FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY

FOUNTAIN HILLS SOUTH FLOODPLAIN DELINEATION STUDY

FCD 92-05

TECHNICAL DATA NOTEBOOK HYDRAULICS

VOLUME 1 OF 2

FEBRUARY 1996
Revised November 1996

Prepared by

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FOUNTAIN HILLS SOUTH
FLOODPLAIN DELINEATION STUDY
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TECHNICAL DATA NOTEBOOK
HYDRAULICS

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VOLUME 2 OF 2

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G. Floodplain and Floodway Maps (Reduced Size)
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PREFACE

The Fountain Hills South Floodplain Delineation Study (Contract No. FCD 92-05) was performed for:

Flood Control District of Maricopa County
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Phoenix, Arizona 85009
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FOUNTAIN HILLS SOUTH
FLOODPLAIN DELINEATION STUDY

FCD 92-05

TECHNICAL DATA NOTEBOOK

HYDRAULICS

INTRODUCTION

The hydraulic analysis presented in this report is for the following washes and tributaries within the south portion of the incorporated area of the Town of Fountain Hills.

WASHES	TRIBUTARIES
Powder Wash	None
Cereus Wash	Chukar Wash Logan Wash
Cyprus Point Wash	None
Jacklin Wash	Kingstree Wash Mangrum Drain
Emerald Wash	None
Malta Drain	None
Colony Wash	Sycamore Wash Greystone Wash Sunburst Wash North Colony Wash Fountain Channel
Laser Drain	None

The hydraulic analysis for Laser Drain was performed for the Flood Control District of Maricopa County (District) under Contract FCD 94-16, of which AGK Engineers, Inc. was subconsultant to George V. Sabol Consulting Engineers. The work for the rest of the washes and tributaries was performed by AGK Engineers, Inc. for the District under Contract FCD 92-05.

The study area and its associated watershed is located at the Town of Fountain Hills, within Sections 14, 15, 16, 17, 20, 21, 22, 23, 26, 27, and 28, Township 3 North, Range 6 East, Gila and Salt River Base and Meridian, Maricopa County, Arizona. (See Figure 1)

The Town of Fountain Hills is an incorporated community with a population of approximately 20,000 people. The Town is surrounded by the McDowell Mountains on the west, Fort McDowell Indian Community on the north and east, and the Salt River Pima Maricopa Indian Community on the south. Topography of the study area is generally desert hill slopes in various phases of urbanization.

The study watershed is approximately 7.6 square miles, with a general drainage direction from west to east toward the Verde River. Washes in the study area are characterized as well defined channels with steep banks and grades. However, the natural drainage pattern of the study area has been somewhat altered since the development of this community in the early 1970's. In addition, roadway and culvert construction in conjunction with urbanization have greatly affected runoff peak discharges throughout the study area.

Climate of the study area is characterized by hot summer, mild winter and infrequent rainfall. The mean annual rainfall is about 8.5 inches, falling normally in two seasons. One season, primarily resulting from local convective storms, lasts from July to mid-September; the other season, mainly formed by cyclonic (frontal) storms, extends from December through March. Of the two types of storms, the summer convective storm is considered to be the more critical flood producing event in this area.

In the early 1970's when urban development commenced in Fountain Hills, a master drainage study was performed by Trico International, Inc. to quantify flows in the study area. However, the assumptions, methodology and procedures used in that study are incompatible with the current criteria set forth by the District and the Federal Emergency Management Agency (FEMA).

As the urbanization progress continued, numerous localized drainage studies have been prepared by various consultants and developers. Nevertheless, it does not appear that any of the previous studies has been specifically performed or used for floodplain delineation purposes in the study area. Due to the differing methodology used in the preparation of these studies and the alteration of development schemes in some areas, few of the results could be reused in this study.

Fountain Hills South Floodplain Delineation

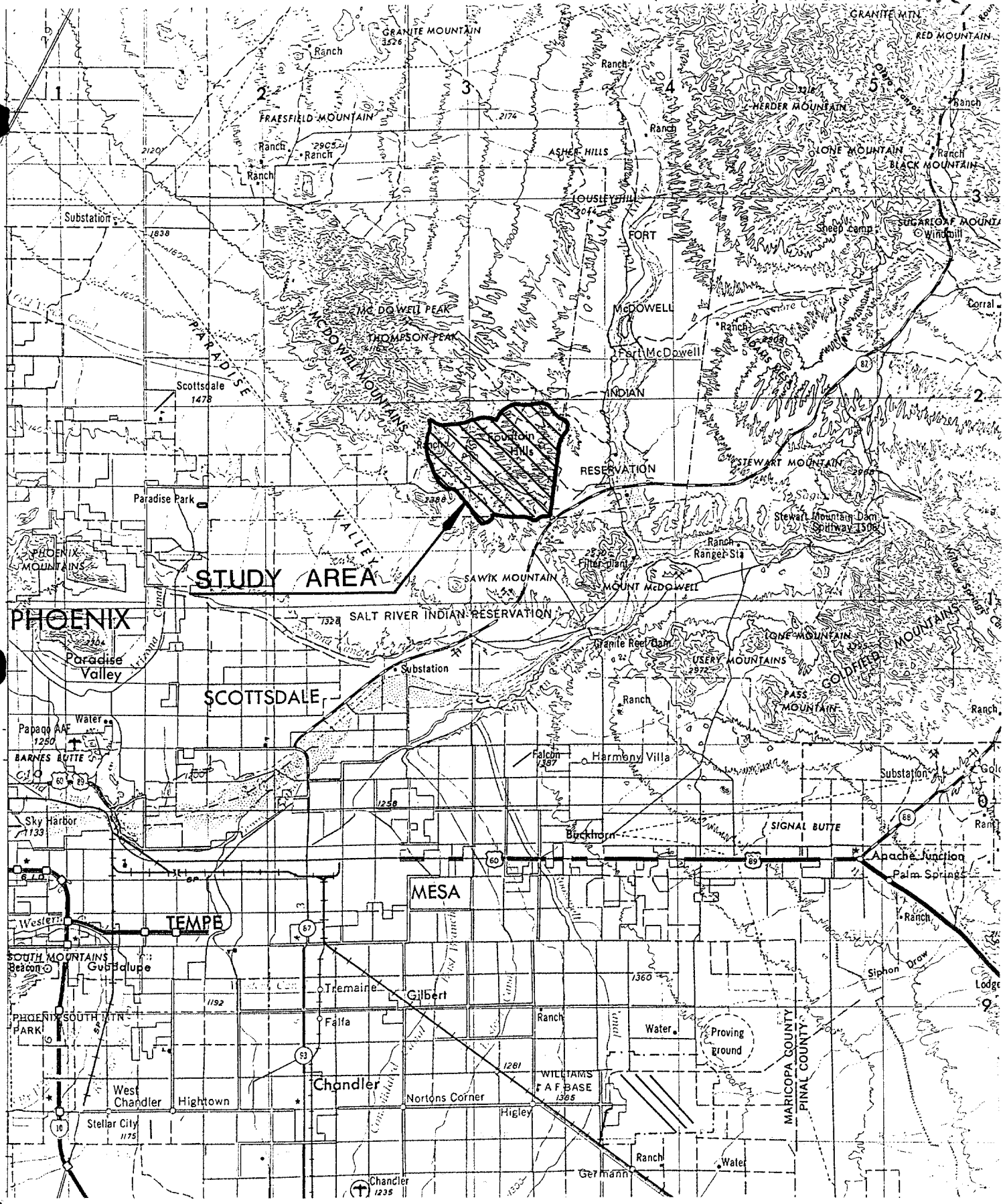

FIGURE 1

VICINITY MAP

SECTION 1: GENERAL DOCUMENTATION AND CORRESPONDENCE

The entire contents of this section are found in **Section 1** of *Fountain Hills South Floodplain Delineation Study, Technical Data Notebook, Hydrology.*

SECTION 2: MAPPING AND SURVEY INFORMATION

2.1 Topographic Mapping

Topographic mapping for the study area within the Town limits was furnished by the District. The base mapping has a scale of 1" = 200' with a contour interval of 2 feet. It was prepared by Kenney Aerial Mapping, Inc. in 1991 under a subcontract with Anderson-Nelson, Inc. who was under contract with the Town of Fountain Hills. Horizontal and vertical controls were set by Anderson-Nelson, Inc.

The base mapping was prepared using a Digital Terrain Model (DTM), based on grid spot elevations using a 75-foot interval, and break lines defining wash flowlines and ridges. Reproducible mylars and digital drawings in Auto CAD format were provided by the District.

The mapping covered Sections 14, 15, 16, 17, 20, 21, 22, 23, 26, 27, and 28, Township 3 North, Range 6 East, Gila and Salt River Base and Meridian, Maricopa County, Arizona.

Topographic information for watershed outside the base mapping area was obtained from the United States Geological Survey (USGS) 7.5 minutes quadrangle maps.

2.2 Survey

Field survey was performed by Valco Surveying Corporation, a subconsultant to AGK Engineers, to provide supplemental topographic information as needed for this project. The horizontal and vertical controls used in field survey were compatible to what were used in the base mapping.

2.3 Survey Field Notes

The Elevation Reference Marks (ERMs) are presented in **Appendix A**. Copies of survey field notes are included in **Appendix B**.

2.4 Watershed Maps

Refer to **Section 3**.

2.5 Hydraulic Analysis Maps

The Floodplain and Floodway Maps as well as their index are presented in **Appendix G** in reduced scale. Full size copies are bound separately from this report.

2.6 Draft FIRM Maps

Full size copies of the draft Flood Insurance Rate Maps (FIRM) are bound separately from this report.

2.7 Community Maps

The community street layout is shown on the Floodplain and Floodway Maps.

SECTION 3: HYDROLOGIC ANALYSIS

The entire contents of this section are found in **Section 3** of *Fountain Hills South Floodplain Delineation Study, Technical Data Notebook, Hydrology."*

SECTION 4: HYDRAULIC ANALYSIS

4.1 Method Description

The floodplains are analyzed using ProHEC2. ProHEC2 is an enhancement of version 4.6.2 of the standard Corps of Engineers program. This enhanced version was developed by Dodson and Associates, June 1992 and provides utilities that allows for plotting of HEC-2 data using AutoCAD.

Cross sections were digitized from the topographic mapping as discussed in Section 2.1. Dimensions and elevations of hydraulic structures such as culverts and catch basins were obtained from field survey. Ground elevations at some selected locations that required more detailed information were also determined from field survey. In addition, a minimum of ten (10) percent of the digitized cross sections were field verified. Results of the verification are presented in **Appendix B.** Elevations used in this study were based on the NGVD 1929 datum.

Starting water surface elevations for the flooding sources at the downstream limit of the study were obtained by the slope-area or critical depth options of the HEC-2 computer program. The same methods were used for the tributaries since the times of concentration for the contributing drainage areas are significantly different from the main channel. Results of the HEC-2 runs for all study reaches are presented in **Appendix E**. The flood profiles are included in **Appendix F**.

4.2 Parameters Estimation

4.2.1 Manning's n Value

4.2.1.1 Introduction

There are 8 separate washes and 16 tributaries contained within the study area and approximately 20 miles of floodplain to be delineated under this project. The washes were divided into reaches of similar hydraulic characteristics and Manning's n values. Each reach was identified by four-character identifier. The first three represent the name of the wash, and the fourth is the reach number. For example, CER2 denotes Cereus Wash, Reach 2. The reach number starts with "1" at the downstream end and increases in the upstream direction.

The limits, location of photographs and n values for each reach are shown on **Plate 1** entitled, "Manning's n Value Map." In calculating the n Value, the following factors were considered:

Bed material particle size
Degree of irregularity of bank slopes
Effect of obstructions
Degree of meandering
Vegetation

The density and type of vegetation have a significant impact on the roughness coefficient (n value). The vegetation within the floodplain were identified as follows:

Brittle Brush
Cactus - Barrel, Cholla, Prickly Pear, Saguaro
Canyon Ragweed
Catclaw
Cottonwood Tree
Creosote brush
Desert Broom
Desert Hackberry
Desert Willow
Grayhorn
Ironwood
Mesquite
Native Grasses
Ocotillo
Palm Tree
Palo Verde Tree
Seep Willow
Triangle Leaf Bursage

4.2.1.2 Methodology

Each reach was identified based on the 1" = 100' aerial photographs. The discerning characteristics were: channel size, vegetation density, and bed materials. Each reach was photographed during the field

reconnaissance at a representative and accessible location. The photography locations are summarized on **Plate 1**.

Manning's roughness coefficients were determined in accordance with the methodology described in *Estimated Manning's Roughness Coefficient for Stream Channels and Floodplain in Maricopa County, Arizona* (USGS, Water Resources Division, April 1991). The method described in this publication selects a base value for the roughness coefficient based exclusively on bed material. This value is then adjusted to account for vegetation, irregularities, obstructions and cross-section variations. In addition, a multiplier can be applied to the adjusted n value if meandering of the reach is significant.

The base roughness coefficient in this study was selected based on the average particle size observed in the field. The typical average size of the bed material in the study area ranges from 0.08" to 2.5". For this range of bed material, the typical values of the roughness coefficient ranges from 0.028 to 0.035. For some of the reaches where the conveying channel is a golf course pathway or street, n values as low as 0.018 were used.

4.2.1.3 n Value Determination

The base values, adjustments and the adjusted values for the Manning's roughness coefficients are shown in **Appendix C**, along with the pictures used in determining these values.

4.2.2 Expansion and Contraction Coefficients

The expansion and contraction coefficients used in the HEC-2 model were determined from the *HEC-2 User's Manual.* For gradual transitions which include most reaches in this study, the contraction and expansion coefficients were set to be 0.1 and 0.3, respectively. At culvert locations where the change on cross sectional geometry is abrupt, the coefficients were set to be 0.3 for contraction and 0.5 for expansion. At locations where the cross sectional area changes significantly, a value of 0.2 and 0.4 were used for these coefficients.

4.3 Cross Section Description

4.3.1. Channel and Overbanks

Prior to obtaining GR records for exact locations, the channel bank stations were approximated by field observation. The stations were then determined with the aid of 1" = 100' aerial photographs. In general, the majority of the washes have a low-flow channel with significantly distinct hydraulic characteristics of those of the surrounding floodplain. The boundaries of the low-flow channel are clearly marked by change in slope, amount of vegetation and bed material. The plotted channel cross sections are presented in **Appendix D.**

4.3.2 Bridges and Constrictions

4.3.2.1 Minor Hydraulic Structures

There are no bridges within the study area. Culverts at roadway crossings comprise the constrictions in the floodplain. There are 33 culverts located within the study area. Culverts range from small 18" x 28" CMP-Arch to multiple barrel concrete boxes. Many of these culverts would be overtopped during a 100-year storm. In this study, all culverts were assumed to be able to withstand an overtopping event. Clogging of the culverts were not assumed in the analysis since no significant amount of debris was encountered during field reconnaissance. On Malta Drive, there are several small culverts that are designed for nuisance flows and are likely to clog during a large event. For floodplain delineation purposes, these culverts were ignored and cross sections along the roadway were used to determine the floodplain boundaries. Some of the culverts appear to have significant amount of storage upstream from the inlet. The effect of upstream storage was accounted for in the hydrology model (HEC-1) and reflected on the HEC-2 by reduced flows through the culvert.

4.3.2.2 Major Hydraulic Structures

There is a major hydraulic structure, namely Stoneridge Dam (Structure No. 19) within the study area. This dam was constructed in the 1970's and is regulated by the Arizona Department of Water Resources (ADWR). The structure was designed to pass the 100-year flow through the principal spillway (culvert) only. The emergency

spillway was designed to pass the ½ PMF. This structure is described in more detail under **Section 3** of this report.

4.4 Calibration

4.4.1 HEC-2 Model Calibration

Since gauging records are not available in the study area, results of the HEC-2 modeling was unable to be calibrated. However, the results were carefully examined and found to be reasonable.

4.4.2 Flow Split

The following five flow split locations were identified within the study area:

Cereus Wash culvert under Saguaro Boulevard. The roadway is overtopped at the existing culvert under Saguaro Boulevard, and the overtopping flow would travel west along Saguaro Boulevard to Laser Drain, where it would be conveyed back to Cereus Wash about 200-feet downstream from the culvert outlet. For modeling purposes, the flow was assumed to stay in the wash but the area between Cereus Wash and Laser Drain, as well as, between Saguaro Boulevard and the confluence of Cereus Wash with Laser Drain were depicted as Zone A.

Cyprus Point Wash culvert under Saguaro Boulevard. The catch basin at the inlet of the culvert under Saguaro Boulevard is not adequate to pass the 100-year flow. The structure was designed for overtopping and most of the overtopping flow would travel north along Saguaro Boulevard for about 800-feet to a low point on the road, then spill over the east side of the road and

re-enter Cyprus Point Wash downstream from the town limits. The flow conditions are further discussed in **Section 4.5 Special Problems**.

South side of Kingstree Boulevard. The south side of Kingstree Boulevard is not high enough to contain the 100-year flow and overtopping would occur. The split flow option of the HEC-2 program was used for modeling the floodplain of this wash. The spill flow from Kingstree was added to Mangrum Wash. A more detailed discussion of the flow conditions at this location is described in **Section 4.5 Special Problems**.

Kingstree Boulevard at Saguaro Boulevard. Most of the flow on Kingstree Boulevard would enter Jacklin Wash upstream from the culvert at Saguaro Boulevard. However, a portion of the flow may spillover Saguaro Boulevard and enter Jacklin Wash downstream from the culvert under Saguaro Boulevard. For modeling purposes, it was assumed that the entire flow entered the wash at the upstream end of the culvert but the floodplain of Kingstree Boulevard was extended to include the area of Saguaro Boulevard that may be inundated.

East side of Fountain Channel. Fountain channel does not have enough capacity to convey the 100-year flow and some of the flow would spill to the adjacent Fountain Lake. This condition is discussed in **Section 4.5 Special Problems**.

4.5 Special Problems

There are several locations that required detailed analysis to better understand the extent of flood flow conditions. The methodology used in the analysis is discussed below.

4.5.1 Powder Wash at Leo Drive

The detailed analysis of Powder Wash indicated that the culvert at Leo Drive has enough capacity to pass the 100-year flow without overtopping the road. During the field reconnaissance, water marks were observed on the road. These water marks appeared to be caused by local flows along Leo Drive, instead of by culvert overflow. Even though the analysis of local flows is not a part of the scope of this study, the road was included in the floodplain because flooding of this area is likely.

4.5.2 Cereus Wash at Saguaro Boulevard

The double 10' x 8' concrete box culvert do not have enough capacity to pass the 100-year flow. The excess flow (about 385 cfs) would spill over and travel west along Saguaro Boulevard to Laser Drain, and eventually would return to Cereus Wash about 200-feet downstream from the culvert outlet. The Manning's formula was used to determine the flow depth along Saguaro Boulevard. Since the flow depth was estimated to be approximately 1.5 feet, which is well above the top of roadway curb, the area bounded by Cereus Wash, Laser Drain and Saguaro Boulevard would be inundated during a 100-year flood. Therefore, this area was designated as Zone A on the Floodplain and Floodway Maps. Detailed calculations are included in **Appendix E**.

4.5.3 Cyprus Point Wash at Saguaro Boulevard

The catch basin at the inlet of the 48-inch CMP does not have enough capacity to pass the 100-year flow and 167 cfs would spill over the road. Most of the flow would travel north along Saguaro Boulevard and some would spill over the curbed island to the frontage road. The overflow was estimated by means of the weir formula (as shown in **Appendix E**). Since the estimated water surface elevation at the downstream end was approximately 1514, this elevation was used for the determination of Zone A limits. The house directly across the street from the catch basin were excluded from the Zone A because there is a wall along the east side of the frontage road in front of these houses.

4.5.4 Kingstree Boulevard at Saguaro Boulevard

See **Section 4.4.2 Split Flow**

4.5.5 Kingstree Drain

Kingstree Drain is a small earthen channel connecting Kingstree Boulevard with Mangrum Drain. At the time of the field reconnaissance, the inlet of the drain at Kingstree Boulevard was blocked by an earthen dyke. The geometry of the inlet was not available due to the blockage. A total of 300 cfs was assumed to flow from Kingstree Boulevard to the drain. This was considered a conservative estimate since the flow in Kingstree Boulevard at this point is only estimated to be 380 cfs. Limits of Zone A were determined with the aid of the HEC-2 computer program.

4.5.6 Kingstree Boulevard Floodplain Boundary

The south side of Kingstree Boulevard is not high enough to contain the 100-year flow and a portion of the flow would spill towards Jacklin Wash at several locations. Since the bank is man made and do not meet FEMA levee requirements, the boundary of floodplain along the south side of Kingstree Boulevard was assumed to coincide with the north floodway boundary of Jacklin Wash. The north floodplain boundary for Kingstree Boulevard was obtained assuming the existing geometry of the south side is maintained. The HEC-2 split flow option was used for determining the spill. Since it is difficult to establish the exact location where the spill flow would enter Jackling Wash, the entire 300-cfs were added to Mangrum Wash at Cross-Section 0.07. This is the highest point where the diverted flow may enter Jacklin Wash or its tributary.

4.5.7 Zone A at Confluence of Mangrum Drain and Jacklin Wash

According to the HEC-2 results, the confluence of Mangrum Drain and Jacklin Wash would not be inundated by the 100-year flow. In reality, however, flood water may be able to flow through this area from some low spots between the cross-sections. Therefore, this area was designated as Zone A on the Floodplain and Floodway Maps (See **Appendix G**).

4.5.8 North Colony Wash at Chama Drive

The 60-inches CMP under Chama Drive does not have enough capacity to convey the 100-year flow without overtopping the road. Approximately 90 cfs would spill over and flow southwesterly along Chama Drive, and then southward along Arroyo Vista Drive until it enters Colony Wash at Cross-

Section 3.65. The flow depth of the split flow was calculated to be approximately 6 inches. For detail calculations, see **Appendix E**.

4.5.9 South Side of Malta Drain

According to the HEC-2 results, the south side of Malta Drain would not be inundated by the 100-year flow. However, flow once entering the south roadside ditch would not be able to return to the north side of roadway. Therefore, this area was depicted as a Community Designated Special Hazard. This area includes Malta Drive itself and a part of the house at the southeast corner of Malta Drive and Ram Drive. This house, according to city officials, has experienced some flooding in the past before the lining of Malta Drain.

4.5.10 Spill from Fountain Channel into Fountain Lake

According to the hydraulic analysis, Fountain Channel does not have sufficient capacity to carry the entire 100-year flow. Therefore, a portion of the flow would spill over the channel bank and discharge into Fountain Lake. The amount of flow entering the lake was determined by use of the HEC-1 computer program. The diversion table for the HEC-1 diversion cards was generated using the multiple profile and split flow options contained in the HEC-2 program. The increase of lake surface elevation due to the spill flow and other inflows was estimated to be 0.37 foot. Since the maximum operational surface of the lake is one (1) foot below the spillway crest, no spillage is expected from the lake. The detailed calculations are shown in **Appendix E**.

4.6 Floodway Modeling

The washes within the study area generally have steep banks, with the 100-year floodplain contained within the banks, as depicted on the individual cross-section plots in **Appendix D**. Each wash is within a platted drainage easement. For these reasons, and for floodplain management purposes, the floodplain will be regulated as floodway. Therefore, all washes shown on the Floodway and Floodplain Maps (**Appendix G**) have a floodplain coincident with floodway. The floodway data for all study washes are included in **Appendix H** of this report.

4.7 Final Results/Computer Model

The final printout of the HEC-2 output files are included in **Appendix E**. The three letter tabs represent an abbreviation of the wash name. The HEC-2 output files are presented in an order based on the wash location from south to north. The tributaries are presented after the main wash from downstream to upstream.

4.8 Computer Model Diskette

The computer diskette included with this report contains all the HEC-2 files generated in this study. This file contains the information used to generate the floodway/floodplain maps and the output printouts presented in **Appendix E** . The diskette is located in a plastic pocket at the back of this report.

SECTION 5: EROSION/SEDIMENT TRANSPORT ANALYSIS

Erosion/sediment transport analysis is not a part of this study.

SECTION 6: REFERENCE MATERIALS

6.1 Other Published Flood Studies

There are no significant published flood studies of record other than those listed under **Section 6.6** of this report.

6.2 Previous FEMA Studies

There are no previous FEMA studies for the study watershed.

6.3 Other Applicable Studies

There are several previous studies of portions of the study area. Refer to **Sections 6.5 and 6.6.**

6.4 Published and Unpublished Historical Flood Information

There is no significant historical flood information of record for this watershed.

6.5 Bibliography

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2. Arizona Department of Water Resources, Engineering Division, Flood Management Section, December 1991. *Requirement for Floodplain Delineation in Riverine Environments.*

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7. Federal Emergency Management Agency, March, 1991. *FEMA 37, Flood Insurance Study Guidelines and Specifications for Study Contractors.*

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9. Flood Control District of Maricopa County, September, 1992. *Drainage Design Manual for Maricopa County, Volume II, Hydraulics.*

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11. U.S. Department of Transportation, September 1985. *Hydraulic Design of Highway Culverts, Hydraulic Design Series No. 5*, FHWA Report No. 1-P-85-15.

12. U.S. Geological Survey, 1991. *Manning's Roughness Coefficients for Stream Channels and Floodplains in Maricopa County, Arizona.*

6.6 Applicable Improvement Plans, Maps and Related Documents

1. Town of Fountain Hills, 1993, *Plat Map, Scale 1" = 800'*

2. Town of Fountain Hills, Arizona, Engineering Department, 1992, *Street Paving Project, East of Fountain Hills Boulevard.*

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19. Standage & Associates Consulting Engineers, 1992, *Drainage Report for Morningside A-L Lakeside Village, Unit two, Fountain Hills, Arizona.*

20. Thomas-Hartig & Associates, Inc., 1988, *Earth Embankment Lake 17 Summit East Golf Course, Fountain Hills, Arizona.*

21. Verno Swabach Associates, 1992, *Fountain Hills Land Use Element - General Plan.*

22. Carter and Associates, Inc., Undated, *Palisades Boulevard Paving Plans, Scale 1" = 40'.*

23. Arizona Department of Transportation, Highway Division, Maricopa County, 1988, *RS-362 (0) P, Shea Boulevard As-builts.*

SECTION 7: CROSS-REFERENCING AND LABELING INFORMATION

Cross-referencing and labeling information are not a part of this report.

SECTION 8: FLOOD INSURANCE STUDY REPORT

See **Appendix H**

APPENDIX A

ELEVATION REFERENCE MARKS

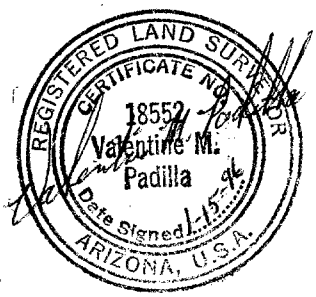
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY

FOUNTAIN HILLS SOUTH FLOODPLAIN DELINEATION STUDY

FCD 92-05

ELEVATION REFERENCE MARKS (ERM)

JANUARY 1996



Prepared by

Valco Surveying Corporation
6426 East Virginia Avenue
Scottsdale, Arizona 85257
(602) 990-2412

ELEVATION REFERENCE MARKS (EMR)
FOUNTAIN HILLS SOUTH PLOODPLAIN DELINEATION STUDY

ID Number	Elevation (ft)	Description
1	1591.21	Top of Brass Cap, at intersection of Last Trail Drive and Saguaro Boulevard, being in the Southeast 1/4 of Section 27, Township 3 North, Range 6 East.
2	1619.95	Top of Brass Cap, at intersection of Leo Drive and Saguaro Boulevard, being in the Southwest 1/4 of Section 27, Township 3 North, Range 6 East.
3	1659.58	Top of Brass Cap at a point of curvature of center line of Powderhorn Drive, 180 feet East of center line of Powder Wash and 600 feet Southeast of Tombstone Drive, being in the Southwest 1/4 of Section 27, Township 3 North, Range 6 East.
4	1550.10	Top of Brass Cap, at intersection of Firebrick Drive and Last Trail Drive, being in the Southwest 1/4 of Section 26, Township 3 North, Range 6 East.
5	1656.11	Top of Brass Cap, at intersection of Laser Drain and Saguaro Boulevard, being in the Southwest 1/4 of Section 26, Township 3 North, Range 6 East.
6	1730.16	Top of Boat Spike at intersection of Nicklaus Drive and Keota Drive, at North 1/4 Section corner of Section 27, Township 3 North, Range 6 East.
7	1782.62	Top of Brass Cap at intersection of Kingstree Boulevard and Keota Drive, being in the Southwest 1/4 of Section 22 Township 3 North, Range 6 East.
8	1772.76	Top of Boat Spike at intersection of Pinto Drive and Fountain Hills Boulevard, being in the Southeast 1/4 of Section 21, Township 3 North, Range 6 East.

ELEVATION REFERENCE MARKS (EMR)
FOUNTAIN HILLS SOUTH PLOODPLAIN DELINEATION STUDY

ID Number	Elevation (ft)	Description
9	1551.77	Top of Boat Spike at intersection of Montery Drive and Rough Circle, being in the Northwest 1/4 of Section 26, Township 3 North, Range 6 East.
10	1564.01	Top of Brass Cap at intersection of Indian Wells Drive and Armour Court, being in the Southwest 1/4 of Section 23, Township 3 North, Range 6 East.
11	1643.42	Top of Boat Spike at a point of curvature of center line of Nicklaus Drive, 200 feet West of Indian Wells, being at the Northeast corner of Section 27, Township 3 North, Range 6 East.
12	1704.96	Top of Boat Spike at intersection Nicklaus Drive and Nelson Drive, being in the Northeast 1/4 of Section 27, Township 3 North, Range 6 East.
13	1710.57	Top of Brass Cap at intersection of Emerald Drive and Baron Drive, being in the Southeast 1/4 of Section 22, Township 3 North, Range 6 East.
14	1727.68	Top of Boat Spike at intersection of Emerald Drive and Fountain Hills Boulevard, being in the Southwest 1/4 of Section 22, Township 3 North, Range 6 East.
15	1631.57	Top of Boat Spike at intersection of Chama Drive and Arroyo Vista Drive, being in the Southeast 1/4 of Section 15, Township 3 North, Range 6 East.
16	1663.65	Top of Boat Spike at intersection of Chama Drive and Fountain Hill Boulevard, being in the Northwest 1/4 of Section 22, Township 3 North, Range 6 East.
17	1714.61	Top of Brass Cap at intersection of Sycamore Drive and Greystone Drive, being in the Northeast 1/4 of Section 21, Township 3 North, Range 6 East.

ELEVATION REFERENCE MARKS (EMR)
FOUNTAIN HILLS SOUTH PLOODPLAIN DELINEATION STUDY

ID Number	Elevation (ft)	Description
18	1742.56	Top of Brass Cap south of point of curvature of Sycamore Drive, 440 feet south of Sunburst Drive, being in the Northeast 1/4 of Section 21, Township 3 North, Range 6 East.
19	1537.91	Top of Boat Spike at intersection of Malta Drive and Parlin Drive, being in the Northeast 1/4 of Section 23, Township 3 North, Range 6 East.
20	1564.81	Top of Brass Cap at center line of Malta Drive, 50 feet East of Quinto Drive, being in the Northwest 1/4 of Section 23, Township 3 North, Range 6 East.
21	1542.14	Top of Brass Cap at intersection of Tioga Drive and Tower Drive, being in the Northeast 1/4 of Section 23 Township 3 North, Range 6 East.
22	1560.08	Top of Brass Cap at intersection of Panorama Drive and Tioga Drive, being in the Northwest 1/4 of Section 23, Township 3 North, Range 6 East.
23	1570.29	Top of Brass Cap at intersection of El Lago Boulevard and Teal Drive, being in the Southwest 1/4 of Section 14, Township 3 North, Range 6 East.
24	1648.97	Top of Boat Spike at intersection of Chama Drive and Gunsight Drive, being in the Southeast 1/4 of Section 15, Township 3 North, Range 6 East.

APPENDIX B

SURVEY FIELD NOTES AND CROSS SECTION VERIFICATIONS

Valco Surveying Corporation

AERIAL CONTROL · MAPPING · LAND SURVEYS
CONSTRUCTION STAKING · MBE/DBE CERTIFIED

602-990-2412

FOUNTAIN HILLS FLOODPLAIN DELINATION STUDY, SOUTH

CONTRACT FCD 92-05

LEVELS FOR VERTICAL CONTROL AND ADJUSTED LEVEL RUNS

REGISTERED LAND SURVEYOR
CERTIFICATE NO. 18552
Valentine M. Padilla
Date Signed 9-30-95
ARIZONA, U.S.A.

INDEX PAGE

JOB NO.	PROJECT	PAGE NUMBER
	Fountain Hills - Flood Study	

Fountain Hills
Flood Study

NGK Engr's 310.43

Vaka's # 01N-010

Levels For Vertical Control Check

Note: Beginning Bench Mark
Provided per Letter Dated Aug. 24, 1992
from Don N. Anderson, P.E., L.S. to Tim Murphy
F.C.D.M.C.
B. of P. Rds brass disk set in concrete on top of a
band at the N.W. Cor. of the Intr. Shea Blvd. &
Bee Line HWY. Disk is stamped "1543.72; 986+15.0
AH 986+08.20/1965". And revised to 1542.457 = (-1.2
Instr. - Nikon DMI - Total Station
Level - Pentax Rod - Philly

Feb. 10, 93
Cloudy & Windy

P.C. - Jim Archibald
π - N. Tenorado
φ - P. Oaton

①	+	HI	−	ELEV	2/26/93 Adjusted Elev.
A-1				1542.457	1543.63
	0.07	1542.53			
A-2			8.88	1533.65	1534.82
	10.72	1544.37			
A3			0.54	1543.83	1545.09
	3.06	1546.89			
A-4			13.56	1533.33	1534.50
	5.27	1538.60			
A-5			0.94	1537.66	1538.83
	18.39	1556.05			
A-6			0.54	1555.51	1556.68
	18.47	1573.98			
A-7			0.42	1573.56	1574.73
	16.80	1590.36			
A-8			0.28	1590.08	1591.25
	0.58	1590.66			
A-9			18.40	1572.26	1573.43
	0.78	1573.04			
A-10			18.81	1554.23	1555.40
	1.12	1555.35			
A-11			18.75	1536.60	1537.77
	11.79	1548.39			
A-12			3.45	1544.74	1545.91

Fountain Hills Flood Study

②

Feb 17, 93 Descriptions

DISC STAMPED 986 + 15.05 "1543.72"
Revised Elev. 1542.457 (-1.26)
ON TOP OF GLO BC 0.42 ABOVE GRADE
SAME AS (1002) (1153 PT) NG ~~1535.55~~ 1534.40
ALUM CAP 2389-3 ADOT
PT (1000) Elev. Per ADOT PGM = 1544.97 (-1.14)

TP BRASS CAP ON RES FENCE LINE

TP TOP OF ROCK E. OF RES LINE

TP ROCK IN ROAD EAST OF RES LINE

TP ROCK IN ROAD EAST OF RES LINE

PANEL PT REBAR TRAV PT 1001

TP ROCK

TP ROCK

TP ROCK

HUB 1' EAST CURB LINE EAST SIDE
SAGUARO DRIVE 300' NORTH OF MONTEREY

(3)	+	HI	-	ELEV	2/24/93 Adjusted Elev's
A-12				1544.24	1545.91
	1.51	1546.25			
A-13			12.88	1233.37	1534.54
	2.27	1535.44			
A-14			12.80	1522.84	1524.00
	0.53	1523.37			
A-15			9.37	1514.00	1515.17
	13.48	1527.48			
A-16			2.97	1524.51	1525.68
	0.44	1524.95			
A-17			11.18	1513.77	1514.94
	9.23	1522.99			
A-18			6.16	1516.83	1518.00
	6.26	1523.09			
A-19			9.32	1513.76	1514.93
	6.78	1520.54			
A-20			5.23	1515.31	1516.48

(4)

Descriptions

HUB EAST SIDE SAGUARO DRIVE 300 N. OF MONTERAY

TP TC EAST SIDE OF SAGUARO

TC PC (EAST SIDE & MEDIAN) SAGUARO DRIVE 200' NORTH OF LEDFERD LANE

TC PC (EAST SIDE SAGUARO WEST SIDE MED) ACCESS UNNAMED OPP DEAD END SIGN

SET 400' SOUTH OF PALMER WAY PK EAST EDGE OF PAV SAGUARO

TP TC SE COR NIBLICK & EAGLE

ON TOP BC PANEL (PT 1144) 0.70 ABOVE GROUND N.G. Elev. ~~1516.13~~ 1517.30

SAME AS A-17

PANEL PT IN INDIAN WELLS & EAGLE Boat Belt

(5)	+	HI	−	ELEV	2/24/93 Adjusted Elevs
A-20				1515.31	1516.48
	1.32	1516.63			
A-21			8.30	1508.33	1509.50
	17.33	1525.66			
A-22			3.42	1522.24	1523.41
	10.05	1532.29			
A-23			7.45	1524.84	1526.01
	*18.40	1543.24			
A-24			1.38	1541.86	1543.03
	3.76	1545.62			
A-25			16.78	1528.84	1530.01
	6.27	1535.11			
A-26			9.36	1525.75	1526.92
	4.08	1529.83			
A-27			2.05	1527.78	1528.95
	10.17	1537.95			
A-28			15.31	1522.64	1523.81
	15.19	1537.83			
A-29			2.80	1535.03	1536.20
	10.00	1545.03			
A-30			4.06	1540.97	1542.14
	14.49	1555.46			
A-31			0.51	1554.95	1556.12

(6)

Descriptions

NW COR LIFT STATION #6
INDIAN WELLS ROAD
TP

TC PC INDIAN WELLS DR NORTH
& EAST SIDE OF SAGUARO BLVD
A-24TP. TC EAST MEDIAN SAGUARO
200' SOUTH OF COMMUNITY CENTER

BC Panel PY 13.8 0.28 ABOVE GROUND
N.G. Elev. ~~1522.36~~ 1523.53

TIOGA DRIVE & TOWOL DRIVE
BC & INT

7	+	HI	-	ELEV	2/26/88 Adjusted Elevs	Descriptions
A-31				1554.95	1556.12	
	6.95	1561.90				PANEL PY (A-32)
A-32			2.99	1558.91	1560.08	BC & INT TIOGA & PANARAMA
	2.89	1561.80				
A-33			21.27	1540.53	1541.70	TC EAST SIDE PANARAMA 50'
	8.10	1548.63				SOUTH OF POWER LINES
A-34			1.11	1547.52	1548.69	TC EAST SIDE PANARAMA
	6.68	1554.20				
A-35			3.76	1550.44	1551.61	PANEL PY BC & INT
						PANARAMA & EL LAGO
	18.00	1568.44				
A-36			4.33	1564.11	1565.28	
	8.08	1572.19				
A-37			3.07	1569.12	1570.29	PANEL PY & INT EL LAGO
	11.28	1580.40				& TEAL DRIVE (BC)
A-38			0.70	1579.70	1580.87	
	6.21	1585.91				
A-39			3.01	1582.90	1584.07	NE COR OF HEADWALL NORTH SIDE
						OF EL LAGO 600' EAST OF & SAGAUDO
	15.67	1598.57				
A-40			1.91	1596.66	1597.83	TC NORTH PC NE RETURN SAGARO
						& EL LAGO

(9)

	+	HI	−	ELEV	2/26/97 Adjusted Elev.
A-40				1590.66	1592.83
	10.75	1607.41			
A-41			1.39	1606.02	1607.19
	14.51	1620.53			
A-42			8.13	1612.40	1613.57
	0.25	1612.65			
A-43			11.66	1600.99	1602.16
	0.45	1601.44			
A-44			13.18	1588.26	1589.43
	0.26	1588.52			
A-45			18.20	1570.32	1571.49
	0.02	1570.34			
A-46			14.13	1556.21	1557.38
	2.44	1558.65			
A-47			13.13	1545.52	1546.69
	0.07	1545.59			
A-48			20.75	1524.84	1526.01

(10)

Descriptions

HAMPLIGHTER WAY & SAGUARO TC (SW COR CENTO

TC WEST SIDE SAGUARO 225' NORTH OF OASIS DRIVE

TC WEST SIDE SAGUARO 300' SOUTH OF OASIS DRIVE

TC N/W RETURN WEST SIDE SAGUARO N. SIDE QUINTO DR. NORTH

375' SOUTH (QUINTO ROAD SOUTH) TC WEST SIDE OF SAGUARO

TC WEST SIDE OF MEDIAN SAGUARO 200' SOUTH OF BOND DRIVE

TC WEST SIDE MEDIAN SAGUARO 180' SOUTH OF RAND ROAD

SAME AS A-23

(11)

	+	HI	−	ELEV	2/26/93 Adjusted Elev's	Descriptions
A-48				1524.84	1526.08	SAME AS A-23
	14.47	1539.31				
A-49			12.67	1526.64	1527.81	120' SOUTH OF AMHERST DR TO WEST SIDE OF SAGUARO
	3.07	1529.71				
A-50			7.87	1521.84	1523.01	TO EAST SIDE MEDIAN SAGUARO 300' SOUTH KINGSTREE BLVD
	2.70	1524.54				
A-51			10.76	1513.78	1514.95	SAME AS (A-17 & A-19) SEE PG 3
	15.33	1529.11				
A-52			15.09	1514.02	1515.19	SAME AS A-15 SEE PG 3
	9.18	1523.20				
A-53			0.36	1522.84	1524.01	SAME AS H-14 SEE PG 3
	22.05	1544.89				
A-54			0.17	1544.72	1545.89	SAME AS A-12 SEE PG 2
	18.74	1563.46				
A-55			0.13	1563.33	1564.50	SOUTH END BULL NOSE & SAGUARO NORTH OF TREVINO DRIVE
	8.90	1572.23				
A-56			9.72	1562.51	1563.68	TO SOUTH SIDE SHEA 150' EAST OF ℄ SAGUARO

(12)

(13)

	+	HI	−	ELEV	2/26/93 Adjusted Elevs
A-56				1562.51	1563.68
	0.78	1563.29			
A-57			10.26	1553.03	1554.20
	1.90	1554.93			
A-58			9.57	1545.36	1546.53
	2.61	1547.97			
			5.50	1542.47	1543.63
				1542.46	

Descriptions

TC TIP OF EASTEND BUCK NOSE & SHEM 1/4 MILE WEST OF BEELINE HWY

SAME AS A-1
Closure 0.01

					2/24/93 Adjusted Elev.
A-1				1542.45	1543.63
	2.26	1544.72			
B-1			12.36	1532.36	1533.53
	3.24	1535.60			
B-2			8.19	1527.41	1528.58
	1.22	1528.63			
B-3			15.93	1512.70	1513.87
	15.99	1528.69			
B-4			0.15	1528.54	1529.21
	17.46	1546.00			
B-5			2.18	1543.82	1544.99

Descriptions

Starting B. Mark

PK IN ASPH EAST SIDE OLD BEELINE ROAD 300' NORTH OF SHEA

3/4" RE BAR ADOT PI 2389-3A 50' WEST OF PAVEMENT OLD BEELINE 1000' NORTH OF SHEA ADOT Elev. 1528.53 (Diff. -1.13) 0.02

ALUM BC 2389-4 ADOT ADOT Elev. 1513.85 (Diff. -1.13) 0.02

TP

ALUM CAP ADOT 2389-3 SAME AS SAME A-3

(17)	+	HI	−	ELEV	2/26/93 Adjusted Elevs
A-40				1596.66	1597.83
	4.80	1601.46			
C-1			5.77	1595.69	1596.86
	5.09	1600.78			
C-2			6.22	1594.56	1595.73
	8.62	1603.18			
C-3			2.32	1600.86	1602.03
	8.39	1609.25			
C-4			0.15	1609.10	1610.27
	10.35	1619.45			
C-5			17.85	1601.60	1602.77
	0.24	1601.84			
C-6			15.75	1586.09	1587.26
	3.40	1589.49			
C-7			18.36	1571.13	1572.30

Descriptions

SEE PG 7

PK SET IN ASPH EAST SIDE OF SAGUARO 150' SOUTH OF AVE OF THE FOUNTAINS 8' WEST OF CURB

TC EAST SIDE SAGUARO OPP ℄ PARKVIEW AVE

19	+	HI	−	EVEN	2/24/93 Adjusted Elevs
C-7				1571.13	1572.30
	0.42	1571.55			
C-8			24.73	1546.82	1547.99
	4.59	1551.41			
C-9			12.01	1539.40	1540.57
	8.91	1548.31			
C-10			9.10	1539.21	1540.38
	11.37	1550.58			
C-11			6.74	1543.84	1545.01

Descriptions

PANEL PT 123 Nail flush w/ N Grade
N.G. Elev. 1543.84 1545.01

POINT 123 IN THE FENCE

(21)	+	HI	−	ELEV	2/24/93 adj'usted Elevs
C-3				1600.86	1602.03
	7.05	1607.91			
D-1			0.16	1607.75	1608.92
	8.17	1615.92			
D-2			1.45	1614.47	1615.64
	20.74	1635.21			
D-3			1.70	1633.51	1634.68
	18.15	1651.66			
D-4			0.61	1651.05	1652.22
	15.69	1666.74			
D-5			3.44	1663.30	1664.47
	14.69	1677.99			
D-6			7.60	1670.39	1671.56
	12.79	1683.18			
D-7			8.58	1674.60	1675.77

Descriptions

SEE PG 17

TC END OF S/W N. SIDE OF PALISADES BLVD 300' EAST OF VERDE RIVER DR

PK IN PAVE IN FRONT OF TOWN HALL N. SIDE OF PALISADES

TC WEST EDGE OF DRIVE N SIDE PALISADES 200' EAST OF MONTANA

BCLY & INT ALMONTE & PALISADES BLVD "PANEL PT"

BC & INT WESTBY DR & PALISADES

TC N. SIDE PALISADES 600' EAST OF FOUNTAIN HILLS DRIVE

& INT PALISADES & FOUNTAIN HILLS DRIVE SOUTH RIM OF H.H PANEL PT

23	+	HT	−	ELEV	2/26/93 Adjusted Elevs	Descriptions
D-7				1674.60	1675.22	
	15 43	1690 03				
D-8			0 04	1689 99	1691.16	SET PK WEST SIDE OF PAV FOUNTAIN HILLS
						600' SOUTH OF PALISADE
	23 34	1713 33				
D-9			0 60	1712 73	1713.90	RE BAR ¢ INT. AVE OF THE FOUNTAINS
						& FOUNTAIN HILLS BLVD
	18 80	1731 53				
D-10			1 20	1730 33	1731.50	SET PK WEST EDGE OF PAV FOUNTAIN
						HILLS BLVD 150' SOUTH OF EL LAGO BLVD
	13 73	1744 06				
D-11			14 29	1729 77	1730.94	TP PK SET ¢ WEST EDGE FOUNTAIN
						HILLS BLVD
	1 40	1731 17				
D-12X			22 81	1708 36	1709.53	¢ INT SEGUNDO & FOUNTAIN
	18 59	1726 95				HILLS BLVD PANEL HT (BOLT)
D-13			24 13	1702 82	1703.99	PK WEST SIDE FOUNTAIN HILLS BLVD
	0 06	1702 88				200' SOUTH OF ARROYO VISTA DR
D-14			24 76	1678 12	1679.29	PK WEST SIDE FOUNTAIN HILLS
						BLVD 250' N. OF CHOLLA DR
	1 45	1679 57				
D-15			0 20	1679 37	1680.54	

(25)	+	HI	−	ELEV	2/26/83 Adjusted Elevs	Description
D-15				1679.37	1680.54	
	3.90	1683.27				
D-16			2.34	1680.93	1682.10	& INT SULLIVAN & FOUNTAIN HILLS BLVD (PANEL PT) BATT
	23.55	1704.48				
D-17			0.30	1704.18	1705.35	TP PK. W SIDE FOUNTAIN HILLS BLVD 300' NORTH OF FOUNTAIN HILLS PLACE
	23.98	1728.16				
D-18			0.15	1728.01	1729.16	PK WEST SIDE OF FOUNTAIN HILLS BLVD OPP FOUNTAIN HILLS PLACE
	22.24	1750.72				
D-19			21.37	1729.35	1730.52	PK WEST SIDE OF FOUNTAIN HILLS BLVD 100' NORTH OF SAWTK CR.
	0.44	1729.79				
D-20			3.28	1726.51	1727.68	(PANEL PT) & INT FOUNTAIN HILLS BLVD & EMERALD DR
	24.46	1750.97				
D-21			0.12	1750.85	1752.02	PK WEST SIDE FOUNTAIN HILLS DR 300' SOUTH OF EMERALD DR
	23.99	1774.84				
D-22			0.11	1774.73	1775.90	TP
	23.16	1797.89				
D-23			1.35	1796.54	1797.71	(PANEL PT) & FOUNTAIN HILLS BLVD 100' NORTH OF KINGS TREE BLVD (BAT

(27)	+	HI	−	ELEV	2/26/88 Adjusted Elevs	Descriptions
D-23				1796.54	1797.71	
	22.08	1818.62				
D-24			2.15	1816.47	1817.64	(PANEL PY) & FOUNTAIN HILLS BLVD 300' NORTH OF PALOMINO BLVD
	12.47	1828.94				
D-25			21.60	1807.34	1808.51	PANEL PY & FOUNTAIN HILLS BLVD 500' NORTH OF PINTO DR
	0.60	1807.94				
D-26			23.21	1784.73	1785.90	
	0.86	1785.59				
D-27			14.00	1771.59	1772.76	(Boat Bolt) & INT PINTO DR & FOUNTAIN HILLS BLVD (PANEL PY)
	0.56	1772.15				
D-28			23.01	1749.14	1750.31	NORTH END BULL NOSE T.C. MEDIAN 50' SOUTH MUSKRAT WAVE
	0.26	1749.40				
D-29			23.82	1725.58	1726.75	TC SOUTH END BULL NOSE & FOUNTAIN HILLS BLVD 100 NORTH OF & SHEA
	3.05	1728.63				
D-30			10.30	1718.33	1719.50	PK SOUTH SIDE SHEA 700' EAST OF FOUNTAIN HILLS BLVD
	2.41	1720.74				
D-31			9.18	1711.56	1712.73	EAST END OF BULL NOSE ¼ MILE EAST OF FOUNTAIN HILLS BLVD & ℄ OF SHEA

(29)

	+	HI	−	ELEV	2/24/93 Adjusted Elevs.	Descriptions
D-31				1711.56	1712.73	
	2.28	1713.84				
D-32			9.42	1704.42	1705.59	PK SOUTH SIDE SHEA 200' WEST OF EAST END OF GUARD RAIL
	2.81	1707.23				
D-33			11.45	1695.78	1696.95	PK SOUTH SIDE OF SHEA
	0.55	1696.33				
D-34			16.65	1679.68	1680.85	
	0.74	1680.42				
D-35			15.88	1664.54	1665.71	PK SOUTH SIDE SHEA 300' WEST OF END OF GUARD RAIL (OVER WASH)
	0.48	1665.02				
D-36			24.55	1640.47	1641.64	PK SOUTH SIDE SHEA
	0.76	1641.23				
D-37			14.37	1626.86	1628.03	
	1.55	1628.41				
D-38			19.93	1608.48	1609.65	PK SOUTH SIDE OF SHEA
	1.20	1609.68				
D-39			14.85	1594.83	1596.00	
	1.16	1595.99				
D-40			9.51	1586.48	1587.65	WEST END BULL NOSE & SHEA 1/4 WEST OF SAGUARO BLVD

(31)	+	HI	−	ELEV	2/24/83 Adjusted Elevs	Descriptions
D-40				1586.48	1587.55	
	0.04	1581.52				
D-41			11.35	1575.17	1576.31	
	1.17	1576.34				
D-42			13.80	1562.54	1563.71	SAME AS A-56 (PG 11)

(33)	+	HI	−	ELEV	2/26/93 Adjusted Elevs
A-58				1545.36	1546.53
	14.84	1560.20			
E-1			11.27	1548.93	1550.10
	9.86	1558.79			
E-2			0.67	1558.12	1559.29
	13.86	1571.98			
E-3			0.38	1571.60	1572.77
	7.82	1579.42			
(E-4)			6.73	1572.69	1573.86
	6.83	1579.52			
E-5			0.59	1578.93	1580.10
	12.14	1591.07			
E-6			6.54	1584.53	1585.70
	15.16	1599.69			
E-7			3.32	1596.37	1597.54
	16.73	1613.10			
✓ E-8			0.80	1612.30	1613.47

Descriptions

SEE : PG 13

℄ INT FIRE BRICK DR & LAST TRAIL (BC PANEL PT)

NORTH END OF DRIVEWAY 16923 LAST TRAIL DR

TC NORTH EDGE OF DRIVE 16821 LAST TRAIL DR

PANEL PT (1152) BC STAMPED 1575.14 N.C. Elev. ~~1572.57~~ 1573.76

27	26
34	35

0.10 ABOVE GROUND

TC EAST SIDE LAST TRAIL DR OPP 16744 LAST TRAIL DR

TC NORTH SIDE LEO DR 50' EAST OF ℄ LAST TRAIL DR

TC MEDIAN OF SAGUARO 300' WEST OF LAST TRAIL DR

TC MEDIAN ℄ SAGUARO 500' EAST OF JAY DR

(35)	+	HI	−	ELEV	2/24/83 Adjusted Elevs
E-8				1612.30	1613.47
	12.90	1625.20			
E-9			1.74	1623.46	1624.63
	13.81	1637.27			
E-10			2.77	1634.50	1635.67
	18.73	1653.23			
E-11			1.21	1652.02	1653.19
	13.29	1665.31			
E-12			6.90	1658.41	1659.58
	17.15	1675.56			
E-13			1.57	1673.99	1675.16
	13.71	1687.70			
E-14			5.70	1682.00	1683.17
	13.75	1695.75			
E-15			17.41	1678.34	1679.51
	17.49	1695.83			
E-16			24.69	1671.14	1672.31

Descriptions

TC ℄ MEDIAN OF SAGUARO 570' WEST OF JET DR

TC WEST SIDE OF RED MOUNTAIN TR 125' NORTH OF SAGUARO

TP

BROKEN BC PC ℄ OF PANDEE HORN 180' EASY OF ℄ OF WASH 600' SE OF TOMBSTONE

TP

GLO BC 0.85 ABOVE GROUND 28 27

PANEL PT (1150) N.G.Elev. ~~1681.99~~ 1678.66 33 34

(37)	+	HI	−	ELEV	2/24/93 Adjusted Elevs	Descriptions
E-16				1671.14	1672.31	
	3.72	1674.86				
E-17			22.85	1652.01	1653.18	SAME AS E-11
	1.33	1653.34				
E-18			18.84	1634.50	1635.67	SAME AS - E-10
	0.46	1634.96				
E-19			11.50	1623.46	1624.63	SAME AS - E-9
	1.94	1625.40				
E-20			7.57	1617.83	1619.00	
	1.90	1619.73				
E-21			16.45	1603.28	1604.45	TC MEDIAN & SAGUARO 500' WEST OF LAST TRAIL
	2.41	1605.69				
E-22			15.73	1589.96	1591.13	TC & BULL NOSE MEDIAN OF SAGUARO 30' EAST OF LAST TRAIL
	2.10	1592.06				
E-23			18.04	1574.02	1575.19	TC EAST SIDE OF SAGUARO 300' SOUTH OF TECHNOLOGY DR
	2.06	1576.08				
E-24			13.70	1562.38	1563.55	TC BULL NOSE & MEDIAN OF SAGUARO 100' SOUTH OF LASER DR

(37)	+	HI	−	ELEV	2/26/93 Adjusted Elevs	Descriptions
E-16				1671.14	1672.31	
	3.72	1674.86				
E-17			22.85	1652.01	1653.18	SAME AS E-11
	1.33	1653.34				
E-18			18.84	1634.50	1635.67	SAME AS - E-10
	0.46	1634.96				
E-19			11.50	1623.46	1624.63	SAME AS - E-9
	1.94	1625.40				
E-20			7.57	1617.83	1619.00	
	1.90	1619.73				
E-21			16.45	1603.28	1604.45	TC MEDIAN & SAGUARO 500' WEST OF LAST TRAIL
	2.41	1605.69				
E-22			15.73	1589.96	1591.13	TC & BULL NOSE MEDIAN OF SAGUARO 30' EAST OF LAST TRAIL
	2.10	1592.06				
E-23			18.04	1574.02	1575.19	TC EAST SIDE OF SAGUARO 300' SOUTH OF TECHNOLOGY DR
	2.06	1576.08				
E-24			13.70	1562.38	1563.55	TC BULL NOSE & MEDIAN OF SAGUARO 100' SOUTH OF LASER DR

(39)

	+	HI	-	ELEV	2/21/93 Adjusted Elevs	Descriptions
E-24				1562.38	1563.55	
	4.02	1566.40				
E-25			3.67	1562.73	1563.90	TC & MEDIAN OF SAGUARO
	5.70	1568.43				250' NORTH OF FIRE BREAK DR
E-26			5.83	1562.60	1563.77	

(41)	+	HI	−	ELEV	2/26/93 Adjusted Elev's
D-23				1796.54	1797.71
	9.91	1806.45			
F-1			12.62	1793.83	1795.00
	2.22	1796.05			
F-2			14.60	1781.45	1782.62
	0.95	1782.40			
F-3			24.43	1757.97	1759.14
	0.75	1758.72			
F-4			21.42	1737.30	1738.47
	1.20	1738.50			
F-5			24.02	1714.48	1715.65
	0.76	1715.24			
F-6			6.72	1708.52	1709.69
	23.31	1731.83			
F-7			2.84	1728.99	1730.16
	2.10	1731.09			
F-8			18.39	1712.70	1713.87

Descriptions

SEE PG 25

(PANEL PT) INDIGO & KINGSTREE
#339 PK

BC & INT KEOTA DR & KINGSTREE

TC 16129 KEOTA

TC 16225 KEOTA

PC BC. KEOTA DR 300' NORTH
OF NICKLAUS DR

PANEL PT NICKLAUS & KEOTA
#404

TC 16506 NICKLAUS DR

(43)	+	HI	−	Elev	2/26/18 Adjusted Elev
F-8				1712.70	1713.87
	3.05	1715.75			
K-9			11.96	1703.79	1704.96
	1.80	1705.59			
F-10			19.65	1685.94	1687.11
	0.40	1686.34			
F-11			21.43	1664.91	1666.08
	0.12	1665.03			
F-12			22.78	1642.25	1643.42
	1.77	1644.02			
F-13			22.21	1621.81	1622.98
	0.25	1622.06			
F-14			16.38	1605.68	1606.85
	1.72	1607.40			
F-15			18.73	1588.67	1589.84
	0.52	1589.19			
F-16			23.73	1565.46	1566.63

Descriptions

#407 PANEL PT BOLT
& INT NELSON DR & NICKLAUS

PANEL PT PC NICKLAUS 200'
NORTH OF GREEN BRIAR DR

PANEL PT PC 16650 NICKLAUS DR

PANEL PT 143 PC & NICKLAUS
DR 200' WEST OF INDIAN WELLS
Pavement Elev. 1642.25 1643.42
TC 10431 INDIAN WELLS

TC EAST SIDE INDIAN WELLS
300' SOUTH OF PLAYER

TP

TC CURB RETURN NW COR JACKLIN
& INDIAN WELLS

(45)	+	HI	−	ELEV	2/26/93 Adjusted Elevs	Descriptions
F-16				1565.46	1566.63	
	0.17	1565.63				
F-17			22.75	1542.88	1544.05	TC INDIAN WELLS OPP 9TH TEE
	2.54	1545.42				
F-18			14.20	1531.22	1532.39	10637 INDIAN WELLS TC
	0.71	1531.93				
F-19			16.65	1515.28	1516.45	SAME AS A-20 SEE PG3

47	+	HI	−	ELEV	2/26/01 adjusted Elevs
G-0				1567.401	1567.401
	2.72	1570.12			
G-1			13.46	1556.66	1556.66
	3.75	1560.41			
G-2			14.88	1545.53	1545.53
	6.02	1551.55			
G-3			7.92	1543.63	1543.63
	7.76	1551.39			
G-4			5.86	1545.53	1545.53
	10.49	1556.02			
G-5			0.07	1555.95	1555.95
	14.33	1570.28			
G-0			2.88	1567.40	1567.40

Description

ADOT P.DM Brass Disk Stamped 1568.65 Sta 969 + 85.72 adjusted by ADOT PDM to (1567.401) (-1.25) per Pat Church

BC SAME AS A-1 PG 1 Project Beginning Bench Mark Stamped "1543.72/1955" Revised to 1542.457 (Diff = 1.17)

Same as beginning B.M. G-0 (see above)

					2/26/93 Adjusted Elevs
A-1				1542.^{51}	1543.^{63}
	5.^{26}	1547.^{72}			
H-1			4.^{96}	1542.^{76}	1543.^{93}
	4.^{84}	1547.^{60}			
H-2			5.^{14}	1542.^{46}	1543.^{63}

Descriptions

SEE PG 1 Project Begowing Bench Mark Stamped "1543.^{22}/1955"

BC IN STAMPED 1545.^{17} (-1.24)

986+15.03 ±30 west of A-1 Brass Cap

SAME AS A-1

Stamped Elev. Diff = 1.^{45}

Physical Diff = 0.^{30} Field

(51)

					2/26/93 Adjusted
E-1				1548.93	1550.10
	13.57	1562.50			
I-1			1.40	1561.10	1562.27
	1.26	1562.36			
I-2			13.43	1548.93	1550.10
A-12				1544.74	1545.91
	7.98	1552.72			
I-3			3.44	1549.28	1550.45
	3.27	1552.55			
I-4			7.81	1544.74	1545.91
A-12				1544.74	1545.91
	17.25	1561.99			
I-5			11.39	1550.60	1551.77
	11.21	1561.81			
I-6			17.06	1544.75	1545.92

Descriptions

E-1 SEE PG 33

416 PANEL PY & INT LUNAR DR & FIREBRICK

SAME AS E-1

SEE PG 1

(PK) PANEL PY & SAFEWARD & MONTEREY DR #

SAME AS A-12

SEE PG 1

PANEL PY #415 & MONTEREY & ROUGH CIR

53

				Elevs	2/24/93 Adjusted Elevs	Descriptions
A-49				1526.64	1527.81	SEE PG 11
	8.77	1535.41				
I-7			3.65	1531.74	1532.93	REBAR PANEL PT & INT KINGSTREE & ZEPHYR DR
	3.36	1535.12				
I-8			8.47	1526.65	1527.82	SAME AS A-49
I-7				1531.74	1532.93	& INT ZEPHYR & KINGSTREE
	3.84	1535.60				
			6.83	1528.77	1529.94	
J-9						PANEL PT & KINGSTREE 200' EAST OF ZEPHYR #378
	6.70	1535.47				
			3.71	1531.74	1532.93	

	+	HI	−	ELEV.
J-1				1679.29
	3.17	1682.46		
J-2			0.50	1681.96
J-2	22.17	1704.13		
J-3			0.52	1703.61
J-3	14.75	1718.36		
J-4			0.61	1717.75
J-4	21.84	1739.59		
J-5			1.37	1738.22
J-5	22.85	1761.07		
J-6			0.70	1760.37
J-6	22.68	1783.05		
J-7			0.21	1782.84

Description

Same as D, 14

South T.C. 300' ± west on Cholla from F. Hills Add# 16313

"Boat spike" @ P.C. cholla Add # 16223

"B.S." @ INT @ cholla & organ Pipe

South T.C. @ Cholla. Add# 16153

North T.C. Add# 16144 E. Cholla.

South T.C. Add# 16131 E. Cholla.

57	+	HI	−	ELEV.	Desc.
J-7				1782.84	
	15.85	1798.69			
J-8			1.25	1797.44	North T.C. Add# 16046 E. Cholla.
J-8	12.58	1810.02			
J-9			0.99	1809.03	(J-9 = Pt. 137) B.S. & Panel. INT. & Cholla & Barrel Cactus way.
J-9	16.93	1825.96			
J-10			0.12	1825.84	North T.C. Add# 15952 E. Cholla
J-10	12.56	1838.40			
J-11			0.32	1838.08	South T.C. S.W. Ref. Cholla & Twin Deer.
J-11	7.19	1845.27			
J-12			8.86	1836.41	B.S. INT. & Twin Deer & Sycamore
J-12	0.95	1837.36			
J-13			24.30	1813.06	North T.C. Add# 15840 Sycamore.

59	+	HI	−	ELEV.	Desc.
J-13				1813.06	
	0.50	1813.56			
J-14			24.73	1788.83	North T.C. sycamore 500' ± East of Twin Deer Road.
J-14	1.63	1790.46			
J-15			23.42	1767.04	North T.C. sycamore 75' ± East of East (P.C.)
J-15	1.02	1768.06			
J-16			24.05	1744.01	North T.C. sycamore 300' ± East of East P.C.
J-16	1.59	1745.60			
J-17			18.09	1727.51	South T/C sycamore Add # 15953
J-17	2.47	1729.98			
J-18			15.37	1714.61	B.C. @ Sycamore & Grey Stone Drive.
J-18	0.47	1715.08			
J-19			6.36	1708.72	North T.C. Sycamore 50' ± South of wash.

61	+	HI	−	ELEV.	Desc.
J-19				1708.72	
	21.14	1729.86			
J-20			0.41	1729.45	S.E. T.C. Sycamore 30'± South of P.C.
J-20	24.68	1754.13			
J-21			11.57	1742.56	B.C. South P.C. Sycamore Dr. 440'± South of Sunburst Dr. (Cont. 3/17/93) "J-Loop"
J-21	22.26	1764.82			
J-22			0.82	1764.00	B.C. Sycamore Dr. 600'± west of Sunburst.
J-22	24.08	1788.08			
J-23			0.97	1787.11	North T.C. Sycamore Dr. 250'± North of Ocotillo.
J-23	23.36	1810.47			
J-24			0.89	1809.58	West T.C. Sycamore Dr. 100'± North of ocotillo
J-24	15.92	1825.50			
J-25			4.54	1820.96	P.K. INT. ℄ of ocotillo & Sycamore.

	+	HI	−	ELEV.
J-25				1820.96
	4 HI	1825.37		
J-26			10.69	1814.68
J-26	2.57	1817.25		
J-27			22.41	1794.84
J-27	4.70	1799.54		
J-28			17.17	1782.37
J-28	1.97	1784.34		
J-29			11.68	1772.66
J-29	0.59	1773.25		
J-30			19.32	1753.93
J-30	1.49	1755.42		
J-31			7.97	1747.45

Desc.

B.C. @ P.C. Ocotillo Dr. Add# 15917 E.

B.S. INT. @ Ocotillo Dr. & Pincushion Way.

North T.C. Ocotillo Add# 16044 E.

South T.C. Ocotillo Add# 16117 E.

North T.C. Ocotillo. 200'± west of Fountain Hills BLVD.

East P.C. Bullnose Fountain H. & Old Trail.

	+	HI	−	ELEV.
J-31				1747.45
	0.49	1747.94		
J-32			17.34	1730.60

Desc.

Same as D-19 ELEV. (1730.52)

	+	HI	−	EL.	Adj. EL.
K,1				1727.68	
	23.13	1750.81			
K,2			0.23	1750.58	50.57
K,2	23.61	1774.19			
K,3			10.20	1763.99	63.97
K,3	0.20	1764.19			
K,4			24.47	1739.72	39.69
K,4	0.41	1740.13			
K,5			15.94	1724.19	24.15
K,5	0.64	1724.83			
K,6			14.21	1710.62	10.57
K,6	0.95	1711.57			
K,7			23.35	1688.22	88.16

Same as D,20 Page #25

No. T.C. Emerald Dr. 250' E. of F. Hills. BLVD.

South T.C. 50' west of Property 16227 Emerald.

South T.C. west Prop line #16327 Emerald Dr

(B.S.) & INT. Emerald & Frisco Dr. Same as Pt. # 431

"New" (B.C.) & INT. Emerald & Baron Dr. Same as Pt. #420

No. T.C. 16524 E. Emerald Dr.

	+	HI	—	EL.	
K.7				1688.22	33.16
	1.01	1689.23			
K, 8			24.54	1664.69	64.62
K.8	0.63	1665.32			
K,9			7.07	1658.25	53.17
K,9	2.30	1660.55			
K.10			23.44	1637.11	37.02
K.10	0.65	1637.76			
K,11			10.90	1626.86	26.76
K,11	0.27	1627.13			
K,12			23.44	1603.69	03.58
K.12	0.31	1604.00			
K.13			18.27	1585.73	85.61

So. T.C. 16545 E. Emerald Dr.

So. T.C. 16641 E. Emerald Dr.

No. T.C. 16748 E. Emerald.

(B.S.) ℄ INT. Emerald & Inca Ave.

E. T.C. #11015 INCA Ave.

5/8" rebar Lot #29 10' East x 40' west of
℄ kingstree BLVD. & INCA AVE.

	+	HI	—	EL.	
K, 13				1585.73	85.61
	1.50	1587.23			
K, 14			21.63	1565.60	65.47
K, 14	1.11	1566.71			
K, 15			16.95	1549.76	49.62
K, 15	0.19	1549.95			
K, 16			9.14	1540.81	40.67
K, 16	2.86	1543.67			
K, 17			10.60	1533.07	32.93

(B.S.) @ Kingstree BLVD. @ Teller Dr.

B.S. @ Kingstree BLVD. Add # 16949

So. T.C. Kingstree BLVD. 250' East of Walsh Dr

Same as I-7 Page 54. EL. 1532.93

73	+	HI	−	EL.	Adj. EL	
L-1				1682.10		See Pg. #26 Same as D-16
	0.36	82.46				
L-2			18.80	1663.66	63.65	(B.S.) & F. Hills @ Chama Dr.
L-2	0.73	64.39				
L-3			24.39	1640.00	39.97	So. T.C. 12052 Chama Dr.
L-3	5.02	45.02				
L-4			13.41	1631.61	31.57	(B.S.) & Chama @ Arroyo Vista Dr.
L-4	8.00	39.61				
L-5			3.09	1636.52	36.47	(B.S.) & Chama Add. # 12270 50' So colony wash.
L-5	16.49	53.01				
L-6			3.98	1649.03	48.97	(B.S.) E of Chama @ Gunsight Dr. P Pt. # 448
L-6	0.55	49.58				
L-7			18.46	1631.12	31.04	T.C. E.P.C./E-Ref 16714 Gunsight.

75	+	HI	−	EL.	Adj EL:
L-7				1631.12	31.04
	0.95	32.07			
			23.86	1608.21	08.12
L-8					

Same as P. Pt. # 363 Pg. 3 Bk. 2 "ERM."

Valco Surveying Corporation

AERIAL CONTROL · MAPPING · LAND SURVEYS
CONSTRUCTION STAKING · MBE/DBE CERTIFIED

602-990-2412

FOUNTAIN HILLS FLOODPLAIN DELINATION STUDY, SOUTH

CONTRACT FCD 92-05

CROSS-SECTIONS, DETAILS, AND STRUCTURE AS BUILTS

REGISTERED LAND SURVEYOR
CERTIFICATE NO. 18552
Valentin M. Padilla
Date Signed 9-30-95
ARIZONA, U.S.A.

