"n" VALUE DETERMINATION REPORT

FLOODPLAIN DELINEATION FOR INDIAN BEND WASH

FCD 93-05

Submitted to:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix, Arizona 85009

Submitted by:

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TABLE OF CONTENTS

Section No.		Page
I.	Introduction	1
II.	Methodology	1
III.	Detailed Analyses	3
IV.	Summary	77
V.	References	85
	Appendix A: Photographic Record of Hydraulic Structures	
	Appendix B: Indian Bend Wash Floodplain Delineation Proposed Cross Section Locations for Orientation Purposes Only	
	Appendix C: Cross Sections of Indian Bend Wash	

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LIST OF FIGURES

CROSS SECTION 0.568	5
CROSS SECTION 0.947	8
CROSS SECTION 1.77	11
CROSS SECTION 2.462	15
CROSS SECTION 3.125	19
CROSS SECTION 3.22	20
CROSS SECTION 3.409	23

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LIST OF FIGURES - Continued

Page

CROSS SECTION 3.977 26

CROSS SECTION 5.205 29

CROSS SECTION 5.587 33

CROSS SECTION 5.966 36

CROSS SECTION 6.40 39

CROSS SECTION 6.96 42

CROSS SECTION 7.837 47

CROSS SECTION 8.333 51

CROSS SECTION 9.223 54

CROSS SECTION 9.564 57

CROSS SECTION 12.22 61

CROSS SECTION 12.97 64

CROSS SECTION 13.83 67

CROSS SECTION 15.06 71

CROSS SECTION 16.05 74

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LIST OF PHOTOGRAPHS

Photograph 3.1
Photo looking upstream at cross section 0.568 6

Photograph 3.2
Photo looking downstream from cross section 0.758 at reach including cross section 0.568 6

Photograph 3.3
Looking downstream in the vicinity of cross section 0.947 9

Photograph 3.4
Looking upstream at the right overbank area in the vicinity of cross section 0.947 9

Photograph 3.5
Looking downstream from grade control structure toward center line of Indian Bend Wash near cross section 1.77 12

Photograph 3.6
Looking downstream from grade control structure toward left overbank of Indian Bend Wash near cross section 1.77 12

Photograph 3.7
Looking upstream from grade control structure upstream of cross section 1.77 at Indian Bend Wash left bank area 13

Photograph 3.8
Looking upstream from grade control structure upstream of cross section 1.77 at Indian Bend Wash right bank area 13

Photograph 3.9
Looking downstream at cross section 2.462 from McDowell Road bridge over Indian Bend Wash 16

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LIST OF PHOTOGRAPHS - Continued

Page

Photograph 3.10
Looking downstream at right bank area of cross section 2.462 from McDowell Road bridge over Indian Bend Wash 16

Photograph 3.11
Looking upstream at the left bank area of cross section 3.125 21

Photograph 3.12
Looking downstream at channel centerline from Murray Road toward cross section 3.22 21

Photograph 3.13
Looking downstream at left channel bank area near cross section 3.409 24

Photograph 3.14
Looking downstream across the channel from near cross section 3.409 left channel bank area 24

Photograph 3.15
Looking upstream from Thomas Road toward cross section 3.977 at Indian Bend Wash centerline 27

Photograph 3.16
Looking upstream from Thomas Road toward cross section 3.977 at Indian Bend Wash right channel bank area 27

Photograph 3.17
Looking downstream across Hayden Road from high-flow channel toward lake at Indian School Road 30

Photograph 3.18
Looking upstream at high flow channel just upstream from Indian School Road 30

Photograph 3.19
Looking downstream at the high-flow channel from Camelback Road 31

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LIST OF PHOTOGRAPHS - Continued

Page

Photograph 3.20
Looking upstream at low-flow channel just north of Indian School Road
Note: Camelback Road bridge in background 31

Photograph 3.21
Looking upstream from Camelback Road at the high-flow channel 34

Photograph 3.22 Looking downstream from Chaparral Road
at the high-flow channel 34

Photograph 3.23
Looking upstream from Chaparral Road at high-flow channel 37

Photograph 3.24
Looking downstream from Jackrabbit Road at low-flow channel 37

Photograph 3.25
Looking upstream from Jackrabbit Road at low-flow channel,
west side of Hayden Road 40

Photograph 3.26
Looking upstream from Jackrabbit Road at high-flow channel,
east of Hayden Road 40

Photograph 3.27
Looking downstream at high-flow channel just south of McDonald Road 41

Photograph 3.28
Looking east along the south side of McDonald Road at
facilities constructed in high-flow channel 43

Photograph 3.29
Looking east across Indian Bend Wash at Hayden Road where
flows weir over during large event 44

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LIST OF PHOTOGRAPHS - Continued

Page

Photograph 3.30
Looking downstream at McDonald Road and trapezoidal channel 44

Photograph 3.31
Looking upstream at Indian Bend Wash just upstream from McDonald Road . . 45

Photograph 3.32
Looking west across Indian Bend Wash near the Arizona Canal 45

Photograph 3.33
Looking west across Indian Bend Wash just
upstream from the Arizona Canal 48

Photograph 3.34
Looking south (downstream) from
Indian Bend Road at the channel centerline 48

Photograph 3.35
Looking upstream from Indian Bend Road at Indian Bend Wash centerline . . . 52

Photograph 3.36
Looking west across Indian Bend Wash from the McCormick Golf Course
between Indian Bend and Scottsdale Roads 52

Photograph 3.37
Looking south from the upstream end of the reach 55

Photograph 3.38
Looking downstream near cross section 9.564 58

Photograph 3.39
Looking upstream near cross section 9.564 58

Photograph 3.40
Looking downstream from Invergordon Road
at Indian Bend Wash centerline 59

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LIST OF PHOTOGRAPHS - Continued

Page

Photograph 3.41
Looking across Indian Bend Wash from the left bank area
just upstream of Invergordon Road 59

Photograph 3.42
Looking upstream near the north end of Camelback Country Club
just south of Shea Boulevard 62

Photograph 3.43
Looking downstream from near Shea Boulevard
at the centerline of Indian Bend Wash 62

Photograph 3.44
Looking upstream from Shea Boulevard
at the centerline of Indian Bend Wash 65

Photograph 3.45
Looking north across Indian Bend Wash
just downstream of Tatum Boulevard 65

Photograph 3.46
Looking upstream from Tatum Boulevard
at the centerline of Indian Bend Wash 68

Photograph 3.47
Looking upstream from Tatum Boulevard at the right bank area
of Indian Bend Wash 68

Photograph 3.48
Looking across Indian Bend Wash from the right bank between
Tatum Boulevard and Cactus Road 69

Photograph 3.49
Looking downstream from the Cactus Road bridge at
Indian Bend Wash centerline 69

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LIST OF PHOTOGRAPHS - Continued

Page

Photograph 3.50
Looking upstream from Cactus Road at the centerline of Indian Bend Wash . . . 72

Photograph 3.51
Looking downstream from near 36th Street at Indian Bend Wash centerline . . . 72

Photograph 3.52
Looking downstream from Presidio Road at Indian Bend Wash centerline
(approximately ¼ mile north of Sweetwater Road) 75

Photograph 3.53
Looking upstream from Presidio Road at Indian Bend Wash centerline 75

Photograph 3.54
Looking downstream from Thunderbird Road
at Indian Bend Wash centerline 76

Photograph 3.55
Looking downstream from Venturoso Park
near 32nd Street and Acoma Road 76

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I. *Introduction*

This report was prepared pursuant to "Scope of Work, Flood Control District of Maricopa County, Floodplain Delineation for Indian Bend Wash" (FCD 93-05), Sections 6.3 and 6.4. Specifically addressed in this report are the results of the field reconnaissance conducted over the full study reach. This report will be incorporated into the Technical Data Notebook, Section 4.2.1.

The purpose of this report is to present the results of a detailed analysis to define Manning's "n" values (roughness coefficients) for Indian Bend Wash from its confluence with the Salt River (City Of Tempe) upstream approximately 16 miles to 32nd Street and Acoma Road (City of Phoenix).

Section II presents the methodology utilized to estimate the Manning's "n" values and digitally prepare cross sections used for analysis.

Section IV presents recommended Manning's "n" values for use in the NH records required by the HEC-2 computer program. Additionally, expansion and contraction coefficients are presented.

Appendix A presents a photographic record of hydraulic structures in Indian Bend Wash. Included are all bridges, drops and other features that effect channel hydraulics.

Appendix B presents the topographic mapping with proposed cross section locations for orientation purposes only. Appendix B provides a plan view perspective of each cross section presented in Section IV, Summary.

Appendix C presents the proposed cross sections for the Indian Bend Wash Floodplain Delineation.

II. Methodology

Values for the Manning's roughness coefficient, "n", may be assigned for conditions that exist at the time of a specific flow event, for average conditions over a range in stage, or for anticipated conditions at the time of some future flow event. The Manning's "n" values developed in this study for the Indian Bend Wash were developed for the 100-year peak flood discharges.

Several sources of data were utilized to develop the "n" values presented in this report. The information available included: 1) aerial photos by Landiscor Aerial Photo, Inc. of Arizona at 1" = 1200', January 4, 1994; 2) ground level photographs of the study reach; and 3) the effective Flood Insurance Study. The ground level photographs were obtained during a field reconnaissance trip conducted over a several week period in November and December of 1994.

The "n" value assigned to a stream reach should represent the factors that tend to impact or impede flow. The procedure used to develop the "n" value for the detailed hydraulic model assigns an "n" value horizontally for the subdivided segments of a specific cross section. The hydraulic model (HEC-2) then computes the average "n" value for the specific section. The Manning's "n" values are placed in the HEC-2 data file in the NH record. The values for

Manning's "n" were compiled based on the methods presented in "Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona" (USGS, 1991) and "Open Channel Hydraulics" (Chow, 1959; Section 5).

The method of determining n values is as follows: 1) select a base value of n for the bed material; 2) select n-value adjustments for channel irregularities and alignment, obstructions, and vegetation; and 3) the sum of the values is the n value for that portion of the cross section. The sum of the values is reflected and defined in the following equation:

$$n = n_b + n_1 + n_2 + n_3 + n_4$$

where;

n =
n_b = base value of n for a straight uniform channel,
n_1 = value for surface irregularities,
n_2 = value for obstruction,
n_3 = value for vegetation, and
n_4 = cross section variation (per Chow, 1959)

The confluence point of Indian Bend Wash with the Salt River has been identified as Station 0.0 for this study. The point was taken from the thalweg confluence depicted on the effective Flood Insurance Rate Map for the Salt River. On all cross sections, the thalweg is identified as Station 10,000 in feet. All cross section identifiers are in river miles measured along the Indian Bend Wash thalweg.

Contraction and expansion coefficients were estimated based on Section 3.2 of the "HEC-2 Water Surface Profiles User's Manual" (USACOE, 1990). For a typical channel reach a contraction coefficient of 0.2 and expansion coefficient of 0.4 was used. Cross sections in the vicinity of a bridge use a contraction coefficient of 0.3 and an expansion coefficient of 0.5.

III. DETAILED ANALYSES

In the detailed analyses that follow, each reach is presented with the following information:

Reach: provides a detailed description of the reach including the political boundaries, and the geologic and man-made features that define the reach.

Cross Section: provides a typical cross section for the reach. Some reaches will have more than one cross section if significant variation is encountered. Cross sections are identified by their distance, in river miles, upstream of the confluence of Indian Bend Wash and the Salt River.

Location of Cross Section: the physical site of the cross section within the reach being studied.

Description of Channel: includes the channel geometry, physical features, channel bed composition, structures, and vegetation of the cross section and the portion of the reach represented by the cross section.

100-Year "n" Value Calculations: present the computations used to determine the "n" value for individual segments of the cross section.

REACH

From the Indian Bend Wash grade control structure at the Salt River upstream to Curry Road. This reach is entirely within the City of Tempe. Included in this reach are the Red Mountain Freeway and the Curry Road bridge. The reach is presented in plan view within Appendix B.

CROSS SECTION 0.568

LOCATION OF CROSS SECTION

Cross section 0.568 is located just upstream of the roller compacted concrete grade control structure and approximately 1000 feet downstream (south) of Curry Road. Cross section locations are presented in Appendix B.

DESCRIPTION OF CHANNEL

The channel is a constructed compound section with a low flow pilot channel. Vegetation is sparse and medium cobbles are the dominant channel bed material in the pilot channel. The Red Mountain Freeway has a bridge with piers set into the grade control structure. These piers are parallel to flow, with the Freeway alignment on a skew over the grade control structure. No backwater is estimated to occur due to the piers, as the flow passes through critical depth at the upstream sill of the grade control structure.

The channel has few irregularities or variations of cross section, few obstructions, sparse vegetation and minor meandering. Channel bed and banks have been assigned a "n" value of 0.03.

100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	Components	"n" Total
Pilot Channel	$n_b = 0.025$	
	$n_1 = 0$	
	$n_2 = 0$	
	$n_3 = 0.005$	
	$n_4 = 0$	**0.030**
Overbank of Compound Section	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0.005$	
	$n_3 = 0.005$	
	$n_4 = 0$	**0.030**

CROSS SECTION 0.568

Photograph 3.1
Photo looking upstream at cross section 0.568

Photograph 3.2
Photo looking downstream from cross section 0.758 at reach including cross section 0.568

REACH

From Curry Road upstream to McKellips Road. This reach is entirely within the City of Tempe From Curry Road to McKellips Road. At McKellips Road, the City of Tempe adjoins the City of Scottsdale. The reach is presented in plan view within Appendix B

CROSS SECTION 0.947

LOCATION OF CROSS SECTION

Cross section 0.947 is located just upstream of Curry Road within the Rio Salado Golf Course. This golf course extends from Curry Road upstream to McKellips Road. Cross section locations are presented in Appendix B.

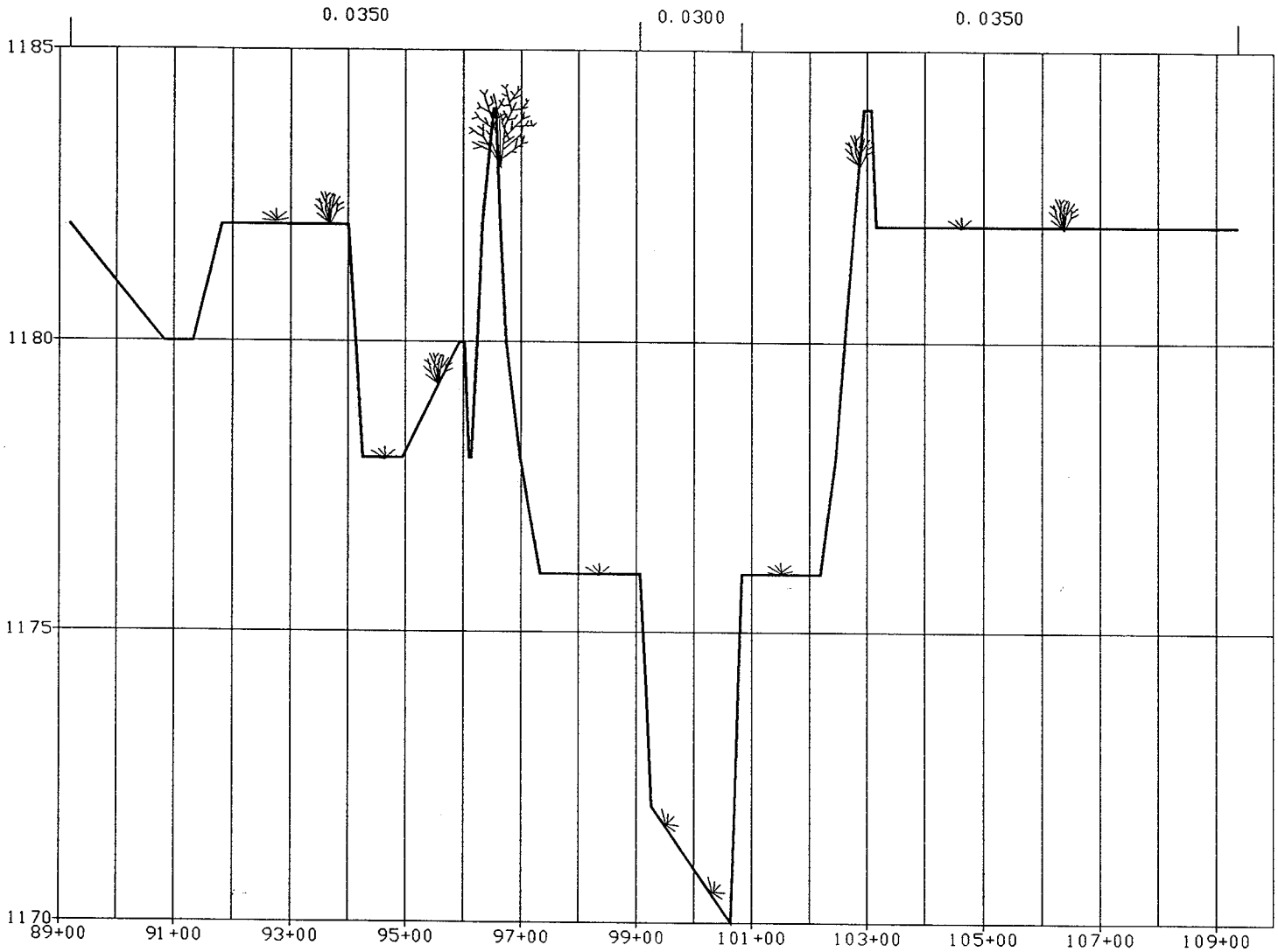
DESCRIPTION OF CHANNEL

The channel is a constructed compound section with a pilot channel containing some grade control structures (low flow only with grouted cobble). Vegetation consists of grass (in fairways and putting greens) and some shrubs.

The channel is relatively uniform with gradually changing elevation, few obstructions, maintained grassy areas and minor meandering. Channel banks and bed have similar hydraulic characteristics and have been assigned a "n" value of 0.03.

100-YEAR N-VALUE CALCULATIONS

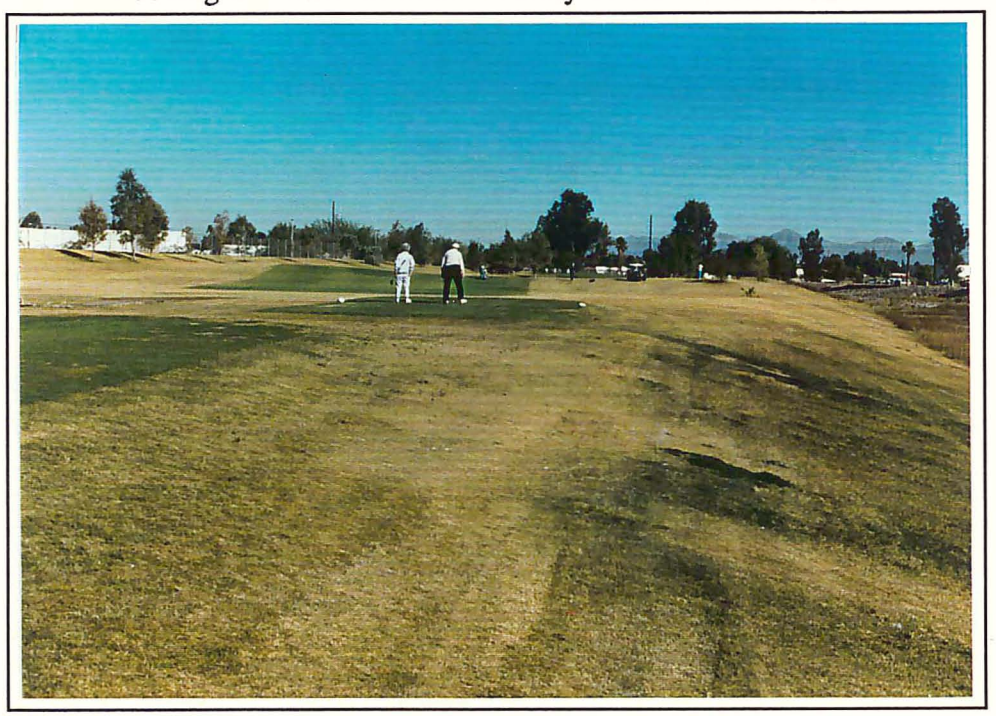
Portion of Cross Section	Components	"n" Total
Pilot Channel	$n_b = 0.02$	
	$n_1 = 0$	
	$n_2 = 0$	
	$n_3 = 0.005$	
	$n_4 = 0.005$	**0.030**
Overbank of Compound Section	$n_b = 0.020$	
	$n_1 = 0.005$	
	$n_2 = 0$	
	$n_3 = 0.005$	
	$n_4 = 0.005$	**0.035**



CROSS SECTION 0.947

Simons, Li & Associates, Inc.
Water Resources & Civil Engineering Consultants

Photograph 3.3
Looking downstream in the vicinity of cross section 0.947



Photograph 3.4
Looking upstream at the right overbank area
in the vicinity of cross section 0.947

REACH

From McKellips Road upstream to Roosevelt Street. This reach encompasses the McKellips Lake Park and is entirely within the City of Scottsdale. Included in this reach are the McKellips Road bridge, McKellips Lake, and the Roosevelt Street low water crossing. The reach is presented in plan view within Appendix B

CROSS SECTION 1.77

LOCATION OF CROSS SECTION

Cross section 1.77 is located approximately 1050 feet upstream of McKellips Road. The cross section crosses one of the two lakes that dominate this reach. Cross section locations are presented in Appendix B.

DESCRIPTION OF CHANNEL

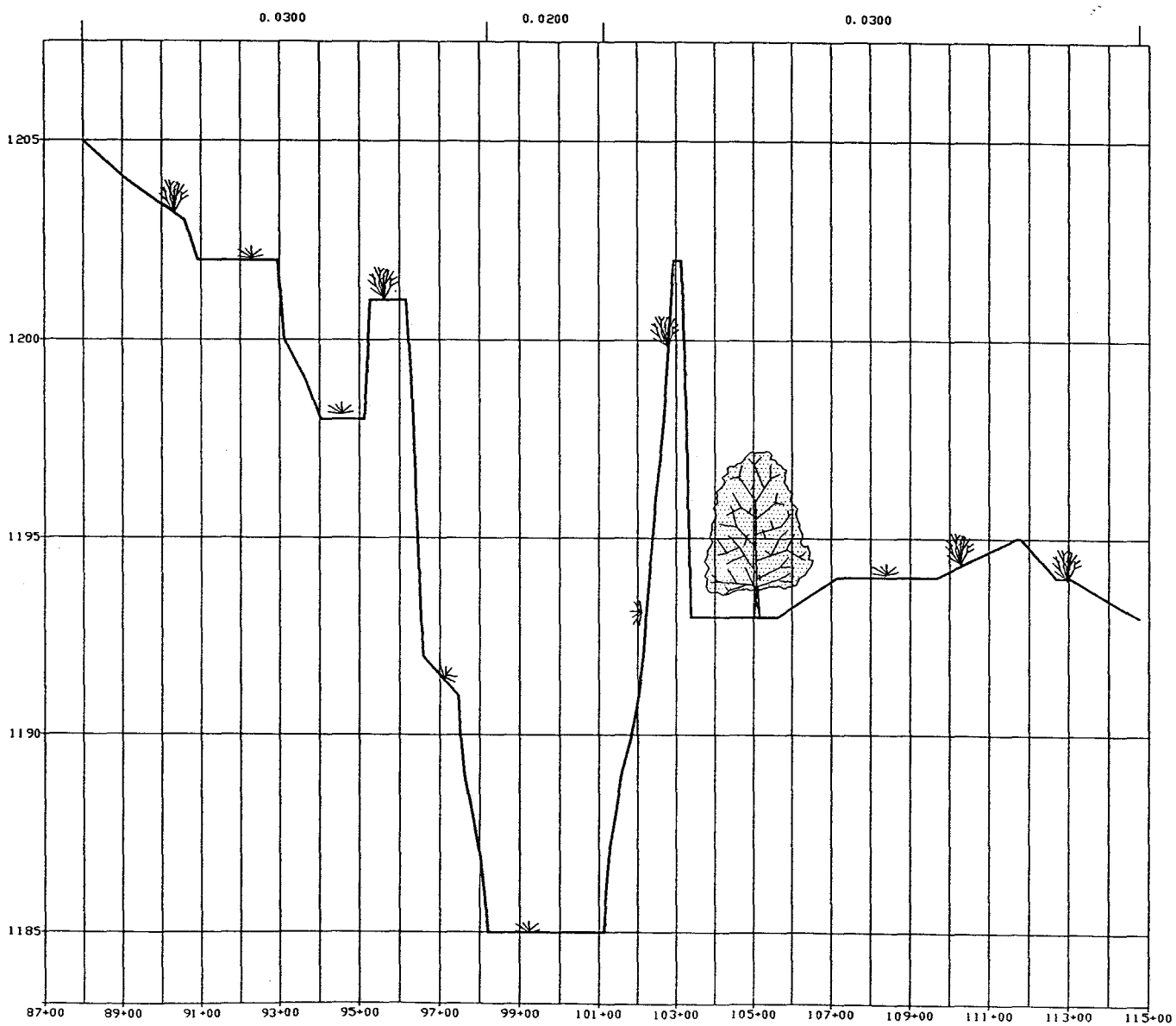
The channel is comprised of two sequential lakes separated by a steep drop structure approximately at the center of the reach. The upper lake will pond to an elevation controlled by the drop (where flow passes through critical to supercritical). The lower (downstream) lake is also controlled by the lake's concrete edge just upstream of the McKellips Road bridge.

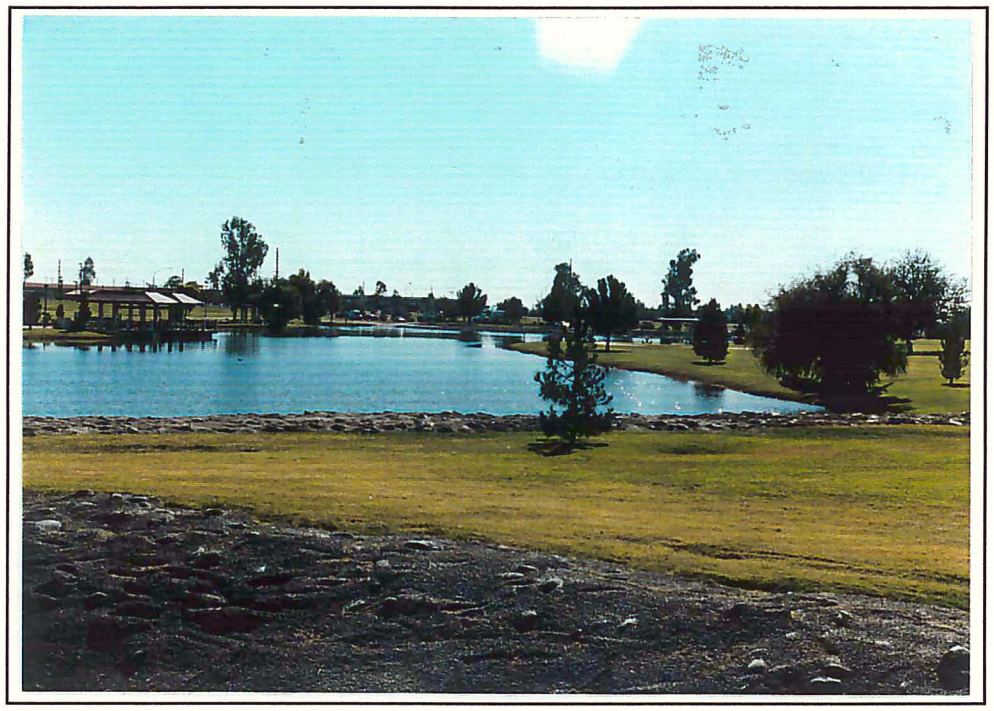
The constructed channel lakes have few obstructions with the exception of control features. Vegetation, meandering, and variation in channel cross section have little effect on the Manning's "n" value due to the broad cross section, lakes, and control features. Overbanks are unobstructed and lined with maintained grass and have been assigned a Manning's "n" value of 0.03. That portion of the lake above the effective flow level has been assigned a Manning's "n" value of 0.02.

100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	Components	"n" Total
Lake Shore and Park Areas	$n_b = 0.02$ $n_1 = 0$ $n_2 = 0.005$ $n_3 = 0.005$ $n_4 = 0$	**0.030**
Lake		**0.020**

CROSS SECTION 1.77

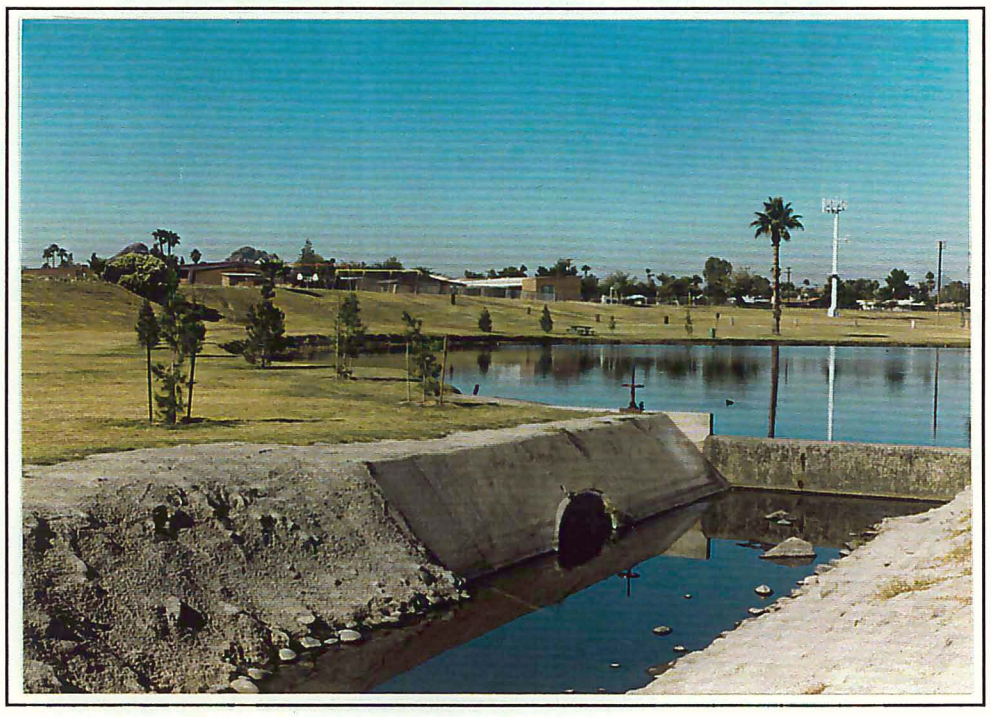




Photograph 3.5
Looking downstream from grade control structure toward center line of Indian Bend Wash near cross section 1.77

Photograph 3.6
Looking downstream from grade control structure toward left overbank of Indian Bend Wash near cross section 1.77

Photograph 3.7
Looking upstream from grade control structure upstream of cross section 1.77 at Indian Bend Wash left bank area



Photograph 3.8
Looking upstream from grade control structure upstream of cross section 1.77 at Indian Bend Wash right bank area

REACH

From Roosevelt Street upstream to McDowell Road entirely within the City of Scottsdale. This reach encompasses a portion of the Vista del Camino Park. This reach includes the McDowell bridge. The reach is presented in plan view within Appendix B

CROSS SECTION 2.462

LOCATION OF CROSS SECTION

Cross section 2.462 is located approximately 835 feet downstream from the McDowell Road bridge. Cross section locations are presented in Appendix B.

DESCRIPTION OF CHANNEL

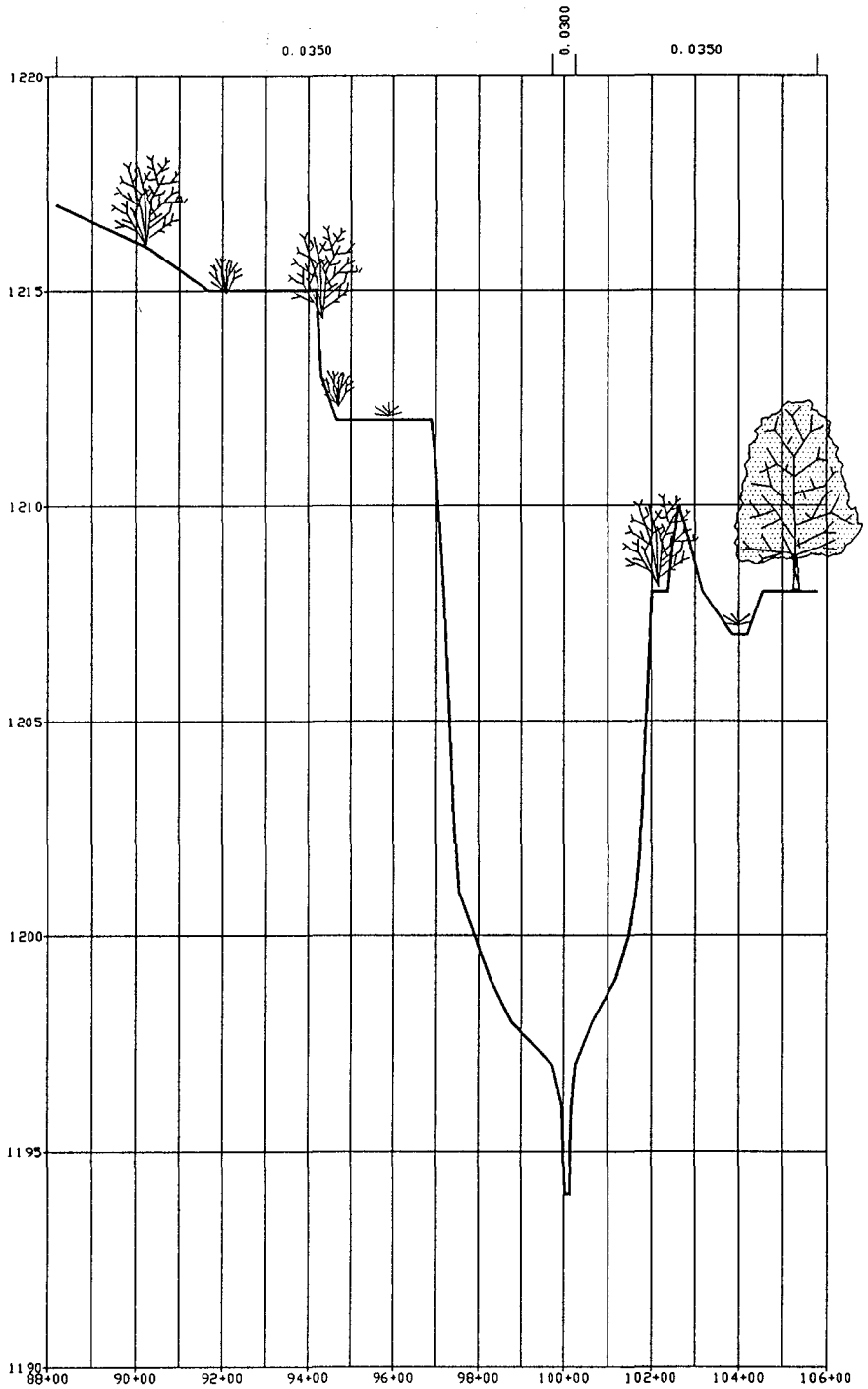
The channel is a constructed compound section with a low flow pilot channel and higher flow overbank areas. The higher flow overbanks are grassy with small trees (trimmed of branches below five feet above the ground). The pilot channel connects small ponds along the reach.

The channel is relatively regular with some variation in cross section primarily due to the occasional pond. Obstructions consist of some maintained trees found in grassy channel bank areas. Channel areas with smooth grass and some trees have be assigned a Manning's "n" value of 0.035. Smooth areas with maintained grass have been assigned a Manning's "n" value of 0.03.

100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	Components	"n" Total
Short Grass with Some Trees	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0.005$	
	$n_3 = 0.010$	
	$n_4 = 0$	**0.035**
Short Grass	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0.005$	
	$n_3 = 0.005$	
	$n_4 = 0$	**0.030**

CROSS SECTION 2.462



Photograph 3.9
Looking downstream at cross section 2.462
from McDowell Road bridge over Indian Bend Wash

Photograph 3.10
Looking downstream at right bank area of cross section 2.462
from McDowell Road bridge over Indian Bend Wash

REACH

From McDowell Road upstream to Murray Lane entirely within the City of Scottsdale. The reach encompasses Eldorado Park and the McDowell Exhibit Plaza. This reach includes the sill structure upstream of the McDowell Road bridge, the McDowell Exhibit Plaza, and the Murray Lane low water crossing. The reach is presented in plan view within Appendix B

CROSS SECTION 3.125

LOCATION OF CROSS SECTION

Cross section 3.125 is located approximately 2500 feet upstream (north) of McDowell Road and 650 feet downstream (south) of Murray Lane. Cross section locations are presented in Appendix B.

DESCRIPTION OF CHANNEL

The channel is a constructed compound section with a small pilot channel. The broad overbank areas are utilized for soccer and baseball fields. The overbank areas are grassy with pruned and maintained trees along the pilot channel. Recreation facilities have break-away fences.

100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	Components	"n" Total
Short Grass with Some Trees	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0.005$	
	$n_3 = 0.010$	
	$n_4 = 0$	**0.035**
Pavement		**0.020**
Short Grass	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0.005$	
	$n_3 = 0.005$	
	$n_4 = 0$	**0.030**
Grass and Dense Trees	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0.005$	
	$n_3 = 0.020$	
	$n_4 = 0$	**0.045**

CROSS SECTION 3.22

LOCATION OF CROSS SECTION

Cross section 3.22 is located at the small pond found just downstream (south) of Murray Lane. Cross section locations are presented in Appendix B. The reach is presented in plan view within Appendix B

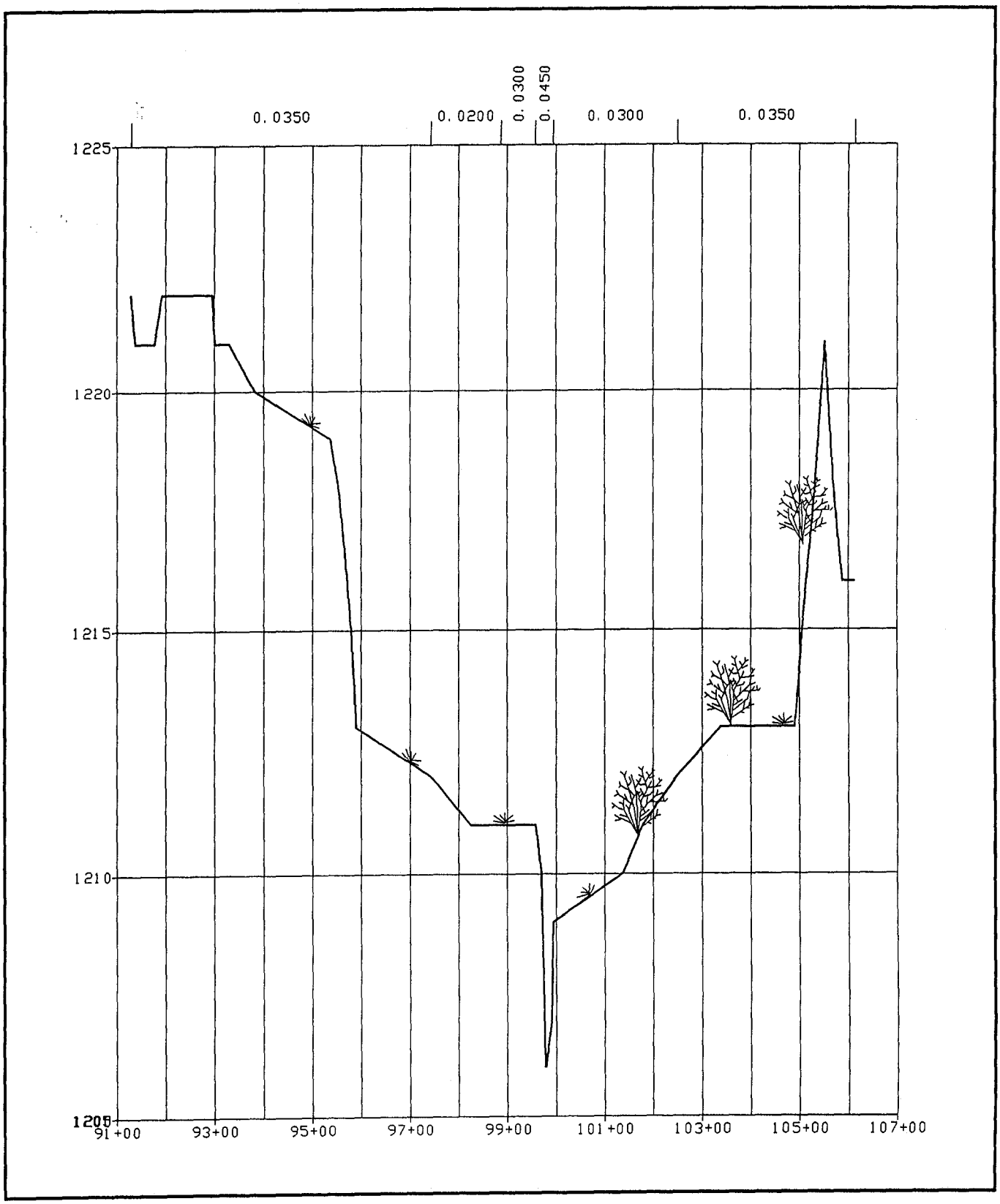
DESCRIPTION OF CHANNEL

The channel is a constructed compound section with a low flow pilot channel that connects small ponds. Left bank areas are smooth grass lined fields. The centerline area is a small pond with a constant water surface elevation during dry periods. The right channel bank area is sparsely vegetated and contains some facilities for the pond such as a parking lot and work shop.

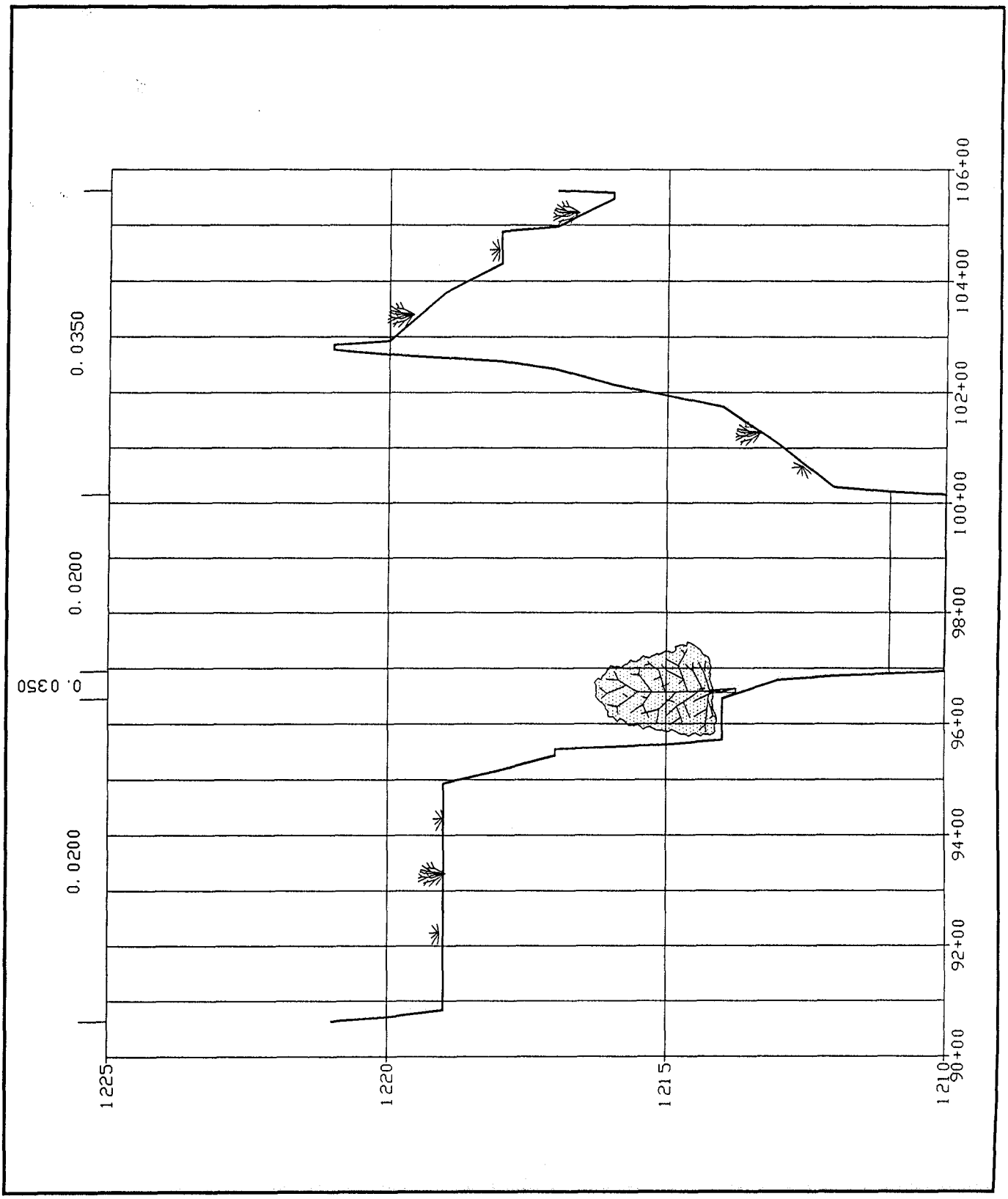
100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	Components	"n" Total
Pavement		**0.020**
Short Grass with Some Trees	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0.005$	
	$n_3 = 0.010$	
	$n_4 = 0$	**0.035**

CROSS SECTION 3.125



CROSS SECTION 3.22



Photograph 3.11
Looking upstream at the left bank area of cross section 3.125

Photograph 3.12
Looking downstream at channel centerline from Murray Road
toward cross section 3.22

REACH

From Murray Lane upstream to Thomas Road and encompasses the Coronado Golf Course. The reach is presented in plan view within Appendix B

CROSS SECTION 3.409

LOCATION OF CROSS SECTION

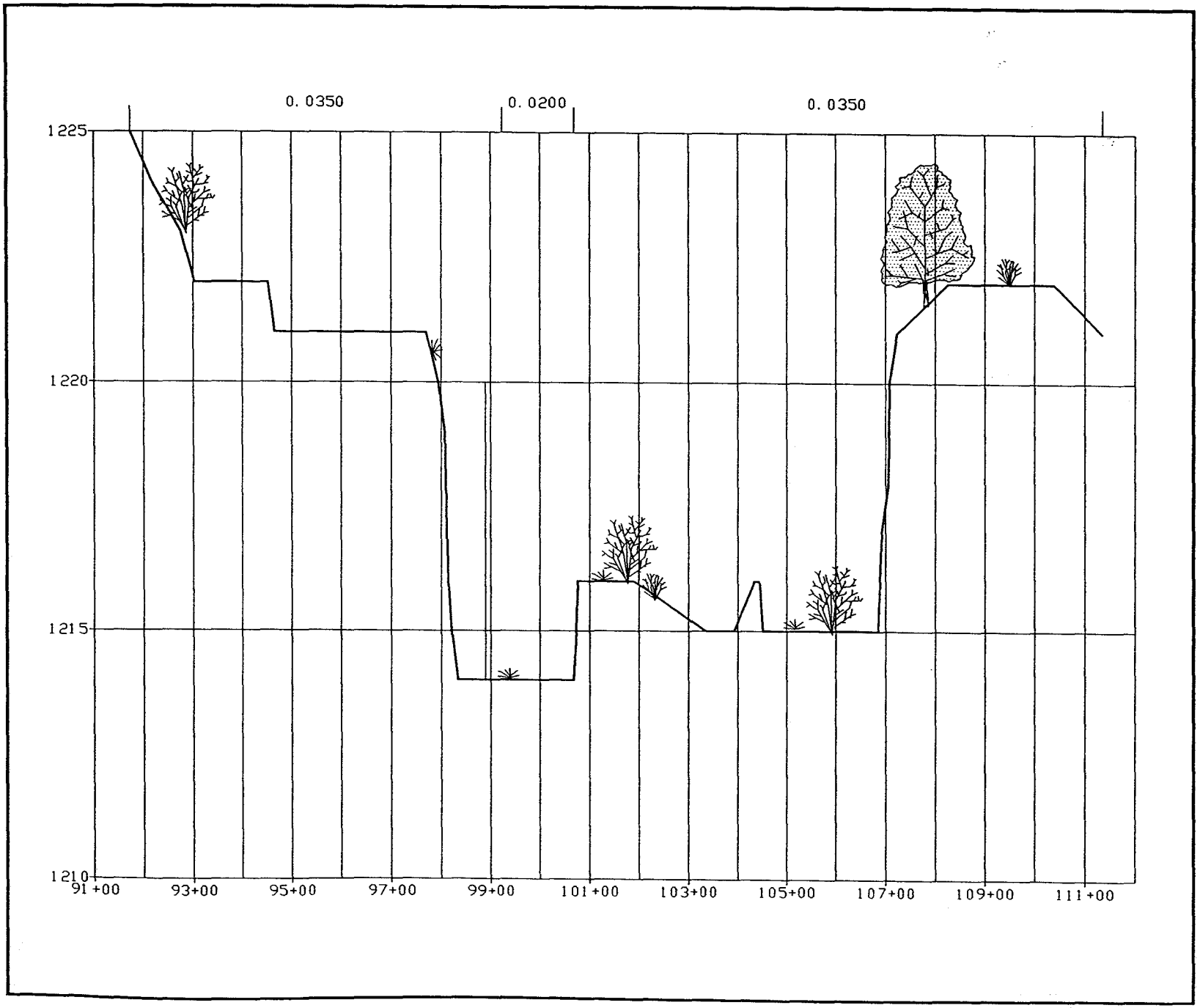
Cross section 3.409 is located in the reach from Murray Lane upstream to Thomas Road. The cross section is approximately 2,000 feet downstream of the Thomas Road bridge. Cross sections locations are presented in Appendix B.

DESCRIPTION OF CHANNEL

The channel is a constructed compound section with a small pilot channel that connects a series of small ponds. The overbank areas serve as fairways and putting greens for the Coronado Golf Course. The cross section is broad with some vegetation and few obstructions to flow. Transitions from cross section to cross section are relatively gradual.

100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	Components	"n" Total
Short Grass with Some Trees	$n_b = 0.020$ $n_1 = 0$ $n_2 = 0.005$ $n_3 = 0.010$ $n_4 = 0$	**0.035**
Lake		**0.020**



CROSS SECTION 3.409

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Photograph 3.13
Looking downstream at left channel bank area near cross section 3.409

Photograph 3.14
Looking downstream across the channel from near cross section 3.409
left channel bank area

REACH

From Thomas Road upstream to Indian School Road. This reach encompasses the Continental Golf Club and Osborn Park. This reach includes the Thomas Road bridge and the Osborn Road low water crossing. The reach is presented in plan view within Appendix B

CROSS SECTION 3.977

LOCATION OF CROSS SECTION

Cross section 3.977 is located approximately 1500 feet downstream (south) of Osborn Road and approximately 1000 feet upstream from Thomas Road. Cross section locations are presented in Appendix B.

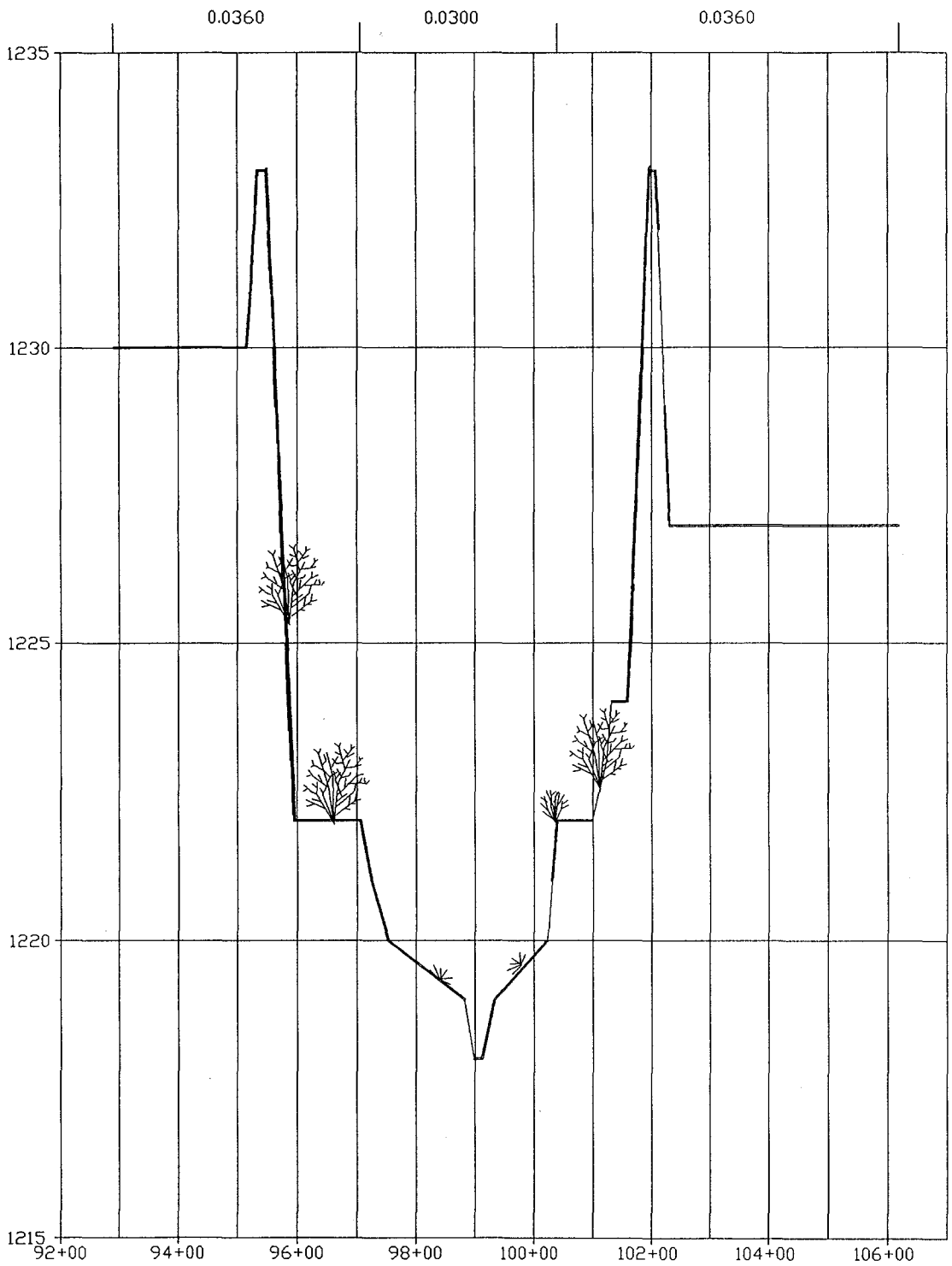
DESCRIPTION OF CHANNEL

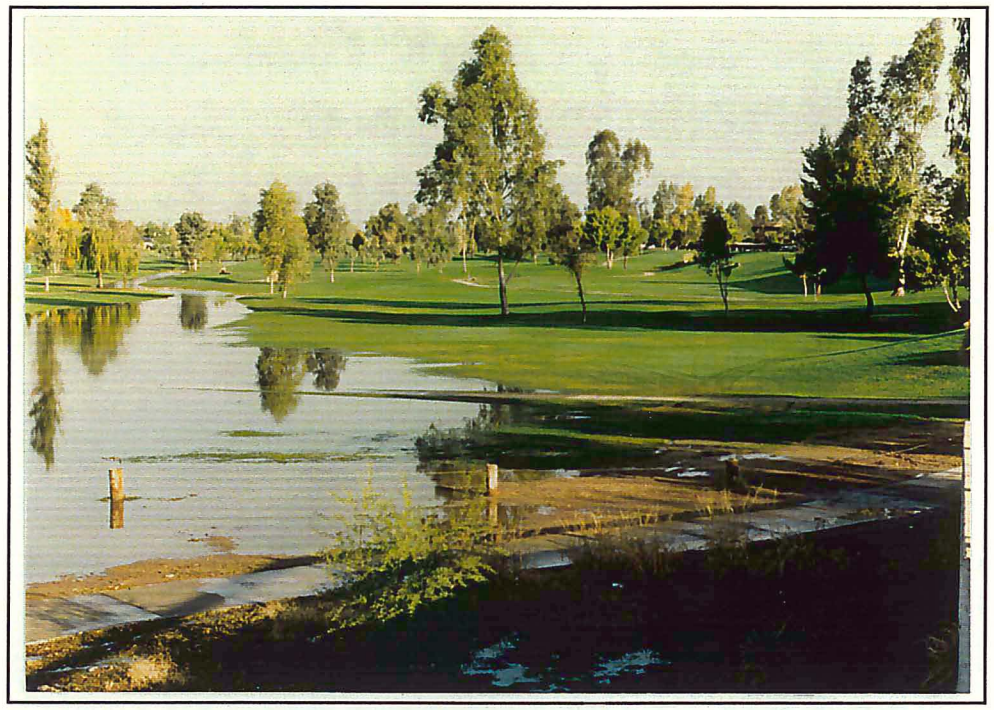
The channel is a constructed compound section with a low flow pilot channel that connects a series of small ponds. The channel overbank and ponds form the fairways and putting greens for the Continental Golf Course. The cross sections through this reach are broad with maintained vegetation.

100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	Components	"n" Total
Short Grass with Some Trees	$n_b = 0.020$	
	$n_1 = 0.005$	
	$n_2 = 0.001$	
	$n_3 = 0.010$	
	$n_4 = 0$	**0.036**
Pilot Channel Area, Grass Without Trees	$n_b = 0.020$	
	$n_1 = 0.005$	
	$n_2 = 0$	
	$n_3 = 0.005$	
	$n_4 = 0$	**0.030**

CROSS SECTION 3.977





Photograph 3.15
Looking upstream from Thomas Road toward cross section 3.977
at Indian Bend Wash centerline

Photograph 3.16
Looking upstream from Thomas Road toward cross section 3.977
at Indian Bend Wash right channel bank area

REACH

From Indian School Road to Camelback Road. This reach encompasses Indian School Park. Included in this reach are the Indian School Road bridge and box culvert, and the low flow bridge at Camelback Road. The reach is presented in plan view within Appendix B

CROSS SECTION 5.205

LOCATION OF CROSS SECTION

Approximately one quarter mile north of Indian School Road. Cross section locations are presented in Appendix B.

DESCRIPTION OF CHANNEL

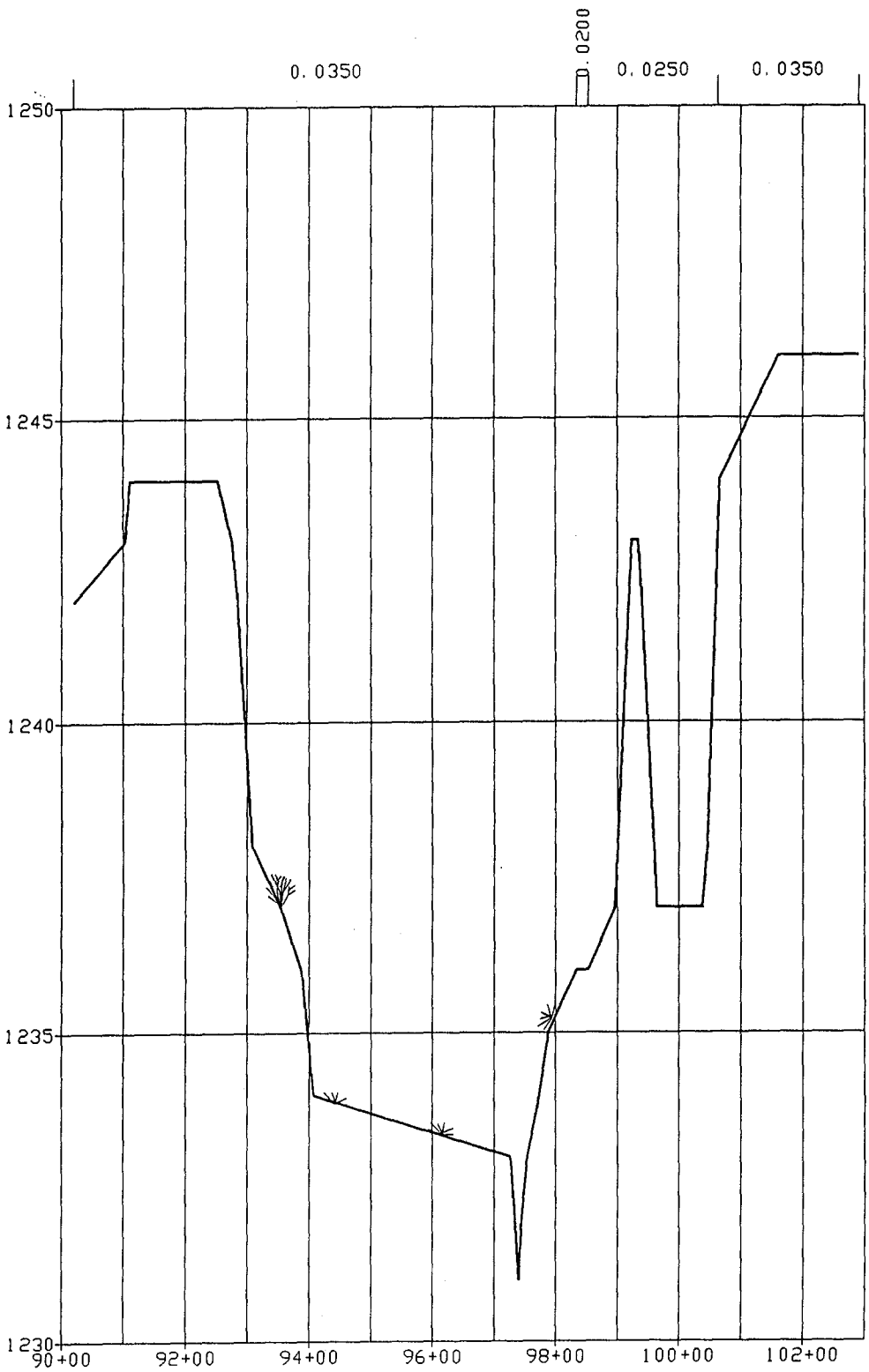
Indian Bend Wash is comprised of two hydraulically separate channels: 1) a low flow channel found in the right (west) portion of the cross section; and 2) a high flow channel in the left (east of Hayden Road) portion of the cross section. The flows that combine at Indian School Road are the result of a constructed split flow that begins at McDonald Drive approximately two miles upstream. The low flow channel is a grass lined constructed channel with an invert that varies in width.

The high flow channel is a broad, constructed channel that is utilized for soccer fields and other activities associated with the Indian Bend Wash Greenbelt.

100-YEAR N-VALUE CALCULATIONS

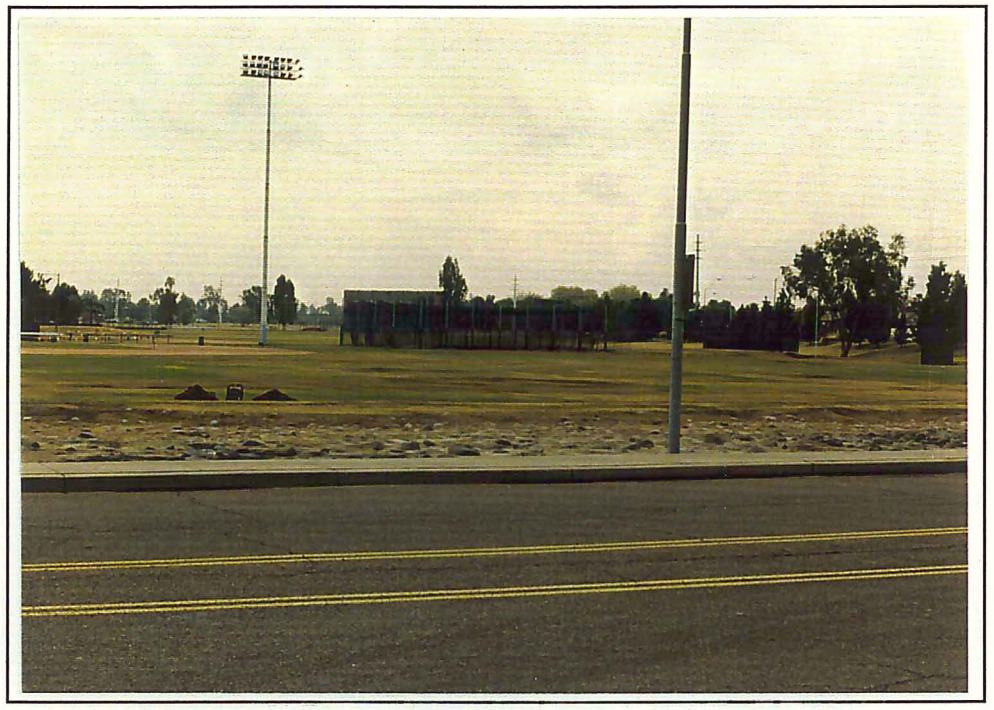
Portion of Cross Section	Components	"n" Total
Low-Flow Channel/ Short Grass	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0$	
	$n_3 = 0.005$	
	$n_4 = 0$	**0.025**
Pavement		**0.020**
High-Flow Channel/ Short Grass with Some Facilities	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0.005$	
	$n_3 = 0.005$	
	$n_4 = 0.005$	**0.035**

CROSS SECTION 5.205

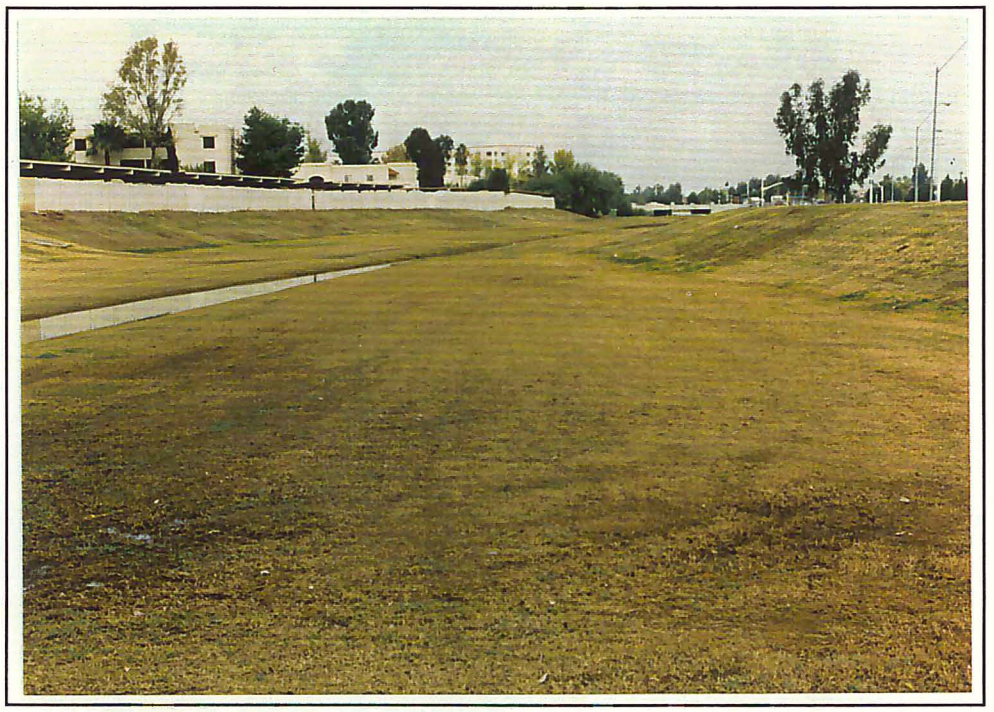


Photograph 3.17
Looking downstream across Hayden Road from high-flow channel toward lake at Indian School Road

Photograph 3.18
Looking upstream at high flow channel just upstream from Indian School Road



Photograph 3.19
Looking downstream at the high-flow channel from Camelback Road



Photograph 3.20
Looking upstream at low-flow channel just north of Indian School Road
Note: Camelback Road bridge in background

REACH

From Camelback Road to Chaparral Road. This reach encompasses the Villa Monterey Golf Course. Included in this reach is the low flow bridge at Chaparral Road. The reach is presented in plan view within Appendix B

CROSS SECTION 5.587

LOCATION OF CROSS SECTION

Approximately 1,000 feet north of Camelback Road. Cross section locations are presented in Appendix B.

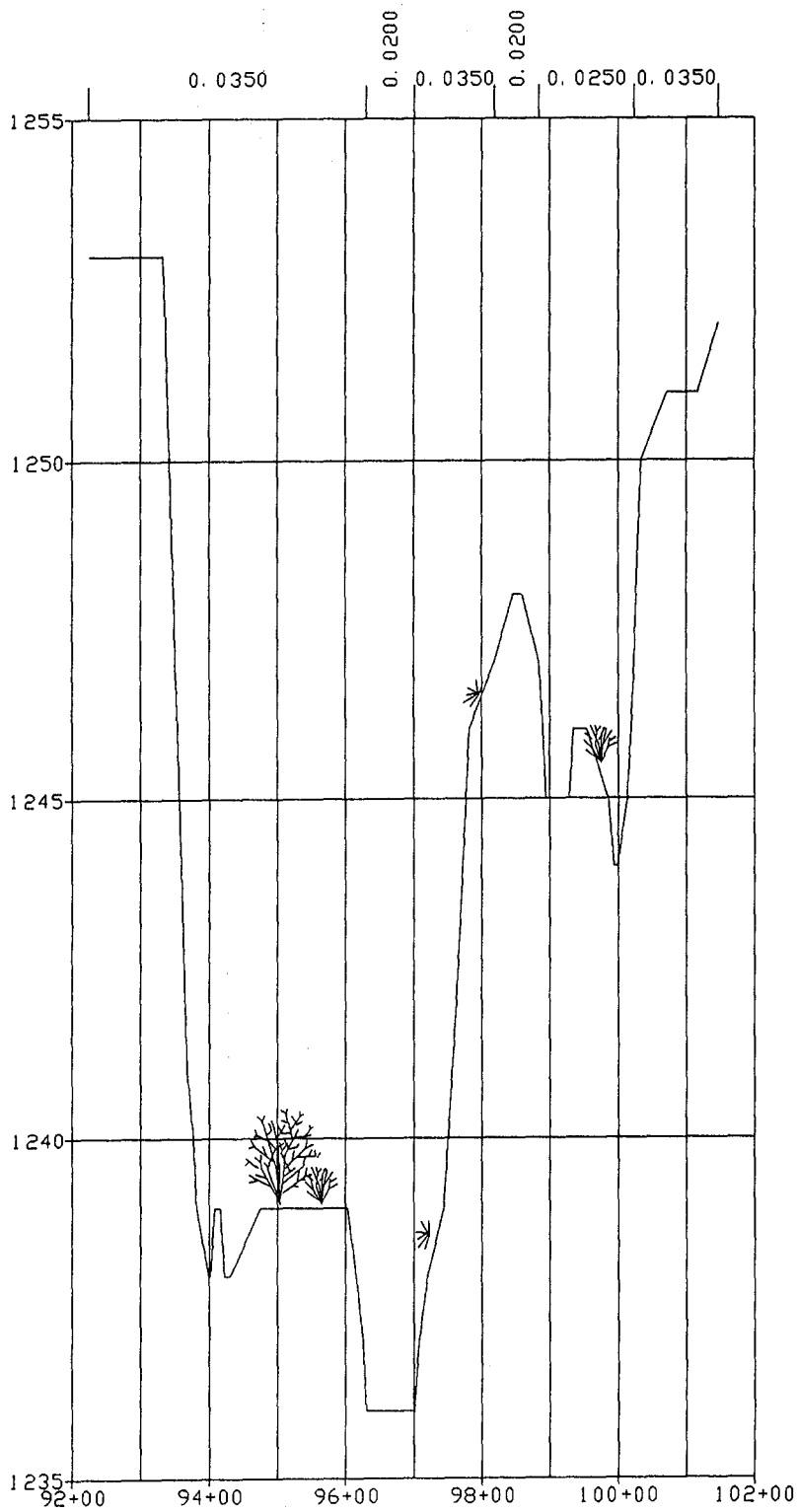
DESCRIPTION OF CHANNEL

This reach is hydraulically similar to the reach just downstream. The low flow channel found on the right side of the cross section (west of Hayden Road) conveys the frequent flows. The high flow channel found on the left side of the cross section conveys flows in excess of the low flow channel capacity. The low flow channel is a constructed grass lined channel. The high flow channel is a broad constructed section that contains golf course uses, small ponds and City park facilities.

100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	Components	"n" Total
High-Flow Channel/ Short Grass with Some Irregularity	$n_b = 0.020$	
	$n_1 = 0.005$	
	$n_2 = 0.005$	
	$n_3 = 0.005$	
	$n_4 = 0$	**0.035**
Lake		**0.020**
Pavement		**0.020**
Low-Flow Channel/ Short Grass	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0$	
	$n_3 = 0.005$	
	$n_4 = 0$	**0.025**

CROSS SECTION 5.587



Photograph 3.21
Looking upstream from Camelback Road at the high-flow channel

Photograph 3.22
Looking downstream from Chaparral Road at the high-flow channel

REACH

From Chaparral Road to Jackrabbit Road. This reach encompasses the southern portion of the Chaparral Park. The reach is entirely within the City of Scottsdale. The reach is presented in plan view within Appendix B

CROSS SECTION 5.966

LOCATION OF CROSS SECTION

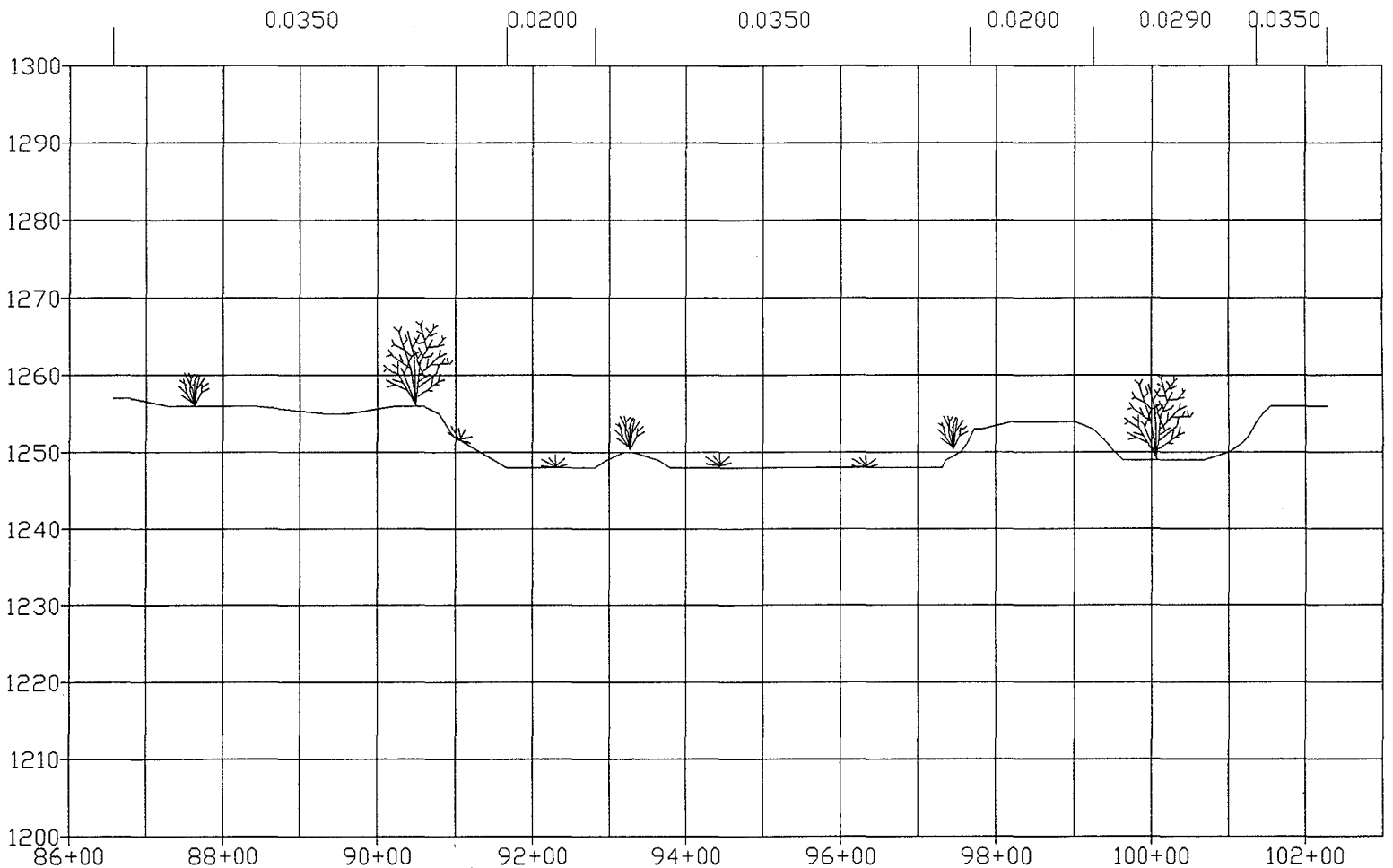
Approximately 300 feet north (upstream) of Chaparral Road. Cross section locations are presented in Appendix B.

DESCRIPTION OF CHANNEL

This reach is hydraulically similar to the reach just downstream. The low flow channel found on the right side of the cross section (west of Hayden Road) conveys the frequent flows. The high flow channel found on the left side of the cross section conveys flows in excess of the low flow channel capacity. The low flow channel is a constructed grass lined channel. The high flow channel is a broad constructed section that contains golf course uses, small ponds and City park facilities.

100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	Components	"n" Total
High-Flow Channel/ Bank Areas Around Lake	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0.005$	
	$n_3 = 0.005$	
	$n_4 = 0.005$	**0.035**
Lake		**0.020**
Pavement		**0.020**
Low-Flow Channel/ Short Grass	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0.004$	
	$n_3 = 0.005$	
	$n_4 = 0$	**0.029**



CROSS SECTION 5.966

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Photograph 3.23
Looking upstream from Chaparral Road at high-flow channel

Photograph 3.24
Looking downstream from Jackrabbit Road at low-flow channel

REACH

From Jackrabbit Road to McDonald Road. This reach encompasses the northern portion Chaparral Park and is entirely within the City of Scottsdale. This reach includes the McDonald Road bridge. The reach is presented in plan view within Appendix B

CROSS SECTION 6.40

LOCATION OF CROSS SECTION

Just upstream of the Jackrabbit Road alignment. Cross section locations are presented in Appendix B.

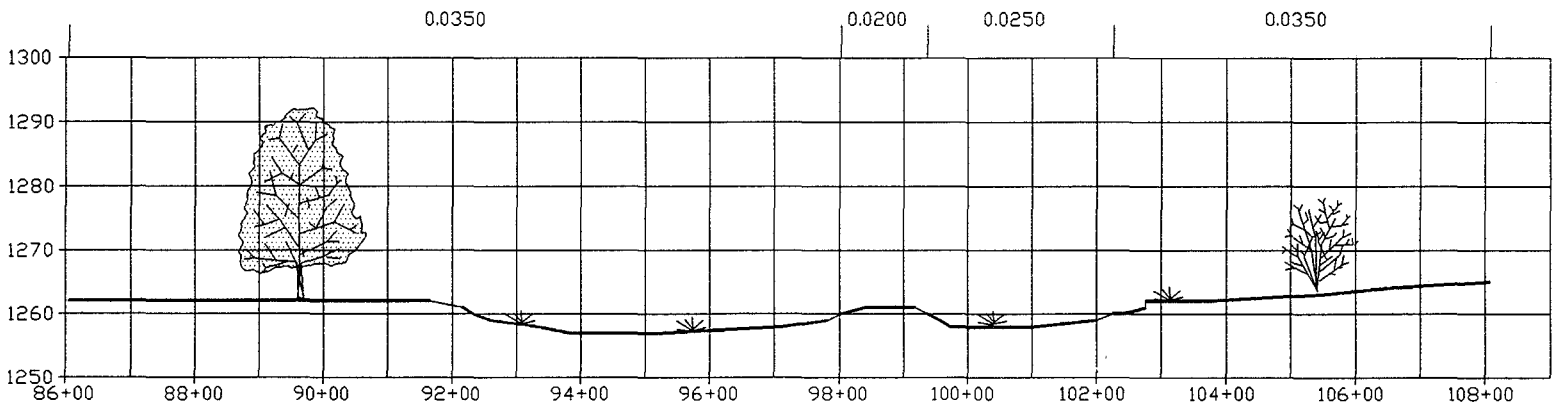
DESCRIPTION OF CHANNEL

This reach is hydraulically similar to the reach just downstream. A portion of this reach has the low-flow and high-flow channel hydraulically connected during large events. The low flow channel (west of Hayden Road) conveys the frequent events, and is composed of a grass lined trapezoidal channel. The high flow channel is a broad grass lined section that contains golf course and open space uses.

100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	Components	"n" Total
High-Flow Channel/ Short Grass	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0.005$	
	$n_3 = 0.005$	
	$n_4 = 0.005$	**0.035**
Pavement		**0.020**
Low-Flow Channel/ Short Grass	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0$	
	$n_3 = 0.005$	
	$n_4 = 0$	**0.025**

CROSS SECTION 6.40



Photograph 3.25
Looking upstream from Jackrabbit Road at low-flow channel,
west side of Hayden Road

Photograph 3.26
Looking upstream from Jackrabbit Road at high-flow channel,
east of Hayden Road

REACH

From McDonald Road to the Arizona Canal. This reach is entirely within the City of Scottsdale. The reach is presented in plan view within Appendix B

CROSS SECTION 6.96

LOCATION OF CROSS SECTION

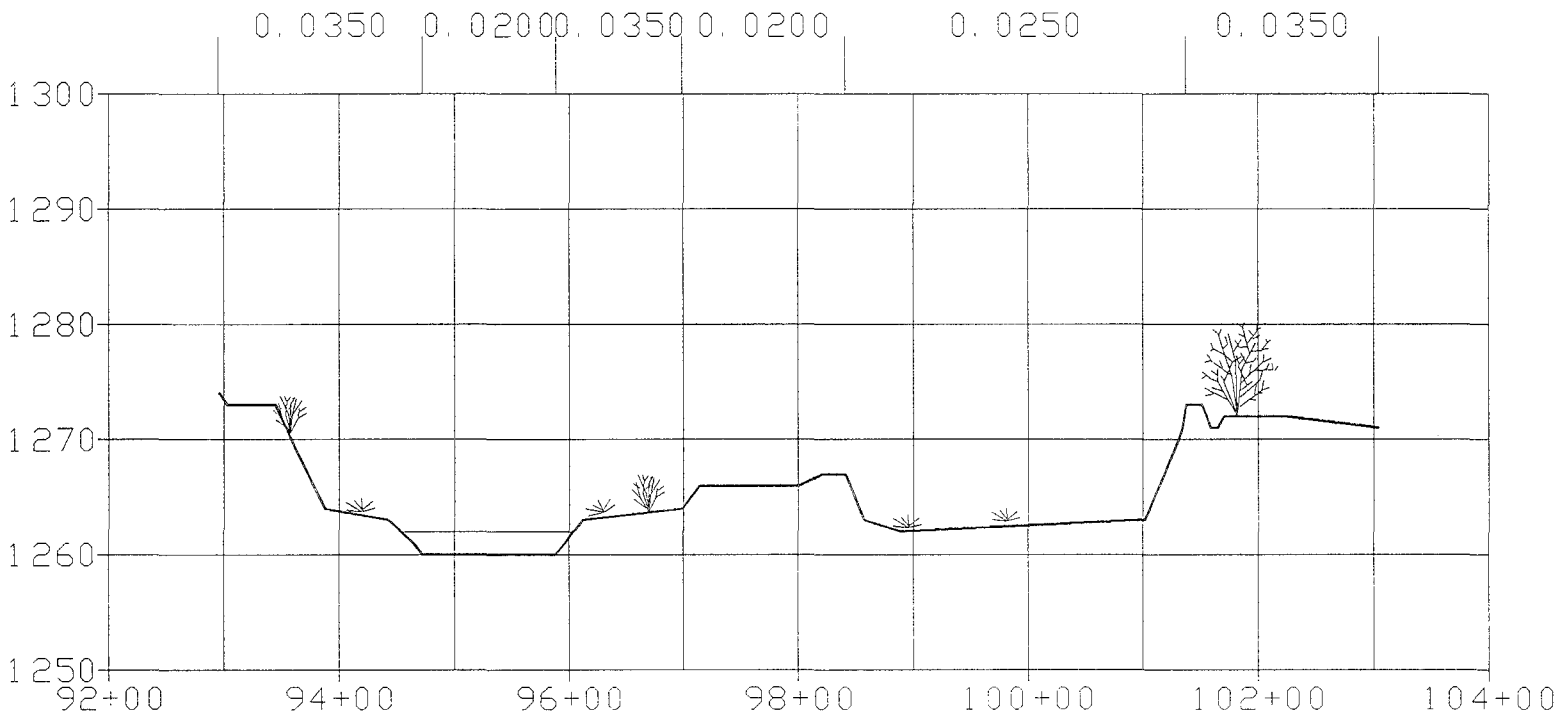
Just upstream of McDonald Road in the area where flow is designed to top Hayden Road during large events. Cross section locations are presented in Appendix B.

DESCRIPTION OF CHANNEL

The southern portion of this reach includes an area where flows are designed to top Hayden Road and weir into the high-flow channel during large events. The channel is a grass-lined trapezoidal section. Flows that enter the high-flow channel is eventually combined with the low-flow discharge at Indian School Road. At Camelback Road, Chaparral Road, and Jackrabbit Road, the two channels are hydraulically connected during the 100-year flood.

100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	Components	"n" Total
Channel Bank Areas with Some Trees	$n_b = 0.020$ $n_1 = 0.005$ $n_2 = 0$ $n_3 = 0.005$ $n_4 = 0.005$	**0.035**
Lake		**0.020**
Pavement		**0.020**
Low-Flow Channel/ Short Grass	$n_b = 0.020$ $n_1 = 0$ $n_2 = 0$ $n_3 = 0.005$ $n_4 = 0$	**0.025**



CROSS SECTION 6.96

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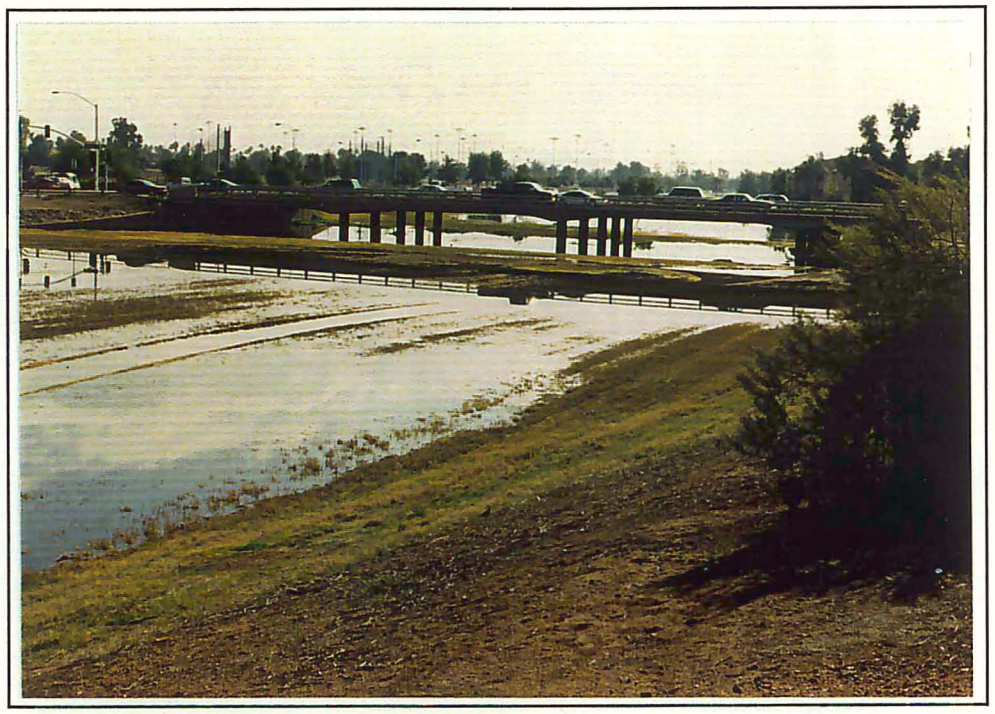
Photograph 3.27
Looking downstream at high-flow channel just south of McDonald Road

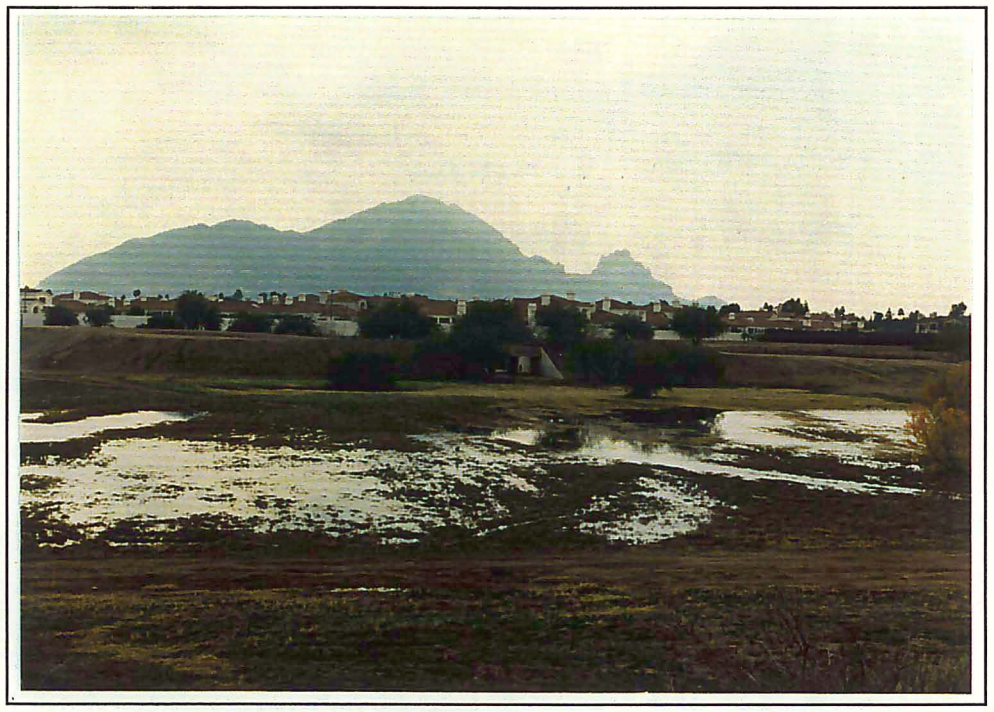
Photograph 3.28
Looking east along the south side of McDonald Road at facilities constructed in high-flow channel

Photograph 3.29
Looking east across Indian Bend Wash at Hayden Road where flows weir over during large event



Photograph 3.30
Looking downstream at McDonald Road and trapezoidal channel

Photograph 3.31
Looking upstream at Indian Bend Wash just upstream from McDonald Road



Photograph 3.32
Looking west across Indian Bend Wash near the Arizona Canal

REACH

From the Arizona Canal to Indian Bend Road. This reach is entirely within the City of Scottsdale. This reach includes the drop at Indian Bend Road and a Hotel on piers. The reach is presented in plan view within Appendix B

CROSS SECTION 7.837

LOCATION OF CROSS SECTION

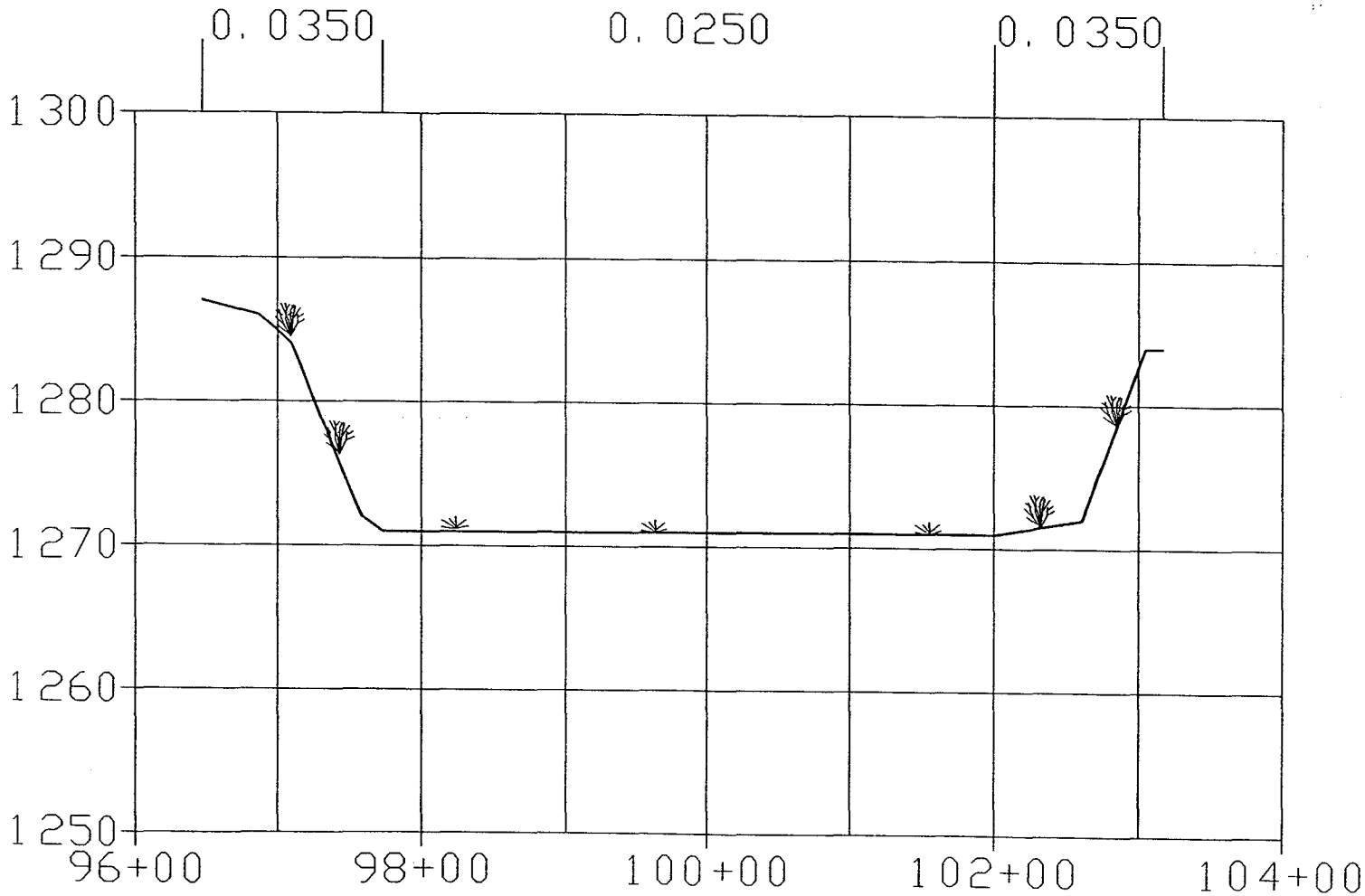
Approximately 860 feet upstream of the Arizona Canal outflow into Indian Bend Wash. Cross section locations are presented in Appendix B.

DESCRIPTION OF CHANNEL

The channel is an earth lined trapezoidal section. Vegetation is sparse consisting of grass and small shrubs. At one location a hotel has been constructed on piers into a portion of the channel.

100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	Components	"n" Total
Channel Bank Areas with Small Shrubs	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0$	
	$n_3 = 0.010$	
	$n_4 = 0.005$	**0.035**
Channel Invert	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0$	
	$n_3 = 0.005$	
	$n_4 = 0$	**0.025**



CROSS SECTION 7.837

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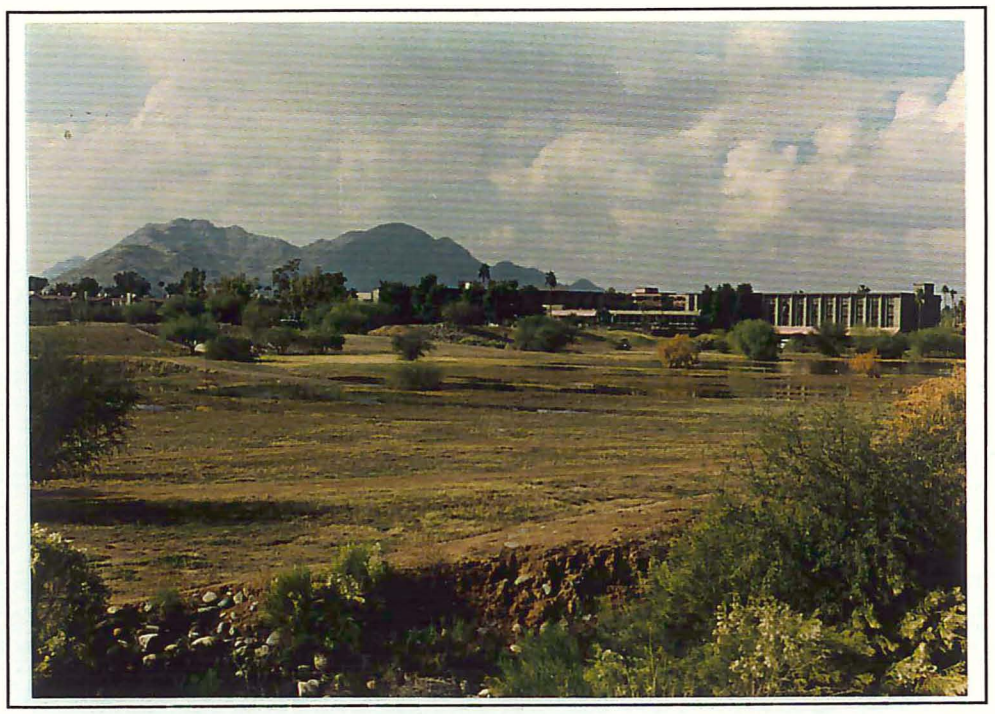


Photograph 3.33
Looking west across Indian Bend Wash just upstream from the Arizona Canal

Photograph 3.34
Looking south (downstream) from Indian Bend Road at the channel centerline

REACH

From Indian Bend Road upstream to Scottsdale Road. The reach is entirely within the City of Scottsdale, although Scottsdale Road is a boundary between the City of Scottsdale and the Town of Paradise Valley. The reach encompasses the McCormick Ranch Golf Course. This reach includes the Scottsdale Road box culvert. The reach is presented in plan view within Appendix B

CROSS SECTION 8.333

LOCATION OF CROSS SECTION

Approximately 1,500 feet upstream of Indian Bend Road. Cross section locations are presented in Appendix B.

DESCRIPTION OF CHANNEL

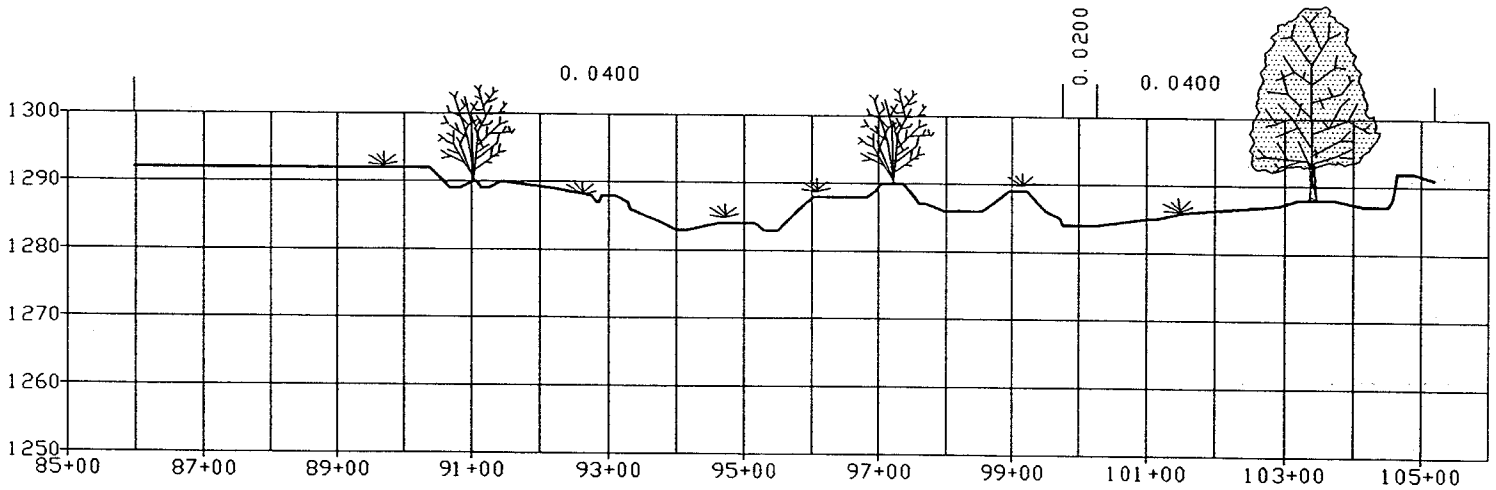
The cross sections of this reach are typical of golf course uses. A small pilot channel defines the thalweg and connects a series of sequential lakes. The topography is flat to gently rolling. Vegetation is comprised mostly of short trimmed grass and small pruned trees.

100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	Components	"n" Total
Rolling Golf Course Areas with Short Grass and Pruned Trees	$n_b = 0.020$	
	$n_1 = 0.010$	
	$n_2 = 0.005$	
	$n_3 = 0.005$	
	$n_4 = 0$	**0.040**
Lake		**0.020**
Fairways	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0$	
	$n_3 = 0.005$	
	$n_4 = 0$	**0.025**

Portion of Cross Section	Components	"n" Total
Channel Banks Along Lakes with Few Trees and Short Grass	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0$	
	$n_3 = 0.010$	
	$n_4 = 0$	**0.030**

CROSS SECTION 8.333



Photograph 3.35
Looking upstream from Indian Bend Road at Indian Bend Wash centerline

Photograph 3.36
Looking west across Indian Bend Wash from the McCormick Golf Course between Indian Bend and Scottsdale Roads

REACH

From Scottsdale Road upstream to the Camelback Country Club. This reach is entirely within the Town of Paradise Valley. The reach is presented in plan view within Appendix B

CROSS SECTION 9.223

LOCATION OF CROSS SECTION

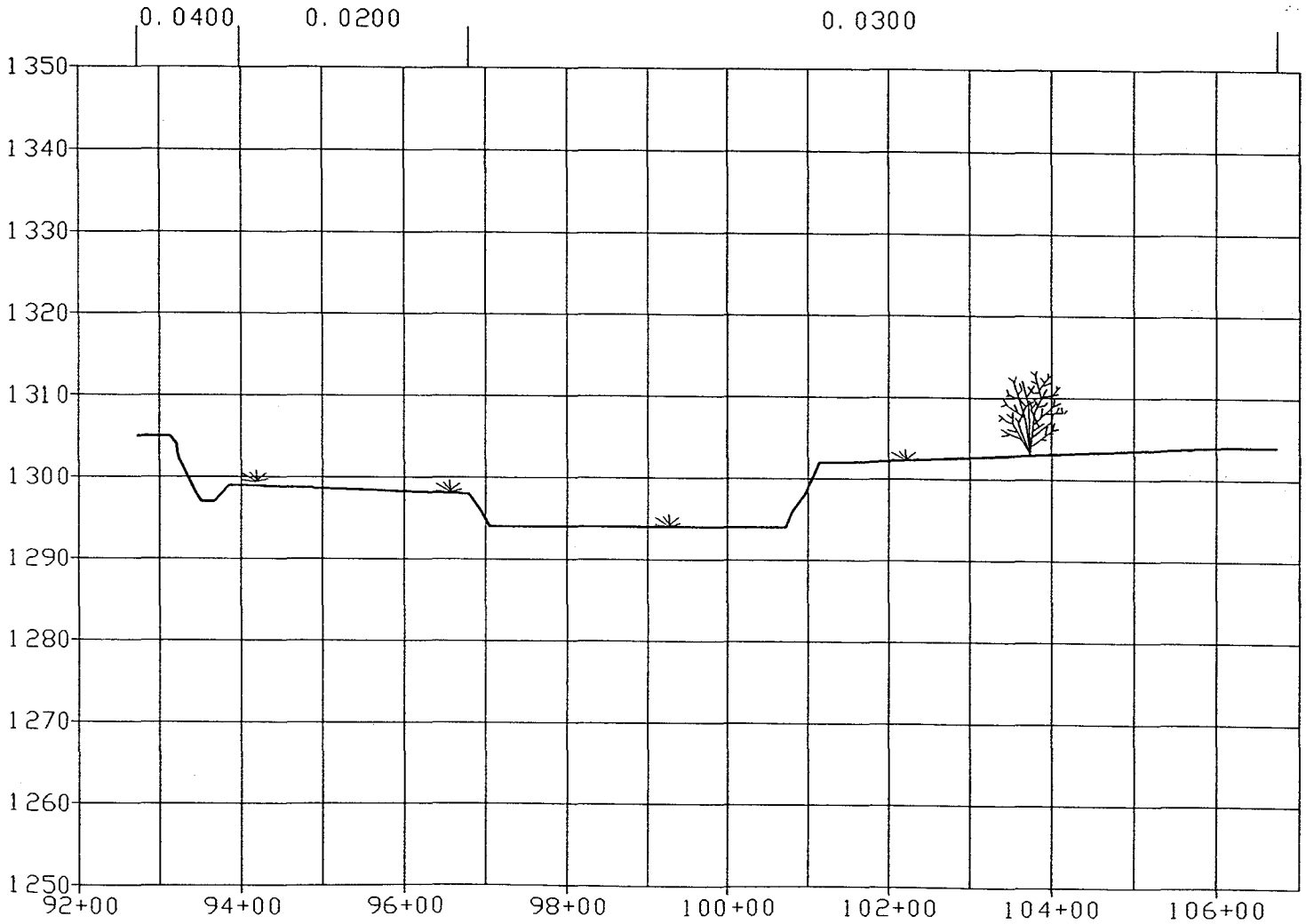
Approximately 500 feet upstream of Scottsdale Road. Cross section locations are presented in Appendix B.

DESCRIPTION OF CHANNEL

This portion of Indian Bend Wash is a short trapezoidal channel section. Vegetation is comprised of short maintained grass.

100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	**Components**	**"n" Total**
Along Scottsdale Road	$n_b = 0.020$	
	$n_1 = 0.005$	
	$n_2 = 0.005$	
	$n_3 = 0.005$	
	$n_4 = 0.005$	**0.040**
Pavement		**0.020**
Trapezoidal Channel Area	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0$	
	$n_3 = 0.005$	
	$n_4 = 0.005$	**0.030**



CROSS SECTION 9.223

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Photograph 3.37
Looking south from the upstream end of the reach
adjacent to Cheney Estates.
Note: Scottsdale Road in the background

REACH

From the southern (downstream) end of Camelback Country Club to the Mountain View Road alignment. This reach encompasses a majority of the Camelback Country Club and is entirely within the Town of Paradise Valley. This reach includes the Invergordon Road and Double Tree Road low water crossings. The reach is presented in plan view within Appendix B

CROSS SECTION 9.564

LOCATION OF CROSS SECTION

Approximately 745 feet upstream of Golf Drive within the Camelback Country Club. Cross section locations are presented in Appendix B.

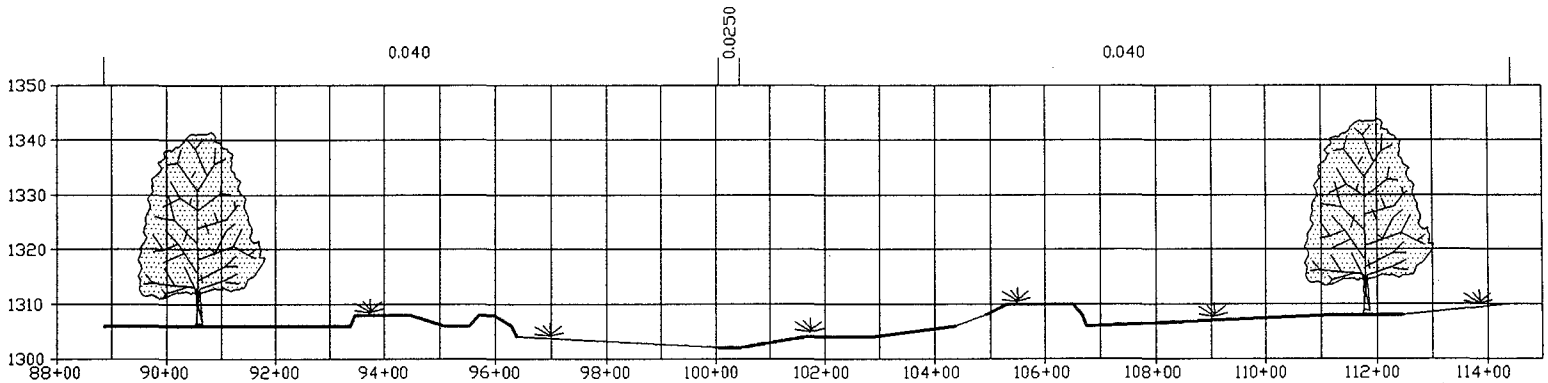
DESCRIPTION OF CHANNEL

The channel through this area is a broad bowl shaped channel with a low-flow pilot channel that conveys the frequent flows. Numerous small ponds are connected by the low-flow portion of the channel. Gold course uses such as fairways, putting greens, and lakes comprise the entire reach. Vegetation is short maintained grass and some pruned trees. Topography varies from smooth gradual contours on the fairways to slightly rolling features in other areas.

100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	Components	"n" Total
Regular Topography with Short Grass	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0$	
	$n_3 = 0.005$	
	$n_4 = 0$	**0.025**
Irregular Topography with Short Grass and Some Trees	$n_b = 0.020$	
	$n_1 = 0.005$	
	$n_2 = 0.005$	
	$n_3 = 0.005$	
	$n_4 = 0.005$	**0.040**

CROSS SECTION 9.564



Photograph 3.38
Looking downstream near cross section 9.564

Photograph 3.39
Looking upstream near cross section 9.564

Photograph 3.40
Looking downstream from Invergordon Road at Indian Bend Wash centerline

Photograph 3.41
Looking across Indian Bend Wash from the left bank area
just upstream of Invergordon Road

REACH

From the Mountain View Road alignment to Shea Boulevard. This reach is within the City of Phoenix with the exception of the southwest corner of Shea Boulevard and 52nd Street. The reach is presented in plan view within Appendix B

CROSS SECTION 12.22

LOCATION OF CROSS SECTION

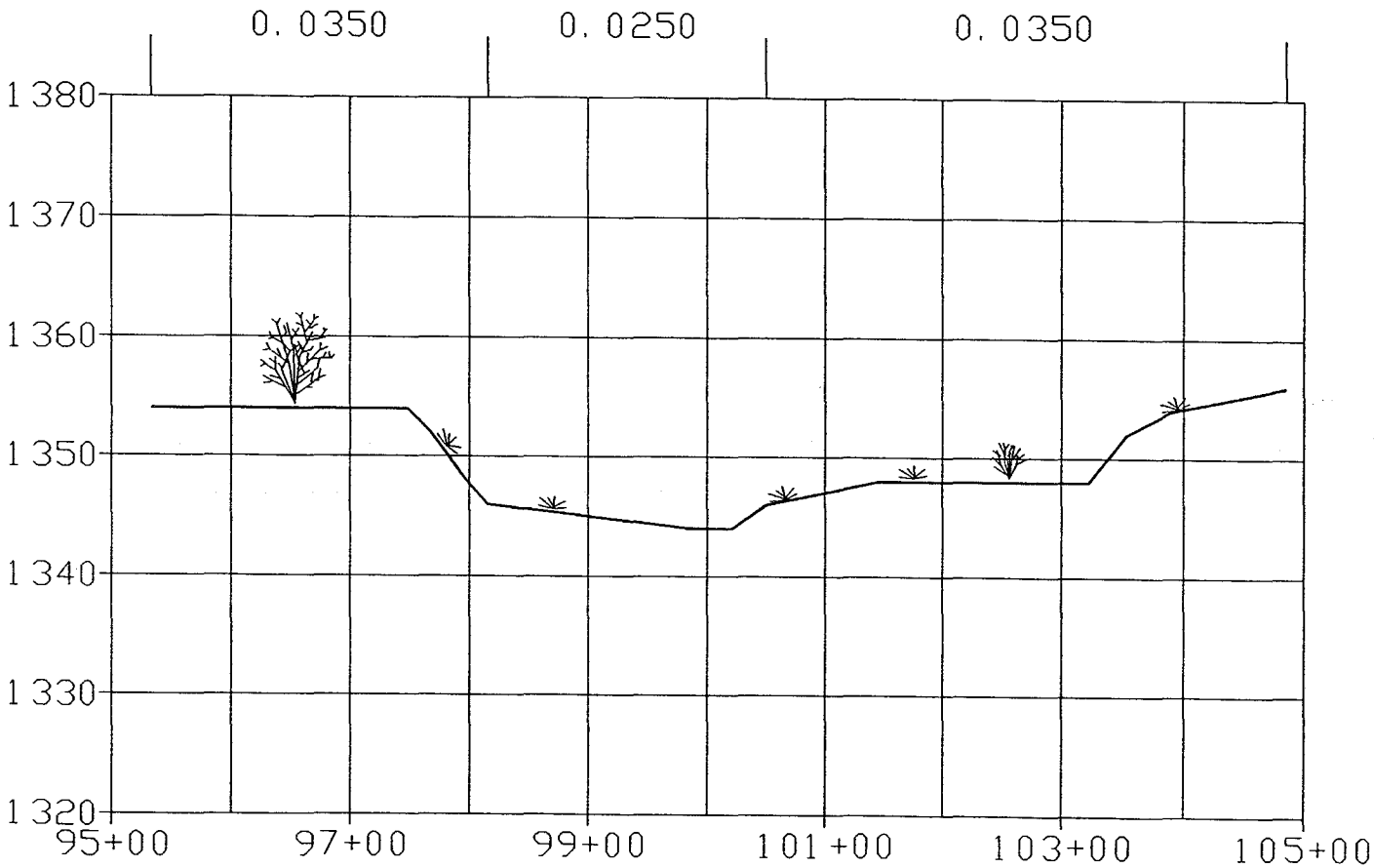
Approximately 1,700 feet downstream of Shea boulevard. Cross section locations are presented in Appendix B.

DESCRIPTION OF CHANNEL

The channel is a broad constructed trapezoidal section with various golf course uses present. Features include golf course fairways, putting greens, and a low flow channel area.

100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	Components	"n" Total
Regular Topography with Short Grass	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0$	
	$n_3 = 0.005$	
	$n_4 = 0$	**0.025**
Irregular Topography with Short Grass and Some Trees	$n_b = 0.020$	
	$n_1 = 0.005$	
	$n_2 = 0$	
	$n_3 = 0.005$	
	$n_4 = 0.005$	**0.035**



CROSS SECTION 12.22

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Photograph 3.42
Looking upstream near the north end of Camelback Country Club
just south of Shea Boulevard

Photograph 3.43
Looking downstream from near Shea Boulevard
at the centerline of Indian Bend Wash

REACH

From Shea Boulevard to Tatum Boulevard. This reach is within the City of Phoenix and encompasses the southern portion of the Stone Creek Golf Course. This reach includes the Shea Boulevard bridge and the Tatum Boulevard bridge. The reach is presented in plan view within Appendix B

CROSS SECTION 12.97

LOCATION OF CROSS SECTION

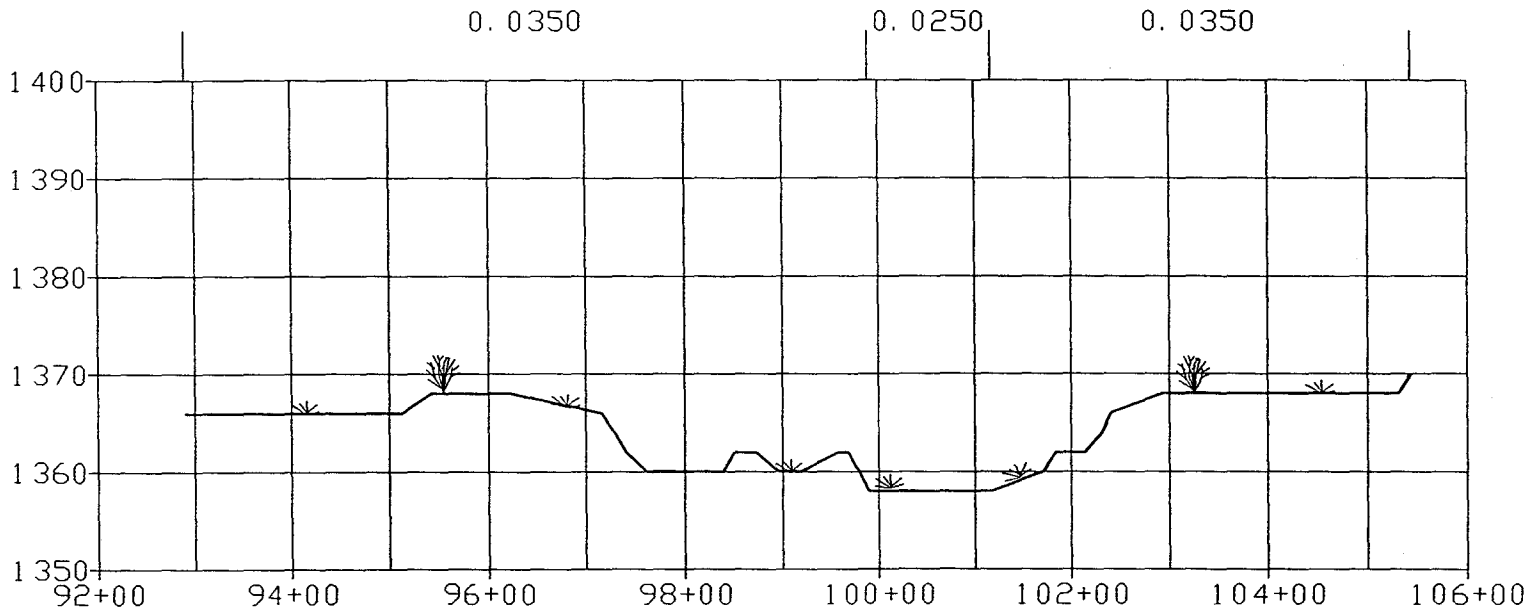
Approximately 2,200 feet upstream of Shea boulevard, between Tatum Boulevard and Shea Boulevard. Cross section locations are presented in Appendix B.

DESCRIPTION OF CHANNEL

The channel is a broad constructed trapezoidal section with various golf course uses. The topography is gently rolling with a small low-flow channel that connects a series of small ponds. The vegetation is comprised of short maintained grass.

100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	Components	"n" Total
Regular Topography with Short Grass	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0$	
	$n_3 = 0.005$	
	$n_4 = 0$	**0.025**
Irregular Topography with Short Grass and Some Trees	$n_b = 0.020$	
	$n_1 = 0.005$	
	$n_2 = 0$	
	$n_3 = 0.005$	
	$n_4 = 0.005$	**0.035**



CROSS SECTION 12.97

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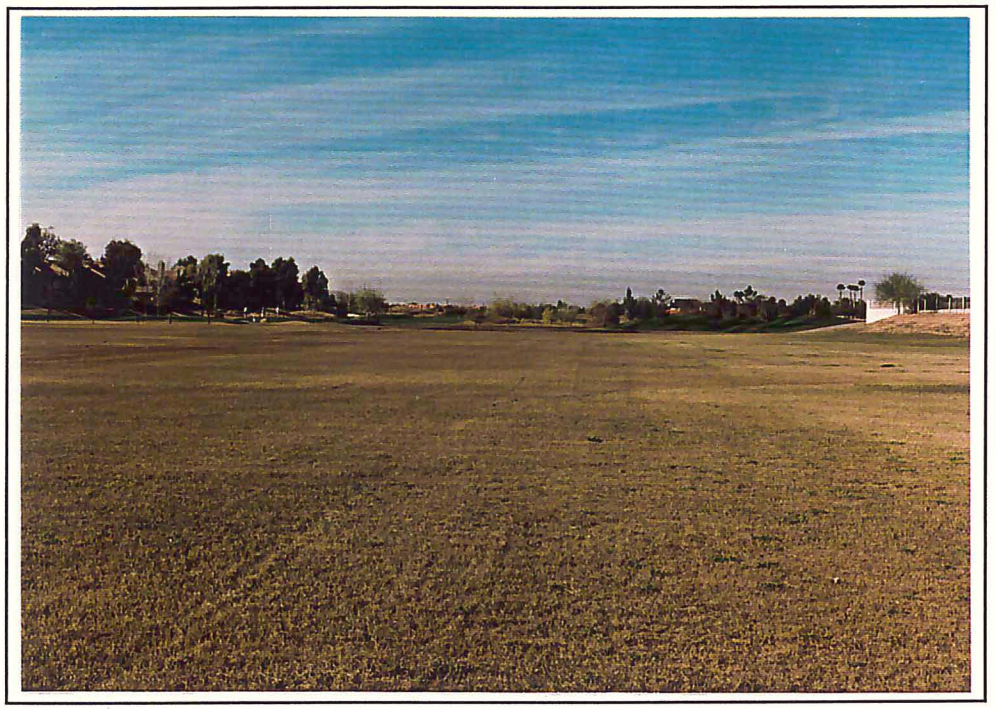


Photograph 3.44
Looking upstream from Shea Boulevard at the centerline
of Indian Bend Wash

Photograph 3.45
Looking north across Indian Bend Wash just downstream
of Tatum Boulevard

REACH

From Tatum Boulevard to Cactus Road. This reach is within the City of Phoenix and encompasses the northern portion of the Stone Creek Golf Course. This reach includes the Cactus Road bridge. The reach is presented in plan view within Appendix B

CROSS SECTION 13.83

LOCATION OF CROSS SECTION

Approximately 1,200 feet upstream of Tatum Boulevard. Cross section locations are presented in Appendix B.

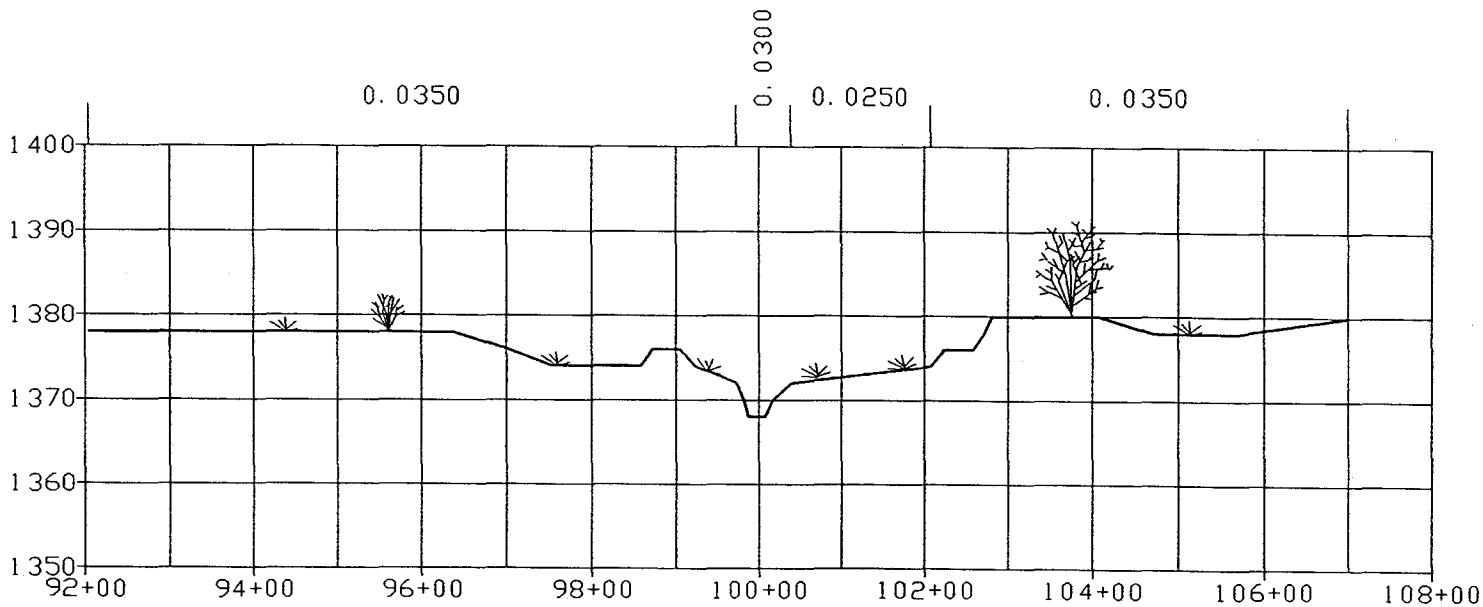
DESCRIPTION OF CHANNEL

The channel is hydraulically similar to the reach downstream. The channel is a broad constructed trapezoidal section with various golf course uses present. Features include golf course fairways, putting greens, and a low flow channel area.

100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	Components	"n" Total
Regular Topography with Short Grass	$n_b = 0.020$ $n_1 = 0$ $n_2 = 0$ $n_3 = 0.005$ $n_4 = 0$	**0.025**
Irregular Topography with Short Grass and Some Trees	$n_b = 0.020$ $n_1 = 0.005$ $n_2 = 0$ $n_3 = 0.005$ $n_4 = 0.005$	**0.035**
Low Flow Channel	$n_b = 0.025$ $n_1 = 0$ $n_2 = 0$ $n_3 = 0.005$ $n_4 = 0$	**0.030**

CROSS SECTION 13.83



Photograph 3.46
Looking upstream from Tatum Boulevard at the centerline of Indian Bend Wash

Photograph 3.47
Looking upstream from Tatum Boulevard at the right bank area of Indian Bend Wash

Photograph 3.48
Looking across Indian Bend Wash from the right bank
between Tatum Boulevard and Cactus Road

Photograph 3.49
Looking downstream from the Cactus Road bridge
at Indian Bend Wash centerline

REACH

From Cactus Road to 36th Street. This reach is entirely within the City of Phoenix and includes the Sweetwater Road low water crossing. The reach is presented in plan view within Appendix B.

