  6160
     2134  2  6164 2140  3  6175 2164  3  6221 2174  3  6247 2184  3  6295
     2200  4  6375 2216  4  6378 2250  4  6379 2268  4  6377 3000  4  6400
     3000  4  6420
    1  2 070 070  1  2 045 045  1  2 090 050  1  2 070 070
```

```
USGS STEP-BACKWATER PROGRAM - VERSION 72.339 *** PAGE COUNT=   33.DATE= 3/22/76

*****************************************************************************
WATER-SURFACE PROFILE FOR: /ASSAR
PAGE  1 OF  2
*****************************************************************************
SECID AT DISTANCE/ LENGTH/DISCHARGE/  AREA  /CONVEYANCE/ ALPHA/  LEW  /  REW
  WS ELEV /    HV  /    HF  /    HE  /     ED  /     V  /    FN  /   ACC   *ID*
*****************************************************************************
    A AT   10000 /     0 /  18200. / 13514. / 1283325. / 2.97 / -219. / 1293.
   631.40 /   0.48 /                 / 631.48 /   1.35 /  0.13/          *IS*
*************************** BEGIN BRIDGE ANALYSIS ***************************
RR BR AT   10000 /       /  18200. /  3104. /  657487. / 1.00 /  883. / 1080.
   631.40 /   0.53 /                           /   5.86 /  0.24 /          *BO*
-----------------------------------------------------------------------------
 NO ROAD OVERFLOW
                                                                           *RG*
-----------------------------------------------------------------------------
    B AT   10800 /   600 /  18200. /  7505. / 1317591. / 1.67 / -446. /  555.
   631.48 /   0.15 /  0.12 /   0.03 / 631.64 /   2.43 /  0.15 / -0.000  *AS*
-----------------------------------------------------------------------------
   N = 0.49 / E = 0.93 / K* = 1.22 /  8191. / 1470805. / 1.61 / -456. /  565.
   632.16 /   0.12 /                 / 632.29 /   2.22 /  0.14 /         *AS*
*************************** END BRIDGE ANALYSIS *****************************
    B AT   10810 /    10 /  18200. /  8191. / 1470805. / 1.61 / -456. /  565.
   632.16 /   0.12 /  0.00 /   0.0  / 632.29 /   2.22 /  0.14 / -0.002 *XS*
-----------------------------------------------------------------------------
    C AT   11800 /   390 /  18200. /  8153. / 1251910. / 1.83 / -365. /  552.
   632.22 /   0.14 /  0.07 /   0.01 / 632.36 /   2.23 /  0.15 / -0.000 *XS*
-----------------------------------------------------------------------------
    D AT   11450 /   450 /  18200. /  7563. / 1050728. / 2.13 / -651. /  400.
   632.31 /   0.19 /  0.11 /   0.03 / 632.50 /   2.41 /  0.16 / -0.000 *XS*
-----------------------------------------------------------------------------
D-E E AT   11900 /   450 /  18200. /  9962. / 1995789. / 1.79 / -296. /  810.
   632.40 /   0.09 /  0.07 /   0.0  / 632.57 /   1.83 /  0.10 / -0.001 *XS*
-----------------------------------------------------------------------------
D&M F AT   12100 /   200 /  18200. /  5584. /  512386. / 1.21 / -449. /  516.
   632.48 /   0.20 /  0.06 /   0.05 / 632.68 /   3.26 /  0.20 / -0.011 *XS*
-----------------------------------------------------------------------------
E   G AT   12300 /   200 /  18200. /  6284. / 1147036. / 2.11 / -498. /  494.
   632.56 /   0.27 /  0.11 /   0.04 / 632.83 /   2.90 /  0.19 / -0.000 *XS*
-----------------------------------------------------------------------------
F   H AT   12500 /   200 /  18200. /  3754. /  972365. / 1.09 / -234. /   82.
   632.56 /   0.44 /  0.06 /   0.06 / 632.96 /   4.85 /  0.22 /  0.002 *XS*
*************************** BEGIN BRIDGE ANALYSIS ***************************
HWYBR AT   12500 /       /  17815. /  2568. /  370522. / 1.00 / -161. /    0.
   632.56 /   0.75 /                           /   6.94 /  0.21 /          *BO*
-----------------------------------------------------------------------------
 ROAD OVERFLOW (CFS) / LEFT       0. / RIGHT      441. /
                                                                           *RG*
-----------------------------------------------------------------------------
G   I AT   12950 /   450 /  18200. /  3894. /  912474. / 1.24 /    2. /  360.
   632.72 /   0.42 /  0.17 /   0.01 / 633.14 /   4.67 /  0.21 / -0.000  *AS*
-----------------------------------------------------------------------------
```

```
USGS STEP-BACKWATER PROGRAM - VERSION 72.339 *** PAGE COUNT= 54.DATE= 3/24/76

==========================================================================
WATER-SURFACE PROFILE FOR: VASSAR
PAGE  1 OF  2
*** FLOODWAY ANALYSIS *** NOR FW
==========================================================================
SECID AT DISTANCE/ LENGTH/DISCHARGE/  AREA  /CONVEYANCE/ ALPHA/  LEW  /  REW
  WS ELEV /    HV  /    HF  /    HE  /     EG  /     V  /    FN  /   ACC    *ID*
==========================================================================
    A AT   10800 /     0 /  18200. /  8430. / 1021196. / 2.29 /  540. / 1290.
  631.48 /   0.17 /                 /  631.57 /   2.16 /  0.16/            *IS*
========================== BEGIN BRIDGE ANALYSIS ==========================
RR BR AT   10800 /       /  18200. /  3104. /  657487. / 1.00 /  883. / 1080.
  631.48 /   0.53 /                           /   5.86 /  0.24 /            *BO*
--------------------------------------------------------------------------
 NO ROAD OVERFLOW
                                                                          *RO*
--------------------------------------------------------------------------
    B AT   10800 /   600 /  18200. /  7584. / 1398008. / 1.66 / -447. /  556.
  631.56 /   0.15 /  0.15 /   0.0  /  631.71 /   2.40 /  0.15 / -0.000  *AS*
--------------------------------------------------------------------------
  M = 0.[illegible] / E = 0.93 / K* = 1.23 /  8277. / 1490557. / 1.61 / -458. /  566.
  632.25 /   0.12 /                 /  632.37 /   2.20 /  0.13 /            *AS*
========================== END BRIDGE ANALYSIS ============================
    B AT   10810 /    10 /  18200. /  6431. / 1298578. / 1.44 /  -85. /  565.
  632.2[illegible] /   0.10 /  0.00 /   9.03 /  632.40 /   2.83 /  0.15 / -0.000  *XS*
--------------------------------------------------------------------------
    C AT   11000 /   390 /  18200. /  7.15. / 1178847. / 1.68 / -100. /  550.
  632.31 /   0.17 /  0.08 /   0.0  /  632.48 /   2.56 /  0.15 / -0.000  *XS*
--------------------------------------------------------------------------
    D AT   11450 /   450 /  18200. /  6874. / 1055090. / 1.78 / -250. /  400.
  632.42 /   0.19 /  0.12 /   0.01 /  632.61 /   2.65 /  0.16 /  0.000  *XS*
--------------------------------------------------------------------------
D-E E AT   11900 /   450 /  18200. /  9332. / 1995339. / 1.60 /    0. /  750.
  632.59 /   0.09 /  0.07 /   0.0  /  632.69 /   1.95 /  0.10 /  0.000  *XS*
--------------------------------------------------------------------------
DAM F AT   12100 /   200 /  18200. /  5420. /  522419. / 1.15 / -400. /  400.
  632.59 /   0.20 /  0.06 /   0.05 /  632.79 /   3.36 /  0.19 / -0.010  *XS*
--------------------------------------------------------------------------
E   G AT   12300 /   200 /  18200. /  5659. / 1127879. / 1.82 / -400. /  300.
  632.66 /   0.29 /  0.11 /   0.05 /  632.95 /   3.22 /  0.19 /  0.000  *XS*
--------------------------------------------------------------------------
F   H AT   12500 /   200 /  18200. /  3787. /  982718. / 1.09 / -234. /   82.
  632.66 /   0.39 /  0.06 /   0.05 /  633.05 /   4.81 /  0.22 / -0.011  *XS*
========================== BEGIN BRIDGE ANALYSIS ==========================
HWYBR AT   12500 /       /  17775. /  2568. /  370522. / 1.00 / -161. /    0.
  632.66 /   0.75 /                           /   6.92 /  0.21 /            *BO*
--------------------------------------------------------------------------
 ROAD OVERFLOW (CFS) / LEFT        0. / RIGHT      478. /
                                                                          *RO*
--------------------------------------------------------------------------
G   I AT   12950 /   450 /  18200. /  3929. /  921517. / 1.24 /    2. /  360.
  632.81 /   0.41 /  0.16 /   0.01 /  633.23 /   4.63 /  0.21 / -0.000  *AS*
--------------------------------------------------------------------------
```

[redacted]

```
DMS9 STEP=HACK:07=R R3X0U4 - V=4570  72.735 000 B132 CONAT=    3.0=T2= 3/13/76

                                  *** TIMEOUT CHECK OPTIMIZOUT ***

 5  1000 6   1 5  24  5  615   12560  2  4
 5  1010    -400  1  4400 -404  1  6361 -416  1  6354 -262  1  6342 -272  1  6333
 5  1011    -100  1  6341      1  2  5143   26  4  6153   36  3  6133   46  3  6120
 5  1012      56  1  6115   66  3  6115   76  3  6114   86  4  6114   96  3  6115
 5  1013     106  3  6114  116  3  6121  126  3  6122  136  3  6125  146  3  6126
 5  1014     156  3  6126  166  3  6136  176  3  6157  187  4  6250  192  5  6291
 5  1015     210  5  6306  240  5  6299  350  5  6293  360     6600
 6  1020  1  2 040 040  1  2 56  040  1  2  40 040  1  2 140 040  1  2 033 040
 3  1001 6   1 0  24  5  615   12560  2  4
                                                                                  SEQUENCE 64202
 5  1010    -400  1  4400 -404  1  6361 -416  1  6354 -262  1  6342 -272  1  6333
 5  1011    -100  1  6341      2  5343   26  4  6153   36  3  6133   46  3  6120
 5  1012      56  1  6115   66  3  6115   76  3  6114   86  4  6114   96  3  6115
 5  1013     106  3  6114  116  3  6121  126  3  6122  136  3  6125  146  3  6126
 5  1014     156  3  6126  166  3  6136  176  3  6157  187  4  6250  192  5  6291
 5  1015     210  5  6306  240  5  6299  350  5  6293  360  -  6600
 6  1020  1  2 040 040  1  2  40 040  1  2 040  40  1  2 04  140  1  2 05  140
 3  1100 4   0 0  15  5  615   13560  1  3
 5  1110    -700  1  4401 -404  1  6357 -340  1  6333 -142  1  6331     3  1  6331
 5  1111      54  2  6315   66  2  6255   78  2  6130  102  2  6128  112  2  6128
 5  1112     126  2  6126  132  2  6117  142  2  6123  152  2  6122  162  2  6121
 5  1113     172  2  6120  182  2  6118  192  2  6114  202  2  6150  230  3  6229
 5  1115     420  4  6260  490  4  6313  636  4  6323  714  4  6321  826  4  6277
 5  1116     874  4  6261  992  4  6273  998  4  6214 1014  4  6212 1014  4  6273
 5  1119    1106  4  6273 1264  4  6307 1261  4  6369 1431  4  6[illegible] 1533  4  [illegible]
 6  1120  1  2 100 10   1  2 042 042  1  2 150 150  1  2 060 150
 3  1200 1  2 0  37  1  615   13560  1  3
 5  1210    -400  1  4400 -484  1  6388 -426  1  6364 -766  1  6313 -736  1  6206
 5  1211    -584  2  6206 -572  2  6156 -662  2  6142 -652  2  6140 -642  2  6123
 5  1212    -632  2  6124 -622  2  6125 -612  2  6125 -612  2  6120 -592  2  6127
 5  1213    -582  2  6124 -516  2  6141 -576  2  6150 -542  2  6156 -550  2  182
 5  1214    -538  3  6224 -408  4  6246 -346  3  6255 -350  3  6277 -256  3  6306
 5  1215     -90  3  6318    0  4  6270  160  3  6268  286  3  6263  374  3  6291
 5  1216     450  4  6362  [illegible]  3  6308  566  3  6340  642  4  6354  760  4  6304
 5  1217     938  4  6392 1.00  3  6603
 6  1220  1  2 100 150  1  2 045 140  1  2 [illegible] 080
 3  1300 88 [illegible] 2  28  2  615   13760                    4 0
                                                                                  **ERROR(S)**
 5  1310    -147  1  6322 -145  1  6150 -150  4  5151 -135  1  6113 -100  1  6125
 5  1311     -90  1  6116  -74  1  5121  -64  1  6322 -147  -  6322  -71  1  6322
 5  1312     -71  1  6120  -51  1  5139  -40  1  6142  -30  1  6153  -20  1  6167
 5  1313     -10  1  6204   -4  1  6215   -3  1  6[illegible]   [illegible]  1  6305   0  1  6322
 5  1314     -71 -9  6324   10  2  619   34  2  6[illegible]  56  2  6305  64  2  6340
 5  1315      10 -9  6390
 6  1320  1  2 035 035  1  2 022 022
 3  1400 88 44 4   3  2   12   [illegible]  2 2                    1
 5  1410      0  1  6415  500  2  6415 1 00  2  6415
 5  1411  9  6  5  32  4  615   14100  2  4
 5  1412    -500  1  6400 -104  1  6372  -8  1  [illegible]  1  6348  135  1  6125
 5  1413     136  1  6400  216  1  6408  [illegible]  1  [illegible]  2  6131
 5  1414     [illegible]  3  6144  256  2  6132  [illegible]  3  6124  276  [illegible]  2  [illegible]
```

```
*****************************************************************************
WATER-SURFACE PROFILE FOR: VASSAR
PAGE  1 OF  1
*****************************************************************************
SECTO AT DISTANCE/ LENGTH/DISCHARGE/  AREA  /CONVEYANCE/ ALPHA/  TEW  /  TEW
 WS ELEV /    HV  /    HF  /    HE  /    EG  /    V   /   SFL  /  ACC   WTOP
*****************************************************************************
    A AT   10010 /      0 /  21500. / 15040. / 1468715. / 2.26 / -265. / 1295.
  632.40 /   0.09 /                 /  632.44 /   1.41 /  0.05/          *150
=============================== BEGIN BRIDGE ANALYSIS ==============================
BW BR AT   10000 /        /  21530. /  3240. /  714176. / 1.00 / -283. / 1320.
  632.40 /   0.45 /                 /          4.54 /   0.26 /          *409*
-----------------------------------------------------------------------------
 SO KNIS OVERFLOW                                                          *000*
-----------------------------------------------------------------------------
    H AT   10600 /    800 /  21500. /  9527. / 1548129. / 1.59 / -461. /  579.
  632.44 /   0.16 /   0.12 /   1.03 /  632.65 /   2.52 /   0.14 / 0.000  *450*
-----------------------------------------------------------------------------
  M = 0.53 / K = 0.93 / KO = 1.00 /  9515. / 1785443. / 1.53 / -476. /  594.
  633.05 /   0.12 /                 /  633.57 /   2.25 /   0.11 /          *050*
=============================== END BRIDGE ANALYSIS ================================
    C AT   11000 /    400 /  21500. /  9344. / 1500690. / 1.73 / -381. /  532.
  633.61 /   0.14 /   0.07 /   1.01 /  633.65 /   2.30 /   0.15 / -0.000  *450*
-----------------------------------------------------------------------------
    D AT   11450 /    450 /  21500. /  8934. / 1249730. / 2.12 / -684. /  400.
  633.85 /   0.19 /   0.11 /   1.02 /  633.79 /   2.41 /   0.16 / -0.000  *450*
-----------------------------------------------------------------------------
D-E S AT   11900 /    450 /  21500. / 11435. / 2271347. / 1.91 / -383. /  421.
  633.74 /   0.10 /   0.07 /   0.0 /  633.84 /   1.88 /   0.10 / -0.000  *450*
-----------------------------------------------------------------------------
DAW E AT   12100 /    200 /  21500. /  6943. /  870670. / 1.22 / -566. /  549.
  633.78 /   0.18 /   0.05 /   1.04 /  633.94 /   3.10 /   0.18 / -0.000  *450*
-----------------------------------------------------------------------------
E    G AT   12300 /    200 /  21500. /  7633. / 1468192. / 2.25 / -500. /  545.
  633.83 /   0.28 /   0.11 /   1.05 /  634.11 /   2.82 /   0.19 / -0.000  *450*
-----------------------------------------------------------------------------
E    H AT   12500 /    200 /  21500. /  4223. / 1113404. / 1.13 / -483. /   42.
  633.80 /   0.45 /   0.05 /   0.09 /  634.29 /   5.09 /   0.23 / 0.000  *450*
=============================== BEGIN BRIDGE ANALYSIS ==============================
HWYBR AT   12500 /        /  21530. /  2568. /  370523. / 1.00 / -161. /    0.
  633.80 /   0.97 /                 /          1.89 /   0.22 /          *400*
-----------------------------------------------------------------------------
 ROAD OVERFLOW (CFS) / LEFT     244. / RIGHT    1117. /                    *000*
-----------------------------------------------------------------------------
G    I AT   12950 /    450 /  21500. /  4354. / 1035084. / 1.28 / -232. /  360.
  633.97 /   0.44 /   0.14 /   0.12 /  634.45 /   4.93 /   0.22 / -0.000  *450*
-----------------------------------------------------------------------------
  M = 0.02 / K = 0.39 / KO = 0.73 /  4373. / 1038564. / 1.28 / -233. /  360.
  634.00 /   0.44 /                 /  634.49 /   4.92 /   0.22 /          *050*
=============================== END BRIDGE ANALYSIS ================================
```

[illegible]

```
WRRS STEP-BACKWATER PROGRAM - VERSION 72.339 *** PAGE COUNT=   54.DATE= 3/24/76

WATER-SURFACE PROFILE FOR: VASSAR
PAGE  1 OF  2
*** FLOODWAY ANALYSIS *** NOR FW
SECTD AT DISTANCE/ LENGTH/DISCHARGE/  AREA  /CONVEYANCE/ ALPHA/  LEN  /  REV
  WS ELEV /    HV  /    HF  /    HE  /     EB  /     V  /    FN  /   ACC   *ID*
   A AT   10000 /      0 /  18200. /  6436. / 1021190. / 2.29 /  540. / 1290.
  631.48 /   0.17 /                  /  631.57 /   2.16 /   0.16/            *IS*
=========================== BEGIN BRIDGE ANALYSIS ==========================
=== AT   10000 /        /  18200. /  3104. /  657487. / 1.00 /  683. / 1080.
  631.46 /   0.53 /                            /   5.06 /   0.24 /            *RO*

NO ROAD OVERFLOW
                                                                            *RG*

   B AT   10400 /    600 /  18200. /  7584. / 1335808. / 1.66 / -447. /  556.
  631.56 /   0.15 /   0.15 /   0.0  /  631.71 /   2.40 /   0.15 / -0.000  *AS*

   N = 0.09 / E = 0.93 / K* = 1.23 /  8277. / 1498557. / 1.61 / -458. /  566.
  632.25 /   0.12 /                  /  632.37 /   2.20 /   0.13 /          *AS*
=========================== END BRIDGE ANALYSIS ============================
   B AT   10410 /     10 /  18200. /  6431. / 1298578. / 1.44 /  -85. /  565.
  632.22 /   0.18 /   0.00 /   0.03 /  632.40 /   2.83 /   0.15 / -0.000  *XS*

   C AT   11000 /    390 /  18200. /  7.15. / 1178847. / 1.68 / -106. /  550.
  632.31 /   0.17 /   0.08 /   0.0  /  632.48 /   2.56 /   0.15 / -0.000  *XS*

   D AT   11450 /    450 /  18200. /  6874. / 1055898. / 1.78 / -250. /  40
  632.42 /   0.19 /   0.12 /   0.01 /  632.61 /   2.65 /   0.16 /  0.000  *XS*

D-E E AT   11900 /    450 /  18200. /  9332. / 1095330. / 1.60 /    0. /  750.
  632.59 /   0.09 /   0.07 /   0.0  /  632.69 /   1.95 /   0.10 /  0.000  *XS*

DAM F AT   12100 /    200 /  18200. /  5420. /  522410. / 1.15 / -400. /  400.
  632.59 /   0.20 /   0.06 /   0.05 /  632.79 /   3.36 /   0.19 / -0.010  *XS*

E   G AT   12300 /    200 /  18200. /  5659. / 1127879. / 1.82 / -400. /  300.
  632.66 /   0.29 /   0.11 /   0.05 /  632.95 /   3.22 /   0.19 /  0.000  *XS*

F   H AT   12500 /    200 /  18200. /  3787. /  582718. / 1.09 / -234. /   82.
  632.66 /   0.39 /   0.06 /   0.05 /  633.05 /   4.81 /   0.22 / -0.011  *XS*
=========================== BEGIN BRIDGE ANALYSIS ==========================
HWYBR AT   12500 /        / 17775. /  2588. /  370522. / 1.00 / -161. /    0.
  632.66 /   0.75 /                            /   6.92 /   0.21 /          *BO*

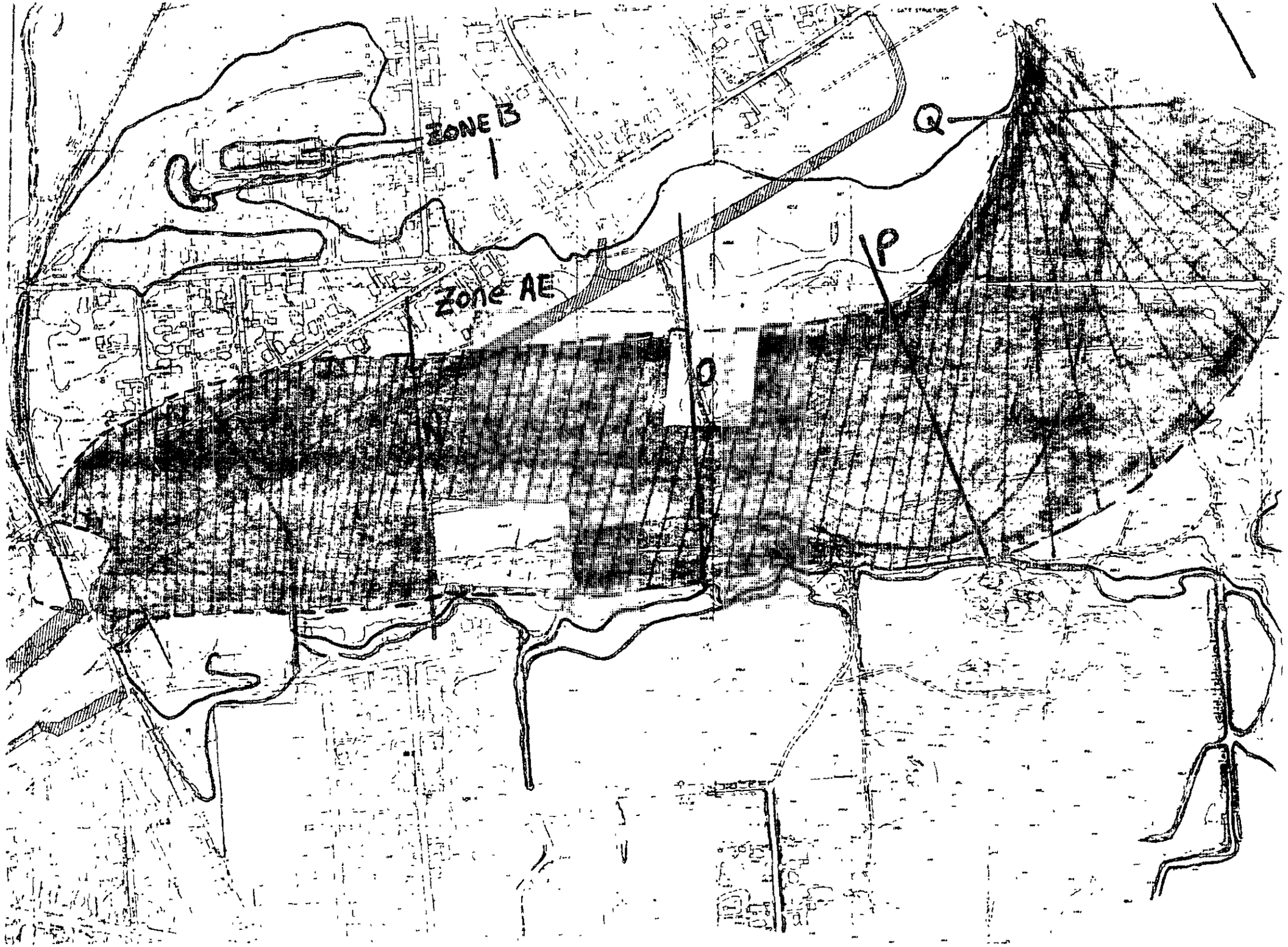
ROAD OVERFLOW (CFS) / LEFT        0. / RIGHT      478. /
                                                                            *RO*

G   I AT   12950 /    450 /  18200. /  3929. /  921517. / 1.24 /    2. /  360.
  632.81 /   0.41 /   0.16 /   0.01 /  633.23 /   4.63 /   0.21 / -0.000  *AS*
```

```
USGS STEP-BACKWATER PROGRAM - VERSION 72.339 *** PAGE COUNT=   26.DATE= 3/31/76

==================================================================================
WATER-SURFACE PROFILE FOR: VASSAR
PAGE  1 OF  1
*** FLOODWAY ANALYSIS *** NOR FW
==================================================================================
SECTO AT DISTANCE/ LENGTH/DISCHARGE/  AREA  /CONVEYANCE/ ALPHA/  LEW  /  REW
  WS ELEV /    HV  /    HF  /    HF  /     EG  /     V  /    FR  /   ACC    *ID*
==================================================================================
I   K AT   13700 /     0 /  18200. /  6282. /  865641. / 2.06 / -790. /    10.
   633.27 /   0.27 /                 / 633.54 /   2.90 /   0.20/            *IS*
================================ BEGIN BRIDGE ANALYSIS ==========================
BR BR AT   13700 /       /  18200. /  2362. /  364274. / 1.00 / -147. /     0.
   633.27 /   0.92 /                 /        /   7.71 /   0.19 /            *BO*
----------------------------------------------------------------------------------
 NO ROAD OVERFLOW
                                                                              *RG*
----------------------------------------------------------------------------------
J   L AT   14100 /   400 /  18200. /  6492. / 1008286. / 1.99 /   80. /  998.
   633.45 /   0.24 /   0.15 /   0.0 /  633.69 /   2.80 /   0.19 / -0.000  *AS*
----------------------------------------------------------------------------------
   M = 0.32 / E = 1.00 / K* = 0.23 /  7189. / 1138510. / 1.98 /   32. /  999.
   634.25 /   0.20 /                 / 634.45 /   2.53 /   0.17 /            *AS*
================================ END BRIDGE ANALYSIS ============================
J   L AT   14110 /    10 /  18200. /  6039. / 1024140. / 1.77 /  224. /  850.
   634.23 /   0.25 /   0.00 /   0.03 / 634.48 /   3.01 /   0.18 / 0.000  *XS*
----------------------------------------------------------------------------------
K   M AT   14700 /   590 /  18200. /  6517. / 1112539. / 2.11 /  200. /  850.
   634.40 /   0.26 /   0.17 /   0.00 / 634.66 /   2.79 /   0.17 / -0.000  *XS*
----------------------------------------------------------------------------------
L   N AT   15300 /   600 /  18200. /  6346. / 1186798. / 1.85 /  241. /  900.
   634.57 /   0.24 /   0.14 /   0.0  / 634.81 /   2.87 /   0.16 / -0.000  *XS*
----------------------------------------------------------------------------------
M   O AT   16250 /   950 /  18200. /  5599. / 1266417. / 1.87 /   95. /  745.
   634.82 /   0.20 /   0.21 /   0.0  / 635.02 /   2.64 /   0.15 / 0.006  *XS*
----------------------------------------------------------------------------------
N   P AT   17250 /  1000 /  18200. /  5334. /  749035. / 2.02 /   32. /  620.
   635.09 /   0.36 /   0.35 /   0.09 / 635.45 /   3.38 /   0.22 / 0.000  *XS*
----------------------------------------------------------------------------------
O   Q AT   18750 /  1500 /  18200. /  7622. /  765248. / 2.17 / -500. /  300.
   636.12 /   0.19 /   0.07 /   0.0  / 636.32 /   2.39 /   0.20 / -0.000  *XS*
----------------------------------------------------------------------------------
P   R AT   19700 /   950 /  18200. /  6694. /  903375. / 1.91 / 1600. / 2198.
   636.57 /   0.22 /   0.45 /   0.01 / 636.79 /   2.72 /   0.19 / -0.000  *XS*
----------------------------------------------------------------------------------

                          END OF THIS PROFILE
```


ZONE B
Q
P
Zone AE
O

```
USCG STEP-BACKWATER PROGRAM - VERSION 72.330 *** PAGE COUNT=   10.DATE= 3/30/76

==========================================================================
WATER-SURFACE PROFILE FOR: VASSAR
PAGE  1 OF  1
==========================================================================
SECTD AT DISTANCE/ LENGTH/DISCHARGE/  AREA  /CONVEYANCE/ ALPHA/  LEW  /  REW
  WS ELEV /    NV  /    HF  /    HZ  /     EG  /     V  /    FN  /   ACC   °TD°
=. ======================================================================
I   G AT   10700 /     0 /  18200. /  9256. / 1074856. / 2.01 / -791. /  661.
   633.27 /   0.15 /                 /  633.61 /   1.97 /   0.16/          °ISO
========================= BEGIN BRIDGE ANALYSIS ==========================
BR OR AT   13700 /       /  18200. /  2362. /  364274. / 1.00 / -147. /    0.
   633.27 /   0.92 /                             /   7.71 /   0.19 /          °BO°
==========================================================================
 NO ROAD OVERFLOW
                                                                          °RO°
==========================================================================
J   L AT   16100 /   400 /  18200. /  6400. /  902939. / 1.99 /   86. /  998.
   633.34 /   0.25 /   0.12 /   0.05 /  633.59 /   2.04 /   0.19 / -0.000  °AS°
==========================================================================
   M = 0.32 / E = 1.00 / K° = 0.81 /  7085. / 1112334. / 1.98 /   39. /  999.
   634.14 /   0.20 /                 /  634.34 /   2.57 /   0.17 /          °AS°
========================= END BRIDGE ANALYSIS ============================
J   L AT   16110 /    10 /  18200. /  7000. / 1113343. / 1.95 /   39. /  999.
   634.14 /   0.20 /   0.00 /   0.0  /  634.34 /   2.57 /   0.17 / -0.000  °AS°
==========================================================================
M   M AT   16700 /   590 /  18200. /  7160. / 1083624. / 2.07 /  200. / 1256.
   634.27 /   0.26 /   0.16 /   0.03 /  634.53 /   2.55 /   0.17 /  0.000  °AS°
==========================================================================
L   N AT   15300 /   600 /  18200. /  6900. / 1107711. / 2.16 /  242. / 1319.
   634.05 /   0.23 /   0.15 /   0.0  /  634.60 /   2.63 /   0.16 / -0.000  °AS°
==========================================================================
   O AT   18250 /   950 /  18200. /  7710. / 1206330. / 2.00 /   17. / 1137.
   634.07 /   0.23 /   0.22 /   0.0  /  634.90 /   2.36 /   0.16 /  0.000  °AS°
==========================================================================
O   P AT   18250 /  1000 /  18200. /  5504. /  733023. / 2.20 /   33. /  706.
   634.97 /   0.37 /   0.37 /   0.07 /  635.35 /   3.29 /   0.23 / -0.000  °AS°
==========================================================================
P   Q AT   18750 /  1500 /  18200. /  7504. /  755600. / 2.21 / -500. /  345.
   635.05 /   0.20 /   0.90 /   0.0  /  635.26 /   2.40 /   0.20 / -0.000  °AS°
==========================================================================
Q   R AT   19700 /   950 /  18200. / 11691. / 1169331. / 2.67 /  550. / 2160.
   635.55 /   0.10 /   0.53 /   0.0  /  635.60 /   1.56 /   0.08 / -0.000  °AS°
==========================================================================

                    END OF THIS PROFILE
```

K

L

M

N

O

P

Q

R

```
WSPS STEP-BACKWATER PROGRAM - VERSION 02.000 000 PAGE COUNT=   00.0472= 3/22/70

==================================================================================
WATER-SURFACE PROFILE FOR: ASSAR
PAGE  1 OF  2
==================================================================================
SECTO AT DISTANCE/ LENGTH/DISCHARGE/  AREA  /CONVEYANCE/ ALFHA/  LEV  /  REV
  US ELEV /    HV  /    HT  /    KZ  /     EG  /     V  /    FR  /   ACC   °ID°
==================================================================================
    A AT   10000 /      0 /  10200. / 13516. / 1203925. / 2.97 / -210. / 1203.
   631.40 /   0.00 /                 / 631.40 /   1.33 /   0.10/          °IS°
================================= BEGIN BRIDGE ANALYSIS ==========================
BR CR AT   10000 /        /  10200. /  3104. /  697607. / 1.00 /  803. / 1033.
   631.40 /   0.53 /                           /   5.63 /   0.26 /          °DD°
==================================================================================
 NO ROAD OVERFLOW
                                                                            °RG°
==================================================================================
    D AT   10000 /    600 /  10200. /  7503. / 1307501. / 1.67 / -440. /  565.
   631.40 /   0.15 /   0.12 /   0.03 / 631.44 /   2.43 /   0.15 / -0.000  °AS°
==================================================================================
   H = 0.60 / E = 0.93 / HO = 1.22 /  8101. / 1470005. / 1.61 / -450. /  565.
   632.10 /   0.12 /                 / 632.20 /   2.22 /   0.14 /          °AS°
================================= END BRIDGE ANALYSIS ============================
    D AT   10310 /     10 /  10300. /  8101. / 1470005. / 1.01 / -430. /  565.
   632.16 /   0.12 /   0.03 /   0.0  / 632.29 /   2.22 /   0.14 / -0.002  °HS°
==================================================================================
    C AT   11000 /    390 /  10200. /  8153. / 1251910. / 1.83 / -335. /  552.
   632.22 /   0.16 /   0.07 /   0.01 / 632.33 /   2.23 /   0.15 / -0.000  °HS°
==================================================================================
    B AT   11490 /    650 /  10200. /  7503. / 1303720. / 2.13 / -061. /  400.
   632.31 /   0.19 /   0.11 /   0.03 / 632.50 /   2.41 /   0.16 / -0.000  °HS°
==================================================================================
B-E E AT   11900 /    490 /  10200. /  9962. / 1903709. / 1.79 / -203. /  010.
   632.40 /   0.09 /   0.07 /   0.0  / 632.57 /   1.03 /   0.10 / -0.001  °HS°
==================================================================================
BAR F AT   12100 /    200 /  10200. /  5504. /  502300. / 1.21 / -440. /  516.
   632.40 /   0.20 /   0.03 /   0.03 / 632.60 /   3.23 /   0.20 / -0.011  °HS°
==================================================================================
E   G AT   12300 /    200 /  10200. /  6200. / 1047035. / 2.11 / -490. /  494.
   632.50 /   0.27 /   0.13 /   0.04 / 632.63 /   2.90 /   0.19 / -0.000  °HS°
==================================================================================
F   H AT   12500 /    200 /  10200. /  3750. /  072300. / 1.09 / -230. /   02.
   632.30 /   0.00 /   0.00 /   0.03 / 632.63 /   0.05 /   0.22 /  0.002  °HS°
================================= BEGIN BRIDGE ANALYSIS ==========================
KUTCH AT   12300 /        /  17015. /  2500. /  370822. / 1.00 / -161. /    0.
   632.95 /   0.75 /                           /   0.94 /   0.21 /          °BD°
==================================================================================
 ROAD OVERFLOW (CFS) / LEFT       0. / RIGHT     401. /
                                                                            °RG°
==================================================================================
G   I AT   12050 /    650 /  10200. /  3006. /  012476. / 1.24 /    2. /  330.
   632.72 /   0.42 /   0.17 /   0.01 / 633.14 /   6.67 /   0.21 / -0.000  °AS°
==================================================================================
```

*** INPUT CARD PRINTOUT ***

```
1     1 VASSAR                                                    10  2  2 99 12
2    10  63387  63327
3  1200 !   X 1  37  3  615   13700  1  3
4  1205  10200  10200
5  1210    -900  1  6400 -886  1  6388 -826  1  6360 -766  1  6313 -716  1  6286
6  1211    -684  2  6286 -672  2  6158 -662  2  6149 -652  2  6140 -642  2  6129
5  1212    -632  2  6126 -622  2  6125 -612  2  6126 -602  2  6125 -592  2  6125
6  1213    -582  2  6129 -576  2  6149 -572  2  6150 -562  2  6156 -550  2  6182
5  1214    -530  3  6226 -480  3  6244 -440  3  6255 -340  3  6277 -266  3  6306
6  1215     -90  3  6300    0  3  6279  140  3  6269  284  3  6268  374  3  6291
5  1216     450  3  6302  630  3  6380  644  3  6340  692  3  6356  760  3  6364
5  1217     930  3  6302 1300  3  6400
6  1220  1  2 100 100  1  2 045 045  1  2 060 060
3  1300 RR RR 2  21  1  615   13700        0        3 0
                                          4                                          **FROM(5)**
5  1310    -147  1  6322 -145  1  6155 -130  1  6154 -115  1  6130 -100  1  6125
5  1311     -90  1  6116  -79  1  6121  -79  1  6322 -147 -9  6322  -71  1  6322
6  1312     -71  1  6120  -50  1  6139  -40  1  6142  -30  1  6153  -20  1  6167
5  1313     -10  1  6279   -3  1  6215   -3  1  6305    0  1  6305    0  1  6322
5  1314     -71 -9  6322
6  1320  1  2 035 035
3  1350 RR 60 4   3  2   12          1  2          2 2                 1
5  1360       0  1  6415  500  2  6415 1000  2  6415
3  1400 J   L 5  33  4  615   14100  1  3
5  1410    -500  1  6400 -104  1  6372  -32  1  6362    0  1  6348  136  1  6325
5  1411     136  1  6400  216  1  6400  216  1  6323  224  2  6318  236  2  6155
5  1412     246  2  6144  256  2  6132  266  2  6124  276  2  6115  286  2  6107
5  1413     296  2  6103  306  2  6105  316  2  6115  326  2  6121  336  2  6130
5  1414     351  2  6156  376  3  6246  498  4  6291  572  4  6287  688  4  6284
5  1415     698  4  6285  718  4  6293  758  4  6266  858  4  6257  918  4  6273
5  1416     988  4  6280 1010  4  6400
6  1420  1  2 100 100  1  2 040 040  1  2 060 060  1  2 060 060
3  1480 J   L 8  32  4  615   14110  1  3
                                                                                SEQUENCE FORMW
5  1410    -500  1  6400 -104  1  6372  -32  1  6362    0  1  6348  136  1    25
5  1411     136  1  6400  216  1  6400  216  1  6323  224  2  6318  236  2  '
5  1412     246  2  6144  256  2  6132  266  2  6124  276  2  6115  286  2  6,  '
5  1413     296  2  6103  306  2  6105  316  2  6115  326  2  6121  336  2  6130
5  1414     351  2  6156  376  3  6246  498  4  6291  572  4  6287  688  4  6284
5  1415     698  4  6285  718  4  6293  758  4  6266  858  4  6257  918  4  6273
5  1416     988  4  6280 1010  4  6400
6  1420  1  2 100 100  1  2 040 040  1  2 060 060  1  2 060 060
3  1500 X   M 8  36  3  615   14700  1  3
5  1510    -144  1  6422  -46  1  6403    0  1  6403    0  1  6450  200  1  6450
5  1511     200  1  6341  242  1  6266  338  2  6259  353  2  6155  373  2  6151
5  1512     383  2  6139  393  2  6129  403  2  6131  413  2  6129  423  2  6129
5  1513     433  2  6138  443  2  6131  453  2  6134  463  2  6134  473  2  6136
5  1514     483  2  6137  493  2  6135  503  2  6133  513  2  6141  519  2  6156
5  1515     530  3  6270  634  3  6277  766  3  6288  918  3  6320  986  3  6329
5  1516    1028  3  6314 1208  3  6341 1322  3  6345 1498  3  6357 1574  3  6357
```

[illegible] WATER PROGRAM - VERSION 72.339 *** DATE [illegible] 3,DATE= 3/1[illegible]/76

*** INPUT CARD DOINTOUT ***

