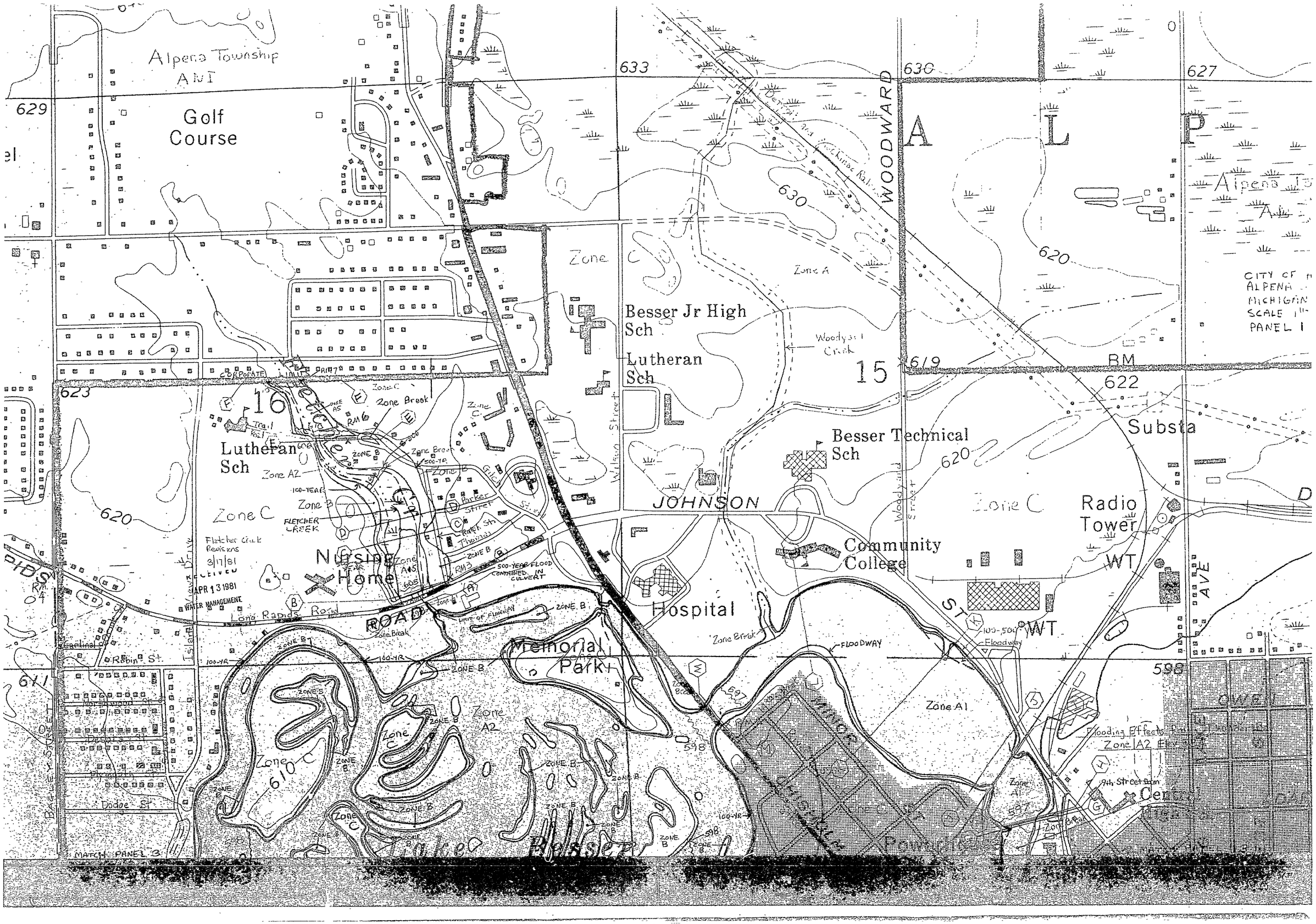
Alpena Township
Golf Course
633
630
627
629
WOODWARD
A L P
Alpena
CITY OF ALPENA MICHIGAN SCALE 1" PANEL 1
Zone A
620
Zone
Besser Jr High Sch
Lutheran Sch
Woodyard Creek
15
619
RM
622
623
16
Zone C
Zone Break
Lutheran Sch
Zone A2
Zone B
FLETCHER CREEK
Besser Technical Sch
Substa
JOHNSON
Zone C
Radio Tower
Community College
Nursing Home
Hospital
Long Rapids Road
ROAD
Memorial Park
FLOODWAY
Zone A1
611
598
597
Zone C
Zone A2
Zone B
Zone A1
Flooding Effects
Zone A2
94th Street Dam
MATCH PANEL 3
Lake Huron

00BREAK00

1) COUNTY: Alpena

2) STUDY NAME: Alpena City/Twp

3) WATERCOURSE: Fletcher Creek

4) DOCUMENT TYPE: 100-yr Encroached

00BREAK00

```
**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED APRIL 1980
  ERROR CORR -  01,02,03,04
  MODIFICATION -  50,51,52,53,54
**************************************************
T1 ALPENA, MICH
T2 FLETCHER CREEK
T3 FLOODWAY DETERMINATION
```

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0.	6.	0.	0.	0.000000	0.00	0.0	0.	597.440	0.000

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	15.000	0.000	-1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

```
   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=   0.100 CEHV=   0.300
*SECNO .000
 2800 NAT Q1=      16.80  WSEL=     597.34  ENC Q1=      18.83  WSEL=     597.44  RATIO= -0.1206
 NAT Q1=      19.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=     597.44

3470 ENCROACHMENT STATIONS=      126.0      181.0  TYPE=      4  TARGET=        0.000
     0.00      2.04    597.44      0.00    597.34    597.56      0.12      0.00      0.00    602.50
     130.        0.      130.        0.        0.       46.        0.        0.        0.    602.10
     0.00      0.00      2.80      0.00     0.070     0.045     0.070     0.000    595.40    134.43
 0.004740        0.        0.        0.         0         0         0      0.00     33.36    167.80


CCHV=   0.300 CEHV=   0.500
*SECNO 165.000
 2800 NAT Q1=      16.69  WSEL=     598.33  ENC Q1=      18.70  WSEL=     598.43  RATIO= -0.1204
 NAT Q1=      19.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=     598.43

3470 ENCROACHMENT STATIONS=      126.0      181.0  TYPE=      4  TARGET=        0.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      610.00 ELREA=      610.00

   165.00      1.92    598.32      0.00    598.33    598.47      0.15      0.90      0.01    603.50
     130.        0.      130.        0.        0.       42.        0.        0.        0.    603.10
     0.01      0.00      3.07      0.00     0.070     0.045     0.070     0.045    596.40    134.64
 0.006286      130.      165.      200.         1         0         0      0.00     32.81    167.45
```

```
   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 330.000
 WATER EL=X5 CARD=   605.600
 2800 NAT Q1=   2129.05  WSEL=    605.50  ENC Q1=   2177.52  WSEL=    605.60  RATIO= -0.0228
 NAT Q1=   2178.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=    605.60

3470 ENCROACHMENT STATIONS=    1328.0    1560.0  TYPE=     4  TARGET=       0.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      610.40 ELREA=      610.40

   330.00     8.40   605.60     0.00   605.50   605.60     0.00     0.00     0.04   600.10
     190.       0.     190.       0.       0.    1729.       0.       4.       1.   600.00
     0.43     0.00     0.11     0.00    0.070    0.045    0.070    0.045   597.20  1328.00
 0.000001     165.     165.     165.        0        0        0     0.00   232.00  1560.00


*SECNO 430.000
 2800 NAT Q1=   2364.81  WSEL=    605.50  ENC Q1=   2364.81  WSEL=    605.60  RATIO=  0.0000
 NAT Q1=   2426.  RATIOS LOB,CH,ROB=  0.0436  0.8977  0.0587  WSEL=    605.60

3470 ENCROACHMENT STATIONS=    1297.3    1616.5  TYPE=     4  TARGET=       0.025
   430.00     8.40   605.60     0.00   605.50   605.60     0.00     0.00     0.00   600.10
     190.       6.     175.       9.     134.    1729.     215.       8.       1.   600.00
     0.72     0.04     0.10     0.04    0.070    0.045    0.070    0.045   597.20  1297.27
 0.000001     100.     100.     100.        0        0        0     0.00   319.24  1616.52
```

```
   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=   0.100 CEHV=   0.300
*SECNO 830.000
 2800 NAT Q1=   2072.42  WSEL=    605.50  ENC Q1=   2072.42  WSEL=    605.60  RATIO=  0.0000
 NAT Q1=   2129.  RATIOS LOB,CH,ROB=  0.0380  0.9109  0.0510  WSEL=    605.60

3470 ENCROACHMENT STATIONS=    1301.5    1604.2  TYPE=     4  TARGET=       0.027
   830.00     7.90   605.60     0.00   605.50   605.60     0.00     0.00     0.00   600.60
     190.       5.     178.       7.     106.    1613.     160.      26.       4.   600.50
     1./7     0.05     0.11     0.05    0.070    0.045    0.070    0.045   597.70  1301.51
 0.000001     400.     400.     400.        0        0        0     0.00   302.70  1604.21


*SECNO 1000.000
 2800 NAT Q1=    294.64  WSEL=    605.50  ENC Q1=    294.64  WSEL=    605.60  RATIO=  0.0000
 NAT Q1=    316.  RATIOS LOB,CH,ROB=  0.1584  0.2948  0.5468  WSEL=    605.60

3470 ENCROACHMENT STATIONS=     415.4     636.3  TYPE=     4  TARGET=       0.068
  1000.00     5.40   605.60     0.00   605.50   605.60     0.00     0.00     0.00   603.70
     190.      25.      60.     104.     126.     123.     361.      31.       5.   601.30
     1.90     0.20     0.49     0.29    0.070    0.045    0.070    0.045   600.20   415.38
 0.000042     170.     170.     170.        0        0        0     0.00   220.92   636.30


*SECNO 1700.000
 2800 NAT Q1=     66.10  WSEL=    605.56  ENC Q1=     66.10  WSEL=    605.66  RATIO=  0.0000
 NAT Q1=     72.  RATIOS LOB,CH,ROB=  0.0002  0.7278  0.2720  WSEL=    605.66
```

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   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HI        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


3470 ENCROACHMENT STATIONS=     950.0    1021.1  TYPE=     4  TARGET=       0.085
  1700.00     3.46   605.66     0.00   605.56   605.69     0.03     0.08     0.01   605.60
     190.       0.     151.      39.       0.     100.      42.      37.       7.   603.30
     2.04     0.00     1.51     0.92    0.070    0.045    0.070    0.045   602.20   950.00
 0.000829     725.     700.     650.        2        0        0     0.00    71.10  1021.10


CCHV=   0.300 CEHV=   0.500
*SECNO 2090.000
 2800 NAT Q1=     22.63  WSEL=    606.20  ENC Q1=     22.63  WSEL=    606.30  RATIO=  0.0000
 NAT Q1=     25.  RATIOS LOB,CH,ROB=  0.0000  0.7789  0.2211  WSEL=    606.30

3470 ENCROACHMENT STATIONS=     660.0     692.4  TYPE=     4  TARGET=       0.097
  2090.00     2.79   606.29     0.00   606.20   606.52     0.24     0.73     0.10   606.90
     190.       0.     165.      25.       0.      40.      12.      38.       8.   604.50
     2.07     0.00     4.11     2.18    0.070    0.045    0.070    0.045   603.50   662.69
 0.007235     350.     390.     425.        2        0        0     0.00    29.71   692.40


SPECIAL BRIDGE
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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

5227 DOWNSTREAM ELEV IS    604.45 ,NOT    606.29 HYDRAULIC JUMP OCCURS DOWNSTREAM (IF LOW FLOW CONTROLS)

SB  XK        XKOR      COFQ      RDLEN     BWC       BWP       BAREA     SS        ELCHU     ELCHD
     1.25      2.90      2.60    150.00     16.50      6.70     17.60      0.00    603.40    603.50

*SECNO 2123.000
 2800 NAT Q1=    856.01  WSEL=    610.44  ENC Q1=    856.01  WSEL=    610.54  RATIO=  0.0000
 NAT Q1=    898.  RATIOS LOB,CH,ROB=  0.2479  0.5623  0.1897  WSEL=    610.54
 WATER EL=CHANGE FROM NATURAL PROFILES BRIDGE

3470 ENCROACHMENT STATIONS=     304.4     637.3  TYPE=     4  TARGET=       0.047
  2123.00     7.12   610.52     0.00   610.44   610.52     0.00     0.00     0.07   607.00
     190.      44.     112.      33.     492.     491.     263.      38.       8.    604.50
     2.12     0.09     0.23     0.13    0.070    0.045    0.070    0.045   603.40   304.43
 0.000005      33.      33.      33.        0        0        5     0.00   332.86   637.28

*SECNO 2223.000
 2800 NAT Q1=    443.29  WSEL=    610.44  ENC Q1=    443.29  WSEL=    610.54  RATIO=  0.0000
 NAT Q1=    468.  RATIOS LOB,CH,ROB=  0.4294  0.1421  0.4285  WSEL=    610.54

3470 ENCROACHMENT STATIONS=     224.7     462.4  TYPE=     4  TARGET=       0.053
  2223.00     6.92   610.52     0.00   610.44   610.52     0.00     0.00     0.00   605.20
     190.      81.      29.      81.     423.      62.     345.      41.       9.    604.80
     2.23     0.19     0.46     0.23    0.070    0.045    0.070    0.045   603.60   224.71
 0.000019     100.     100.     100.        0        0        0     0.00   237.69   462.40
```

```
   SECNO     DEPTH     CWSEL     CRIWS     WSELR     EG        HV        HI        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=   0.100 CEHV=   0.300
*SECNO 2713.000
 2800 NAT Q1=    323.60  WSEL=    610.45  ENC Q1=    323.60  WSEL=    610.55  RATIO=  0.0000
 NAT Q1=    345.  RATIOS LOB,CH,ROB=  0.2113  0.1280  0.6607  WSEL=    610.55

3470 ENCROACHMENT STATIONS=     287.6     527.7  TYPE=     4  TARGET=       0.063
  2713.00     5.33   610.53     0.00   610.45   610.53     0.00     0.01     0.00   606.40
     190.      36.      26.     128.     170.      48.     471.      49.      11.   606.20
     2.69     0.21     0.55     0.27    0.070    0.045    0.070    0.045   605.20   287.61
 0.000035     490.     490.     490.        0        0        0     0.00   240.04   527.66
```

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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED APRIL 1980
  ERROR CORR -  01,02,03,04
  MODIFICATION -  50,51,52,53,54
**************************************************
NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST
```

EAR STORM

SUMMARY PRINTOUT TABLE 110

	SECNO	CWSEL	DIFKWS	EG	TOPWID	QLOB	QCH	QROB	PERENC	STENCL	STCHL	STCHR	STENCR
	0.000	597.34	0.34	597.48	32.90	0.00	130.00	0.00	0.00	0.00	126.00	181.00	0.00
	0.000	597.44	0.10	597.56	33.36	0.00	130.00	0.00	0.00	126.00	126.00	181.00	181.00
	165.000	598.33	0.00	598.47	32.88	0.00	130.00	0.00	0.00	0.00	126.00	181.00	0.00
	165.000	598.32	-0.01	598.47	32.81	0.00	130.00	0.00	0.00	126.00	126.00	181.00	181.00
*	330.000	605.50	0.00	605.50	232.00	0.00	190.00	0.00	0.00	0.00	1328.00	1560.00	0.00
*	330.000	605.60	0.10	605.60	232.00	0.00	190.00	0.00	0.00	1328.00	1328.00	1560.00	1560.00
	430.000	605.50	0.00	605.50	425.42	8.07	171.06	10.87	0.00	0.00	1328.00	1560.00	0.00
	430.000	605.60	0.10	605.60	319.24	5.95	175.08	8.97	0.03	1297.27	1328.00	1560.00	1616.52
	830.000	605.50	0.00	605.50	412.65	7.02	173.59	9.39	0.00	0.00	1328.00	1560.00	0.00
	830.000	605.60	0.10	605.60	302.70	4.84	177.86	7.29	0.03	1301.51	1328.00	1560.00	1604.21
	1000.000	605.50	0.00	605.50	371.59	28.55	57.30	104.16	0.00	0.00	485.00	520.00	0.00
	1000.000	605.60	0.10	605.60	220.92	25.47	60.28	104.26	0.07	415.38	485.00	520.00	636.30
	1700.000	605.56	0.00	605.58	116.98	0.00	139.66	50.34	0.00	0.00	950.00	1000.00	0.00
	1700.000	605.66	0.10	605.69	71.10	0.00	151.00	39.00	0.09	950.00	950.00	1000.00	1021.10
	2090.000	606.20	0.00	606.40	51.17	0.00	150.42	39.58	0.00	0.00	660.00	685.00	0.00
	2090.000	606.29	0.08	606.52	29.71	0.00	164.54	25.46	0.10	660.00	660.00	685.00	692.40
*	2123.000	610.44	0.00	610.44	566.30	45.43	108.71	35.86	0.00	0.00	490.00	580.00	0.00
*	2123.000	610.52	0.08	610.52	332.86	44.43	112.36	33.21	0.05	304.43	490.00	580.00	637.28

SECNO	CWSEL	DIFKWS	EG	TOPWID	QLOB	QCH	QROB	PERENC	STENCL	STCHL	STCHR	STENCR
2223.000	610.44	0.00	610.44	377.98	80.96	27.74	81.30	0.00	0.00	370.00	380.00	0.00
2223.000	610.52	0.08	610.52	237.69	80.79	28.62	80.59	0.05	224.71	370.00	380.00	462.40
2713.000	610.45	0.00	610.45	365.55	38.89	25.01	126.10	0.00	0.00	368.00	378.00	0.00
2713.000	610.53	0.08	610.53	240.04	36.35	26.06	127.59	0.06	287.61	368.00	378.00	527.66

SUMMARY OF ERRORS

```
NOTE      SECNO=  330.000  PROFILE= 1  WSEL BASED ON X5 CARD
NOTE      SECNO=  330.000  PROFILE= 2  WSEL BASED ON X5 CARD

CAUTION   SECNO= 2123.000  PROFILE= 1  HYDRAULIC JUMP D.S.
CAUTION   SECNO= 2123.000  PROFILE= 2  HYDRAULIC JUMP D.S.
```

FLOODWAY DATA, EAR STORM
PROFILE NO. 2

	STATION	FLOODWAY WIDTH	FLOODWAY SECTION AREA	FLOODWAY MEAN VELOCITY	WATER SURFACE ELEVATION WITH FLOODWAY	WATER SURFACE ELEVATION WITHOUT FLOODWAY	DIFFERENCE
	0.000	33.	46.	2.8	597.4	597.3	0.1
A	165.000	33.	42.	3.1	598.3	598.3	0.0
B	330.000	232.	1729.	0.1	605.6	605.5	0.1
	430.000	319.	2078.	0.1	605.6	605.5	0.1
C	830.000	303.	1879.	0.1	605.6	605.5	0.1
D	1000.000	221.	611.	0.3	605.6	605.5	0.1
	1700.000	71.	143.	1.3	605.7	605.6	0.1
E	2090.000	30.	52.	3.7	606.3	606.2	0.1
	2123.000	333.	1246.	0.2	610.5	610.4	0.1
	2223.000	238.	830.	0.2	610.5	610.4	0.1
F	2713.000	240.	689.	0.3	610.5	610.4	0.1

00BREAK00

1) COUNTY: Alpena

2) STUDY NAME: Alpena Cty/Twp

3) WATERCOURSE: Fletcher Creek

4) DOCUMENT TYPE: 100-yr Natural

00BREAK00

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*************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED APRIL 1980
  ERROR CORR -  01,02,03,04
  MODIFICATION -  50,51,52,53,54
*************************************************
T1 ALPENA, MICH
T2 FLETCHER CREEK - FLOODWAY
T3 100-YEAR STORM
```

RECEIVED
APR 13 1981
WATER MANAGEMENT

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0.	4.	0.	0.	0.006000	0.00	0.0	0.	597.000	0.000

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	1.000	0.000	-1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

J3 VARIABLE CODES FOR SUMMARY PRINTOUT

	110.000	200.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
QT	6.000	70.000	120.000	130.000	165.000	130.000	130.000	0.000	0.000	0.000
NC	0.070	0.070	0.045	0.100	0.300	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	0.000	11.000	126.000	181.000	0.000	0.000	0.000	0.000	-1.000	0.000
GR	606.800	0.000	603.500	126.000	597.500	136.000	596.400	157.000	597.100	164.000
GR	603.100	181.000	603.000	200.000	605.300	300.000	606.100	400.000	606.100	500.000
GR	605.600	700.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NC	0.000	0.000	0.000	0.300	0.500	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000

X1	165.000	0.000	0.000	0.000	130.000	200.000	165.000	0.000	1.000	0.000
X3	10.000	0.000	0.000	0.000	0.000	0.000	0.000	610.000	610.000	0.000
QT	6.000	110.000	160.000	190.000	250.000	190.000	190.000	0.000	0.000	0.000
FT	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	330.000	17.000	1328.000	1560.000	165.000	165.000	165.000	0.000	0.000	0.000
X3	10.000	0.000	0.000	0.000	0.000	0.000	0.000	610.400	610.400	0.000
X5	6.000	602.700	605.000	605.500	607.500	605.600	605.600	0.000	0.000	0.000
GR	612.000	0.000	610.000	200.000	607.200	1100.000	607.600	1175.000	607.300	1200.000
GR	602.200	1300.000	600.100	1328.000	598.700	1350.000	597.200	1400.000	597.900	1450.000
GR	597.700	1500.000	599.200	1550.000	600.000	1560.000	602.700	1600.000	603.700	1650.000
GR	612.100	1700.000	612.400	1800.000	0.000	0.000	0.000	0.000	0.000	0.000
FT	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	430.000	0.000	0.000	0.000	100.000	100.000	100.000	0.000	0.000	0.000
NC	0.000	0.000	0.000	0.100	0.300	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	830.000	0.000	0.000	0.000	400.000	400.000	400.000	0.000	0.500	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	1000.000	9.000	485.000	520.000	170.000	170.000	170.000	0.000	0.000	0.000
GR	610.000	0.000	605.500	340.000	603.800	430.000	603.700	485.000	601.500	510.000
GR	600.200	515.000	601.300	520.000	604.800	690.000	610.000	850.000	0.000	0.000
FT	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	1700.000	7.000	950.000	1000.000	725.000	650.000	700.000	0.000	0.000	0.000
GR	610.000	0.000	605.700	910.000	605.600	950.000	602.200	985.000	603.200	990.000
GR	603.300	1000.000	610.000	1200.000	0.000	0.000	0.000	0.000	0.000	0.000
NC	0.000	0.000	0.000	0.300	0.500	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000

X1	2090.000	6.000	660.000	685.000	350.000	425.000	390.000	0.000	0.000	0.000
X3	10.000	0.000	0.000	0.000	0.000	0.000	0.000	606.000	606.000	0.000
GR	610.000	0.000	607.000	600.000	606.900	660.000	603.500	675.000	604.500	685.000
GR	610.000	780.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SB	1.250	2.900	2.600	150.000	16.500	6.700	17.600	0.000	603.400	603.500
FT	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	2123.000	7.000	490.000	580.000	33.000	33.000	33.000	0.000	0.000	0.000
X2	0.000	0.000	1.000	605.300	610.300	0.000	0.000	0.000	0.000	0.000
X3	10.000	0.000	0.000	0.000	0.000	0.000	0.000	610.300	610.300	0.000
GR	615.000	0.000	610.000	170.000	607.000	490.000	603.400	570.000	604.500	580.000
GR	610.000	690.000	615.000	1050.000	0.000	0.000	0.000	0.000	0.000	0.000
FT	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	2223.000	10.000	370.000	380.000	100.000	100.000	100.000	0.000	0.000	0.000
GR	615.000	0.000	613.200	100.000	609.300	200.000	607.400	302.000	607.300	350.000
GR	605.200	370.000	603.600	378.000	604.800	380.000	610.000	520.000	615.000	850.000
NC	0.000	0.000	0.000	0.100	0.300	0.000	0.000	0.000	0.000	0.000
FT	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	2713.000	12.000	368.000	378.000	490.000	490.000	490.000	0.000	0.000	0.000
GR	616.100	0.000	614.500	100.000	610.600	200.000	608.800	300.000	608.700	344.000
GR	606.400	368.000	605.200	374.000	606.200	378.000	606.500	400.000	609.000	550.000
GR	609.900	550.000	616.600	850.000	0.000	0.000	0.000	0.000	0.000	0.000
EJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

```
   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 1

CCHV=   0.100 CEHV=   0.300
*SECNO .000
     0.00      1.94    597.34      0.00    597.00    597.48      0.14      0.00      0.00    602.50
     130.       0.      130.       0.        0.       43.        0.        0.        0.     602.10
     0.00      0.00      3.02      0.00     0.070     0.045     0.070     0.000    595.40    134.60
 0.005988       0.        0.        0.         0         0         5      0.00     32.90    167.51


CCHV=   0.300 CEHV=   0.500
*SECNO 165.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      610.00 ELREA=      610.00

   165.00      1.93    598.33      0.00      0.00    598.47      0.14      0.99      0.00    603.50
     130.       0.      130.       0.        0.       43.        0.        0.        0.     603.10
     0.02      0.00      3.04      0.00     0.070     0.045     0.070     0.045    596.40    134.61
 0.006067      130.      165.      200.         1         0         0      0.00     32.88    167.49


*SECNO 330.000
 WATER EL=X5 CARD=   605.500

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      610.40 ELREA=      610.40

   330.00      8.30    605.50      0.00      0.00    605.50      0.00      0.00      0.04    600.10
     190.       0.      190.       0.        0.     1706.        0.        3.        1.     600.00
     0.43      0.00      0.11      0.00     0.070     0.045     0.070     0.045    597.20   1328.00
 0.000001      165.      165.      165.         0         0         0      0.00    232.00   1560.00
```

```
   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       WIN       ELMIN       SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID      ENDST

*SECNO 430.000
   430.00     8.30    605.50      0.00      0.00    605.50      0.00      0.00      0.00    600.10
     190.       8.     171.       11.      229.     1706.     291.       8.        1.     600.00
     0.72     0.04      0.10      0.04     0.070     0.045    0.070     0.045    597.20   1235.29
 0.000001     100.     100.      100.         2         0        0      0.00    425.42   1660.71

CCHV=   0.100 CEHV=   0.300
*SECNO 830.000
   830.00     7.80    605.50      0.00      0.00    605.50      0.00      0.00      0.00    600.60
     190.       7.     174.        9.      185.     1590.     241.      27.        5.     600.50
     1.80     0.04      0.11      0.04     0.070     0.045    0.070     0.045    597.70   1245.09
 0.000001     400.     400.      400.         0         0        0      0.00    412.65   1657.74

*SECNO 1000.000
  1000.00     5.30    605.50      0.00      0.00    605.50      0.00      0.00      0.00    603.70
     190.      29.      57.      104.      173.      120.     424.      33.        7.     601.30
     1.96     0.17      0.48      0.25     0.070     0.045    0.070     0.045    600.20    339.96
 0.000042     170.     170.      170.         0         0        0      0.00    371.59    711.55

*SECNO 1700.000
  1700.00     3.36    605.56      0.00      0.00    605.58      0.03      0.08      0.01    605.60
     190.       0.     140.       50.        0.       95.      76.      40.       11.     603.30
     2.11     0.00      1.46      0.66     0.070     0.045    0.070     0.045    602.20    950.43
 0.000826     725.     700.      650.         2         0        0      0.00    116.98   1067.41
```

```
   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       FLMIN       SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID      ENDST


CCHV=   0.300 CEHV=   0.500
*SECNO 2090.000
  2090.00      2.70    606.20      0.00      0.00    606.40      0.20      0.73      0.09    606.90
     190.        0.      150.       40.        0.      38.       25.       41.       11.    604.50
     2.14      0.00      3.96      1.59     0.070     0.045     0.070     0.045    603.50    663.11
 0.007049      350.      390.      425.         3         0         0      0.00     51.17    714.28


SPECIAL BRIDGE

5227 DOWNSTREAM ELEV IS    604.45 ,NOT    606.20 HYDRAULIC JUMP OCCURS DOWNSTREAM (IF LOW FLOW CONTROLS)

SB  XK        XKOR      COFQ      RDLEN     BWC       BWP       BAREA     SS        ELCHU     ELCHD
     1.25      2.90      2.60    150.00     16.50      6.70     17.60      0.00    603.40    603.50

*SECNO 2123.000
PRESSURE AND WEIR FLOW


 EGPRS      EGLWC       H3       QWEIR      QPR       BAREA   TRAPEZOID      ELLC      ELTRU
                                                                 AREA
   611.45    607.05     0.00       20.      171.       18.       19.       605.30    610.30


  2123.00      7.04    610.44      0.00      0.00    610.44      0.00      4.03      0.00    607.00
     190.       45.      109.       36.      623.      484.      357.       41.       12.    604.50
     2.19      0.07      0.22      0.10     0.070     0.045     0.070     0.045    603.40    155.15
 0.000005       33.       33.       33.         0         0         5      0.00    566.30    721.45
```

```
   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 2223.000
  2223.00      6.84    610.44      0.00      0.00    610.44      0.00      0.00      0.00    605.20
     190.       81.       28.       81.      461.      61.      431.       44.       13.     604.80
     2.32      0.18      0.46      0.19     0.070    0.045     0.070     0.045    603.60    170.85
 0.000018      100.      100.      100.         2        0         0      0.00    377.98    548.83

CCHV=   0.100 CEHV=   0.300
*SECNO 2713.000
  2713.00      5.25    610.45      0.00      0.00    610.45      0.00      0.01      0.00    606.40
     190.       39.       25.      126.      219.      47.      501.       54.       17.     606.20
     2.82      0.18      0.53      0.25     0.070    0.045     0.070     0.045    605.20    208.74
 0.000034      490.      490.      490.         0        0         0      0.00    365.55    574.30
```

1) COUNTY: ALPENA

2) STUDY NAME: ALPENA City/TWP

3) WATERCOURSE: FLetcher Creek

4) DOCUMENT TYPE: Report

JOHNSON

DESIGN NOTES AND COMPUTATIONS

SUBJECT

JOB NUMBER

Exhibit 2

Fletcher Creek; Description of HEC II Model

PREPARED BY DATE CHECKED BY SHEET NO. OF

BERNARD JOHNSON INCORPORATED
2021 K Street, N W - Washington, D C 20006 202/862-8600
ENGINEERS - ARCHITECTS PLANNERS

JOHNSON
ENGINEERS
ARCHITECTS
PLANNERS

DESIGN NOTES AND COMPUTATIONS

SUBJECT:

JOB NUMBER

Starting water surface by slope-area method. ? 597.0

Cross section 0

Surveyed section 165 moved 165 feet downstream and lowered 1.0 foot.

Cross section 165

Actual field surveyed cross section located just downstream of the culverts at Long Rapids Road. Overbanks assumed non-effective until water overtops road.

Culverts at Long Rapids Road

There are two seperate culverts at Long Rapids Road. One 165' long 30" CMP and one 165' long 42" RCP.

Neither the normal bridge or special bridge routine hands culverts like this well. Instead, a rating curve for both culverts was drafted by analyzing each seperately using "Hydraulic Charts for Highway Culverts", Federal Highway Administration. Using the X5 card, upstream cross section (330) is automatically filled to the designated elevation

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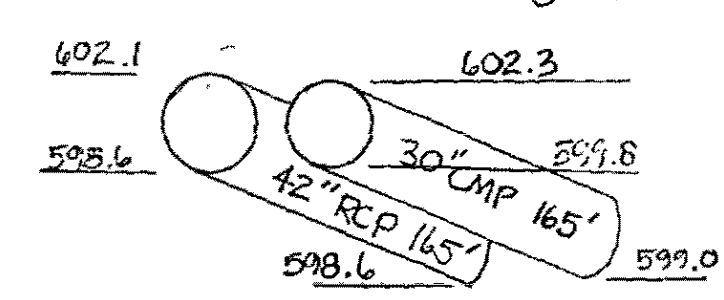
DESIGN NOTES AND COMPUTATIONS

SUBJECT.

JOB NUMBER

Verify HECII assumptions for culvert at Long Rapids Road on Fletcher Creek

Actual Conditions:



$$A_{30''} = \pi\left(\frac{30}{2(12)}\right)^2 = 4.90\ ft^2$$

$$C_{30''} = 2\pi\left(\frac{30}{2(12)}\right) = 7.85\ ft$$

$$A_{42''} = \pi\left(\frac{42}{(12)(2)}\right) = 9.62\ ft^2$$

$$C_{42''} = 2\pi\left(\frac{42}{12(2)}\right) = 11.00\ ft$$

$$A_T = 9.62 + 4.90 = 14.52$$

$$C_T = 11.00 + 7.85 = 18.85$$

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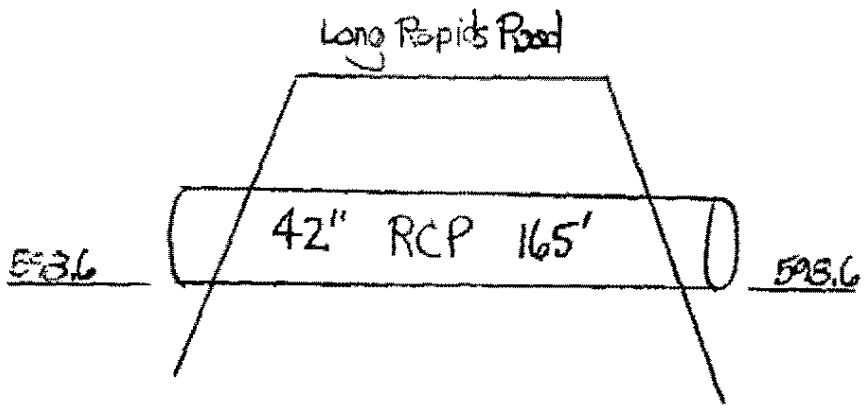
DESIGN NOTES AND COMPUTATIONS

SUBJECT.

JOB NUMBER



Outlet Control

Q cfs	$\frac{d_c+D}{2}$	H (ft)	Backwater Elev
70	$\frac{2.6+3.5}{2}$ = 3.1	1.9	603.6
80	$\frac{2.8+3.5}{2}$ = 3.1	2.5	604.2
90	$\frac{3.0+3.5}{2}$ = 3.3	3.1	605.0
100	$\frac{3.1+3.5}{2}$ = 3.3	3.8	605.7
110	$\frac{3.2+3.5}{2}$ = 3.4	4.8	606.8
120	$\frac{3.3+3.5}{2}$ = 3.4	5.6	607.6
130	ϕ = 3.5	6.6	608.7
140	ϕ = 3.5	7.7	609.8
150	ϕ = 3.5	9.0	611.1

Inlet Control

HW/D	Backwater Elev
1.30	603.2
1.45	603.7
1.65	604.4
1.90	605.3
2.20	606.3
2.50	607.4
2.80	608.4
3.20	609.8
3.50	610.9

Outlet Control

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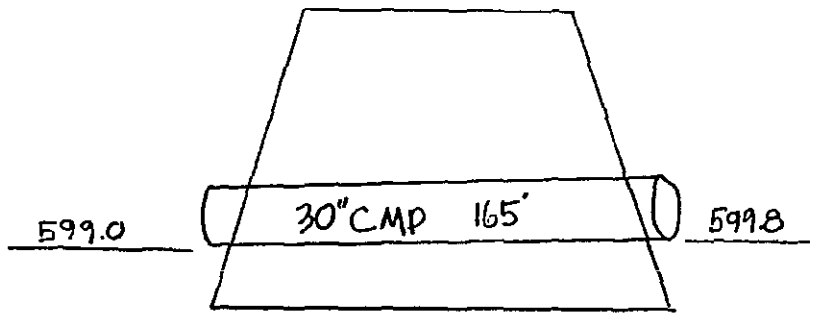
DESIGN NOTES AND COMPUTATIONS

SUBJECT

JOB NUMBER

30" CMP



Outlet Control

Q(cfs)	$\frac{d_c+D}{2}$	H(ft)	Backwater Elev
25	$\frac{1.7+2.5}{2}=2.1$	2.9	604.0
30	$\frac{1.8+2.5}{2}=2.2$	4.0	605.2
35	$\frac{2.0+2.5}{2}=2.3$	5.5	606.8
40	$\frac{2.2+2.5}{2}=2.4$	7.0	608.4
45	$\frac{2.3+2.5}{2}=2.4$	9.0	610.4
50	$\frac{2.3+2.5}{2}=2.4$	11.0	612.4

Inlet Control

H_w/D	Backwater Elev
1.1	602.4
1.2	602.8
1.5	603.6
1.6	603.7
2.0	604.8
2.2	605.3

Pipe is outlet controlled

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DESIGN NOTES AND COMPUTATIONS

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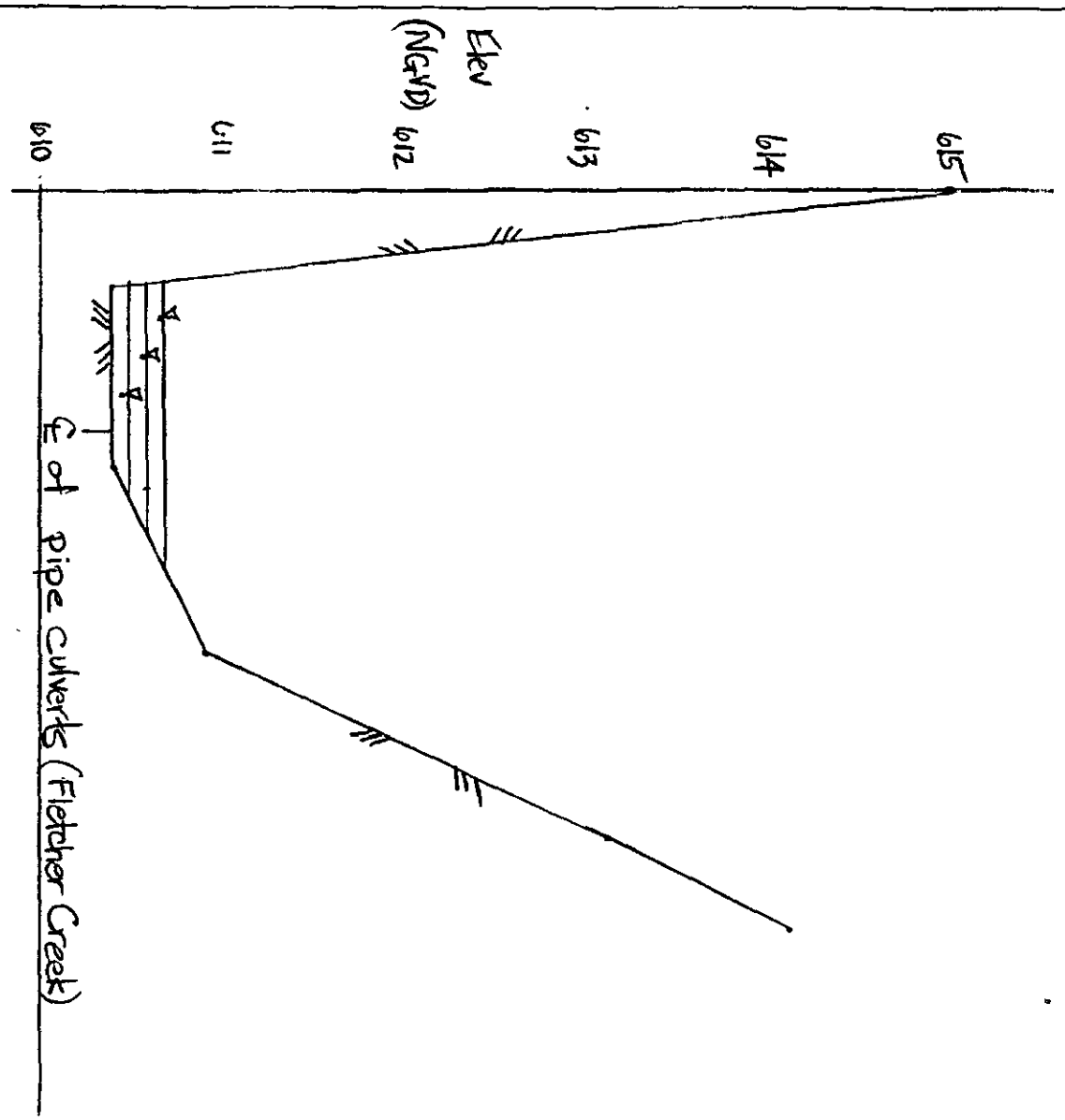

Top of Road
over Long Rapids
Road
Alpena, Mich

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Weir flow over Long Rapids Road (Fletcher Creek)

Eqn. $Q = CLH^{3/2}$ $C = 2.5$

Elevation (NGVD)	Head (feet)	Effective Length (feet)	Q (cfs)
610.4	0		00
610.5	.1	210	16.6
610.6	.2	220	49.2
610.7	.3	250	102.7

Summary of Results

Q	Elevation u.s
110	604.4
160	607.7
190	610.4
250	610.6

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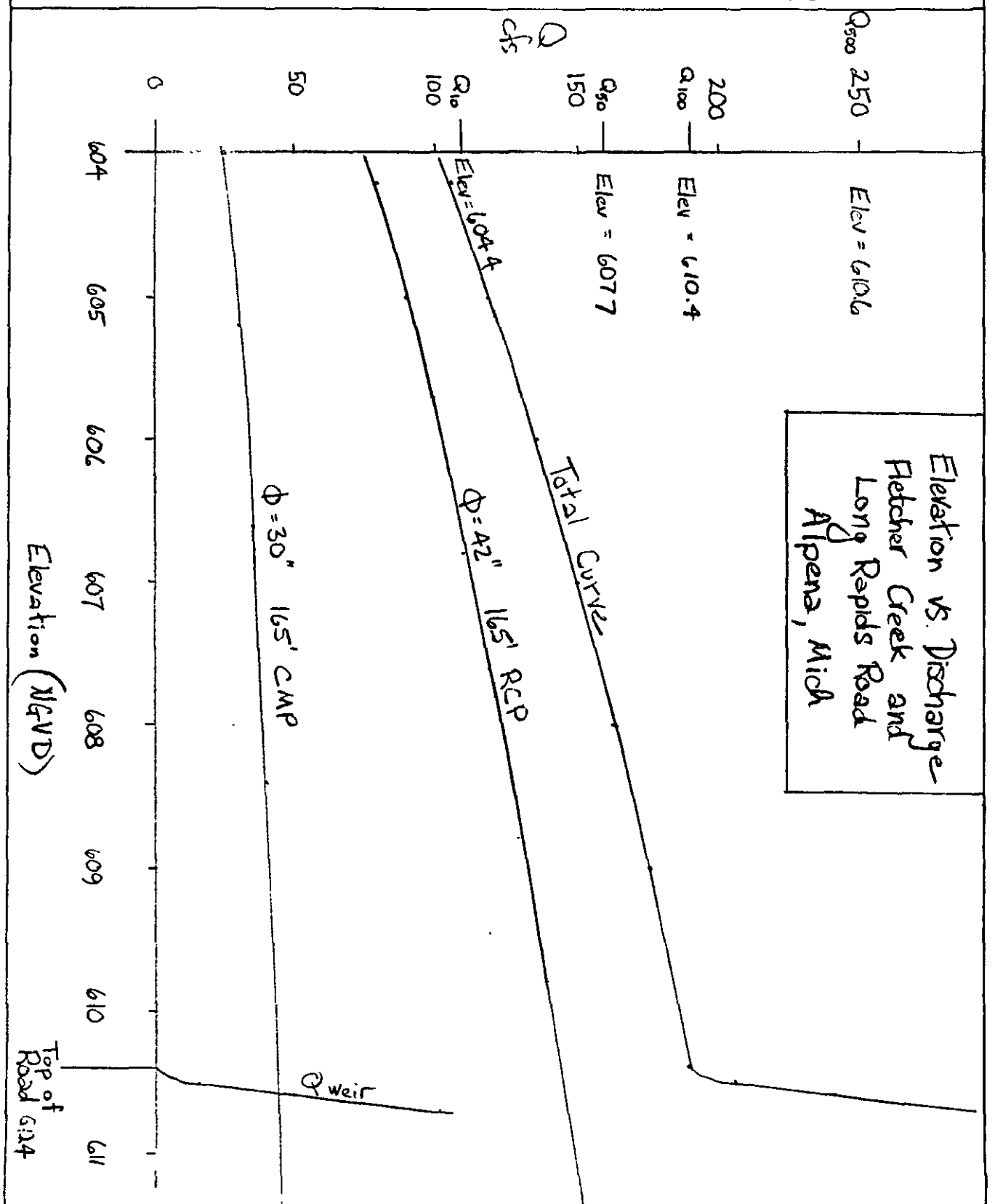

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SUBJECT

JOB NUMBER

Cross section 330 B

Actual field surveyed cross section. Overbank areas taken from quad map.

Located just upstream of Long Rapid's Road.

Overbanks assumed non-effective until water overtops roadway.

Elevations at this cross section are determined by the rating curve for the culverts (X5 card).

Cross section 430

Surveyed section 330 moved 100 feet upstream.

Cross section 730

Surveyed section 330 moved 400 feet upstream and raised .5 foot.

Cross section 1000

Surveyed section 2713 moved 1713 feet downstream and lowered 5.1 feet.

Cross section 1700

Surveyed section 2713 moved 1013 feet downstream and lowered 3.7 feet.

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DESIGN NOTES AND COMPUTATIONS

SUBJECT.

JOB NUMBER

Cross section 2090

Surveyed section 2713 moved 623 feet downstream and lowered 3.7 feet.

Located just downstream of Trail Road.

Overbanks non-effective until water overtops road

Trail Road

Trail Road culverts are a series of four oval culverts. The diagrams on the next pages explain how the culverts were made into an equivalent section for the special bridge routine.

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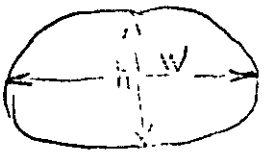
SUBJECT.

JOB NUMBER

Culverts at the Trail over Fletcher Creek

33' long



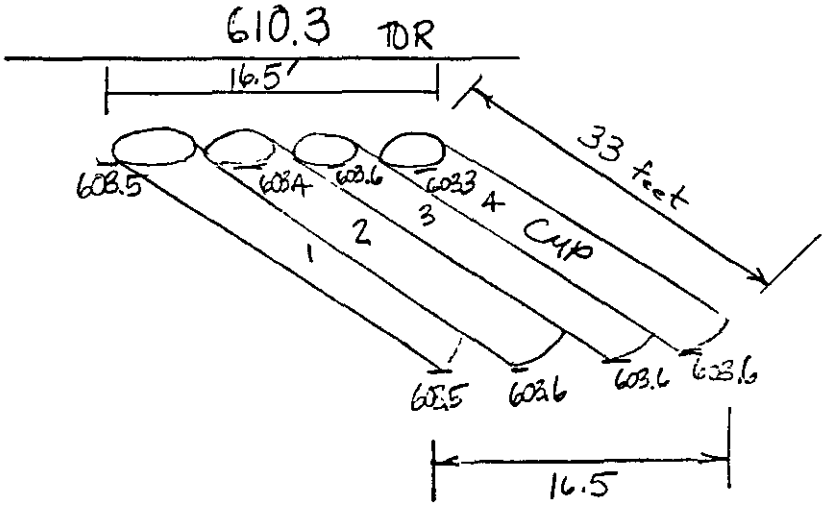
$$A = \frac{\pi}{4}(w)(H)$$

h = 1.8'
w = 3.0'

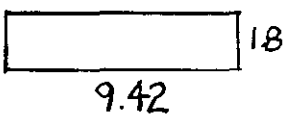
$$A = (\cancel{4})\frac{\pi}{\cancel{4}}(w)(H)$$

$$= 16.96 \text{ sq.ft (total of 4)}$$

Culvert Set up



Average Section



Loss Coeff. K for orifice flow

$$K = K_{inlake} + K_{outlet} + K_{friction}$$

$$K_{friction} = \frac{29.1\, n^2 L}{R^{4/3}}$$

Assume flowing full

n = .050 L = 33

WP = 7.77

$$R = \frac{A}{WP} = \left(\frac{16.96}{7.77}\right) = .55$$

$$WP = 2\pi\sqrt{\frac{a^2+b^2}{2}} = 7.77 \text{ ft}$$

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$$K_f = \frac{29.1 \quad .03^2 \quad 33}{.55^{4/3}} = 1.94$$

$$K_T = 1 + .5 + 1.94$$

$$= 3.44$$

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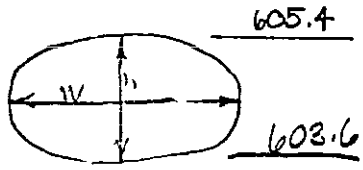
SUBJECT.

JOB NUMBER

Culverts at Trail over Fletcher Creek
610.3 TOR



$A = \frac{\pi}{4}(w)(h)$

$w = 30' = 36''$
$h = 1.8' = 22''$

Outlet Control

	4·Q(cfs)	Q cfs	TW	$\frac{d_c+D}{2}$	H(feet)	Backwater Elev.
Q_{10}	27.5	110	1.3	$\frac{1.4+1.8}{2} = 1.6$	1.7	606.6
Q_{50}	40.0	160	4.0	$\frac{1.8+1.8}{2} = 1.8$	3.8	611.4 over roadway
Q_{100}	47.5	190	6.8	$\frac{1.9+1.8}{2} = 1.8$	5.0	615.4 "
Q_{500}	62.5	250	7.0	$\frac{2.3+1.8}{2} = 2.0$	8.6	619.2 "

This verifies that the 50-year storm overtops the road

PREPARED BY DATE CHECKED BY SHEET NO OF

JOHNSON
ENGINEERS
ARCHITECTS
PLANNERS

DESIGN NOTES AND COMPUTATIONS

SUBJECT:

JOB NUMBER

Cross section 2123

Surveyed section 2713 moved 590 feet downstream and lowered 3.7 feet

Cross section 2223

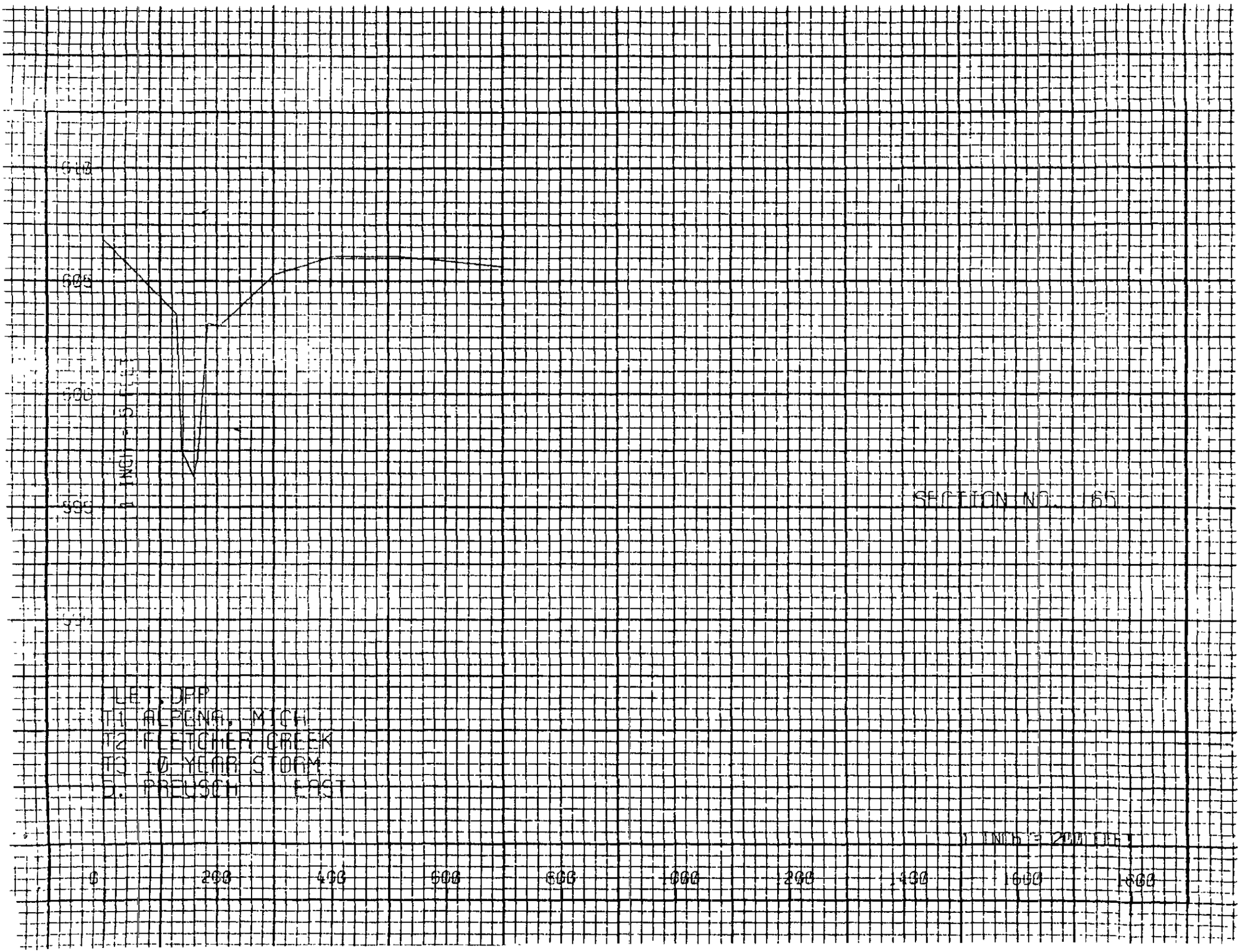
Surveyed section 2713 moved 490 feet downstream and lowered 3.6 feet

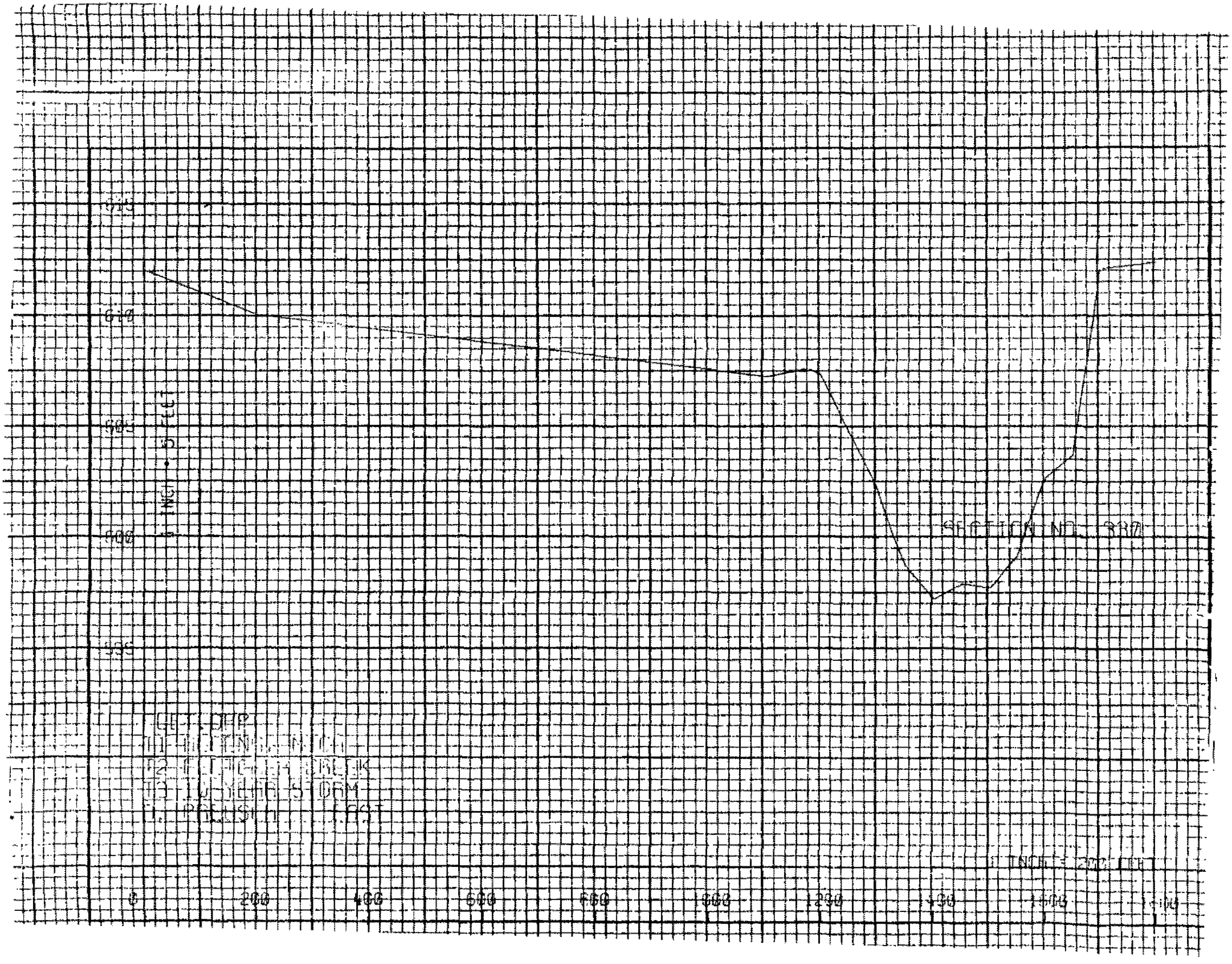
Cross section 2713

Actual field surveyed section located at the north city limits of Alpena.

PREPARED BY DATE CHECKED BY SHEET NO. OF

BERNARD JOHNSON INCORPORATED
2021 K STREET, N.W. · WASHINGTON, D.C. 20006 · 202/862-8600


610
605
600
595
1 INCH = 5 FEET
SECTION NO. 165
LET, DPP
T1 ALPENA, MICH
T2 FLETCHER CREEK
T3 10 YEAR STORM
D. PREUSCH EAST
1 INCH = 200 FEET
0
200
400
600
800
1000
1200
1400
1600
1800


SECTION NO. 330
1 INCH = 5 FEET
0
200
400
600
800
1000
1200
1400
1600
595
600
605
610
615

1 INCH = 5 FEET
ELEVATION IN FEET

00BREAK00

1) COUNTY: Alpena

2) STUDY NAME: Alpena City / Twp

3) WATERCOURSE: Fletcher Creek

4) DOCUMENT TYPE: Summary

00BREAK00

