BLIND PASS
INLET MANAGEMENT PLAN

Volume II

Technical Appendices B - G

Submitted To:

CAPTIVA EROSION PREVENTION DISTRICT

November 1993

COASTAL PLANNING & ENGINEERING, INC.

APPENDIX B

COMPARATIVE BEACH PROFILE PLOTS

Comparative Beach Profile Plots

1974 (DNR) vs. 1988 (CPE)

COASTAL PLANNING & ENGINEERING, INC.

COASTAL PLANNING & ENGINEERING, INC.
2481 N.W. BOCA RATON BOULEVARD
BOCA RATON, FLORIDA 33431
(407) 391-8102

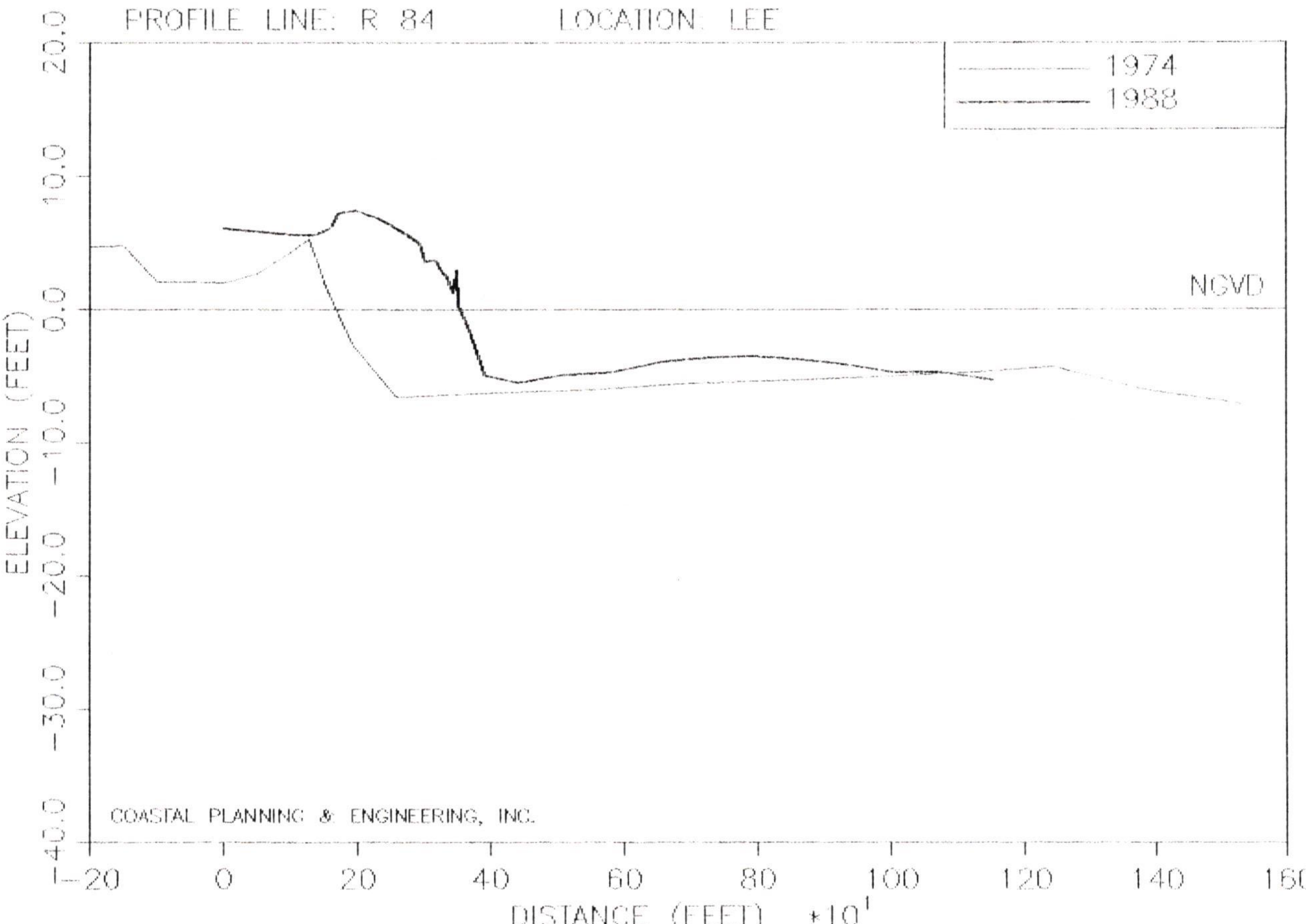
CP&E COASTAL SURVEY DATA ANALYSIS SYSTEM
PROJECT AREA: LEE

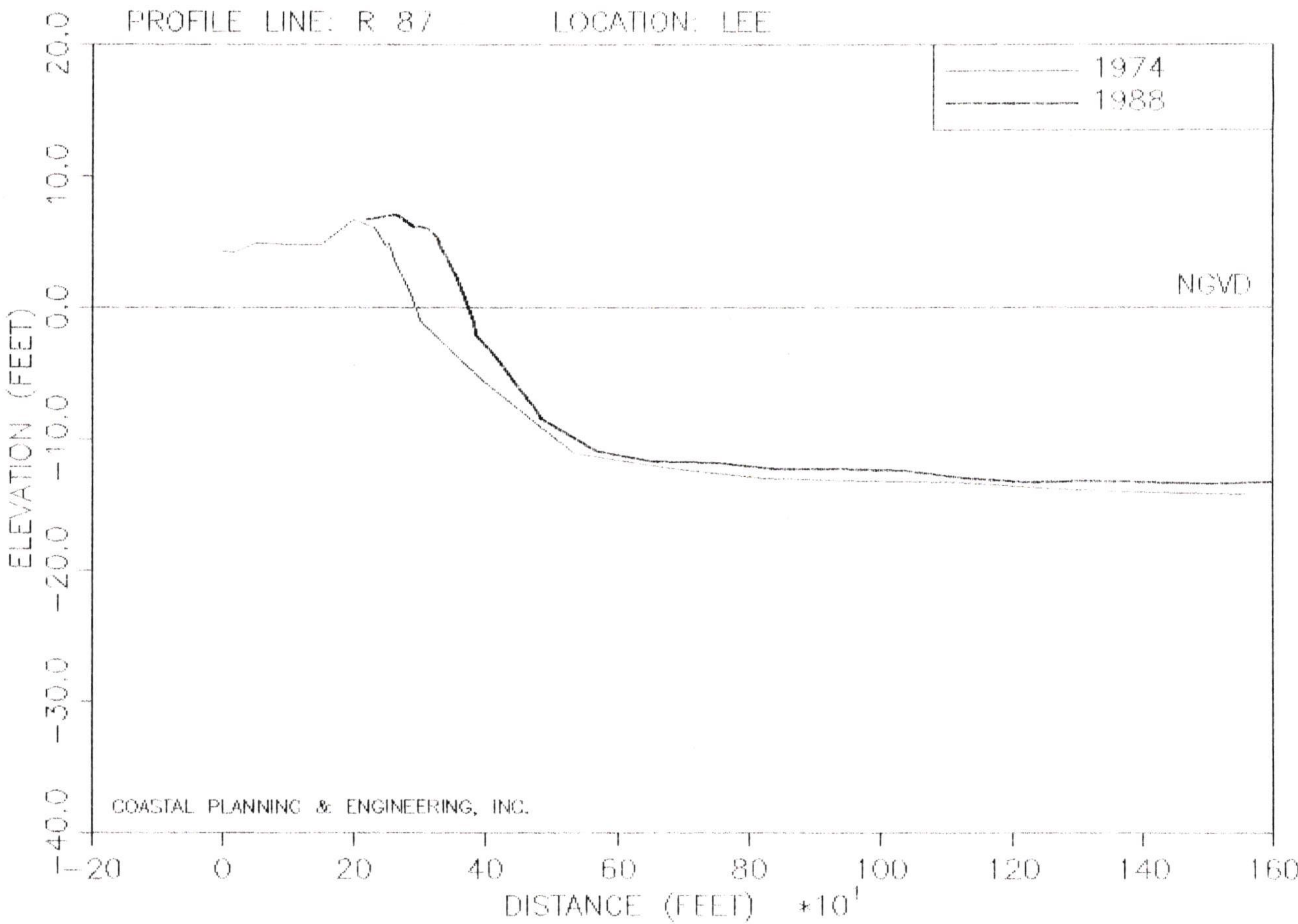
DATA FILE INFORMATION:

LINE INDEX 1	LINE INDEX 2	OLD FILE NAME	NEW FILE NAME
1	10	A:LEE74A.DNR	A:LEE88A.CPE
1	10	A:LEE74B.DNR	A:LEE88B.CPE
1	10	A:LEE74C.DNR	A:LEE88C.CPE
1	3	A:LEE74D.DNR	A:LEE88D.CPE

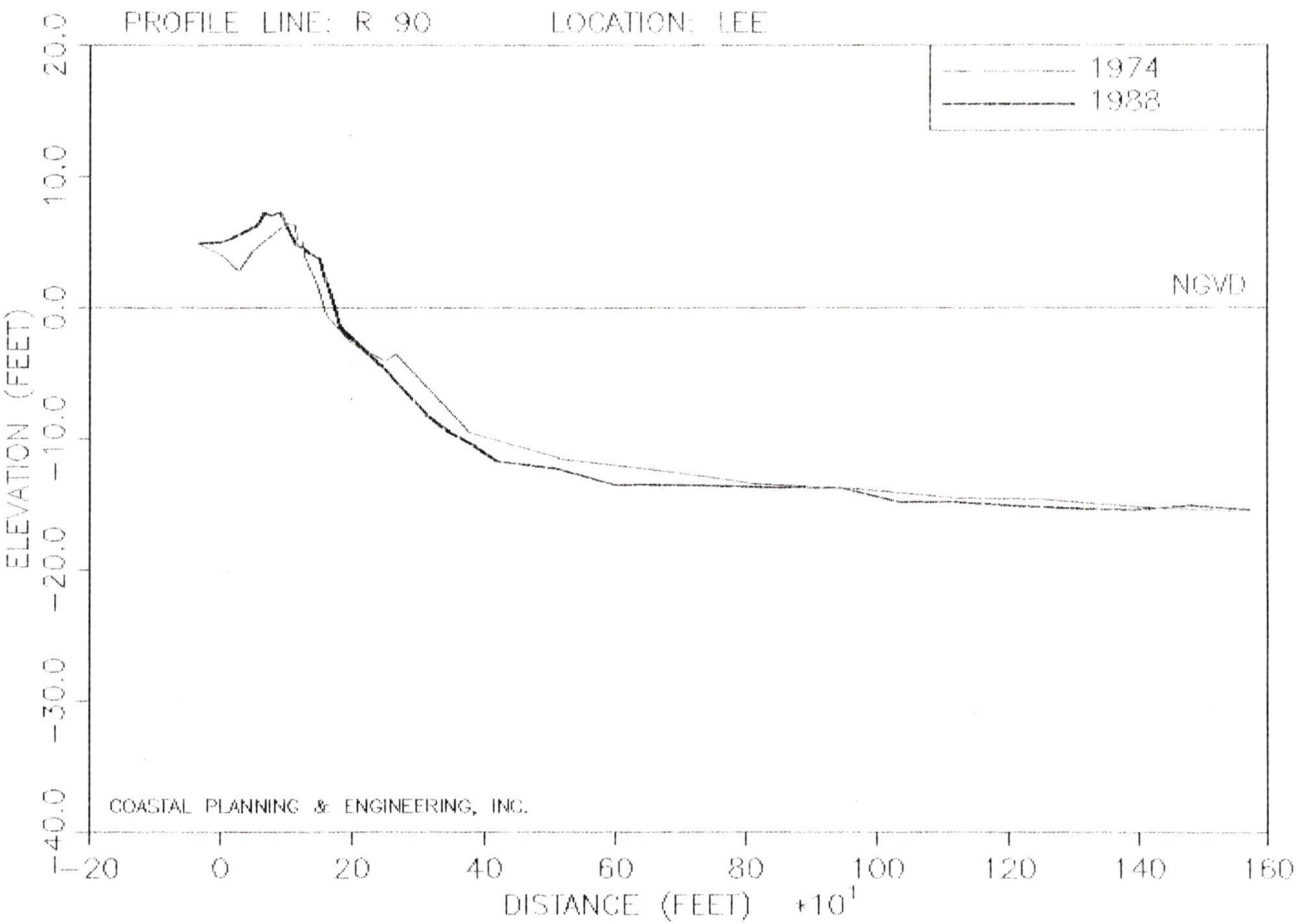
DATA DISK NUMBER =
REFERENCE DATUM = NGVD

PRINTED BY: LRA
PRINTED ON: 3-10-92


PROFILE LINE: R 84
LOCATION: LEE
1974
1988
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]
COASTAL PLANNING & ENGINEERING, INC.



PROFILE LINE: R 87
LOCATION: LEE
1974
1988
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]


PROFILE LINE: R 90
LOCATION: LEE
1974
1988
NGVD
ELEVATION (FEET)
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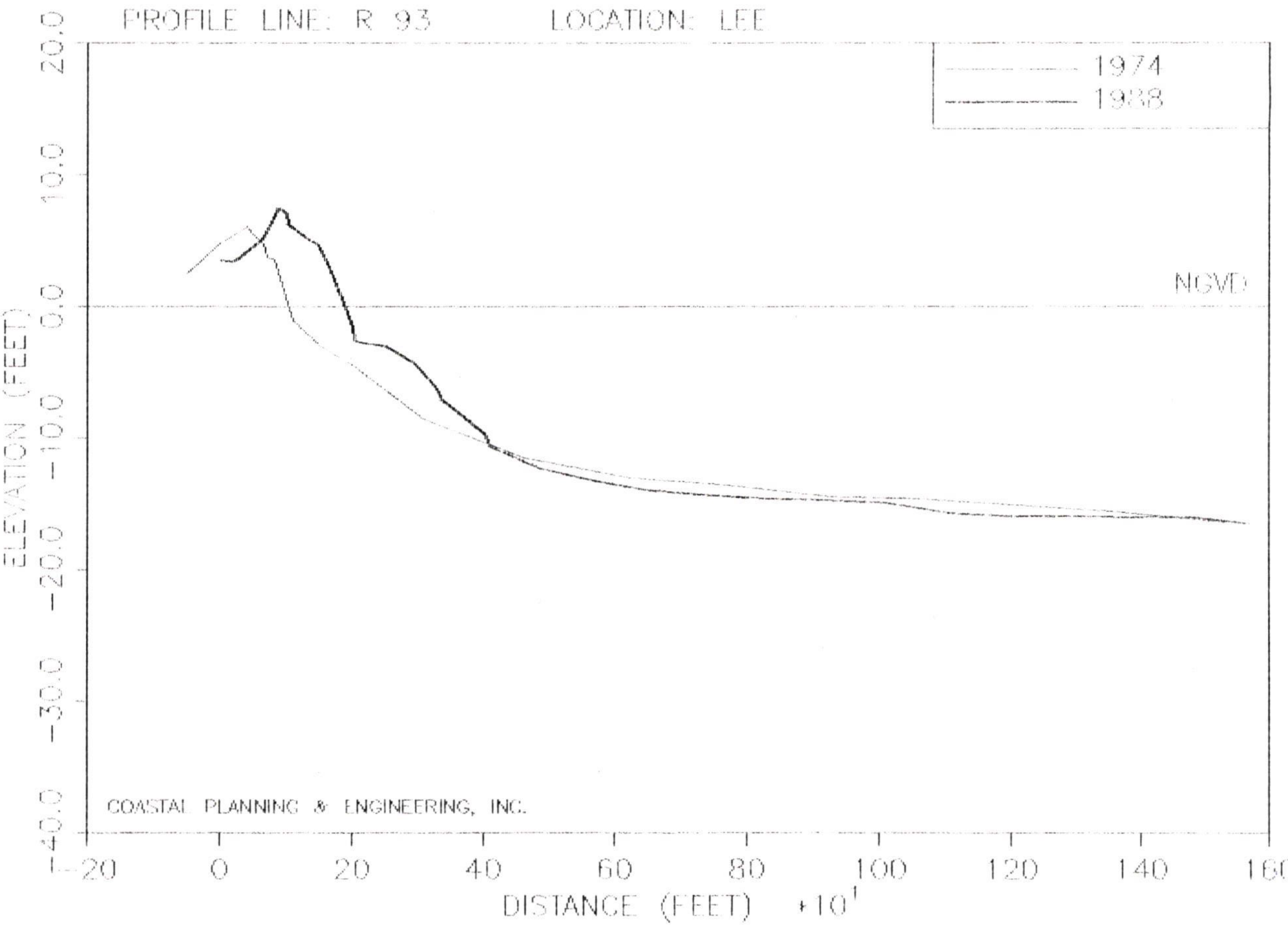
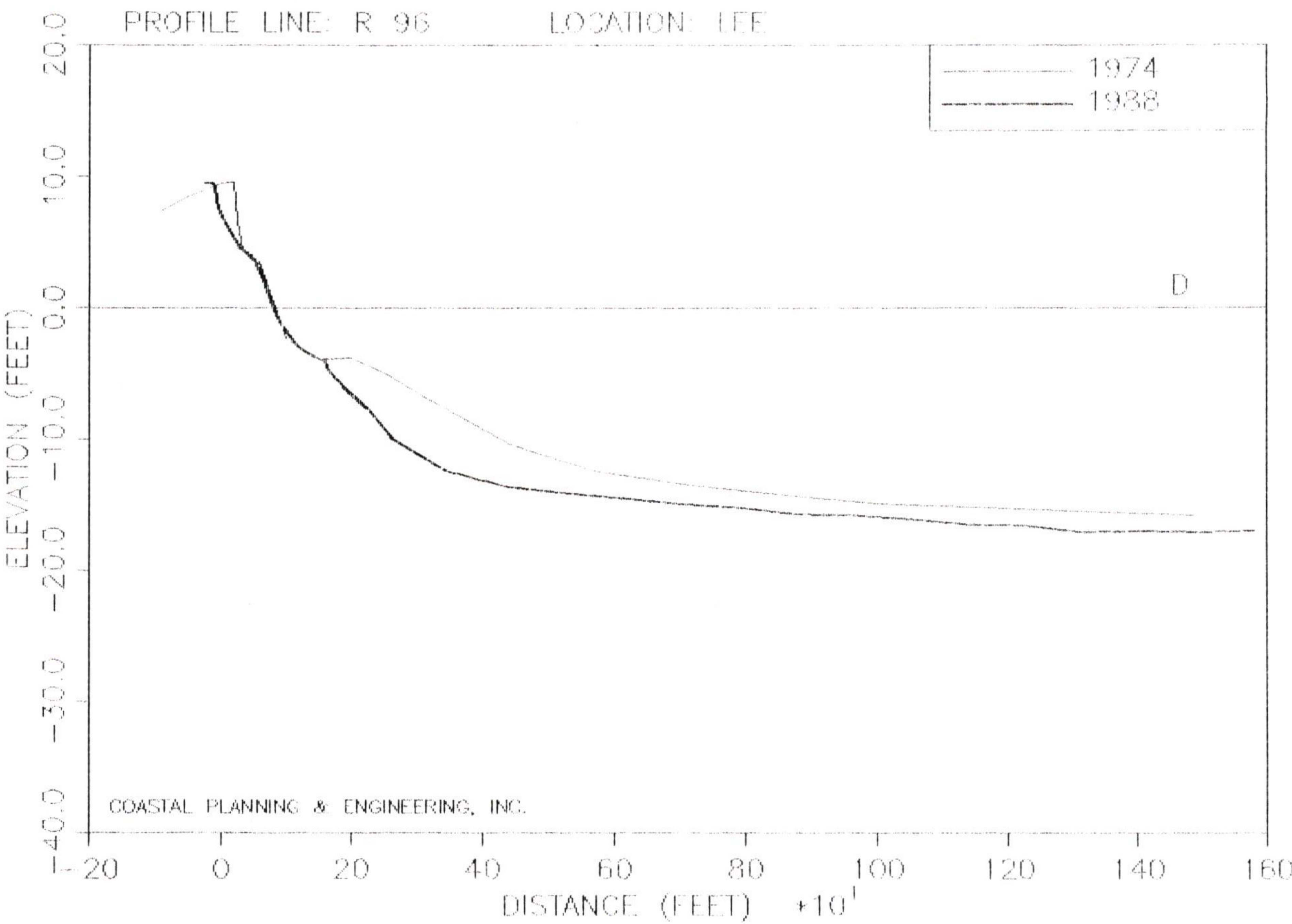
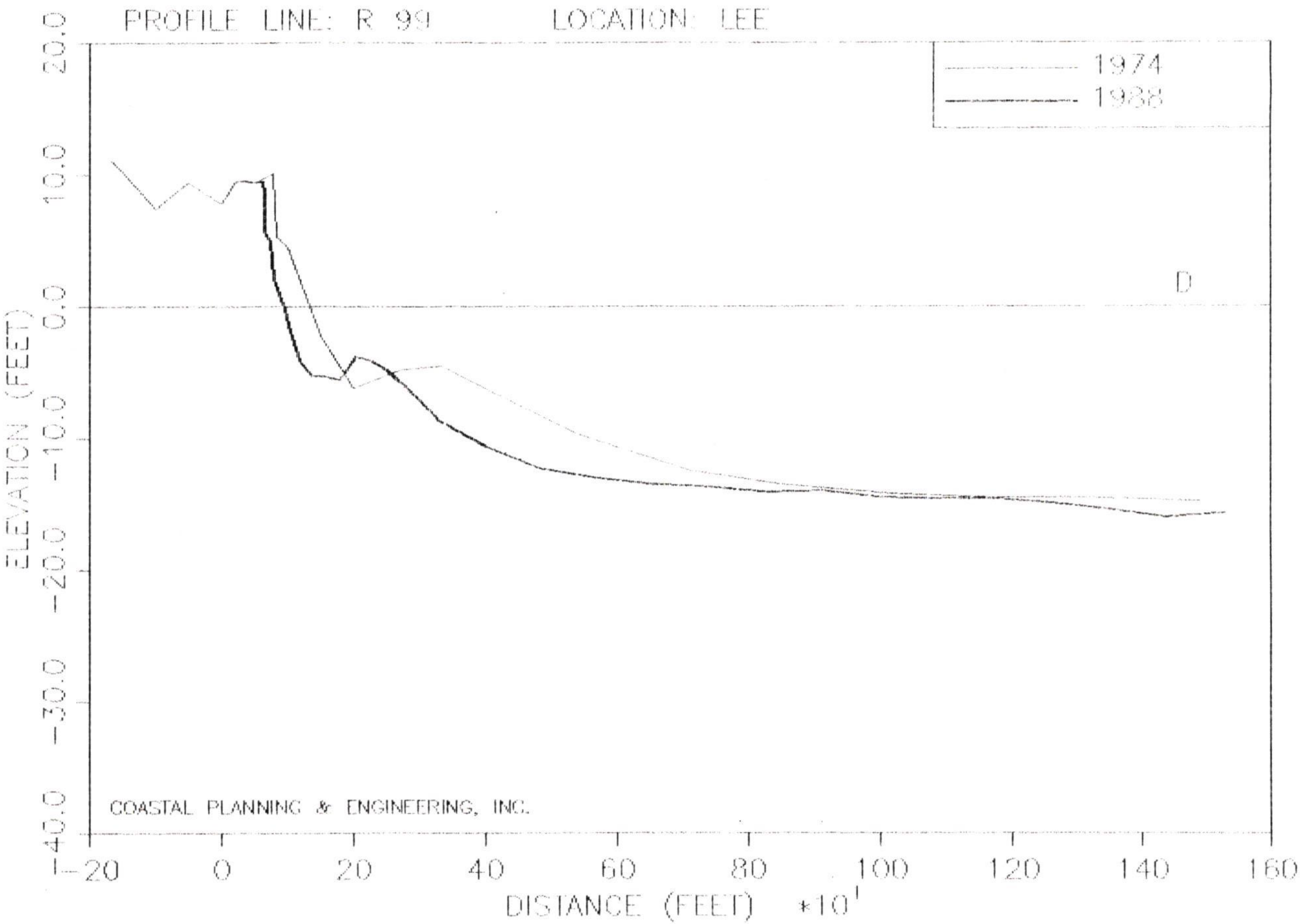
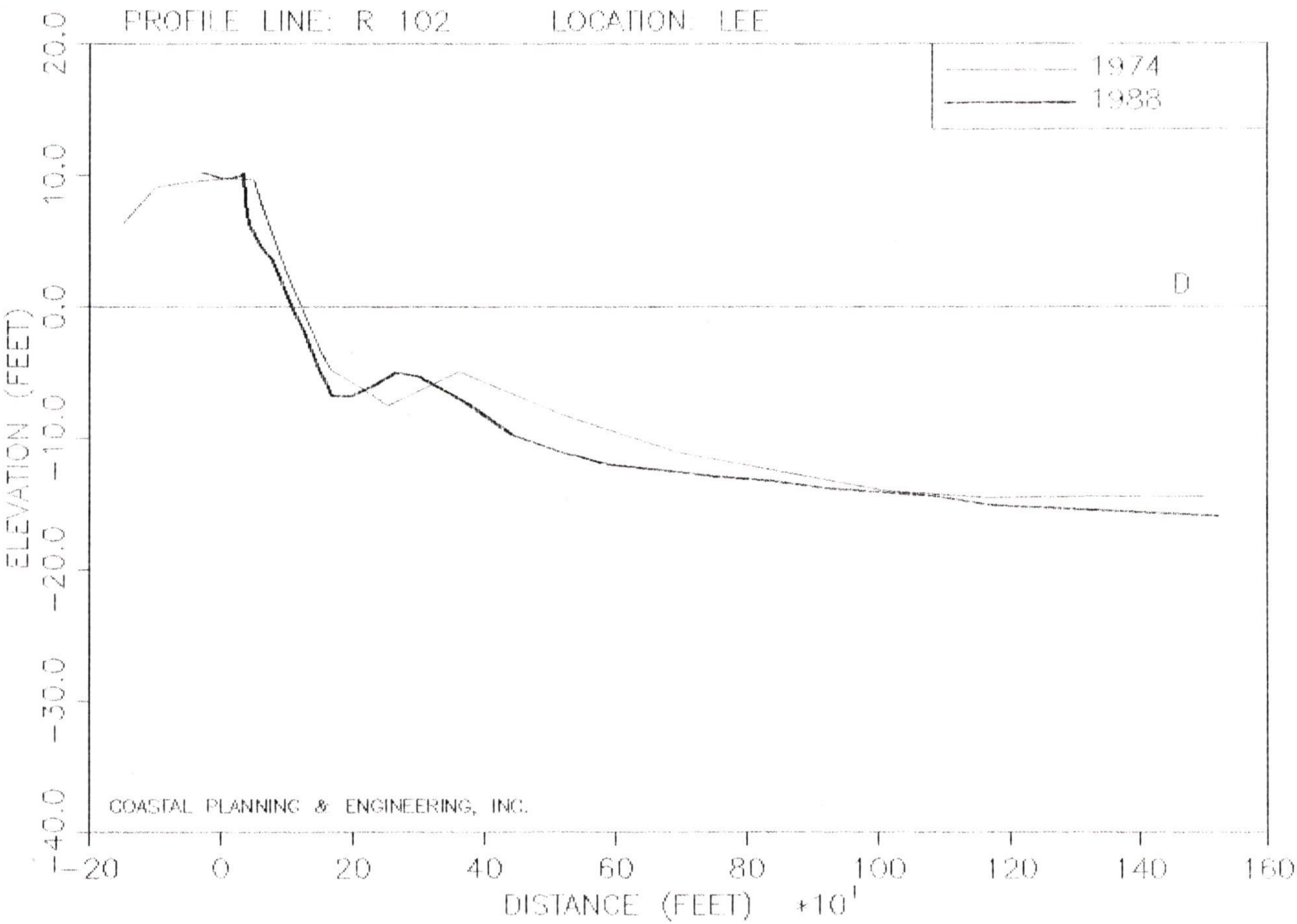
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1
COASTAL PLANNING & ENGINEERING, INC.

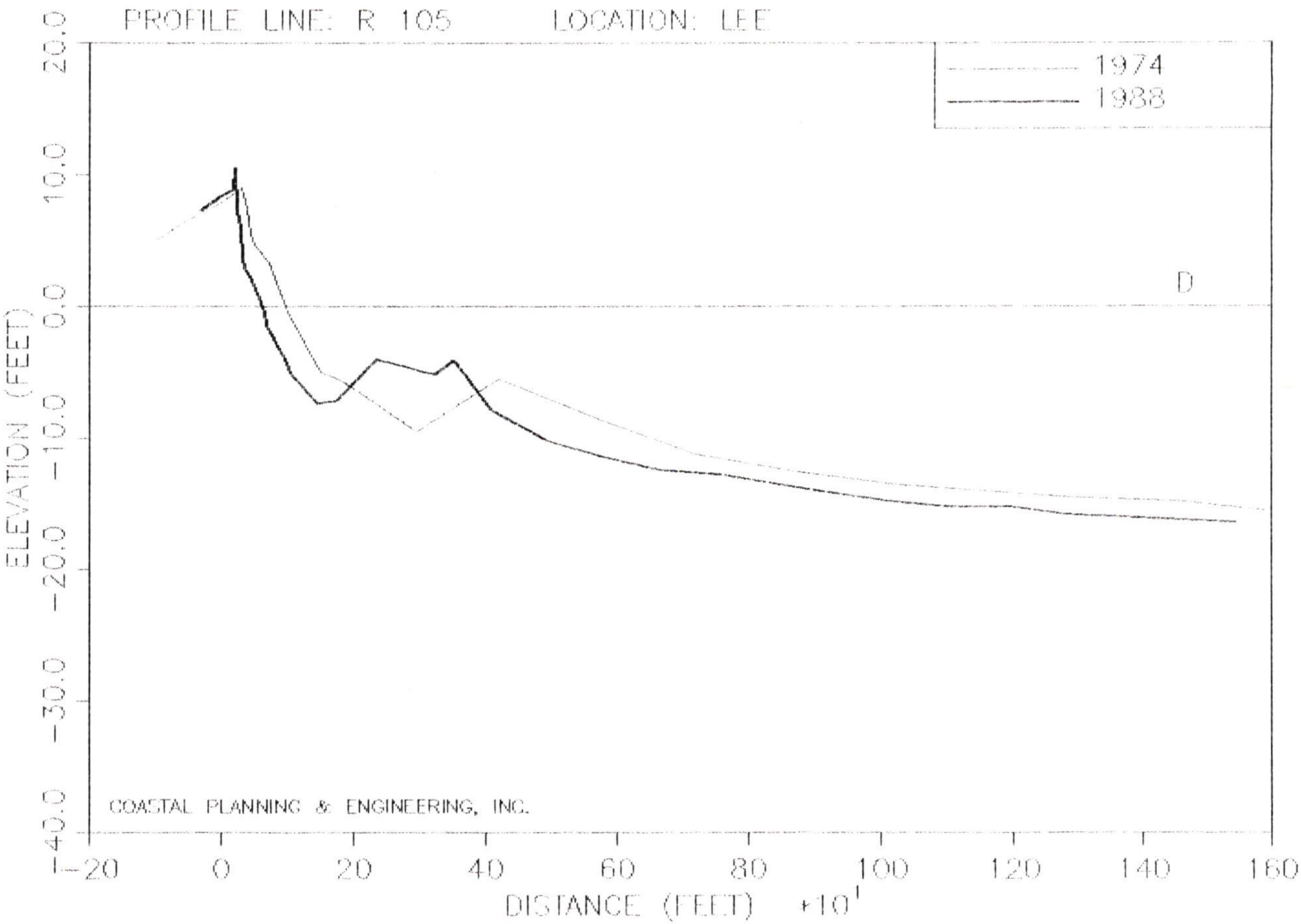

PROFILE LINE: R 93
LOCATION: LEE
1974
1988
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1



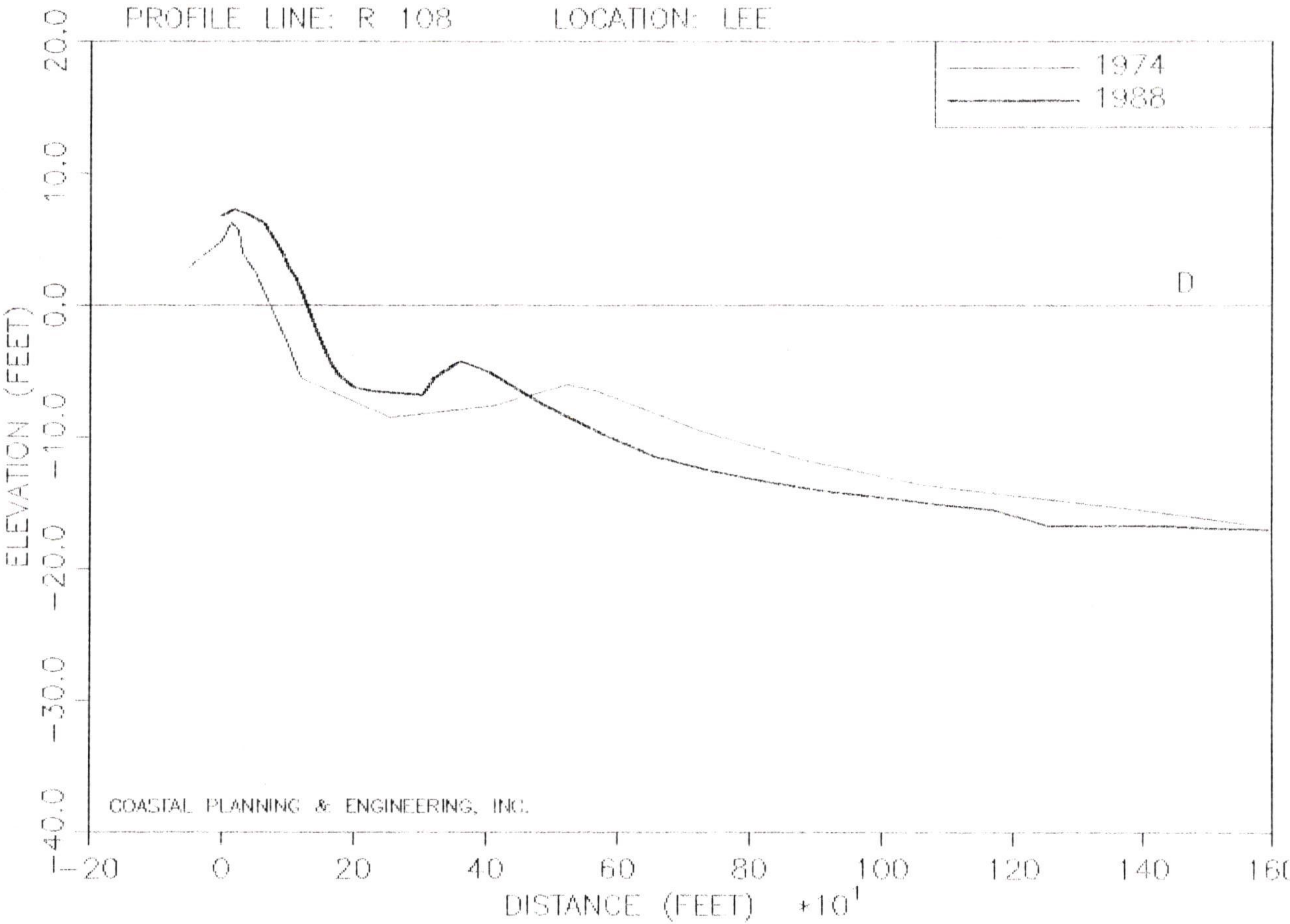
PROFILE LINE: R 96
LOCATION: LEE
1974
1988
D
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]


PROFILE LINE: R 99
LOCATION: LEE
1974
1988
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
D
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

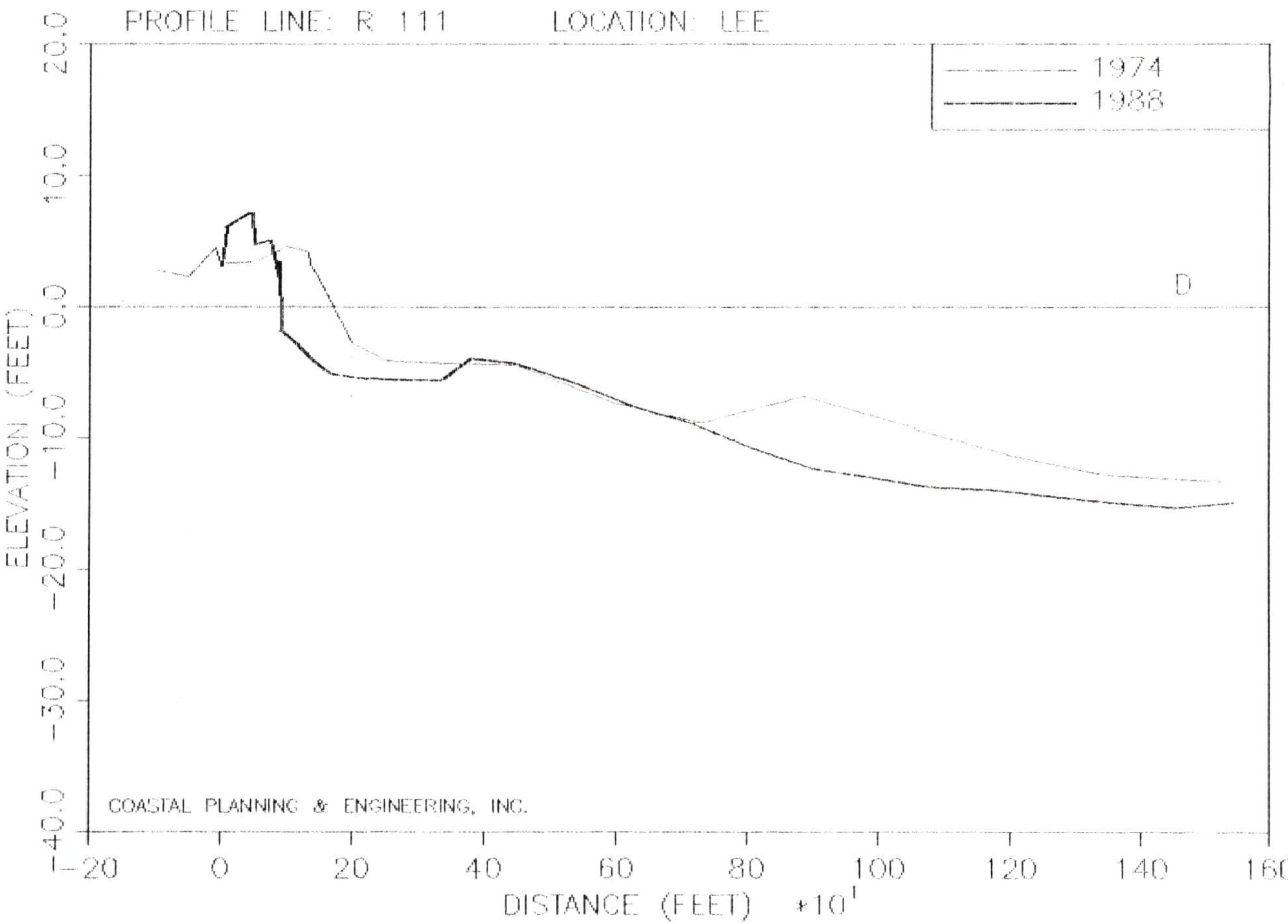

PROFILE LINE: R 102
LOCATION: LEE
1974
1988
D
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]
COASTAL PLANNING & ENGINEERING, INC.

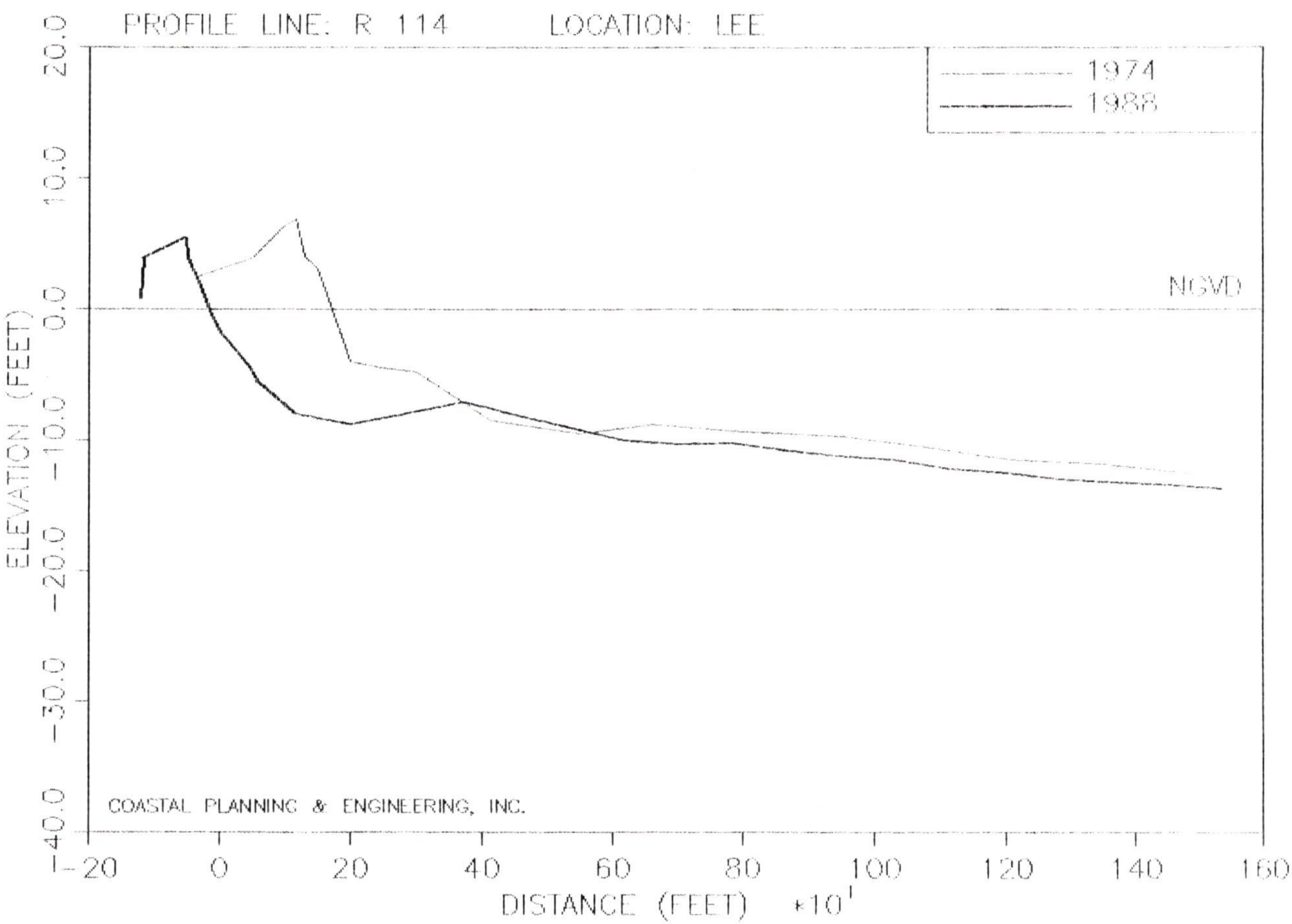


PROFILE LINE: R 105
LOCATION: LEE
1974
1988
D
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]
COASTAL PLANNING & ENGINEERING, INC.



PROFILE LINE: R 108
LOCATION: LEE
1974
1988
D
COASTAL PLANNING & ENGINEERING, INC.
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]


PROFILE LINE: R 111
LOCATION: LEE
1974
1988
D
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
DISTANCE (FEET) *10[1]
-20
0
20
40
60
80
100
120
140
160
COASTAL PLANNING & ENGINEERING, INC.


PROFILE LINE: R 114
LOCATION: LEE
1974
1988
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

Comparative Beach Profile Plots

September 1985 (CPE) vs. August 13, 1988 (CPE)

COASTAL PLANNING & ENGINEERING, INC.
2481 N.W. BOCA RATON BOULEVARD
BOCA RATON, FLORIDA 33431
(407) 391-8102

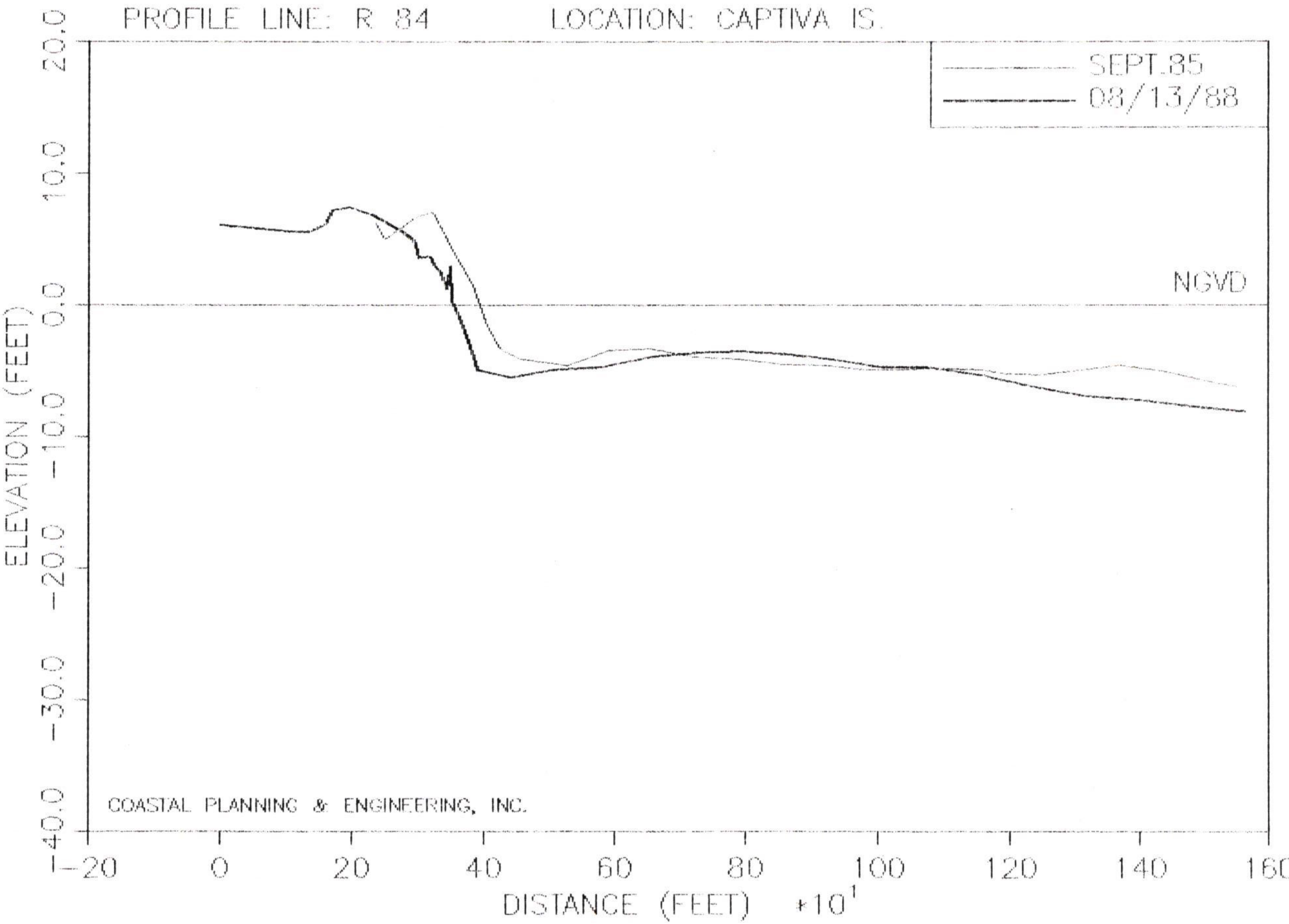
CP&E COASTAL SURVEY DATA ANALYSIS SYSTEM
PROJECT AREA: CAPTIVA IS.

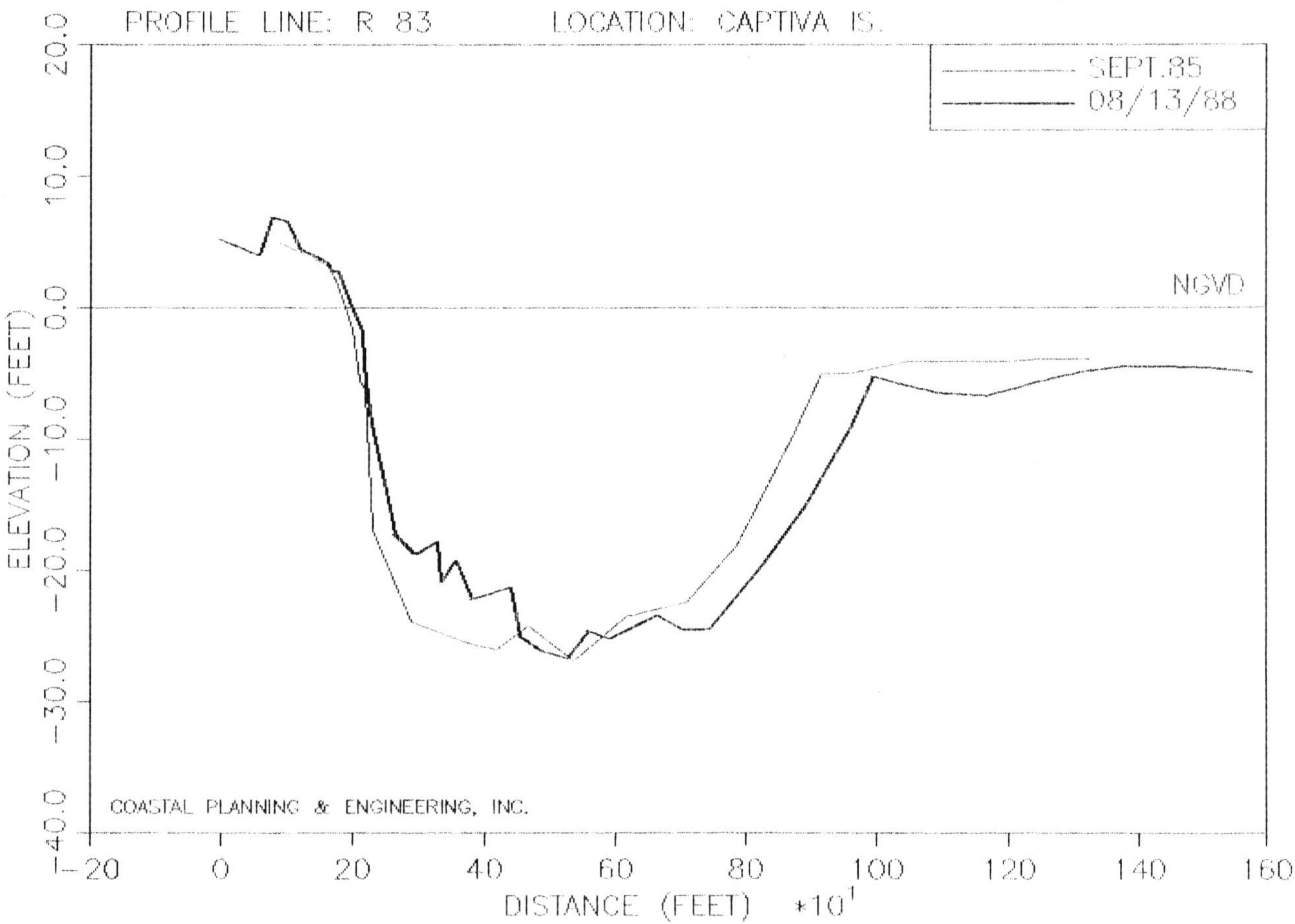
DATA FILE INFORMATION:

LINE INDEX 1	LINE INDEX 2	OLD FILE NAME	NEW FILE NAME
1	10	A:CI8509A.CPE	A:CI8808A.CPE
1	10	A:CI8509B.CPE	A:CI8808B.CPE
1	10	A:CI8509C.CPE	A:CI8808C.CPE
1	3	A:CI8509D.CPE	A:CI8808D.CPE

DATA DISK NUMBER =
REFERENCE DATUM = NGVD

PRINTED BY: LRA
PRINTED ON: 3-10-92


PROFILE LINE: R 84
LOCATION: CAPTIVA IS.
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1
COASTAL PLANNING & ENGINEERING, INC.


PROFILE LINE: R 83
LOCATION: CAPTIVA IS.
SEPT.85
08/13/88
NGVD
COASTAL PLANNING & ENGINEERING, INC.
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

COASTAL PLANNING & ENGINEERING, INC.
2481 N.W. BOCA RATON BOULEVARD
BOCA RATON, FLORIDA 33431
(407) 391-8102

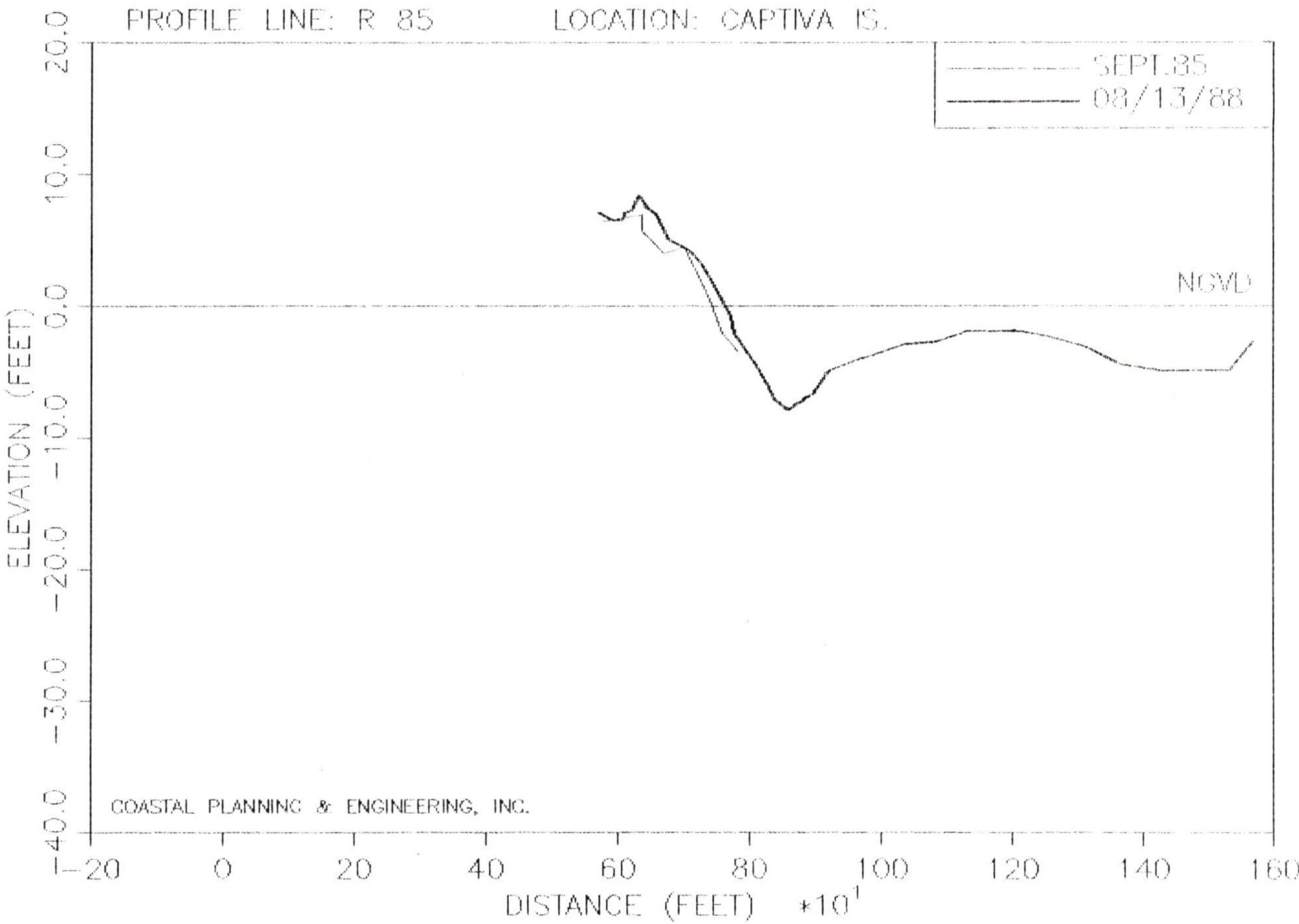
CP&E COASTAL SURVEY DATA ANALYSIS SYSTEM
PROJECT AREA: CAPTIVA ISLAND

DATA FILE INFORMATION:

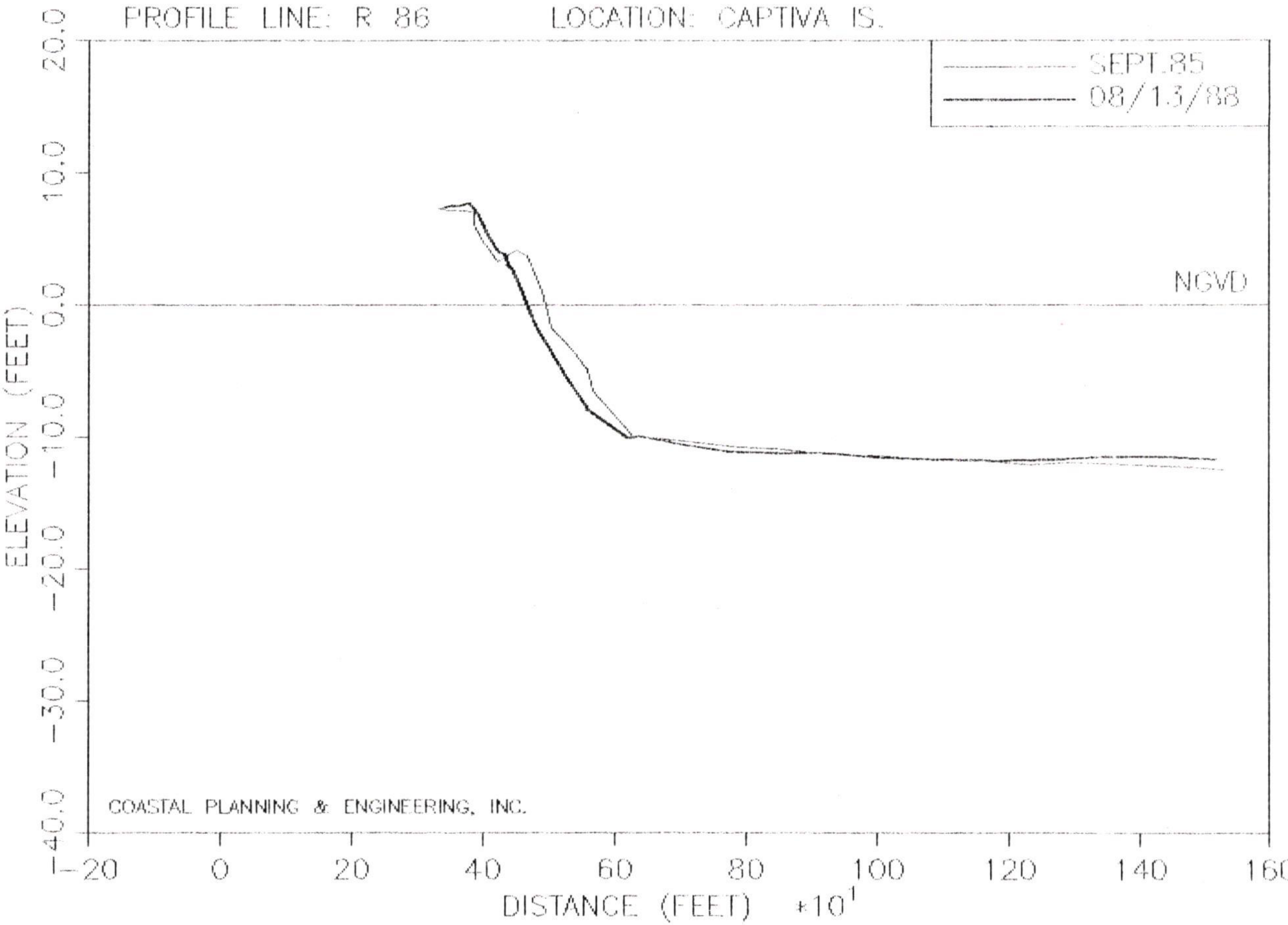
LINE INDEX 1	LINE INDEX 2	OLD FILE NAME	NEW FILE NAME
1	10	A:CI8509D.CPE	A:CI8808D.CPE
1	10	A:CI8509E.CPE	A:CI8808E.CPE
1	10	A:CI8509F.CPE	A:CI8808F.CPE
1	2	A:CI8509G.CPE	A:CI8808G.CPE

DATA DISK NUMBER =
REFERENCE DATUM = NGVD

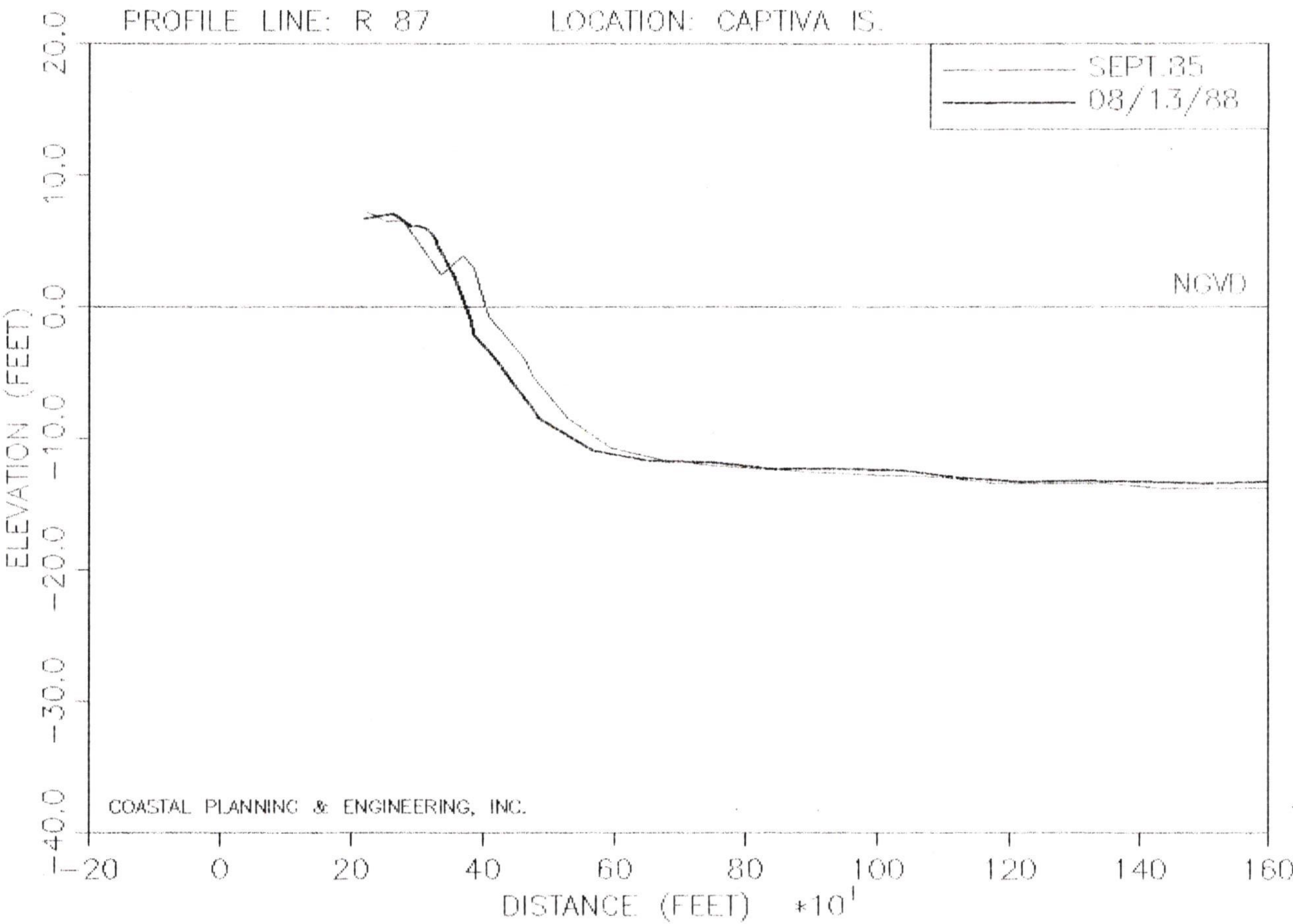
PRINTED BY: LRA
PRINTED ON: 3-10-92



PROFILE LINE: R 85
LOCATION: CAPTIVA IS.
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]



PROFILE LINE: R 86
LOCATION: CAPTIVA IS.
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]
COASTAL PLANNING & ENGINEERING, INC.



PROFILE LINE: R 87
LOCATION: CAPTIVA IS.
SEPT.35
08/13/88
NGVD
ELEVATION (FEET)
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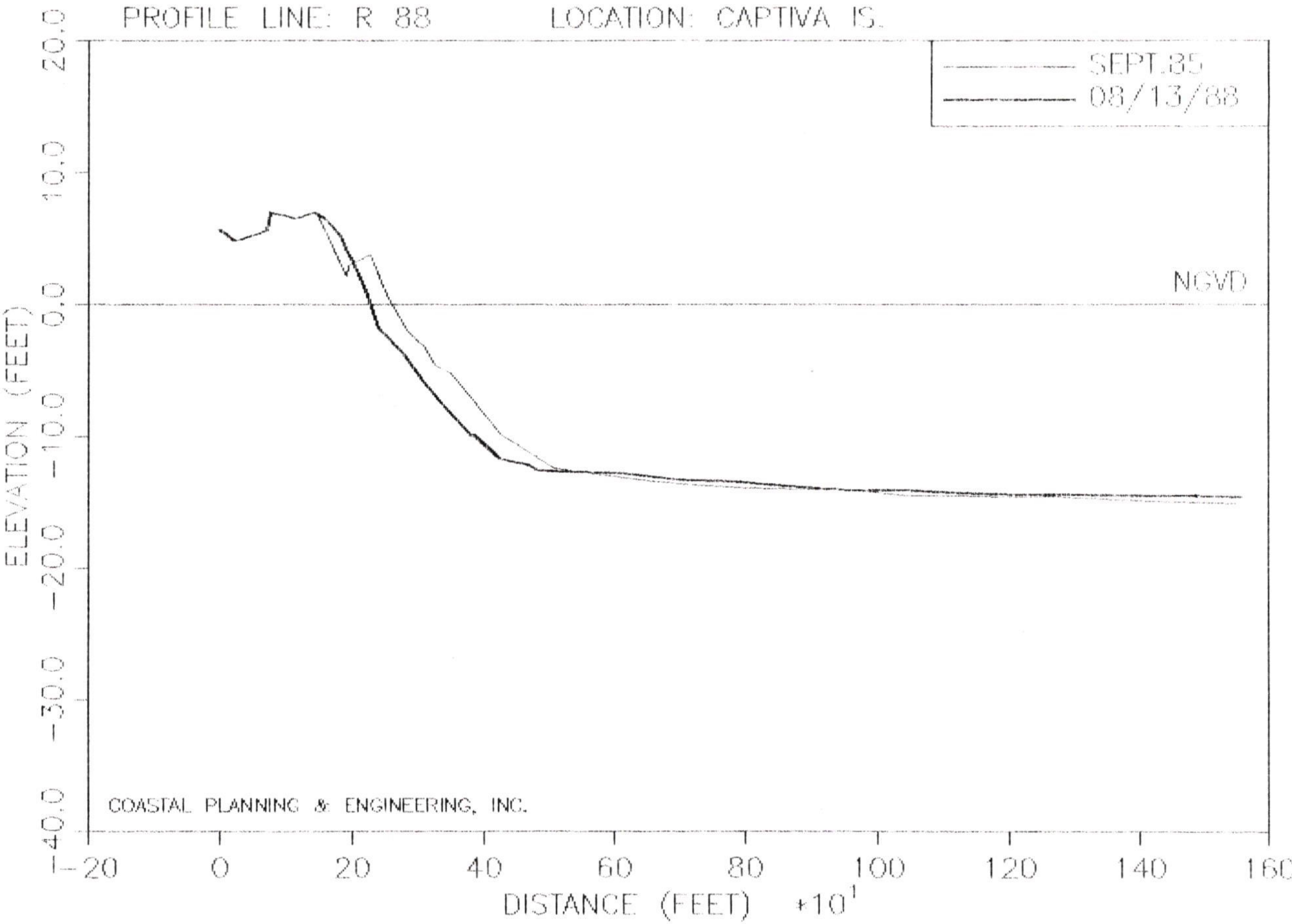
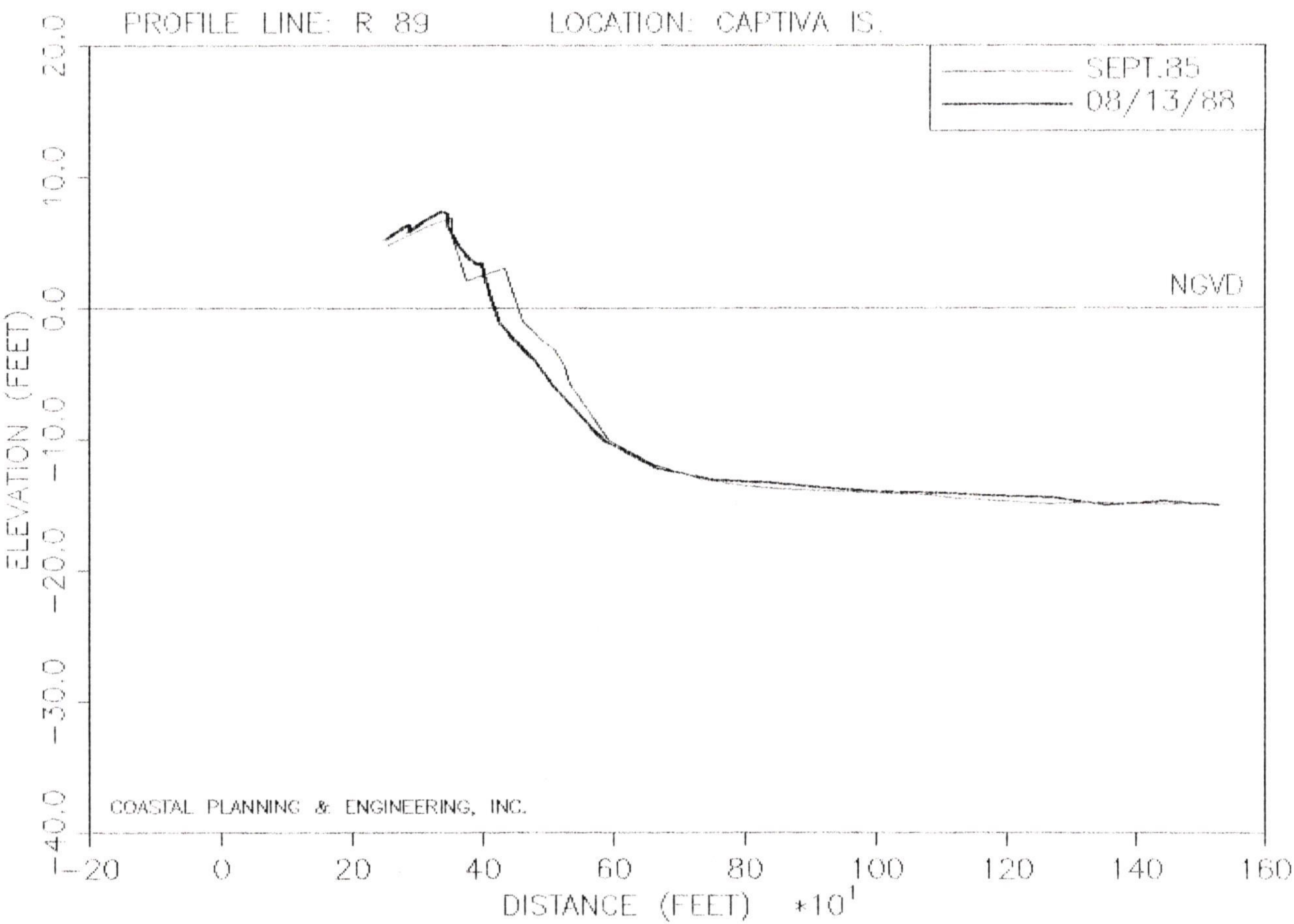
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]


PROFILE LINE: R 88
LOCATION: CAPTIVA IS.
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1


PROFILE LINE: R 89
LOCATION: CAPTIVA IS.
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
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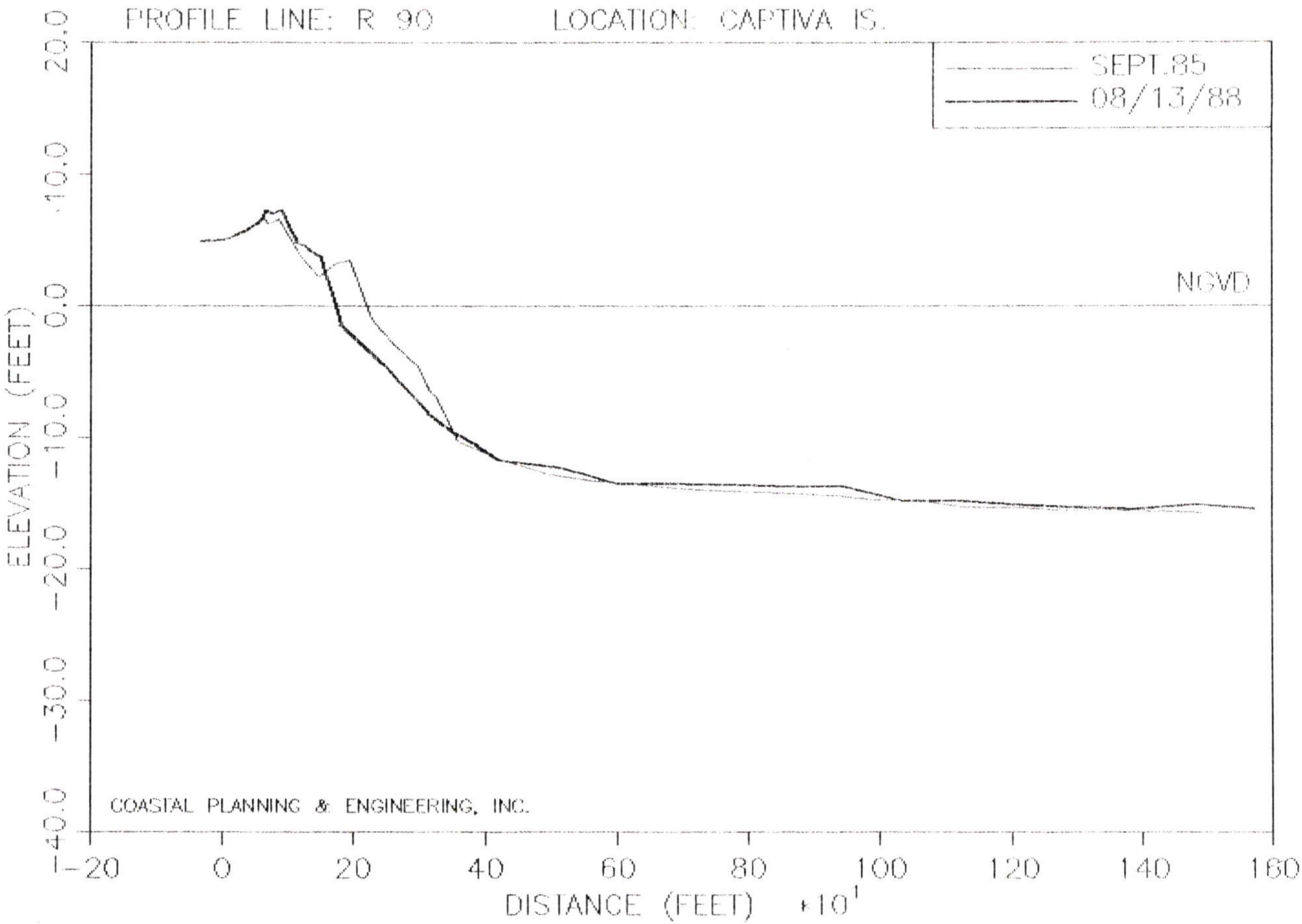
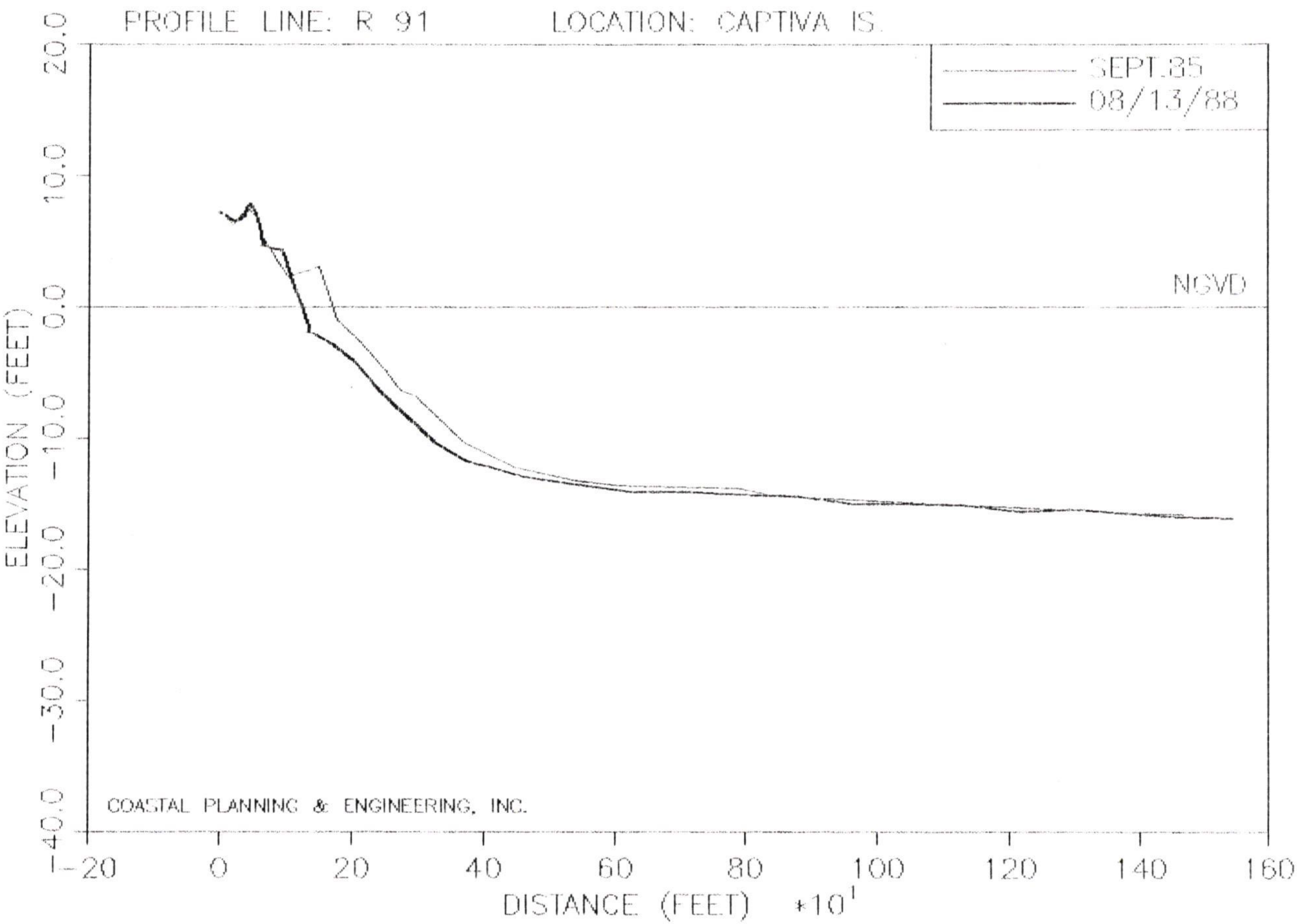
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1



PROFILE LINE: R 90
LOCATION: CAPTIVA IS.
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1



PROFILE LINE: R 91
LOCATION: CAPTIVA IS.
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
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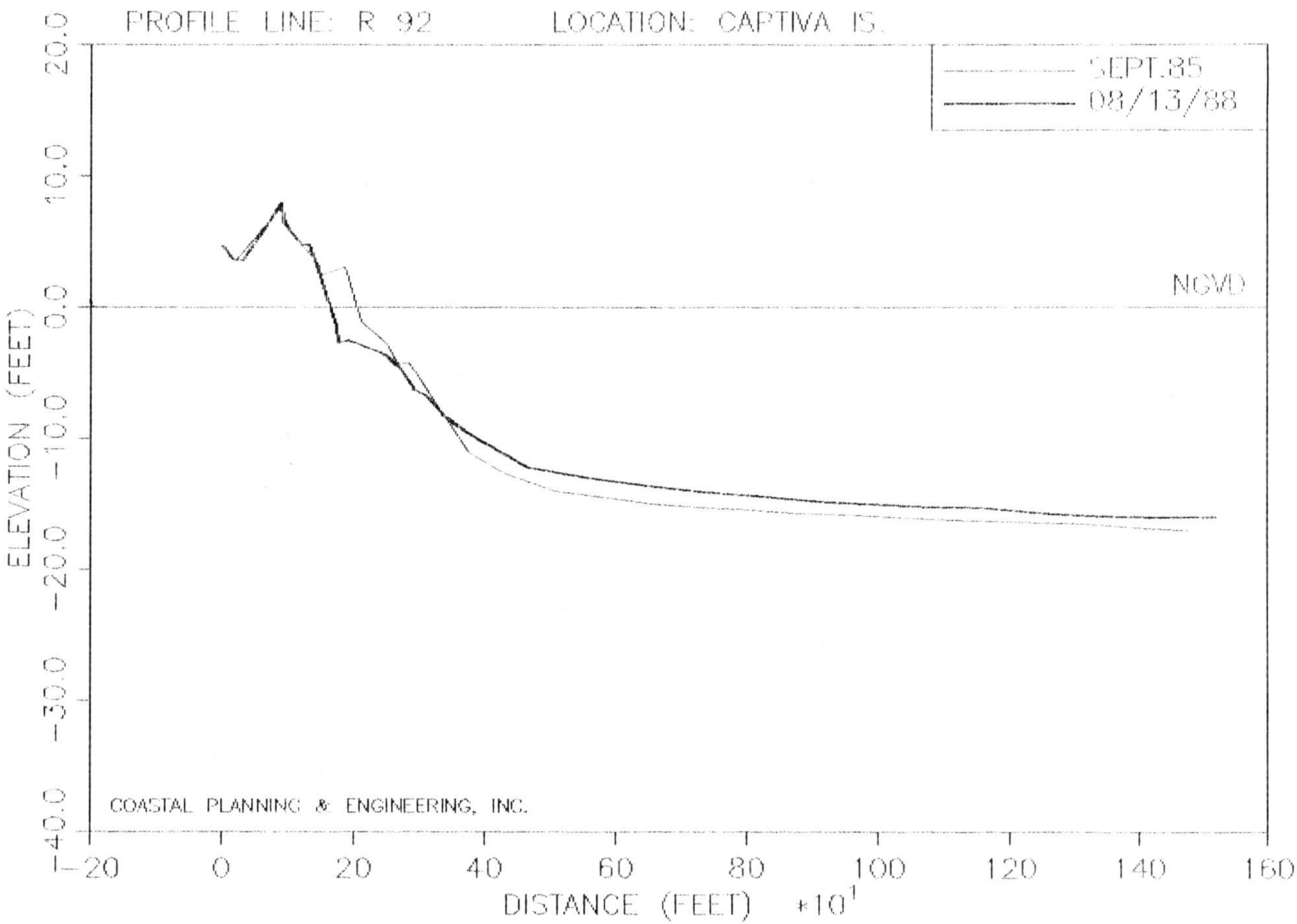
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]



PROFILE LINE: R 92
LOCATION: CAPTIVA IS.
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
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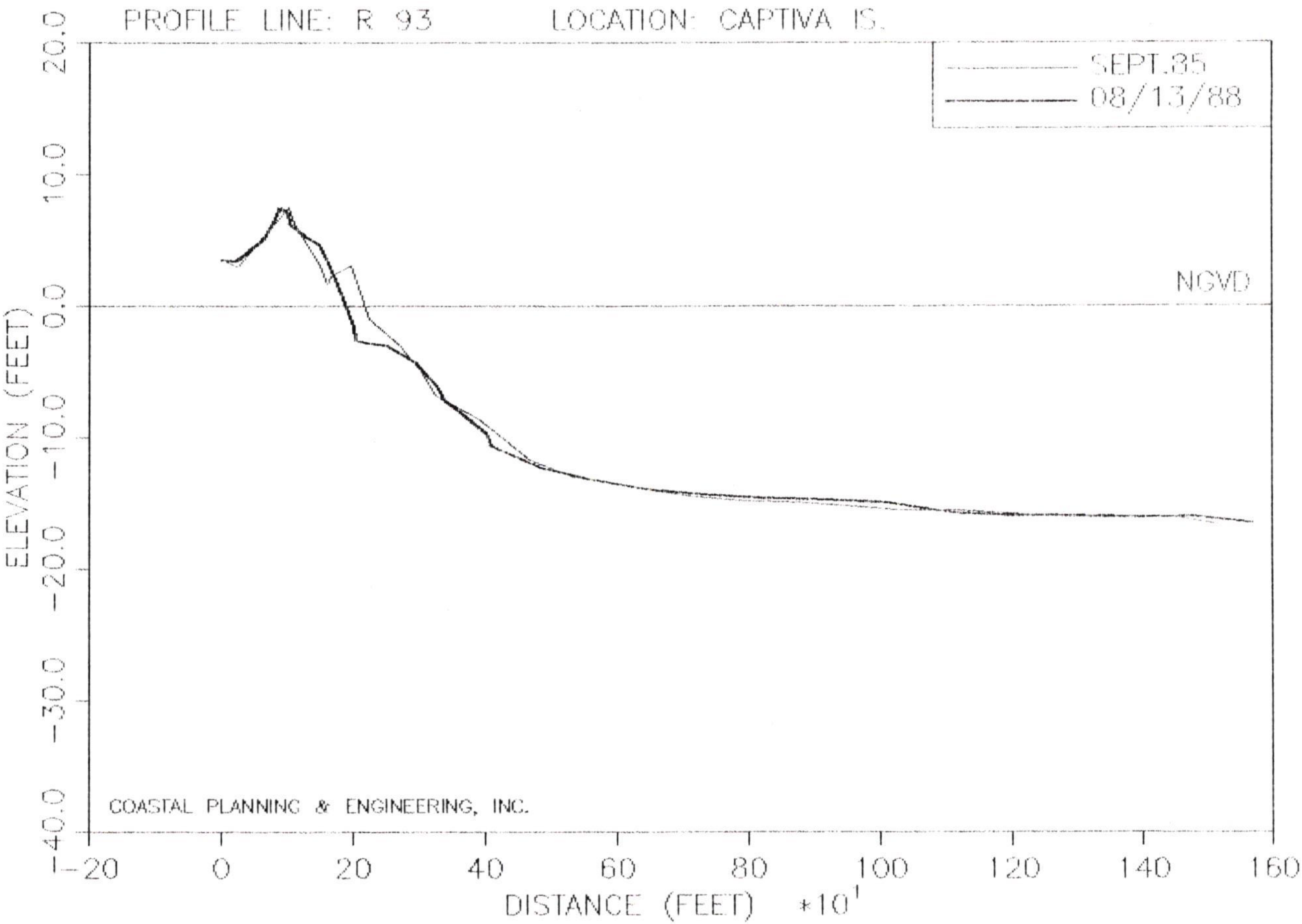
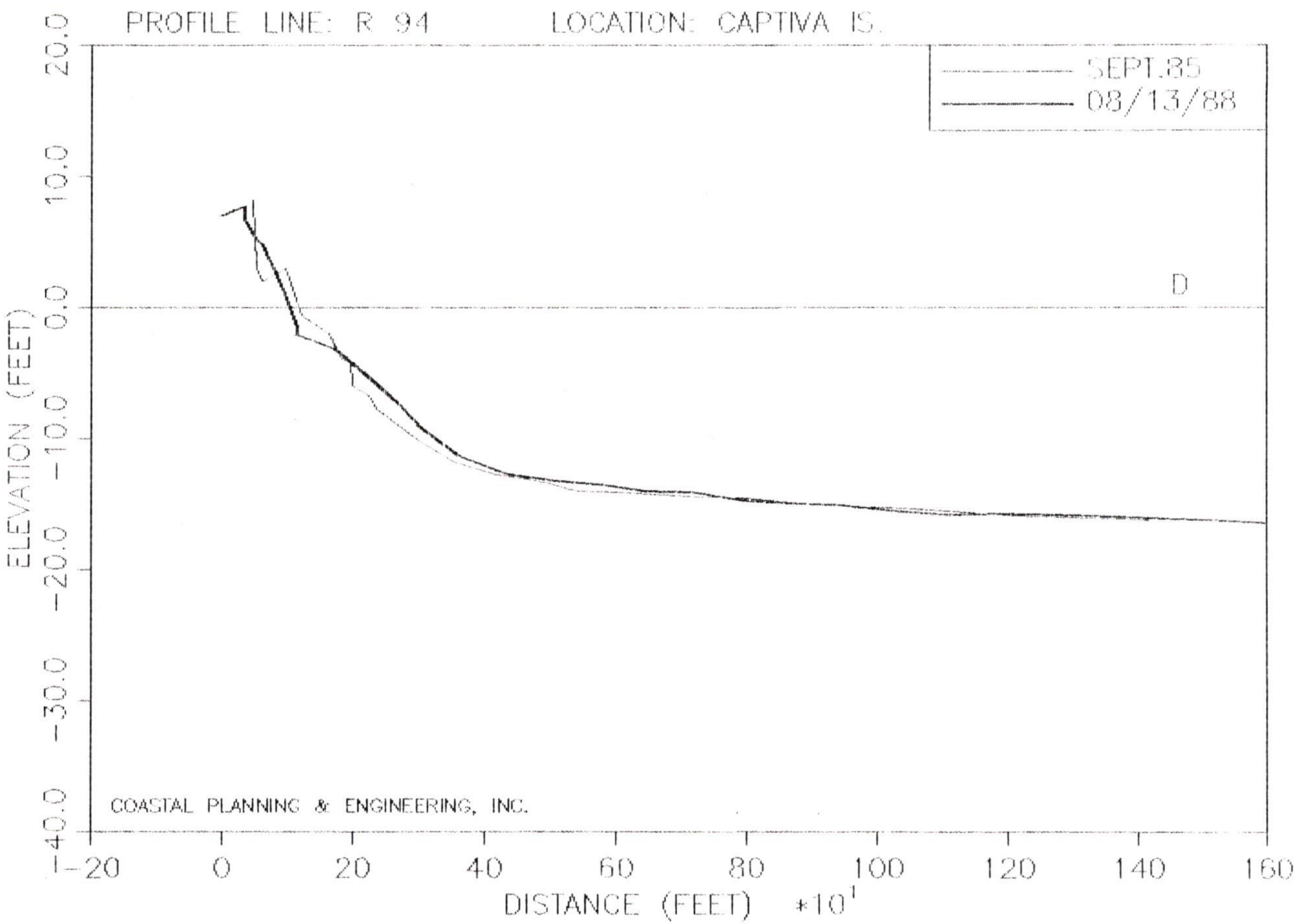
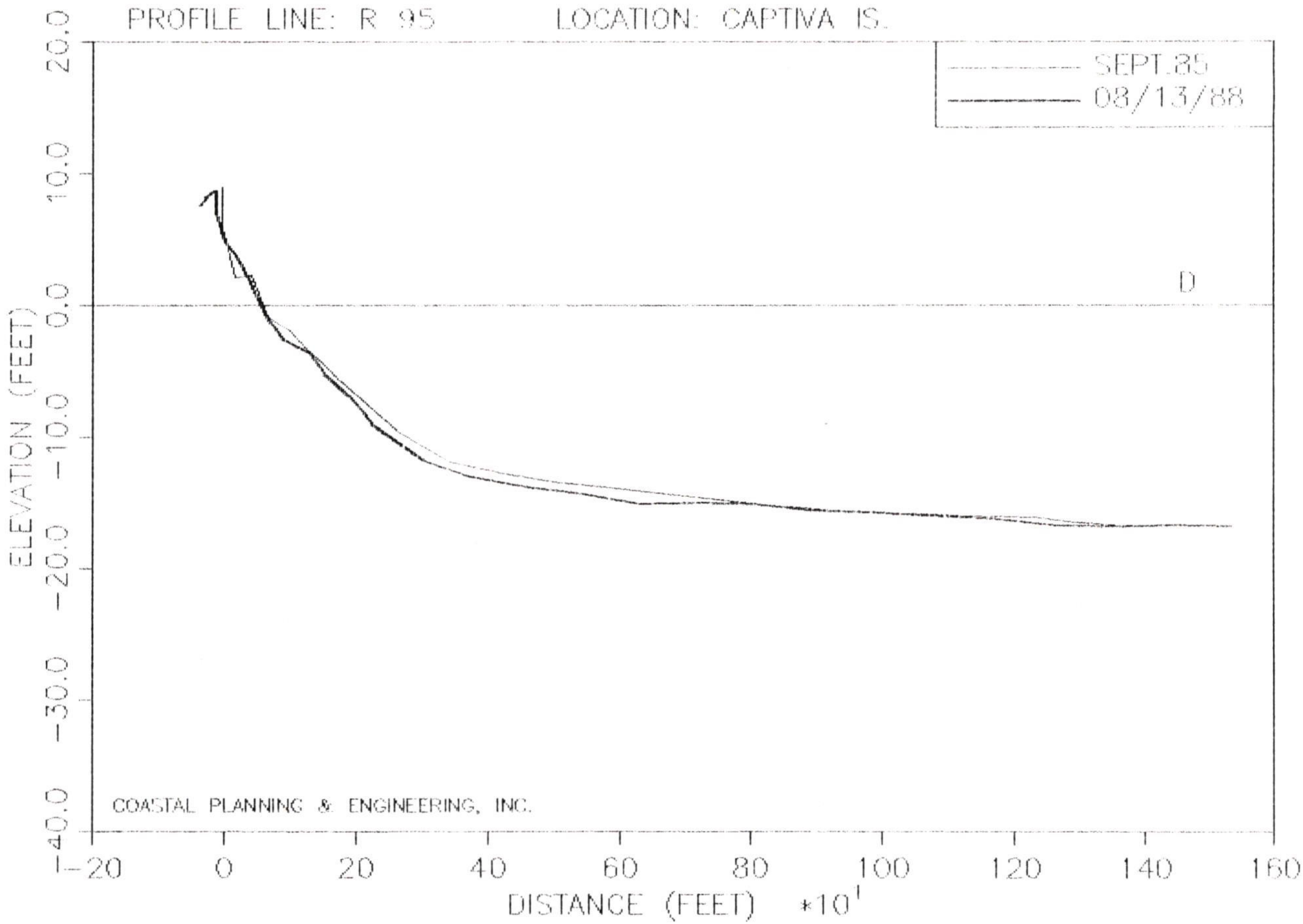
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]


PROFILE LINE: R 93
LOCATION: CAPTIVA IS.
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]



PROFILE LINE: R 94
LOCATION: CAPTIVA IS.
SEPT.85
08/13/88
D
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]