77	+	HI	-	ELEV
D-29				1726 75
	7 93	1734 68		
M-1			3 84	1730 84
	7 83	1738 67		
M-2			0 14	1738 53
	9 48	1748 01		
M-3			0 34	1747 67
	10 35	1758 02		
M-4			0 27	1757 75
	7 66	1765 41		
M-5			2 57	1762 84
	0 13	1762 97		
M-6			15 29	1747 68
	0 55	1748 23		
M-7			9 68	1738 55
	0 22	1738 77		
M-8			7 92	1730 85
	4 08	1734 93		
M-9			8 20	1726 73

SEE PAGE 27

PK NORTH SIDE SHEA 600' WEST OF FOUNTAIN HILLS BLVD

PK NORTH SIDE SHEA 1100' WEST OF FOUNTAIN HILLS

PK NORTH SIDE SHEA 1500' WEST OF FOUNTAIN HILLS

PK NORTH RETURN WEST END OF BULLNOSE & SHEA 1/2 MILE WEST OF FOUNTAIN HILLS

SAME AS M-3

SAME AS M-2

SAME AS M-1

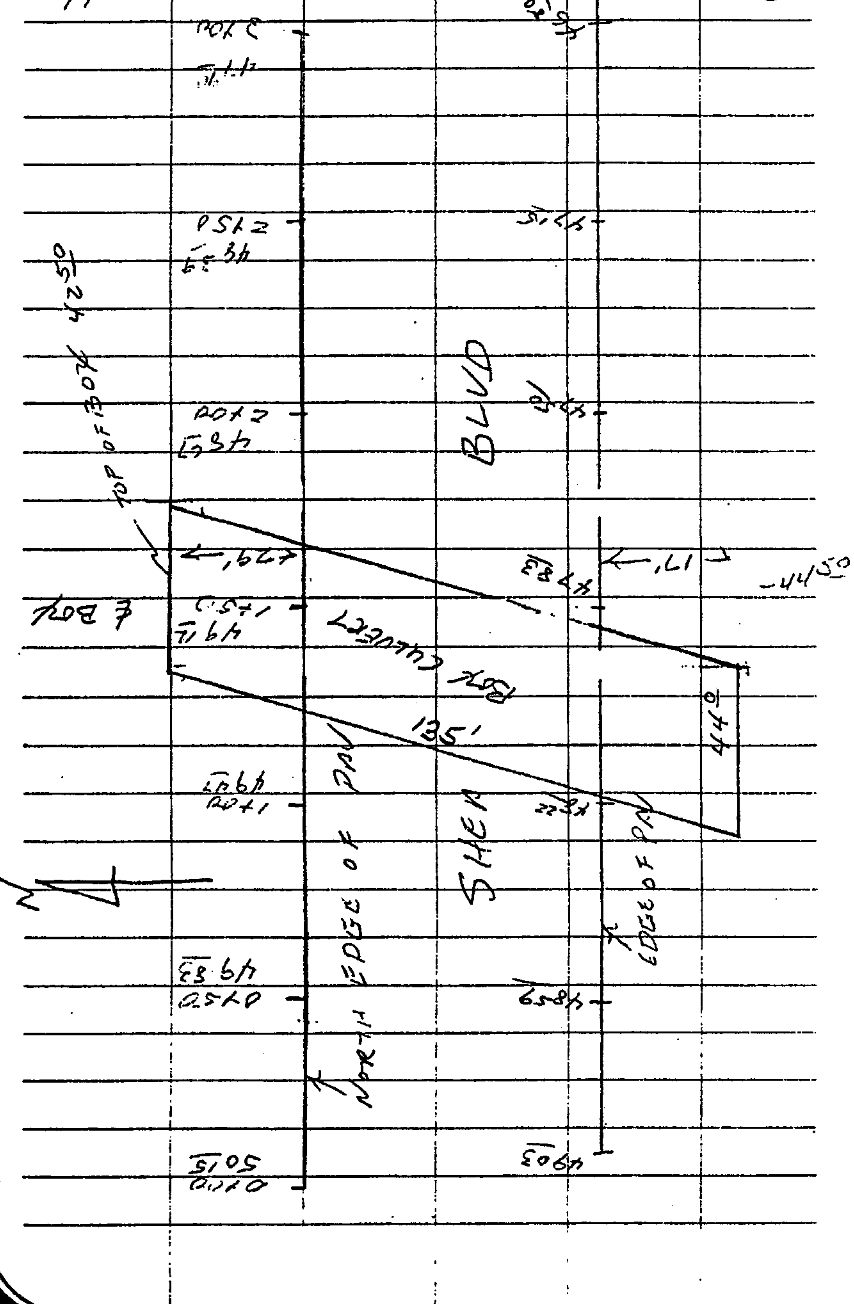
SAME AS D-29

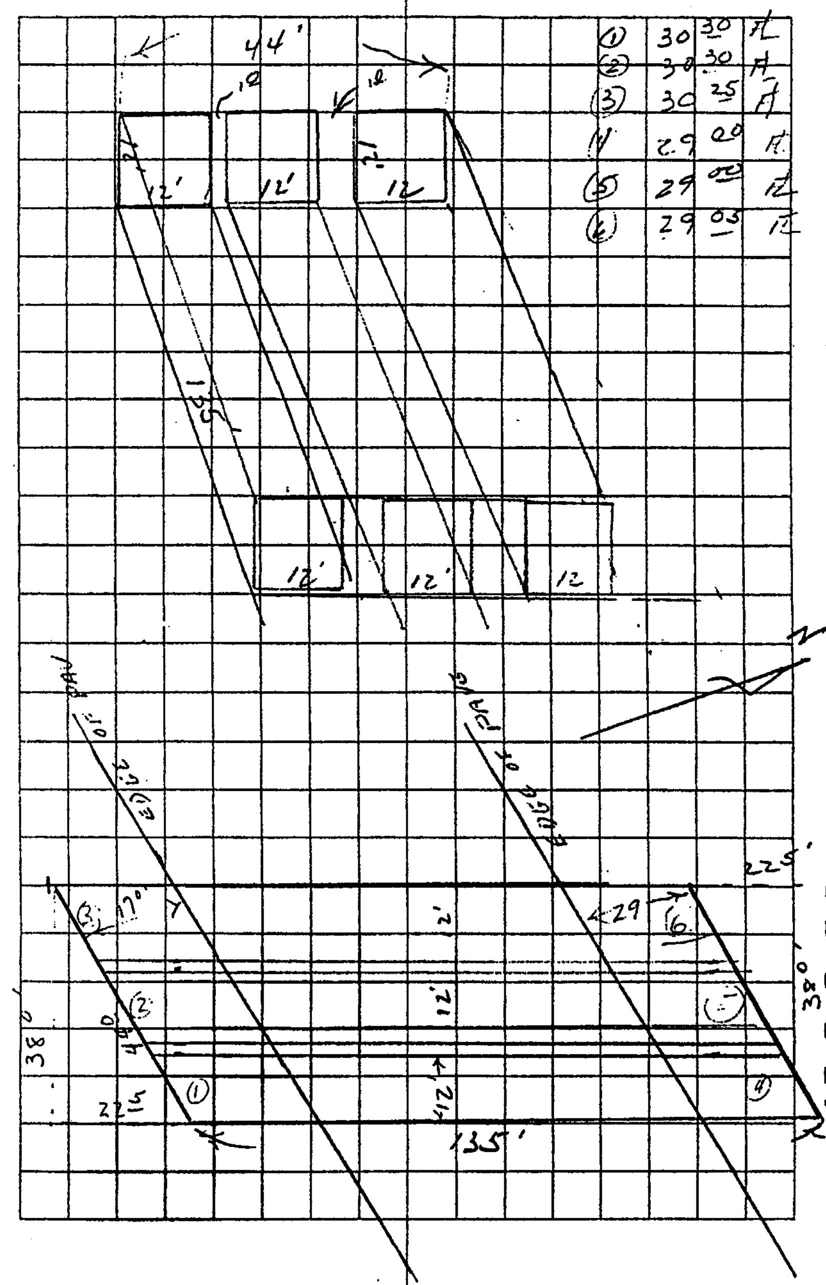
CONC. BOX CULVERT .2 MILES EAST OF SAGUARO BLVD ON SHEA AT CEREUS WASH

79

3/30/93

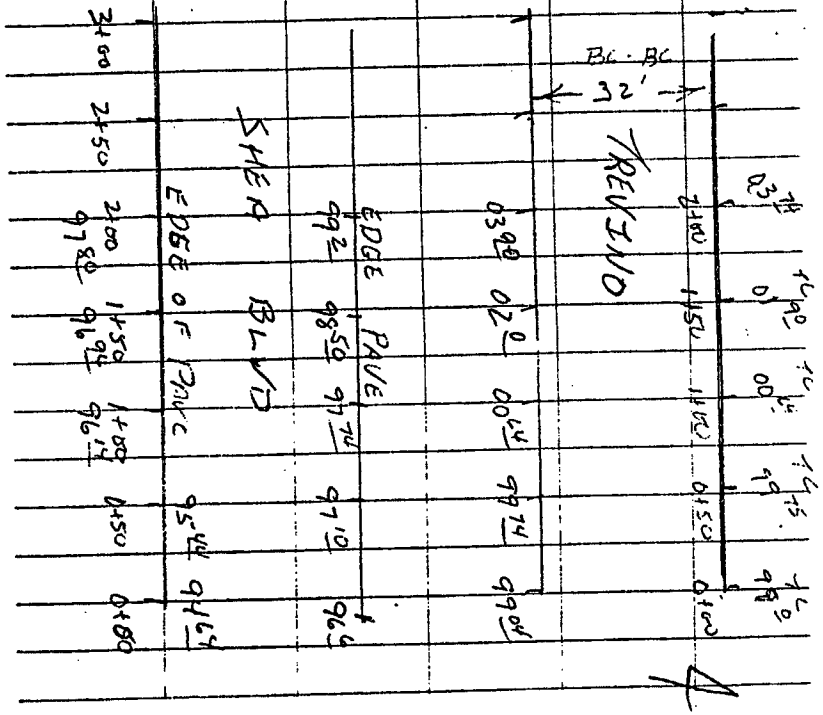
J ARCHIBALD
W. ODTEN

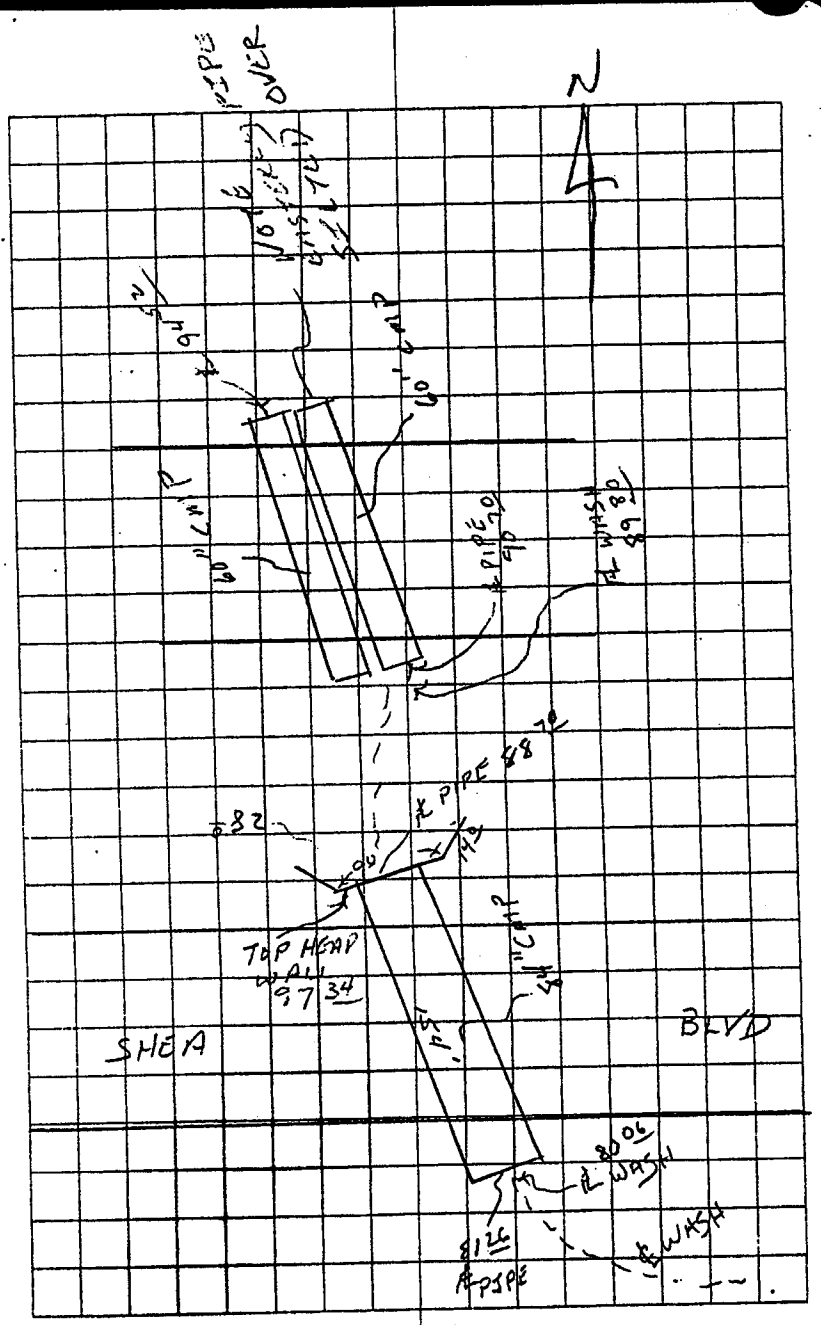




83 .4 MILES WEST OF SAGUARO

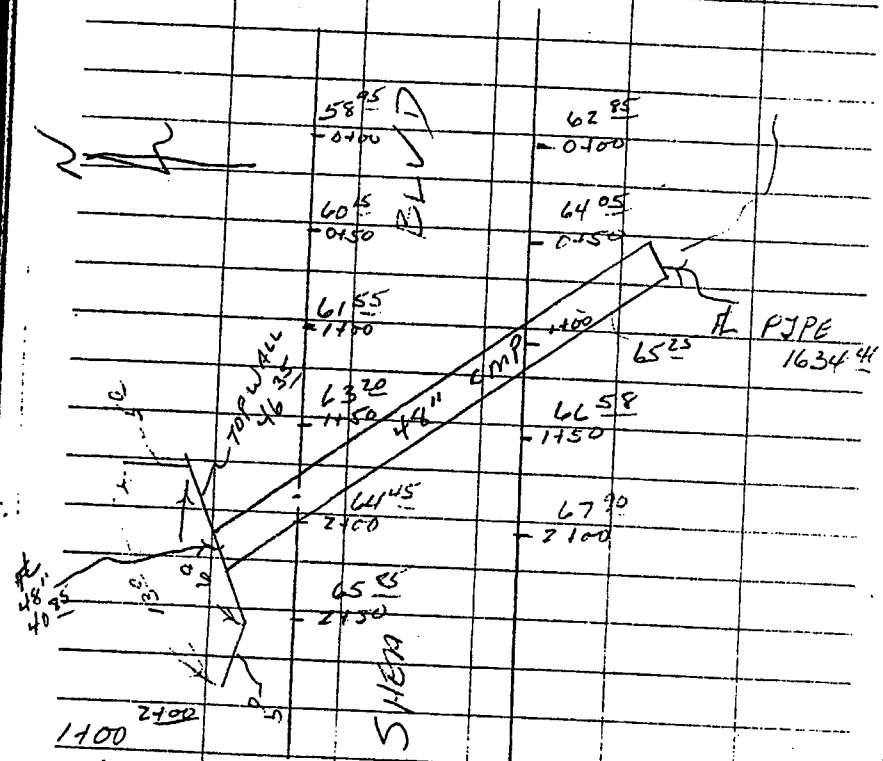
0+50	321-53-40	45 50	101-53-40	℄ PIPE 84"
	47-00-40	152 50	88-53-30	℄ PIPE 84"
	48-08-00	174 40	89-01-20	℄ 60"
	50-06-00	172 25	89-05-00	℄ 60"
	56-34-00	265 50	87-41-20	℄ 60"
	55-16-00	266 75	87-41-30	℄ 60"
	90-00-00	184 60	88-21-00	EP TORINO N
	90-00-00	89 65	88-24-00	EP SHEA N
	32-58-00	333 25	86-58-20	EP TORINO N





87 ✓

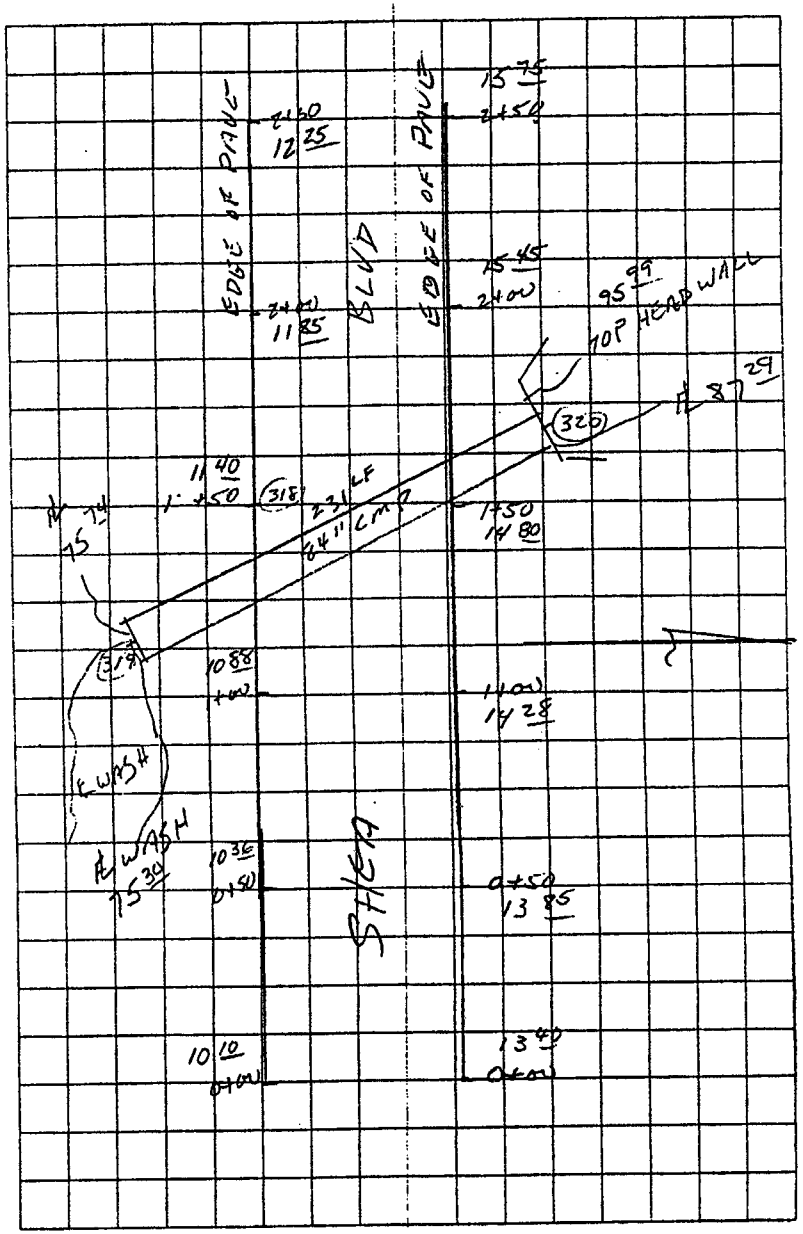
9 MILES WEST OF SAGUARO



311 312	0-00+00	174 00	91-31-40	℄ 48"
313	342-10-00	188 30	89-20-30	E P
314	57-56-00	84 50	92-08-00	E P
315	133-54-00	100 20	90-47-00	E P
316	316-23-00	136 60	88-01-00	E P
317	178-34-00	71 00	104-05-40	℄ 48"

1100 2+00

SHGA 91	BLVD TOWN	.3 MILES TRAIN	HILLS	EAST BLVD	of
318 319	0-00-00	83 90	102-53-40		START 84" [illegible]
326	203-55-00	153 30	90-11-40		N END 84" [illegible]
321	183-12-00	119 00	87-39-30		E P
322	277-40-00	143 20	88-47-00		E P
323	316-24-00	134 70	90-16-30		E P
324	134-07-00	127 50	89-16-30		E P

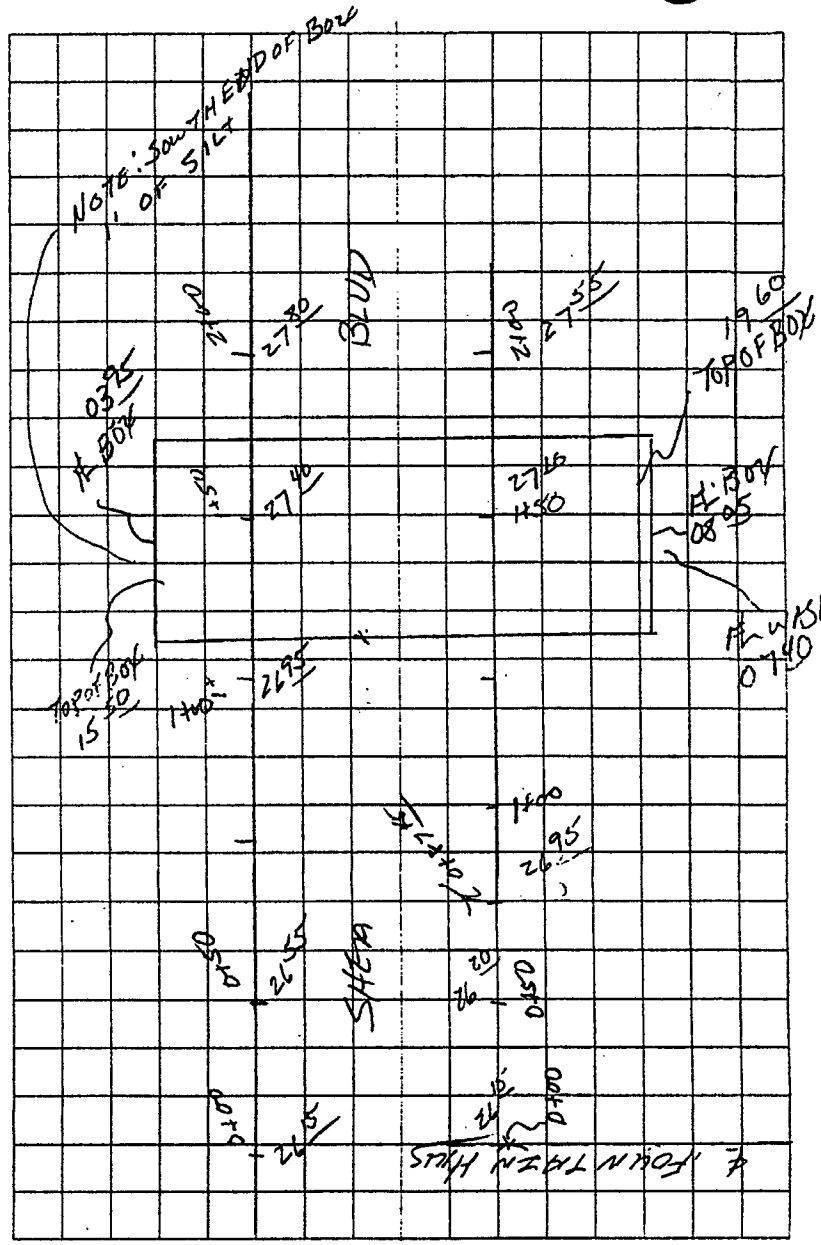


93 SHEA BLVD 100' WEST OF
FOUNTAIN HILLS BLVD

0+87 45 85 WEST
325 326

326	0-00-00	117 85	89-20-40	
327	180-00-00	87 45	90-00-00	[illegible]
328	222-52-00	140 80	90-09-50	EP
329	317-48-00	141 81	89-22-20	EP
330	296-10-00	128 40	90-53-40	WEST SIDE BOX(S) END
331	15-41-00	60 32	92-19-50	WEST SIDE BOX (N) END

133' x 10' x 10' BOX CULVERT

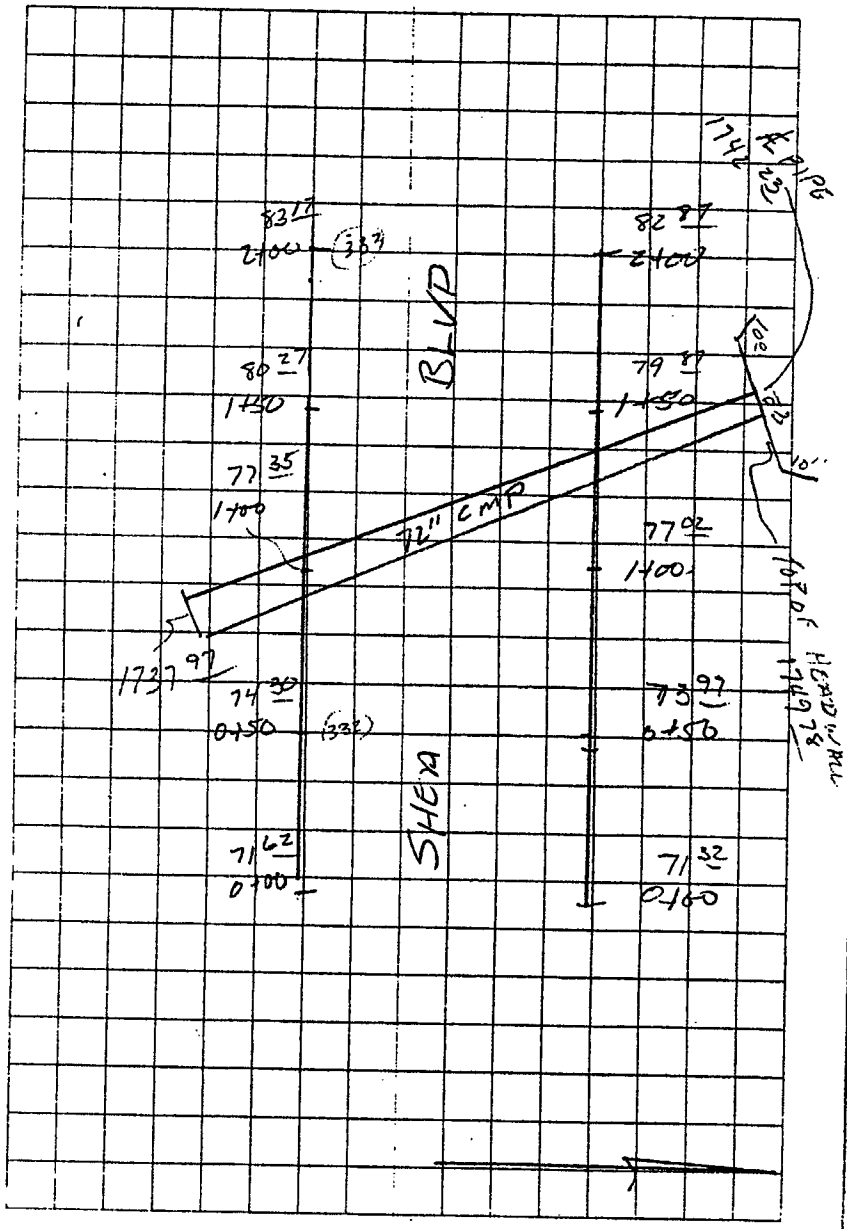


95 .3 MILES WEST OF FOUNTAIN HILLS BLVD

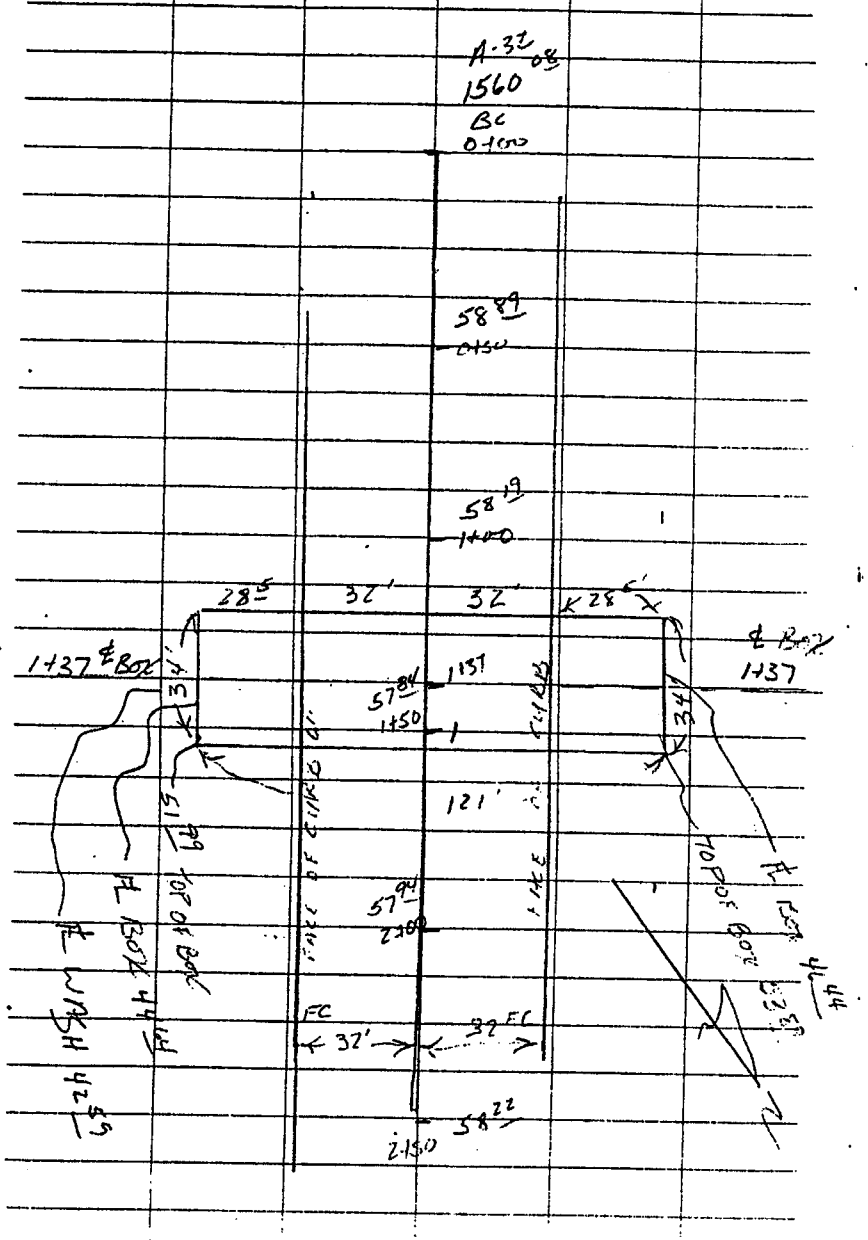
1 SIDE

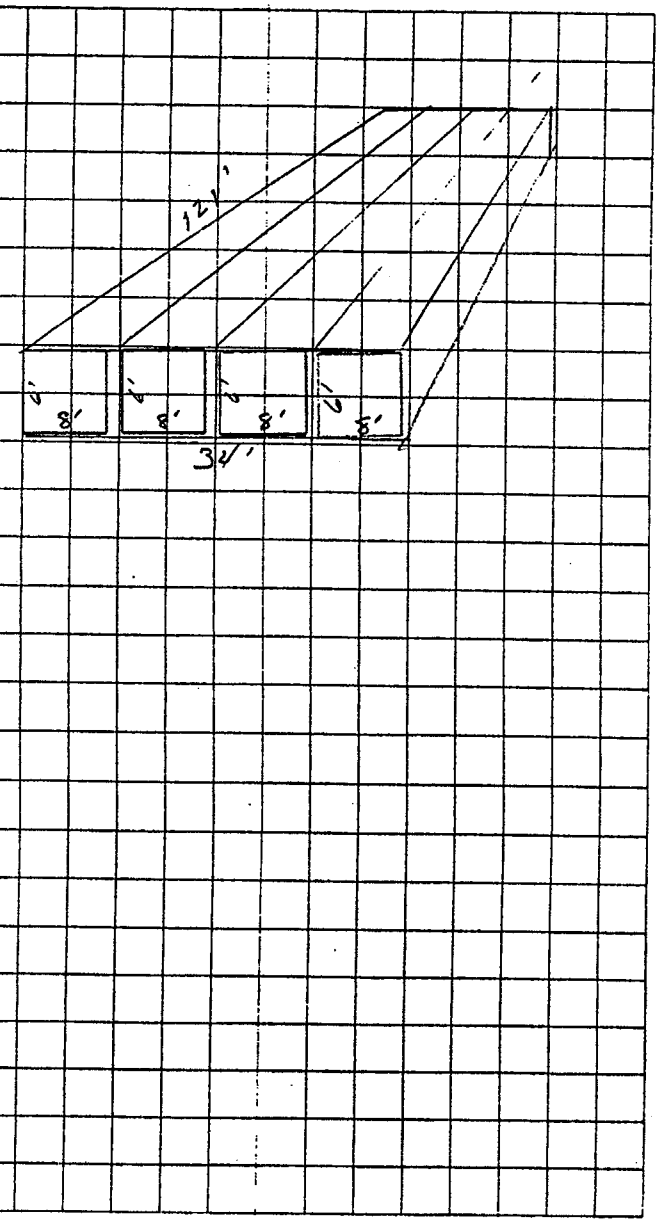
0+50 BS 2+50

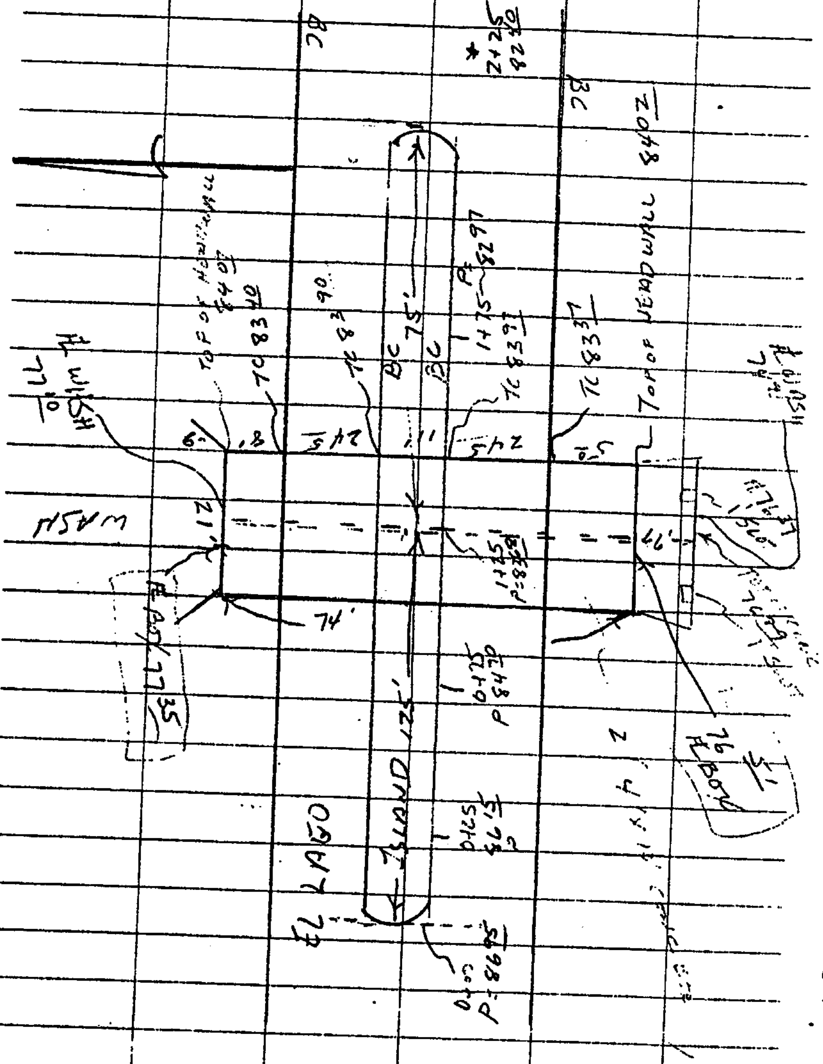
332 333 334	283-01-00	64 10	114 55-00		S END 72" PIPE
335	41-00-00	137 38	87-27-40		TRANPT
335 332 336	201-00-00	89 80	101-06-00		N END 72" PIPE



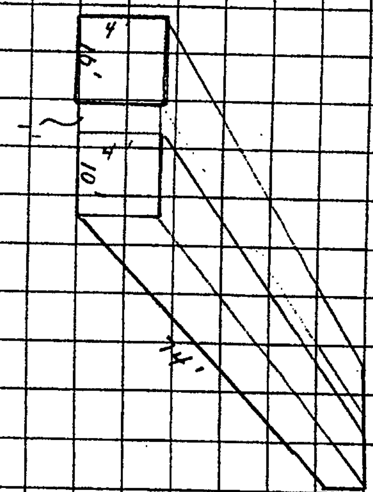
91 0+00 ℄ INY PANAMA AT 1062

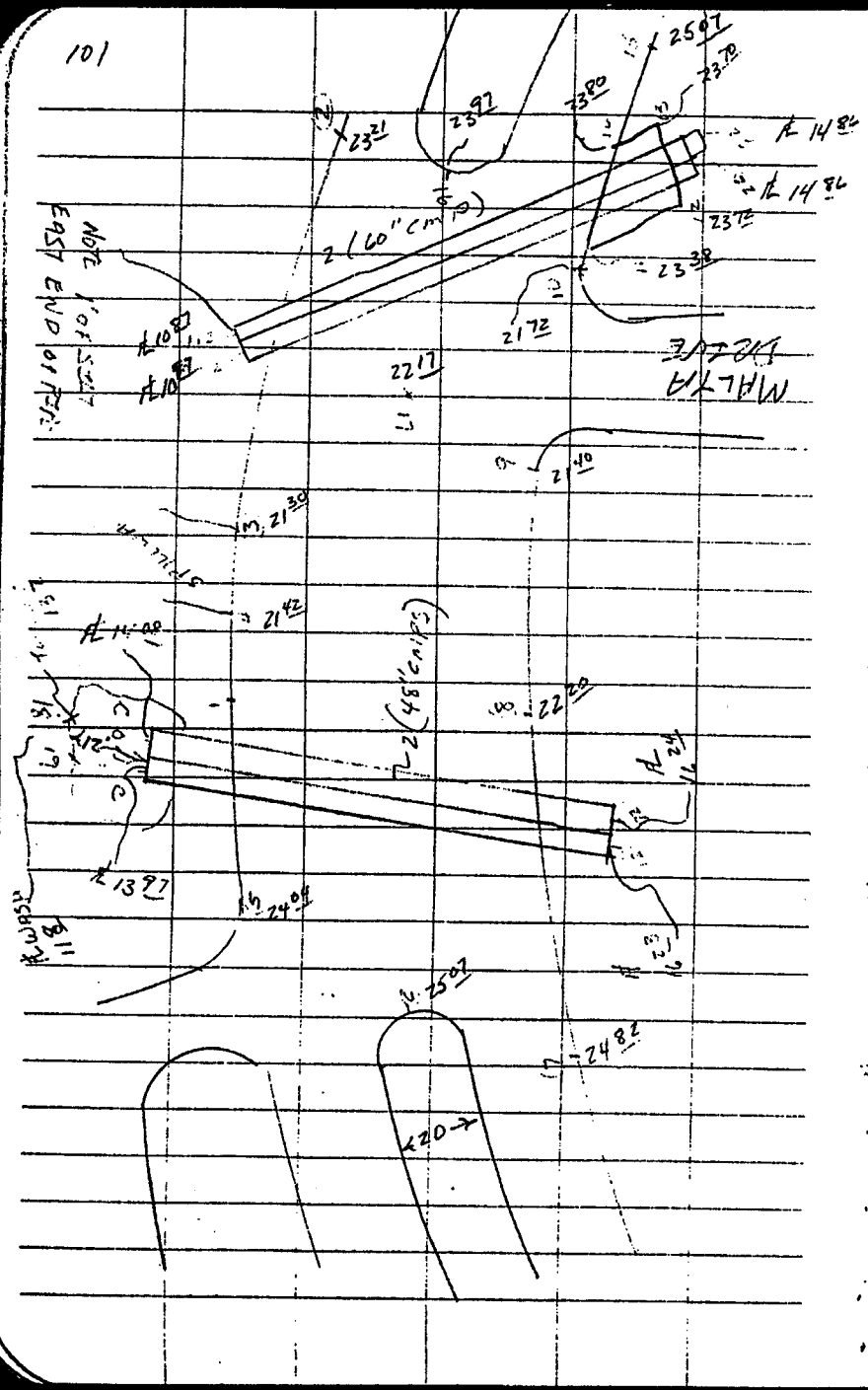






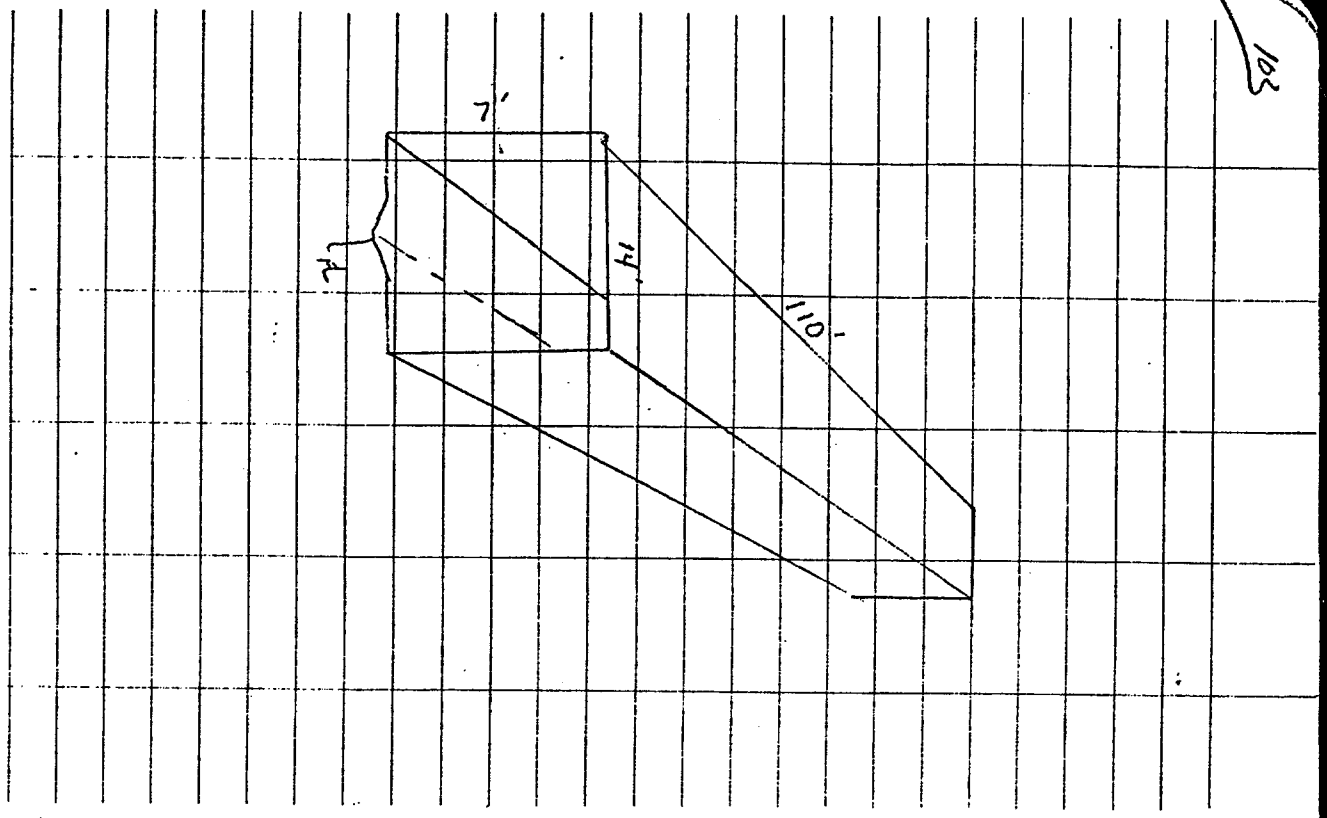
CONC BOX CULVERT
EL LAGO BLVD 600' EAST OF
SAGUARO BLVD

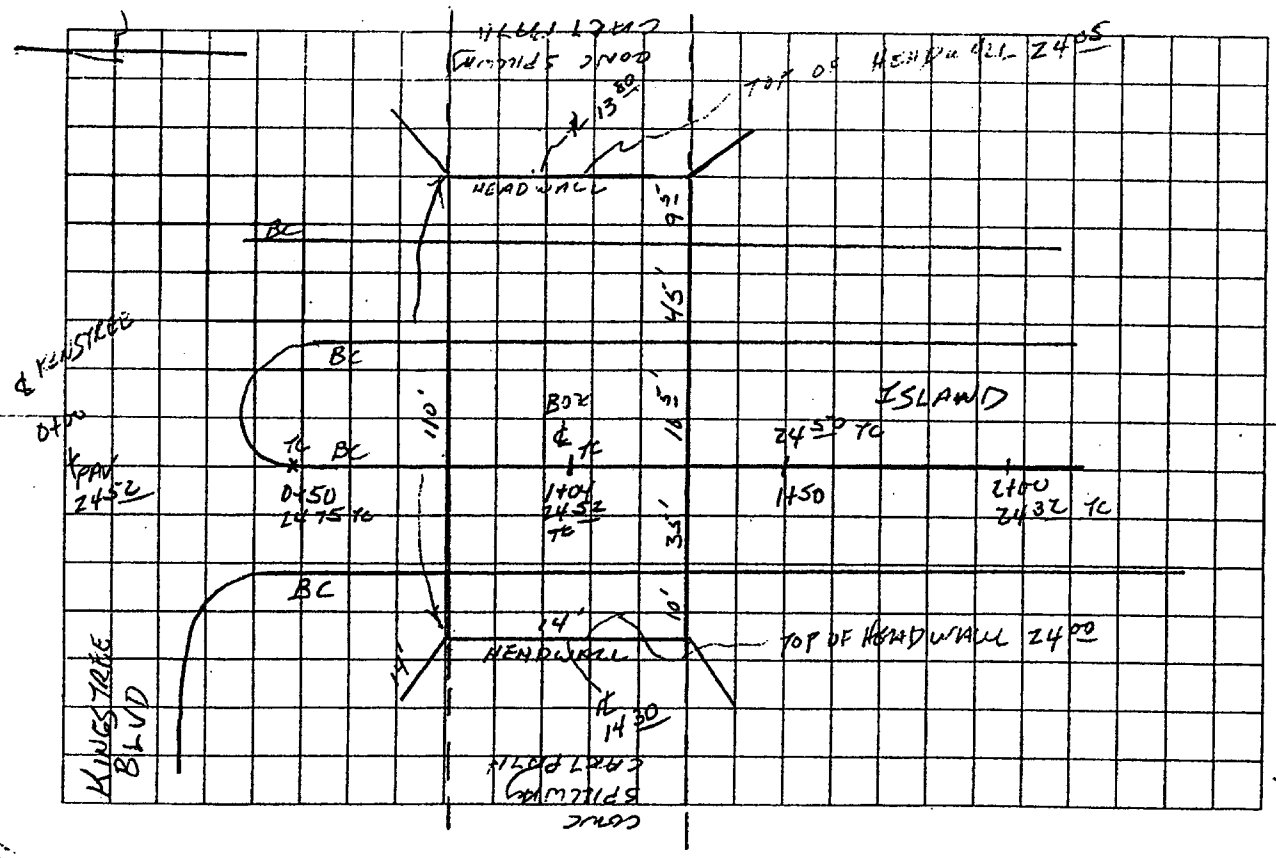




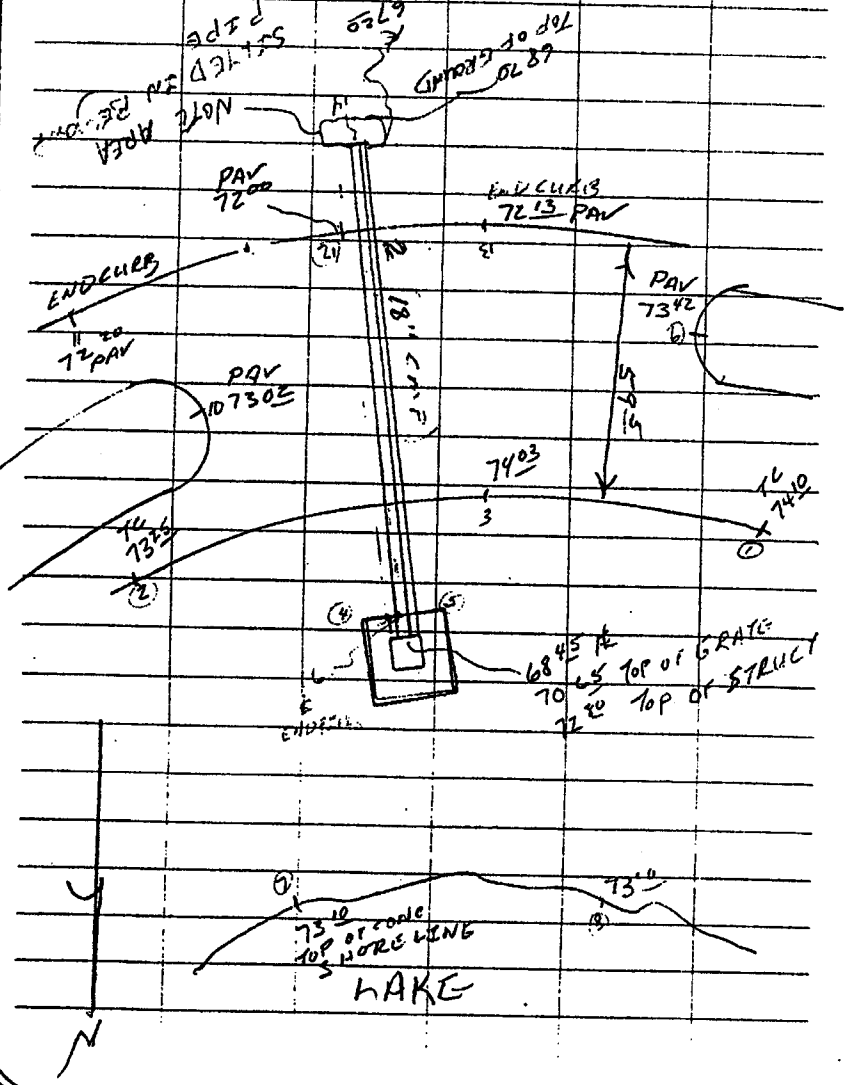
"SAGUARO & MALTA

341	342	0-00-00	270 10		89-33-00
343	3	354-07-00	55 10		89-48-00
344	4	354-10-00	10 80		88-22-00
345	5	169-52-00	89 10		88-06-00
346	6	146-54-00	116 30		88-02-00
347	7	132-08-00	147 00		88-34-00
348	8	98-51-00	93 00		89-20-00
349	9	48-31-00	109 70		89-51-00
350	10	28-34-00	167 10		89-48-00
351	11	18-26-00	284 40		89-34-00
352	12	22-35-00	304 50		89-30-00
353	13	19-20-00	317 50		89-32-00
354	14	17-40-00	311 40		89-32-00
355	15	16-49-00	357 40		89-23-00
356	16	9-42-00	279 75		89-25-00
357	17	17-59-00	114 70		89-28-00
358	18	190-56-00	84 25		88-48-00
359	19	189-56-00	89 20		87-32-00
360	20	114-08-00	135 90		88-23-00
361	21	115-44-00	139 30		88-21-00
362	22	21-42-00	319 50		89-38-00
363	23	21-10-00	326 20		89-39-00
364	24	349-41-00	180 10		89-07-00
365	25	349-34-00	183 30		89-05-00


7'
14'
110'


CONC BOX CULVERT AND KINGSTREE
SABLINO BLVD
CONC SPILLWAY CRACT PATTY
TOP OF HEADWALL 24.05
13.30
HEADWALL
BC
45'
BC
ISLAND
110'
BOX
TC
24.50 TC
TC BC
0+50
24.75 TC
1+00
24.52
TC
1+50
2+00
24.32 TC
35'
BC
14'
10'
HEADWALL
TOP OF HEADWALL 24.00
14.30
CONC SPILLWAY CRACT PATTY
KINGSTREE BLVD
& KINGSTREE
0+00
KPAV
24.52

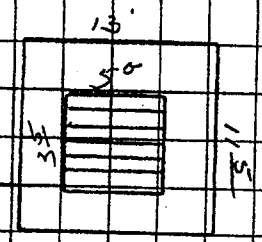
105



2 (18" CMPS

EL LAGO 180' WEST OF TEAL DR.

371	1	0-00-00	154 20	90-11-00
372	3	7-36-00	78 60	
374	4	359-11-00	78 15	
375	5	5-13-00	67 80	
376	6	359-14-00	70-50	
377	7	358-05-00	146 00	
378	8	258-11-00	106 40	
379	9	77-05-00	31 25	
380	10	15-10-00	137 50	
381	11	25-42-00	150 50	
382	12	36-46-00	116 60	
383	13	55-59-00	80 00	
384	14	32-16-00	152 46	
	15			



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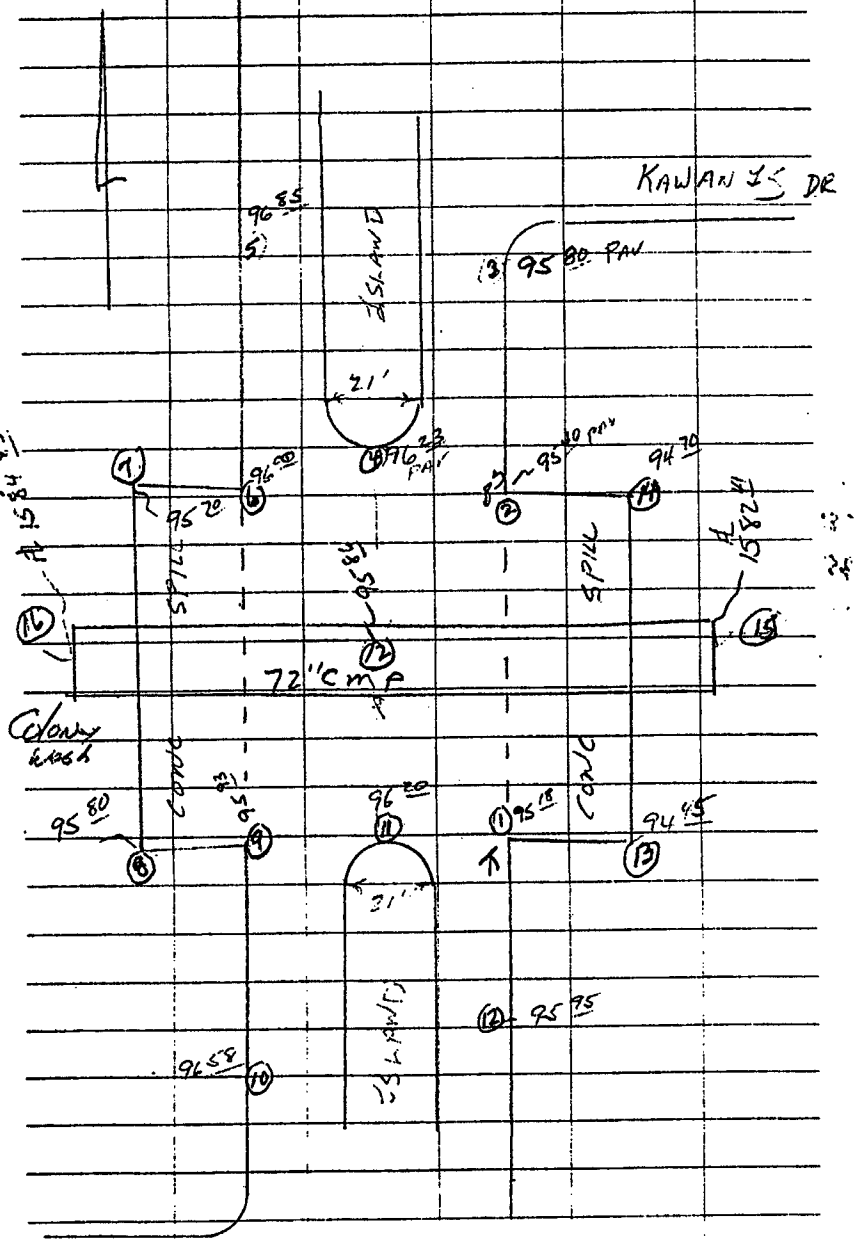
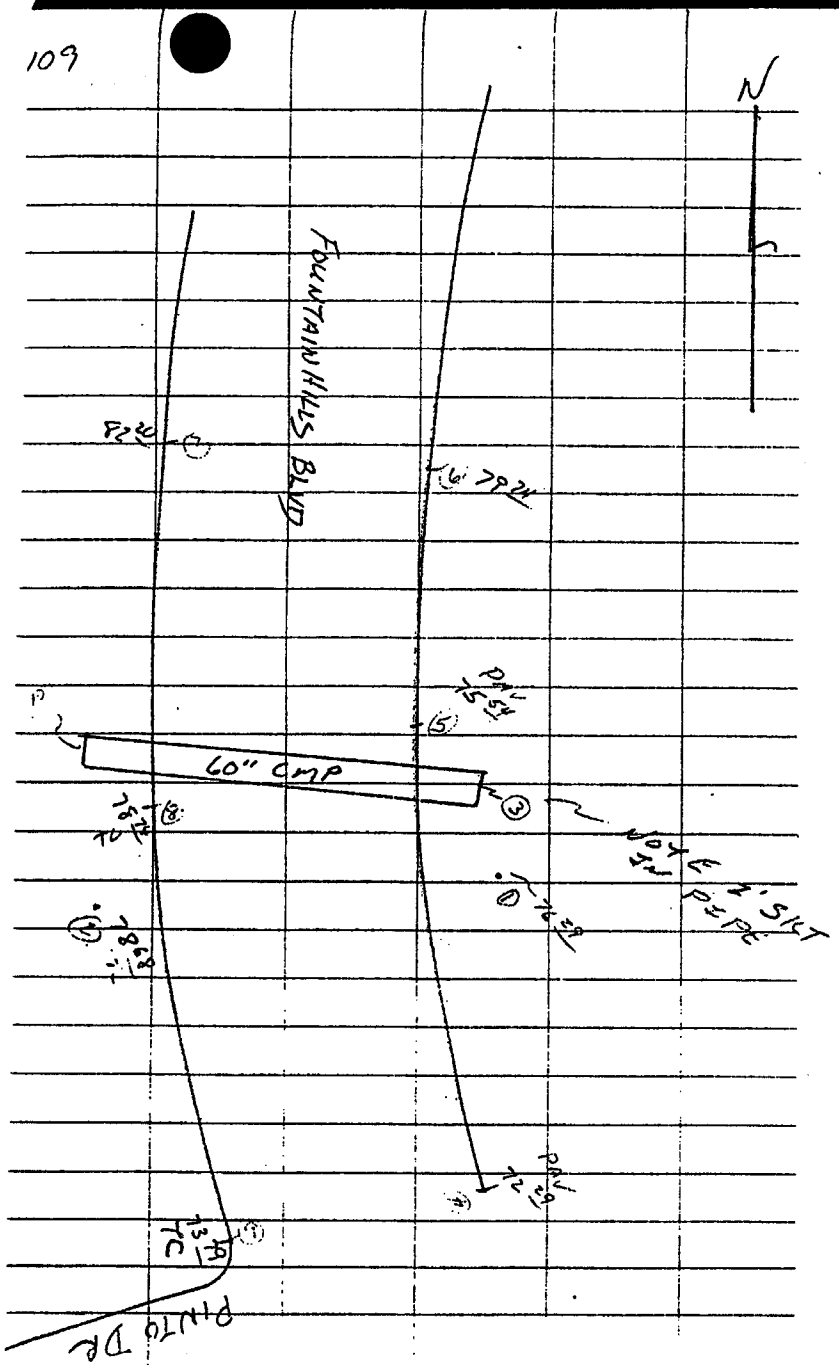


SAGUARO BLVD 300' NORTH OF LAMPLIGHTER WAY

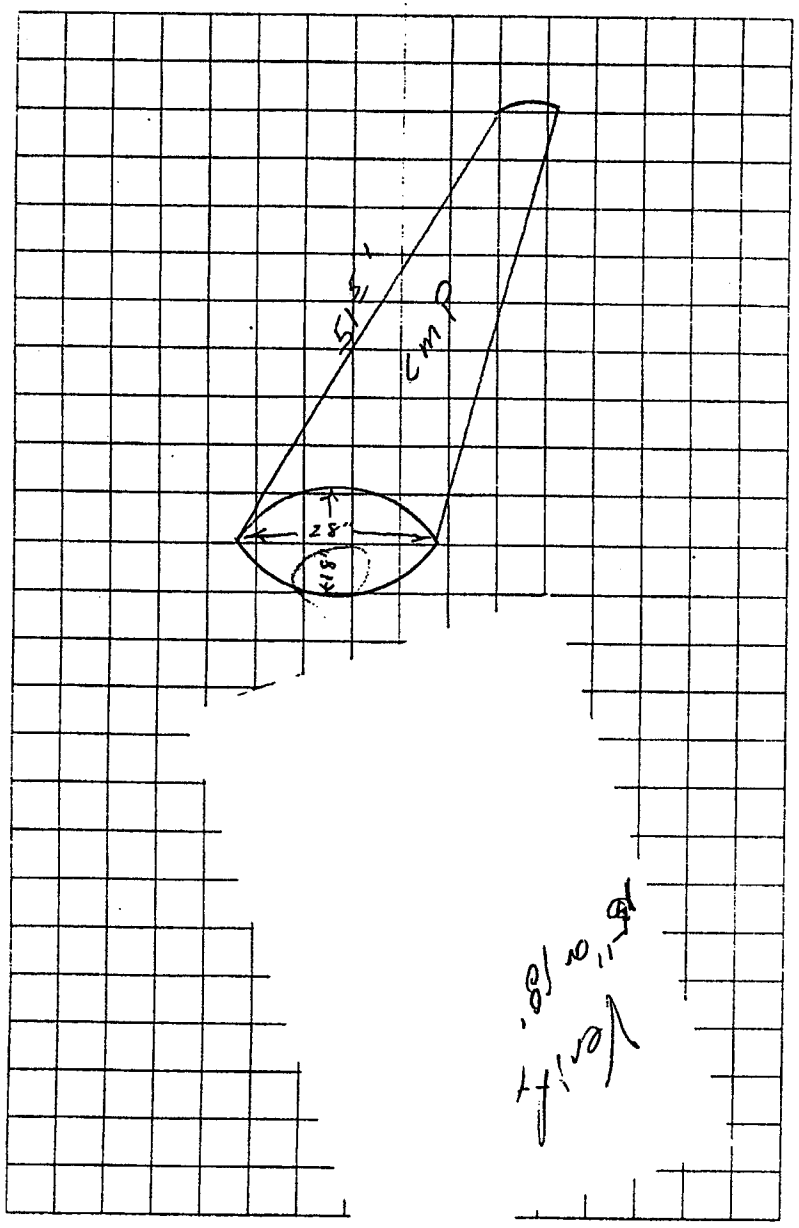
T1	2	0-00-00	81 25
	3	0-13-00	104 35
	4	332-11-00	92 70
	5	326-54-00	161 15
	6	313-14-00	120 70
	7	304-29-00	132 80
	8	274-27-00	113 00
	9	273-08-00	88 80
	10	246-52-00	96 15
	11	271-46-00	46 40
	12	180-32-00	39 00
	13	75 42	19 75
	14	16-42-00	78 00
	15	43-01-00	57 85
	16	287-33-00	133 00
	17	312-33-00	62 90

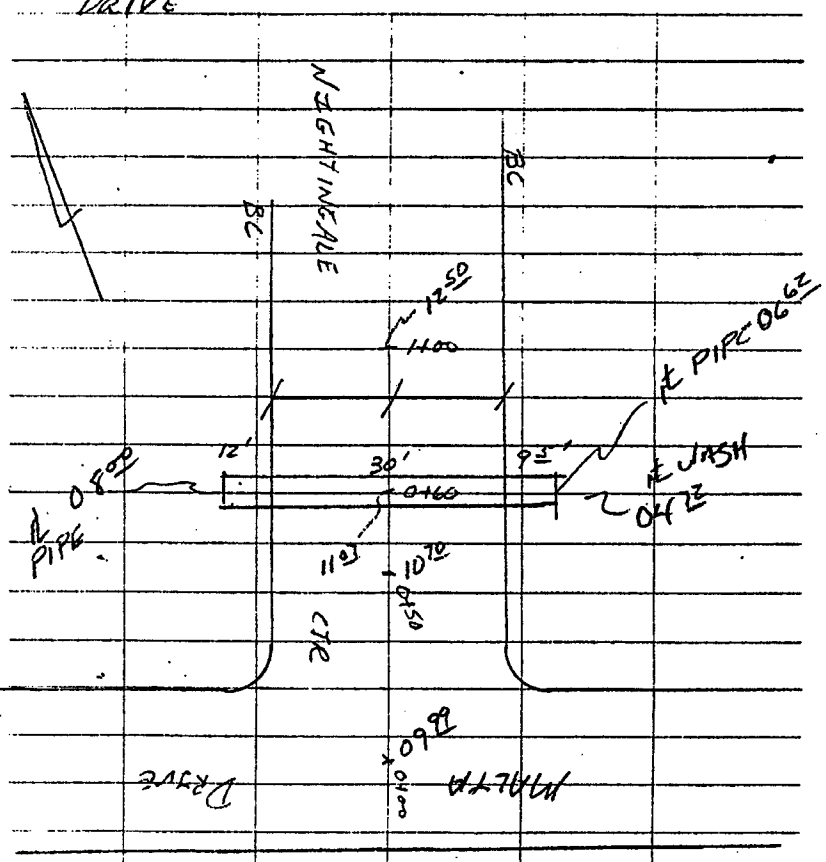


FOUNTAIN HILLS 100' NORTH OF PINTO DRIVE

391	1	2		0-00-00				109.00				89-11-00					
393	3			136-46-00				41.24				119-27-49					
394	4			270-47-00				90.60				92-03-00					
395	5			326-51-00				38.00				90-00-00					
396	6			40-13-00				67.00				86-42-00					
397	7			32-30-00				114.00				86-53-00					
398	8			6-29-00				98.70				88-08-00					
399	9			309-08-00				107.85				90-58-00					
	2	1															
400	10			210-40-00				40.20				108-31-53					
	1	1		HI 5.10				ROD 5.80				(3) Top of Pipe					
	7	2		HI 5.20				ROD 9.05				(10) Top of Pipe					

NIGHTINGALE CIR 60' NORTH OF MALTA DRIVE

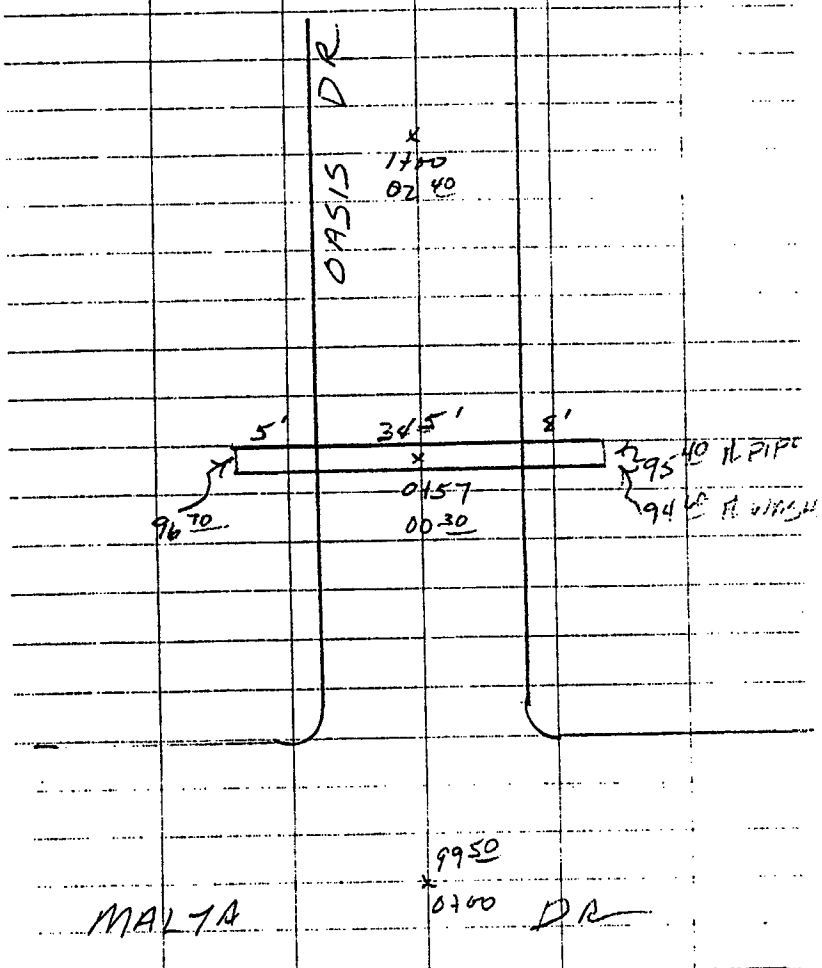




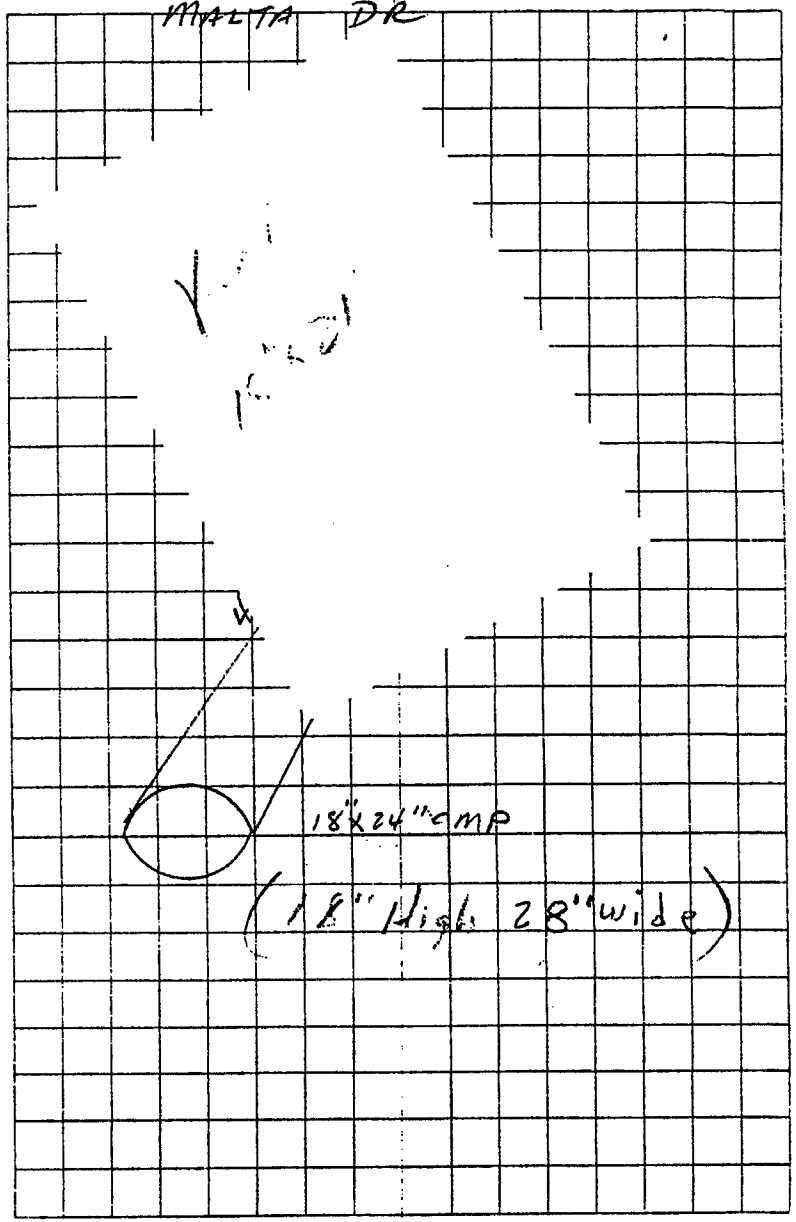
NOTE ELIPTICAL PIPE 28" x 15"

111

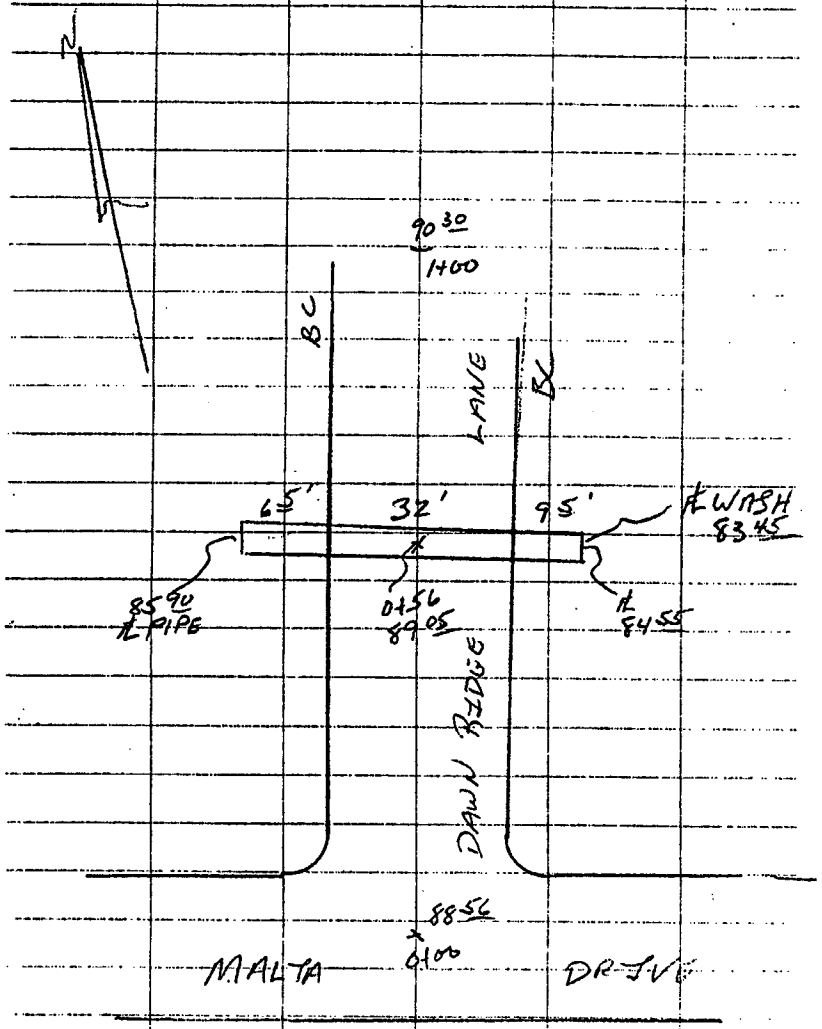
113



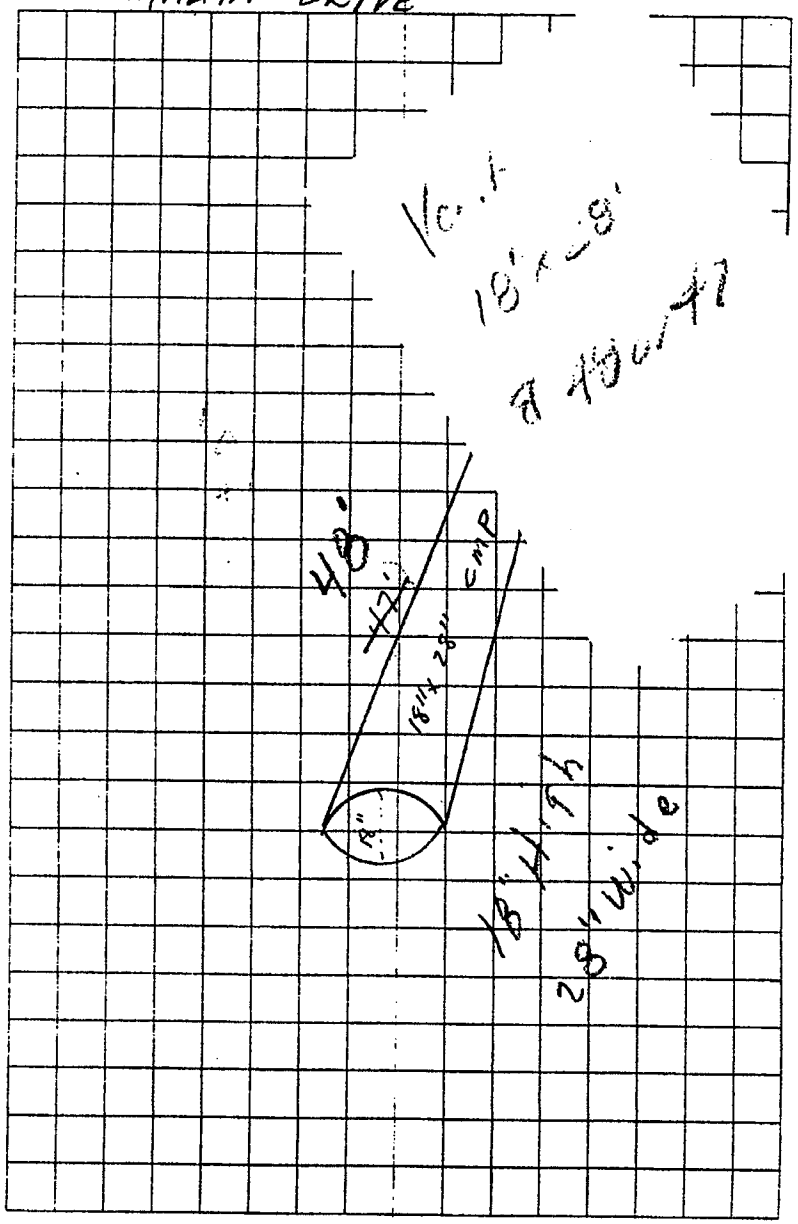
OASIS DR 57' NORTH OF MALTA DR



115



DAWN RIDGE LANE 56' NORTH OF MALTA DRIVE



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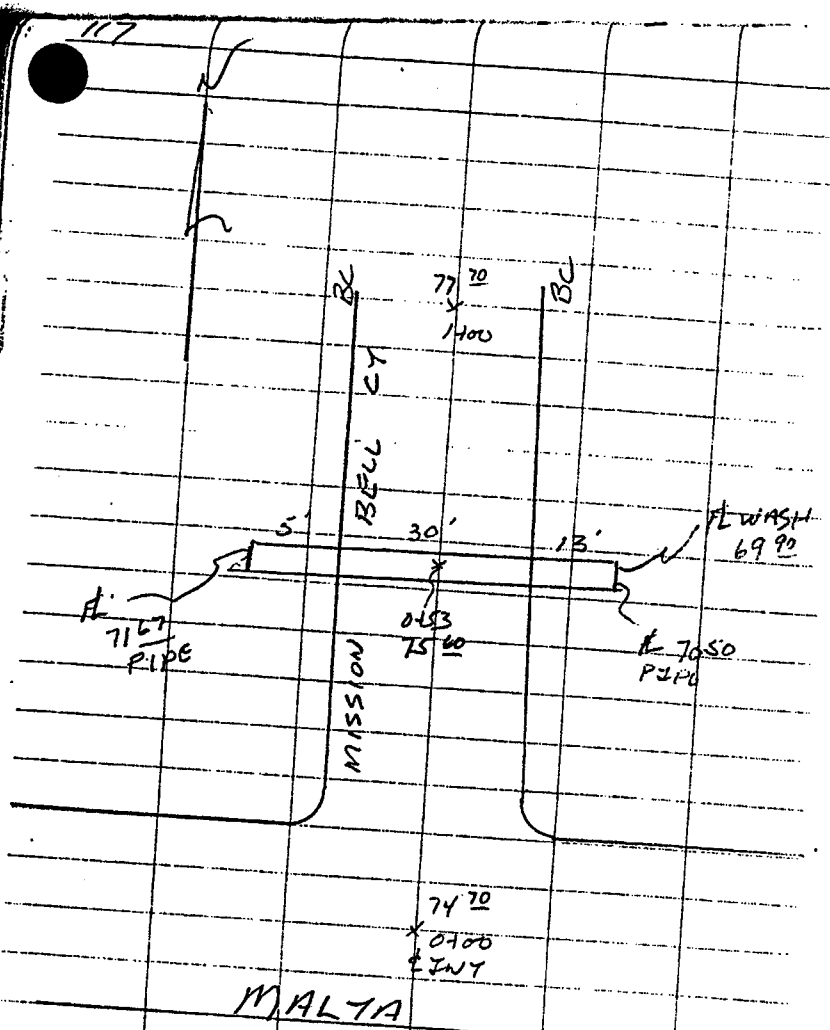
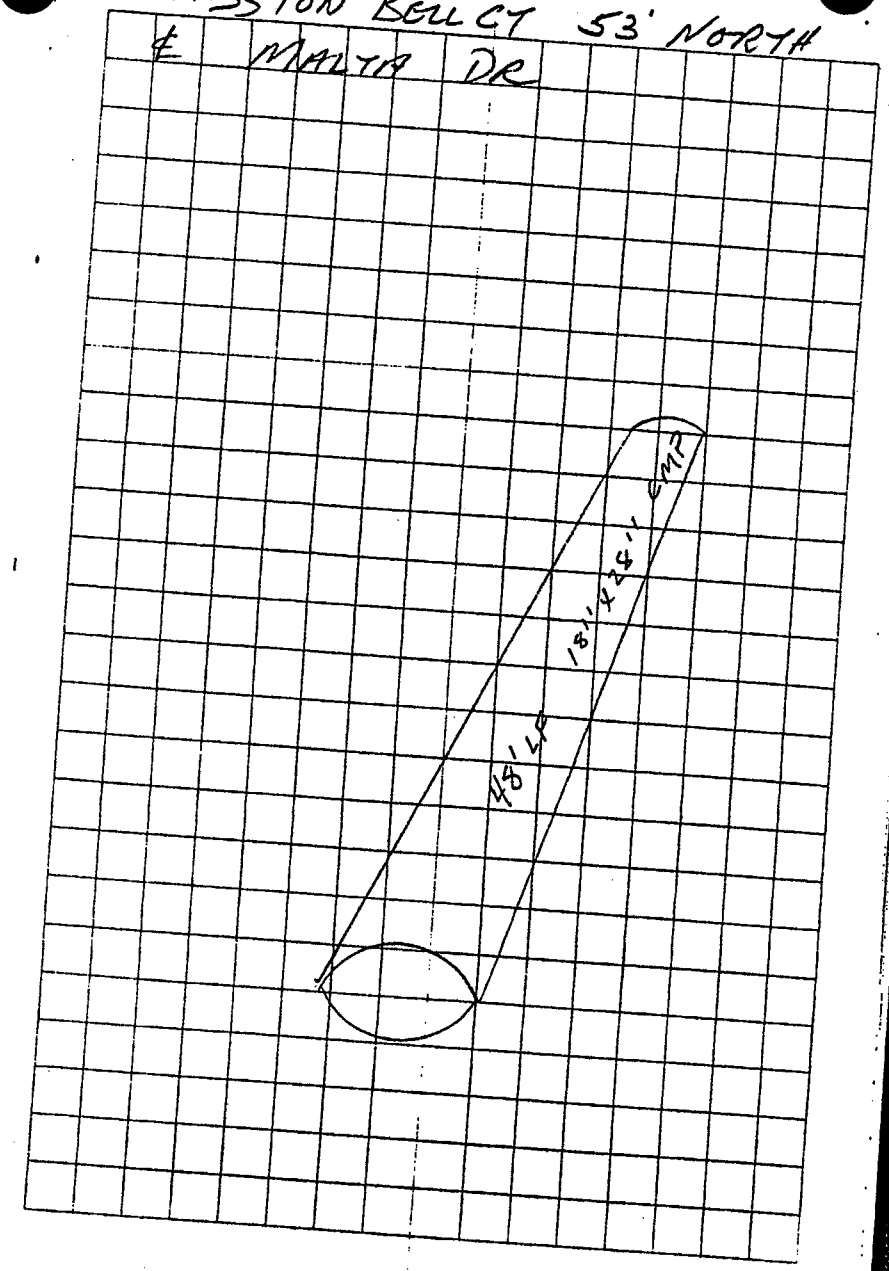
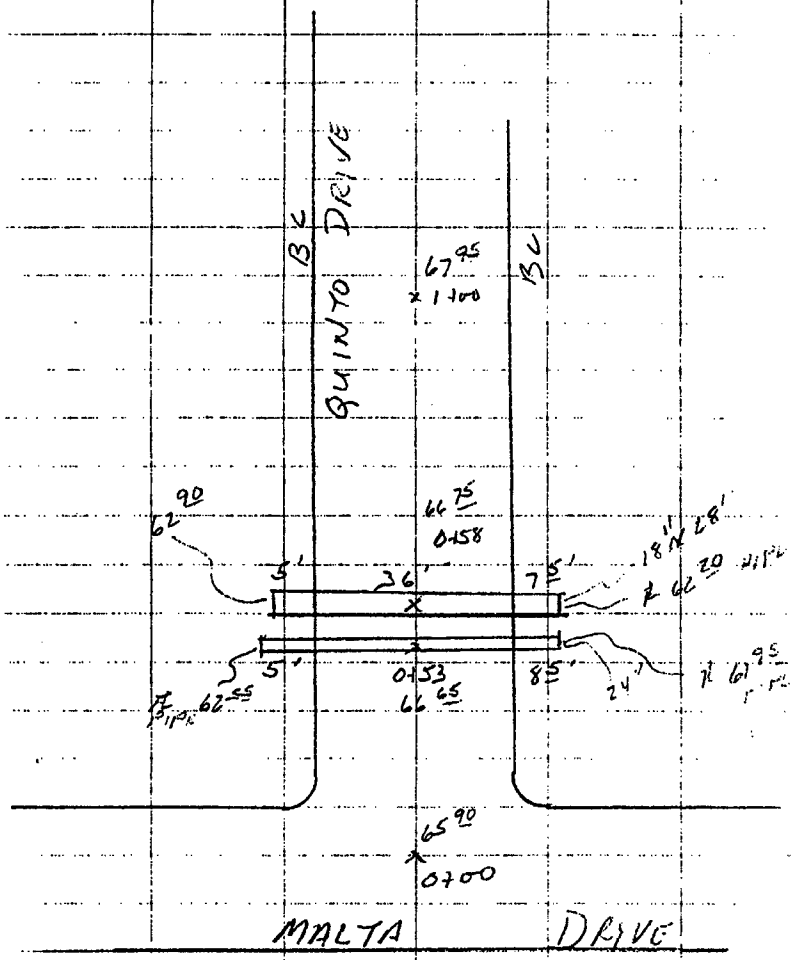
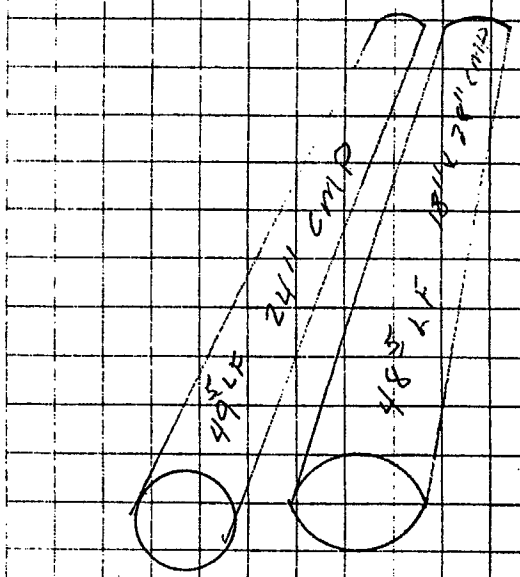


MISSION BELL CT 53' NORTH

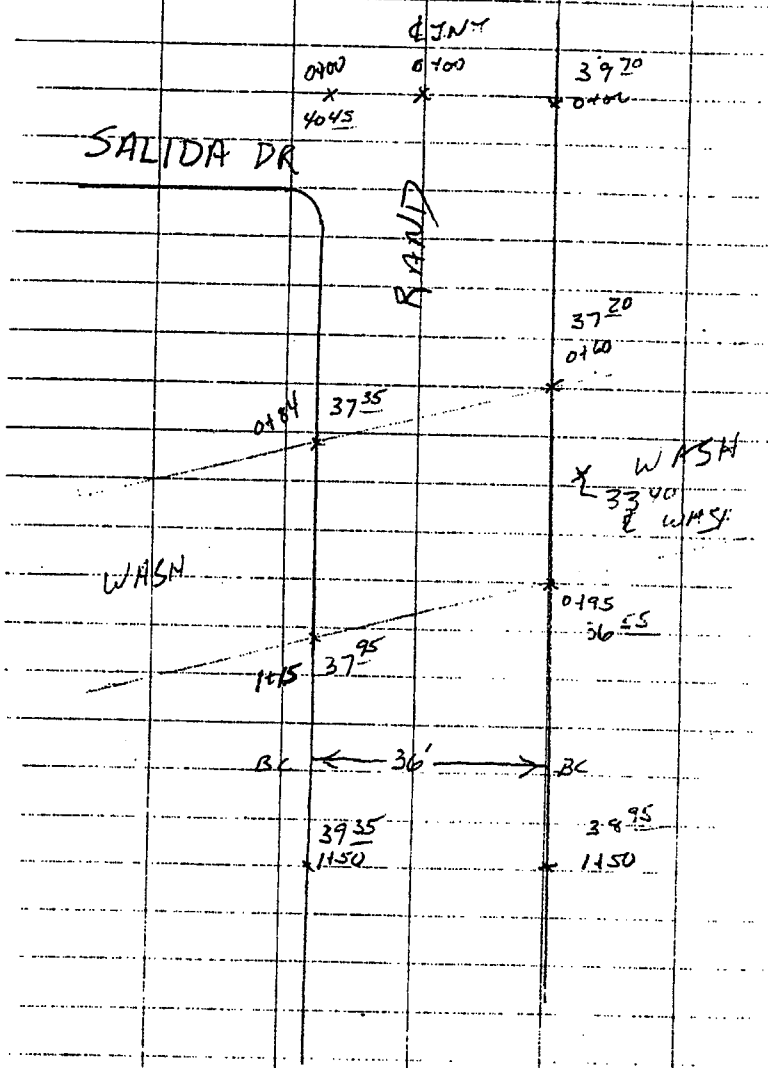




QUINTO DRIVE NORTH OF MALTA



123

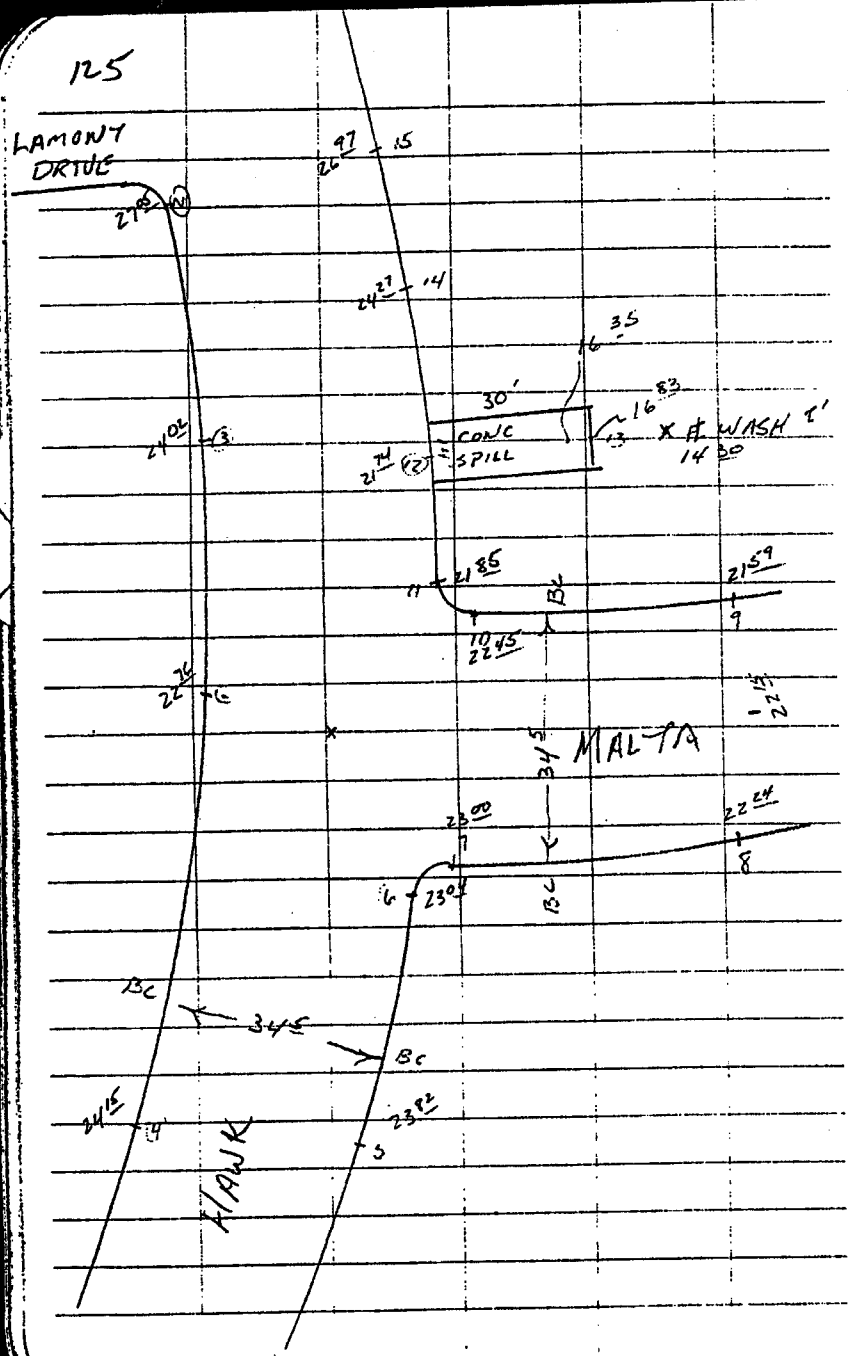


RAND DRIVE 155' NORTH OF MALTA

NOTE NO PIPE WASH CROSSES OVER PAVEMENT

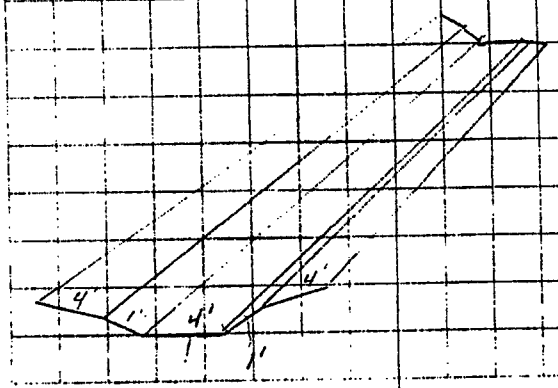
(NO)