```
*************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED APRIL 1980
  ERROR CORR -  01,02,03,04
  MODIFICATION -  50,51,52,53,54
*************************************************
NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST
```

AR STORM

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
	0.000	0.00	0.00	0.00	595.40	70.00	596.89	0.00	596.99	60.02	2.43	28.84	9.04
	0.000	0.00	0.00	0.00	595.40	120.00	597.27	0.00	597.40	59.90	2.94	40.81	15.50
	0.000	0.00	0.00	0.00	595.40	130.00	597.34	0.00	597.48	59.88	3.02	43.00	16.80
	0.000	0.00	0.00	0.00	595.40	165.00	597.55	0.00	597.72	59.84	3.28	50.25	21.33
	165.000	165.00	0.00	0.00	596.40	70.00	597.89	0.00	597.98	60.42	2.43	28.78	9.01
	165.000	165.00	0.00	0.00	596.40	120.00	598.26	0.00	598.40	60.67	2.95	40.65	15.41
	165.000	165.00	0.00	0.00	596.40	130.00	598.33	0.00	598.47	60.67	3.04	42.81	16.69
	165.000	165.00	0.00	0.00	596.40	165.00	598.55	0.00	598.72	60.70	3.30	50.02	21.18
*	330.000	165.00	0.00	0.00	597.20	110.00	602.70	0.00	602.70	0.01	0.10	1056.10	957.60
*	330.000	165.00	0.00	0.00	597.20	160.00	605.00	0.00	605.00	0.01	0.10	1589.69	1893.24
*	330.000	165.00	0.00	0.00	597.20	190.00	605.50	0.00	605.50	0.01	0.11	1705.69	2129.05
*	330.000	165.00	0.00	0.00	597.20	250.00	607.50	0.00	607.50	0.01	0.12	2169.69	3179.45
	430.000	100.00	0.00	0.00	597.20	110.00	602.70	0.00	602.70	0.01	0.10	1156.00	984.17
	430.000	100.00	0.00	0.00	597.20	160.00	605.00	0.00	605.00	0.01	0.09	2015.43	2072.25
	430.000	100.00	0.00	0.00	597.20	190.00	605.50	0.00	605.50	0.01	0.10	2224.95	2364.81
	430.000	100.00	0.00	0.00	597.20	250.00	607.50	0.00	607.50	0.00	0.10	3151.11	3734.27
	830.000	400.00	0.00	0.00	597.70	110.00	602.70	0.00	602.70	0.02	0.11	1005.53	803.54
	830.000	400.00	0.00	0.00	597.70	160.00	605.00	0.00	605.00	0.01	0.10	1812.40	1799.44
	830.000	400.00	0.00	0.00	597.70	190.00	605.50	0.00	605.50	0.01	0.11	2015.56	2072.42
	830.000	400.00	0.00	0.00	597.70	250.00	607.50	0.00	607.50	0.01	0.11	2891.92	3359.71

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
	1000.000	170.00	0.00	0.00	600.20	110.00	602.66	0.00	602.72	42.92	2.33	71.49	16.79
	1000.000	170.00	0.00	0.00	600.20	160.00	605.00	0.00	605.00	0.63	0.53	541.17	200.87
	1000.000	170.00	0.00	0.00	600.20	190.00	605.50	0.00	605.50	0.42	0.48	716.47	294.64
	1000.000	170.00	0.00	0.00	600.20	250.00	607.50	0.00	607.50	0.08	0.28	1672.23	902.44
	1700.000	700.00	0.00	0.00	602.20	110.00	604.59	0.00	604.63	19.57	1.76	77.72	24.87
	1700.000	700.00	0.00	0.00	602.20	160.00	605.09	0.00	605.13	13.79	1.70	121.43	43.09
	1700.000	700.00	0.00	0.00	602.20	190.00	605.56	0.00	605.58	8.26	1.46	171.53	66.10
	1700.000	700.00	0.00	0.00	602.20	250.00	607.51	0.00	607.51	0.54	0.60	874.47	339.52
	2090.000	390.00	0.00	0.00	603.50	110.00	605.84	0.00	606.04	72.30	3.63	30.29	12.94
	2090.000	390.00	0.00	0.00	603.50	160.00	606.05	0.00	606.23	66.28	3.70	55.85	19.65
	2090.000	390.00	0.00	0.00	603.50	190.00	606.20	0.00	606.40	70.49	3.96	62.80	22.63
	2090.000	390.00	0.00	0.00	603.50	250.00	607.54	0.00	607.59	10.67	2.13	215.97	76.52
	2123.000	33.00	610.30	605.30	603.40	110.00	607.59	0.00	607.60	0.62	0.48	228.21	139.99
*	2123.000	33.00	610.30	605.30	603.40	160.00	609.77	0.00	609.78	0.17	0.38	424.37	393.66
*	2123.000	33.00	610.30	605.30	603.40	190.00	610.44	0.00	610.44	0.05	0.22	1464.23	856.01
	2123.000	33.00	610.30	605.30	603.40	250.00	610.71	0.00	610.71	0.07	0.27	1623.33	974.53
	2223.000	100.00	0.00	0.00	603.60	110.00	607.60	0.00	607.61	3.50	1.31	178.24	58.83
	2223.000	100.00	0.00	0.00	603.60	160.00	609.78	0.00	609.78	0.28	0.52	723.31	302.11
	2223.000	100.00	0.00	0.00	603.60	190.00	610.44	0.00	610.44	0.18	0.46	953.54	443.29
	2223.000	100.00	0.00	0.00	603.60	250.00	610.71	0.00	610.71	0.24	0.53	1060.57	512.83
	2713.000	490.00	0.00	0.00	605.20	110.00	607.88	0.00	607.90	11.62	1.83	123.32	32.28
	2713.000	490.00	0.00	0.00	605.20	160.00	609.80	0.00	609.80	0.60	0.64	548.25	206.72
	2713.000	490.00	0.00	0.00	605.20	190.00	610.45	0.00	610.45	0.34	0.53	766.20	323.60
	2713.000	490.00	0.00	0.00	605.20	250.00	610.73	0.00	610.73	0.43	0.62	870.58	383.04

AR STORM

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	0.000	70.00	596.89	0.00	0.00	-0.11	30.90	0.00
	0.000	120.00	597.27	0.38	0.00	0.27	32.60	0.00
	0.000	130.00	597.34	0.07	0.00	0.34	32.90	0.00
	0.000	165.00	597.55	0.22	0.00	0.55	33.88	0.00
	165.000	70.00	597.89	0.00	0.99	0.00	30.90	165.00
	165.000	120.00	598.26	0.38	0.99	0.00	32.58	165.00
	165.000	130.00	598.33	0.07	0.99	0.00	32.88	165.00
	165.000	165.00	598.55	0.22	0.99	0.00	33.85	165.00
*	330.000	110.00	602.70	0.00	4.81	0.00	232.00	165.00
*	330.000	160.00	605.00	2.30	6.74	0.00	232.00	165.00
*	330.000	190.00	605.50	0.50	7.17	0.00	232.00	165.00
*	330.000	250.00	607.50	2.00	8.95	0.00	232.00	165.00
	430.000	110.00	602.70	0.00	0.00	0.00	309.82	100.00
	430.000	160.00	605.00	2.30	0.00	0.00	412.64	100.00
	430.000	190.00	605.50	0.50	0.00	0.00	425.42	100.00
	430.000	250.00	607.50	2.00	0.00	0.00	642.04	100.00
	830.000	110.00	602.70	0.00	0.00	0.00	292.61	400.00
	830.000	160.00	605.00	2.30	0.00	0.00	399.87	400.00
	830.000	190.00	605.50	0.50	0.00	0.00	412.65	400.00
	830.000	250.00	607.50	2.00	0.00	0.00	463.77	400.00
	1000.000	110.00	602.66	0.00	-0.04	0.00	89.46	170.00
	1000.000	160.00	605.00	2.34	0.00	0.00	329.73	170.00
	1000.000	190.00	605.50	0.50	0.00	0.00	371.59	170.00
	1000.000	250.00	607.50	2.00	0.00	0.00	584.23	170.00
	1700.000	110.00	604.59	0.00	1.93	0.00	78.44	700.00
	1700.000	160.00	605.09	0.50	0.09	0.00	98.29	700.00
	1700.000	190.00	605.56	0.47	0.06	0.00	116.98	700.00
	1700.000	250.00	607.51	1.95	0.01	0.00	597.05	700.00

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	2090.000	110.00	605.84	0.00	1.25	0.00	20.28	390.00
	2090.000	160.00	606.05	0.22	0.96	0.00	48.14	390.00
	2090.000	190.00	606.20	0.15	0.64	0.00	51.17	390.00
	2090.000	250.00	607.54	1.34	0.03	0.00	246.49	390.00
	2123.000	110.00	607.59	0.00	1.76	0.00	90.00	33.00
*	2123.000	160.00	609.77	2.18	3.72	0.00	90.00	33.00
*	2123.000	190.00	610.44	0.66	4.24	0.00	566.30	33.00
	2123.000	250.00	610.71	0.27	3.17	0.00	595.33	33.00
	2223.000	110.00	607.60	0.00	0.01	0.00	164.24	100.00
	2223.000	160.00	609.78	2.18	0.00	0.00	326.26	100.00
	2223.000	190.00	610.44	0.66	0.00	0.00	377.98	100.00
	2223.000	250.00	610.71	0.27	0.00	0.00	403.09	100.00
	2713.000	110.00	607.88	0.00	0.28	0.00	130.19	490.00
	2713.000	160.00	609.80	1.92	0.02	0.00	304.92	490.00
	2713.000	190.00	610.45	0.65	0.01	0.00	365.55	490.00
	2713.000	250.00	610.73	0.28	0.01	0.00	389.68	490.00

SUMMARY OF ERRORS

```
NOTE     SECNO=  330.000  PROFILE= 1  WSEL BASED ON X5 CARD
NOTE     SECNO=  330.000  PROFILE= 2  WSEL BASED ON X5 CARD
NOTE     SECNO=  330.000  PROFILE= 3  WSEL BASED ON X5 CARD
NOTE     SECNO=  330.000  PROFILE= 4  WSEL BASED ON X5 CARD

CAUTION  SECNO= 2123.000  PROFILE= 2  HYDRAULIC JUMP D.S.
CAUTION  SECNO= 2123.000  PROFILE= 3  HYDRAULIC JUMP D.S.
```

00BREAK00

1) COUNTY: Alpena

2) STUDY NAME: Alpena City/ Twp

3) WATERCOURSE: McLary Creek

4) DOCUMENT TYPE: 100-yr Escroached

00BREAK00

```
T2 ALPENA, MICH.
T3 FLOODWAY RUN

J1   ICHECK     INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0.        7.        0.        0.   0.000000     0.00      0.0       0.    615.580    0.000
J2   NPROF      IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
     15.000     0.000    -1.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000


CCHV=   0.100 CEHV=   0.300
 2800 NAT Q1=      95.40  WSEL=     615.48  ENC Q1=      95.40  WSEL=     615.58  RATIO=  0.0000
 NAT Q1=     117.  RATIOS LOB,CH,ROB=  0.2612  0.6606  0.0782  WSEL=     615.58
   SECNO     DEPTH     CWSEL     CRIWS     WSELR     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     COR R     TOPWID      ENDST
```

```
3470 ENCROACHMENT STATIONS=      620.3     1250.0  TYPE=      4  TARGET=        0.188
   500.00      4.50    615.58      0.00    615.48    615.60      0.02      0.00      0.00    614.88
      300.      82.      218.       0.       302.      152.       0.        0.        0.     615.28
     0.00      0.27      1.44      0.00     0.100     0.060     0.100     0.000    611.08    620.27
 0.000791        0.        0.       0.         0         0         1      0.00    629.74   1250.01

 2800 NAT Q1=      93.00  WSEL=     615.90  ENC Q1=      93.00  WSEL=     616.00  RATIO=  0.0000
 NAT Q1=    119.  RATIOS LOB,CH,ROB=  0.1592  0.6734  0.1674  WSEL=     616.00

3470 ENCROACHMENT STATIONS=      822.2     1565.3  TYPE=      4  TARGET=        0.220
   900.00      4.88    615.96      0.00    615.90    615.99      0.03      0.38      0.00    615.68
      300.      21.      258.      21.       86.      178.      107.       4.        7.     615.68
     0.09      0.24      1.45      0.20     0.100     0.060     0.100     0.058    611.08    822.22
 0.001100      500.      400.      300.         2         0         1      0.00    743.06   1565.28

 2800 NAT Q1=      92.42  WSEL=     616.42  ENC Q1=      92.42  WSEL=     616.52  RATIO=  0.0000
 NAT Q1=    103.  RATIOS LOB,CH,ROB=  0.0643  0.8416  0.0942  WSEL=     616.52

3470 ENCROACHMENT STATIONS=      457.8      631.8  TYPE=      4  TARGET=        0.103
  1400.00      4.13    616.51      0.00    616.42    616.54      0.03      0.55      0.00    615.98
      300.       4.      282.      14.       12.      184.       43.       8.       12.     615.98
     0.19      0.33      1.53      0.32     0.100     0.060     0.100     0.059    612.38    457.79
 0.001085      500.      500.      550.         3         0         1      0.00    174.00    631.80

 2800 NAT Q1=      59.91  WSEL=     617.27  ENC Q1=      59.91  WSEL=     617.37  RATIO=  0.0000
 NAT Q1=     70.  RATIOS LOB,CH,ROB=  0.1955  0.3825  0.4220  WSEL=     617.37

3470 ENCROACHMENT STATIONS=      223.1      478.8  TYPE=      4  TARGET=        0.140
  1950.00      3.79    617.37      0.00    617.27    617.41      0.04      0.87      0.00    616.38
      300.      44.      132.     124.       62.       60.      167.      11.       15.     616.28
     0.30      0.72      2.22      0.74     0.100     0.060     0.100     0.059    613.58    223.15
 0.002481      550.      550.      550.         3         0         1      0.00    255.62    478.76

 2800 NAT Q1=     230.40  WSEL=     617.47  ENC Q1=     230.40  WSEL=     617.57  RATIO=  0.0000
 NAT Q1=    252.  RATIOS LOB,CH,ROB=  0.1743  0.6741  0.1516  WSEL=     617.57
   SECNO     DEPTH     CWSEL     CRIWS     WSELR     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

3470 ENCROACHMENT STATIONS=     1195.0     1779.0  TYPE=      4  TARGET=        0.087
  2325.00      5.67    617.55      0.00    617.47    617.56      0.00      0.15      0.00    616.28
```

```
     300.      57.     210.      33.     322.     317.     157.      16.      19.    616.38
     0.50     0.18     0.66     0.21    0.100    0.060    0.100    0.059   611.88  1194.99
 0.000155     375.     375.     375.        3        0        1     0.00   584.03  1779.02


 2800 NAT Q1=      39.39  WSEL=     617.70  ENC Q1=      39.39  WSEL=     617.80  RATIO=  0.0000
 NAT Q1=      42.  RATIOS LOB,CH,ROB=  0.2112  0.7888  0.0000  WSEL=     617.80

3470 ENCROACHMENT STATIONS=       49.1      100.0  TYPE=      4  TARGET=        0.064

OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=       616.10 ELREA=       618.40

  3000.00     5.26   617.76     0.00   617.70   617.92     0.16     0.31     0.05   616.10
     300.      48.     252.       0.      29.      74.       0.      23.      24.   618.40
     0.56     1.65     3.42     0.00    0.100    0.060    0.100    0.059   612.50    49.09
 0.006062     700.     675.     650.        3        0        1     0.00    46.86    95.95
```

SUMMARY PRINTOUT FOR MULTIPLE PROFILES

WAY RUN

SECTION NUMBER	CHANNEL LENGTH	MIN EL OF ROADWAY	MAX EL OF LOW CHORD	MIN EL GROUND	DISCHARGE (CFS)	CWSEL	TQ	EG	TOPWID	STENCL	STENCR	WSELK

00BREAK00

1) COUNTY: Alpena

2) STUDY NAME: Alpena City/ Twp

3) WATERCOURSE: McLary Creek

4) DOCUMENT TYPE: 100-yr Natural

00BREAK00

```
@TOF

%DCL-E-OPENIN, error opening _DRA0:[PREUSCH]TOF.COM; as input
-RMS-E-FNF, file not found
$ TYPE [WMACOUT.DAT
```

FINAL

RECEIVED
APR 13 1981
WATER MANAGEMENT

FLOODWAY RUN
McLARY CREEK
REVISED 1/14/81

```
*************************************************
*        HEC2 VERSION UPDATED JAN 1976          *
* ERROR CORRECTIONS 01,02,03,04,05,06,07,08,09 *
*      MODIFICATIONS 52,53,54,55,56,57,58       *
*************************************************

I1 MCLARY CREEK
```

T2 ALPENA, MICHIGAN
T3 FLOOD INS. PROJECT

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0.	4.	0.	0.	0.001000	0.00	0.0	0.	612.000	0.000

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	1.000	0.000	-1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

J3	1.000	34.000	3.000	4.000	27.000	28.000	9.000	0.000	0.000	0.000
NC	0.100	0.100	0.060	0.100	0.300	0.000	0.000	0.000	0.000	0.000
RT	6.000	180.000	260.000	300.000	390.000	300.000	300.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	9.100	1.400	0.000	536.000	1736.000
X1	500.000	7.000	1200.000	1250.000	0.000	0.000	0.000	0.000	0.480	0.000
X4	2.000	615.500	200.000	615.500	2250.000	0.000	0.000	0.000	0.000	0.000
GR	620.000	0.000	614.400	1200.000	611.400	1210.000	610.600	1220.000	612.300	1240.000
GR	614.800	1250.000	620.000	2750.000	0.000	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	9.100	1.400	0.000	660.000	1860.000
X1	900.000	9.000	1075.000	1150.000	500.000	300.000	400.000	0.000	0.480	0.000
X4	2.000	615.800	200.000	615.800	2400.000	0.000	0.000	0.000	0.000	0.000
GR	620.000	0.000	615.100	1000.000	615.200	1075.000	612.000	1092.000	610.600	1100.000
GR	611.800	1106.000	615.200	1150.000	615.200	1200.000	620.000	2600.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	9.100	1.400	0.000	354.000	778.000
X1	1400.000	10.000	479.000	550.000	500.000	550.000	500.000	0.000	0.480	0.000
GR	620.000	0.000	615.400	400.000	615.400	450.000	615.500	479.000	612.600	492.000
GR	612.200	500.000	611.900	508.000	615.500	550.000	615.500	700.000	620.000	1500.000
ET	0.000	0.000	0.000	0.000	0.000	9.100	1.400	0.000	160.000	540.000
X1	1950.000	9.000	288.000	312.000	550.000	550.000	550.000	0.000	0.480	0.000
GR	620.000	0.000	616.000	200.000	615.900	288.000	613.900	295.000	613.100	300.000
GR	614.100	304.000	615.800	312.000	616.000	500.000	620.000	700.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	9.100	1.400	0.000	1250.000	1700.000
X1	2325.000	9.000	1550.000	1650.000	375.000	375.000	375.000	0.000	0.480	0.000
GR	620.000	0.000	615.800	1500.000	615.800	1550.000	613.300	1591.000	611.400	1600.000
GR	611.400	1600.000	615.900	1650.000	615.800	1800.000	620.000	2100.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	9.100	1.400	0.000	29.000	95.000
X1	3000.000	11.000	66.000	100.000	700.000	650.000	675.000	0.000	0.000	0.000
X3	10.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GR	620.000	0.000	616.000	50.000	616.100	66.000	612.900	73.000	616.500	88.000
GR	618.400	100.000	616.300	112.000	614.300	120.000	612.500	126.000	616.000	132.000
GR	620.000	900.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
EJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

```
CCHV=   0.100 CEHV=   0.300
   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
```

```
     500.00      4.40    615.48      0.00    612.00    615.51      0.03      0.00      0.00    614.88
       300.       60.       231.       9.     289.      146.      89.        0.        0.     615.28
       0.00      0.21      1.58      0.10     0.100     0.060     0.100     0.000    611.08    235.24
   0.000989        0.        0.        0.         0         0        18      0.00   1915.45   2150.69

     900.00      4.82    615.90      0.00      0.00    615.92      0.02      0.42      0.00    615.68
       300.       31.       241.      28.     185.      173.     198.        5.       19.     615.68
       0.10      0.17      1.39      0.14     0.100     0.060     0.100     0.059    611.08    195.91
   0.001041       500.       400.     300.         1         0         1      0.00   2208.18   2404.09

    1400.00      4.04    616.42      0.00      0.00    616.45      0.03      0.53      0.00    615.98
       300.       15.       263.      21.      54.      178.      83.       10.       35.     615.98
       0.20      0.29      1.48      0.26     0.100     0.060     0.100     0.059    612.38    353.05
   0.001054       500.       500.     550.         0         0         1      0.00    425.16    778.21

    1950.00      3.69    617.27      0.00      0.00    617.31      0.03      0.85      0.00    616.38
       300.       55.       124.     121.      89.       57.     182.       14.       40.     616.28
       0.32      0.62      2.17      0.66     0.100     0.060     0.100     0.059    613.58    160.60
   0.002508       550.       550.     550.         1         0         1      0.00    378.80    539.40

    2325.00      5.59    617.47      0.00      0.00    617.47      0.01      0.16      0.00    616.28
       300.       47.       210.      43.     311.      308.     221.       19.       45.     616.38
       0.52      0.15      0.68      0.19     0.100     0.060     0.100     0.059    611.88   1076.40
   0.000170       375.       375.     375.         3         0         1      0.00    808.33   1884.72


OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      616.10 ELREA=      618.40

    3000.00      5.20    617.70      0.00      0.00    617.85      0.14      0.34      0.04    616.10
       300.       60.       240.       0.      45.       72.       0.        27.       52.     618.40
       0.59      1.35      3.32      0.00     0.100     0.060     0.100     0.060    612.50     28.69
   0.005801       700.       675.     650.         3         0         1      0.00     66.92     95.61


*********************************************
*        HEC2 VERSION UPDATED JAN 1976      *
* ERROR CORRECTIONS 01,02,03,04,05,06,07,08,09 *
*      MODIFICATIONS 52,53,54,55,56,57,58   *
*********************************************


T1 MCLARY CREEK
```

00BREAK00

1) COUNTY: Alpena

2) STUDY NAME: Alpena City/Twp

3) WATERCOURSE: McLary Creek

4) DOCUMENT TYPE: Report

00BREAK00

JOHNSON
ENGINEERS
ARCHITECTS
PLANNERS

DESIGN NOTES AND COMPUTATIONS

SUBJECT

JOB NUMBER

Revisions to McLary Creek

1. First cross section was moved 500 feet upstream of mouth in order to have the overbanks not located in Mud Lake. The HEC-2 model was adjusted accordingly (Distance between cross sections A and B were shortened on X1 card).

2. Cross sections A and B were adjusted to account for the swampy, flat overbanks. Instead of showing a gradual rise from the banks to the 620' contour, extra ground points were added near the end stations with lower elevations. This was done by adding X4 cards in the HEC-2 program.

RECEIVED
APR 13 1981
WATER MANAGEMENT

PREPARED BY DATE CHECKED BY SHEET NO OF

BERNARD JOHNSON INCORPORATED
2021 K Street, N.W · Washington, D.C 20006 · 202/862-8600
ENGINEERS · ARCHITECTS · PLANNERS

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
McLary Creek								
A	500	630	454	0.7	616.6	615.5[2]	615.6[2]	0.1
B	900	743	371	0.8	616.6	615.9[2]	616.0[2]	0.1
C	1400	174	239	1.3	616.6	616.4[2]	616.5[2]	0.1
D	1950	256	289	1.0	617.3	617.3	617.4	0.1
E	2325	584	796	0.4	617.5	617.5	617.6	0.1
F	3000	47	103	2.9	617.7	617.7	617.8	0.1

[1] Feet above mouth

[2] Water-surface elevations computed without consideration of backwater effects

TABLE 3

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF ALPENA, MI.
(ALPENA CO.)

FLOODWAY DATA

McLARY CREEK

JOHNSON
ENGINEERS
ARCHITECTS
PLANNERS

DESIGN NOTES AND COMPUTATIONS

SUBJECT

JOB NUMBER

RECEIVED
APR 13 1981
WATER MANAGEMENT

Exhibit 3

Military Creek; Description of HEC II Model

PREPARED BY DATE CHECKED BY SHEET NO OF

BERNARD JOHNSON INCORPORATED
2021 K STREET, N.W. · WASHINGTON, D.C. 20006 · 202/862-8600

JOHNSON
ENGINEERS
ARCHITECTS
PLANNERS

DESIGN NOTES AND COMPUTATIONS

SUBJECT

JOB NUMBER

Start water elevation by slope-area method. Actual levels in McLary Creek will be governed by backwater from Mud Lake

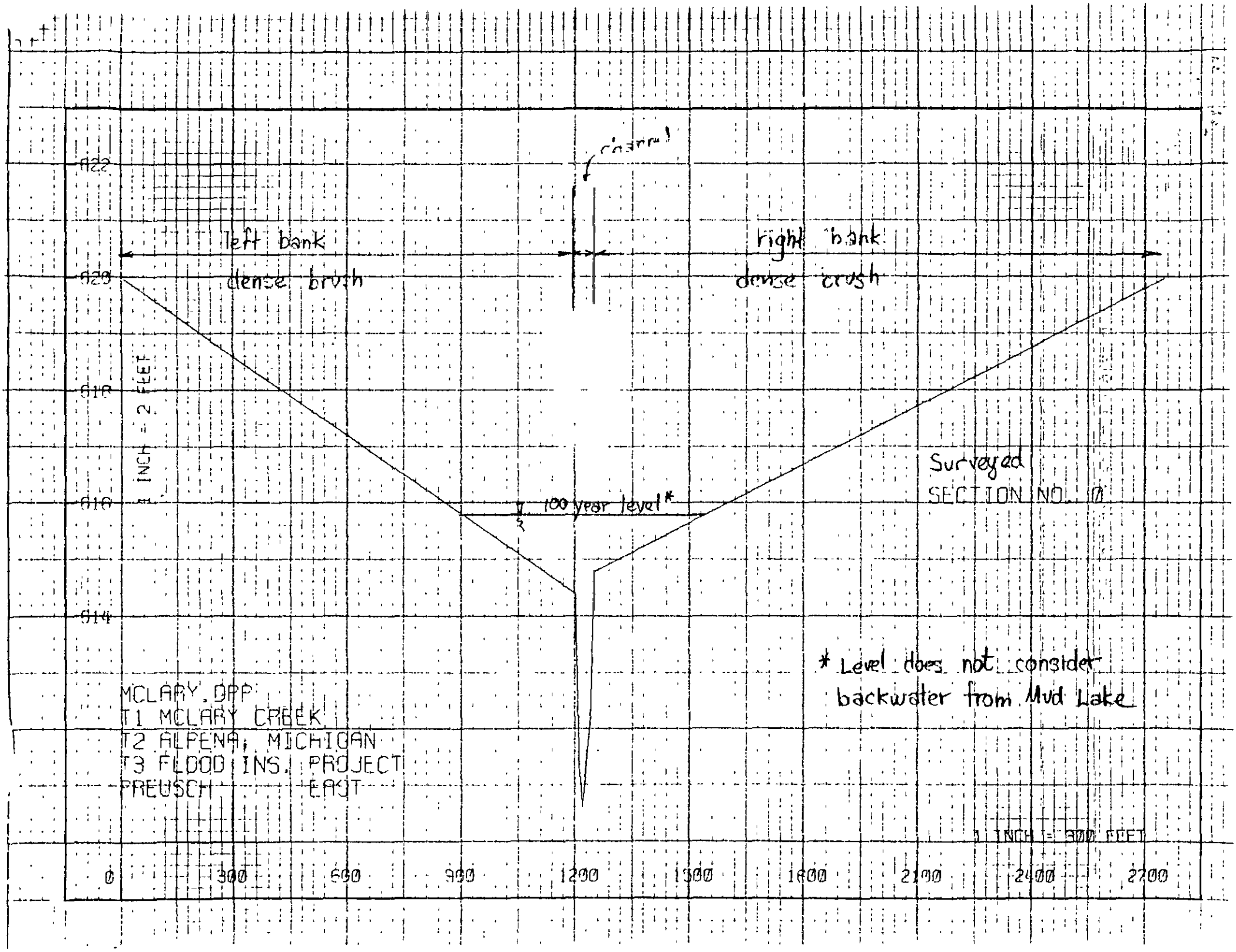
Cross sections 0, 900, 1400, 1950, 2325

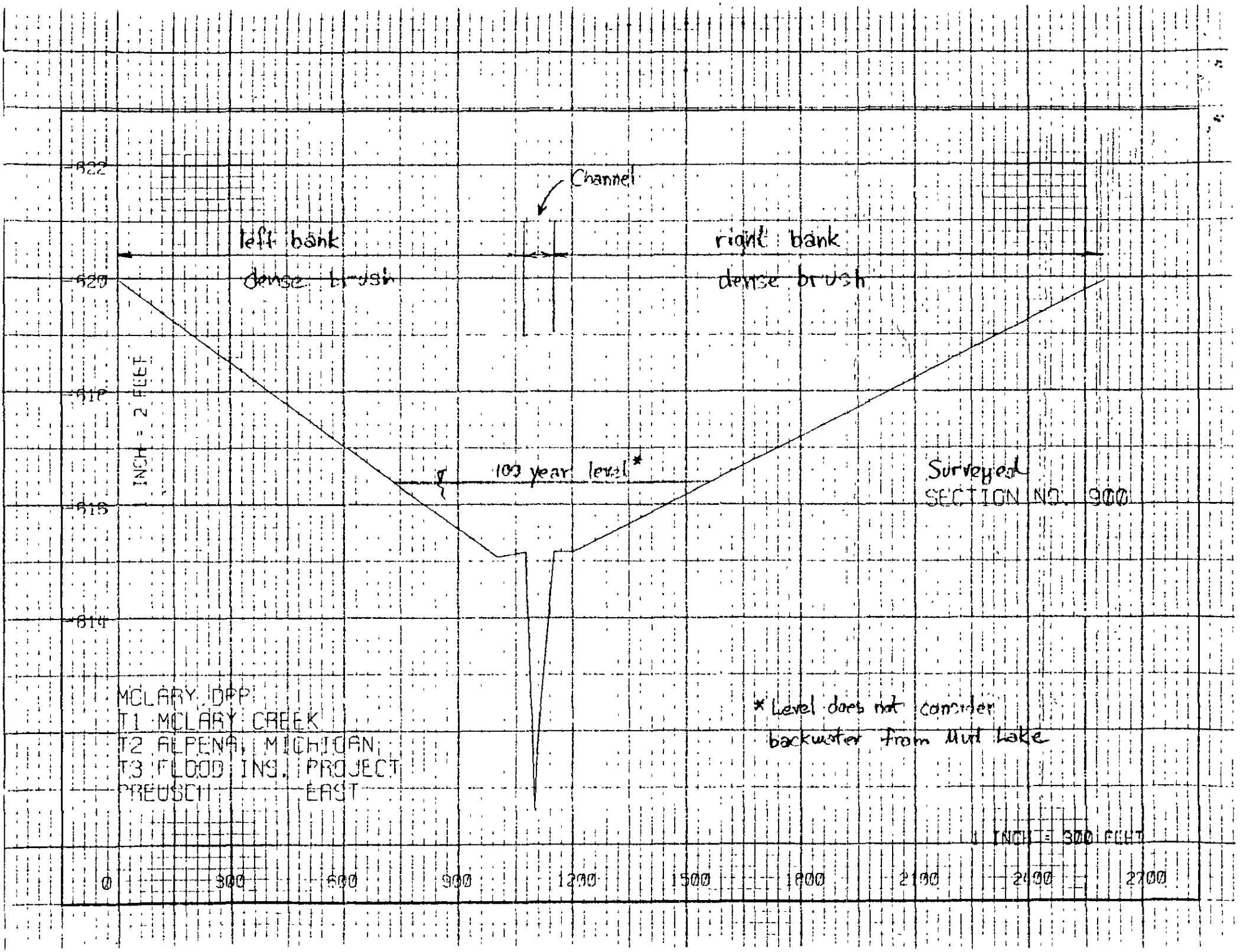
Survey information for these cross sections were done for the MDNR for another project A correction factor of .43 foot was added to all elevations to tie in with NGVD. Elevations were checked in June, 1980.

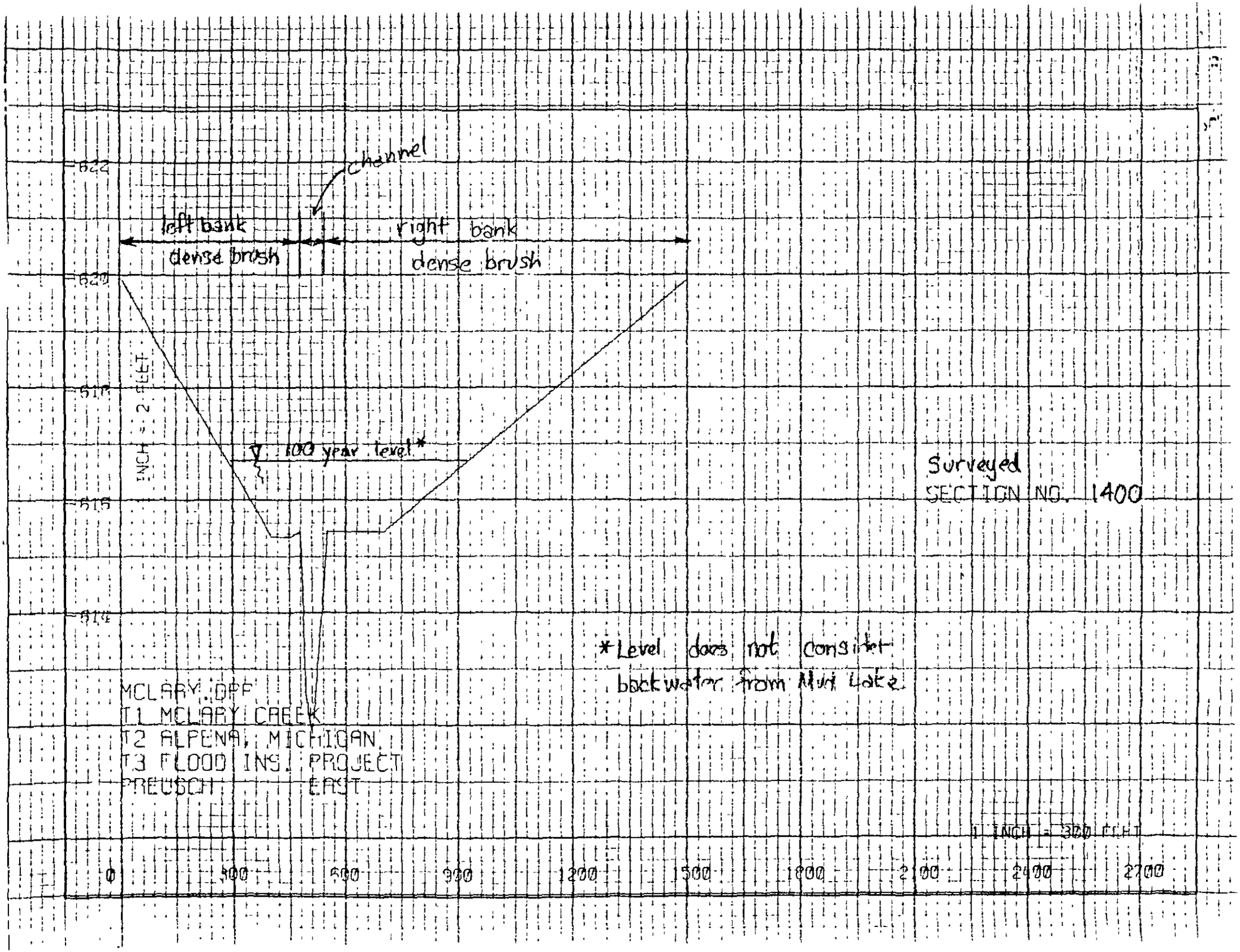
No bridges or structures are included within the detailed reach

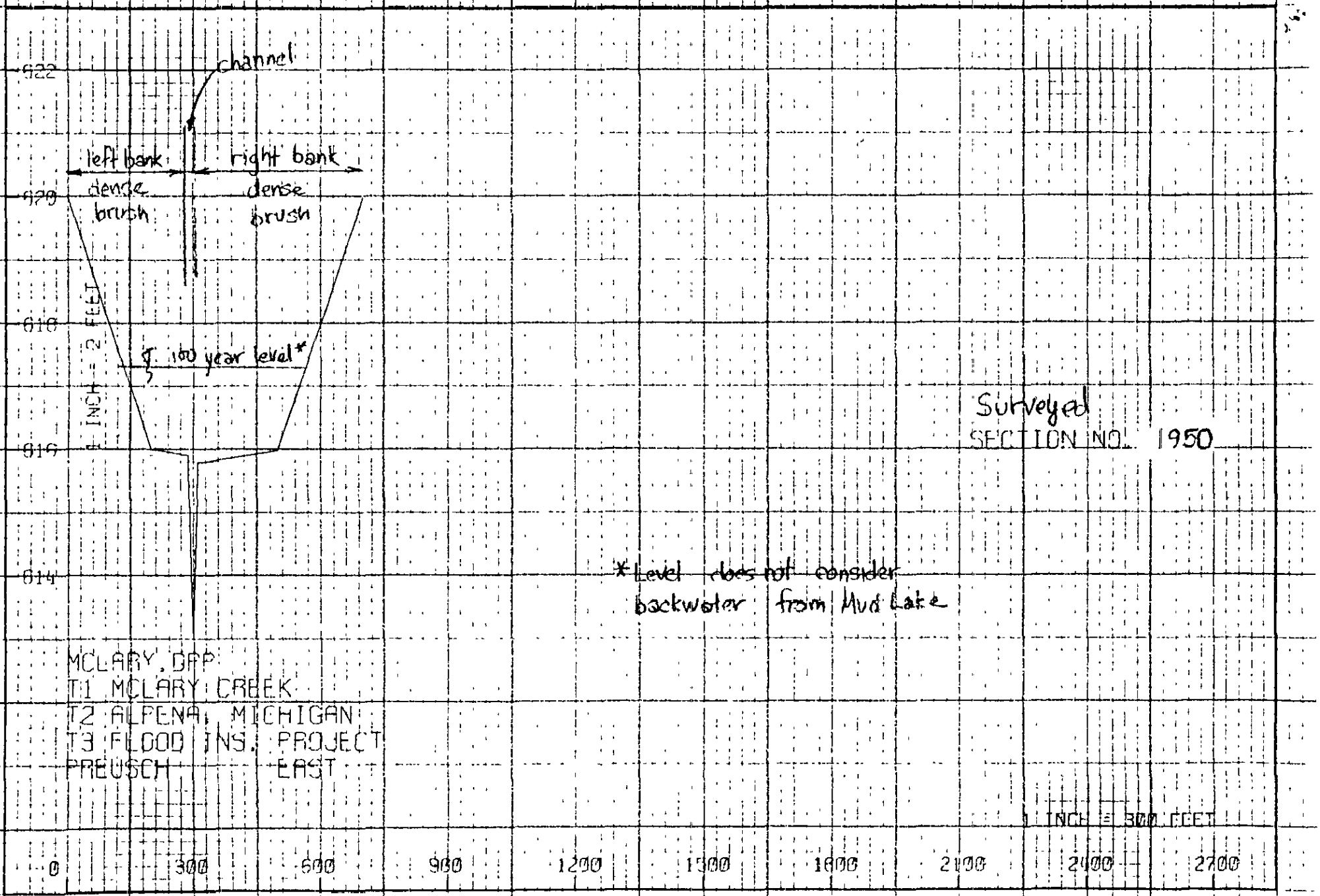
PREPARED BY DP DATE CHECKED BY NJA SHEET NO 1 OF

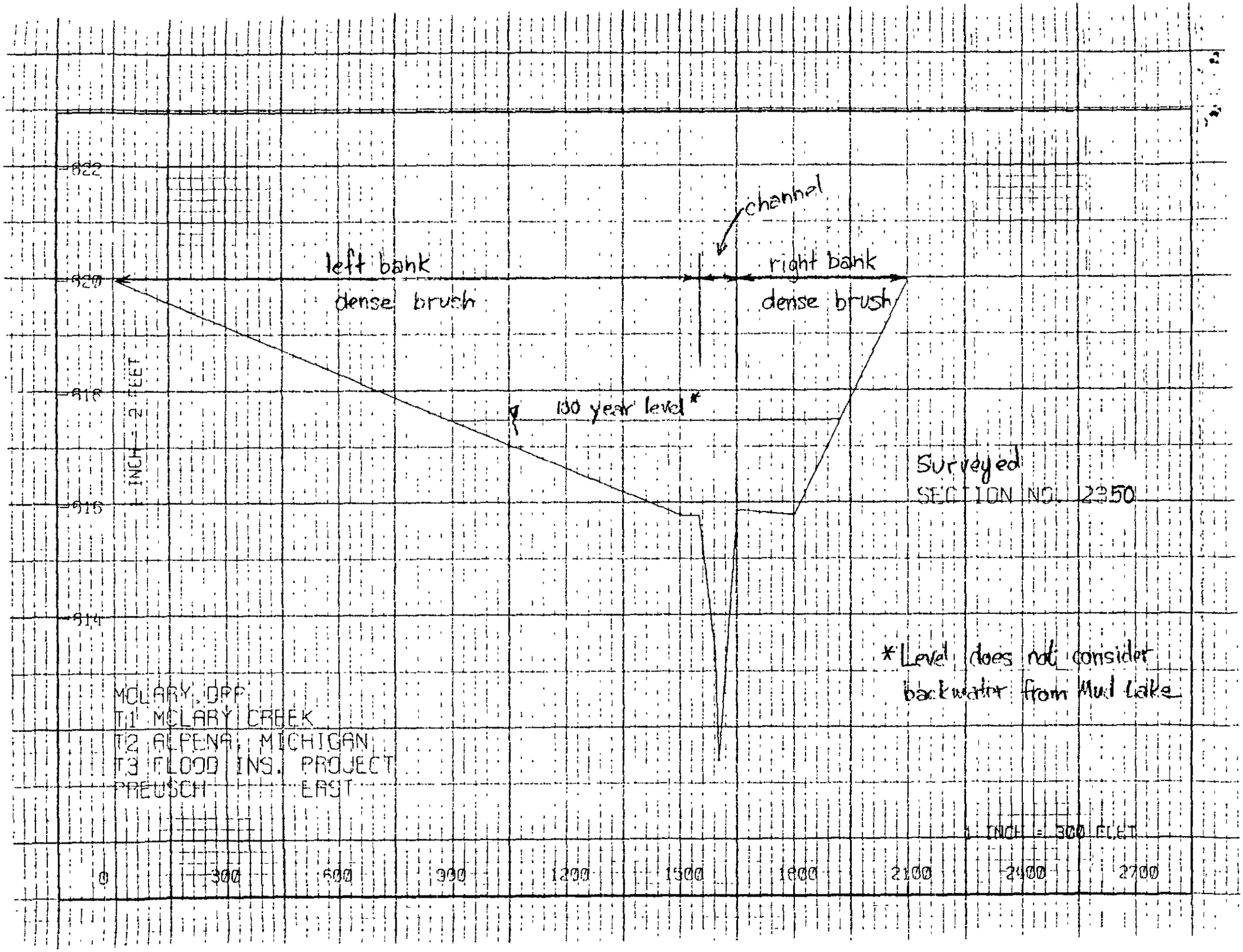
BERNARD JOHNSON INCORPORATED
2021 K STREET, N.W. · WASHINGTON, D.C. 20006 · 202/862-8600


channel
left bank
dense brush
right bank
dense brush
822
820
818
816
814
1 INCH = 2 FEET
100 year level*
Surveyed
SECTION NO. 10
* Level does not consider backwater from Mud Lake
MCLARY.DPP
T1 MCLARY CREEK
T2 ALPENA, MICHIGAN
T3 FLOOD INS. PROJECT
PREUSCH EAST
1 INCH = 300 FEET
0
300
600
900
1200
1500
1800
2100
2400
2700


Channel
left bank
dense brush
right bank
dense brush
100 year level*
Surveyed
SECTION NO. 900
*Level does not consider backwater from Mud Lake
MCLARY DAM
T1 MCLARY CREEK
T2 ALPENA, MICHIGAN
T3 FLOOD INS. PROJECT
PREUSCH EAST
1 INCH = 2 FEET
1 INCH = 300 FEET
622
620
618
616
614
0
300
600
900
1200
1500
1800
2100
2400
2700


channel
left bank
dense brush
right bank
dense brush
622
620
618
616
614
1 INCH = 2 FEET
100 year level*
Surveyed
SECTION NO. 1400
*Level does not consider
backwater from Mud Lake
MCLARY DPF
T1 MCLARY CREEK
T2 ALPENA, MICHIGAN
T3 FLOOD INS. PROJECT
PREUSCH EAST
1 INCH = 300 FEET
0
300
600
900
1200
1500
1800
2100
2400
2700


channel
left bank
dense brush
right bank
dense brush
100 year level*
922
920
918
916
914
1 INCH = 2 FEET
*Level does not consider backwater from Mud Lake
Surveyed
SECTION NO. 1950
MCLARY, DAP
T1 MCLARY CREEK
T2 ALPENA, MICHIGAN
T3 FLOOD INS. PROJECT
PREUSCH EAST
1 INCH = 300 FEET
0
300
600
900
1200
1500
1800
2100
2400
2700


channel
left bank
dense brush
right bank
dense brush
100 year level*
Surveyed
SECTION NO. 2350
*Level does not consider backwater from Mud Lake
922
920
918
916
914
1 INCH = 2 FEET
MCLARY, DRP
T1 MCLARY CREEK
T2 ALPENA, MICHIGAN
T3 FLOOD INS. PROJECT
PREUSCH EAST
1 INCH = 300 FEET
0
300
600
900
1200
1500
1800
2100
2400
2700

JOHNSON
ENGINEERS ARCHITECTS PLANNERS

DESIGN NOTES AND COMPUTATIONS

SUBJECT: McClary Creek, Alpena Township
Floodway Computations

JOB NUMBER 80047

Utilizing Detailed HEC-2 Printout

Q_{100} = 300 cfs

Cross Section	Width (ft)	Total Section Area (sq. ft)	Mean Velocity (fps) = Q/A
A(500)	630	454	0.7
B(900)	743	371	0.8
C(1400)	174	239	1.3
D(1950)	256	289	1.0
E(2325)	584	796	0.4
F(3000)	47	103	2.9

Total Area = ALOB + ACH + AROB

RECEIVED
APR 13 1981
WATER MANAGEMENT

PREPARED BY TS DATE 3/17/81 CHECKED BY SHEET NO 1 OF 1

00BREAK00

1) COUNTY: Alpena

2) STUDY NAME: Alpena City/Twp

3) WATERCOURSE: McLeary Creek

4) DOCUMENT TYPE: Summary

00BREAK00

OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA= 616.10 ELREA= 618.40

3000.00	5.45	617.95	0.00	0.00	618.13	0.18	0.38	0.05	616.10
390.	88.	302.	0.	54.	80.	0.	35.	54.	618.40
0.58	1.62	3.79	0.00	0.100	0.060	0.100	0.059	612.50	25.58
0.007077	700.	675.	650.	3	0	1	0.00	71.60	97.18

SUMMARY PRINTOUT FOR MULTIPLE PROFILES

FAR STORM

SECTION NUMBER	CHANNEL LENGTH	MIN EL OF ROADWAY	MAX EL OF LOW CHORD	MIN EL GROUND	DISCHARGE (CFS)	CWSEL	TQ	EG	TOPWID	STENCL	STENCR	WSELR
500.00	0.00	0.00	0.00	611.08	180.00	615.02	56.46	615.05	270.75	0.00	0.00	612.00
500.00	0.00	0.00	0.00	611.08	260.00	615.38	81.91	615.41	1323.13	0.00	0.00	612.00
500.00	0.00	0.00	0.00	611.08	300.00	615.48	95.40	615.51	1915.45	0.00	0.00	612.00
500.00	0.00	0.00	0.00	611.08	390.00	615.60	123.17	615.63	2064.04	0.00	0.00	612.00
900.00	400.00	0.00	0.00	611.08	180.00	615.45	54.46	615.47	70.74	0.00	0.00	0.00
900.00	400.00	0.00	0.00	611.08	260.00	615.82	77.07	615.85	2201.13	0.00	0.00	0.00
900.00	400.00	0.00	0.00	611.08	300.00	615.90	93.00	615.92	2208.18	0.00	0.00	0.00
900.00	400.00	0.00	0.00	611.08	390.00	616.02	123.37	616.04	2218.28	0.00	0.00	0.00
1400.00	500.00	0.00	0.00	612.38	180.00	615.96	58.15	615.98	150.94	0.00	0.00	0.00
1400.00	500.00	0.00	0.00	612.38	260.00	616.34	85.64	616.36	406.09	0.00	0.00	0.00
1400.00	500.00	0.00	0.00	612.38	300.00	616.42	92.42	616.45	425.16	0.00	0.00	0.00
1400.00	500.00	0.00	0.00	612.38	390.00	616.58	108.84	616.61	466.51	0.00	0.00	0.00
1950.00	550.00	0.00	0.00	613.58	180.00	616.86	30.04	616.91	338.26	0.00	0.00	0.00
1950.00	550.00	0.00	0.00	613.58	260.00	617.14	49.52	617.18	366.39	0.00	0.00	0.00
1950.00	550.00	0.00	0.00	613.58	300.00	617.27	59.91	617.31	378.80	0.00	0.00	0.00
1950.00	550.00	0.00	0.00	613.58	390.00	617.50	82.24	617.53	402.00	0.00	0.00	0.00
2325.00	375.00	0.00	0.00	611.88	180.00	617.05	154.77	617.06	631.03	0.00	0.00	0.00
2325.00	375.00	0.00	0.00	611.88	260.00	617.34	204.35	617.34	753.37	0.00	0.00	0.00
2325.00	375.00	0.00	0.00	611.88	300.00	617.47	230.40	617.47	808.33	0.00	0.00	0.00
2325.00	375.00	0.00	0.00	611.88	390.00	617.70	283.75	617.70	907.57	0.00	0.00	0.00
3000.00	675.00	0.00	0.00	612.50	180.00	617.25	28.59	617.34	58.41	0.00	0.00	0.00
3000.00	675.00	0.00	0.00	612.50	260.00	617.57	35.93	617.70	64.39	0.00	0.00	0.00
3000.00	675.00	0.00	0.00	612.50	300.00	617.70	39.39	617.85	66.92	0.00	0.00	0.00

3000.00	675.00	0.00	0.00	612.50	390.00	617.95	46.36	618.13	71.60	0.00	0.00	0.00

SECTION NUMBER	DISCHARGE CFS	CWSEL	CWSEL DIFF EACH Q	CWSEL DIFF EACH SECTION	CWSEL-WSELK	TOPWID	T.W. DIFF	LENGTH
500.000	180.000	615.018	0.000	0.000	0.000	270.746	0.000	0.000
500.000	260.000	615.382	0.364	0.000	0.000	1323.131	-1052.385	0.000
500.000	300.000	615.478	0.096	0.000	0.000	1915.450	-1644.705	0.000
500.000	390.000	615.600	0.122	0.000	0.000	2064.036	-1793.290	0.000
900.000	180.000	615.447	0.000	0.429	0.000	70.740	0.000	400.000
900.000	260.000	615.822	0.376	0.441	0.000	2201.127	-2130.387	400.000
900.000	300.000	615.899	0.077	0.421	0.000	2208.180	-2137.440	400.000
900.000	390.000	616.016	0.116	0.416	0.000	2218.279	-2147.540	400.000
1400.000	180.000	615.960	0.000	0.513	0.000	150.942	0.000	500.000
1400.000	260.000	616.338	0.378	0.516	0.000	406.095	-255.152	500.000
1400.000	300.000	616.423	0.085	0.524	0.000	425.161	-274.219	500.000
1400.000	390.000	616.576	0.153	0.560	0.000	466.510	-315.568	500.000
1950.000	180.000	616.857	0.000	0.897	0.000	338.263	0.000	550.000
1950.000	260.000	617.144	0.287	0.806	0.000	366.394	-28.131	550.000
1950.000	300.000	617.274	0.130	0.850	0.000	378.796	-40.533	550.000
1950.000	390.000	617.499	0.225	0.923	0.000	402.002	-63.739	550.000
2325.000	180.000	617.051	0.000	0.194	0.000	631.028	0.000	375.000
2325.000	260.000	617.337	0.286	0.193	0.000	753.368	-122.340	375.000
2325.000	300.000	617.466	0.128	0.192	0.000	808.326	-177.298	375.000
2325.000	390.000	617.697	0.232	0.198	0.000	907.568	-276.541	375.000
3000.000	180.000	617.252	0.000	0.201	0.000	58.411	0.000	675.000
3000.000	260.000	617.570	0.318	0.233	0.000	64.392	-5.981	675.000
3000.000	300.000	617.705	0.135	0.239	0.000	66.922	8.511	675.000
3000.000	390.000	617.953	0.248	0.255	0.000	71.604	-13.193	675.000

DATA FOR LAST CROSS SECTION

PROFILE	TYPE ENC	TARGET	TOP WIDTH AREA-ACRES	TOP WIDTH AREA-DIFF
1	0.000	0.000	15.741	0.000
2	0.000	0.000	48.054	32.313
3	0.000	0.000	51.586	35.845
4	0.000	0.000	54.308	38.567

00BREAK00

1) COUNTY: Alpena

2) STUDY NAME: Alpena City/Twp

3) WATERCOURSE: Thunder Bay River

4) DOCUMENT TYPE: 100-Yr Encroached

00BREAK00

```
*SECNO 31808.000
 31808.00      6.91    607.13      0.00      0.00    607.67      0.54      4.89      0.09    620.12
   10700.        0.    10700.        0.        0.     1814.        0.     2088.      218.    606.82
     2.28      0.00      5.90      0.31     0.060     0.035     0.060     0.035    600.22   1159.27
 0.002020     5300.     5300.     5300.         3         0         0      0.00    332.47   1491.74
```


THIS RUN EXECUTED 23-JAN-81 14:16:42