PROFILE LINE: R 95
LOCATION: CAPTIVA IS.
SEPT.85
08/13/88
D
ELEVATION (FEET)
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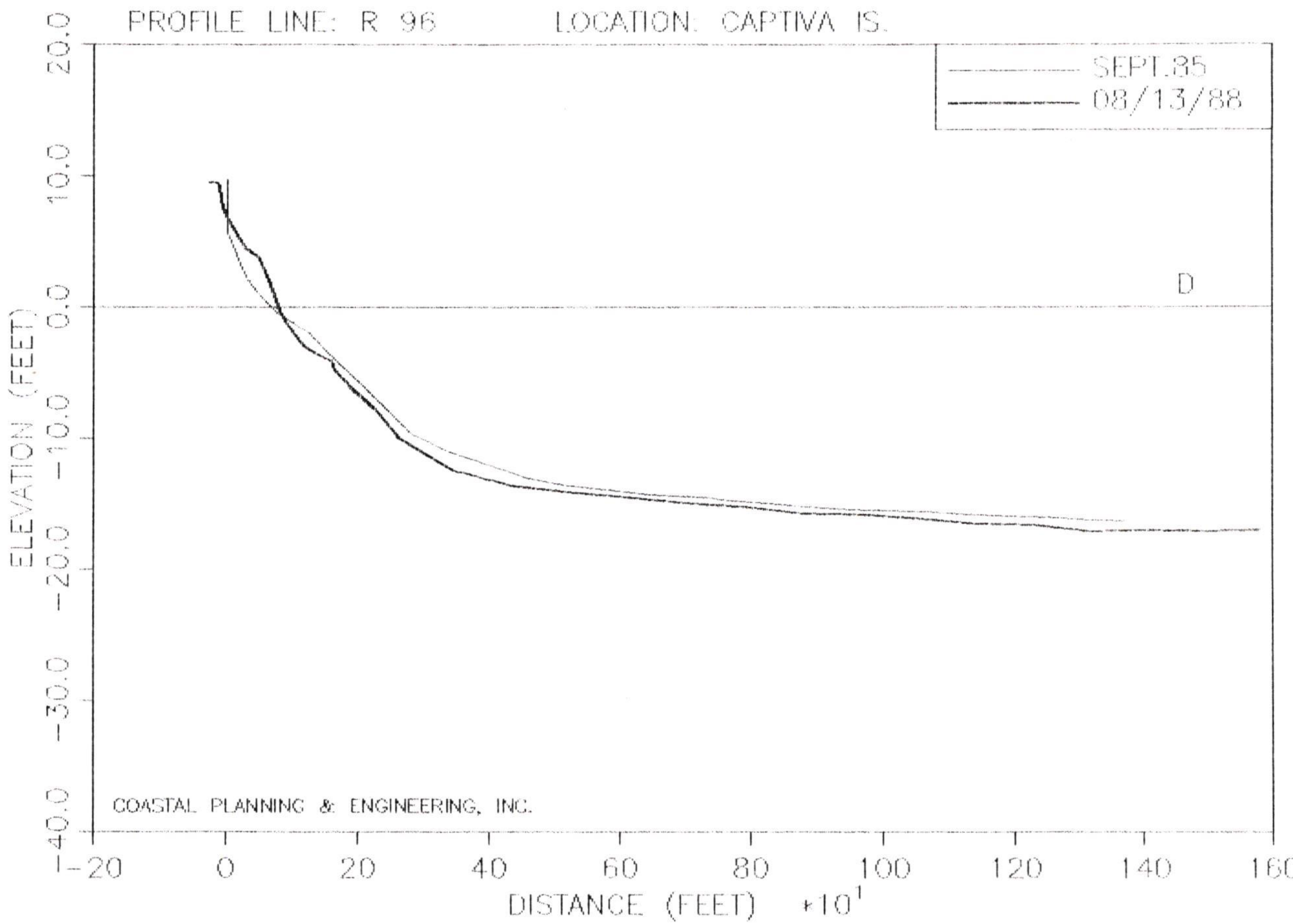
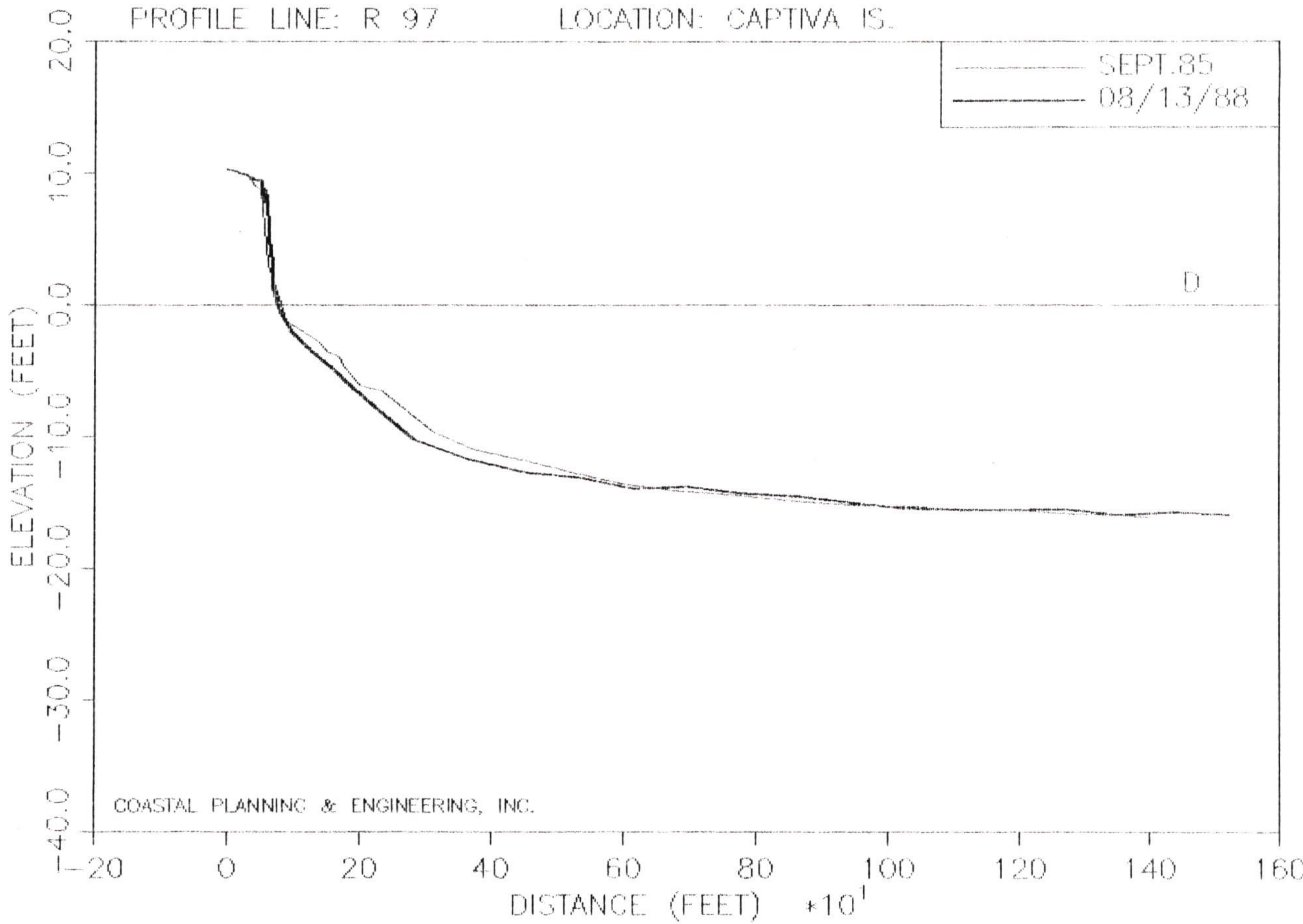
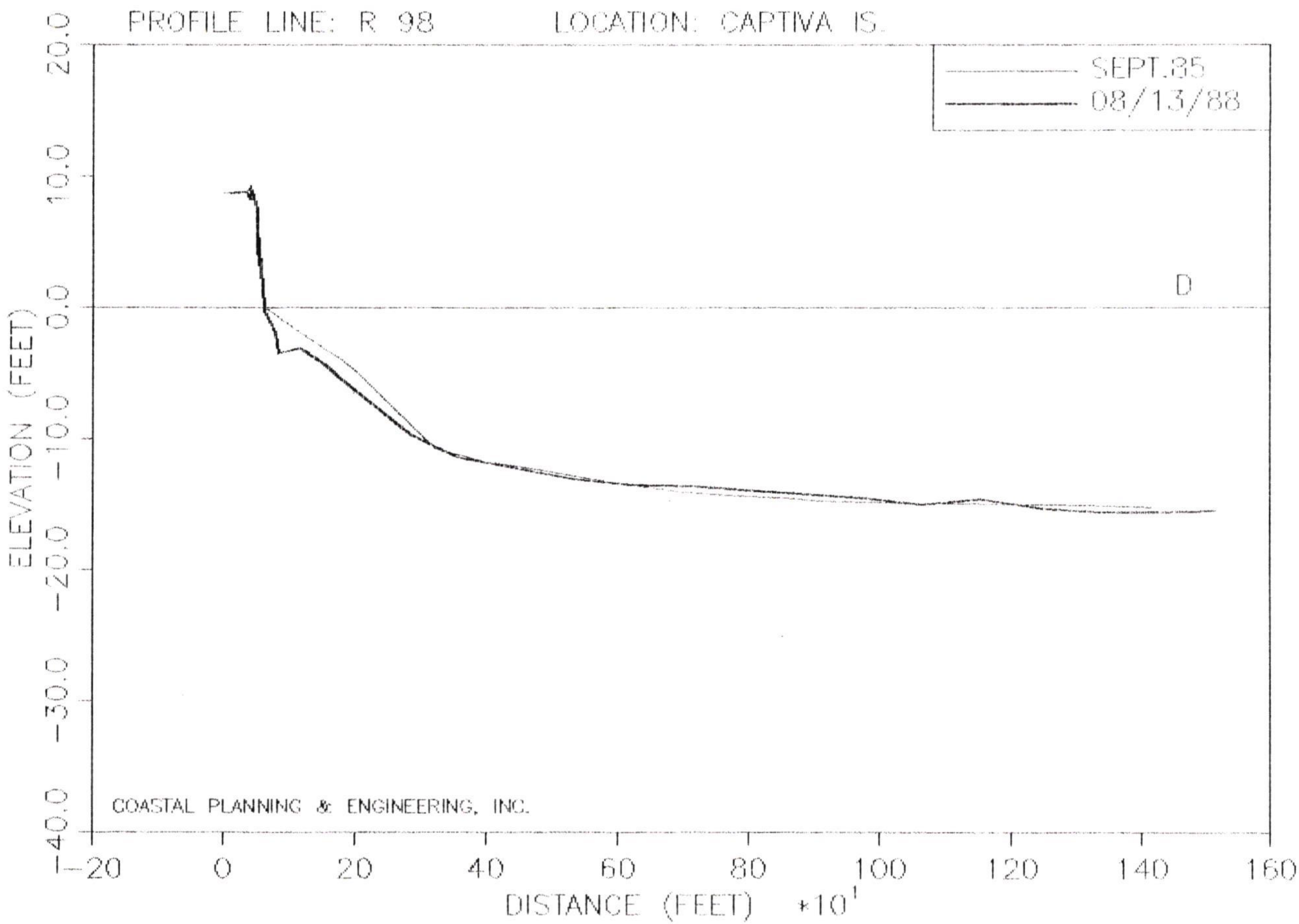
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1

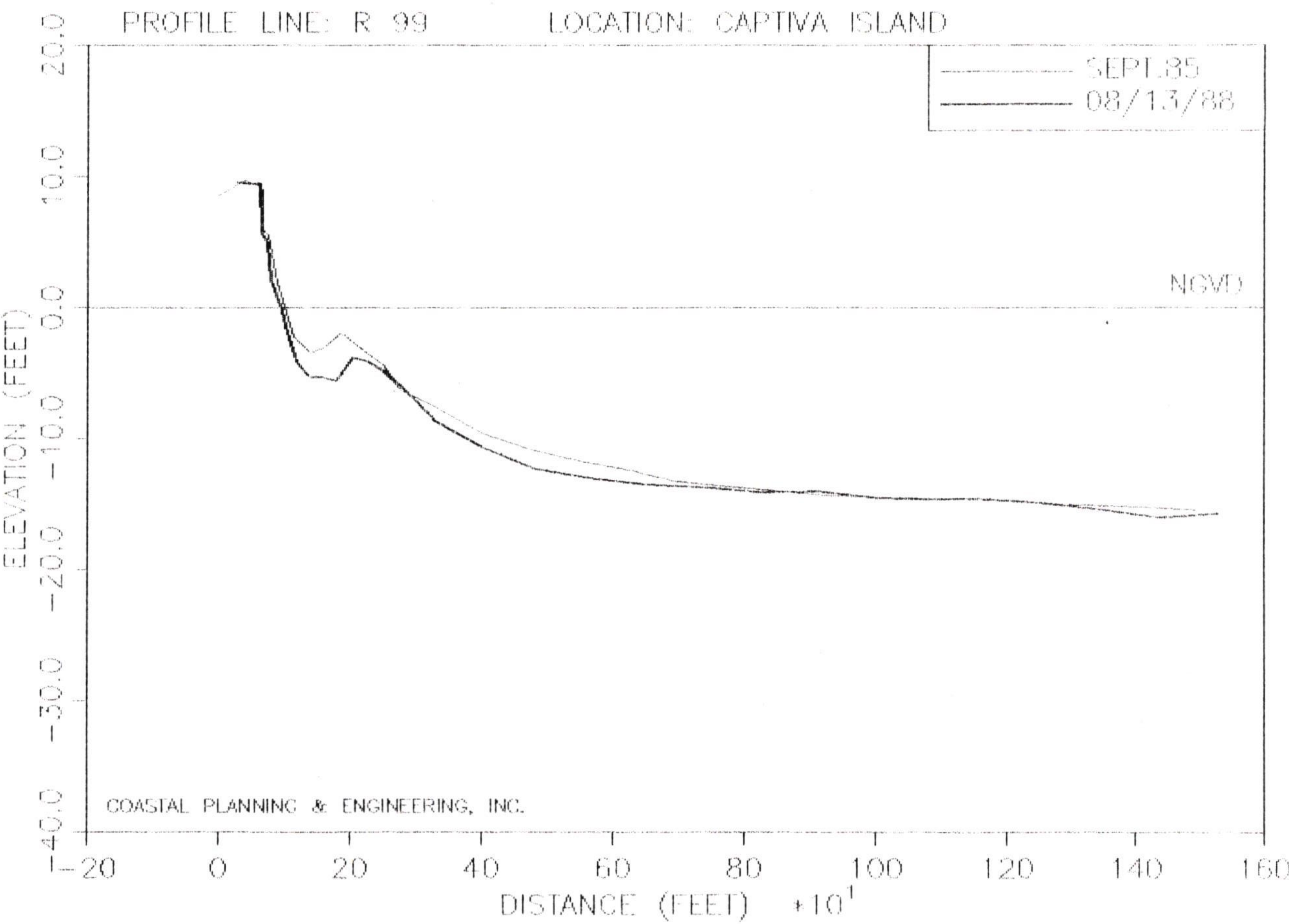


PROFILE LINE: R 96
LOCATION: CAPTIVA IS.
SEPT.85
08/13/88
D
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

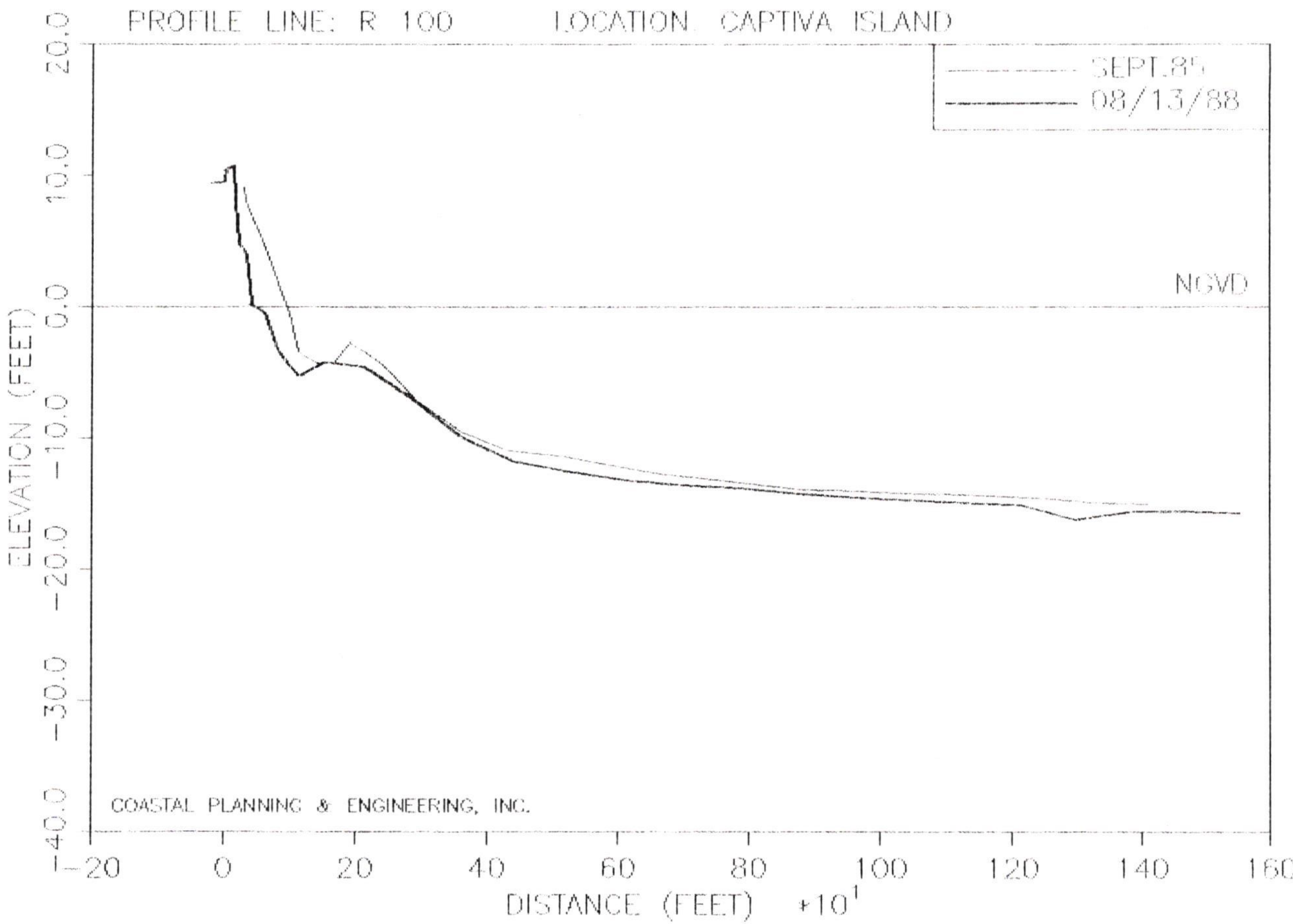

PROFILE LINE: R 97
LOCATION: CAPTIVA IS.
SEPT.85
08/13/88
D
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

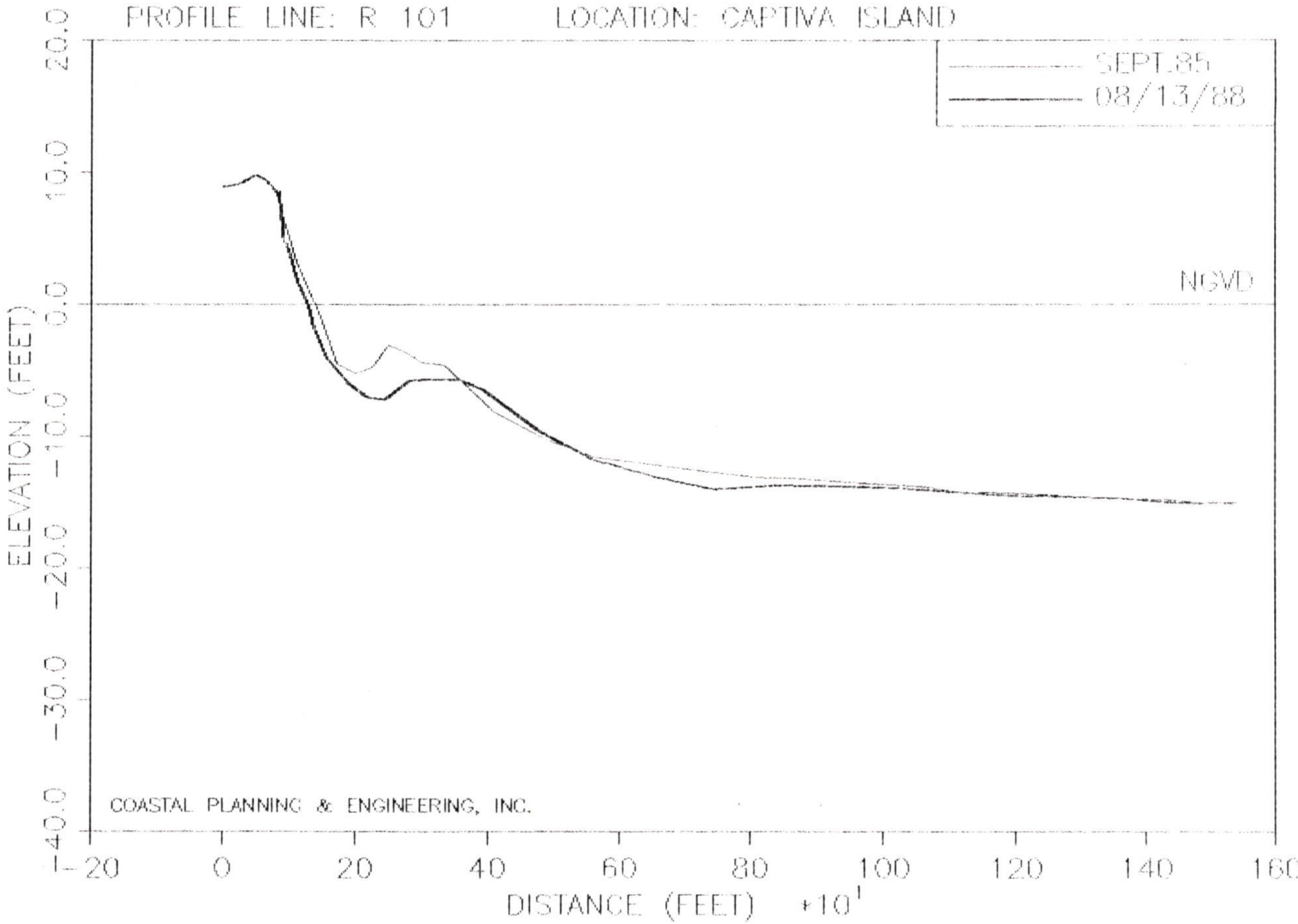


PROFILE LINE: R 98
LOCATION: CAPTIVA IS.
SEPT.85
08/13/88
D
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

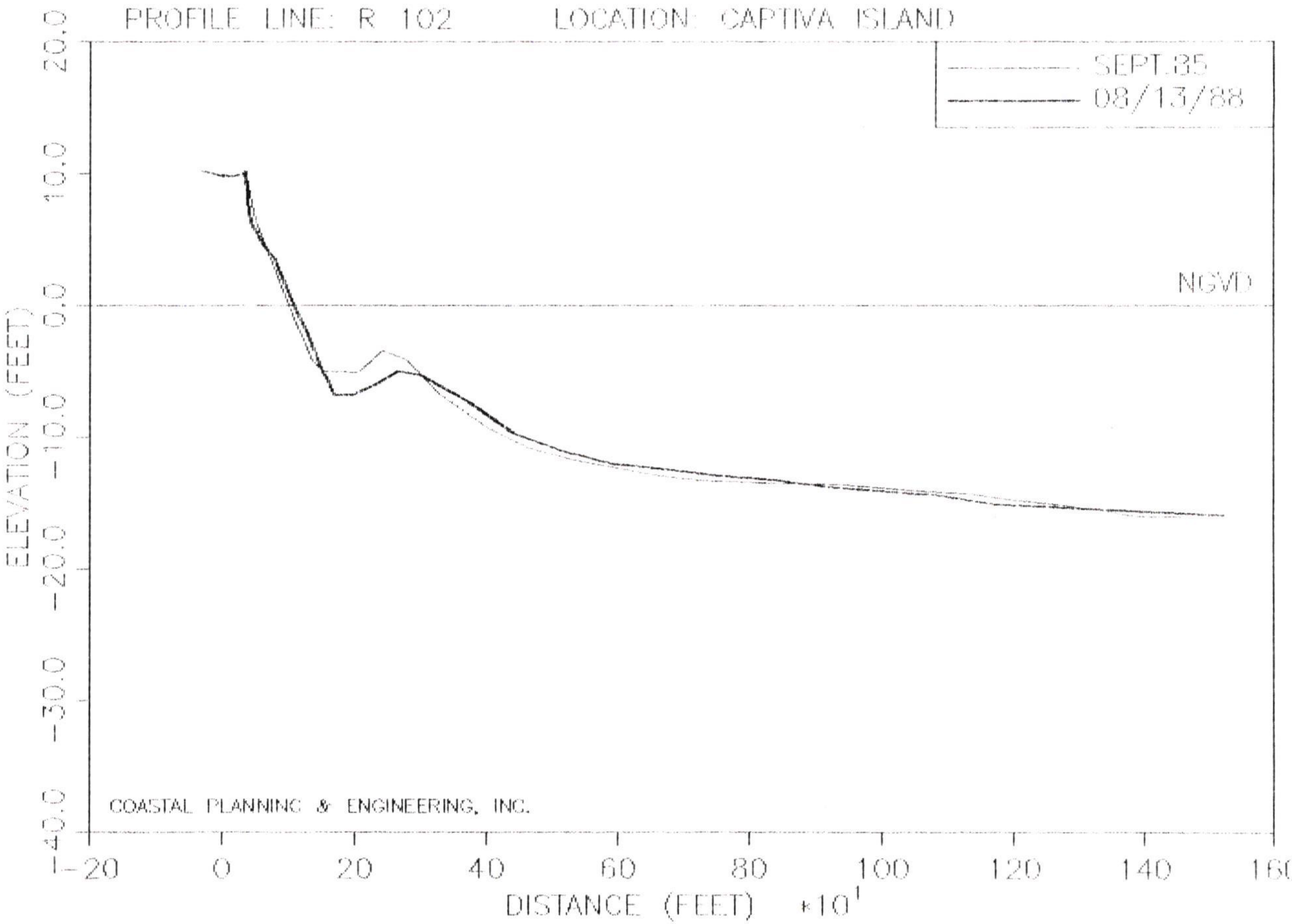


PROFILE LINE: R 99
LOCATION: CAPTIVA ISLAND
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

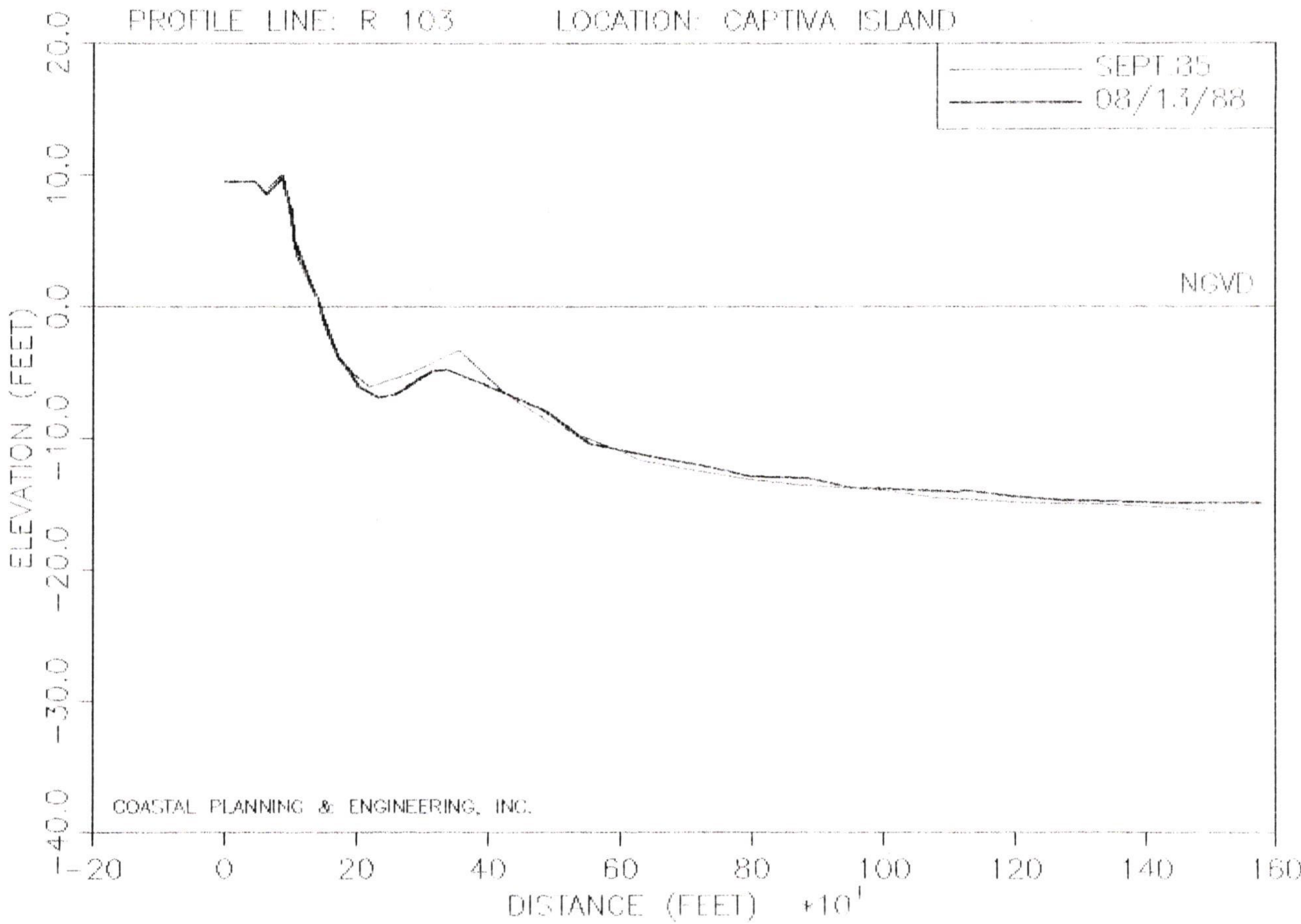

PROFILE LINE: R 100
LOCATION. CAPTIVA ISLAND
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10¹



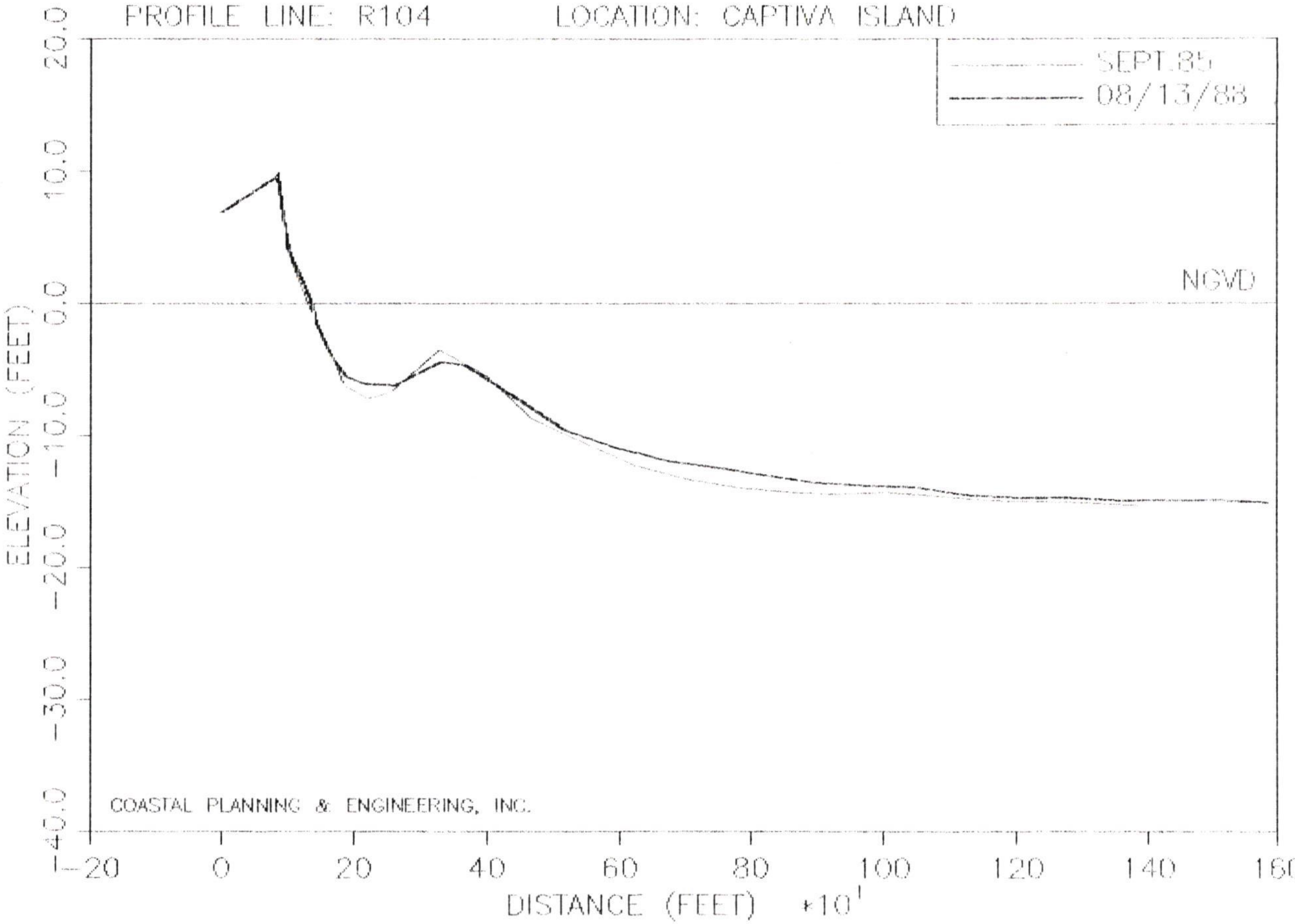
PROFILE LINE: R 101
LOCATION: CAPTIVA ISLAND
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]
COASTAL PLANNING & ENGINEERING, INC.



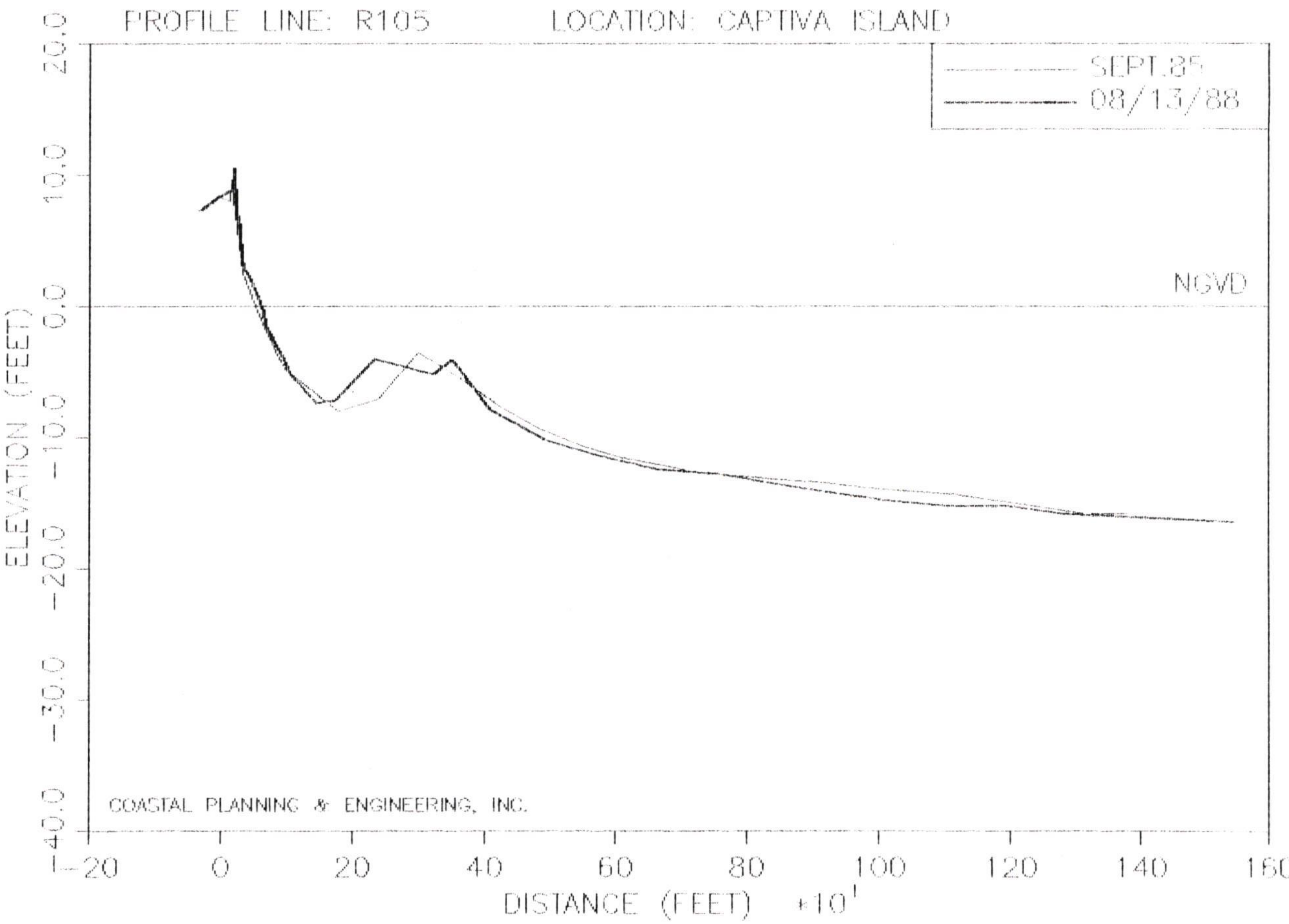
PROFILE LINE: R 102
LOCATION: CAPTIVA ISLAND
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

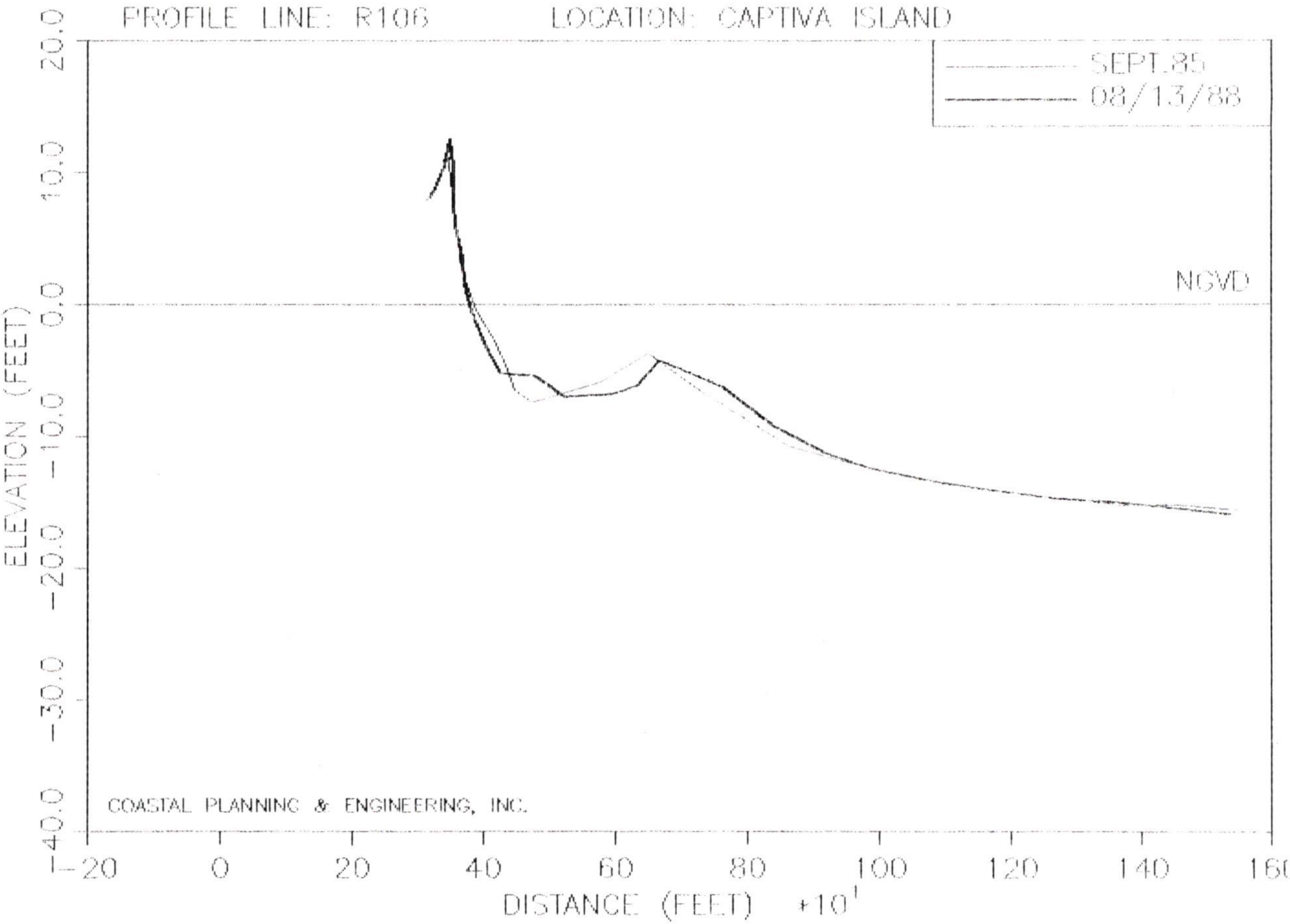


PROFILE LINE: R 103
LOCATION: CAPTIVA ISLAND
SEPT.85
08/13/88
NGVD
COASTAL PLANNING & ENGINEERING, INC.
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

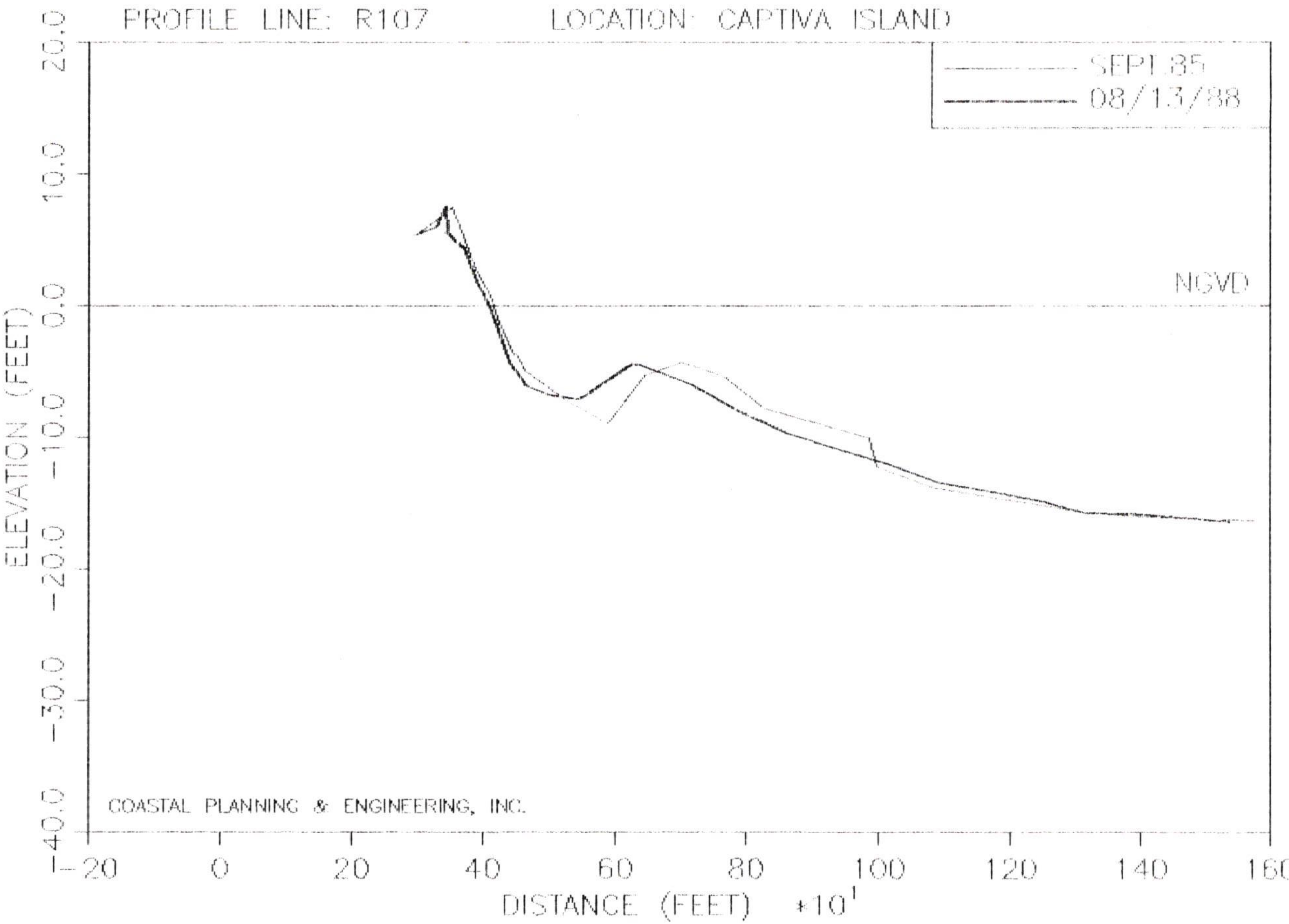


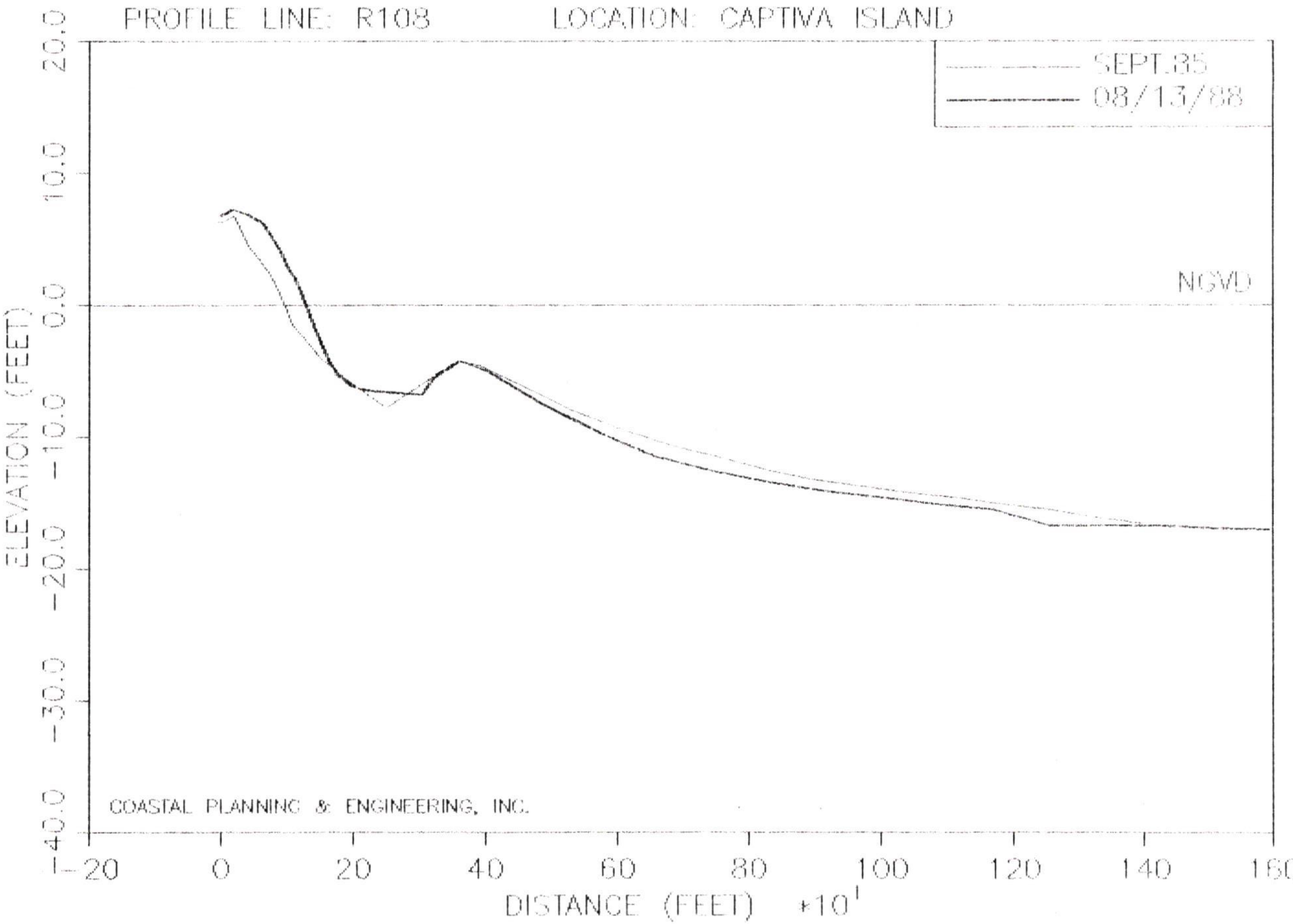
PROFILE LINE: R104
LOCATION: CAPTIVA ISLAND
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

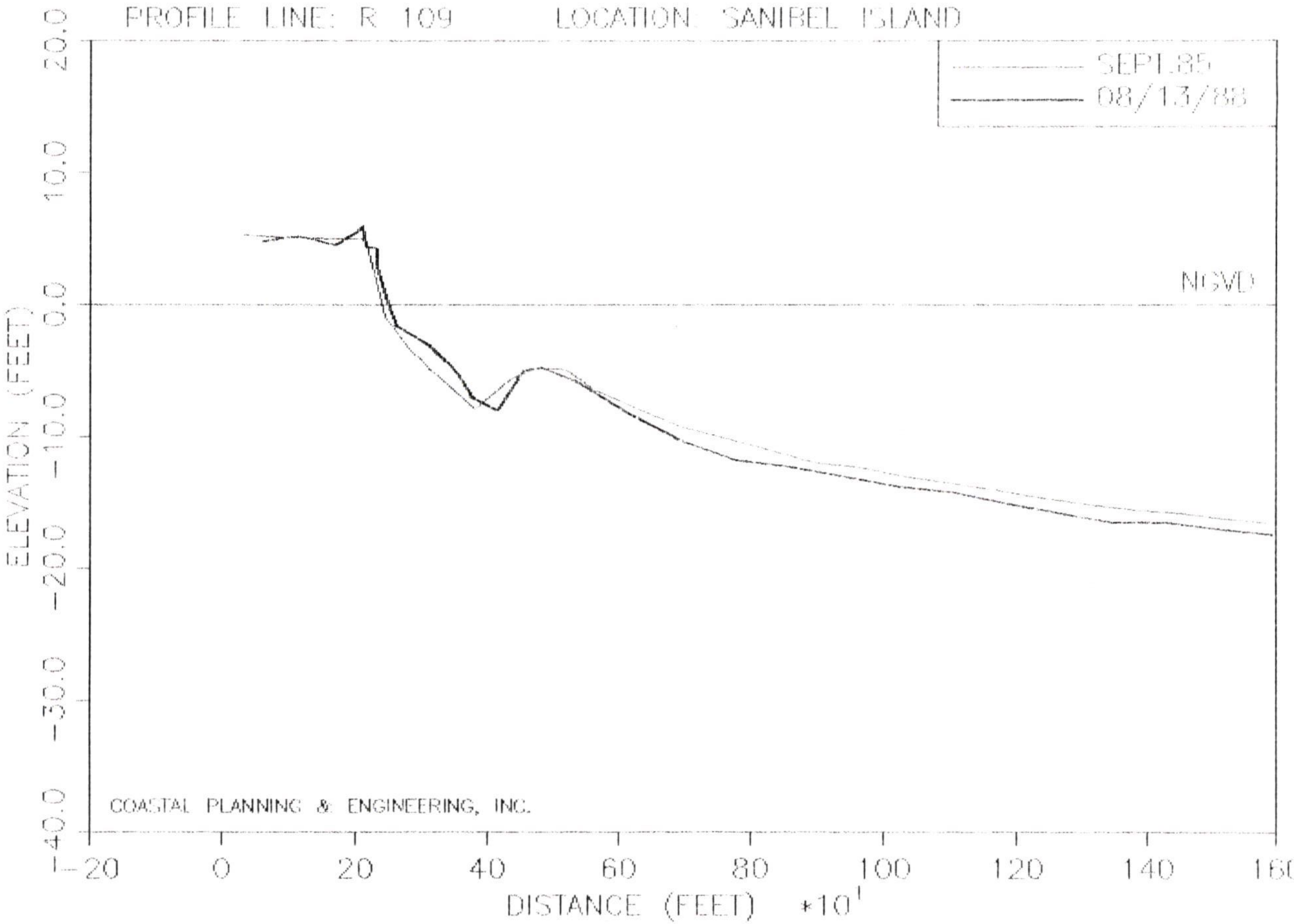

PROFILE LINE: R105
LOCATION: CAPTIVA ISLAND
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]



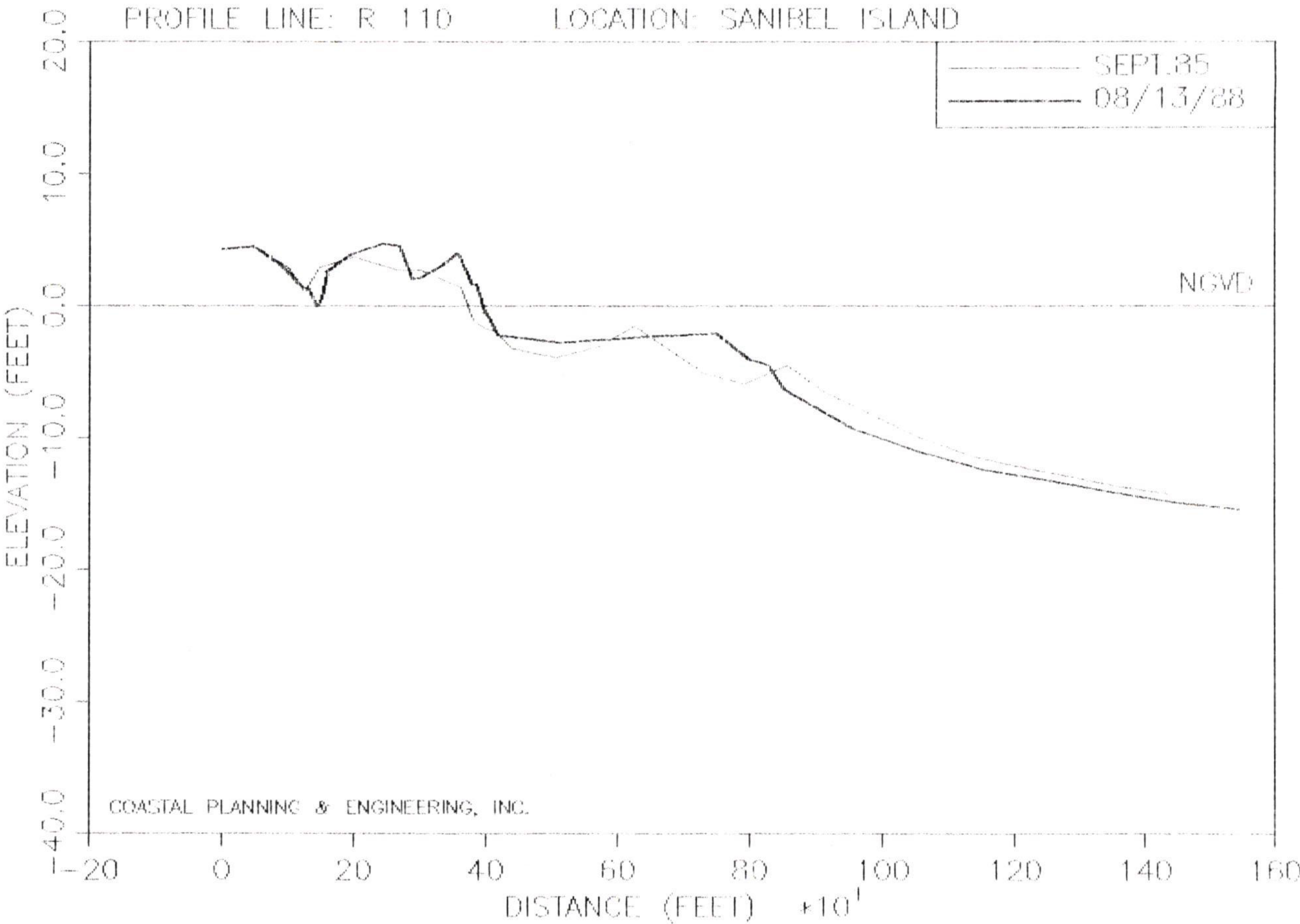
PROFILE LINE: R106
LOCATION: CAPTIVA ISLAND
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]


PROFILE LINE: R107
LOCATION: CAPTIVA ISLAND
SEP1.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

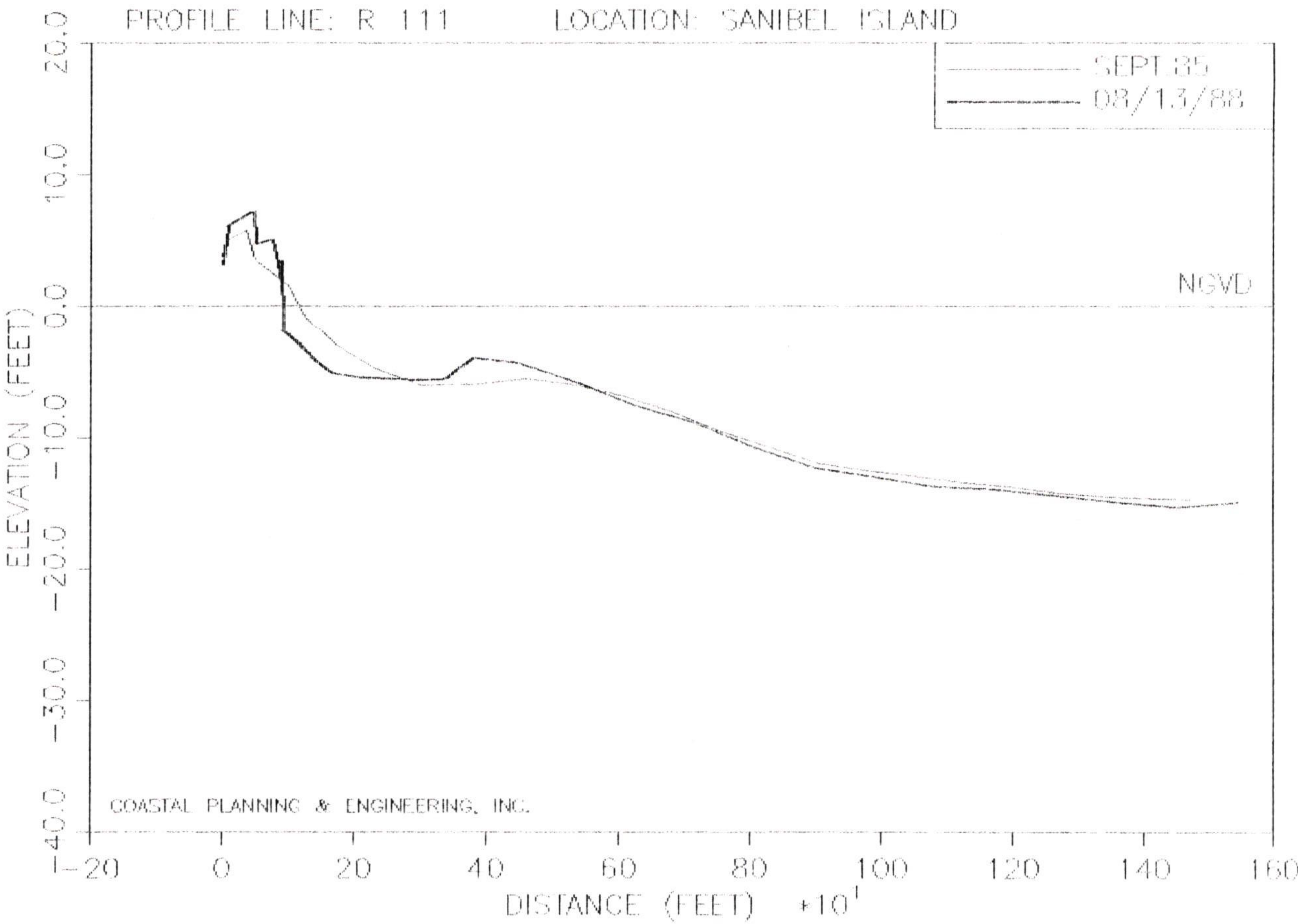

PROFILE LINE: R108
LOCATION: CAPTIVA ISLAND
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1

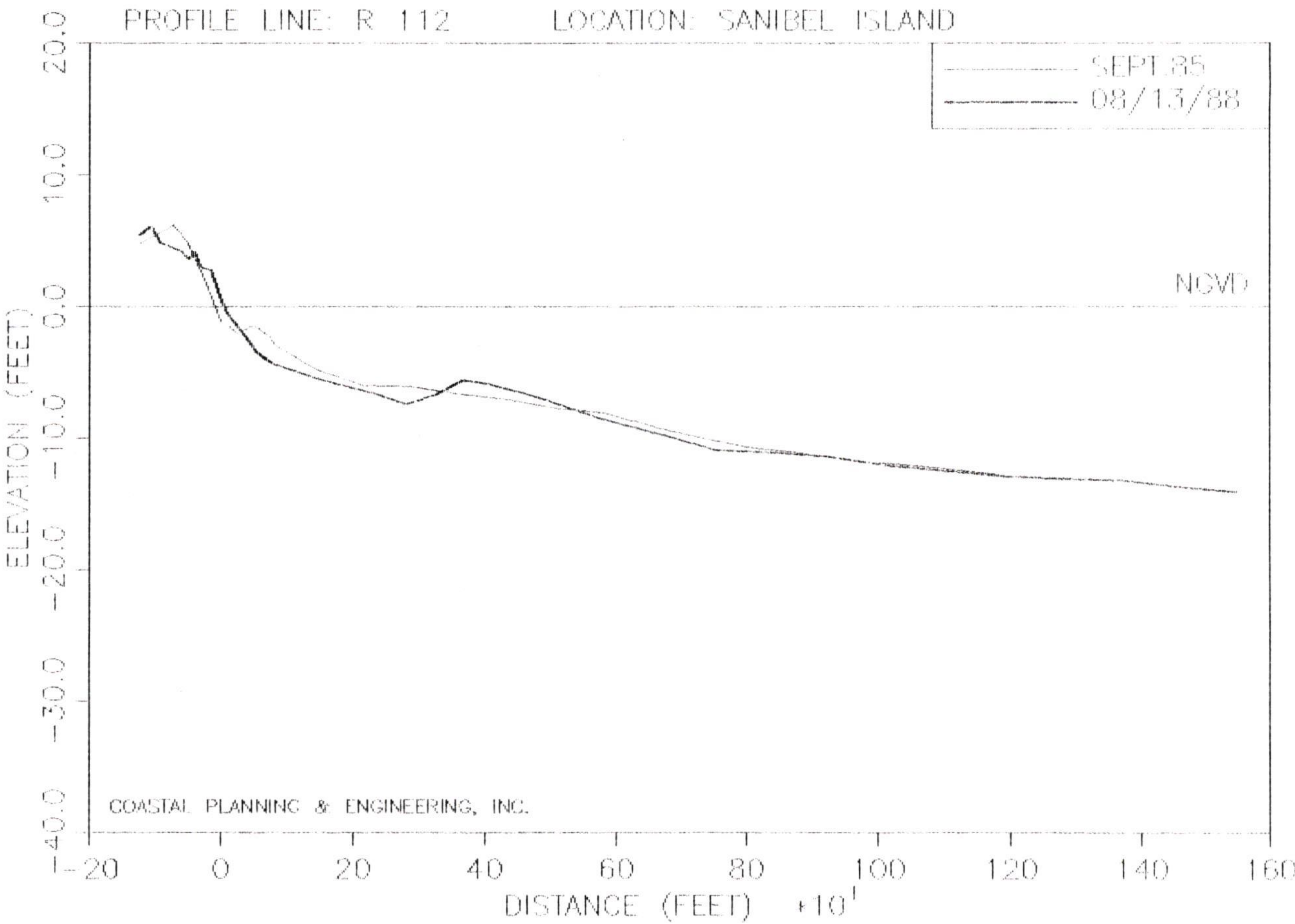


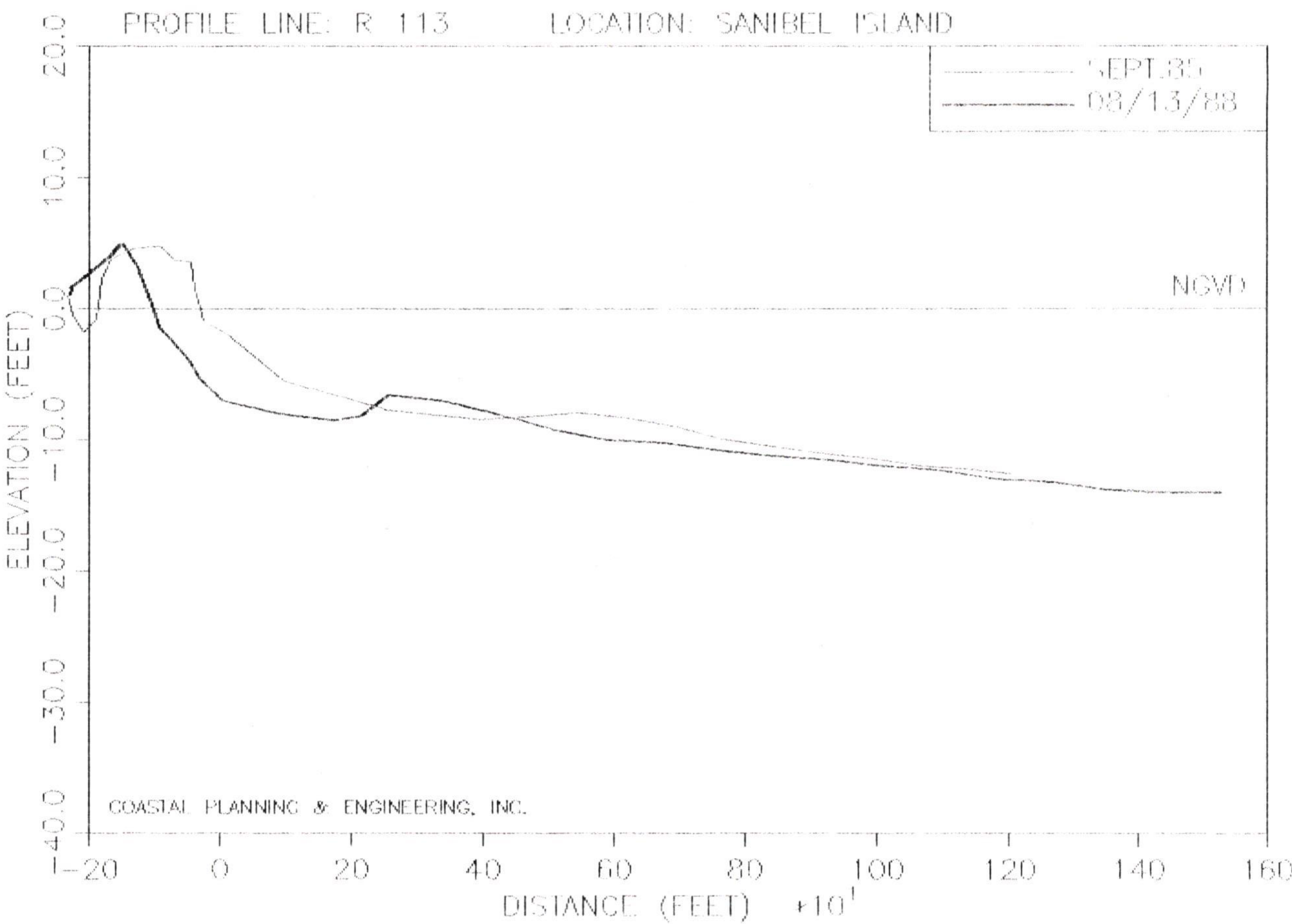
PROFILE LINE: R 109
LOCATION: SANIBEL ISLAND
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

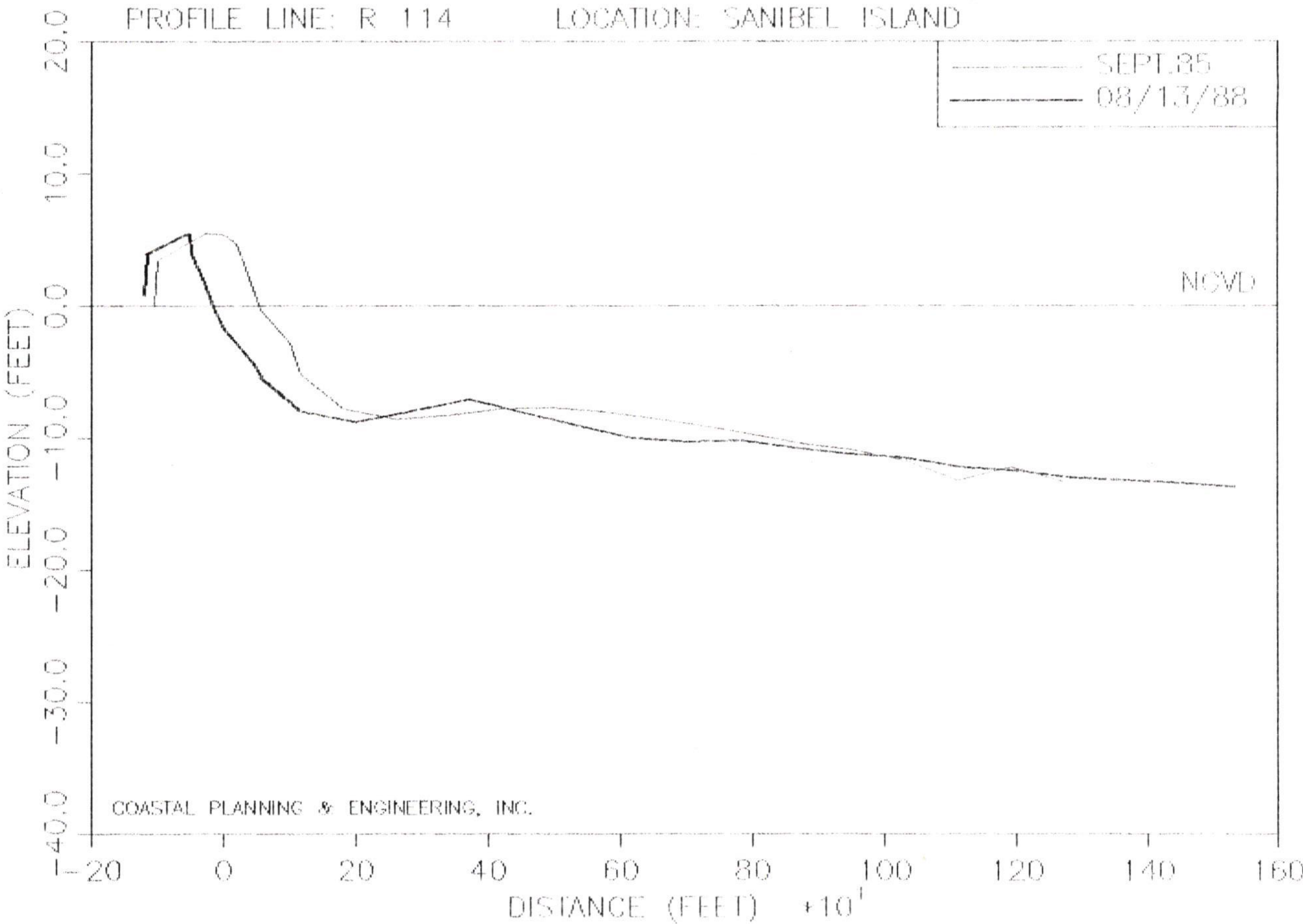


PROFILE LINE: R 110
LOCATION: SANIBEL ISLAND
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10

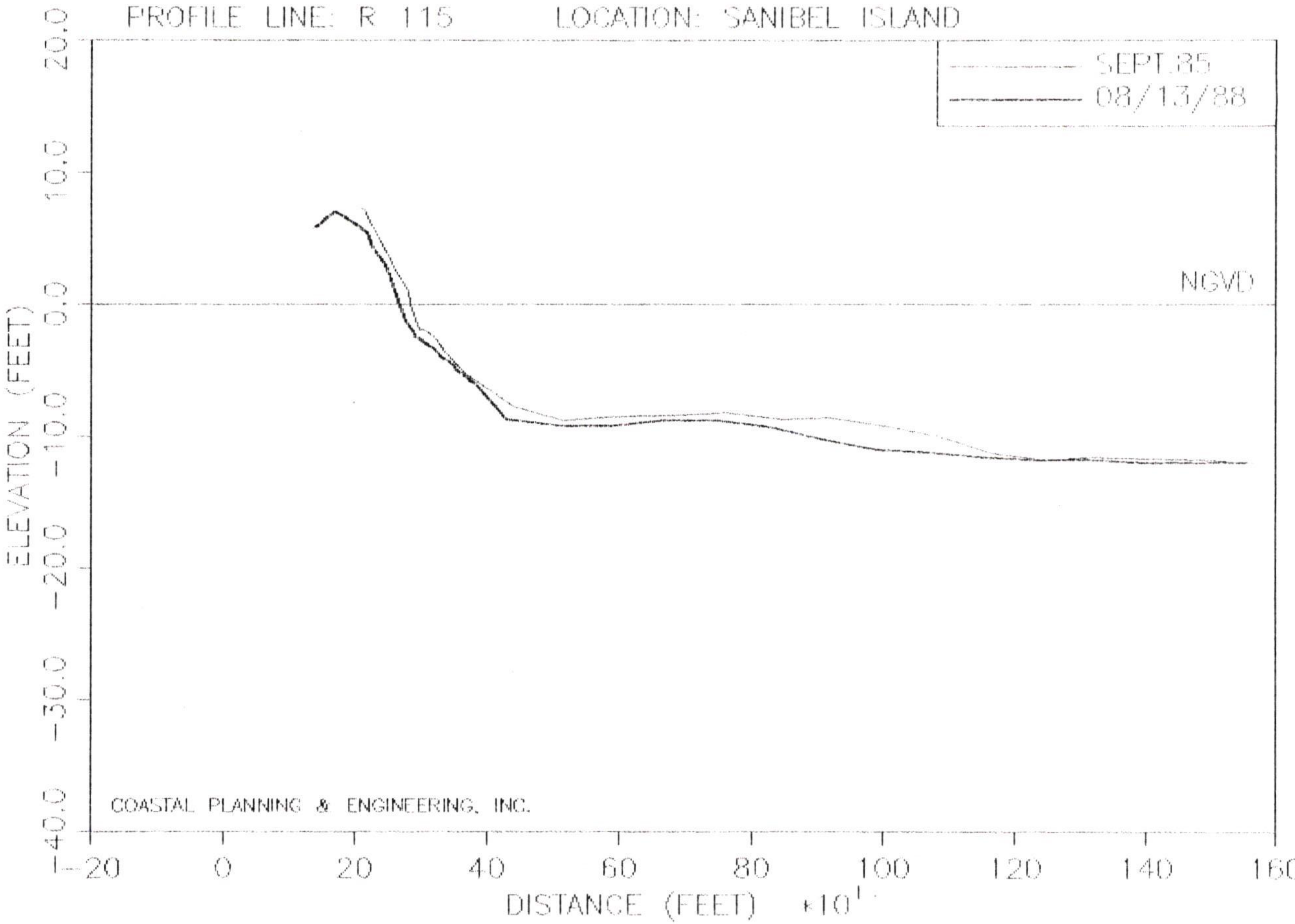

PROFILE LINE: R 111
LOCATION: SANIBEL ISLAND
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]
COASTAL PLANNING & ENGINEERING, INC.


PROFILE LINE: R 112
LOCATION: SANIBEL ISLAND
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

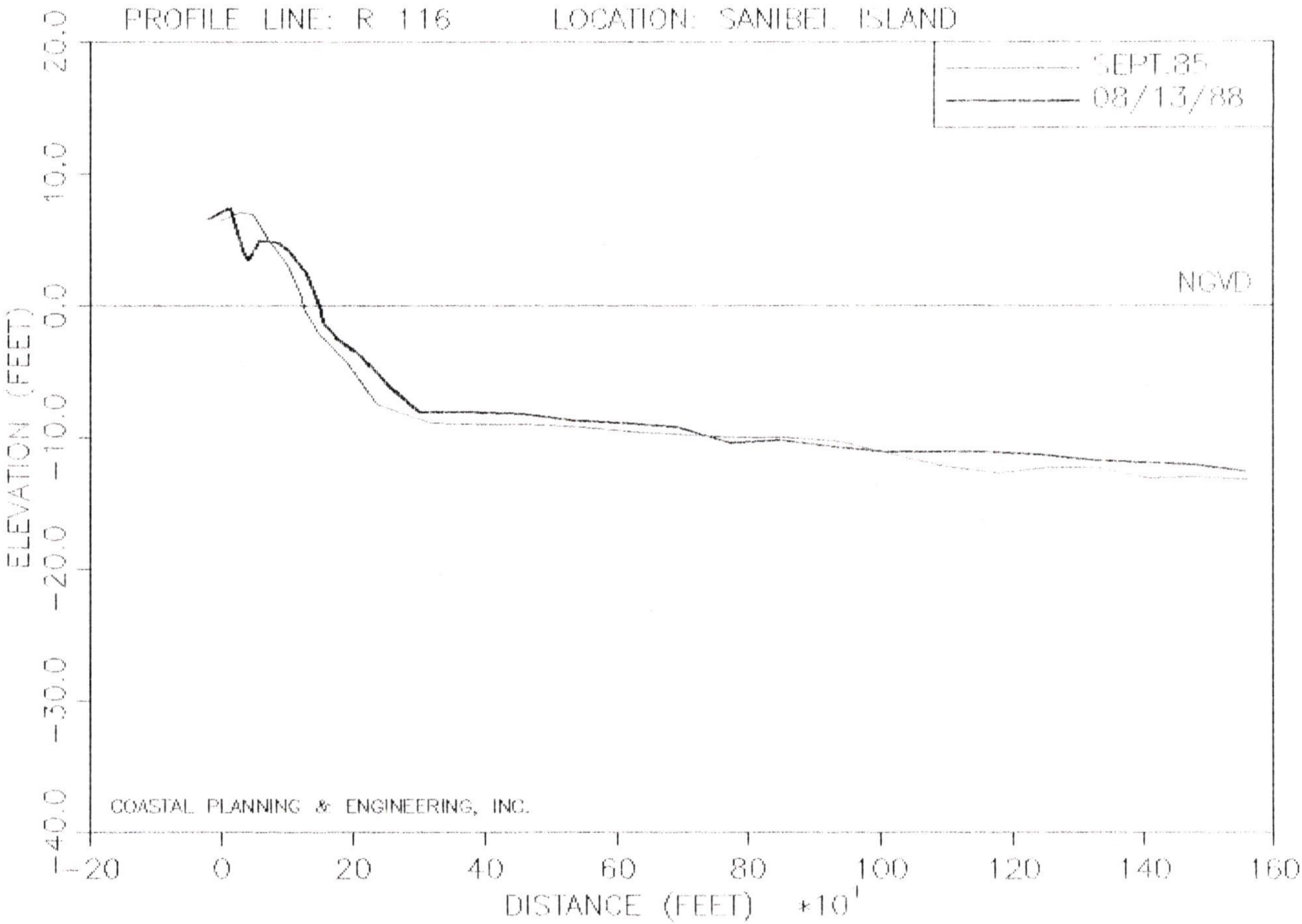

PROFILE LINE: R 113
LOCATION: SANIBEL ISLAND
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]



PROFILE LINE: R 114
LOCATION: SANIBEL ISLAND
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10¹



PROFILE LINE: R 115
LOCATION: SANIBEL ISLAND
SEPT.85
08/13/88
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]
COASTAL PLANNING & ENGINEERING, INC.


PROFILE LINE: R 116
LOCATION: SANIBEL ISLAND
SEPT.85
08/13/88
NGVD
COASTAL PLANNING & ENGINEERING, INC.
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

Comparative Beach Profile Plots

1974 (DNR) vs. 1989 (DNR)

COASTAL PLANNING & ENGINEERING, INC.
2481 N.W. BOCA RATON BOULEVARD
BOCA RATON, FLORIDA 33431
(407) 391-8102

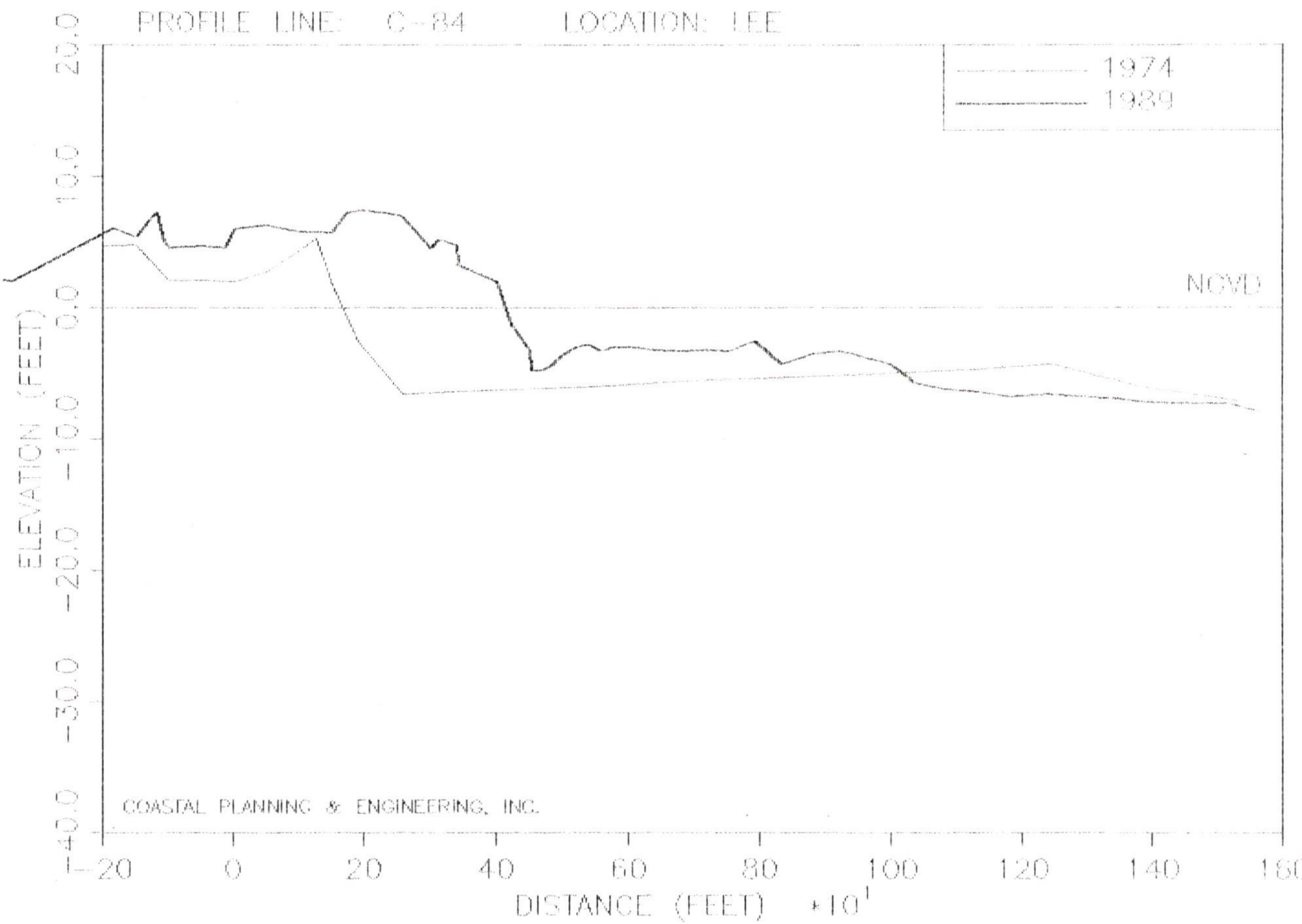
CP&E COASTAL SURVEY DATA ANALYSIS SYSTEM
PROJECT AREA: LEE

DATA FILE INFORMATION:

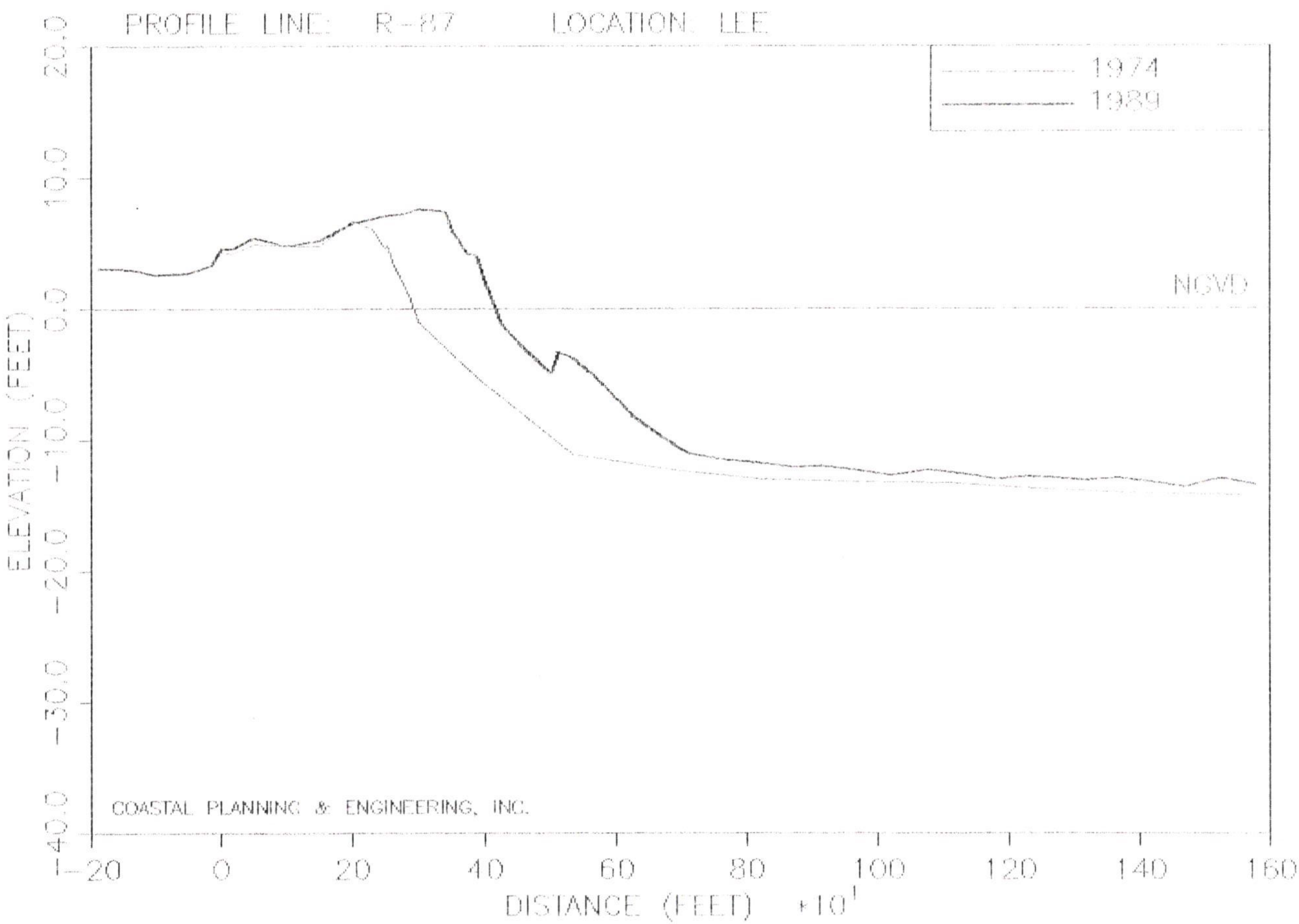
LINE INDEX 1	LINE INDEX 2	OLD FILE NAME	NEW FILE NAME
1	10	A:LEE74A.DNR	A:LEE89A.DNR
1	10	A:LEE74B.DNR	A:LEE89B.DNR
1	10	A:LEE74C.DNR	A:LEE89C.DNR
1	10	A:LEE74D.DNR	A:LEE89D.DNR
1	6	A:LEE74E.DNR	A:LEE89E.DNR

DATA DISK NUMBER =
REFERENCE DATUM = NGVD

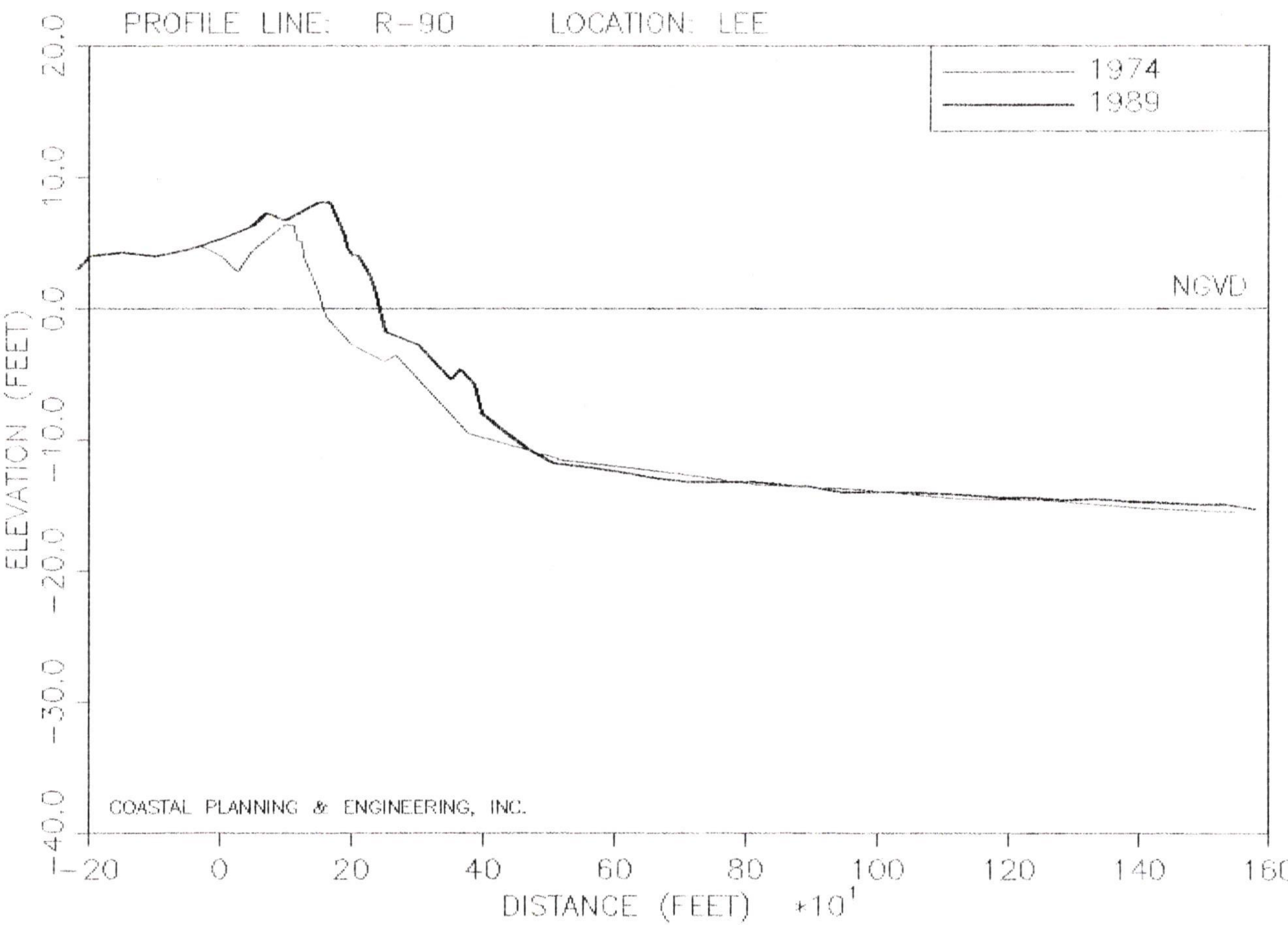
PRINTED BY: LRA
PRINTED ON: 3-10-92



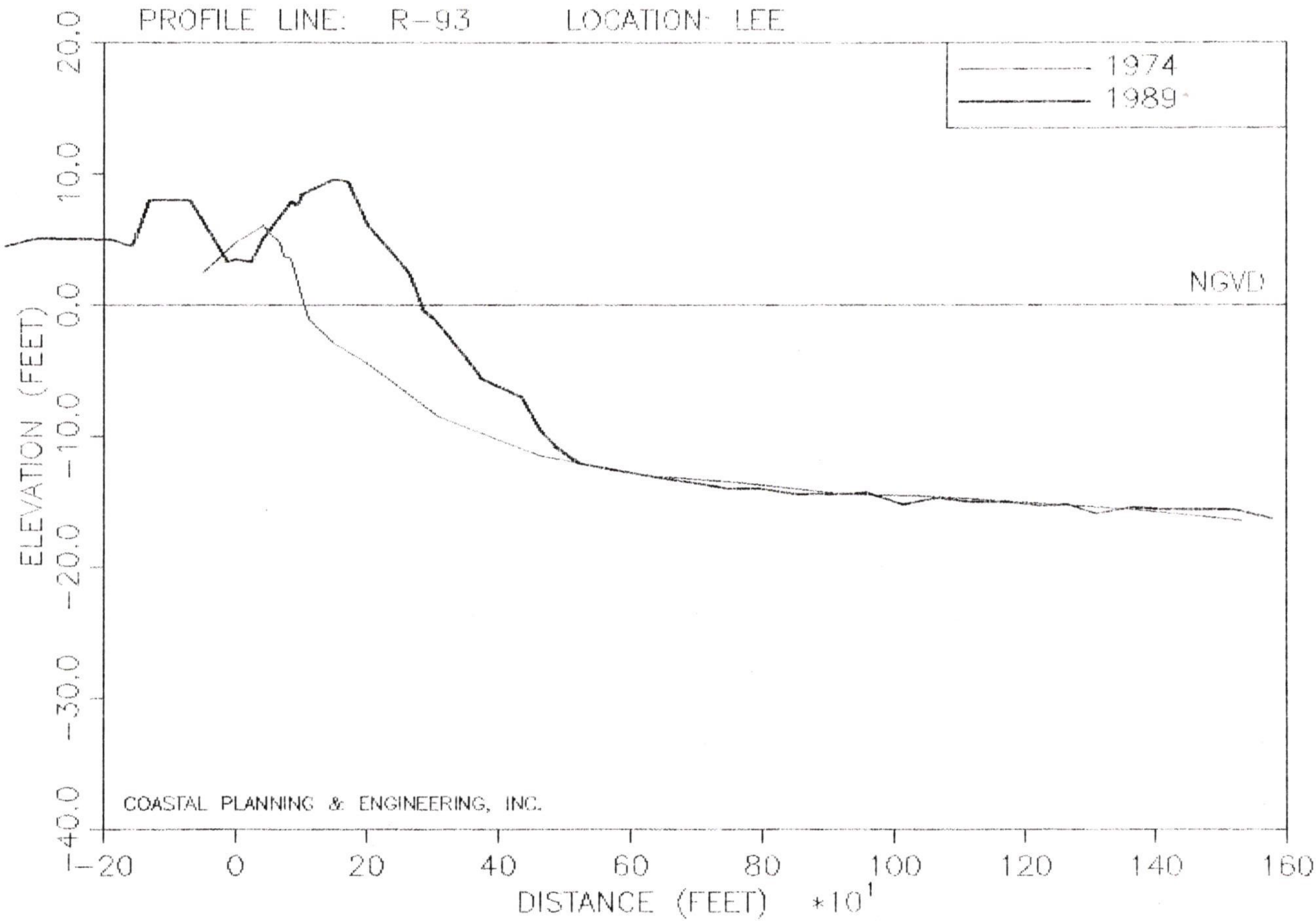
PROFILE LINE: C-84
LOCATION: LEE
1974
1989
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]
COASTAL PLANNING & ENGINEERING, INC.



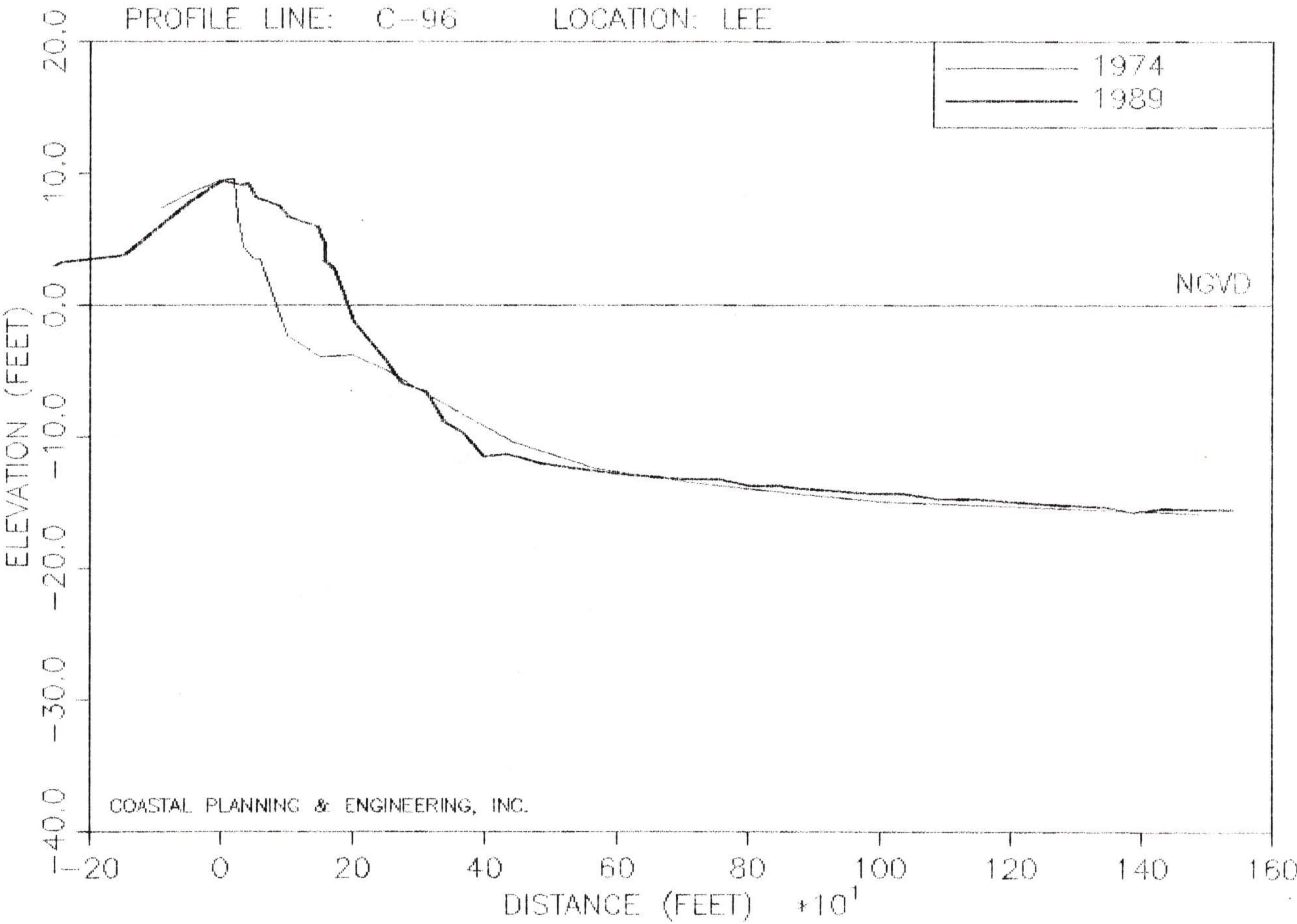
PROFILE LINE: R-87 LOCATION: LEE
1974
1989
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]
COASTAL PLANNING & ENGINEERING, INC.