```
[illegible] 6   1 5  20  5  615   12950  2  4
[illegible]    -300  1  6400  -454  1  6361  -316  1  [illegible]  -242  1  6342  -212  1  6333
[illegible]    -100  1  6381     0  2  6343    26  3  6150    36  3  6115    45  3  6125
[illegible]      56  3  6116    66  3  6115    76  3  [illegible]    [illegible]  [illegible]  [illegible]  3  6113
[illegible]     106  3  6119   116  3  6121   126  3  [illegible]   136  3  [illegible]   146  3  6120
[illegible]     156  3  6126   166  3  6130   176  3  [illegible]   187  4  [illegible]   192  5  6231
[illegible]     270  5  6384   [illegible]  5  6296   [illegible]  [illegible]  [illegible]  [illegible]
[illegible]  1  2 040 040  1  2 040 040  1  2 [illegible]  1  2 [illegible]  1  2 [illegible]
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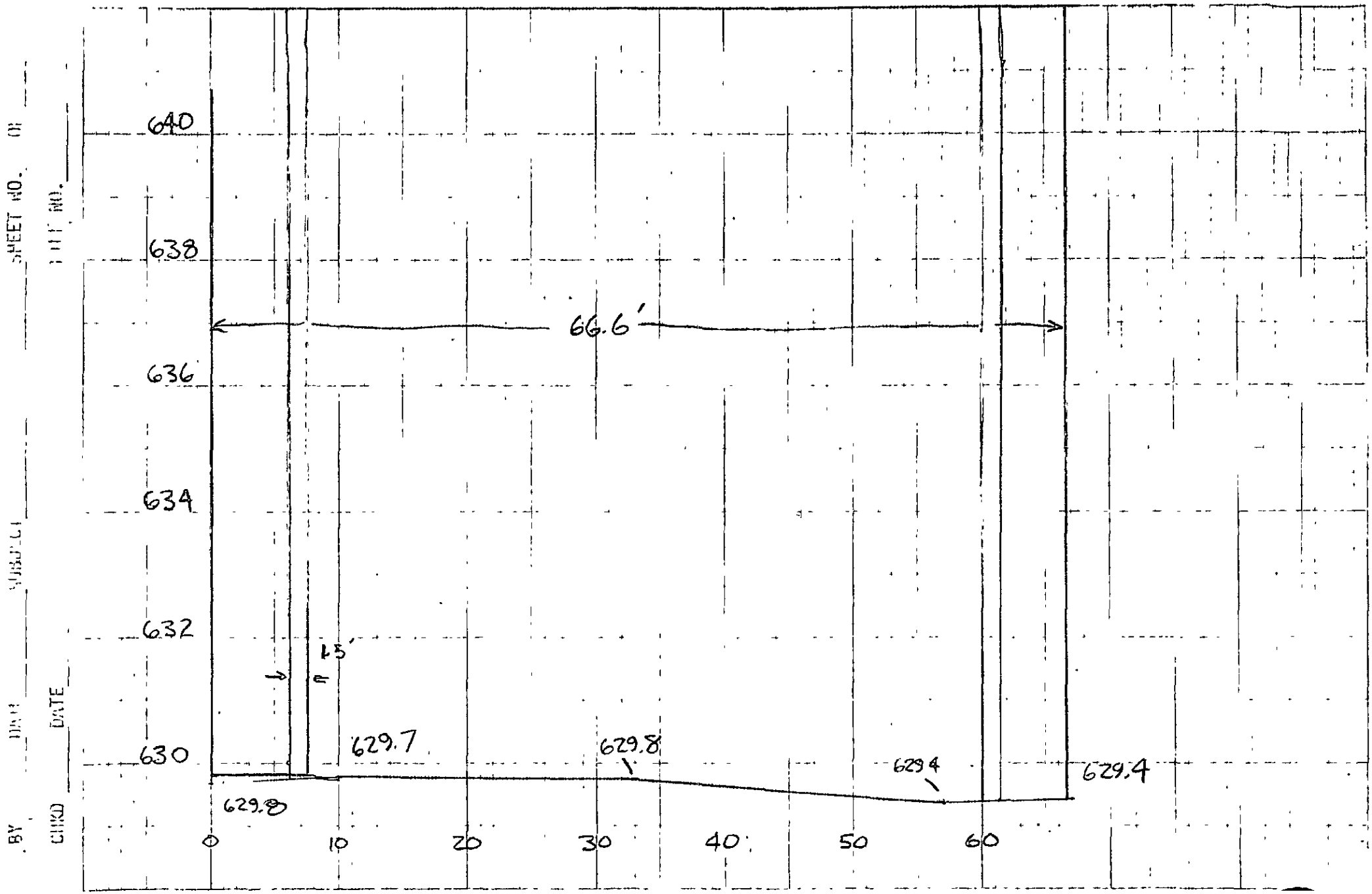
[illegible]    -300  1  6400  -454  1  6341  -314  1  [illegible]  -242  1  [illegible]  -272  1  [illegible]
[illegible]    -100  1  6381     0  2  6343    26  3  [illegible]    [illegible]  1  6133    46  3  6140
[illegible]      56  3  6116    66  3  6115    76  3  [illegible]    [illegible]  4  6115    96  3  6115
[illegible]     106  3  6119   116  3  6121   126  3  [illegible]   136  3  [illegible]   146  3  6126
[illegible]     156  3  6126   166  3  6130   176  3  [illegible]   187  4  [illegible]  [illegible]  5  6231
[illegible]     270  5  6384   [illegible]  5  [illegible]   [illegible]  [illegible]  [illegible]  [illegible]
[illegible]  1  2 040 040  1  2  [illegible]  1  2 [illegible]  1  2 [illegible]  1  2 050 [illegible]
[illegible] 4   1 0  35  4  615   1330   1  3
[illegible]    -700  1  6400  [illegible]  1  [illegible]  -1[illegible]  1  [illegible]  -1[illegible]  1  6351     0  1  6330
[illegible]      50  2  6315    [illegible]  2  [illegible]    [illegible]  2  [illegible]   132  2  [illegible]   112  2  [illegible]
[illegible]     122  2  6126   132  2  6112   142  2  [illegible]   [illegible]  2  6122   162  2  6121
[illegible]     172  2  6120   182  2  6119   192  2  6114   232  2  [illegible]   232  1  6224
[illegible]     428  4  6244   440  4  [illegible]  [illegible]  4  [illegible]   714  4  6321   726  6  6277
[illegible]     878  4  6261   [illegible]  4  6270   936  4  6212  1014  4  6214  1134  4  6270
[illegible]    1086  4  6273  1224  4  6307  1294  4  6344  1414  4  [illegible]  1577  4  6404
[illegible]  1  2 100 100  1  2 040 040  1  2 100 100  1  2 100 100
[illegible] 1  [illegible] 0  37  3  615   1370  1  3
[illegible]    -484  1  6400  -686  1  6344  -438  1  6300  -744  1  6313  -735  1  6306
[illegible]    -484  2  6206  -672  2  6194  -642  2  6141  -672  2  6148  -642  2  6123
[illegible]    -632  2  6176  -622  2  6125  -512  2  6120  -512  2  6125  -592  2  6125
[illegible]    -582  2  6129  -570  2  6144  -572  2  6132  -562  2  6154  -550  2  6142
[illegible]    -538  3  6226  -468  3  6244  -450  3  6277  -350  3  6277  -205  3  6306
[illegible]     -90  3  6308     0  3  6279   140  3  [illegible]   [illegible]  3  6261   374  3  6291
[illegible]     450  3  6302   [illegible]  3  6314   544  3  [illegible]   612  3  6356   740  3  6364
[illegible]     538  3  6342  [illegible]  3  [illegible]
[illegible]  1  2 100 100  1  2 [illegible]  1  [illegible]
[illegible] 4  [illegible]  26  2  615   1370  [illegible]
[illegible]    -147  1  6372  -145  1  6372  -133  1  [illegible]  -115  1  [illegible]  -100  1  6125
[illegible]     -98  1  6116  -74  1  [illegible]  -70  1  6324  -107  [illegible]  [illegible]  -71  1  6322
[illegible]     -71  1  6120  -50  1  6134  -4  1  [illegible]  -10  1  6154  -20  1  [illegible]
[illegible]     -10  1  6205  -3  1  6215  -3  1  [illegible]  [illegible]  1  6305    0  1  [illegible]
[illegible]     -71  -9  6326  10  2  6390  34  2  [illegible]  [illegible]  2  6385   64  2  6390
[illegible]      10  -9  6390
[illegible]  1  2 035 035  1  2 [illegible]
[illegible]  4  [illegible]  2  12  [illegible]  1  2  [illegible]  1
[illegible]    0  1  [illegible]  [illegible]  2  [illegible]  [illegible]  [illegible]  [illegible]
[illegible] 1  5  32  4  615   141[illegible]  2  4
[illegible]    -500  1  6400  -1[illegible]  1  6372  -[illegible]  1  [illegible]  [illegible]  1  [illegible]  [illegible]  1  [illegible]
[illegible]     130  1  6400  216  1  6408  218  1  [illegible]  [illegible]  2  6313  [illegible]  2  [illegible]
[illegible]     246  2  6144  256  2  6132  246  2  [illegible]  [illegible]  2  6115  [illegible]  2  [illegible]
```


640
638
636
634
632
630
66.6'
R 5'
629.7
629.8
629.4
629.4
629.8
0
10
20
30
40
50
60
SHEET NO.
OF
SUBJECT
DATE
BY
CHKD

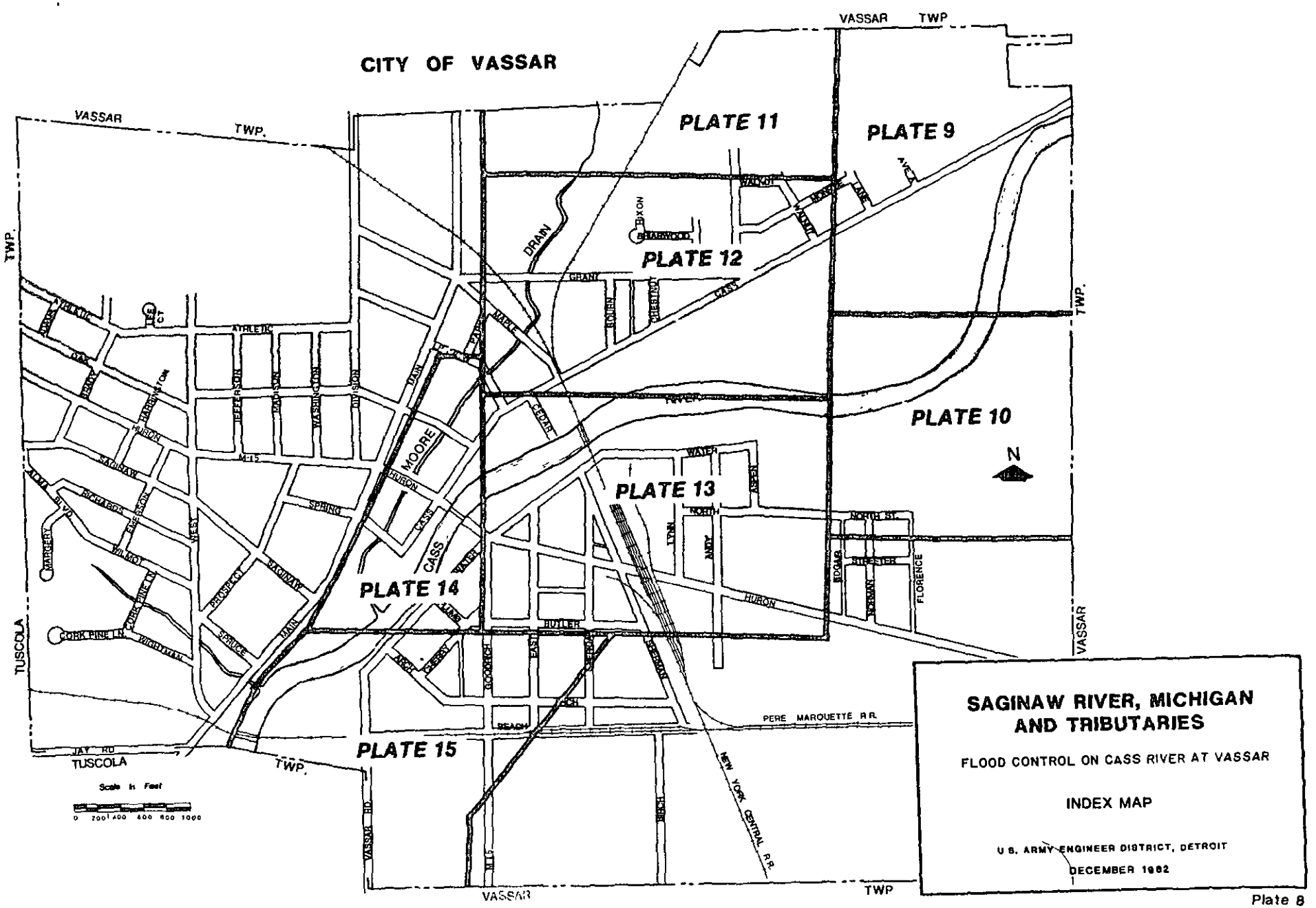
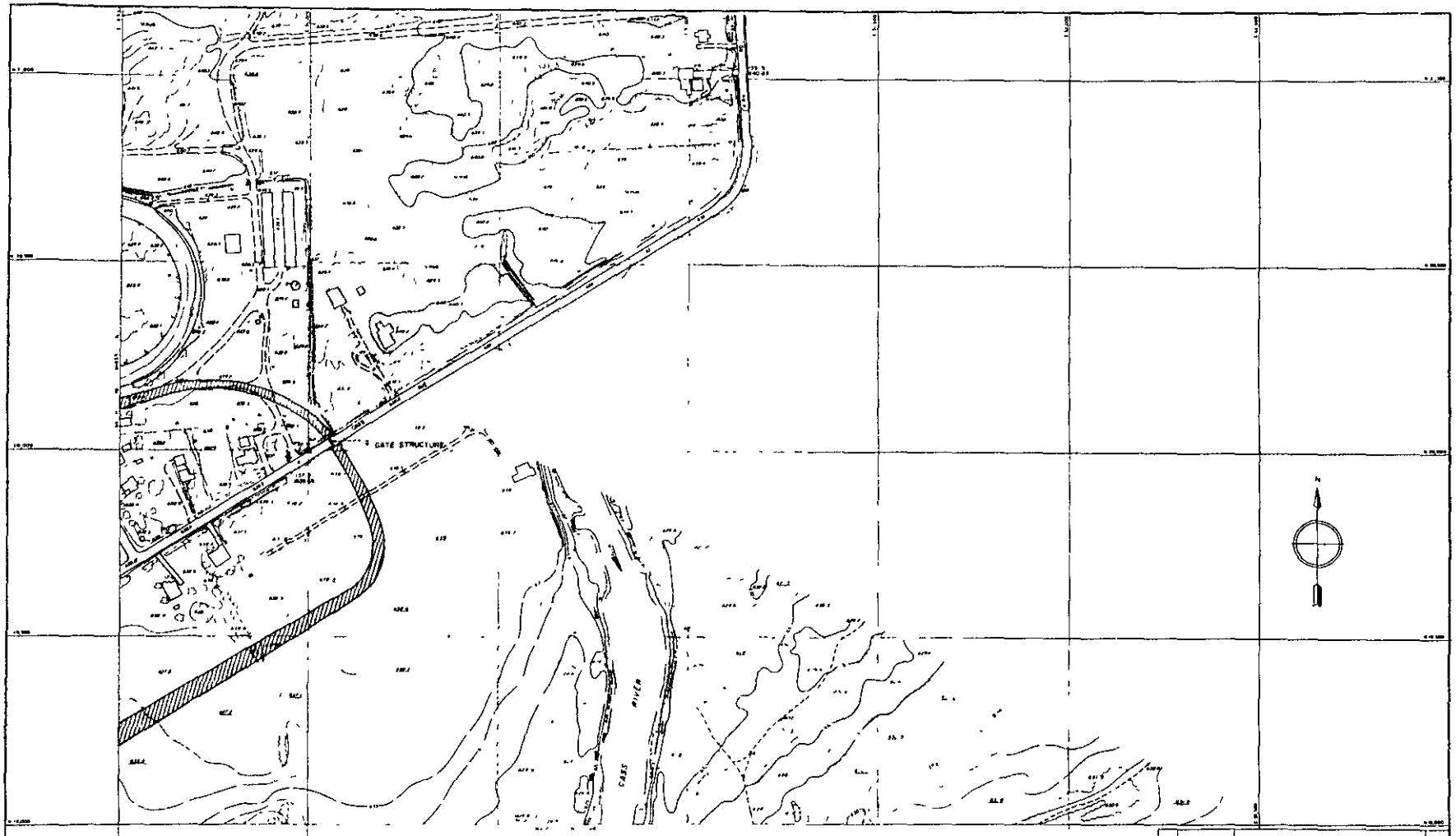

CITY OF VASSAR
VASSAR TWP.
VASSAR TWP
TWP.
TUSCOLA
TUSCOLA TWP.
VASSAR
TWP
PLATE 9
PLATE 10
PLATE 11
PLATE 12
PLATE 13
PLATE 14
PLATE 15
N
SAGINAW RIVER, MICHIGAN AND TRIBUTARIES
FLOOD CONTROL ON CASS RIVER AT VASSAR
INDEX MAP
U.S. ARMY ENGINEER DISTRICT, DETROIT
DECEMBER 1962
Scale in Feet
0 200 400 600 800 1000
PERE MARQUETTE R.R.
NEW YORK CENTRAL R.R.
CASS
MOORE
DRAIN
MAIN
HURON
WATER
BUTLER
GRANT
RIVER
CEDAR
ATHLETIC
SPRING
SAGINAW
PROSPECT
SPRUCE
WILMOT
CORK PINE LN.
MARGERT
JAY RD
VASSAR RD
BEACH
NORTH
NORTH ST.
HOUGH
BIRCH
ELM
ASPEN
LYNN
ANDY
EDGAR
NORMAN
FLORENCE
GOODRICH
EASTON
ARCH
CHERRY
HOLDEN
CHESTNUT
MARKET
BLACKWOOD
DIXON
WASHINGTON
JEFFERSON
JACKSON
DIVISION
MILLS
WEST
EAST
PARK
OAK
HENRY
ALVIN
RICHARDS
ERIESON
WILLIAM
LAKE
TAYLOR
AVE.

Plate 8



U S ARMY ENGINEER DISTRICT DETROIT
CORPS OF ENGINEERS
DETROIT MICHIGAN

SAGINAW RIVER, MICHIGAN
and TRIBUTARIES

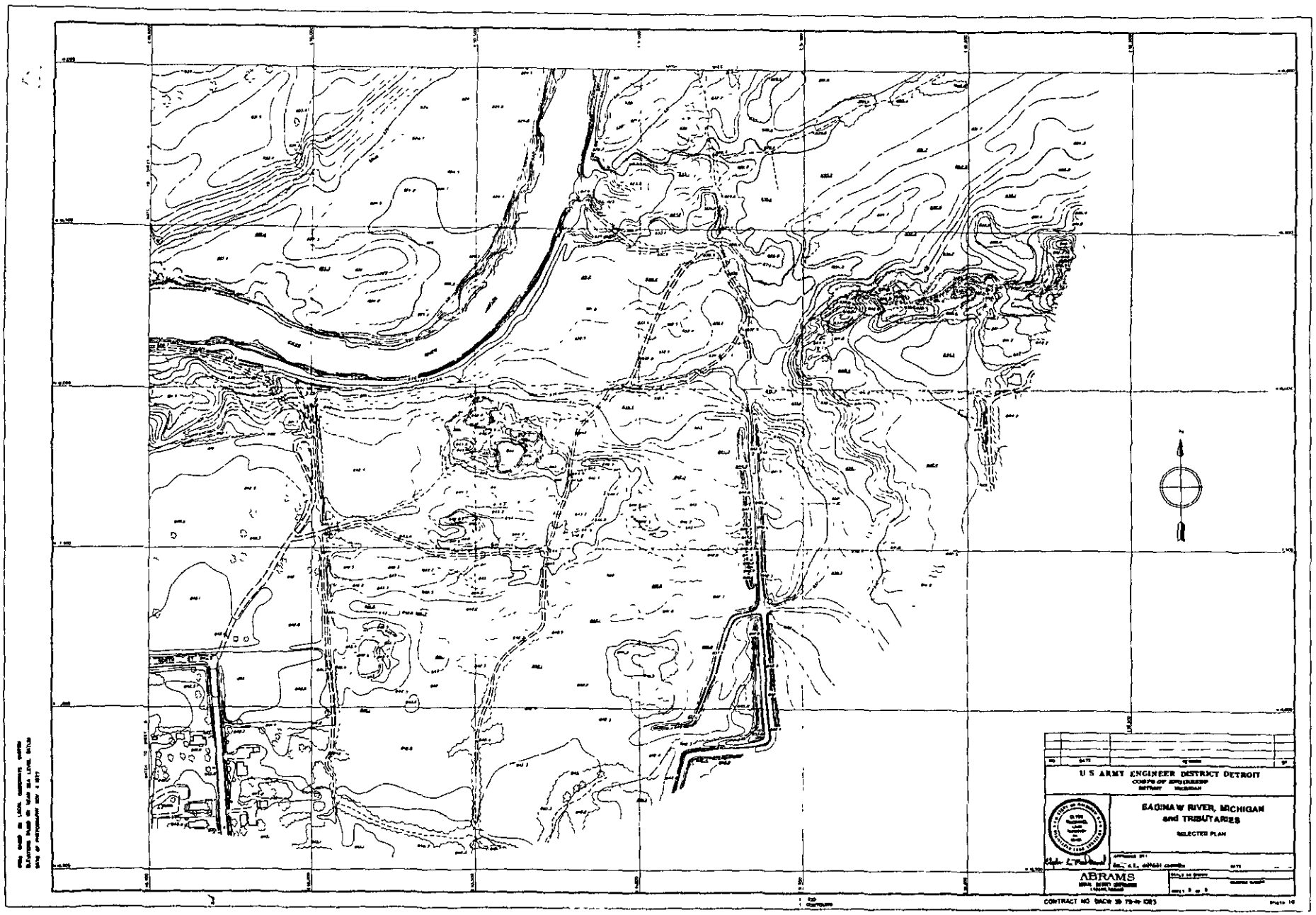
SELECTED PLAN

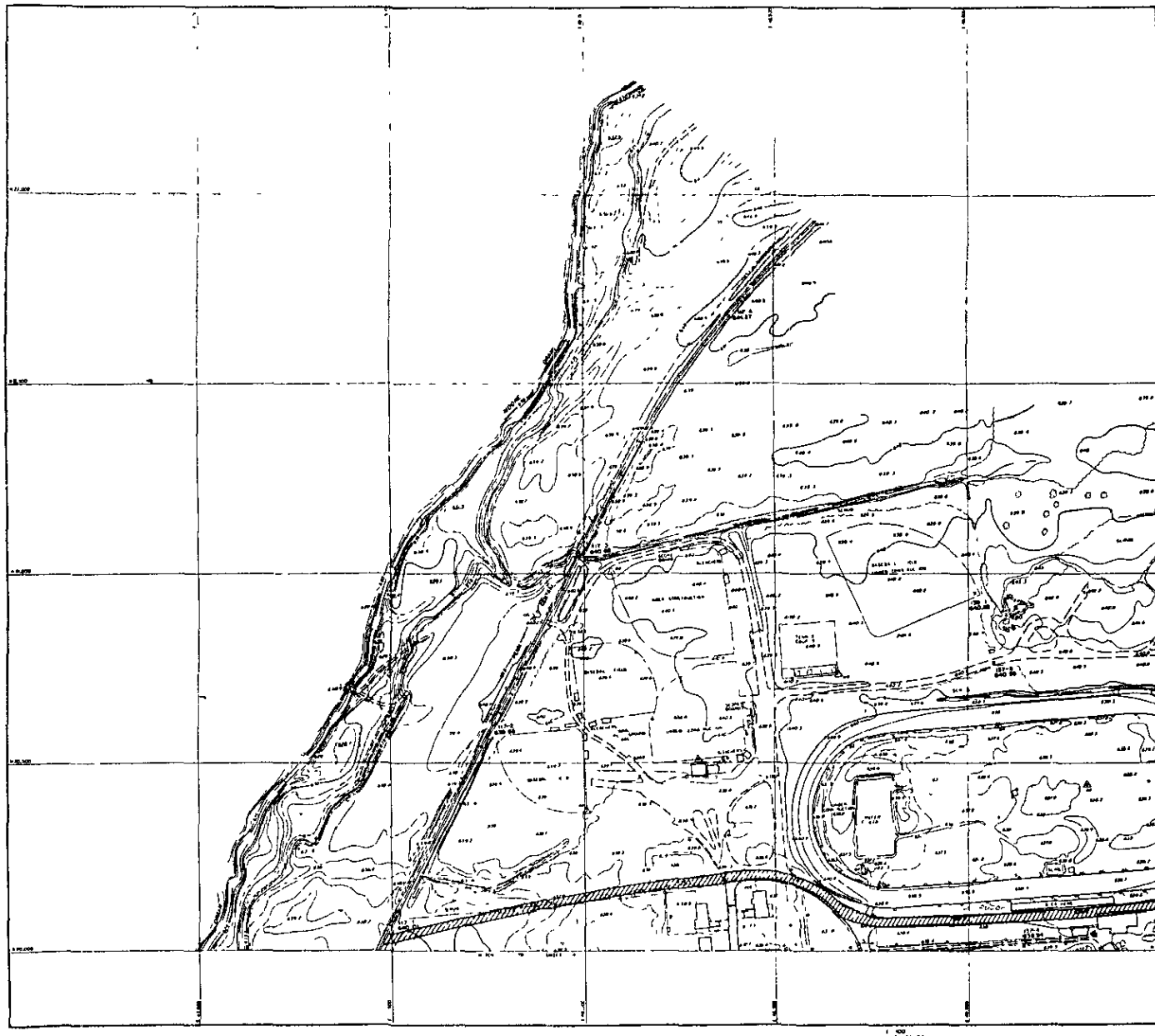
ABRAMS
CIVIL ENGINEERS
LANSING, MICHIGAN

CONTRACT NO. DACW-35 79-P-0023

Plate 9

20
1 CONTOURS


U S ARMY ENGINEER DISTRICT DETROIT
SAGINAW RIVER, MICHIGAN
and TRIBUTARIES
SELECTED PLAN
ABRAMS
CONTRACT NO DACW 35 79-C-0083

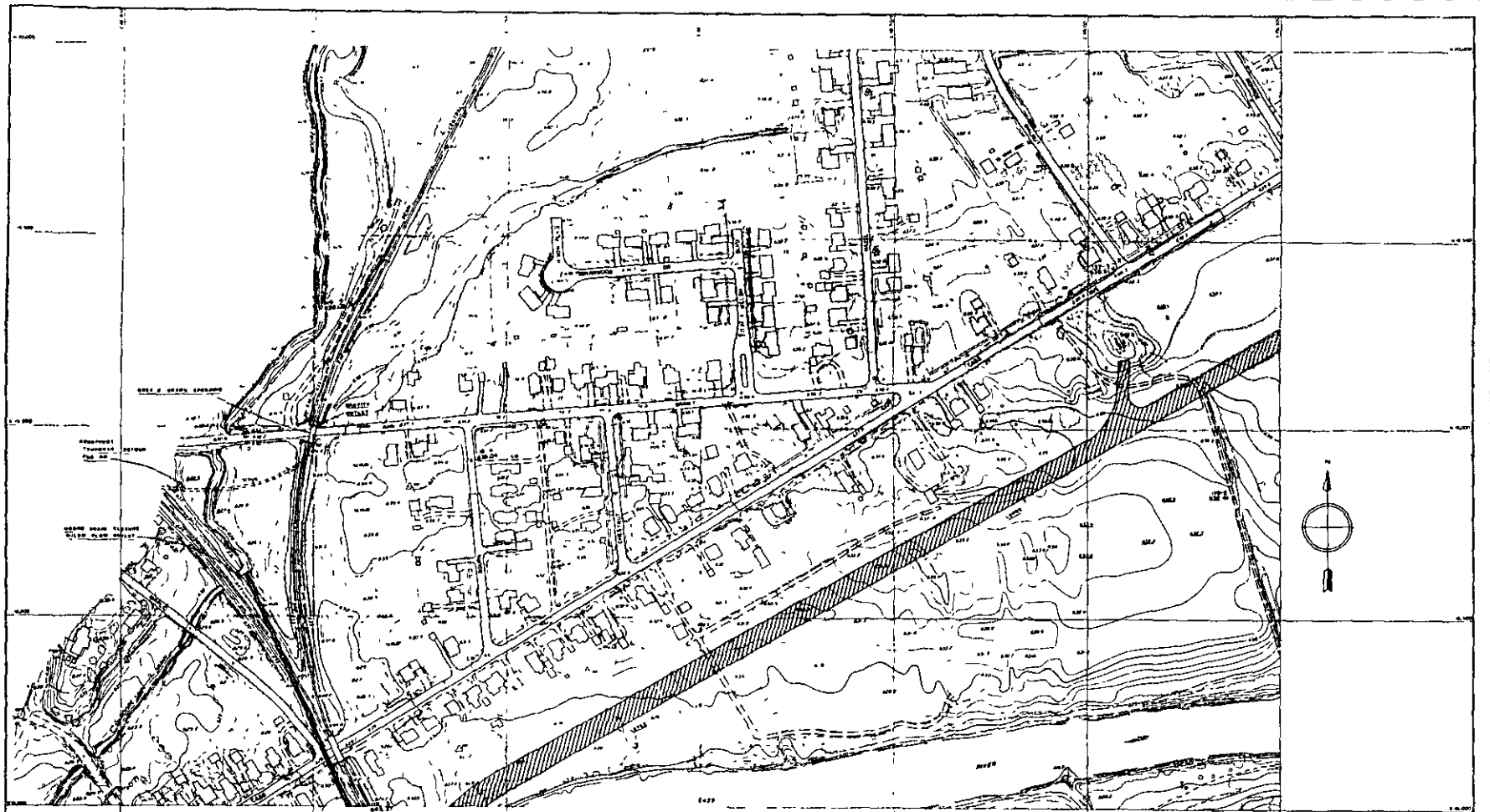


U. S. ARMY ENGINEER DISTRICT DETROIT
CORPS OF ENGINEERS
DETROIT MICHIGAN

SAGINAW RIVER, MICHIGAN
and TRIBUTARIES
SELECTED PLAN

ABRAMS

CONTRACT NO DACW 35 79-M 1083



U.S. ARMY ENGINEER DISTRICT DETROIT
CORPS OF ENGINEERS
DETROIT MICHIGAN

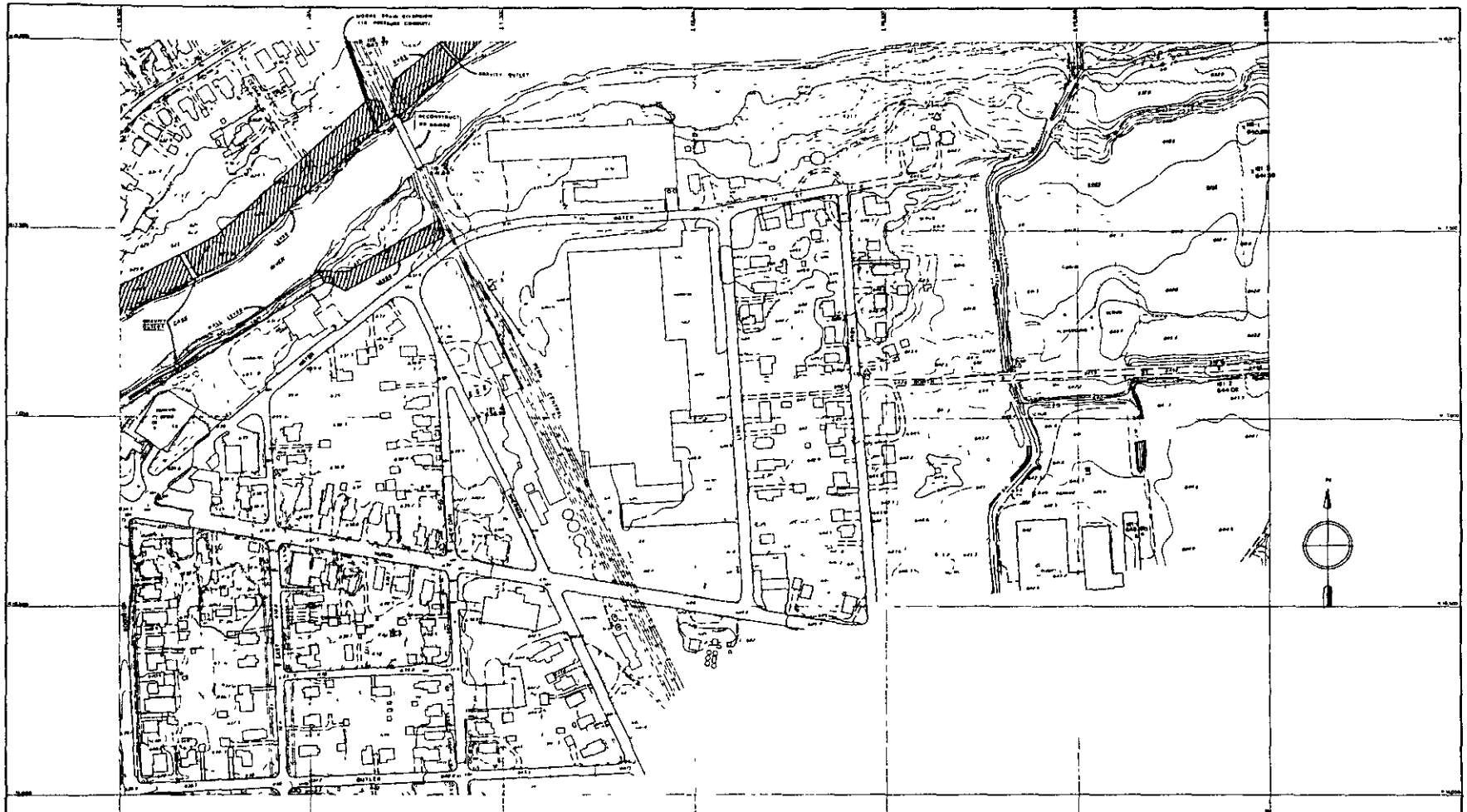
SAGINAW RIVER, MICHIGAN
and TRIBUTARIES

SELECTED PLAN

ABRAMS

CONTRACT NO. DACW-38 79-C-0013

Plate 17



U. S. ARMY ENGINEER DISTRICT DETROIT
CORPS OF ENGINEERS
DETROIT MICHIGAN

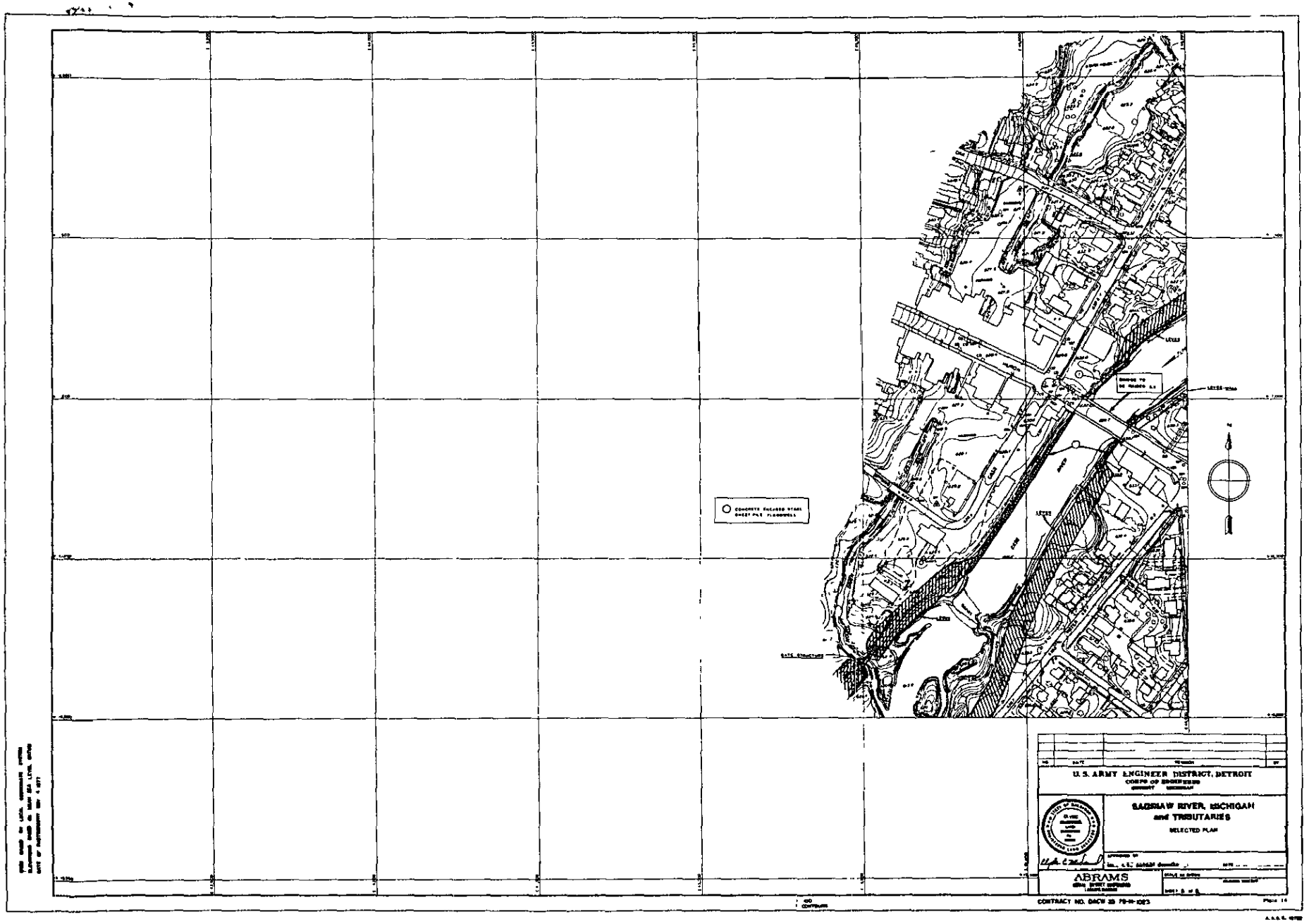
SAGINAW RIVER, MICHIGAN
and TRIBUTARIES

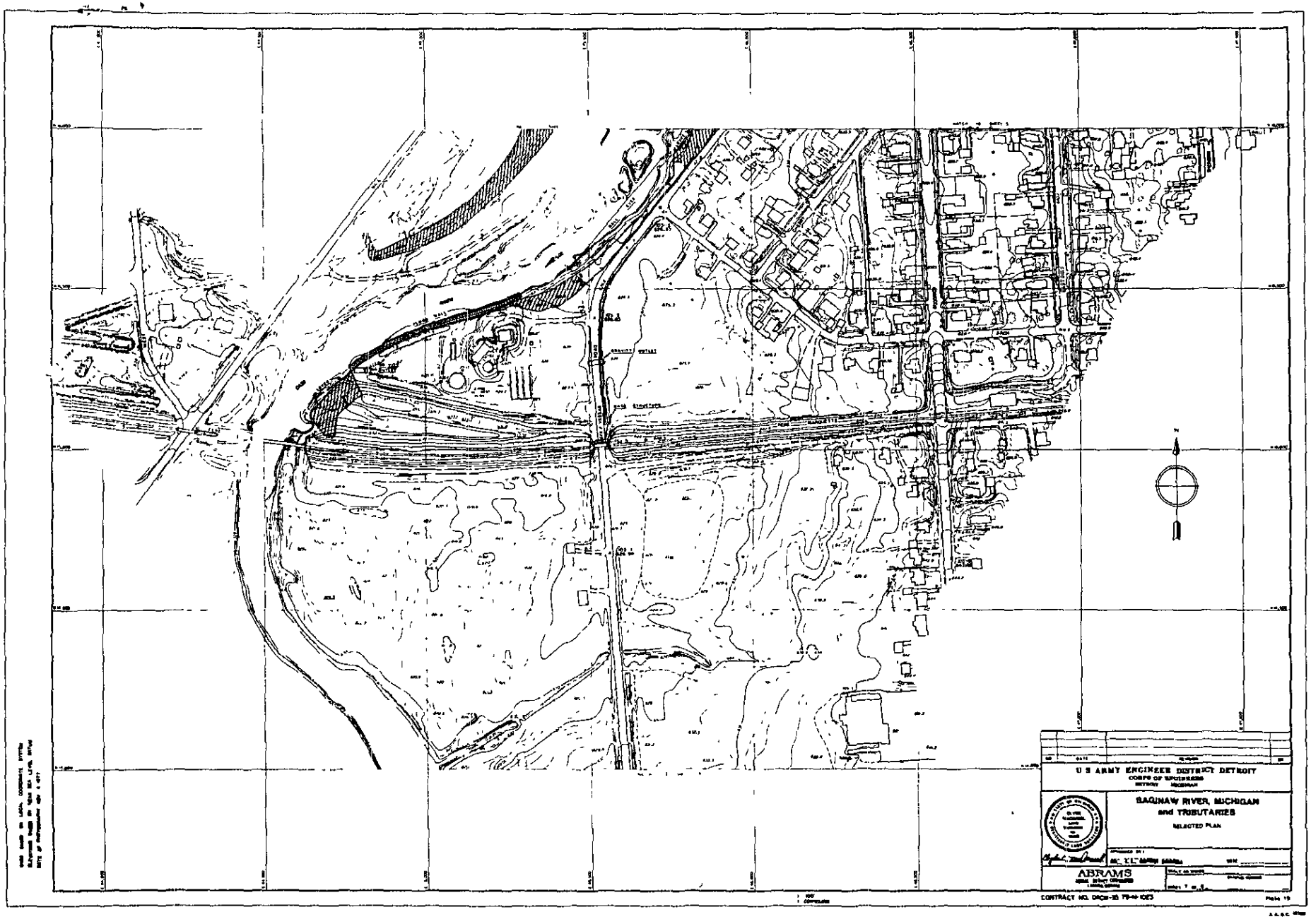
SELECTED PLAN

ABRAMS

CONTRACT NO. DACW-35 79-C-0013

Plate 13


CONCRETE FACIGED STONE
SHEET PILE FLOODWALL
LEVEE
GATE STRUCTURE
U.S. ARMY ENGINEER DISTRICT, DETROIT
CORPS OF ENGINEERS
SAGINAW RIVER, MICHIGAN
and TRIBUTARIES
SELECTED PLAN
ABRAMS
CONTRACT NO. DACW 35 79-M-0873


U S ARMY ENGINEER DISTRICT DETROIT
CORPS OF ENGINEERS
DETROIT MICHIGAN
SAGINAW RIVER, MICHIGAN
and TRIBUTARIES
SELECTED PLAN
ABRAMS
CONTRACT NO. DACW-35 79-C-1023

FROM: Rex Copsey
Archon Associates Inc.
4970 Northwind Drive Suite 202
East Lansing, MI 48823

TO: Bruce Merrey
MDNR Land & Water Mgmt
P.O. Box 30028
Lansing, MI 48909

SUBJECT: Vassar Apartments

OUR JOB NO.:

DATE OF MEMO: 10/7/88

MESSAGE

Please fill out the permit application & return. A letter of non objection from the City would be very helpful. A floodplain permit will be required but I do not see a problem with issuing a permit. Please contact Steve Spencer at Imlay City (313-724-2015) to see if an Inland Lakes & Streams Act (Act 346, P.A. of 1972) will be required for the "drain" enclosure. I will be out of the office until the 13th, the letter you requested will be out next week. 517-335-3181

SIGNED Bruce Merrey

SENDER — DO NOT WRITE BELOW THIS LINE

REPLY

If you have questions before the 13th, contact Dan Morgan at 517-335-3191

Talladd Rick Rose of Imlay City and I conducted a site investigation yesterday. They will fill the site and let us know if we need to file permits.

SIGNED Jack M. McLaughlin DATE 11-1-88

REPLY

SENDER — Retain part 2 for your follow-up, send parts 1 and 3 to addressee
RECIPIENT — Retain part 1 and return part 3

City of Vassar FIS

Under-pass Opening @ Cass Road

$$\text{Area} = (637.3 - 629.8) \times 6 + \frac{(637.3 - 629.7) + (637.3 - 628.8)}{2} 25.5 + \frac{(637.3 - 629.8) + (637.3 - 629.4)}{2} 24 + (637.3 - 629.4) \times 8.1 = 486 \text{ ft}^2$$

TWEL = 636.8

wls = 637.3

R.R Bridge Opening

$$3206 \text{ ft}^2 - 146' \times (636.7 - 632.2) = 2549 \text{ ft}^2$$

$$A_T = 2549 + 486 = 3035$$

1986 Q ≈ 21,000 cfs $\quad \Delta h \sim .5 - .6$ ft

$$21{,}000 = 3035 \sqrt{\frac{(.5)(64.4)}{XKOR}} \Rightarrow XKOR = .67$$

1942 Flood Gage = 19.0 ⇒ Stage = 631.38

Peak stages and discharges of Cass River at Vassar, Mich.

Water year	Date	Gage height (feet)	Discharge (cfs)
1904	Apr. 1, 1904	19.0	-
1910	Mar 6, 1910	15.0	-
1911	Apr. 7, 1911	12.3	-
1912	May 22, 1912	18.5	-
1913	Mar 15, 1913	14.7	
1914	Mar.28,31,1914	13.5	-
1915	Feb. 25, 1915	12 9	-
1916	Mar. 30, 1916	18.9	-
1917	Apr. 6, 1917	13.7	-
1918	Mar. 21, 1918	17.0	-
1919	Mar. 18, 1919	15.2	-
1920	Mar. 17, 1920	12.8	-
1921	Apr. 23, 1921	12.7	-
1922	Apr.12,18,1922	13.6	-
1923	May 18, 1923	15.2	-
1924	May 10, 1924	13.3	-
1925	Mar. 22, 1925	12.8	-
1926	Mar. 24, 1926	15.6	-
1927	Mar. 14, 1927	13.5	-
1928	Apr. 8, 1928	13.7	-
1929	Apr. 6, 1929	18.5	-
1930	Feb. 26, 1930	15.0	-
1931	Mar. 29, 1931	10.4	-
1932	Mar. 27, 1932	11.8	-
1933	Apr. 2, 1933	13 4	-
1938	Feb. 7, 1938	16.8	-
1939	Apr. 19, 1939	11.2	-
1940	Mar. 31, 1940	12.3	-
1941	Mar. 15, 1941	9.4	-
1942	Mar. 18, 1942	19.0	-
1943	Feb. 24, 1943	13.4	-
1944	Feb. 27, 1944	10 0	-
1945	May 18, 1945	11.9	-
1946	Mar. 8, 1946	16.7	-
1947	Apr. 6, 1947	17.8	-
1948	Mar. 20, 1948	20.8	18,000
1949	Feb. 16, 1949	11.64	4,930
	Feb. 26, 1949	9 5	3,010
1950	Jan. 26, 1950	9.7	3,170
	Mar. 9, 1950	10.9	4,220
	Mar. 28, 1950	16 60	11,300
	Apr 5, 1950	16.3	10,800
1950	July 18, 1950	12.5	5,950
1951	Dec. 4, 1950	12.0	5,450
	Dec. 8, 1950	11.1	4,560
	Jan. 4, 1951	10.8	4,340
	Feb. 21, 1951	14.09	7,830
	Feb. 27, 1951	13.1	6,620
	Mar. 31, 1951	9.4	3,220
	Apr. 26, 1951	13.0	6,500
1952	Nov. 14, 1951	10.3	3,940
	Jan. 17, 1952	9.6	3,380
	Feb. 5, 1952	11.2	4,680
	Mar. 12, 1952	12.60	6,060
	Mar. 20, 1952	9.9	3,620
	Apr. 8, 1952	10.7	4,260
	Apr. 14, 1952	12.2	5,650
1953	Mar. 5, 1953	10.5	4,100
	Mar. 16, 1953	11.0	4,500
	May 3, 1953	11.7	5,150
	Aug. 9, 1953	9.4	3,220
1954	Feb. 17, 1954	13.2	6,740
	Feb. 22, 1954	12.4	5,850
	Mar. 20, 1954	9.9	3,620
	Mar. 26, 1954	13.54	7,100
	Apr. 28, 1954	10.6	4,180
1955	Mar. 4, 1955	9.0	3,000
	Mar. 12, 1955	10.80	4,340
1956	Mar. 8, 1956	13.10	6,620
	Apr. 30, 1956	10.7	4,260
	May 7, 1956	12.4	5,850
	May 11, 1956	11.6	5,050
	May 13, 1956	11.49	4,950
1957	Apr. 8, 1957	8.40	2,560
1958	Mar. 6, 1958	a7.64	1,940
1959	Mar. 26, 1959	11.72	5,350
	Apr. 4, 1959	13.75	7,400
1960	Dec. 29, 1959	10.25	4,090
	Apr. 1, 1960	16.70	11,400
1961	Sept.27, 1961	7.50	1,800
1962	Mar. 20, 1962	12.88	6,480
	May 3, 1962	9.92	3,830

a Occurred preceding day (backwater from ice).
Note.--Readings from June 1, 1912, to Aug. 31, 1919, are probably about 2 ft too high.

1515. Cass River at Frankenmuth, Mich

Location --Lat 43°19'35", long 83°44'50", in sec.27, T.11 N., R 6 E., on right bank half a mile west of Frankenmuth, 3.4 miles upstream from Dead Creek, and 5.4 miles downstream from Perry Creek.

Drainage area.--848 sq mi.

Gage --Nonrecording prior to Oct. 1, 1936; recording thereafter. At site half a mile upstream at datum 1.81 ft lower prior to March 1909. At site half a mile downstream at datum 0.04 ft higher July 18, 1935, to Sept 30, 1936, and June 20, 1939, to Sept. 30, 1949. Datum of gage is 583 96 ft above mean sea level, datum of 1929 (levels by Michigan Department of Conservation).

Stage-discharge relation.--Defined by current-meter measurements below 16,000 cfs prior to 1949 and below 12,000 cfs since 1950

Bankfull stage.--17 ft.

Remarks.--Only annual peak shown for 1908. Base for partial-duration series, 3,500 cfs.

Peak stages and discharges of Cass River at Frankenmuth, Mich.

Water year	Date	Gage height (feet)	Discharge (cfs)
1908	Mar. 16, 1908	21.0	9,550
1936	Mar. 13, 1936	a16.05	3,200
1940	Apr 1, 1940	15.48	5,650
1941	Dec. 30, 1940	11 13	2,600
1942	Mar. 10, 1942	a20.91	12,000
	Mar. 18, 1942	20.88	17,700
1943	Dec. 28, 1942	-	4,200
	Feb 25, 1943	a18.52	4,700
	Mar 16, 1943	20.50	16,100
	May 12, 1943	15.60	5,420
	June 3, 1943	14.68	4,730
1944	Feb. 28, 1944	15.34	5,180
1945	May 19, 1945	16.07	5,930
	June 3, 1945	17 27	7,360
	June 29, 1945	13.89	4,170
1946	Oct. 2, 1945	13 05	3,580
	Jan. 6, 1946	a15.34	4,200
	Jan 10, 1946	13.35	3,840
	Mar. 8, 1946	19.08	11,800
1947	Apr. 6, 1947	20 23	15,400
	May 14, 1947	13.91	4,170
1948	Mar. 20, 1948	20 83	17,600
	Apr. 1, 1948	13 53	3,900
1949	Feb 16, 1949	15.22	5,290
1950	Jan. 26, 1950	14.18	3,920
	Mar. 9, 1950	16.40	5,600
	Mar 28, 1950	21.00	12,500
	Apr. 5, 1950	20.84	12,100
	July 18, 1950	16.79	6,000
1951	Dec. 4, 1950	16.44	5,600
	Dec 8, 1950	15.30	4,640
	Jan. 4, 1951	16.33	5,500
	Feb. 21, 1951	a18.98	8,000
	Feb. 27, 1951	a18.54	7,000
1951	Mar 5, 1951	14 04	[illegible]
	Apr 23, 1951	13 71	3,620
	Apr. 26, 1951	15 02	[illegible]
1952	Jan. 18, 1952	a17.36	4,500
	Feb 5, 1952	a20.29	5,500
	Mar. 12, 1952	a20 00	7,100
	Mar. 20, 1952	14 37	[illegible]
	Apr 8, 1952	16 02	5,000
	Apr 14, 1952	17 15	[illegible]
1953	Mar. 5, 1953	a15 70	4,100
	Mar. 16, 1953	11 80	[illegible]
	May 3, 1953	16 [illegible]	[illegible]
1954	Sept.17, 1954	a22 44	7,500
	Feb. 22, 1954	17 63	7 100
	Mar. 20, 1954	14 04	3 800
	Mar. 26, 1954	16 21	3 000
	Apr 28, 1954	15.50	4 800
1955	Jan 7, 1955	13 53	[illegible],500
	Mar 4, 1955	13 80	[illegible]
	Mar. 12, 1955	15 51	[illegible]
1956	Mar 8, 1956	a18.73	8,000
	Apr. 30, 1956	16 04	5,200
	May 7, 1956	17 90	[illegible]
	May 11, 1956	17 22	[illegible]
	May 13, 1956	17.35	[illegible]
1957	Feb. 27, 1957	b13 08	3,400
1958	Mar 5, 1958	c12 [illegible]	[illegible]
1959	Mar. 26, 1959	a17 52	6,000
	Apr. 3, 1959	18 77	8,560
1960	Dec 29, 1959	[illegible]	[illegible]
	Apr. 1, 1960	[illegible]	[illegible]
1961	Sept.27, 1961	11 78	[illegible]
1962	Mar 20, 1962	[illegible]	[illegible]
	May 3, 1962	15 [illegible]	[illegible]

a Backwater from ice.
b Occurred Feb. 26, 1957 (backwater from ice).
c Occurred Mar. 1, 1958 (backwater from ice).

1520. Cass River at Bridgeport, Mich

Location --Lat 43°21'30", long 83°52'55", in NE¼ sec 16, T 11 N , R 5 E on downstream side of highway bridge in Bridgeport and 7 miles [illegible] mouth

Drainage area.--985 sq mi.

Gage --Nonrecording Datum of gage is 57[illegible] ft above [illegible] At different datum in 1908

Bankfull stage --15 ft, U S. Weather Bureau flood stage, 18 ft

Remarks.--Records for flood seasons only furnished by U S Weather Bureau, except for 1908 Only annual peak gage heights are shown

FROM: Bruce Mercuri

TO: Hope Cushing

SUBJECT: Cass River @ Vassar Peak Flows

OUR JOB NO:

DATE OF MEMO: 6/12/87

MESSAGE

We used an extrapolation between Wahjamega and Frankenmuth for the Vassar location. The peak discharge record at Vassar (1948-82) missed 4 of the top 7 peaks recorded at Frankenmuth. We would expect the log Pearson at Vassar to be an underestimate of flows. I have attached a copy of the log Pearson at Frankenmuth and Wahjamega along with a copy of our extrapolation.

SIGNED Hope Cushing

SENDER — DO NOT WRITE BELOW THIS LINE

FROM: Dave Hamilton
Hydrology Unit

TO: Bruce Mercuri
Technical Review

SUBJECT: City of Vassar FIS, Cass River

OUR JOB NO:

DATE OF MEMO: 3/30/87

MESSAGE

I am in the process of revising the City of Vassar's FIS. To request the revision, I will also have to run the 10, 50, and 500-year discharges. Please provide me with Q_{10}, Q_{50}, Q_{500} for the Cass River at Vassar (DA = 710 mi²). I have been running Q_{100} = 22,800 cfs, is this appropriate?

SIGNED Bruce

SENDER — DO NOT WRITE BELOW THIS LINE

REPLY

Q_{10} = 13,700 cfs

Q_{50} = 20,000 cfs

Q_{100} = 22,800 cfs

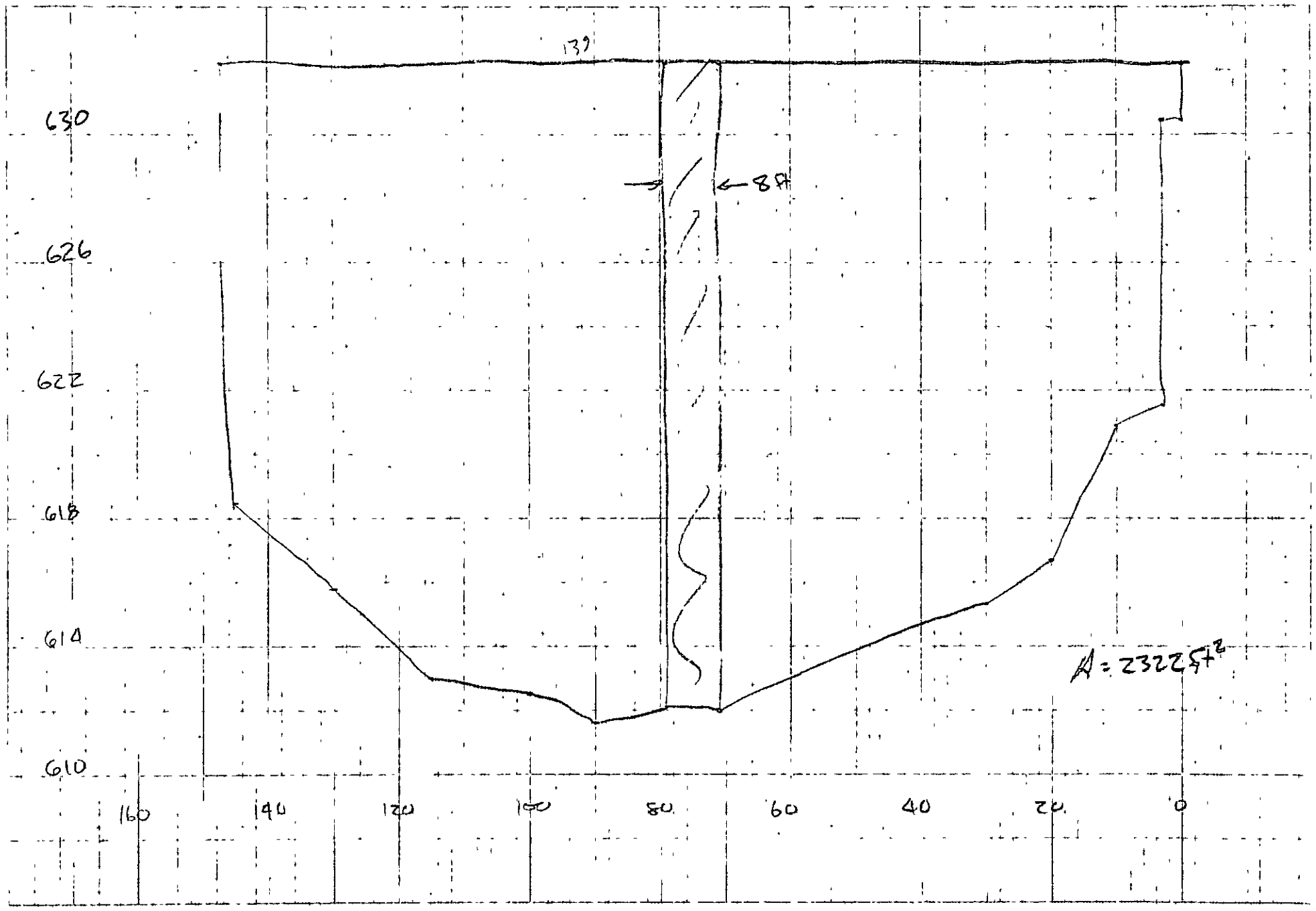
Q_{500} = 25,600 cfs

SIGNED David A. Hamilton

DATE 3-31-87

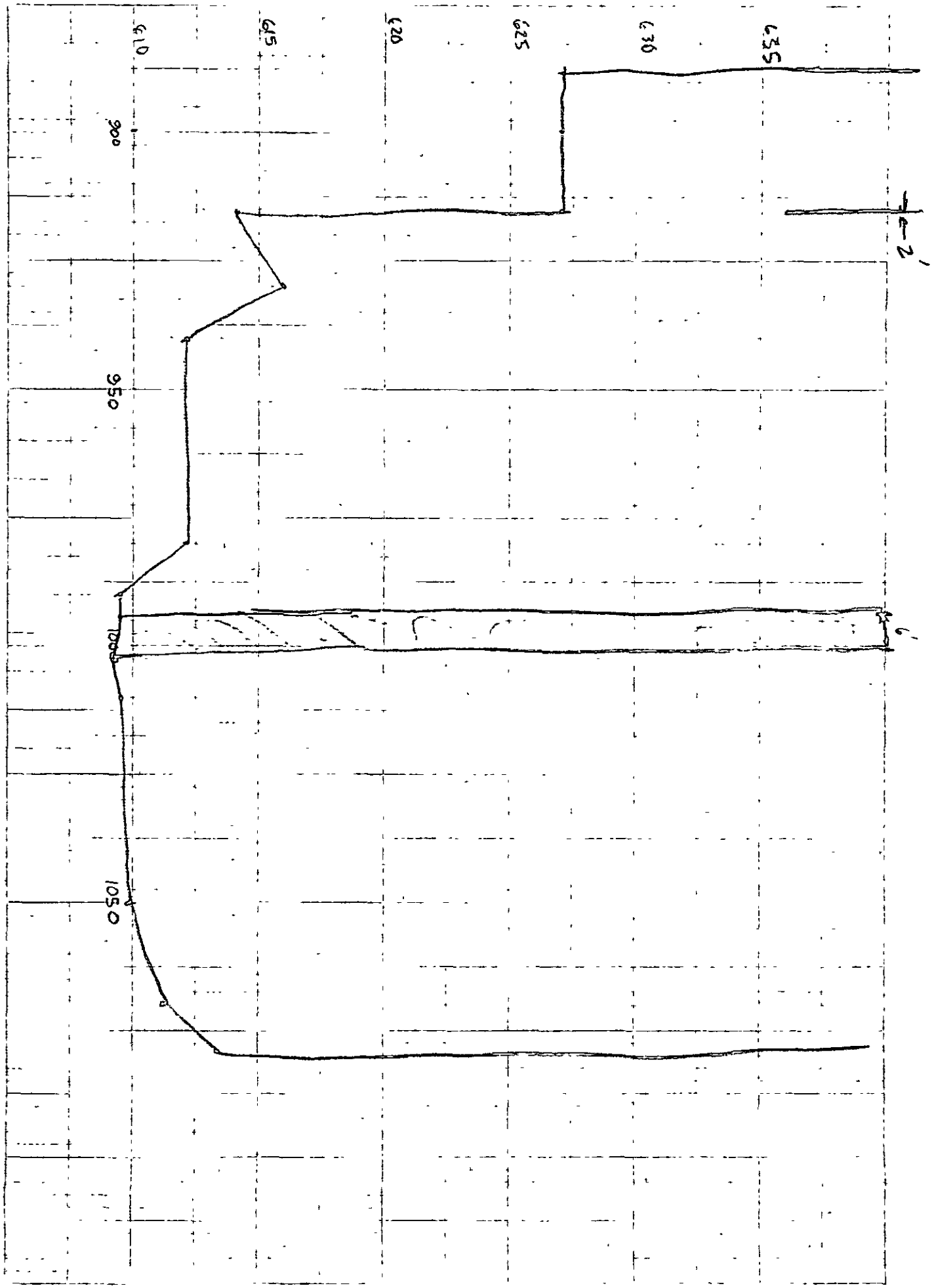
REPLY

SENDER — Retain part 2 for your follow-up, send parts 1 and 3 to addressee
RECIPIENT — Retain part 1 and return part 3

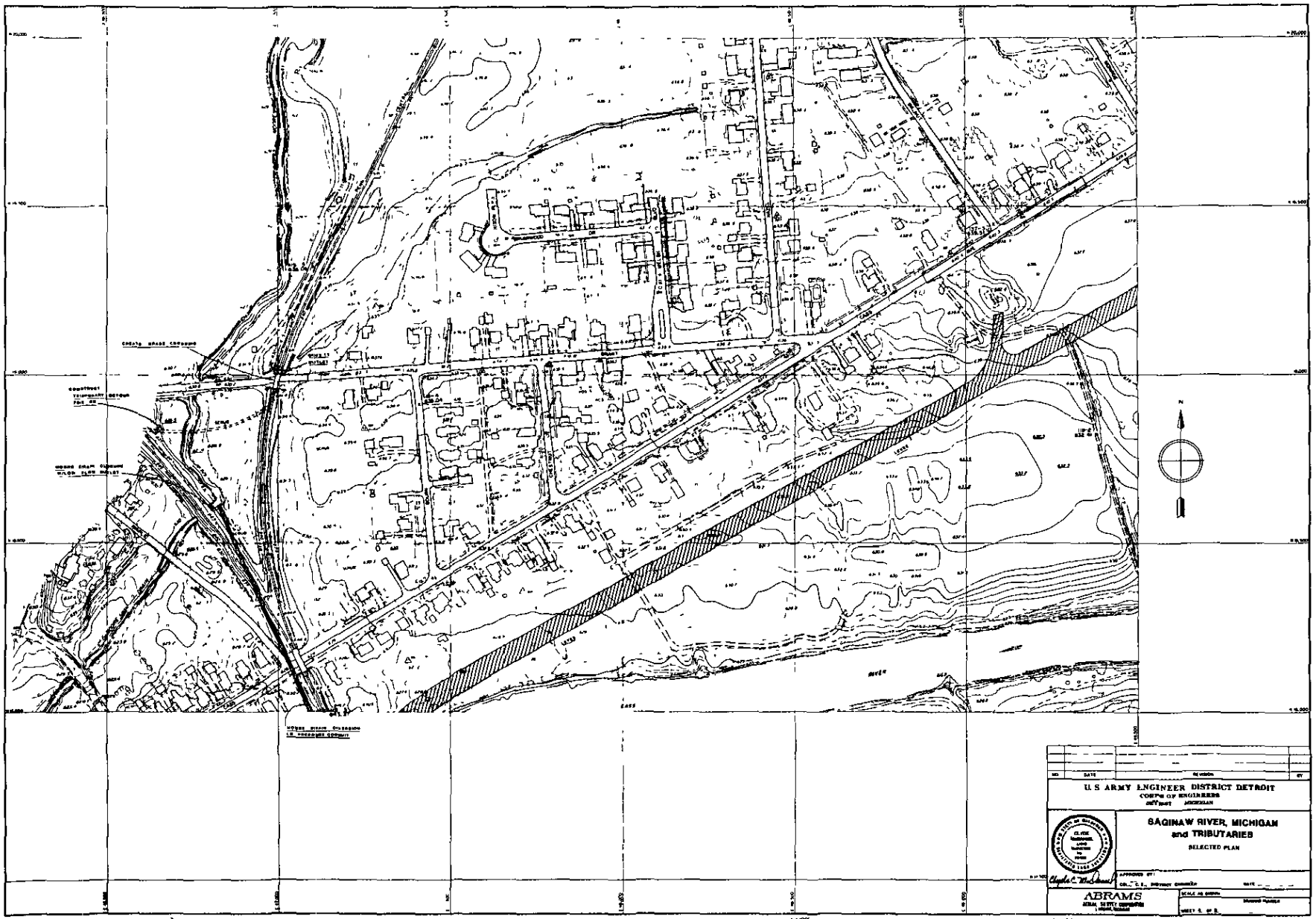

139
8ft
630
626
622
618
614
610
160
140
120
100
80
60
40
20
0
A = 2322 ft²

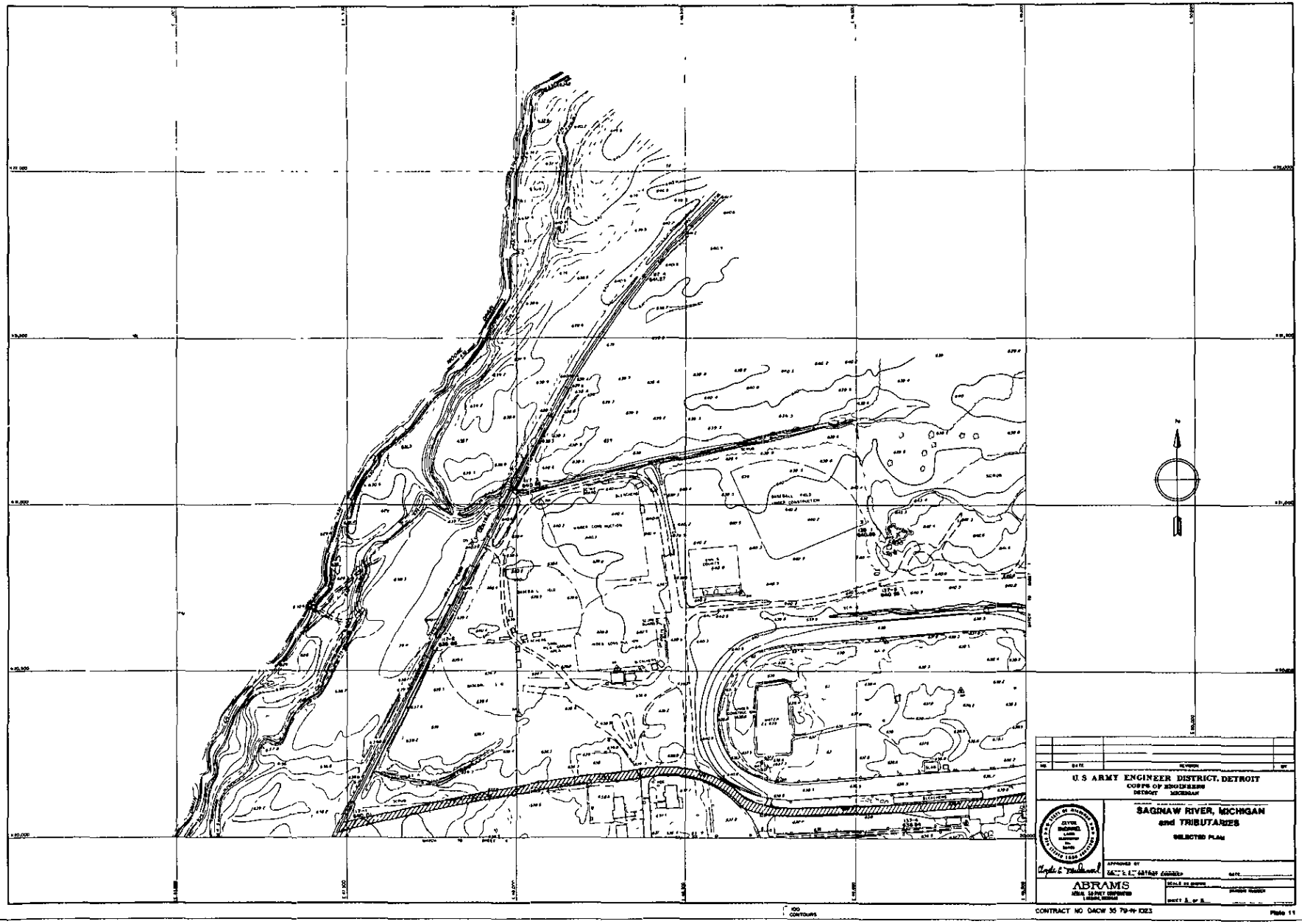
BY_____ DATE _____ SUBJECT _____ SHEET NO. ___ OF ___

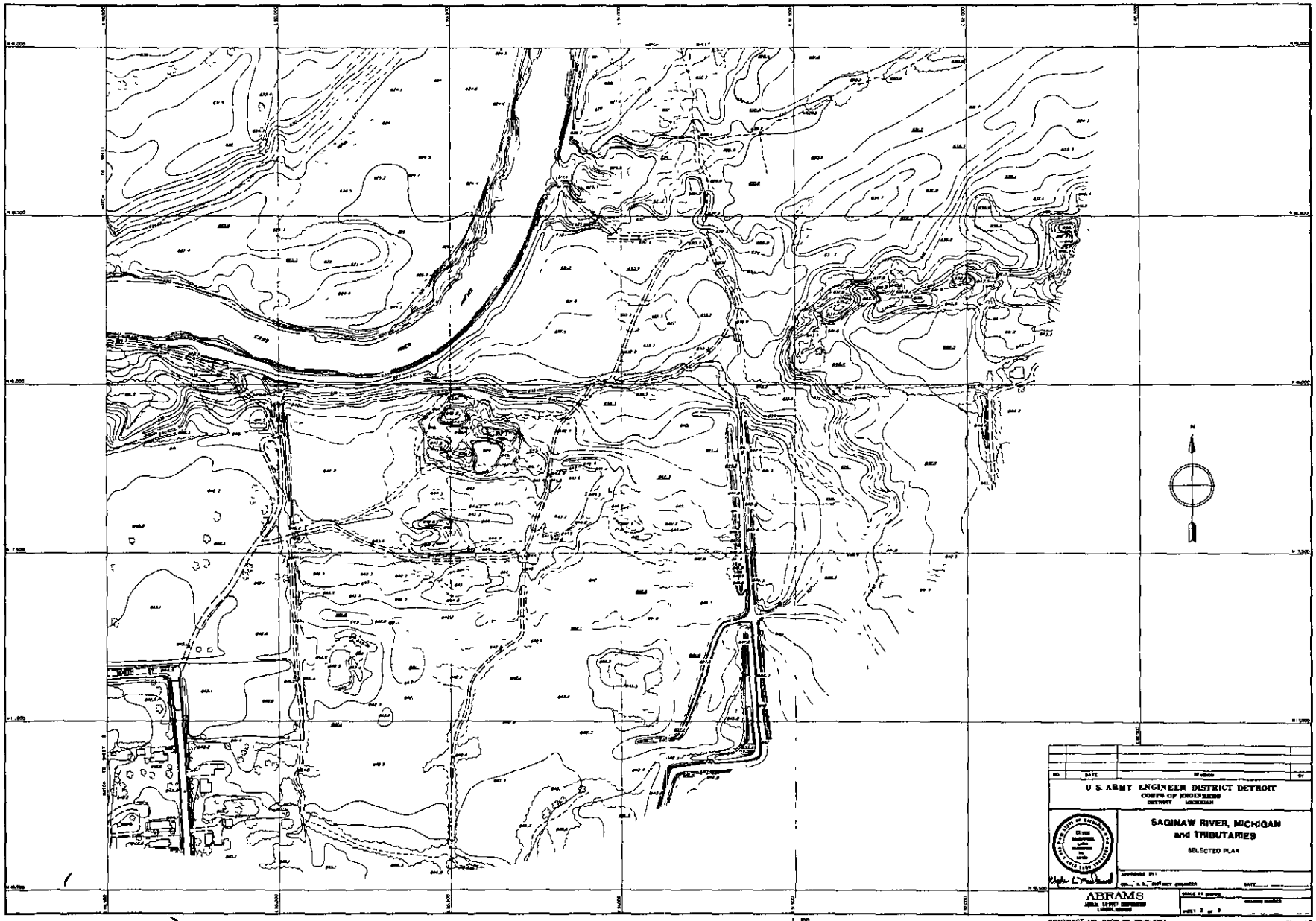
CHKD. _____ DATE _____ FILE NO. _____

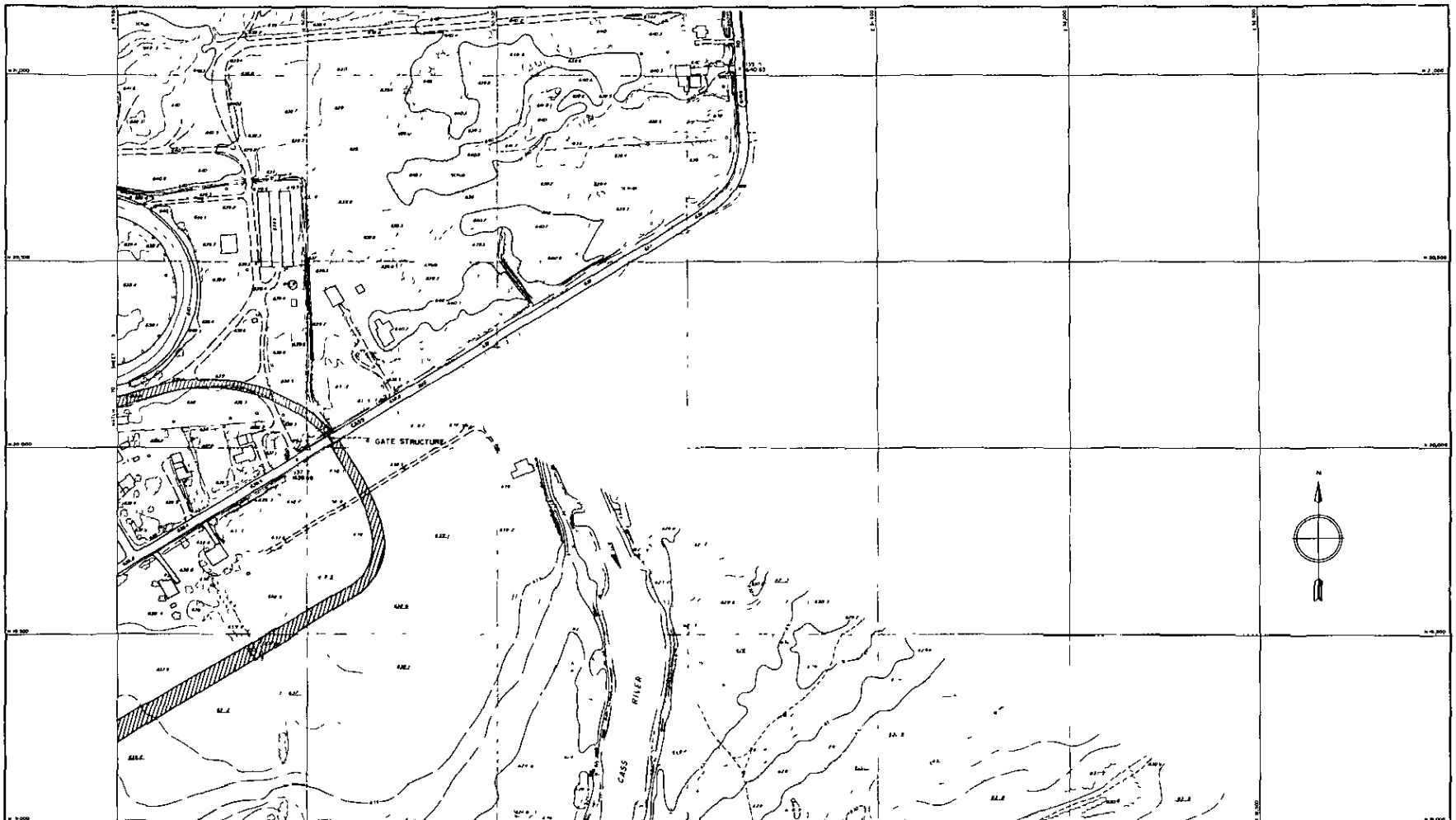


245-0-2


CREATE BRIDGE CROSSING
COUNTY
TEMPORARY DETOUR
FOR
HOUSE DRAIN CROSSING
WILDS SLOW ROUTE
HOUSE DRAIN CROSSING
IN PRESENT CONDITION
N
U.S. ARMY ENGINEER DISTRICT DETROIT
CORPS OF ENGINEERS
DETROIT MICHIGAN
SAGINAW RIVER, MICHIGAN
and TRIBUTARIES
SELECTED PLAN
APPROVED BY
COL. C.E. DISTRICT ENGINEER
DATE
ABRAMS
SCALE AS SHOWN
SHEET 5 OF 8
CONTRACT NO DACW-35 78-M-0323
Plate 12


GRID BASED ON LOCAL COORDINATE SYSTEM
ELEVATIONS BASED ON MEAN SEA LEVEL DATUM
DATE OF PHOTOGRAPHY NOV 4 1977
BASEBALL FIELD
UNDER CONSTRUCTION
100 CONTOURS
U.S. ARMY ENGINEER DISTRICT, DETROIT
CORPS OF ENGINEERS
DETROIT MICHIGAN
SAGINAW RIVER, MICHIGAN
and TRIBUTARIES
SELECTED PLAN
ABRAMS
CONTRACT NO DACW 35 79-R-0023
Plate 11


N
U.S. ARMY ENGINEER DISTRICT DETROIT
CORPS OF ENGINEERS
DETROIT
MICHIGAN
SAGINAW RIVER, MICHIGAN
and TRIBUTARIES
SELECTED PLAN
ABRAMS
CONTRACT NO DACW-35 79-N-1023
Plate 10



GRID BASED ON LOCAL COORDINATE SYSTEM
ELEVATIONS BASED ON MEAN SEA LEVEL DATUM
DATE OF PHOTOGRAPHY NOV 4 1977

NO.	DATE	REVISION	BY

U S ARMY ENGINEER DISTRICT DETROIT
CORPS OF ENGINEERS
DETROIT MICHIGAN

SAGINAW RIVER, MICHIGAN and TRIBUTARIES

SELECTED PLAN

APPROVED BY:
COL., C.E., DISTRICT ENGINEER — DATE

ABRAMS
AERIAL SURVEY CORPORATION
LANSING, MICHIGAN

SCALE AS SHOWN

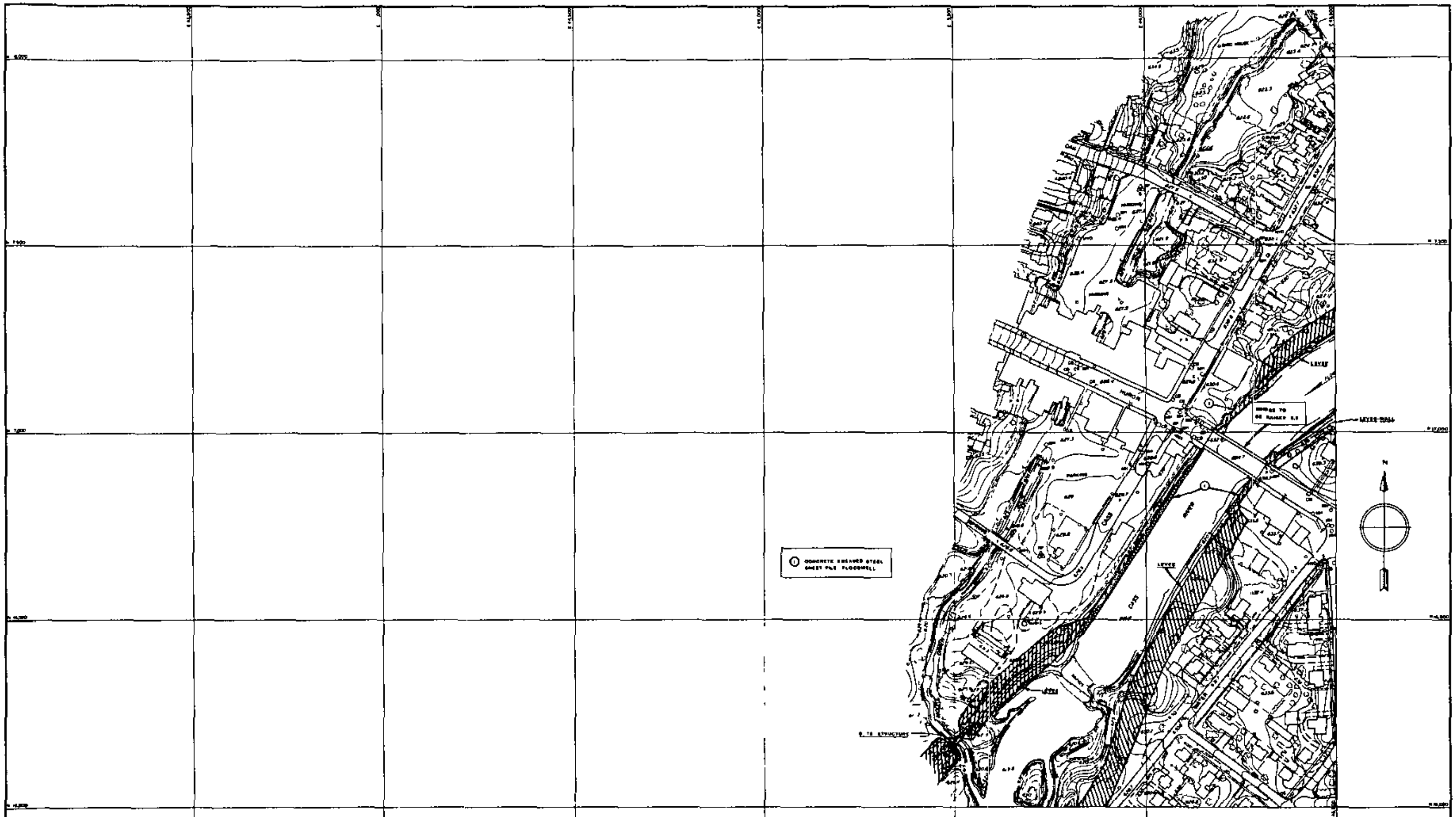
SHEET 1 OF 5

1 CONTOURS

CONTRACT NO DACW-35-79-N-1023

Plate 5

A-4.8.6 4078



GRID BASED ON LOCAL COORDINATE SYSTEM
ELEVATIONS BASED ON MEAN SEA LEVEL DATUM
DATE OF PHOTOGRAPHY NOV 4 1977

NO	DATE	REVISION	BY

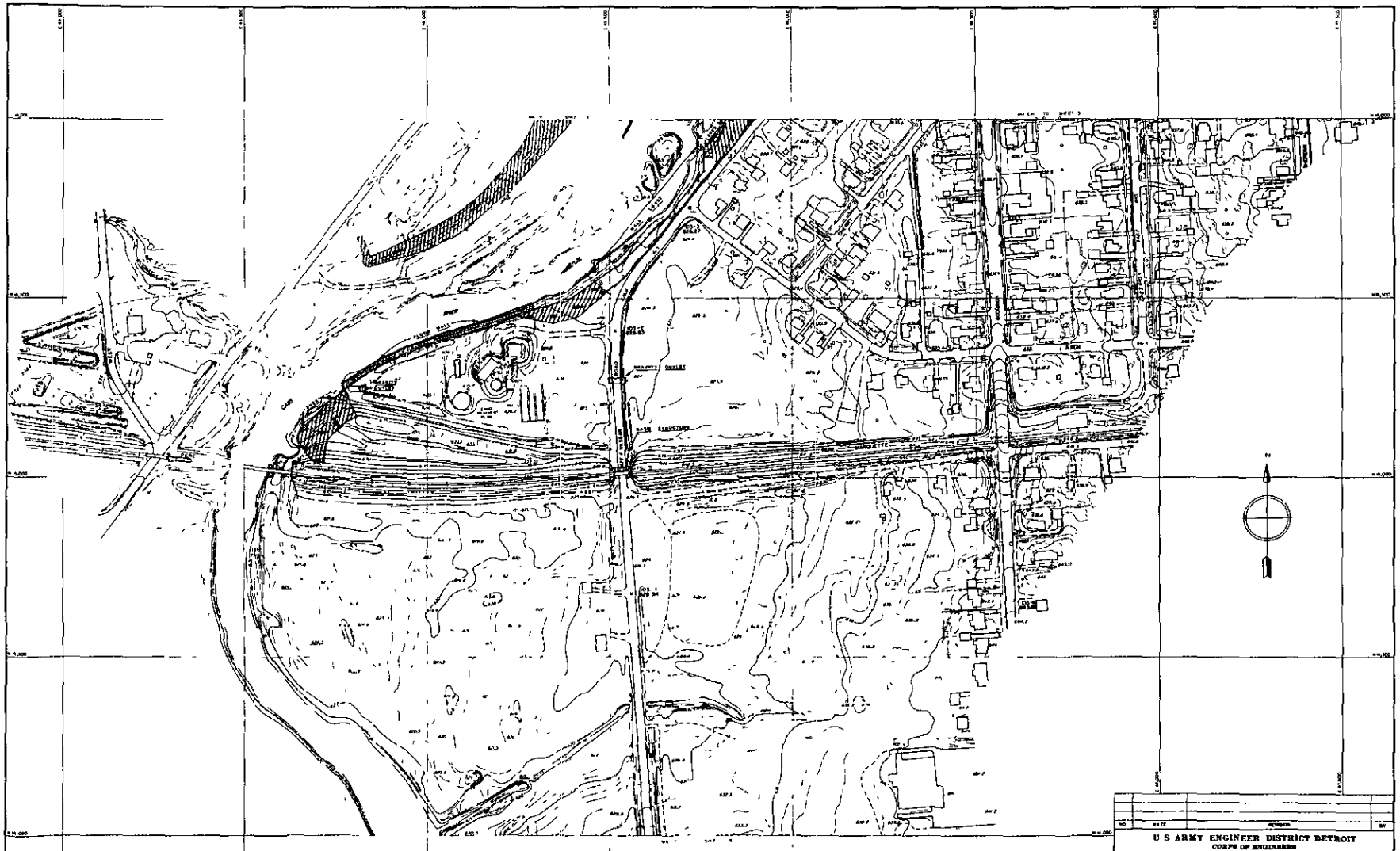
U S ARMY ENGINEER DISTRICT DETROIT
CORPS OF ENGINEERS
DETROIT MICHIGAN

SAGINAW RIVER, MICHIGAN
and TRIBUTARIES
SELECTED PLAN

ABRAMS

CONTRACT NO. DACW-35-79-M-0023

Plate 14



NOTE: 1 FOOT CONTOURS

U S ARMY ENGINEER DISTRICT DETROIT
CORPS OF ENGINEERS
DETROIT MICHIGAN

SAGINAW RIVER, MICHIGAN
and TRIBUTARIES

SELECTED PLAN

APPROVED BY
CHIEF, C.E. DISTRICT ENGINEER DATE

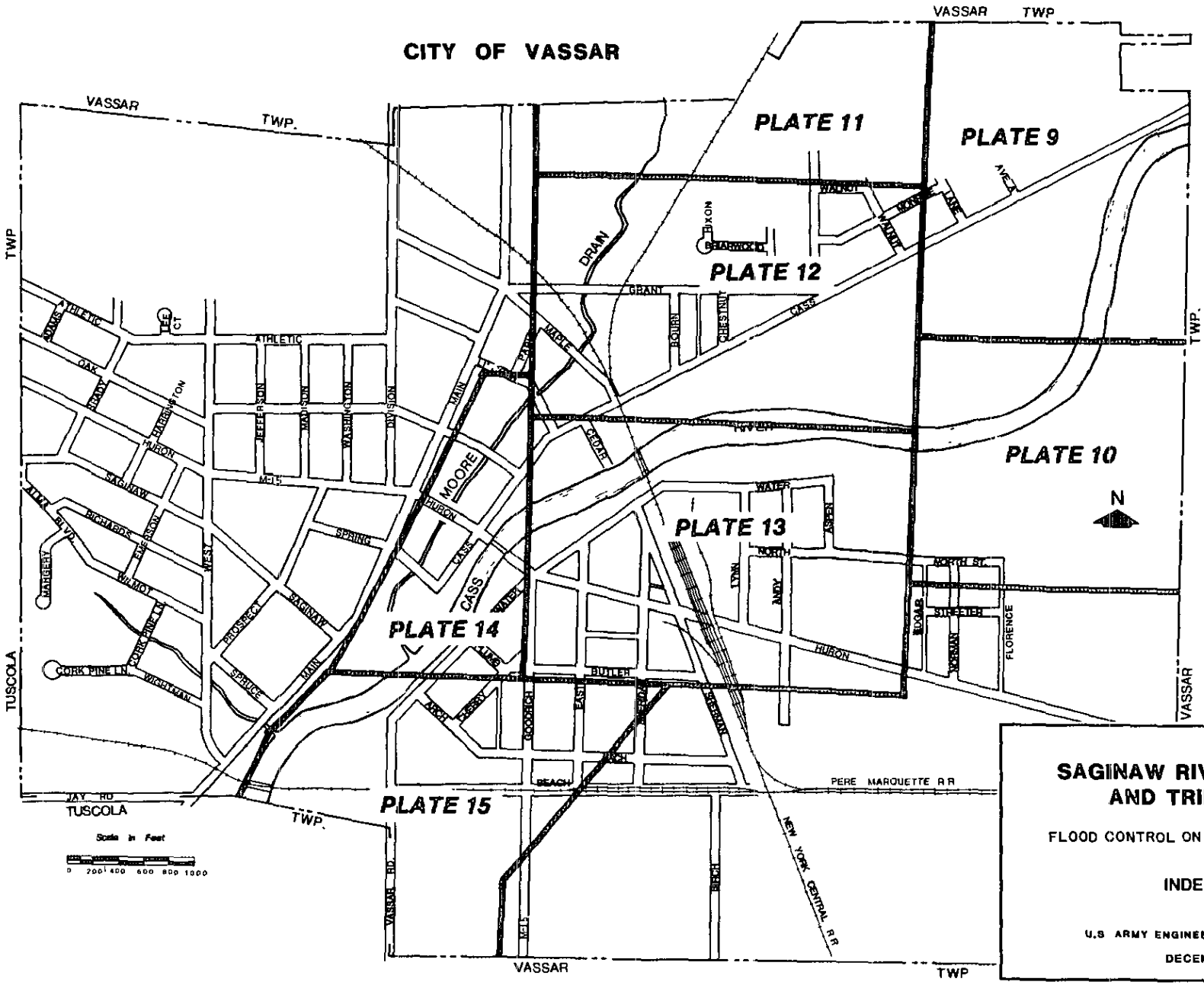
ABRAMS
NAVAL DISTRICT ENGINEER
LAKE HURON

SCALE AS SHOWN
SHEET 7 OF 8
DRAWING NUMBER

CONTRACT NO DACW 35-79-M-1023

Plate 18

A.A.B.C. 10-1950



SAGINAW RIVER, MICHIGAN AND TRIBUTARIES

FLOOD CONTROL ON CASS RIVER AT VASSAR

INDEX MAP

U.S. ARMY ENGINEER DISTRICT, DETROIT

DECEMBER 1982

CORPS OF ENGINEERS

U. S. ARMY

TYPICAL CROSS-SECTION

TYPICAL DIKE SECTION

1942 FLOOD LINE

CASS RIVER

DRIVING TRACK

PROFILES FROM C.S. 78+50 TO C.S. 154+00

DISTANCE ALONG CENTERLINE IN HUNDRED FOOT STATIONS

LOG OF BORINGS

AUTHORIZED PLAN

SAGINAW RIVER, MICH., AND TRIBUTARIES

FLOOD CONTROL ON CASS RIVER AT VASSAR

PLAN & PROFILES

Sheet 4 of 30 Sheets — Scale As Shown

Corps of Engineers, Detroit District — 18 January 1954

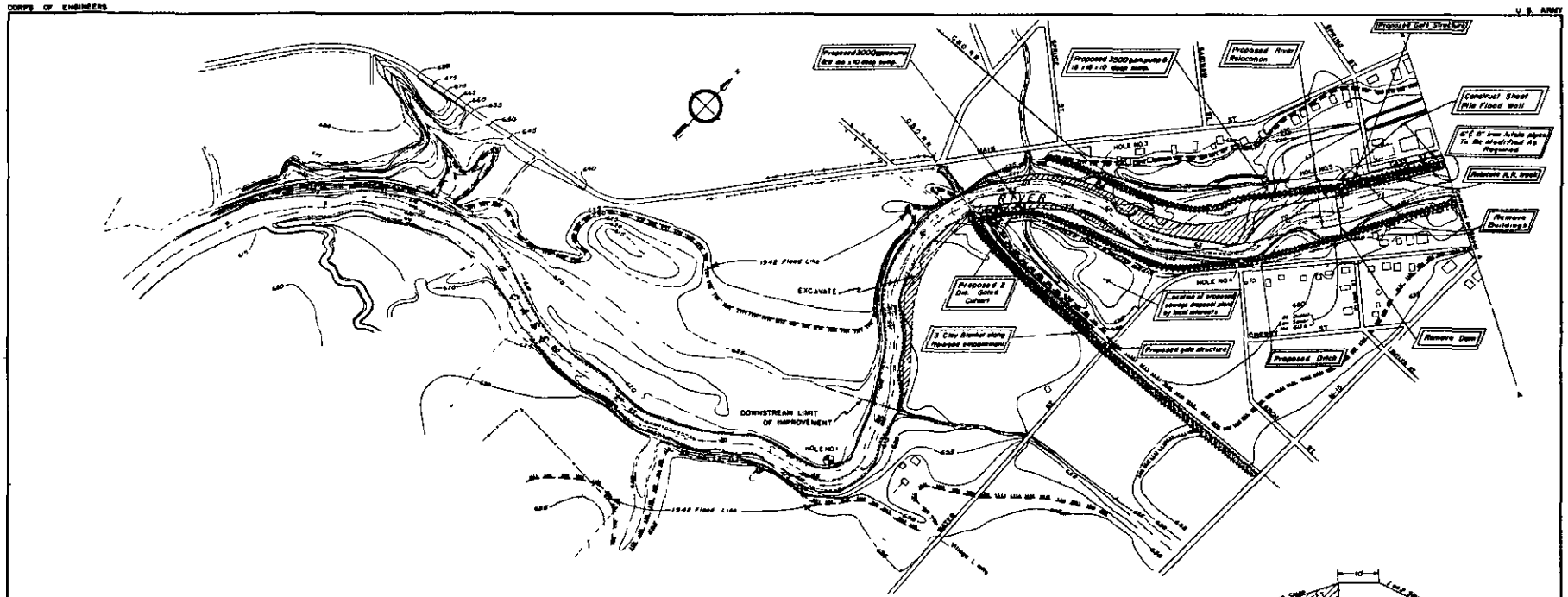
Submitted: Chief, Engineering Division — Approved: Col. C.E. District Engineer

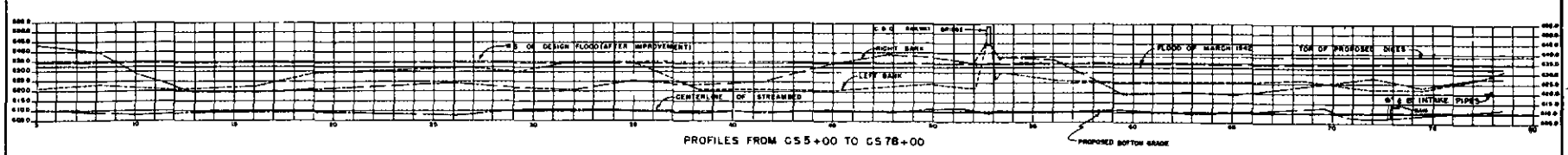
Drawn by R.L.P. — File No. To Accompany Survey Report

Checked by A.K. — Dated 15 January 1954

Plate 7

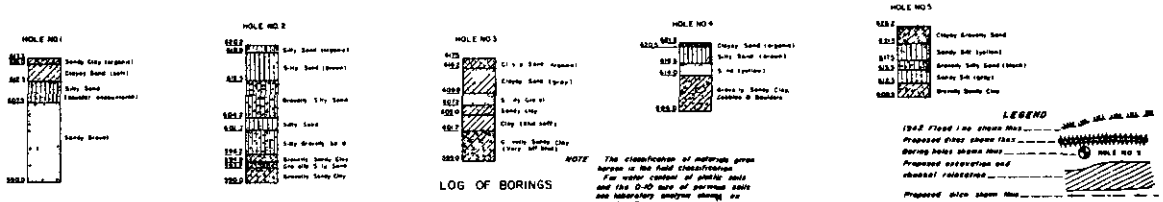
CORPS OF ENGINEERS — U. S. ARMY





PROFILES FROM CS 5+00 TO CS 78+00

AUTHORIZED PLAN



LOG OF BORINGS

NOTE: The classification of materials given herein is the field classification. For water content of plastic soils and the 0-10 size of pervious soils see laboratory analysis sheets, as appropriate.

SAGINAW RIVER, MICH., AND TRIBUTARIES
FLOOD CONTROL ON CASS RIVER AT VASSAR
PLAN & PROFILES

16 20 Sheets	Sheet 9	Scale As Shown

Scale of Feet

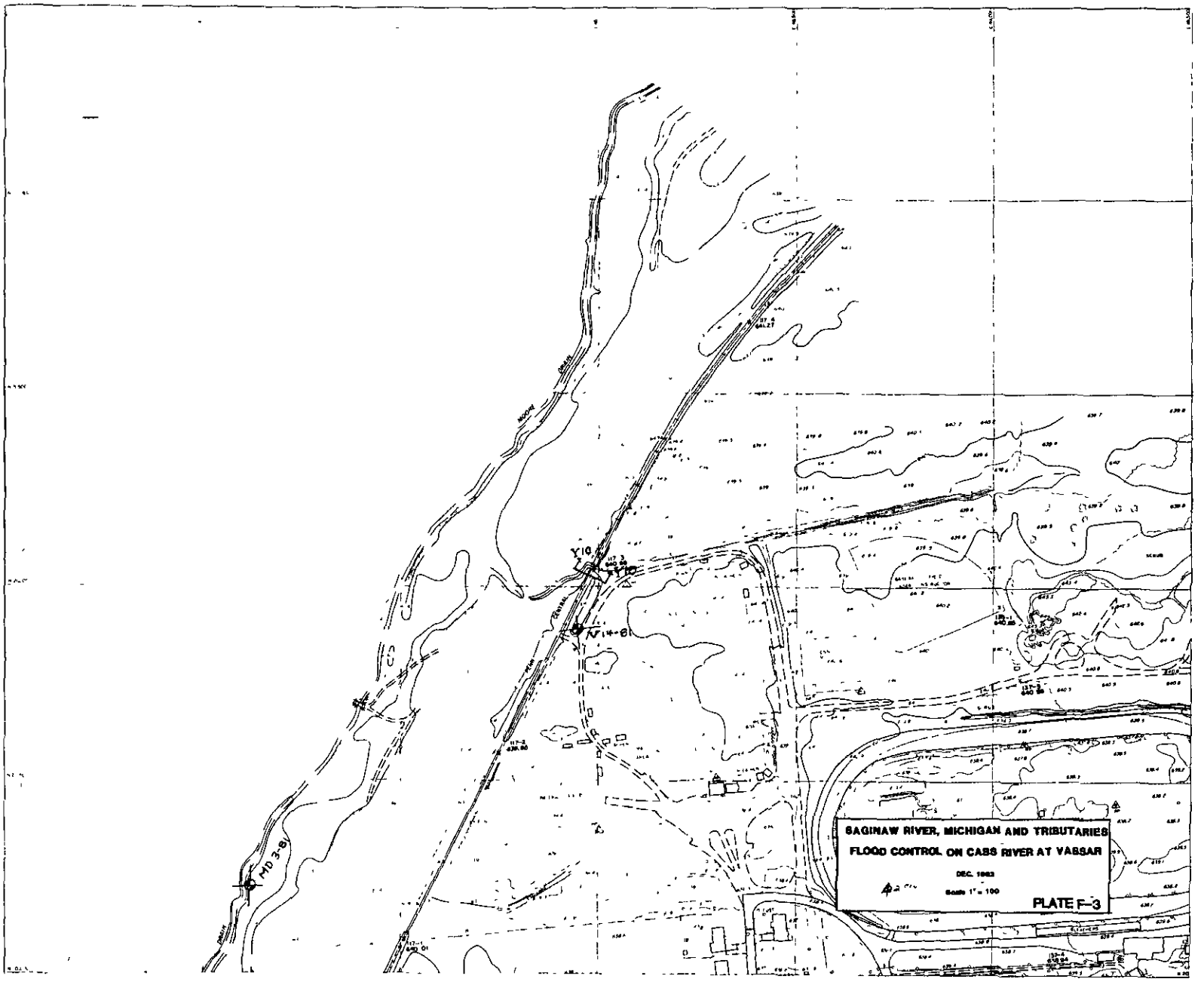
Corps of Engineers, Detroit District — 15 January 1954

Submitted: Chief, Engineering Division — Approved: Col., C.E. District Engineer

Drawn by R.J.P. — File No. — To Accompany Survey Report

Checked by A.K. — D Sog 12/100 — Dated 15 January 1954

Plate 6


SAGINAW RIVER, MICHIGAN AND TRIBUTARIES
FLOOD CONTROL ON CASS RIVER AT VASSAR
DEC. 1963
Scale 1" = 100
PLATE F-3

RELATIVE DENSITY & CONSISTENCY TABLE		
SAND, SILT RELATIVE DENSITY		
NO. OF BLOWS REQ'D TO DRIVE A SAMPLE 1 FT. USING 140" HAMMER FALLING 30"	2" O.D. SAMPLER (STD PEN.)	
SAMPLE DESCRIPTION		
VERY LOOSE	<4	
LOOSE	4 - 10	
MEDIUM DENSE	10 - 30	
DENSE	30 - 50	
VERY DENSE	>50	
CONSISTENCY CLAY		
NO. OF BLOWS REQ'D TO DRIVE A SAMPLE 1 FT USING 140" HAMMER FALLING 30"	2" O.D. SAMPLER (STD PEN.)	
VERY SOFT	<2	
SOFT	2 - 4	
MEDIUM STIFF	4 - 8	
STIFF	8 - 15	
VERY STIFF	15 - 30	
HARD	>30	

635.8 58,400
604.8

.000468 ~61000

Cass River
City of Vassar

167
612.38
629 08

1986 Stage : 24.8
Datum = 612.38
637.18

1948 Stage 20.8
612.38
633.18 (18,000)

635.9
635.1
635.0

Frankenmuth 20.88
Datum 583.96
604.84

16.5 @ 11,300
612.38
628.88

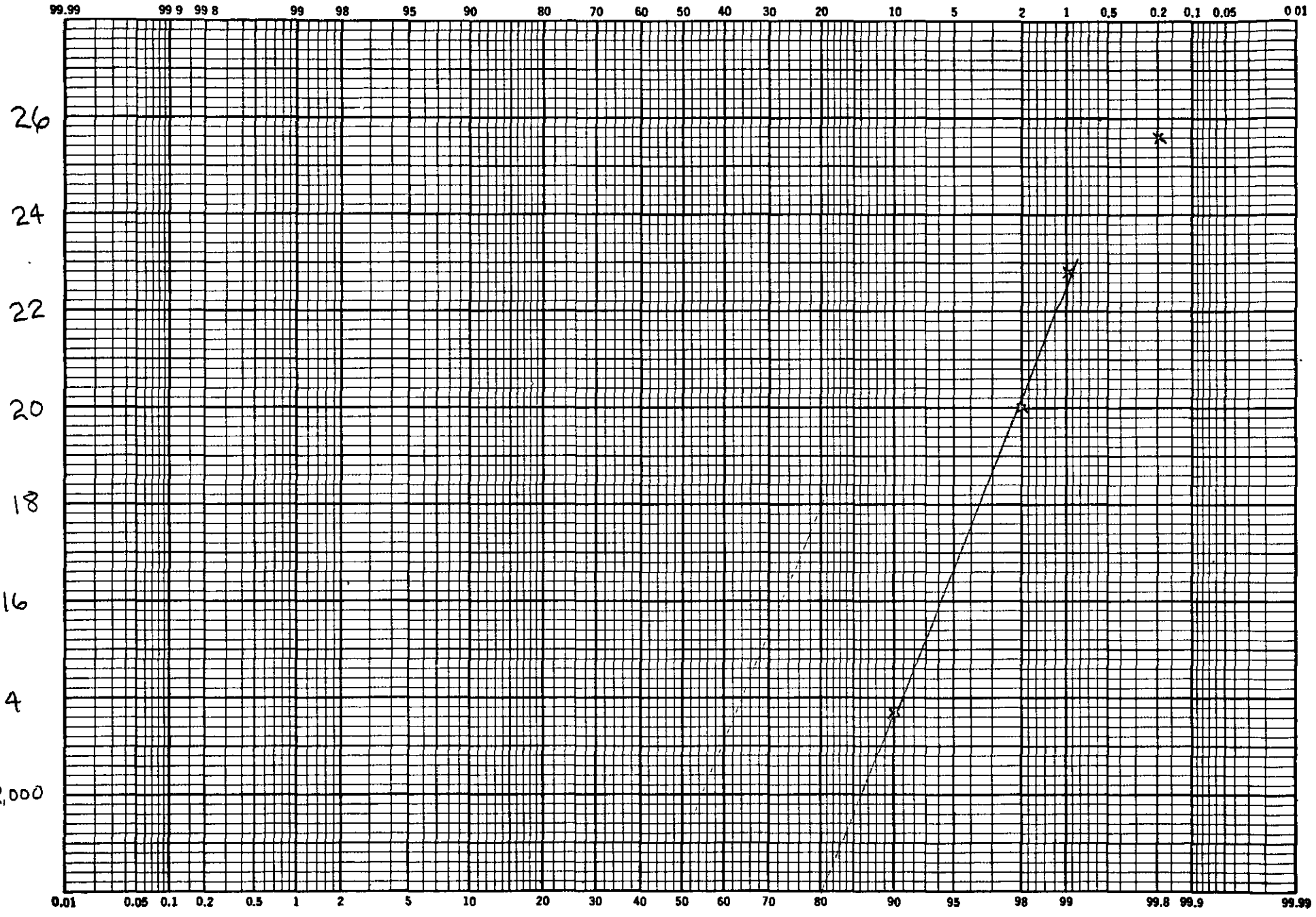
Using .00034 slope - not able to match previous HWM's, based on spring flows

S_o = .00034 630.5
S_o = .000468 629.6
HWM 628.88

1942 Flood slope per COE report
632.4

PROBABILITY X 90 DIVISIONS

R 4505



STATION 04150500 CASS RIVER AT CASS CITY, MICH.

AGENCY: USGS
STATE: 26
COUNTY: 157
DISTRICT: 26

STATION LOCATOR
LAT. LONG
433503 0831034

DRAINAGE AREA 359 00 SQ MI
CONTRIBUTING DRAINAGE AREA: SQ MI
GAGE DATUM: 697 92 (NGVD)
BASE DISCHARGE 1400 00 CFS

WATER YEAR	DATE	PEAK DISCHARGE (CFS)	DISCHARGE CODES	GAGE HEIGHT (FT)	GAGE HT CODES	HIGHEST SINCE	MAX GAGE HEIGHT (FT)	DATE	GAGE HT CODES	NUMBER OF PARTIAL PEAKS
1948	03/20/48	8460.00		15.80						0
1949	02/15/49	2740.00		10.58						1
	04/01/49	1850.00								
1950	03/28/50	7250 00		14 31						0
1951	02/27/51	4150.00		12.05						0
1952	03/11/52	3300.00		11.21						0
1953	05/03/53	2510.00		9.71	2		10.42	03/04/53	1	2
	03/04/53	2200.00	2	10.42						
	03/16/53	2430.00		9.62						
1954	03/26/54	4240.00		11.85						5
	02/16/54	3150.00		10.54						
	02/21/54	3710 00		11.23						
	03/01/54	1430.00		8.19						
	03/20/54	2060 00		9.08						
	04/27/54	2060.00		9.00						
1955	03/11/55	2990.00		10 29						5
	12/29/54	1710.00		8.59						
	01/06/55	1990 00		8.95						
	02/23/55	1500.00	2	8 70						
	03/04/55	1600.00		8.46						
	03/22/55	1430.00		8.21						
1956	03/07/56	3710.00		11.19						5
	04/03/56	1500.00		8 32						
	04/30/56	2830.00		10.13						
	05/06/56	3310.00		10 71						
	05/10/56	3150.00		10 47						
	05/13/56	2990.00		10 28						
1957	04/07/57	1710.00		8.60	2		9 87	02/26/57	1	2
	02/26/57	1400.00	2							
	04/28/57	1500.00		8 30						
1958	03/05/58	1280.00		7.99	2		9.02	03/03/58	1	0
1959	04/04/59	3900.00		11.58						1
	03/26/59	2800.00	2							
1960	03/31/60	6810.00		14.41						3
	12/13/59	1430.00		8.43						
	12/29/59	2260 00		9.60						
	05/31/60	1420.00		8.34						
1961	09/27/61	1400.00		8.80	2		9 00	02/24/61	1	0
1962	03/18/62	3980 00		11 67						1
	05/03/62	1990 00		9 22						
1963	03/26/63	3170.00		10 76						0
1964	04/07/64	236.00		5 82						0
1965	04/08/65	4820 00		12.52	2		12 63	02/10/65	1	2
	02/10/65	1500 00		12 63	1					
	03/06/65	1500 00		11.28						
1966	03/04/66	2170.00		9.47						1

	03/24/66	2130.00		9.42					
1967	03/28/67	8280.00		15.39					7
	12/09/66	1600.00		8.63					
	04/03/67	2970.00		10.51					
	04/07/67	1660.00		8.73					
	04/17/67	3830.00		11.50					
	04/22/67	1870.00		9.04					
	06/18/67	1430.00		8 66					
	06/22/67	1410 00		8 65					
1968	02/02/68	6400.00		14 83					6
	11/04/67	1440 00		8.49					
	12/12/67	3000 00		10.55					
	12/22/67	2630.00		10.09					
	03/27/68	4500.00		12.20					
	03/29/68	1410.00		8.35					
	06/27/68	2190.00		9.56					
1969	05/10/69	4020.00		11.71					2
	04/05/69	1870.00		9.04					
	04/18/69	1510.00		8.48					
1970	04/22/70	2080 00		9 44					2
	04/09/70	1830 00		9 16					
	07/11/70	1710.00		8 94					
1971	03/16/71	5160.00		12 86					2
	03/01/71	2600.00	2						
	04/02/71	1560.00		8 56					
1972	03/22/72	5480.00		13 18					1
	04/17/72	3430 00		11 06					
1973	04/02/73	4870 00		12.57	2	13 81	01/01/73	1	8
	01/01/73	4700 00		13.81					
	01/19/73	1450.00		9 21					
	03/06/73	2100.00		10 18					
	03/15/73	3050.00		12 50					
	03/25/73	2460 00		9 88					
	05/09/73	1660.00		8.76					
	05/29/73	1770.00		9 00					
	06/29/73	1650.00		8 83					
1974	03/05/74	5960.00		13 64					5
	12/28/73	1630 00		8.69					
	01/27/74	4350.00		12.05					
	02/24/74	1800.00							
	04/04/74	4620.00		12.38					
	05/17/74	4730 00		12.43					
1975	04/19/75	5460 00		13.16					4
	02/20/75	2000.00		10.55					
	03/25/75	3600.00		11 24					
	04/14/75	1760.00		8 89					
	06/06/75	1570.00		8 71					
1976	03/06/76	6810.00		14 37					8
	12/15/75	3090.00		10.66					
	02/20/76	2700.00							
	02/27/76	3120 00							
	03/13/76	3980 00		11 67					
	03/21/76	3720.00							
	03/28/76	1560 00							
	04/26/76	2850.00		10 36					
	05/07/76	3520 00		11.16					
1977	03/10/77	1610 00		8 85	1				1
	03/13/77	1410.00		8.32					
1978	03/24/78	4570 00		12.51	1				4
	12/02/77	1780 00							

	03/29/78	3440 00	11 07					
	04/01/78	3260 00	10.87					
	04/05/78	3020.00	10.58					
1979	04/14/79	3640.00	11 27	2	12 11	03/05/79	1	1
	03/05/79	1970 00	12 11	1				
1980	03/18/80	2910 00	10 44					3
	12/26/79	1740.00	8.86					
	04/04/80	2020.00	9.28					
	04/15/80	2160 00	9 51					
1981	09/05/81	4400 00	13.00					5
	02/20/81	3460 00	11 09					
	03/01/81	1420.00	8 33					
	04/29/81	1470 00	8.50					
	05/12/81	3090.00	10.76					
	09/28/81	2370.00	10.42					
1982	03/31/82	5030.00	13 32					4
	10/02/81	3640 00	12 10					
	10/07/81	1500.00	8.99					
	03/15/82	4520.00						
	06/02/82	2280 00	10 31					
1983	04/15/83	2980 00	10.53					3
	12/26/82	1470.00	8.42					
	03/29/83	1540 00	8.85					
	05/03/83	2320 00	9.68					
1984	06/18/84	5080 00	13.27					8
	11/17/83	1560.00	8 91					
	12/13/83	1820 00	9.34					
	02/14/84	4500 00	12 20					
	03/17/84	2540.00	9 97					
	03/22/84	3450.00	11 08					
	03/26/84	1960 00	9 17					
	04/18/84	2000.00	9.25					
	05/26/84	1960.00	9 54					
1985	04/06/85	8650.00	15 61					7
	11/12/84	1610 00	9.10					
	11/16/84	2000 00	9.72					
	12/22/84	1460 00	8 42					
	12/30/84	4940.00	12 65					
	02/28/85	4490.00	12 19					
	03/12/85	5720.00	13 41					
	03/29/85	4840 00	12 54					

STATION 04151500 CASS RIVER AT FRANKENMUTH, MICH

AGENCY.	USGS	STATION LOCATOR		DRAINAGE AREA:	841 00 SQ MI
STATE:	26	LAT	LONG	CONTRIBUTING DRAINAGE AREA	SQ MI
COUNTY:	145				
DISTRICT	26	431940	0834453	GAGE DATUM:	583.96 (NGVD)
				BASE DISCHARGE:	3500.00 CFS

WATER YEAR	DATE	PEAK DISCHARGE (CFS)	DISCHARGE CODES	GAGE HEIGHT (FT)	GAGE HT CODES	HIGHEST SINCE	MAX GAGE HEIGHT (FT)	DATE	GAGE HT CODES	NUMBER OF PARTIAL PEAKS
1908	03/16/08	9550 00	7							0
1936	03/13/36	3200.00	7							0
1940	04/01/40	5650 00								0
1941	12/30/40	2600.00								0
1942	03/18/42	17700 00								0
1943	03/16/43	16100.00								2
	05/12/43	5420 00								
	06/03/43	4730 00								
1944	02/28/44	5180 00								0
1945	06/03/45	7360 00								0
1946	03/08/46	11800 00								0
1947	04/06/47	15400 00								0
1948	03/20/48	17600 00								1
	04/01/48	3900 00								
1949	02/16/49	5290 00								0
1950	03/28/50	12500.00		21.00						4
	01/26/50	3920.00								
	03/09/50	5600 00								
	04/05/50	12100 00								
	07/18/50	6000 00								
1951	02/21/51	8000.00		18.98	1					7
	12/04/50	5600 00		16.44						
	12/08/50	4640 00								
	01/04/51	5500 00		16 33						
	02/27/51	7000 00	2							
	03/05/51	3800 00		14.04						
	04/23/51	3620 00		13.71						
	04/26/51	4400 00		15.02						
1952	03/12/52	7100 00		20 03	1					5
	01/18/52	4500 00	2							
	02/05/52	8500.00	2							
	03/20/52	4040.00		14.37						
	04/08/52	5200.00		16.02						
	04/14/52	6500.00		17.15						
1953	05/03/53	5900 00		16 70						2
	03/05/53	4100 00	2	15 70						
	03/16/53	4340 00		14.90						
1954	03/26/54	8000.00		18 21	2		22 44	02/17/54	1	4
	02/17/54	7500 00	2	22.44	1					
	02/22/54	7100.00		17 63						
	03/20/54	3800 00		14.04						
	04/28/54	4800.00		15.50						
1955	03/12/55	4800.00		15 51						2
	01/07/55	3500 00		13.53						
	03/04/55	3680 00		13.80						
1956	03/08/56	8000.00	2	18 73	1					4

	04/30/56	5200 00		16 04					
	05/07/56	7550.00		17.90					
	05/11/56	6500 00		17.22					
	05/13/56	6800.00		17.38					
1957	02/27/57	3400.00		13.34	2	13 68	02/26/57	1	0
1958	03/05/58	2760 00		12 11	2	12 34	03/01/58	1	0
1959	04/03/59	8560 00		18.77					1
	03/26/59	6000.00	2						
1960	04/01/60	11900 00		21 00					1
	12/29/59	4320 00		14 86					
1961	09/27/61	2590 00		11 78					0
1962	03/20/62	8870 00		19 64					1
	05/03/62	4610.00		15.51					
1963	03/26/63	5290.00		16 32					0
1964	05/01/64	615 00		6 50					0
1965	04/09/65	7330.00		18 36					2
	02/12/65	5000 00		18 22					
	03/07/65	6300 00		18 33					
1966	03/25/66	3440.00		13.74	2	13.91	03/05/66	1	0
1967	03/29/67	11000 00		20.60					3
	04/04/67	4680 00		15 60					
	04/18/67	6220.00		17 32					
	04/23/67	3840 00		14.40					
1968	02/03/68	11000.00		23 37	1				4
	12/13/67	5040 00		16 04					
	12/23/67	3860.00		14 44					
	03/28/68	7780 00		18 71					
	06/28/68	3600.00		14.00					
1969	05/11/69	6960 00		18 40					0
1970	07/12/70	6300 00		17.40					0
1971	03/17/71	8460 00		19 16					1
	03/01/71	5200 00		18 06					
1972	03/23/72	7510 00		18 50					1
	04/18/72	4700 00		15 62					
1973	01/02/73	7200 00		20 31					4
	03/07/73	4580.00		15.48					
	03/16/73	6830 00		17 93					
	04/03/73	7060 00		18 13					
	05/30/73	3520.00		13 87					
1974	03/06/74	8920 00		19 44					3
	01/28/74	6340 00		17 44					
	04/05/74	6040 00		17 14					
	05/18/74	6400 00		17 50					
1975	04/20/75	7910 00		18 80					2
	02/25/75	3950.00		15 66					
	03/26/75	5470 00		16 52					
1976	03/06/76	13700 00		22.83					8
	12/16/75	4820 00		15 78					
	02/21/76	5620.00							
	02/28/76	5790 00		16 88					
	03/14/76	6920.00		18 02					
	03/22/76	7300.00		18 33					
	03/28/76	4140 00		14 90					
	04/27/76	5920 00		17.26					
	05/08/76	6090 00		17 57					
1977	09/19/77	3400 00		13.72					0
1978	03/25/78	8090 00		18 92					3
	03/30/78	5610 00		16 68					
	04/02/78	5380 00		16 42					
	04/05/78	4810 00		15 76					

1979	03/06/79	5930 00	18 43	1				1
	04/15/79	4980 00	15 97					
1980	04/16/80	4050 00	14 75					0
1981	09/06/81	8320.00	19.79					3
	02/20/81	7650 00	18.60					
	05/12/81	5930 00	17.02					
	09/28/81	4640.00	16 25					
1982	03/17/82	8860 00			20 96	03/16/82	1	2
	10/03/81	6420 00	18.63					
	04/01/82	7900 00	18 79					
1983	04/16/83	5180 00	15 80					1
	05/03/83	4500.00	15 01					
1984	06/19/84	8720 00	19 20	2	19 37	02/14/84	1	4
	02/14/84	8180 00	19.37	1				
	03/22/84	5590 00	16.26					
	04/18/84	3590 00	13.83					
	05/27/84	3980 00	14 36					
1985	04/07/85	12700 00	22 16					4
	12/31/84	7930 00	18 52					
	02/26/85	10400 00	20 50					
	03/13/85	9820 00	20.08					
	03/30/85	8370 00	18 90					
		≈2,600						

STATION 04151000 CASS RIVER AT VASSAR, MICH.

AGENCY.	USGS	STATION LOCATOR	DRAINAGE AREA:	710.00	SQ MI
STATE·	26	LAT LONG	CONTRIBUTING DRAINAGE AREA:		SQ MI
COUNTY	157				
DISTRICT:	26	432215 0833452	GAGE DATUM:	612.38	(NGVD)
			BASE DISCHARGE	3000.00	CFS

WATER YEAR	DATE	PEAK DISCHARGE (CFS)	DISCHARGE CODES	GAGE HEIGHT (FT)	GAGE HT CODES	HIGHEST SINCE	MAX GAGE HEIGHT (FT)	DATE	GAGE HT CODES	NUMBER OF PARTIAL PEAKS
1948	03/20/48	18000.00		20 80	633.18					0
1949	02/16/49	4930 00		11 64						1
	02/26/49	3010 00								
1950	03/28/50	11300.00		16.60						0
1951	02/21/51	7830 00		14 09						0
1952	03/12/52	6060 00		12 60						0
1953	05/03/53	5150.00		11 70						0
1954	03/26/54	7100.00		13 54						4
	02/17/54	6740 00		13 20						
	02/22/54	5850 00		12.40						
	03/20/54	3620 00		9.90						
	04/28/54	4180 00		10.60						
1955	03/12/55	4340 00		10 80						1
	03/03/55	3000 00	2							
1956	03/08/56	6620 00		13 10						4
	04/30/56	4260 00		10.70						
	05/07/56	5850 00		12.40						
	05/11/56	5050 00		11 60						
	05/13/56	4950.00		11 49						
1957	04/08/57	2560.00		8 40						0
1958	03/06/58	1940 00		7 43	2		7 64	03/05/58	1	0
1959	04/04/59	7400 00		13 75						1
	03/26/59	5350.00		11 72						
1960	04/01/60	11400.00		16 70	629.08					1
	12/29/59	4090 00		10.35						
1961	09/27/61	1800 00		7.50						0
1962	03/20/62	6480.00		12 88						1
	05/03/62	3830 00		9 92						
1963	03/26/63	4630 00		10 92						0
1964	05/01/64	498 00		4.93						0
1965	04/08/65	6680.00		13.08						2
	02/11/65	5480.00		11.87						
	03/06/65	5000.00		12 71						
1966	03/24/66	3110.00		8.94						0
1967	03/29/67	10800.00		16.26	628.64					4
	04/04/67	4110.00		10.01						
	04/18/67	5470 00		11 71						
	04/22/67	3320 00		9.02						
	06/18/67	3160 00		8.79						
1968	02/03/68	8900 00		16.98	1					3
	12/12/67	4350.00		10 31						
	03/27/68	7730 00		14 02						
	06/28/68	3120 00		8.75						
1969	05/11/69	6270.00	[illegible]	12 63						0
1970	07/11/70	5590.00	[illegible]	11 86						1
	04/22/70	3340 00		9.05						

1971	03/17/71	8250 00	3/16	7010	14.42						0
1972	03/23/72	7400.00			13 75						0
1973	04/03/73	6780 00	2/23	7150	13 18	2		15.35	01/02/73	1	0
1974	03/05/74	8800 00			15.74						0
1975	04/20/75	7750 00			14 04						0
1976	03/06/76	11900.00			17 70	630.08					0
1977	03/11/77	2750 00			8 23						0
1978	03/25/78	6820.00			13.22						0
1979	04/15/79	4940.00	2								0
1980	04/16/80	3610 00			9 39						0
1981	09/06/81	8360.00			14 51						0
1982	03/16/82	7920 00			14 17						0
1986		~21000		~636.1	~23.7						

612.38

9-910
(Rev. 2-66)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

Sta. No. 4-1510

Rating table for Cass River at Vassar, Mich.

from June 28, 1968 to ....., from ..... to ....., from ..... to .....

Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs
3.00	30	10	5.00	770	50	7.00	1890	70	9.00	3300	80	11.00	4900	80	13.00	6600	100	15.00	9000	140
.10	40	12	.10	820		.10	1960		.10	3380		.10	4980		.10	6700		.10	9140	
.20	52	18	.20	870		.20	2030		.20	3460		.20	5060		.20	6800		.20	9280	
.30	70	22	.30	920		.30	2100		.30	3540		.30	5140		.30	6900		.30	9420	
.40	92	24	.40	970		.40	2170		.40	3620		.40	5220		.40	7000	100	.40	9560	
.50	116	32	.50	1020		.50	2240		.50	3700		.50	5300		.50	7100	120	.50	9700	
.60	148	36	.60	1070		.60	2310		.60	3780		.60	5380		.60	7220		.60	9840	
.70	184	36	.70	1120		.70	2380		.70	3860		.70	5460		.70	7340		.70	9980	
.80	220	40	.80	1170		.80	2450		.80	3940		.80	5540		.80	7460		.80	10120	
.90	260		.90	1220		.90	2520		.90	4020		.90	5620	80	.90	7580	120	.90	10260	140
4.00	300		6.00	1270		8.00	2590		10.00	4100		12.00	5700	90	14.00	7700	130	16.00	10400	150
.10	340		.10	1320		.10	2660		.10	4180		.10	5790		.10	7830		.10	10550	
.20	380	40	.20	1370	50	.20	2730		.20	4260		.20	5880		.20	7960		.20	10700	
.30	420	50	.30	1420	60	.30	2800		.30	4340		.30	5970		.30	8090		.30	10850	
.40	470		.40	1480	60	.40	2870		.40	4420		.40	6060		.40	8220		.40	11000	
.50	520		.50	1540	70	.50	2940		.50	4500		.50	6150		.50	8350		.50	11150	
.60	570		.60	1610		.60	3010		.60	4580		.60	6240		.60	8480		.60	11300	
.70	620		.70	1680		.70	3080		.70	4660		.70	6330		.70	8610		.70	11450	
.80	670		.80	1750		.80	3150	70	.80	4740		.80	6420		.80	8740		.80	11600	
.90	720	50	.90	1820	70	.90	3220	80	.90	4820	80	.90	6510	90	.90	8870	130	.90	11750	150

This table is applicable for open-channel conditions. It is based on 4 discharge measurements made during 1968 (Nos. 255-258) and is fairly well defined between cfs and cfs. Comp by rwl date 9/13/68

and is the same as rating table No. 12 above 6.5 ft

Use to hundredths

Chd by DLF date 9/13/68

Table No. 13

U.S. GOVERNMENT PRINTING OFFICE 1966 O—287 473

September 1986 FLOOD DATA ("National Water Conditions" summary)

WRD station number	Stream and place of determination	Drainage area (mi^2)	Period of known floods	Maximum flood previously known: Date	Stage (ft)	Discharge (ft^3/s)	Maximum during present flood: Date/ Time	Stage (ft)	Discharge ft^3/s	Discharge cfs/ mi^2
	WHITE RIVER BASIN									
04122200	White River nr Whitehall	406	1957-	Sept. 1, 1975	7.46	5,400	Sept. 13 @ 1500	7.33	5,020	12.4
	PERE MARQUETTE BASIN									
04122500	Pere Marquette River at Scottville	681	1939-	July 1, 1969	6.26	2,970	Sept. 13 @ 1600	8.07	6,340	9.31
	MUSKEGON RIVER BASIN									
04121900	Little Muskegon River nr Morley	138	1966-	July 18, 1982	6.98	1,390	Sept. 12 @ 1130	8.57	2,360	17.1
04122000	Muskegon River at Newaygo	a2,350	1908, 1909-15, 1916-19, 1930-	Mar. 25, 1913	--	14,950*	Sept. 12 @ 1000	19.56	23,100	9.83
	GRAND RIVER BASIN									
04115000	Maple River at Maple Rapids	434	1904, 1944-	Mar. 20, 1948	--	6,500*	Sept. 12	12.33	7,920	18.2
04116500	Flat River at Smyrna	528	1950-	Apr. 22, 1967	7.27	3,100	Sept. 13	9.07	4,700	8.9
	TITTABAWASSEE RIVER BASIN									
04154000	Chippewa River nr Mt. Pleasant	416	1910-27, 1930-31, 1932-	Mar. 8, 1946	12.78	4,960	Sept. 12 @ 0800	15.58	6,660	16.0
04155000	Pine River at Alma	288	1910-28, 1930-	Mar. 19, 1948	10.81	4,400	Sept. 12 @ 0700	12.82	5,220	18.1
04155500	Pine River at Midland	a390	1934-38, 1948-	Mar. 20, 1948	10.0	6,360	Sept. 12 @ 0400	11.74	9,360	24.0
04156000	Tittabawassee River at Midland	a2,400	1907-	Mar. 28, 1916	29.7	34,800	Sept. 13 @ 0200	33.94	42,000	17.5
	SAGINAW RIVER BASIN									
04150500	Cass River at Cass City	359	1947-	Mar. 20, 1948	15.8	8,460	Sept. 12 @ 2200	19.82	12,500	34.8
04150800	Cass River at Wahjamega	645	1968-	Mar. 6, 1976	19.92	11,700	Sept. 13 @ 0800	26.64	20,600	31.9
04151500	Cass River at Frankenmuth	841	1908-09, 1935-36, 1939-	Mar. 18, 1942	20.88	17,700	Sept. 13 @ 2200	27.53	22,600	26.9
04157000	Saginaw River at Saginaw	a6,060		Mar. 30, 1904	24.9	68,000	Sept. 15 @ 0900	24.16	54,000	8.91

* Maximum daily
a Approximately

9-818
(Rev. 2-66)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

Sta. No. 4-1510

Rating table for Cass River at Vassar, Mich. Datum of Gage = 612.38

from June 28, 1968 to ..... from ..... to ..... from ..... to .....

Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs
3.00	30	10	5.00	770	50	7.00	1890	70	9.00	3300	80	11.00	4900	80	13.00	6600	100	15.00	9000	140
.10	40	12	.10	820		.10	1960		.10	3380		.10	4980		.10	6700		.10	9140	
.20	52	18	.20	870		.20	2030		.20	3460		.20	5060		.20	6800		.20	9280	
.30	70	22	.30	920		.30	2100		.30	3540		.30	5140		.30	6900		.30	9420	
.40	92	24	.40	970		.40	2170		.40	3620		.40	5220		.40	7000	100	.40	9560	
.50	116	32	.50	1020		.50	2240		.50	3700		.50	5300		.50	7100	120	.50	9700	
.60	148	36	.60	1070		.60	2310		.60	3780		.60	5380		.60	7220		.60	9840	
.70	184	36	.70	1120		.70	2380		.70	3860		.70	5460		.70	7340		.70	9980	
.80	220	40	.80	1170		.80	2450		.80	3940		.80	5540		.80	7460		.80	10120	
.90	260		.90	1220		.90	2520		.90	4020		.90	5620	80	.90	7580	120	.90	10260	140
4.00	300		6.00	1270		8.00	2590		10.00	4100		12.00	5700	90	14.00	7700	130	16.00	10400	150
.10	340		.10	1320		.10	2660		.10	4180		.10	5790		.10	7830		.10	10550	
.20	380	40	.20	1370	50	.20	2730		.20	4260		.20	5880		.20	7960		.20	10700	
.30	420	50	.30	1420	60	.30	2800		.30	4340		.30	5970		.30	8090		.30	10850	
.40	470		.40	1480	60	.40	2870		.40	4420		.40	6060		.40	8220		.40	11000	
.50	520		.50	1540	70	.50	2940		.50	4500		.50	6150		.50	8350		.50	11150	
.60	570		.60	1610		.60	3010		.60	4580		.60	6240		.60	8480		.60	11300	
.70	620		.70	1680		.70	3080		.70	4660		.70	6330		.70	8610		.70	11450	
.80	670		.80	1750		.80	3150	70	.80	4740		.80	6420		.80	8740		.80	11600	
.90	720	50	.90	1820	70	.90	3220	80	.90	4820	80	.90	6510	90	.90	8870	130	.90	11750	150

This table is applicable for open-channel conditions. It is based on 4 discharge measurements made during 1968 (Nos. 255-258)

and is fairly well defined between ..... cfs and ..... cfs. Comp by WL date 9/13/68

and is the same as rating table No. 12 above 6.5 ft

Use to hundredths.

Chd by WLF date 9/13/68

Table No 13

U.S. GOVERNMENT PRINTING OFFICE 1966 O—207-473

9-210
(Rev. 2-66)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

Sta. No. 4-1510

Rating table for Cass River at Vassar, Mich.

from June 28, 1968 to , from to , from to

Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs
3.00	30	10	5.00	770	50	7.00	1890	70	9.00	3300	80	11.00	4900	90	13.00	6600	100	15.00	9000	140
.10	40	12	.10	820		.10	1960		.10	3380		.10	4980		.10	6700		.10	9140	
.20	52	18	.20	870		.20	2030		.20	3460		.20	5060		.20	6800		.20	9280	
.30	70	22	.30	920		.30	2100		.30	3540		.30	5140		.30	6900		.30	9420	
.40	92	24	.40	970		.40	2170		.40	3620		.40	5220		.40	7000	100	.40	9560	
.50	116	32	.50	1020		.50	2240		.50	3700		.50	5300		.50	7100	120	.50	9700	
.60	148	36	.60	1070		.60	2310		.60	3780		.60	5380		.60	7220		.60	9840	
.70	184	36	.70	1120		.70	2380		.70	3860		.70	5460		.70	7340		.70	9980	
.80	220	40	.80	1170		.80	2450		.80	3940		.80	5540		.80	7460		.80	10120	
.90	260		.90	1220		.90	2520		.90	4020		.90	5620	80	.90	7580	120	.90	10260	140
4.00	300		6.00	1270		8.00	2590		10.00	4100		12.00	5700	90	14.00	7700	130	16.00	10400	150
.10	340		.10	1320		.10	2660		.10	4180		.10	5790		.10	7830		.10	10550	
.20	380	40	.20	1370	50	.20	2730		.20	4260		.20	5880		.20	7960		.20	10700	
.30	420	50	.30	1420	60	.30	2800		.30	4340		.30	5970		.30	8090		.30	10850	
.40	470		.40	1480	60	.40	2870		.40	4420		.40	6060		.40	8220		.40	11000	
.50	520		.50	1540	70	.50	2940		.50	4500		.50	6150		.50	8350		.50	11150	
.60	570		.60	1610		.60	3010		.60	4580		.60	6240		.60	8480		.60	11300	
.70	620		.70	1680		.70	3080		.70	4660		.70	6330		.70	8610		.70	11450	
.80	670		.80	1750		.80	3150	70	.80	4740		.80	6420		.80	8740		.80	11600	
.90	720	50	.90	1820	70	.90	3220	80	.90	4820	90	.90	6510	90	.90	8870	130	.90	11750	150

This table is applicable for open-channel conditions. It is based on 4 discharge measurements made during 1968 (Nos. 255-258)

and is fairly well defined ~~between~~ cfs and cfs. Comp by [illegible] date 9/13/68

and is the same as rating table No. 12 above 6.5 ft

Use to hundredths

Ckd by [illegible] date 9/13/68

Table No. 13

U.S. GOVERNMENT PRINTING OFFICE 1966 O—207-473

9-910
(Rev. 2-66)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

Sta. No. 4-1510

Rating table for Cass River at Vassar, Mich.

from June 28, 1968 to , from to , from to

Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs	Gage height Feet	Discharge Cfs	Difference Cfs
3.00	30	10	5.00	770	50	7.00	1890	70	9.00	3300	80	11.00	4900	90	13.00	6600	100	15.00	9000	140
.10	40	12	.10	820		.10	1960		.10	3380		.10	4980		.10	6700		.10	9140	
.20	52	18	.20	870		.20	2030		.20	3460		.20	5060		.20	6800		.20	9280	
.30	70	22	.30	920		.30	2100		.30	3540		.30	5140		.30	6900		.30	9420	
.40	92	24	.40	970		.40	2170		.40	3620		.40	5220		.40	7000	100	.40	9560	
.50	116	32	.50	1020		.50	2240		.50	3700		.50	5300		.50	7100	120	.50	9700	
.60	148	36	.60	1070		.60	2310		.60	3780		.60	5380		.60	7220		.60	9840	
.70	184	36	.70	1120		.70	2380		.70	3860		.70	5460		.70	7340		.70	9980	
.80	220	40	.80	1170		.80	2450		.80	3940		.80	5540		.80	7460		.80	10120	
.90	260		.90	1220		.90	2520		.90	4020		.90	5620	80	.90	7580	120	.90	10260	140
4.00	300		6.00	1270		8.00	2590		10.00	4100		12.00	5700	90	14.00	7700	130	16.00	10400	150
.10	340		.10	1320		.10	2660		.10	4180		.10	5790		.10	7830		.10	10550	
.20	380	40	.20	1370	50	.20	2730		.20	4260		.20	5880		.20	7960		.20	10700	
.30	420	50	.30	1420	60	.30	2800		.30	4340		.30	5970		.30	8090		.30	10850	
.40	470		.40	1480	60	.40	2870		.40	4420		.40	6060		.40	8220		.40	11000	
.50	520		.50	1540	70	.50	2940		.50	4500		.50	6150		.50	8350		.50	11150	
.60	570		.60	1610		.60	3010		.60	4580		.60	6240		.60	8480		.60	11300	
.70	620		.70	1680		.70	3090		.70	4660		.70	6330		.70	8610		.70	11450	
.80	670		.80	1750		.80	3150	70	.80	4740		.80	6420		.80	8740		.80	11600	
.90	720	50	.90	1820	70	.90	3220	80	.90	4820	80	.90	6510	90	.90	8870	130	.90	11750	150

This table is applicable for open-channel conditions. It is based on 4 discharge measurements made during 1968 (Nos. 255-258)

and is fairly well defined ~~between~~ cfs and cfs. Comp by [illegible] date 9/13/68

and is the same as rating table No 12 above 65 A

Use to hundredths

Chk by [illegible] date 9/13-68

Table No. 13

U.S. GOVERNMENT PRINTING OFFICE 1966 O—207-473

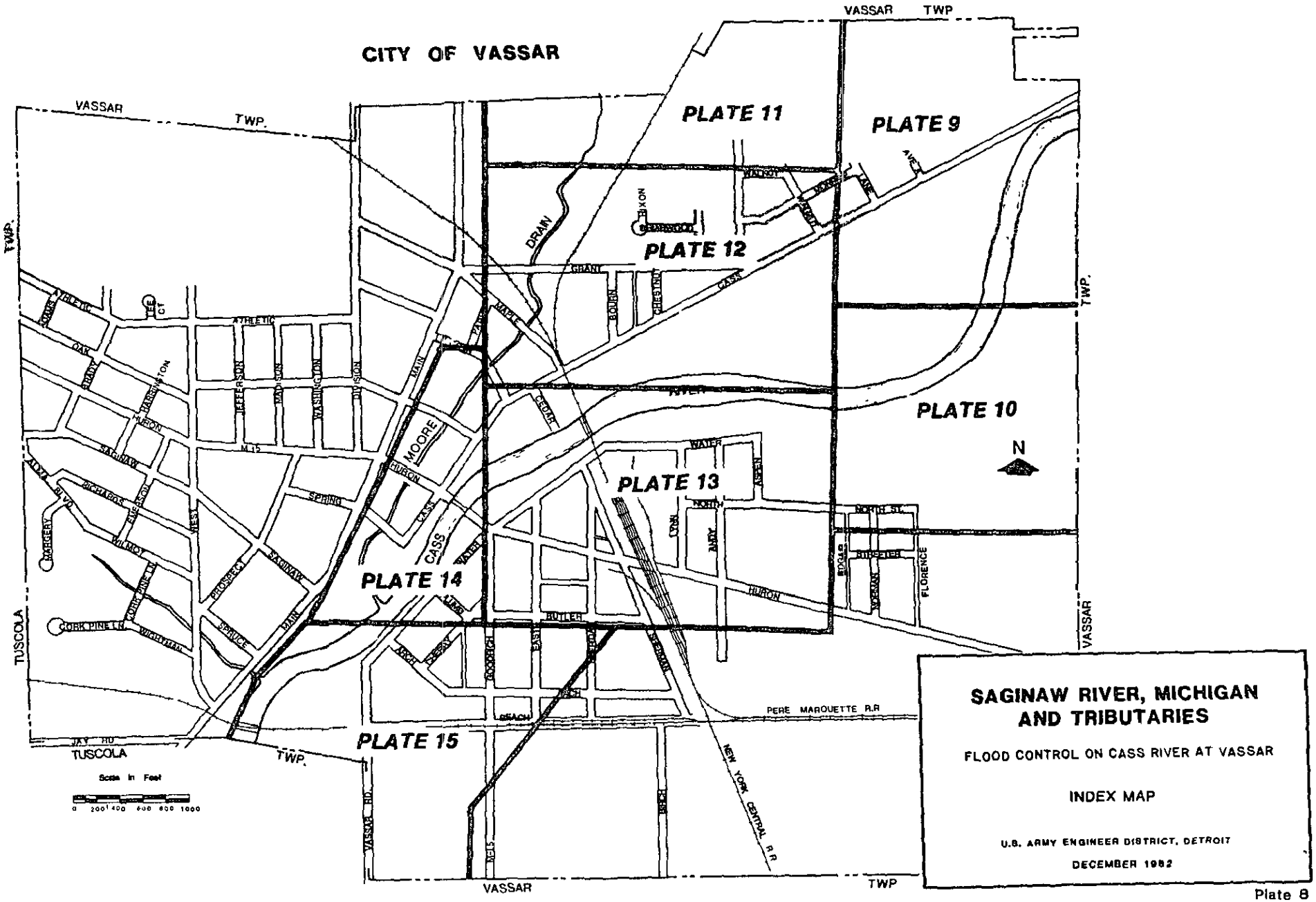
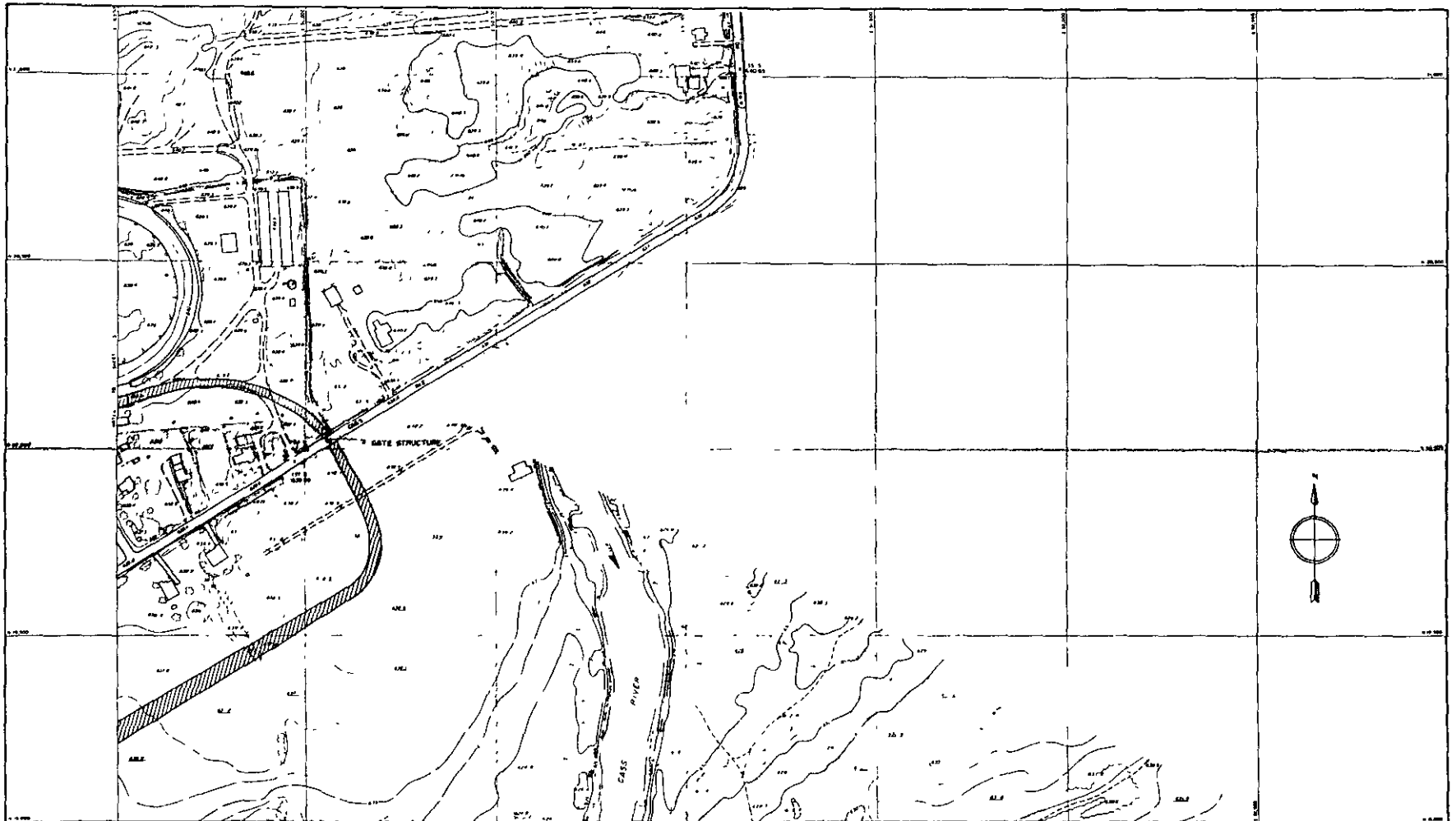

CITY OF VASSAR
VASSAR TWP.
VASSAR TWP
PLATE 9
PLATE 10
PLATE 11
PLATE 12
PLATE 13
PLATE 14
PLATE 15
TUSCOLA TWP.
TUSCOLA
VASSAR
N
Scale in Feet
0 200 400 600 800 1000
SAGINAW RIVER, MICHIGAN AND TRIBUTARIES
FLOOD CONTROL ON CASS RIVER AT VASSAR
INDEX MAP
U.S. ARMY ENGINEER DISTRICT, DETROIT
DECEMBER 1982

Plate 8



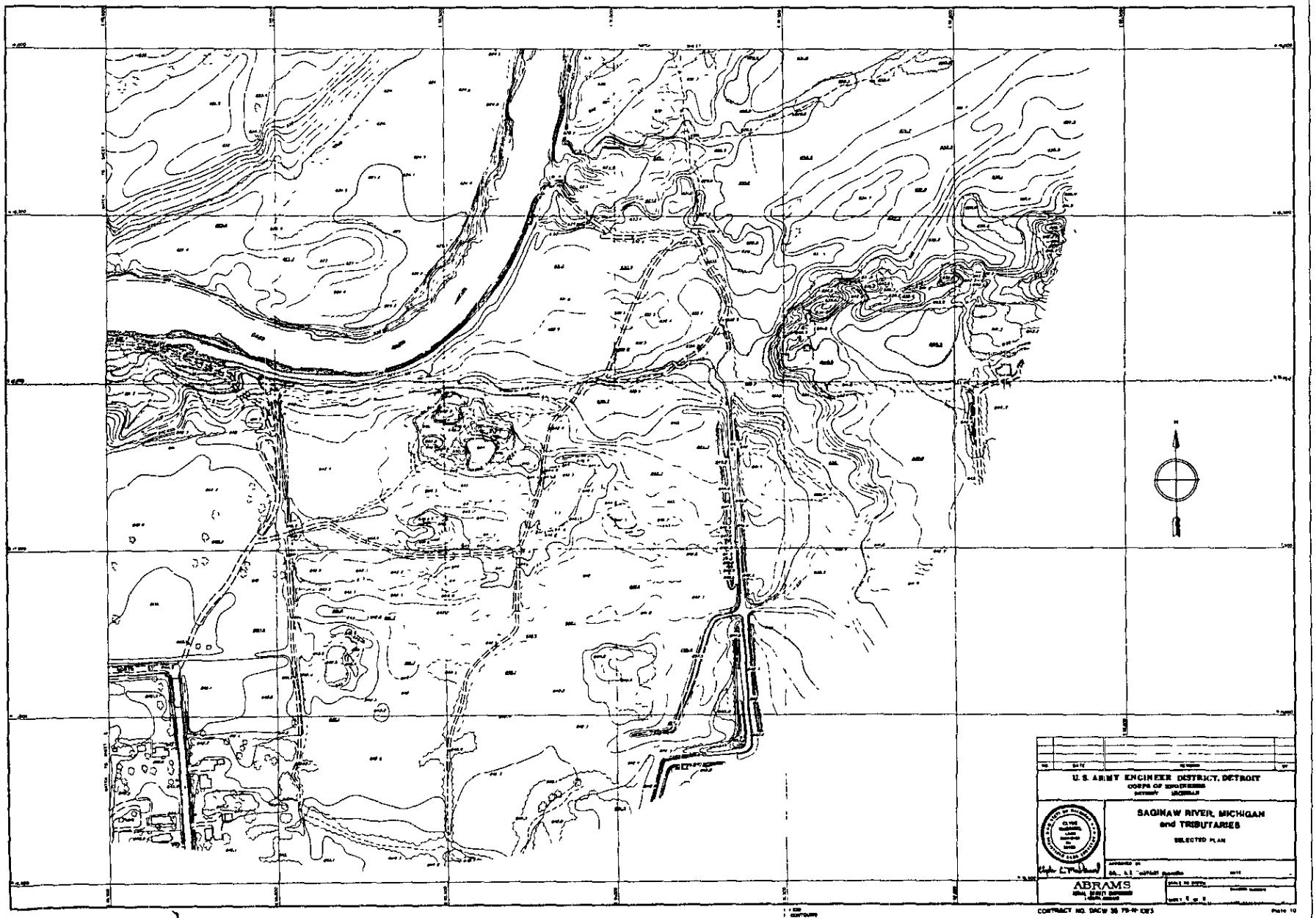
U.S. ARMY ENGINEER DISTRICT DETROIT
CORPS OF ENGINEERS
DETROIT MICHIGAN

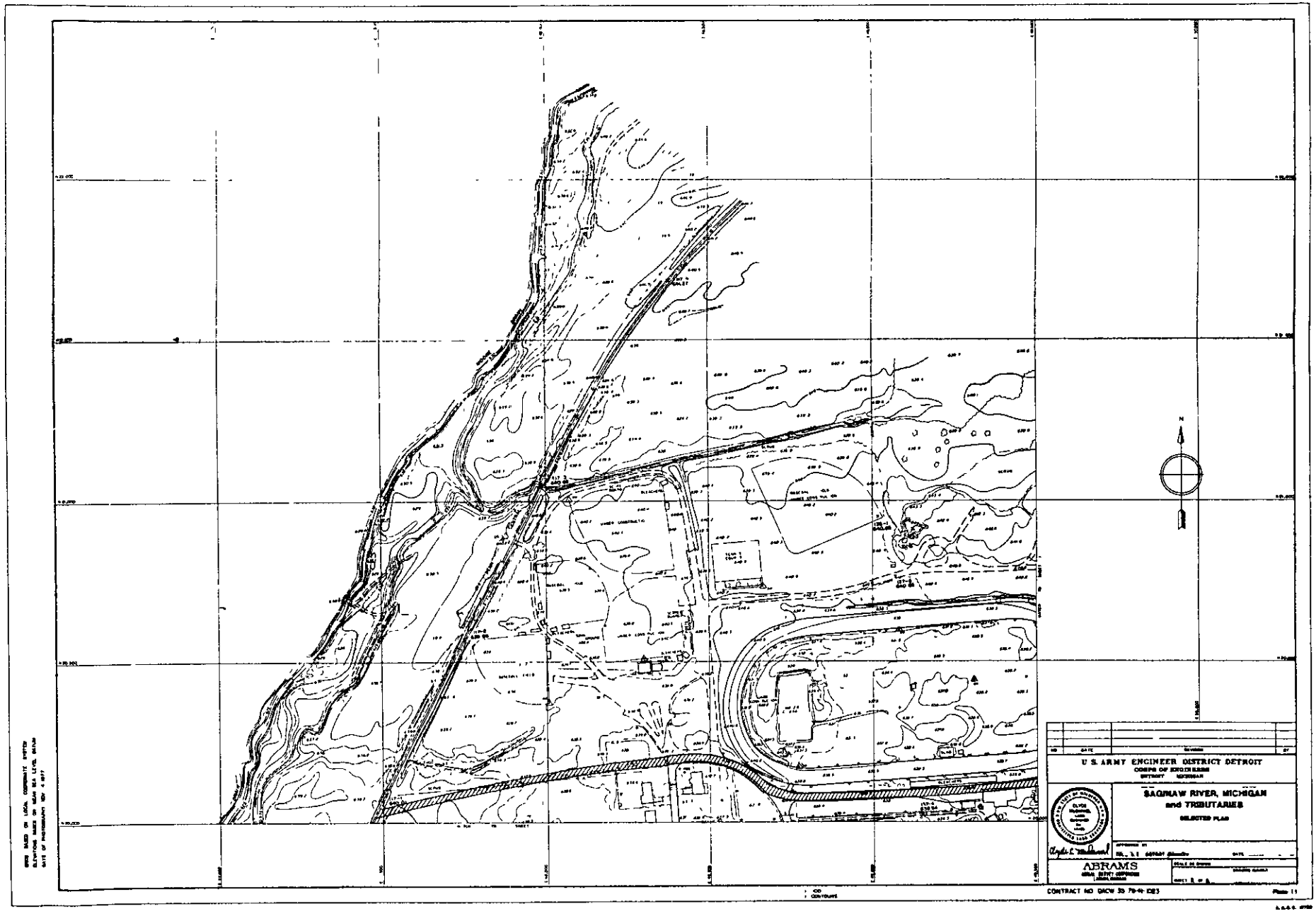
SAGINAW RIVER, MICHIGAN
and TRIBUTARIES

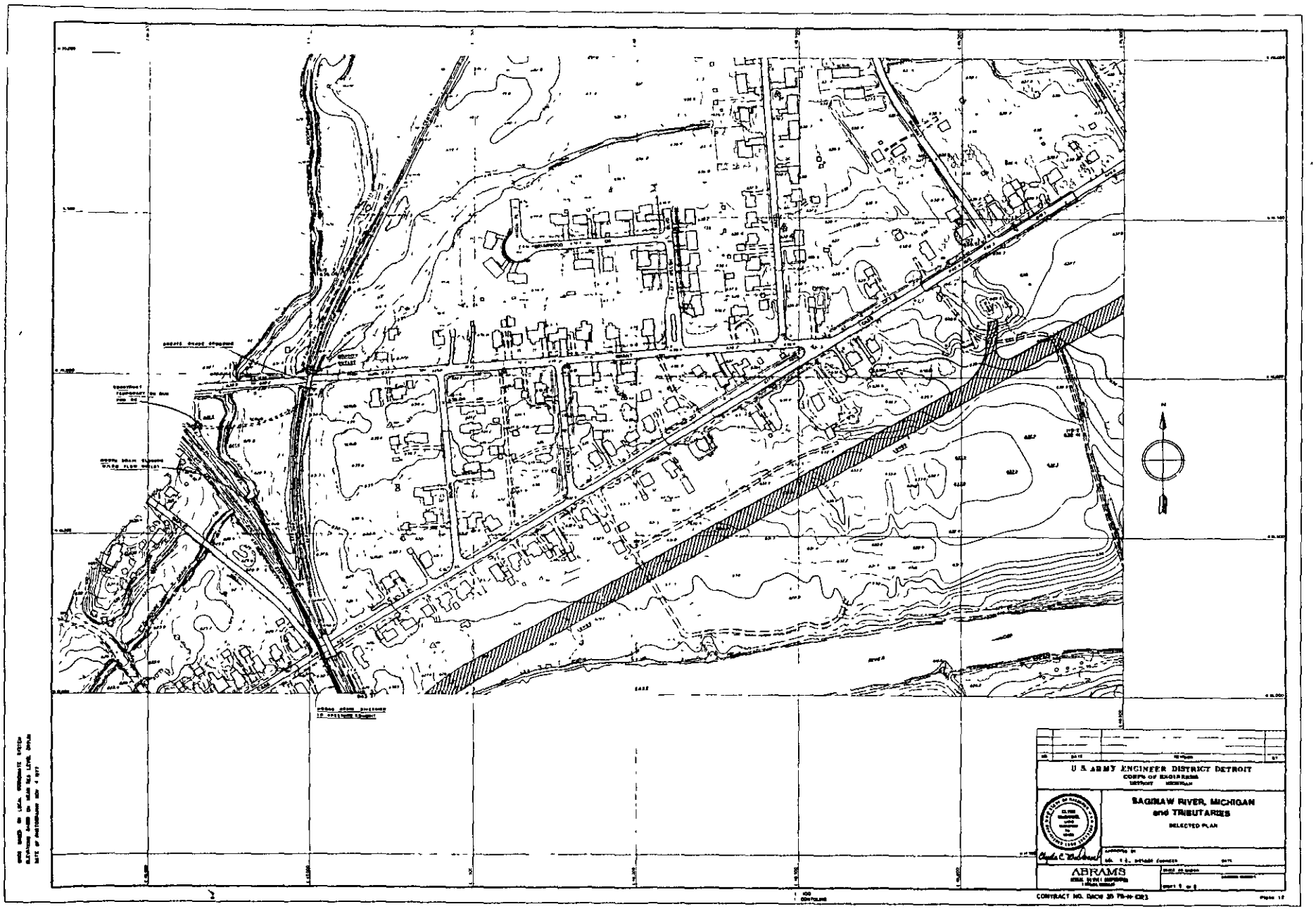
SELECTED PLAN

ABRAMS

CONTRACT NO. DACW 35-75-C-0013


U.S. ARMY ENGINEER DISTRICT, DETROIT
CORPS OF ENGINEERS
DETROIT MICHIGAN
SAGINAW RIVER, MICHIGAN
and TRIBUTARIES
SELECTED PLAN
ABRAMS
CONTRACT NO. DACW 35 79-C-0013
Plate 10


GRID BASED ON LOCAL COORDINATE SYSTEM
ELEVATIONS BASED ON MEAN SEA LEVEL DATUM
DATE OF PHOTOGRAPHY NOV 4 1977
N
NO
DATE
REVISION
BY
U.S. ARMY ENGINEER DISTRICT DETROIT
CORPS OF ENGINEERS
DETROIT MICHIGAN
SAGINAW RIVER, MICHIGAN
and TRIBUTARIES
SELECTED PLAN
ABRAMS
CONTRACT NO DACW 35 79-R-0123
Plate 11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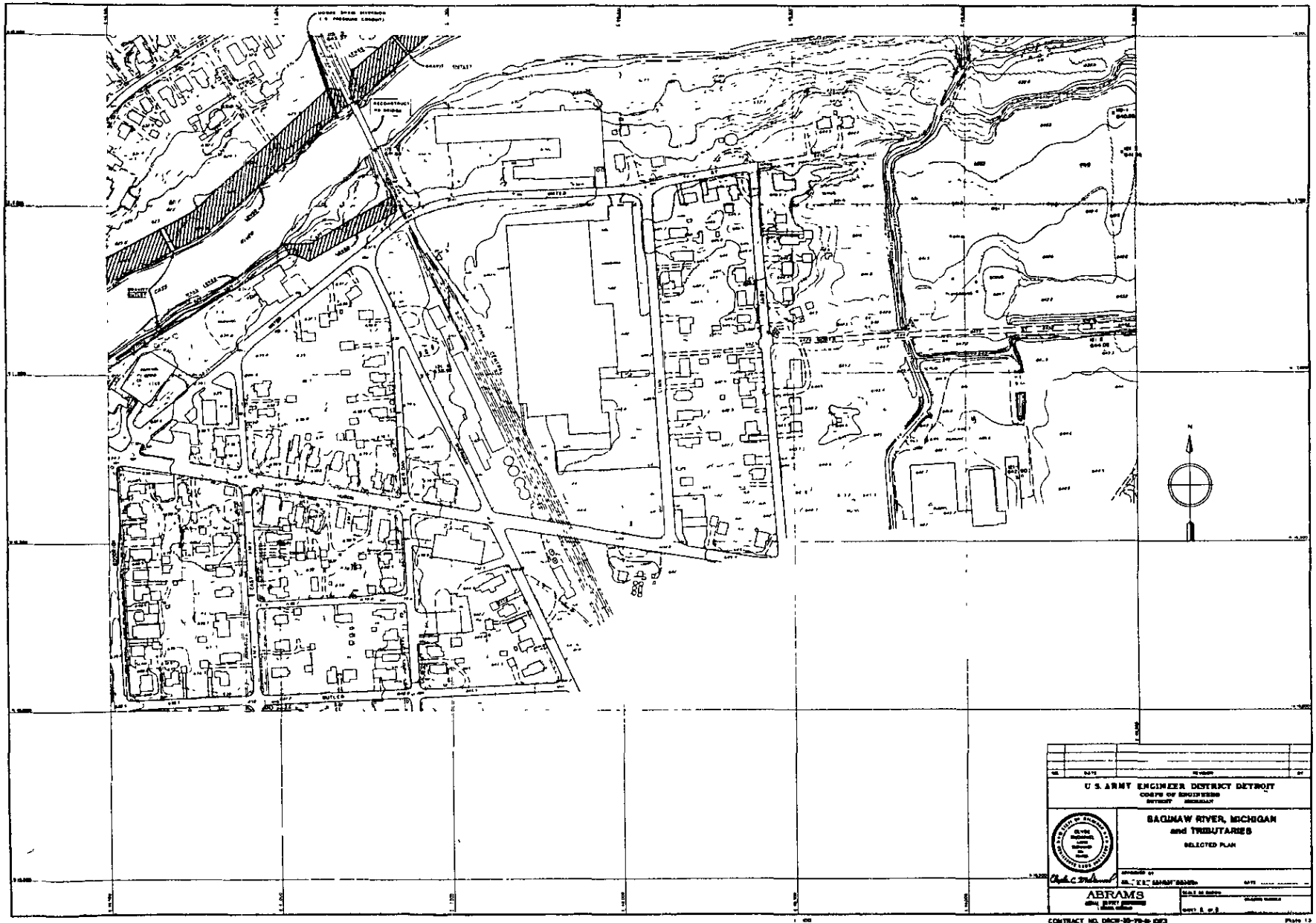
DETROIT MICHIGAN
SAGINAW RIVER, MICHIGAN
and TRIBUTARIES
SELECTED PLAN
ABRAMS
CONTRACT NO. DACW 35-79-H-0023



U. S. ARMY ENGINEER DISTRICT DETROIT
CORPS OF ENGINEERS
DETROIT MICHIGAN

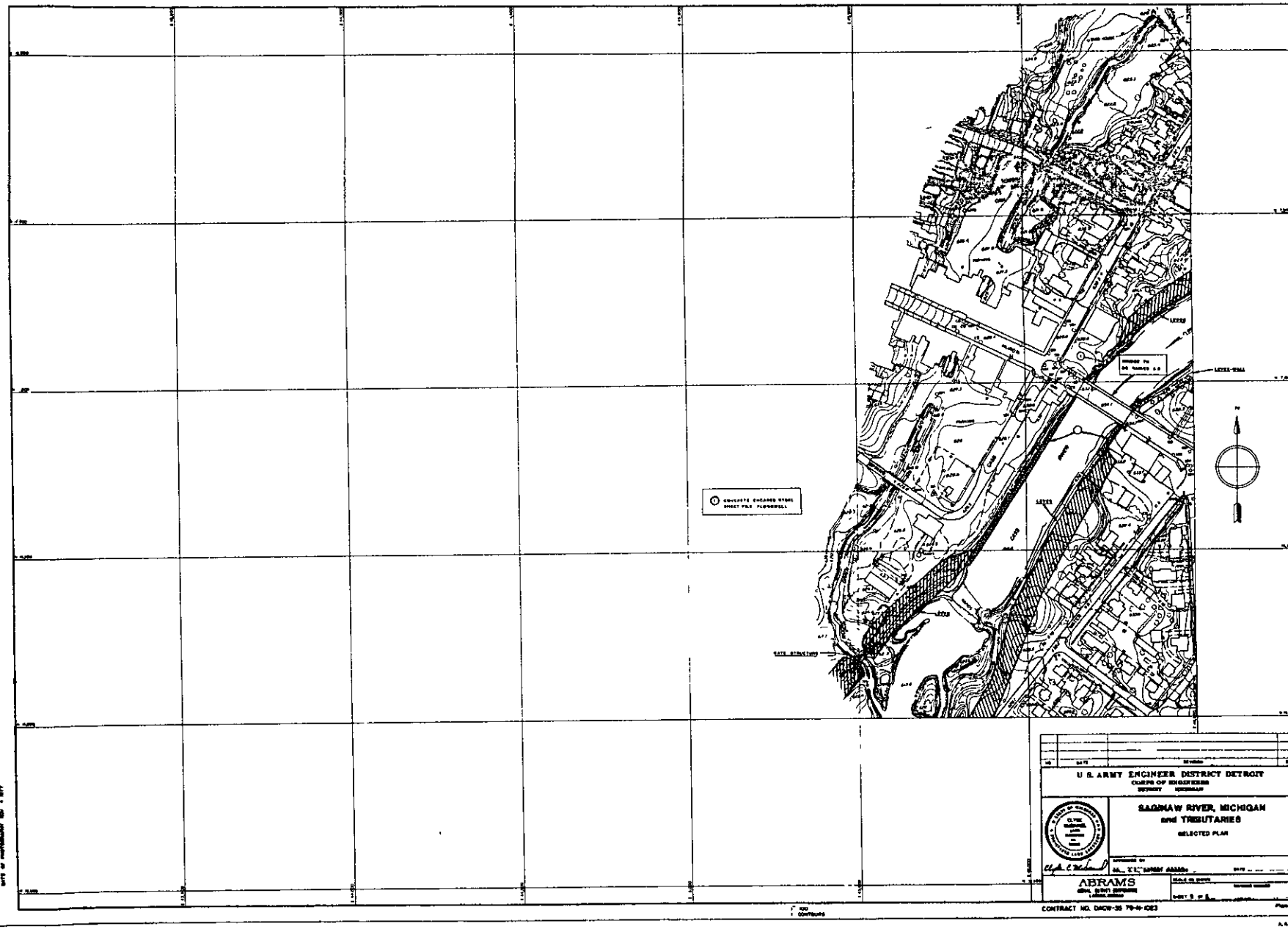
SAGINAW RIVER, MICHIGAN
and TRIBUTARIES

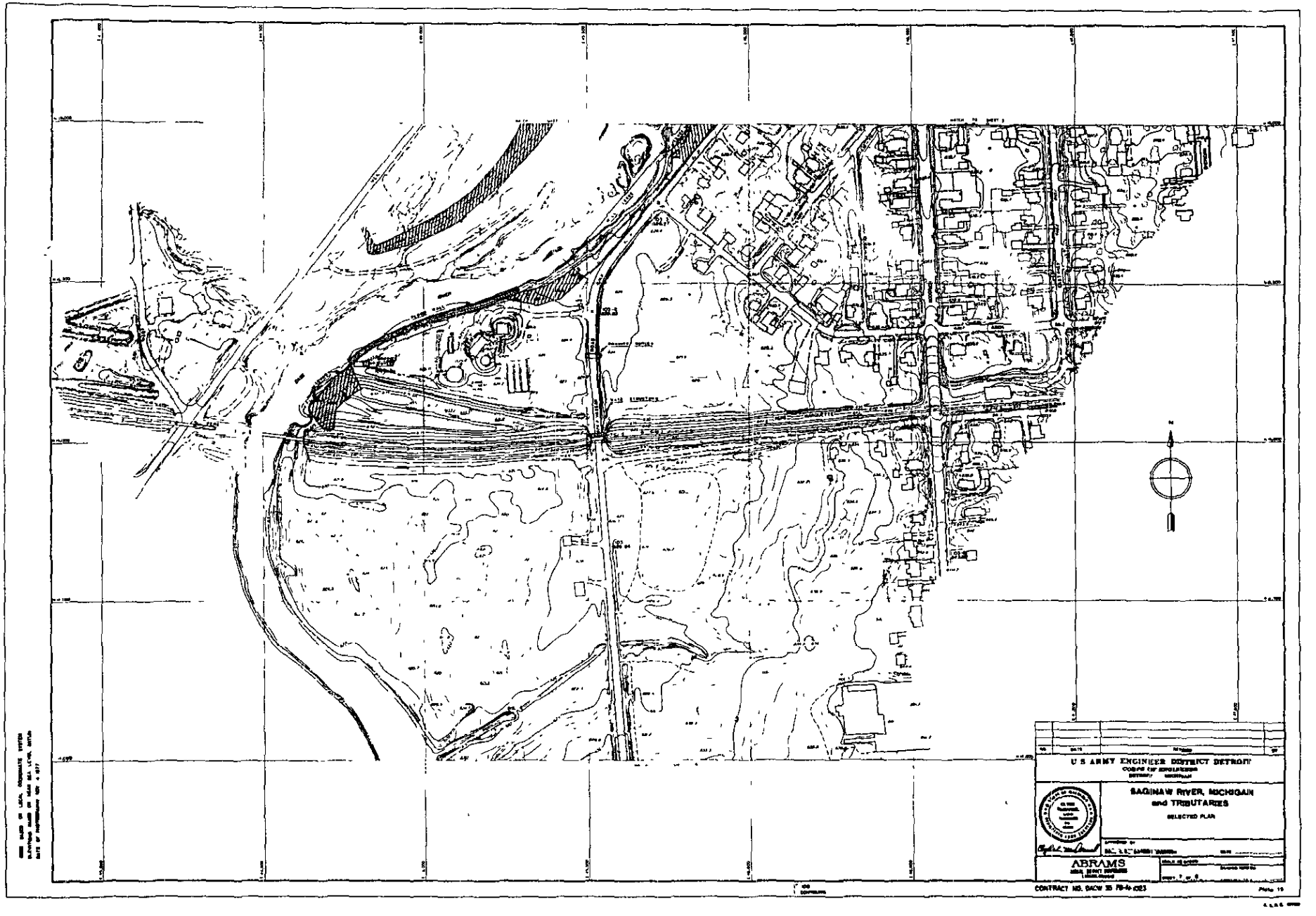
SELECTED PLAN

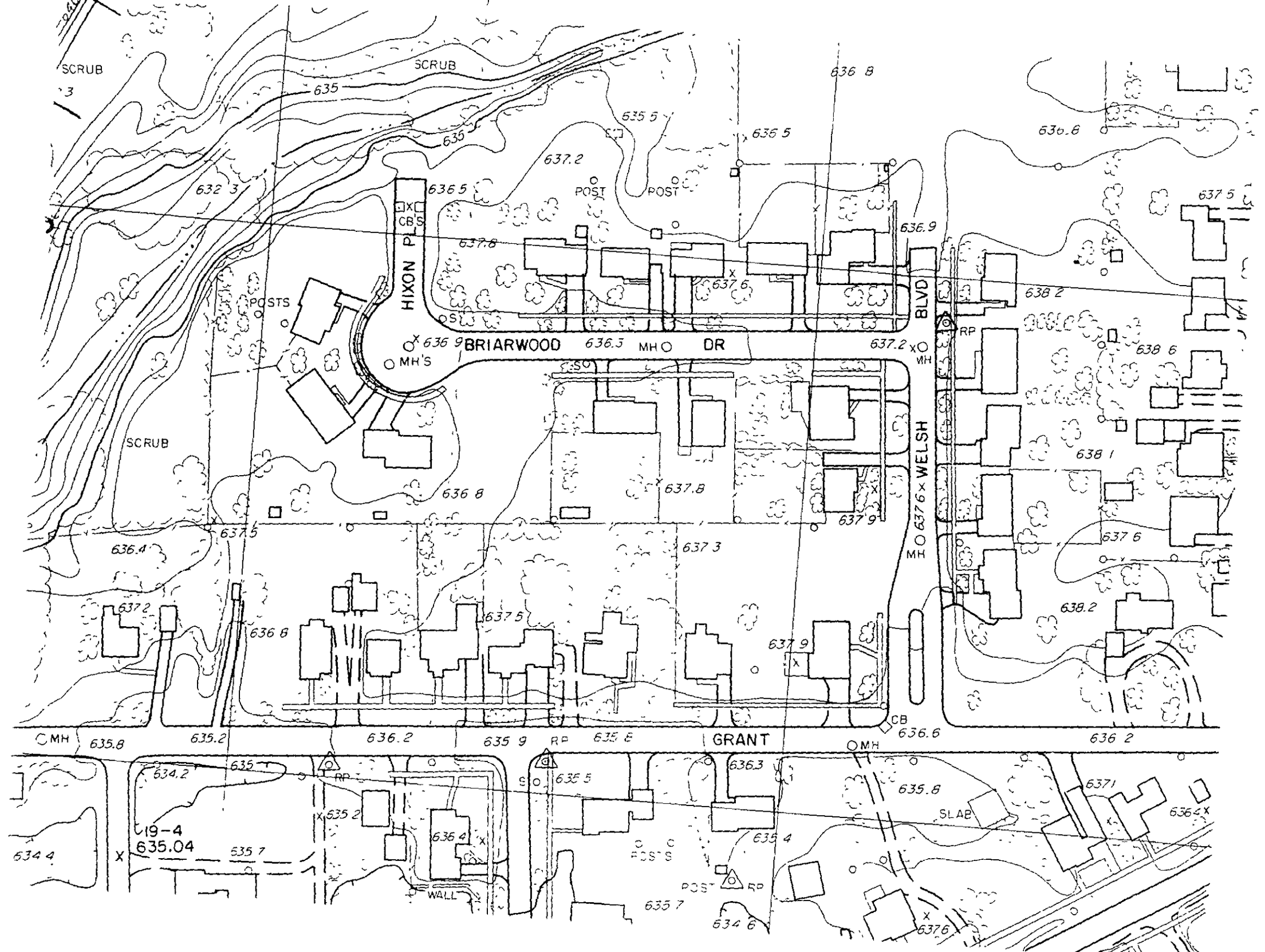
ABRAMS

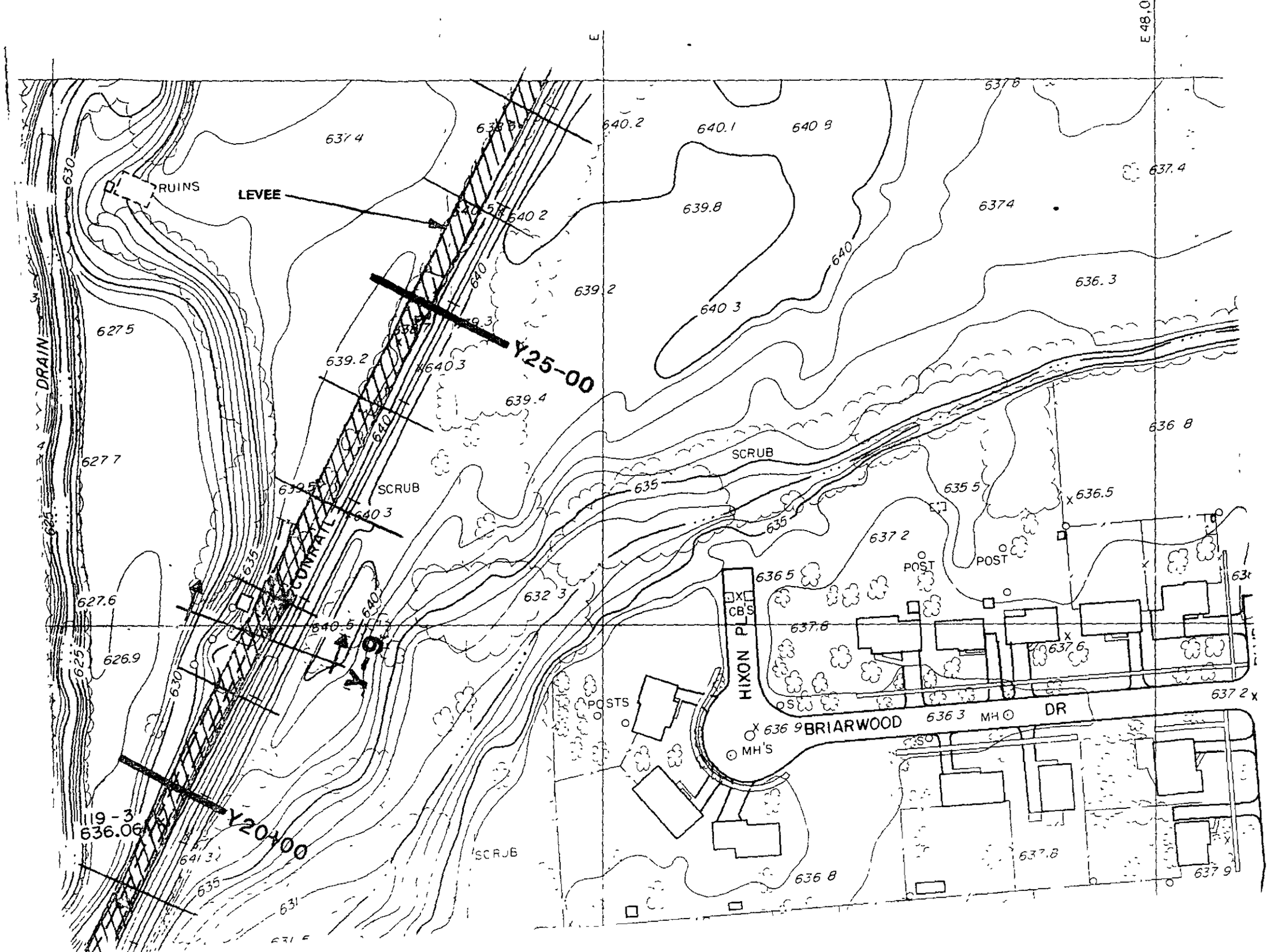
CONTRACT NO. DACW-35-79-C-0023

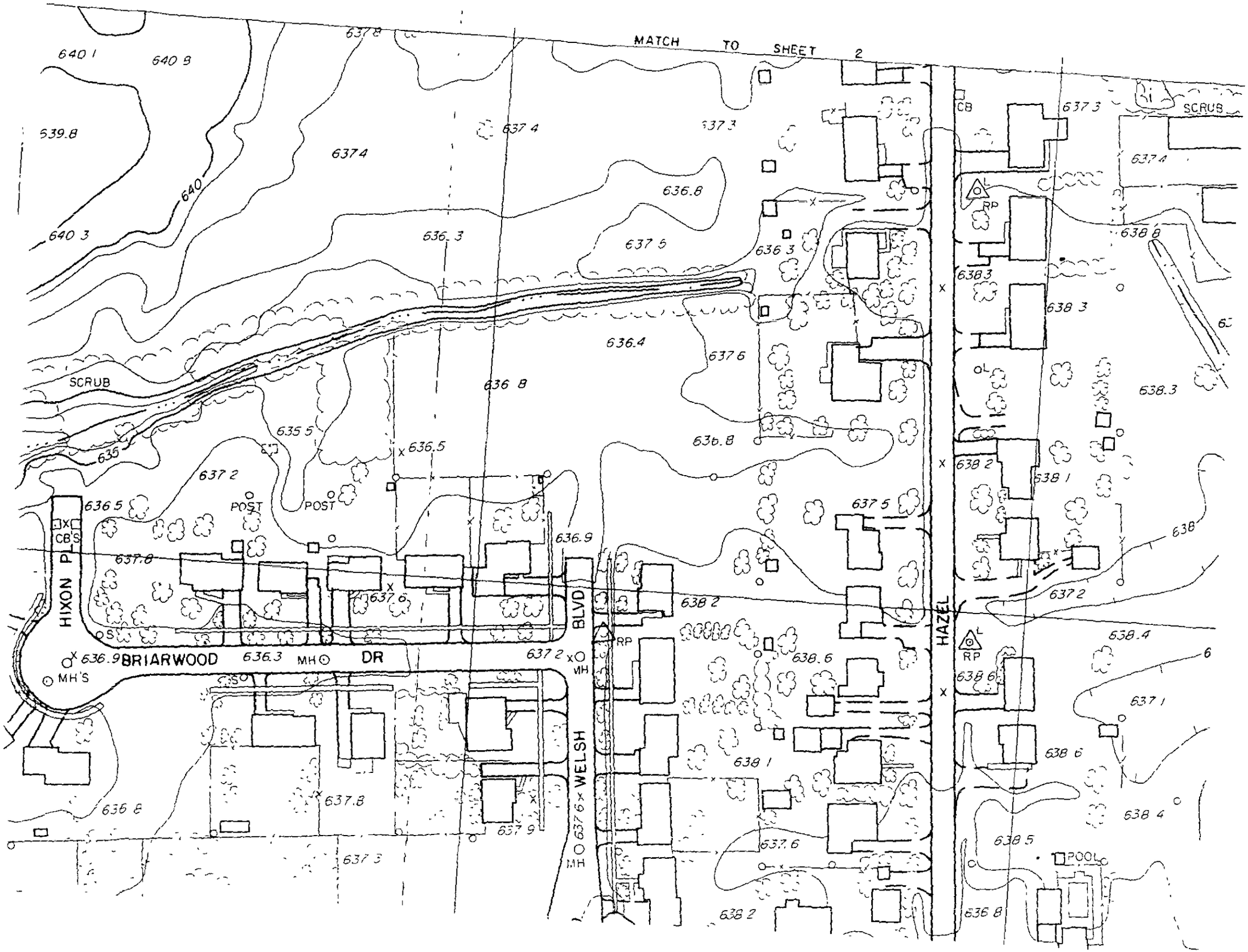
PLATE 13


LEVEE
LEVEE-TEMA
LEVEE
LEVEE
GATE STRUCTURE
CONCRETE ENCASED STEEL SHEET PILE FLOODWALL
U.S. ARMY ENGINEER DISTRICT DETROIT
CORPS OF ENGINEERS
DETROIT MICHIGAN
SAGINAW RIVER, MICHIGAN
and TRIBUTARIES
SELECTED PLAN
ABRAMS
CONTRACT NO. DACW-35 79-A-1023


U S ARMY ENGINEER DISTRICT DETROIT
CORPS OF ENGINEERS
SAGINAW RIVER, MICHIGAN
and TRIBUTARIES
SELECTED PLAN
ABRAMS
CONTRACT NO. DACW 35 78-A-0023


SCRUB
SCRUB
635
635
636 8
635 5
636 5
636.8
637.2
632 3
636 5
POST
POST
637 5
CB'S
HIXON PL
637.8
636.9
637 6
638 2
POSTS
BLVD
RP
636 9
BRIARWOOD
636.3
MH
DR
637.2
MH
638 6
MH'S
SCRUB
WELSH
638 1
636 8
637.8
637 9
637 6
MH
637 5
636.4
637 3
637 2
636 8
637.5
637 9
638.2
CB
636.6
636 2
MH
635.8
635.2
636.2
635 9
RP
635 8
GRANT
MH
634.2
635
RP
635 5
636.3
635.8
6371
SLAB
635 2
636 4
635 4
19-4
635.04
634 4
635 7
POSTS
WALL
POST
RP
635 7
634 6
637.6


RUINS
LEVEE
DRAIN
CONRAIL
SCRUB
Y25-00
Y-9
Y20+00
19-3
636.06
HIXON PL
BRIARWOOD DR
CB'S
MH'S
POSTS
POST
MH
637.4
639.8
640.1
640.2
640.3
639.2
639.4
636.3
636.8
635.5
636.5
637.2
637.8
637.6
637.9
636.9
636.5
632.3
627.5
627.7
627.6
626.9
635
640
630
625


MATCH TO SHEET 2
640 1
640 8
639.8
640
640 3
637 4
637 3
636.8
636 3
637 5
636 3
636.4
637 6
636 8
635 5
636.5
636.8
637 2
636 5
POST
POST
637.8
636.9
637 6
637 2
636.9
BRIARWOOD
636.3
MH
DR
MH'S
HIXON PL
CB'S
SCRUB
635
637 8
637 4
637 3
CB
SCRUB
637 4
638 8
638.3
638 3
638.3
638 2
638 1
637 5
638
637 2
638.4
637 1
638 6
638 4
638 5
POOL
636 8
638 2
637.6
638.6
638 6
638 1
637.8
637 9
637 3
636 8
637 6
MH
WELSH
BLVD
HAZEL
RP
RP
RP

USGS STEP-BACKWATER PROGRAM - VERSION 72.349 *** PAGE COUNT= 1 DATE= 3/31/76

*** INPUT CARD PRINTOUT ***