125

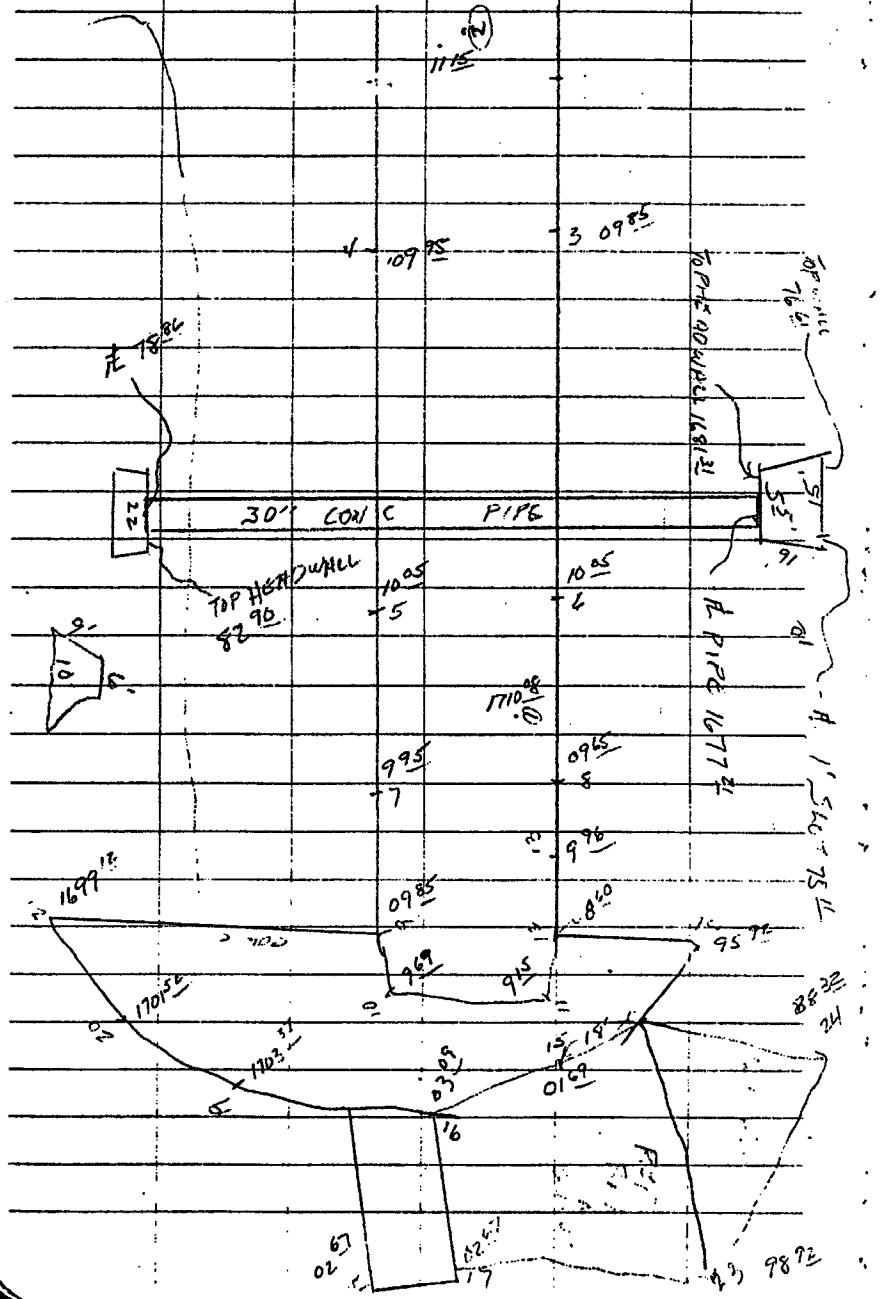


INT MALTA & HAWK

420			
431	1	0-00-00	155 45
433	3	4-48-00	85 65
434	4	198-03-00	94 90
	5	179-50-00	102 60
	6	149-52-00	46 70
	7	118-12-00	53 90
	8	110-52-00	93 45
	9	91-06-00	92 00
	10	83-55-00	54 55
	11	51-14-00	47 55
	12	40-58-00	60 25
	13	59-20-00	80 90
	14	70-03-00	110 40
	15	10-58-00	166 00



127



DAM

401	402				
1	3	0-00-00	292 40		
3.		1-47-00	262 75		
4		358-70-00	259 70		
5		356-47-00	163 00		
6		1-58-00	162 00		
7		348-57-00	55 55		
8		6-56-00	51 30		
9		185-01-00	52 25		
10		152-46-00	91 90		
11		174-26-00	89 45	88-31-00	
12		170-11-00	83 50	88-48-00	
13		175-22-00	68 50	87-25-00	
14		149-57-00	96 25	93-05-00	
15		167-28-00	101 50	—	
16		175-12-00	105 75	—	
17		164-46-00	192 50	—	
18		167-19-00	97 50	—	
19		157-06-00	108 90	—	
20		178-13-00	97 00	—	
21		265-54-00	87 75	91 58-00	
22		278-[illegible]-00	92 [illegible]	100-00-00	
23		[illegible]	193 [illegible]	93-09-00	
24		137-55-00	157 30	95-07-00	
25		52-51-00	86 10	107-09-00	

SYM	+	HI	-	ELEV
J-18				1714 61
	0 02	1714 63		
O-1			11 67	1702 96
	2 61	1705 57		
O-2			11 11	1694 46
	5 23	1699 69		
O-3			16 07	1683 62
	24 10	1707 72		
O-4			4 63	1703 09
	12 50	1715 59		
O-5			4 44	1711 15
	2 37	1713 52		
O-6			9 01	1704 51
	3 29	1707 80		
O-7			11 05	1696 75
	6 99	1703 74		
O-8			1 25	1702 49
	8 77	1711 26		
O-9	1		2 48	1708 78

SEE PG 59 BC

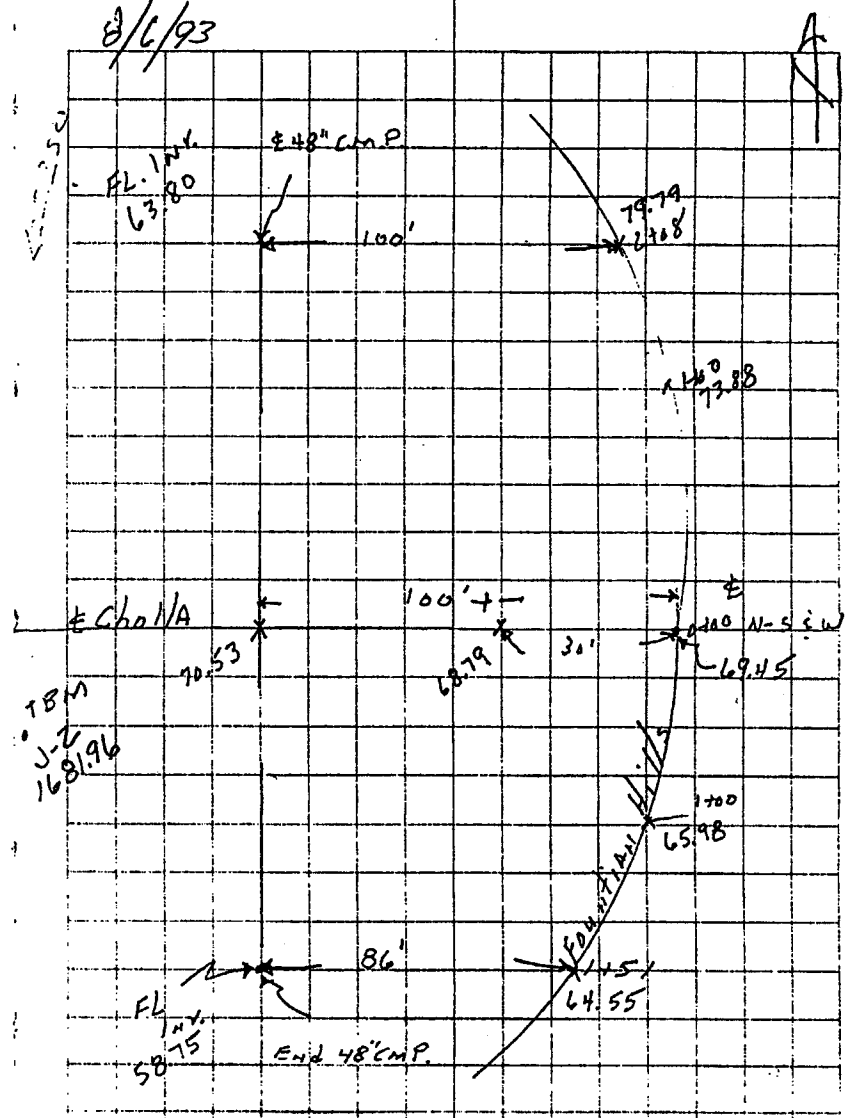
PT # 16

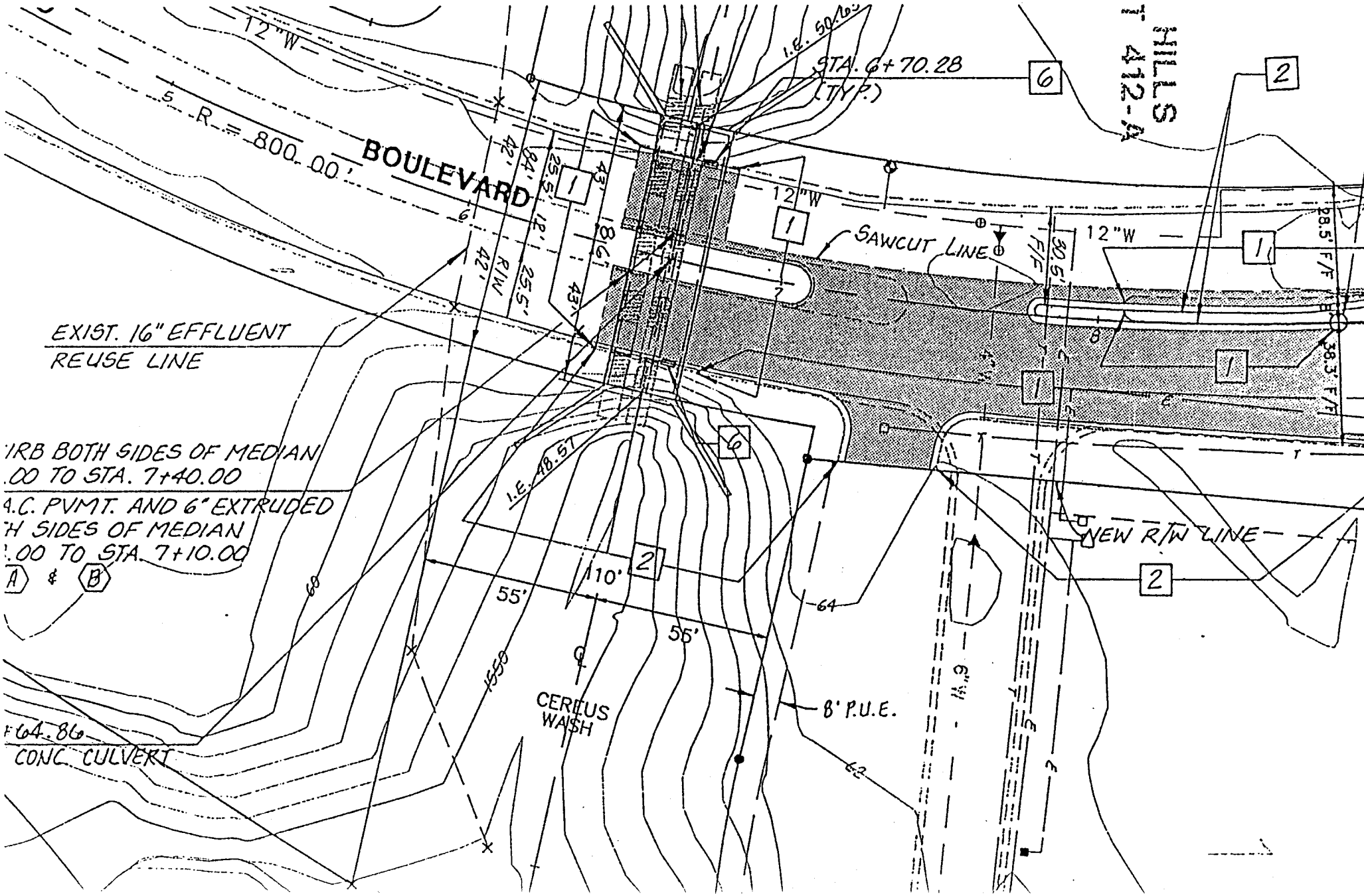
PT # 2

SAME AS J-19

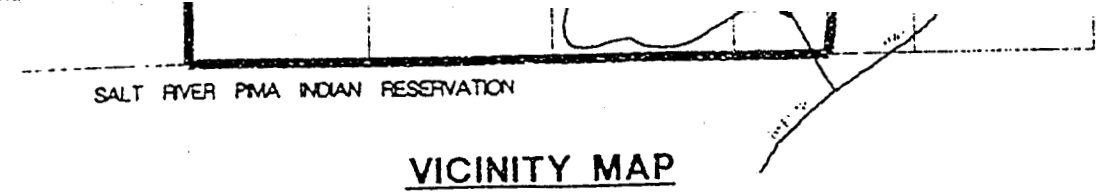
Sta	+	H. I.	−	Elev
TBM J-2				1681.96
	3.39	85.35		
1+00 W.			14.82	70.53
0+30 W.			16.56	68.79
0+00 N.S.&W.			15.90	69.45
1+00 N.			11.47	73.88
2+08 N.			5.56	79.79
℄ N.			21.55	63.80
1+00 S.			19.37	65.98
1+51 S.			20.80	64.55
℄ S.			26.60	58.75
L-2 TBM			21.70	63.65

8/6/93



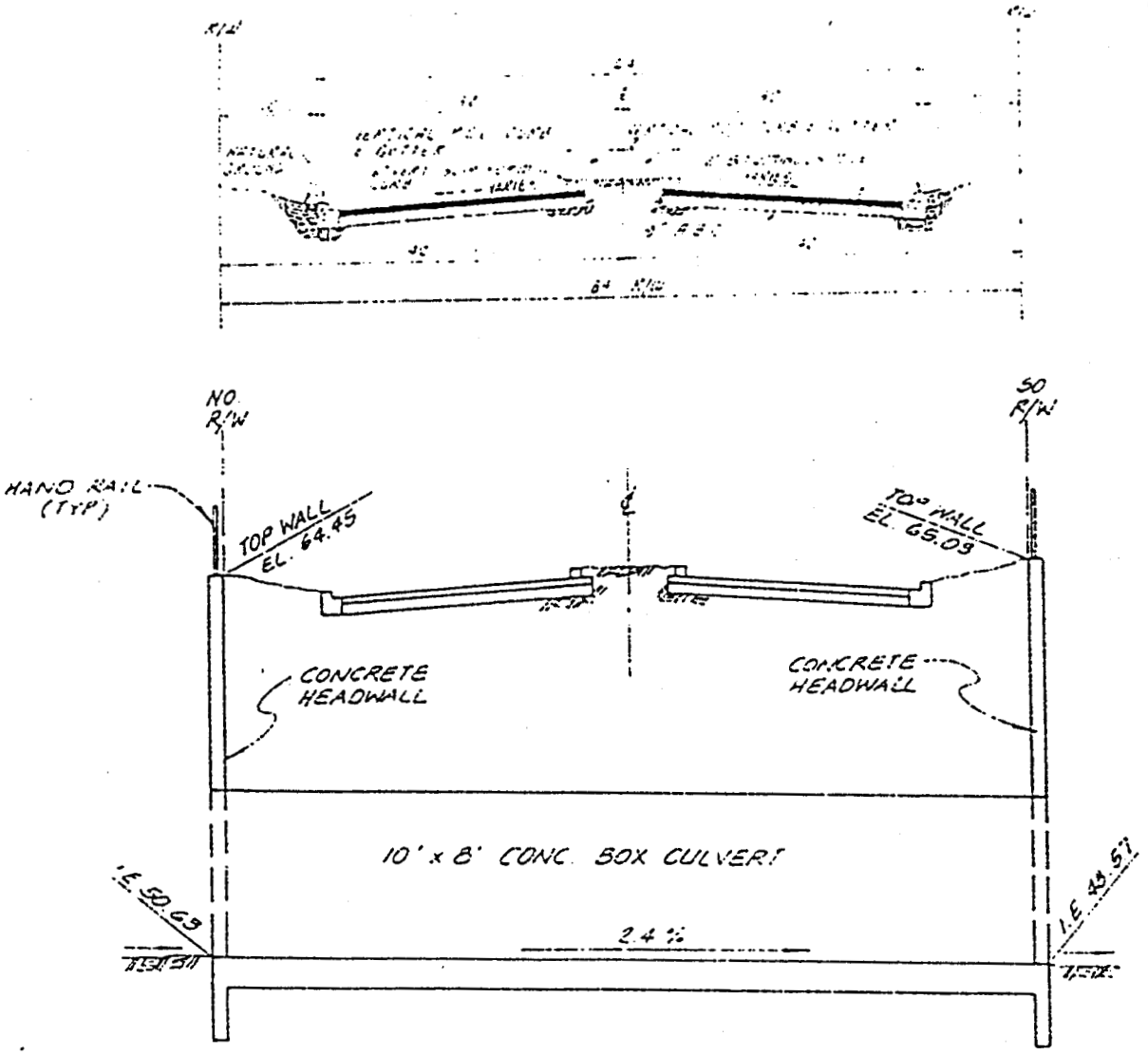

12"W
R = 800.00'
BOULEVARD
STA. 6+70.28
(TYP.)
I.E. 50.65
12"W
SAWCUT LINE
12"W
28.5' F/F
38.3' F/F
30.5'
F/F
EXIST. 16" EFFLUENT
REUSE LINE
IRB BOTH SIDES OF MEDIAN
.00 TO STA. 7+40.00
A.C. PVMT. AND 6" EXTRUDED
H SIDES OF MEDIAN
.00 TO STA. 7+10.00
A & B
I.E. 48.57
NEW R/W LINE
110'
55'
55'
CEREUS
WASH
8' P.U.E.
64.86
CONC. CULVERT
42'
94.12'
25.5'
43'
18.6'
RIW
42'
25.5'
43'
60
1550
64
62

HILLS
T 412-A



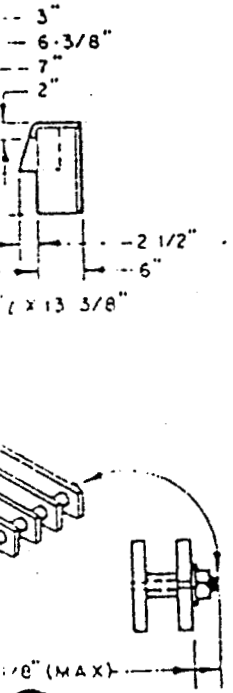
VICINITY MAP

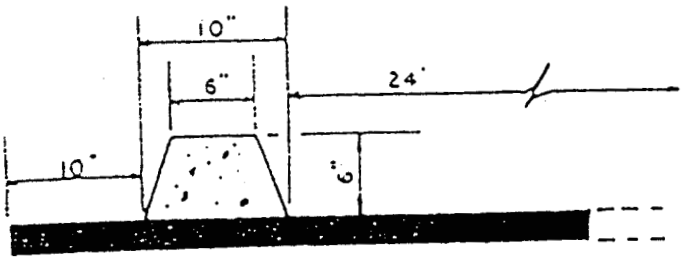
NTS



84' R/W MAJOR COLLECTOR ROAD

DETAIL (A)





6" VERT. SUB-FO

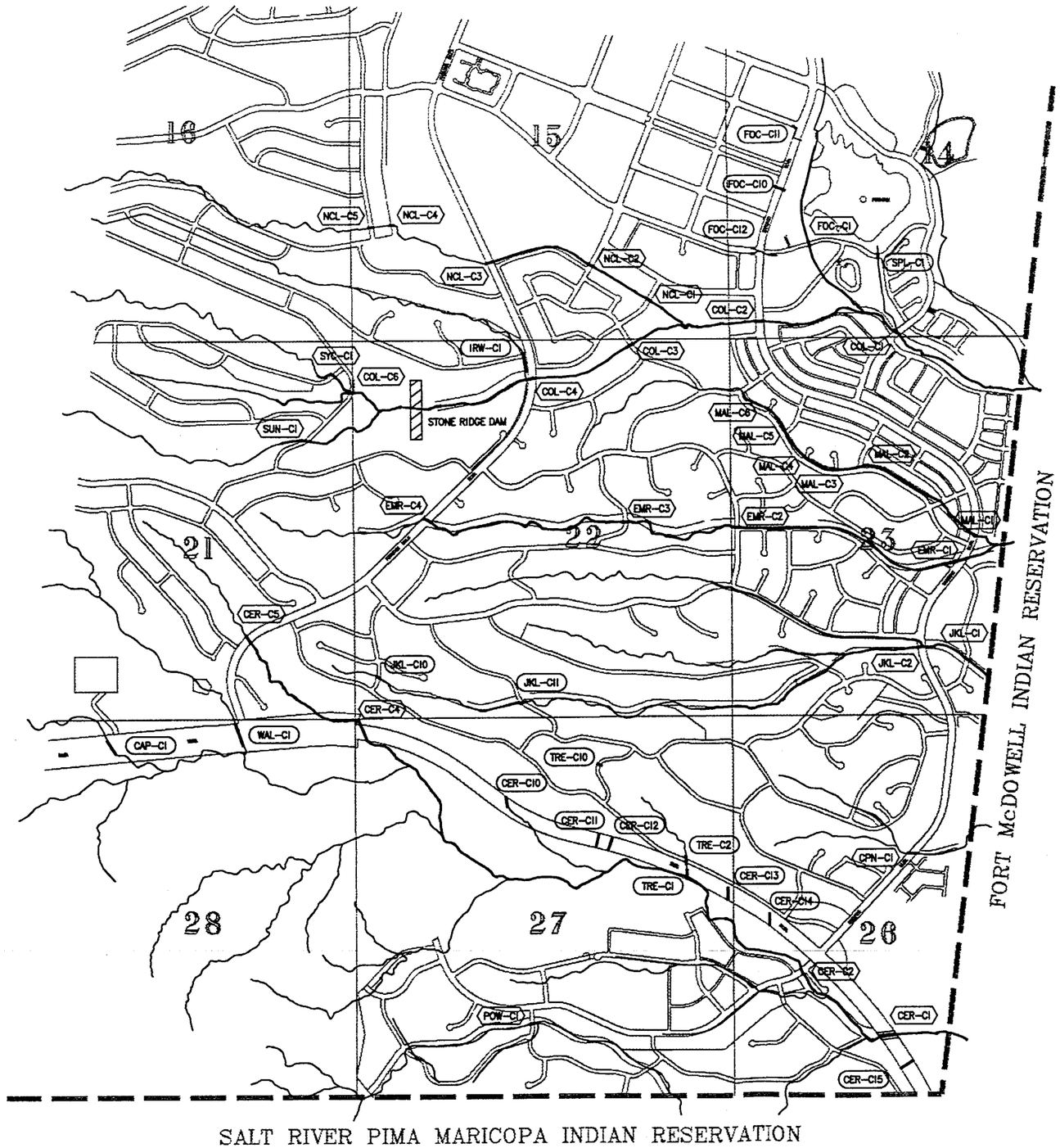
FOUNTAIN HILLS F

BY	
DATE	

BLVD.

CONSTRUCTION NOTES

1. SAWCUT & REMOVE CONC. CURB AND A.C. PVM'T.
2. INSTALL 6" CURB & GUTTER PER M.A.G. STD. DET. 220-A.
3. INSTALL 6" EXTRUDED CURB.
4. REMOVE 2-60" C.M.P.
5. CONSTRUCT 86 L.F. CONCRETE DOUBLE BOX CULVERT PER A.D.O.T. STD. DET. B-02.20, TABLE II, S=10', H=8', SKEW=0°, SLOPE=0.024% (ADJUST SLOPE TO FLOW LINE OF WASH), INLET & OUTLET WINGS STD. DET. B-04.60, 45° SKEW & 4:1 EMBANKMENT SLOPES AND HEADWALL W/HAND RAIL. SHT. 1, DET. "A"
6. INSTALL MODIFIED CATCH BASIN PER DET. "C" SHEET 1.
7. SURVEY MONUMENT PER M.A.G. STD. DET. 120-1 TYPE B.



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF FOUNTAIN HILLS SOUTH

F.C.D. CONTRACT NO. FCD 92-05

LEGEND

CULVERT	—
HEC-1 AND HEC-2 CULVERT	CER-C1
HEC-1 CULVERT ONLY	CAP-C1
HEC-2 HYDRAULIC BASELINE	———
HEC-1 HYDRAULIC BASELINE	———

N

800 0' 800 1,600

SCALE: 1"= 800'

ACK ENGINEERS, INC.
2255 NORTH 44TH STREET, SUITE 330
PHOENIX, ARIZONA 85008
TELEPHONE (602) 244-2566

	BY	DATE
DESIGN	HAA	3/96
DESIGN CHK.	SEK	3/96
PLANS	JDS	3/96
PLANS CHK.	HAA	3/96
SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

SHEET 1 OF 1

Dwg. Name: C:\FTHILLS\CLRTMAP.Dwg
Date: REV. MAR. 28, 1996 7:00am

Culvert ID	Culvert size	Roadway Name
POW-C1	5-48" CMP	Leo Drive
CER -C1	3 barrel 12' X 12' box	Shea Boulevard
CER -C2	2 barrel 10' X 8' box	Saguaro Boulevard
CER -C4	1-84" CMP	Shea Boulevard
CER -C5	1-60" CMP	Fountain Hills Boulevard
CER -C10	1-48" CMP	Shea Boulevard
CER -C11	1-36" CMP	Shea Boulevard
CER -C12	1-24" CMP	Shea Boulevard
CER -C13	2-30" CMP	Shea Boulevard
CER -C14	1-36" CMP	Shea Boulevard
CER -C15	2-30" CMP	Shea Boulevard
TRE -C1	1-84" CMP	Shea Boulevard
TRE -C2	2-60" CMP	Trevino Drive
TRE -C10	1-43" X 27" CMA	Nelson Road
WAL -C1	10' X 10' Box	Shea Boulevard
CAP -C1	2-72" CMP	Shea Boulevard
CPW -C1	1-48" CMP	Saguaro Boulevard
JKL -C1	2-60" CMP	Indian Wells Drive
JKL -C2	7' X 14' Box	Saguaro Boulevard
JKL -C10	36" CMP	Apiam way
JKL -C11	42" CMP	Keota Drive
EMR -C1	2-60" CMP	Saguaro Boulevard
EMR -C2	1-60" CMP	Inca Avenue
EMR -C3	1-600" CMP	Baron Drive
EMR -C4	1-60" CMP Bottom 1' grouted	Fountain Hills Boulevard
MAL -C1	2-48" CMP	Saguaro Boulevard
MAL -C2	1-24 CMP and 1-18" X 28" CM	Quinto Drive
MAL -C3	1-18"X28" CMA	Mission Bell Court
MAL -C4	1-18"X28" CMA	Dawn Ridge Lane
MAL -C5	1-18"X28" CMA	Oasis Drive
MAL -C6	1-18"X28" CMA	Nightingale Circle
COL -C1	4 Barrel 6"X8' Box	Panorama Drive
COL -C2	1-72" CMP	Saguaro Boulevard
COL -C3	2-60" CMP	Arroyo vista Drive
COL -C4	2-60" CMP 1 with bottom grout	Fountain Hills Boulevard
COL -C6	2-60" CMP and 1-48" CMP	Sycamore Drive
FOC -C1	2 Barrel 4' X 10' Box	El Lago Boulevard
FOC -C10	1-36" CMP	Saguaro Boulevard
FOC -C11	1-36" CMP	Saguaro Boulevard
FOC -C12	1-54" concrete lined CMP	Saguaro Boulevard
NCL -C1	1-60" CMP	Chama Drive
NCL -C2	1-60" CMP and 1-66" CMP	La Montana Drive
NCL -C3	1-60" CMP	Fountain Hills Boulevard

Culvert ID	Culvert size	Roadway Name
NCL -C4	1-60" CMP	Mountainside Road
NCL - C5	1-60" CMP	Minosa Drive
IRW -C1	1-48" CMP	Cholla Drive
SUB -C1	1-48" CMP	Sycamore Drive
SYC -C1	1-60" CMP	Greystone Drive
SPL -C1	2-18" CMP	El Lago Boulevard

If found please return to

Name Valco Surveying Corporation

Address 6426 E. Virginia Ave.

Phone (602) 990-2412

Projects Fountain Hills Flood Study

AGK Engr's # 310.43

Valco Surveying Corp. # 0116-010

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Meredith, N.H. 03253

Fountain Hill Flood Study

Drainage Structure "As Bui Hs"

ACK Engr's # 310.43

Valco Surveying Corp. # 0116-010

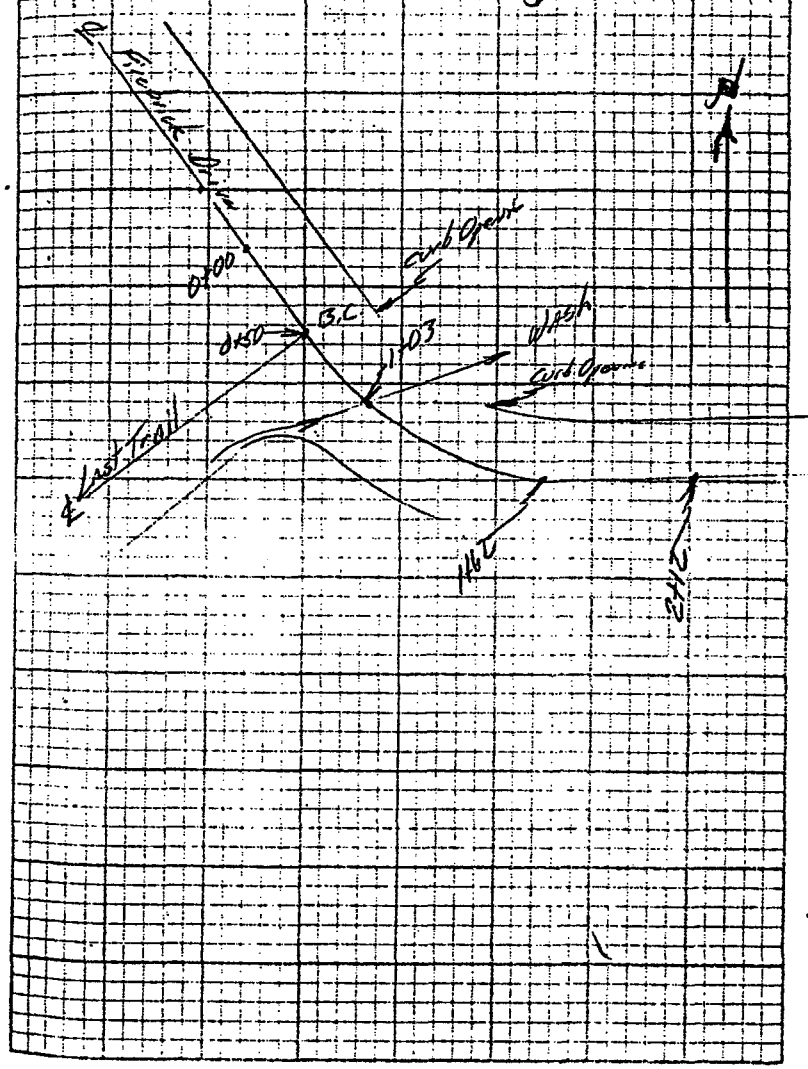
Note: Bench Marks used for drainage structure "As bu. Hs" are adjusted Bench Mark Elev's dated 2-26-93, from levels run for Vertical Control Verification from Bureau of Public Roads Brass Disk Stamped "969+85.72, 1568.65; 1955" & Adjusted by ADOT to 1567.401 (-1.249) 1965.

3/15/93

STA	Elev.	Description
0+00	1551.54	℄ Pavement
0+50	1550.10	℄ Brass Cap. Bench Mark
1+03	1549.43	Approximate ℄ Crossing
1+62	1549.87	℄ P.C.
2+12	1550.83	℄ Pavement

3/15/93 Drainage Structure "As built"

Firebrick Drive East of
Last Trail Drive Intersection
Wet Crossing



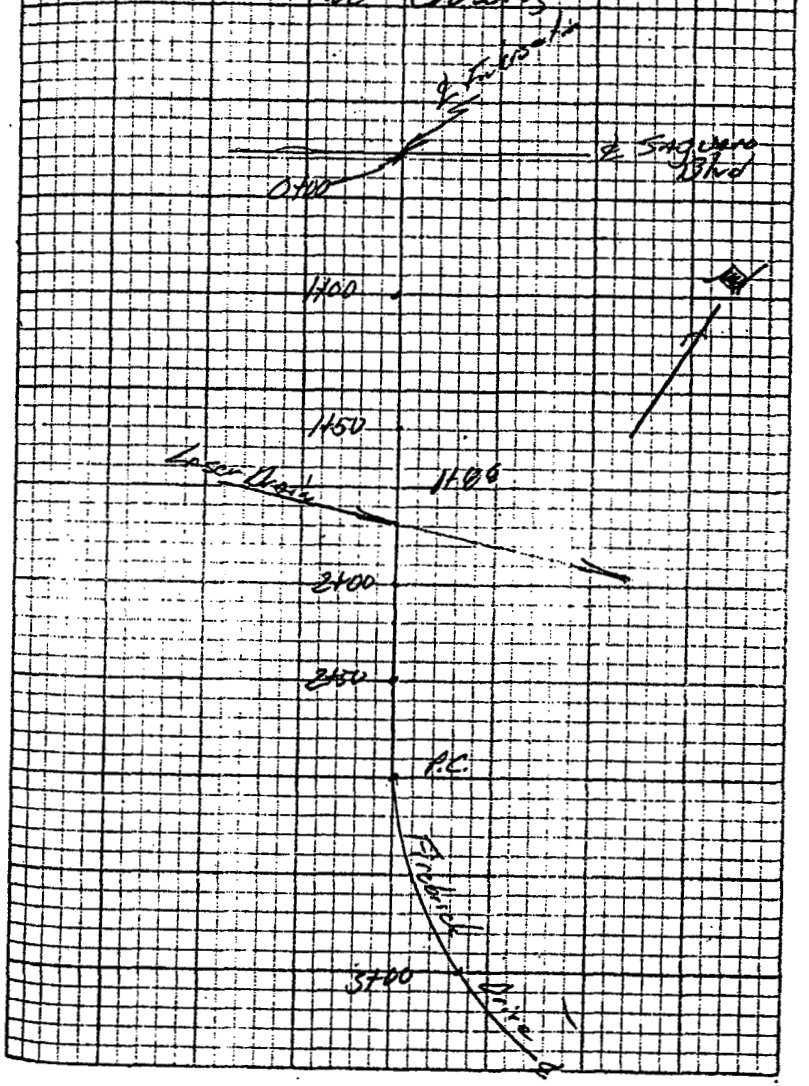
STA	Elevs.	Descriptions
0+00	1563.90	℄ Intl. Firebrick Drive ⊄ Saguaro Blvd
1+00	1560.25	
1+50	1556.71	
1+80	1554.50	Approx ⊄ Crossing
2+00	1554.81	
2+50	1557.70	
		⊄ P.C.
3+00	1559.75	

"As Builts"

Laser Drain X-ing

Firebrick Drive S.E. of Saguaro Blvd

With Crossing



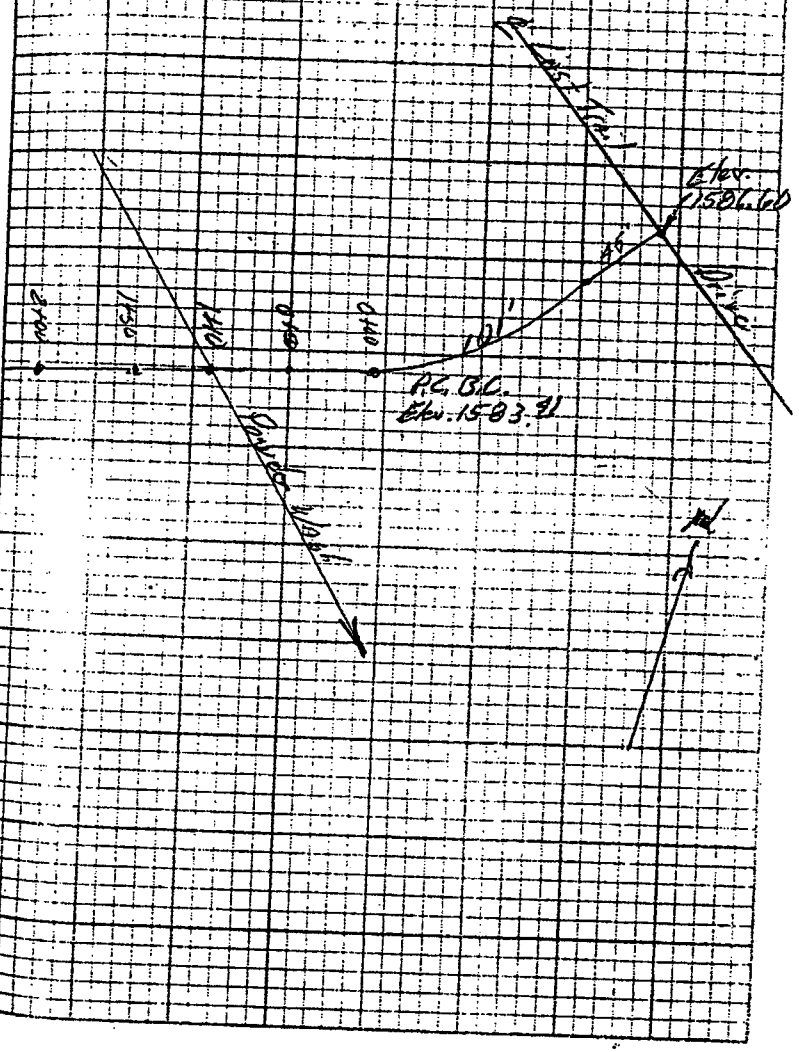
STA		
	Elevs	
0+00	1583.41	
+50	1581.41	
1+10	1579.40	Approx. ℄ Crossing
1+50	1580.67	
2+00	1583.62	

"As Built"

Ponder Wash X-ing Leo Drive

South of Last Trail Drive

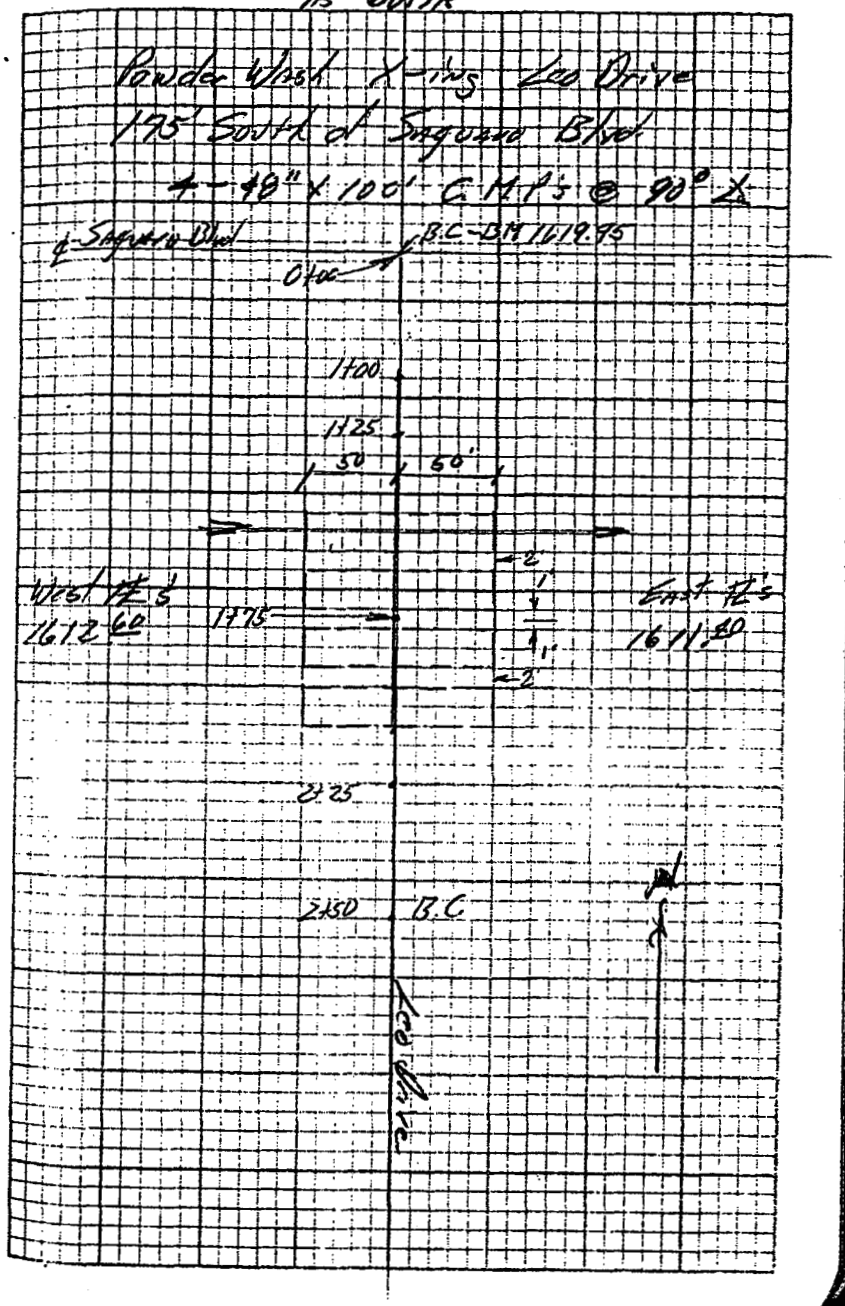
Wet Crossing



STA	Elevs	Description
0+00	1619.95	℄ Intersection
1+00	1620.98	Pavement
1+25	1620.99	Pavement
1+75	1620.92	℄ Pipe X-ing
2+25	1620.99	Pavement
2+50	1621.15	Brass Cap

"As built"

Powder Wash X-ing Leo Drive
175' South of Sagauro Blvd
4-48" x 100' CMP's @ 90° ∠

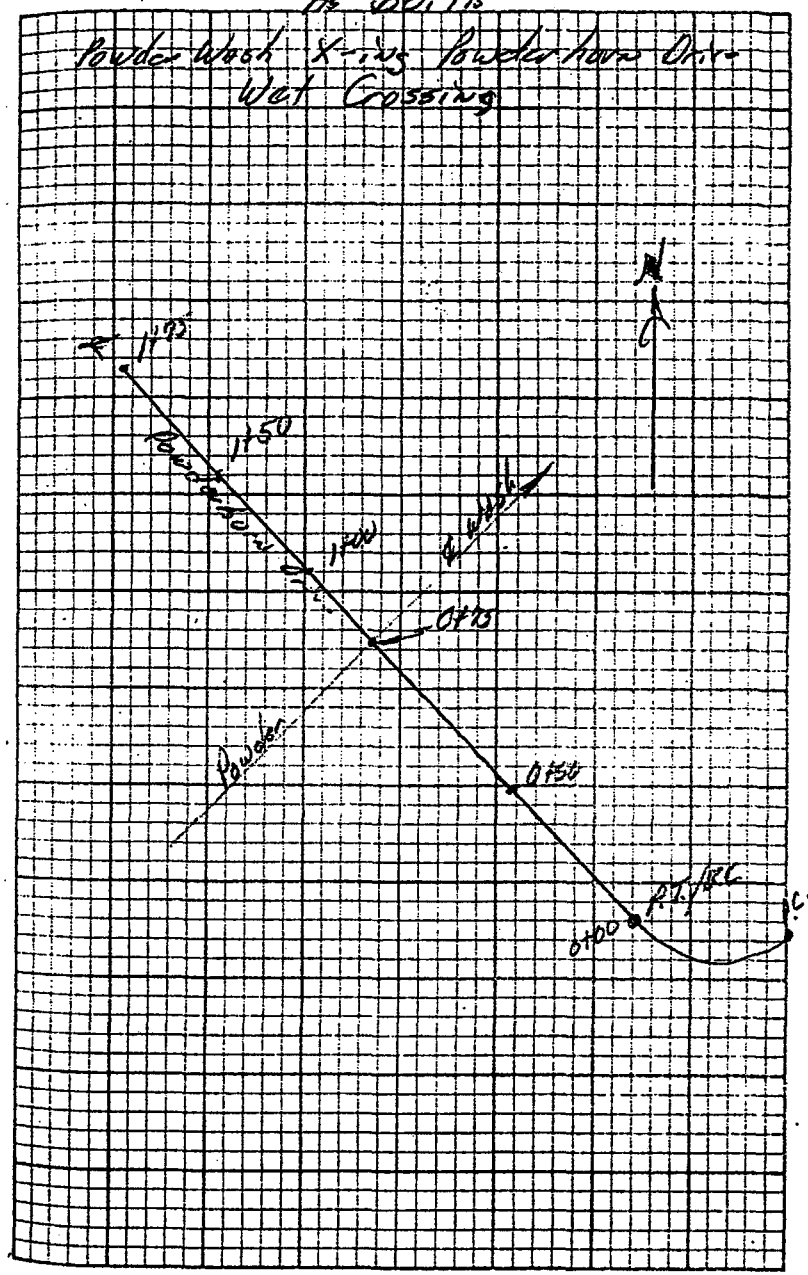


STA	Elevs	Description
1+75	1657.76	Pavement
1+50	1656.36	Pavement
1+00	1654.92	Pavement
0+75	1654.10	Approx. ℄ Crossing
0+50	1654.72	Pavement
0+00	1657.39	P.T. B. Cap
	1659.58	P.C. Brass Cap Bench Mark

"As Built"

Powder Wash X-ing Powderhorn Drive

Wet Crossing



STA

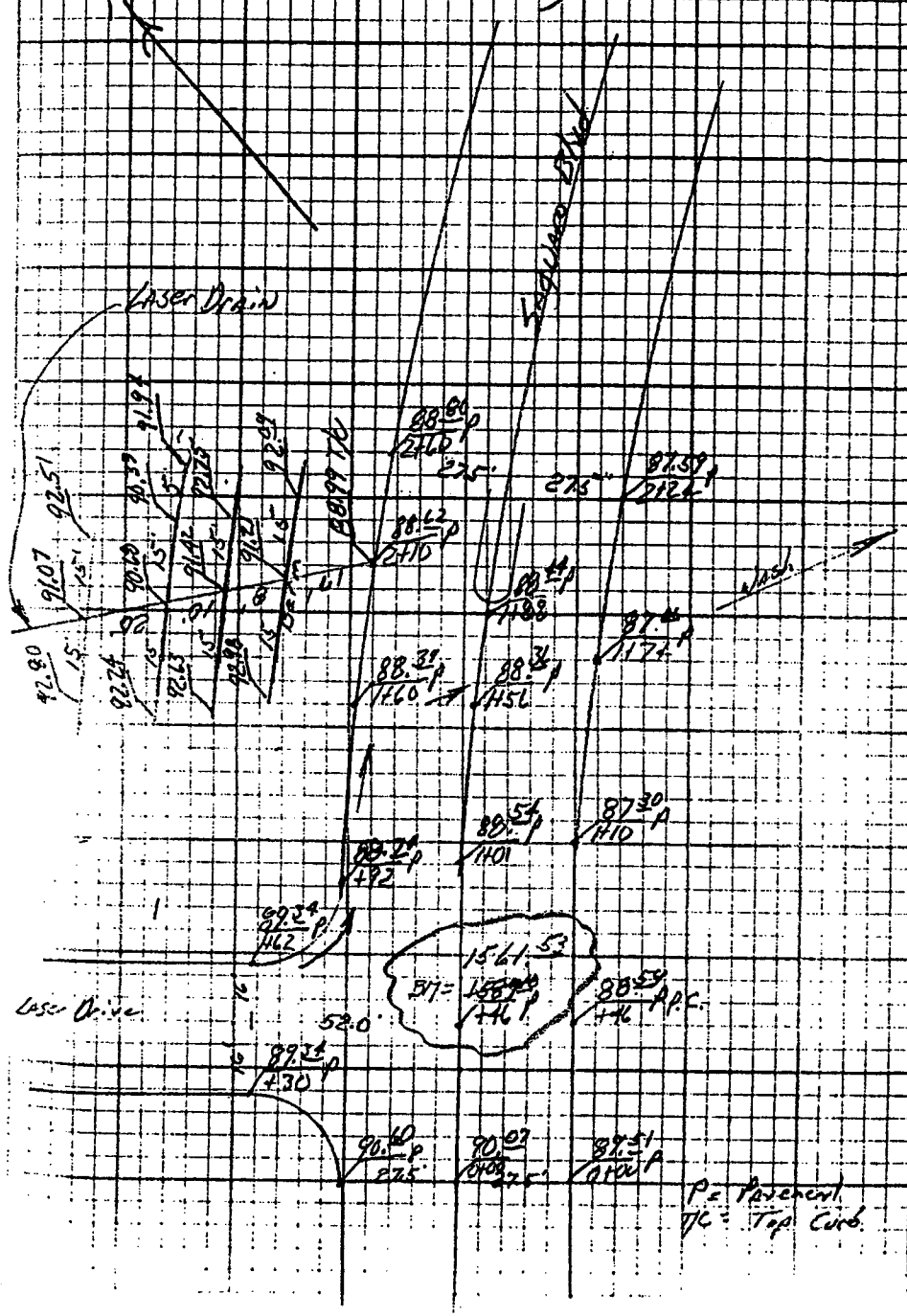
Elev

8/8/93
Wrong T.B.M.'s
Used on both
As built's

Note: Laser Drain is Bermed west of curb and ponds - no defined drainage x-ing Saguaro Blvd.

8/8/93 Note: All elev.'s on this Page wrong by + 27.57'
B.M. Inter 1589.10 Previous Levels
- 27.57
New B.M. Elev = 1561.53

Laser Drain X-ing Saguaro Blvd
North of Laser Drive
Wet Crossing



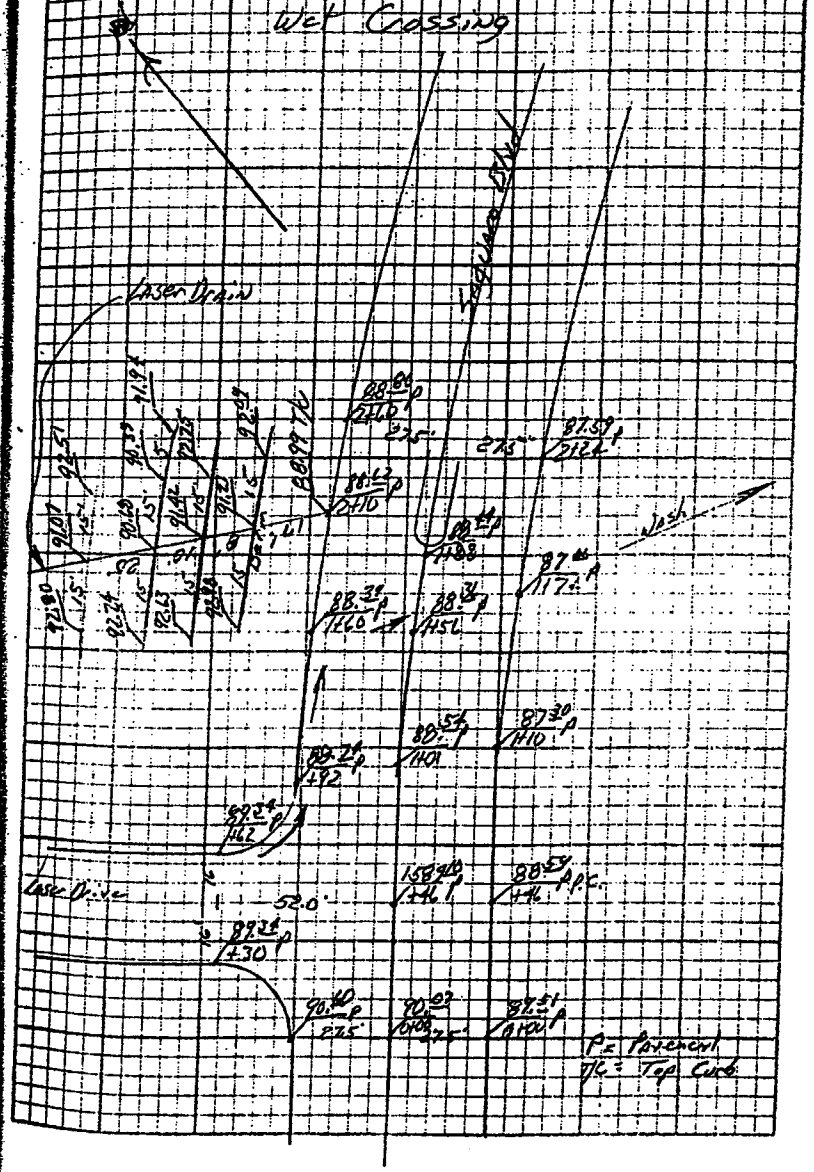
STA

Elev

Note: Laser Drain is Bermed west of curb and ponds - no defined drainage x-ing Saguaro Blvd

As Built

Laser Drain X-ing Saguaro Blvd
North of Laser Drive
Wet Crossing

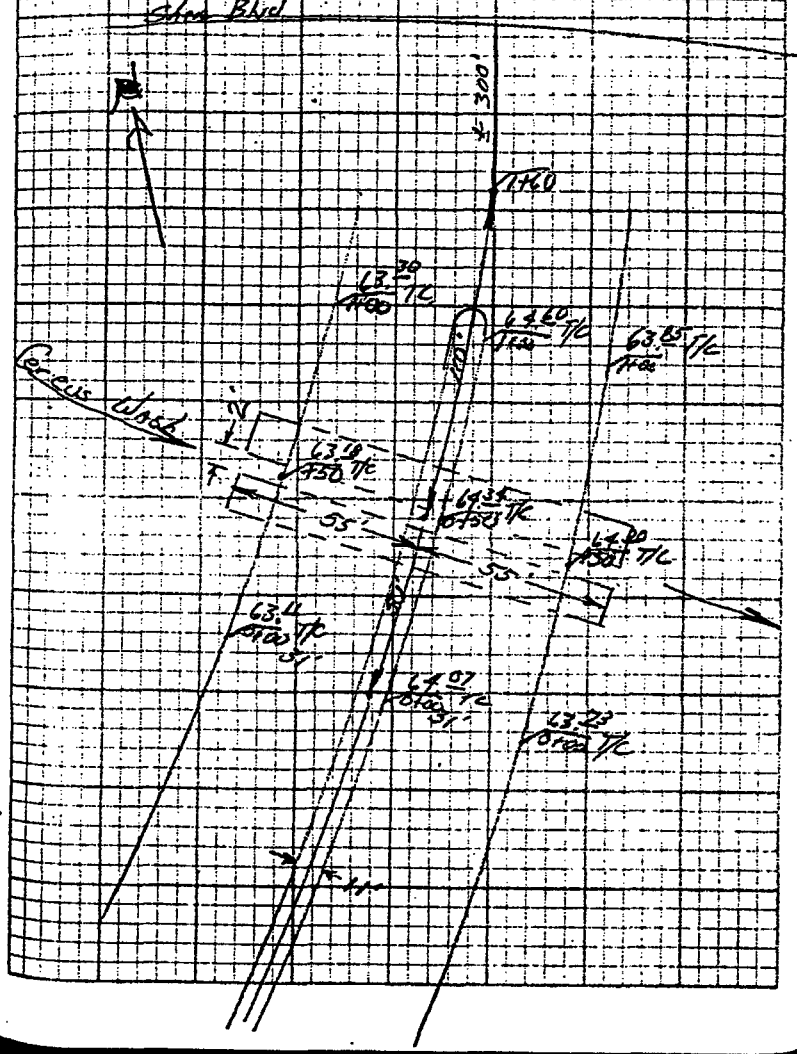


STA	Elev's				
0+50	2-60"x110' C.M.P's				
	West Ft's 1549.75				
	East Ft's 1546.30				

"As Built"

Cercus Wash crossing Sequoia Blvd
± 410' South of Stea Blvd

2'-60" x 110' C.M.P's



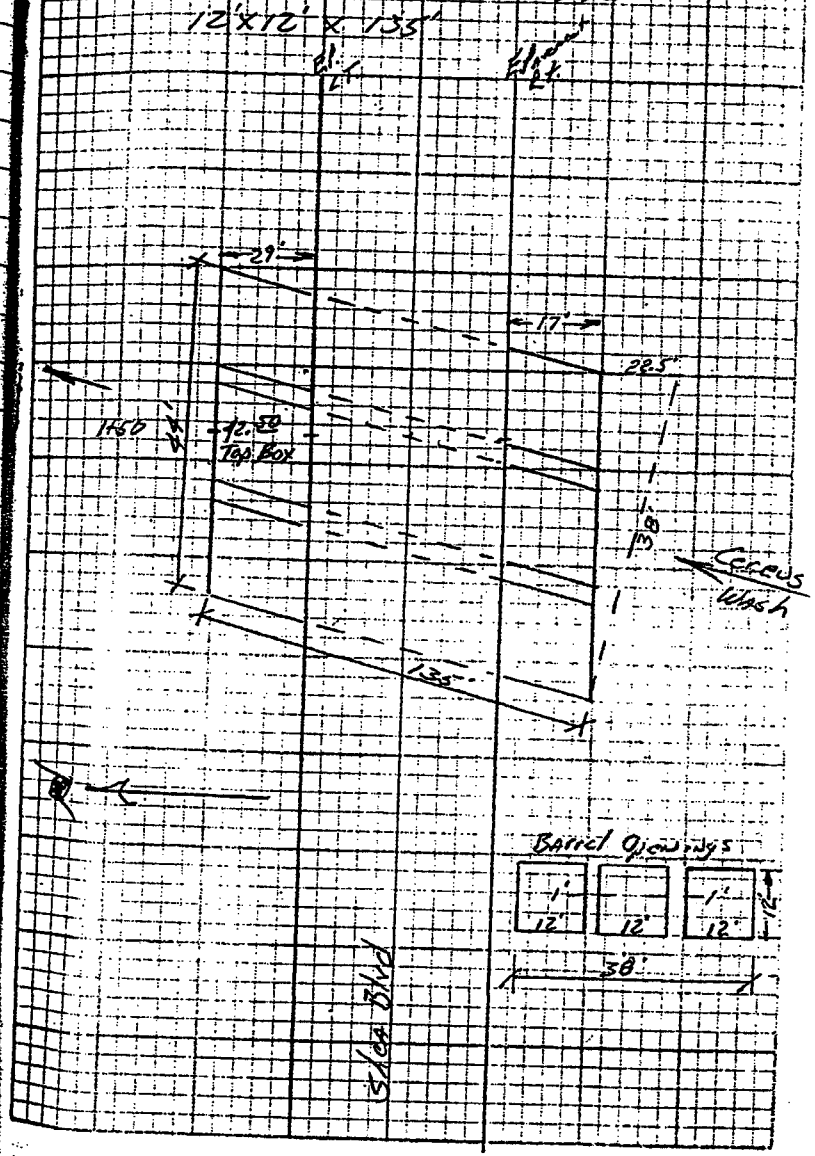
E.P. Elev's

STA	LT.	RT.
3+00	47.20	46.80
+50	48.39	47.15
2+00	48.67	47.50
1+50 ℄ Box @	49.63	47.03
1+00	49.47	48.22
+50	49.23	48.59
0+00	50.15	49.03

Northend North FE's = 29.00
South FE's = 30.30

3/30/93 As Builts

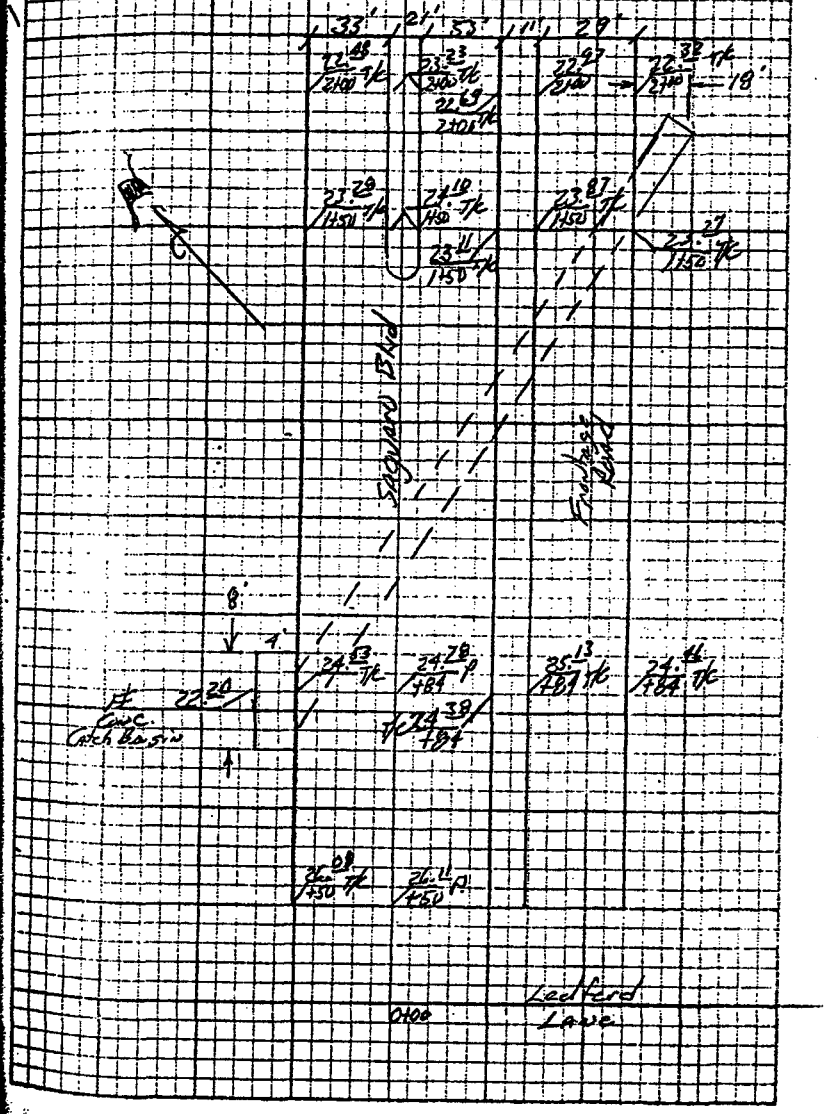
Cereus Wash Crossing Silva Blvd
± 0.2 miles east of Saguaro Blvd & Silva Blvd
3-Barrel Concrete Box Culvert
12'x12' x 133'



STA	
2+00	℄ 48" C.M.P. ⊥ Elev. 15.53 Rt.
1+50	
0+84	℄ 48" C.M.P. ⊥ 16.43 LT.
0+50	
0+00	℄ Intr. Saguaro Dr. & Ledford Lane

'As Built'

Cypress Point Wash Crossing
Saguaro Blvd
1-48" x 187' C.M.P.

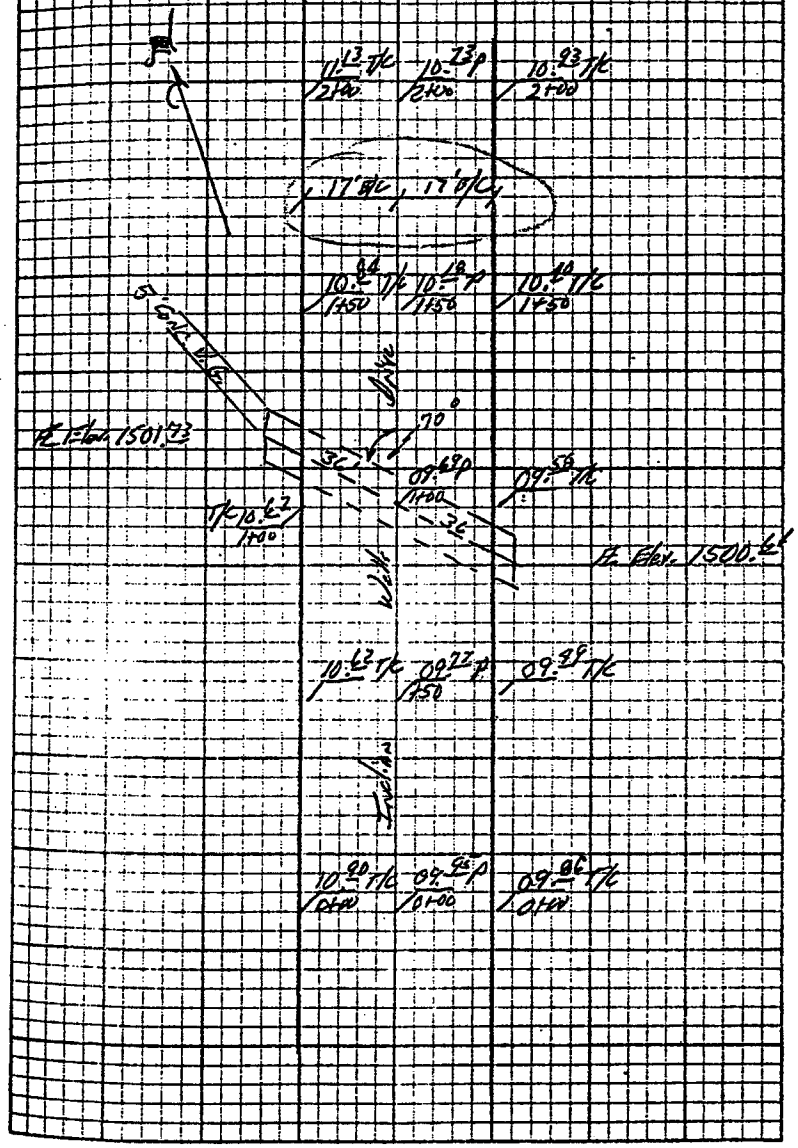


STA					
2+00					
1+50					
1+00	2-60" x 72' C.M.P.'s	FL Elev.			
+50					
0+00					

"As Built"

Jackin Wash Crossing Indian Wells Dr.

2-60" x 72' C.M.P.'s

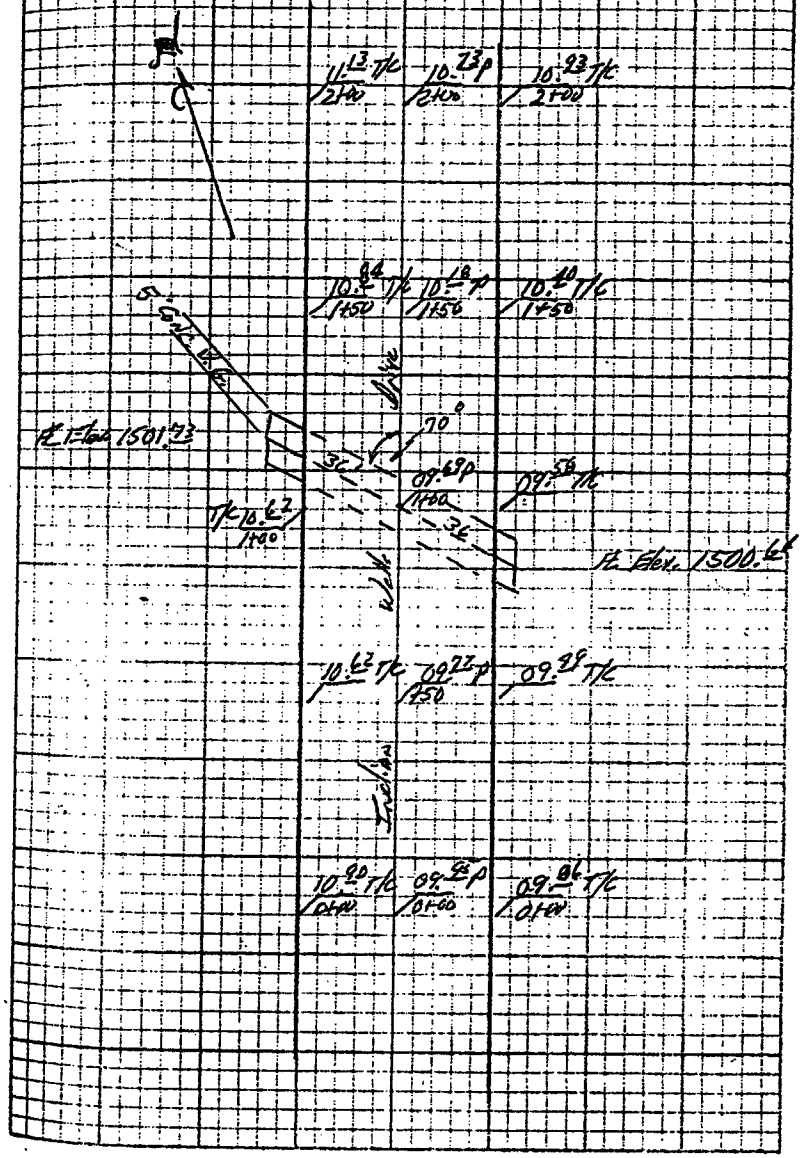


STA	
2+00	
1+50	
1+00	2-60" x 72' C.M.P's ft. Elev.
+50	
0+00	

"As Builts"

Jackin Wash Crossing Building Walk Dr.

2-60" x 72' C.M.P's

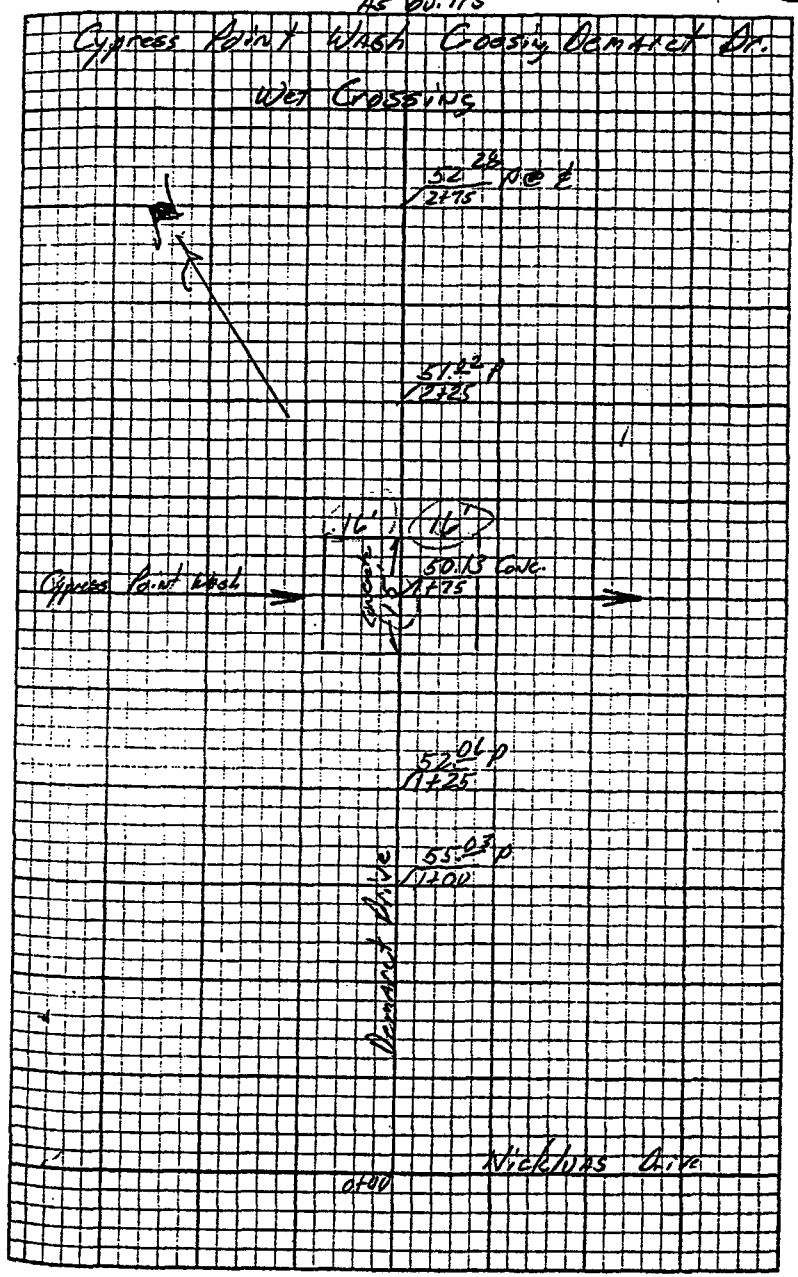


STA					
2+75					
2+25					
1+75					
1+25					
1+00					
0+00	℄ Intr.	Demaret	Drive &	Nicklaus	Dr.

'As Builts'

Cypress Point Wash Crossing Demaret Dr.

Wet Crossing

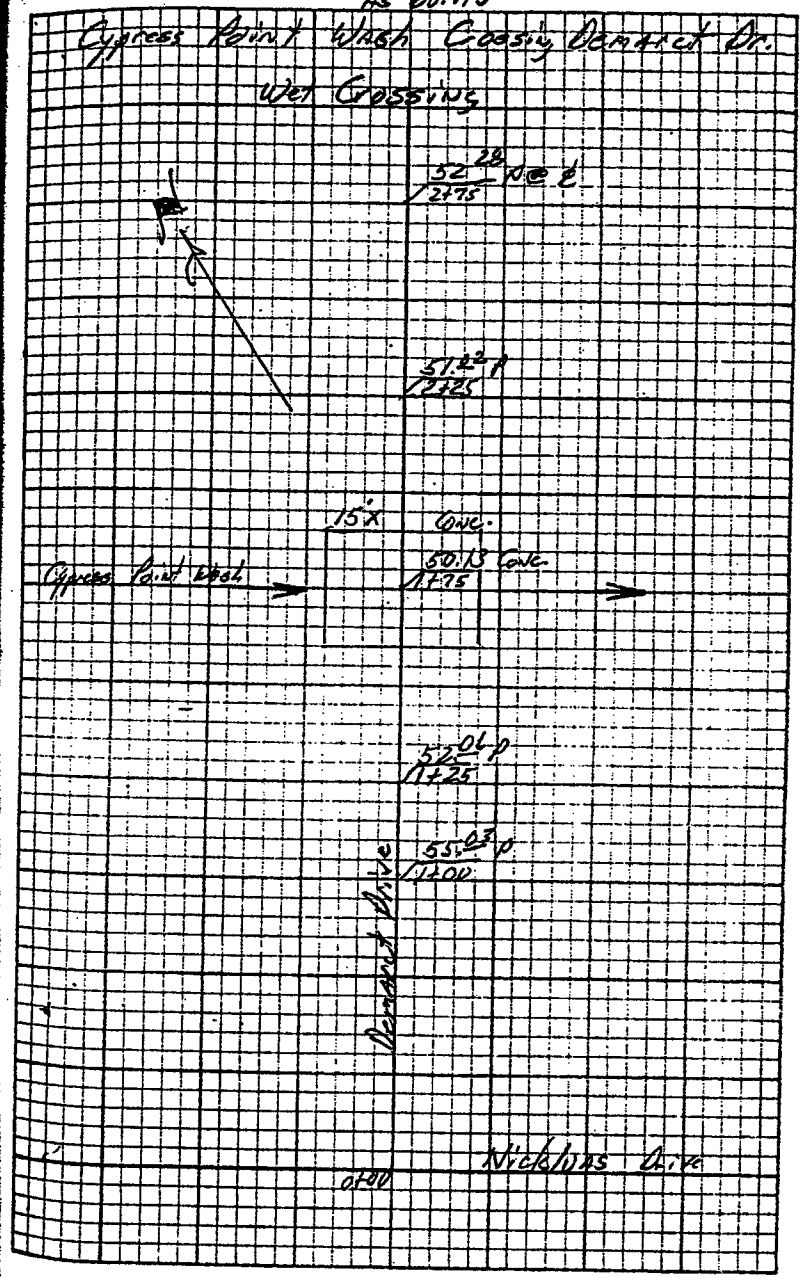


STA					
2+75					
2+25					
1+75					
1+25					
1+00					
0+00	℄ Int.	Demaret	Drive &	Nicklaus	Dr.

"As Built"

Cypress Point Wash Crossing Demaret Dr.