```
*************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED APRIL 1980
  ERROR CORR -  01,02,03,04
  MODIFICATION -  50,51,52,53,54
*************************************************

T1 ALPENA, MICH.
T2 FLOOD INSURANCE STUDY
T3 FLOODWAY DETERMINATION

J1  ICHECK     INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

      0.        6.        0.        0.   0.000000     0.00      0.0       0.    579.500    0.000

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALDC      IBW       CHNIM     ITRACE

    15.000    0.000    -1.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
```



```
   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=   0.100 CEHV=   0.300
*SECNO .000
 2800 NAT Q1=   9496.83  WSEL=    579.40  ENC Q1=   9496.83  WSEL=    579.50  RATIO=  0.0000
 NAT Q1=   9588.  RATIOS LOB,CH,ROB=  0.0210  0.9790  0.0000  WSEL=    579.50

3470 ENCROACHMENT STATIONS=     106.5     3 0.0  TYPE=     4  T RGET=       0.009
```

```
     0.00     23.90    579.50      0.00    579.40    579.66      0.16      0.00      0.00    575.00
   10700.      124.   10576.        0.      215.     3302.        0.        0.        0.    580.00
     0.00      0.58     3.20      0.00     0.070     0.035     0.070     0.000    555.60    106.52
 0.000127        0.        0.        0.         0         0         0      0.00    233.06    339.58


*SECNO 1349.000
 2800 NAT Q1=  11317.55  WSEL=    579.59  ENC Q1=  11406.37  WSEL=    579.69  RATIO= -0.0078
 NAT Q1=  11406.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=    579.69

3470 ENCROACHMENT STATIONS=     276.0     522.0  TYPE=     4  TARGET=       0.000
  1349.00     23.60    579.70      0.00    579.59    579.80      0.11      0.14      0.01    588.20
   10700.        0.   10700.        0.        0.     4081.        0.      118.        7.    583.70
     0.14      0.00     2.62      0.00     0.070     0.035     0.070     0.035    556.10    296.44
 0.000088     1349.     1349.     1349.         2         0         0      0.00    223.69    520.12


CCHV=   0.300 CEHV=   0.500
*SECNO 1449.000
 2800 NAT Q1=   6577.00  WSEL=    579.55  ENC Q1=   6625.85  WSEL=    579.65  RATIO= -0.0074
 NAT Q1=   6626.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=    579.65

3265 DIVIDED FLOW


3470 ENCROACHMENT STATIONS=     275.0     500.0  TYPE=     4  TARGET=       0.000
  1449.00     23.65    579.65      0.00    579.55    579.87      0.22      0.01      0.06    588.50
   10700.        0.   10700.        0.        0.     2845.        0.      126.        7.    585.20
     0.15      0.00     3.76      0.00     0.070     0.035     0.070     0.035    556.00    319.52
 0.000261      100.      100.      100.         2         0         0      0.00    146.48    500.00


*SECNO 1450.000
 2800 NAT Q1=   6577.12  WSEL=    579.55  ENC Q1=   6625.97  WSEL=    579.65  RATIO= -0.0074
 NAT Q1=   6626.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=    579.65
```



```
   SECNO     DEPTH     CWSEL     CRIWS     WSELR     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


3265 DIVIDED FLOW


3370 NORMAL BRIDGE,NRD=  0 MIN ELTRD=  591.60 MAX ELLC=  585.20
```

```
3470 ENCROACHMENT STATIONS=      275.0      500.0  TYPE=      4  TARGET=        0.000
  1450.00     23.66    579.66      0.00    579.55    579.87      0.22      0.00      0.00    588.50
   10700.        0.    10700.        0.        0.     2845.        0.      126.        8.    585.20
     0.15      0.00      3.76      0.00     0.070     0.035     0.070     0.035    556.00    319.52
 0.000261        1.        1.        1.         0         0         0      0.00    146.48    500.00


*SECNO 1510.000
 2800 NAT Q1=    6584.89  WSEL=     579.57  ENC Q1=    6633.96  WSEL=     579.67  RATIO= -0.0075
 NAT Q1=    6634.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=     579.67

3265 DIVIDED FLOW


3370 NORMAL BRIDGE,NRD=  0 MIN ELTRD=  591.60 MAX ELLC=  585.20


3470 ENCROACHMENT STATIONS=      275.0      500.0  TYPE=      4  TARGET=        0.000
  1510.00     23.67    579.67      0.00    579.57    579.89      0.22      0.02      0.00    588.50
   10700.        0.    10700.        0.        0.     2848.        0.      130.        8.    585.20
     0.15      0.00      3.76      0.00     0.070     0.035     0.070     0.035    556.00    319.52
 0.000260       60.       60.       60.         0         0         0      0.00    146.48    500.00


*SECNO 1512.000
 2800 NAT Q1=    6585.40  WSEL=     579.57  ENC Q1=    6634.23  WSEL=     579.67  RATIO= -0.0074
 NAT Q1=    6634.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=     579.67

3265 DIVIDED FLOW


3470 ENCROACHMENT STATIONS=      275.0      500.0  TYPE=      4  TARGET=        0.000
  1512.00     23.67    579.67      0.00    579.57    579.89      0.22      0.00      0.00    588.50
   10700.        0.    10700.        0.        0.     2848.        0.      130.        8.    585.20
     0.15      0.00      3.76      0.00     0.070     0.035     0.070     0.035    556.00    319.52
 0.000260        2.        2.        2.         0         0         0      0.00    146.48    500.00
```



```
   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      XLORR     ITRIAL    IDC       ICONT     CORAR     TOPWID      ENDST


*SECNO 1662.000
 2800 NAT Q1=    9976.63  WSEL=     579.70  ENC Q1=   10059.56  WSEL=     579.80  RATIO= -0.0083
 NAT Q1=   10060.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=     579.80
```

```
3470 ENCROACHMENT STATIONS=       40.0      240.0  TYPE=      4  TARGET=        0.000
  1662.00     22.80    579.80     0.00    579.70    579.94     0.14      0.02      0.02    582.20
   10700.        0.    10700.       0.        0.     3576.       0.       141.       8.     581.20
     0.17      0.00      2.99     0.00     0.070     0.035    0.070     0.035   557.00     41.75
 0.000113      150.      150.     150.         2         0        0      0.00   196.56    238.31


CCHV=   0.100 CEHV=   0.300
*SECNO 2231.000
 2800 NAT Q1=  13985.62  WSEL=    579.83  ENC Q1=  14117.18  WSEL=    579.93  RATIO= -0.0094
 NAT Q1=  14117.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=    579.93

3470 ENCROACHMENT STATIONS=       20.0      420.0  TYPE=      4  TARGET=        0.000
  2231.00     21.23    579.93     0.00    579.83    579.99     0.06      0.04      0.01    581.20
   10700.        0.    10700.       0.        0.     5372.       0.       199.      12.     591.20
     0.25      0.00      1.99     0.00     0.070     0.035    0.070     0.035   558.70     21.31
 0.000057      569.      569.     569.         2         0        0      0.00   341.49    362.79


*SECNO 2881.000
 2800 NAT Q1=  18939.88  WSEL=    579.89  ENC Q1=  19115.87  WSEL=    579.99  RATIO= -0.0093
 NAT Q1=  19116.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=    579.99

3470 ENCROACHMENT STATIONS=       20.0      430.0  TYPE=      4  TARGET=        0.000
  2881.00     22.98    579.98     0.00    579.89    580.02     0.04      0.03      0.00    581.20
   10700.        0.    10700.       0.        0.     6952.       0.       291.      17.     581.20
     0.37      0.00      1.54     0.00     0.070     0.035    0.070     0.035   557.00     20.71
 0.000031      650.      650.     650.         2         0        0      0.00   407.81    428.52


*SECNO 3281.000
 2800 NAT Q1=   6355.52  WSEL=    579.82  ENC Q1=   6448.49  WSEL=    579.92  RATIO= -0.0146
 NAT Q1=   6448.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=    579.92
  3281.00     16.42    579.92     0.00    579.82    580.09     0.17      0.03      0.04    591.20
   10700.        0.    10700.       0.        0.     3220.       0.       338.      21.     591.20
     0.40      0.00      3.32     0.00     0.070     0.035    0.070     0.035   563.50     30.72
 0.000275      400.      400.     400.         2         0        0      0.00   303.40    334.12
```



```
   SECNO     DEPTH     CWSEL     CRIWS     WSELR     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 3947.000
 2800 NAT Q1=   3204.68  WSEL=    579.92  ENC Q1=   3268.22  WSEL=    580.02  RATIO= -0.0198
 NAT Q1=   3268.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=    580.02
```

```
3470 ENCROACHMENT STATIONS=      70.0      313.0  TYPE=     4  TARGET=        0.000
  3947.00    13.72   580.02     0.00   579.92   580.51     0.49     0.32     0.10   587.30
   10700.       0.   10700.       0.       0.    1907.       0.     377.      25.    587.30
     0.43     0.00     5.61     0.00    0.070    0.035    0.070    0.035   566.30    73.97
 0.001074     666.     666.     666.        2        0        0     0.00   230.43   304.40


*SECNO 4612.000
 2800 NAT Q1=   2123.66  WSEL=    580.76  ENC Q1=   2176.41  WSEL=    580.86  RATIO= -0.0248
 NAT Q1=   2176.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=    580.86

3470 ENCROACHMENT STATIONS=      70.0      313.0  TYPE=     4  TARGET=        0.000
  4612.00    11.82   580.82     0.00   580.76   581.64     0.82     1.04     0.10   590.00
   10700.       0.   10700.       0.       0.    1474.       0.     403.      28.    590.00
     0.46     0.00     7.26     0.00    0.070    0.035    0.070    0.035   569.00    75.00
 0.002463     665.     665.     665.        2        0        0     0.00   227.15   302.16


CCHV=   0.300 CEHV=   0.500
*SECNO 4762.000
 2800 NAT Q1=   3785.65  WSEL=    581.48  ENC Q1=   3846.44  WSEL=    581.58  RATIO= -0.0161
 NAT Q1=   3846.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=    581.58

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      592.10 ELREA=      592.10

  4762.00    16.52   581.52     0.00   581.48   581.95     0.43     0.19     0.12   590.00
   10700.       0.   10700.       0.       0.    2029.       0.     409.      29.    590.00
     0.47     0.00     5.27     0.00    0.070    0.035    0.070    0.035   565.00    15.26
 0.000788     150.     150.     150.        2        0        0     0.00   212.37   227.63


SPECIAL BRIDGE

SB  XK        XKOR      COFQ      RDLEN     BWC       BWP       BAREA     SS        ELCHU     ELCHD
     0.90      1.56      2.60    272.00    185.60      6.00   4430.00      2.00    571.00    571.00

*SECNO 4829.000
23-JAN-81  14:16:31                                                                          PAGE    22


   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


CLASS A LOW FLOW

3420 BRIDGE W.S.=    581.50 BRIDGE VELOCITY=,      5.08      C LCULATED CHANNEL AREA=,     2105.
```

```
 EGPRS      EGLWC       H3       QWEIR      QPR       BAREA   TRAPEZOID      ELLC      ELTRD
                                                              AREA
    0.00    582.02     0.02        0.    10700.     4430.     4032.      589.60    596.10


3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      596.10 ELREA=      596.10

  4829.00    16.59   581.59     0.00   581.49   582.02     0.43     0.07     0.00   590.00
   10700.       0.   10700.       0.       0.    2044.       0.     412.      29.    590.00
     0.47     0.00     5.23     0.00    0.070    0.035    0.070    0.035   565.00    15.13
 0.000770      67.      67.      67.        0        0        0     0.00   212.63   227.76


*SECNO 4859.000
 2800 NAT Q1=   4490.41  WSEL=    581.68  ENC Q1=   4564.33  WSEL=    581.78  RATIO= -0.0165
 NAT Q1=   4564.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=    581.78
  4859.00    16.47   581.77     0.00   581.68   582.08     0.30     0.02     0.04   590.30
   10700.       0.   10700.       0.       0.    2422.       0.     414.      29.    590.30
     0.47     0.00     4.42     0.00    0.070    0.035    0.070    0.035   565.30    18.42
 0.000550      30.      30.      30.        2        0        0     0.00   254.63   273.05


CCHV=   0.100 CEHV=   0.300
*SECNO 5159.000
 2800 NAT Q1=   2153.07  WSEL=    581.67  ENC Q1=   2208.45  WSEL=    581.77  RATIO= -0.0257
 NAT Q1=   2208.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=    581.77
  5159.00     8.76   581.76     0.00   581.67   582.51     0.75     0.30     0.13   592.00
   10700.       0.   10700.       0.       0.    1544.       0.     427.      31.    592.00
     0.48     0.00     6.93     0.00    0.070    0.035    0.070    0.035   573.00    22.11
 0.002347     300.     300.     300.        2        0        0     0.00   247.23   269.34


*SECNO 5183.000
 WATER EL=X5 CARD=   597.100
 2800 NAT Q1=  19084.60  WSEL=    597.00  ENC Q1=  19248.22  WSEL=    597.10  RATIO= -0.0086
 NAT Q1=  19248.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=    597.10

3470 ENCROACHMENT STATIONS=     145.0     465.0  TYPE=     4  TARGET=       0.000
23-JAN-81  14:16:31                                                                    PAGE   23


   SECNO     DEPTH     CWSEL     CRIWS     WSELR     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


3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      601.10 ELREA=      601.10
```

```
  5183.00    23.10   597.10     0.00   597.00   597.15     0.05     0.00     0.07   585.00
   10700.       0.   10700.       0.       0.    6262.       0.     429.      31.    580.00
     0.49     0.00     1.71     0.00    0.070    0.035    0.035    0.035   574.00   145.00
 0.000033      24.      24.      24.        0        0        0     0.00   320.00   465.00


CCHV=   0.300 CEHV=   0.500
*SECNO 5383.000
 2800 NAT Q1=  22196.18  WSEL=    597.04  ENC Q1=  22196.18  WSEL=    597.14  RATIO=  0.0000
 NAT Q1=  22434.  RATIOS LOB,CH,ROB=  0.0135  0.9865  0.0000  WSEL=    597.14

3470 ENCROACHMENT STATIONS=     135.2     755.0  TYPE=     4  TARGET=       0.011

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      585.80 ELREA=      599.10

  5383.00    22.33   597.13     0.00   597.04   597.16     0.02     0.01     0.01   585.80
   10700.      31.   10669.       0.     102.    8744.       0.     464.      33.    599.10
     0.53     0.31     1.22     0.00    0.070    0.035    0.070    0.035   574.80   135.17
 0.000023     225.     200.     175.        2        0        0     0.00   604.35   739.51


CCHV=   0.300 CEHV=   0.500
*SECNO 5583.000
 2800 NAT Q1=  16594.37  WSEL=    597.03  ENC Q1=  16737.29  WSEL=    597.13  RATIO= -0.0086
 NAT Q1=  16737.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=    597.13

3470 ENCROACHMENT STATIONS=     145.0     465.0  TYPE=     4  TARGET=       0.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      602.00 ELREA=      602.00

  5583.00    21.53   597.13     0.00   597.03   597.18     0.05     0.01     0.02   586.60
   10700.       0.   10700.       0.       0.    5761.       0.     498.      36.    581.60
     0.56     0.00     1.86     0.00    0.070    0.035    0.035    0.035   575.60   145.00
 0.000043     225.     200.     175.        1        0        0     0.00   320.00   465.00
```



```
   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
     1.05       1.54       2.50     700.00     245.00      47.60    605.00       1.58     577.20     577.20
```

```
*SECNO 5593.000
CLASS A LOW FLOW

3420 BRIDGE W.S.=    597.10 BRIDGE VELOCITY=,      2.35      CALCULATED CHANNEL AREA=,     4553.

 FGPRS      EGLWC       H3       QWEIR      QPR       BAREA   TRAPEZOID      ELLC     ELTRD
                                                                 AREA
     0.00    597.19      0.01        0.    10700.     6065.     5081.       599.10    605.30


3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      599.20 ELREA=      599.20

  5593.00    21.54   597.14     0.00   597.04   597.19     0.05     0.01     0.00   586.60
   10700.       0.   10700.       0.       0.    5761.       0.     499.      36.    581.60
     0.56     0.00     1.86     0.00    0.070    0.035    0.035    0.035   575.60   145.00
 0.000041      10.      10.      10.        0        0        0     0.00   320.00   465.00


*SECNO 5693.000
 2800 NAT Q1=  19091.17  WSEL=    597.07  ENC Q1=  19091.17  WSEL=    597.17  RATIO=  0.0000
 NAT Q1=  19328.  RATIOS LOB,CH,ROB=  0.0130  0.9870  0.0000  WSEL=    597.17

3470 ENCROACHMENT STATIONS=     142.9     755.0  TYPE=     4  TARGET=       0.012

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      587.20 ELREA=      600.50

  5693.00    20.97   597.17     0.00   597.07   597.20     0.03     0.00     0.01   587.20
   10700.       4.   10696.       0.      20.    7942.       0.     515.      37.    600.50
     0.58     0.20     1.35     0.00    0.060    0.035    0.060    0.035   576.20   142.92
 0.000031      100.     100.     100.        2        0        0     0.00   586.05   728.97


CCHV=   0.100 CEHV=   0.300
*SECNO 6693.000
 2800 NAT Q1=  26549.84  WSEL=    597.11  ENC Q1=  26704.30  WSEL=    597.21  RATIO= -0.0058
 NAT Q1=  26946.  RATIOS LOB,CH,ROB=  0.0090  0.9910  0.0000  WSEL=    597.21

3470 ENCROACHMENT STATIONS=     261.0    1359.0  TYPE=     4  TARGET=       0.009
23-JAN-81  14:16:31                                                                    PAGE   25


   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


3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      589.20 ELREA=      602.50
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  6693.00     19.01    597.21      0.00    597.11    597.22      0.01      0.02      0.00    589.20
   10700.        0.    10700.        0.        0.   12230.        0.      746.       55.    602.50
     0.90      0.00      0.87      0.00     0.060     0.035     0.060     0.035    578.20    261.00
 0.000016     1000.     1000.     1000.         1         0         0      0.00   1047.61   1308.61


*SECNO 7653.000
 2800 NAT Q1=  14643.64  WSEL=    597.12  ENC Q1=  14814.36  WSEL=    597.22  RATIO= -0.0117
 NAT Q1=  14814.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=    597.22
  7653.00     13.92    597.22      0.00    597.12    597.26      0.04      0.03      0.01    600.00
   10700.        0.    10700.        0.        0.    6728.        0.      955.       73.    600.00
     1.07      0.00      1.59      0.00     0.060     0.035     0.060     0.035    583.30      8.33
 0.000052      960.      960.      960.         2         0         0      0.00    566.69    575.02


*SECNO 8013.000
 2800 NAT Q1=   9063.86  WSEL=    597.11  ENC Q1=   9063.86  WSEL=    597.21  RATIO=  0.0000
 NAT Q1=   9199.  RATIOS LOB,CH,ROB=  0.0662  0.9288  0.0050  WSEL=    597.21

3470 ENCROACHMENT STATIONS=    1776.2    2234.0  TYPE=     4  TARGET=       0.015
  8013.00     13.18    597.21      0.00    597.11    597.30      0.09      0.03      0.02    590.03
   10700.      623.    10077.        0.      618.    4025.        0.      1003.       78.    590.03
     1.11      1.01      2.50      0.00     0.060     0.035     0.060     0.035    584.03   1776.18
 0.000143      500.      360.      150.         2         0         0      0.00    457.83   2234.00


*SECNO 8480.000
 2800 NAT Q1=   4460.78  WSEL=    597.08  ENC Q1=   4460.78  WSEL=    597.18  RATIO=  0.0000
 NAT Q1=   4546.  RATIOS LOB,CH,ROB=  0.0489  0.9482  0.0029  WSEL=    597.18

3470 ENCROACHMENT STATIONS=    1208.4    1487.8  TYPE=     4  TARGET=       0.019
  8480.00     11.47    597.18      0.00    597.08    597.49      0.31      0.12      0.07    591.71
   10700.      367.    10333.        0.      211.    2270.        0.      1042.       82.    591.71
     1.14      1.74      4.55      0.00     0.060     0.035     0.060     0.035    585.71   1208.36
 0.000593      467.      467.      467.         2         0         0      0.00    279.49   1487.84


*SECNO 8714.000
 2800 NAT Q1=   3450.78  WSEL=    597.15  ENC Q1=   3450.78  WSEL=    597.25  RATIO=  0.0000
 NAT Q1=   3515.  RATIOS LOB,CH,ROB=  0.0410  0.9568  0.0022  WSEL=    597.25
23-JAN-81  14:16:31                                                                    PAGE   26


   SECNO     DEPTH     CWSEL     CRIWS     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
```

```
3470 ENCROACHMENT STATIONS=     1095.4     1339.1  TYPE=      4  TARGET=        0.018
  8714.00     10.69    597.24      0.00    597.15    597.71      0.47      0.18      0.05    592.55
   10700.      269.    10431.        0.      130.     1876.        0.     1054.       83.    592.55
     1.15      2.06      5.56      0.00     0.060     0.035     0.060     0.035    586.55   1095.39
 0.000991      234.      234.      234.         2         0         0      0.00    243.67   1339.06


*SECNO 8831.000
 2800 NAT Q1=    2639.91  WSEL=     597.13  ENC Q1=    2639.91  WSEL=     597.22  RATIO=  0.0000
 NAT Q1=    2699.  RATIOS LOB,CH,ROB=  0.0333  0.9651  0.0016  WSEL=     597.22

3470 ENCROACHMENT STATIONS=      994.3     1205.2  TYPE=      4  TARGET=        0.022
  8831.00      9.94    597.22      0.00    597.13    597.94      0.72      0.15      0.07    593.28
   10700.      145.    10555.        0.       66.     1543.        0.     1058.       84.    593.28
     1.16      2.21      6.84      0.00     0.060     0.035     0.060     0.035    587.28    994.31
 0.001690      117.      117.      117.         2         0         0      0.00    210.84   1205.15


*SECNO 8948.000
 2800 NAT Q1=    2089.37  WSEL=     597.16  ENC Q1=    2089.37  WSEL=     597.26  RATIO=  0.0000
 NAT Q1=    2140.  RATIOS LOB,CH,ROB=  0.0262  0.9727  0.0010  WSEL=     597.26

3470 ENCROACHMENT STATIONS=      935.0     1120.8  TYPE=      4  TARGET=        0.024
  8948.00      9.25    597.25      0.00    597.16    598.28      1.03      0.25      0.09    594.00
   10700.       35.    10665.        0.       17.     1309.        0.     1062.       84.    594.00
     1.16      2.04      8.15      0.00     0.060     0.035     0.060     0.035    588.00    934.98
 0.002701      117.      117.      117.         2         0         0      0.00    185.81   1120.79


CCHV=    0.300 CEHV=    0.500
*SECNO 9113.000
 2800 NAT Q1=    2086.72  WSEL=     597.57  ENC Q1=    2134.71  WSEL=     597.67  RATIO= -0.0230
 NAT Q1=    2135.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=     597.67

3470 ENCROACHMENT STATIONS=      940.2     1120.8  TYPE=      4  TARGET=        0.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=       607.00 ELREA=       607.00

  9113.00      9.43    597.73      0.00    597.57    598.72      0.99      0.43      0.01    594.30
   10700.        0.    10700.        0.        0.     1342.        0.     1067.       85.    594.30
     1.17      0.00      7.97      0.00     0.060     0.035     0.060     0.035    588.30    940.18
 0.002508      165.      165.      165.         2         0         0      0.00    180.61   1120.79
```



```
   SECNO     DEPTH     CWSEL     CRIWS     WSELR     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     TOP' ID     ENDST
```

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SPECIAL BRIDGE

SB  XK        XKOR      COFQ      RDLEN     BWC       BWP       BAREA     SS        ELCHU     ELCHD
    0.90      1.56      2.90    182.00    140.00     16.00   2080.00      1.54    588.70    588.70

*SECNO 9153.000
CLASS A LOW FLOW

3420 BRIDGE W.S.=    597.38 BRIDGE VELOCITY=,      8.97      CALCULATED CHANNEL AREA=,     1193.

 EGPRS      EGLWC       H3       QWEIR      OPR       BAREA   TRAPEZOID      ELLC      ELTRD
                                                               AREA
    0.00    598.89     0.26        0.    10700.      2080.     2309.      604.30    609.30


3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      609.30 ELREA=      609.30

  9153.00     9.66   597.96     0.00   597.86   598.89     0.93     0.17     0.00   594.30
   10700.       0.   10700.       0.       0.    1383.       0.    1069.      85.    594.30
     1.17     0.00     7.74     0.00    0.060    0.035    0.060    0.035   588.30   940.18
 0.002212      40.      40.      40.        0        0        0     0.00   180.61  1120.79

*SECNO 9253.000
 2800 NAT Q1=   2466.86  WSEL=    598.27  ENC Q1=   2466.86  WSEL=    598.37  RATIO=  0.0000
 NAT Q1=   2522.  RATIOS LOB,CH,ROB=  0.0335  0.9649  0.0016  WSEL=    598.37

3470 ENCROACHMENT STATIONS=     924.1    1120.8  TYPE=     4  TARGET=       0.022
  9253.00     9.88   598.28     0.00   598.27   599.12     0.84     0.21     0.03   594.40
   10700.      148.  10552.       0.      62.    1424.       0.    1072.      85.    594.40
     1.17     2.37     7.41     0.00    0.060    0.035    0.060    0.035   588.40   924.13
 0.002010      100.     100.     100.        2        0        0     0.00   196.67  1120.79


CCHV=   0.100 CEHV=   0.300
*SECNO 15913.000
 WATER EL=X5 CARD=   598.370
 2800 NAT Q1=   3934.59  WSEL=    598.27  ENC Q1=   3999.69  WSEL=    598.37  RATIO= -0.0165
 NAT Q1=   4010.  RATIOS LOB,CH,ROB=  0.0026  0.9974  0.0000  WSEL=    598.37

3470 ENCROACHMENT STATIONS=    1050.0    1308.0  TYPE=     4  TARGET=       0.003
 15913.00    16.77   598.37     0.00   598.27   598.72     0.35     1.65     0.05   595.90
   10700.       0.   10700.       0.       0.    2249.       0.    1135.      93.    600.00
     1.26     0.00     4.76     0.00    0.060    0.035    0.060    0.035   581.60  1050.00
 0.000725    1460.    1460.    1460.        0        0        0     0.00   256.80  1306.80
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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      XNI       XNCH      XNR       WTN       ELMIN       SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID      ENDST


*SECNO 18163.000
 2800 NAT Q1=   5038.57  WSEL=    599.65  ENC Q1=   5088.27  WSEL=    599.75  RATIO= -0.0099
 NAT Q1=   5123.  RATIOS LOB,CH,ROB=  0.0068  0.9932  0.0000  WSEL=    599.75

3470 ENCROACHMENT STATIONS=    1050.0    1308.0  TYPE=     4  TARGET=       0.007
 18163.00    18.14   599.74     0.00   599.65   600.00     0.26     1.27     0.01   595.90
   10700.       0.   10700.       0.       0.    2601.       0.    1260.     106.    600.00
     1.41     0.00     4.11     0.00    0.060    0.035    0.060    0.035   581.60  1050.00
 0.000453    2250.    2250.    2250.        2        0        0     0.00   257.81  1307.81


CCHV=   0.300 CEHV=   0.500
*SECNO 18313.000
 2800 NAT Q1=   8182.05  WSEL=    599.87  ENC Q1=   8289.97  WSEL=    599.97  RATIO= -0.0132
 NAT Q1=   8290.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=    599.97

3470 ENCROACHMENT STATIONS=    1170.0    1475.0  TYPE=     4  TARGET=       0.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      608.00 ELREA=      608.00

 18313.00    20.95   599.95     0.00   599.87   600.08     0.13     0.04     0.04   599.20
   10700.       0.   10700.       0.       0.    3721.       0.    1271.     107.    600.00
     1.42     0.00     2.88     0.00    0.060    0.035    0.060    0.035   579.00  1170.00
 0.000167     150.     150.     150.        2        0        0     0.00   304.88  1474.88


SPECIAL BRIDGE

SB  XK        XKOR      COEQ      RDLEN     BWC       BWP       BAREA     SS        ELCHU     ELCHD
     0.90      1.56      2.20    240.00    140.00     12.00   3990.00      2.38    583.50    583.50

*SECNO 18348.000
CLASS A LOW FLOW

3420 BRIDGE W.S.=    599.92 BRIDGE VELOCITY=,      3.90      CALCULATED CHANNEL AREA=,     2744.

 EGPRS     EGLWC      H3        QWEIR     QPR       BAREA   TRAPEZOID      ELLC      ELTRD
                                                              AREA
     0.00    600.10     0.01        0.    10700.    3990.     4085.      606.00    609.30
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3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      609.30 ELREA=      609.30

23-JAN-81  14:16:31                                                                                                    PAGE   29

   SECNO     DEPTH     CWSEL     CRIWS     WSELR     FG        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

 18348.00    20.97   599.97      0.00    599.87   600.10      0.13      0.02      0.00    599.20
   10700.       0.   10700.       0.        0.    3727.        0.     1274.      108.     600.00
     1.43     0.00     2.87     0.00     0.060    0.035     0.060     0.035   579.00   1170.00
 0.000166     35.      35.      35.         0        0         0      0.00   304.93   1474.93

*SECNO 18508.000
 2800 NAT Q1=   5784.34  WSEL=    599.83  ENC Q1=   5847.71  WSEL=    599.93  RATIO= -0.0110
 NAT Q1=   5848.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=    599.93

3470 ENCROACHMENT STATIONS=    1000.0    1180.0  TYPE=     4  TARGET=       0.000
 18508.00    18.43   599.93      0.00    599.83   600.22      0.29      0.04      0.08    600.00
   10700.       0.   10700.       0.        0.    2473.        0.     1285.      108.     600.00
     1.44     0.00     4.33     0.00     0.060    0.035     0.060     0.035   581.50   1000.15
 0.000335    160.     160.     160.         2        0         0      0.00   179.80   1179.95

CCHV=   0.100 CEHV=   0.300
*SECNO 22508.000
 2800 NAT Q1=   6578.26  WSEL=    600.92  ENC Q1=   6640.11  WSEL=    601.02  RATIO= -0.0094
 NAT Q1=   6657.  RATIOS LOB,CH,ROB=  0.0025  0.9975  0.0000  WSEL=    601.02

3470 ENCROACHMENT STATIONS=    1000.0    1180.0  TYPE=     4  TARGET=       0.003
 22508.00    19.51   601.01      0.00    600.92   601.26      0.25      1.04      0.00    600.00
   10700.       0.   10700.       0.        0.    2668.        0.     1492.      123.     600.00
     1.68     0.00     4.01     0.00     0.060    0.035     0.060     0.035   581.50   1000.00
 0.000264    3500.    3500.    3500.         2        0         0      0.00   180.00   1180.00

*SECNO 25508.000
 2800 NAT Q1=   5653.10  WSEL=    602.06  ENC Q1=   5747.48  WSEL=    602.16  RATIO= -0.0167
 NAT Q1=   5755.  RATIOS LOB,CH,ROB=  0.0000  0.9986  0.0014  WSEL=    602.16

3470 ENCROACHMENT STATIONS=    1146.0    1491.0  TYPE=     4  TARGET=       0.001
 25508.00    10.74   602.14      0.00    602.06   602.33      0.19      1.07      0.01    611.30
   10700.       0.   10700.       0.        0.    3092.        0.     1723.      144.     598.00
     1.96     0.00     3.46     0.00     0.060    0.035     0.060     0.035   591.40   1155.36
 0.000355    3500.    3500.    3500.         2        0         0      0.00   335.65   1491.00
```

```
*SECNO 26508.000
 2800 NAT Q1=   4667.03  WSEL=    602.46  ENC Q1=   4757.89  WSEL=    602.56  RATIO= -0.0195
 NAT Q1=   4762.  RATIOS LOB,CH,ROB=  0.0000  0.9992  0.0008  WSEL=    602.56
23-JAN-81  14:16:31                                                                    PAGE   30

   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


3470 ENCROACHMENT STATIONS=    1146.0    1491.0  TYPE=     4  TARGET=       0.001
 26508.00      9.73   602.53      0.00   602.46   602.77      0.23      0.42      0.01   612.70
   10700.        0.   10700.        0.       0.    2754.        0.     1790.      151.    599.40
     2.03     0.00     3.89     0.00    0.060    0.035    0.060     0.035   592.80  1156.39
 0.000517    1000.    1000.    1000.        2        0        0      0.00   334.61  1491.00


*SECNO 31808.000
 2800 NAT Q1=   2380.50  WSEL=    607.13  ENC Q1=   2452.74  WSEL=    607.23  RATIO= -0.0303
 NAT Q1=   2453.  RATIOS LOB,CH,ROB=  0.0000  1.0000  0.0000  WSEL=    607.23

3470 ENCROACHMENT STATIONS=    1146.0    1491.0  TYPE=     4  TARGET=       0.000
 31808.00      6.93   607.15      0.00   607.13   607.68      0.54      4.82      0.09   620.12
   10700.        0.   10700.        0.       0.    1818.        0.     2068.      192.    606.82
     2.28     0.00     5.89     0.00    0.060    0.035    0.060     0.035   600.22  1159.26
 0.002009    5300.    5300.    5300.        3        0        0      0.00   331.74  1491.00

23-JAN-81  14:16:31                                                                    PAGE   31


                                                                   THIS RUN EXECUTED 23-JAN-81  14:16:50
*************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED APRIL 1980
  ERROR CORR -  01,02,03,04
  MODIFICATION -  50,51,52,53,54
*************************************************

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

EAR

SUMMARY PRINTOUT TABLE  150
```

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
0.000	0.00	0.00	0.00	555.60	10700.00	579.40	0.00	579.56	1.27	3.19	3706.15	9496.83
0.000	0.00	0.00	0.00	555.60	10700.00	579.50	0.00	579.66	1.27	3.20	3516.76	9496.77
1349.000	1349.00	0.00	0.00	556.10	10700.00	579.59	0.00	579.70	0.89	2.64	4057.59	11317.55
1349.000	1349.00	0.00	0.00	556.10	10700.00	579.70	0.00	579.80	0.88	2.62	4080.51	11408.76
1449.000	100.00	0.00	0.00	556.00	10700.00	579.55	0.00	579.77	2.65	3.78	2830.32	6577.00
1449.000	100.00	0.00	0.00	556.00	10700.00	579.65	0.00	579.87	2.61	3.76	2845.42	6627.34
1450.000	1.00	591.60	585.20	556.00	10700.00	579.55	0.00	579.77	2.65	3.78	2830.36	6577.12
1450.000	1.00	591.60	585.20	556.00	10700.00	579.66	0.00	579.87	2.61	3.76	2845.44	6627.40
1510.000	60.00	591.60	585.20	556.00	10700.00	579.57	0.00	579.79	2.64	3.78	2832.69	6584.89
1510.000	60.00	591.60	585.20	556.00	10700.00	579.67	0.00	579.89	2.60	3.76	2847.73	6635.04
1512.000	2.00	0.00	0.00	556.00	10700.00	579.57	0.00	579.79	2.64	3.78	2832.84	6585.40
1512.000	2.00	0.00	0.00	556.00	10700.00	579.67	0.00	579.89	2.60	3.76	2847.88	6635.54
1662.000	150.00	0.00	0.00	557.00	10700.00	579.70	0.00	579.84	1.15	3.01	3556.03	9976.63
1662.000	150.00	0.00	0.00	557.00	10700.00	579.80	0.00	579.94	1.13	2.99	3575.89	10060.58
2231.000	569.00	0.00	0.00	558.70	10700.00	579.83	0.00	579.89	0.59	2.00	5338.29	13985.62
2231.000	569.00	0.00	0.00	558.70	10700.00	579.93	0.00	579.99	0.57	1.99	5372.33	14116.79
2881.000	650.00	0.00	0.00	557.00	10700.00	579.89	0.00	579.92	0.32	1.55	6911.78	18939.88
2881.000	650.00	0.00	0.00	557.00	10700.00	579.98	0.00	580.02	0.31	1.54	6951.52	19113.69
3281.000	400.00	0.00	0.00	563.50	10700.00	579.82	0.00	579.99	2.83	3.35	3189.57	6355.52
3281.000	400.00	0.00	0.00	563.50	10700.00	579.92	0.00	580.09	2.75	3.32	3219.93	6448.66
3947.000	666.00	0.00	0.00	566.30	10700.00	579.92	0.00	580.42	11.15	5.68	1884.94	3204.68
3947.000	666.00	0.00	0.00	566.30	10700.00	580.02	0.00	580.51	10.74	5.61	1907.24	3265.71

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
4612.000	665.00	0.00	0.00	569.00	10700.00	580.76	0.00	581.60	25.39	7.33	1460.00	2123.66
4612.000	665.00	0.00	0.00	569.00	10700.00	580.82	0.00	581.64	24.63	7.26	1473.80	2156.22
4762.000	150.00	0.00	0.00	565.00	10700.00	581.48	0.00	581.91	7.99	5.30	2020.08	3785.65
4762.000	150.00	0.00	0.00	565.00	10700.00	581.52	0.00	581.95	7.88	5.27	2029.13	3811.89
4829.000	67.00	596.10	589.60	565.00	10700.00	581.49	0.00	581.93	7.95	5.29	2023.23	3794.78
4829.000	67.00	596.10	589.60	565.00	10700.00	581.59	0.00	582.02	7.70	5.23	2044.47	3856.54

	4859.000	30.00	0.00	0.00	565.30	10700.00	581.68	0.00	581.99	5.68	4.46	2398.09	4490.41
	4859.000	30.00	0.00	0.00	565.30	10700.00	581.77	0.00	582.08	5.50	4.42	2422.47	4561.39
	5159.000	300.00	0.00	0.00	573.00	10700.00	581.67	0.00	582.44	24.70	7.04	1519.56	2153.07
	5159.000	300.00	0.00	0.00	573.00	10700.00	581.76	0.00	582.51	23.47	6.93	1544.06	2208.45
*	5183.000	24.00	0.00	0.00	574.00	10700.00	597.00	0.00	597.05	0.31	1.72	6230.00	19084.60
*	5183.000	24.00	0.00	0.00	574.00	10700.00	597.10	0.00	597.15	0.33	1.71	6262.03	18594.63
	5383.000	200.00	0.00	0.00	574.80	10700.00	597.04	0.00	597.06	0.23	1.22	9065.17	22196.18
	5383.000	200.00	0.00	0.00	574.80	10700.00	597.13	0.00	597.16	0.23	1.22	8846.16	22193.88
	5583.000	200.00	0.00	0.00	575.60	10700.00	597.03	0.00	597.08	0.42	1.87	5728.69	16594.37
	5583.000	200.00	0.00	0.00	575.60	10700.00	597.13	0.00	597.18	0.43	1.86	5760.66	16230.22
	5593.000	10.00	605.30	599.10	575.60	10700.00	597.04	0.00	597.09	0.42	1.87	5729.47	16598.15
	5593.000	10.00	605.30	599.10	575.60	10700.00	597.14	0.00	597.19	0.41	1.86	5761.47	16752.91
	5693.000	100.00	0.00	0.00	576.20	10700.00	597.07	0.00	597.10	0.31	1.34	8183.72	19091.17
	5693.000	100.00	0.00	0.00	576.20	10700.00	597.17	0.00	597.20	0.31	1.35	7962.23	19081.71
	6693.000	1000.00	0.00	0.00	578.20	10700.00	597.11	0.00	597.13	0.16	0.87	12476.74	26549.84
	6693.000	1000.00	0.00	0.00	578.20	10700.00	597.21	0.00	597.22	0.16	0.87	12230.01	26535.15
	7653.000	960.00	0.00	0.00	583.30	10700.00	597.12	0.00	597.16	0.53	1.60	6676.15	14643.64
	7653.000	960.00	0.00	0.00	583.30	10700.00	597.22	0.00	597.26	0.52	1.59	6727.61	14813.00
	8013.000	360.00	0.00	0.00	584.03	10700.00	597.11	0.00	597.20	1.39	2.49	4868.52	9063.86
	8013.000	360.00	0.00	0.00	584.03	10700.00	597.21	0.00	597.30	1.43	2.50	4642.82	8949.19
	8480.000	467.00	0.00	0.00	585.71	10700.00	597.08	0.00	597.38	5.75	4.52	2605.04	4460.78
	8480.000	467.00	0.00	0.00	585.71	10700.00	597.18	0.00	597.49	5.93	4.55	2480.68	4393.04
	8714.000	234.00	0.00	0.00	586.55	10700.00	597.15	0.00	597.60	9.61	5.52	2108.32	3450.78
	8714.000	234.00	0.00	0.00	586.55	10700.00	597.24	0.00	597.71	9.91	5.56	2006.22	3399.03
	8831.000	117.00	0.00	0.00	587.28	10700.00	597.13	0.00	597.82	16.43	6.78	1695.87	2639.91
	8831.000	117.00	0.00	0.00	587.28	10700.00	597.22	0.00	597.94	16.90	6.84	1608.36	2602.47
	8948.000	117.00	0.00	0.00	588.00	10700.00	597.16	0.00	598.14	26.23	8.06	1412.69	2089.37
	8948.000	117.00	0.00	0.00	588.00	10700.00	597.25	0.00	598.28	27.01	8.15	1326.27	2059.01

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
9113.000	165.00	0.00	0.00	588.30	10700.00	597.57	0.00	598.60	26.29	8.15	1313.11	2086.72
9113.000	165.00	0.00	0.00	588.30	10700.00	597.73	0.00	598.72	25.08	7.97	1341.94	2136.75
9153.000	40.00	609.30	604.30	588.30	10700.00	597.86	0.00	598.81	23.11	7.84	1364.99	2225.93

	9153.000	40.00	609.30	604.30	588.30	10700.00	597.96	0.00	598.89	22.12	7.74	1383.05	2275.22
	9253.000	100.00	0.00	0.00	588.40	10700.00	598.27	0.00	599.07	18.81	7.27	1582.77	2466.86
	9253.000	100.00	0.00	0.00	588.40	10700.00	598.28	0.00	599.12	20.10	7.41	1485.87	2386.86
*	15913.000	1460.00	0.00	0.00	581.60	10700.00	598.27	0.00	598.63	7.40	4.80	2257.11	3934.59
*	15913.000	1460.00	0.00	0.00	581.60	10700.00	598.37	0.00	598.72	7.25	4.76	2248.53	3974.77
	18163.000	2250.00	0.00	0.00	581.60	10700.00	599.65	0.00	599.92	4.51	4.12	2664.89	5038.57
	18163.000	2250.00	0.00	0.00	581.60	10700.00	599.74	0.00	600.00	4.53	4.11	2600.82	5027.22
	18313.000	150.00	0.00	0.00	579.00	10700.00	599.87	0.00	600.00	1.71	2.90	3694.42	8182.05
	18313.000	150.00	0.00	0.00	579.00	10700.00	599.95	0.00	600.08	1.67	2.88	3721.13	8276.69
	18348.000	35.00	609.30	606.00	579.00	10700.00	599.87	0.00	600.00	1.71	2.89	3696.22	8188.43
	18348.000	35.00	609.30	606.00	579.00	10700.00	599.97	0.00	600.10	1.66	2.87	3726.69	8296.45
	18508.000	160.00	0.00	0.00	581.50	10700.00	599.83	0.00	600.12	3.42	4.36	2455.40	5784.34
	18508.000	160.00	0.00	0.00	581.50	10700.00	599.93	0.00	600.22	3.35	4.33	2473.37	5847.79
	22508.000	3500.00	0.00	0.00	581.50	10700.00	600.92	0.00	601.17	2.65	4.03	2738.36	6578.26
	22508.000	3500.00	0.00	0.00	581.50	10700.00	601.01	0.00	601.26	2.64	4.01	2668.18	6582.52
	25508.000	3500.00	0.00	0.00	591.40	10700.00	602.06	0.00	602.25	3.58	3.49	3084.38	5653.10
	25508.000	3500.00	0.00	0.00	591.40	10700.00	602.14	0.00	602.33	3.55	3.46	3092.07	5681.99
	26508.000	1000.00	0.00	0.00	592.80	10700.00	602.46	0.00	602.70	5.26	3.92	2739.24	4667.03
	26508.000	1000.00	0.00	0.00	592.80	10700.00	602.53	0.00	602.77	5.17	3.89	2753.71	4706.40
	31808.000	5300.00	0.00	0.00	600.22	10700.00	607.13	0.00	607.67	20.20	5.90	1814.03	2380.50
	31808.000	5300.00	0.00	0.00	600.22	10700.00	607.15	0.00	607.68	20.09	5.89	1817.84	2387.46

EAR

SUMMARY PRINTOUT TABLE 150

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
0.000	10700.00	579.40	0.00	0.00	0.00	329.50	0.00
0.000	10700.00	579.50	0.10	0.00	0.10	233.06	0.00
1349.000	10700.00	579.59	0.00	0.19	0.00	223.27	1349.00
1349.000	10700.00	579.70	0.10	0.20	0.10	223.69	1349.00
1449.000	10700.00	579.55	0.00	-0.04	0.00	146.47	100.00
1449.000	10700.00	579.65	0.10	-0.04	0.10	146.48	100.00

1450.000	10700.00	579.55	0.00	0.00	0.00	146.47	1.00
1450.000	10700.00	579.66	0.10	0.00	0.10	146.48	1.00
1510.000	10700.00	579.57	0.00	0.02	0.00	146.48	60.00
1510.000	10700.00	579.67	0.10	0.02	0.10	146.48	60.00
1512.000	10700.00	579.57	0.00	0.00	0.00	146.48	2.00
1512.000	10700.00	579.67	0.10	0.00	0.10	146.48	2.00
1662.000	10700.00	579.70	0.00	0.13	0.00	196.37	150.00
1662.000	10700.00	579.80	0.10	0.13	0.10	196.56	150.00
2231.000	10700.00	579.83	0.00	0.13	0.00	340.88	569.00
2231.000	10700.00	579.93	0.10	0.13	0.10	341.49	569.00
2881.000	10700.00	579.89	0.00	0.06	0.00	407.64	650.00
2881.000	10700.00	579.98	0.10	0.05	0.10	407.81	650.00
3281.000	10700.00	579.82	0.00	-0.07	0.00	302.88	400.00
3281.000	10700.00	579.92	0.10	-0.07	0.10	303.40	400.00
3947.000	10700.00	579.92	0.00	0.11	0.00	230.26	666.00
3947.000	10700.00	580.02	0.10	0.10	0.10	230.43	666.00
4612.000	10700.00	580.76	0.00	0.84	0.00	227.05	665.00
4612.000	10700.00	580.82	0.06	0.81	0.06	227.15	665.00
4762.000	10700.00	581.48	0.00	0.71	0.00	212.22	150.00
4762.000	10700.00	581.52	0.04	0.70	0.04	212.37	150.00
4829.000	10700.00	581.49	0.00	0.02	0.00	212.27	67.00
4829.000	10700.00	581.59	0.10	0.07	0.10	212.63	67.00
4859.000	10700.00	581.68	0.00	0.18	0.00	254.22	30.00
4859.000	10700.00	581.77	0.10	0.18	0.10	254.63	30.00
5159.000	10700.00	581.67	0.00	-0.01	0.00	246.80	300.00
5159.000	10700.00	581.76	0.10	-0.01	0.10	247.23	300.00

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	5183.000	10700.00	597.00	0.00	15.33	0.00	320.00	24.00
*	5183.000	10700.00	597.10	0.10	15.34	0.10	320.00	24.00
	5383.000	10700.00	597.04	0.00	0.04	0.00	654.47	200.00
	5383.000	10700.00	597.13	0.10	0.03	0.10	604.35	200.00
	5583.000	10700.00	597.03	0.00	-0.01	0.00	320.00	200.00

5583.000	10700.00	597.13	0.10	-0.01	0.10	320.00	200.00
5593.000	10700.00	597.04	0.00	0.01	0.00	320.00	10.00
5593.000	10700.00	597.14	0.10	0.01	0.10	320.00	10.00
5693.000	10700.00	597.07	0.00	0.04	0.00	641.26	100.00
5693.000	10700.00	597.17	0.10	0.04	0.10	586.05	100.00
6693.000	10700.00	597.11	0.00	0.04	0.00	1141.65	1000.00
6693.000	10700.00	597.21	0.10	0.04	0.10	1047.61	1000.00
7653.000	10700.00	597.12	0.00	0.01	0.00	565.60	960.00
7653.000	10700.00	597.22	0.10	0.01	0.10	566.69	960.00
8013.000	10700.00	597.11	0.00	-0.01	0.00	599.13	360.00
8013.000	10700.00	597.21	0.10	-0.01	0.10	457.83	360.00
8480.000	10700.00	597.08	0.00	-0.03	0.00	349.68	467.00
8480.000	10700.00	597.18	0.10	-0.03	0.10	279.49	467.00
8714.000	10700.00	597.15	0.00	0.06	0.00	302.34	234.00
8714.000	10700.00	597.24	0.10	0.07	0.10	243.67	234.00
8831.000	10700.00	597.13	0.00	-0.02	0.00	261.17	117.00
8831.000	10700.00	597.22	0.09	-0.03	0.09	210.84	117.00
8948.000	10700.00	597.16	0.00	0.04	0.00	235.02	117.00
8948.000	10700.00	597.25	0.09	0.03	0.09	185.81	117.00
9113.000	10700.00	597.57	0.00	0.41	0.00	180.61	165.00
9113.000	10700.00	597.73	0.16	0.48	0.16	180.61	165.00
9153.000	10700.00	597.86	0.00	0.29	0.00	180.61	40.00
9153.000	10700.00	597.96	0.10	0.23	0.10	180.61	40.00
9253.000	10700.00	598.27	0.00	0.41	0.00	243.19	100.00
9253.000	10700.00	598.28	0.01	0.32	0.01	196.67	100.00
* 15913.000	10700.00	598.27	0.00	0.00	0.00	285.63	1460.00
* 15913.000	10700.00	598.37	0.10	0.09	0.10	256.80	1460.00
18163.000	10700.00	599.65	0.00	1.38	0.00	303.53	2250.00
18163.000	10700.00	599.74	0.09	1.37	0.09	257.81	2250.00

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFNWS	TOPWID	XLCH
18313.000	10700.00	599.87	0.00	0.21	0.00	304.66	150.00
18313.000	10700.00	599.95	0.09	0.21	0.09	304.88	150.00

18348.000	10700.00	599.87	0.00	0.01	0.00	304.68	35.00
18348.000	10700.00	599.97	0.10	0.02	0.10	304.93	35.00
18508.000	10700.00	599.83	0.00	-0.04	0.00	179.53	160.00
18508.000	10700.00	599.93	0.10	-0.04	0.10	179.80	160.00
22508.000	10700.00	600.92	0.00	1.10	0.00	365.53	3500.00
22508.000	10700.00	601.01	0.09	1.08	0.09	180.00	3500.00
25508.000	10700.00	602.06	0.00	1.14	0.00	345.16	3500.00
25508.000	10700.00	602.14	0.08	1.14	0.08	335.65	3500.00
26508.000	10700.00	602.46	0.00	0.40	0.00	341.76	1000.00
26508.000	10700.00	602.53	0.08	0.39	0.08	334.61	1000.00
31808.000	10700.00	607.13	0.00	4.68	0.00	332.47	5300.00
31808.000	10700.00	607.15	0.01	4.61	0.01	331.74	5300.00

SUMMARY OF ERRORS

NOTE SECNO= 5183.000 PROFILE= 1 WSEL BASED ON X5 CARD
NOTE SECNO= 5183.000 PROFILE= 2 WSEL BASED ON X5 CARD

NOTE SECNO=15913.000 PROFILE= 1 WSEL BASED ON X5 CARD
NOTE SECNO=15913.000 PROFILE= 2 WSEL BASED ON X5 CARD

FLOODWAY DATA, EAR
PROFILE NO. 2

STATION	FLOODWAY WIDTH	FLOODWAY SECTION AREA	FLOODWAY MEAN VELOCITY	WATER SURFACE ELEVATION WITH FLOODWAY	WATER SURFACE ELEVATION WITHOUT FLOODWAY	DIFFERENCE
0.000	233.	3517.	3.0	579.5	579.4	0.1
1349.000	224.	4081.	2.6	579.7	579.6	0.1
1449.000	180.	2845.	3.8	579.7	579.6	0.1
1450.000	180.	2845.	3.8	579.7	579.6	0.1
1510.000	180.	2848.	3.8	579.7	579.[illegible]	0.1

1512.000	180.	2848.	3.8	579.7	579.6	0.1
1662.000	197.	3576.	3.0	579.8	579.7	0.1
2231.000	341.	5372.	2.0	579.9	579.8	0.1
2881.000	408.	6952.	1.5	580.0	579.9	0.1
3281.000	303.	3220.	3.3	579.9	579.8	0.1
3947.000	230.	1907.	5.6	580.0	579.9	0.1
4612.000	227.	1474.	7.3	580.9	580.8	0.1
4762.000	212.	2029.	5.3	581.5	581.5	0.0
4829.000	213.	2044.	5.2	581.6	581.5	0.1
4859.000	255.	2422.	4.4	581.8	581.7	0.1
5159.000	247.	1544.	6.9	581.8	581.7	0.1
5183.000	320.	6262.	1.7	597.1	597.0	0.1
5383.000	604.	8846.	1.2	597.1	597.0	0.1
5583.000	320.	5761.	1.9	597.1	597.0	0.1
5593.000	320.	5761.	1.9	597.1	597.0	0.1
5693.000	586.	7962.	1.3	597.2	597.1	0.1
6693.000	1048.	12230.	0.9	597.2	597.1	0.1
7653.000	567.	6728.	1.6	597.2	597.1	0.1
8013.000	458.	4643.	2.3	597.2	597.1	0.1
8480.000	279.	2481.	4.3	597.2	597.1	0.1
8714.000	244.	2006.	5.3	597.2	597.1	0.1
8831.000	211.	1608.	6.7	597.2	597.1	0.1
8948.000	186.	1326.	8.1	597.3	597.2	0.1
9113.000	181.	1342.	8.0	597.8	597.6	0.2
9153.000	181.	1383.	7.7	598.0	597.9	0.1
9253.000	197.	1486.	7.2	598.3	598.3	0.0
15913.000	257.	2249.	4.8	598.4	598.3	0.1
18163.000	258.	2601.	4.1	599.8	599.7	0.1
18313.000	305.	3721.	2.9	600.0	599.9	0.1
18348.000	305.	3727.	2.9	600.0	599.9	0.1
18508.000	180.	2473.	4.3	599.9	599.8	0.1
22508.000	180.	2668.	4.0	601.0	600.9	0.1
25508.000	336.	3092.	3.5	602.2	602.1	0.1
26508.000	335.	2754.	3.9	602.6	602.5	0.1
31808.000	332.	1818.	5.9	607.1	607.1	0.0

computer error; see detailed printout

THIS RUN EXECUTED 23-JAN-81 14:16:53

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*************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED APRIL 1980
  ERROR CORR -  01,02,03,04
  MODIFICATION -  50,51,52,53,54
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00BREAK00

1) COUNTY: Alpena

2) STUDY NAME: Alpena City/Rural

3) WATERCOURSE: Thunder Bay River

4) DOCUMENT TYPE: 100-yr Natural

00BREAK00

FINAL

MOISE COPY

THIS RUN EXECUTED 23-JAN-81 14:16:31

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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED APRIL 1980
  ERROR CORR -  01,02,03,04
  MODIFICATION -  50,51,52,53,54
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RECEIVED
APR 23 1981
WATER MANAGEMENT

T1 ALPENA, MICH
T2 THUNDER BAY RIVER
T3 100-YEAR

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0.	4.	0.	0.	0.000000	0.00	0.0	0.	579.400	0.000

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	1.000	0.000	-1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