```
1      ! "ASSEM                                                    10  2  2 99 12
2     11  63327  63327
3  1200 1   K 1  37  3  615   13700  1  3
4  1205  1A200  1A200
5  1210    -900  1  6400 -886  1  6384 -826  1  6361 -766  1  6313 -736  1  6286
5  1211    -604  2  6206 -672  2  6156 -662  2  6143 -652  2  6140 -642  2  6128
5  1212    -632  2  6126 -622  2  6125 -612  2  6125 -602  2  6125 -592  2  6125
5  1213    -582  2  6129 -576  2  6149 -572  2  6150 -562  2  6156 -550  2  6182
5  1214    -538  3  6226 -488  3  6244 -440  3  6255 -240  3  6277 -266  3  6336
5  1215     -90  3  6368    0  3  6274  140  3  6263  286  3  6288  374  3  6291
5  1216     450  3  6302  630  3  6304  644  3  6341   69  3  6356  780  3  6364
5  1217     930  3  6382 1000  3  6400
6  1220  1  2 100 100  1  2 045 045  1  2 060 060
3  1300 RR RR 2  21  1  615   13700          0        3 0
                                                   *                                    **ERROR(S)**
5  1310    -147  1  6322 -145  1  6185 -130  1  6158 -115  1  6130 -100  1  6125
5  1311     -90  1  6116  -79  1  6121  -79  1  6122 -147  -9  6322  -71  1  6322
5  1312     -71  1  6120  -50  1  6139  -40  1  6142  -30  1  6153  -20  1  6157
5  1313     -10  1  6209   -3  1  6215   -3  1  6305    0  1  6305    0  1  6312
5  1314     -71  -9  6322
6  1320  1  2 035 035
3  1350 RR GR 4   3  2   12          1  2          2 2                  1
5  1400       0  1  6415  500  2  6415 1000  2  6415
3  1400 J   L 5  33  4  615   14100  1  3
5  1410    -500  1  6400 -104  1  6372  -38  1  6352    0  1  6348  136  1  6325
5  1411     136  1  6400  216  1  6400  216  1  6323  224  2  6318  236  2  6155
5  1412     244  2  6144  256  2  6132  266  2  6124  276  2  6115  286  2  6107
5  1413     296  2  6103  306  2  6105  316  2  6115  326  2  6121  336  2  6130
5  1414     351  2  6156  371  3  6240  376  3  6256  498  3  6291  572  4  6287
5  1415     606  4  6284  698  4  6285  718  4  6293  758  4  6266  858  4  6257
5  1416     918  4  6273  988  4  6280 1010  4  6400
6  1420  1  2 100 100  1  2 040 040  1  2 060 060  1  2 060 060
3  1401 J   L 9  32  4  615   14110  1  3
                                                                                  SEQUENCE ERROR
5  1410    -500  1  6400 -104  1  6372  -38  1  6362    0  1  6348  136  1  6325
5  1411     136  1  6400  216  1  6400  216  1  6323  224  2  6318  236  2  6155
5  1412     245  2  6144  256  2  6132  266  2  6124  276  2  6115  286  2  6107
5  1413     296  2  6103  306  2  6105  316  2  6115  326  2  6121  336  2  6130
5  1414     351  2  6156  376  3  6256  498  3  6291  572  4  6287  606  4  6284
5  1415     698  4  6285  718  4  6293  758  4  6265  858  4  6257  918  4  6273
5  1416     988  4  6280 1010  4  6400
6  1420  1  2 100 100  1  2 040 040  1  2 060 060  1  2 060 060
3  1500 K   M 0  36  3  615   14700  1  3
5  1510    -148  1  6422  -46  1  6403    0  1  6403    0  1  6450  200  1  6450
5  1511     260  1  6341  242  1  6266  338  2  6254  343  2  6155  373  2  6151
5  1512     383  2  6139  393  2  6129  403  2  6131  413  2  6129  423  2  6129
5  1513     433  2  6138  443  2  6131  453  2  6134  463  2  6136  473  2  6136
5  1514     483  2  6137  493  2  6135  503  2  6133  513  2  6141  519  2  6156
5  1515     930  3  6270  634  3  6277  766  3  6295  [illegible]  3  6320  986  3  6329
5  1516    1020  3  6314 1208  3  6341 1322  3  6345 1408  3  6357 1534  3  6367
```