CROSS SECTION 15.06

LOCATION OF CROSS SECTION

Approximately 500 feet downstream of 36th Street between 36th Street and Cactus Road. Cross section locations are presented in Appendix B.

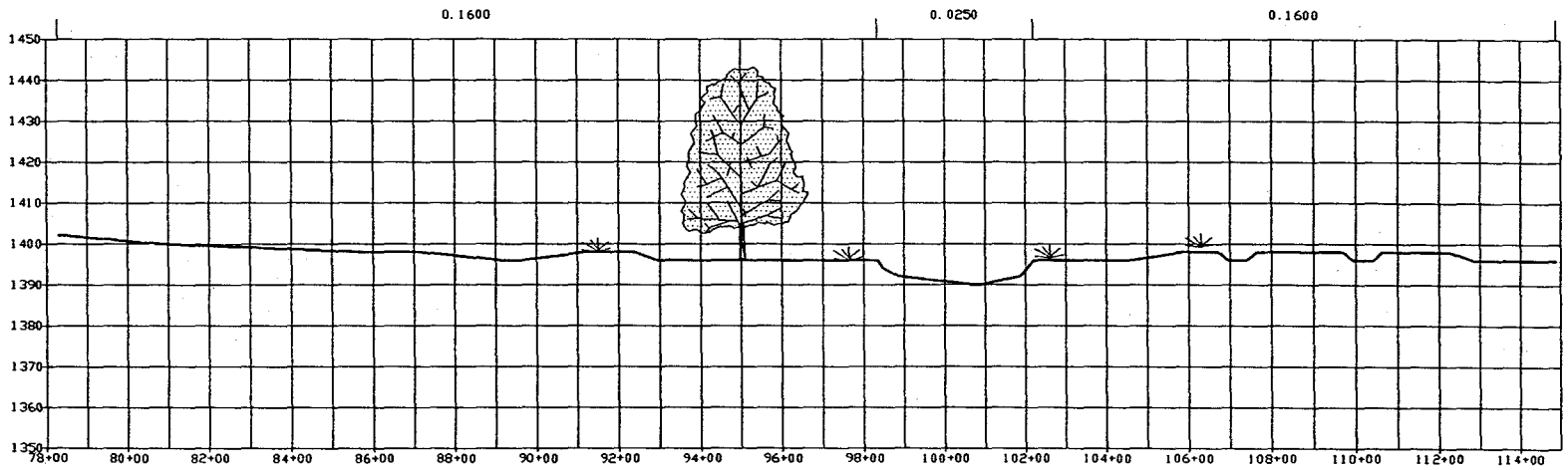
DESCRIPTION OF CHANNEL

The channel is a broad trapezoidal section with few contours and sparse vegetation. Vegetation consists of short grass and some small trees. The cross section is regular and varies only slightly.

100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	Components	"n" Total
Grass Trapezoidal Section	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0$	
	$n_3 = 0.005$	
	$n_4 = 0$	**0.025**
Pavement Areas		**0.020**
Residential Housing Areas	$n_b = 0.020$	
	$n_1 = 0.02$	
	$n_2 = 0.06$	
	$n_3 = 0.05$	
	$n_4 = 0.01$	**0.16**

CROSS SECTION 15.06



Photograph 3.50
Looking upstream from Cactus Road at the centerline of Indian Bend Wash

Photograph 3.51
Looking downstream from near 36th Street at Indian Bend Wash centerline

REACH

From 36th Street to 32nd Street at Acoma Road. This reach is entirely within the City of Phoenix. The upper portion of the reach encompasses a portion of Venturoso Park. The reach is presented in plan view within Appendix B

CROSS SECTION 16.05

LOCATION OF CROSS SECTION

At Hearn Road between 32nd Street and 36th Street. Cross section locations are presented in Appendix B.

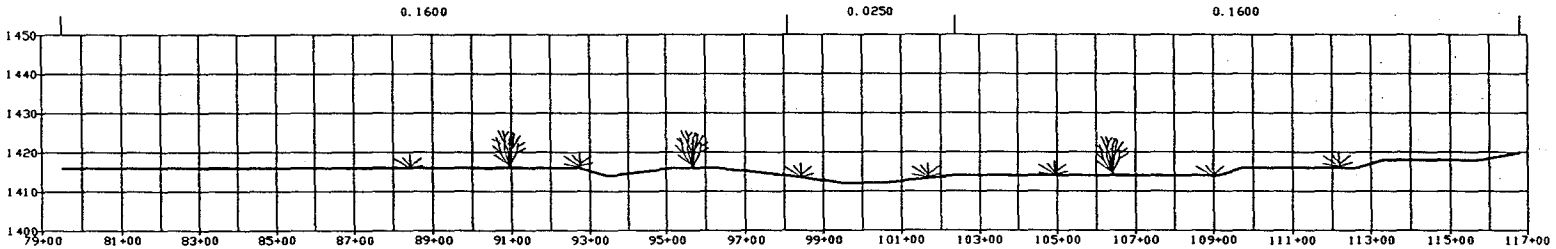
DESCRIPTION OF CHANNEL

The channel is a sparsely vegetated broad trapezoidal section. Few obstructions exist with the exception of several low water crossings. Very little variation between sections is present.

100-YEAR N-VALUE CALCULATIONS

Portion of Cross Section	Components	"n" Total
Regular Topography with Short Grass	$n_b = 0.020$	
	$n_1 = 0$	
	$n_2 = 0$	
	$n_3 = 0.005$	
	$n_4 = 0$	**0.025**
Residential Housing Areas	$n_b = 0.020$	
	$n_1 = 0.02$	
	$n_2 = 0.06$	
	$n_3 = 0.05$	
	$n_4 = 0.01$	**0.16**

CROSS SECTION 16.05



Photograph 3.52
Looking downstream from Presidio Road at Indian Bend Wash centerline
(approximately ¼ mile north of Sweetwater Road)

Photograph 3.53
Looking upstream from Presidio Road at Indian Bend Wash centerline

Photograph 3.54
Looking downstream from Thunderbird Road at Indian Bend Wash centerline

Photograph 3.55
Looking downstream from Venturoso Park near 32nd Street and Acoma Road

IV. SUMMARY

Section III presents the detailed information and recommended "n" values for use in HEC-2 analysis. The detailed results include: 1) recommended Manning's "n" values based on proposed NH records to be placed in HEC-2 computer data input files; 2) photographic documentation of floodplain characteristics; 3) determination of channel bank stations; 4) field observation of possible overflow areas; and 5) field measurement of hydraulic structures dimensions.

In the following summary table, each cross section is presented with its associated "n" value to be used on the NH record. Appendix B presents the cross sections in plan view and Appendix D graphically presents each cross sections.

The following information is included in the Summary Table:

SEC NO:	Section number measured in miles upstream from the confluence of Indian Bend Wash with the Salt River
STA:	Station within the cross section
"n":	Mannings "n" value for that portion of the cross section
CCHV:	Contraction Coefficient
CEHV:	Expansions Coefficient

SEC NO	STA	n	STA	n	STA	n	STA	n	STA	n	CCHV	CEHV	REMARKS
0.437											0.2	0.4	
0.475	10713	0.045									0.2	0.4	
0.491	9221	0.030	9811	0.030	10627	0.030					0.2	0.4	
0.568	9885	0.030	10122	0.030	11377	0.030					0.2	0.4	
0.663	9885	0.030	10122	0.030	11377	0.030					0.2	0.4	
0.758	9923	0.035	10099	0.030	11420	0.035					0.3	0.5	
0.776	11323	0.020									0.3	0.5	Curry Road Bridge
0.791	10996	0.020									0.3	0.5	
0.852	9928	0.035	10089	0.030	10940	0.035					0.2	0.4	
0.947	9906	0.035	10083	0.030	10936	0.035					0.2	0.4	
1.040	9911	0.035	10127	0.030	11460	0.035					0.2	0.4	
1.136	9772	0.035	10007	0.030	11382	0.035					0.2	0.4	
1.231	9937	0.035	10147	0.030	11633	0.035					0.2	0.4	
1.326	9903	0.035	10107	0.030	12184	0.030					0.2	0.4	
1.420	9886	0.035	10127	0.030	11470	0.030					0.3	0.5	
1.515	9945	0.035	10103	0.030	11279	0.035					0.3	0.5	
1.554	11491	0.020									0.3	0.5	McKellips Road Bridge
1.570	11373	0.020									0.3	0.5	
1.582	9966	0.030	10053	0.020	11483	0.030					0.3	0.5	
1.610	9772	0.030	10098	0.020	11414	0.030					0.2	0.4	
1.705	9956	0.030	10083	0.020	11452	0.030					0.2	0.4	
1.770	9819	0.030	10114	0.020	11476	0.030					0.2	0.4	
1.787	9806	0.030	10119	0.020	11380	0.030					0.2	0.4	
1.794	10185	0.035	10237	0.030	11530	0.035					0.2	0.4	
1.799	9954	0.035	9998	0.030	11413	0.030					0.2	0.4	
1.827	10024	0.035	10055	0.031	11237	0.035					0.2	0.4	
1.894	9904	0.030	10216	0.020	11028	0.030					0.2	0.4	
1.990	9953	0.035	9986	0.030	10500	0.035	10942	0.050			0.2	0.4	
2.047	9973	0.035	10050	0.030	10336	0.035	10862	0.510			0.2	0.4	
2.080	10032	0.035	10074	0.030	10454	0.035	10821	0.050			0.2	0.4	Near Roosevelt Street
2.178	9979	0.035	10037	0.030	10932	0.035					0.2	0.4	
2.273	9972	0.035	10115	0.030	10778	0.035					0.2	0.4	
2.367	9974	0.035	10093	0.021	10693	0.035					0.2	0.4	
2.462	9973	0.035	10026	0.030	10578	0.035					0.2	0.4	
2.557	9908	0.035	10076	0.020	10655	0.035					0.3	0.5	
2.610	9770	0.035	10019	0.020	10300	0.035					0.3	0.5	
2.620	9813	0.035	10012	0.020	10467	0.035					0.3	0.5	
2.629	9820	0.035	10035	0.020	10480	0.035					0.3	0.5	McDowell Road Bridge
2.652	9818	0.035	10034	0.020	10447	0.035					0.3	0.5	
2.653	9818	0.035	10034	0.020	10447	0.035					0.3	0.5	

SEC NO	STA	n	STA	n	STA	n	STA	n	STA	n	CCHV	CEHV	REMARKS
2.658	10438	0.020									0.3	0.5	
2.662	10438	0.020									0.3	0.5	
2.663	9746	0.035	10025	0.020	10436	0.035					0.3	0.5	
2.700	10048	0.035	10139	0.050	10202	0.030	10289	0.020	10604	0.035	0.3	0.5	
	10704	0.035									0.3	0.5	
2.746	9854	0.035	9963	0.020	10109	0.050	10287	0.035	10387	0.020	0.3	0.4	
2.770	9728	0.035	9792	0.020	9934	0.035	10071	0.051	10312	0.035	0.3	0.4	
	10413	0.020	10697	0.035							0.3	0.4	
2.775	9733	0.035	9785	0.020	9915	0.035	10091	0.050	10326	0.035	0.3	0.4	
	10408	0.020	10714	0.035							0.3	0.4	
2.780	9709	0.035	9792	0.020	9967	0.035	10016	0.045	10276	0.035	0.3	0.4	
	10388	0.020	10721	0.035							0.3	0.4	
2.790	9704	0.035	9893	0.020	10011	0.045	10727	0.035			0.3	0.4	
2.810	9887	0.035	10016	0.020	10078	0.045	10794	0.035			0.3	0.4	
2.820	9803	0.035	9841	0.020	9961	0.035	9990	0.045	10810	0.035	0.3	0.4	
2.827	9809	0.035	9922	0.020	9997	0.035	10024	0.045	10218	0.020	0.3	0.4	
	10800	0.035									0.3	0.4	
2.841	10010	0.035	10047	0.045	10280	0.020	10801	0.035			0.3	0.4	
2.936	9865	0.020	10042	0.030	10063	0.045	10743	0.035			0.3	0.4	
3.030	9553	0.035	9690	0.020	9994	0.030	10045	0.045	10562	0.030	0.3	0.4	
3.125	9743	0.035	9887	0.020	9985	0.030	9994	0.045	10249	0.030	0.3	0.4	
	10613	0.035									0.3	0.4	
3.220	9645	0.020	9695	0.035	10016	0.020	10561	0.035			0.3	0.4	
3.270	9509	0.035	9762	0.020	10599	0.035					0.3	0.4	
3.280	10791	0.035									0.3	0.4	
3.409	9924	0.035	10068	0.020	11135	0.035					0.3	0.4	
3.488											0.3	0.4	
3.490	9898	0.035	10310	0.030	11335	0.035					0.3	0.4	
3.504	9966	0.030	10354	0.035	11333	0.030					0.3	0.4	
3.510	10208	0.035	11338	0.030							0.3	0.4	
3.548	9890	0.035	10067	0.030	11325	0.035					0.3	0.4	
3.590	9822	0.035	9986	0.030	11375	0.035					0.3	0.4	
3.600	9773	0.035	10001	0.030	11393	0.035					0.3	0.4	
3.660	9772	0.035	9998	0.030	11349	0.035					0.3	0.4	
3.710	9690	0.035	9995	0.030	11516	0.035					0.3	0.4	
3.730	9672	0.035	10076	0.030	11542	0.035					0.3	0.5	
3.760	11554	0.020									0.3	0.5	Thomas Road Bridge
3.780	11583	0.020									0.3	0.5	
3.811	11586	0.035									0.3	0.5	
3.883	11632	0.035									0.3	0.5	

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SEC NO	STA	n	STA	n	STA	n	STA	n	STA	n	CCHV	CEHV	REMARKS
3.977	9706	0.036	10039	0.030	10620	0.036					0.3	0.4	
4.072	9843	0.036	10171	0.030	10469	0.036					0.3	0.4	
4.167	9744	0.036	9990	0.020	10461	0.036					0.3	0.4	
4.220	9736	0.036	10017	0.030	10371	0.036					0.3	0.4	
4.250	9623	0.036	9979	0.020	10597	0.036					0.3	0.4	
4.290	9617	0.036	10007	0.031	10465	0.036					0.3	0.4	
4.356	9646	0.036	10122	0.030	10393	0.036					0.3	0.4	
4.451	9598	0.036	10096	0.030	10623	0.036					0.3	0.4	
4.546	10228	0.036	10457	0.030	11001	0.036					0.3	0.4	
4.640	10213	0.036	10329	0.030	10767	0.036					0.3	0.4	
4.735	10023	0.036	10426	0.030	11096	0.036					0.3	0.4	
4.830	9502	0.036	10091	0.020	10690	0.036					0.5	0.5	
4.850	9295	0.036	9421	0.020	9968	0.035	10010	0.020	10665	0.036	0.5	0.5	
4.855	10661	0.020									0.5	0.5	
4.870	10576	0.020									0.5	0.5	
4.873	9286	0.035	9466	0.020	9908	0.030	10348	0.020	10653	0.035	0.5	0.5	
4.892	9282	0.035	9419	0.020	9479	0.030	9875	0.020	10083	0.025	0.5	0.5	
	10673	0.035									0.5	0.5	
4.924	9295	0.035	9409	0.020	9496	0.030	9863	0.020	9932	0.030	0.2	0.4	
	10215	0.025	10705	0.035							0.2	0.4	
4.952	9303	0.035	9447	0.020	9487	0.030	9638	0.020	9888	0.030	0.2	0.4	
	10026	0.025	10655	0.035							0.2	0.4	
4.990	9485	0.035	9491	0.020	9937	0.035	10086	0.025	10302	0.035	0.2	0.4	
5.110	9785	0.035	9884	0.020	10104	0.025	10133	0.035			0.2	0.4	
5.205	9834	0.035	9853	0.020	10063	0.025	10290	0.035			0.2	0.4	
5.300	9736	0.035	9869	0.020	10044	0.025	10235	0.035			0.2	0.4	
5.357	9794	0.035	9903	0.020	10054	0.025	10290	0.035			0.3	0.5	
5.360	10861	0.020									0.3	0.5	
5.372	10809	0.020									0.3	0.5	
5.385	9610	0.035	9672	0.020	9795	0.035	9889	0.020	10045	0.025	0.3	0.5	
	10161	0.035									0.2	0.4	
5.492	9481	0.035	9604	0.020	9791	0.035	9835	0.020	9991	0.025	0.2	0.4	
	10105	0.035									0.2	0.4	
5.587	9630	0.035	9701	0.020	9818	0.035	9884	0.020	10023	0.025	0.2	0.4	
	10146	0.035									0.2	0.4	
5.682	9443	0.035	9523	0.020	9790	0.035	9905	0.020	10025	0.025	0.2	0.4	
	10079	0.035									0.2	0.4	
5.777	9784	0.035	9889	0.020	10034	0.025	10190	0.035			0.2	0.4	
5.867	9446	0.035	9524	0.020	9790	0.035	9914	0.020	10098	0.025	0.2	0.4	
	10679	0.035									0.2	0.4	

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SEC NO	STA	n	STA	n	STA	n	STA	n	STA	n	CCHV	CEHV	REMARKS
5.871	9769	0.035	9916	0.020	10096	0.025	10686	0.035			0.3	0.5	
5.886	10744	0.020									0.3	0.5	
5.900	10774	0.020									0.3	0.5	Chaparral Road
5.925	9771	0.035	9933	0.020	10090	0.025	10218	0.035			0.3	0.5	
5.996	9167	0.035	9281	0.020	9767	0.035	9924	0.020	10136	0.029	0.2	0.4	
	10228	0.035									0.2	0.4	
6.060	10138	0.035									0.2	0.4	
6.155	9296	0.035	9724	0.020	9862	0.035	9915	0.020	10166	0.029	0.2	0.4	
	10268	0.035									0.2	0.4	
6.250	9564	0.035	9664	0.020	9871	0.035	9931	0.020	10297	0.029	0.2	0.4	
6.345	9396	0.035	9861	0.030	9926	0.020	10159	0.025	10409	0.035	0.2	0.4	
6.390	10887	0.020									0.2	0.4	
6.400	9801	0.030	9937	0.020	10225	0.025	10808	0.035			0.2	0.4	
6.440	10887	0.020									0.2	0.4	
6.530	9891	0.035	9947	0.020	10101	0.025	10309	0.035			0.2	0.4	
6.630	9872	0.035	9927	0.020	10069	0.025	10109	0.035			0.2	0.4	
6.723	9856	0.035	9944	0.020	10066	0.025	10193	0.035			0.2	0.4	
6.820	9778	0.035	9849	0.020	10116	0.025	10186	0.035			0.2	0.4	
6.856	9647	0.050	9827	0.020	10115	0.025	10245	0.035			0.2	0.4	
6.879	9622	0.050	9878	0.020	10110	0.025	10374	0.035			0.3	0.5	
6.880	10670	0.020									0.3	0.5	
6.893	9660	0.035	9898	0.020	10168	0.025	10768	0.035			0.3	0.5	
6.910	9668	0.035	9870	0.020	10117	0.025	10288	0.035			0.2	0.4	
6.960	9472	0.035	9588	0.020	9699	0.035	9841	0.020	10137	0.025	0.2	0.4	
	10304	0.035									0.2	0.4	
7.008	9828	0.020	10367	0.025							0.2	0.4	
7.102	9822	0.020	10559	0.025							0.2	0.4	
7.197	9782	0.035	10241	0.025	10440	0.035					0.2	0.4	
7.290											0.2	0.4	
7.390	9676	0.035	10277	0.025	10461	0.035					0.2	0.4	
7.481	9679	0.035	10233	0.025	10338	0.035					0.2	0.4	
7.576	9739	0.035	10216	0.025	10512	0.035					0.2	0.4	
7.670	9674	0.035	10197	0.025	10347	0.350					0.2	0.4	
7.765	9743	0.035	10208	0.025	10393	0.035					0.2	0.4	
7.837	9773	0.035	10201	0.025	10317	0.035					0.2	0.4	
7.883	9842	0.035	10111	0.020	10414	0.035					0.2	0.4	
7.995	9854	0.035	10189	0.025	10430	0.035					0.3	0.5	
7.979	10486	0.020									0.3	0.5	
7.988	11074	0.020									0.3	0.5	
7.992	11175	0.020									0.3	0.5	

SEC NO	STA	n	STA	n	STA	n	STA	n	STA	n	CCHV	CEHV	REMARKS
8.144											0.2	0.4	
8.239	9223	0.040	9425	0.030	9542	0.020	10046	0.040	10130	0.020	0.2	0.4	
	10813	0.040									0.2	0.4	
8.333	9976	0.040	10027	0.020	10519	0.040					0.2	0.4	
8.428	9981	0.040	10037	0.020	10174	0.040	10705	0.030			0.2	0.4	
8.523	10005	0.040	10063	0.020	10411	0.040	10457	0.020	11140	0.030	0.2	0.4	
8.656	9957	0.040	9997	0.020	10443	0.040	10695	0.030			0.2	0.4	
8.752	9273	0.040	9483	0.030	10231	0.020	10278	0.030	10366	0.040	0.2	0.4	
	11044	0.030									0.2	0.4	
8.996	9246	0.030	10212	0.020	10367	0.031					0.2	0.4	
9.123	11418	0.020									0.2	0.4	
9.132	11214	0.020									0.3	0.5	
9.139	10763	0.020									0.3	0.5	
9.223	9398	0.020	9679	0.020	10672	0.030					0.2	0.4	
9.283	9387	0.020	9964	0.035	10516	0.030					0.2	0.4	
9.375	8998	0.020	11111	0.030							0.2	0.4	
9.470	11415	0.030									0.2	0.4	
9.564	10005	0.040	10043	0.025	11444	0.040					0.2	0.4	
9.578	9980	0.040	10018	0.025	10836	0.040					0.2	0.4	
9.659	9937	0.040	10042	0.025	11219	0.040					0.2	0.4	
9.754	9971	0.040	10058	0.025	11424	0.040					0.2	0.4	
9.849	9909	0.040	10092	0.025	11148	0.040					0.2	0.4	
9.943	9953	0.040	10093	0.025	11228	0.040					0.2	0.4	
10.040	9886	0.040	10147	0.025	10910	0.040					0.2	0.4	
10.130	9846	0.040	10235	0.025	11131	0.040					0.2	0.4	
10.230	9830	0.040	10103	0.025	10642	0.040					0.2	0.4	
10.320	9789	0.040	10353	0.025	10680	0.040					0.2	0.4	
10.380	10441	0.020									0.2	0.4	Invergordon Road
10.400	10450	0.020									0.2	0.4	
10.410	10754	0.025									0.2	0.4	
10.510	9864	0.040	10160	0.025	10267	0.040					0.2	0.4	
10.610	9776	0.040	10348	0.025	10887	0.040					0.2	0.4	
10.700	9925	0.040	10094	0.020	10667	0.040					0.2	0.4	
10.800	9819	0.040	10109	0.020	10723	0.040					0.2	0.4	
10.890	9855	0.040	10015	0.025	10478	0.040					0.2	0.4	
10.990	9929	0.040	10125	0.025	10686	0.040					0.2	0.4	
11.080	9959	0.040	10226	0.020	11197	0.040					0.2	0.4	Doubletree Road
11.150	9952	0.040	10113	0.020	11137	0.040					0.2	0.4	
11.170	9953	0.040	10142	0.025	10644	0.040					0.2	0.4	
11.270	9879	0.040	10130	0.025	10625	0.040					0.2	0.4	

Simons, Li & Associates, Inc.
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SEC NO	STA	n	STA	n	STA	n	STA	n	STA	n	CCHV	CEHV	REMARKS
11.360	9816	0.040	10190	0.025	10903	0.040					0.2	0.4	
11.460	9947	0.040	10137	0.025	10820	0.040					0.2	0.4	
11.550	9744	0.040	9940	0.025	10473	0.040					0.2	0.4	
11.650	9855	0.035	10117	0.025	10564	0.035					0.2	0.4	
11.740	9909	0.035	10180	0.025	10938	0.035					0.2	0.4	
11.840	9862	0.035	10130	0.025	10602	0.035					0.2	0.4	
11.930	9969	0.035	10130	0.025	10419	0.020	10781	0.035			0.2	0.4	
12.030	9957	0.035	10290	0.025	10757	0.035					0.2	0.4	
12.120	9816	0.035	10050	0.025	10485	0.035					0.2	0.4	
12.220	9810	0.035	10050	0.025	10480	0.035					0.2	0.4	
12.310	9829	0.025									0.2	0.4	
12.410	10336	0.025									0.2	0.4	
12.500	10582	0.020									0.2	0.4	
12.540	10786	0.020									0.3	0.5	Shea Boulevard
12.560	10569	0.025									0.3	0.5	
12.600	10364	0.025									0.2	0.4	
12.690	9794	0.035	10007	0.020	10288	0.035					0.2	0.4	
12.780	9909	0.035	10015	0.020	10462	0.035					0.2	0.4	
12.880	9990	0.035	10117	0.025	10543	0.035					0.2	0.4	
12.970	9975	0.035	10050	0.025	1044	0.035					0.2	0.4	
13.070	9847	0.035	10053	0.025	10296	0.035					0.2	0.4	
13.160	9624	0.035	9723	0.025	9917	0.035	10142	0.025	10638	0.035	0.2	0.4	
13.250	1088	0.020									0.3	0.5	
13.380	10271	0.020									0.3	0.5	Tatum Boulevard
13.400	9926	0.035	10048	0.025	10207	0.035					0.3	0.5	
13.450	9835	0.035	10030	0.030	10186	0.025	10356	0.035			0.3	0.5	
13.540	9925	0.035	10115	0.030	10608	0.035					0.2	0.4	
13.640	9912	0.035	10108	0.030	10648	0.035					0.2	0.4	
13.730	9973	0.035	10039	0.030	10207	0.025	10701	0.035			0.2	0.4	
13.830	9948	0.035	10111	0.030	10844	0.025					0.2	0.4	
13.920	9821	0.035	9988	0.030	10484	0.025	10686	0.035			0.2	0.4	
14.020	9837	0.035	10060	0.030	10256	0.020	11011	0.035			0.2	0.4	
14.110	9922	0.035	10031	0.030	10992	0.035					0.2	0.4	
14.210	9954	0.035	10093	0.030	10887	0.035					0.2	0.4	
14.300	9921	0.035	10285	0.030	11028	0.035					0.2	0.4	
14.390	10397	0.020									0.3	0.5	
14.440	10240	0.020									0.3	0.5	
14.470	10174	0.025									0.3	0.5	Cactus Road
14.490	10479	0.025									0.3	0.5	
14.580	9568	0.160	10418	0.025	10683	0.160					0.3	0.5	

Simons, Li & Associates, Inc.
Water Resources & Civil Engineering Consultants

SEC NO	STA	n	STA	n	STA	n	STA	n	STA	n	CCHV	CEHV	REMARKS
14.660	9600	0.160	10043	0.025	10847	0.160					0.3	0.5	
14.750	9814	0.160	10232	0.025	11359	0.160					0.2	0.4	40th Street
14.850	9822	0.160	10238	0.025	11742	0.160					0.2	0.4	
14.960	9834	0.160	10220	0.025	11490	0.160					0.2	0.4	GR Pt Spot Elv–Chnnl
15.060	9710	0.160	10117	0.025	11494	0.160					0.2	0.4	
15.150	9801	0.160	10232	0.250	12189	0.160					0.2	0.4	
15.250	9563	0.160	11723	0.020							0.2	0.4	36th Street
15.320	9526	0.160	11761	0.020							0.2	0.4	
15.330	9679	0.160	10562	0.025	11759	0.160					0.2	0.4	
15.333	9243	0.160	10367	0.025	11384	0.160					0.2	0.4	
15.440	9593	0.160	10329	0.025	11351	0.160					0.2	0.4	
15.530	9917	0.160	10504	0.025	11371	0.160					0.2	0.4	
15.630	9800	0.160	10335	0.025	11518	0.160					0.2	0.4	
15.720	9514	0.160	10782	0.020	11900	0.160					0.2	0.4	
15.810	9654	0.160	10822	0.025	11933	0.160					0.2	0.4	
15.820	9824	0.160	10305	0.025	11975	0.160					0.2	0.4	
15.910	9812	0.160	10257	0.025	11780	0.160					0.2	0.4	
15.980	9810	0.160	10239	0.025	11680	0.160					0.2	0.4	
16.050	9609	0.160	10073	0.025	11505	0.160					0.2	0.4	
16.100	9863	0.160	10270	0.025	1511	0.160					0.2	0.4	
16.190	10364	0.025	10880	0.160							0.2	0.4	
16.290	9871	0.160	10351	0.025	10605	0.160					0.2	0.4	

V. REFERENCES

U.S. Army Corps of Engineers, Hydrologic Engineering Center, "HEC-2 Water Surface Profiles", Users Manual, September, 1900

Thomsen, B.W., H.W. Hjalmerson, "Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona", U.S.G.S., 1991, prepared for the Flood Control District of Maricopa County.

Federal Emergency Management Agency, Federal Insurance Administration, "Flood Insurance Study Guidelines and Specifications for Study Contractors", (FEMA 37), March 1993

Chow, V.T., Open-Channel Hydraulics, New York: McGraw-Hill, 1959.

Simons, Li & Associates, Inc., "Design Manual for Engineering Analysis of Fluvial Systems," prepared for the Arizona Department of Water Resources, March, 1985.

Flood Control District of Maricopa County, "Hydrologic Design Manual for Maricopa County, Arizona", September, 1990.

Simons, Li & Associates, Inc., "Rainbow Wash Flood Insurance Study, Gila River Through S.R. 85" prepared for the Flood Control District of Maricopa County, May, 1994.

U.S. Army Corps of Engineers, Los Angeles District, "Gila River Basin, Arizona, Indian Bend Wash, Design Memorandum No. 1, General Design Memorandum - Phase I, Plan Formulation for Indian Bend Wash, Supplementary Report on Side Channels System", September, 1974.

U.S. Army Corps of Engineers, Los Angeles District, "Gila River Basin, Arizona, Indian Bend Wash, Design Memorandum No. 4, Feature Design for Interceptor Channel, Project Design for Indian Bend Wash", January, 1980.

U.S. Army Corps of Engineers, Los Angeles District, "Gila River Basin, Arizona, Indian Bend Wash, Design Memorandum No. 1, General Design Memorandum - Phase II, Project Design for Indian Bend Wash", May, 1975.

U.S. Army Corps of Engineers, Los Angeles District, "Gila River Basin, Arizona, Indian Bend Wash, Design Memorandum No. 3, Feature Design for Inlet Channel, Project Design for Indian Bend Wash", January, 1978.

Federal Emergency Management Agency, "Flood Insurance Rate Map, Map No. 04013C1660D", April 15, 1988.

Federal Emergency Management Agency, "Flood Insurance Rate Map, Map No. 04013C1695D", April 15, 1988.

Federal Emergency Management Agency, "Flood Insurance Rate Map, Map No. 04013C2171D", April 15, 1988.

Federal Emergency Management Agency, "Flood Insurance Rate Map, Map No. 04013C1680D", April 15, 1988.

Federal Emergency Management Agency, "Flood Insurance Study, City of Scottsdale, Arizona, Maricopa County", June 4, 1984.

Federal Emergency Management Agency, "Flood Insurance Study, City of Tempe, Arizona, Maricopa County", February, 1980.

Federal Emergency Management Agency, "Flood Insurance Study, Town of Paradise Valley, Arizona, Maricopa County", November, 1979.

Federal Emergency Management Agency, "Flood Insurance Study, Town of Paradise Valley, Arizona, Maricopa County", June, 1986.

Federal Emergency Management Agency, "Flood Insurance Study, Maricopa County, Arizona and Incorporated Areas, Volume 1 of 9", December 3, 1993.

Federal Emergency Management Agency, "Flood Insurance Study, City of Phoenix, Arizona, Maricopa County", June 1, 1984.

Federal Emergency Management Agency, "Flood Insurance Study, Maricopa County, Arizona and Incorporated Areas, Volume 1 of 7", September 4, 1991.

Federal Emergency Management Agency, "Flood Insurance Study, City of Phoenix, Arizona, Maricopa County", June, 1979.

Federal Emergency Management Agency, "Flood Insurance Study, Maricopa County, Arizona and Incorporated Areas, Volume 5 of 9", December 3, 1993.

Federal Emergency Management Agency, "Flood Insurance Study, Maricopa County, Arizona Unincorporated Areas", May, 1979.

Sullivan and Masson Consulting Engineers, "Final Report Lateral Drainage of Indian Bend Wash", for Flood Control District of Maricopa County, March 7, 1978.

Yost and Gardner Engineers, "Master Drainage Study, Indian Bend Wash", prepared for the City of Phoenix, Arizona, April, 1975.

Federal Highway Administration, "User's Manual for WSPRO - A Computer Model for Water Surface Profile Computations" September, 1990.

APPENDIX A

PHOTOGRAPHIC RECORD OF HYDRAULIC STRUCTURES

APPENDIX A

Photographic Record of Hydraulic Structures

Photo A.1	Indian Bend Wash Grade Control Structure at the Salt River
Photo A.2	Red Mountain Freeway Bridge Over the Indian Bend Wash Grade Control Structure
Photo A.3	Curry Road Bridge
Photo A.4	McKellips Road Bridge
Photo A.5	Drop Between Lakes at Station 1.80
Photo A.6	Roosevelt Street Low Water Crossing
Photo A.7	McDowell Road Bridge Over Indian Bend Wash
Photo A.8	McDowell Road Bridge Upstream Sill
Photo A.9	Thomas Road Bridge Over Indian Bend Wash
Photo A.10	Osborn Road Low Water Crossing
Photo A.11	Indian School Road Bridge
Photo A.12	Indian School Road Box Culvert Near Bridge in Photo A.11
Photo A.13	Pedestrian Underpass Under Hayden Road Connecting High Flow and Low Flow Channels
Photo A.14	Camelback Road Bridge over the Indian Bend Wash Low-Flow Channel
Photo A.15	Chaparral Road Bridge Over the Indian Bend Wash Low-Flow Channel
Photo A.16	McDonald Road Bridge
Photo A.17	Hotel Constructed on Piers Just Downstream from Indian Bend Road
Photo A.18	Indian Bend Road Drop Structure
Photo A.19	Scottsdale Road Bridge
Photo A.20	Grade Control Upstream of Scottsdale Road
Photo A.21	Low-Water Crossing at Invergordon Road
Photo A.22	Low-Water Crossing at Double Tree Road

Photo A.23	Shea Boulevard Bridge
Photo A.24	Shea Boulevard Bridge
Photo A.25	Tatum Boulevard Bridge
Photo A.26	Cactus Road Bridge
Photo A.27	Cactus Road Bridge
Photo A.28	Sweetwater Road Low-Water Crossing

Photo A.1
Indian Bend Wash Grade Control Structure at the Salt River,
Looking North at the Toe of the Structure

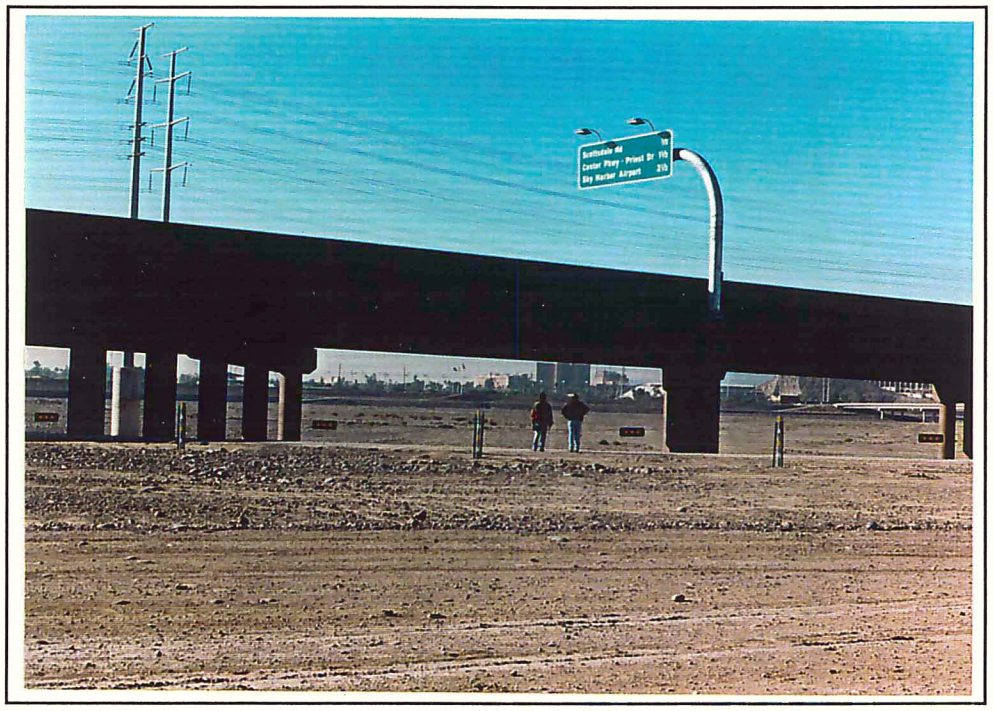


Photo A.2
Red Mountain Freeway Bridge Over the Indian Bend Wash Grade
Control Structure, Looking South at Top of Sill

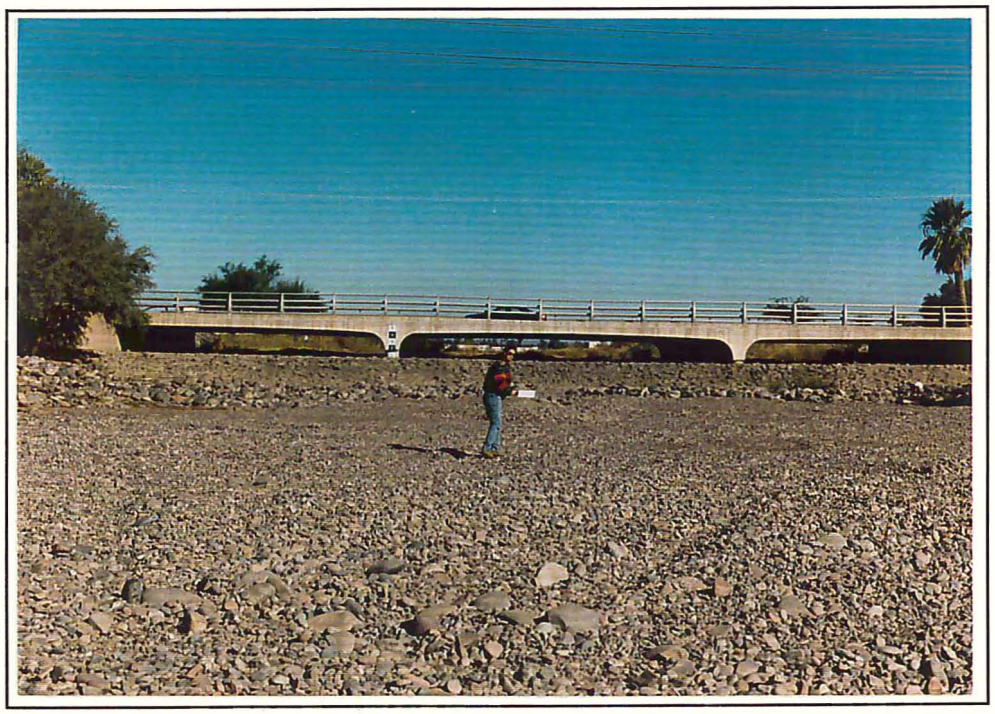


Photo A.3
Curry Road Bridge, Looking North at Downstream Side of Bridge

Photo A.4
McKellips Road Bridge, Looking South at Upstream Side of Bridge

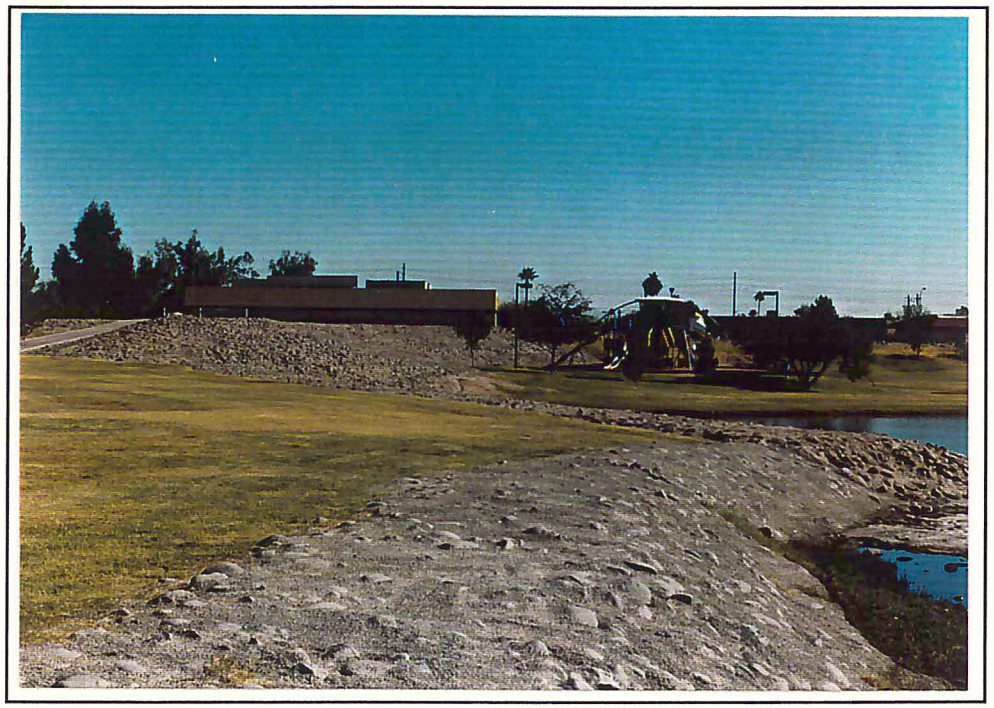


Photo A.5
Drop Between Lakes at Station 1.80, Looking East

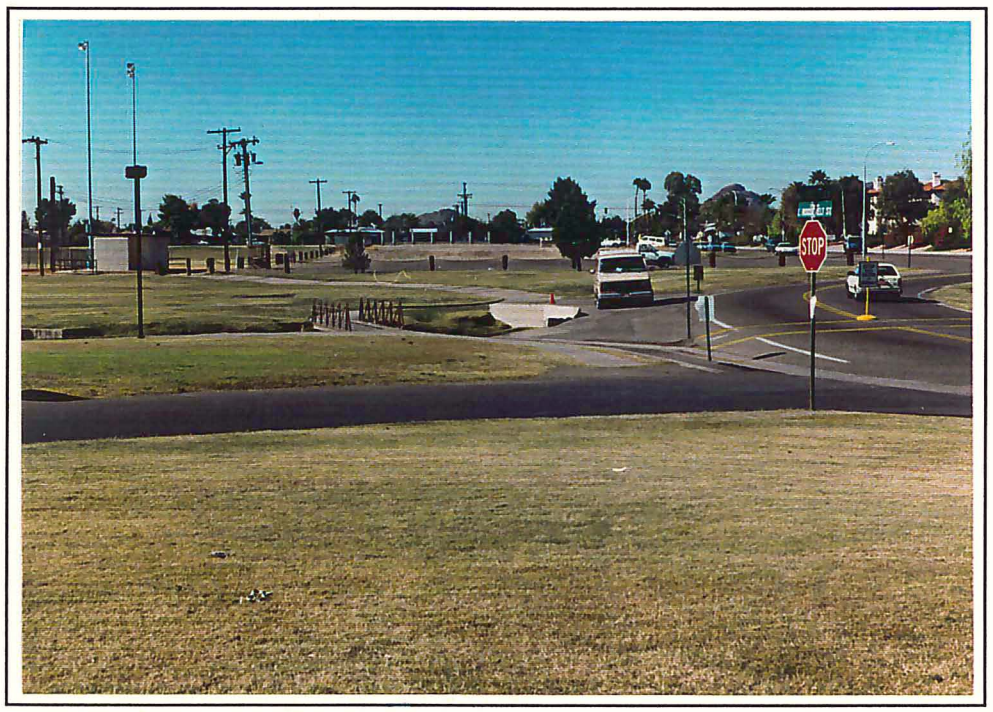


Photo A.6
Roosevelt Street Low Water Crossing, Looking West From Left Bank Area

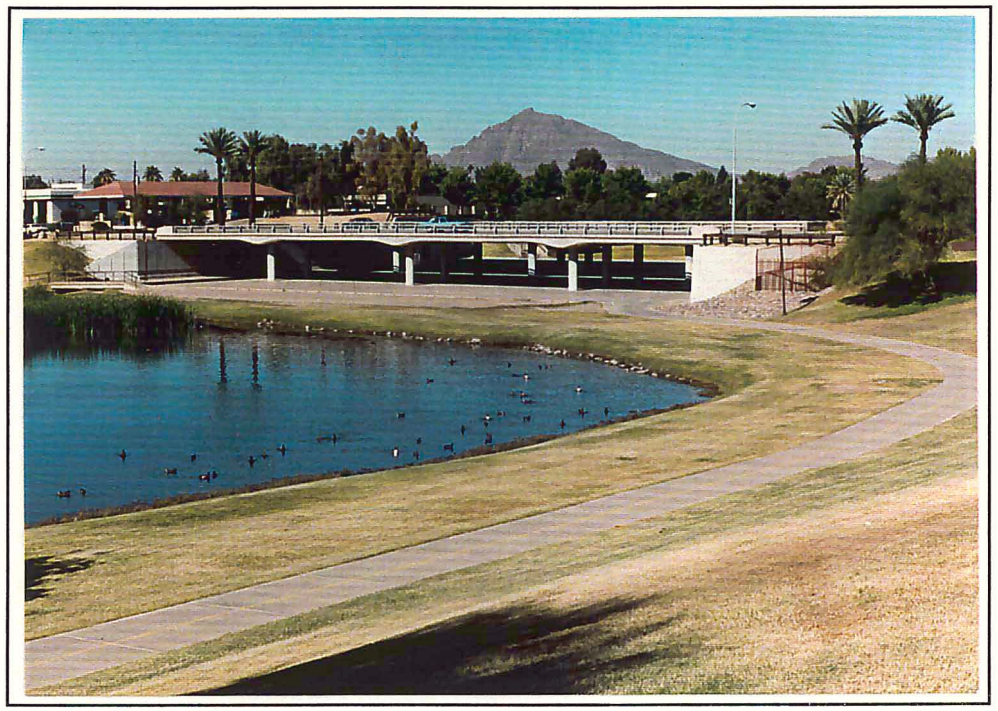


Photo A.7
McDowell Road Bridge Over Indian Bend Wash,
Looking Northwest at Downstream Side of Bridge

Photo A.8
Sill Structure Upstream of McDowell Road Bridge, Looking West

Photo A.9
Thomas Road Bridge Over Indian Bend Wash,
Looking North at Downstream Side of Bridge

Photo A.10
Osborn Road Low Water Crossing, Looking Southeast Across Indian Bend Wash

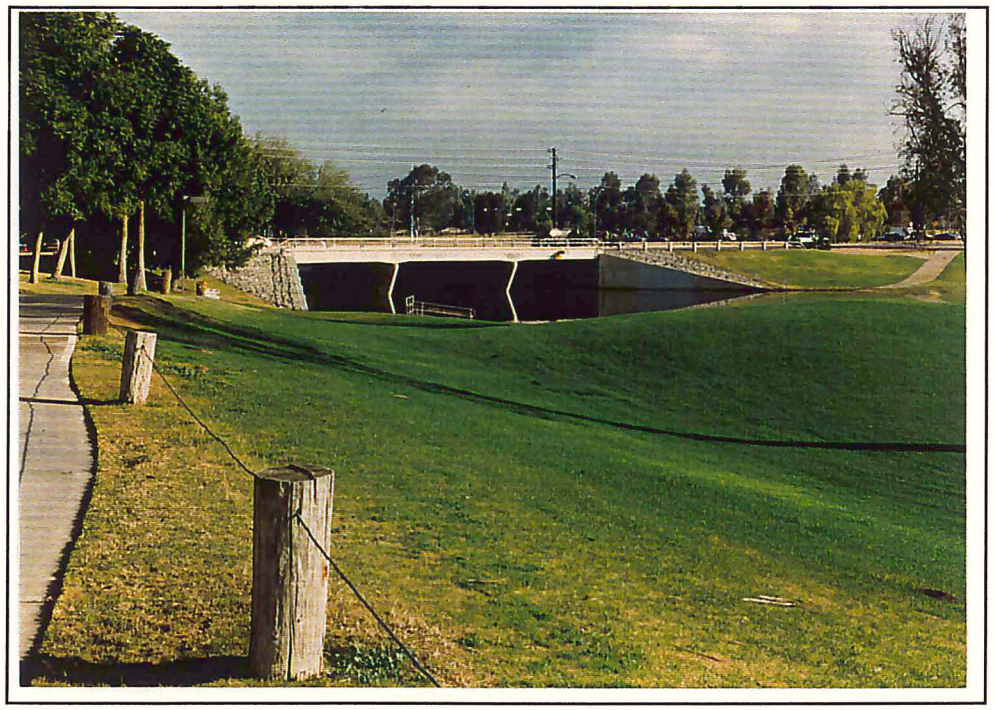


Photo A.11
Indian School Road Bridge, Looking North at Downstream Side of Bridge

Photo A.12
Indian School Road Box Culvert, Looking Northeast at Downstream Side

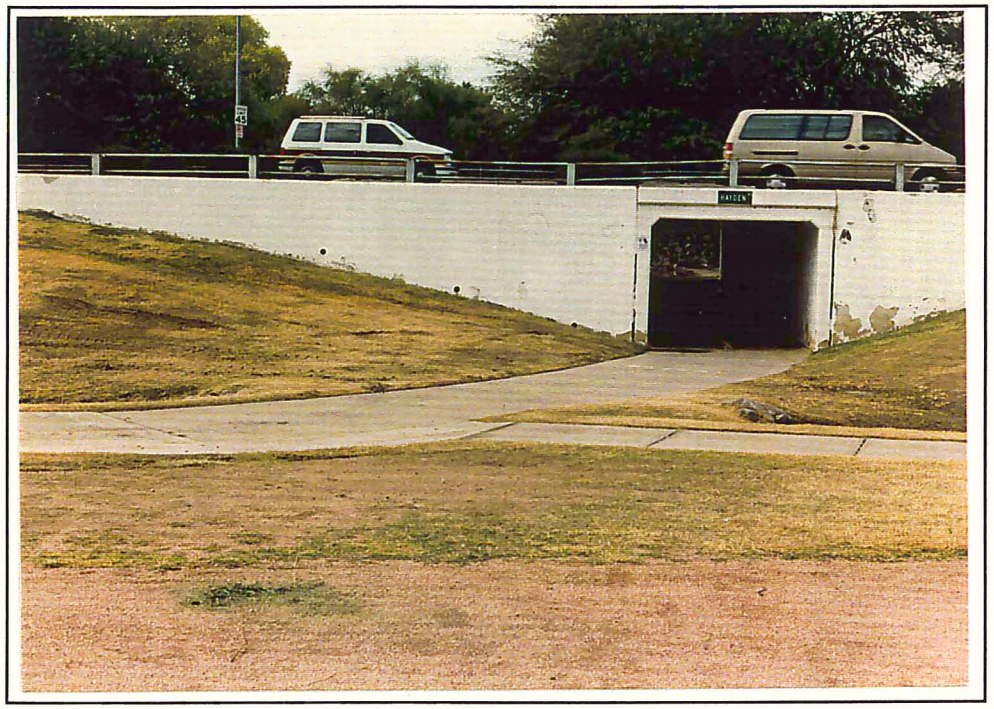


Photo A.13
Pedestrian Underpass Under Hayden Road Connecting High Flow and Low Flow Channels,
Looking West From High Flow Channel Side

Photo A.14
Camelback Road Bridge Over the Indian Bend Wash Low-Flow Channel,
Looking South at Upstream Side of Bridge

Photo A.15
Chaparral Road Bridge Over the Indian Bend Wash Low-Flow Channel,
Looking Southeast at Upstream Side of Bridge

Photo A.16
McDonald Road Bridge, Looking South at Upstream Side of Bridge

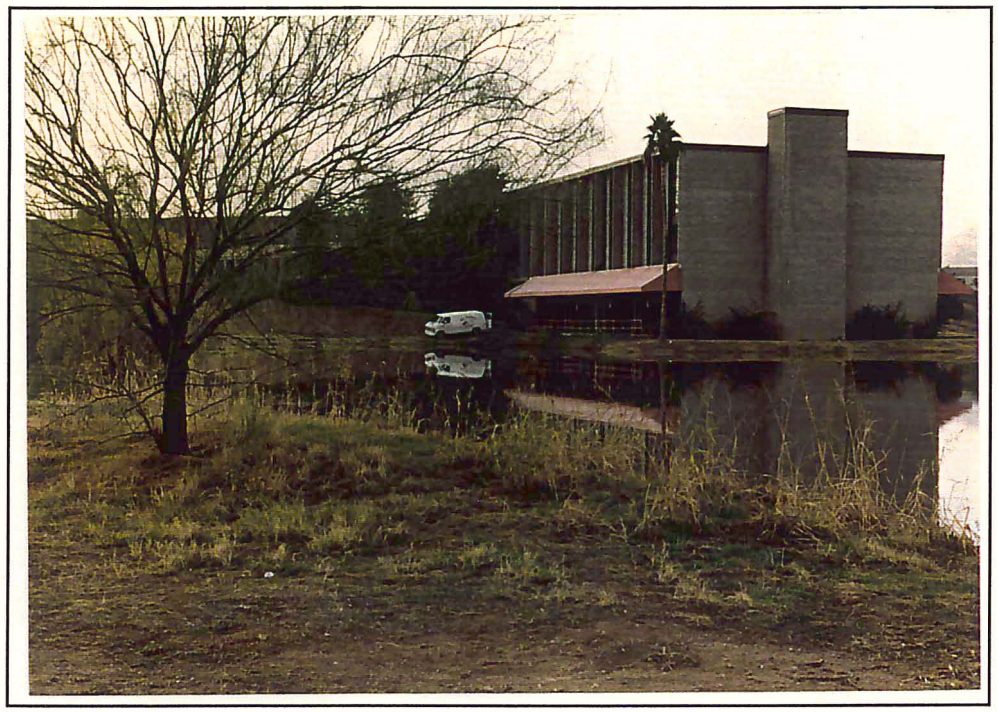


Photo A.17
Hotel Constructed on Piers Just Downstream from Indian Bend Road,
Looking Northwest from Left Bank

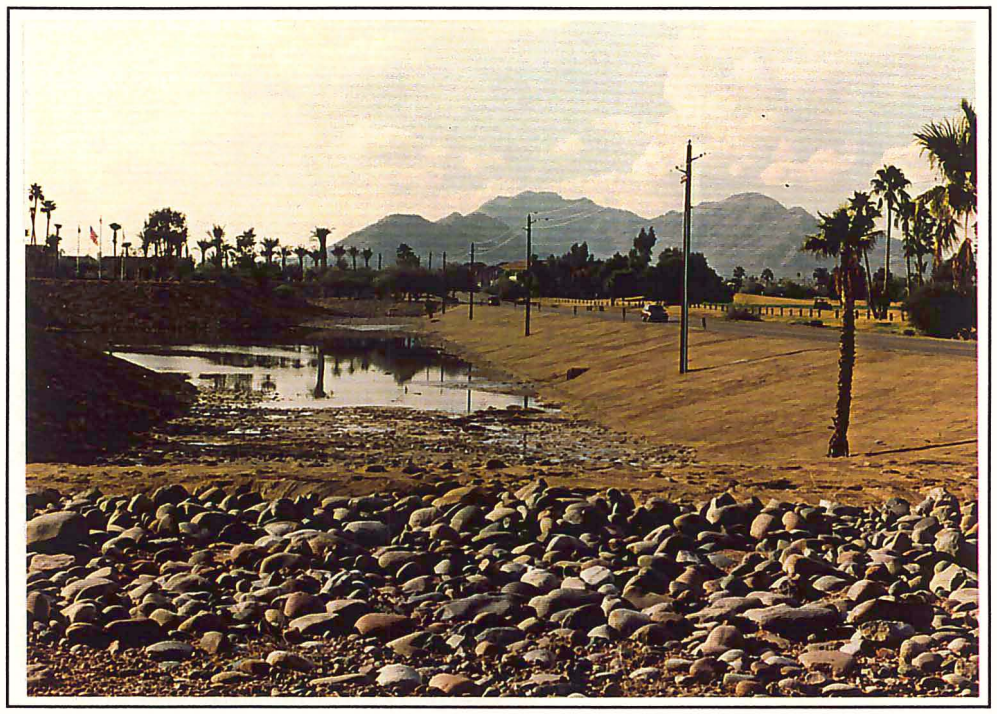


Photo A.18
Indian Bend Drop Structure, Looking West at Downstream Side of Drop

Photo A.19
Scottsdale Road Bridge, Looking East at Upstream Side of Box Culvert

Photo A.20
Grade Control Upstream of Scottsdale Road, Looking West

Photo A.21
Low-Water Crossing at Invergordon Road, Looking North at Box Culvert

Photo A.22
Low-Water Crossing at Double Tree Road, Looking North at Box Culvert

Photo A.23
Shea Boulevard Bridge, Looking Northwest at Downstream Side of Bridge

Photo A.24
Shea Boulevard Bridge, Looking South at Upstream side of Bridge

Photo A.25
Tatum Boulevard Bridge, Looking at Downstream Side of Bridge

Photo A.26
Cactus Road Bridge, Looking at Downstream Side of Bridge From Left Bank Area

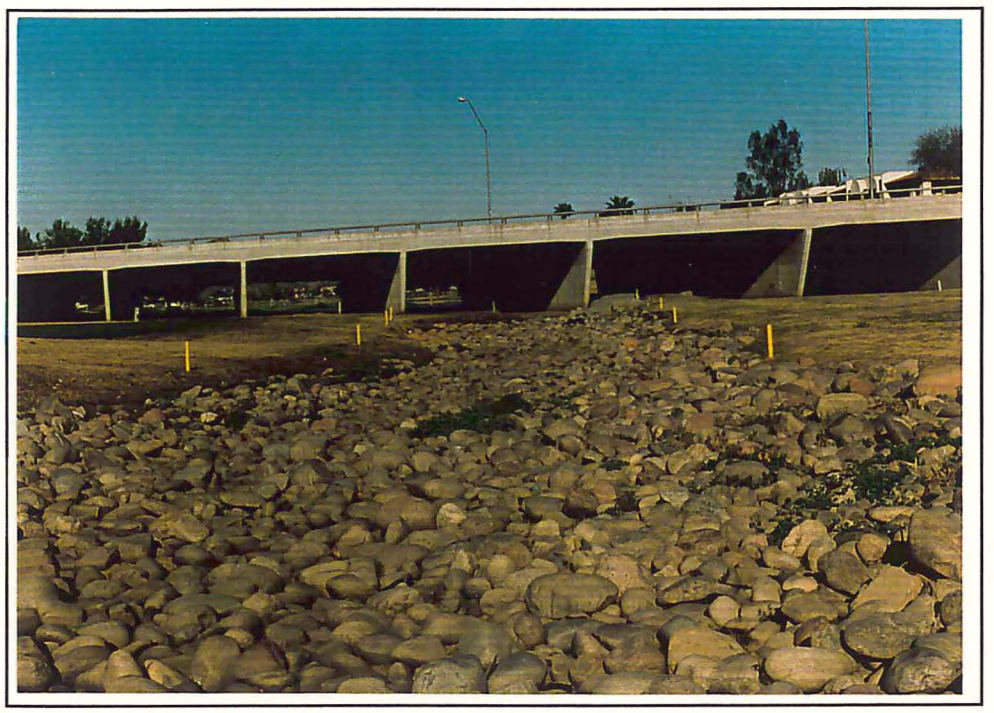


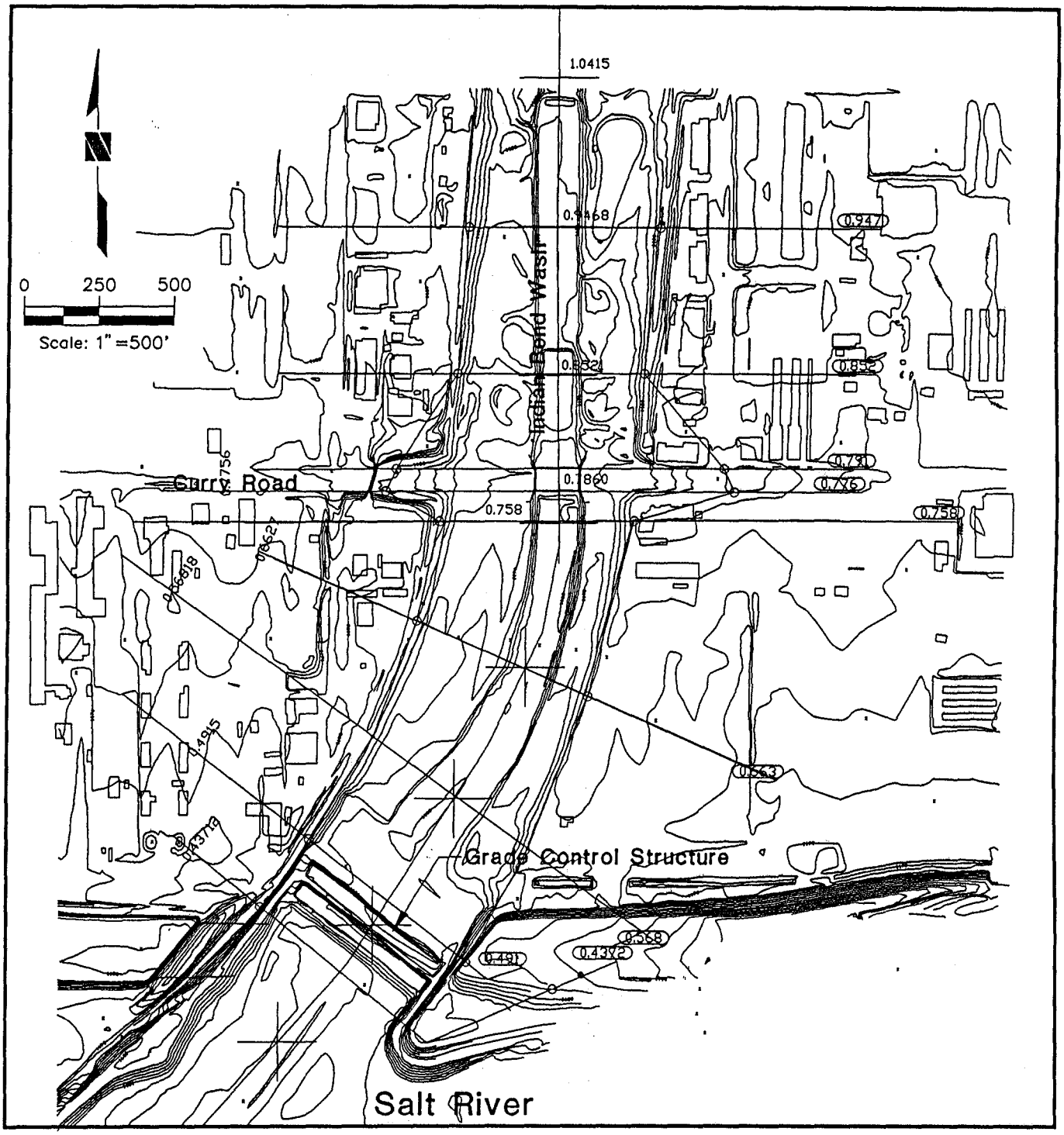
Photo A.27
Cactus Road Bridge, Looking Upstream Just Downstream From Bridge

Photo A.28
Sweetwater Road Low Water Crossing, Looking Upstream from 36th Street

APPENDIX B

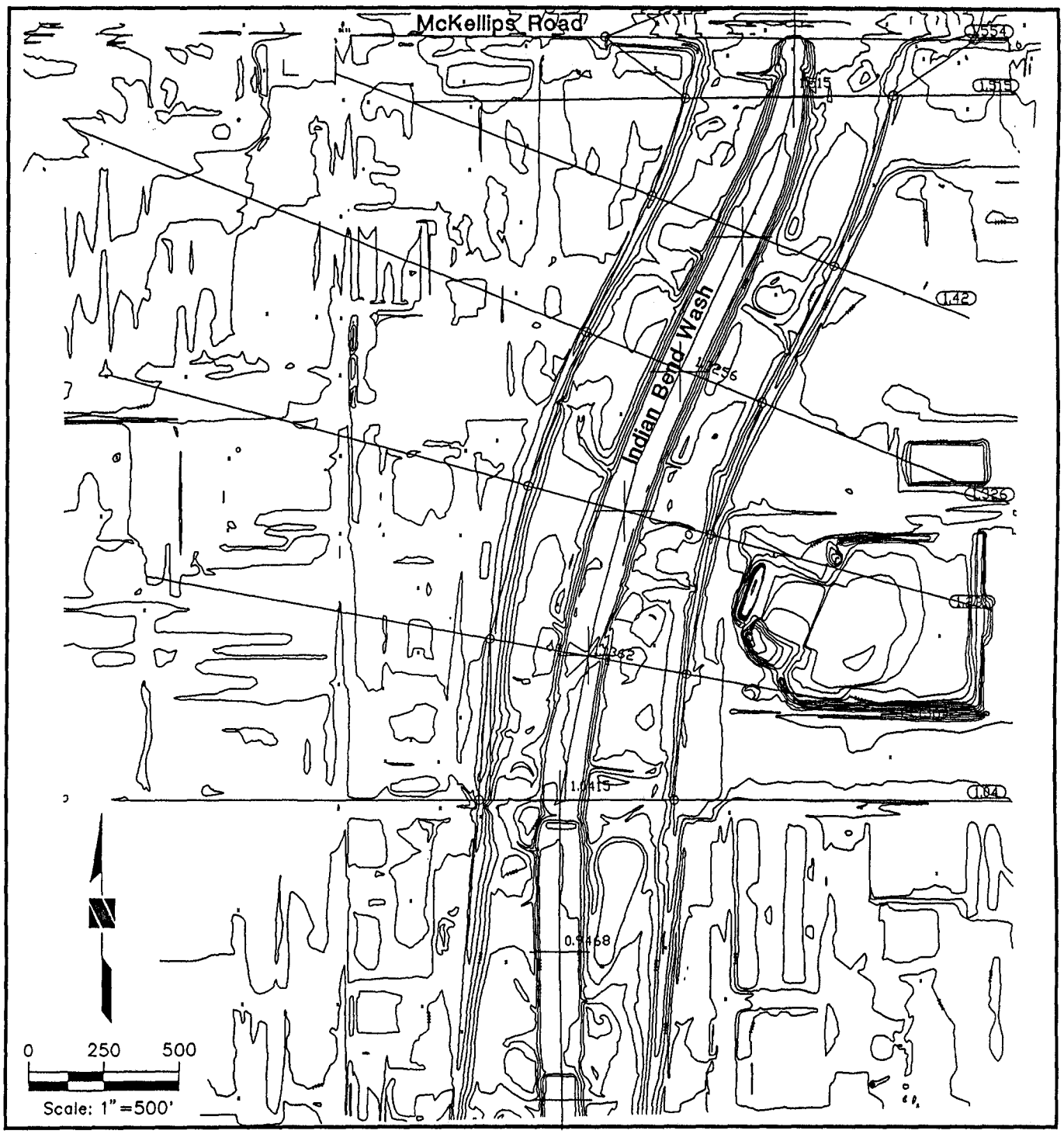
INDIAN BEND WASH FLOODPLAIN DELINEATION PROPOSED CROSS SECTION LOCATIONS FOR ORIENTATION PURPOSES ONLY