Wet Crossing

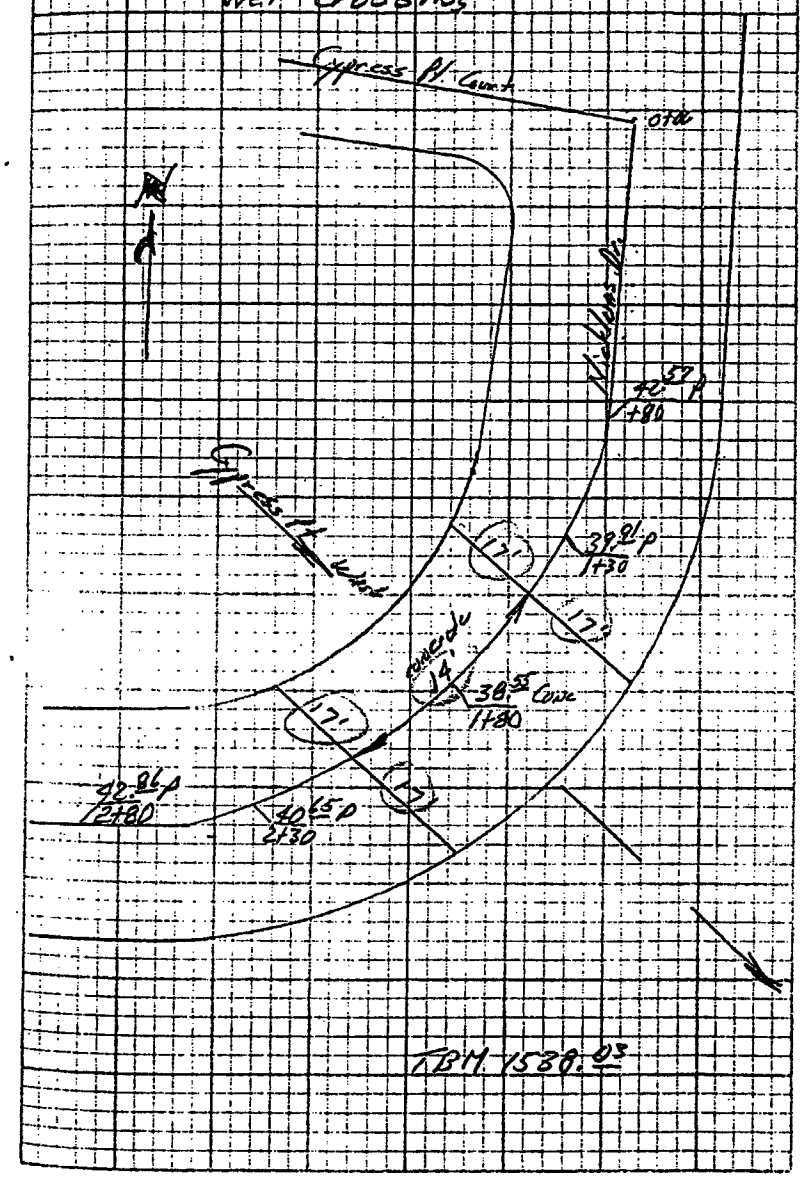


STP

"As Builts"

Cypress Point Wash Crossing Nicholas Drive

Wet Crossing

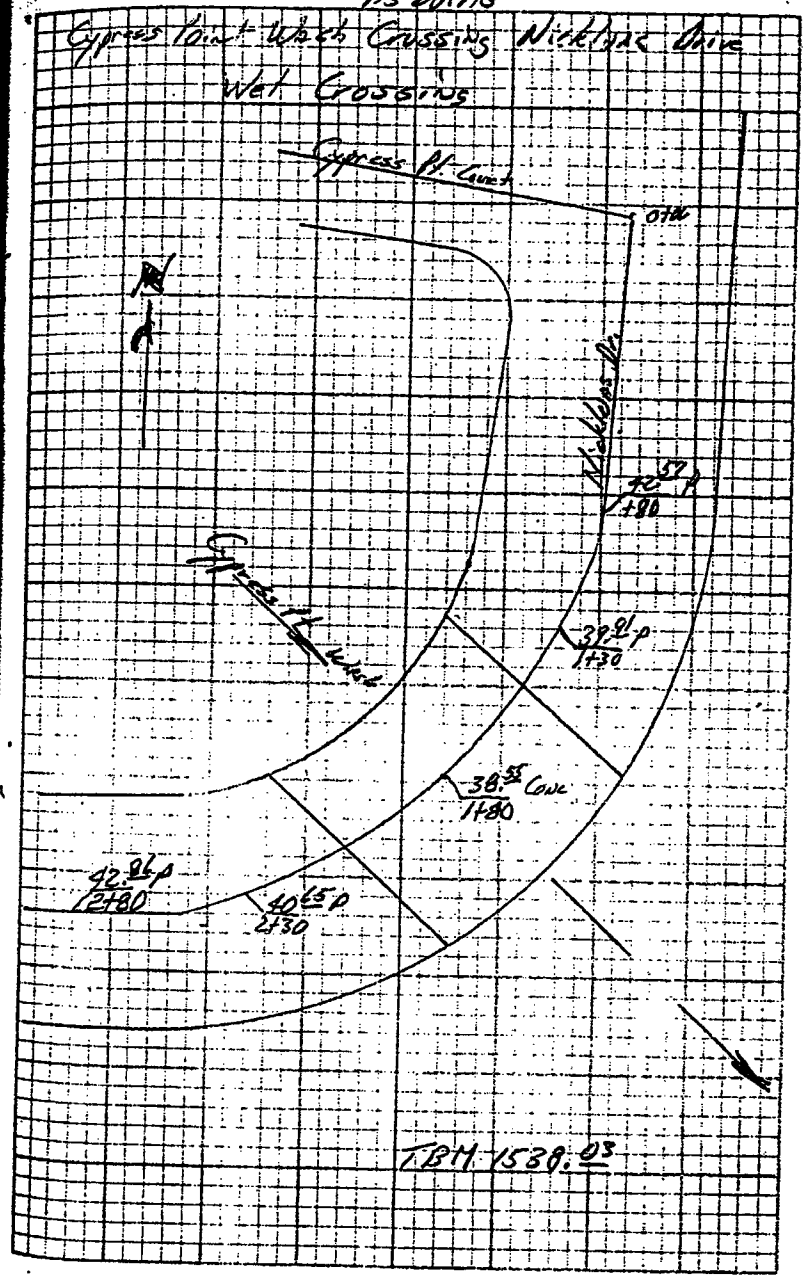


STA

"As Builts"

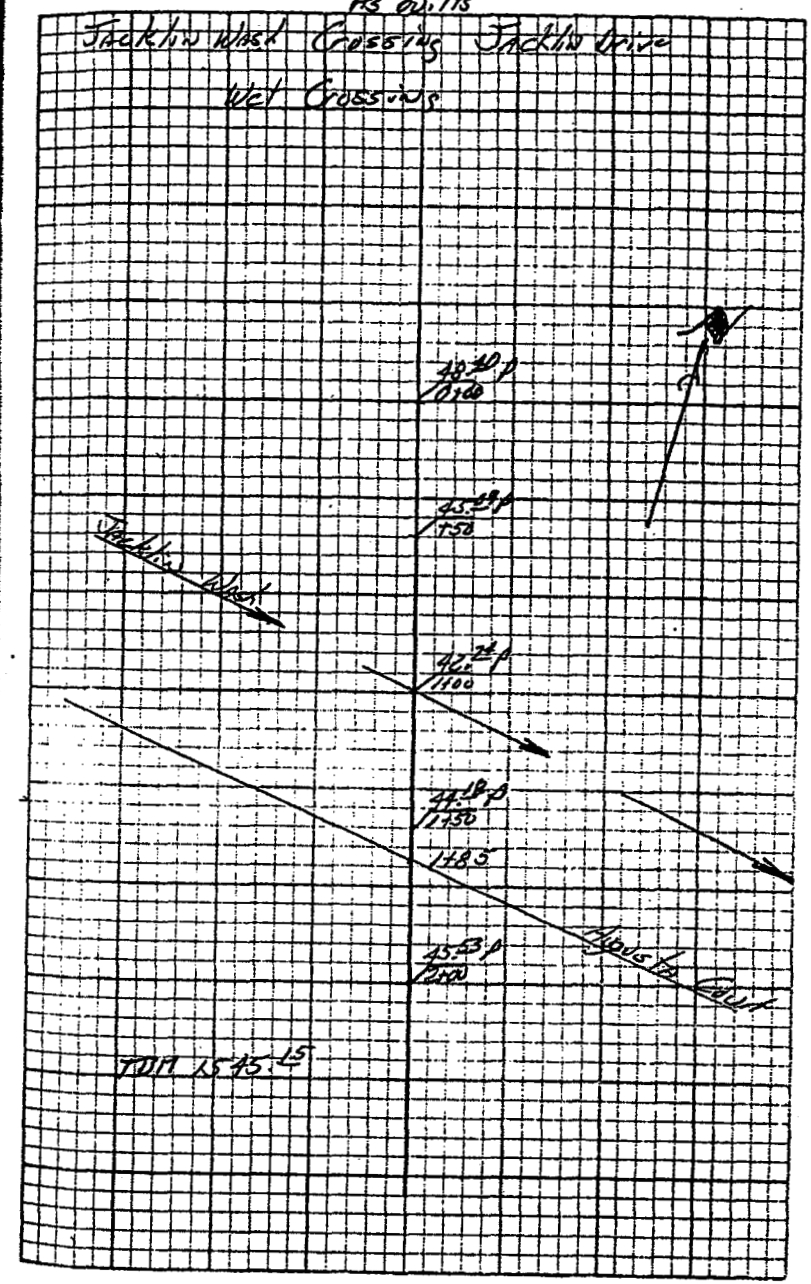
Cypress Point Watch Crossing Nicklaus Drive

Wet Crossing



STA					
0+00					
+50					
1+00					
1+50					
1+85	℄ Intersection Jacklin Dr ℄ Augusta Court				
2+00					

"As Builts"

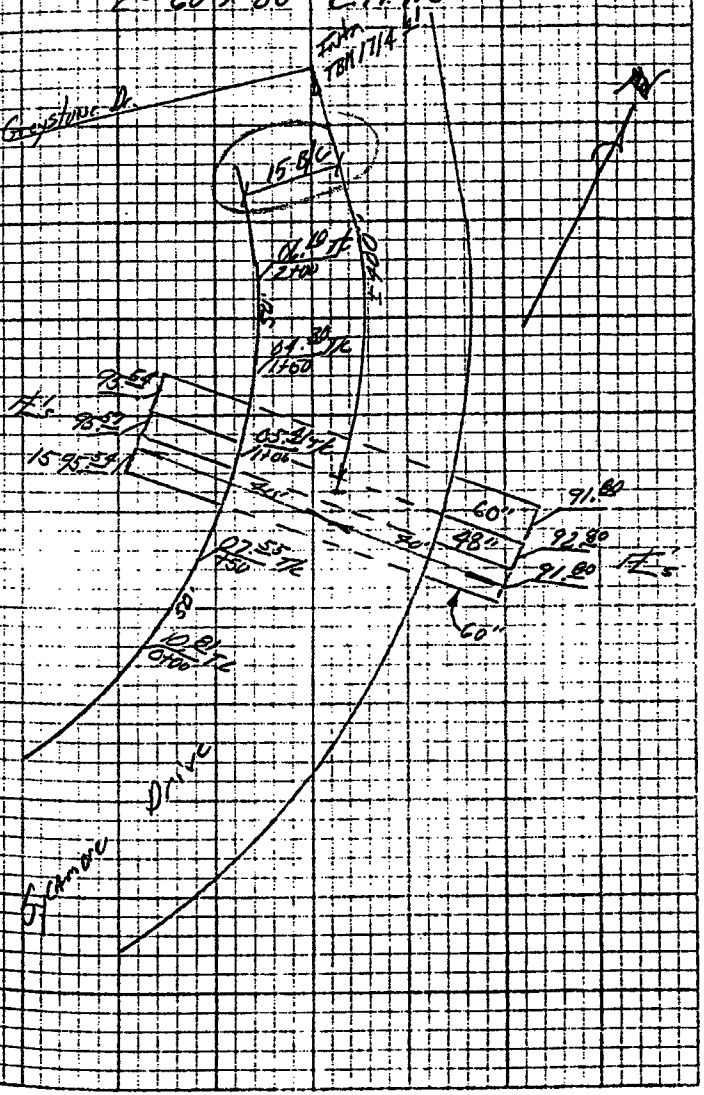


STA

"As Builts"

Colony Wash Crossing Sycamore Drive
± 400' South of Greystone Drive

1- 48" x 80' C.M.P.
2- 60" x 80' C.M.P.s

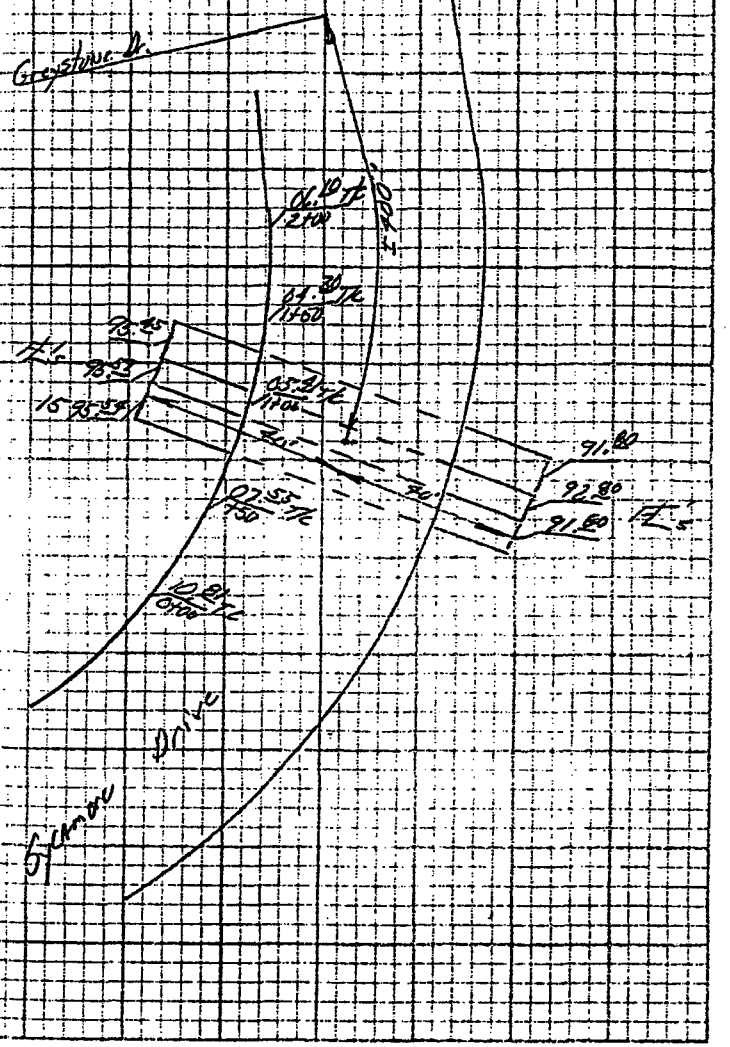


STP

"As Builts"

Colony Wash Crossing Sycamore Drive
± 400' South of Greystone Drive

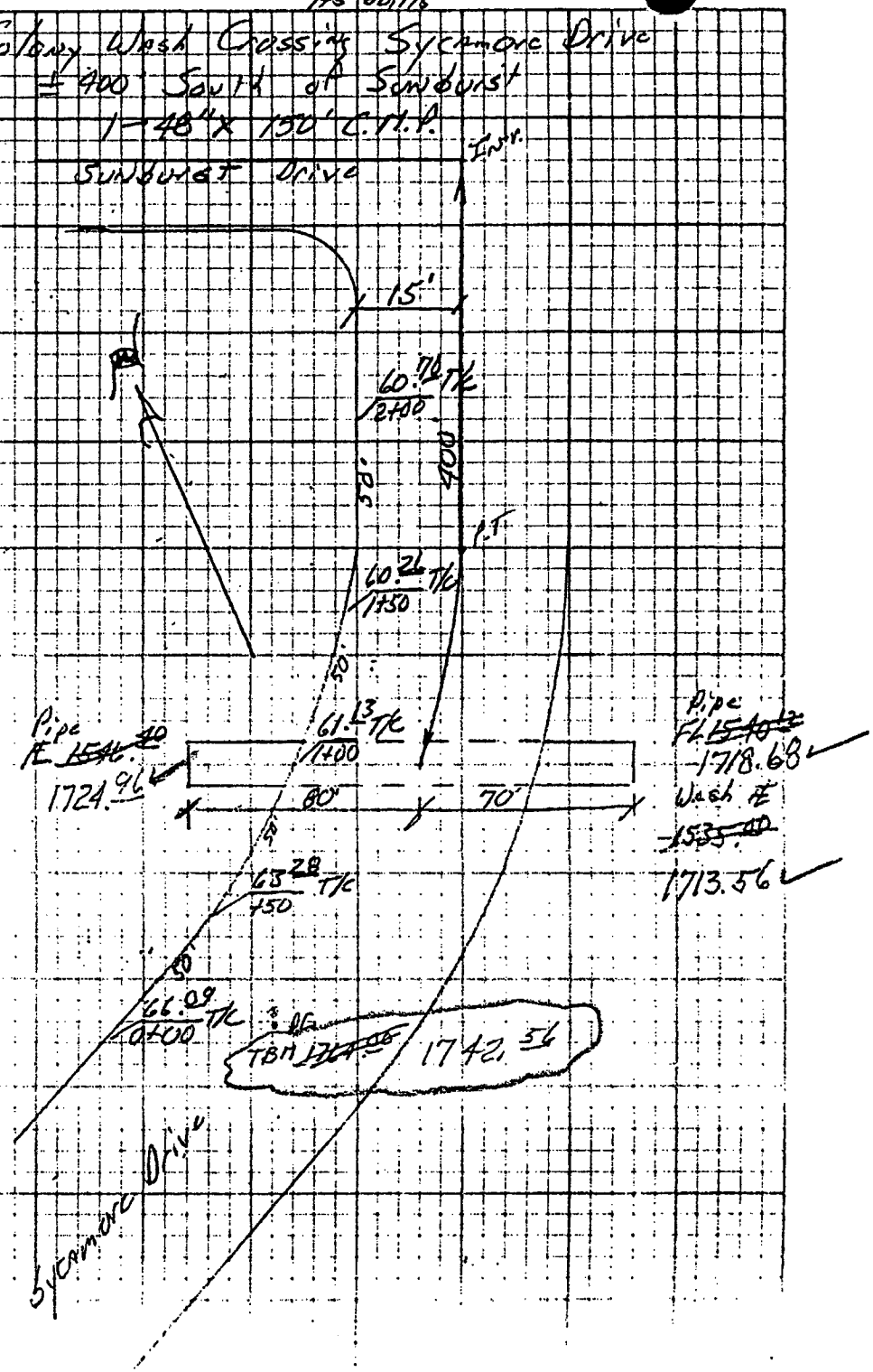
1- 48" x 80' C.M.P.
2- 60" x 80' C.M.P.s



STA

"As builts"

Colony Wash Crossing Sycamore Drive
± 400 South of Sundust
1-48" x 150' C.M.P.
Sundust Drive

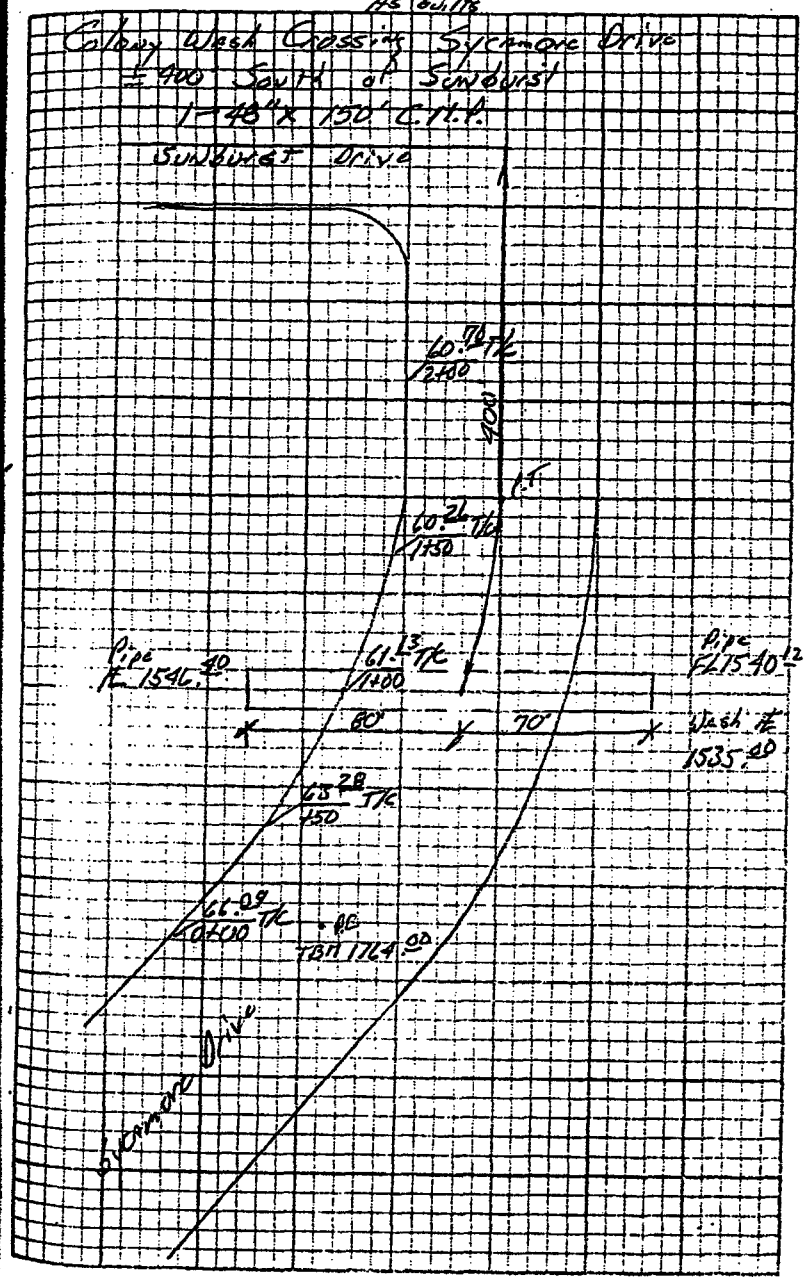


8/6/93 Note: Elev. previous B.M.
1764.00
1742.56 New Elev.
- 21.44 Adjustment on Road
"As builts"

STA

"As built"

Colony Wash Crossing Sycamore Drive
± 900 South of Sunburst
1-48" x 150' C.M.P.



STA	
1+00	1-60" x 140' C.M.P. @ 90°
	70' Lt & Rt

"As built"

Encinal Wash Crossing Baron Drive

1-60" x 140' C.M.P.

T.B.M. @ ℄ P.T.
1638.52

34.92 T/C
1+99

33.95 T/C
1+66

33.03 Hump
1+33

33.41 T/C
1+00

Rt Elev. 1628.00 — 70' — Lt 70' → Rt Elev. 1623.00
Lt Elev. 1620.20

35.05 T/C
0+56

78' Bk

37.78 T/C
0+00

STA

1+00 1-60" x 140' C.M.P. @ 90°
70' Lt & Rt

"As built"

Emerald Wash Crossing Baron Drive

1-60" x 140' C.M.P.

TBM @ ℄ P.T.
1638.52

34.92 T/C
1+99

33.95 T/C
1+66

B.C.
P.T.

33.03 Approx
1+33

33.61 T/C
1+00

Rt Elev 1628.00

70'

70'

Rt Elev. 1623.00

Rt Wash 1620.80

50

35.05 T/C
1+50

B.C
P.C

50

37.28 T/C
0+00

S.T.P.

1+00 1-60"x122' C.M.P.
90° to ℄

1+50

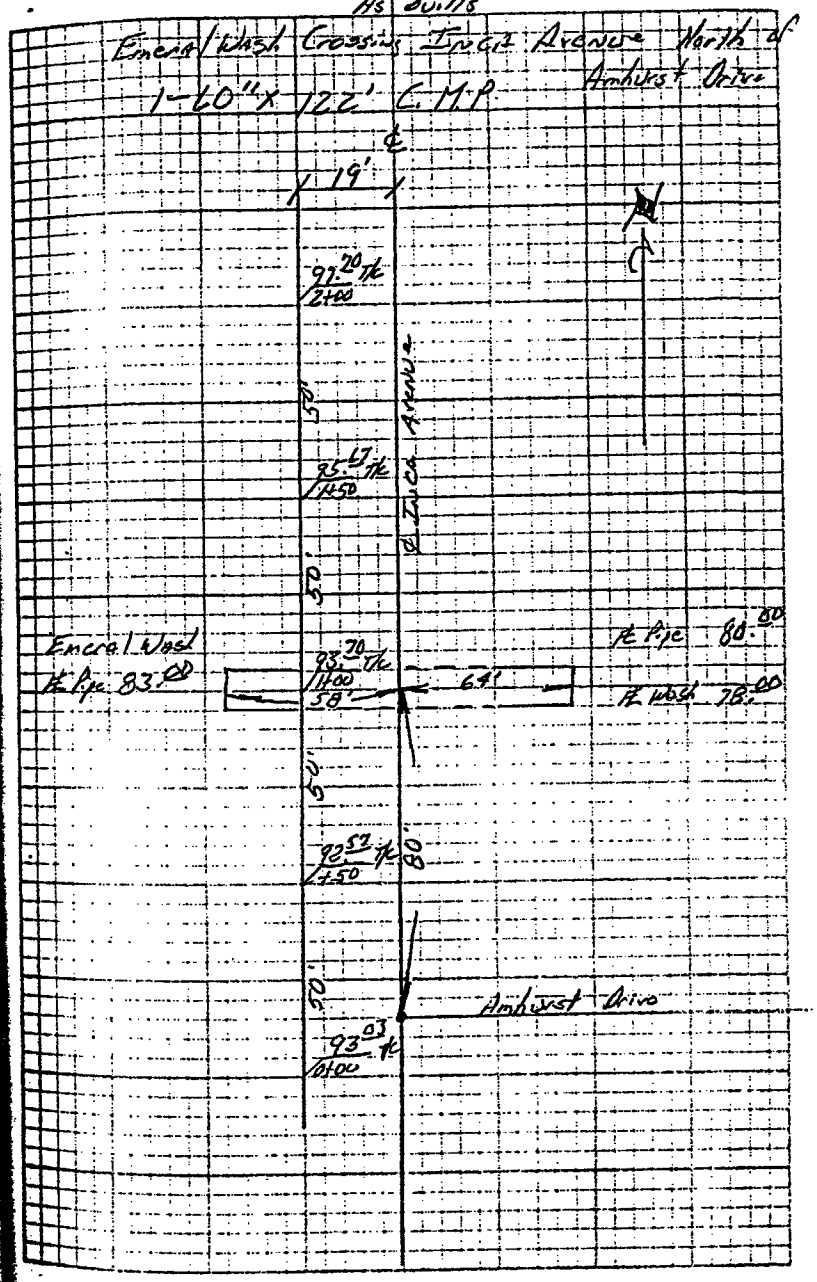
0+20 ℄ Inter Inca Ave & Amhurst Drive

0+00

"As Builts"

Encinal/Wash. Crossing Inca Avenue North of Amhurst Drive

1-60"x 122' C.M.P.

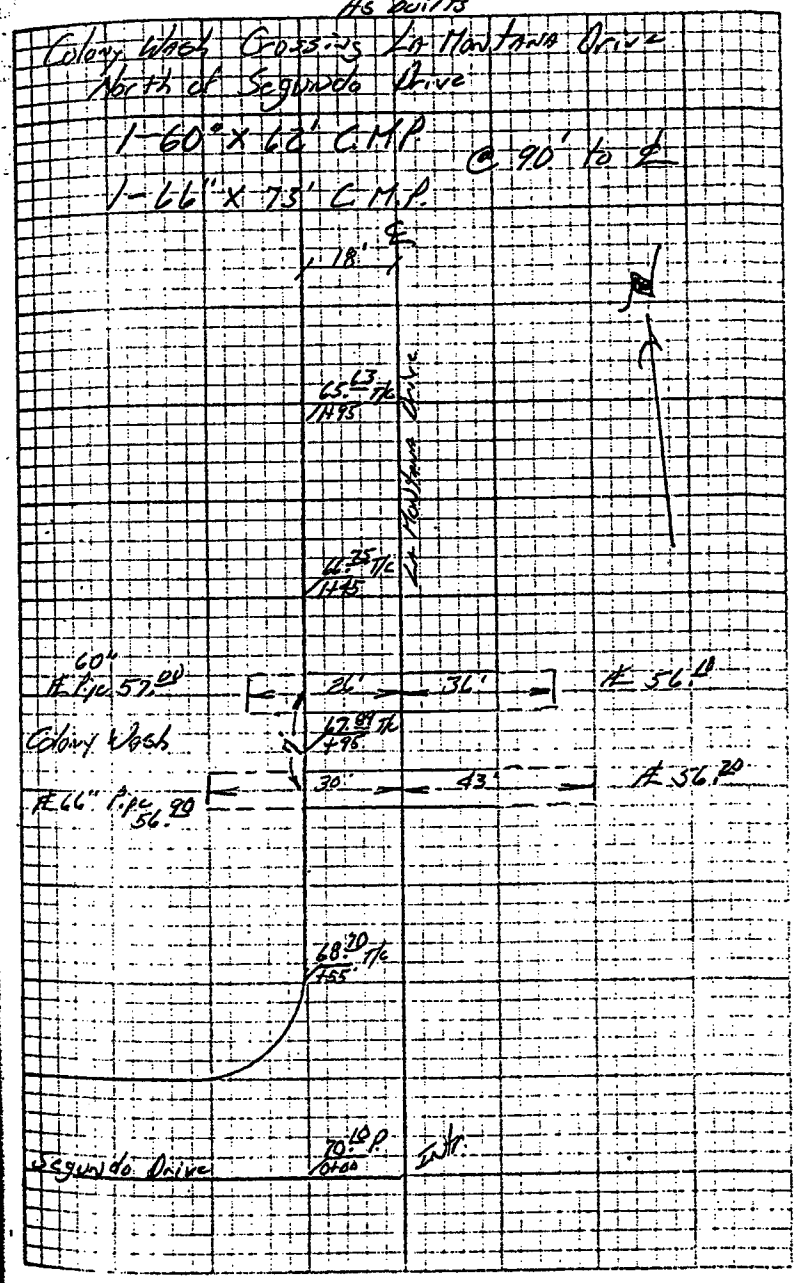


STA	
1+95	
1+45	
0+98.5	℄ 60" x 62' C.M.P @ 90°
0+95	
0+91.5	℄ 66" x 73' C.M.P @ 90°
0+55	
0+00	

"As built"

Colony Wash Crossing La Montana Drive
North of Segundo Drive

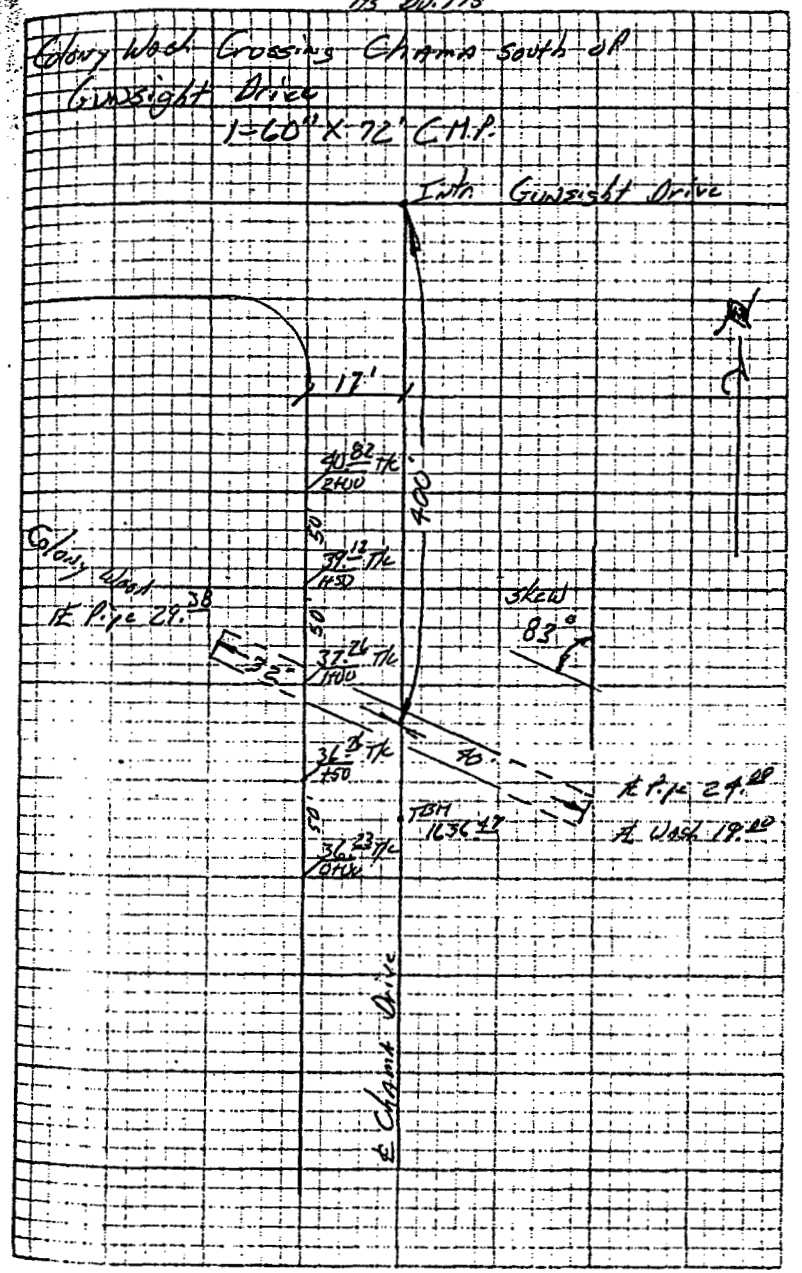
1-60" x 62' C.M.P. @ 90° to ℄
1-66" x 73' C.M.P.



STB

"As Builts"

Colony Wash Crossing Chama south of Gunsight Drive
1-60" X 72' C.M.P.



STA

2+00

1+03.50 1-60"x 94' C.M.P. @ 90°

0+96.50 1-60"x 94' C.M.P. @ 90°

0+00

"As Built's"

Colony Wash Crossing Arroyo Vista Drive
2-60"x 94' C.M.P.

Intersection
T.B.M. 1631.57

Channel

29.22 TC / 2+00 — 29.12 P

50

29.13 TC / 1+50 — 28.57 P

46' 48'

E 16.64 — 28.78 TC / 1+00 — 28.85 P — E 14.53

Colony Wash

E 16.64 — E 14.53

29.18 TC / 1+50 — 28.73 P

50

30.91 TC / 0+00 — 30.50 P

16' 16'

Arroyo Vista Drive

℄

5+1

3+04 F. of Pipe 77' Lt. E 1691.39

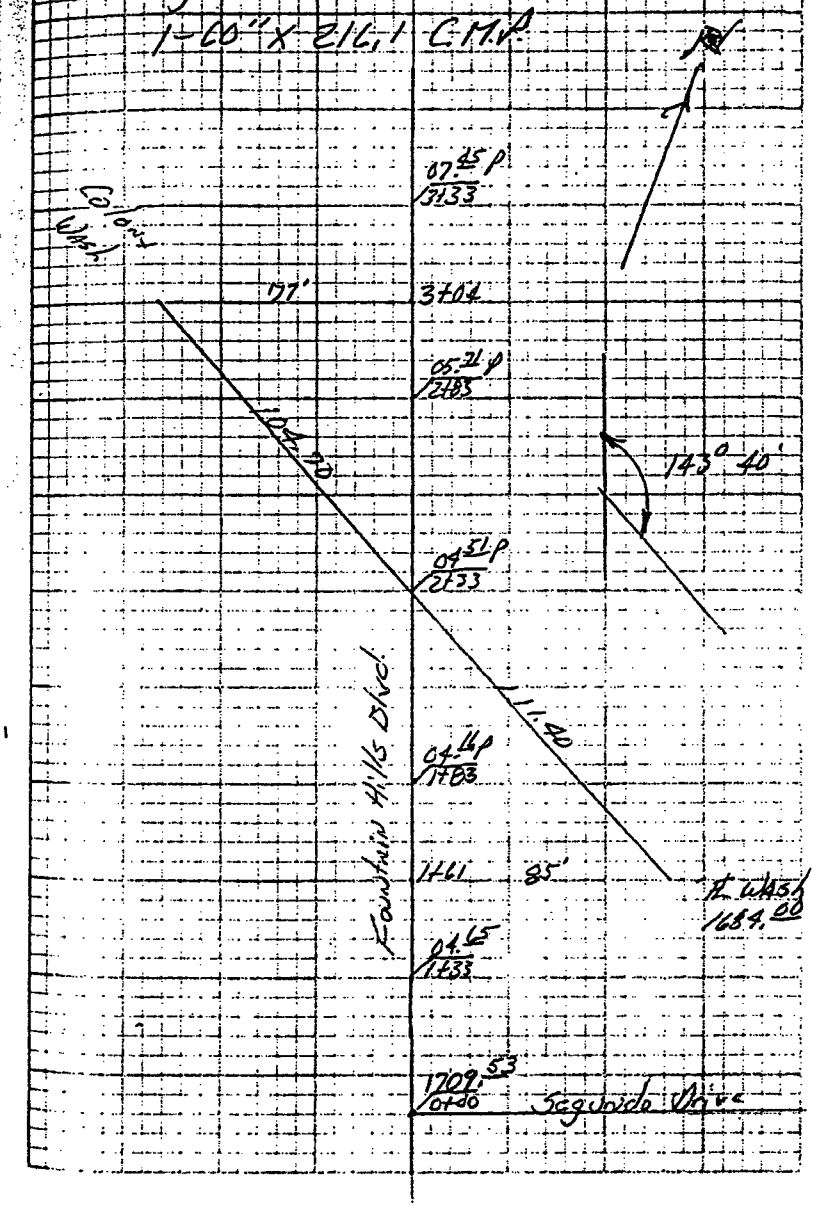
2+35 1-60"x 216.1' C.M.P.
Skew 143°40' S.E.

1+61 F. of Pipe 85' Rt. E 1688.23

0+00 Intersection

'As Builts'

Colony Wash Crossing F. Hills Blvd North of Segundo Drive
1-60"x 216.1 C.M.P.

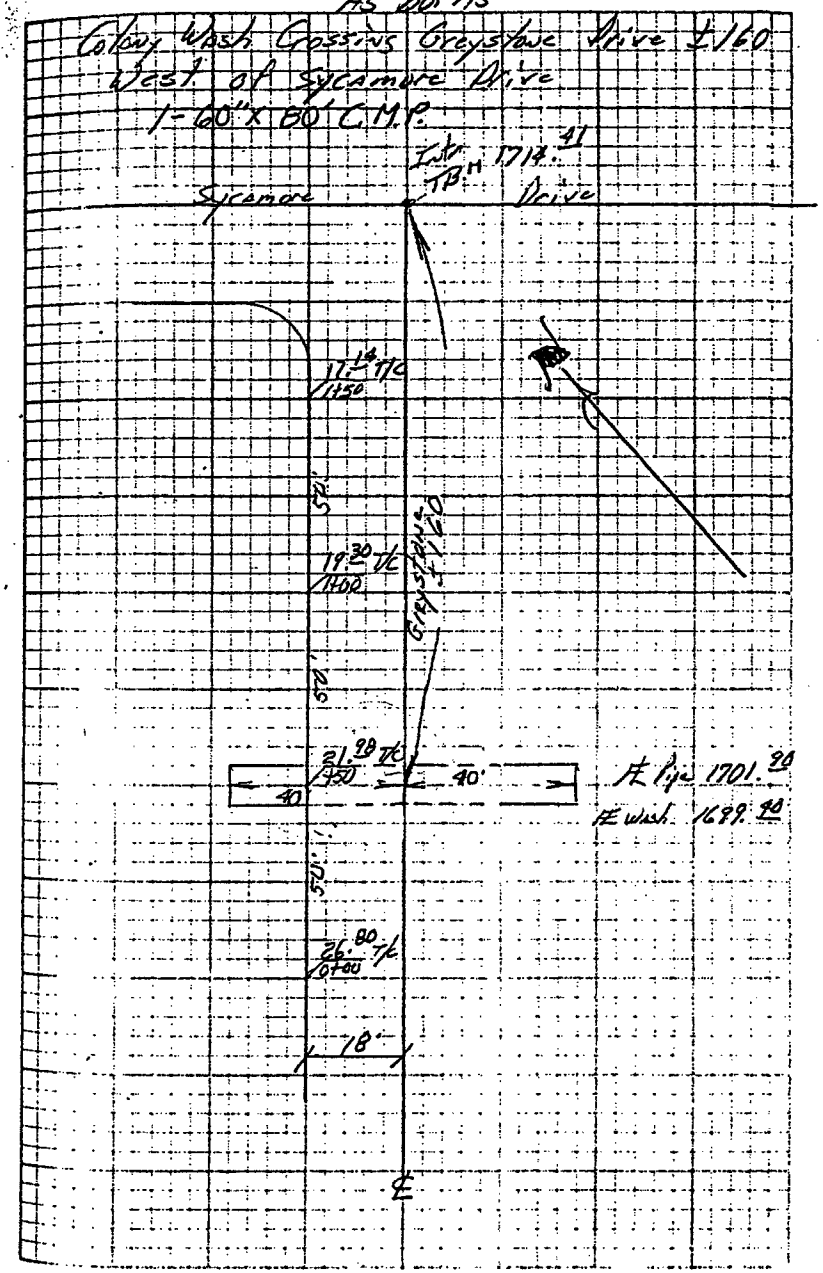


STP

0+50 1-60"x 80' C.M.P. 40' Lt & Rt
C 90°

"As Built"

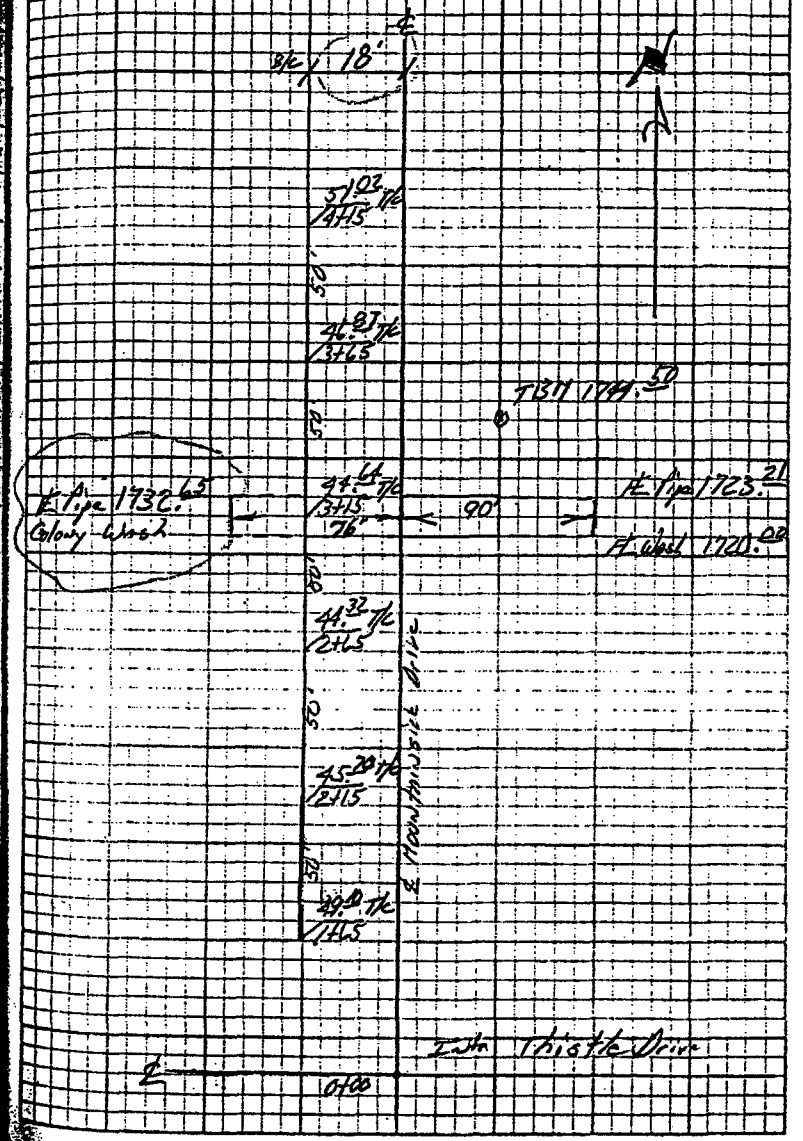
Colony Wash Crossing Greystone Drive 1+60
West of Sycamore Drive
1-60"x 80' C.M.P.



STA					
3+15	1-60"X 166' C.M.P. 76' Lt & 90' Rt @ 90°				

"As Builts"

Colony Wash Crossing Mountainside Drive
± 315' North of Thistle Drive
1-60" X 166' C.M.P.

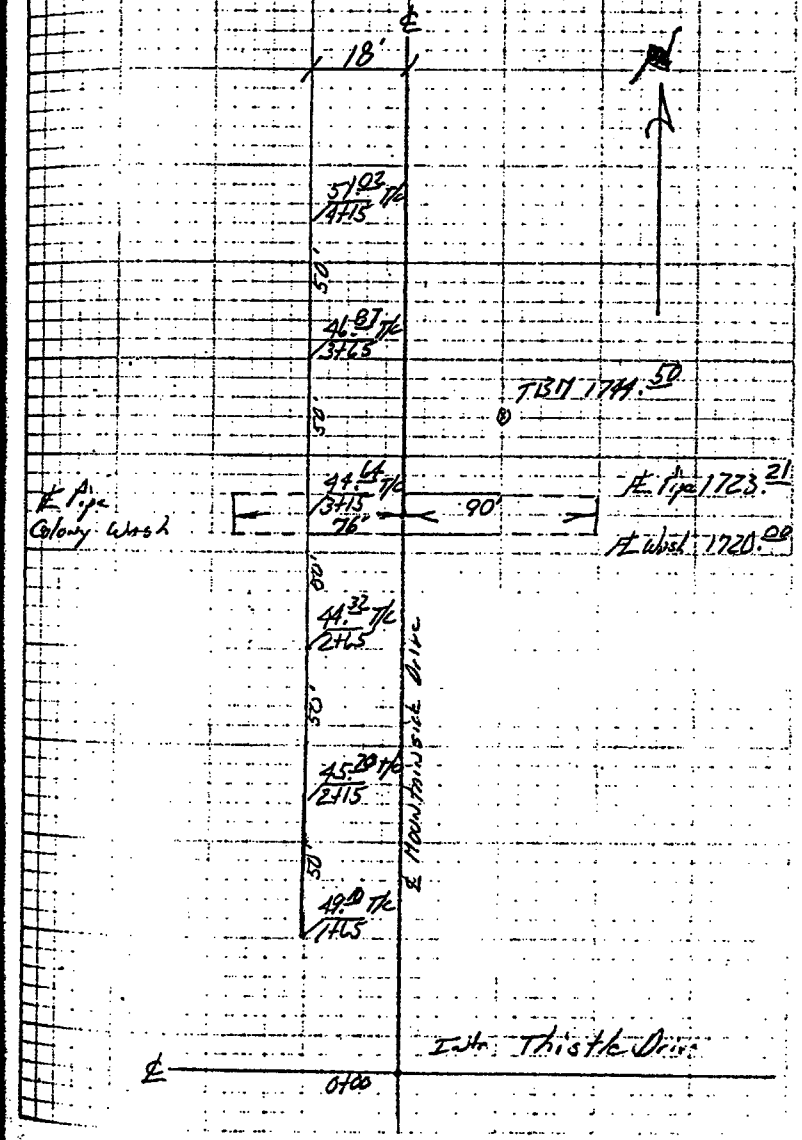


STA

3+15 1-60"X 166' C.M.P. 76' Lt & 90' Rt
@ 90°

"As Built"

Colony Wash Crossing Mountainside Drive
±315' North of Thistle Drive
1-60"X 166' C.M.P.



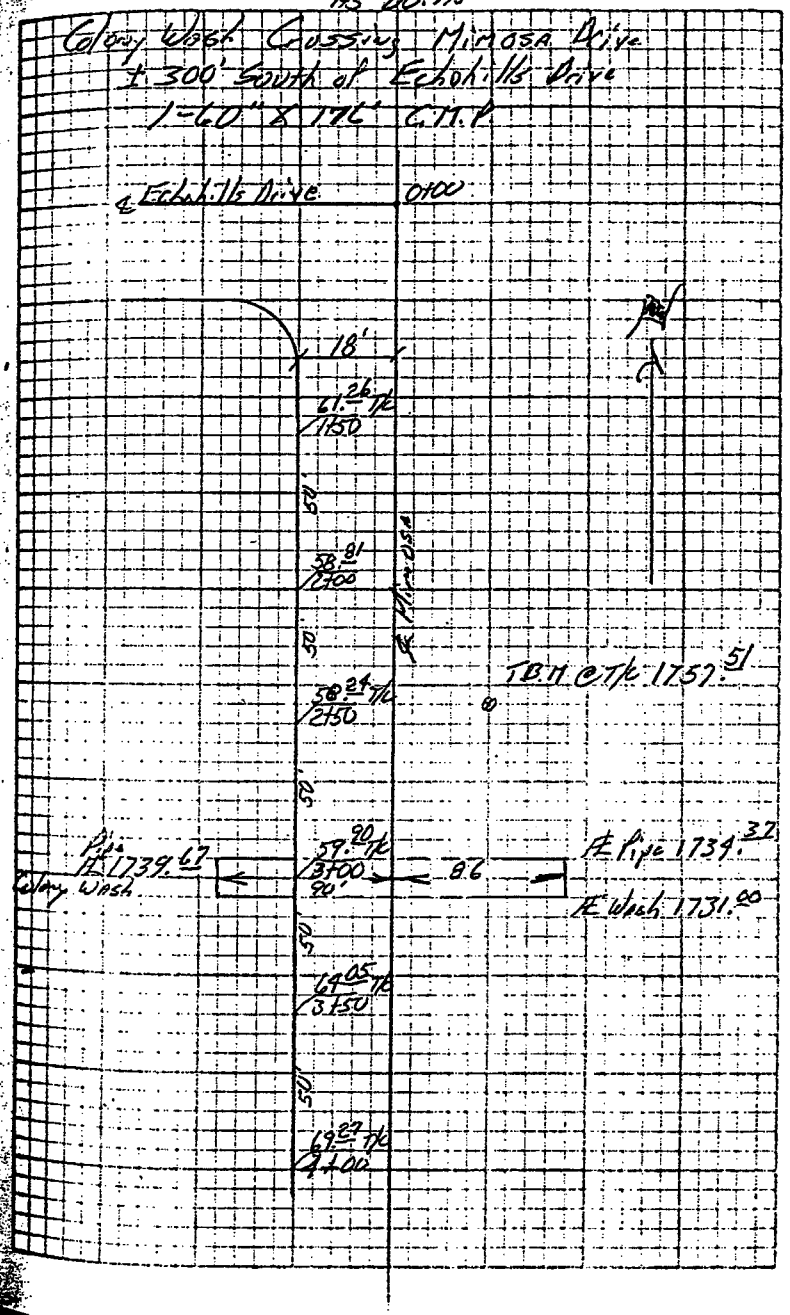
STA

0100 ℄ Intersection

3+00 1-60" x 176' C.M.P. 90' Lt & 86 Rt
@ 90°

"As Built"

Colony Wash Crossing Mimosa Drive
± 300' South of Echo Hills Drive
1-60" x 176' C.M.P.

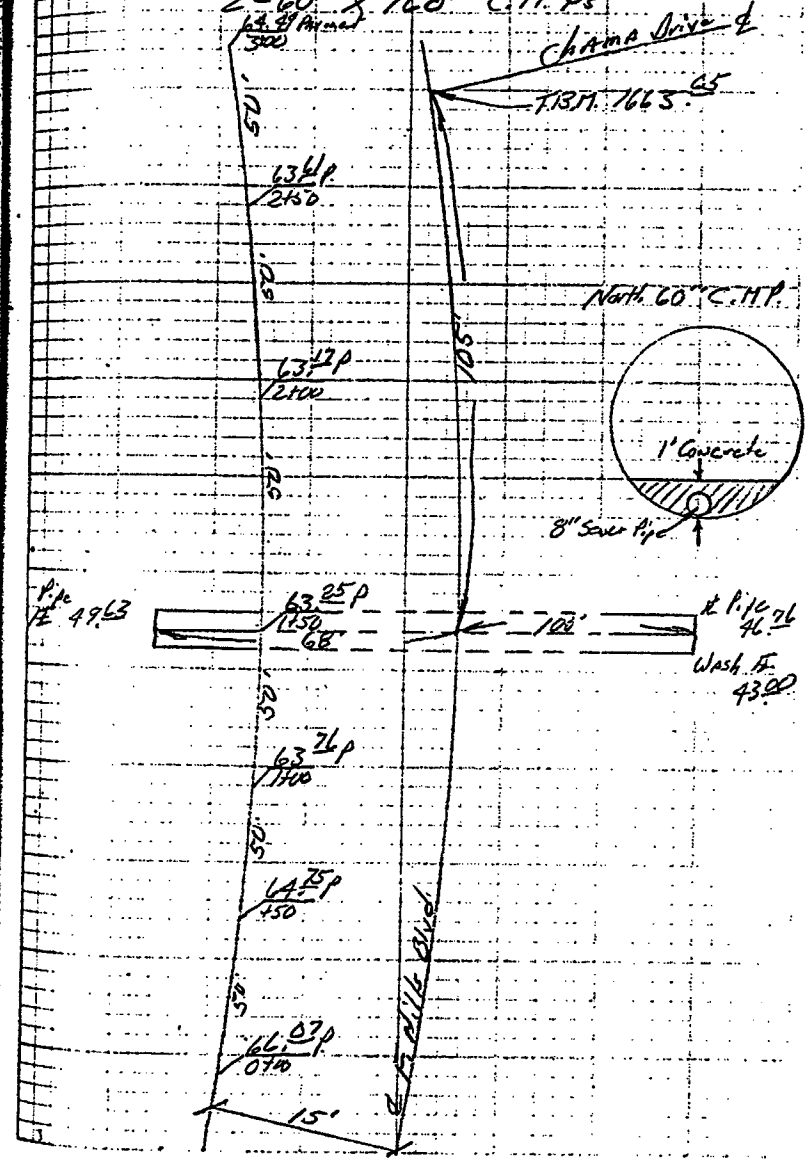


STA

1+50 2-60"X 168' C.M.P.'s 68' Lt & 100' Rt

"As Built"

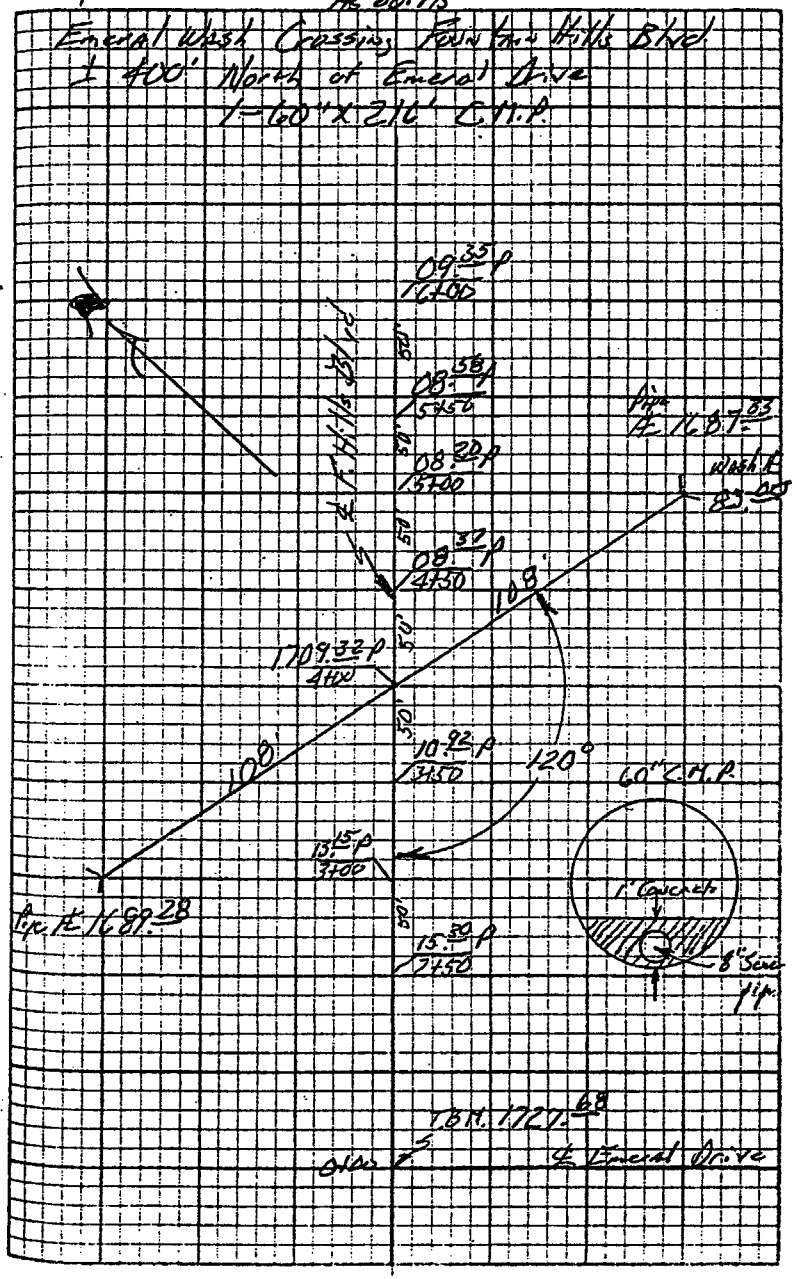
Colony Wash Crossing Fountain Hills Blvd
± 105' South of Chama Drive
2-60" X 168' C.M.P.'s



STA	
4+00	1-60" x 216' C.M.P. @ 120° Skew
0+00	Intersection F.H. Blvd & Emerald Drive

"As Built"

Emerald Wash Crossing Fountain Hills Blvd.
± 400' North of Emerald Drive
1-60" x 216' C.M.P.

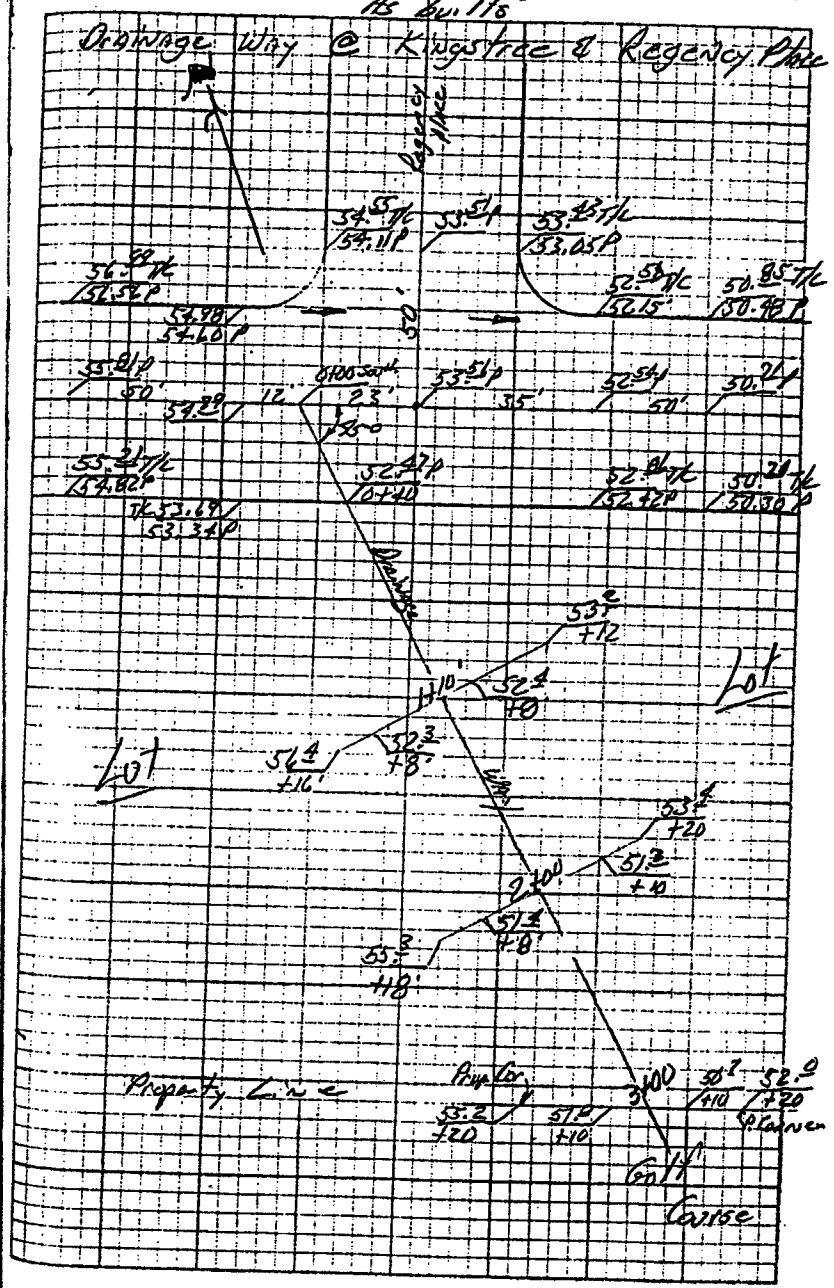


STA

& Int. Kingstree & Regency Place

"As Built"

Drainage Way @ Kingstree & Regency Place

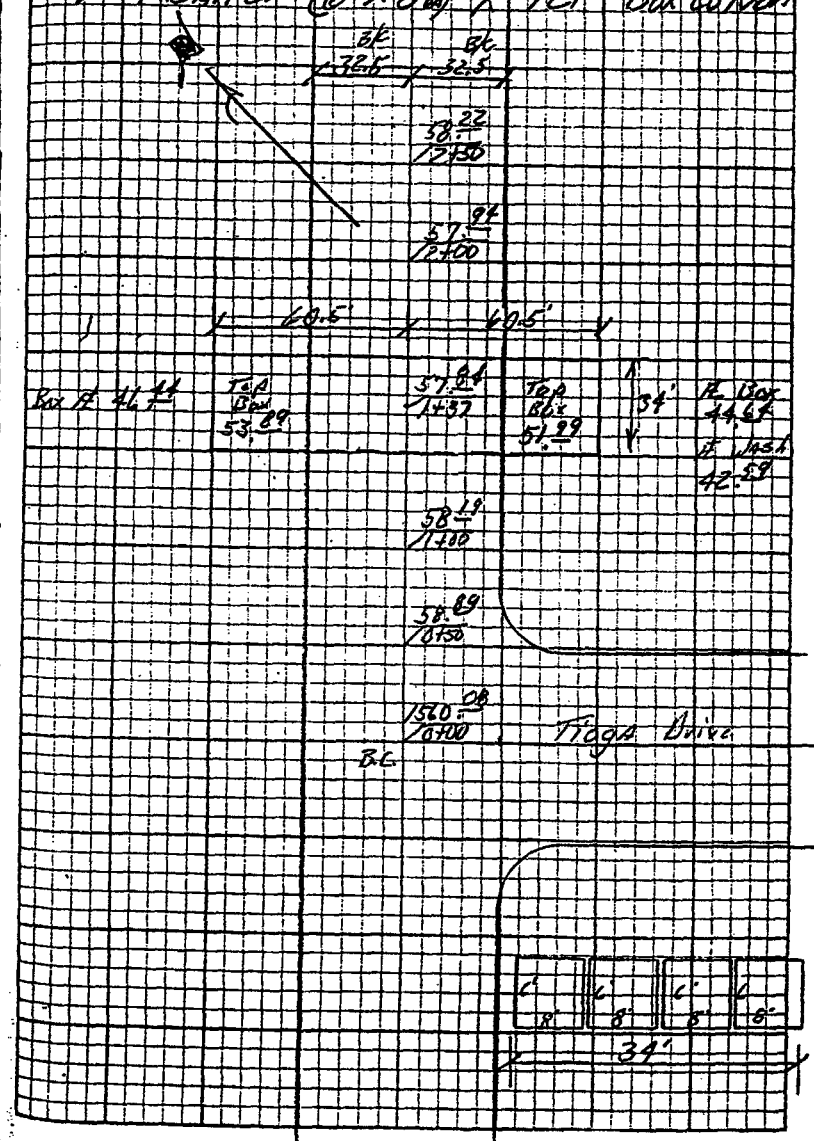


STA					
1+37	℄ Box Culvert 4-Barrel (6'x8') x 121'				
0+00	B. Cap @ ℄ Intr. Panorama Dr. & Tioga Drive				

"As Built"

Colony Wash Crossing Panorama Drive N.E. of Tioga Drive

1-4 Barrel (6'x8') x 121' Box Culvert



STA

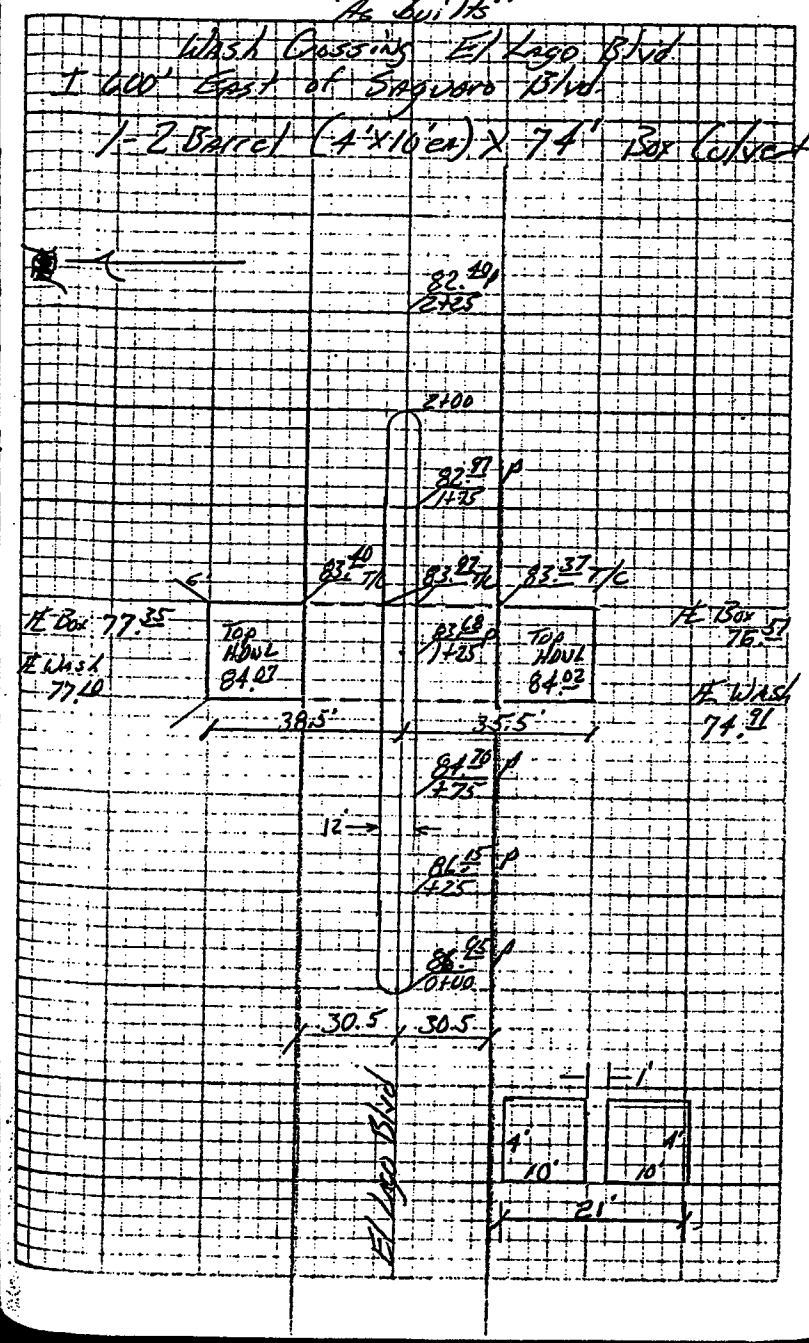
1+25 ℄ Box Culvert (4'x10') x 74' 2-Barrel

"As Built"

Wash Crossing El Lago Blvd.

1,600' East of Seaguard Blvd.

1-2 Barrel (4'x10' ea) x 74' Box Culvert

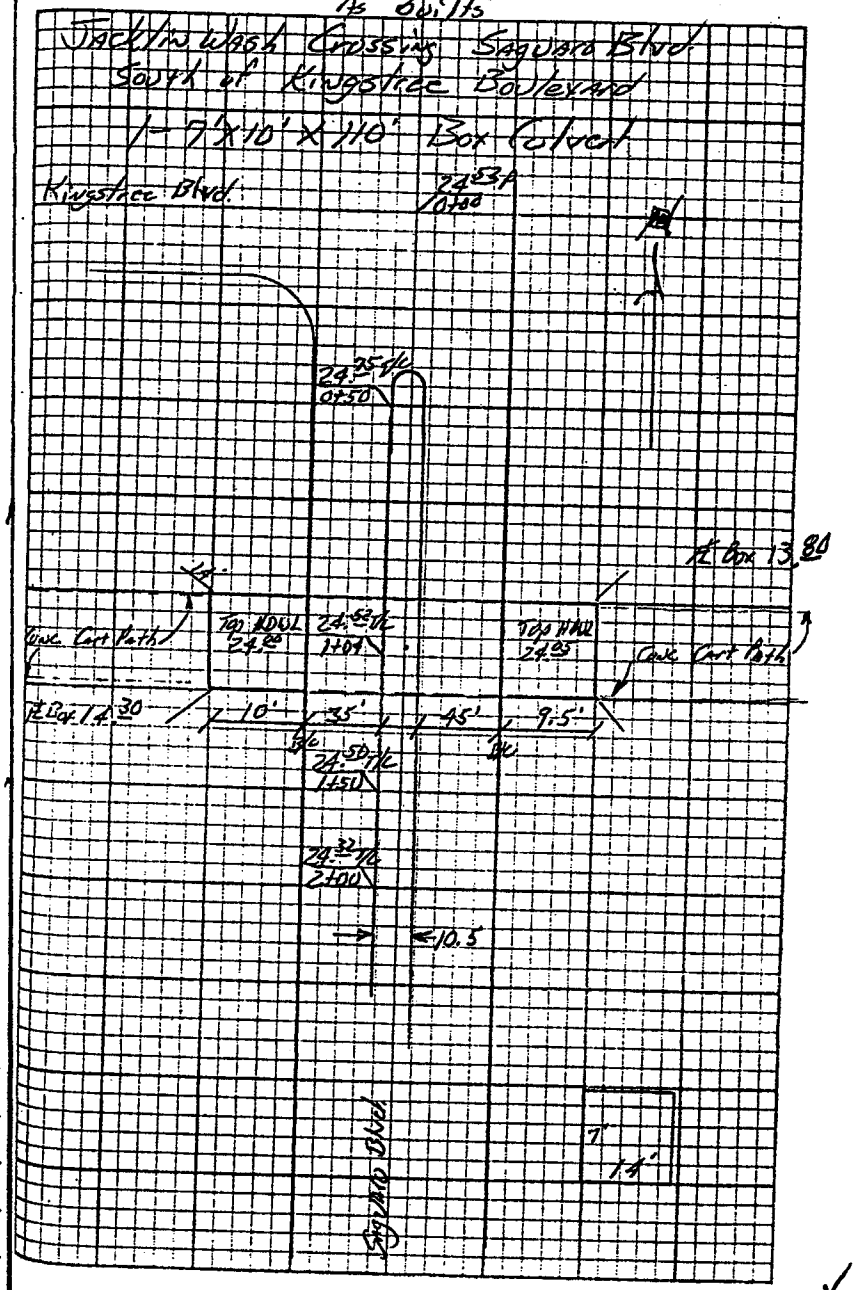


STA

1+04 ℄ Box Culvert 7'x14'x 110'

"As Built"

Jackin Wash Crossing Saguaro Blvd
South of Kingstree Boulevard
1-7'x10'x110' Box Culvert



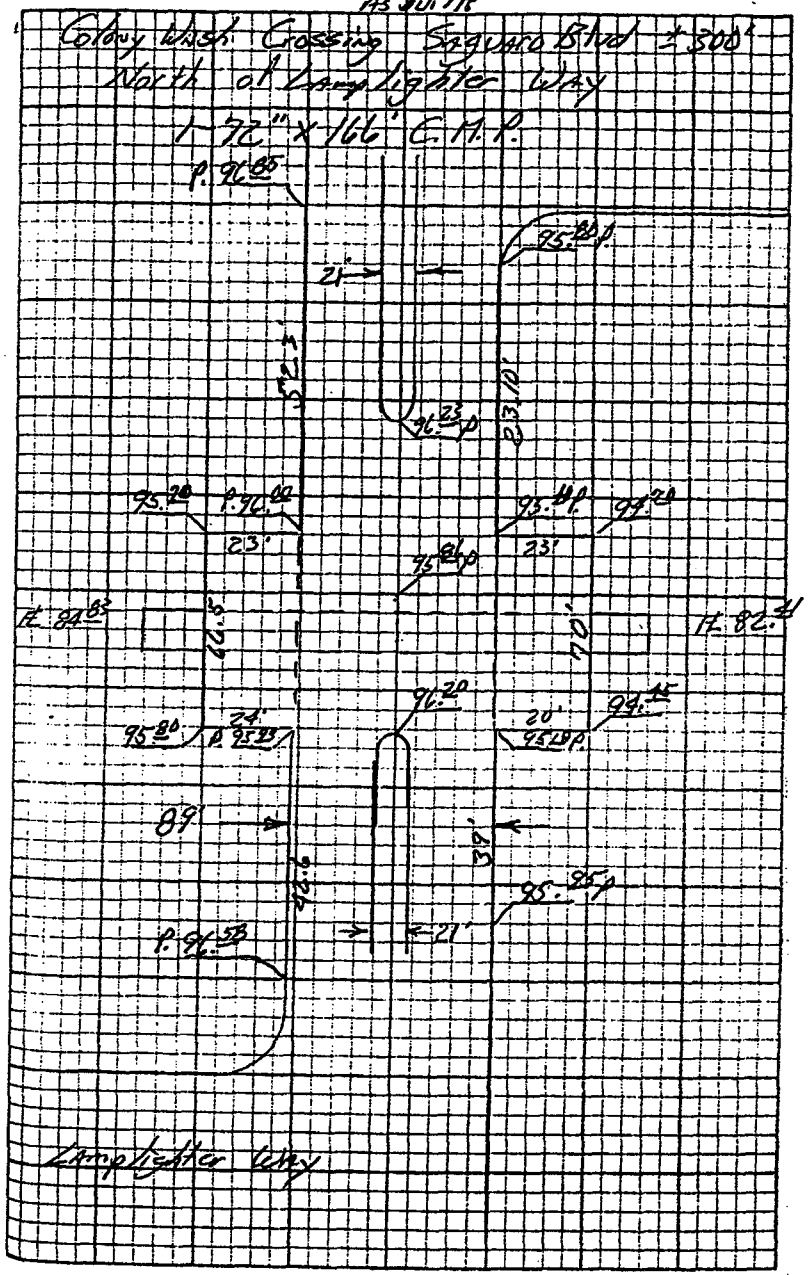
37

TA

1-72" x 166' C.M.P.
w/ Concrete Apron Spillway on
Both sides of Roadway

"As Built"

Colony Wash Crossing Saguaro Blvd ± 300'
North of Lamplighter Way
1-72" x 166' C.M.P.

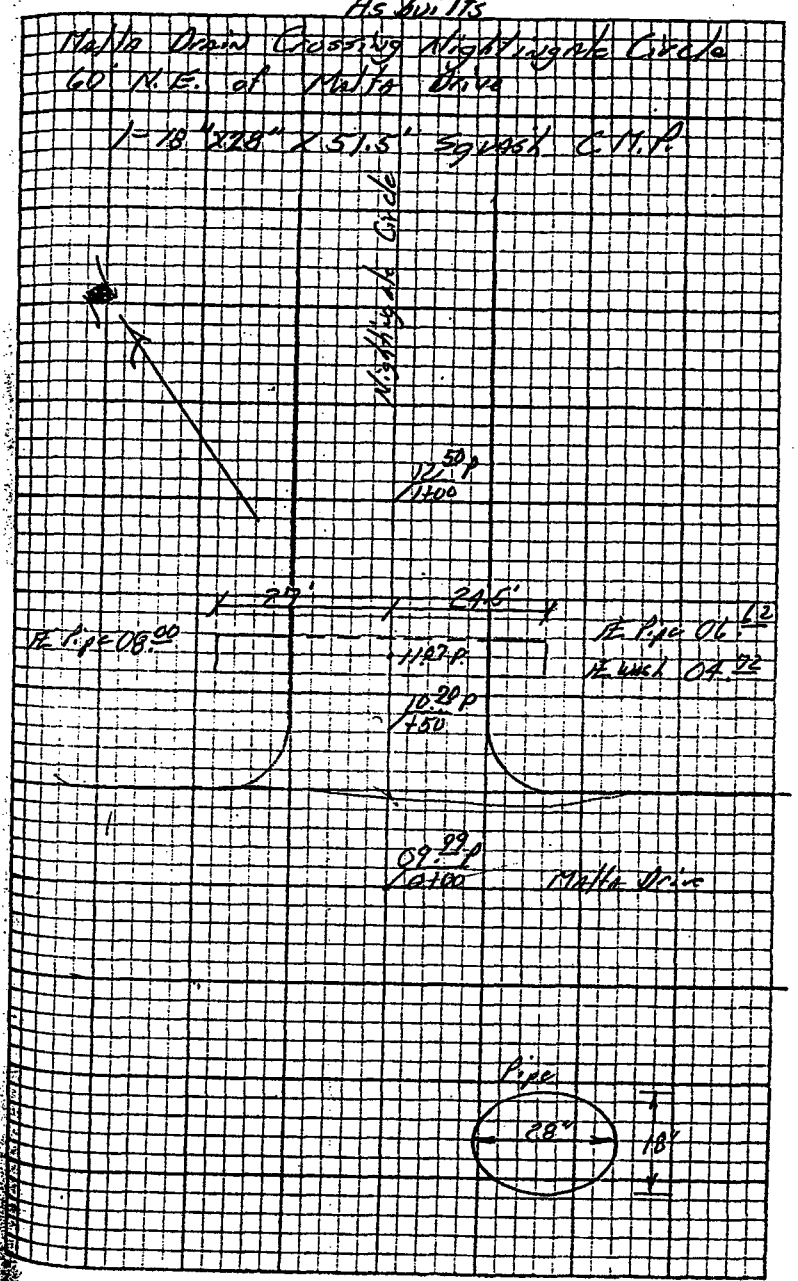


STA					
0+60	@ 1-18"x28"x51.5' Squash C.M.P.				

"As Built"

Malta Drain Crossing Nightingale Circle
60 N.E. of Malta Drive

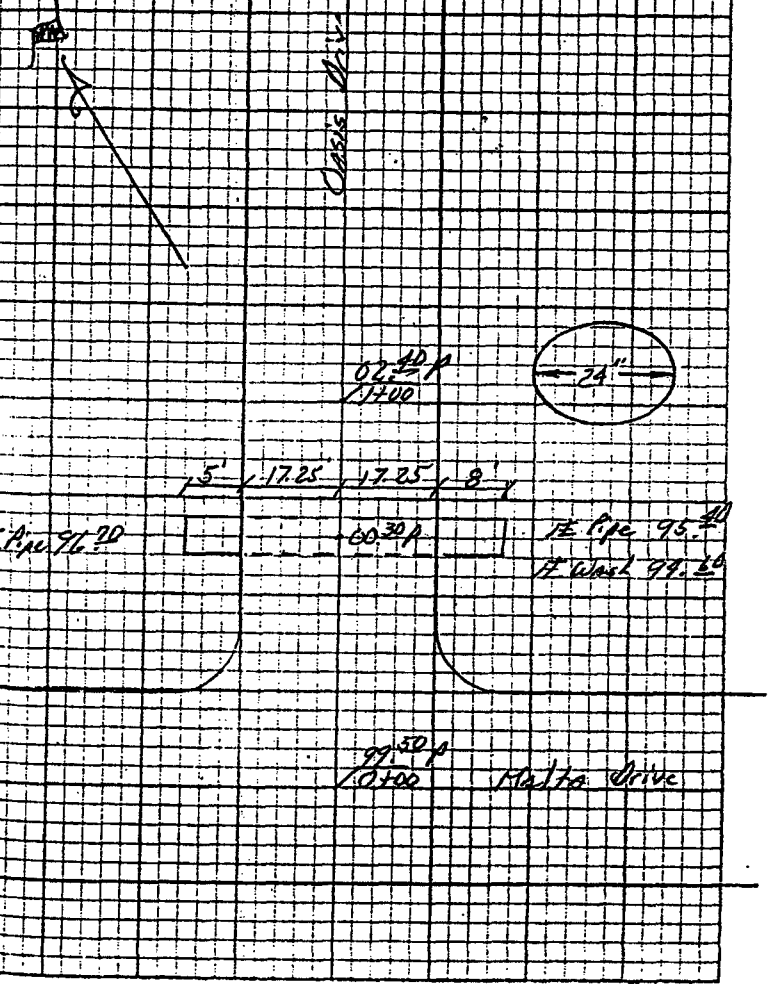
1-18"x28"x51.5' Squash C.M.P.



STA					
0+57	℄ 1-18"x24" x 47.5' Squash CMP.				