```
==================================================================================
WATER-SURFACE PROFILE FOR: WASSAR
PAGE  1 OF  1
==================================================================================
SECID AT DISTANCE/ LENGTH/DISCHARGE/  AREA  /CONVEYANCE/ ALPHA/  LFW  /  RFW
  MS ELEV /    HV  /    HF  /    HE  /    EG  /     V  /    FR  /   ACC   *ID*
==================================================================================
I   K AT   13700 /      0 /  16700. /  8143. /  925880. / 2.52 / -741. /  637.
   632.49 /   0.16 /                 /  632.65 /   2.05 /  0.17/          *IS*
******************************* BEGIN BRIDGE ANALYSIS ******************************
BR BR AT   13700 /        /  16700. /  2362. /  364274. / 1.00 / -147. /    0.
   632.49 /   0.78 /                 /    7.07 /   0.19 /                  *BO*
----------------------------------------------------------------------------------
 NO ROAD OVERFLOW
                                                                            *OG*
----------------------------------------------------------------------------------
J   L AT   14100 /    400 /  16700. /  5787. /  886192. / 2.00 /  131. /  996.
   632.58 /   0.26 /   0.14 /   0.05 /  632.84 /   2.89 /   0.19 / -0.008  *AS*
----------------------------------------------------------------------------------
   W = 0.28 / E = 1.00 / K* = 0.69 /  6250. /  966213. / 1.49 /   97. /  997.
   633.16 /   0.22 /                 /  633.38 /   2.67 /   0.18 /         *AS*
***************************** END BRIDGE ANALYSIS ******************************
J   L AT   14110 /     10 /  16700. /  6255. /  966646. / 1.96 /   97. /  997.
   633.16 /   0.22 /   0.00 /   0.0  /  633.37 /   2.67 /   0.18 / -0.007  *XS*
----------------------------------------------------------------------------------
K   M AT   14700 /    590 /  16700. /  6190. /  983489. / 2.31 /  204. / 1155.
   633.31 /   0.26 /   0.17 /   0.02 /  633.57 /   2.70 /   0.18 / -0.000  *XS*
----------------------------------------------------------------------------------
L   N AT   15300 /    600 /  16700. /  5902. / 1048907. / 1.97 /  269. / 1261.
   633.49 /   0.24 /   0.16 /   0.0  /  633.73 /   2.83 /   0.17 /  0.000  *XS*
----------------------------------------------------------------------------------
    O AT   16250 /    950 /  10700. /  6689. / 1064689. / 2.48 /   28. / 1100.
   633.74 /   0.24 /   0.24 /   0.0  /  633.98 /   2.50 /   0.17 /  0.008  *XS*
----------------------------------------------------------------------------------
N   P AT   17250 /   1000 /  16700. /  4944. /  649752. / 2.15 /   41. /  759.
   634.07 /   0.38 /   0.40 /   0.07 /  634.45 /   3.38 /   0.23 /  0.000  *XS*
----------------------------------------------------------------------------------
O   Q AT   18750 /   1500 /  16700. /  6898. /  664417. / 2.29 / -500. /  320.
   635.21 /   0.21 /   0.97 /   0.0  /  635.42 /   2.42 /   0.21 / -0.000  *XS*
----------------------------------------------------------------------------------
P   R AT   19700 /    950 /  16700. / 10423. / 1023450. / 2.76 /  629. / 2195.
   635.71 /   0.11 /   0.39 /   0.0  /  635.82 /   1.60 /   0.08 /  0.012  *XS*
----------------------------------------------------------------------------------
```

END OF THIS PROFILE

FROM: [illegible]
Hydrology [illegible]

TO: [illegible]
[illegible]

SUBJECT: Ct. of Uvas [illegible] FIS Pajaro River

OUR JOB NO.

DATE OF MEMO 3/30/87

MESSAGE

I am [illegible] the purpose of reviewing the Ct. of Uvas [illegible] FIS. To request the revision I will also have to run the 10, 50, and 500 year discharges. Please provide me with Q_{10} Q_{50} Q_{500} for the Pajaro River at Uvas [illegible] (A = 710 mi²) I have been running Q_{100} = 22,800 cfs, is this appropriate?

SIGNED [illegible]

SENDER — DO NOT WRITE BELOW THIS LINE

REPLY

Q_{10} = 13,700 cfs

Q_{50} = 20,000 cfs

Q_{100} = 22,800 cfs

Q_{500} = 25,600 cfs

SIGNED David A. [illegible]

DATE 3-31-87

REPLY

SENDER — Retain part 2 for your follow-up, send parts 1 and 3 to addressee
RECIPIENT — Retain part 1 and return part 3

TO: Bruce Menerey

FROM: Hope Crosby

SUBJECT: Cass River @ Vassar Peak Flows

OUR JOB NO.

DATE OF MEMO 6/12/87

MESSAGE

We used ~~a~~ an extrapolation between Wahjamega and Frankenmuth for the Vassar location. The peak discharge record at Vassar (1948-82) missed 4 of the top 7 peaks recorded at Frankenmuth. We would expect the log Pearson at Vassar to be an underestimate. I have attached a copy of the log Pearson at Frankenmuth and Wahjamega along with a copy of our extrapolation.

SIGNED Hope Crosby

SENDER – DO NOT WRITE BELOW THIS LINE

REPLY

SIGNED

DATE

ORIGINAL

SENDER — Retain part 2 for your follow-up, send parts 1 and 3 to addressee
RECIPIENT — Retain part 1 and return part 3