Indian Bend Wash at Curry Road



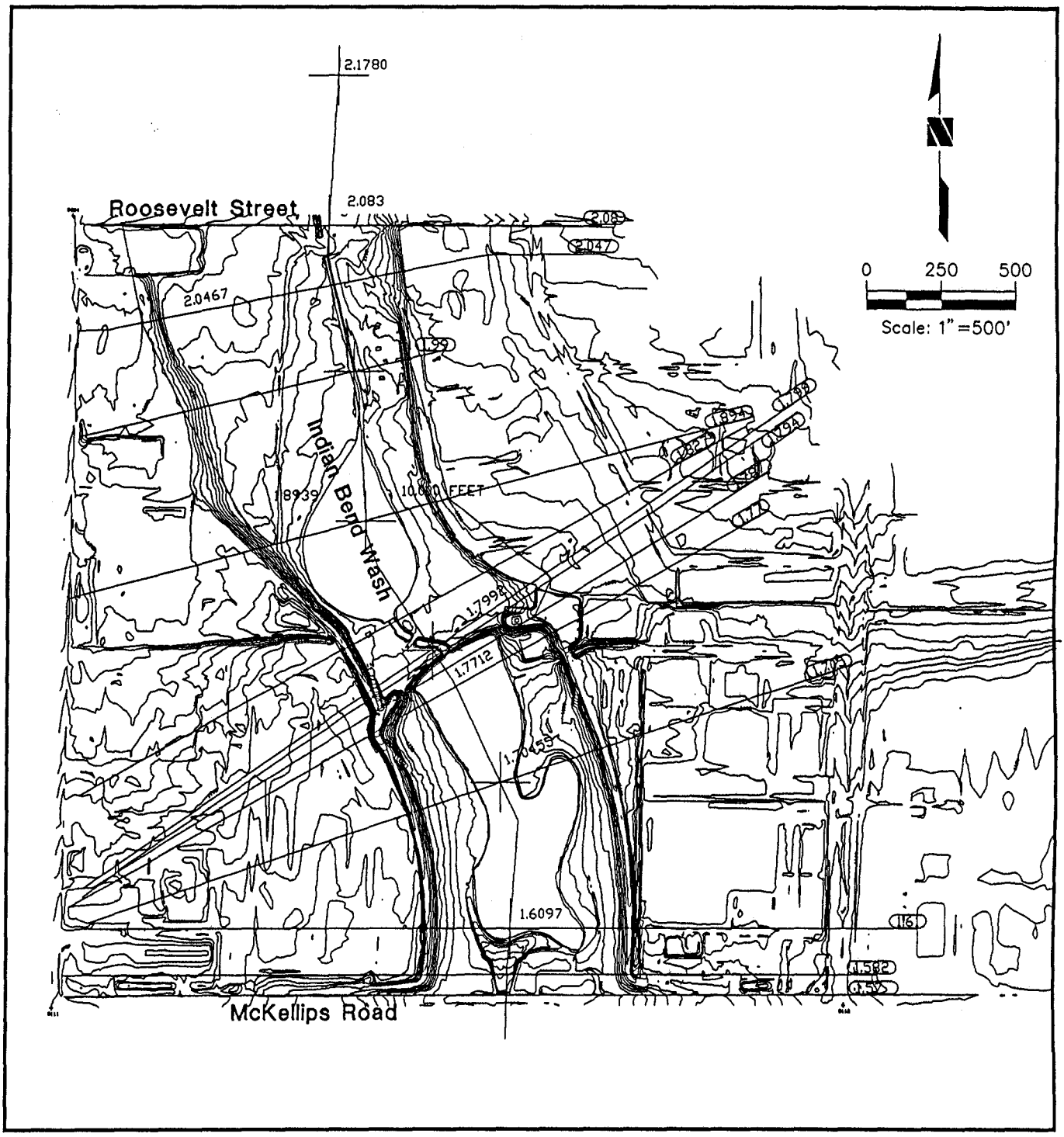
STATION 0.437 TO 0.947

McKellips Road



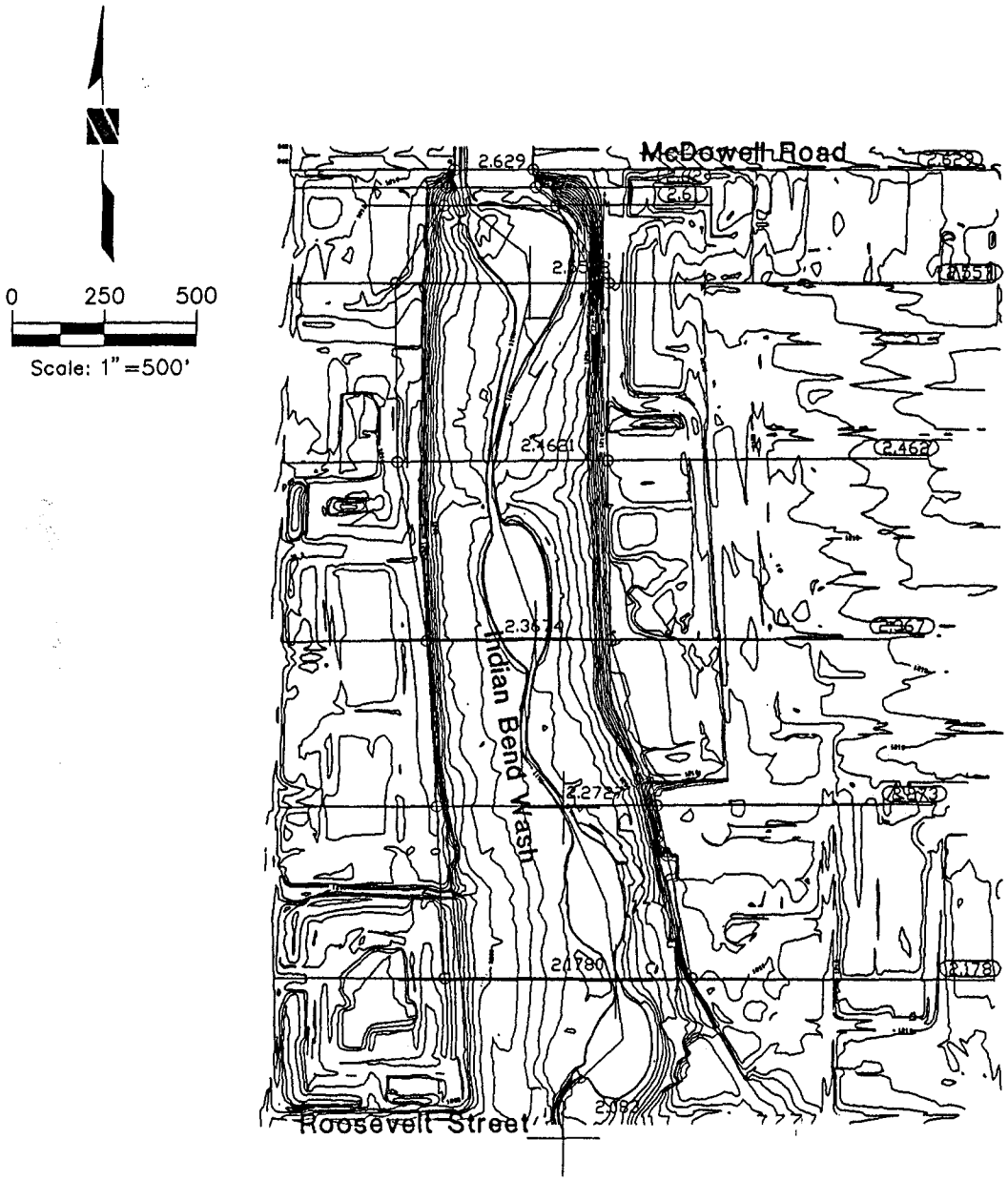
STATION 1.04 TO 1.554

McKellips Road to Mid-Section Roosevelt Street



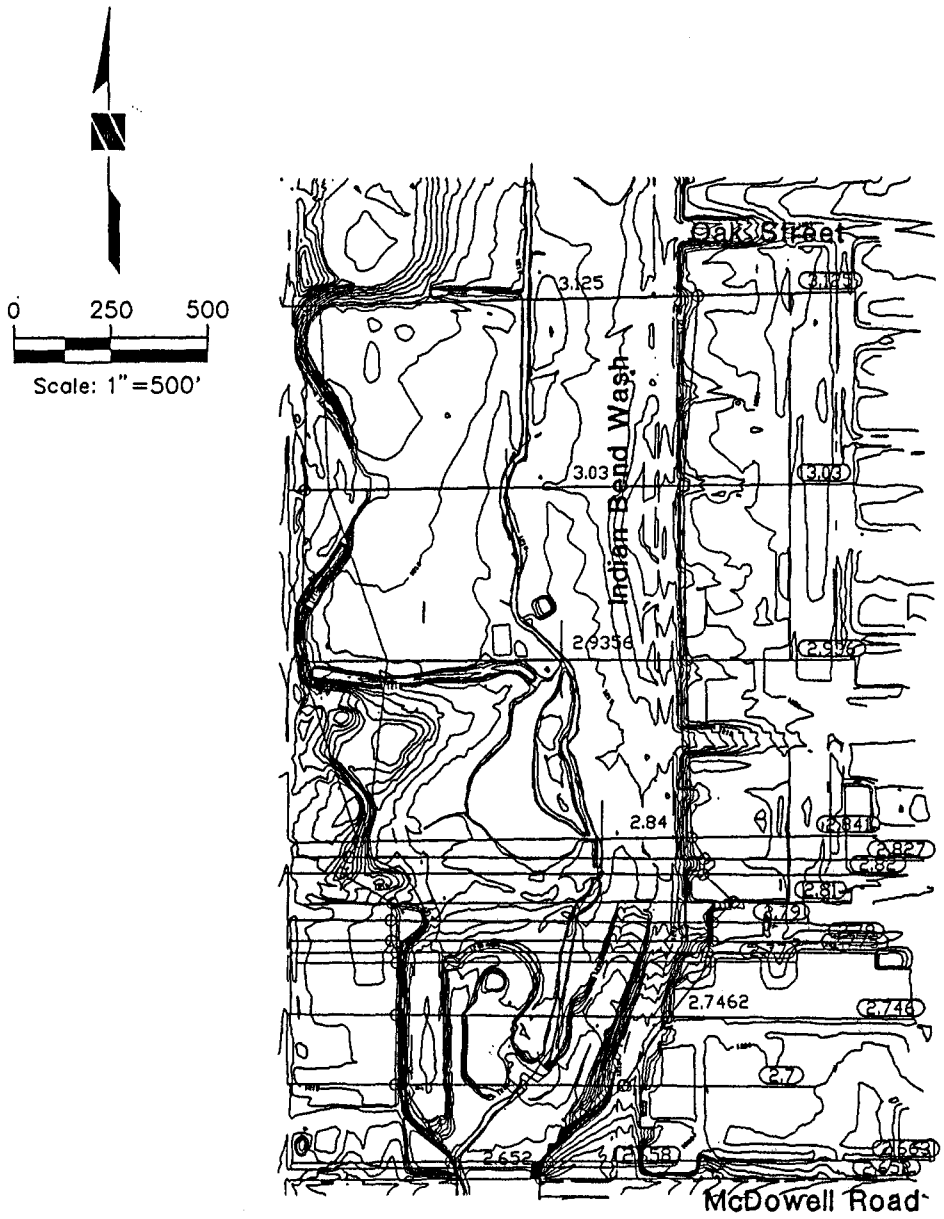
STATION 1.57 TO 2.08

Roosevelt Street to McDowell Road



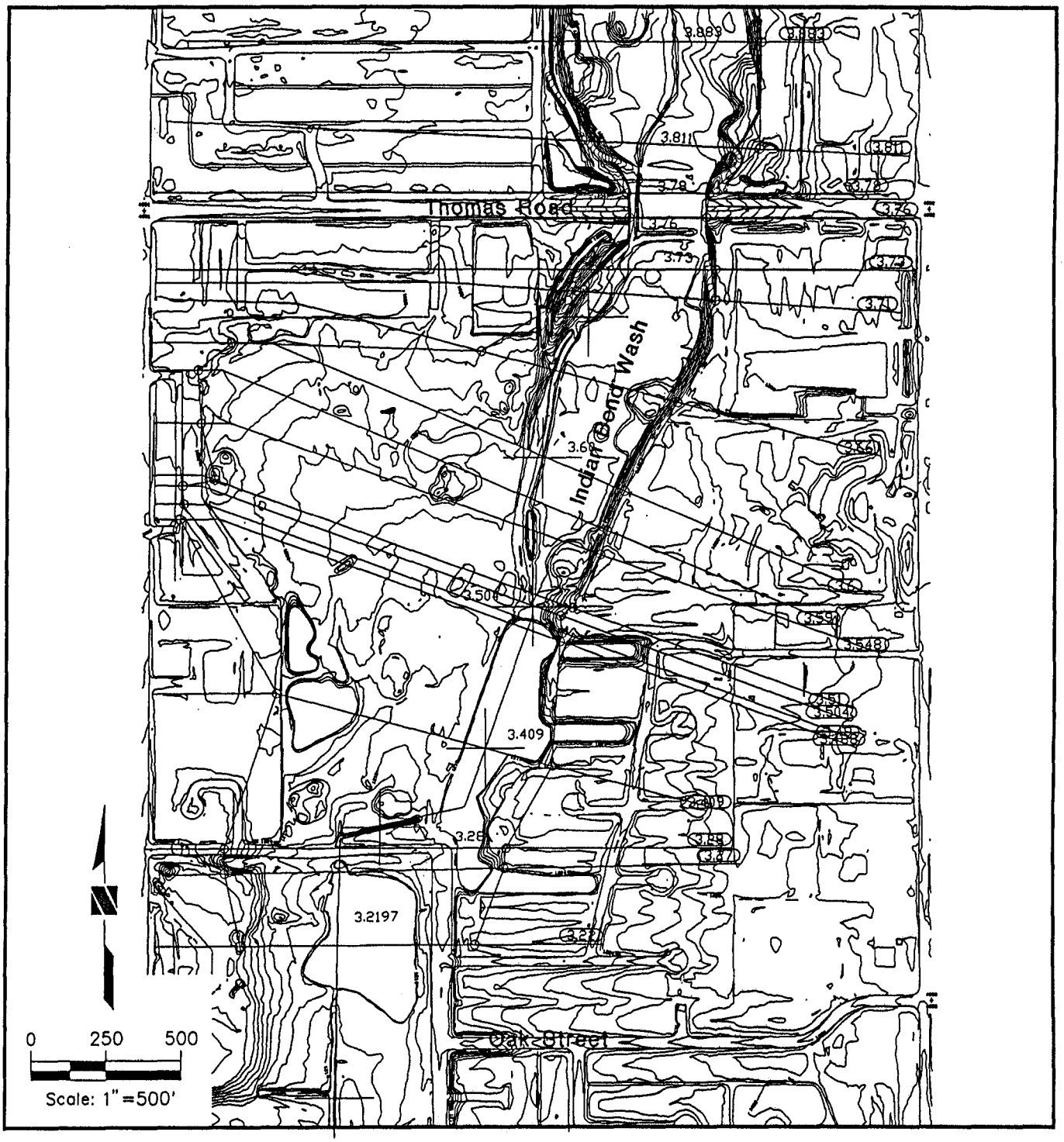
STATION 2.178 TO 2.629

McDowell Road to Mid-Section



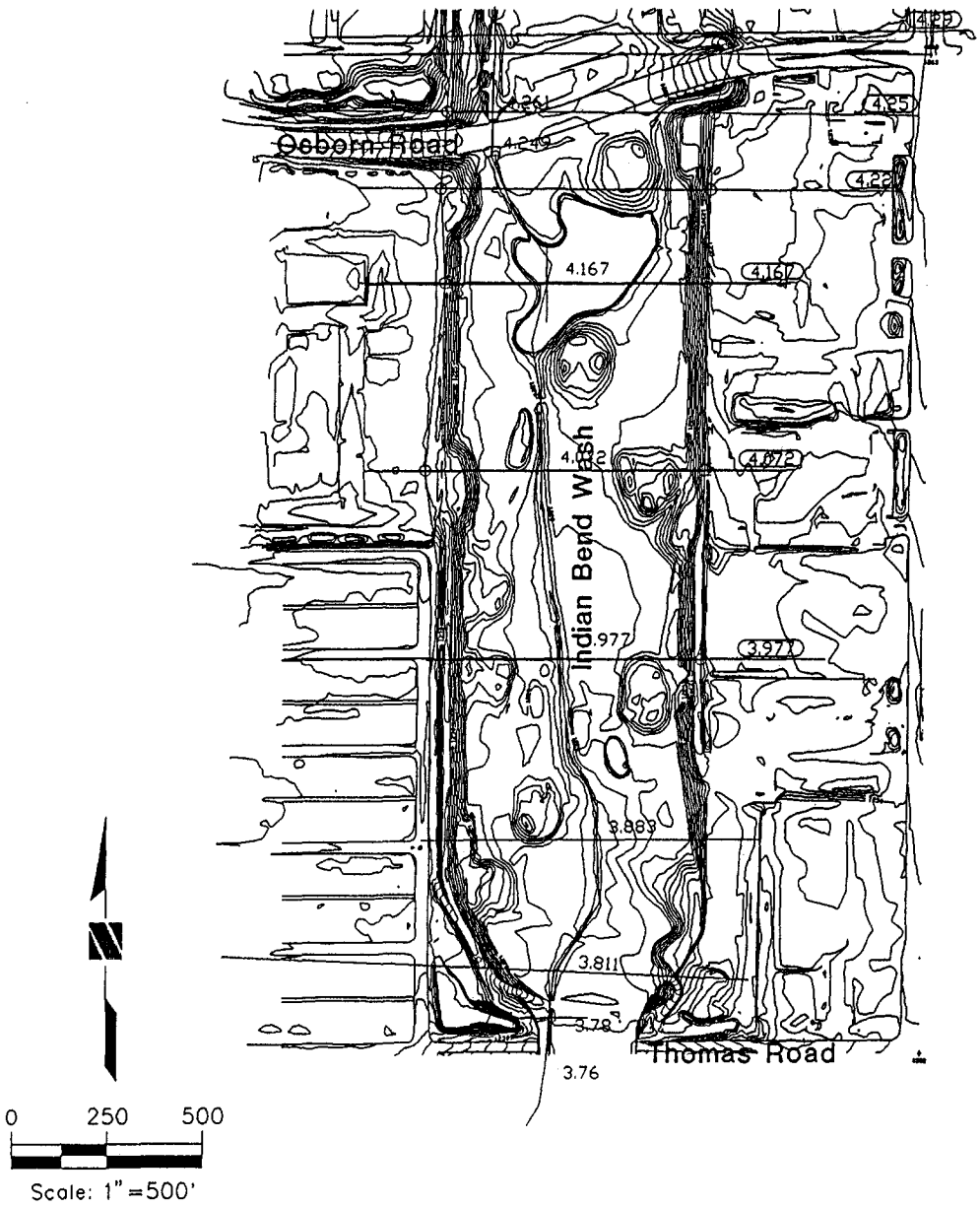
STATION 2.652 TO 3.125

Murray Lane to Thomas Road



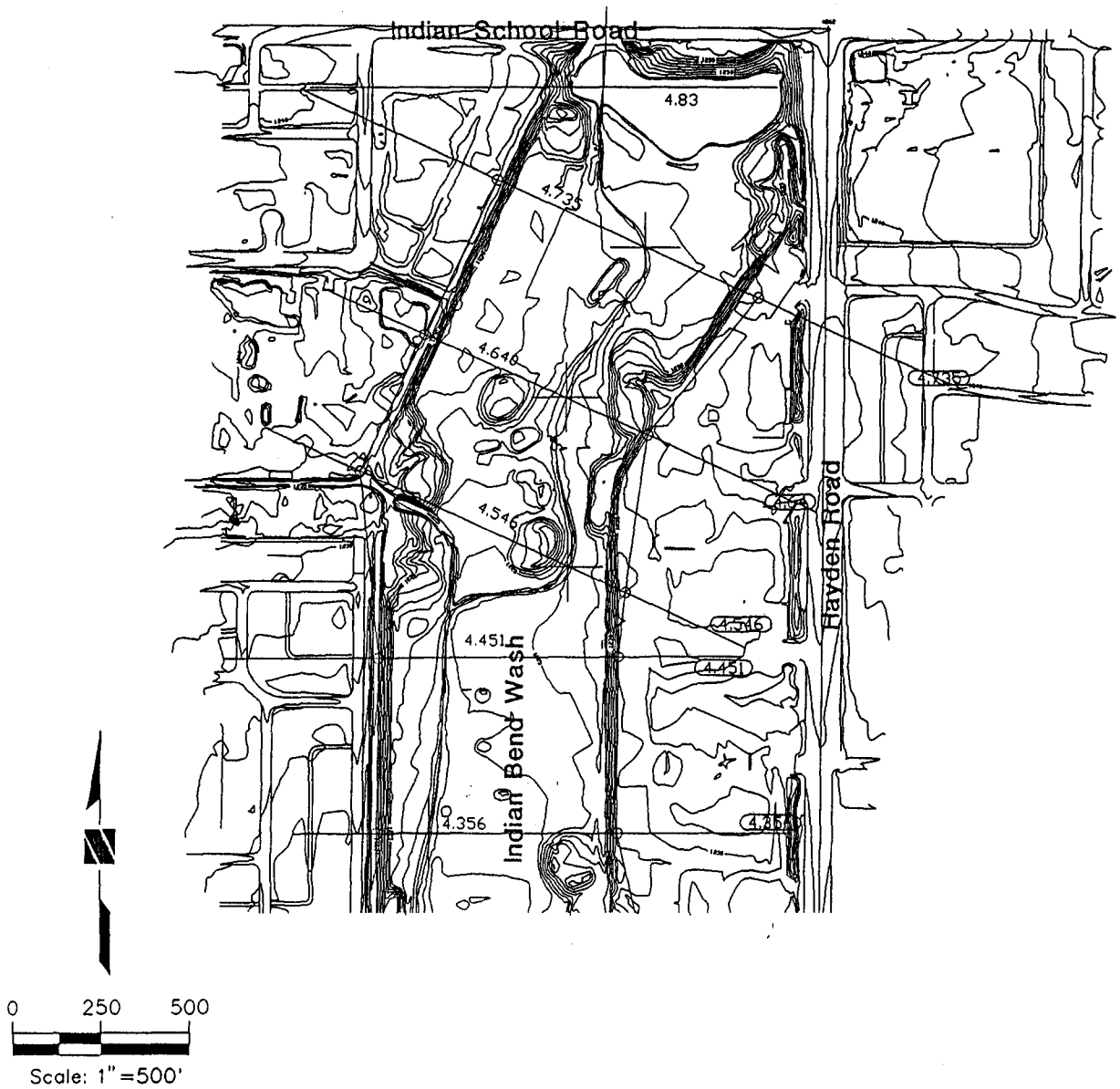
STATION 3.22 TO 3.883

Thomas Road to Osborn Road



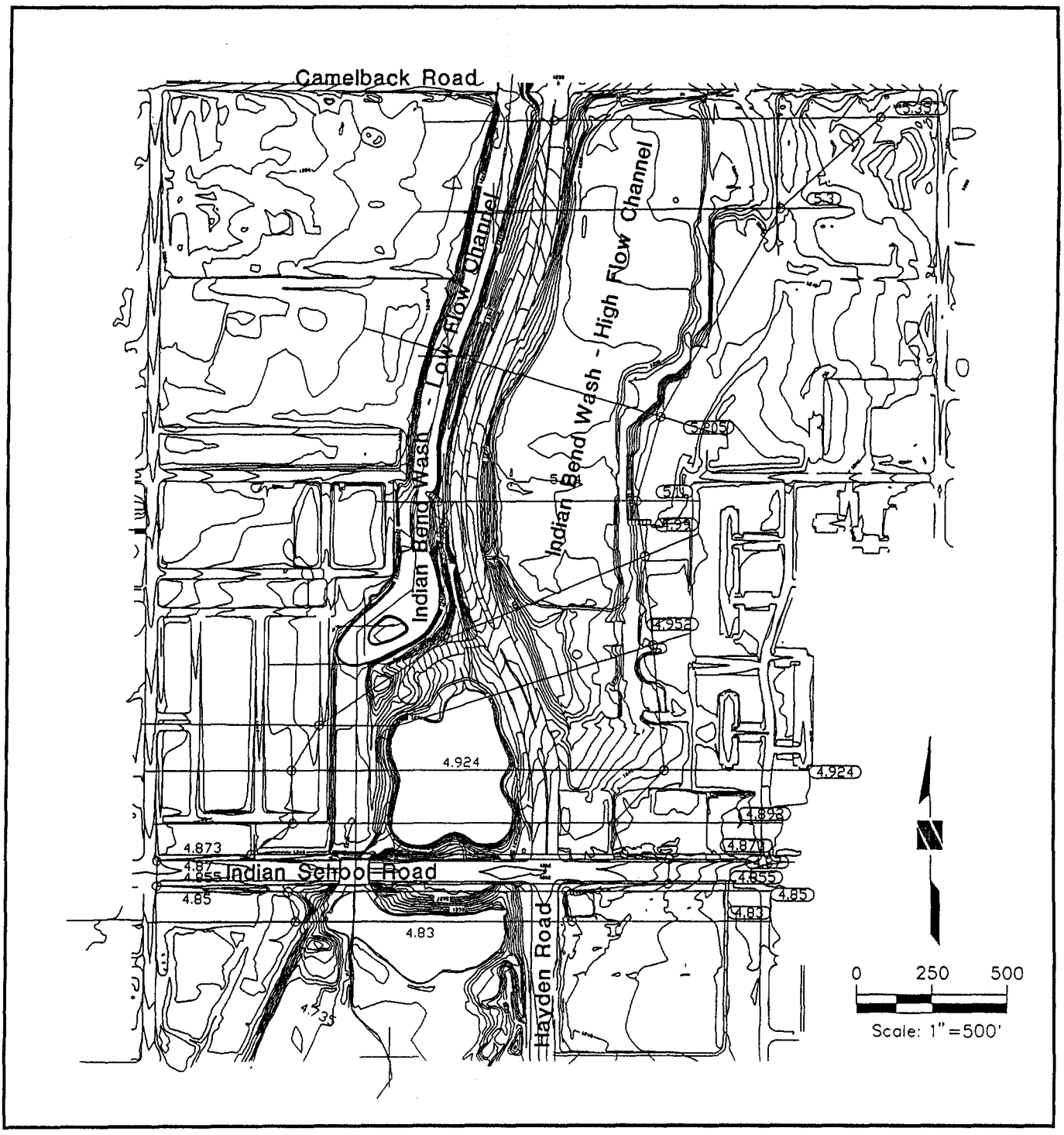
STATION 3.76 TO 4.29

Osborn Road to Indian School Road



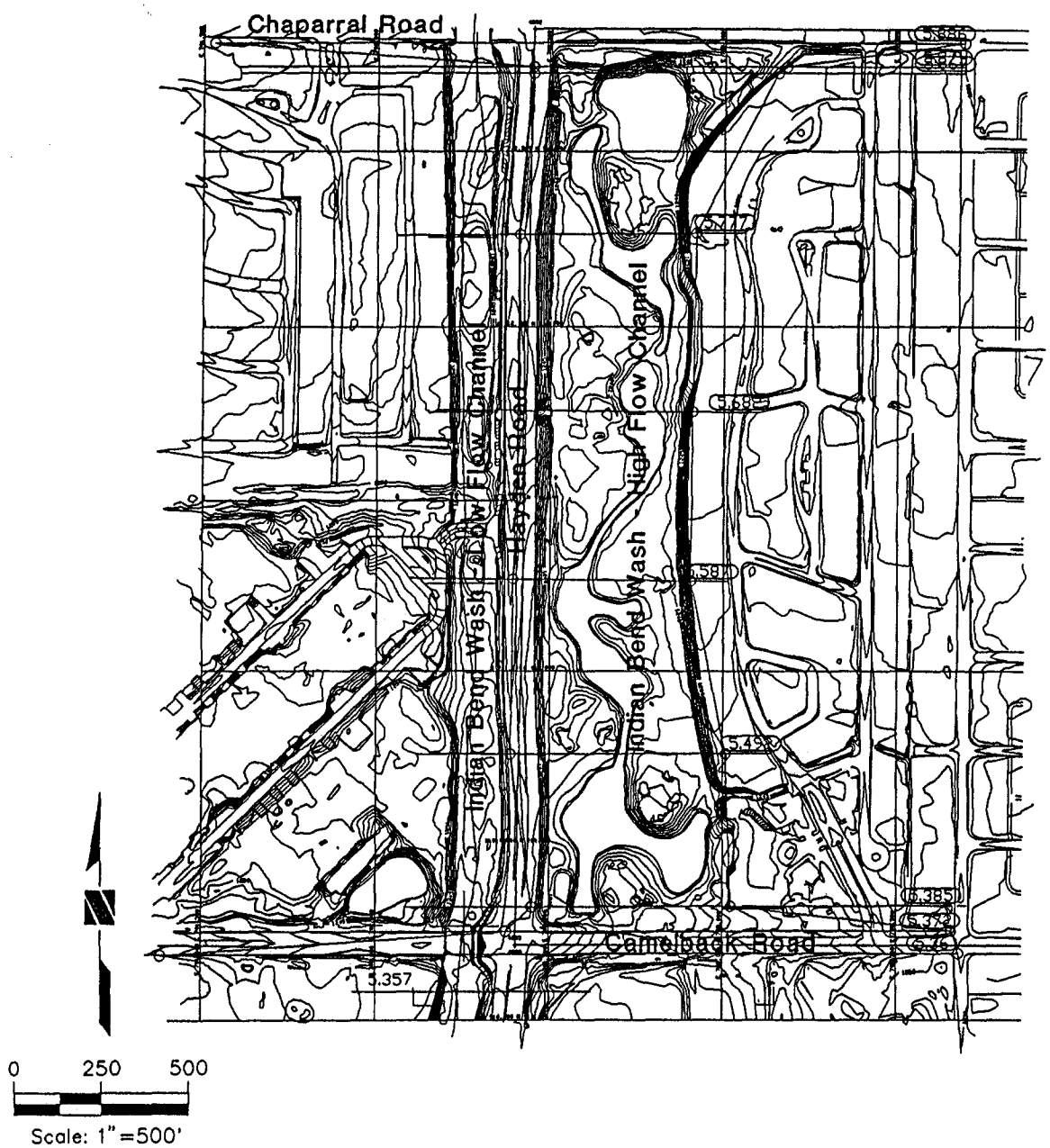
STATION 4.356 TO 4.735

Indian School Road to Camelback Road



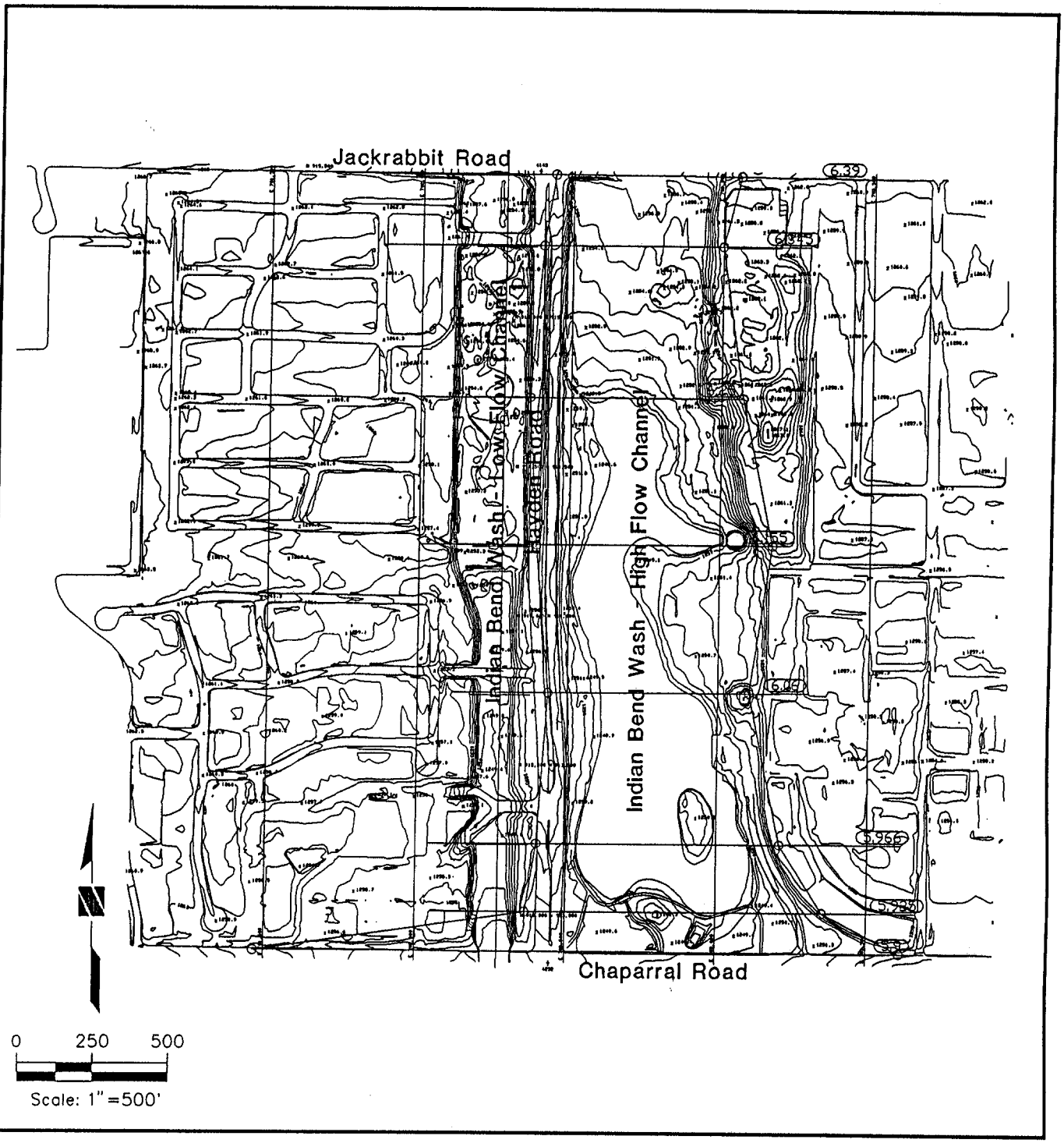
STATION 4.83 TO 5.357

Camelback Road to Chaparral Road



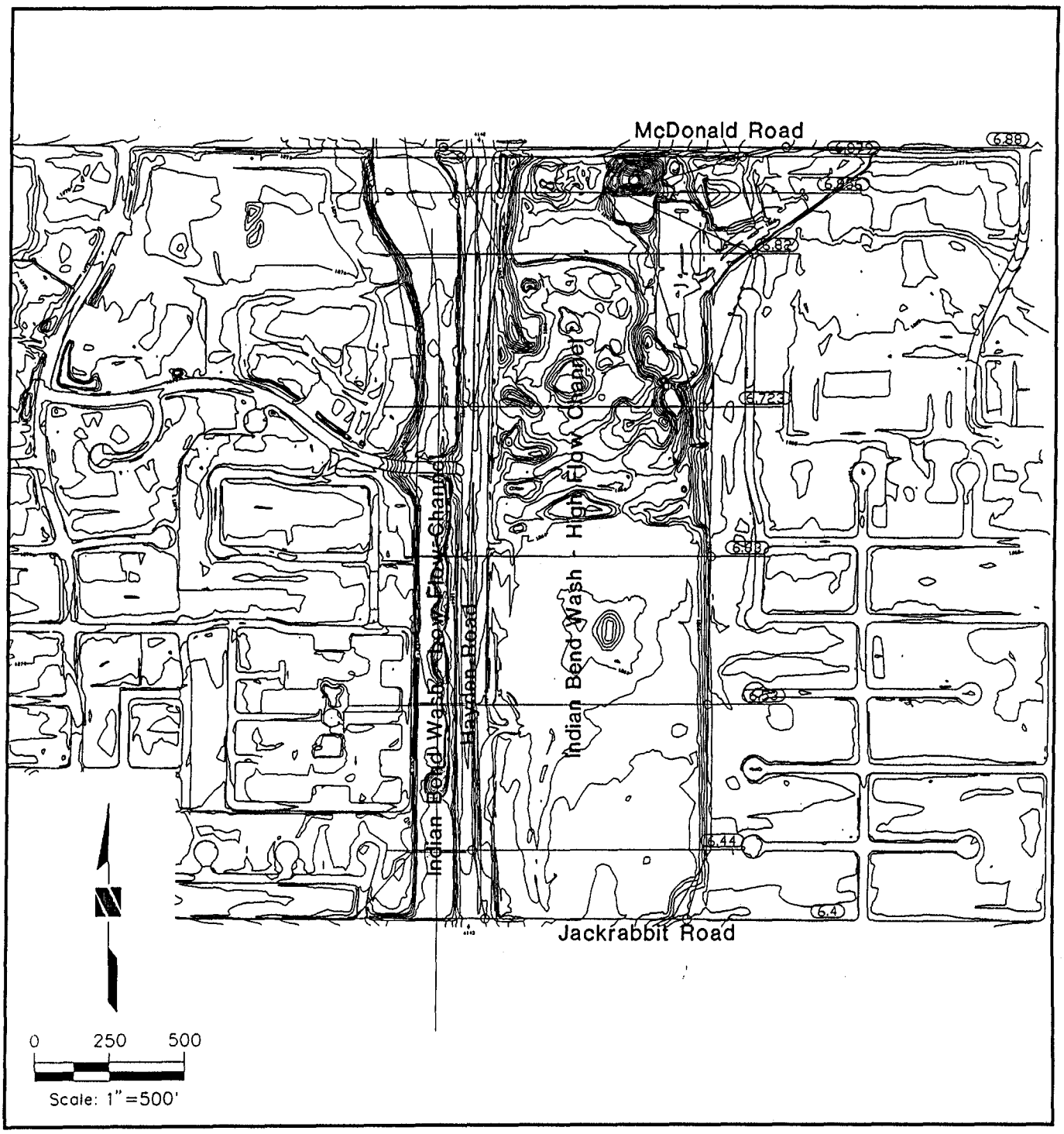
STATION 5.372 TO 5.886

Chaparral Road to Jackrabbit Road



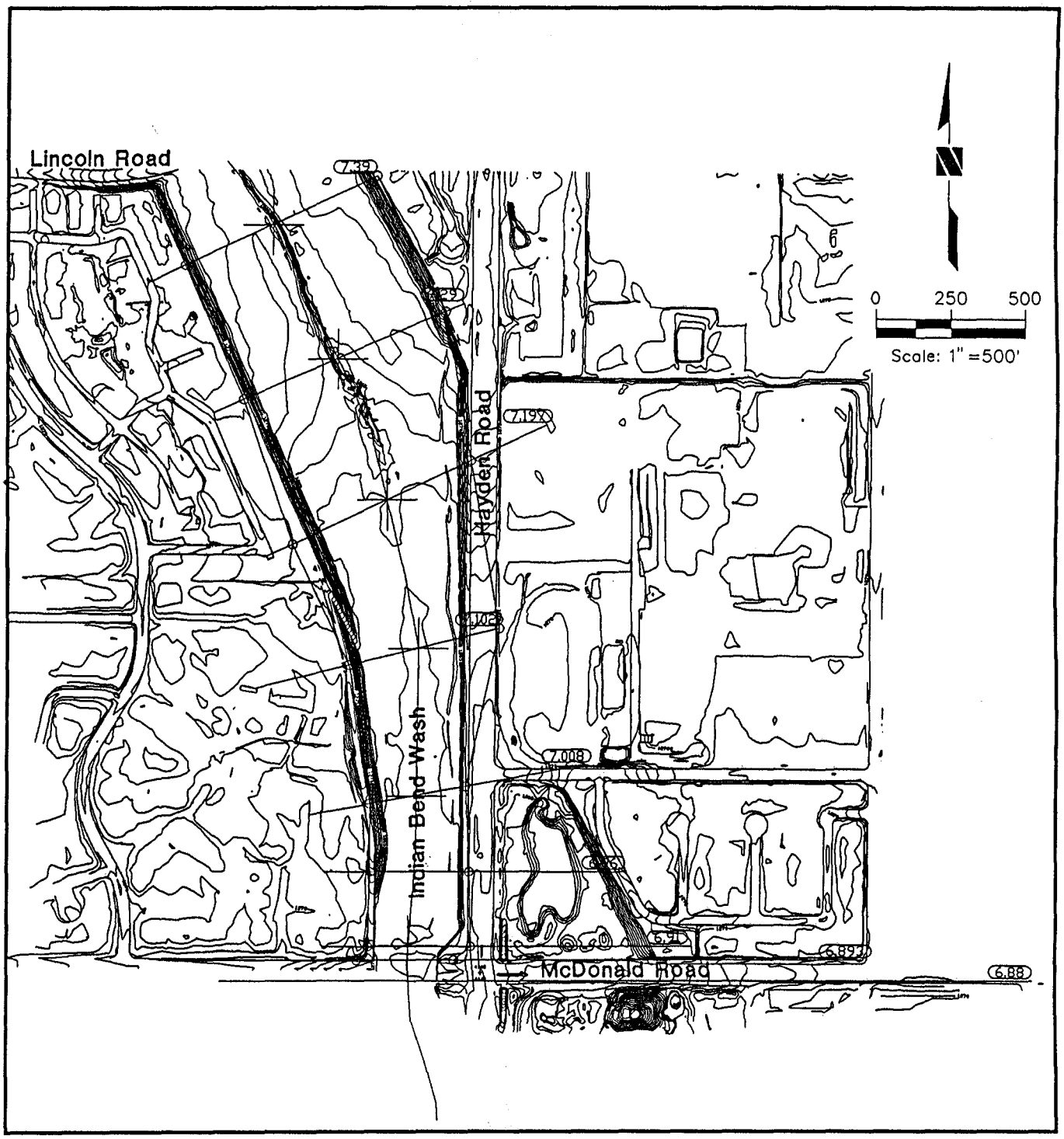
STATION 5.9 TO 6.39

Jackrabbit Road to McDonald Drive



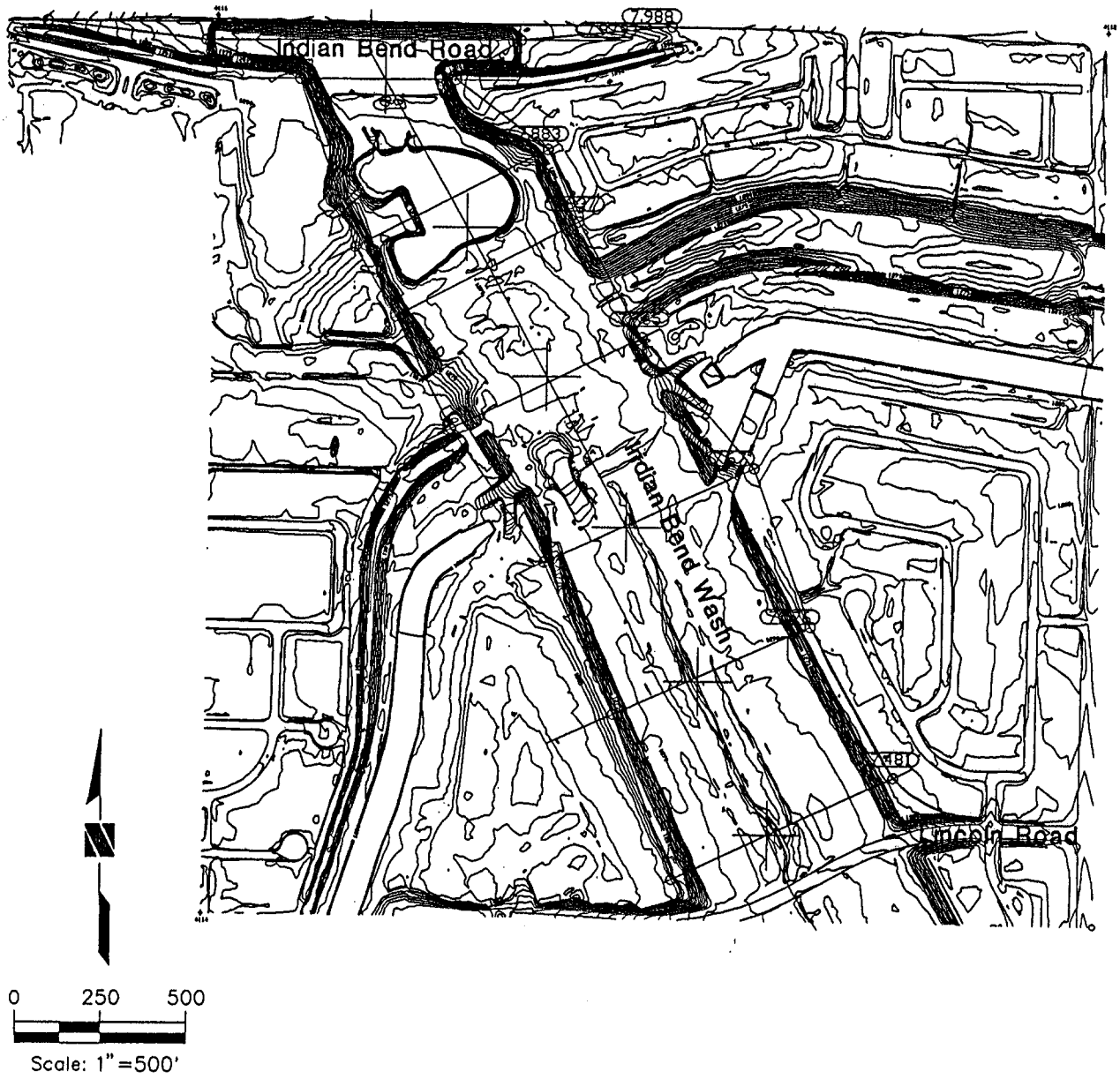
STATION 6.4 TO 6.88

McDonald Drive to Lincoln Drive



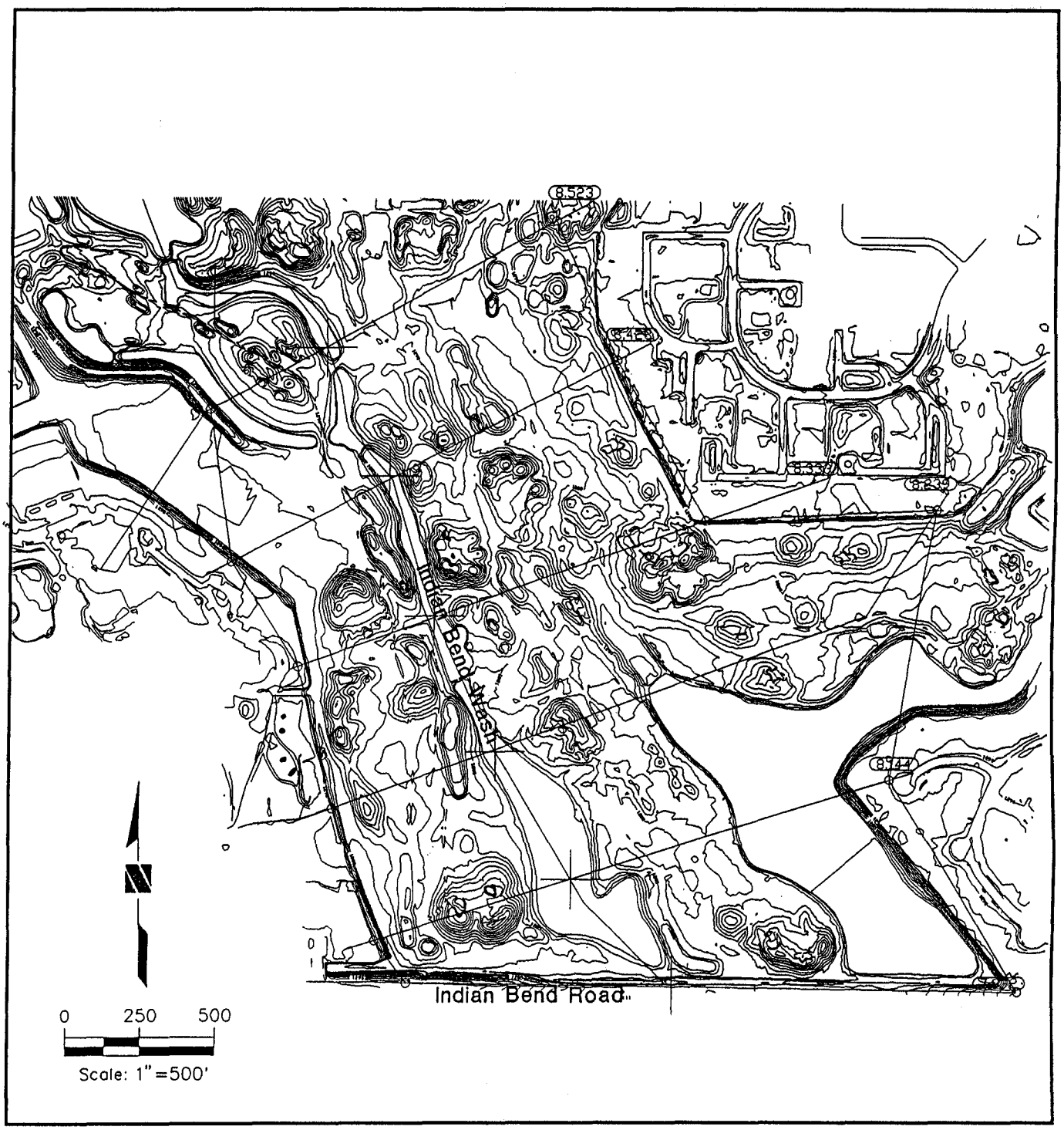
STATION 6.88 TO 7.39

Lincoln Drive to Indian Bend Road



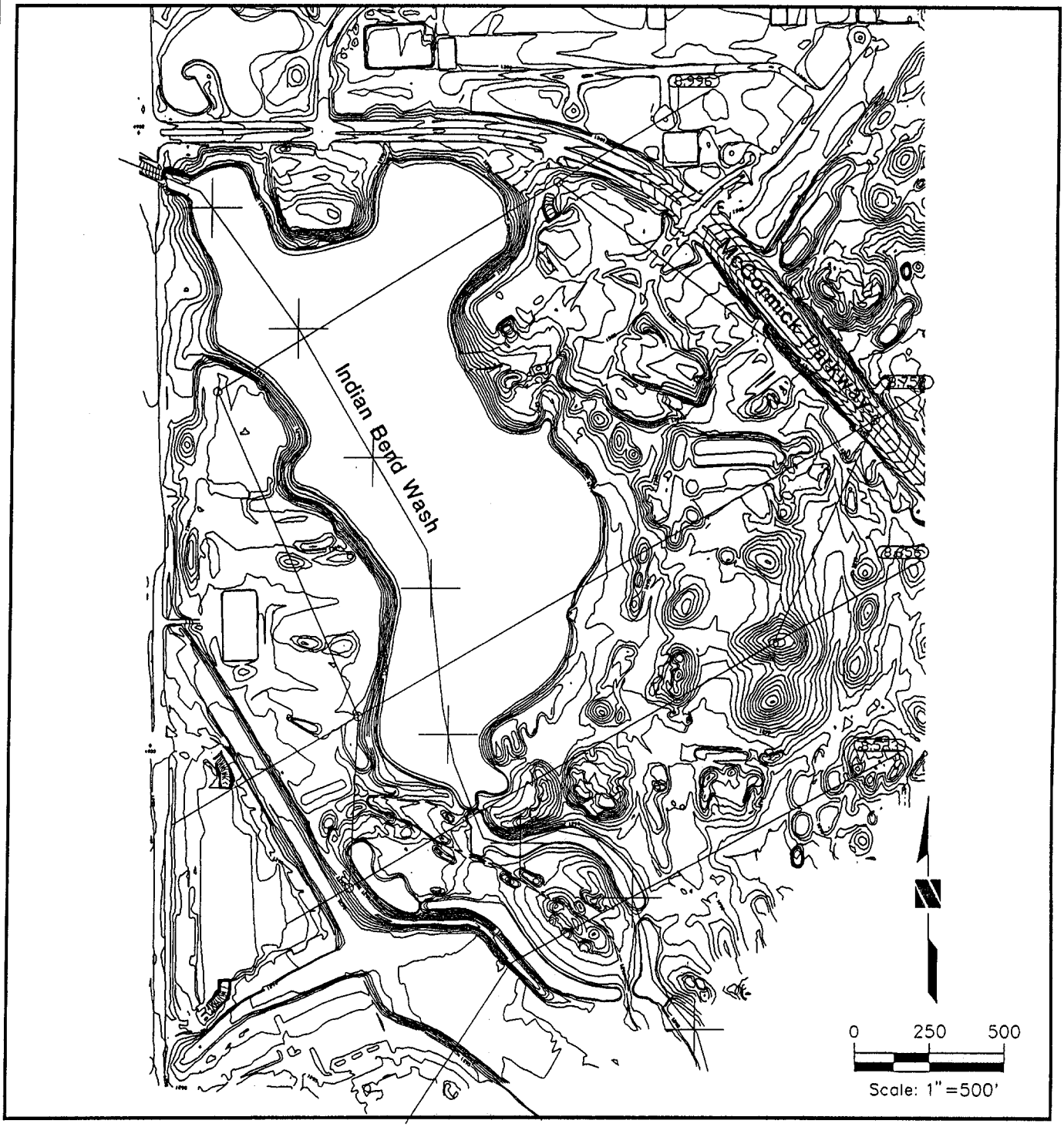
STATION 7.481 TO 7.988

Indian Bend Road



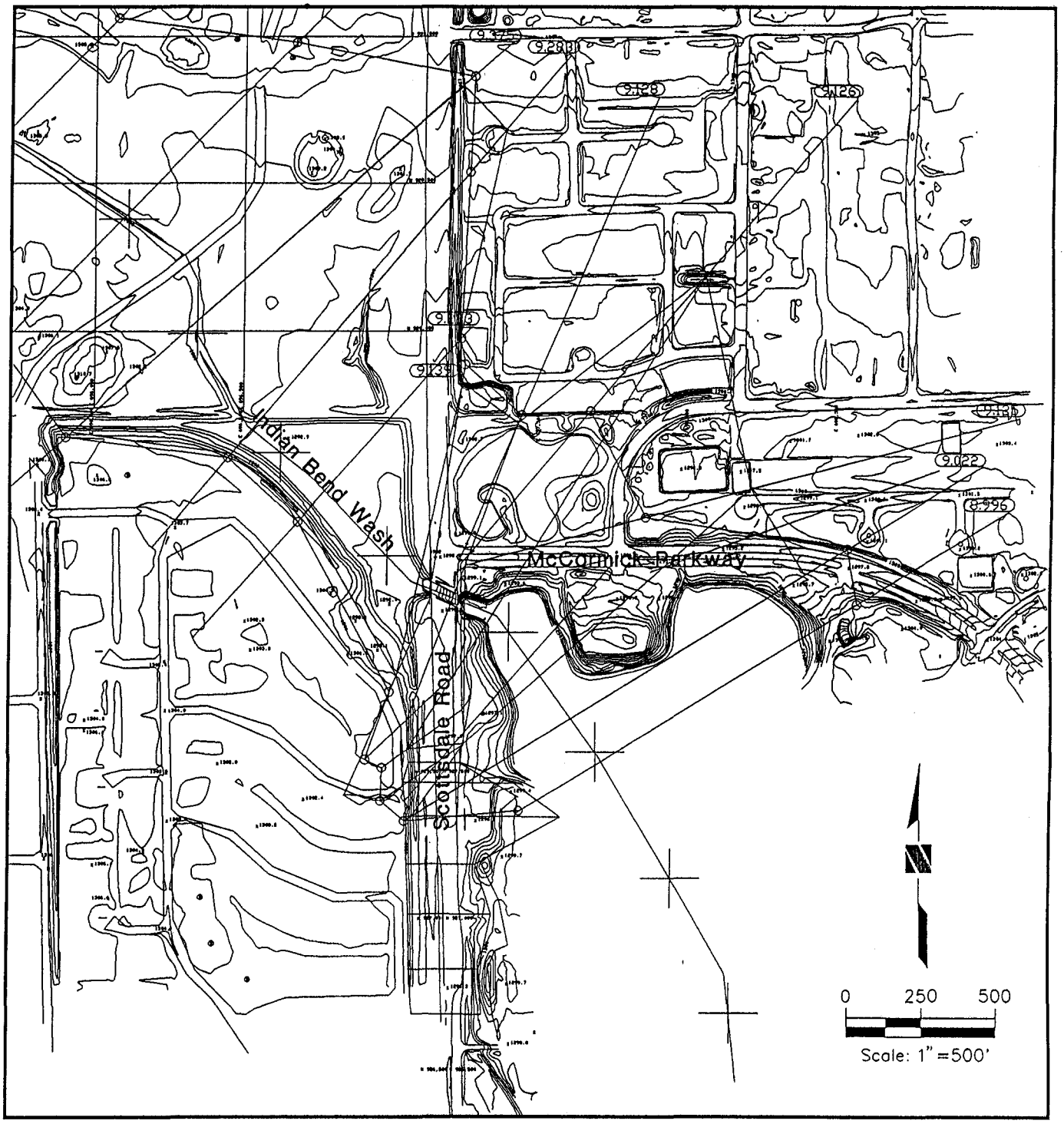
STATION 7.992 TO 8.523

Scottsdale Road at McCormick Parkway



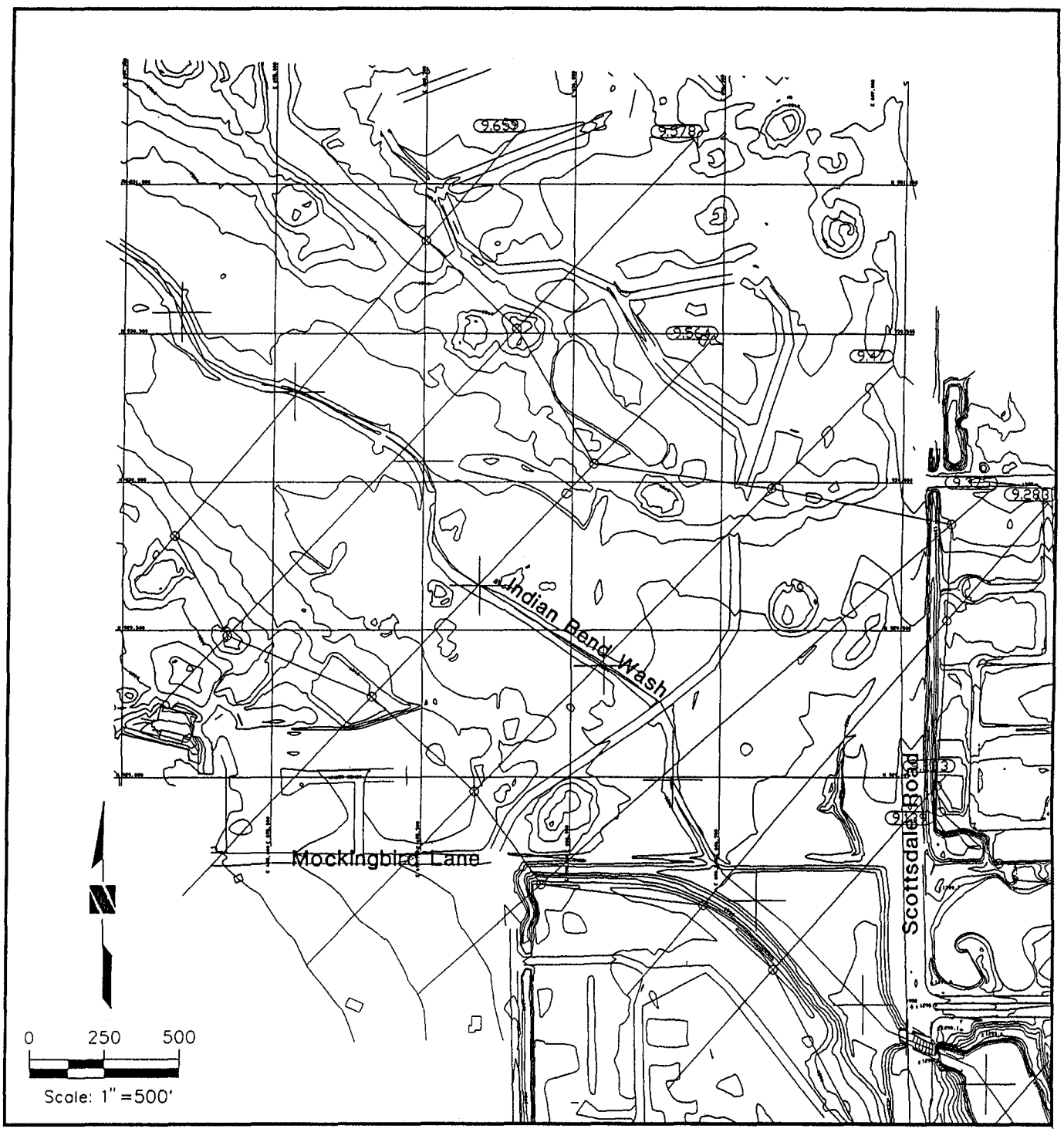
STATION 8.656 TO 8.996

Scottsdale Road at Golf Drive



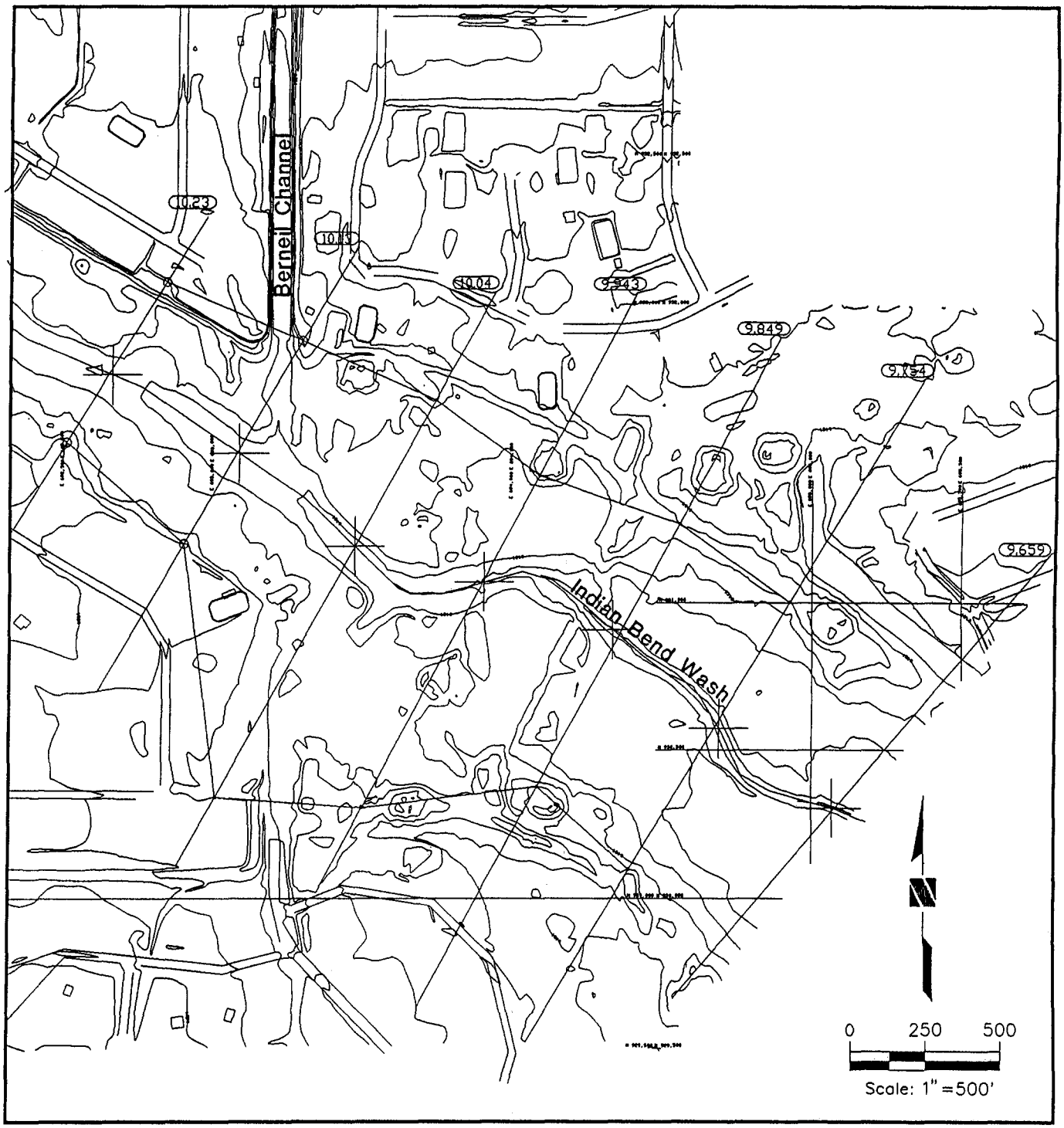
STATION 8.996 TO 9.375

Camelback Country Club



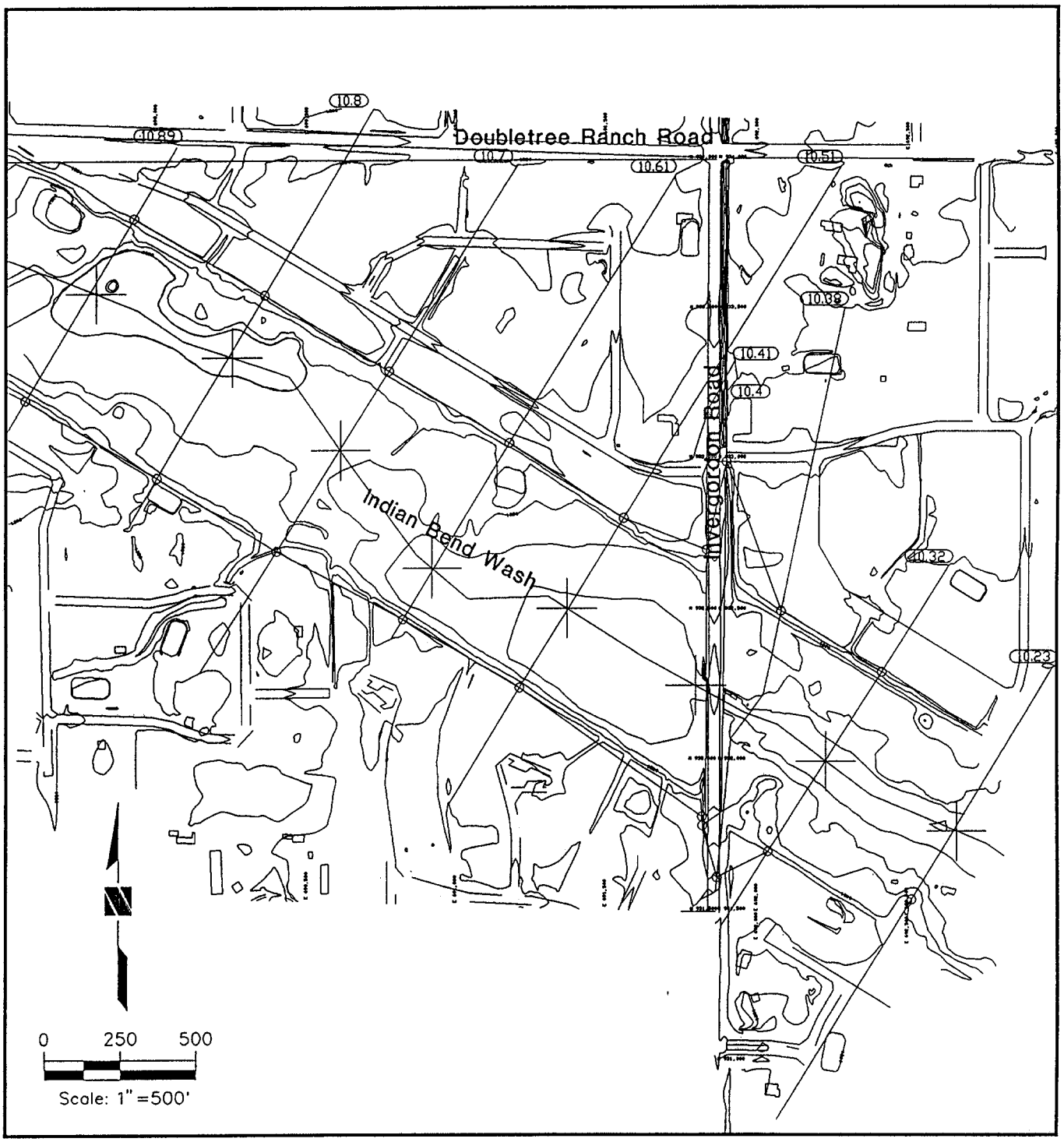
STATION 9.137 TO 9.659

Invergordon Road



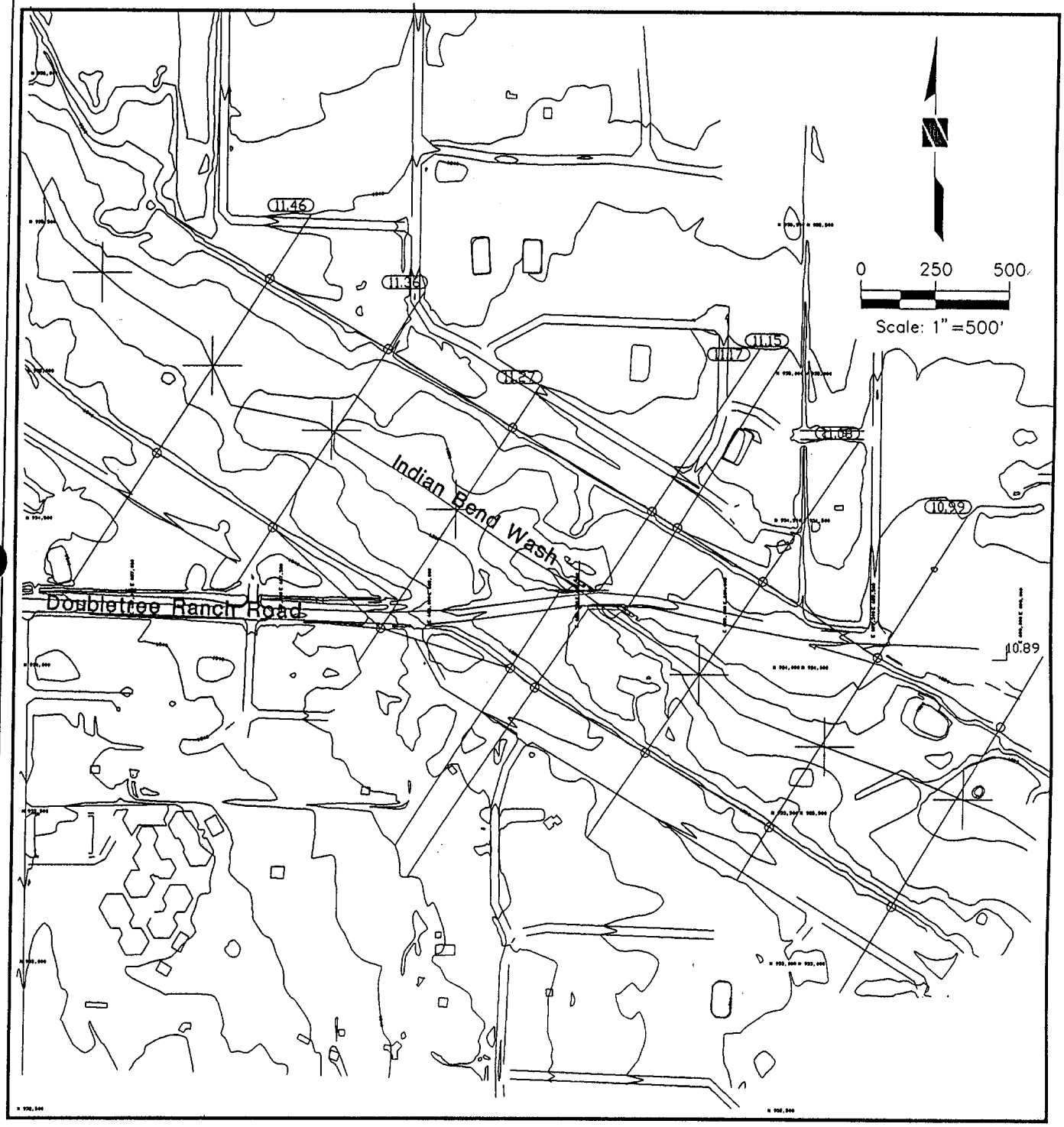
STATION 9.659 TO 10.23

Invergordon Road to Doubletree Ranch Road



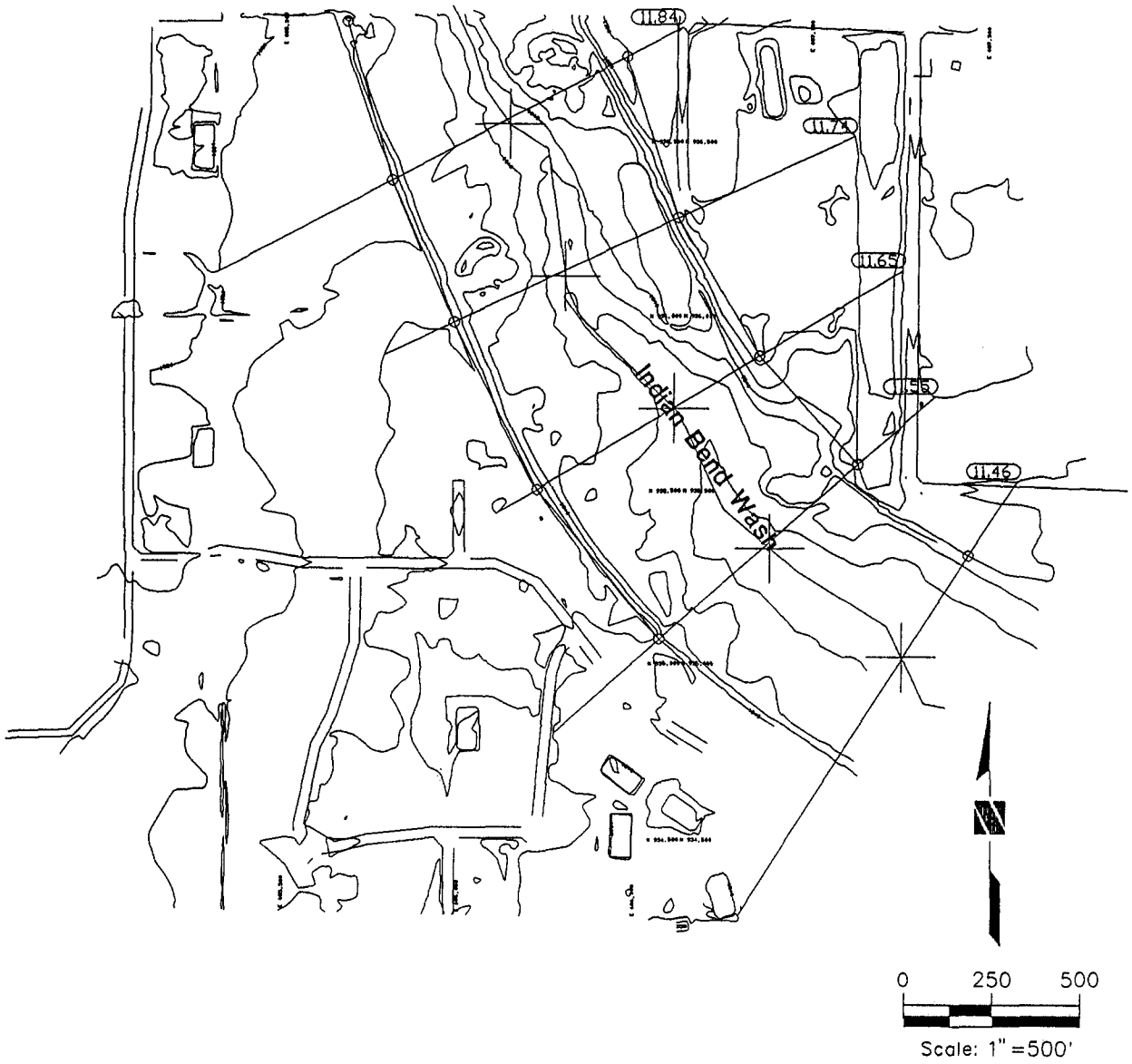
STATION 10.23 TO 10.89

Doubletree Ranch Road



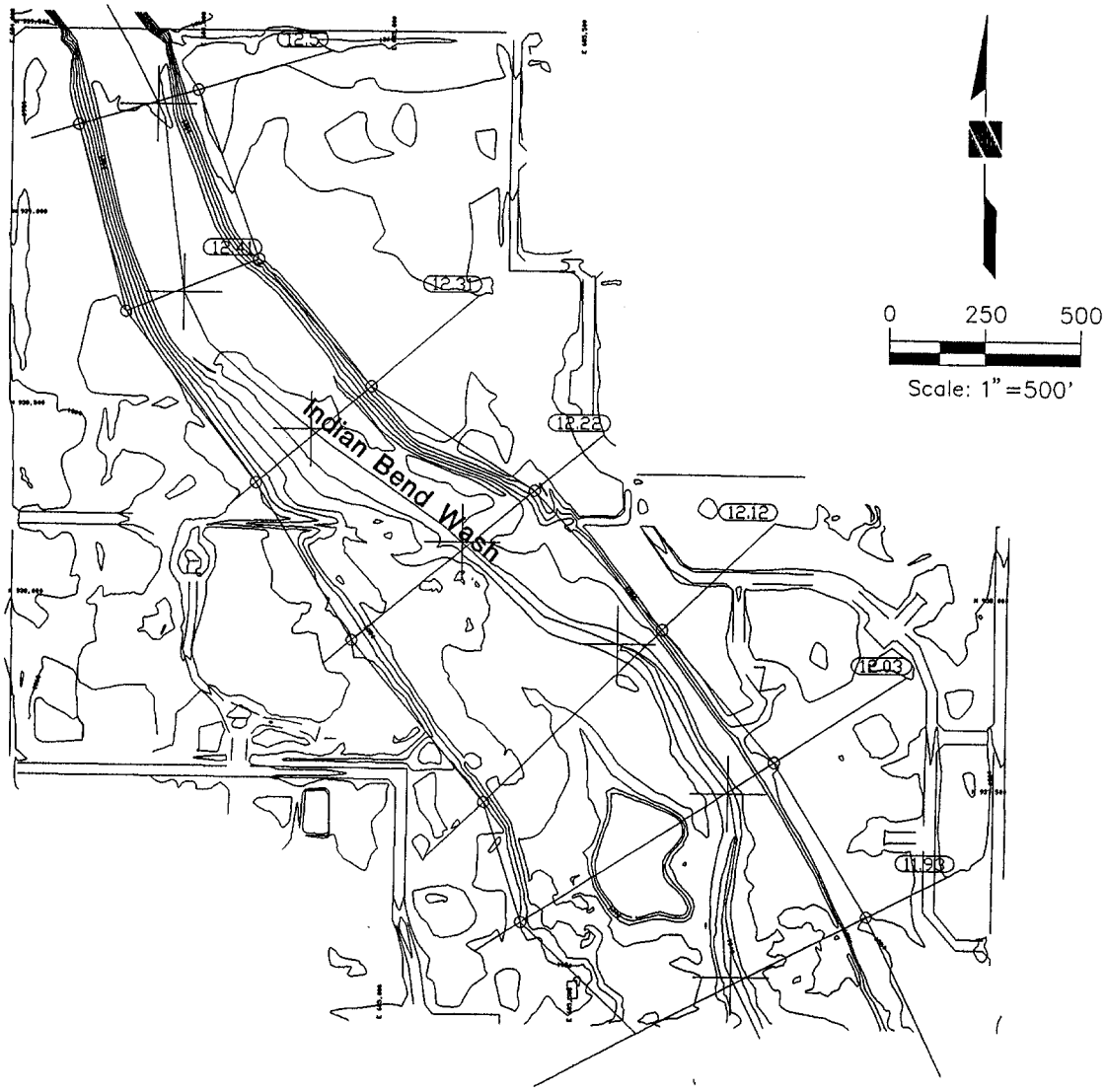
STATION 10.89 TO 11.46

Mountain View Road



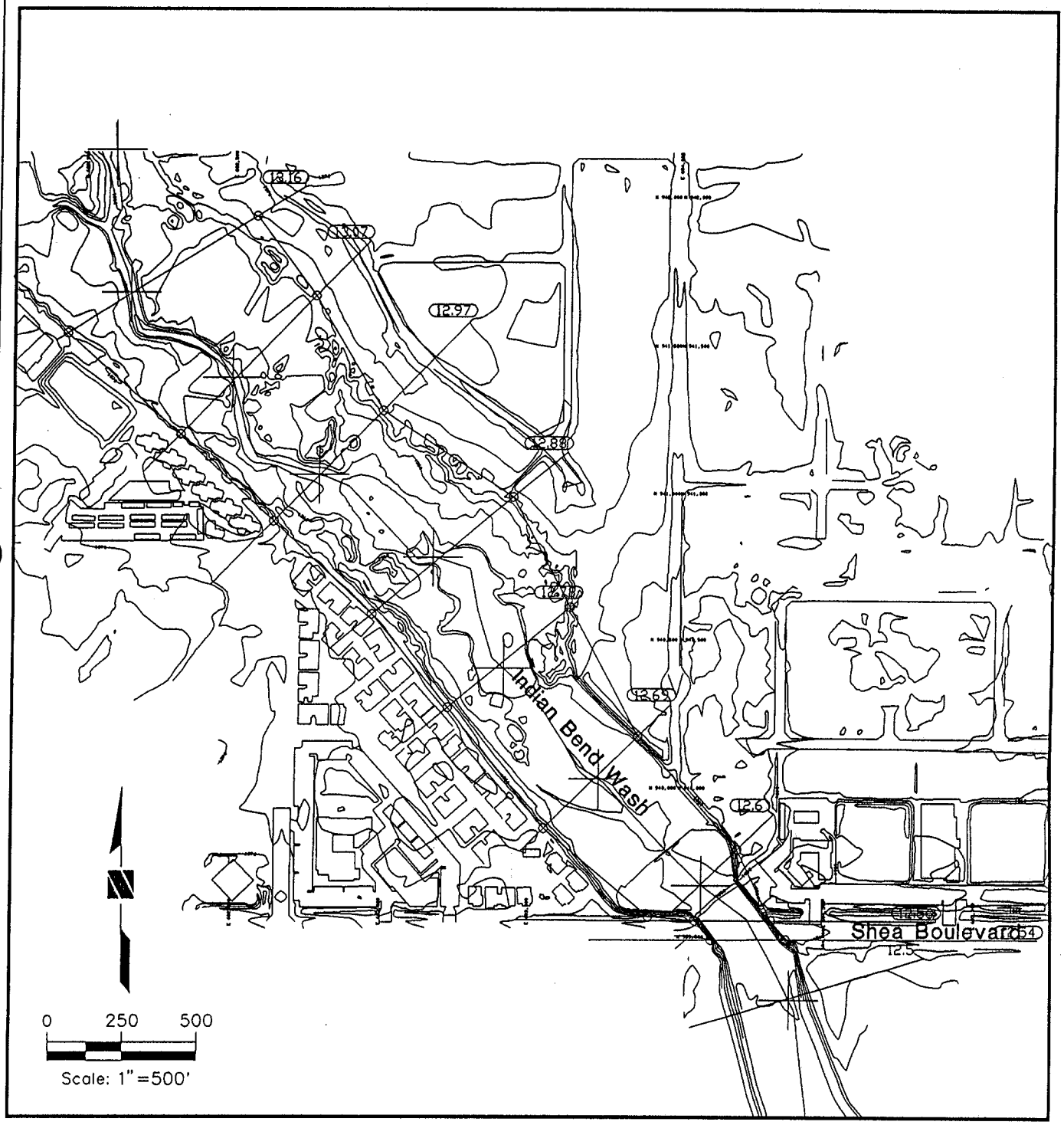
STATION 11.48 TO 11.84

Mountain View Road to Shea Boulevard



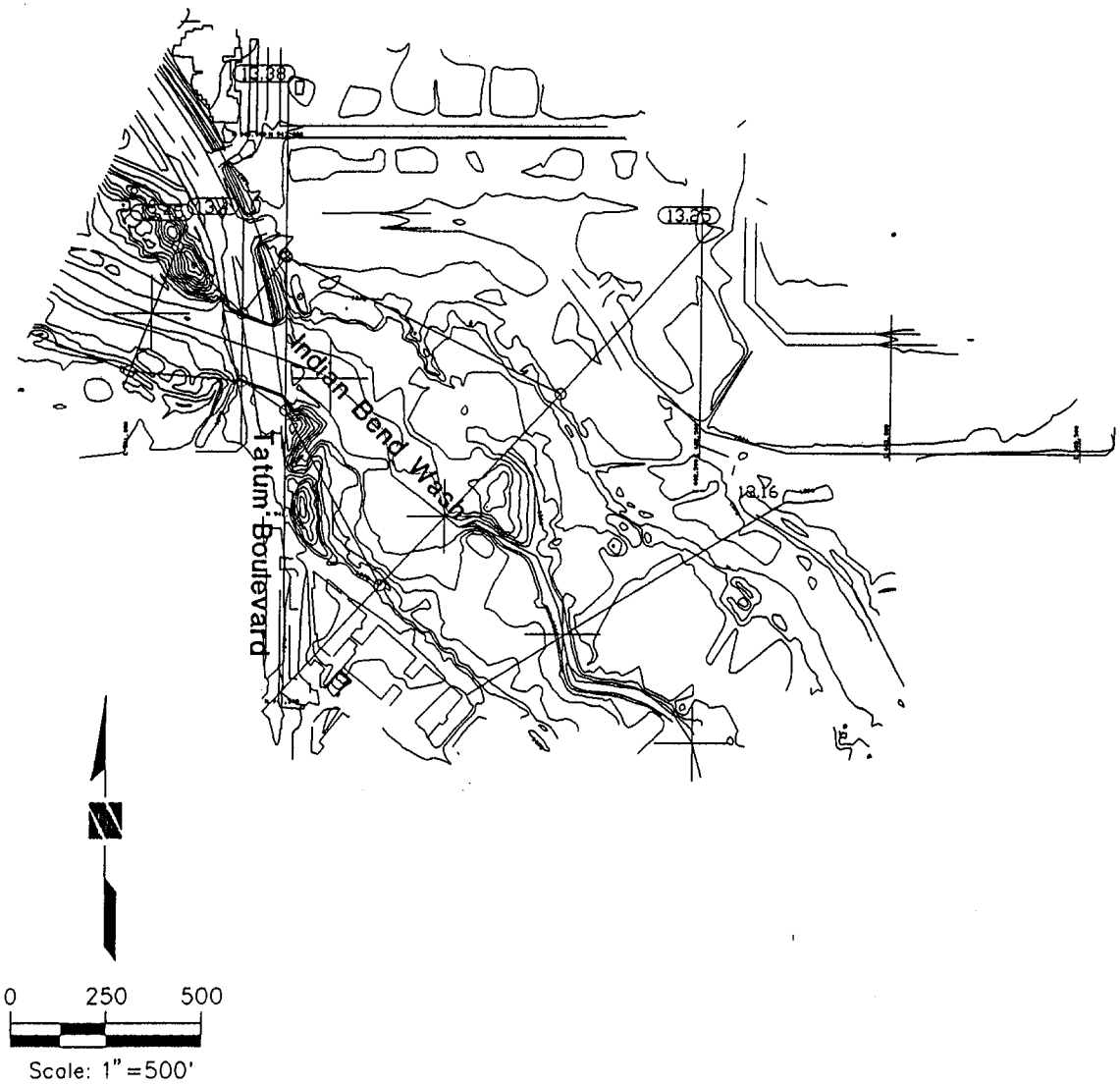
STATION 11.93 TO 12.5

Shea Boulevard



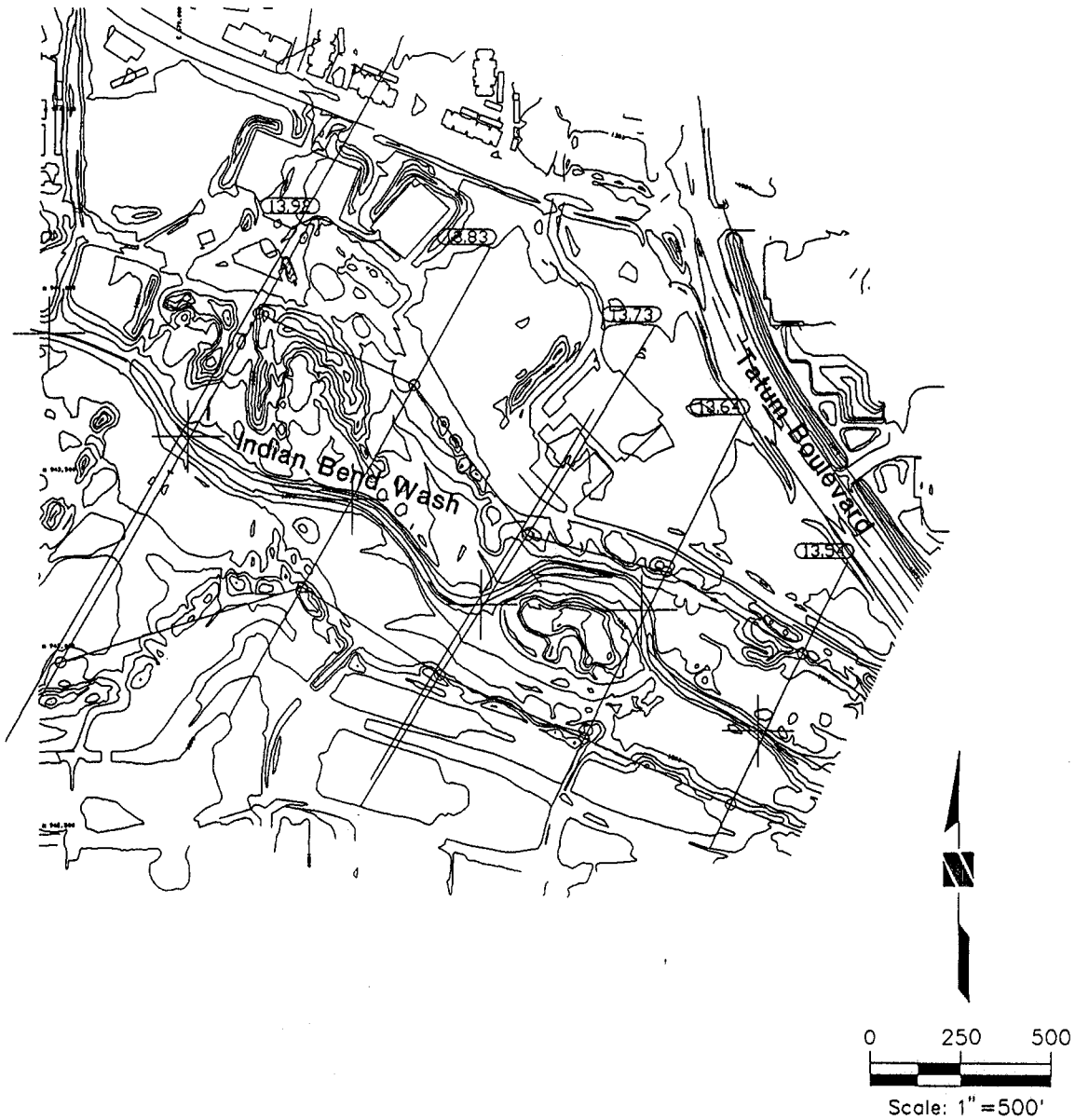
STATION 12.54 TO 13.16

Tatum Boulevard



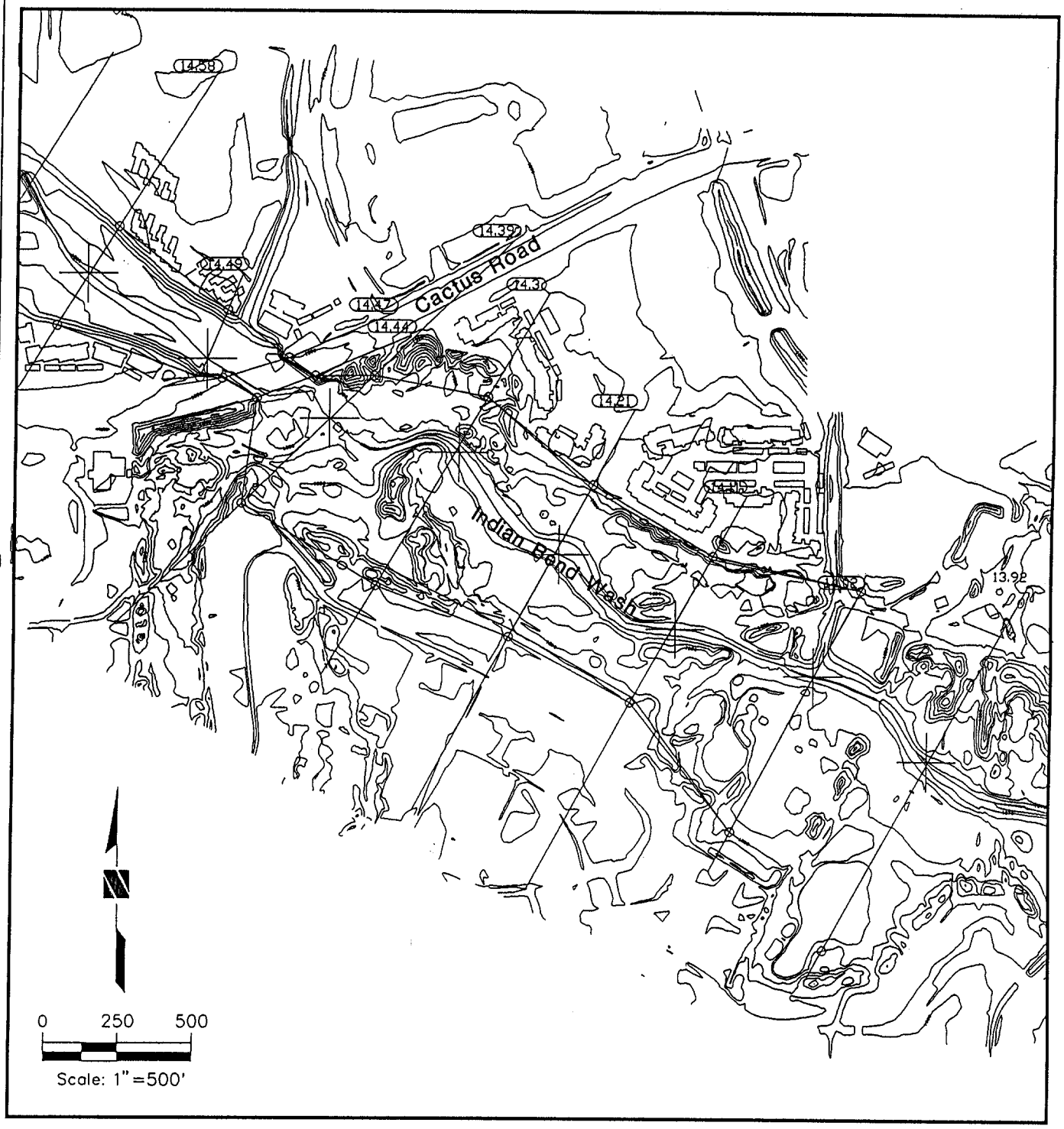
STATION 13.16 TO 13.45

Tatum Boulevard at Copper Springs Golf Course



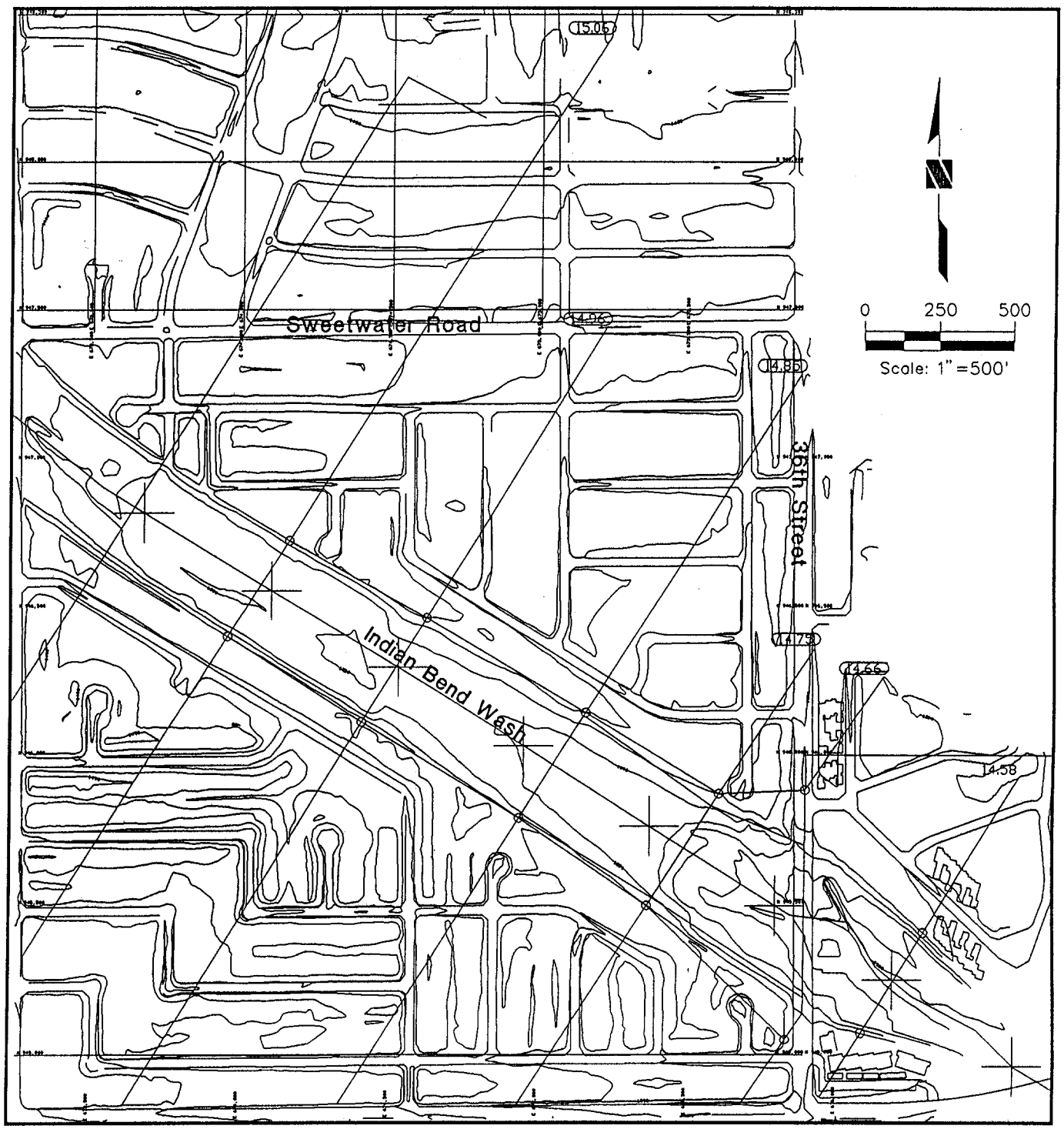
STATION 13.54 TO 13.92

Cactus Road



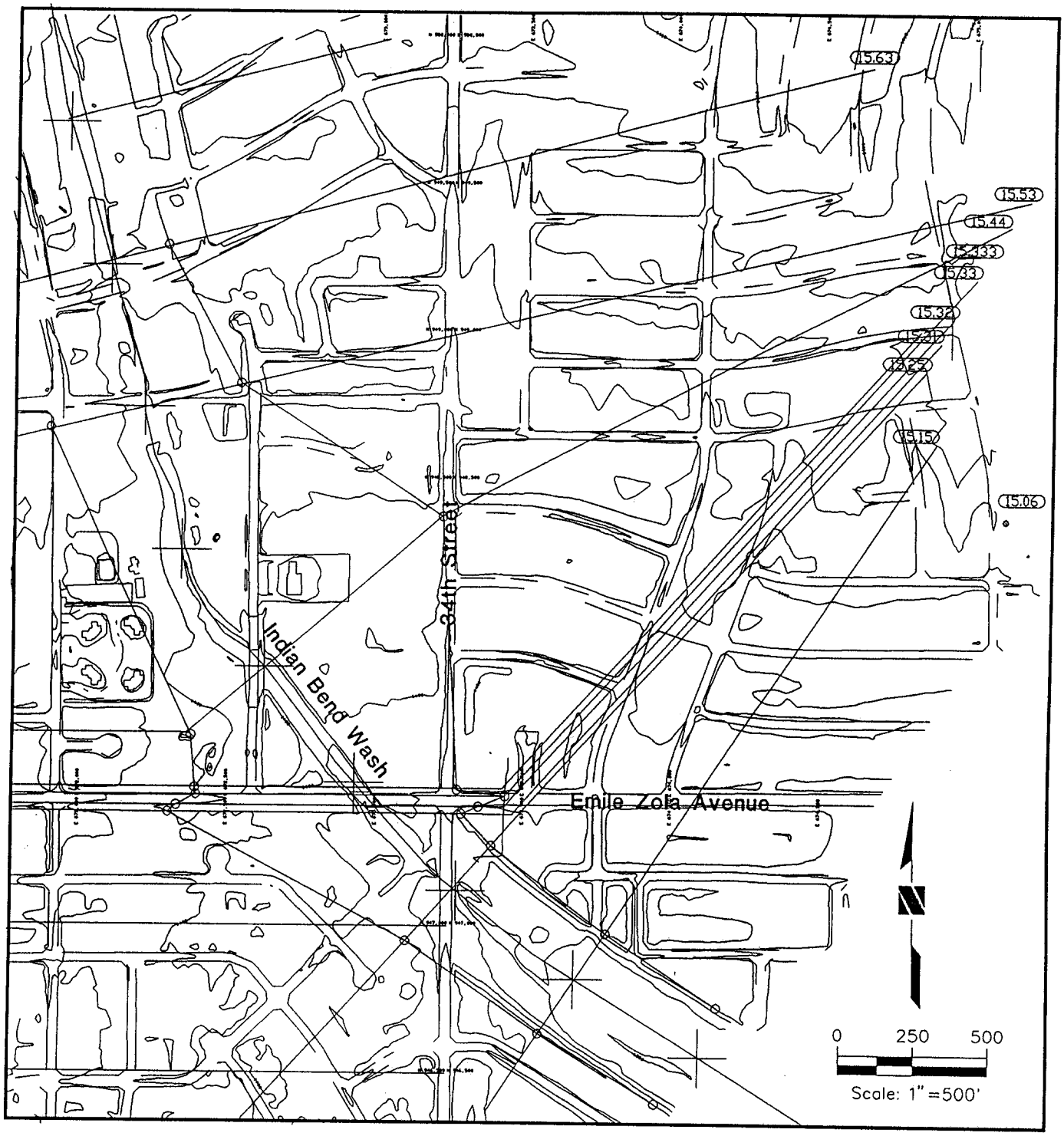
STATION 13.92 TO 14.58

36th Street to Sweetwater Road



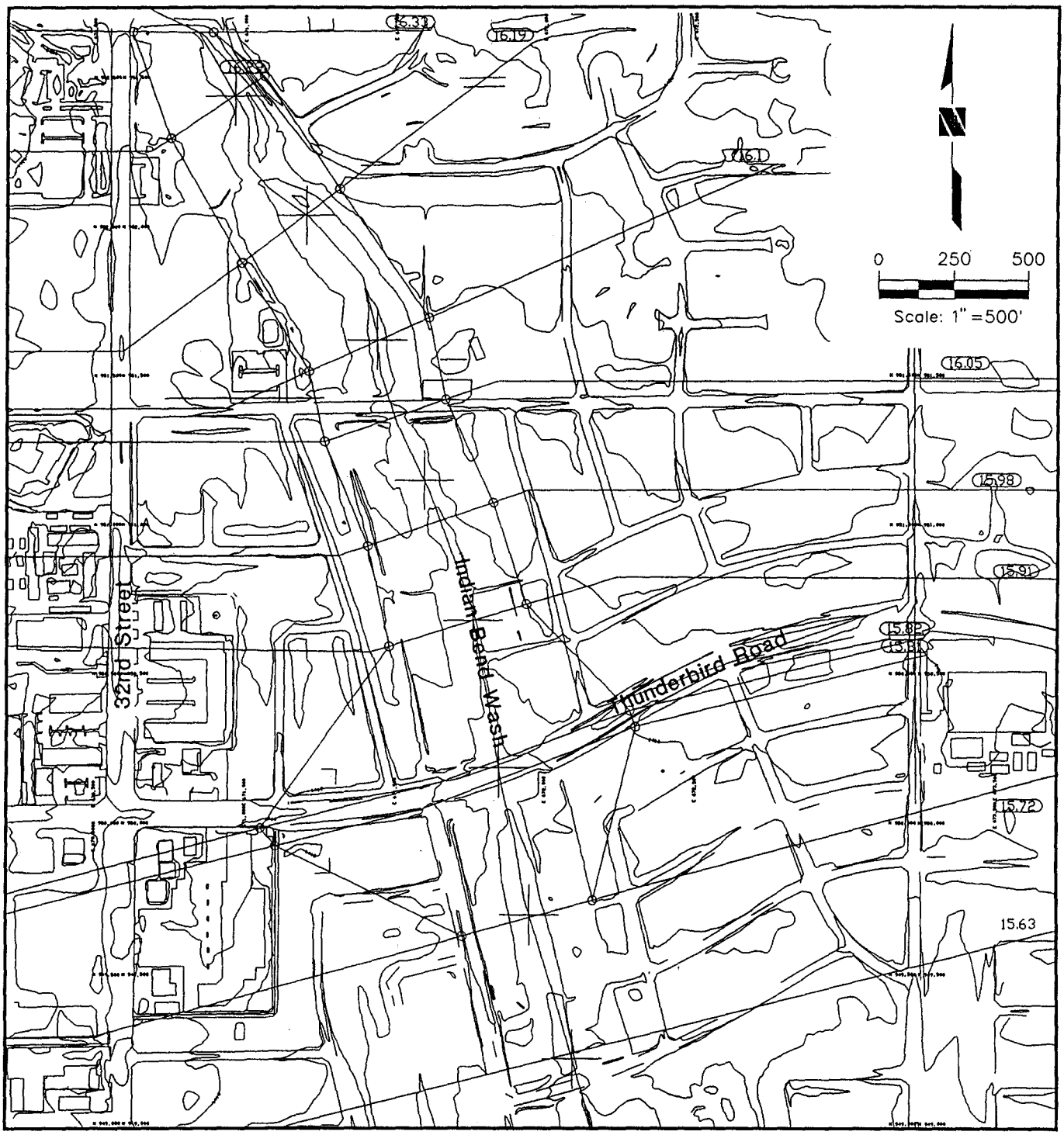
STATION 14.58 TO 15.06

34th Street at Emile Zola Avenue



STATION 15.06 TO 15.63

Thunderbird Road at 32nd Street



STATION 15.63 TO 16.33

APPENDIX C

CROSS SECTIONS OF INDIAN BEND WASH

APPENDIX C

I. INTRODUCTION

This appendix was prepared pursuant to "Scope of Work Flood Control District of Maricopa County Floodplain Delineation for Indian Bend Wash" (FCD 93-05), Section 6.5 and is intended to be included in the Technical Data Notebook as Section 4.3 (Cross Section Description).

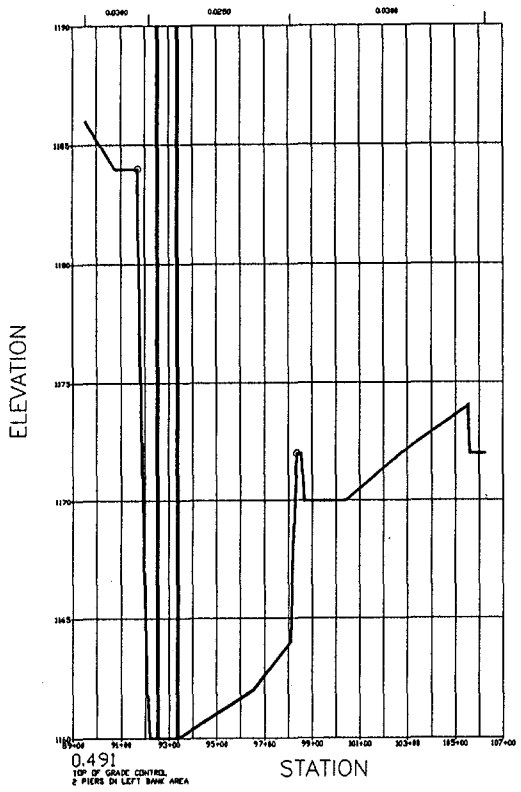
The topographic mapping for the Indian Bend Wash floodplain delineation, in digital form, was used to delineate the wash thalweg. This was accomplished in a Digital Terrain Model (DTM) within the AutoCADD environment. The thalweg centerline line represents a cross section station (GR and X component) of 10,000 feet.

Cross sections are labeled in river miles upstream from the confluence of Indian Bend Wash with the Salt River. Cross sections are spaced approximately 500 feet apart, with closer spacing at critical locations such as bridges. Criteria for cross section selection include: 1) representative of local stream reach; 2) oriented perpendicular to flow; 3) avoid inclusion of non-effective flow areas; and 4) include the predicted 100-year floodplain.

Cross section plots were reviewed in conjunction with aerial photographs, topographic mapping and ground level photographs to determine if the sections were representative of the local stream reach. Bank stations were assigned based on the low-flow or pilot channels along many of the reaches.

Section II of this report presents the individual cross sections for the Indian Bend Wash Floodplain Delineation.

II. CROSS SECTIONS



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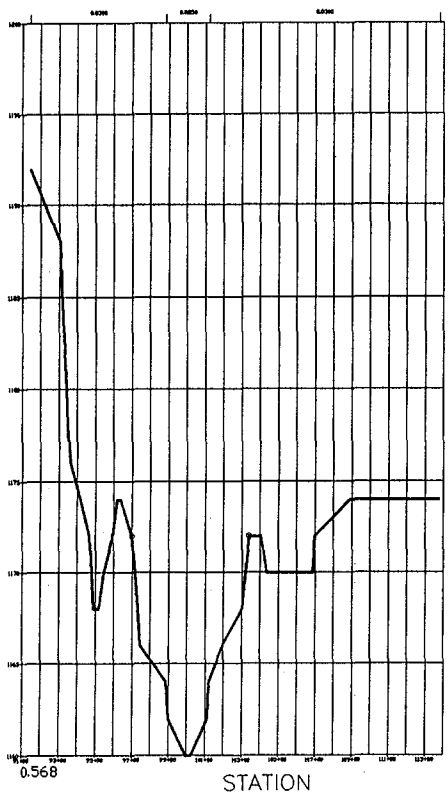

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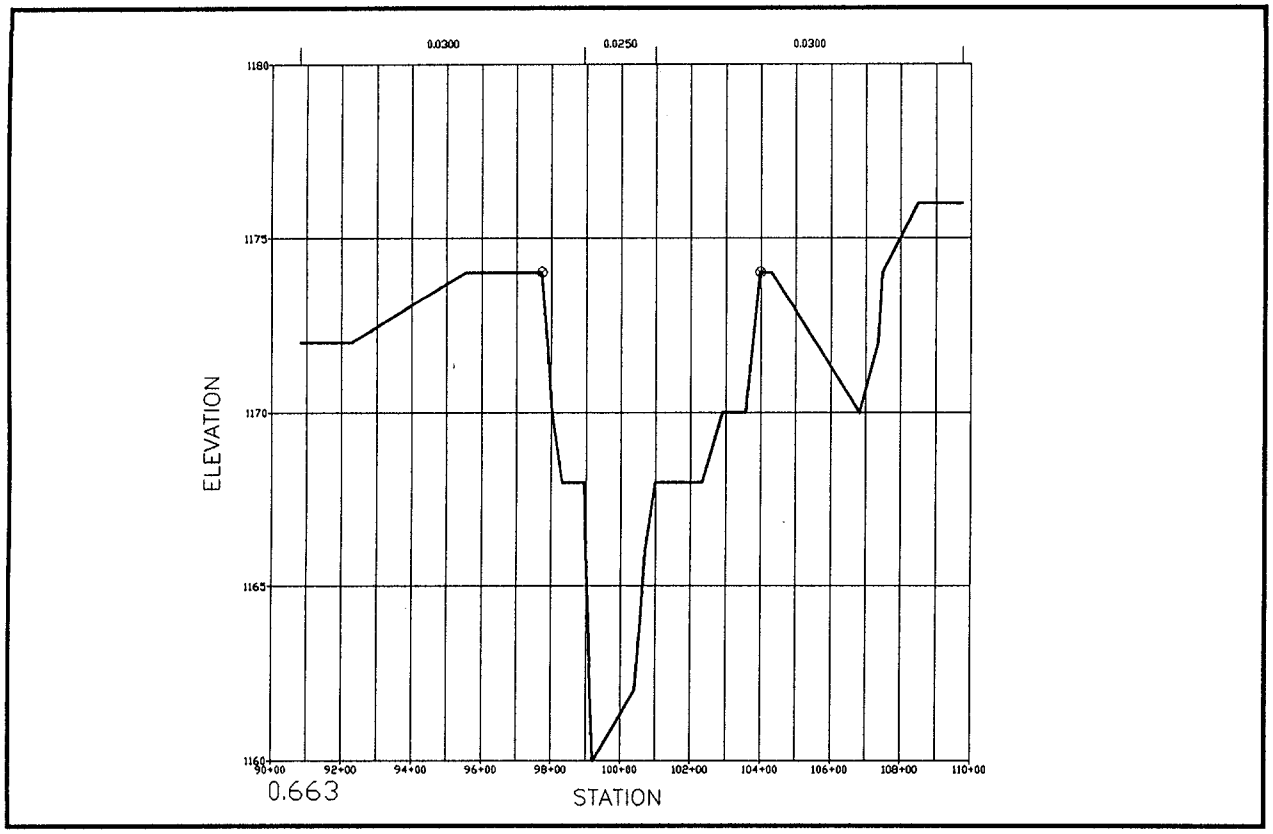

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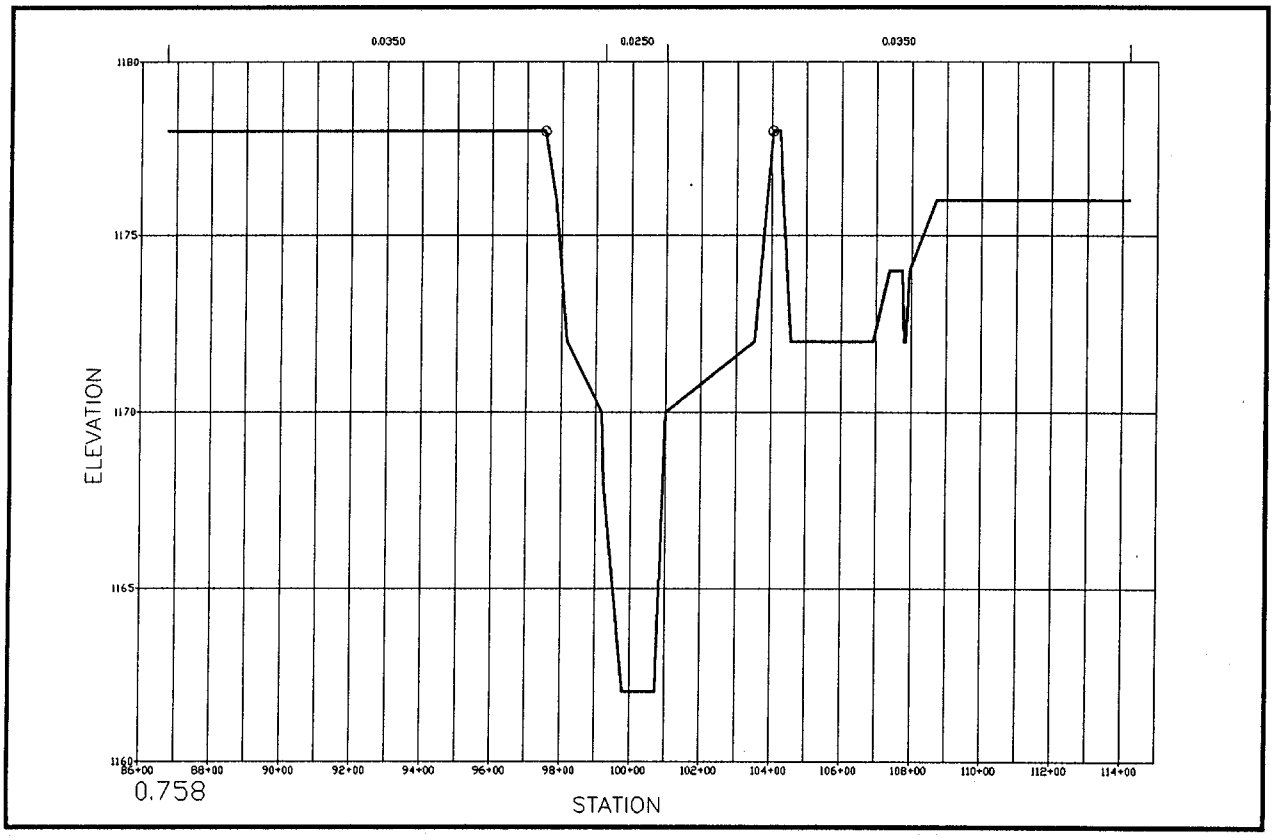

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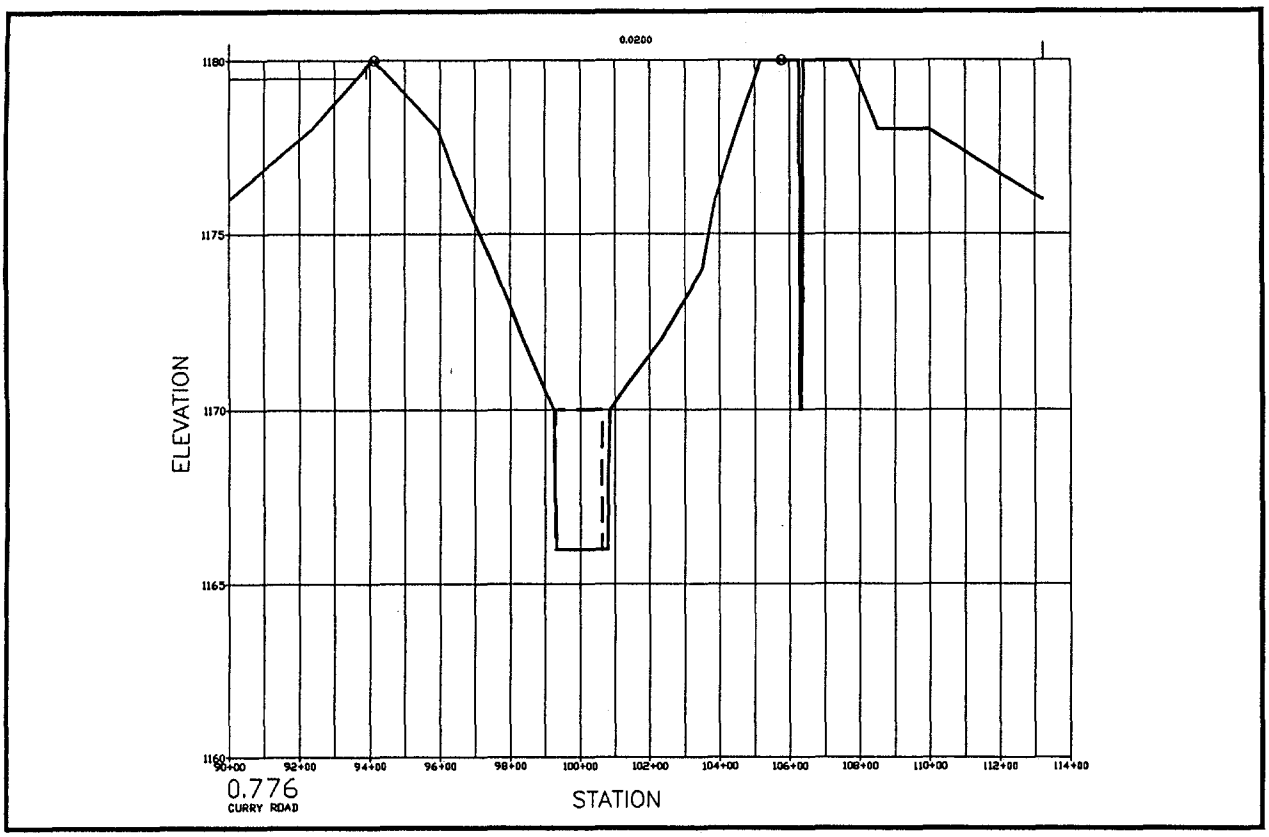

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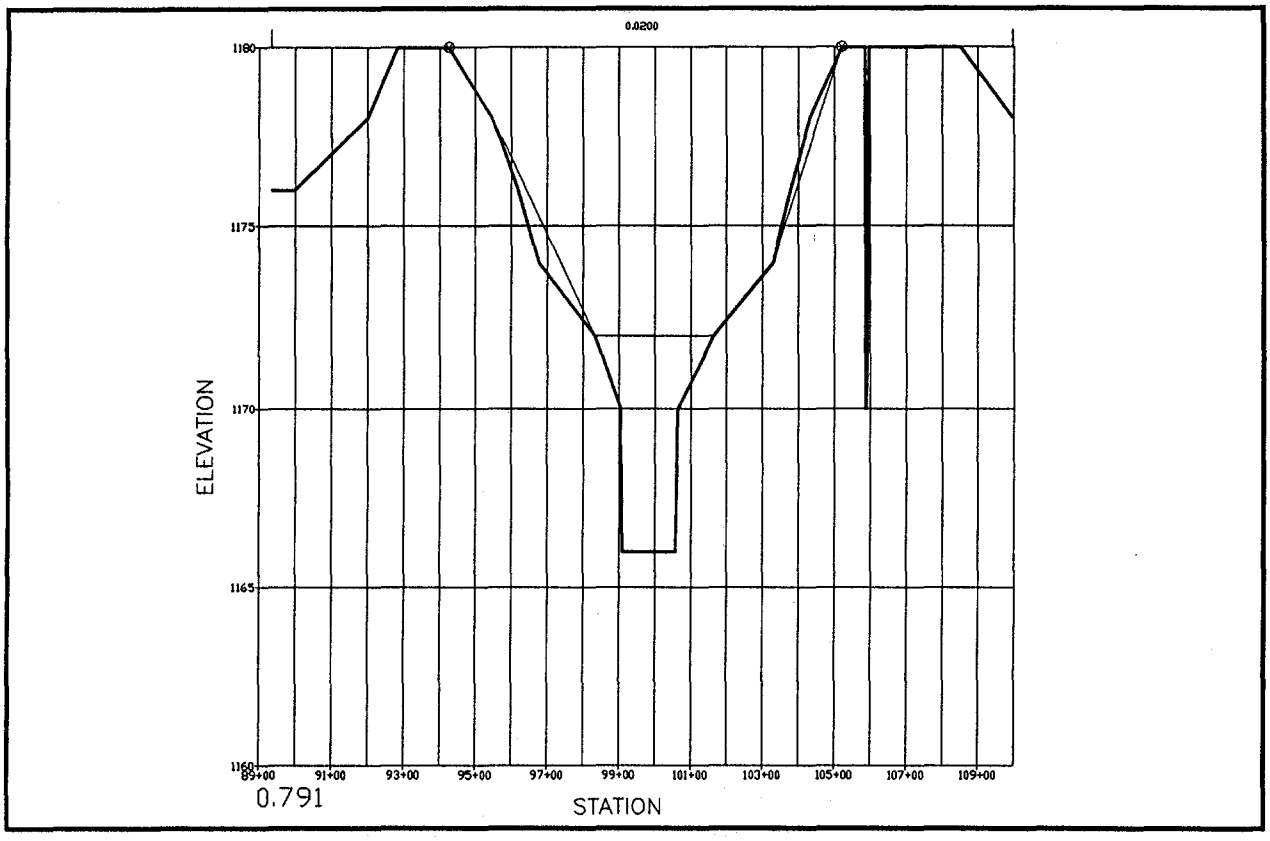

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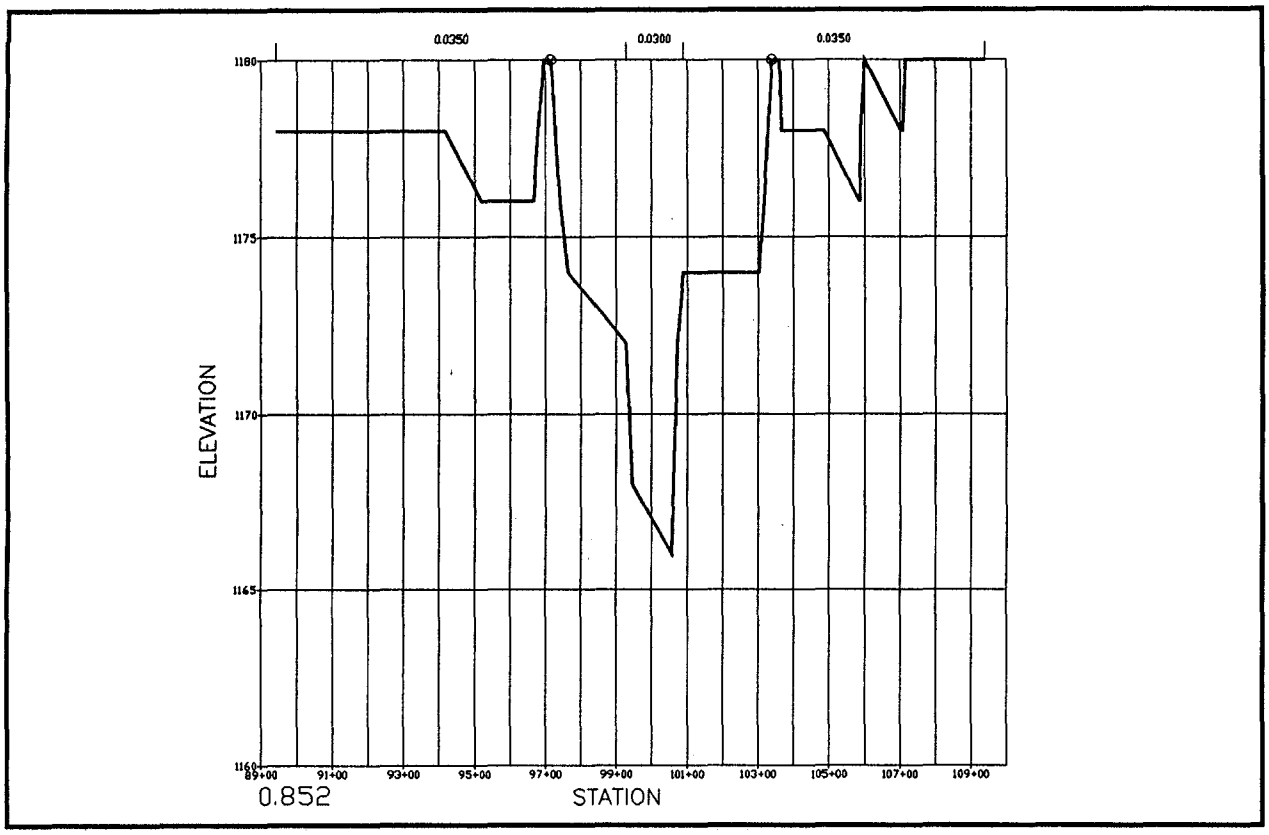

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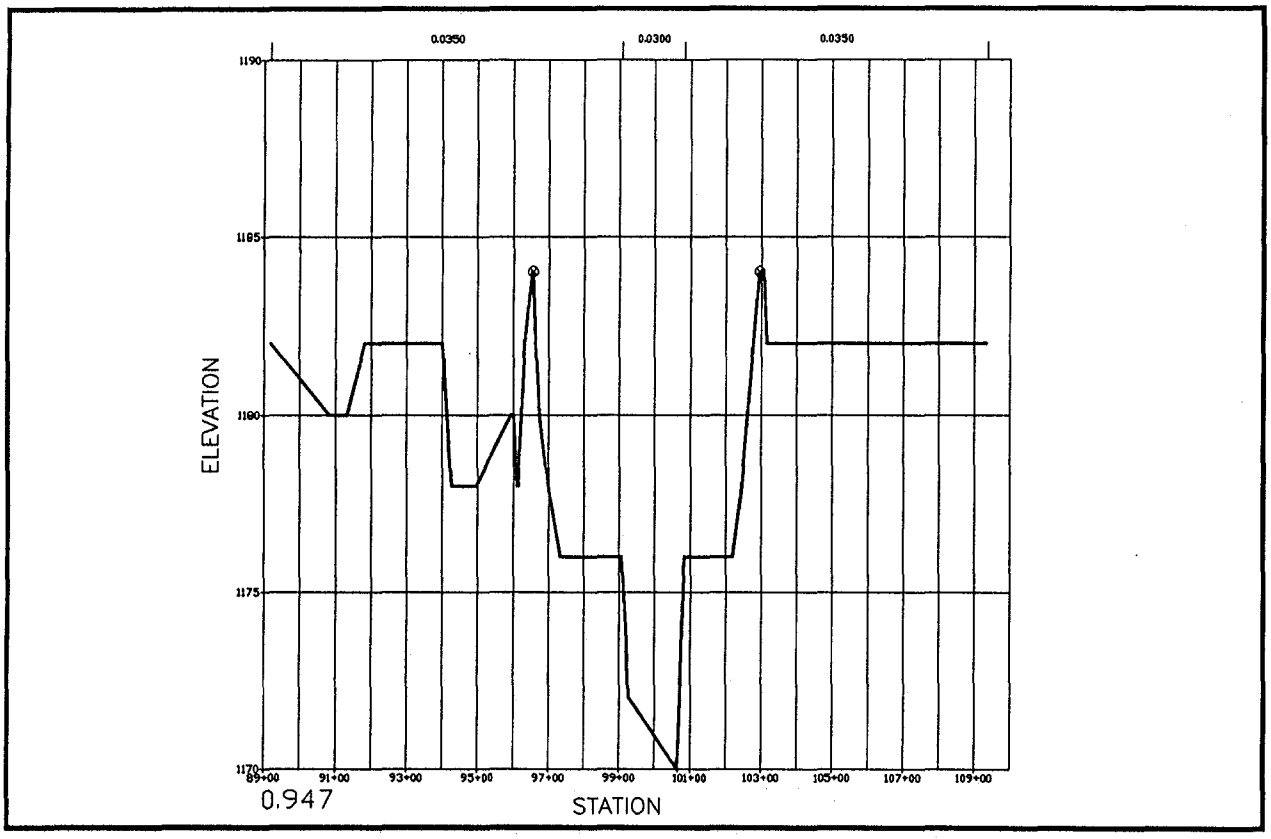

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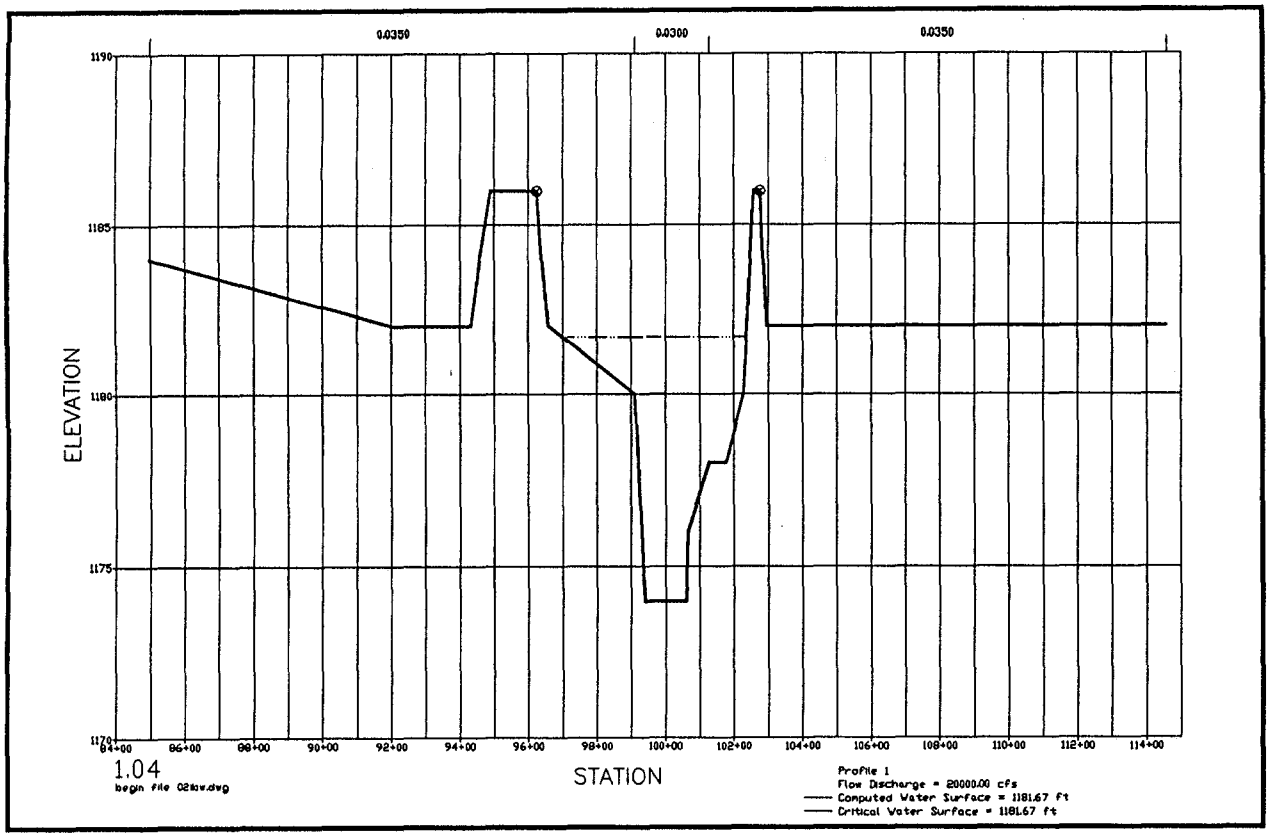

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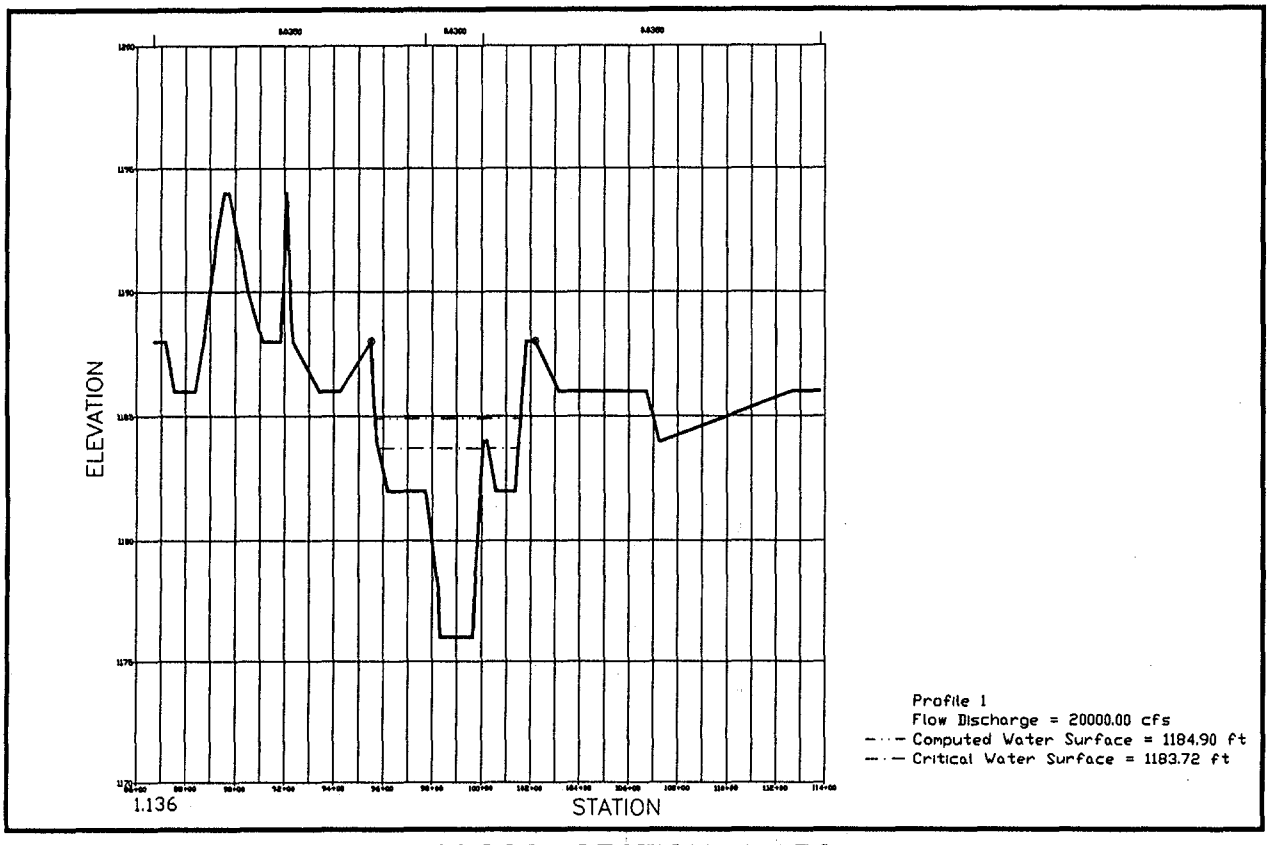

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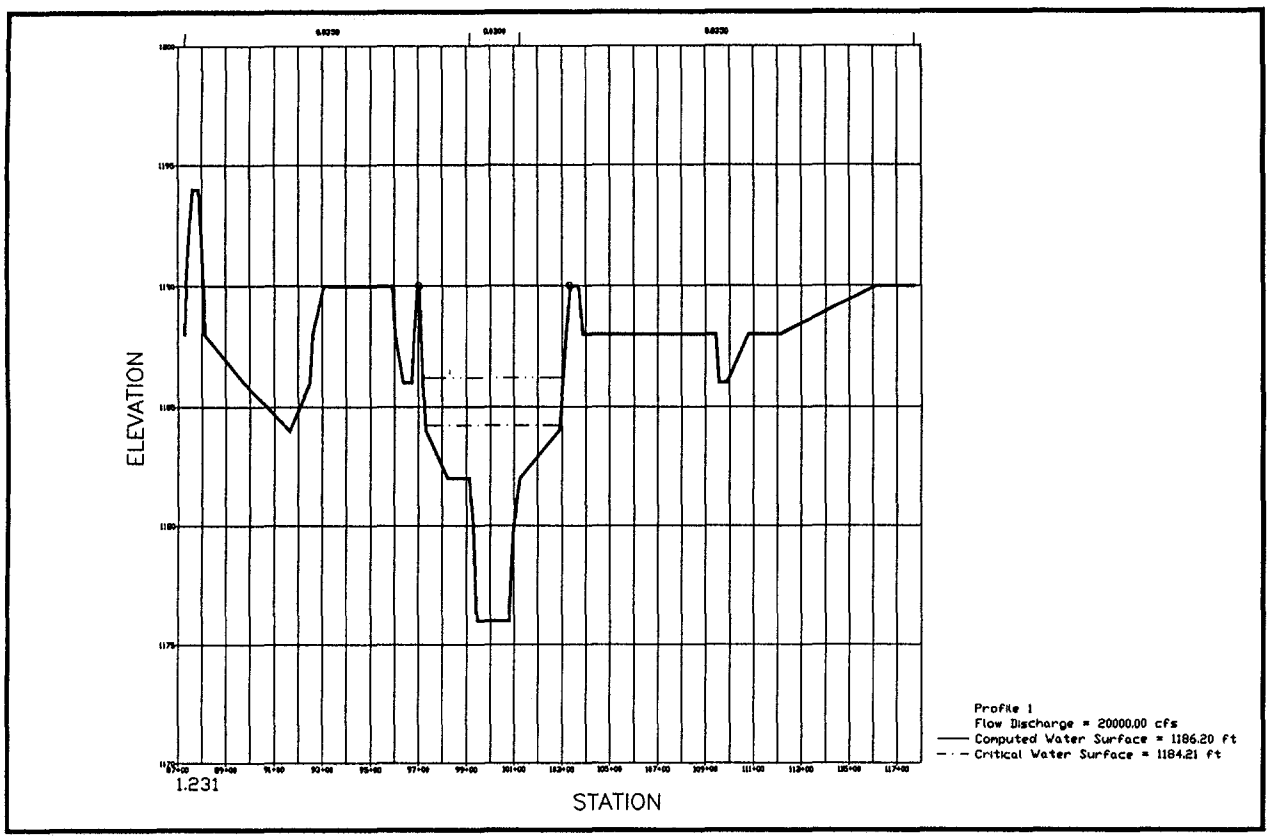

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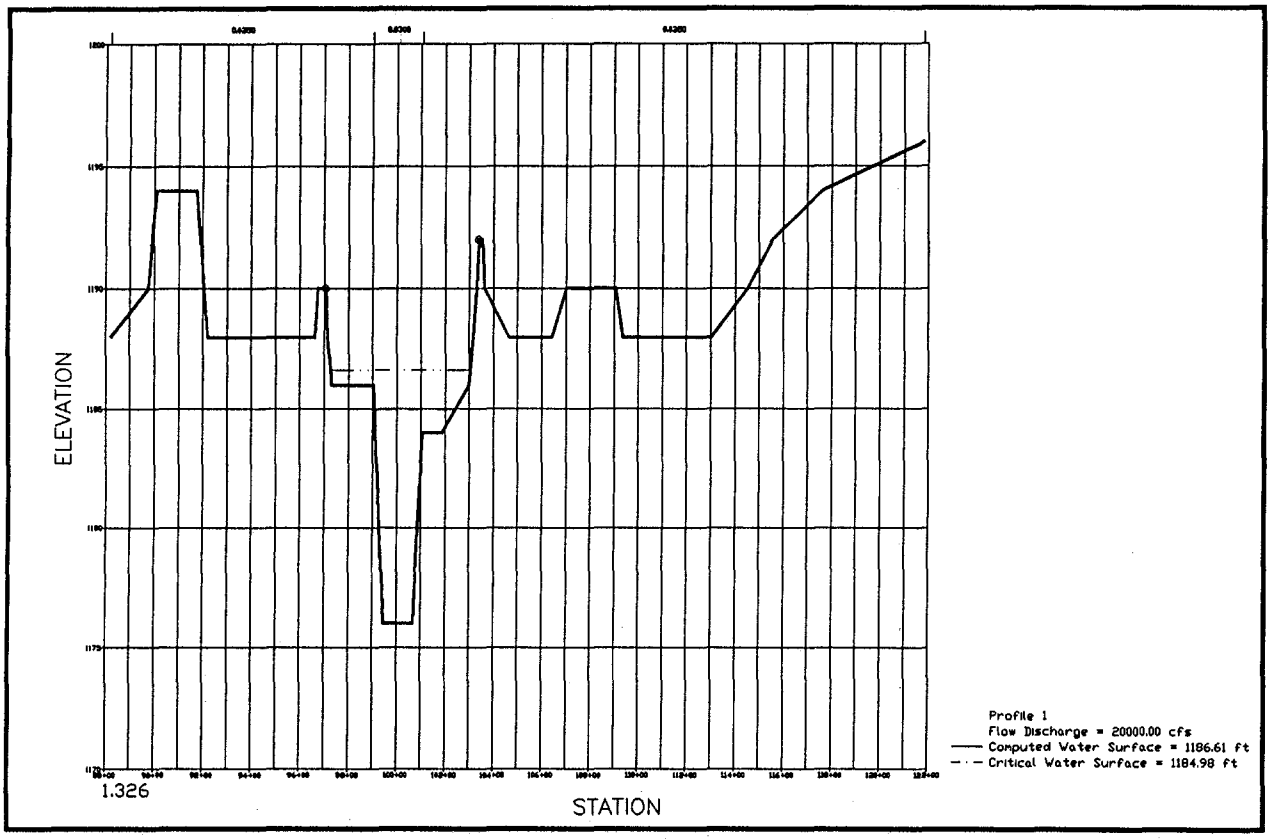

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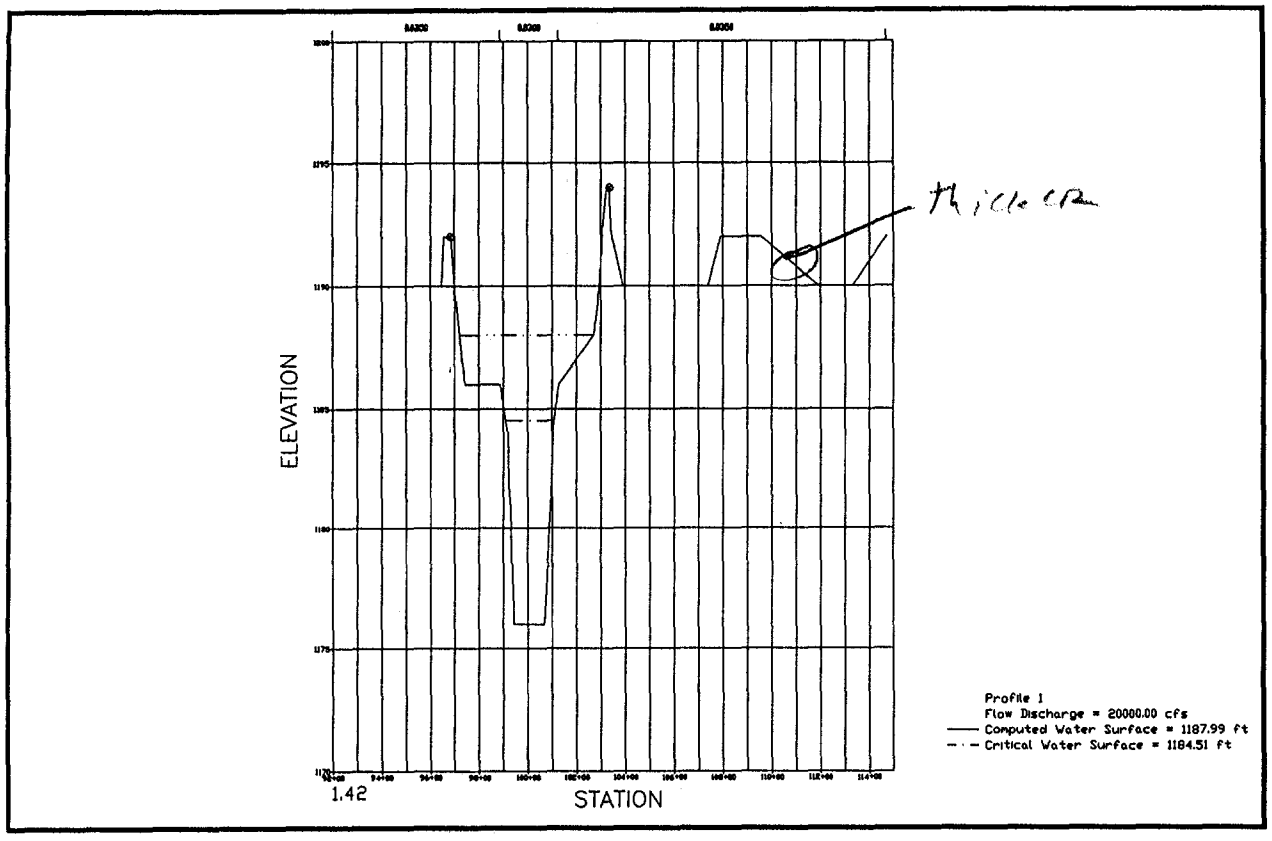

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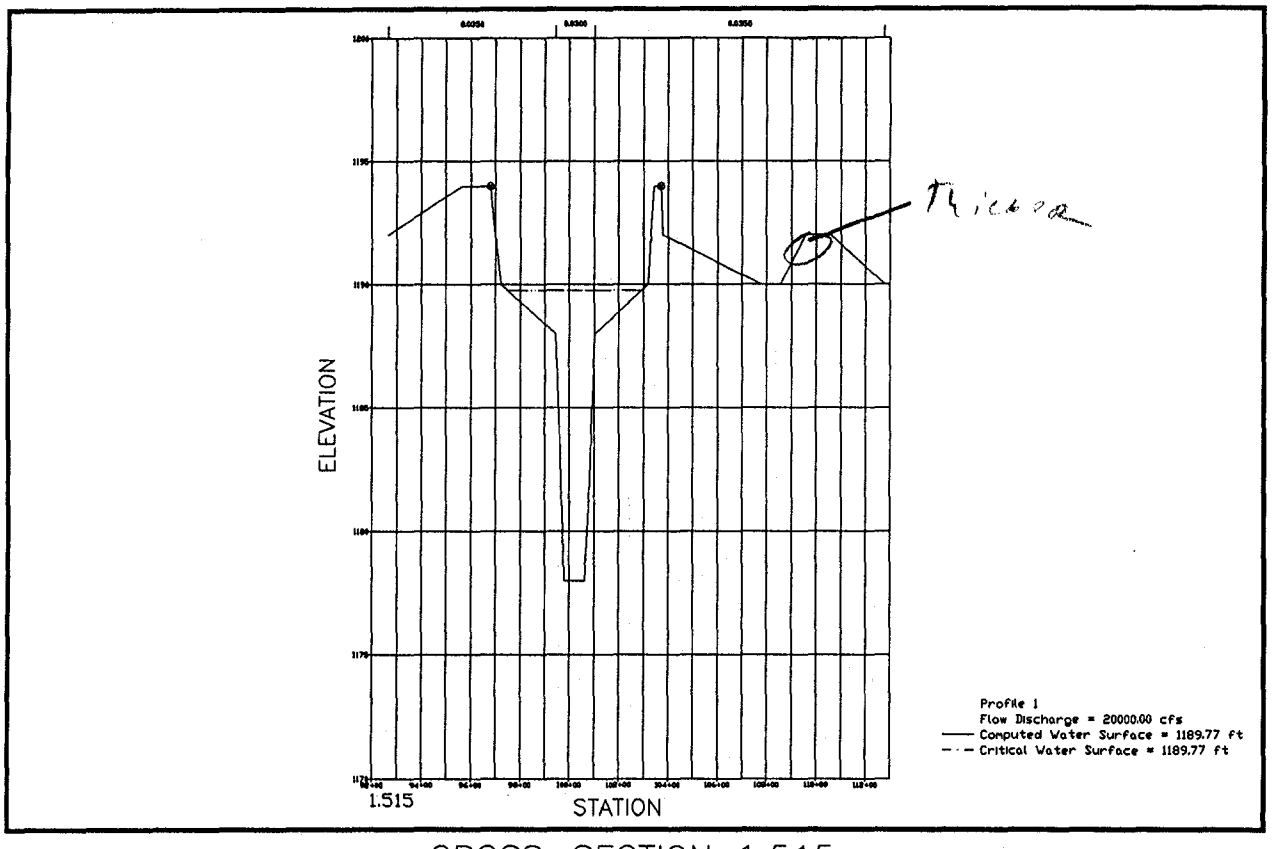

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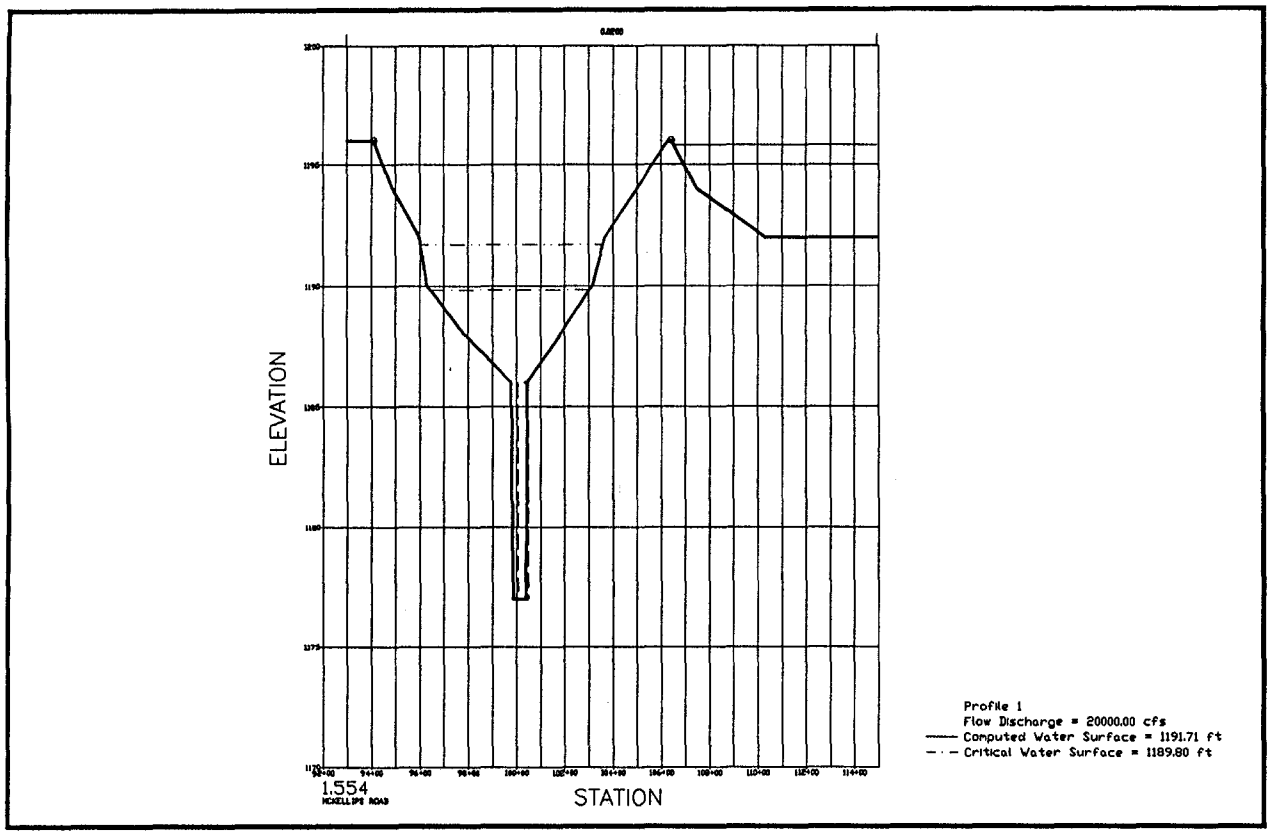

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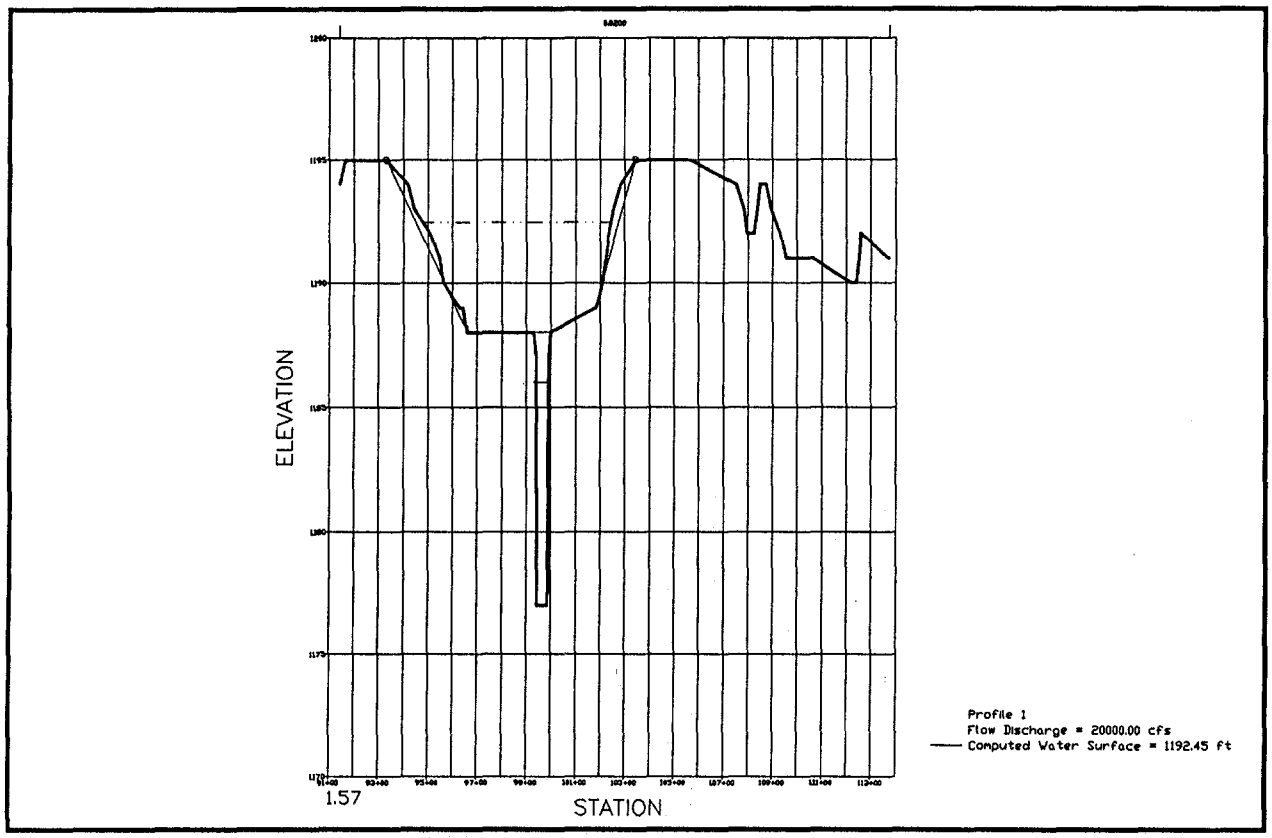

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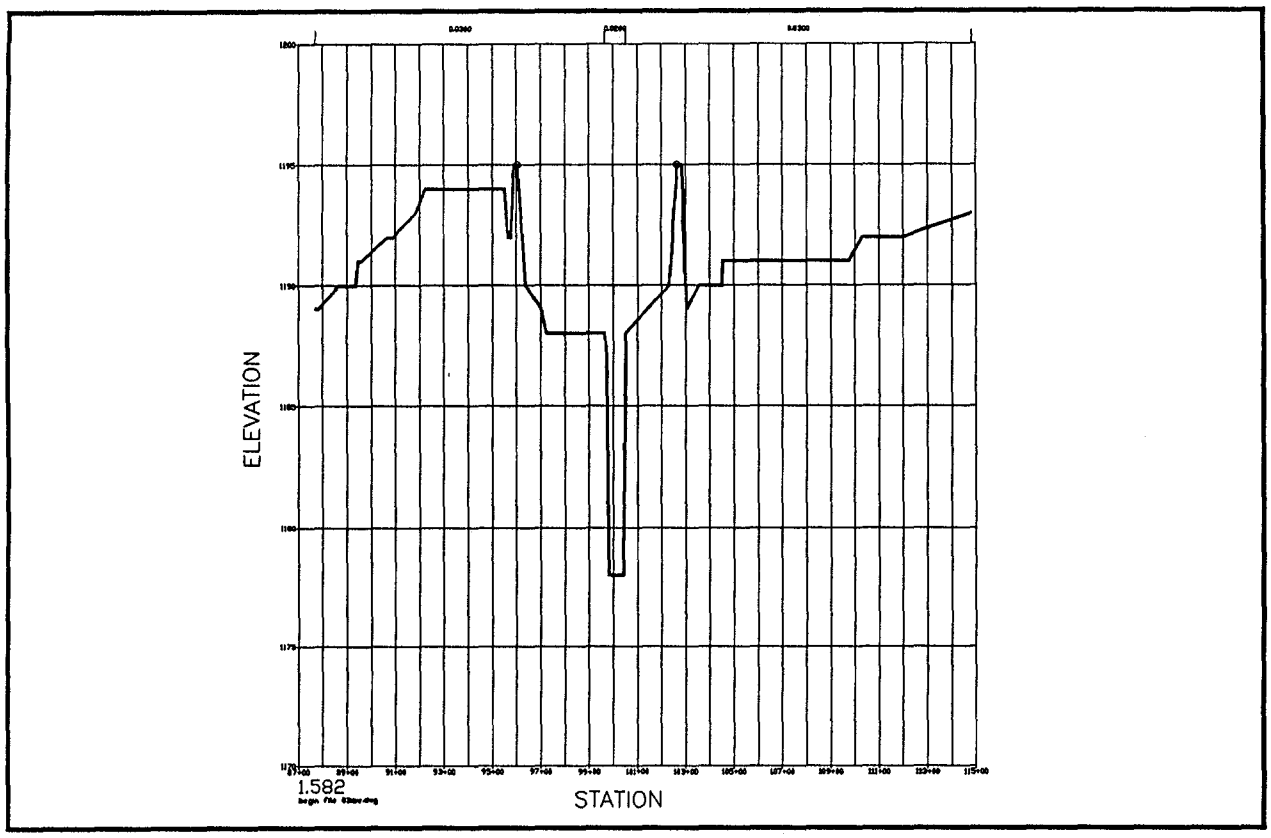

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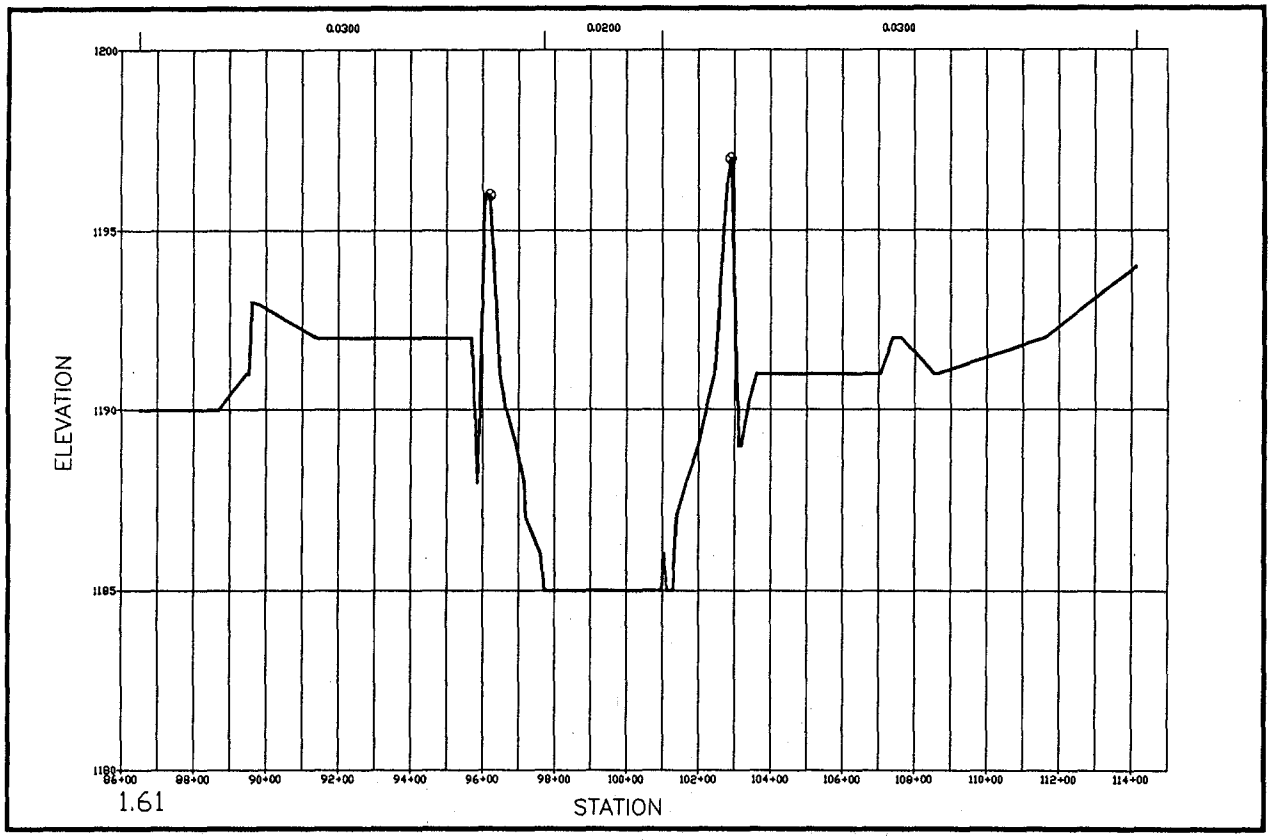

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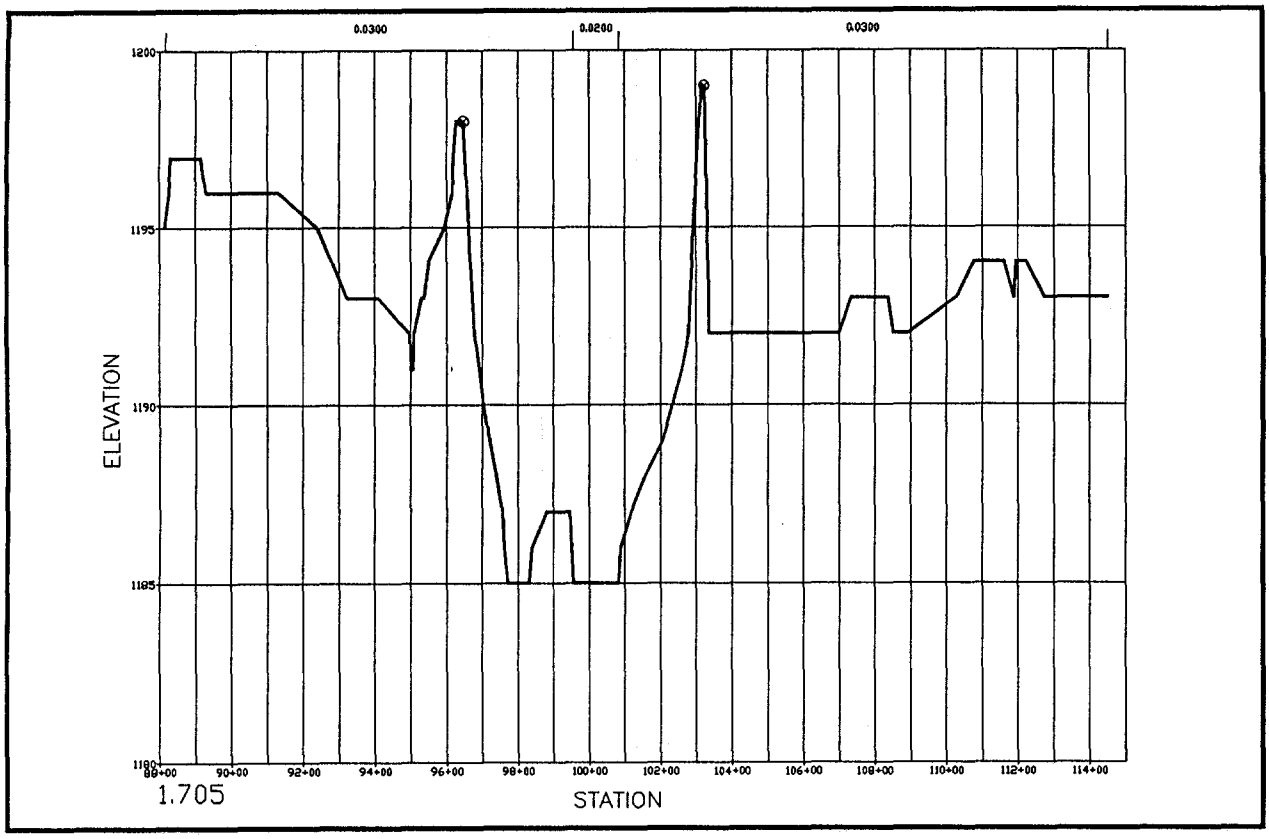

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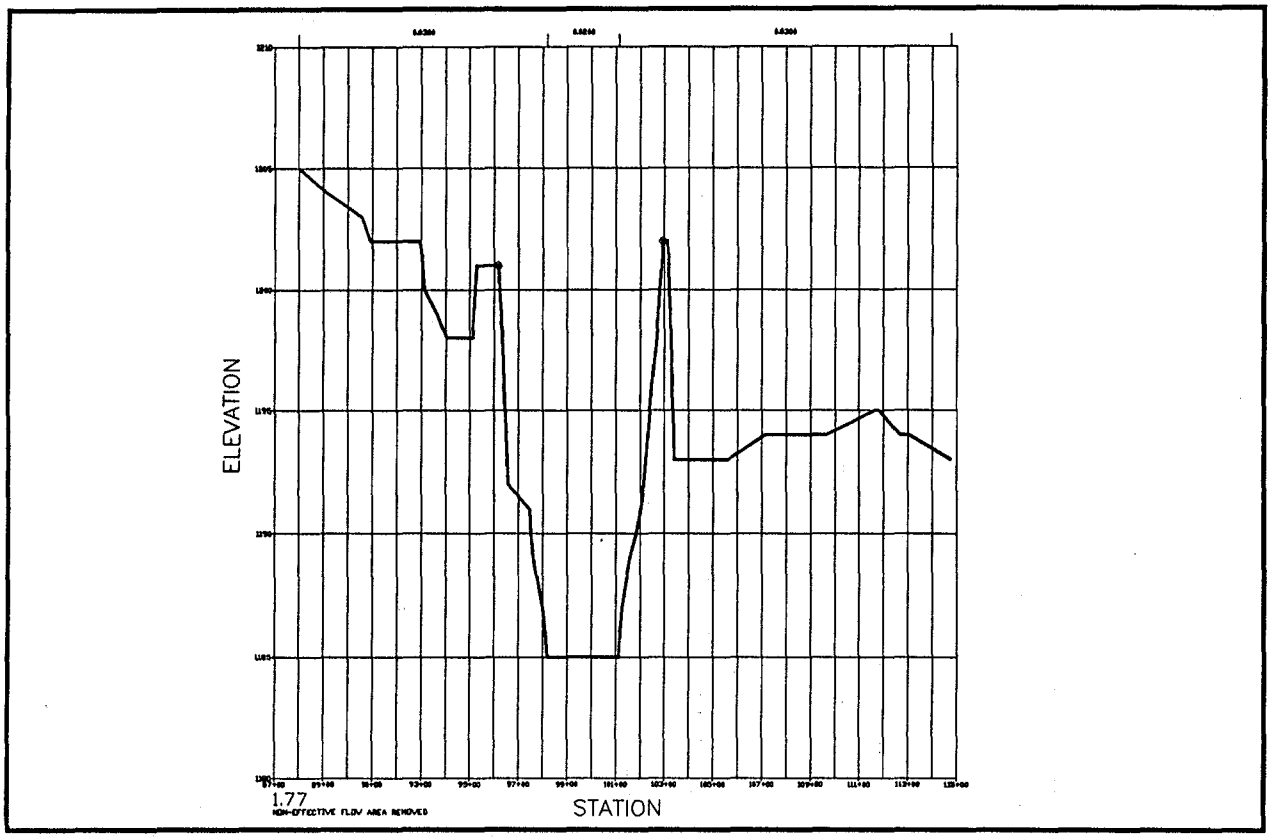

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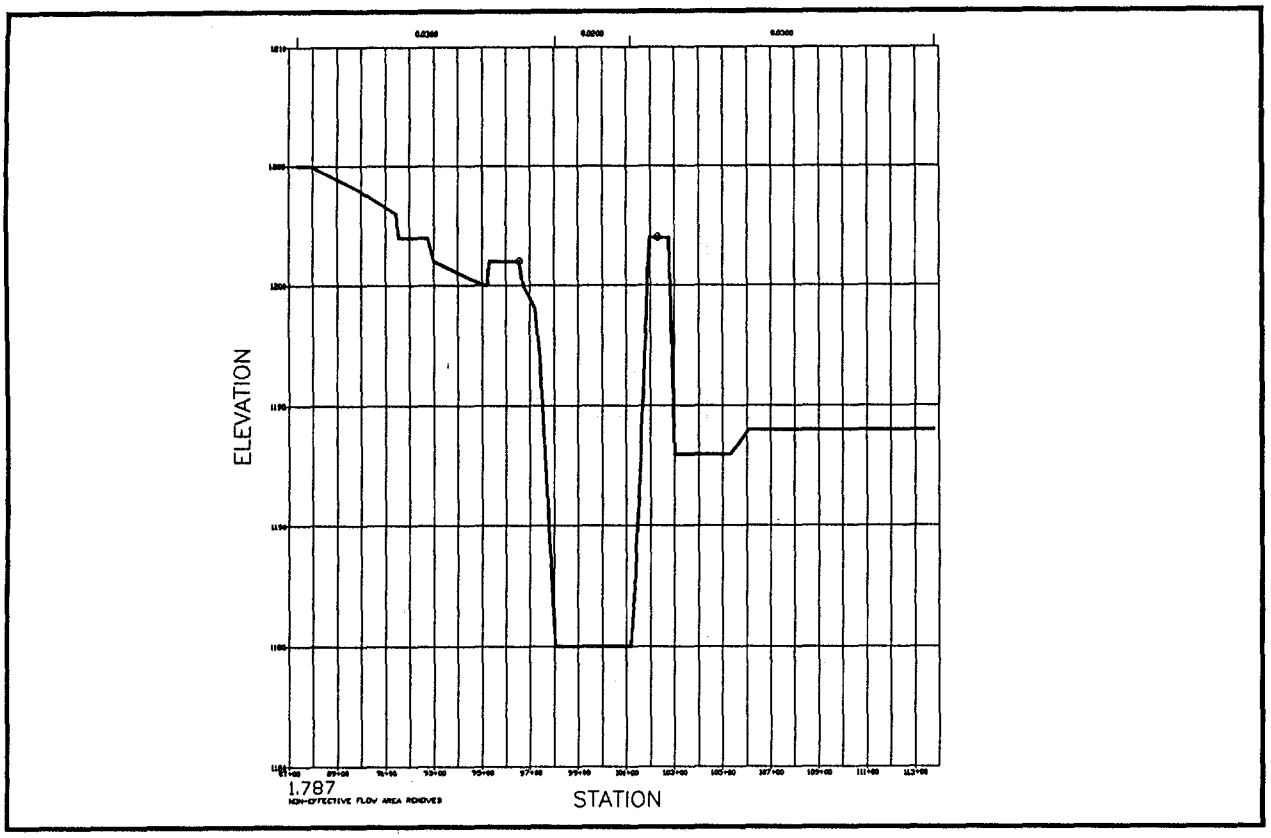

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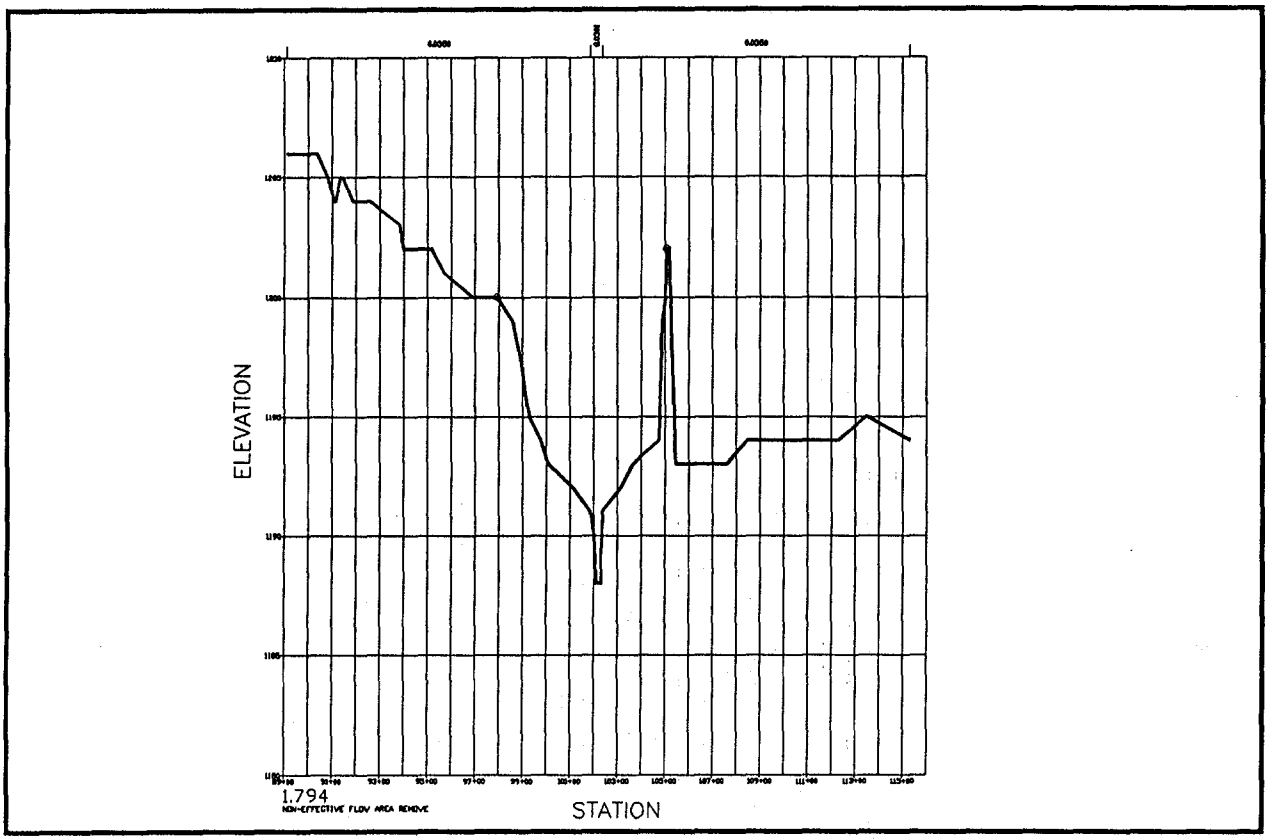

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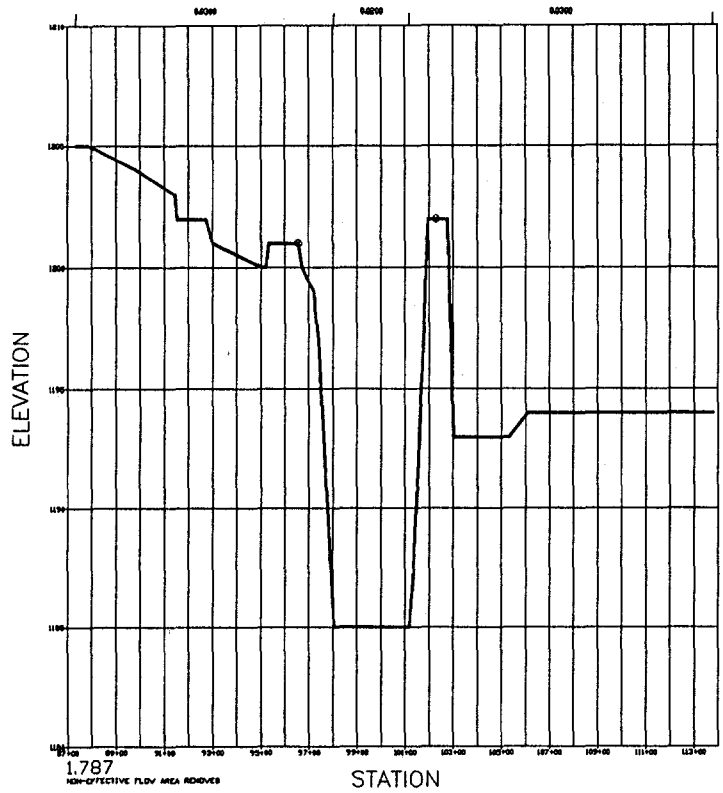

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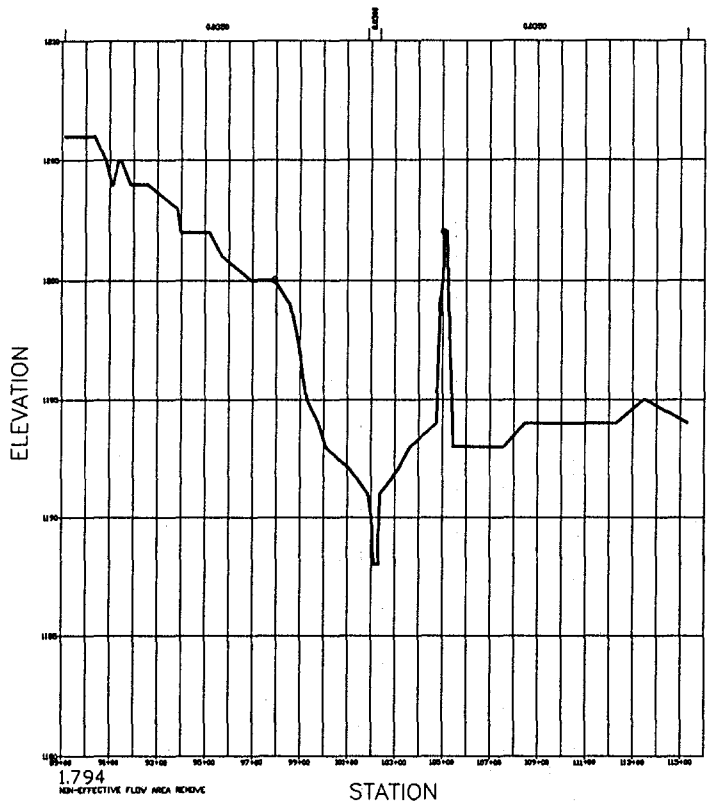

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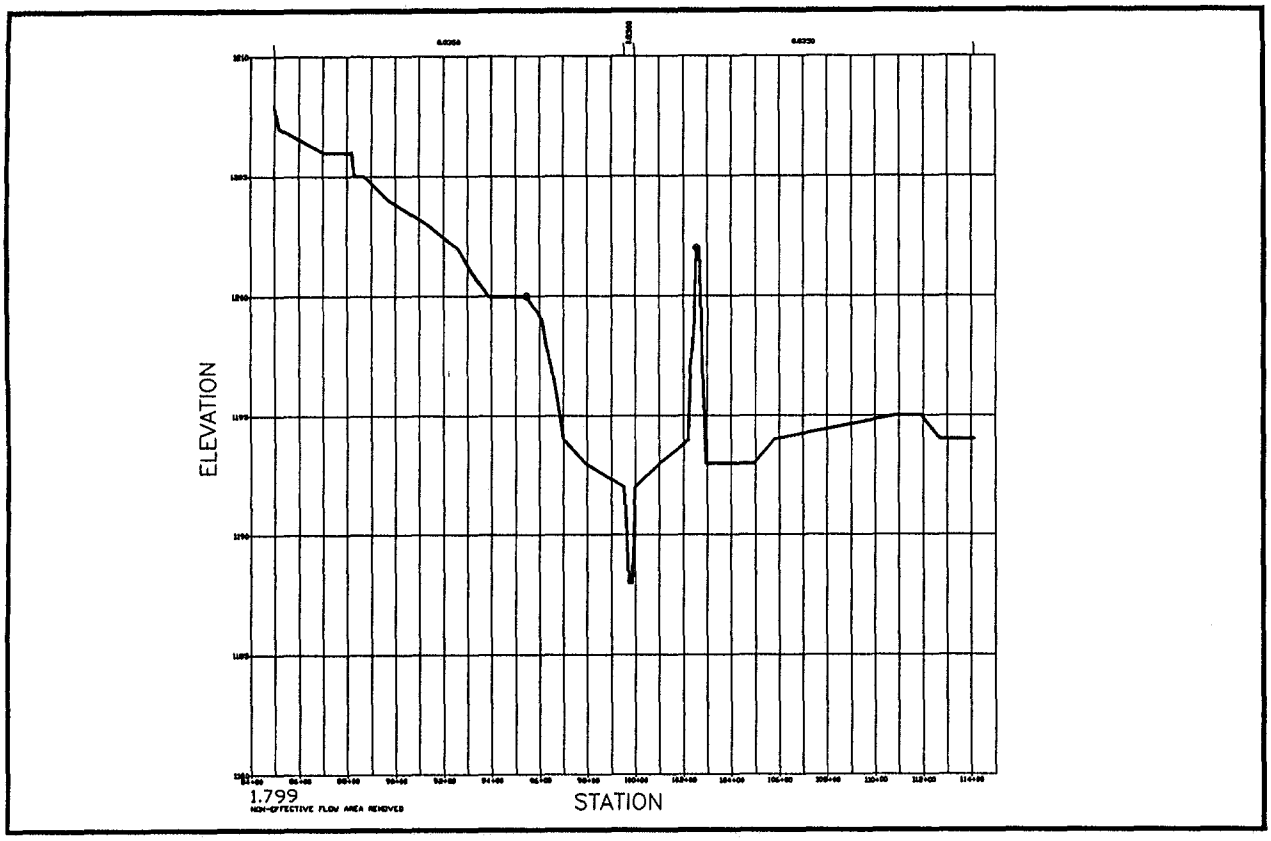