J3 VARIABLE CODES FOR SUMMARY PRINTOUT

150.000	200.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

QT	6.000	6548.000	9262.000	10700.000	13800.000	10700.000	10700.000	0.000	0.000	0.000
NC	0.070	0.070	0.035	0.100	0.300	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	0.000	21.000	160.000	340.000	0.000	0.000	0.000	0.000	1.200	0.000
GR	578.800	0.000	575.800	50.000	573.800	160.000	569.300	170.000	563.600	180.000
GR	561.300	190.000	559.600	200.000	558.300	210.000	556.800	220.000	554.800	230.000
GR	555.800	240.000	554.400	250.000	554.500	260.000	554.700	270.000	555.000	280.000
GR	554.800	290.000	556.600	300.000	560.800	310.000	565.800	320.000	566.800	330.000
GR	578.800	340.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	1349.000	16.000	276.000	522.000	1349.000	1349.000	1349.000	0.000	0.000	0.000
GR	588.400	0.000	587.700	200.000	588.200	276.000	580.100	295.000	573.100	320.000
GR	563.100	340.000	559.100	360.000	557.100	380.000	556.100	400.000	556.100	420.000
GR	557.100	440.000	560.100	460.000	558.100	500.000	558.100	510.000	583.700	522.000
GR	588.500	603.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NC	0.000	0.000	0.000	0.300	0.500	0.000	0.000	0.000	0.000	0.000

ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	1449.000	15.000	275.000	500.000	100.000	100.000	100.000	0.000	0.000	0.000
GR	588.500	0.000	587.500	200.000	588.500	275.000	586.800	277.000	586.800	319.000
GR	573.000	320.000	563.000	340.000	558.800	370.000	585.200	370.000	585.200	404.000
GR	556.000	404.000	558.100	440.000	560.000	460.000	558.200	500.000	585.200	500.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000

X1	1450.000	0.000	0.000	0.000	1.000	1.000	1.000	0.000	0.000	0.000
X2	0.000	0.000	0.000	585.200	591.600	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	1510.000	0.000	0.000	0.000	60.000	60.000	60.000	0.000	0.000	0.000
X2	0.000	0.000	0.000	585.200	591.600	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	1512.000	0.000	0.000	0.000	2.000	2.000	2.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	1662.000	9.000	40.000	240.000	150.000	150.000	150.000	0.000	1.200	0.000
GR	590.000	0.000	581.000	40.000	567.300	50.000	557.800	90.000	555.800	170.000
GR	556.300	200.000	571.700	230.000	580.000	240.000	590.000	270.000	0.000	0.000
NC	0.000	0.000	0.000	0.100	0.300	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	2231.000	10.000	20.000	420.000	569.000	569.000	569.000	0.000	1.200	0.000
GR	590.000	0.000	580.000	20.000	570.300	30.000	557.800	60.000	557.500	150.000
GR	557.700	210.000	564.600	260.000	568.600	300.000	570.300	320.000	590.000	420.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	2881.000	11.000	20.000	430.000	650.000	650.000	650.000	0.000	1.200	0.000
GR	590.000	0.000	580.000	20.000	562.800	30.000	555.800	50.000	558.700	140.000
GR	561.300	200.000	563.000	280.000	562.600	380.000	571.800	420.000	580.000	430.000
GR	590.000	450.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	3281.000	10.000	0.000	540.000	400.000	400.000	400.000	0.000	1.200	0.000
GR	590.000	0.000	580.000	30.000	562.300	40.000	563.800	100.000	566.500	160.000
GR	571.100	210.000	569.800	270.000	569.100	290.000	580.000	340.000	590.000	540.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000

X1	3947.000	13.000	70.000	313.000	666.000	666.000	666.000	0.000	-2.700	0.000
GR	590.000	0.000	588.000	20.000	586.000	43.000	590.000	70.000	579.000	76.000
GR	578.000	120.000	577.000	133.000	573.000	170.000	570.000	250.000	569.000	255.000
GR	579.000	300.000	590.000	313.000	596.000	330.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	4612.000	0.000	0.000	0.000	665.000	665.000	665.000	0.000	2.700	0.000
NC	0.000	0.000	0.000	0.300	0.500	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000

X1	4762.000	8.000	0.000	243.000	150.000	150.000	150.000	0.000	0.000	0.000
X3	10.000	0.000	0.000	0.000	0.000	0.000	0.000	592.100	592.100	0.000
GR	590.000	0.000	575.000	27.000	574.000	86.000	565.000	123.000	565.000	146.000
GR	574.000	188.000	574.000	214.000	590.000	243.000	0.000	0.000	0.000	0.000
SB	0.900	1.560	2.600	272.000	185.600	6.000	4430.000	2.000	571.000	571.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	4829.000	0.000	0.000	0.000	67.000	67.000	67.000	0.000	0.000	0.000
X2	0.000	0.000	1.000	589.600	596.100	0.000	0.000	0.000	0.000	0.000
X3	10.000	0.000	0.000	0.000	0.000	0.000	0.000	596.100	596.100	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	4859.000	0.000	0.000	0.000	30.000	30.000	30.000	1.200	0.300	0.000
NC	0.000	0.000	0.000	0.100	0.300	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	5159.000	8.000	0.000	243.000	300.000	300.000	300.000	1.200	2.000	0.000
GR	590.000	0.000	575.000	27.000	574.000	86.000	571.000	123.000	571.000	146.000
GR	574.000	188.000	574.000	214.000	590.000	243.000	0.000	0.000	0.000	0.000
NC	0.070	0.035	0.035	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	5183.000	39.000	145.000	465.000	24.000	24.000	24.000	0.000	-1.600	0.000
X3	10.000	0.000	0.000	0.000	0.000	0.000	0.000	601.100	601.100	0.000
X5	6.000	597.000	597.000	597.000	597.500	597.100	597.100	0.000	0.000	0.000
GR	604.000	0.000	603.800	21.000	604.200	22.000	603.600	35.000	600.100	58.000
GR	599.200	80.000	597.600	85.000	597.100	86.000	593.600	95.000	592.600	105.000
GR	590.600	125.000	586.600	145.000	585.600	165.000	584.600	185.000	582.600	205.000
GR	581.600	225.000	578.600	245.000	577.600	265.000	578.600	285.000	576.600	305.000
GR	577.600	325.000	576.600	345.000	574.600	425.000	575.600	445.000	581.600	465.000

GR	588.600	485.000	593.600	505.000	592.600	525.000	587.600	545.000	586.600	565.000
GR	584.600	605.000	585.600	685.000	590.600	705.000	592.600	725.000	596.600	729.000
GR	599.900	755.000	596.900	800.000	595.900	864.000	601.000	1300.000	0.000	0.000
NC	0.070	0.070	0.035	0.300	0.500	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	5383.000	39.000	145.000	755.000	225.000	175.000	200.000	0.000	-0.800	0.000
X3	10.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GR	604.000	0.000	603.800	21.000	604.200	22.000	603.600	35.000	600.100	58.000
GR	599.200	80.000	597.600	85.000	597.100	86.000	593.600	95.000	592.600	105.000
GR	590.600	125.000	586.600	145.000	585.600	165.000	584.600	185.000	582.600	205.000
GR	581.600	225.000	578.600	245.000	577.600	265.000	578.600	285.000	576.600	305.000
GR	577.600	325.000	576.600	345.000	576.600	425.000	575.600	445.000	581.600	465.000
GR	588.600	485.000	593.600	505.000	592.600	525.000	587.600	545.000	586.600	565.000
GR	584.600	605.000	585.600	685.000	590.600	705.000	592.600	725.000	596.600	729.000
GR	599.900	755.000	596.900	800.000	595.900	864.000	601.000	1300.000	0.000	0.000
NC	0.070	0.035	0.035	0.300	0.500	0.000	0.000	0.000	0.000	0.000

ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	5583.000	39.000	145.000	465.000	225.000	175.000	200.000	0.000	0.000	0.000
X3	10.000	0.000	0.000	0.000	0.000	0.000	0.000	602.000	602.000	0.000
GR	604.000	0.000	603.800	21.000	604.200	22.000	603.600	35.000	600.100	58.000
GR	599.200	80.000	597.600	85.000	597.100	86.000	593.600	95.000	592.600	105.000
GR	590.600	125.000	586.600	145.000	585.600	165.000	584.600	185.000	582.600	205.000
GR	581.600	225.000	578.600	245.000	577.600	265.000	578.600	285.000	576.600	305.000
GR	577.600	325.000	576.600	345.000	576.600	425.000	575.600	445.000	581.600	465.000
GR	588.600	485.000	593.600	505.000	592.600	525.000	587.600	545.000	586.600	565.000
GR	584.600	605.000	585.600	685.000	590.600	705.000	592.600	725.000	596.600	729.000
GR	599.900	755.000	596.900	800.000	595.900	864.000	601.000	1300.000	0.000	0.000
SB	1.050	1.560	2.500	700.000	245.000	47.600	6065.000	1.580	577.200	577.200
EI	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	5593.000	0.000	0.000	0.000	10.000	10.000	10.000	0.000	0.000	0.000
X2	0.000	0.000	1.000	599.100	605.300	0.000	0.000	0.000	0.000	0.000
X3	10.000	0.000	0.000	0.000	0.000	0.000	0.000	599.200	599.200	0.000
NC	0.060	0.060	0.035	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	5693.000	39.000	145.000	755.000	100.000	100.000	100.000	0.000	0.600	0.000
X3	10.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GR	604.000	0.000	603.800	21.000	604.200	22.000	603.600	35.000	600.100	58.000
GR	599.200	80.000	597.600	85.000	597.100	86.000	593.600	95.000	592.600	105.000
GR	590.600	125.000	586.600	145.000	585.600	165.000	584.600	185.000	582.600	205.000
GR	581.600	225.000	578.600	245.000	577.600	265.000	578.600	285.000	576.600	305.000

GR	577.600	325.000	576.600	345.000	576.600	425.000	575.600	445.000	581.600	465.000
GR	588.600	485.000	593.600	505.000	592.600	525.000	587.600	545.000	586.600	565.000
GR	584.600	605.000	585.600	685.000	590.600	705.000	592.600	725.000	596.600	729.000
GR	599.900	755.000	596.900	800.000	595.900	864.000	601.000	1300.000	0.000	0.000
NC	0.000	0.000	0.000	0.100	0.300	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	6693.000	0.000	0.000	0.000	1000.000	1000.000	1000.000	1.800	2.000	0.000
X3	10.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	7653.000	4.000	0.000	600.000	960.000	960.000	960.000	0.000	0.000	0.000
GR	600.000	0.000	583.300	50.000	583.300	450.000	600.000	600.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	8013.000	25.000	937.000	1117.000	500.000	150.000	360.000	2.000	-3.970	0.000
GR	609.700	0.000	607.500	137.000	604.600	237.000	603.800	537.000	602.200	737.000
GR	601.400	837.000	597.500	884.000	596.000	897.000	594.000	917.000	594.000	937.000
GR	592.000	957.000	588.000	997.000	589.000	1017.000	589.000	1077.000	590.000	1097.000
GR	594.000	1117.000	597.000	1121.000	598.000	1122.000	600.100	1125.000	601.400	1145.000
GR	611.300	1179.000	614.100	1237.000	613.700	1299.000	611.800	1321.000	611.600	1337.000

ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	8480.000	0.000	0.000	0.000	467.000	467.000	467.000	0.666	1.680	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	8714.000	0.000	0.000	0.000	234.000	234.000	234.000	0.900	0.840	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	8831.000	0.000	0.000	0.000	117.000	117.000	117.000	0.900	0.725	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	8948.000	0.000	0.000	0.000	117.000	117.000	117.000	0.930	0.725	0.000
NC	0.000	0.000	0.000	0.300	0.500	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	9113.000	0.000	0.000	0.000	165.000	165.000	165.000	0.000	0.300	0.000
X3	10.000	0.000	0.000	0.000	0.000	0.000	0.000	607.000	607.000	0.000
SB	0.900	1.560	2.900	182.000	140.000	16.000	2080.000	1.540	588.700	588.700
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000

X1	9153.000	0.000	0.000	0.000	40.000	40.000	40.000	0.000	0.000	0.000
X2	0.000	0.000	1.000	604.300	609.300	0.000	0.000	0.000	0.000	0.000
X3	10.000	0.000	0.000	0.000	0.000	0.000	0.000	609.300	609.300	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	9253.000	0.000	0.000	0.000	100.000	100.000	100.000	0.000	0.100	0.000
NC	0.000	0.000	0.000	0.100	0.300	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	15913.000	13.000	1050.000	1308.000	1460.000	1460.000	1460.000	0.000	0.000	0.000
* X5	6.000	597.440	597.930	598.270	599.320	598.370	598.370	0.000	0.000	0.000
GR	605.000	0.000	600.000	1000.000	595.900	1050.000	594.300	1110.000	592.500	1125.000
GR	590.000	1165.000	588.400	1195.000	585.700	1225.000	581.600	1265.000	584.400	1285.000
GR	593.200	1303.000	600.000	1308.000	605.000	1315.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	18163.000	0.000	0.000	0.000	2250.000	2250.000	2250.000	0.000	0.000	0.000
NC	0.000	0.000	0.000	0.300	0.500	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000

X1	18313.000	13.000	1170.000	1475.000	150.000	150.000	150.000	0.000	0.000	0.000
X3	10.000	0.000	0.000	0.000	0.000	0.000	0.000	608.000	608.000	0.000
GR	605.000	0.000	601.000	1000.000	600.000	1135.000	599.200	1170.000	599.000	1190.000
GR	583.000	1295.000	584.500	1325.000	584.500	1360.000	579.000	1400.000	580.000	1425.000
GR	600.000	1475.000	610.000	1650.000	611.500	1700.000	0.000	0.000	0.000	0.000
SB	0.900	1.560	2.200	240.000	140.000	12.000	3990.000	2.380	583.500	583.500
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	18348.000	0.000	0.000	0.000	35.000	35.000	35.000	0.000	0.000	0.000
X2	0.000	0.000	1.000	606.000	609.300	0.000	0.000	0.000	0.000	0.000
X3	10.000	0.000	0.000	0.000	0.000	0.000	0.000	609.300	609.300	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000
X1	18508.000	14.000	1000.000	1180.000	160.000	160.000	160.000	0.000	0.000	0.000
GR	605.000	0.000	600.000	1000.000	595.200	1010.000	589.300	1026.000	584.900	1046.000
GR	582.800	1076.000	583.100	1106.000	581.500	1136.000	582.600	1146.000	585.000	1156.000
GR	590.700	1166.000	593.700	1176.000	600.000	1180.000	605.000	1185.000	0.000	0.000
NC	0.000	0.000	0.000	0.100	0.300	0.000	0.000	0.000	0.000	0.000
ET	0.000	0.000	0.000	0.000	0.000	1.400	0.000	0.000	0.000	0.000

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X1   22508.000      0.000      0.000      0.000   3500.000   3500.000   3500.000      0.000      0.000      0.000
ET       0.000      0.000      0.000      0.000      0.000      1.400      0.000      0.000      0.000      0.000

X1   25508.000     16.000   1146.000   1491.000   3500.000   3500.000   3500.000      0.000      0.000      0.000
GR     634.100      0.000    611.900    800.000    610.100   1000.000    611.300   1146.000    597.600   1160.000
GR     596.400   1170.000    594.400   1200.000    592.200   1220.000    592.200   1340.000    591.400   1360.000
GR     592.400   1380.000    592.400   1480.000    597.400   1488.000    598.000   1491.000    619.600   1542.000
GR     635.000   1700.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
ET       0.000      0.000      0.000      0.000      0.000      1.400      0.000      0.000      0.000      0.000

X1   26508.000      0.000      0.000      0.000   1000.000   1000.000   1000.000      0.000      1.400      0.000
ET       0.000      0.000      0.000      0.000      0.000      1.400      0.000      0.000      0.000      0.000

X1   31808.000      0.000      0.000      0.000   5300.000   5300.000   5300.000      0.000      7.420      0.000
EJ       0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
23-JAN-81  14:16:31                                                                                   PAGE    7

   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 1

CCHV=   0.100 CEHV=   0.300
*SECNO .000
     0.00     23.80    579.40      0.00    579.40    579.56      0.16      0.00      0.00    575.00
   10700.      215.    10485.        0.      422.     3284.        0.        0.        0.    580.00
     0.00      0.51      3.19      0.00     0.070     0.035     0.070     0.000    555.60     10.00
 0.000127        0.        0.        0.         0         0         0      0.00    329.50    339.50

*SECNO 1349.000
  1349.00     23.49    579.59      0.00      0.00    579.70      0.11      0.14      0.00    588.20
   10700.        0.    10700.        0.        0.     4058.        0.      120.        9.    583.70
     0.14      0.00      2.64      0.00     0.070     0.035     0.070     0.035    556.10    296.80
 0.000089     1349.     1349.     1349.         2         0         0      0.00    223.27    520.08

CCHV=   0.300 CEHV=   0.500
*SECNO 1449.000

3265 DIVIDED FLOW

  1449.00     23.55    579.55      0.00      0.00    579.77      0.22      0.01      0.06    588.50
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```
  10700.       0.   10700.       0.       0.    2830.       0.     128.       9.    585.20
   0.15      0.00     3.78     0.00    0.070    0.035    0.070    0.035   556.00   319.53
0.000265     100.     100.     100.        2        0        0     0.00   146.47   500.00


*SECNO 1450.000

3265 DIVIDED FLOW


3370 NORMAL BRIDGE,NRD=  0 MIN ELTRD=  591.60 MAX ELLC=  585.20

 1450.00    23.55   579.55     0.00     0.00   579.77     0.22     0.00     0.00   588.50
  10700.       0.   10700.       0.       0.    2830.       0.     128.       9.    585.20
   0.15      0.00     3.78     0.00    0.070    0.035    0.070    0.035   556.00   319.53
0.000265       1.       1.       1.        0        0        0     0.00   146.47   500.00


*SECNO 1510.000
23-JAN-81  14:16:31                                                                          PAGE    8

   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


3265 DIVIDED FLOW


3370 NORMAL BRIDGE,NRD=  0 MIN ELTRD=  591.60 MAX ELLC=  585.20

 1510.00    23.57   579.57     0.00     0.00   579.79     0.22     0.02     0.00   588.50
  10700.       0.   10700.       0.       0.    2833.       0.     132.       9.    585.20
   0.15      0.00     3.78     0.00    0.070    0.035    0.070    0.035   556.00   319.52
0.000264      60.      60.      60.        0        0        0     0.00   146.48   500.00


*SECNO 1512.000

3265 DIVIDED FLOW

 1512.00    23.57   579.57     0.00     0.00   579.79     0.22     0.00     0.00   588.50
  10700.       0.   10700.       0.       0.    2833.       0.     132.       9.    585.20
   0.15      0.00     3.78     0.00    0.070    0.035    0.070    0.035   556.00   319.52
0.000264       2.       2.       2.        0        0        0     0.00   146.48   500.00


*SECNO 1662.000
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  1662.00     22.70    579.70      0.00      0.00    579.84      0.14      0.03      0.02    582.20
   10700.        0.    10700.        0.        0.     3556.        0.      143.       10.    581.20
     0.17      0.00      3.01      0.00     0.070     0.035     0.070     0.035    557.00     41.83
 0.000115      150.      150.      150.         2         0         0      0.00    196.37    238.19


CCHV=   0.100 CEHV=   0.300
*SECNO 2231.000
  2231.00     21.13    579.83      0.00      0.00    579.89      0.06      0.05      0.01    581.20
   10700.        0.    10700.        0.        0.     5338.        0.      201.       13.    591.20
     0.25      0.00      2.00      0.00     0.070     0.035     0.070     0.035    558.70     21.41
 0.000059      569.      569.      569.         2         0         0      0.00    340.88    362.29


*SECNO 2881.000
  2881.00     22.89    579.89      0.00      0.00    579.92      0.04      0.03      0.00    581.20
   10700.        0.    10700.        0.        0.     6912.        0.      293.       19.    581.20
     0.36      0.00      1.55      0.00     0.070     0.035     0.070     0.035    557.00     20.76
 0.000032      650.      650.      650.         0         0         0      0.00    407.64    428.40
```



```
   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 3281.000
  3281.00     16.32    579.82      0.00      0.00    579.99      0.17      0.03      0.04    591.20
   10700.        0.    10700.        0.        0.     3190.        0.      339.       22.    591.20
     0.40      0.00      3.35      0.00     0.070     0.035     0.070     0.035    563.50     30.78
 0.000283      400.      400.      400.         2         0         0      0.00    302.88    333.66


*SECNO 3947.000
  3947.00     13.62    579.92      0.00      0.00    580.42      0.50      0.33      0.10    587.30
   10700.        0.    10700.        0.        0.     1885.        0.      378.       26.    587.30
     0.43      0.00      5.68      0.00     0.070     0.035     0.070     0.035    566.30     74.02
 0.001115      666.      666.      666.         0         0         0      0.00    230.26    304.28


*SECNO 4612.000
  4612.00     11.76    580.76      0.00      0.00    581.60      0.83      1.07      0.10    590.00
   10700.        0.    10700.        0.        0.     1460.        0.      403.       30.    590.00
     0.45      0.00      7.33      0.00     0.070     0.035     0.070     0.035    569.00     75.04
 0.002539      665.      665.      665.         2         0         0      0.00    227.05    302.09
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```
CCHV=   0.300 CEHV=   0.500
*SECNO 4762.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      592.10 ELREA=      592.10

  4762.00    16.48   581.48     0.00     0.00   581.91     0.44     0.20     0.12   590.00
   10700.       0.   10700.       0.       0.   2020.       0.     409.      30.   590.00
     0.46     0.00     5.30     0.00    0.070    0.035    0.070    0.035   565.00    15.34
 0.000799     150.     150.     150.        2        0        0     0.00   212.22   227.56


SPECIAL BRIDGE

SB  XK        XKOR      COFQ      RDLEN     BWC       BWP       BAREA     SS        ELCHU     ELCHD
    0.90      1.56      2.60     272.00   185.60      6.00   4430.00      2.00    571.00    571.00

*SECNO 4829.000
CLASS A LOW FLOW

3420 BRIDGE W.S.=    581.45 BRIDGE VELOCITY=,      5.11      CALCULATED CHANNEL AREA=,     2096.
23-JAN-81  14:16:31                                                                          PAGE    10


   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


 EGPRS      EGLWC      H3        QWEIR      QPR       BAREA    TRAPEZOID      ELLC      ELTRD
                                                                  AREA
     0.00   581.93      0.02        0.    10700.     4430.     4032.      589.60    596.10


3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      596.10 ELREA=      596.10

  4829.00    16.49   581.49     0.00     0.00   581.93     0.43     0.01     0.00   590.00
   10700.       0.   10700.       0.       0.   2023.       0.     413.      31.   590.00
     0.47     0.00     5.29     0.00    0.070    0.035    0.070    0.035   565.00    15.31
 0.000795      67.      67.      67.        0        0        0     0.00   212.27   227.58


*SECNO 4859.000
  4859.00    16.38   581.68     0.00     0.00   581.99     0.31     0.02     0.04   590.30
   10700.       0.   10700.       0.       0.   2398.       0.     414.      31.   590.30
     0.47     0.00     4.46     0.00    0.070    0.035    0.070    0.035   565.30    18.63
 0.000568      30.      30.      30.        2        0        0     0.00   254.22   272.84
```

```
CCHV=   0.100 CEHV=   0.300
*SECNO 5159.000
  5159.00      8.67    581.67      0.00      0.00    582.44      0.77      0.31      0.14    592.00
   10700.        0.    10700.        0.        0.     1520.        0.      428.       33.    592.00
     0.48      0.00      7.04      0.00     0.070     0.035     0.070     0.035    573.00     22.32
 0.002470      300.      300.      300.         2         0         0      0.00    246.80    269.12


*SECNO 5183.000
 WATER EL=X5 CARD=   597.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      601.10 ELREA=      601.10

  5183.00     23.00    597.00      0.00      0.00    597.05      0.05      0.00      0.07    585.00
   10700.        0.    10700.        0.        0.     6230.        0.      430.       33.    580.00
     0.48      0.00      1.72      0.00     0.070     0.035     0.035     0.035    574.00    145.00
 0.000031       24.       24.       24.         0         0         0      0.00    320.00    465.00


CCHV=   0.300 CEHV=   0.500
23-JAN-81  14:16:31                                                                          PAGE    11

   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 5383.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      585.80 ELREA=      599.10

  5383.00     22.24    597.04      0.00      0.00    597.06      0.02      0.01      0.01    585.80
   10700.       143.    10557.        0.      380.     8685.        0.      465.       35.    599.10
     0.53      0.38      1.22      0.00     0.070     0.035     0.070     0.035    574.80     84.26
 0.000023       225.      200.      175.         2         0         0      0.00    654.47    738.73


CCHV=   0.300 CEHV=   0.500
*SECNO 5583.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      602.00 ELREA=      602.00

  5583.00     21.43    597.03      0.00      0.00    597.08      0.05      0.01      0.02    586.60
   10700.        0.    10700.        0.        0.     5729.        0.      499.       37.    581.60
     0.56      0.00      1.87      0.00     0.070     0.035     0.035     0.035    575.60    145.00
 0.000042       225.      200.      175.         1         0         0      0.00    320.00    465.00
```

SPECIAL BRIDGE

SB	XK	XKOR	COFQ	RDLFN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
	1.05	1.56	2.50	700.00	245.00	47.60	6065.00	1.58	577.20	577.20

*SECNO 5593.000
CLASS A LOW FLOW

3420 BRIDGE W.S.= 597.00 BRIDGE VELOCITY=, 2.36 CALCULATED CHANNEL AREA=, 4527.

EGPRS	EGLWC	H3	QWEIR	QPR	BAREA	TRAPEZOID AREA	ELLC	ELTRD
0.00	597.09	0.01	0.	10700.	6065.	5081.	599.10	605.30

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA= 599.20 ELREA= 599.20

5593.00	21.44	597.04	0.00	0.00	597.09	0.05	0.01	0.00	586.60
10700.	0.	10700.	0.	0.	5729.	0.	500.	37.	581.60
0.56	0.00	1.87	0.00	0.070	0.035	0.035	0.035	575.60	145.00
0.000042	10.	10.	10.	0	0	0	0.00	320.00	465.00

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 5693.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA= 587.20 ELREA= 600.50

5693.00	20.87	597.07	0.00	0.00	597.10	0.03	0.00	0.01	587.20
10700.	136.	10564.	0.	299.	7884.	0.	516.	39.	600.50
0.58	0.46	1.34	0.00	0.060	0.035	0.060	0.035	576.20	87.61
0.000031	100.	100.	100.	2	0	0	0.00	641.26	728.87

CCHV= 0.100 CEHV= 0.300
*SECNO 6693.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA= 589.20 ELREA= 602.50

6693.00	18.91	597.11	0.00	0.00	597.13	0.01	0.02	0.00	589.20
10700.	94.	10606.	0.	345.	12132.	0.	753.	59.	602.50

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     0.90      0.27      0.87      0.00     0.060     0.035     0.060     0.035    578.20    166.79
 0.000016     1000.     1000.     1000.         0         0         0      0.00   1141.65   1308.44

*SECNO 7653.000
  7653.00     13.82    597.12      0.00      0.00    597.16      0.04      0.03      0.01    600.00
   10700.        0.     10700.       0.        0.     6676.        0.      964.       78.    600.00
     1.07      0.00      1.60      0.00     0.060     0.035     0.060     0.035    583.30      8.60
 0.000053      960.      960.      960.         1         0         0      0.00    565.60    574.20

*SECNO 8013.000
  8013.00     13.08    597.11      0.00      0.00    597.20      0.09      0.03      0.02    590.03
   10700.      699.     9949.       52.      796.     3993.       79.     1013.       83.    590.03
     1.11      0.88      2.49      0.66     0.060     0.035     0.060     0.035    584.03   1681.41
 0.000139      500.      360.      150.         1         0         0      0.00    599.13   2280.54

*SECNO 8480.000
  8480.00     11.37    597.08      0.00      0.00    597.38      0.30      0.12      0.06    591.71
   10700.      513.    10157.       30.      333.     2247.       25.     1053.       88.    591.71
     1.14      1.54      4.52      1.22     0.060     0.035     0.060     0.035    585.71   1147.44
 0.000575      467.      467.      467.         2         0         0      0.00    349.68   1497.11
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   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS    BANK ELEV
   Q         OLOB      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 8714.000
  8714.00     10.60    597.15      0.00      0.00    597.60      0.46      0.17      0.05    592.55
   10700.      429.     10249.       23.      235.     1857.       17.     1066.       90.    592.55
     1.15      1.83      5.52      1.38     0.060     0.035     0.060     0.035    586.55   1043.76
 0.000961      234.      234.      234.         1         0         0      0.00    302.34   1346.09

*SECNO 8831.000
  8831.00      9.85    597.13      0.00      0.00    597.82      0.69      0.14      0.07    593.28
   10700.      345.     10339.       16.      161.     1525.       11.     1071.       90.    593.28
     1.16      2.15      6.78      1.52     0.060     0.035     0.060     0.035    587.28    949.21
 0.001643      117.      117.      117.         2         0         0      0.00    261.17   1210.39

*SECNO 8948.000
  8948.00      9.16    597.16      0.00      0.00    598.14      0.98      0.24      0.09    594.00
   10700.      270.     10430.       10.      113.     1293.        7.     1075.       91.    594.00
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     1.16      2.40      8.06      1.53     0.060     0.035     0.060     0.035    588.00    889.95
 0.002623      117.      117.      117.         2         0         0      0.00    235.02   1124.97


CCHV=   0.300 CEHV=   0.500
*SECNO 9113.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      607.00 ELREA=      607.00

  9113.00      9.27    597.57      0.00      0.00    598.60      1.03      0.43      0.02    594.30
   10700.        0.    10700.        0.        0.    1313.        0.     1080.       92.    594.30
     1.17      0.00      8.15      0.00     0.060     0.035     0.060     0.035    588.30    940.18
 0.002629      165.      165.      165.         2         0         0      0.00    180.61   1120.79


SPECIAL BRIDGE

SB  XK        XKOR      COFQ      RDLEN     BWC       BWP       BAREA     SS        ELCHU     ELCHD
     0.90      1.56      2.90    182.00    140.00     16.00   2080.00      1.54    588.70    588.70

*SECNO 9153.000
CLASS A LOW FLOW

3420 BRIDGE W.S.=    597.20 BRIDGE VELOCITY=,      9.18      CALCULATED CHANNEL AREA=,     1165.
23-JAN-81  14:16:31                                                                          PAGE   14

   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


 EGPRS     EGLWC       H3        QWEIR      QPR       BAREA   TRAPEZOID      ELLC      ELTRD
                                                                 AREA
     0.00    598.81      0.29        0.    10700.     2080.     2309.      604.30    609.30


3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      609.30 ELREA=      609.30

  9153.00      9.56    597.86      0.00      0.00    598.81      0.95      0.21      0.00    594.30
   10700.        0.    10700.        0.        0.    1365.        0.     1082.       92.    594.30
     1.17      0.00      7.84      0.00     0.060     0.035     0.060     0.035    588.30    940.18
 0.002311       40.       40.       40.         0         0         0      0.00    180.61   1120.79


*SECNO 9253.000
  9253.00      9.87    598.27      0.00      0.00    599.07      0.80      0.21      0.05    594.40
```

```
   10700.      348.    10336.       16.      151.     1422.       10.     1085.       93.    594.40
    1.17      2.31      7.27      1.60     0.060     0.035     0.060     0.035    588.40    882.49
 0.001881     100.      100.      100.         2         0         0      0.00    243.19   1125.68


CCHV=   0.100 CEHV=   0.300
*SECNO 15913.000
 WATER EL=X5 CARD=   598.270
 15913.00    16.67   598.27      0.00      0.00    598.63      0.36      1.63      0.04    595.90
   10700.      26.   10674.        0.       34.     2223.        0.     1149.      101.    600.00
    1.26     0.75     4.80      0.00     0.060     0.035     0.060     0.035    581.60   1021.10
 0.000740    1460.    1460.     1460.         0         0         0      0.00    285.63   1306.73


*SECNO 18163.000
 18163.00    18.05   599.65      0.00      0.00    599.92      0.26      1.28      0.01    595.90
   10700.      69.   10631.        0.       86.     2579.        0.     1276.      117.    600.00
    1.41     0.80     4.12      0.00     0.060     0.035     0.060     0.035    581.60   1004.22
 0.000451    2250.    2250.     2250.         3         0         0      0.00    303.53   1307.75


CCHV=   0.300 CEHV=   0.500
*SECNO 18313.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=      608.00 ELREA=      608.00

23-JAN-81  14:16:31                                                                          PAGE   15

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


 18313.00    20.87   599.87      0.00      0.00    600.00      0.13      0.04      0.04    599.20
   10700.       0.   10700.        0.        0.     3694.        0.     1287.      118.    600.00
    1.42     0.00     2.90      0.00     0.060     0.035     0.060     0.035    579.00   1170.00
 0.000171     150.     150.      150.         2         0         0      0.00    304.66   1474.66


SPECIAL BRIDGE

SB  XK        XKOR      COFQ      RDLEN     BWC       BWP       BAREA     SS        ELCHU     ELCHD
     0.90      1.56      2.20    240.00    140.00     12.00   3990.00      2.38    583.50    583.50

*SECNO 18348.000
CLASS A LOW FLOW

3420 BRIDGE W.S.=     599.83 BRIDGE VELOCITY=,       3.93      CALCULATED CHANNEL AREA=,      2726.
```

EGPRS	EGLWC	H3	QWEIR	QPR	BAREA	TRAPEZOID AREA	ELLC	ELTRD
0.00	600.00	0.01	0.	10700.	3990.	4085.	606.00	609.30

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA= 609.30 ELREA= 609.30

18348.00	20.87	599.87	0.00	0.00	600.00	0.13	0.01	0.00	599.20
10700.	0.	10700.	0.	0.	3696.	0.	1290.	118.	600.00
1.43	0.00	2.89	0.00	0.060	0.035	0.060	0.035	579.00	1170.00
0.000171	35.	35.	35.	0	0	0	0.00	304.68	1474.68

*SECNO 18508.000

18508.00	18.33	599.83	0.00	0.00	600.12	0.29	0.04	0.08	600.00
10700.	0.	10700.	0.	0.	2455.	0.	1302.	119.	600.00
1.44	0.00	4.36	0.00	0.060	0.035	0.060	0.035	581.50	1000.36
0.000342	160.	160.	160.	2	0	0	0.00	179.53	1179.89

CCHV= 0.100 CEHV= 0.300

*SECNO 22508.000

22508.00	19.42	600.92	0.00	0.00	601.17	0.25	1.05	0.00	600.00
10700.	20.	10679.	0.	85.	2653.	0.	1510.	141.	600.00
1.68	0.24	4.03	0.19	0.060	0.035	0.060	0.035	581.50	815.39
0.000265	~~3500.~~ 4000	~~3500.~~ 4000	~~3500.~~ 4000	2	0	0	0.00	365.53	1180.92

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

*SECNO 25508.000

25508.00	10.66	602.06	0.00	0.00	602.25	0.19	1.07	0.01	611.30
10700.	0.	10686.	14.	0.	3065.	19.	1744.	169.	598.00
1.96	0.00	3.49	0.71	0.060	0.035	0.060	0.035	591.40	1155.44
0.000358	~~3500.~~ 3000	~~3500.~~ 3	3500. 3000	2	0	0	0.00	345.16	1500.59

*SECNO 26508.000

26508.00	9.66	602.46	0.00	0.00	602.70	0.24	0.43	0.01	612.70
10700.	0.	10692.	8.	0.	2728.	11.	1811.	177.	599.40
2.03	0.00	3.92	0.71	0.060	0.035	0.060	0.035	592.80	1156.47
0.000526	1000.	1000.	1000.	2	0	0	0.00	341.76	1498.22

00BREAK00

1) COUNTY: Alpena

2) STUDY NAME: Alpena City/Twp

3) WATERCOURSE: Thunder Bay River

4) DOCUMENT TYPE: Report

00BREAK00

HYDRAULIC SUMMARY REPORT

CITY OF ALPENA, ALPENA COUNTY, MICHIGAN
ALPENA TOWNSHIP, ALPENA COUNTY, MICHIGAN

RECEIVED
NOV 06 1980
WATER MANAGEMENT

Prepared by
Bernard Johnson Incorporated
for the
U.S. Army Corps of Enginers,
Detroit District

November 1980

TABLE OF CONTENTS

1.0 INTRODUCTION

2.0 HYDRAULIC ANALYSES

2.1 General Methodology

2.2 Specific Considerations

3.0 REFERENCES

TABLES

Table 1 - Summary of Discharges

Table 2 - Summary of Elevations

EXHIBITS

Exhibit 1 - Detailed Description of Thunder Bay River

Exhibit 2 - Detailed Description of Fletcher Creek

Exhibit 3 - Detailed Description of McLary Creek

Exhibit 4 - Computations for Long Lake Analysis

Exhibit 5 - Approximate Study Computations

Exhibit 6 - Cross Section Locater Maps and Profile Plots

1.0 INTRODUCTION

This report summarizes the methods and computations used to develop peak flood elevations for two communities; City of Alpena, Alpena County, Michigan and Alpena Township, Alpena County, Michigan. The computed elevations will be used for the preparation of a Type-15 Flood Insurance Report for each community. The results will be finalized upon review and approval from the U.S. Army Corps of Engineers, Detroit District (COE) and the Michigan Department of Natural Resources (DNR).

The flooding sources and their study limits analyzed in this report are outlined below:

- Thunder Bay - Detailed study along shoreline in Alpena and Alpena Township
- Thunder Bay River - Detailed study from its mouth with Thunder Bay to the Alpena city limits (Bagley Street); limited detail study from the Alpena city limits to the west line of section 17 (USGS quad) in Alpena Township; and approximate study from west line of Section 17 to Four Mile Dam
- Fletcher Creek - Detailed study from its mouth with Thunder Bay River to the northern Alpena city limits
- Woodward Creek - Approximate study from its confluence with Thunder Bay River to U.S. Highway 23
- Mud Lake -Detailed Study
- Mud Creek (South outlet of Mud Lake) - Detailed study from Mud Lake to Werth road
- Unnamed Drain between Mud Lake and Thunder Bay - Limited detail analysis from Mud Lake to Bagley Street; approximate study from Bagley Street to Thunder Bay River
- McLary Creek - Detailed Study from Mud Lake to Tamrack Road; approximate study from Tamrack Road to Alpena Township limits
- Long Lake - Detailed Study

No calcs to speak of

No calcs

Cross section and bridge geometry for the detailed hydraulic analyses were obtained from existing bridge plans and field surveys taken during late July and early August 1980. In some instances, additional overbank points were obtained from USGS 7.5 minute quads (Reference 1).

Discharges used for the analyses were developed by Bernard Johnson Incorporated (BJI) for the COE (Reference 2). The discharges are presently being reviewed and finalized by the COE and DNR. The discharges used are summarized in Table 1, "Summary of Discharges."

the value computed and used for this report. No detailed back-up calculations were available from FERC, therefore, it was concluded that the capacity computed for this report is valid for the purposes of the Flood Insurance Program.

A hydraulic analysis of the Thunder Bay River was done by R. S. Scott and Associates of Alpena as part of the design for the Bagley Street bridge. The elevations computed were about 2-3 feet higher than those proposed in this report. However, no detailed calculations were available and the detailed analysis presented in this report is considered to be accurate for Flood Insurance purposes.

A detailed explaination of the HEC-2 model, including loss coefficients, bridge notes and sketches, and cross section plots, for the Thunder Bay River is shown in Exhibit 1.

Fletcher Creek

Due to the unusual nature of the culverts at Long Rapids Road, losses through the culvert were estimated using the procedures and nomographs developed by the Federal Highway Administration (Reference 8). Detailed calculations along with a description of the HEC-2 model are shown in Exhibit 2.

Mud Lake, Mud Creek and Unnamed Drain

An analysis of these flooding sources was included in the supplement to the Hydrologic Summary Report prepared by BJI (Reference 2). A Soil Conservation Service (SCS) TR-20 computer routing (Reference 9) was used to determine peak elevations for Mud Lake. HEC-2 computer runs of Mud Creek indicated the elevations on the lake will control the elevotions of Mud Creek down to Werth Road. From a thorough analysis of the Unnamed Drain, it was concluded that the area acts as a ponded sump area and it was recommended that the area be designated as a shallow flooding Zone AH with a constant water-surface elevation. The peak elevations for the area are summarized in Table 2.

McLary Creek

A detailed description of the HEC-2 model is included in Exhibit 3. ?

Long Lake

The SCS TR-20 computer program (Reference 9) was used to determine peak flood elevotions for Long Lake. Curve Numbers (CN) were developed based upon the procedures outlined in the SCS National Engineering Handbook (Reference 10). Time of concentrations (Tc) were developed using the method recommended by the DNR (Reference 11). Detailed calculations are included as Exhibit 4. The peak elevations are summarized in Table 2.

?

Contraction and expansion coefficients and bridge loss coefficients were developed based upon recommendations of the COE (Reference 3). Detailed explanations of loss coefficients is included in the exhibits.

2.2 Specific Considerations

Thunder Bay

As discussed in the supplement to our hydrologic summary report, various organizations and individuals have been contacted in order to locate stage records and high water information for the bay. Since no records have been found, the open-coast elevations of Lake Huron will be used for Thunder Bay (Reference 5). The proposed peak elevation-frequency relationships are summarized in Table 2, "Summary of Elevations."

TABLE 2 - SUMMARY OF ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION ABOVE NGVD (feet) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
THUNDER BAY Entire Shoreline	582.3	583.2	583.5	584.1
MUD LAKE Entire Shoreline	615.5	616.5	616.6	617.1
LONG LAKE Entire Shoreline	651.4	651.7 ~~651.5~~	651.8 ~~651.6~~	651.9 ~~651.7~~

Thunder Bay River

For the Ninth Street Dam, a rating curve was developed using equations developed by the Bureau of Reclamation (Reference 6). The Alpena Power Company, operators of the dam, maintain a constant pool elevation (597.0 NGVD) upstream of the dam. The analysis indicates that at the normal pool elevation with all seven gates open, the capacity of the dam exceeds the peak discharges except for the 500-year flood. Detailed calculations for the Ninth Street Dam are included in Exhibit 1.

In order to estimate losses through Lake Besser, two cross sections were developed through the lake from USGS topographic maps. The cross sections were entered into the computer model in order to represent the low velocities and large increase in area through the lake.

The discharge capacity computed for the Ninth Street Dam was compared with values obtained from the Federal Energy Regulatory Commission (FERC) (Reference 7). The capacity on record at FERC was slightly less than

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
THUNDER BAY RIVER					
At Ninth Street Dam	1,260	6,548	9,262	10,700	13,800
At Four Mile Dam	1,245	*	*	10,300	*
FLETCHER CREEK					
At Long Rapids Road	3.4	110	160	190	250
McLARY CREEK					
At mouth	7.1	180	260	300	390
MUD CREEK					
At Werth Road	15.5	50[1]	148[1]	176[1]	320[1]
UNNAMED CREEK					
At mouth of Mud Lake (Flow into Lake)	0.32	21	*	72	* approx
At confluence with Thunder Bay River	0.55	*	*	107	* approx
WOODWARD CREEK					
At mouth	4.7	*	*	250	* approx

*Not required for Flood Insurance Study
[1]Affected by storage from Mud Lake

2.0 HYDRAULIC ANALYSES

2.1 General Methodology

For streams studied by detailed methods, the COE HEC-2 step-backwater computer model (Reference 3) was used to develop streom profiles. Roughness coefficients (Manning's "n" values) were developed from field investigations based upon engineering judgement aided by standard hydraulic references (Reference 4). The range of values are summarized below:

Flooding Source	Manning's "n" Values Channel	Overbanks
Thunder Bay River	0.035	0.06 - 0.07
Fletcher Creek	0.045	0.07
McClary Creek	0.060	0.10
Mud Creek	0.060	0.10

Approximate Study Areas

For the Thunder Bay River, peak elevations for the approximate reach were determined by extending the HEC-2 run for the detailed study area. A cross section just downstream of Four Mile Dam was interpolated using surveys downstream and USGS quad maps.

For McLary Creek and Woodward Creek, elevations were determined using normal depth calculations. Cross sections for Woodward Creek were developed from rechannelization plans and USGS quad maps. Cross sections for McLary Creek were developed from surveys downstream and quad maps. Calculations are included as Exhibit 5.

For all streams studied in detail, maps showing the location of cross sections and profile plots are included as Exhibit 6.

3.0 REFERENCES

1. U.S. Geological Survey, 7.5-Minute Quad Maps, Scale 1"=2000', Contour Interval 10 feet: Alpena, Lake Winyah, Long Lake East, and Long Lake West, Michigan.

2. Bernard Johnson Incorporated, Hydrologic Summary Report, July and October, 1980.

3. U.S. Army Corps of Engineers, Generalized Computer Program, "HEC-2 Water-Surface Profiles," Users Manual, Hydrologic Engineering Center, Davis, California, August 1979.

4. Chow, Ven Te, Open-Channel Hydraulics, McGraw-Hill Book Company, New York, 1959.

5. U.S. Army Corps of Engineers, "Report on Great Lake Open-Coast Flood Levels," Detroit, Michigan, February 1977.

6. U.S. Department of Interior, Bureau of Reclamation, Design of Small Dams, Second Edition, Revised Reprint, Washington, D.C., 1974.

7. Letter received from Federal Energy Regulation Commission, Chicago Regional Office, dated June 19, 1980.

8. U.S. Department of Transportation, Federal Highway Administration, Hydraulic Engineering Circular No. 5, "Hydraulic Charts for the Selection of Highway Culverts," December 1965.

9. U.S. Department of Agriculture, Soil Conservation Service, Technical Release No. 20, "Computer Program for Project Formulation Hydrology," May 1965.

10. U.S. Department of Agriculture, Soil Conservation Service, National Engineering Handbook, Section 4, "Hydrology", 1972.

11. Michigan Department of Natural Resources, "SCS Methodology" prepared by Richard C. Sorrell, Bureau of Land and Water Management, Hydrologic Engineering Section, May 1977.

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DESIGN NOTES AND COMPUTATIONS

SUBJECT

JOB NUMBER

Exhibit 5

Hydraulics for Approximate Stages

original submittal

PREPARED BY | DATE | CHECKED BY | SHEET NO | OF

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DESIGN NOTES AND COMPUTATIONS

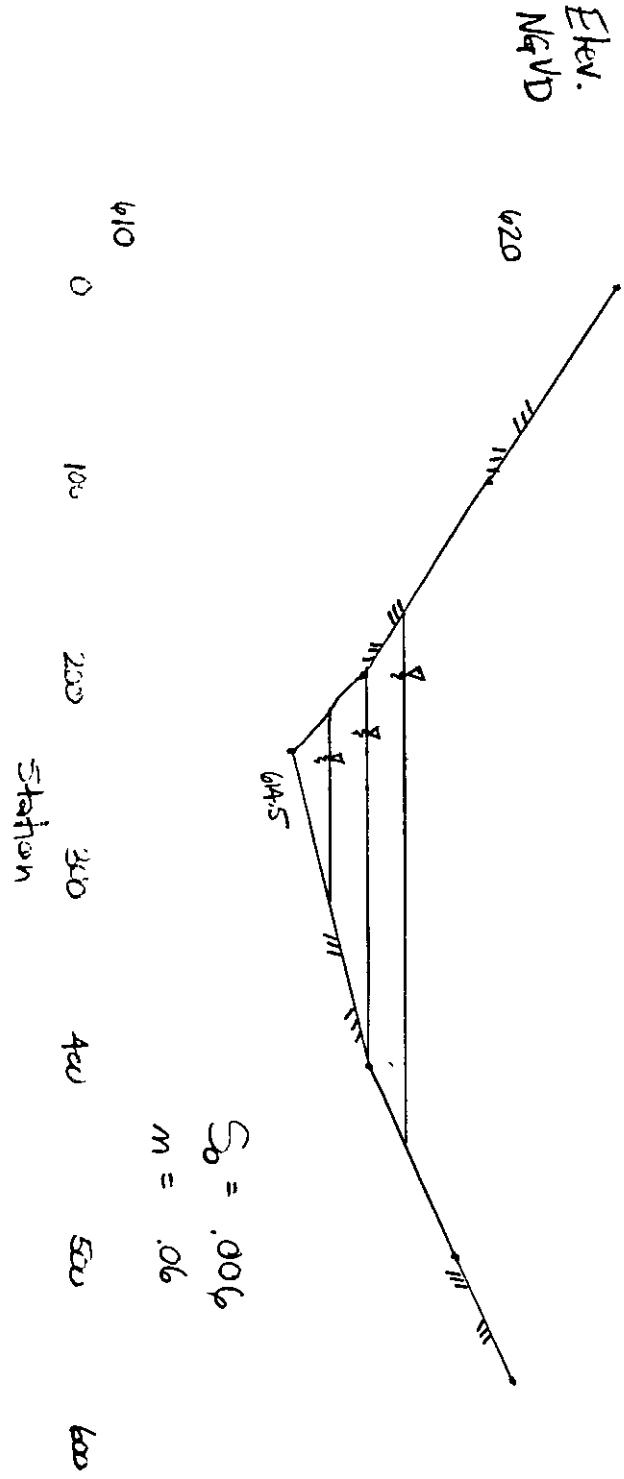
SUBJECT

Cross Section 50' west of Bagley Road at Unnamed Trib

JOB NUMBER

looking downstream

Assume surveyed cross section 50' upstream of Bagley Road on Unnamed Tributary to Lake Besser is the same just downstream



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DESIGN NOTES AND COMPUTATIONS

SUBJECT

JOB NUMBER

Normal depth calculations

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

Elev	depth	Area	WP	Q
617.5	3	405	270	1020
616.5	2	200	200	385
615.5	1	48	97	58

Depth between 1 and 2 feet 100 year

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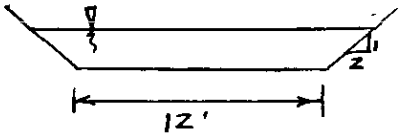
DESIGN NOTES AND COMPUTATIONS

SUBJECT: Woodward Creek Approx.

JOB NUMBER

Section 1



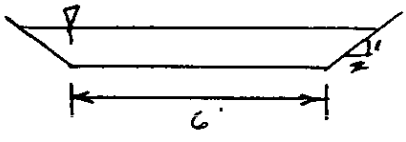
$S_o = .0023$
$n = .04$

$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$

Assume normal depth
ie $S_o = S_f$

Y	Q cfs
2	75
3	160
3.5	213
3.7	237
4.0	276
4.1	289 ← Y_{100}
5.0	426
8.0	1121

Section 2



$S_o = .006$
$n = .04$

Y	Q(cfs)
2	70
3	156
4	285 ← Y_{100}
5	460

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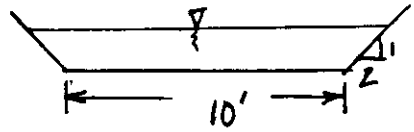
DESIGN NOTES AND COMPUTATIONS

SUBJECT: Woodward Creek

JOB NUMBER

Section 3

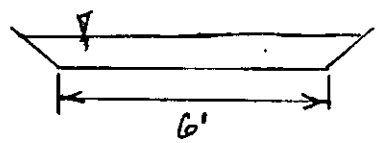


$S_o = .001$

$n = .04$

Y	Q
2	42
4	160
5	250
5.1	260
5.2	270
5.3	282 ← Y100
5.4	292

Section 4



$S_o = .004$

$n = .04$

Y	Q
2	57
4	232
4.2	258
4.3	272
4.4	285 ← Y100
5	376
8	1081

PREPARED BY DP DATE CHECKED BY HJK SHEET NO. 4 OF

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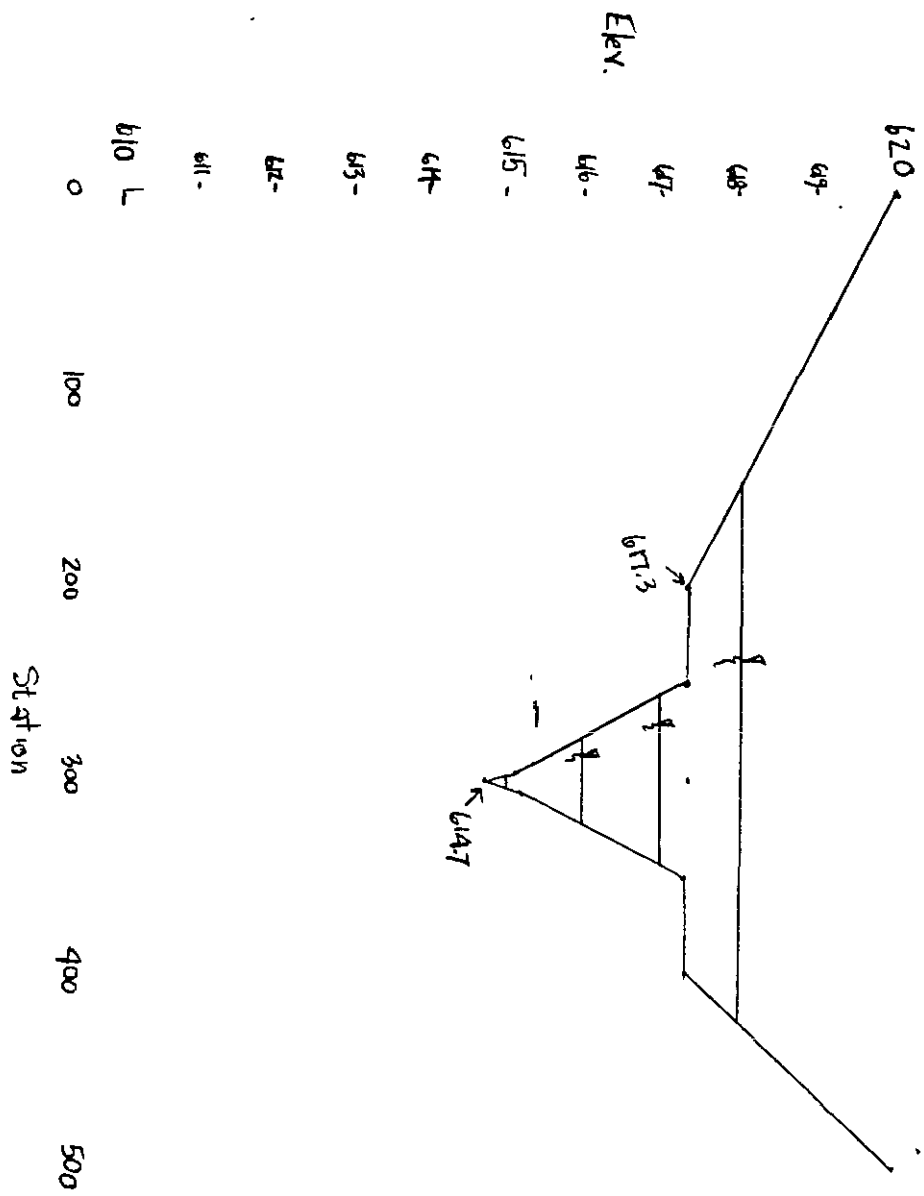
DESIGN NOTES AND COMPUTATIONS

SUBJECT: McLary Creek (Approx) U.S. of Tammrack Rd

JOB NUMBER



20 +00

PREPARED BY DP DATE 4/9 CHECKED BY MJW SHEET NO. 5 OF

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DESIGN NOTES AND COMPUTATIONS

SUBJECT:

JOB NUMBER

Assume normal depth ie. slope of water surface is the same as the ground slope

$S = \frac{2.3}{1200} = .0019 \quad n = .06$

Mannings Eqn $Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$

Elev	Depth	A	WP	R	Q
615.0	0.3	1.5	10	.15	.45 cfs
616.0	1.3	32.3	44	.73	28
617.0	2.3	102.4	89	1.15	121
618.0	3.3	298	275	1.08	339

$Q_{100} = 300$

PREPARED BY DP DATE CHECKED BY NJK SHEET NO. 6 OF

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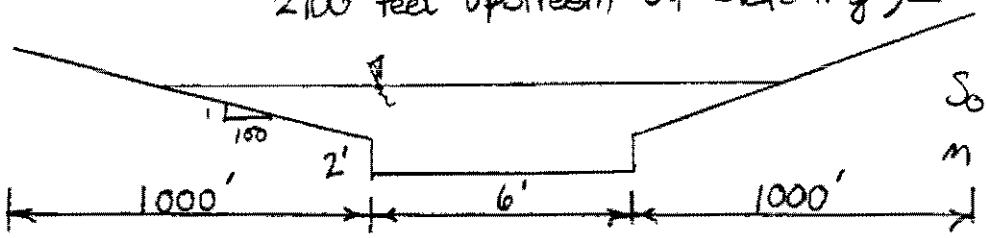
DESIGN NOTES AND COMPUTATIONS

SUBJECT
McLary Creek (App)

JOB NUMBER

Section 2

Assume this section 2100 feet upstream of State Hwy 32



$S_o = .005$
$n = .06$

$A = 6(h)$
$WP = 6 + 2h$

h	A	$R^{2/3}$	Q cfs
1	6	.82	8.70
2	12	1.13	23.00
3	112	.657	129.30
4	412	1.019	737.83

PREPARED BY DP DATE CHECKED BY NH SHEET NO. 7 OF

BERNARD JOHNSON INCORPORATED
2021 K Street, N.W. Washington, D.C. 20006 202/862-8600
ENGINEERS ARCHITECTS PLANNERS

COMPUTATION SHEET

PROJECT Alpena FIS Thunder Bay River

ITEM Revisions to hydraulics

SHEET NO. ___ OF ___ SHEETS

DATE 3 APRIL 1981

FILE

COMPUTED BY RAMellh CHECKED BY

REF. DRWG. NO.