```
JSGS STEP-BACKWATER PROGRAM - VERSION 72.339 *** PAGE COUNT*   14.DATE* 3/31/76

**********************************************************************
WA  W-SURFACE PROFILE FOR VASSAW
PAGE  1 OF  1
**********************************************************************
SECTN D. DISTANCE/ LENGTH/DISCHARGE/  AREA  /CONVEYANCE/ ALPHA/  LEW  /  REW
  WS ELEV /    HV  /    HF       HE  /    FG  /     V  /    FD  /   ACC    *ID*
**********************************************************************
T   K AT   13700 /      0 /  18200. /  9254. / 1074854. / 2.41 / -791. /  641.
   633.27 /   0.15 /                  / 633.41 /   1.97 /   0.16/          *IS*
****************************** BEGIN BRIDGE ANALYSIS ******************
BR PW AT   13700 /        /  18200. /  2362. /  364274. / 1.00 / -147. /    0.
   633.27 /   0.92 /                            /   7.71 /   0.19 /          *HD*
----------------------------------------------------------------------
 NO ROAD OVERFLOW
                                                                        *BG*
----------------------------------------------------------------------
I   L AT   14100 /    400 /  18200. /  6414. /  992939. / 1.99 /   86. /  999.
   633.34 /   0.25 /   0.14 /   0.05 /  633.59 /   2.84 /   0.19 / -0.000  *AS*
----------------------------------------------------------------------
   M = 0.32 / F = 1.00 / K* = 0.81 /  7035. / 1112334. / 1.98 /   39. /  999.
   634.14 /   0.20 /                / 634.34 /   2.57 /   0.17 /          *AS*
****************************** END BRIDGE ANALYSIS ********************
J   L AT   14110 /     10 /  18200. /  7093. / 1113343. / 1.95 /   39. /  999.
   634.14 /   0.20 /   0.00 /   0.0  /  634.34 /   2.57 /   0.17 / -0.006  *XS*
----------------------------------------------------------------------
K   M AT   14700 /    590 /  18200. /  7140. / 1098424. / 2.57 /  200. / 1256.
   634.27 /   0.26 /   0.16 /   0.03 /  634.53 /   2.55 /   0.17 /  0.000  *XS*
----------------------------------------------------------------------
L   N AT   15300 /    600 /  18200. /  6909. / 1187711. / 2.16 /  242. / 1319.
   634.45 /   0.23 /   0.15 /   0.0  /  634.68 /   2.63 /   0.16 / -0.000  *XS*
----------------------------------------------------------------------
    O AT   16250 /    950 /  18200. /  7719. / 1204330. / 2.64 /   17. / 1137.
   634.67 /   0.23 /   0.22 /   0.0  /  634.90 /   2.35 /   0.16 /  0.000  *XS*
----------------------------------------------------------------------
N   P AT   17250 /   1000 /  18200. /  5606. /  733627. / 2.28 /   33. /  786.
   634.97 /   0.37 /   0.37 /   0.07 /  635.35 /   3.25 /   0.23 / -0.000  *XS*
----------------------------------------------------------------------
O   Q AT   18750 /   1500 /  18200. /  7594. /  755400. / 2.21 / -500. /  345.
   636.05 /   0.20 /   0.90 /   0.0  /  636.24 /   2.40 /   0.20 / -0.000  *XS*
----------------------------------------------------------------------
P   R AT   19700 /    950 /  18200. / 11691. / 1169331. / 2.67 /  550. / 2198.
   636.50 /   0.10 /   0.36 /   0.0  /  636.60 /   1.56 /   0.08 / -0.000  *XS*
----------------------------------------------------------------------