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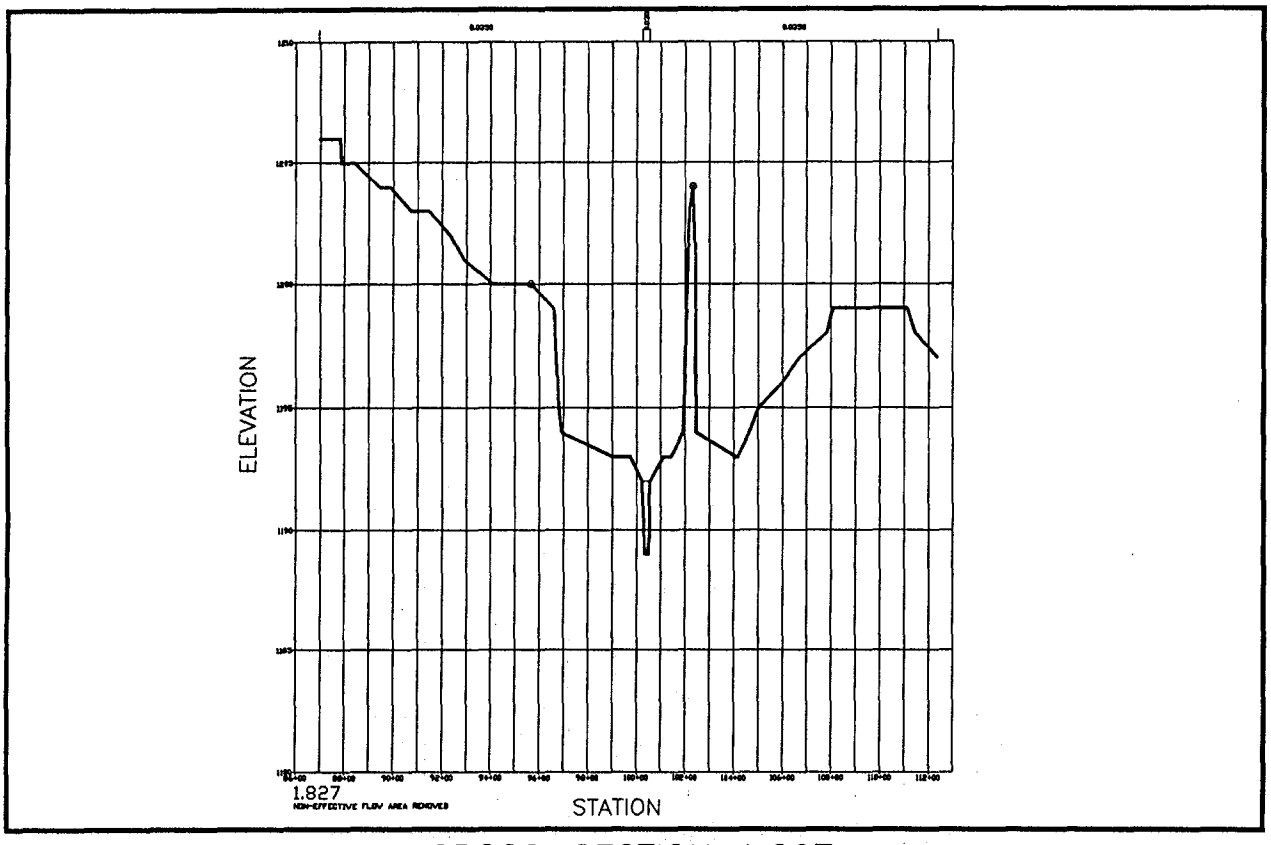

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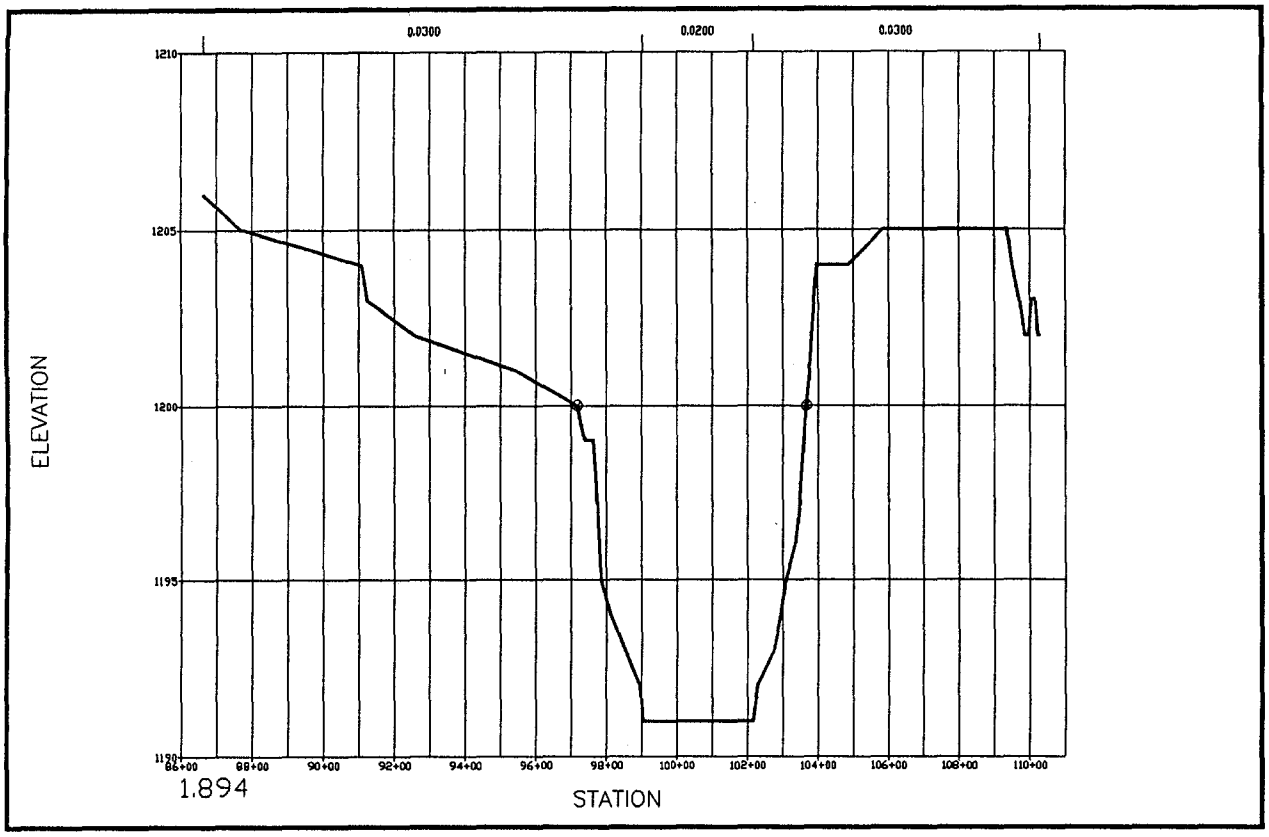

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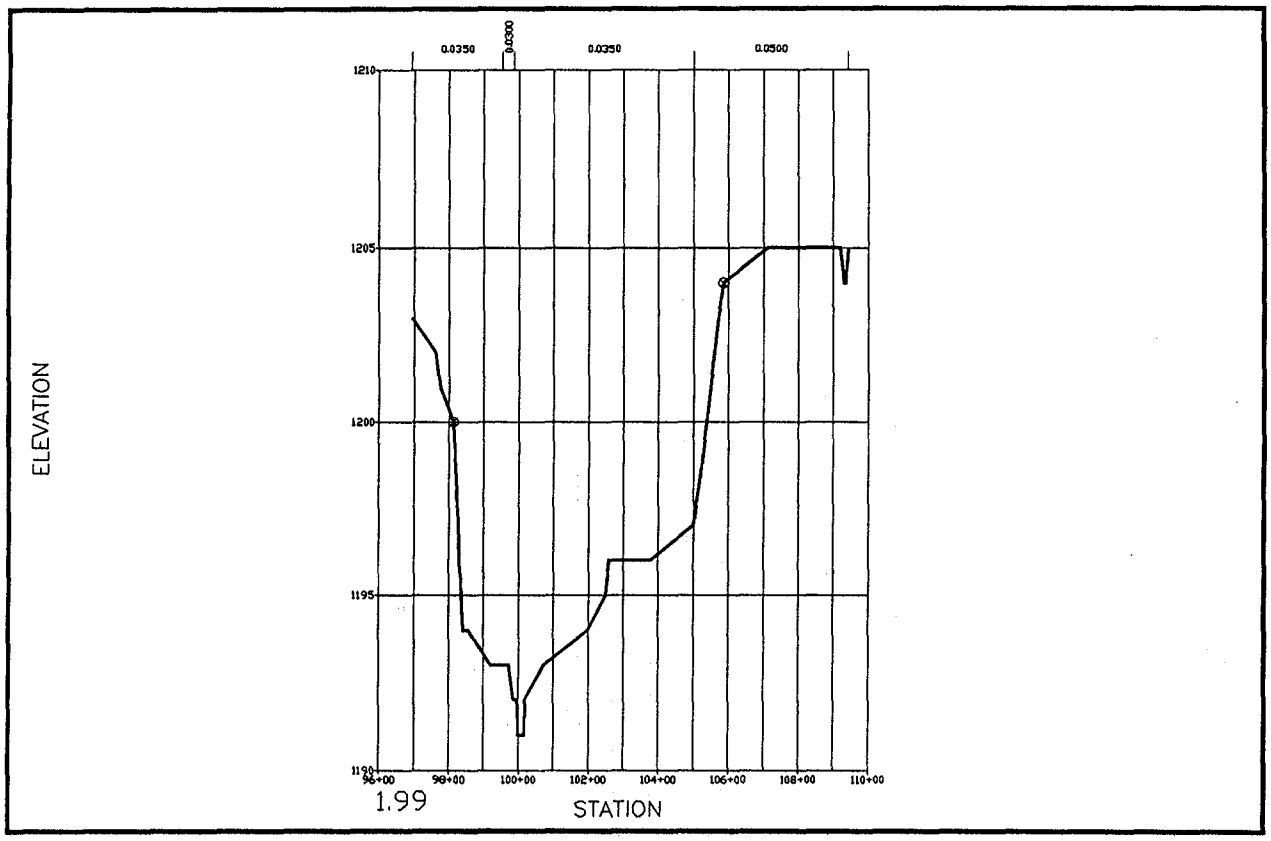

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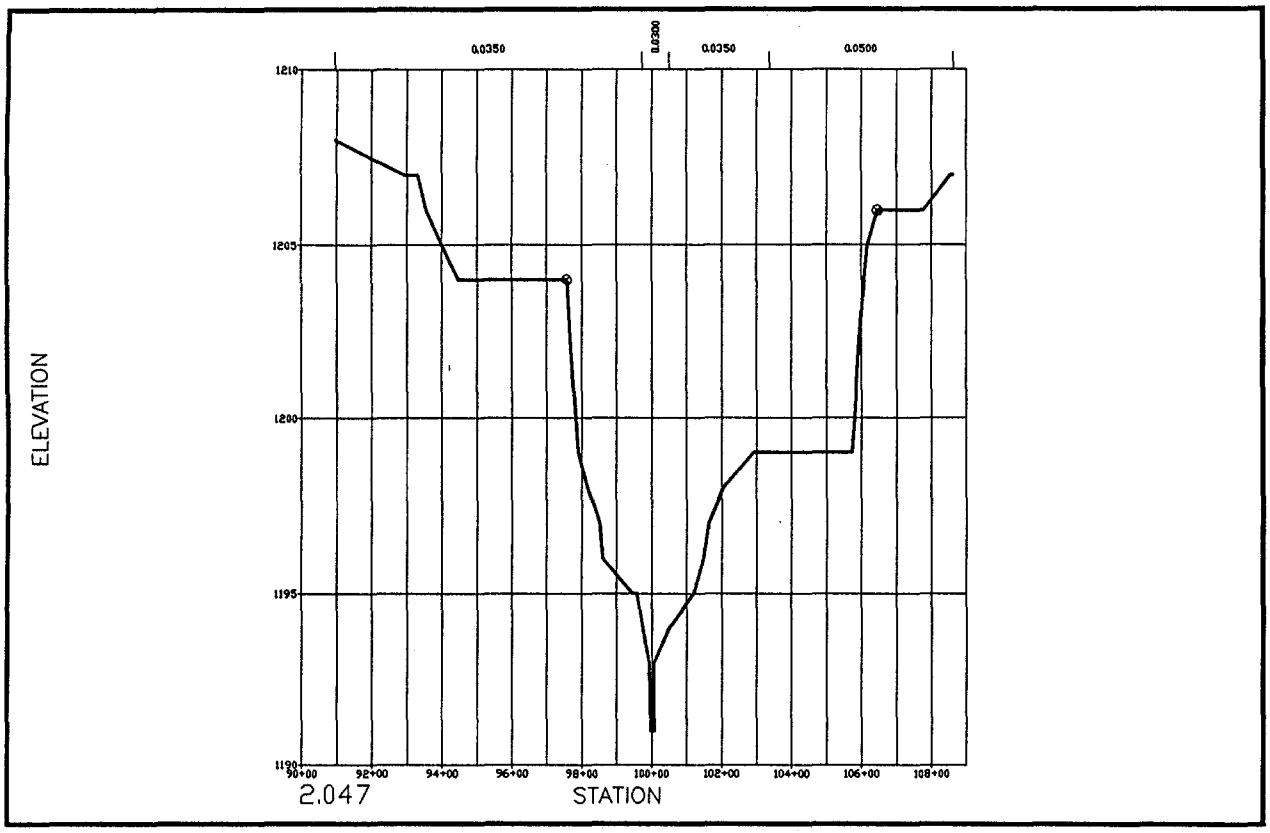

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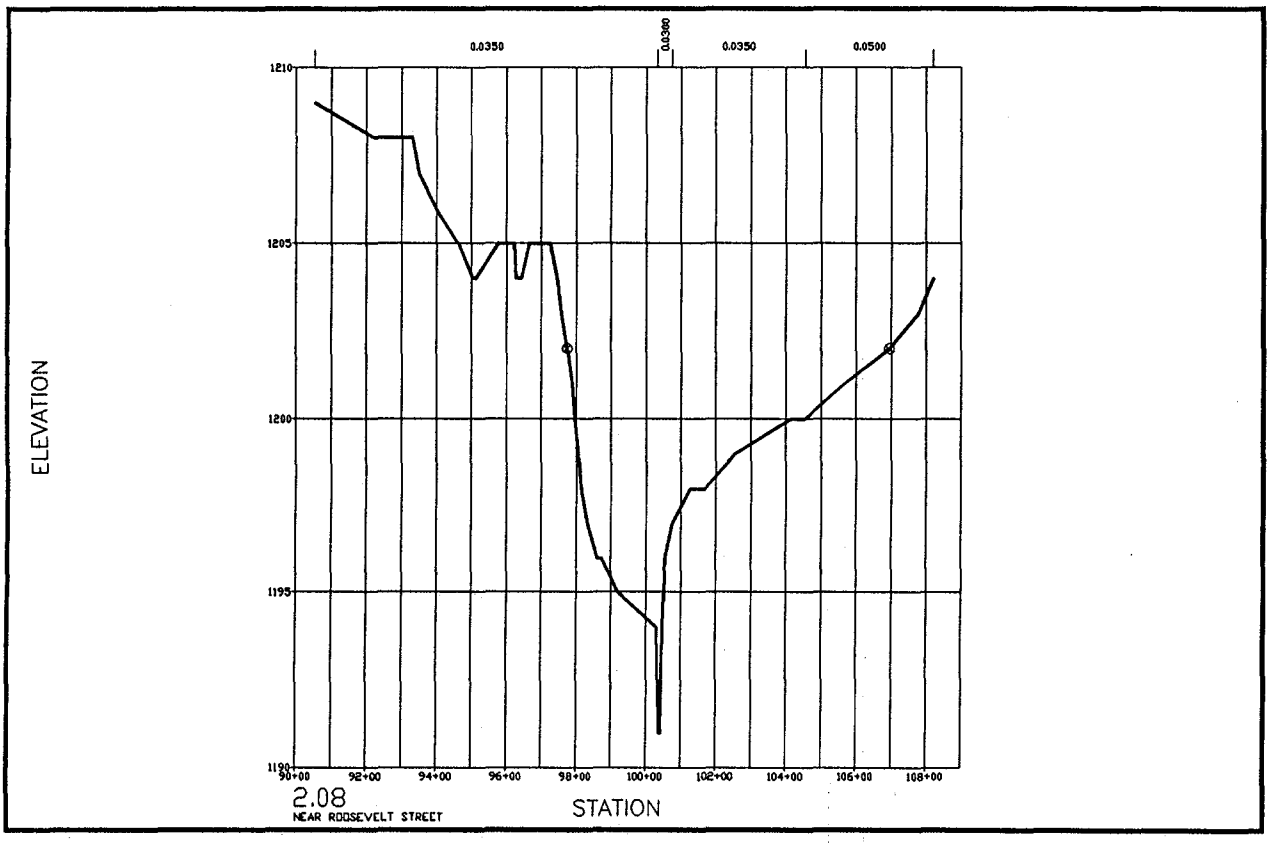

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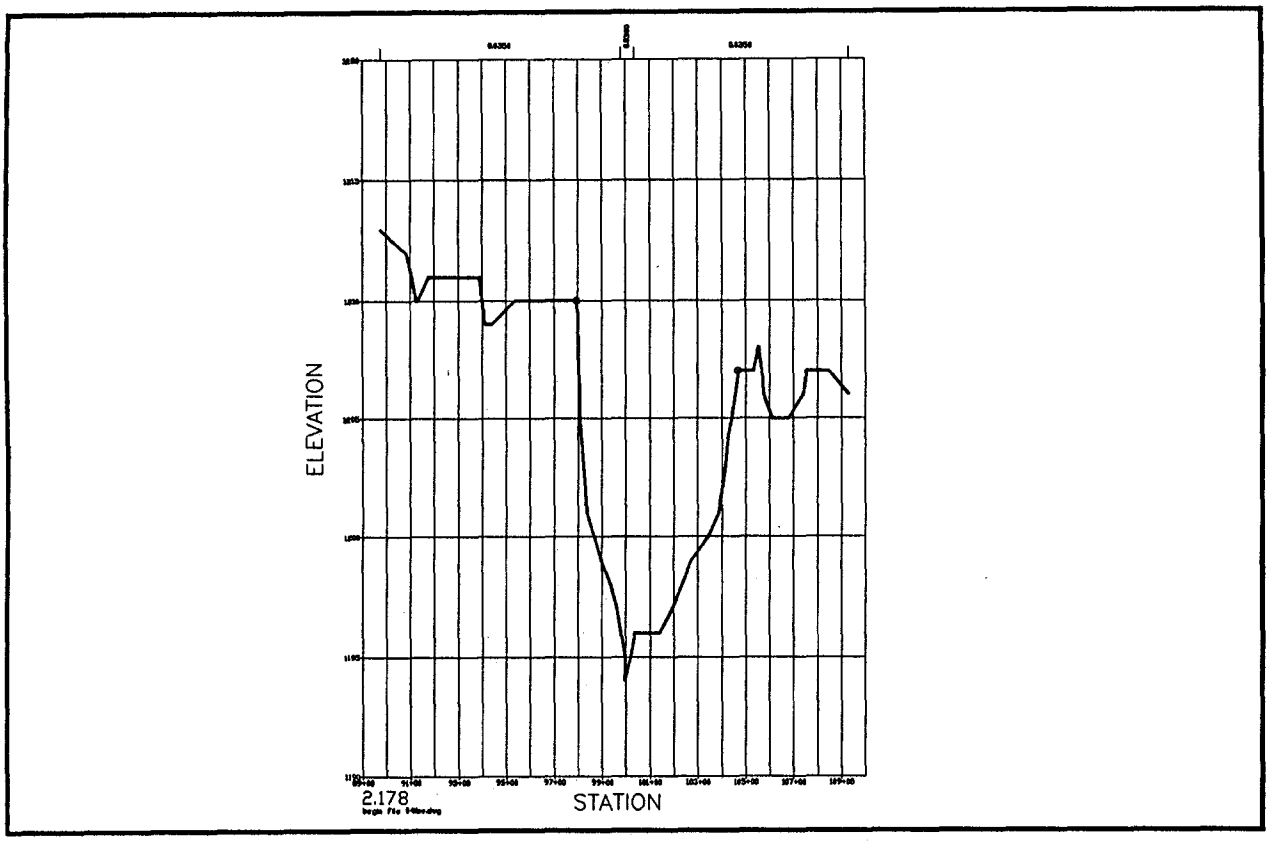

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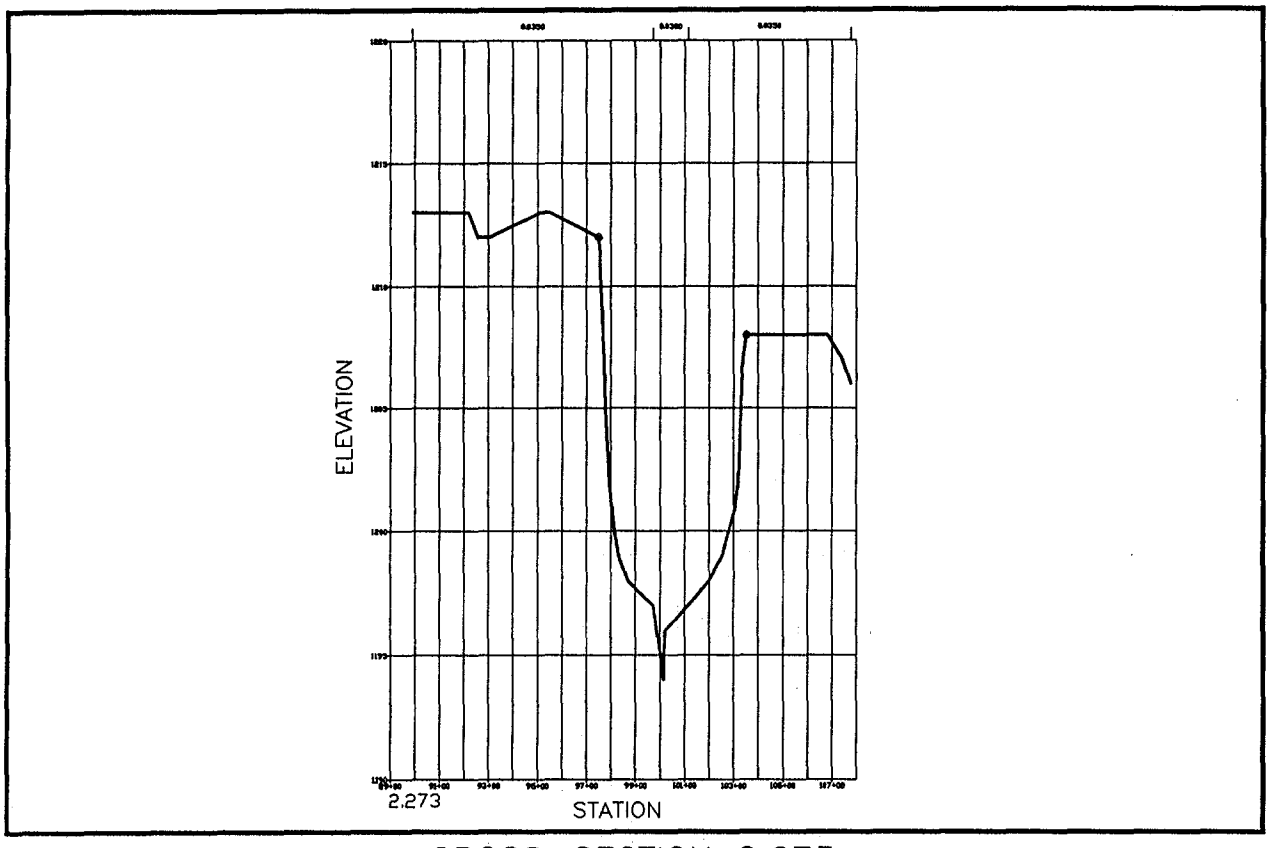

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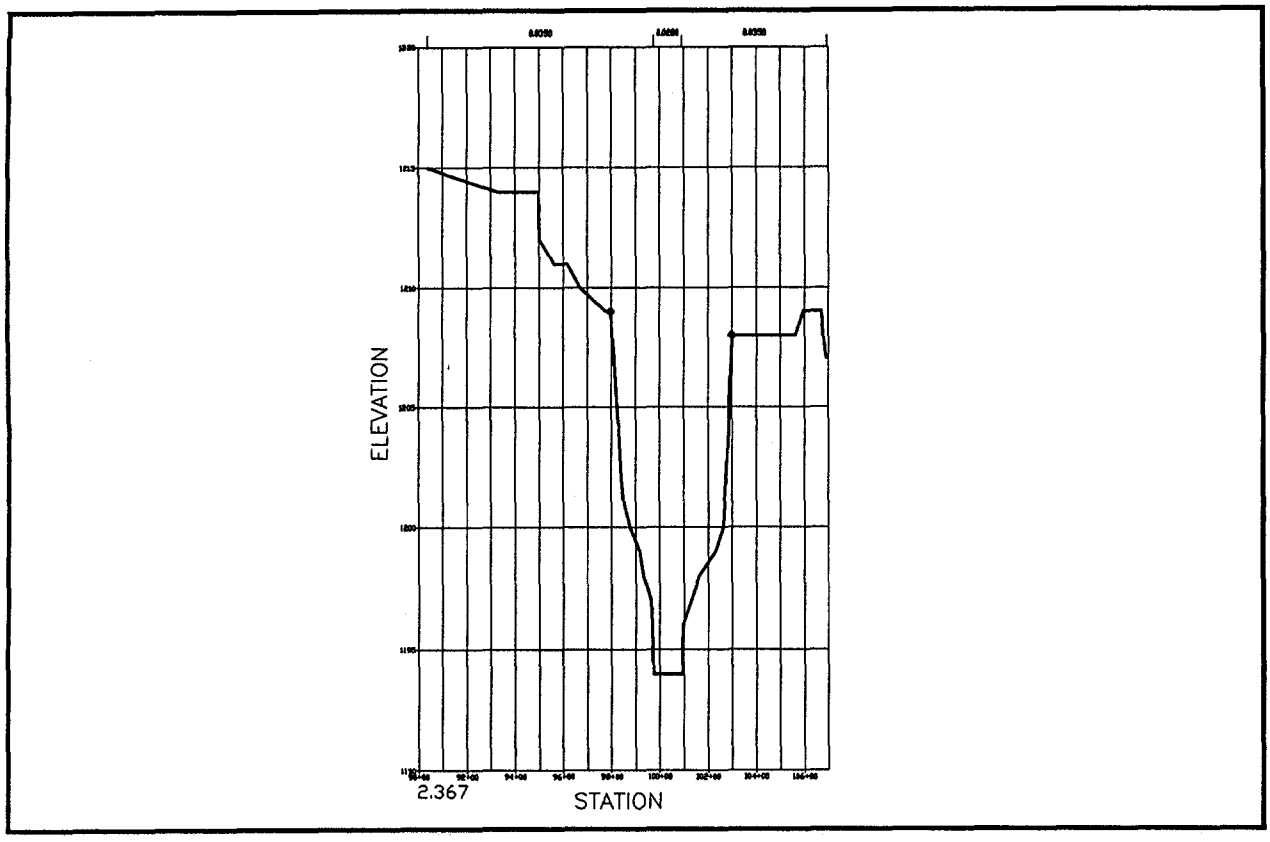

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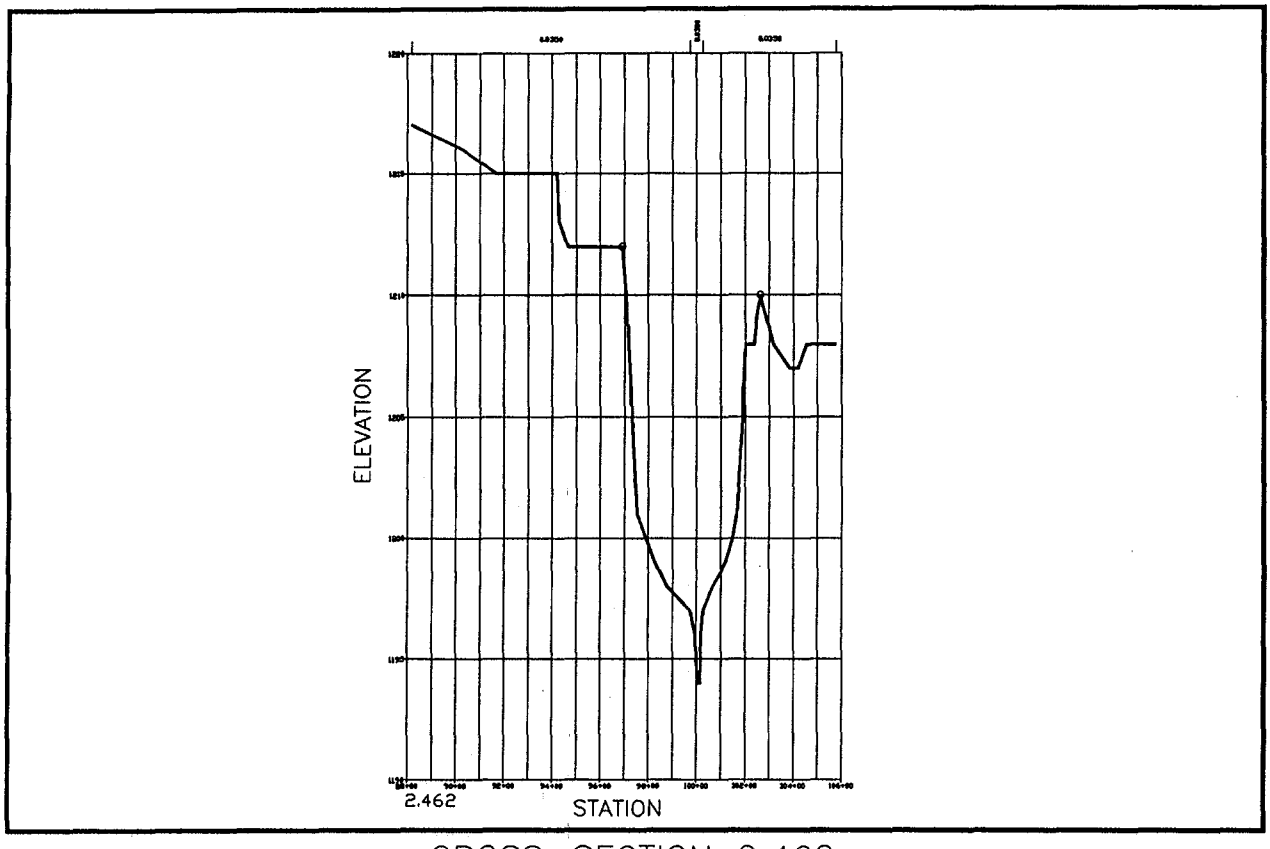

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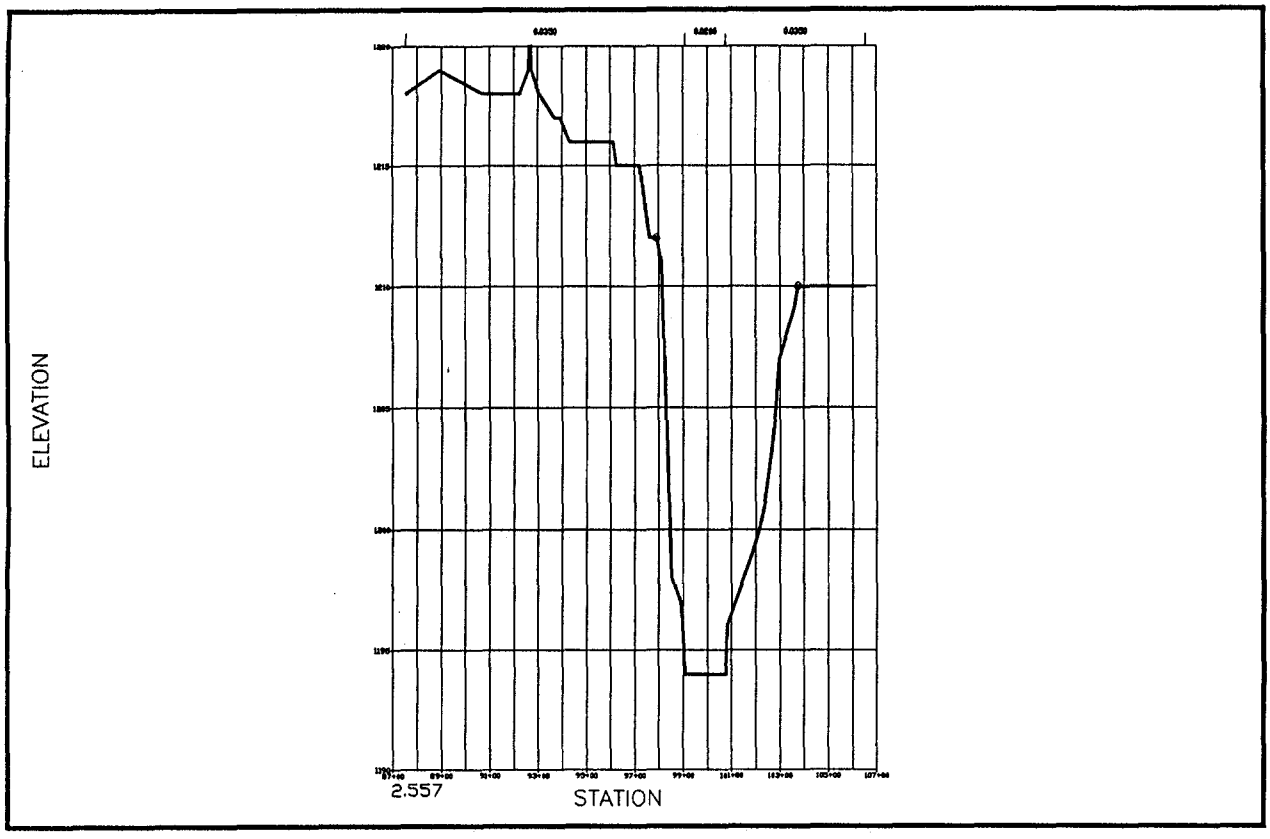

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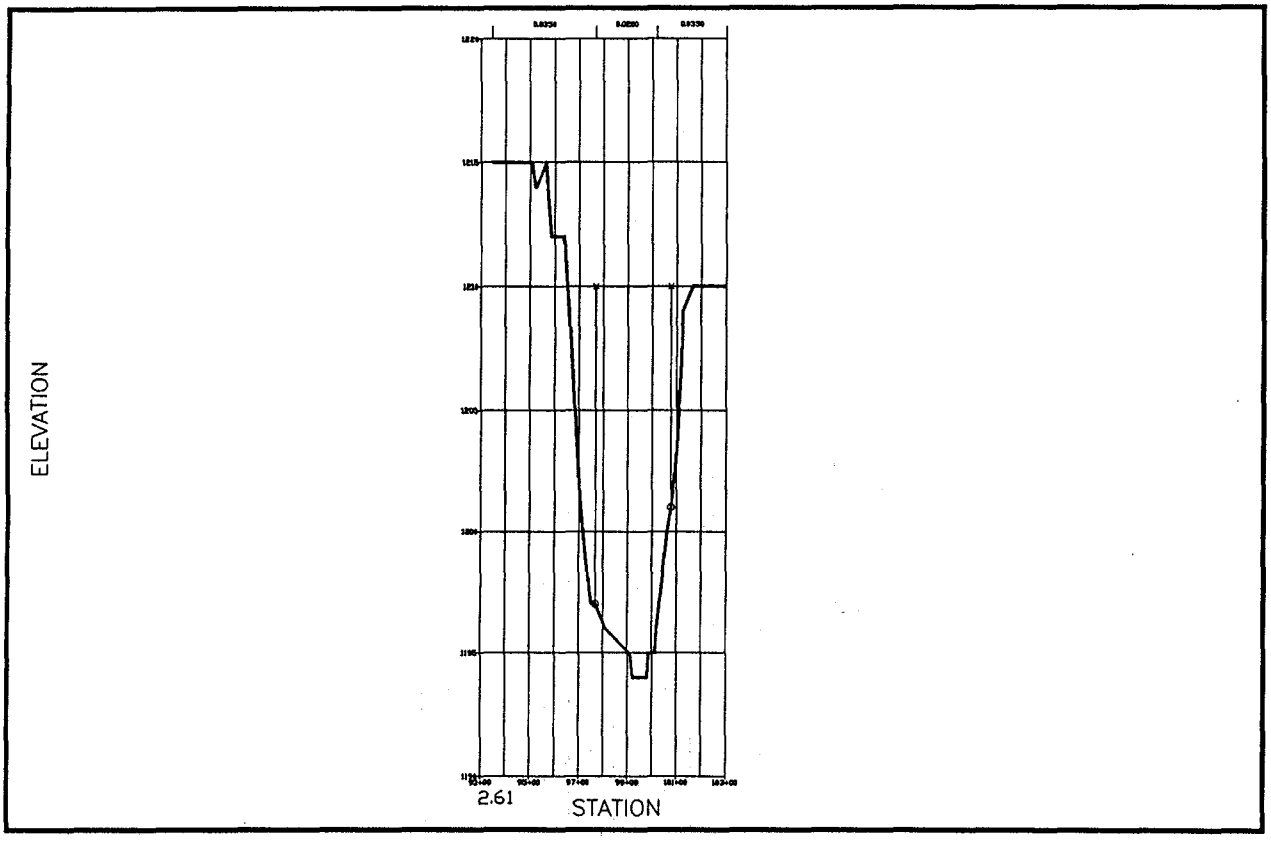

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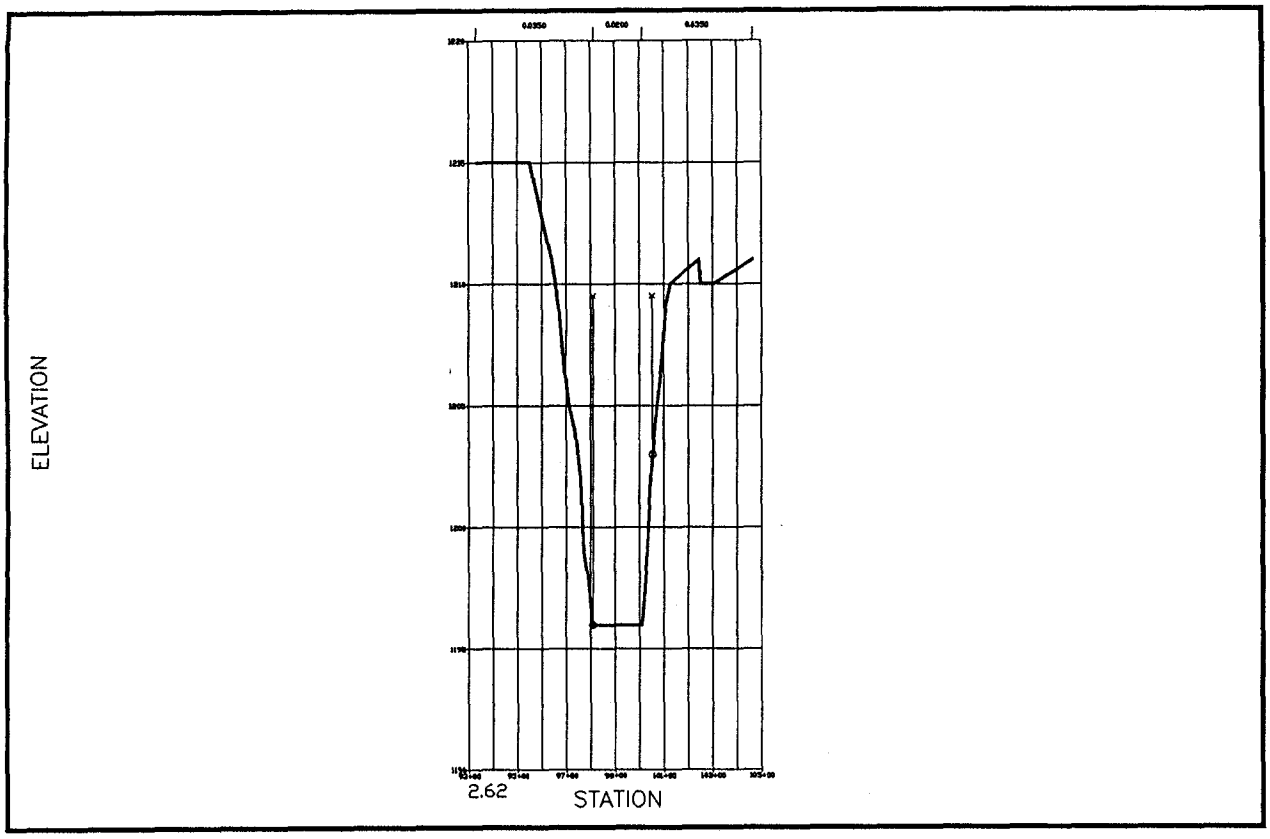

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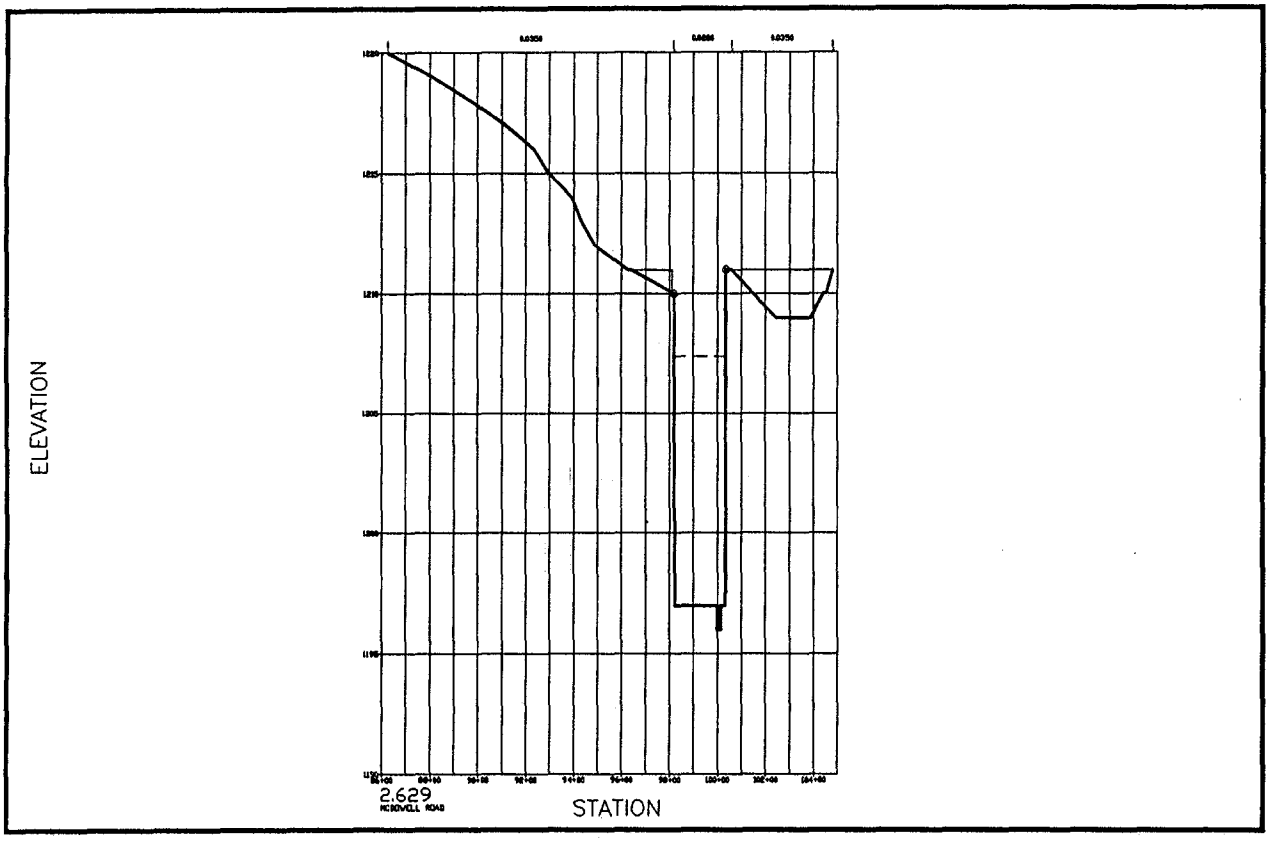

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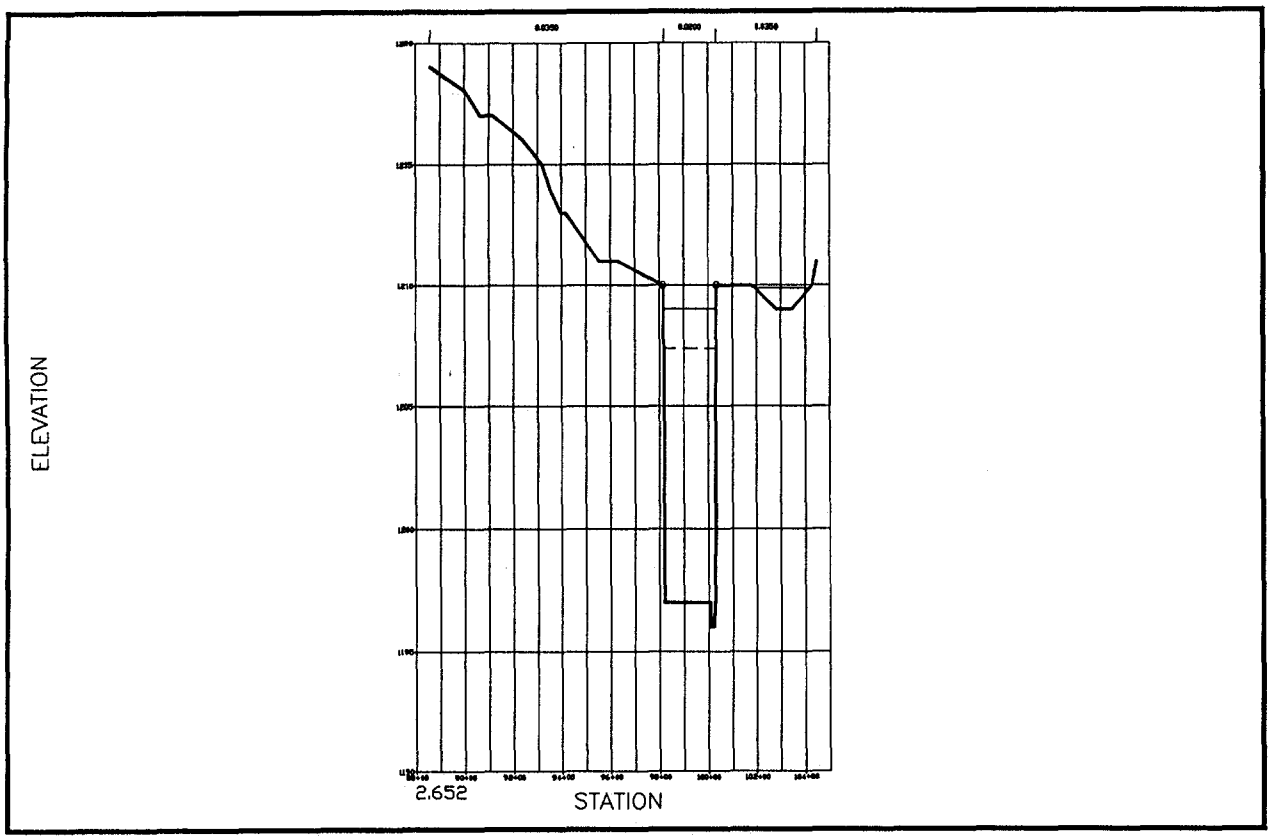

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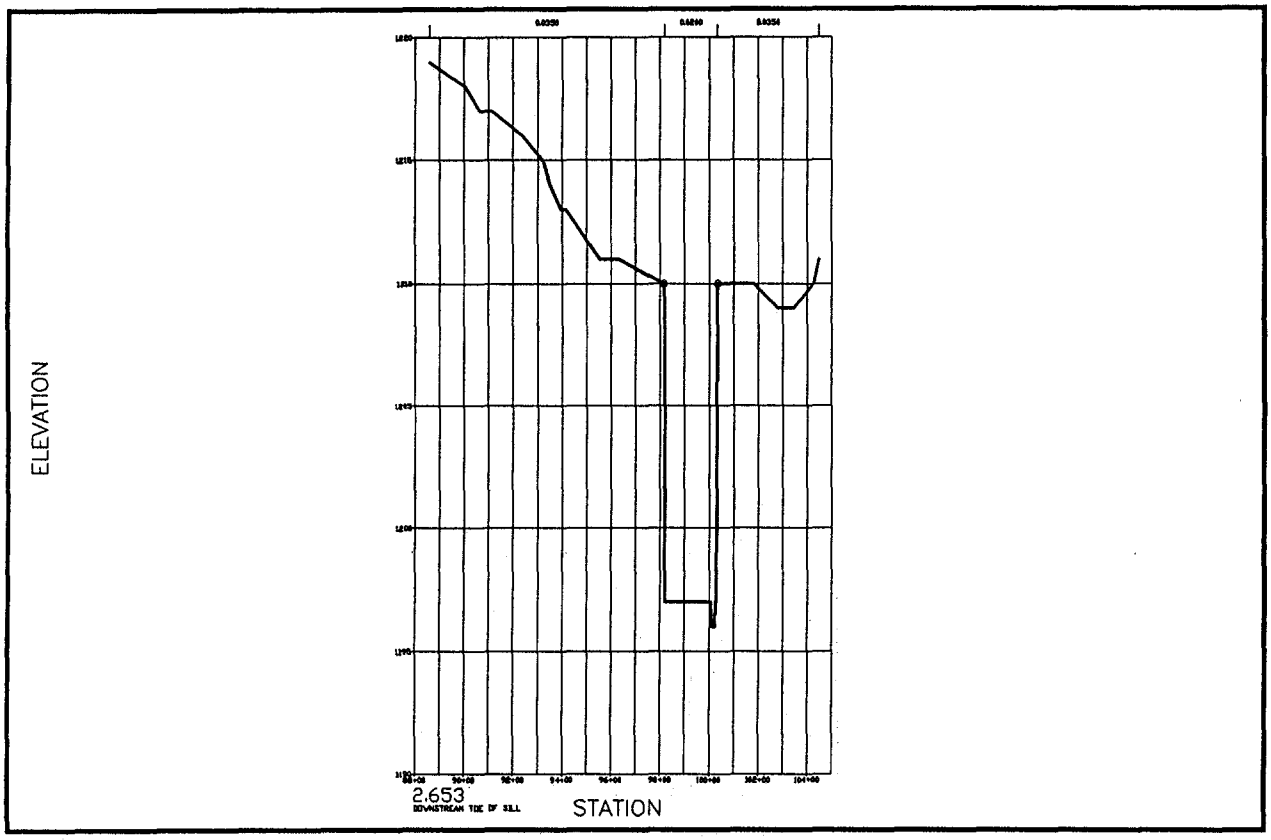

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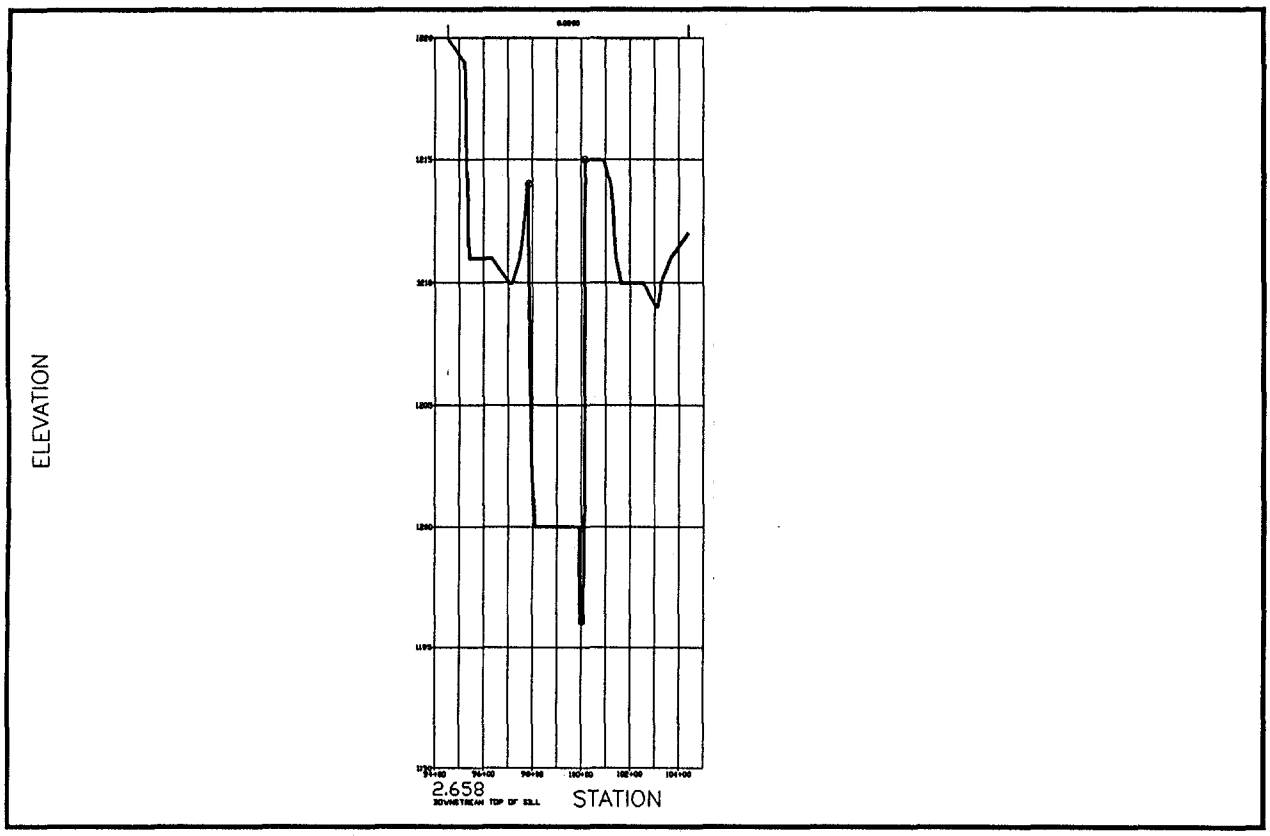

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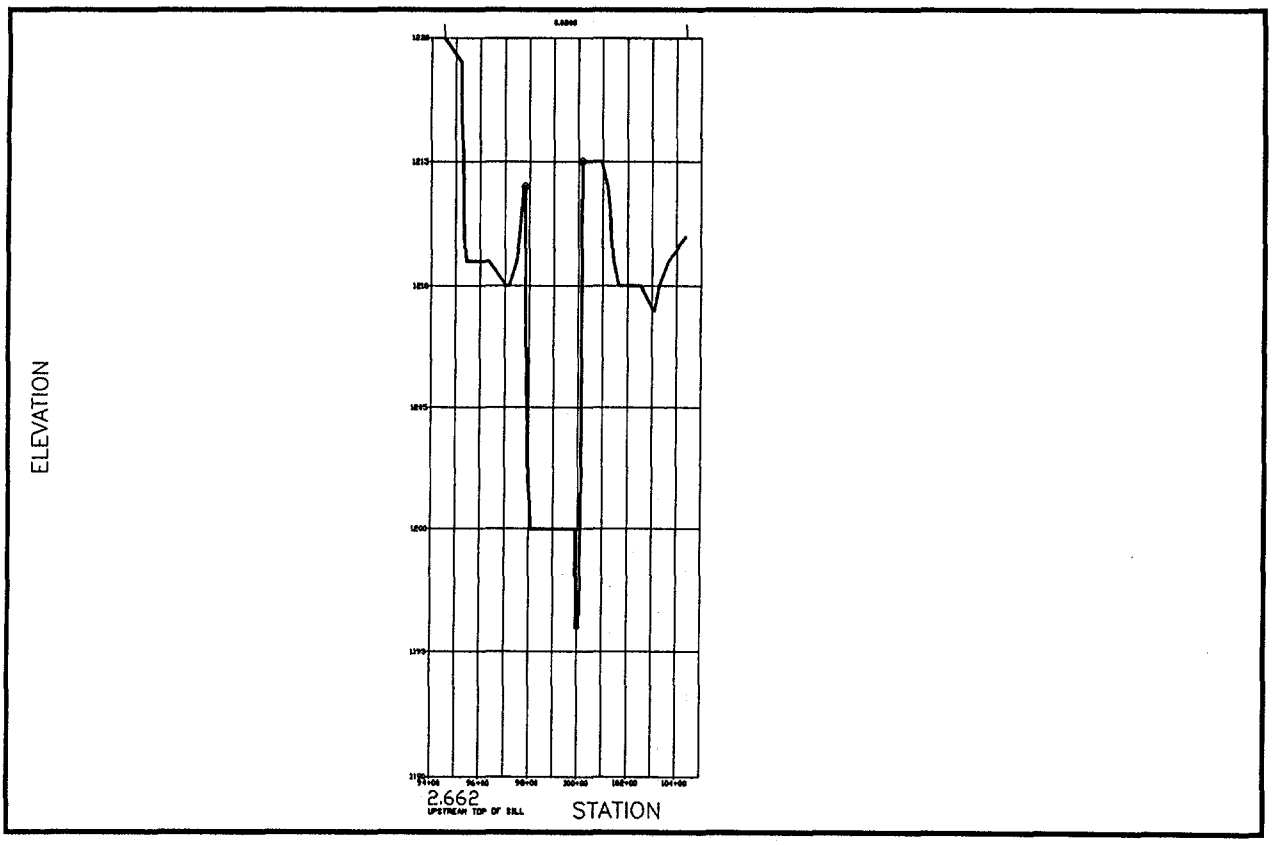

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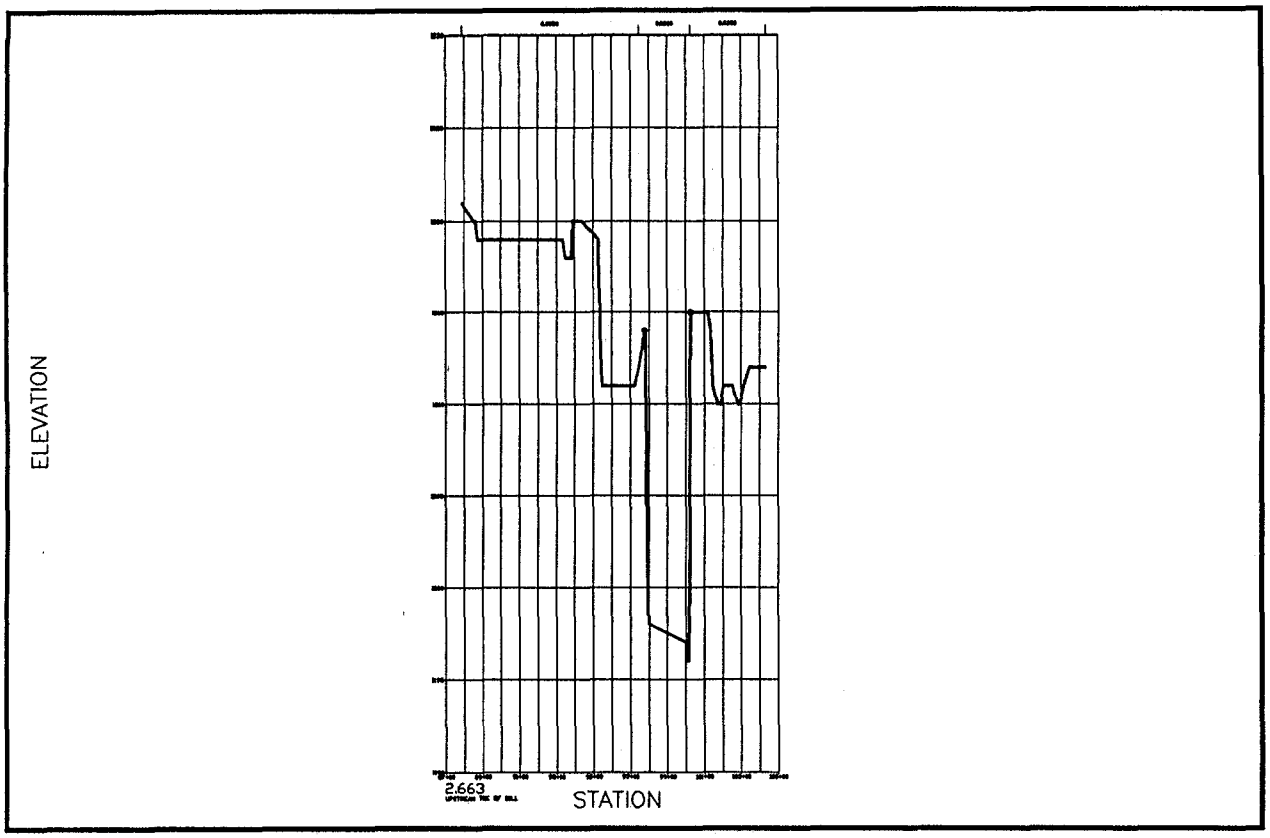

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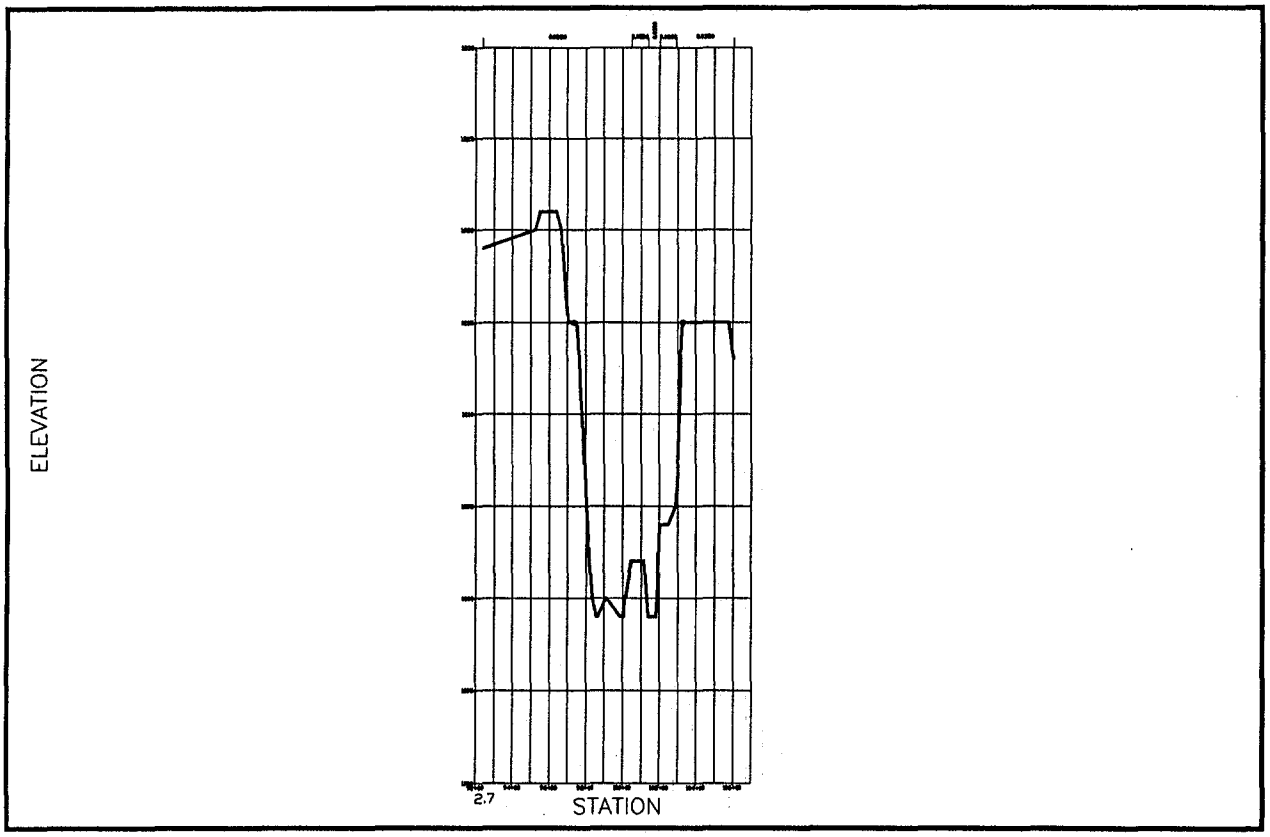

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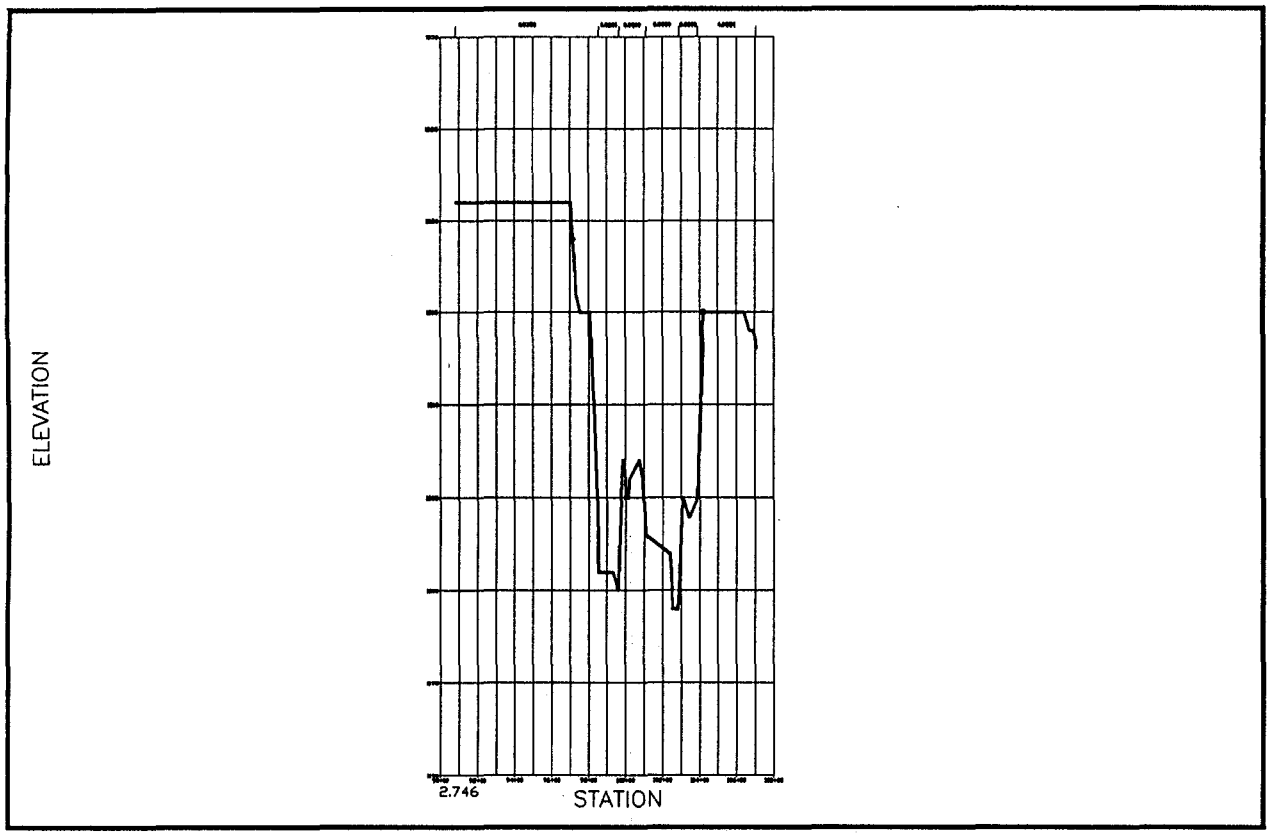

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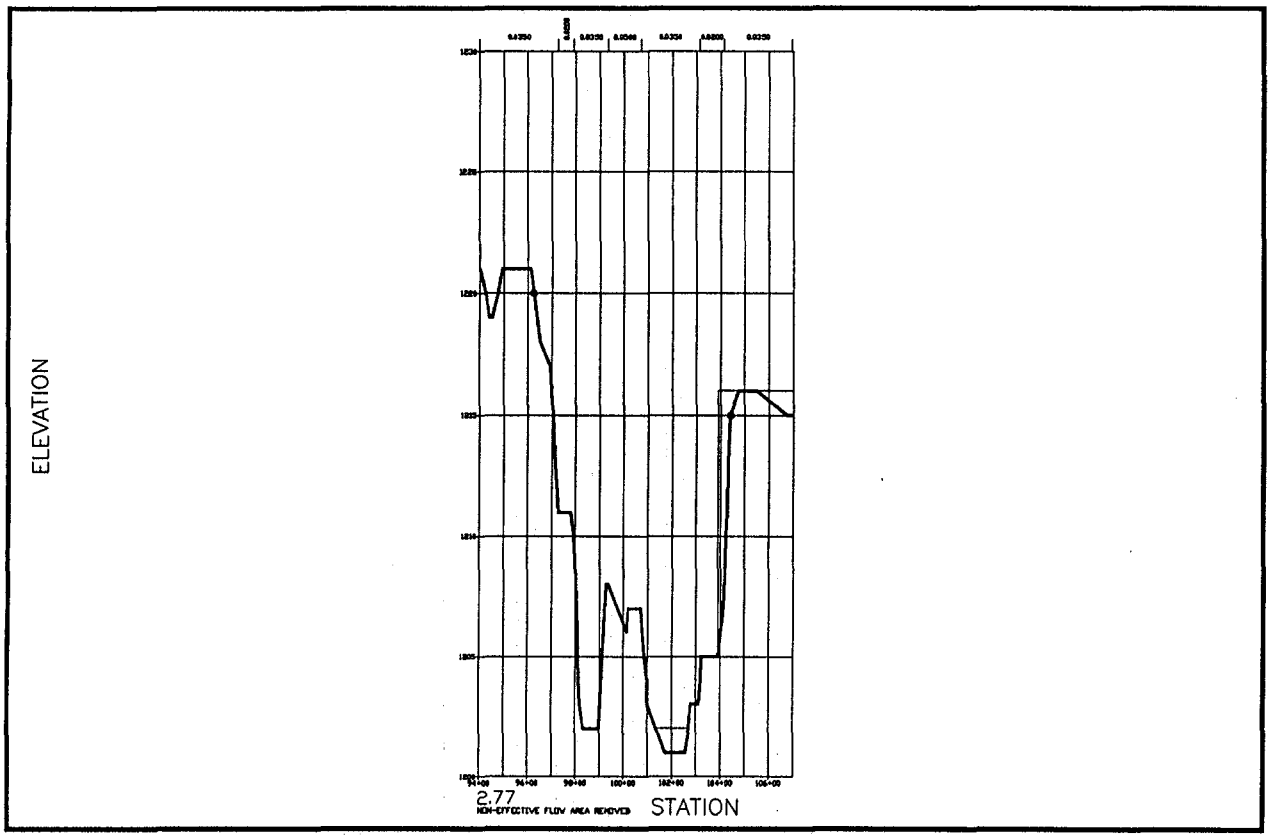

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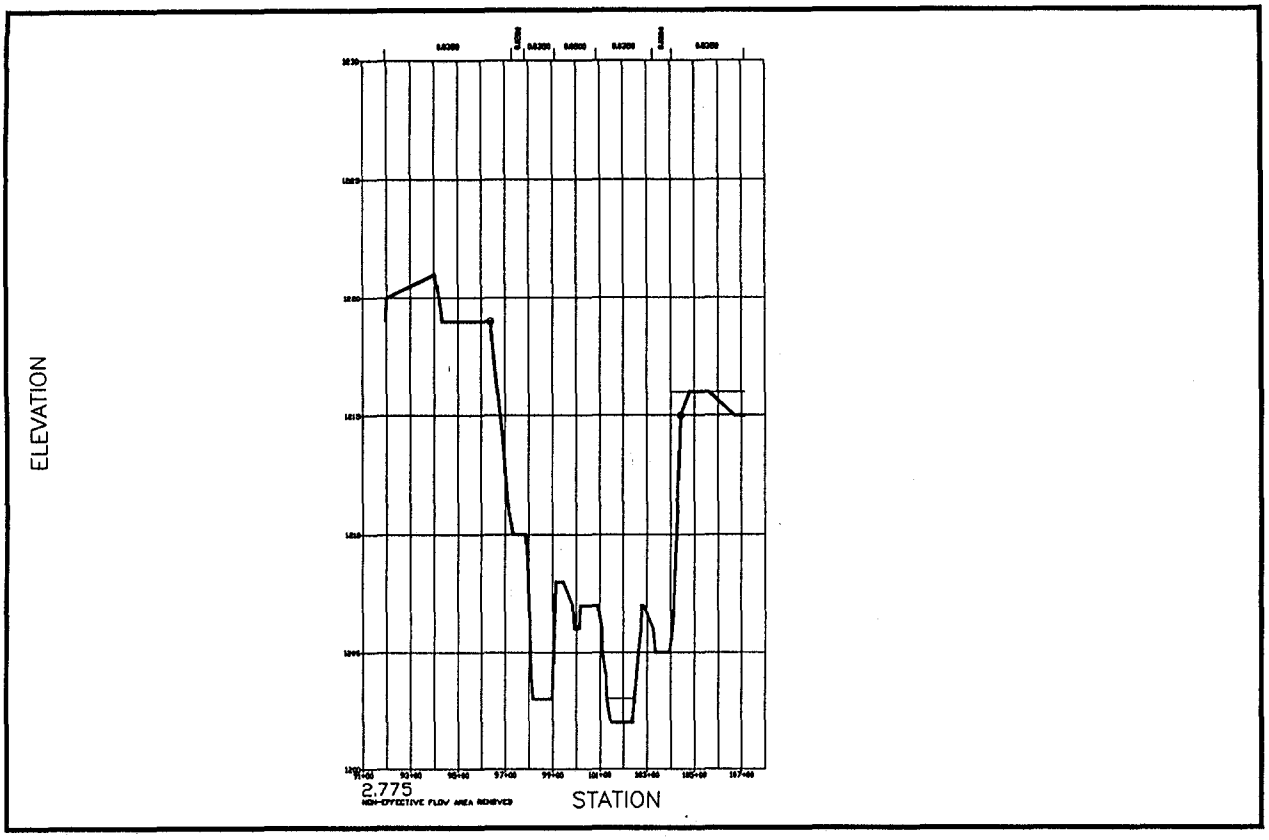

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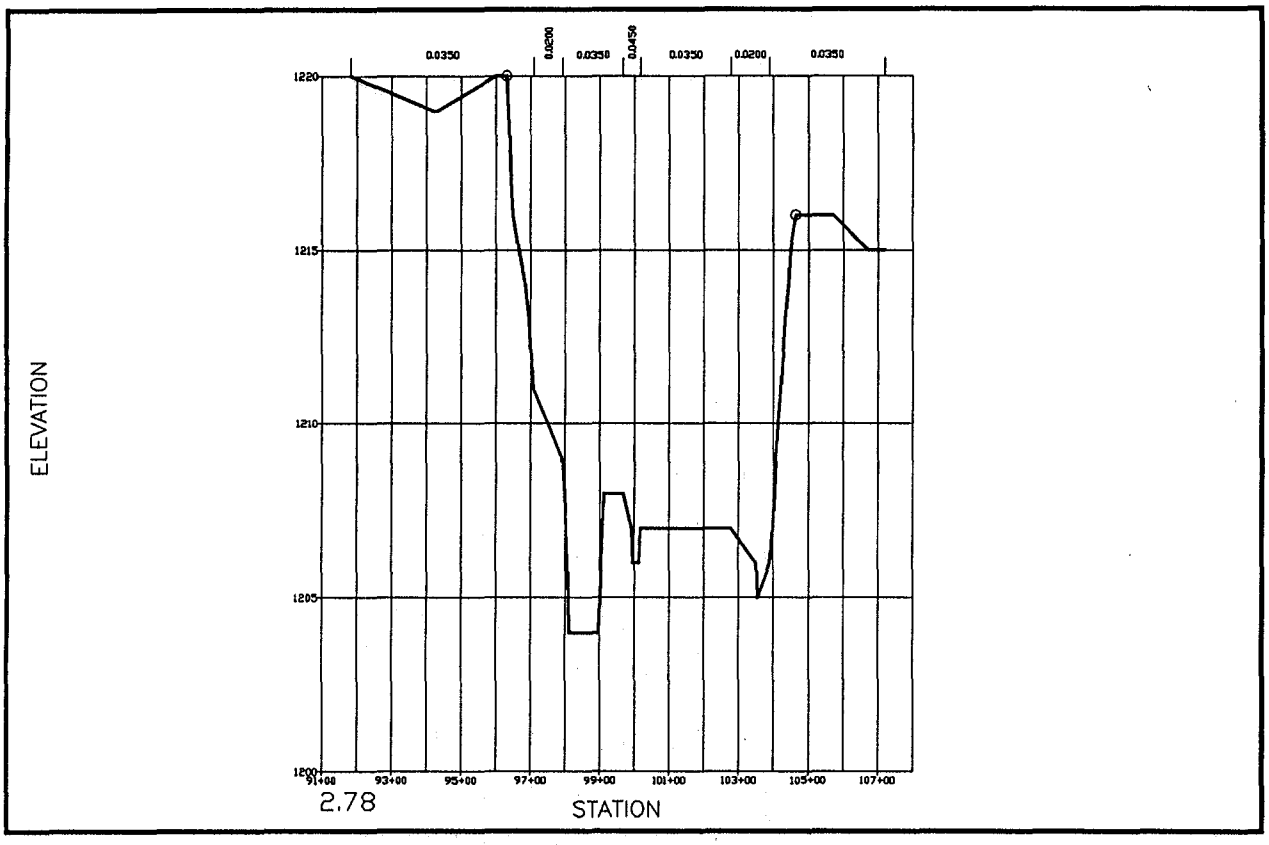

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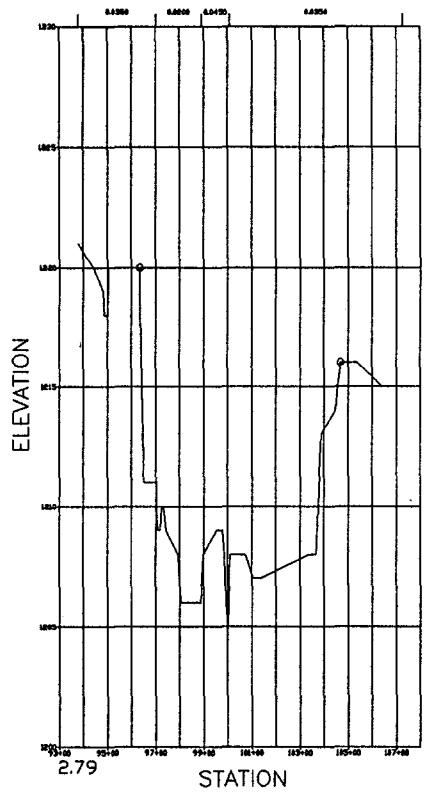

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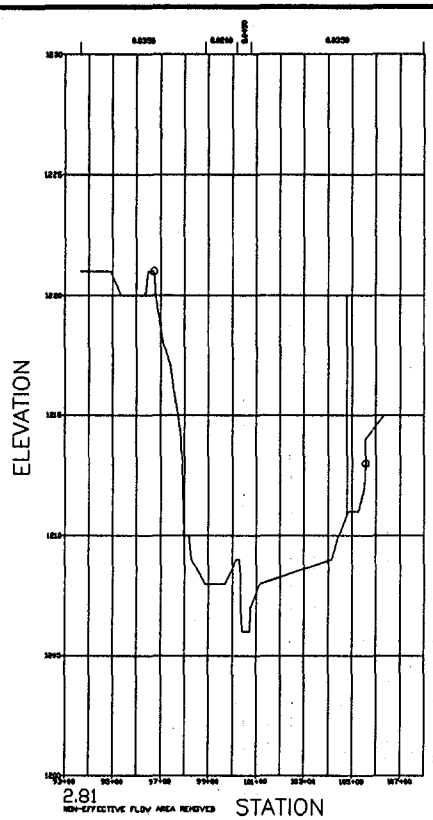

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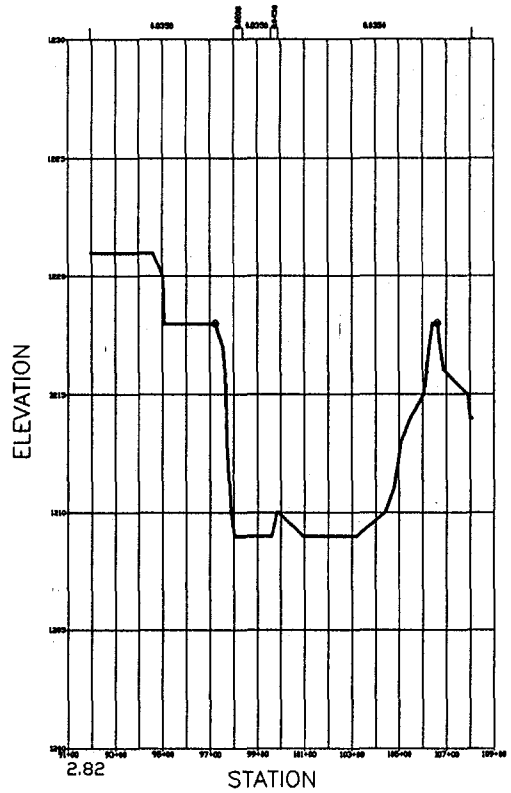

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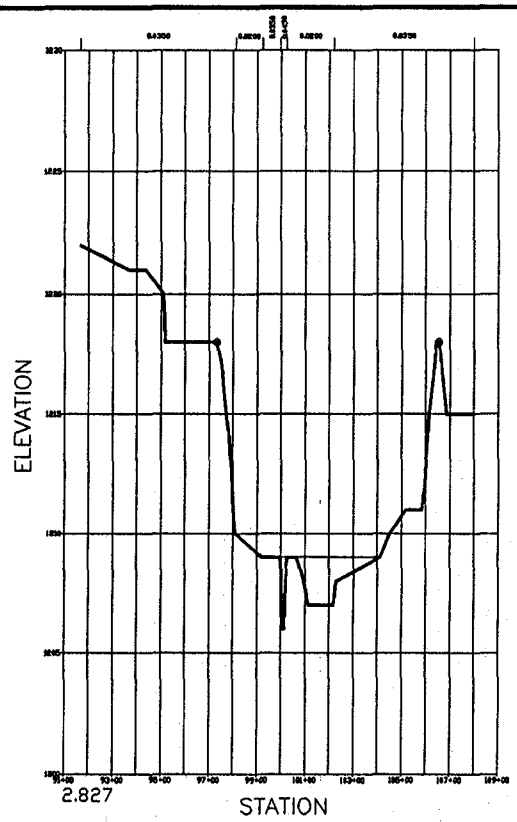

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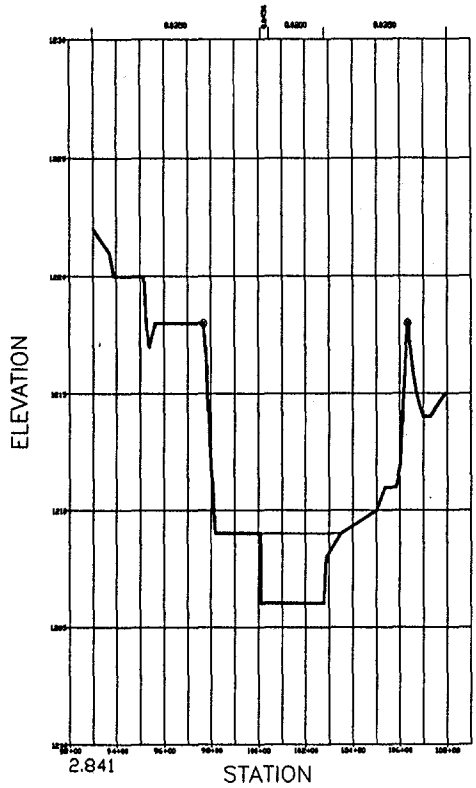

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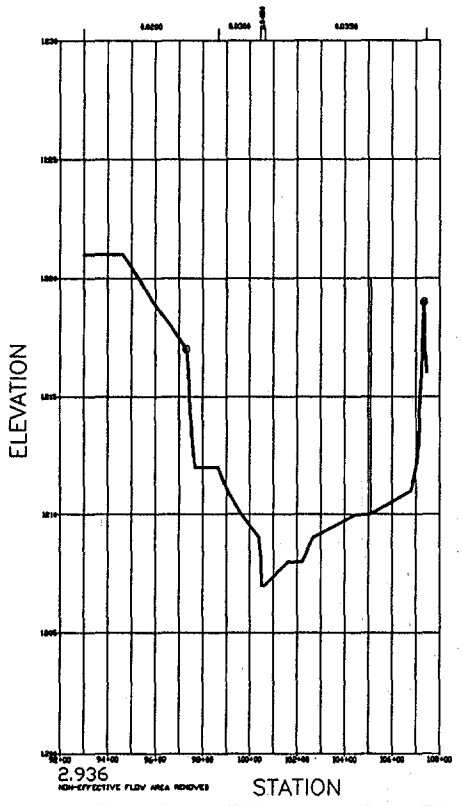

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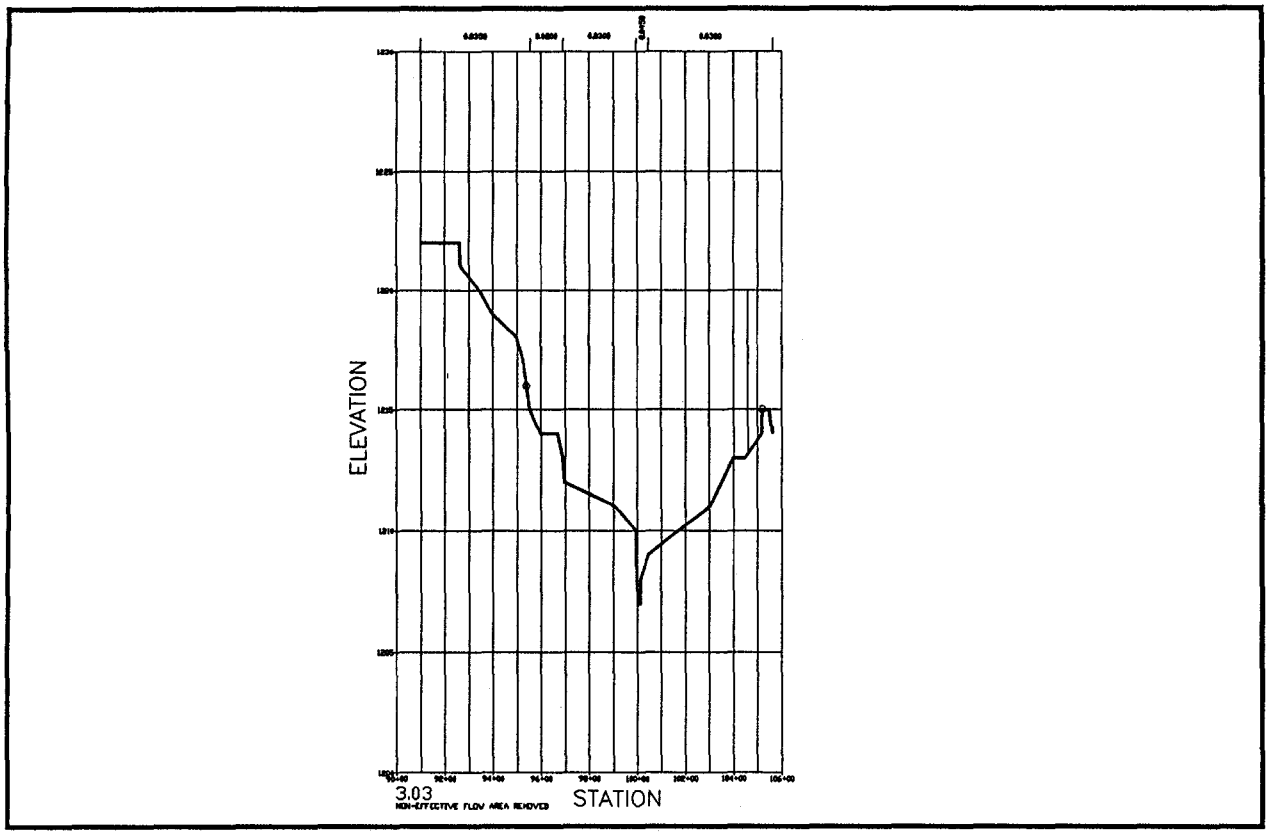

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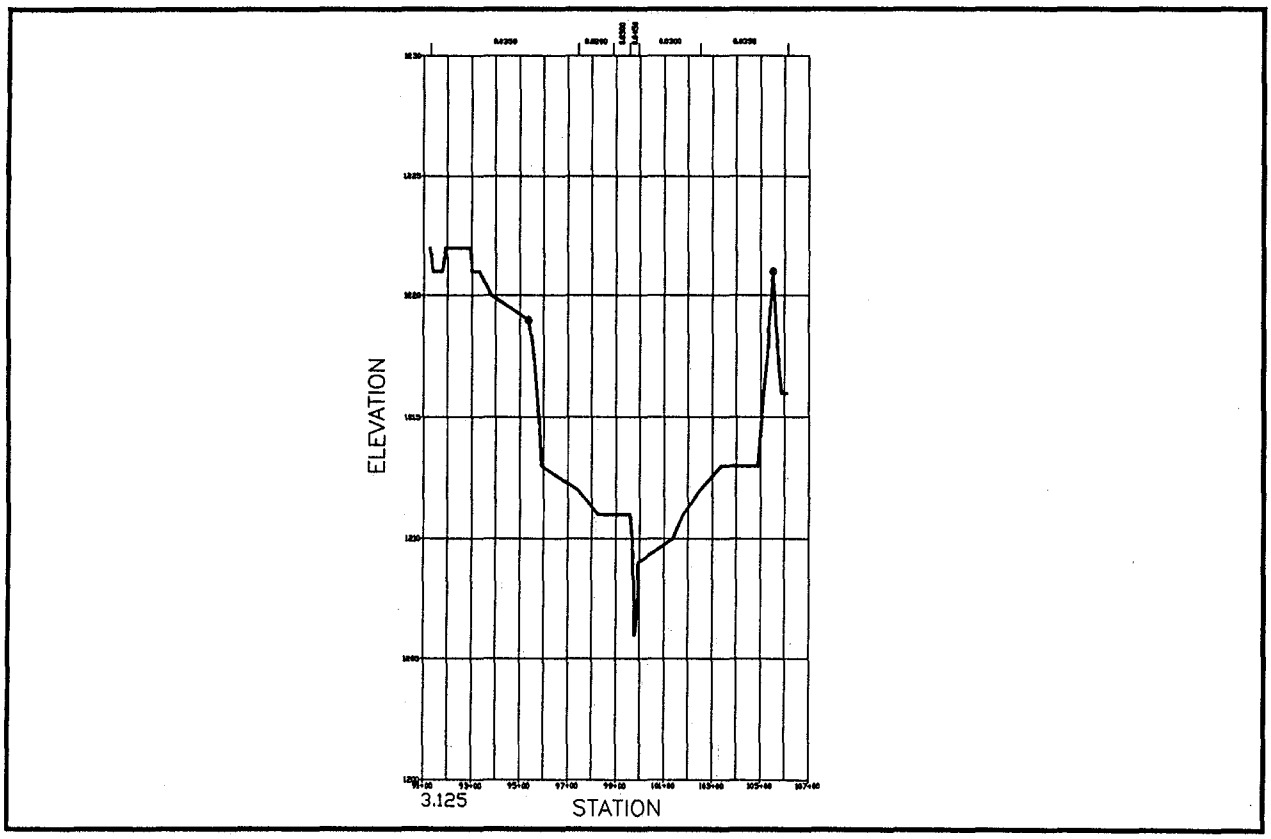

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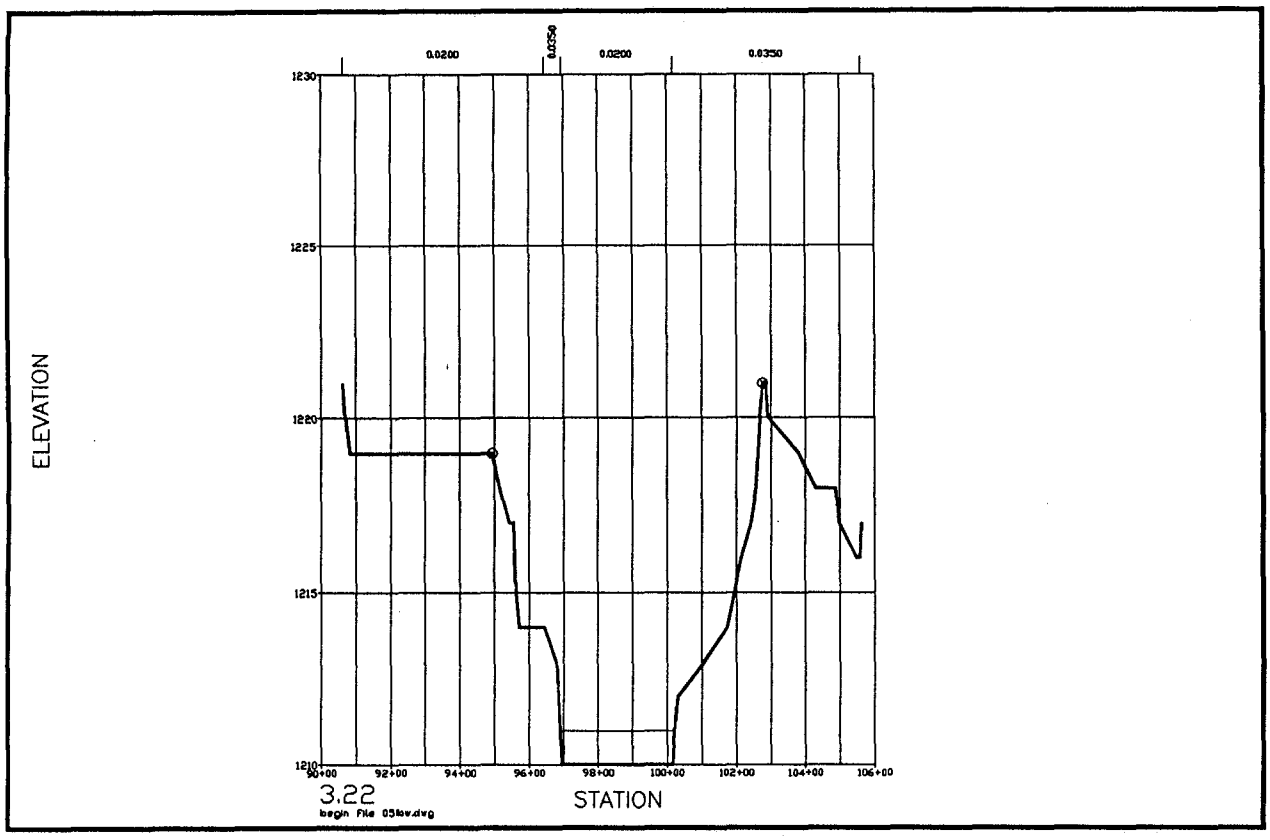

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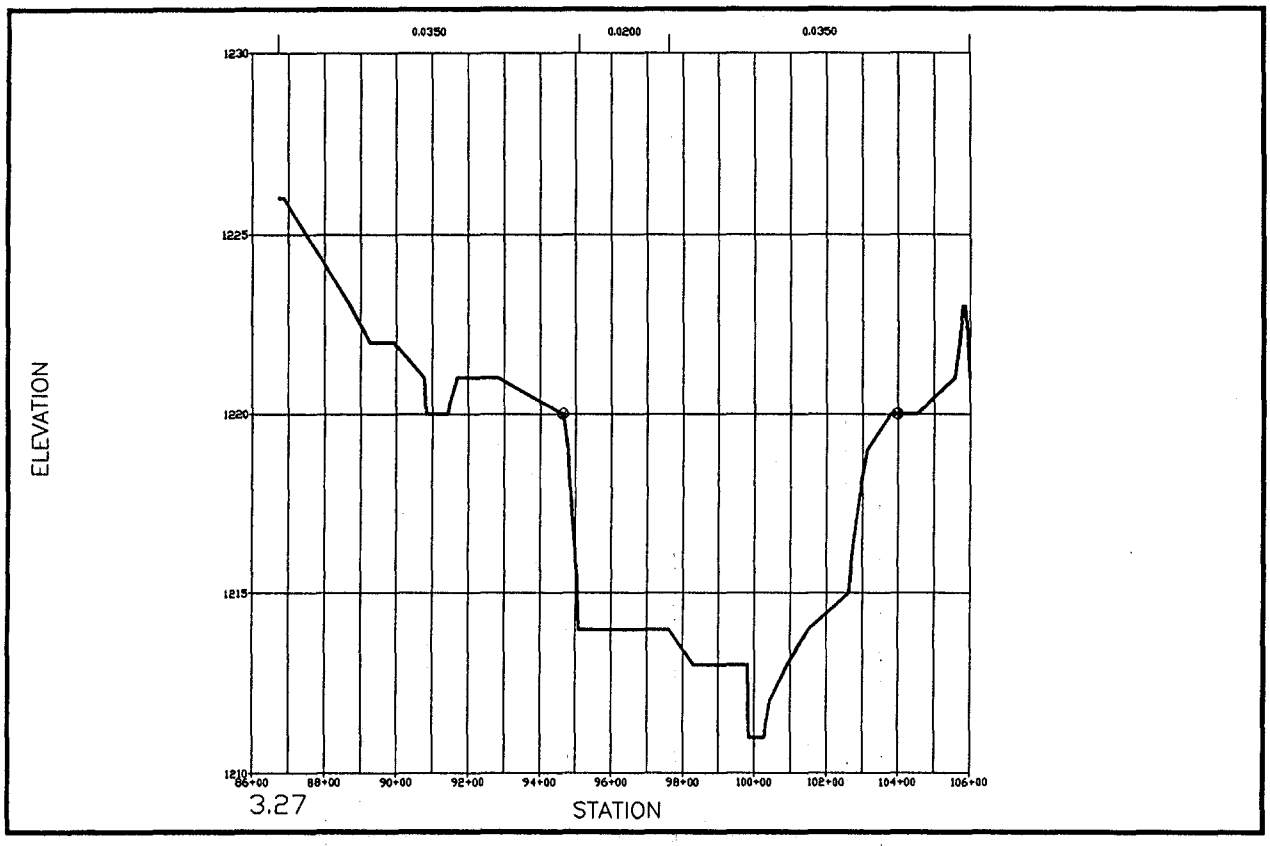

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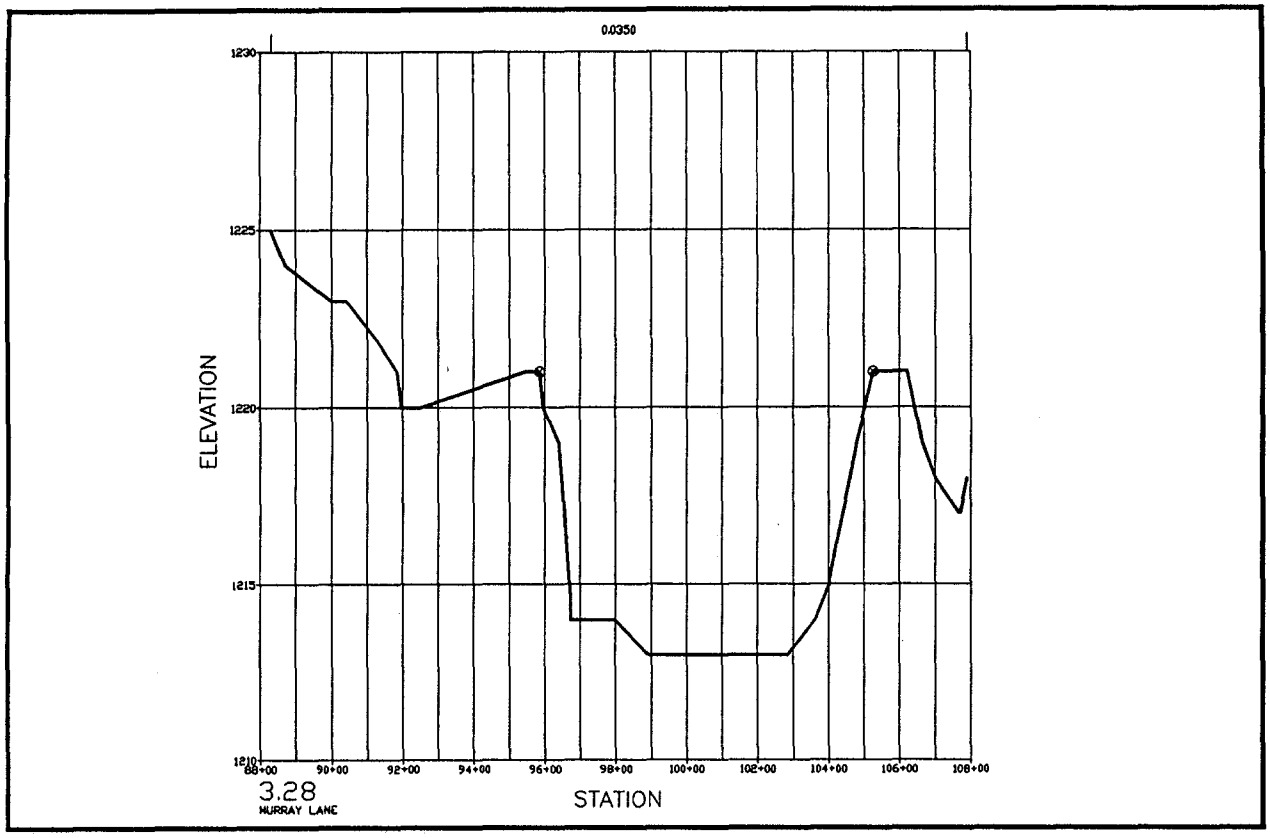

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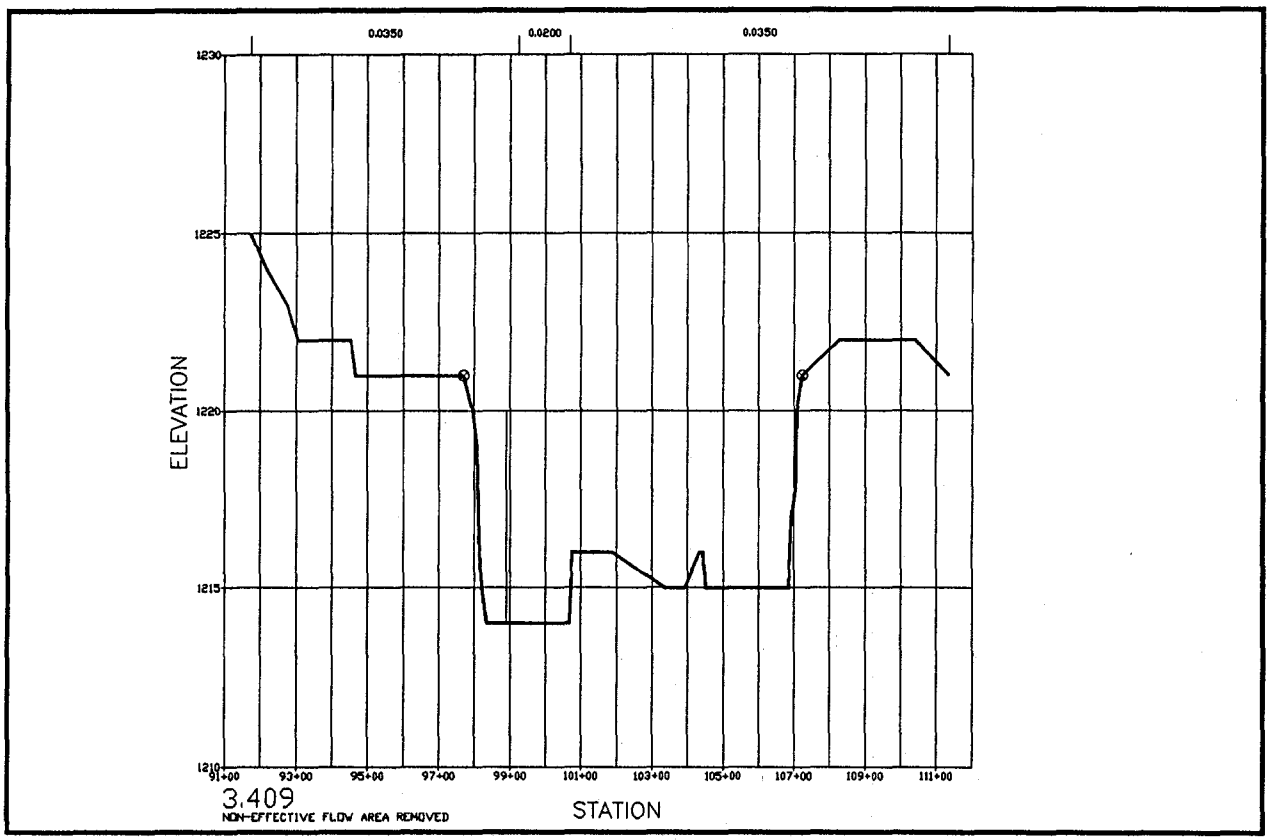

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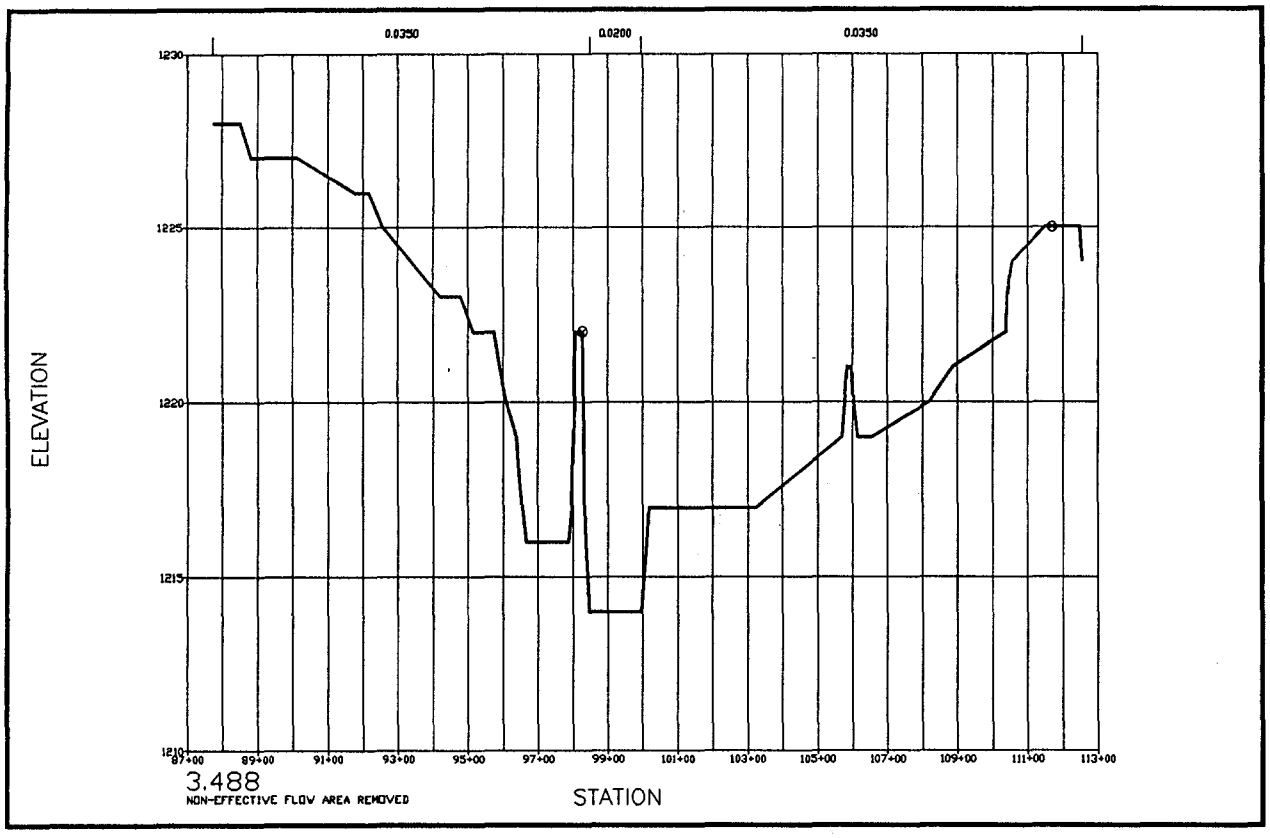

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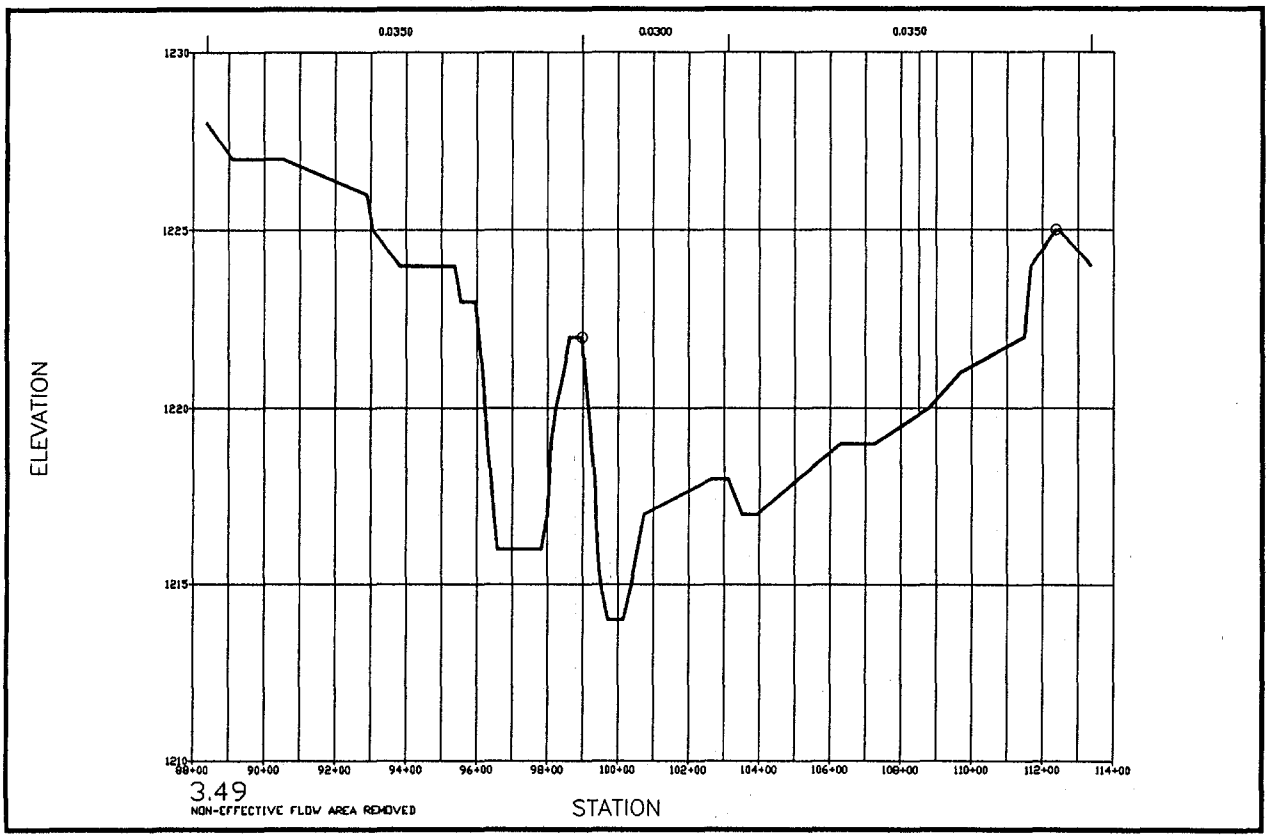

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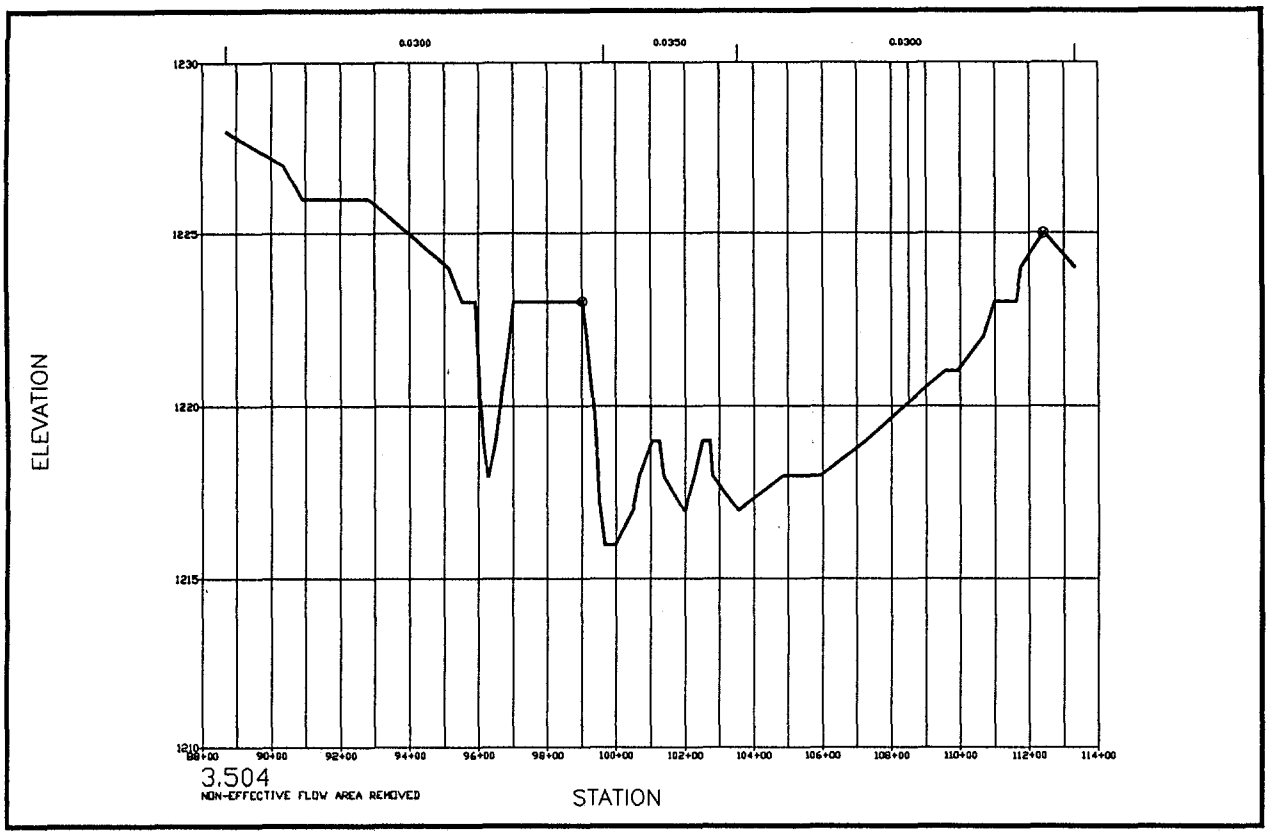

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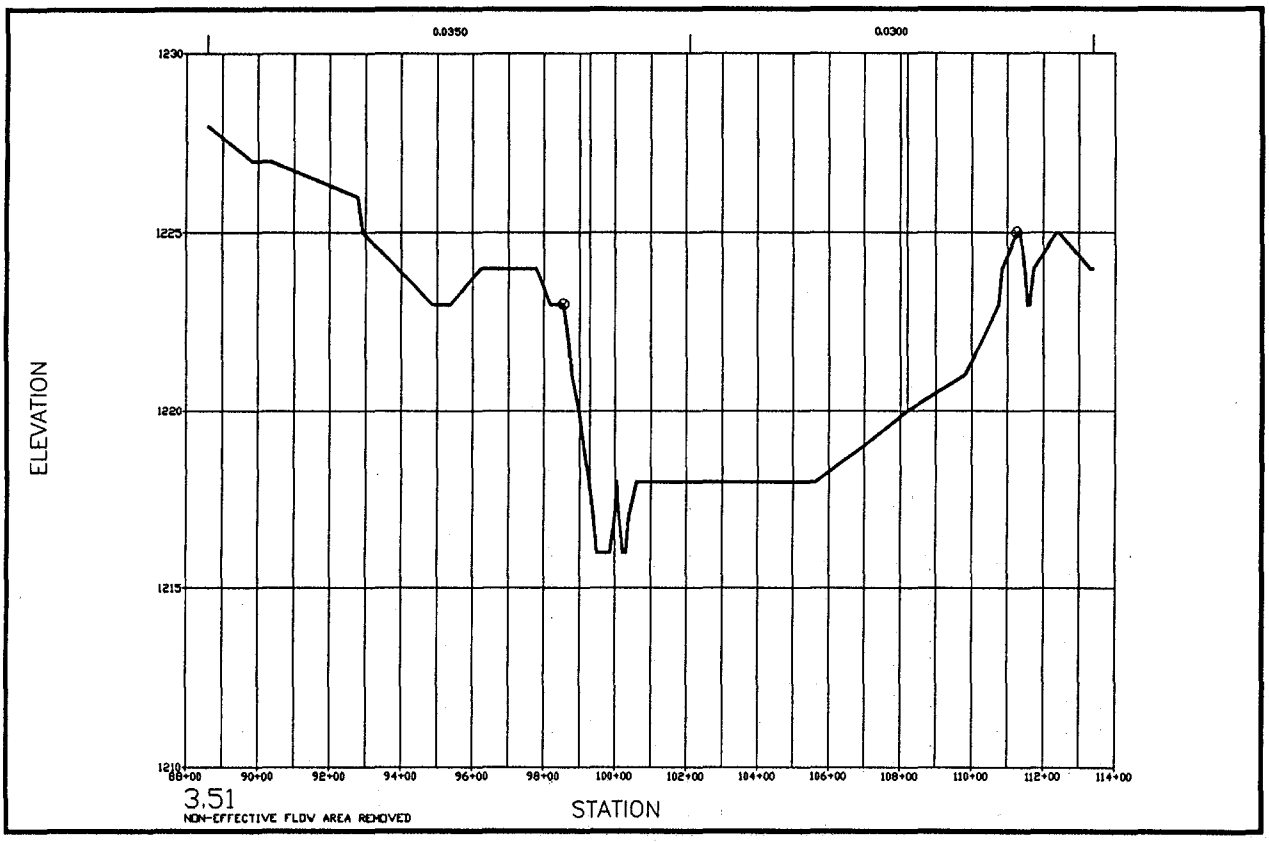

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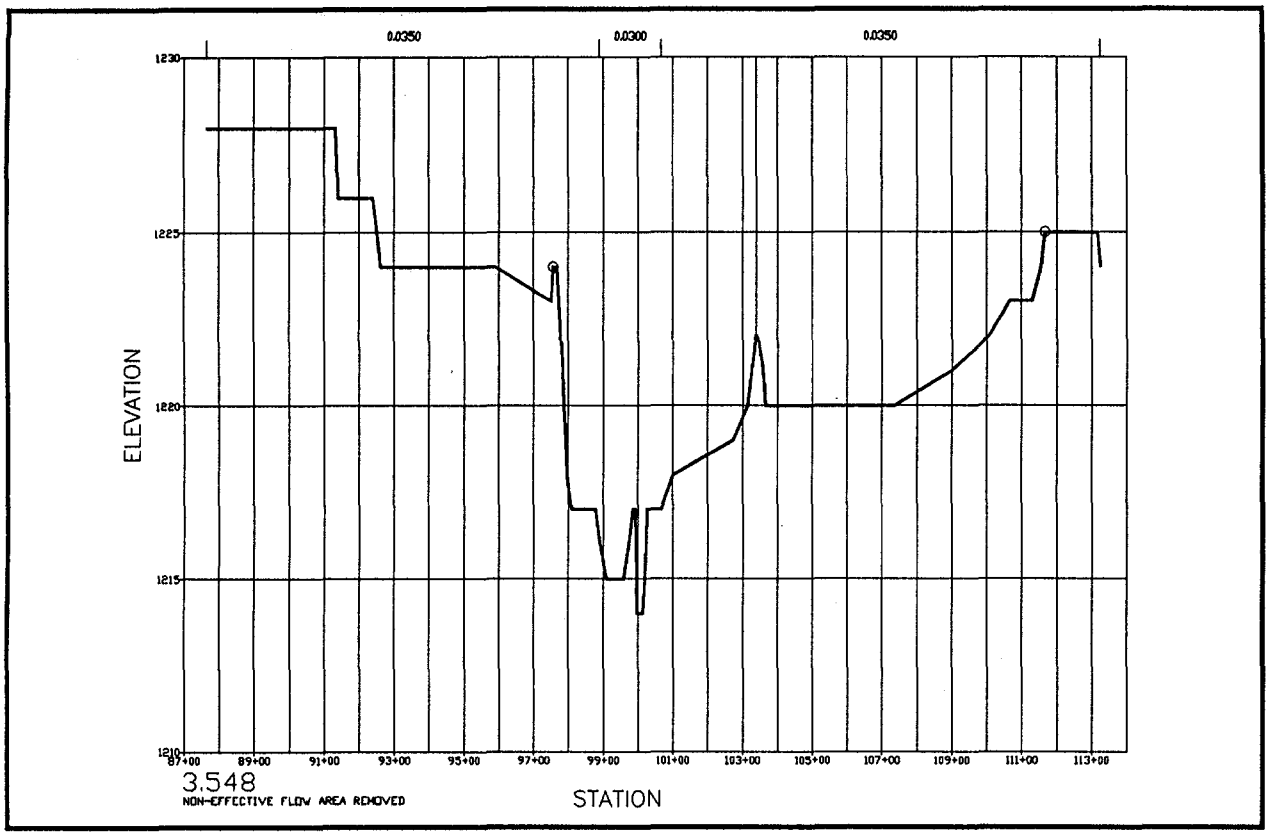

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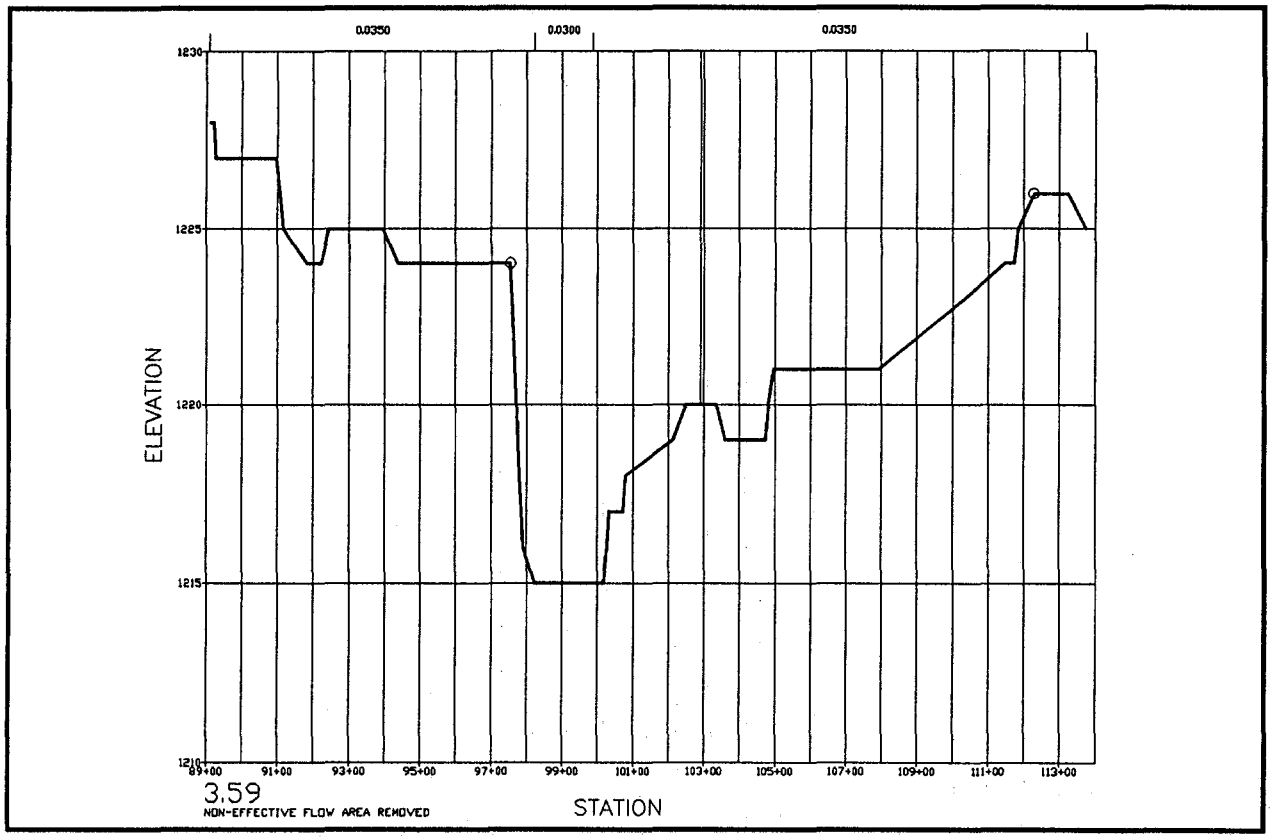