RECEIVED APR 13 1981 WATER MANAGEMENT

Thunder Bay River

1.) Sections were added in the area between Secno 7653 and Secno 8714 and the model was adjusted to better represent actual conditions in this reach.

2.) The reach between Secno 14453 and 17813 has been changed. A constant elevation was assumed through the meander area.

3.) Alpena Power Company's policy is to maintain a certain water surface elevation on the impoundment. When a flood event occurs and the impoundment is full to the specified elevation, all incoming flow is discharged. The impoundment is usually full in March and April when the majority of annual peak floods occur. The statement you suggested will be added to the study reports and profiles.

4.) In addition to problem areas mentioned in your comments, numerous minor improvements were made to the model. In general changes included invert adjustments to match available data, cross section locations, additional sections, overbank geometry and bridge area corrections.

NCE Form 6
22 Aug 77

JOHNSON
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DESIGN NOTES AND COMPUTATIONS

SUBJECT
Thunder Bay River Revisions

JOB NUMBER

1. Cross section 1381 (B) was moved downstream to station 1349.

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APR 13 1981
WATER MANAGEMENT

2. Left bank, right bank, and channel distances at the bend between cross sections 7653 and 8013 were adjusted.

3. Bagley Street is skewed to the ℄ of Thunder Bay River. This is why the length of the bridge is wider than the adjacent top widths. An effective trapazoidal approximation has replaced the original one in the computer model. The topography near the bridge also shows a narrowing of the channel just upstream of the bridge.

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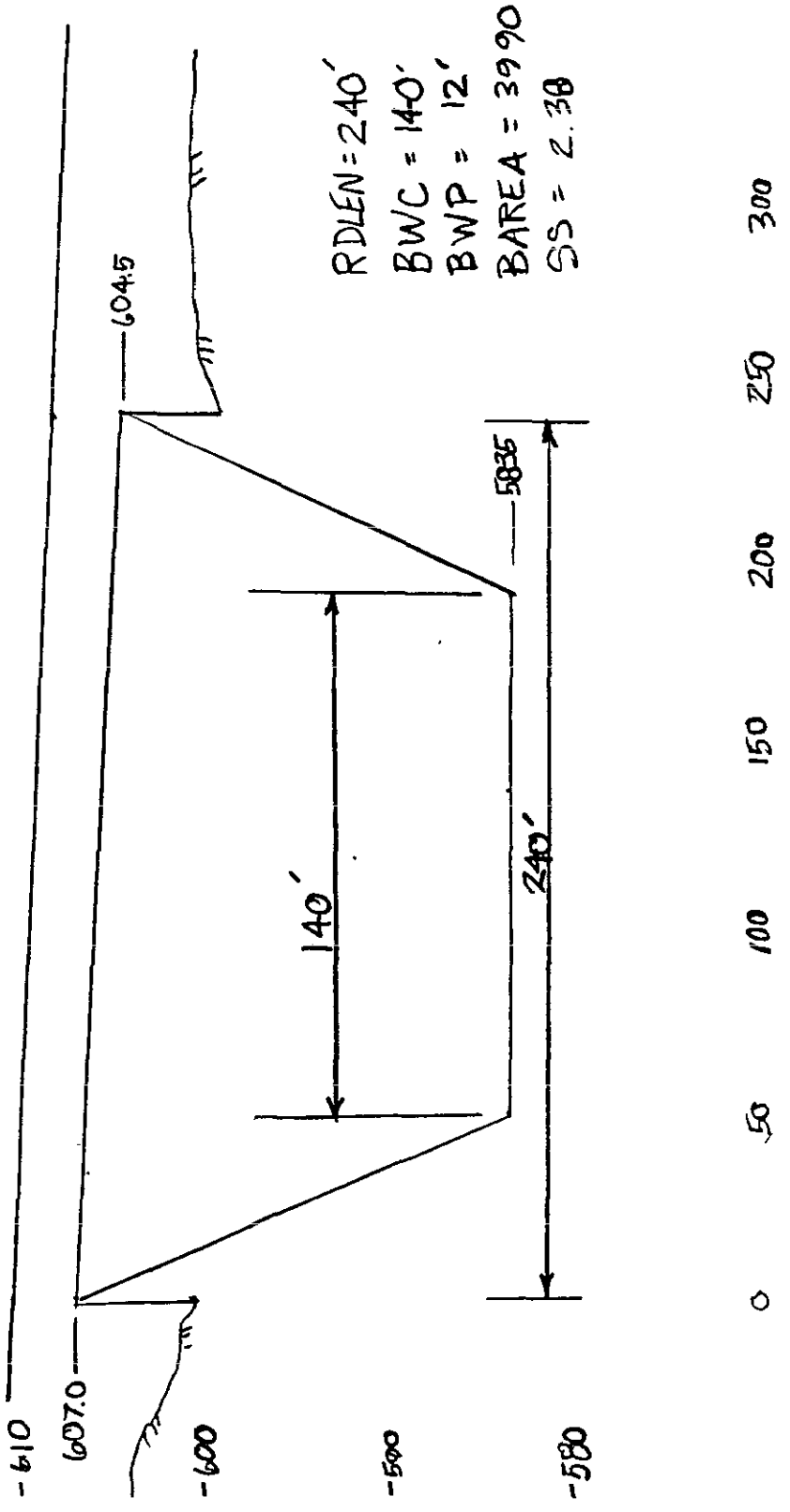
CONSULTING ENGINEERS PLANNERS

DESIGN NOTES AND COMPUTATIONS

SUBJECT

JOB NUMBER

Bagley Street : New trapezoidal Approximation, Effective Area Used because bridge is skewed



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GENERAL TELEPHONE CO. OF MICHIGAN
040 U.S. 23 NORTH
LPENA, MICHIGAN 49707

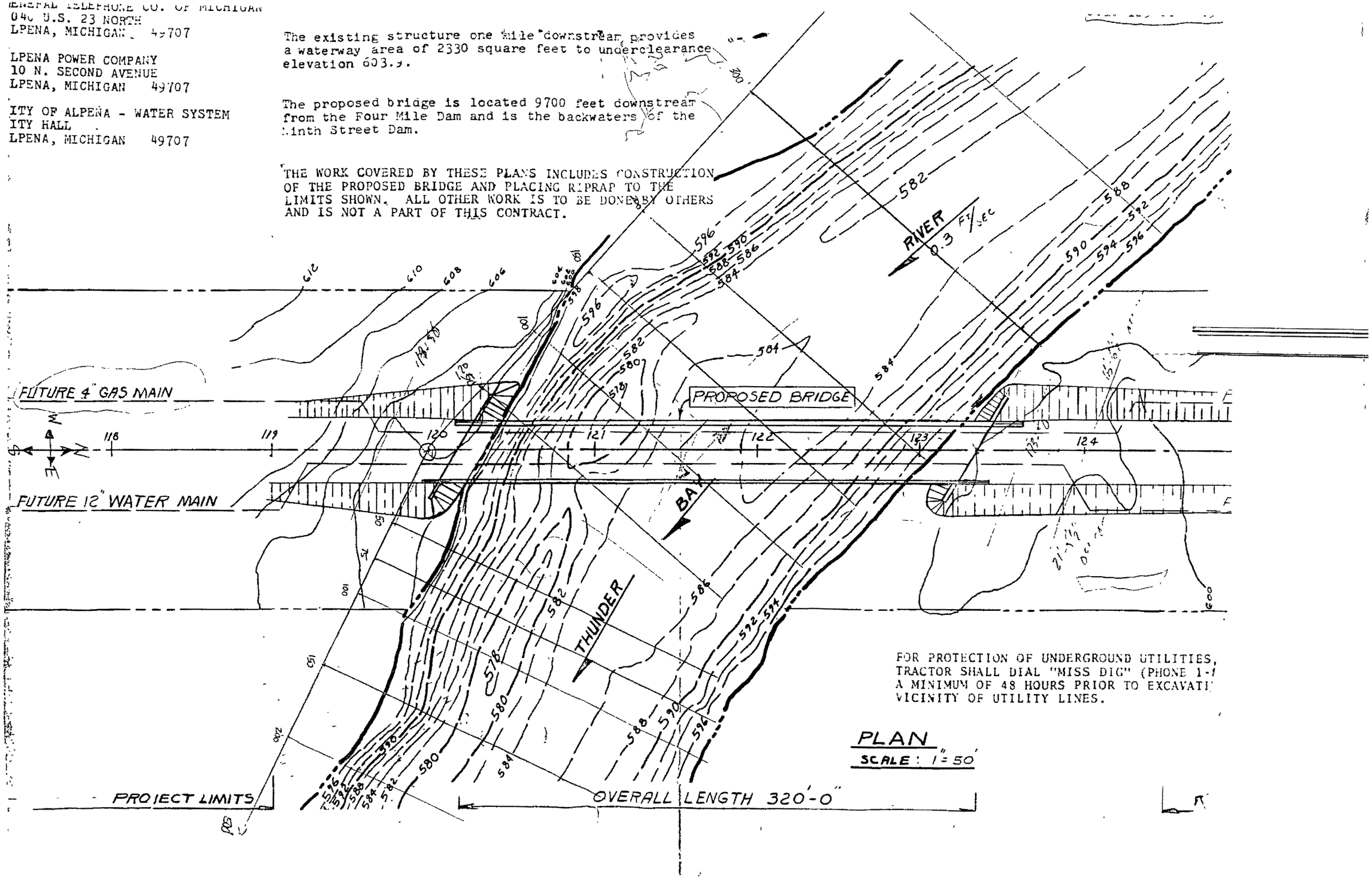
LPENA POWER COMPANY
10 N. SECOND AVENUE
LPENA, MICHIGAN 49707

ITY OF ALPENA - WATER SYSTEM
ITY HALL
LPENA, MICHIGAN 49707

The existing structure one mile downstream provides a waterway area of 2330 square feet to underclearance elevation 603.9.

The proposed bridge is located 9700 feet downstream from the Four Mile Dam and is the backwaters of the Ninth Street Dam.

THE WORK COVERED BY THESE PLANS INCLUDES CONSTRUCTION OF THE PROPOSED BRIDGE AND PLACING RIPRAP TO THE LIMITS SHOWN. ALL OTHER WORK IS TO BE DONE BY OTHERS AND IS NOT A PART OF THIS CONTRACT.



FOR PROTECTION OF UNDERGROUND UTILITIES, TRACTOR SHALL DIAL "MISS DIG" (PHONE 1-
A MINIMUM OF 48 HOURS PRIOR TO EXCAVATI
VICINITY OF UTILITY LINES.

JOHNSON ENGINEERS ARCHITECTS PLANNERS

DESIGN NOTES AND COMPUTATIONS

SUBJECT

JOB NUMBER

Exhibit 1

Thunder Bay River

Description of HECII Model

Caution: Accompanied original submittal; changes in comps and assumptions may have occurred.

⇒ New hydraulic appendix w/ revisions ⇒ attached (dated 4/13/81)

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DESIGN NOTES AND COMPUTATIONS

SUBJECT: HEC2 Description: T-Bay River

JOB NUMBER

The average slope used to move cross sections between Thunder Bay and Chisholm Street is .004.

Cross Sector 0

Surveyed cross section 1350 moved 1350 feet downstream and lowerd 5.4 feet.

Starting water surface for all four discharges was 580.0 (NGVD) This is the approximate mean lake elevation as shown on the Alpena, Michigan quatrangle map. and publisted by COE.

Cross Section 1350

Actual field surveyed cross section located 100 feet downstream of 2nd Street Bridge

Cross Section 1450

Surveyed section 1350 moved 100 feet upstream and raised .4 foot located just down stream of 2nd St. Bridge. Over banks non-effective

2nd Street Bridge (see drawing) Special Bridge

Pier shape (K) = .9 semicircular nose and tail
Width of piers = 34 feet
Bottom width = 170 (from drawing)

Class A Low Flow for all discharges.
Bridge opening estimated by cross section 1450.

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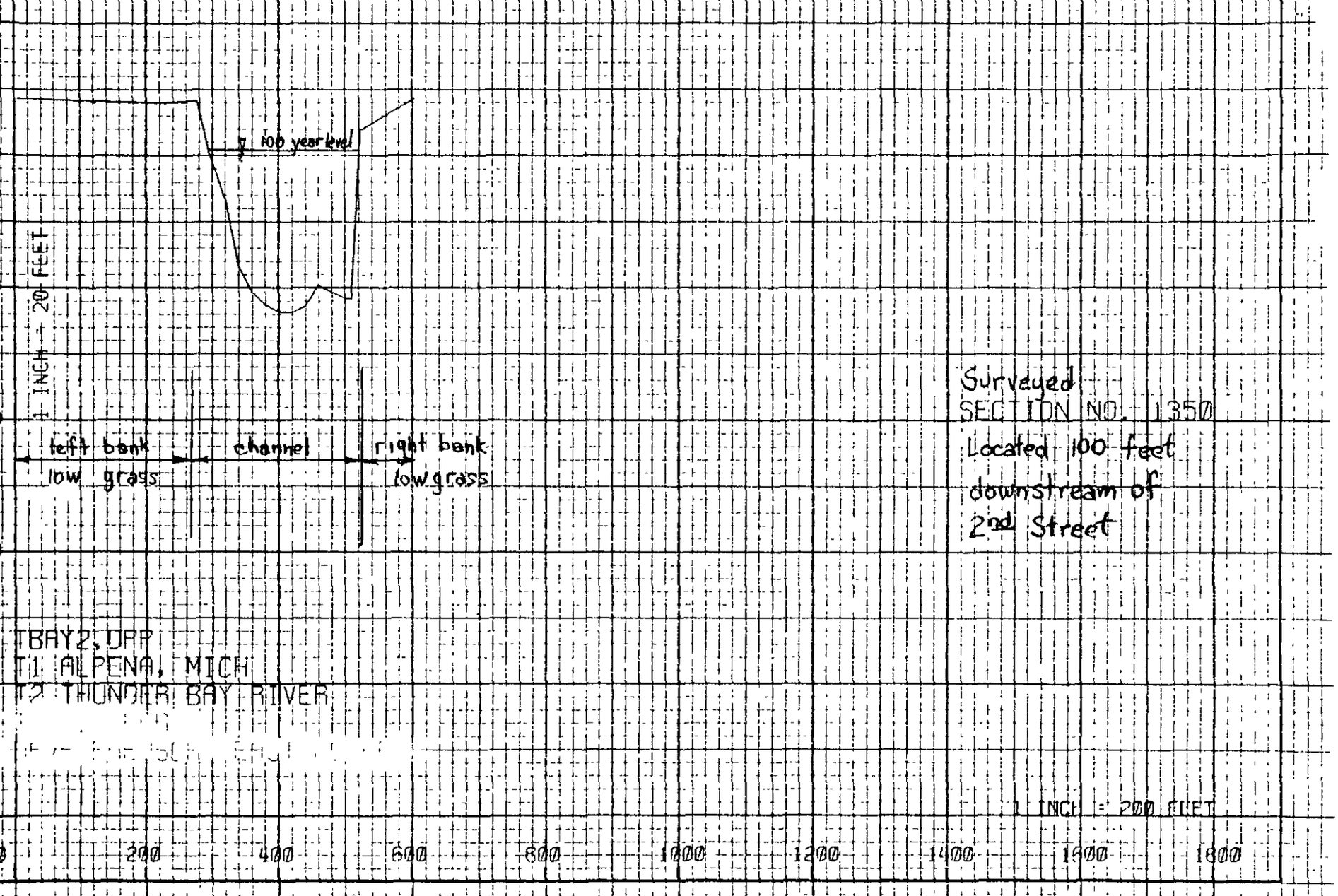

Surveyed
SECTION NO. 1350
Located 100 feet
downstream of
2nd Street

TBAY2, DAP
T1 ALPENA, MICH
T2 THUNDER BAY RIVER

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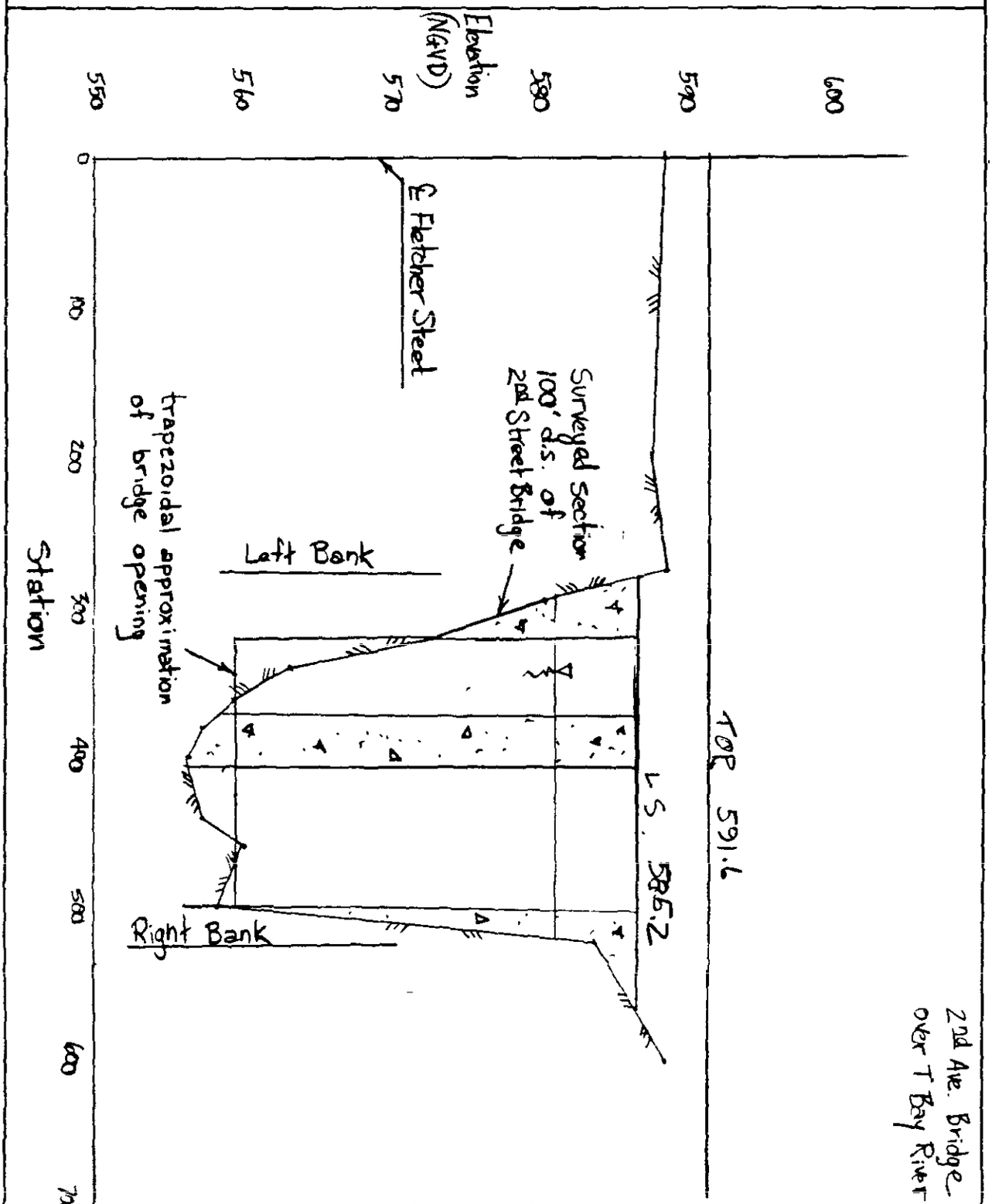
ENGINEERS
ARCHITECTS
PLANNERS

DESIGN NOTES AND COMPUTATIONS

SUBJECT:

JOB NUMBER



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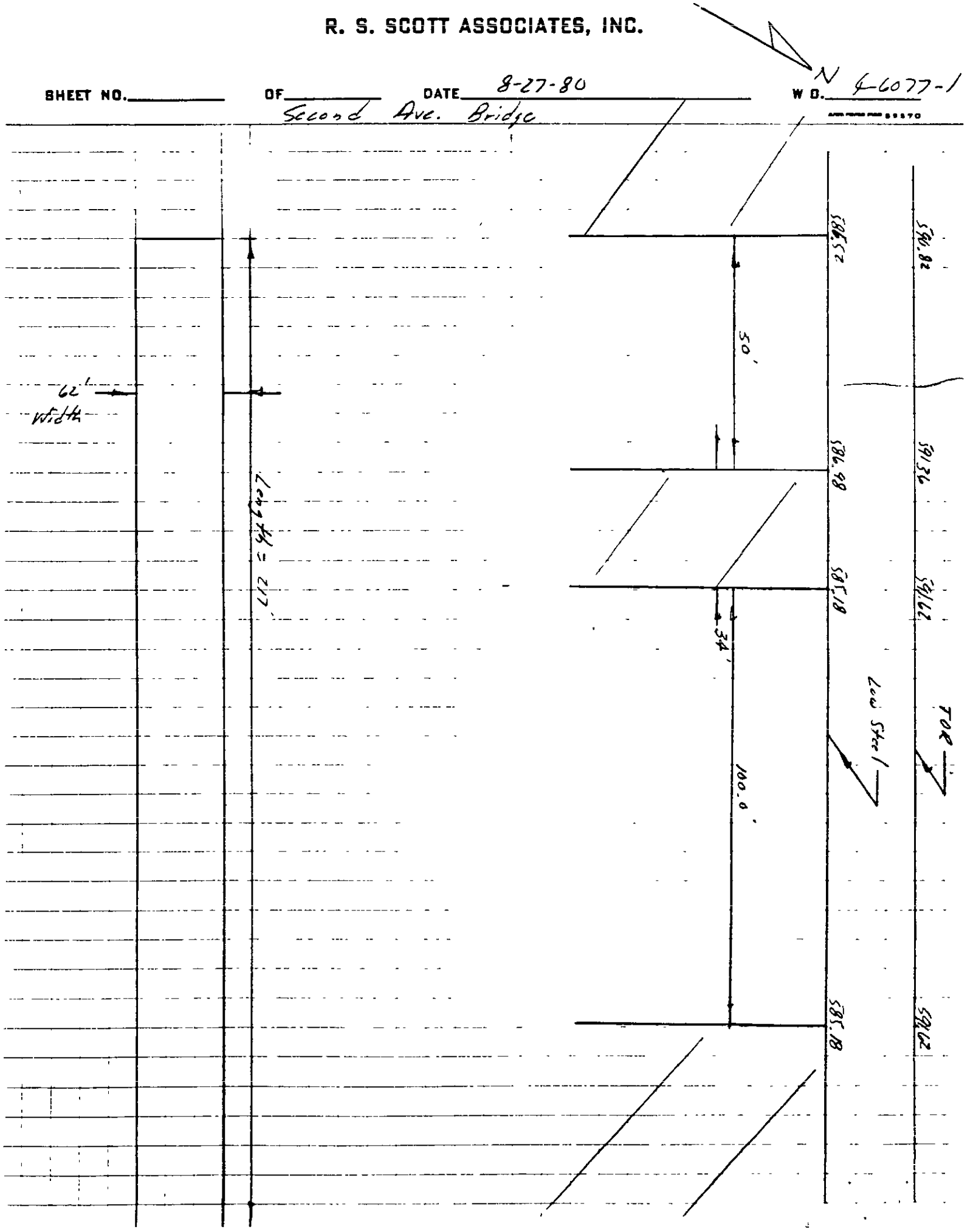
Second Ave. Bridge



JOHNSON, ENGINEERS ARCHITECTS PLANNERS

DESIGN NOTES AND COMPUTATIONS

SUBJECT

JOB NUMBER

Cross Section 1512

Surveyed section 1350 moved 162 feet upstream. Located just upstream of 2nd Street Bridge.
Overbank areas non-effective.

Cross Section 1612

Surveyed section 1350 moved 262 feet upstream. and raised .8 foot Located 100 feet upstream of 2nd Street Bridge.

Cross Section 2612 and 3612

Survey section 1350 moved 1262 and 2262 feet upstream and raised 4.6 and 8.8 feet, respectively.

Cross Section 4612

Actual field surveyed cross section taken from topographic information developed for the Ninth Street Bridge during July of 1970.
Located 150 feet downstream of 9th Street.

Cross section 4762

Surveyed section 4612 moved 150 feet upstream and raised .60 feet. Section reduced to 83% of it original width to account for the narrowing of the river. Located just downstream of 9th Street.
Overbank areas assumed non-effective.

9th Street Bridge (see drawing)

Special Bridge

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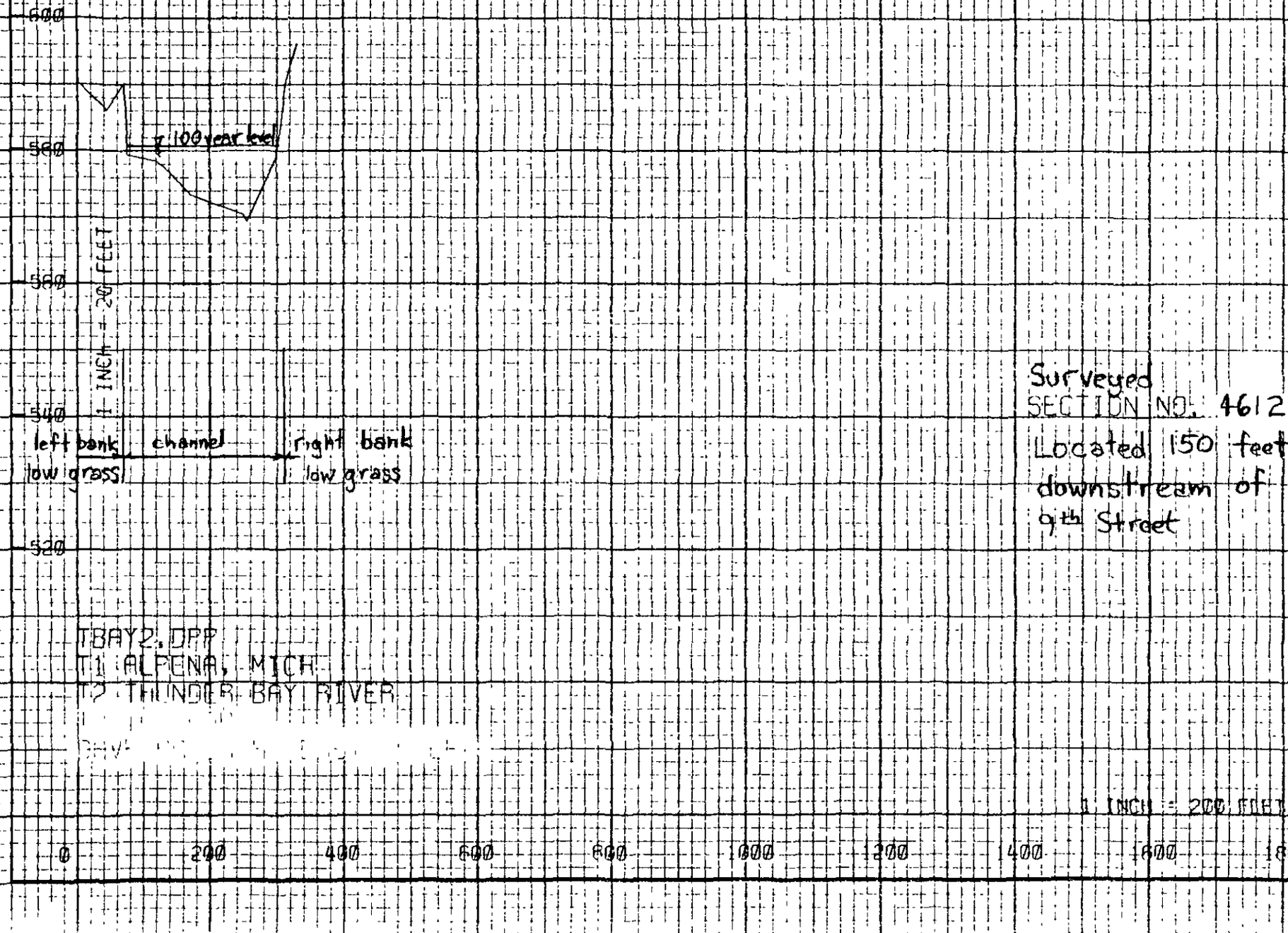


Surveyed
SECTION NO. 4612
Located 150 feet
downstream of
9th Street

TBAY2.DPP
T1 ALPENA, MICH
T2 THUNDER BAY RIVER

DESIGN NOTES AND COMPUTATIONS

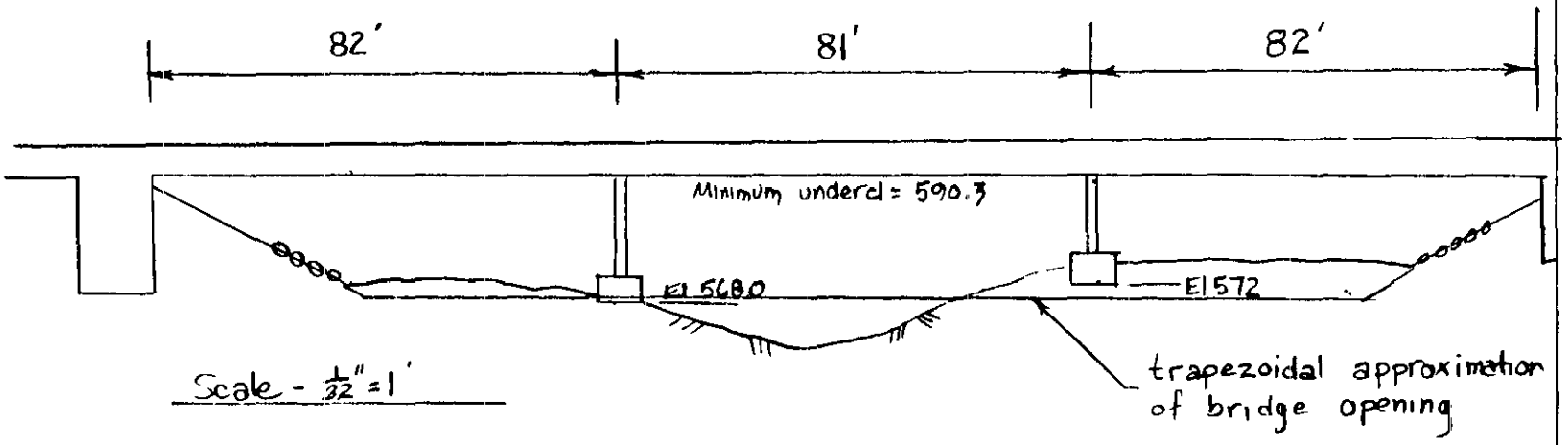
JOB NUMBER

SUBJECT

9th Street Bridge

taken from bridge plans April, 1971 R.S. Scott Eng Co. as designers

Used for bridge geometry only, cross sections upstream and downstream taken from topo developed at bridge site



Scale - $\frac{1}{32}$" = 1'

Pier shape coeff = .9 semicircular nose and tail

Width of piers = 6'

bottom width = 185'

side slopes = 2/1

Class A Low Flow for all discharges

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DESIGN NOTES AND COMPUTATIONS

SUBJECT

JOB NUMBER

Cross Section 4829

Surveyed section 4612 moved 217 feet upstream and raised .6 foot Section reduced to 83% of original length.

Located just upstream of 9th Street

Overbanks non-effective

Cross section 4859

Surveyed section 4612 moved 247 feet upstream and raised .9 foot Cross section widened back to original width by increasing length of cross section 4829 by 120%

Located 30' upstream of 9th Street

Cross Section 5159

Surveyed section 4612 moved 547 feet upstream and raised 2.9 feet

Located just downstream of the 9th Street Dam

9th Street Dam

A rating curve is developed for the dam. The seven tainter gates and a spillway are analyzed. Confirmation with Alpena Power Co shows that their normal operating head is at 597.0 (NGVD). The rating curve shows the operating head can be maintained at 597.0 for discharging all discharges except the 500-year storm

Flowage rights ≈ 600.9

assumed gates fully open.

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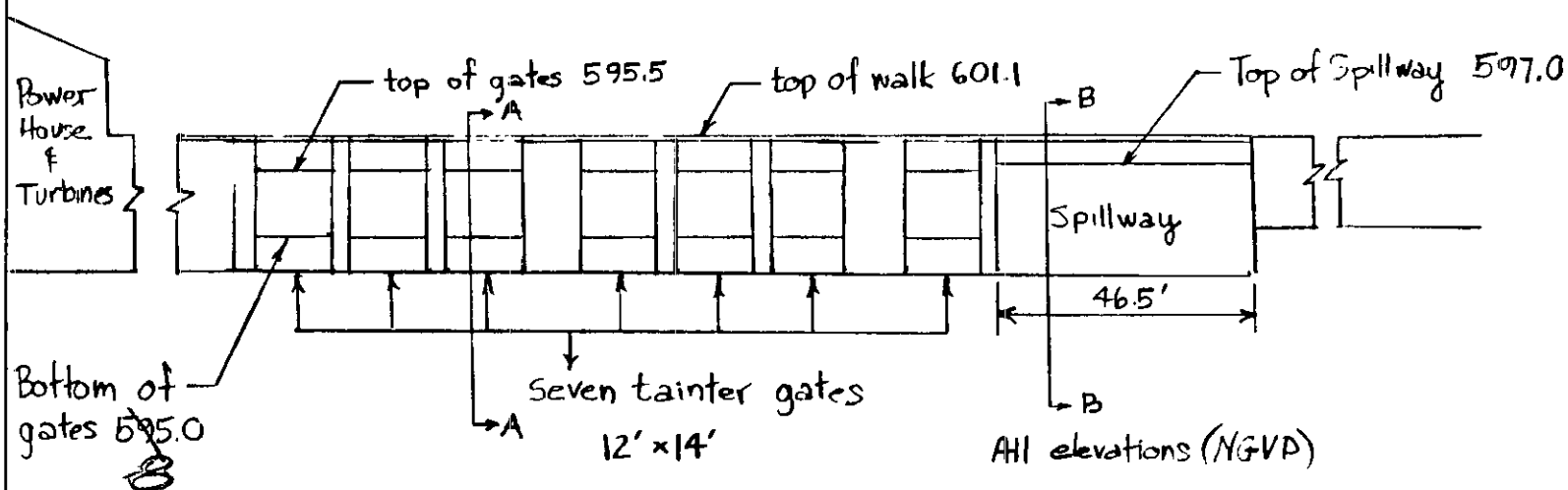
DESIGN NOTES AND COMPUTATIONS

JOB NUMBER

SUBJECT:

9th Street Dam



view looking upstream

for sections A-A and BB see rating curve development information obtained from the Federal Energy Regulatory Commission

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DESIGN NOTES AND COMPUTATIONS

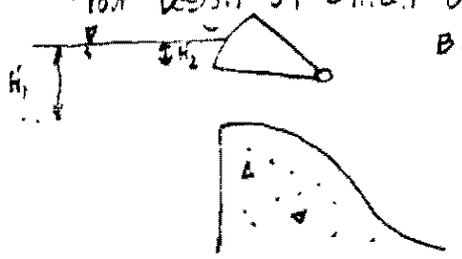
SUBJECT: Rating Curve of 9th Street Dam

JOB NUMBER

A. for tainter gates

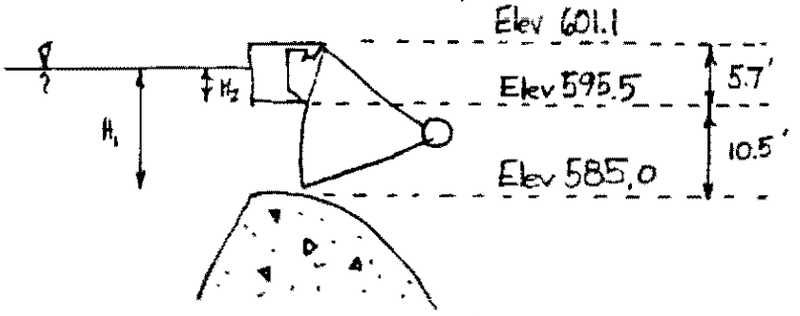
$$Q = \frac{2}{3}\sqrt{2g}\, CL\left(H_1^{3/2} - H_2^{3/2}\right)$$

from "Design of small Dams" p 395
Bureau of Reclamation



Actual gate set-up

Section A-A



Assume $\frac{V_1^2}{2g} = 0$

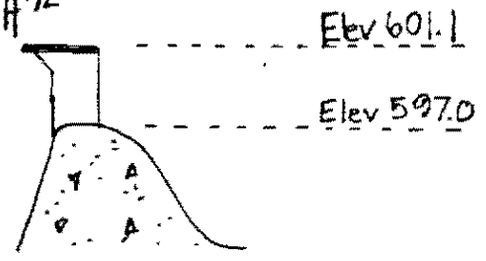
$L = 14'$
$N_0 = 7$

B. for weir

$$Q = C L H^{3/2}$$

Section B-B

$C = 3.5$
$L = 165'$



C. flow through turbines not considered

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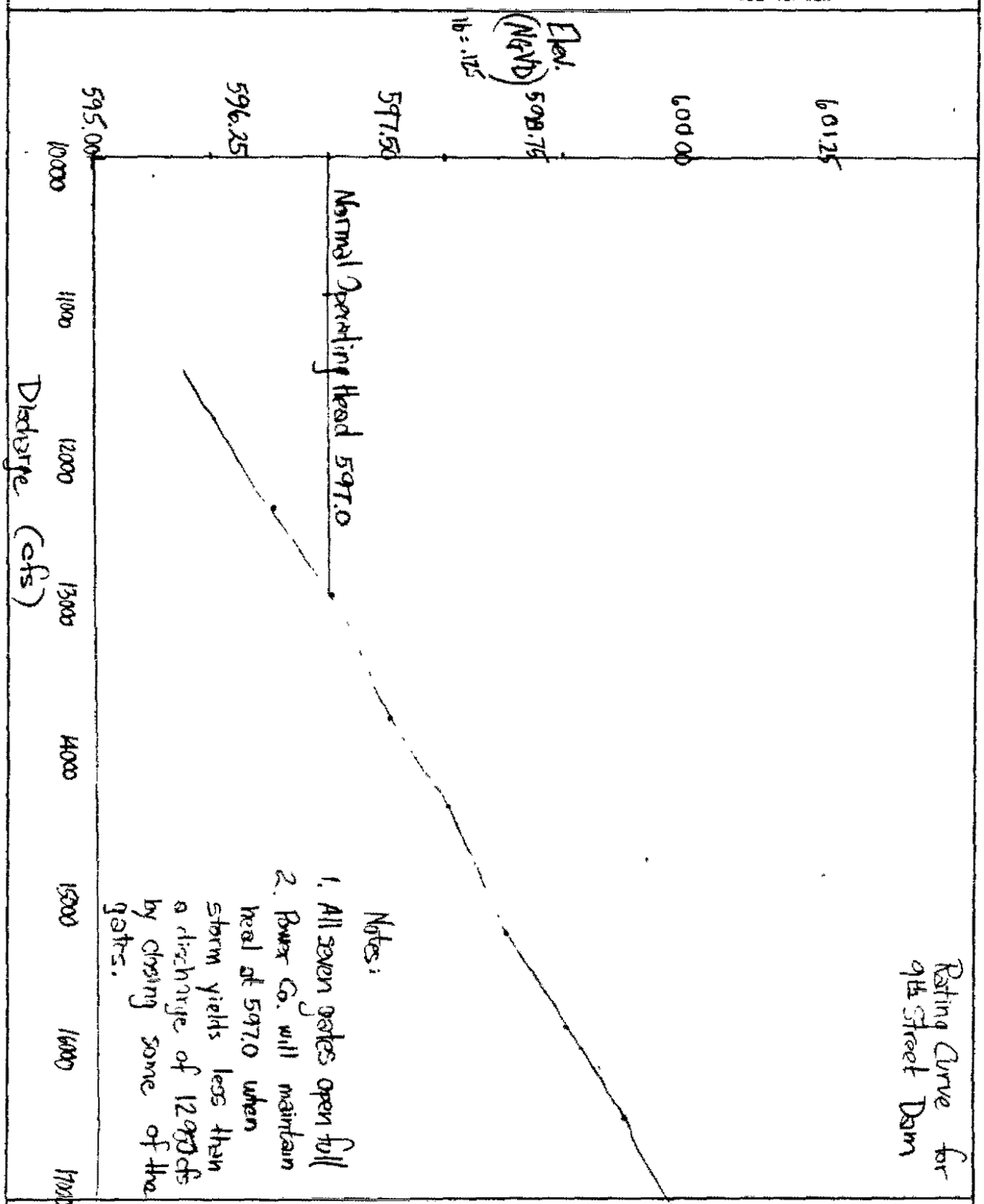
DESIGN NOTES AND COMPUTATIONS

SUBJECT:

JOB NUMBER



Notes:

1. All seven gates open full
2. Power Co. will maintain head at 597.0 when storm yields less than a discharge of 12,000 cfs by closing some of the gates.

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DESIGN NOTES AND COMPUTATIONS

SUBJECT
Rating Curve for 9th Street Dam

JOB NUMBER

All Gates Open

Elev. (NGVD)	Q_{gates} (cfs)	Q_{weir} (cfs)	Q_{total} (cfs)
596.0	11743	0	11743
596.5	12355	0	12355
597.0	12915	0	12915
597.5	13664	58	13722
598.0	14175	163	14338
598.5	14900	299	15199
599.0	15379	460	15839
599.5	15841	643	16484
600.0	16290	846	17136
600.5	16986	1065	18051
601.0	17415	1302	18717

$$Q = \frac{2}{3}\sqrt{2g}\, CL \left(H_1^{3/2} - H_2^{3/2}\right)$$

All gates open full

$$Q = \left[\frac{2}{3}\sqrt{64.4}\,(7)(14)\right]\left(H_1^{3/2} - H_2^{3/2}\right) \cdot f(H_1)$$

where $f(H_1) = C$

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DESIGN NOTES AND COMPUTATIONS

SUBJECT

JOB NUMBER

Cross Section 5183

Survey section 5583 moved 400 feet downstream and lowered 1.6 feet.

Located just upstream of the 9th Street Dam.

Banks located at the end of the spillway and end of the tainter gates. Overbanks non-effective until water overtops the walkway This never happens

The right overbank value of n is changed to .035 because the right bank has been moved into the channel to account for the smaller width of the dam.

Cross Section 5383

Surveyed section 5583 moved 200 feet downstream and lowered .8 foot

Located 200 feet downstream of the D&M Railroad.

Bank locations placed at the natural banks and n value of the right overbank is change back to .070.

Overbank areas assumed non-effective

Cross Section 5583

Actual field surveyed cross section.

Located just downstream of D&M Railroad.

Banks located at the ends of the bridge

Right bank n value change to .035 because it is part of the natural channel

Overbanks assummed non-effective until water tops roadway.

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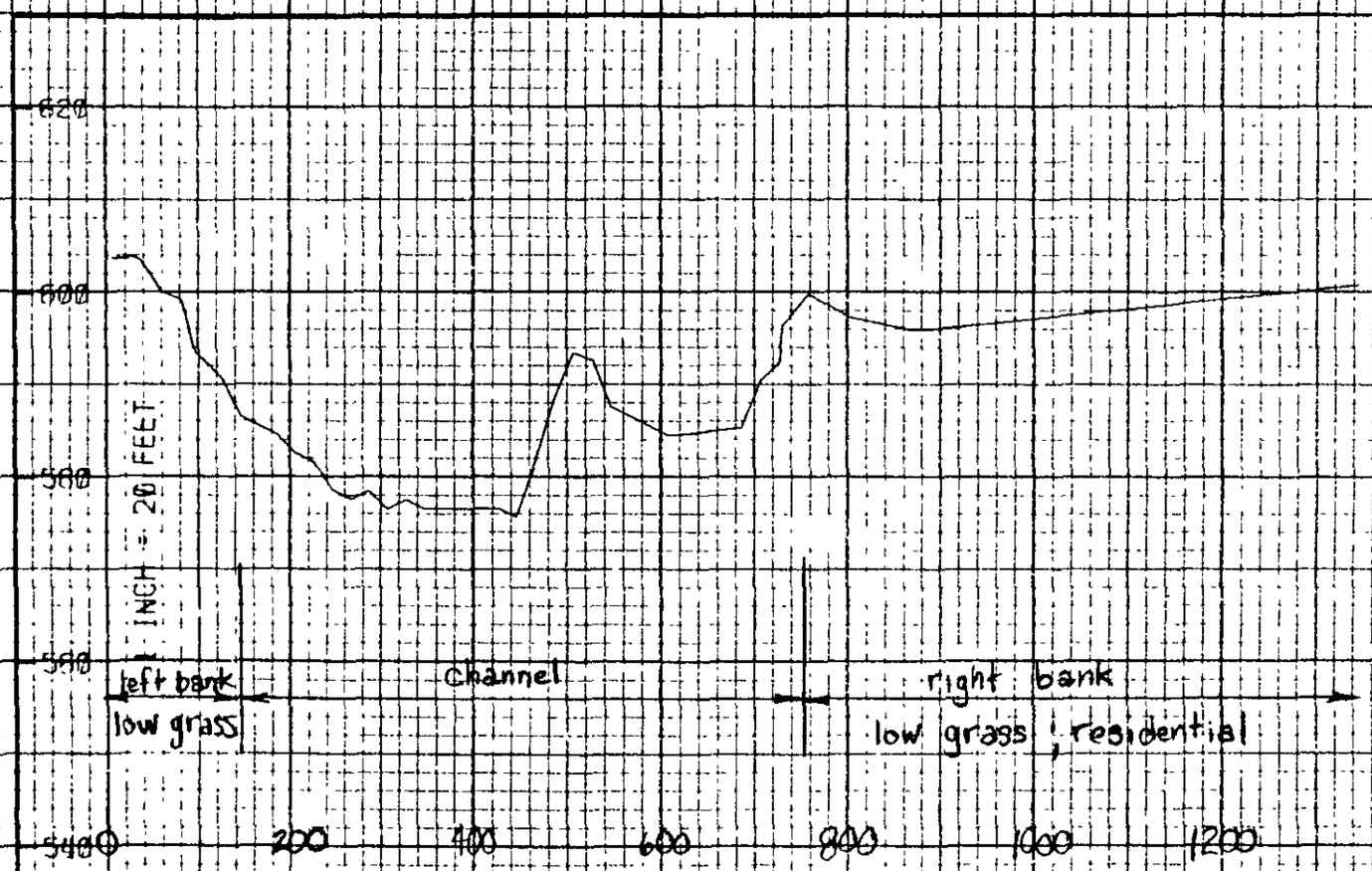

Surveyed
SECTION NO. 5583
Located 200 feet downstream of Detroit and Mackinac Railroad

TBAY.DPF
T1 ALPENA, MICH
T2 THUNDER BAY RIVER
T3 10-YEAR STORM

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DESIGN NOTES AND COMPUTATIONS

SUBJECT

JOB NUMBER

D&A Railroad Bridge (see drawing) Special Bridge

Pier shape coefficient = 1.05 90° triangular nose and tail

Bottom width = 245'

Width of pier = 47.6'

side slopes = 1 58

Class A Low Flow for all discharges.

Bridge opening estimated by cross section 5583

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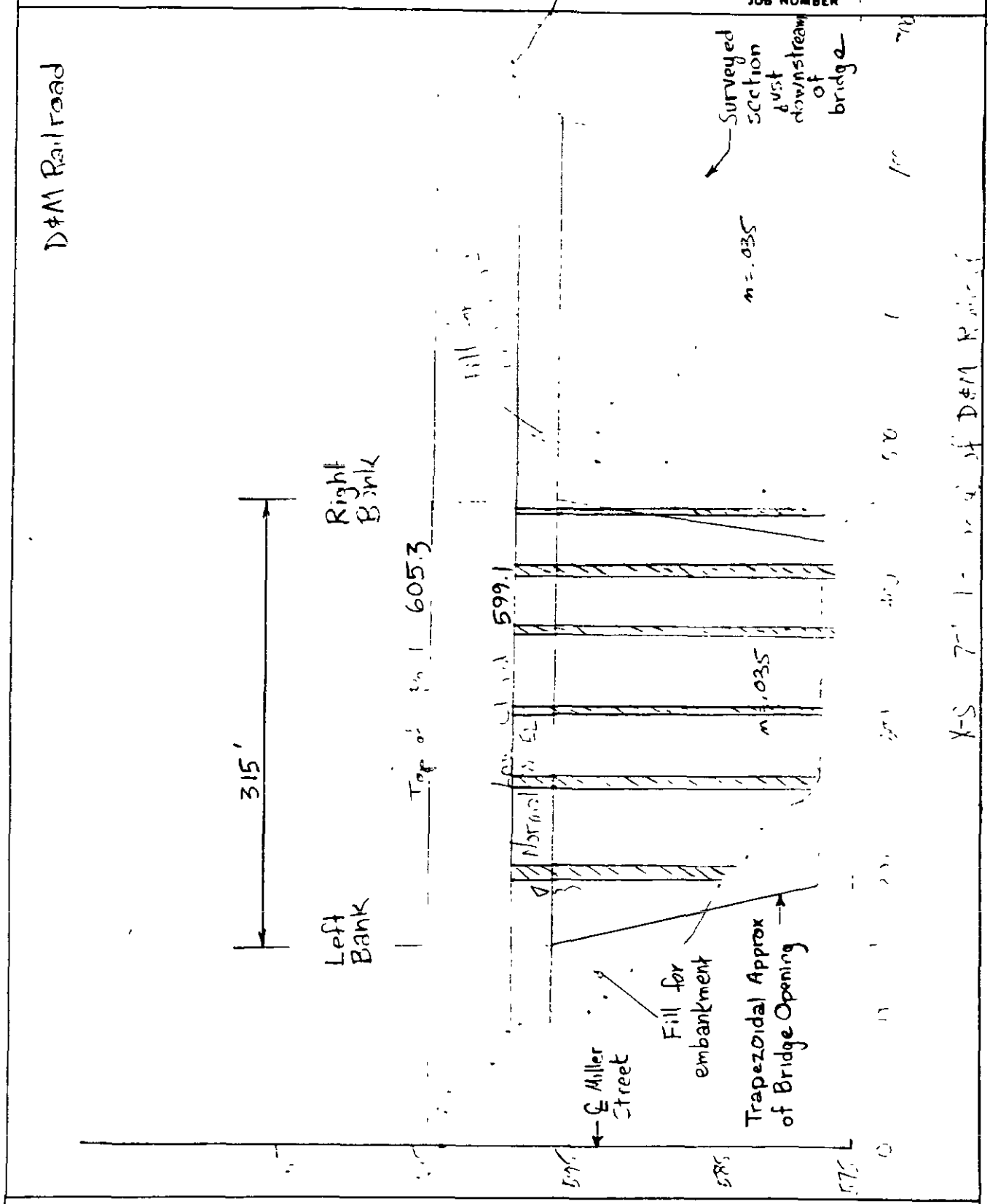
DESIGN NOTES AND COMPUTATIONS

SUBJECT

JOB NUMBER



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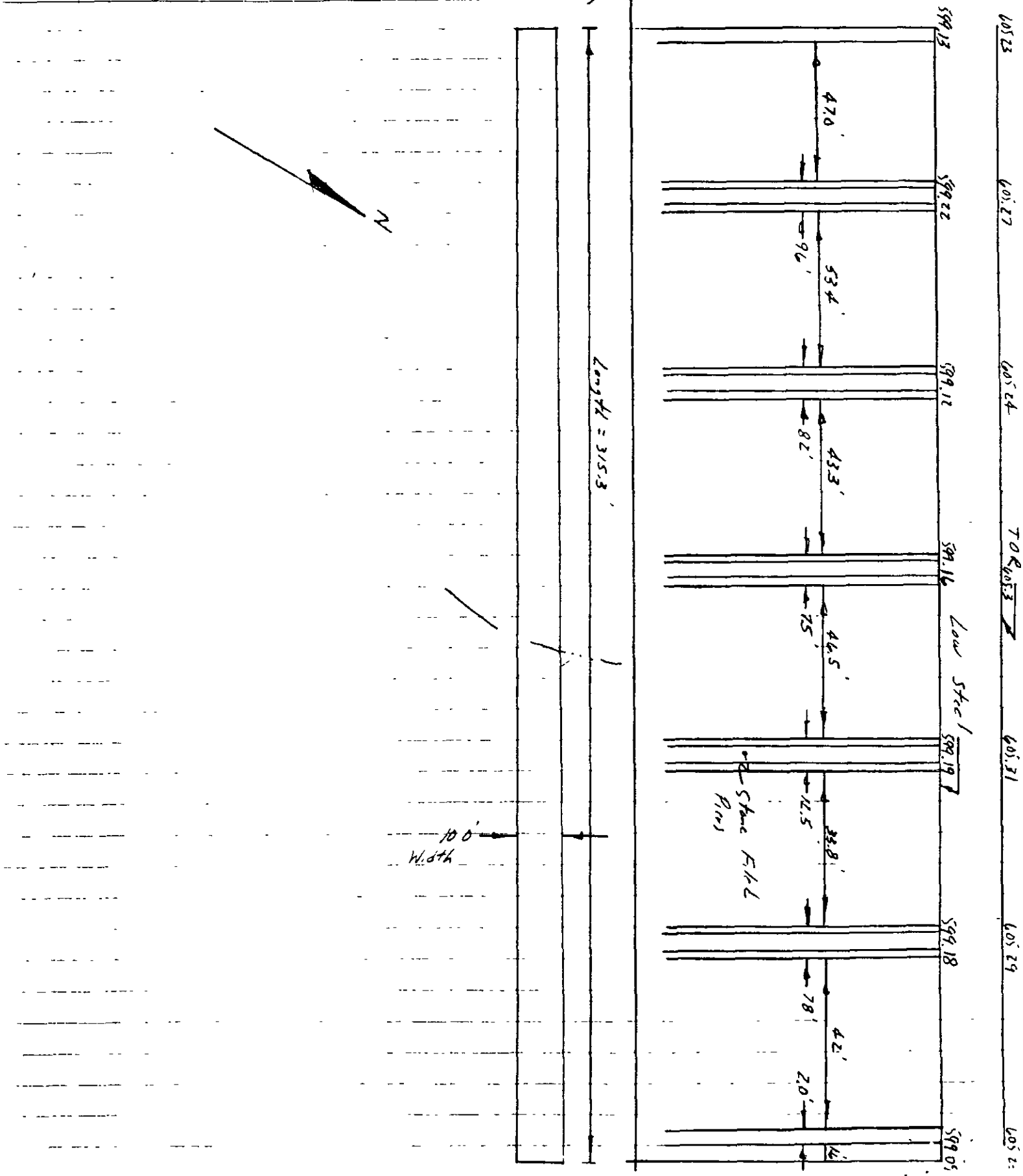
D. & M. Railroad Bridge



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DESIGN NOTES AND COMPUTATIONS

SUBJECT

JOB NUMBER

Cross Section 5593

Surveyed section 5583 moved 10 feet upstream. Located just upstream of D&M Railroad

Bank locations and n values are same as at cross section 5583.

Overbanks assumed non-effective till water overtops road.

Cross Section 5693

Surveyed section 5583 moved 110 feet upstream and raised .6 foot

Located 100 feet upstream of D&M Railroad

Bank locations are relocated at their natural banks and the right overbank n value is changed from .035 to .060.