                    END OF THIS PROFILE
```

Sta.	+	H.I.	−	Elev.	
				637.46	BM
	4.02	641.48			
			5.00	636.48	
	3.99	640.47			
			1.32	639.15	
	1.44	640.59			
			4.10	636.49	
	5.22	641.71			
			4.23	637.48	BM
			4.46	637.23	
	3.78	641.01			
			3.72	637.29	
			4.4	~~636.61~~	
			3.82	637.19	
			4.08	636.93	TP.
	4.26	641.19			
			4.45	636.74	
			4.04	637.15	
			3.75	637.44	

	+	HI	−	Elev.	
				637.46	BM
	4.02	641.48			
			5.00	636.48	
	3.99	640.47			
			1.32	639.15	
	1.44	640.59			
			4.10	636.49	
	5.22	641.71			
			4.23	637.48	BM
			4.48	637.23	
	3.78	641.01			
			3.72	637.29	
			4.4 ~~636.61~~		
			3.82	637.19	
			4.08	636.93	T.P.
	4.26	641.19			
			4.45	636.74	
			4.04	637.15	
			3.75	637.44	

@ 640 Brainwood Fair in Driveway HWM

@ 633 Fair ~~Poor~~ Sidewalk & Driveway HWM

@ 665 Poor

627 Welsh Good

+	HI	−	Elev.	
			639.03	RIM
3.30	642.33			
		425	638.08	RD HAZel
		5.04	637.29	
		4.40	637.93	TP
4.43	642.36			
		4.26	638.10	TP
438	642.48			
		523	637.25	

Good 619 HAZel

City of Vassar

Tuscola Co.
Cass River

+	HI	−		
			633.41	
.84	634.25			
		5.51		
			628.75	
+7.8	8	-	636.55	
		3.86	630.39	
+6.35			636.74	
		4.46	629.79	TP.
6.46	636.25			
		4.13	632.12	
4.04	636.16			
		3.93	632.23	
4.5			636.78	

Top of Fire Hydrant Cass
a Bonn

337 CASS HWM

HWM

HWM 335

300 Cass

Photo of R.R
d/s Face
Span ~57x2.5

+	HI	−		=
2.14	635.55			633.41
		.80	634.75	
6.23	640.98			
		5.13	635.85	
		6.82	634.16	
1.26	635.42			
		6.15	629.27	
6.11	635.38			
		.61	639.77	
11.3			64657	
		.08	~~696.49~~	
			635.30	
9.30	644.60		636.74	
		7.86	~~637.90~~	

BM Cass & Baum

intersect Grant & Baum

Road elev @ R.R @ Grant
ELLC

285

Sta	+	HI	−		Elev
			3.32		632.28
	4.54	636.88			
			4.18		632.64
	5.5				638.1
		632.60	4.22		628.38
		636.99			
	4.39	~~632.71~~	~~4.39~~		632.60
			3.92		~~628.85~~
	~~4.4~~				
					634.29
	2.67	636.96			
			3.92		633.04
	4.4				637.44
					634.29
	2.79	637.08			
			.66		636.42
	1.2				6376

MAX
Mr. Hemingway
512 N. Cass Cnfo & COE EPR
Vassar 48768
HWM

526

H/WM 526

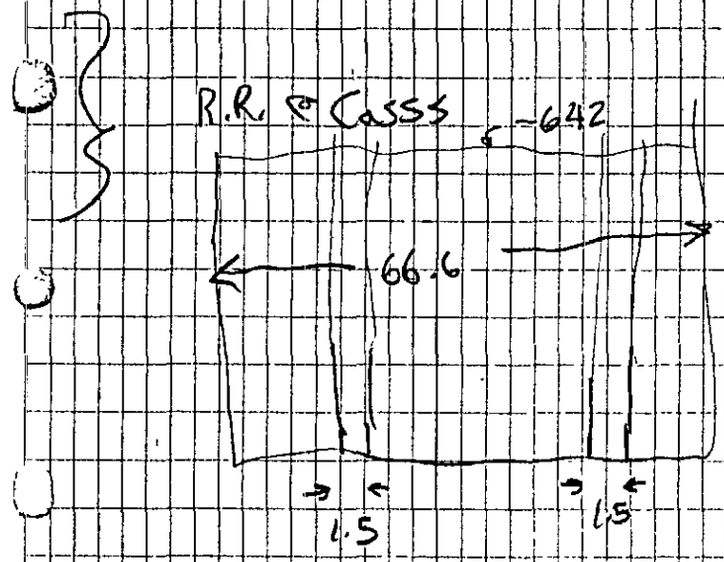
Bench

HWM 627 Cass

Station	+	H.I	−		Elev.
					634.29
	179	636.08			
			2.67		633.41
	.12	633.53			
sidewalk			4.12		629.41
edge Rd			4.15		629.38
℄ Rd			3.78		629.75
edge Rd			3.82		629.71
			3.72		629.81
			3.86		629.67
Hum Sign					
↳	7.4				
419			-.09		633.44
Hum	4.0				637.4
			2.24		631.29
	4.31	635.60			
fire hyd.			2.19		633.41
			1.72		633.88
	3.4				632.28
			2.31		633.29
	3.9				632.19

Bench @ Cass & Chestnut

Top of fire hydrant Cass & Bourn



430 Porch Elev
Hum

429 Porch Elev
Hum

REVISED FLOOD INSURANCE STUDY
CITY OF VASSAR
TUSCOLA COUNTY

Prepared for:

Federal Emergency Management Agency

Prepared by:

Michigan Department of Natural Resources
Land and Water Management Division
Lansing, Michigan

July 1987
Revised September 1988

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Hydraulic Analysis
Cass River
City of Vassar, Tuscola County

Introduction

The hydraulic analysis for the Cass River was prepared as a revision to the existing Flood Insurance Study for the City of Vassar. The analysis begins about 1700 feet downstream of the corporate limits and continues to the upstream corporate limit, a total of about 1.8 miles.

Background

The September 1986 flood on the Cass River at Vassar exceeded the 100-year flood elevations shown in the Flood Insurance Study by about 2 to 3 feet. Due to the extensive damage to residential and business structures, the City has developed a plan to relocate the downtown business district and residential areas to locations outside of the 100-year floodplain. This analysis was prepared to better define the 100-year floodplain and floodway.

The July 1987 report prepared by this office is superseded by this report. At the request of the City of Vassar, the "losses" shown at the New York Central Railroad crossing (cross sections K & L) were reanalyzed. The current analysis has used 1986 high water mark information in the vicinity of the crossing to produce stages that are consistent with the 1986 flood. As a result, 100-year flood stages upstream of cross section K have been reduced by about one foot from what was shown in the 1987 report. However, the stages are still about two feet higher than the original FIS for the City.

The 1986 flood was the flood of record on all of the gaging stations on the Cass River. At Vassar the flood peak was estimated to be about 21,000 cfs, as compared to the previous record peak discharge of about 18,000 cfs, in 1948. The Flood Insurance Study (FIS) prepared in 1976, had used a 100-year discharge of 18,200 cfs. The revised 100-year flood flow which includes the 1986 flood and 10 additional years of record has been computed to be 22,800 cfs.

The bridge and cross sectional information used in the hydraulic analysis was obtained from the technical support data for the City of Vassar FIS prepared by the U.S. Geological Survey. The U.S. Army Corps of Engineers computer program HEC-2 (Reference #1) was used to revise the flood profiles for the City of Vassar. The hydraulic calculations in the original FIS were made on the E-431 computer program (Reference #2). Because of differences in computational methods between HEC-2 and E-431, there are minor differences in the flood stages computed for similar discharges.

Table 1 provides a cross-reference between the HEC-2 model and the FIS mapping. The floodway and floodplain delineations are based upon the topographic information contained in the Corps of Engineer's Flood Insurance Study for the City of Vassar's Flood Control Project (Reference #4), and have been drawn on a copy of the City of Vassar's Floodway Flood Boundary Map (Reference #3).

Table 1
City of Vassar - Cass River
Cross Section Location

HEC-2 Input	FIS Map Designation	Description
8300	-	1700 feet d/s of corporate limit
9500	-	500 feet d/s of corporate limit
10000	A	d/s corporate limit 95 ft. d/s of Pere Marquette Railroad Bridge
10600	B	
11000	C	
11450	D	At Saginaw Street Extended
11900	E	
12100	F	
12300	G	
12500	H	200 feet d/s of Huron Street
12700		Flow in right overbank at Huron Street restricted due to buildings
12950	I	180 feet u/s of Huron Street
13350	J	

HEC-2 Input	FIS Map Designation	Description
13700	K	d/s of New York Central Railroad
13925		At New York Central Railroad Flow area includes Cass Road underpass. Discharge coefficient reduces, to match 1986 high water marks.
14100	L	160 feet u/s of NYCRR
14700	M	
15300	N	
16250	O	
17250	P	
18750	Q	
19700	R	upstream corporate limit

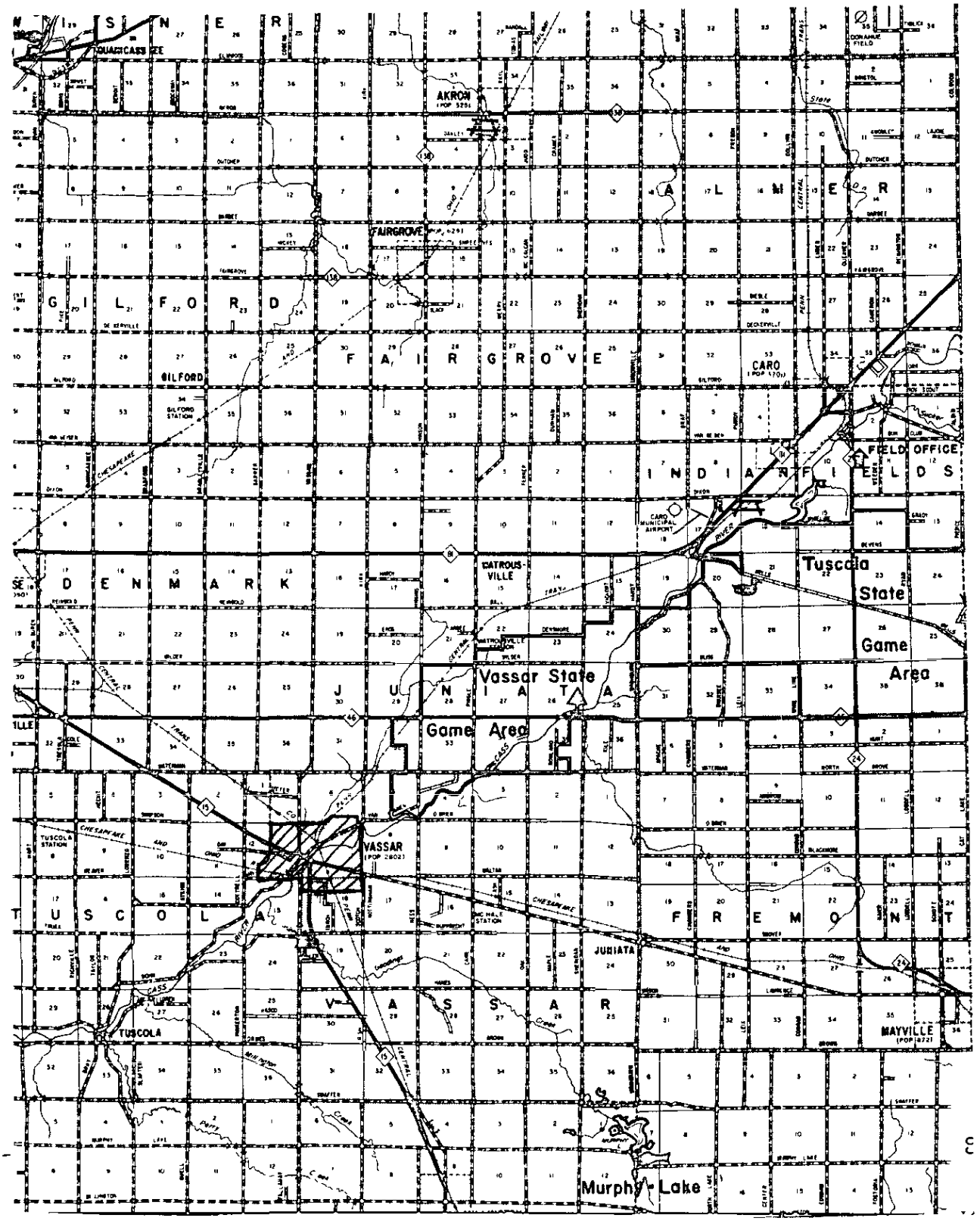

Figure 1 - Site Location Map
City of Vassar
Tuscola County

Hydrology

The peak discharge-frequency relationships for Vassar were based upon an interpolation of the log-Pearson Type III analyses for the Wahjamega Gage (drainage area = 645 square miles) and the Frankenmuth Gage (DA = 841 square miles). The gage record at Wahjamega was extended by a correlation of the Frankenmuth gage record. The gaging station at Vassar (DA = 710 square miles) was discontinued in 1982.

Table 2 - Summary of Discharges

Flooding Source and Location	Drainage Area (Sq. Miles)	Peak Discharge (FIS) CFS 10-yr	50-yr	100-yr	500-yr
Cass River at Huron Street	710	13,700	20,000	22,800	29,400

Hydraulics

Starting Conditions

The profiles were begun about 1700 feet downstream of the corporate limit, using the slope-area method to obtain the starting water surface elevation. The slope was obtained from the 1986 high water marks.

Coefficients

Manning's roughness coefficients were based upon early spring conditions, and ranged from .03 to .04 within the channel. At some locations, very high "n" values were used in the overbanks either to obtain a reasonable flow distribution or to try to account for obstructions.

Contraction and expansion coefficients (Reference #1) of .1 and .3, respectively, were used for smooth transitions. In the vicinity of bridges, these values were increased to .3 and .5, respectively. At the Pere Marquette Railroad Bridge, the values were increased to .6 and .8 to better define the loss during flood flows.

Bridge Losses

The energy losses due to bridges were computed using HEC-2 Special Bridge and Normal Bridge Routines (Reference #1).

In the vicinity of bridges and other obstructions, flow was allowed to contract at a 1:1 ratio and expand at a rate of 4:1.

Huron Street (SECNO 12700-12770)

A large portion of the weir is ineffective due to the buildings in the right overbank, and the solid guardrail on the bridge. The model has been adjusted to reflect this condition.

New York Central RR (SECNO 13925-13940)

The crossing was modeled using the special bridge routine. The total bridge area includes the area of the bridge at the Cass River, and the area of the underpass at Cass Road. During the 100-year flood, the Cass Road underpass has about 490 square feet of opening and Grant Stret has about 100 square feet of opening functioning as a waterway. The discharge coefficient was adjusted tomatch the 1986 high wtaer marks at the bridge.

The roughness coefficients and effective flow areas in the vicinity of the crossing were also adjusted to get a reasonable flow distribution upstream and downstream of the Cass Road underpass.

Past Flooding

The flood of record occurred in September 1986. The discharge was estimated to be about 21,000 cfs. The City provided the following high water marks that resulted from the flood.

	Elevation, Feet (NGVD)	
1.	634.5	At Vassar Road about 100 feet north of Procter. (Southern City Limits).
2.	635.8	At Wastewater Treatment Plant on Water Street north of railroad.
3.	636.75	At City Hall on Huron Street (upstream) in left overbank.
4.	637.4	At intersection of Cass and Bourn Streets.

The Michigan Department of Natural Resources also obtained high water marks in the vicinity of the New York Central Railroad (SECNO 13925). The high water marks agreed well with those provided by the City.

The U.S.G.S. gaging station at Vassar was discontinued in 1982. Following is a list of recorded stages and estimated discharges from the gaging station (Reference #5 and #6).

Table 3 Vassar Gaging Station Rating Curve

Date	Estimated Peak Discharge (cfs)	Elevation, Ft. (NGVD)	
3/20/48	18,000	633.18	
3/6/76	11,900	630.08	
4/1/60	11,400	629.08	
3/28/50	11,300	628.98	
3/29/67	10,800	628.64	
2/3/68	8,900	629.36	stage due to ice jamming
3/5/74	8,800	628.12	
9/6/81	8,360	626.89	

The gaging station had been located downstream of Huron Street. The 1986 flood, flood stage of about 636.1, was about 3 feet higher than any previous event.

The 1986 flood was only the second flood of any magnitude that did not occur in the spring of the year. It was noted that at this gage and other gages affected by the 1986 flood, the rating curves would have underestimated stages for the measured discharges by 1 to 2 feet. It is our hypothesis that, since the rating curves have been based upon stream gaging measurements of spring floods, a summer of early fall flood would result in higher stages due to the additional flow resistance from vegetation. This may be particularly true for a flood the magnitude of the 1986 flood, which inundated large portions of overbank areas, and had stages high enough to get into the leaves and branches of trees. During early spring floods, there would be very little vegetation to provide resistance to flow.

Calibration

The 1986 high water marks were used to calibrate the hydraulic model. However, it was noted that the hydraulic model calibrated to the 1986 flood would not match the stage-discharge characteristics at the old gage site. It was decided that the flood profiles would be started using the slope-area method with the slope from the 1986 flood. Since virtually all flood events in the past have occurred in the springtime, the roughness coefficients were reduced to reflect spring vegetation.

The following table shows the comparison of the computed stage to the USGS gaging station rating curve.

Table 4 - Calibration Results
At Gaging Station (XSEC 12700)
Elevation, Ft. (NGVD)

Discharge cfs	Computed Stage	Gage Rating Curve
18000	633.1	633.2
11900	629.5	630.1
10800	628.8	628.7
8800	627.4	628.1

1986 High Water Marks

	Elevation, Ft. (NGVD)	
XSEC	Computed Stage	High Water Mark
8300	634.5	634.5
10600	635.9	635.8
12950	636.8	636.8
15300	637.4	637.4

This revised analysis has resulted in a loss at NYC Railroad that matches the 1986 high water marks.

Comparison to Previous Studies

In addition to the existing Flood Insurance Study (FIS), there is also a Flood Control Report (FCR) for the Cass River at Vassar prepared by the U.S. Army Corps of Engineers. Following is listing comparing stages from the FIS, the Flood Control Report, and the proposed hydraulic model.

Table 5 - Comparison to Previous Studies

	Elevation, Ft. (NGVD)				
FIS XSEC	FIS	FIS Revised	FCR	FIS Revised	FIS Revised
	Q = 18,200 cfs		Q = 21,500 cfs		Q_{100} = 22,800 cfs
A	631.4	632.1	633.6	633.6	634.2
H	632.7	633.2	635.0	634.9	635.5
J	632.9	634.1	635.9	635.9	636.6
K	633.3	634.2	636.2	635.9	636.6
L	634.2	634.7	637.9	636.6	637.3
R	636.6	636.2	638.8	638.0	638.7

The primary differences between the original FIS hydraulic model and the revised model include: (1) The starting slope for the revised model has been based on the 1986 flood, and is somewhat flatter than what has been used in the original model. (2) The revised model calculates more head loss at Huron Street, which appears reasonable. The original model showed very little loss through the bridge even though it was going pressure flow, with a velocity of about 7 feet per second. (3) Upstream of the New York Central RR (XSEC 13940), the revised model has used a wider "natural" floodway and has resulted in a lower loss due to "friction".

The Corps of Engineers profile and the revised model profile for 21,500 cfs show similar results, except fo rthe loss computed at the NYC Railroad crossing.

Floodway Development

The floodway for the Cass River was determined using the HEC-2 encroachment method #4 (Reference #1). This encroachment option eliminates conveyance from each side of the floodplain until a surcharge of no more than .1 foot is obtained. Due to man-made restrictions such as bridges and buildings, the floodway is well-defined in many areas of the City. In these areas, the floodway has been determined by delineating smooth curvilinear lines with 4:1 expansion, and 1:1 contraction of flow.

Results

The hydraulic analysis has computed the 10-, 50-, 100-, and 500-year flood elevations for the Cass River. This information will be used as basis for a revision request for the City of Vassar FIS. The floodway portion of the 100-year floodplain was developed and has been plotted on the work map in Appendix A.

Table 6 contains a summary of 10-, 50-, 100-, and 500-year flood elevations at selected cross sections. The flood profiles are plotted in Appendix B and are based upon unobstructed, springtime flow. The flood elevations on the profiles are considered valid only if hydraulic structures remain unobstructed, operate properly and do not fail.

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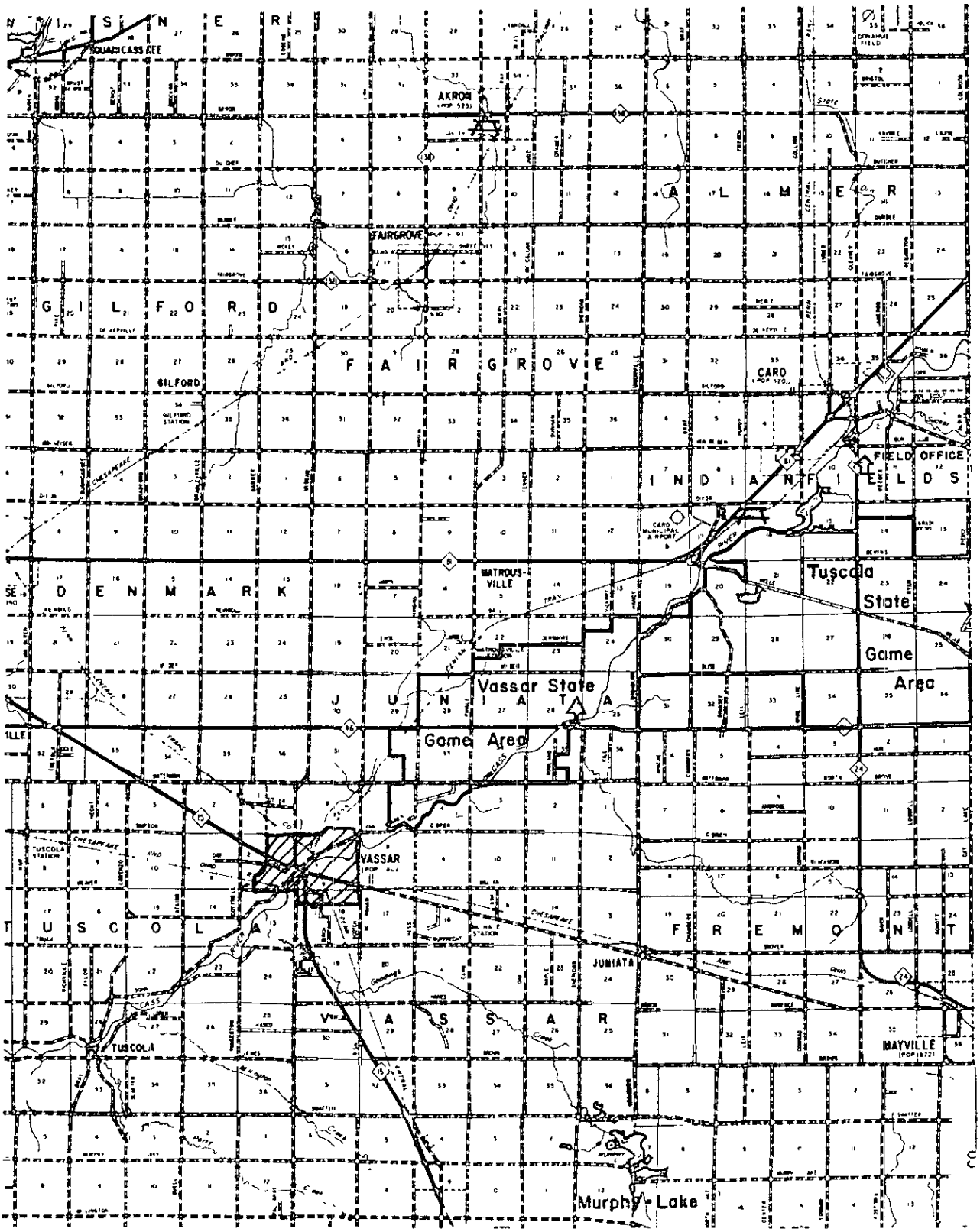
Table 6
Summary of Flood Elevations
City of Vassar Revised Flood Insurance Study
Cass River

Cross Section Designation	Location	Flood Elevations, Ft. (NGVD) 10-year	50-year	100-year	500-year
	Discharge, cfs	13,700	20,000	22,800	29,400
A	d/s corporate limit	629.7	633.0	634.2	636.6
B	480 ft. u/s of Pere Marquette Railroad	630.3	633.8	635.2	638.0
C	860 ft. u/s of Pere Marquette Railroad	630.5	634.1	635.4	638.3
D	Saginaw Street Extended	630.5	634.1	635.5	638.3
H	d/s of Huron Street	630.6	634.1	635.5	638.3
I	u/s of Huron Street	631.1	635.0	636.3	639.0
J		631.2	635.1	636.5	639.2
K	d/s of NYCRR	631.3	635.2	636.6	639.2
L	u/s of NYCRR	631.7	635.8	637.3	640.5
M		631.8	635.9	637.4	640.6
N	Ash Street Extended	632.0	636.0	637.5	640.7
O		632.1	636.1	637.6	640.8
P	—	632.3	636.3	637.8	641.0
Q		633.1	636.9	638.3	641.4
R	u/s corporate limit	633.6	637.2	638.6	641.7

Figure 1 - Site Location Map
City of Vassar
Tuscola County



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SECND	YLCH	ELTRE	ELLC	ELMIN	Q	DWEEL	DRIWS	ES	IAKIS	VCP	AFES	[illegible]
50.000	1500.00	.00	.00	[illegible]	13700.00	633.05	.00	633.31	6.17	5.44	5167.44	5513.39
50.000	1500.00	.00	.00	[illegible]	20000.00	636.85	.00	637.03	3.87	4.95	8216.12	10159.07
50.000	1500.00	.00	.00	615.20	22800.00	638.33	.00	638.50	3.36	4.83	9676.63	12428.75
50.000	1500.00	.00	.00	615.20	29400.00	641.44	.00	641.55	2.55	4.[illegible]	13620.31	15406.14
[illegible]	1050.00	.00	.00	614.40	13700.00	633.58	.00	633.72	2.64	4.16	7507.22	8435.19
[illegible]	1050.00	.00	.00	614.40	20000.00	637.20	.00	637.35	1.47	3.52	12821.8[illegible]	16315.8[illegible]
[illegible]	1050.00	.00	.00	614.40	22800.00	638.64	.00	638.71	1.21	3.35	15149.42	20587.47
[illegible]	1050.00	.00	.00	614.40	29400.00	641.65	.00	641.74	.[illegible]	3.14	20[illegible].17	[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
50.000	400.00	.00	.00	611.40	17700.00	631.18	.00	631.43	2.75	4.52	4240.51	6254.45
50.000	400.00	.00	.00	611.47	20000.00	635.11	.00	635.40	2.26	4.72	7418.71	10307.32
50.000	400.00	.00	.00	611.46	22800.00	636.49	.00	636.76	2.08	4.77	8654.94	15817.04
50.000	400.00	.00	.00	611.40	29400.00	639.17	.00	639.44	1.65	4.84	11071.23	21597.44
40.000	350.00	.00	.00	612.50	17700.00	631.12	.00	631.52	3.69	5.09	4634.90	7213.26
40.000	350.00	.00	.00	612.50	20000.00	635.45	.00	635.49	2.69	4.99	6856.15	10189.60
40.000	350.00	.00	.00	612.50	22800.00	636.52	.00	636.65	2.54	5.03	7836.21	14309.77
40.000	350.00	.00	.00	612.50	29400.00	639.24	.00	639.52	2.41	5.12	9757.16	18947.77
35.000	225.00	.00	.00	612.50	17700.00	631.19	.00	631.73	4.22	5.52	3911.09	6657.51
35.000	225.00	.00	.00	612.50	20000.00	635.17	.00	635.25	3.82	5.63	6484.52	10278.35
35.000	225.00	.00	.00	612.50	22800.00	636.92	.00	637.02	3.30	6.14	7321.04	11672.52
35.000	225.00	.00	.00	612.50	29400.00	639.17	.00	639.73	3.94	6.68	9128.61	14815.87
40.000	15.00	641.50	632.20	612.50	17700.00	631.73	.00	631.75	4.23	5.52	3911.12	6657.55
40.000	15.00	641.50	632.20	612.50	20000.00	635.32	.00	635.51	3.67	5.85	6409.51	10475.34
40.000	15.00	641.50	632.20	612.50	22800.00	636.90	.00	637.37	3.54	5.99	7674.44	12120.69
40.000	15.00	641.50	632.20	612.50	29400.00	640.09	.00	640.59	3.39	6.33	9750.98	15975.80
30.000	10.00	.00	.00	612.50	17700.00	631.23	.00	631.77	3.7[illegible]	5.42	4074.70	7114.71
30.000	10.00	.00	.00	612.50	20000.00	635.40	.00	635.84	3.06	5.76	6859.54	11426.01
30.000	10.00	.00	.00	612.50	22800.00	636.95	.00	637.39	2.91	5.83	7916.62	13776.76
30.000	10.00	.00	.00	612.50	29400.00	640.14	.00	640.60	2.71	6.15	10098.35	17837.81
30.000	150.00	.00	.00	610.30	17700.00	631.69	.00	631.90	4.10	3.88	4171.66	6765.08
30.000	150.00	.00	.00	610.30	20000.00	635.77	.00	635.96	2.80	3.79	6723.5[illegible]	10[illegible]7.66
30.000	150.00	.00	.00	610.30	22800.00	637.32	.00	637.55	2.33	3.82	7742.15	14935.03
30.000	150.00	.00	.00	610.30	29400.00	640.52	.00	640.71	2.00	3.98	9768.47	21777.86
[illegible]	590.00	.00	.00	611.90	17700.00	631.84	.00	632.06	1.93	3.91	4333.50	9850.93
[illegible]	590.00	.00	.00	611.90	20000.00	635.61	.00	636.09	1.64	4.14	8155.22	15674.21
[illegible]	590.00	.00	.00	611.90	22800.00	637.40	.00	637.67	1.56	4.24	9238.27	18178.61
[illegible]	590.00	.00	.00	611.90	29400.00	640.99	.00	640.87	1.45	4.46	11640.27	24441.62
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AY DATA. CASS RIVER 100YR FLO
E NO. 2

ION	------- FLOODWAY ------- WIDTH	SECTION AREA	MEAN VELOCITY	WATER SURFACE ELEVATION WITH FLOODWAY	WITHOUT FLOODWAY	DIFFERENCE
.000	653.	8336.	2.7	633.8	633.7	.1
.000	397.	6201.	3.7	634.1	634.0	.1
.000	236.	4464.	5.1	634.3	634.2	.1
.000	190.	3647.	6.3	634.3	634.2	.1
.000	197.	3725.	6.1	634.3	634.2	.1
.000	197.	3726.	6.1	634.3	634.2	.1
. [illegible]	200.	3695.	6.2	634.3	634.2	.1
.[illegible]	600.	7820.	2.9	635.3	635.2	.1
.00[illegible]	650.	9207.	2.5	635.5	635.4	.1
.000	650.	8935.	2.6	635.6	635.5	.1
[illegible]00	750.	11620.	2.0	635.7	635.6	.1
.	750.	7426.	3.1	635.6	635.5	.1
.[illegible]	786.	8397.	2.7	635.6	635.5	.1
. [illegible]	592.	5021.	4.5	635.6	635.5	.1
.[illegible]00	592.	5034.	4.5	635.6	635.5	.1
.[illegible]00	602.	5416.	4.2	636.4	636.3	.1
. [illegible]	602.	5499.	4.1	636.4	636.3	.1
..	898.	8730.	2.8	636.6	636.5	.1
.[illegible]	714.	7895.	2.9	636.7	636.6	.1
[illegible]00	664.	7436.	3.1	636.6	636.5	.1
[illegible]00	654.	7493.	3.0	637.0	636.9	.1
[illegible]00	684.	7976.	2.9	637.0	636.9	.1
.	70[illegible]	7773.	2.9	637.4	637.3	.1
.	300.	9752.	2.4	637.5	637.4	.1
	719.	8471.	2.7	637.6	637.5	.1
[illegible]	836.	9716.	2.3	637.7	637.6	.1
. [illegible]	896.	9122.	2.5	637.9	637.8	.1
.00[illegible]	771.	9231.	2.5	638.4	638.3	.1
.[illegible]	1512.	14[illegible]7.	1.5	638.7	638.6	.1

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                                                                THIS RUN EXECUTED 01-31-89
*********************************************
  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
*********************************************


C
T1      VASSAR FLOODPLAIN INFORMATION   USING DATA FROM FIS
T2      FLOOD DISCHARGES BASED UPON COMPS INCLUDING 1986 PEAK FLOW
T3      CASS RIVER     100YR FLOW NATURAL CONDITIONS      VASSAR2.FWY

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

      0.        3.        0.        0.   .000301       .00        .0    22800.   633.690      .000

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

     1.000      .000    -1.000      .000      .000      .850      .000      .000      .000      .000

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

   150.000   200.000      .000      .000      .000      .000      .000      .000      .000      .000


NC       .100      .100      .045      .100      .300      .000      .000      .000      .000      .000
ET       .000     4.100      .000   1538.000  2191.000      .000      .000      .000      .000      .000
                CHANNEL FROM XSEC 9500.  OVERBANK FROM TOPO
                1986 HWM FROM CITY   634.5
X1   8300.000     10.000   1567.000  1667.000      .000      .000      .000      .000      .000      .000
GR    635.000   1437.000    630.000  1537.000   612.200   1567.000   608.700   1567.000   608.700  1667.000
GR    612.200   1667.000    620.000  1692.000   625.000   2107.000   630.000   2137.000   635.000  2497.000

X1   9500.000     23.000   1449.000  1667.000  1200.000    800.000  1200.000      .000      .000      .000
X3       .000      .000      .000  1300.000      .000   1697.000      .000      .000      .000      .000
GR    638.000      .000    628.900   250.000   626.100    332.000   626.400    390.000   622.500    494.000
GR    626.200    608.000    622.700   692.000   623.600    800.000   620.500    898.000   620.500    990.000
GR    623.900   1183.000    622.700  1339.000   622.600   1411.000   621.400   1449.000   622.800   1527.000
GR    612.200   1567.000    608.700  1567.000   608.700   1667.000   612.200   1667.000   635.500   1699.000
GR    635.600   1761.000    637.100  1847.000   638.000   1900.000      .000      .000      .000      .000

NC       .000      .000      .000      .600      .800      .000      .000      .000      .000      .000
                FIS XSEC A   DS PERE MARQUETTE RR BRIDGE ELLC 644
                DS CORP LIMIT
X1  10000.000      .000      .000      .000    500.000    500.000    500.000      .000      .000      .000
X3       .000      .000      .000  1440.000      .000   1676.000      .000      .000      .000      .000

X1  10095.000      .000      .000      .000     95.000     95.000     95.000      .000      .000      .000
X3       .000      .000      .000  1463.000      .000   1653.000      .000      .000      .000      .000
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X1  10100.000    23.000   917.000  1079.000     5.000     5.000     5.000      .000      .000      .000
X2      .000      .000      .000   644.600   653.900      .000      .000      .000      .000      .000
X3      .000      .000      .000   883.000      .000  1080.000      .000      .000      .000      .000
GR    645.400   883.000   627.100   883.000   627.100   899.000   627.000   915.000   644.600   915.100
GR    645.400   917.000   614.100   917.100   616.000   930.000   612.100   980.000   609.500   990.000
GR    609.500   994.000   645.000   995.000   645.000  1001.000   609.300  1002.000   609.500  1010.000
GR    608.900  1020.000   609.100  1030.000   609.000  1040.000   609.900  1050.000   610.800  1060.000
GR    611.200  1070.000   613.400  1079.000   645.500  1080.000      .000      .000      .000      .000

X1  10115.000      .000      .000      .000    15.000    15.000    15.000      .000      .000      .000
X2      .000      .000      .000   644.600   653.900      .000      .000      .000      .000      .000
X3      .000      .000      .000   883.000      .000  1080.000      .000      .000      .000      .000

NC      .070      .080      .045      .000      .000      .000      .000      .000      .000      .000
X1  10120.000    24.000   876.000   966.000     5.000     5.000     5.000      .000      .000      .000
X3      .000      .000      .000   835.000   653.900  1035.000   653.900      .000      .000      .000
GR    635.000      .000   628.500   100.000   627.200   214.000   624.300   500.000   624.700   606.000
GR    624.700   700.000   625.800   862.000   612.200   876.000   611.400   886.000   610.800   896.000
GR    610.200   906.000   610.100   916.000   609.800   926.000   609.100   936.000   608.800   946.000
GR    608.900   956.000   609.300   966.000   610.700   976.000   611.300   986.000   612.200   994.000
GR    629.000  1018.000   636.100  1124.000   637.800  1190.000   638.000  1244.000      .000      .000

                XSEC B     1986 HWM FROM CITY  635.8
X1  10600.000     .000      .000      .000   480.000   480.000   480.000      .000      .000      .000
X3      .000      .000      .000   476.000      .000  1076.000      .000      .000      .000      .000

NC      .000      .000      .000      .100      .300      .000      .000      .000      .000      .000
NH     5.000      .045   718.000      .040   814.000      .100   894.000      .040   942.000      .070
NH  1052.000      .000      .000      .000      .000      .000      .000      .000      .000      .000
                XSEC C
X1  11000.000    31.000   518.000   806.000   380.000   380.000   380.000      .000      .000      .000
X3      .000      .000      .000   400.000      .000  1050.000      .000      .000      .000      .000
GR    639.000    50.000  6350.000   100.000   628.000   189.000   627.800   224.000   627.100   474.000
GR    626.800   500.000   624.300   560.000   625.500   718.000   624.200   720.000   612.500   724.000
GR    608.400   736.000   608.800   746.000   608.400   756.000   608.600   766.000   609.200   776.000
GR    609.600   786.000   610.800   796.000   612.500   806.000   621.000   814.000   620.200   854.000
GR    620.300   894.000   612.700   912.000   611.900   923.000   612.700   934.000   619.300   942.000
GR    619.100   958.000   622.200  1004.000   620.200  1016.000   623.500  1030.000   628.200  1052.000
GR    639.000  1052.000      .000      .000      .000      .000      .000      .000      .000      .000

NC      .000      .000      .000      .100      .300      .000      .000      .000      .000      .000
NH     5.000      .060  1020.000      .045  1174.000      .100  1250.000      .040  1300.000      .070
NH  1600.000      .000      .000      .000      .000      .000      .000      .000      .000      .000
                XSEC D
X1  11450.000    26.000  1070.000  1174.000   450.000   450.000   450.000      .000      .000      .000
X3      .000      .000      .000   750.000      .000  1400.000      .000      .000      .000      .000
GR    640.000    50.000   637.300   156.000   634.900   282.000   631.800   362.000   630.800   522.000
GR    629.400   676.000   626.700   870.000   626.400  1042.000   625.500  1070.000   612.400  1084.000
GR    608.900  1096.000   608.800  1106.000   608.400  1116.000   606.600  1126.000   609.200  1136.000
GR    609.600  1146.000   610.800  1156.000   612.400  1166.000   621.000  1174.000   620.200  1214.000
GR    619.000  1250.000   611.500  1280.000   618.000  1300.000   620.000  1350.000   627.300  1400.000
GR    640.000  1600.000      .000      .000      .000      .000      .000      .000      .000      .000
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NC      .050      .100      .040      .000      .000      .000      .000      .000      .000      .000
                XSEC E
X1  11900.000    34.000  1082.000  1391.000   450.000   450.000   450.000      .000      .000      .000
X3      .000      .000      .000  1000.000      .000  1750.000      .000      .000      .000      .000
GR   637.000   300.000   634.000   600.000   632.300   716.000   629.100   944.000   628.900   970.000
GR   627.900  1000.000   627.300  1048.000   625.700  1082.000   620.500  1100.000   612.500  1148.000
GR   608.300  1158.000   607.900  1168.000   608.200  1188.000   608.900  1208.000   605.900  1228.000
GR   600.900  1248.000   604.400  1268.000   607.100  1288.000   611.400  1308.000   610.300  1328.000
GR   612.600  1353.000   626.100  1391.000   627.800  1423.000   627.600  1455.000   631.000  1455.000
GR   630.700  1551.000   626.600  1551.000   625.900  1617.000   618.600  1677.000   622.500  1735.000
GR   625.200  1743.000   630.600  1759.000   631.000  1797.000   637.000  1850.000      .000      .000

NC      .070      .050      .040      .000      .000      .000      .000      .000      .000      .000
                XSEC F
X1  12100.000    24.000   804.000  1000.000   200.000   200.000   200.000      .000      .000      .000
X3      .000      .000      .000   600.000      .000  1350.000      .000      .000      .000      .000
GR   640.000   200.000   636.000   400.000   633.500   450.000   632.500   550.000   630.500   650.000
GR   626.600   780.000   623.000   804.000   620.500   850.000   619.500   882.000   617.900   903.000
GR   614.100   903.000   614.100   958.000   617.000   958.000   618.000   980.000   622.000   980.000
GR   626.000  1000.000   628.500  1054.000   629.000  1100.000   628.000  1200.000   626.500  1280.000
GR   628.600  1400.000   632.000  1500.000   635.000  1600.000   640.000  1750.000      .000      .000

NC      .070      .060      .035      .000      .000      .000      .000      .000      .000      .000
                XSEC G
X1  12300.000    40.000   774.000   948.000   200.000   200.000   200.000      .000      .000      .000
X3      .000      .000      .000   674.000      .000  1460.000      .000      .000      .000      .000
GR   640.000   200.000   636.000   370.000   633.500   416.000   633.200   464.000   631.700   552.000
GR   631.300   590.000   626.000   774.000   615.500   796.000   614.300   806.000   613.300   816.000
GR   612.000   827.000   611.700   836.000   611.700   846.000   610.800   856.000   610.400   866.000
GR   610.400   876.000   610.700   886.000   611.000   896.000   611.400   906.000   611.500   916.000
GR   612.600   919.000   615.500   929.000   620.600   938.000   626.300   948.000   627.400   962.000
GR   628.200  1000.000   628.400  1026.000   628.900  1064.000   629.000  1108.000   628.100  1162.000
GR   626.900  1206.000   626.500  1224.000   626.600  1270.000   627.200  1298.000   627.200  1322.000
GR   628.700  1376.000   629.700  1434.000   630.900  1440.000   634.300  1550.000   640.000  1700.000

NC      .040      .025      .030      .300      .500      .000      .000      .000      .000      .000
                XSEC H  DS HURON STREET BRIDGE  WEIR FLOW IN ROB  XKOR ADJ
X1  12500.000    28.000   765.000   967.000   200.000   200.000   200.000      .000      .000      .000
X3      .000      .000      .000   490.000      .000  1082.000      .000      .000      .000      .000
X4     2.000   640.000   597.100   640.000   722.900      .000      .000      .000      .000      .000
GR   640.000   450.000   636.200   481.000   634.900   497.000   633.600   521.000   632.800   597.000
GR   633.000   723.000   633.300   759.000   633.200   765.000   615.600   805.000   613.900   814.000
GR   612.400   825.000   611.600   835.000   612.600   845.000   612.000   855.000   612.100   865.000
GR   611.600   875.000   611.300   885.000   612.100   895.000   612.100   905.000   611.800   915.000
GR   612.000   925.000   613.200   935.000   615.600   950.000   627.700   967.000   630.100  1000.000
GR   630.000  1050.000   629.400  1082.000   640.000  1082.000      .000      .000      .000      .000

NC      .000      .025      .000      .000      .000      .000      .000      .000      .000      .000
X1  12700.000      .000      .000      .000   200.000   200.000   200.000      .000      .000      .000
X3      .000      .000      .000   490.000      .000  1082.000      .000      .000      .000      .000
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SB      .000     1.500     2.800      .000   161.000      .000  2568.000      .000   611.300   611.300
X1 12770.000      .000      .000      .000    70.000    70.000    70.000      .000      .000      .000
X2      .000      .000     1.000   630.000   633.300      .000      .000      .000      .000      .000
X3      .000      .000      .000   480.000      .000  1082.000      .000      .000      .000      .000
BT    13.000   608.000   635.900      .000   726.000   634.500      .000   800.000   633.900      .000
BT   857.000   633.900      .000   858.000   640.000      .000   908.000   640.000      .000   908.000
BT   634.500      .000   959.000   635.200      .000   960.000   637.900      .000  1118.000   637.000
BT      .000  1119.000   633.900      .000  1190.000   631.300      .000  1222.000   630.300      .000

NH     8.000      .040   758.000      .025   798.000      .040   900.000    10.000  1000.000      .040
NH  1187.000      .050  1270.000    10.000  1270.000      .025  1360.000      .000      .000      .000
                XSEC I  US HURON STREET BRIDGE   1986 HWM FROM CITY 636.75
X1 12950.000    29.000  1026.000  1187.000   180.000   180.000   180.000      .000      .000      .000
X3      .000      .000      .000   758.000      .000      .000      .000      .000      .000      .000
GR   640.000   200.000   636.100   546.000   635.400   684.000   634.200   758.000   633.300   798.000
GR   638.100   900.000   634.300  1000.000   615.600  1026.000   613.300  1036.000   612.000  1046.000
GR   611.000  1056.000   611.500  1066.000   611.300  1076.000   611.400  1086.000   611.600  1096.000
GR   611.900  1106.000   612.100  1116.000   612.200  1126.000   612.500  1136.000   612.600  1146.000
GR   612.600  1156.000   613.600  1166.000   615.700  1176.000   625.000  1187.000   629.100  1192.000
GR   630.400  1270.000   629.900  1328.000   629.500  1360.000   640.000  1360.000      .000      .000

NC      .000      .000      .000      .100      .300      .000      .000      .000      .000      .000
NH     8.000      .100   752.000      .025  1000.000      .100  1054.000      .040  1230.000      .150
NH  1428.000    10.000  1498.000      .025  1598.000      .100  2500.000      .000      .000      .000
                XSEC J
X1 13350.000    35.000  1054.000  1230.000   400.000   400.000   400.000      .000      .000      .000
X3      .000      .000      .000   900.000      .000  1798.000      .000      .000      .000      .000
X4     1.000   632.000  1598.000      .000      .000      .000      .000      .000      .000      .000
GR   640.000   300.000   636.700   332.000   636.500   660.000   635.100   752.000   633.000  1000.000
GR   631.500  1054.000   625.500  1066.000   615.600  1088.000   612.800  1102.000   612.800  1112.000
GR   612.600  1122.000   611.700  1132.000   612.000  1142.000   612.200  1152.000   612.100  1162.000
GR   612.600  1172.000   611.800  1182.000   611.400  1192.000   615.600  1222.000   622.900  1230.000
GR   626.600  1428.000   631.300  1498.000   632.300  1636.000   632.000  1714.000   627.700  1826.000
GR   625.100  1878.000   627.000  1998.000   621.200  1998.000   621.200  2014.000   627.000  2014.000
GR   627.300  2086.000   630.700  2224.000   634.900  2260.000   638.000  2400.000   640.000  2500.000

NC      .000      .000      .000      .300      .500      .000      .000      .000      .000      .000
NH     8.000      .100   316.000      .040   462.000      .150   560.000   100.000   734.000      .500
NH   910.000      .015  1000.000      .030  1140.000   100.000  2000.000      .000      .000      .000
                XSEC K  DS NEW YORK CENTRAL RR   INEFFECT AREA ASSUMED IN ROB
X1 13700.000    37.000   316.000   462.000   350.000   350.000   350.000      .000      .000      .000
X2      .000      .000      .000      .000      .000      .000      .000      .000      .000    15.000
X3      .000      .000      .000   316.000   641.500  1030.000      .000      .000      .000      .000
GR   640.000   100.000   638.800   114.000   636.000   174.000   631.300   234.000   620.600   264.000
GR   620.600   316.000   615.600   328.000   614.800   338.000   614.000   348.000   612.800   358.000
GR   612.600   368.000   612.500   378.000   612.600   388.000   612.500   398.000   612.500   408.000
GR   612.900   418.000   614.900   424.000   615.000   428.000   615.600   438.000   618.200   450.000
GR   622.600   462.000   624.400   512.000   625.500   560.000   627.700   640.000   630.600   734.000
GR   630.800   910.000   627.900  1000.000   626.800  1140.000   626.800  1284.000   629.100  1374.000
GR   630.200  1450.000   630.800  1630.000   634.000  1644.000   635.600  1692.000   636.400  1760.000
GR   638.200  1938.000   640.000  2000.000      .000      .000      .000      .000      .000      .000
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NH      4.000      .100   316.000      .040   462.000   100.000   910.000      .017  2000.000      .000
                BRIDGE AREA INCLUDES CASS ROAD UNDERPASS
                DISCHARGE COEFFICIENT REDUCED TO REPRODUCE 1986 LOSSES
X1  13925.000      .000      .000      .000   225.000   225.000   225.000      .000      .000      .000
X2      .000      .000      .000      .000      .000      .000      .000      .000      .000    15.000
X3      .000      .000      .000   316.000      .000   980.000      .000      .000      .000      .000

SB      .000     1.050     2.700   500.000    65.000      .000  3150.000     2.050   612.500   612.500
X1  13940.000      .000      .000      .000    15.000    15.000    15.000      .000      .000      .000
X2      .000      .000     1.000   632.200   641.500      .000      .000      .000      .000    15.000
X3      .000      .000      .000   316.000      .000   980.000      .000      .000      .000      .000

X1  13950.000      .000      .000      .000    10.000    10.000    10.000      .000      .000      .000
X2      .000      .000      .000      .000      .000      .000      .000      .000      .000    15.000
X3      .000      .000      .000   306.000      .000   990.000      .000      .000      .000      .000

XH      5.000      .100  1224.000      .075  1498.000      .400  1606.000    10.000  1656.000      .040
CH   2010.000      .000      .000      .000      .000      .000      .000      .000      .000      .000
                XSEC L  US NEW YORK CENTRAL RR
X1  14100.000     33.000  1224.000  1498.000   150.000   150.000   150.000      .000      .000      .000
X2      .000      .000      .000      .000      .000      .000      .000      .000      .000    15.000
X3      .000      .000      .000  1120.000      .000  1820.000      .000      .000      .000      .000
X4     1.000   624.000  1371.000      .000      .000      .000      .000      .000      .000      .000
GR   640.000   500.000   637.200   896.000   636.200   962.000   634.800  1000.000   632.500  1136.000
GR   640.000  1136.000   640.000  1216.000   632.300  1216.000   631.800  1224.000   615.500  1236.000
GR   614.400  1246.000   613.200  1256.000   612.400  1266.000   611.500  1276.000   610.700  1286.000
GR   610.300  1296.000   610.500  1306.000   611.500  1316.000   612.100  1326.000   613.000  1336.000
GR   615.600  1351.000   625.600  1376.000   629.100  1498.000   628.700  1572.000   628.400  1606.000
GR   628.400  1656.000   628.500  1698.000   629.300  1718.000   626.600  1758.000   625.700  1858.000
GR   627.300  1918.000   628.000  1988.000   640.000  2010.000      .000      .000      .000      .000

ET      .000     4.100     4.100  1230.000  2030.000      .000      .000      .000      .000      .000
NC      .100      .100      .040      .100      .300      .000      .000      .000      .000      .000
                XSEC M
X1  14700.000     36.000  1338.000  1530.000   590.000   590.000   590.000      .000      .000      .000
GR   642.200   852.000   640.300   954.000   640.300  1000.000   645.000  1000.000   645.000  1200.000
GR   634.100  1200.000   626.600  1242.000   625.800  1338.000   615.500  1363.000   615.100  1373.000
GR   613.900  1383.000   612.900  1393.000   613.100  1403.000   612.900  1413.000   612.900  1423.000
GR   613.000  1433.000   613.100  1443.000   613.400  1453.000   613.400  1463.000   613.600  1473.000
GR   613.700  1483.000   613.500  1493.000   613.300  1503.000   614.100  1513.000   615.600  1519.000
GR   627.000  1530.000   627.700  1634.000   629.800  1766.000   632.000  1938.000   632.900  1966.000
GR   631.400  2028.000   634.100  2208.000   634.500  2322.000   635.700  2498.000   636.700  2534.000
GR   642.000  2600.000      .000      .000      .000      .000      .000      .000      .000      .000

ET      .000     1.400     4.100   220.000  1020.000      .000      .000      .000      .000      .000
NH      4.000      .120   378.000      .040   553.000      .120   574.000      .050  2000.000      .000
                XSEC N      1986 HWH FROM CITY 637.4
X1  15300.000     32.000   378.000   574.000   600.000   600.000   600.000      .000      .000      .000
GR   543.000      .000   642.000   182.000   631.200   268.000   626.600   378.000   615.500   396.000
GR   614.100   406.000   613.900   416.000   613.700   426.000   613.500   436.000   613.200   446.000
GR   612.900   456.000   612.800   466.000   612.500   476.000   612.200   486.000   612.000   496.000
GR   611.800   506.000   611.700   516.000   611.800   526.000   612.300   536.000   613.100   546.000
GR   615.600   553.000   626.100   574.000   629.400   708.000   630.500   858.000   632.100   902.000
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GR    632.500    951.000    632.900   1067.000    636.200   1197.000    637.700   1371.000    637.900   1635.000
GR    639.900   1811.000    642.000   2000.000       .000       .000       .000       .000       .000       .000

ET       .000      1.400      4.100    100.000   1000.000       .000       .000       .000       .000       .000
NC       .120       .120       .040       .000       .000       .000       .000       .000       .000       .000
                XSEC Q
X1  16250.000     32.000    300.000    497.000    950.000    950.000    950.000       .000       .000       .000
GR    638.800       .000    632.800     24.000    631.500    142.000    626.700    300.000    615.600    315.000
GR    614.400    325.000    614.500    335.000    614.200    345.000    613.800    355.000    613.400    365.000
GR    613.200    375.000    613.300    385.000    613.200    395.000    613.200    405.000    613.000    415.000
GR    612.800    425.000    612.700    435.000    612.800    445.000    612.600    455.000    613.200    465.000
GR    615.600    473.000    621.900    497.000    623.200    531.000    625.800    595.000    632.400    731.000
GR    632.500    951.000    632.900   1067.000    636.200   1197.000    637.700   1371.000    637.900   1635.000
GR    639.900   1811.000    642.000   2000.000       .000       .000       .000       .000       .000       .000

ET       .000      6.100      4.100     52.000   1200.000     52.000    950.000       .000       .000       .000
NC       .100       .100       .045       .000       .000       .000       .000       .000       .000       .000
                XSEC P
X1  17250.000     26.000     52.000    224.000   1000.000   1000.000   1000.000       .000       .000       .000
GR    639.900       .000    639.000       .100    632.700     52.000    629.300     68.000    619.200    106.000
GR    615.500    120.000    614.400    130.000    613.500    140.000    612.400    150.000    612.100    160.000
GR    612.600    170.000    612.800    180.000    613.100    190.000    613.600    200.000    615.600    210.000
GR    621.900    224.000    623.200    268.000    625.800    332.000    625.800    468.000    632.400    688.000
GR    632.900    704.000    636.200    834.000    637.700   1008.000    637.900   1270.000    639.900   1446.000
GR    642.000   1600.000       .000       .000       .000       .000       .000       .000       .000       .000

ET       .000      1.400      6.100    510.000   1782.000    510.000   1400.000       .000       .000       .000
NH      4.000       .070   1000.000       .050   1080.000       .150   1204.000       .100   3200.000       .000
                XSEC Q
X1  18750.000     21.000   1000.000   1080.000   1500.000   1500.000   1500.000       .000       .000       .000
GR    642.000    500.000    630.000    501.000    627.000   1000.000    616.300   1014.000    615.800   1024.000
GR    615.200   1034.000    615.500   1044.000    615.300   1054.000    615.500   1064.000    616.300   1080.000
GR    617.800   1128.000    620.400   1152.000    629.700   1206.000    632.900   1250.000    636.400   1356.000
GR    638.600   1542.000    637.900   1710.000    637.700   1896.000    638.600   2160.000    639.700   2190.000
GR    642.000   3200.000       .000       .000       .000       .000       .000       .000       .000       .000

ET       .000      1.400      4.100    586.000   2200.000       .000       .000       .000       .000       .000
NH      4.000       .070   2044.000       .045   2140.000       .090   2200.000       .070   3000.000       .000
                XSEC R  US CORP LIMIT
X1  19700.000     26.000   2044.000   2140.000   1050.000   1050.000   1050.000       .000       .000       .000
GR    642.000       .000    640.000    200.000    635.000    700.000    630.000   1200.000    626.800   1990.000
GR    627.000   2016.000    624.400   2044.000    617.500   2052.000    616.700   2060.000    615.700   2070.000
GR    615.100   2080.000    614.900   2090.000    614.400   2100.000    615.100   2110.000    616.000   2120.000
GR    616.400   2130.000    617.500   2140.000    622.100   2164.000    624.700   2174.000    629.500   2184.000
GR    637.500   2200.000    637.800   2216.000    637.900   2250.000    637.700   2268.000    640.000   3000.000
GR    642.000   3000.000       .000       .000       .000       .000       .000       .000       .000       .000
EJ       .000       .000       .000       .000       .000       .000       .000       .000       .000       .000
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  SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       QLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


#PROF 1

CCHV=    .100 CEHV=    .300
#SECNO 8300.000
                CHANNEL FROM XSEC 9500.  OVERBANK FROM TOPO
                1986 HWM FROM CITY   634.5
 8300.00    24.99   633.69      .00   633.69   633.99      .30      .00      .00   612.20
  22800.     625.   13812.    8363.     514.    2499.    5759.       0.       0.   612.20
     .00     1.22     5.53     1.45     .085     .038     .085     .000   608.70  1463.20
 .000303       0.       0.       0.        0        0        0      .00   939.48  2402.68


#SECNO 9500.000

3470 ENCROACHMENT STATIONS=    1300.0    1697.0  TYPE=     1  TARGET=     397.000
 9500.00    25.33   634.03      .00      .00   634.34      .31      .35      .00   621.40
  22800.    2611.   19755.     435.    1711.    4123.     327.     178.      15.   612.20
     .07     1.53     4.79     1.33     .085     .038     .085     .000   608.70  1300.00
 .000317    1200.    1200.     800.        1        0        0      .00   396.97  1696.97


CCHV=    .600 CEHV=    .800
#SECNO 10000.000

3470 ENCROACHMENT STATIONS=    1440.0    1676.0  TYPE=     1  TARGET=     236.000
                FIS XSEC A   DS PERE MARQUETTE RR BRIDGE ELLC 644
                DS CORP LIMIT
10000.00    25.48   634.18      .00      .00   634.63      .45      .18      .11   621.40
  22800.     121.   22478.     201.     114.    4158.     168.     239.      19.   612.20
     .10     1.06     5.41     1.20     .085     .038     .085     .000   608.70  1440.00
 .000399     500.     500.     500.        0        0        0      .00   236.00  1676.00


#SECNO 10095.000

3470 ENCROACHMENT STATIONS=    1463.0    1653.0  TYPE=     1  TARGET=     190.000
10095.00    25.49   634.19      .00      .00   634.81      .61      .05      .13100000.00
  22800.       0.   22800.       0.       0.    3628.       0.     247.      19. 100000.00
     .10      .00     6.28      .00     .085     .038     .085     .000   608.70  1463.00
 .000673      95.      95.      95.        1        0        0      .00   190.00  1653.00
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  SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


*SECNO 10100.000

3265 DIVIDED FLOW


3370 NORMAL BRIDGE,NRD=  0 MIN ELTRD=  653.90 MAX ELLC=  644.60


3470 ENCROACHMENT STATIONS=     883.0    1080.0  TYPE=     1  TARGET=     197.000
 10100.00    25.29   634.19      .00      .00   634.84      .64      .00      .02   645.40
   22800.     310.   22489.       1.     228.    3472.       7.     248.      19.   613.40
      .10     1.36     6.48      .22     .085     .038     .085     .000   608.90   883.00
  .000722       5.       5.       5.        0        0        0      .00   188.05  1079.65


*SECNO 10115.000

3265 DIVIDED FLOW


3370 NORMAL BRIDGE,NRD=  0 MIN ELTRD=  653.90 MAX ELLC=  644.60


3470 ENCROACHMENT STATIONS=     883.0    1080.0  TYPE=     1  TARGET=     197.000
 10115.00    25.30   634.20      .00      .00   634.85      .64      .01      .00   645.40
   22800.     310.   22488.       1.     228.    3473.       7.     249.      19.   613.40
      .10     1.36     6.48      .22     .085     .038     .085     .000   608.90   883.00
  .000721      15.      15.      15.        0        0        0      .00   188.05  1079.65


*SECNO 10120.000

3470 ENCROACHMENT STATIONS=     835.0    1035.0  TYPE=     1  TARGET=     200.000
 ELENCL=    653.90  ELENCR=    653.90
 10120.00    25.38   634.18      .00      .00   634.97      .80      .00      .12   612.20
   22800.    1072.   20076.    1652.     441.    2651.     584.     250.      19.   611.30
      .10     2.43     7.57     2.83     .060     .038     .068     .000   608.80   835.00
  .000547       5.       5.       5.        2        0        0      .00   200.00  1035.00


*SECNO 10600.000
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  SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


3301 HV CHANGED MORE THAN HVINS


3470 ENCROACHMENT STATIONS=     476.0    1076.0  TYPE=     1  TARGET=     600.000
                XSEC B      1986 HWM FROM CITY  635.8
 10600.00    26.40   635.20      .00      .00   635.46      .26      .16      .32   612.20
   22800.    7521.   13955.    1324.    4218.    2763.     785.     313.      24.   611.30
      .14     1.78     5.05     1.69     .060     .038     .068     .000   608.80   476.00
  .000230     480.     480.     480.        2        0        0      .00   600.00  1076.00


CCHV=    .100 CEHV=    .300
1490 NH CARD USED
*SECNO 11000.000

3470 ENCROACHMENT STATIONS=     400.0    1050.0  TYPE=     1  TARGET=     650.000
                XSEC C
 11000.00    27.03   635.43      .00      .00   635.54      .10      .06      .02100000.00
   22800.       0.   14872.    7928.       0.    5299.    3852.     386.      29.   612.50
      .18      .00     2.81     2.06     .060     .032     .051     .000   608.40   400.00
  .000129     380.     380.     380.        2        0        0      .00   650.00  1050.00


CCHV=    .100 CEHV=    .300
1490 NH CARD USED
*SECNO 11450.000

3470 ENCROACHMENT STATIONS=     750.0    1400.0  TYPE=     1  TARGET=     650.000
                XSEC D
 11450.00    28.88   635.48      .00      .00   635.61      .13      .06      .01   625.50
   22800.    5090.    9592.    8118.    2755.    2522.    3603.     479.      36.   621.00
      .22     1.85     3.80     2.25     .042     .038     .052     .000   606.60   750.00
  .000154     450.     450.     450.        2        0        0      .00   650.00  1400.00


*SECNO 11900.000

3470 ENCROACHMENT STATIONS=    1000.0    1750.0  TYPE=     1  TARGET=     750.000
                XSEC E
 11900.00    34.65   635.55      .00      .00   635.65      .10      .04      .00   625.70
   22800.     706.   19969.    2125.     689.    7452.    3416.     585.      43.   626.10
      .28     1.02     2.68      .62     .043     .034     .085     .000   600.90  1000.00
  .000055     450.     450.     450.        1        0        0      .00   750.00  1750.00
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  SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      THA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


*SECNO 12100.000

3470 ENCROACHMENT STATIONS=     600.0    1350.0  TYPE=     1  TARGET=     750.000
                XSEC F
 12100.00    21.39   635.49      .00      .00   635.71      .23      .02      .04   623.00
   22800.    2078.   14775.    5947.    1382.    3281.    2698.     628.      46.   626.00
      .29     1.50     4.50     2.20     .060     .034     .043     .000   614.10   600.00
  .000267     200.     200.     200.        2        0        0      .00   750.00  1350.00


*SECNO 12300.000

3470 ENCROACHMENT STATIONS=     674.0    1460.0  TYPE=     1  TARGET=     786.000
                XSEC G
 12300.00    25.11   635.51      .00      .00   635.75      .24      .04      .00   626.00
   22800.     928.   16825.    5047.     808.    3737.    3786.     664.      50.   626.30
      .31     1.15     4.50     1.33     .060     .030     .051     .000   610.40   674.00
  .000142     200.     200.     200.        0        0        0      .00   786.00  1460.00


CCHV=    .300 CEHV=    .500
*SECNO 12500.000

3265 DIVIDED FLOW


3470 ENCROACHMENT STATIONS=     490.0    1082.0  TYPE=     1  TARGET=     592.000
                XSEC H  DS HURON STREET BRIDGE  WEIR FLOW IN ROB  XKOR ADJ
 12500.00    24.17   635.47      .00      .00   635.86      .39      .03      .07   633.20
   22800.     265.   20690.    1845.     301.    4008.     673.     695.      53.   627.70
      .32      .88     5.16     2.74     .034     .025     .021     .000   611.30   490.00
  .000154     200.     200.     200.        2        0        0      .00   466.07  1082.00


*SECNO 12700.000

3265 DIVIDED FLOW


3470 ENCROACHMENT STATIONS=     490.0    1082.0  TYPE=     1  TARGET=     592.000
 12700.00    24.20   635.50      .00      .00   635.89      .38      .03      .00   633.20
   22800.     270.   20675.    1854.     305.    4014.     676.     718.      55.   627.70
      .33      .89     5.15     2.74     .034     .025     .021     .000   611.30   490.00
  .000153     200.     200.     200.        0        0        0      .00   466.07  1082.00
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  SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


SPECIAL BRIDGE

SB  XK       XKOR     COFQ     RDLEN    BWC      BWP      BAREA    SS       ELCHU    ELCHD
     .00     1.50     2.80      .00   161.00      .00  2568.00      .00   611.30   611.30

*SECNO 12770.000

3265 DIVIDED FLOW

PRESSURE AND WEIR FLOW


 EGPRS     EGLWC      H3      QWEIR     QPR      BAREA   TRAPEZOID     ELLC     ELTRD
                                                          AREA
   637.34   635.89     .00     4879.   17896.    2568.    3011.      630.00   633.30


3470 ENCROACHMENT STATIONS=     480.0    1082.0  TYPE=     1  TARGET=     602.000
 12770.00    25.00   636.30      .00      .00   636.64      .34      .75      .00   633.20
   22800.     419.   20284.    2097.     429.    4175.     768.     726.      56.   627.70
     .33      .98     4.86     2.73     .034     .025     .021     .000   611.30   480.19
  .000129     70.      70.      70.        2        0        3      .00   475.90  1082.00


1490 NH CARD USED
*SECNO 12950.000

3265 DIVIDED FLOW


3470 ENCROACHMENT STATIONS=     758.0    1360.0  TYPE=     1  TARGET=    -758.000
                XSEC I  US HURON STREET BRIDGE    1986 HWM FROM CITY 636.75
 12950.00    25.33   636.33      .00      .00   636.67      .34      .03      .00   615.60
   22800.    1075.   18890.    2835.     550.    3772.    1129.     749.      58.   625.00
     .34     1.96     5.01     2.51     .033     .034     .029     .000   611.00   758.00
  .000202    180.     180.     180.        0        0        0      .00   517.54  1360.00


CCHV=    .100 CEHV=    .300
1490 NH CARD USED
*SECNO 13350.000

3470 ENCROACHMENT STATIONS=     900.0    1798.0  TYPE=     1  TARGET=     898.000
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                XSEC J
 13350.00    25.08   636.48      .00      .00   636.75      .28      .08      .01   631.50
   22800.     788.   17859.    4153.     534.    3769.    4345.     813.      64.   622.90
      .37     1.48     4.74      .96     .033     .034     .095     .000   611.40   900.00
  .000208     400.     400.     400.        2        0        0      .00   898.00  1798.00


CCHV=    .300 CEHV=    .500
1490 NH CARD USED
*SECNO 13700.000

3470 ENCROACHMENT STATIONS=     316.0    1030.0  TYPE=     1  TARGET=     714.000
 ELENCL=    641.50  ELENCR= 100000.00
                XSEC K  DS NEW YORK CENTRAL RR   INEFFECT AREA ASSUMED IN ROB
 13700.00    24.05   636.55      .00      .00   636.84      .29      .08      .00   620.60
   22800.       0.   16048.    6752.       0.    3190.    4641.     880.      71.   622.60
      .40      .00     5.03    1.46     .033     .034     .068     .000   612.50   316.00
  .000254     350.     350.     350.        0        0        0      .00   714.00  1030.00

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FLOW DISTRIBUTION FOR SECNO=  13700.00          CWSEL=    636.55

STA=     316.     462.     512.     560.     910.    1000.    1030.
  PER Q=     70.4      2.9      2.3       .8     19.7      3.8
   AREA=   3189.6    652.4    556.7   2520.6    647.8    263.0
    VEL=      5.0      1.0      1.0       .1      6.9      3.3

1490 NH CARD USED
*SECNO 13925.000

3470 ENCROACHMENT STATIONS=     316.0     980.0  TYPE=     1  TARGET=     664.000
                BRIDGE AREA INCLUDES CASS ROAD UNDERPASS
                DISCHARGE COEFFICIENT REDUCED TO REPRODUCE 1986 LOSSES
 13925.00    24.01   636.51      .00      .00   637.02      .51      .07      .11   620.60
   22800.       0.   19575.    3225.       0.    3184.    4192.     919.      74.   622.60
      .41      .00     6.15     .77     .033     .034     .158     .000   612.50   316.00
  .000380     225.     225.     225.        2        0        0      .00   664.00   980.00


FLOW DISTRIBUTION FOR SECNO=  13925.00          CWSEL=    636.51

STA=     316.     462.     640.     980.
  PER Q=     85.9       .0     14.1
   AREA=   3184.2   1998.5   2193.7
    VEL=      6.1       .0      1.5
```

```
  SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


SPECIAL BRIDGE

SB  XK       XKOR     COFQ     RDLEN    BWC      BWP      BAREA    SS       ELCHU    ELCHD
     .00     1.05     2.70   500.00    65.00      .00  3150.00     2.05   612.50   612.50

*SECNO 13940.000
PRESSURE FLOW


 EGPRS     EGLWC      H3      QWEIR     QPR      PAREA   TRAPEZOID     ELLC     ELTRD
                                                          AREA
   637.37   637.02     .00       0.   22800.    3150.    2076.     632.20   641.50


3470 ENCROACHMENT STATIONS=    316.0    980.0  TYPE=    1  TARGET=    664.000
 13940.00   24.39  636.89     .00     .00  637.37     .48     .35     .00  620.60
   22800.      0.  19407.   3393.      0.   3240.   4389.    921.     74.   622.60
      .41     .00    5.99     .77    .000    .034    .156    .000  612.50  316.00
  .000354     15.     15.     15.       2       0       0     .00  664.00  980.00


FLOW DISTRIBUTION FOR SECNO=  13940.00         CWSEL=    636.89

STA=     316.     462.     640.     980.
  PER Q=     85.1       .0     14.9
   AREA=   3239.6   2066.1   2322.7
    VEL=      6.0       .0      1.5

*SECNO 13950.000

3470 ENCROACHMENT STATIONS=    306.0    990.0  TYPE=    1  TARGET=    684.000
 13950.00   24.44  636.94     .00     .00  637.38     .44     .00     .01  620.60
   22800.    165.  18926.   3709.    163.   3247.   4500.    923.     75.   622.60
      .41    1.01    5.83     .82    .085     034    .133    .000  612.50  306.00
  .000291     10.     10.     10.       2       0       0     .00  684.00  990.00


FLOW DISTRIBUTION FOR SECNO=  13950.00         CWSEL=    636.94

STA=     306.     316.     462.     990.
  PER Q=      .7    83.0     16.3
   AREA=    163.4   3246.8   4499.6
    VEL=      1.0      5.8      .8
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  SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       QLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


1490 NH CARD USED
*SECNO 14100.000

3265 DIVIDED FLOW


3470 ENCROACHMENT STATIONS=    1120.0    1820.0  TYPE=     1  TARGET=     700.000
                XSEC L  US NEW YORK CENTRAL RR
 14100.00    27.01   637.31      .00      .00   637.49      .19      .04      .08   631.80
   22800.      66.   17825.    4910.     117.    4659.    2961.     950.      77.    629.10
      .42      .56     3.83     1.66     .085     .038     .059     .000   619.30  1120.00
  .000233     150.     150.     150.        2        0        0      .00   620.00  1820.00


FLOW DISTRIBUTION FOR SECNO=  14100.00          CWSEL=    637.31

STA=    1120.    1224.    1498.    1698.    1758.    1820.
  PER Q=       .3     78.2      5.8      6.9      8.8
   AREA=    116.8   4659.0   1737.5    542.5    681.2
    VEL=       .6      3.8       .8      2.9      3.0

CCHV=    .100 CEHV=    .300
*SECNO 14700.000

3470 ENCROACHMENT STATIONS=    1230.0    2030.0  TYPE=     1  TARGET=     800.000
                XSEC M
 14700.00    24.49   637.39      .00      .00   637.62      .23      .11      .01   625.80
   22800.    1254.   18284.    3262.    1191.    4314.    3777.    1065.      86.    627.00
      .47     1.05     4.24      .86     .085     .034     .085     .000   612.90  1230.00
  .000156     590.     590.     590.        2        0        0      .00   800.00  2030.00


1490 NH CARD USED
*SECNO 15300.000

3470 ENCROACHMENT STATIONS=     220.0    1020.0  TYPE=     1  TARGET=     800.000
                XSEC N       1986 HWM FROM CITY 637.4
 15300.00    25.84   637.54      .00      .00   637.71      .17      .08      .01   626.60
   22800.     710.   16981.    5108.    1109.    4513.    3319.    1191.      97.    626.10
      .52      .64     3.76     1.54     .102     .035     .043     .000   611.70   220.00
  .000126     600.     600.     600.        2        0        0      .00   800.00  1020.00
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  SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      THA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


*SECNO 16250.000

3470 ENCROACHMENT STATIONS=     100.0    1000.0  TYPE=     1  TARGET=     900.000
                XSEC O
 16250.00    25.03   637.63      .00      .00   637.85      .22      .13      .02   626.70
   22800.    1111.   18769.    2920.    1595.    4515.    3899.    1398.     116.    621.90
      .59      .70     4.16      .75     .102     .034     .102     .000   612.60   100.00
  .000144     950.     950.     950.        2        0        0      .00   900.00  1000.00


*SECNO 17250.000

3470 ENCROACHMENT STATIONS=      52.0    1200.0  TYPE=     1  TARGET=    1148.000
                XSEC P
 17250.00    25.73   637.83      .00      .00   638.04      .21      .19      .00   632.70
   22800.       0.   15103.    7697.       0.    3383.    5753.    1617.     139.    621.90
      .68      .00     4.46     1.34     .085     .038     .085     .000   612.10    52.00
  .000266    1000.    1000.    1000.        2        0        0      .00  1122.73  1174.73


1490 NH CARD USED
*SECNO 18750.000

3470 ENCROACHMENT STATIONS=     510.0    1400.0  TYPE=     1  TARGET=     890.000
                XSEC Q
 18750.00    23.12   638.32      .00      .00   638.49      .17      .45      .00   627.00
   22800.   10062.    8382.    4356.    4827.    1731.    2971.    1939.     174.    616.30
      .82     2.08     4.84     1.47     .059     .043     .108     .000   615.20   510.00
  .000337    1500.    1500.    1500.        2        0        0      .00   890.00  1400.00


1490 NH CARD USED
*SECNO 19700.000

3470 ENCROACHMENT STATIONS=     586.0    2200.0  TYPE=     1  TARGET=    1614.000
                XSEC R  US CORP LIMIT
 19700.00    24.23   638.63      .00      .00   638.70      .07      .20      .01   624.40
   22800.   14534.    7227.    1039.   12179.    2158.     802.    2236.     204.    617.50
      .97     1.19     3.35     1.30     .059     .038     .077     .000   614.40   586.00
  .000122    1050.    1050.    1050.        0        0        0      .00  1614.00  2200.00
```

THIS RUN EXECUTED 01-31-89

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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
T2
T3

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0.	2.	0.	0.	.000000	.00	.0	22800.	633.790	.000

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	15.000	.000	-1.000	.000	.000	.850	.000	.000	.000	.000

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  SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


#PROF 2

CCHV=    .100 CEHV=    .300
#SECNO 8300.000

3470 ENCROACHMENT STATIONS=    1538.0    2191.0  TYPE=     1  TARGET=     653.000
               CHANNEL FROM XSEC 9500.  OVERBANK FROM TOPO
               1986 HWM FROM CITY   634.5
  8300.00    25.09   633.79      .00   633.69   634.09      .30      .00      .00   612.20
   22800.     528.   13897.    8375.     377.    2509.    5501.       0.       0.    612.20
      .00     1.40     5.54     1.52     .085     .038     .085     .000   608.70  1538.00
  .000303       0.       0.       0.        0        0        0      .00   653.00  2191.00


#SECNO 9500.000

3470 ENCROACHMENT STATIONS=    1300.0    1697.0  TYPE=     1  TARGET=     397.000
  9500.00    25.43   634.13      .00   634.03   634.44      .31      .34      .00   621.40
   22800.    2623.   19741.     436.    1726.    4145.     330.     174.      12.    612.20
      .07     1.52     4.76     1.32     .085     .038     .085     .000   608.70  1300.00
  .000311    1200.    1200.     800.        1        0        0      .00   397.00  1697.00


CCHV=    .600 CEHV=    .800
#SECNO 10000.000

3470 ENCROACHMENT STATIONS=    1440.0    1676.0  TYPE=     1  TARGET=     236.000
               FIS XSEC A   DS PERE MARQUETTE RR BRIDGE ELLC 644
               DS CORP LIMIT
 10000.00    25.58   634.28      .00   634.18   634.72      .44      .17      .11   621.40
   22800.     121.   22478.     201.     115.    4180.     169.     235.      16.    612.20
      .10     1.05     5.38     1.19     .085     .038     .085     .000   608.70  1440.00
  .000392     500.     500.     500.        0        0        0      .00   236.00  1676.00


#SECNO 10095.000

3470 ENCROACHMENT STATIONS=    1463.0    1653.0  TYPE=     1  TARGET=     190.000
 10095.00    25.59   634.29      .00   634.19   634.90      .61      .05      .13100000.00
   22800.       0.   22800.       0.        0.    3647.       0.     244.      16. 100000.00
      .10      .00     6.25      .00     .085     .038     .085     .000   608.70  1463.00
  .000662      95.      95.      95.        1        0        0      .00   190.00  1653.00
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  SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


#SECND 10100.000

3265 DIVIDED FLOW


3370 NORMAL BRIDGE,NRD=  0 MIN ELTRD=  653.90 MAX ELLC=  644.60


3470 ENCROACHMENT STATIONS=     883.0    1080.0  TYPE=     1  TARGET=     197.000
 10100.00    25.39   634.29      .00   634.19   634.93      .64      .00      .02   645.40
   22800.     314.   22484.       1.     231.    3487.       7.     245.      16.    613.40
      .10     1.36     6.45      .22     .085     .038     .085     .000   608.90   883.00
  .000712       5.       5.       5.        0        0        0      .00   188.05  1079.65


#SECND 10115.000

3265 DIVIDED FLOW


3370 NORMAL BRIDGE,NRD=  0 MIN ELTRD=  653.90 MAX ELLC=  644.60


3470 ENCROACHMENT STATIONS=     883.0    1080.0  TYPE=     1  TARGET=     197.000
 10115.00    25.40   634.30      .00   634.20   634.94      .64      .01      .00   645.40
   22800.     314.   22484.       1.     231.    3488.       7.     246.      16.    613.40
      .10     1.36     6.45      .22     .085     .038     .085     .000   608.90   883.00
  .000712      15.      15.      15.        0        0        0      .00   188.06  1079.65


#SECND 10120.000

3470 ENCROACHMENT STATIONS=     835.0    1035.0  TYPE=     1  TARGET=     200.000
 ELENCL=    653.90  ELENCR=    653.90
 10120.00    25.47   634.27      .00   634.18   635.06      .79      .00      .12   612.20
   22800.    1078.   20063.    1659.     445.    2662.     588.     246.      16.    611.30
      .10     2.42     7.54     2.82     .060     .038     .068     .000   608.80   835.00
  .000539       5.       5.       5.        2        0        0      .00   200.00  1035.00


#SECND 10600.000
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   SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS   BANK ELEV
   Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
   TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
   SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


3301 HV CHANGED MORE THAN HVINS


3470 ENCROACHMENT STATIONS=     476.0    1076.0  TYPE=     1  TARGET=     600.000
                XSEC B      1986 HWM FROM CITY  635.8
 10600.00    26.49   635.29      .00   635.20   635.54      .26      .16      .32   612.20
   22800.    7558.   13913.    1329.    4254.    2773.     793.     310.      21.    611.30
      .14     1.78     5.02     1.68     .060     .038     .068     .000   608.80   476.00
  .000226     480.     480.     480.        2        0        0      .00   600.00  1076.00