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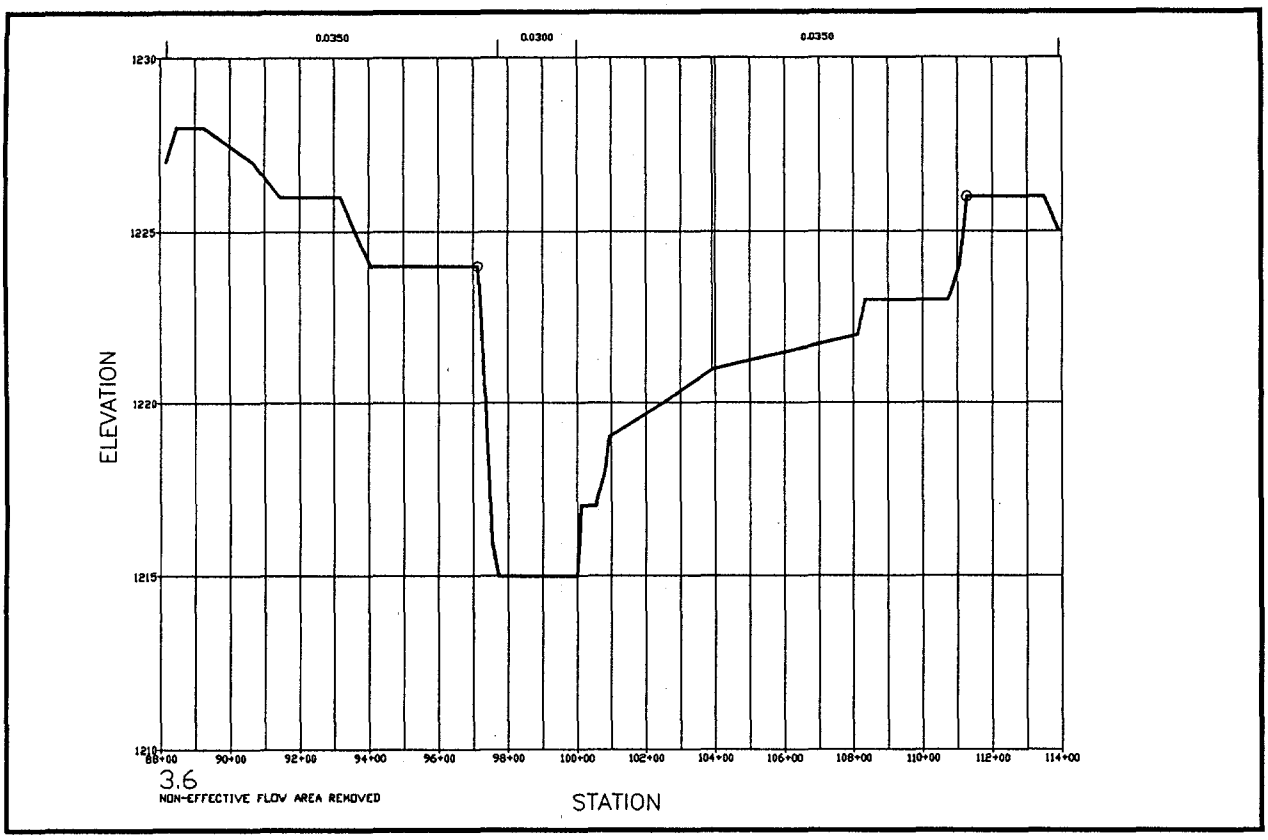

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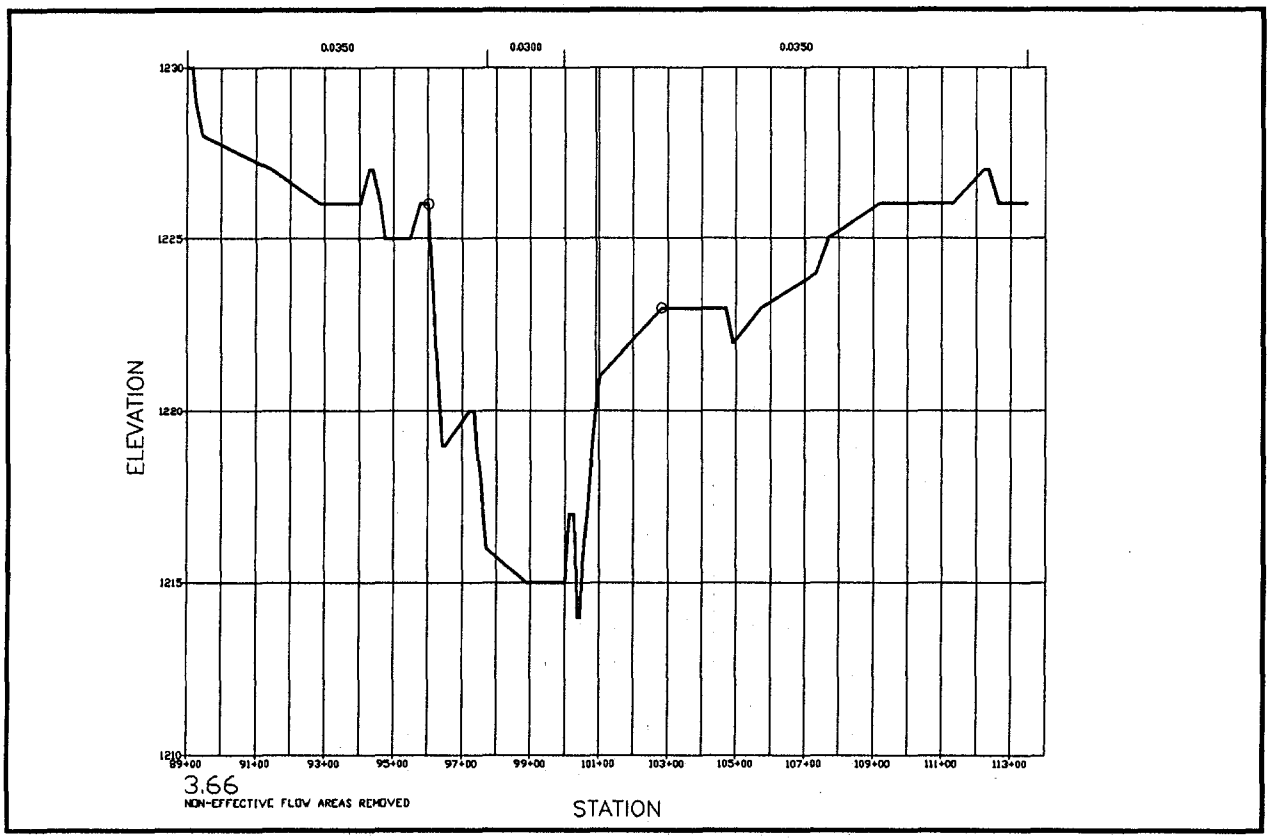

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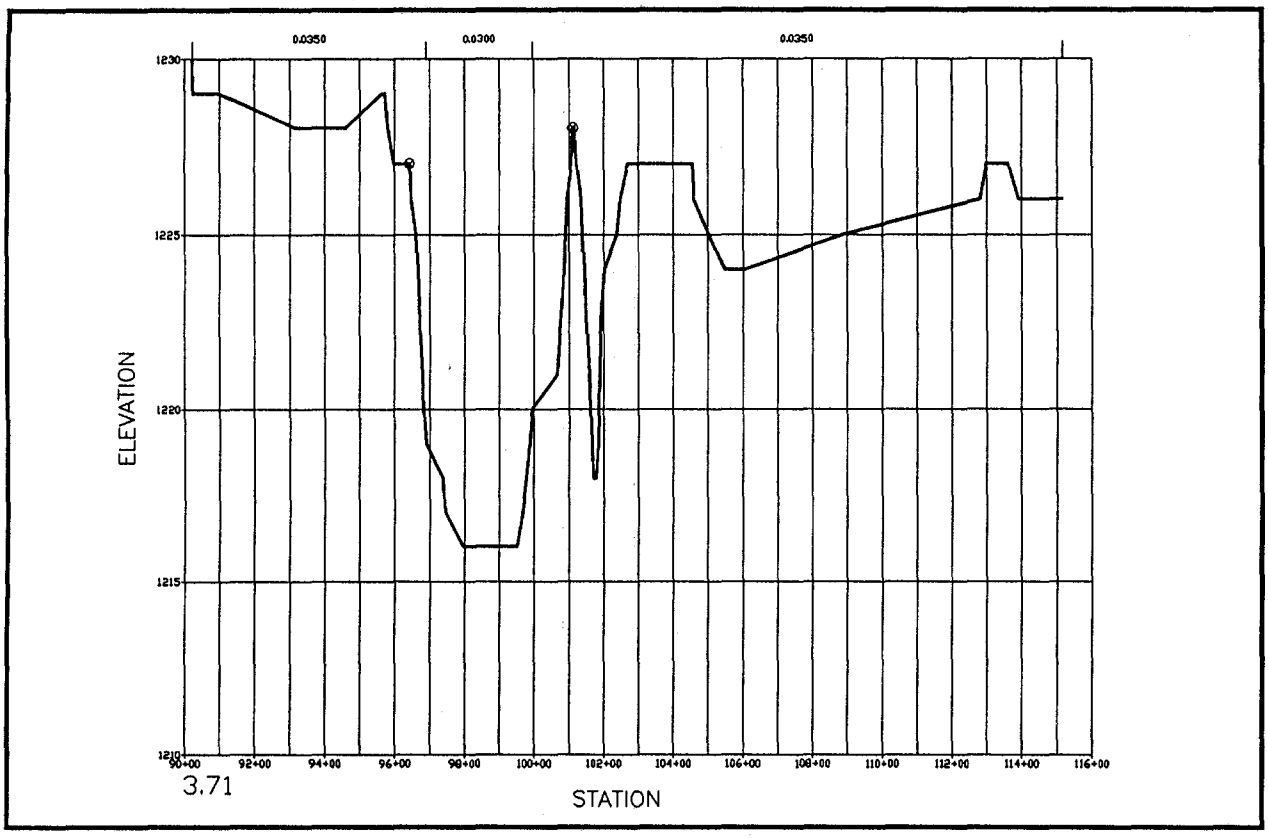

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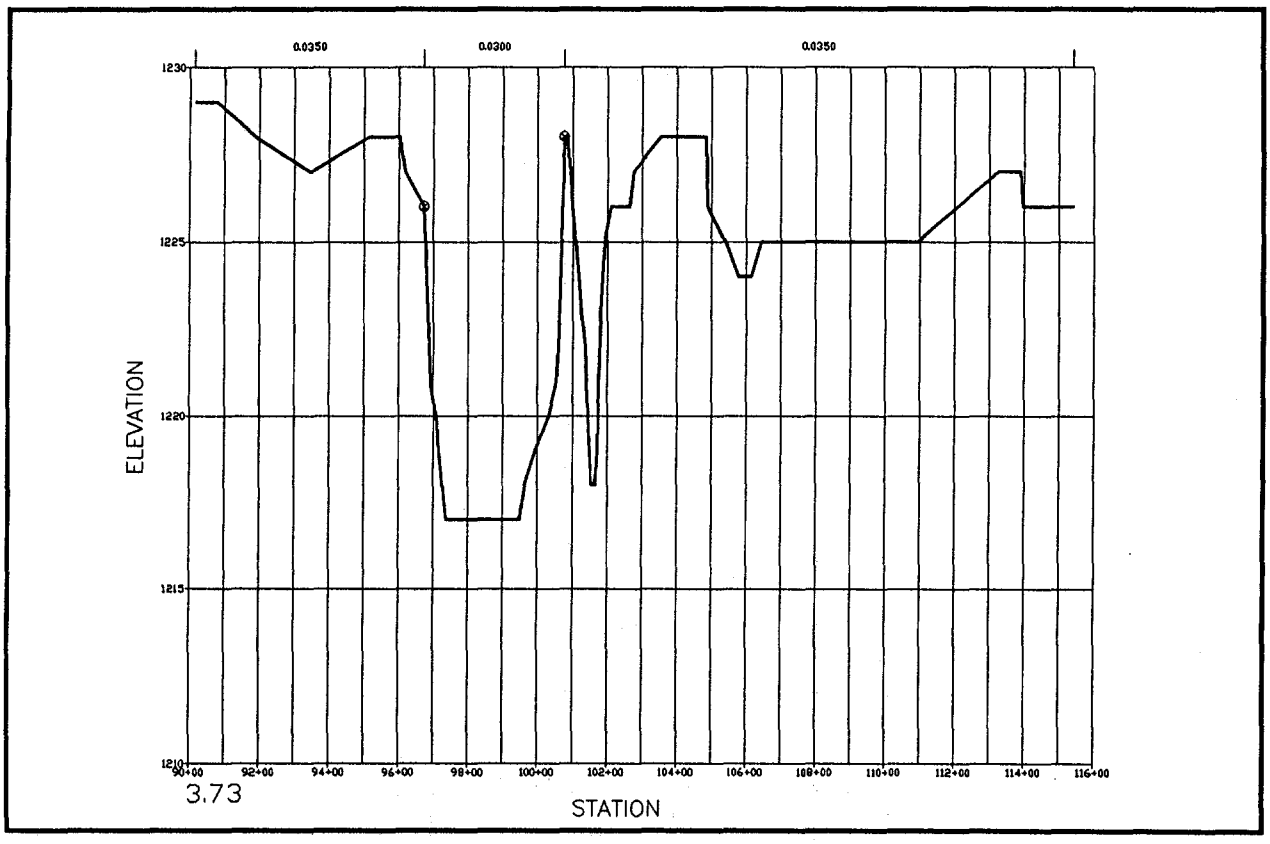

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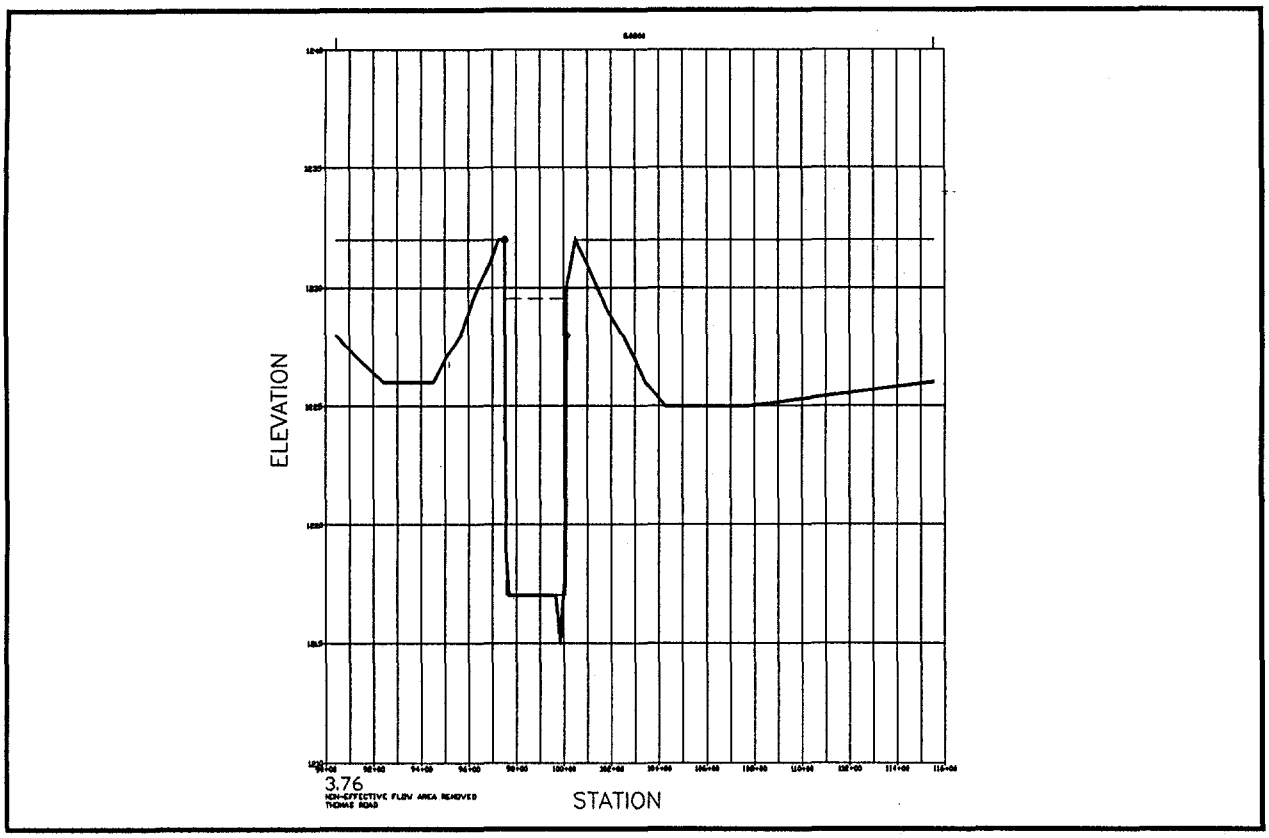

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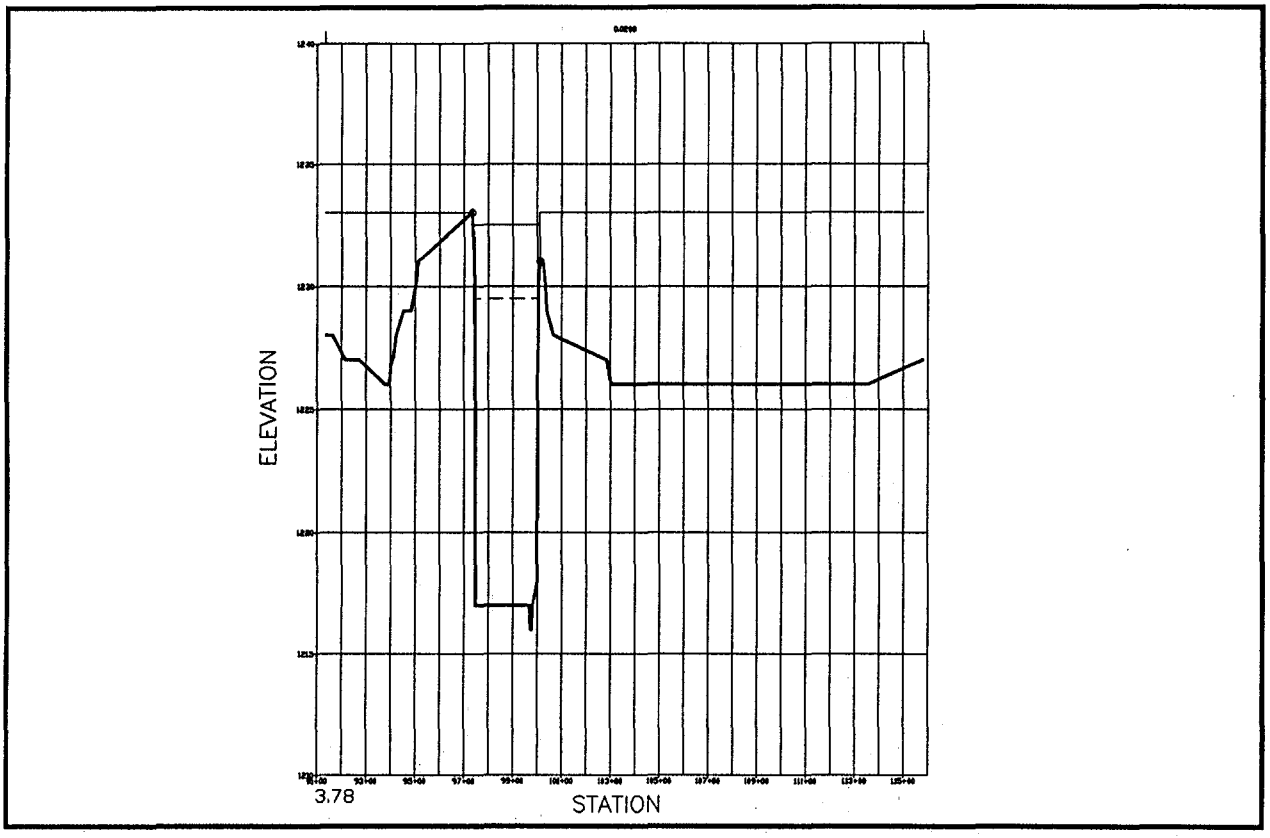

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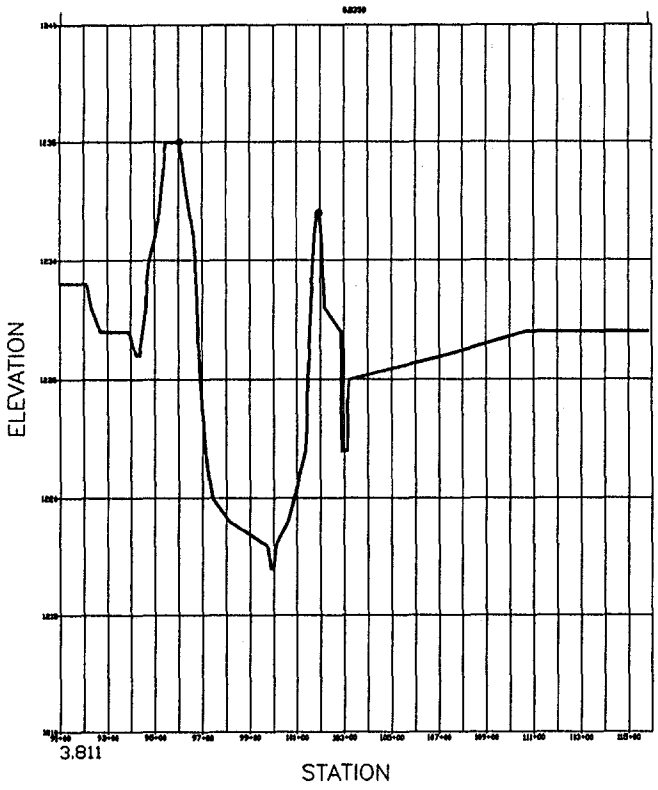

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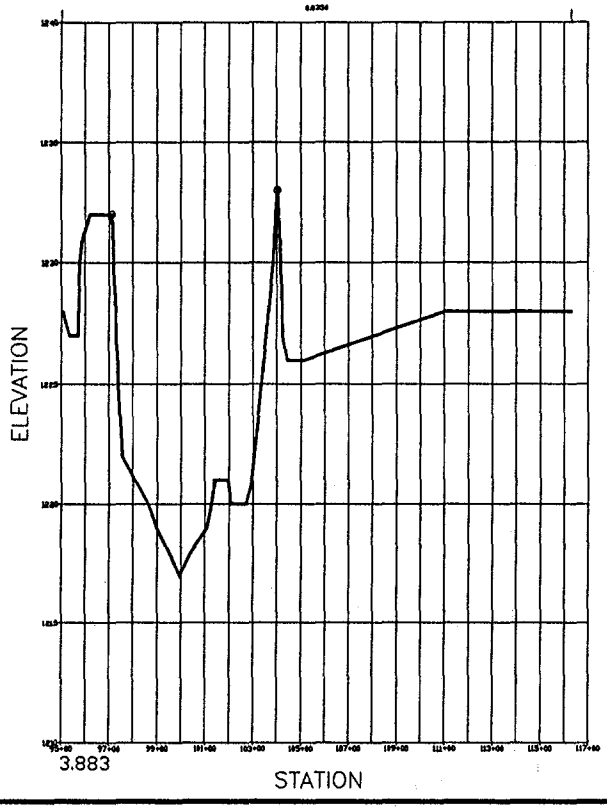

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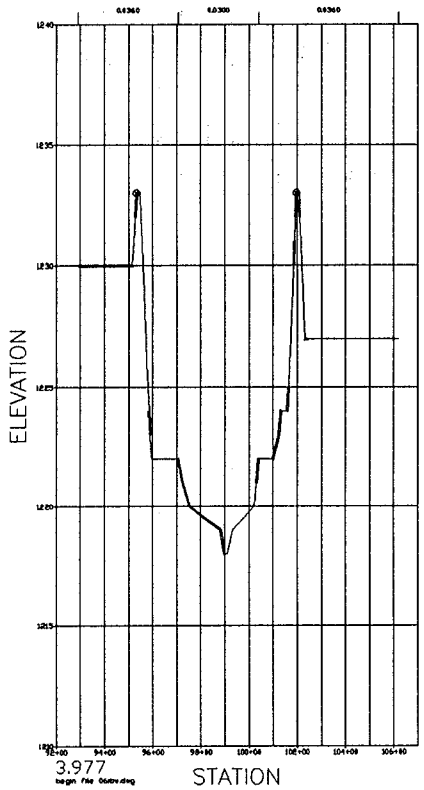

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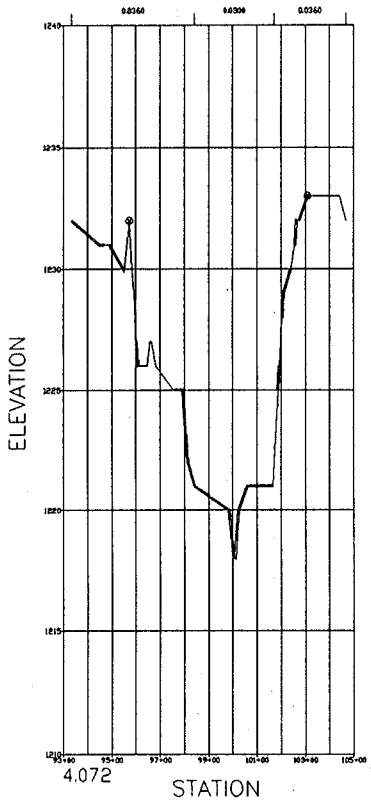

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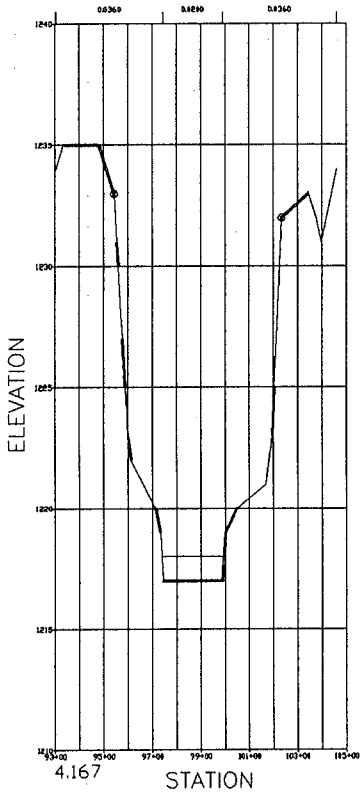

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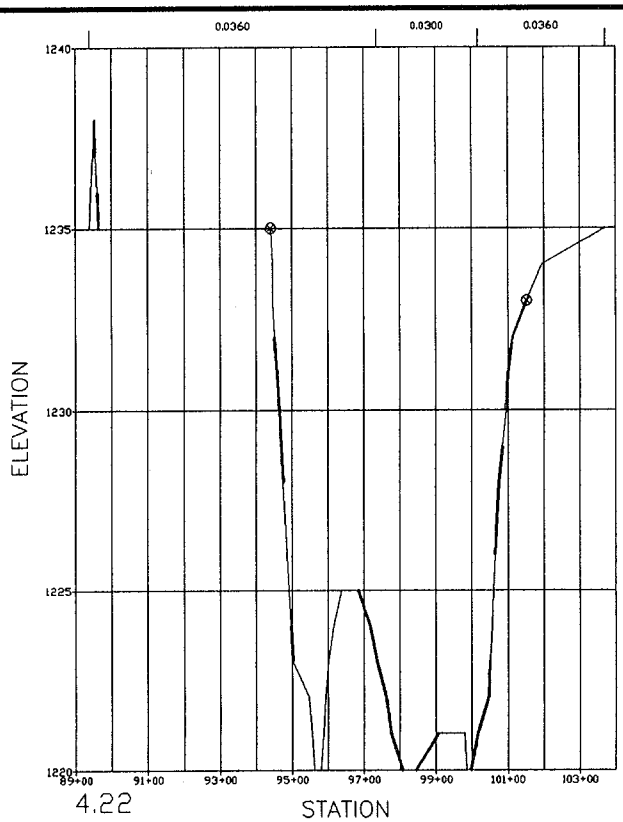

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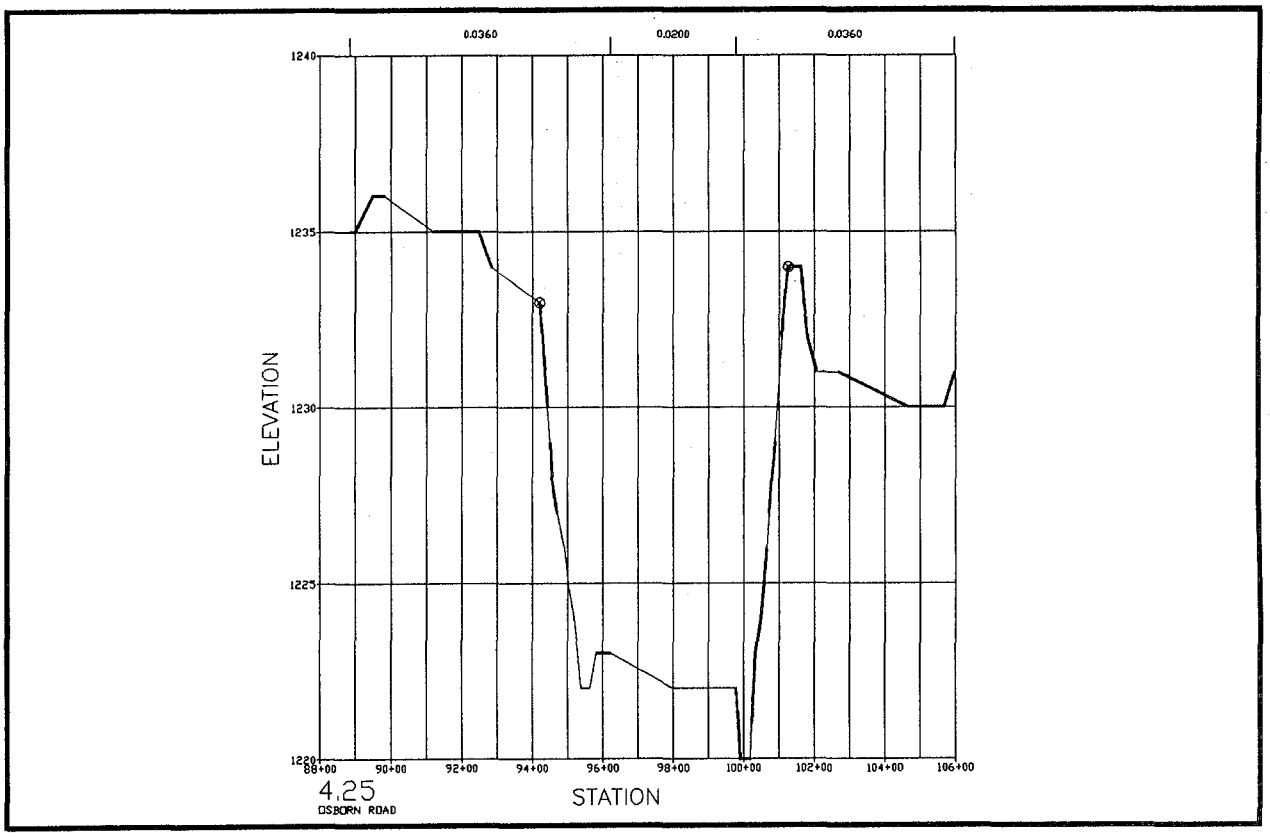

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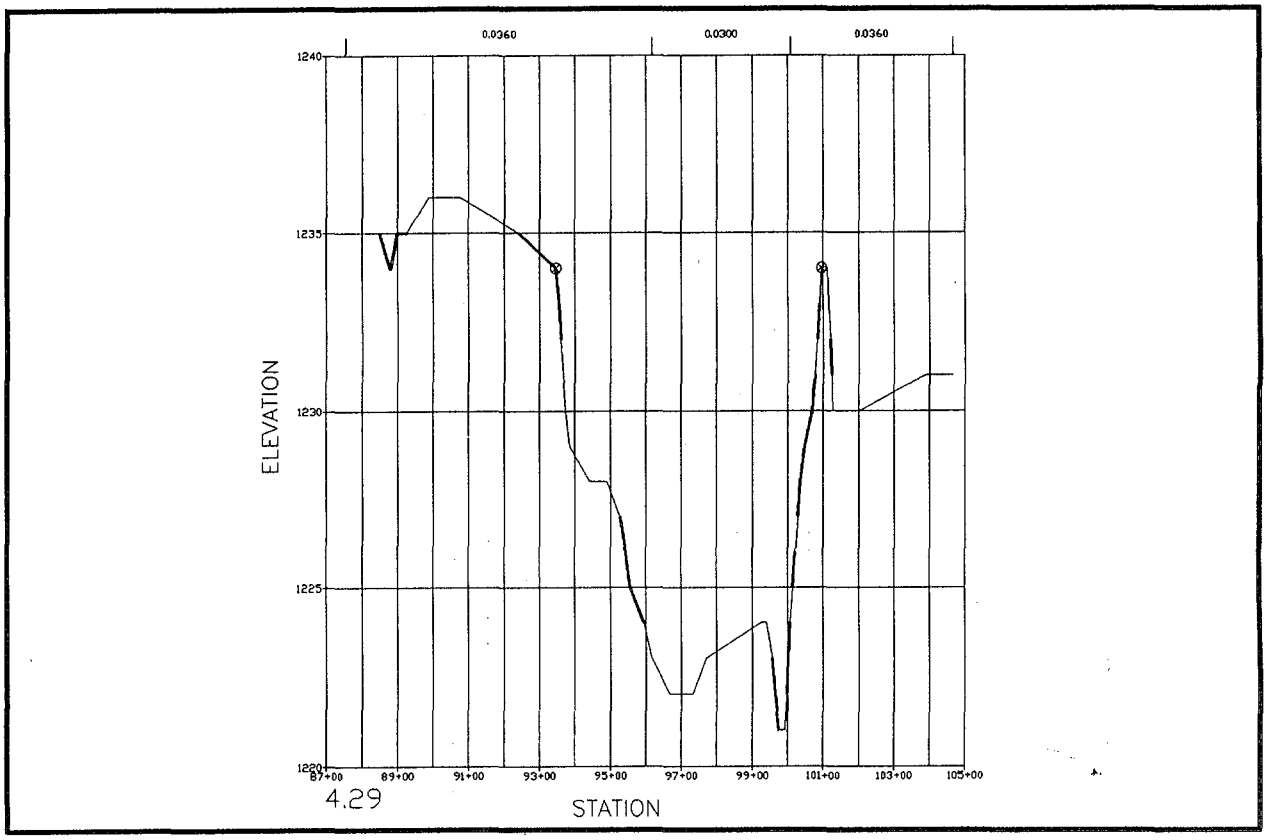

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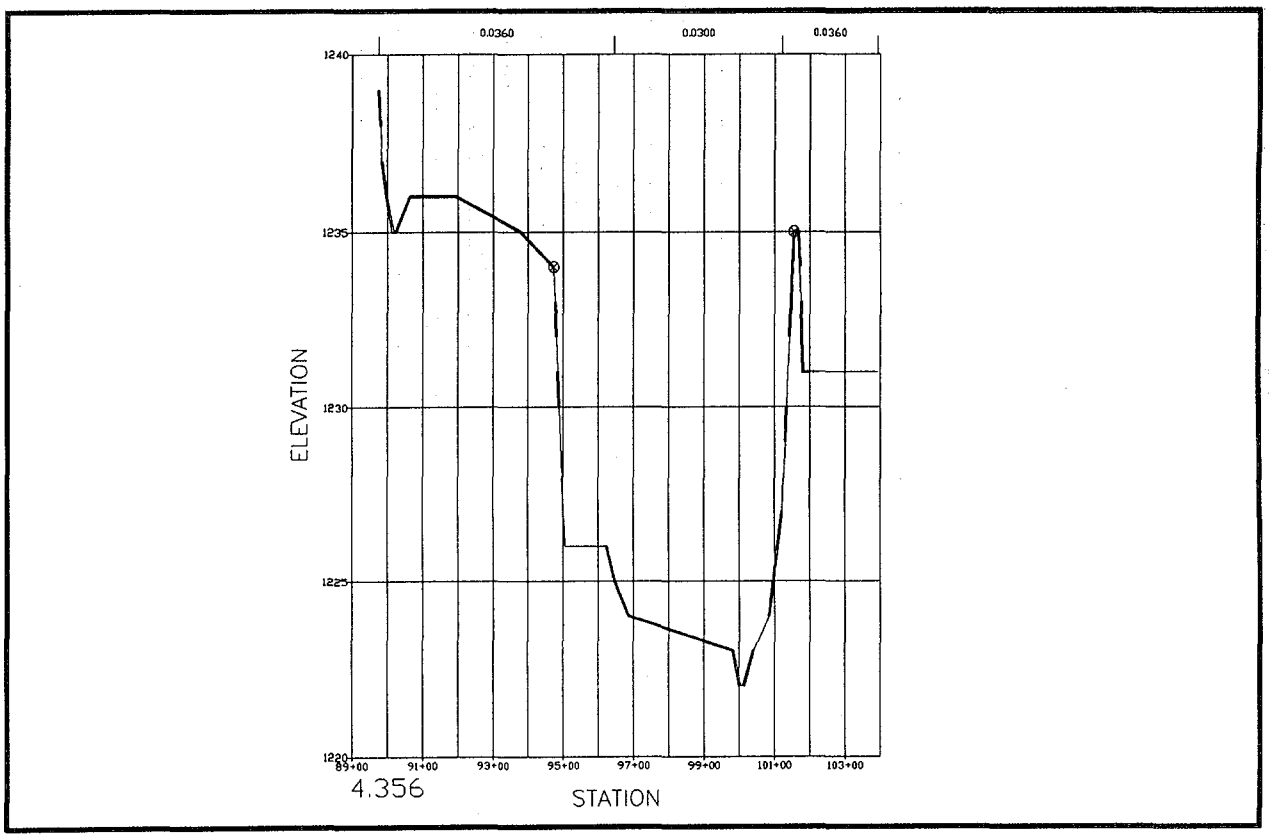

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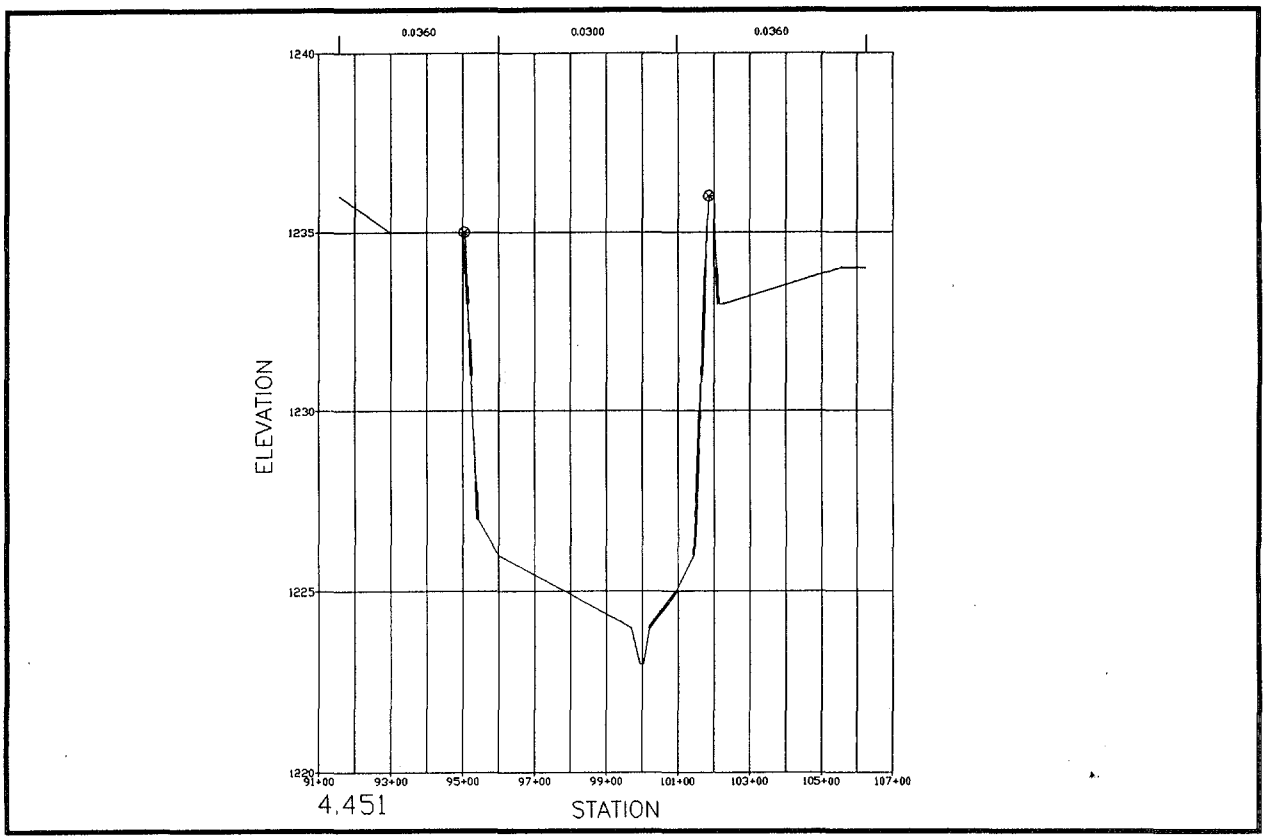

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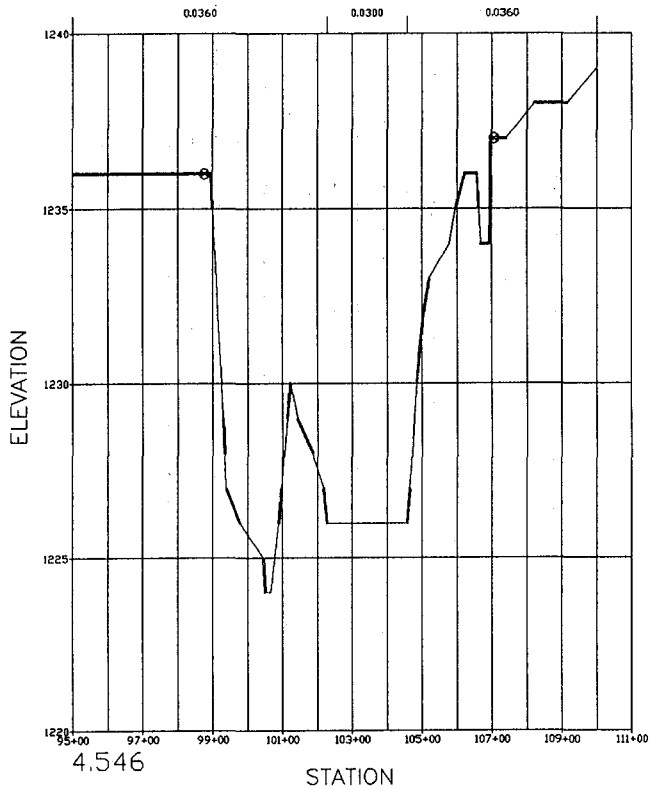

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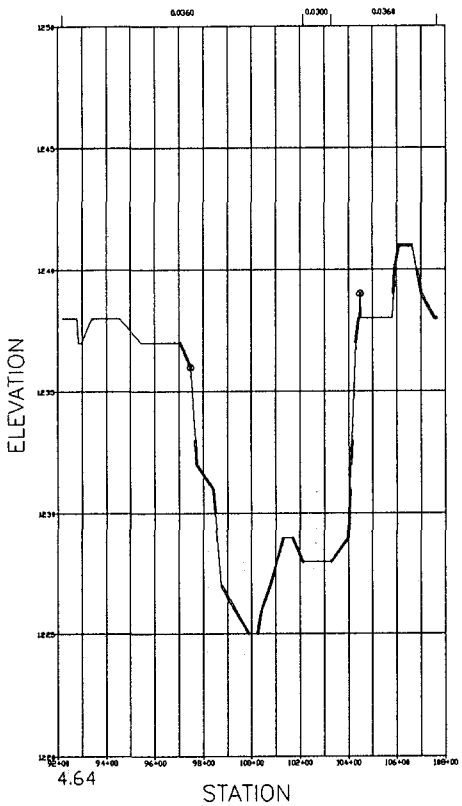

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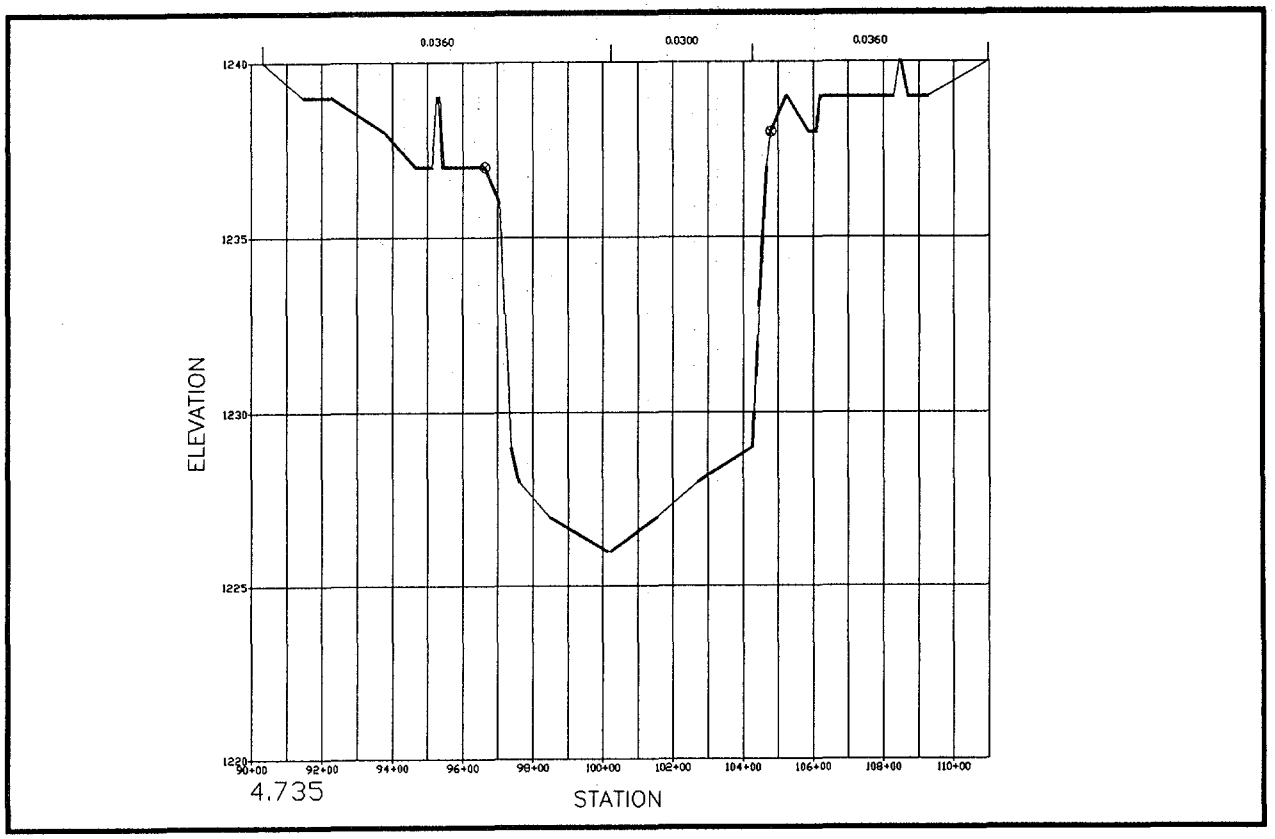

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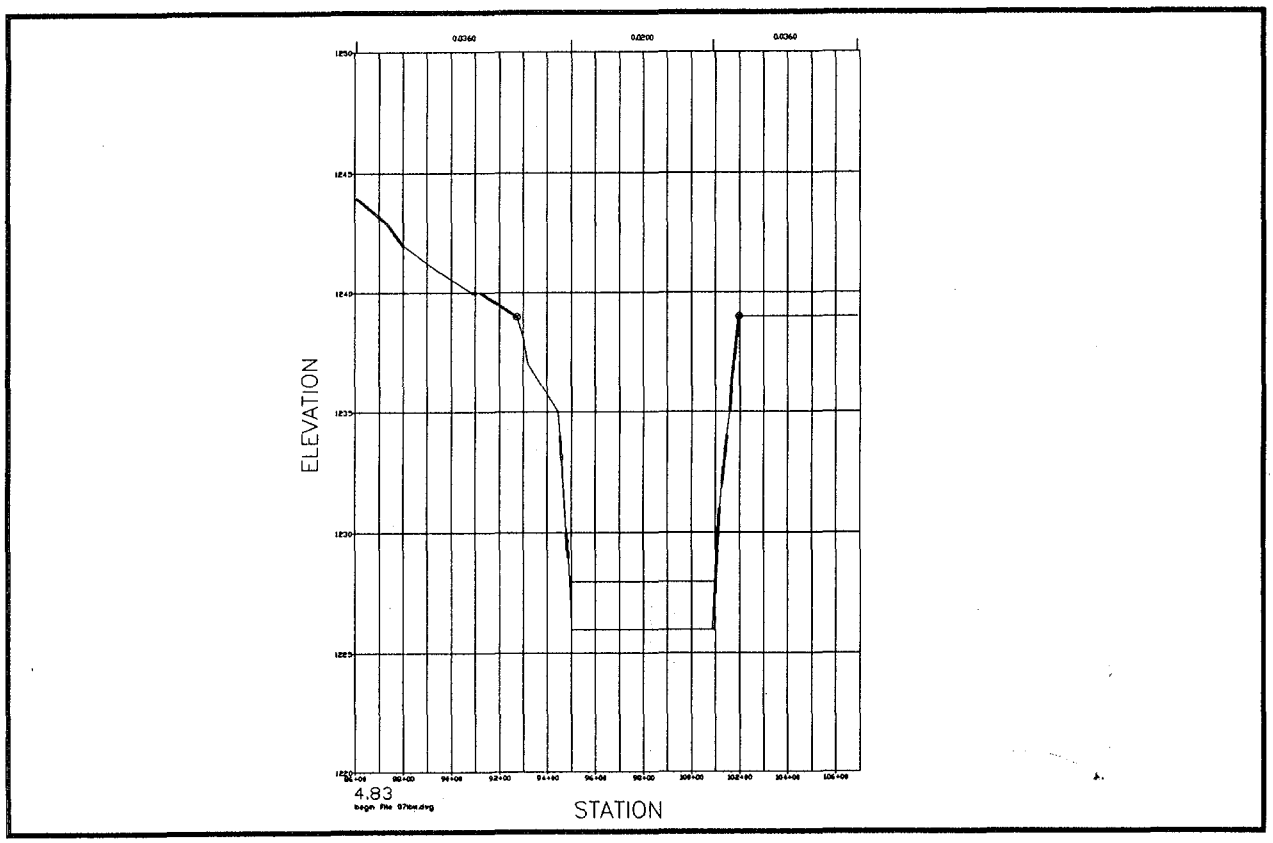

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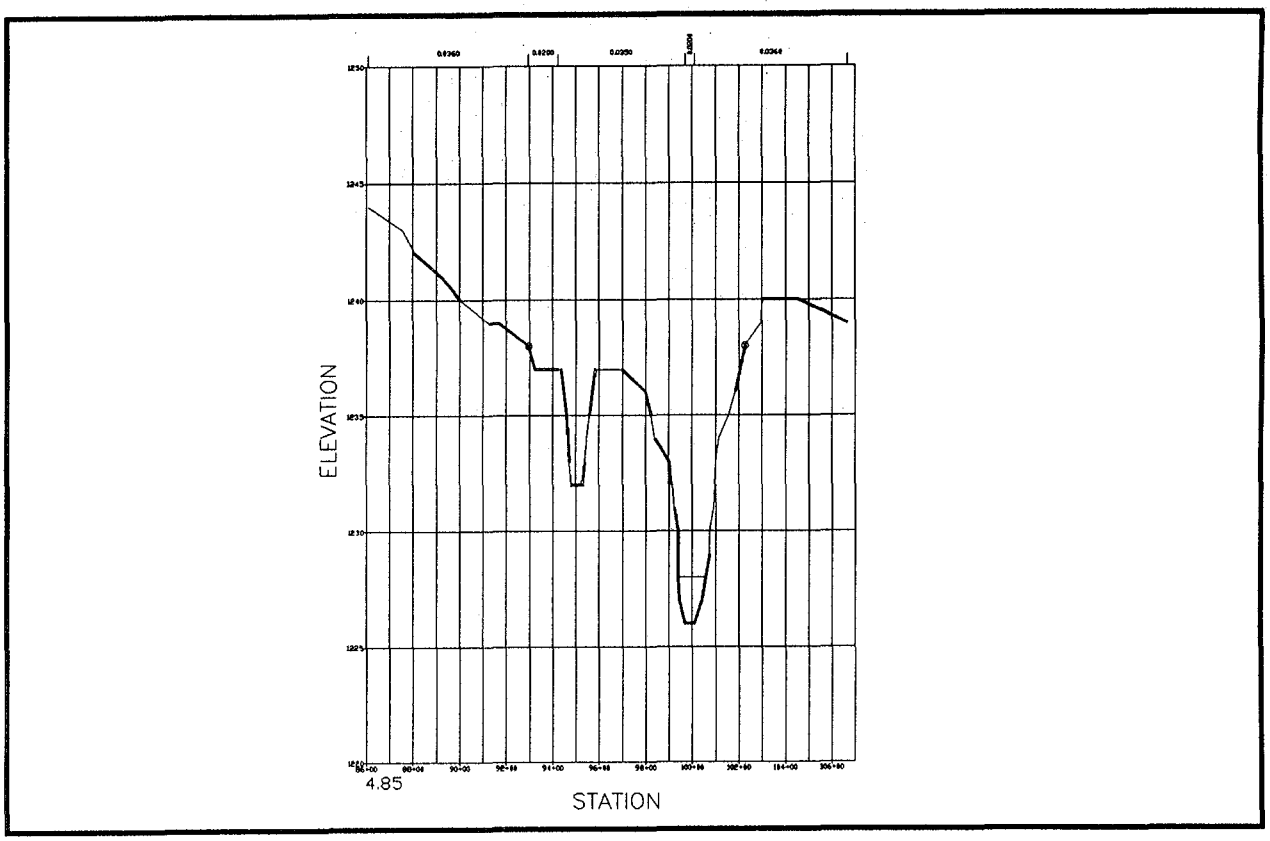

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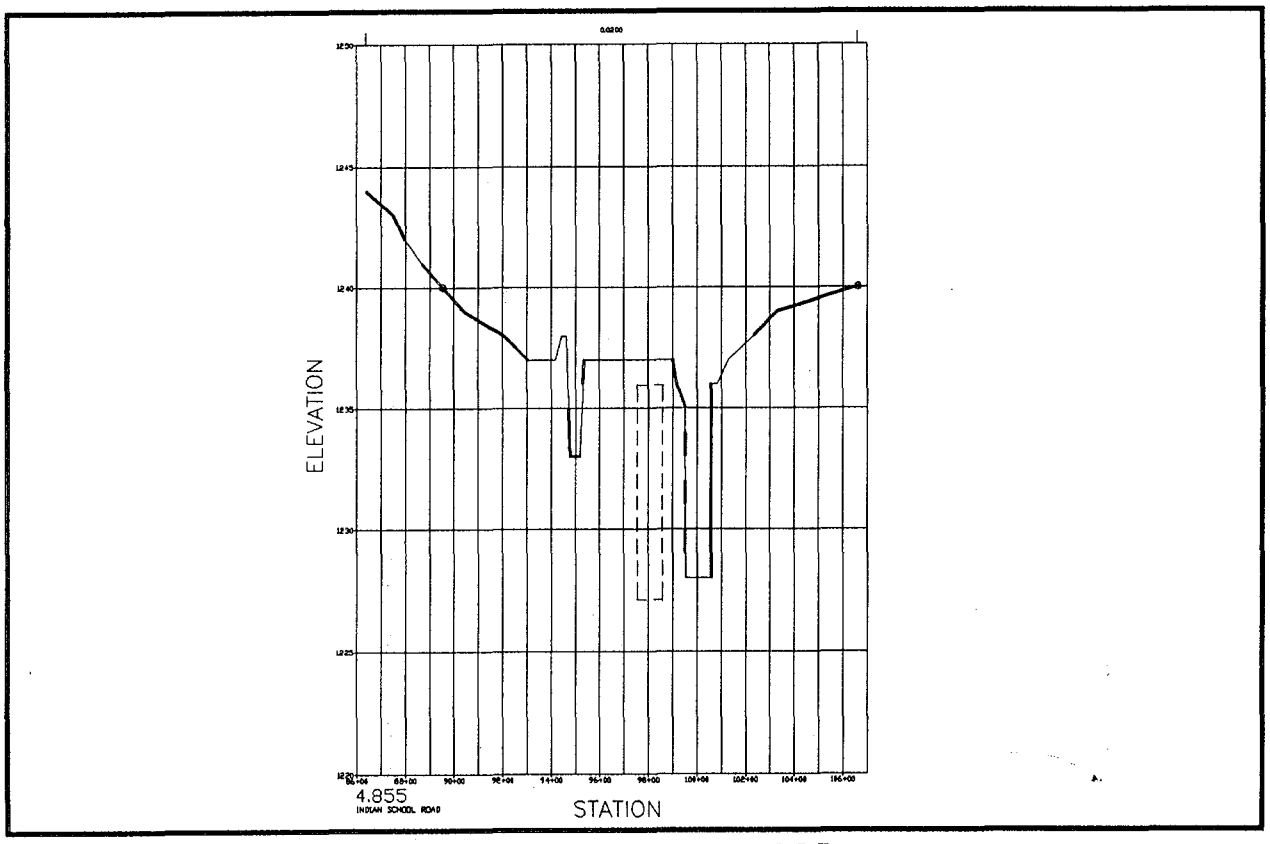

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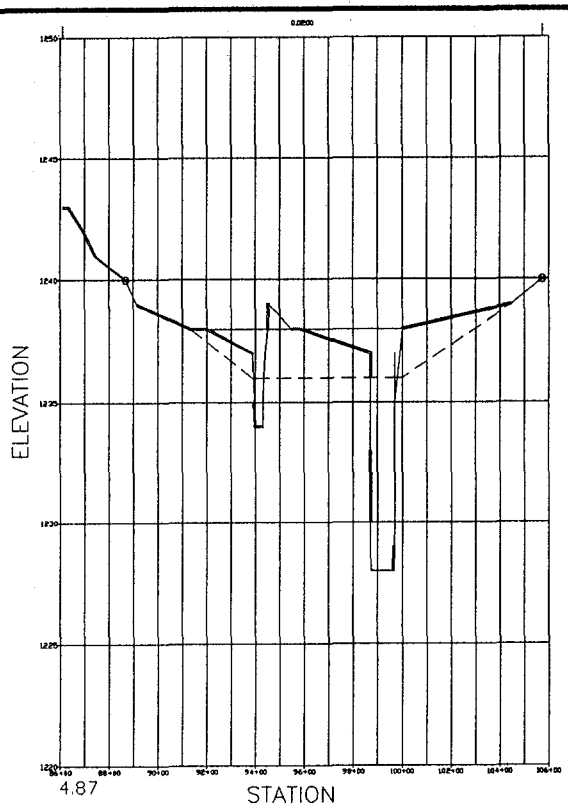

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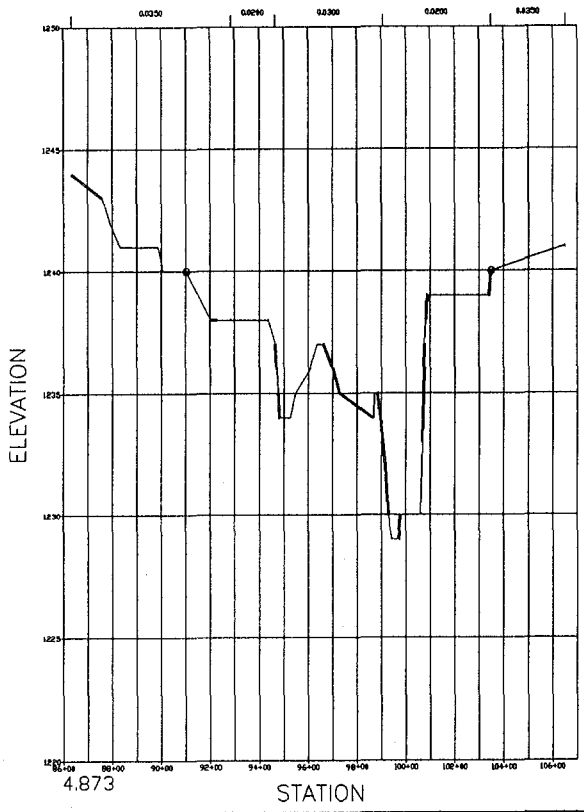

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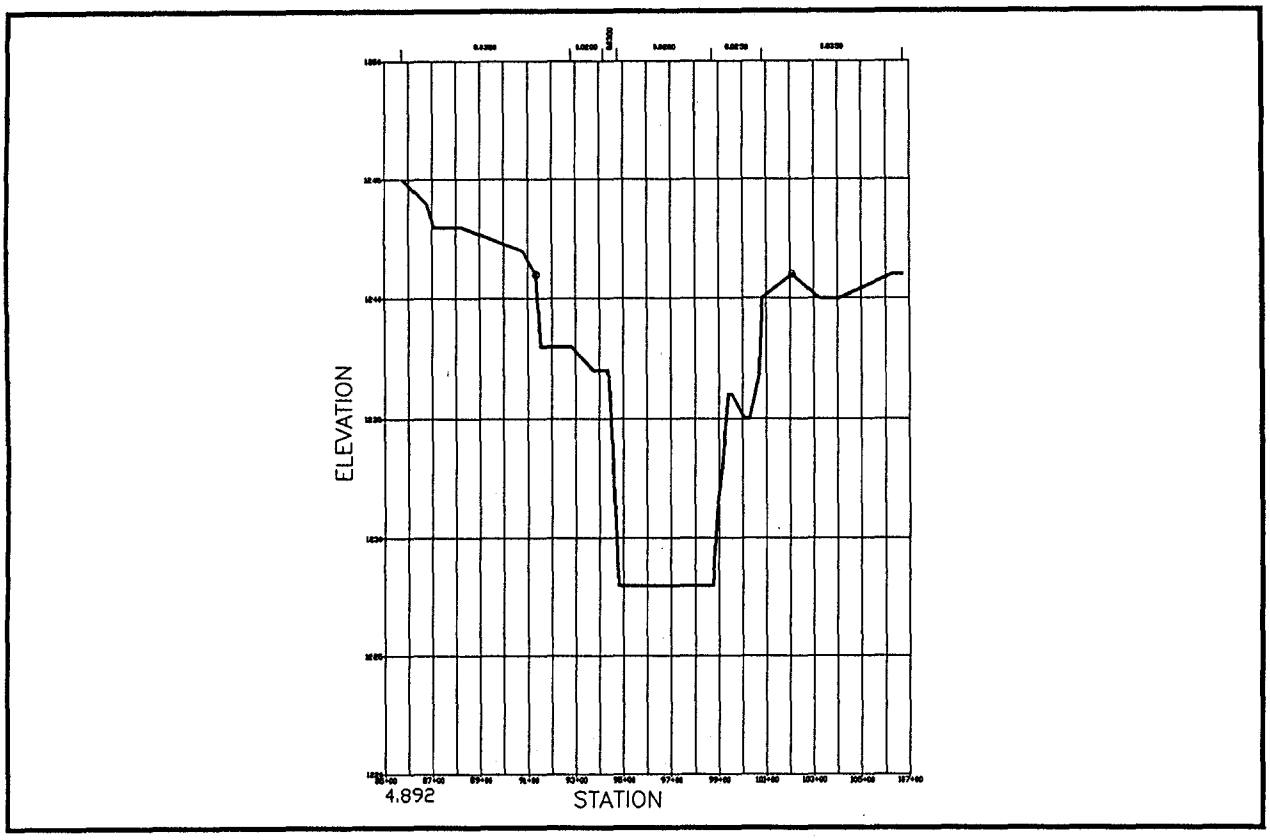

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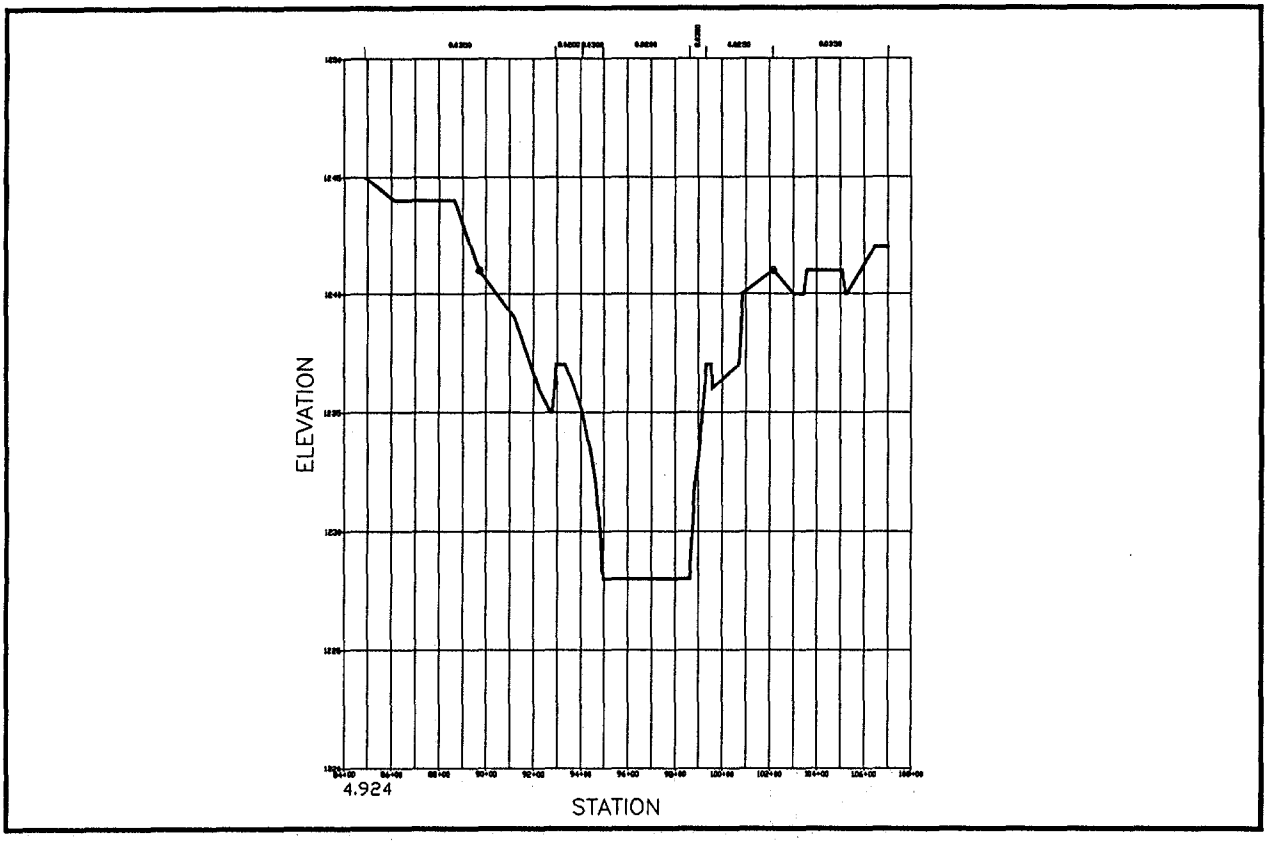

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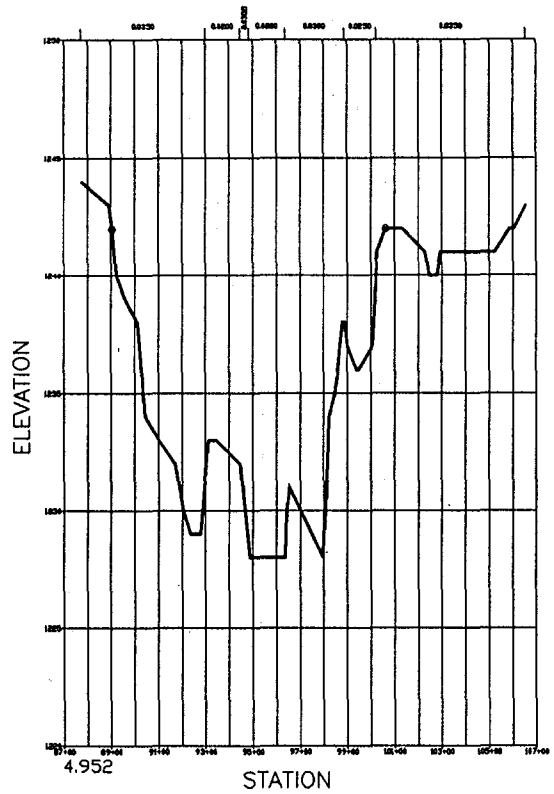

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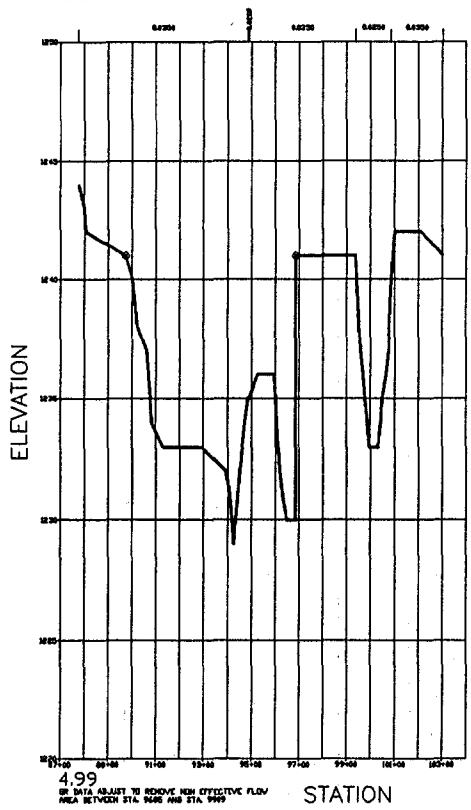

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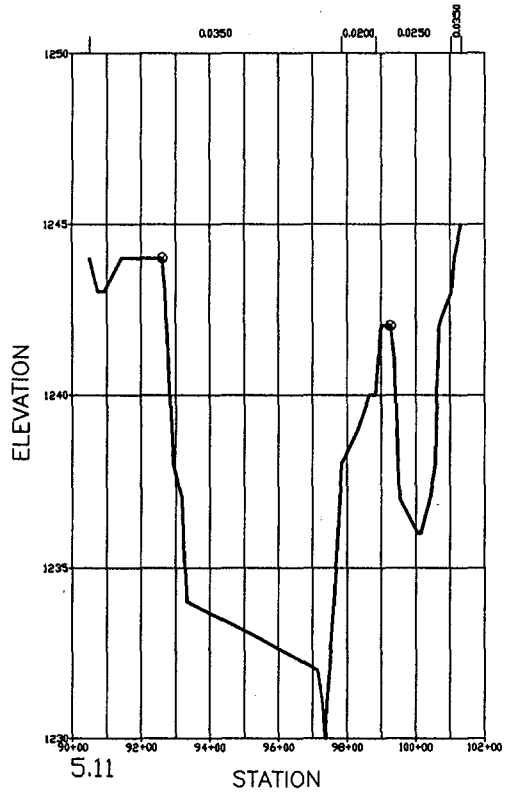

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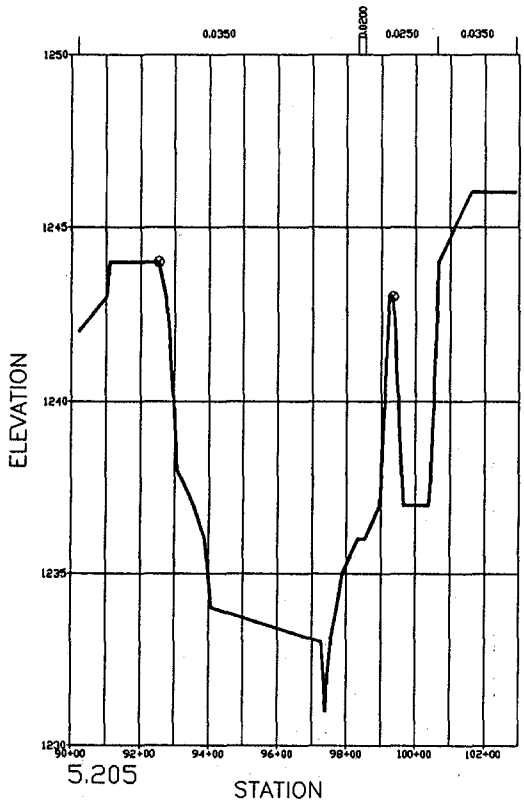

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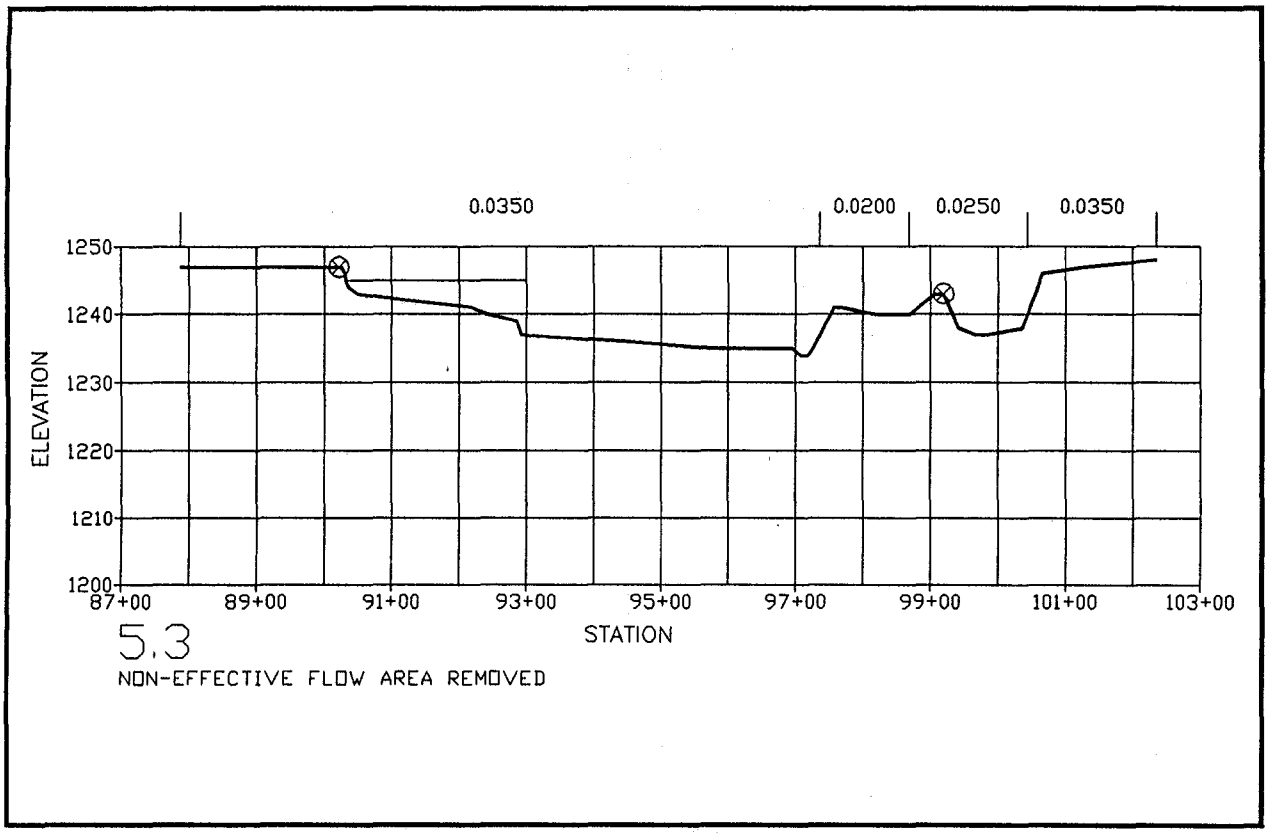

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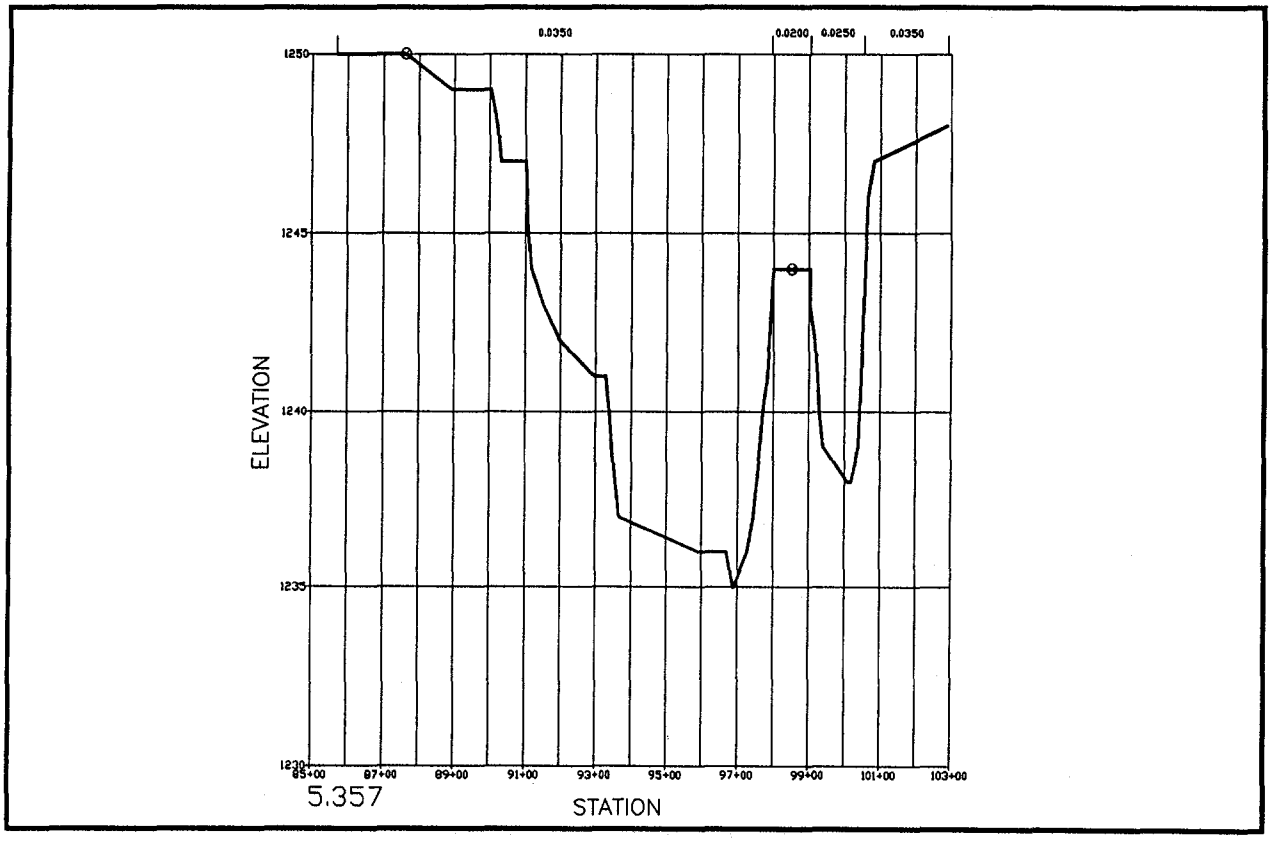

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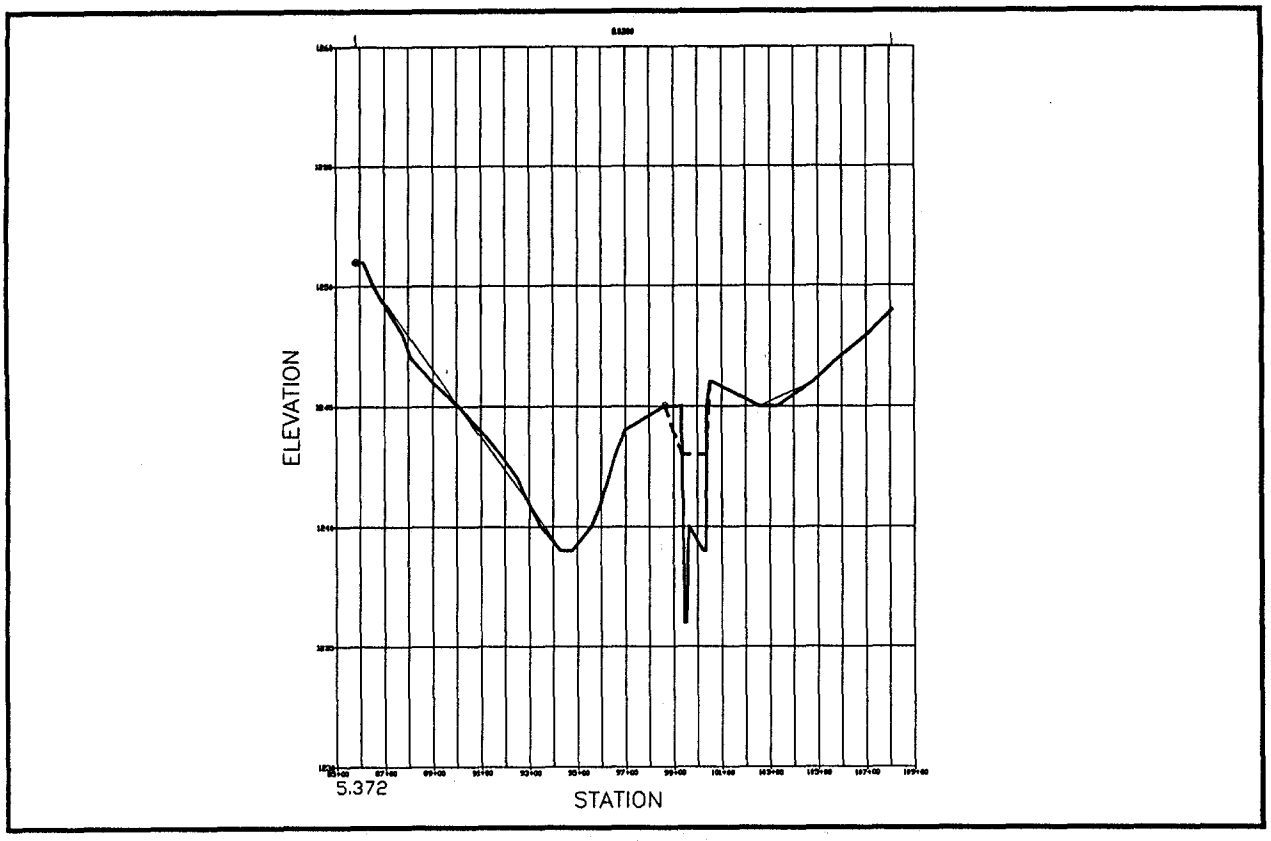

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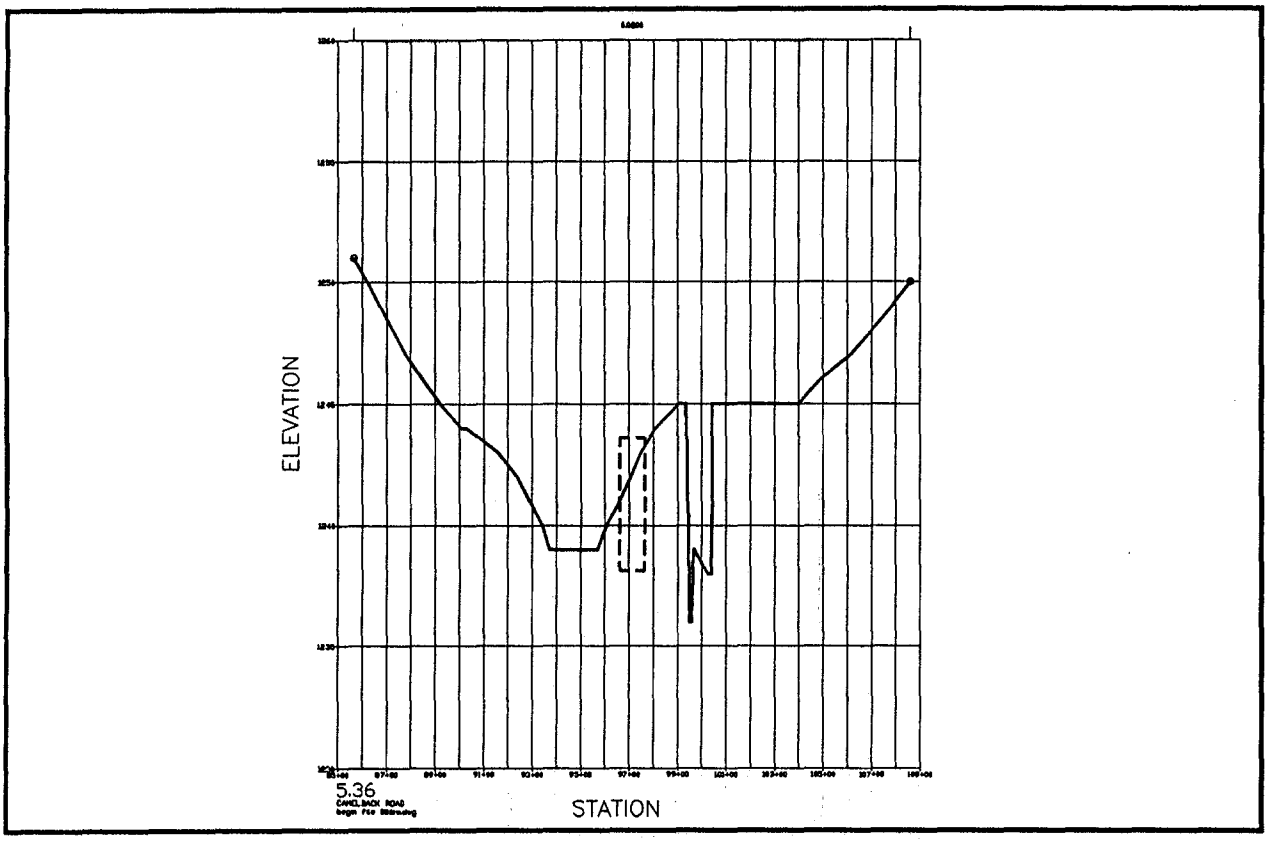

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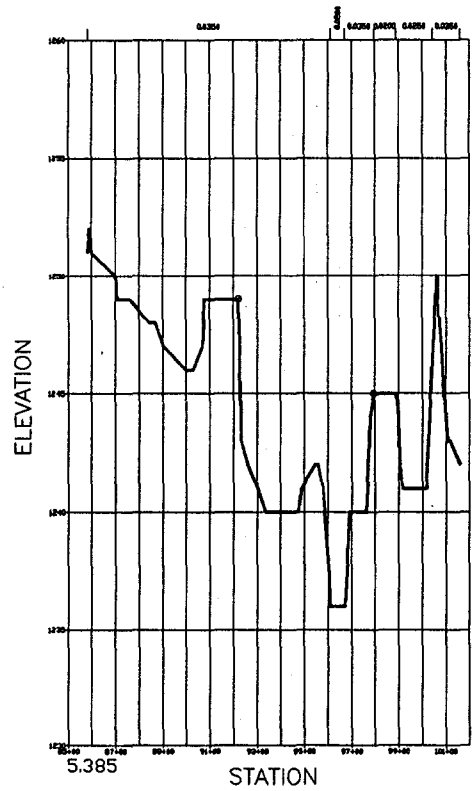

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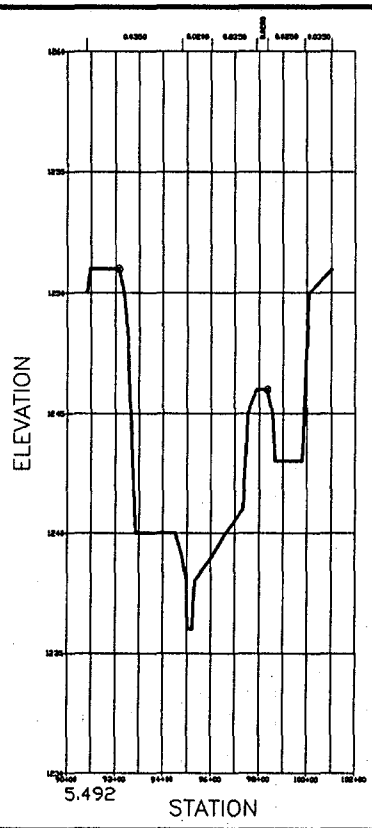

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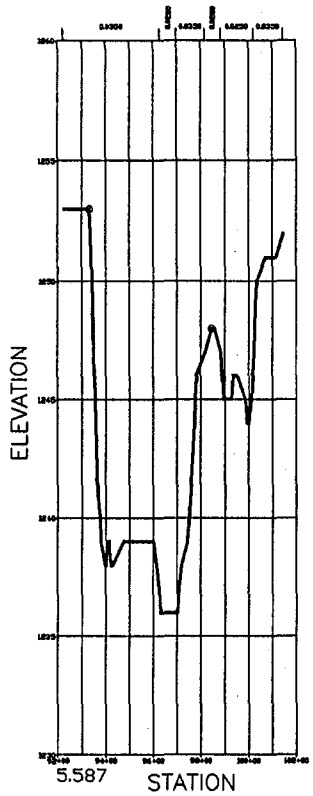

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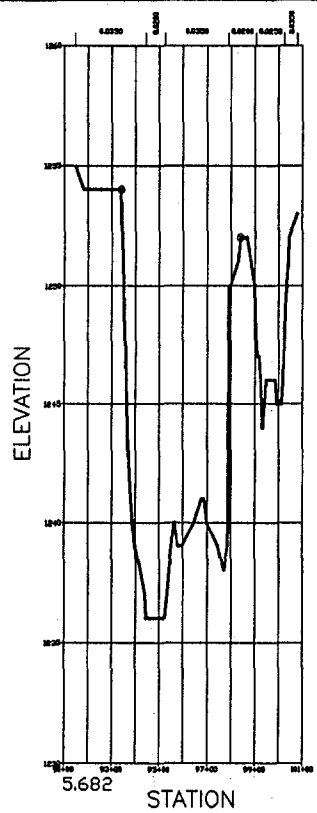

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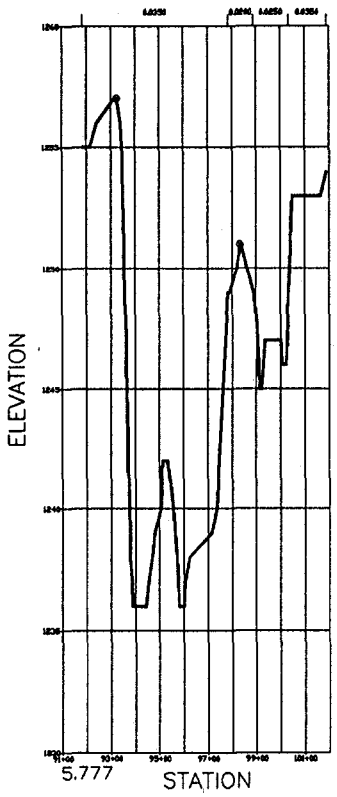

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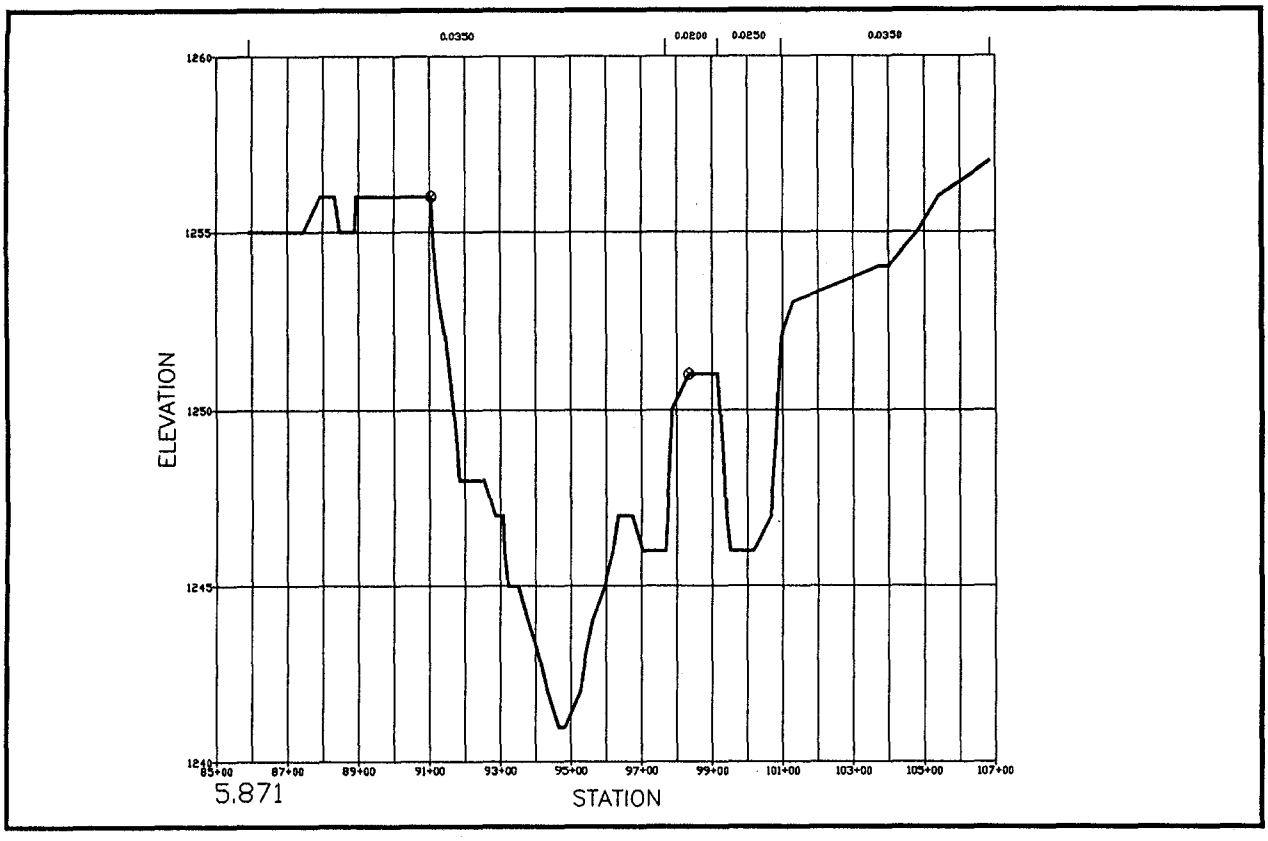

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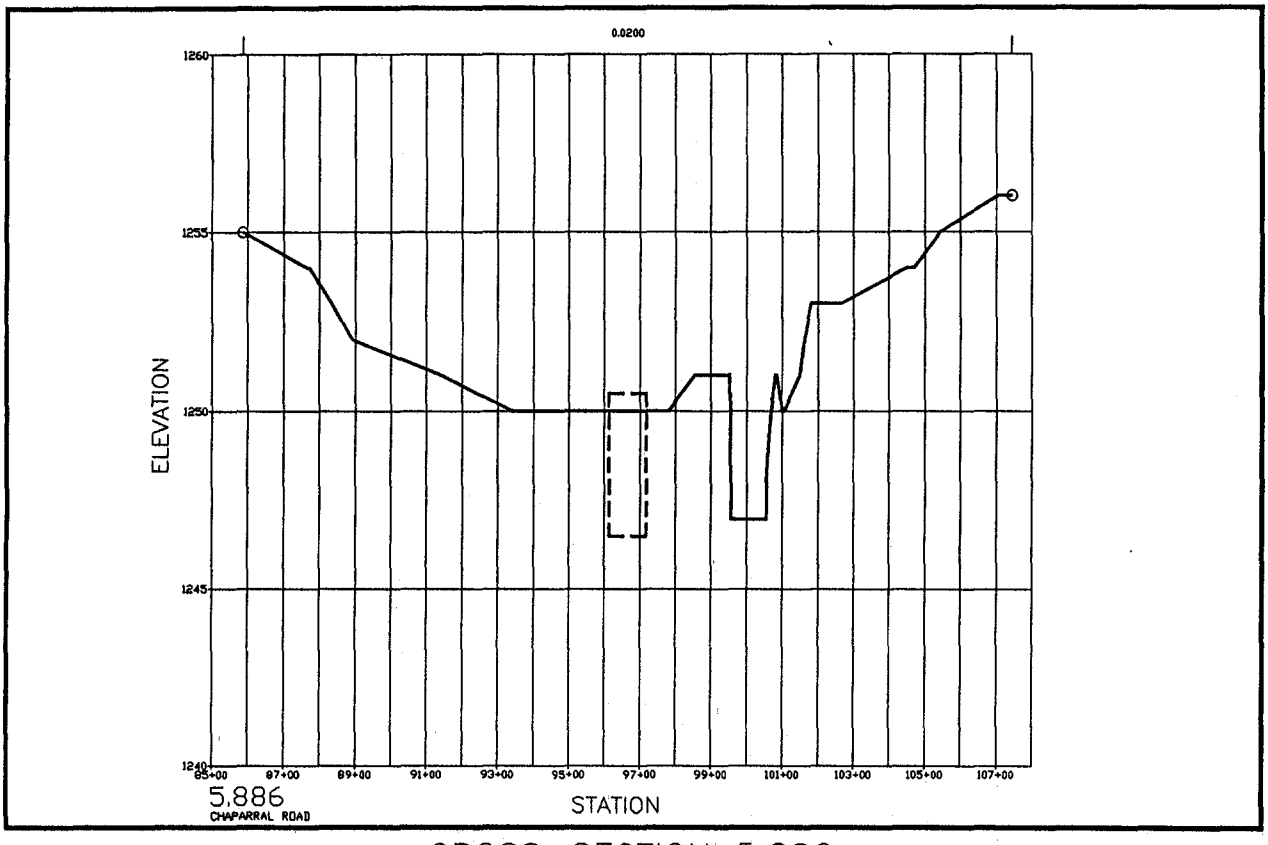

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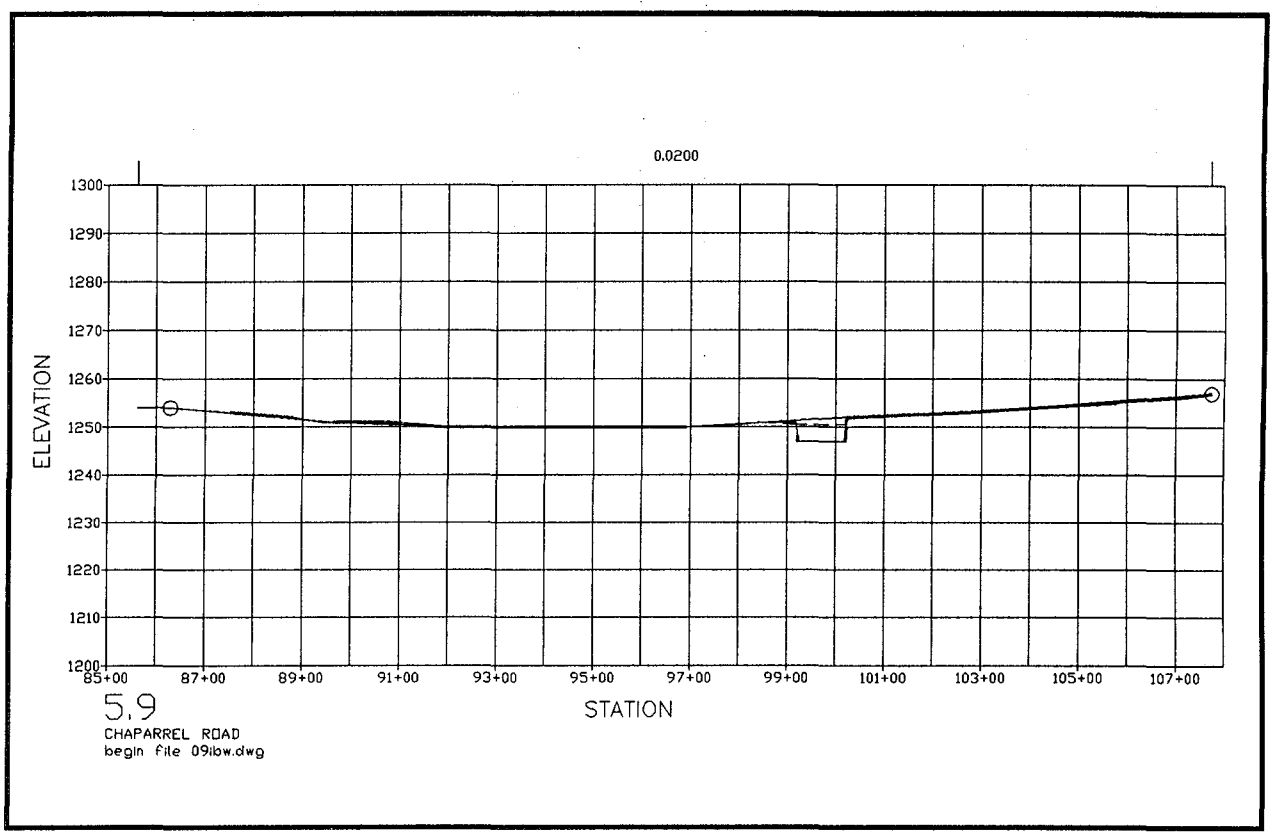

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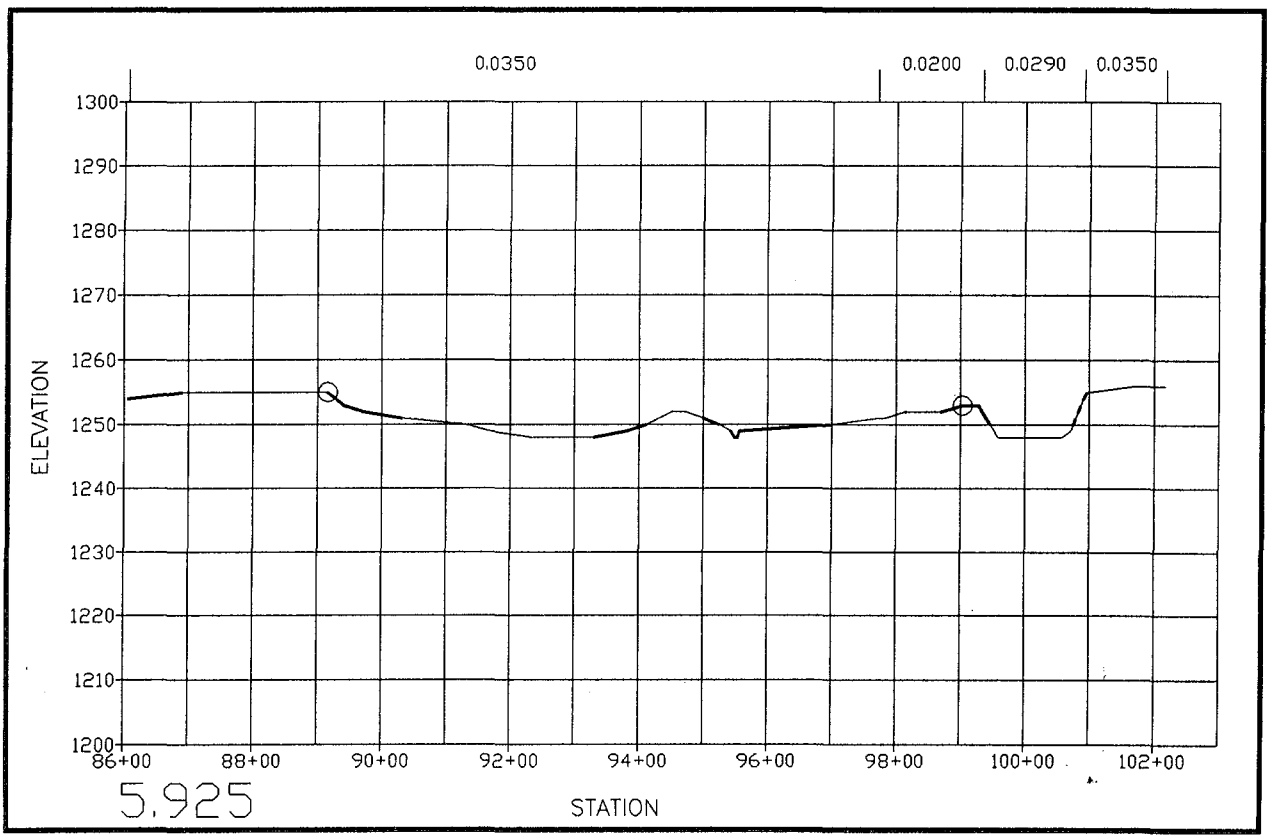

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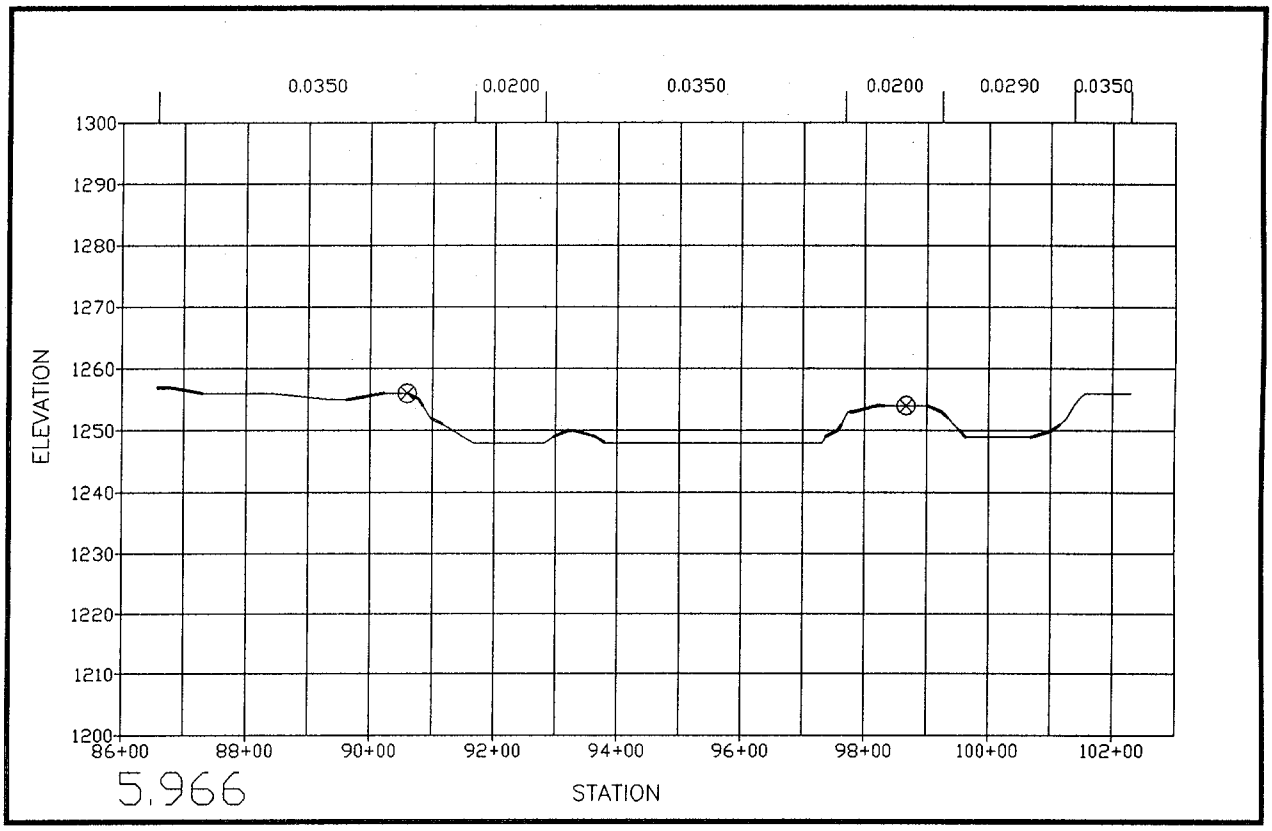

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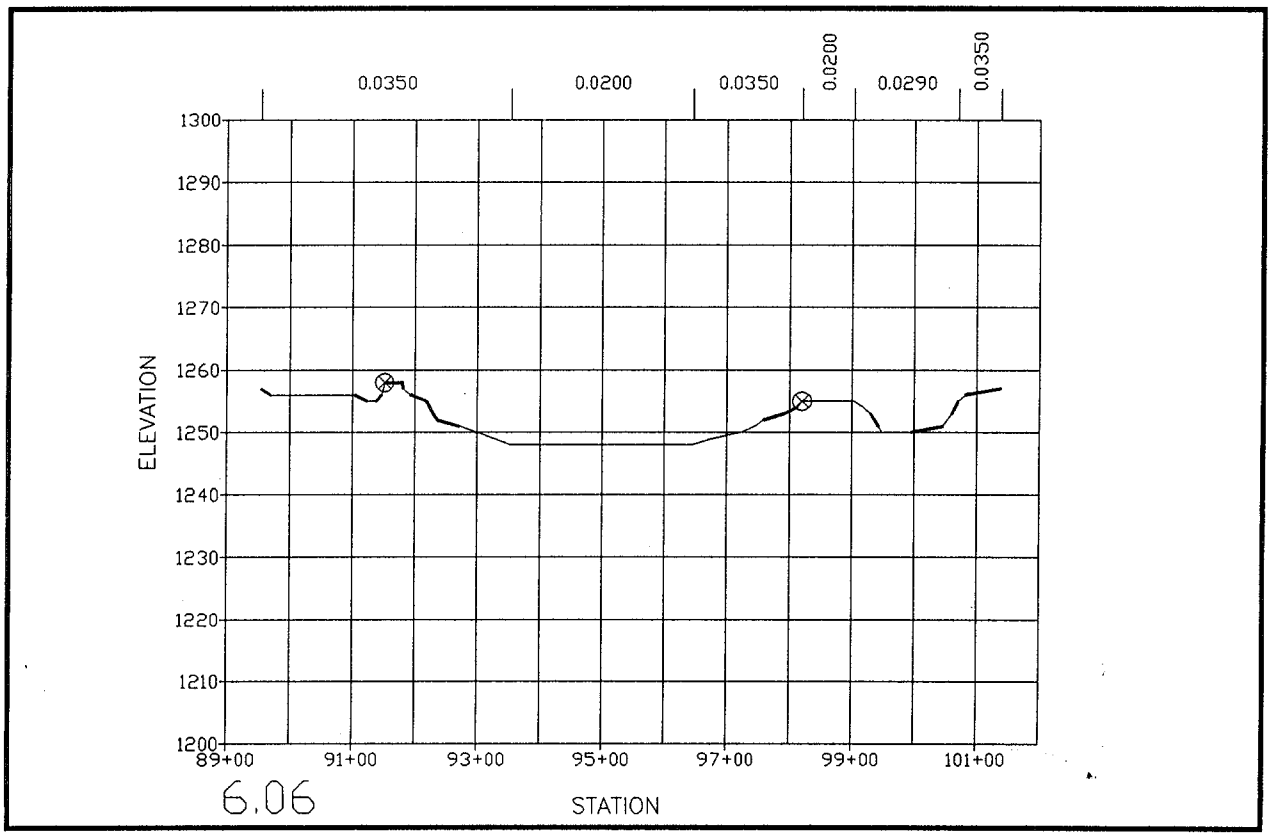

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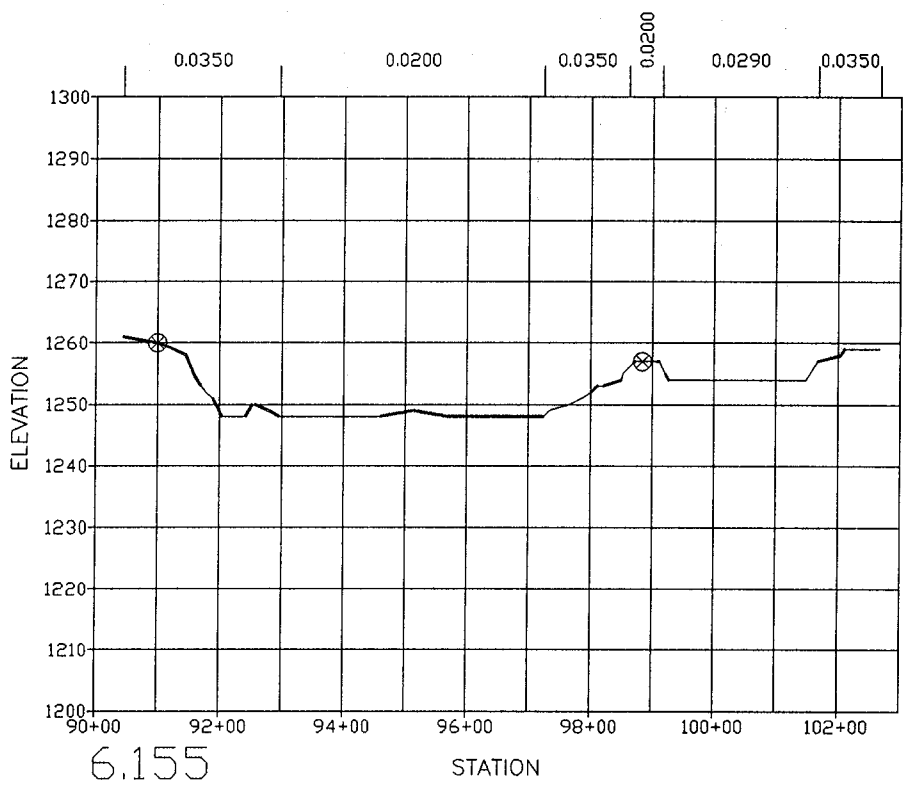

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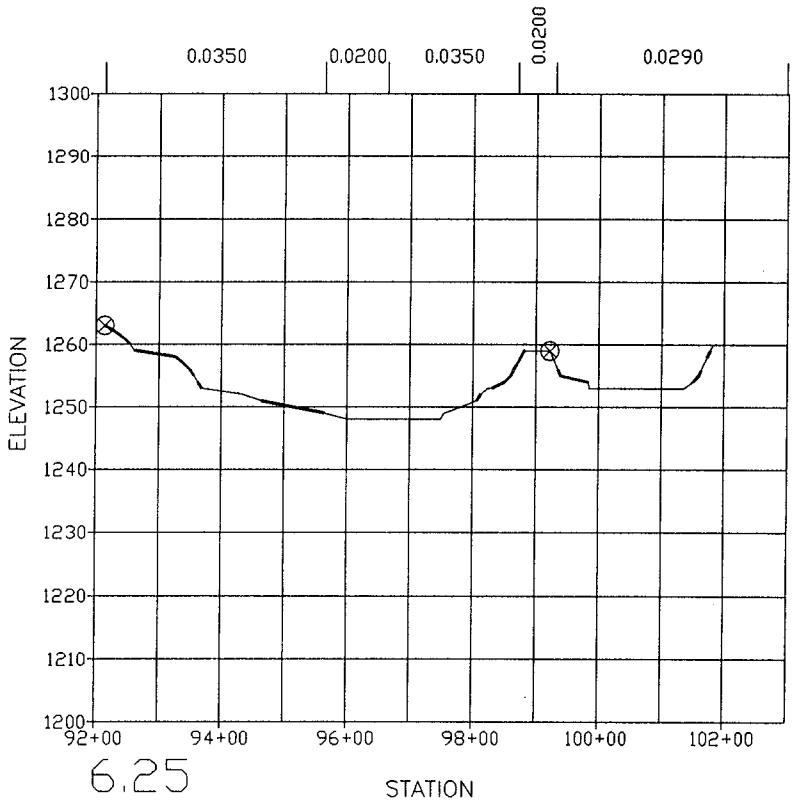

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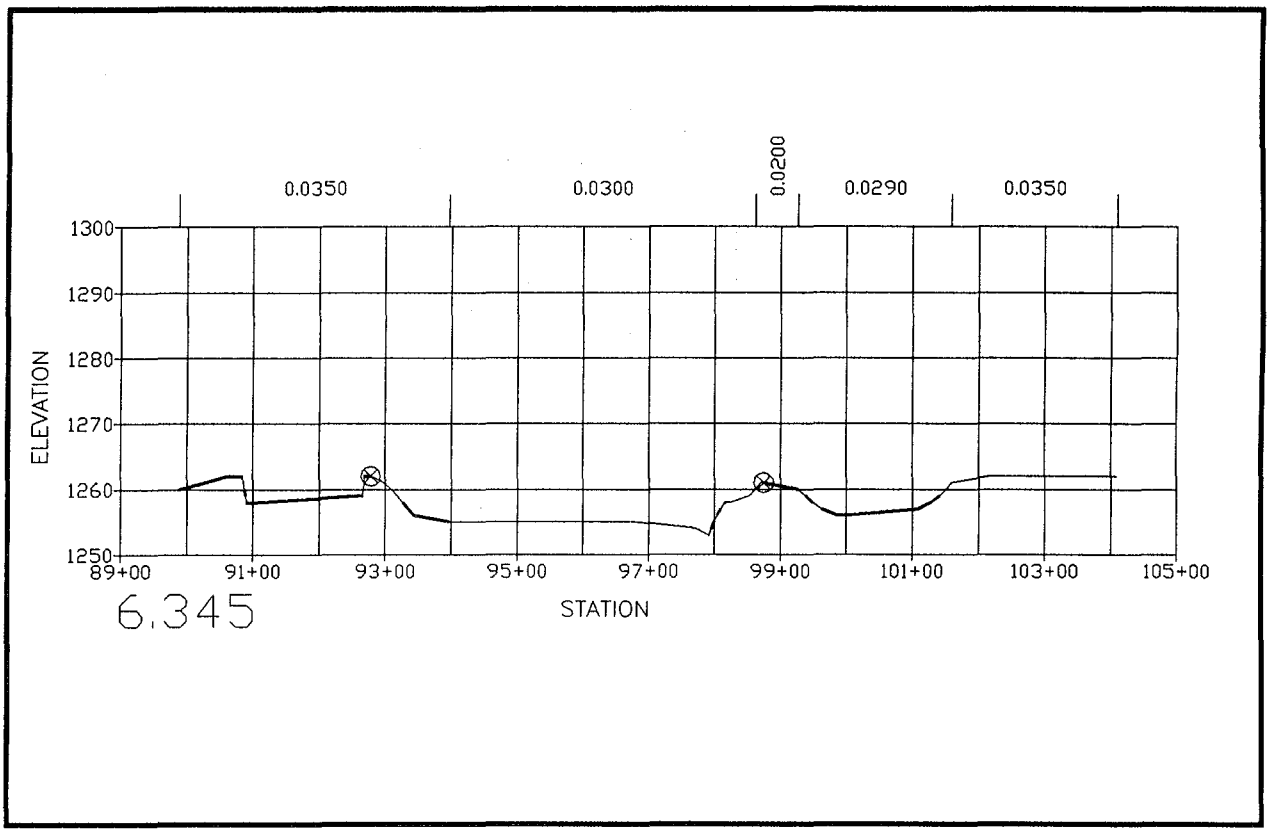

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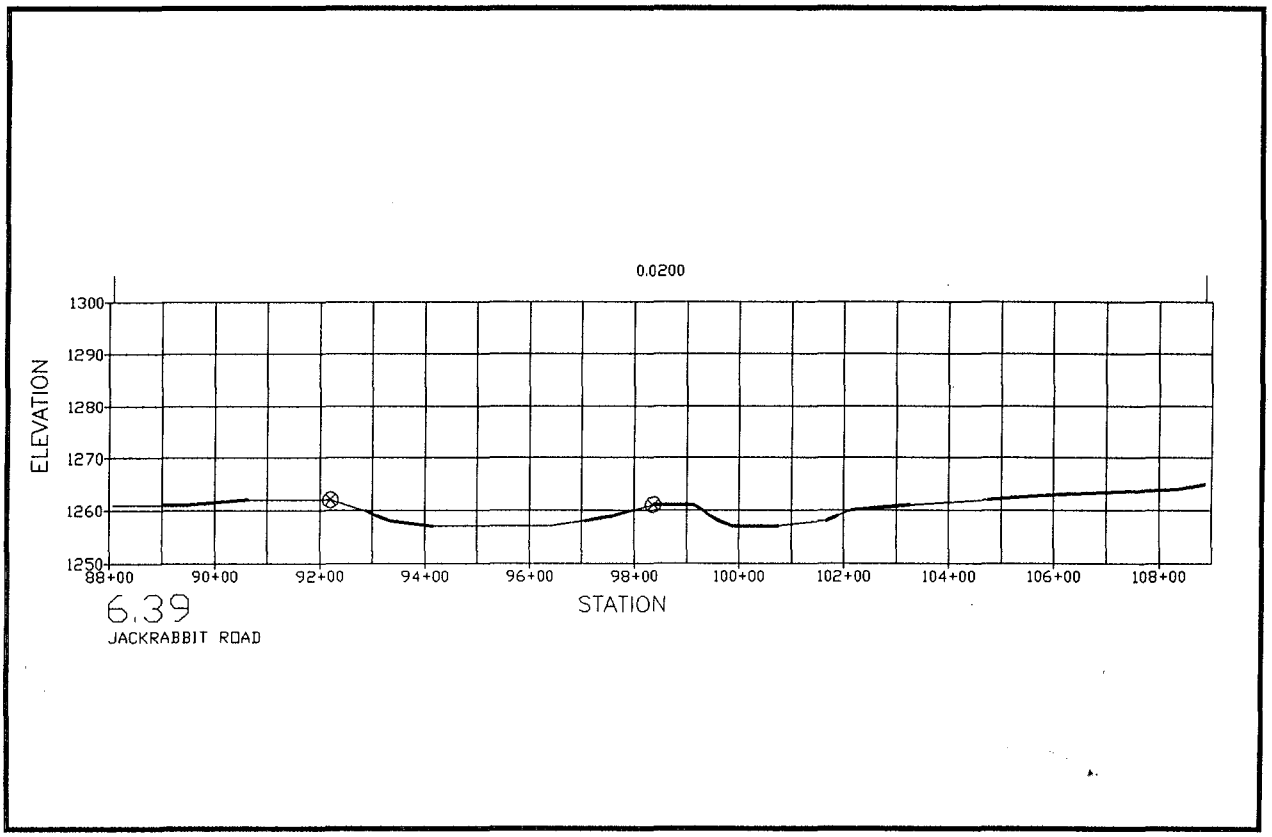

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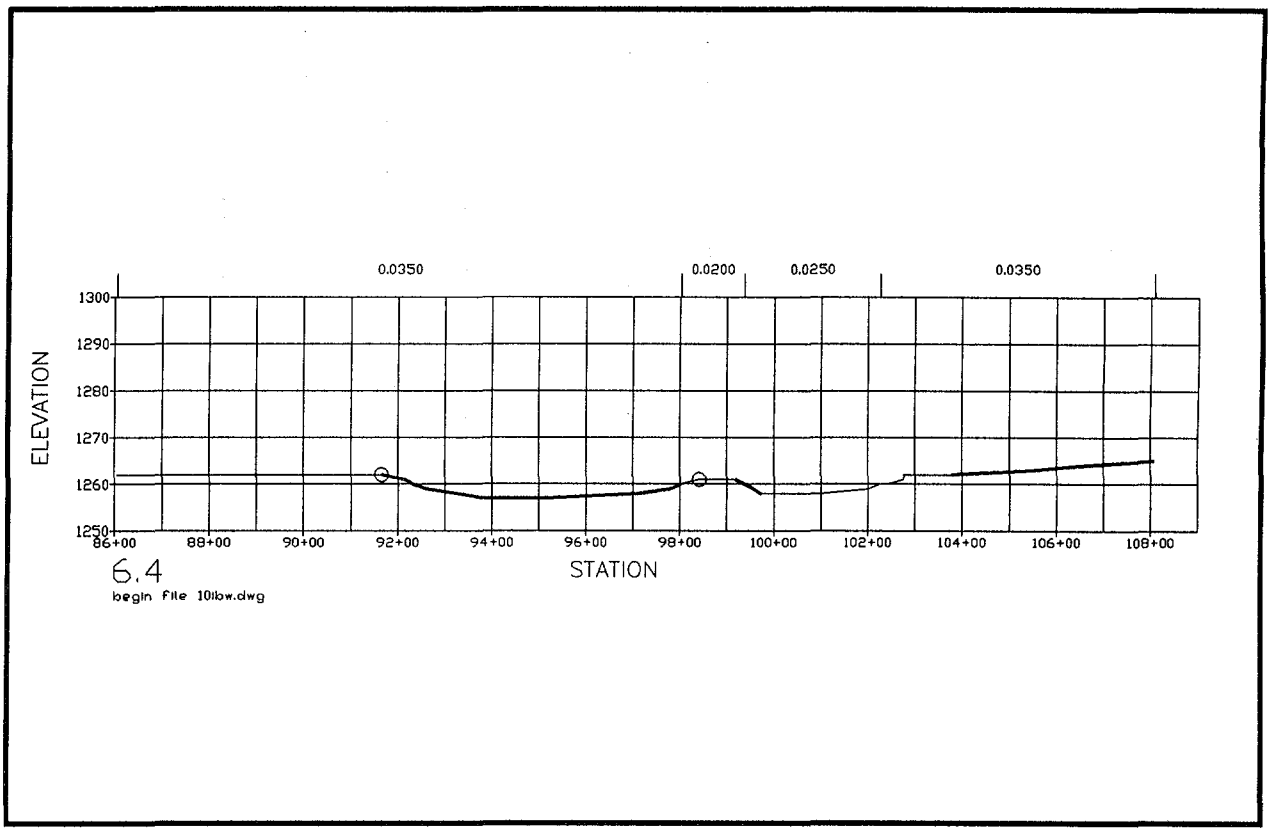