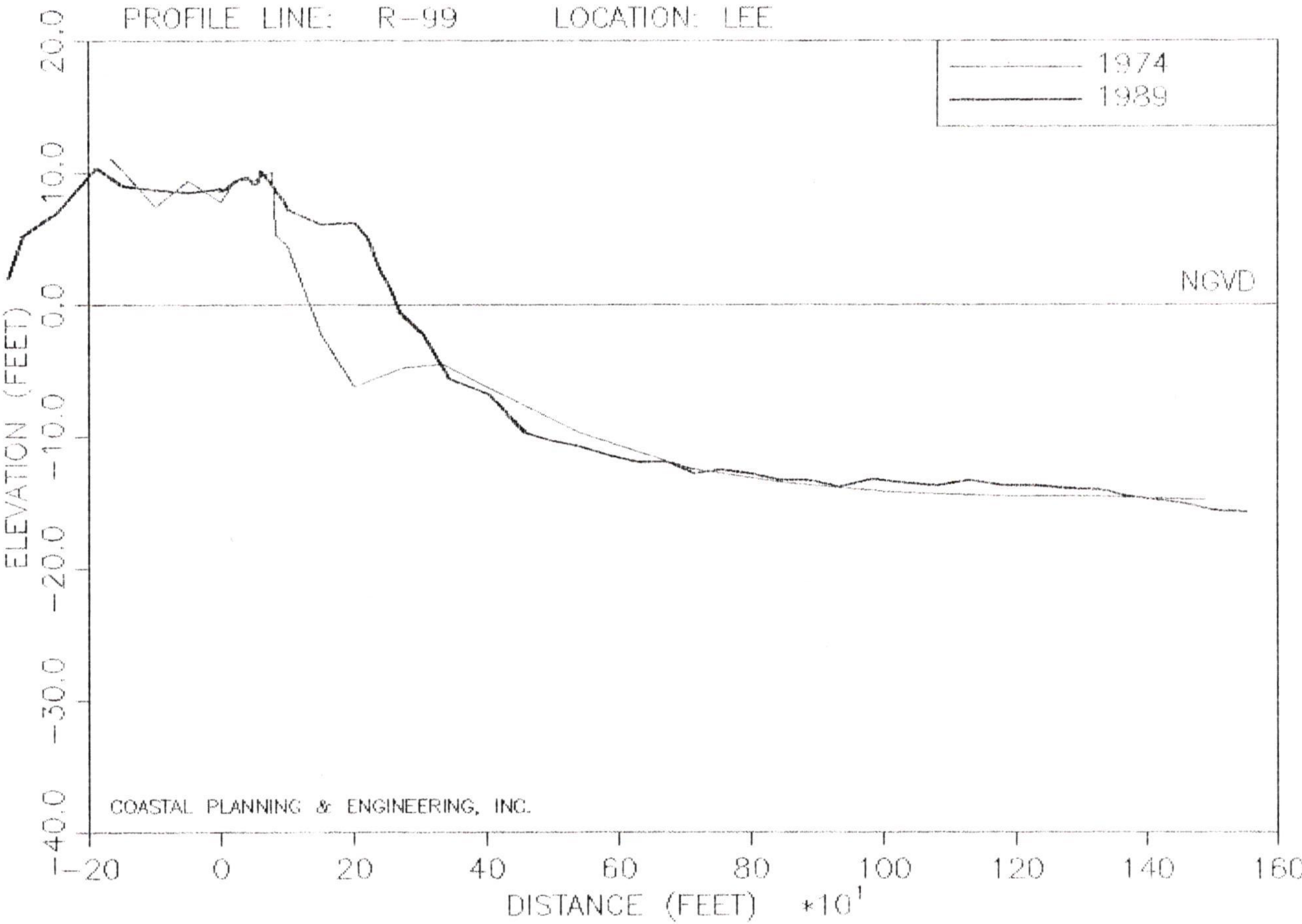
PROFILE LINE: R-90
LOCATION: LEE
1974
1989
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

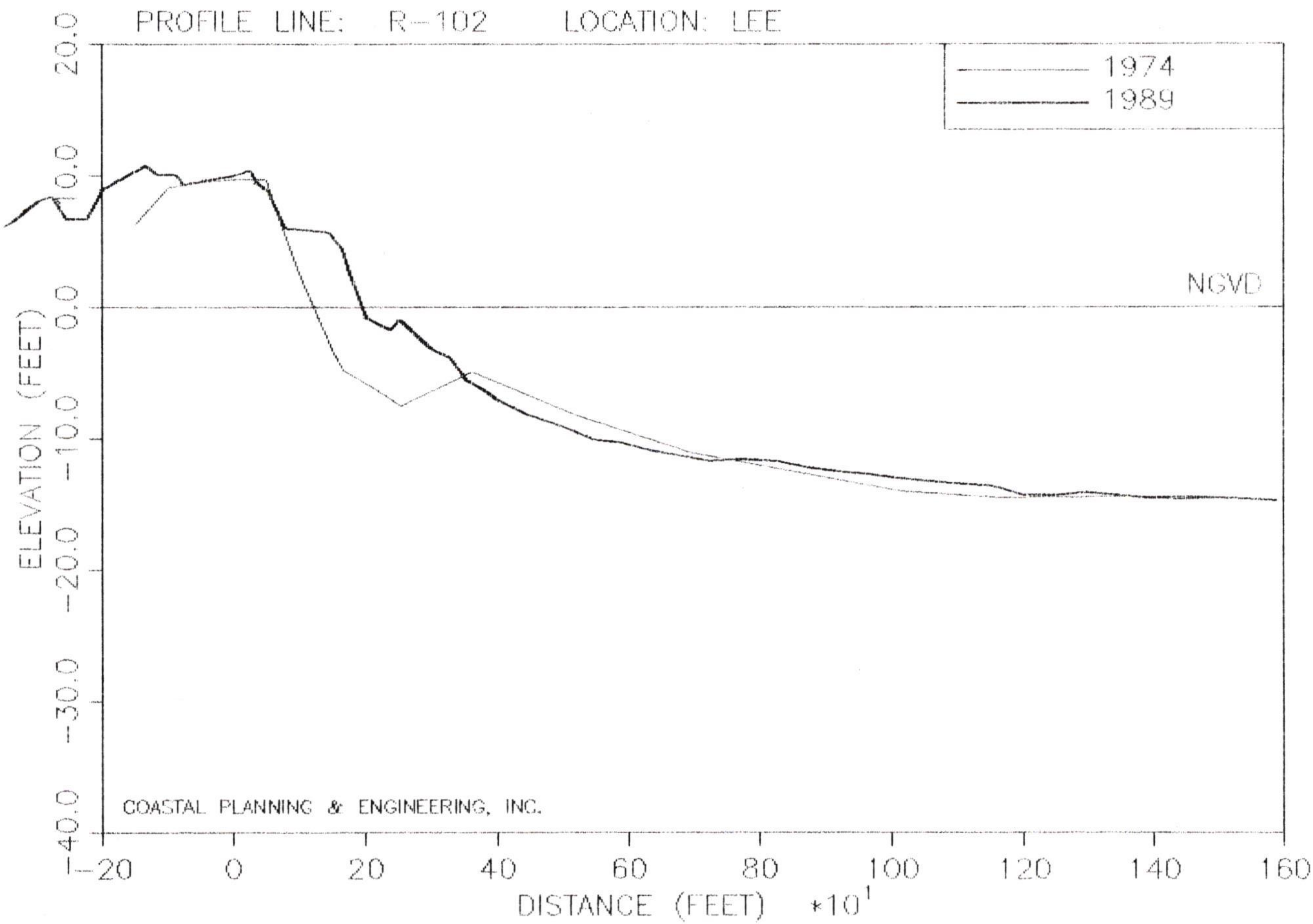


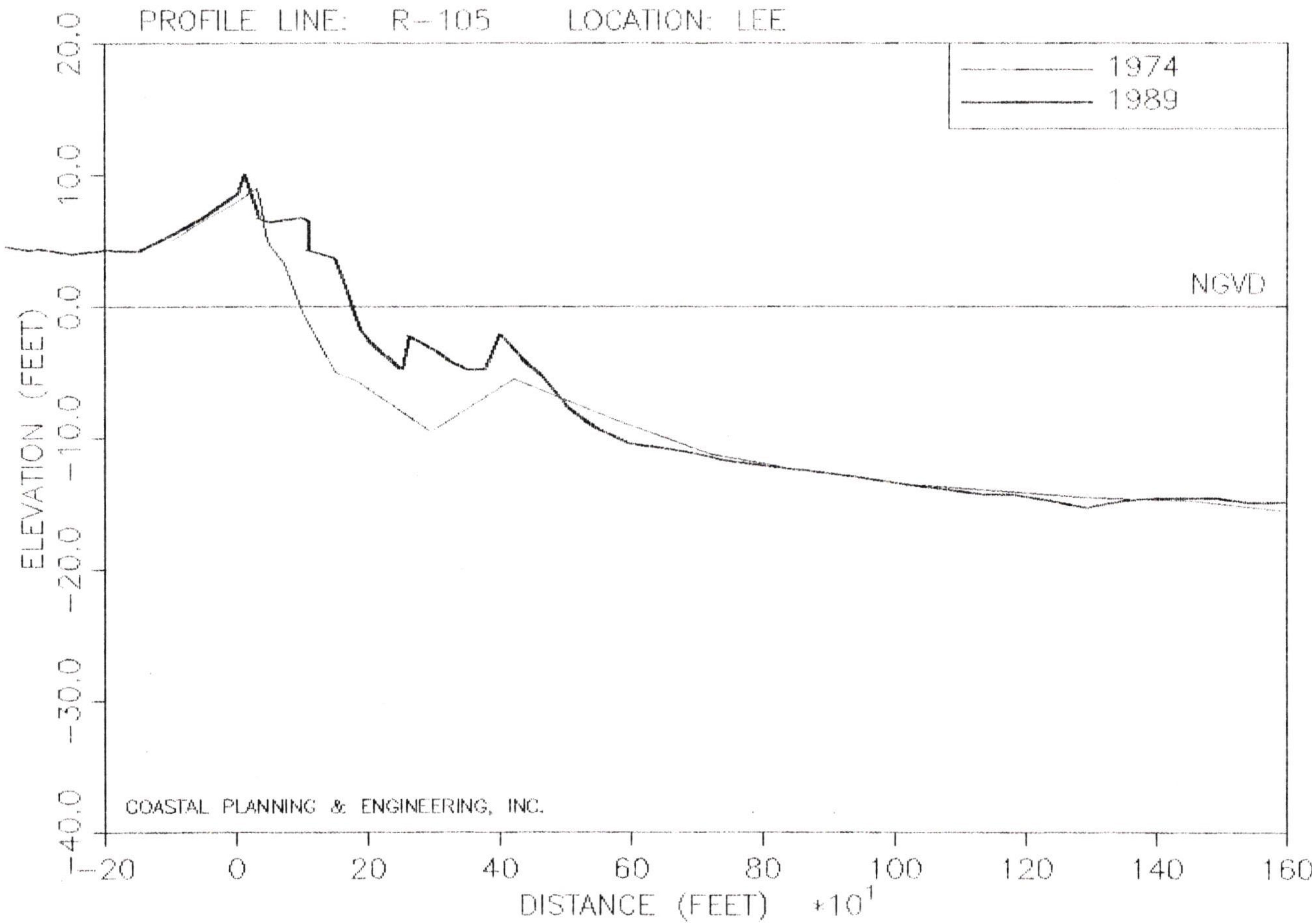
PROFILE LINE: R-93
LOCATION: LEE
1974
1989
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

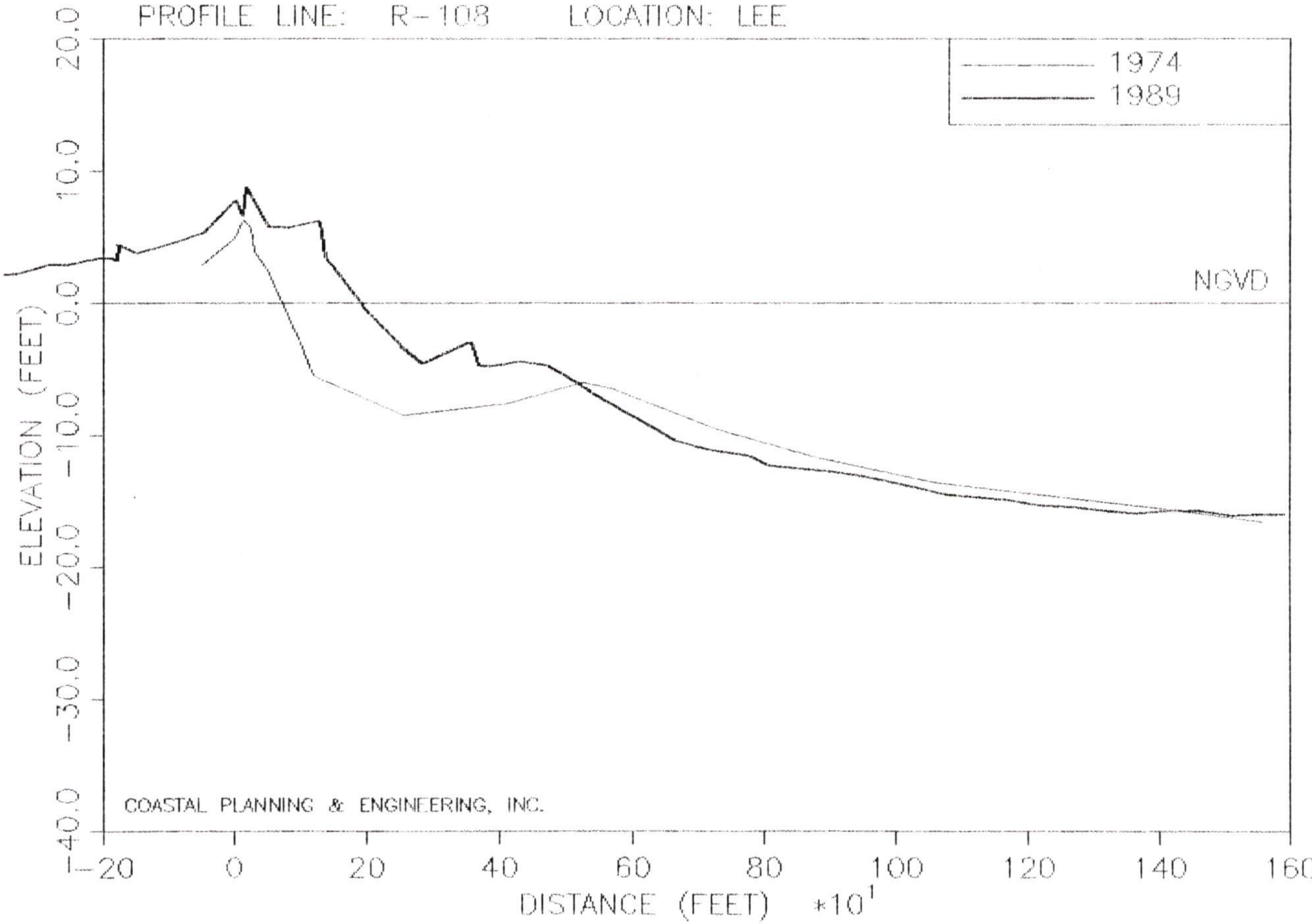


PROFILE LINE: C-96
LOCATION: LEE
1974
1989
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

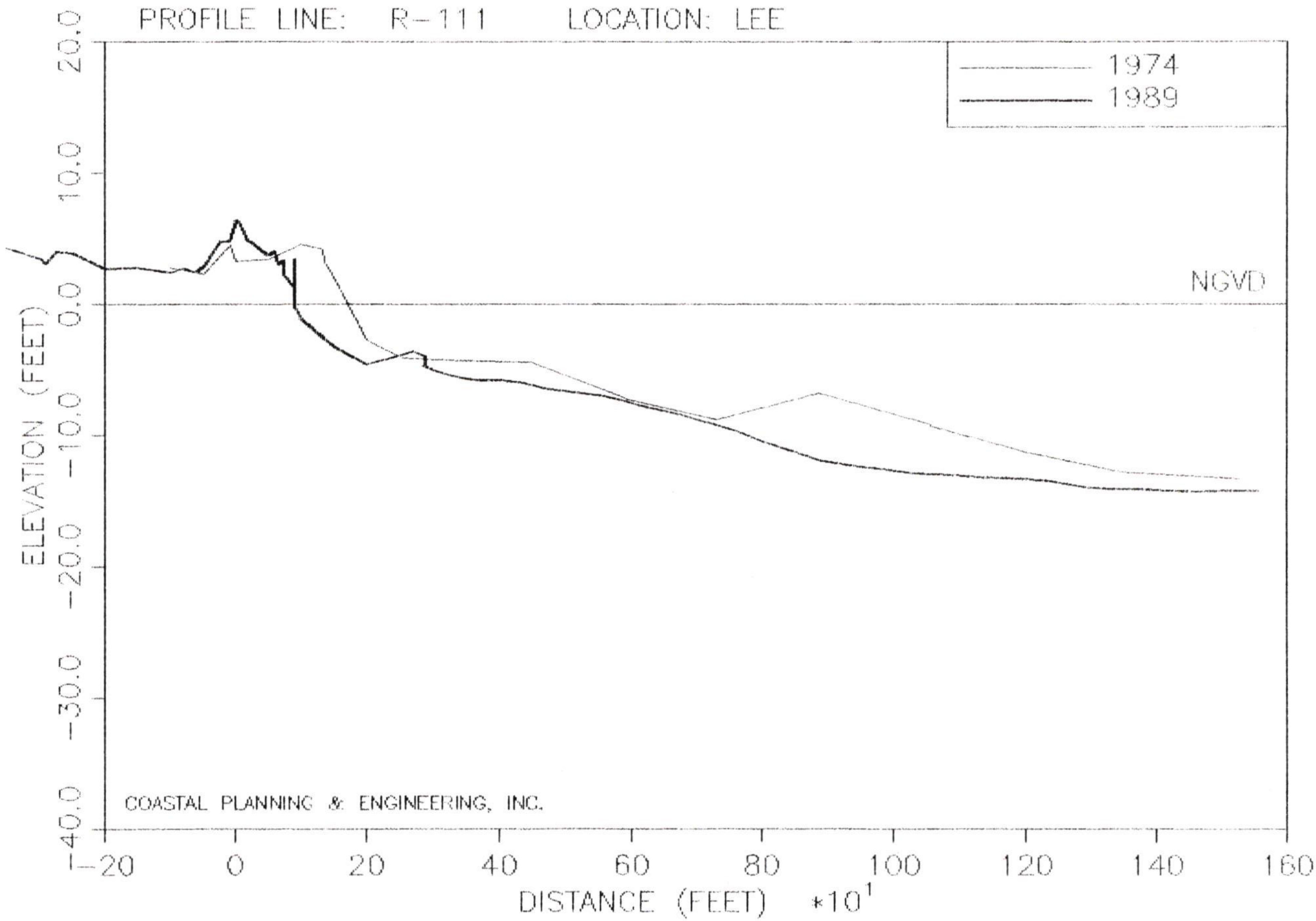

PROFILE LINE: R-99
LOCATION: LEE
1974
1989
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^{1}


PROFILE LINE: R-102 LOCATION: LEE
1974
1989
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]
COASTAL PLANNING & ENGINEERING, INC.

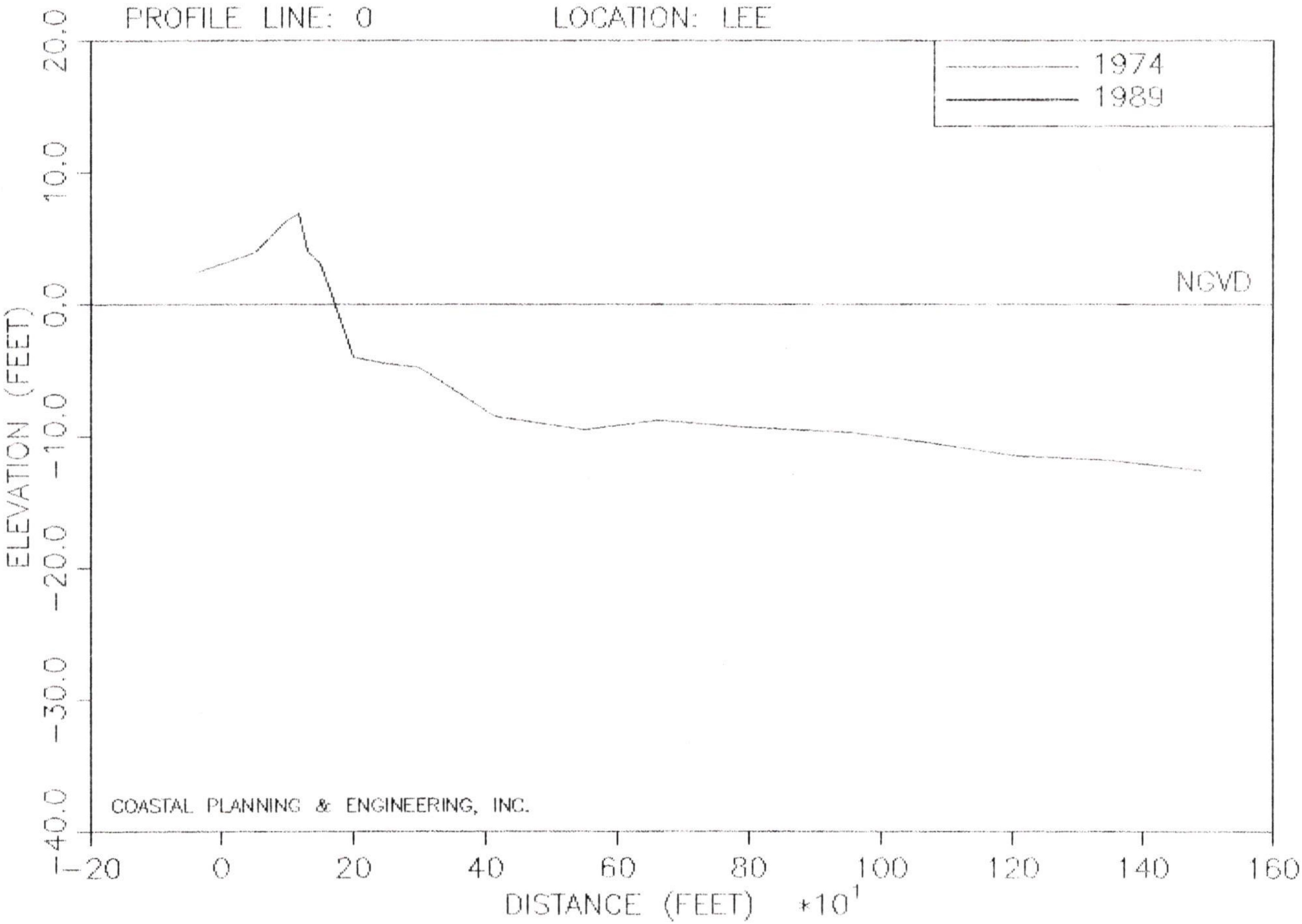

PROFILE LINE: R-105 LOCATION: LEE
1974
1989
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]
COASTAL PLANNING & ENGINEERING, INC.

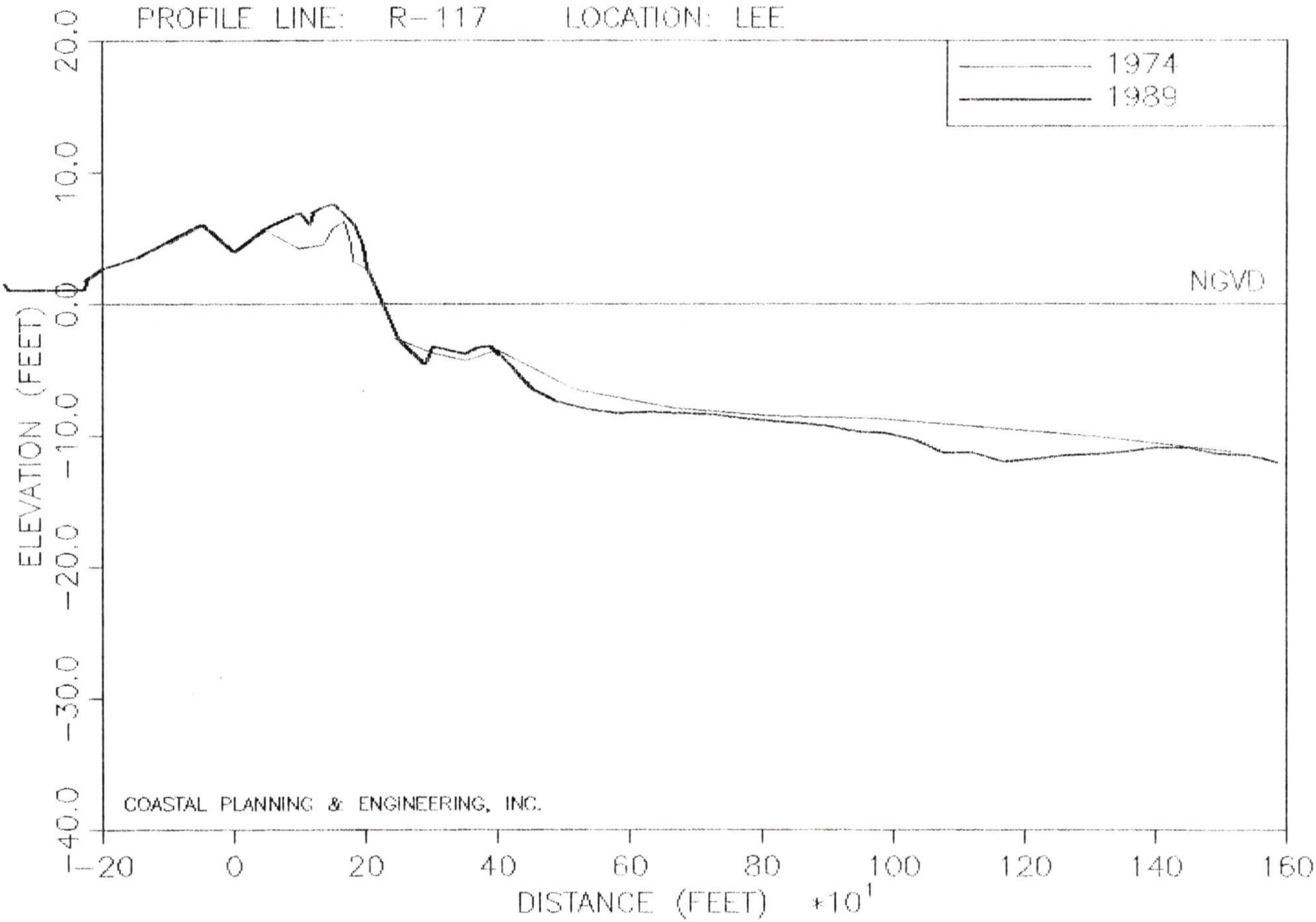


PROFILE LINE: R-108
LOCATION: LEE
1974
1989
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]
COASTAL PLANNING & ENGINEERING, INC.

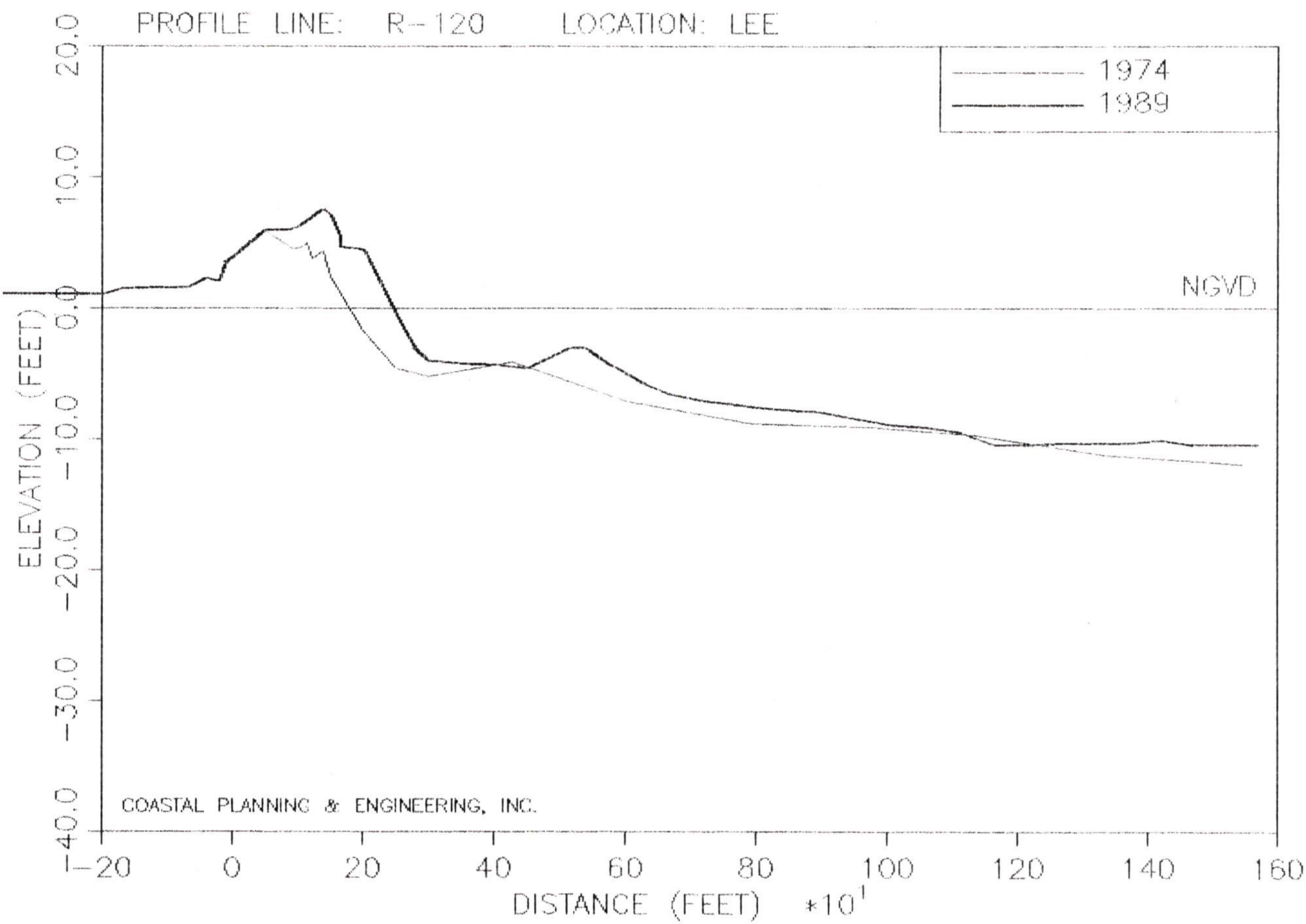


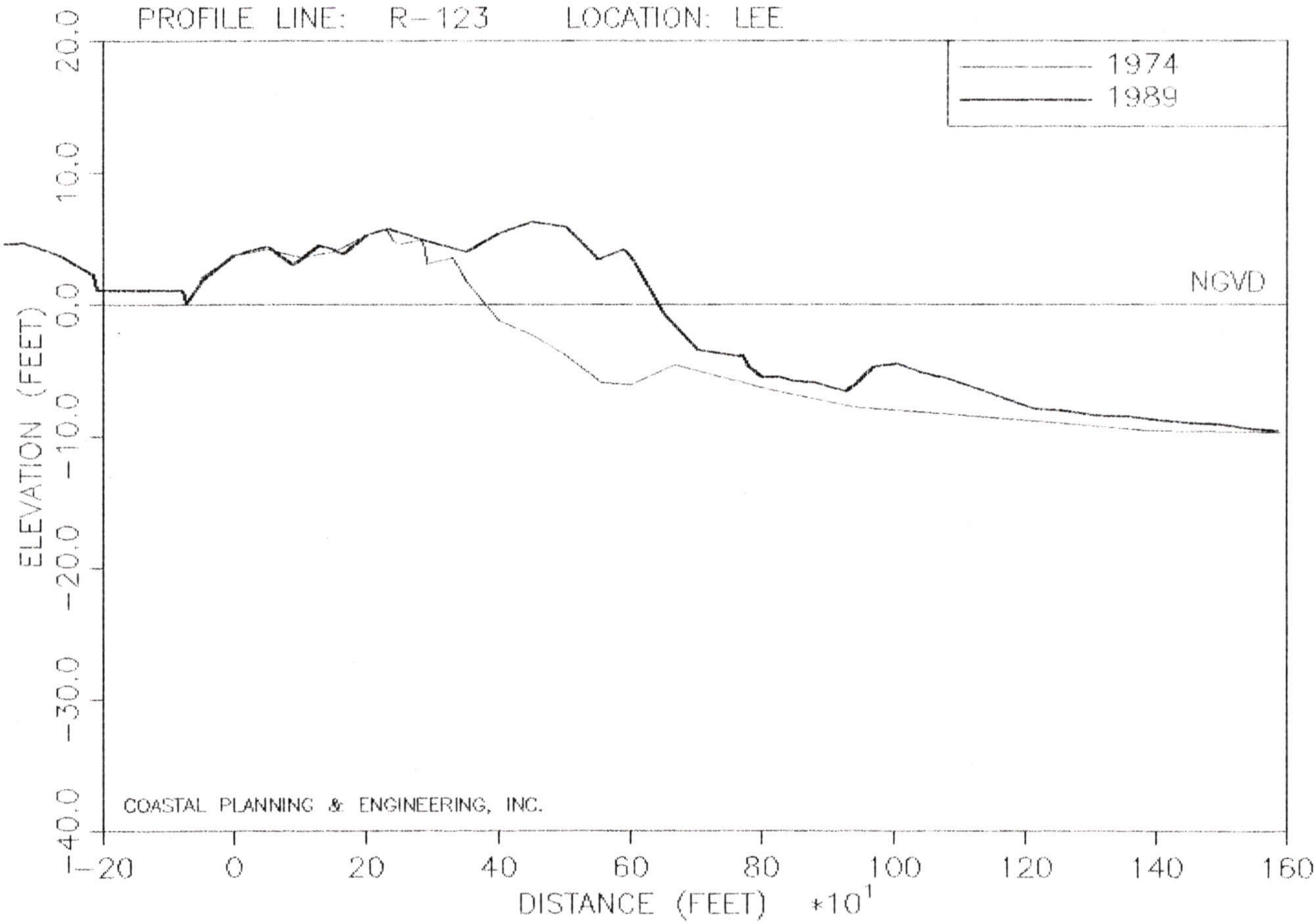
PROFILE LINE: R-111 LOCATION: LEE
1974
1989
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]
COASTAL PLANNING & ENGINEERING, INC.

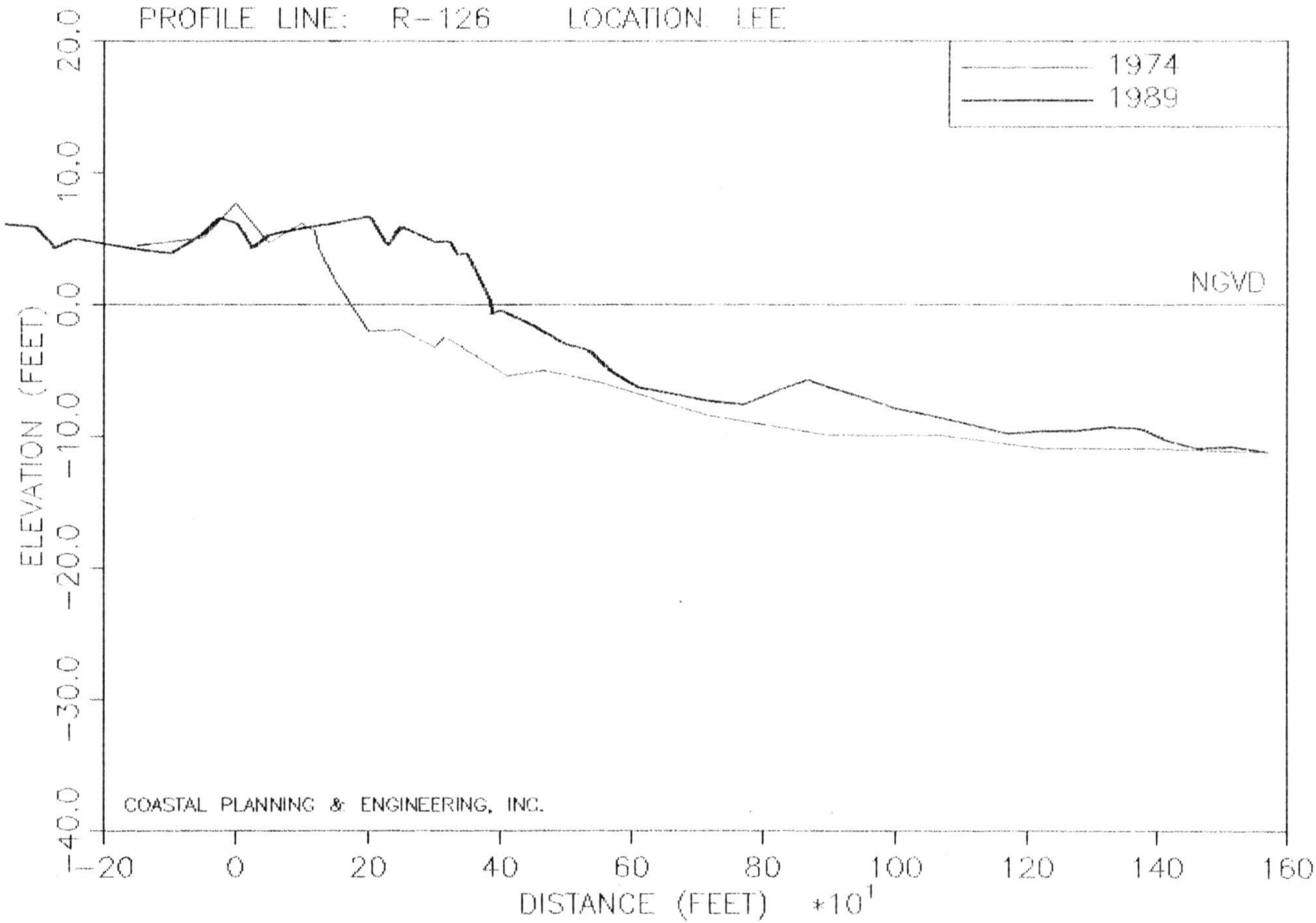

PROFILE LINE: 0
LOCATION: LEE
1974
1989
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1
COASTAL PLANNING & ENGINEERING, INC.

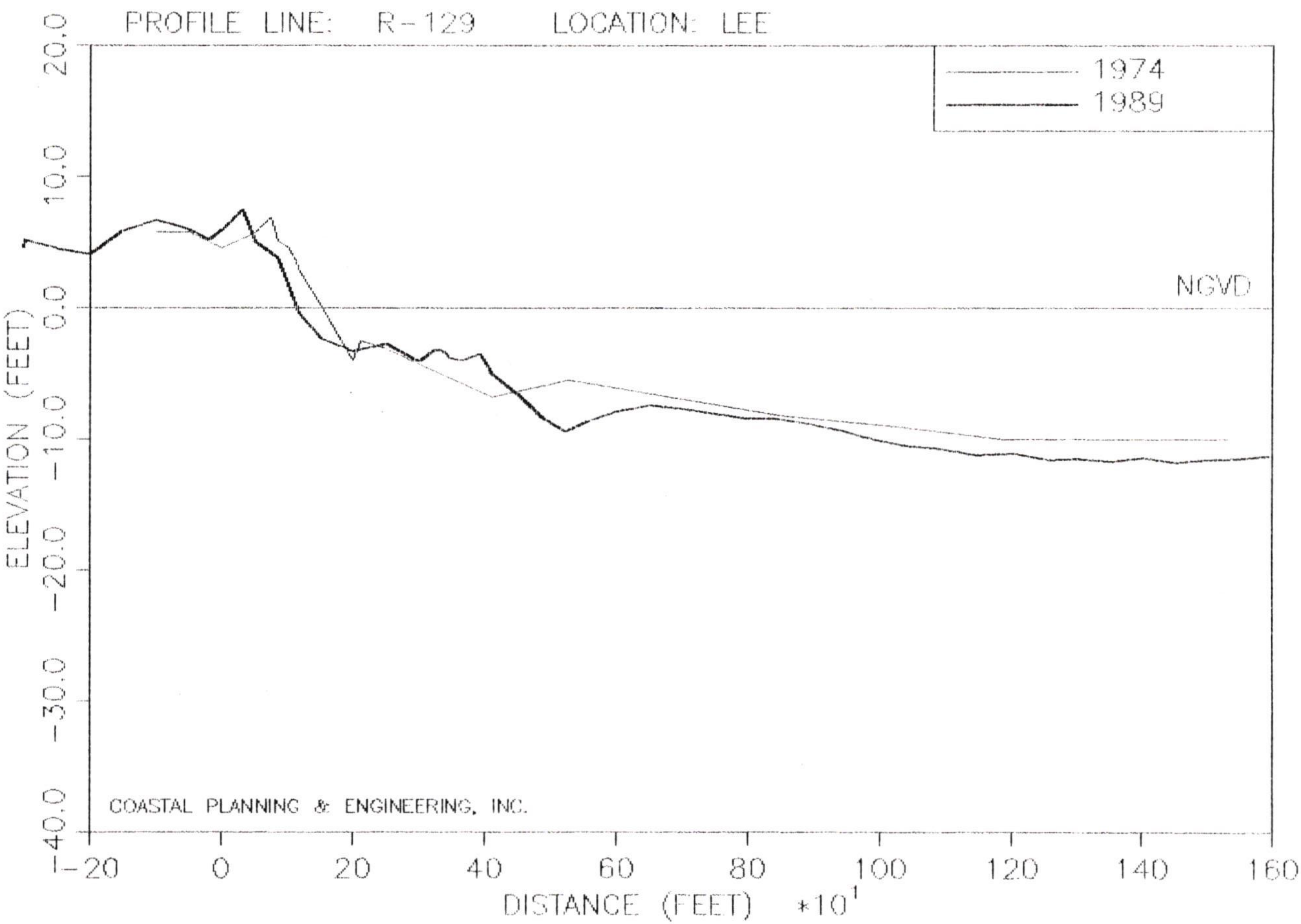


PROFILE LINE: R-117 LOCATION: LEE
1974
1989
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]


PROFILE LINE: R-120 LOCATION: LEE
1974
1989
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]
COASTAL PLANNING & ENGINEERING, INC.

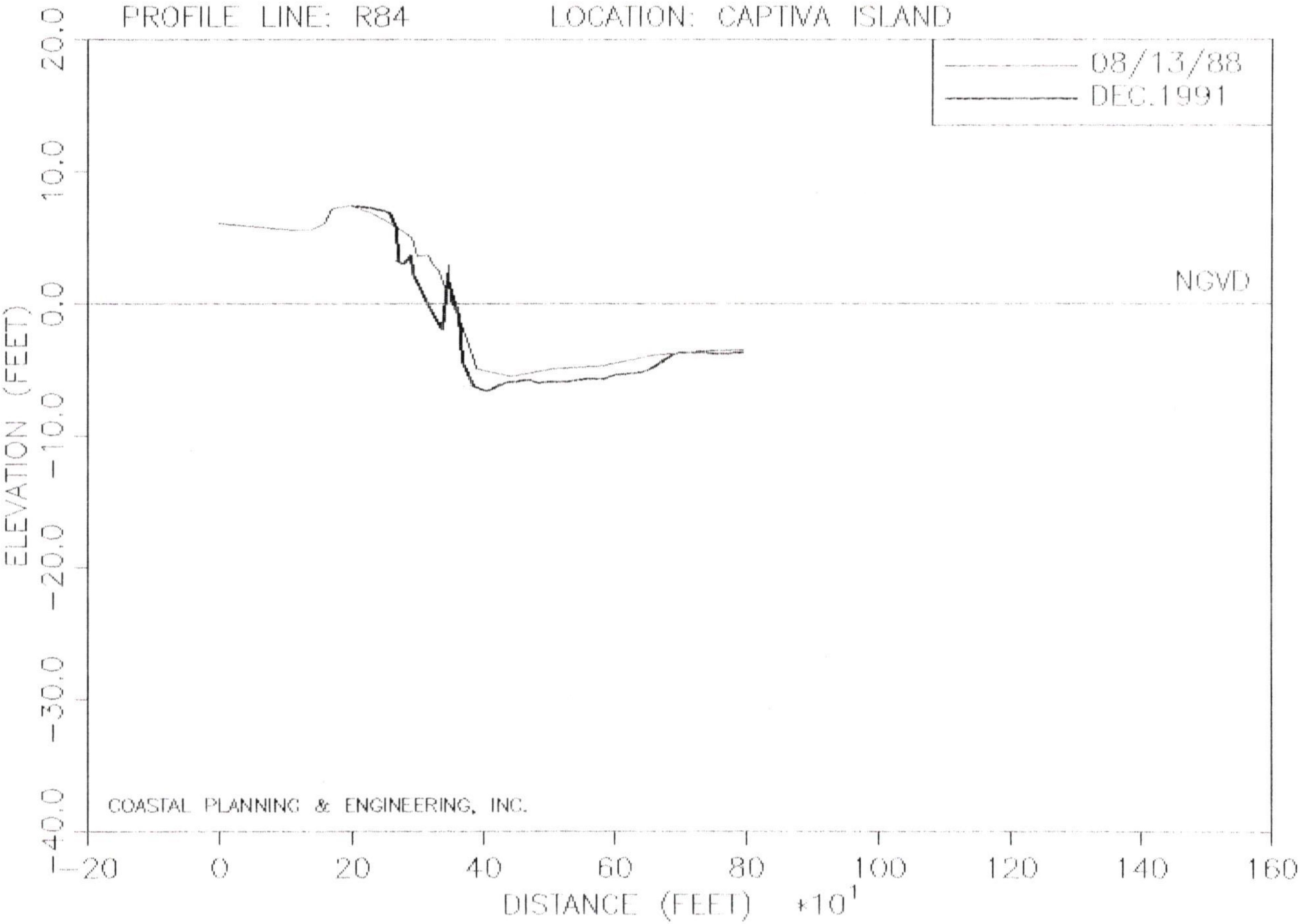

PROFILE LINE: R-123 LOCATION: LEE
1974
1989
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1
COASTAL PLANNING & ENGINEERING, INC.


PROFILE LINE: R-126 LOCATION: LEE
1974
1989
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

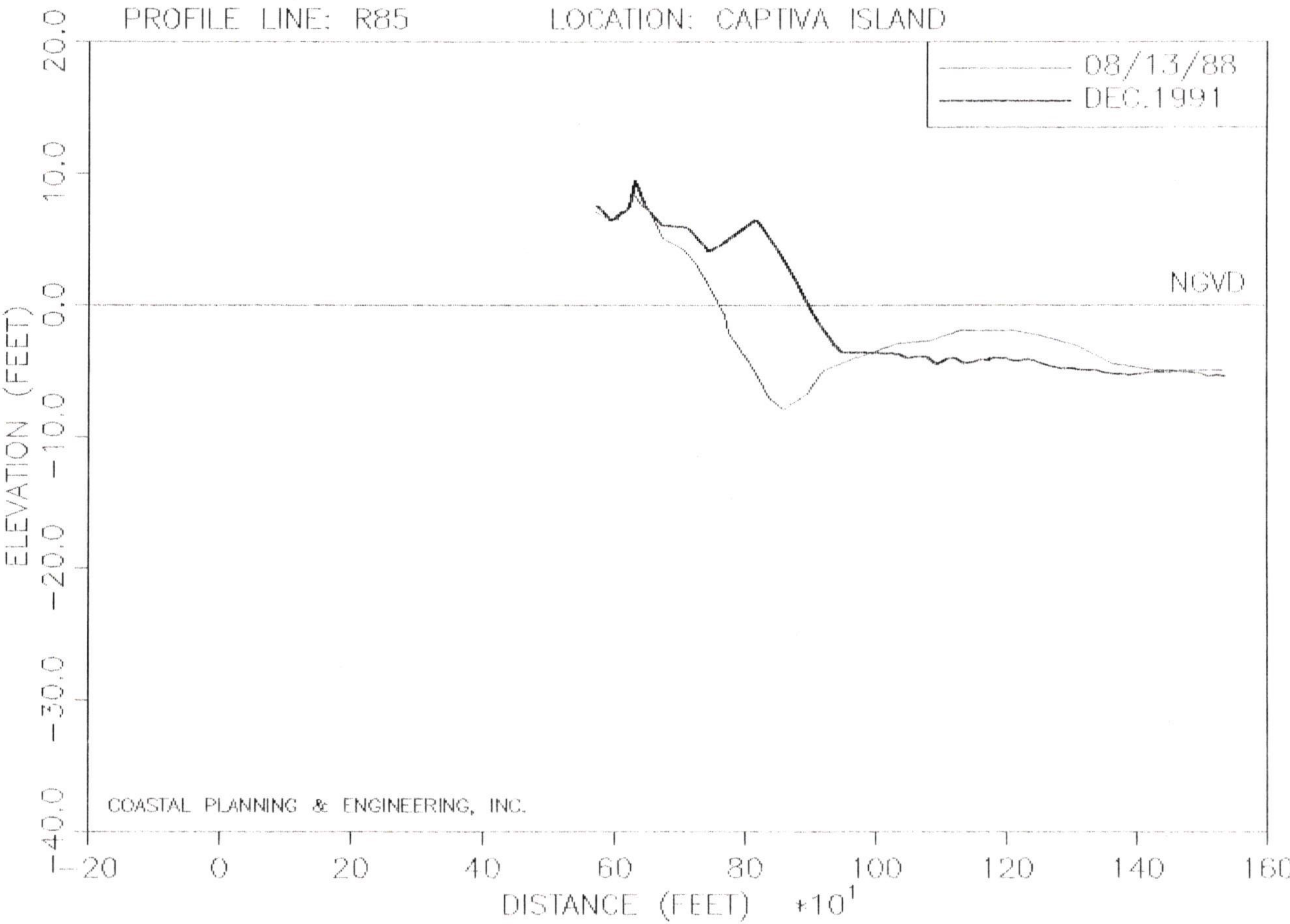

PROFILE LINE: R-129 LOCATION: LEE
1974
1989
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1

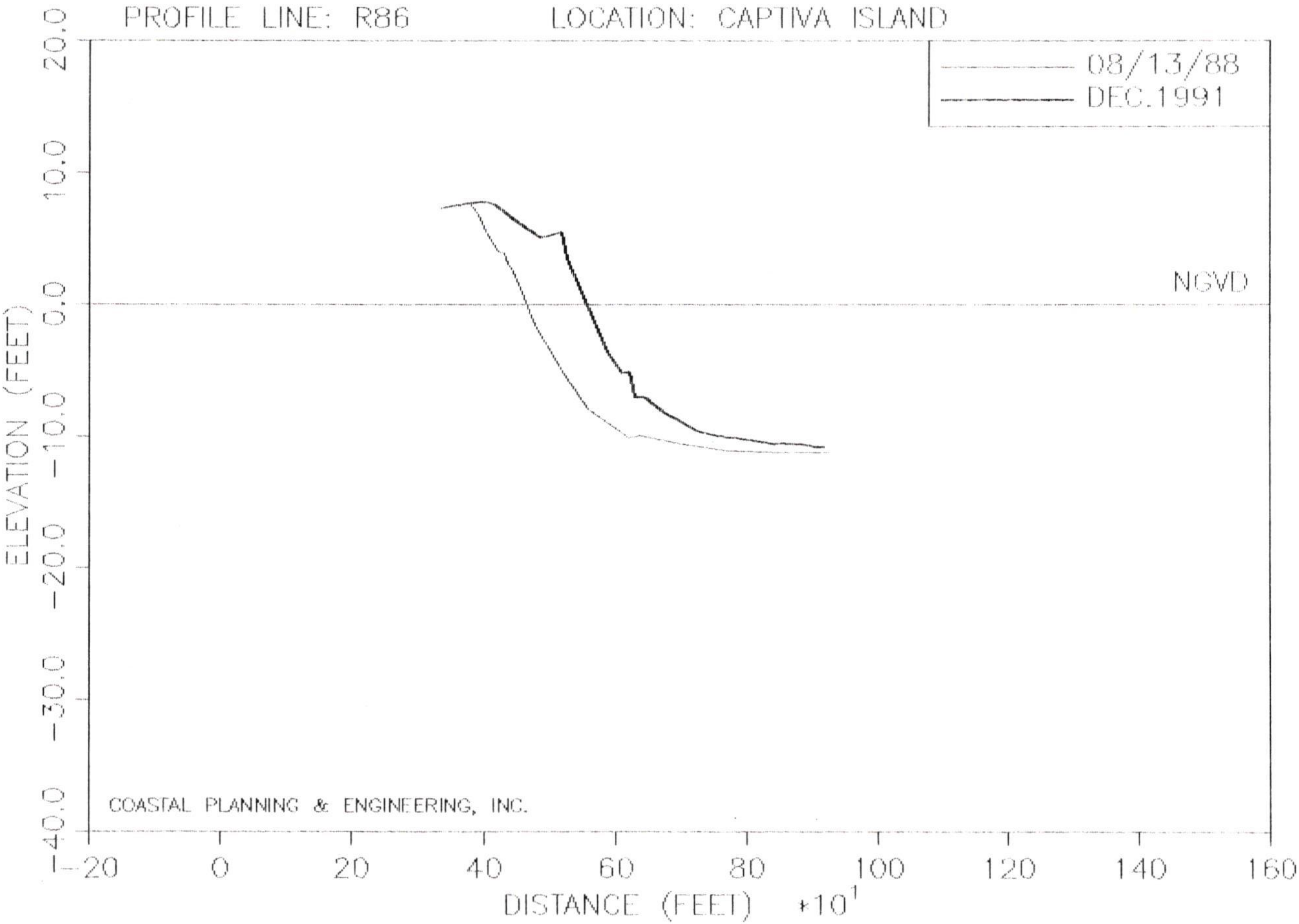
Comparative Beach Profile Plots

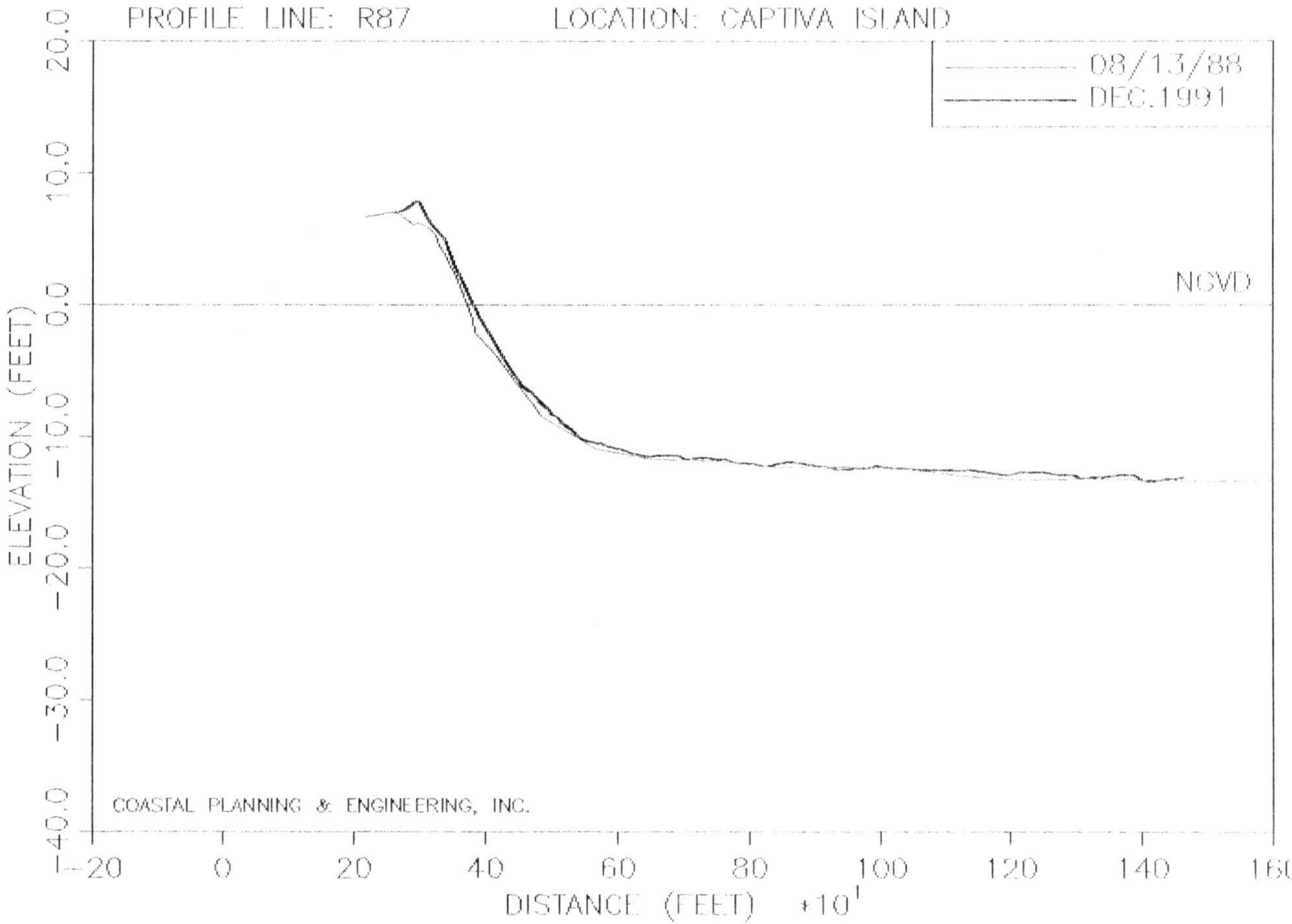
August 13, 1988 (CPE) vs. December 1991 (CPE)



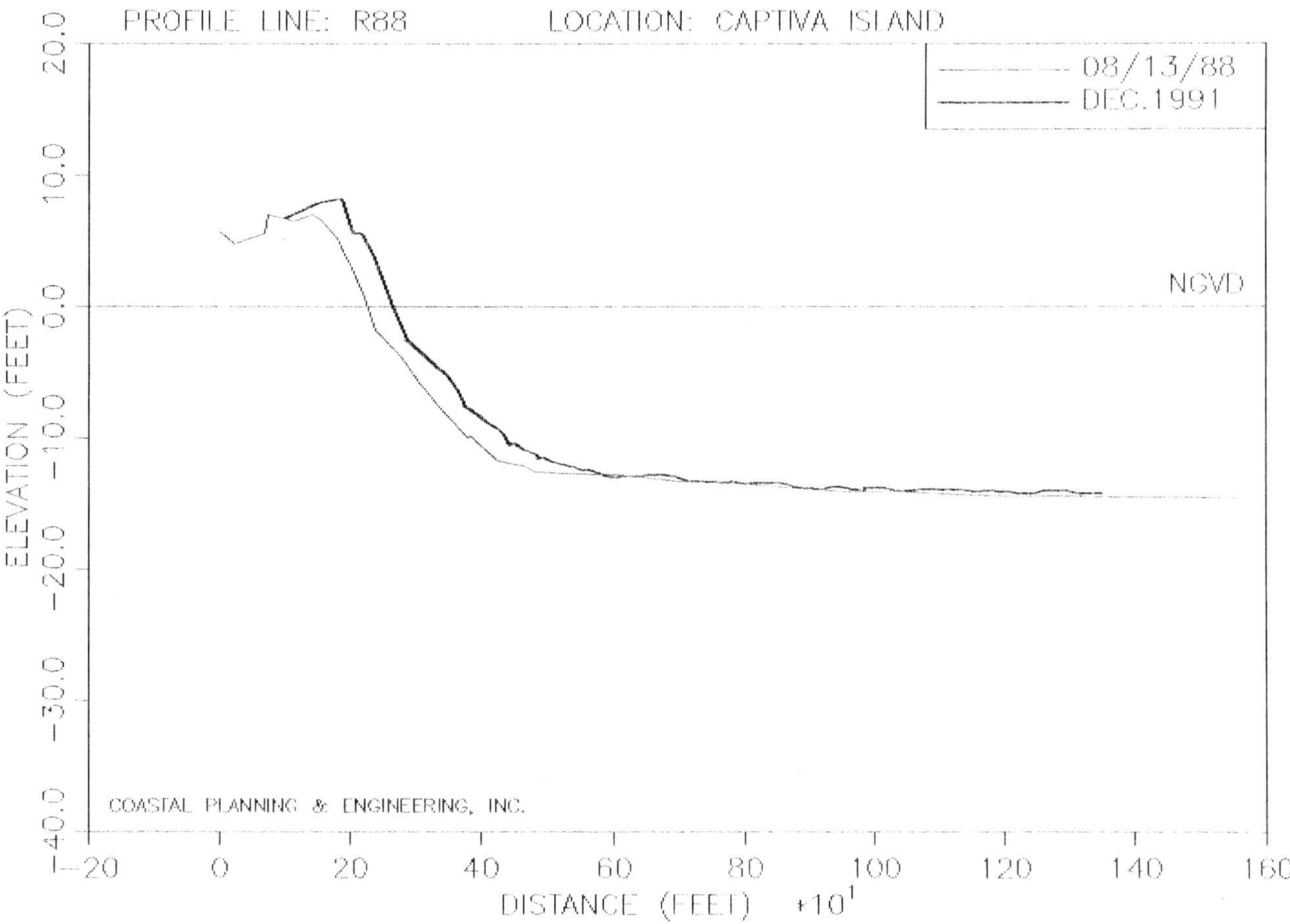
PROFILE LINE: R84
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]


PROFILE LINE: R85
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

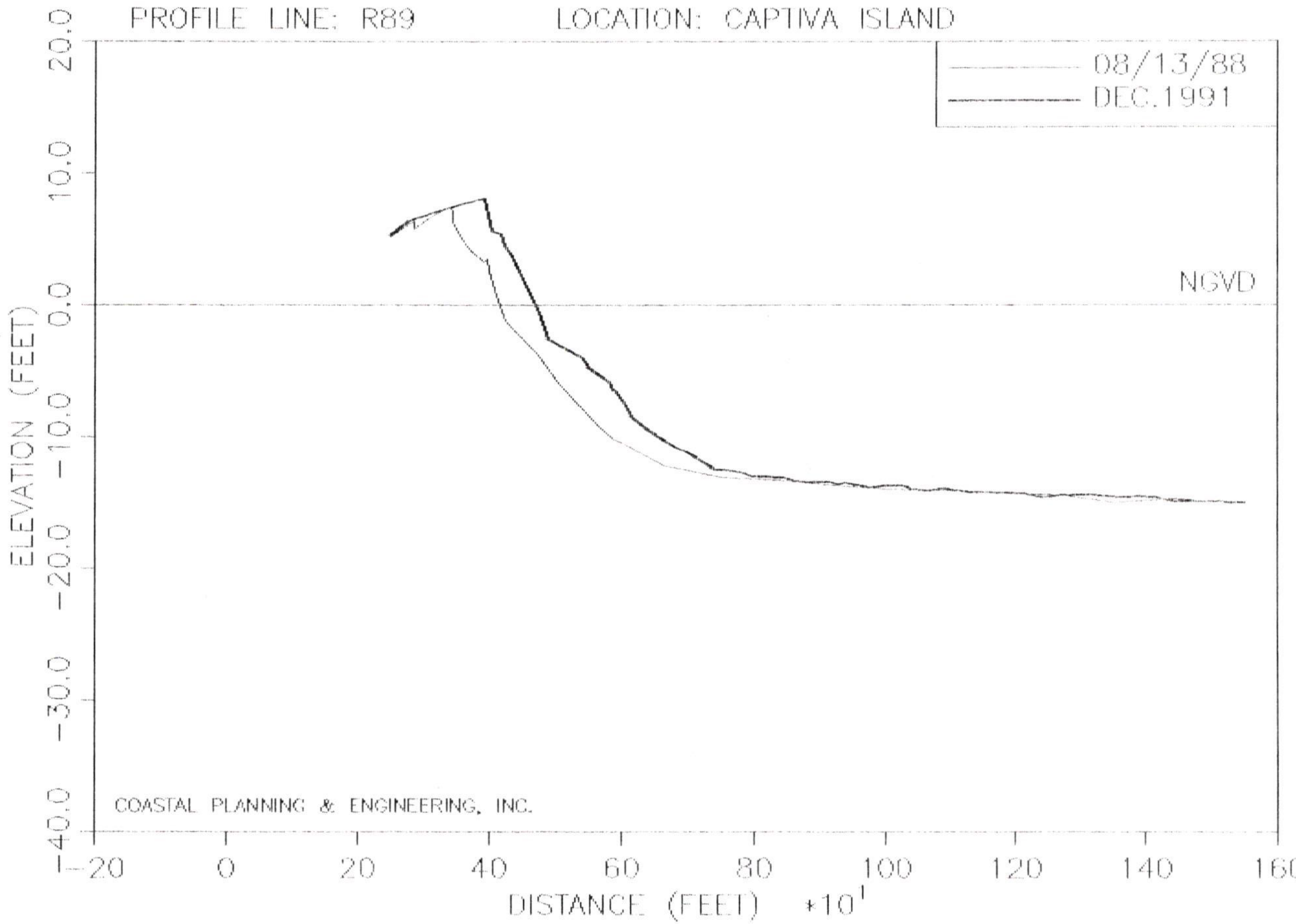

PROFILE LINE: R86
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]



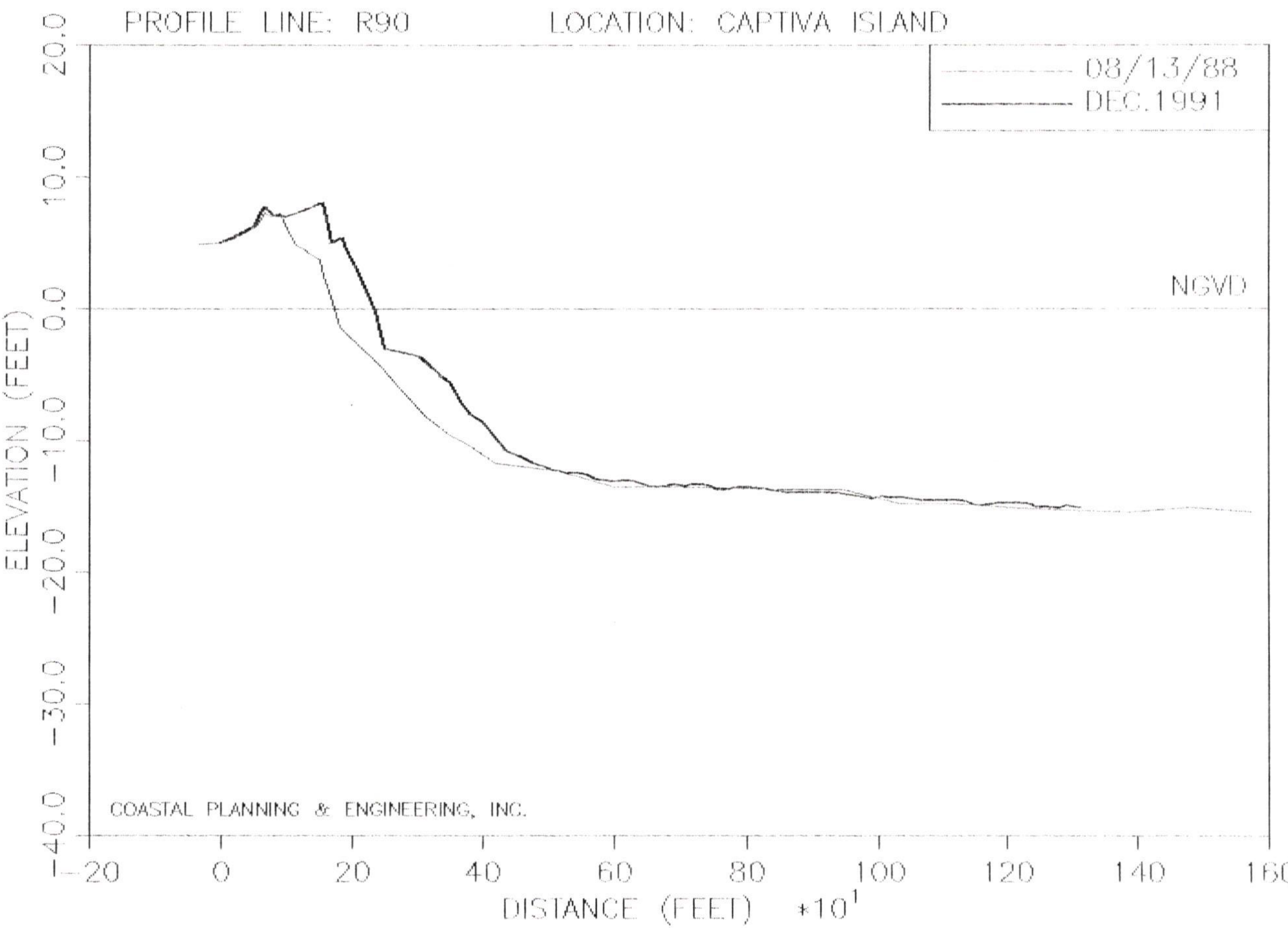
PROFILE LINE: R87
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

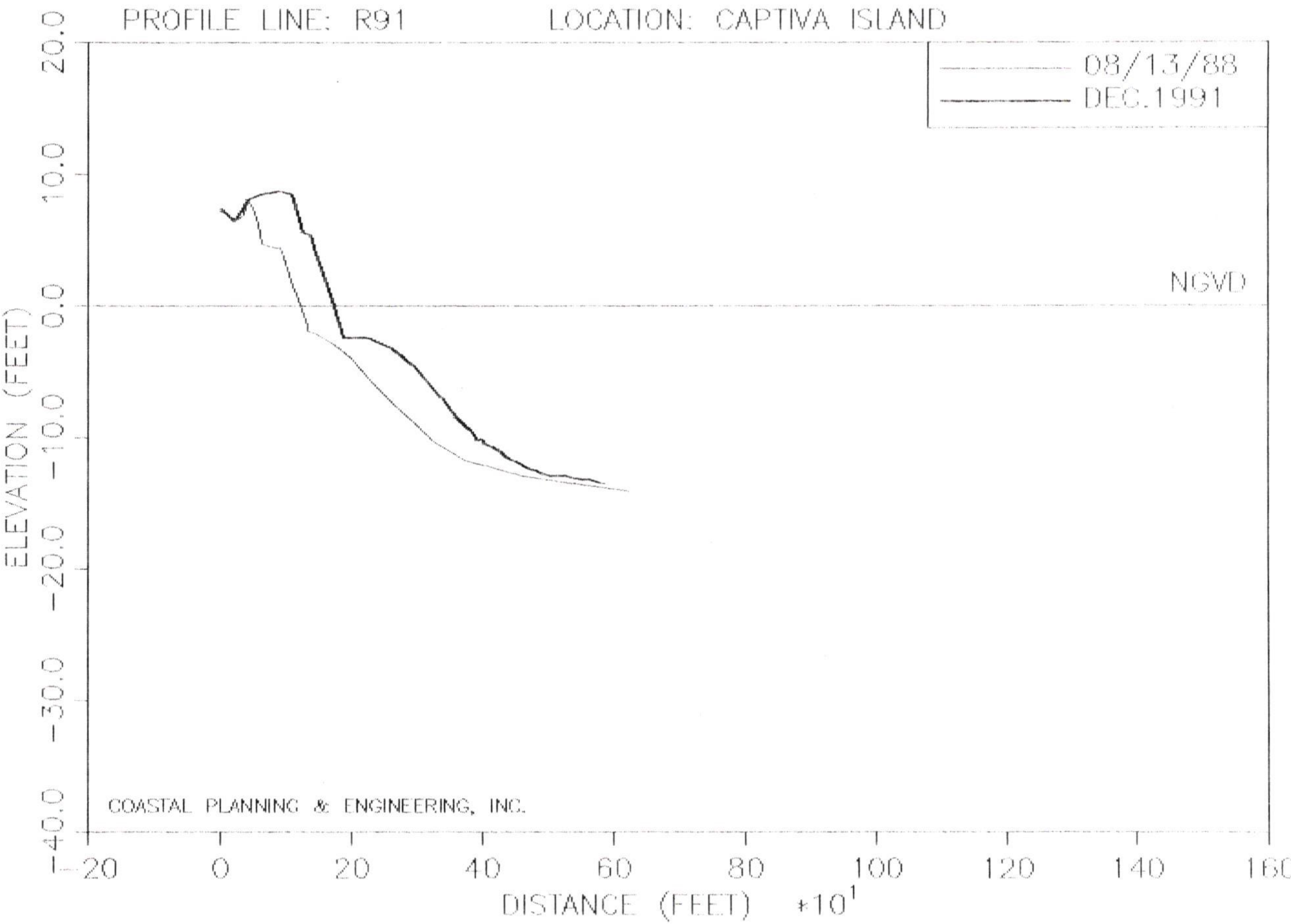


PROFILE LINE: R88
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1

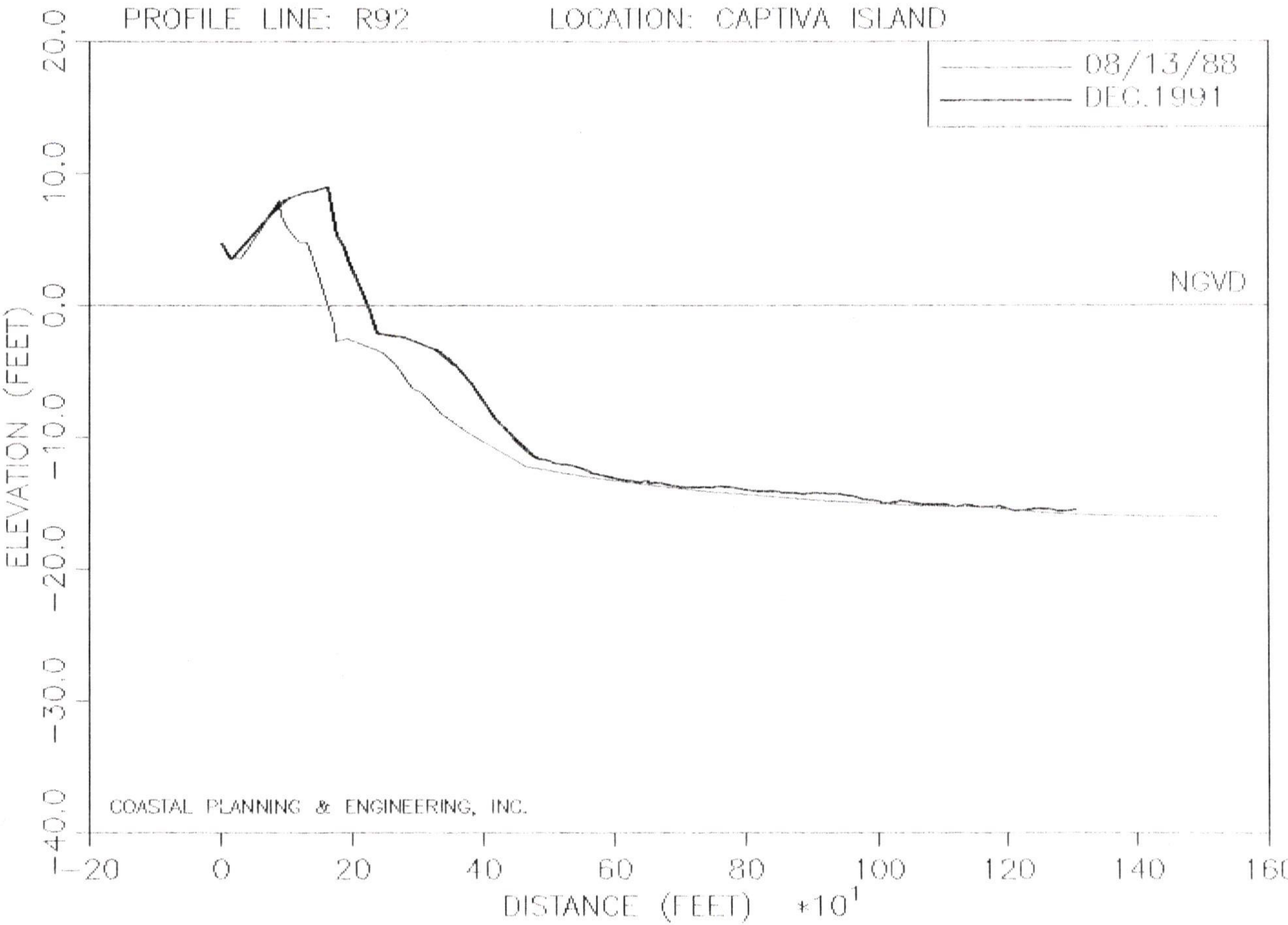


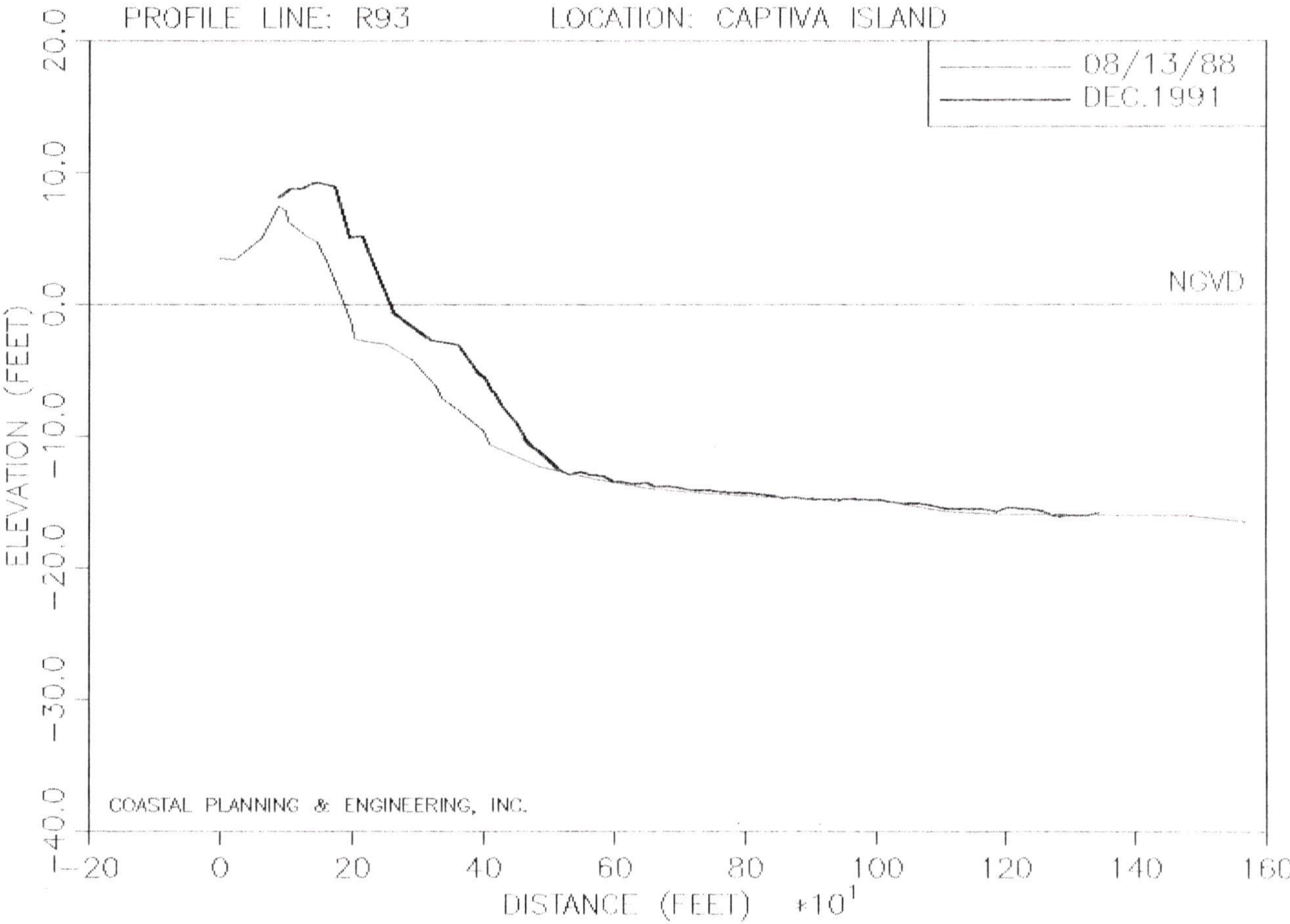
PROFILE LINE: R89
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]


PROFILE LINE: R90
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1

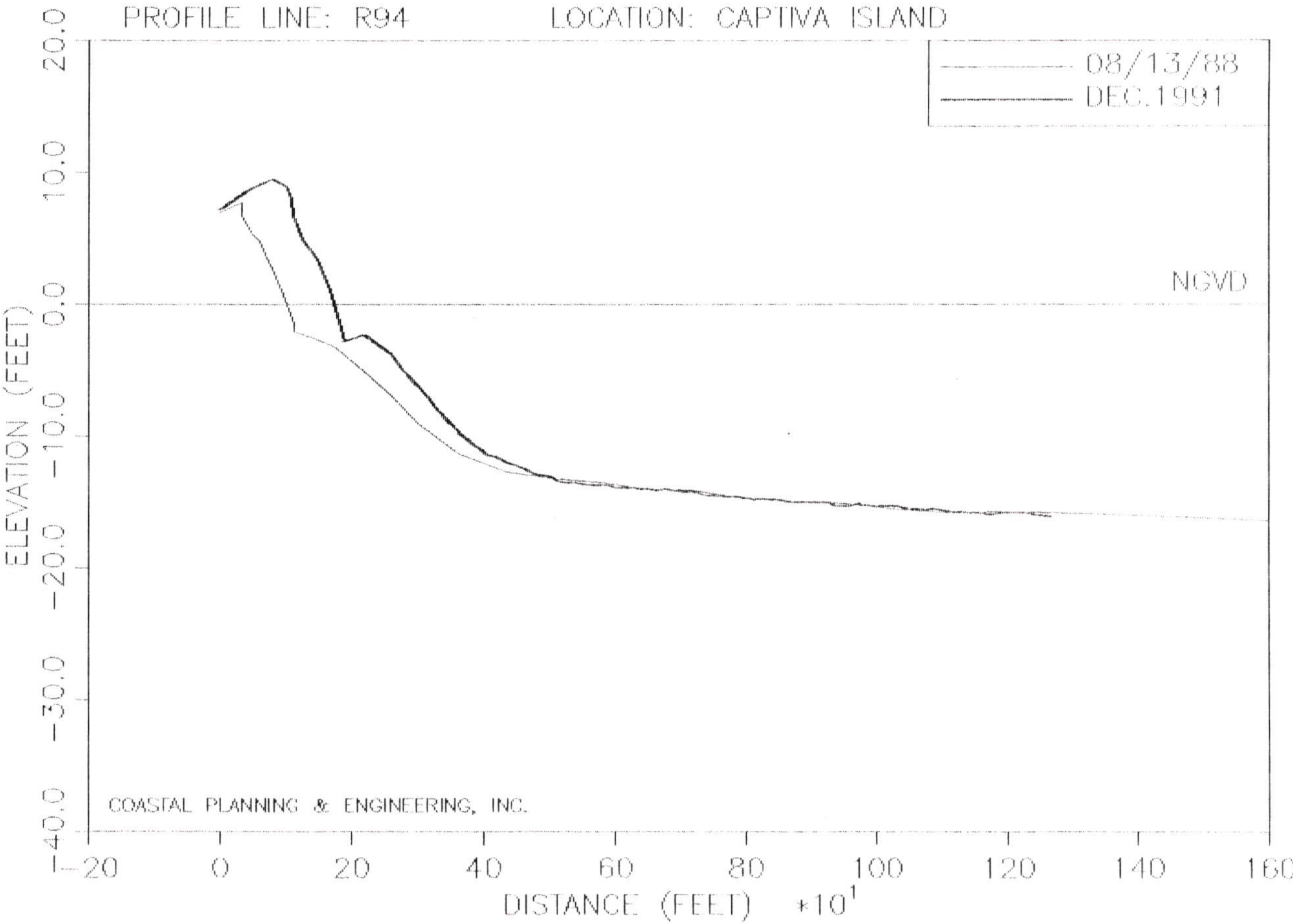


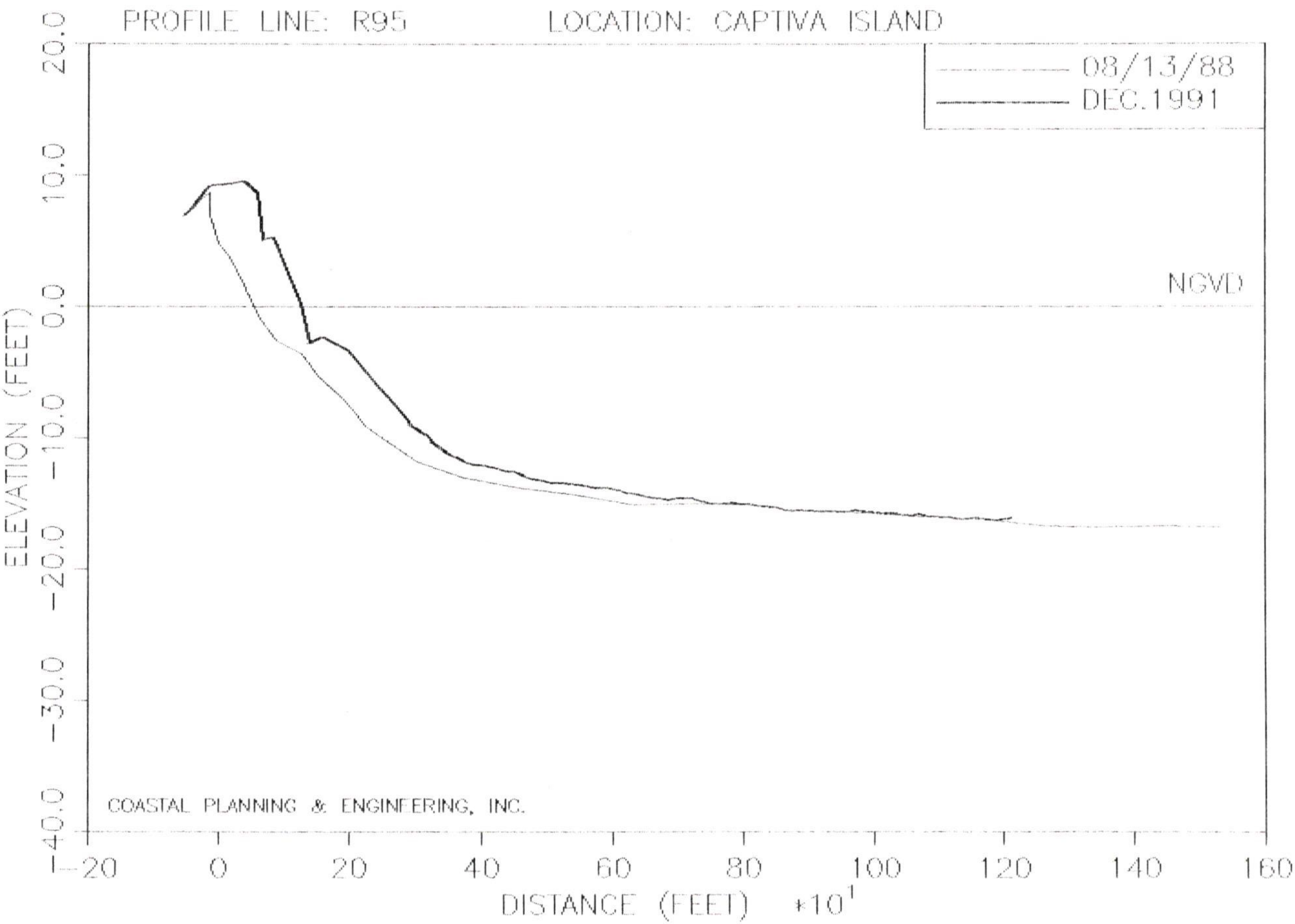
PROFILE LINE: R91
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1


PROFILE LINE: R92
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1
COASTAL PLANNING & ENGINEERING, INC.

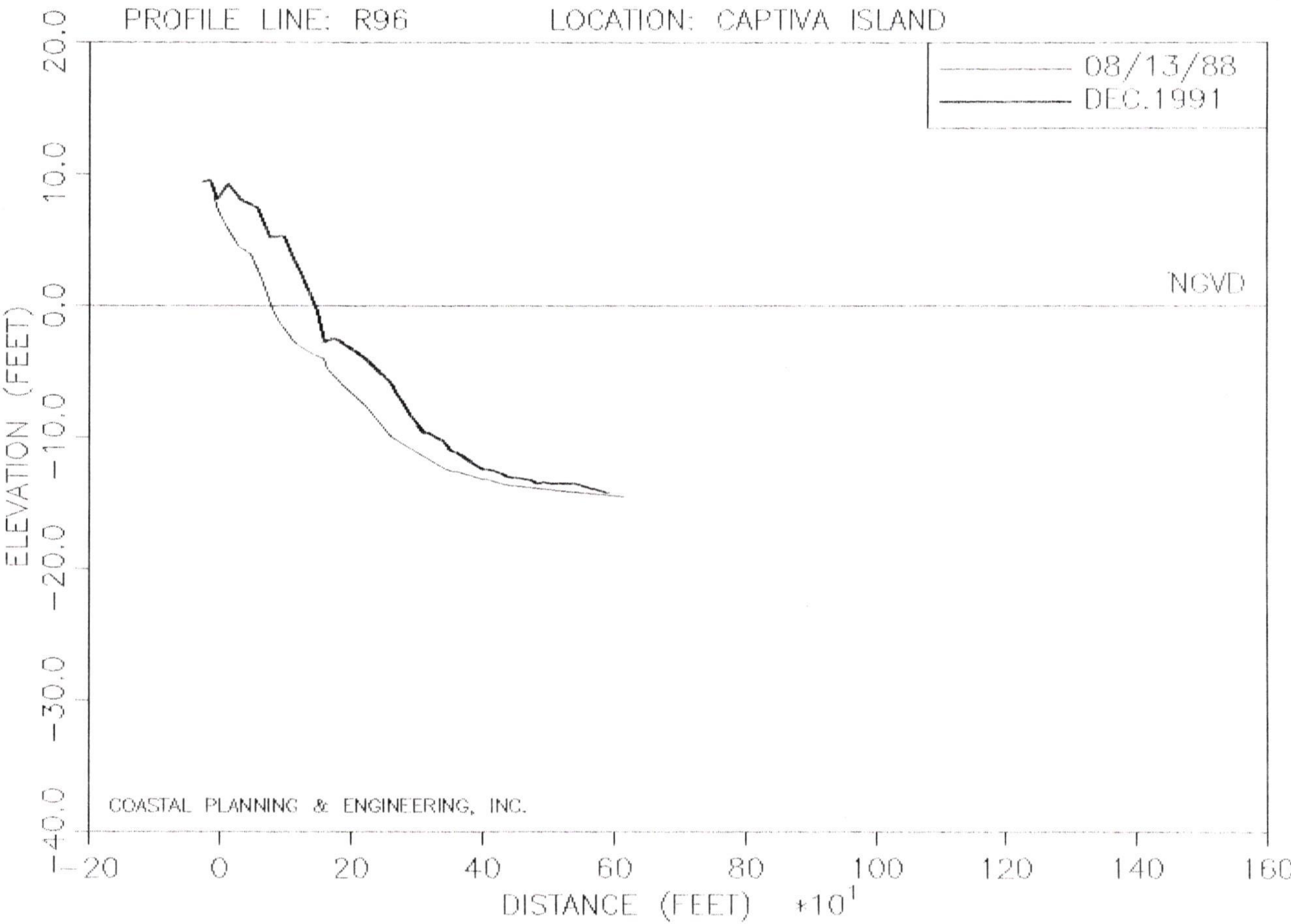


PROFILE LINE: R93
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1

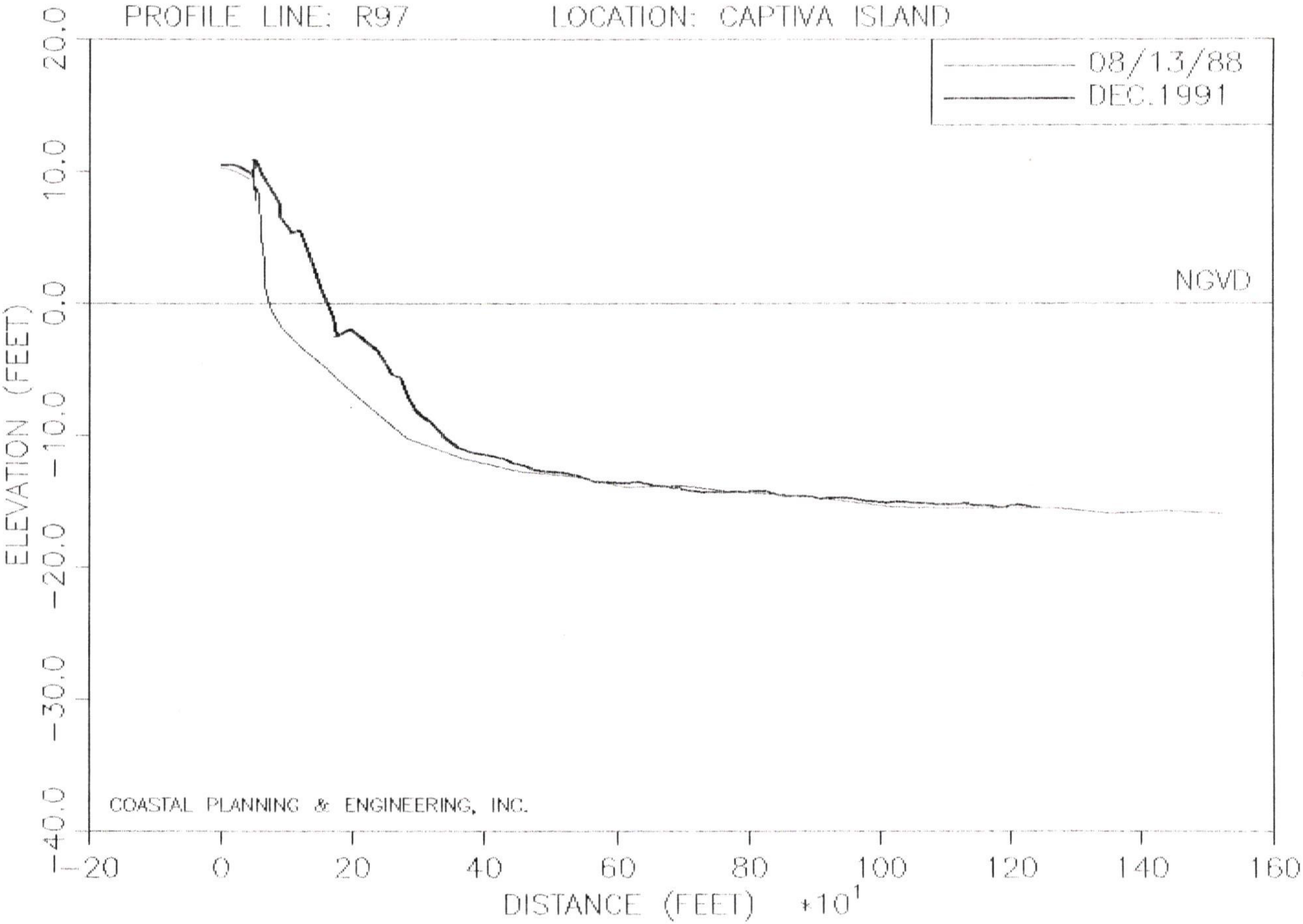

PROFILE LINE: R94
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

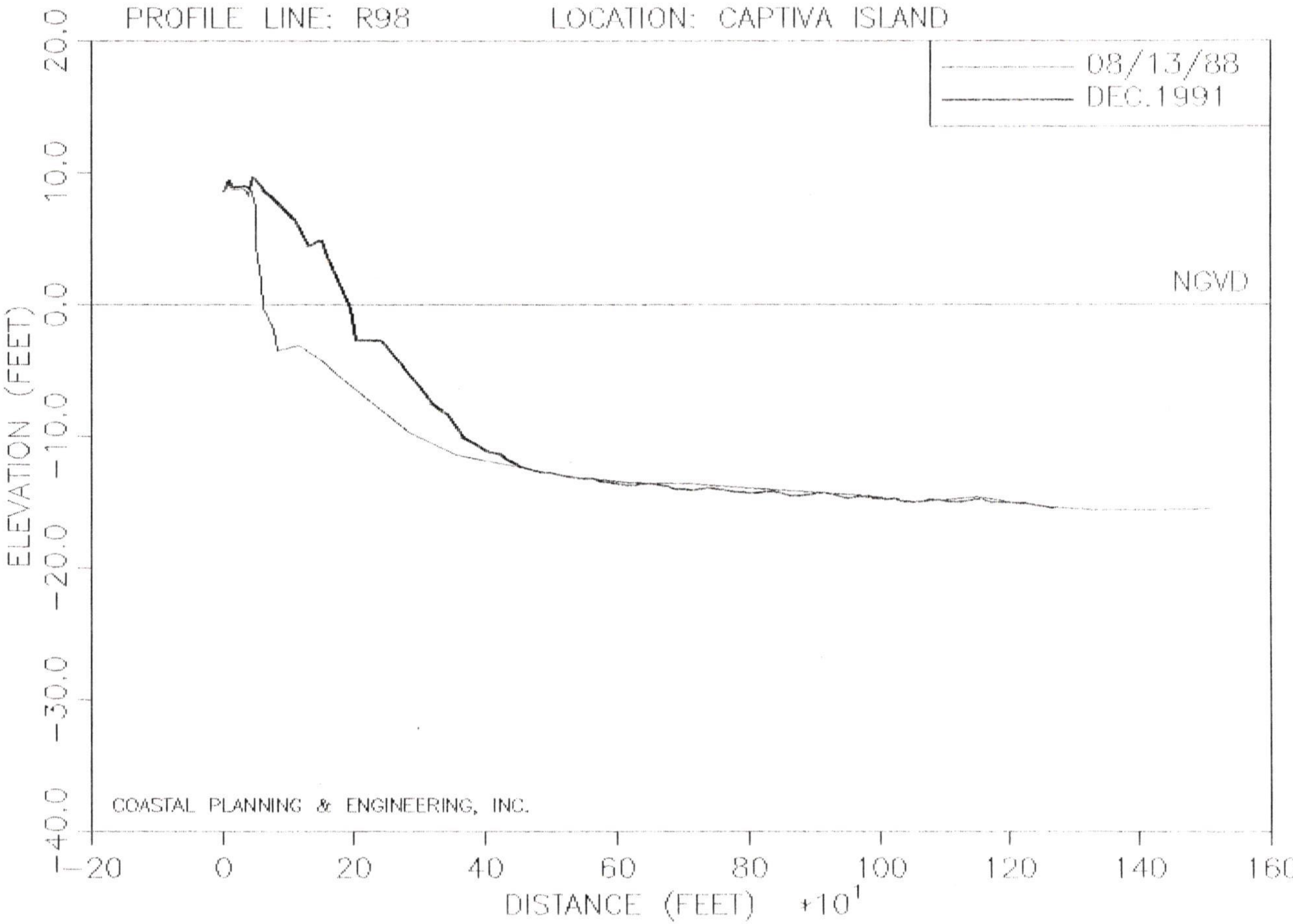


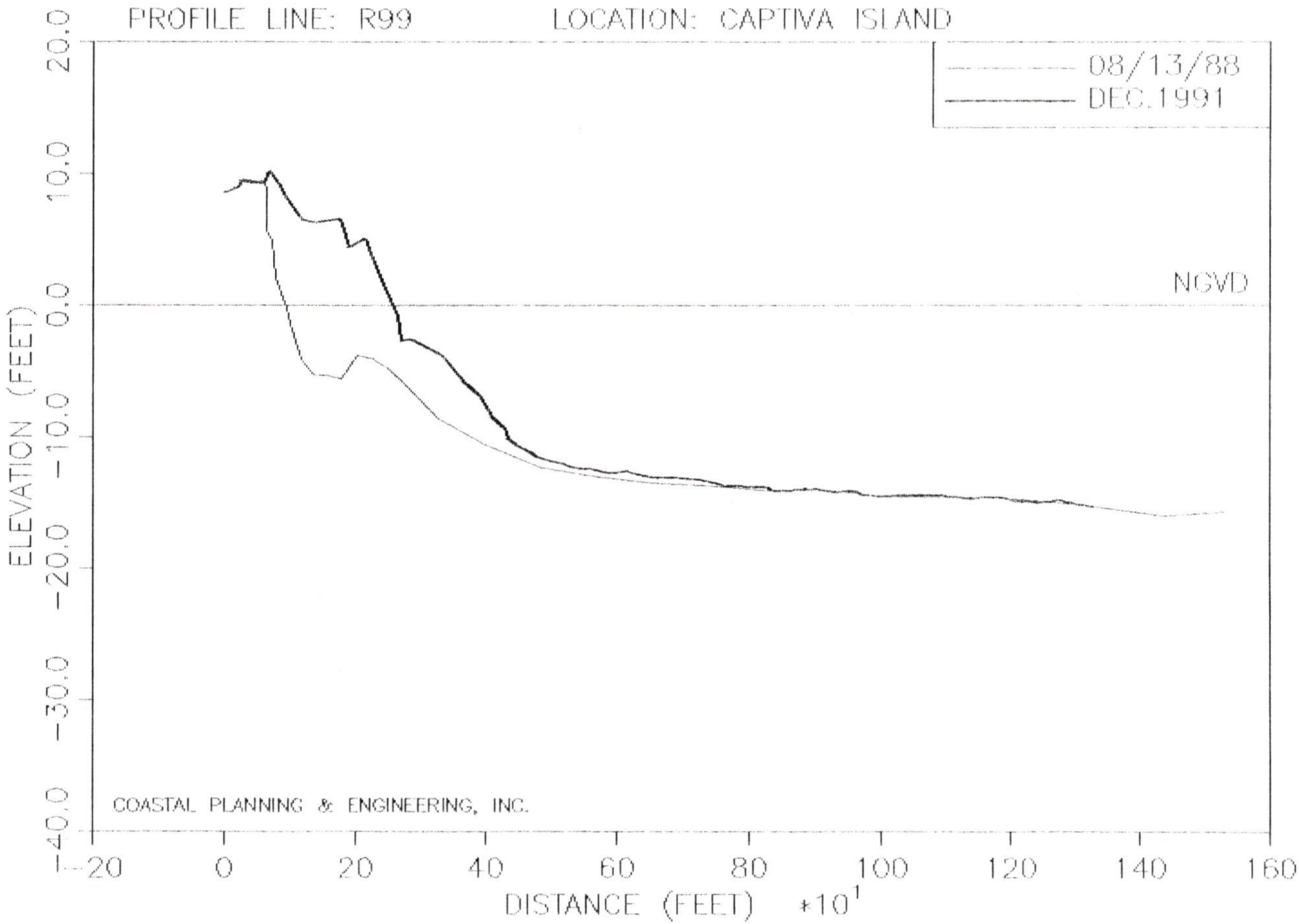
PROFILE LINE: R95
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
COASTAL PLANNING & ENGINEERING, INC.
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

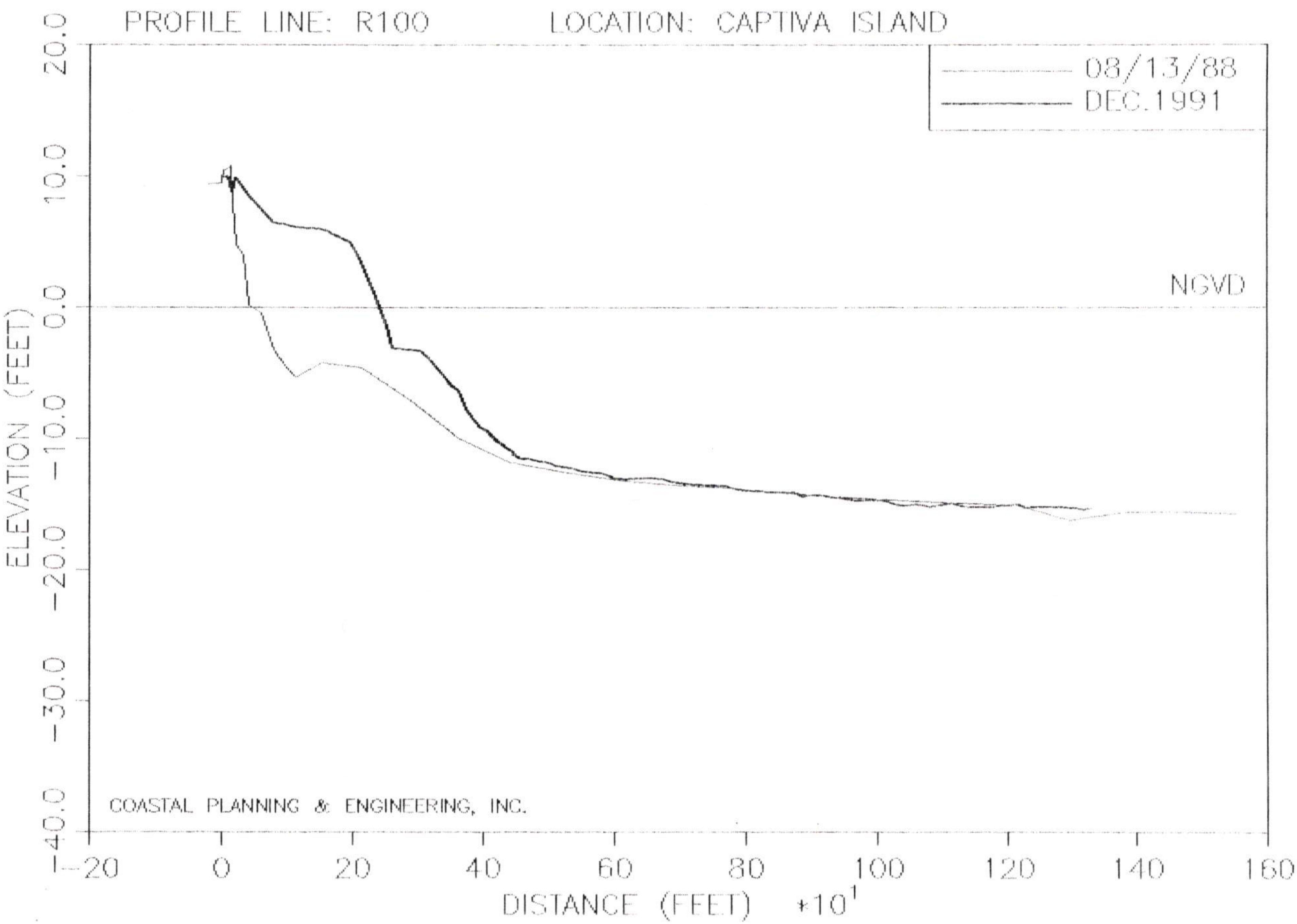


PROFILE LINE: R96
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1

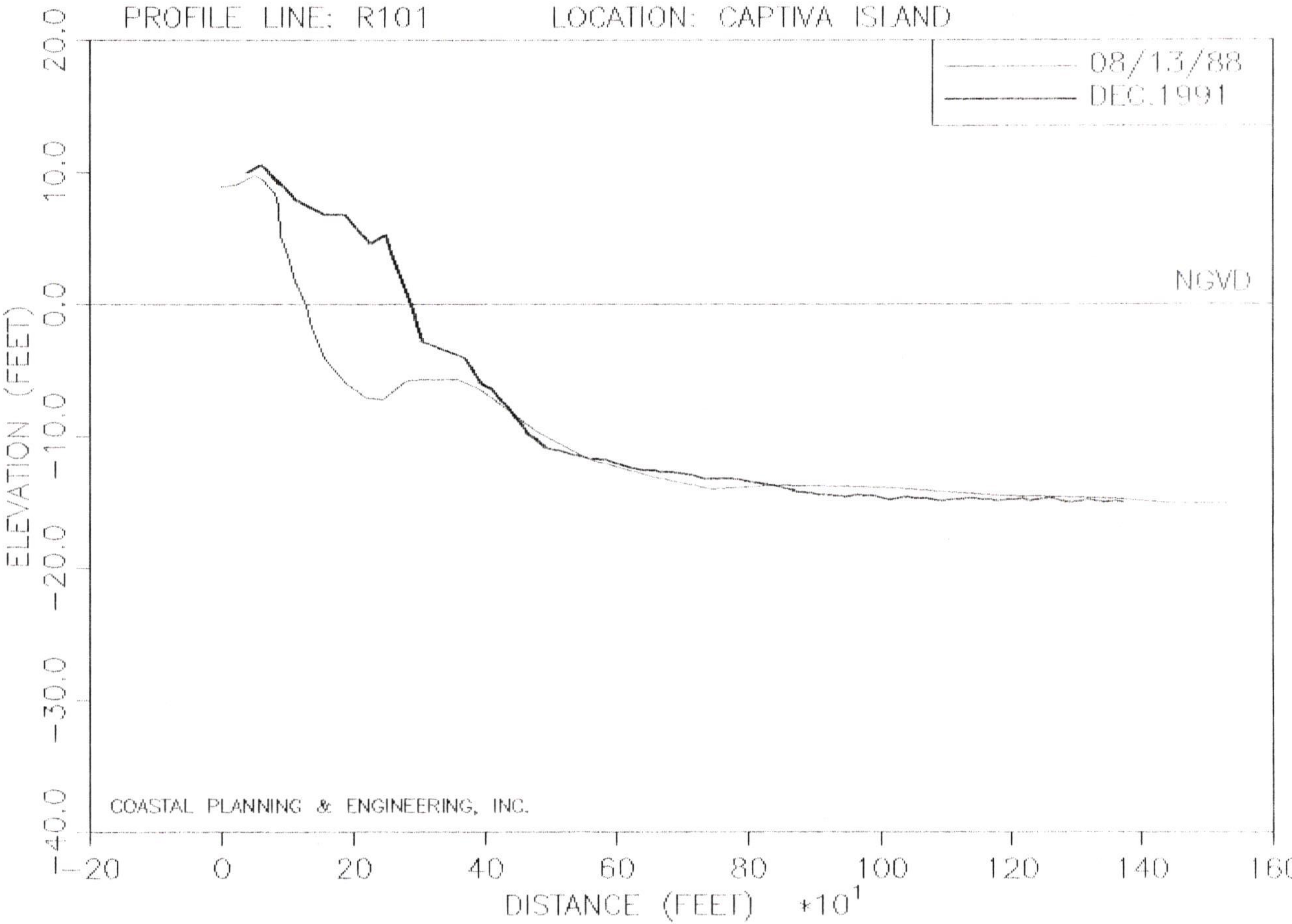

PROFILE LINE: R97
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1

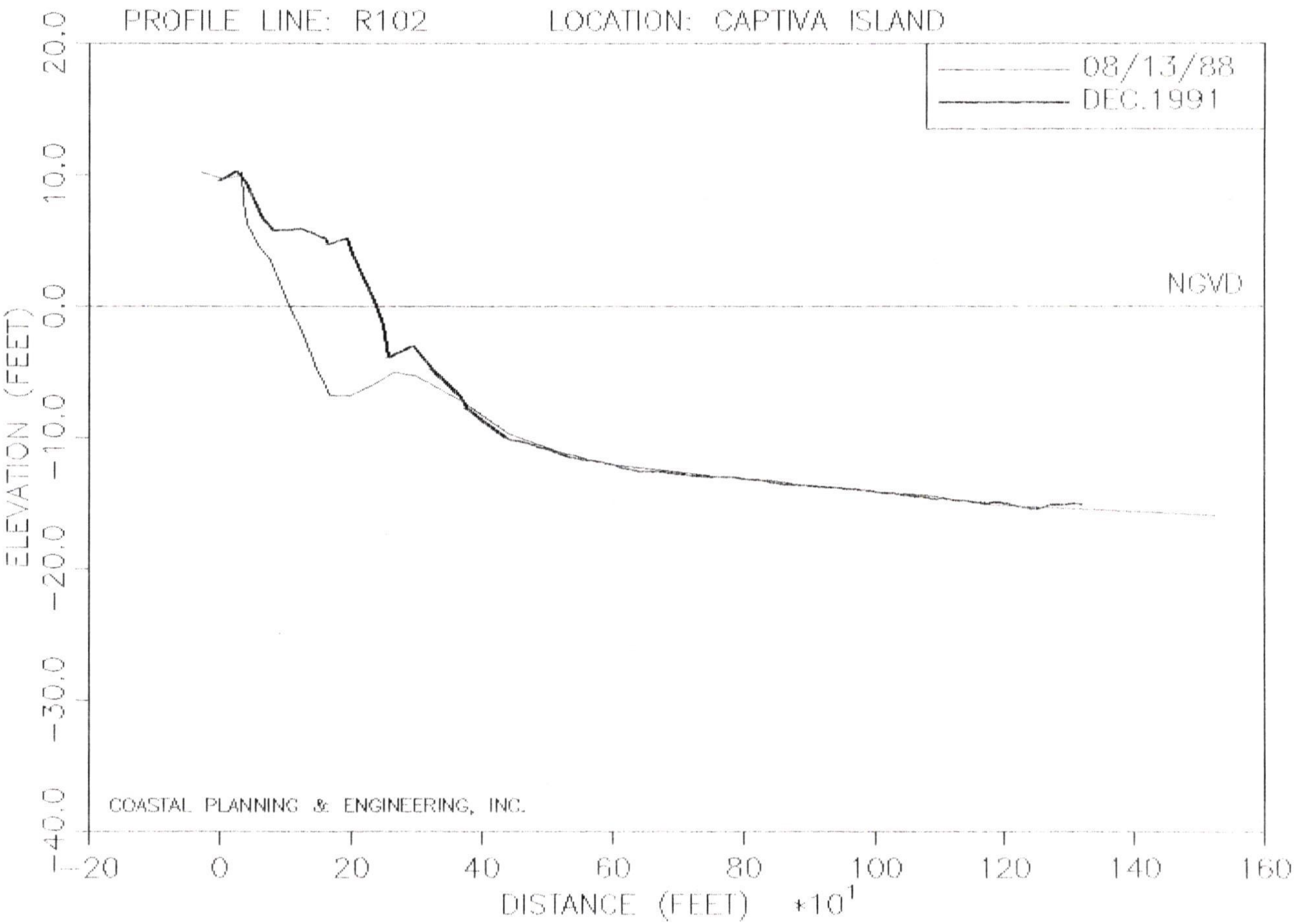

PROFILE LINE: R98
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10¹
COASTAL PLANNING & ENGINEERING, INC.