CCHV=    .100 CEHV=    .300
1490 NH CARD USED
*SECNO 11000.000

3470 ENCROACHMENT STATIONS=     400.0    1050.0  TYPE=     1  TARGET=     650.000
                XSEC C
 11000.00    27.12   635.52      .00   635.43   635.62      .10      .06      .02100000.00
   22800.       0.   14878.    7922.       0.    5333.    3873.     384.      26.    612.50
      .18      .00     2.79     2.05     .060     .032     .051     .000   608.40   400.00
  .000127     380.     380.     380.        2        0        0      .00   650.00  1050.00


CCHV=    .100 CEHV=    .300
1490 NH CARD USED
*SECNO 11450.000

3470 ENCROACHMENT STATIONS=     750.0    1400.0  TYPE=     1  TARGET=     650.000
                XSEC D
 11450.00    28.96   635.56      .00   635.48   635.69      .13      .06      .01   625.50
   22800.    5127.    9562.    8111.    2782.    2531.    3622.     478.      33.    621.00
      .23     1.84     3.78     2.24     .042     .038     .052     .000   606.60   750.00
  .000152     450.     450.     450.        2        0        0      .00   650.00  1400.00


*SECNO 11900.000

3470 ENCROACHMENT STATIONS=    1000.0    1750.0  TYPE=     1  TARGET=     750.000
                XSEC E
 11900.00    34.74   635.64      .00   635.55   635.74      .10      .04      .00   625.70
   22800.     712.   19949.    2139.     696.    7478.    3446.     584.      40.    626.10
      .28     1.02     2.67      .62     .043     .034     .085     .000   600.90  1000.00
  .000055     450.     450.     450.        1        0        0      .00   750.00  1750.00
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  SECNO    DEPTH    CWSEL    CRIWS    HSELK    EG       HV       HL       OLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


*SECNO 12100.000

3470 ENCROACHMENT STATIONS=     600.0    1350.0  TYPE=     1  TARGET=     750.000
                XSEC F
 12100.00    21.47   635.57      .00   635.49   635.79      .22      .02      .04   623.00
   22800.    2094.   14723.    5983.    1400.    3298.    2728.     628.      43.   626.00
      .29     1.50     4.46     2.19     .060     .034     .043     .000   614.10   600.00
  .000261     200.     200.     200.        2        0        0      .00   750.00  1350.00


*SECNO 12300.000

3470 ENCROACHMENT STATIONS=     674.0    1460.0  TYPE=     1  TARGET=     786.000
                XSEC G
 12300.00    25.20   635.60      .00   635.51   635.83      .24      .04      .00   626.00
   22800.     935.   16772.    5092.     816.    3752.    3829.     664.      47.   626.30
      .31     1.15     4.47     1.33     .060     .030     .051     .000   610.40   674.00
  .000140     200.     200.     200.        0        0        0      .00   786.00  1460.00


CCHV=    .300 CEHV=    .500
*SECNO 12500.000

3265 DIVIDED FLOW


3470 ENCROACHMENT STATIONS=     490.0    1082.0  TYPE=     1  TARGET=     592.000
                XSEC H  DS HURON STREET BRIDGE  WEIR FLOW IN ROB  XKOR ADJ
 12500.00    24.26   635.56      .00   635.47   635.94      .38      .03      .07   633.20
   22800.     280.   20648.    1872.     314.    4025.     682.     695.      50.   627.70
      .32     .89     5.13     2.74     .034     .025     .021     .000   611.30   490.00
  .000151     200.     200.     200.        2        0        0      .00   466.07  1082.00


*SECNO 12700.000

3265 DIVIDED FLOW


3470 ENCROACHMENT STATIONS=     490.0    1082.0  TYPE=     1  TARGET=     592.000
 12700.00    24.29   635.59      .00   635.50   635.97      .38      .03      .00   633.20
   22800.     285.   20634.    1881.     318.    4031.     686.     718.      52.   627.70
      .33     .90     5.12     2.74     .034     .025     .021     .000   611.30   490.00
  .000150     200.     200.     200.        0        0        0      .00   466.07  1082.00
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  SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


SPECIAL BRIDGE

SB  XK       XKOR     COFQ     RDLEN    BWC      BWP      BAREA    SS       ELCHU    ELCHD
     .00     1.50     2.80      .00   161.00      .00  2568.00      .00   611.30   611.30

*SECNO 12770.000

3265 DIVIDED FLOW

PRESSURE AND WEIR FLOW


 EGPRS     EGLWC      H3       QWEIR     QPR      BAREA   TRAPEZOID     ELLC     ELTRD
                                                            AREA
   637.42   635.97     .00     5091.   17935.    2568.     3011.     630.00   633.30



3470 ENCROACHMENT STATIONS=     480.0    1082.0  TYPE=     1  TARGET=     602.000
 12770.00    25.09   636.39     .00   636.30   636.72     .33      .76      .00   633.20
   22800.     437.   20238.   2124.     443.    4194.    779.     726.      53.   627.70
      .33      .99     4.83    2.73     .034     .025    .021     .000   611.30   480.00
  .000127     70.      70.     70.        2        0       2      .00   476.10  1082.00


1490 NH CARD USED
*SECNO 12950.000

3265 DIVIDED FLOW


3470 ENCROACHMENT STATIONS=     758.0    1360.0  TYPE=     1  TARGET=    -758.000
                XSEC I  US HURON STREET BRIDGE    1986 HWM FROM CITY 636.75
 12950.00    25.42   636.42     .00   636.33   636.75     .33      .03      .00   615.60
   22800.    1093.   18832.   2874.     567.    3787.   1145.     749.      55.   625.00
      .35     1.93     4.97    2.51     .033     .034    .029     .000   611.00   758.00
  .000199    180.     180.    180.        0        0       0      .00   521.97  1360.00


CCHV=    .100 CEHV=    .300
1490 NH CARD USED
*SECNO 13350.000

3470 ENCROACHMENT STATIONS=     900.0    1798.0  TYPE=     1  TARGET=     898.000
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                XSEC J
 13350.00    25.17   636.57      .00   636.48   636.84      .27      .08      .01   631.50
   22800.     816.   17786.    4199.     548.    3785.    4397.     814.      61.    622.90
      .37     1.49     4.70      .95     .033     .034     .094     .000   611.40   900.00
  .000204     400.     400.     400.        2        0        0      .00   898.00  1798.00


CCHV=    .300 CEHV=    .500
1490 NH CARD USED
*SECNO 13700.000

3470 ENCROACHMENT STATIONS=     316.0    1030.0  TYPE=     1  TARGET=     714.000
 ELENCL=    641.50  ELENCR= 100000.00
                XSEC K  DS NEW YORK CENTRAL RR   INEFFECT AREA ASSUMED IN ROB
 13700.00    24.14   636.64      .00   636.55   636.92      .28      .08      .00   620.60
   22800.       0.   15990.    6810.       0.    3203.    4692.     881.      68.    622.60
      .40      .00     4.99     1.45     .033     .034     .068     .000   612.50   316.00
  .000249     350.     350.     350.        0        0        0      .00   714.00  1030.00


FLOW DISTRIBUTION FOR SECNO=  13700.00         CWSEL=    636.64
  ------  -   -----       - -          - ---                          -  -  -

STA=     316.     462.     512.     560.     910.    1000.    1030.
  PER Q=     70.1      3.0      2.3       .8     19.9      3.9
   AREA=   3202.7    656.9    561.0   2552.2    656.0    265.7
    VEL=      5.0      1.0       .9       .1      6.9      3.3

1490 NH CARD USED
*SECNO 13925.000

3470 ENCROACHMENT STATIONS=     316.0     980.0  TYPE=     1  TARGET=     664.000
                BRIDGE AREA INCLUDES CASS ROAD UNDERPASS
                DISCHARGE COEFFICIENT REDUCED TO REPRODUCE 1986 LOSSES
 13925.00    24.10   636.60      .00   636.51   637.10      .50      .07      .11   620.60
   22800.       0.   19535.    3265.       0.    3197.    4239.     921.      71.    622.60
      .41      .00     6.11      .77     .033     .034     .158     .000   612.50   316.00
  .000374     225.     225.     225.        2        0        0      .00   664.00   980.00


FLOW DISTRIBUTION FOR SECNO=  13925.00         CWSEL=    636.60

STA=     316.     462.     640.     980.
  PER Q=     85.7       .0     14.3
   AREA=   3197.3   2014.5   2224.2
    VEL=      6.1       .0      1.5
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  SECNO    DEPTH    CHSEL    CRIWS    WSELK    EG       HV       HL       OLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    YLOBL    YLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


SPECIAL BRIDGE

SB  XK        XKOR      COFQ      RDLEN     BWC       BWP       BAREA     SS        ELCHU     ELCHD
     .00      1.05      2.70    500.00     65.00       .00   3150.00      2.05    612.50    612.50

*SECNO 13940.000
PRESSURE FLOW


 ESPRS      EGLWC      H3       QWEIR      QFR       BAREA   TRAPEZOID      ELLC     ELTRD
                                                              AREA
   637.46    637.10      .00        0.    22800.     3150.     2076.      632.20    641.50


3470 ENCROACHMENT STATIONS=     316.0     980.0  TYPE=     1  TARGET=     664.000
 13940.00    24.49   636.99      .00   636.89   637.46      .47      .36      .00   620.60
   22800.       0.   19365.    3436.       0.    3254.    4439.     923.      72.    622.60
      .41      .00     5.95      .77     .000     .034     .155     .000   612.50   316.00
  .000348      15.      15.      15.        2        0        0      .00   664.00   980.00


FLOW DISTRIBUTION FOR SECNO=  13940.00          CHSEL=    636.99

STA=     316.     462.     640.     980.
  PER Q=     84.9       .0     15.1
   AREA=   3253.8   2083.3   2355.6
    VEL=      6.0       .0      1.5

*SECNO 13950.000

3470 ENCROACHMENT STATIONS=     306.0     990.0  TYPE=     1  TARGET=     684.000
 13950.00    24.54   637.04      .00   636.94   637.47      .43      .00      .01   620.60
   22800.     164.   18884.    3752.     164.    3261.    4550.     925.      72.    622.60
      .41     1.00     5.79      .82     .095     .034     .133     .000   612.50   306.00
  .000286      10.      10.      10.        2        0        0      .00   684.00   990.00


FLOW DISTRIBUTION FOR SECNO=  13950.00          CHSEL=    637.04

STA=     306.     316.     462.     990.
  PER Q=       .7     82.8     16.5
   AREA=    164.4   3260.8   4550.4
    VEL=      1.0      5.8       .8
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  SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


1490 NH CARD USED
*SECNO 14100.000

3265 DIVIDED FLOW


3470 ENCROACHMENT STATIONS=    1120.0    1820.0  TYPE=     1  TARGET=     700.000
                XSEC L  US NEW YORK CENTRAL RR
 14100.00    27.10   637.40      .00   637.31   637.58      .18      .04      .07   631.80
   22800.      67.   17799.    4934.     119.    4634.    2990.     952.      74.    629.10
      .42      .56     3.80     1.65     .085     .038     .059     .000   610.30  1120.00
  .000229     150.     150.     150.        2        0        0      .00   620.00  1820.00


FLOW DISTRIBUTION FOR SECNO=  14100.00          CWSEL=    637.40
-----------------------------------------------------------------------------------------
STA=    1120.    1224.    1498.    1698.    1758.    1820.
  PER Q=       .3     78.1      5.9      6.9      8.8
   AREA=    119.0   4683.6   1755.5    547.9    686.8
    VEL=       .6      3.8       .8      2.9      2.9

CCHV=    .100 CEHV=    .300
*SECNO 14700.000

3470 ENCROACHMENT STATIONS=    1230.0    2030.0  TYPE=     1  TARGET=     800.000
                XSEC M
 14700.00    24.58   637.48      .00   637.39   637.70      .22      .11      .01   625.80
   22800.    1259.   18246.    3295.    1201.    4331.    3821.    1068.      84.    627.00
      .47     1.05     4.21      .86     .085     .034     .085     .000   612.90  1230.00
  .000153     590.     590.     590.        2        0        0      .00   800.00  2030.00


1490 NH CARD USED
*SECNO 15300.000
 2800 NAT Q1=  20334.40  WSEL=    637.54  ENC Q1=  20334.40  WSEL=    637.64  RATIO=   .0000
 NAT Q1=  21124.  RATIOS LOB,CH,ROB=   .0306   .7220   .2474  WSEL=    637.64

3470 ENCROACHMENT STATIONS=     337.7    1056.9  TYPE=     4  TARGET=       .037
                XSEC N       1986 HWM FROM CITY 637.4
 15300.00    25.92   637.62      .00   637.54   637.79      .18      .08      .00   626.60
   22800.     274.   17118.    5409.     410.    4529.    3533.    1191.      94.    626.10
      .52      .67     3.78     1.53     .102     .035     .043     .000   611.70   337.75
  .000126     600.     600.     600.        2        0        0      .00   719.10  1056.85
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  SECNO    DEPTH    CWSEL    CRINS    WSELK    EG       HV       HL       DLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


*SECNO 16250.000
 2800 NAT Q1=  19027.88  WSEL=    637.63  ENC Q1=  19027.88  WSEL=    637.73  RATIO=   .0000
 NAT Q1=  19704.  RATIOS LOB,CH,ROB=   .0583   .8007   .1410  WSEL=    637.73

3470 ENCROACHMENT STATIONS=     142.8     978.5  TYPE=     4  TARGET=        .034
                XSEC Q
 16250.00    25.11   637.71      .00   637.63   637.93      .23      .13      .02   626.70
   22800.     971.   18914.    2915.    1355.    4531.    3830.    1389.     111.    621.90
      .60      .72     4.17      .76     .102     .034     .102     .000   612.60   142.84
  .000144     950.     950.     950.        2        0        0      .00   835.63   978.47


*SECNO 17250.000

3470 ENCROACHMENT STATIONS=      52.0     950.0  TYPE=     1  TARGET=     898.000
                XSEC P
 17250.00    25.81   637.91      .00   637.83   638.13      .21      .19      .00   632.70
   22800.       0.   15063.    7737.       0.    3398.    5784.    1606.     131.    621.90
      .68      .00     4.43     1.34     .085     .038     .085     .000   612.10    52.00
  .000261    1000.    1000.    1000.        2        0        0      .00   898.00   950.00


1490 NH CARD USED
*SECNO 18750.000
 2800 NAT Q1=  12412.54  WSEL=    638.32  ENC Q1=  12412.54  WSEL=    638.42  RATIO=   .0000
 NAT Q1=  12687.  RATIOS LOB,CH,ROB=   .4453   .3625   .1923  WSEL=    638.42

3470 ENCROACHMENT STATIONS=     516.4    1287.2  TYPE=     4  TARGET=        .022
                XSEC Q
 18750.00    23.20   638.40      .00   638.32   638.57      .17      .44      .00   627.00
   22800.   10118.    8455.    4227.    4810.    1738.    2703.    1924.     160.    616.30
      .82     2.10     4.87     1.56     .060     .043     .109     .000   615.20   516.40
  .000339    1500.    1500.    1500.        2        0        0      .00   770.79  1287.19


1490 NH CARD USED
*SECNO 19700.000
 2800 NAT Q1=  20667.67  WSEL=    638.63  ENC Q1=  20667.67  WSEL=    638.73  RATIO=   .0000
 NAT Q1=  21067.  RATIOS LOB,CH,ROB=   .6396   .3131   .0473  WSEL=    638.73

3470 ENCROACHMENT STATIONS=     666.8    2178.4  TYPE=     4  TARGET=        .019
                XSEC R  US CORP LIMIT
 19700.00    24.31   638.71      .00   638.63   638.78      .07      .20      .01   624.40
   22800.   14614.    7277.     909.   12043.    2165.     664.    2214.     187.    617.50
      .97     1.21     3.36     1.37     .060     .038     .077     .000   614.40   666.80
  .000122    1050.    1050.    1050.        2        0        0      .00  1511.57  2178.37
```

THIS RUN EXECUTED 01-31-89

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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

CASS RIVER 100YR FLD

SUMMARY PRINTOUT TABLE 150

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
8300.000	.00	.00	.00	608.70	22800.00	633.69	.00	633.99	3.03	5.53	8772.34	13095.55
8300.000	.00	.00	.00	608.70	22800.00	633.79	.00	634.09	3.03	5.54	8388.30	13102.76
9500.000	1200.00	.00	.00	608.70	22800.00	634.03	.00	634.34	3.17	4.79	6160.94	12796.91
9500.000	1200.00	.00	.00	608.70	22800.00	634.13	.00	634.44	3.11	4.76	6200.99	12919.96
10000.000	500.00	.00	.00	608.70	22800.00	634.18	.00	634.63	3.99	5.41	4440.41	11408.41
10000.000	500.00	.00	.00	608.70	22800.00	634.28	.00	634.72	3.92	5.38	4464.15	11508.69
10095.000	95.00	.00	.00	608.70	22800.00	634.19	.00	634.81	6.73	6.28	3628.11	8791.38
10095.000	95.00	.00	.00	608.70	22800.00	634.29	.00	634.90	6.62	6.25	3646.83	8862.10
10100.000	5.00	653.90	644.60	608.90	22800.00	634.19	.00	634.84	7.22	6.48	3706.63	8486.12
10100.000	5.00	653.90	644.60	608.90	22800.00	634.29	.00	634.93	7.12	6.45	3725.18	8542.73
10115.000	15.00	653.90	644.60	608.90	22800.00	634.20	.00	634.85	7.21	6.48	3707.62	8489.13
10115.000	15.00	653.90	644.60	608.90	22800.00	634.30	.00	634.94	7.12	6.45	3726.14	8545.64
10120.000	5.00	.00	.00	608.80	22800.00	634.18	.00	634.97	5.47	7.57	3675.41	9745.50
10120.000	5.00	.00	.00	608.80	22800.00	634.27	.00	635.06	5.39	7.54	3695.16	9818.45
10600.000	480.00	.00	.00	608.80	22800.00	635.20	.00	635.46	2.30	5.05	7766.14	15025.83
10600.000	480.00	.00	.00	608.80	22800.00	635.29	.00	635.54	2.26	5.02	7819.94	15161.45
11000.000	380.00	.00	.00	608.40	22800.00	635.43	.00	635.54	1.29	2.81	9151.01	20085.28
11000.000	380.00	.00	.00	608.40	22800.00	635.52	.00	635.62	1.27	2.79	9206.63	20265.04
11450.000	450.00	.00	.00	606.60	22800.00	635.48	.00	635.61	1.54	3.80	8880.26	18345.13
11450.000	450.00	.00	.00	606.60	22800.00	635.56	.00	635.69	1.52	3.78	8935.41	18510.62
11900.000	450.00	.00	.00	600.90	22800.00	635.55	.00	635.65	.55	2.68	11556.82	30613.54
11900.000	450.00	.00	.00	600.90	22800.00	635.64	.00	635.74	.55	2.67	11619.53	30821.57

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
12100.000	200.00	.00	.00	614.10	22800.00	635.49	.00	635.71	2.67	4.50	7361.83	13955.35
12100.000	200.00	.00	.00	614.10	22800.00	635.57	.00	635.79	2.61	4.46	7425.91	14124.51
12300.000	200.00	.00	.00	610.40	22800.00	635.51	.00	635.75	1.42	4.50	8330.95	19103.71
12300.000	200.00	.00	.00	610.40	22800.00	635.60	.00	635.83	1.40	4.47	8397.49	19289.24
12500.000	200.00	.00	.00	611.30	22800.00	635.47	.00	635.86	1.54	5.16	4981.45	18368.00
12500.000	200.00	.00	.00	611.30	22800.00	635.56	.00	635.94	1.51	5.13	5020.77	18535.54
12700.000	200.00	.00	.00	611.30	22800.00	635.50	.00	635.89	1.53	5.15	4995.25	18426.68
12700.000	200.00	.00	.00	611.30	22800.00	635.59	.00	635.97	1.50	5.12	5034.34	18593.61
12770.000	70.00	633.30	630.00	611.30	22800.00	636.30	.00	636.64	1.29	4.86	5371.40	20056.15
12770.000	70.00	633.30	630.00	611.30	22800.00	636.39	.00	636.72	1.27	4.83	5415.97	20253.45
12950.000	180.00	.00	.00	611.00	22800.00	636.33	.00	636.67	2.02	5.01	5450.97	16022.28
12950.000	180.00	.00	.00	611.00	22800.00	636.42	.00	636.75	1.99	4.97	5499.38	16177.95
13350.000	400.00	.00	.00	611.40	22800.00	636.48	.00	636.75	2.08	4.74	8647.15	15800.23
13350.000	400.00	.00	.00	611.40	22800.00	636.57	.00	636.84	2.04	4.70	8729.53	15978.83
13700.000	350.00	.00	.00	612.50	22800.00	636.55	.00	636.84	2.54	5.03	7830.11	14296.02
13700.000	350.00	.00	.00	612.50	22800.00	636.64	.00	636.92	2.49	4.99	7894.56	14441.59
13925.000	225.00	.00	.00	612.50	22800.00	636.51	.00	637.02	3.80	6.15	7376.44	11669.13
13925.000	225.00	.00	.00	612.50	22800.00	636.60	.00	637.10	3.74	6.11	7436.06	11789.43
13940.000	15.00	641.50	632.20	612.50	22800.00	636.89	.00	637.37	3.54	5.99	7628.40	12115.78
13940.000	15.00	641.50	632.20	612.50	22800.00	636.99	.00	637.46	3.48	5.95	7692.64	12225.68
13950.000	10.00	.00	.00	612.50	22800.00	636.94	.00	637.38	2.91	5.83	7909.80	13364.85
13950.000	10.00	.00	.00	612.50	22800.00	637.04	.00	637.47	2.86	5.79	7975.55	13491.08
14100.000	150.00	.00	.00	610.30	22800.00	637.31	.00	637.49	2.33	3.83	7737.00	14920.83
14100.000	150.00	.00	.00	610.30	22800.00	637.40	.00	637.58	2.29	3.80	7792.78	15073.87
14700.000	590.00	.00	.00	612.90	22800.00	637.39	.00	637.62	1.56	4.24	9281.68	18263.85
14700.000	590.00	.00	.00	612.90	22800.00	637.48	.00	637.70	1.53	4.21	9352.39	18422.54
15300.000	600.00	.00	.00	611.70	22800.00	637.54	.00	637.71	1.26	3.76	8940.94	20334.40
15300.000	600.00	.00	.00	611.70	22800.00	637.62	.00	637.79	1.26	3.78	8470.74	20288.35
16250.000	950.00	.00	.00	612.60	22800.00	637.63	.00	637.85	1.44	4.16	10008.89	19027.88
16250.000	950.00	.00	.00	612.60	22800.00	637.71	.00	637.93	1.44	4.17	9716.43	18992.92
17250.000	1000.00	.00	.00	612.10	22800.00	637.83	.00	638.04	2.66	4.46	9135.88	13972.99
17250.000	1000.00	.00	.00	612.10	22800.00	637.91	.00	638.13	2.61	4.43	9182.09	14108.93
18750.000	1500.00	.00	.00	615.20	22800.00	638.32	.00	638.49	3.37	4.84	9529.55	12412.54
18750.000	1500.00	.00	.00	615.20	22800.00	638.40	.00	638.57	3.39	4.87	9250.86	12377.57

SECND	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
19700.000	1050.00	.00	.00	614.40	22800.00	638.63	.00	638.70	1.22	3.35	15138.98	20667.67
19700.000	1050.00	.00	.00	614.40	22800.00	638.71	.00	638.78	1.22	3.36	14871.62	20636.31

CASS RIVER 100YR FLO

SUMMARY PRINTOUT TABLE 150

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
8300.000	22800.00	633.69	.00	.00	.00	939.48	.00
8300.000	22800.00	633.79	.10	.00	.10	653.00	.00
9500.000	22800.00	634.03	.00	.34	.00	396.97	1200.00
9500.000	22800.00	634.13	.10	.34	.10	397.00	1200.00
10000.000	22800.00	634.18	.00	.15	.00	236.00	500.00
10000.000	22800.00	634.28	.10	.15	.10	236.00	500.00
10095.000	22800.00	634.19	.00	.02	.00	190.00	95.00
10095.000	22800.00	634.29	.10	.01	.10	190.00	95.00
10100.000	22800.00	634.19	.00	.00	.00	188.05	5.00
10100.000	22800.00	634.29	.10	.00	.10	188.05	5.00
10115.000	22800.00	634.20	.00	.01	.00	188.05	15.00
10115.000	22800.00	634.30	.10	.01	.10	188.06	15.00
10120.000	22800.00	634.18	.00	-.03	.00	200.00	5.00
10120.000	22800.00	634.27	.10	-.03	.10	200.00	5.00
10600.000	22800.00	635.20	.00	1.02	.00	600.00	480.00
10600.000	22800.00	635.29	.09	1.01	.09	600.00	480.00
11000.000	22800.00	635.43	.00	.24	.00	650.00	380.00
11000.000	22800.00	635.52	.09	.23	.09	650.00	380.00
11450.000	22800.00	635.48	.00	.04	.00	650.00	450.00
11450.000	22800.00	635.56	.08	.04	.08	650.00	450.00
11900.000	22800.00	635.55	.00	.08	.00	750.00	450.00
11900.000	22800.00	635.64	.08	.08	.08	750.00	450.00
12100.000	22800.00	635.49	.00	-.07	.00	750.00	200.00
12100.000	22800.00	635.57	.09	-.07	.09	750.00	200.00
12300.000	22800.00	635.51	.00	.03	.00	786.00	200.00
12300.000	22800.00	635.60	.08	.03	.08	786.00	200.00
12500.000	22800.00	635.47	.00	-.04	.00	466.07	200.00
12500.000	22800.00	635.56	.08	-.04	.08	466.07	200.00
12700.000	22800.00	635.50	.00	.03	.00	466.07	200.00
12700.000	22800.00	635.59	.08	.03	.08	466.07	200.00
12770.000	22800.00	636.30	.00	.79	.00	475.90	70.00
12770.000	22800.00	636.39	.09	.80	.09	476.10	70.00

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
12950.000	22800.00	636.33	.00	.03	.00	517.54	180.00
12950.000	22800.00	636.42	.09	.03	.09	521.97	180.00
13350.000	22800.00	636.48	.00	.15	.00	898.00	400.00
13350.000	22800.00	636.57	.09	.15	.09	898.00	400.00
13700.000	22800.00	636.55	.00	.08	.00	714.00	350.00
13700.000	22800.00	636.64	.09	.07	.09	714.00	350.00
13925.000	22800.00	636.51	.00	-.04	.00	664.00	225.00
13925.000	22800.00	636.60	.09	-.04	.09	664.00	225.00
13940.000	22800.00	636.89	.00	.38	.00	664.00	15.00
13940.000	22800.00	636.99	.10	.39	.10	664.00	15.00
13950.000	22800.00	636.94	.00	.05	.00	684.00	10.00
13950.000	22800.00	637.04	.10	.05	.10	684.00	10.00
14100.000	22800.00	637.31	.00	.37	.00	620.00	150.00
14100.000	22800.00	637.40	.09	.36	.09	620.00	150.00
14700.000	22800.00	637.39	.00	.08	.00	800.00	590.00
14700.000	22800.00	637.48	.09	.08	.09	800.00	590.00
15300.000	22800.00	637.54	.00	.14	.00	800.00	600.00
15300.000	22800.00	637.62	.08	.14	.08	719.10	600.00
16250.000	22800.00	637.63	.00	.09	.00	900.00	950.00
16250.000	22800.00	637.71	.08	.09	.08	835.63	950.00
17250.000	22800.00	637.83	.00	.20	.00	1122.73	1000.00
17250.000	22800.00	637.91	.09	.21	.09	898.00	1000.00
18750.000	22800.00	638.32	.00	.50	.00	890.00	1500.00
18750.000	22800.00	638.40	.08	.49	.08	770.79	1500.00
19700.000	22800.00	638.63	.00	.31	.00	1614.00	1050.00
19700.000	22800.00	638.71	.08	.31	.08	1511.57	1050.00

FLOODWAY DATA. CASS RIVER 100YR FLO
PROFILE NO. 2

STATION	FLOODWAY WIDTH	FLOODWAY SECTION AREA	FLOODWAY MEAN VELOCITY	WATER SURFACE ELEVATION WITH FLOODWAY	WATER SURFACE ELEVATION WITHOUT FLOODWAY	DIFFERENCE
8300.000	653.	8386.	2.7	633.8	633.7	.1
9500.000	397.	6201.	3.7	634.1	634.0	.1
10000.000	236.	4464.	5.1	634.3	634.2	.1
10095.000	190.	3647.	6.3	634.3	634.2	.1
10100.000	197.	3725.	6.1	634.3	634.2	.1
10115.000	197.	3726.	6.1	634.3	634.2	.1
10120.000	200.	3695.	6.2	634.3	634.2	.1
10600.000	600.	7820.	2.9	635.3	635.2	.1
11000.000	650.	9207.	2.5	635.5	635.4	.1
11450.000	650.	8935.	2.6	635.6	635.5	.1
11900.000	750.	11620.	2.0	635.7	635.6	.1
12100.000	750.	7426.	3.1	635.6	635.5	.1
12300.000	786.	8397.	2.7	635.6	635.5	.1
12500.000	592.	5021.	4.5	635.6	635.5	.1
12700.000	592.	5034.	4.5	635.6	635.5	.1
12770.000	602.	5416.	4.2	636.4	636.3	.1
12950.000	602.	5499.	4.1	636.4	636.3	.1
13350.000	898.	8730.	2.6	636.6	636.5	.1
13700.000	714.	7895.	2.9	636.7	636.6	.1
13925.000	664.	7436.	3.1	636.6	636.5	.1
13940.000	664.	7693.	3.0	637.0	636.9	.1
13950.000	684.	7976.	2.9	637.0	636.9	.1
14100.000	700.	7793.	2.9	637.4	637.3	.1
14700.000	800.	9352.	2.4	637.5	637.4	.1
15300.000	719.	8471.	2.7	637.6	637.5	.1
16250.000	836.	9716.	2.3	637.7	637.6	.1
17250.000	898.	9182.	2.5	637.9	637.8	.1
18750.000	771.	9251.	2.5	638.4	638.3	.1
19700.000	1512.	14872.	1.5	638.7	638.6	.1

THIS RUN EXECUTED 01-31-89

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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

T2 100YR FLOW

T3

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0.	3.	0.	0.	.000301	.00	.0	22800.	634.000	.000
J2	NFROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	3.000	.000	-1.000	.000	.000	.850	.000	.000	.000	.000

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  SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


#PROF 2

CCHV=    .100 CEHV=    .300
#SECNO 8300.000
  8300.00    25.00   633.70      .00   634.00   634.00      .30      .00      .00   612.20
   22800.     626.   13805.    8369.     515.    2500.    5770.       0.       0.   612.20
      .00     1.21     5.52     1.45     .085     .038     .085     .000   608.70  1462.92
  .000302       0.       0.       0.        0        0        3      .00   940.76  2403.68


#SECNO 9500.000

3470 ENCROACHMENT STATIONS=    1300.0    1697.0  TYPE=     1  TARGET=     397.000
  9500.00    25.34   634.04      .00      .00   634.35      .31      .35      .00   621.40
   22800.    2612.   19753.     435.    1713.    4126.     327.     178.      15.   612.20
      .07     1.52     4.79     1.33     .085     .038     .085     .000   608.70  1300.00
  .000317    1200.    1200.     800.        1        0        0      .00   396.99  1696.99


CCHV=    .600 CEHV=    .800
#SECNO 10000.000

3470 ENCROACHMENT STATIONS=    1440.0    1676.0  TYPE=     1  TARGET=     236.000
 10000.00    25.49   634.19      .00      .00   634.64      .45      .18      .11   621.40
   22800.     121.   22478.     201.     114.    4161.     168.     239.      19.   612.20
      .10     1.06     5.40     1.20     .085     .038     .085     .000   608.70  1440.00
  .000399     500.     500.     500.        0        0        0      .00   236.00  1676.00


#SECNO 10095.000

3470 ENCROACHMENT STATIONS=    1463.0    1653.0  TYPE=     1  TARGET=     190.000
 10095.00    25.51   634.21      .00      .00   634.82      .61      .05      .13100000.00
   22800.       0.   22800.       0.       0.    3630.       0.     248.      19. 100000.00
      .10      .00     6.28      .00     .085     .038     .085     .000   608.70  1463.00
  .000671      95.      95.      95.        1        0        0      .00   190.00  1653.00


#SECNO 10100.000

3265 DIVIDED FLOW
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   SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS   BANK ELEV
   Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
   TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
   SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


3370 NORMAL BRIDGE,NRD=  0 MIN ELTRD=  653.90 MAX ELLC=  644.60


3470 ENCROACHMENT STATIONS=     883.0    1080.0  TYPE=     1  TARGET=     197.000
 10100.00    25.30   634.20      .00      .00   634.85      .64      .00      .02   645.40
   22800.     310.   22488.       1.     228.    3474.       7.     248.      19.    613.40
      .10     1.36     6.47      .22     .085     .038     .085     .000   608.90   883.00
  .000721       5.       5.       5.        0        0        0      .00   188.05  1079.65


*SECNO 10115.000

3265 DIVIDED FLOW


3370 NORMAL BRIDGE,NRD=  0 MIN ELTRD=  653.90 MAX ELLC=  644.60


3470 ENCROACHMENT STATIONS=     883.0    1080.0  TYPE=     1  TARGET=     197.000
 10115.00    25.32   634.22      .00      .00   634.86      .64      .01      .00   645.40
   22800.     311.   22488.       1.     229.    3475.       7.     249.      19.    613.40
      .10     1.36     6.47      .22     .085     .038     .085     .000   608.90   883.00
  .000720      15.      15.      15.        0        0        0      .00   188.05  1079.65


*SECNO 10120.000

3470 ENCROACHMENT STATIONS=     835.0    1035.0  TYPE=     1  TARGET=     200.000
 ELENCL=    653.90  ELENCR=    653.90
 10120.00    25.39   634.19      .00      .00   634.98      .80      .00      .12   612.20
   22800.    1072.   20074.    1653.     442.    2652.     584.     250.      19.    611.30
      .10     2.43     7.57     2.83     .060     .038     .068     .000   608.80   835.00
  .000546       5.       5.       5.        2        0        0      .00   200.00  1035.00


*SECNO 10600.000

3301 HV CHANGED MORE THAN HVINS


3470 ENCROACHMENT STATIONS=     476.0    1076.0  TYPE=     1  TARGET=     600.000
 10600.00    26.41   635.21      .00      .00   635.47      .26      .16      .32   612.20
   22800.    7525.   13950.    1325.    4223.    2765.     786.     313.      24.    611.30
      .14     1.78     5.05     1.69     .060     .038     .068     .000   608.80   476.00
  .000230     480.     480.     480.        2        0        0      .00   600.00  1076.00
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   SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS   BANK ELEV
   Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
   TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
   SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


CCHV=    .100 CEHV=    .300
1490 NH CARD USED
*SECNO 11000.000

3470 ENCROACHMENT STATIONS=     400.0    1050.0  TYPE=     1  TARGET=     650.000
 11000.00    27.05   635.45     .00      .00   635.55     .10      .06     .02100000.00
   22800.       0.   14873.    7927.       0.    5303.    3858.     387.      29.    612.50
      .18      .00     2.80     2.06     .060     .032     .051     .000   608.40   400.00
  .000129     360.     380.     380.        2        0        0      .00   650.00  1050.00


CCHV=    .100 CEHV=    .300
1490 NH CARD USED
*SECNO 11450.000

3470 ENCROACHMENT STATIONS=     750.0    1400.0  TYPE=     1  TARGET=     650.000
 11450.00    28.89   635.49     .00      .00   635.62     .13      .06      .01   625.50
   22800.    5095.    9588.    8117.    2758.    2523.    3605.     480.      36.    621.00
      .22     1.85     3.80     2.25     .042     .038     .052     .000   606.60   750.00
  .000154     450.     450.     450.        2        0        0      .00   650.00  1400.00


*SECNO 11900.000

3470 ENCROACHMENT STATIONS=    1000.0    1750.0  TYPE=     1  TARGET=     750.000
 11900.00    34.66   635.56     .00      .00   635.66     .10      .04      .00   625.70
   22800.     707.   19966.    2127.     690.    7455.    3420.     586.      43.    626.10
      .28     1.02     2.68     .62     .043     .034     .085     .000   600.90  1000.00
  .000055     450.     450.     450.        1        0        0      .00   750.00  1750.00


*SECNO 12100.000

3470 ENCROACHMENT STATIONS=     600.0    1350.0  TYPE=     1  TARGET=     750.000
 12100.00    21.40   635.50     .00      .00   635.72     .23      .02      .04   623.00
   22800.    2080.   14769.    5951.    1385.    3284.    2702.     629.      46.    626.00
      .29     1.50     4.50     2.20     .060     .034     .043     .000   614.10   600.00
  .000266     200.     200.     200.        2        0        0      .00   750.00  1350.00


*SECNO 12300.000

3470 ENCROACHMENT STATIONS=     674.0    1460.0  TYPE=     1  TARGET=     786.000
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  SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XWL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


 12300.00   25.13   635.53     .00      .00   635.76     .24      .04      .00   626.00
   22800.    929.   16818.   5053.     809.   3739.   3792.     665.     50.    626.30
      .31    1.15     4.50    1.33     .060    .030    .051     .000   610.40   674.00
  .000142    200.     200.    200.       0       0       0      .00   786.00  1460.00


CCHV=    .300 CEHV=    .500
*SECNO 12500.000

3265 DIVIDED FLOW


3470 ENCROACHMENT STATIONS=     490.0    1082.0  TYPE=     1  TARGET=     592.000
 12500.00   24.18   635.48     .00      .00   635.87     .38      .03      .07   633.20
   22800.    267.   20685.   1848.     303.   4010.    674.     696.     53.    627.70
      .32     .83     5.16    2.74     .034    .025    .021     .000   611.30   490.00
  .000154    200.     200.    200.       2       0       0      .00   466.07  1082.00


*SECNO 12700.000

3265 DIVIDED FLOW


3470 ENCROACHMENT STATIONS=     490.0    1082.0  TYPE=     1  TARGET=     592.000
 12700.00   24.22   635.52     .00      .00   635.90     .38      .03      .00   633.20
   22800.    272.   20670.   1858.     307.   4016.    677.     719.     55.    627.70
      .33     .89     5.15    2.74     .034    .025    .021     .000   611.30   490.00
  .000153    200.     200.    200.       0       0       0      .00   466.07  1082.00



SPECIAL BRIDGE

SB  XK       XKOR     COFQ     RDLEN    BWC      BHP      BAREA    SS       ELCHU    ELCHD
     .00     1.50     2.80       .00   161.00      .00  2568.00      .00   611.30   611.30

*SECNO 12770.000

3265 DIVIDED FLOW

PRESSURE AND WEIR FLOW
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  SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       QLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CDRAR    TOPWID     ENDST


 EGPRS      EGLHC      H3       QWEIR      QPR       BAREA   TRAPEZOID      ELLC     ELTRD
                                                              AREA
    637.35    635.90       .00     4897.    17879.     2568.     3011.      630.00    633.30


3470 ENCROACHMENT STATIONS=     480.0    1082.0  TYPE=     1  TARGET=     602.000
 12770.00    25.01   636.31      .00      .00   636.64      .34      .75      .00   633.20
   22800.     421.   20280.    2100.     430.    4177.     769.     727.      56.    627.70
      .33      .98     4.86     2.73     .034     .025     .021     .000   611.30   490.12
  .000129      70.      70.      70.        2        0        3      .00   475.98  1082.00


1490 NH CARD USED
*SECNO 12950.000

3265 DIVIDED FLOW


3470 ENCROACHMENT STATIONS=     758.0    1360.0  TYPE=     1  TARGET=    -758.000
 12950.00    25.34   636.34      .00      .00   636.67      .34      .03      .00   615.60
   22800.    1077.   18885.    2838.     551.    3773.    1131.     749.      58.    625.00
      .34     1.95     5.00     2.51     .033     .034     .029     .000   611.00   758.00
  .000202     180.     180.     180.        0        0        0      .00   517.96  1360.00


CCHV=    .100 CEHV=    .300
1490 NH CARD USED
*SECNO 13350.000

3470 ENCROACHMENT STATIONS=     900.0    1798.0  TYPE=     1  TARGET=     898.000
 13350.00    25.09   636.49      .00      .00   636.76      .28      .08      .01   631.50
   22800.     790.   17852.    4158.     535.    3770.    4350.     814.      64.    622.90
      .37     1.48     4.73      .96     .033     .034     .095     .000   611.40   900.00
  .000208     400.     400.     400.        2        0        0      .00   898.00  1798.00


CCHV=    .300 CEHV=    .500
1490 NH CARD USED
*SECNO 13700.000

3470 ENCROACHMENT STATIONS=     316.0    1030.0  TYPE=     1  TARGET=     714.000
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  SECNO    DEPTH    CWSEL    CRIWS    WSELK    ES       HV       HL       OLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


 ELENCL=    641.50  ELENCR= 100000.00
 13700.00    24.06   636.56      .00      .00   636.85      .29      .08      .00   620.60
   22800.       0.   16042.    6758.       0.    3191.    4645.     880.      71.    622.60
      .40      .00     5.03     1.45     .033     .034     .068     .000   612.50   316.00
  .000254     350.     350.     350.        0        0        0      .00   714.00  1030.00
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 FLOW DISTRIBUTION FOR SECNO=  13700.00         CWSEL=    636.56

 STA=     316.     462.     512.     560.     910.    1000.    1030.
   PER Q=     70.4      2.9      2.3       .8     19.7      3.8
    AREA=   3190.8    652.8    557.1   2523.6    648.6    263.2
     VEL=      5.0      1.0      1.0       .1      6.9      3.3

 1490 NH CARD USED
 *SECNO 13925.000

 3470 ENCROACHMENT STATIONS=     316.0     980.0  TYPE=     1  TARGET=     664.000
  13925.00    24.02   636.52      .00      .00   637.02      .50      .07      .11   620.60
   22800.       0.   19571.    3229.       0.    3185.    4197.     920.      74.    622.60
      .41      .00     6.14      .77     .033     .034     .158     .000   612.50   316.00
  .000380     225.     225.     225.        2        0        0      .00   664.00   980.00


 FLOW DISTRIBUTION FOR SECNO=  13925.00         CWSEL=    636.52

 STA=     316.     462.     640.     980.
   PER Q=     85.8       .0     14.1
    AREA=   3185.5   2000.0   2196.6
     VEL=      6.1       .0      1.5


 SPECIAL BRIDGE

 SB  XK        XKOR      COFQ      RDLEN     BWC       BHP       BAREA     SS        ELCHU     ELCHD
      .00      1.05      2.70    500.00     65.00       .00   3150.00      2.05    612.50    612.50

 *SECNO 13940.000
 PRESSURE FLOW
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  SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


 EGFRS      EGLWC      H3       QWEIR      QPR       BAREA   TRAPEZOID      ELLC     ELTRD
                                                             AREA
   637.37    637.02      .00        0.    22800.     3150.     2076.      632.20    641.50


3470 ENCROACHMENT STATIONS=     316.0     980.0  TYPE=     1  TARGET=     664.000
 13940.00    24.40   636.90      .00      .00   637.37      .47      .35      .00   620.60
   22800.       0.   19403.    3397.       0.    3241.    4393.     922.      74.   622.60
      .41      .00     5.99      .77     .000     .034     .156     .000   612.50   316.00
  .000354      15.      15.      15.        2        0        0      .00   664.00   980.00


FLOW DISTRIBUTION FOR SECNO=  13940.00         CWSEL=    636.90

STA=     316.     462.     640.     980.
  PER Q=     85.1       .0     14.9
   AREA=   3241.0   2067.7   2325.8
    VEL=      6.0       .0      1.5

*SECNO 13950.000

3470 ENCROACHMENT STATIONS=     306.0     990.0  TYPE=     1  TARGET=     684.000
 13950.00    24.45   636.95      .00      .00   637.39      .44      .00      .01   620.60
   22800.     165.   18922.    3713.     163.    3248.    4504.     924.      75.   622.60
      .41     1.01     5.83      .82     .085     .034     .133     .000   612.50   306.00
  .000291      10.      10.      10.        2        0        0      .00   684.00   990.00


FLOW DISTRIBUTION FOR SECNO=  13950.00         CWSEL=    636.95

STA=     306.     316.     462.     990.
  PER Q=       .7     83.0     16.3
   AREA=    163.5   3248.1   4504.4
    VEL=      1.0      5.8       .8

1490 NH CARD USED
*SECNO 14100.000

3265 DIVIDED FLOW
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   SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       QLOSS   BANK ELEV
   Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
   TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
   SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST



3470 ENCROACHMENT STATIONS=    1120.0    1820.0  TYPE=     1  TARGET=     700.000
 14100.00    27.02   637.32      .00      .00   637.50      .19      .04      .08   631.80
   22800.      66.   17822.    4912.     117.    4661.    2964.     951.      77.    629.10
      .42      .56     3.82     1.66     .085     .038     .059     .000   610.30  1120.00
  .000233     150.     150.     150.        2        0        0      .00   620.00  1820.00
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FLOW DISTRIBUTION FOR SECNO=  14100.00          CWSEL=    637.32

STA=    1120.    1224.    1498.    1698.    1758.    1820.
  PER Q=       .3     78.2      5.8      6.9      8.8
   AREA=    117.0   4661.3   1739.1    543.0    681.7
    VEL=       .6      3.8       .8      2.9      3.0

CCHV=    .100 CEHV=    .300
*SECNO 14700.000

3470 ENCROACHMENT STATIONS=    1230.0    2030.0  TYPE=     1  TARGET=     800.000
 14700.00    24.50   637.40      .00      .00   637.63      .23      .11      .01   625.80
   22800.    1254.   18280.    3266.    1192.    4315.    3781.    1066.      86.    627.00
      .47     1.05     4.24      .86     .085     .034     .085     .000   612.90  1230.00
  .000156     590.     590.     590.        2        0        0      .00   800.00  2030.00


1490 NH CARD USED
*SECND 15300.000

3470 ENCROACHMENT STATIONS=     220.0    1020.0  TYPE=     1  TARGET=     800.000
 15300.00    25.84   637.54      .00      .00   637.72      .17      .08      .01   626.60
   22800.     711.   16976.    5113.    1111.    4514.    3323.    1192.      98.    626.10
      .52      .64     3.76     1.54     .102     .035     .042     .000   611.70   220.00
  .000125     600.     600.     600.        2        0        0      .00   800.00  1020.00


*SECNO 16250.000

3470 ENCROACHMENT STATIONS=     100.0    1000.0  TYPE=     1  TARGET=     900.000
 16250.00    25.04   637.64      .00      .00   637.86      .22      .13      .02   626.70
   22800.    1112.   18765.    2923.    1597.    4517.    3903.    1399.     116.    621.90
      .59      .70     4.15      .75     .102     .034     .102     .000   612.60   100.00
  .000143     950.     950.     950.        2        0        0      .00   900.00  1000.00
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  SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS   BANK ELEV
  Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
  TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
  SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


*SECNO 17250.000

3470 ENCROACHMENT STATIONS=      52.0    1200.0  TYPE=     1  TARGET=    1148.000
 17250.00    25.73   637.83      .00      .00   638.05      .21      .19      .00   632.70
   22800.       0.   15099.    7701.       0.    3384.    5760.    1619.     139.    621.90
      .68      .00     4.46     1.34     .085     .038     .085     .000   612.10    52.00
  .000266    1000.    1000.    1000.        2        0        0      .00  1132.65  1184.65


1490 NH CARD USED
*SECNO 18750.000

3265 DIVIDED FLOW


3470 ENCROACHMENT STATIONS=     510.0    1782.0  TYPE=     1  TARGET=    1272.000
 18750.00    23.13   638.33      .00      .00   638.50      .17      .45      .00   627.00
   22800.   10054.    8369.    4377.    4831.    1732.    3114.    1943.     179.    616.30
      .82     2.08     4.83     1.41     .060     .042     .108     .000   615.20   510.00
  .000336    1500.    1500.    1500.        2        0        0      .00  1184.90  1782.00


1490 NH CARD USED
*SECNO 19700.000

3470 ENCROACHMENT STATIONS=     586.0    2200.0  TYPE=     1  TARGET=    1614.000
 19700.00    24.24   638.64      .00      .00   638.71      .07      .20      .01   624.40
   22800.   14537.    7224.    1039.   12188.    2159.     803.    2242.     213.    617.50
      .97     1.19     3.35     1.29     .059     .038     .077     .000   614.40   586.00
  .000121    1050.    1050.    1050.        0        0        0      .00  1614.00  2200.00
```

THIS RUN EXECUTED 01-31-89

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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

CASS RIVER 10 YR FLOW

SUMMARY PRINTOUT TABLE 150

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10Y*S	VCH	AREA	.01K
8300.000	.00	.00	.00	608.70	13700.00	629.15	.00	629.42	3.03	4.84	5423.48	7864.05
8300.000	.00	.00	.00	608.70	20000.00	632.46	.00	632.75	3.03	5.34	7687.10	11489.47
8300.000	.00	.00	.00	608.70	22800.00	633.70	.00	634.00	3.02	5.52	8785.42	13114.67
9500.000	1200.00	.00	.00	608.70	13700.00	629.55	.00	629.77	3.04	3.92	4400.75	7861.88
9500.000	1200.00	.00	.00	608.70	20000.00	632.82	.00	633.10	3.09	4.53	5684.19	11369.68
9500.000	1200.00	.00	.00	608.70	22800.00	634.04	.00	634.35	3.17	4.79	6166.05	12812.55
10000.000	500.00	.00	.00	608.70	13700.00	629.70	.00	629.98	3.52	4.24	3383.21	7305.52
10000.000	500.00	.00	.00	608.70	20000.00	632.97	.00	633.36	3.82	5.06	4154.08	10226.40
10000.000	500.00	.00	.00	608.70	22800.00	634.19	.00	634.64	3.99	5.40	4443.32	11420.68
10095.000	95.00	.00	.00	608.70	13700.00	629.72	.00	630.10	5.61	4.93	2778.95	5786.05
10095.000	95.00	.00	.00	608.70	20000.00	632.98	.00	633.52	6.35	5.89	3397.80	7936.23
10095.000	95.00	.00	.00	608.70	22800.00	634.21	.00	634.82	6.71	6.28	3630.45	8800.22
10100.000	5.00	653.90	644.60	608.90	13700.00	629.73	.00	630.11	5.14	4.91	2867.02	6040.14
10100.000	5.00	653.90	644.60	608.90	20000.00	632.98	.00	633.54	6.58	6.02	3479.02	7799.77
10100.000	5.00	653.90	644.60	608.90	22800.00	634.20	.00	634.85	7.21	6.47	3708.97	8493.22
10115.000	15.00	653.90	644.60	608.90	13700.00	629.74	.00	630.12	5.13	4.91	2869.97	6048.30
10115.000	15.00	653.90	644.60	608.90	20000.00	632.99	.00	633.55	6.57	6.02	3480.26	7803.46
10115.000	15.00	653.90	644.60	608.90	22800.00	634.22	.00	634.86	7.20	6.47	3709.95	8496.23
10120.000	5.00	.00	.00	608.80	13700.00	629.73	.00	630.20	4.17	5.77	2786.65	6712.74
10120.000	5.00	.00	.00	608.80	20000.00	632.97	.00	633.66	5.08	7.05	3434.07	8873.01
10120.000	5.00	.00	.00	608.80	22800.00	634.19	.00	634.98	5.46	7.57	3677.89	9754.65
10600.000	480.00	.00	.00	608.80	13700.00	630.23	.00	630.49	2.58	4.61	4840.67	8537.27
10600.000	480.00	.00	.00	608.80	20000.00	633.83	.00	634.09	2.35	4.92	6947.22	13036.86
10600.000	480.00	.00	.00	608.80	22800.00	635.21	.00	635.47	2.30	5.05	7772.92	15042.88