Overbank areas assumed non-effective. Right bank elevation of 5999 prevents water from pouring into the overbanks.

Cross Section 6693

Surveyed section 5583 moved 1110 feet upstream and raised 2.6 feet.

Same banks and n values as 5693

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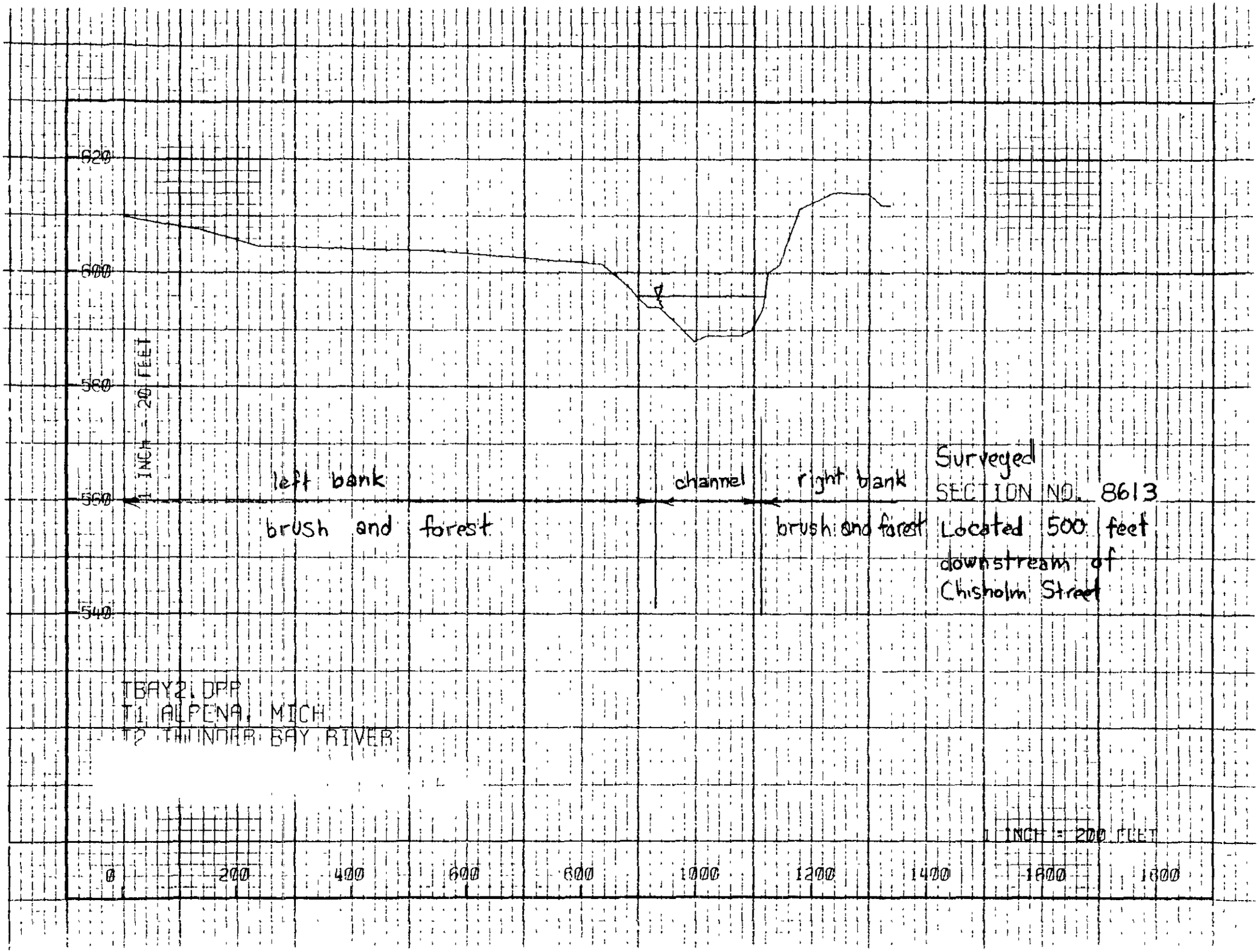
620
600
580
560
540
1 INCH = 20 FEET
left bank
brush and forest
channel
right bank
brush and forest
Surveyed
SECTION NO. 8613
Located 500 feet
downstream of
Chisholm Street
TBAY2.DPP
T1 ALPENA, MICH
T2 THUNDER BAY RIVER
1 INCH = 200 FEET
0
200
400
600
800
1000
1200
1400
1600
1800

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DESIGN NOTES AND COMPUTATIONS

SUBJECT

JOB NUMBER

Cross section 8613

A total surveyed section taken 165 feet downstream of Chisholm Street Bridge and moved downstream 335 feet and lowered .2 foot

Located 500 feet downstream of Chisholm Street.

Cross Section 9113

Surveyed cross section taken 165 feet downstream of Chisholm Street. Moved 165 feet upstream and raised .1 foot

Located just downstream of Chisholm Street.

Over banks assumed non-effective until water over tops roadway.

Chisholm Street Bridge (see drawing) Special Bridge

River cross section under bridge was taken by sounding. Soundings were taken at all high spots under the bridge This accounts for the rubble remains from a previous bridge that was not cleared.

Pier coefficient = .9 semicircular nose and tail

Bottom width = 136 feet

Width of piers = 16 feet

Bridge experiences Class B Low Flow for all discharges. Water goes through critical depth. This is caused by the constriction of the old bridge rubble

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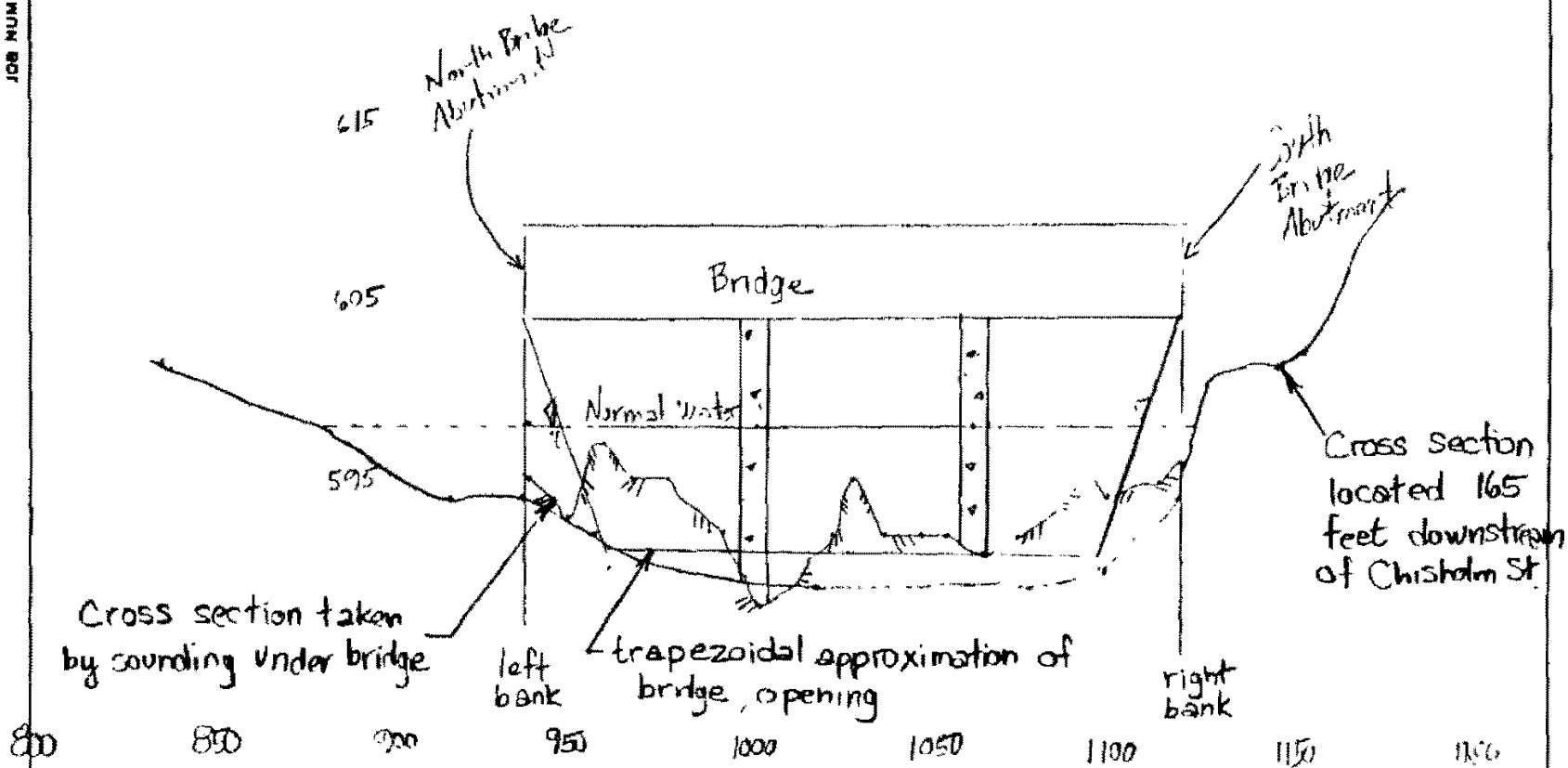
DESIGN NOTES AND COMPUTATIONS

JOB NUMBER

SUBJECT

Chisholm Street Bridge



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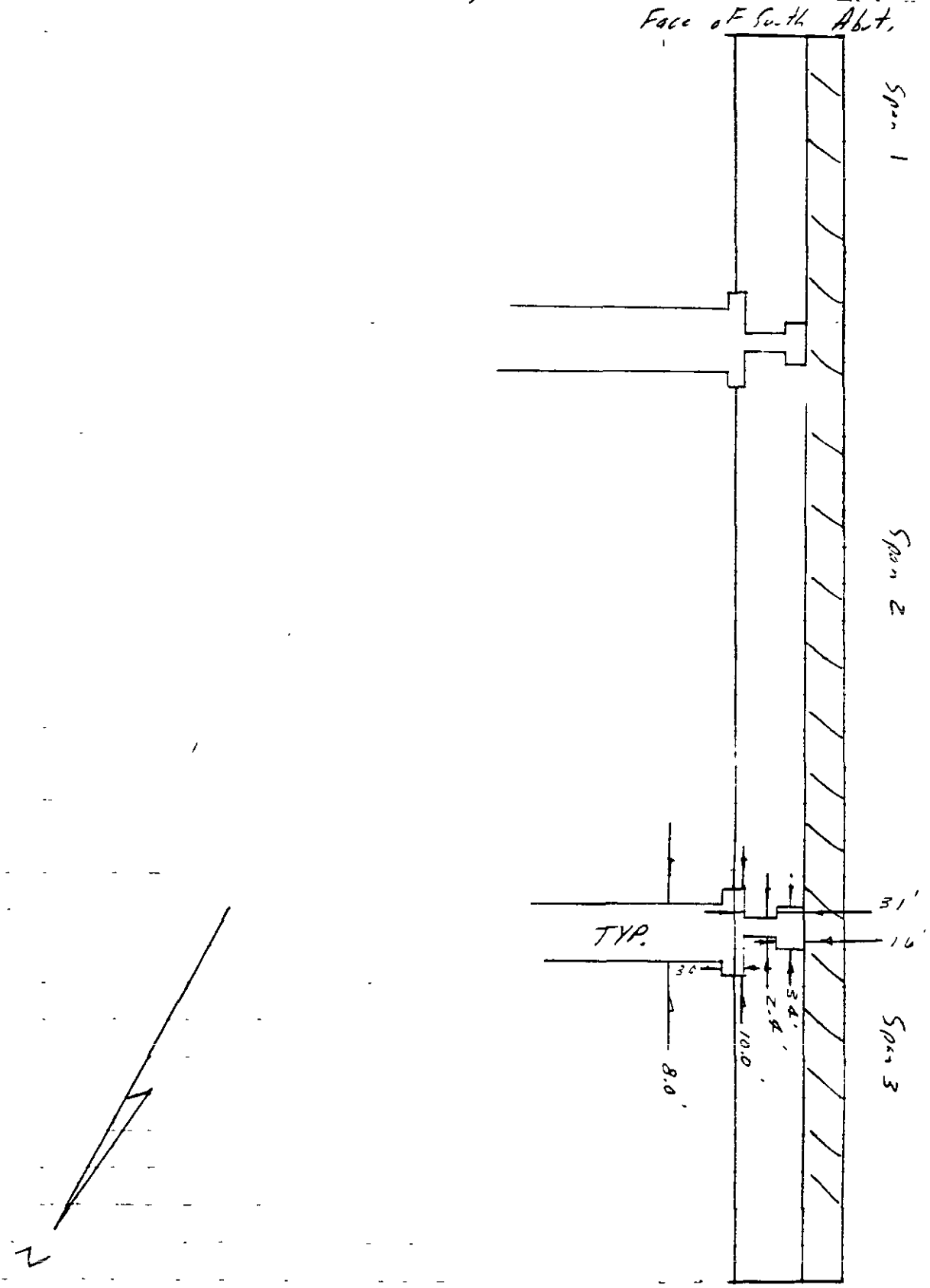
Underclearance of Chisholm St. Bridge (Additional Measurements)



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DESIGN NOTES AND COMPUTATIONS

SUBJECT

JOB NUMBER

Cross Section 9153

Surveyed cross section taken 165 feet downstream of Chisholm Street Moved 205 feet upstream and raised .1 foot

Located just upstream of Chisholm Street.

Overbanks non-effective until water flows over roadway

Cross Section 9253

Surveyed cross section taken 165 feet downstream of Chisholm Street. Moved 305 feet upstream and raised .2 foot.

Located 100 feet upstream of Chisholm Street

Cross Section 12013 and 14453

These sections are taken from the quad map in Lake Besser. The inverts were interpolated between surveyed cross sections 9253 and 17813 Overbank areas and width of channel came from the quad maps. A flat bottom is assumed Reduction for the islands is taken into account.

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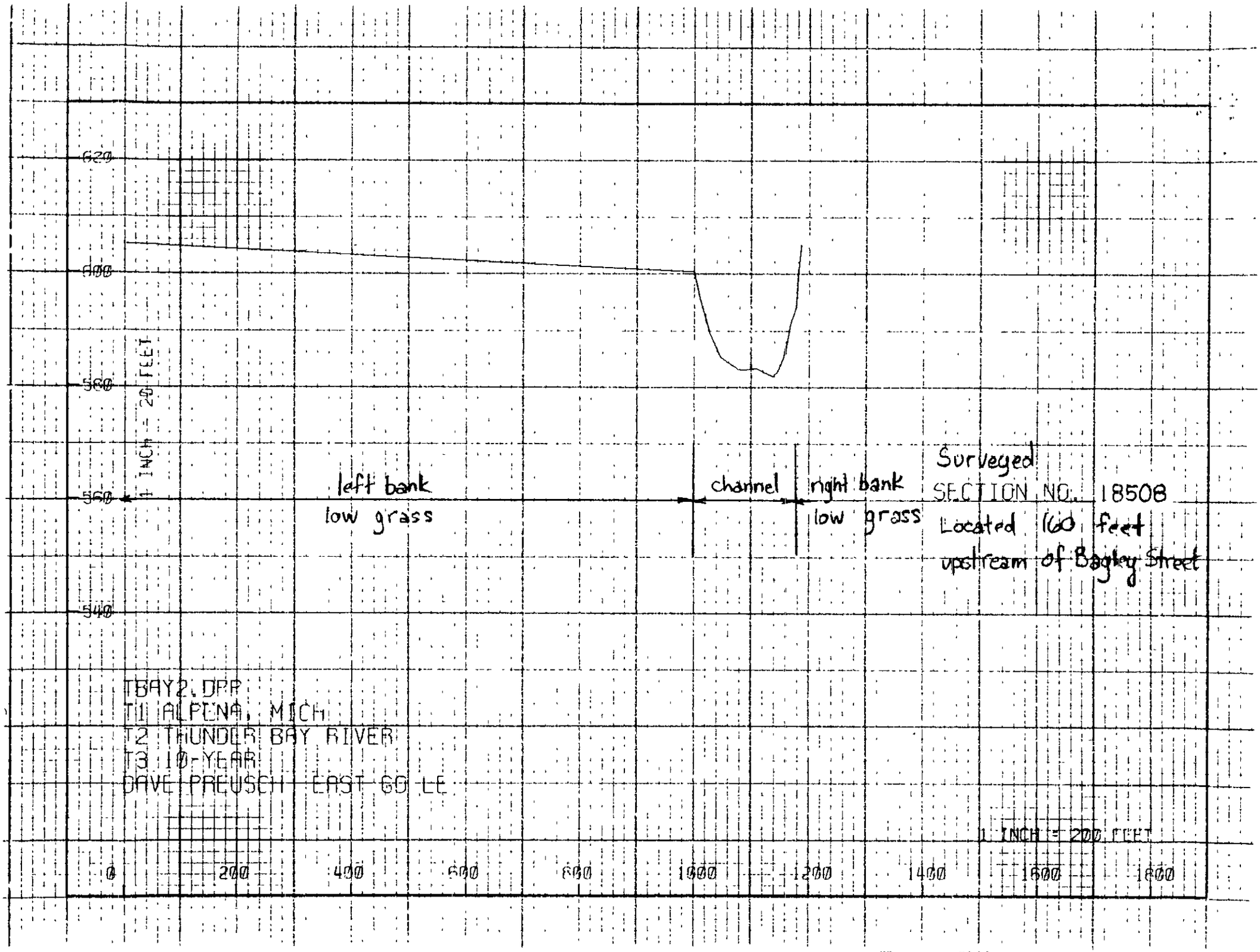
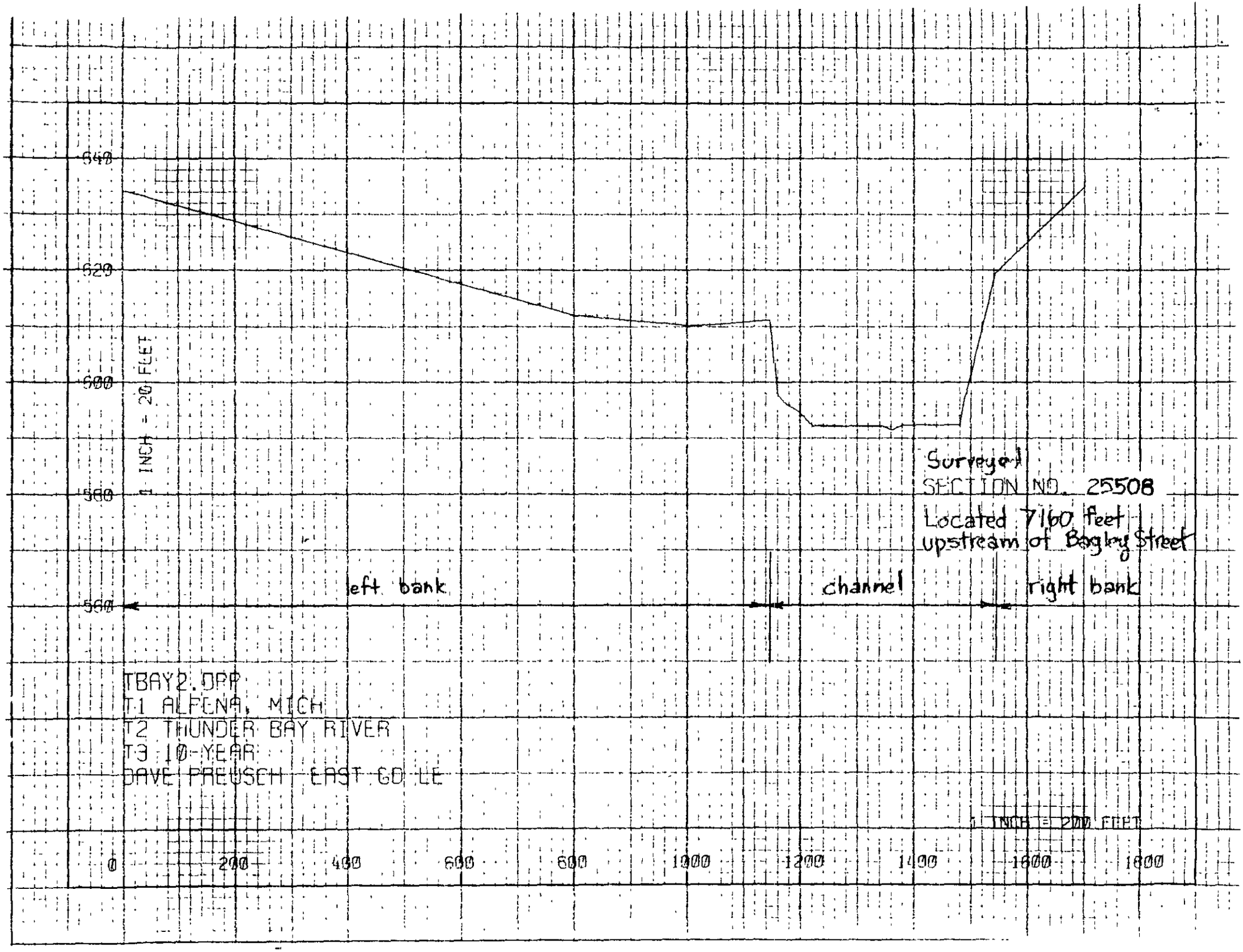

620
600
580
560
540
1 INCH = 20 FEET
left bank
low grass
channel
right bank
low grass
Surveyed
SECTION NO. 18508
Located 160 feet
upstream of Bagley Street
TBAY2.DPP
T1 ALPENA, MICH
T2 THUNDER BAY RIVER
T3 10-YEAR
DAVE PREUSCH EAST GO LE
1 INCH = 200 FEET
0
200
400
600
800
1000
1200
1400
1600
1800


640
620
600
580
560
1 INCH = 20 FEET
Surveyed
SECTION NO. 25508
Located 7160 feet
upstream of Bagley Street
left bank
channel
right bank
TBAY2.DAT
T1 ALPENA, MICH
T2 THUNDER BAY RIVER
T3 10-YEAR
DAVE PREUSCH EAST GO LE
1 INCH = 200 FEET
0
200
400
600
800
1000
1200
1400
1600
1800

JOHNSON
ENGINEERS ARCHITECTS PLANNERS

DESIGN NOTES AND COMPUTATIONS

SUBJECT

JOB NUMBER

Cross Section 18348

Surveyed section 18313 moved upstream 35 feet.

Located just upstream of Bagley Street.

Overbanks assumed non-effective until water overtops roadway.

Cross section 18508 (for limited detail study)

Actual field surveyed cross section taken from topographic information developed for the construction of Bagley Street Bridge.

Located 160 feet upstream of Bagley Street.

Cross Section 25508 (for limited detail study)

Actual field surveyed cross section located 7160 feet upstream of Bagley Street.

Cross section 26508 (for limited detail study

Surveyed section 25508 moved upstream 1000 feet and raised 1.4 feet Average slope = .0014

Cross section 31808 (for approximate study)

Surveyed section 25508 moved 5300 feet upstream and raised 7.42 feet.

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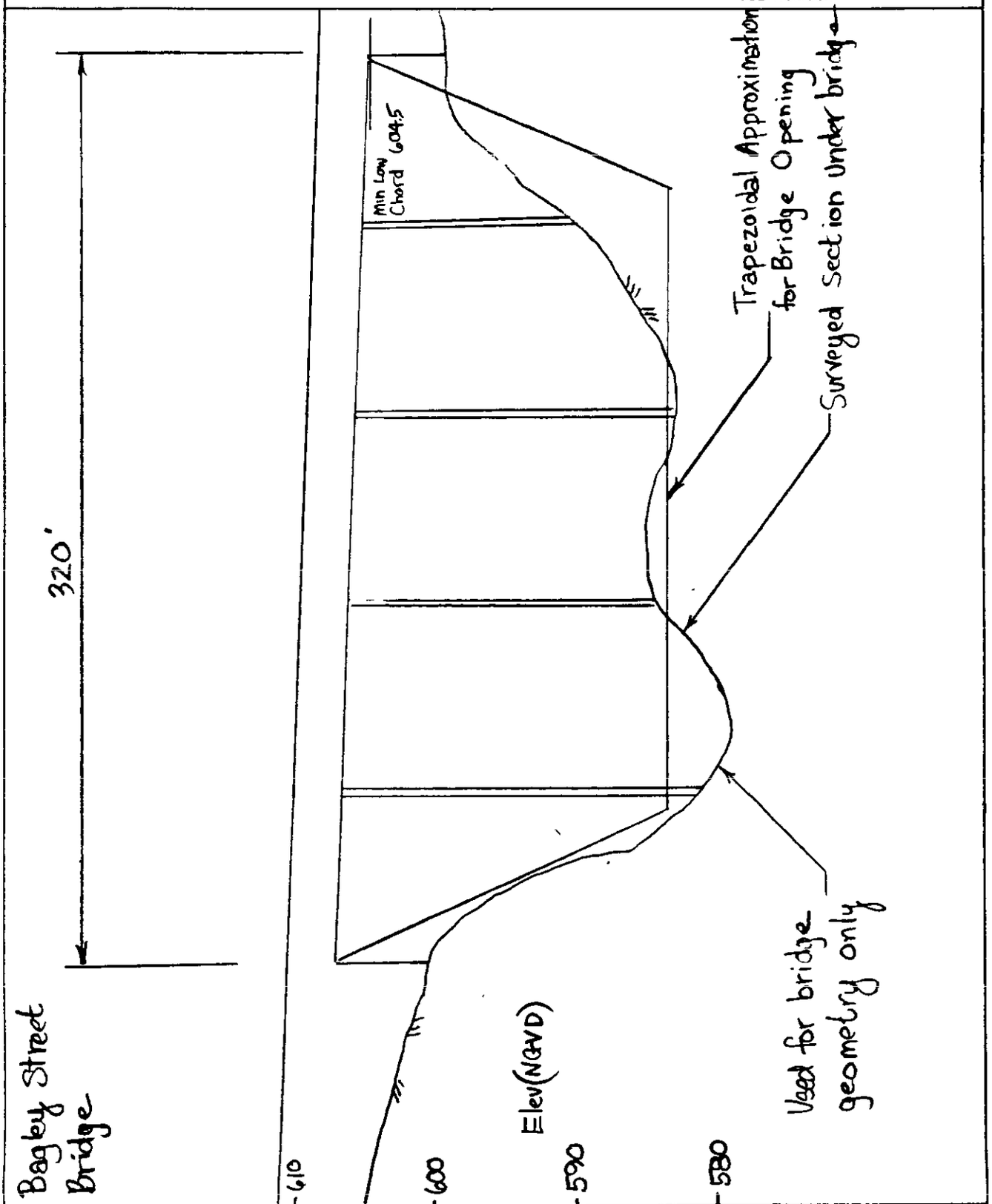
DESIGN NOTES AND COMPUTATIONS

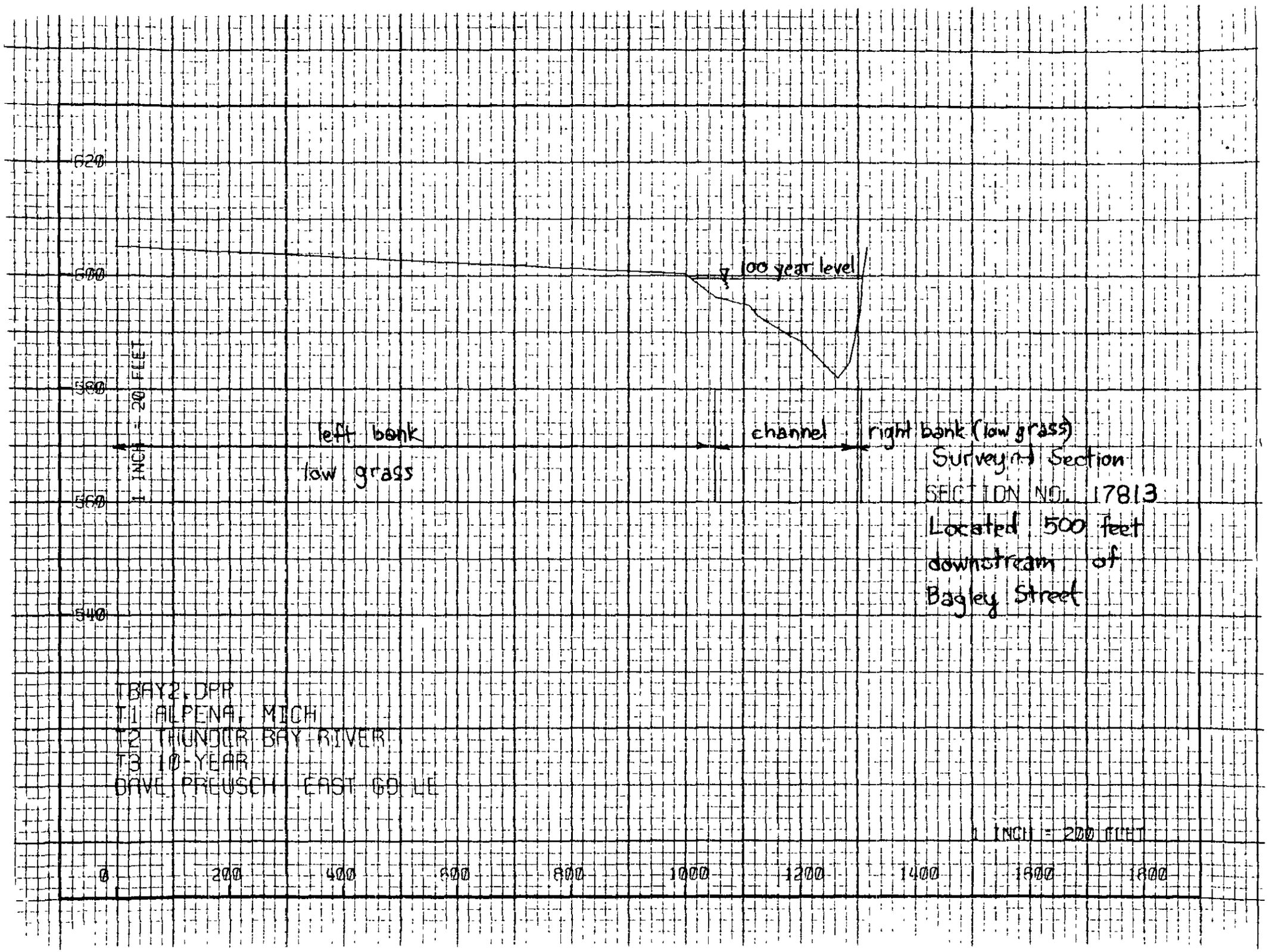
SUBJECT

JOB NUMBER



PREPARED BY DP DATE CHECKED BY SHEET NO. 26 OF

BERNARD JOHNSON INCORPORATED
2021 K Street, N.W Washington, D.C 20006 202/862-8600


620
600
580
560
540
100 year level
1 INCH = 20 FEET
left bank
low grass
channel
right bank (low grass)
Survey Section
SECTION NO. 17813
Located 500 feet
downstream of
Bagley Street
TBAY2.DPR
T1 ALPENA, MICH
T2 THUNDER BAY RIVER
T3 10-YEAR
DAVE PREUSCH EAST GO LE
1 INCH = 200 FEET
0
200
400
600
800
1000
1200
1400
1600
1800

JOHNSON
ENGINEERS
ARCHITECTS
PLANNERS

DESIGN NOTES AND COMPUTATIONS

SUBJECT

JOB NUMBER

Cross Section 17813

Actual field surveyed cross section taken from topographic information developed for the construction of Bagley Street Bridge

Located 500 feet downstream of Bagley Street.

Cross Section 18313

Actual field surveyed cross section taken from topographic information developed for the construction of Bagley Street Bridge.

Located just downstream of Bagley Street.

Overbanks non-effective until water overtops roadway. (Cross section not plotted)

Bagley Street Bridge (see drawing) Special Bridge

Bridge geometry taken from plans of Bagley Street Bridge construction project.

Pier coefficient = .9 semi circular nose and tail
Bridge width = 220'
Pier width = 12'
Side slopes = 2.13

Class A Low Flow is developed for all discharges.

PREPARED BY DR DATE CHECKED BY NH SHEET NO 2A OF

00BREAK00

1) COUNTY: Alpena

2) STUDY NAME: Alpena City / Twp

3) WATERCOURSE: Thunder Bay River

4) DOCUMENT TYPE: Summary

00BREAK00

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SUMMARY PRINTOUT TABLE 150

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRTWS	CO	TOK*S	VCH	AREA	.01K
0.000	0.00	0.00	0.00	555.60	6548.00	579.40	0.00	579.46	0.48	1.95	3706.15	9496.83
0.000	0.00	0.00	0.00	555.60	9262.00	579.40	0.00	579.52	0.95	2.76	3706.15	9496.83
0.000	0.00	0.00	0.00	555.60	10700.00	579.40	0.00	579.56	1.27	3.19	3706.15	9496.83
0.000	0.00	0.00	0.00	555.60	13800.00	579.40	0.00	579.66	2.11	4.12	3706.15	9496.83
1349.000	1349.00	0.00	0.00	556.10	6548.00	579.47	0.00	579.51	0.34	1.63	4028.50	11202.11
1349.000	1349.00	0.00	0.00	556.10	9262.00	579.55	0.00	579.63	0.68	2.29	4044.74	11266.53
1349.000	1349.00	0.00	0.00	556.10	10700.00	579.59	0.00	579.70	0.89	2.64	4057.59	11317.55
1349.000	1349.00	0.00	0.00	556.10	13800.00	579.72	0.00	579.90	1.46	3.38	4086.44	11432.37
1449.000	100.00	0.00	0.00	556.00	6548.00	579.46	0.00	579.54	1.01	2.32	2816.40	6530.67
1449.000	100.00	0.00	0.00	556.00	9262.00	579.51	0.00	579.68	1.99	3.28	2824.75	6558.45
1449.000	100.00	0.00	0.00	556.00	10700.00	579.55	0.00	579.77	2.65	3.78	2830.32	6577.00
1449.000	100.00	0.00	0.00	556.00	13800.00	579.65	0.00	580.02	4.34	4.85	2845.13	6626.38
1450.000	1.00	591.60	585.20	556.00	6548.00	579.46	0.00	579.54	1.01	2.32	2816.42	6530.73
1450.000	1.00	591.60	585.20	556.00	9262.00	579.51	0.00	579.68	1.99	3.28	2824.77	6558.51
1450.000	1.00	591.60	585.20	556.00	10700.00	579.55	0.00	579.77	2.65	3.78	2830.36	6577.12
1450.000	1.00	591.60	585.20	556.00	13800.00	579.65	0.00	580.02	4.34	4.85	2845.19	6626.56
1510.000	60.00	591.60	585.20	556.00	6548.00	579.46	0.00	579.55	1.00	2.32	2817.31	6533.70
1510.000	60.00	591.60	585.20	556.00	9262.00	579.53	0.00	579.69	1.99	3.28	2826.53	6564.37
1510.000	60.00	591.60	585.20	556.00	10700.00	579.57	0.00	579.79	2.64	3.78	2832.69	6584.89
1510.000	60.00	591.60	585.20	556.00	13800.00	579.68	0.00	580.04	4.32	4.84	2849.01	6639.34
1512.000	2.00	0.00	0.00	556.00	6548.00	579.46	0.00	579.55	1.00	2.32	2817.35	6533.82
1512.000	2.00	0.00	0.00	556.00	9262.00	579.53	0.00	579.69	1.99	3.28	2826.63	6564.70
1512.000	2.00	0.00	0.00	556.00	10700.00	579.57	0.00	579.79	2.64	3.78	2832.84	6585.40
1512.000	2.00	0.00	0.00	556.00	13800.00	579.68	0.00	580.05	4.32	4.84	2849.32	6640.35
1662.000	150.00	0.00	0.00	557.00	6548.00	579.51	0.00	579.57	0.44	1.86	3519.26	9821.71
1662.000	150.00	0.00	0.00	557.00	9262.00	579.62	0.00	579.73	0.87	2.62	3541.26	9914.30
1662.000	150.00	0.00	0.00	557.00	10700.00	579.70	0.00	579.84	1.15	3.01	3556.03	9976.63
1662.000	150.00	0.00	0.00	557.00	13800.00	579.90	0.00	580.13	1.85	3.84	3595.12	10142.06

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
2231.000	569.00	0.00	0.00	558.70	6548.00	579.56	0.00	579.59	0.23	1.25	5243.96	13624.03
2231.000	569.00	0.00	0.00	558.70	9262.00	579.72	0.00	579.77	0.45	1.75	5298.80	13833.92
2231.000	569.00	0.00	0.00	558.70	10700.00	579.83	0.00	579.89	0.59	2.00	5338.29	13985.62
2231.000	569.00	0.00	0.00	558.70	13800.00	580.11	0.00	580.21	0.92	2.54	5434.46	14357.02
2881.000	650.00	0.00	0.00	557.00	6548.00	579.58	0.00	579.60	0.13	0.96	6788.38	18403.78
2881.000	650.00	0.00	0.00	557.00	9262.00	579.77	0.00	579.79	0.24	1.35	6862.60	18725.60
2881.000	650.00	0.00	0.00	557.00	10700.00	579.89	0.00	579.92	0.32	1.55	6911.78	18939.88
2881.000	650.00	0.00	0.00	557.00	13800.00	580.20	0.00	580.26	0.50	1.96	7040.30	19503.93

	3281.000	400.00	0.00	0.00	563.50	6548.00	579.56	0.00	579.63	1.15	2.10	3110.69	6115.58
	3281.000	400.00	0.00	0.00	563.50	9262.00	579.71	0.00	579.85	2.19	2.93	3158.04	6259.26
	3281.000	400.00	0.00	0.00	563.50	10700.00	579.82	0.00	579.99	2.83	3.35	3189.57	6355.52
	3281.000	400.00	0.00	0.00	563.50	13800.00	580.09	0.00	580.37	4.36	4.22	3272.95	6612.32
	3947.000	666.00	0.00	0.00	566.30	6548.00	579.60	0.00	579.80	4.75	3.62	1810.52	3003.99
	3947.000	666.00	0.00	0.00	566.30	9262.00	579.80	0.00	580.18	8.79	4.99	1855.44	3124.58
	3947.000	666.00	0.00	0.00	566.30	10700.00	579.92	0.00	580.42	11.15	5.68	1884.94	3204.68
	3947.000	666.00	0.00	0.00	566.30	13800.00	580.25	0.00	581.02	16.32	7.04	1961.35	3415.49
	4612.000	665.00	0.00	0.00	569.00	6548.00	579.97	0.00	580.38	14.55	5.11	1280.18	1716.51
	4612.000	665.00	0.00	0.00	569.00	9262.00	580.47	0.00	581.15	22.17	6.65	1392.56	1967.25
	4612.000	665.00	0.00	0.00	569.00	10700.00	580.76	0.00	581.60	25.39	7.33	1460.00	2123.66
	4612.000	665.00	0.00	0.00	569.00	13800.00	581.44	0.00	582.58	30.45	8.54	1615.53	2500.67
	4762.000	150.00	0.00	0.00	565.00	6548.00	580.34	0.00	580.55	4.43	3.68	1779.76	3110.31
	4762.000	150.00	0.00	0.00	565.00	9262.00	581.07	0.00	581.42	6.86	4.79	1932.80	3535.45
	4762.000	150.00	0.00	0.00	565.00	10700.00	581.48	0.00	581.91	7.99	5.30	2020.08	3785.65
	4762.000	150.00	0.00	0.00	565.00	13800.00	582.38	0.00	582.98	10.04	6.24	2212.50	4356.13
	4829.000	67.00	596.10	589.60	565.00	6548.00	580.34	0.00	580.55	4.42	3.68	1780.94	3113.53
	4829.000	67.00	596.10	589.60	565.00	9262.00	581.08	0.00	581.43	6.84	4.79	1935.22	3542.31
	4829.000	67.00	596.10	589.60	565.00	10700.00	581.49	0.00	581.93	7.95	5.29	2023.23	3794.78
	4829.000	67.00	596.10	589.60	565.00	13800.00	582.40	0.00	583.00	9.97	6.22	2217.38	4370.93
	4859.000	30.00	0.00	0.00	565.30	6548.00	580.43	0.00	580.58	3.29	3.14	2083.52	3607.94
	4859.000	30.00	0.00	0.00	565.30	9262.00	581.23	0.00	581.48	4.95	4.06	2283.83	4162.64
	4859.000	30.00	0.00	0.00	565.30	10700.00	581.68	0.00	581.99	5.68	4.46	2398.09	4490.41
	4859.000	30.00	0.00	0.00	565.30	13800.00	582.66	0.00	583.08	6.93	5.21	2650.48	5242.17
	5159.000	300.00	0.00	0.00	573.00	6548.00	580.41	0.00	580.87	18.93	5.39	1213.97	1505.10
	5159.000	300.00	0.00	0.00	573.00	9262.00	581.21	0.00	581.89	23.56	6.58	1408.42	1908.11
	5159.000	300.00	0.00	0.00	573.00	10700.00	581.67	0.00	582.44	24.70	7.04	1519.56	2153.07
	5159.000	300.00	0.00	0.00	573.00	13800.00	582.65	0.00	583.60	25.57	7.82	1764.96	2729.03
*	5183.000	24.00	0.00	0.00	574.00	6548.00	597.00	0.00	597.02	0.12	1.05	6230.00	19084.60
*	5183.000	24.00	0.00	0.00	574.00	9262.00	597.00	0.00	597.03	0.24	1.49	6230.00	19084.60
*	5183.000	24.00	0.00	0.00	574.00	10700.00	597.00	0.00	597.05	0.31	1.72	6230.00	19084.60
*	5183.000	24.00	0.00	0.00	574.00	13800.00	597.50	0.00	597.57	0.48	2.16	6390.00	19908.48

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
5383.000	200.00	0.00	0.00	574.80	6548.00	597.01	0.00	597.02	0.09	0.74	9050.71	22143.80
5383.000	200.00	0.00	0.00	574.80	9262.00	597.03	0.00	597.04	0.17	1.05	9059.45	22175.48
5383.000	200.00	0.00	0.00	574.80	10700.00	597.04	0.00	597.06	0.23	1.22	9065.17	22196.18
5383.000	200.00	0.00	0.00	574.80	13800.00	597.56	0.00	597.59	0.35	1.51	9407.88	23448.72
5583.000	200.00	0.00	0.00	575.60	6548.00	597.01	0.00	597.03	0.16	1.14	5722.91	16566.47
5583.000	200.00	0.00	0.00	575.60	9262.00	597.02	0.00	597.06	0.31	1.62	5726.00	16581.36
5583.000	200.00	0.00	0.00	575.60	10700.00	597.03	0.00	597.08	0.42	1.87	5728.69	16594.37
5583.000	200.00	0.00	0.00	575.60	13800.00	597.54	0.00	597.63	0.63	2.34	5891.07	17385.74

5593.000	10.00	605.30	599.10	575.60	6548.00	597.01	0.00	597.03	0.16	1.14	5722.27	16863.36
5593.000	10.00	605.30	599.10	575.60	9262.00	597.03	0.00	597.07	0.31	1.62	5726.54	16584.00
5593.000	10.00	605.30	599.10	575.60	10700.00	597.04	0.00	597.09	0.42	1.87	5729.47	16598.15
5593.000	10.00	605.30	599.10	575.60	13800.00	597.56	0.00	597.64	0.63	2.34	5896.29	17411.39
5693.000	100.00	0.00	0.00	576.20	6548.00	597.03	0.00	597.04	0.12	0.82	8149.95	18966.80
5693.000	100.00	0.00	0.00	576.20	9262.00	597.06	0.00	597.08	0.24	1.16	8171.78	19047.17
5693.000	100.00	0.00	0.00	576.20	10700.00	597.07	0.00	597.10	0.31	1.34	8183.72	19091.17
5693.000	100.00	0.00	0.00	576.20	13800.00	597.62	0.00	597.66	0.46	1.66	8533.86	20336.55
6693.000	1000.00	0.00	0.00	578.20	6548.00	597.04	0.00	597.05	0.06	0.54	12397.88	26284.98
6693.000	1000.00	0.00	0.00	578.20	9262.00	597.08	0.00	597.09	0.12	0.76	12445.04	26443.25
6693.000	1000.00	0.00	0.00	578.20	10700.00	597.11	0.00	597.13	0.16	0.87	12476.74	26549.84
6693.000	1000.00	0.00	0.00	578.20	13800.00	597.68	0.00	597.69	0.23	1.07	13119.51	28745.83
7653.000	960.00	0.00	0.00	583.30	6548.00	597.04	0.00	597.06	0.20	0.99	6632.80	14501.40
7653.000	960.00	0.00	0.00	583.30	9262.00	597.09	0.00	597.12	0.40	1.39	6658.04	14584.17
7653.000	960.00	0.00	0.00	583.30	10700.00	597.12	0.00	597.16	0.53	1.60	6676.15	14643.64
7653.000	960.00	0.00	0.00	583.30	13800.00	597.68	0.00	597.74	0.77	1.97	6992.40	15693.45
8013.000	360.00	0.00	0.00	584.03	6548.00	597.04	0.00	597.08	0.53	1.54	4824.79	8956.17
8013.000	360.00	0.00	0.00	584.03	9262.00	597.09	0.00	597.15	1.05	2.16	4850.19	9018.73
8013.000	360.00	0.00	0.00	584.03	10700.00	597.11	0.00	597.20	1.39	2.49	4868.52	9063.86
8013.000	360.00	0.00	0.00	584.03	13800.00	597.68	0.00	597.81	1.94	3.04	5213.94	9901.98
8480.000	467.00	0.00	0.00	585.71	6548.00	597.03	0.00	597.15	2.20	2.78	2587.30	4417.95
8480.000	467.00	0.00	0.00	585.71	9262.00	597.06	0.00	597.29	4.34	3.92	2597.97	4443.72
8480.000	467.00	0.00	0.00	585.71	10700.00	597.08	0.00	597.38	5.75	4.52	2605.04	4460.78
8480.000	467.00	0.00	0.00	585.71	13800.00	597.62	0.00	598.06	7.84	5.48	2796.01	4927.26
8714.000	234.00	0.00	0.00	586.55	6548.00	597.06	0.00	597.23	3.74	3.42	2080.21	3385.07
8714.000	234.00	0.00	0.00	586.55	9262.00	597.11	0.00	597.45	7.32	4.80	2096.65	3423.47
8714.000	234.00	0.00	0.00	586.55	10700.00	597.15	0.00	597.60	9.61	5.52	2108.32	3450.78
8714.000	234.00	0.00	0.00	586.55	13800.00	597.70	0.00	598.36	12.87	6.65	2275.60	3847.19
8831.000	117.00	0.00	0.00	587.28	6548.00	597.05	0.00	597.31	6.37	4.19	1675.83	2594.65
8831.000	117.00	0.00	0.00	587.28	9262.00	597.09	0.00	597.62	12.48	5.89	1687.99	2622.09
8831.000	117.00	0.00	0.00	587.28	10700.00	597.13	0.00	597.82	16.43	6.78	1695.87	2639.91
8831.000	117.00	0.00	0.00	587.28	13800.00	597.66	0.00	598.65	21.67	8.14	1837.64	2964.74

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
8948.000	117.00	0.00	0.00	588.00	6548.00	597.06	0.00	597.44	10.32	5.01	1389.27	2038.77
8948.000	117.00	0.00	0.00	588.00	9262.00	597.12	0.00	597.87	20.04	7.07	1403.37	2069.20
8948.000	117.00	0.00	0.00	588.00	10700.00	597.16	0.00	598.14	26.23	8.06	1412.69	2089.37
8948.000	117.00	0.00	0.00	588.00	13800.00	597.69	0.00	599.09	33.95	9.62	1539.02	2368.25
9113.000	165.00	0.00	0.00	588.30	6548.00	597.22	0.00	597.65	11.67	5.25	1247.74	1916.47
9113.000	165.00	0.00	0.00	588.30	9262.00	597.43	0.00	598.23	21.01	7.19	1288.00	2020.64
9113.000	165.00	0.00	0.00	588.30	10700.00	597.57	0.00	598.60	26.29	8.15	1313.11	2086.72
9113.000	165.00	0.00	0.00	588.30	13800.00	598.22	0.00	599.66	32.92	9.65	1429.92	2405.19

	9153.000	40.00	609.30	604.30	588.30	6548.00	597.28	0.00	597.70	11.26	5.19	1261.37	1951.48
	9153.000	40.00	609.30	604.30	588.30	9262.00	597.62	0.00	598.38	19.27	7.01	1321.76	2109.66
	9153.000	40.00	609.30	604.30	588.30	10700.00	597.86	0.00	598.81	23.11	7.84	1364.99	2225.93
	9153.000	40.00	609.30	604.30	588.30	13800.00	598.72	0.00	600.00	26.86	9.08	1519.88	2662.65
	9253.000	100.00	0.00	0.00	588.40	6548.00	597.44	0.00	597.82	10.43	5.02	1384.03	2027.50
	9253.000	100.00	0.00	0.00	588.40	9262.00	597.93	0.00	598.59	16.47	6.60	1500.54	2282.20
	9253.000	100.00	0.00	0.00	588.40	10700.00	598.27	0.00	599.07	18.81	7.27	1582.77	2466.86
	9253.000	100.00	0.00	0.00	588.40	13800.00	599.32	0.00	600.31	20.15	8.17	1844.77	3074.48
*	15913.000	1460.00	0.00	0.00	581.60	6548.00	597.44	0.00	597.60	3.87	3.25	2024.48	3330.67
*	15913.000	1460.00	0.00	0.00	581.60	9262.00	597.93	0.00	598.22	6.33	4.33	2160.73	3681.92
*	15913.000	1460.00	0.00	0.00	581.60	10700.00	598.27	0.00	598.63	7.40	4.80	2257.11	3934.59
*	15913.000	1460.00	0.00	0.00	581.60	13800.00	599.32	0.00	599.79	8.40	5.51	2564.14	4760.90
	18163.000	2250.00	0.00	0.00	581.60	6548.00	598.21	0.00	598.35	2.84	2.96	2239.59	3888.42
	18163.000	2250.00	0.00	0.00	581.60	9262.00	599.13	0.00	599.35	4.05	3.77	2505.43	4600.50
	18163.000	2250.00	0.00	0.00	581.60	10700.00	599.65	0.00	599.92	4.51	4.12	2664.89	5038.57
	18163.000	2250.00	0.00	0.00	581.60	13800.00	600.90	0.00	601.24	5.01	4.69	3129.10	6168.27
	18313.000	150.00	0.00	0.00	579.00	6548.00	598.33	0.00	598.39	0.87	2.02	3245.90	7033.84
	18313.000	150.00	0.00	0.00	579.00	9262.00	599.31	0.00	599.42	1.49	2.63	3527.03	7597.81
	18313.000	150.00	0.00	0.00	579.00	10700.00	599.87	0.00	600.00	1.71	2.90	3694.42	8182.05
	18313.000	150.00	0.00	0.00	579.00	13800.00	601.15	0.00	601.33	2.03	3.38	4087.17	9675.04
	18348.000	35.00	609.30	606.00	579.00	6548.00	598.33	0.00	598.39	0.87	2.02	3246.65	7036.10
	18348.000	35.00	609.30	606.00	579.00	9262.00	599.32	0.00	599.43	1.48	2.62	3528.49	7602.84
	18348.000	35.00	609.30	606.00	579.00	10700.00	599.87	0.00	600.00	1.71	2.89	3696.22	8188.43
	18348.000	35.00	609.30	606.00	579.00	13800.00	601.16	0.00	601.34	2.03	3.37	4089.76	9685.25
	18508.000	160.00	0.00	0.00	581.50	6548.00	598.31	0.00	598.45	1.82	2.99	2186.61	4859.69
	18508.000	160.00	0.00	0.00	581.50	9262.00	599.29	0.00	599.52	2.89	3.93	2358.66	5446.12
	18508.000	160.00	0.00	0.00	581.50	10700.00	599.83	0.00	600.12	3.42	4.36	2455.40	5784.34
	18508.000	160.00	0.00	0.00	581.50	13800.00	601.09	0.00	601.50	4.23	5.13	2802.84	6711.05
	22508.000	3500.00	0.00	0.00	581.50	6548.00	598.92	0.00	599.04	1.57	2.86	2293.18	5320.59
	22508.000	3500.00	0.00	0.00	581.50	9262.00	600.23	0.00	600.44	2.34	3.66	2532.63	6057.26
	22508.000	3500.00	0.00	0.00	581.50	10700.00	600.92	0.00	601.17	2.65	4.03	2738.36	6578.26
	22508.000	3500.00	0.00	0.00	581.50	13800.00	602.43	0.00	602.76	3.06	4.62	3519.44	7892.38

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
25508.000	3500.00	0.00	0.00	591.40	6548.00	599.71	0.00	599.84	3.57	2.87	2281.62	3467.23
25508.000	3500.00	0.00	0.00	591.40	9262.00	601.28	0.00	601.44	3.61	3.30	2813.35	4873.09
25508.000	3500.00	0.00	0.00	591.40	10700.00	602.06	0.00	602.25	3.58	3.49	3084.38	5653.10
25508.000	3500.00	0.00	0.00	591.40	13800.00	603.68	0.00	603.91	3.48	3.81	3647.47	7398.95
26508.000	1000.00	0.00	0.00	592.80	6548.00	600.13	0.00	600.31	5.94	3.35	1952.88	2687.58
26508.000	1000.00	0.00	0.00	592.80	9262.00	601.68	0.00	601.90	5.48	3.75	2474.54	3957.42
26508.000	1000.00	0.00	0.00	592.80	10700.00	602.46	0.00	602.70	5.26	3.92	2739.24	4667.03
26508.000	1000.00	0.00	0.00	592.80	13800.00	604.05	0.00	604.33	4.85	4.22	3288.85	6268.07

31808.000	5300.00	0.00	0.00	600.22	6548.00	605.50	0.00	605.91	22.96	5.12	1279.38	1366.55
31808.000	5300.00	0.00	0.00	600.22	9262.00	606.59	0.00	607.09	21.25	5.67	1634.76	2009.44
31808.000	5300.00	0.00	0.00	600.22	10700.00	607.13	0.00	607.67	20.20	5.90	1814.03	2380.50
31808.000	5300.00	0.00	0.00	600.22	13800.00	608.27	0.00	608.89	18.00	6.60	2194.29	3253.12

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SUMMARY PRINTOUT TABLE 150

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
0.000	6548.00	579.40	0.00	0.00	0.00	329.50	0.00
0.000	9262.00	579.40	0.00	0.00	0.00	329.50	0.00
0.000	10700.00	579.40	0.00	0.00	0.00	329.50	0.00
0.000	13800.00	579.40	0.00	0.00	0.00	329.50	0.00

1349.000	6548.00	579.47	0.00	0.07	0.00	222.74	1349.00
1349.000	9262.00	579.55	0.07	0.15	0.00	223.04	1349.00
1349.000	10700.00	579.59	0.05	0.19	0.00	223.27	1349.00
1349.000	13800.00	579.72	0.13	0.32	0.00	223.79	1349.00
1449.000	6548.00	579.46	0.00	-0.02	0.00	146.47	100.00
1449.000	9262.00	579.51	0.06	-0.03	0.00	146.47	100.00
1449.000	10700.00	579.55	0.04	-0.04	0.00	146.47	100.00
1449.000	13800.00	579.65	0.10	-0.07	0.00	146.48	100.00
1450.000	6548.00	579.46	0.00	0.00	0.00	146.47	1.00
1450.000	9262.00	579.51	0.06	0.00	0.00	146.47	1.00
1450.000	10700.00	579.55	0.04	0.00	0.00	146.47	1.00
1450.000	13800.00	579.65	0.10	0.00	0.00	146.48	1.00
1510.000	6548.00	579.46	0.00	0.01	0.00	146.47	60.00
1510.000	9262.00	579.53	0.06	0.01	0.00	146.47	60.00
1510.000	10700.00	579.57	0.04	0.02	0.00	146.48	60.00
1510.000	13800.00	579.68	0.11	0.03	0.00	146.48	60.00
1512.000	6548.00	579.46	0.00	0.00	0.00	146.47	2.00
1512.000	9262.00	579.53	0.06	0.00	0.00	146.47	2.00
1512.000	10700.00	579.57	0.04	0.00	0.00	146.48	2.00
1512.000	13800.00	579.68	0.11	0.00	0.00	146.48	2.00
1662.000	6548.00	579.51	0.00	0.05	0.00	196.00	150.00
1662.000	9262.00	579.62	0.11	0.10	0.00	196.22	150.00
1662.000	10700.00	579.70	0.08	0.13	0.00	196.37	150.00
1662.000	13800.00	579.90	0.20	0.22	0.00	196.75	150.00
2231.000	6548.00	579.56	0.00	0.05	0.00	339.18	569.00
2231.000	9262.00	579.72	0.16	0.10	0.00	340.17	569.00
2231.000	10700.00	579.83	0.11	0.13	0.00	340.88	569.00
2231.000	13800.00	580.11	0.28	0.21	0.00	342.59	569.00
2881.000	6548.00	579.58	0.00	0.02	0.00	407.09	650.00
2881.000	9262.00	579.77	0.18	0.04	0.00	407.42	650.00
2881.000	10700.00	579.89	0.12	0.06	0.00	407.64	650.00
2881.000	13800.00	580.20	0.31	0.09	0.00	408.20	650.00