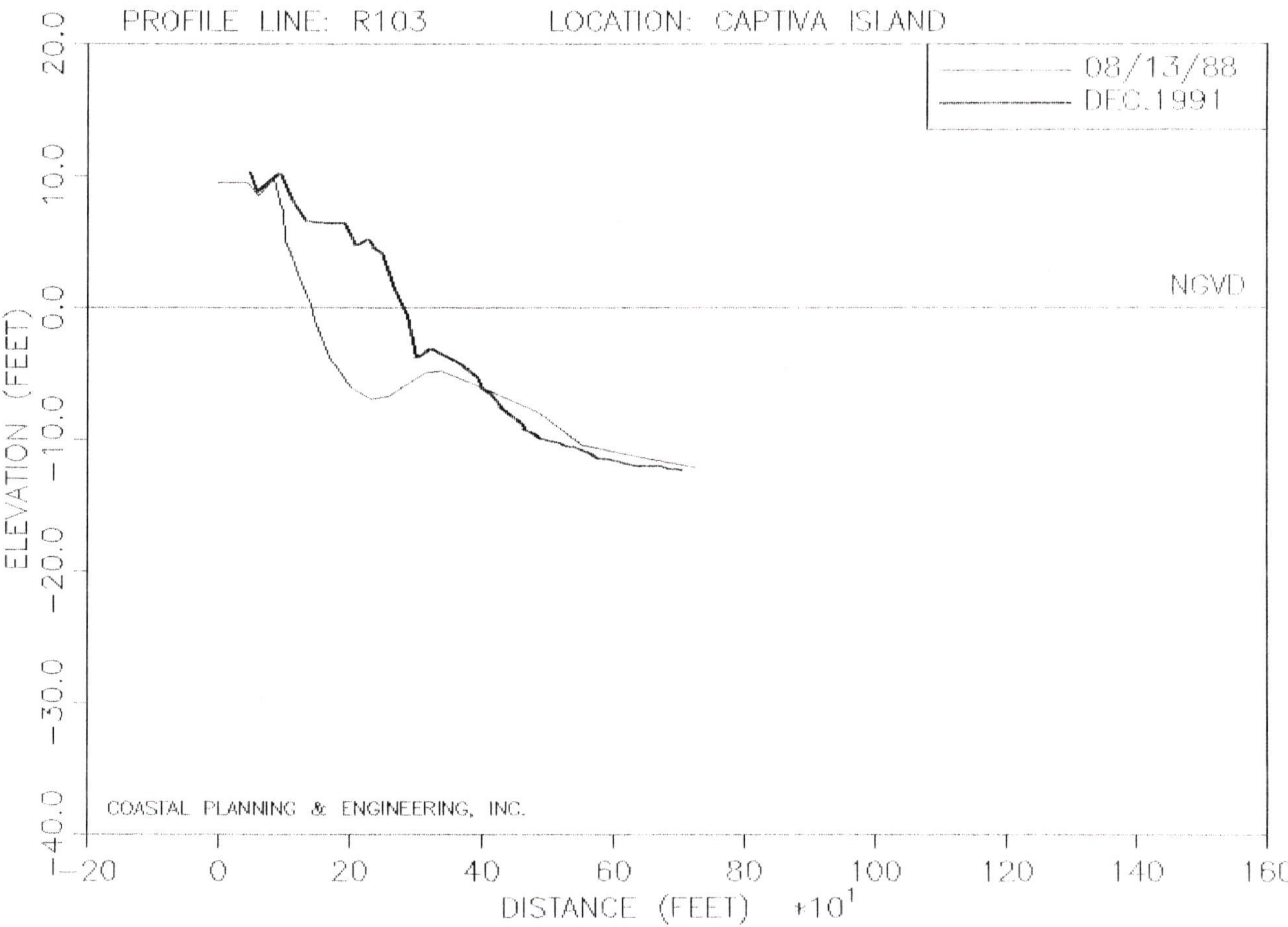

PROFILE LINE: R99
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1



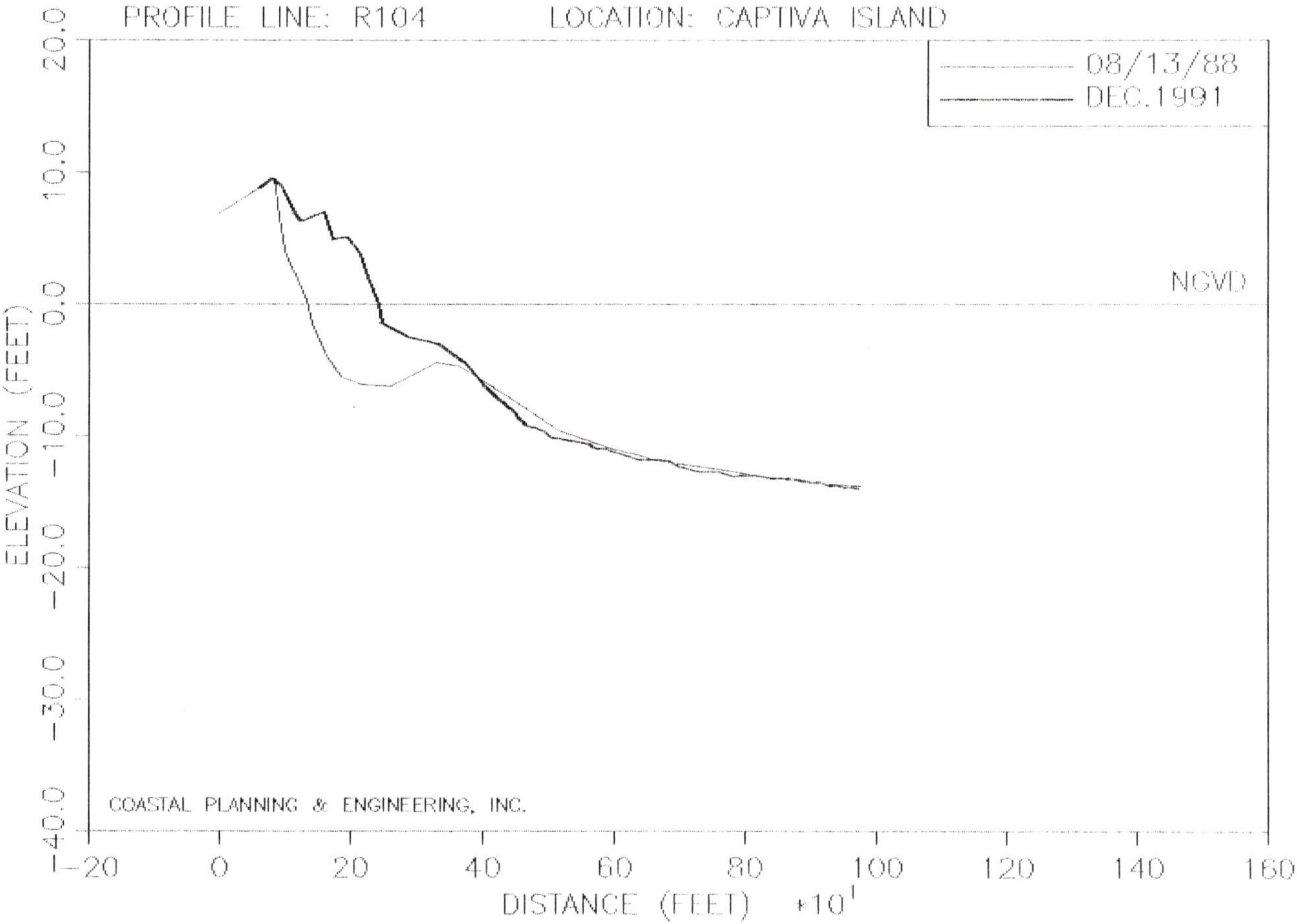
PROFILE LINE: R100
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

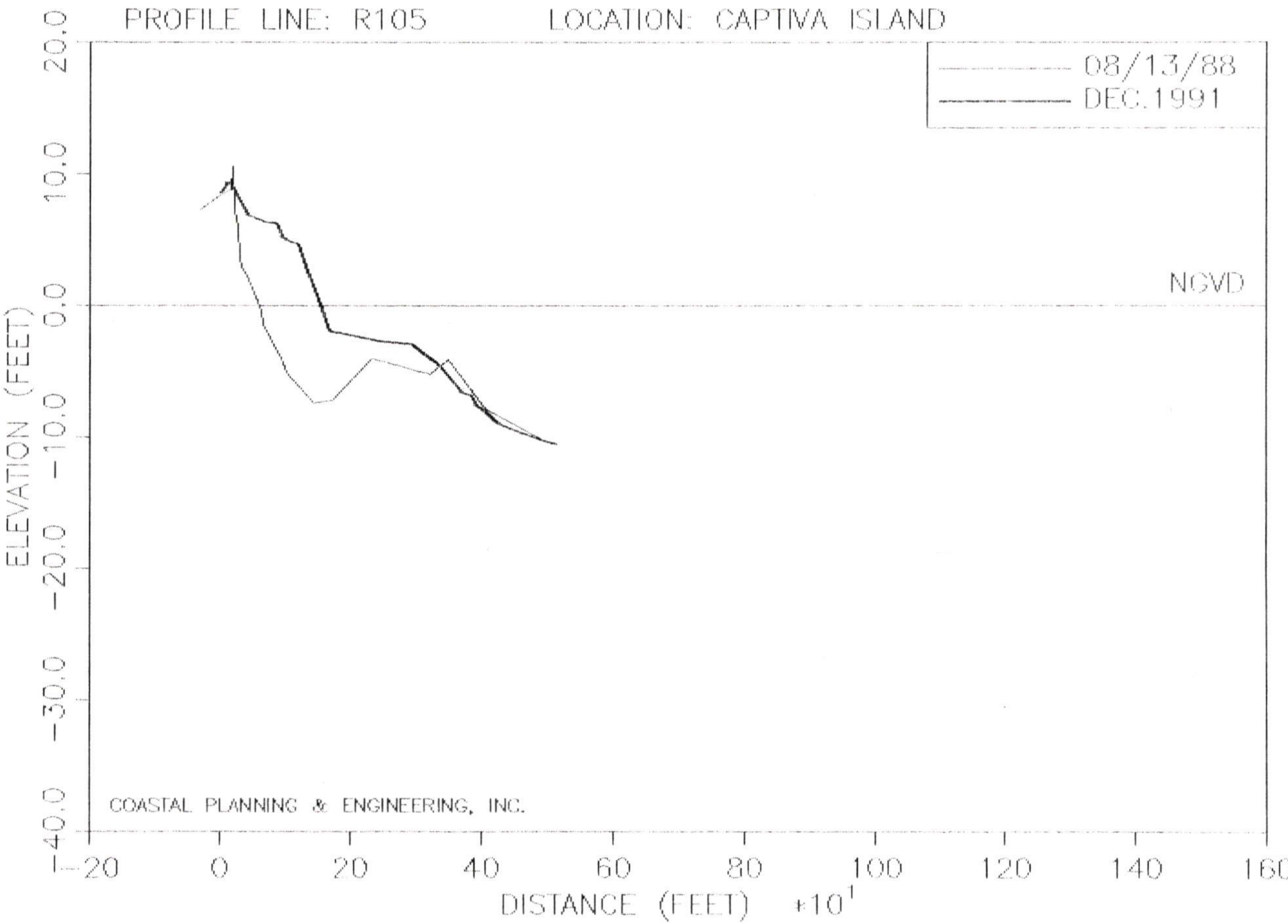

PROFILE LINE: R101
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

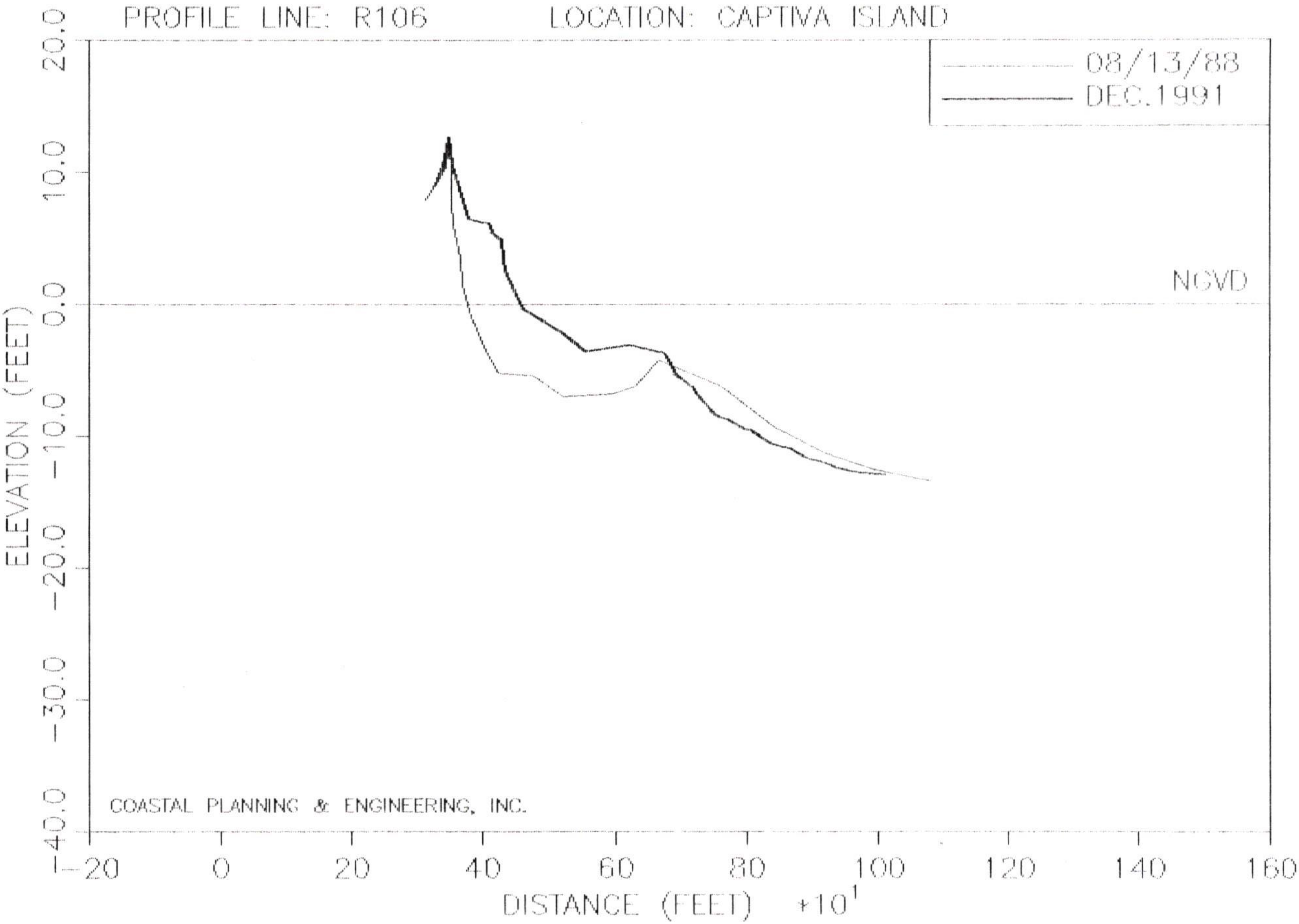

PROFILE LINE: R102
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]



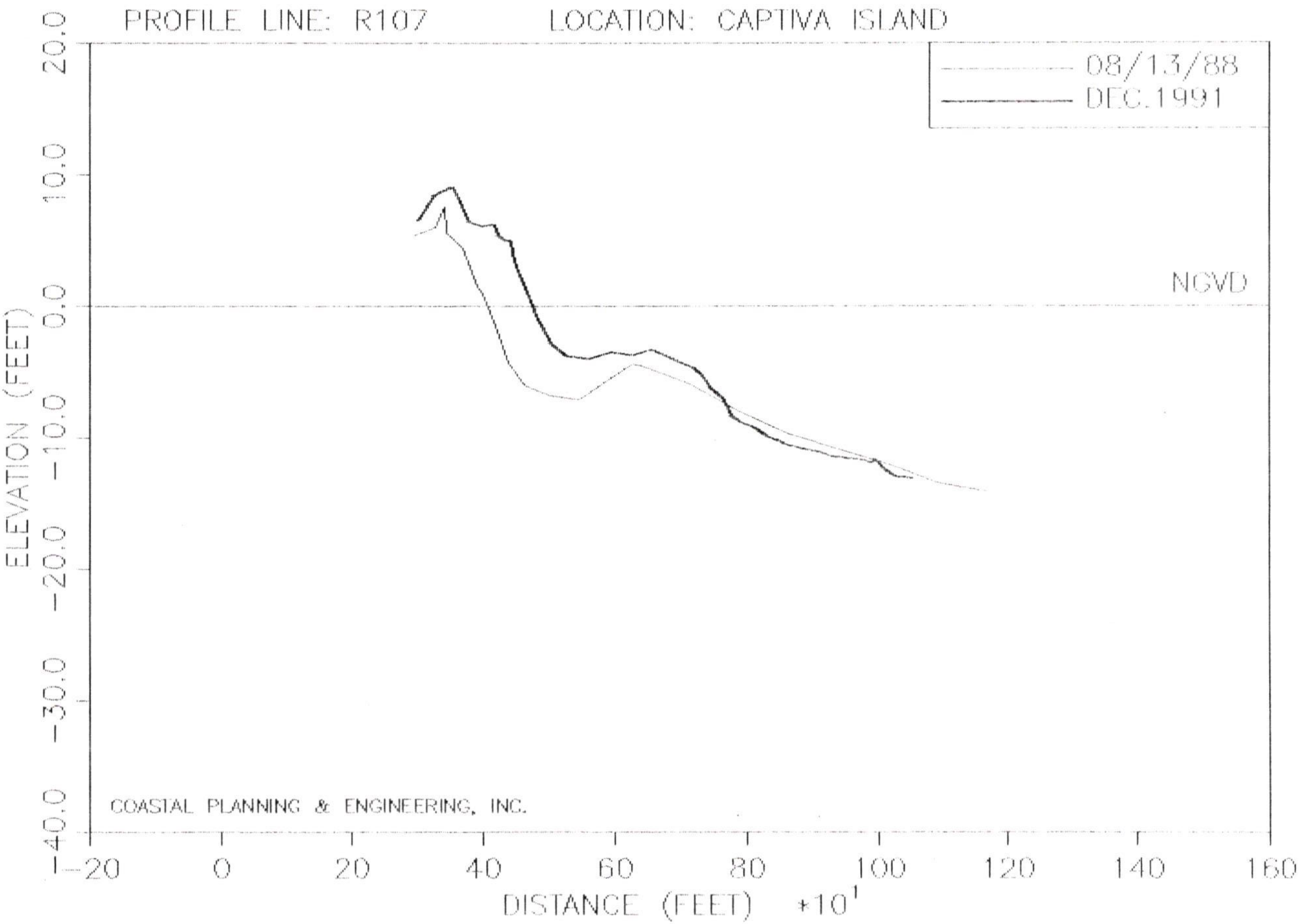
PROFILE LINE: R103
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]
COASTAL PLANNING & ENGINEERING, INC.


PROFILE LINE: R104
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

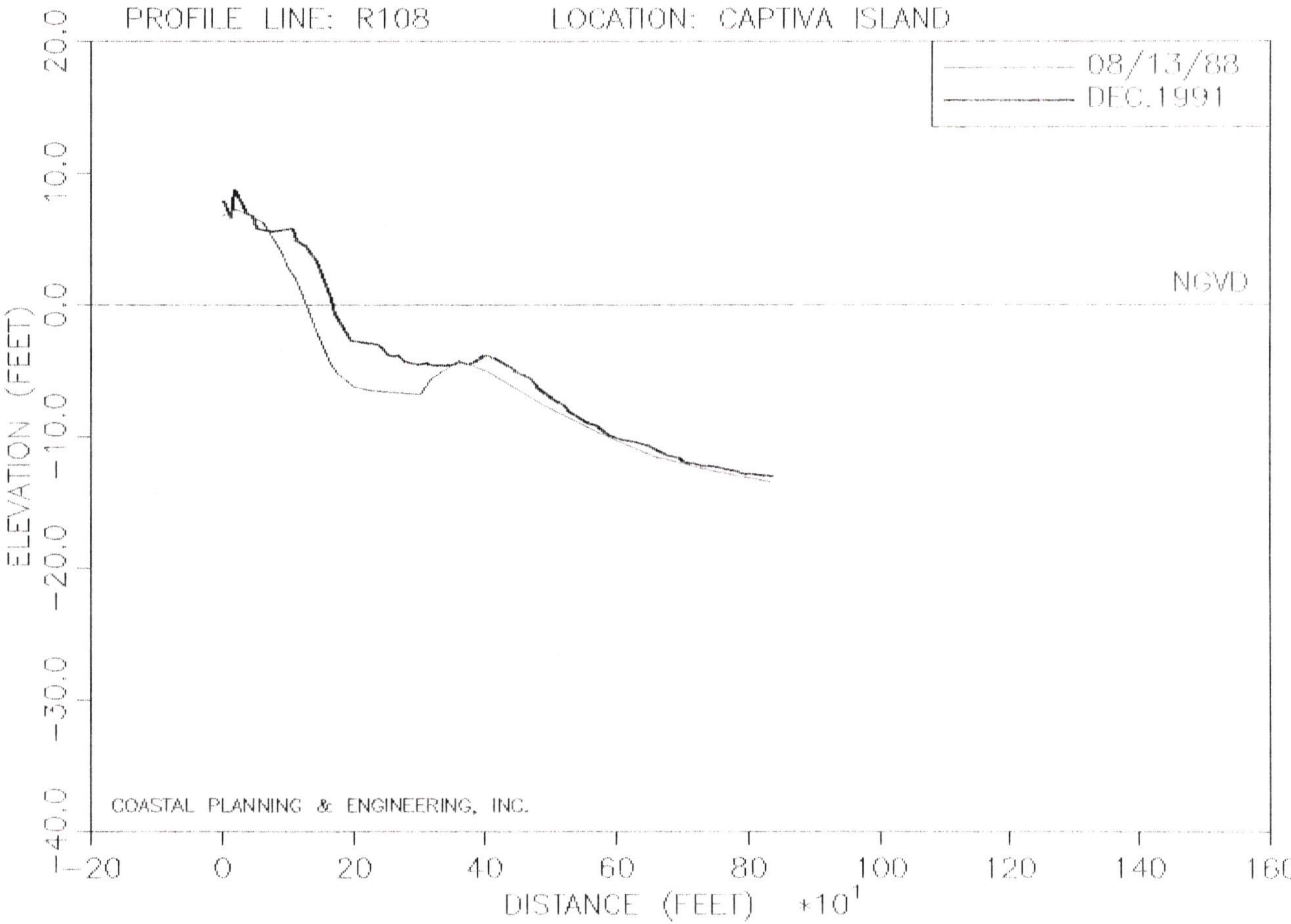

PROFILE LINE: R105
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1

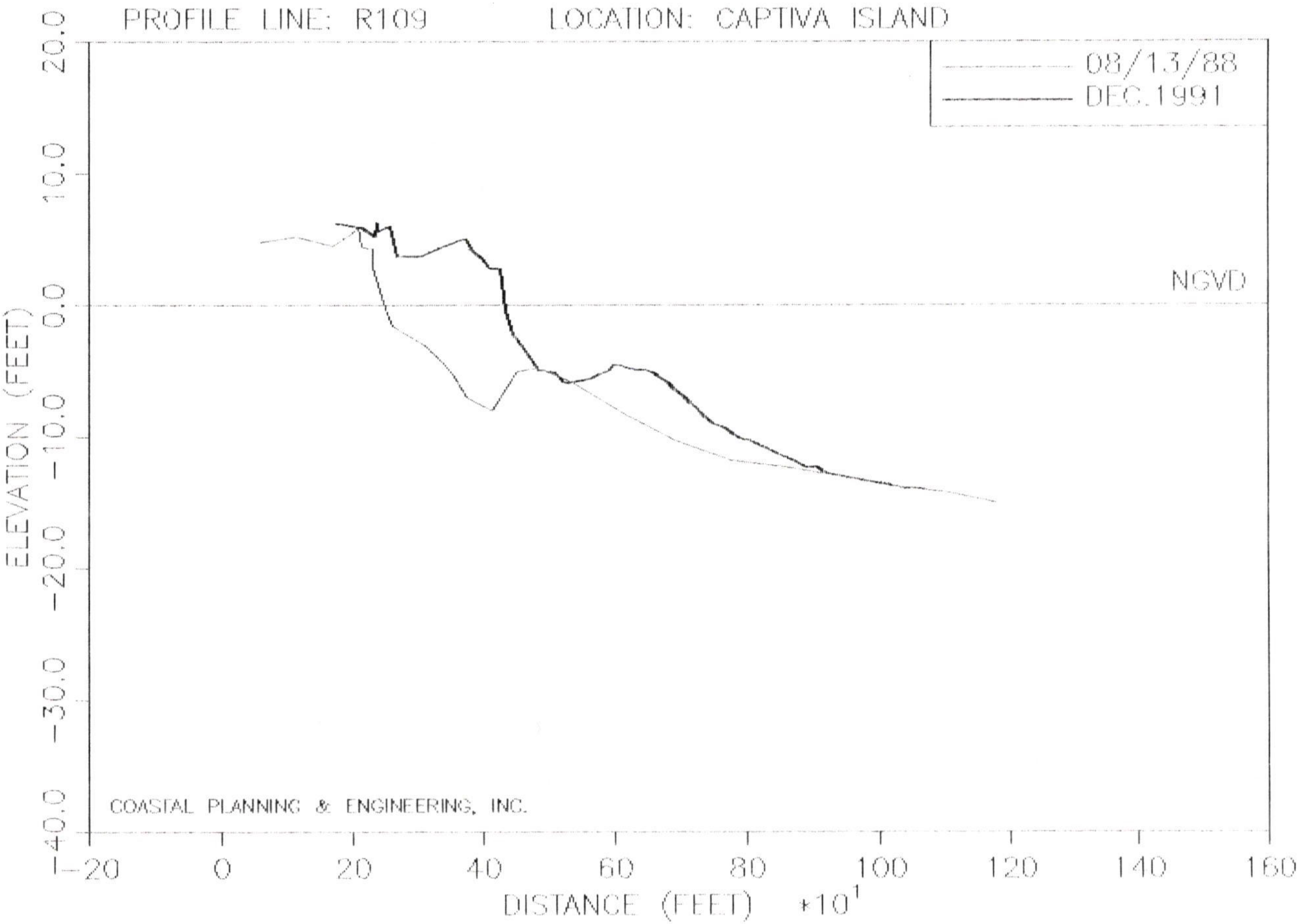


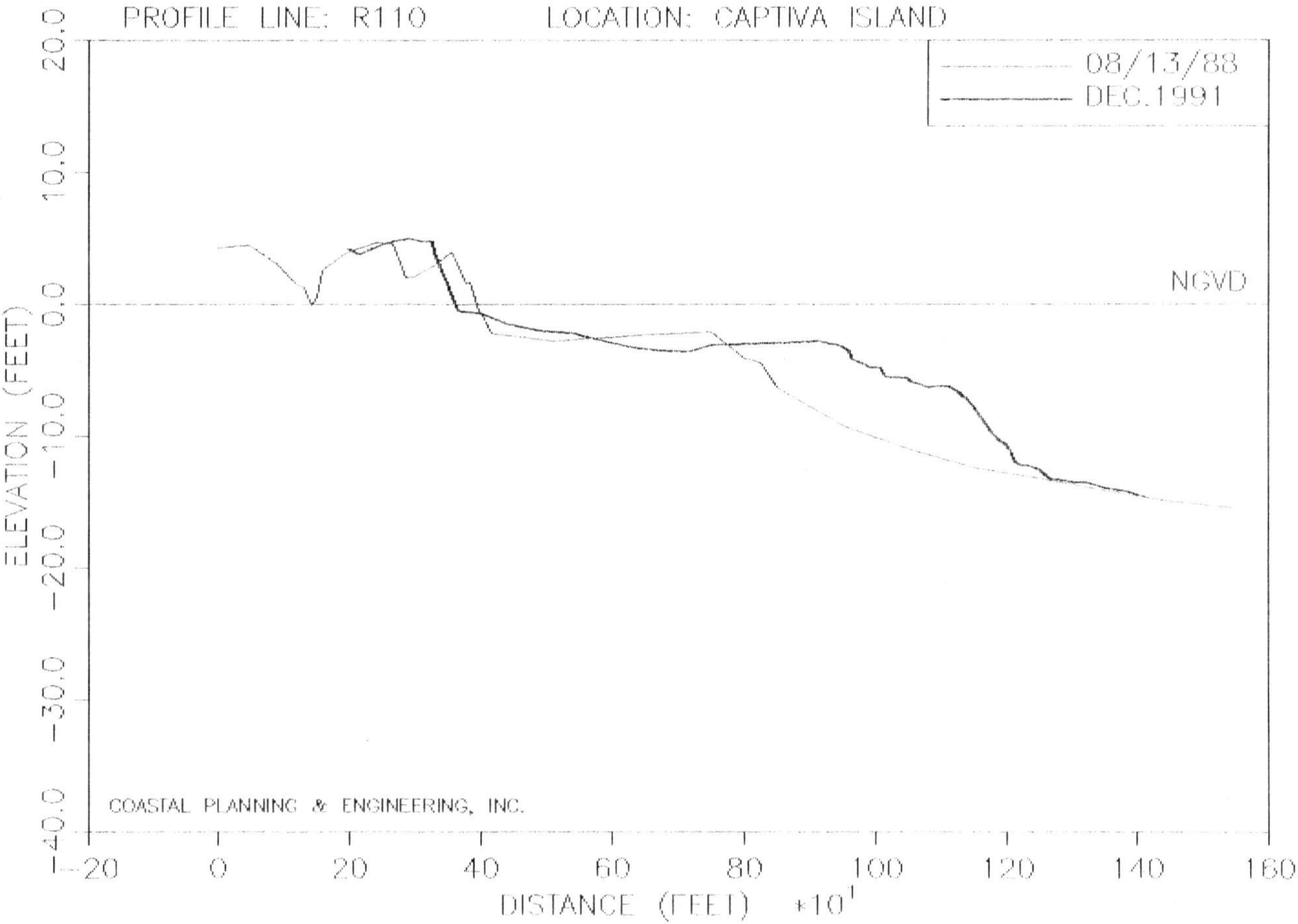
PROFILE LINE: R106
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]



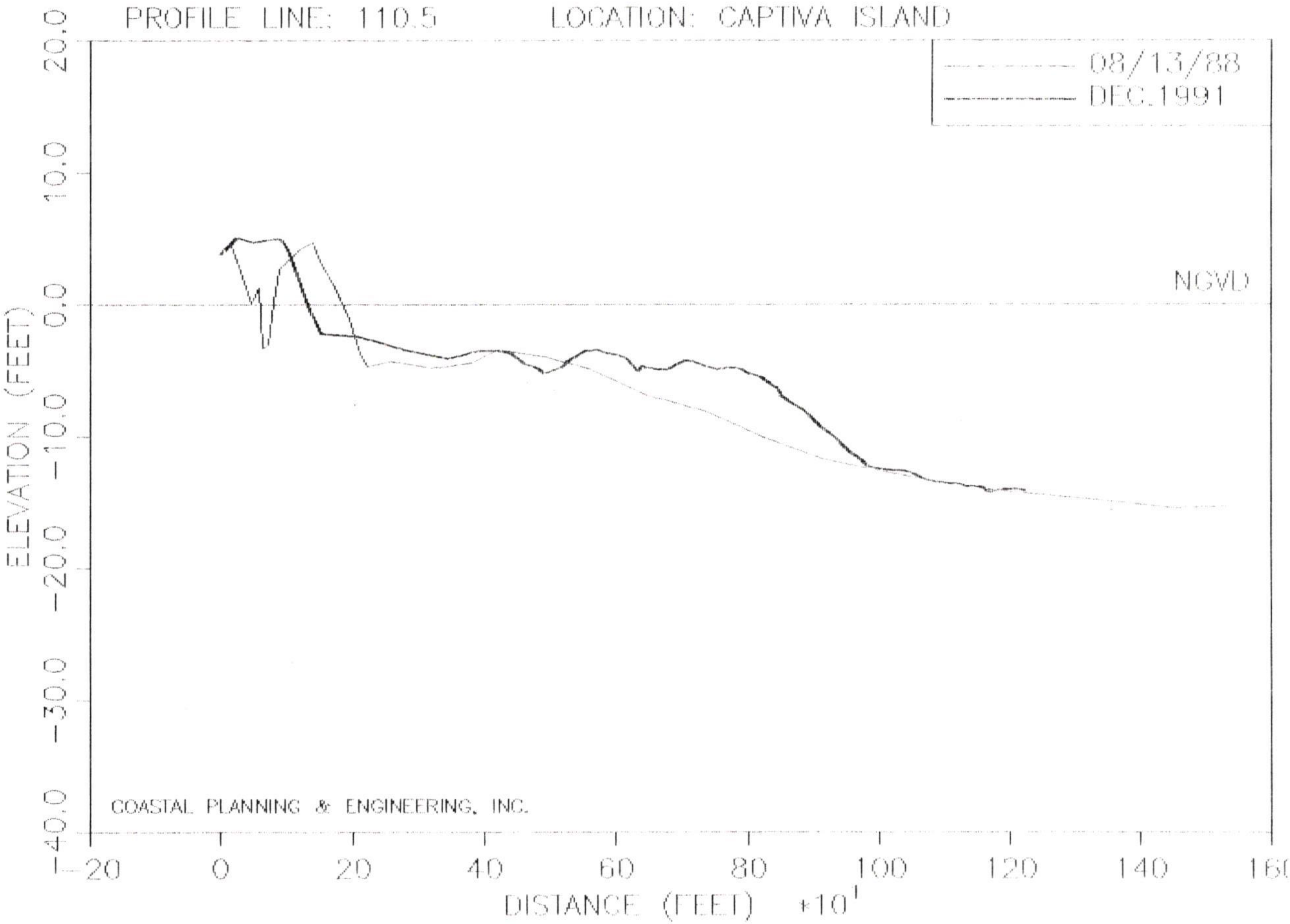
PROFILE LINE: R107
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]


PROFILE LINE: R108
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

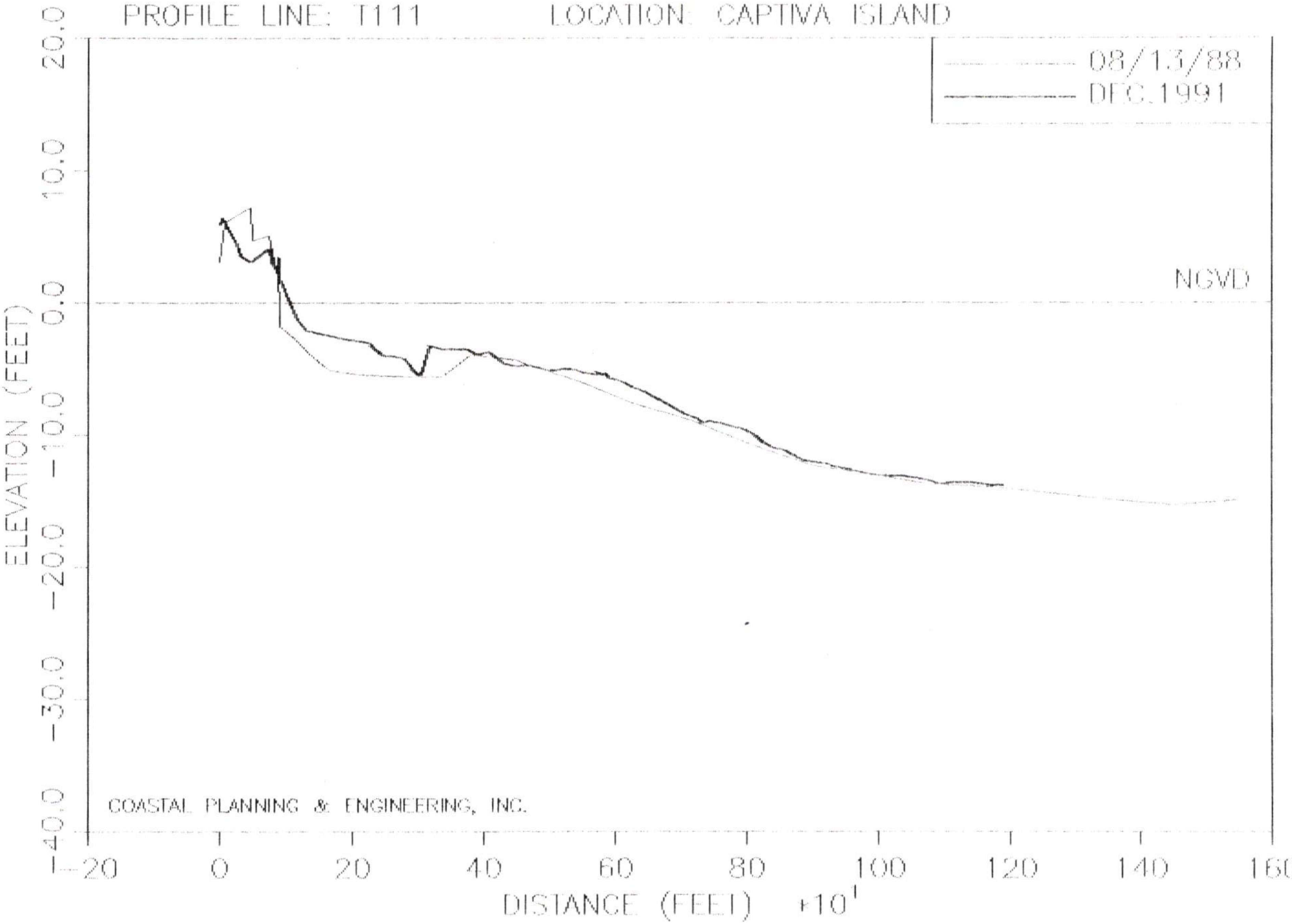

PROFILE LINE: R109
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10^1



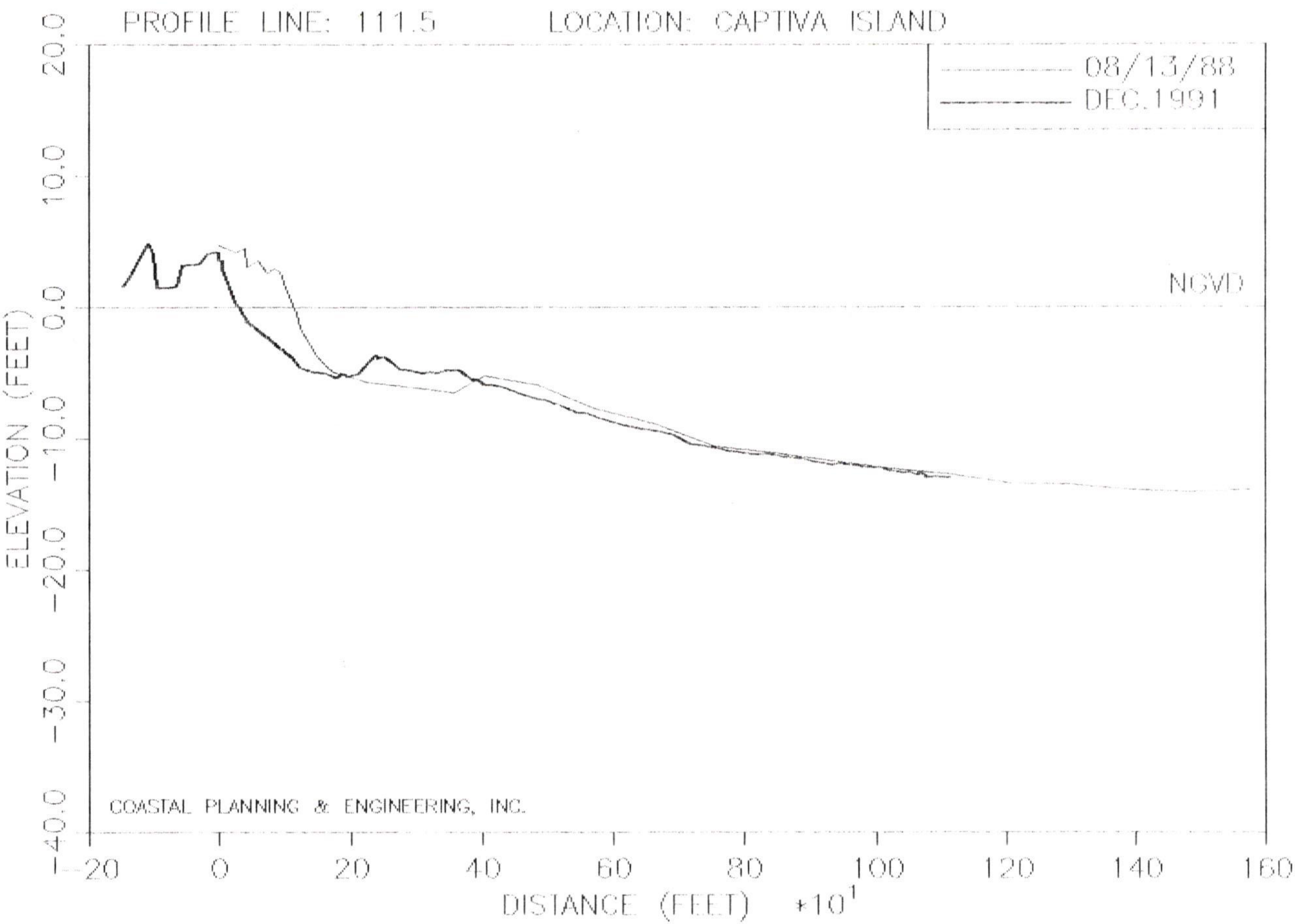
PROFILE LINE: R110
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]
COASTAL PLANNING & ENGINEERING, INC.



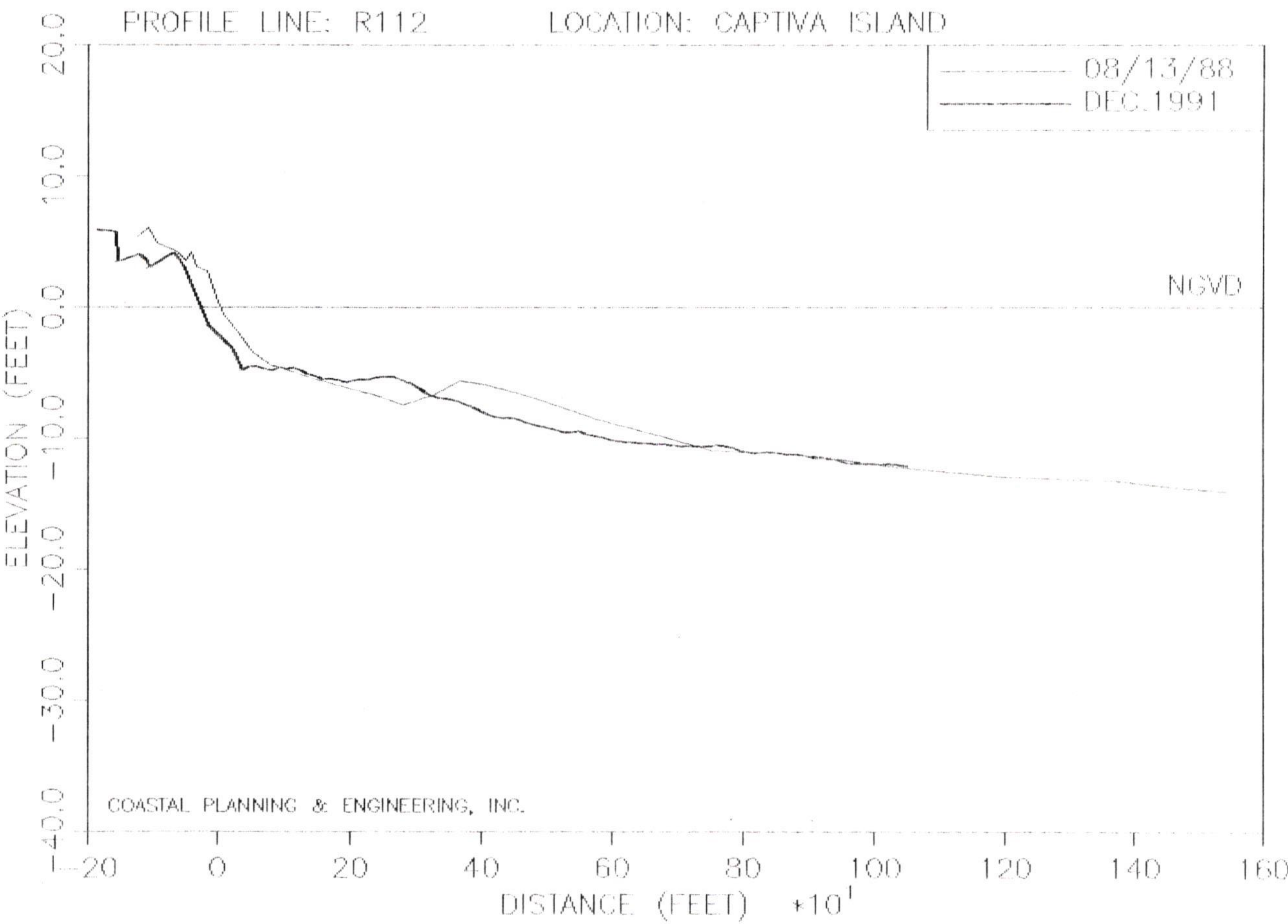
PROFILE LINE: 110.5
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

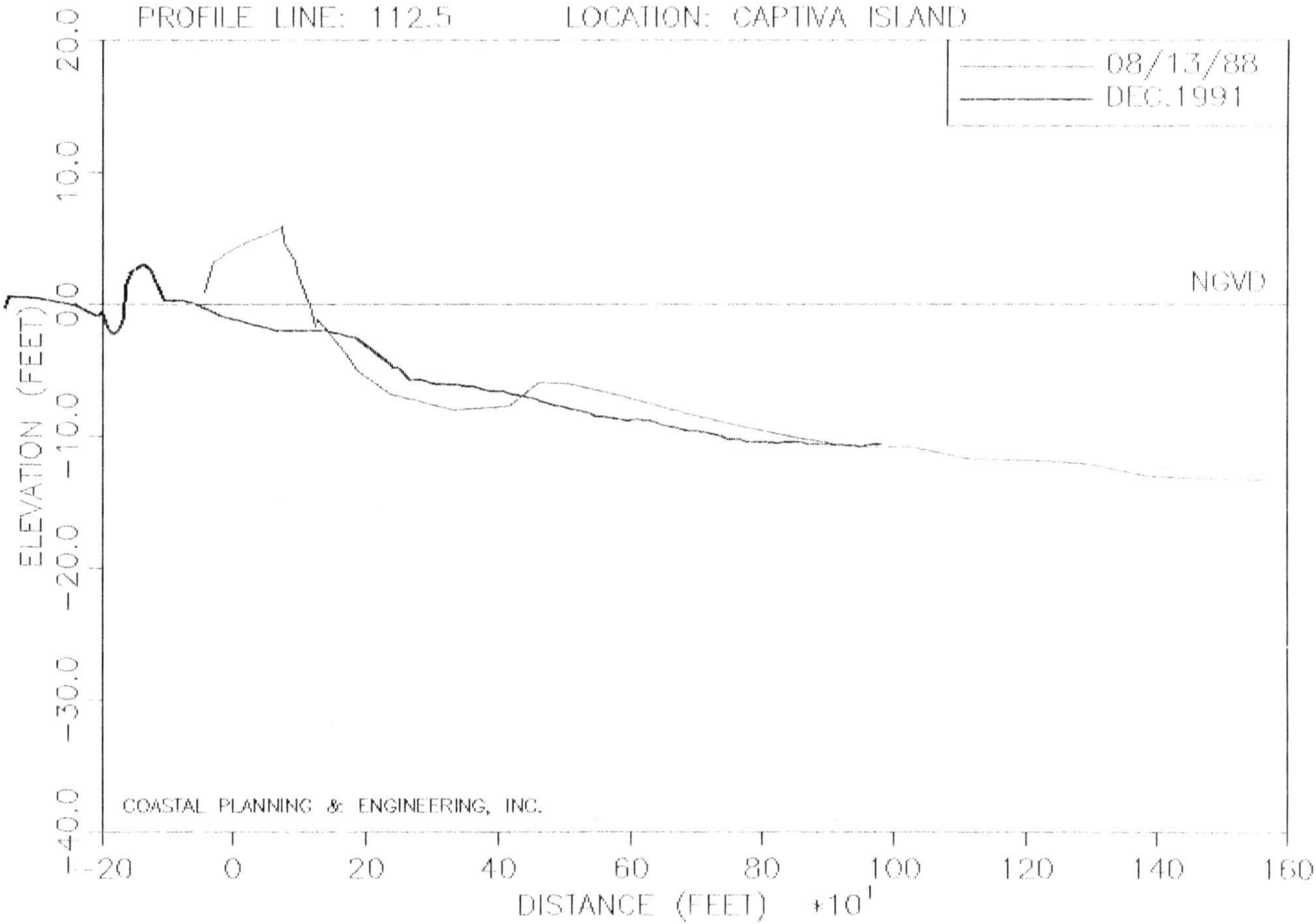


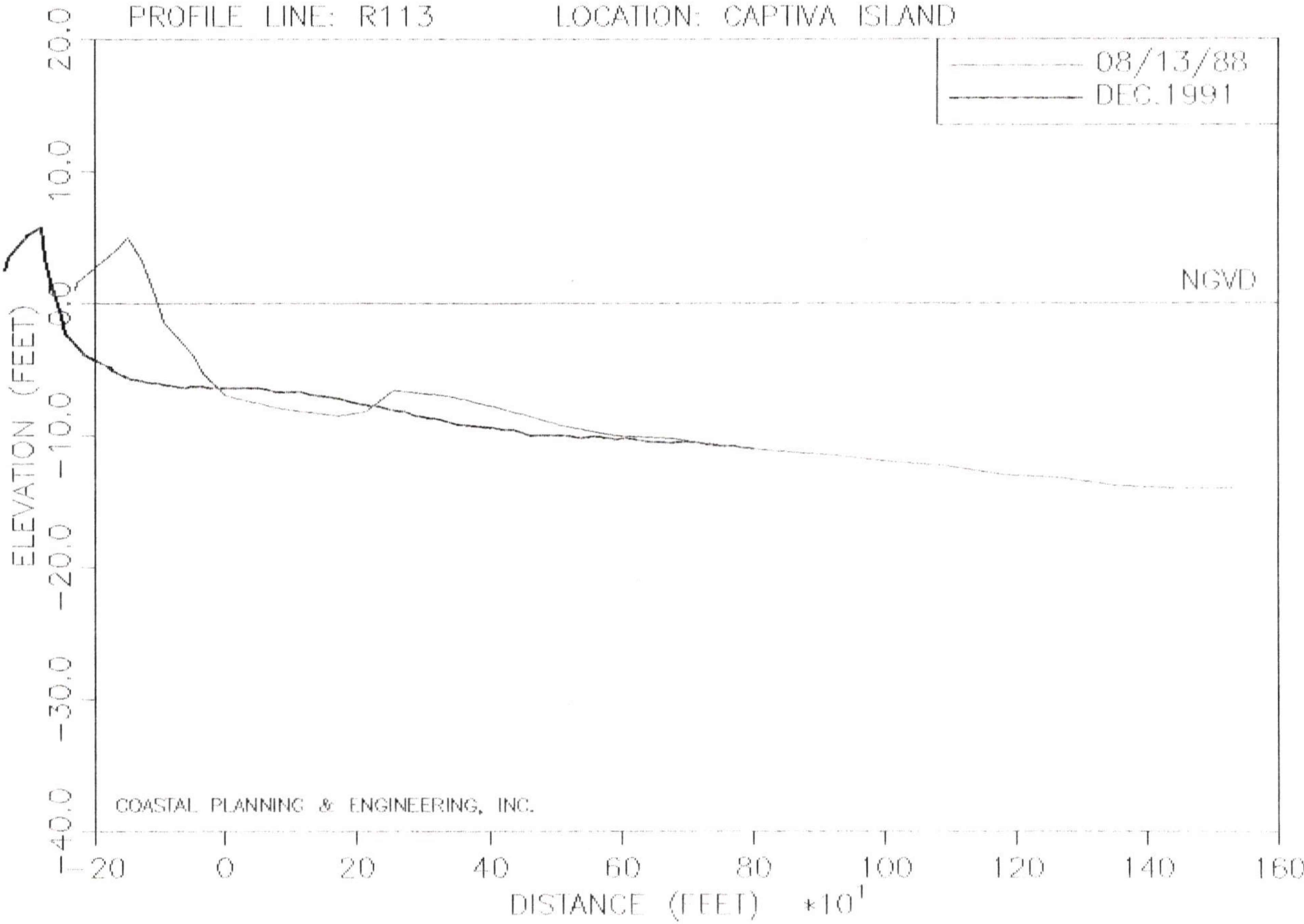
PROFILE LINE: T111
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]



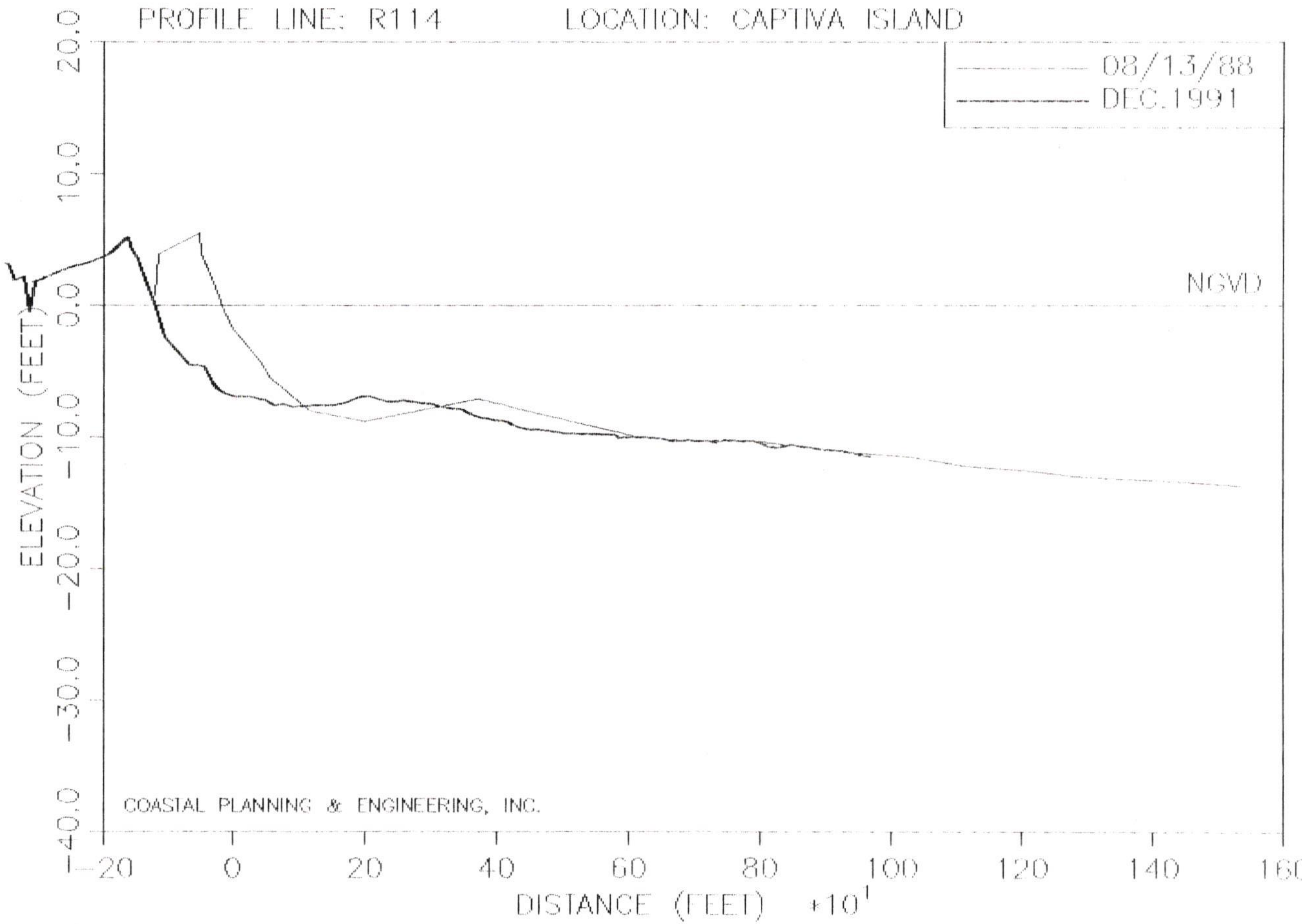
PROFILE LINE: 111.5
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]


PROFILE LINE: R112
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
COASTAL PLANNING & ENGINEERING, INC.
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) $*10^1$

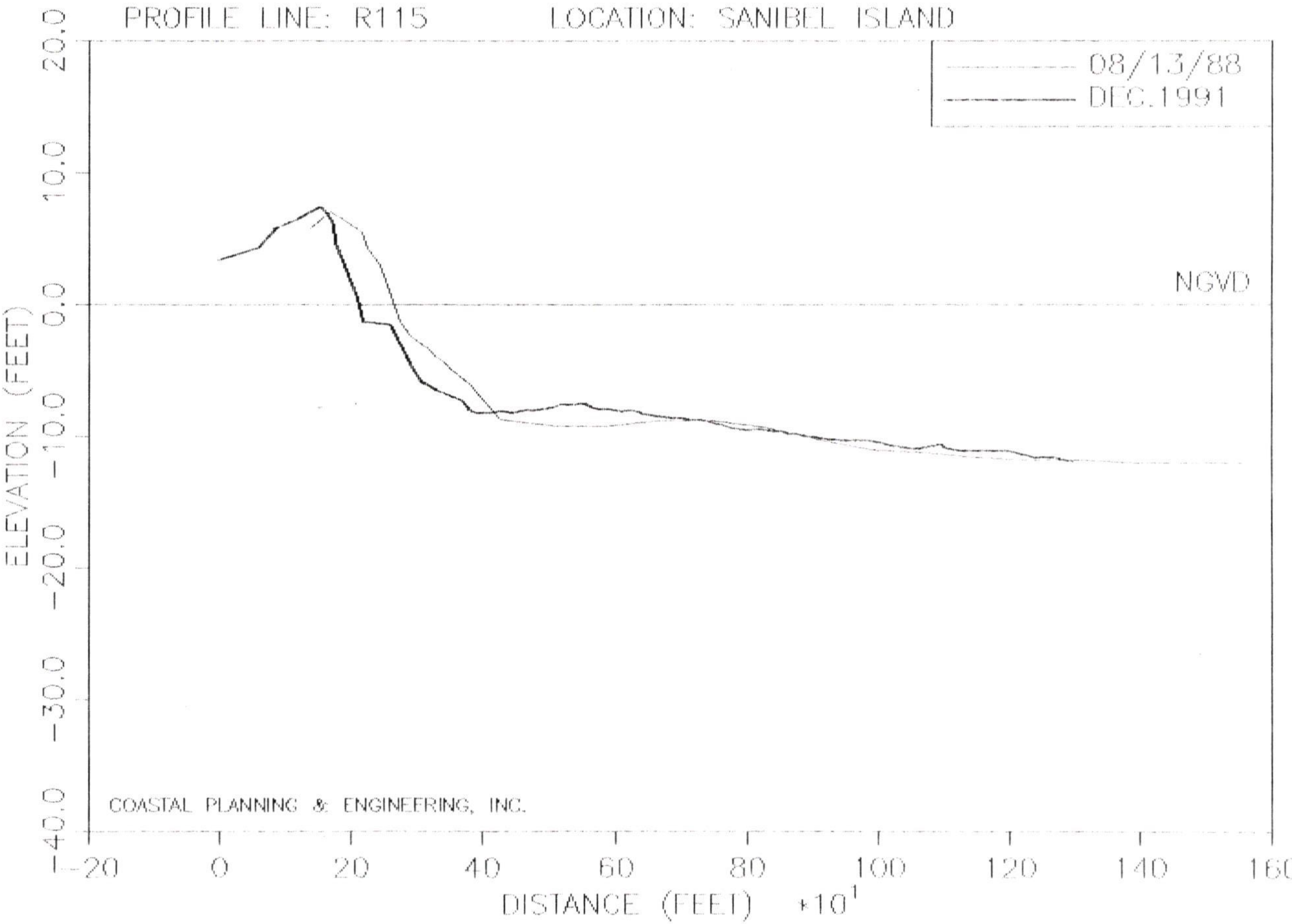

PROFILE LINE: 112.5
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]



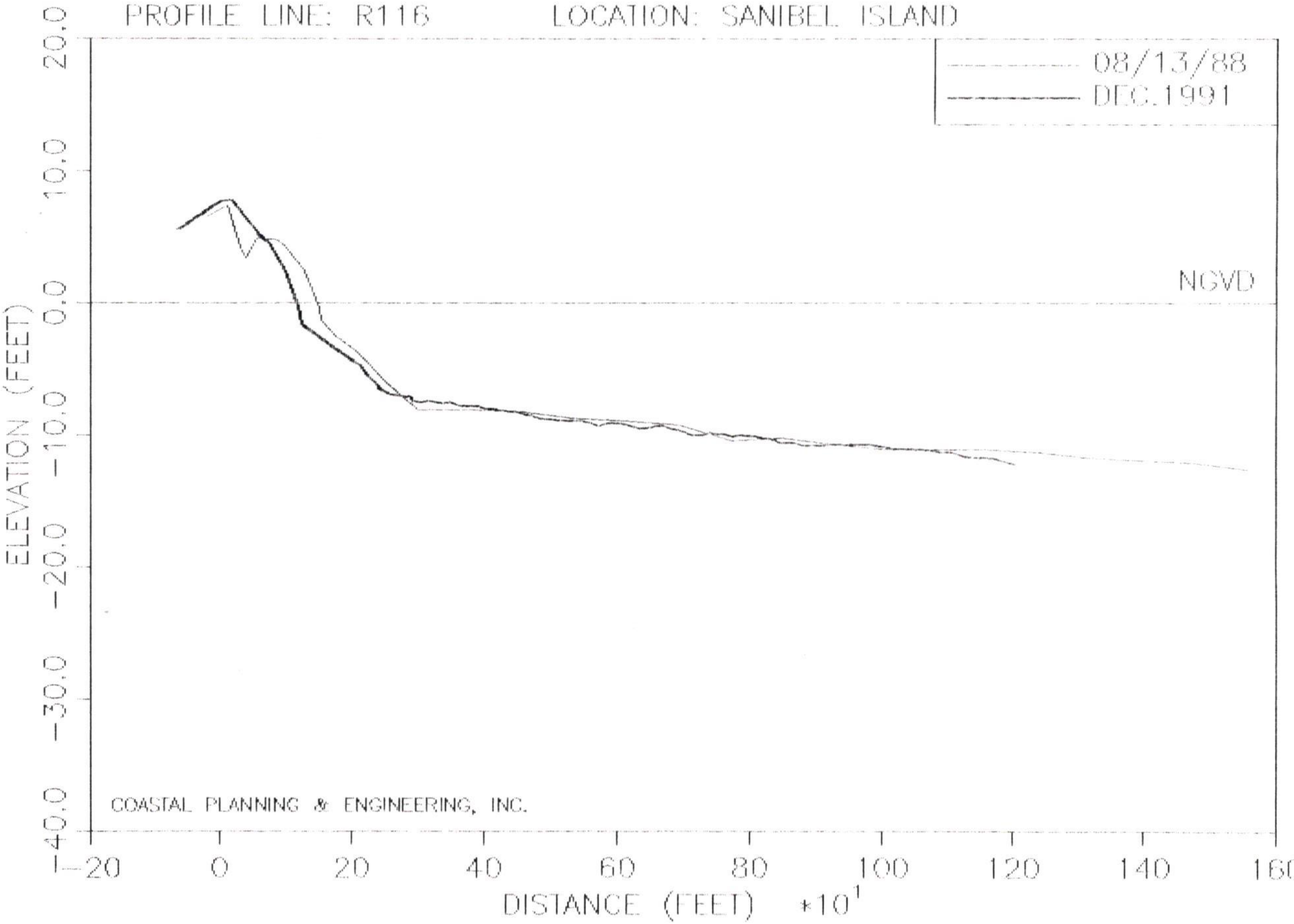
PROFILE LINE: R113
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]



PROFILE LINE: R114
LOCATION: CAPTIVA ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]



PROFILE LINE: R115
LOCATION: SANIBEL ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]



PROFILE LINE: R116
LOCATION: SANIBEL ISLAND
08/13/88
DEC.1991
NGVD
ELEVATION (FEET)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
COASTAL PLANNING & ENGINEERING, INC.
-20
0
20
40
60
80
100
120
140
160
DISTANCE (FEET) *10[1]

APPENDIX C

ENGINEERING ALTERNATIVES
COST ESTIMATES

BLIND PASS (LEE CO.) INLET MANAGEMENT PLAN
ENGINEERING ALTERNATIVES COST ESTIMATE

ALTERNATIVE: A.1. REMOVE THE JETTY

		REMOVAL COSTS	
CONTINGENCY	15%	MOB COST	$50,000
E&D&S&A	10%	10,800 TONS @ $30	$324,000

YEAR	FUTURE WORTH	PRESENT WORTH FACTOR	PRESENT WORTH
1992	$473,110	1.00000	$473,110
1993	$0	0.97087	$0
1994	$0	0.94260	$0
1995	$0	0.91514	$0
1996	$0	0.88849	$0
1997	$0	0.86261	$0
1998	$0	0.83748	$0
1999	$0	0.81309	$0
2000	$0	0.78941	$0
2001	$0	0.76642	$0
2002	$0	0.74409	$0
2003	$0	0.72242	$0
2004	$0	0.70138	$0
2005	$0	0.68095	$0
2006	$0	0.66112	$0
2007	$0	0.64186	$0
2008	$0	0.62317	$0
2009	$0	0.60502	$0
2010	$0	0.58739	$0
2011	$0	0.57029	$0
2012	$0	0.55368	$0
2013	$0	0.53755	$0
2014	$0	0.52189	$0
2015	$0	0.50669	$0
2016	$0	0.49193	$0
2017	$0	0.47761	$0
2018	$0	0.46369	$0
2019	$0	0.45019	$0
2020	$0	0.43708	$0
2021	$0	0.42435	$0
2022	$0	0.41199	$0
2023	$0	0.39999	$0
2024	$0	0.38834	$0
2025	$0	0.37703	$0
2026	$0	0.36604	$0
2027	$0	0.35538	$0
2028	$0	0.34503	$0
2029	$0	0.33498	$0
2030	$0	0.32523	$0
2031	$0	0.31575	$0
2032	$0	0.30656	$0
2033	$0	0.29763	$0
2034	$0	0.28896	$0
2035	$0	0.28054	$0
2036	$0	0.27237	$0
2037	$0	0.26444	$0
2038	$0	0.25674	$0
2039	$0	0.24926	$0
2040	$0	0.24200	$0
2041	$0	0.23495	$0
2042	$0	0.22811	$0

SUM OF PRESENT WORTHS	$473,110
CAPITAL RECOVERY FACTOR	0.03887
AVERAGE ANNUAL VALUE	$18,388

BLIND PASS (LEE CO.) INLET MANAGEMENT PLAN
ENGINEERING ALTERNATIVES COST ESTIMATE

ALTERNATIVE: A.2. REMOVE THE JETTY AND FILL THE INLET

CONTINGENCY	15%	MOB COST	$50,000
E&D&S&A	10%	SAND COST	
		14,000 CY @$5	$70,000
		SHEET PILE WALL	$30,000
		ROCK WORK	
		10,900 TONS @ $50	$545,000

YEAR	FUTURE WORTH	PRESENT WORTH FACTOR	PRESENT WORTH
1992	$879,175	1.00000	$879,175
1993	$0	0.97087	$0
1994	$0	0.94260	$0
1995	$0	0.91514	$0
1996	$0	0.88849	$0
1997	$0	0.86261	$0
1998	$0	0.83748	$0
1999	$0	0.81309	$0
2000	$0	0.78941	$0
2001	$0	0.76642	$0
2002	$0	0.74409	$0
2003	$0	0.72242	$0
2004	$0	0.70138	$0
2005	$0	0.68095	$0
2006	$0	0.66112	$0
2007	$0	0.64186	$0
2008	$0	0.62317	$0
2009	$0	0.60502	$0
2010	$0	0.58739	$0
2011	$0	0.57029	$0
2012	$0	0.55368	$0
2013	$0	0.53755	$0
2014	$0	0.52189	$0
2015	$0	0.50669	$0
2016	$0	0.49193	$0
2017	$0	0.47761	$0
2018	$0	0.46369	$0
2019	$0	0.45019	$0
2020	$0	0.43708	$0
2021	$0	0.42435	$0
2022	$0	0.41199	$0
2023	$0	0.39999	$0
2024	$0	0.38834	$0
2025	$0	0.37703	$0
2026	$0	0.36604	$0
2027	$0	0.35538	$0
2028	$0	0.34503	$0
2029	$0	0.33498	$0
2030	$0	0.32523	$0
2031	$0	0.31575	$0
2032	$0	0.30656	$0
2033	$0	0.29763	$0
2034	$0	0.28896	$0
2035	$0	0.28054	$0
2036	$0	0.27237	$0
2037	$0	0.26444	$0
2038	$0	0.25674	$0
2039	$0	0.24926	$0
2040	$0	0.24200	$0
2041	$0	0.23495	$0
2042	$0	0.22811	$0

SUM OF PRESENT WORTHS	$879,175
CAPITAL RECOVERY FACTOR	0.03887
AVERAGE ANNUAL VALUE	$34,170

BLIND PASS (LEE CO.) INLET MANAGEMENT PLAN
ENGINEERING ALTERNATIVES COST ESTIMATE

ALTERNATIVE:B.1.a. BEACH NOURISHMENT OF NORTHERN SANIBEL

CONTINGENCY	15%	MOBILIZATION	$500,000
E&D&S&A	10%	UNIT COST	$6.00
		FILL VOLUME	320,000
		ADVANCED NOUR	210,000

YEAR	FUTURE WORTH	PRESENT WORTH FACTOR	PRESENT WORTH	FILL VOLUME(CY)
1992	$0	1.00000	$0	0
1993	$4,655,200	0.97087	$4,519,612	530000
1994	$0	0.94260	$0	
1995	$0	0.91514	$0	
1996	$0	0.88849	$0	
1997	$0	0.86261	$0	
1998	$0	0.83748	$0	
1999	$2,226,400	0.81309	$1,810,267	210000
2000	$0	0.78941	$0	
2001	$0	0.76642	$0	
2002	$0	0.74409	$0	
2003	$0	0.72242	$0	
2004	$0	0.70138	$0	
2005	$2,226,400	0.68095	$1,516,070	210000
2006	$0	0.66112	$0	
2007	$0	0.64186	$0	
2008	$0	0.62317	$0	
2009	$0	0.60502	$0	
2010	$0	0.58739	$0	
2011	$2,226,400	0.57029	$1,269,685	210000
2012	$0	0.55368	$0	
2013	$0	0.53755	$0	
2014	$0	0.52189	$0	
2015	$0	0.50669	$0	
2016	$0	0.49193	$0	
2017	$2,226,400	0.47761	$1,063,341	210000
2018	$0	0.46369	$0	
2019	$0	0.45019	$0	
2020	$0	0.43708	$0	
2021	$0	0.42435	$0	
2022	$0	0.41199	$0	
2023	$2,226,400	0.39999	$890,531	210000
2024	$0	0.38834	$0	
2025	$0	0.37703	$0	
2026	$0	0.36604	$0	
2027	$0	0.35538	$0	
2028	$0	0.34503	$0	
2029	$2,226,400	0.33498	$745,806	210000
2030	$0	0.32523	$0	
2031	$0	0.31575	$0	
2032	$0	0.30656	$0	
2033	$0	0.29763	$0	
2034	$0	0.28896	$0	
2035	$2,226,400	0.28054	$624,601	210000
2036	$0	0.27237	$0	
2037	$0	0.26444	$0	
2038	$0	0.25674	$0	
2039	$0	0.24926	$0	
2040	$0	0.24200	$0	
2041	$2,226,400	0.23495	$523,093	210000
2042	$0	0.22811	$0	
SUM OF PRESENT WORTHS			$12,963,006	
CAPITAL RECOVERY FACTOR			0.03887	
AVERAGE ANNUAL VALUE			$503,814	

BLIND PASS (LEE CO.) INLET MANAGEMENT PLAN
ENGINEERING ALTERNATIVES COST ESTIMATE

ALTERNATIVE:B.1.b. BEACH NOURISHMENT
MAINTENANCE ON CAPTIVA ISLAND SCHEDULE

CONTINGENCY	15%	MOBILIZATION	$500,000
E&D&S&A	10%	UNIT COST	$6.00
		FILL GAPS	320,000
		ADVANCED NOUR	210,000

YEAR	FUTURE WORTH	PRESENT WORTH FACTOR	PRESENT WORTH	FILL VOLUME(CY)
1992	$0	1.00000	$0	0
1993	$3,858,250	0.97087	$3,745,874	425000
1994	$0	0.94260	$0	
1995	$0	0.91514	$0	
1996	$1,593,900	0.88849	$1,416,160	210000
1997	$0	0.86261	$0	
1998	$0	0.83748	$0	
1999	$0	0.81309	$0	
2000	$0	0.78941	$0	
2001	$0	0.76642	$0	
2002	$1,593,900	0.74409	$1,186,011	210000
2003	$0	0.72242	$0	
2004	$0	0.70138	$0	
2005	$0	0.68095	$0	
2006	$0	0.66112	$0	
2007	$0	0.64186	$0	
2008	$1,593,900	0.62317	$993,266	210000
2009	$0	0.60502	$0	
2010	$0	0.58739	$0	
2011	$0	0.57029	$0	
2012	$0	0.55368	$0	
2013	$0	0.53755	$0	
2014	$1,593,900	0.52189	$831,844	210000
2015	$0	0.50669	$0	
2016	$0	0.49193	$0	
2017	$0	0.47761	$0	
2018	$0	0.46369	$0	
2019	$0	0.45019	$0	
2020	$1,593,900	0.43708	$696,657	210000
2021	$0	0.42435	$0	
2022	$0	0.41199	$0	
2023	$0	0.39999	$0	
2024	$0	0.38834	$0	
2025	$0	0.37703	$0	
2026	$1,593,900	0.36604	$583,439	210000
2027	$0	0.35538	$0	
2028	$0	0.34503	$0	
2029	$0	0.33498	$0	
2030	$0	0.32523	$0	
2031	$0	0.31575	$0	
2032	$1,593,900	0.30656	$488,621	210000
2033	$0	0.29763	$0	
2034	$0	0.28896	$0	
2035	$0	0.28054	$0	
2036	$0	0.27237	$0	
2037	$0	0.26444	$0	
2038	$1,593,900	0.25674	$409,212	210000
2039	$0	0.24926	$0	
2040	$0	0.24200	$0	
2041	$0	0.23495	$0	
2042	$0	0.22811	$0	

SUM OF PRESENT WORTHS	$10,351,084
CAPITAL RECOVERY FACTOR	0.03887
AVERAGE ANNUAL VALUE	$402,300

BLIND PASS (LEE CO.) INLET MANAGEMENT PLAN
ENGINEERING ALTERNATIVES COST ESTIMATE

ALTERNATIVE:B.2. RESTORE NORTHERN SANBIEL AND STABILIZE WITH GROIN FIELD

CONTINGENCY	15%	UNIT COST	$6.00 /CY
E&D&S&A	10%	MOBILIZATION	$500,000
		GROIN COSTS	
		1,2,3	$1,810,000
		4	$497,000

YEAR	FUTURE WORTH	PRESENT WORTH FACTOR	PRESENT WORTH	FILL VOLUME(CY)
1992	$0	1.00000	$0	
1993	$3,984,750	0.97087	$3,868,689	140000
1994	$0	0.94260	$0	
1995	$0	0.91514	$0	
1996	$0	0.88849	$0	
1997	$628,705	0.86261	$542,326	
1998	$0	0.83748	$0	
1999	$0	0.81309	$0	
2000	$0	0.78941	$0	
2001	$0	0.76642	$0	
2002	$0	0.74409	$0	
2003	$0	0.72242	$0	
2004	$0	0.70138	$0	
2005	$0	0.68095	$0	
2006	$0	0.66112	$0	
2007	$0	0.64186	$0	
2008	$0	0.62317	$0	
2009	$0	0.60502	$0	
2010	$0	0.58739	$0	
2011	$0	0.57029	$0	
2012	$0	0.55368	$0	
2013	$0	0.53755	$0	
2014	$0	0.52189	$0	
2015	$0	0.50669	$0	
2016	$0	0.49193	$0	
2017	$0	0.47761	$0	
2018	$0	0.46369	$0	
2019	$0	0.45019	$0	
2020	$0	0.43708	$0	
2021	$0	0.42435	$0	
2022	$0	0.41199	$0	
2023	$0	0.39999	$0	
2024	$0	0.38834	$0	
2025	$0	0.37703	$0	
2026	$0	0.36604	$0	
2027	$0	0.35538	$0	
2028	$0	0.34503	$0	
2029	$0	0.33498	$0	
2030	$0	0.32523	$0	
2031	$0	0.31575	$0	
2032	$0	0.30656	$0	
2033	$0	0.29763	$0	
2034	$0	0.28896	$0	
2035	$0	0.28054	$0	
2036	$0	0.27237	$0	
2037	$0	0.26444	$0	
2038	$0	0.25674	$0	
2039	$0	0.24926	$0	
2040	$0	0.24200	$0	
2041	$0	0.23495	$0	
2042	$0	0.22811	$0	

SUM OF PRESENT WORTHS	$4,411,016
CAPITAL RECOVERY FACTOR	0.03887
AVERAGE ANNUAL VALUE	$171,436

BLIND PASS (LEE CO.) INLET MANAGEMENT PLAN
ENGINEERING ALTERNATIVES COST ESTIMATE

ALTERNATIVE: B.3. RESTORE NORTHERN SANIBEL, REMOVE JETTY EXTENSION AND PLACE EXTRA FILL ON CAPTIVA ISLAND, AND RENOURISH CAPTIVA AND SANIBEL TOGETHER

CONTINGENCY	15%	MOBILIZATION	$500,000
E&D&S&A	10%	UNIT COST	$6.00
		FILL VOLUME	160,000
EXT. REMOVAL	$375,000	ADVANCED NOUR	210,000

YEAR	FUTURE WORTH	PRESENT WORTH FACTOR	PRESENT WORTH	FILL VOLUME(CY)
1992	$0	1.00000	$0	0
1993	$3,345,925	0.97087	$3,248,471	295000
1994	$0	0.94260	$0	
1995	$0	0.91514	$0	
1996	$2,049,300	0.88849	$1,820,777	270000
1997	$0	0.86261	$0	
1998	$0	0.83748	$0	
1999	$0	0.81309	$0	
2000	$0	0.78941	$0	
2001	$0	0.76642	$0	
2002	$1,821,600	0.74409	$1,355,441	240000
2003	$0	0.72242	$0	
2004	$0	0.70138	$0	
2005	$0	0.68095	$0	
2006	$0	0.66112	$0	
2007	$0	0.64186	$0	
2008	$1,593,900	0.62317	$993,266	210000
2009	$0	0.60502	$0	
2010	$0	0.58739	$0	
2011	$0	0.57029	$0	
2012	$0	0.55368	$0	
2013	$0	0.53755	$0	
2014	$1,593,900	0.52189	$831,844	210000
2015	$0	0.50669	$0	
2016	$0	0.49193	$0	
2017	$0	0.47761	$0	
2018	$0	0.46369	$0	
2019	$0	0.45019	$0	
2020	$1,593,900	0.43708	$696,657	210000
2021	$0	0.42435	$0	
2022	$0	0.41199	$0	
2023	$0	0.39999	$0	
2024	$0	0.38834	$0	
2025	$0	0.37703	$0	
2026	$1,593,900	0.36604	$583,439	210000
2027	$0	0.35538	$0	
2028	$0	0.34503	$0	
2029	$0	0.33498	$0	
2030	$0	0.32523	$0	
2031	$0	0.31575	$0	
2032	$1,593,900	0.30656	$488,621	210000
2033	$0	0.29763	$0	
2034	$0	0.28896	$0	
2035	$0	0.28054	$0	
2036	$0	0.27237	$0	
2037	$0	0.26444	$0	
2038	$1,593,900	0.25674	$409,212	210000
2039	$0	0.24926	$0	
2040	$0	0.24200	$0	
2041	$0	0.23495	$0	
2042	$0	0.22811	$0	

SUM OF PRESENT WORTHS	$10,427,728
CAPITAL RECOVERY FACTOR	0.03887
AVERAGE ANNUAL VALUE	$405,279

BLIND PASS (LEE CO.) INLET MANAGEMENT PLAN
ENGINEERING ALTERNATIVES COST ESTIMATE

ALTERNATIVE: B.5. SOUTH JETTY AND BEACH NOURISHMENT ON NORTHERN SANIBEL

CONTINGENCY	15%	MOBILIZATION	$500,000
E&D&S&A	10%	UNIT COST	$6.00
		FILL VOLUME	320,000
SOUTH JETTY	$1,057,000	ADVANCED NOUR	210,000

YEAR	FUTURE WORTH	PRESENT WORTH FACTOR	PRESENT WORTH	FILL VOLUME (CY)
1992	$0	1.00000	$0	0
1993	$5,195,355	0.97087	$5,044,034	425000
1994	$0	0.94260	$0	
1995	$0	0.91514	$0	
1996	$1,593,900	0.88849	$1,416,160	210000
1997	$0	0.86261	$0	
1998	$0	0.83748	$0	
1999	$0	0.81309	$0	
2000	$0	0.78941	$0	
2001	$0	0.76642	$0	
2002	$1,593,900	0.74409	$1,186,011	210000
2003	$0	0.72242	$0	
2004	$0	0.70138	$0	
2005	$0	0.68095	$0	
2006	$0	0.66112	$0	
2007	$0	0.64186	$0	
2008	$1,593,900	0.62317	$993,266	210000
2009	$0	0.60502	$0	
2010	$0	0.58739	$0	
2011	$0	0.57029	$0	
2012	$0	0.55368	$0	
2013	$0	0.53755	$0	
2014	$1,593,900	0.52189	$831,844	210000
2015	$0	0.50669	$0	
2016	$0	0.49193	$0	
2017	$0	0.47761	$0	
2018	$0	0.46369	$0	
2019	$0	0.45019	$0	
2020	$1,593,900	0.43708	$696,657	210000
2021	$0	0.42435	$0	
2022	$0	0.41199	$0	
2023	$0	0.39999	$0	
2024	$0	0.38834	$0	
2025	$0	0.37703	$0	
2026	$1,593,900	0.36604	$583,439	210000
2027	$0	0.35538	$0	
2028	$0	0.34503	$0	
2029	$0	0.33498	$0	
2030	$0	0.32523	$0	
2031	$0	0.31575	$0	
2032	$1,593,900	0.30656	$488,621	210000
2033	$0	0.29763	$0	
2034	$0	0.28896	$0	
2035	$0	0.28054	$0	
2036	$0	0.27237	$0	
2037	$0	0.26444	$0	
2038	$1,593,900	0.25674	$409,212	210000
2039	$0	0.24926	$0	
2040	$0	0.24200	$0	
2041	$0	0.23495	$0	
2042	$0	0.22811	$0	

SUM OF PRESENT WORTHS	$11,649,244
CAPITAL RECOVERY FACTOR	0.03887
AVERAGE ANNUAL VALUE	$452,754

BLIND PASS (LEE CO.) INLET MANAGEMENT PLAN
ENGINEERING ALTERNATIVES COST ESTIMATE

ALTERNATIVE:B.6. PURCHASE HOMES AND REROUTE ROAD TO THE EAST

CONTINGENCY	15%	HOMES BUYOUT	$2,350,000
E&D&S&A	10%	REROUTE ROAD	$625,000

YEAR	FUTURE WORTH	PRESENT WORTH FACTOR	PRESENT WORTH
1992	$3,493,125	1.00000	$3,493,125
1993	$0	0.97087	$0
1994	$0	0.94260	$0
1995	$0	0.91514	$0
1996	$0	0.88849	$0
1997	$0	0.86261	$0
1998	$0	0.83748	$0
1999	$0	0.81309	$0
2000	$0	0.78941	$0
2001	$0	0.76642	$0
2002	$0	0.74409	$0
2003	$0	0.72242	$0
2004	$0	0.70138	$0
2005	$0	0.68095	$0
2006	$0	0.66112	$0
2007	$0	0.64186	$0
2008	$0	0.62317	$0
2009	$0	0.60502	$0
2010	$0	0.58739	$0
2011	$0	0.57029	$0
2012	$0	0.55368	$0
2013	$0	0.53755	$0
2014	$0	0.52189	$0
2015	$0	0.50669	$0
2016	$0	0.49193	$0
2017	$0	0.47761	$0
2018	$0	0.46369	$0
2019	$0	0.45019	$0
2020	$0	0.43708	$0
2021	$0	0.42435	$0
2022	$0	0.41199	$0
2023	$0	0.39999	$0
2024	$0	0.38834	$0
2025	$0	0.37703	$0
2026	$0	0.36604	$0
2027	$0	0.35538	$0
2028	$0	0.34503	$0
2029	$0	0.33498	$0
2030	$0	0.32523	$0
2031	$0	0.31575	$0
2032	$0	0.30656	$0
2033	$0	0.29763	$0
2034	$0	0.28896	$0
2035	$0	0.28054	$0
2036	$0	0.27237	$0
2037	$0	0.26444	$0
2038	$0	0.25674	$0
2039	$0	0.24926	$0
2040	$0	0.24200	$0
2041	$0	0.23495	$0
2042	$0	0.22811	$0

SUM OF PRESENT WORTHS	$3,493,125
CAPITAL RECOVERY FACTOR	0.03887
AVERAGE ANNUAL VALUE	$135,762

BLIND PASS (LEE CO.) INLET MANAGEMENT PLAN
ENGINEERING ALTERNATIVES COST ESTIMATE

ALTERNATIVE:B.7. PURCHASE HOMES AND REVET ROAD

CONTINGENCY	15%	HOMES BUYOUT	$2,350,000
E&D&S&A	10%	REVETMENT	$800,000

YEAR	FUTURE WORTH	PRESENT WORTH FACTOR	PRESENT WORTH
1992	$3,714,500	1.00000	$3,714,500
1993	$0	0.97087	$0
1994	$0	0.94260	$0
1995	$0	0.91514	$0
1996	$0	0.88849	$0
1997	$126,500	0.86261	$109,120
1998	$0	0.83748	$0
1999	$0	0.81309	$0
2000	$0	0.78941	$0
2001	$0	0.76642	$0
2002	$126,500	0.74409	$94,128
2003	$0	0.72242	$0
2004	$0	0.70138	$0
2005	$0	0.68095	$0
2006	$0	0.66112	$0
2007	$0	0.64186	$0
2008	$0	0.62317	$0
2009	$0	0.60502	$0
2010	$0	0.58739	$0
2011	$0	0.57029	$0
2012	$0	0.55368	$0
2013	$0	0.53755	$0
2014	$0	0.52189	$0
2015	$0	0.50669	$0
2016	$0	0.49193	$0
2017	$0	0.47761	$0
2018	$0	0.46369	$0
2019	$0	0.45019	$0
2020	$0	0.43708	$0
2021	$0	0.42435	$0
2022	$0	0.41199	$0
2023	$0	0.39999	$0
2024	$0	0.38834	$0
2025	$0	0.37703	$0
2026	$0	0.36604	$0
2027	$0	0.35538	$0
2028	$0	0.34503	$0
2029	$0	0.33498	$0
2030	$0	0.32523	$0
2031	$0	0.31575	$0
2032	$0	0.30656	$0
2033	$0	0.29763	$0
2034	$0	0.28896	$0
2035	$0	0.28054	$0
2036	$0	0.27237	$0
2037	$0	0.26444	$0
2038	$0	0.25674	$0
2039	$0	0.24926	$0
2040	$0	0.24200	$0
2041	$0	0.23495	$0
2042	$0	0.22811	$0