"As Builts"

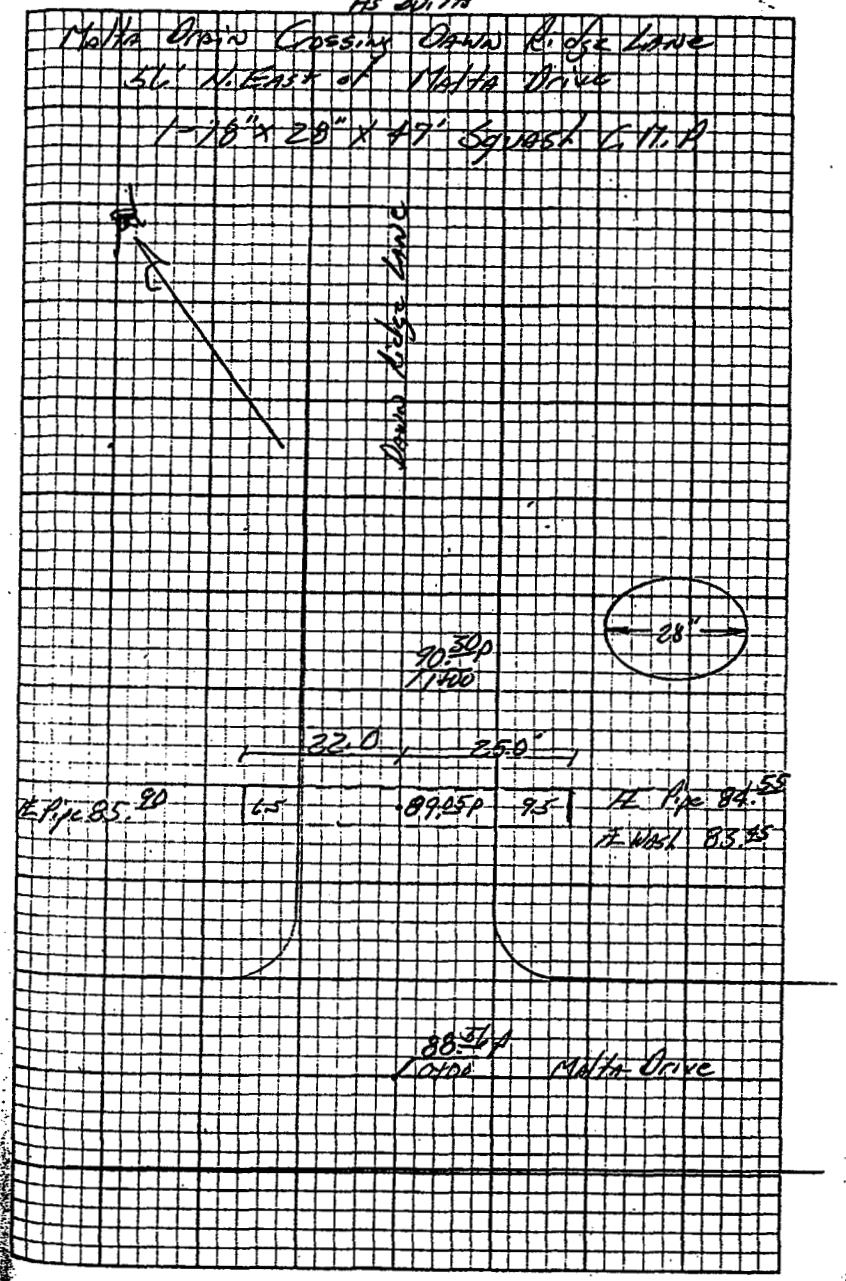
Malta Drain Crossing Oasis Drive
57' N.E. of Malta Drive
1-18"x 24"x 47.5' Squash CMP



STA					
0456	℄ 1-18"x 28"x 47' Squash Pipe				

"As Built"

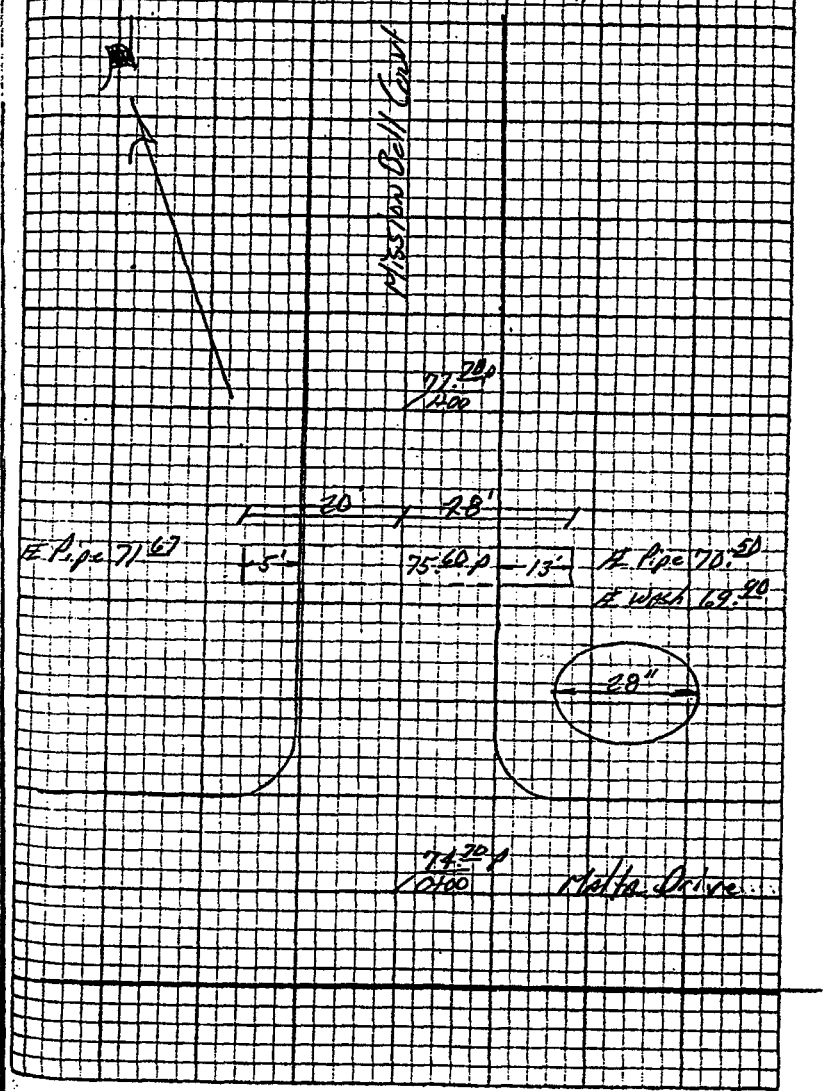
Malta Drive Crossing Dawn Ridge Lane
56' N.East of Malta Drive
1-18"x 28"x 47' Squash C.M.P



STA					
0+53'	1-18"x 28'x 48' Squash C.M.P.				
0+00	℄ Intr				

As Built

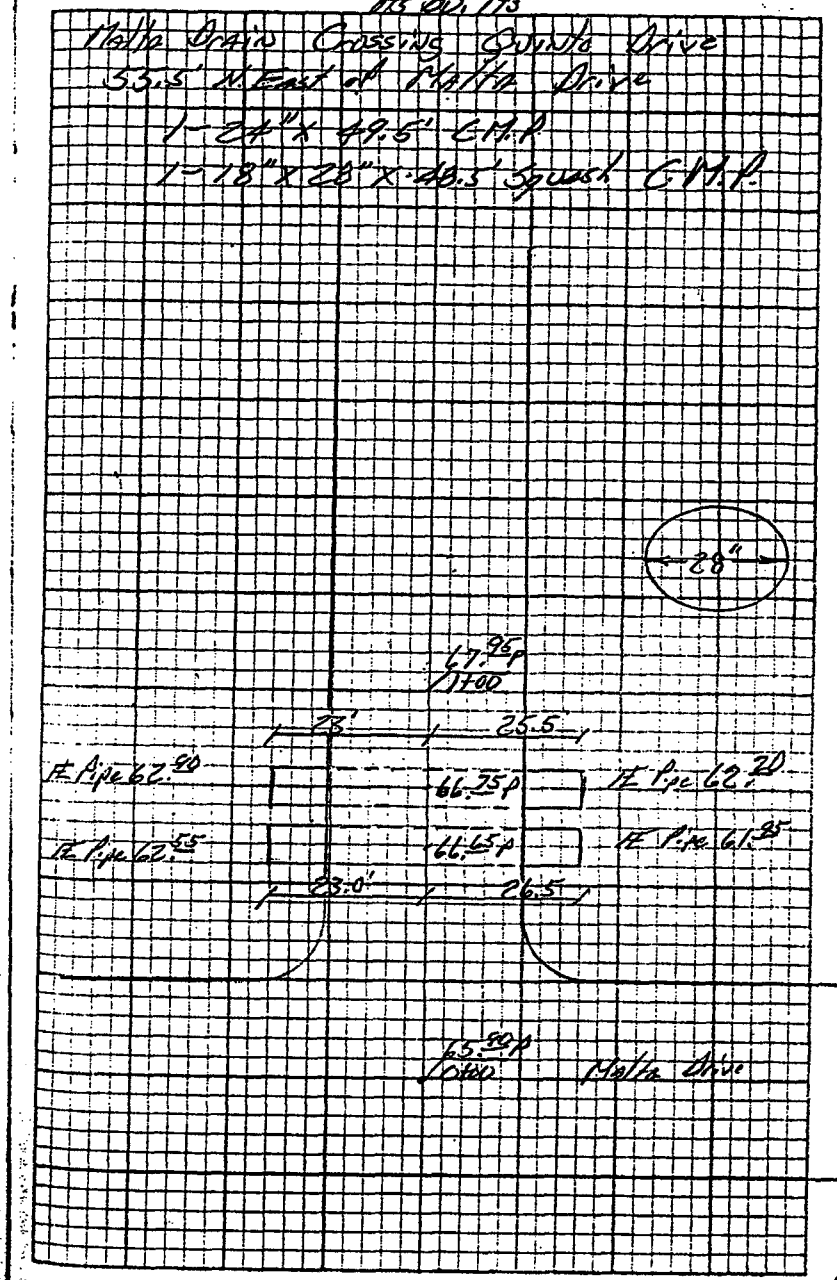
Malta Drain Crossing Mission Bell Court
53' N.East of Malta Drive
1-18"x 28"x 48' Squash C.M.P.



STA					
0+58	1-18"x 28" x 48.5' Squash C.M.P.				
0+53	1-24"x 49.5' CMP				
0+00	℄ Intersection				

"As Builts"

Malta Drain Crossing Santa Drive
53.5' N. East of Malta Drive
1-24" x 49.5' C.M.P.
1-18" x 28" x 48.5' Squash C.M.P.

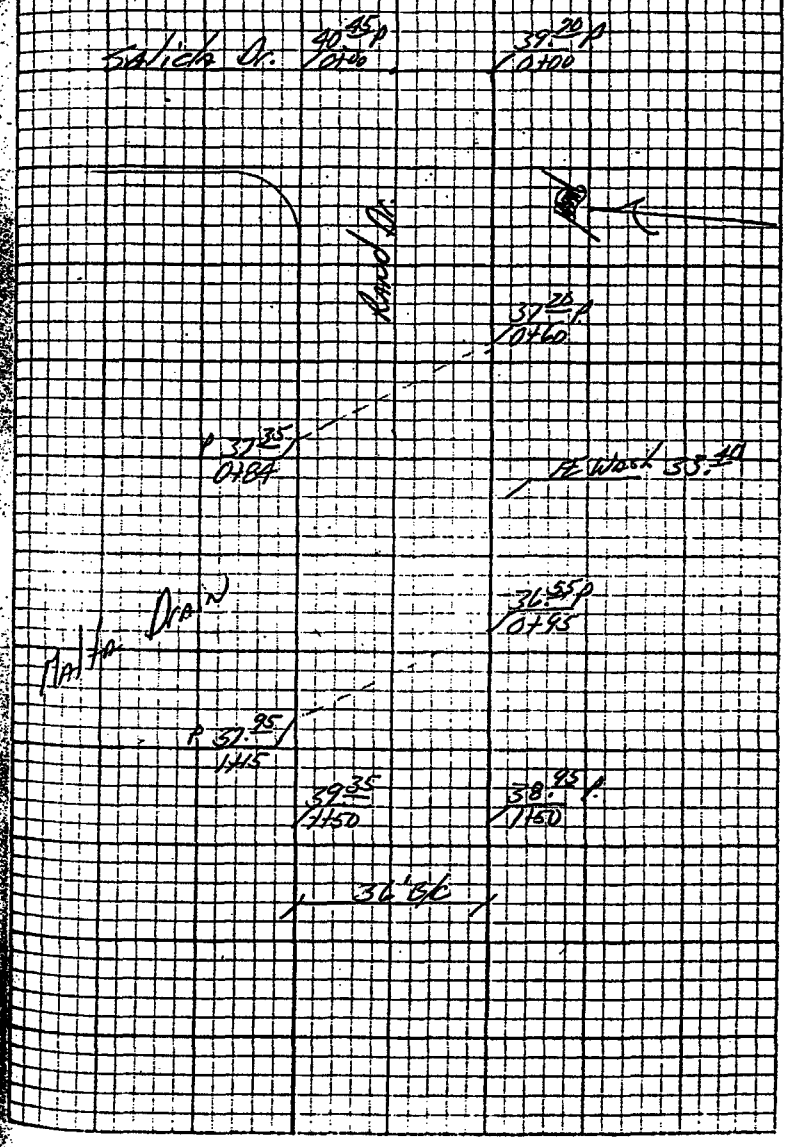


STP

0+00 ℄ Intersection

"As built"

Hallahan Crossing Rand Drive S. West of Salida Drive West Crossing Pavement



STA		H.I.	—	Elev.
BM #J-8				1681.96
	3.39	85.35		

1-48" x 350' C.M.P.

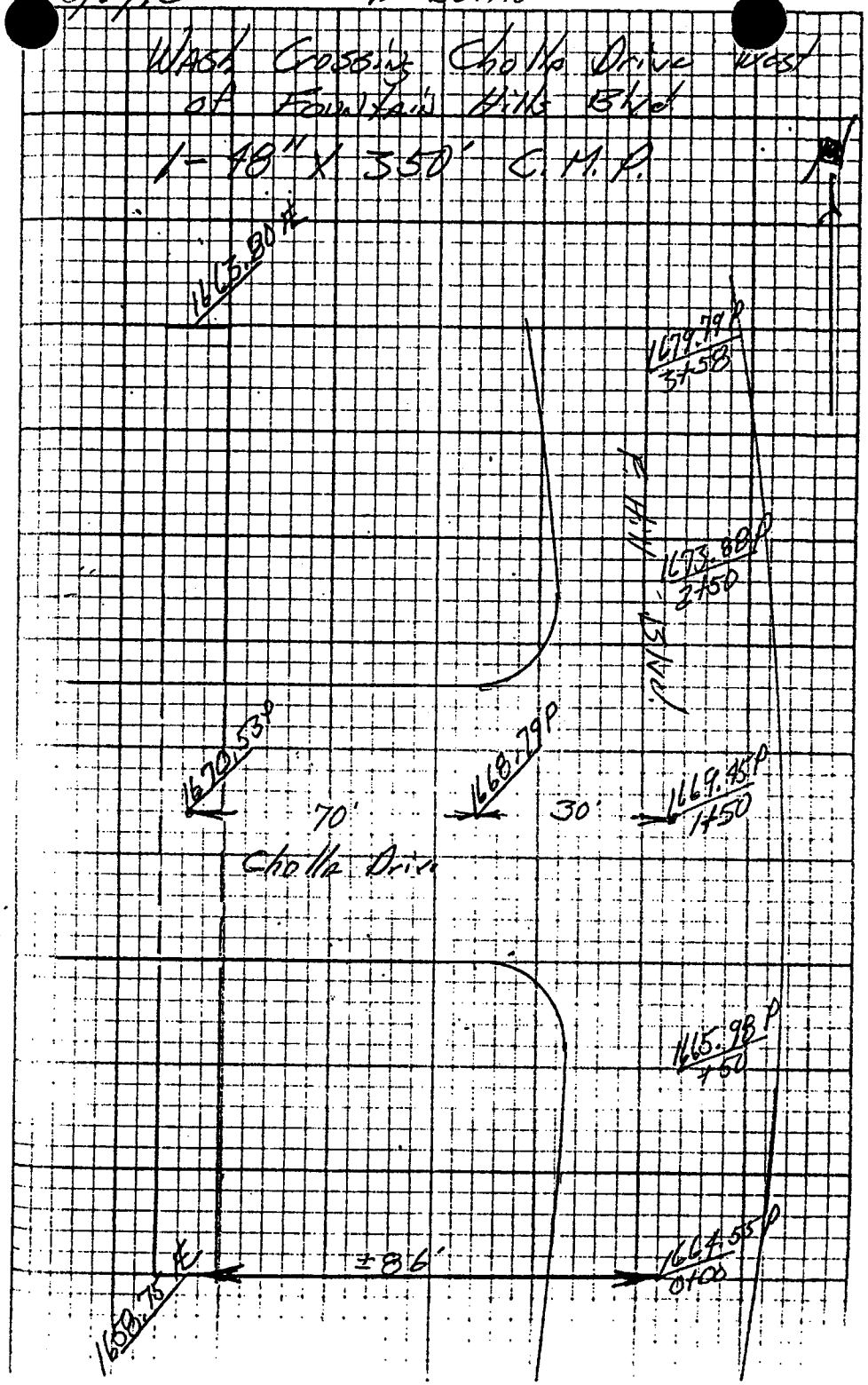
8/8/93
Miss Pipe
As Builts
Cholla Dr.
& F.H.'s Blvd.
CP.

8/6/93 As Builts

31

West Crossing Cholla Drive West of Fountain Hills Blvd

1-48" x 350' C.M.P.



Valco Surveying Corporation

AERIAL CONTROL · MAPPING · LAND SURVEYS
CONSTRUCTION STAKING · MBE/DBE CERTIFIED

602-990-2412

FOUNTAIN HILLS FLOODPLAIN DELINATION STUDY, SOUTH

CONTRACT FCD 92-05

ERM'S AND DESCRIPTIONS

REGISTERED LAND SURVEYOR
CERTIFICATE NO.
18552
Valentin Vaca Medina
Date Signed 9-30-95
ARIZONA, U.S.A.

SOKKIA™

MADE IN U.S.A.

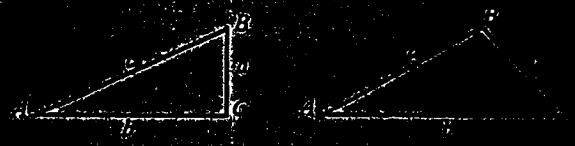
SOKKIA™

ECONOMY
FIELD BOOK

10/93 F. Hills
Flood Study
AGK # 31043
Vol. # 0116-00

ERM's - Level &
Description.

FORMULAE FOR SOLVING RIGHT TRIANGLES



$\sin A = \frac{a}{c} = \cos B$ $\cot A = \frac{b}{a} = \tan B$

$\cos A = \frac{b}{c} = \sin B$ $\sec A = \frac{c}{b} = \csc B$

$\tan A = \frac{a}{b} = \cot B$ $\csc A = \frac{c}{a} = \sec B$

Given	Required	Solution
A, c	B, a, b	$B = 90° - A$; $a = c \sin A$; $b = c \cos A$
A, b	B, a, c	$B = 90° - A$; $a = b \tan A$; $c = \frac{b}{\cos A}$
A, a	B, b, c	$B = 90° - A$; $b = a \cot A$; $c = \frac{a}{\sin A}$
a, c	A, B, b	$\sin A = \frac{a}{c}$; $\cos B = \frac{a}{c}$; $b = \sqrt{(c+a)(c-a)}$
a, b	A, B, c	$\tan A = \frac{a}{b}$; $\cot B = \frac{a}{b}$; $c = \sqrt{a^2+b^2}$

FORMULAE FOR SOLVING OBLIQUE TRIANGLES

Given	Required	Solution
A, a, b	B, c	$\sin B = \frac{b \sin A}{a}$; $c = \frac{a \sin C}{\sin A}$
A, B, a	b	$b = \frac{a \sin B}{\sin A}$
a, b, C	A, c	$A + B = 180° - C$; $c = \frac{a \sin C}{\sin A}$
a, b, c	Area	side $\frac{a+b+c}{2}$; area $= \sqrt{s(s-a)(s-b)(s-c)}$
A, b, c	Area	area $= \frac{bc \sin A}{2}$
A, B, C, a	Area	area $= \frac{a^2 \sin B \sin C}{2 \sin A}$

MADE IN U.S.A.

Fountain Hills Flood Study

ERM's - Description
Level Runs

10-93

P.C. Porter
T. N. Tempelsta

3/12/93
P.O.
N.T.
1

#	+	HI	—	EL =
A,23				1526.01
	12.86	1538.87		
#375			0.96	1537.91
# 375	0.86	1538.77		
A,23			12.76	1526.01

Description

T/C PC. Indian wells Dr. North
@ N.E. Cor Saguaro

"Boat spike" @ Mc/Ha & Parlin

3/12/93
P.O.
NT (2)

#	+	HI	−	ELEV.	Description
A 42				1613.57	See Level Book Pg. 9
	11.22	1624.79			
#388			0.69	1624.10	(B.S.) @ Hawk Dr. 215' ± west of INT of Saguaro & Hawk Dr.
#388	0.51	1624.61			
A 42			11.04	1613.57	A-23 - 1526.01 P. 5

#	+	HI	−	ELEV.
A,40				1597.83
	11.39	1609.22		
# 363			1.10	1608.12
# 363	1.23	1609.35		
A,40			11.51	1597.84

Description

3/12/93
☒ P.O.
☐ N.T.

(3)

See Pg. 8 Book 1

(B.S.) @ Gunsight Dr. 290 ± west of Saguaro

3/12/93

#	+	HI	−	ELEV.
E,22				1591.13
	4.79	1595.92		
B.C.			4.71	1591.21
B.C.	4.64	1595.85		
E,22			4.72	1591.13

See Pg. 37 Bk. 1

(B.C.) @ ℄ Lost Trail & Saguaro

3/12/93

#	+	HI	−	ELEV.	Description
E.9				1624.63	See Pg. 35 Bk. 2
	2.07	1626.70			
B.C.			6.75	1619.95	(B.C.) @ ℄ LEO & Saguaro
B.C.	6.66	1626.61			
E.9			1.99	1624.62	

#	+	HI	—	ELEV
E,10				1635.67
	22.31	1657.98		
#			1.87	1656.11
#	1.69	1657.80		
			22.12	1635.68

3/12/93

Description

Pg. 35 Bk 1

(B.C.) @ Kaser Dr. & Saguaro

#	+	HI	−	ELEV.
E, 22				1591.13
	3.24	1594.37		
Nail (B.S.)			5.27	1589.10
Nail (B.S.)	5.20	1594.30		
E, 22			3.16	1591.14

3/12/93

Description

Pg. 37

Nail (B.S.) @ Laser & Saguaro
600' ± South of SHEA.
In Front of Sheriff Sub-Station.

#	+	HI	−	ELEV.
D, 39				~~1597.00~~ 96.00
	9.96	1606.96		
TBM			2.06	~~1604.90~~ 03.90
TBM	1.83	1606.73		
			9.73	1597.00

Pg. 29 Bk. 1

TBM "X" on concrete N.W. Cor
Catch basin Address 16664 W. Trevino
(North Side)

-5/12/95
P.O.
N.T.

#	+	HI	−	ELEV.
D,29				1726.75
	2.61	1729.36		
T.B.M.			3.12	1726.24
TBM	2.96	1729.20		
D,29			2.45	1726.75

See Pg. 27 Bk. 1

N.E. Bolt on Signal Pole basin
North East Signal Pole.
SHEA & Fountain hills

3/12/93

#	+	HI	−	ELEV.
D-23				1797.71
	6.52	1804.23		
#338			0.28	1803.95
#338	0.58	1804.53		
D-23			6.82	1797.71

Pg. 25 Bk. 1

(Nail) @ E. Kingsfree & Fountain hills
03 below Pav.

3/12/93

Pg. 43

(B.S.) & Armour Cir. & Indian wells

#	+	HI	—	ELEV.
F,16				1566.63
	5.10	1571.73		
# TBM			7.72	1564.01
TBM	7.95	1571.96		
F,16			5.34	1566.62

Desc.

(B.C.) & Armour Cir. & Indian wells

#	+	HI	—	EL.
B.M.				1564.01
	0.40	1564.41		
T.P.			14.01	1550.40
T.P.	2.28	1552.68		
ERM			7.53	1545.15
ERM.	7.37	1552.52		
TP			2.13	1550.39
TP	15.40	1565.79		
B.M.			1.78	1564.01

West T.C. Jacklin Dr.

Nail & of Jacklin & Augusta

Brass Cap. ℄ I.T. Last Trail & Leo Dr.
EL = 1586.60

#	+	H.I.	—	ELEV.
F,6				1709.69
	0.41	1710.10		
TP			22.83	1687.27
TP	0.93	1688.20		
ERM			13.91	1674.29
ERM	14.02	1688.31		
TP			1.04	1687.27
TP	23.01	1710.28		
F,6			0.60	1709.68

Bk. 1 Page 42

North T.C. Keota Dr. 125' East of East P.C.

(B.C.) west P.C. Keota Dr. 35' North of Jacklin Wash (New Pav. & B.C.)

#	+	HI	−	ELEV.
ERM.				1545.15
	6.72	1551.87		
K.16			11.22	1540.65
K.16				
ERM				

Nail & Jacklin & Augusta.

#	+	HI	−	EL.
K,6				1710.57
	0.92	11.49		
TP 1			24.76	1686.73
TP 1	0.65	87.38		
TP 2			24.43	1662.95
TP 2	0.33	63.28		
TP.3			22.34	1640.94
TP.3	0.36	41.30		
ERM			2.77	1638.53

See Page #68 Bk. 1

So. T.C. Baron Drive 150' No. of Emerald.

So. T.C. Baron Dr. 50' west of P.C.

E. T.C. Baron Dr. 50' So. of No P.C.

P.K. 150' No. Emerald wash.
also pk. # 1399 / .30 So. pk 399.

#	+	HI	—	EL.
K,11				1626.76
	1.78	23.54		
TP-1			21.54	1607.00
TP-1	0.45	1607.45		
ERM			15.41	1592.04

See Pg. 70 Bk. #1

Pk. & Incn @ Amhurst Dr.
Pt. 1384 / 4' SW. of #384

#	+	HI	—	EL.
C,1				1596.86
	5.94	1602.80		
ERM			5.00	1597.80
ERM	5.31	1603.11		
C,1			6.24	1596.87

3/26/93

Desc.

Bk. 1 Pg. 18

(Nail) & Saguaro @ A.O.T. Fountains

3/26/93

Pg. 8 - Bk. 1

(BC) & Quail Ridge & Panarama.

#	+	HI	—	EL.
A-33				1541.70.
	11.67	53.37		
ERM			2.65	1550.72
ERM	2.57	53.29		
A.33			11.60	1541.69

4/5/93

#	+	HI	—	EL.	
				1730.94	
D-11	24.89	55.83			
TP-1			0.16	1755.67	1755.68
TP-1	14.94	70.61			
TP-2			0.87	1769.74	1769.75
TP-2	12.98	82.72			
TP-3			24.15	1758.57	1758.59
TP-3	0.70	59.27			
ERP			14.79	1744.48	1744.50
ERM	14.75	1759.43			
TP-3			0.88	1758.55	1758.58
TP-3	24.43	82.98			
TP-2			13.25	1769.73	1769.76
		cont. Next		Page	

D-11 ELEV. = 1730.94
Bk 1, Pg. 24

#	+	Cont. HI	—	EL.	
				1769.73	
TP-2	0.57	70.30			
TP-1			14.65	1755.65	1755.69
TP-1	0.18	55.83			
D, 11			24.93	1730.90	1730.94

#	+	HI	−	ELEV.
#375/N,1				1537.91
	8.04	45.95		
N, 2			2.90	1543.05
N, 2	12.09	55.14		
N, 3			1.19	1553.95
N, 3	11.49	1565.44		
N, 4			0.63	1564.81
N, 4	11.89	1576.70		
N, 5			3.51	1573.19
N, 5	16.71	1589.90		
N, 6			1.34	1588.56
N, 6	11.85	1600.41		
N, 7			0.91	1599.50

375 also N, 1

"PK" @ Malta Dr. & Rand Dr.
also # 1372

No. T/C 100' E. of # 17123 Malta Dr.

"BC" @ Malta 50' E. of Quinto Dr.

"BC" @ Malta 50' E of Mission Bell CT.

"PK" Panel Point Malta & Dawnridge.

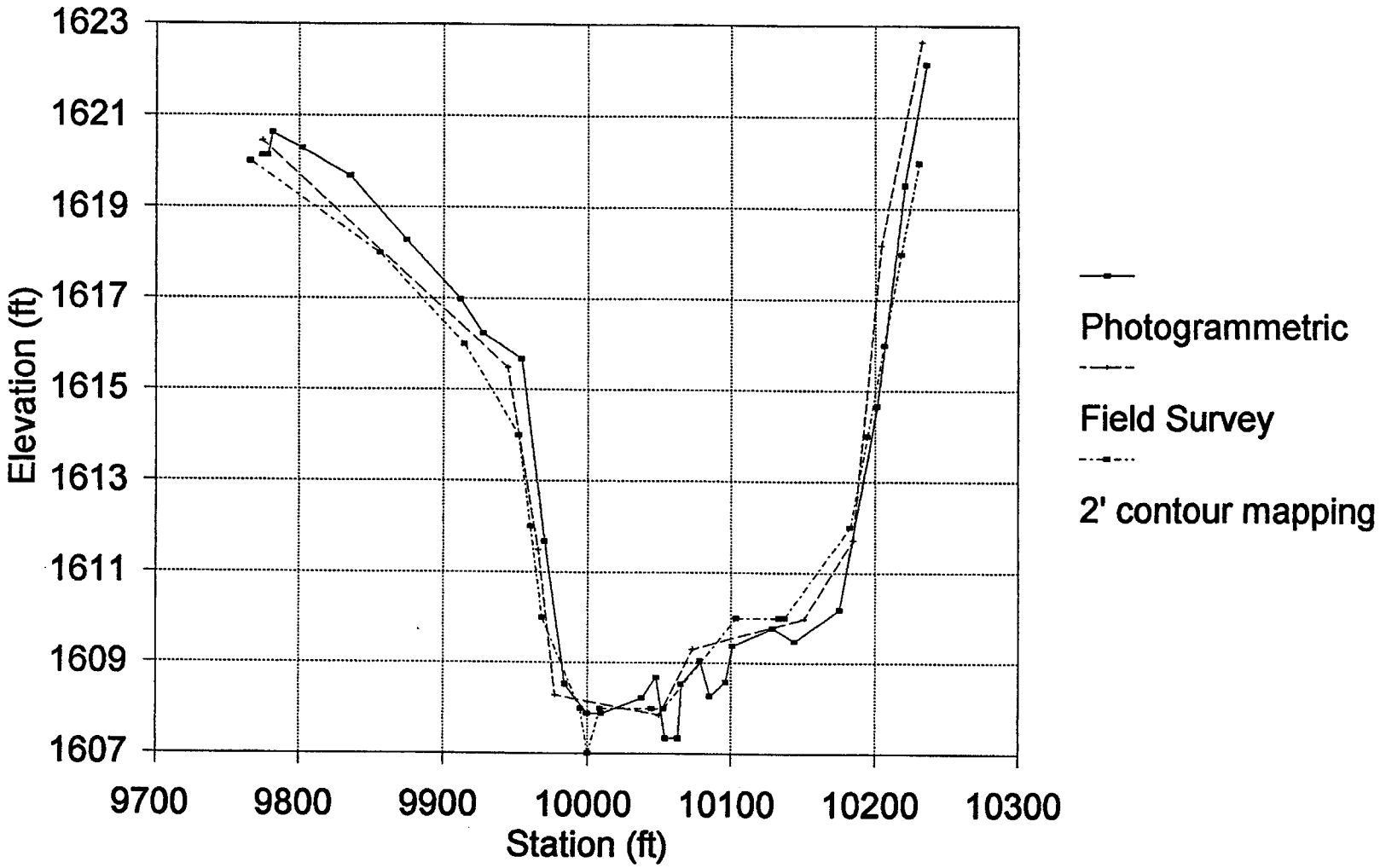
E. Rim M/H Malta & Oasis Dr.

※	+	HI	−	ELEV.	
N7				1599.50	
	12.60	1612.10			
N,8			2.11	1609.99	E. Rim M/H Malta @ Nightingale Cir.
N,8	13.08	1623.07			
N,9			0.17	1622.90	E. Rim M/H Malta @ Hawk Dr.
N,9	9.37	1632.27			
N,10			8.17	1624.10	Same as # 388