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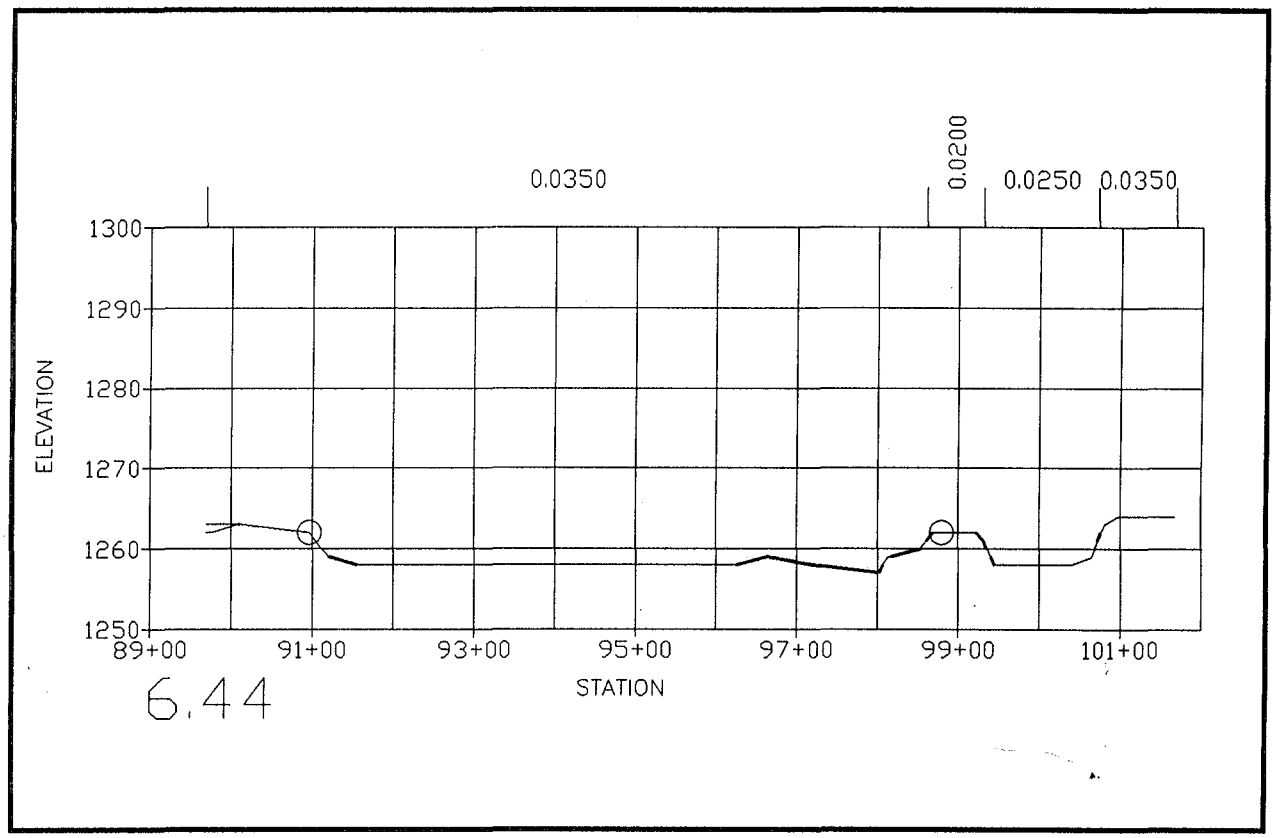

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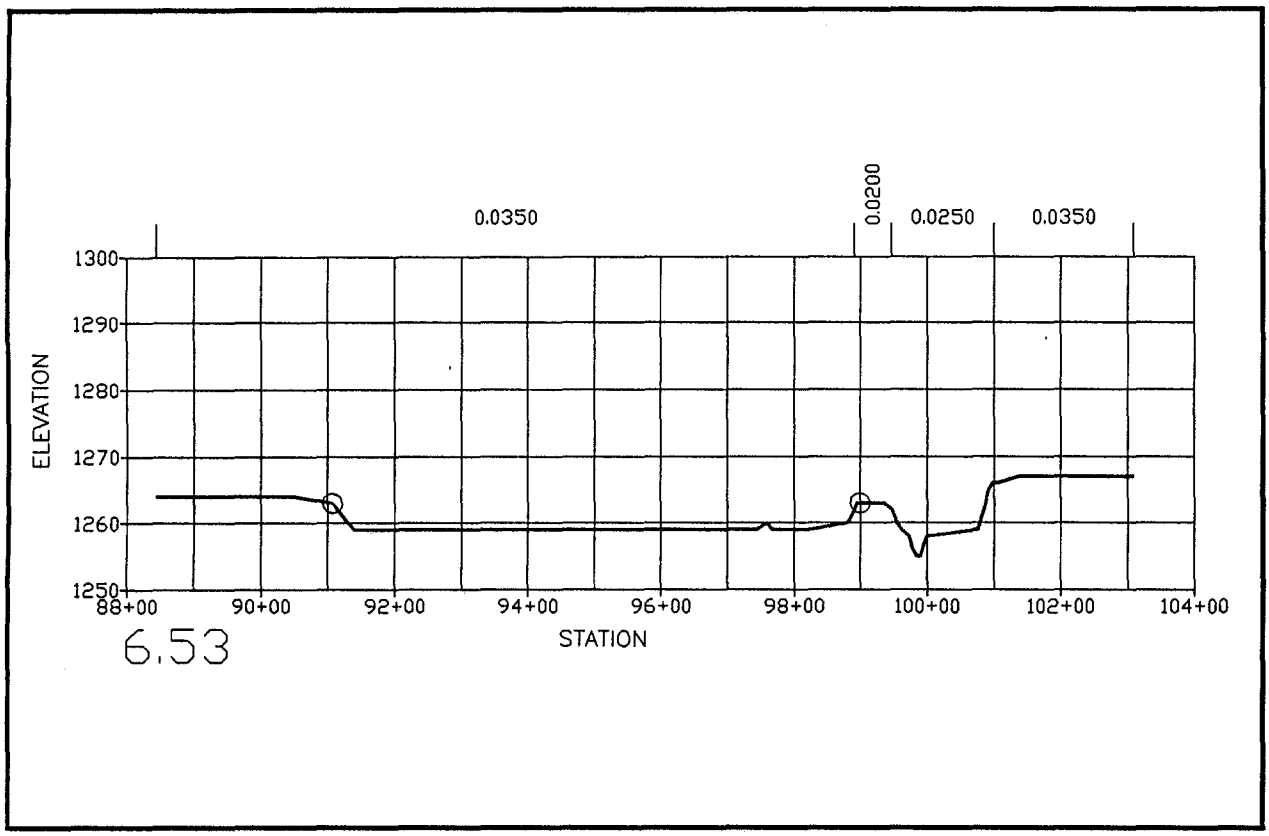

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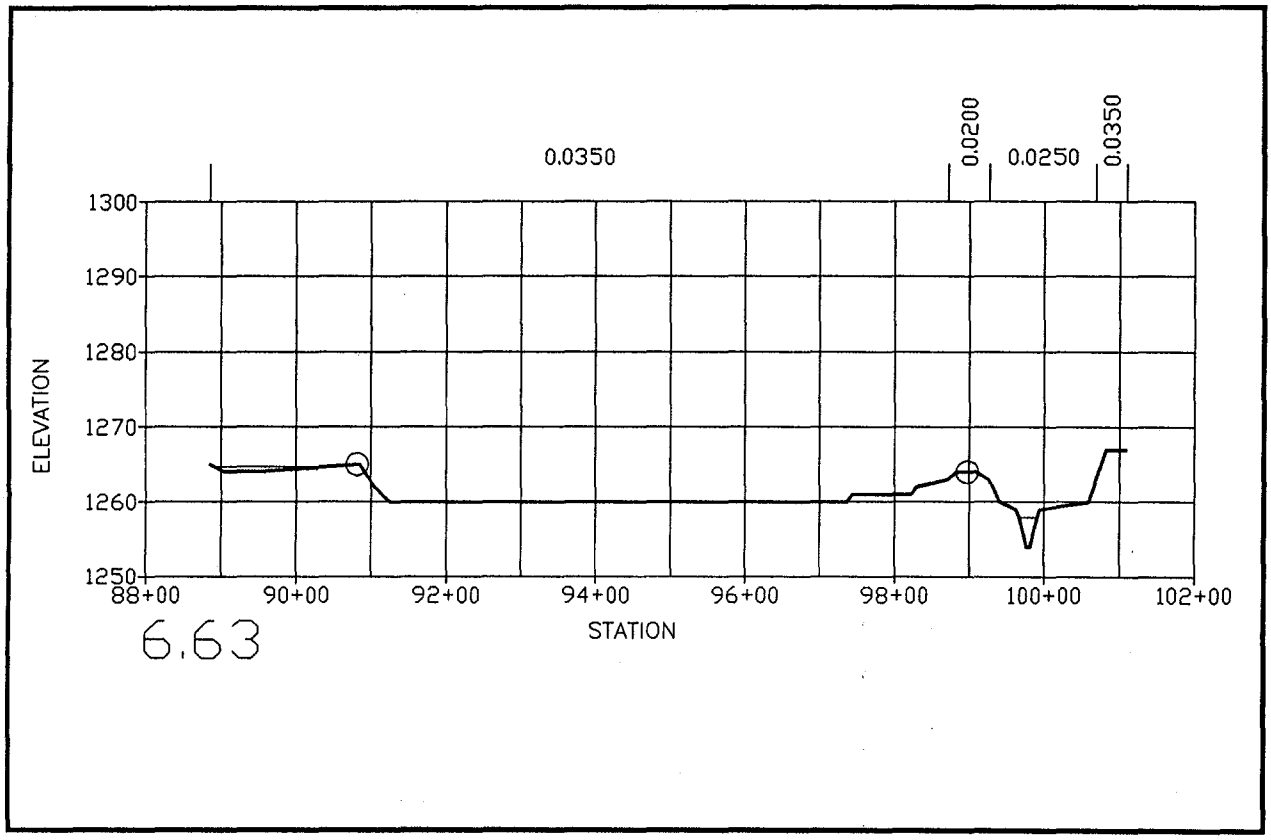

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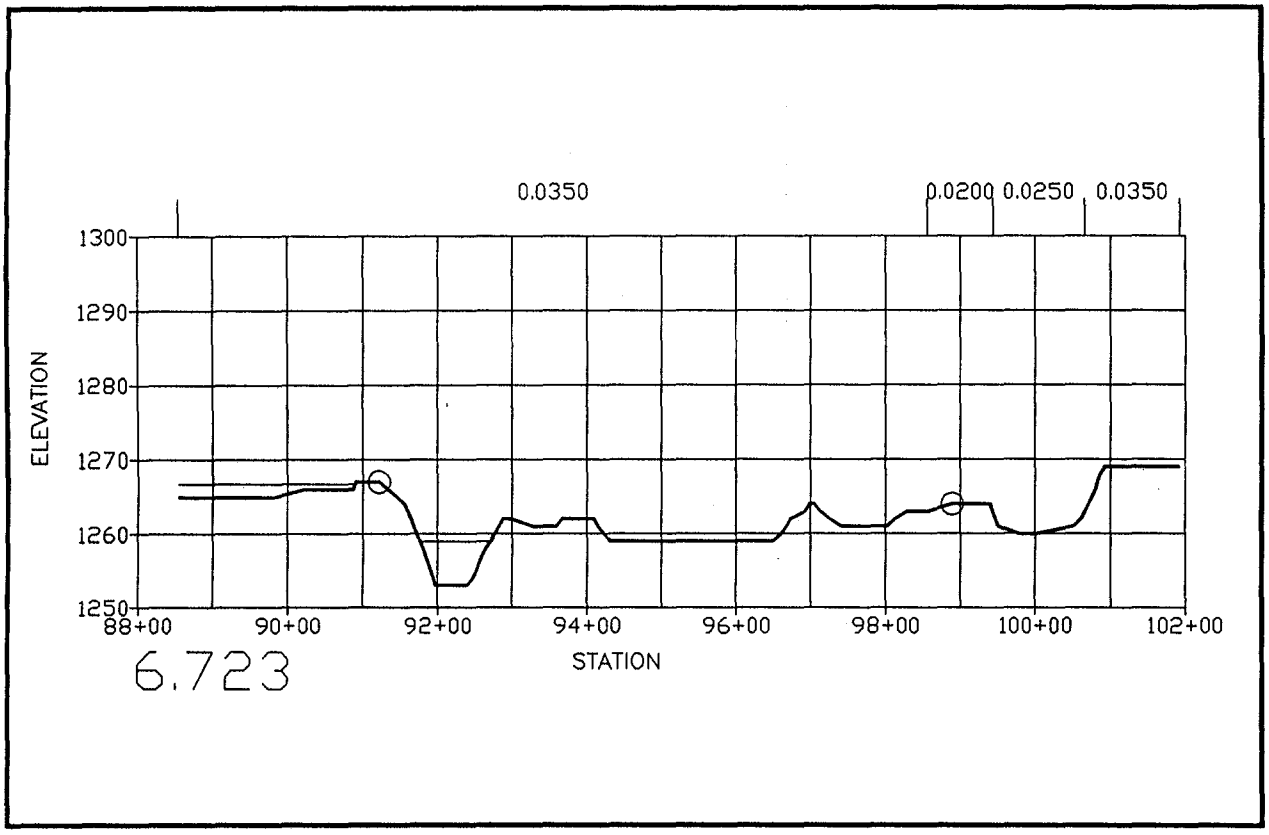

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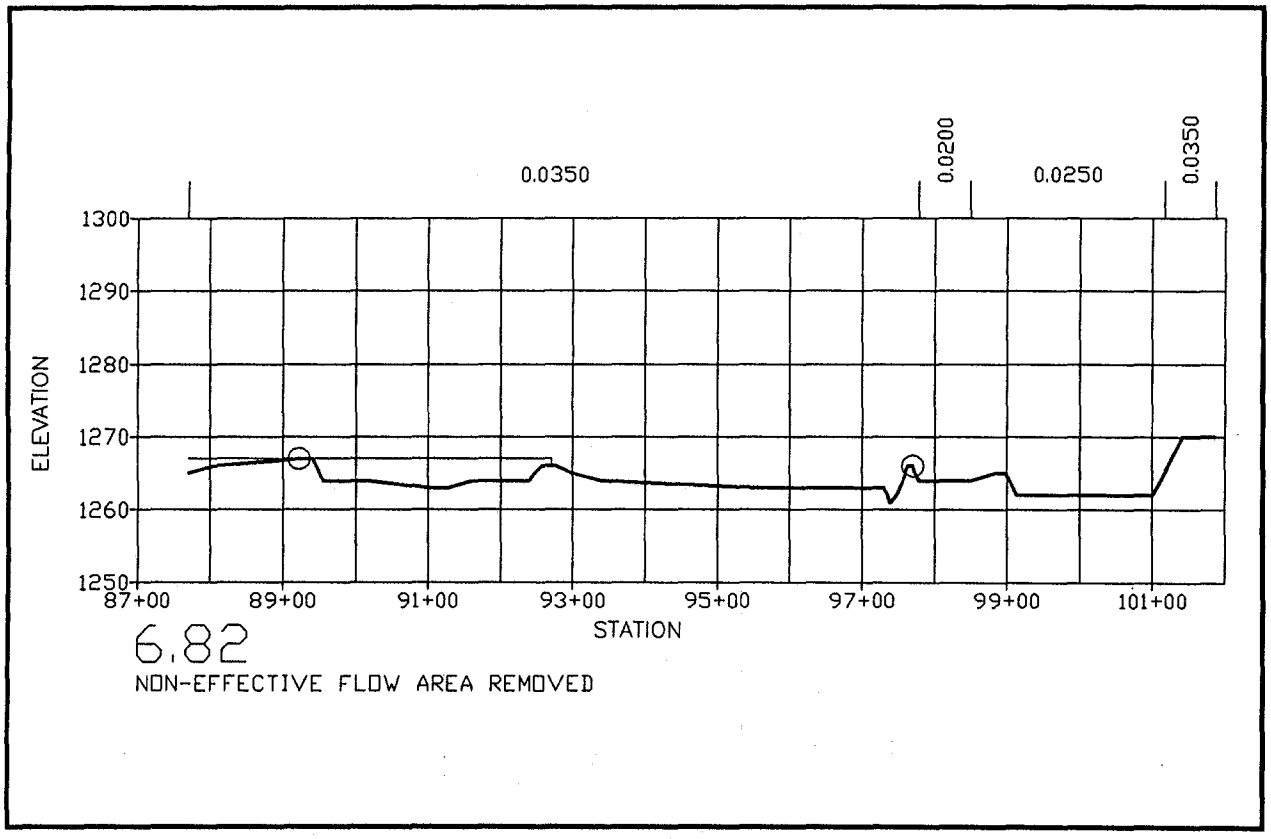

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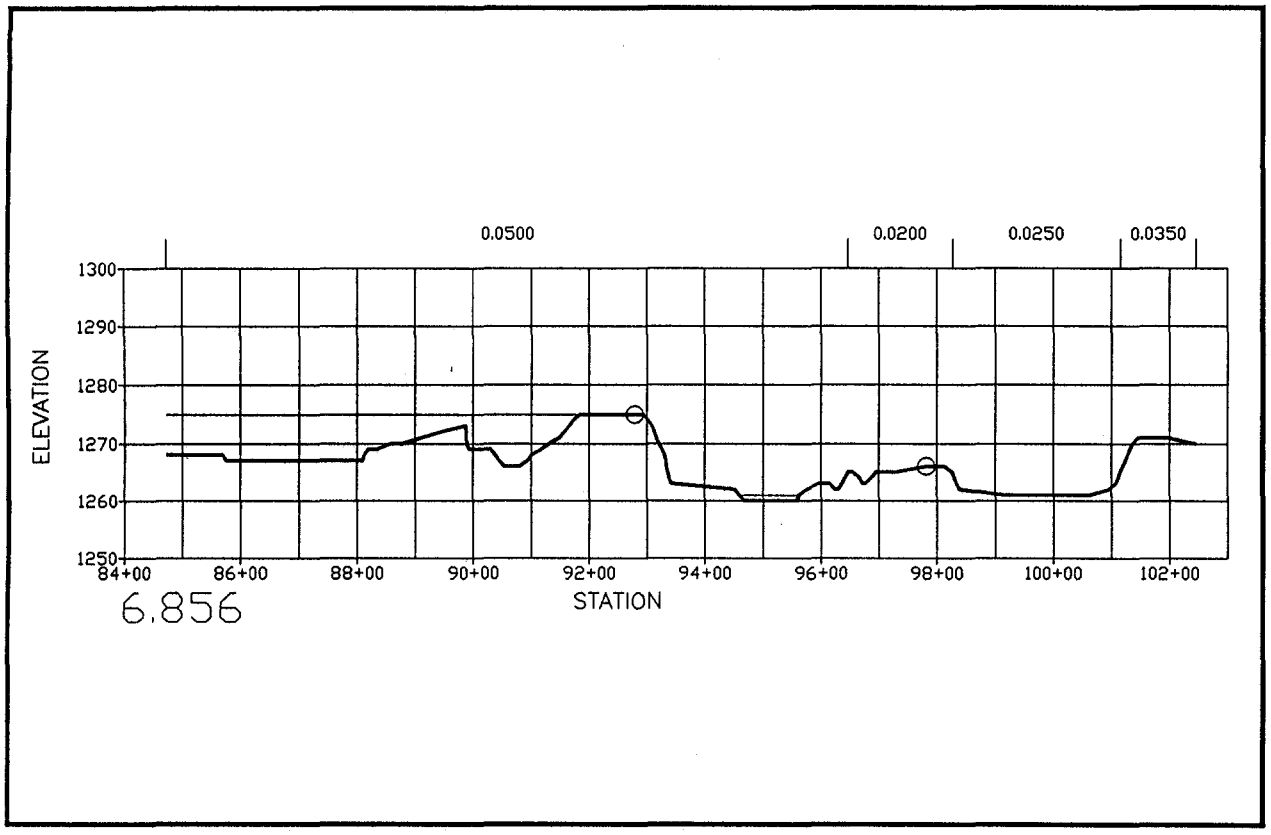

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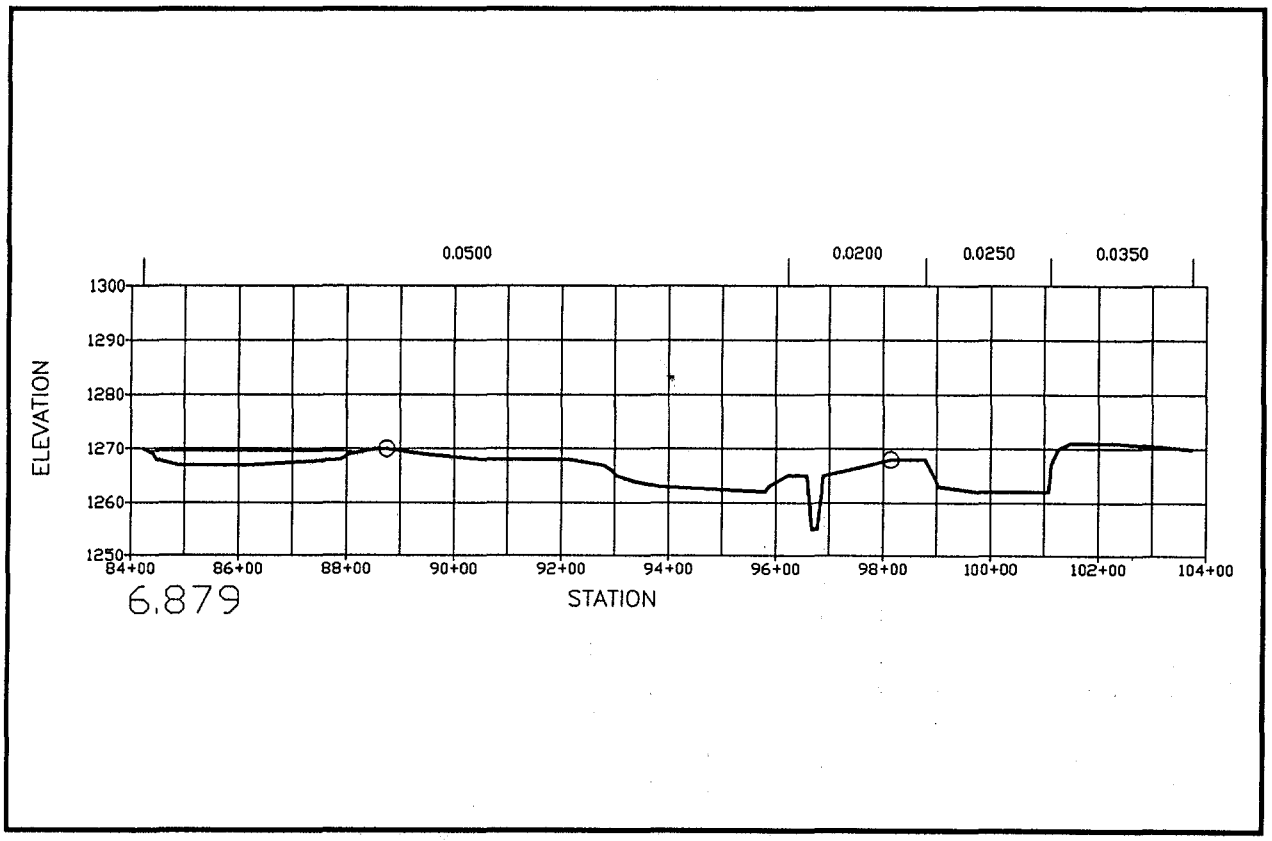

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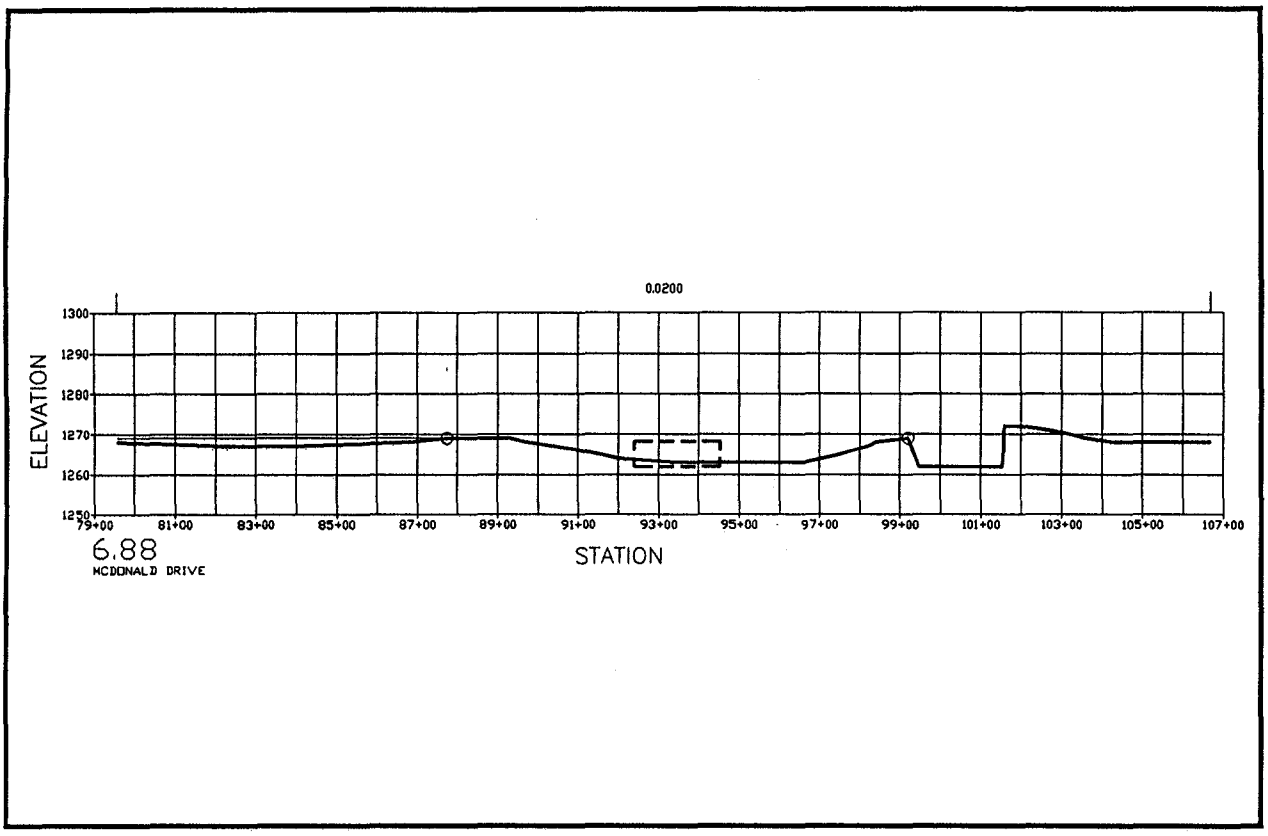

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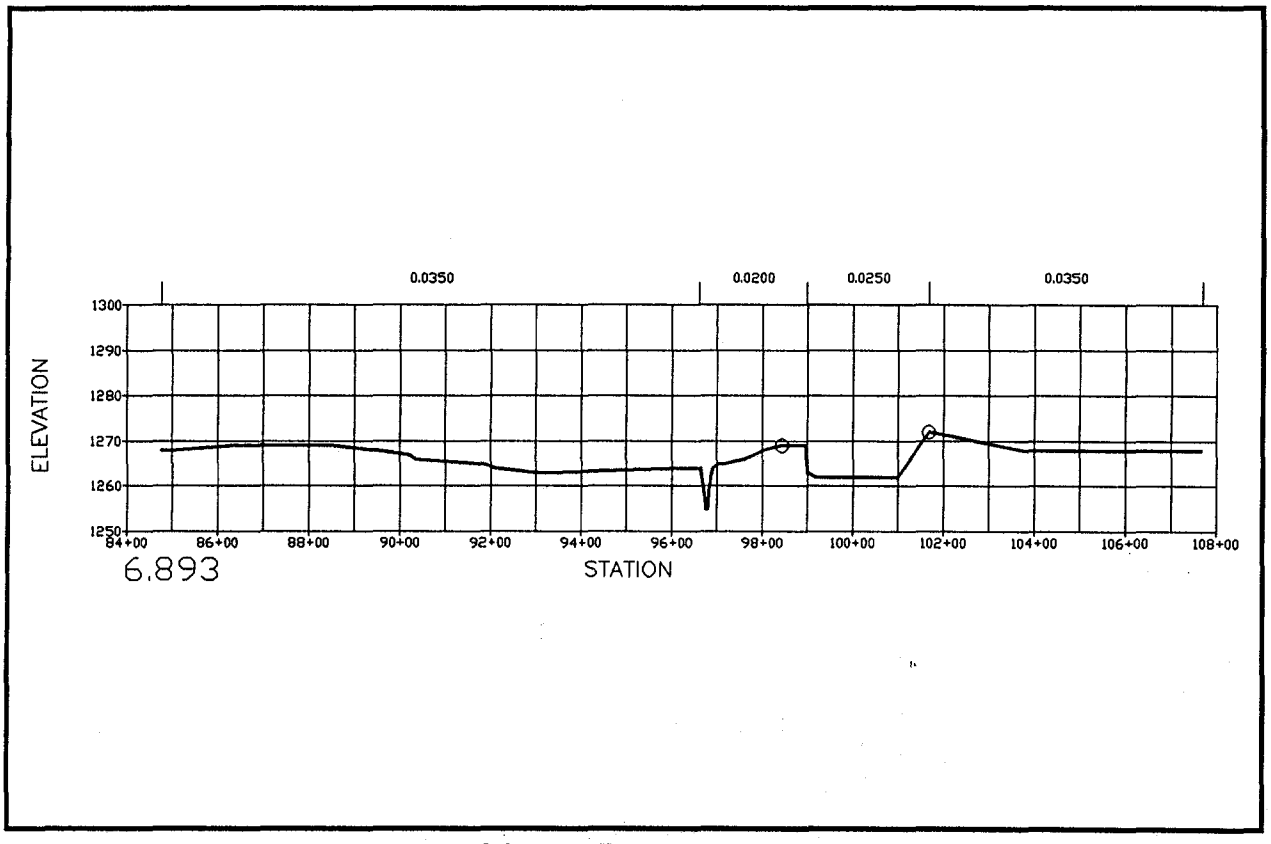

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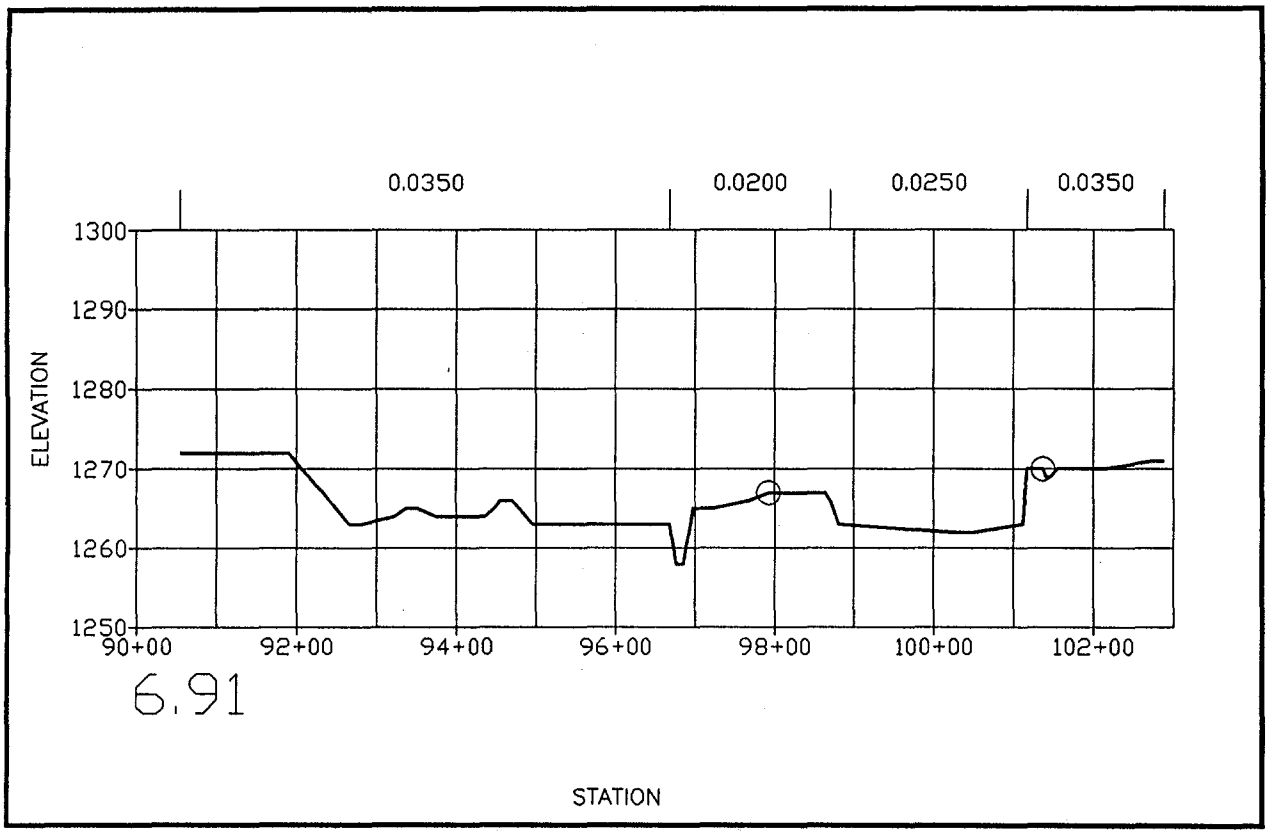

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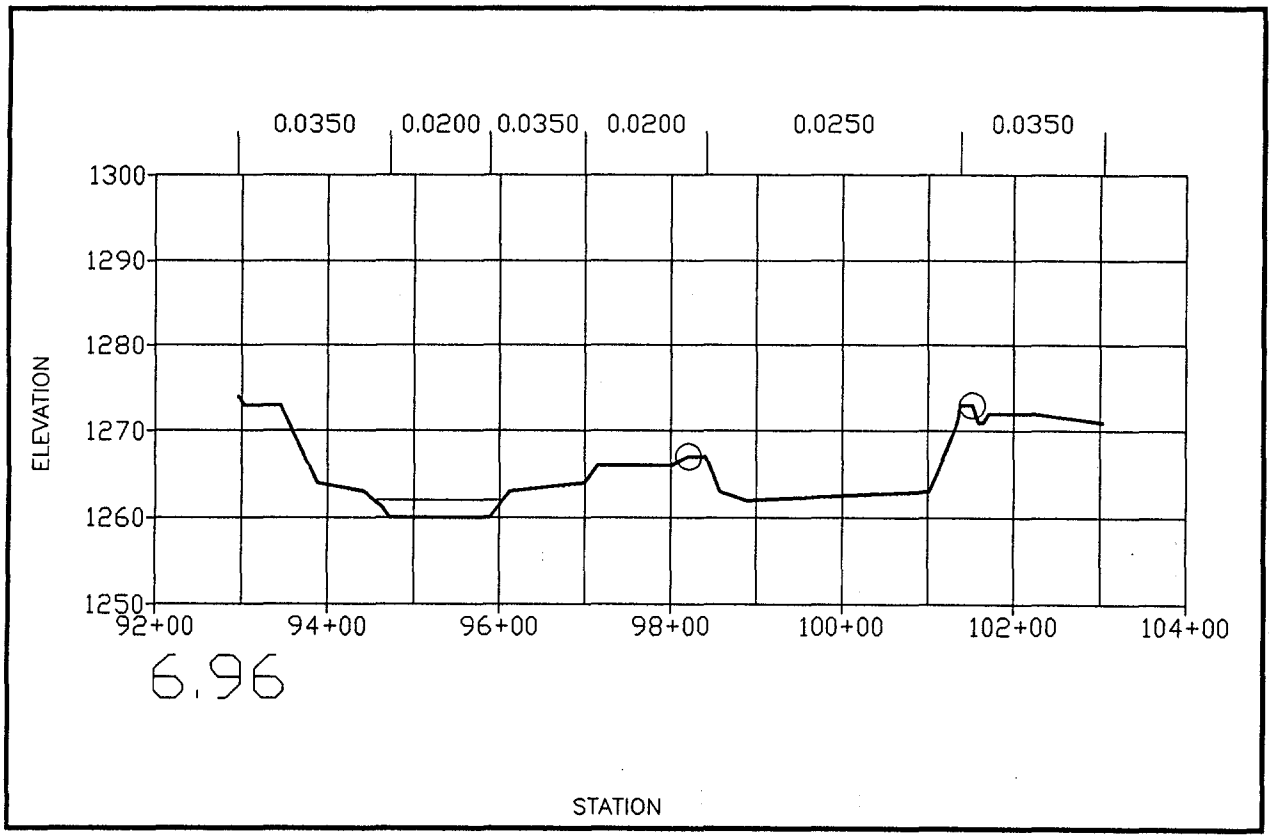

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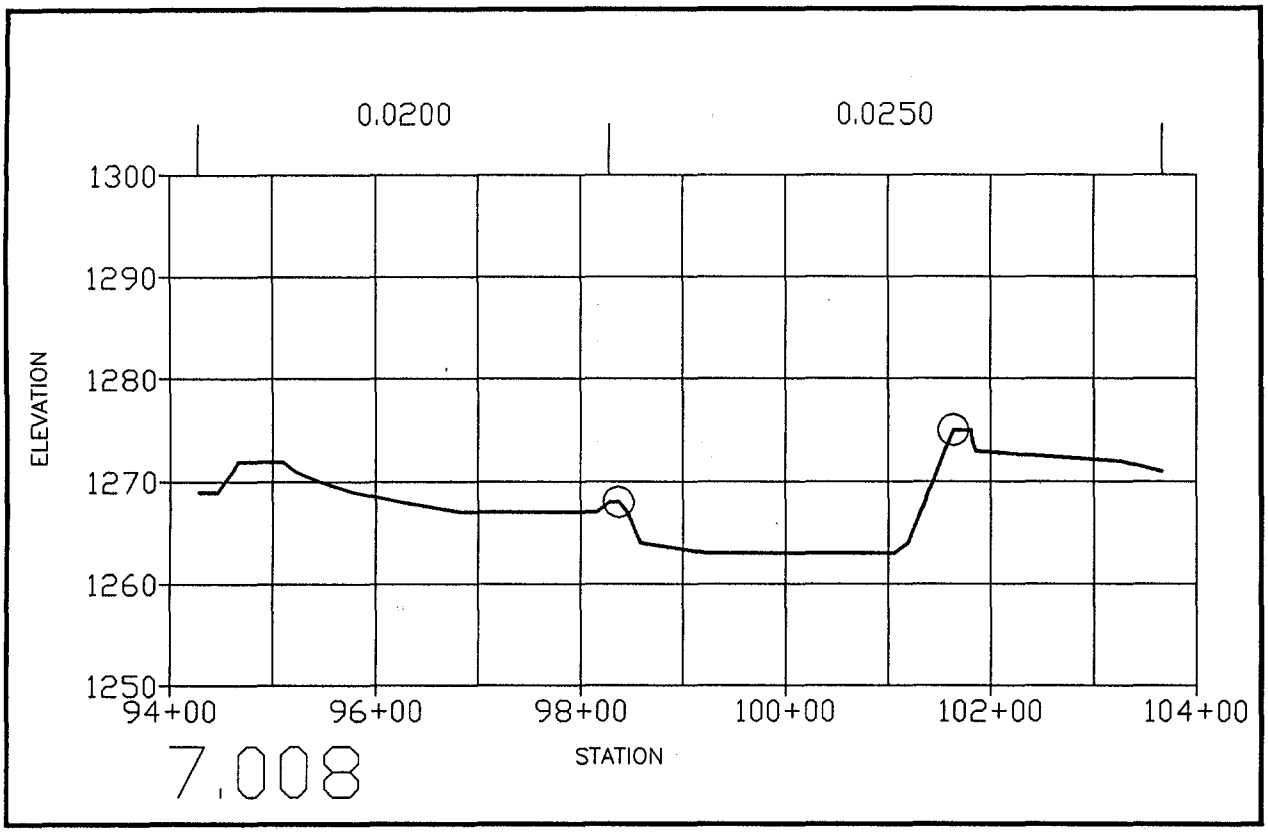

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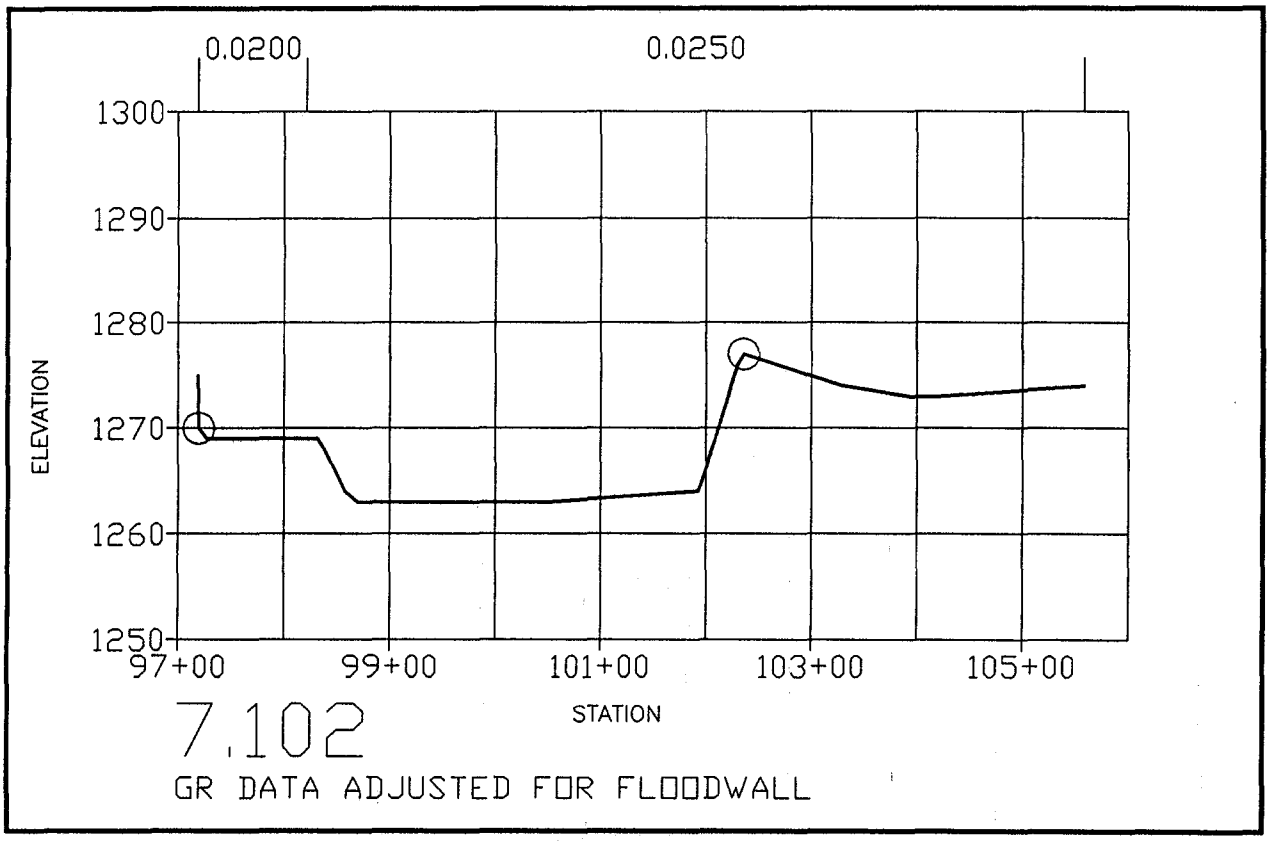

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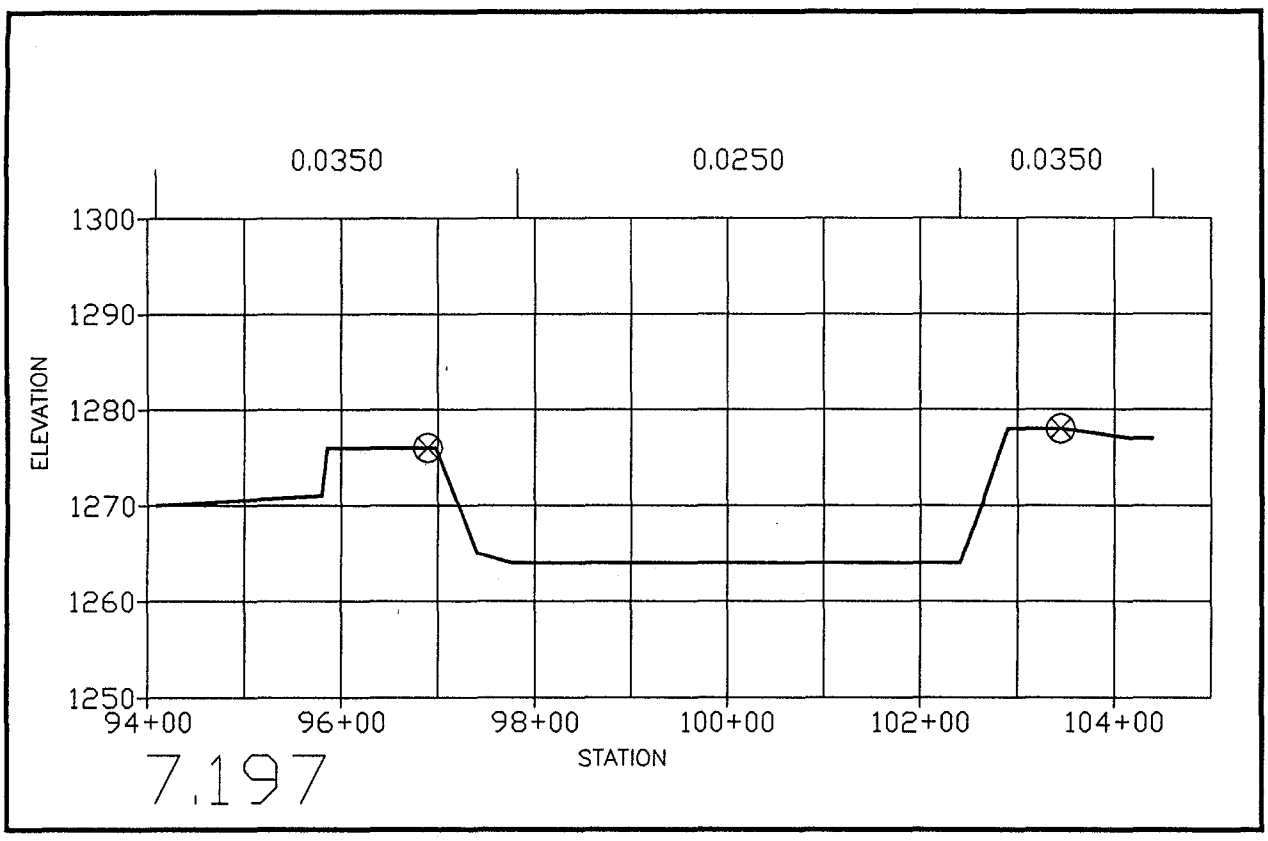

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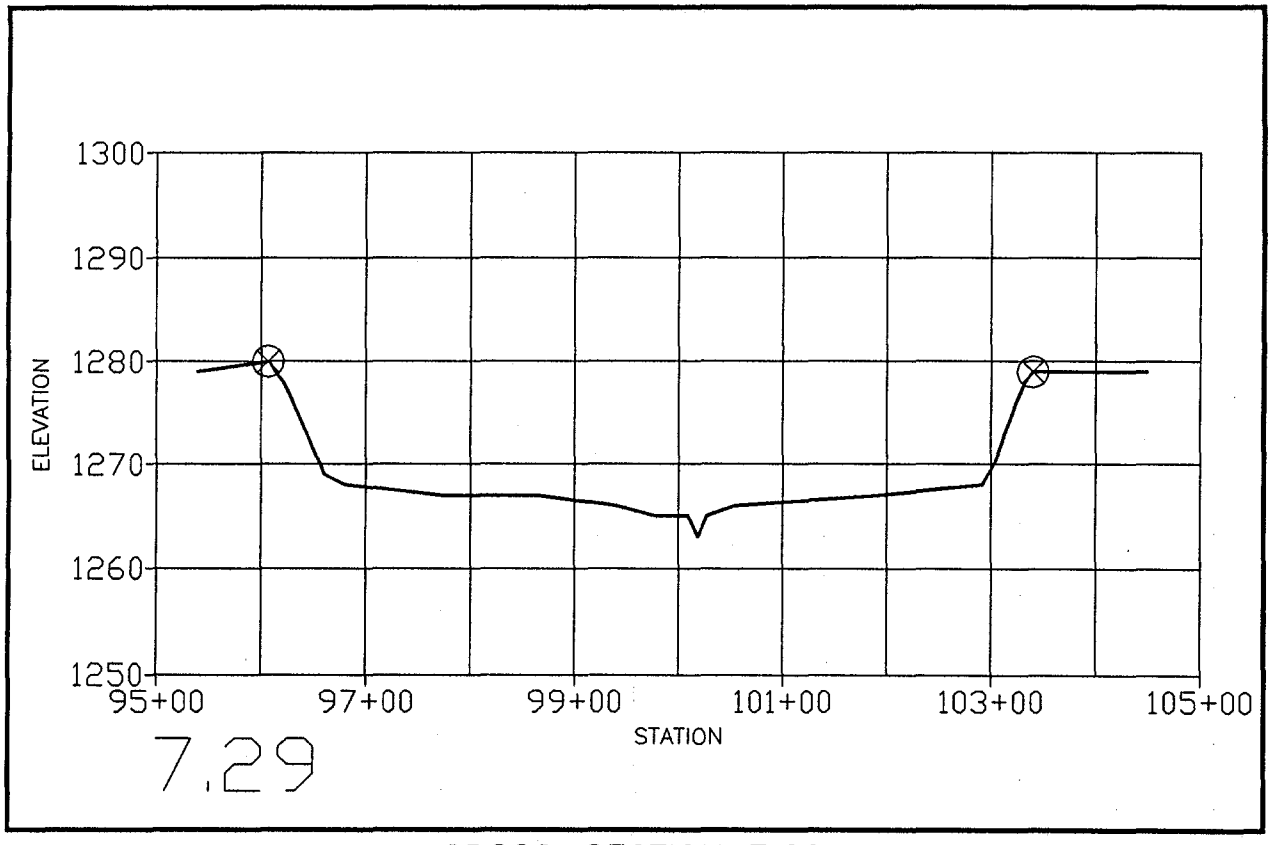

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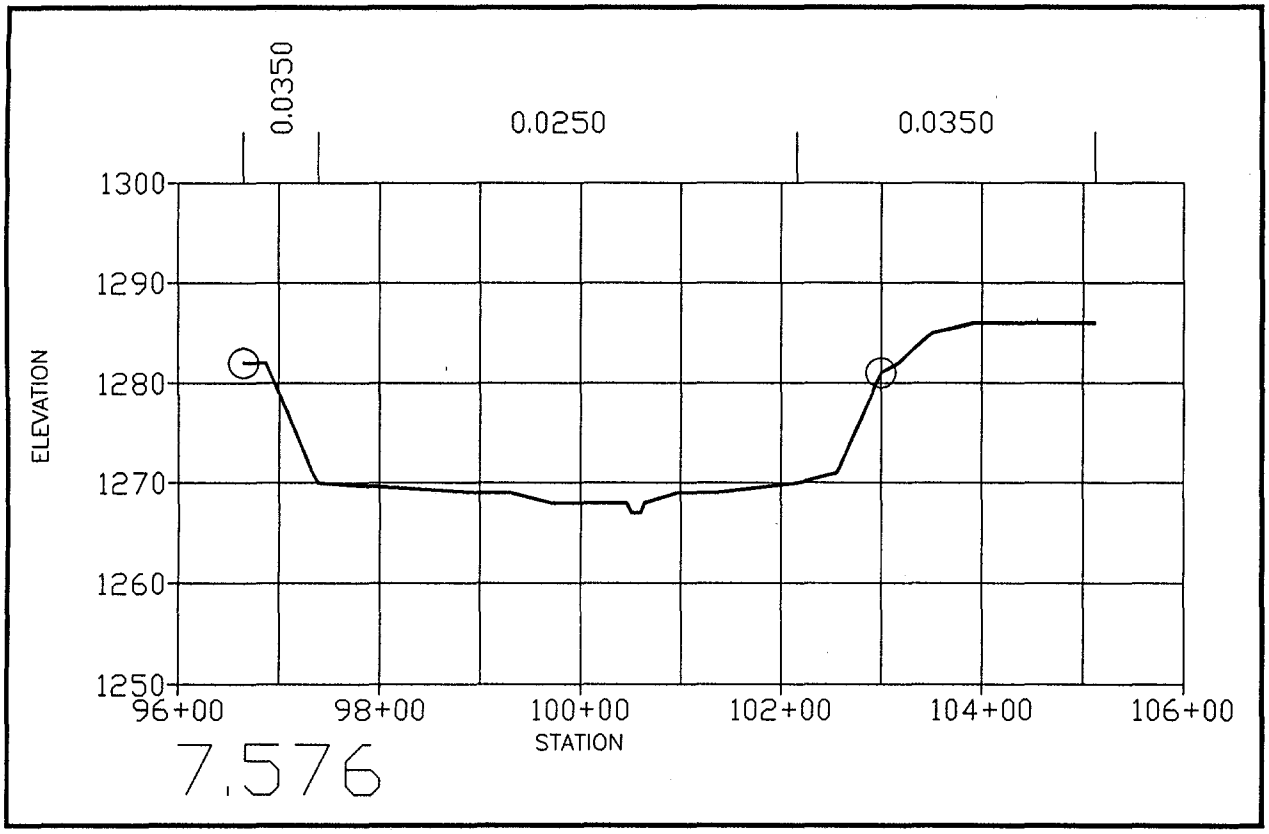

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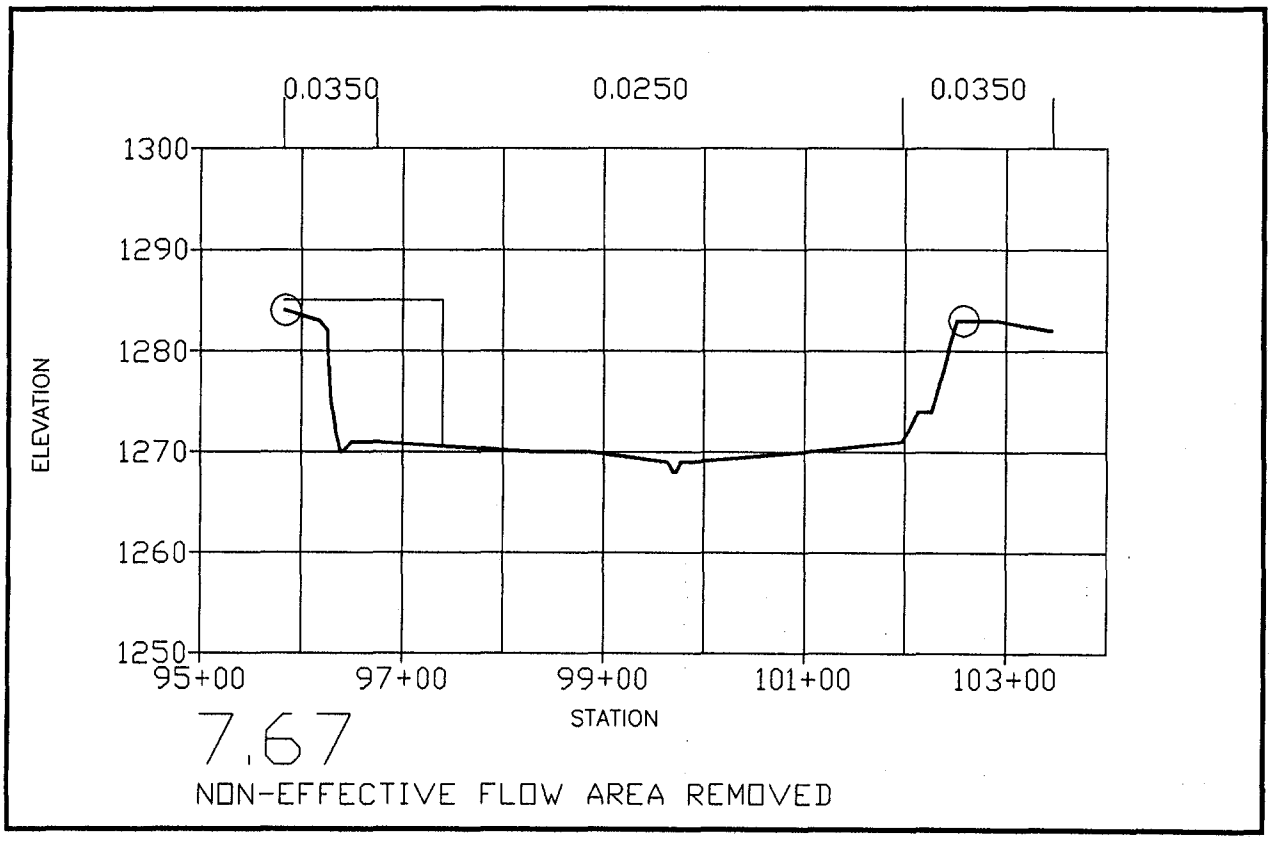

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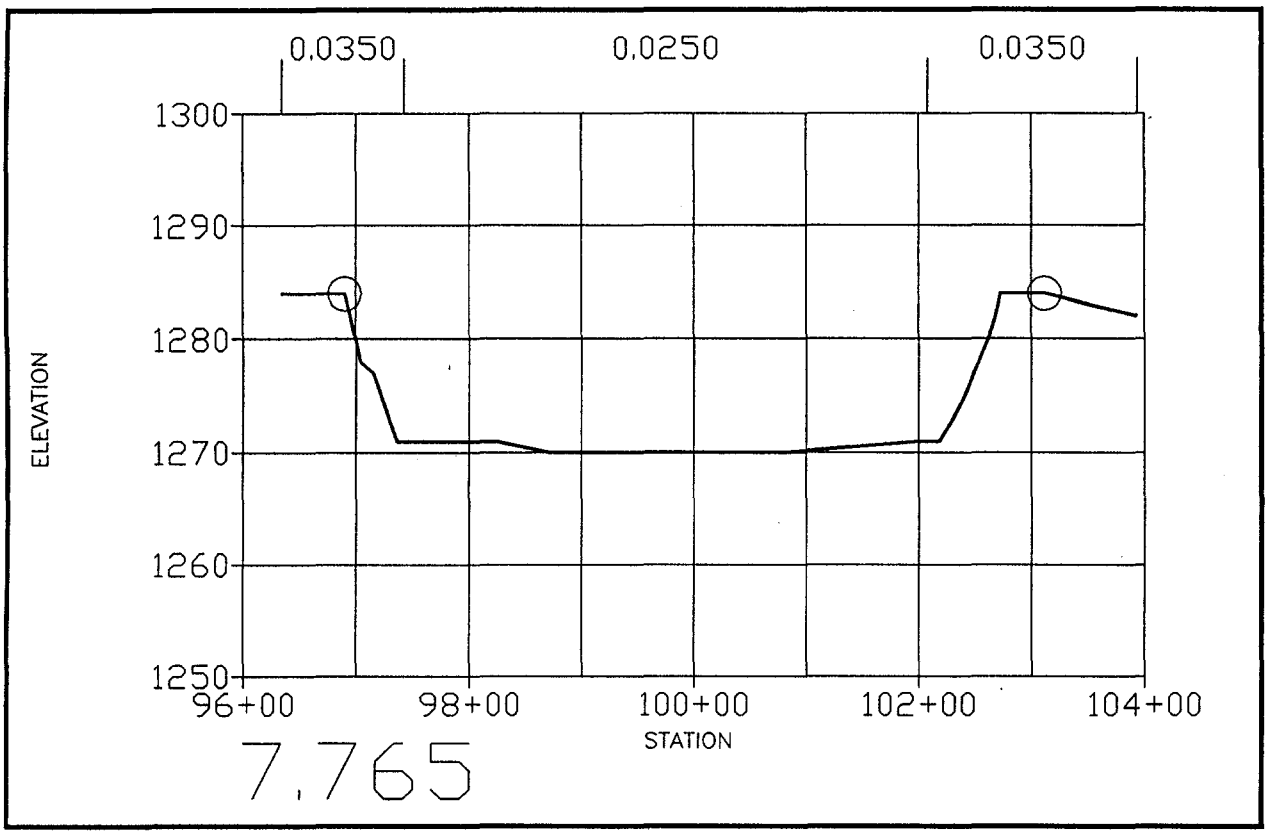

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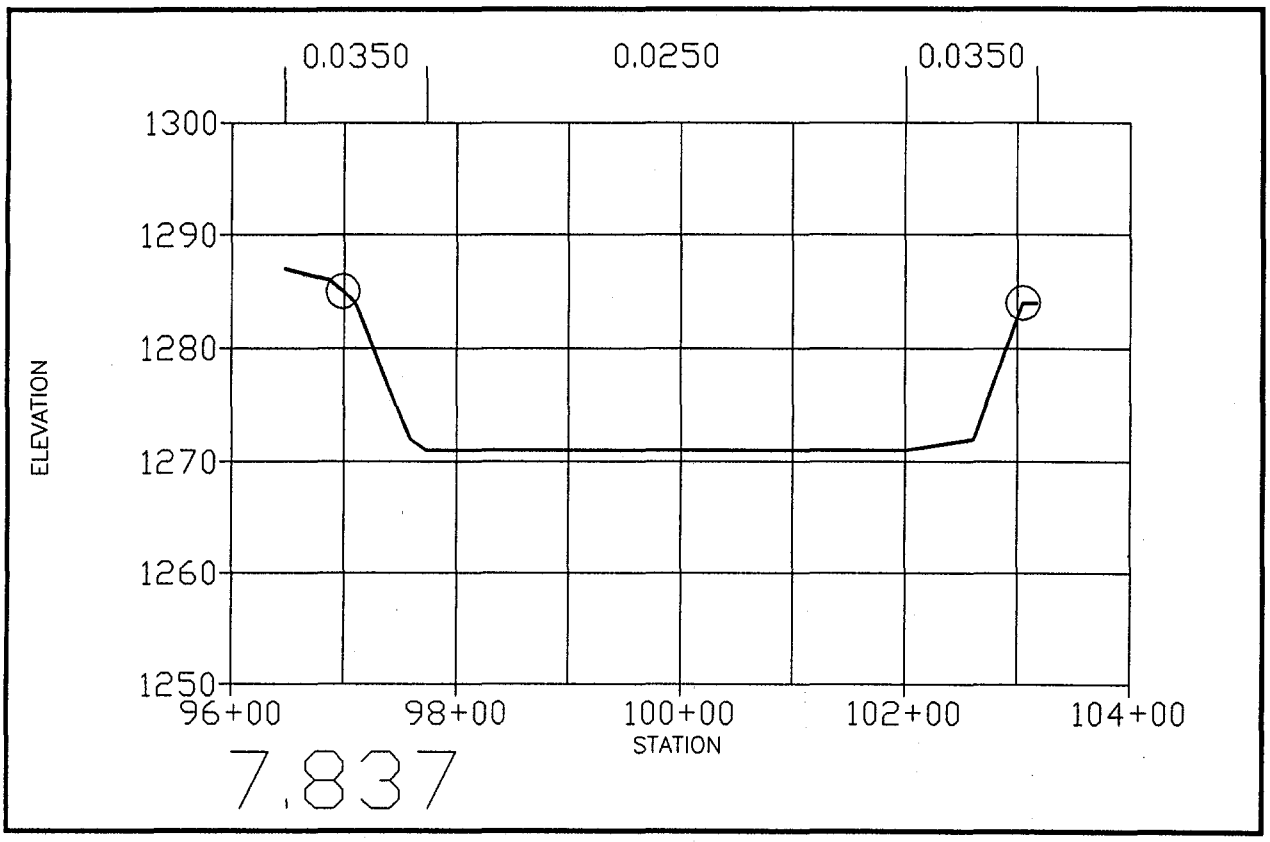

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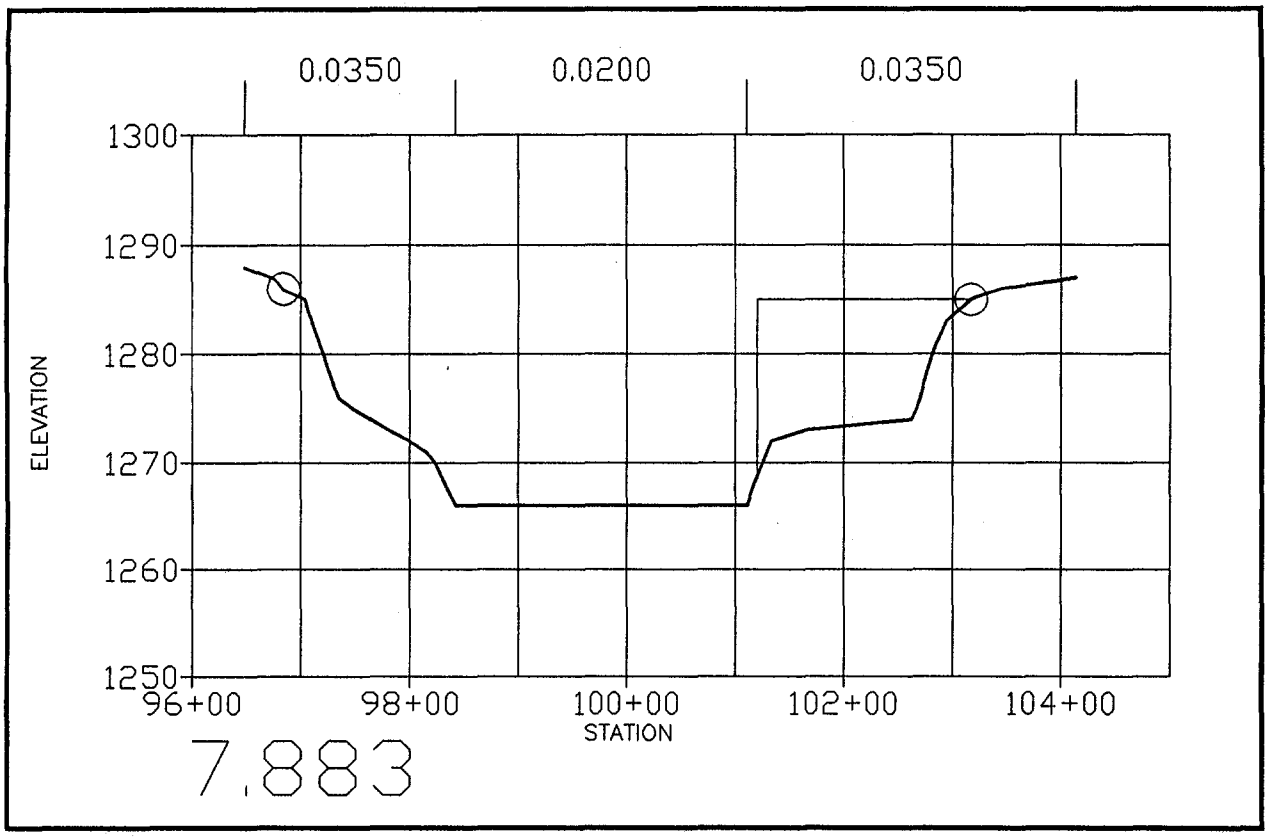

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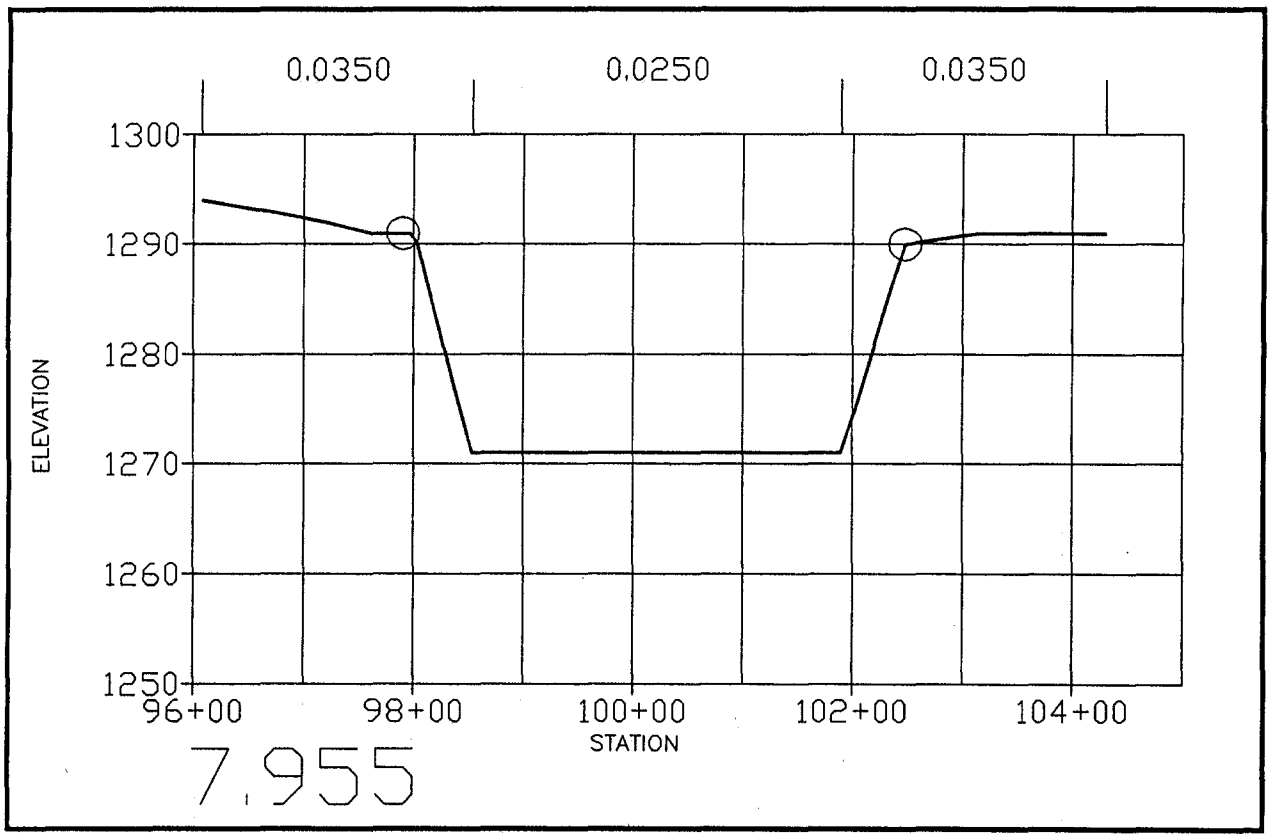

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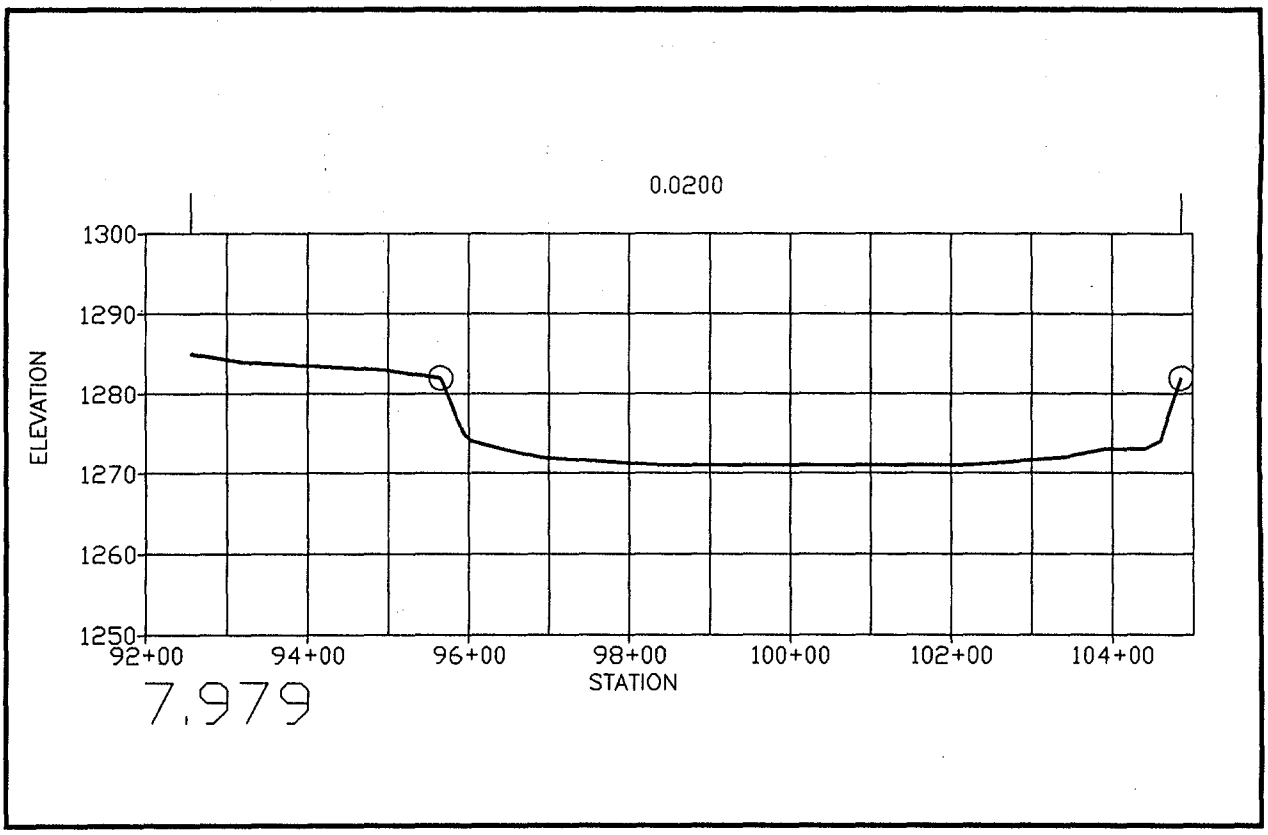

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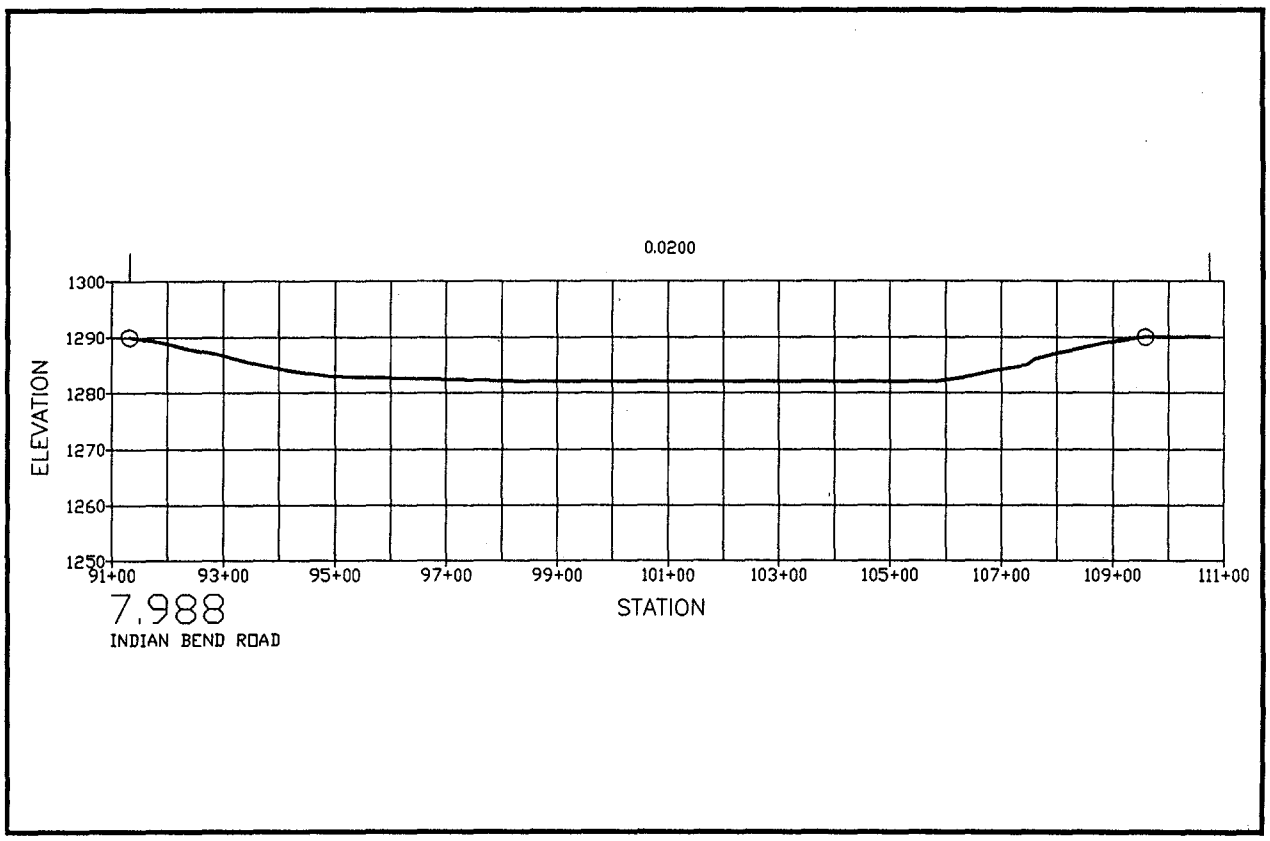

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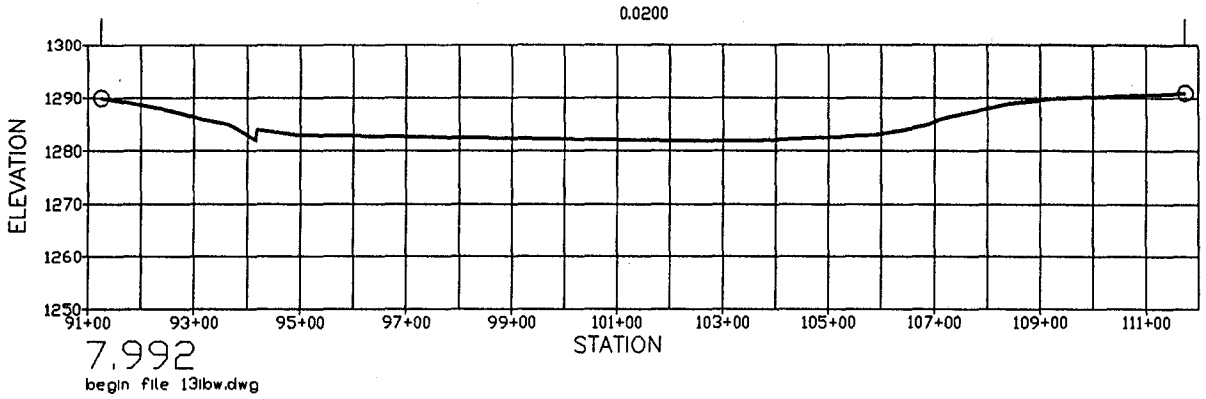

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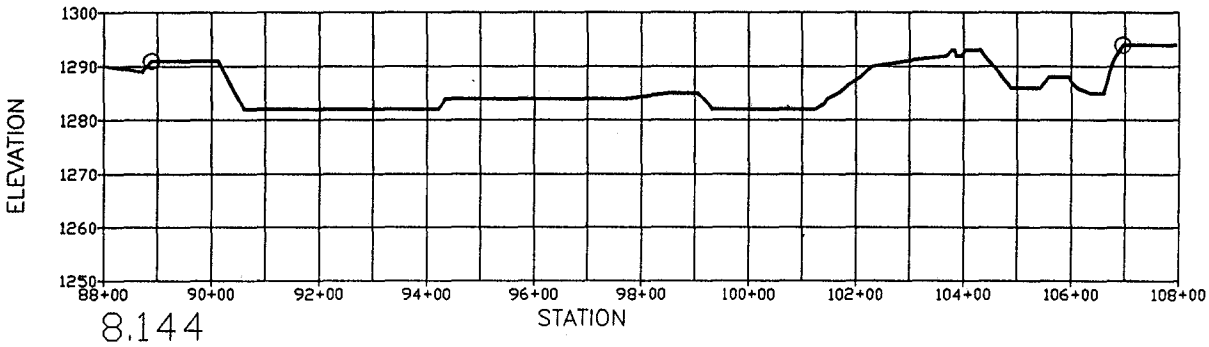

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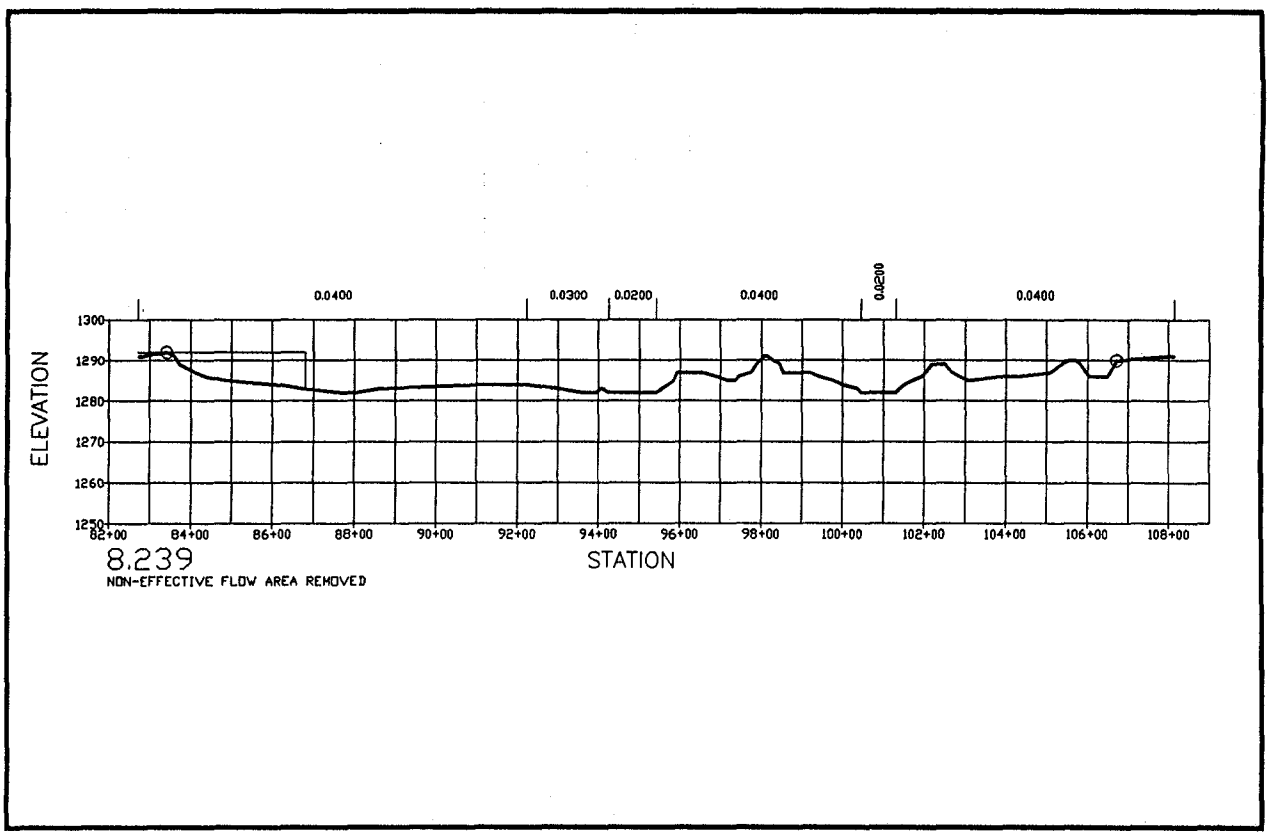

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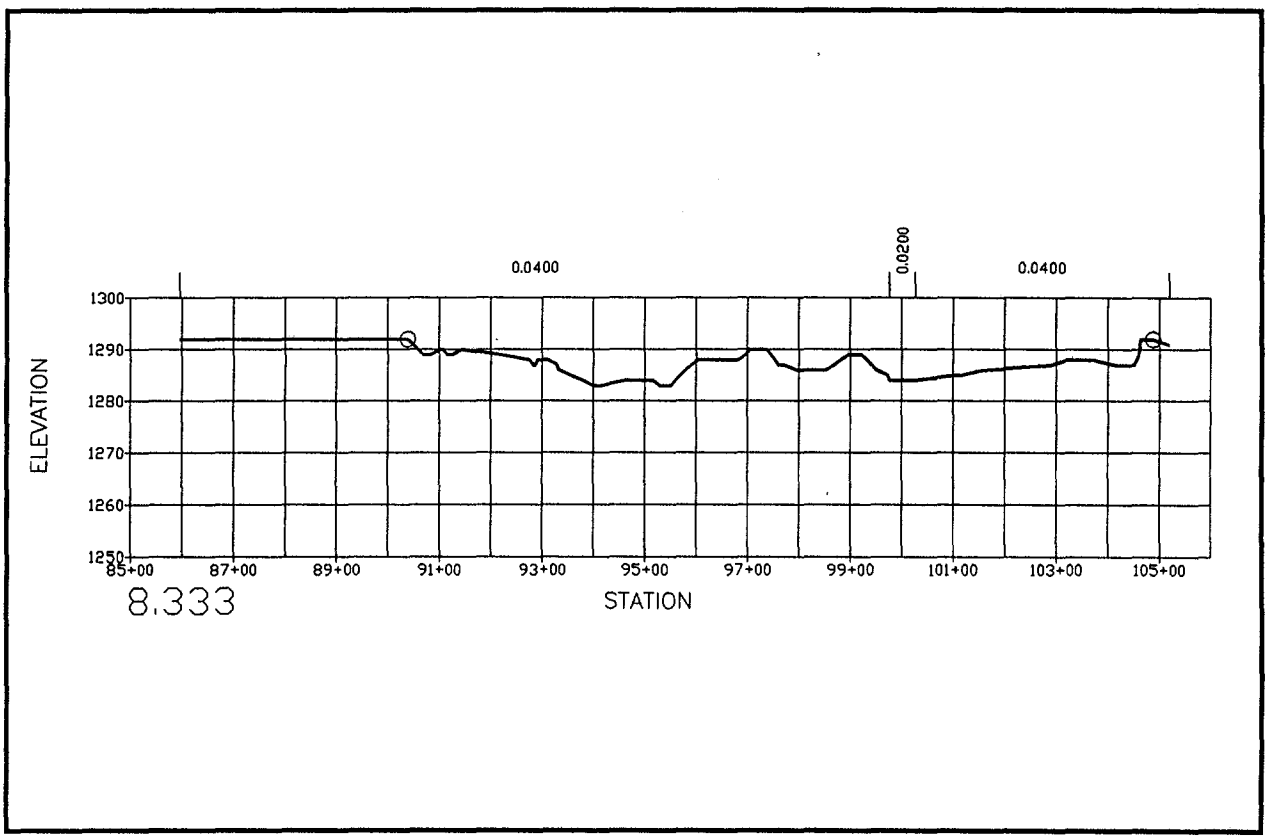

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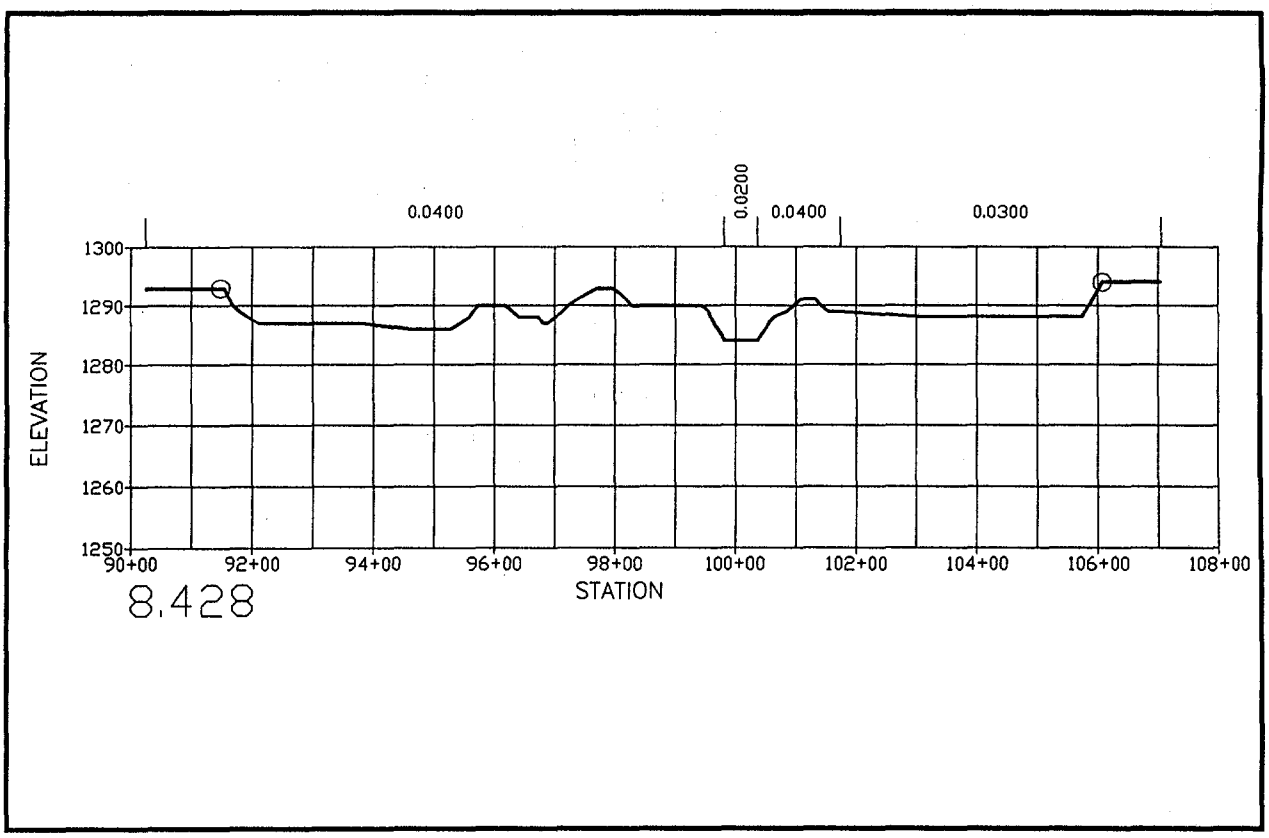

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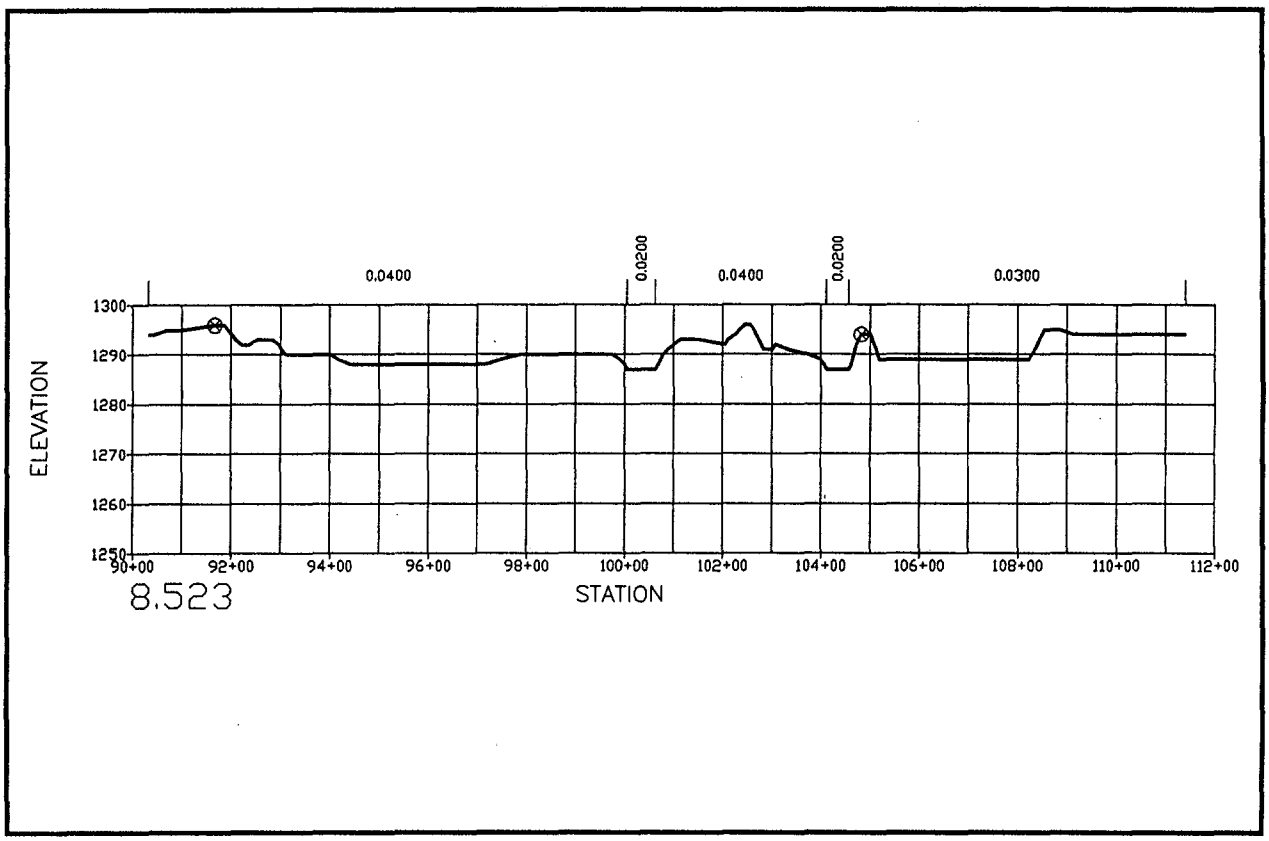

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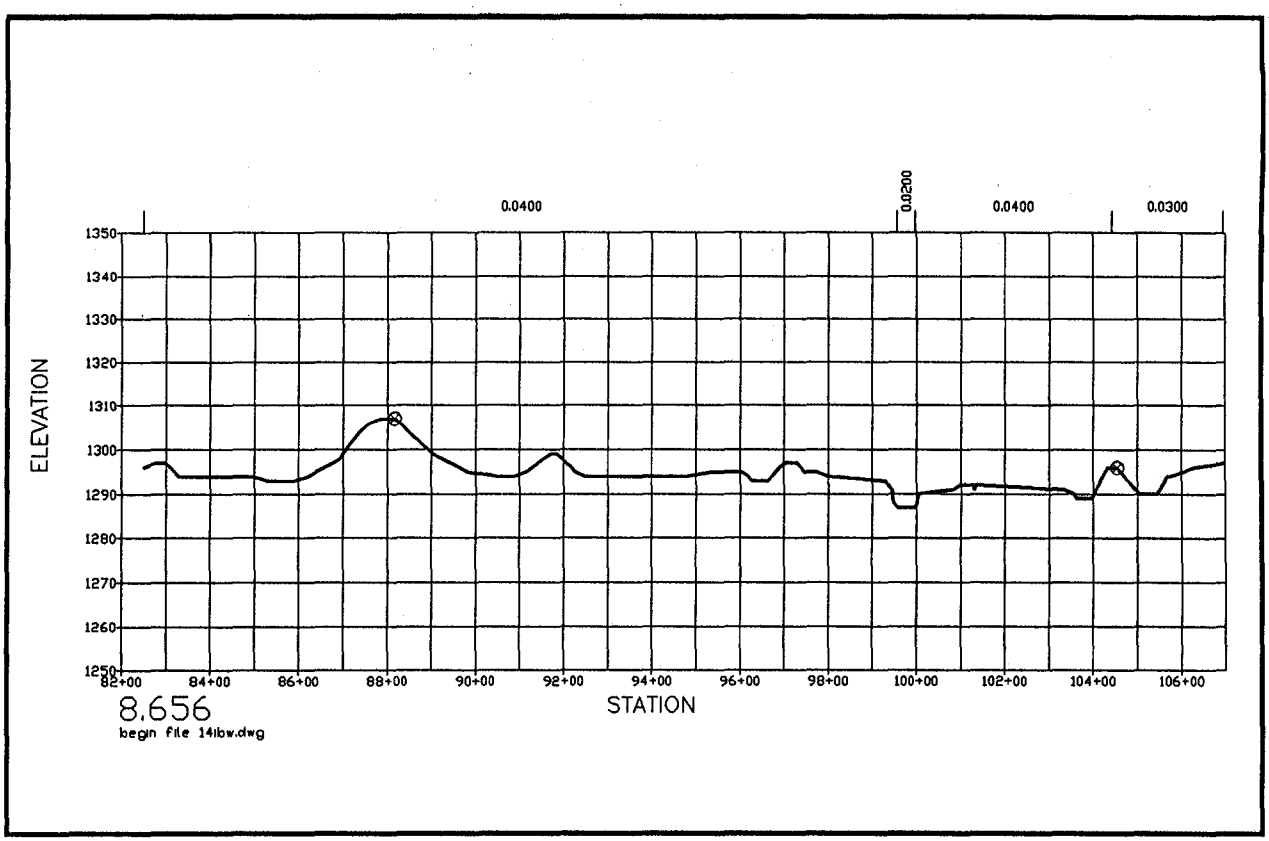

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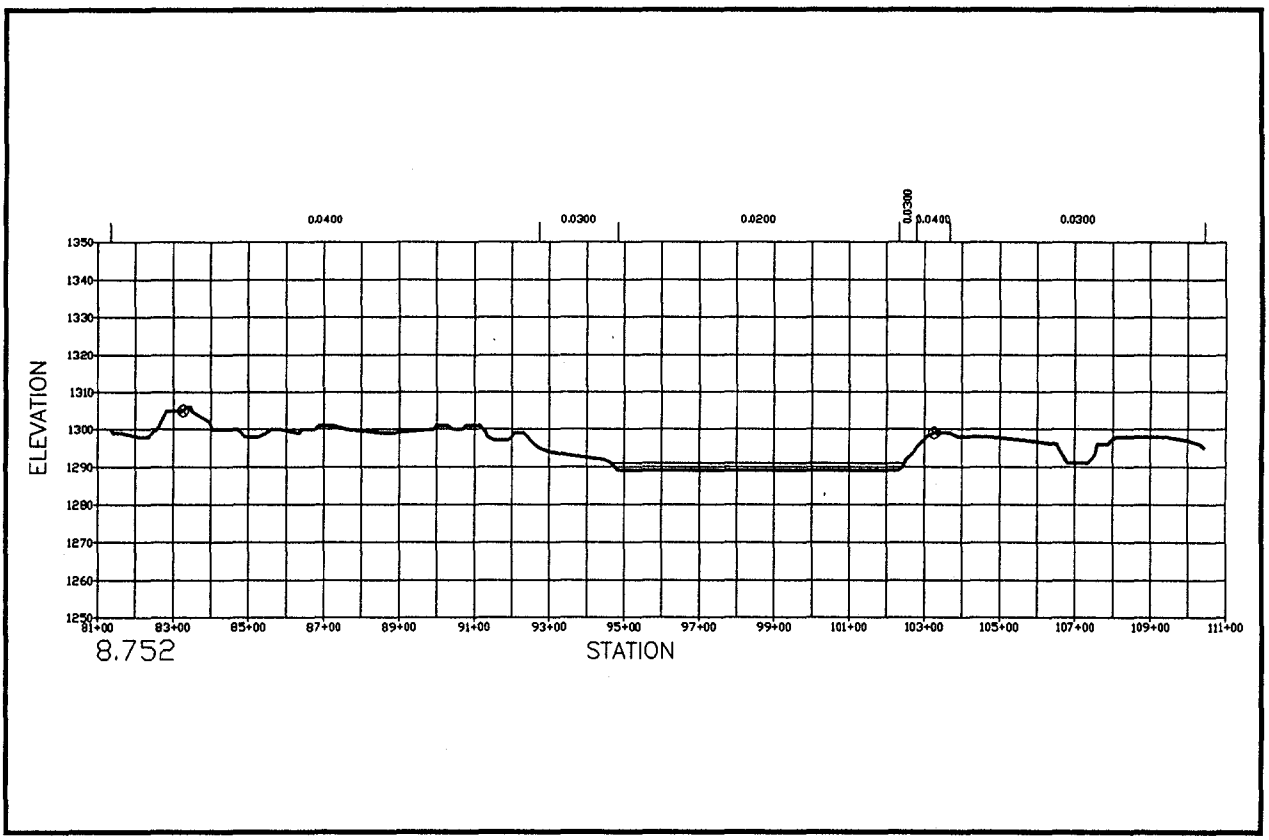

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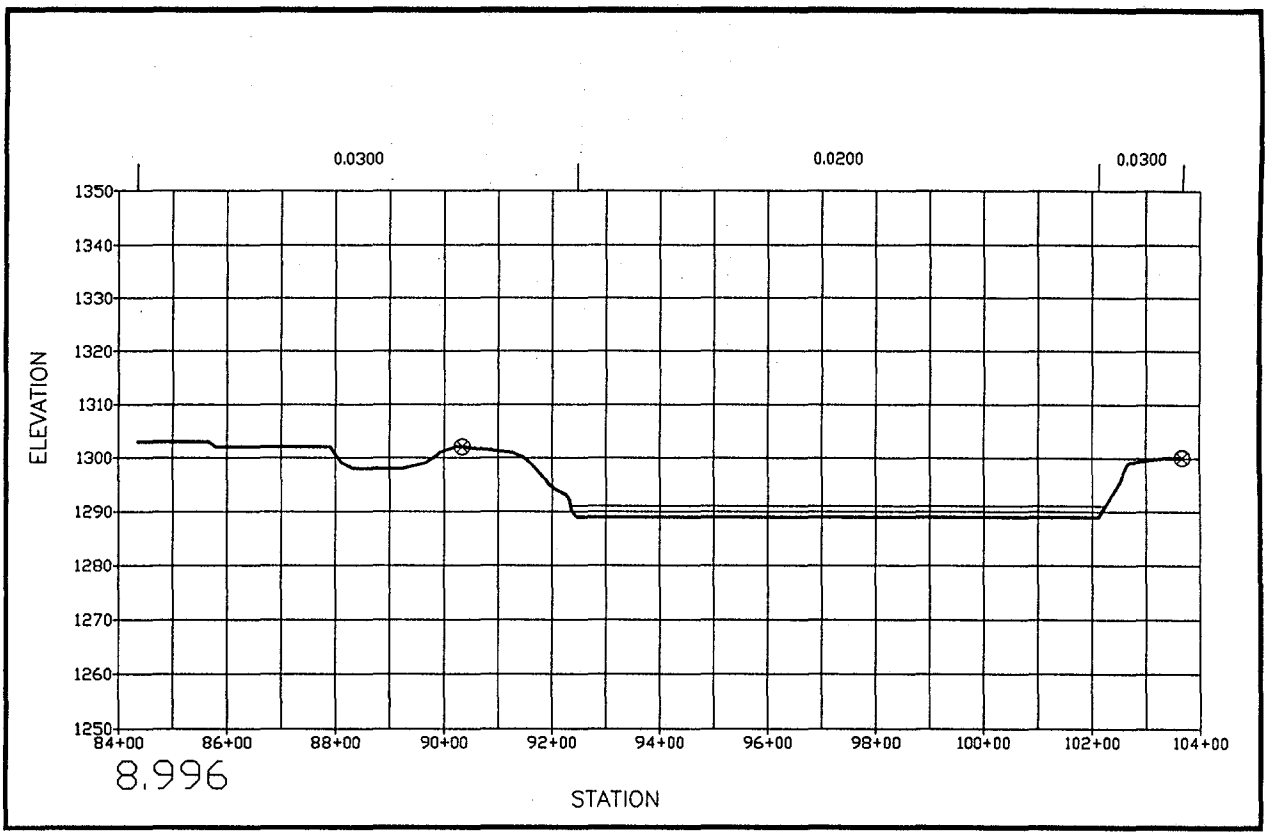

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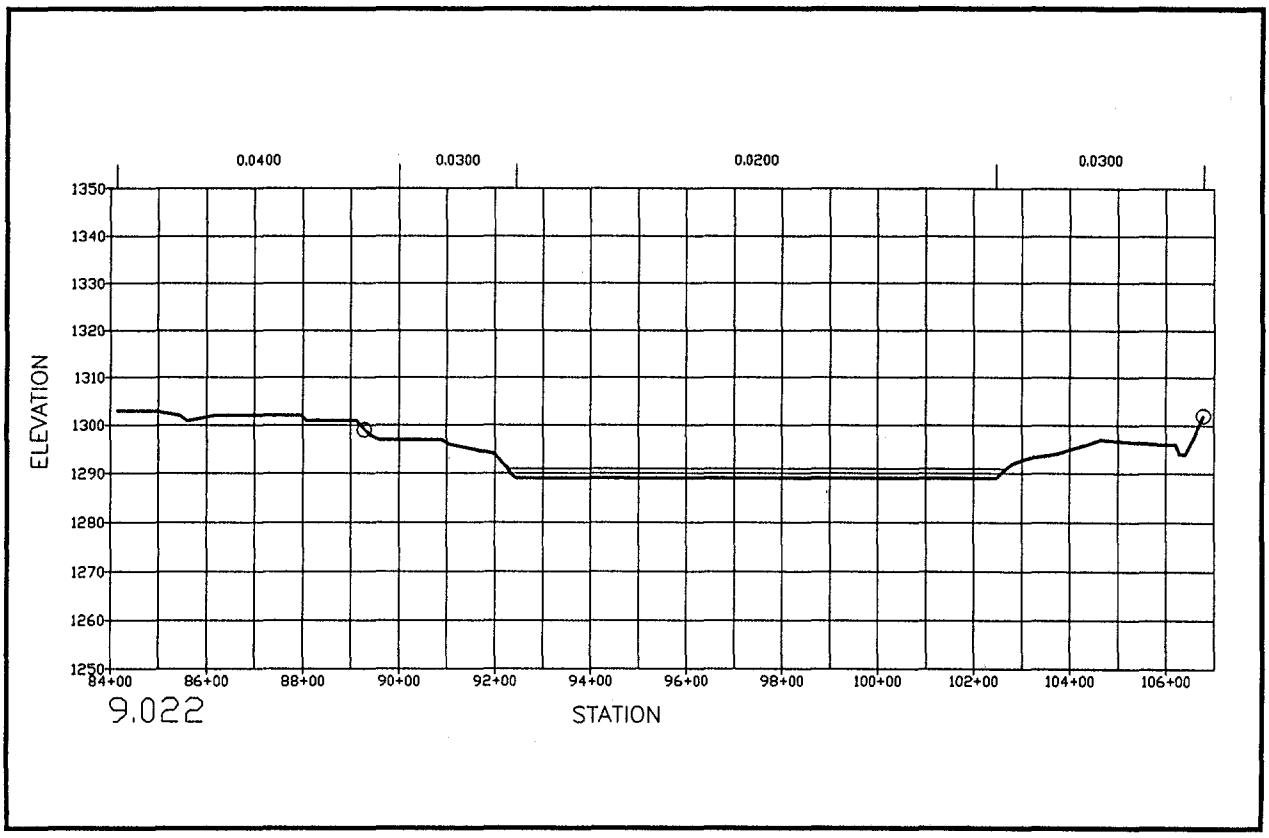

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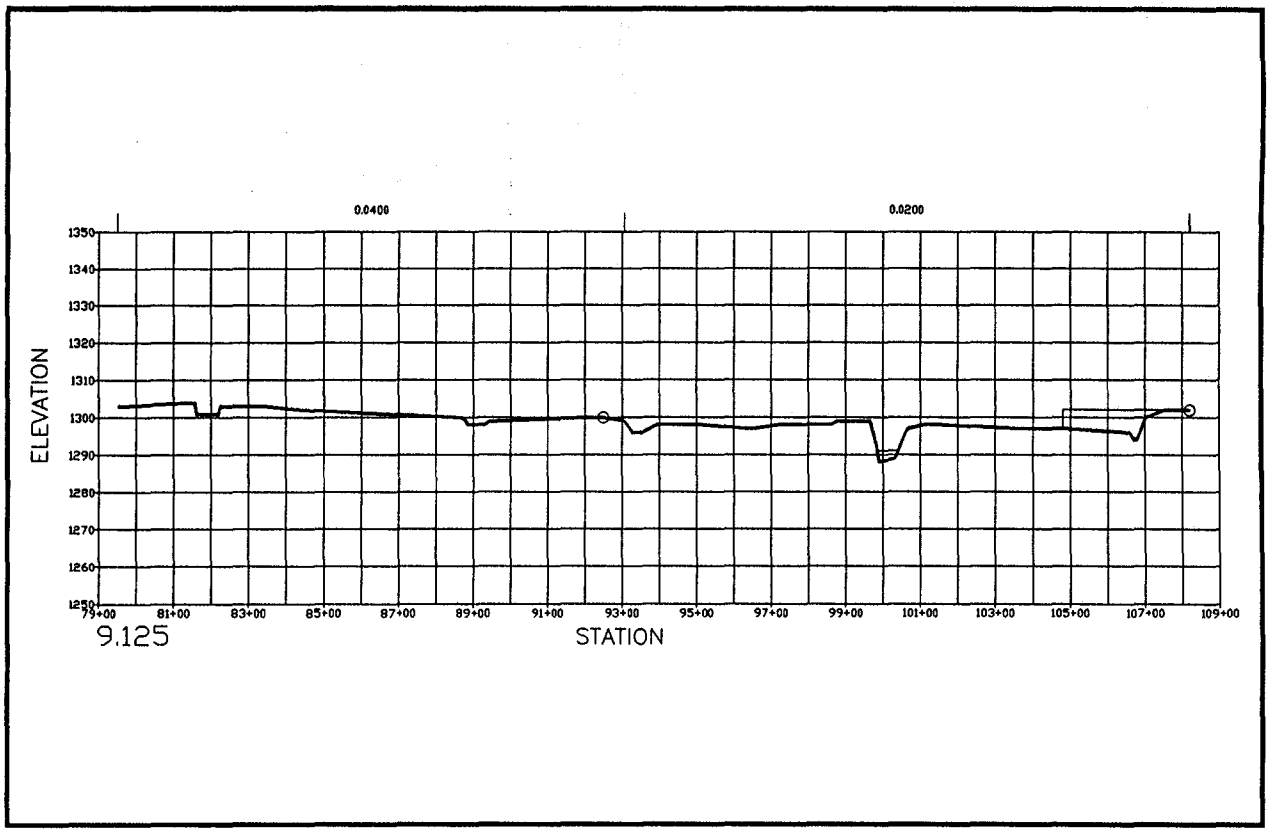

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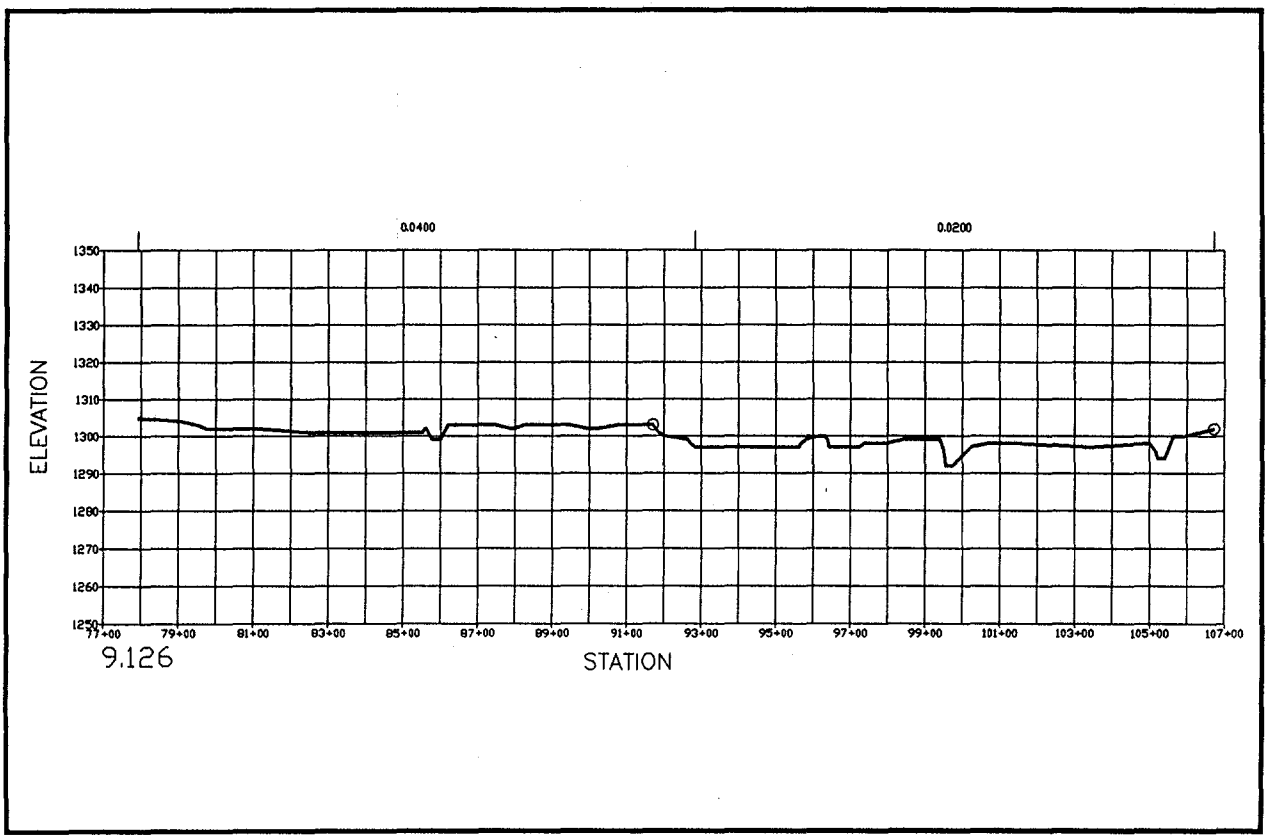

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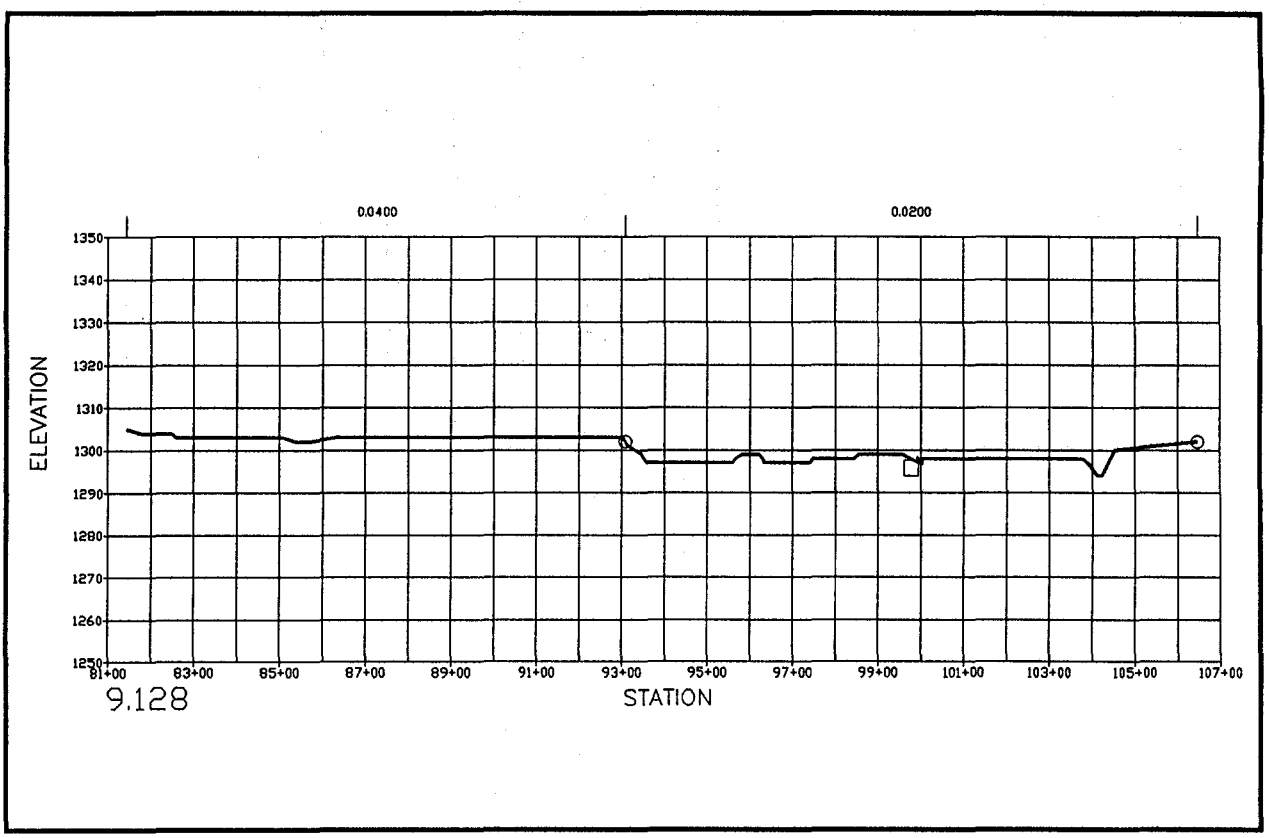

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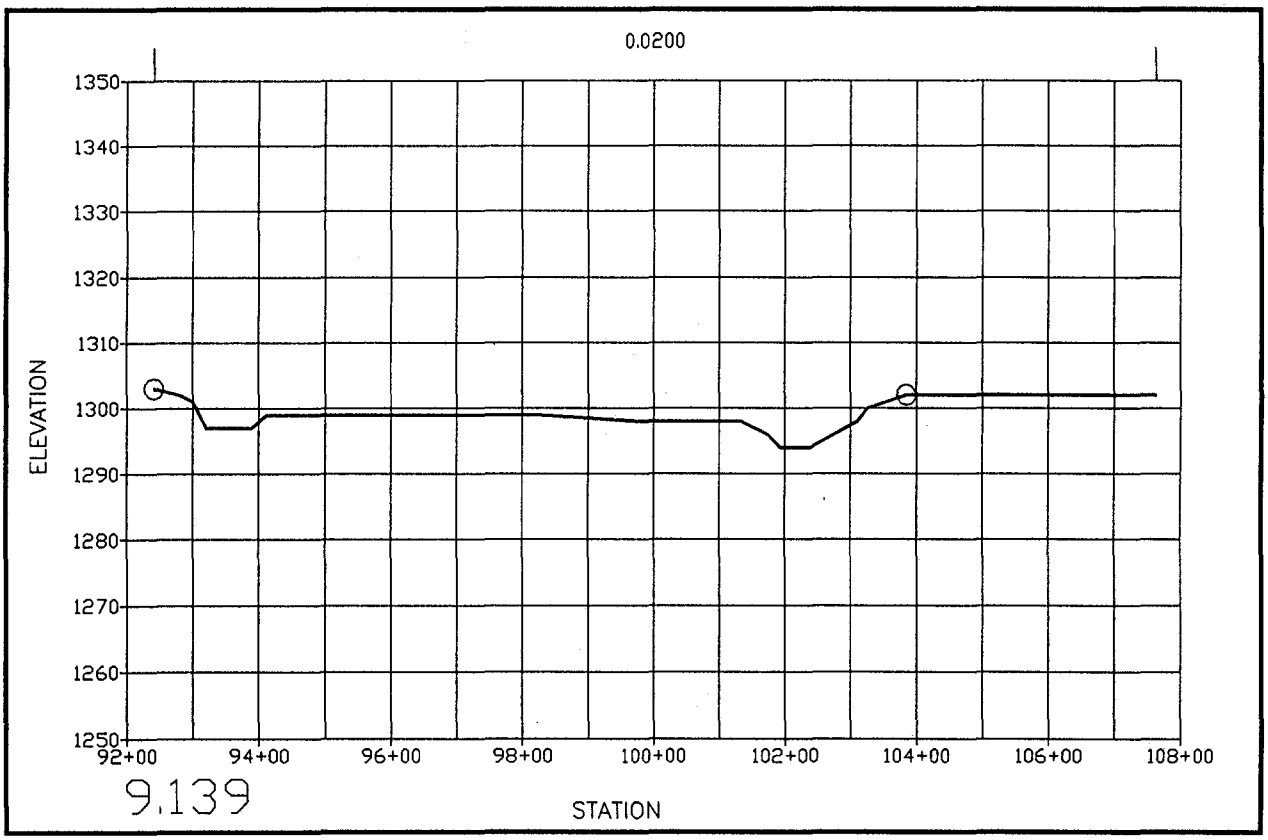

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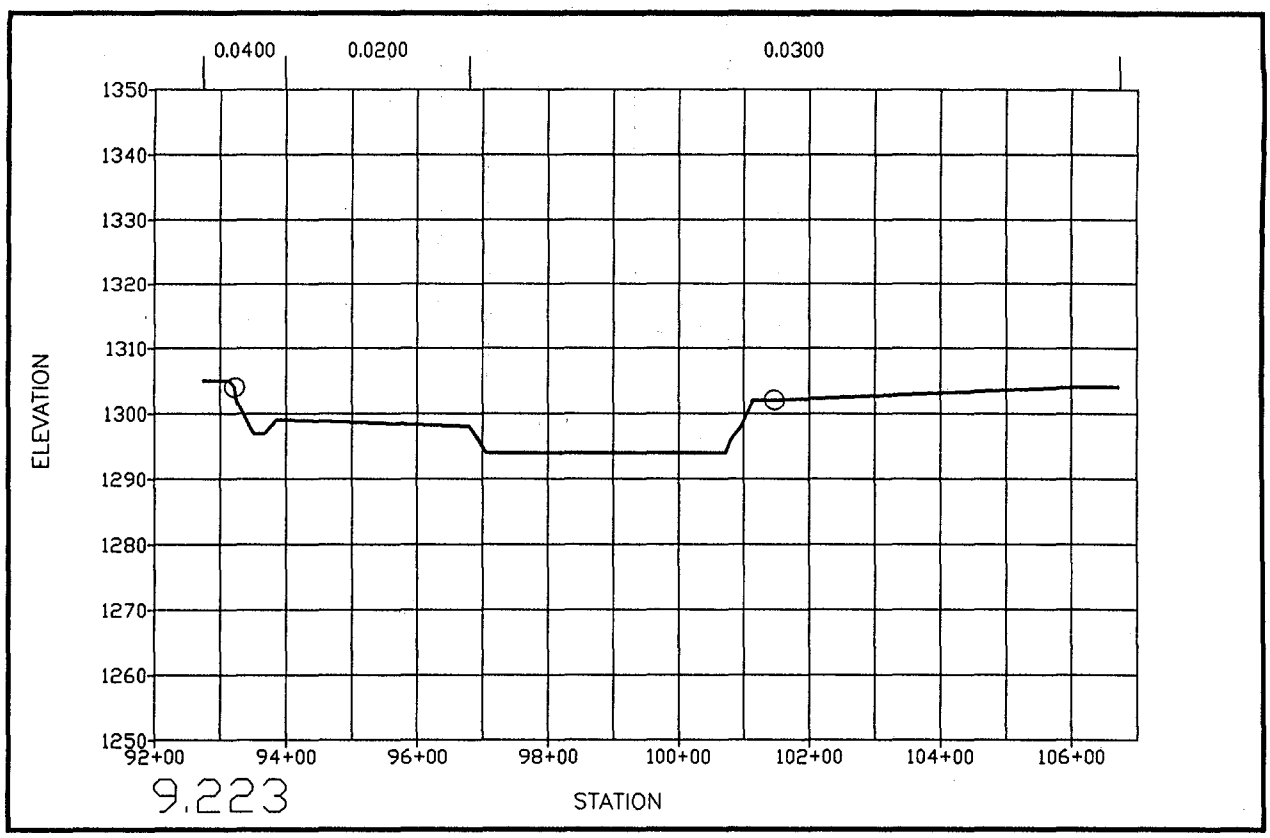

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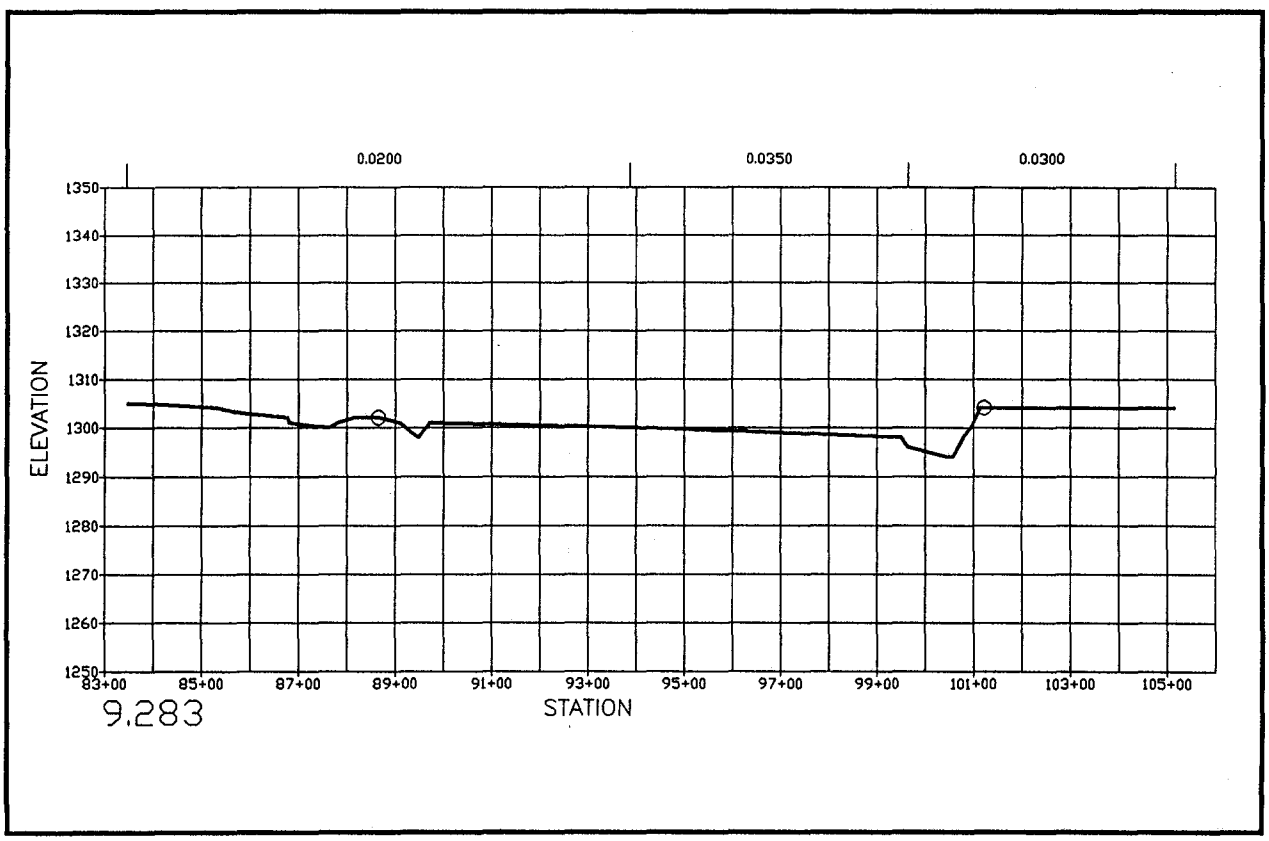