SUM OF PRESENT WORTHS	$3,917,748
CAPITAL RECOVERY FACTOR	0.03887
AVERAGE ANNUAL VALUE	$152,265

BLIND PASS(LEE CO.) INLET MANAGEMENT PLAN
ENGINEERING ALTERNATIVES COST ESTIMATE

ALTERNATIVE:B.8. DREDGE FLOOD SHOAL

CONTINGENCY	15%	MOBILIZATION	$150,000
E&D&S&A	10%	UNIT COST	$2.50

YEAR	FUTURE WORTH	PRESENT WORTH FACTOR	PRESENT WORTH	FILL VOLUME(CY)
1992	$0	1.00000	$0	0
1993	$379,500	0.97087	$368,447	60000
1994	$0	0.94260	$0	
1995	$0	0.91514	$0	
1996	$0	0.88849	$0	
1997	$0	0.86261	$0	
1998	$0	0.83748	$0	
1999	$0	0.81309	$0	
2000	$0	0.78941	$0	
2001	$0	0.76642	$0	
2002	$0	0.74409	$0	
2003	$0	0.72242	$0	
2004	$0	0.70138	$0	
2005	$0	0.68095	$0	
2006	$0	0.66112	$0	
2007	$0	0.64186	$0	
2008	$0	0.62317	$0	
2009	$0	0.60502	$0	
2010	$0	0.58739	$0	
2011	$0	0.57029	$0	
2012	$0	0.55368	$0	
2013	$0	0.53755	$0	
2014	$0	0.52189	$0	
2015	$0	0.50669	$0	
2016	$0	0.49193	$0	
2017	$0	0.47761	$0	
2018	$0	0.46369	$0	
2019	$0	0.45019	$0	
2020	$0	0.43708	$0	
2021	$0	0.42435	$0	
2022	$0	0.41199	$0	
2023	$379,500	0.39999	$151,795	60000
2024	$0	0.38834	$0	
2025	$0	0.37703	$0	
2026	$0	0.36604	$0	
2027	$0	0.35538	$0	
2028	$0	0.34503	$0	
2029	$0	0.33498	$0	
2030	$0	0.32523	$0	
2031	$0	0.31575	$0	
2032	$0	0.30656	$0	
2033	$0	0.29763	$0	
2034	$0	0.28896	$0	
2035	$0	0.28054	$0	
2036	$0	0.27237	$0	
2037	$0	0.26444	$0	
2038	$0	0.25674	$0	
2039	$0	0.24926	$0	
2040	$0	0.24200	$0	
2041	$0	0.23495	$0	
2042	$0	0.22811	$0	

SUM OF PRESENT WORTHS	$520,242
CAPITAL RECOVERY FACTOR	0.03887
AVERAGE ANNUAL VALUE	$20,219

BLIND PASS (LEE CO.) INLET MANAGEMENT PLAN
ENGINEERING ALTERNATIVES COST ESTIMATE

ALTERNATIVE:B.10. COUNTY BUILDS 800' REVETMENT, MAINTAIN BEACH ON NORTH SANIBEL, RENOURISH WITH CAPTIVA PROJECT

CONTINGENCY	15%	MOBILIZATION	$500,000
E&D&S&A	10%	UNIT COST	$6.00

YEAR	FUTURE WORTH	PRESENT WORTH FACTOR	PRESENT WORTH	FILL VOLUME(CY)
1992	$1,012,000	1.00000	$1,012,000	
1993	$1,657,150	0.97087	$1,608,883	135000
1994	$0	0.94260	$0	
1995	$0	0.91514	$0	
1996	$2,049,300	0.88849	$1,820,777	270000
1997	$0	0.86261	$0	
1998	$0	0.83748	$0	
1999	$0	0.81309	$0	
2000	$0	0.78941	$0	
2001	$0	0.76642	$0	
2002	$1,821,600	0.74409	$1,355,441	240000
2003	$0	0.72242	$0	
2004	$0	0.70138	$0	
2005	$0	0.68095	$0	
2006	$0	0.66112	$0	
2007	$0	0.64186	$0	
2008	$1,593,900	0.62317	$993,266	210000
2009	$0	0.60502	$0	
2010	$0	0.58739	$0	
2011	$0	0.57029	$0	
2012	$0	0.55368	$0	
2013	$0	0.53755	$0	
2014	$1,593,900	0.52189	$831,844	210000
2015	$0	0.50669	$0	
2016	$0	0.49193	$0	
2017	$0	0.47761	$0	
2018	$0	0.46369	$0	
2019	$0	0.45019	$0	
2020	$1,593,900	0.43708	$696,657	210000
2021	$0	0.42435	$0	
2022	$0	0.41199	$0	
2023	$0	0.39999	$0	
2024	$0	0.38834	$0	
2025	$0	0.37703	$0	
2026	$1,593,900	0.36604	$583,439	210000
2027	$0	0.35538	$0	
2028	$0	0.34503	$0	
2029	$0	0.33498	$0	
2030	$0	0.32523	$0	
2031	$0	0.31575	$0	
2032	$1,593,900	0.30656	$488,621	210000
2033	$0	0.29763	$0	
2034	$0	0.28896	$0	
2035	$0	0.28054	$0	
2036	$0	0.27237	$0	
2037	$0	0.26444	$0	
2038	$1,593,900	0.25674	$409,212	210000
2039	$0	0.24926	$0	
2040	$0	0.24200	$0	
2041	$0	0.23495	$0	
2042	$0	0.22811	$0	

SUM OF PRESENT WORTHS	$9,800,141
CAPITAL RECOVERY FACTOR	0.03887
AVERAGE ANNUAL VALUE	$380,887

BLIND PASS(LEE CO.) INLET MANAGEMENT PLAN
ENGINEERING ALTERNATIVES COST ESTIMATE

ALTERNATIVE:B.11. BEACH NOURISHMENT AND SEGMENTED OFFSHORE BREAKWATER

CONTINGENCY	15%	SAND UNIT	$6.00	/CY
E&D&S&A	10%	MOBILIZATION	$500,000	
		BREAKWATER COSTS		
		1000 FT. @ $3,100/FT.	$3,100,000	

YEAR	FUTURE WORTH	PRESENT WORTH FACTOR	PRESENT WORTH	FILL VOLUME(CY)
1992	$0	1.00000	$0	
1993	$5,768,400	0.97087	$5,600,388	160000
1994	$0	0.94260	$0	
1995	$0	0.91514	$0	
1996	$0	0.88849	$0	
1997	$0	0.86261	$0	
1998	$0	0.83748	$0	
1999	$0	0.81309	$0	
2000	$0	0.78941	$0	
2001	$0	0.76642	$0	
2002	$0	0.74409	$0	
2003	$0	0.72242	$0	
2004	$0	0.70138	$0	
2005	$0	0.68095	$0	
2006	$0	0.66112	$0	
2007	$0	0.64186	$0	
2008	$0	0.62317	$0	
2009	$0	0.60502	$0	
2010	$0	0.58739	$0	
2011	$0	0.57029	$0	
2012	$0	0.55368	$0	
2013	$0	0.53755	$0	
2014	$0	0.52189	$0	
2015	$0	0.50669	$0	
2016	$0	0.49193	$0	
2017	$0	0.47761	$0	
2018	$0	0.46369	$0	
2019	$0	0.45019	$0	
2020	$0	0.43708	$0	
2021	$0	0.42435	$0	
2022	$0	0.41199	$0	
2023	$0	0.39999	$0	
2024	$0	0.38834	$0	
2025	$0	0.37703	$0	
2026	$0	0.36604	$0	
2027	$0	0.35538	$0	
2028	$0	0.34503	$0	
2029	$0	0.33498	$0	
2030	$0	0.32523	$0	
2031	$0	0.31575	$0	
2032	$0	0.30656	$0	
2033	$0	0.29763	$0	
2034	$0	0.28896	$0	
2035	$0	0.28054	$0	
2036	$0	0.27237	$0	
2037	$0	0.26444	$0	
2038	$0	0.25674	$0	
2039	$0	0.24926	$0	
2040	$0	0.24200	$0	
2041	$0	0.23495	$0	
2042	$0	0.22811	$0	

SUM OF PRESENT WORTHS	$5,600,388
CAPITAL RECOVERY FACTOR	0.03887
AVERAGE ANNUAL VALUE	$217,662

BLIND PASS (LEE CO.) INLET MANAGEMENT PLAN
ENGINEERING ALTERNATIVES COST ESTIMATE

ALTERNATIVE:C.1. MOBILE JET PUMP SAND TRANSFER SYSTEM

CONTINGENCY	15%	MOBILIZATION	$500,000
E&D&S&A	10%	UNIT COST	$6.00

YEAR	FUTURE WORTH	PRESENT WORTH FACTOR	PRESENT WORTH	SAND VOLUMES (CY)
1992	$934,000	1.00000	$934,000	
1993	$3,101,550	0.97087	$3,011,214	295000
1994	$230,000	0.94260	$216,797	
1995	$230,000	0.91514	$210,483	
1996	$2,279,300	0.88849	$2,025,129	270000
1997	$230,000	0.86261	$198,400	
1998	$230,000	0.83748	$192,621	
1999	$230,000	0.81309	$187,011	
2000	$230,000	0.78941	$181,564	
2001	$230,000	0.76642	$176,276	
2002	$2,051,600	0.74409	$1,526,583	240000
2003	$230,000	0.72242	$166,157	
2004	$230,000	0.70138	$161,317	
2005	$230,000	0.68095	$156,619	
2006	$230,000	0.66112	$152,057	
2007	$230,000	0.64186	$147,628	
2008	$1,823,900	0.62317	$1,136,594	210000
2009	$230,000	0.60502	$139,154	
2010	$230,000	0.58739	$135,101	
2011	$230,000	0.57029	$131,166	
2012	$230,000	0.55368	$127,345	
2013	$230,000	0.53755	$123,636	
2014	$1,823,900	0.52189	$951,880	210000
2015	$230,000	0.50669	$116,539	
2016	$230,000	0.49193	$113,145	
2017	$230,000	0.47761	$109,849	
2018	$230,000	0.46369	$106,650	
2019	$230,000	0.45019	$103,543	
2020	$1,823,900	0.43708	$797,184	210000
2021	$230,000	0.42435	$97,600	
2022	$230,000	0.41199	$94,757	
2023	$230,000	0.39999	$91,997	
2024	$230,000	0.38834	$89,318	
2025	$230,000	0.37703	$86,716	
2026	$1,823,900	0.36604	$667,629	210000
2027	$230,000	0.35538	$81,738	
2028	$230,000	0.34503	$79,357	
2029	$230,000	0.33498	$77,046	
2030	$230,000	0.32523	$74,802	
2031	$230,000	0.31575	$72,623	
2032	$1,823,900	0.30656	$559,129	210000
2033	$230,000	0.29763	$68,454	
2034	$230,000	0.28896	$66,461	
2035	$230,000	0.28054	$64,525	
2036	$230,000	0.27237	$62,646	
2037	$230,000	0.26444	$60,821	
2038	$1,823,900	0.25674	$468,262	210000
2039	$230,000	0.24926	$57,330	
2040	$230,000	0.24200	$55,660	
2041	$230,000	0.23495	$54,039	
2042	$230,000	0.22811	$52,465	

SUM OF PRESENT WORTHS	$16,819,015
CAPITAL RECOVERY FACTOR	0.03887
AVERAGE ANNUAL VALUE	$653,679

BLIND PASS MOBILE JETPUMP SAND TRANSFER SYSTEM

ITEM	QUANTITY	UNIT	UNIT PRICE	COST IN $1000
MOB.DEMOB	1	JOB	$80,000	$80
CRANE	1	EA	$75,000	$75
JET PUMP	2	EA	$10,000	$20
CLEAR WATER PUMP				
JET PUMP(270 hp)	1	EA	$47,500	$48
SLURRY PUMP(270 hp)	1	EA	$58,400	$58
POWERLINE	1	JOB	$40,000	$40
VALVING & CONTROLS	1	JOB	$50,000	$50
OPERATION BUILDING 1000 SF	1	JOB	$100,000	$100
PIPE				
STEEL 3/4" WALLS				
12" INTAKE & MISC.	500	L.F.	$60	$30
FLEXIBLE(12 inch)	1,000	L.F.	$90	$90
HD PE(14" 110 psi)	2,200	L.F.	$27	$59
SUBTOTAL				$650
CONTINGENCIES (25%)				$162
TOTAL CONSTRUCTION				$812
E&D. S&A (15%)				$122
TOTAL COST				$934

BLIND PASS (LEE CO.) MANAGEMENT PLAN
ENGINEERING ALTERNATIVES COST ESTIMATE

ALTERNATIVE:C.2. JET PUMP WITH FLUIDIZER

CONTINGENCY	15%	EQUIPMENT	$1,067,000
E&D&S&A	10%	OPER. & MAINT	$200,000 ($/YR)
		UNIT COST	$6.00
		MOBILIZATION	$500,000

YEAR	FUTURE WORTH	PRESENT WORTH FACTOR	PRESENT WORTH	FILL VOLUME(CY)
1992	$1,267,000	1.00000	$1,267,000	
1993	$1,811,250	0.97087	$1,758,495	125000
1994	$230,000	0.94260	$216,797	
1995	$230,000	0.91514	$210,483	
1996	$2,279,300	0.88849	$2,025,129	270000
1997	$230,000	0.86261	$198,400	
1998	$230,000	0.83748	$192,621	
1999	$230,000	0.81309	$187,011	
2000	$230,000	0.78941	$181,564	
2001	$230,000	0.76642	$176,276	
2002	$2,051,600	0.74409	$1,526,583	240000
2003	$230,000	0.72242	$166,157	
2004	$230,000	0.70138	$161,317	
2005	$230,000	0.68095	$156,619	
2006	$230,000	0.66112	$152,057	
2007	$230,000	0.64186	$147,628	
2008	$1,823,900	0.62317	$1,136,594	210000
2009	$230,000	0.60502	$139,154	
2010	$230,000	0.58739	$135,101	
2011	$230,000	0.57029	$131,166	
2012	$230,000	0.55368	$127,345	
2013	$230,000	0.53755	$123,636	
2014	$1,823,900	0.52189	$951,880	210000
2015	$230,000	0.50669	$116,539	
2016	$230,000	0.49193	$113,145	
2017	$230,000	0.47761	$109,849	
2018	$230,000	0.46369	$106,650	
2019	$230,000	0.45019	$103,543	
2020	$1,823,900	0.43708	$797,184	210000
2021	$230,000	0.42435	$97,600	
2022	$230,000	0.41199	$94,757	
2023	$230,000	0.39999	$91,997	
2024	$230,000	0.38834	$89,318	
2025	$230,000	0.37703	$86,716	
2026	$1,823,900	0.36604	$667,629	210000
2027	$230,000	0.35538	$81,738	
2028	$230,000	0.34503	$79,357	
2029	$230,000	0.33498	$77,046	
2030	$230,000	0.32523	$74,802	
2031	$230,000	0.31575	$72,623	
2032	$1,823,900	0.30656	$559,129	210000
2033	$230,000	0.29763	$68,454	
2034	$230,000	0.28896	$66,461	
2035	$230,000	0.28054	$64,525	
2036	$230,000	0.27237	$62,646	
2037	$230,000	0.26444	$60,821	
2038	$1,823,900	0.25674	$468,262	210000
2039	$230,000	0.24926	$57,330	
2040	$230,000	0.24200	$55,660	
2041	$230,000	0.23495	$54,039	
2042	$230,000	0.22811	$52,465	

SUM OF PRESENT WORTHS	$15,899,297
CAPITAL RECOVERY FACTOR	0.0389
AVERAGE ANNUAL VALUE	$617,934

BLIND PASS (LEE CO.) INLET MANAGEMENT PLAN
ENGINEERING ALTERNATIVES COST ESTIMATE

ALTERNATIVE: C.3. RESTORE NORTHERN SANIBEL, MAINTAIN WITH DEWATERING SYSTEM

CONTINGENCY	15%	UNIT COST	$6.00 /CY
E&D&S&A	10%	MOBILIZATION	$500,000
		DEWATERING SYSTEM	
		$400 PER FOOT	$720,000
		MAINT & POWER/YR.	$22,500

YEAR	FUTURE WORTH	PRESENT WORTH FACTOR	PRESENT WORTH	INITIAL VOLUME
1992	$2,786,163	1.00000	$2,786,163	160000
1993	$25,875	0.97087	$25,121	
1994	$25,875	0.94260	$24,390	
1995	$25,875	0.91514	$23,679	
1996	$25,875	0.88849	$22,990	
1997	$25,875	0.86261	$22,320	
1998	$25,875	0.83748	$21,670	
1999	$25,875	0.81309	$21,039	
2000	$25,875	0.78941	$20,426	
2001	$25,875	0.76642	$19,831	
2002	$25,875	0.74409	$19,253	
2003	$25,875	0.72242	$18,693	
2004	$25,875	0.70138	$18,148	
2005	$25,875	0.68095	$17,620	
2006	$25,875	0.66112	$17,106	
2007	$25,875	0.64186	$16,608	
2008	$25,875	0.62317	$16,124	
2009	$25,875	0.60502	$15,655	
2010	$25,875	0.58739	$15,199	
2011	$25,875	0.57029	$14,756	
2012	$25,875	0.55368	$14,326	
2013	$25,875	0.53755	$13,909	
2014	$25,875	0.52189	$13,504	
2015	$25,875	0.50669	$13,111	
2016	$25,875	0.49193	$12,729	
2017	$25,875	0.47761	$12,358	
2018	$25,875	0.46369	$11,998	
2019	$25,875	0.45019	$11,649	
2020	$25,875	0.43708	$11,309	
2021	$25,875	0.42435	$10,980	
2022	$25,875	0.41199	$10,660	
2023	$25,875	0.39999	$10,350	
2024	$25,875	0.38834	$10,048	
2025	$25,875	0.37703	$9,756	
2026	$25,875	0.36604	$9,471	
2027	$25,875	0.35538	$9,196	
2028	$25,875	0.34503	$8,928	
2029	$25,875	0.33498	$8,668	
2030	$25,875	0.32523	$8,415	
2031	$25,875	0.31575	$8,170	
2032	$25,875	0.30656	$7,932	
2033	$25,875	0.29763	$7,701	
2034	$25,875	0.28896	$7,477	
2035	$25,875	0.28054	$7,259	
2036	$25,875	0.27237	$7,048	
2037	$25,875	0.26444	$6,842	
2038	$25,875	0.25674	$6,643	
2039	$25,875	0.24926	$6,450	
2040	$25,875	0.24200	$6,262	
2041	$25,875	0.23495	$6,079	
2042	$25,875	0.22811	$5,902	

SUM OF PRESENT WORTHS	$3,451,920
CAPITAL RECOVERY FACTOR	0.03887
AVERAGE ANNUAL VALUE	$134,161

APPENDIX D

ENVIRONMENTAL ASSESSMENT OF BYPASSING AND SAND SOURCE ALTERNATIVES

A. Inlet Closure

Closure of the inlet could adversely affect the surrounding environment. Closing the inlet may result in some stagnation of the surrounding estuarine waters. Water quality and dissolved oxygen concentrations of the estuarine waters adjacent to the pass may decrease as a result of inlet closure. Organisms immediately adjacent to Blind Pass which rely on tidal inlet currents to provide food or other nutrients, or to remove pollutants, may perish. Migratory estuarine-marine species, such as seatrout and the common snook, would be denied ready access to estuarine nursery grounds or marine spawning sites.

B. Bypassing Systems

Many of the proposed sand bypassing alternatives involve the placement of sand from a borrow site onto the beach. If implemented, these alternatives would have similar impacts on the surrounding environment. A majority of these impacts are expected to be minimal, temporary, or can be minimized by using specific procedures. These impacts will be discussed as a group in the following paragraphs. Environmental impacts which are specific to a given alternative are discussed later.

All the proposed sand bypassing alternatives which involve the placement of sand on the beach will have both positive and negative environmental impacts. Depending upon the quantity of the sand used, sand placement would either help maintain, or would greatly increase, the amount of available sea turtle nesting habitat. On the other hand, if sand placement occurs during the sea turtle nesting season, a sea turtle monitoring and nest relocation program would be required by the Florida Department of Natural Resources, the Florida Department of Environmental Regulation and the U.S. Fish and Wildlife Service (Florida Statute 370.12, F.A.C. 16B-41; Endangered Species Act of 1973; and Futch, unpublished).

In addition to the quantity of sand placed on the beach, the quality of sand (silt/clay content and sand grain size), could also affect the surrounding environment. Depending upon the quality of the sand used, sand placement could result in increased turbidity in the nearshore zone. However, if quality (low silt/clay content), compatible sand is used, any increases in turbidity should be temporary.

Placement of sand on the beach will also have a temporary, negative impact on the beach infaunal community. Beach infauna will be buried by sand placement, but is expected to quickly re-populate any affected areas (Nelson, 1985; Saunders, unpublished).

And finally, the placement of sand on the beach, especially that placed south of Blind Pass, could ultimately result in increased, or permanent closure of the tidal entrance to Clam Bayou. Unless mitigated for, the permanent or increased closure of this tidal channel would result in increased stagnation and isolation of both the bayou and Old Blind Pass. As a result, both water quality and dissolved oxygen concentrations may decrease, thereby negatively impacting fish and invertebrate nursery grounds, as well as wading bird populations. Increased closure of the tidal channel would also limit the access of migratory estuarine-marine species to their spawning and nursery grounds. Any engineering alternatives which permanently close the tidal entrance to Clam Bayou may require mitigation in order to be permittable.

Those alternatives which involve the dredging of sand from an ebb tidal shoal, flood shoal, or offshore borrow area would also have some negative environmental impacts. These impacts include the loss of benthic infauna at the dredge site (CSA, 1987; Bowen and Marsh, 1988), as well as increased turbidity. Since infauna tend to quickly re-populate disturbed areas (Turbeville and Marsh, 1982; Nelson, 1985; Bowen and Marsh, 1988; Saunders, unpublished), the loss of benthic infauna is expected to be temporary. On the other hand, increased turbidity at the dredge site may negatively affect surrounding seagrass beds or exposed hardbottom communities (CSA, 1987). Therefore, it is recommended that dredge sites in proximity to seagrass beds, or within 400-500 feet of hardbottom, be avoided.

A list of the specific environmental impacts associated with each of the proposed alternatives is provided below.

1. <u>Beach Nourishment of Northern Sanibel</u>

In addition to those impacts associated with offshore dredging and subsequent sand placement, the construction of a 3600 foot beach restoration project could result in the closure of the tidal entrance to Clam Bayou.

2. <u>Restore Northern Sanibel and Stabilize with Groin Field</u>

In addition to the impacts associated with the dredging of a borrow site and the placement of sand on the beach, this alternative would have additional environmental impacts associated with the construction of the groins. Construction of the groins would result in the loss of infauna within the footprint of the groins. However, this loss is not expected to adversely impact the surrounding environment. On the other hand, if groin construction is to occur during sea turtle nesting season, a sea turtle monitoring and nest relocation program would have to be implemented to avoid the burial of, or mechanical damage to, sea turtle nests (Florida Statute 370.12; F.A.C. 16B-41; Endangered Species Act of 1973; and Futch, unpublished).

3. <u>Restore Northern Sanibel, Remove Jetty Extension, Renourish Captiva and Northern Sanibel Together</u>

The removal of the jetty extension and renourishment of Captiva's south beach could result in increased shoaling at the entrance to Blind Pass. Depending on its severity, this shoaling could result in decreased tidal flushing of the estuary, or in an extreme case, closure of the inlet. Any significant decrease in the tidal flushing could result in the same environmental impacts listed in Section A, "Close the Inlet". In addition, the restoration of northern Sanibel could result in the closure of the tidal entrance to Clam Bayou. The environmental impacts associated with the dredging of a borrow site and the placement of sand on the beach are also valid for this alternative.

The removal of the jetty extension would also have some environmental impact. The jetty currently provides habitat and shelter for a variety of fishes and motile invertebrates, as well as an attachment site for sessile invertebrates and algae. The removal of the jetty extension would result in the loss of approximately 100 linear feet of habitat.

4. Restore Northern Sanibel and Overfill South Captiva Island

The construction of a feeder beach on South Captiva Island could result in increased shoaling at the entrance to Blind Pass. If the shoaling does not significantly reduce the tidal flushing of the estuary, it will not adversely affect the surrounding environment. However, if the shoaling does significantly decrease the tidal flushing through the inlet, it could result in the same environmental impacts listed in Section A, "Close the Inlet". In addition, the restoration of northern Sanibel could result in the closure of the tidal entrance to Clam Bayou. The environmental impacts associated with the dredging of a borrow site and sand placement are also valid for this alternative.

5. South Jetty and Beach Nourishment on Northern Sanibel

The addition of a jetty south of Blind Pass could provide additional habitat and shelter for a variety of fishes and motile invertebrates, as well as an attachment site for certain algae and sessile invertebrates. If jetty construction is to occur during the sea turtle nesting season, however, a sea turtle monitoring and nest relocation program would have to be implemented for the construction area in order to avoid mechanical damage to sea turtle nests (Florida Statute 370.12; F.A.C. 16B-41; Endangered Species Act of 1973; and Futch, unpublished). The restoration of northern Sanibel could result in the closure of the tidal entrance to Clam Bayou. The environmental impacts associated with dredge sites and sand placement are valid for this alternative.

6. Purchase Homes and Reroute Road

By itself this alternative will have minimal environmental impact. However, if it is not constructed in conjunction with an erosion control alternative, the continuing erosion will cause the same environmental impacts described in B.9, the "no action" alternative.

7. Purchase Homes and Revet Road

By itself this alternative will have limited environmental impact. Construction of the revetment would result in the loss of the few remaining mangroves adjacent to the road. However, if this alternative is not constructed in conjunction with an erosion control alternative, the continuing erosion will cause the same environmental impacts described in B.9, the "no action" alternative.

8. Dredge Flood Shoal

The flood shoal is located within the Pine Island Sound Aquatic Preserve (Lindblad, personal communication). Since its formation, the flood shoal has become vegetated by a variety of grasses and herbs, including fringe rush (Fimbristylis spathacea), sea blite (Suaeda linearis), sea purslane (Sesuvium portulacastrum), saltwort (Batis maritima), salt grass (Distichlis spicata) and railroad vine (Ipomoea pes-caprae), as well as red, black and white mangroves, and buttonwoods. Meanwhile, the intertidal and shallow submerged portions of the shoal provide habitat for shallow water organisms such as false cerith snails (Batillaria minima), barnacles (Balanus amphitrite) and horseshoe crabs (Limulus polyphemus). A variety of shorebirds and wading birds also feed and rest on the flood shoal (Lindblad, personal communication). Dredging the shoal would eliminate this viable native plant community, and important shallow water and bird habitat. In addition, turbidity caused by the dredging of the shoal could adversely impact viable seagrass beds located east of the shoal. This alternative is not recommended for further consideration.

9. No Action

The "no action" alternative would have some significant environmental impacts. If erosion downdrift of Blind Pass remains unchecked, it will eventually result in the loss of much of the beach ecosystem. As a result, a majority of the available sea turtle nesting habitat would be lost. Continued erosion of the beach could also result in the loss of any remaining native upland vegetation or mangroves located adjacent to the beach. And, although erosion would most likely increase the stability of the inlet leading into Clam Bayou and Old Blind Pass, thereby increasing the tidal flushing of the bayou, the continuous erosion could result in the loss of some of the ecologically important mangrove forest which surrounds the bayou.

10. County Builds Revetment, Maintain Beach on Northern Sanibel, Renourish with Captiva Project

This alternative would have some negative impacts on the surrounding environment. The construction of the revetment would result in the loss of the few remaining mangroves adjacent to the road. Restoration of the beach could result in the closure of the tidal entrance to Clam Bayou. And finally, the impacts associated with dredge and fill activities would also be valid for this alternative.

11. Beach Nourishment and Segmented Offshore Breakwater

The construction of segmented breakwaters would have both positive and negative impacts to the surrounding environment. The construction of emergent breakwaters could provide additional habitat and shelter for a variety of fishes and motile invertebrates, as well as an attachment site for sessile invertebrates and algae. Construction of the breakwaters would result in the loss of infauna within the footprint of the breakwaters. Nevertheless, this loss is not expected to significantly affect the surrounding environment. If breakwater construction is scheduled to occur during the sea turtle nesting season, a sea turtle monitoring and nest relocation program would have to be implemented for the construction area so as to avoid mechanical damage to sea turtle nests (Florida Statute 370.12; F.A.C. 16B-41; Endangered Species Act of 1973; Futch, unpublished). The environmental impacts associated with dredge sites and sand placement are also valid for this alternative.

C. Experimental Systems

1. Mobile Jet Pump

The environmental impacts caused by the jet pump system are expected to be temporary, or may be minimized using specific procedures. A majority of these environmental impacts will occur in the 500 feet of beach and nearshore north of Blind Pass, and in the vicinity of the sand placement. The environmental impacts associated with sand placement have been discussed previously.

Beach and surfzone organisms in proximity to the crane and pipelines are expected to be negatively impacted by this alternative. Sea turtle nesting along the 500 feet of beach north of the inlet would also be affected by this alternative. The implementation of a sea turtle monitoring and nest relocation program for the 500 feet of beach north of the inlet would be required to prevent mechanical damage to nests during the sea turtle nesting season (Florida Statute 370.12; F.A.C. 16B-41; Endangered Species Act of 1973; Futch, unpublished).

Construction of the deposition basin and operation of the jet pump is expected to cause some localized turbidity. While the amount of turbidity will depend upon the silt/clay content and the sand grain size of the material dredged, normal gulf tides and currents are expected to quickly dissipate any resulting turbidity. This temporary increase in turbidity is not expected to adversely affect the surrounding sand bottom.

2. Jet Pumps in Ebb Shoal with Fluidizer

The environmental impacts caused by this alternative are expected to be minimal. Although this alternative will increase the turbidity and sedimentation over the ebb shoal, the impact to the surrounding sand habitat is expected to be minimal. This alternative is not expected to adversely affect seagrasses within the sound. The environmental impacts associated with the dredging of the shoal and sand placement have been discussed previously.

APPENDIX E

INLET STABILITY STUDY AT BLIND PASS
LEE COUNTY, FLORIDA

INLET STABILITY STUDY AT BLIND PASS, LEE COUNTY, FLORIDA

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November, 1991

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INLET STABILITY STUDY AT BLIND PASS, LEE COUNTY, FLORIDA

SUMMARY

This investigation was motivated by the need to examine the stability of Blind Pass inlet in conjuction with a study to develop options for the management of the inlet and the nearby beaches. The study efforts entailed using analytical models based on Keulegan-type inlets to attempt to characterize the long-term stability of Blind Pass, and a numerical model based on one-dimensional integrated momentum and flow and sediment continuity equations to model its short-term stability. Interpretation of photographic records coupled with a review of published reports was vital in assessing the morphological development of Blind Pass.

Based on these efforts, it may be concluded that the rate of sediment supply to the inlet has reduced measurably, principally a result of jetty construction and its subsequent extension. From long-term stability criteria, Blind Pass is found to be marginally stable based on present configuration. At this stage of its continuing development, this inlet is apparently still adjusting to an equilibrium state. Other than external factors such as variation in wave-induced sediment transport and the relative well-being of adjacent inlets especially Redfish Pass, the apparent reluctance to gravitate toward equilibrium may be the result of the lateral restraint imposed by bridge abutments. The altered morphological response manifests in a greater than expected depth at the inlet cross-section. However, further excursion of the depth due to scour is likely to be met with increased soil strength and reduced scouring power of the flow, thereby preventing the adjustment of the inlet section to the predicted equilibrium state. In terms of short-term stability, it is suggested that the critical rate of deposition in the inlet for which the inlet is just in a self-flushing condition is about 250 cu.m/day, which is in qualitative agreement with the volumetric computation based on the growth of the flood tidal shoal.

To the extent that two geographically close inlets can interact mutually, theoretical considerations indicate that one of the inlets will exhibit tendency toward shoaling and eventual closure. Based on past documented developments of Blind Pass and Redfish Pass, it is apparent that Redfish Pass is the dominant inlet in the analogous twin-inlet system considered. While Blind Pass has undergone alternate closure and reopening, underscoring its susceptibility to instability, the chronic shoreline erosion prevalent along Captiva Island appears to have helped reduce the sediment loading that would otherwise have gained ingress into the inlet. Furthermore, the interruption of longshore sediment transport by the jetty and the efficient bar-bypassing mechanism across the inlet further mitigate against any tendency toward permanent closure.

The analytical and numerical efforts yield a "potential" representation of the inlet in a simplified setting. Combining the idealized scenario considered with field experience derived from published reports, it is suggested that the efforts at shore protection, especially jetty construction, may have given a new lease of life to Blind Pass. However, some engineering improvements such as channel dredging in the interior may be required to ensure the continuous presence of the inlet.

Chapter 1

INTRODUCTION

1.1 Background

Blind Pass is one of many inlets that punctuate the southwest coast of Florida facing the Gulf of Mexico. Located in Lee County, it separates the Captiva Island to the north and Sanibel Island to the south and connects a part of Pine Island Sound to the Gulf. The inlet was first opened naturally around three hundred years ago and for quite a while behaved as a tide-dominated inlet with a prograding ebb-tidal shoal. Since the opening of Redfish Pass to the north in 1926, the inlet has gravitated toward a wave-dominated one, and is less stable. The capture by Redfish Pass of a substantial portion of the tidal prism that had kept Blind Pass active since its inception by the Redfish Pass is evidenced by the alternate closure and opening that has typified its existence up to at least the middle 1980s. Its emphemeral existence is also evidenced by the disintegration of the once stable ebb tidal shoal to relative insignificance. Concern, for instance, regarding the water quality in the part of Pine Island Sound that abuts the inlet has prompted studies on the morphological development of the inlet and its longevity. The present study is motivated by the need to examine the stability of the inlet in conjunction with a study to develop options for the management of the inlet and the nearby beaches.

1.2 Scope of Study

The scope of study as embodied in this report is confined to the physical inlet response using both analytical and numerical approaches to inlet hydraulics. The report outlines the approaches and calibration process and presents the computation results in an effort to characterize the inlet stability. The report consists of the following main elements:

a) collation and review of all the available study reports on Blind Pass in order to reconstruct the morphological development of the inlet with the aim of obtaining input parameters for subsequent analysis;

b) analysis of primary and secondary data;

c) detailing the use of analytical and numerical approaches to characterize the inlet stability behavior with a view to predicting its response under different scenarios; and

d) preliminary conclusions and recommendation for refinement.

The numerical model used is a one-dimensional code that describes the response of a Keulegan-type inlet-bay system to sinusoidal tidal forcing. The model includes the effect of precipitation and has been applied to Phillips Inlet south of Panama City [Lin, 1988].

Chapter 2

MORPHOLOGICAL STUDY

2.1 Morphological Changes

In addition to the relevant study reports, the authors have relied on the collection of old aerial photographs in the Coastal Engineering Archives and monitoring reports associated with the Captiva Island Beach Nourishment Project [Coastal Planning & Engineering, Inc., 1990 & 1991] and the associated photographic records supplied by Coastal Planning and Engineering, Inc. This store of documented and photographic information was converted into a chronology of events and description of temporal morphological changes to facilitate better understanding of the morphological development of the inlet as summarized in Tables 2.1 and 2.2, respectively.

It is apparent from Table 2.1 that Blind Pass has undergone a series of closures and reopenings as a consequence of the predominant southerly drift. The alternate inlet closure and opening represent an efficient pathway whereby sediments are fed to the south, i.e., Sanibel Island. Prior to 1926, the inlet section at Blind Pass measured 200 m across by 5 m deep due to the appreciable water surface area it commanded in the Pine Island Sound. Following the opening of Redfish Pass in 1926, the tidal prism that had maintained Blind Pass shrunk considerably due to flow diversion through Redfish Pass, which grew to a size about twenty times that of Blind Pass with significant development of the ebb-tidal shoal. Subsequently, there has been at least three episodes of downdrift migration, closure, and reopening. While the first two phases of the cycle may occur over time, the reopening is usually an episodic phenomenon that occurs during storm events. Since severe storm events are always accompanied by storm surges, some as much as 2 m above the mean water level, it is likely that the sand bar was breached by the overtopping water from the sea and the subsequent enlargement of the initial breach was aided by scouring of the pilot channel by outflowing water from the bay side. Consequently, the time of occurrence of inlet closure is easier to trace, normally being narrowed down to the particular hurricane that occurred in the year concerned. Examples are 1960 (Hurricane Donna), 1972 (Hurricane Agnes) and

Table 2.1: A Chronology of Events, Blind Pass

Year	*Event*	*Remarks*
995 BP -655 BP	Original pass opened.	ref. CPE. Inc.
300 BP	Pass broke through barrier island.	ref. Winton et al.
1883	Inlet broke through near the current podition.	ref. CPE. Inc.
1888	Inlet @ throat = 200 m x 5 m. Downstream offset of 250 m.	ref. US Army COE.
1926	Opening of Redfish Pass.	A substantial portion of tidal prism captured.
1941	New inlet opened near current position. Possibly the result of hurricane.	ref. CPE. Inc.
1953	Inlet width at throat = 60 m.	ref. 5.
1958	Inlet width at throat = 20 m.	ref. 5.
8/29-9/13/ 1960	Hurricane Donna reopened pass.	ref. CPE. Inc.
1961	Direct inlet closed. Flow exit further south.	ref. CPE. Inc.
1962	Gulf entrance reportedly closed by storm action.	ref. US Army COE.
1964	Inlet closed by spit.	ref. CPE. Inc.
1966	Historical flow area = 95 m^2.	ref. Winton et al.
1970	Historical flow area = 160 m^2.	ref. Winton et al.
1972	Hurricane Agnes reopened pass.	ref. Hine.
1972	Short rip-rap jetty constructed on the north side.	ref. CPE. Inc.
1974	Historical flow area = 140 m^2.	ref. Winton et al.
1975	Historical flow area = 42 m^2.	ref. Winton et al.
11/76	Gradual inlet narrowing in the past several months closed inlet to boat traffic.	ref. Island Rept.
May 1977	Inlet closed by tidal accretion.	ref. Larson.
1979	Inlet closed.	ref. Davis & Gibeaut.
6/1982	Subtropical 'No-Name' storm reopened pass. Minimum Cross-sectional area = 56 m^2.	ref. Hine.
12/1987	Inlet closed	ref. Dean & O'Brien.
1988	Inlet remained open.	ref. Davis & Gibeaut.
11/88	Terminal groin lengthened by 31 m.	ref. CPE. Inc.
8/1991	Throat Cross-section below NGVD = 64 m^2.	Computed based on field data.

1982 (Subtropical Storm 'No Name'). On the other hand, the estimation of the time of closure is very rough indeed and is usually given in interval of years in published reports. The preparation of Table 2.2 is in part aimed at arriving at a better estimate of an actual closure event so that its replication by the numerical model will yield the values of the relevant calibrating parameters for predictive purposes.

As apparent from Table 2.2, there are gaps in the sequence of aerial photographs and at other times there is a cluster of closely spaced shots in time. While this irregular temporal coverage does help elucidate some of the processes, the static and gapped coverage does not reveal substantially more information as regards the timing of the closure events. However, the lateral migration of the inlet channel and the timing of the construction and completion of the north jetty are apparent from the photographic records. The jetty is believed to have been constructed within a several-month period from July to November, 1972. The episodic nature of the inlet opening is also borne out, this paricular one occuring within the three-week period from June 23 to July 15, 1972. Prior to the inlet opening, the southward extending inlet channel was observed to be clogged with wave overwash deposits. The clogged waterway may have helped to concentrate bay water in the wave-created pilot channel, and hence to scour out a more or less equilibrium inlet channel as evident from the progressive widening of the inlet from time-lapsed photographs.

2.2 Longshore Sediment Transport

An estimation of the longshore sediment transport is a necessary input to the numerical model. A concomitant input is the estimated percentage of the amount of longshore drift that enters the inlet during the ebb, the amount that deposits on the flood tidal shoal, the amount that leaves the inlet in the ensuing flood, the amount of the ejected material that deposits on the ebb-tidal shoal or rejoins the longshore transport system, and the amount that returns in the next ebb-flood cycle. A sediment budget balance will then enable an estimate of the amount of littoral materials that actually settle out during each ebb-flood cycle and deposit in the inlet section to be made.

A relatively simple way of computing littoral drift along the coastline of Florida based on visually observed waves from ships has been presented by Walton [1973]. The method uses the SSMO (Summary of Synoptic Meteorological Observations) wave data, which are a compilation of meteorological and sea state observations made from ships plying through "Data Squares" defined by their longitudes and latitudes, as input in computing longshore energy flux and consequent littoral drift based on linear wave theory. The basic equation used is:

$$Q_l = C\frac{\gamma}{8}H_o^2 C_{go} \cos\alpha_o \sin\alpha_b K_f^2 \frac{24.(3600)}{10^6} \tag{2.1}$$

where

Table 2.2: Temporal Morphological Changes at Blind Pass

Date	*Observation*	*Record Type*
1859	Wide inlet channel flanked by south-growing sand spit and exit far to the south of interior channel.	Fig. 1.3 in ref. Winton et al.
1883	Inlet broke through the spit.	Air photo.
1944	Direct inlet closed. Inlet flow exit about 2.0 km south of interior channel.	Airphoto. (ref. 13)
Early 1950s	Direct Inlet closed. Inlet flow exit south of interior channel and was flanked on the left by southward growing sand spit with vegetation on its northern half.	Airphoto.
1958	Inlet has migrated about 2.8 km to the south.	Fig. 1.3 in ref. Winton et al.
1960	Hurricane Donna opened a new gap at the spit.	Air photo.
1961	Gap closed and inlet exit far to the south.	Air-photo.
2/66	Direct inlet closed. Inlet flow exit further south outside record confines. Closure bar not vegetated.	Slide.
2/14/70	Inlet completely closed. Closure bar not vegatated.	Airphoto.
4/72	Direct inlet closed. No jetty yet. Inlet flow exit further south outside record confines. However, closure bar has thinned.	Slide.
6/23/72	Direct inlet essentially closed. Wave overwash deposits clogged up exit channel. Rock outcrops/partial jetty (?) visible.	Airphoto.
7/15/72	Direct inlet partially open. (size = $\frac{1}{3}$ of bridge span.)	Airphoto.
11/30/72	Inlet size = $\frac{1}{2}$ of bridge span. Jetty in place. Updrift fillet began to form. Rivermouth bar deflected close to left bank.	Airphoto.
7/73	Inlet open. Jetty in place. Updrift accretion fillet just visible.	Oblique photo.
1975	Inlet open.	Fig. in ref. CPE. Inc.
May(?)/78	Inlet partially open. ($\frac{1}{3}$ of bridge span.)	Airphoto.
1978	Inlet completely closed.	Fig. 1.3 in ref. Winton et al.

Table 2.2: Temporal Morphological Changes at Blind Pass (continued)

Date	*Observation*	*Record Type*
10/25/78	Inlet completely closed. Updrift fillet full.	Airphoto.
11/1/78	Inlet completely closed. Updrift fillet full. Downdrift beach straight.	Airphoto.
11/2/78	Inlet completely closed. Updrift fillet full.	Airphoto.
11/12/78	Inlet completely closed. Updrift fillet full.	Airphoto.
12/80	Inlet completely closed. Updrift fillet full.	Slide.
5/14/85	Inlet open. Updrift fillet full.	Airphoto.
10/8/85	Inlet open. Updrift fillet receded slightly behind jetty head.	Airphoto.
2/25/86	Inlet open. Updrift fillet full.	Airphoto.
5/9/86	Inlet open. However, sediment bypassed jettyand recurved into inlet mouth. Inlet channel deflected southeastward.	Airphoto.
10/3/86	Inlet open. Updrift fillet receded behind jetty head. Downdrift deposition disappeared and bulge appeared on right bank of mouth.	Airphoto
1/87	Inlet open. Updrift fillet full. Flow confined by linear ebb-shoal bar.	Slide.
4/1/87	Inlet open.	Blown up airphoto.
2/90	Inlet open. Updrift fillet full. (Jetty extended by 31 m by end of 1988.)	Slide.
5/1/90	Inlet open. Updrift fillet receded slightly behind jetty head.	airphoto.
12/13/90	Inlet open. Updrift fillet about 15 m behind jetty head.	Blown up airphoto.
12/30/90	Inlet open. Updrift accretion full and sediment bypassed jetty and deposited immediately downdrift.	Airphoto
4/9/91	Inlet open. Updrift fillet receded behind jetty head. Downstream deposition disappeared. Right bank of inlet mouth deflected southward forming funnel shape followed by a planform bulge.	Airphoto.

Q_l = littoral drift rate ($\frac{yd^3}{day}$);

C = a constant correlation coefficient equalling 125;

γ = specfic weight of sea water (= 64 $\frac{lbs}{ft^3}$);

H_o = deepwater wave height (ft);

C_{go} = deepwater wave group velocity (ft/s);

α_o = deepwater wave approach angle;

α_b = breaking wave angle; and

K_f = friction-percolation coefficient (= 0.01).

While the method contains numerous assumptions, which is a necessary outcome of the simplicity of approach adopted, the magnitudes of net drift computed are in reasonable agreement with other estimates. Hence, the annual drift values for Blind Pass, which lies within the physiographic reach from San Carlos to Boca Grande, are taken from the littoral drift roses in the above report [Walton, 1973] based on the local azimuth of the shore normal. The azimuth angles are an average of the shoreline trends at several different times, care being taken to disregard local variations in order to reflect the more regional shore orientation. A follow-up work by Walton [1976] has included the monthly drift roses and the same were extracted to yield monthly drift values for Blind Pass as summarized in Table 2.3.

Blind Pass is situated at the break in shoreline orientation, which signifies the abrupt end of the north-western terminus of Sanibel Island. The major change in shore configuration at this point is controlled by a subsurface structure formed in the geologic past [Hine, 1987]. From Table 2.3 it is noticed that there are two distinct drift patterns, predominant northerly from March to September and the reverse for the balance of the year. The high northerly transport tends to coincide with the hurricane seasons, which usually occur during the third quadrant of the year and the hurricane route generally veers to follow a direction in the north-east sector after tracking through the lower half of the Florida peninsula.

On the other hand, the southerly transport is a consequence of winter wave action. Combined with the photographic interpretation in previous sections, it is suggested that the northerly drift is the agent that tends to close Blind Pass while the hurricanes are responsible for the reopening episodes, primarily associated with storm surges generated in the process. Other relevant volumetric rates have been computed for the flood tidal shoal; these being being 14,000 $yd^3/year$ for the period 1956 - 1960 and 2200 $yd^3/year$ for 1960 - 1989 respectively [Coastal Planning & Engineering, Inc., 1990]. While the reduction in the growth of the flood tidal shoal may be linked to the repeated closure of the inlet,

Table 2.3: Longshore Transport Rate at Blind Pass

Month	*Transport South* $\Theta_n = 255° N$ (m^3/day)	*Transport North* $\Theta_n = 220° N$ (m^3/day)	*Gross* (m^3/day)	*Net* (m^3/day)
Annual	350	230	580	120 S
January	840	90	920	750 S
February	750	150	900	600 S
March	410	250	660	160 S
April	50	400	450	350 N
May	80	240	320	160 N
June	20	300	320	280 N
July	100	120	220	20 N
August	50	170	220	120 N
September	90	250	340	160 N
October	220	160	380	60 S
November	320	100	420	220 S
December	240	210	450	30 S

longshore transport system is relatively easily and rapidly carried southward across the inlet and passed on to the downdrift [Hine, 1987], an efficient bar-bypassing process.

For comparison purposes, Davis & Gibeaut [1990] have reported a net southerly drift of 84,000 m^3/yr compared to about 44,000 m^3/yr based on Table 2.3. On the other hand, Coastal Planning & Engineering, Inc. [1991] gives the net longshore transport at Blind Pass as about 31,000 m^3/yr for the period 1974 - 1989 while the corresponding figures for the periods 1955 - 1974 and 1941 - 1955 are given as about 54,000 and 82,000 m^3/yr, respectively. Considering the usually large differences that attend sediment transport prediction, the above values can be deemed as close, the discrepancies at least in part arising from the subjective interpretation of the shoreline azimuth for the former two since they are both based on littoral drift roses of Walton [1973].

Chapter 3

FIELD DATA ANALYSIS

The following field data collected in July/August 1991 by Coastal Planning & Engineering, Inc. were analysed to obtain geometric and hydraulic data required for the subsequent portion of the study:

a) cross-sectional survey covering the inlet and a substantial part of the flood shoal;

b) one continuous point current measurement at about one-third depth located at the throat section;

c) two surface current measurements using drogues; and

d) spot tidal elevation measurements at selected locations and times.

3.1 Tides

While simultaneous measurement of both ocean and bay tides is desirable, the scant tide data collected in the field necessitates recourse to predicted tides by National Ocean Service (NOS), which was found to be in general agreement with the few measured spot tidal elevations. Hence, the NOS Tide Tables are used to generate the Gulf tide required in the analysis.

These tides are generated numerically using the tidal constituents reported in Winton et al [1981], which are then plugged into the general equation:

$$\eta_n = a_0 + \sum_{i=1}^{N} a_i \cos(\frac{2\pi t}{T_i} - \delta_i) \tag{3.1}$$

where η_n is the resultant tidal variation at time t, being composed of N constituents. The amplitude, phase, and period of the i^{th} constituents are a_i, δ_i, and T_i, respectively. a_0 denotes the displacement from the reference datum, in this case the 1965 Mean Low Water,

Table 3.1: Tidal Constituents used in Generating Gulf Tide (a_0=0.18 m)

Constituent	*Period*, T_i (*solarhr.*)	*Amplitude*, a_i (m)	*Phase*, δ_i (*degree*)
M_2	12.421	0.1869	77.8219
S_2	12.000	0.1001	99.6483
N_2	12.658	0.0299	194.7250
K_1	23.934	0.0528	185.8221
O_1	25.819	0.1079	115.1912
P_1	24.066	0.0601	132.1366
K_2	11.967	0.1351	342.0671
ν_2	12.626	0.0157	145.0242
M_1	24.833	0.0082	248.4851
J_1	23.099	0.0088	238.9296
Q_1	26.868	0.0298	221.5013
L_2	12.191	0.0461	140.3845
M_{tm}	219.191	0.0539	62.4574
M_f	327.869	0.0578	81.6405
M_{sf}	354.365	0.0690	225.0921
M_m	661.230	0.0161	193.1122

to the mean water level. Table 3.1 lists the 16 tidal constituents with their respective periods, amplitudes and phases, the latter two being obtained by harmonic analysis of a 35-day period continuous tidal data collected in Oct/Nov 1978 and conducted by Winton et al [1981].

Fig. 3.1 shows a plot of the generated tide, which exhibits a mixed state with two unequal highs and lows in a day. The mean tide range is about 0.50 m while the mean diurnal range is 0.80 m as reported in the NOS Tide Tables. Fig. 3.2 shows the variation of Gulf tidal range that will be used as input for the numerical model.

The generated tides are reduced to National Geodetic Vertical Datum (1929) by using the following tidal datums for the open coast gage at South Captiva Island (Station I.D.: 5383) [Balsillie et al, 1987]:

Mean Higher High Water = 0.46 m NGVD;

Mean High Water = 0.39 m NGVD;

Mean Tide Datum = 0.13 m NGVD;

Mean Lower Low Water = -0.13 m NGVD;

Mean Low Water = -0.29m NGVD; and

Mean Tide Range = 0.52 m.

Another source has placed the MHW on adjacent beaches at 0.52 m NGVD [Coastal Engineering & Planning, Inc., 1991]. Judging from the simplicity of approach and the many assumptions inherent in the study approach, the discrepancy was deemed tolerable and no effort was made to reconcile the difference. As an added simplification, the NGVD was used as the reference datum to compute the geometric properties of the inlet as elaborated in subsequent sections. The difference in the mean tide level between the Gulf and the bay is taken from Winton et al [1981], being 0.10 m, and is used in the model.

3.2 Currents

The measured current, which is mainly tide-driven and shown in Fig. 3.3, shows a similar pattern of change to the tidal variation. Current deflection from the inlet axis is apparent from Fig. 3.4, where the ebb and flood flow directions are each modified by the inlet exit and entrance geometry. The peak ebb current is stronger than the peak flood current, being about 1.3 m/s and 0.9 m/s respectively. The corresponding peak surface currents are about 1.6 m/s and 1.3 m/s based on surface drogue measurements. Assuming a theoretical logarithmic velocity distribution and accounting for variation in the transverse direction, the mean cross-sectionally averaged velocity is taken to be about 1.1 m/s for calibration purposes. This value is also consistent with those indicated in coastal charts, which indicate that velocities up to 1.1 m/s may be expected to occur in inlet throats.

3.3 Geometric Data

The survey data were analysed to yield the geometric data as summarized in Table 3.2 and graphically depicted in Fig. 3.5 and 3.6.

It is noted that while the throat flow depth, h_c, occurs at Section 4, the throat flow area, Ac, occurs at section 10. In the field, Section 10 is located at a constricted part of the flow channel due to the presence of an island that bifurcates the flow. This island most likely originated as a part of the flood tidal shoal the subaerial part of which became colonized by vegetation and eventually the entire complex became a stable feature. There are other mangrove-covered islands within the channel that connects Pine Island Sound to the Gulf. Immediately downstream of Section 10 is a branch channel that serves as an escape conduit for the incoming flood flow that would otherwise pile up against the constricted Section 10. Hence, for the present purpose, the inlet channel is considered to be stretching from Sections 1 to 7, and the water area thereafter is considered part of the

Table 3.2: Geometric Data for Blind Pass

Cross-section No.	Distance (m)	Cross-section Area (m^2)	Mean Depth (m)
1	0	125	0.8
2	29	91	1.0
3	60	64	1.5
4	76	64	2.1
5	116	94	1.8
6	134	74	1.2
7	163	78	0.9
10	259	52	1.4
11	312	57	1.2
12	648	76	0.8
13	984	189	0.7
14	1296	313	0.9
15	1548	234	0.7
16	1747	275	0.5

bay area. Confining the analysis to the first seven sections, h_c and A_c are found to be 2.1 m and 64 m^2, respectively.

The equivalent length of the inlet, L_c, is next computed using the following expression [Bruun, 1978]:

$$L_c = A_c^2 h_c^{\frac{4}{3}} \sum_{i=1}^{7} \frac{\Delta x_i}{h_i^{\frac{4}{3}} A_i^2} \tag{3.2}$$

where A_i and h_i are the individual cross-sectional areas and mean flow depths below Mean Water Level as summarized in Table 3.2 and Δx_i is the channel length of the ith segment. In this way, the equivalent length is found to be 194 m, i.e., longer than the measured length due to the irregular geometric shape of the inlet that increases flow resistance.

Chapter 4

ANALYTICAL STUDY

4.1 Inlet Hydraulics

The first part of the analytical study entails using the one dimensional model equation developed for the Keulegan-type bay to obtain parameters that characterize the hydraulic behavior of the inlet. The principal assumptions inherent in the analysis are:

a) the forcing tidal variation is sinusoidal in time;

b) effects of tides dominate over wave-induced effects;

c) negligible spatial variation in water surface elevation and velocity within the inlet channel; and

d) the bay is a small and deep body of water in which the kinetic energy of the flow issuing from the channel is dissipated, and the instantaneous water surface is horizontal throughout.

Combining the resulting momentum and continuity equations leads to the following second-order ordinary differential equation as the governing equation of motion [Bruun, 1978]:

$$\frac{d^2\eta_B}{dt^2} + \frac{F}{2L_c}\frac{d\eta_B}{dt}\left|\frac{d\eta_B}{dt}\right| + \frac{gA_c}{L_cA_B}\eta_B = \frac{gA_c}{L_cA_B}\eta_o \tag{4.1}$$

where

η_o = ocean elevation;

η_B = bay elevation;

A_B = bay surface area;

A_c = cross-sectional area at throat;

L_c = equivalent channel length;

g = acceleration due to gravity; and

F = impedance given by:

$$F = k_{en} + k_{ex} + \frac{fL_c}{4h_c} \tag{4.2}$$

where

k_{en} = entrance loss;

k_{ex} = exit loss; and

f = Darcy-Weisbach friction factor.

A relatively simple solution to the non-dimensional form of the governing equation of motion based on the describing function technique can be found in Bruun [1978]. The resulting solutions as used in the present study are reproduced below:

$$\tilde{\eta}_o = \sin \alpha \tilde{t} \tag{4.3}$$

$$\tilde{\eta}_B = \tilde{a}_B \sin(\alpha \tilde{t} - \epsilon) \tag{4.4}$$

$$\tilde{u} = \tilde{u}_{max} \cos(\alpha \tilde{t} - \epsilon) \tag{4.5}$$

$$\tilde{a}_B = \left\{ \frac{[(1-\alpha^2)^4 + \mu^2]^{\frac{1}{2}} - (1-\alpha^2)^2}{\frac{1}{2}\mu^2} \right\}^{\frac{1}{2}} \tag{4.6}$$

$$\epsilon = \tan^{-1}\left[\frac{\mu \tilde{a}_B}{2(1-\alpha^2)}\right] \tag{4.7}$$

$$\tilde{u}_{max} = \tilde{a}_B \tag{4.8}$$

where

$\tilde{\eta}_o = \frac{\eta_o}{a_o}$; $\tilde{\eta}_B = \frac{\eta_B}{a_o}$; $\tilde{t} = \left[\frac{gA_c}{L_cA_B}\right]^{\frac{1}{2}} t$; $\tilde{u} = \frac{\bar{u}A_c}{a_o\sigma A_B}$;

α = dimensionless tidal frequency = $\left[\frac{L_cA_B}{gA_c}\right]^{\frac{1}{2}} \sigma$;

$\tilde{a}_B = \frac{a_B}{a_o}$;

a_B = bay tidal amplitude;

a_o = ocean tidal amplitude;

$\bar{u}$ = depth-averaged flow velocity;

$\mu = \frac{16\beta\alpha^2}{3\pi}$;

β = dimensionless damping coefficient $= \frac{FA_B}{2L_cA_c}a_o$; and

σ = tidal frequency

In addition, an additional correction to L_c in the dimensional tidal frequency, α, is included via the following equations:

$$L_c' = \frac{W_c}{\pi} \ln\left[\frac{2\alpha\sqrt{gh_c}}{\sigma W_c}\right] \tag{4.9}$$

$$L_{c1} = L_c + L_c' \tag{4.10}$$

where

L_c' = correction;

W_c = width of idealized inlet; and

L_{c1} = value to be used in evaluating α.

Since α also appears in Equation 4.9 above, the correction is obtained iteratively.

4.2 Long-term Stability

The second part of the analytical study involves computation of the relation between the repletion coefficient, K, and the maximum flow velocity at the throat, u_{max}, which enables a qualitative assessment of the hydraulic stability of the inlet to be made. This is followed by the use of the O'Brien relationship linking the tidal prism, Ω, and the minimum flow area, A_c, from which the sedimentary regime of the inlet can be derived. The superposition of the hydraulic and sedimentary stability criteria then yields the inlet stability diagram for Blind Pass.

The various analytical expressions required for the above analysis are well-documented in the literature [Bruun, 1978; Escoffier & Walton, 1979; Mehta & Bruun, 1983] and are reproduced below:

Hydraulic Stability:

$$K = \frac{A_cF_n\sqrt{2g}T}{2\pi A_B\sqrt{a_o}} \tag{4.11}$$

$$F_n = (\frac{2gLn^2}{R^{\frac{4}{3}}} + m)^{-\frac{1}{2}} \tag{4.12}$$

where F_n is a dimensionless head loss parameter. The value of K is then obtained iteratively using the following equation:

$$K = \sqrt{e}\tilde{a}_B \left\{1 - \left[1 - \alpha_i^2(\frac{K_i}{K})^p\right]^2 \tilde{a}_B^2\right\}^{-\frac{1}{4}} \tag{4.13}$$

where

$$e = \frac{4}{\pi}[\frac{1}{3}\cos\theta_n(2 + \sin^2\theta_n) + \theta_n \sin\theta_n] \tag{4.14}$$

$$\theta_n = \sin^{-1}(\frac{Tq}{2\pi a_o A_B \tilde{a}_B}] \tag{4.15}$$

$$\alpha^2 = \alpha_i^2(\frac{K}{K_i})^{-p} \tag{4.16}$$

$$A_c = A_{ci}(\frac{K}{K_i})^p \tag{4.17}$$

$$U_{max} = \frac{2\pi a_o A_B \tilde{a}_B}{TA_c}(1 + \sin\theta_n) \tag{4.18}$$

where q is the tributary inflow and other parameters are as defined earlier.

The above set of equations, which is described in Escoffier & Walton [1979], incorporates the effects of inertia through the dimensionless tidal frequency term, α, and of tributary inflow through q found in the equation containing e. Equations 4.16 and 4.17 are assumed variations of α and A_c relative to K where the subscript i denotes initial values before accretion or erosion. The value of the parameter p lies between 0.6 for the condition when the wetted perimeter is assumed to vary but not R, the hydraulic radius, and 1.0 for the opposite condition in response to sedimentary processes. It is used here as a calibrating parameter to reproduce the measured flow velocity.

Sedimentary Stability

$$\Omega = \frac{U_{max}A_cT}{\pi C_k} \tag{4.19}$$

$$\Omega = a^{-\frac{1}{m}}A_c^{\frac{1}{m}} \tag{4.20}$$

Combining the above two equations leads to the following equation describing the relationship between U_{max} and A_c:

$$U_{max} = \frac{\pi C_k}{T}a^{-\frac{1}{m}}A_c^{\frac{1-m}{m}} \tag{4.21}$$

where C_k varies between 0.811 and 0.999 and is taken as 0.86 here. Values of a and m have been published for the Gulf of Mexico for "*Zero, One & Two*" and "*Zero & One*" jetty conditions [Bruun, 1978]. It was found that the two set of values yield $U_{max} \propto A_c$ relationships that are not far from each other in the present case. Hence, the values for the "*Zero & One*" jetty condition, i.e, a=3.51×10^{-4} and m=0.86, are used in this study.

Chapter 5

NUMERICAL MODELING

5.1 Model Description

The model is a one-dimensional dynamic model that is based on integrated momentum equation for flow and DuBoys formula for sediment transport. The model first computes the flow discharge and water depth in each numerical cell along the axis of the inlet using an iterative approach based on a given Gulf tide, bay area, bed resistance represented by the Manning's n, and exit and entrance losses. The integrated momentum equation that governs the tidal flow along the inlet is:

$$\eta_o - \eta_B = \frac{u_{m_i}^2}{2g}(k_{ex} + k_{en}) + \sum_{i=1}^{N} \Delta H_i \tag{5.1}$$

where

u_m = flow velocity in cell i;

ΔH_i = heat loss due to friction in cell i; and

N = total number of cells.

The values of η_o are specified from the generated Gulf tide mentioned earlier while the values of η_B are computed from the values of $\tilde{a}_B$ and ϵ computed from the analytical study. So is A_B, which is the result of the flow calibration exercise in the analytical study. The friction head loss in each cell is computed based on the Manning's Equation:

$$u_m = \frac{1}{n}(\Delta h)^{\frac{1}{2}} h^{\frac{2}{3}} \tag{5.2}$$

where both the uniform flow condition ($\Delta h = S$, the slope of the energy grade line) and the wide channel assumptions ($R \approx h$) have been invoked.

Once the flow conditions have been computed, the sediment fluxes entering and leaving each cell are computed by the DuBoys formula for given hydraulic conditions and sediment properties. The Duboys formula expresses the volumetric sediment transport rate per unit width, q_s, in terms of the excess shear stress as follows:

$$q_s = C_s \tau_o (\tau_o - \tau_{cr.h}) \tag{5.3}$$

where

τ_o = average bed shear stress = γRS;

$\tau_{cr.h}$ = critical shear stress for incipient motion on a horizontal bed;

Duboys'$C_s = \frac{0.173}{d^{\frac{3}{4}}}$

d = sediment size in mm; and

γ = unit weight of water.

$\tau_{cr.h}$ is computed from the Shields Diagram assuming that the flow is in the turbulent rough range (Roughness Reynolds Number, R_e $(= \frac{u_* d}{\nu}) > 70$) where the dimensionless Shear Stress, Θ_t, is a constant at 0.06. A metric conversion factor of 4.05×10^{-5} need to be incorporated into the expression for C_s, which is taken from Graf [1984].

The sediment conservation equation for each compartment is then:

$$\int_{t_1}^{t_2} q_{s_{in}} W \, dt - \int_{t_1}^{t_2} q_{s_{out}} W \, dt - m[(Wh)_{t_1} - (Wh)_{t_2}] = 0 \tag{5.4}$$

where the subscripts *in* and *out* denote fluxes into and out of the compartment, and m and W are the porosity of the sediment and the cross-sectional width, respectively. In order for the computation to proceed, initial conditions are ascribed for q_s, W and h, and boundary conditions assigned to q_s in terms of M, the fraction of littoral drift that enters the inlet, and ξ, the composite factor that represents the fraction of M that deposits during flood and the subsequent ebb in each time increment of the tidal cycle. An implict assumption is that bed erosion and deposition occur uniformly throughtout the entire inlet.

The flow area then adjusts to the sediment scour or deposition by changing the width to suit the new flow depth. Based on an examination of a large number of inlets, an empirical relation that expresses the gemetric relationship between W and h for the minimum flow area of the following form has been in use [Bruun, 1978]:

$$h = aW^b \tag{5.5}$$

Values of a and b used in the model are 0.087 and 0.88, respectively, for W and h in meters, based on the trend line for jettied inlet [Bruun, 1978].

Table 5.1: Calibrated Parameters from Analytical Method

T (hr)	a_o (m)	f	A_B (m^2)	$\tilde{a}_B$	ϵ
12.42	0.20	0.025	2.80 $\times 10^6$	0.86	33.3
12.42	0.25	0.025	2.10 $\times 10^6$	0.92	26.0
12.42	0.30	0.025	1.70 $\times 10^6$	0.94	21.5
12.42	0.35	0.025	1.43 $\times 10^6$	0.96	18.1
12.42	0.40	0.025	1.25 $\times 10^6$	0.97	15.9

5.2 Preliminary Runs

A series of run was first conducted using the same input data as for Phillips Inlet, except the geometric data which were based on conditions at Blind Pass. The runs always terminated early due to the exponential growth of the inlet cross-section, even under the condition of appreciable sediment input. After a few more runs, it was found necessary to reduce the C_s coefficient in Eq. 5.3 by 100-fold. The next series of runs were for different values of the bay area, A_B, calibrated againest different values of a_o to achieve an average flow velocity of about 1.1 m/s as shown in Table 5.1

The range of a_o selected encompasses the mean tide range on one end and the mean diurnal range on the other end. As observed, higher values of a_o lead to lower A_B and ϵ but higher $\tilde{a}_B$ values. Fig. 5.1 shows the results of comparative runs for the case of the fraction of littoral drift that enters the inlet, M, equalling 1,000 m^3/day, which indicates that lower values of η_o, and hence, higher A_B values, result in inlet widening. Since the chosen emphasis here is on inlet closure, the largest value of η_o, i.e., 0.40 m, was adopted for all subsequent runs.

The next preliminary test runs involved inputting various arbitrary values of M to assess the response of inlet under different scenarios. As indicated in Fig. 5.2, the inlet demonstrated no tendency to close even at M = 2,900 m^3/day, a very large figure indeed that is unlikely to be realized at the site. This is interpreted as the overwhelming effect of the erosion algorithm in the model. Fig. 5.3 indicates two comparative runs with the q_s reduction coefficient of 0.01 and 0.001, which is equivalent to reducing the C_s coefficient in Eq. 5.3 by another 10 times, for the case of M = 1,000 m^3/day. The latter case seemed to perform as expected, i.e,. exhibiting tendency to close. Hence, the value of 0.001 was adopted for subsequent runs.

With these input data, the model was run to simulate conditions after a week as indicated in Fig. 5.4 (a) and (b). While the output for the flow area is reasonable other than some initial high-frequency oscillations, which is not unusual for model start-up, the

Table 5.2: Final Input Values for Numerical Model Runs

L	194 m	h	64 m	n	0.05	n_p	0.4
d	0.26 mm	K_{en}	1.00	K_{ex}	0.05	a_o	0.40 m
T	12.00 $hr.$	$\tilde{a}_B$	0.64	ϵ	51	A_B	1.9 $\times 10^6 m^2$
ξ	0.3	RF_{q_s}	0.001	RF_{η_o}	0.75	$\tau_{cr.h}$	0.88 $\frac{N}{m^2}$

output for velocity is too excessive. It was then decided to increase the roughness to reduce the flow velocity to a more realistic level, being achieved by increasing the value of Manning's n from 0.03 to 0.05.

The relevant input parameters were recomputed from the analytical method using the revised n value. The value of friction factor, f, which is an input in the analytical method, was computed using the following relationship:

$$n = h^{\frac{1}{6}} \left[\frac{f}{8g} \right]^{\frac{1}{2}} \tag{5.6}$$

Table 5.2 lists all the inputs to the numerical model for the final runs where n_p, the only unexplained parameter thusfar, is the sediment porosity. The only varying input is M, which ranges from 200 to 2000 m^3/day.

In Table 5.2, RF_{q_s} and $RF_{\eta o}$ denote the reduction factors for the flow-induced bottom erosion rate computed using DuBoys formulation, and the forcing tide amplitude in the Gulf, respectively. The critical shear stress for incipient motion, $\tau_{cr.h}$, is computed from the graph for metric units (Fig. 7.2) in Graf [1984]. The average sediment size, d, is taken from the US Army Corps of Engineers Report [1969], which lists the representative beach sediment for beaches adjacent to Blind Pass.

Chapter 6

RESULTS AND DISCUSSION

In the literature on inlet stability, a distinction between long-term and short-term stability is frequently made. The former refers to the gradual deterioration of the inlet due to shoaling and may occur over several months or even decades. On the other hand, short-term stability is associated with storm events, which can result in inlet closure. Hence, while the former considers average conditions, the latter is necessarily linked to the intensity and duration of storm events.

6.1 Long-term stability

One of the frequently used criteria for long-term stability is the sedimentary and hydraulic stability diagram discussed in Chapter 4 : Analytical Study. Since there is substantial temporal variation in the tide conditions, two stability diagrams were prepared: one based on the mean tide condition (average of the two daily tides) and the other one based on the same parameter inputs for the numerical model, which represents a more extreme condition associated with the average of the higher daily tides only. This was done in the hope that the two conditions would envelope the expected behavioral range of the inlet.

The inlet performance for the mean tide condition is shown in Fig. 6.1, which indicates that the K value for the present inlet configuration (1.19) is more than K_c (0.74 in this case), indicating that the inlet is stable under the scenario considered. On the other hand, K-curve for the more extreme condition indicates that the K value for the present inlet (0.73 in this case) is very close to the corresponding K_c, which ranges from 0.42 to 0.74 depending on the p value used, as shown in Fig. 6.2. The figure also shows a lower peak velocity, which is expected due to the higher resistance coefficent used ($n = 0.05$). Hence, while Blind Pass may be deemed as stable under mean tide condition, it is only marginally stable under the more extreme tidal forcing scenario. Escoffier & Walton [1979] have recommended that the value of K for an inlet should always be considerably larger than K_c for stability. In a more quantitative sense, Oliveira [1976] has stated that a tidal inlet characterized by $K < 0.6$ is in a condition of non-steady alluvial equilibrium, which means that shoaling may be in progress there.

Perhaps a more complete picture may be gleaned from Fig. 6.3 and 6.4, which includes sedimentary regime as well. In both figures, curves for three different p values, which is the exponent characterizing the variation of the critical flow area, A_c, with K as discussed previously, have been drawn. The curve for $p = 0.7$ corresponds to that shown in Fig. 6.1. As indicated, higher p values lead to a shift to smaller A_c. However, the recession part of the curves remains relatively constant. Hence, the stable flow area, which is the point of interception of the two stability curves, is about 125 m^2 and 150 m^2 based on averaged and more extreme conditions respectively. These values are close to the historical flow area of Blind Pass in 1966, 1970, and 1974 (Table 2.1).

Based on both Fig. 6.3 and 6.4, the critical flow area ranges from 25 to 80 m^2, depending on the value of p used. The fact that the present cross-sectional area at the inlet throat (64 m^2) under mean conditions is between the critical and stable flow areas quoted above seems to indicate that the inlet is within the stable side of the stability diagram. However, the proximity of the present A_c value to the critical flow area, even disregarding the more extreme conditions where the present A_c value lies to the left of the critical flow area, does reflect the uncertainty on which the above interpretation is based, given possible errors in the field data collection and the simplicity of the approach adopted. Without distinguishing between the tidal conditions as was done here, Foster [1991] has characterized Blind Pass as a marginally stable inlet.

It should be noted that long-term criteria, as established from the above methodolody, presuppose adequate sand supply to satisfy the sedimentary regime. Hence, its application to improved inlets where sediment pathways are interrupted by human intervention as is the case in Blind Pass, requires judicious interpretation. Conceivably, the north jetty cuts off some of the natural flow of the littoral drift, thereby alleviating the shoaling tendency at Blind Pass. As pointed out by Hine [1987], the inlet jetty, although constructed to function as a terminal groin to retain beach nourishment to the north, has provided a measure of stability for this comparatively unstable inlet.

6.2 Short-term Stability

The results of the numerical runs are shown in Fig. 6.5 to Fig. 6.16 for M values ranging from 200 to 2000 m^3/day, a ten-fold increase. The length of run duration was chosen such that it would encompass an entire spring-neap tidal cycle, a period of approximately a month. Since the model was run each time with a constant M value, the duration of about a month more or less fits in with the strong monthly variation in littoral transport exhibited in Table 2.4.

In general, the model outputs in the form of temporal variations of flow area and flow velocity follow the same trend as that of the Gulf tide, which would be expected since the tide is the primary forcing agent. The variation reflects the influence of the two unequal tides in a day typical of a strongly mixed tide. Where the two daily tides approach each other in magnitude (day 7 to day 11), the variation is a smooth oscillation. At other times, the lower of the two tides is almost non-existent and the water level is sustained at almost the same elevation for hours. The horizontal trend of the variation (day 16 to day 18) is indicative of the tideless condition, which also appears in the velocity plots.

The flow area reaches a maximum of about 150 m^2, which is within the historical flow area reported. On the other hand, the simulation of flow velocity is perhaps less satisfactory, occasionally reaching a maximum of about 3 m/s during ebb flow, except for the M = 200 m^3/day run. However, most of the flows are within the 2 m/s cap. Flows of such magnitudes are not entirely unrealistic, if they occur only during part of the tidal cycle when spring, or even perigean spring, conditions prevail.

It is seen that up to about M = 600 m^3/day, the inlet exhibits either stable or slight accreting conditions. From M = 700 m^3/day to 800 m^3/day, the shoaling trend is clearly noticeable, but the inlet still remains open at the one-month cut-off point. The inlet closes in about a month for M = 900 m^3/day and thereafter the time of closure is more rapid as the M value increases to 2000 m^3/day where the inlet closes in twelve days. These outputs, therefore, are in qualitative agreement with the expected behavior of Blind Pass under increasing sediment loading.

As supported by photographic interpretation and qualitative observations made in published reports on the survivability of Blind Pass, the closure takes place over a period of months. Bearing this observation in mind, it is suggested that the critical M value for which the inlet is just in a self-flushing condition is probably around 700 - 900 m^3/day. Multiplying M by the ξ factor (= 0.3) used in the model, which is a reasonable estimate of the actual fraction of sediment that ultimately desposits on the bed of the inlet over a flood-ebb cycle from the total amount of sediments that enter the inlet, results in an actual rate of deposition of about 250 m^3.

There are no field data available on the rate of littoral drift that enters the inlet, other than the figures obtained from volumetric difference of the temporal growth of the flood tidal shoal. Since it has been acknowledged that the value computed for the period 1960 - 1965 is conservative, implying low, a reasonable estimate of the rate of deposition is probably three times the computed figure ($\approx$ 30 m^3/day), i.e., about 100 m^3/day. Considering the prevailing thinking that sediment transport predictions can differ by $\pm$ 200%, the M value based on numerical model is perhaps not too far-fetched.

The corresponding figure for post-1965 period is about one-sixth of the earlier value. Hence, by the same token, there is quite a reduction in the amount of littoral material that entered the inlet after the 1960s. The change is attributed mainly to the presence of the north jetty as explained earlier. Hence, it is possible that any southerly transport that manages to bypass the jetty is jettisoned to deeper water and subsequently brought back to shore at a point further downdrift beyond the inlet by the process of bar bypassing. In trying to explain the role of northerly transport, which can be appreciable in the middle of the year (about half of the maximum monthly southerly transport) based on computation, it can be argued that the littoral drift roses actually represent potential transport, i.e., solely based on the sediment transporting power of the waves. Hence, the realization of the actual transport is contingent upon the availability of mobile material. Looking at the regional scale of the shoreline orientation south of Blind Pass, it is apparent that the reach of shoreline immediately south of Blind Pass, the azimuth of which was used in computing littoral transport, is a relatively short transition that joins with the major shoreline of the Sanibel Island that trends roughly 280° N. Hence, it is conceivable that the nearshore bathymetry around this area may cause the waves to arrive at a more normal incidence, and hence result in a less sediment transport capacity.

Another aspect of inlet closure of Blind Pass is the southerly growth of the inlet channel south of its interior channel. This type pf lengthening of the inlet channel almost always precedes inlet closure. It increases flow resistance and hence, reduces the tidal prism. As the channel lengthens, it becomes hydraulically less efficient up to a point where the wave-induced transport just out-balances the tidal flow and closes the inlet at its southerly exit position. The closed channel then shoals from within until a storm event breaches across the enclosed sand bar, usually at the end of the interior channel. The encircling sand bar can also act to obstruct northerly drift from gaining entry into the inlet proper, in a way supporting the premise that the northerly drift may not feature strongly in the inlet closure process. The strong directional preference of ebb flow at Blind Pass also mitigates against any significant sediment movement to the north as suggested by Foster [1991].

It is intersting to note that in the sediment budget prepared by Coastal Engineering & Planning, Inc. [1991], the stretch of shoreline immediately south of Blind Pass ($\approx$ 1,800 m long) has lost about 17,000 m^3/yr for the period 1859 - 1941, 38,000 m^3/yr for 1955 - 1974, 30,000 m^3/yr for 1974 - 1978, and again 38,000 m^3/yr for 1978 - 1988. While these losses may be linked to the inlet sink, it is more likely the result of interruption in southerly drift by first the evolution of the ebb-tidal shoal at Redfish Pass and later the jetty and other protection works along the Captiva Island. The report also indicates the successive reduction in net southerly transport to the south of Redfish Pass for the three periods, 1941 - 1955, 1955 - 1974 and 1974 - 1989. In every case, no losses to the Blind Pass was indicated in the littoral budget established. Again, this may be construed as insignificant sediment supply to the inlet.

While Blind Pass has undergone alternate closure and reopening, the chronic shoreline erosion prevalent along Captiva Island appears to have helped reduce the sediment loading that would otherwise have gained ingress into the inlet. Analysis by Walton [1977] has shown that from 1859 to 1967, the shoreline of the sand bulge seaward of the interior channel of Blind Pass has progressively receded close to about 550 m. While this loss may reflect an efficient mode of sand transfer to the south, it does help mitigate against any tendency toward closure by removing sand from the region immediately offshore of the inlet via alongshore littoral transport.

6.3 Limitations of Approach Methodology

A drawback of the present approach is that it does not account for the presence of multiple inlets that share a common bay of water. Theoretical considerations by van de Kreeke [1985] for a twin- inlet system, albeit with certain simplifying assumptions, has shown that the condition for the existence of stable equilibrium flow area for both inlets is that the enhanced parts of the equilibrium flow curves computed based on the stability analysis of Escoffier [1940] intersect. In the event that no such intersection occurs, then a combination of individual flow area for which both inlets are in equilibrium with the flow conditions does not exist. In other words, one of the two inlets will survive; the other will close eventually.

The significance of the inter-relationship among the inlets is already attested to by the effect of the opening of Redfish Pass on the behavior of Blind Pass. Winton et al [1981], using a numerical approach, has attempted to investigate one facet of the problem, that being the effect of different inlet sizes of Blind Pass on the overall tidal response of Pine Island Sound. They concluded that these changes (up to an inlet cross-sectional area of 1400 m^2), did not significantly change the overall tidal response. However, they did acknowledge that there will be water interchange.

The effect of closing Redfish Pass was also simulated and they found no significant changes in flows through the other inlets. Specifically, their results indicated that the closing of Redfish Pass caused a slight decrease in the flows and in the maximum velocities through Blind Pass and Captiva Pass. However, Foster [1991] has cited Blind Pass, in qualitative terms, as an example whereby changes in the amount of tidal prism, as shared among a group of geographically close inlets, is a strong factor controlling inlet throat cross-section and stability. Nevertheless, these surprising results of Winton et al [1981] may be explained on the premise that the system may have equilibrated to such an extent that it has become irreversible. In fact, this finding may be used to support the premise of the present approach, i.e, treating it as essentially a single inlet system. The other major discrepancy between theirs and the present study is in the maximum velocity through the inlet. For the present configuration, their model predicted a maximum spring velocity of about 0.6 m/s, compared to the measured velocity of about 1.1 m/s used in the present study. They also attributed the very weak dependence of flow velocities on inlet cross-section area and flow depth, which their results indicated, on the fact that the tidal prisms through Redfish Pass and through the southern model boundary (San Carlos Bay) provide a tidal head difference between the inner and outer ends of Blind Pass, and hence, is the dominant factor which controls the flows through Blind Pass.

The constant inlet length assumption employed in the model is also not reflective of the actual tendency of the inlet to increase its length with time. As explained, inlet lengthening increases flow resistance, and the resulting reduced flow velocity makes the inlet more prone to closure. Another complicating element appears in the form of flow constriction imposed by structures. The fact that a bridge spans across Blind Pass implies that the inlet cross-section will not be able to adjust according to the pre-determined $h \propto W$ relationship. In this case, the restriction imposed by the bridge abutments appears to have resulted in a deeper section than expected based on the morphological relation.

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Fig. 3.1 GENERATED GULF TIDES, BLIND PASS

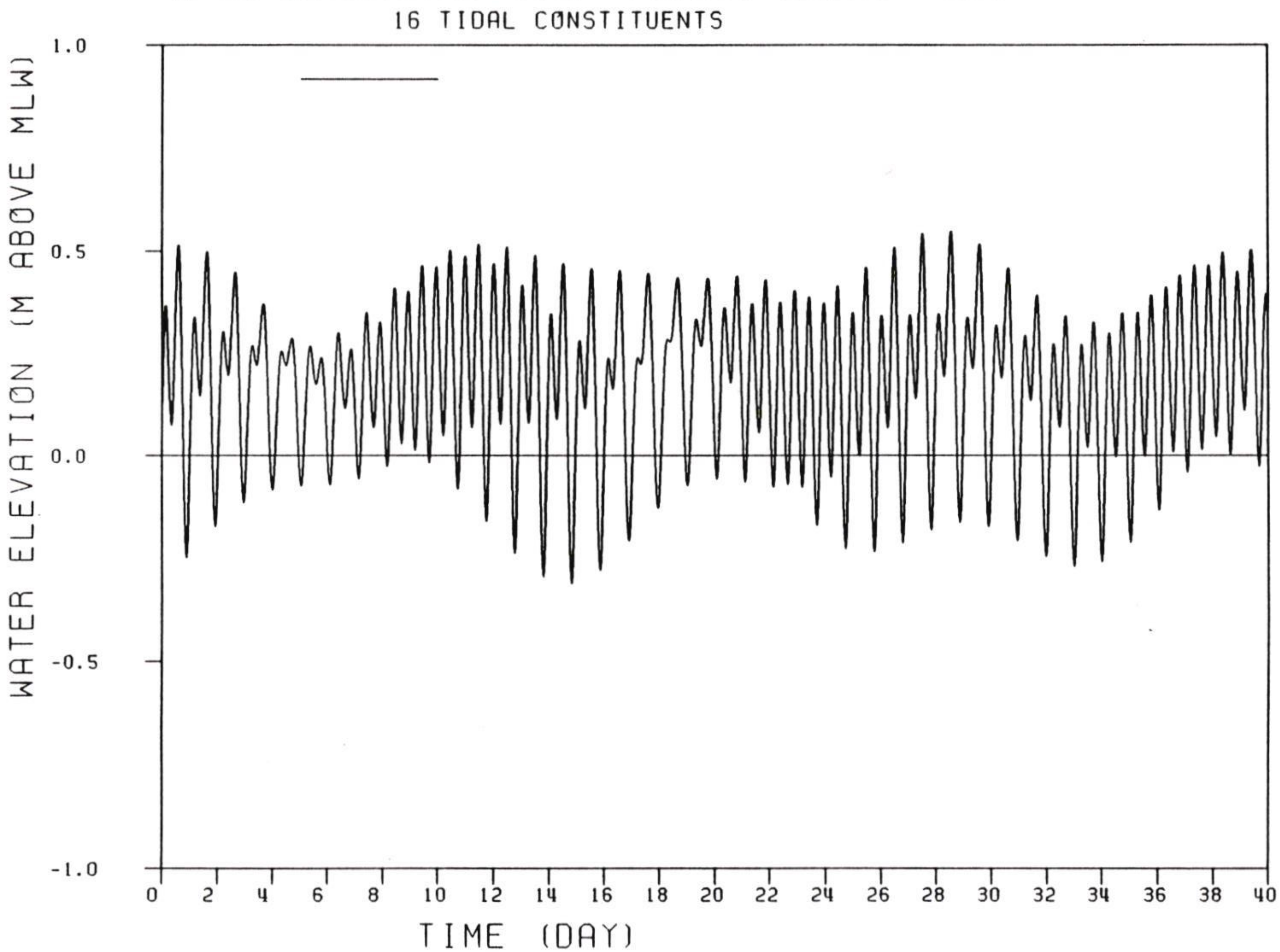


Fig.3.2 VARIATION OF GULF TIDAL RANGE

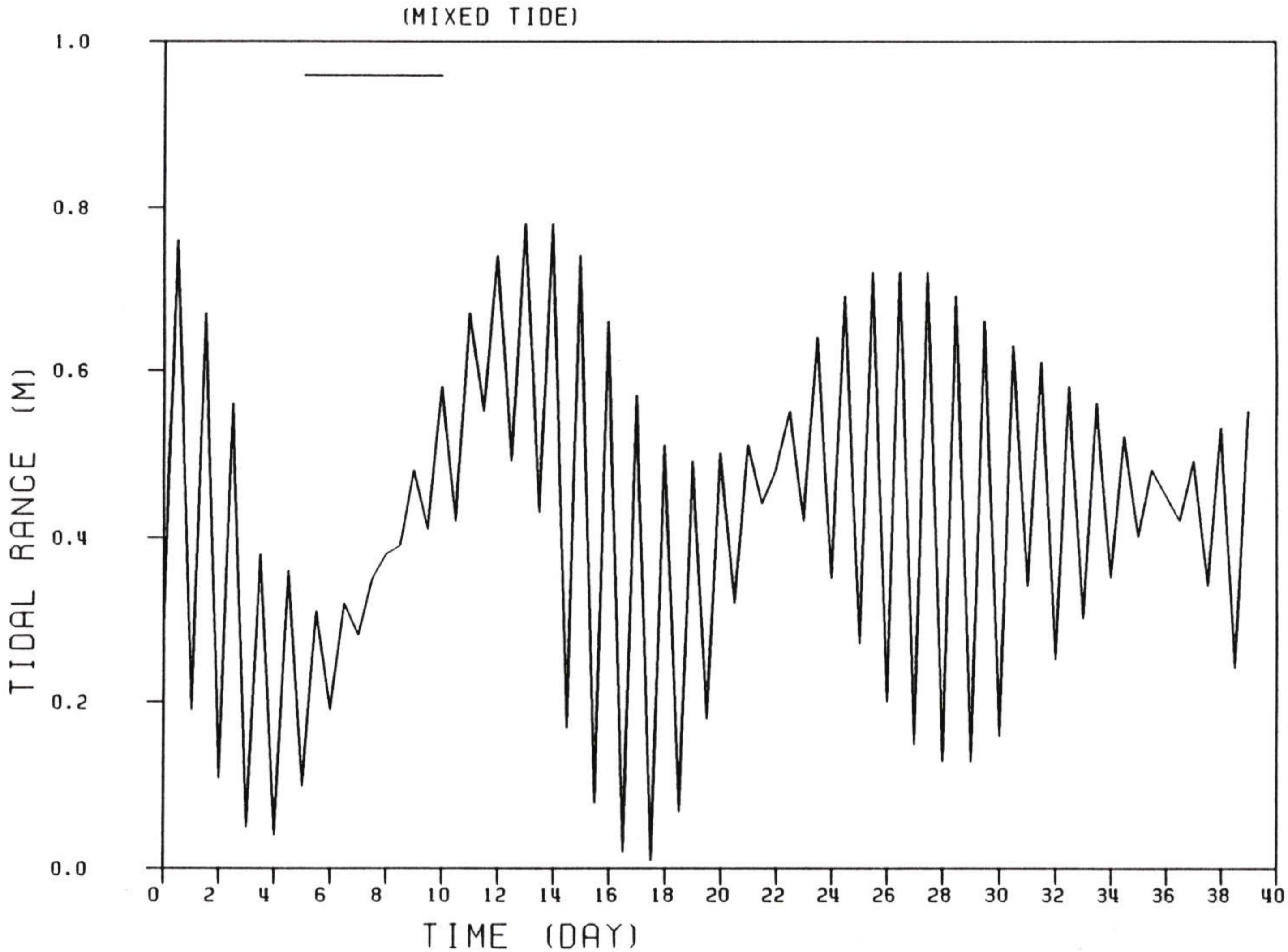


Fig. 3.3 MEASURED PØINT VELØCITY AT BLIND PASS

(STARTING TIME: 3.21 PM,31/7/91)

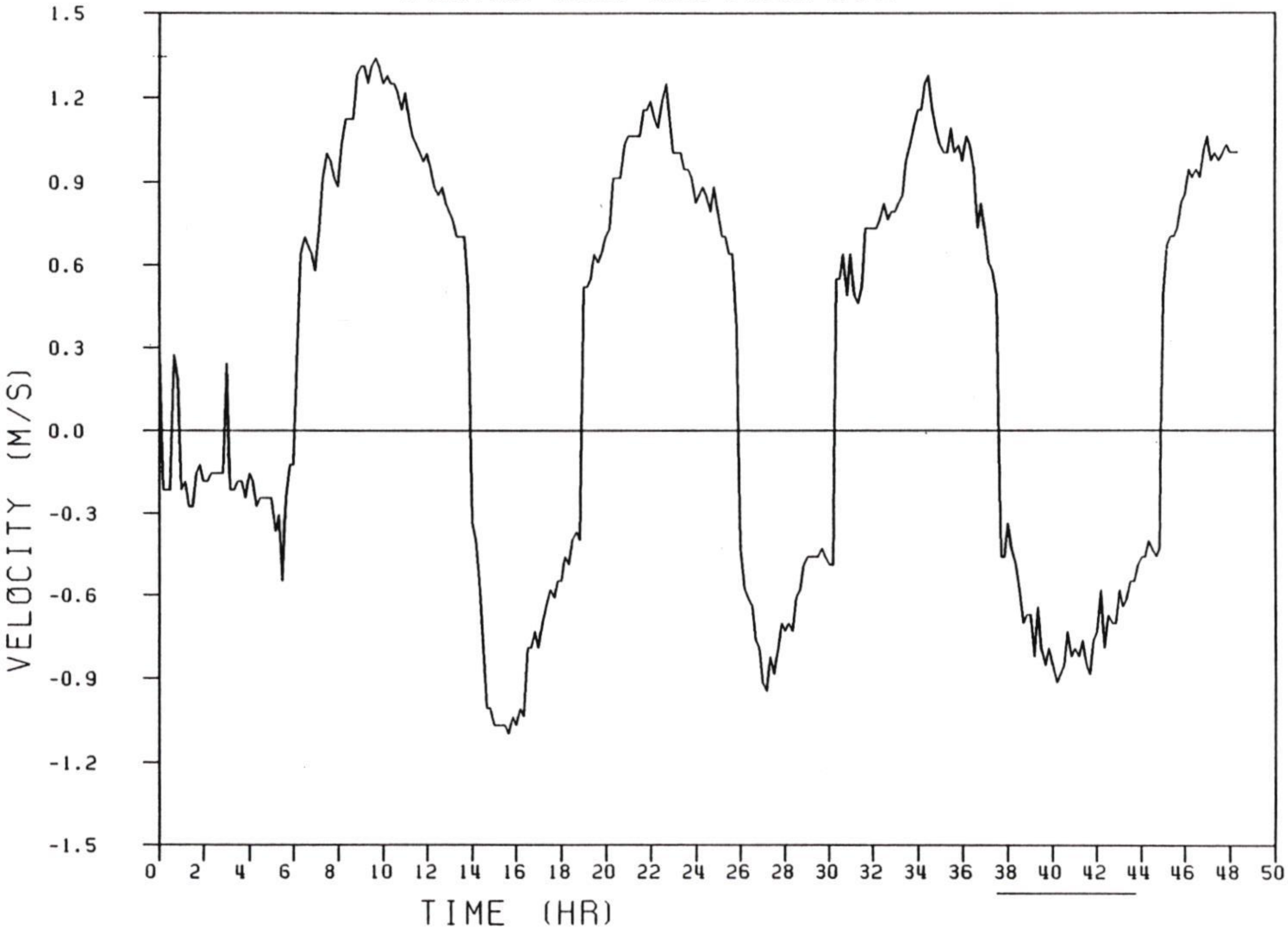
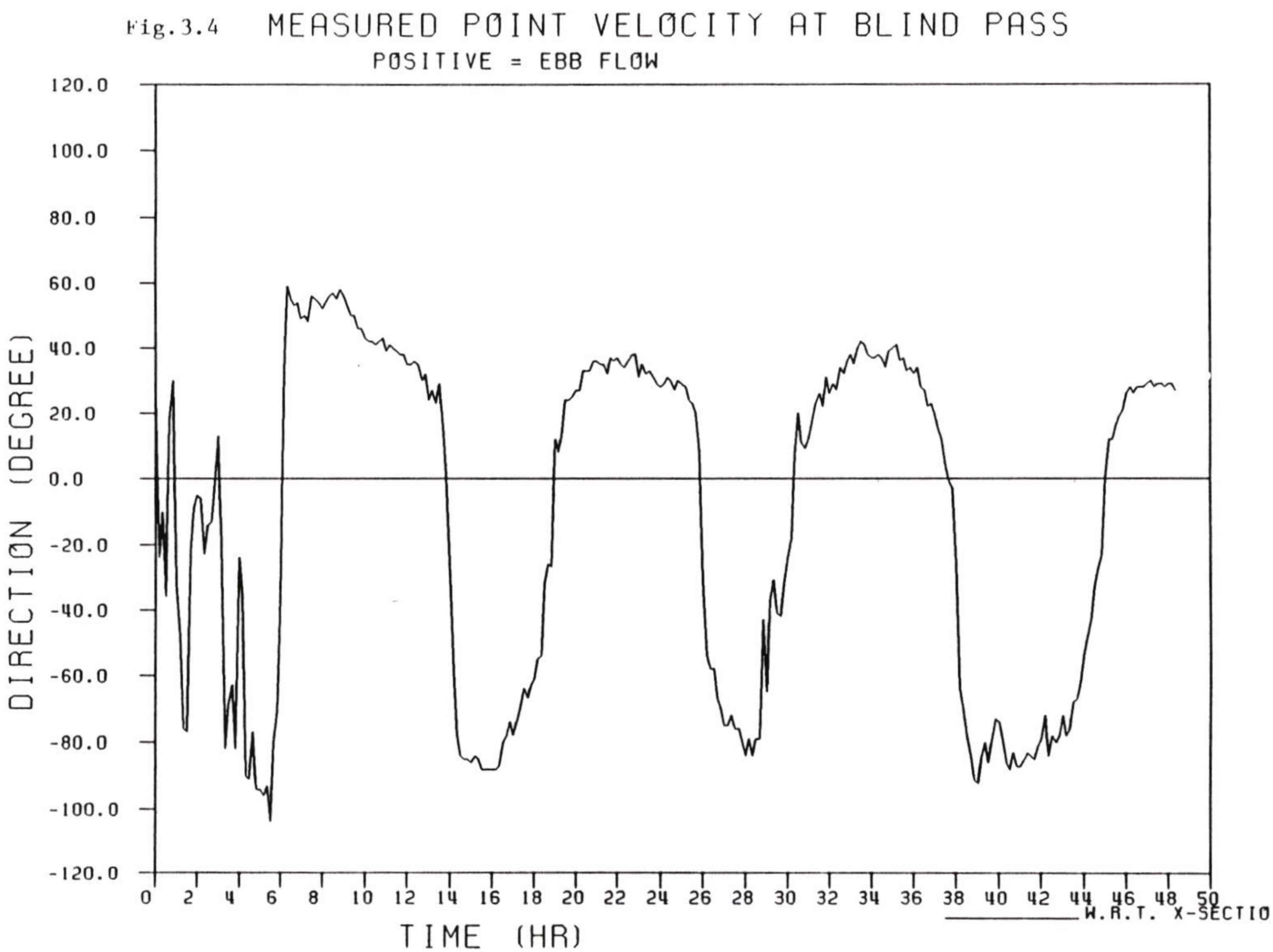
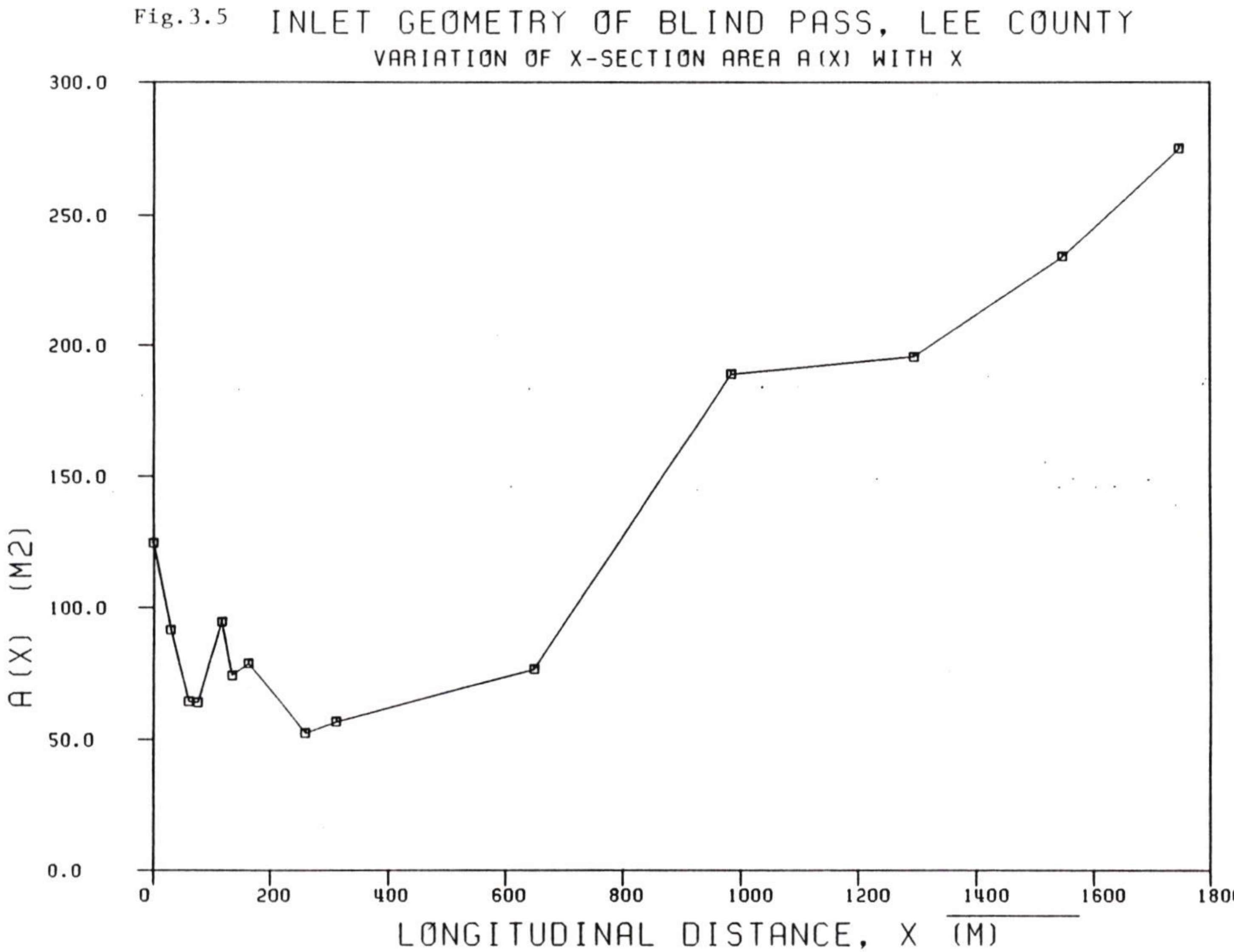