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
3281.000	6548.00	579.56	0.00	-0.03	0.00	301.54	400.00
3281.000	9262.00	579.71	0.16	-0.05	0.00	302.34	400.00
3281.000	10700.00	579.82	0.10	-0.07	0.00	302.88	400.00
3281.000	13800.00	580.09	0.27	-0.11	0.00	304.30	400.00
3947.000	6548.00	579.60	0.00	0.04	0.00	229.70	666.00
3947.000	9262.00	579.80	0.20	0.08	0.00	230.04	666.00
3947.000	10700.00	579.92	0.13	0.11	0.00	230.26	666.00
3947.000	13800.00	580.25	0.33	0.16	0.00	230.83	666.00

	4612.000	6548.00	579.97	0.00	0.37	0.00	225.68	665.00
	4612.000	9262.00	580.47	0.50	0.67	0.00	226.53	665.00
	4612.000	10700.00	580.76	0.30	0.84	0.00	227.05	665.00
	4612.000	13800.00	581.44	0.68	1.19	0.00	228.23	665.00
	4762.000	6548.00	580.34	0.00	0.37	0.00	208.09	150.00
	4762.000	9262.00	581.07	0.73	0.60	0.00	210.73	150.00
	4762.000	10700.00	581.48	0.41	0.71	0.00	212.22	150.00
	4762.000	13800.00	582.38	0.90	0.93	0.00	215.47	150.00
	4829.000	6548.00	580.34	0.00	0.01	0.00	208.11	67.00
	4829.000	9262.00	581.08	0.74	0.01	0.00	210.77	67.00
	4829.000	10700.00	581.49	0.42	0.02	0.00	212.27	67.00
	4829.000	13800.00	582.40	0.91	0.03	0.00	215.55	67.00
	4859.000	6548.00	580.43	0.00	0.08	0.00	248.80	30.00
	4859.000	9262.00	581.23	0.80	0.15	0.00	252.26	30.00
	4859.000	10700.00	581.68	0.45	0.18	0.00	254.22	30.00
	4859.000	13800.00	582.66	0.98	0.26	0.00	258.49	30.00
	5159.000	6548.00	580.41	0.00	-0.01	0.00	241.38	300.00
	5159.000	9262.00	581.21	0.80	-0.01	0.00	244.84	300.00
	5159.000	10700.00	581.67	0.45	-0.01	0.00	246.80	300.00
	5159.000	13800.00	582.65	0.99	0.01	0.00	251.08	300.00
*	5183.000	6548.00	597.00	0.00	16.59	0.00	320.00	24.00
*	5183.000	9262.00	597.00	0.00	15.79	0.00	320.00	24.00
*	5183.000	10700.00	597.00	0.00	15.33	0.00	320.00	24.00
*	5183.000	13800.00	597.50	0.50	14.85	0.00	320.00	24.00
	5383.000	6548.00	597.01	0.00	0.01	0.00	654.23	200.00
	5383.000	9262.00	597.03	0.01	0.03	0.00	654.37	200.00
	5383.000	10700.00	597.04	0.01	0.04	0.00	654.47	200.00
	5383.000	13800.00	597.56	0.52	0.06	0.00	660.21	200.00
	5583.000	6548.00	597.01	0.00	0.00	0.00	320.00	200.00
	5583.000	9262.00	597.02	0.01	-0.01	0.00	320.00	200.00
	5583.000	10700.00	597.03	0.01	-0.01	0.00	320.00	200.00
	5583.000	13800.00	597.54	0.52	-0.02	0.00	320.00	200.00

Engineering Company

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
5593.000	6548.00	597.01	0.00	0.00	0.00	320.00	10.00
5593.000	9262.00	597.03	0.01	0.01	0.00	320.00	10.00
5593.000	10700.00	597.04	0.01	0.01	0.00	320.00	10.00
5593.000	13800.00	597.56	0.52	0.02	0.00	320.00	10.00
5693.000	6548.00	597.03	0.00	0.01	0.00	641.08	100.00
5693.000	9262.00	597.06	0.03	0.03	0.00	641.20	100.00
5693.000	10700.00	597.07	0.02	0.04	0.00	641.26	100.00
5693.000	13800.00	597.62	0.54	0.06	0.00	646.08	100.00

6693.000	6548.00	597.04	0.00	0.01	0.00	1141.21	1000.00
6693.000	9262.00	597.08	0.04	0.03	0.00	1141.47	1000.00
6693.000	10700.00	597.11	0.03	0.04	0.00	1141.65	1000.00
6693.000	13800.00	597.68	0.56	0.06	0.00	1145.27	1000.00
7653.000	6548.00	597.04	0.00	0.00	0.00	564.69	960.00
7653.000	9262.00	597.09	0.04	0.00	0.00	565.22	960.00
7653.000	10700.00	597.12	0.03	0.01	0.00	565.60	960.00
7653.000	13800.00	597.68	0.56	0.01	0.00	572.26	960.00
8013.000	6548.00	597.04	0.00	0.00	0.00	595.11	360.00
8013.000	9262.00	597.09	0.04	0.00	0.00	597.45	360.00
8013.000	10700.00	597.11	0.03	-0.01	0.00	599.13	360.00
8013.000	13800.00	597.68	0.56	-0.01	0.00	678.93	360.00
8480.000	6548.00	597.03	0.00	-0.01	0.00	348.76	467.00
8480.000	9262.00	597.06	0.03	-0.02	0.00	349.31	467.00
8480.000	10700.00	597.08	0.02	-0.03	0.00	349.68	467.00
8480.000	13800.00	597.62	0.54	-0.05	0.00	359.35	467.00
8714.000	6548.00	597.06	0.00	0.02	0.00	300.83	234.00
8714.000	9262.00	597.11	0.05	0.05	0.00	301.71	234.00
8714.000	10700.00	597.15	0.04	0.06	0.00	302.34	234.00
8714.000	13800.00	597.70	0.55	0.08	0.00	311.15	234.00
8831.000	6548.00	597.05	0.00	-0.01	0.00	260.09	117.00
8831.000	9262.00	597.09	0.05	-0.02	0.00	260.75	117.00
8831.000	10700.00	597.13	0.03	-0.02	0.00	261.17	117.00
8831.000	13800.00	597.66	0.53	-0.04	0.00	268.88	117.00
8948.000	6548.00	597.06	0.00	0.01	0.00	234.05	117.00
8948.000	9262.00	597.12	0.06	0.03	0.00	234.63	117.00
8948.000	10700.00	597.16	0.04	0.04	0.00	235.02	117.00
8948.000	13800.00	597.69	0.53	0.03	0.00	240.83	117.00
9113.000	6548.00	597.22	0.00	0.16	0.00	180.61	165.00
9113.000	9262.00	597.43	0.21	0.31	0.00	180.61	165.00
9113.000	10700.00	597.57	0.14	0.41	0.00	180.61	165.00
9113.000	13800.00	598.22	0.65	0.53	0.00	180.61	165.00

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
9153.000	6548.00	597.28	0.00	0.07	0.00	180.61	40.00
9153.000	9262.00	597.62	0.33	0.19	0.00	180.61	40.00
9153.000	10700.00	597.86	0.24	0.29	0.00	180.61	40.00
9153.000	13800.00	598.72	0.86	0.50	0.00	180.61	40.00
9253.000	6548.00	597.44	0.00	0.15	0.00	233.83	100.00
9253.000	9262.00	597.93	0.49	0.31	0.00	238.72	100.00
9253.000	10700.00	598.27	0.34	0.41	0.00	243.19	100.00
9253.000	13800.00	599.32	1.04	0.60	0.00	257.30	100.00

*	15913.000	6548.00	597.44	0.00	0.00	0.00	274.90	1460.00
*	15913.000	9262.00	597.93	0.49	0.00	0.00	281.23	1460.00
*	15913.000	10700.00	598.27	0.34	0.00	0.00	285.63	1460.00
*	15913.000	13800.00	599.32	1.05	0.00	0.00	299.21	1460.00
	18163.000	6548.00	598.21	0.00	0.77	0.00	284.84	2250.00
	18163.000	9262.00	599.13	0.92	1.20	0.00	296.66	2250.00
	18163.000	10700.00	599.65	0.52	1.38	0.00	303.53	2250.00
	18163.000	13800.00	600.90	1.25	1.58	0.00	489.15	2250.00
	18313.000	6548.00	598.33	0.00	0.12	0.00	276.41	150.00
	18313.000	9262.00	599.31	0.99	0.18	0.00	303.29	150.00
	18313.000	10700.00	599.87	0.55	0.21	0.00	304.66	150.00
	18313.000	13800.00	601.15	1.29	0.25	0.00	305.00	150.00
	18348.000	6548.00	598.33	0.00	0.00	0.00	276.43	35.00
	18348.000	9262.00	599.32	0.99	0.00	0.00	303.30	35.00
	18348.000	10700.00	599.87	0.55	0.01	0.00	304.68	35.00
	18348.000	13800.00	601.16	1.29	0.01	0.00	305.00	35.00
	18508.000	6548.00	598.31	0.00	-0.02	0.00	175.41	160.00
	18508.000	9262.00	599.29	0.97	-0.03	0.00	178.06	160.00
	18508.000	10700.00	599.83	0.54	-0.04	0.00	179.53	160.00
	18508.000	13800.00	601.09	1.27	-0.07	0.00	399.41	160.00
	22508.000	6548.00	598.92	0.00	0.60	0.00	177.06	3500.00
	22508.000	9262.00	600.23	1.31	0.94	0.00	225.63	3500.00
	22508.000	10700.00	600.92	0.70	1.10	0.00	365.53	3500.00
	22508.000	13800.00	602.43	1.51	1.34	0.00	669.03	3500.00
	25508.000	6548.00	599.71	0.00	0.79	0.00	337.20	3500.00
	25508.000	9262.00	601.28	1.56	1.05	0.00	342.49	3500.00
	25508.000	10700.00	602.06	0.79	1.14	0.00	345.16	3500.00
	25508.000	13800.00	603.68	1.62	1.25	0.00	350.63	3500.00
	26508.000	6548.00	600.13	0.00	0.42	0.00	333.88	1000.00
	26508.000	9262.00	601.68	1.55	0.41	0.00	339.13	1000.00
	26508.000	10700.00	602.46	0.78	0.40	0.00	341.76	1000.00
	26508.000	13800.00	604.05	1.60	0.37	0.00	347.15	1000.00

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
31808.000	6548.00	605.50	0.00	5.37	0.00	319.17	5300.00
31808.000	9262.00	606.59	1.09	4.91	0.00	330.04	5300.00
31808.000	10700.00	607.13	0.54	4.68	0.00	332.47	5300.00
31808.000	13800.00	608.27	1.14	4.22	0.00	336.32	5300.00

SUMMARY OF ERRORS

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NOTE     SECNO= 5183.000  PROFILE= 1  WSEL BASED ON X5 CARD
NOTE     SECNO= 5183.000  PROFILE= 2  WSEL BASED ON X5 CARD
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  MODIFICATION -  50,51,52,53,54
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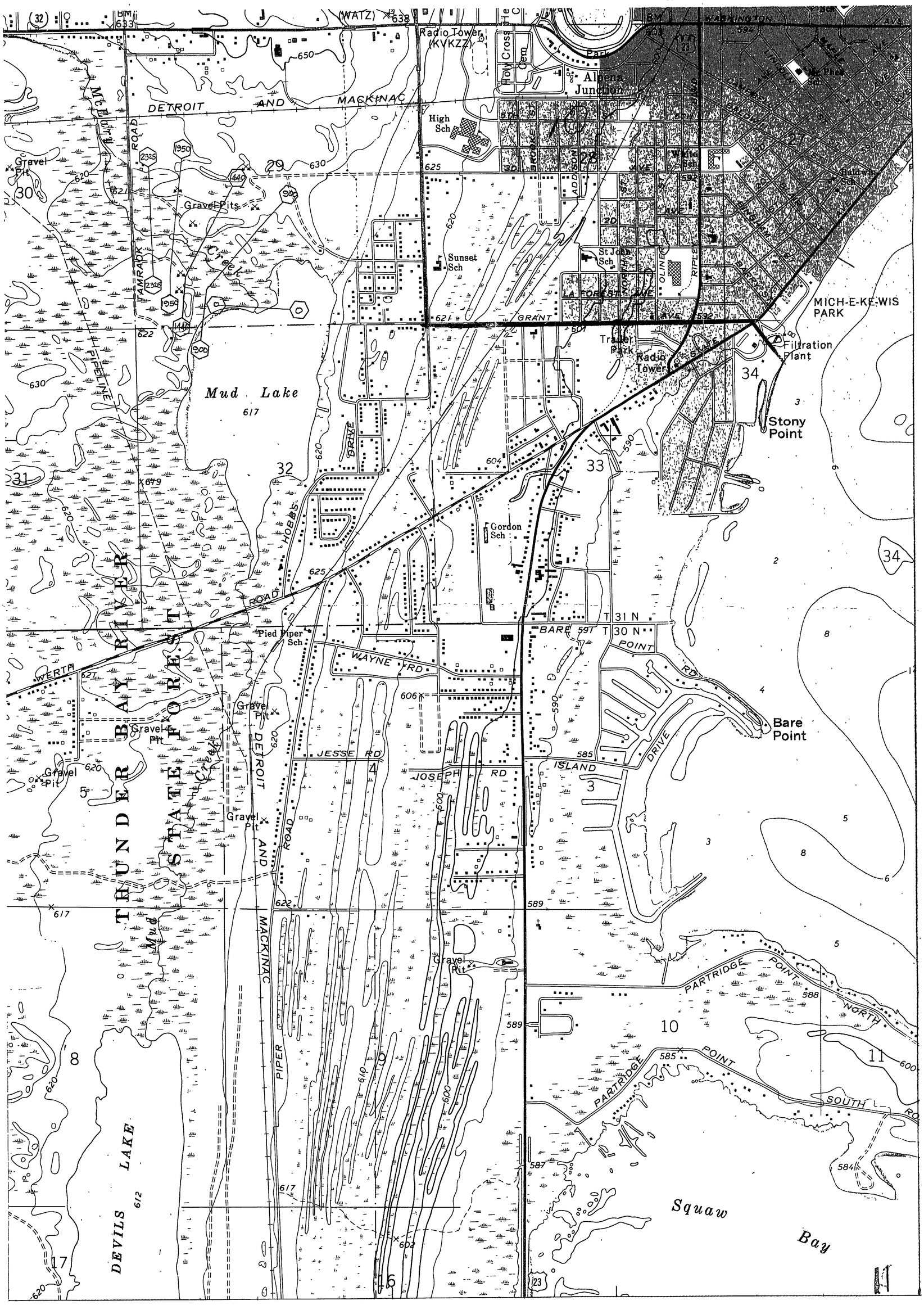

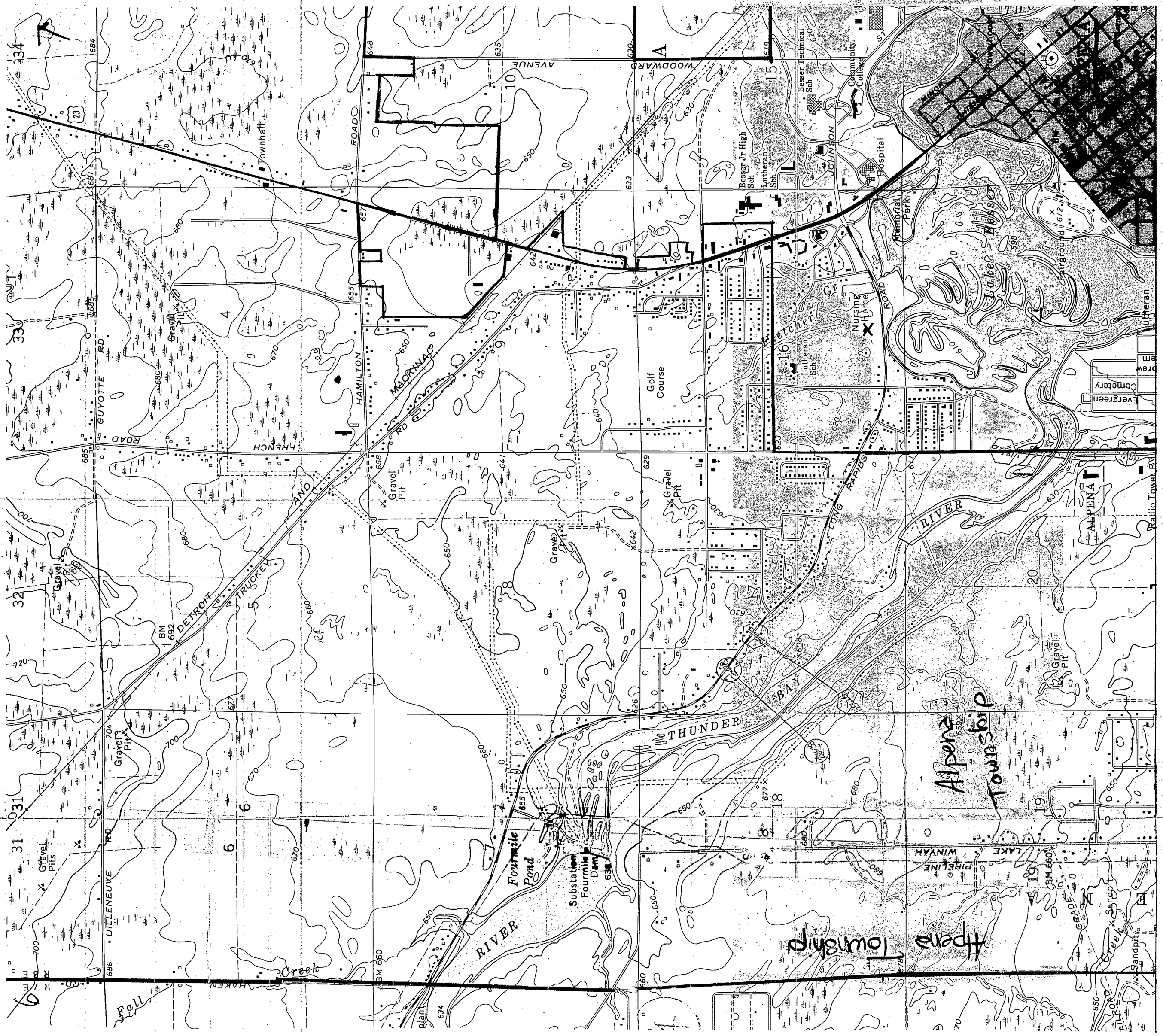
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Alpena Township
THUNDER BAY RIVER
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Substation
Lake Winyah
Pipeline
Lake Huron
Fletcher Nursing Home
Golf Course
Besser Jr High Sch
Lutheran Sch
Besser Technical Sch
Community College
Hospital
Memorial Park
Fairgrounds
Evergreen Cemetery
Lutheran Sch
Radio Tower
Gravel Pit
Townhall
Sandpit
Creek
Fall Creek
HAMILTON ROAD
WOODWARD AVENUE
JOHNSON ROAD
LONG RAPIDS
MACKINAC RD
DETROIT AND MACKINAC RD
TRUCKEY
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GUYOTTE RD
UTLENEUVE RD
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ALPENA
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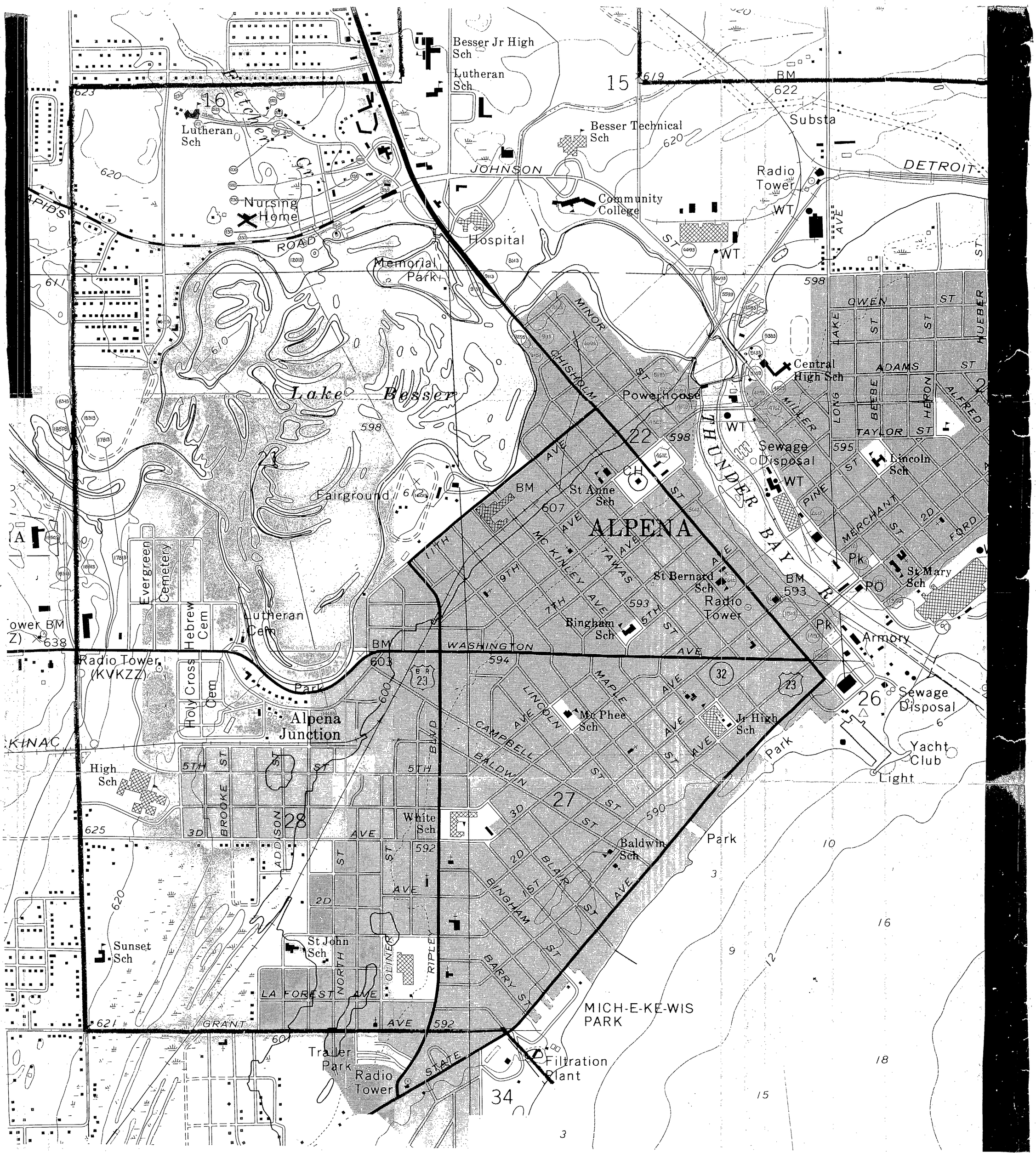
BM 660
BM 692
BM 660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ROAD
Hospital
Memorial Park
Lake Besser
Fairground
Powerhouse
Central High Sch
Sewage Disposal
Lincoln Sch
THUNDER BAY R
ALPENA
St Anne Sch
St Bernard Sch
Radio Tower
Bingham Sch
St Mary Sch
Armory
Evergreen Cemetery
Hebrew Cem
Lutheran Cem
Radio Tower (KVKZZ)
Holy Cross Cem
Park
Alpena Junction
WASHINGTON
Mc Phee Sch
Jr High Sch
Sewage Disposal
Yacht Club
Light
High Sch
White Sch
Baldwin Sch
Sunset Sch
St John Sch
MICH-E-KE-WIS PARK
Trailer Park
Radio Tower
Filtration Plant
GRANT
STATE
MINOR
CHISHOLM
MILLER
OWEN
ADAMS
TAYLOR
PINE
MERCHANT
FORD
MC KINLEY
TAWAS
LINCOLN
MAPLE
CAMPBELL
BALDWIN
BLAIR
BINGHAM
BARRY
BROOKE
ADDISON
RIPLEY
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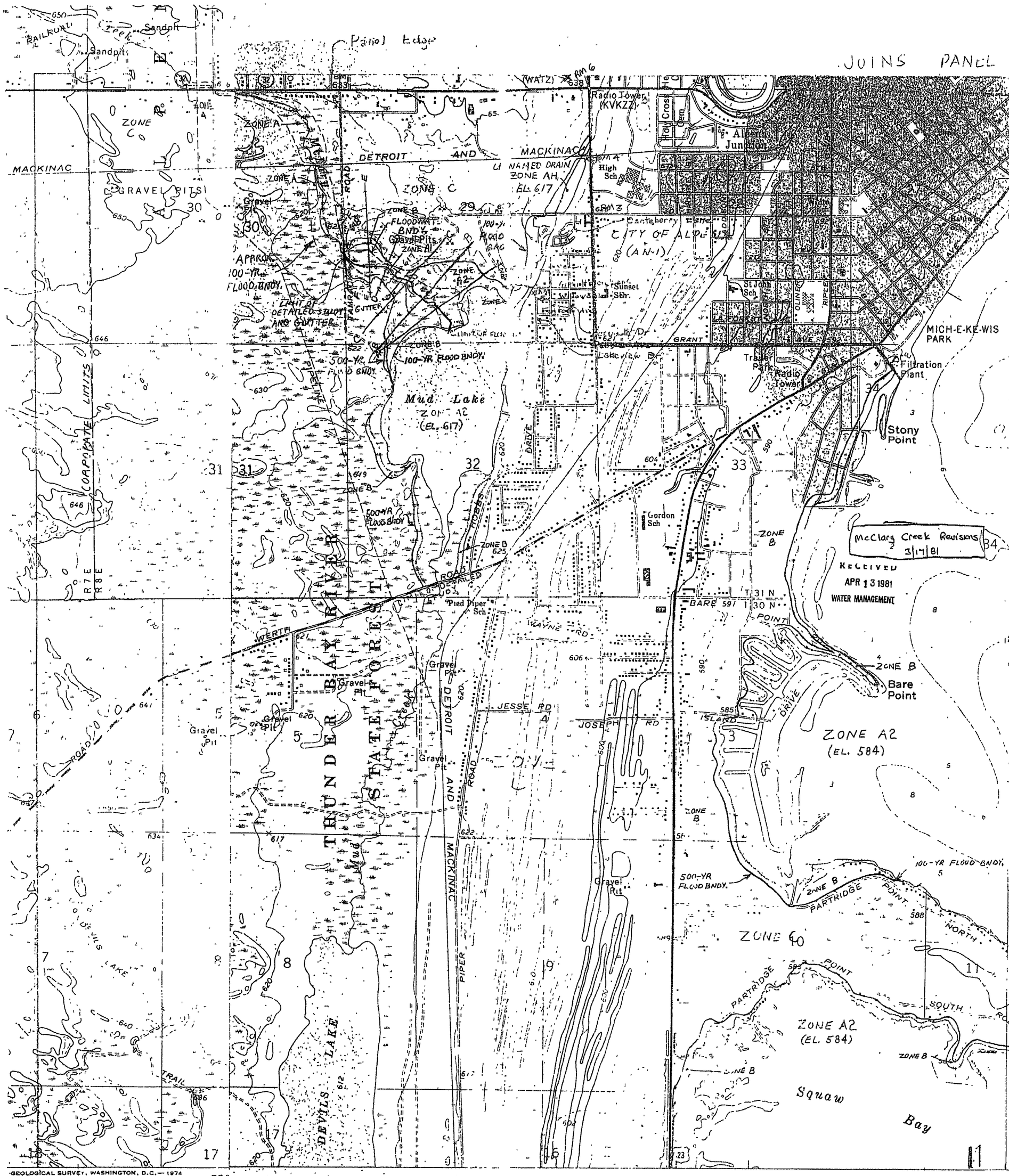
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JOIN PANEL B
MACKINAC
DETROIT AND MACKINAC ROAD
ZONE A
ZONE C
ZONE A2
ZONE B
GRAVEL PITS
Gravel Pit
Radio Tower (KVKZZ)
High Sch
Alberta Junction
CITY OF ALPENA (AN-1)
Sunset Str.
St John Sch
MICH-E-KE-WIS PARK
Filtration Plant
Trailer Park
Radio Tower
Stony Point
Mud Lake
ZONE A2 (EL. 617)
Gordon Sch
Pied Piper Sch
THUNDER BAY STATE FOREST
DEVILS LAKE
Bare Point
ZONE A2 (EL. 584)
PARTRIDGE POINT NORTH ROAD
PARTRIDGE POINT SOUTH ROAD
Squaw Bay
100-YR FLOOD BNDY.
500-YR FLOOD BNDY.
LIMIT OF DETAILED STUDY AND GUTTER
NAMED DRAIN ZONE AH EL. 617
APPROX 100-YR FLOOD BNDY.
CORPORATE LIMITS
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McClary Creek Revisions 3/17/81
RECEIVED APR 13 1981 WATER MANAGEMENT
GEOLOGICAL SURVEY, WASHINGTON, D.C.—1974
302000m E.
ROAD CLASSIFICATION

1) COUNTY: Alpena

2) STUDY NAME: Alpena Twp

3) WATERCOURSE: Wave Run-up

4) DOCUMENT TYPE: Report

DRAFT

TECHNICAL LETTER REPORT ON
ALPENA TOWNSHIP, MICHIGAN

Prepared by the U.S. Army Corps of Engineers
for the Federal Emergency Management Agency

Detroit, Michigan
October 1990

TECHNICAL LETTER REPORT ON
ALPENA TOWNSHIP, MICHIGAN

TABLE OF CONTENTS

Title	Page
TABLE OF CONTENTS	i
LIST OF FIGURES	ii
LIST OF TABLES	ii
1.0 INTRODUCTION	1
1.1 PURPOSE OF STUDY	1
1.2 AUTHORITY AND ACKNOWLEDGMENTS	1
1.3 COORDINATION	1
2.0 AREA STUDIED	3
2.1 COMMUNITY DESCRIPTION	3
2.2 PRINCIPAL FLOOD PROBLEMS	5
3.0 ENGINEERING METHODS	5
4.0 A-ZONE AND V-ZONE DELINEATION	6
5.0 CONCLUSIONS	14
6.0 GLOSSARY	15
7.0 REFERENCES	16
8.0 DEFINITION OF TERMS	17

TECHNICAL LETTER REPORT ON
ALPENA TOWNSHIP, MICHIGAN

LIST OF FIGURES

Number	Title	Page
1.	ALPENA TOWNSHIP LOCATION MAP	4
2.	ALPENA TOWNSHIP A & V-ZONE DELINEATIONS ON A BEACH/BLUFF SYSTEM (PROFILE A-1)	8
3.	ALPENA TOWNSHIP A & V-ZONE DELINEATIONS ON A BEACH/BLUFF SYSTEM (PROFILE A-2)	9
4.	ALPENA TOWNSHIP A & V-ZONE DELINEATIONS ON A BEACH/BLUFF SYSTEM (PROFILE A-3)	10
5.	ALPENA TOWNSHIP A & V-ZONE DELINEATIONS ON A BEACH/DUNE SYSTEM (PROFILE A-4)	11
6.	ALPENA TOWNSHIP A & V-ZONE DELINEATIONS ON A BEACH/DUNE SYSTEM (PROFILE A-5)	12

LIST OF TABLES

Number	Title	Page
1.	SHORELINE PROFILES, ALPENA TOWNSHIP, MICHIGAN	2

Appendix	Title
A	FIS PROFILES AND COMPUTATIONS

TECHNICAL LETTER REPORT ON
ALPENA TOWNSHIP, MICHIGAN

1.0 INTRODUCTION

1.1 Purpose of Study

This report describes the application of the procedures developed in the 1989 "Great Lakes Wave Runup Methodology Study" to flood levels on Saginaw Bay, specifically in Alpena Township, Michigan. The flood levels were developed in the April 1988 "Revised Report on Great Lakes Open-Coast Flood Levels".

1.2 Authority and Acknowledgments

The "Great Lakes Wave Runup Methodology Study" was prepared in 1989 by the U.S. Army Corps of Engineers (COE) for the Federal Emergency Management Agency (FEMA), for application to future coastal Flood Insurance Studies (FIS) and/or restudies of communities bordering the Great Lakes. The work was conducted under Inter-Agency Work Agreement, EMW-89-E-3218, Project Order No. 1, between the COE and FEMA. The 100-year flood levels from the September 1989 report referenced above, were used to compute the maximum wave runup elevations required for updating the existing FIS in Alpena Township on Lake Huron. TABLE 1 lists profile elevations, and the 100-year and 500-year flood levels at five locations. The five profiles were plotted from data obtained from a June 1990 survey.

1.3 Coordination

The "Flood Levels Report For Saginaw Bay", along with examples of the application of the methodology from the 1989 "Great Lakes Wave Runup Methodology Study", were presented to FEMA on March 1, 1990. The procedures outlined in the above

SHORELINE PROFILES

ALPENA TOWNSHIP, MICHIGAN

Profile Location	Water's Edge Elevation *	Beach Berm Elevation *	100-year Flood Levels	500-year Flood Levels
1. Alpena-1 (U.S. 23, #8339)	579.5	585.5	583.8	584.7
2. Alpena-2 (U.S. 23, #7424)	"	"	"	"
3. Alpena-3 (U.S. 23, #6525)	"	"	"	"
4. Alpena-4 (S. Partridge Point Road)	"	"	"	"
5. Alpena-5 (N. Partridge Point Road)	"	"	"	"

Note: * from June 1990 survey

TABLE 1

references were approved at this meeting for application to all Saginaw Bay FIS sites, including Alpena Township.

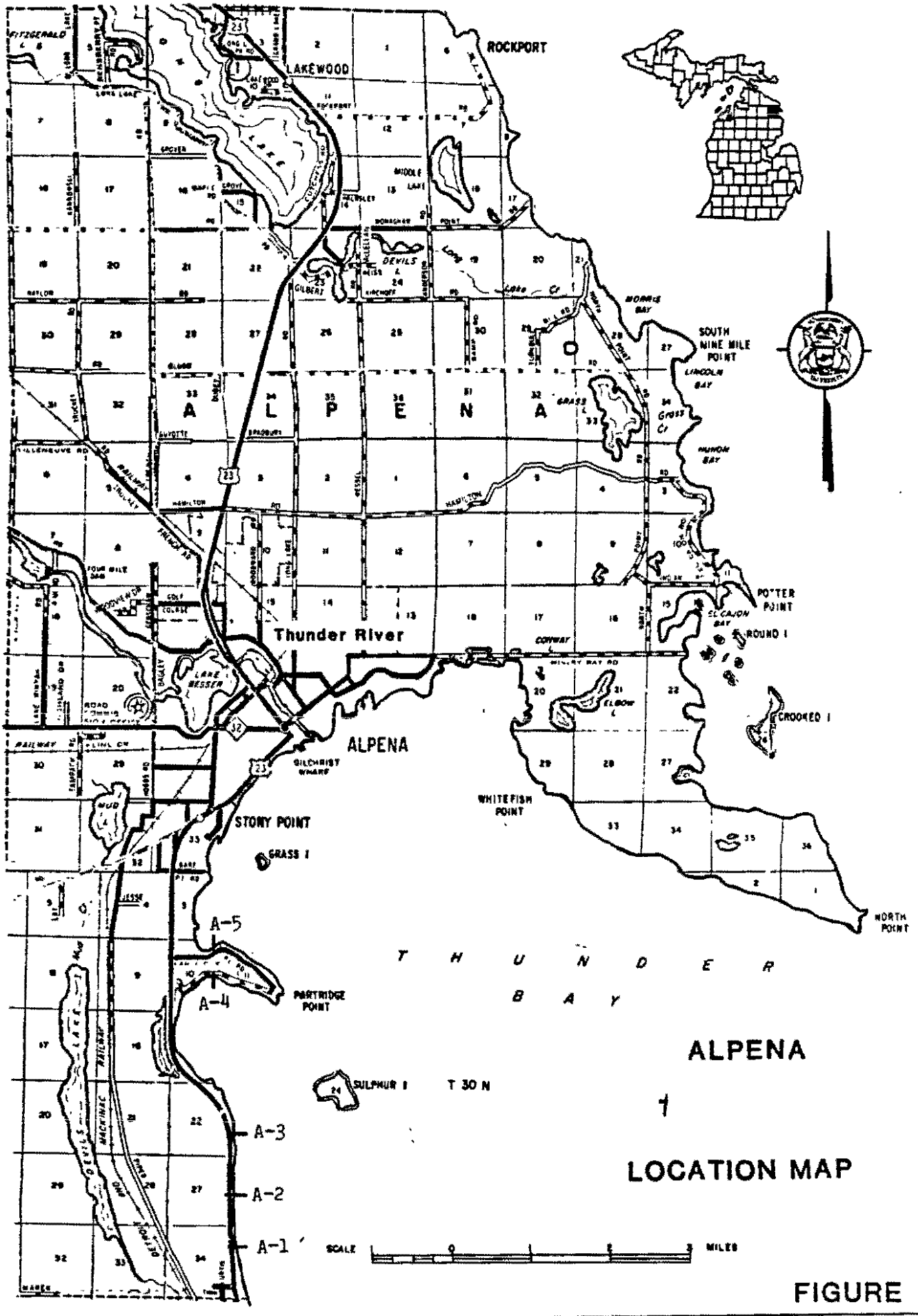
2.0 AREA STUDIED

2.1 Community Description

The Township of Alpena, Michigan, shown on FIGURE 1, is situated on both sides of the lower three miles of the Thunder River, on Thunder Bay. Alpena Township has a shoreline approximately 31 miles long and it also encompasses the City of Alpena. Bathymetry in Thunder Bay varies from 60 foot depths near the river mouth to shoal waters less than five feet deep bordering the southern shores of the bay. Bottom materials are variable, ranging from stone to gravel, to sand or clay. The Thunder Bay shoreline is protected to some extent from northeasterly and easterly storms by North Point.

The City of Alpena has a population of about 14,682 and is the county seat of Alpena County. Principle industries of the city and their products are the Huron Portland Cement Company - cement; Abitibi Corporation - wallboard and other wood products; Fletcher Paper Company - paper products; and the Besser Manufacturing Company - concrete block machinery.

The waterfront of Alpena is exposed from the southeast to a fetch of about 100 miles. Ordinary fluctuations of water levels at Alpena are of the same magnitude and frequency as apply generally to harbors on Lake Huron. The lowest seasonable lake stages usually prevail during the winter months and the highest during the summer months. In the past 100 years, fluctuations of



ALPENA

LOCATION MAP

FIGURE 1

water levels on Lake Huron, as measured by monthly means, have ranged from a minimum of 575.35 feet to a maximum 581.62 feet (IGLD, 1955).

2.2 Principal Flood Problems

On a daily basis, the water level of Thunder Bay often changes, due to variations in wind and barometric pressure. Occasionally, a surge of considerable proportions takes place within a few hours, due to strong and persistent northerly or southerly winds.

During the navigation season, 1 April through 30 November, winds from the effective fetch from the northeast to southwest occur about 38 percent of the time in Thunder Bay. The highest monthly recorded winds are from the east and southeast directions. Accordingly, the Alpena Township shoreline is subject to ~~severe wind~~ and wave conditions during a large percentage of the time.

Uh-Uh!! 38% of time and E-SE is a small % of this!

When lake levels are high and storms occur from the northeast to southwest, shoreline communities located in Alpena Township are usually subjected to extreme conditions. Along the Alpena Township shoreline, substantial flooding has occurred because of the flat topography in the reaches on Thunder Bay.

no effect from SW

3.0 ENGINEERING METHODS

The flood levels established in the U.S. Army Corps of Engineer's April 1988 "Revised Report on Great Lakes Open-Coast Flood Levels" and the procedures developed in the 1989 "Great Lakes Wave Runup Methodology Study" were used to analyze the

flooding potential at the five Alpena Township FIS sites on Thunder Bay shown on FIGURE 1. The hydraulic analyses presented herein involved the determination of the wave runup components and maximum wave runup elevations for selected sites. The analyses utilized the methodology and flood levels established in the reports referenced above.

Input data used for flood calculations include site specific design wave, water depth at the toe of the structure, and wave period. Additional data such as nearshore profiles, high water marks, and existing conditions, bathymetry and topography, were also analyzed to determine the maximum wave runup elevation at each site. This technical letter report presents the wave runup application procedures for each of the five FIS sites located in Alpena Township. Representative profiles for each site are included in APPENDIX A.

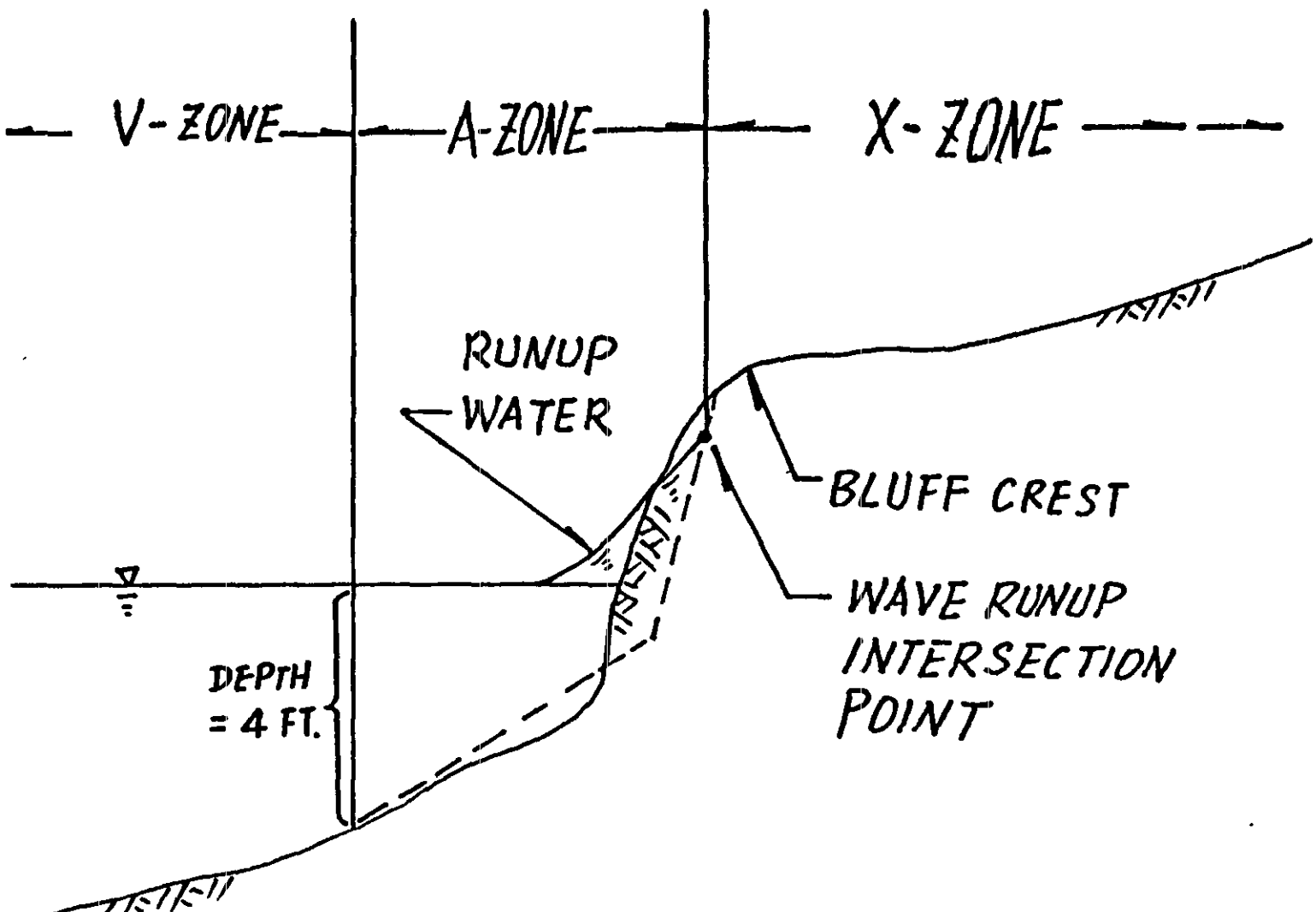
4.0 A-ZONE and V-Zone Delineations

Reaches of the Alpena Township shoreline in the surf zone which are subject to significant wave attack are referred to by FEMA as Coastal High Hazard Zones or velocity ("V") Zones. A "V" Zone is the flood insurance rate zone that corresponds to the 100-year coastal floodplain that has additional hazards associated with storm waves. The "V" Zone is defined in FEMA's "Guidelines For Great Lakes Wave Runup Computation And Mapping" as the maximum elevation reached by the wave runup associated with the 100-year flood level. This section at the shoreline

and/or structure is critical in terms of causing significant structural damage. An "A" Zone is the flood insurance rate zone that corresponds to the 100-year flood levels that are determined in the FIS by detailed methods. It is further defined as that area that is inundated by the 100-year flood and shoreward of the "V" Zone.

Two different A and V-Zone flood conditions exist for the FIS sites in Alpena Township. The first type of condition involves a beach/bluff system where wave runup does not overtop the existing beach/bluff. The V/A demarcation line is fixed at the point where the 100-year storm water depth is equal to 4 feet on the lakeward side of the bluff. The A/X demarcation line is fixed at the point where the wave runup intersects the calculated post-storm profile. The V-zone is the maximum elevation reached by wave runup associated with the 100-year flood level. This type of flooding condition is representative of profiles Alpena-1, Alpena-2, and Alpena-3 and is shown on FIGURES 2-4. The second flood condition existing in Alpena Township, involves the flooding or breaching of an existing beach/dune by the 100-year flood. For this case, the V/A-zone demarcation line is where the largest 100-year water depth for the flooded area on the landward side of the beach/dune heel point is less than 4 feet. The V-zone is lakeward of this line, while the A-zone is landward. This mapping is considered appropriate for profiles Alpena-4 and Alpena-5, and are shown on FIGURES 5 & 6.

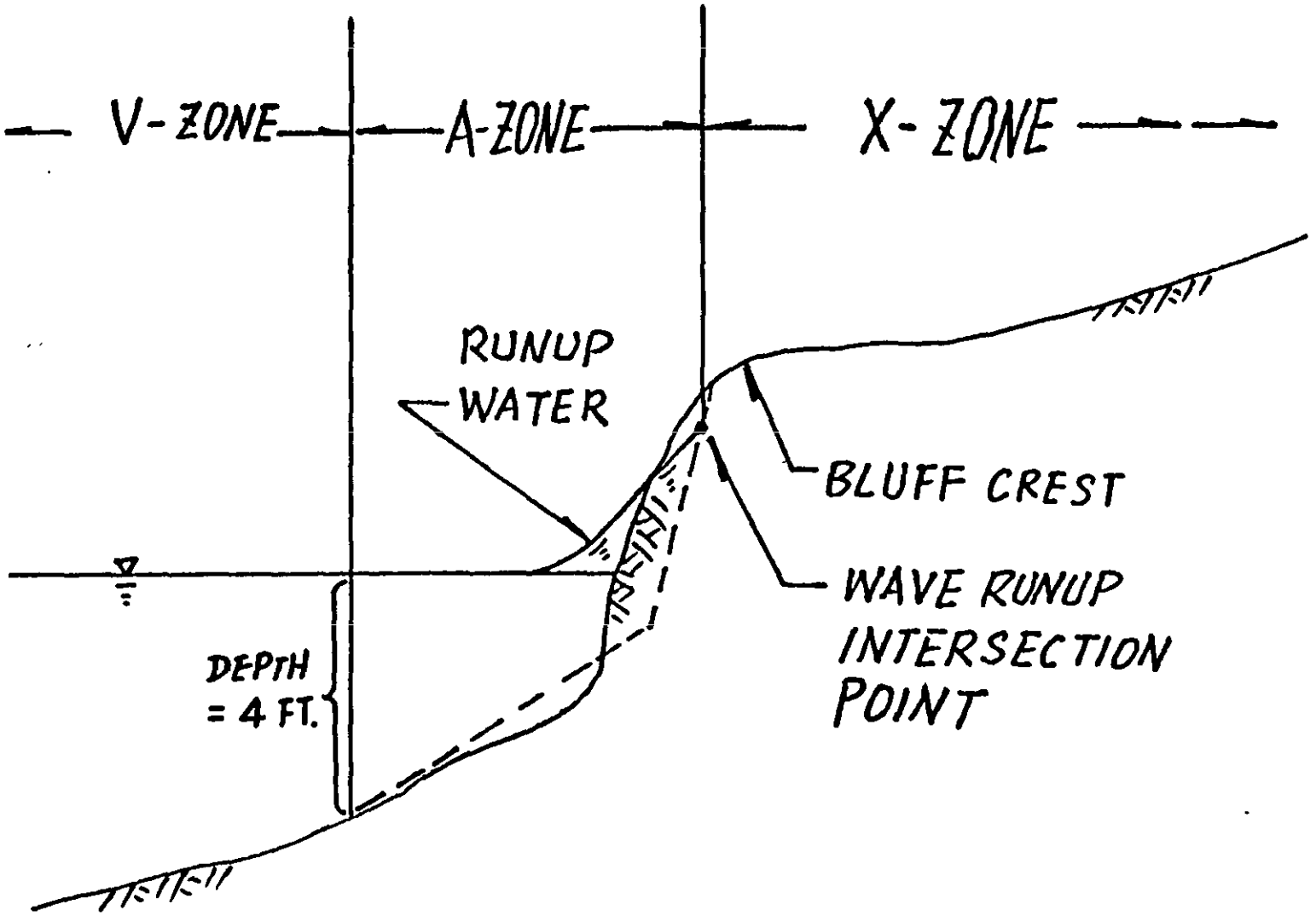
ALPENA TOWNSHIP A & V-ZONE DELINEATIONS ON A BEACH/BLUFF SYSTEM



ALPENA-1

FIGURE 2

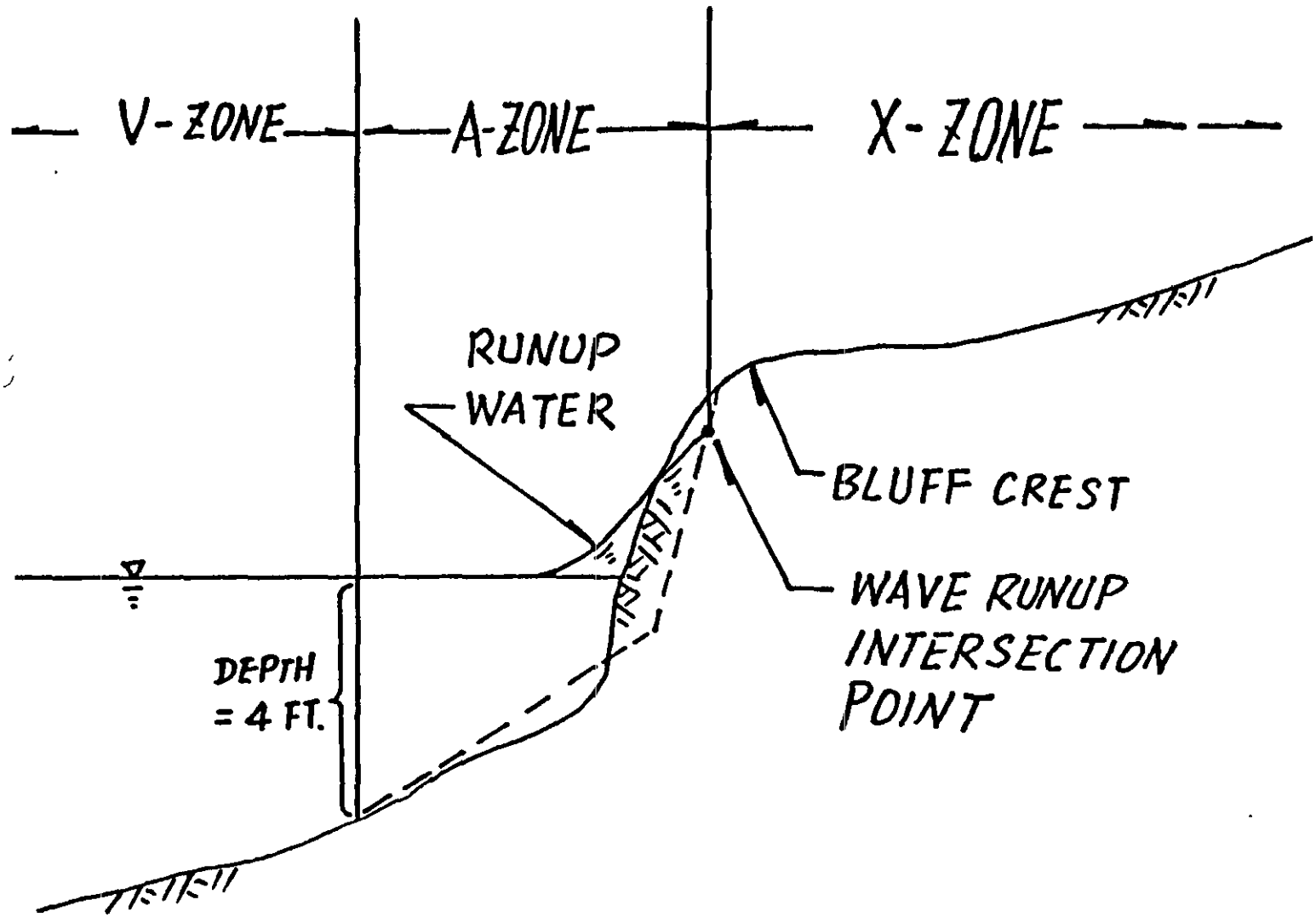
ALPENA TOWNSHIP A & V-ZONE DELINEATIONS ON A BEACH/BLUFF SYSTEM



ALPENA-2

FIGURE 3

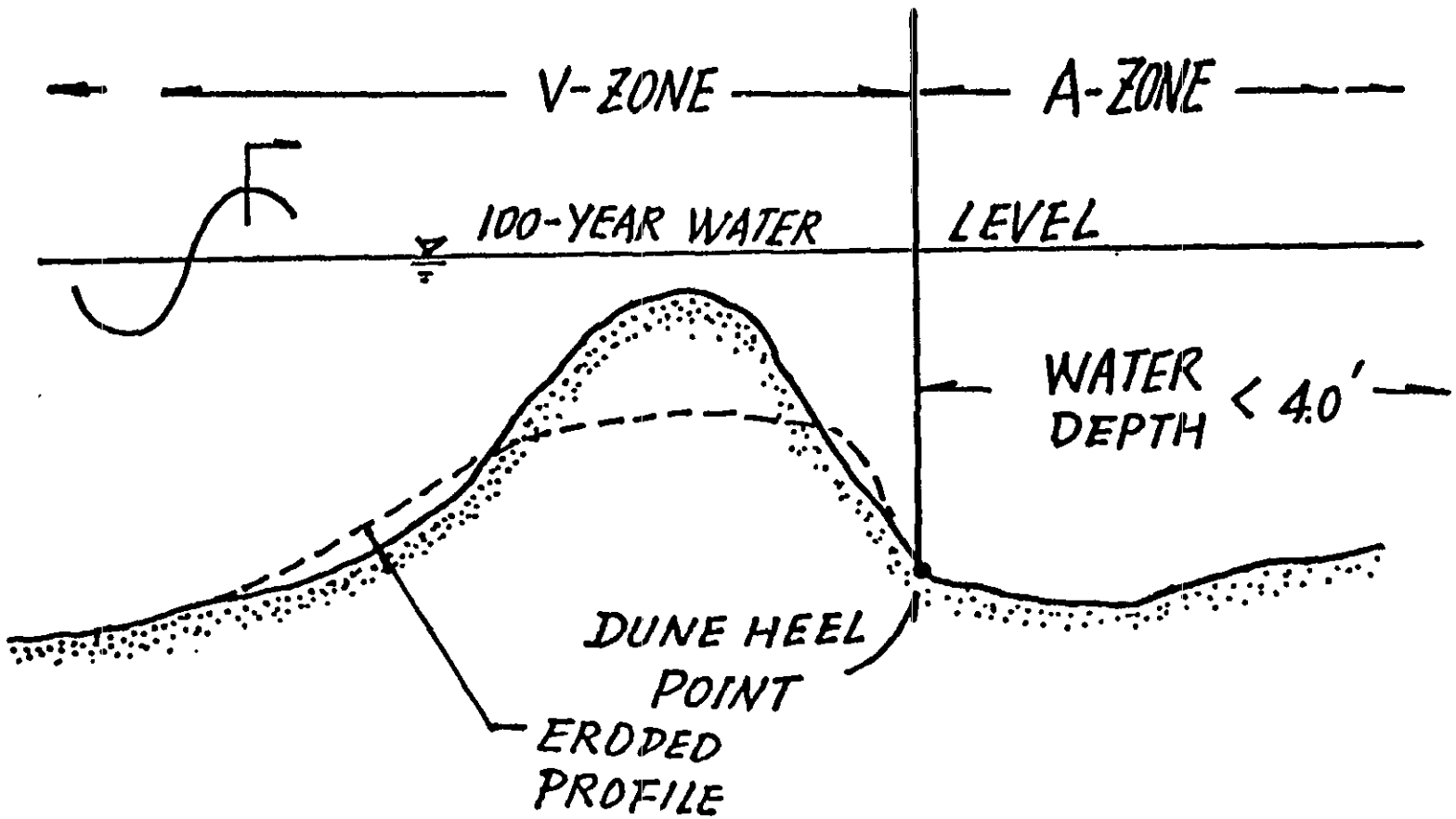
ALPENA TOWNSHIP A & V-ZONE DELINEATIONS ON A BEACH/BLUFF SYSTEM



ALPENA-3

FIGURE 4

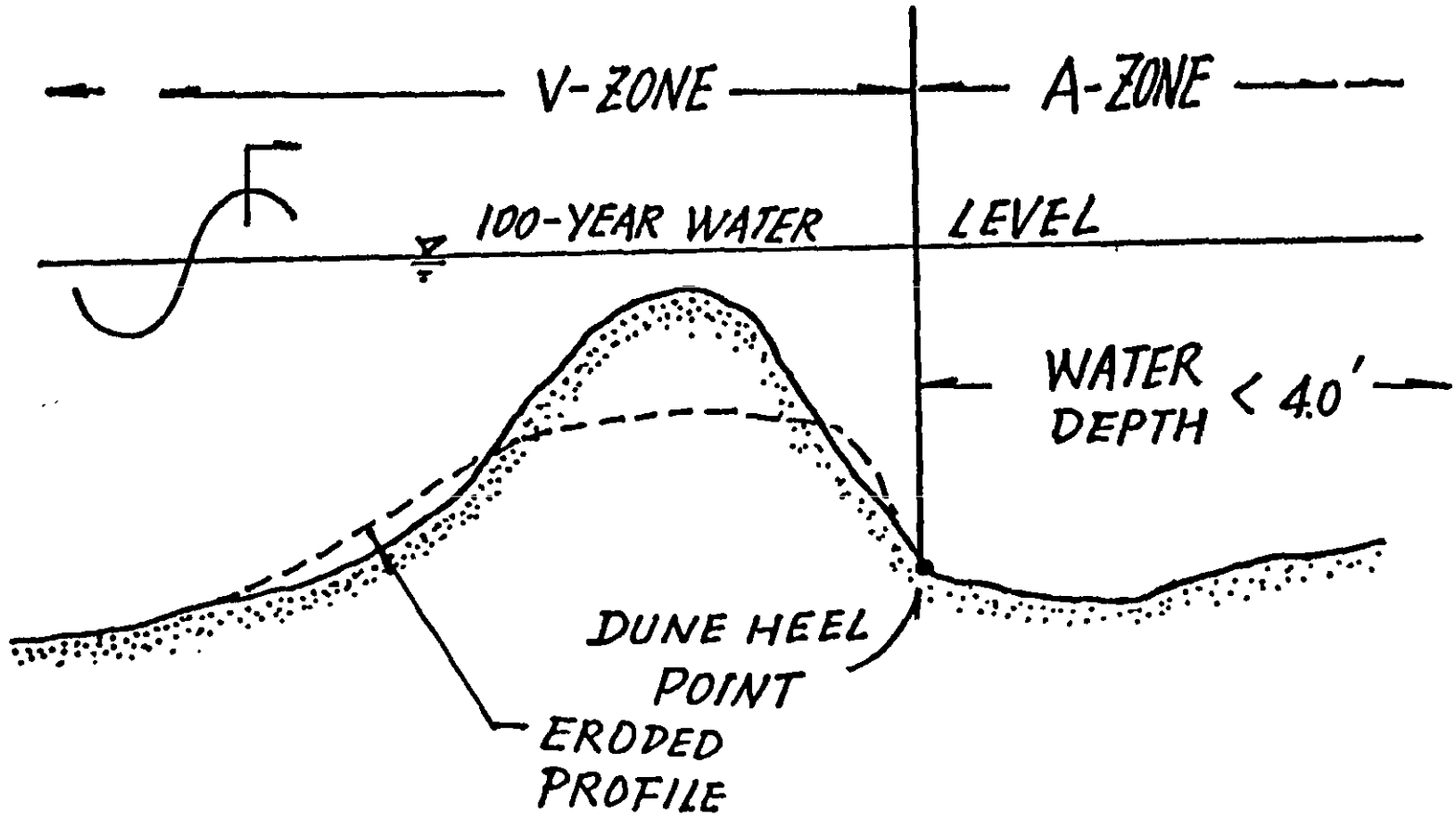
ALPENA TOWNSHIP A & V-ZONE DELINEATIONS ON A BEACH/DUNE SYSTEM



ALPENA-4

FIGURE 5

ALPENA TOWNSHIP A & V-ZONE DELINEATIONS ON A BEACH/DUNE SYSTEM



ALPENA-5

FIGURE 6

The "A" Zones and "V" Zones for these sites have been delineated according to FEMA's Guidelines for Great Lakes Wave Runup Computation and Mapping and are shown on the attached work maps.