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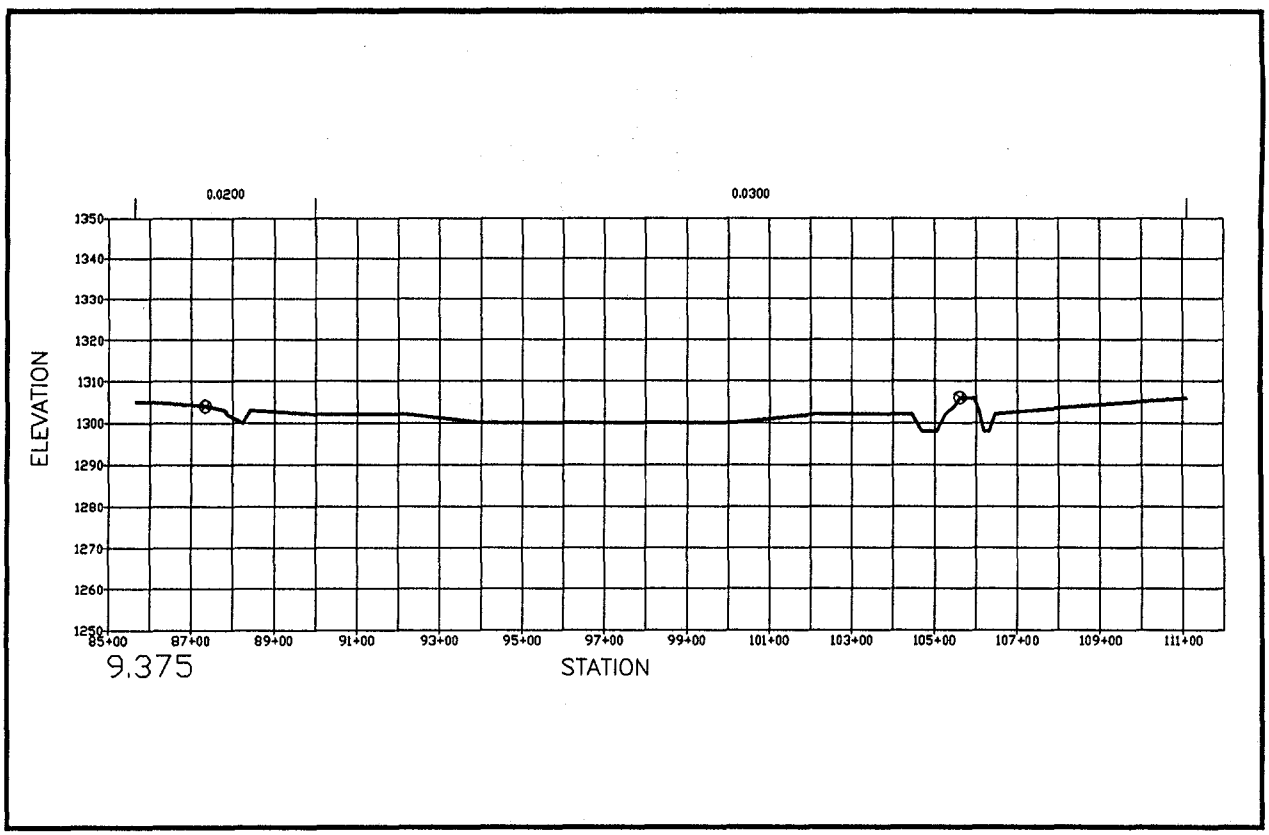

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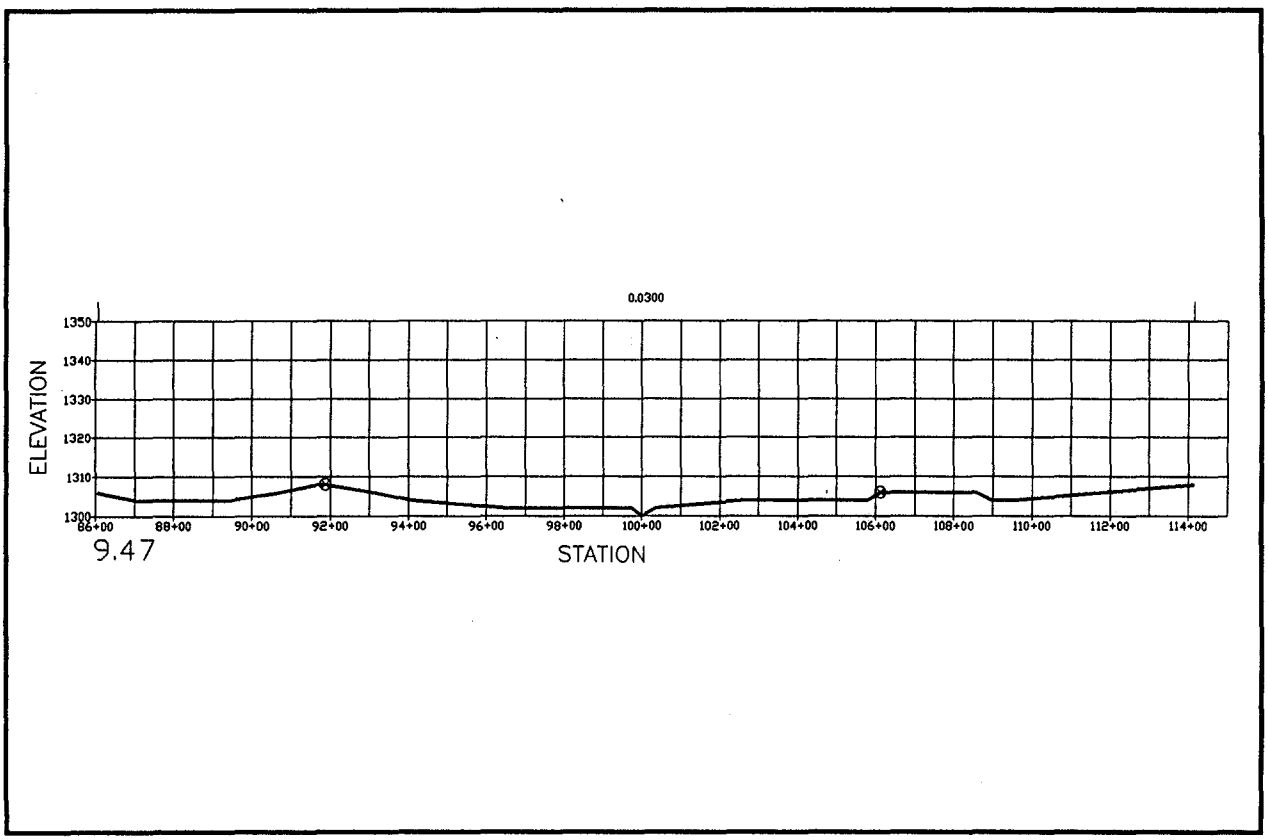

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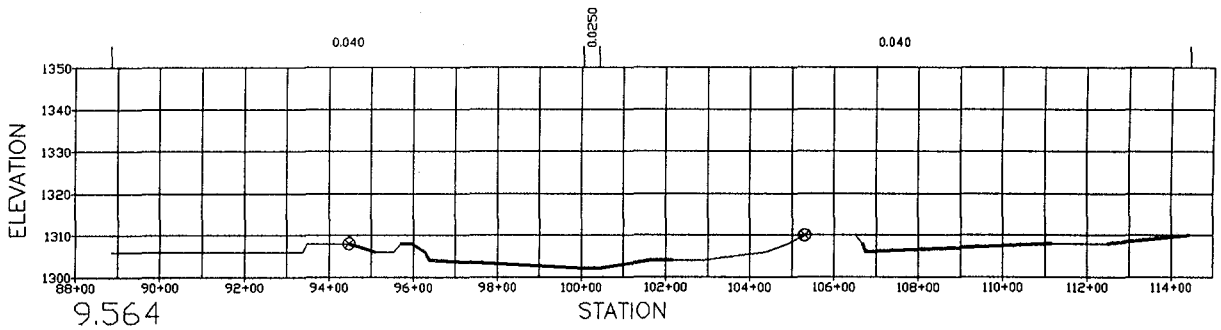

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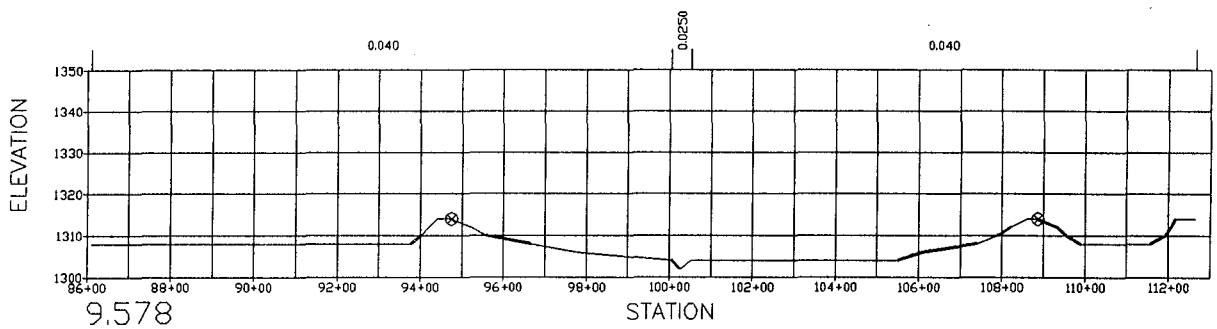

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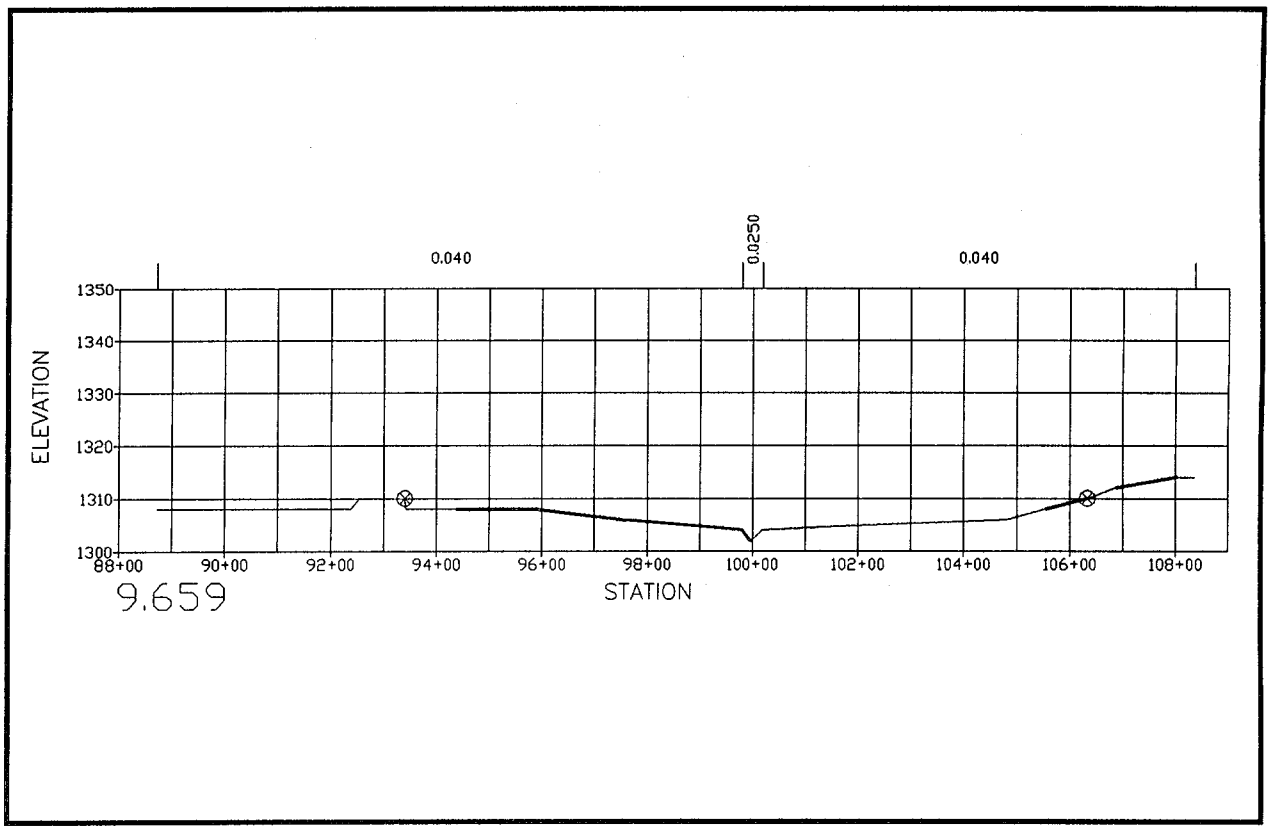

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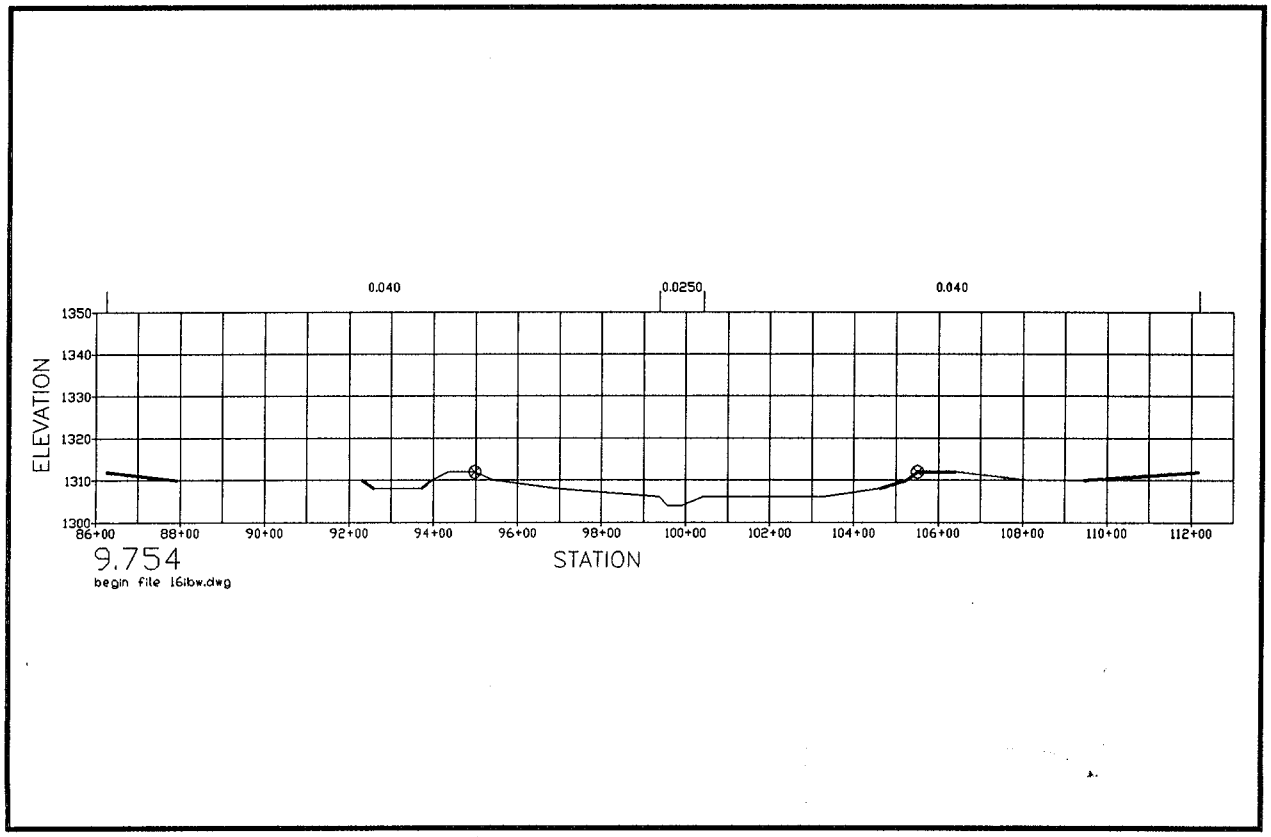

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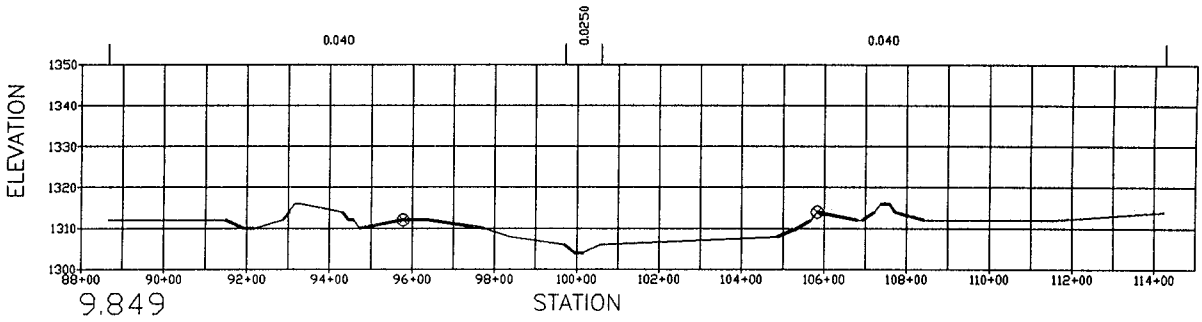

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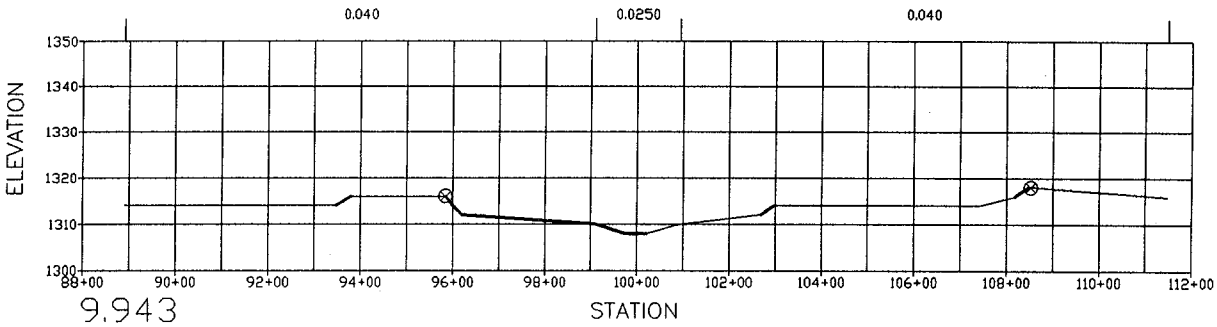

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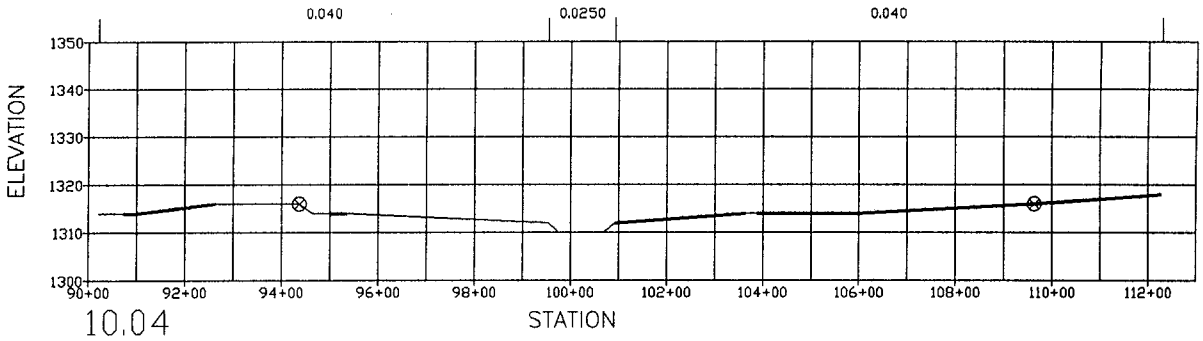

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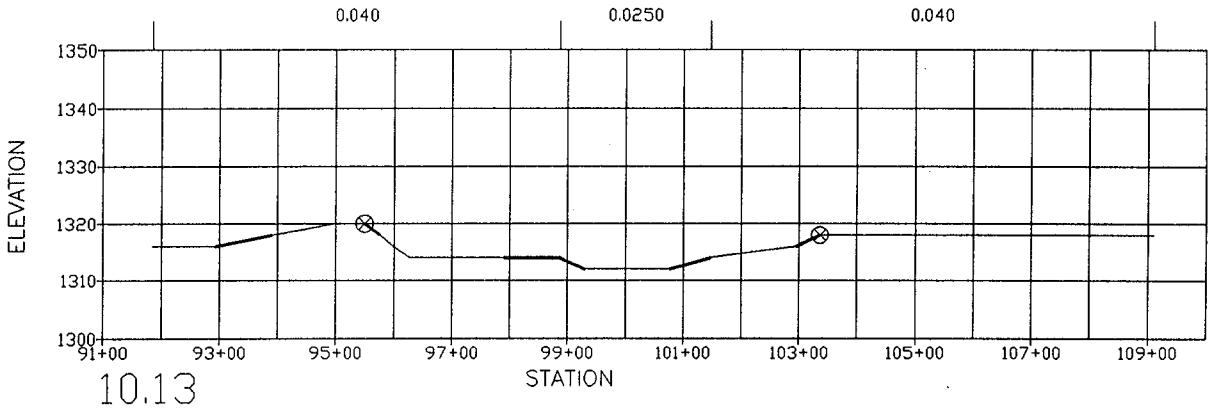

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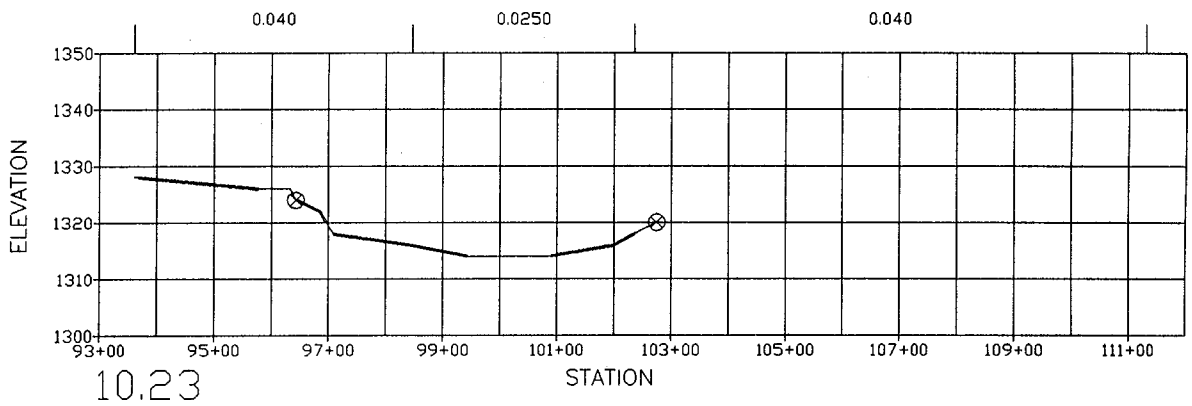

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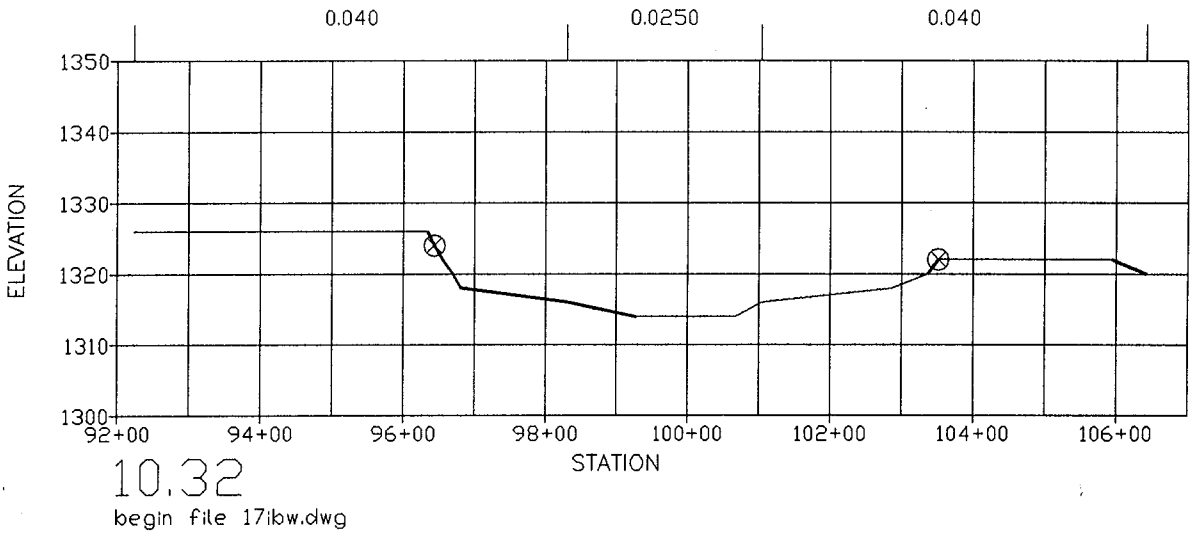

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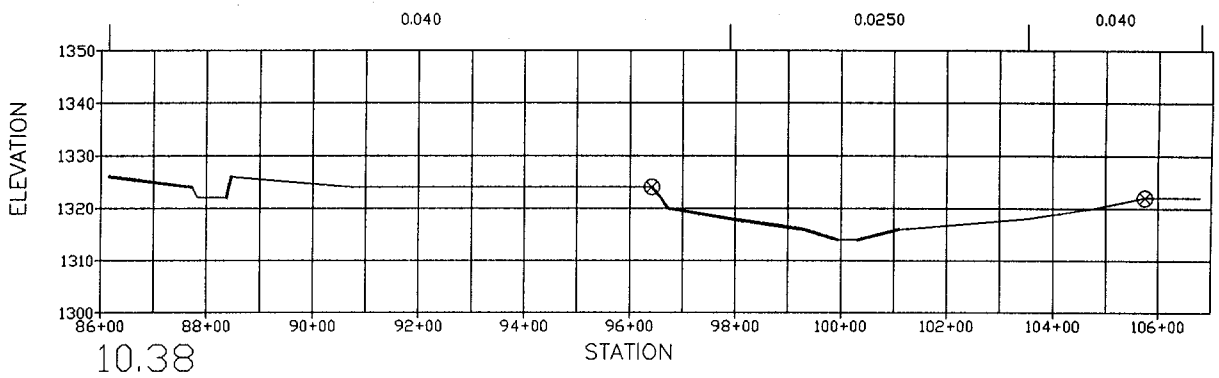

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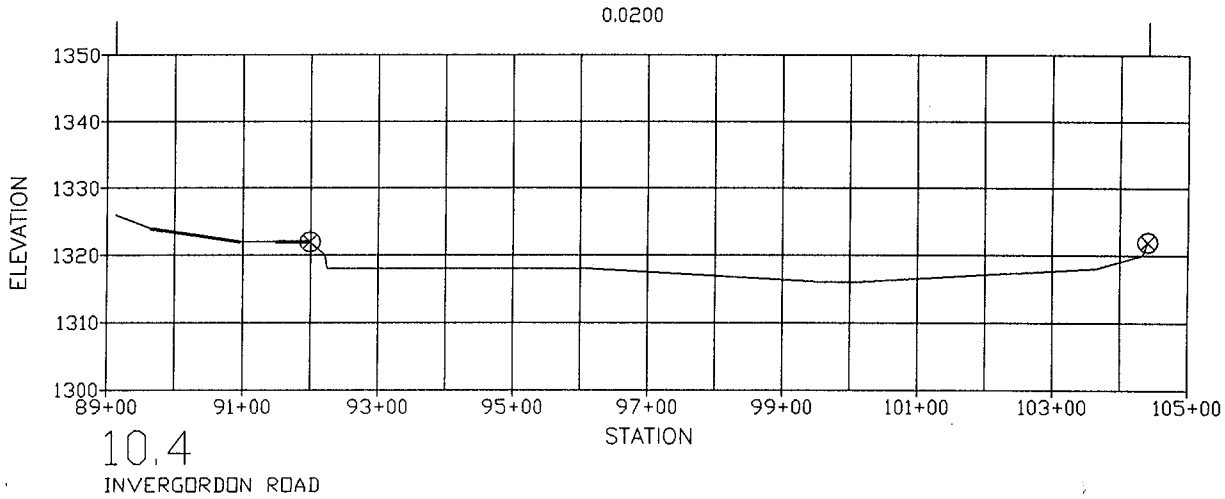
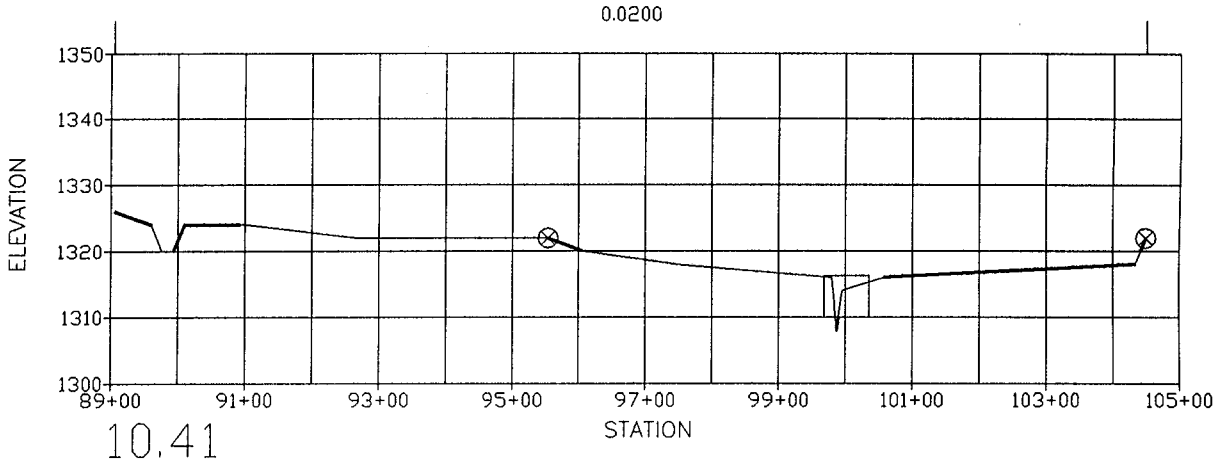


10.4
INVERGORDON ROAD

CROSS-SECTION 10.4



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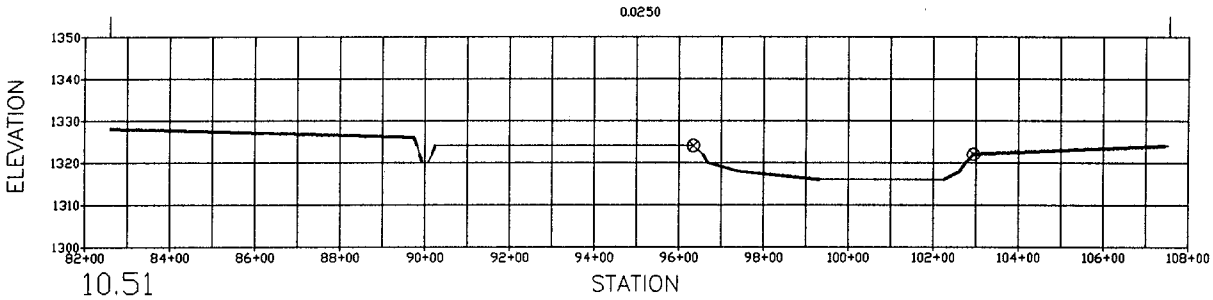

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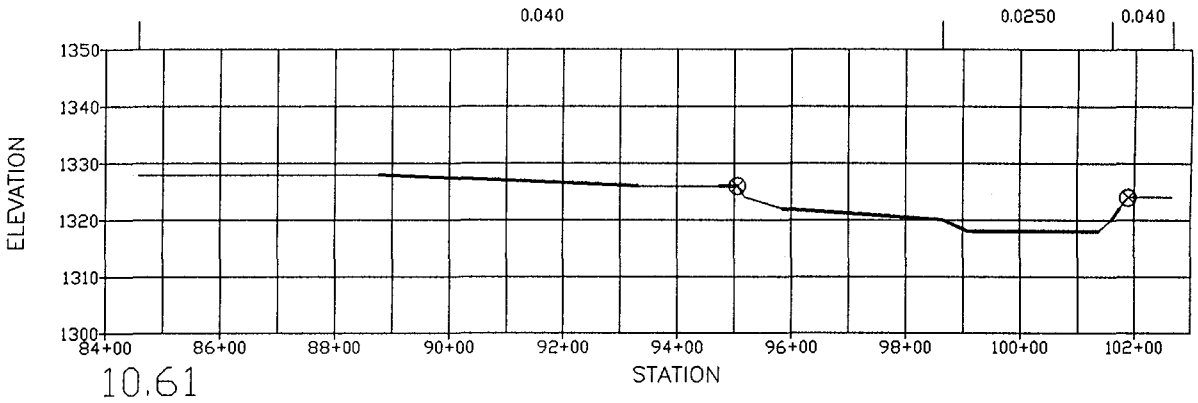

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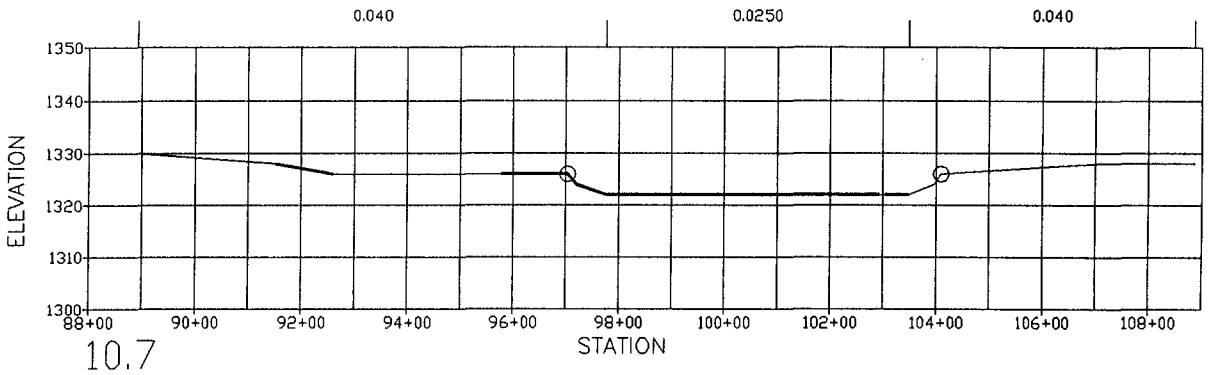

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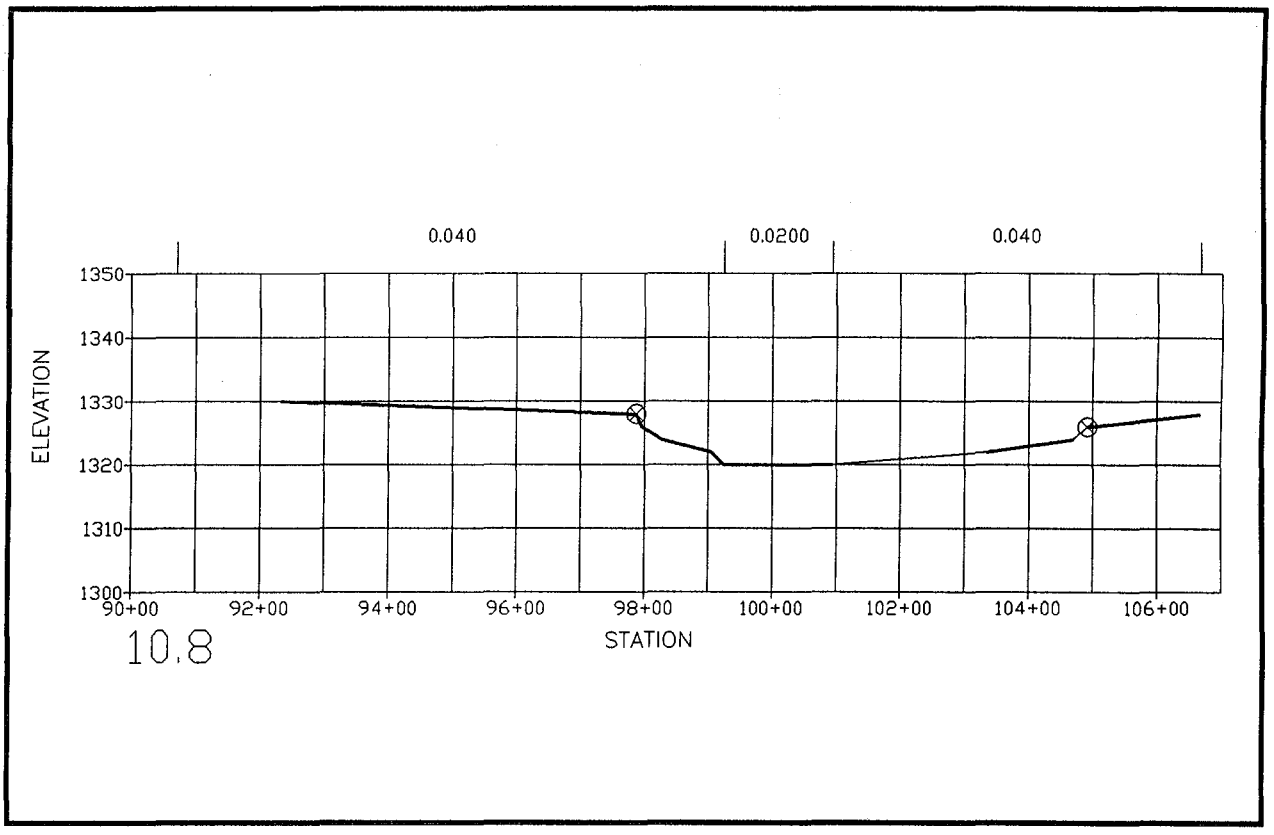

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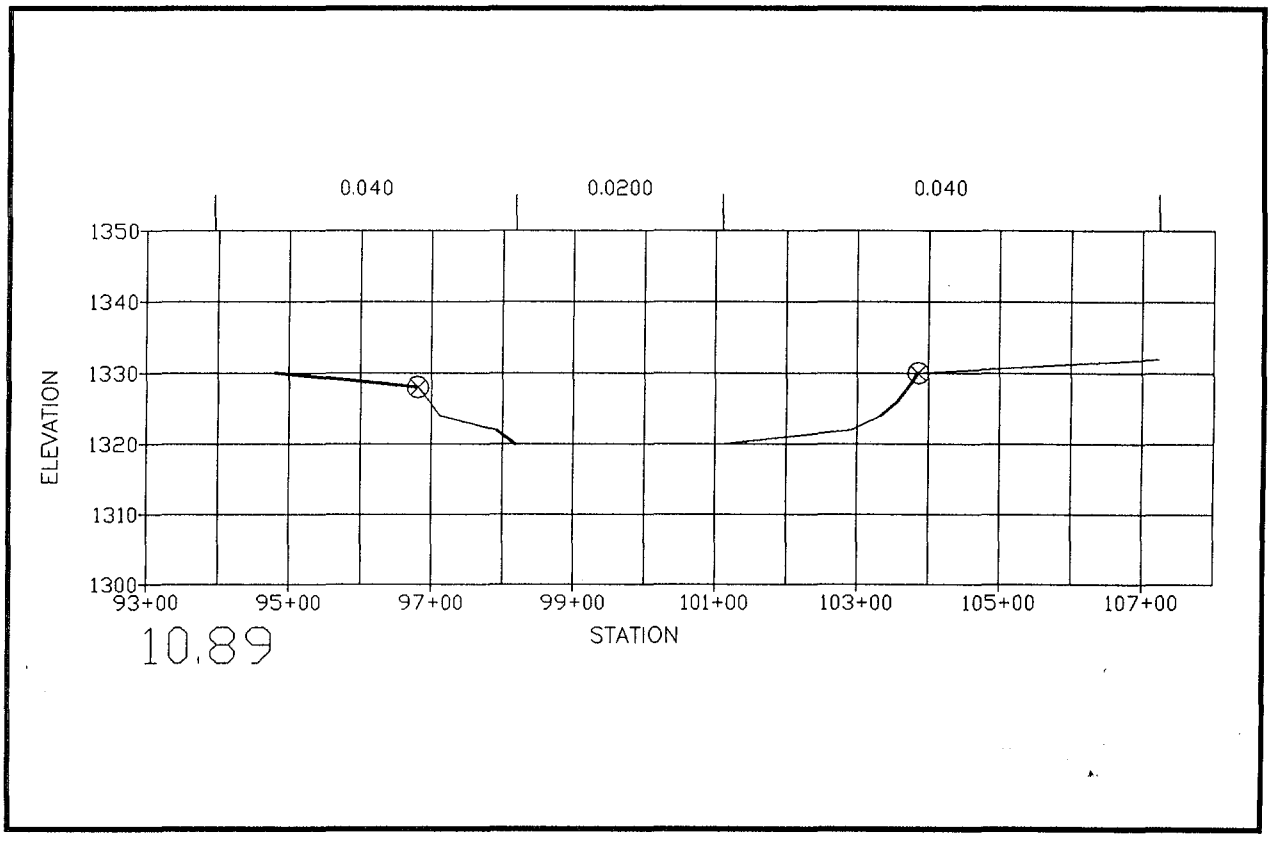

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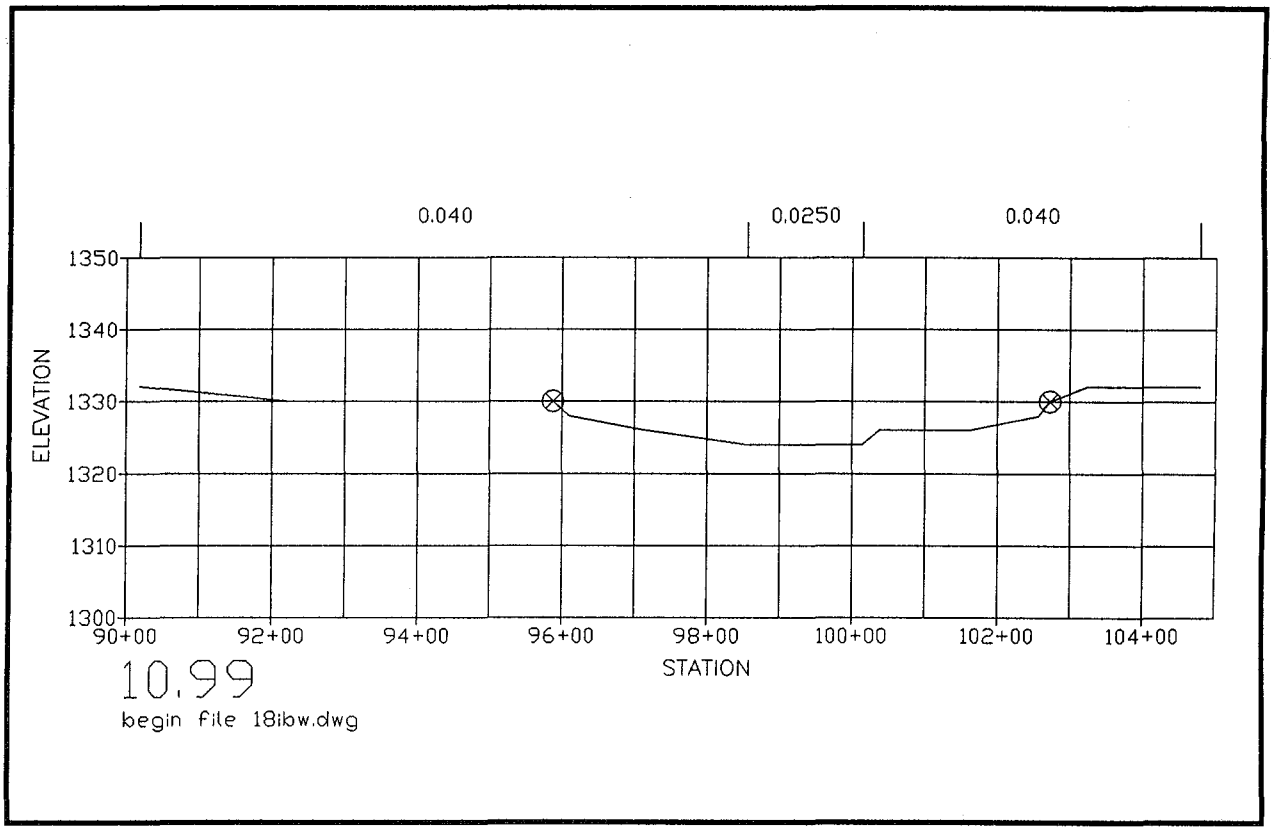

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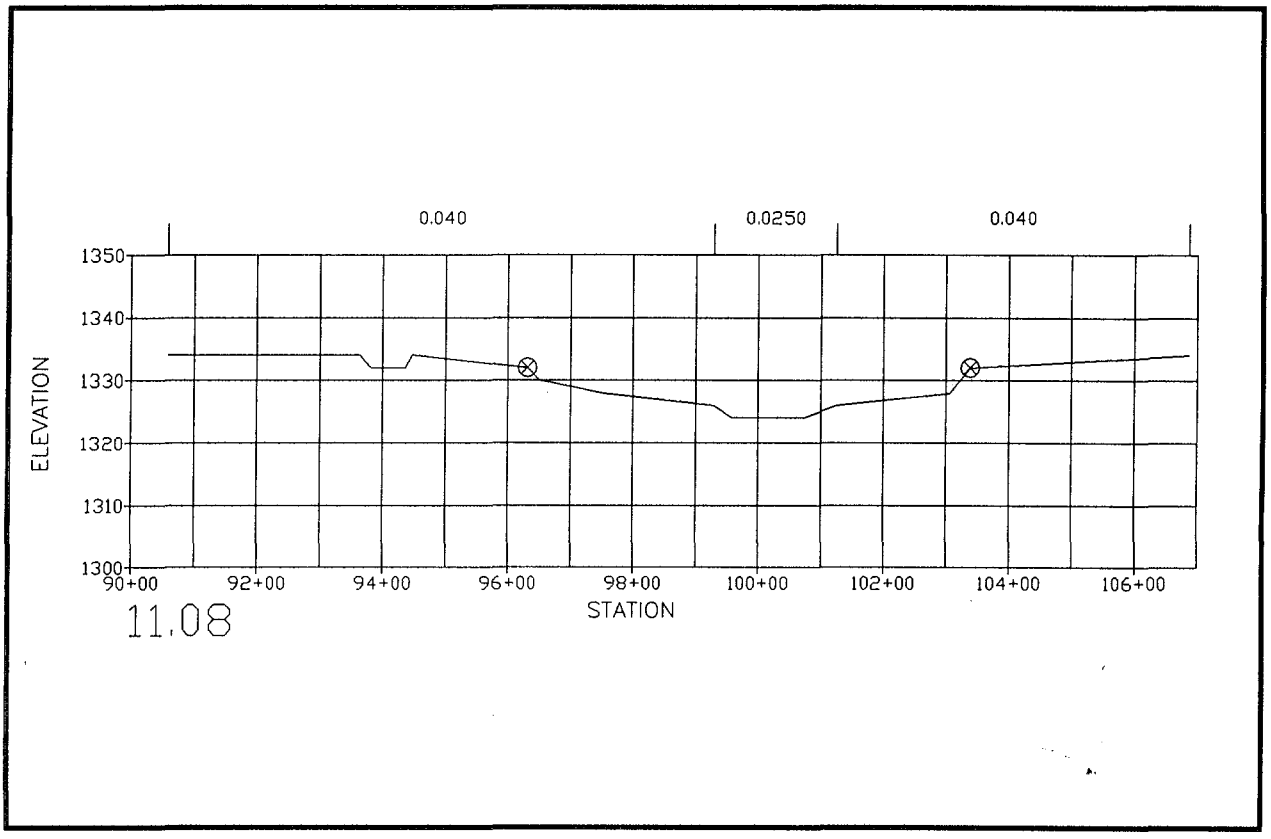

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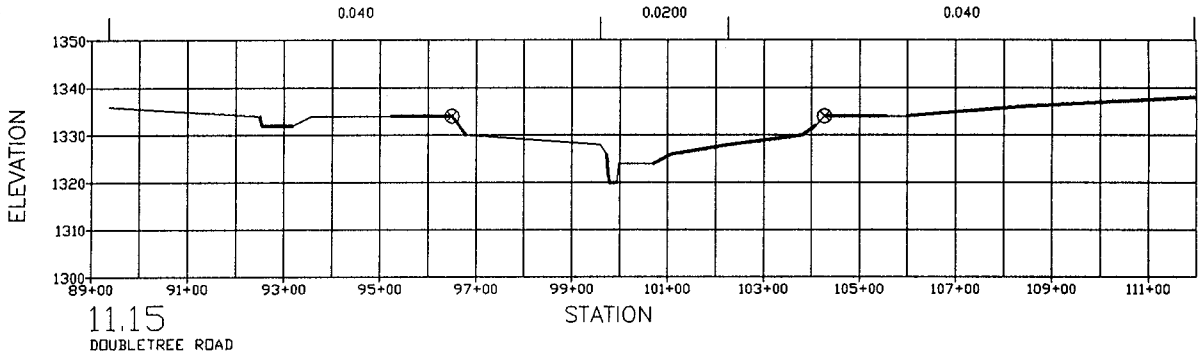

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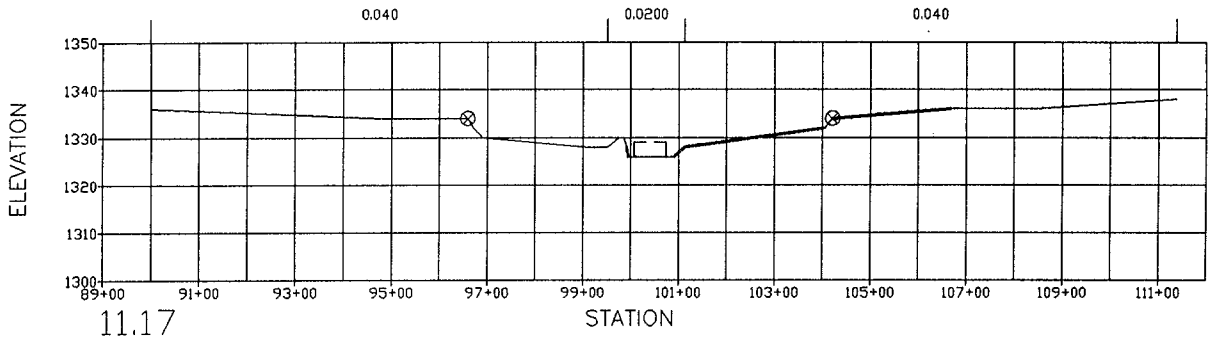

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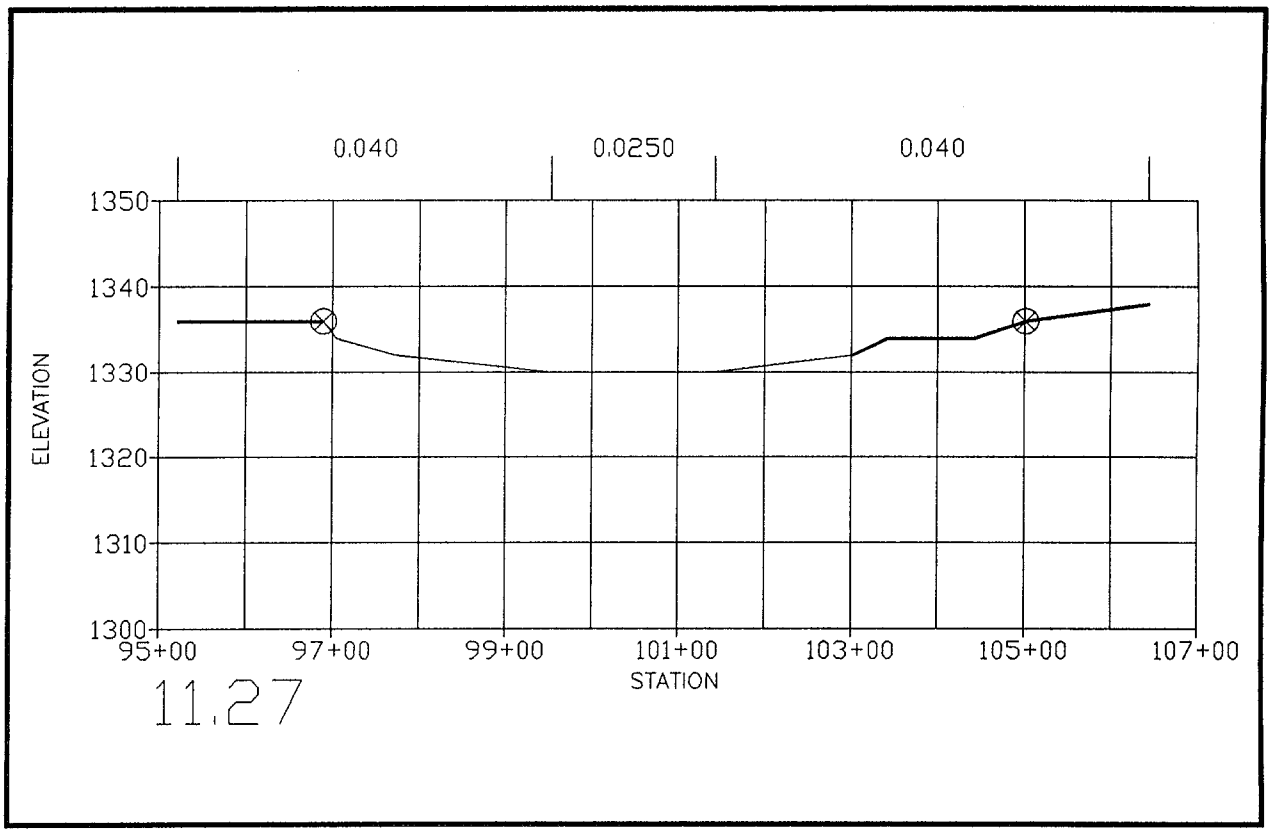

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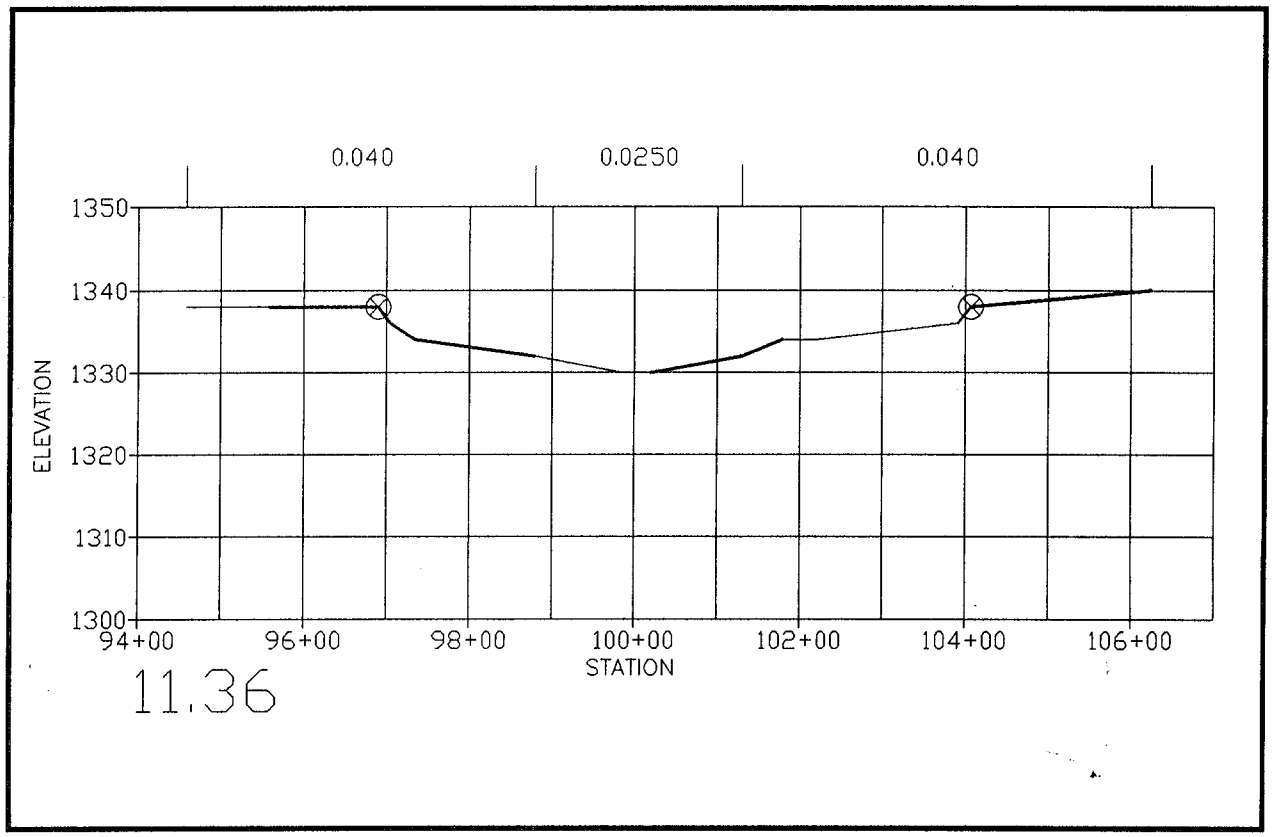

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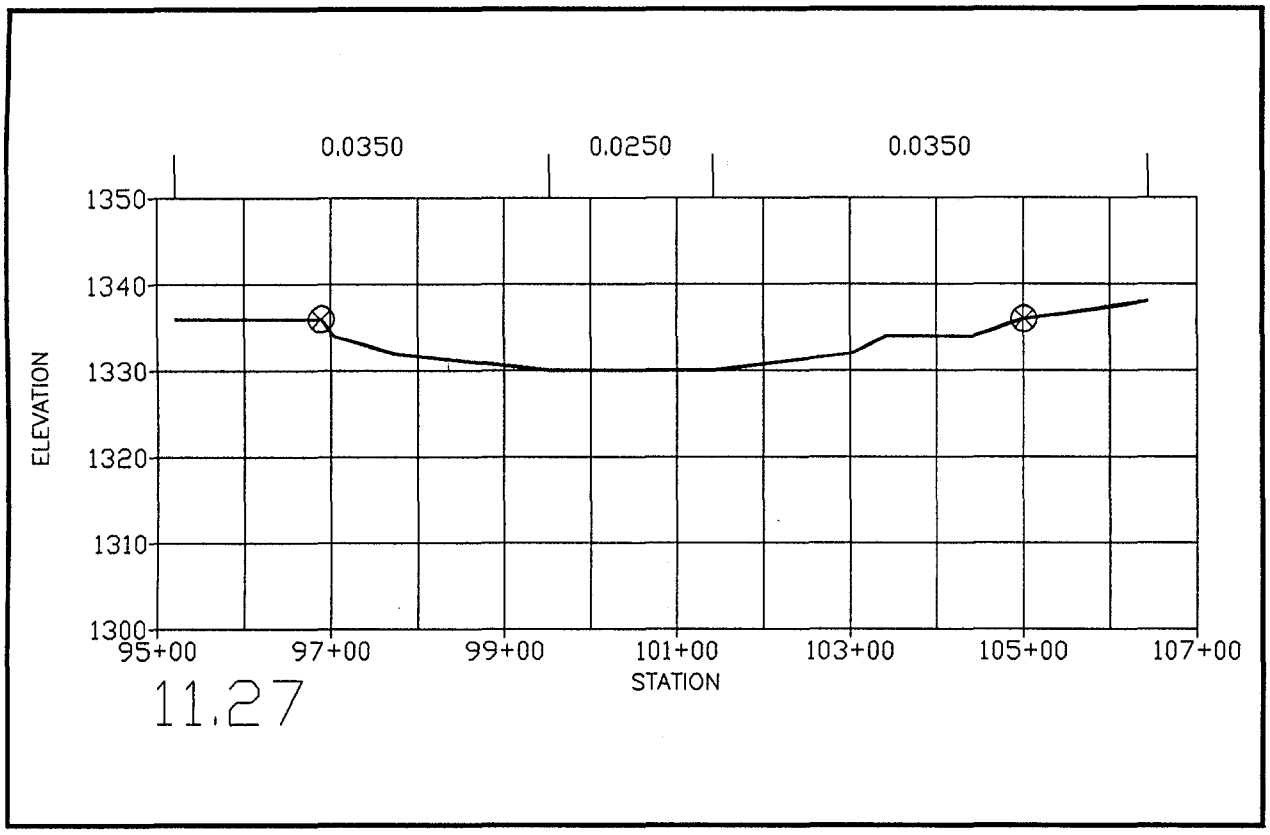

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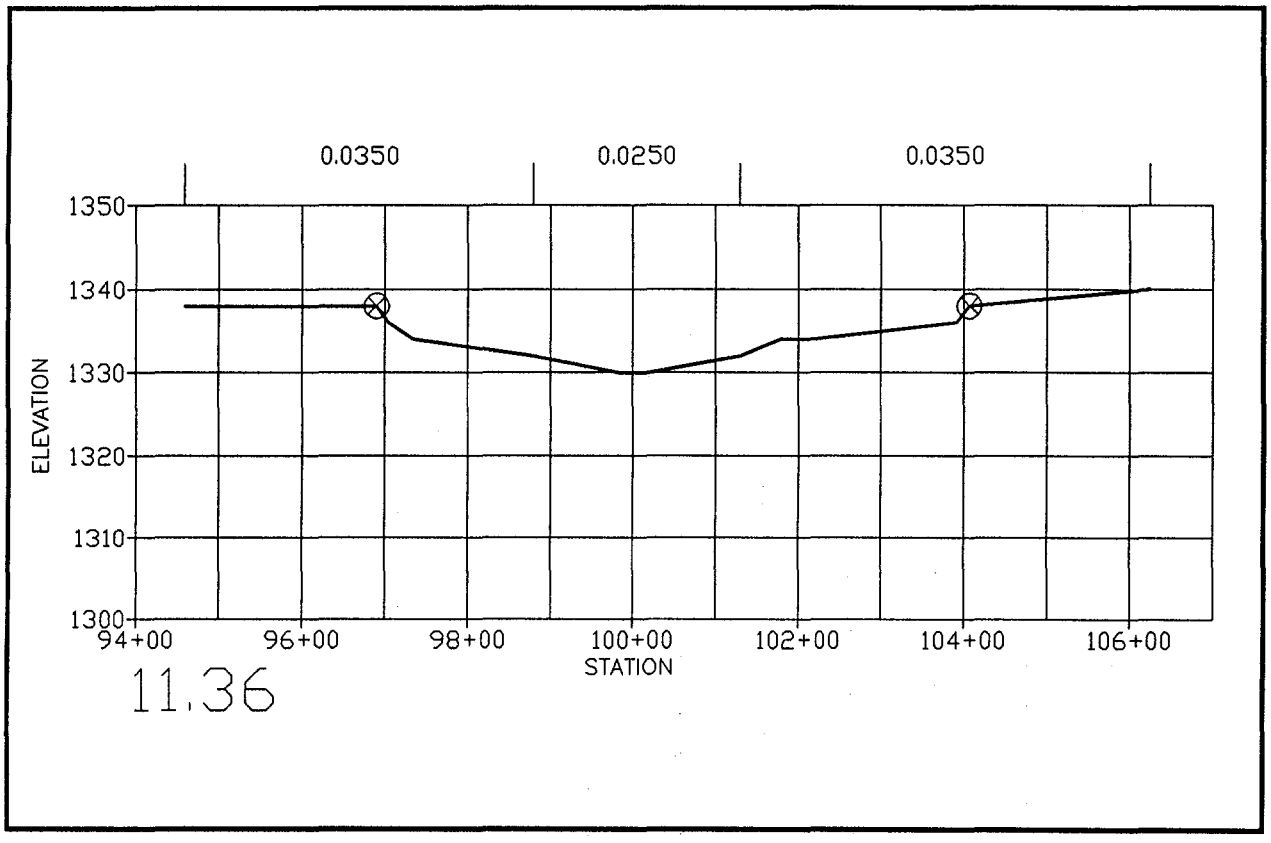

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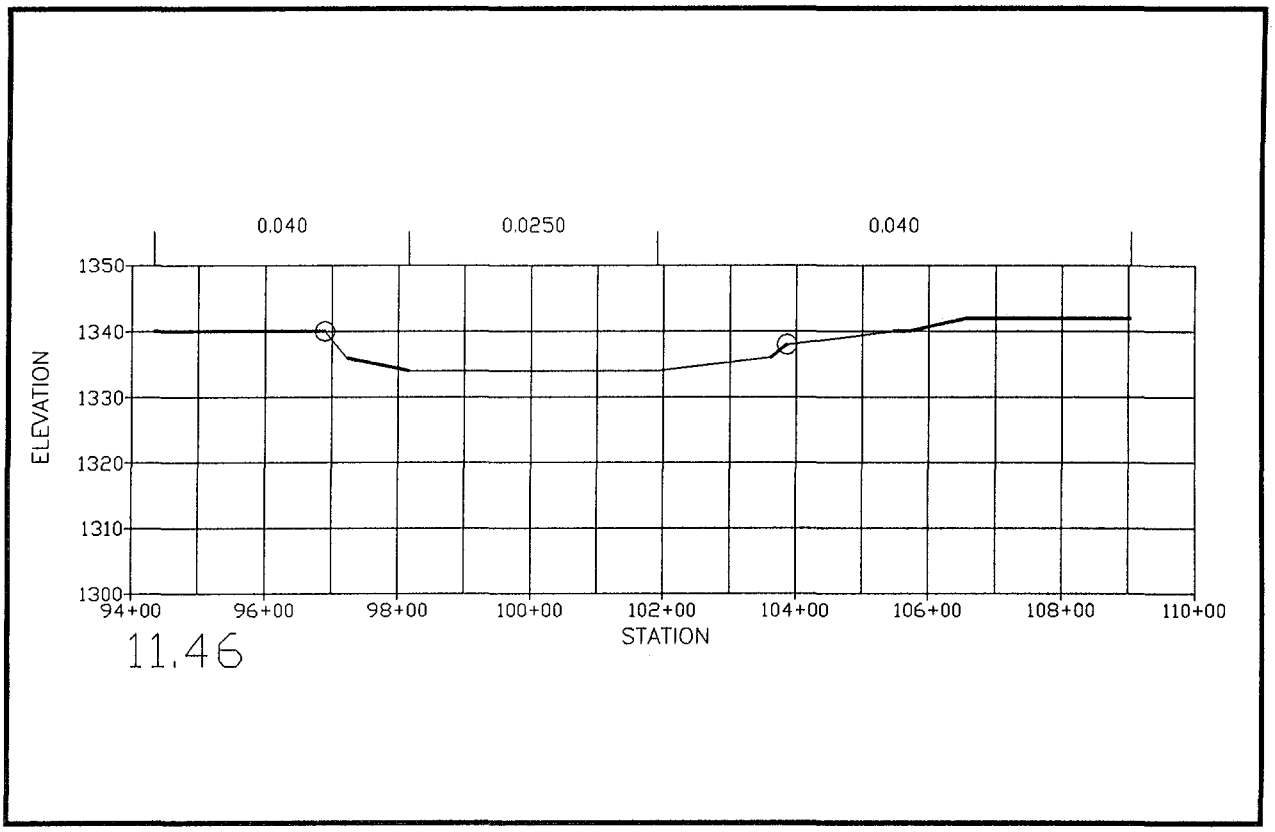

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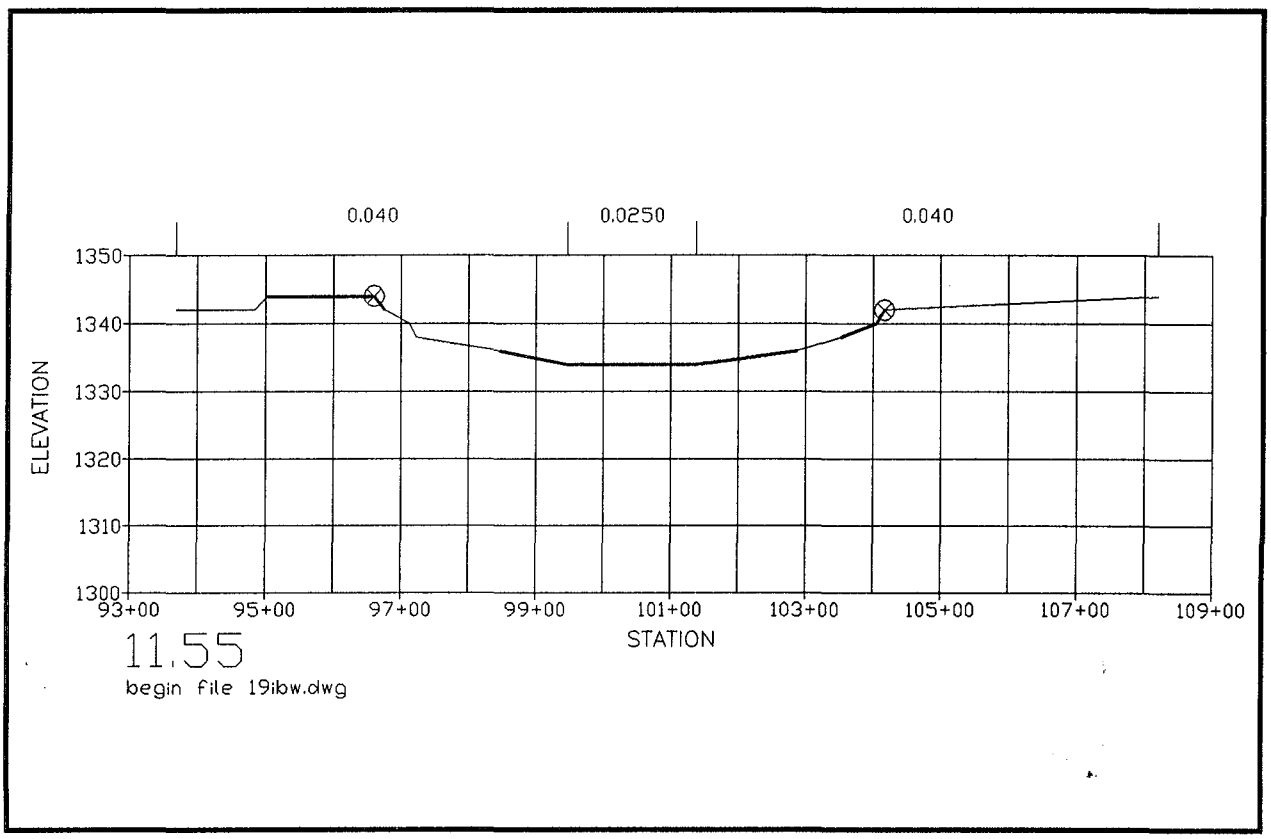

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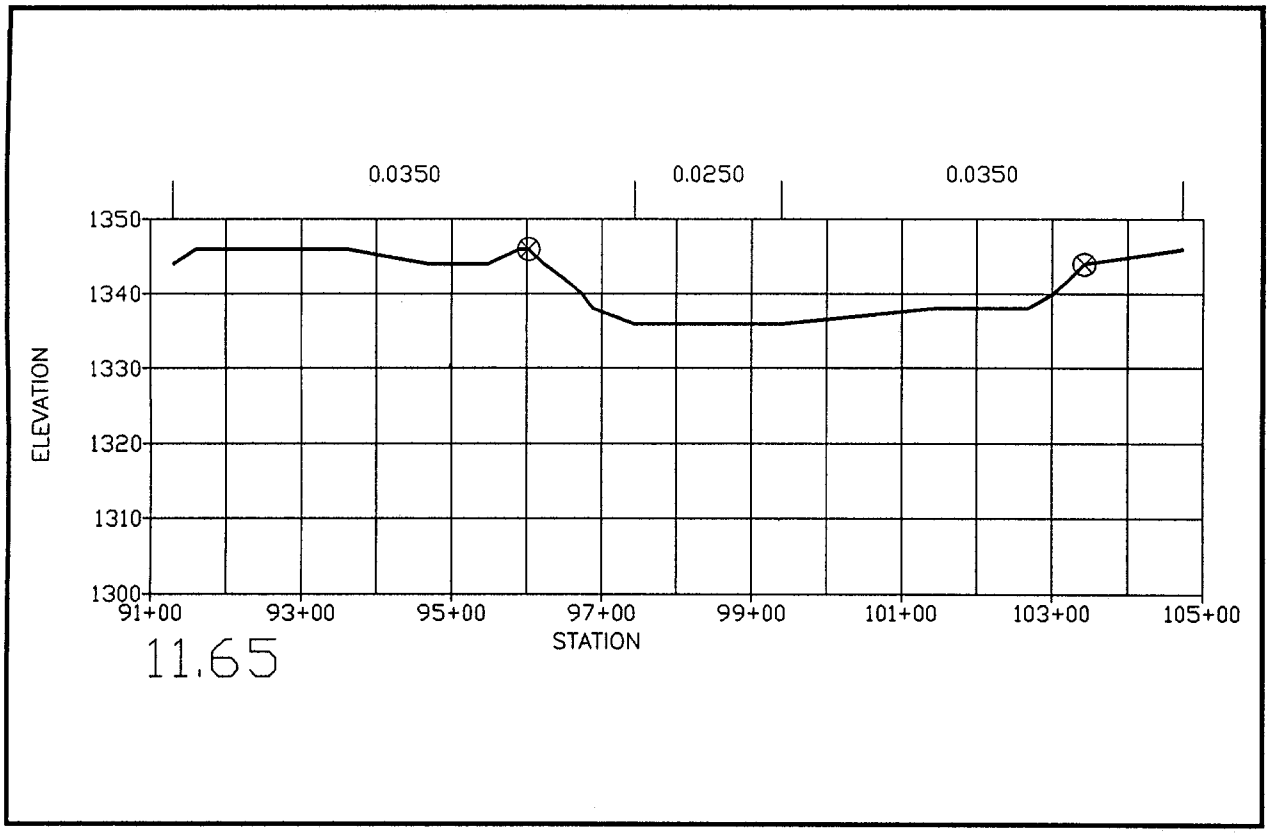

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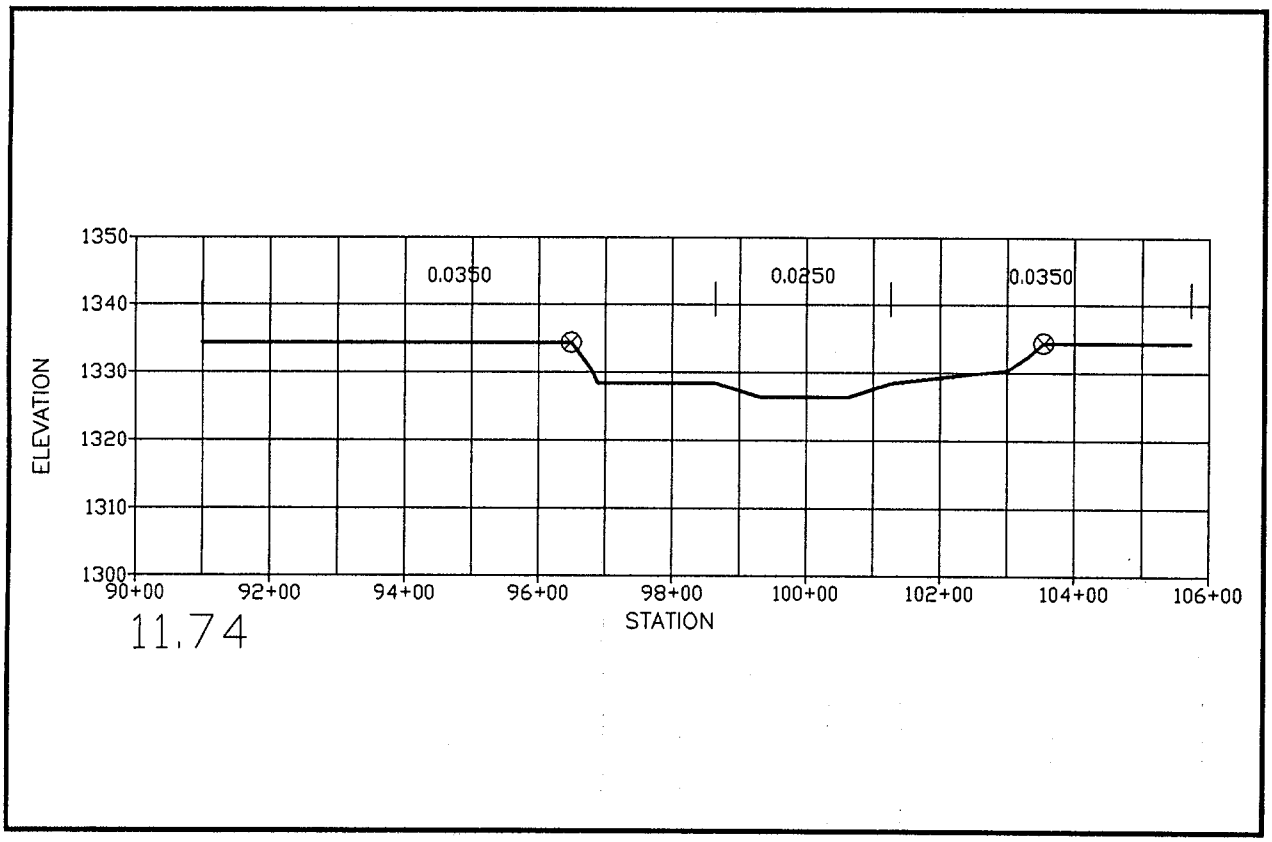

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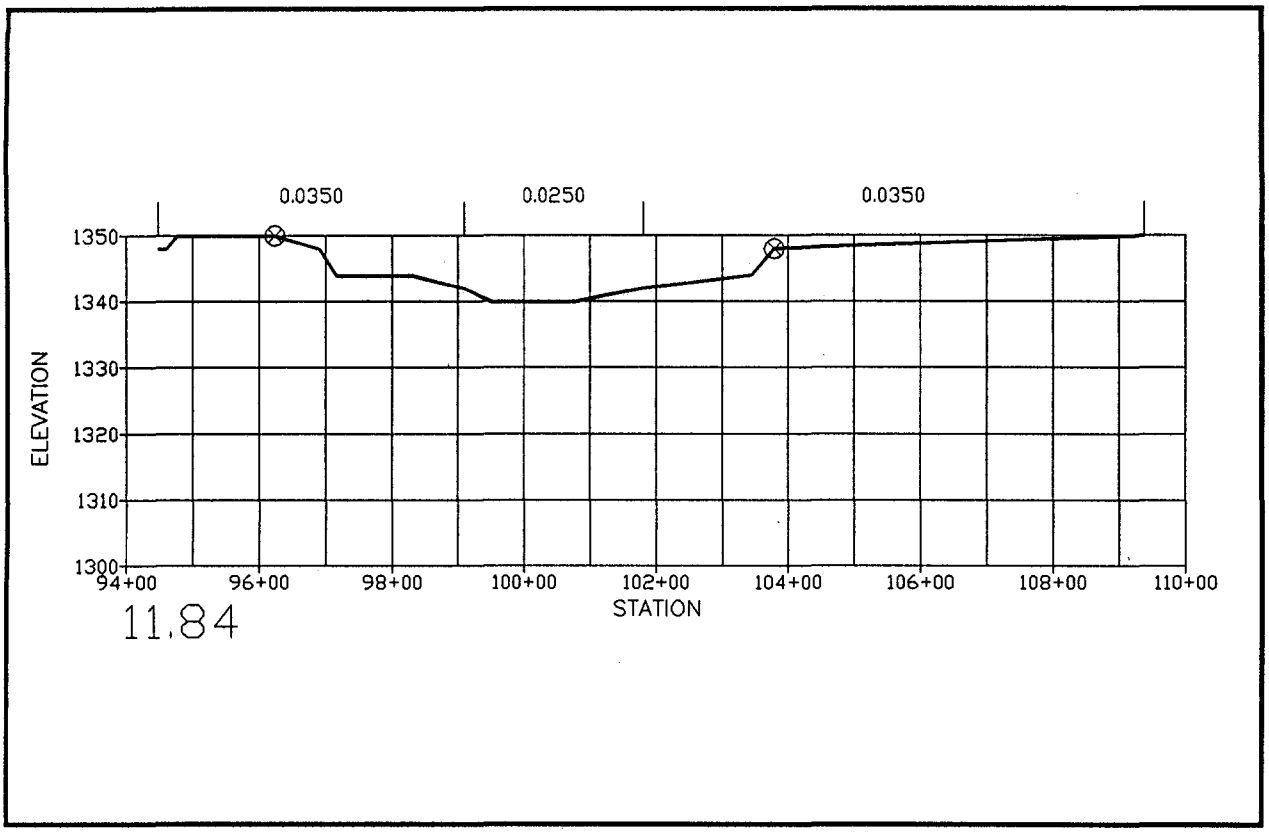

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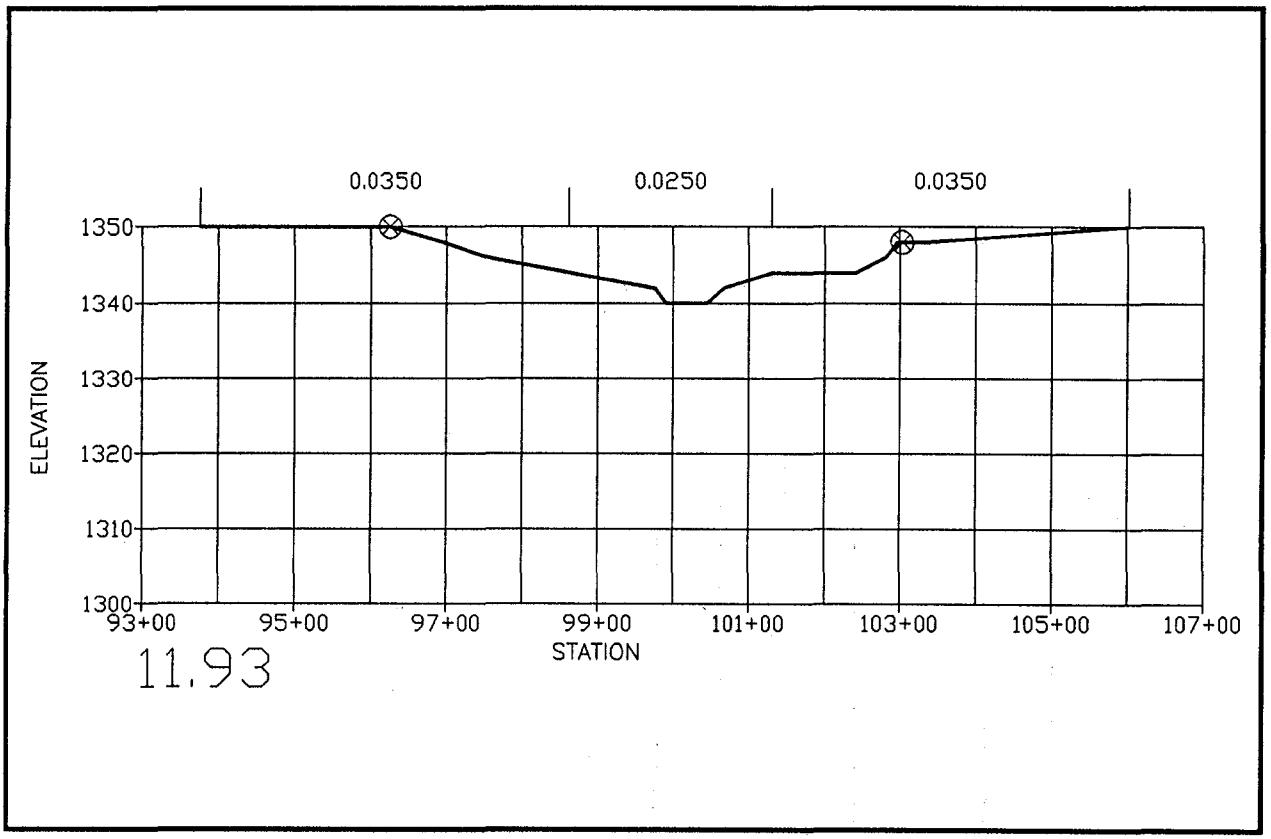

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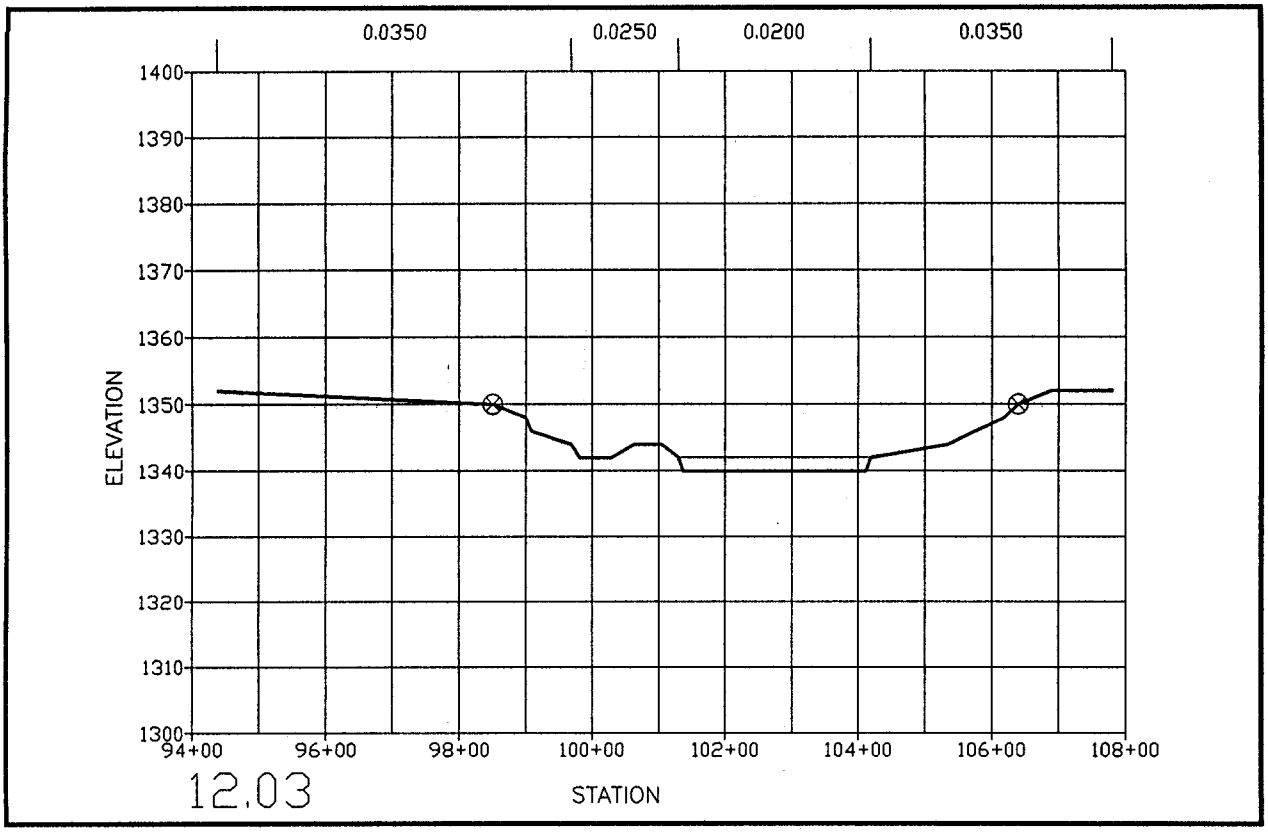

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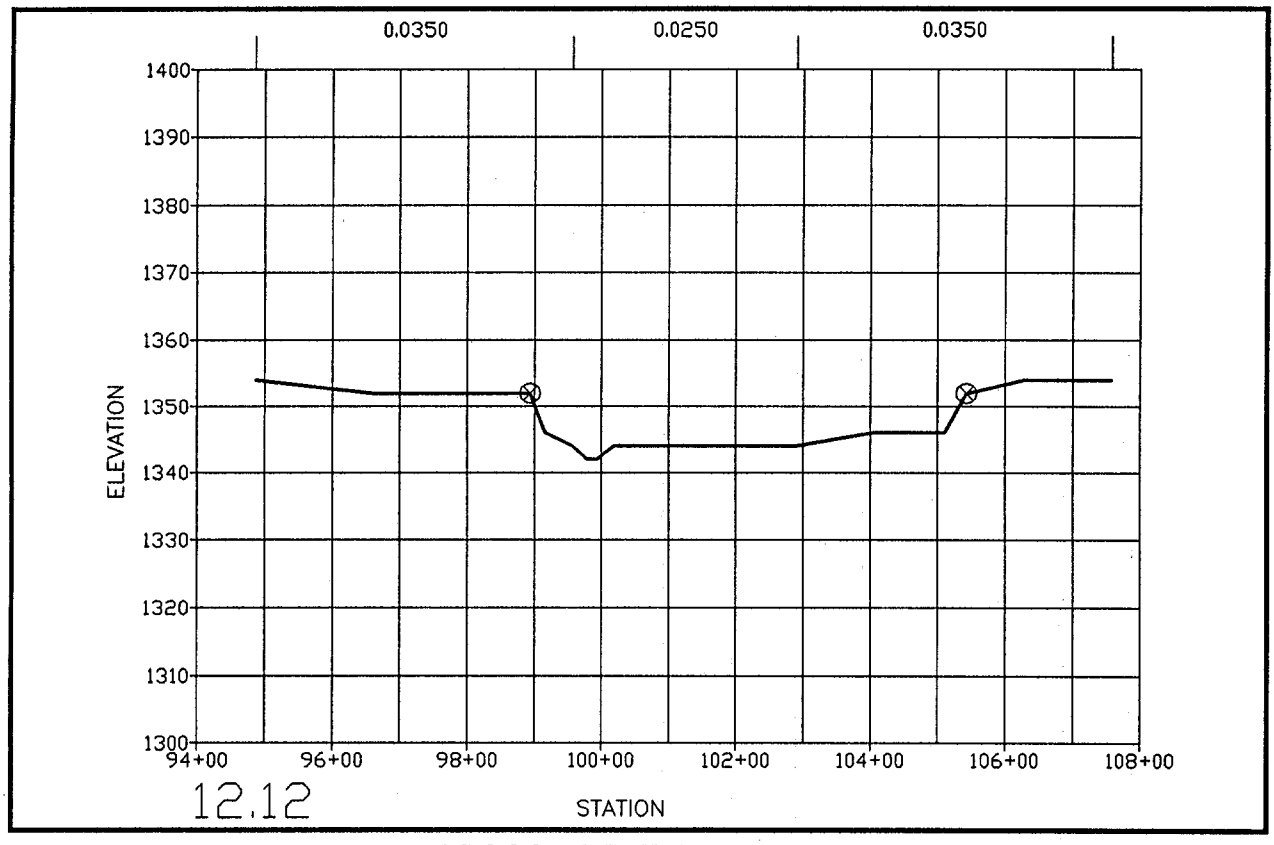

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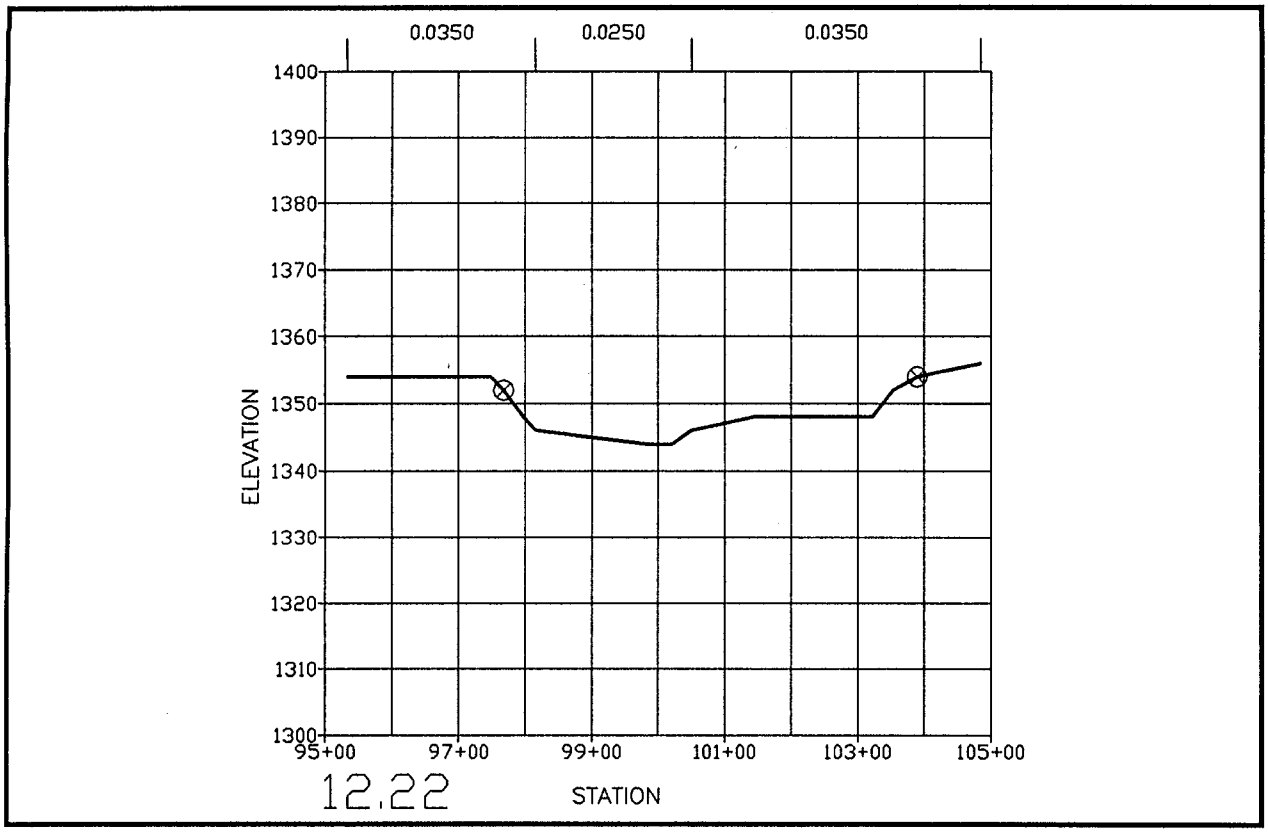

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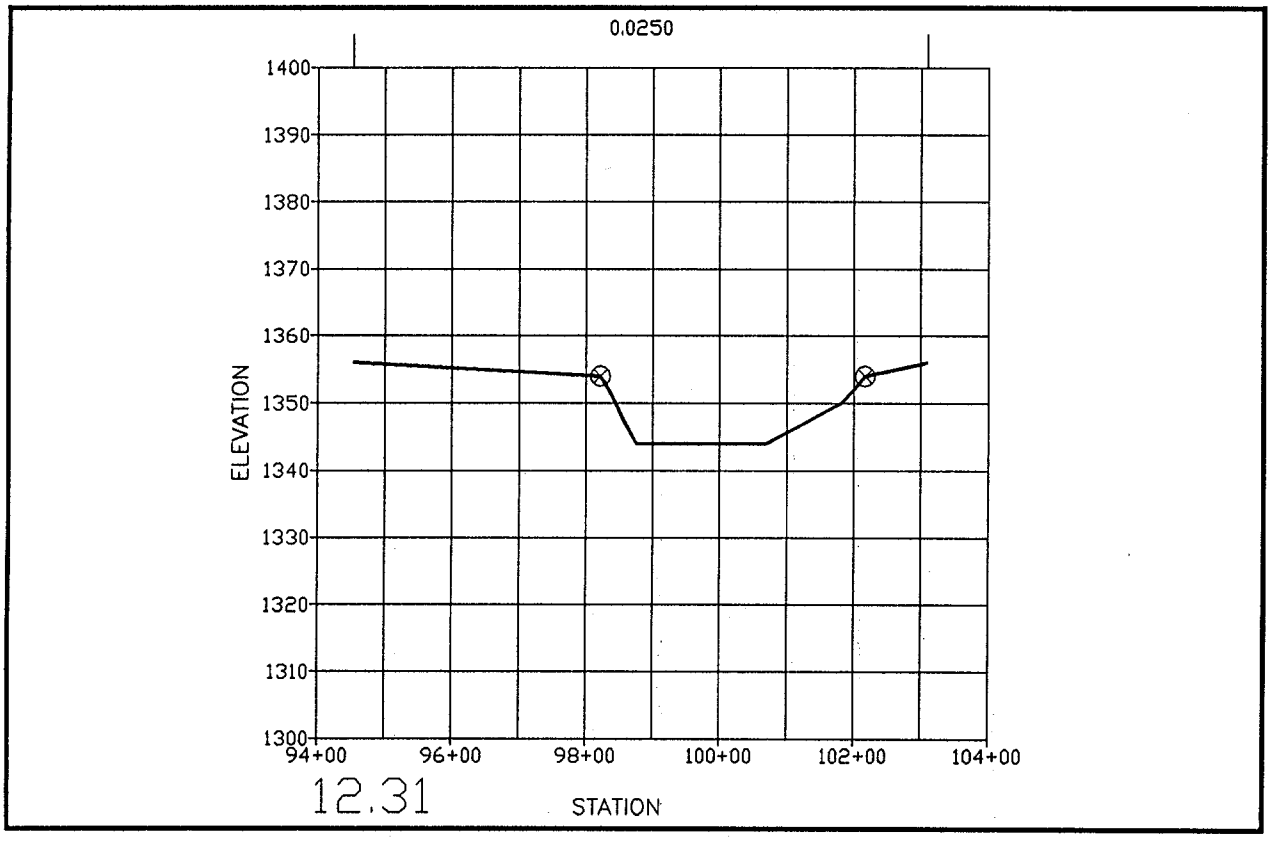

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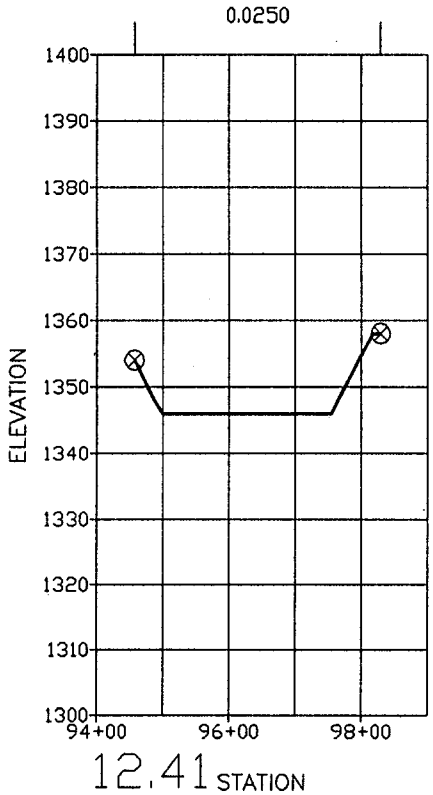

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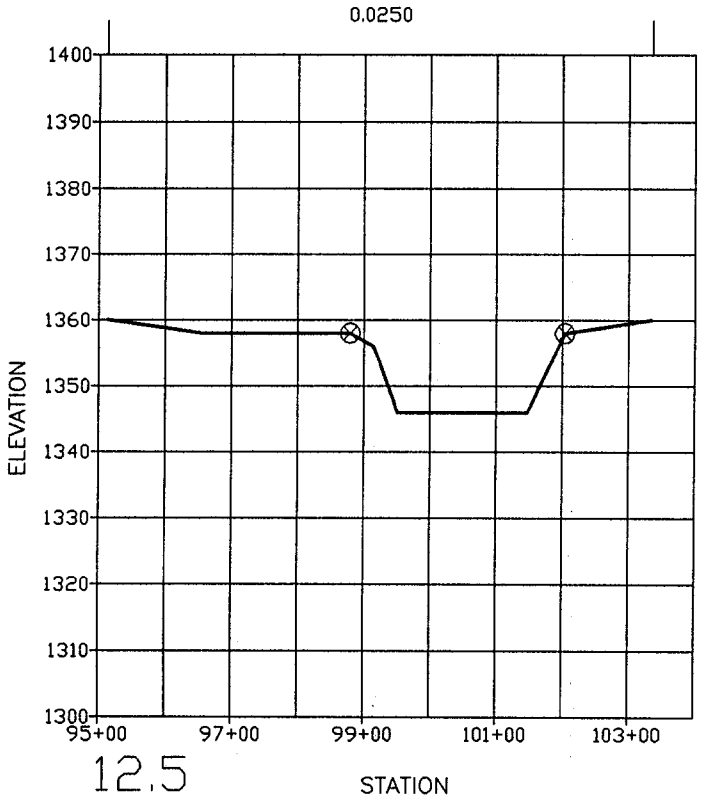

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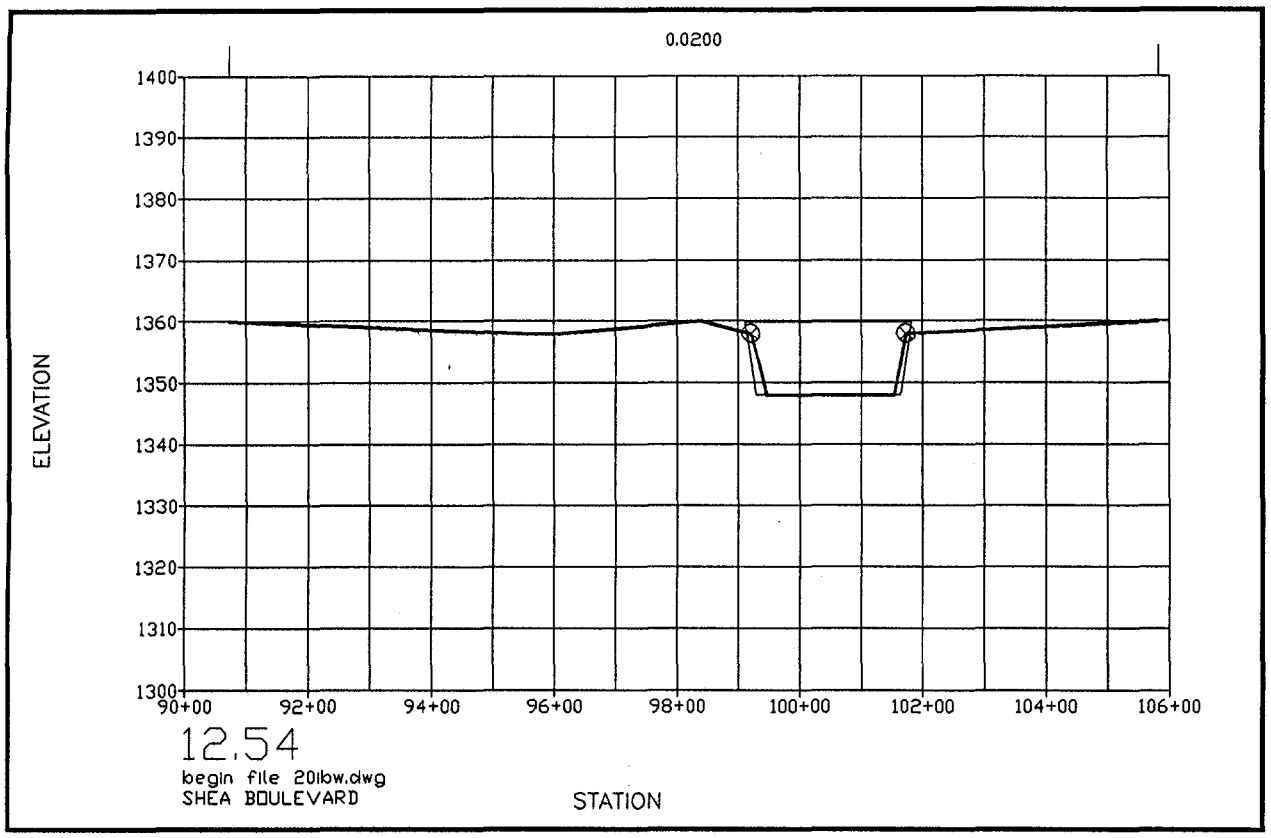

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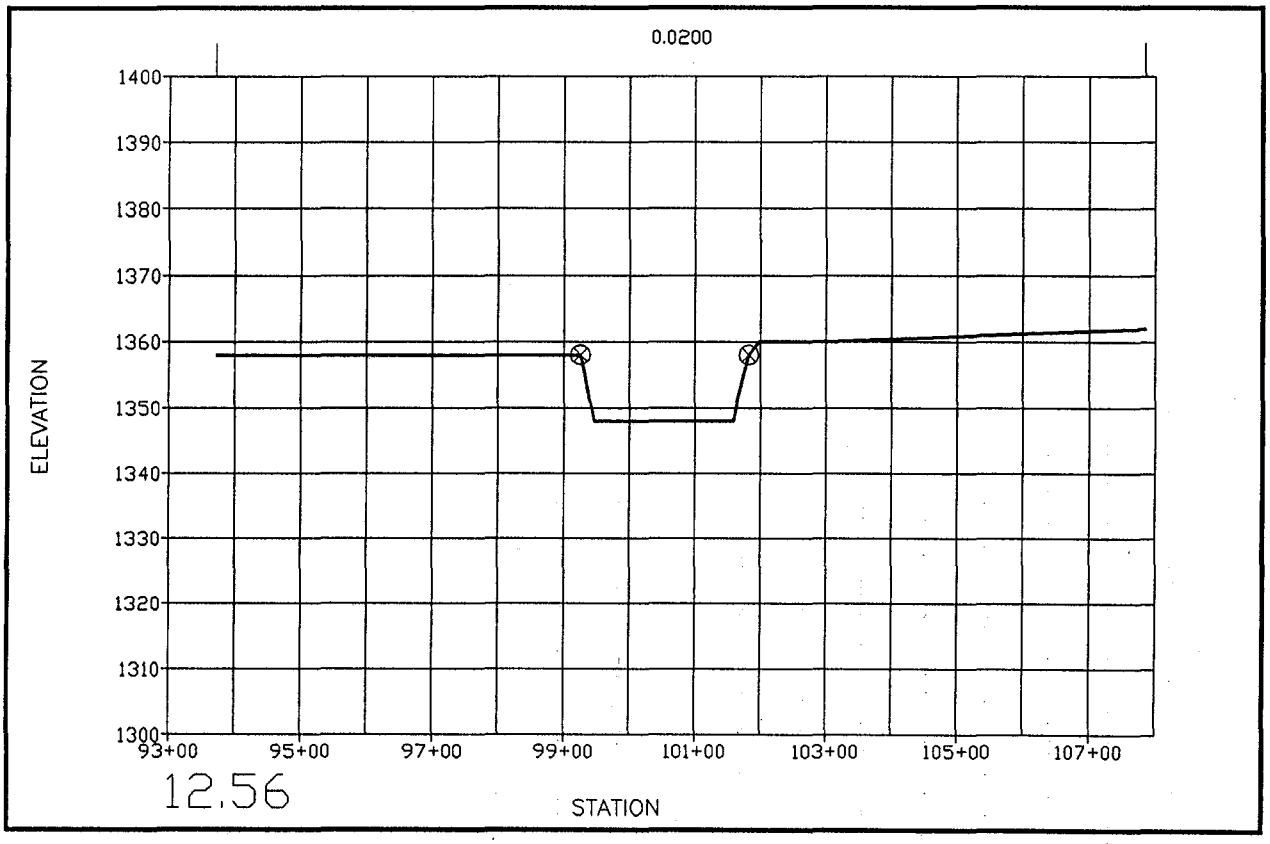

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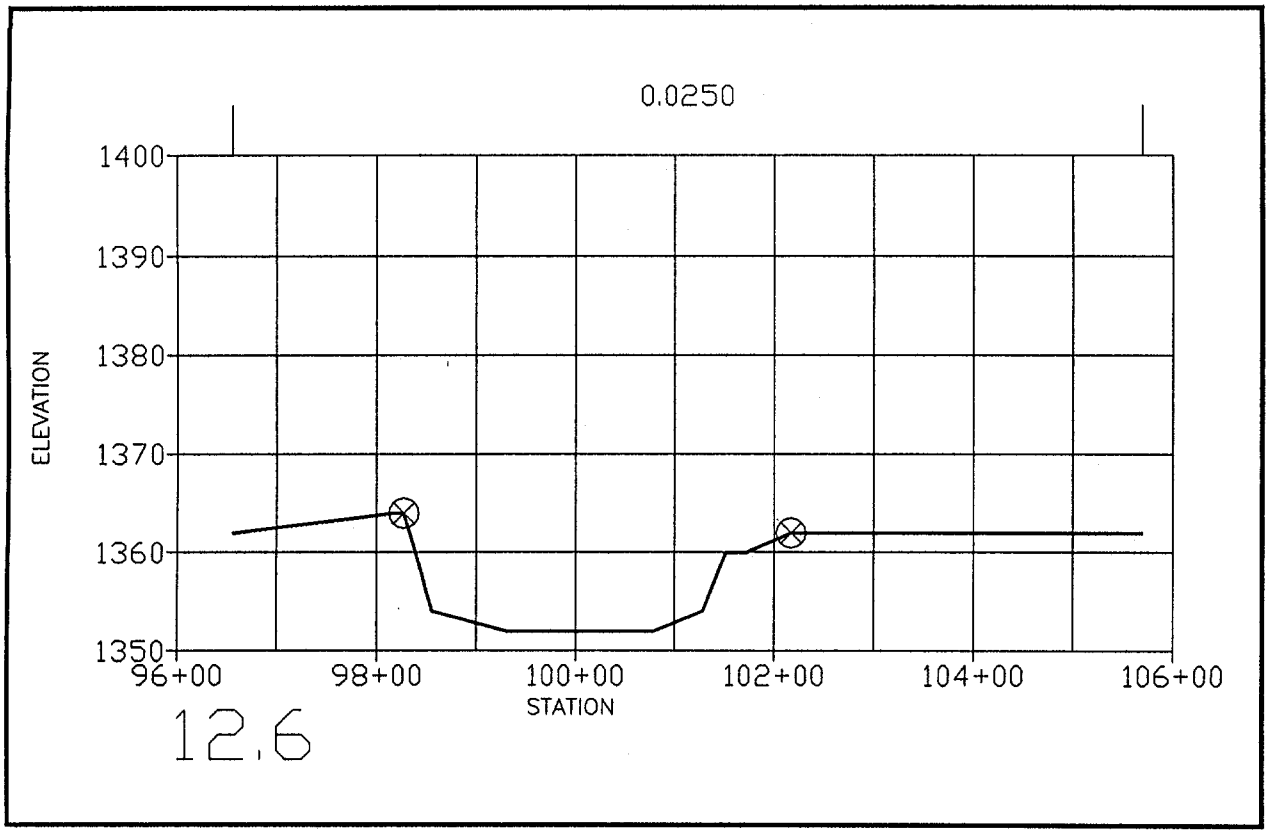

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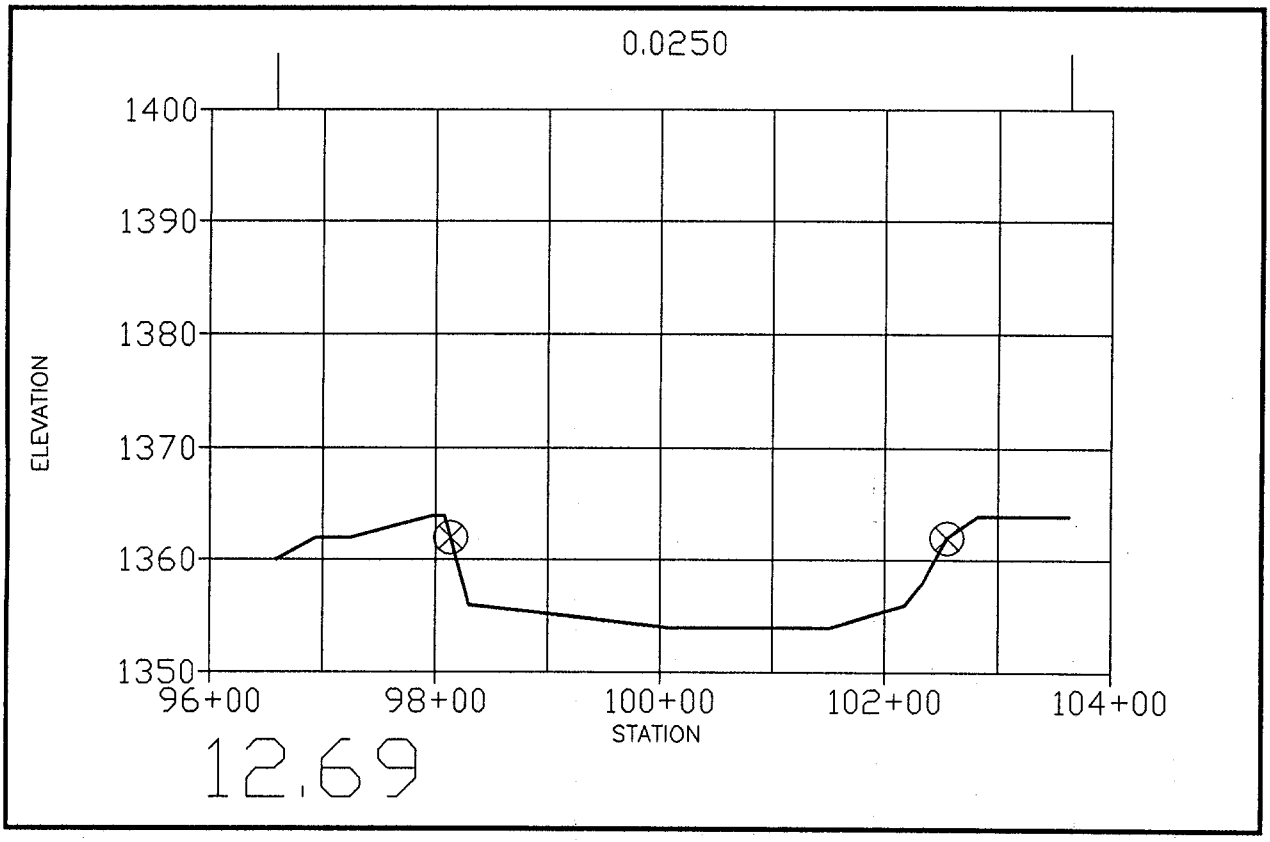

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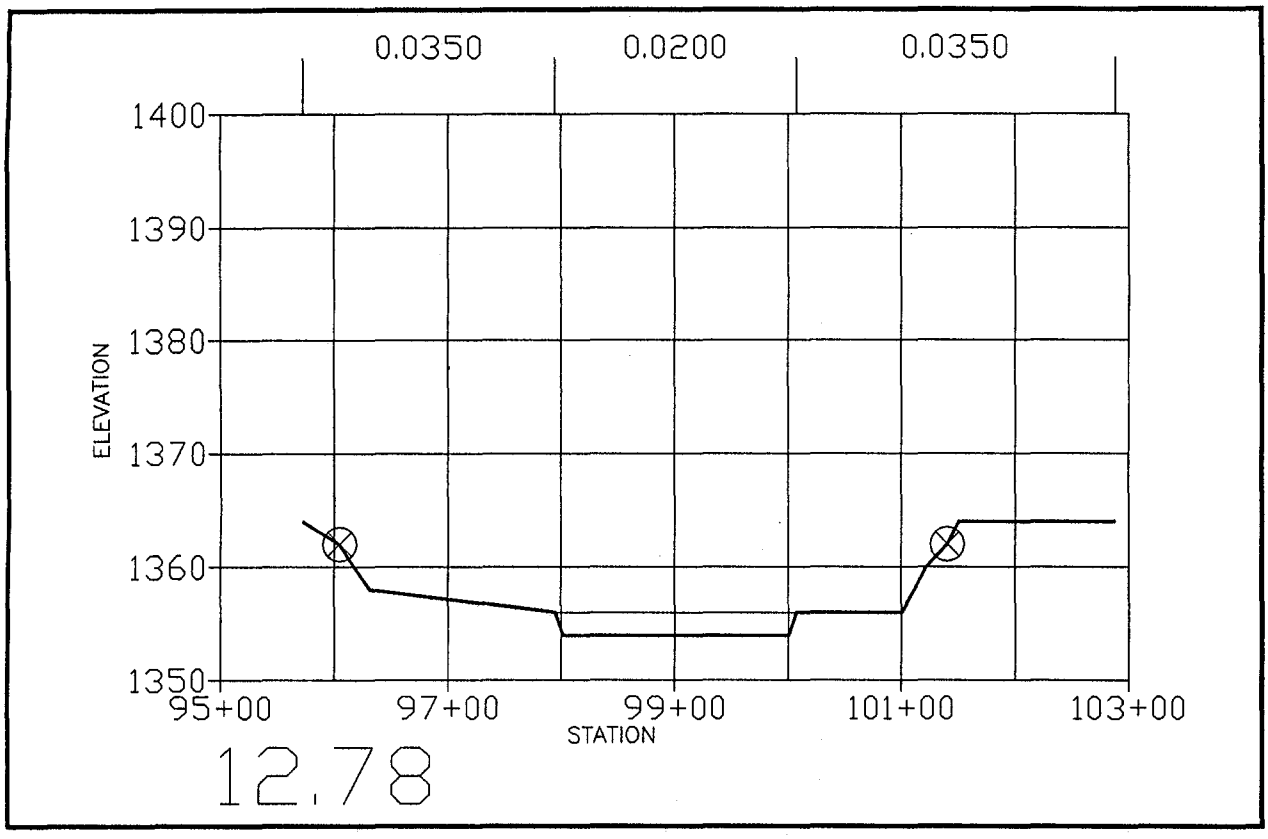

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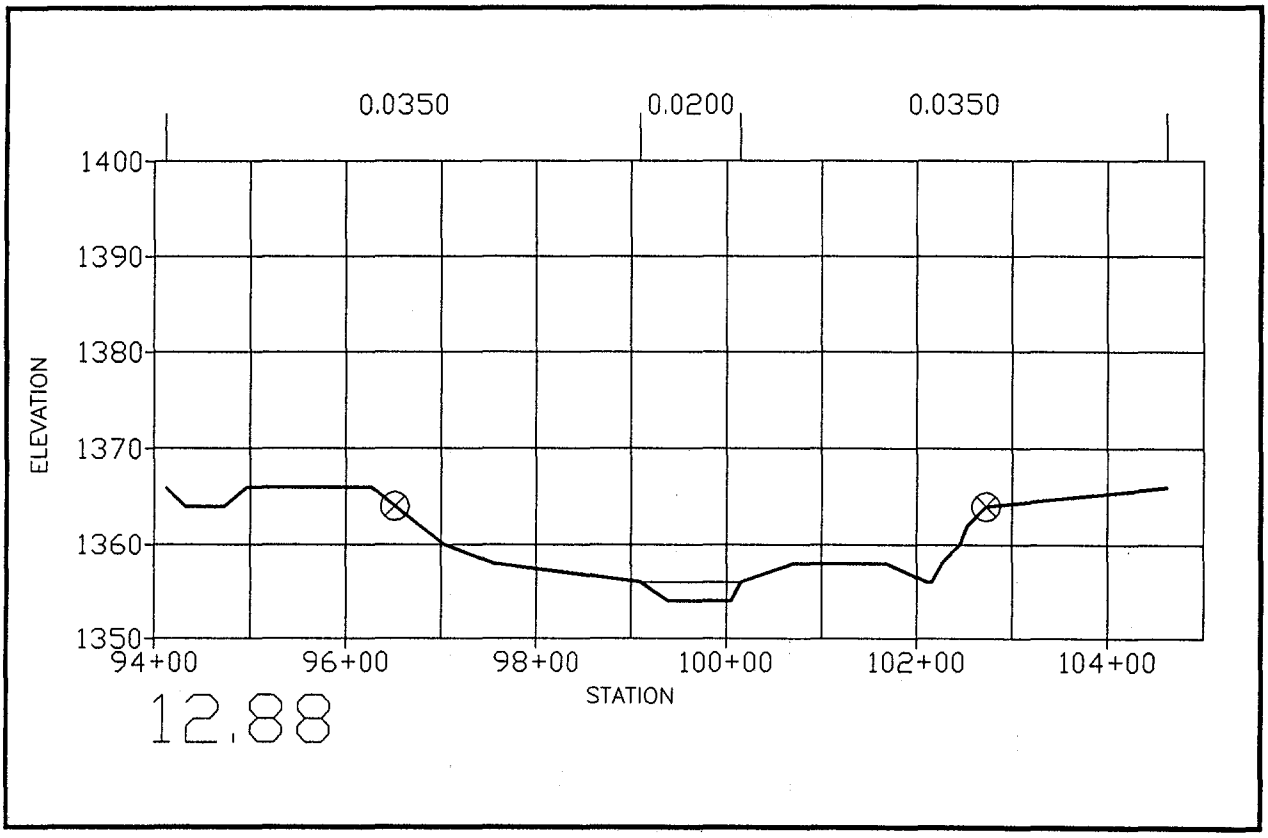

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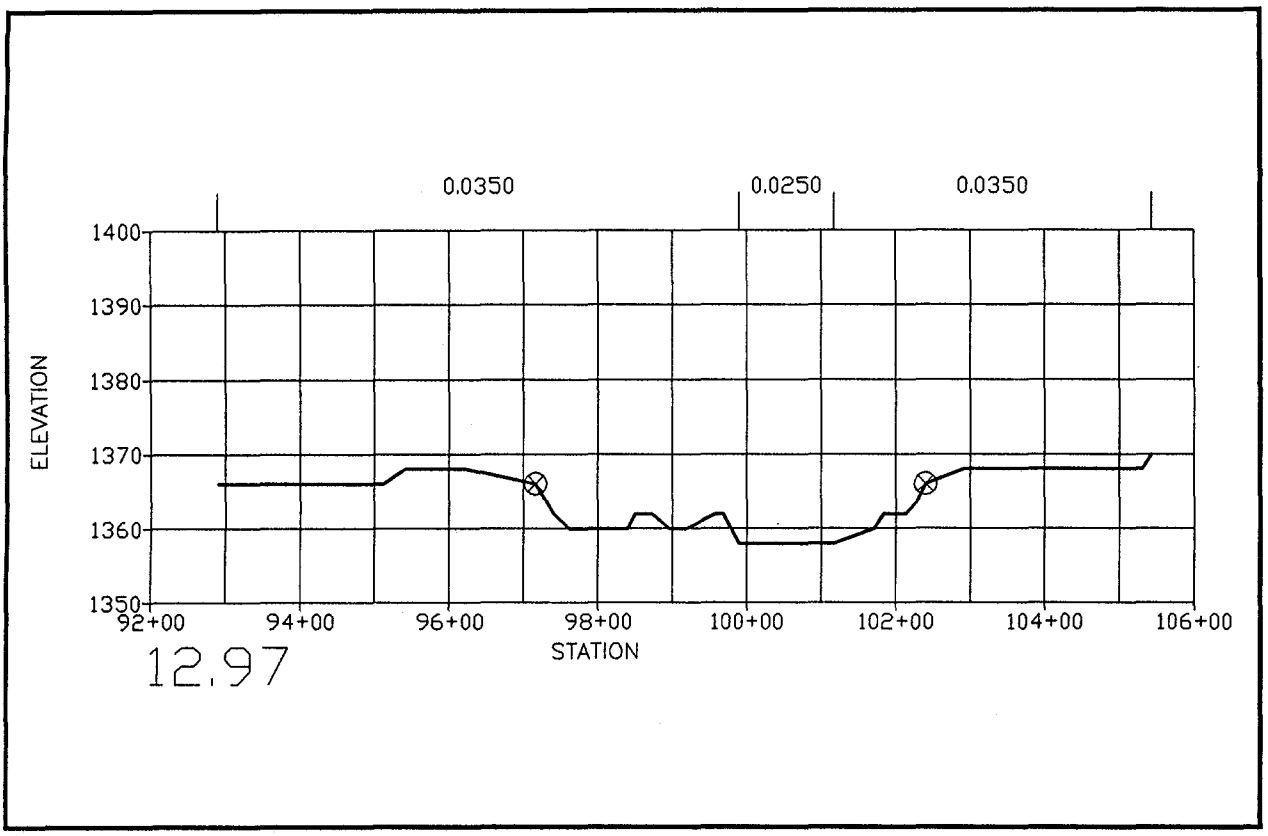