CROSS SECTION VERIFICATIONS

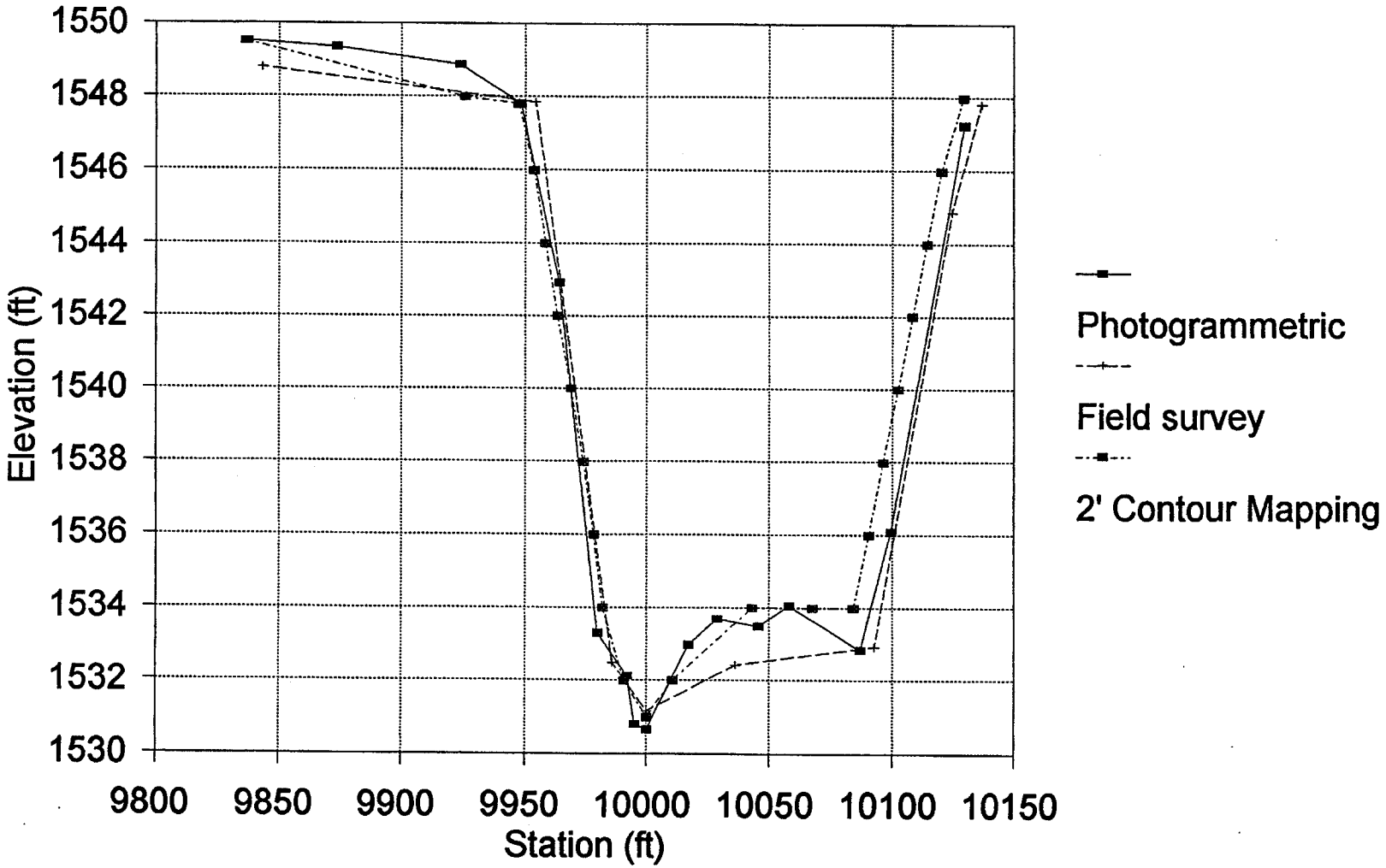
Powder Wash X-Sec # POW37

Chk sec # 1



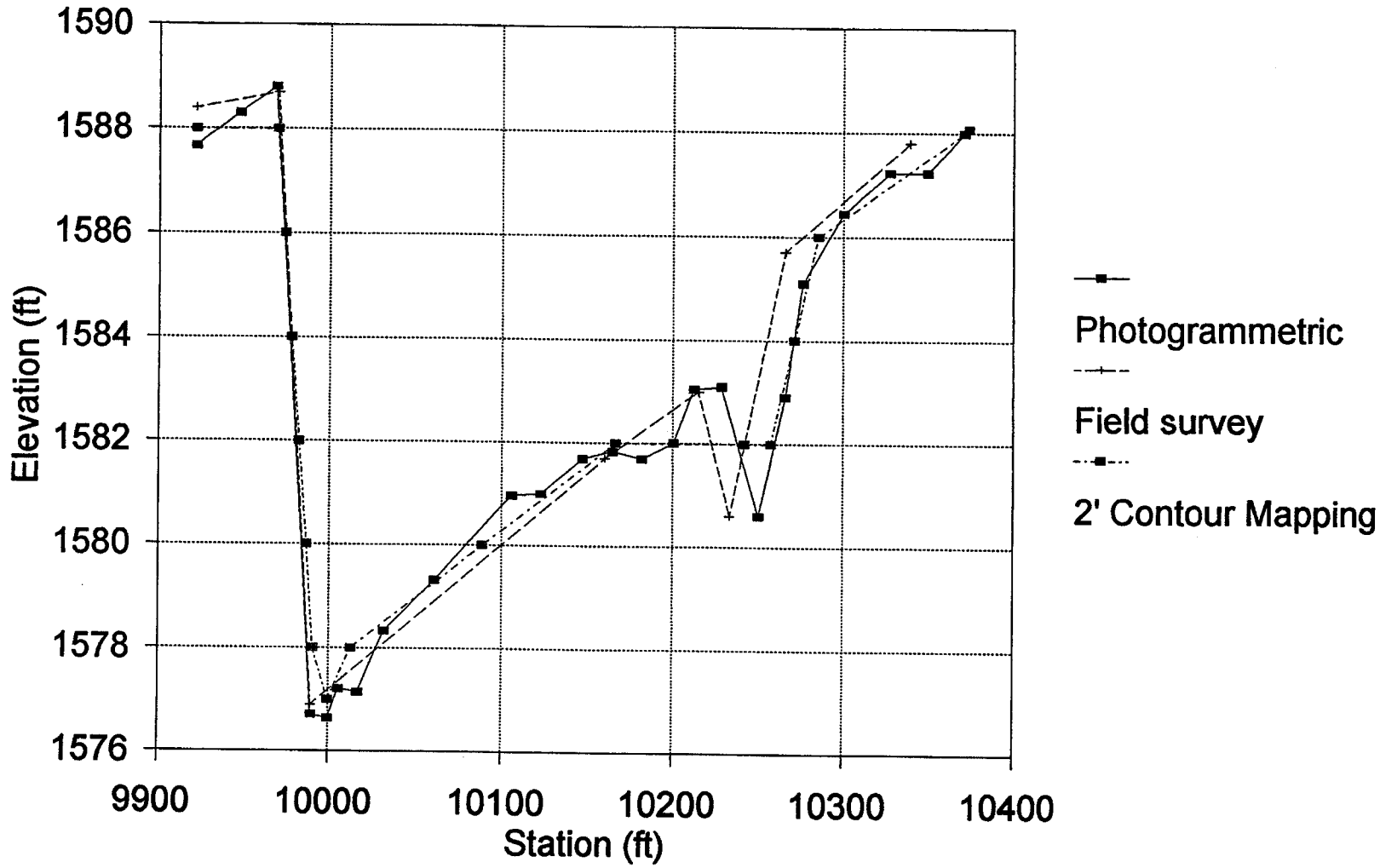
Cereus Wash X-Sec # CER273

Chk sec # 2



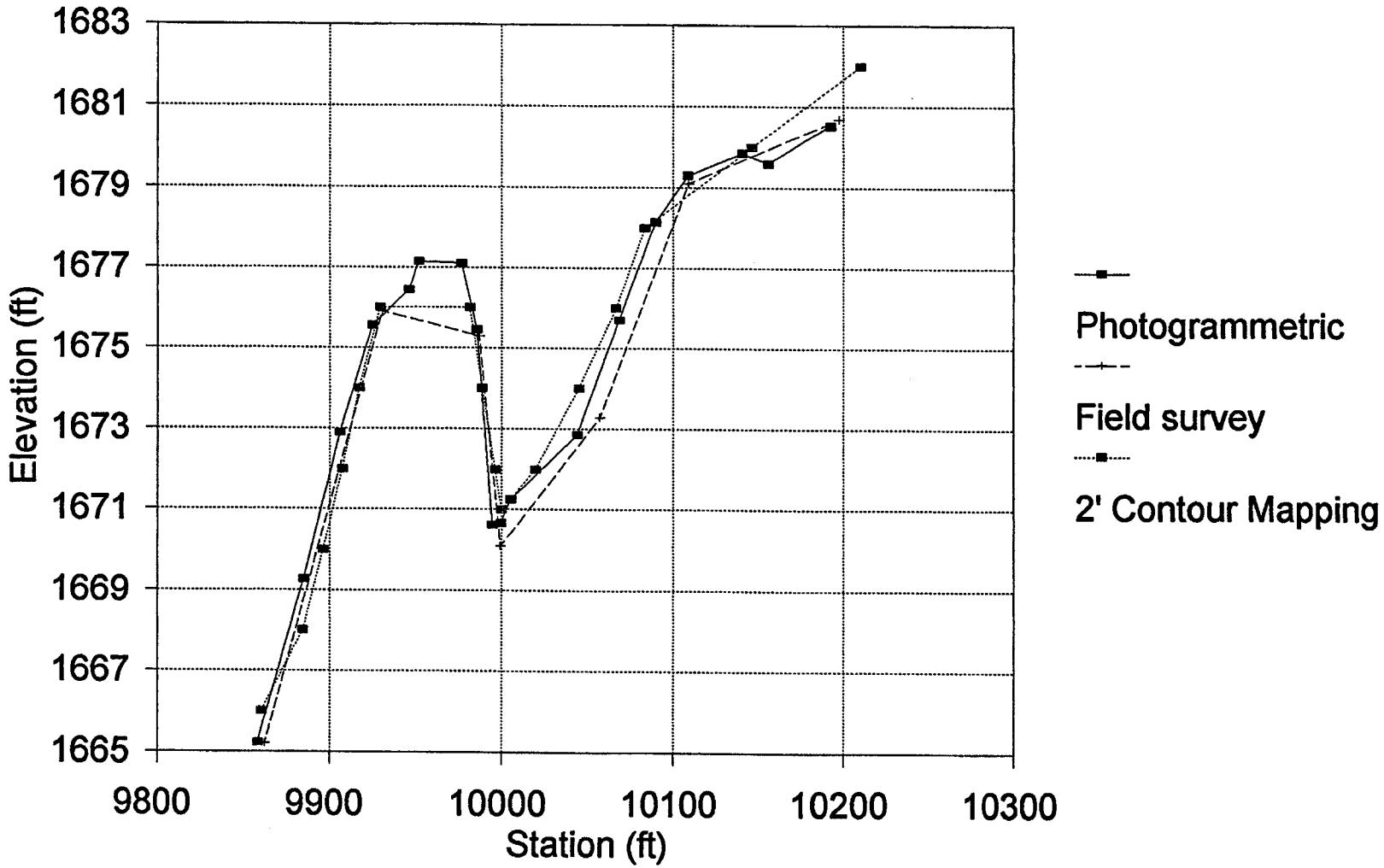
Cereus Wash X-sec # CER342

Chk sec # 3



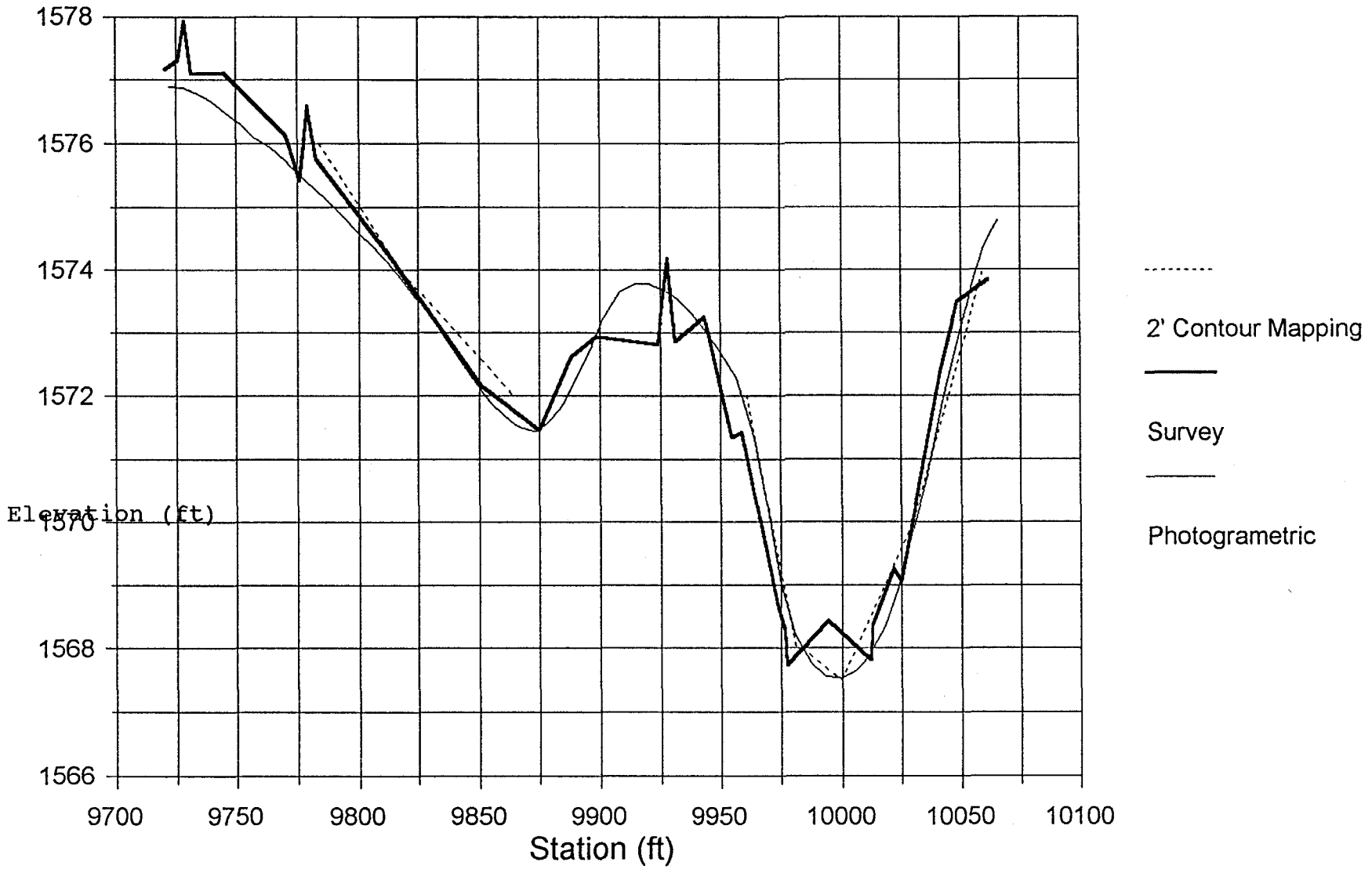
Logan Wash X-Sec # LOG449

Chk sec # 5



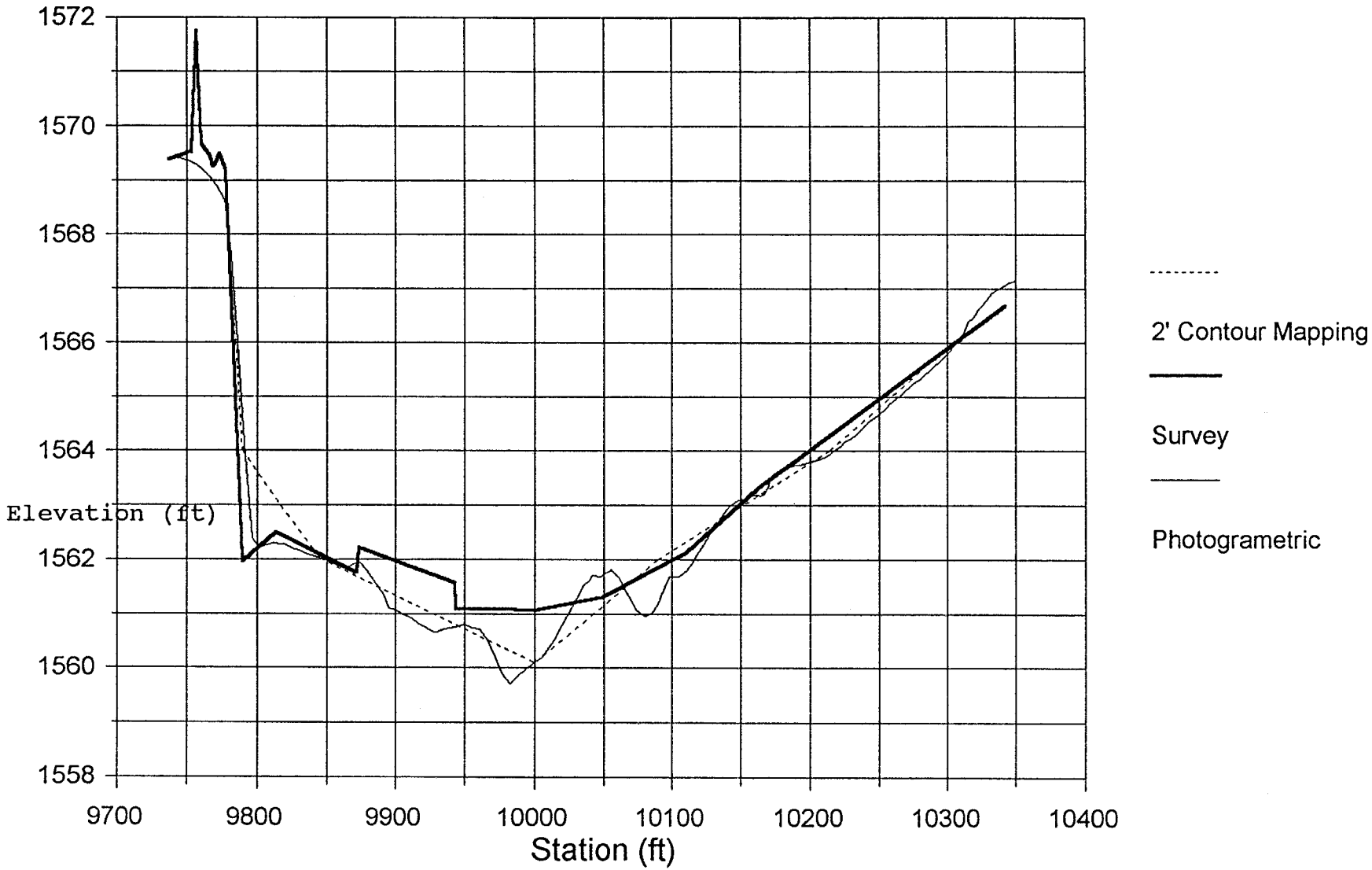
Laser Drain X-sec # LD-271

Chk sec # 1



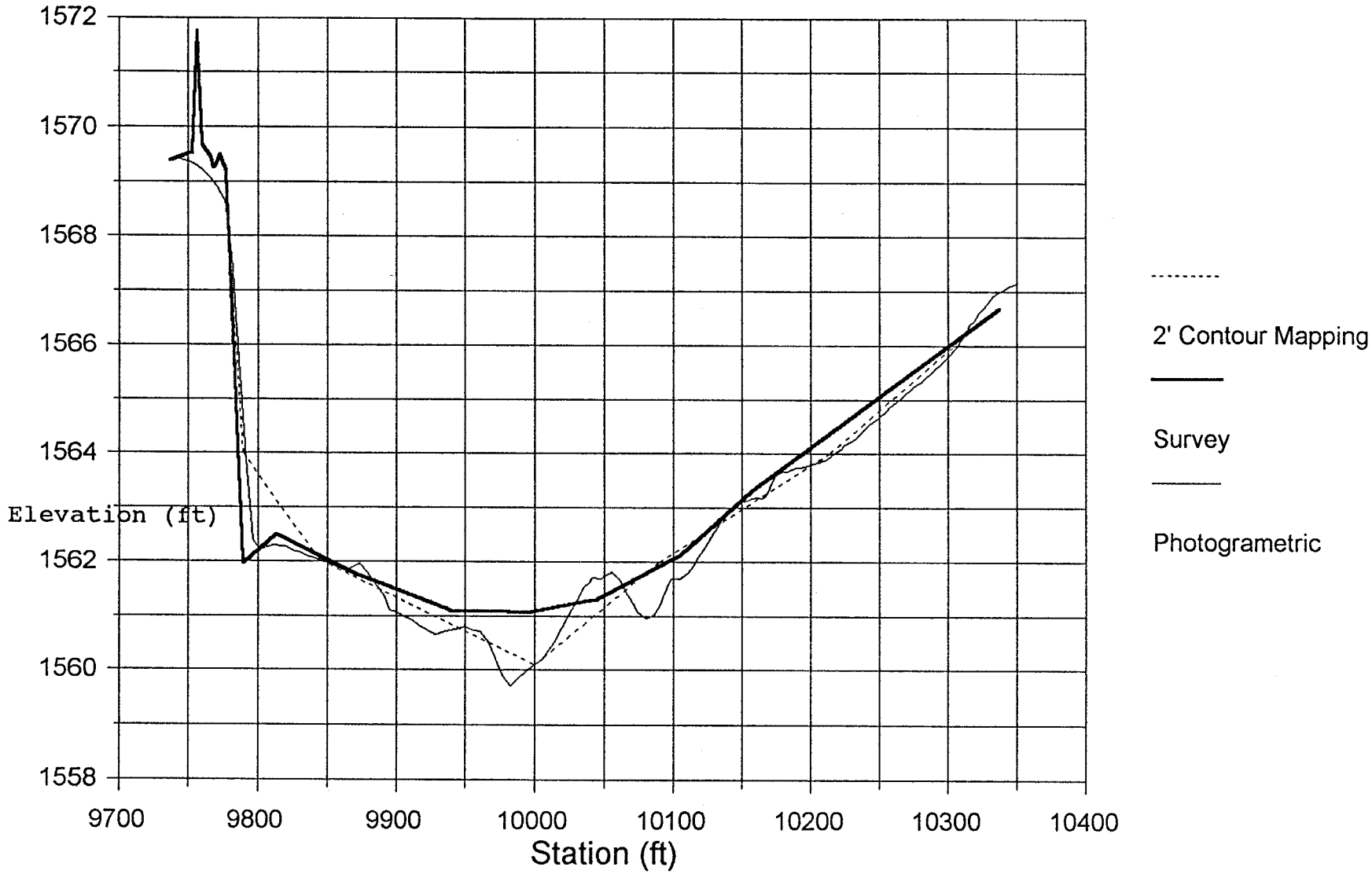
Laser Drain X-sec # LD-197

Chk sec # 2



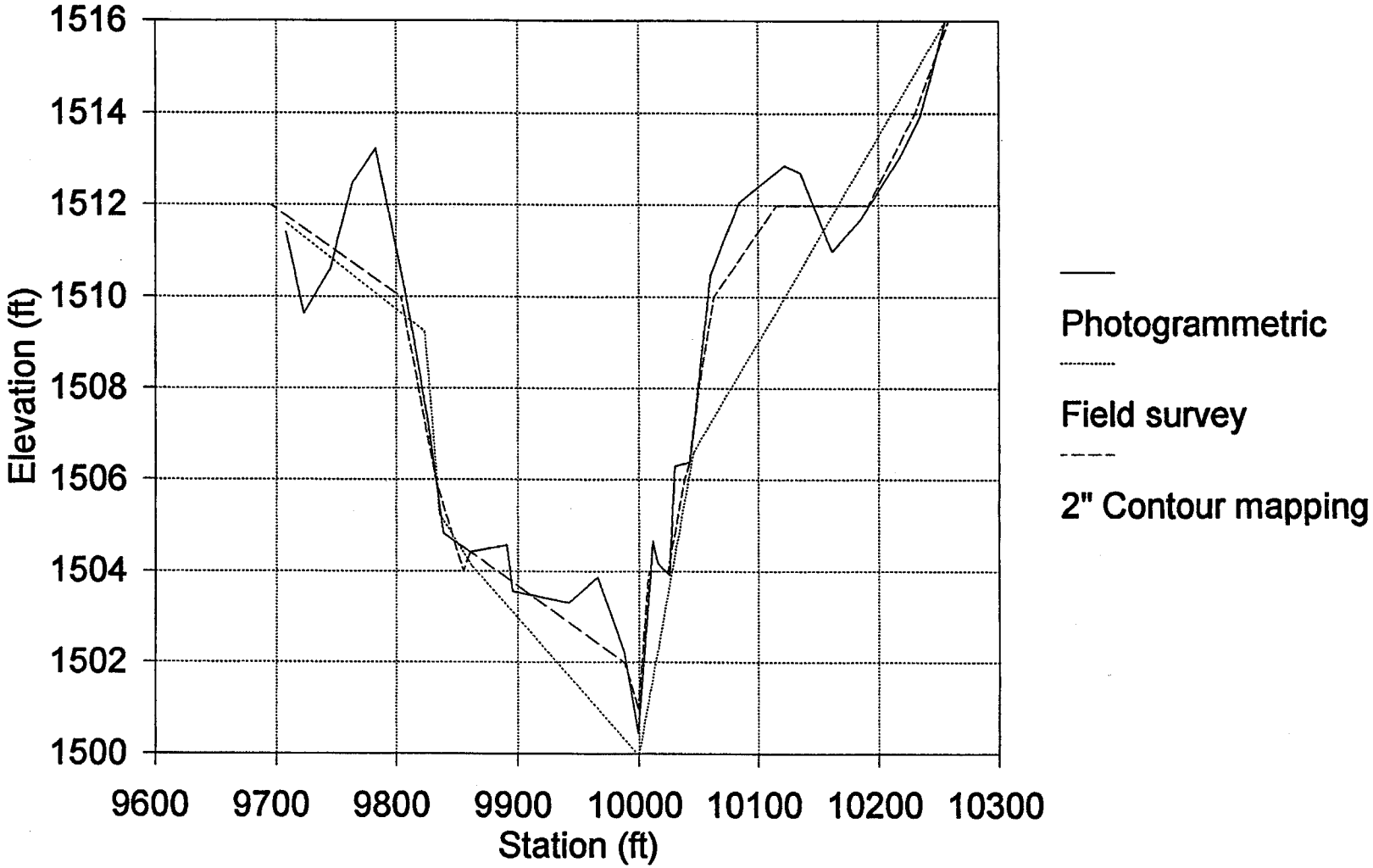
Laser Drain X-sec # LD-197

Chk sec # 2



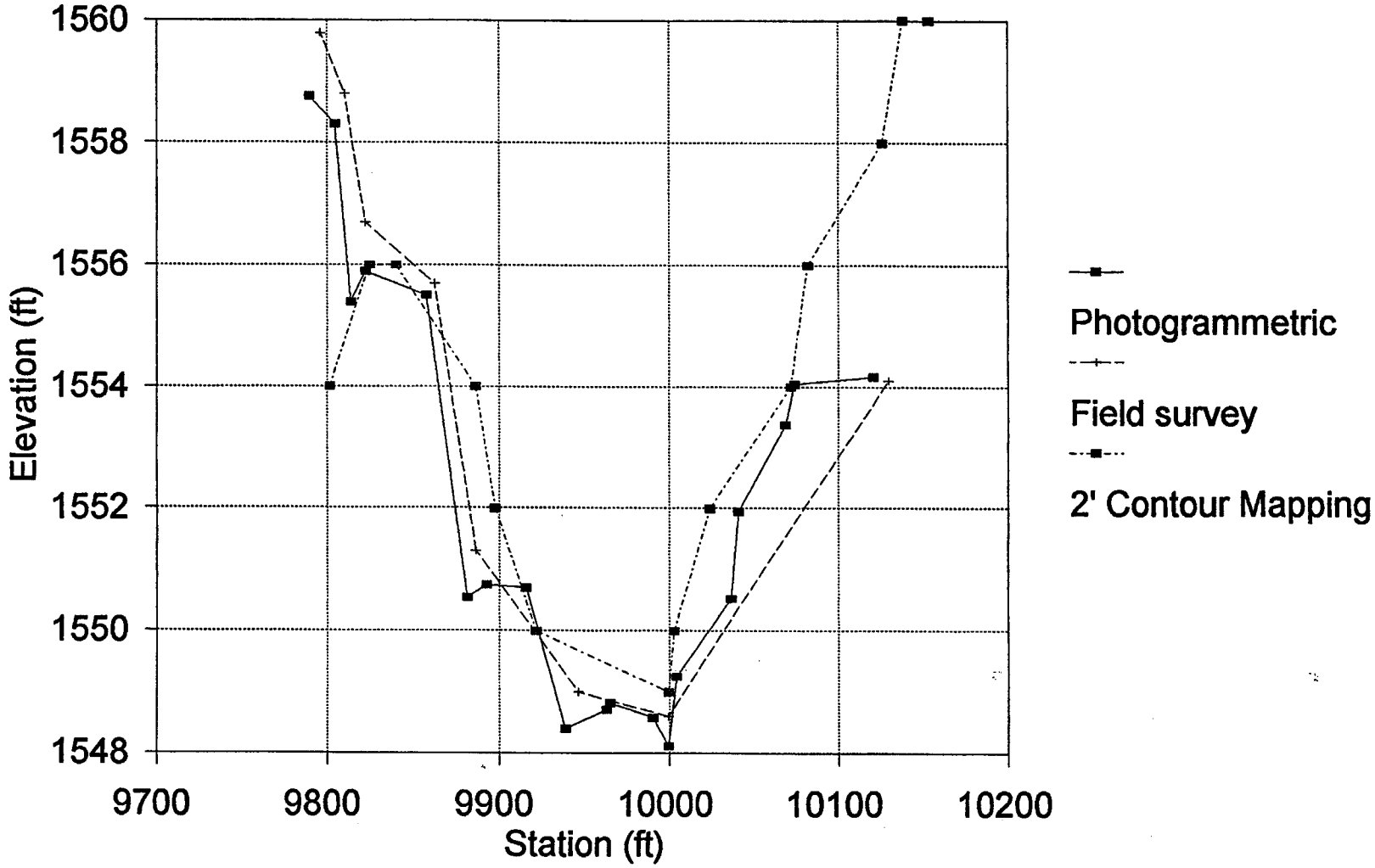
Cyprus Point Wash X-Sec #CPW225

Chk sec # 6



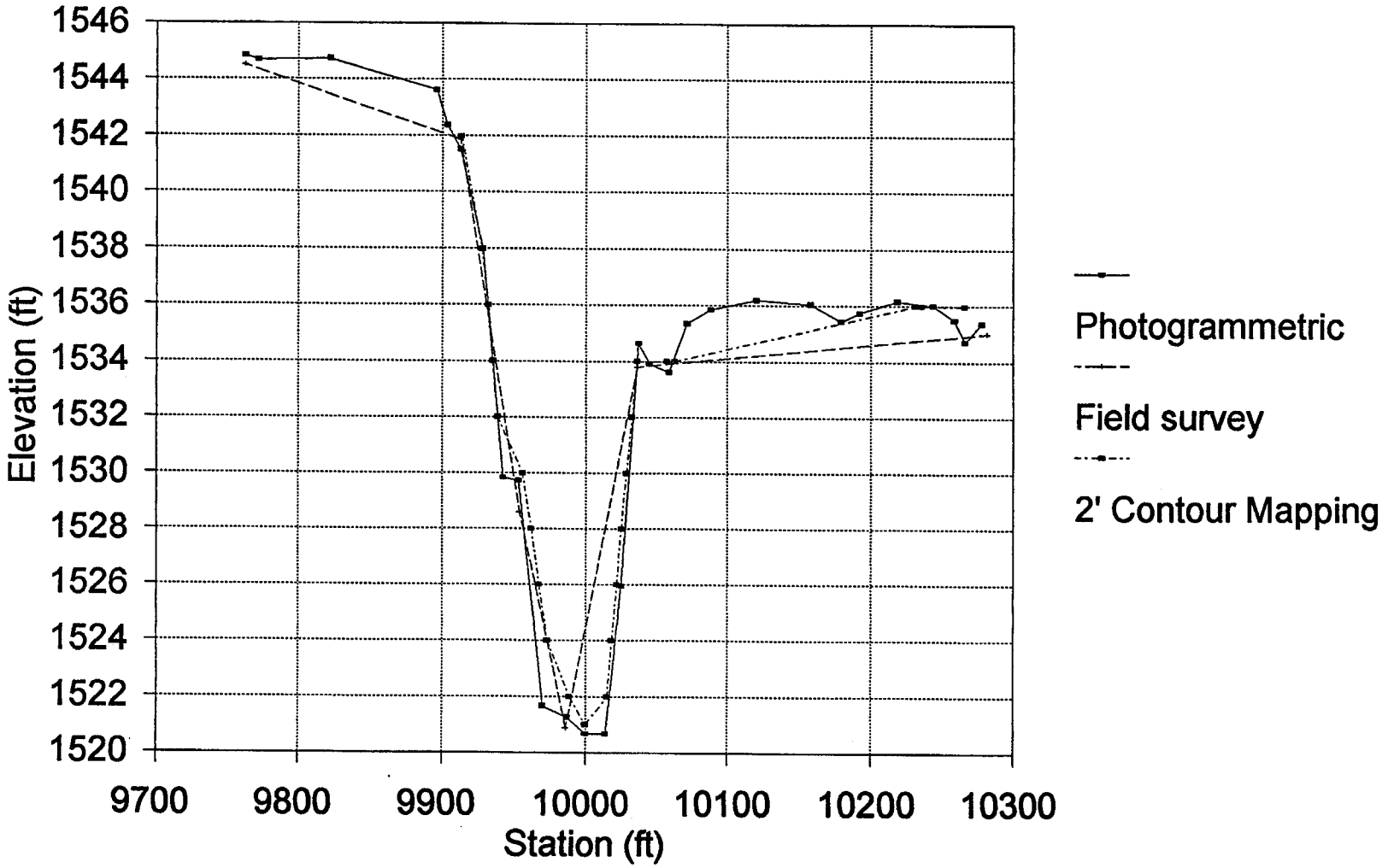
Kingstree Blvd. X-Sec #KGS279

Chk sec # 7



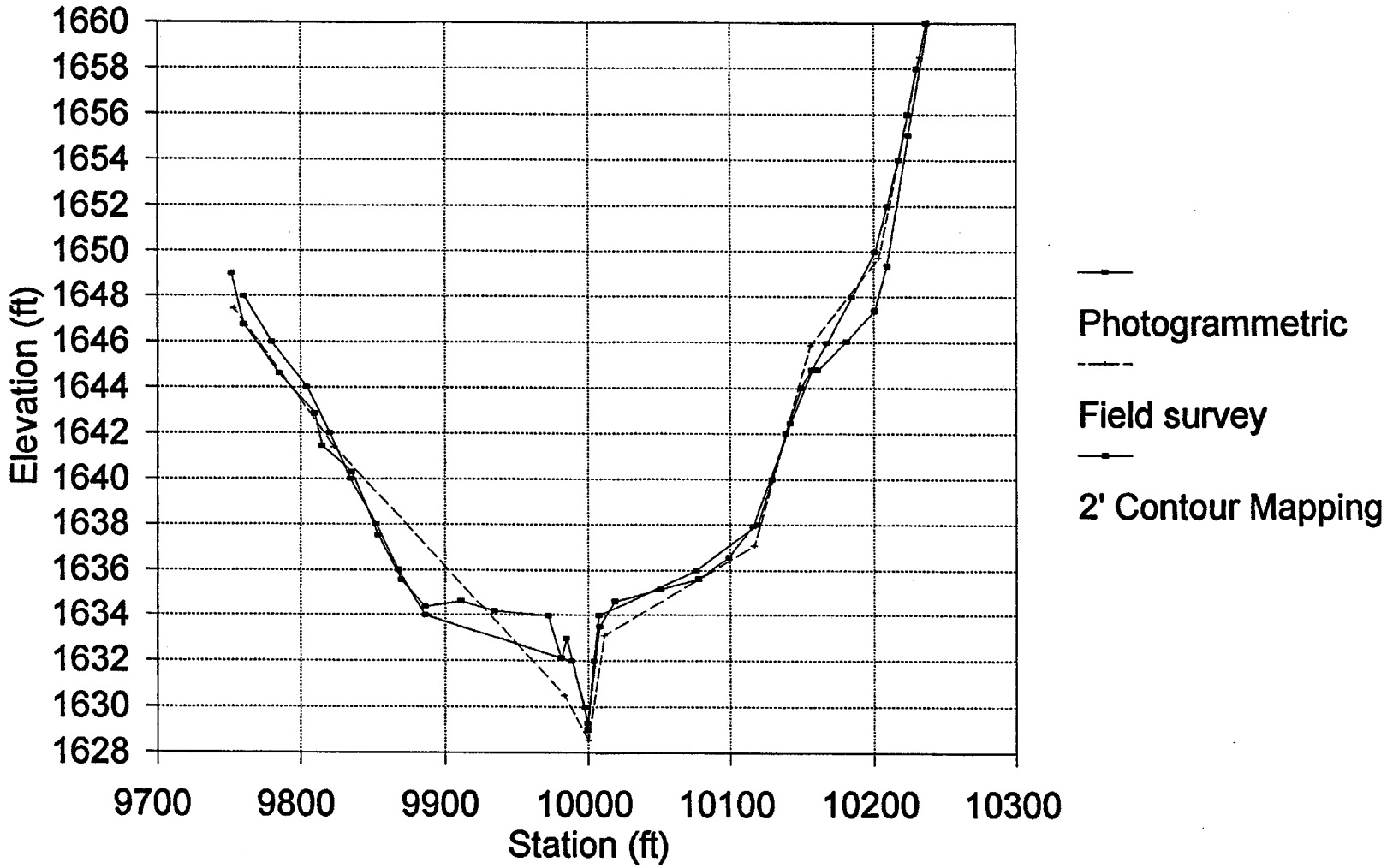
Emerald Wash X-Sec # EMR243

Chk sec # 8



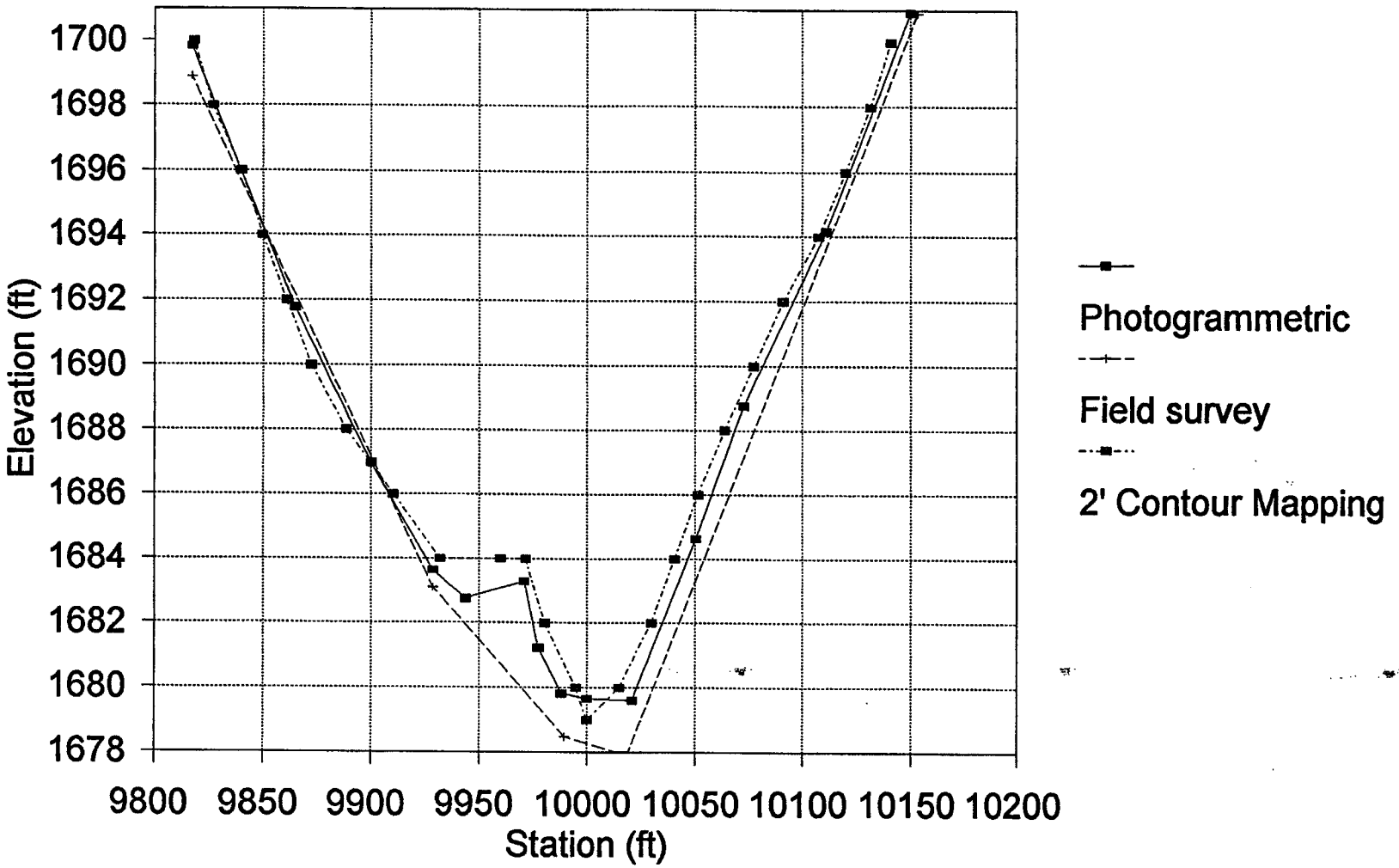
Fountain Channel X-Sec # EMR335

Chk sec # 9



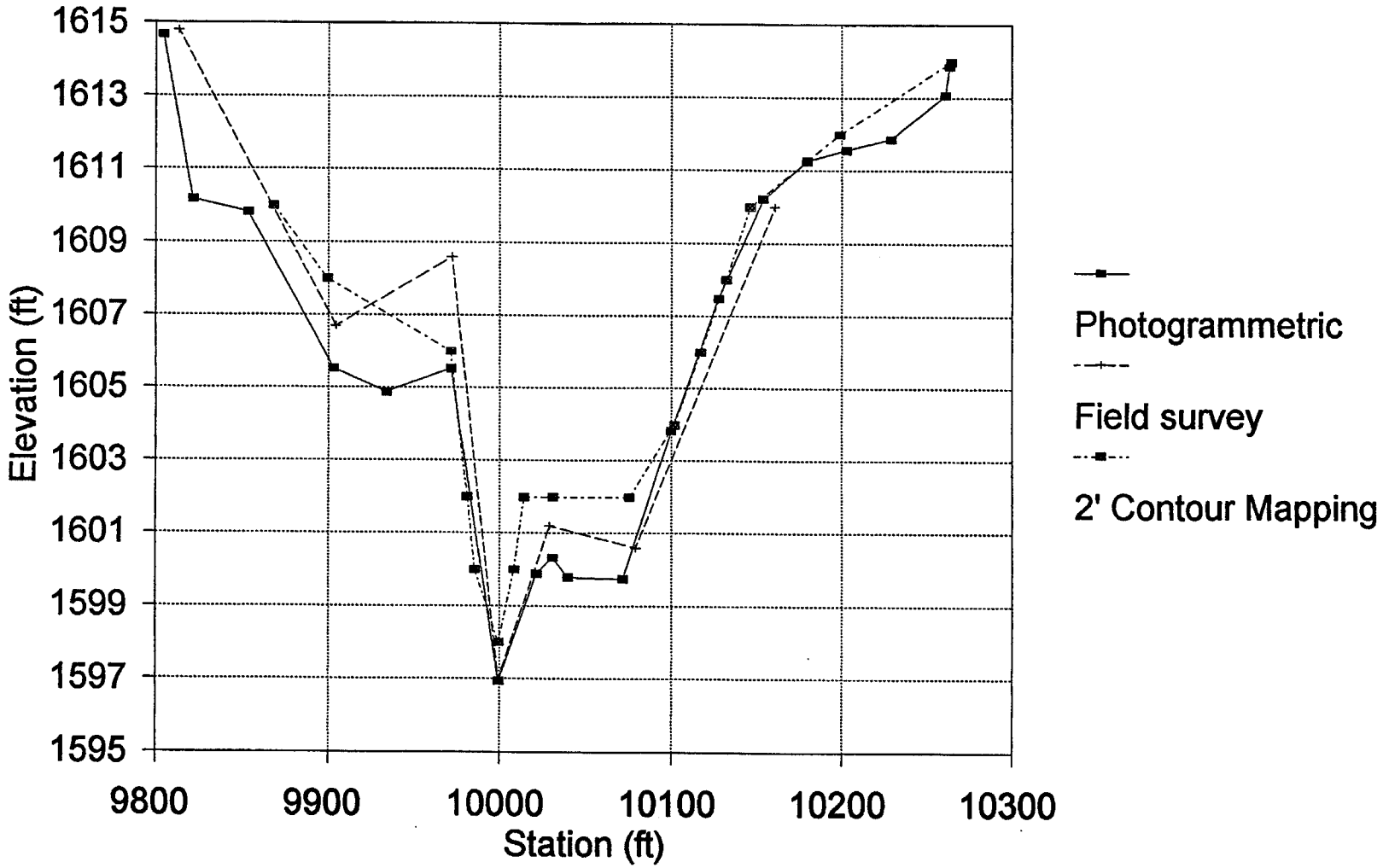
Emerald Wash X-Sec # EMR388

Chk sec # 10



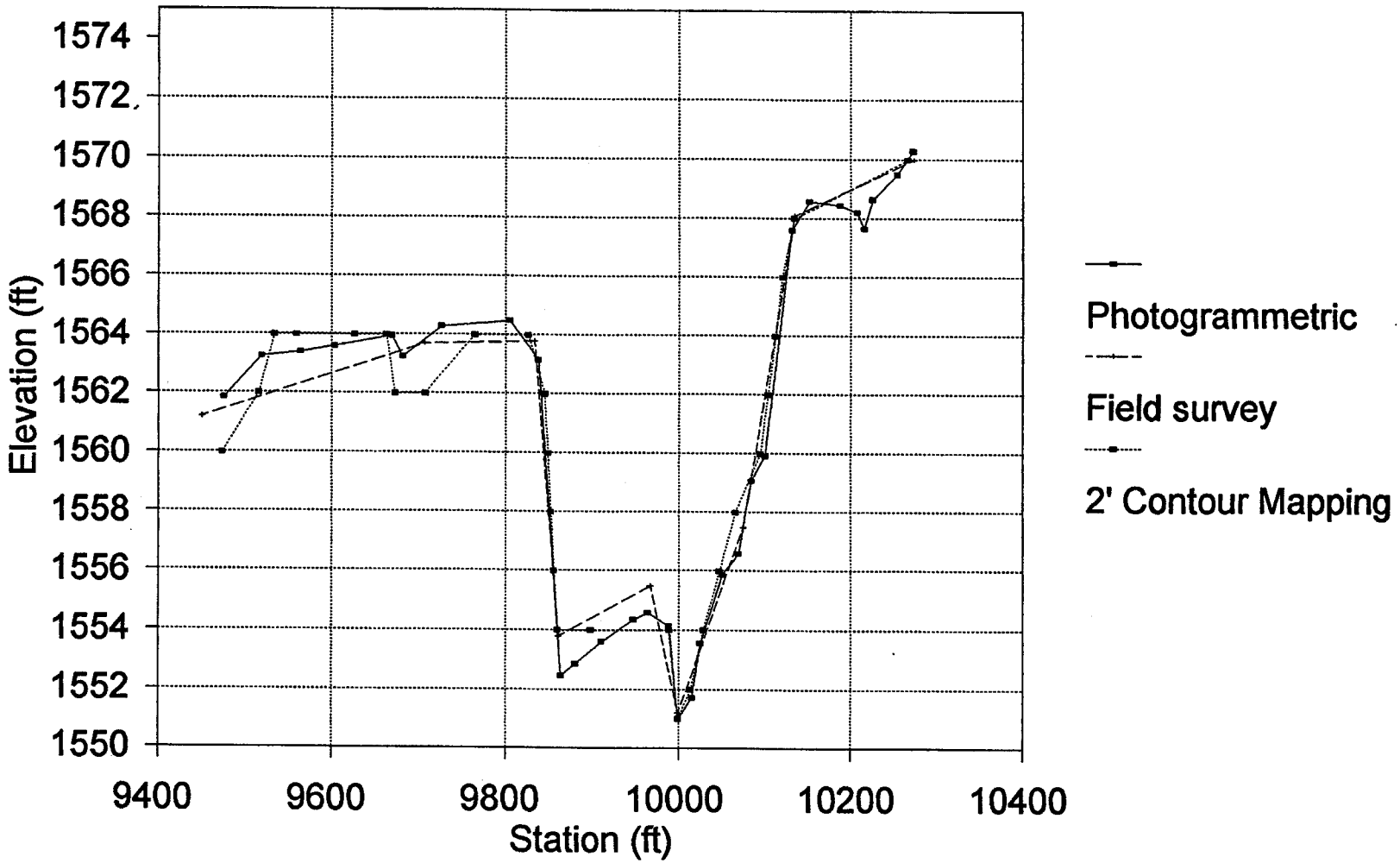
Malta Wash X-Sec # MLT297

Chk sec # 11



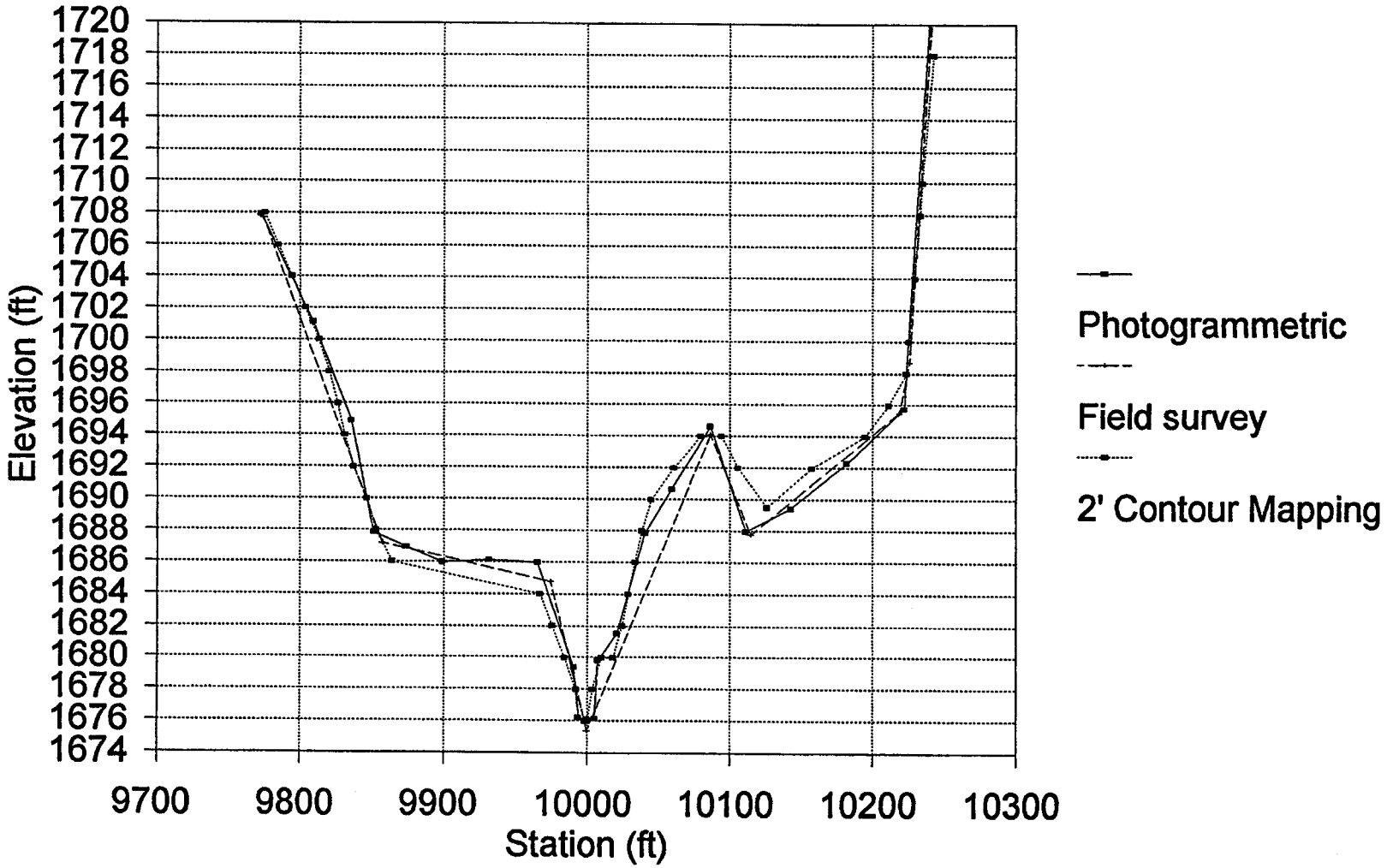
Colony Wash X-Sec # COL299

Chk sec # 12



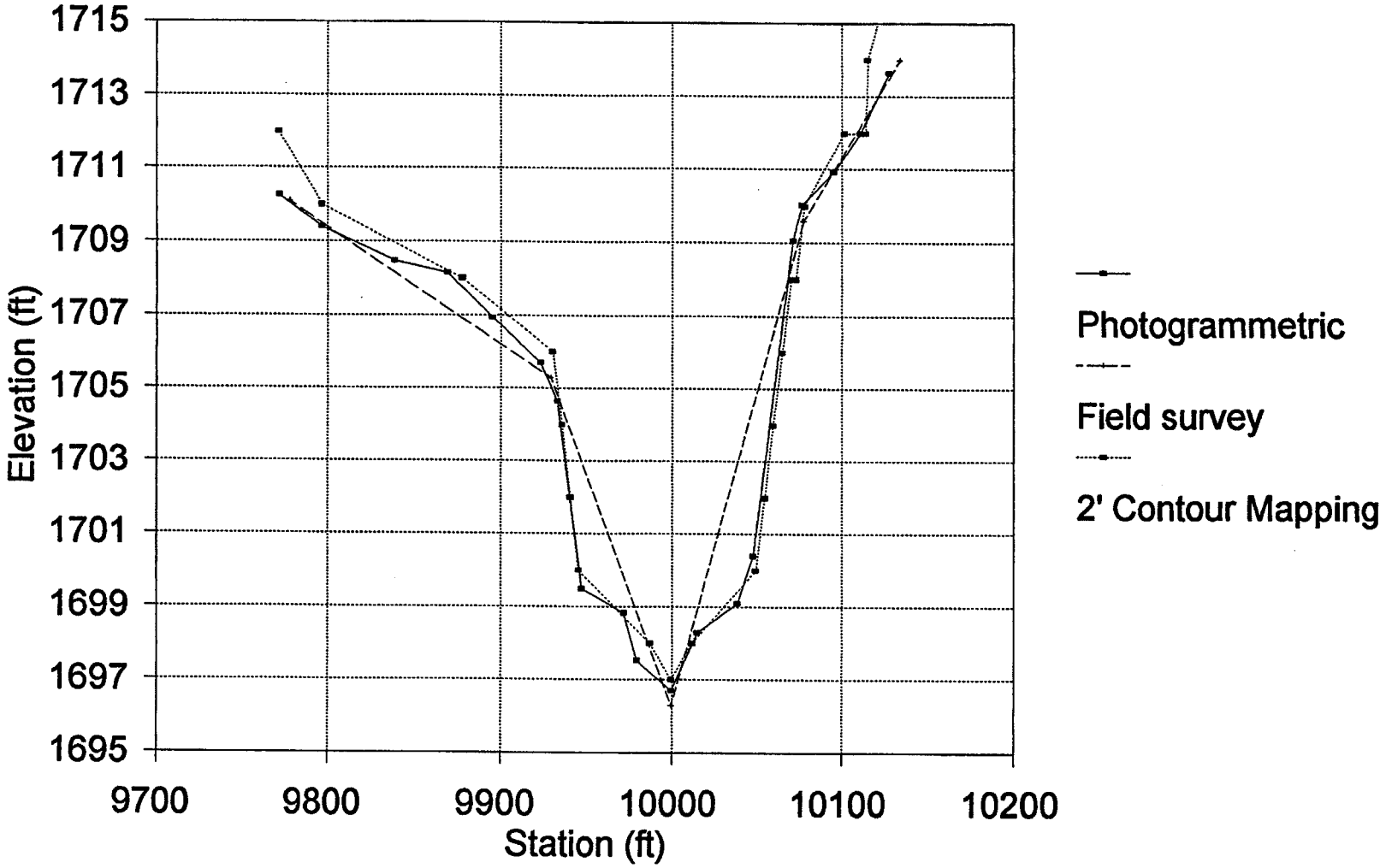
Colony Wash X-Sec # COL430

Chk sec # 13



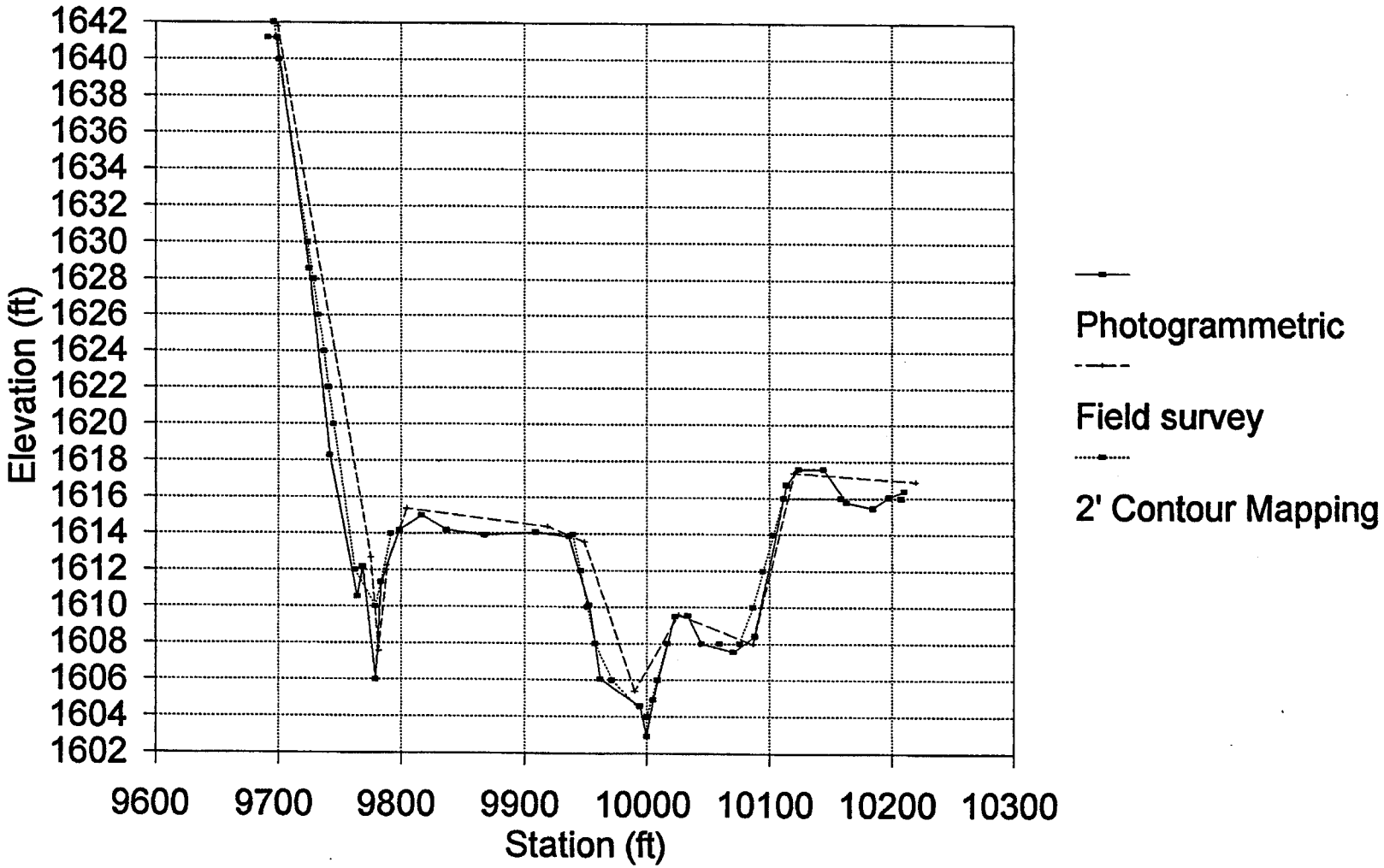
Colony Wash X-sec # CER448

Chk sec # 14



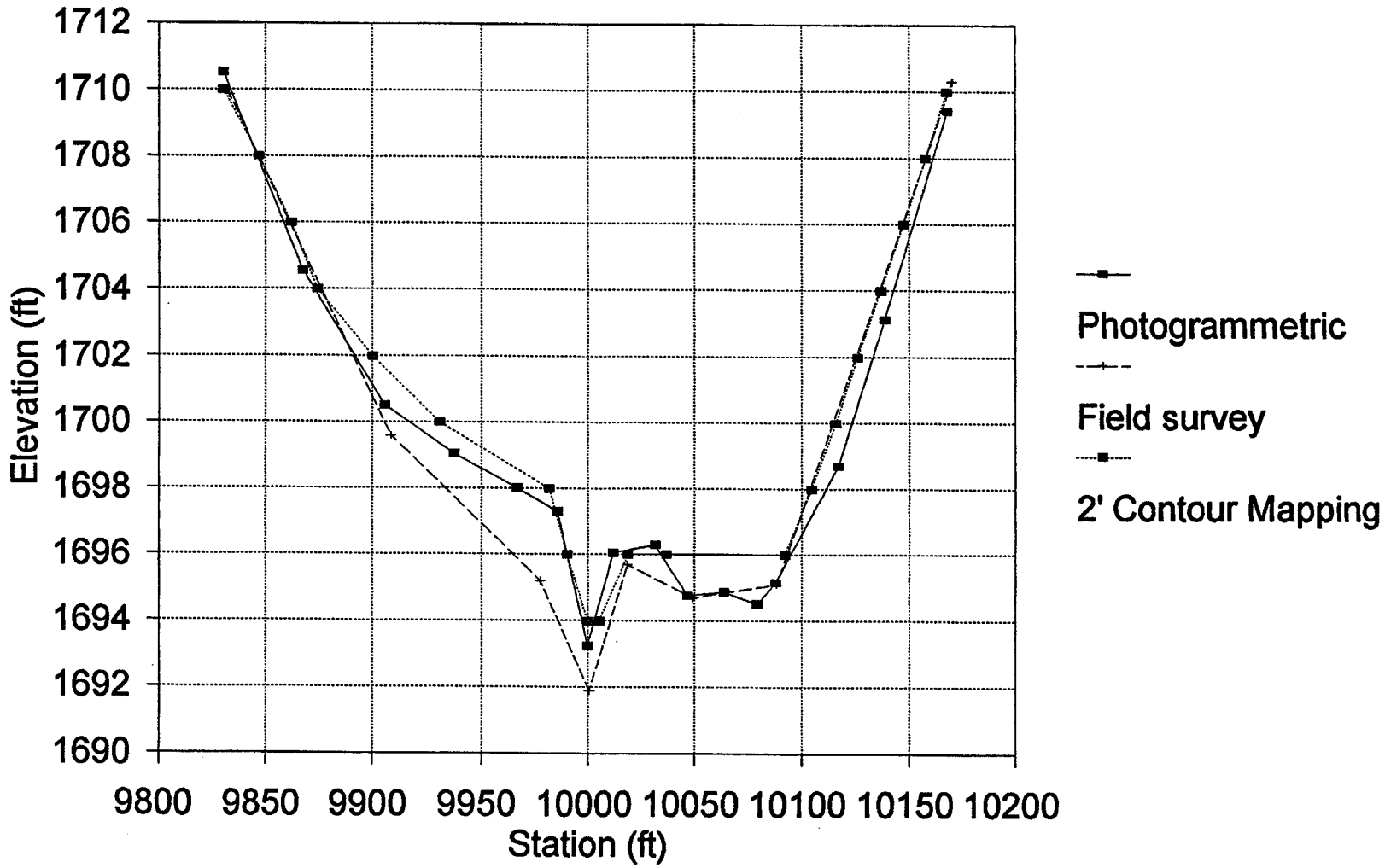
Colony/North Colony Wash X-Sec #357

Chk sec # 15



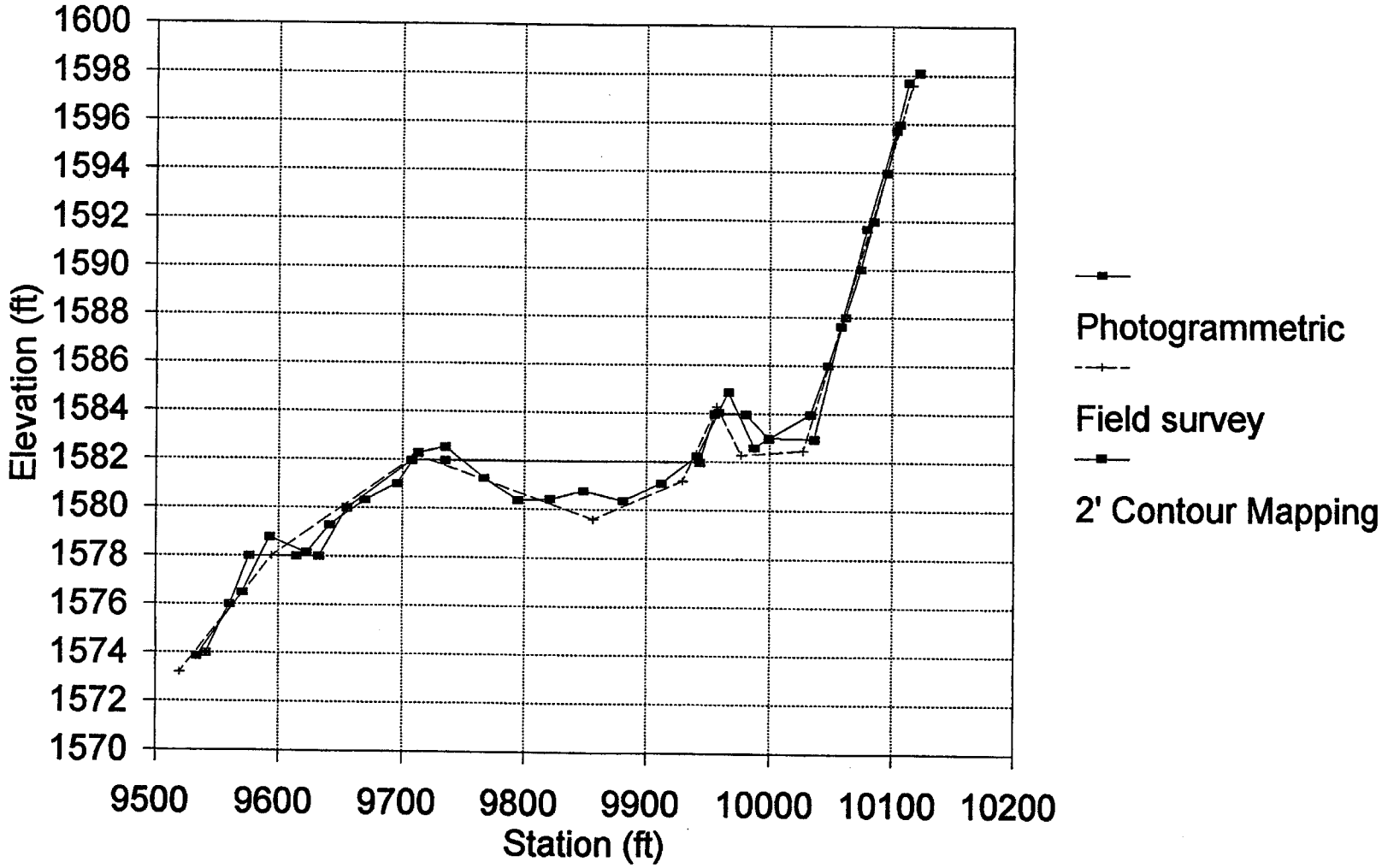
North Colony Wash X-Sec # NCL412

Chk sec # 16



Fountain Channel X-Sec # FC346

Chk sec # 17



APPENDIX C

MANNING'S N VALUE DETERMINATION CALCULATIONS

FLOOD CONTROL DISTRICT

OF

MARICOPA COUNTY

2801 WEST DURANGO STREET PHOENIX, ARIZONA 85009

FOUNTAIN HILLS (SOUTH)

FLOOD DELINEATION STUDY

ESTIMATION OF MANNING'S N VALUE

FCD CONTRACT NO. 92-05

September, 1993

PREPARED BY:

ACK ENGINEERS, INC.
2255 N. 44th St. Suite 330
Phoenix, Az 85008
(602) 244-2566

4.2 Parameter Estimation

4.2.1 Manning's n Value

4.2.1.1 Introduction

There are 8 separate washes and 16 tributaries contained within the study area and approximately 20 miles of floodplain to be delineated under this project. The washes have been divided into reaches of similar hydraulic characteristics and Manning's n values assigned to the reaches based on their typical characteristics. Each reach has been identified with four-character identifier. The first three represent the name of the wash, and the fourth is the reach number: for example, CER2 denotes Cereus Wash, Reach 2. The reach numbers start with "1" at the downstream end and increases in the upstream direction.

The limits, location of photographs and n values for each reach are shown on Exhibit 1 entitled, "Manning's n Value Map". In calculating the n Value, the following factors were considered:

- Bed material particle size
- Degree of irregularity of the bank slopes
- Effect of obstruction
- Degree of meandering
- Vegetation

The density and type of vegetation have significant impact on the roughness coefficient (n value). The vegetation within the flood plain has been identified to include the following:

- Brittle Brush
- Cactus - Barrel, Cholla, Prickly Pear, Saguaro
- Canyon Ragweed
- Catclaw
- Cottonwood tree
- Creosote brush
- Desert Broom
- Desert Hackberry
- Desert Willows
- Grayhorn
- Ironwood
- Mesquite
- Native Grasses

Ocotillo
Palm Tree
Palo Verde Tree
Seep Willow
Triangle Leaf Bursage

4.2.1.2 Methodology

Each reach was identified with the aid of 1" = 100' aerial photographs. The discerning characteristics were channel size, vegetation density, and bed materials. Each reach was photographed during the field reconnaissance phase at a representative and accessible location. The photography locations are summarized on Exhibit 1.

Manning's roughness coefficients were determined in accordance with the methodology described in *Estimated Manning's Roughness Coefficient for Streams Channels and Flood Plains in Maricopa County, Arizona* (USGS, Water Resources Division, April 1991). The method described in this publication selects a base value for the roughness coefficient exclusively on bed material. This base value is then modified by adding adjustments to account for vegetation, irregularities, obstructions and cross-section variations. In addition, a multiplier can be applied to the adjusted n-value if meandering of the reach is significant.

The base roughness coefficient was selected based on the average particle size observed in the field. The typical average size of the bed materials in the study area ranges from 0.08" to 2.5". For this size of bed material the typical values of the roughness coefficient range from 0.028 to 0.035. For some of reaches where the conveying channel is a golf course, pathway or street, n values as low as 0.018 were used. Values greater than 0.035 were use for reaches where the average particle size is larger than 2.5 inches.

4.2.1.3 n Value Determination

The base values, adjusting values and the adjusted values for manning's roughness coefficient are show in the following tables.

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Powder Wash - POW1
Location: Downstream from Leo Dr. - South east ¼ of section 27
Picture: No picture

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.030	0.030	0.030
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010			
	Medium		.010 - .025			
	Large		.025 - .050	0.030		0.030
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005		0.005	
	Freq. Alt.		.010 - .015			
			0.34	0.060	0.035	0.060
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.060	0.035	0.060

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Powder Wash - POW2
Location: Between Leo Dr. and Powderhorn Dr. - South ½ of section 27
Picture: POW-P1, POW-P2, POW-P3

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.030	0.030	0.030
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.002	
	Medium		.010 - .025	0.015		0.025
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.045	0.032	0.055
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.045	0.032	0.055

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Powder Wash - POW3
Location: Upstream from Powderhorn Dr. - South west ¼ section 27
Picture: POW-4

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.030	0.030	0.030
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010			
	Medium		.010 - .025	0.02		0.02
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.050	0.030	0.050
Degree of Meandering	Minor	m	1.00	1.00		1.00
	Appreciable		1.15		1.15	
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.050	0.035	0.050

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Cereus Wash - CER1
Location: Downstream from Saguaro Blvd. - South west ¼ of section 26
Picture: CER-P1

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.027	0.030	0.027
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.002	
	Medium		.010 - .025			
	Large		.025 - .050	0.060		0.070
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005	0.002	0.002	0.002
	Freq. Alt.		.010 - .015			
			0.34	0.089	0.034	0.099
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.089	0.034	0.099

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Cereus Wash - CER2
Location: From downstream from Saguaro Blvd. to Trevino Wash confluence - South west ¼ of section 26
Picture: CER-P2, CER-P3, CER-P4, CER-P5, CER-P6

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.028	0.030	0.028
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.002	
	Medium		.010 - .025			
	Large		.025 - .050			
	Very Large		.050 - .100	0.05		0.05
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.078	0.032	0.078
Degree of Meandering	Minor	m	1.00	1.00		1.00
	Appreciable		1.15		1.15	
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.078	0.037	0.078

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Cereus Wash - CER3
Location: North east ¼ of section 27
Picture: No picture

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.027		0.027
	Coarse sand		.026 - .035		0.027	
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.008	
	Medium		.010 - .025			
	Large		.025 - .050	0.030		0.030
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005	0.001	0.001	0.001
	Freq. Alt.		.010 - .015			
			0.34	0.058	0.036	0.058
Degree of Meandering	Minor	m	1.00	1.00		1.00
	Appreciable		1.15		1.15	
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.058	0.041	0.058

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Cereus Wash - CER4
Location: North west ¼ of section 27
Picture: CER-P7, CER-P8, CER-P9, CER-P10, CER-P11

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.029		0.029
	Coarse sand		.026 - .035		0.027	
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010	0.010	0.010	0.010
	Medium		.010 - .025			
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005	0.005	0.005	0.005
	Freq. Alt.		.010 - .015			
			0.34	0.044	0.042	0.044
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.044	0.042	0.044

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Cereus Wash - CER5
Location: Between Logan Wash and Chukar Wash confluences - North west ¼ of section 27
Picture: CER-P12

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.027		0.027
	Coarse sand		.026 - .035		0.029	
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010	0.006		0.006
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.002	
	Medium		.010 - .025	0.02		0.02
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005	0.003	0.003	0.003
	Freq. Alt.		.010 - .015			
			0.34	0.056	0.034	0.056
Degree of Meandering	Minor	m	1.00	1.00		1.00
	Appreciable		1.15		1.15	
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.056	0.039	0.058

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Cereus Wash - CER6
Location: Between Chukar Wash and Walnut Wash confluence - North west ¼ of seection 27
Picture: CER-P13

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.027		0.027
	Coarse sand		.026 - .035		0.029	
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005	0.003		0.003
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.002	
	Medium		.010 - .025	0.020		0.020
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005	0.001	0.001	0.001
	Freq. Alt.		.010 - .015			
			0.34	0.051	0.032	0.051
Degree of Meandering	Minor	m	1.00	1.00		1.00
	Appreciable		1.15		1.15	
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.051	0.037	0.051

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Cereus Wash - CER7
Location: Upstream from the confluence of Walnut Wash - South east ¼ of section 21
Picture: CER-P14, CER-P15

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.030	0.030	0.030
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.008	
	Medium		.010 - .025	0.015		0.015
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005	0.002	0.002	0.002
	Freq. Alt.		.010 - .015			
			0.34	0.047	0.040	0.047
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.047	0.040	0.047

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Last Trail Drain - LTD1
Location: South West ¼ section 26
Picture: LTD-P1, LTD-P2

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.028		0.028
	Coarse sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050		0.040	
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010		0.006	
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.001	
	Medium		.010 - .025			
	Large		.025 - .050	0.040		0.04
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005	0.001	0.004	0.001
	Freq. Alt.		.010 - .015			
			0.34	0.069	0.051	0.069
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.069	0.051	0.069

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills (Laser Drain)
Stream: Laser drain
Location: Reach LD-0 (Downstream from Firebrick Dr.)
Photo No: **16,17,21**

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_1	.012 - .018			
	Firm Soil		.025 -.032			
	Coarse Sand		.026 - .035	0.028	0.028	0.028
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_2	0			
	Minor		.001 - .005	0.005		
	Moderate		.006 - .010		0.006	0.010
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_3	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_4	.002 - .010			
	Medium		.010 - .025	0.025	0.01	
	Large		.025 - .050			0.030
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_5	0			
	Occ. Alt.		.001 - .005			0.005
	Freq. Alt.		.010 - .015			
				0.058	0.044	0.073
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Sever		1.3			
$n = (n_1+n_2+n_3+n_4+n_5)m$				0.058	0.044	0.073

File: MAN-R0.TBL

April 3, 1996

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills (Laser Drain)
Stream: Laser drain
Location: Reach LD-1 (Upstream from Firebrick Dr.)
Photo No: 15

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_1	.012 - .018			
	Firm Soil		.025 -.032			
	Coarse Sand		.026 - .035	0.028	0.030	0.028
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_2	0			
	Minor		.001 - .005	0.005	0.005	0.005
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_3	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_4	.002 - .010			
	Medium		.010 - .025	0.025		
	Large		.025 - .050		0.030	0.030
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_5	0			
	Occ. Alt.		.001 - .005			0.005
	Freq. Alt.		.010 - .015			
				0.058	0.065	0.068
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Sever		1.3			
$n = (n_1+n_2+n_3+n_4+n_5)m$				0.058	0.065	0.068

File: MAN-R1.TBL

April 3, 1996

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills (Laser Drain)
Stream: Laser drain
Location: Reach LD-2 (Downstream from Saguaro Blvd.)
Photo No: 11,12

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_1	.012 - .018			
	Firm Soil		.025 -.032			
	Coarse Sand		.026 - .035	0.028	0.030	0.028
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_2	0			
	Minor		.001 - .005	0.005	0.005	0.005
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_3	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_4	.002 - .010			0.005
	Medium		.010 - .025	0.025		
	Large		.025 - .050		0.03	
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_5	0			
	Occ. Alt.		.001 - .005			0.005
	Freq. Alt.		.010 - .015			
				0.058	0.065	0.043
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Sever		1.3			
$n = (n_1+n_2+n_3+n_4+n_5)m$				0.058	0.065	0.043

File: MAN-R2.TBL

April 3, 1996

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills (Laser Drain)
Stream: Laser drain
Location: Reach LD-3 (Between Technology Drive) and Saguaro Blvd.)
Photo No: **4,5,8**

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_1	.012 - .018		0.018	
	Firm Soil		.025 -.032			
	Coarse Sand		.026 - .035	0.028		0.028
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_2	0			
	Minor		.001 - .005	0.001		0.001
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_3	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_4	.002 - .010			
	Medium		.010 - .025			
	Large		.025 - .050	0.030		0.030
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_5	0			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
				0.059	0.018	0.059
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Sever		1.3			
$n = (n_1+n_2+n_3+n_4+n_5)m$				0.059	0.018	0.059

File: MAN-R3.TBL

April 3, 1996

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills (Laser Drain)
Stream: Laser drain
Location: Reach LD-4 (Upstream from technology Drive)
Photo No: 0,3

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_1	.012 - .018		0.018	
	Firm Soil		.025 -.032			
	Coarse Sand		.026 - .035			0.028
	Gravel		.028 - .035	0.030		
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_2	0			
	Minor		.001 - .005	0.001		0.001
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_3	.000 - .004	0.004		0.004
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_4	.002 - .010			
	Medium		.010 - .025			
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_5	0			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
				0.035	0.018	0.033
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Sever		1.3			
$n = (n_1+n_2+n_3+n_4+n_5)m$				0.035	0.018	0.033

File: MAN-R4.TBL

April 3, 1996

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Trevino Wash - TRE1
Location: North east ¼ of section 27
Picture: TRE-P1, TRE-P2

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.030	0.030	0.030
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.004	
	Medium		.010 - .025	0.025		0.025
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.055	0.034	0.055
Degree of Meandering	Minor	m	1.00	1.00		1.00
	Appreciable		1.15		1.15	
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.055	0.039	0.055

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Logan Wash - LOG1
Location: South west ¼ of section 27
Picture: LOG-P1, LOG-P2

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.027		0.027
	Coarse sand		.026 - .035		0.029	
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005		0.002	
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.001	
	Medium		.010 - .025	0.025		0.025
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005	0.002	0.002	0.002
	Freq. Alt.		.010 - .015			
			0.34	0.054	0.034	0.054
Degree of Meandering	Minor	m	1.00	1.00		1.00
	Appreciable		1.15		1.15	
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.054	0.039	0.054

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Chukar Wash - CHU1
Location: North west ¼ of section 27
Picture: CHU-P1, CHU-P2

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.028		0.028
	Coarse sand		.026 - .035		0.030	
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.002	
	Medium		.010 - .025	0.010		0.010
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005	0.002	0.002	0.002
	Freq. Alt.		.010 - .015			
			0.34	0.040	0.034	0.040
Degree of Meandering	Minor	m	1.00			
	Appreciable		1.15	1.15	1.15	1.15
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.046	0.039	0.046

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Cap Wash - Walnut Wash - CAP1
Location: North ½ of section 28
Picture: CAP-WAL-1, CAP-P2, CAP-P3

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.029		0.029
	Coarse sand		.026 - .035		0.029	
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.002	
	Medium		.010 - .025			
	Large		.025 - .050	0.030		0.030
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.059	0.031	0.059
Degree of Meandering	Minor	m	1.00	1.00		1.00
	Appreciable		1.15		1.15	
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.059	0.036	0.059

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Walnut Wash - WAL2
Location: Upstream from Shea Blvd. - South east ¼ of section 21
Picture: WAL-P4, WAL-P5

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.027		0.027
	Coarse sand		.026 - .035		0.030	
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.003	
	Medium		.010 - .025	0.015		0.015
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005	0.004	0.004	0.004
	Freq. Alt.		.010 - .015			
			0.34	0.046	0.037	0.046
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.046	0.037	0.046

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Cyprus Point Wash - CPW1
Location: North east ¼ of section 26
Picture: CPW-P1, CPW-P2

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.032	0.032	0.032
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.004	
	Medium		.010 - .025	0.015		0.015
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000	0.002	0.002	0.002
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.049	0.038	0.049
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.049	0.038	0.049

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Cyprus Point Wash - CPW2
Location: North west ¼ of section 26
Picture: CPW-P3

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.025	0.025	0.025
	Coarse sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010	0.002	0.002	0.002
	Medium		.010 - .025			
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.027	0.027	0.027
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.027	0.027	0.027

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Cyprus Point Wash - CPW3
Location: North west ¼ of section 26
Picture: CPW-P4, CPW-P5, CPW-P6

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.028		0.028
	Coarse sand		.026 - .035		0.028	
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030	0.030		0.030
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.004	
	Medium		.010 - .025	0.010		0.010
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.068	0.032	0.068
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.068	0.032	0.068

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Cyprus Point Wash - CPW4
Location: North east ¼ of section 26
Picture: CPW-P7

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.028		0.028
	Coarse sand		.026 - .035		0.028	
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010	0.009	0.004	0.009
	Medium		.010 - .025			
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.037	0.032	0.037
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.037	0.032	0.037

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Cyprus Point Wash - CPW5
Location: North west ¼ of section 26
Picture: No picture

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018		0.018	
	Firm soil		.025 - .032	0.028		0.028
	Coarse sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010	0.004		0.004
	Medium		.010 - .025			
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.032	0.018	0.032
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.032	0.018	0.032

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Jacklin Wash - JKL1
Location: South east ¼ of section 23
Picture: JKL-P1, JKL-P2

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050	0.035	0.035	0.035
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010			
	Medium		.010 - .025		0.010	
	Large		.025 - .050			
	Very Large		.050 - .100	0.050		0.050
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.085	0.045	0.085
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.085	0.045	0.085

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Jacklin Wash - JKL2
Location: South west ¼ of section 23
Picture: JKL-P3, JKL-P4, JKL-P5

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018		0.017	
	Firm soil		.025 - .032	0.025		0.025
	Coarse sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010	0.002		0.002
	Medium		.010 - .025			
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.027	0.017	0.027
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.027	0.017	0.027

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Jacklin Wash - JKL3
Location: South east ¼ of section 22
Picture: No picture

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.025	0.025	0.025
	Coarse sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.002	
	Medium		.010 - .025	0.013		0.013
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.038	0.027	0.038
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.038	0.027	0.038

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Jacklin Wash - JKL4
Location: South east ¼ of section 22
Picture: JKL-P6

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.028	0.028	0.028
	Coarse sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.002	
	Medium		.010 - .025	0.018		0.018
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005	0.005	0.005	0.005
	Freq. Alt.		.010 - .015			
			0.34	0.051	0.035	0.051
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.051	0.035	0.051

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Mangrum Drain - MAN1
Location: South west ¼ of section 23
Picture: MAN-P1

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.025	0.025	0.025
	Coarse sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010	0.002		0.002
	Medium		.010 - .025			
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.027	0.025	0.027
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.027	0.025	0.027

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Kingstree Blvd. - KIN1
Location: South west ¼ of section 23
Picture: No picture

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018		0.018	
	Firm soil		.025 - .032	0.025		0.025
	Coarse sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			0.021
	Severe		.040 - .060	0.040		
Vegetation	Small	n_3	.002 - .010			
	Medium		.010 - .025	0.010		0.010
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.075	0.018	0.056
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.075	0.018	0.056

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Kingstree Blvd. - KIN2
Location: South east ¼ of section 22
Picture: KIN-P1, KIN-P2

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.030	0.030	0.030
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.002	
	Medium		.010 - .025	0.020		0.020
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005	0.001	0.001	0.001
	Freq. Alt.		.010 - .015			
			0.34	0.051	0.033	0.051
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.051	0.033	0.051

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Emerald Wash - EMR1
Location: South east ¼ of section 23
Picture: EMR-P1, EMR-P2

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050	0.035	0.040	0.035
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.008	
	Medium		.010 - .025			
	Large		.025 - .050	0.030		0.030
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.065	0.048	0.065
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.065	0.048	0.065

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Emerald Wash - EMR2
Location: South west ¼ of section 23
Picture: EMR-P3, EMR-P4

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050	0.035	0.040	0.035
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.009	
	Medium		.010 - .025	0.020		0.020
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.055	0.049	0.055
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.055	0.049	0.055

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Emerald Wash - EMR3
Location: North east ¼ of section 22, North west ¼ of section 23
Picture: EMR-P5

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.029		0.029
	Gravel		.028 - .035		0.030	
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.008	
	Medium		.010 - .025	0.015		0.015
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.044	0.038	0.044
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.044	0.038	0.044

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Emerald Wash - EMR4
Location: North ½ of section 22,
Picture: EMR-P6, EMR-P7, EMR-P8

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.029	0.030	0.029
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.002	
	Medium		.010 - .025	0.015		0.015
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005	0.002	0.002	0.002
	Freq. Alt.		.010 - .015			
			0.34	0.046	0.034	0.046
Degree of Meandering	Minor	m	1.00	1.00		1.00
	Appreciable		1.15		1.15	
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.046	0.039	0.046

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Emerald Wash - EMR5
Location: North west ¼ of section 22
Picture: No picture

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.035	0.030	0.035
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.008	
	Medium		.010 - .025	0.025		0.025
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005	0.002	0.002	0.002
	Freq. Alt.		.010 - .015			
			0.34	0.062	0.040	0.062
Degree of Meandering	Minor	m	1.00	1.00		1.00
	Appreciable		1.15		1.15	
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.062	0.046	0.062

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Malta drain - MLT1
Location: North west ¼ of section 23
Picture: MAL-P1, MAL-P2

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.032	0.030	0.032
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.005	
	Medium		.010 - .025	0.020		0.020
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.052	0.035	0.052
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.052	0.035	0.052

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Malta drain - MLT2
Location: North west ¼ of section 23
Picture: MAL-P3

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.032	0.030	0.032
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.005	
	Medium		.010 - .025	0.015		0.015
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.047	0.035	0.047
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.047	0.035	0.047

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Malta drain - MLT3
Location: North west ¼ of section 23
Picture: MAL-P4

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.032	0.030	0.032
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.005	
	Medium		.010 - .025	0.025		0.025
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.057	0.035	0.057
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.057	0.035	0.057

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: CLN1
Location: Colony Wash - Downstream from Panorama Blvd. - North east ¼ of section 23
Picture: COL-P1

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.030		0.030
	Coarse sand		.026 - .035		0.034	
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010			
	Medium		.010 - .025	0.015		0.015
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005	0.003	0.003	0.003
	Freq. Alt.		.010 - .015			
			0.34	0.048	0.037	0.048
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.048	0.037	0.048

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: CLN2
Location: Colony Wash - Upstream from Panorama Blvd. - South west ¼ of section 14
Picture: COL-P2

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.030		0.030
	Coarse sand		.026 - .035		0.030	
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.003	
	Medium		.010 - .025	0.030		0.030
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.060	0.033	0.060
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.060	0.033	0.060

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: CLN3
Location: Colony Wash - South east ¼ of section 15
Picture: COL-P3

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.030		0.030
	Coarse sand		.026 - .035		0.030	
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.008	
	Medium		.010 - .025	0.015		0.015
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.045	0.038	0.045
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.045	0.038	0.045

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: CLN4
Location: Colony Wash - Downstream from Fountain Hills Blvd - North ½ of section 22
Picture: COL-P4

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.030		0.030
	Coarse sand		.026 - .035		0.030	
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010	0.010	0.003	0.010
	Medium		.010 - .025			
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.040	0.033	0.040
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.040	0.033	0.040

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Spillway Channel - SPL1
Location: South west ¼ of section 14
Picture: No picture

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.025	0.025	0.025
	Coarse sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.002	
	Medium		.010 - .025	0.010		0.010
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.035	0.027	0.035
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.035	0.027	0.035

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Spillway Channel - SPL2
Location: South west ¼ of section 14
Picture: SPL-P1

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.025	0.025	0.025
	Coarse sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010	0.002	0.002	0.002
	Medium		.010 - .025			
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.027	0.027	0.027
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.027	0.027	0.027

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Fountain Channel - FNC1
Location: South west ¼ of section 14
Picture: FNC-P1

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.029	0.029	0.029
	Coarse sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.002	
	Medium		.010 - .025			
	Large		.025 - .050	0.029		0.029
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.058	0.031	0.058
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.058	0.031	0.058

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Fountain Channel - FNC2
Location: North west ¼ of section 14
Picture: FNC-P2, FNC-P3

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.025	0.025	0.025
	Coarse sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010	0.004	0.003	0.004
	Medium		.010 - .025			
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.029	0.028	0.029
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.029	0.028	0.029

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: North Colony Wash - NCL1
Location: South east ¼ of section 15
Picture: NCL-P1

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.030	0.030	0.030
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010		0.008	
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010	0.010		0.010
	Medium		.010 - .025			
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.040	0.038	0.040
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.040	0.038	0.040

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: North Colony Wash - NCL2
Location: South east ¼ of section 15
Picture: NCL-P2, NCL-P3

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.030	0.030	0.030
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.005	
	Medium		.010 - .025	0.015		0.015
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.045	0.035	0.045
Degree of Meandering	Minor	m	1.00	1.00		1.00
	Appreciable		1.15		1.15	
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.045	0.040	0.045

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: North Colony Wash - NCL3
Location: South west ¼ of section 15
Picture: NCL-P4

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.028		0.028
	Coarse sand		.026 - .035		0.028	
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.008	
	Medium		.010 - .025	0.010		0.010
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.038	0.036	0.038
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.038	0.036	0.038

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Ironwoood Wash - IRW1
Location: South west ¼ of section 15
Picture: IRW-P1

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.030	0.030	0.030
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.002	
	Medium		.010 - .025	0.010		0.010
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.040	0.032	0.040
Degree of Meandering	Minor	m	1.00	1.00		1.00
	Appreciable		1.15		1.15	
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.040	0.037	0.040

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Sycamore Wash - SYC1
Location: North east ¼ of section 21
Picture: SYC-P1, SYC-P2

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.030		0.030
	Coarse sand		.026 - .035		0.030	
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.004	
	Medium		.010 - .025	0.015		0.015
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.045	0.034	0.045
Degree of Meandering	Minor	m	1.00	1.00		1.00
	Appreciable		1.15		1.15	
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.045	0.039	0.045

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Greystone Wash - GRS1
Location: North east ¼ of section 21
Picture: GRE-P1, GRE-P2

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.030		0.030
	Coarse sand		.026 - .035		0.030	
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.005	
	Medium		.010 - .025	0.020		0.020
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.050	0.035	0.050
Degree of Meandering	Minor	m	1.00	1.00		1.00
	Appreciable		1.15		1.15	
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.050	0.040	0.050

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Sunburst Wash - SUN1
Location: North east ¼ of section 21
Picture: SUN-P1, SUN-P2, SUN-P3

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.032	0.030	0.032
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.005	
	Medium		.010 - .025	0.015		0.025
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.047	0.035	0.057
Degree of Meandering	Minor	m	1.00	1.00		1.00
	Appreciable		1.15		1.15	
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.047	0.040	0.057

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Panorama Channel - PAN1
Location: South east ¼ of section 14
Picture: PAN-P1, PAN-P2

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032			
	Coarse sand		.026 - .035	0.030	0.030	0.030
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010			
	Medium		.010 - .025			
	Large		.025 - .050			
	Very Large		.050 - .100	0.100	0.070	0.100
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.130	0.100	0.130
Degree of Meandering	Minor	m	1.00	1.00	1.00	1.00
	Appreciable		1.15			
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.130	0.100	0.130

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Fountain Hills South Flood Delineation Study
Stream: Panorama Channel - PAN2
Location: South east ¼ of section 14
Picture: PAN-P3

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Concrete	n_b	.012 - .018			
	Firm soil		.025 - .032	0.030		
	Coarse sand		.026 - .035		0.030	0.030
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	.000			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		0.003	
	Medium		.010 - .025	0.015		0.015
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	.000			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
			0.34	0.045	0.033	0.045
Degree of Meandering	Minor	m	1.00	1.00		1.00
	Appreciable		1.15		1.15	
	Sever		1.30			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.045	0.038	0.045

POW-P1

POW-P2

POWDER WASH

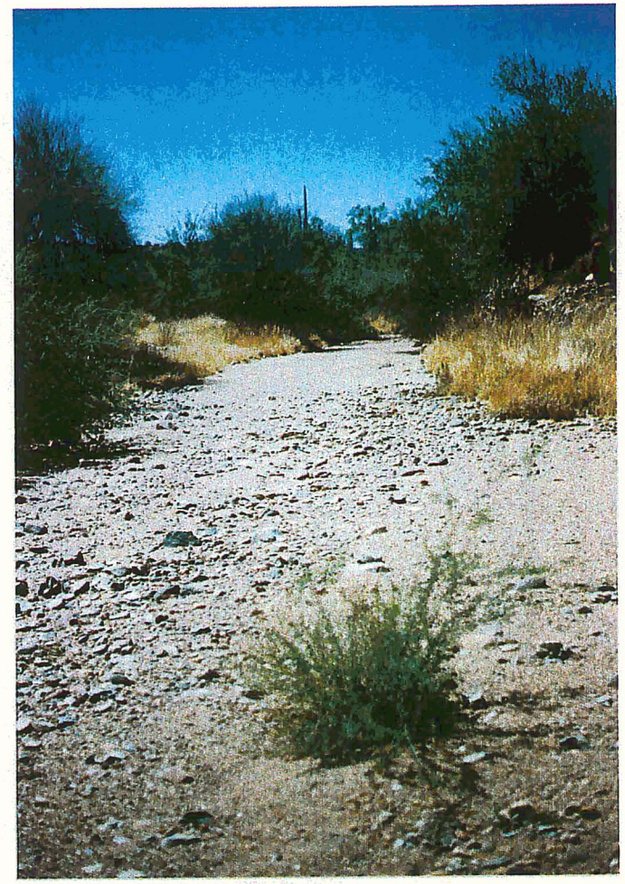
POW-P3

POW-P4

CEREUS WASH

CER-P1

CER-P2



CER-P3

CEREUS WASH

CER-P4

CER-P5

CER-P6

CEREUS WASH

CER-P10

CER-P7 CER-P8 CER-P9

CER-P11

CER-P12

CEREUS WASH

CER-P13

CEREUS WASH

CER-P15

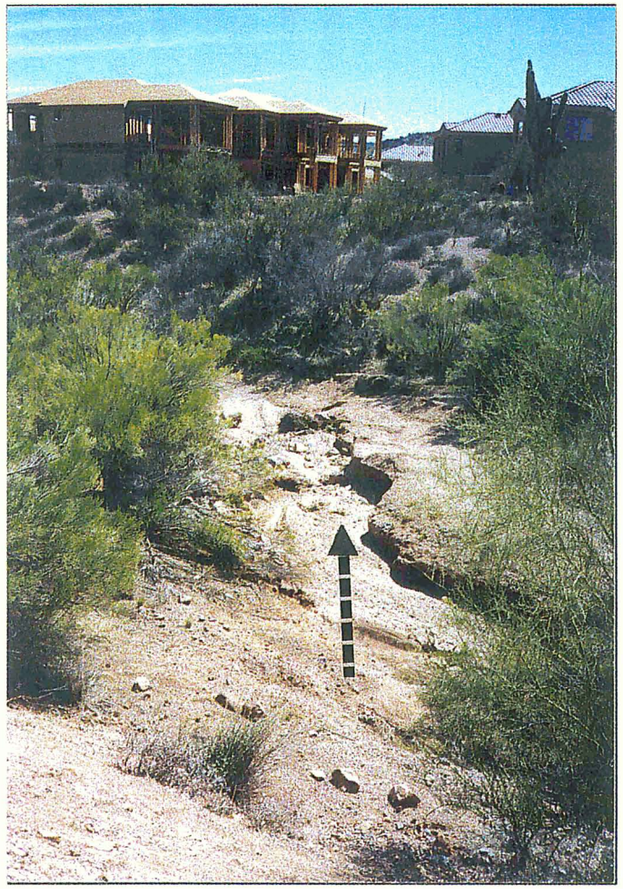
CER-P14

LAST TRAIL DRAIN

LTD-P1

LTD-P2

Reach LD-0



Laser Drain from right bank

Laser Drain downstream from Firebrick Lane

Laser Drain at confluence with Cereus Wash

LASER DRAIN
Reach LD-1

Laser Drain upstream from Firebrick Lane

LASER DRAIN
Reach LD-2

Laser Drain downstream from Saguaro Boulevard

Laser Drain downstream from Saguaro Boulevard

LASER DRAIN
Reach LD-3

Laser Drive 100-feet east of Technology Drive

Laser Drive 300-feet east of Technology Drive

Laser Drive 200-feet west of Saguaro Boulevard

LASER DRAIN
Reach LD-4

Laser Drive towards Technology Drive

Technology Drive towards Laser Drive

TREVINO WASH

TRE-P1

TRE-P2

LOGAN WASH

LOG-P2

LOG-P1

CHUKAR WASH

CHU-P1

CHU-P2

WAL-CAP-P1

CAP-P2

C.A.P.

WASH

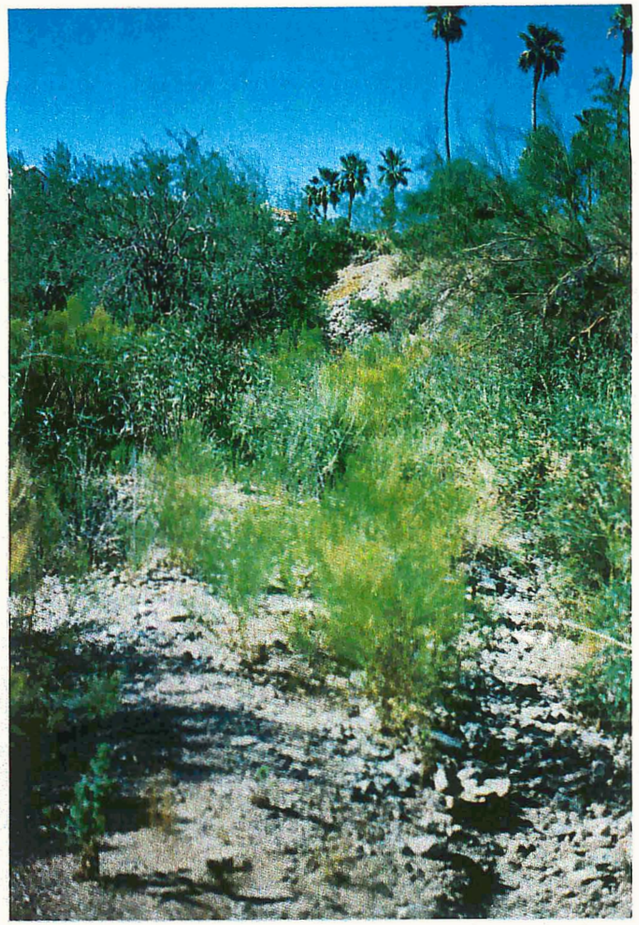
CAP-P3

WALNUT

WASH

WALNUT WASH

WAL-P4



WAL-P5

CPW-P1

CPW-P2

CYPRUS POINT WASH

CPW-P3

CPW-P4

CYPRUS POINT WASH

CPW-P5

CPW-P6

CPW-P7

JKL-P1

JKL-P2

JKL-P3

JACKLIN WASH

JACKILN WASH

JKL-P4

JKL-P5

JKL-P6

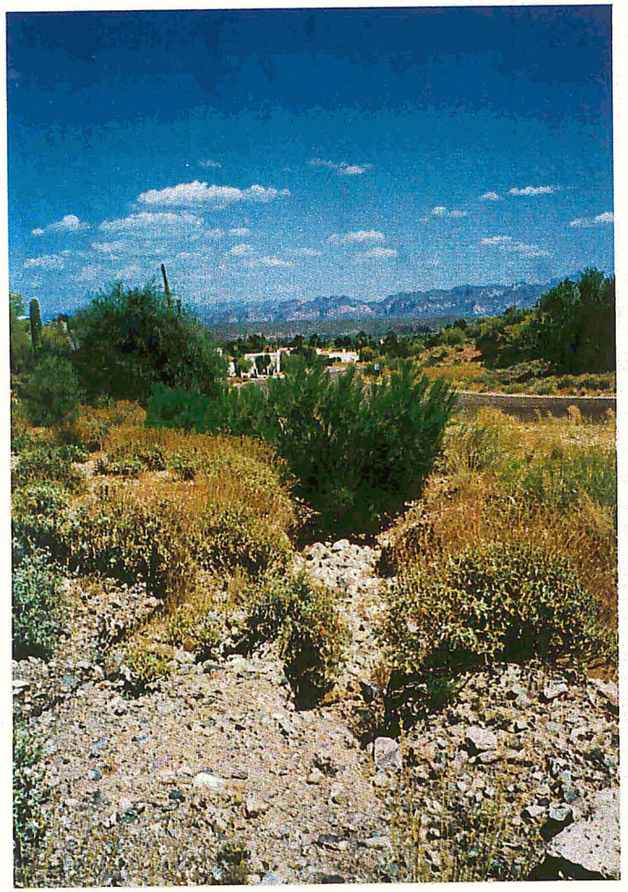
MANGRUM DRAIN

MAN-P1

MAN-P2

Upstream from limit of study

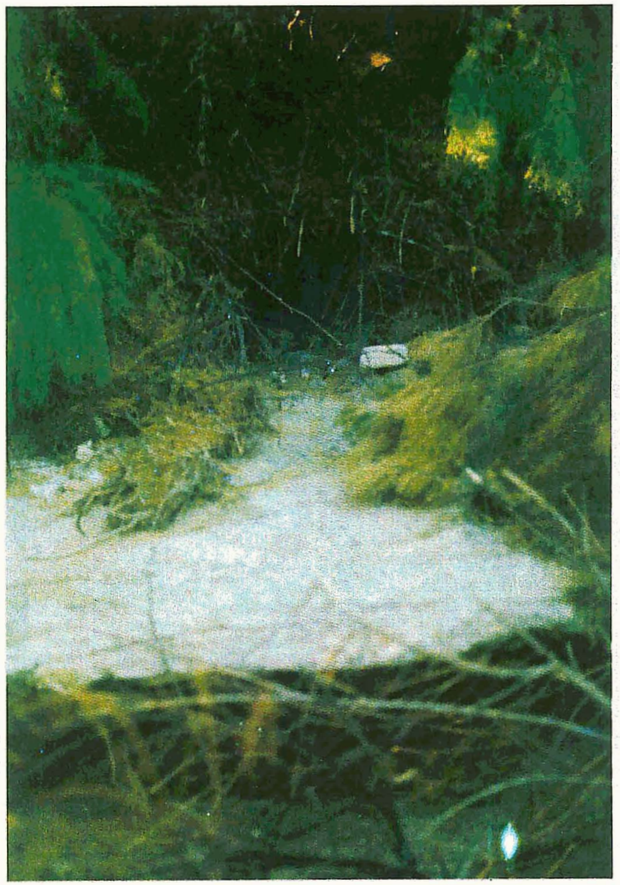
KIN-P1



KIN-P2

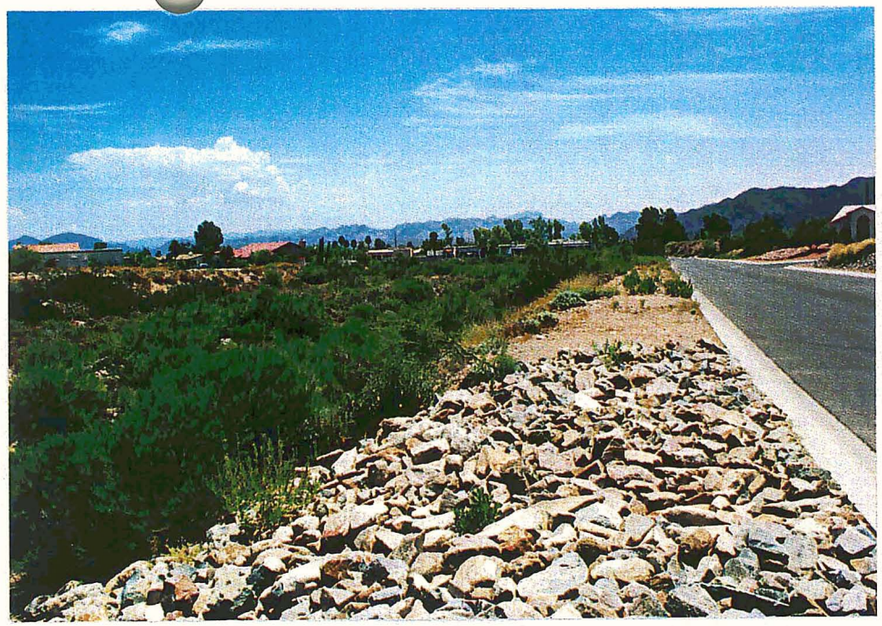
KINGSTREE BLVD

EMERALD WASH

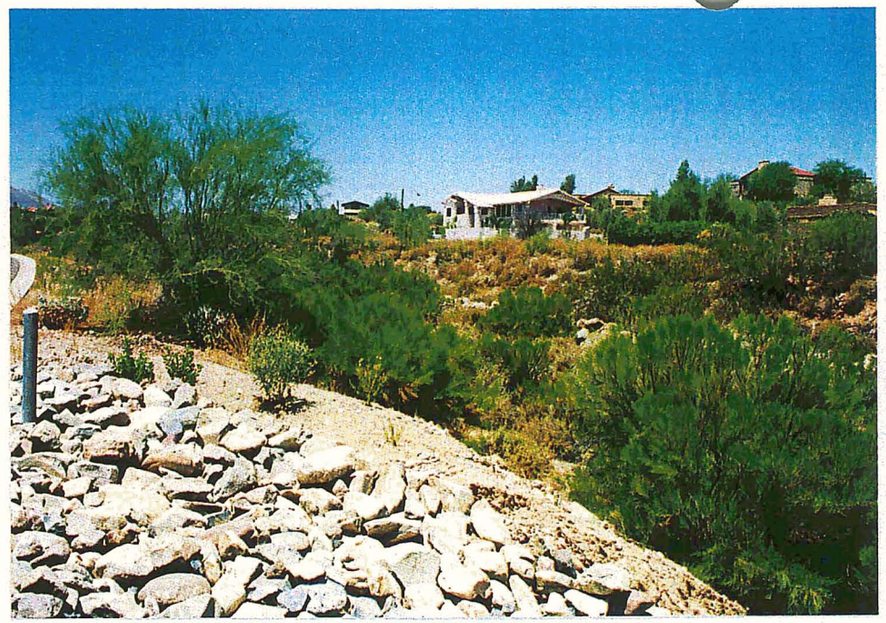


EMR-P1

EMR-P2



EMR-P3



EMR-P4

EMERALD WASH

EMR-P5

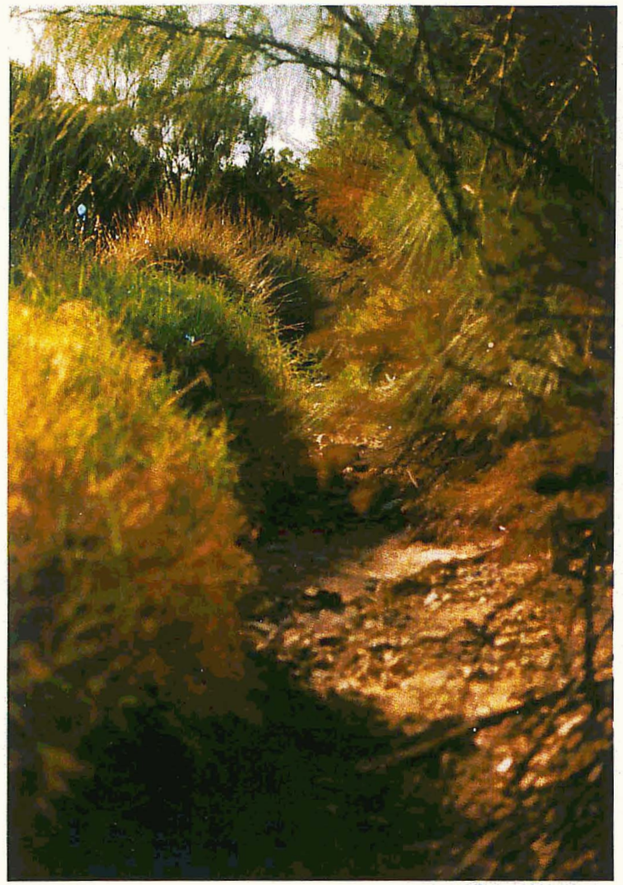
EMR-P6

EMERALD WASH

EMR-P7

EMR-P8

MAL-P1



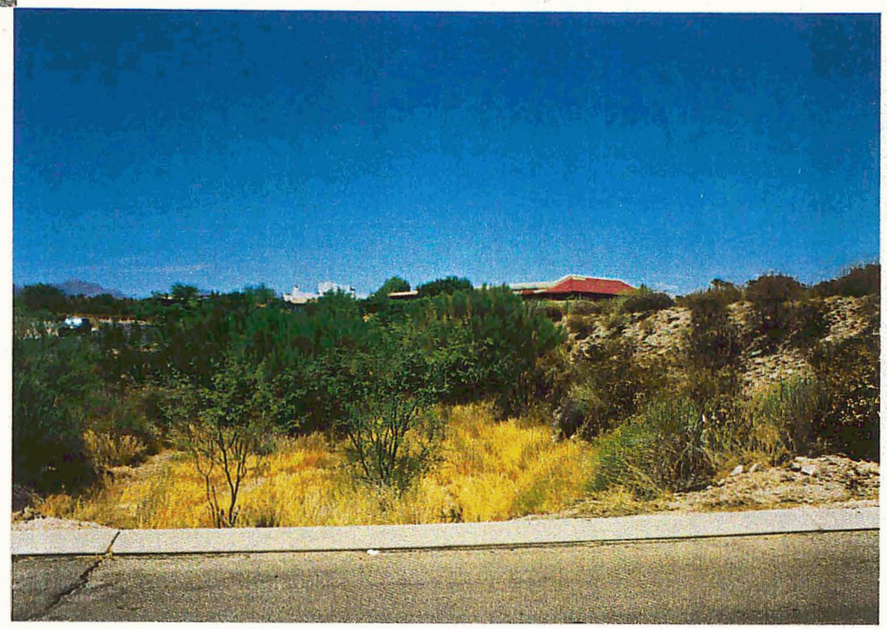
MAL-P2

MALTA DRAIN

MALTA DRAIN

MAL-P3

MAL-P4



COL-P1

COL-P2

COLONY WASH

COL-P3

COL-P4

SPL-P1

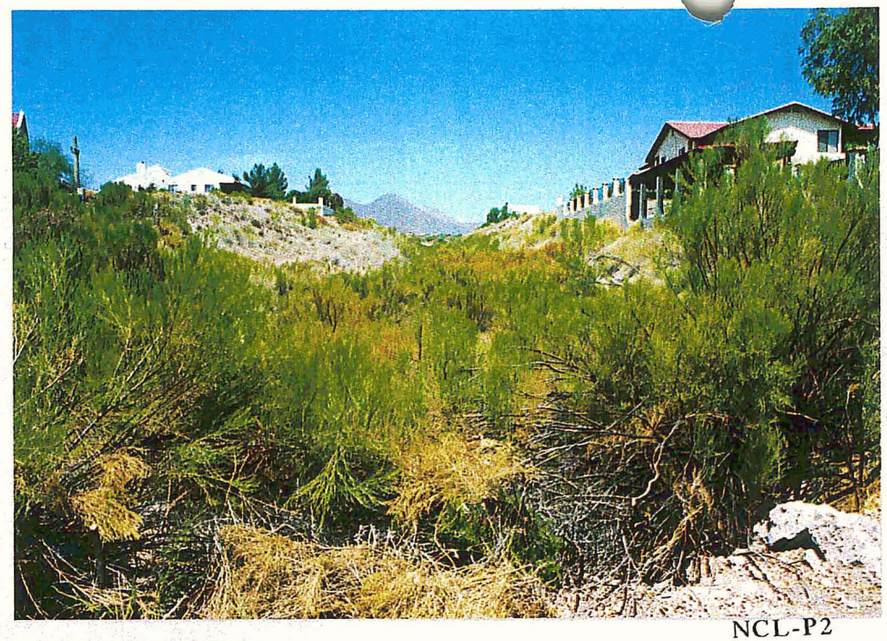
FNC-P1

SPILLWAY CHANNEL & FOUNTAIN CHANNEL

FNC-P2

FNC-P3

NCL-P1



NCL-P2

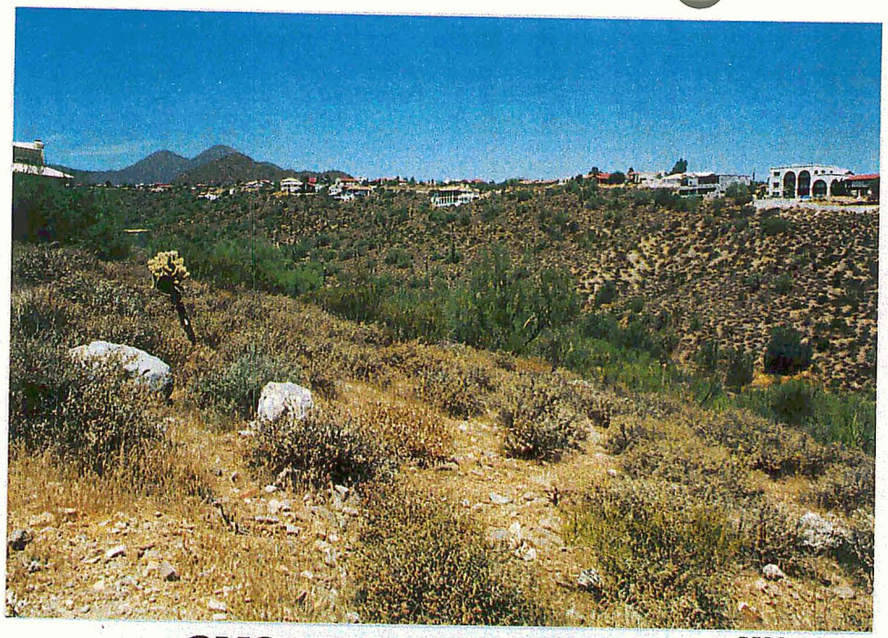
NORTH COLONY WASH

NCL-P3

NCL-P4

IRONWOOD WASH

IRW-P1



SYCAMORE WASH

SYC-P1

SYC-P2

GRE-P1

GRE-P2

GREYSTONE WASH

SUNBURST WASH

SUN-P1

SUN-P2

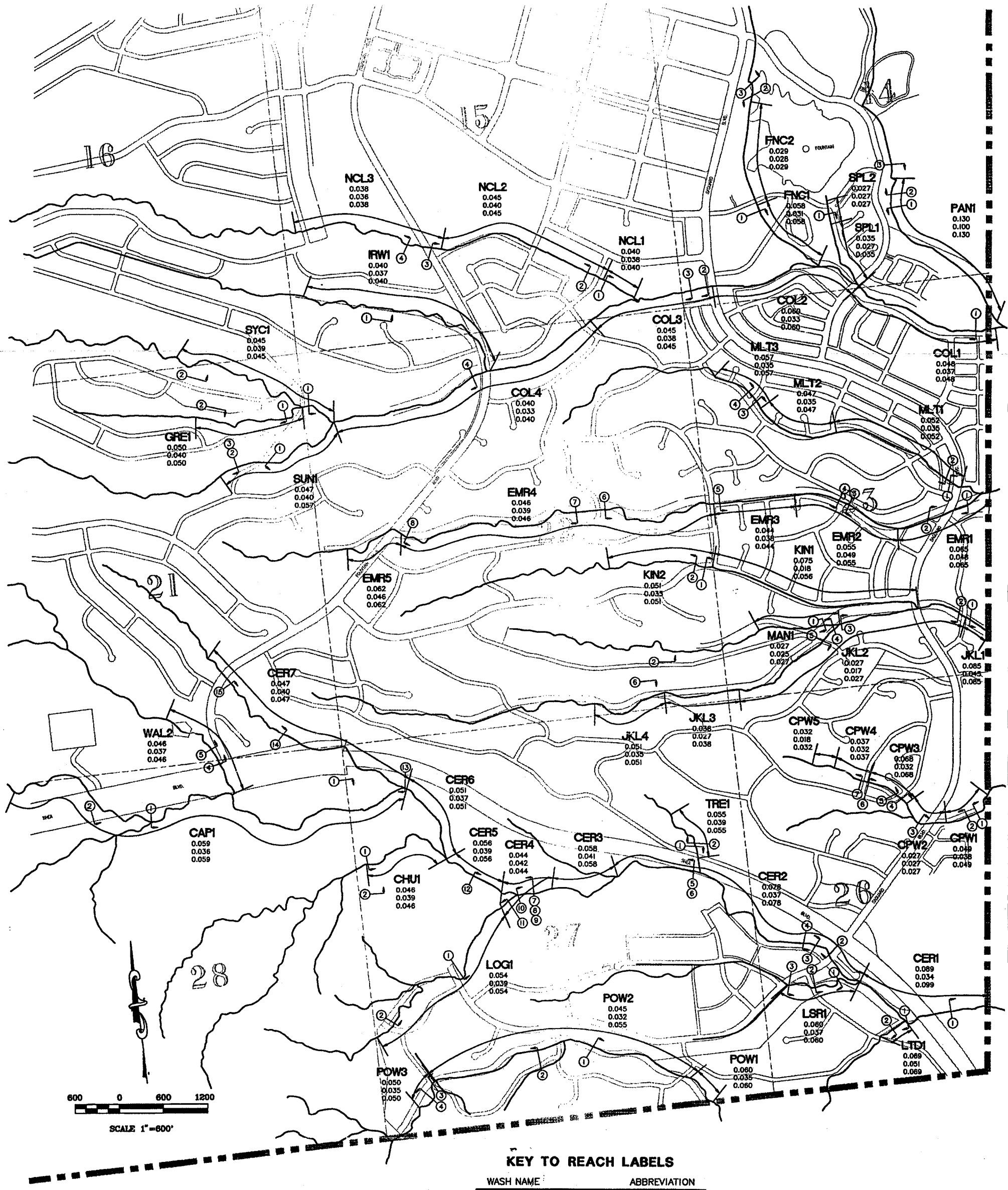
SUN-P3

PANORAMA CHANNEL

PAN-P3

PAN-P2

PAN-P1



KEY TO REACH LABELS

WASH NAME	ABBREVIATION
C.A.P. WASH	CAP
CEREUS WASH	CER
CHUKAR WASH	CHU
COLONY WASH	COL
CYPRUS POINT WASH	CPW
EMERALD WASH	EMR
FOUNTAIN CHANNEL	FNC
GREYSTONE WASH	GRE
IRONWOOD WASH	IRW
JACKLIN WASH	JKL
KINGSTREE WASH	KIN
LASER DRAIN	LSR
LAST TRAIL DRAIN	LTD
LOGAN WASH	LOG
MALTA DRAIN	MLT
MANGRUM DRAIN	MAN
NORTH COLONY WASH	NCL
PANORAMA CHANNEL	PAN
POWDER WASH	POW
SPILLWAY CHANNEL	SPL
SUNBURST WASH	SUN
SYCAMORE WASH	SYC
TREVINO WASH	TRE
WALNUT WASH	WAL

LEGEND

REACH LABEL	CER7
PHOTO LOCATION AND DIRECTION	⑤—
HYDRAULIC BASE LINE	
LEFT OVERBANK n VALUE	0.047
MAIN CHANNEL n VALUE	0.040
RIGHT OVERBANK n VALUE	0.047

EXHIBIT 1

MANNINGS n VALUE MAP

Proj. No. 310.43

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF FOUNTAIN HILLS SOUTH

F.C.D. CONTRACT NO. 92-05

DESIGN	HAA	
DRAWN	JDS	
CHECKED	SEK	
REVISIONS:		

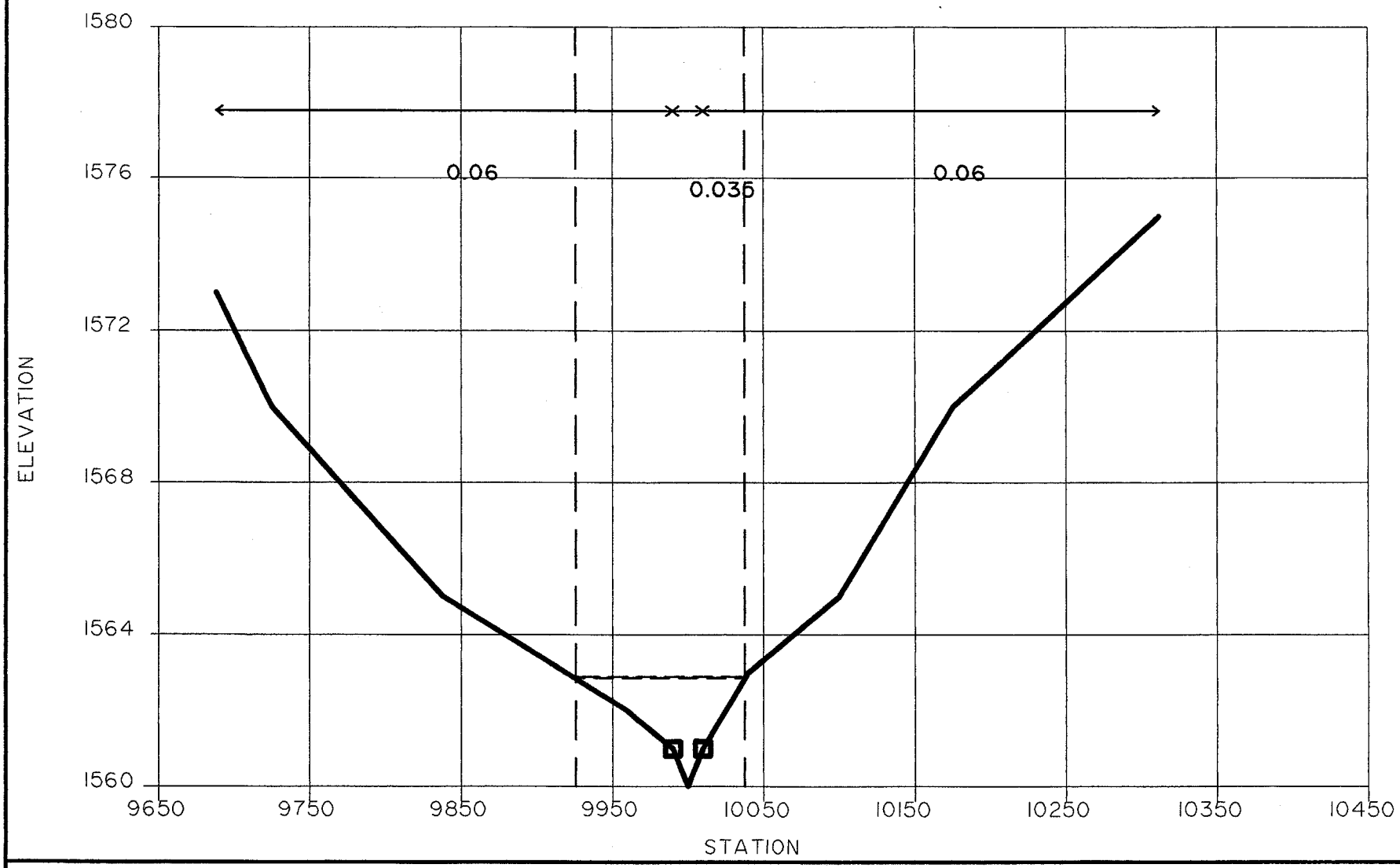
ACK ENGINEERS, INC.
2255 NORTH 44TH STREET, SUITE 330
PHOENIX, ARIZONA 85008
TELEPHONE (602) 244-2566

FILE: MANING DATE: 09/14/93

Assumed Thalweg of Laser Drain
LD-3
LD-2
LD-1
SAGUARO
DRIVE

APPENDIX D

CROSS SECTION PLOTS



SECTION : 9999

Fountain Hills (south) FIS

Powder Wash

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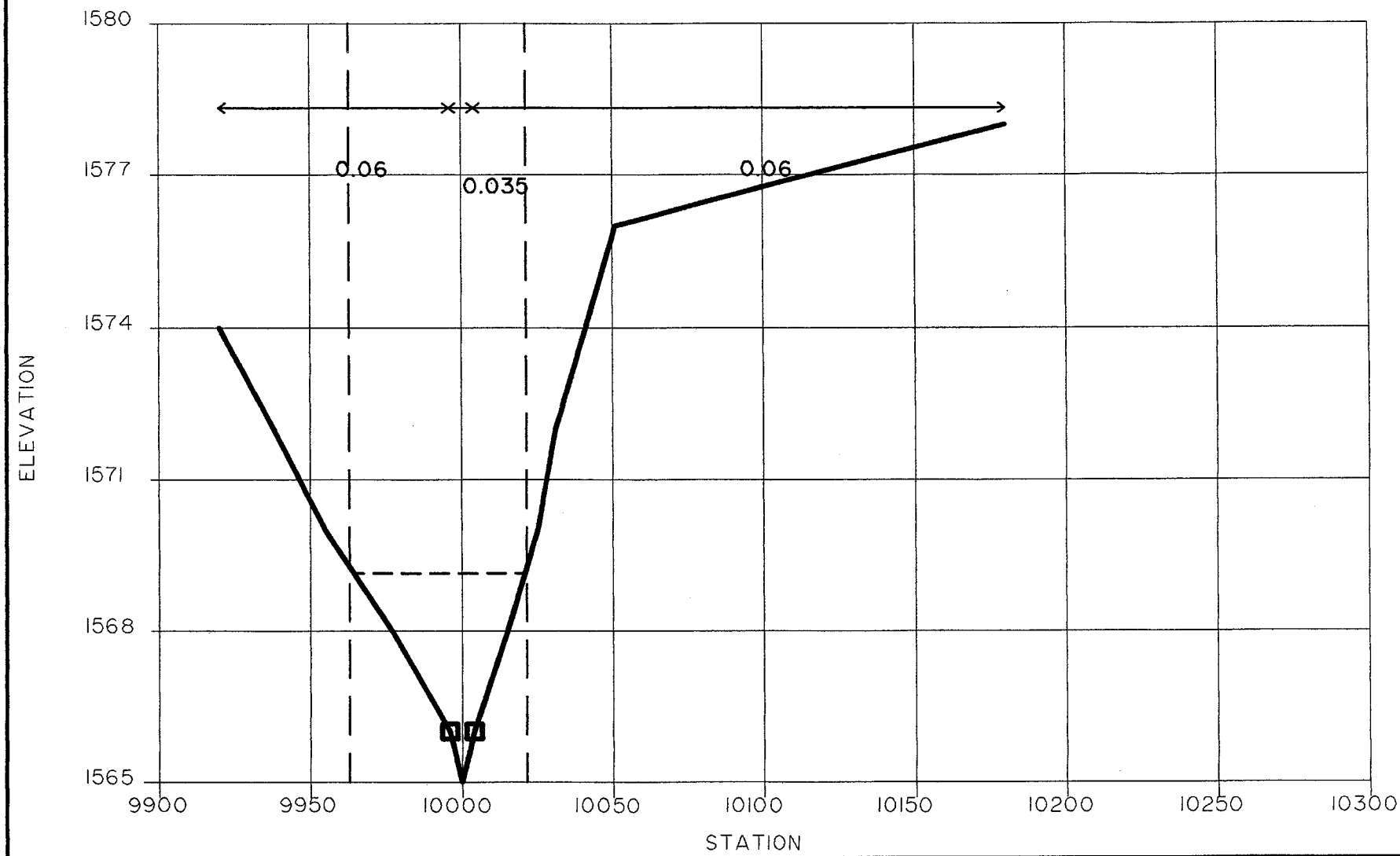

SECTION : 10000

Fountain Hills (south) FIS

Powder Wash

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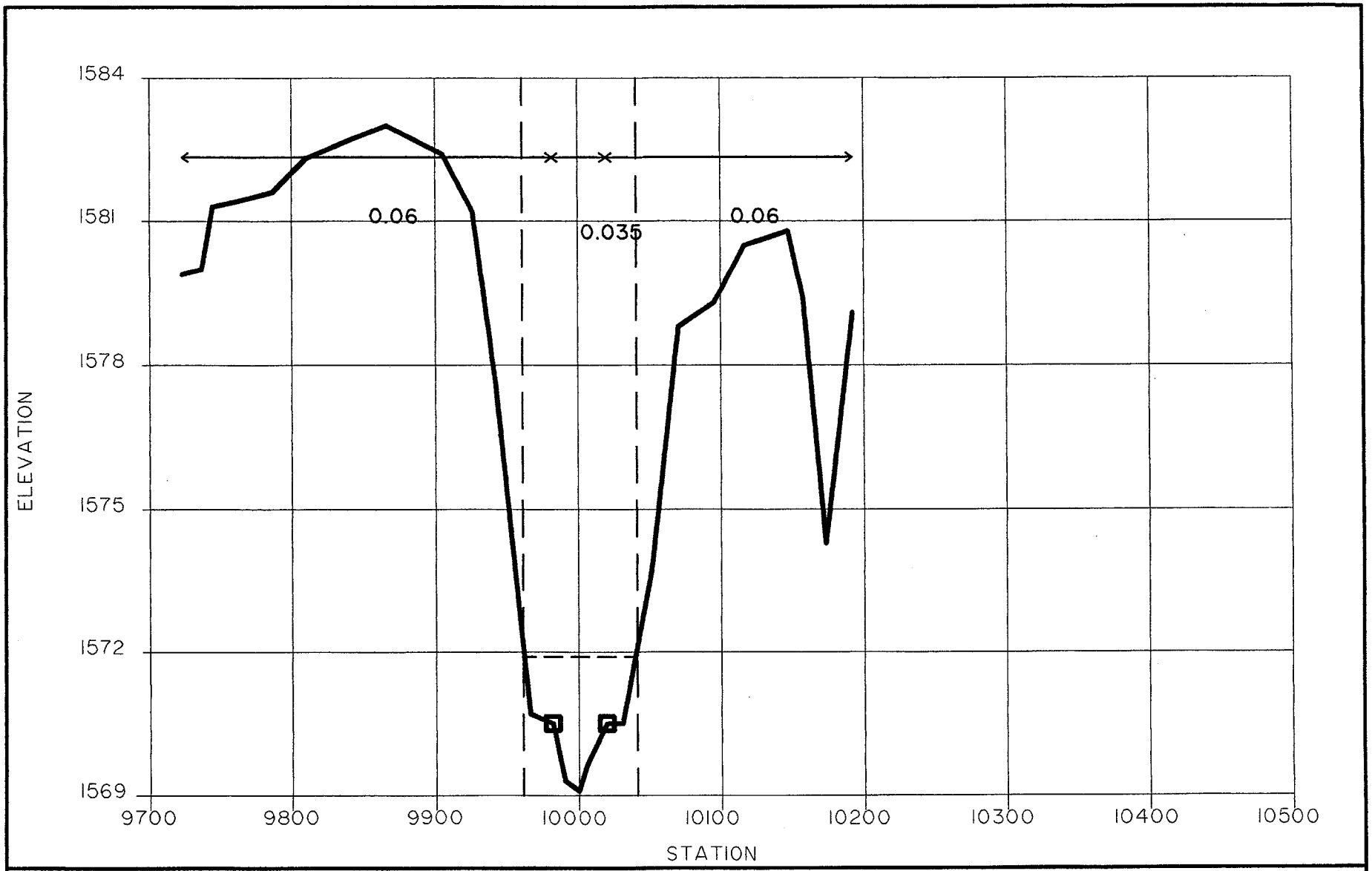