Fig.3.4



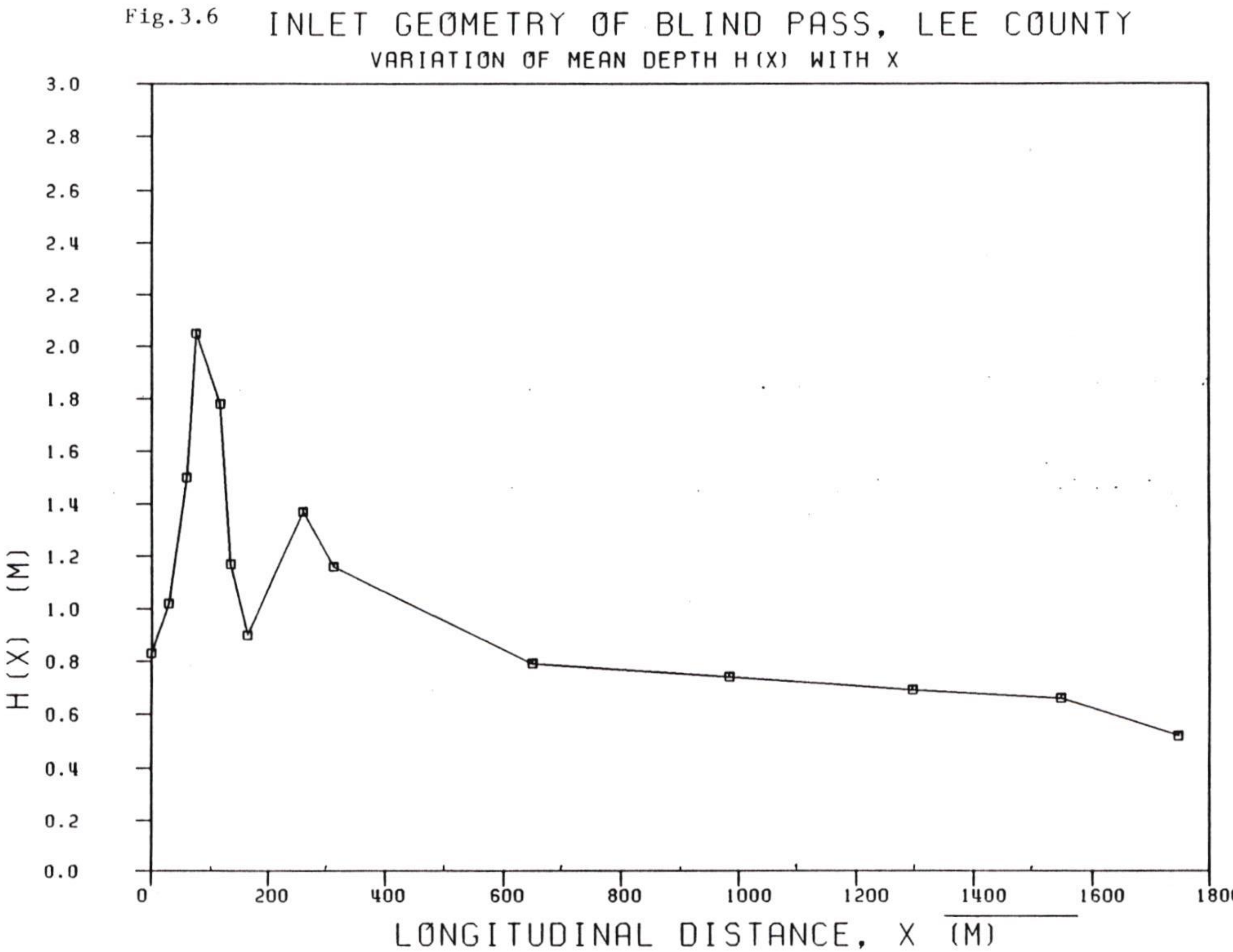
MEASURED PØINT VELØCITY AT BLIND PASS
PØSITIVE = EBB FLØW
DIRECTIØN (DEGREE)
120.0
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
-40.0
-60.0
-80.0
-100.0
-120.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50
TIME (HR)
W.R.T. X-SECTIO

Fig.3.5



INLET GEOMETRY OF BLIND PASS, LEE COUNTY
VARIATION OF X-SECTION AREA A(X) WITH X
300.0
250.0
200.0
150.0
100.0
50.0
0.0
A(X) (M2)
0
200
400
600
800
1000
1200
1400
1600
1800
LONGITUDINAL DISTANCE, X (M)

Fig.3.6



INLET GEOMETRY OF BLIND PASS, LEE COUNTY
VARIATION OF MEAN DEPTH H(X) WITH X
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
H(X) (M)
0
200
400
600
800
1000
1200
1400
1600
1800
LONGITUDINAL DISTANCE, X (M)

Fig. 5.1 Variation of Flow Area with Time
(Different Gulf Tide Ranges)

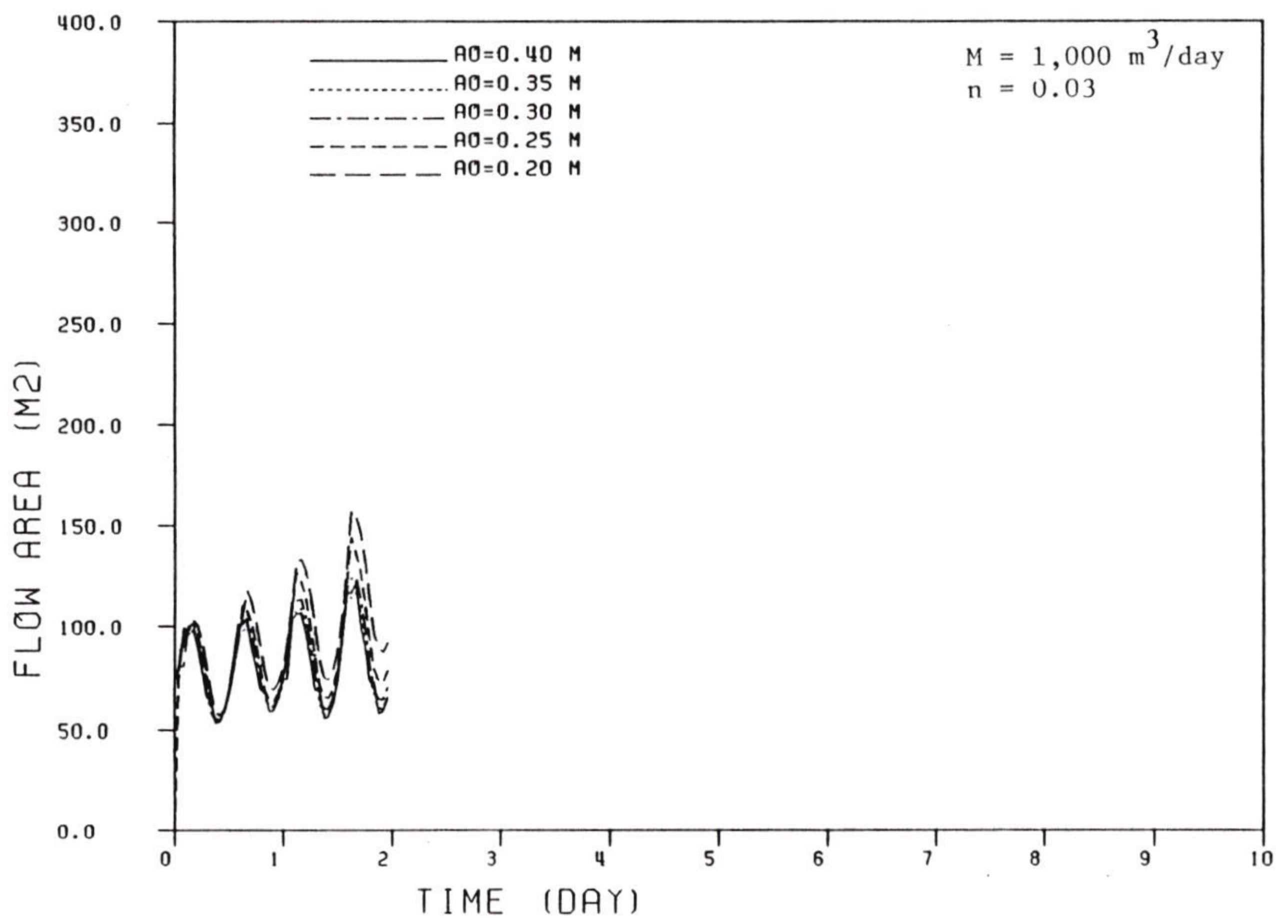


Fig. 5.2 Variation of Flow Area with Time
(Different M Values)

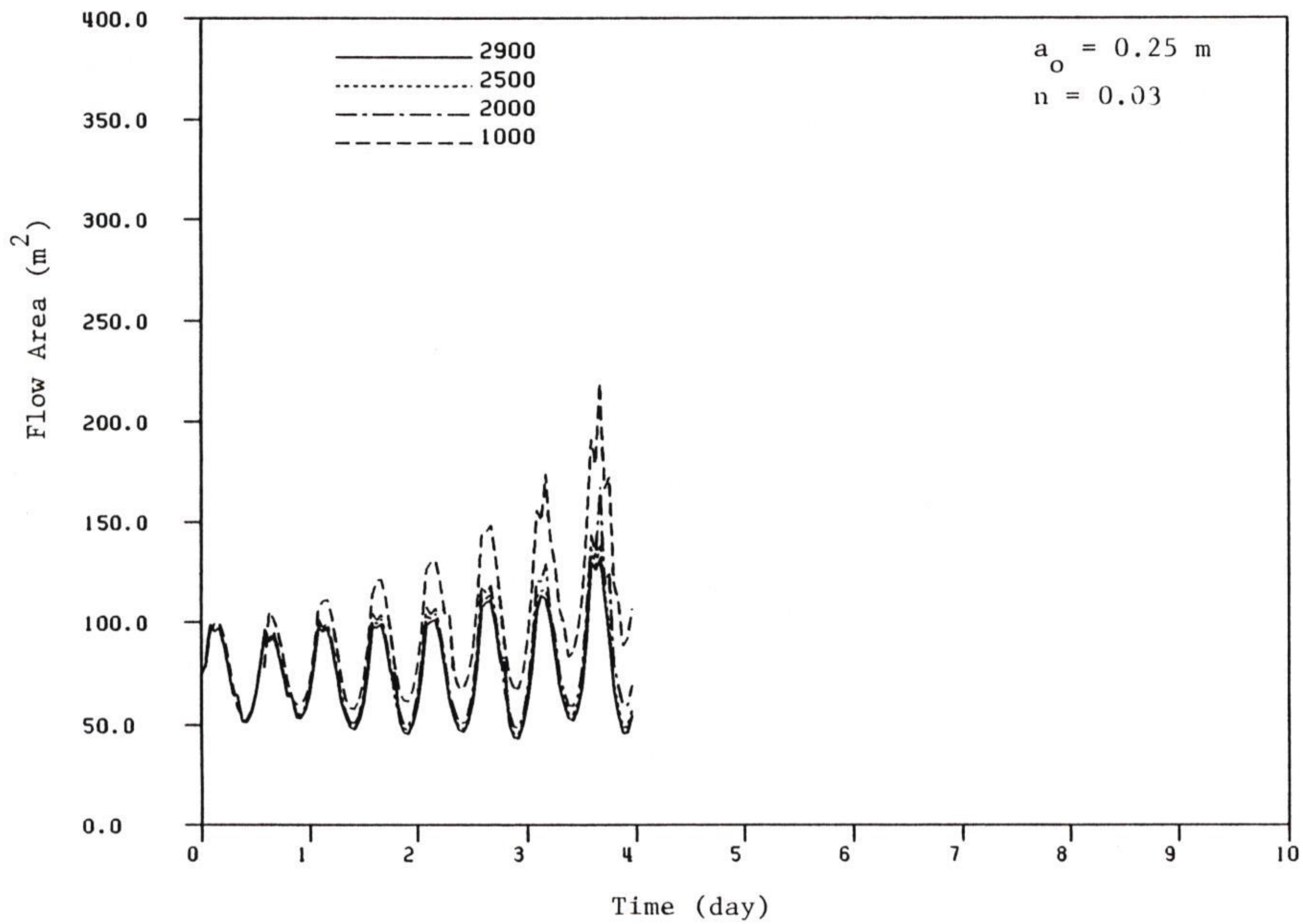
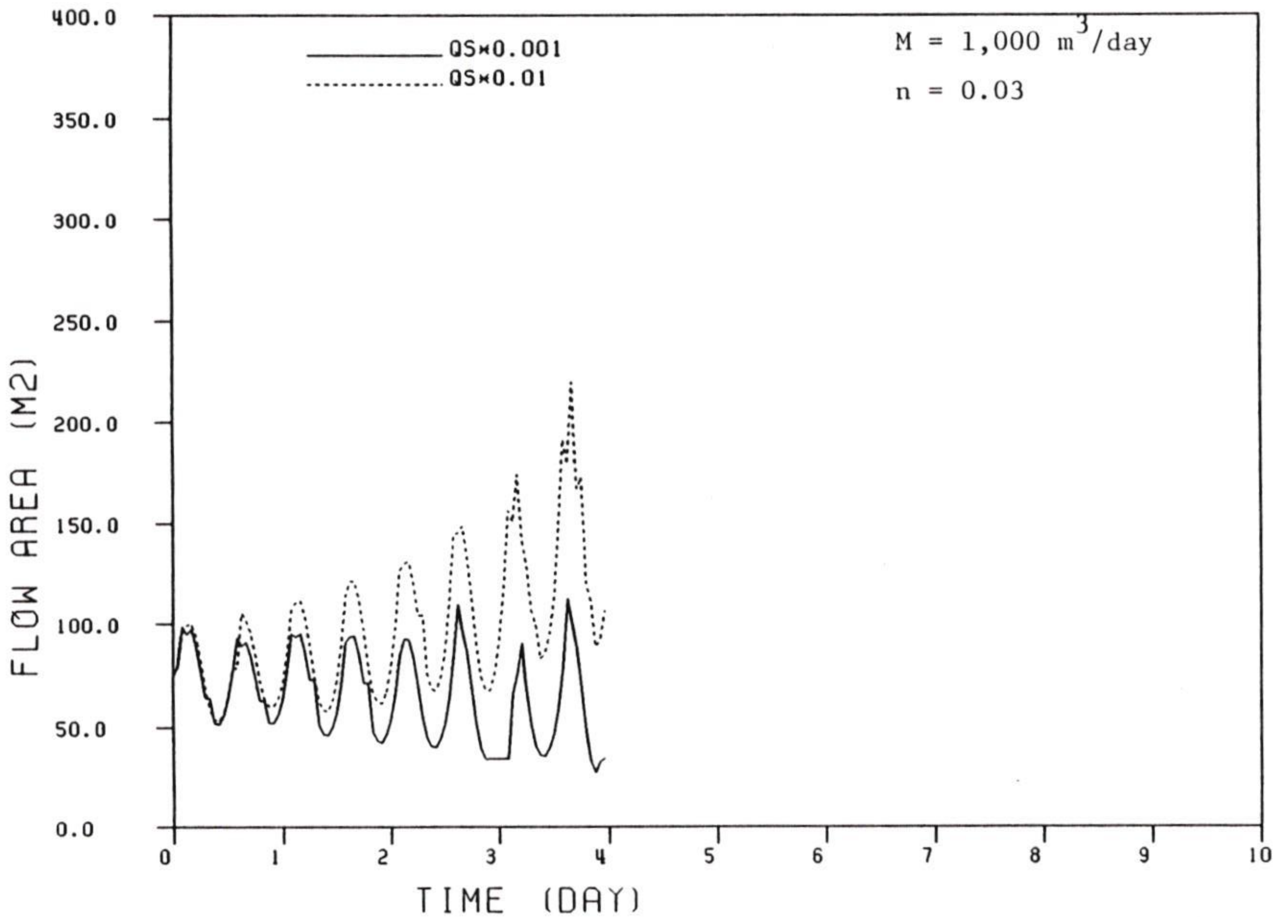


Fig. 5.3 Variation of Flow Area with Time
(Different Q_s Reduction Factors)



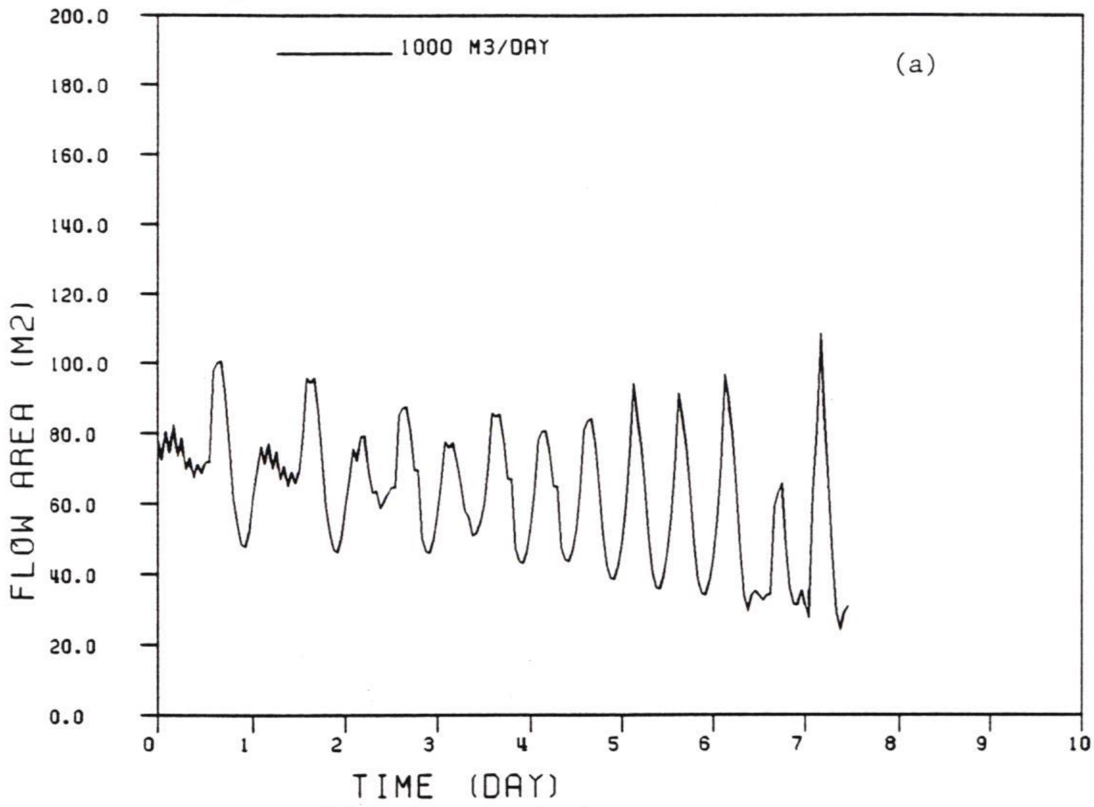


Fig. 5.4 Variation of Flow Area/Velocity with Time
($M = 1000\ m^3/day$; $n = 0.03$)

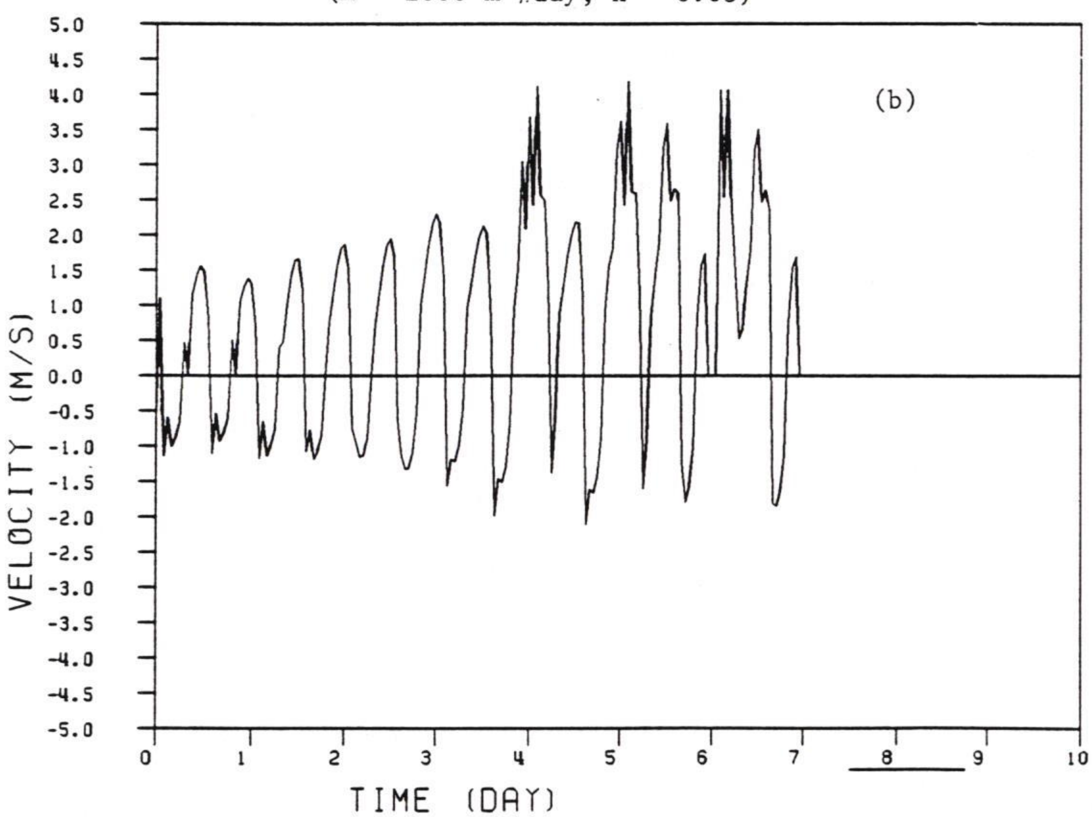


FIG.6.1: CRIT. K VALUE, BLIND P
(MEAN TIDE CONDITION)

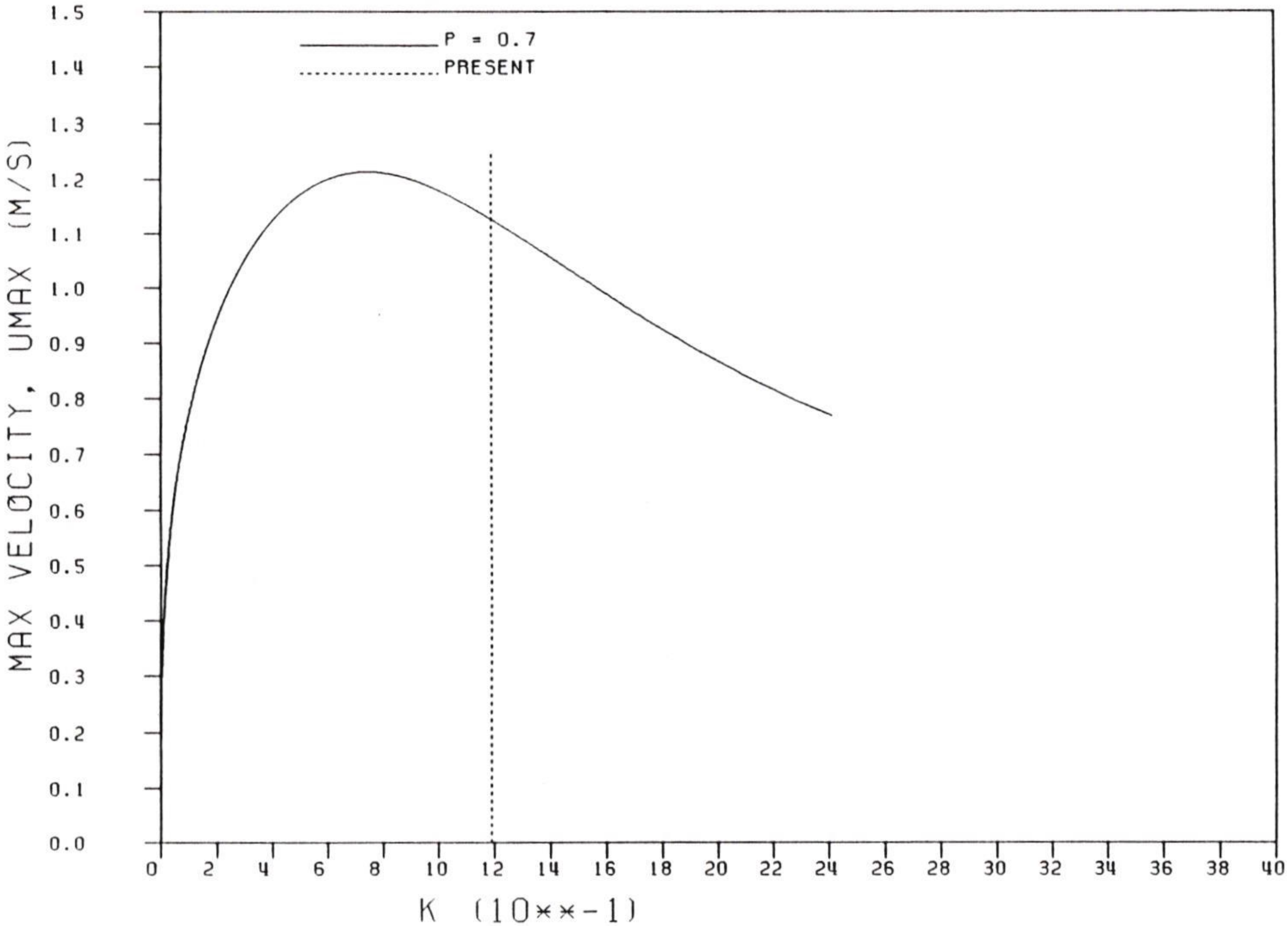


FIG.6.2:CRIT. REPLETION COEFF., BLIND P.
(MEAN DIURNAL TIDE CONDITION)

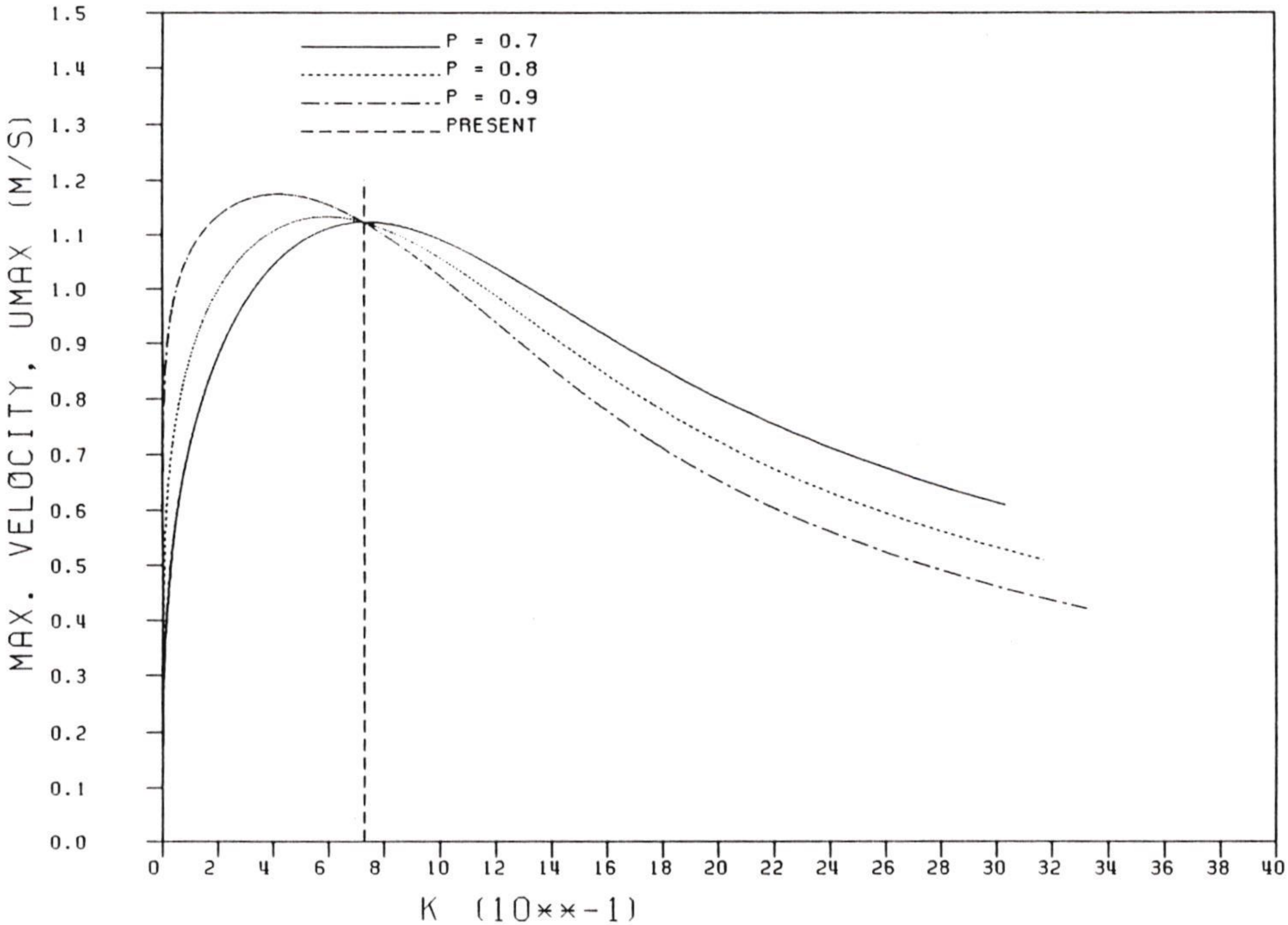


FIG. 6.3: STABILITY DIAGRAM, BLIND P.
(MEAN TIDE CONDITION)

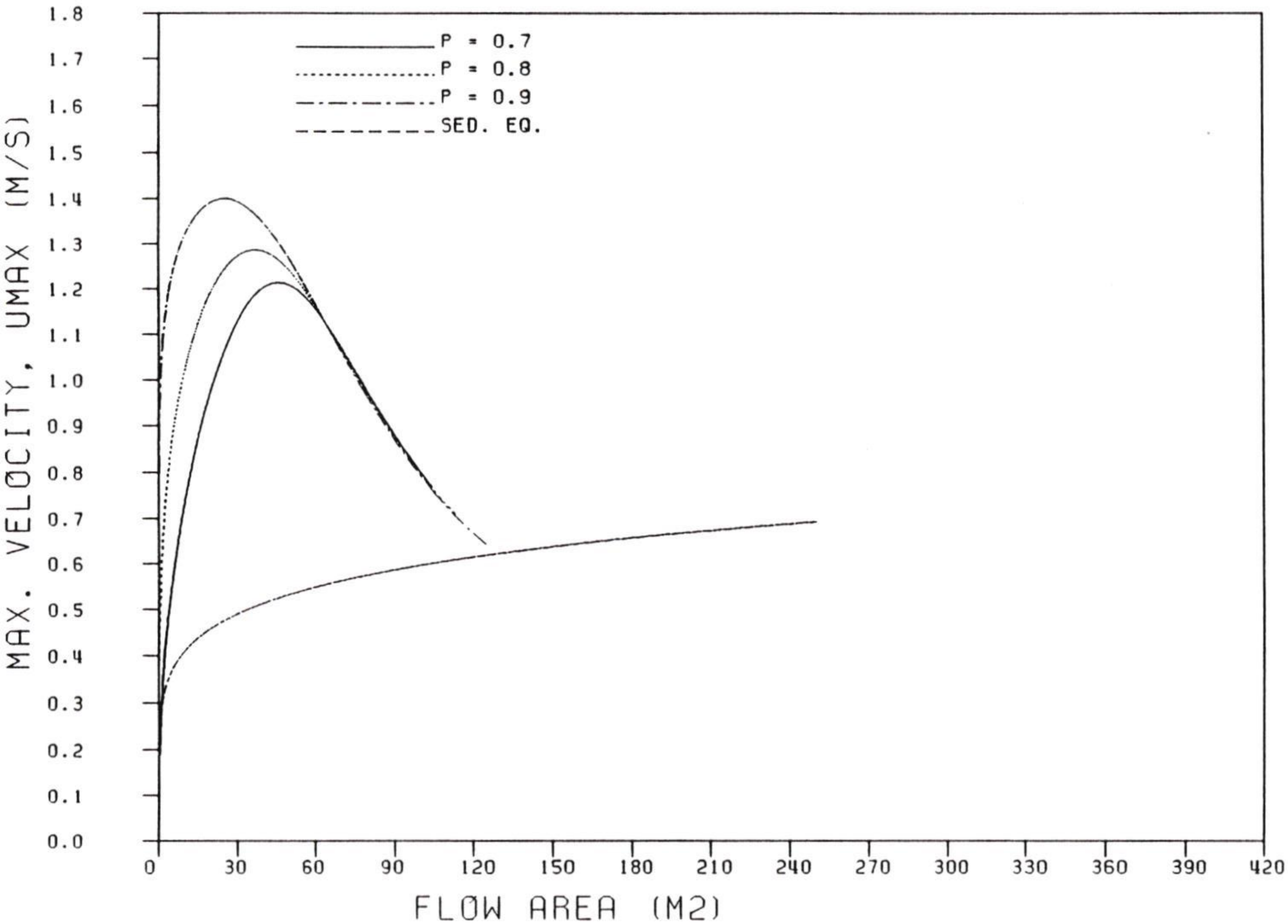
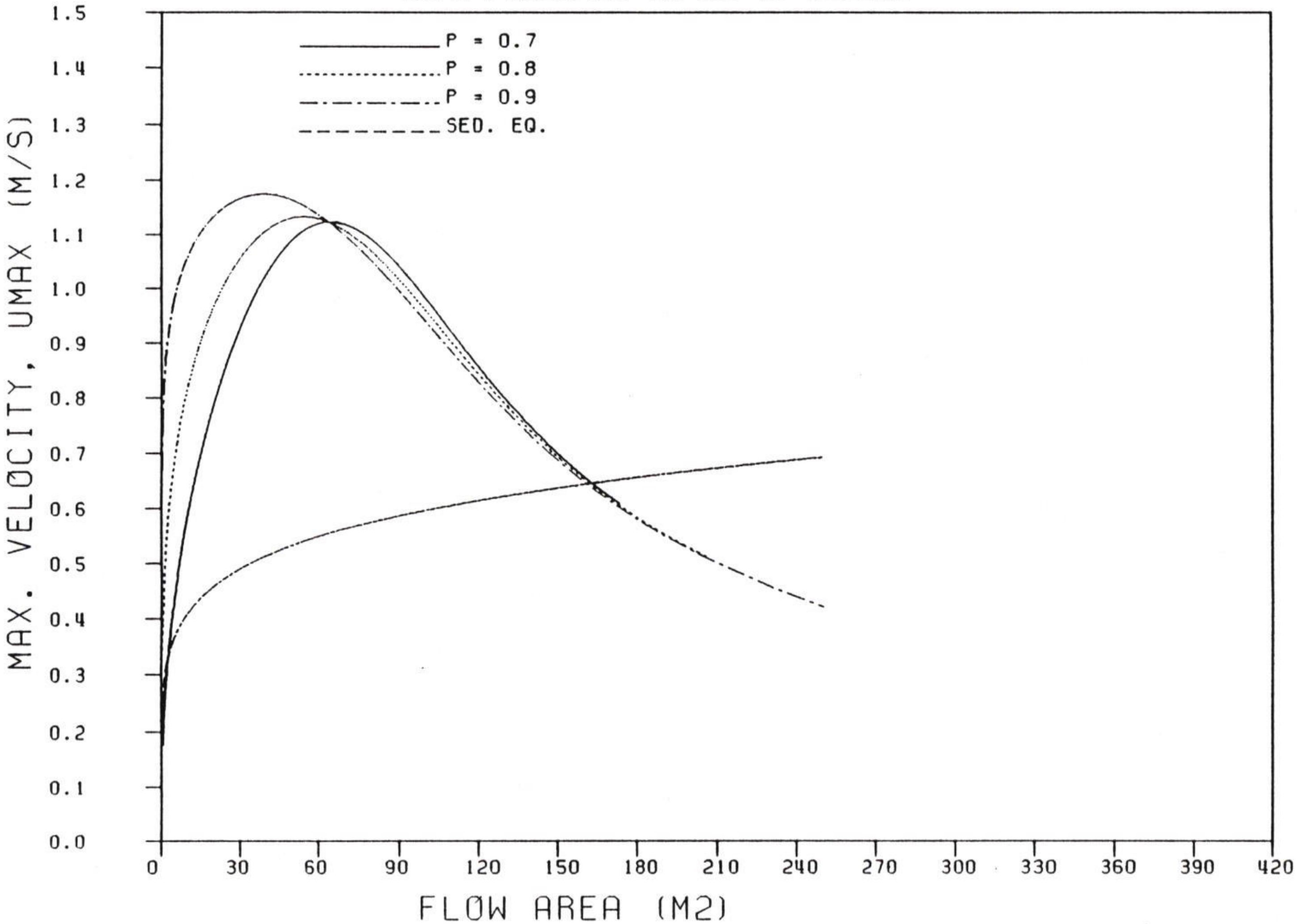


FIG.6.4: STABILITY DIAGRAM, BLIND P.
(SAME PARAMETER INPUTS AS MODELS)



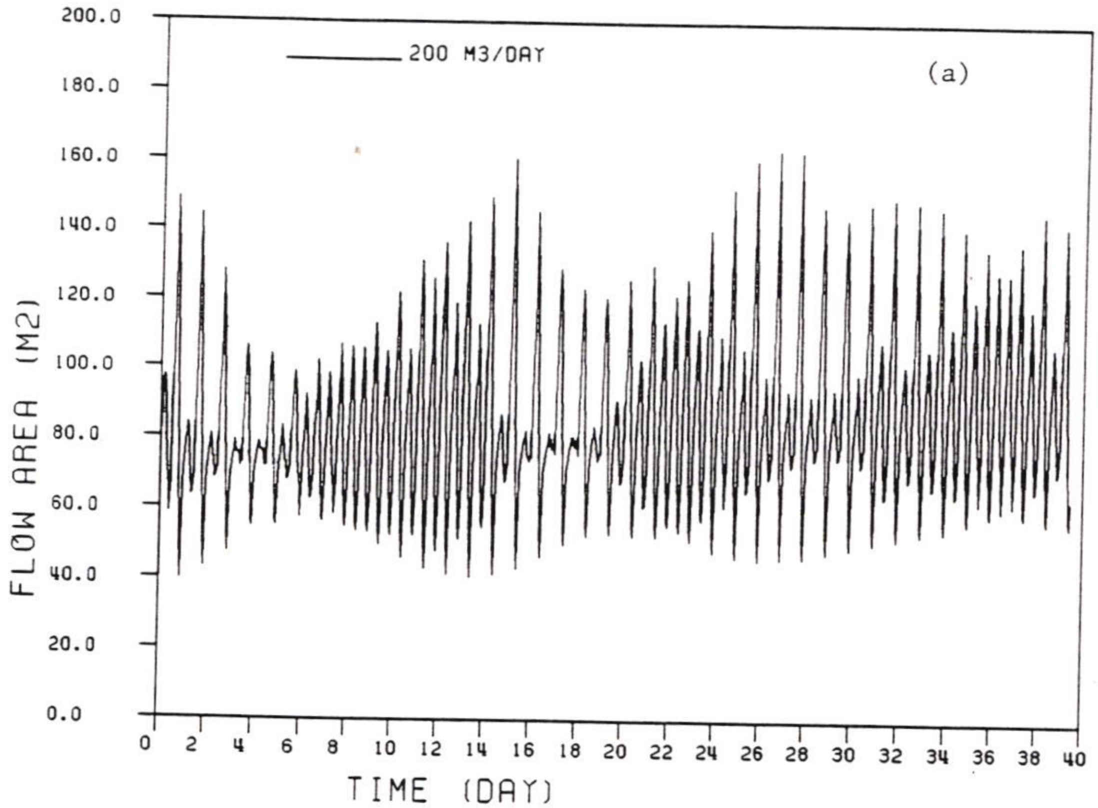
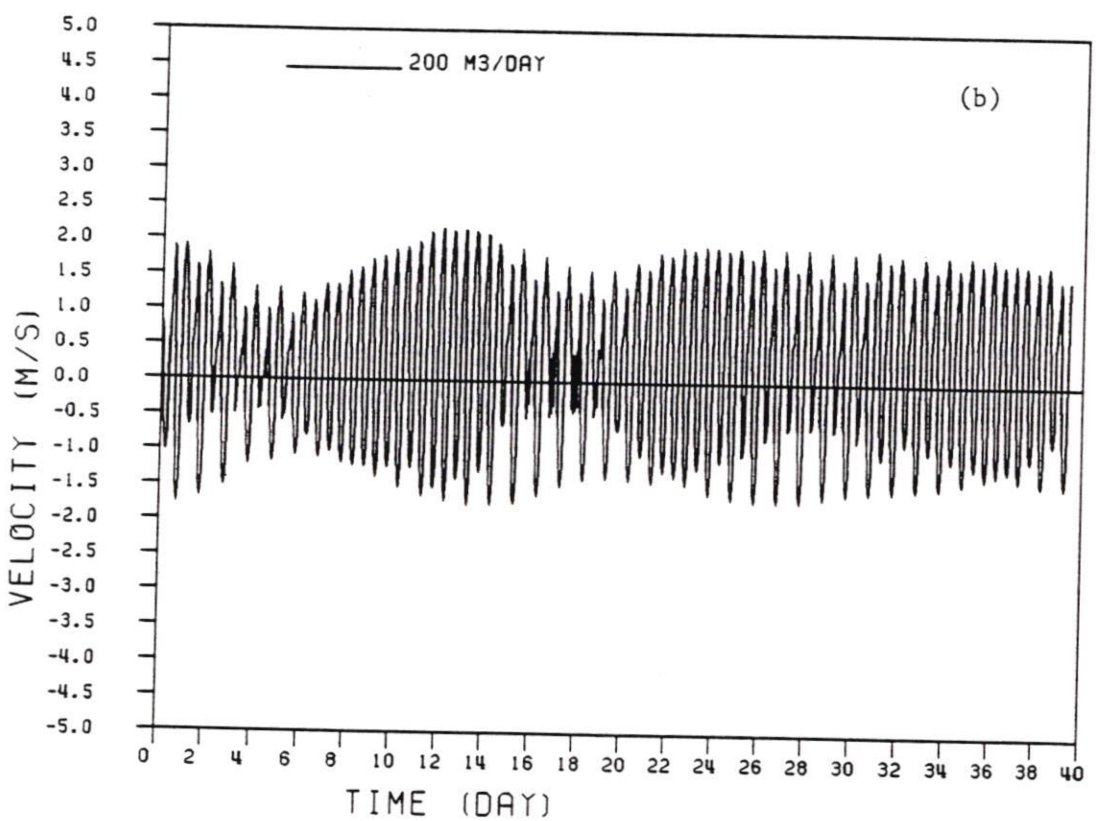


Fig. 6.5 Variation of Flow Area/Velocity with Time
($M = 200\ m^3$/day)



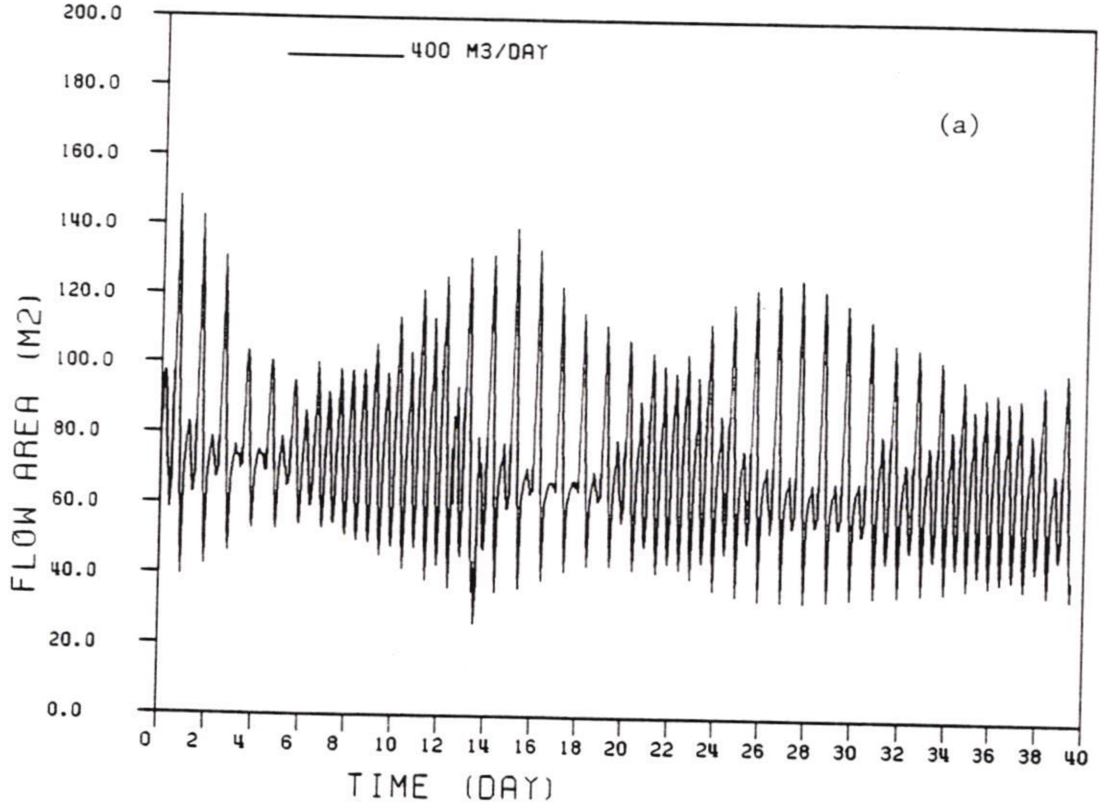
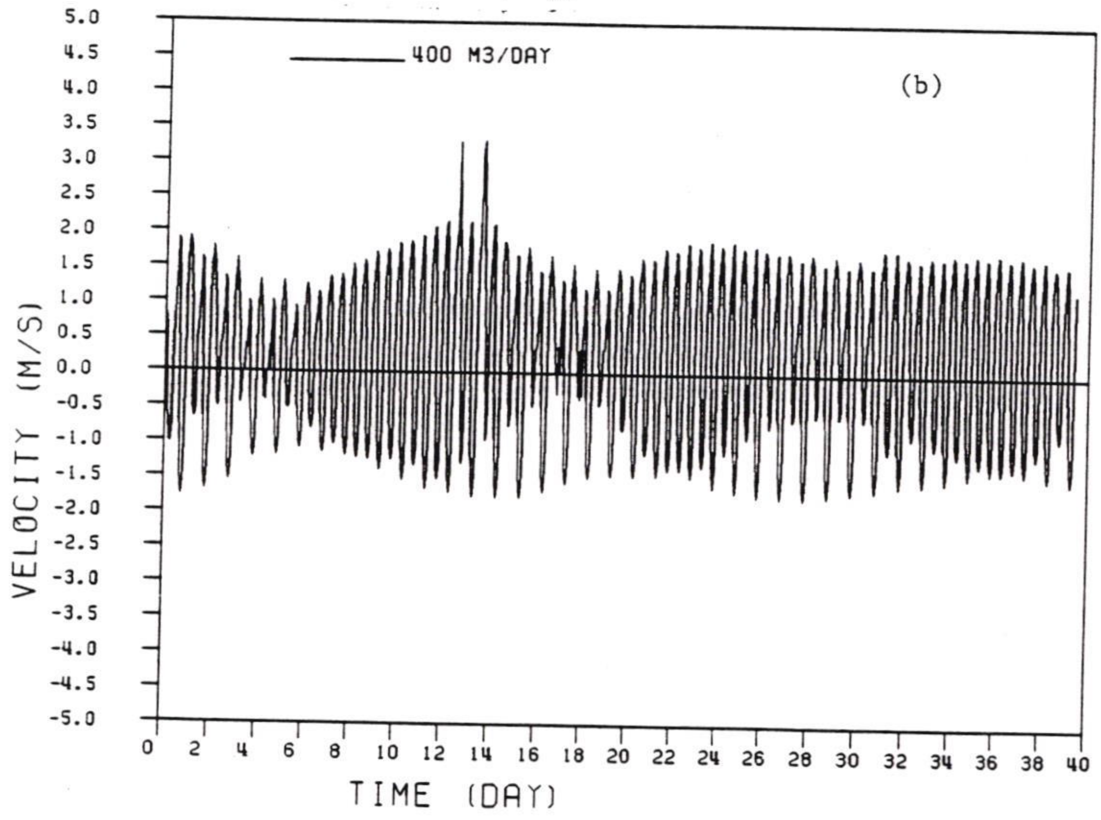


Fig. 6.6 Variation of Flow Area/Velocity with Time

(M = 400 m^3/day)



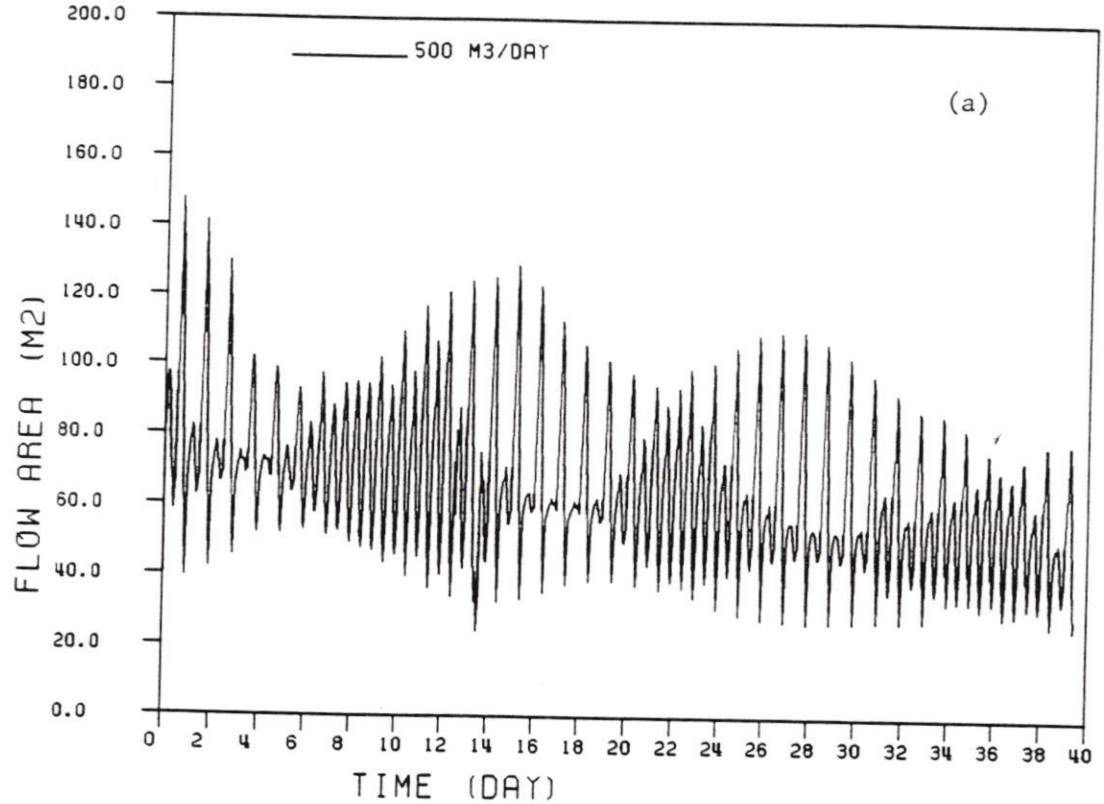
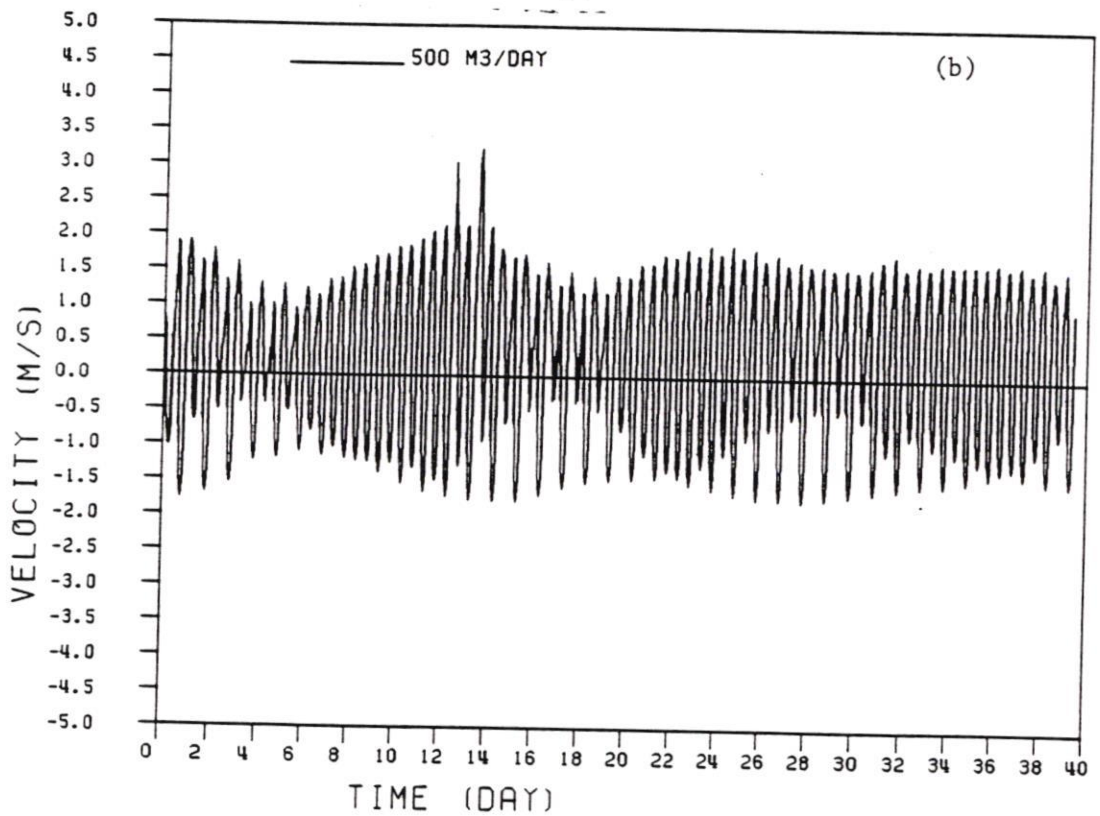


Fig. 6.7 Variation of Flow Area/Velocity with Time

($M = 500\ m^3/day$)



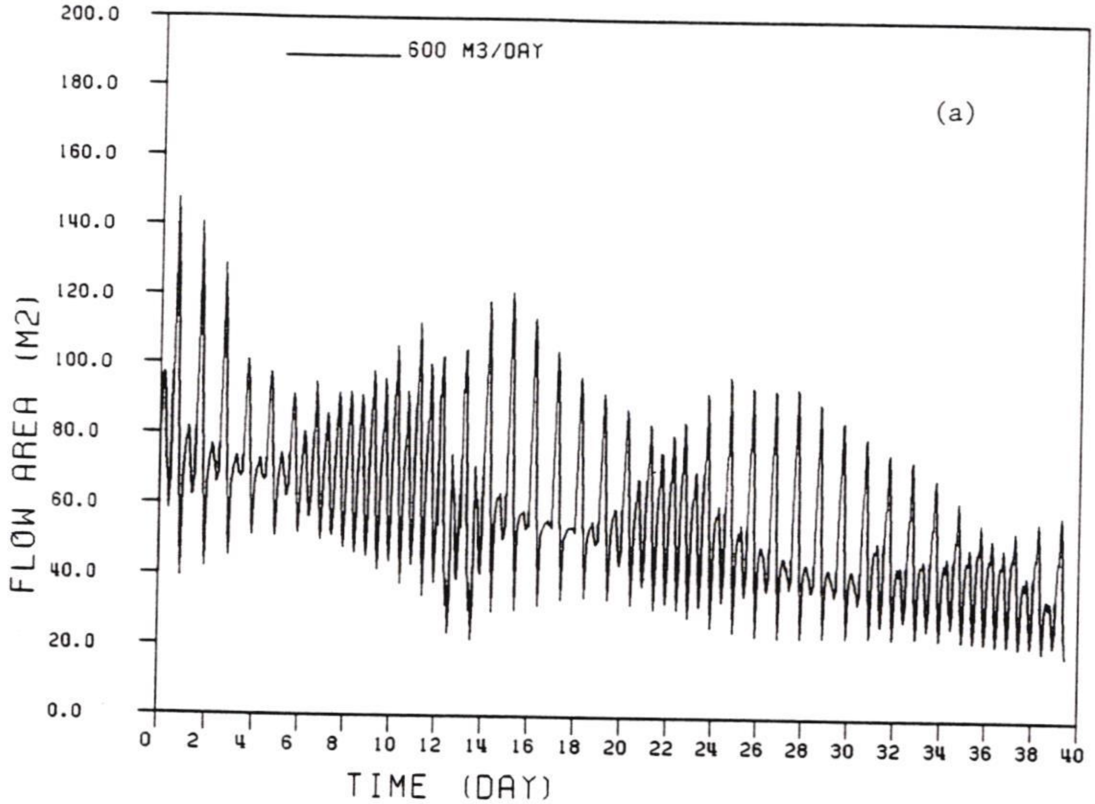
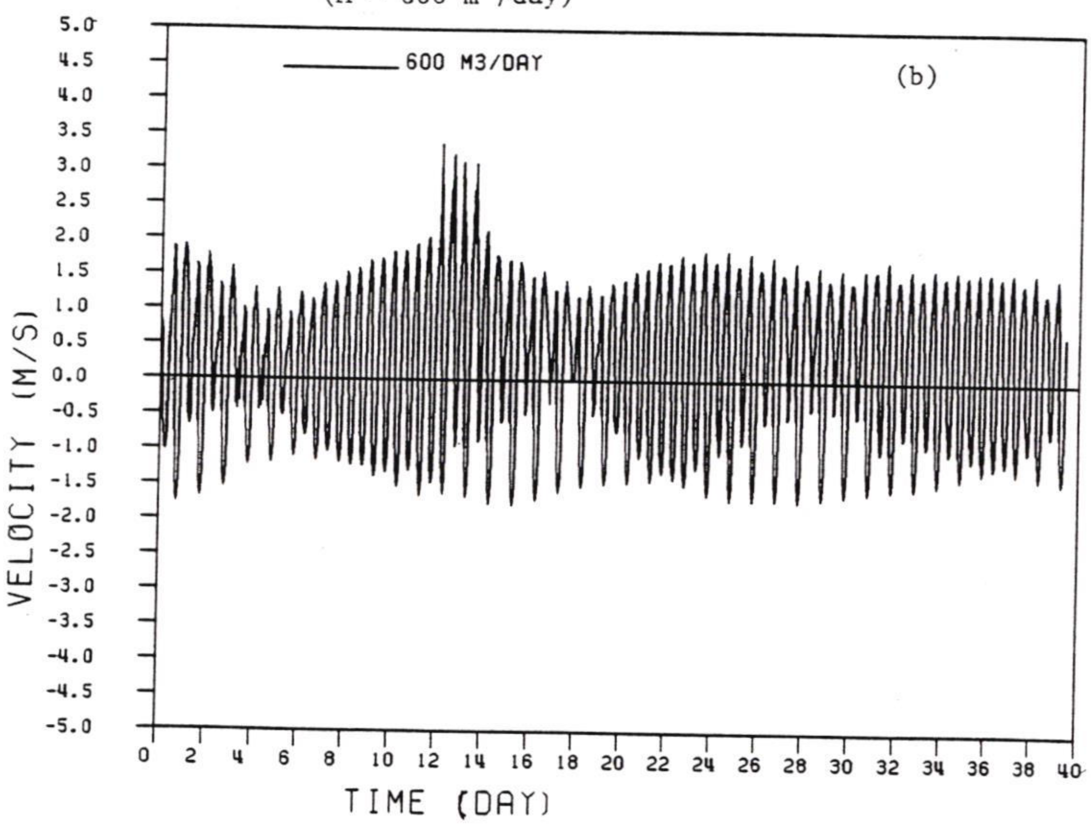


Fig. 6.8 Variation of Flow Area/Velocity with Time

($M = 600\ m^3/day$)



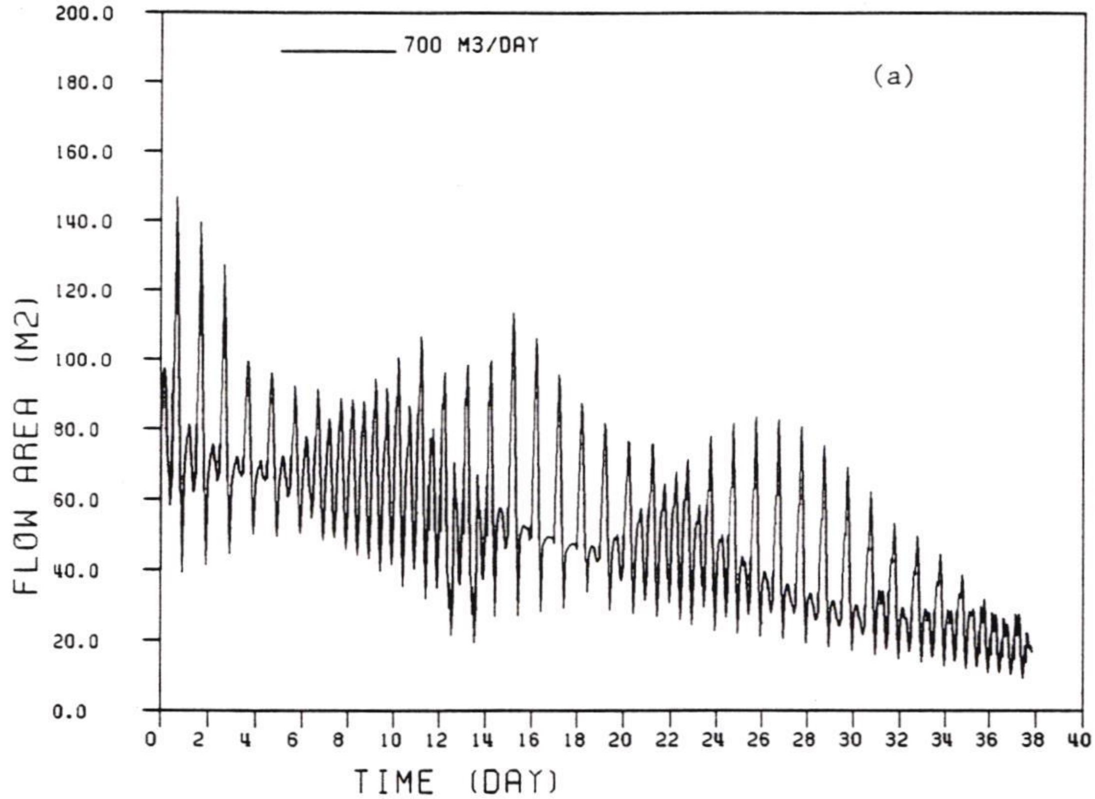
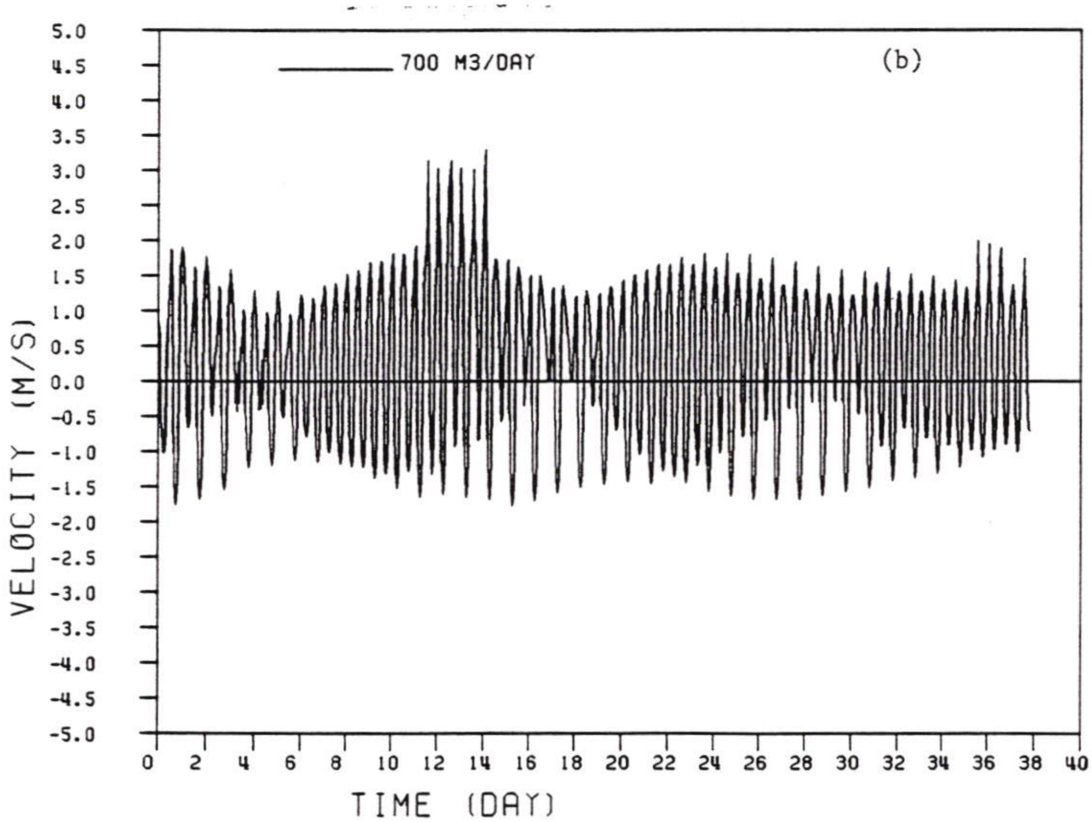


Fig. 6.9 Variation of Flow Area/Velocity with Time

(M = 700 m^3/day)



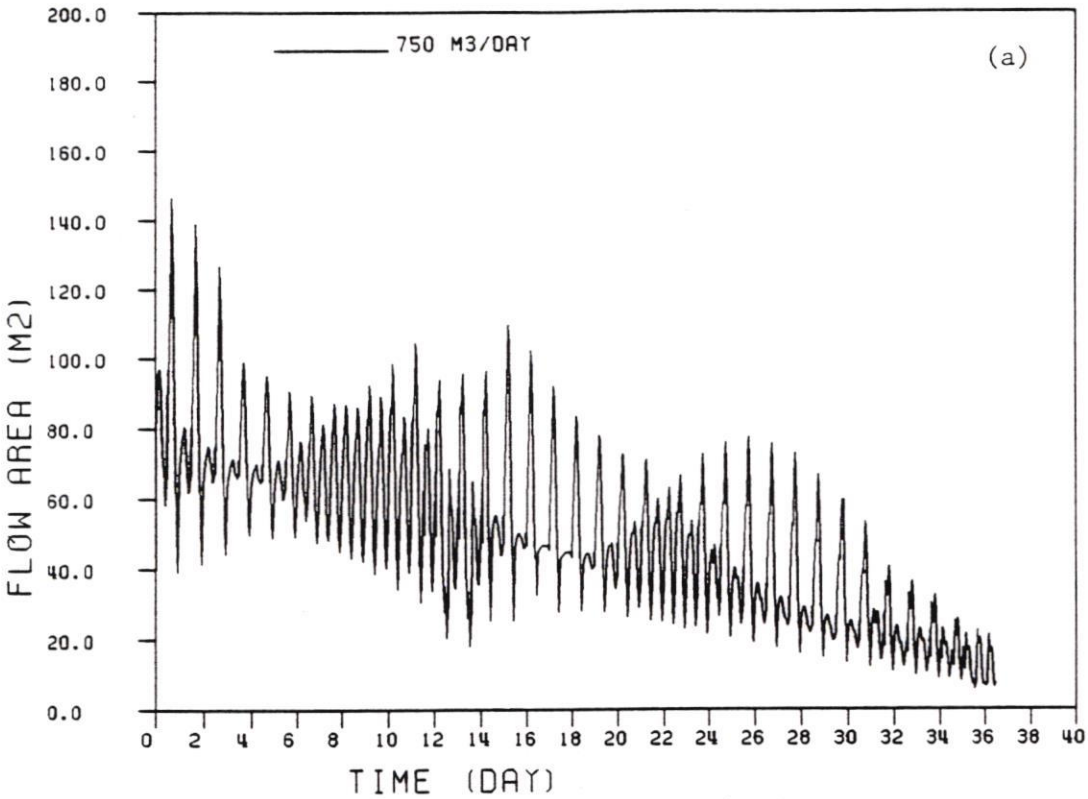
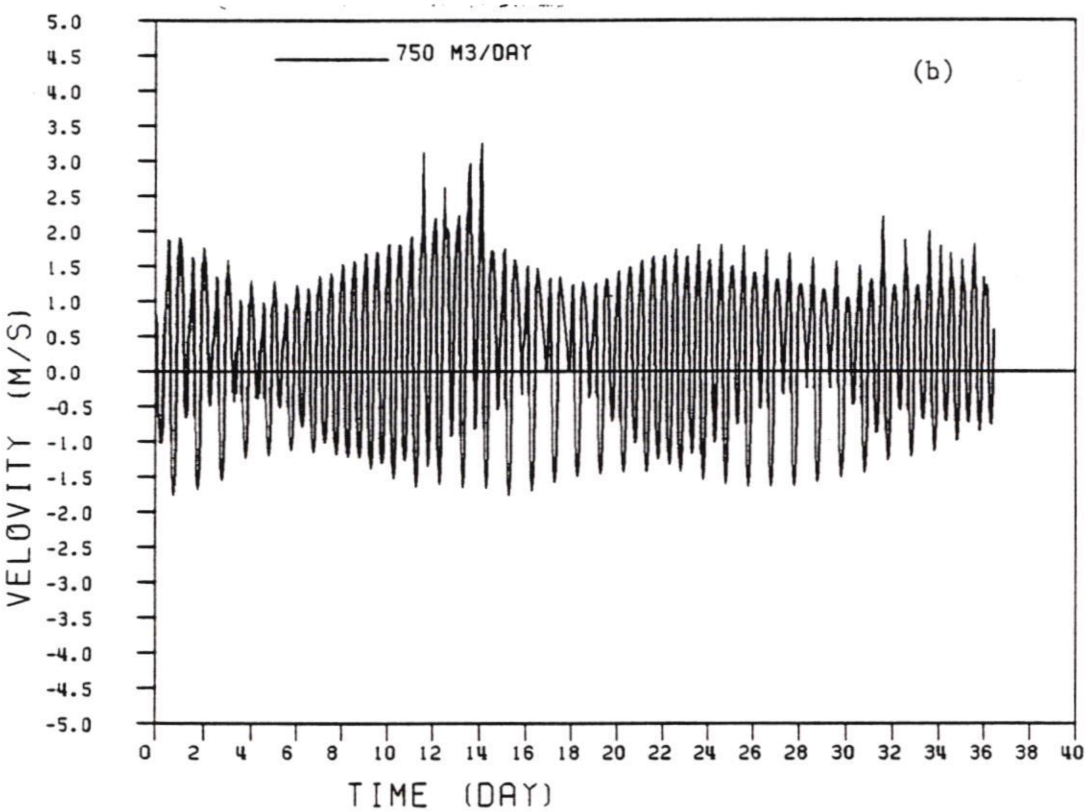


Fig. 6.10 Variation of Flow Area/Velocity with Time

(M = 750 m^3/day)



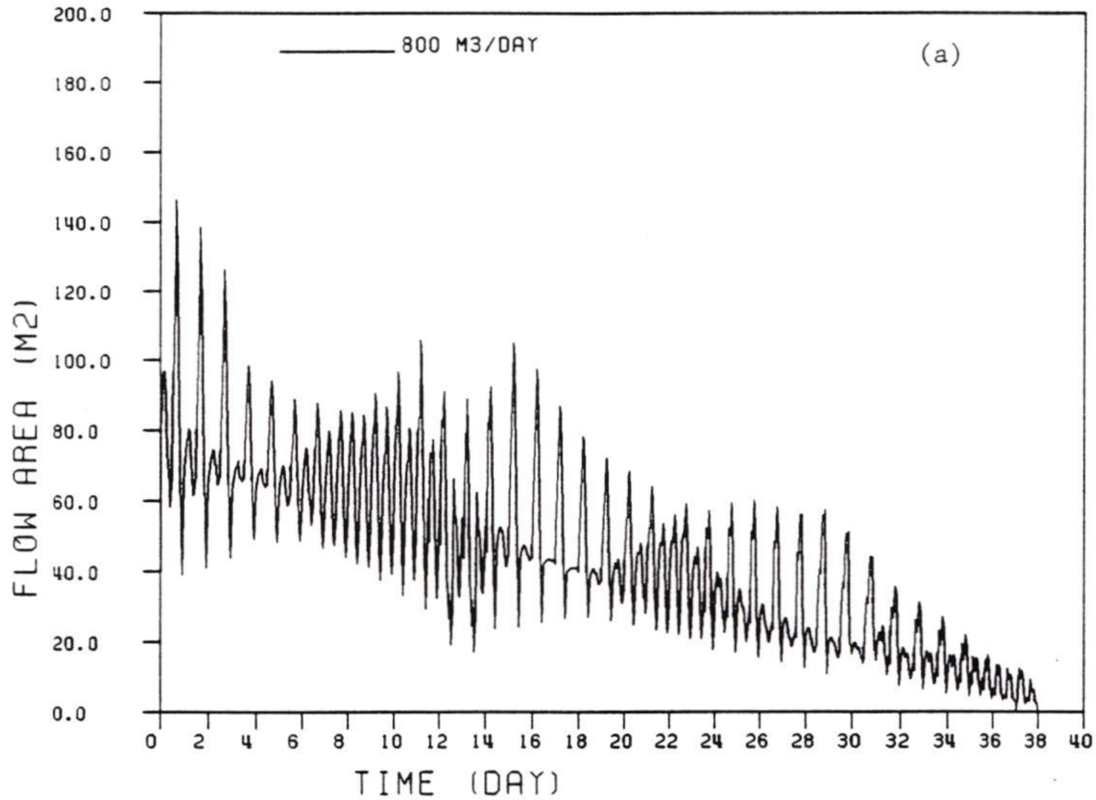
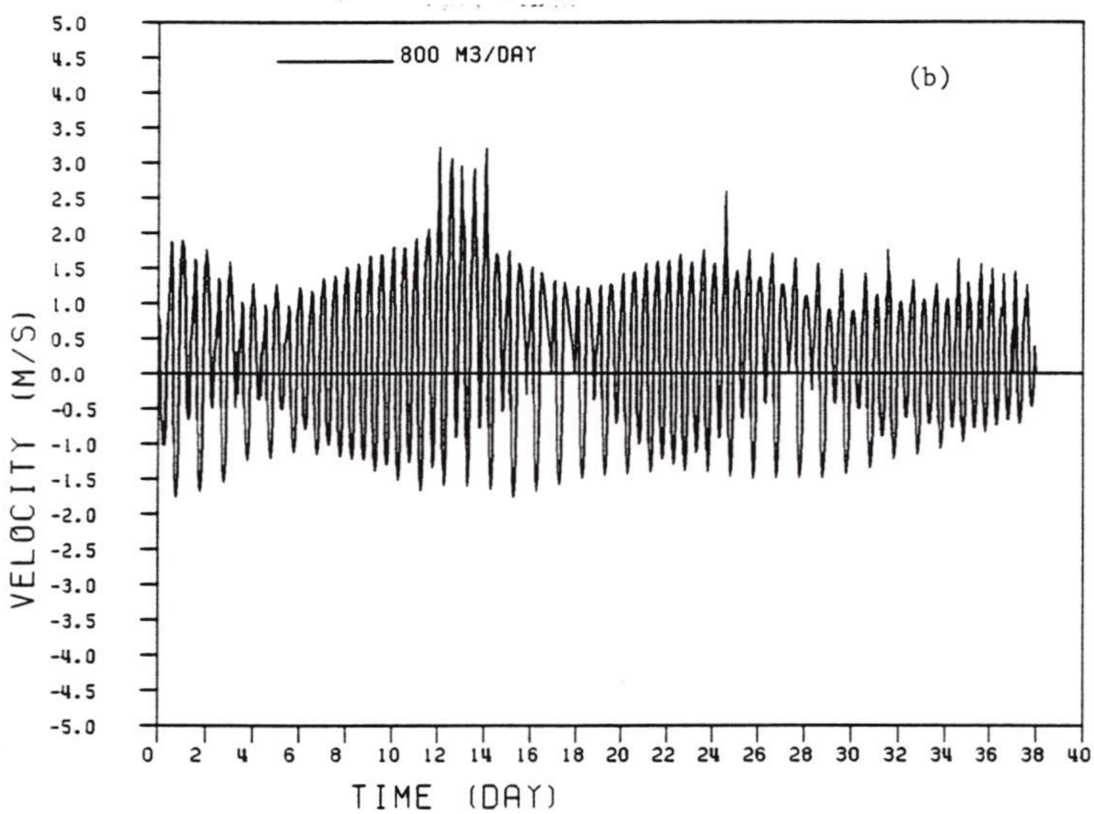


Fig. 6.11 Variation of Flow Area/Velocity with Time

($M = 800\ m^3/day$)



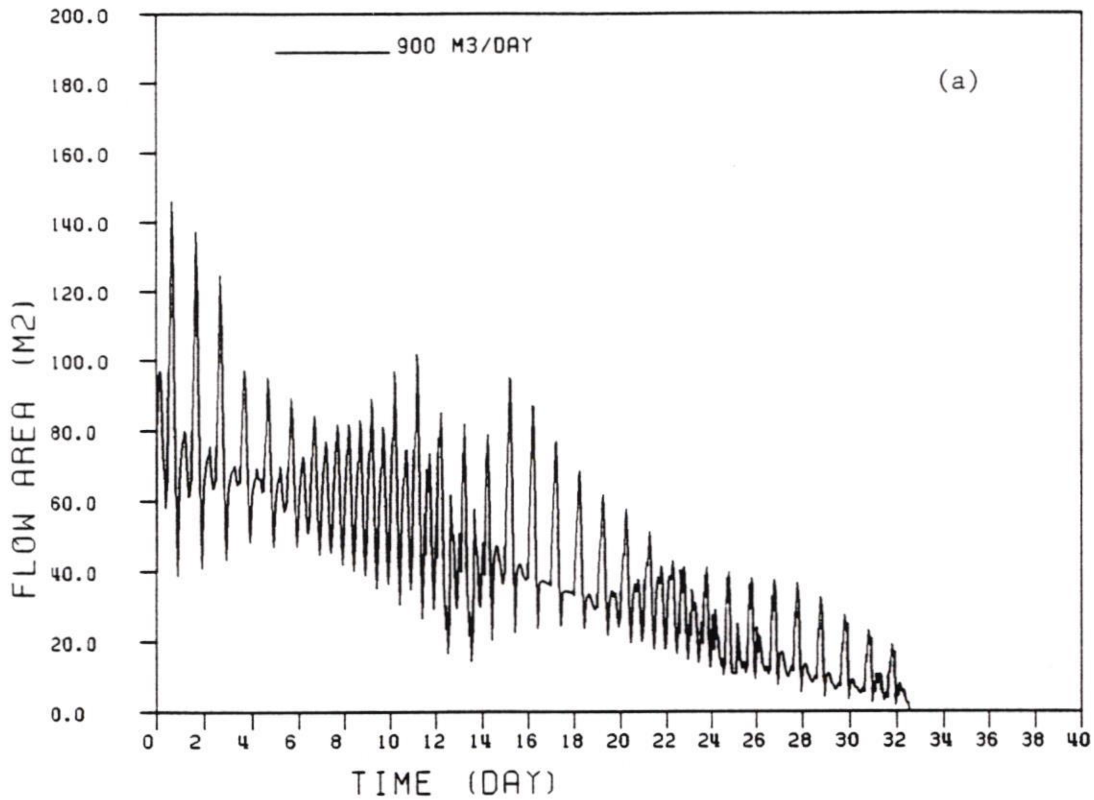
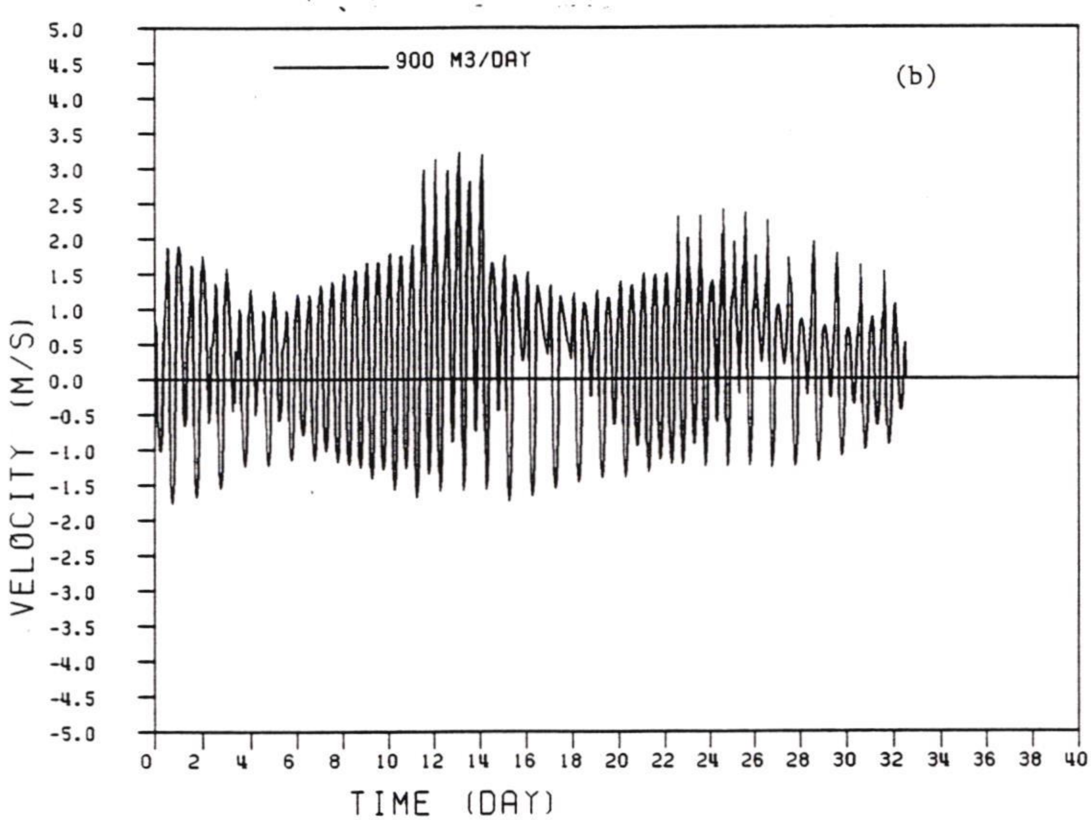


Fig. 6.12 Variation of Flow Area/Velocity with Time
($M = 900\ m^3/day$)



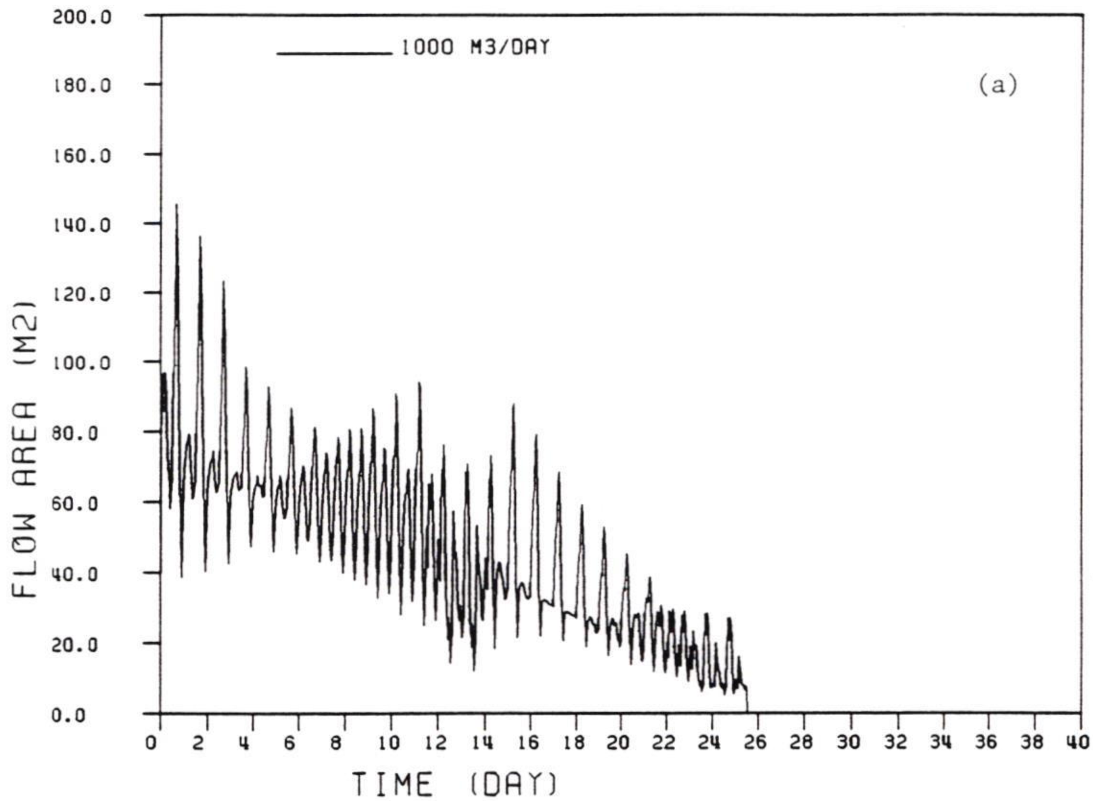
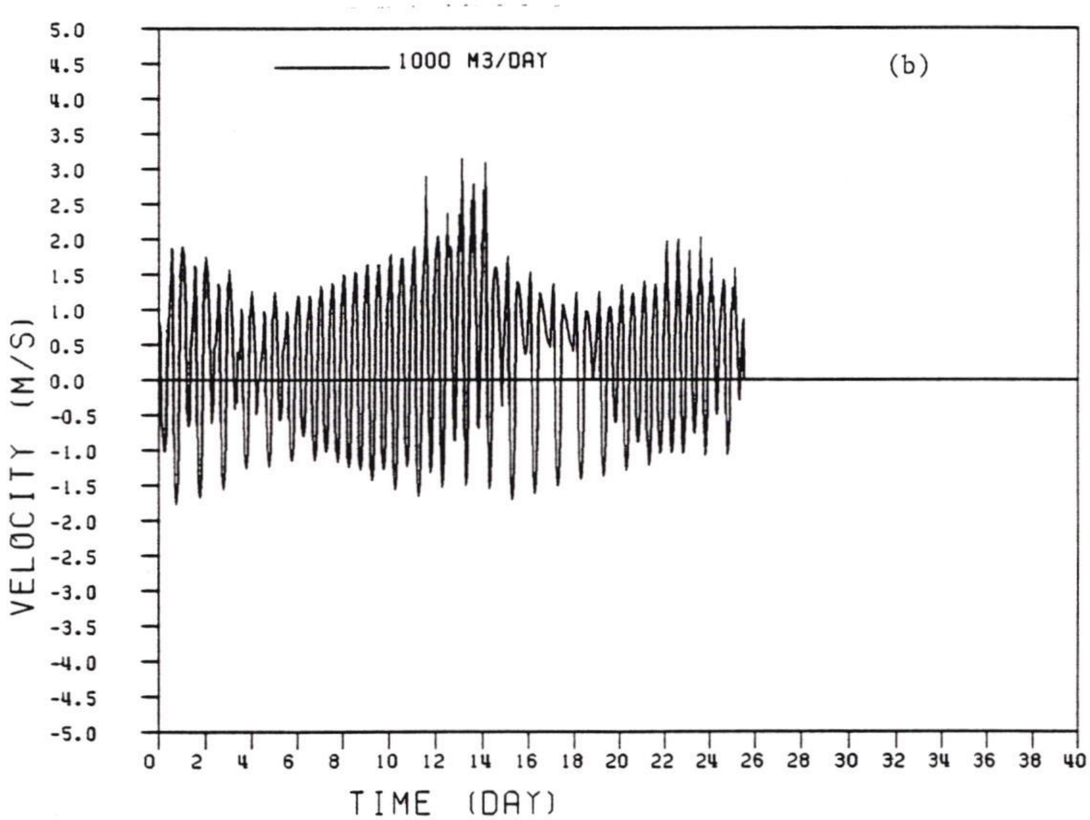


Fig. 6.13 Variation of Flow Area/Velocity with Time
($M = 1000\ m^3/day$)



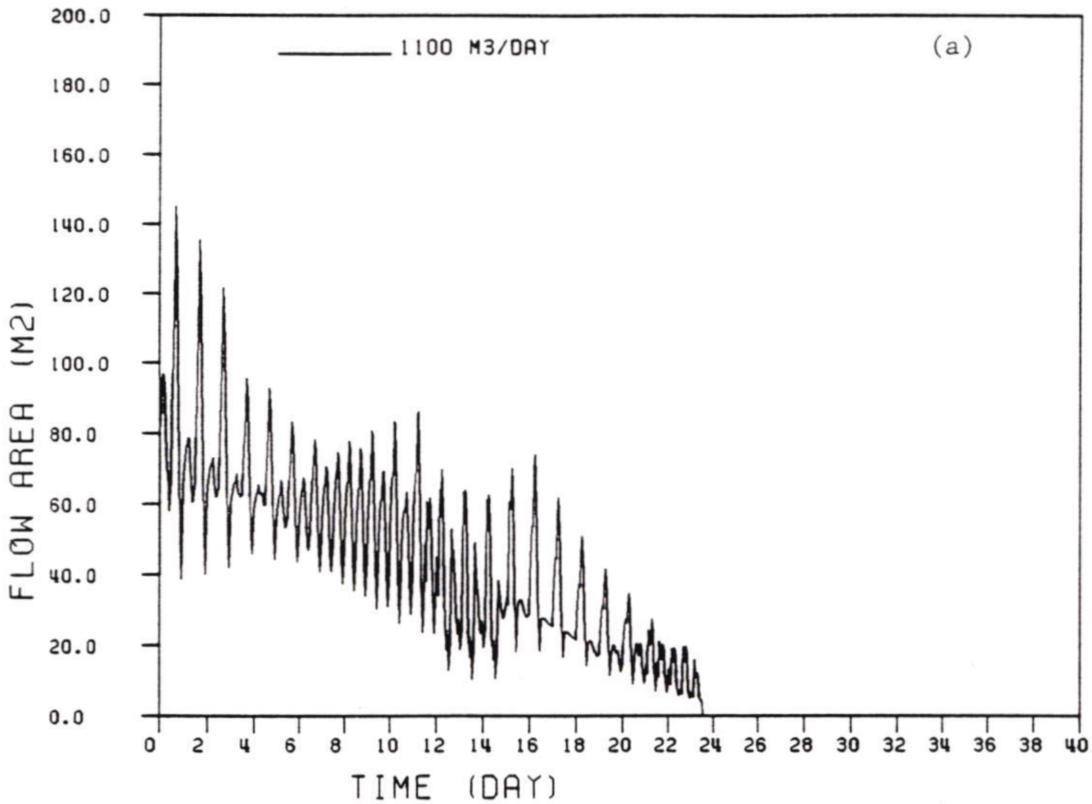
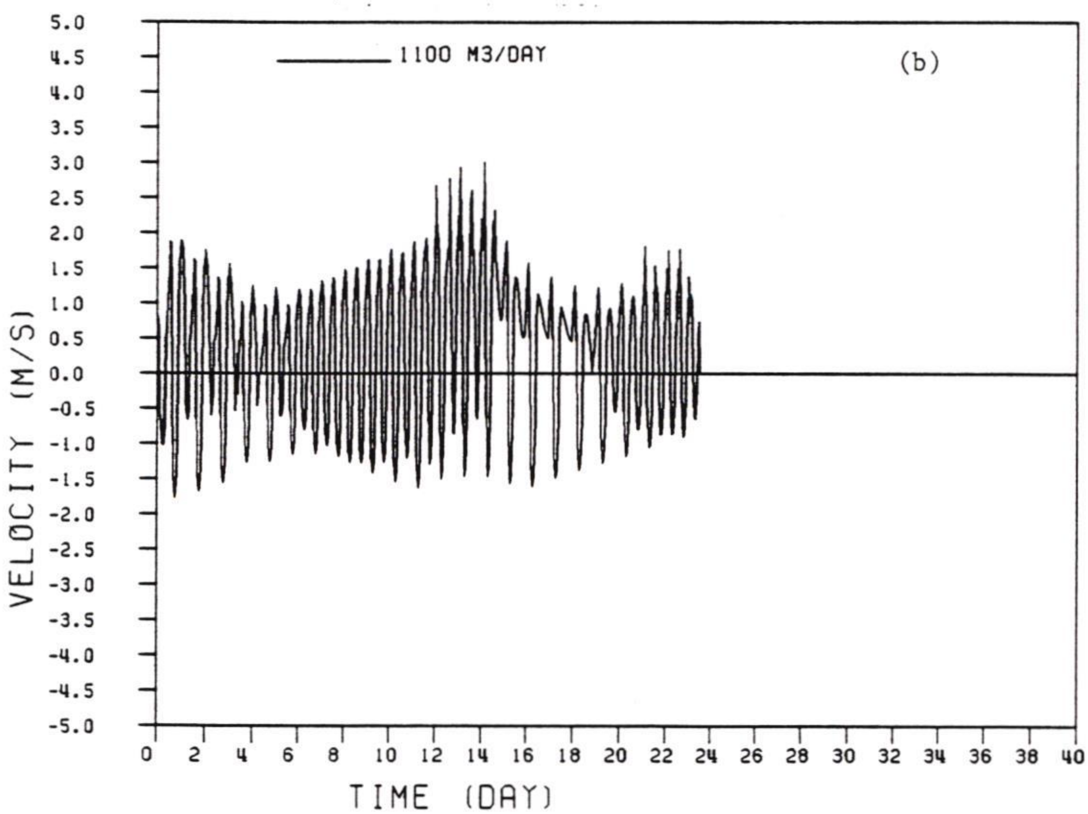


Fig. 6.14 Variation of Flow Area/Velocity with Time
($M = 1100\ m^3/day$)



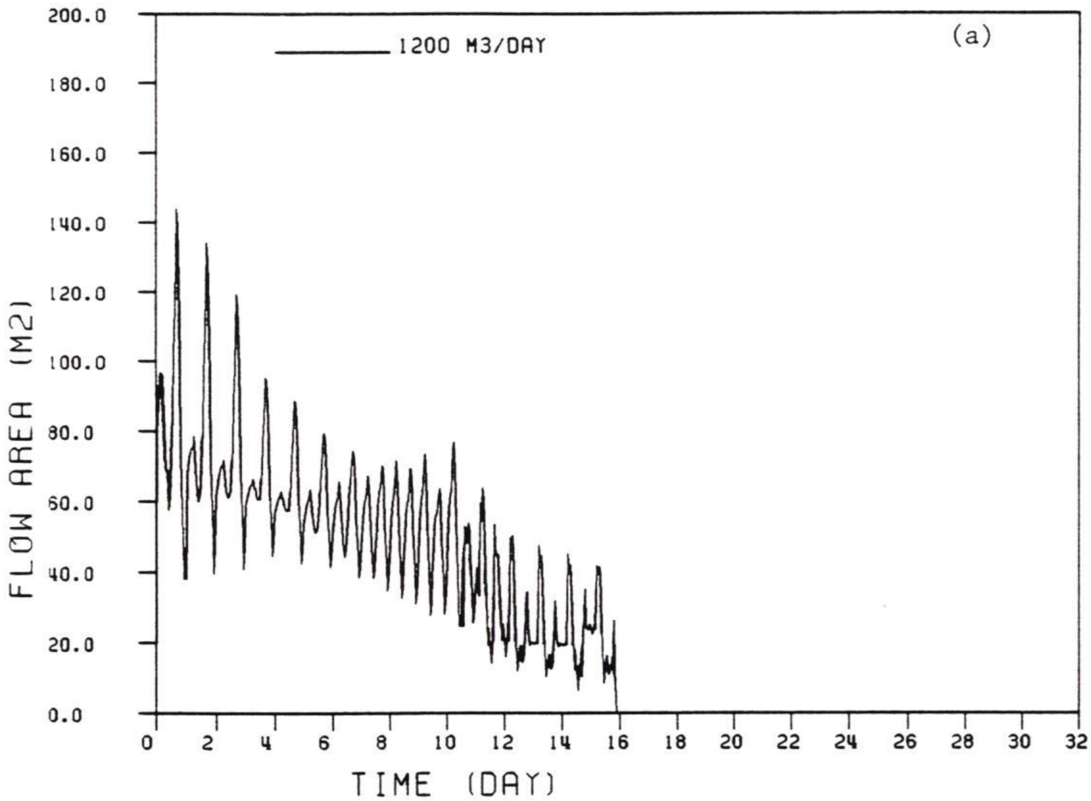
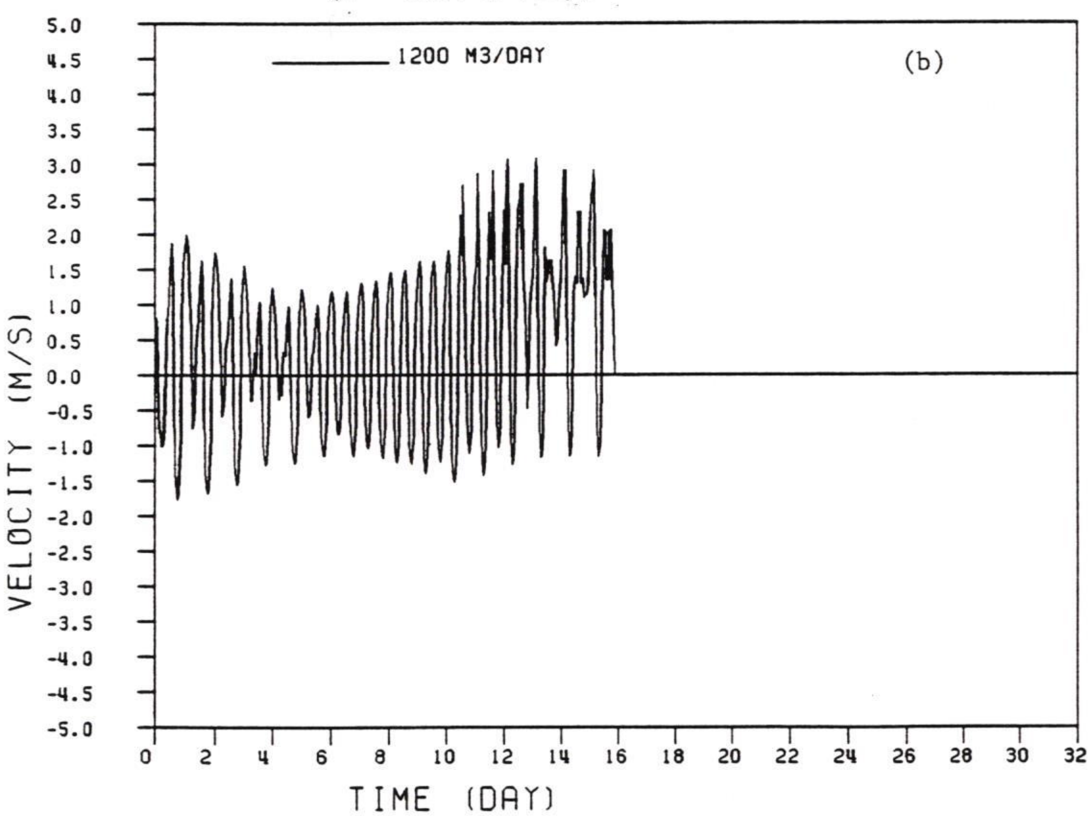


Fig. 6.15 Variation of Flow Area/Velocity with Time
($M = 1200\ m^3$/day)



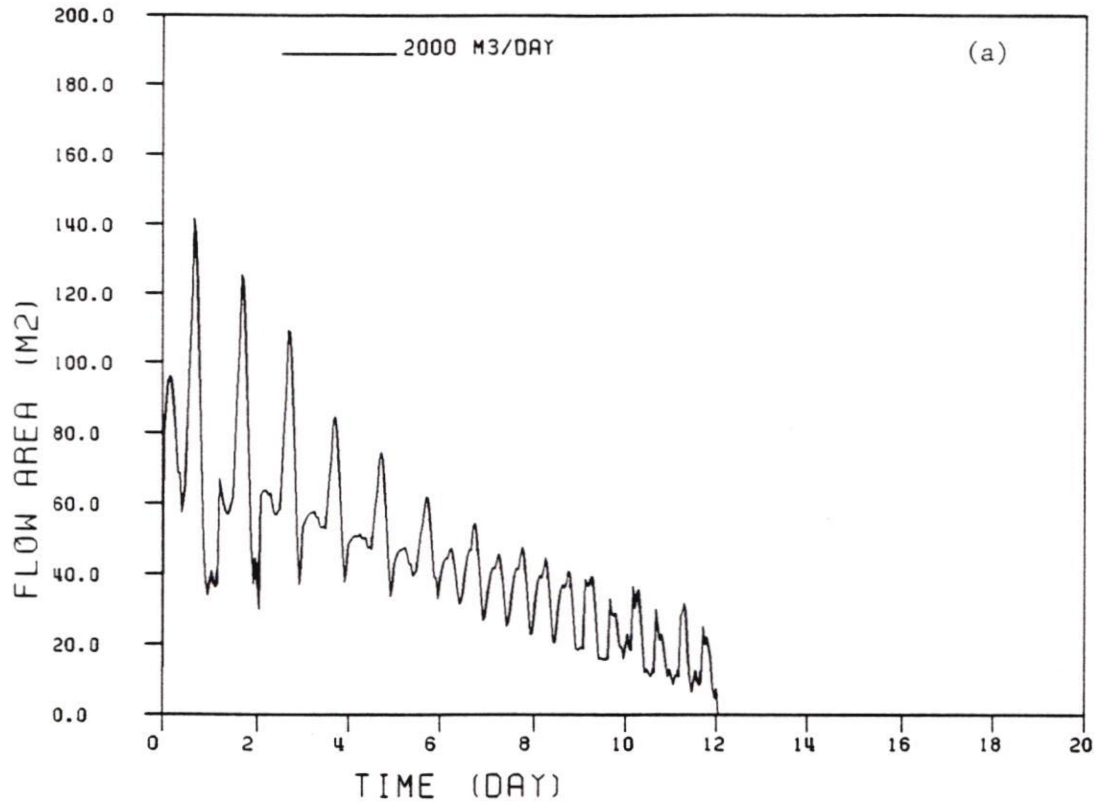
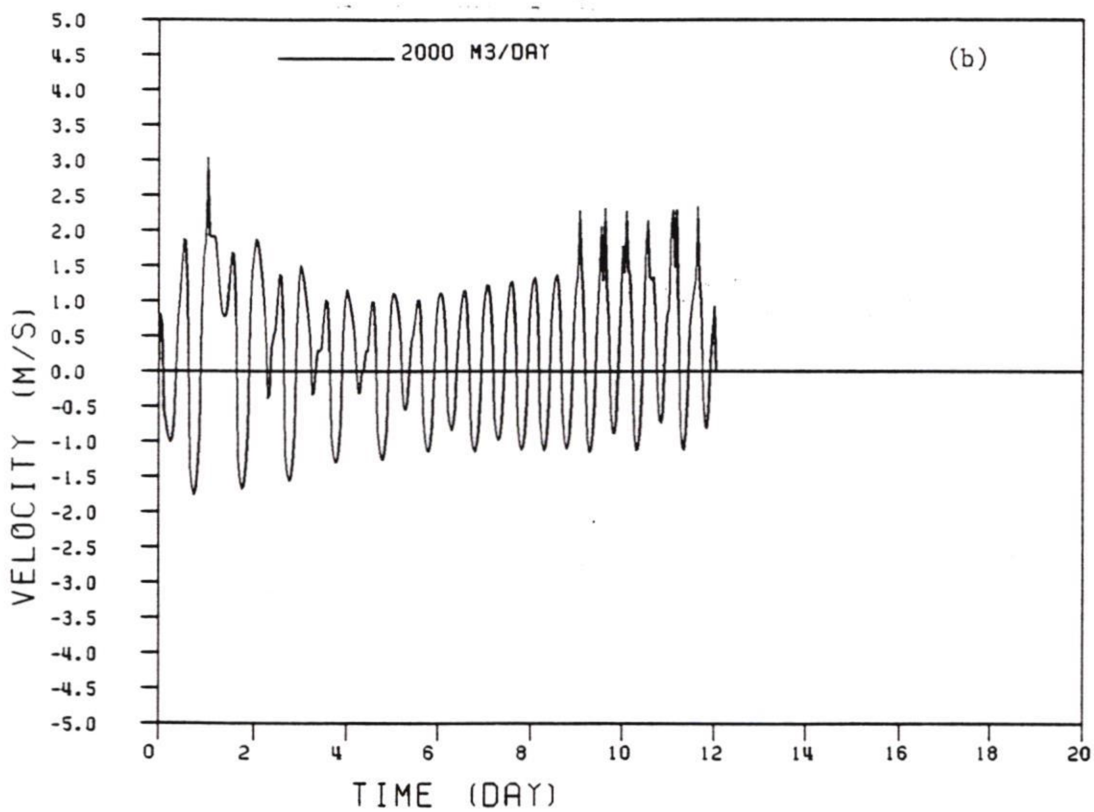


Fig. 6.16 Variation of Flow Area/Velocity with Time
($M = 2000\ m^3$/day)



OFFICE: 1010 NW 39th STREET
GAINESVILLE, FL 32605 PHONE: 904-373-1230 **NUTECH CONSULTANTS, INC.**

December 9, 1991

Doug Mann
Coastal Planning and Engineering
2481 NW Boca Raton Boulevard
Boca Raton, FL 33431

Dear Doug:

With reference to your communication of November 19, I have decided to respond via this letter as opposed to a phone call as you suggested. Please consider these comments, together with the report on the stability analysis already delivered, and my letter to Tom dated September 10, as the final communication for the work for which I was contracted by CPE.