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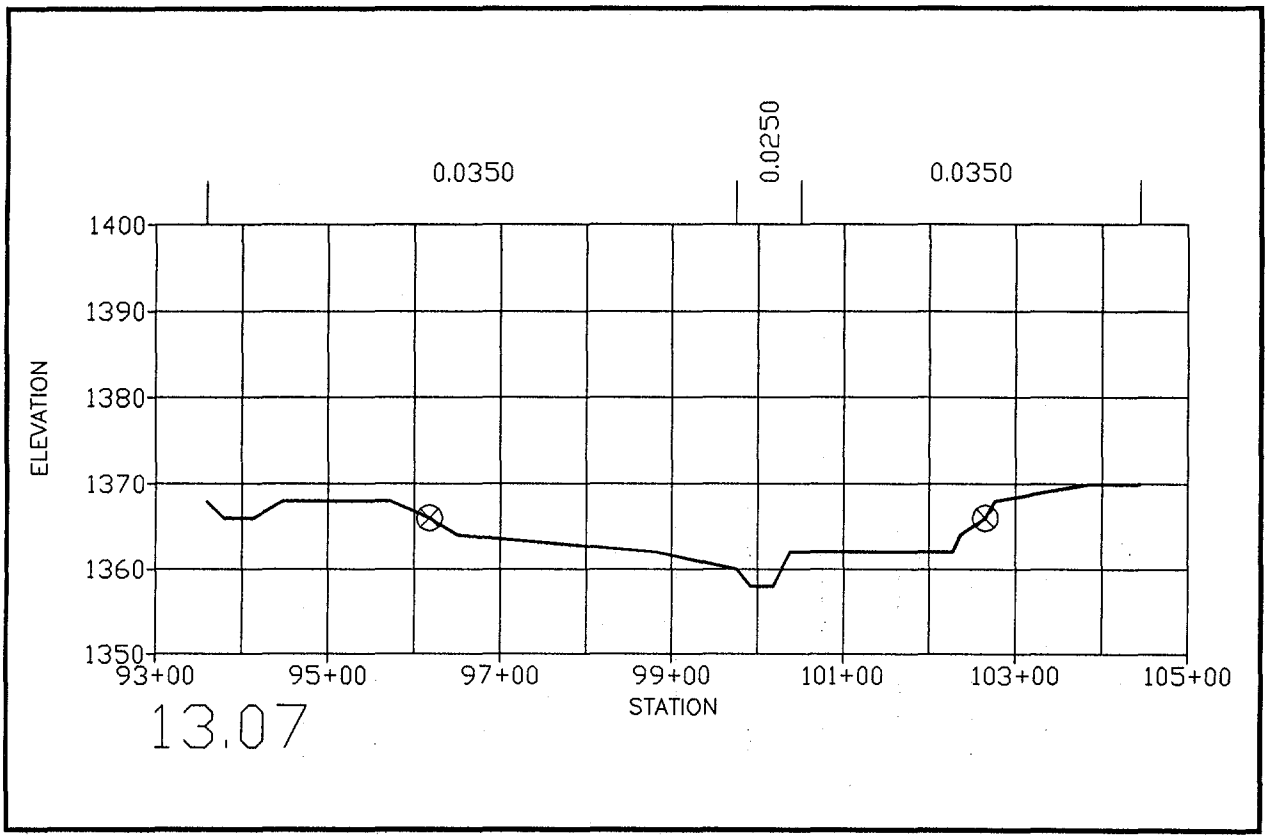

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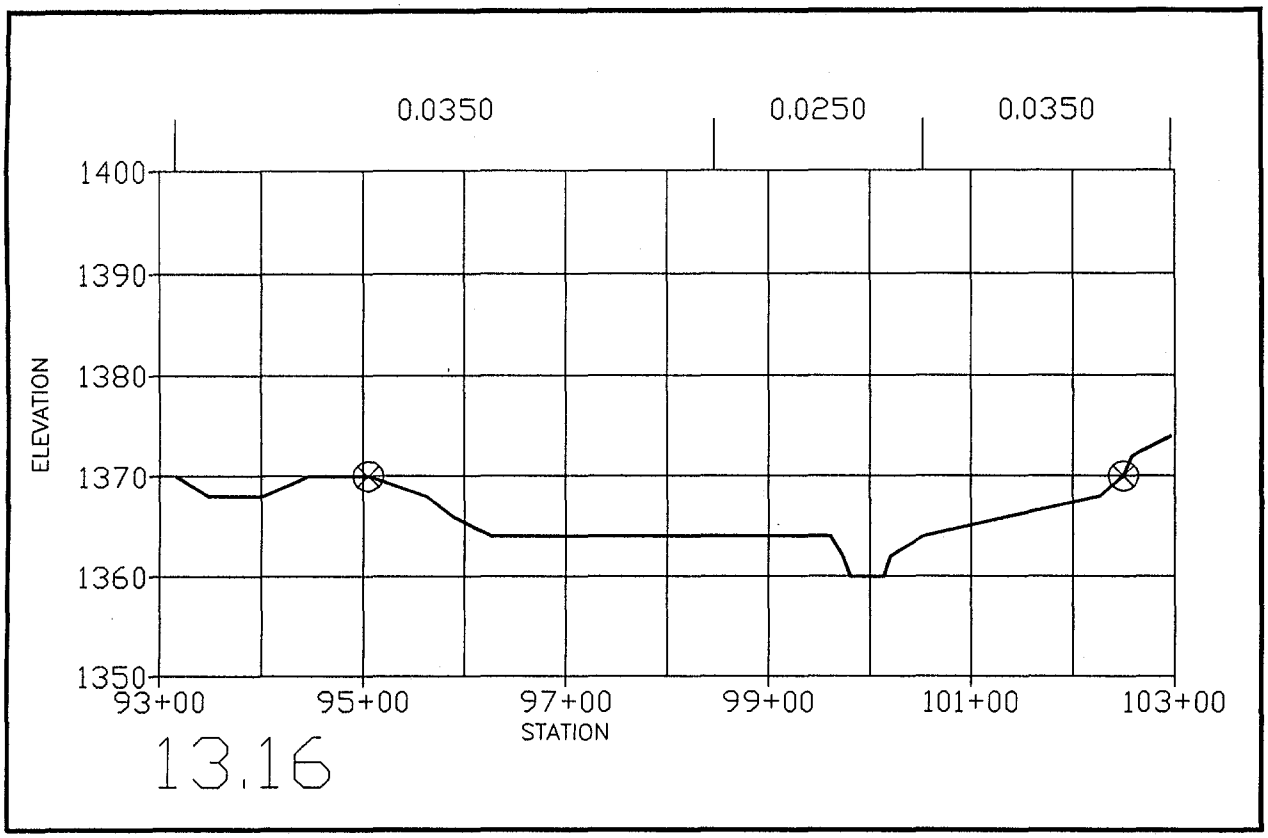

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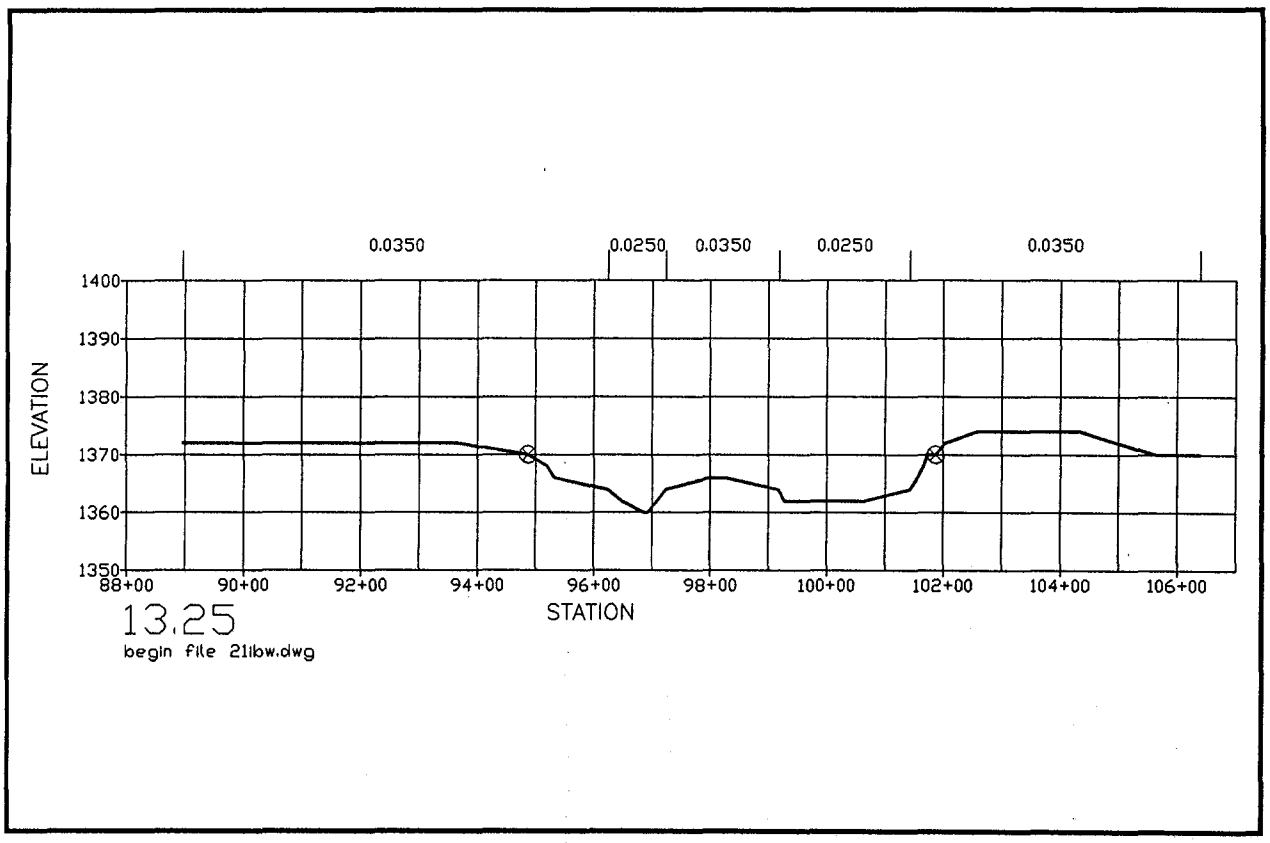

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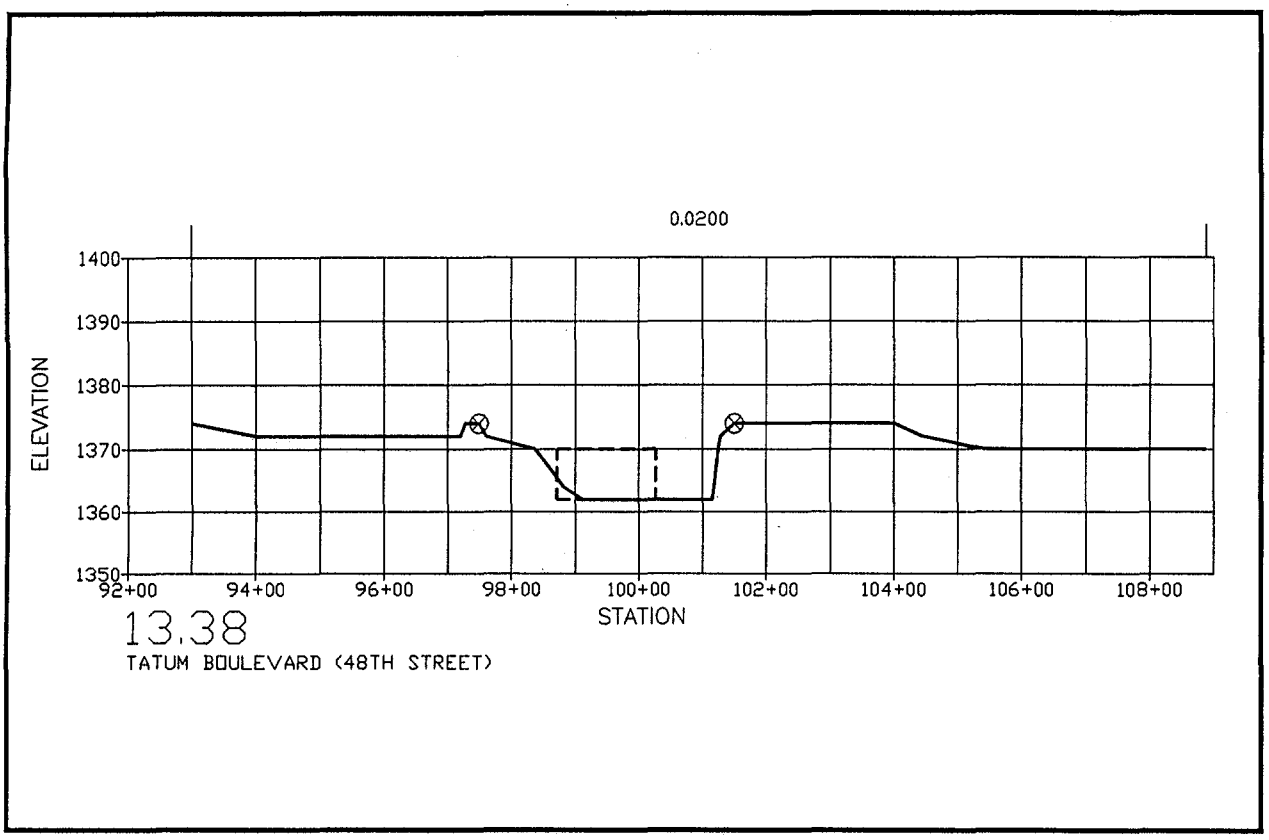

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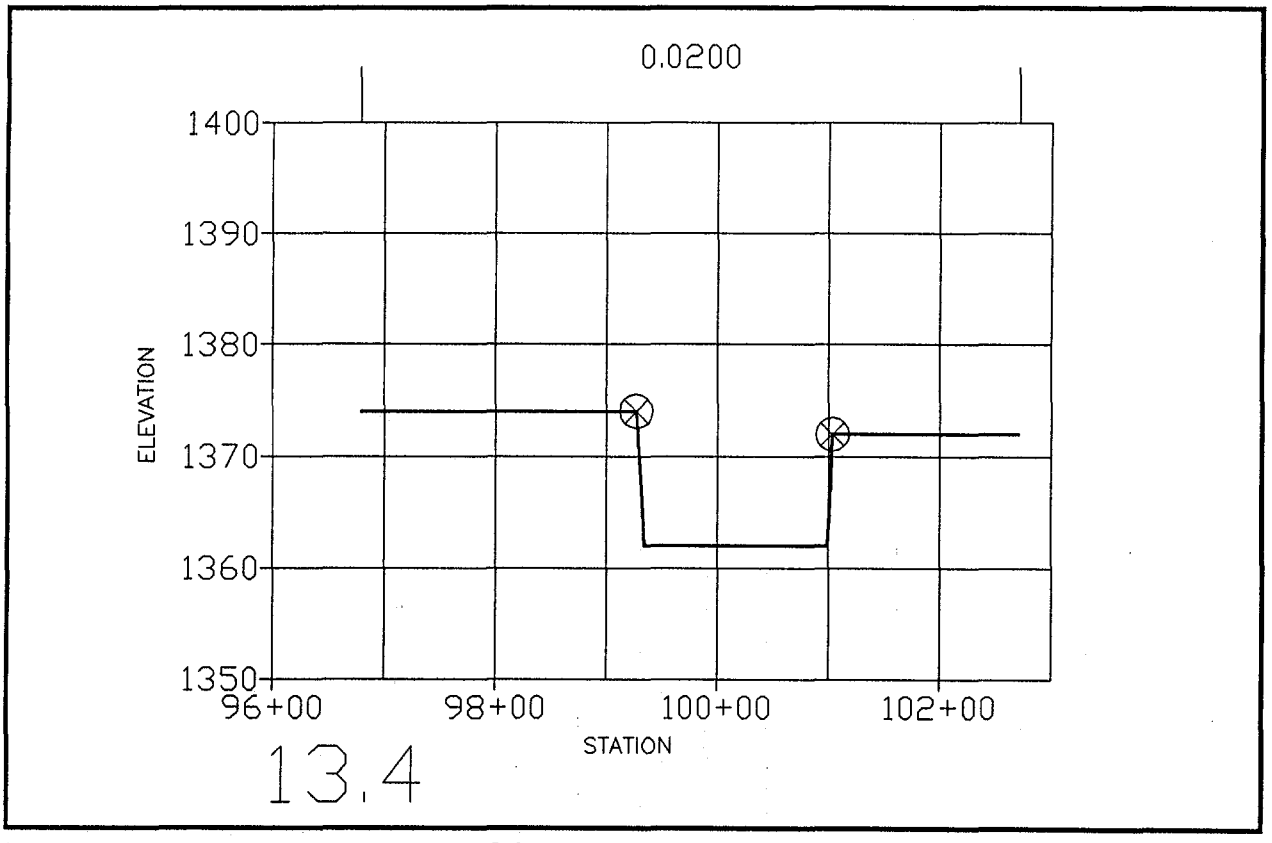

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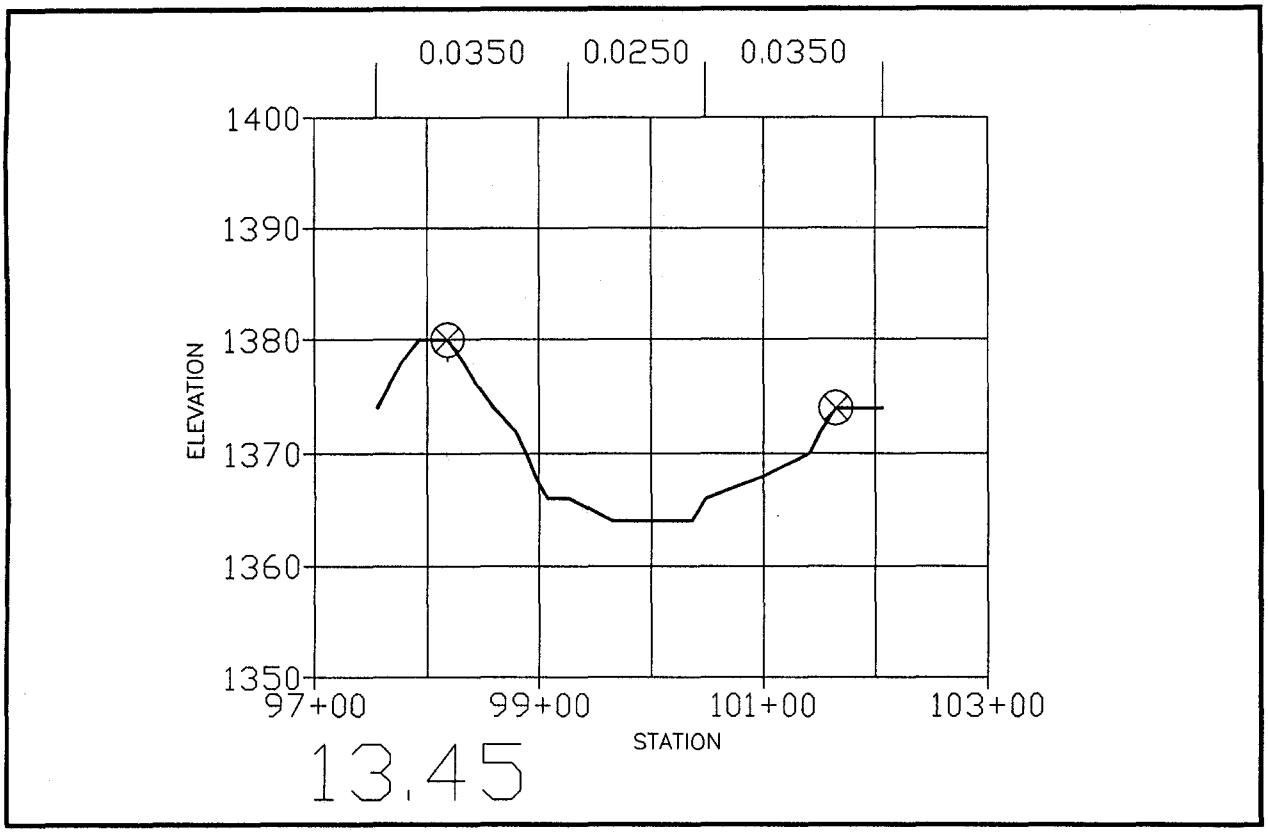

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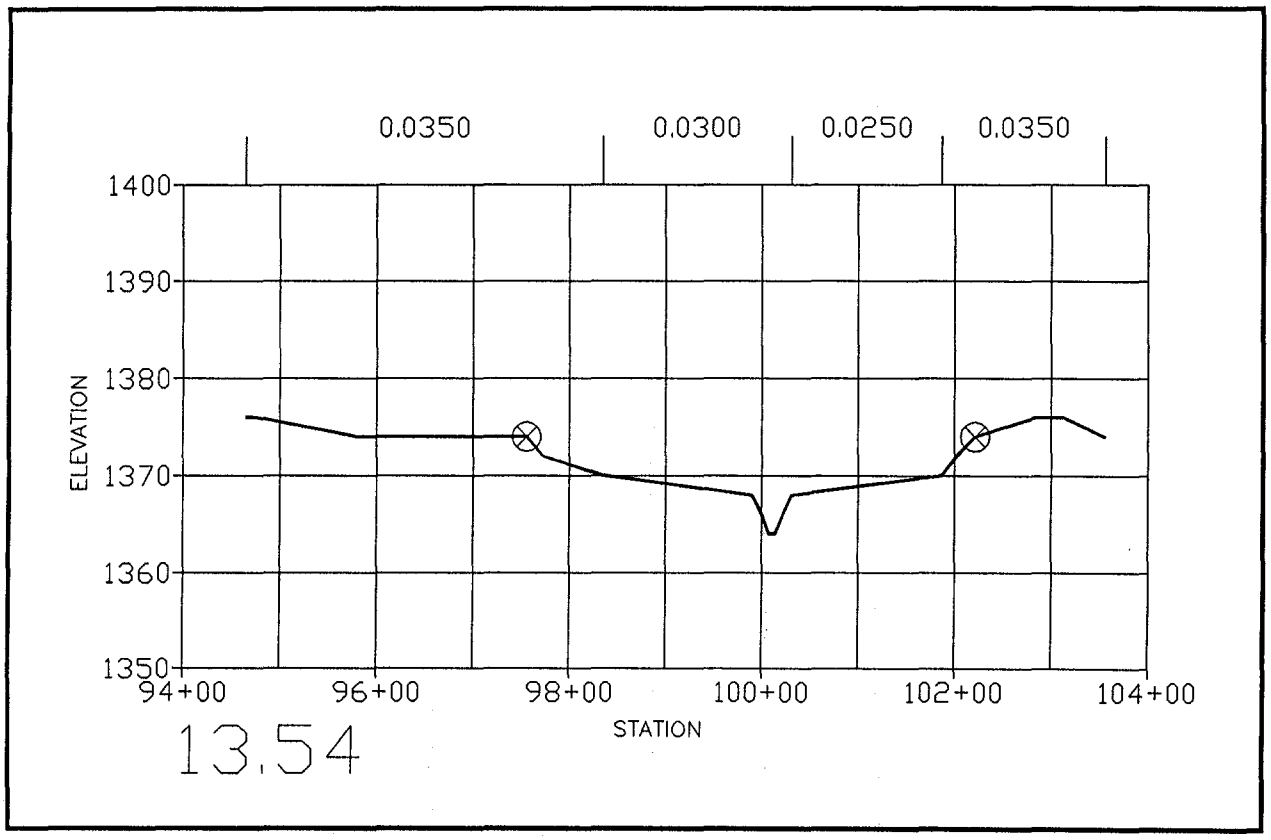

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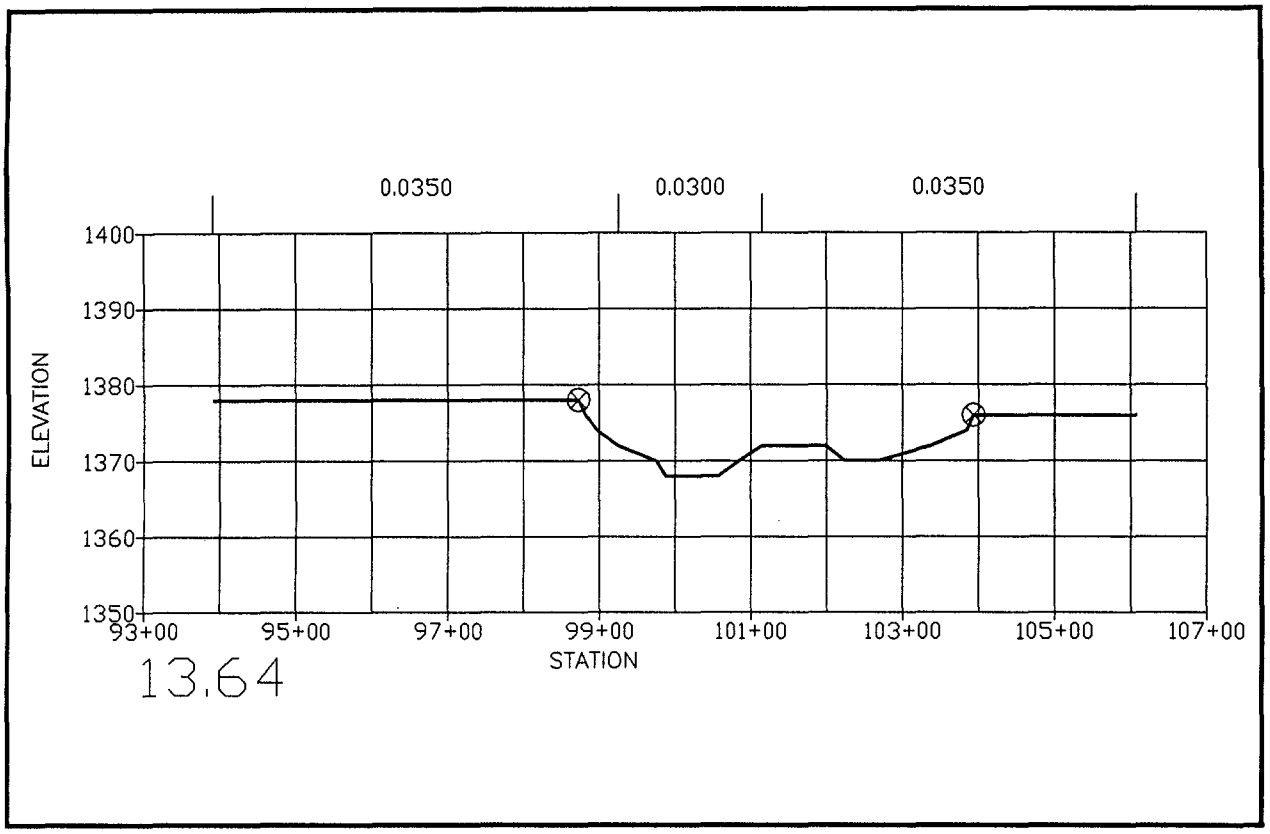

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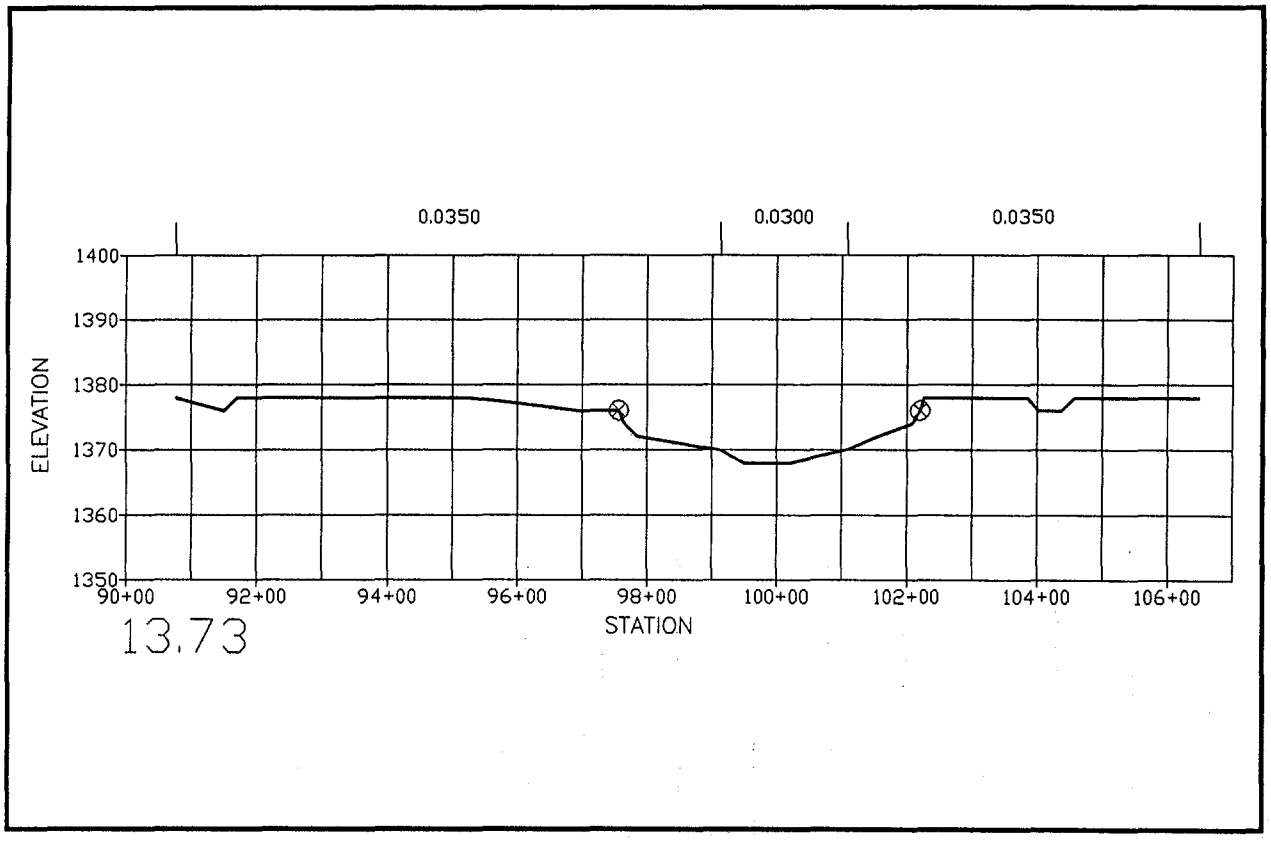

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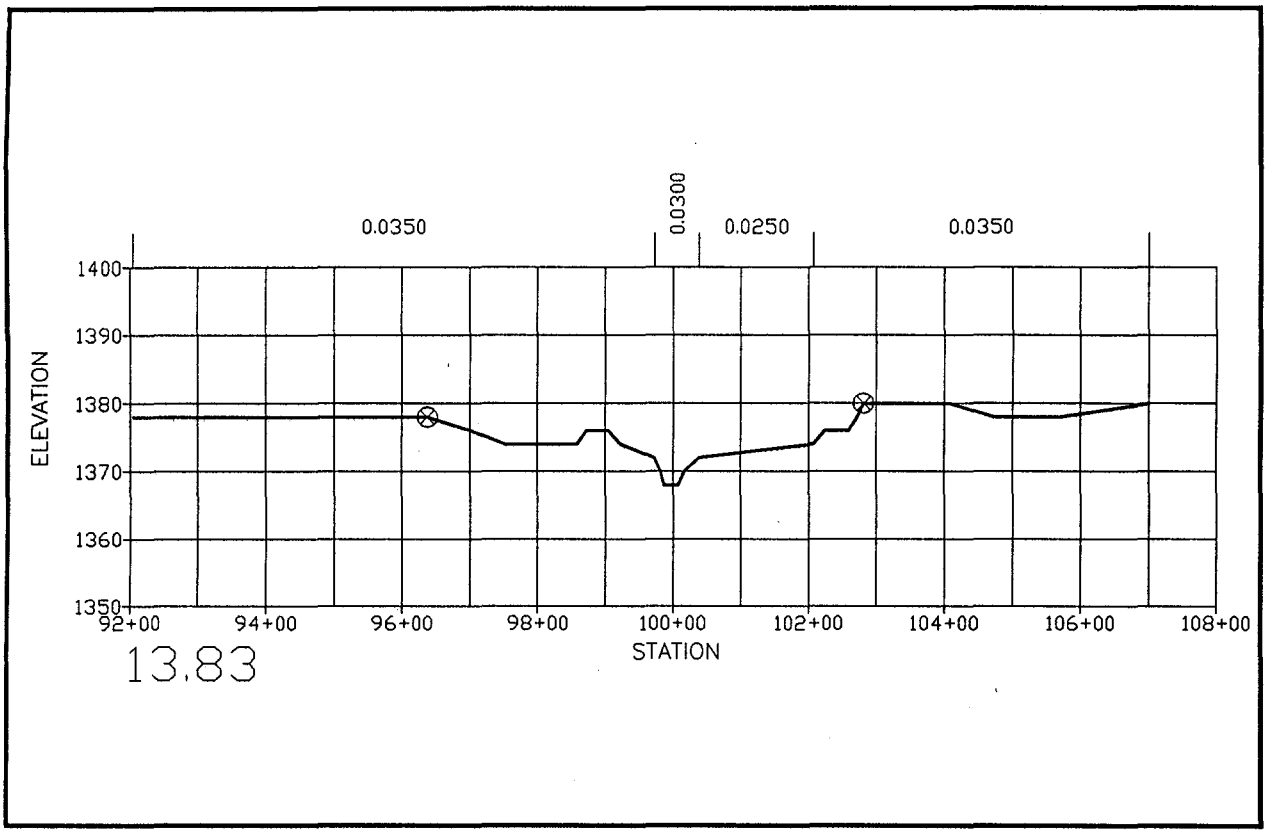

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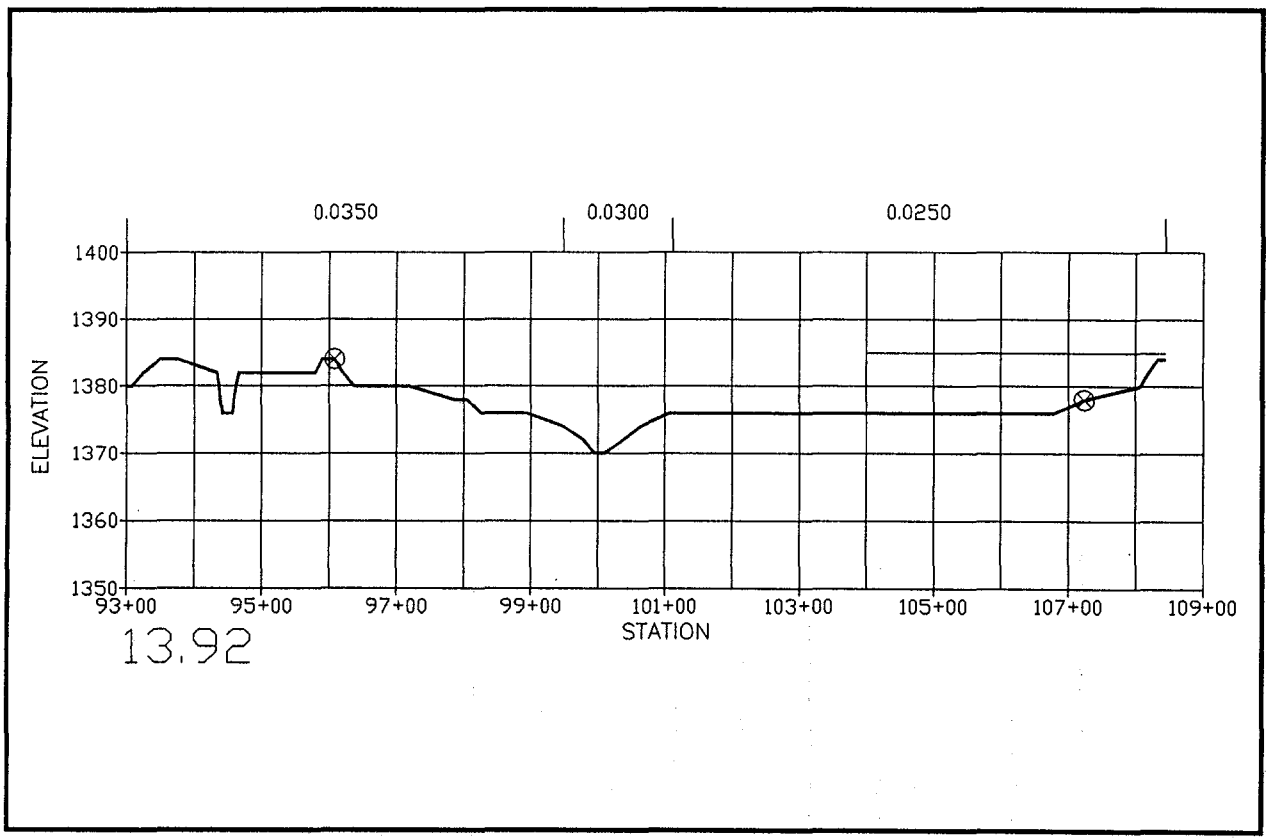

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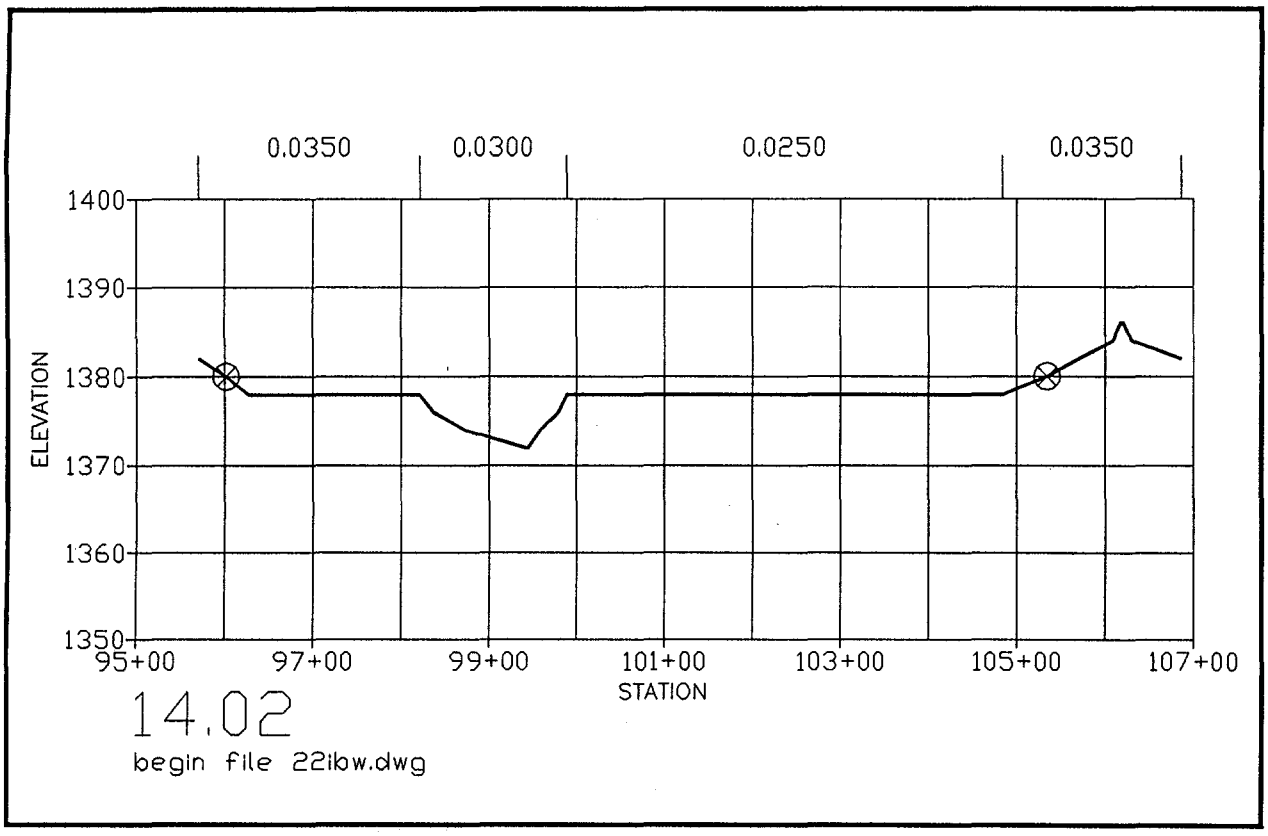

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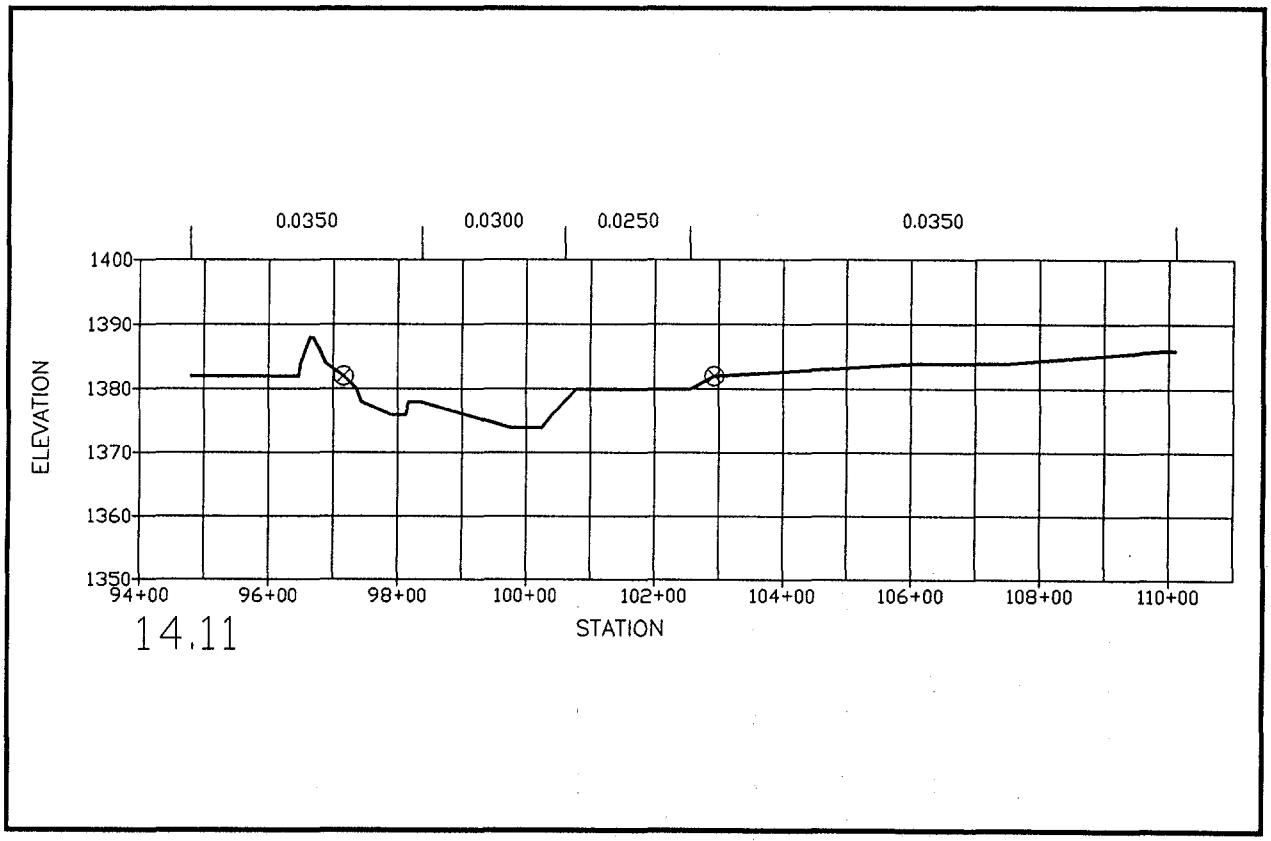

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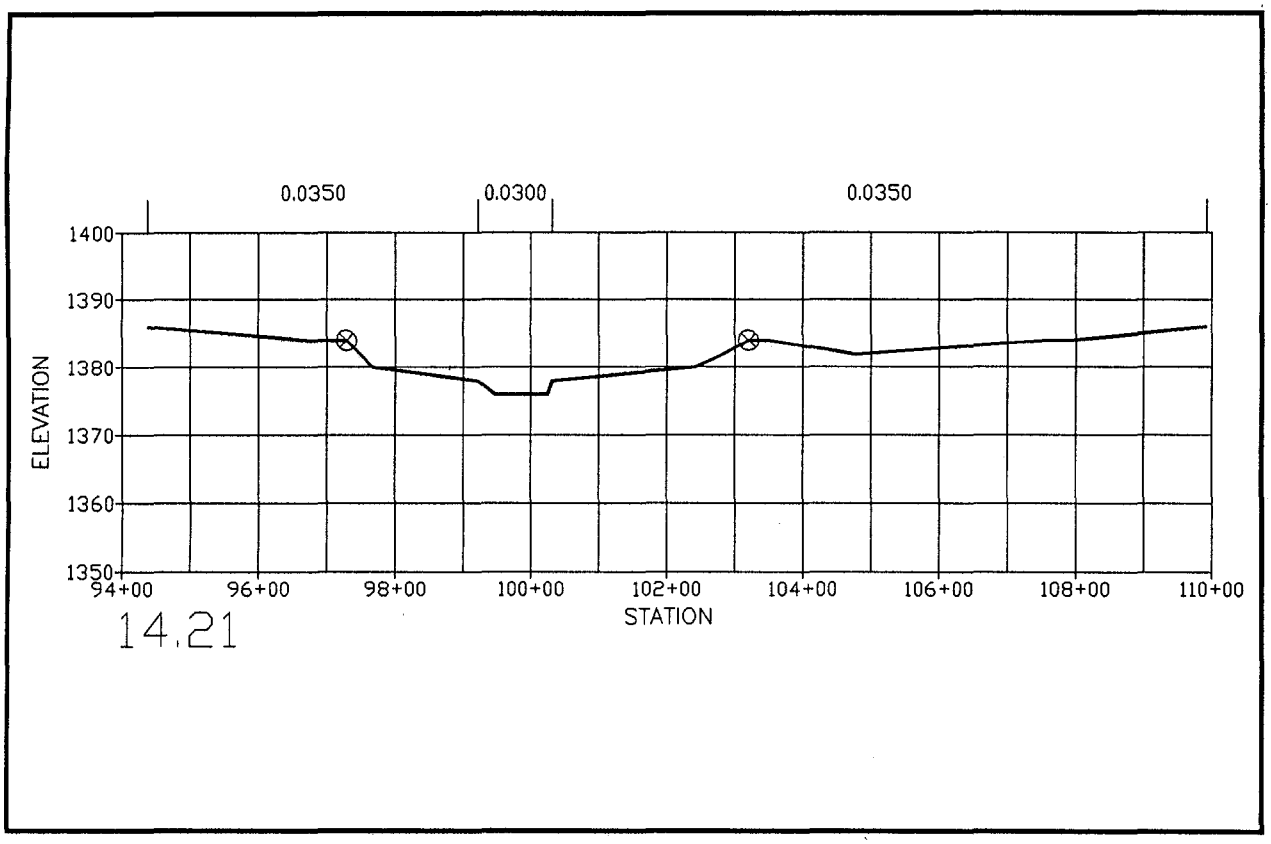

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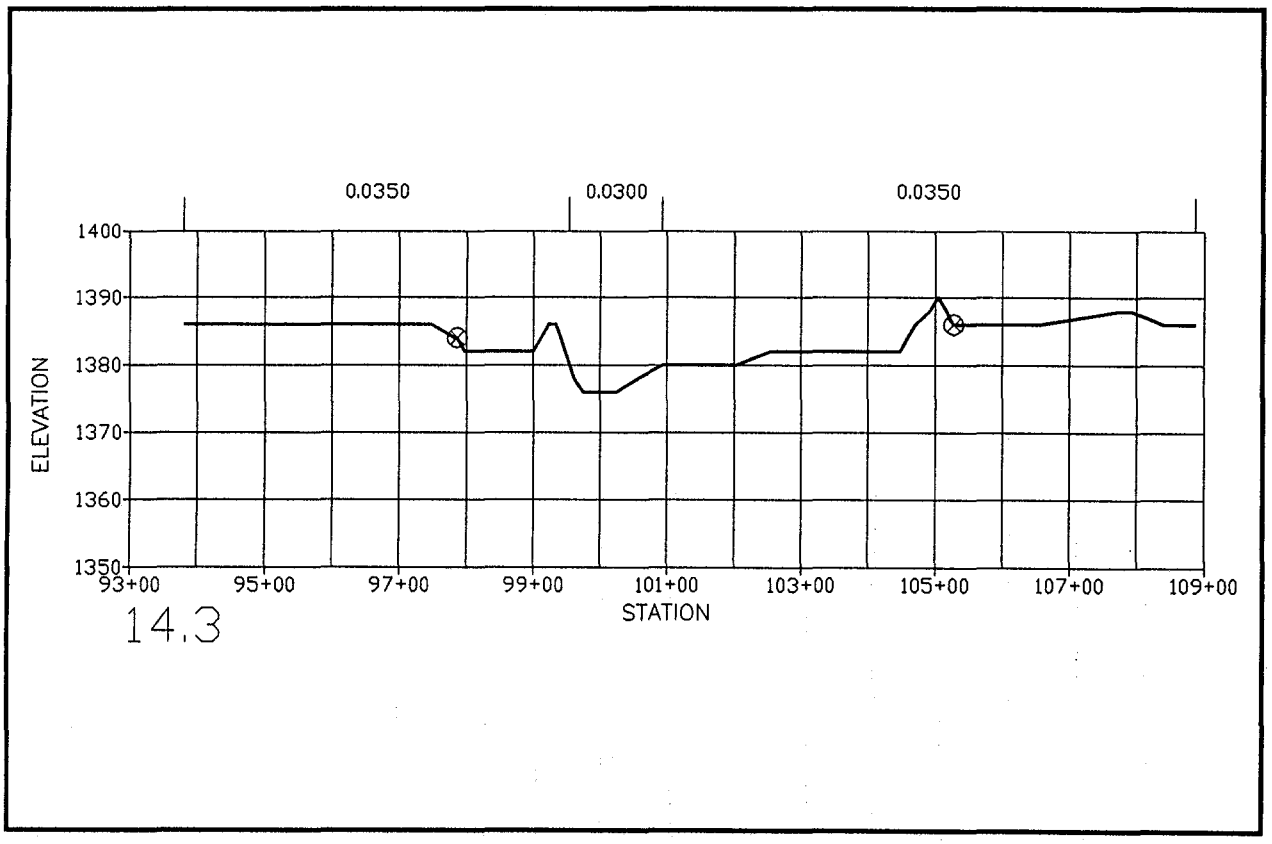

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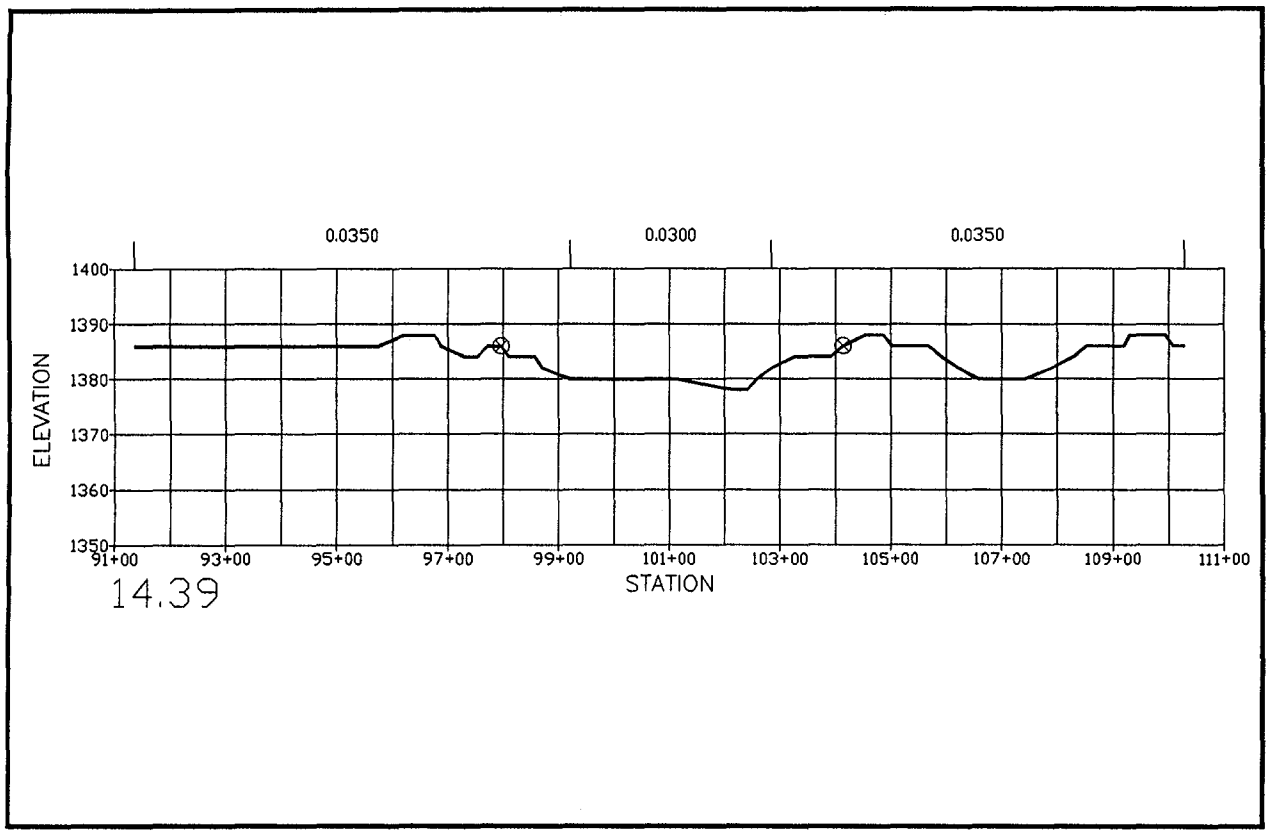

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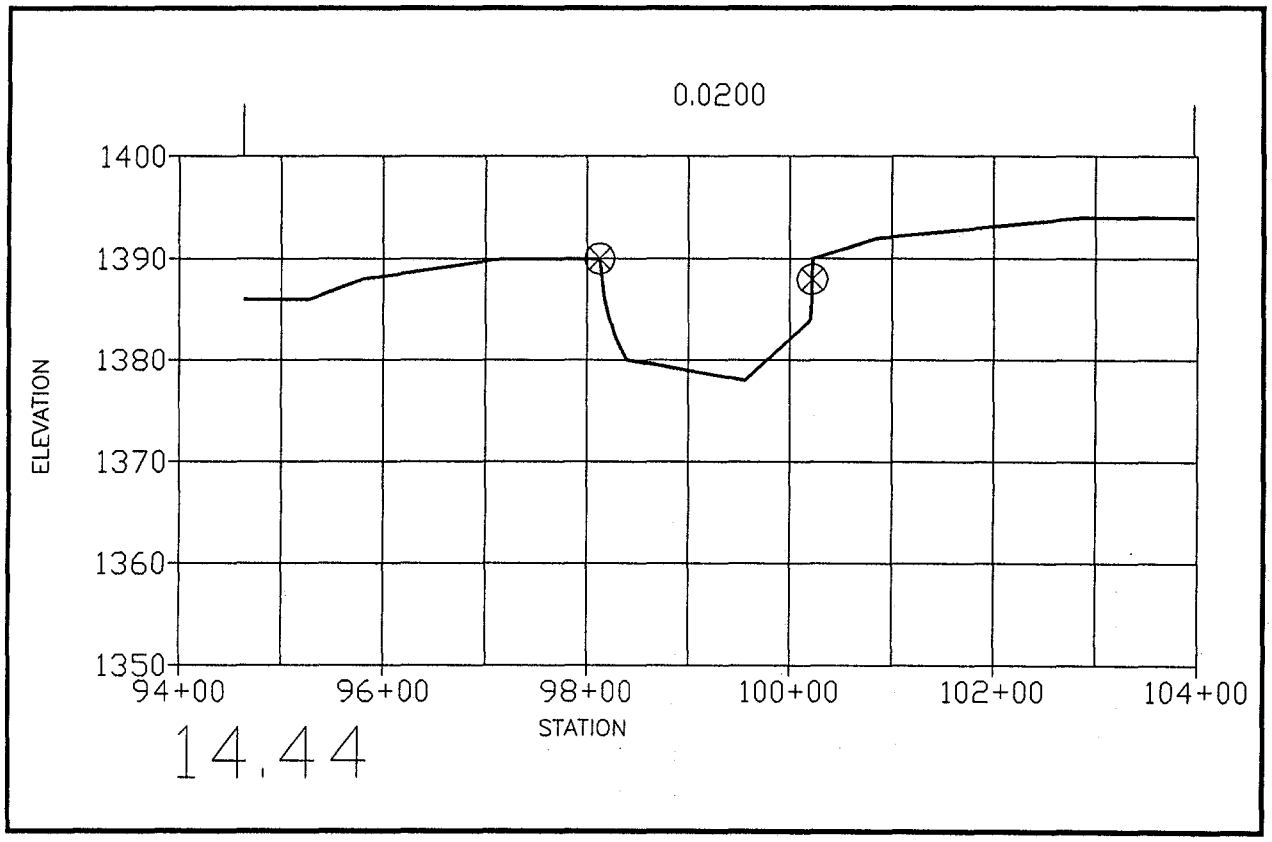

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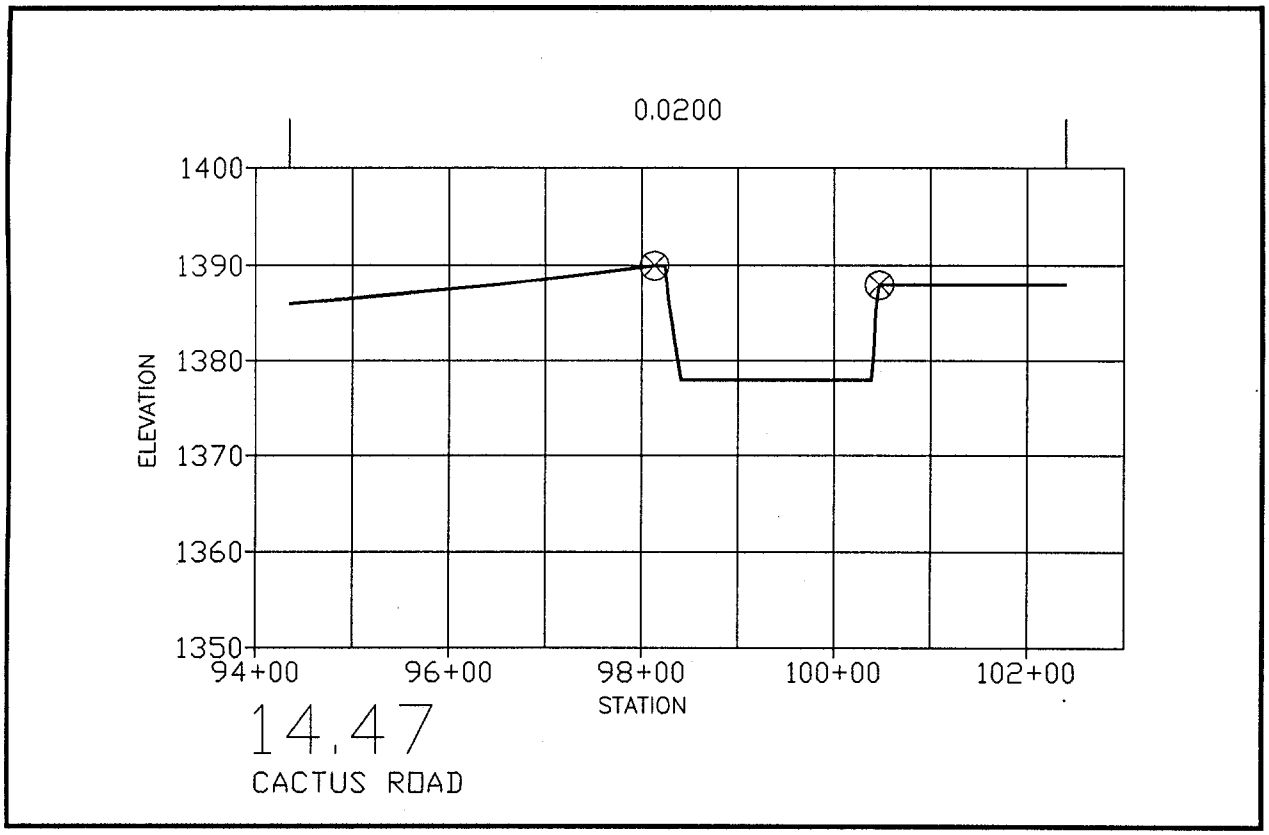

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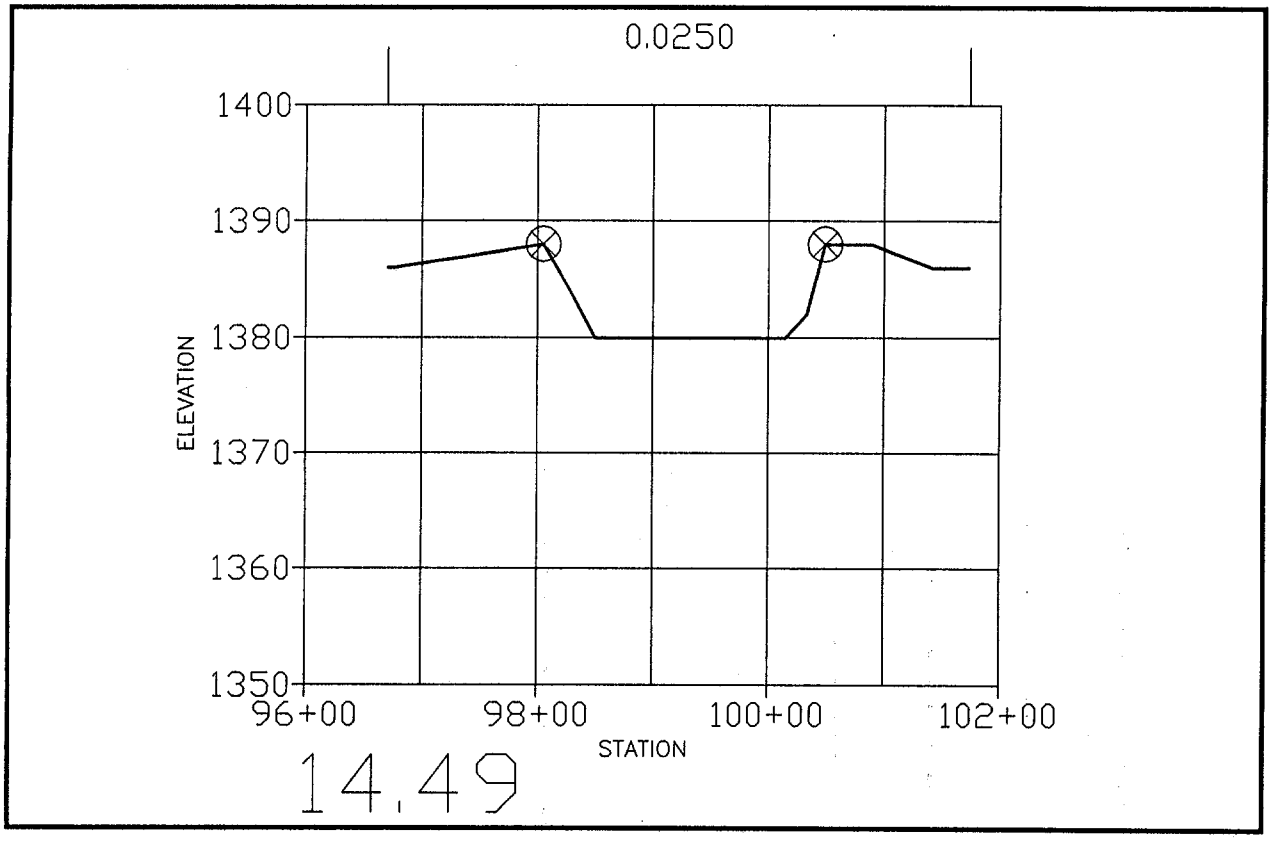

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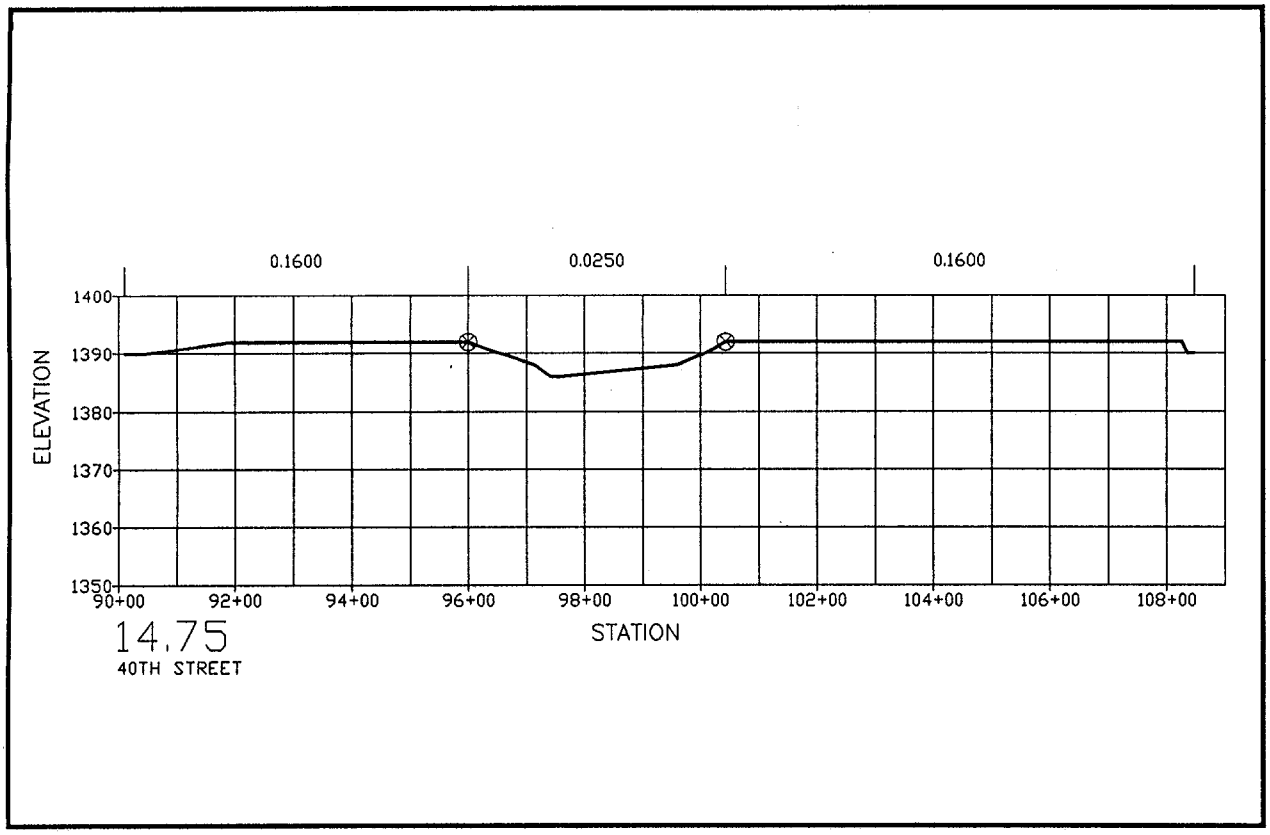

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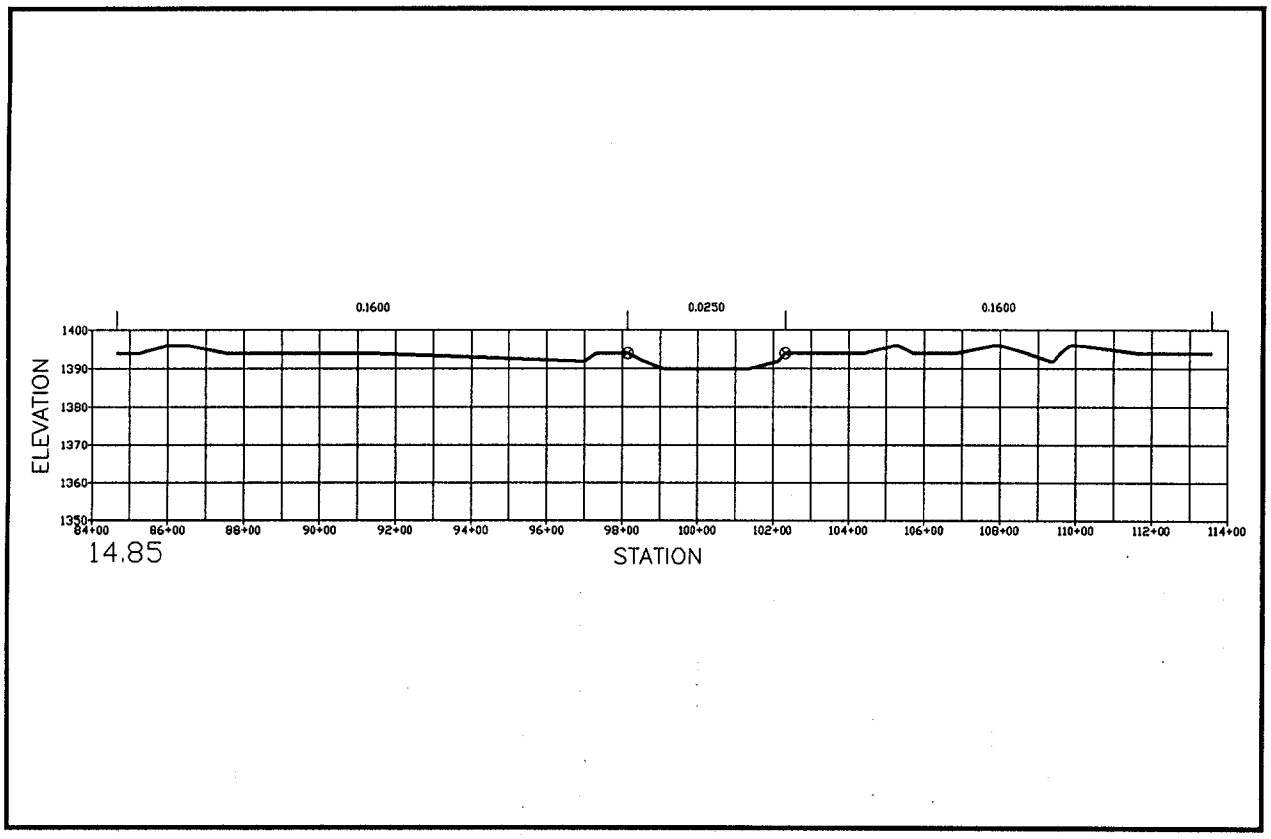

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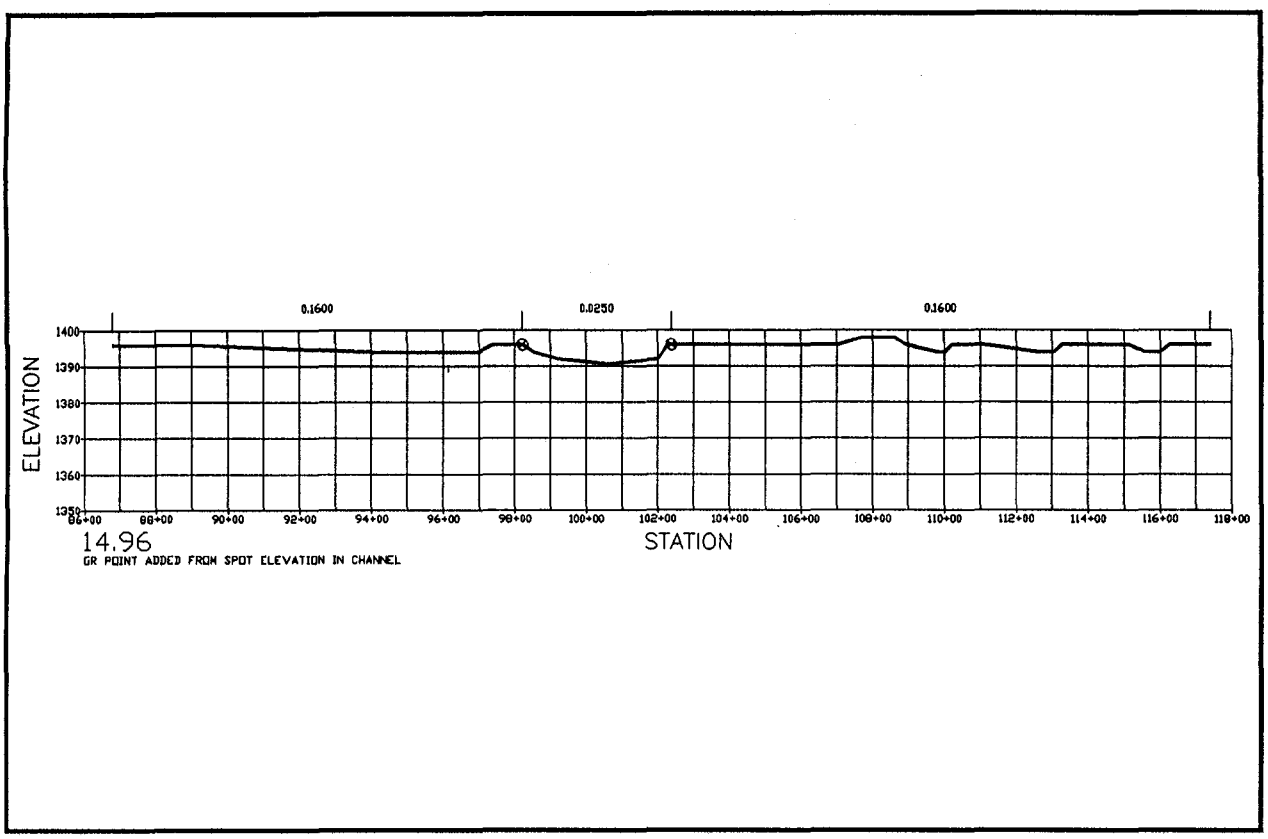

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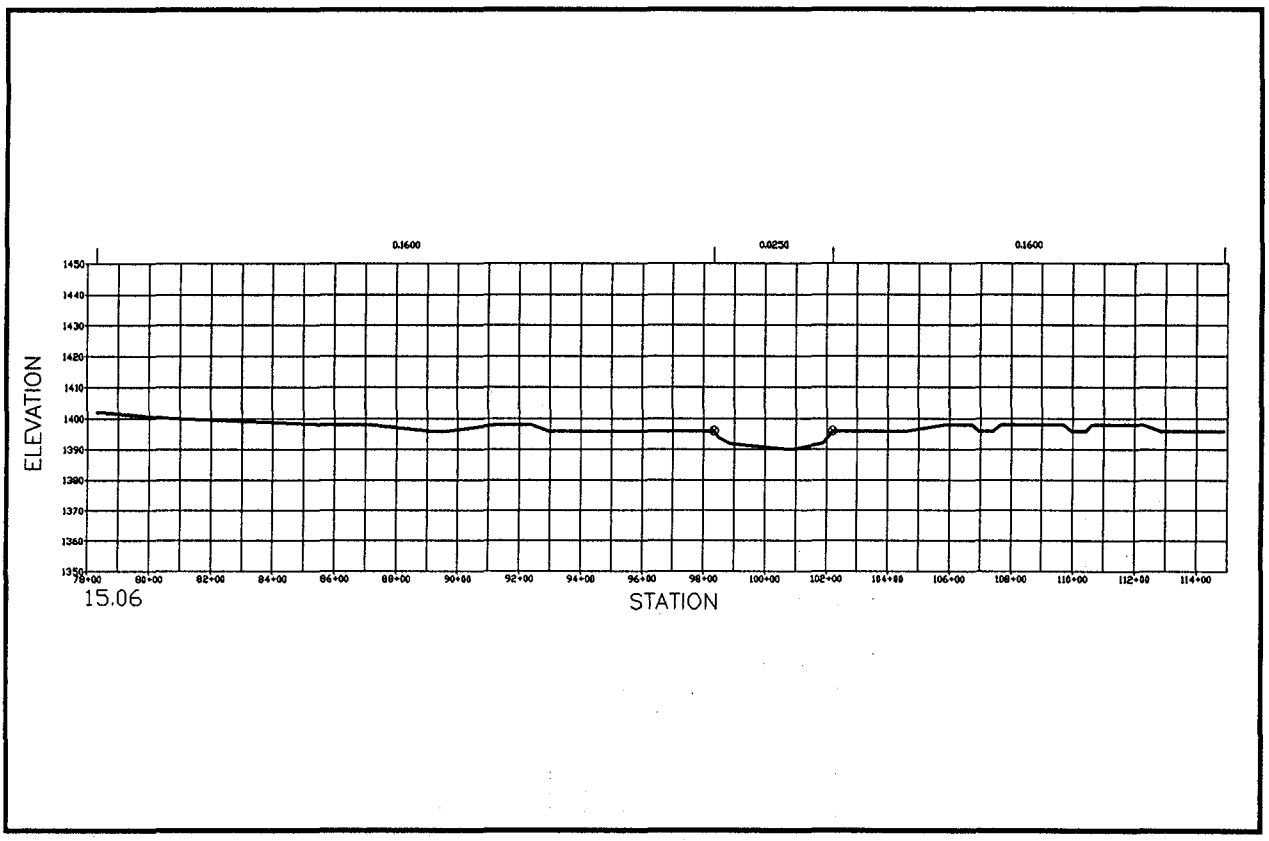

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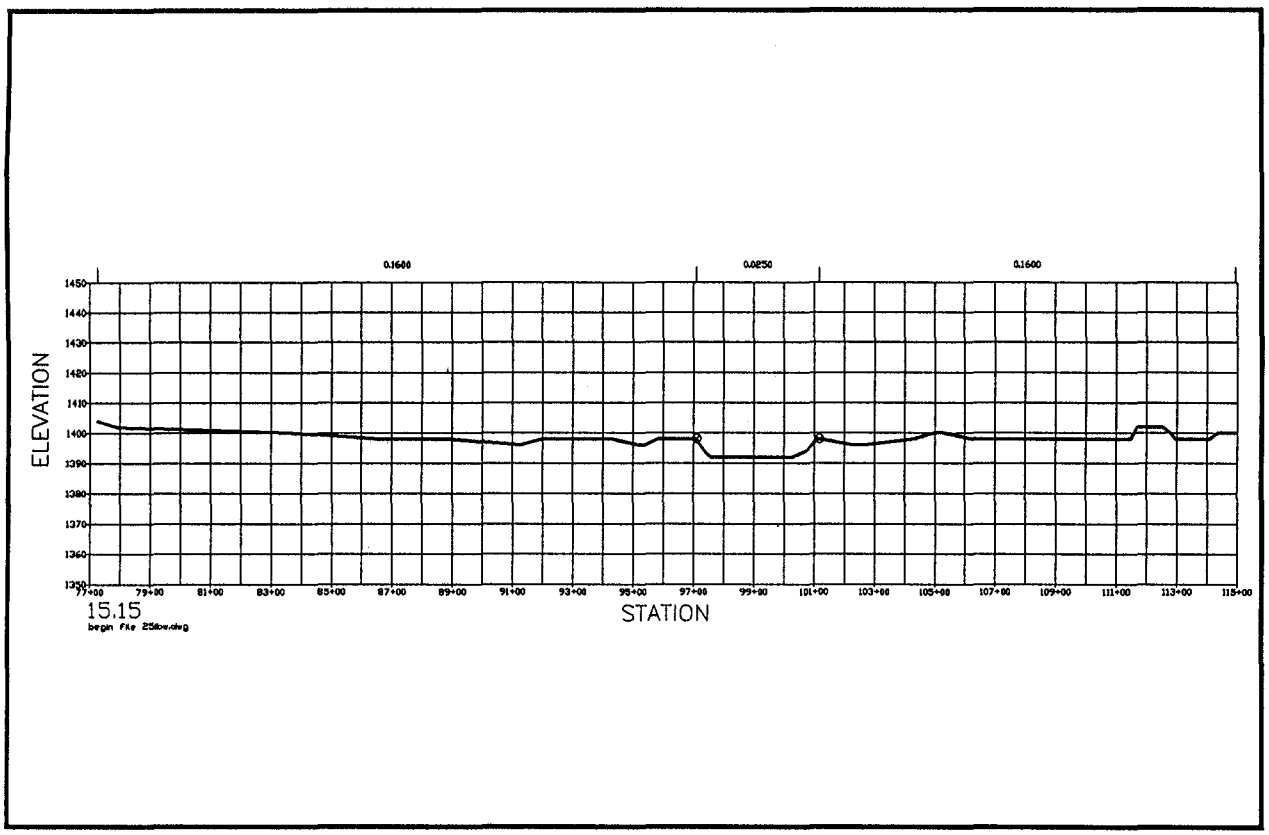

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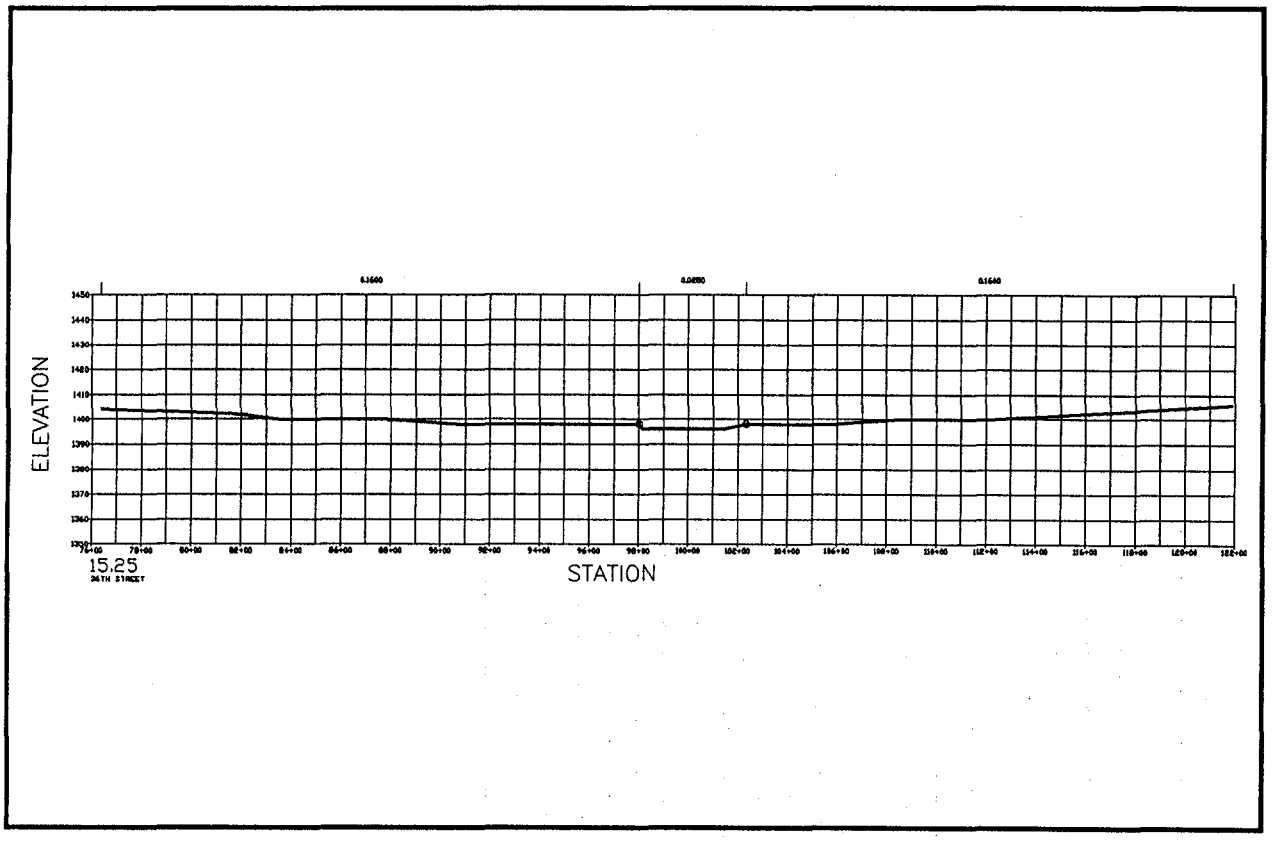

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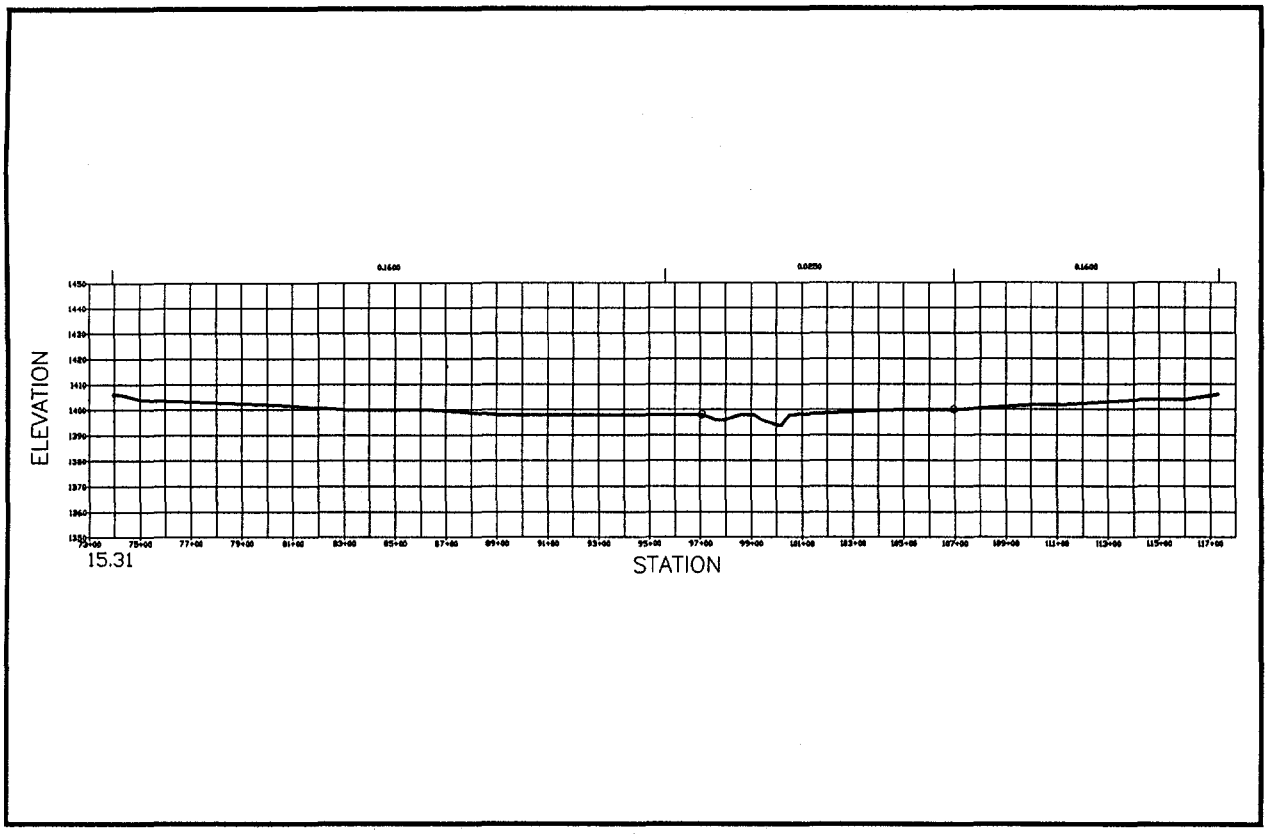

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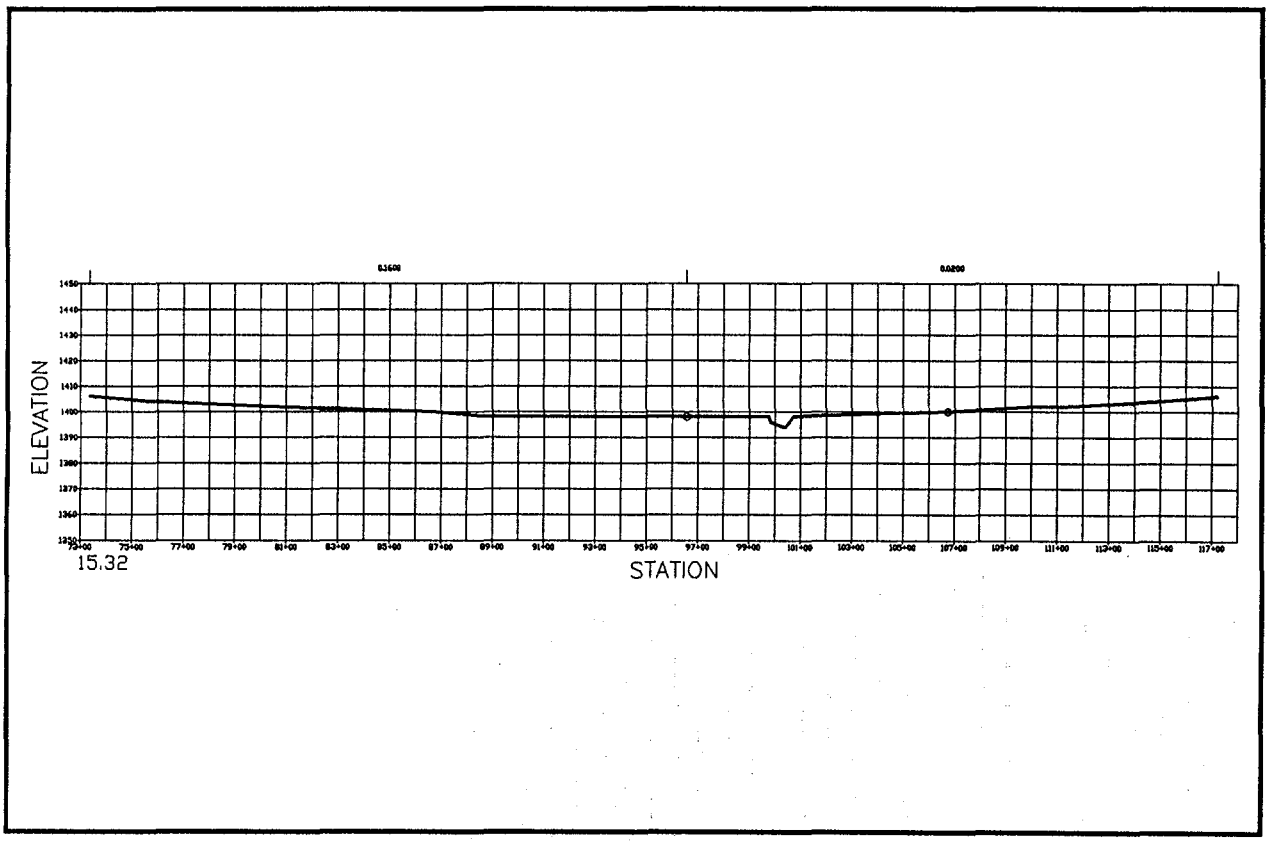

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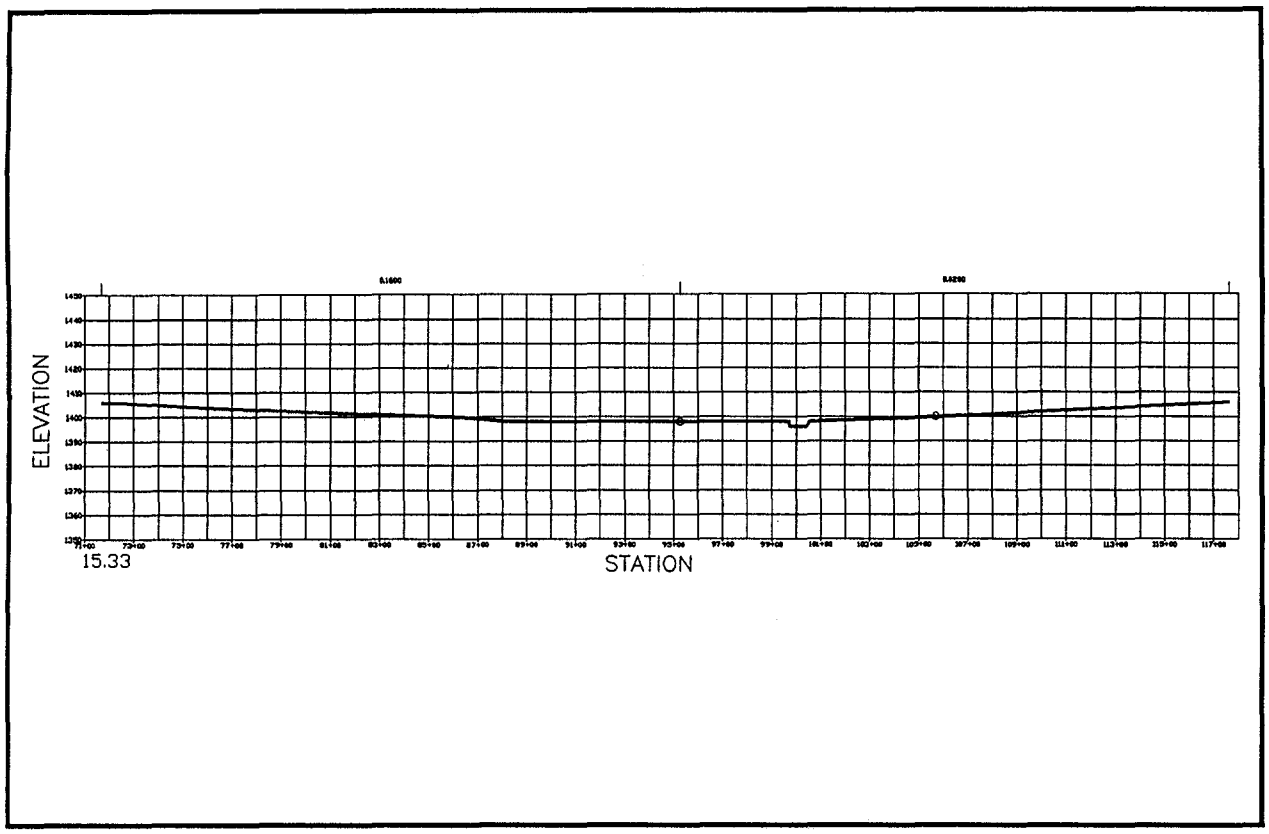

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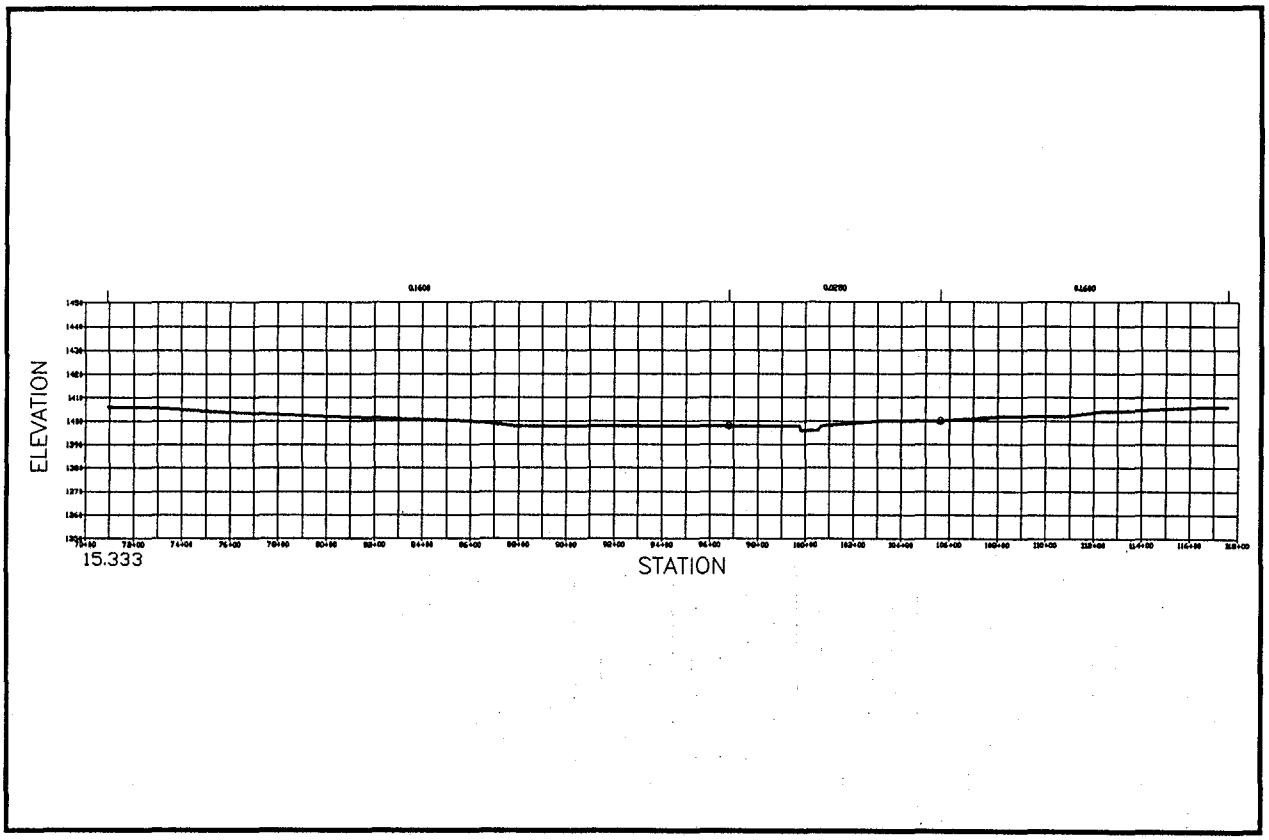

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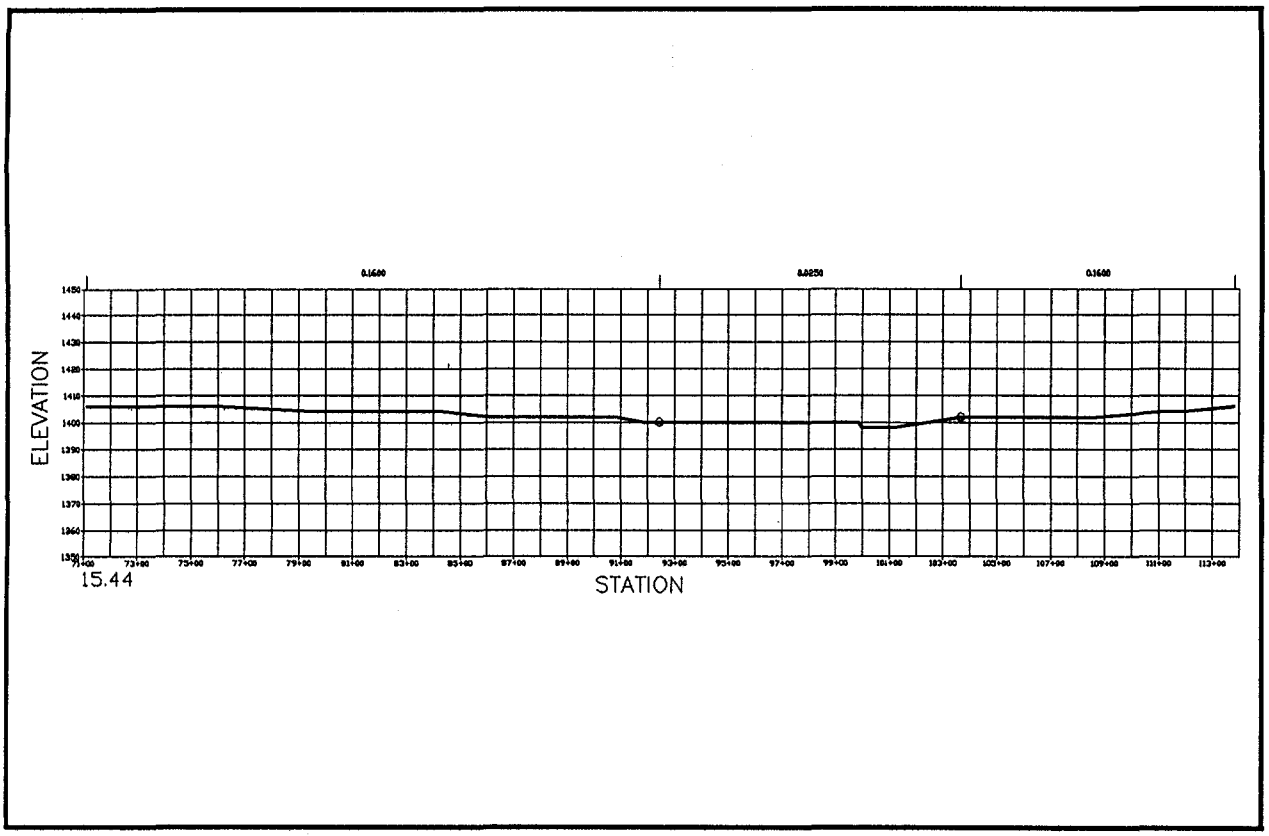

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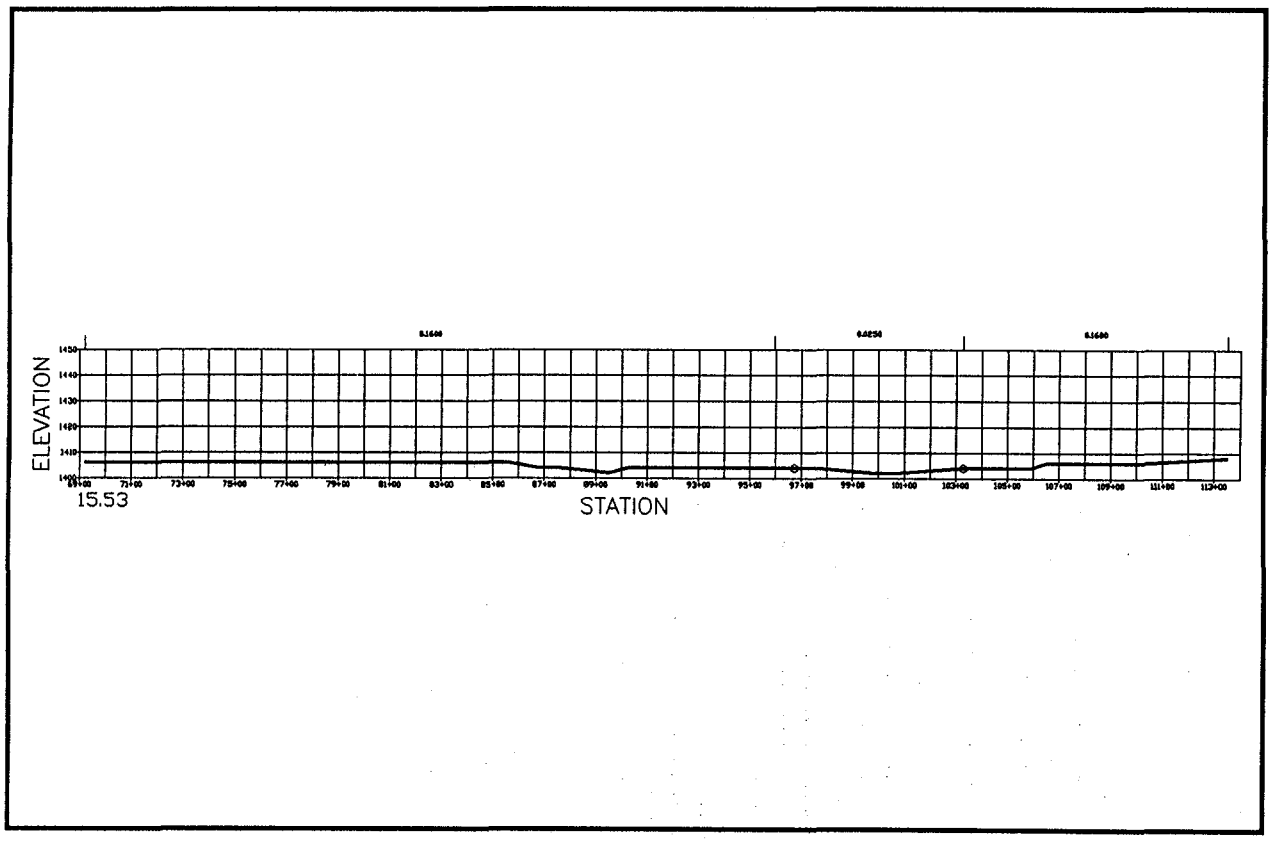

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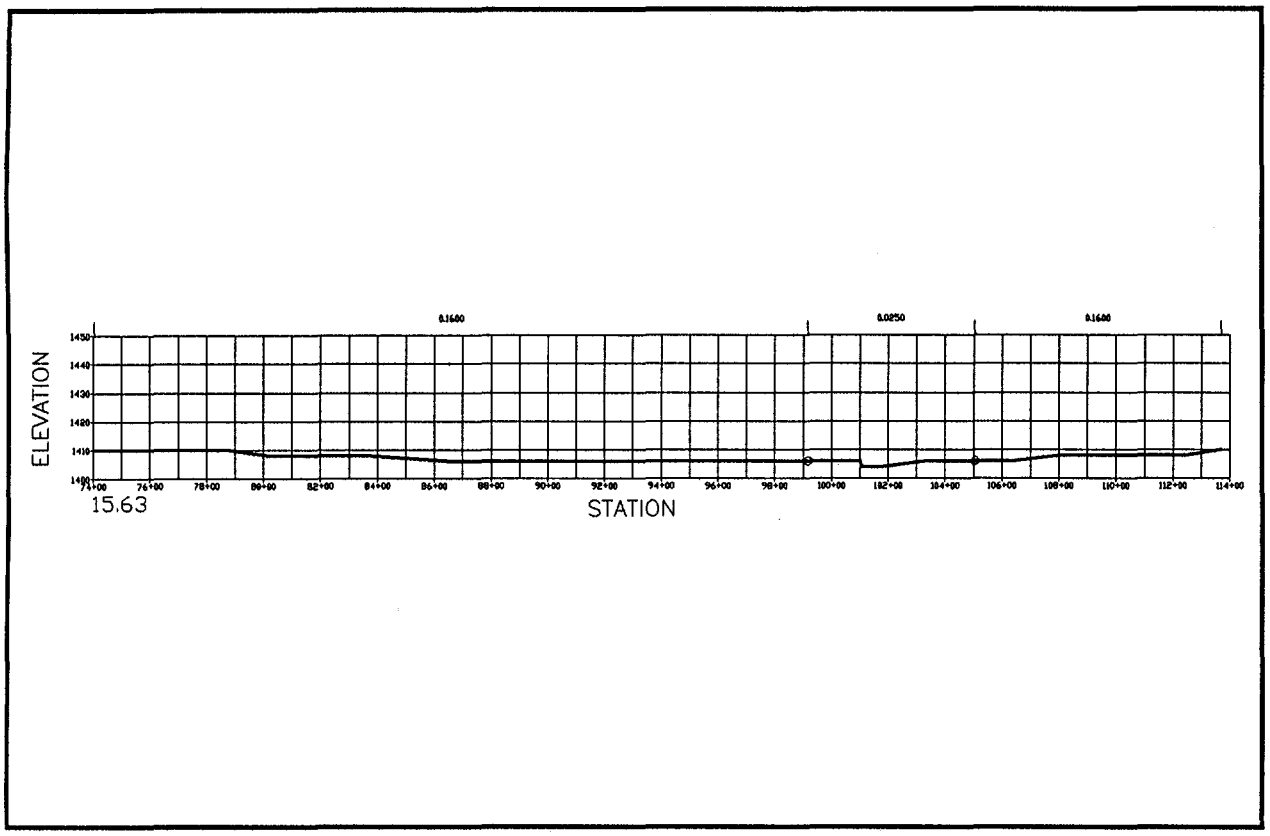

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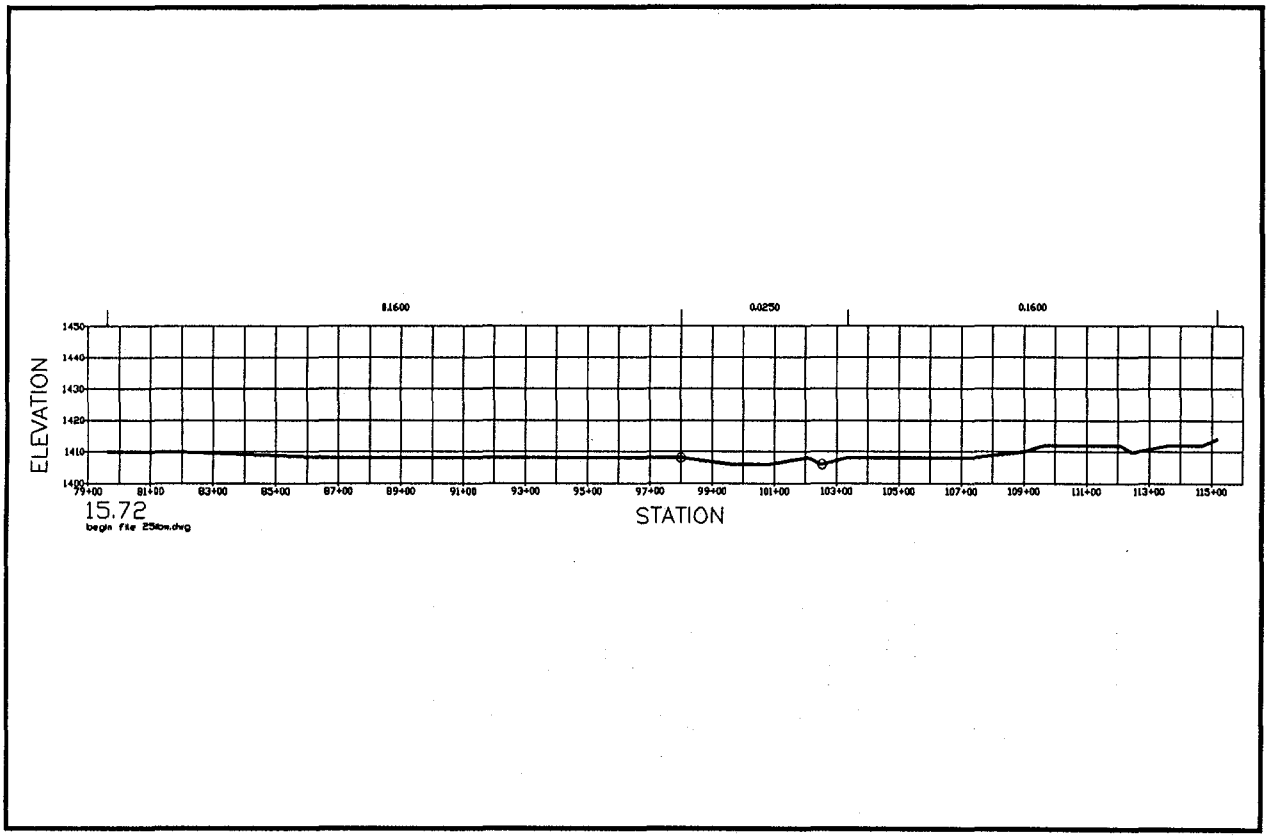

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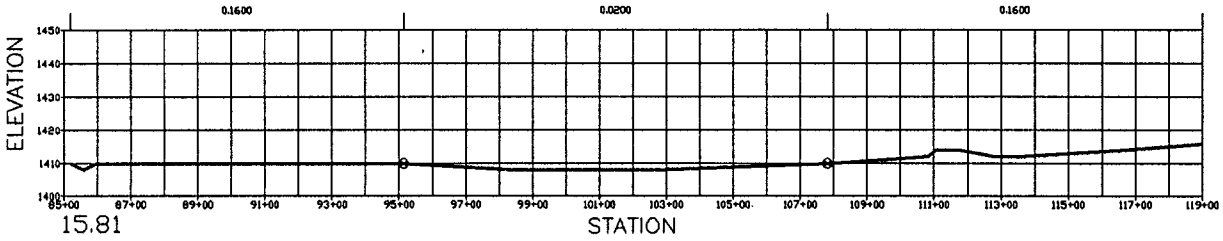

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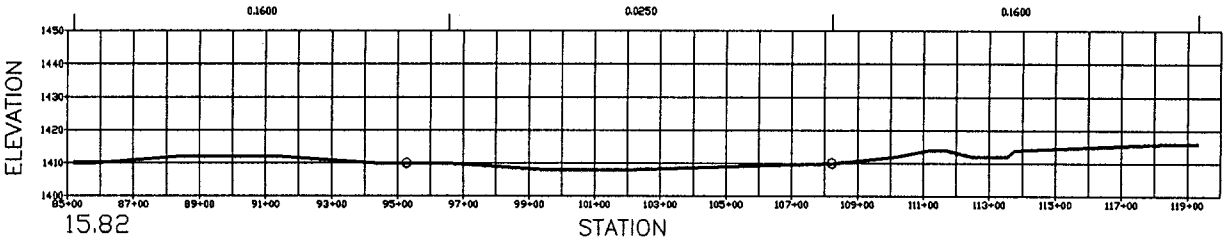

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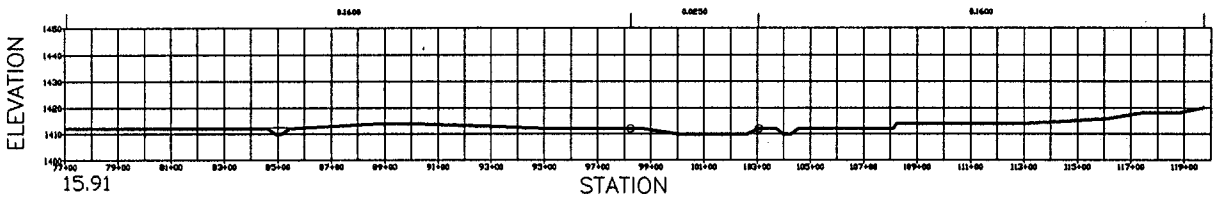

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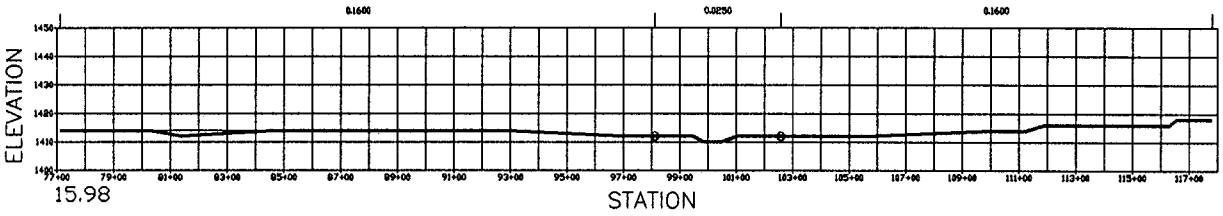

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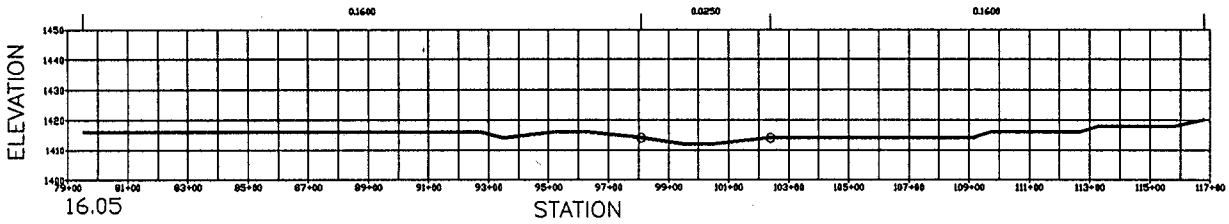

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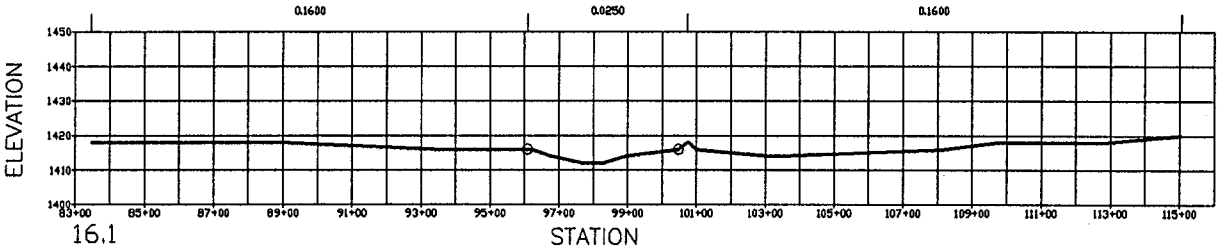

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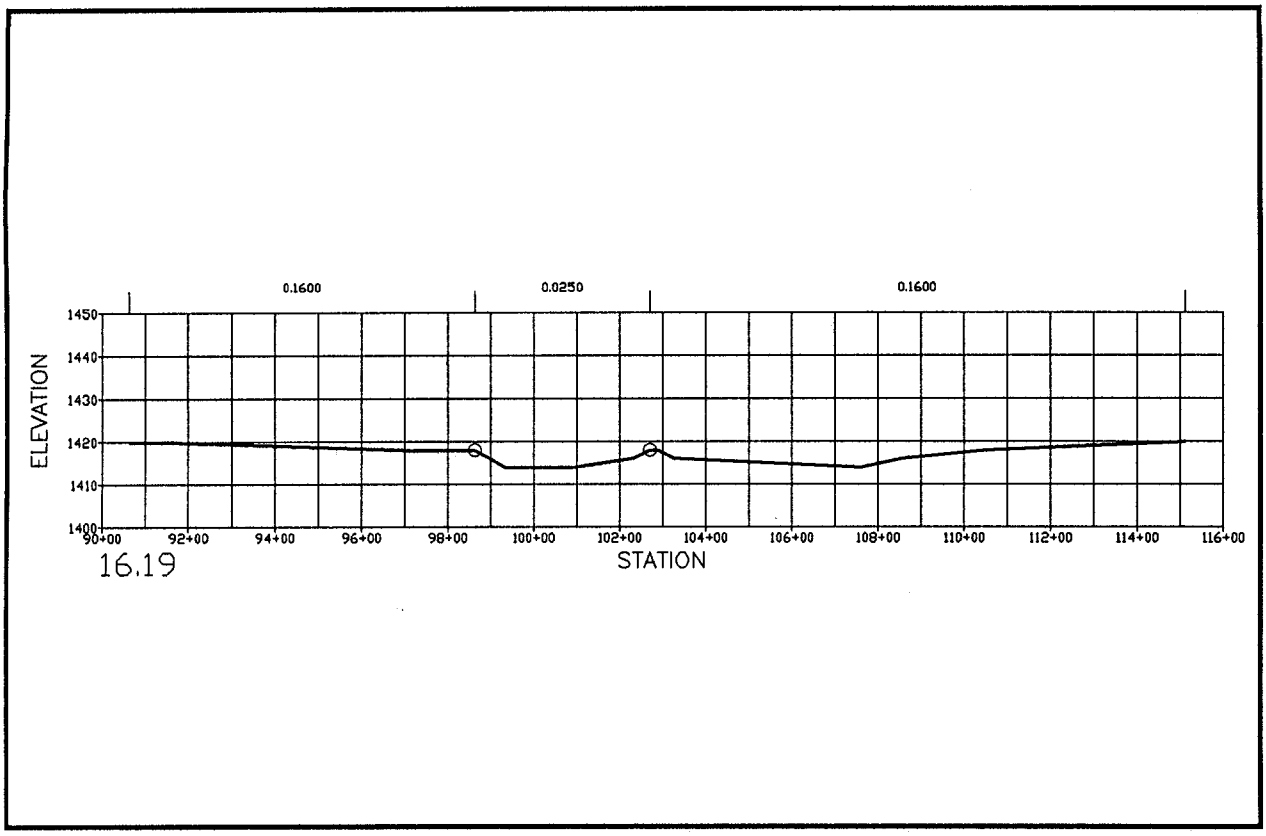

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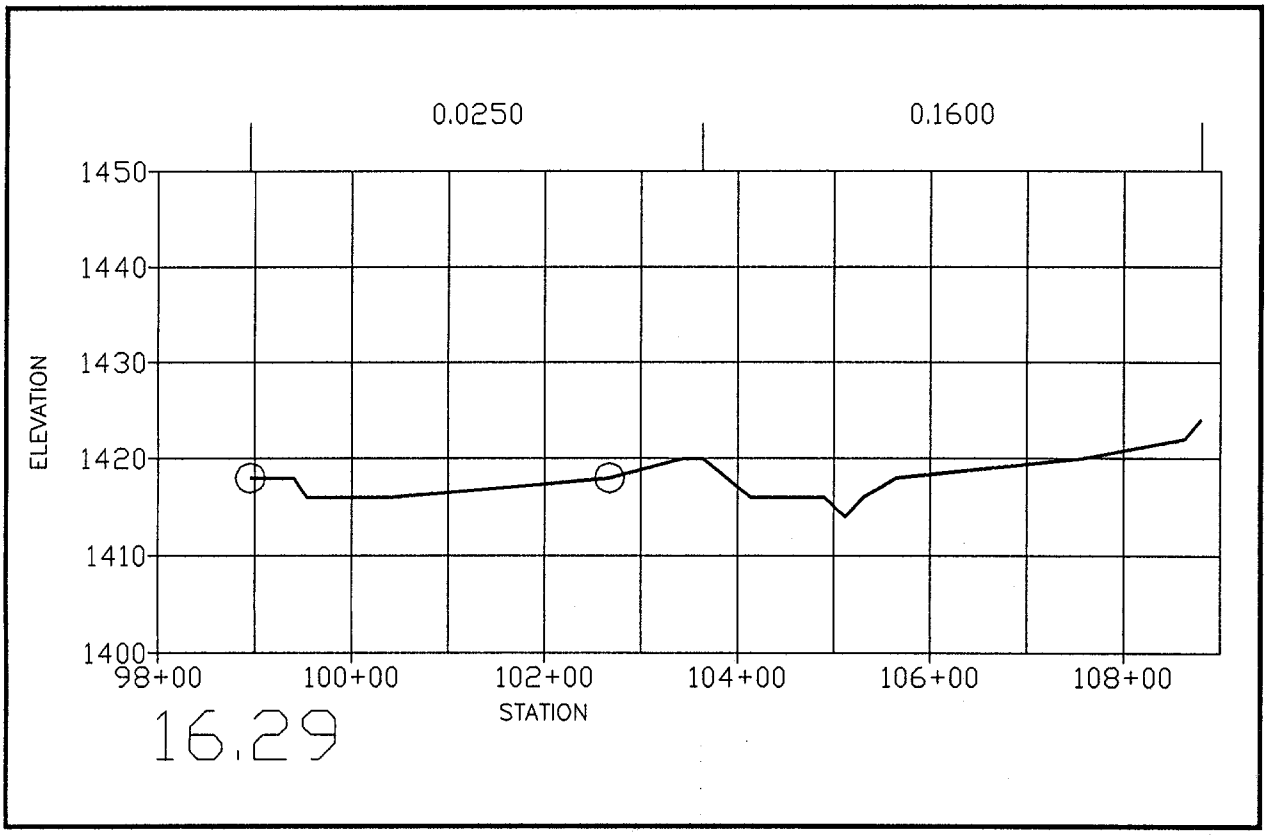

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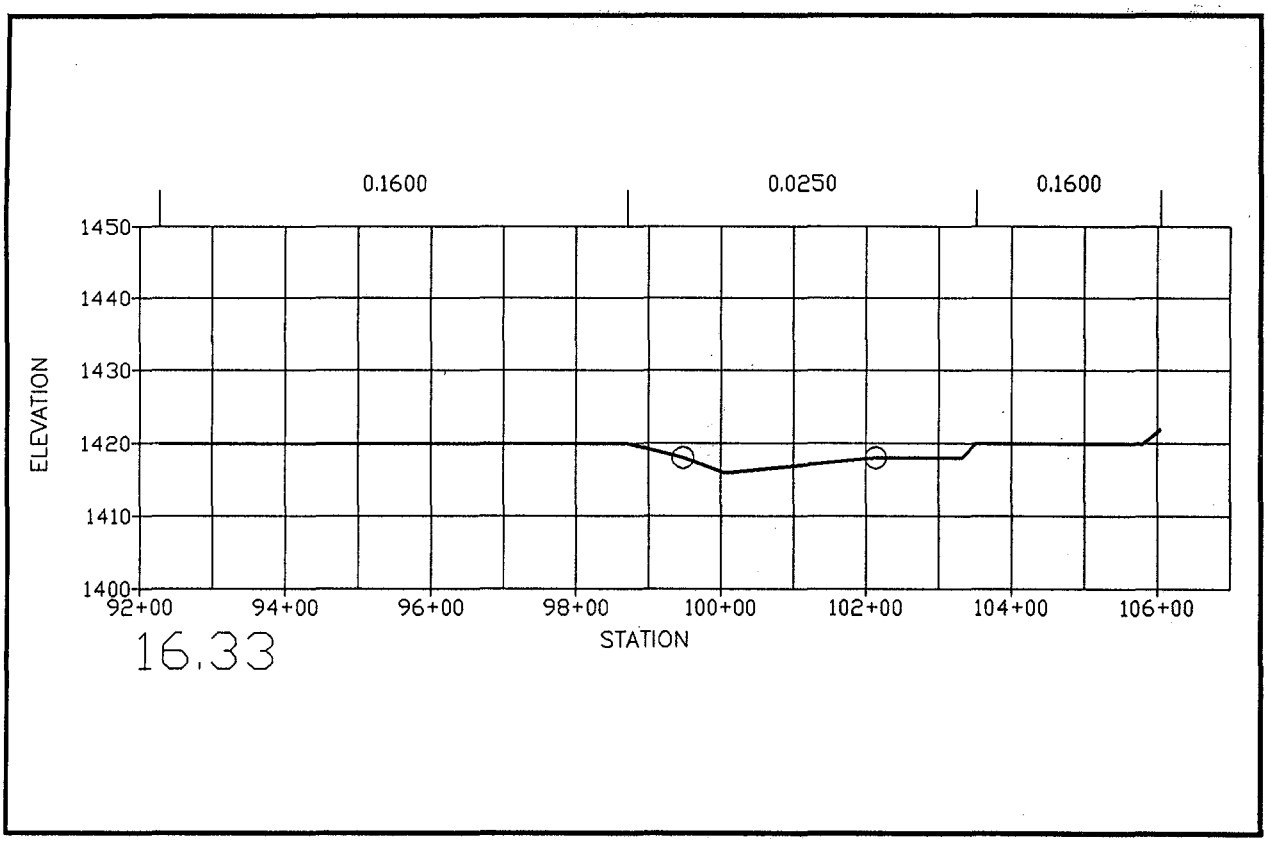

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