SECND	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
11000.000	380.00	.00	.00	608.40	13700.00	630.49	.00	630.58	1.55	2.65	5936.96	11015.18
11000.000	380.00	.00	.00	608.40	20000.00	634.07	.00	634.17	1.33	2.73	8266.07	17324.77
11000.000	380.00	.00	.00	608.40	22800.00	635.45	.00	635.55	1.29	2.80	9158.07	20108.06
11450.000	450.00	.00	.00	606.60	13700.00	630.54	.00	630.67	1.86	3.59	5669.94	10046.19
11450.000	450.00	.00	.00	606.60	20000.00	634.12	.00	634.25	1.60	3.73	7995.64	15803.47
11450.000	450.00	.00	.00	606.60	22800.00	635.49	.00	635.62	1.54	3.80	8887.21	18366.80
11900.000	450.00	.00	.00	600.90	13700.00	630.65	.00	630.71	.48	2.15	7900.58	19685.87
11900.000	450.00	.00	.00	600.90	20000.00	634.20	.00	634.29	.54	2.53	10539.35	27334.49
11900.000	450.00	.00	.00	600.90	22800.00	635.56	.00	635.66	.55	2.68	11564.74	30639.78
12100.000	200.00	.00	.00	614.10	13700.00	630.47	.00	630.82	5.47	5.08	3628.85	5859.92
12100.000	200.00	.00	.00	614.10	20000.00	634.11	.00	634.36	3.09	4.58	6333.05	11372.33
12100.000	200.00	.00	.00	614.10	22800.00	635.50	.00	635.72	2.66	4.50	7369.97	13976.80
12300.000	200.00	.00	.00	610.40	13700.00	630.63	.00	630.89	1.84	4.31	4497.44	10097.15
12300.000	200.00	.00	.00	610.40	20000.00	634.15	.00	634.40	1.52	4.45	7255.91	16236.93
12300.000	200.00	.00	.00	610.40	22800.00	635.53	.00	635.76	1.42	4.50	8339.39	19127.20
12500.000	200.00	.00	.00	611.30	13700.00	630.64	.00	630.94	1.60	4.47	3155.39	10817.23
12500.000	200.00	.00	.00	611.30	20000.00	634.12	.00	634.49	1.59	5.01	4365.84	15837.24
12500.000	200.00	.00	.00	611.30	22800.00	635.48	.00	635.87	1.54	5.16	4986.37	18388.92
12700.000	200.00	.00	.00	611.30	13700.00	630.67	.00	630.98	1.59	4.46	3166.05	10858.32
12700.000	200.00	.00	.00	611.30	20000.00	634.16	.00	634.53	1.58	5.00	4379.66	15892.32
12700.000	200.00	.00	.00	611.30	22800.00	635.52	.00	635.90	1.53	5.15	5000.17	18447.65
12770.000	70.00	633.30	630.00	611.30	13700.00	631.05	.00	631.33	1.47	4.33	3282.91	11318.41
12770.000	70.00	633.30	630.00	611.30	20000.00	634.95	.00	635.28	1.33	4.71	4741.83	17363.16
12770.000	70.00	633.30	630.00	611.30	22800.00	636.31	.00	636.64	1.29	4.86	5375.64	20074.87
12950.000	180.00	.00	.00	611.00	13700.00	631.07	.00	631.37	2.28	4.49	3313.88	9074.96
12950.000	180.00	.00	.00	611.00	20000.00	634.98	.00	635.31	2.07	4.87	4798.13	13899.71
12950.000	180.00	.00	.00	611.00	22800.00	636.34	.00	636.67	2.02	5.00	5455.49	16036.82
13350.000	400.00	.00	.00	611.40	13700.00	631.18	.00	631.47	2.76	4.52	4339.80	8253.21
13350.000	400.00	.00	.00	611.40	20000.00	635.11	.00	635.40	2.26	4.72	7418.71	13307.38
13350.000	400.00	.00	.00	611.40	22800.00	636.49	.00	636.76	2.08	4.73	8654.94	15817.04
13700.000	350.00	.00	.00	612.50	13700.00	631.25	.00	631.62	3.60	5.09	4053.76	7216.63
13700.000	350.00	.00	.00	612.50	20000.00	635.19	.00	635.49	2.69	4.99	6856.16	12189.60
13700.000	350.00	.00	.00	612.50	22800.00	636.56	.00	636.85	2.54	5.03	7836.21	14309.77
13925.000	225.00	.00	.00	612.50	13700.00	631.29	.00	631.75	4.24	5.52	3910.11	6656.36
13925.000	225.00	.00	.00	612.50	20000.00	635.17	.00	635.65	3.82	5.93	6484.52	10238.33
13925.000	225.00	.00	.00	612.50	22800.00	636.52	.00	637.02	3.80	6.14	7382.04	11698.52
13940.000	15.00	641.50	632.20	612.50	13700.00	631.30	.00	631.76	4.24	5.52	3910.15	6656.40
13940.000	15.00	641.50	632.20	612.50	20000.00	635.36	.00	635.83	3.67	5.85	6609.51	10435.84
13940.000	15.00	641.50	632.20	612.50	22800.00	636.90	.00	637.37	3.54	5.99	7634.44	12126.09

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
13950.000	10.00	.00	.00	612.50	13700.00	631.33	.00	631.77	3.71	5.42	4073.57	7109.25
13950.000	10.00	.00	.00	612.50	20000.00	635.40	.00	635.84	3.06	5.70	6858.54	11426.01
13950.000	10.00	.00	.00	612.50	22800.00	636.95	.00	637.39	2.91	5.83	7916.02	13376.76
14100.000	150.00	.00	.00	610.30	13700.00	631.69	.00	631.90	4.10	3.88	4270.88	6763.49
14100.000	150.00	.00	.00	610.30	20000.00	635.77	.00	635.96	2.60	3.79	6783.50	12407.66
14100.000	150.00	.00	.00	610.30	22800.00	637.32	.00	637.50	2.33	3.82	7742.19	14935.03
14700.000	590.00	.00	.00	612.90	13700.00	631.84	.00	632.06	1.93	3.91	4882.58	9849.45
14700.000	590.00	.00	.00	612.90	20000.00	635.86	.00	636.09	1.64	4.14	8059.32	15634.21
14700.000	590.00	.00	.00	612.90	22800.00	637.40	.00	637.63	1.56	4.24	9288.27	18278.61
15300.000	600.00	.00	.00	611.70	13700.00	631.98	.00	632.17	1.71	3.70	4664.12	10477.65
15300.000	600.00	.00	.00	611.70	20000.00	636.00	.00	636.18	1.36	3.75	7716.79	17140.37
15300.000	600.00	.00	.00	611.70	22800.00	637.54	.00	637.72	1.25	3.76	8947.54	20352.40
16250.000	950.00	.00	.00	612.60	13700.00	632.13	.00	632.33	1.64	3.70	5162.04	10697.45
16250.000	950.00	.00	.00	612.60	20000.00	636.11	.00	636.33	1.48	4.04	8644.61	16413.56
16250.000	950.00	.00	.00	612.60	22800.00	637.64	.00	637.86	1.43	4.15	10016.03	19042.12
17250.000	1000.00	.00	.00	612.10	13700.00	632.34	.00	632.58	3.81	4.41	4976.46	7019.07
17250.000	1000.00	.00	.00	612.10	20000.00	636.31	.00	636.53	2.90	4.44	7787.54	11752.28
17250.000	1000.00	.00	.00	612.10	22800.00	637.83	.00	638.05	2.66	4.46	9144.41	13984.83
18750.000	1500.00	.00	.00	615.20	13700.00	633.05	.00	633.31	6.18	5.44	5162.62	5512.27
18750.000	1500.00	.00	.00	615.20	20000.00	636.85	.00	637.03	3.87	4.95	8218.18	10169.07
18750.000	1500.00	.00	.00	615.20	22800.00	638.33	.00	638.50	3.36	4.83	9676.63	12438.75
19700.000	1050.00	.00	.00	614.40	13700.00	633.58	.00	633.72	2.64	4.16	7302.16	8436.70
19700.000	1050.00	.00	.00	614.40	20000.00	637.20	.00	637.28	1.47	3.52	12821.80	16518.81
19700.000	1050.00	.00	.00	614.40	22800.00	638.64	.00	638.71	1.21	3.35	15149.42	20687.43

CASS RIVER 10 YR FLOW

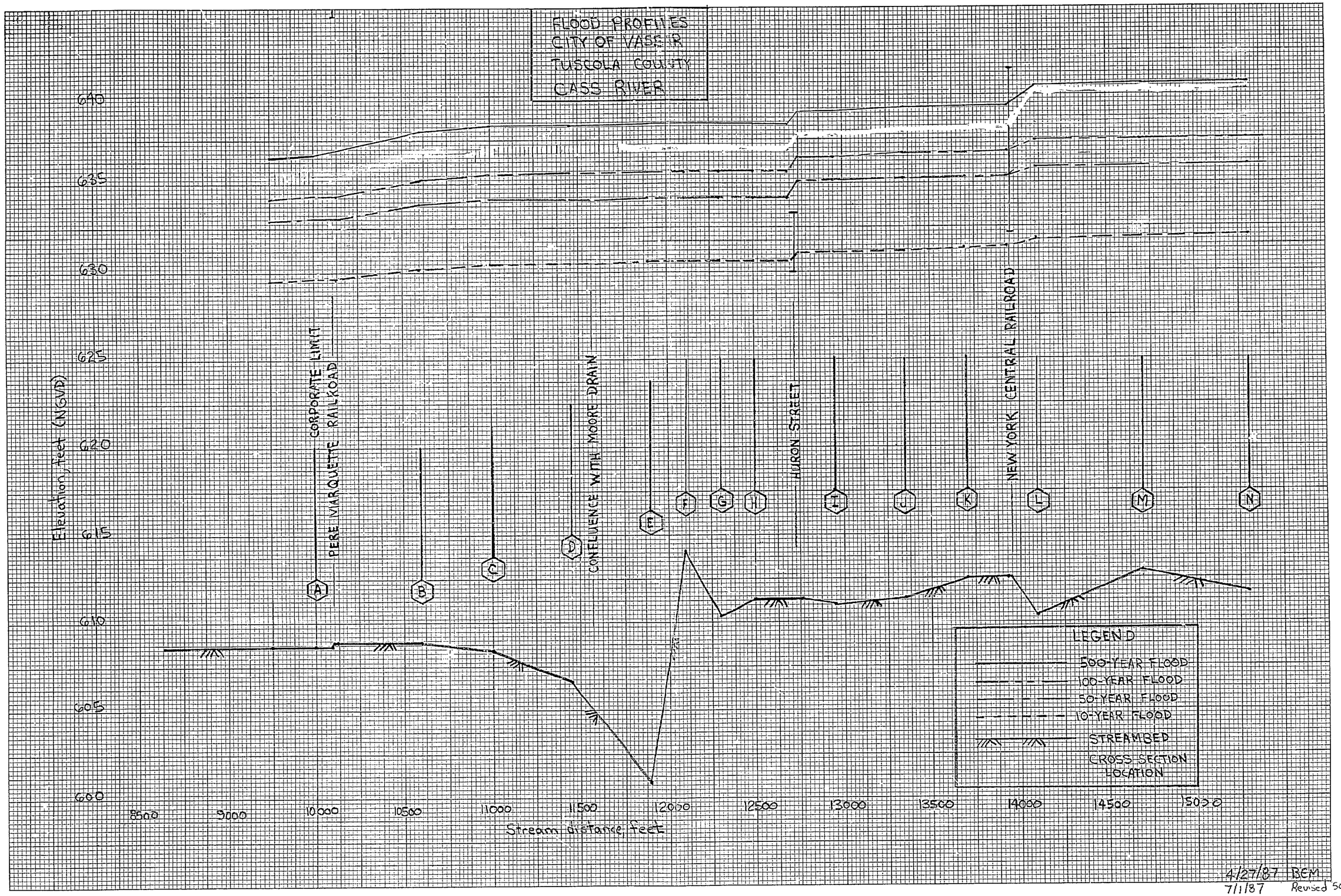
SUMMARY PRINTOUT TABLE 150

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
8300.000	13700.00	629.15	.00	.00	1.15	593.45	.00
8300.000	20000.00	632.46	3.31	.00	-.54	826.40	.00
8300.000	22800.00	633.70	1.24	.00	-.30	940.76	.00
9500.000	13700.00	629.55	.00	.40	.00	390.83	1200.00
9500.000	20000.00	632.82	3.27	.36	.00	395.32	1200.00
9500.000	22800.00	634.04	1.22	.34	.00	396.99	1200.00
10000.000	13700.00	629.70	.00	.15	.00	236.00	500.00
10000.000	20000.00	632.97	3.26	.15	.00	236.00	500.00
10000.000	22800.00	634.19	1.22	.15	.00	236.00	500.00
10095.000	13700.00	629.72	.00	.02	.00	190.00	95.00
10095.000	20000.00	632.98	3.26	.02	.00	190.00	95.00
10095.000	22800.00	634.21	1.22	.02	.00	190.00	95.00
10100.000	13700.00	629.73	.00	.01	.00	187.62	5.00
10100.000	20000.00	632.98	3.25	.00	.00	187.93	5.00
10100.000	22800.00	634.20	1.22	.00	.00	188.05	5.00
10115.000	13700.00	629.74	.00	.01	.00	187.62	15.00
10115.000	20000.00	632.99	3.25	.01	.00	187.93	15.00
10115.000	22800.00	634.22	1.22	.01	.00	188.05	15.00
10120.000	13700.00	629.73	.00	-.02	.00	193.83	5.00
10120.000	20000.00	632.97	3.24	-.03	.00	200.00	5.00
10120.000	22800.00	634.19	1.22	-.03	.00	200.00	5.00
10600.000	13700.00	630.23	.00	.51	.00	560.44	480.00
10600.000	20000.00	633.83	3.60	.86	.00	600.00	480.00
10600.000	22800.00	635.21	1.38	1.02	.00	600.00	480.00
11000.000	13700.00	630.49	.00	.26	.00	650.00	380.00
11000.000	20000.00	634.07	3.58	.24	.00	650.00	380.00
11000.000	22800.00	635.45	1.37	.24	.00	650.00	380.00
11450.000	13700.00	630.54	.00	.05	.00	650.00	450.00
11450.000	20000.00	634.12	3.58	.04	.00	650.00	450.00
11450.000	22800.00	635.49	1.37	.04	.00	650.00	450.00
11900.000	13700.00	630.65	.00	.11	.00	654.00	450.00
11900.000	20000.00	634.20	3.55	.08	.00	750.00	450.00
11900.000	22800.00	635.56	1.37	.08	.00	750.00	450.00
12100.000	13700.00	630.47	.00	-.17	.00	699.10	200.00
12100.000	20000.00	634.11	3.64	-.09	.00	750.00	200.00
12100.000	22800.00	635.50	1.38	-.07	.00	750.00	200.00

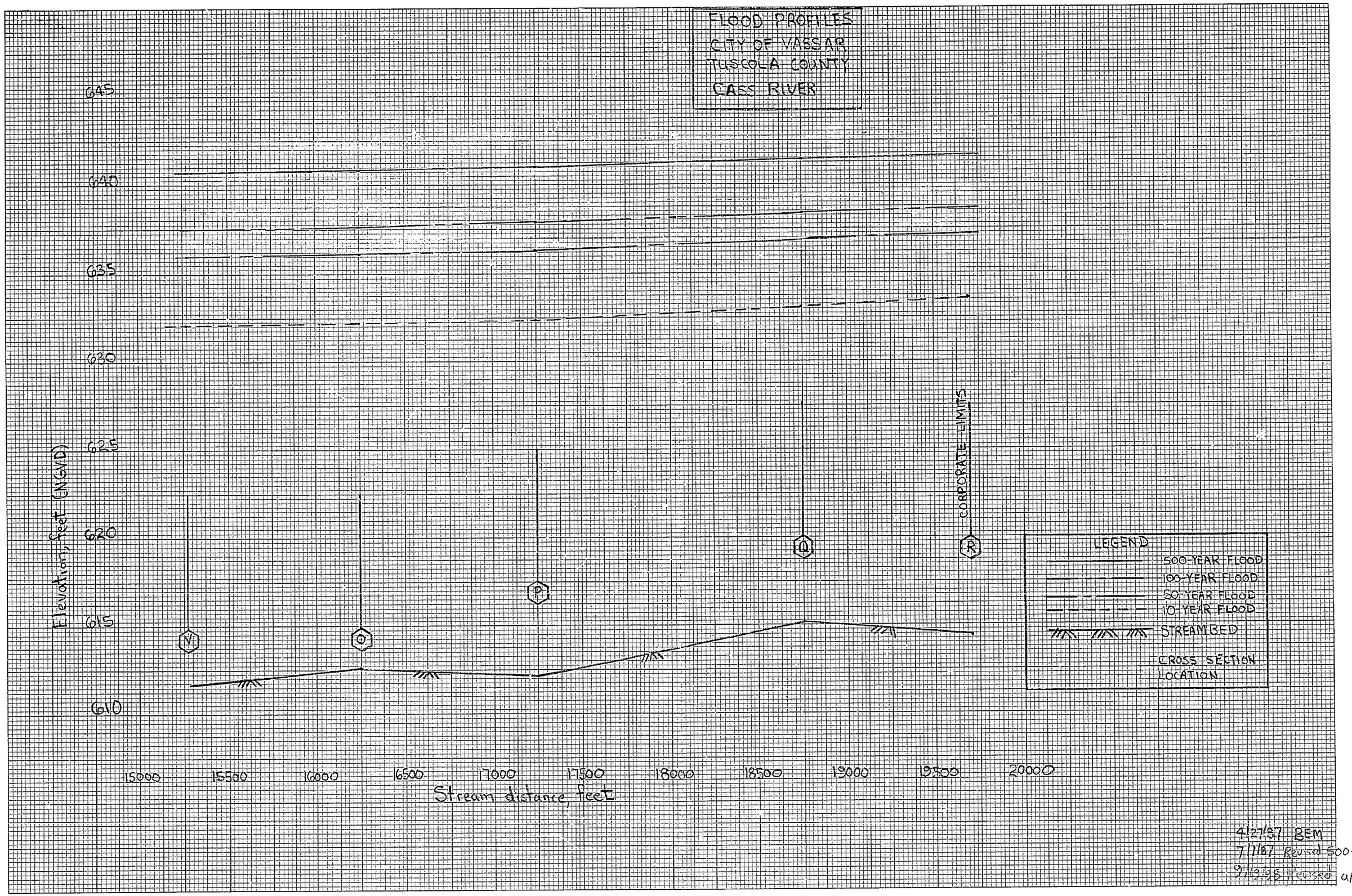
SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
12300.000	13700.00	630.63	.00	.15	.00	764.63	200.00
12300.000	20000.00	634.15	3.53	.04	.00	786.00	200.00
12300.000	22800.00	635.53	1.37	.03	.00	786.00	200.00
12500.000	13700.00	630.64	.00	.01	.00	311.17	200.00
12500.000	20000.00	634.12	3.49	-.03	.00	444.69	200.00
12500.000	22800.00	635.48	1.36	-.04	.00	466.07	200.00
12700.000	13700.00	630.67	.00	.03	.00	311.25	200.00
12700.000	20000.00	634.16	3.49	.03	.00	445.26	200.00
12700.000	22800.00	635.52	1.36	.03	.00	466.07	200.00
12770.000	13700.00	631.05	.00	.38	.00	312.10	70.00
12770.000	20000.00	634.95	3.91	.80	.00	459.72	70.00
12770.000	22800.00	636.31	1.35	.79	.00	475.98	70.00
12950.000	13700.00	631.07	.00	.03	.00	355.51	180.00
12950.000	20000.00	634.98	3.91	.03	.00	453.59	180.00
12950.000	22800.00	636.34	1.36	.03	.00	517.96	180.00
13350.000	13700.00	631.18	.00	.10	.00	504.06	400.00
13350.000	20000.00	635.11	3.93	.13	.00	898.00	400.00
13350.000	22800.00	636.49	1.38	.15	.00	898.00	400.00
13700.000	13700.00	631.25	.00	.08	.00	714.00	350.00
13700.000	20000.00	635.19	3.94	.08	.00	714.00	350.00
13700.000	22800.00	636.56	1.37	.08	.00	714.00	350.00
13925.000	13700.00	631.29	.00	.04	.00	664.00	225.00
13925.000	20000.00	635.17	3.88	-.02	.00	664.00	225.00
13925.000	22800.00	636.52	1.35	-.04	.00	664.00	225.00
13940.000	13700.00	631.30	.00	.01	.00	664.00	15.00
13940.000	20000.00	635.36	4.06	.19	.00	664.00	15.00
13940.000	22800.00	636.90	1.54	.38	.00	664.00	15.00
13950.000	13700.00	631.33	.00	.03	.00	684.00	10.00
13950.000	20000.00	635.40	4.07	.05	.00	684.00	10.00
13950.000	22800.00	636.95	1.55	.05	.00	684.00	10.00
14100.000	13700.00	631.69	.00	.36	.00	595.92	150.00
14100.000	20000.00	635.77	4.08	.37	.00	620.00	150.00
14100.000	22800.00	637.32	1.55	.37	.00	620.00	150.00
14700.000	13700.00	631.84	.00	.15	.00	715.86	590.00
14700.000	20000.00	635.86	4.02	.09	4.02	800.00	590.00
14700.000	22800.00	637.40	1.54	.08	.00	800.00	590.00
15300.000	13700.00	631.98	.00	.13	.00	636.78	600.00
15300.000	20000.00	636.00	4.03	.14	4.03	790.20	600.00
15300.000	22800.00	637.54	1.54	.14	.00	800.00	600.00

SECNO	Q	CHSEL	DIFHSP	DIFHSX	DIFKWS	TOPWID	XLCH
16250.000	13700.00	632.13	.00	.16	.00	625.68	950.00
16250.000	20000.00	636.11	3.98	.11	3.98	900.00	950.00
16250.000	22800.00	637.64	1.52	.09	.00	900.00	950.00
17250.000	13700.00	632.34	.00	.21	.00	632.44	1000.00
17250.000	20000.00	636.31	3.97	.20	3.97	794.86	1000.00
17250.000	22800.00	637.83	1.52	.20	.00	1132.65	1000.00
18750.000	13700.00	633.05	.00	.70	.00	744.47	1500.00
18750.000	20000.00	636.85	3.80	.54	3.80	884.08	1500.00
18750.000	22800.00	638.33	1.48	.50	.00	1184.90	1500.00
19700.000	13700.00	633.58	.00	.53	.00	1349.30	1050.00
19700.000	20000.00	637.20	3.62	.35	3.62	1613.41	1050.00
19700.000	22300.00	638.64	1.44	.31	.00	1614.00	1050.00

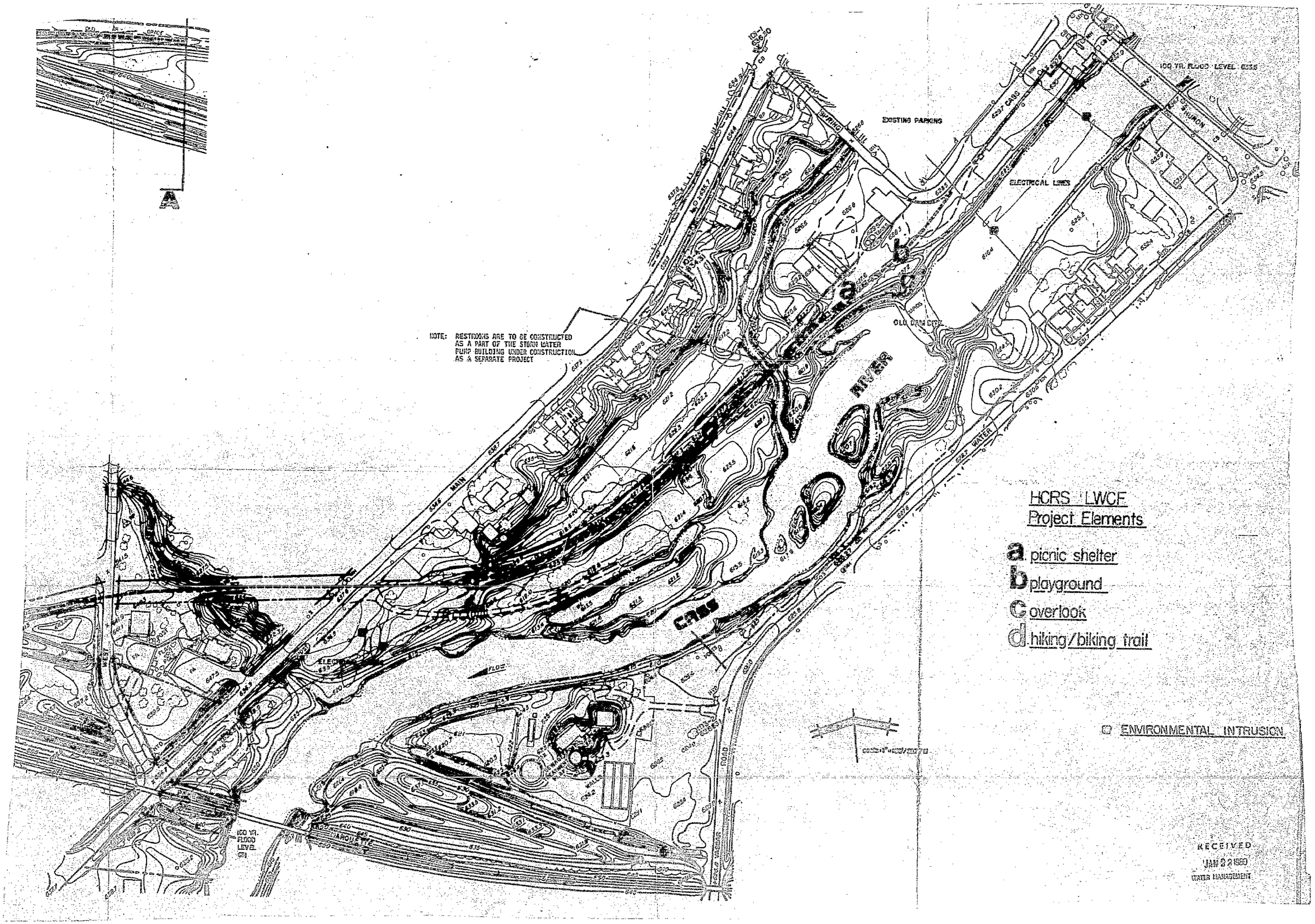
N



4/27/87 BCM
7/1/87 Revised 500-yr
9/19/88 Revised w/ L

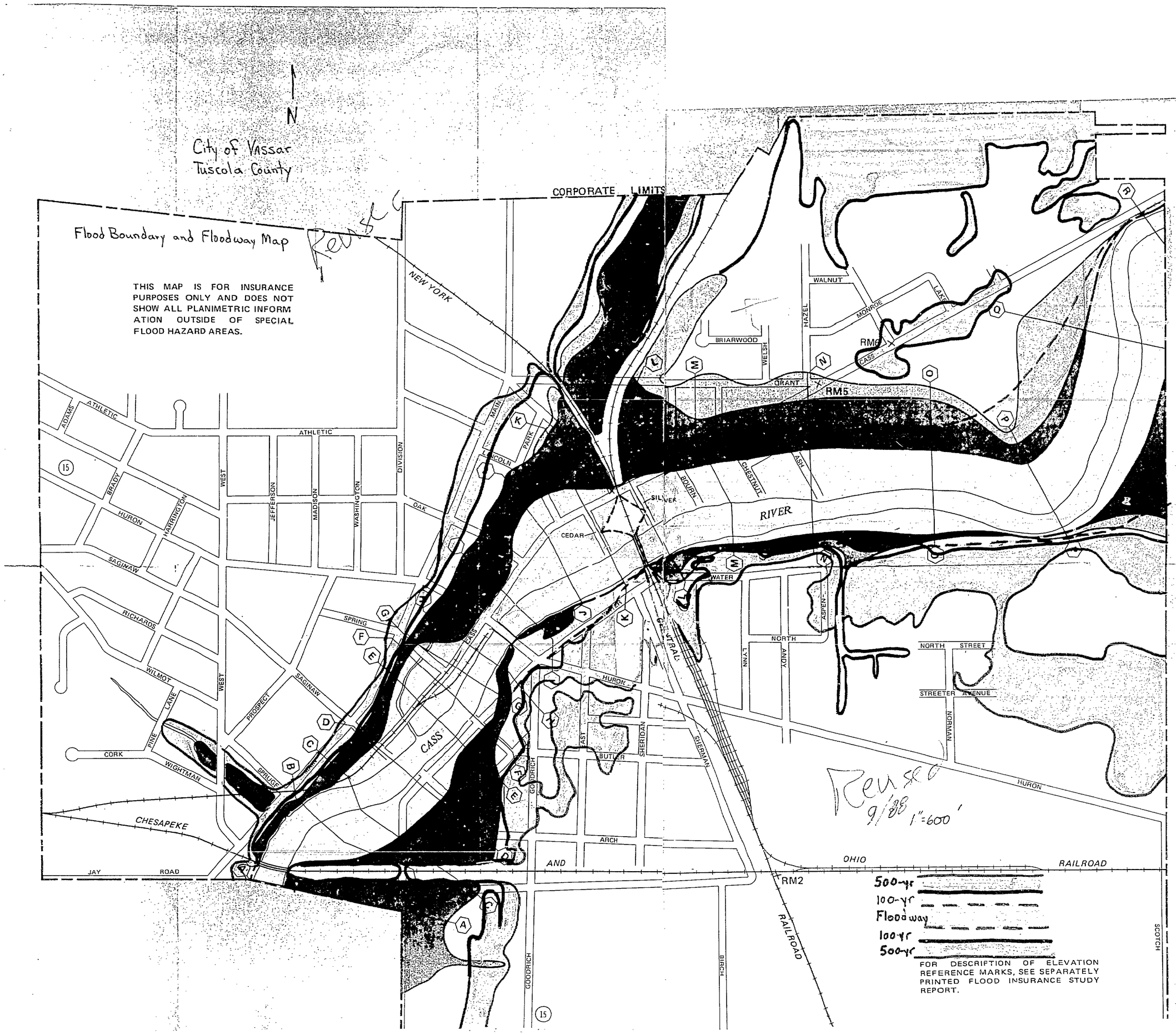

FLOOD PROFILES
CITY OF VASSAR
TUSCOLA COUNTY
CASS RIVER
645
640
635
630
625
620
615
610
Elevation, feet (NGVD)
V
O
P
Q
R
CORPORATE LIMITS
LEGEND
500-YEAR FLOOD
100-YEAR FLOOD
50-YEAR FLOOD
10-YEAR FLOOD
STREAMBED
CROSS SECTION LOCATION
15000
15500
16000
6500
17000
17500
18000
18500
19000
19500
20000
Stream distance, feet
4/27/87 BEM
7/1/87 Revised 500-yr
9/19/88 Revised u/s L

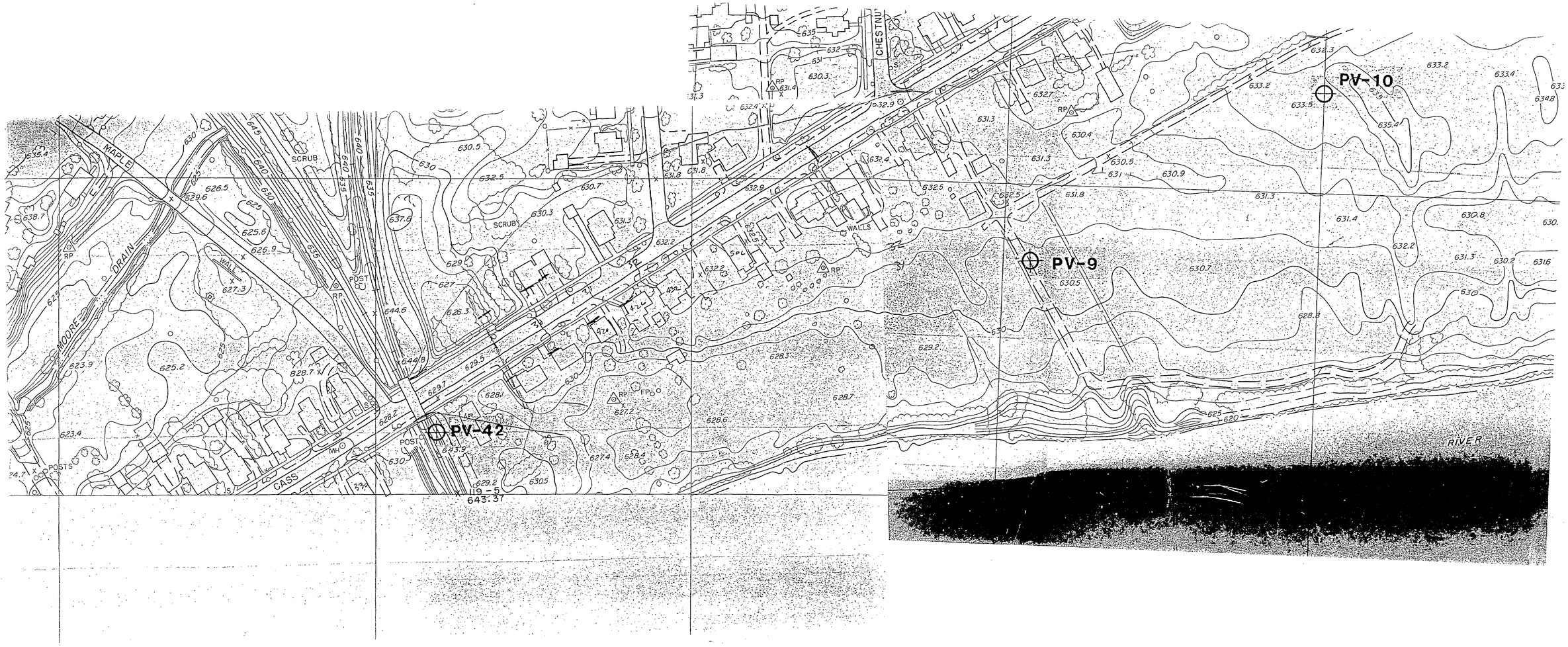
R 4510-1

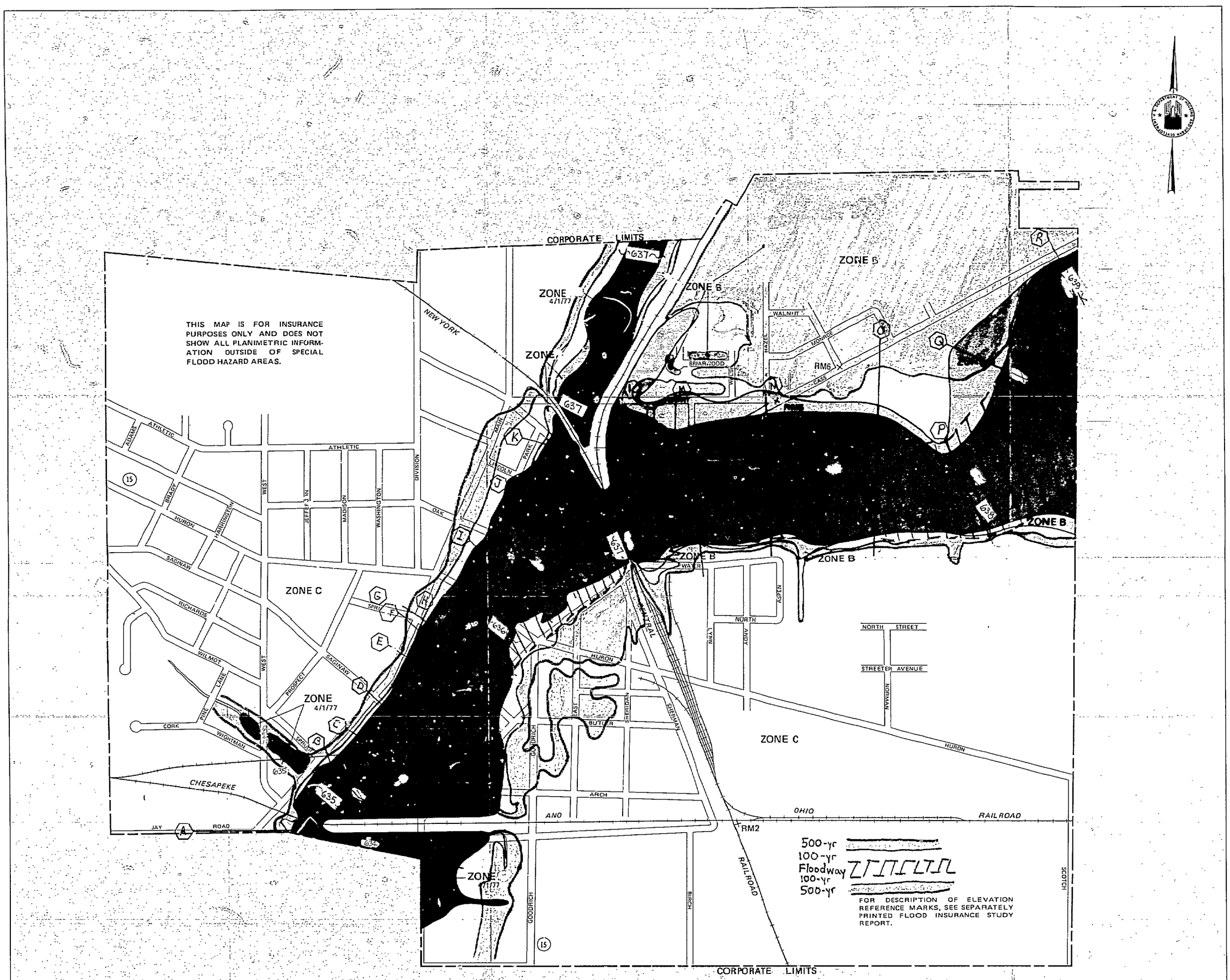


RECEIVED
JAN 2 2 1980
WATER MANAGEMENT

City of Missoula
Missoula Co.
N
500-yr
100-yr
Floodway
LAKE STATION
Y
Z
X
A
B
© MISSOULA COUNTY
DIGITAL CARTOGRAPHY

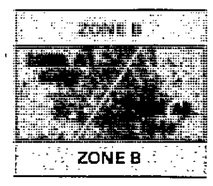

N
City of Vassar
Tuscola County
Flood Boundary and Floodway Map
Revised
THIS MAP IS FOR INSURANCE PURPOSES ONLY AND DOES NOT SHOW ALL PLANIMETRIC INFORMATION OUTSIDE OF SPECIAL FLOOD HAZARD AREAS.
CORPORATE LIMITS
NEW YORK
CENTRAL
RAILROAD
OHIO
RAILROAD
AND
CHESAPEKE
CASS
RIVER
RM2
RM5
RM6
ATHLETIC
ADAMS
BRADY
HURON
HARRINGTON
WEST
JEFFERSON
MADISON
WASHINGTON
DIVISION
OAK
SAGINAW
RICHARDS
WILMOT
LANE
PINE
CORK
WIGHTMAN
PROSPECT
SPRUCE
SPRING
MAIN
PARK
LINCOLN
SILVER
CEDAR
WATER
BRIARWOOD
WELSH
HAZEL
WALNUT
MONROE
LAKE
GRANT
CASS
ROURN
CHESTNUT
ASH
ASPEN
NORTH
STREET
STREETER AVENUE
LYNN
ANDY
NORMAN
HURON
BUTLER
EAST
SHERIDAN
SHERMAN
GOODRICH
ARCH
BIRCH
SCOTCH
JAY
ROAD
15
Revised 9/88 1"=600'
500-yr
100-yr
Floodway
100-yr
500-yr
FOR DESCRIPTION OF ELEVATION REFERENCE MARKS, SEE SEPARATELY PRINTED FLOOD INSURANCE STUDY REPORT.


PV-42
PV-9
PV-10
MAPLE
MOORE
DRAIN
CASS
CHESTNUT
RIVER
SCRUB
WALL
WALLS
POST
POSTS
RP
FP
MH
119-5
643.37



KEY TO SYMBOLS

ZONE DESIGNATIONS* WITH DATE OF IDENTIFICATION ie., 12/2/74



Base Flood Elevation Line with elevation in feet — 513

Base Flood Elevation where uniform within zone — (EL. 987' MSL)

Elevation Reference Mark — RM7

River Mile — • M1.5

*EXPLANATION OF ZONE DESIGNATIONS

A flood insurance map displays the zone designations for a community according to areas of designated flood hazards. The zone designations used by FIA are:

Zone	Explanation
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
AO	Areas of 100-year shallow flooding; flood depth 1 to 3 feet; product of flood depth (feet) and velocity (feet per second) less than 15.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by a flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Area between limits of 100-year flood and 500-year flood; areas of 100-year shallow flooding where depths less than 1 foot.
C	Areas outside 500-year flood.
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
VO	Areas of 100-year shallow flooding with velocity; flood depth 1 to 3 feet; product of depth (feet) and velocity (feet per second) more than 15.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

CONSULT NFIA SERVICING COMPANY OR LOCAL INSURANCE AGENT OR BROKER TO DETERMINE IF PROPERTIES IN THIS COMMUNITY ARE ELIGIBLE FOR FLOOD INSURANCE.

INITIAL IDENTIFICATION DATE: JUNE 14, 1974

CONVERSION TO REGULAR PROGRAM: APRIL 1, 1977

APPROXIMATE SCALE IN FEET: 600 0 600

FLOOD HAZARD BOUNDARY MAP H-01
FLOOD INSURANCE RATE MAP I-01

CITY OF VASSAR, MICHIGAN
TUSCOLA COUNTY
Revised September 1988

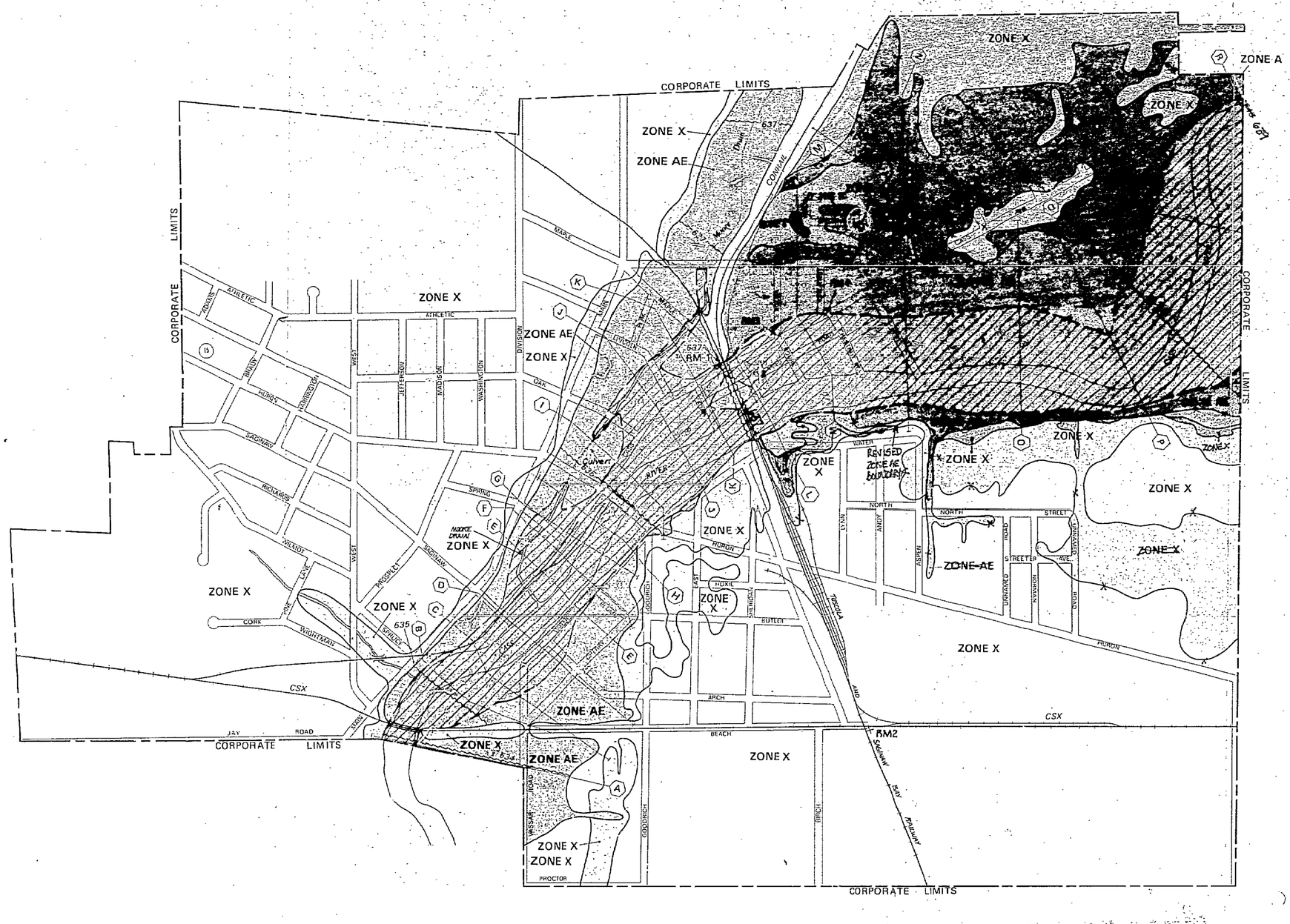
PANEL H&I-01

PAGE 1 OF 1 PRINTED

EFFECTIVE DATE:
APRIL 1, 1977

COMMUNITY NUMBER:
260208B

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
FEDERAL INSURANCE ADMINISTRATION



LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- **ZONE A** — No base flood elevations determined.
- **ZONE AE** — Base flood elevations determined.
- **ZONE AH** — Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- **ZONE AO** — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE A99** — To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.
- **ZONE V** — Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- **ZONE VE** — Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

- **ZONE X** — Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

- **ZONE X** — Areas determined to be outside 500-year flood plain.
- **ZONE D** — Areas in which flood hazards are undetermined.

Flood Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

513 — Base Flood Elevation Line; Elevation in Feet*

D — D — Cross Section Line

(EL 987) — Base Flood Elevation in Feet Where Uniform Within Zone*

RM7 X — Elevation Reference Mark

•M1.5 — River Mile

*Referenced to the National Geodetic Vertical Datum of 1929

NOTES

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas.

Certain areas not in the Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Refer to Floodway Data Table where floodway width is shown at 1/20 inch.

Coastal base flood elevations apply only landward of the shoreline.

Elevation reference marks are described in the Flood Insurance Study Report.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of this map.

MAP REPOSITORY

INITIAL IDENTIFICATION:

JUNE 14, 1974

FLOOD HAZARD BOUNDARY MAP REVISIONS:

FLOOD INSURANCE RATE MAP EFFECTIVE:

APRIL 1, 1977

FLOOD INSURANCE RATE MAP REVISIONS:

Map revised
to change special flood hazard areas, zone designations and base flood elevations; add streets and street names; revise corporated limits and to reflect new FEMA title block.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620

N

APPROXIMATE SCALE IN FEET

600 0 600

FLOOD PRONE STREET INDEX

NOTES TO USER

This index provides a list of all streets shown on the Flood Insurance Rate Map (FIRM) that are partially or totally within Special Flood Hazard Areas (SFHAs). This index should not be used as an authoritative source for determining whether specific streets, properties, or buildings are within an SFHA. The appropriate FIRM panel must be consulted for these purposes. This index is intended to be used only as a guide for determining which FIRM panel displays the street in question and the relative location of the street on the FIRM panel.

KEY

street name ..... panel number (old location)

BAKER STREET 0005 (A2)

NAMED STREETS

ARCH	0001 (B3,C3)
ASH	0001 (C2,D2)
BEACH	0001 (B3)
BOURNE	0001 (C2)
BRIARWOOD	0001 (C2)
BUTLER	0001 (C3)
CASS	0001 (B3,C3,D2,E1,E2)
CEDAR	0001 (C2)
CHERRY	0001 (B3,C3)
CHESTNUT	0001 (C2)
EAST	0001 (C3)
GRANT	0001 (C2,D2)
HAZEL	0001 (D2)
HIXON	0001 (C2)
HURON	0001 (B3,C3)
LANE	0001 (D2)
LINCOLN	0001 (C2)
MAIN	0001 (B3)
MAPLE	0001 (C2)
MONROE	0001 (D2)
NORTH STREET	0001 (D2)
OAK	0001 (B2,C2)
PARK	0001 (C2)
PLUMB	0001 (B3,C3)
SAGINAW	0001 (B3)
SILVER	0001 (C2)
SPRING	0001 (B3)
VASSAR ROAD	0001 (B3,B4)
WALNUT	0001 (D2)
WATER	0001 (B3,C3)
WELSH	0001 (C2)

NUMBERED STREETS

STATE HIGHWAY 15	0001 (B3,C3)

NATIONAL FLOOD INSURANCE PROGRAM

ANNOTATED

FIRM

FLOOD INSURANCE RATE MAP

CITY OF
VASSAR,
MICHIGAN
TUSCOLA COUNTY

(ONLY PANEL PRINTED)

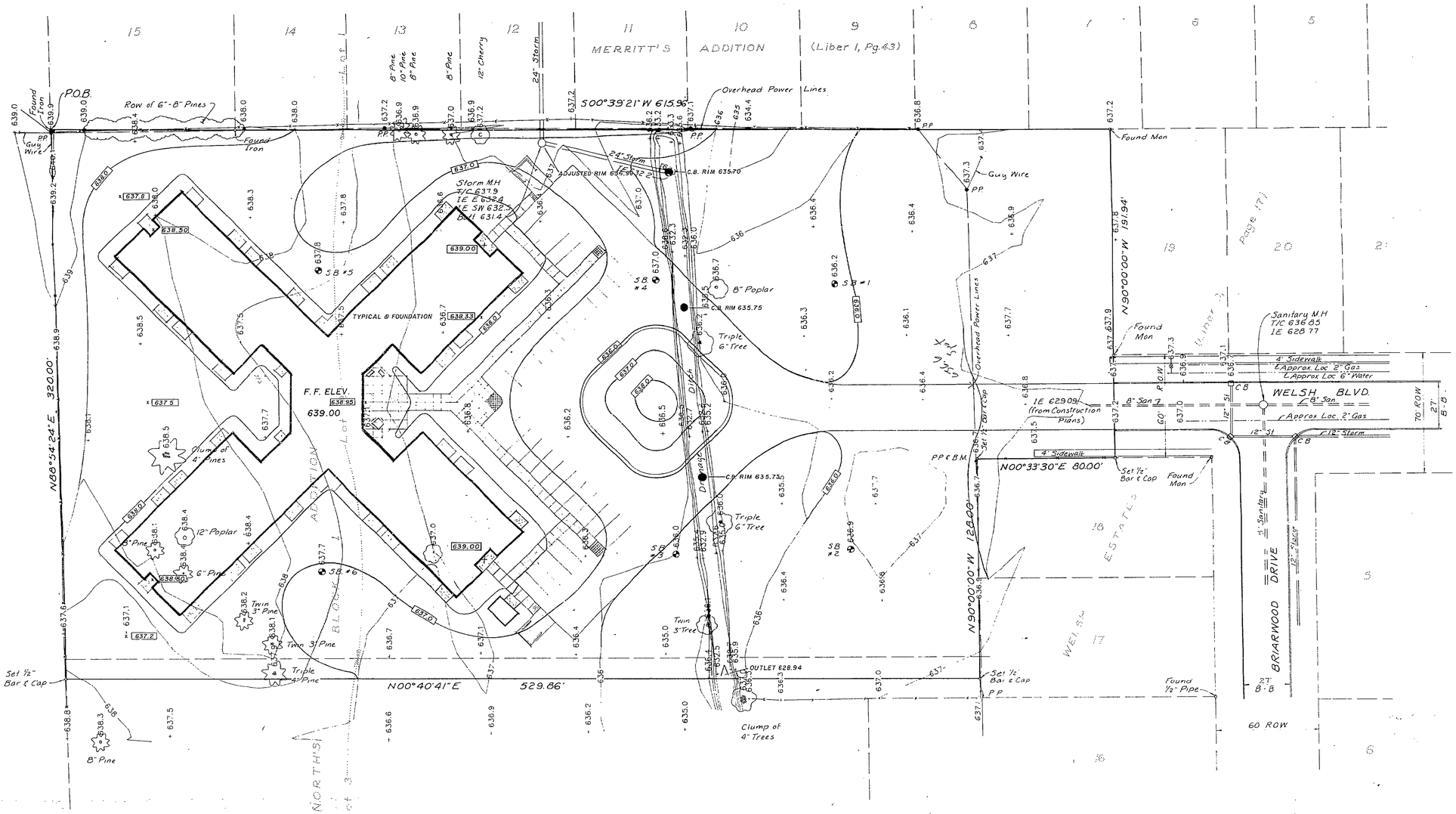
PRELIMINARY

COMMUNITY-PANEL NUMBER
260208 0001 C

MAP REVISED:
ENCLOSURE FOR FEMA LETTER DATED: NOV 14 1998

Federal Emergency Management Agency

[redacted]



SITE GRADING NOTES

1. ALL GRADES AT BUILDINGS ARE TO PITCH AWAY IN LAWN AND PLANTING AREAS AT A MINIMUM OF 5% IN THE FIRST 10' (6" IN 10').
2. SLOPES BETWEEN SPOT ELEVATIONS SHALL BE UNIFORM.
3. SWALES SHALL BE SMOOTH AND ROUNDED WITH NO ABRUPT CHANGES IN GRADE.
4. SPOT ELEVATIONS SHOWN AT CURBS ARE GIVEN TO BOTTOM.
5. THE CONTRACTOR IS RESPONSIBLE FOR RESTORING ALL AREAS DISTURBED IN EARTHMOVING PROCEEDURES.
6. GRADING DESIGN DOES NOT NECESSARILY IMPLY A BALANCED CUT AND FILL. IT IS THE RESPONSIBILITY OF THE GRADING CONTRACTOR TO REMOVE EXCESS CUT MATERIALS FROM THE SITE OR PROVIDE FILL MATERIALS AS REQUIRED.

GRADING KEY

800	EXISTING CONTOUR	800	NEW CONTOUR
+ 800.00	EXIST. SPOT ELEV.	+ 800.00	NEW SPOT ELEV.
	EXIST. VEGETATION	+ TW 800.00	TOP OF WALL ELEV.
	NEW YARD DRAIN		NEW CATCH BASIN

SCALE: 1" = 30'

BENCH MARK
Railroad Spike in Power Pole
NE Corner Lot 18 Welsh Estates
Elev. 637.46

THESE CONSTRUCTION DOCUMENTS HAVE BEEN PREPARED IN ACCORDANCE WITH THE STATE OF MICHIGAN 1987 B.O.C.A. CODE AND OTHER APPLICABLE RULES

SITE GRADING PLAN

ARCHON ASSOCIATES INCORPORATED
SUITE 202 4970 NORTHWIND DRIVE
EAST LANSING, MICHIGAN 48823

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ARCHON ASSOCIATES, INC.
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VASSAR APARTMENTS
VASSAR, MICHIGAN

PROJECT NO. 88-17

ISSUE DATE 8 AUGUST 88

REVISIONS

SHEET NO. L3