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Fountain Hills (south) FIS

Powder Wash

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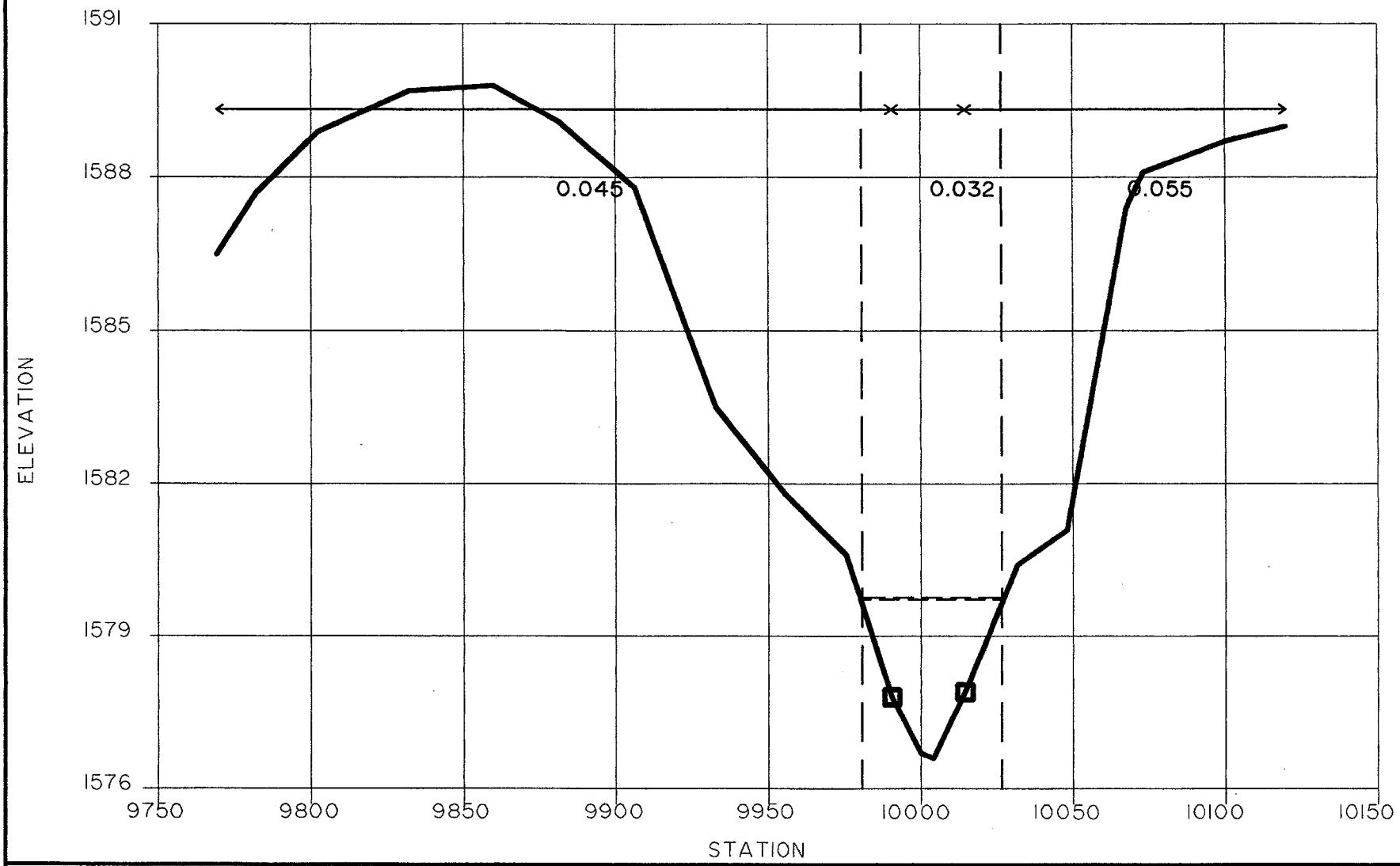

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Fountain Hills (south) FIS

Powder Wash

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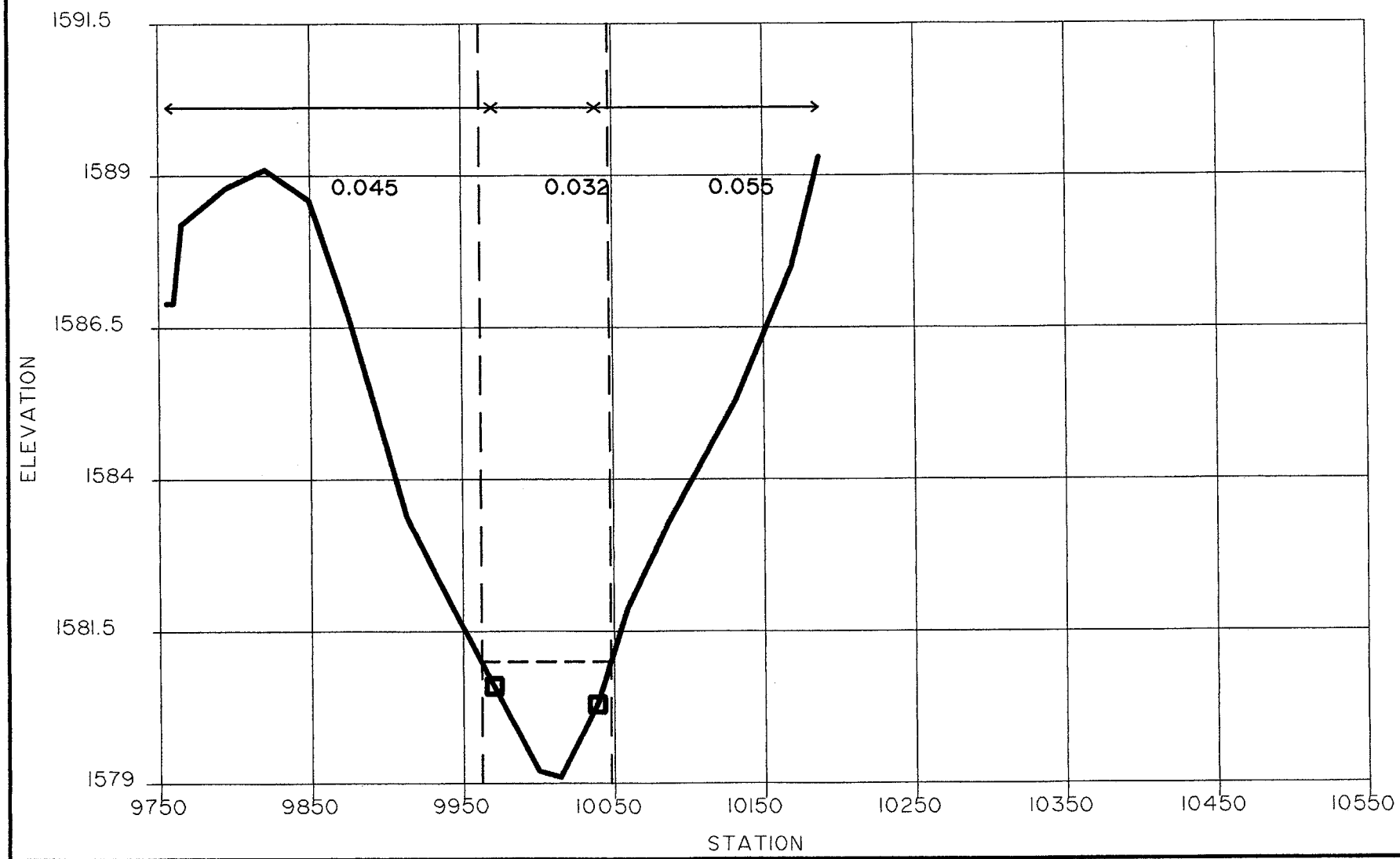
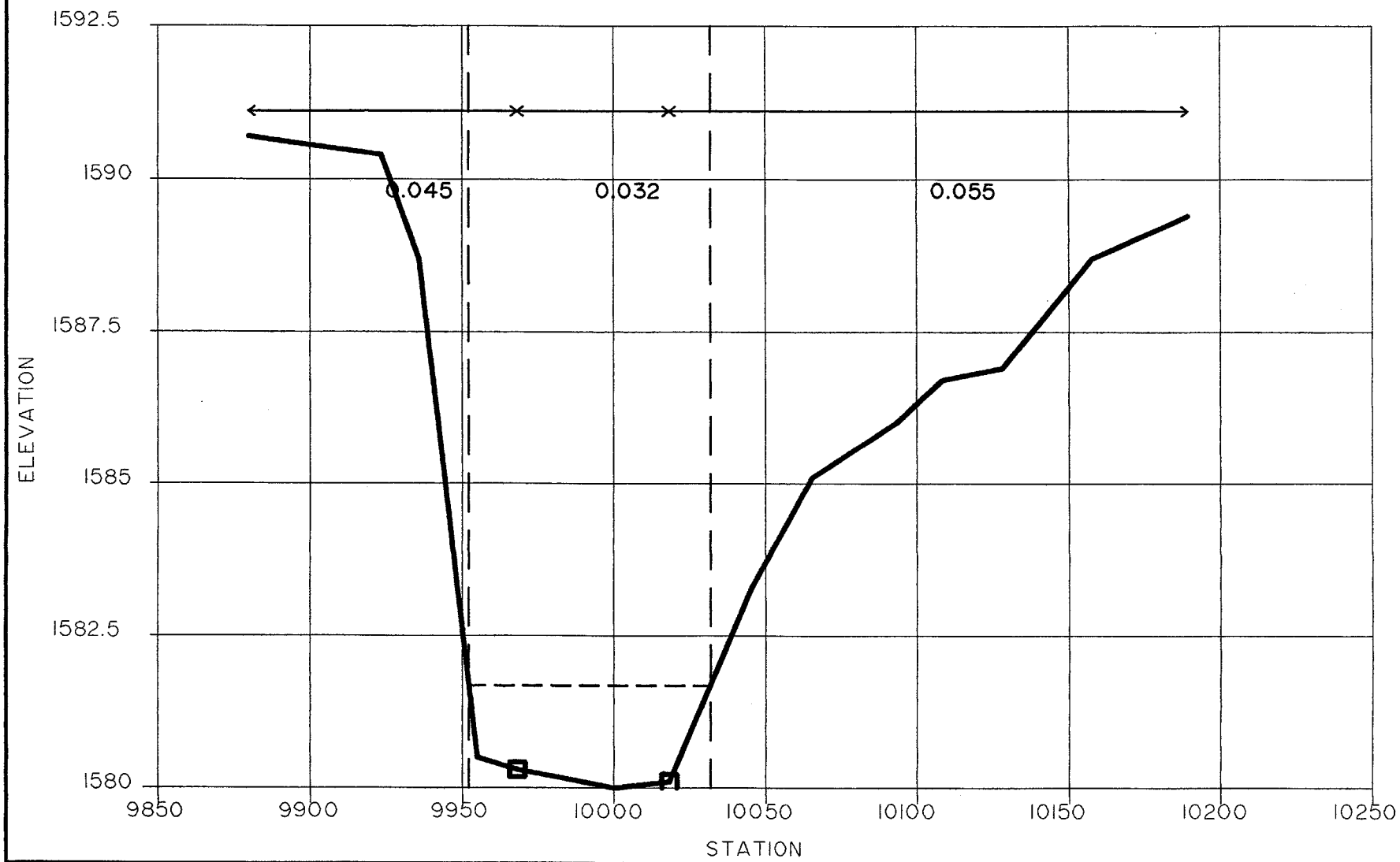