I have reviewed the various Blind Pass (Lee County) Management Plan alternatives in relation to "potential effects that inlet modifications might have on the nature of the inlet" (vide Scope of Work, p.4). In my evaluation of the alternatives I have had to recognize that I have looked at the stability of Blind Pass, but have not been involved in the study of Clam Bayou, which was beyond the scope of my analysis work, although it does constitute an important component of the overall plan. I therefore will not comment on issues related to the stablity or impacts on Clam Bayou.

As for Blind Pass, let me make the following comments relative to the three categories of alternatives listed in the table with the decision matrix: A (I?). Close the Inlet, B. Inlet Bypassing Systems, and C. Experimental Systems.

A. Close the Inlet: For both the sub-categories A.1 and A.2 you have recommended nos, with which I agree.

B. Inlet Bypassing Systems: For items B.1 through B.10 please refer to my letter to Tom (copy enclosed); you will note that my recommendations are inherently at some variance with those being considered for the following reasons: 1) Given the scope of my work, I have given paramountcy to the need to maintain a channel that will not close, hence 2) I have not considered the beach nourishment needs which in any case I was not directly concerned with, and 3) I have not made any ecological impact evaluation. Given these factors it is not surprising that I do not concur with all the nos and maybes indicated in the decision matrix. On the other hand, what I have in mind for Blind Pass alone has been stated in my letter, although I would further recommend that no plan that involves either beach nourishment and/or jetty construction near Blind Pass be implemented without a thorough examination of inlet response (via physical and/or numerical modeling) to the proposed changes. Specifically I would be concerned with: 1) the potential for closure without any south jetty, since in my opinion closure in this case is rather likely, and 2) shape, length and orientation of the south jetty (note the difference between my proposal and yours e.g. for alternative B.5). My own design, which is rather arbitrary and one that would require modification in tandem with the beach nourishment needs, is for conceptual purposes only, and I cannot recommend it without a separate extensive study. Personally I would not be potentially interested in carrying out such a study however.

C. Experimental Systems: From my perpective we must differ again since I would favor C.1 or C.2 over C.3. In any event I question the practicality of instituting in the recent future any of the three alternatives considered.

Sincerely

Ashish J. Mehta

Ashish J. Mehta

COLLEGE OF ENGINEERING

UNIVERSITY OF FLORIDA

GAINESVILLE, FLORIDA 32611-2083
PHONE: (904) 392-1436 SC: 622-1436
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COASTAL AND OCEANOGRAPHIC
ENGINEERING DEPARTMENT
336 WEIL HALL

November 18, 1991

Tom Campbell
Coastal Planning & Engineering
2481 NW Boca Raton Boulevard
Boca Raton, FL 33431

Dear Tom:

It was good to have met you at Captiva and to discuss with you issues related to Blind Pass. Let me congratulate you once again on your presentation effort; it demonstrated your hard work in grasping the key elements in the complex project, as well as your dexterity in answering the questions posed.

As you indicated during your presentation, my comments on possible solutions to the stability matters at Blind Pass were the outcome of the stability analysis and did not constitute a component of the options then presented. I do however wish to reiterate my opinion, which is however quite tentative, considering the limited scope of my involvement in the overall study, and I trust I would not be over–extending the charge in re my part of the work.

As a result of the beach nourishment related projects that have taken place in that area, the interior environment of Blind Pass can by no means be considered to be undisturbed; for one thing, sand from the beach seems to have accumulated in the interior. At any rate, aerial photographs suggest that although visible sand accumulation may have been due to normal littoral transport along that shoreline, that the intake of sand by the inlet has been enhanced by the nourishment project, even though long term, post-jetty data suggest that the average rate of influx has dropped due to the jetty. Our examination of the stability issue does indicate that the stability of this inlet has been marginal for years, but that the jetty has helped reduce the potential frequency of closure of the mouth, although by no means eliminating that likelihood. On the other hand, the interior area has become shallower hence hydraulically less efficient that before.

While the decision to keep the inlet open or close it (by active means or by "default") may be dependent on the management option chosen, it is my position that the inlet should be kept open actively as an integral component of any management plan, for reasons of the quality of the waters immediately interior of the mouth, for the health of the bird preserve, and for fish and larval transport. I therefore support your Alternative B.6 to remove the flood shoal, which will only cause a temporary perturbation to the system. In addition I suggest that a small relief channel (of dimensions and configuration to be decided) should be considered to improve water ingress and egress. The assertion that a small a channel would cause the inlet to widen to the size of Redfish Pass is entirely unsupported by engineering calculations. Also, the sand that has accumulated in the interior will not leave that area of its own accord, and in fact there is some danger that if allowed to accumulate unchecked then, since the (elevation) relief in that area is very low, a significant storm could open an alternate passage through the barrier in that region.

Alternative B.5 shows a jetty that may be suitable for the nourishment project, but if such a nourishment project were not an issue, then I would recommend a much shorter structure as I have sketched (attached). Note that this sketch is wholly qualitative, unsupported by any coastal engineering investigation on my part. Note also however that since the dimensions of the inlet are controlled to some extent by the bridge, the B.5 structure may not serve as an effective jetty for the inlet; it may actually cause sand to become trapped between the two jetties and enhance the possibility of closure, as for example occurred at Blind Pass in Pinellas County. The structure I have sketched could be extended somewhat, parallel to the north jetty, if the beach immediately south is nourished. However it should not be extended too much in the beginning at least; later if necessary that can be accomplished. The idea here is to minimize human perturbation as far as possible, and monitor impact before further action.

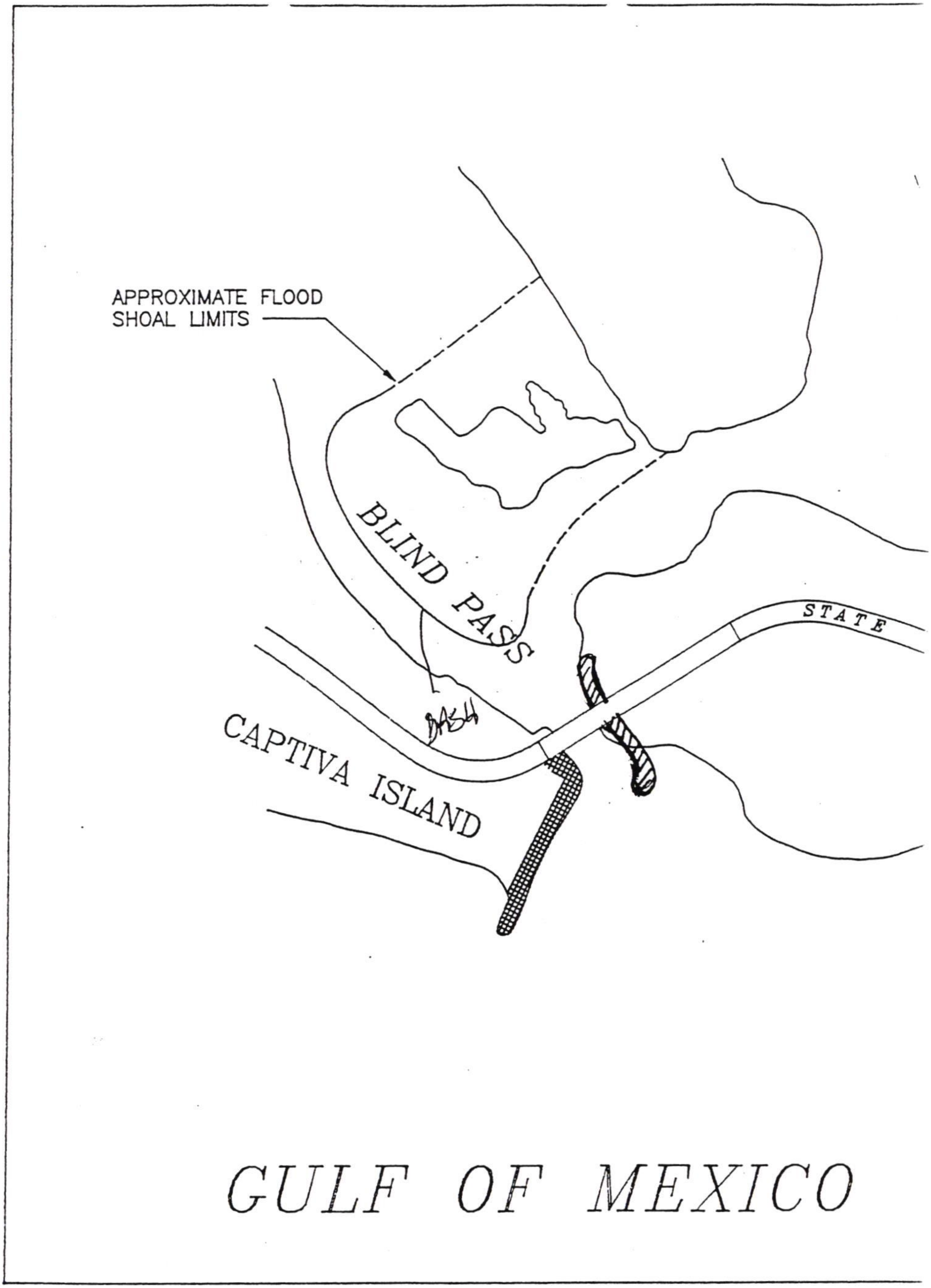
These comments are mere suggestions and are for your information only; they do not constitute a part of the stability report I have submitted. Nevertheless I trust they will serve some useful purpose in your well thoughtout management study.

Sincerely yours,

Ashish J. Mehta

Ashish J. Mehta
Professor

AJM/cjv


APPROXIMATE FLOOD SHOAL LIMITS
BLIND PASS
STATE
CAPTIVA ISLAND
GULF OF MEXICO

City of Sanibel

800 Dunlop Road
Sanibel, Florida 33957

AREA CODE - 813

CITY COUNCIL	472-4135
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December 5, 1991

RECEIVED DEC - 9 1991

Mr. Ralph Clark
State of Florida
Department of Natural Resources
Office of Beach Management
Marjory Stoneman Douglas Building
3900 Commonwealth Blvd.
Tallahassee, FL 32399

Re: Blind Pass Inlet Management Plan

Dear Mr. Clark:

Enclosed is a copy of the questions the City's consulting engineer, Ken Humiston of Humiston & Moore, has given to Coastal Planning & Engineering regarding the Blind Pass Inlet Management Plan interim report.

On December 3 the Sanibel City Council heard a presentation regarding the study by Mr. Thomas Campbell. Council took no action, but instructed our consulting engineer to return on December 17 with an analysis of the findings of the report. I will send you a copy of his analysis and would appreciate, in turn, copies of any correspondence from you to the inlet management plan consultant.

Thank you for your cooperation in this matter.

Respectfully,

Gary A. Price

Gary A. Price,
City Manager

GAP/VJS

cc: Sanibel City Council
Ken Humiston, Humiston & Moore
Sanibel City Attorney
Dr. Robert G. Dean
Captiva Erosion Prevention District
Thomas J. Campbell, Coastal Planning & Engineering

HUMISTON
& MOORE
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DESIGN AND
PERMITTING

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NAPLES, FLORIDA
FAX 813 261 5297
PHONE 813 261 8160

December 4, 1991

Mr. Gary Price, City Manager
City of Sanibel
800 Dunlop Road
Sanibel, Florida 33957

Re: Review of Blind Pass Inlet Management Plan Interim Report #2
H&M File No. 1-035

Dear Gary,

We have completed our review of the Interim Report and are providing the following comments. Our comments primarily have to do with our concern that the Interim Report does not adequately address the goals of the State Inlet Management Guidelines.

Inlet Management Plan Goals

The interim report states that its purpose "...is to provide the basis for discussion of inlet management options for Blind Pass", but it doesn't state the purpose of inlet management.

The general purpose of inlet management plans, under section 161.161 of the Florida Statutes, is to "evaluate each improved (developed) coastal inlet and determine whether the inlet is a significant cause of erosion", and "..to mitigate the erosive impact..".

Blind Pass is considered to be an improved (developed) inlet by virtue of the fact that there is a north jetty. The jetty was constructed to protect the upland from erosion by trapping littoral drift, and later extended to reduce end losses from the Captiva beach nourishment. It was not built to maintain Blind Pass as a navigable inlet. Based on this, and discussions at the December 3rd City Council meeting, the goals of this plan need not include keeping Blind Pass or Clam Bayou open.

The goals of the inlet management plan for Blind Pass should therefore include restoration of the natural littoral processes that have been disrupted by the jetty, and should provide an adequate beach in those areas that have been adversely impacted. An adequate beach would provide recreational area, storm protection for the upland including the road which is a critical evacuation route, and an environmental resource for sea turtle nesting.

It is our understanding that another goal of the management plan was to resolve controversy over a DNR directive regarding implementation of a jetty extension permit condition. That permit condition calls for removal of the extension and mitigation of erosion on Sanibel. What the plan does, however, is restate the terms of the DNR directive, and does not address resolution of this issue.

Management Alternatives

Several recent investigations have identified the north jetty as a cause of the erosion on the north end of Sanibel Island. The Interim Report recognizes this but does not recognize removal of, or modification of that structure, as a viable part of the management plan. The reason given for rejecting any alternative involving removal of the structure is the assumption that it would result in pass closure, and that the pass must be maintained for water quality purposes. The Interim Report instead focuses on a variety of alternative solutions involving additional structures and beach nourishment.

It should be understood that the above comments pertain to the Interim Report as a preliminary document, and that CEPD's consultant is still in the process of formulating the plan. You have already provided CEPD's consultant with a list of our questions pertaining primarily to technical issues, which CEPD's consultant indicated would be addressed in the next draft of the report. However, we also believe that more emphasis should be directed toward adverse impacts which have resulted from the jetty, and management options should begin by addressing the cause of the erosion.

Recommendation

We recommend that these comments be presented for review at the next Inlet Management Plan Review Committee meeting. We also suggest that it would be beneficial to have technical representation from the state at these meetings to discuss issues that concern compliance with DNR guidelines.

Sincerely Yours,

HUMISTON & MOORE ENGINEERS

Ken Humiston

Kenneth K. Humiston, P.E.

City of Sanibel

800 Dunlop Road
Sanibel, Florida 33957

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CITY COUNCIL	472-4135
A[illegible]STRATIVE	472-3700
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PARKS & RECREATION	472-3373
PLANNING	472-4136
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PUBLIC WORKS	472-6397

December 9, 1991

Mr. Steven Cutler, Chairman
Captiva Erosion Prevention District
P. O. Box 365
Captiva, FL 33924

Re: Blind Pass Inlet Management Plan Subcommittee

Dear Steve:

For quite some time, in the spirit of cooperation and the desire to accomplish a mutually satisfactory conclusion, I have been faithfully attending the Blind Pass Inlet Management Plan Subcommittee meetings, at no small sacrifice to the City of Sanibel.

I have attended these meetings in spite of my serious concerns that the report prepared by Coastal Planning and Engineering, Inc., as the same firm that is involved in the groin/Department of Natural Resources permitting issue, could not be unbiased and would not fairly represent the actual circumstances; creating a situation where the City could have little confidence that an accurate report was being discussed.

At almost all of these meetings one or more of the representatives from the affected agencies (i.e. Department of Natural Resources, Lee County, or West Coast Inland Navigation District) was absent. In fact, at some meetings only the Captiva Erosion Prevention District and the City of Sanibel were represented.

In the meantime, the beach continues to erode, homes and properties are increasingly threatened, the City's and Captiva's evacuation route has become even closer to the active beach, and nothing definite has been accomplished.

The proper consideration of an appropriate plan which will affect us all far into the future demands that full representation be provided. Without complete cooperation from all sides, it is useless to continue in this process.

By copy of this letter, I am notifying all parties involved how non-productive this process has become and urging more cooperation.

Respectfully,

Gary Price

Gary A. Price,
City Manager

GAP/VJS

cc: Sanibel City Council
Lee County Commissioner John Manning
Acting County Administrator Bob Gray
Lee County Planning - Jim Lavender
Lee County Marine Sciences - Chuck Listowski
State Div. of Coastal Engineering & Regulation - Kirby Green
State Div. of Beaches & Shores - Lonnie Ryder
State Div. of Beaches & Shores - Ralph Clark
West Coast Inland Navigation District - Jim Armstrong
Captiva Erosion Prevention District - Alison Hagerup
Sanibel City Attorney Bob Pritt

City of Sanibel

800 Dunlop Road
Sanibel, Florida 33957

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PUBLIC WORKS	472-6397

November 25, 1991

Mr. Steve Cutler
Chairman
Captiva Erosion Prevention District
11550 Chapin Lane
P. O. Box 365
Captiva, FL 33924

Dear Steve:

This letter is to confirm Thomas Campbell is scheduled to appear before the Sanibel City Council on December 3, 1991 at 1:30 PM to present the draft Blind Pass Inlet Management Plan.

The City has retained the services of Ken Humiston, Humiston & Moore Engineers, to review this plan and advise the City Council. In this regard Ken has submitted the attached questions. These are forwarded to you so that the responses can be addressed at the meeting. I have taken the liberty of faxing the questions directly to Tom to allow more time to prepare a response.

If you have any questions please feel free to give me a call.

Respectfully,

Gary Price

Gary A. Price
City Manager

GAP:PAK

HUMISTON
& MOORE
ENGINEERS

COASTAL
ENVIRONMENTAL
DESIGN AND
PERMITTING

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PHONE 813 261 3160

November 22, 1991

Mr. Gary Price, City Manager
City of Sanibel
800 Dunlop Road
Sanibel, Florida 33957

SENT VIA FAX

Re: Blind Pass Inlet Management Study, Review of CEPD Interim Report. H&M File No. 1-035

Dear Mr. Price,

As a follow up to our discussions today, we are providing you with the following list of questions regarding the Blind Pass Inlet Management Study Interim Report No. 2. The answers to these questions will help us to complete our review of the report.

1. The littoral budget analysis is based on horizontal changes in shoreline position which are converted to representative volume changes by application of a conversion factor. It is stated in the Interim Report that the conversion factor was determined through a "coastal engineering analysis" but that analysis is not presented.

Q1. How was the conversion factor established? (Please provide a copy of the "coastal engineering analysis").

2. The conversion factor of .67 cubic yards per square foot of beach is reduced by half, to .33, to account for overwash along a short section of the first mile of Sanibel Island. This means that half of the erosion on Sanibel is being attributed to overwash.

Q2. Is this based on assumptions or is there justification for this modification, and if so what, in detail, is that justification? (Please provide any data that was used to establish this conversion factor).

3. The transport rates given in Figures 1, 2, and 3 correspond to the volume changes, in terms of the volume change equaling the difference between the transport in and the transport out, but any number of other levels of transport rates could also satisfy this condition.

Q3. How were the transport rates determined from the converted volume changes, ie. what boundary conditions were used to establish the transport rates?

4. Page 13 refers to the post construction period as starting in 1989, but the jetty extension was completed in September 1988. Some of the most severe post construction erosion occurred on Sanibel immediately following completion of the extension.

Q4. Why is this not considered as part of the post construction time period and has it been consistently neglected throughout the analysis?

5. Paragraph 2 on page 13 presents a volume change on north Sanibel which includes sand which accumulated on the ebb tidal shoal at Blind Pass between Sanibel and Captiva.

Q5. Why is the sand on the Blind Pass ebb shoal considered to be part of Sanibel Island?

6. The last paragraph on page 13 states that 1989/91 was an "atypical period" and the beach erosion north of the Blind Pass groin "suggests" that during a more typical year the inlet would bypass 53,000 cubic yards.

Q6a. How was the 53,000 cubic yard figure computed?

Q6b. Was consideration given to the possibility that the pre-nourishment period may have had "atypical periods" as well?

7. The third paragraph on page 14 states that since August 1988 the beach in Sanibel has eroded at 40,000 cy/yr.

Q7. Why is 40,000 cy/yr used here instead of the 20,000 cy/yr that is given in Figure 17

8. Paragraph 2 on page 15 states "The major cause of the recent rapid shoreline recession on Northern Sanibel is the continued overwash of the Sanibel Island at two locations in the first mile. This process was initiated by Tropical Storm Keith and continues through today".

Q8a. Have overwash quantities been measured?

Q8b. Did overwash ever occur prior to Keith?

Q8c. Has there ever been overwash due to storms on Captiva Island?

Q8d. Is there documentation of overwash occurring after Keith?

9. Paragraph C. on page 15 states that the jetty extension in 1988 caused approximately 36,000 cy more erosion in northern Sanibel from November 1988 through April 1991.

Q9. How would you explain the discrepancy between this and the erosion rate given in Figure 1?

10. There are ten alternatives listed under inlet bypassing systems.

Q10. What do alternatives 1, 2, 4, 5, 6, 7, 9, and 10 have to do with sand bypassing?

11. The conclusion is made that the jetty extension has caused erosion on Sanibel Island, but that its removal would destabilize Blind Pass and may close it, and that therefore this is not recommended as an alternative management plan.

Q11. Given the fact that Blind Pass was intermittently closed prior to the jetty extension, how was it determined that the potential closure of Blind Pass is a more serious concern than the erosion on Sanibel Island?

12. In addition to jetty removal and jetty extension removal, there are many other possible modifications to the jetty that would improve natural sand bypass.

Q12. Why were no other jetty modifications considered?

13. The last paragraph on page 67 says that CEPD's contribution to the inlet management plan should be equated to their obligation to mitigate erosion damages to the Sanibel shoreline, as required by DNR under an existing permit condition, and that $35,000 contributed toward the management plan should reduce the permit condition obligation.

Q13. How was it determined that preparation of an inlet management plan by CEPD would relieve CEPD of their obligation under the DNR permit condition?

We suggest that these questions be forwarded to CEPD's engineer so that they will be able to address them at the December 3 City Council meeting.

Sincerely yours,

HUMISTON & MOORE ENGINEERS

Ken Humiston

Ken Humiston, P.E.

Tom Gardner, Executive Director

FLORIDA DEPARTMENT OF NATURAL RESOURCES

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399

November 14, 1991

Mr. Thomas Campbell, President
Coastal Planning and
Engineering, Inc.
2481 Boca Raton Boulevard
Boca Raton, Florida 33431

Dear Tom:

I recently reviewed the draft Blind Pass Inlet Management Plan Interim Report No. 1 and gave my comments to Norman Beumel. I understand that report is being updated or finalized now. I also understand that work is also underway on Redfish Pass and a first report will soon be available.

I am sorry that I missed the recent meeting with the Captiva Erosion Prevention District. We will have contracted studies of about seventeen inlets this year (plus five last year) and, given our budget constraints, we can not possibly attend all the inlet study briefings and meetings. Enclosed is a draft of maps showing the inlet locations for each fiscal year of studies. The future FY's are not cast in stone but will give you some guidance on our current prioritization.

I have been reviewing the Blind Pass Interim Report No. 2 and have the following comments and questions. I may have more comments as I continue a review of this report but these are my initial thoughts.

p. 29 <u>Alternative 1a.</u>

What is the survivability of these flushing culverts? Where in Florida do these culverts exist and what is their repair and maintenance history? What threshold erosion/tide/wave conditions will damage these culverts and what is the annual frequency of these threshold conditions? What is the annualized maintenance costs of these culverts?

p. 37 <u>Alternative 3</u>

What is the basis for believing that the removal of the groin extension will close Blind Pass? Why not consider beach fill removal north of the groin extension and transfer to Sanibel? Why not consider using the surety bond to cover the groin extension removal cost?

p. 37 <u>Alternative 4</u>

How can 4 be recommended and 3 not be recommended when their disadvantage is the potential closure of Blind Pass?

p. 39 <u>Alternative 6</u>

What is the basis for not recommending this option? It's a substantially lower cost than 2 or 4 which were recommended and there are no stated adverse impacts.

p. 41 <u>Alternative 7</u>

On what basis is it not a desirable option?

p. 43 <u>Alternative 9</u>

It should also be mentioned that this alternative does not address the mandate for bypassing as set forth in Chapter 161, F.S.

p. 47 <u>Alternative C.1</u>

Why does it have to be considered a loss of public beach? If the natural bypass quantity is being mechanically transferred and if sand is transferred from one beach to another, why do concerns have to be biased to the beach on Captiva Island?

p. 49 <u>Alternative C.3</u>

It should be noted that an experimental beach dewatering project is to be installed south of Ft. Pierce Inlet. The results of the Ft. Pierce experiment need to be evaluated before consideration on Sanibel Island.

p. 52 Alternative B.3 should be considered further. Alternatives B.6 and B.7 should also be considered further. Alternative C.3 should not be considered further at this time unless the Ft. Pierce dewatering project proves successful.

p. 53 VII.A. When Big Hickory Pass, Dunedin Pass, and Midnight Pass closed, the water quality and D.O. did not decrease, so how is closure of Blind Pass going to decrease water quality and D.O. in Pine Island Sound? How are organisms going to be induced to perish? Will not fish just use other open inlets? Are not they just opportunistic when it comes to using an open Blind Pass?

p. 57 3. See comments for p. 37 (Alternative 3). The transfer of sand by truck from Captiva Island to Sanibel Island would have different impacts than dredging from either an offshore source or the inlet shoals.

p. 59 7. The armoring in conjunction with continued erosion will result in the loss of beach. This loss of beach will have an impact on infauna and nesting sea turtles and will provide habitat for other species.

p. 59 8. The physical feasibility of nonhydraulic removal of flood shoal material leaving a perimeter buffer should be investigated when further consideration is given this option. This was a viable option following the subtropical storm of June, 1974, when a substantial quantity of material was transported northward into the inlet off of Sanibel Island's beach. In its current configuration this option might not be physically feasible, but if it is, its environmental impact could be limited.

p. 62 3. What is the impact of dewatering on the infauna community? Was this factor investigated at the Sailfish Point project site?

p. 64 D. Has it not been established that the groin extension and erosion control project has been affecting the northern shoreline of Sanibel Island, notwithstanding any differences of professional opinion as to the quantity of the impact? A most important fact has been excluded - the CEPD is the local sponsor of this study.

p. 67 Paragraph 5. How can it be concluded that the groin which Lee County constructed impacted the beach, yet the extension of the same groin constructed by this study sponsor may or may not have impacted the beach? The purpose of the CEPD's placement of 15,000 cubic yards of material on Sanibel Island is to mitigate the impact of their permitted erosion control project not to maintain the natural bypassing of the inlet. The CEPD's level of responsibility in sand bypassing is subject to further discussion but should not be affected by their responsibility to mitigate for damages caused by their project.

p. 69 The levels of governmental responsibility should be reviewed in greater detail and be subject to debate. It may be prudent to identify levels of government funding only for those alternatives which are to be considered further and not raise debate over funding levels for projects which will not receive further consideration.

p. 70 What is the target date for the fourth workshop meeting? Can each agency's review comments be circulated prior to meeting?

Sincerely,

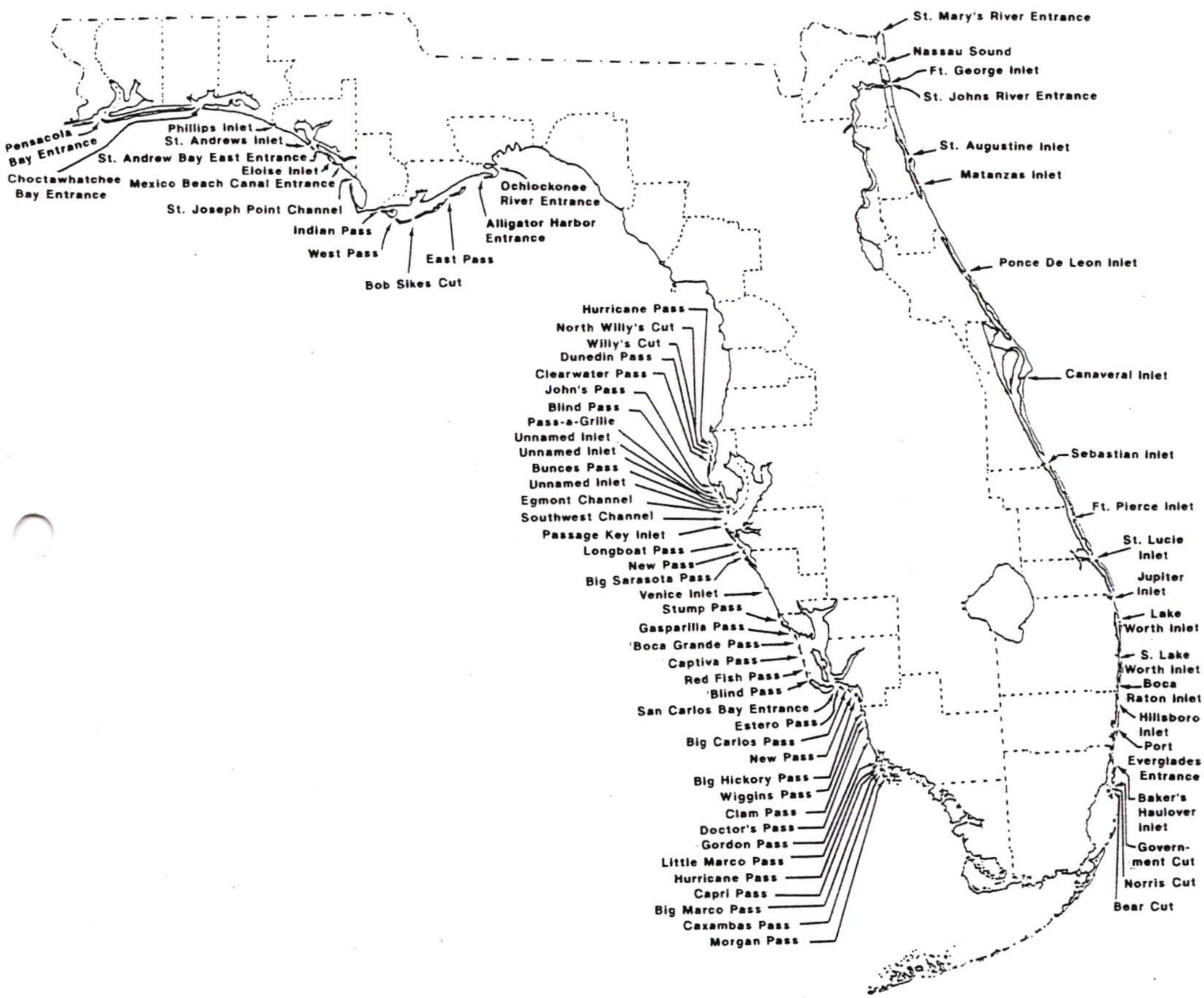
Ralph R. Clark

Ralph R. Clark
Office of Beach Management

RRC/bc

cc: Alison Hagerup
Gary Price
Chuck Listowski

DRAFT



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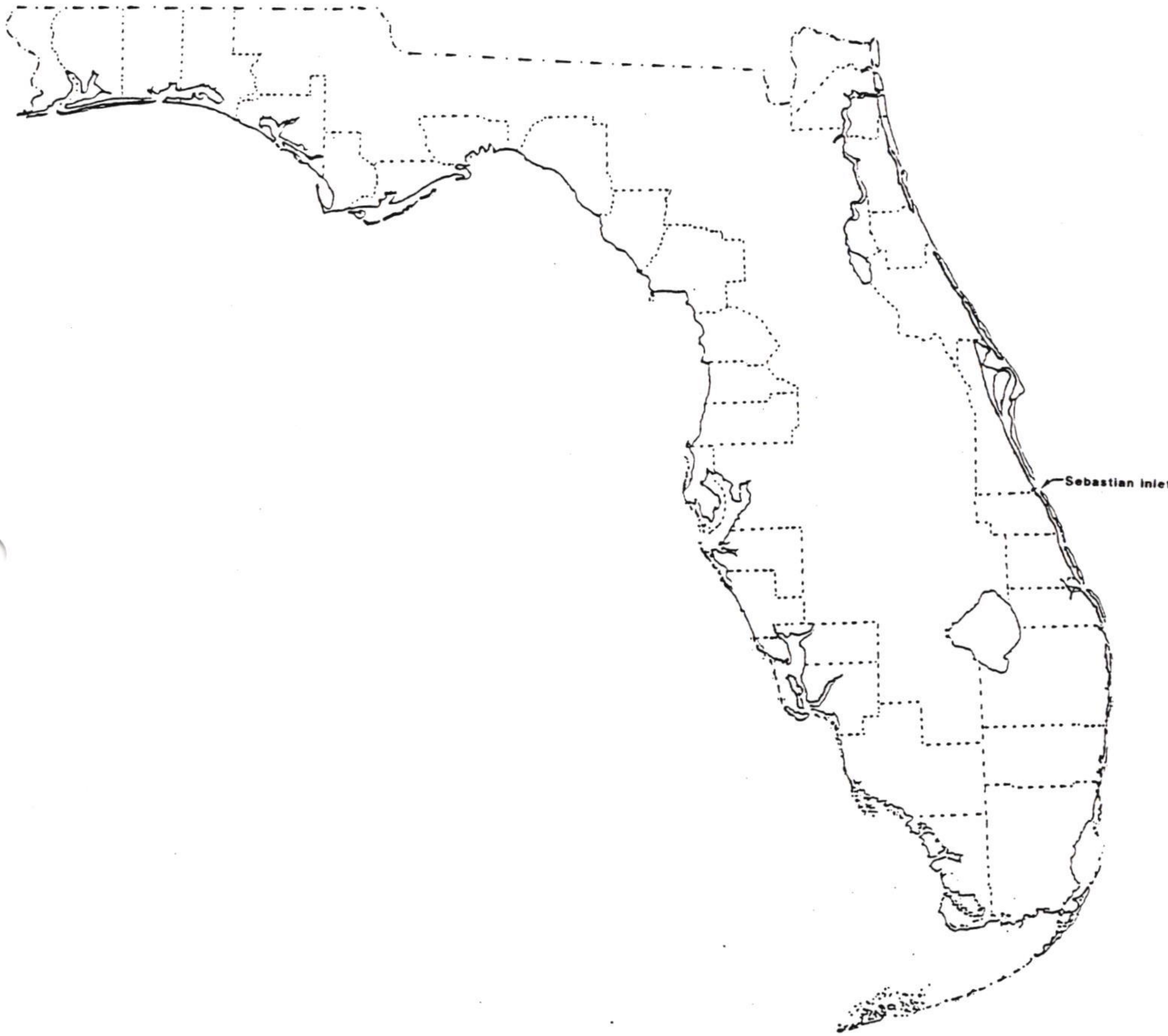

Status of
Inlet Management Planning
FY 1988-89

APPENDIX F

PERTINENT CORRESPONDENCE

COASTAL PLANNING & ENGINEERING, INC.

COASTAL & OCEAN ENGINEERING
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8401.75

February 21, 1992

Mr. Ralph Clark
Florida Department of Natural Resources
3900 Commonwealth Boulevard
Tallahassee, FL 32399

Dear Mr. Clark:

I have received your comments on the Blind Pass Inlet Management Plan Interim Report No. 2. We have taken steps to address comments that we have received by revising Interim Report No. 2. Our response to your comments are as follows:

Page 29 - Alternative 1.a. - questions about flushing culverts.

> We agree with your concerns about flushing culverts. As a result of that, we have deleted flushing culverts from the plan. In place of these culverts we have left some of the fill out fronting Clam Pass Bayou area. This should recreate similar conditions that prevailed before extensive erosion took place in this area. It is expected that the pass will open and close periodically as has been the case historically.

Alternative 3 - to address your concerns.

> We do believe that removal of the jetty extension would cause Blind Pass to be less stable than it was before the beach nourishment project was constructed in 1988/89. On the basis of our analysis, our conclusion is that from 1955-1974 (for most of that time period there was no jetty at Blind Pass) Blind Pass was closed for most of that time. After the county groin was constructed in 1972, sand quantities were reduced from 68,000 to 38,000 cubic yards per year. The inlet closed in 1977 and was reopened by the "No Name" storm in 1982 during that period. Therefore, with 38,000 cubic yards moving past Blind Pass, it appears to be closed about a third of the time. If the jetty extension were removed, sand quantities leaving Captiva Island would greatly exceed the rates experienced from 1955-1974. During most of that time period the inlet remained closed. That is the basis of our evaluation and conclusion that the inlet would be closed without the jetty extension if the beaches of Captiva were continually nourished.

> We do not consider beach fill removal on Turner Beach and transferring that sand to northern Sanibel as feasible. This would create an eroded condition of the beaches at Turner Beach and make the hurricane evacuation route vulnerable to storm damage on the northern approach road to the Blind Pass bridge.

If this alternative were implemented, one source of funds could be the surety bond, as you suggested, to have the groin extension removal funded. The source of funds is beyond the intent of this particular section of the report which deals specifically with feasibility. The surety bond is a consideration in the sections concerning funding.

Alternative 4

Alternative 4 would likewise affect the stability of Blind Pass at a point further offshore. Based on a study by Dr. Mehta, we have concluded that the longer jetties have added to the stability of the inlet, making the inlet more capable of handling higher sediment loading. Therefore, under alternate 5, sediment transport would be higher, but the inlet would be more hydraulically capable to handle the extra sediment load and be less likely to close.

Alternative 6

Although this option is much lower cost, it is felt that it would allow erosion of northern Sanibel to continue unabated. At some point in time the erosion would impact other structures and eventually the rerouted evacuation route. For this reason, we don't feel this alternative is viable. Based on your comments, we have added additional discussion to alternative 6 which addresses these concerns.

Alternative 7

We had not viewed Alternative 7 as a desirable option because we felt that it allowed the beach to erode totally away. The shoreline opposite the road would be a hardened shoreline and the beaches south of the revetted area would continue to erode. However, this option does indeed solve the storm protection problem for the evacuation route and removes a number of structures from the surfzone area. We have modified the write-up of this section to remove the term "not desirable option."

Alternative 9

We have added a sentence to the discussion of this option indicating that the option does not achieve the sand bypassing and erosion control goals of the program.

Alternative C.1.

We believe that the implementation of a sand bypass system with a crane on a public beach area would inhibit the use of the public beach. Also, it is our finding that dredging sand from the beach at Turner Beach would provide for a narrower beach most of the time. We don't feel that the concerns are biased to the beach on Captiva Island.

Alternative C.3.

We have modified Alternative C.3. to include your concerns about the experimental nature of the dewatering project and DNR's possible requirement that the experiment wait the outcome of the Fort Pierce installation.

Comments on Page 52

We have changed the recommendations on D.3. to a maybe so it will be considered further as you suggested. Alternatives B.6. and B.7. are also changed from no to maybe in recommendations. Alternative C.3. remains a maybe, however, the concept of waiting for the Fort Pierce installation to prove valid is included in the text.

Comments on Inlet Closure

The text has been modified to address your concerns. We still feel, however, that permanent closure of the pass would lead to degraded water quality within the waters of the pass and possible reduction of water quality in portions of Pine Island Sound.

Comments on Page 57 - 3.

See our response to your comment on page 37.

Comments on Page 59

Our comments on the environmental acceptability of dredging the shoal assumes a small dredge would be used. While it may be true that mechanical transfer of sand is possible from these shoals, we still feel that the feasibility of using this limited source of sand doesn't warrant further consideration.

Comments on Page 62

Currently we don't know what the impacts of dewatering are on the infauna community off of Sailfish Point. By copy of this letter I am requesting that our environmental department investigate this matter further and report back to me.

Comments on Page 67, Paragraph 5

It is quite possible that the county groin impacted the beach while the groin extension does not impact the beach. That is because the groin extension was built in conjunction with a beach restoration program which widened the entire island a comparable amount.

Therefore, sand transfer from Captiva Island is probably as much as, if not greater than, the sand transfer that was occurring before the project was initiated.

I disagree with your analysis that CEPD's level of involvement is not related to the level of mitigation that will be required due to their structure. The structure extension was needed to avoid extensive losses of the beach fill from the project. The level of involvement and the reason why CEPD is involved in the program has a lot to do with the potential impacts that the structures that have aided their project have on adjacent beaches. However, I have modified the paragraph to include your comments relative to this issue.

Comment on Page 69

The purpose of page 69 is to suggest levels of funding that engineer feels would be appropriate based on his study to date. We have deleted this section of the report from the revised document.

Comments on Page 70

The next workshop meeting is to be held on February 25, 1992.

I have sent a copy of the revised Interim Report No. 2 to Lonnie for your review and comment.

Sincerely,

COASTAL PLANNING & ENGINEERING, INC.

Thomas J. Campbell, P.E.
President

cc: Steve Cutler
Alison Hagerup
Chuck Listowski
Gary Price
Lonnie Ryder
Jim Armstrong - WCIND
Bob Dean
Ashish Mehta, Ph.D
Mark Leadon

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8401.75

February 21, 1992

Mr. Steve Cutler
16790 Captiva Road
Captiva Island, FL 33924

Re: December 1991 Letter - Blind Pass Inlet Management Plan

Dear Steve:

In response to the letter we received dated December 19, 1991 from Sanibel and my discussions with the CEPD, we have developed a series of goals for the inlet management plan to be included in the revised version of Interim Report No. 2. A copy of those goals is attached. We suggest that a detailed review of goals be undertaken at the next meeting of the ad hoc committee.

Sincerely,

COASTAL PLANNING & ENGINEERING, INC.

Thomas J. Campbell, P.E.
President

TJC:jo

bpl01:840175.120

cc: Ralph Clark
Lonnie Ryder
Gary Price
Jim Lavender, Lee Co. Parks & Recreation
Jim Armstrong, WCIND
Alison Hagerup

GOALS OF THE INLET MANAGEMENT PLAN

The following goals are a composite of goals suggested by the State program and local governments.

A. Mitigate erosion caused by the inlet.

B. Re-establish littoral drift to downdrift beaches that are being affected by the existence of the inlet.

C. Maintain flushing and navigation to pre-1988 levels.

D. Protect the evacuation route from storm damage.

E. Control erosion north and south of the pass to protect County parks and private homes.

F. Accomplish goals A - E addressing long term environmental impacts.

G. Accomplish goals A - F in an economically responsible manner.

H. Quantify the impacts that the 1972 groin built by Lee County may have had on the beach in northern Sanibel Island.

I. Quantify impacts that the 1988/89 Captiva beach restoration/groin extension project may have had on the beach in northern Sanibel Island.

J. Develop intergovernmental programs to implement the Inlet Management Plan.

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8401.75

February 21, 1992

Mr. Steve Cutler
Chairman of the Ad Hoc Committee
for the Blind Pass Inlet Management Plan
16790 Captiva Road
Captiva Island, FL 33924

Dear Mr. Cutler:

We have revised the Interim Report No. 2 of the Blind Pass Inlet Management Plan to address concerns raised at the ad hoc committee meetings and comments received through Sanibel and from the State of Florida. Two letters, dated November 22, 1991 and December 4, 1991, from Humiston Moore Engineers contained a number of comments relative to the reports. Our response to those comments is as follows:

On the November 22, 1991 letter, Question 1:

> The conversion factor on Captiva was established based on a berm elevation of +6 and a depth of closure for active littoral movement of -12. On Sanibel Island the conversion factor varies because there are a number of areas where water bodies are captured by land masses.

Question 2:

> Conversion factors in the revised Interim Report have been further developed to demonstrate the reduced volumes associated with captured water bodies. Detailed justification is shown in the revised Interim Report No. 2.

Question 3:

> Boundary conditions have been thoroughly explained in the revised Interim Report No.2. The southern boundary condition is based on measured accretion rates in southern Sanibel Island.

Question 4:

> Both 1988 and 1989 have been analyzed in the revised report to demonstrate changes from when the groin was constructed and when the beach was completed.

Question 5:

Most of the sand in the Blind Pass ebb shoal is directly seaward of the northern beaches of Sanibel Island. It is unclear at this time whether that will remain a permanent shoal or will migrate to the beach. The revised report analyzes the beach volume with and without the shoal. It should be noted that a portion of the shoal volume is included in the profiles that are taken from northern Sanibel. The revised document addresses the distinction between ebb shoal materials and beach volumes.

Question 6:

This section has been revised. The source of all numbers has been stated.

Question 7:

This section has been revised. A full explanation of source of erosion and shoreline data is included.

Question 8:

Overwash quantities have been measured and are included in the revised report.

Question 8b:

Overwash probably did occur prior to Keith.

Question 8c:

There probably has been overwash due to some storms on Captiva Island.

Question 8d:

There is documentation of overwash which has occurred after Keith and it is included in the report.

Question 9:

The difference between Figure 1 and the 36,000 cy as previously analyzed, has to do with the term of the evaluation that was made. This section has been revised, however, to include a more accurate determination of land vs. water mass in Sanibel.

Question 10:

Alternatives that provide for placement of sand on a beach equivalent to the sand to the littoral drift quantities is consistent with the inlet management plan goals as established by the FDNR. Therefore, any plan that places sand on a downdrift beach to reinstate littoral drift quantities is a sand bypassing option.

Question 11:

We have never stated that the closure of Blind Pass is more important than erosion of Sanibel Island. We have changed the goal relative to Blind Pass to achieve a level of stability no less than that which existed prior to the Captiva Island beach nourishment project. The intermittent closure of Blind Pass as a condition would not preclude the implementation of one of the options as the plan is currently formulated.

Question 12:

We are aware that there are a number of jetty configurations that could affect inlet performance, however, we do not feel in this case that any other jetty modifications need be considered to improve sand bypassing. If Humiston/Moore has specific suggestions relative to jetty configurations they feel are potential improvements, they should indicate what those are and ask them to be considered. At this time we are not proposing to expand the number of inlet sand transfer options to include further jetty modifications.

Question 13:

This section of the report has been modified. It has not been determined that the preparation of an inlet management plan would relieve CEPD of obligations under a FDNR permit.

Responses to December 4, 1991 letter, Paragraph 2:

We have included a list of goals.

Paragraph 4:

The suggested goals of the plan have been modified to maintain Blind Pass at a level of flushing and navigation consistent with pre-1988 conditions.

Paragraph 5:

The goals of the plan do include restoration of natural littoral processes, storm protection of the evacuation routes and environmental protection.

Page 2, Paragraph 1:

We have included a goal to identify impacts of coastal structures on the beach.

Paragraph 2:

Jetty extension removal has no longer been rejected because it results in pass closure.

Paragraph 3:

Mr. Moore's comment in this regard is noted.

These comments will be reviewed at the next planned review committee meeting. The State has been invited to attend all of the ad hoc committee meetings of the inlet management plan and we will continue to discuss with the State how the plan can be developed to meet FDNR guidelines.

If you have any questions concerning the above responses to comments by Humiston Moore, please contact me. I suggest that we discuss these further at our next ad hoc committee meeting.

Sincerely,

COASTAL PLANNING & ENGINEERING, INC.

Thomas J. Campbell, P.E.
President

TJC:jo

cc: Alison Hagerup
Bob Dean
Ralph Clark
Chuck Listowski
Gary Price
Lonnie Ryder
Jim Armstrong
Ashish Mehta, Ph.D.
Mark Leadon

bpl:84017502.120

City of Sanibel

800 Dunlop Road
Sanibel, Florida 33957

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PLANNING	472-4136
POLICE	472-3111
PUBLIC WORKS	472-6397

December 19, 1991

Mr. Steven Cutler, Chairman
Captiva Erosion Prevention District
P. O. Box 365
Captiva, FL 33924

Re: Blind Pass Inlet Management Plan

Dear Steve:

At its regular meeting of December 17, the Sanibel City Council discussed the Blind Pass Inlet Management Plan interim report.

Council instructed me to send you a copy of Humiston and Moore's letter dated December 4 with their comments on the interim report prepared by Coastal Planning and Engineering, Inc.

Council also discussed the goals that should be considered when evaluating any particular "solution". Their discussion led to the final "list" as follows:

1. Maintain a hurricane evacuation route.
2. Restore natural functioning of the pass and adjacent beaches to historical performance levels.
3. Use no hardening device that affects the day-to-day natural functioning of the beach.
4. Control erosion south of the pass, including the area of the County park, Sanibel-Captiva Road, and developed upland properties.

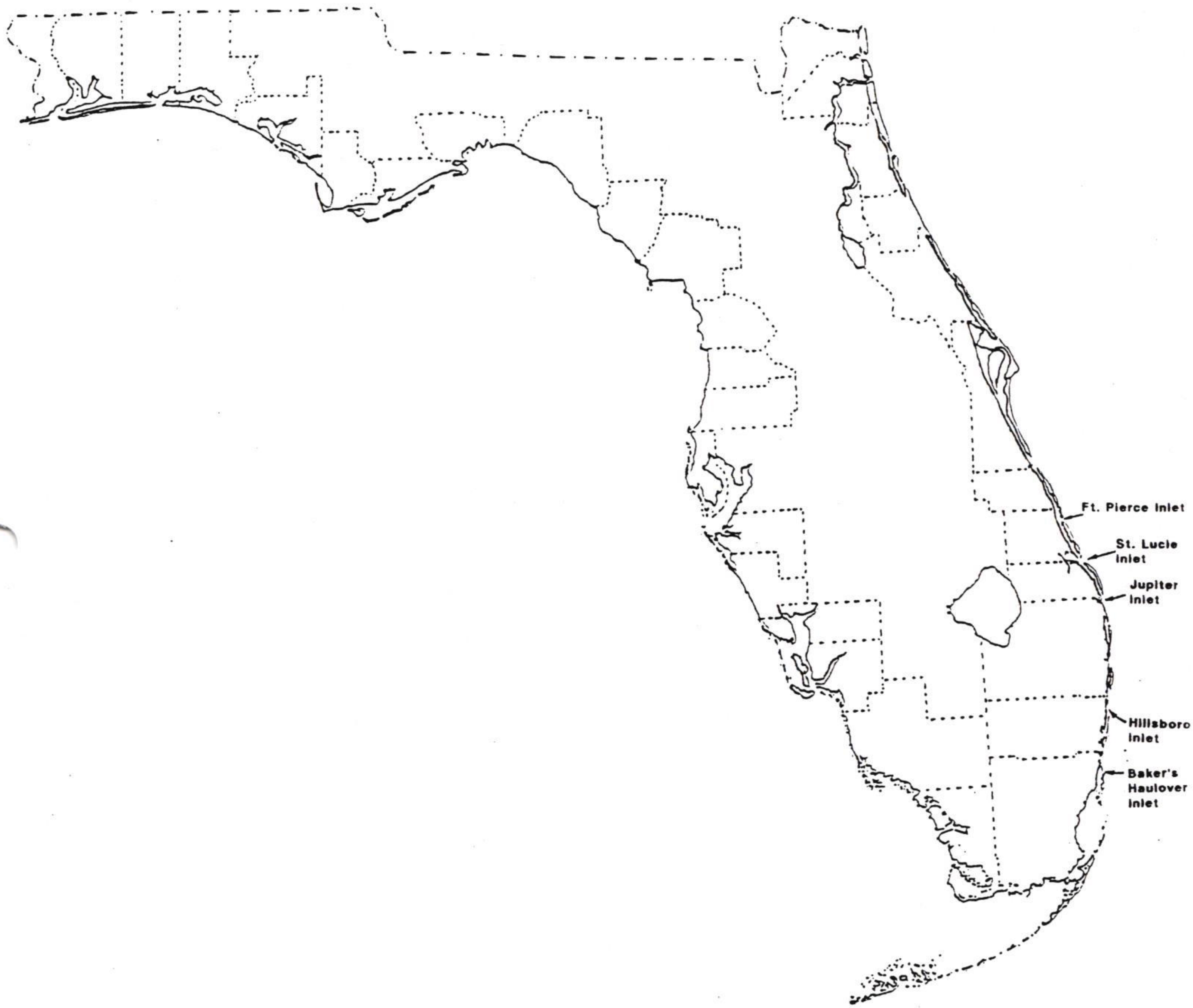
Council instructed me to also send you this list of goals requesting that the possible solutions be judged against these goals. I trust that this is sufficient; if not, please let me know.

HAPPY HOLIDAYS!!

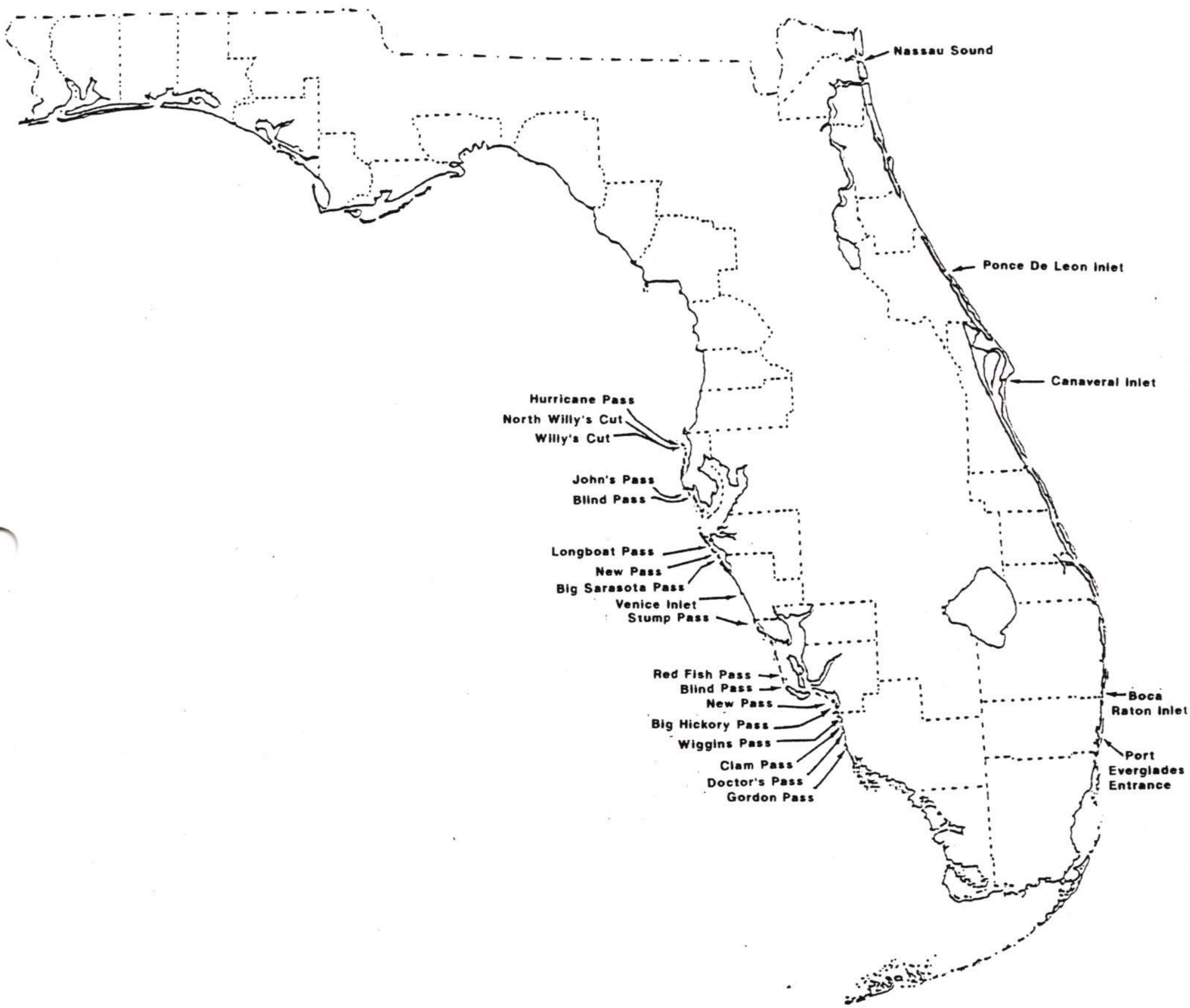
Respectfully,

Gary A. Price,
City Manager
GAP/VJS

cc: Sanibel City Council
Lee County Commissioner John Manning
Acting County Administrator Bob Gray
Lee County Parks & Recreaction - Jim Lavender
Lee County Marine Sciences - Chuck Listowski
State Div. of Coastal Engineering & Regulation - Kirby Green
State Div. of Beaches & Shores - Lonnie Ryder
State Div. of Beaches & Shores - Ralph Clark
West Coast Inland Navigation District - Jim Armstrong
Captiva Erosion Prevention District - Alison Hagerup
Sanibel City Attorney Bob Pritt



Status of Inlet Management Planning FY 1990-91



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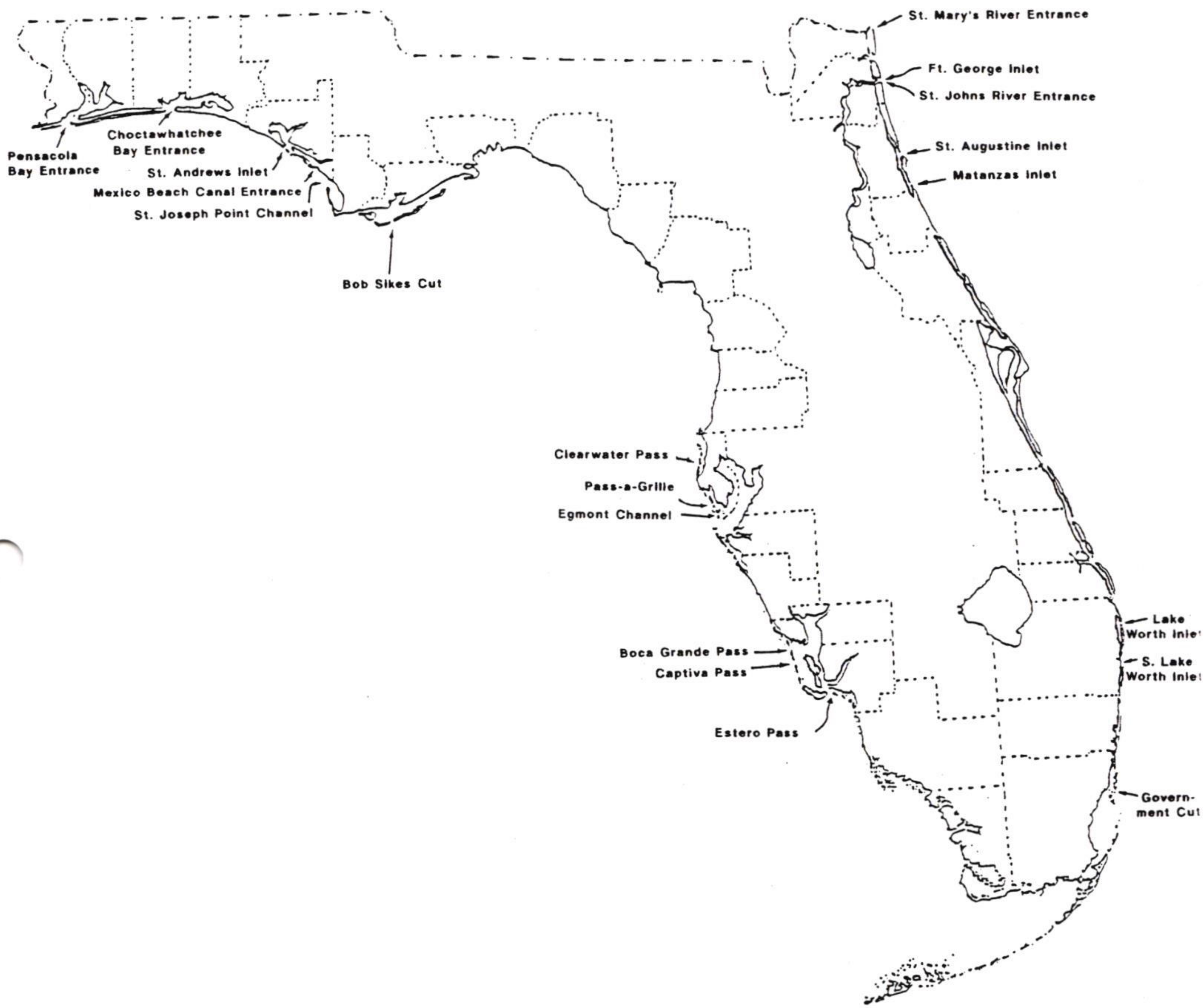

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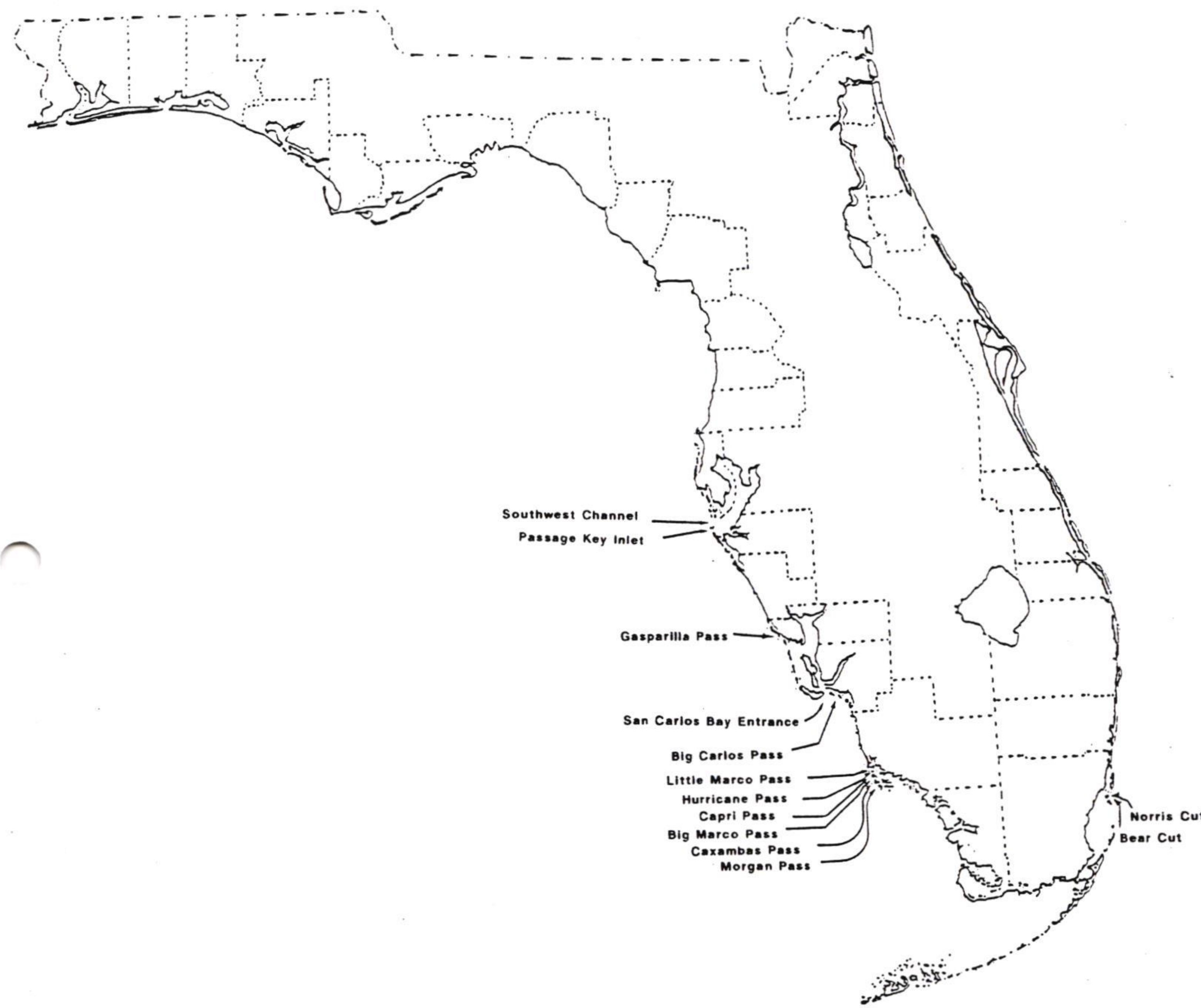

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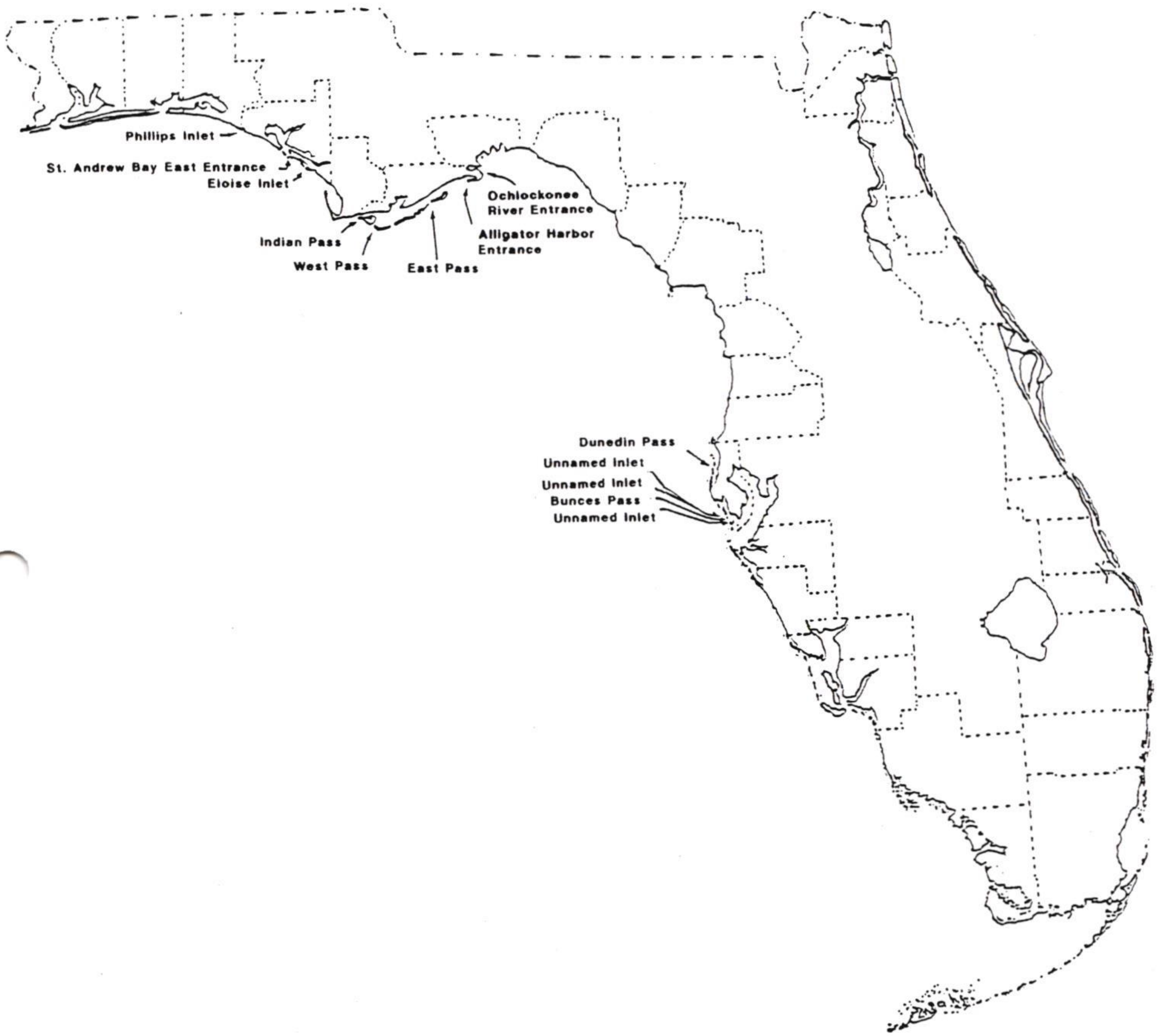
For FY 1993-94



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8401.75

August 2, 1991

Ms. Alison Hagerup
Captiva Erosion Prevention District
P. O. Box 365
Captiva, FL 33924

Dear Alison:

We have received a copy of a letter from July 23, 1991 from Mr. Gary Price. We have taken the steps to incorporate his comments into the ongoing study of Blind Pass as you have directed.

Some of the comments require further discussion at the next committee meeting. The following details our response to Mr. Price's comments.

A. The study proposes one ebb tidal shoal survey. Mr. Price suggests a continual monitoring of the ebb shoal. The future monitoring program could be modified to include an ebb shoal survey as directed by the Board. This, however, would not necessarily be part of this study but could be a recommendation of the study. Concern about possible reduction of the ebb shoal will be addressed in the evaluation of inlet options.

B. Mr. Price's comments on Phase II (4) methodology. As suggested, we will consider the changing geography of Captiva and Sanibel in our historical review of sand movement along the islands. The model and analysis of today's conditions will reflect the current geography of the islands. We will model Dr. Dean's recommendation as one of the alternatives as suggested by Mr. Price.

C. The no action alternative will be evaluated to establish long term trends without further modification of the inlet (as suggested by Mr. Price).

D. We will take into consideration Mr. Price's concern about further disturbance to the inlet potentially causing problems. The analysis will identify the uncertainties with each potential solution so that the committee can assess the risks involved with further disturbance or modification of the existing inlet.

E. The term "adjacent beaches" in Phase II, C.3 on page 3 refers to the beaches that are adjacent to Blind Pass for a distance of beach that is affected by the pass. This distance will be determined by the evaluation of shoreline data.

Please advise if additional action is required to address Mr. Price's concerns.

Sincerely,

COASTAL PLANNING & ENGINEERING, INC.

Thomas J. Campbell, P.E.
President

TJC:jo
rpbp01:84017501.802

cc: Ad Hoc Committee Members
Dr. Dean
Dr. Mehta
Norman Beumel
Susan Beumel

City of Sanibel

800 Dunlop Road
Sanibel, Florida 33957

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PUBLIC WORKS	472-6397

July 23, 1991

Alison Hagerup, Administrator
Captiva Erosion Prevention District
P. O. Box 365
Captiva, FL 33924

Re: Blind Pass Scope of Work Agreement

Dear Alison:

I have reviewed the Blind Pass Inlet Management Plan Scope of Work and have the following comments:

Field Investigations:

- The health of the ebb tide shoal should be monitored to ensure that there are no negative impacts to this protective feature. Ebb tidal shoal is a natural protective barrier to waves and should be maintained. Ebb tide shoal should not be diminished by dredging or sand by-pass. Periodic surveys should continue to monitor shoal migration since situation has not been determined to be static. Monitoring should continue to project long term erosion. We need an extensive cooperative monitoring program.

PHASE 2 (4)

- This is speculative based on past geography which has been drastically altered. Should consider ongoing monitoring to include these techniques to verify validity of method used for interpretation.

- Mitigate Sanibel per Dr. Dean's recommendation.

- Leave pass be and monitor stability to see if inlet really needs modification.

- Further disturbance could be disastrous.

Finally, in PHASE 2 C3, on page 3, we need a definition of "adjacent" beaches.

Respectfully,

Gary.

Gary A. Price,
City Manager
GAP/VJS

APPENDIX G

Computer Modeling of Engineering Alternatives

APPENDIX G

Computer Modeling of Engineering Alternatives

A. Summary

To verify the conclusions of the engineering alternatives section, two numerical models were used to simulate the wave climate and the resulting sediment transport processes. The wave climate model indicates a low variation in breaking wave height and wave angle along Captiva. Greater local variations in breaking wave characteristics were predicted along northern Sanibel.

The shoreline model was calibrated to reflect the existing littoral budget for Captiva Island and Sanibel Island. The shoreline model confirmed that the selected plan encompasses the components that will resolve the erosion problem on northern Sanibel Island. The model also shows that the volume of fill in the selected plan may be underestimated and that the volumes need to be re-evaluated when the selected plan is implemented. The selected plan as described in the main text is recommended for implementation with the understanding that the volumes of fill should be further evaluated in a final design.

B. Introduction and Scope

Recent developments in wave refraction and shoreline modeling software have enabled engineers to better model wave and beach changes. Nevertheless, they are only one of a number of design tools available to engineers for assessing coastal designs. The models are limited by the industry's knowledge of wave and sediment transport processes. The models should be viewed as providing approximations of changes in littoral drift that can be expected as a result of proposed changes of the shoreline.

The study area that was modeled includes the area from just north of Redfish Pass to approximately two miles south of Blind Pass. The offshore boundary for the wave refraction model was approximately the -30 foot (NGVD) contour.

Simulations of shoreline movement were performed to determine what could be expected to occur on Captiva and/or northern Sanibel if the selected alternatives were implemented. The alternatives were based on the preliminary engineering that was performed in the engineering section of the inlet management plan.

C. Captiva-Sanibel Wave Climate

The wave climate at Captiva and northern Sanibel was developed using the USACE (1989) wave hindcast for the Gulf of Mexico. The data set is a compilation of predicted wave height, period, and direction at 3-hour intervals for selected sites within the Gulf of Mexico. The closest site to the project area is Station 42. The average wave height and directional distribution is summarized in Figure G1. Only waves propagating toward shore were considered in this analysis.

Station 42 is located offshore of southern Captiva in 55 feet of water. In order to utilize the wave data for the shoreline model, representative waves were shoaled and refracted to breaking conditions using the software, REFRACT, version 2.0 (Dalrymple, 1991).

The nearshore bathymetry was digitized on a 600-foot by 600-foot grid. A computer plot of the bathymetry is shown in Figure G2. Some smoothing of the offshore contours was necessary to ensure that reasonable results were obtained from the model. Some of the irregularities in the contours, Figure G2, are the result of the computer graphics software and are not included in the digitized bathymetry.

Twelve wave period and direction combinations were simulated using the REFRACT software. A one-foot offshore wave height was used in all simulations to determine breaking wave height coefficients along the shoreline which are used in the shoreline model.

Due to limitations of the model for the given bathymetry, wave angles greater than approximately 315° or less than approximately 225° were unable to be simulated. For these large wave angles, the offshore bathymetry is too irregular and the model attempts to refract the wave back offshore. This leads to numerical errors in the model and unrealistic results. Breaking wave height and angle for offshore wave angles greater than 315° and less than 225° were assumed to be equivalent to the results of the 315° and 225° simulations, respectively.

The results of the wave refraction model are presented in Sub-Appendix G-1. The results indicate that there are areas of minor wave height variations along the shoreline. The average wave height variation along the majority of Captiva was approximately 10%. One exception was the area 3,000 feet north of Blind Pass which had an average wave height of approximately 30% above the remainder of the island. The average wave height on northern Sanibel varied by approximately 40% with the highest average waves occurring 3,000 feet south of Blind Pass.

D. Numerical Shoreline Simulation

For this analysis, a one-line shoreline model was used which incorporates seawalls and groins as boundary conditions (Hanson, 1986). This model was adapted to accept the USACE Wave Information Study (WIS) hindcast data as an input. The results of the wave refraction model were utilized as input into the sediment transport model.

Within the study area are two inlets, Blind Pass and Clam Bayou Pass. The shoreline model is not capable of modeling these features. The shoreline was assumed to be

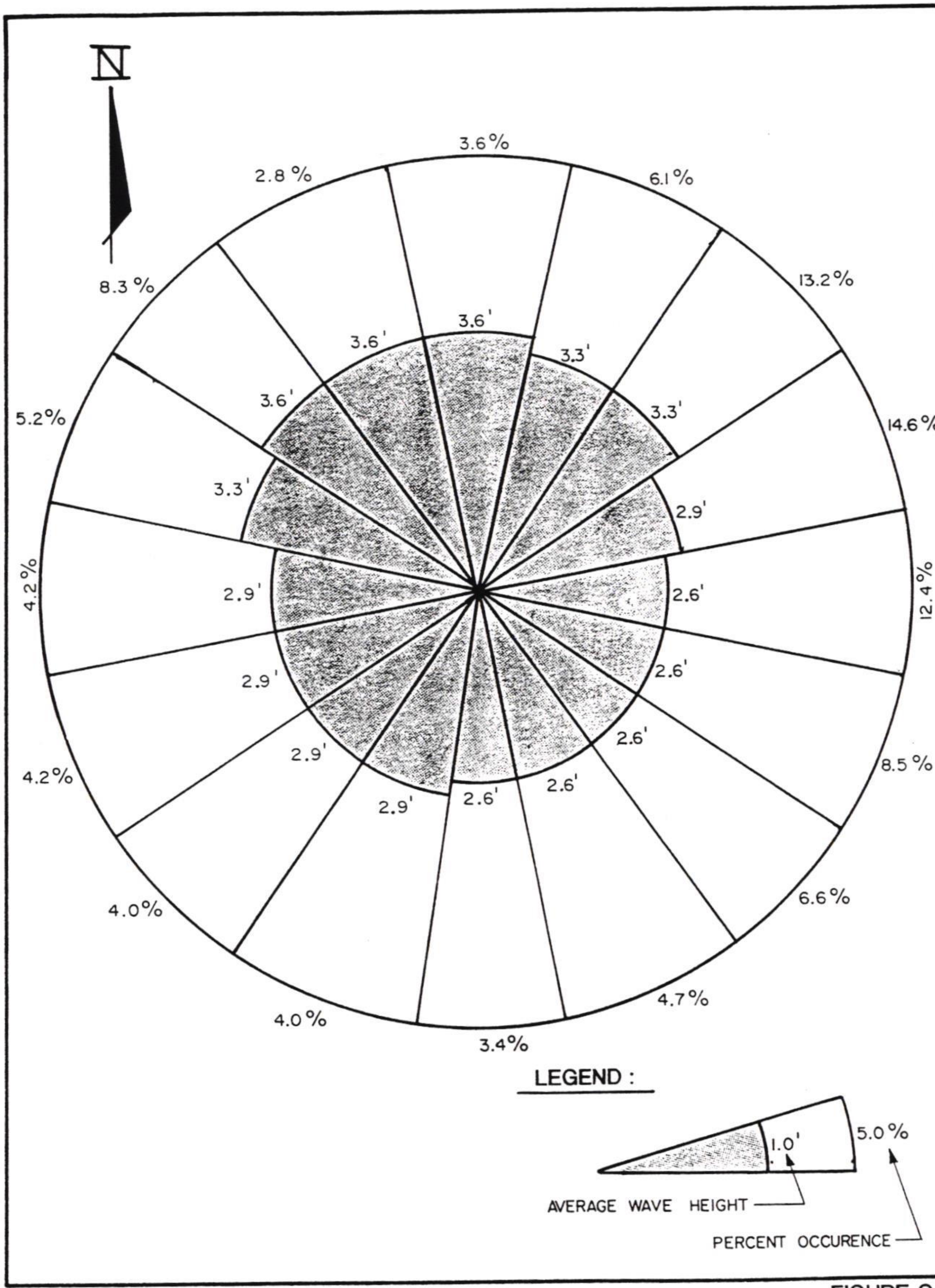

FIGURE G1

DISTRIBUTION OF AVERAGE WAVE HEIGHT AND DIRECTION

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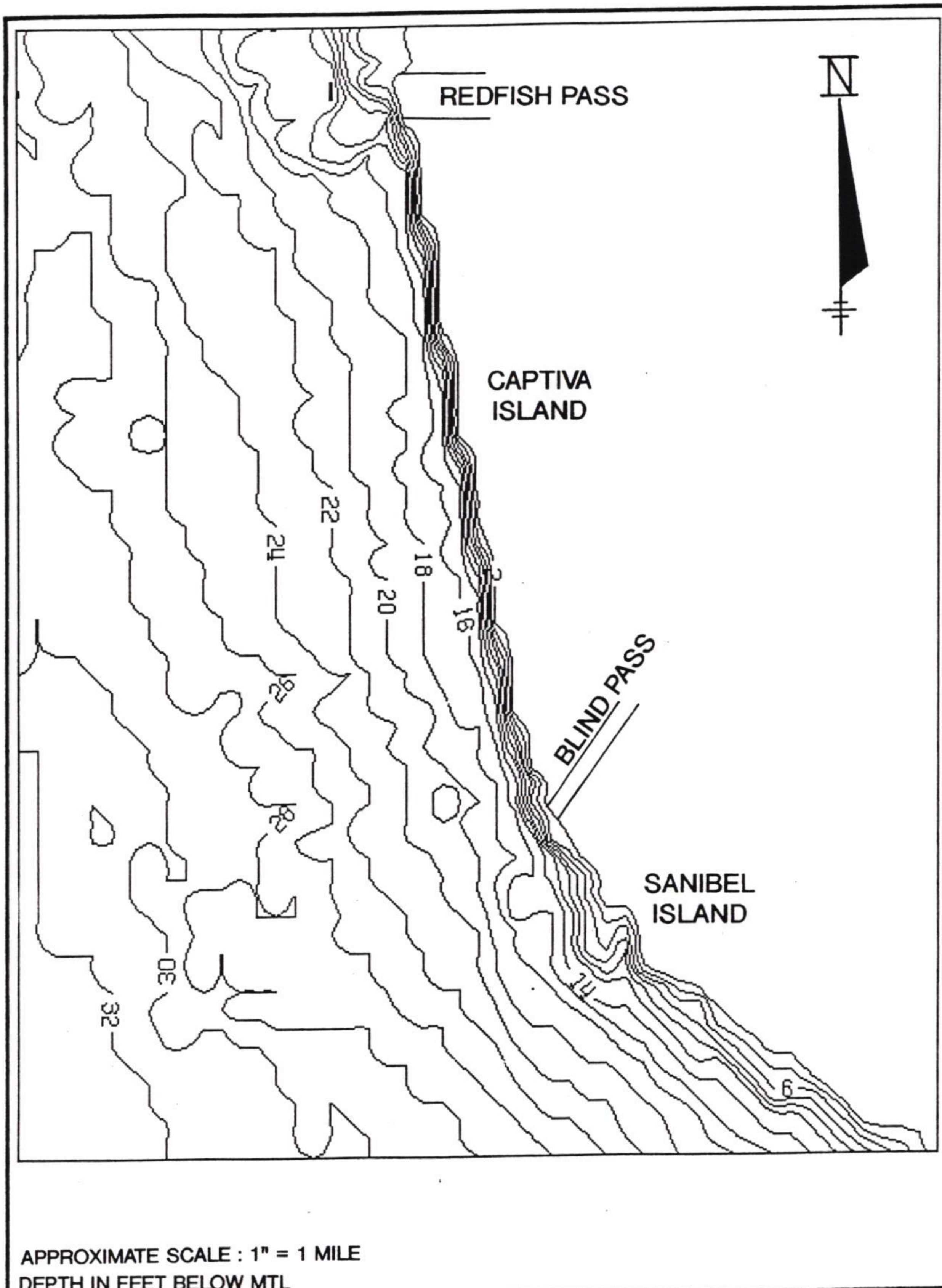

FIGURE G2

WAVE REFRACTION MODEL BATHYMETRY

continuous in front of both of the inlets. At Blind Pass, the following additional conditions were applied:

1. Littoral drift bypassing the terminal groin was equal to the littoral drift at the inlet. This prevented erosion from occurring at the inlet.

2. No storage of sand in the ebb shoal was considered.

3. If the littoral drift was south to north at the inlet, no northward bypassing occurs due to the offset in the shoreline.

E. WIS Database

The WIS data is a 20-year data set representing the years 1956 to 1975. The net littoral drift potential on a true north-south shoreline was estimated for each year, and was found to vary significantly (Table G1). The average littoral drift based on the offshore WIS data was 129,500 cubic yards (south) with a standard deviation of 91,000 c.y.

From the 20 years of data, 6 years were selected to be used in the shoreline model simulations. The years that were selected were those that were closest to the average littoral drift potential. The years selected are 1972, 1969, 1963, 1961, 1967, 1970. Since the shoreline model is nonlinear, the order in which the years of wave data are simulated will make a difference in the results. In order to minimize significant variations in the results, the order of the 6 years of data was established so that a year of slightly higher littoral drift is followed by a year of slightly lower littoral drift. The order that was established for all simulations is as indicated above.

F. Calibration

The shoreline model was calibrated against the expected sediment budget for Captiva and Sanibel (Figure G3). This is the same budget as shown in Figure 20 of the main report. The calibration of the model was achieved by proportionally reducing all the breaking wave angles. The calibration was performed such that the average littoral drift after 6 years of simulation was equivalent to the littoral drift in Figure G3. Therefore, simulation of the proposed alternatives will be a numerical simulation of the expected littoral budget on those alternatives. Since the annual littoral drift has been shown to vary significantly (Table G1), actual performance of constructed alternatives could vary.

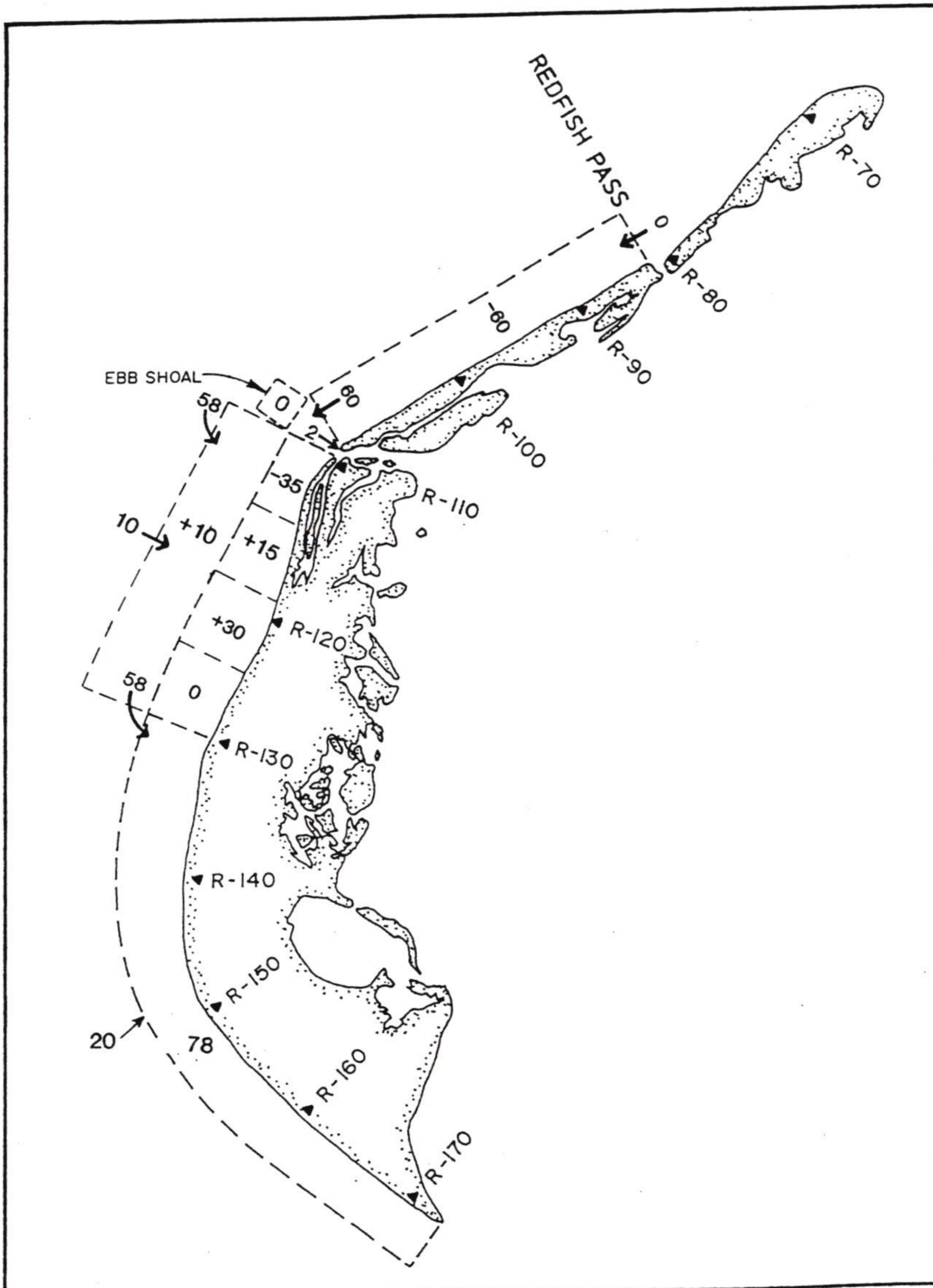

FIGURE G3

CAPTIVA - SANIBEL FUTURE SEDIMENT BUDGET

Table G1

Littoral Drift Potential
at Captiva and Sanibel Islands

YEAR	NET LITTORAL DRIFT (C.Y.)
1956	-325,000
1957	-26,900
1958	-267,000
1959	-48,900
1960	-57,700
1961	-162,000
1962	-226,000
1963	-102,000
1964	-60,400
1965	-56,100
1966	-185,000
1967	-90,300
1968	-284,000
1969	-145,000
1970	-152,000
1971	-32,400
1972	-122,000
1973	-195,000
1974	-50,500
1975	-2,010
Average	-129,500

Note: Negative sign denotes drift to the south.

G. Results of Simulations

All shoreline change simulations were based on the April 1989 (post-construction) shoreline. The effect of six years of wave data were simulated for the 1989 shoreline without any alternatives to provide a basis of comparison. The results are shown as existing conditions in Figures G4, G6, G8, G10, G12, G14.

To simulate improved conditions, engineering alternatives were superimposed on the April 1989 shoreline. Some adjustments were then made to reflect the difference between the 1989 shoreline and the 1991 shoreline. The 1991 shoreline was used in the engineering alternatives section of the plan. The adjustments are described for each alternative in the following sections.

Each alternative is compared against the existing condition by plotting the littoral drift as a function position along the shoreline. While the littoral drift was modeled for the entire study area, the alongshore limit of the plots is from approximately R100 to R115 to emphasize the performance of the engineering alternatives. Erosion or accretion can be determined from the littoral drift curve by examining the gradient, or slope, of the curve. If the littoral drift is increasing in a southerly direction, the beach is eroding. If the littoral drift is decreasing in a southerly direction, the beach is accreting.

1. Alternative A.1. Remove Jetty Extension.

This alternative is the removal of the 100-foot jetty extension that was constructed in 1988. The removal of the groin extension will result in an increase in the littoral drift at Blind Pass of approximately 17,200 c.y./yr. The results are graphically shown in Figure G4. The effects on Captiva will be evident as far north as profile 106.5. The impacted northern area is relatively short due to the bend in the shoreline near profile 106. The shoreline immediately north of the jetty would erode back approximately 120 feet as a result of the jetty removal. This erosion would reduce the storm protection to the road north of Blind Pass as well as result in the loss of most of the public beach. (Figure G5).

The additional littoral drift being transported onto Sanibel Island affects the shoreline to R113. The model indicates a short area of accretion at R110, but the remaining shoreline from R110 to R113 continues to erode. Due to the increase in bypassing at Blind Pass, the erosion rate is less than the existing conditions. (Figure G5). The model suggests that the 100 foot groin extension caused only a small part of the erosion that has occurred on northern Sanibel.

The computer model confirms the conclusions of the engineering appendix. It is recommended that the jetty not be removed as part of the inlet management plan.

2. Alternative B.3. Feeder beach on Captiva.

This alternative consists of placing 90,000 c.y. of sand on Captiva every 6 years. The feeder beach will sacrificially erode and increase the bypassing of sand onto Sanibel.