The formal submittal of the Alpena Township study will include original mylar copies showing sufficient detail for submittal to FEMA's technical review contractor.

5.0 CONCLUSIONS

For each of the Alpena Township sites where the 100-year flood levels inundate shoreline property, the inundated area will experience a minimal water depth shoreward of the shoreline protection. This water depth will generate a negligible wave across the property. Therefore, the 100-year flood levels will be used to delineate the flood profiles at each site.

Accordingly, where structures protect against flooding, the 100-year "A" and "V" Zones, based on wave runup elevations, will be delineated on the work maps in the final FIS for the site.

In conclusion, it is recommended that the delineated 100-year flood profiles for the five Alpena Township sites included here be used by FEMA for updating the Alpena Township FIS's.

6.0 GLOSSARY

Annual Maximum Instantaneous Water Level: The highest water level that was recorded during a year by a gage with a sampling frequency of an hour or less.

A-Zone: The Flood Insurance Rate Zone that corresponds to the 100-year floodplain that is determined in the Flood Insurance Study by detailed methods.

AO-Zone: The Flood Insurance Rate Zone that corresponds to the inland termination point of water overtopping a beach and/or dune condition.

Floodplain: The area adjoining a river, stream, watercourse, ocean, lake or other body of standing water that has been or may be covered by floodwater.

International Great Lakes Datum (IGLD): Common reference datum for the Great Lakes area established in 1955 based on mean water level in the St. Lawrence River at Father Point, Quebec (near Atlantic Ocean).

Runup: The rush of water up a beach or structure from the breaking of a wave. Also, the vertical height of uprush above the still-water level.

Still-water level: The elevation that the water surface would assume if all wave action were absent.

Storm-water level: The rise above the normal water level on the open-coast, due to wind stress on the water surface.

V-Zone: The maximum elevation reached by the wave runup associated with the 100-year flood level.

Wave height: The vertical distance between the wave crest and the preceding trough.

Wave setup: The superelevation of the water surface over normal surge elevation due to the onshore mass transport of the water by wave action alone.

Wind setup: The vertical rise in the still-water level on the leeward side of a body of water caused by wind stresses on the surface of the water.

X-Zone: The Flood Insurance Rate Zone that corresponds to the landward side of a dune heel point.

7.0 REFERENCES

1. U.S. Army Corps of Engineers, Coastal Engineering Research Center, Vicksburg, MS, "Shore Protection Manual," Volumes I & II, 1984.

2. U.S. Army Corps of Engineers, Detroit District, "Phase I, Revised Report on Great Lakes Open-Coast Flood Levels," April 1988.

3. U.S. Army Corps of Engineers, Detroit District, "Phase II, Revised Report on Great Lakes Open-Coast Flood Levels," April 1988.

4. U.S. Army Corps of Engineers, Detroit District, "Appendices, Revised Report on Great Lakes Open-Coast Flood Levels," April 1988.

5. U.S. Army Corps of Engineers, Coordinating Committee on Great Lakes Basin Hydraulic and Hydrologic Data, "History of Water Level Gauges, Upper Great Lakes and the St. Clair - Detroit Rivers," January 1978.

6. U.S. Army Corps of Engineers, North Central Division, "Great Lakes Region Inventory Report National Shoreline Study," August 1978.

7. U.S. Army Corps of Engineers, Detroit District, "Flood Levels Report - Saginaw Bay," September 1989.

8. U.S. Army Corps of Engineers, Detroit District, "Flood Levels Report - Anchor Bay," September 1989.

9. Great Lakes Environmental Research Laboratory, Ann Arbor, Michigan, SCHWAB, D.J., and LYNN, E.W., "Great Lakes Storm Surge Planning Program," 1987.

10. U.S. Army Corps of Engineers, Detroit District, "Phase II Report on Great Lakes Flood Levels - Little Bay De Noc," August 1981.

11. U.S. Army Corps of Engineers, Detroit District, "Phase II Report on Great Lakes Flood Levels - Big Bay De Noc", July 1981.

12. FEMA Great Lakes "A" Zone and "V" Zone Delineations

8.0 DEFINITION OF TERMS

SYMBOL	DEFINITION
a	Wave transmission coefficient
b	Wave transmission coefficient
d	Relative depth (ft.)
ξ	Surf parameter
ϵ	Significant wave steepness
f'	Frequency (sec.)
g	Gravitational constant (ft./sec^2)
H_i	Incident wave height (ft.)
H_o'	Unrefracted deepwater wave height (ft.)
H_{mo}	Zero-moment wave height (ft.)
H_s	Average height of the 1/3 highest waves (ft.)
k	Dimensionless wave number
L_m	Wavelength (ft.)
L_o	Deepwater wavelength (ft.)
θ	Structure slope (degrees)
R	Wave runup (ft.)
T'	Wave period (sec.)
T_m	Spectral peak period (sec.)
α	Spectral parameter

TECHNICAL LETTER REPORT ON ALPENA TOWNSHIP, MICHIGAN

APPENDIX A

Prepared by the U.S. Army Corps of Engineers
for the Federal Emergency Management Agency

Detroit, Michigan
August 1990

TECHNICAL LETTER REPORT ON
ALPENA, MICHIGAN

SYNOPSIS

APPENDIX A outlines the procedures necessary to calculate the wave runup component and the maximum wave runup elevation associated with the 100-year flood level. These data, with the information provided from the profile surveys will enable the user to delineate the 100-year "A" and "V" Zone profiles according to FEMA's Guidelines for Great Lakes Wave Runup Computation and Mapping. The following list shows the five Alpena Township sites and their 100-year and 500-year flood profile elevations. It should be noted that the same procedures can be used to calculate the 500-year profiles. Samples of these computations are included in APPENDIX A.

Alpena Township FIS Sites	100-year Flood Profile Elevation (ft., NGVD)	500-year Flood Profile Elevation (ft., NGVD)
1. Alpena-1	588.5 } runup ele	589.4
2. Alpena-2	588.5	589.4
3. Alpena-3	587.6	588.5
4. Alpena-4	583.8 } static 100-yr ele	584.7
5. Alpena-5	583.8	584.7

FIS PROFILE
ALPENA-1

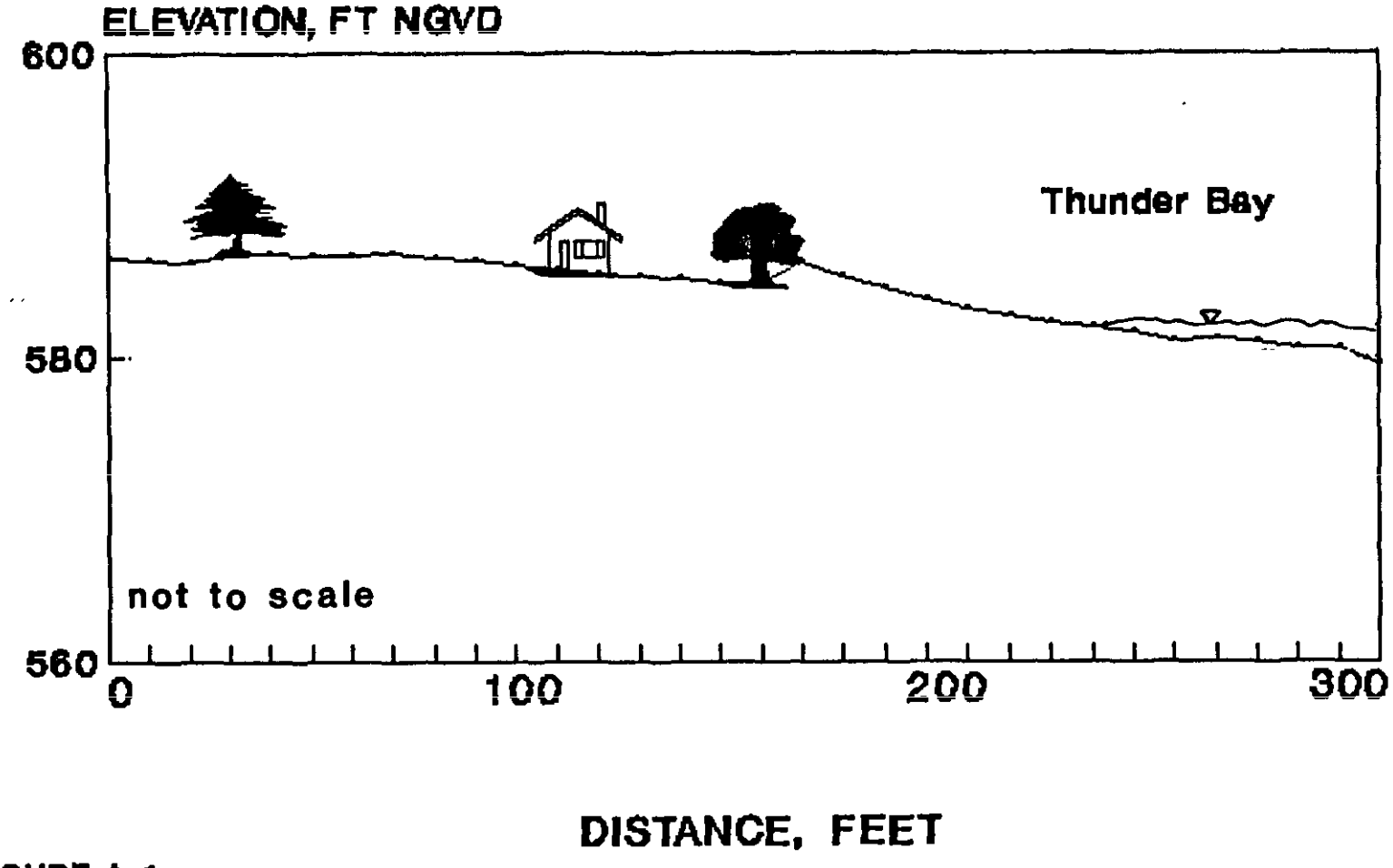


FIGURE A-1

RUNUP COMPUTATION
WAVE RUNUP ON A BEACH at X-C ALPENA-1

```
          runup on:  beach
    100-year flood: 583.8 feet above NGVD
water depth at toe:  26.0 feet            1st: significant wave computation
     wave period T:  10.9
                T':   5.7
                 L: 315.13
 deep water wave H:  24.6 feet
                 K:   2.1
             alpha:   0.0112
               Hmo:  15.6
             d bar:   0.0068
           epsilon:   0.0124
           Hs/Hmo:    1.000
 Hs in deep water:  15.6                  (significant wave)
      beach slope:   0.05000  (tan 30H:1V = 0.03333)
       beach zeta:   0.312               2nd: wave runup computation
      beach runup:   4.7
   runup elevation: 588.5 feet above NGVD
```

B:\>

$1.11\sqrt{ds}$

$Ele_{100} = 583.8$ ✓

$Ele_{500} = 584.7$ ✓

```
                    RUNUP COMPUTATION
          WAVE RUNUP ON A BEACH at X-C ALPENA-1
        runup on:  beach
   500-year flood: 584.7 feet above NGVD
water depth at toe:  26.0 feet          1st: significant wave computation
     wave period T:  10.9
                T':   5.7
                 L: 315.13
 deep water wave H:  24.6 feet
                 K:   2.1
             alpha:   0.0112
               Hmo:  15.6
             d bar:   0.0068
           epsilon:   0.0124
            Hs/Hmo:   1.000
  Hs in deep water:  15.6               (significant wave)
       beach slope:   0.05000  (tan 30H:1V = 0.03333)
        beach zeta:   0.312             2nd: wave runup computation
       beach runup:   4.7
   runup elevation: 589.4 feet above NGVD
```

B:\>

FIS PROFILE
ALPENA-2

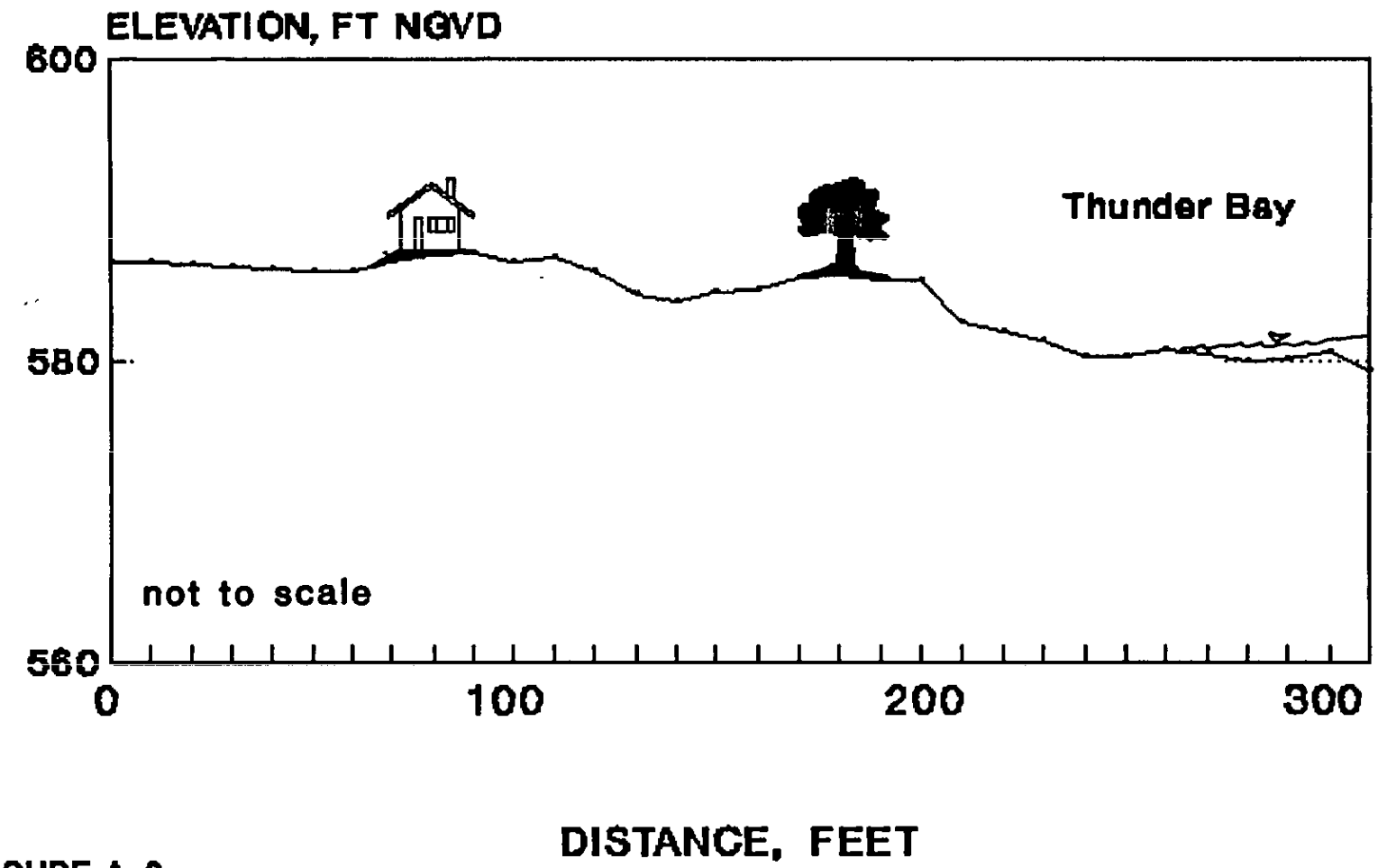


FIGURE A-2

RUNUP COMPUTATION

WAVE RUNUP ON A BEACH at X-C ALPENA-2

```
          runup on:  beach
   100-year flood: 583.8 feet above NGVD
water depth at toe:  26.0 feet          1st: significant wave computation
     wave period T:  10.9
                T':   5.7
                 L: 315.13
 deep water wave H:  24.6 feet
                 K:   2.1
             alpha:   0.0112
               Hmo:  15.6 ---------> = .6(26) default
             d bar:   0.0068
           epsilon:   0.0124
            Hs/Hmo:   1.000 --- default
  Hs in deep water:  15.6            (significant wave)
       beach slope:   0.05000  (tan 30H:1V = 0.03333)
        beach zeta:   0.312            2nd: wave runup computation
       beach runup:   4.7
   runup elevation: 588.5 feet above NGVD
```

B:\>

```
                    RUNUP COMPUTATION
          WAVE RUNUP ON A BEACH at X-C ALPENA-2
          runup on:  beach
   500-year flood: 584.7 feet above NGVD
 water depth at toe:  26.0 feet          1st: significant wave computation
100-year wave period T:  10.9
                  T':   5.7
                   L: 315.13
100-yr deep water wave H:  24.6 feet
                   K:   2.1
               alpha:   0.0112
                 Hmo:  15.6
               d bar:   0.0068
             epsilon:   0.0124
              Hs/Hmo:   1.000
   Hs in deep water:  15.6                (significant wave)
        beach slope:   0.05000  (tan 30H:1V = 0.03333)
         beach zeta:   0.312              2nd: wave runup computation
        beach runup:   4.7
     runup elevation: 589.4 feet above NGVD


B:\>
```

FIS PROFILE
ALPENA-3

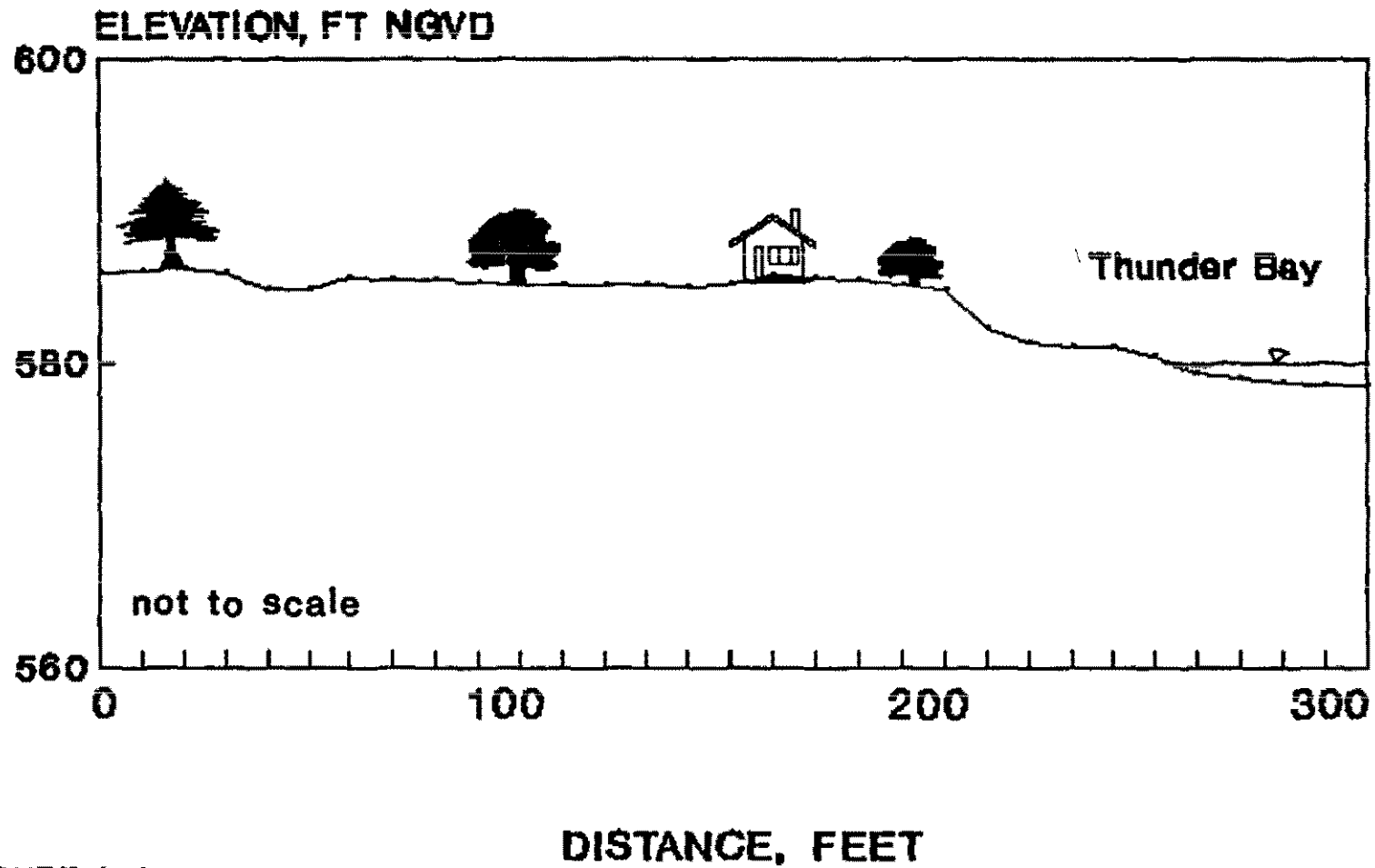


FIGURE A-3

RUNUP COMPUTATION
WAVE RUNUP ON A BEACH at X-C ALPENA-3

```
          runup on:  beach
    100-year flood: 583.8 feet above NGVD
water depth at toe:  26.0 feet            1st: significant wave computation
     wave period T:  10.9
                T':   5.7
                 L: 315.13
 deep water wave H:  24.6 feet
                 K:   2.1
            alpha:   0.0112
              Hmo:  15.6
            d bar:   0.0068
          epsilon:   0.0124
           Hs/Hmo:   1.000
  Hs in deep water:  15.6                 (significant wave)
       beach slope:  0.09000  (tan 30H:1V = 0.03333)
        beach zeta:  0.562                2nd: wave runup computation
       beach runup:  8.5
   runup elevation: 592.3 feet above NGVD
```

B:\>

```
                    RUNUP COMPUTATION
          WAVE RUNUP ON A BEACH at X-C ALPENA-3
        runup on:  beach
  500-year flood: 584.7 feet above IGLD, optional
water depth at toe:  26.0 feet          1st: significant wave computation
    wave period T:  10.9       (enter per Ref. 3)
               T':   5.7
                L: 315.13
 deep water wave H:  24.6 feet  (enter per Ref. 3)
                K:   2.1
            alpha:   0.0112
              Hmo:  15.6
            d bar:   0.0068
          epsilon:   0.0124
           Hs/Hmo:   1.000     (enter per Ref. 4, Figure 10)
 Hs in deep water:  15.6                (significant wave)
      beach slope:   0.09000  (tan 30H:1V = 0.03333)
       beach zeta:   0.562              2nd: wave runup computation
      beach runup:   8.5
   runup elevation: 593.2 feet above IGLD
```

B:\>

FIS PROFILE
ALPENA-4

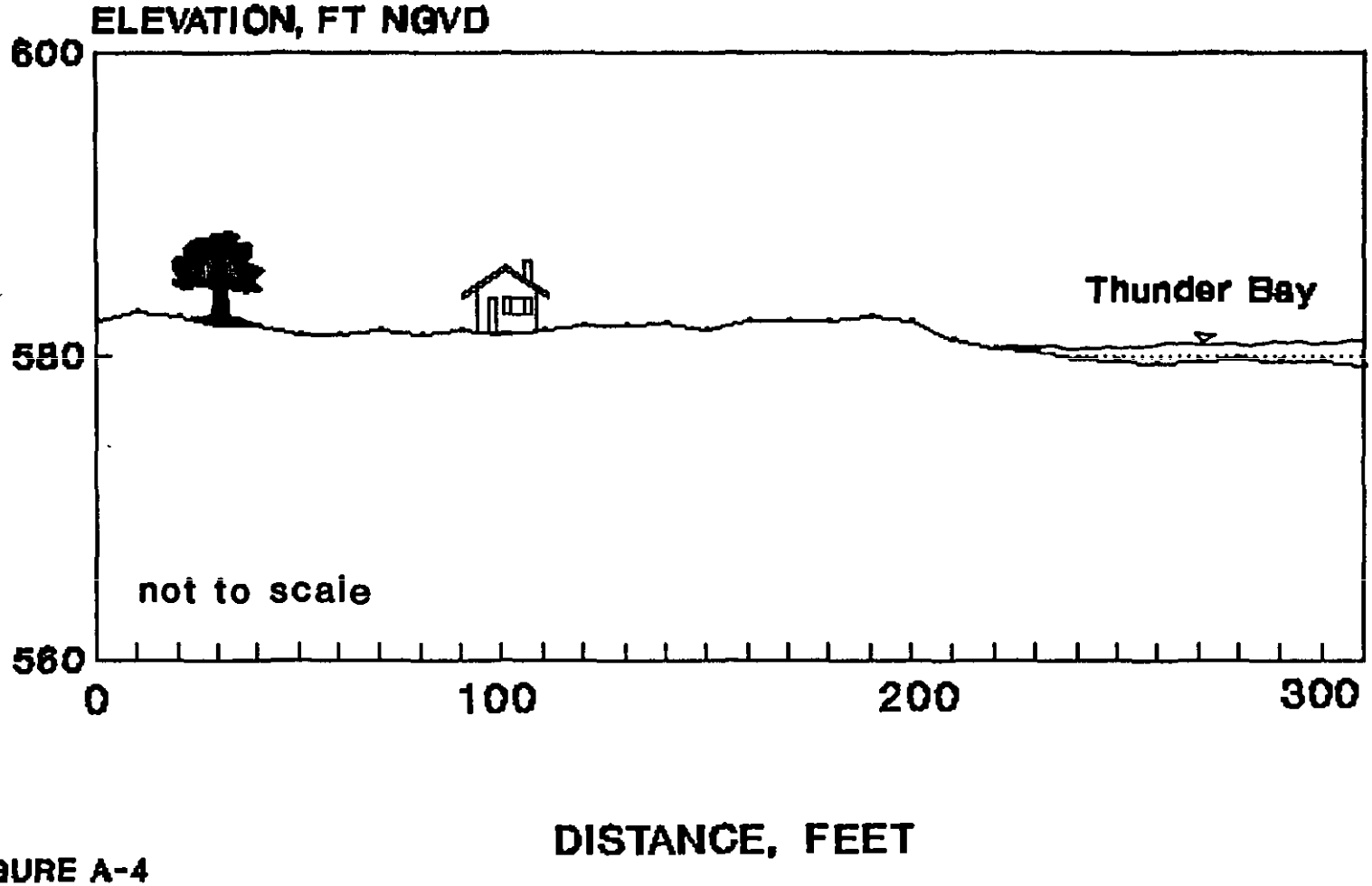


FIGURE A-4

RUNUP COMPUTATION
WAVE RUNUP ON A BEACH at X-C ALPENA-4

```
          runup on:  beach
    100-year flood: 583.8 feet above NGVD
water depth at toe:  26.0 feet            1st: significant wave computation
     wave period T:  10.9
                T':   5.7
                 L: 315.13
 deep water wave H:  24.6 feet
                 K:   2.1
             alpha:   0.0112
               Hmo:  15.6
             d bar:   0.0068
           epsilon:   0.0124
           Hs/Hmo:    1.000
  Hs in deep water:  15.6                 (significant wave)
       beach slope:   0.02500  (tan 30H:1V = 0.03333)
        beach zeta:   0.156               2nd: wave runup computation
       beach runup:   2.4
   runup elevation: 586.2  feet above NGVD
```

constant from site to site

B:\>

RUNUP COMPUTATION

WAVE RUNUP ON A BEACH at X-C ALPENA-4

```
          runup on:  beach
   500-year flood: 584.7 feet above NGVD
water depth at toe:  26.0 feet            1st: significant wave computation
     wave period T:  10.9
                T':   5.7
                 L: 315.13
 deep water wave H:  24.6 feet
                 K:   2.1
             alpha:   0.0112
               Hmo:  15.6
             d bar:   0.0068
           epsilon:   0.0124
            Hs/Hmo:   1.000
  Hs in deep water:  15.6                 (significant wave)
       beach slope:   0.02500  (tan 30H:1V = 0.03333)
        beach zeta:   0.156               2nd: wave runup computation
       beach runup:   2.4
    runup elevation: 587.1 feet above NGVD
```

B:\>

FIS PROFILE
ALPENA-5

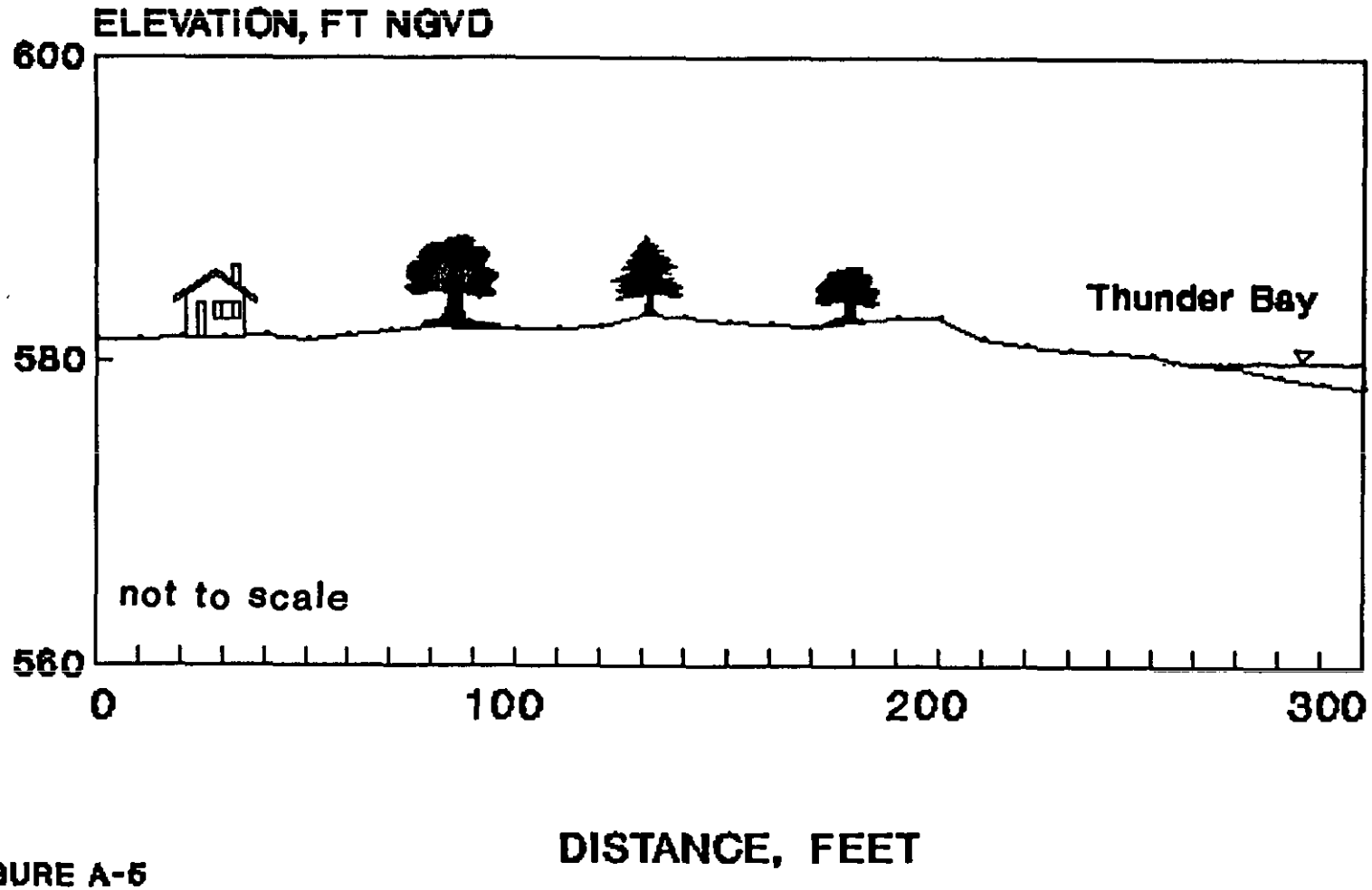


FIGURE A-5

SYNOPSIS

APPENDIX A outlines the procedures necessary to calculate the wave runup component and the maximum wave runup elevation associated with the 100-year flood level. These data, with the information provided from the profile surveys will enable the user to delineate the 100-year VE, AE, AO, X-Zone profiles according to FEMA's 1990 Guidelines for Great Lakes Wave Runup Computation and Mapping. The following list shows the five Alpena Township sites and their 100-year wave runup elevations. Samples of these computations are included in APPENDIX A.

Alpena Township FIS Sites	100-year Wave Runup Elevation (ft., NGVD)
1. Alpena-1	587.7
2. Alpena-2	587.7
3. Alpena=3	587.0
4. Alpena-4	583.8 *
5. Alpena-5	583.8 *

* NOTE: Open-Coast 100-year flood level

RUNUP COMPUTATION
WAVE RUNUP AT ALPENA TOWNSHIP, ALPENA-1

```
                runup on:  beach
          100-year flood: 583.8 feet above IGLD, optional
      water depth at toe:  26.0 feet            1st: significant wave computation
  100-year wave period T:  10.9        (enter per Ref. 3)
                      T':   5.7
                       L: 315.13
100-yr deep water wave H:  24.6 feet  (enter per Ref. 3)
                       K:   2.1
                   alpha:   0.0112
                     Hmo:  10.6
                   d bar:   0.0068
                 epsilon:   0.0084
                  Hs/Hmo:   1.032     (enter per Ref. 4, Figure 10)
        Hs in deep water:  10.9                 (significant wave)
             beach slope:   0.05000  (tan 30H:1V = 0.03333)
              beach zeta:   0.374               2nd: wave runup computation
             beach runup:   3.9
          runup elevation: 587.7 feet above IGLD
```

A:\>NOTE: ALL ELEVATIONS ABOVE ARE IN FEET ABOVE NGVD

RUNUP COMPUTATION
WAVE RUNUP AT ALPENA TOWNSHIP, ALPENA-2

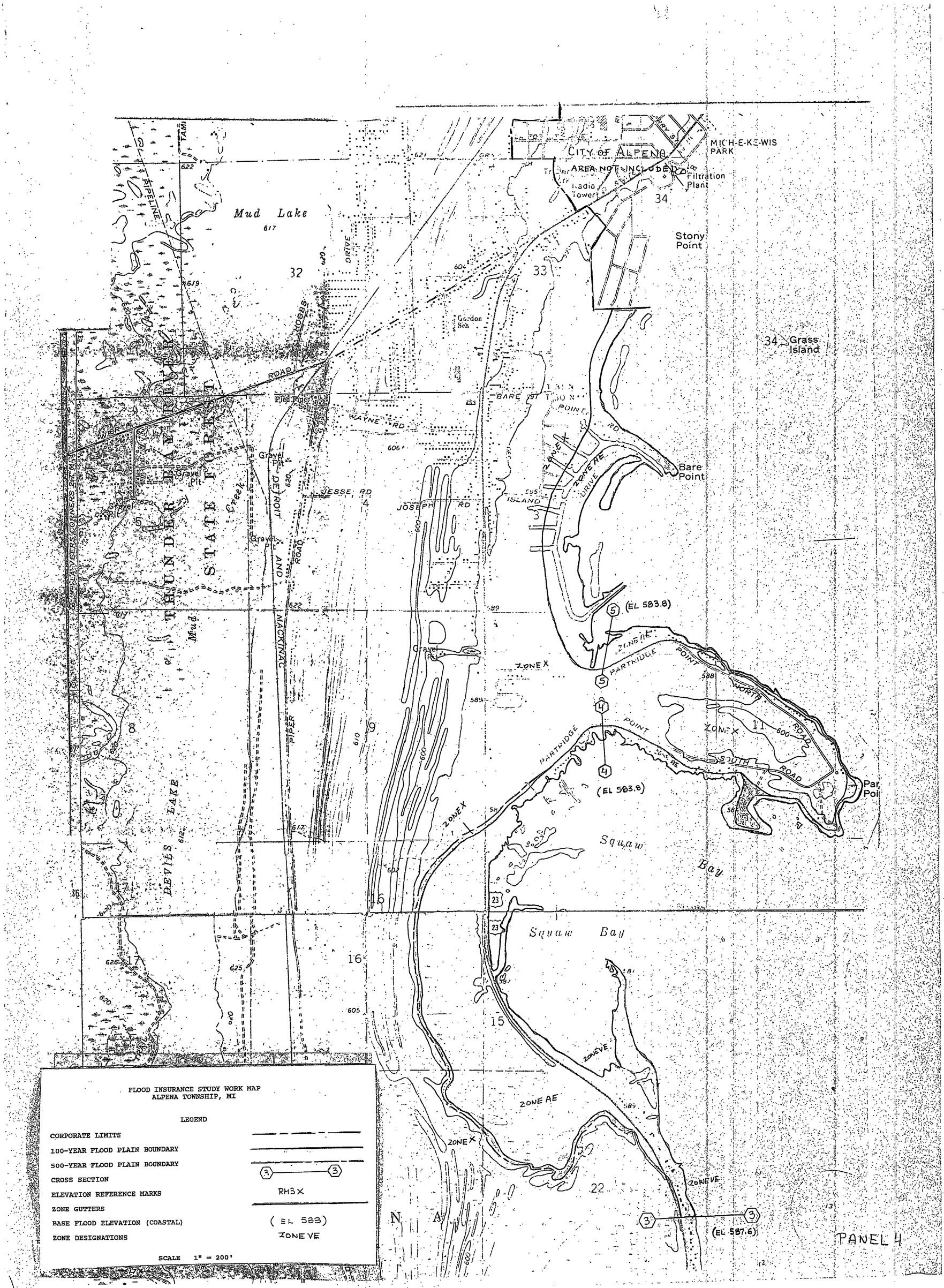
```
                runup on:  beach
        100-year flood: 583.8 feet above IGLD, optional
    water depth at toe:  26.0 feet            1st: significant wave computation
  100-year wave period T:  10.9        (enter per Ref. 3)
                     T':   5.7
                      L: 315.13
100-yr deep water wave H:  24.6 feet  (enter per Ref. 3)
                      K:   2.1
                  alpha:   0.0112
                    Hmo:  10.6
                  d bar:   0.0068
                epsilon:   0.0084
                 Hs/Hmo:   1.032      (enter per Ref. 4, Figure 10)
       Hs in deep water:  10.9                  (significant wave)
            beach slope:   0.05000  (tan 30H:1V = 0.03333)
             beach zeta:   0.374               2nd: wave runup computation
            beach runup:   3.9
         runup elevation: 587.7 feet above IGLD
```

A:\>NOTE: ALL ELEVATIONS ABOVE ARE IN FEET ABOVE NGVD

RUNUP COMPUTATION
WAVE RUNUP AT ALPENA TOWNSHIP, ALPENA-3

```
                runup on:  beach
        100-year flood: 583.8 feet above IGLD, optional
    water depth at toe:  26.0 feet           1st: significant wave computation
 100-year wave period T:  10.9       (enter per Ref. 3)
                     T':   5.7
                      L: 315.13
100-yr deep water wave H:  24.6 feet  (enter per Ref. 3)
                      K:   2.1
                  alpha:   0.0112
                    Hmo:  10.6
                  d bar:   0.0068
                epsilon:   0.0084
                 Hs/Hmo:   1.032     (enter per Ref. 4, Figure 10)
       Hs in deep water:  10.9                (significant wave)
            beach slope:   0.04000  (tan 30H:1V = 0.03333)
             beach zeta:   0.299              2nd: wave runup computation
            beach runup:   3.2
         runup elevation: 587.0 feet above IGLD
```

A:\>NOTE: ALL ELEVATIONS ABOVE ARE IN FEET ABOVE NGVD

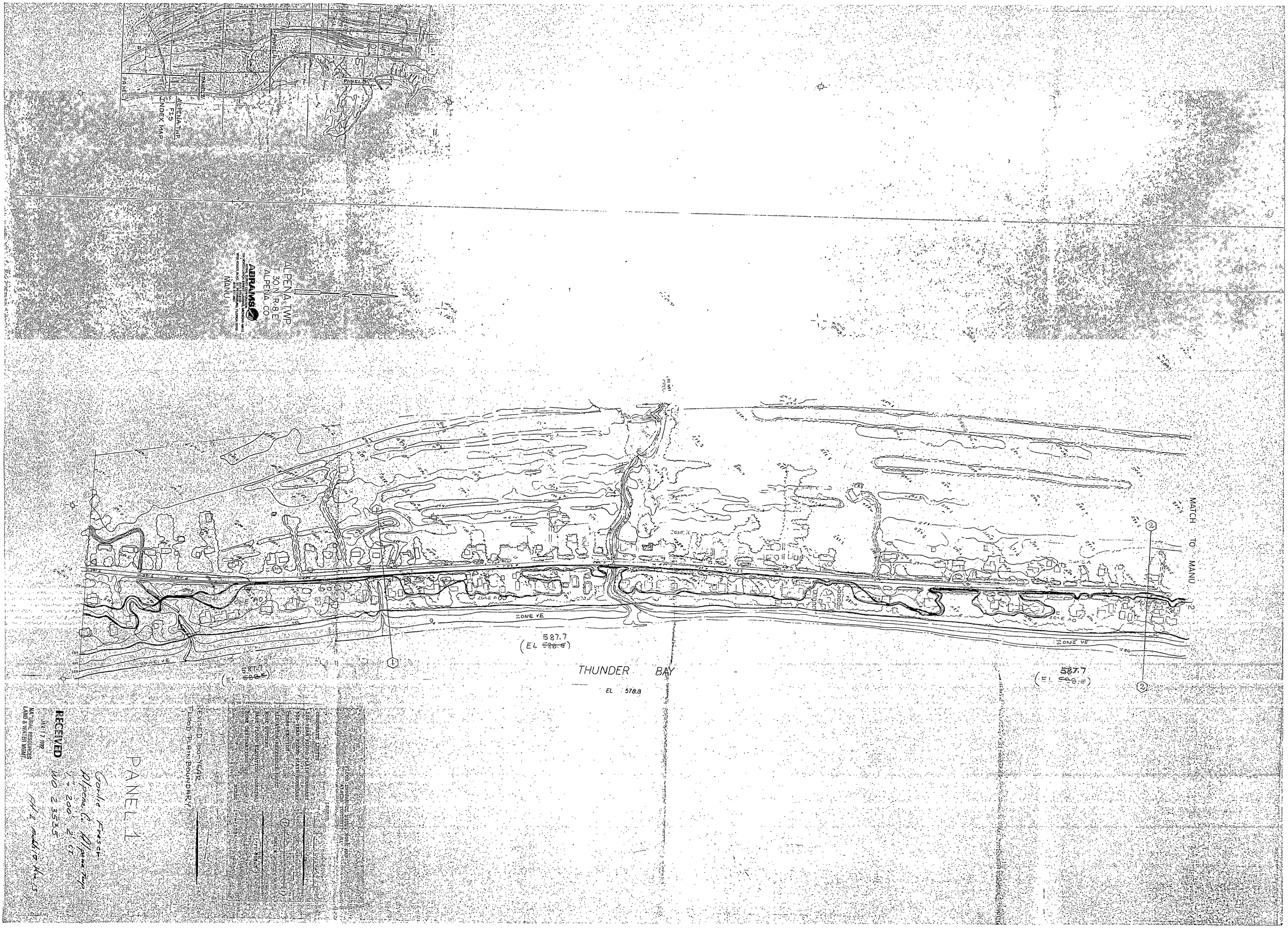


FLOOD INSURANCE STUDY WORK MAP
ALPENA TOWNSHIP, MI

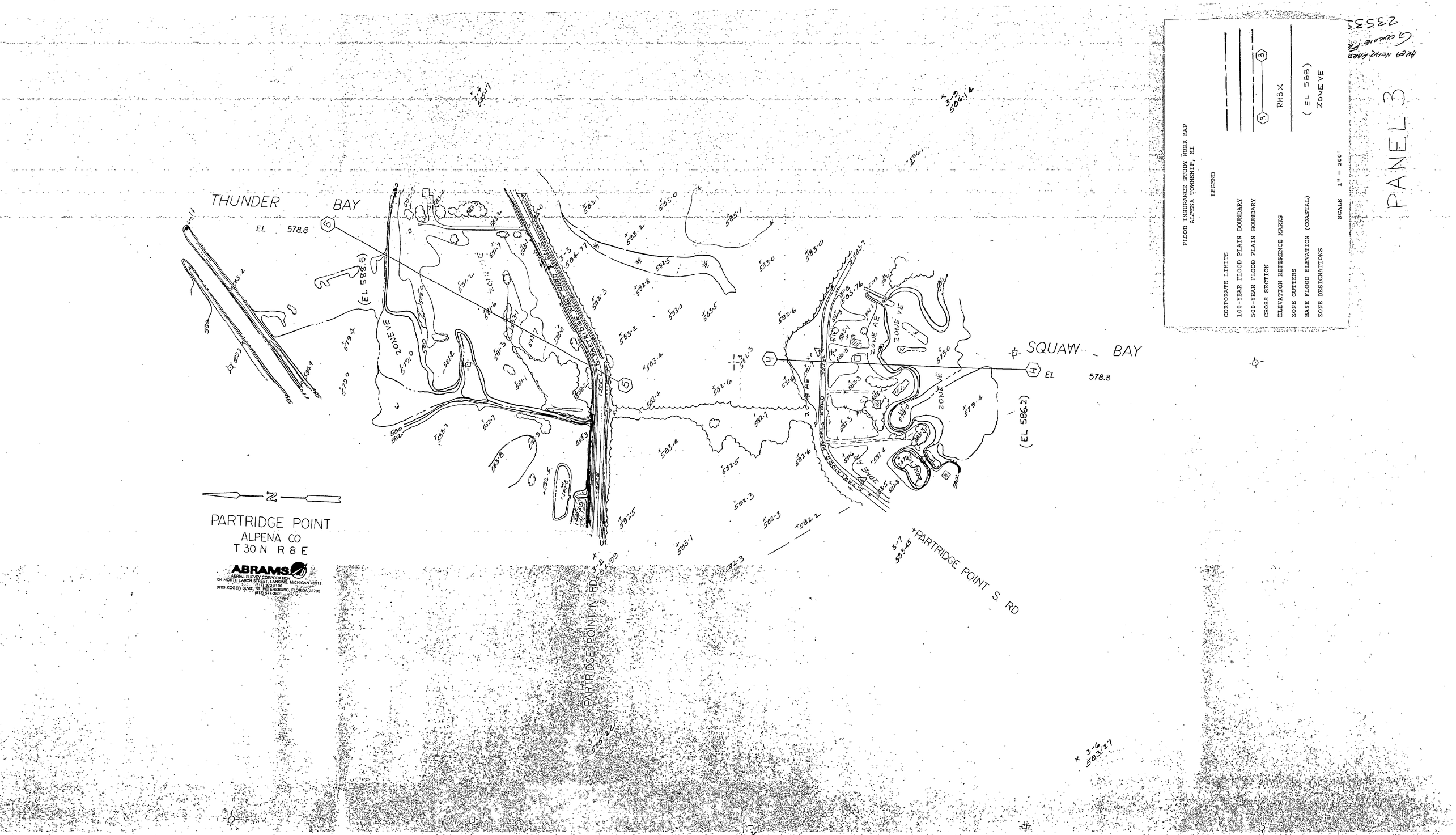
LEGEND

CORPORATE LIMITS	
100-YEAR FLOOD PLAIN BOUNDARY	
500-YEAR FLOOD PLAIN BOUNDARY	
CROSS SECTION	3 — 3
ELEVATION REFERENCE MARKS	RM3X
ZONE GUTTERS	
BASE FLOOD ELEVATION (COASTAL)	(EL 583)
ZONE DESIGNATIONS	ZONE VE

SCALE 1" = 200'


PANEL 1
PANEL 5
PANEL 6
PANEL 7
PANEL 8
ALPENA TWP.
F.I.S. INDEX MAP
ALPENA TWP.
T. 30 N. R. 8 E.
ALPENA CO.
ABRAMS
MANU
MATCH TO MANU
ZONE VE
ZONE AO
ZONE X
587.7
(EL ~~580.5~~)
THUNDER BAY
EL 578.8
COMMUNITY NUMBER
120-284 FLOOD PLAIN BOUNDARY
PANEL NUMBER
GROSS SECTOR
BASE FLOOD ELEVATION (CONTOUR)
BASE FLOOD ELEVATION
ELEVATION (REFERENCE)
FLOOD PLAIN BOUNDARY
FLOOD WAY BOUNDARY
FLOOD WAY
SCALE
PANEL 1
Gordie Fraser
Alpena Co. Alpena Twp
1" = 200' 2 of
MD 2 3535
FH 2 mile to Hill
RECEIVED
JAN 17 1992
NATURAL RESOURCES
LAND & WATER MGMT.
REVISED DOC-YEAR
FLOOD PLAIN BOUNDARY

THUNDER BAY
EL 578.8
ZONE VE
ZONE X
MATCH TO MANU
PANEL 2
ALPENA TWP
T 30 N R 8 E
ALPENA CO
ABRAMS
MANU 2


THUNDER BAY
EL 578.8
(EL 586.6)
ZONE VE
PARTRIDGE POINT NORTH ROAD
SQUAW BAY
EL 578.8
(EL 586.2)
ZONE AE
ZONE VE
PARTRIDGE POINT S. RD
PARTRIDGE POINT N. RD
N
PARTRIDGE POINT
ALPENA CO
T 30 N R 8 E
ABRAMS
AERIAL SURVEY CORPORATION
124 NORTH LARCH STREET, LANSING, MICHIGAN 48912
(517) 372-8100
9700 KOGER BLVD., ST. PETERSBURG, FLORIDA 33702
(813) 577-3801
FLOOD INSURANCE STUDY WORK MAP
ALPENA TOWNSHIP, MI
LEGEND
CORPORATE LIMITS
100-YEAR FLOOD PLAIN BOUNDARY
500-YEAR FLOOD PLAIN BOUNDARY
CROSS SECTION
ELEVATION REFERENCE MARKS
ZONE GUTTERS
BASE FLOOD ELEVATION (COASTAL)
ZONE DESIGNATIONS
SCALE 1" = 200'
RM5X
(EL 583)
ZONE VE
PANEL 3