Figure G6 shows the results of placing the feeder beach from 3,000 feet north of the pass to 5,200 feet north of the pass. This is the area that is currently experiencing higher erosion than the remainder of Captiva Island. Figures G6 and

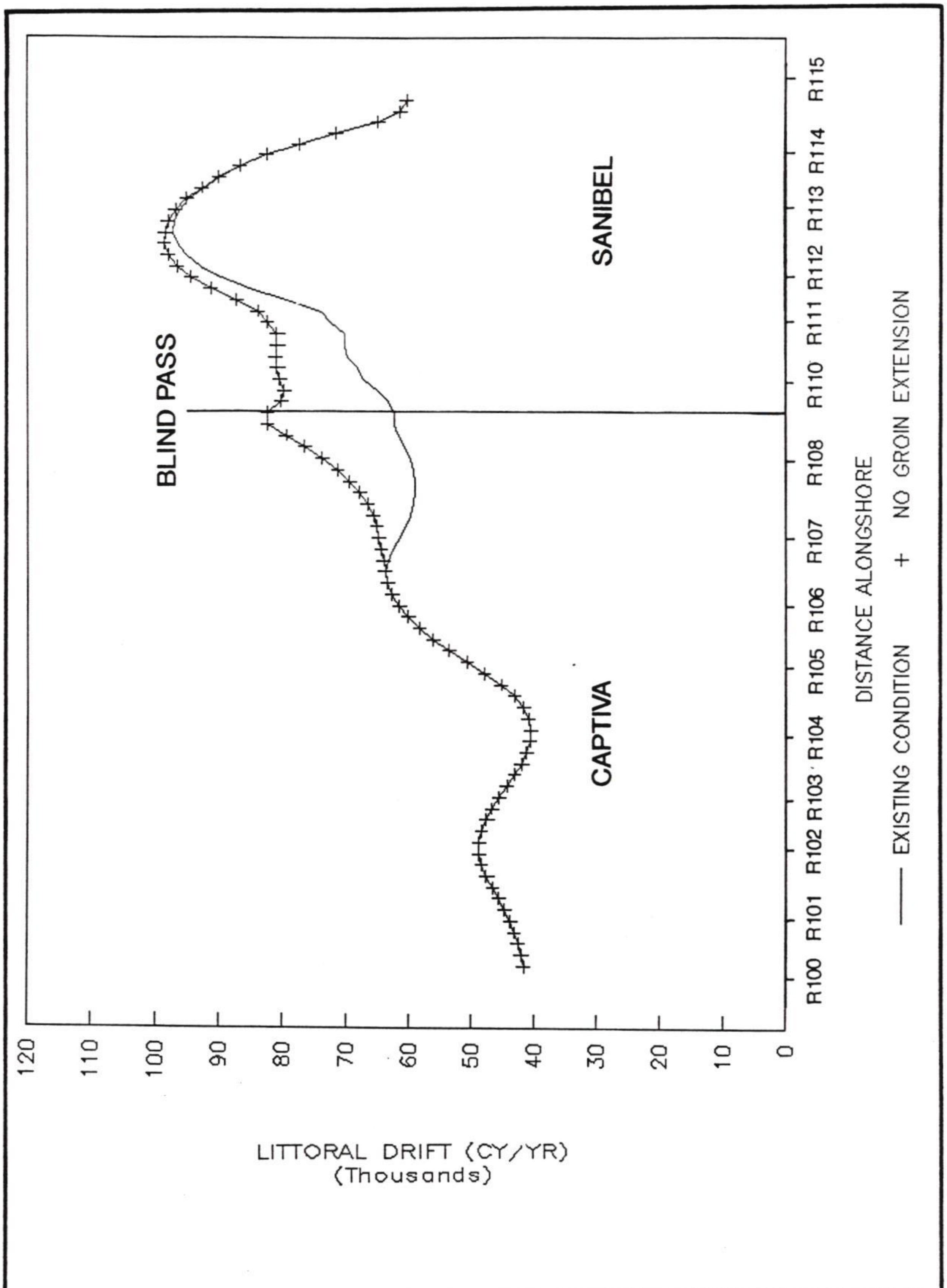

FIGURE G4

REMOVE GROIN EXTENSION ALTERNATIVE A.1.

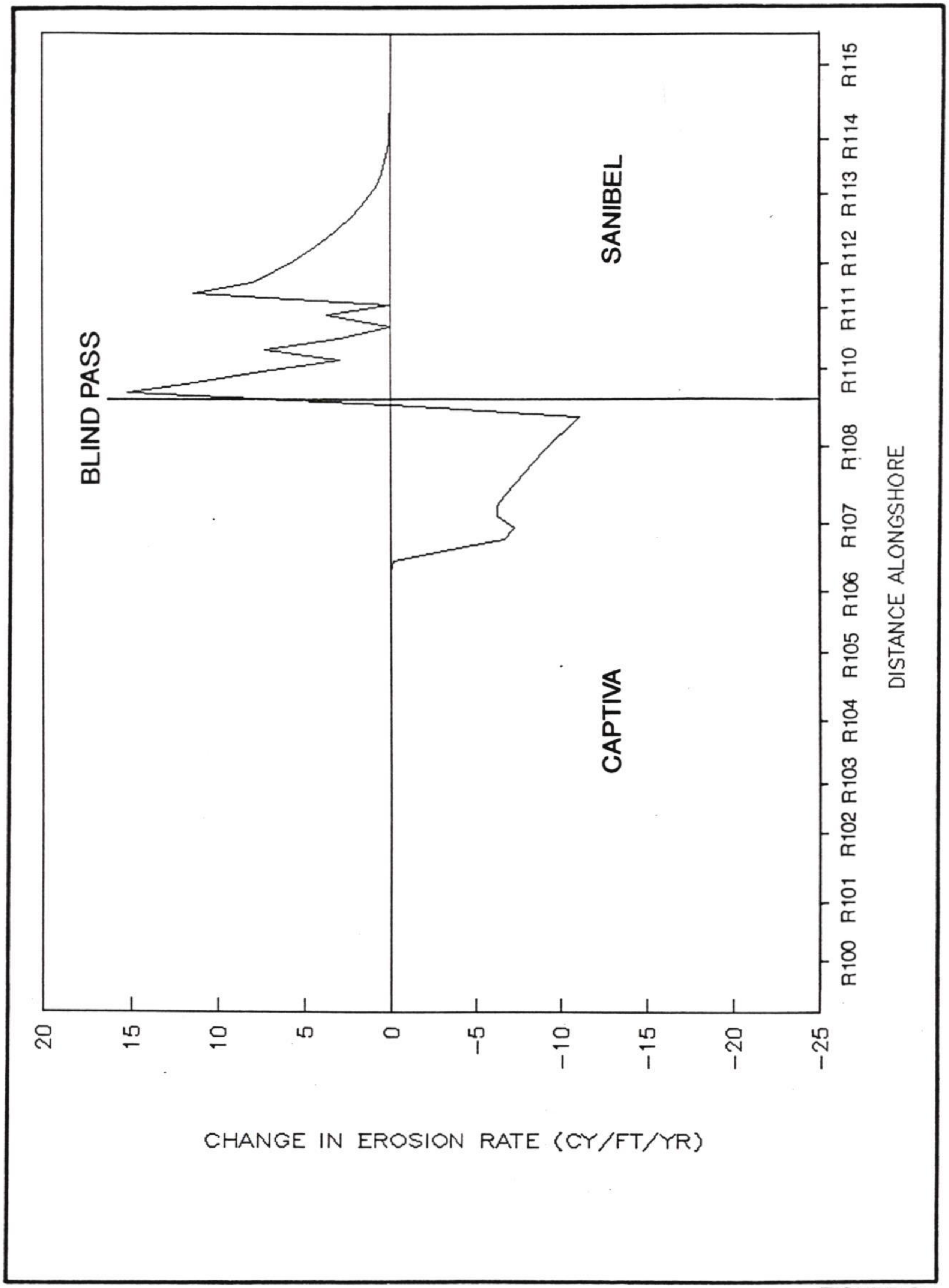

FIGURE G5

REMOVE GROIN ALTERNATIVE A.1.

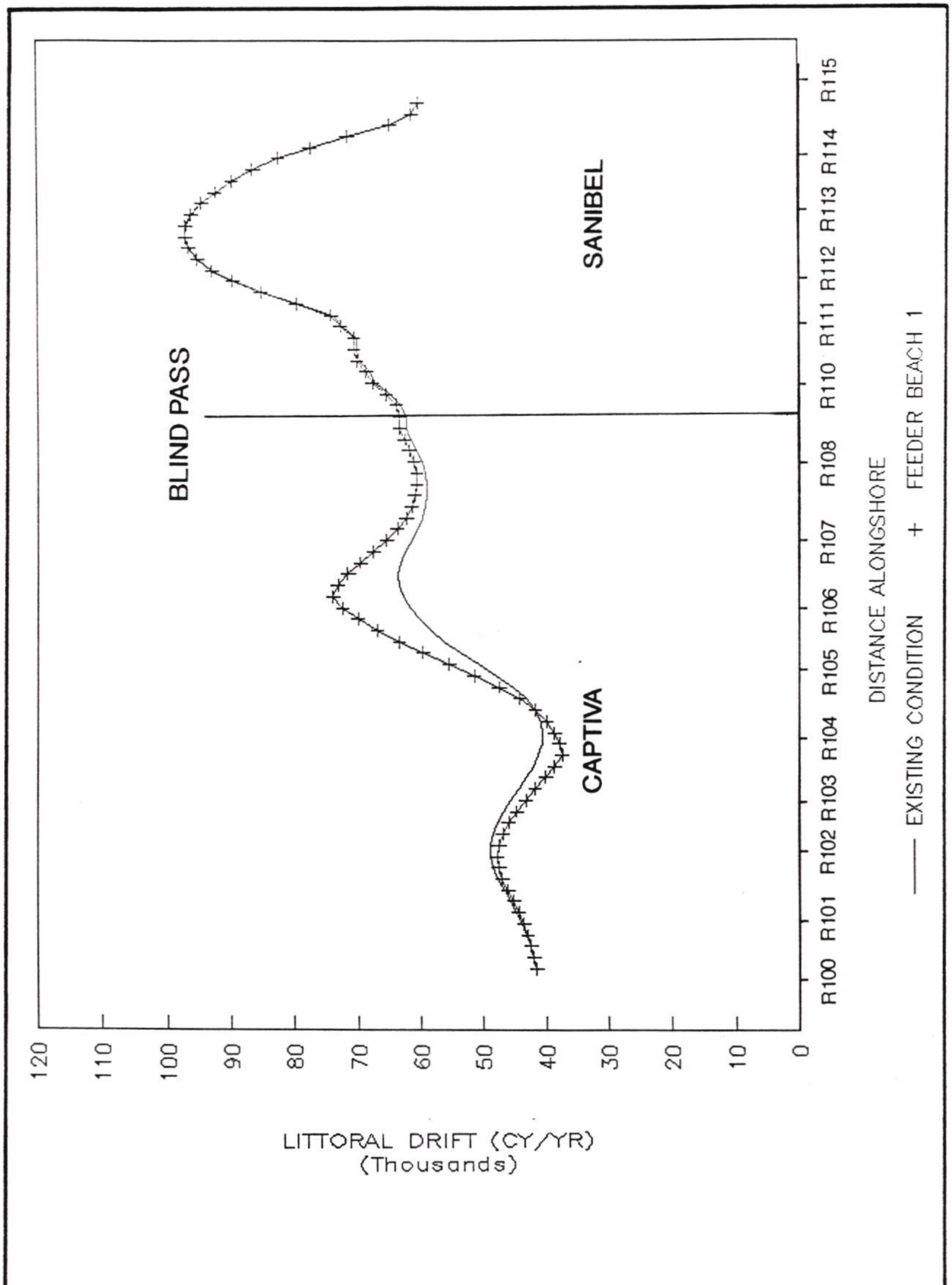

FIGURE G6

FEEDER BEACH 1 ALTERNATIVE B.3

G7 show that the feeder beach in this location would not substantially benefit Sanibel. Most of the sand remains on Captiva with some of the sand being transported to the north.

Since the location of the feeder beach was not identified in the engineering alternatives section, a second location was simulated to determine if the feeder beach concept was viable. The second feeder beach was located from 200 feet north of the pass to 2,400 feet north of the pass. The average littoral drift distribution is shown in Figure G8.

Figure G8 shows an increase in the southward moving littoral drift of 9,000 c.y./yr. at the pass. The majority of the sand is transported onto Sanibel. The model predicts that while 15,000 c.y./yr. of sand was placed on Captiva, only 9,000 c.y./yr. (on average), would be bypassed. It may be necessary to increase the volume of the initial feeder beach to provide an increase in bypassing of 15,000 c.y./yr. This can be accomplished during the final design phase.

Figures G8 and G9 indicate that construction of a feeder beach on Captiva is a viable alternative. The beach erodes and provides an increase in the littoral drift at the inlet. As a result, the gradient in the littoral drift on northern Sanibel decreases. This indicates lower erosion rates. This alternative is recommended to be included as part of the comprehensive plan.

3. Alternative B.1.a. 3600 Foot Nourishment on Sanibel.

This alternative, as designed in the engineering appendix, called for placement of 320,000 c.y. of sand plus 210,000 c.y. of advanced nourishment on northern 3600 feet of Sanibel. These volumes were based on the 1991 shoreline. In order to provide a meaningful comparison, the initial fill emplaced on the 1989 shoreline was reduced to 165,000 c.y. plus 210,000 c.y. of advanced fill to account for erosion since 1989. Figures G10 and G11 show the results of the simulation.

Figure G10 shows that the magnitude of the littoral drift increases on Sanibel as a result of placing sand on the beach. This is significant in the vicinity of R113 where the littoral drift is approximately 105,000 c.y./yr. By the end of 6 years, all of the advanced nourishment and the initial fill is eroded away. This occurs because the fill length is short and diffusion losses were not included in the advanced nourishment volume estimate (Figure G11). However, the fill does provide storm protection for the road while it is in place. Final design efforts should increase the volume necessary to maintain a minimum beach on northern Sanibel. This alternative is recommended to be incorporated into the selected plan.

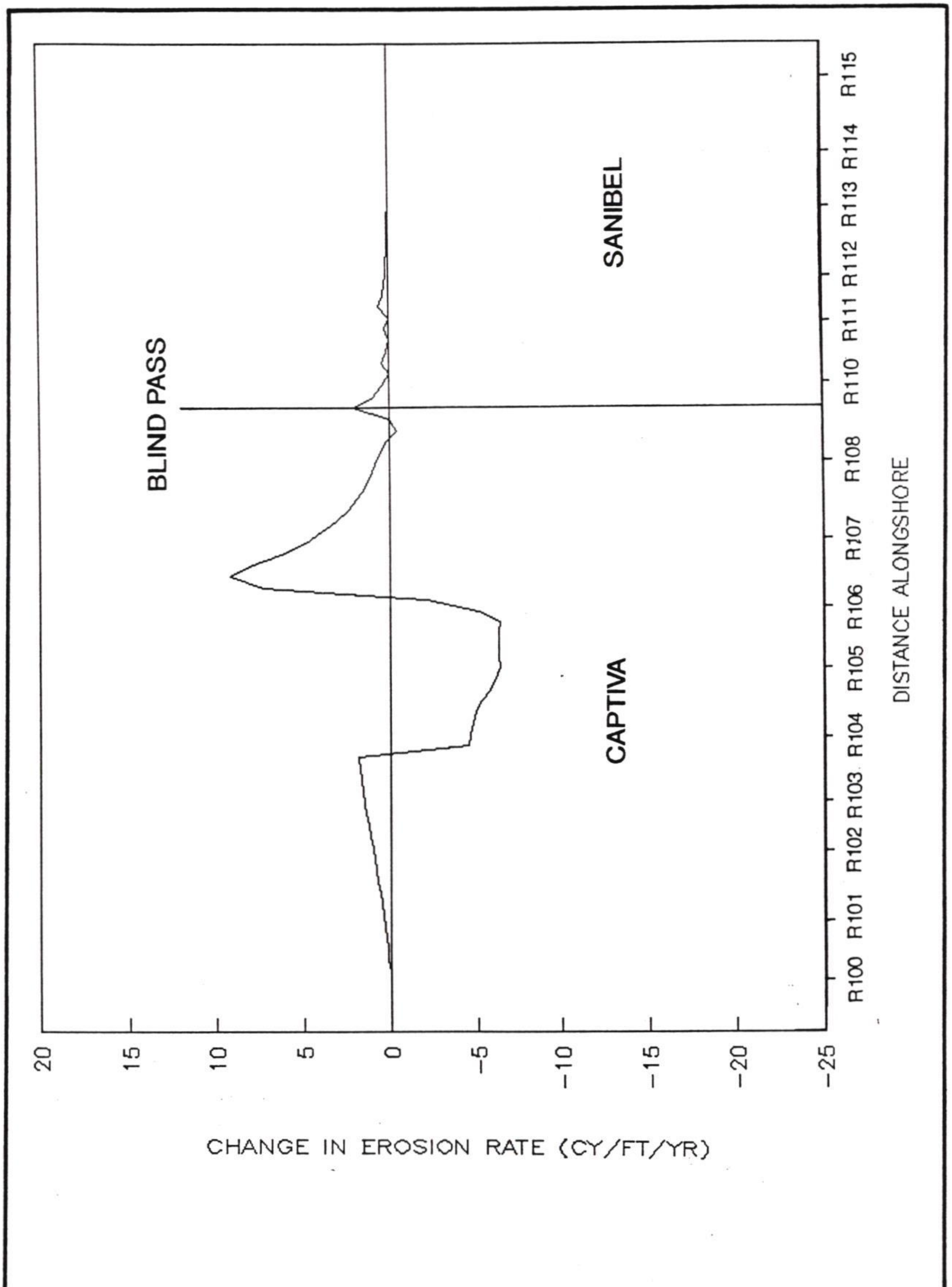

FIGURE G7

FEEDER BEACH 1 ALTERNATIVE B.3.

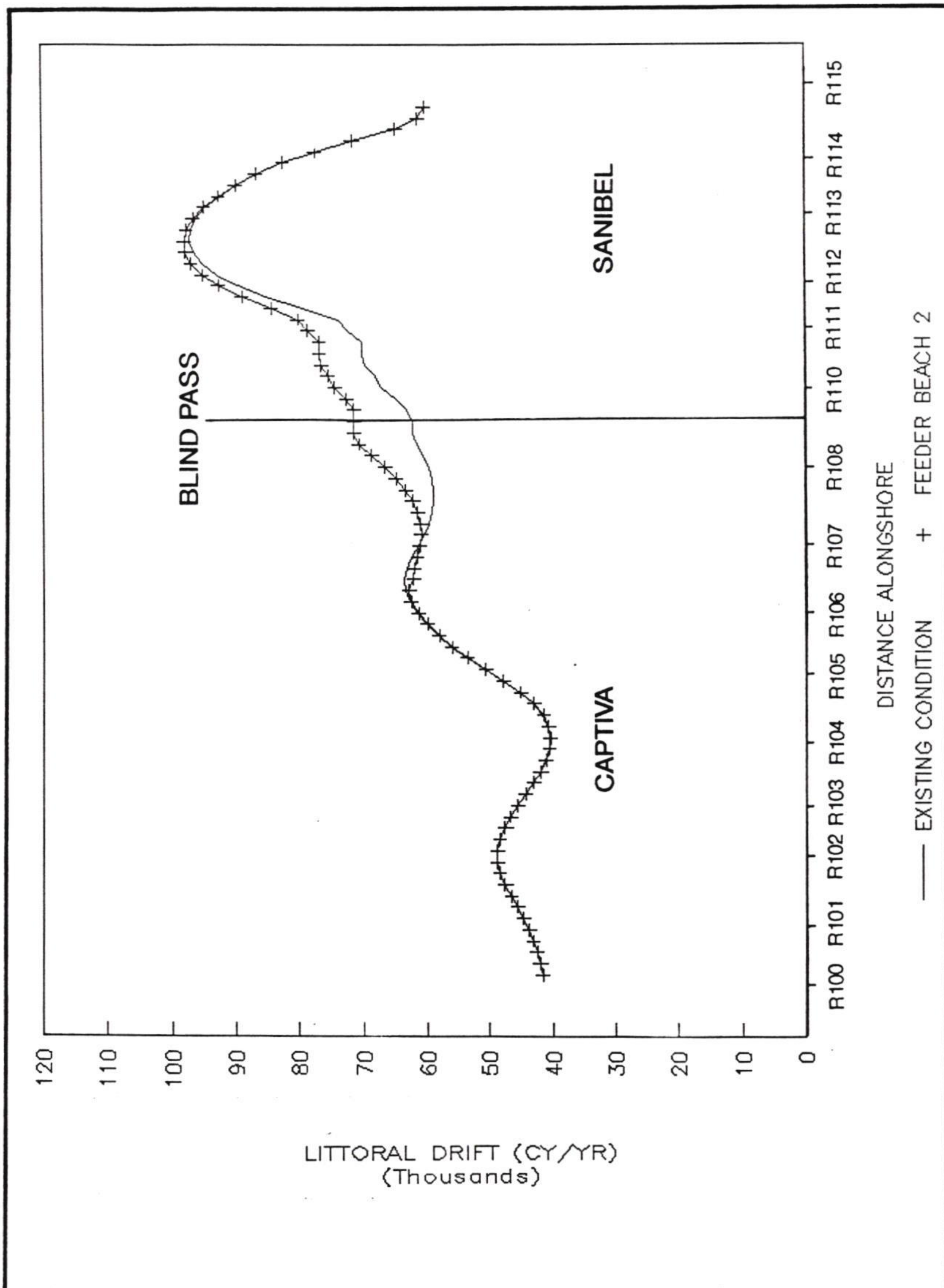

FIGURE G8

FEEDER BEACH 2 ALTERNATIVE B.3

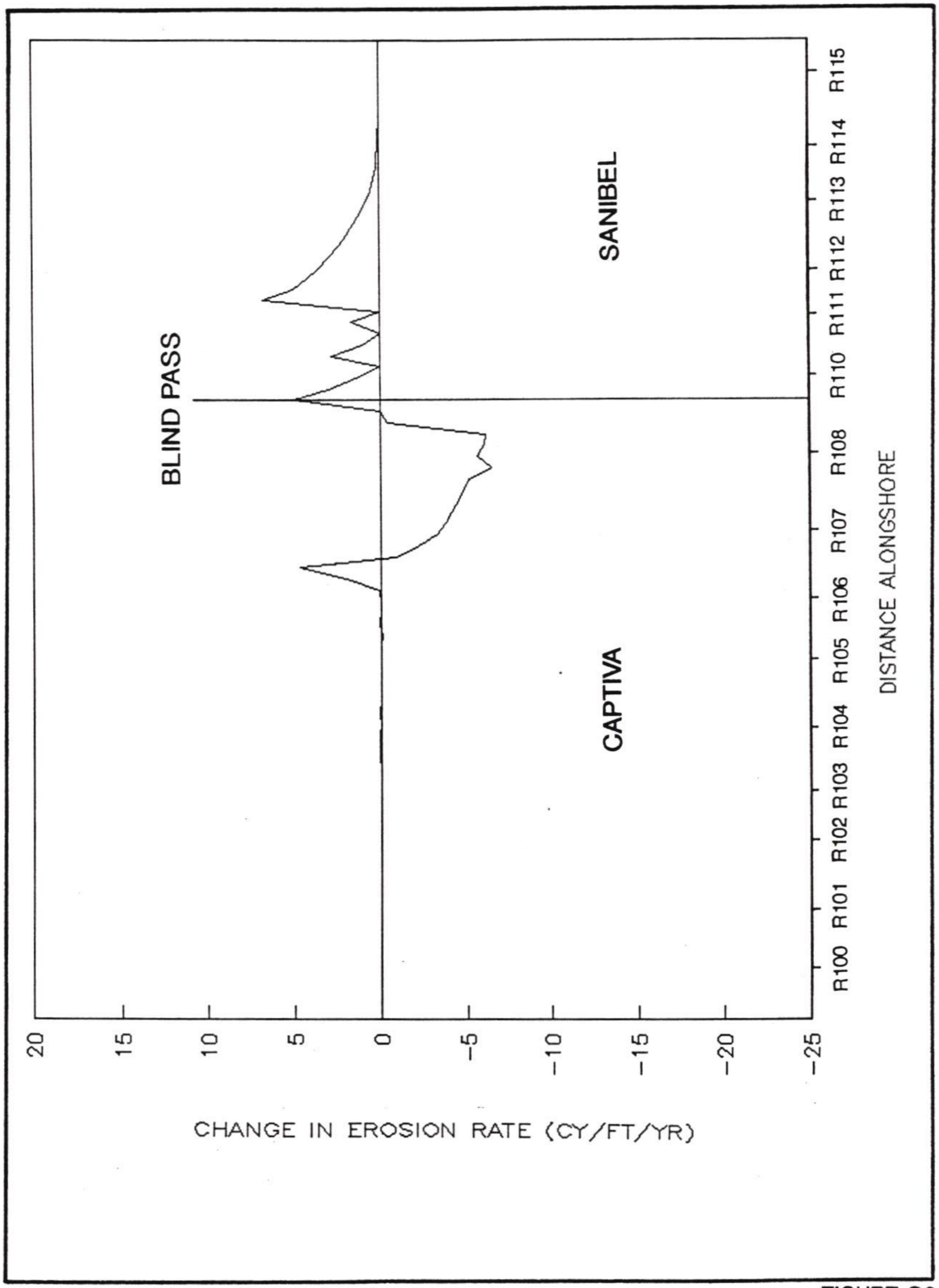

FIGURE G9

FEEDER BEACH 2 ALTERNATIVE B.3.

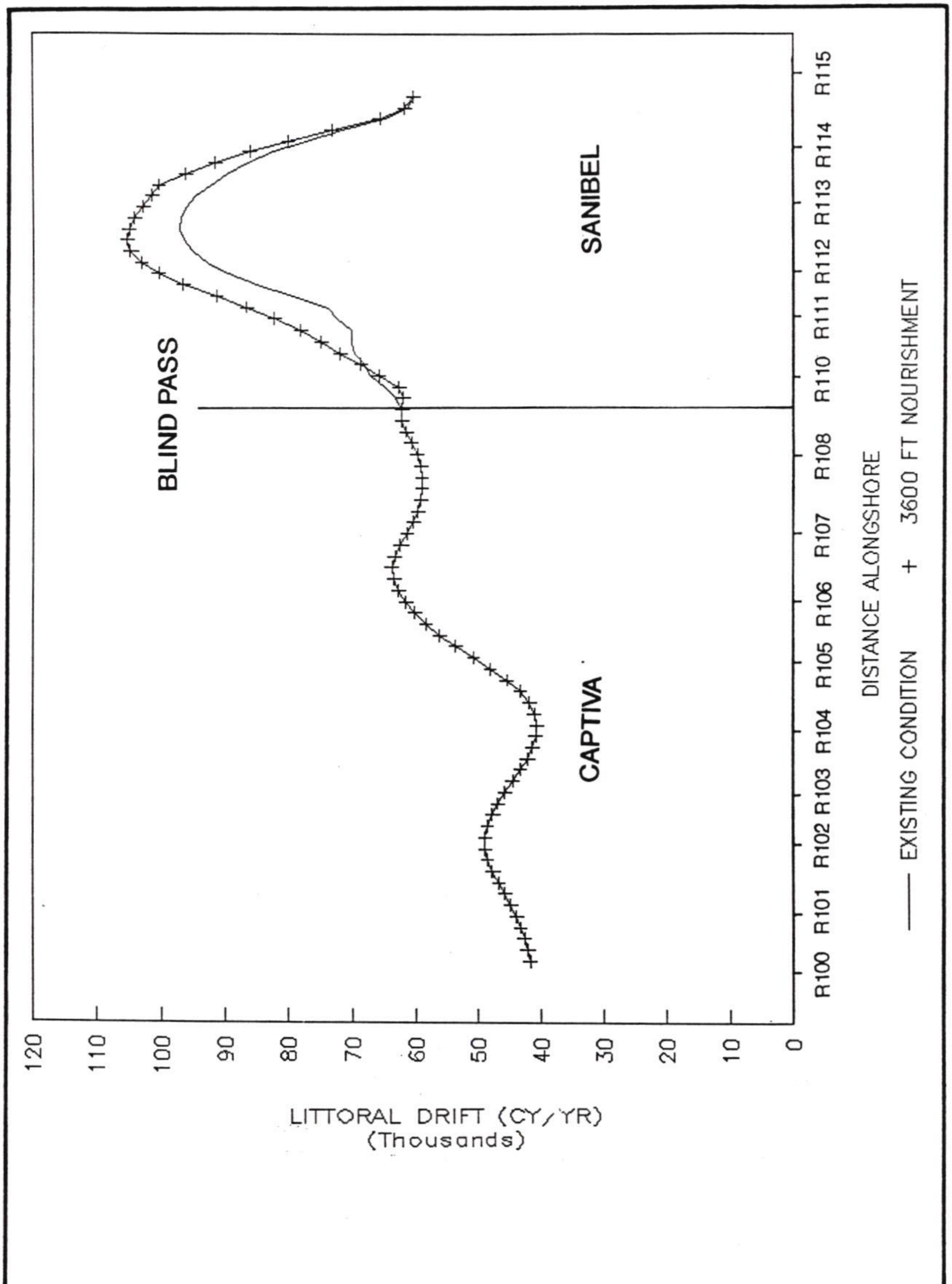

FIGURE G10

3600 FT. NOURISHMENT ALTERNATIVE B.1.a.

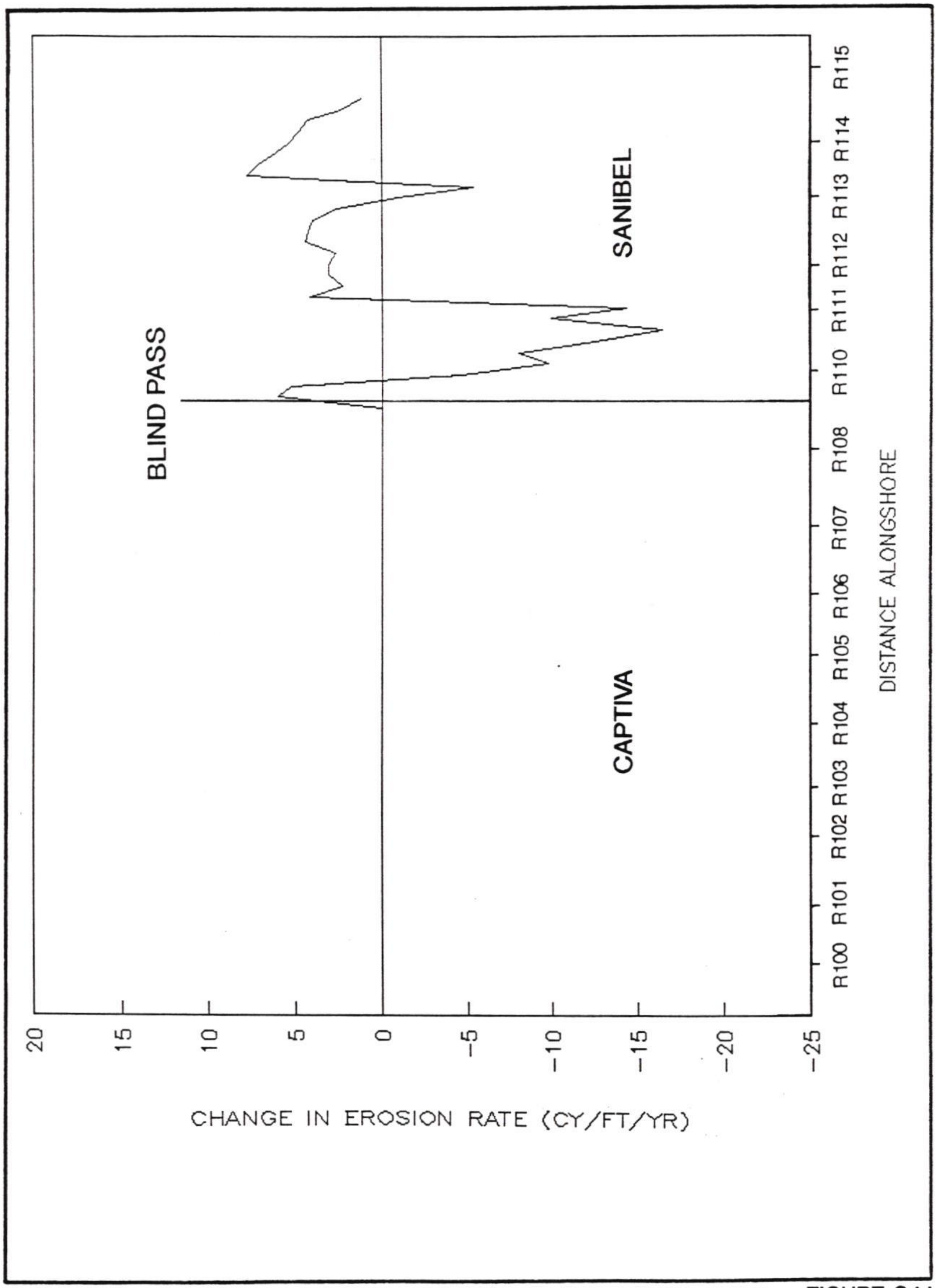

FIGURE G11

3600 FT. NOURISHMENT ALTERNATIVE B.1.a.

4. Alternative B.10. 1800 Foot Beach Nourishment.

This alternative, as specified in the engineering alternatives section, is a 1800 foot long fill design to stabilize the beach in front of the road and houses only. The design was to place 3 years of advanced fill in 1993, with an expected erosion rate of 45,000 c.y./yr. To provide a fair comparison of alternatives, a 6-year fill on the 1989 shoreline was simulated. The results are shown graphically in Figures G12 and G13.

The littoral drift increases to a rate of approximately 109,000 c.y./yr. (Figure G12). This rate erodes the fill quickly. All of the fill is gone by the end of the six year simulation because the fill volume estimates did not include diffusion losses.

The overall performance of this alternative is not as good as the 3600 foot fill. (Alternative B.1.a). The maximum littoral drift rate is higher which results in a shorter fill life. While additional engineering could provide an adequate fill volume, the 1800 foot fill will not perform as well as the 3600 foot fill. The 1800 foot fill is not recommended to be incorporated in the selected plan.

5. Selected Plan.

The selected plan, as described in the inlet management plan consists of the following components:

a. 800-foot long revetment in front of road on Sanibel.
b. 90,000 c.y. feeder beach on Captiva, located just north of the terminal groin.
c. 120,000 c.y. of advanced nourishment on Sanibel over 3600 feet.
d. 300,000 c.y. to re-establish the Sanibel shoreline over 3600 feet.

Since the simulations are run on the 1989 shoreline as a baseline, the volume to re-establish the shoreline was reduced to 280,000 c.y. to account for erosion since April 1989. The advanced nourishment volume was not modified. The impact of the 800-foot long road revetment was not modeled since the shoreline did not erode back to the location of the revetment. The results of the model are shown in Figures G14 and G15.

The model predicts that the selected plan would perform better than any of the individual alternatives. The feeder beach causes an increase in the littoral drift on southern Captiva which reduces the erosion rate on northern Sanibel. The increase in bypassing is 9,000 c.y./yr. (Figure G14). The fill placed on Sanibel erodes at a slightly lower rate than if the feeder beach were not present. This is

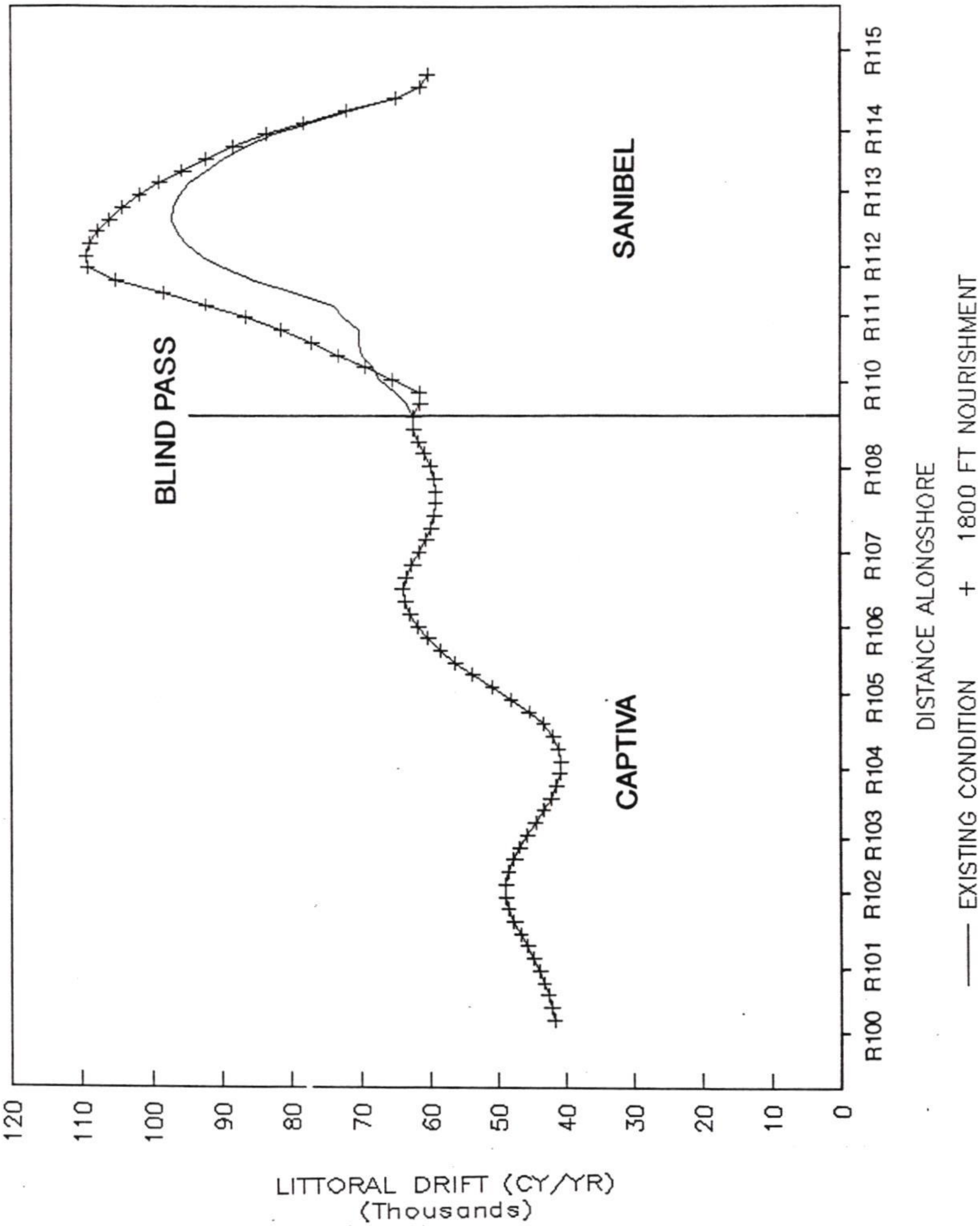

FIGURE G12

1800 FT. NOURISHMENT ALTERNATIVE B.10

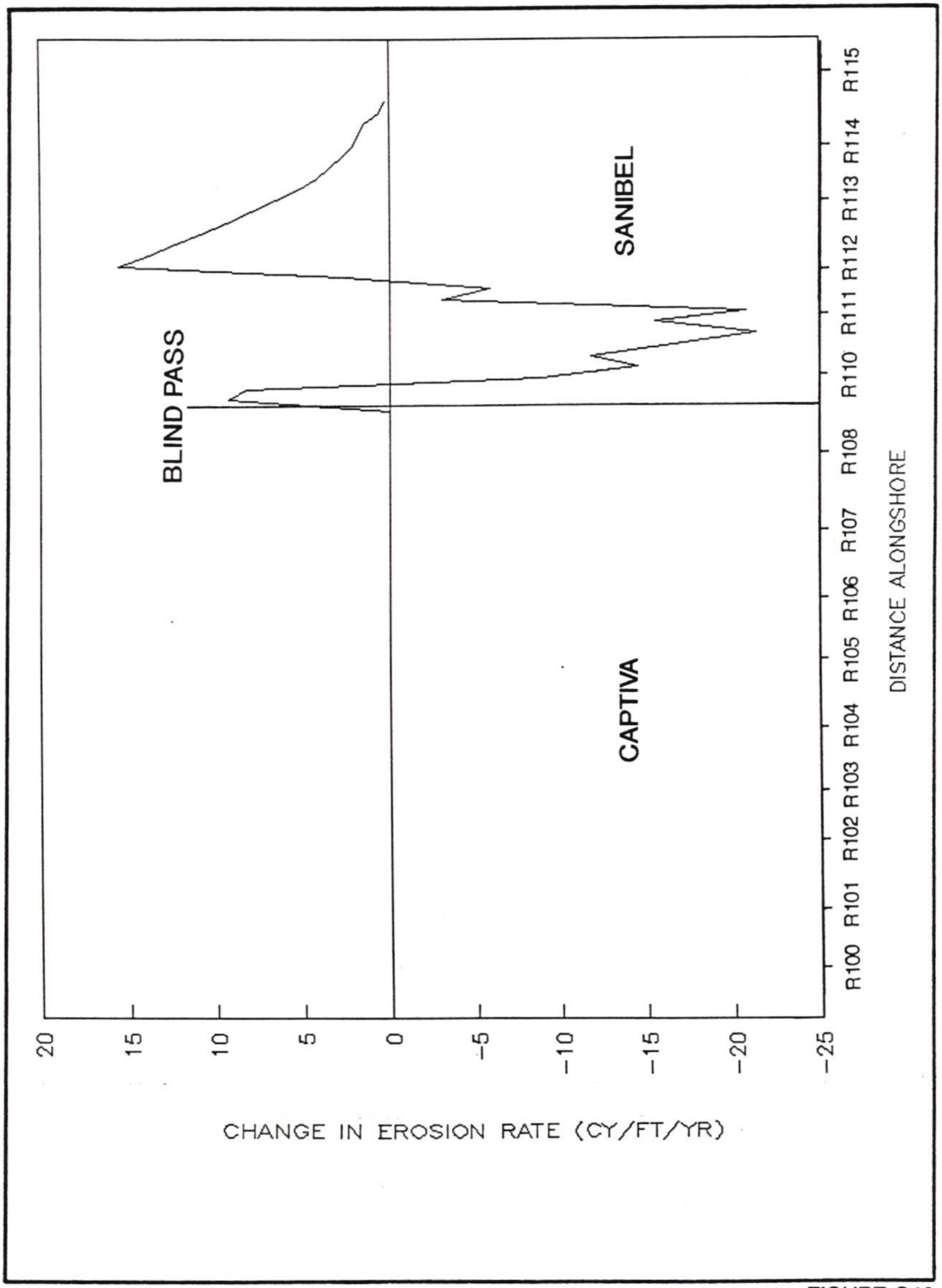

FIGURE G13

1800 FT. NOURISHMENT ALTERNATIVE B.10.

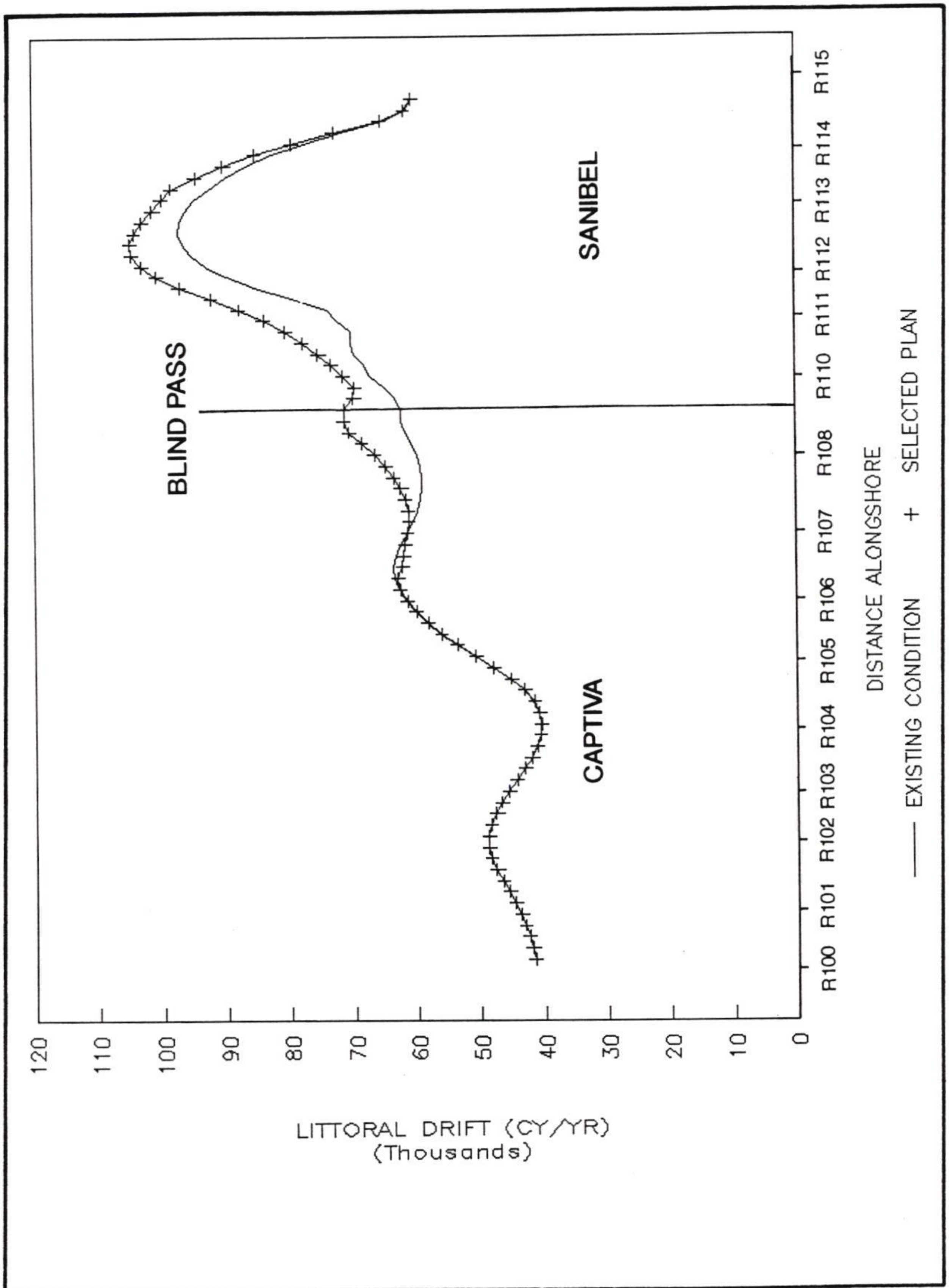

FIGURE G14

SELECTED PLAN

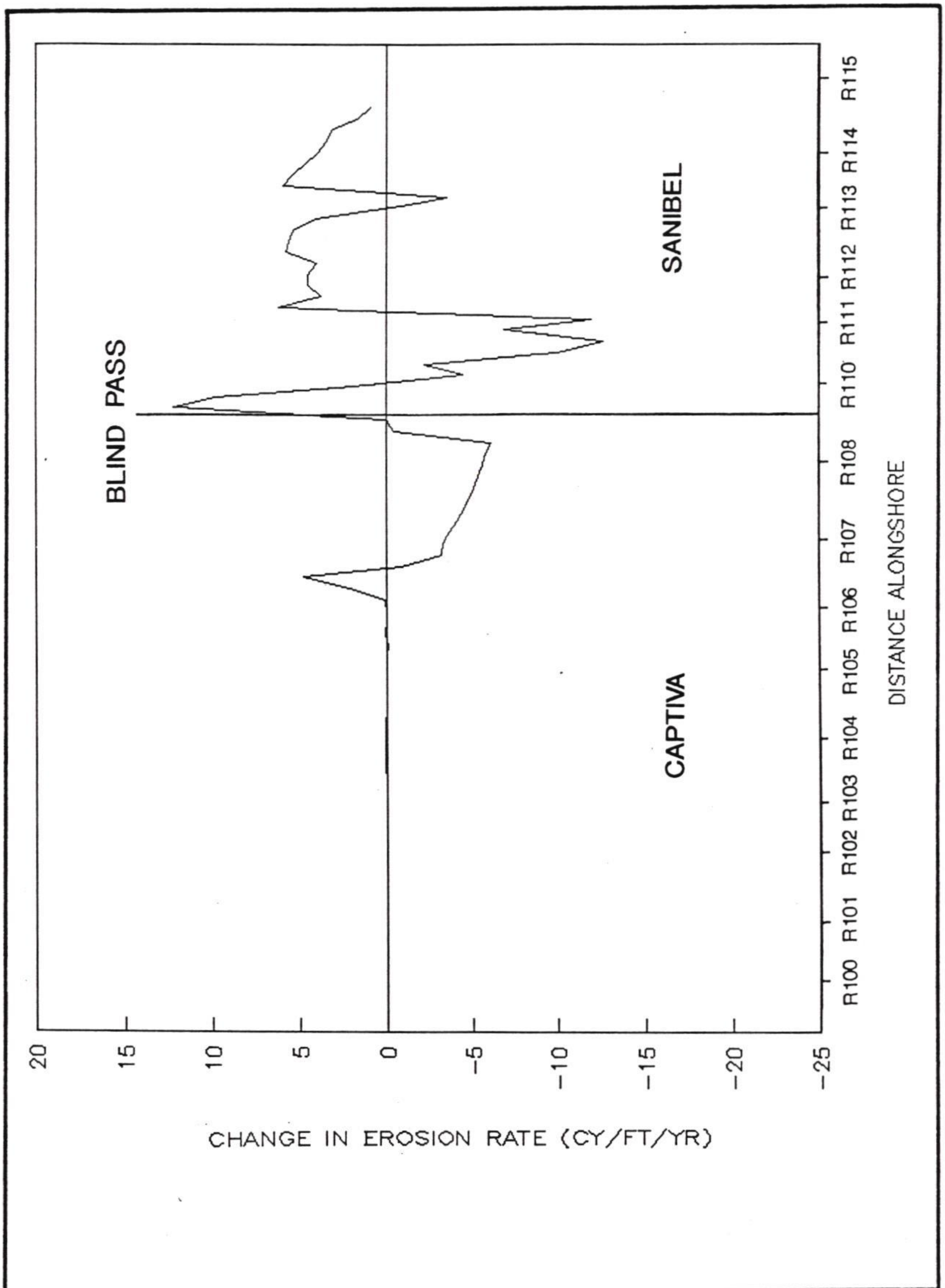

FIGURE G15

SELECTED PLAN

evident graphically by comparing the maximum littoral drift on Sanibel in Figures G14 and G10.

The quantities of fill, for the 3600 foot beach fill and the feeder beach, appear underestimated (Figure G16). Final engineering design should consider increasing the volume of fill to provide actual bypassing of 15,000 c.y./yr. of fill at Blind Pass and assure that the restored design beach is not eroded between dredgings.

H. Conclusions

The results of the simulations of the alternatives indicate that the selected plan provides the most benefits to both Sanibel and Captiva Island. The feeder beach on Captiva should be located adjacent to Blind Pass. The feeder beach will increase the bypassing rate 9,000 c.y./yr., while providing additional storm protection to the road. Further engineering of the fill quantity could increase the bypassing rate up to the desired rate of 15,000 c.y./yr.

The restoration and advanced nourishment when placed over a 3600 foot length appear to stabilize the shoreline if the fill quantities are increased to account for diffusion losses. While further engineering is necessary on this aspect of the fill design, this plan is still recommended for implementation.

The 800-foot road revetment will provide storm protection for the evacuation route. The revetment was not modeled, since the shoreline did not erode back to the road in the fill alternative.

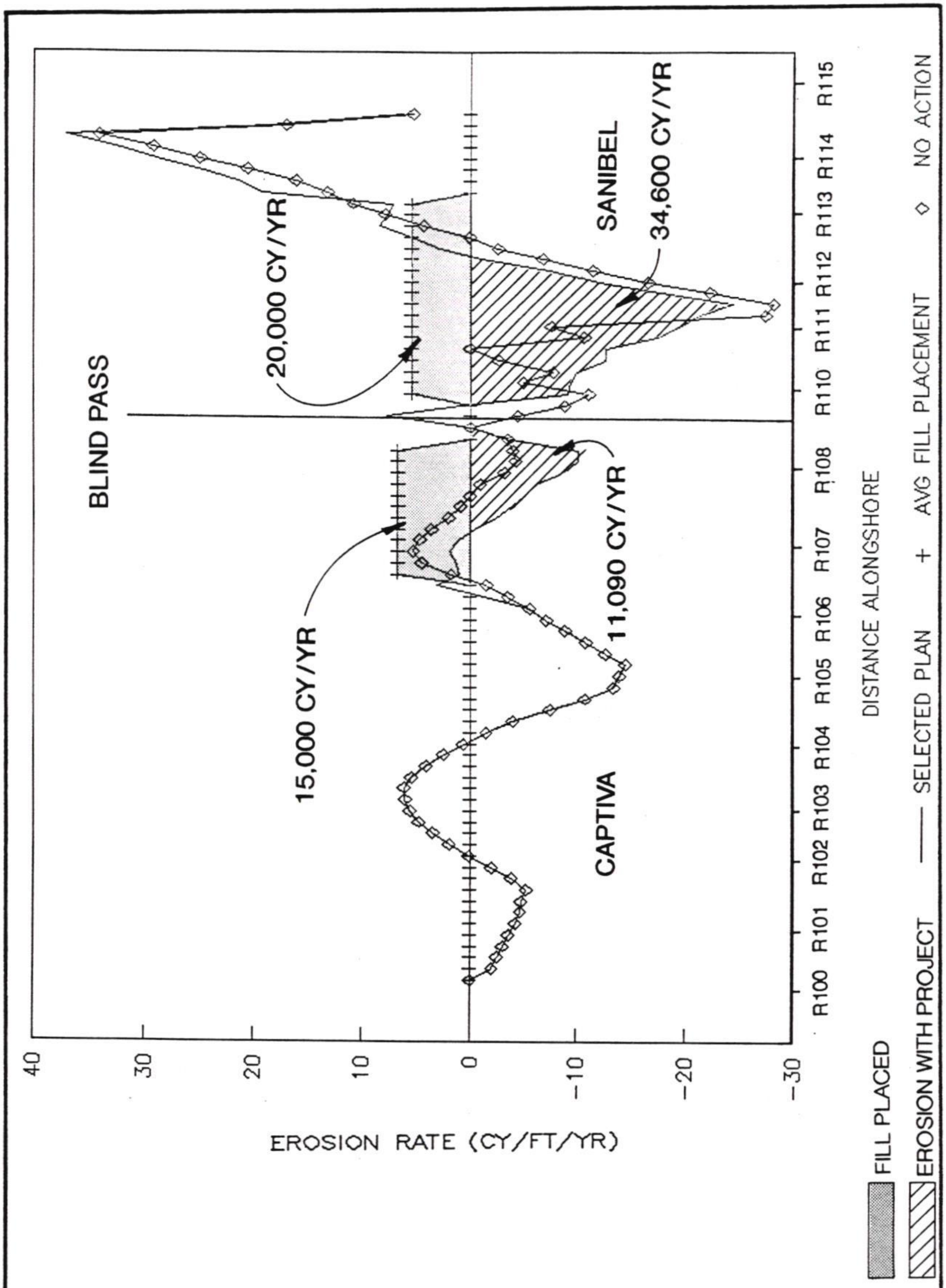

FIGURE G16

SELECTED PLAN

References

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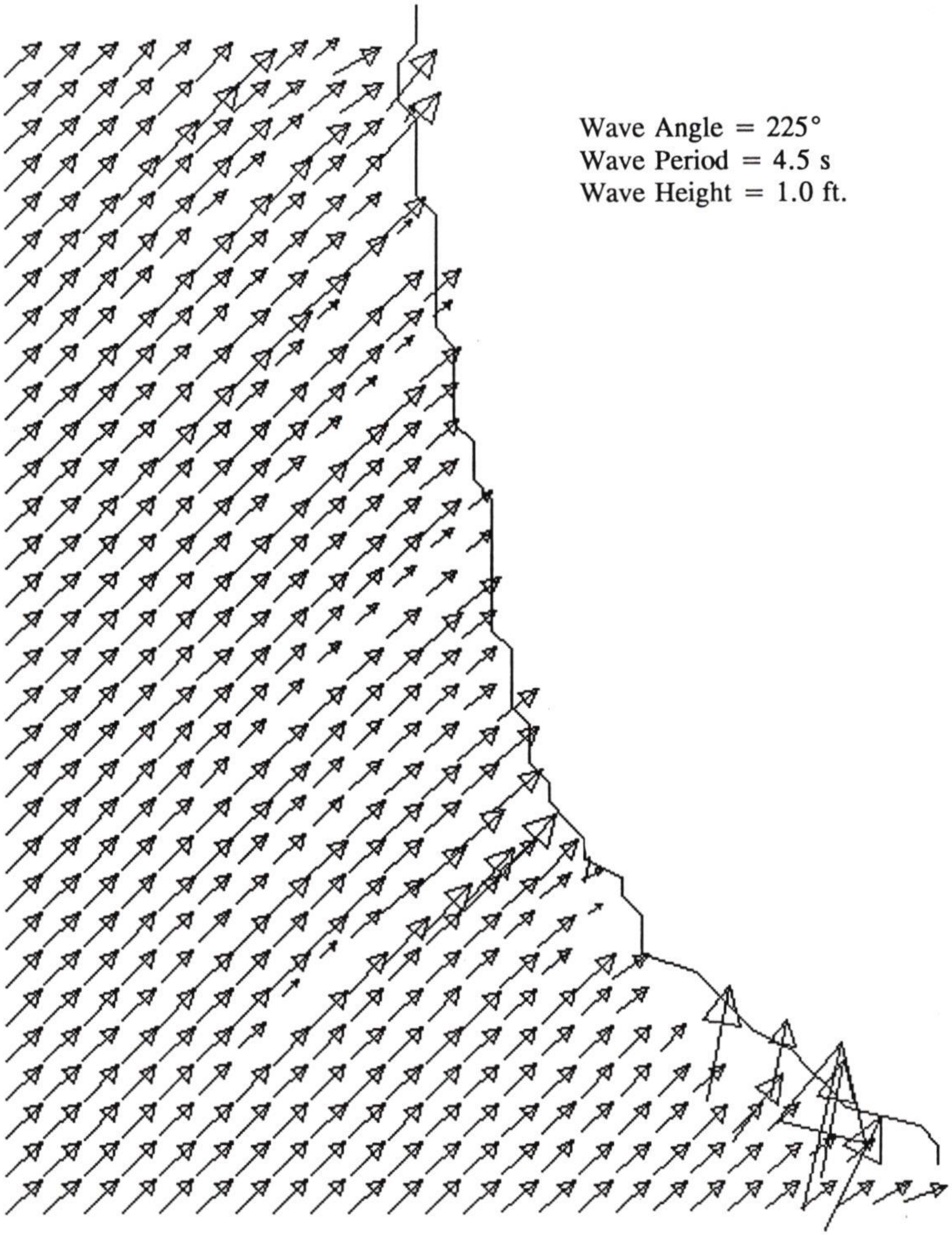
Hanson, H., "Seawall Boundary Condition in Numerical Models of Shoreline Evaluation," Coastal Engineering Research Center, Technical Report CERC-86-3, 1986.

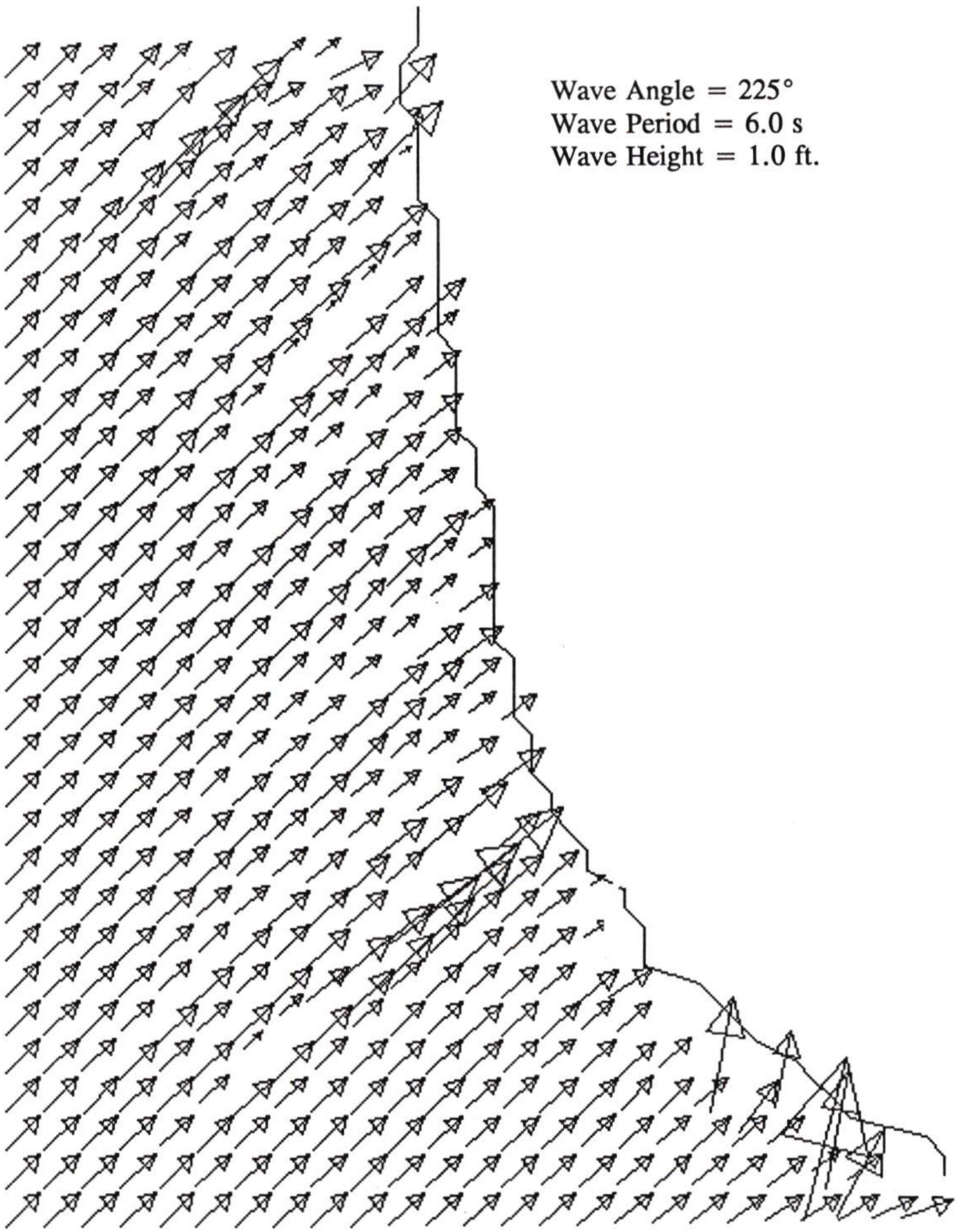
U.S. Army Corps of Engineers, "Gulf of Mexico Hindcast Wave Information," WIS Report 18, Waterways Experiment Station, 1989.

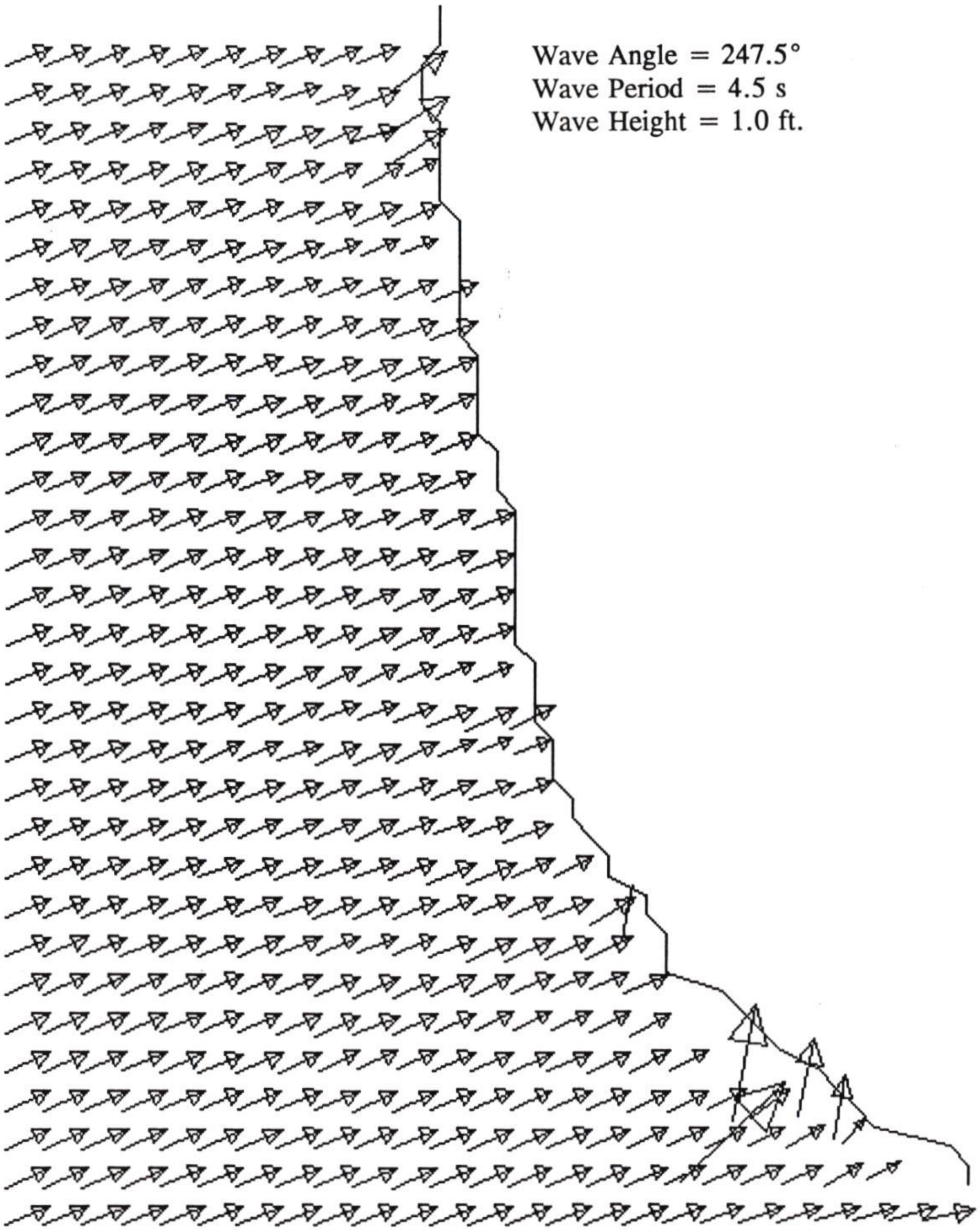
SUB-APPENDIX G1

Wave Refraction Diagrams

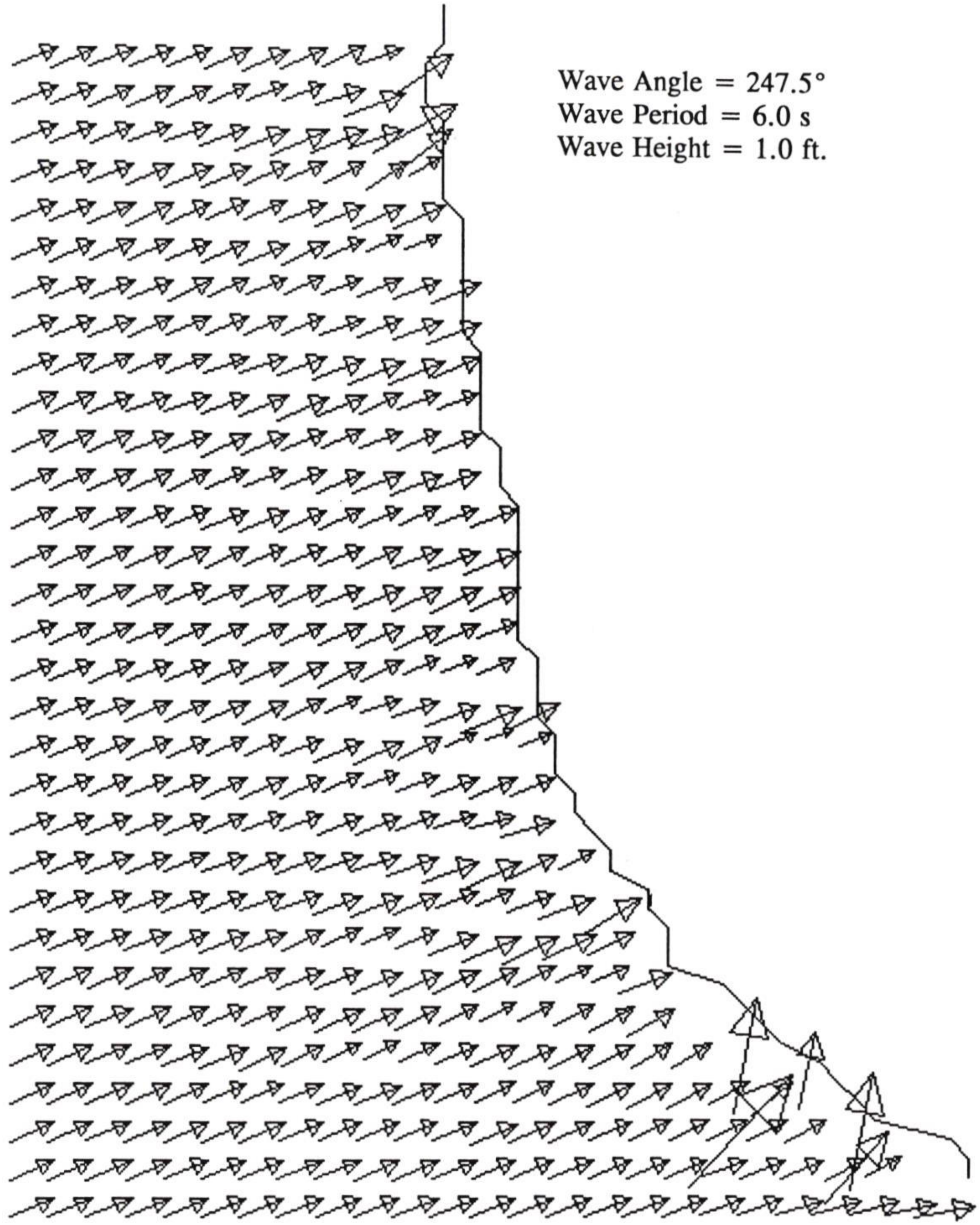
Note: The arrow diagrams represent the size and direction of the wave at selected locations. Data is plotted for every second grid point in both directions. The length of the arrow is proportional to the wave height.

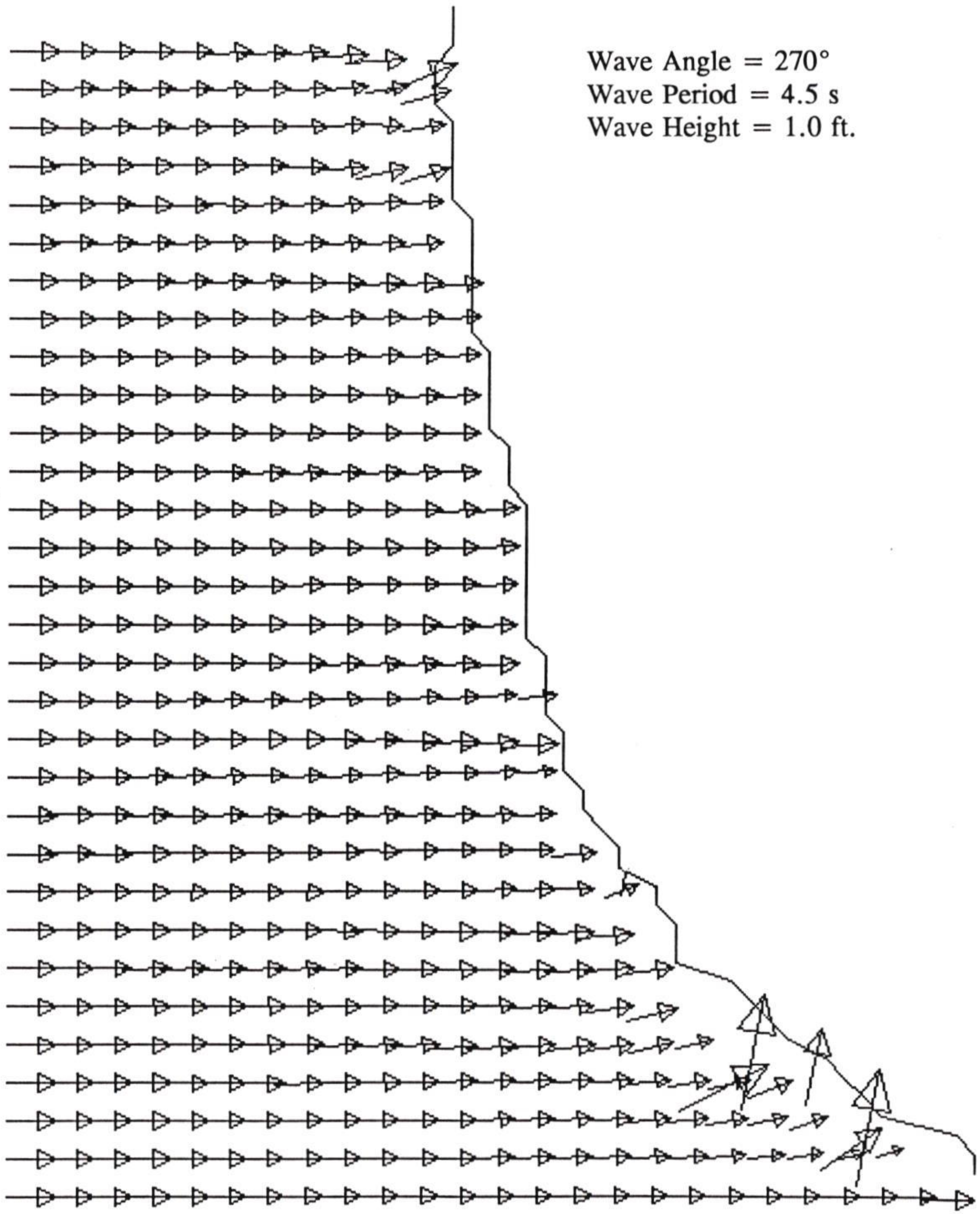

Wave Angle = 225°
Wave Period = 4.5 s
Wave Height = 1.0 ft.

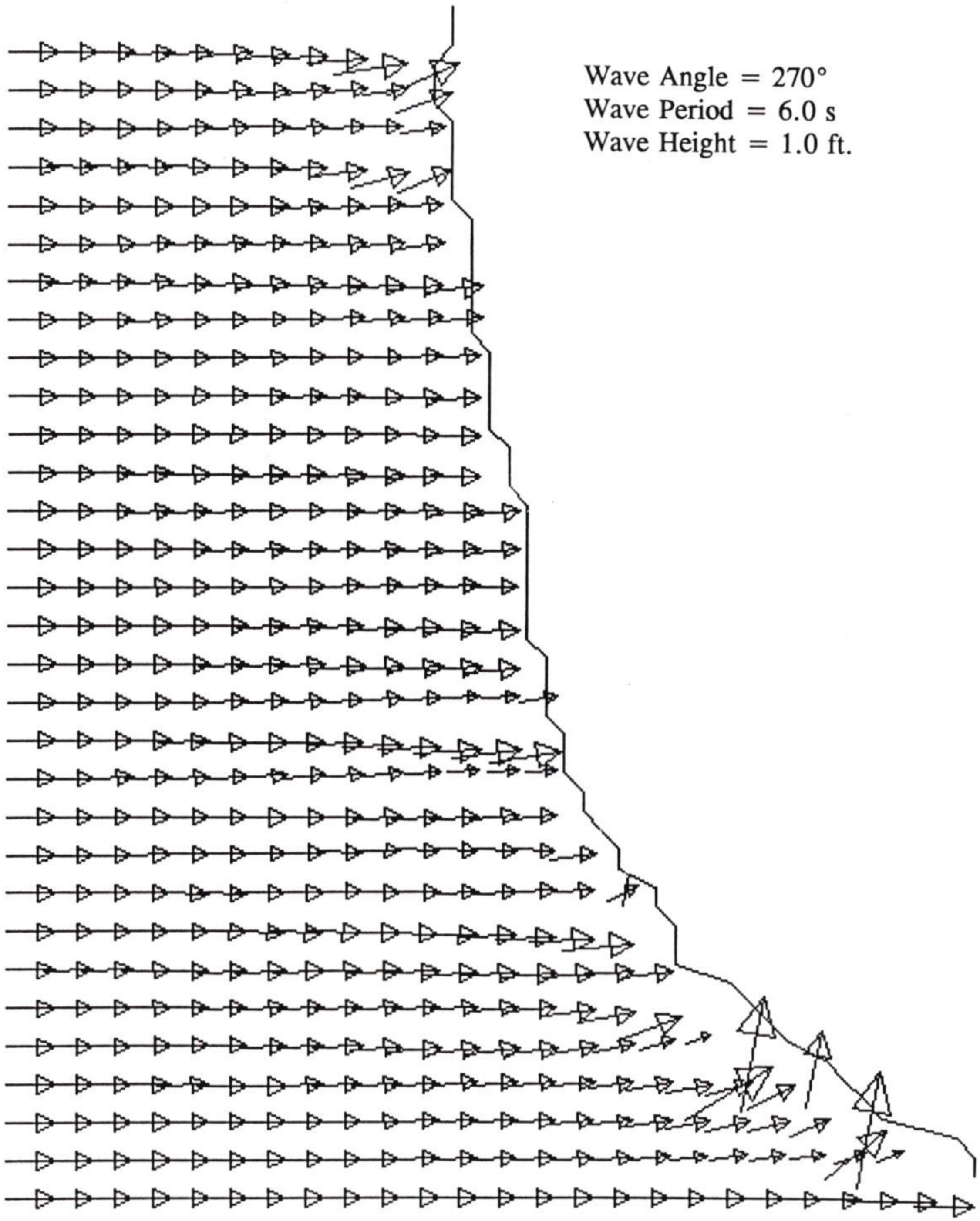

Wave Angle = 225°
Wave Period = 6.0 s
Wave Height = 1.0 ft.



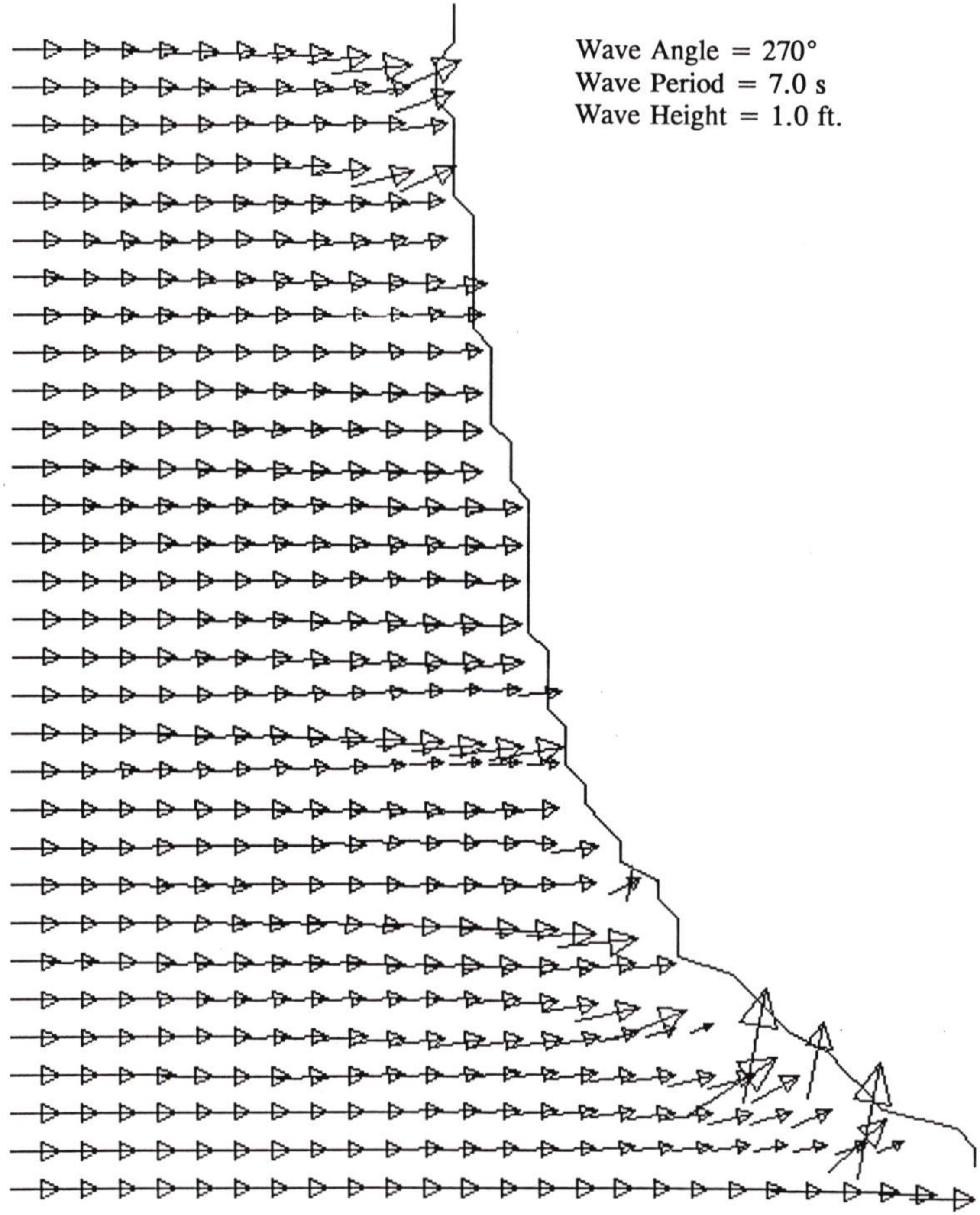
Wave Angle = 247.5°
Wave Period = 4.5 s
Wave Height = 1.0 ft.


Wave Angle = 247.5°
Wave Period = 6.0 s
Wave Height = 1.0 ft.

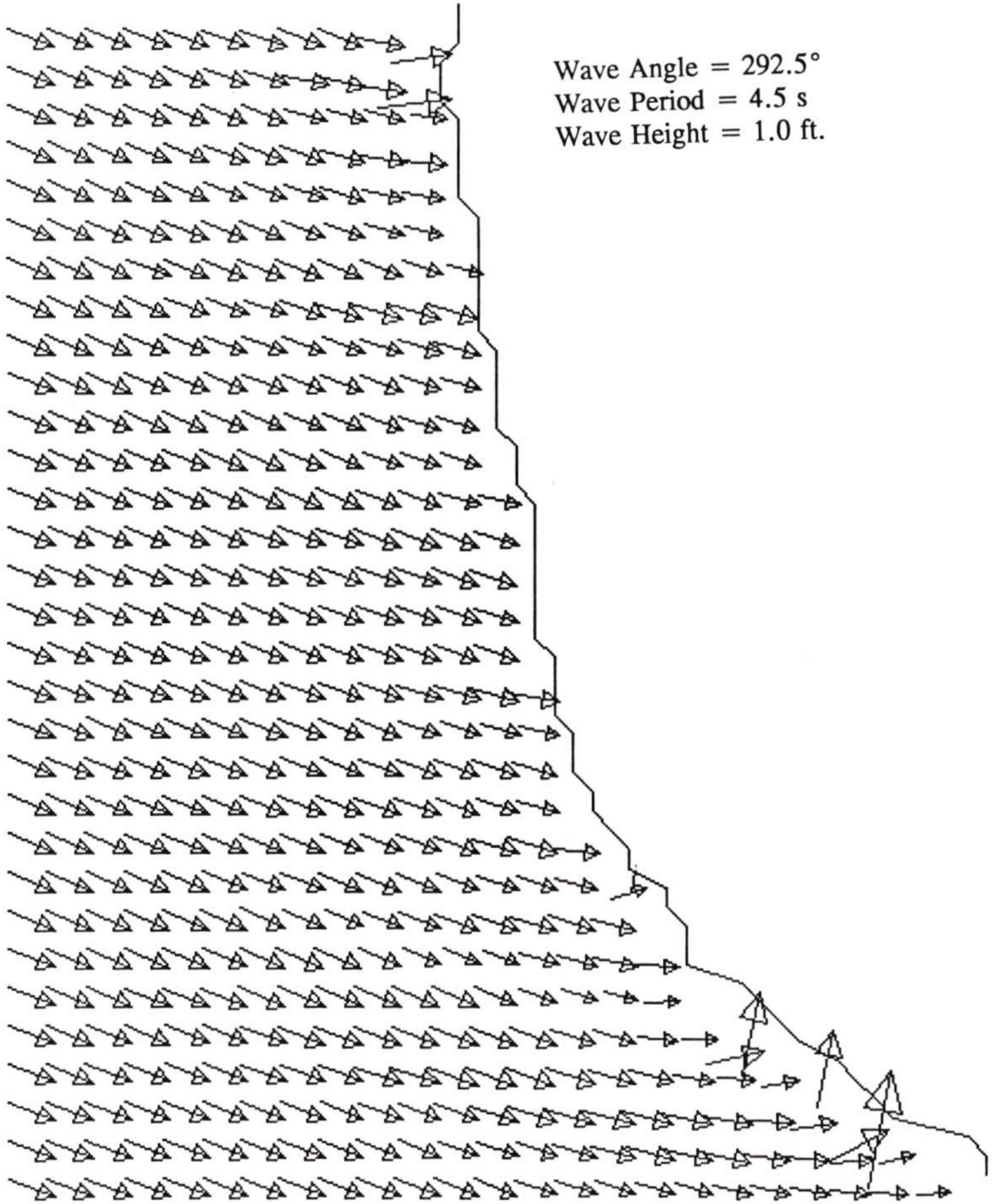

Wave Angle = 270°
Wave Period = 4.5 s
Wave Height = 1.0 ft.

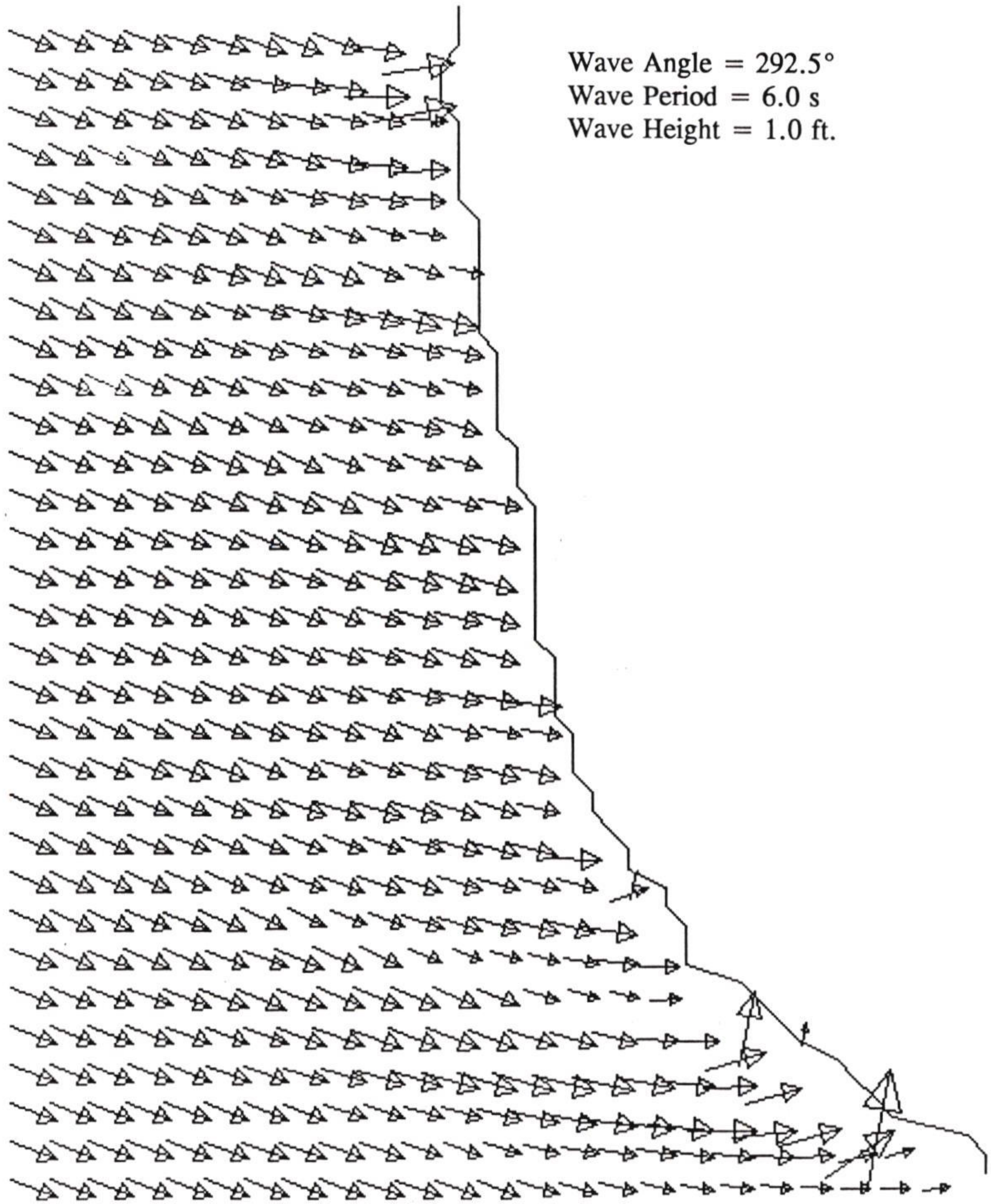


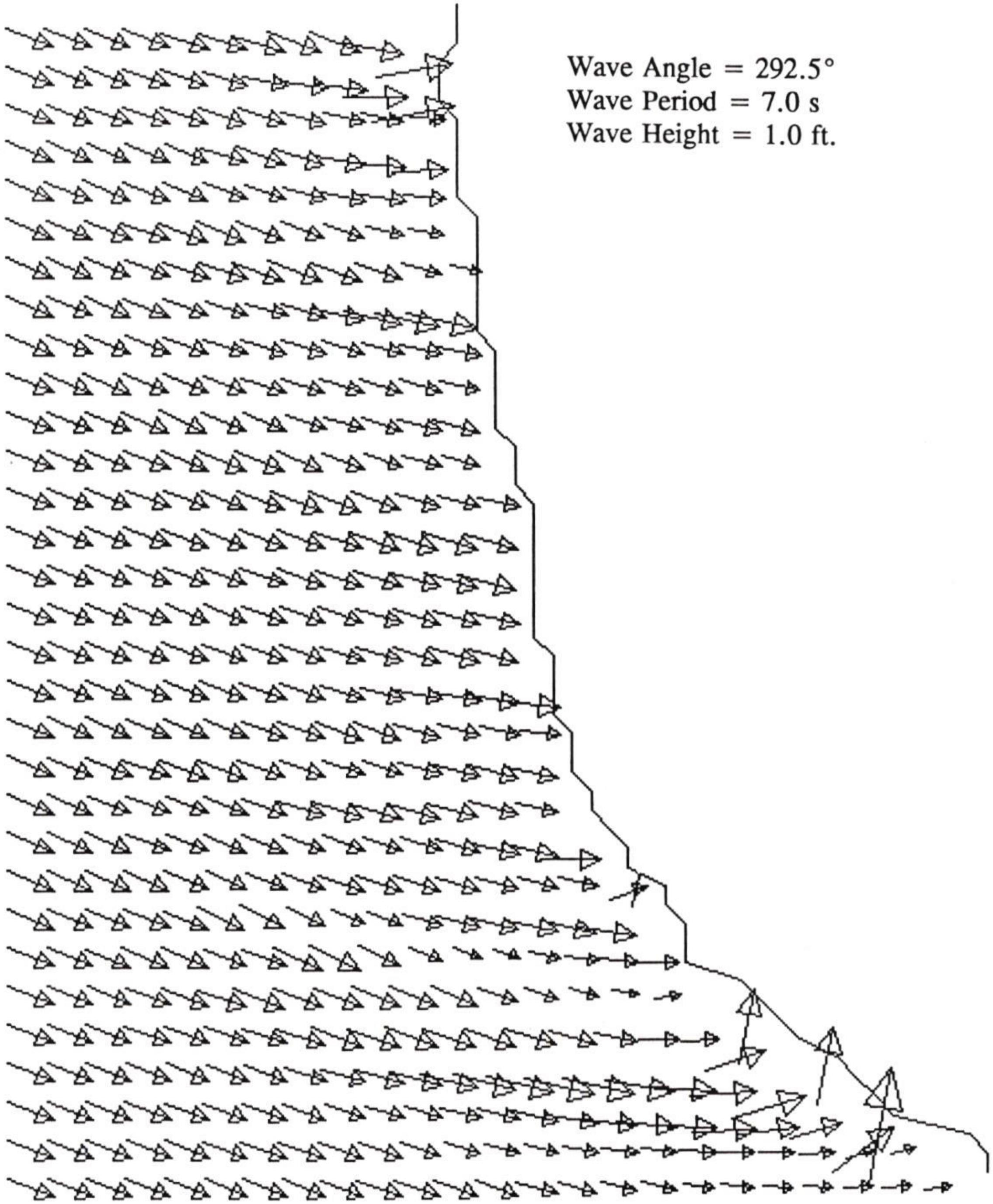
Wave Angle = 270°
Wave Period = 6.0 s
Wave Height = 1.0 ft.

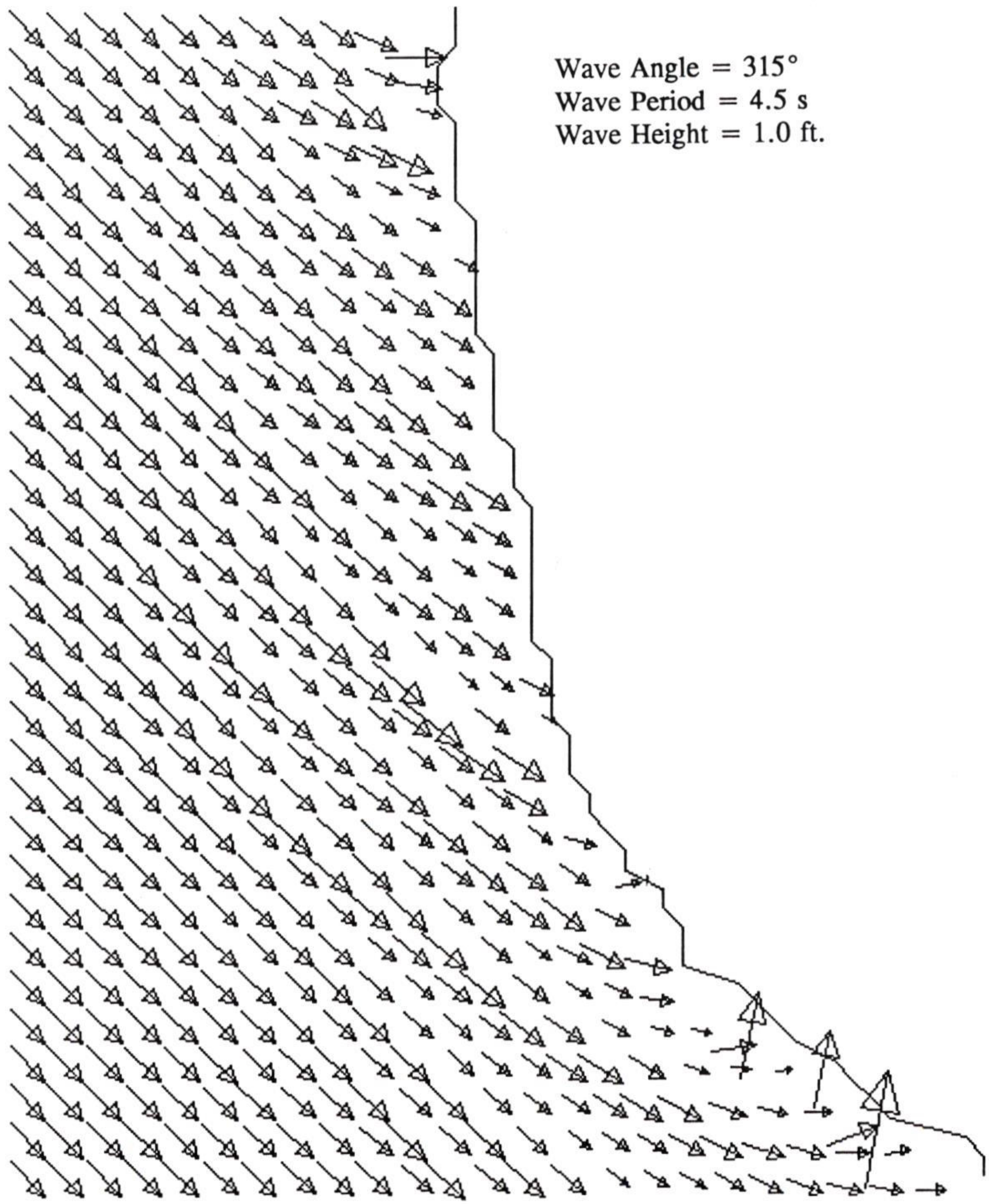


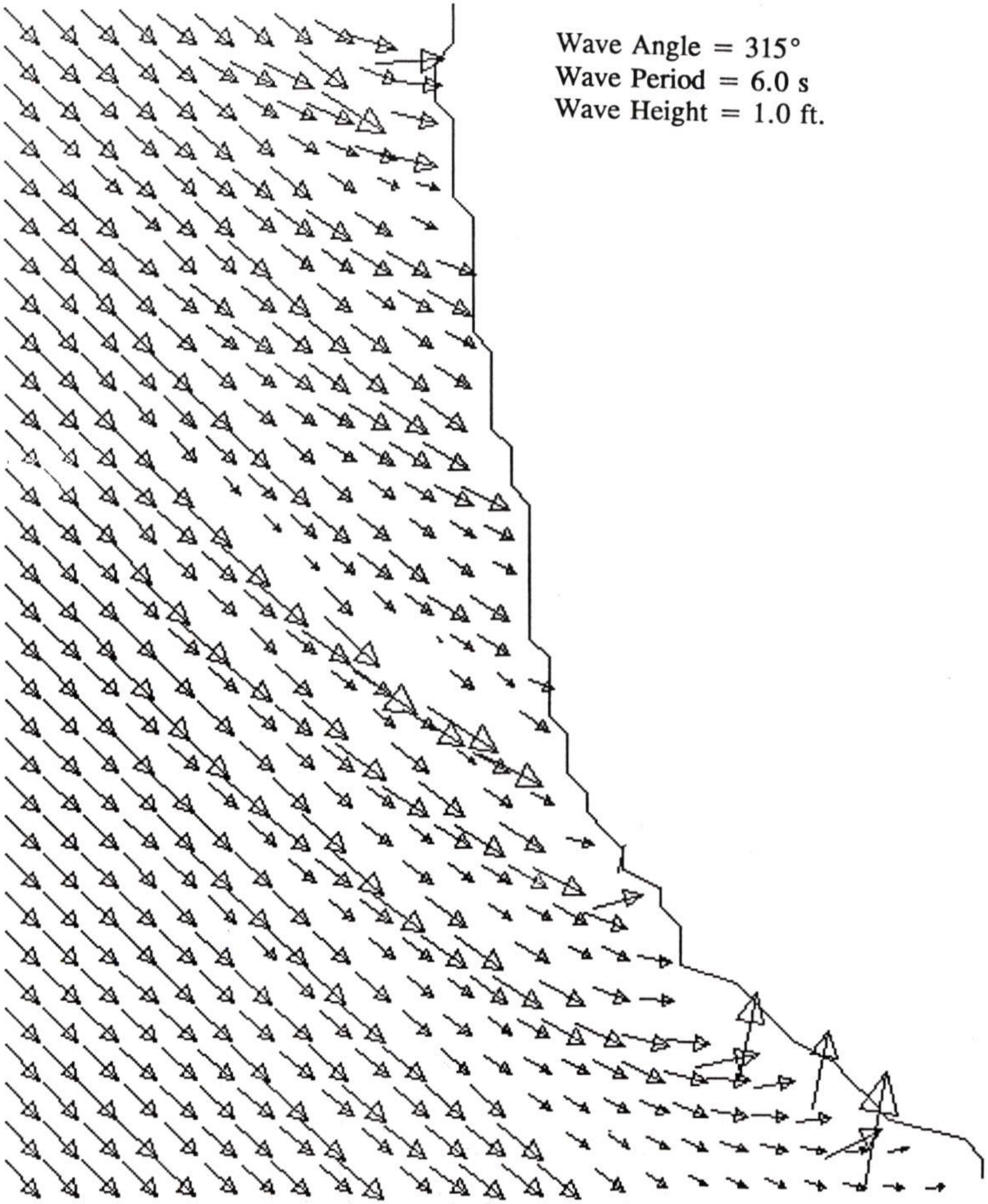
Wave Angle = 270°
Wave Period = 7.0 s
Wave Height = 1.0 ft.


Wave Angle = 292.5°
Wave Period = 4.5 s
Wave Height = 1.0 ft.


Wave Angle = 292.5°
Wave Period = 6.0 s
Wave Height = 1.0 ft.


Wave Angle = 292.5°
Wave Period = 7.0 s
Wave Height = 1.0 ft.


Wave Angle = 315°
Wave Period = 4.5 s
Wave Height = 1.0 ft.



Wave Angle = 315°
Wave Period = 6.0 s
Wave Height = 1.0 ft.