SECTION : 0.09

Fountain Hills (south) FIS

Powder Wash

File: POW-XSEC.DWG

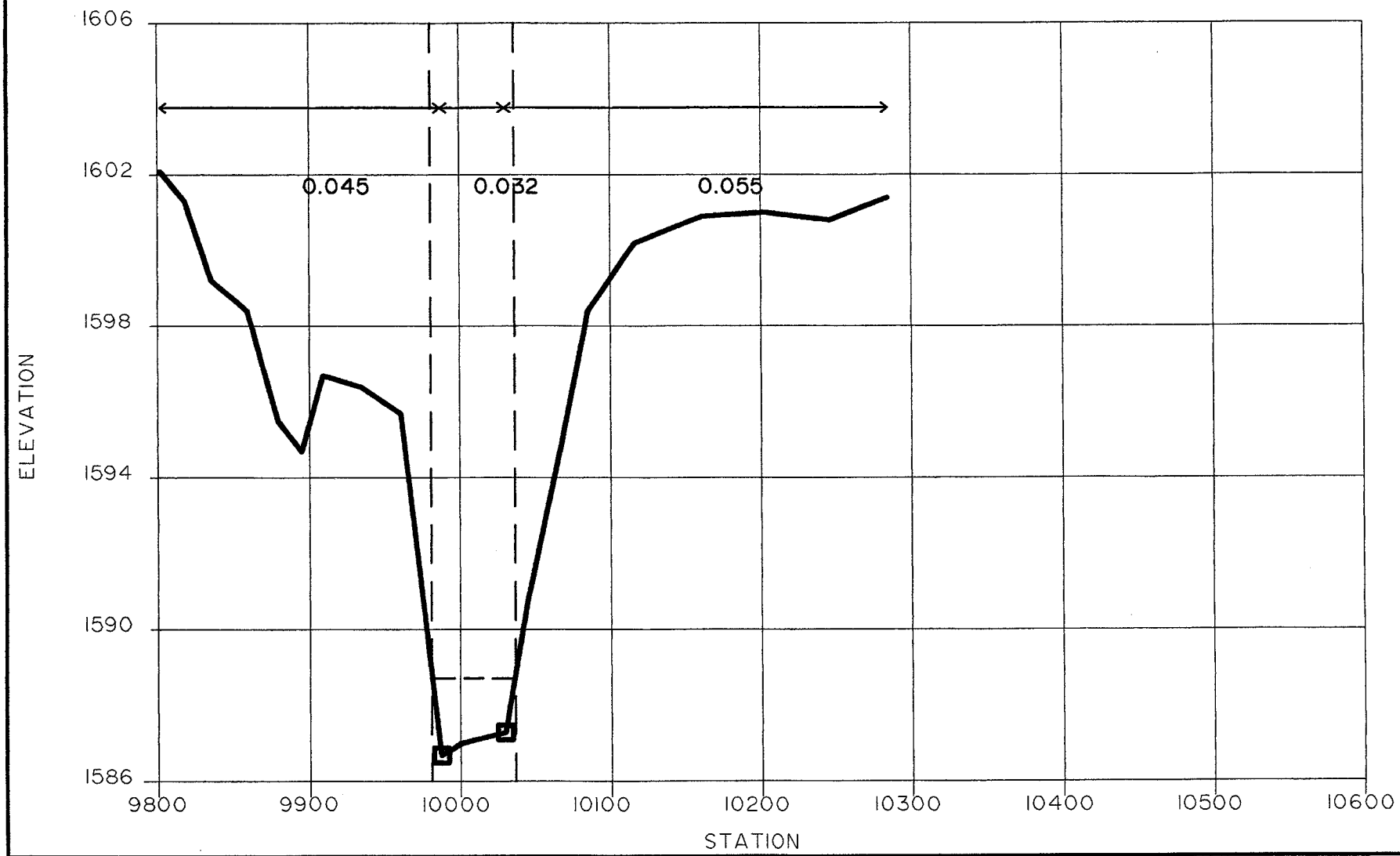


SECTION : 0.10

Fountain Hills (south) FIS

Powder Wash

File: POW-XSEC.DWG

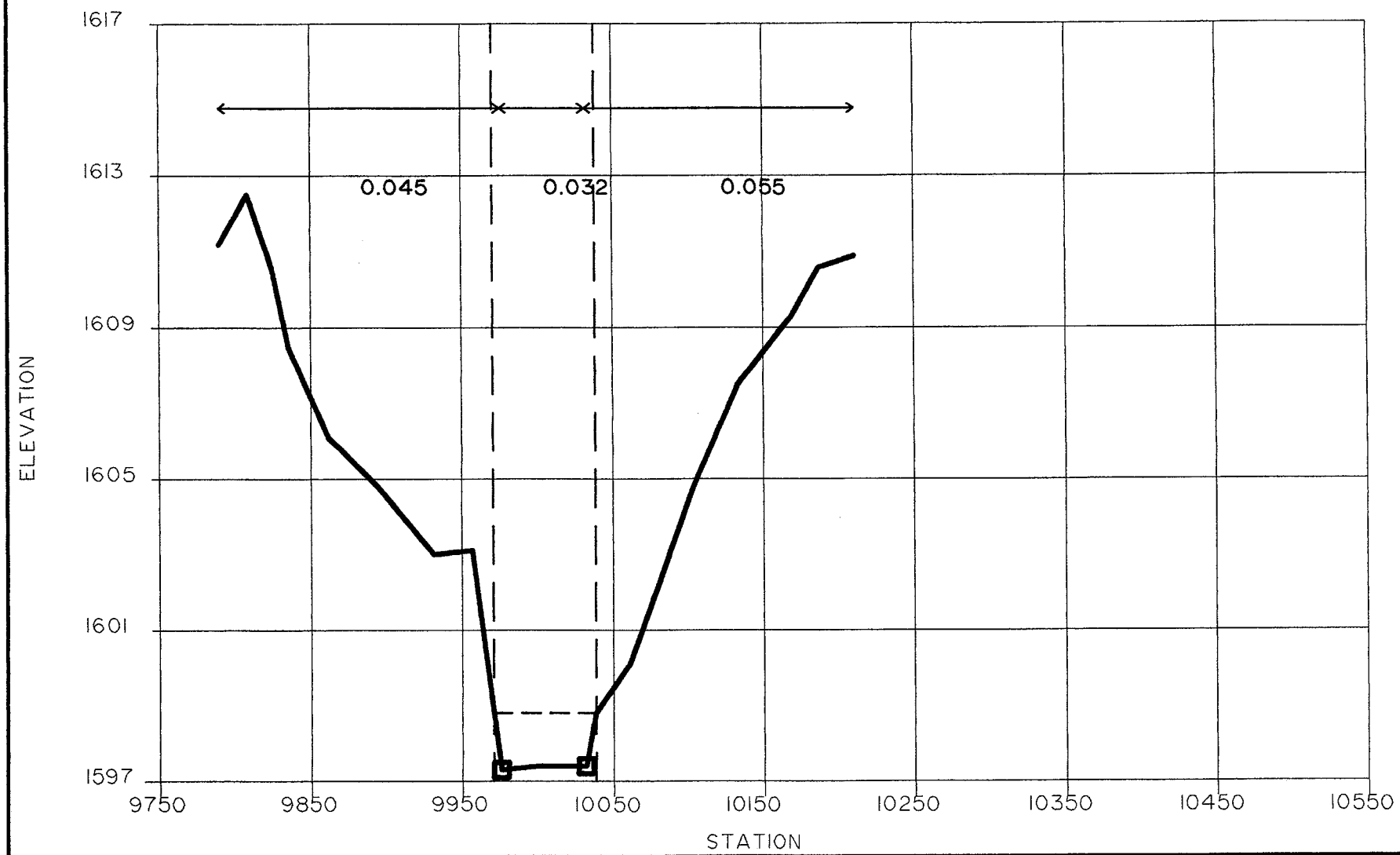


SECTION : 0.19

Fountain Hills (south) FIS

Powder Wash

File: POW-XSEC.DWG

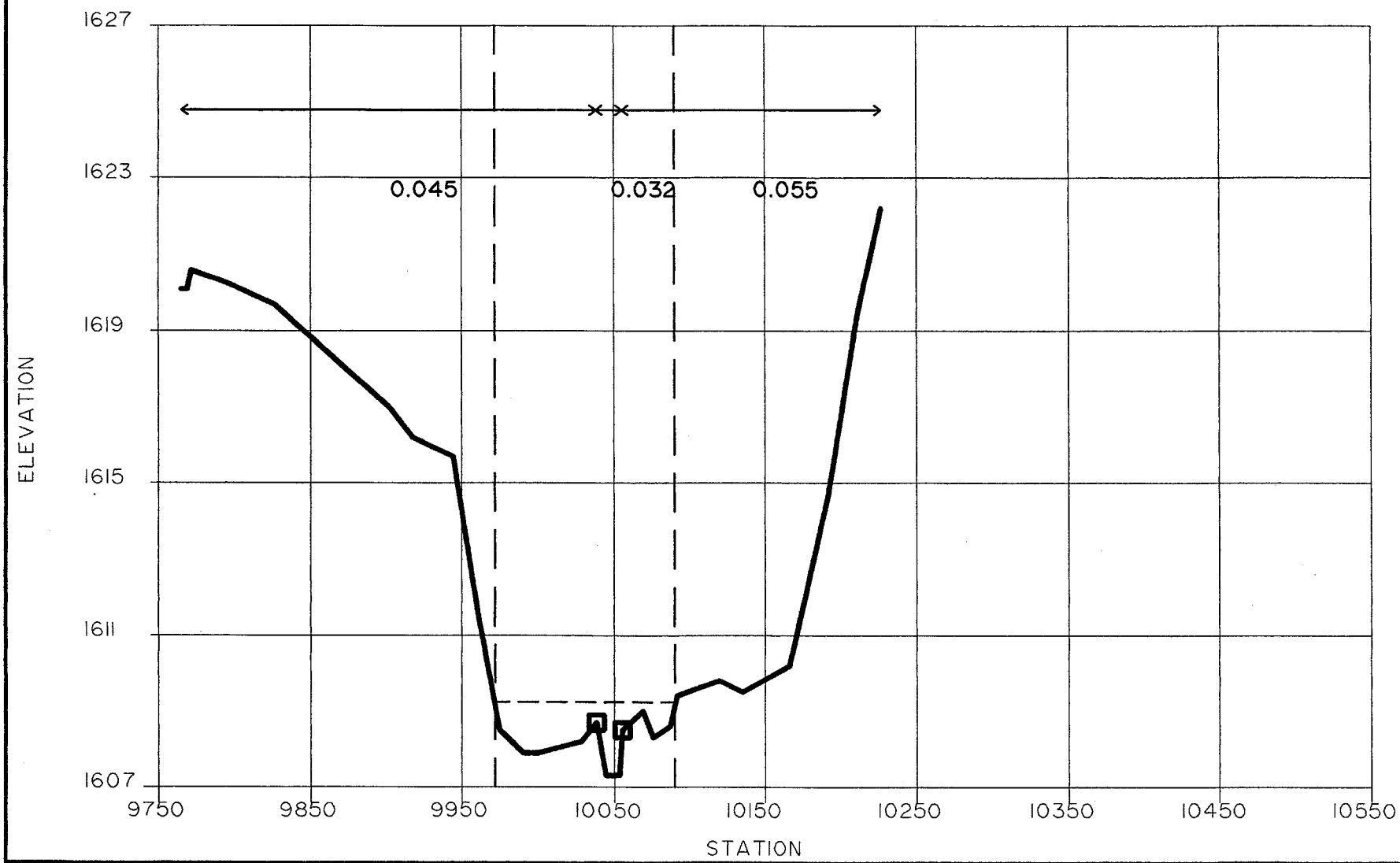


SECTION : 0.29

Fountain Hills (south) FIS

Powder Wash

File: POW-XSEC.DWG

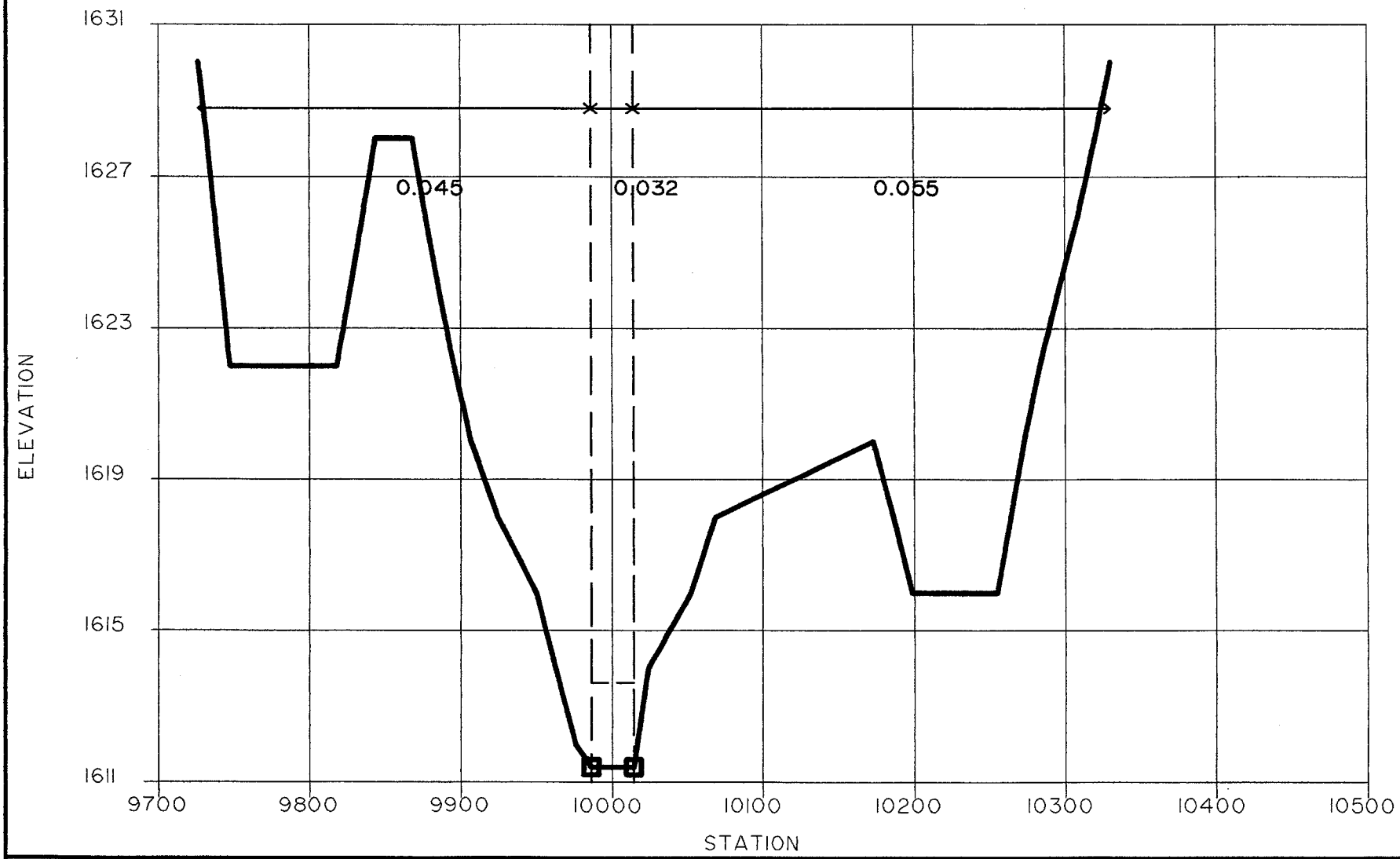


SECTION : 0.38

Fountain Hills (south) FIS

Powder Wash

File: POW-XSEC.DWG

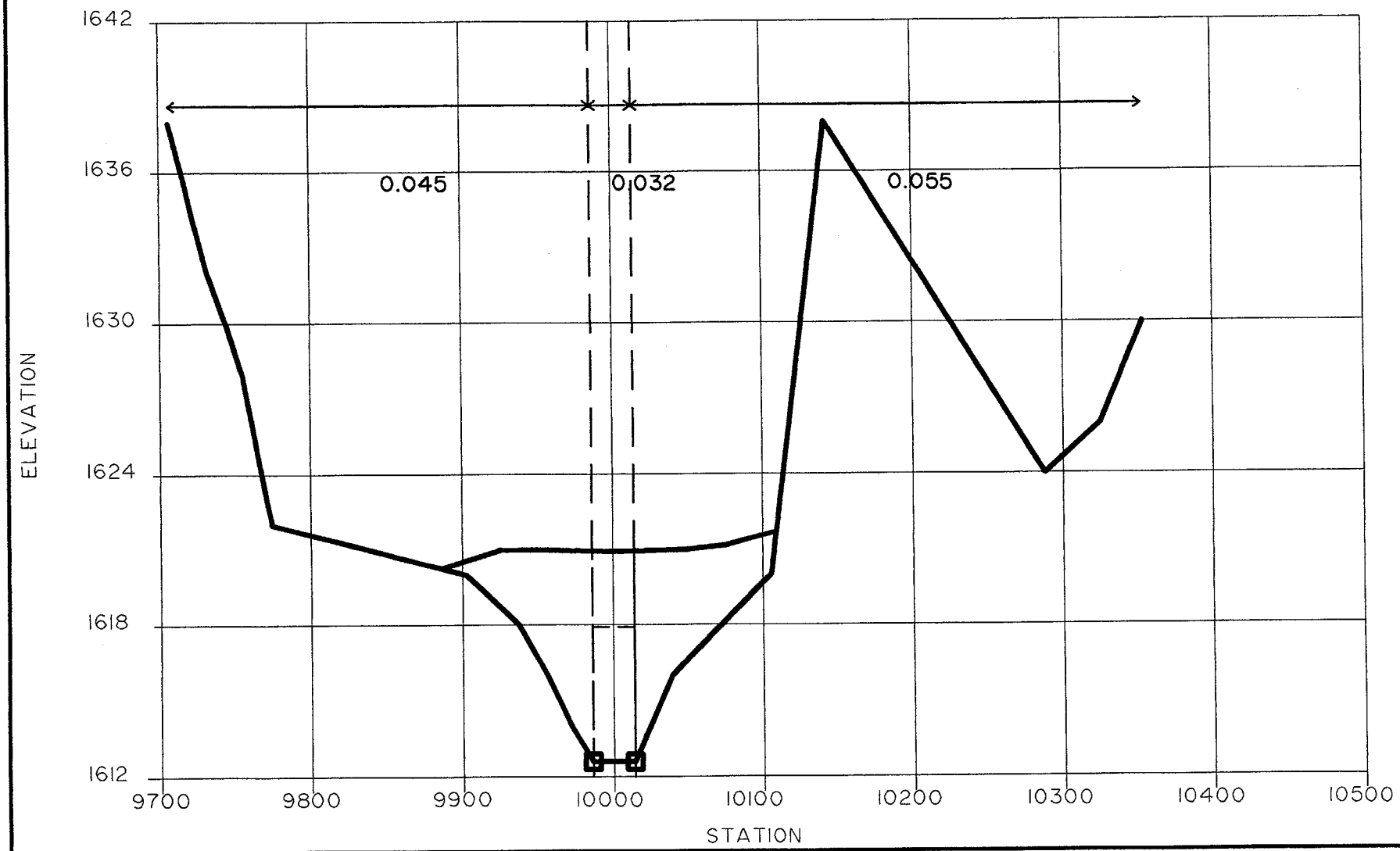


SECTION : 0.42

Fountain Hills (south) FIS

Powder Wash

File: POW-XSEC.DWG

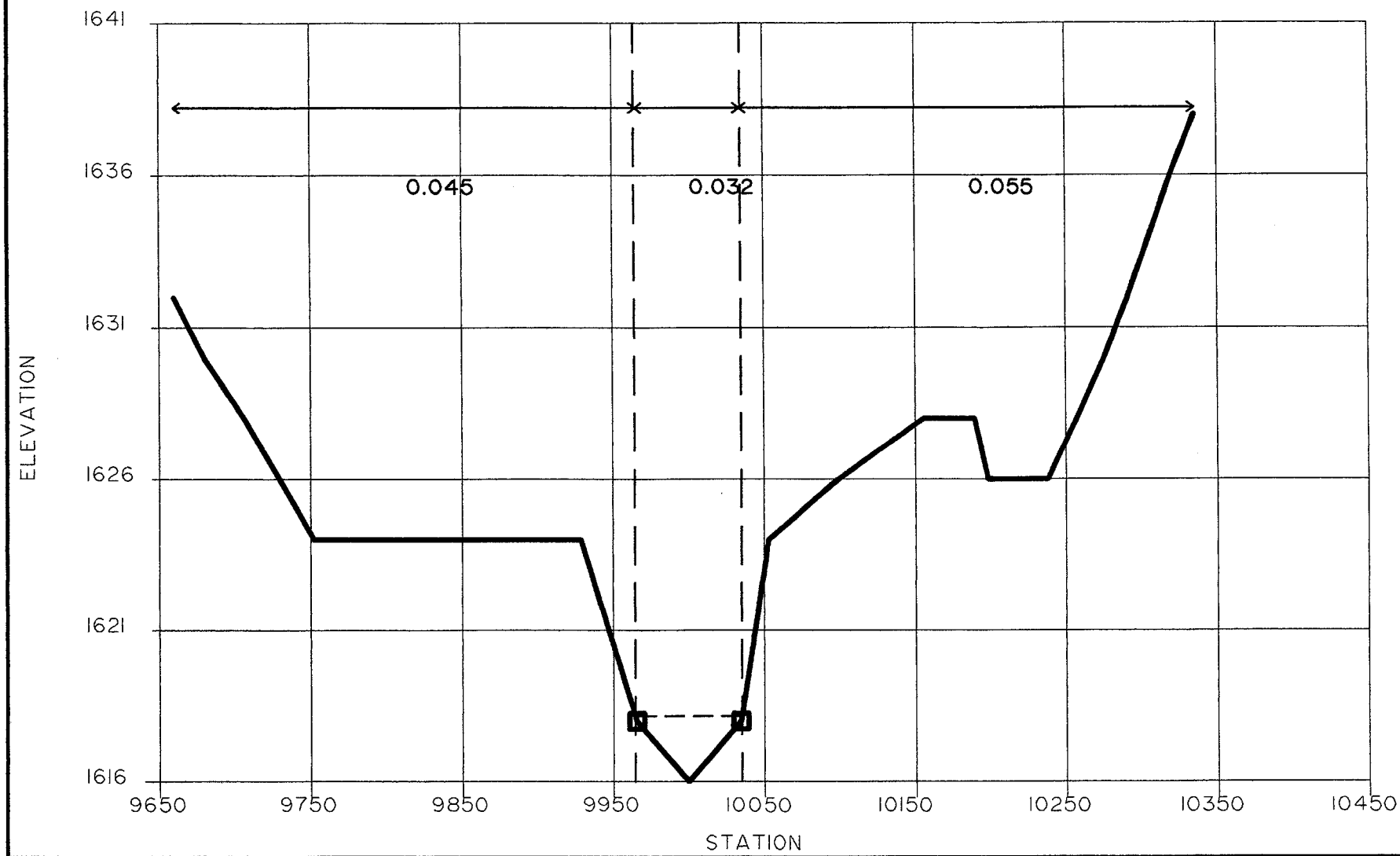


SECTION : 0.44

Fountain Hills (south) FIS

Powder Wash

File: POW-XSEC.DWG

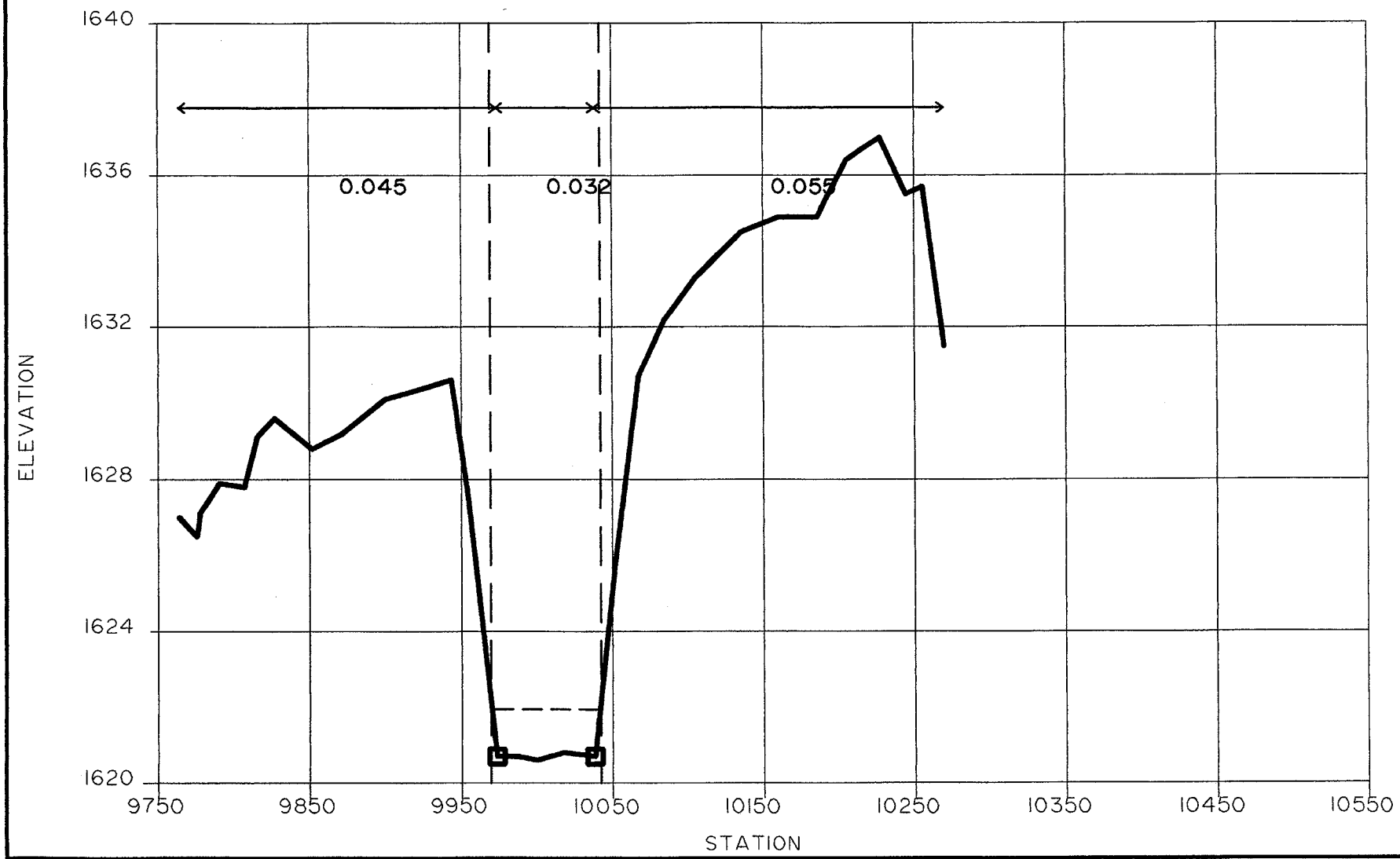


SECTION : 0.48

Fountain Hills (south) FIS

Powder Wash

File: POW-XSEC.DWG

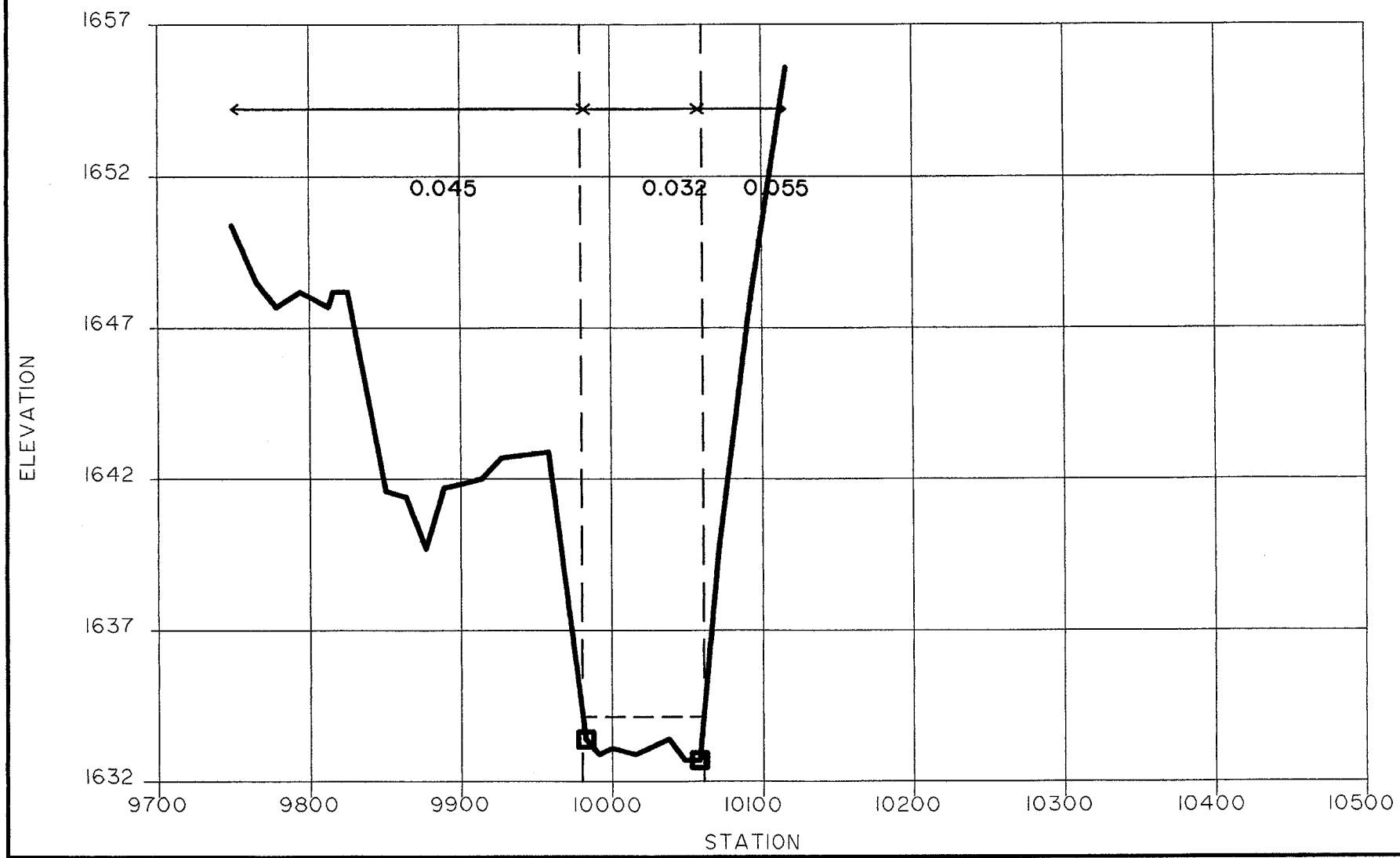


SECTION : 0.53

Fountain Hills (south) FIS

Powder Wash

File: POW-XSEC.DWG

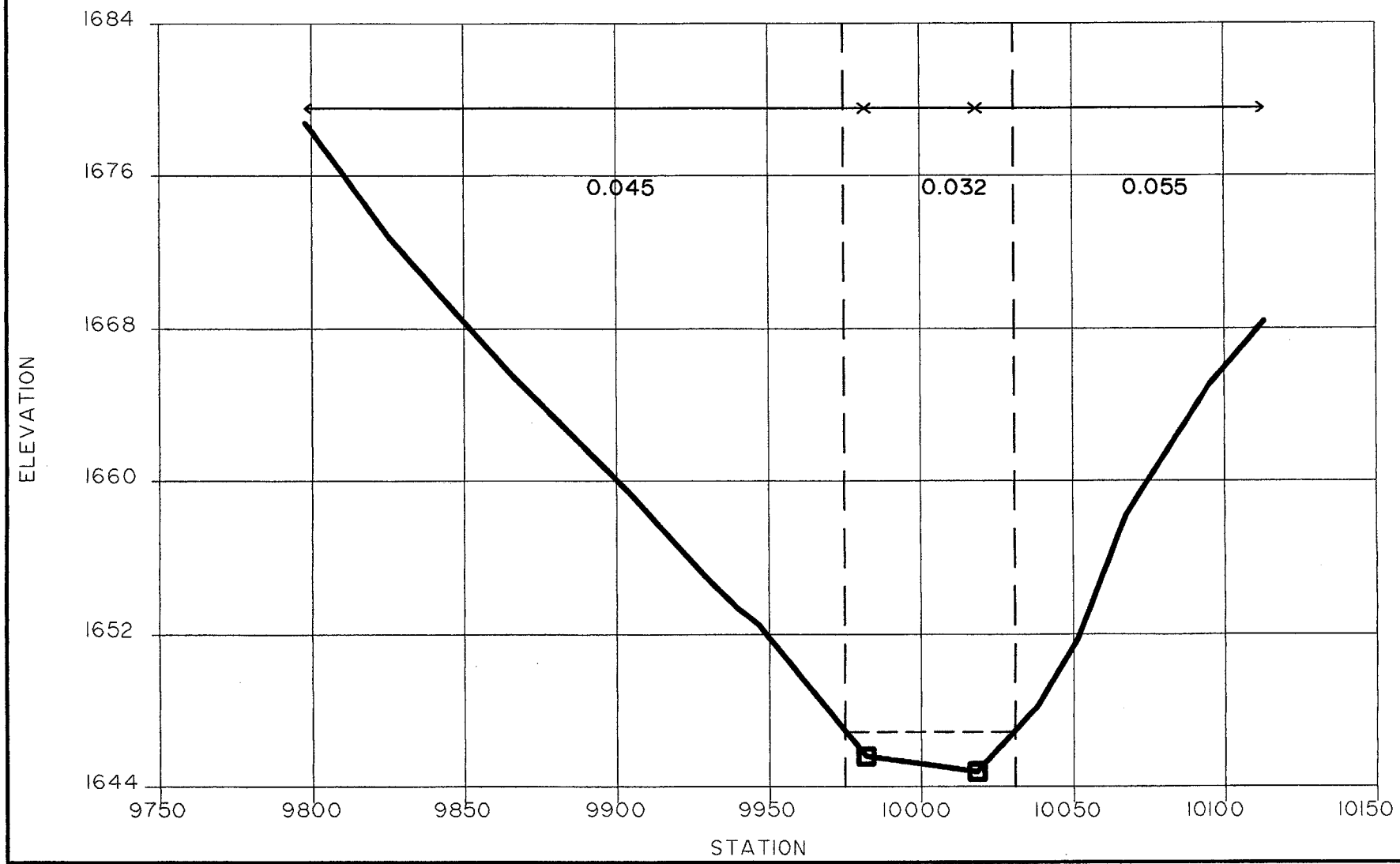


SECTION : 0.63

Fountain Hills (south) FIS

Powder Wash

File: POW-XSEC.DWG

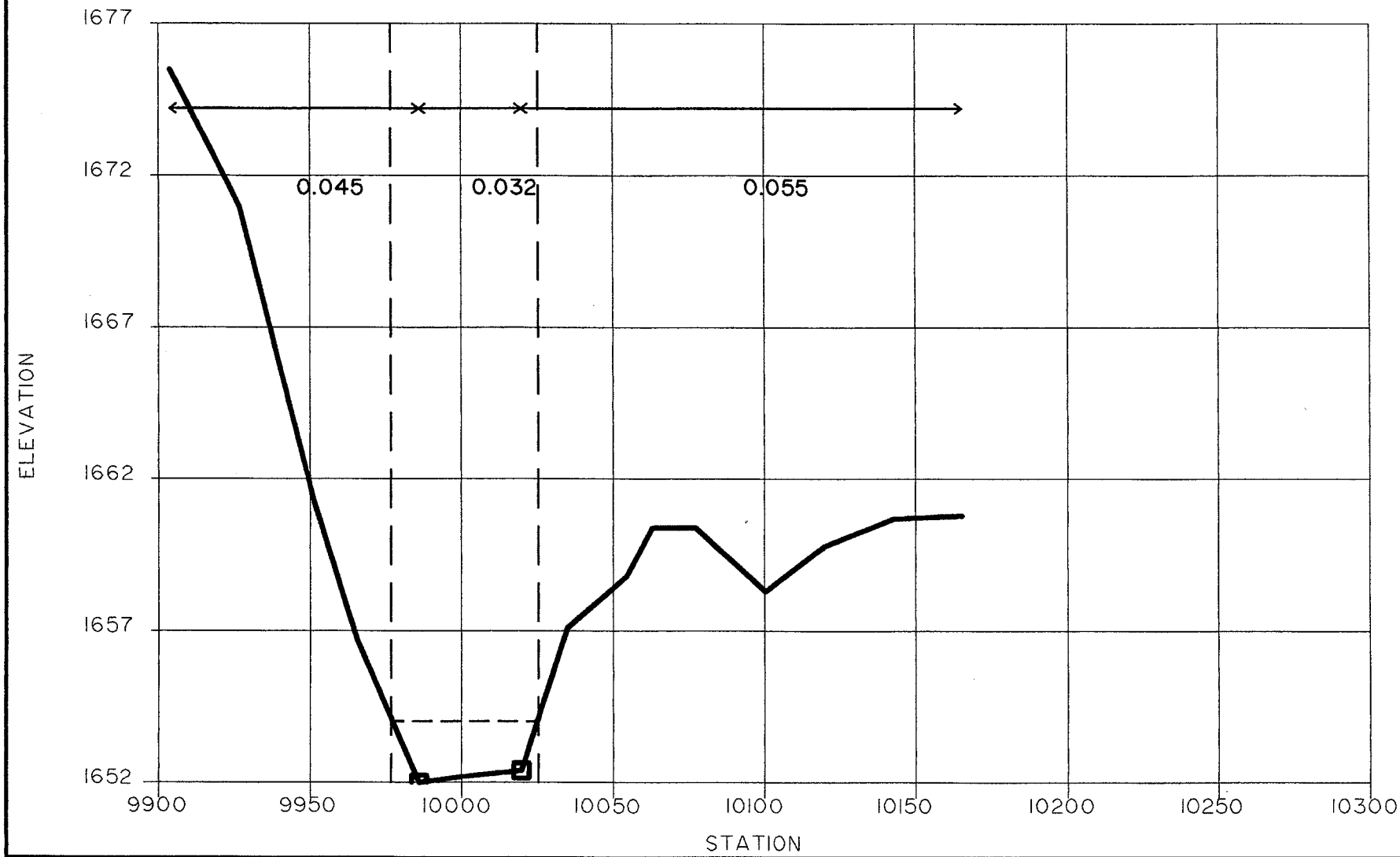


SECTION : 0.72

Fountain Hills (south) FIS

Powder Wash

File: POW-XSEC.DWG

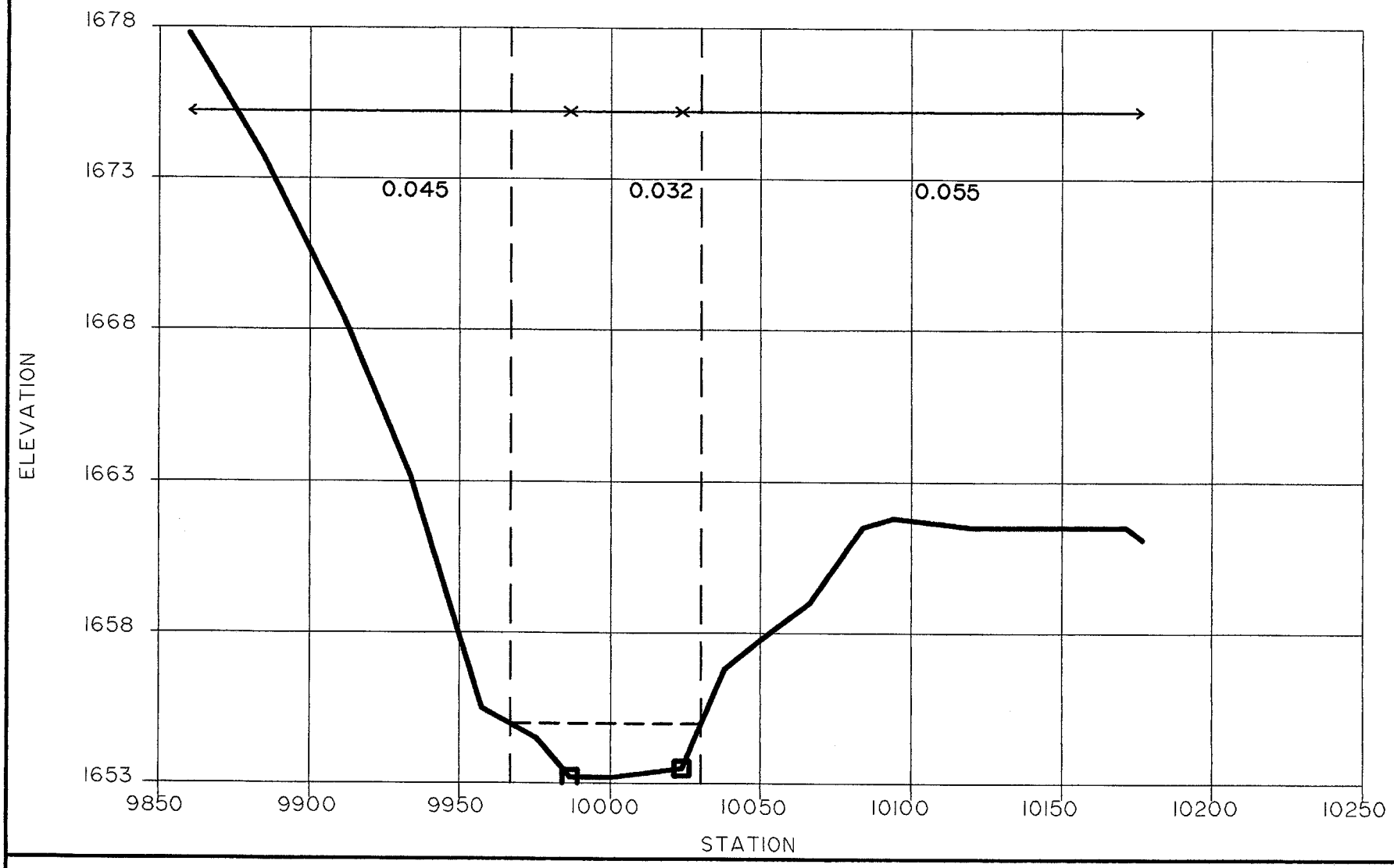


SECTION : 0.78

Fountain Hills (south) FIS

Powder Wash

File: POW-XSEC.DWG

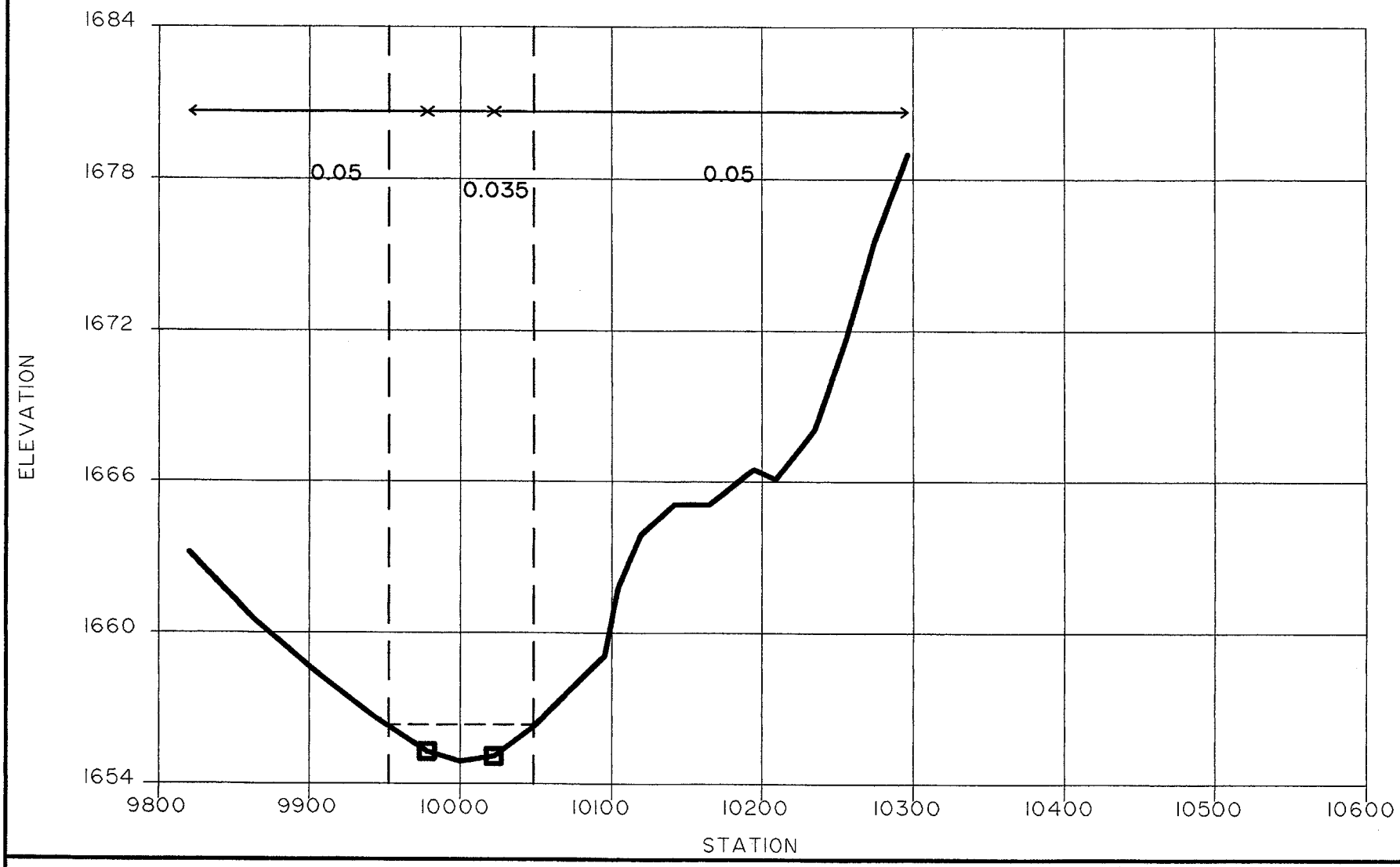


SECTION : 0.79

Fountain Hills (south) FIS

Powder Wash

File: POW-XSEC.DWG

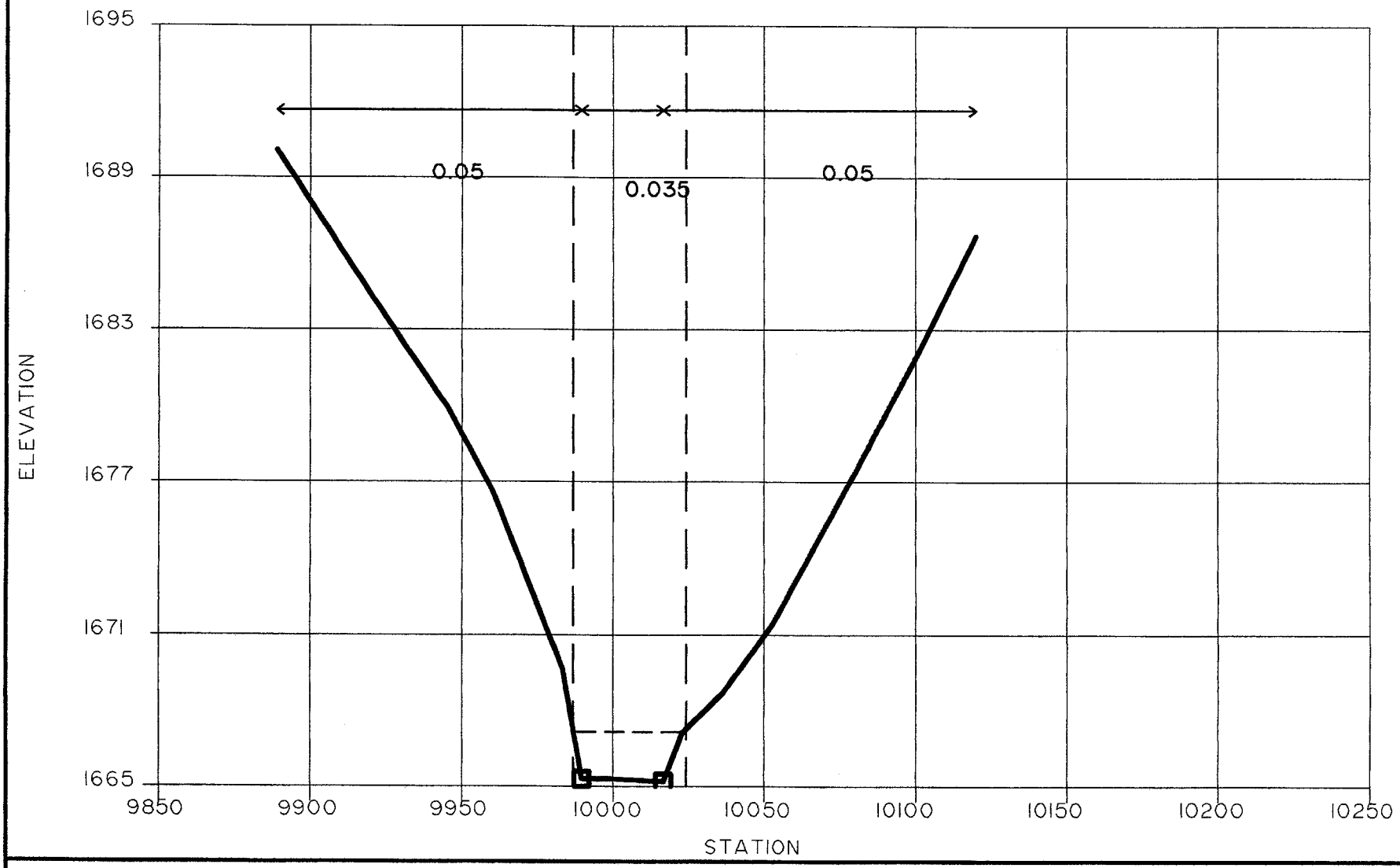


SECTION : 0.80

Fountain Hills (south) FIS

Powder Wash

File: POW-XSEC.DWG

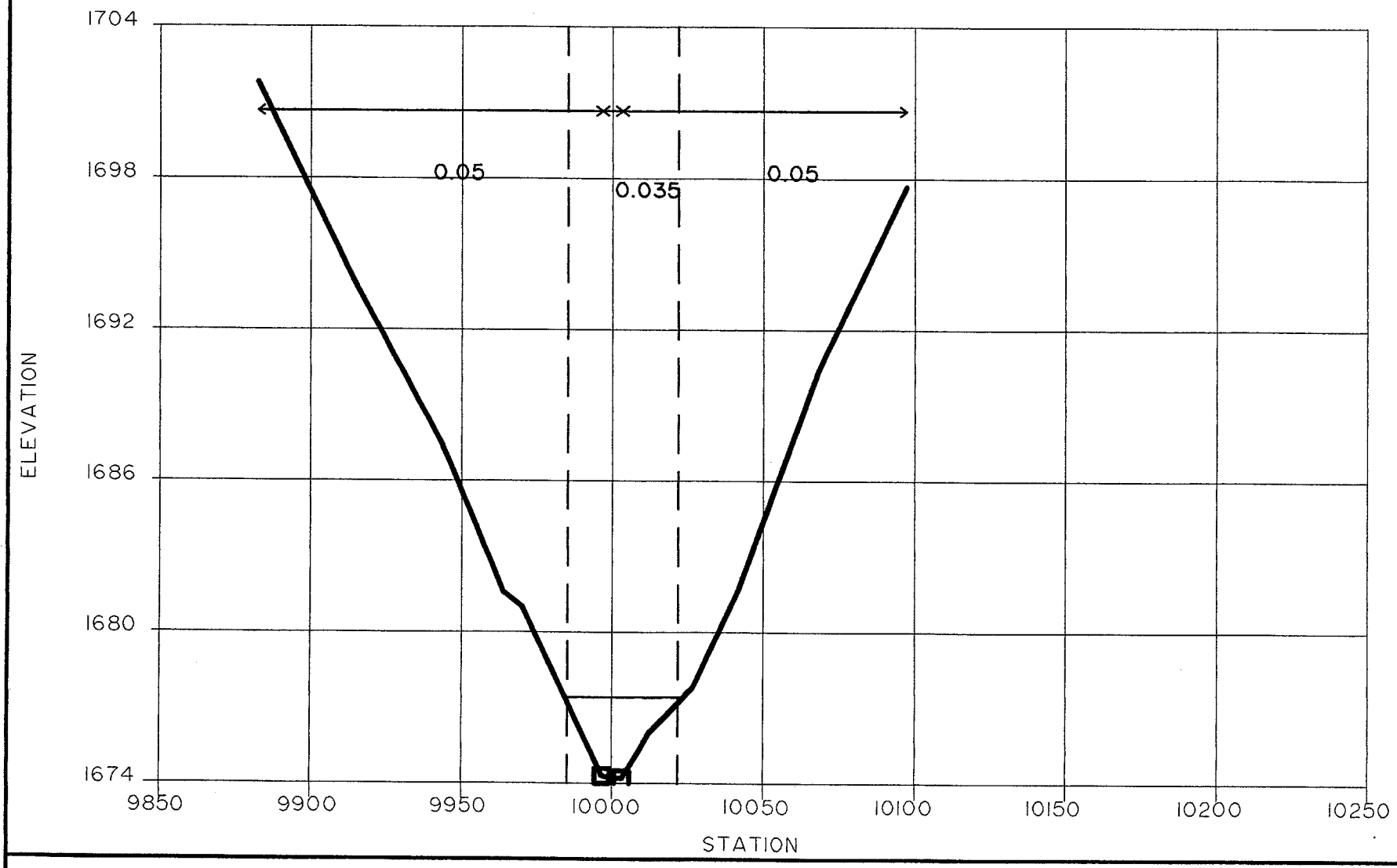


SECTION : 0.89

Fountain Hills (south) FIS

Powder Wash

File: POW-XSEC.DWG

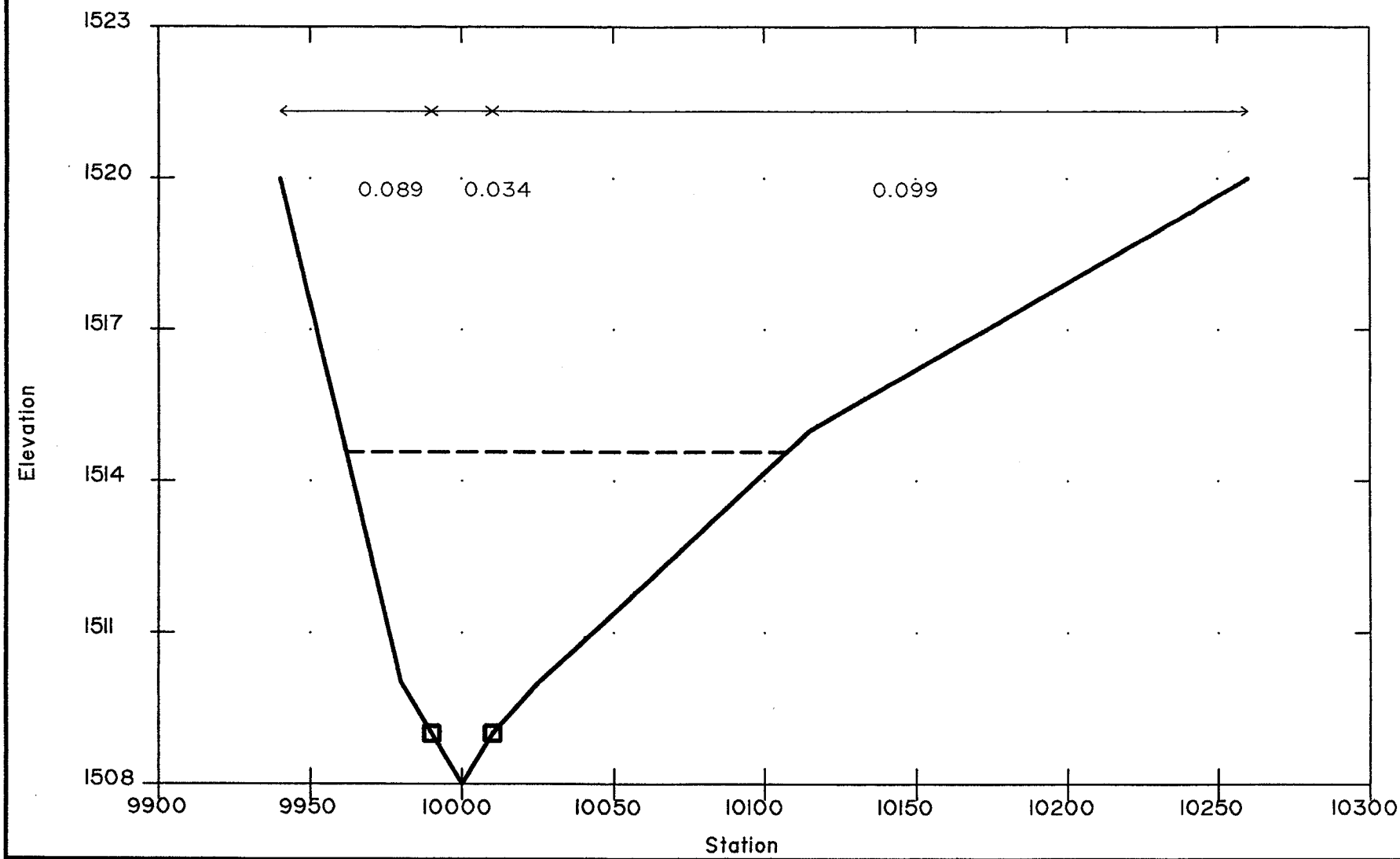


SECTION : 0.97

Fountain Hills (south) FIS

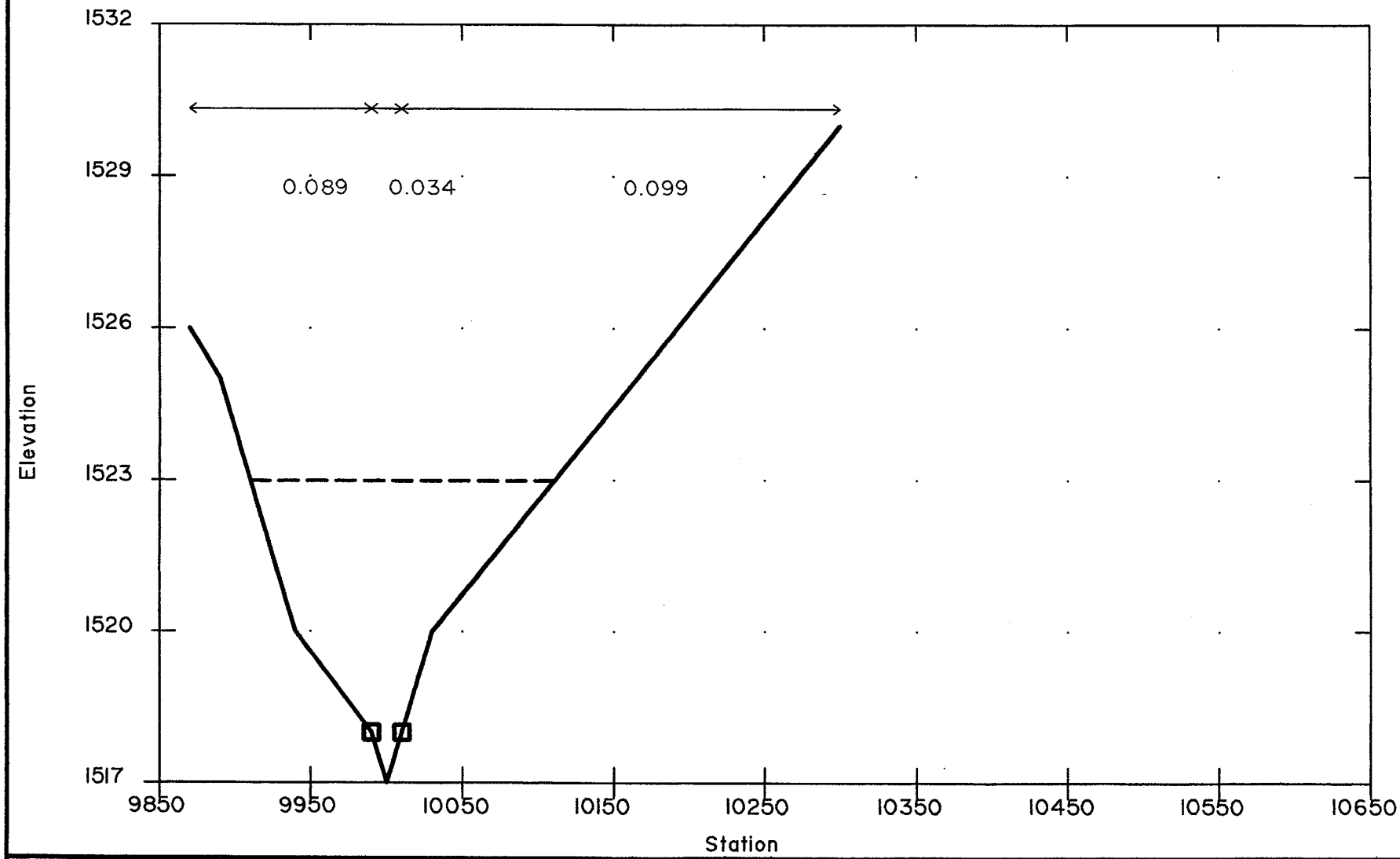
Powder Wash

File: POW-XSEC.DWG



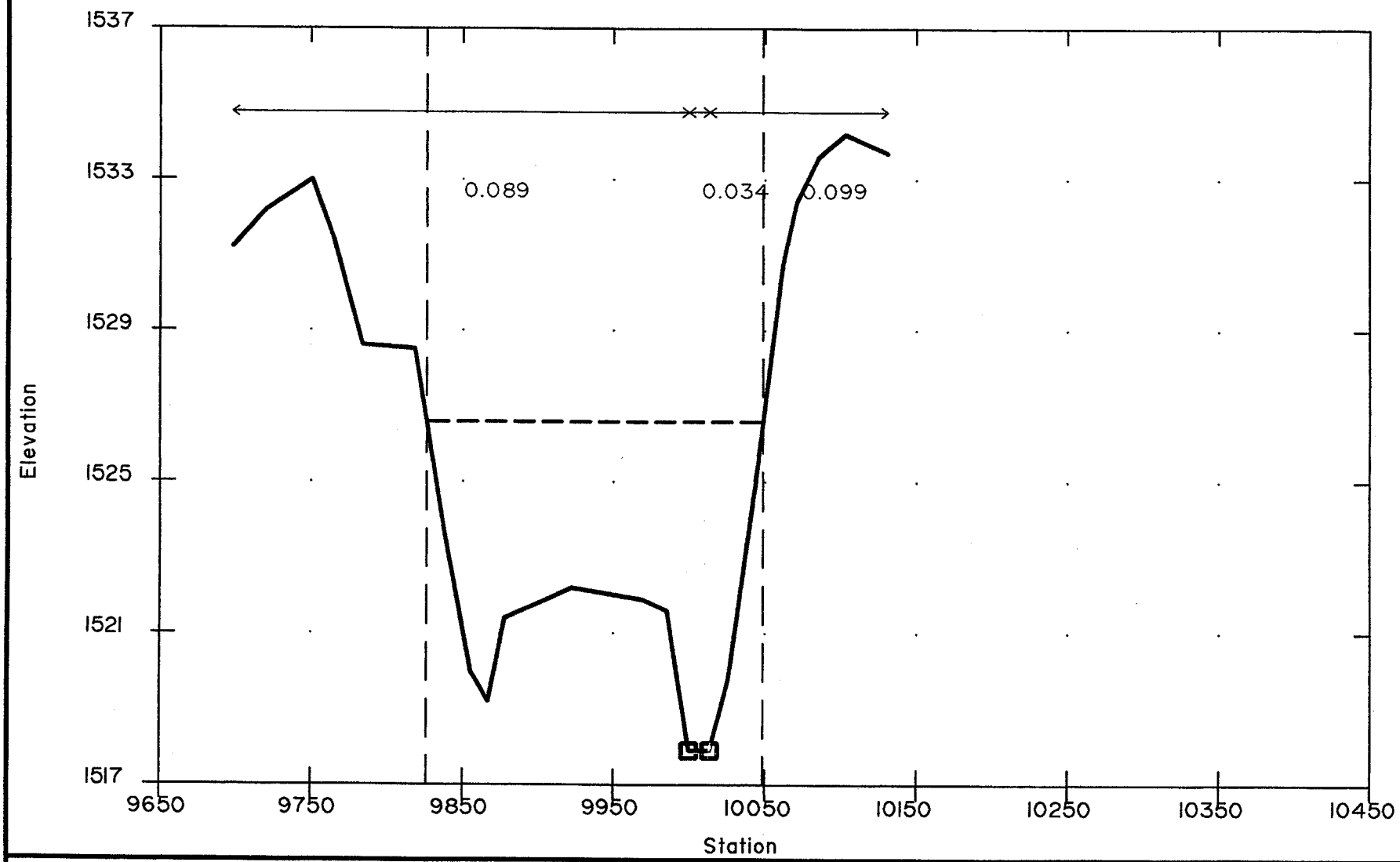
SECTION : 1000

Fountain Hills FIS
Cereus wash



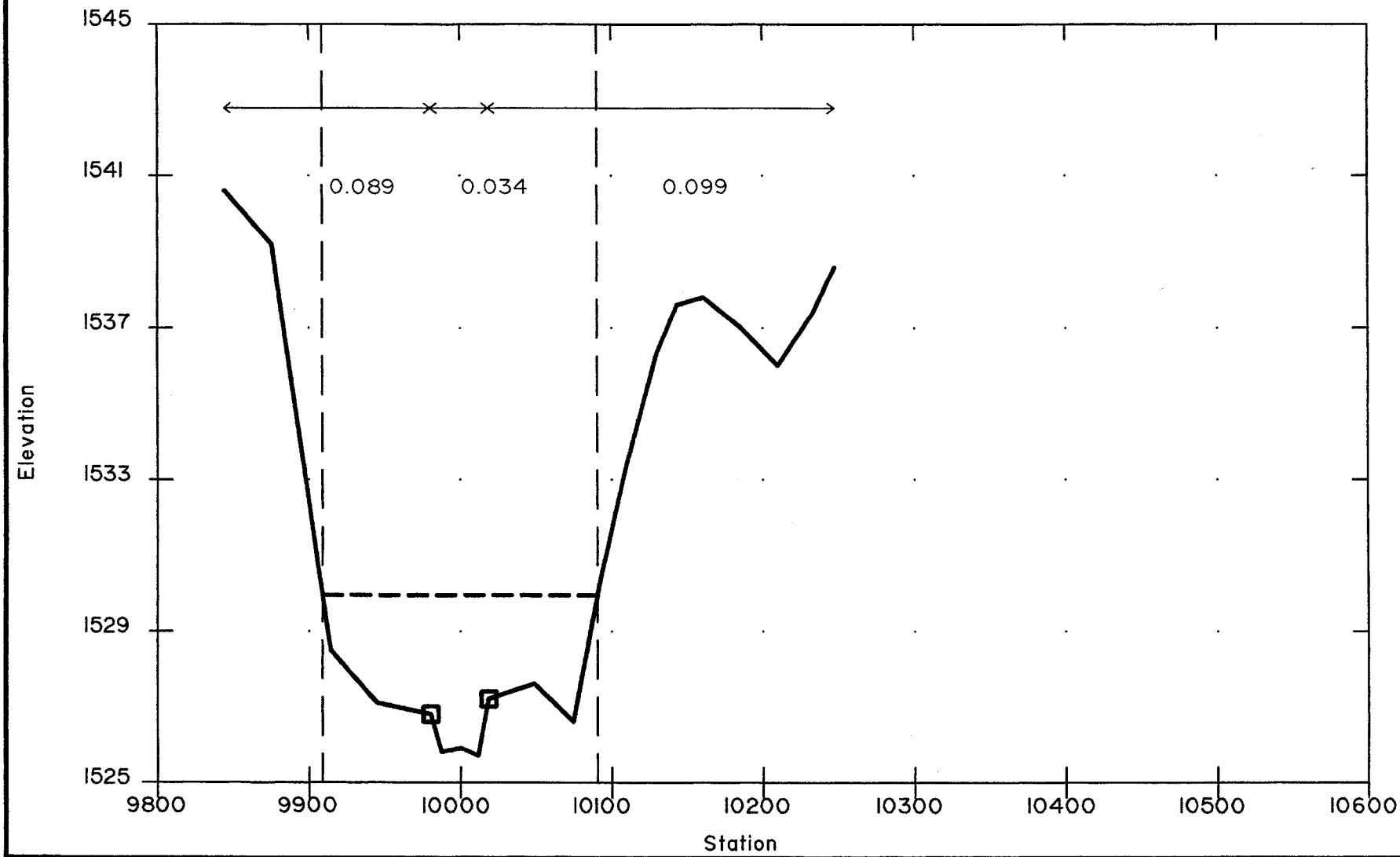
SECTION : 1001

Fountain Hills FIS
Cereus wash



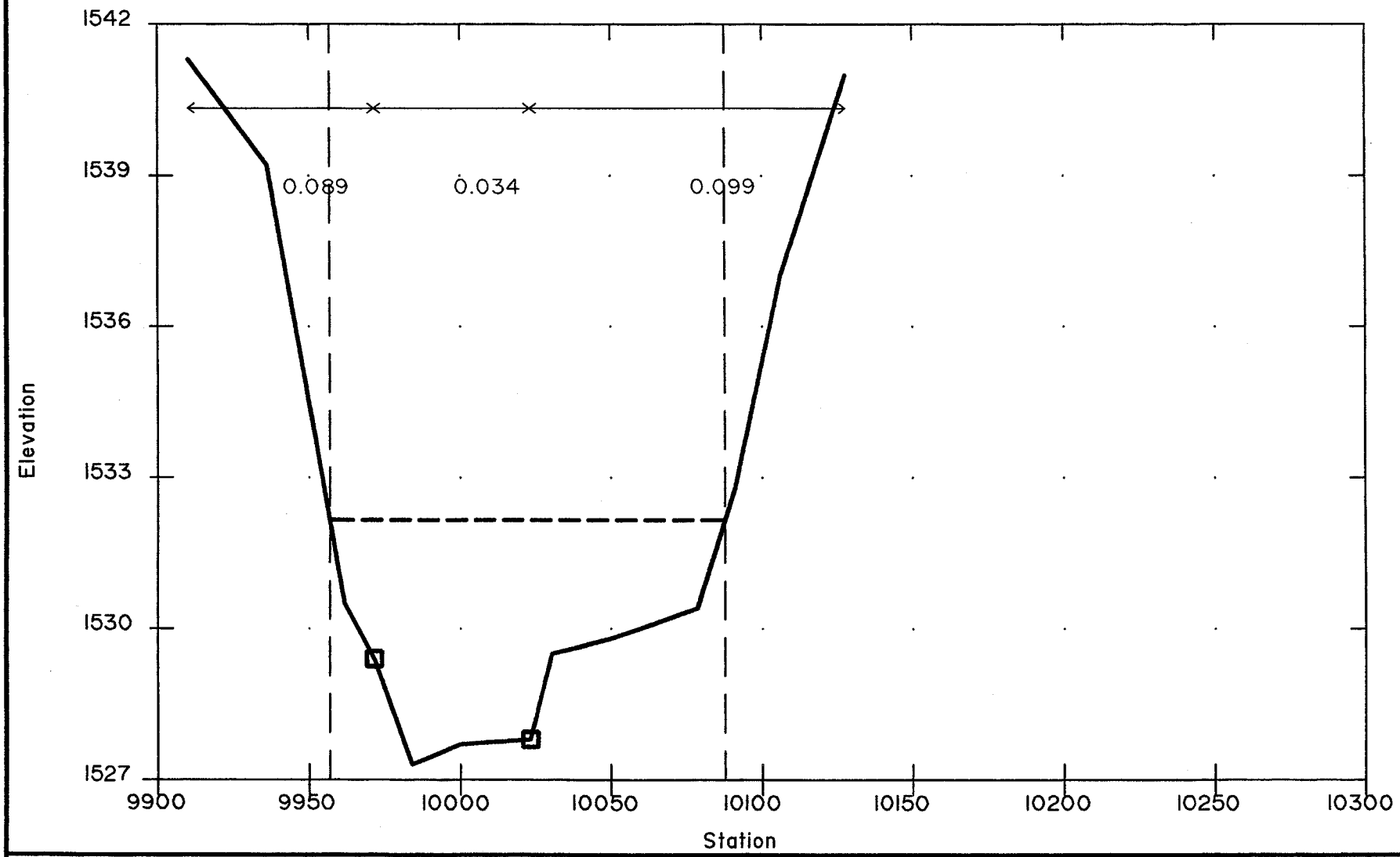
SECTION : 2.56

Fountain Hills FIS
Cereus wash



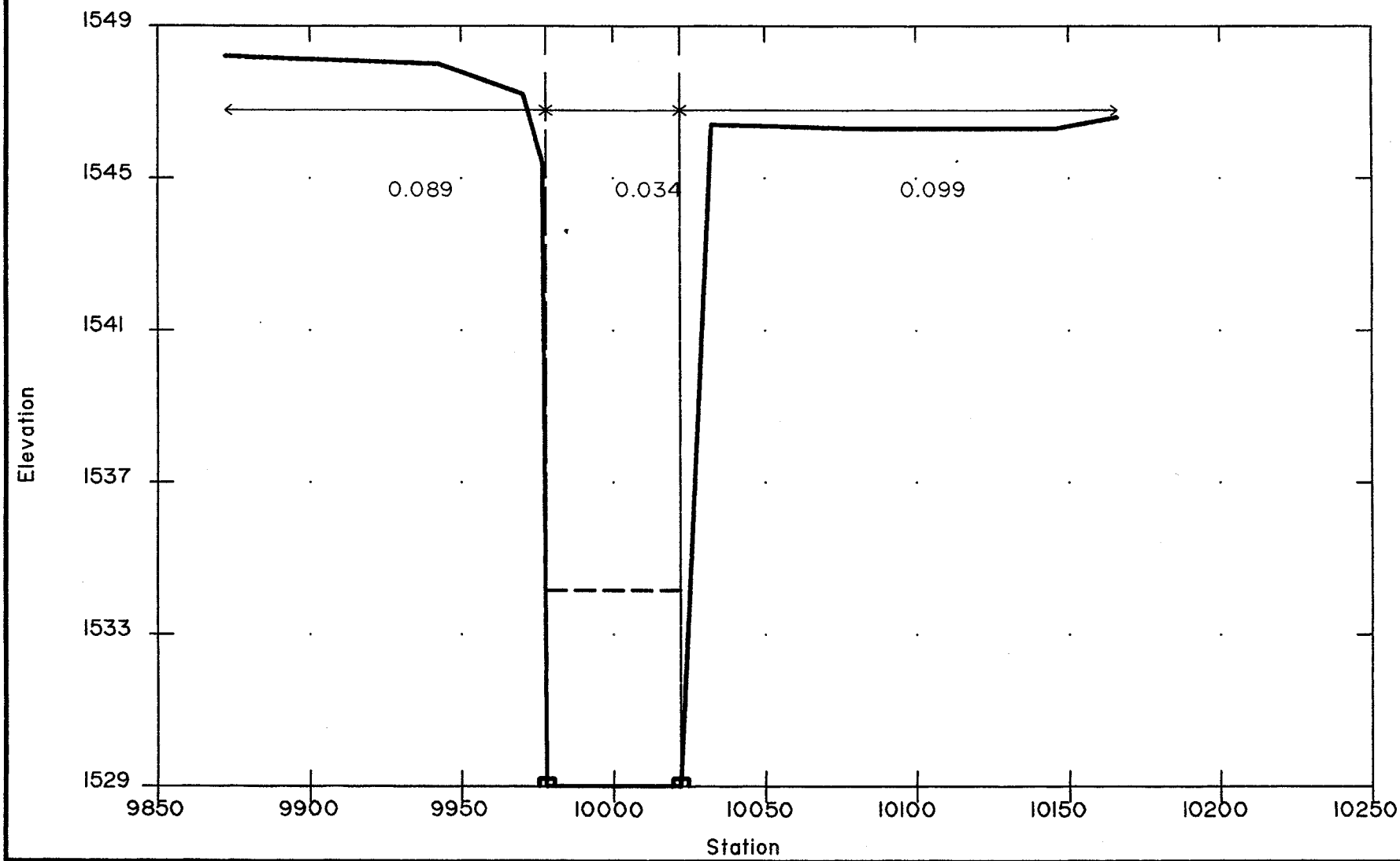
SECTION : 2.65

Fountain Hills FIS
Cereus wash



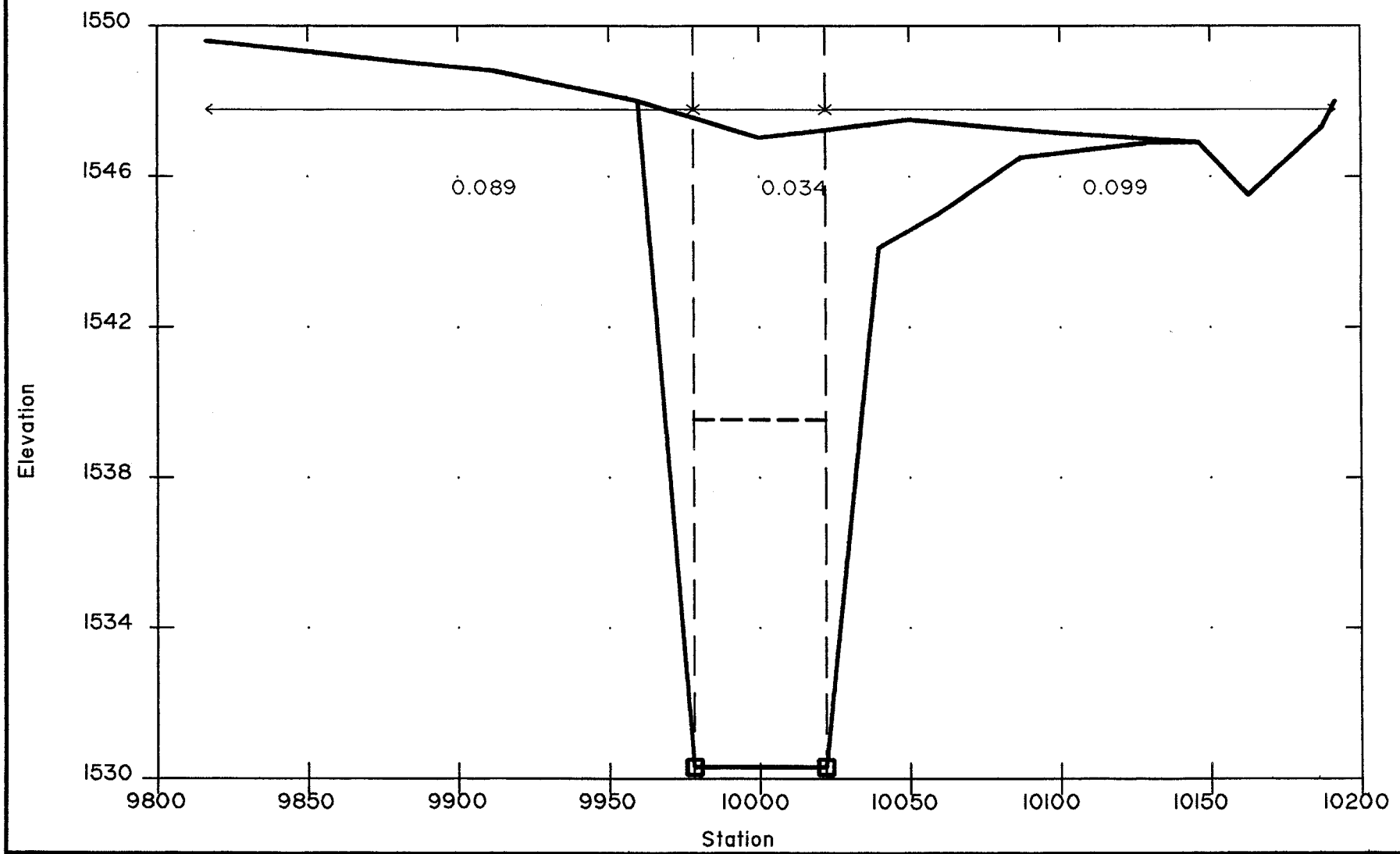
SECTION : 2.68

Fountain Hills FIS
Cereus wash



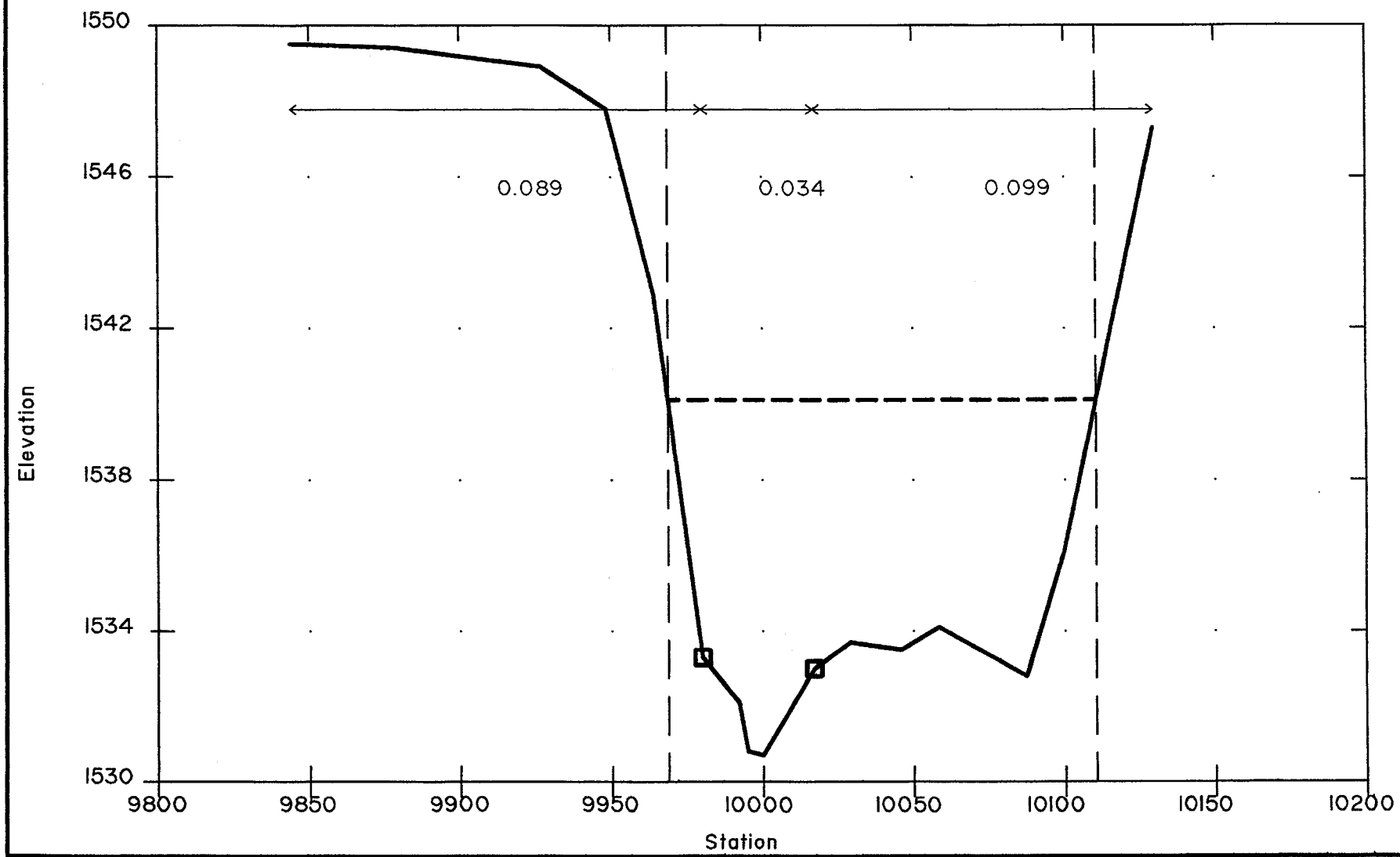
SECTION : 2.70

Fountain Hills FIS
Cereus wash



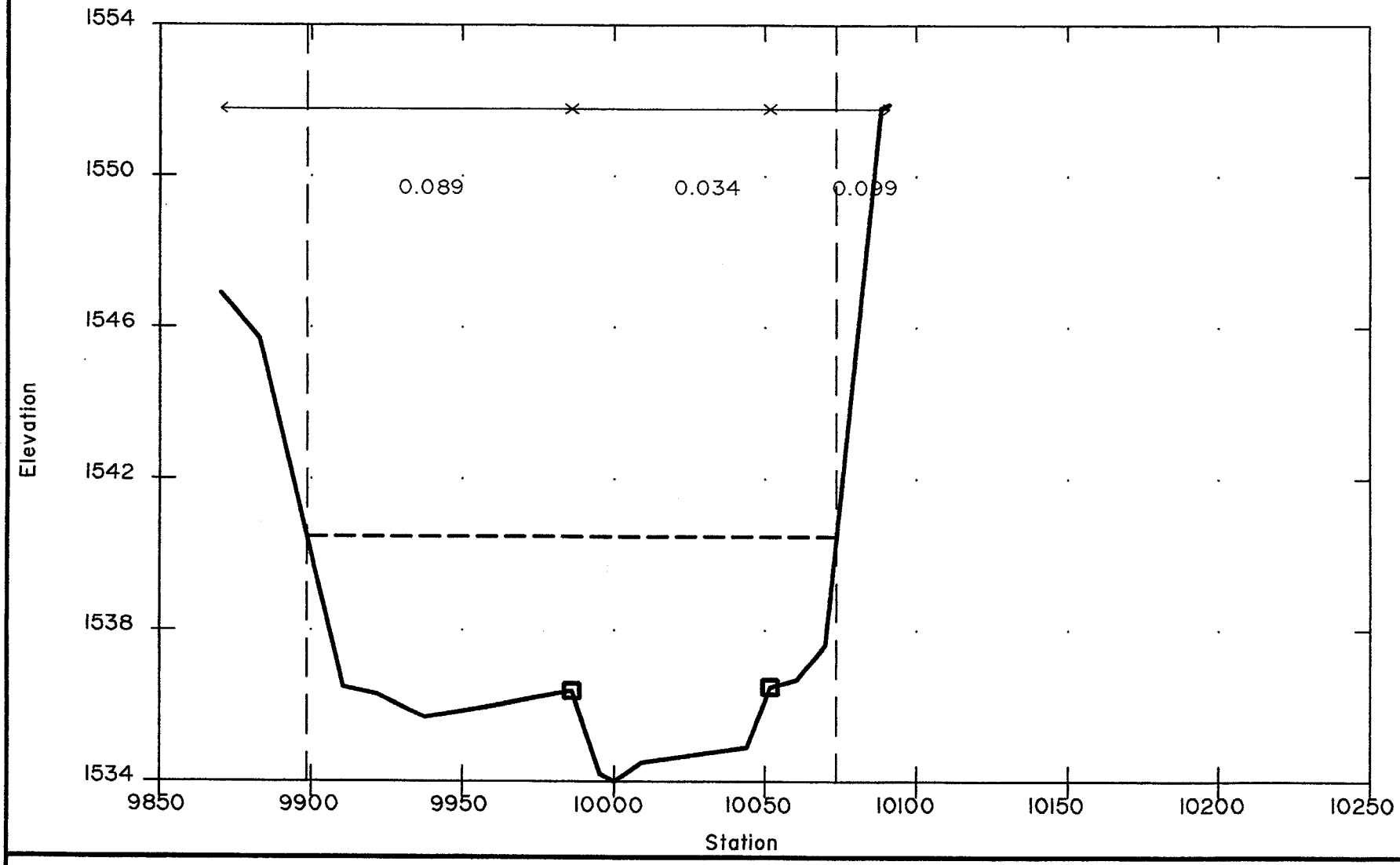
SECTION : 2.73

Fountain Hills FIS
Cereus wash



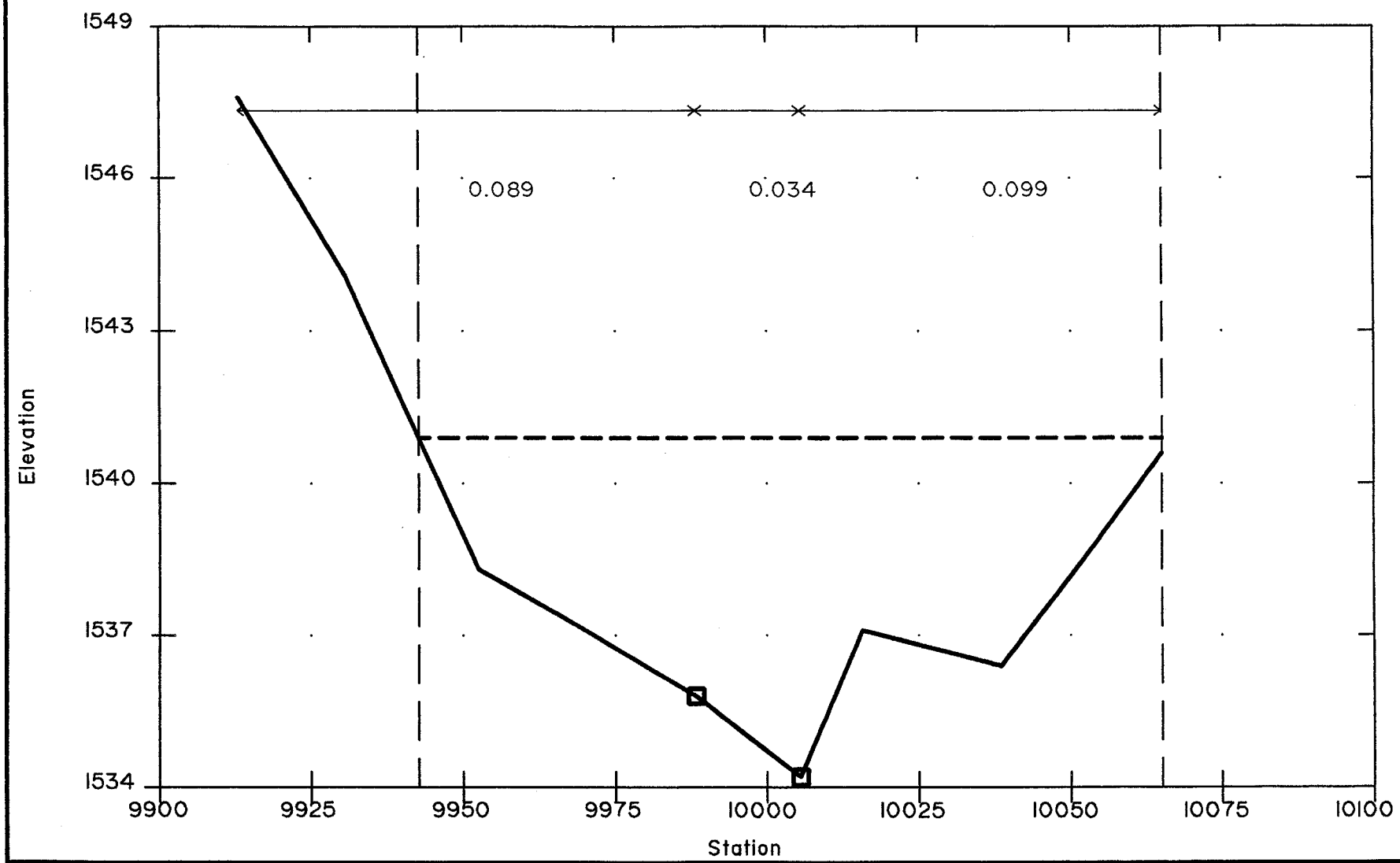
SECTION : 2.74

Fountain Hills FIS
Cereus wash



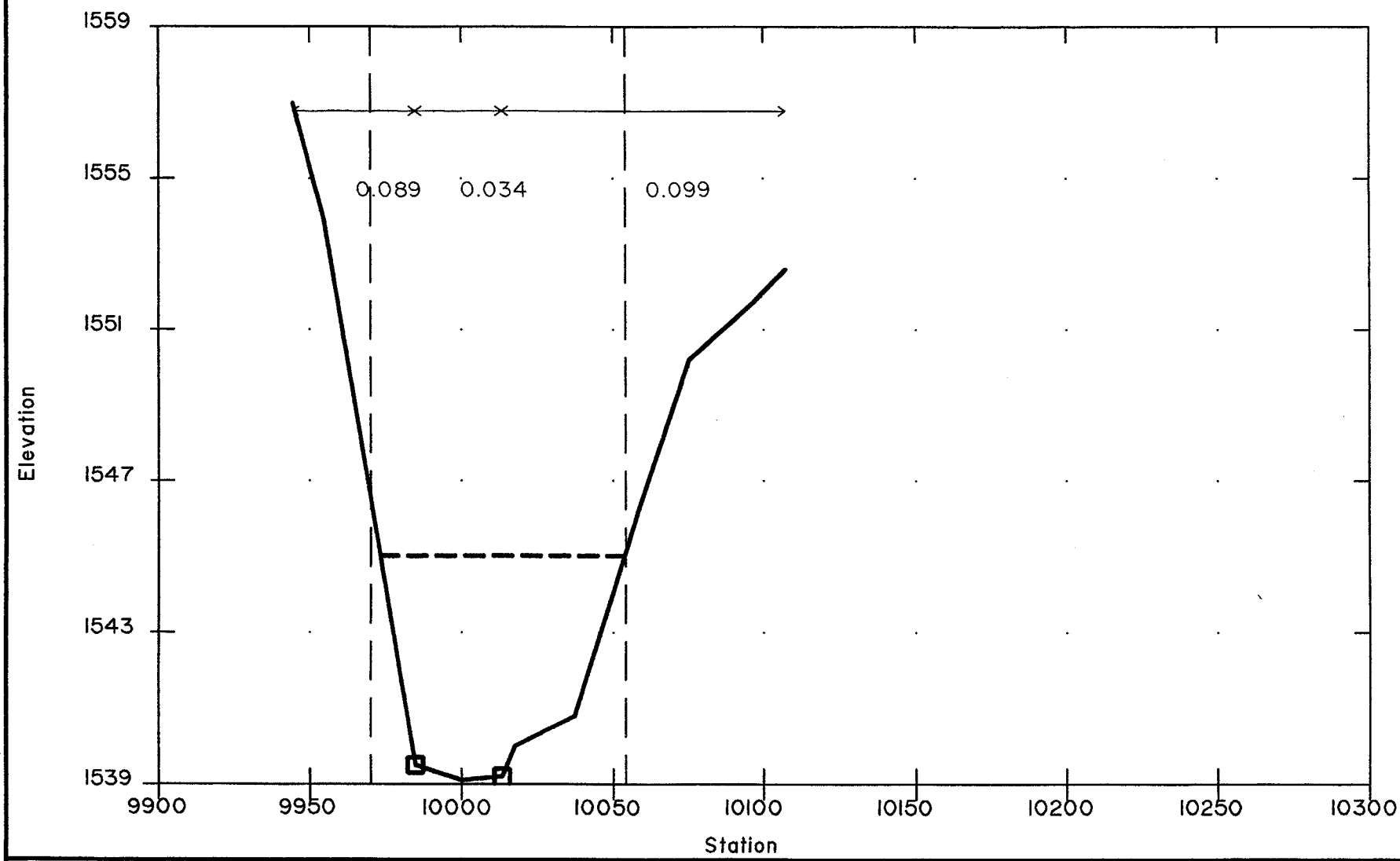
SECTION : 2.78

Fountain Hills FIS
Cereus wash



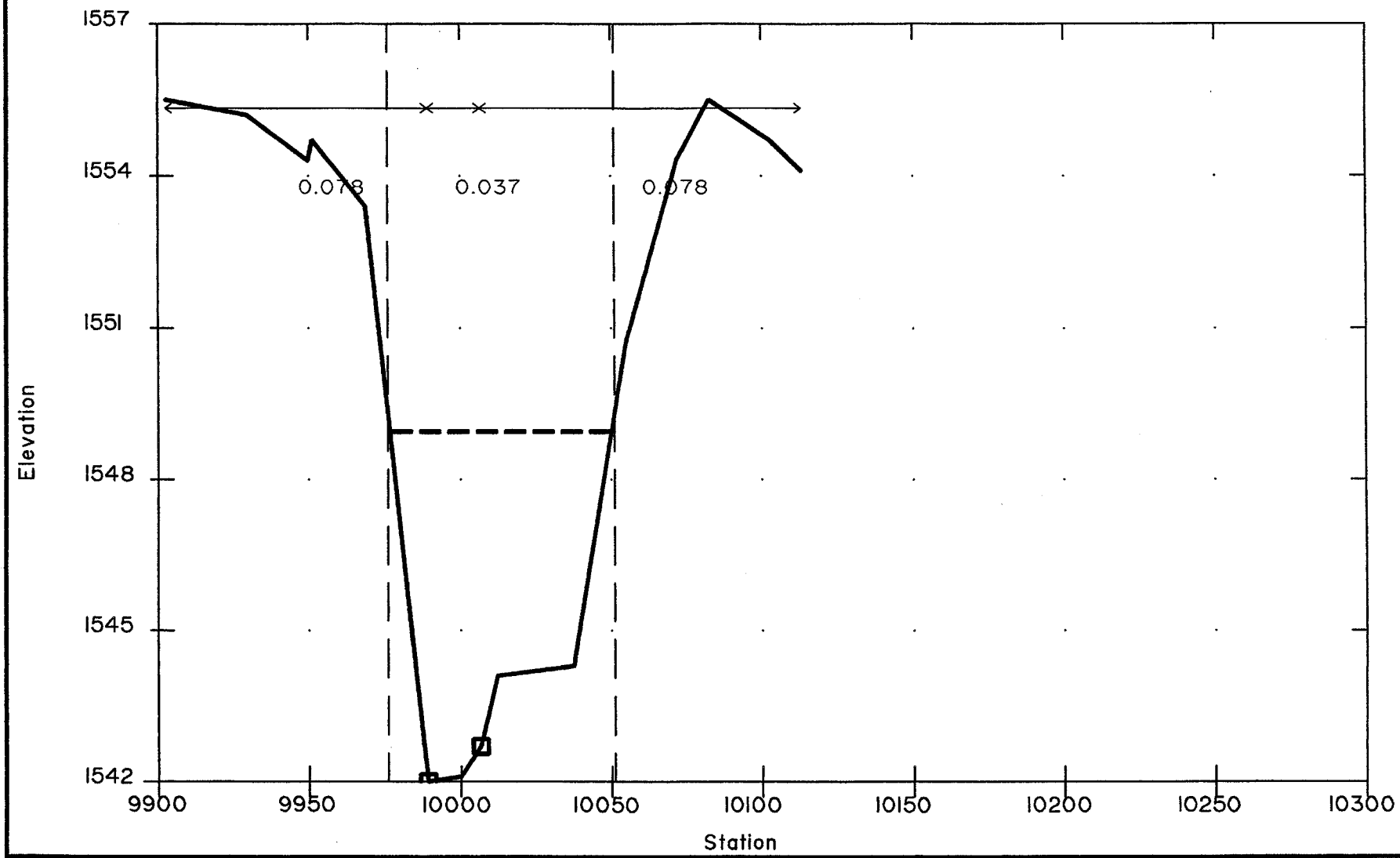
SECTION : 2.80

Fountain Hills FIS
Cereus wash



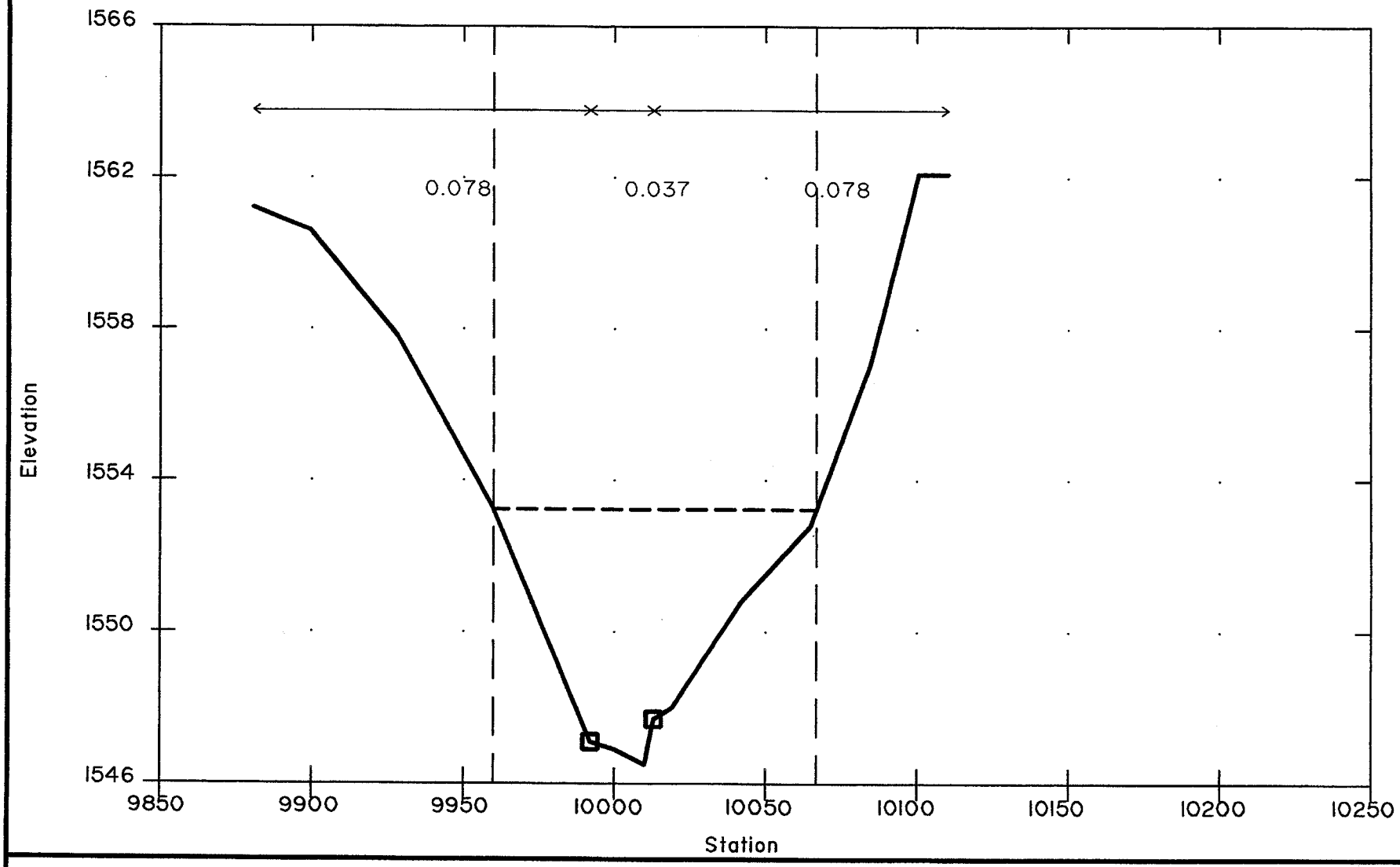
SECTION : 2.88

Fountain Hills FIS
Cereus wash



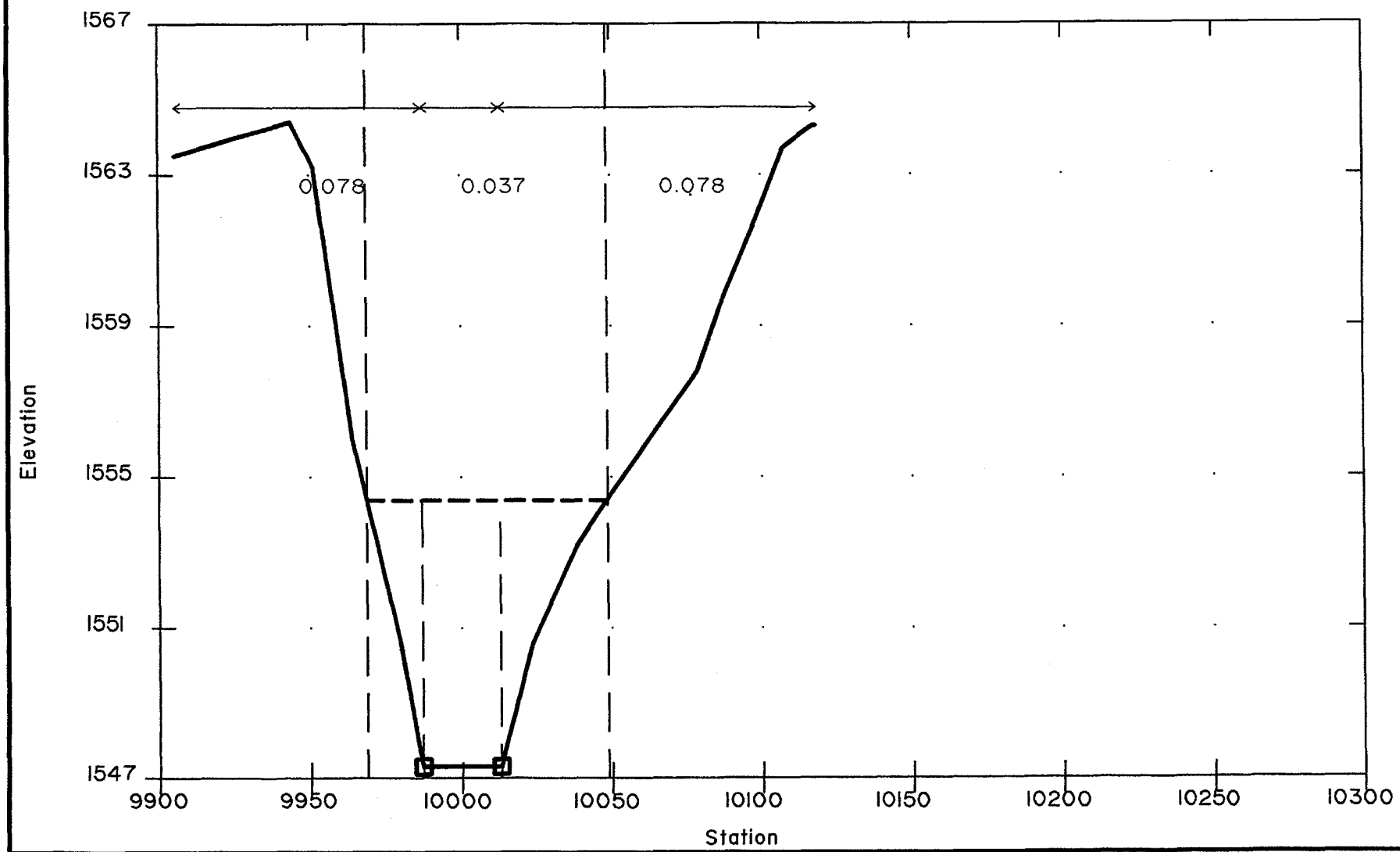
SECTION : 2.94

Fountain Hills FIS
Cereus wash



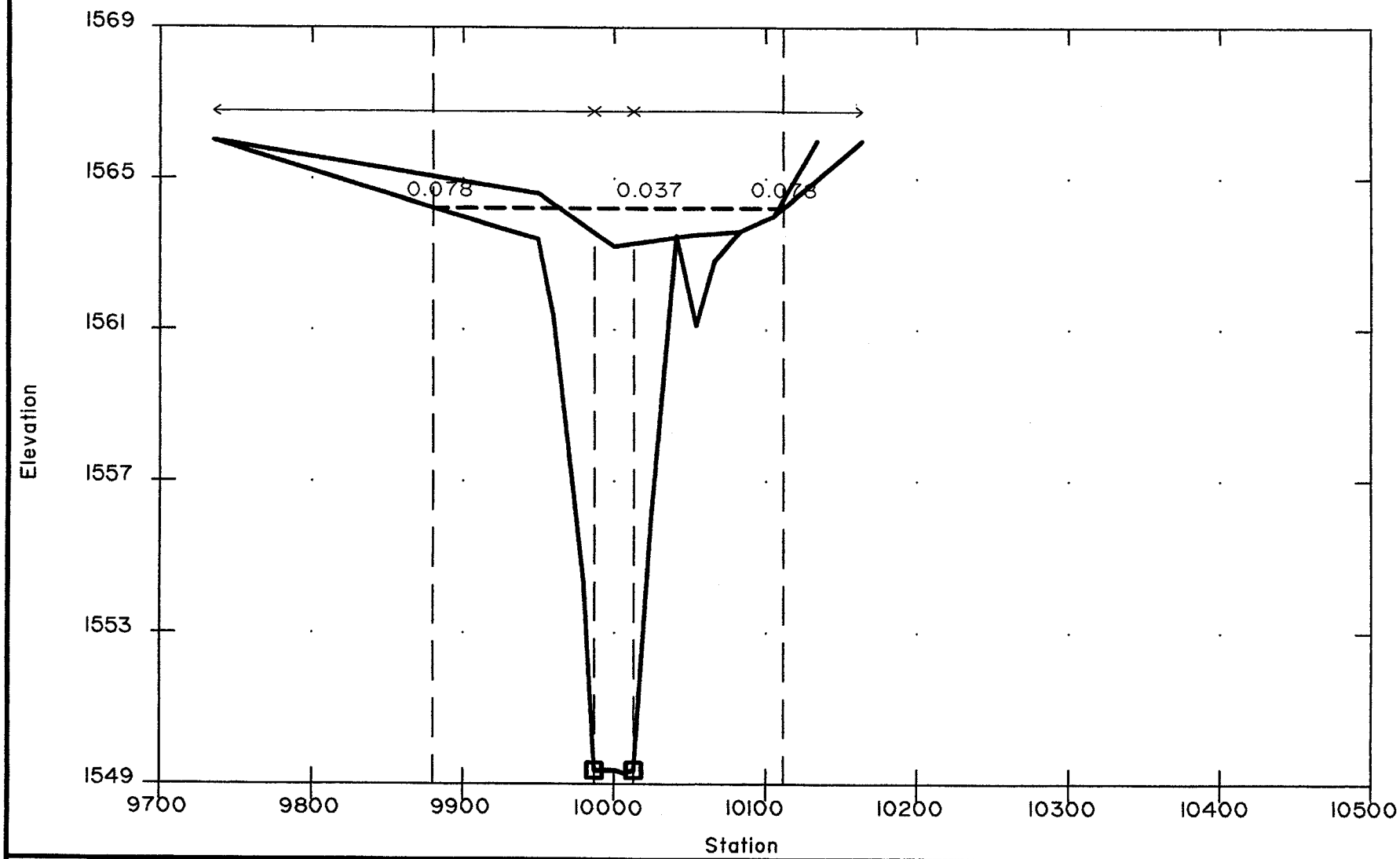
SECTION : 3.00

Fountain Hills FIS
Cereus wash



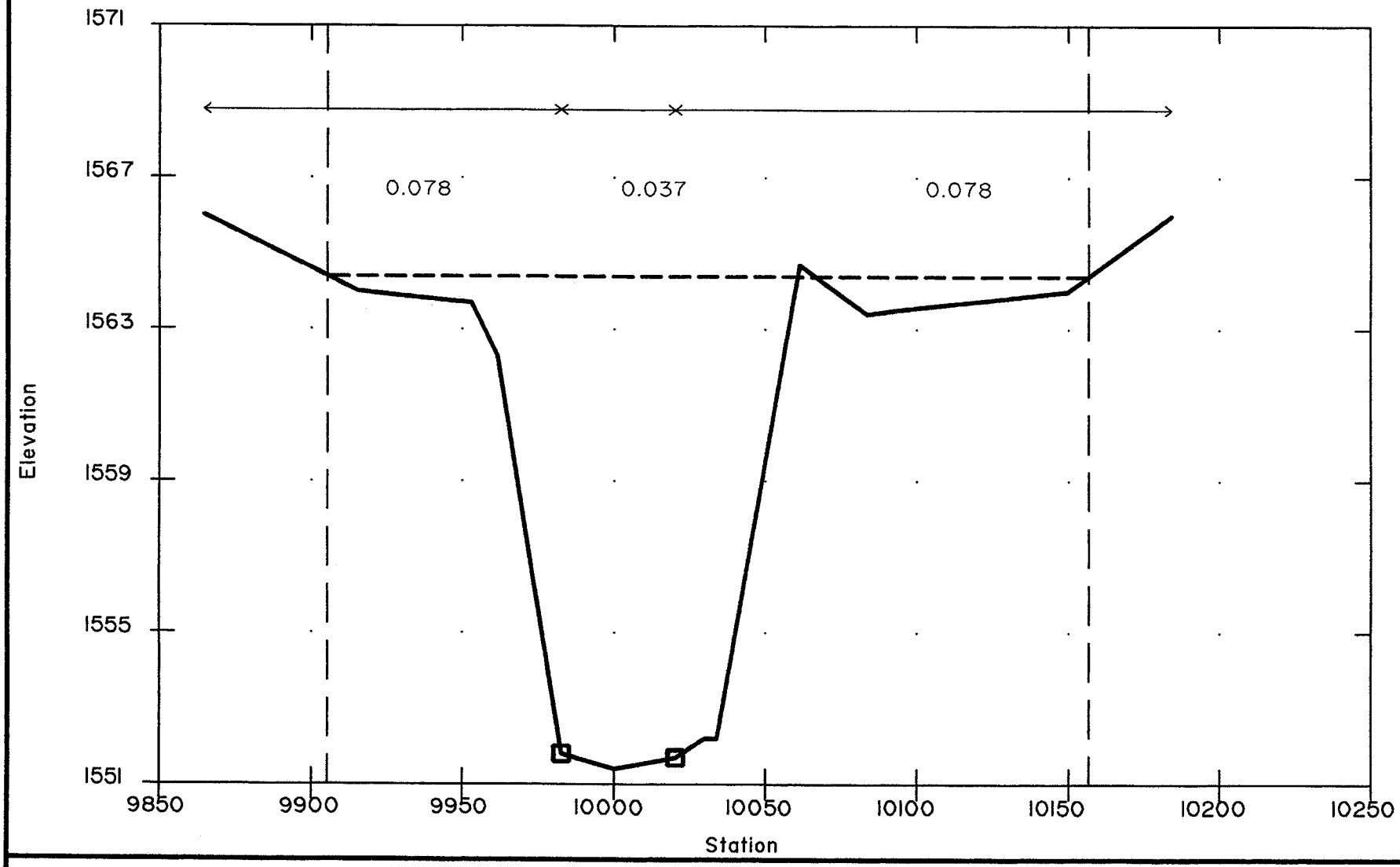
SECTION : 3.01

Fountain Hills FIS
Cereus wash



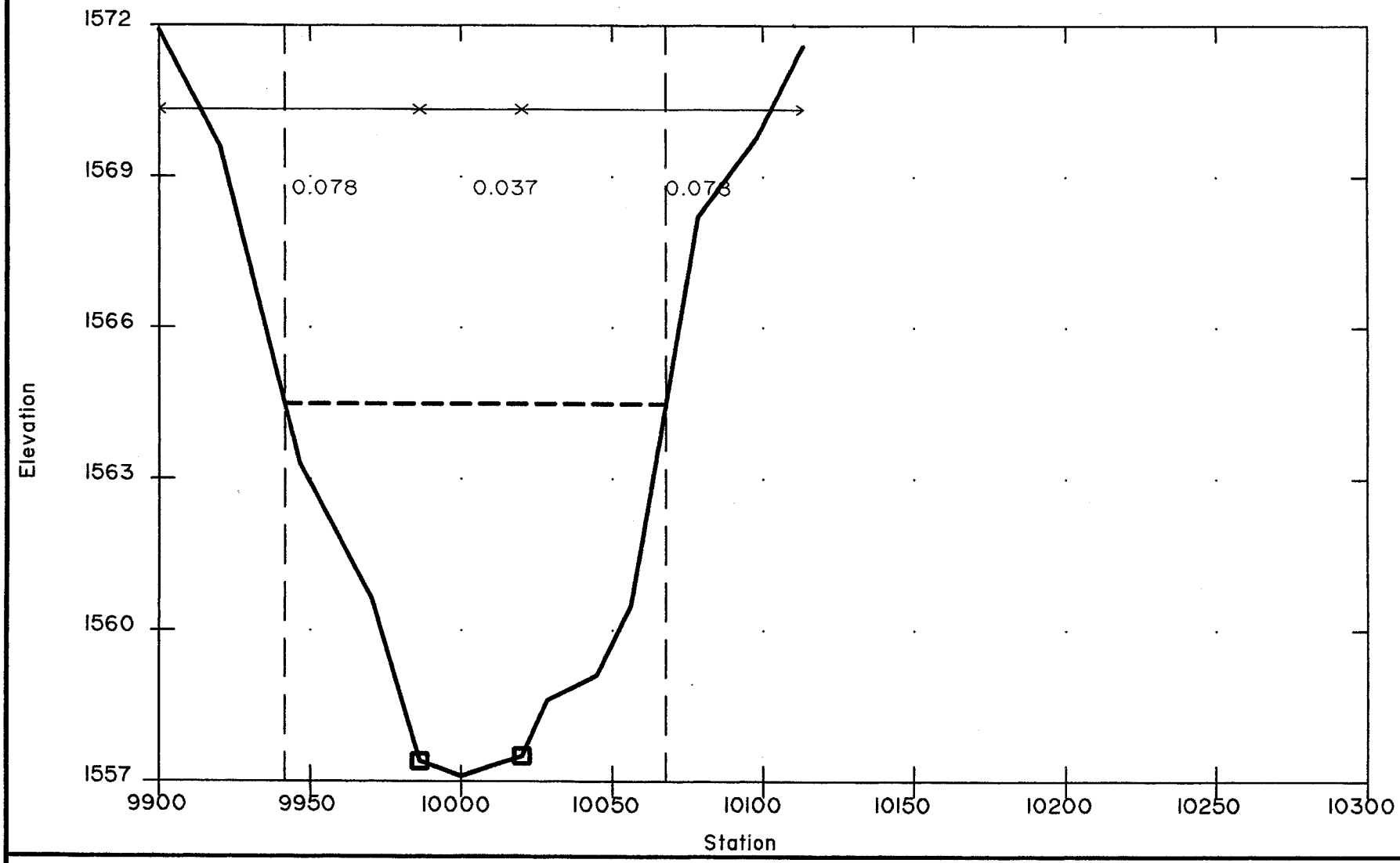
SECTION : 3.04

Fountain Hills FIS
Cereus wash



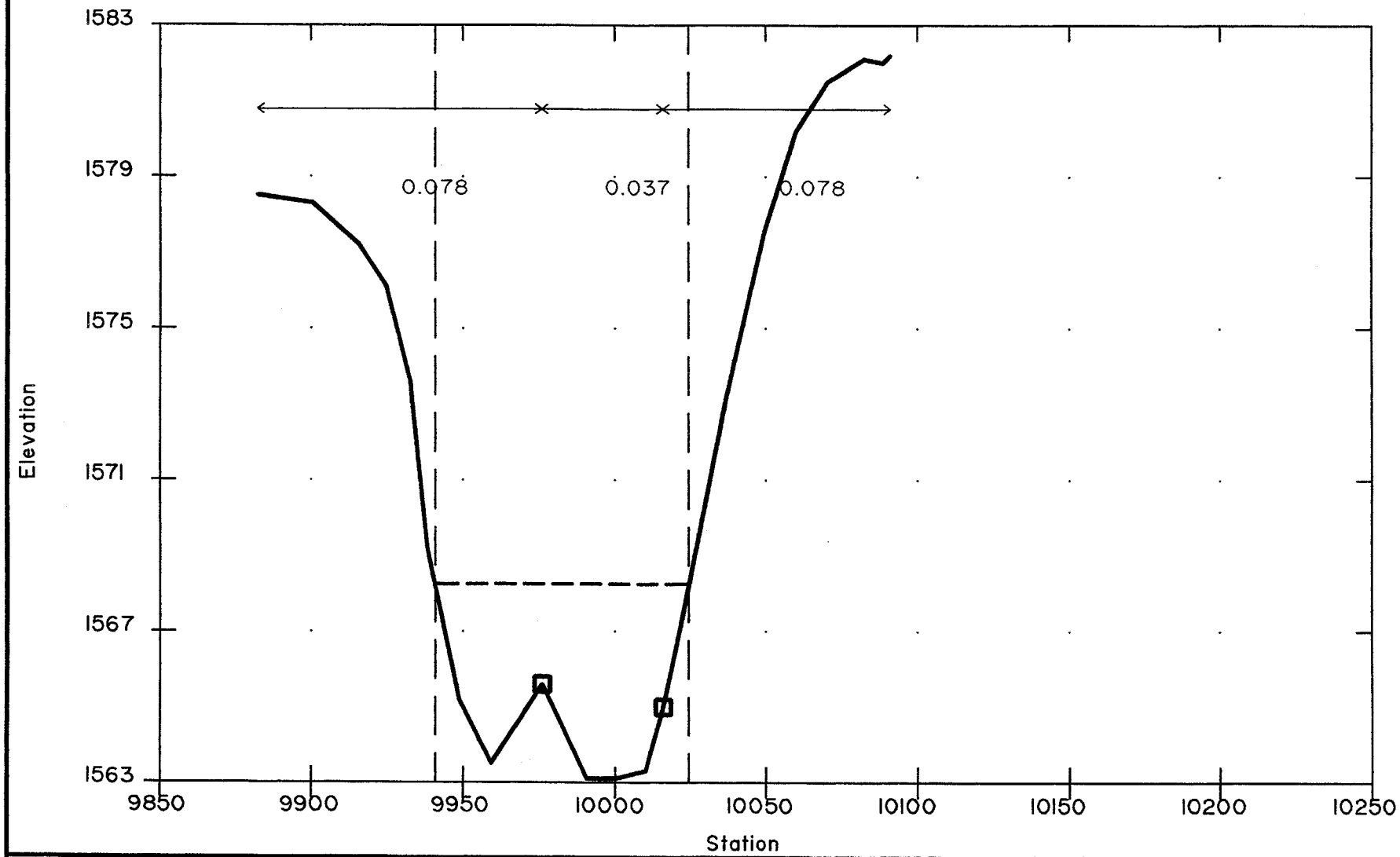
SECTION : 3.05

Fountain Hills FIS
Cereus wash



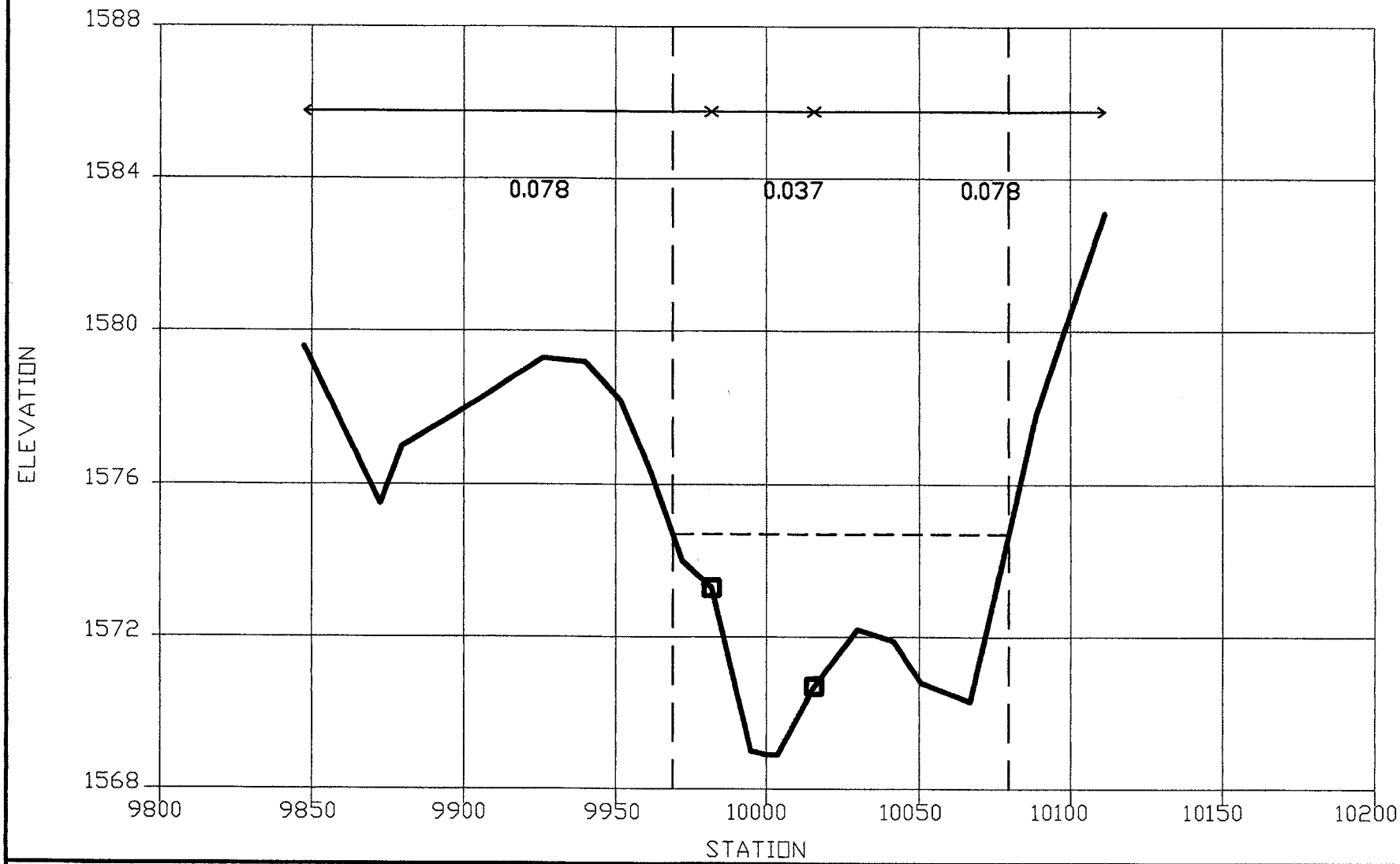
SECTION : 3.14

Fountain Hills FIS
Cereus wash



SECTION : 3.23

Fountain Hills FIS
Cereus wash

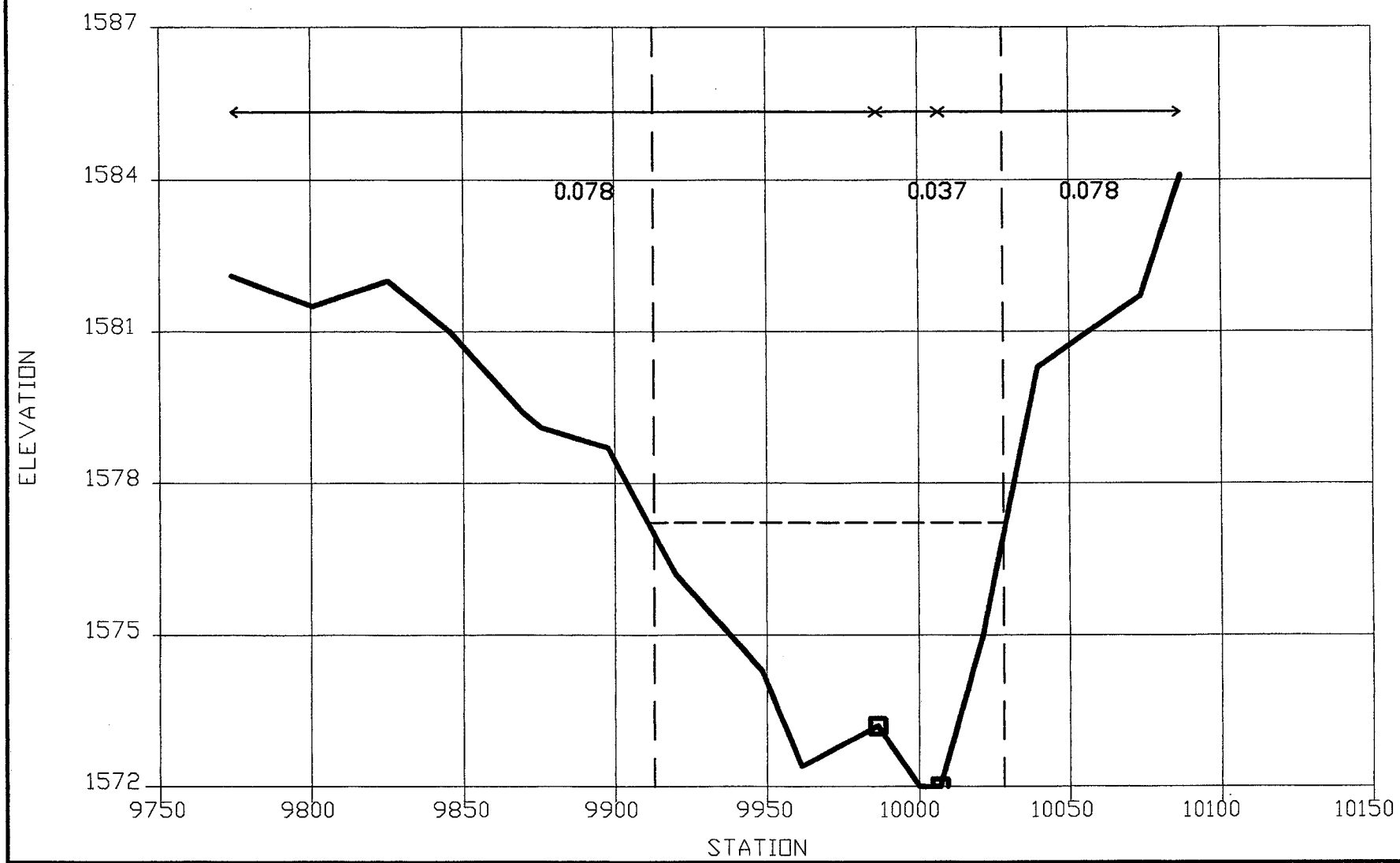


SECTION : 3.32

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

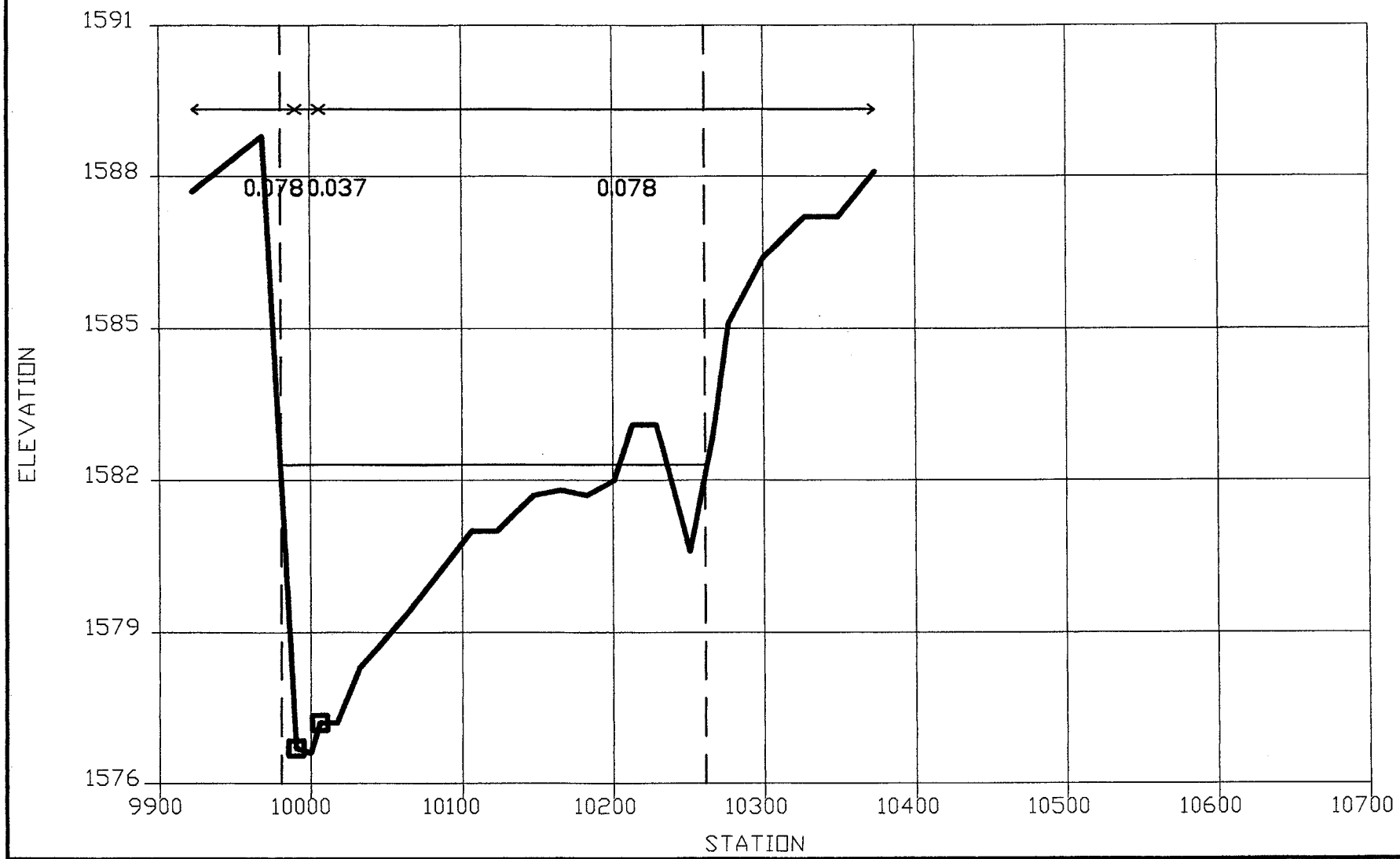


SECTION : 3.36

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

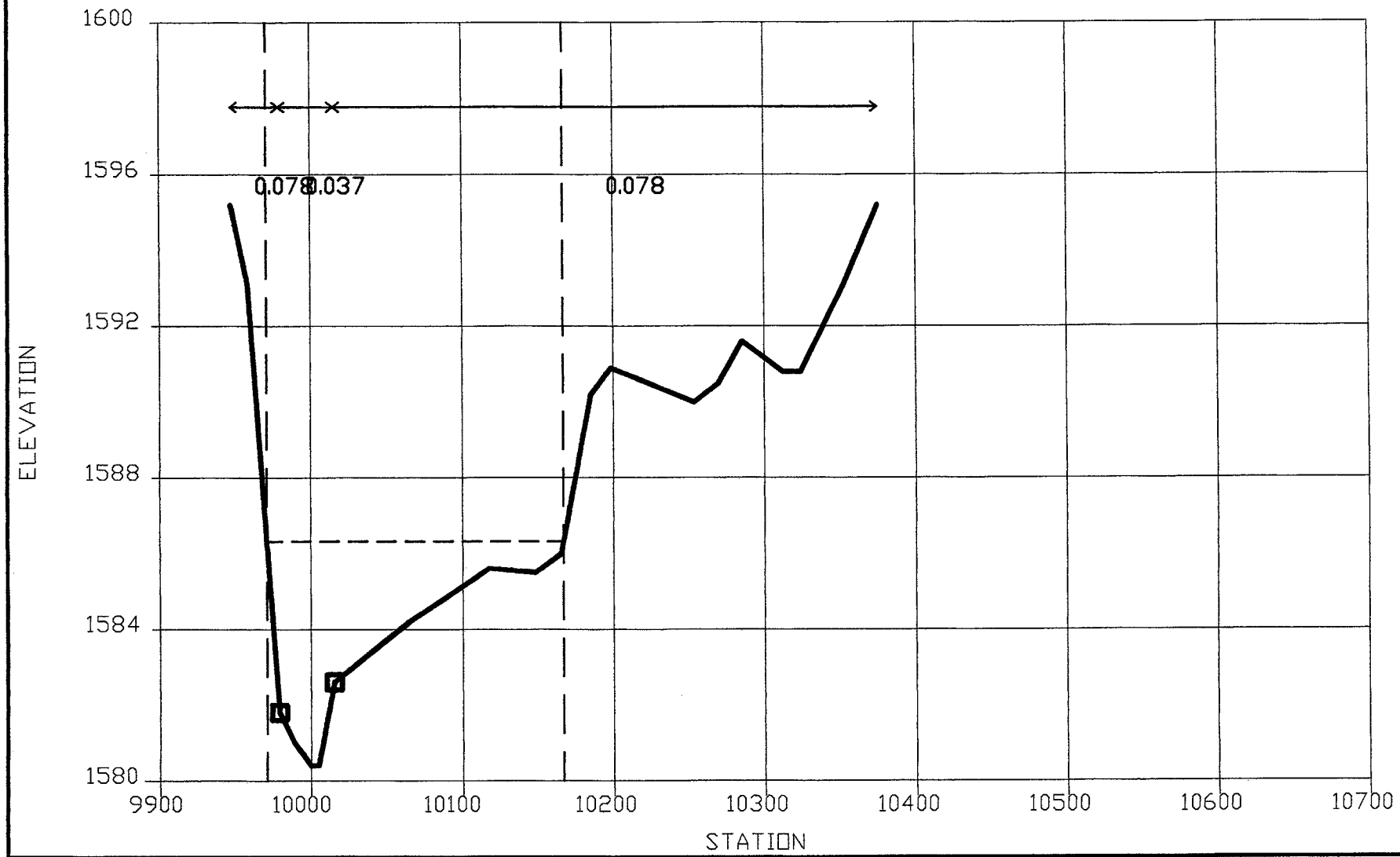


SECTION : 3.42

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

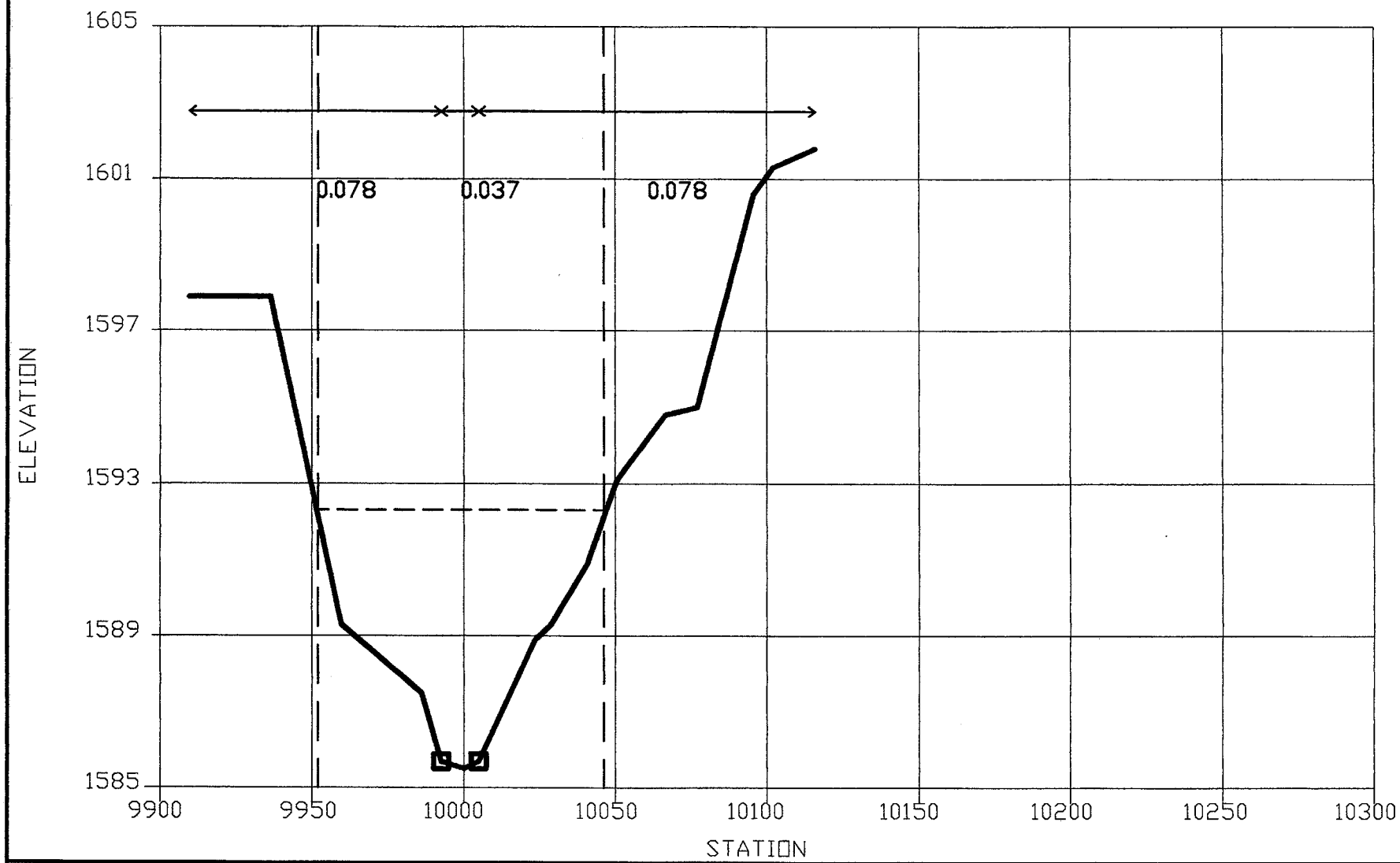


SECTION : 3.50

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

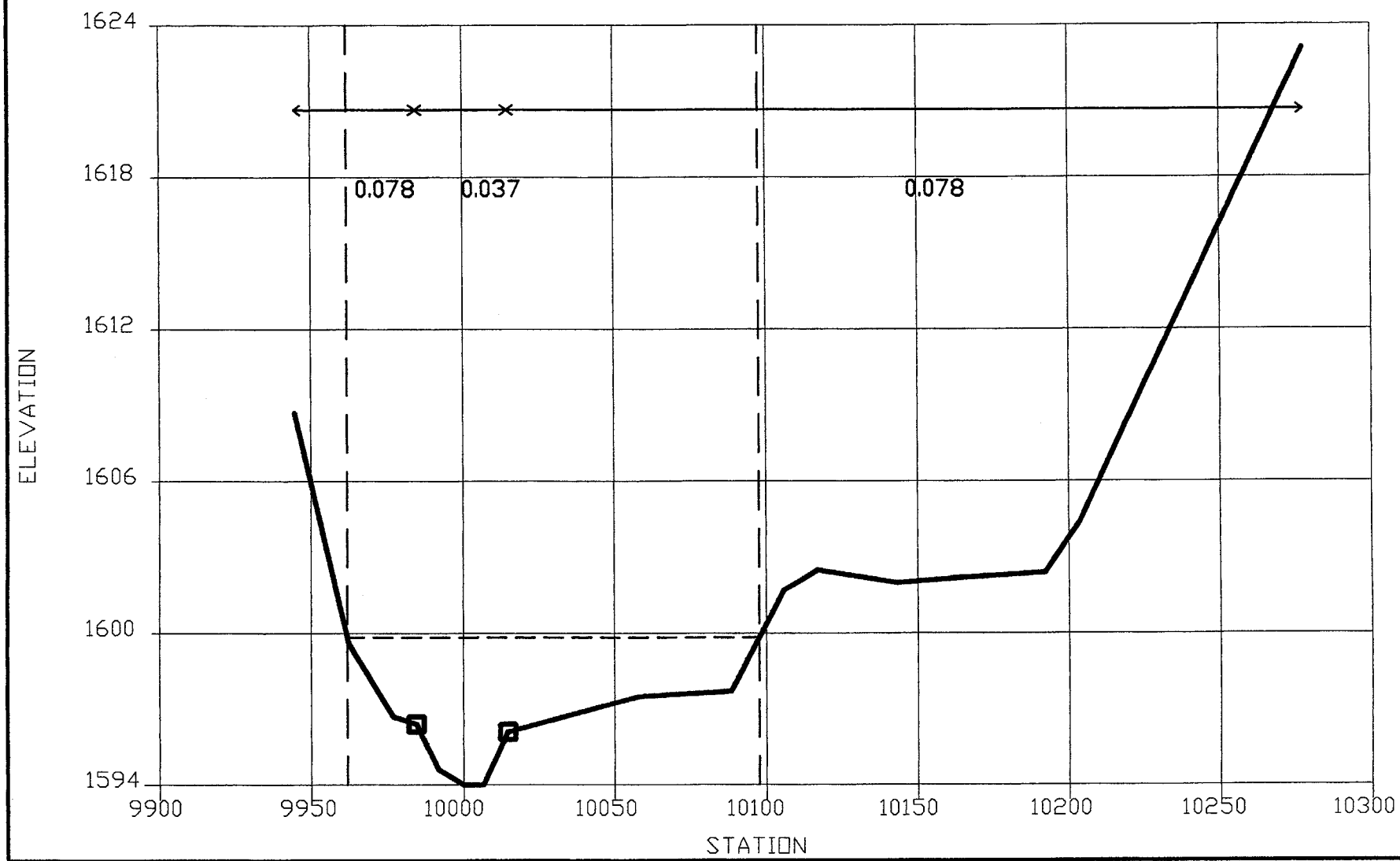


SECTION : 3.59

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

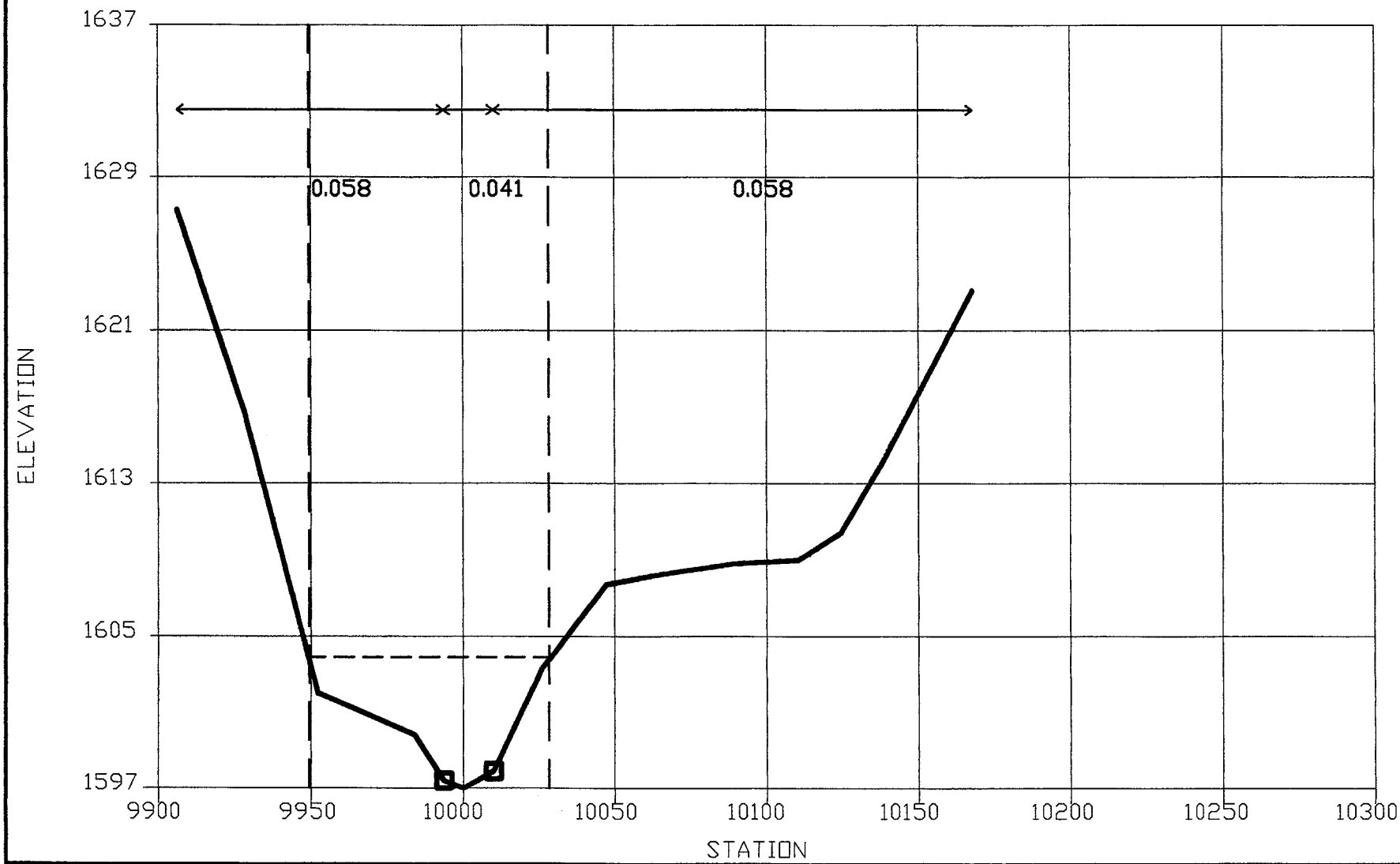


SECTION : 3.69

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

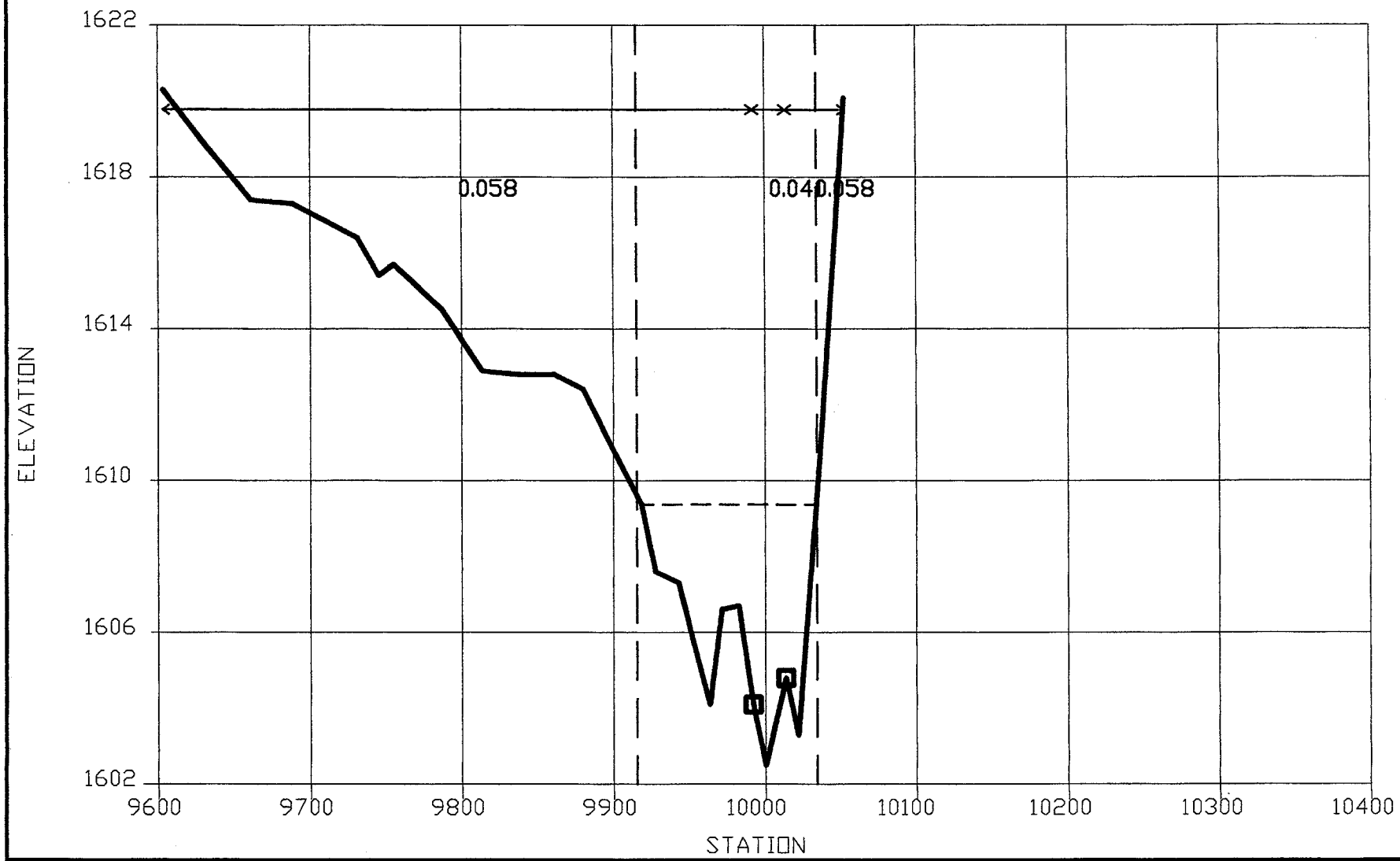


SECTION : 3.74

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

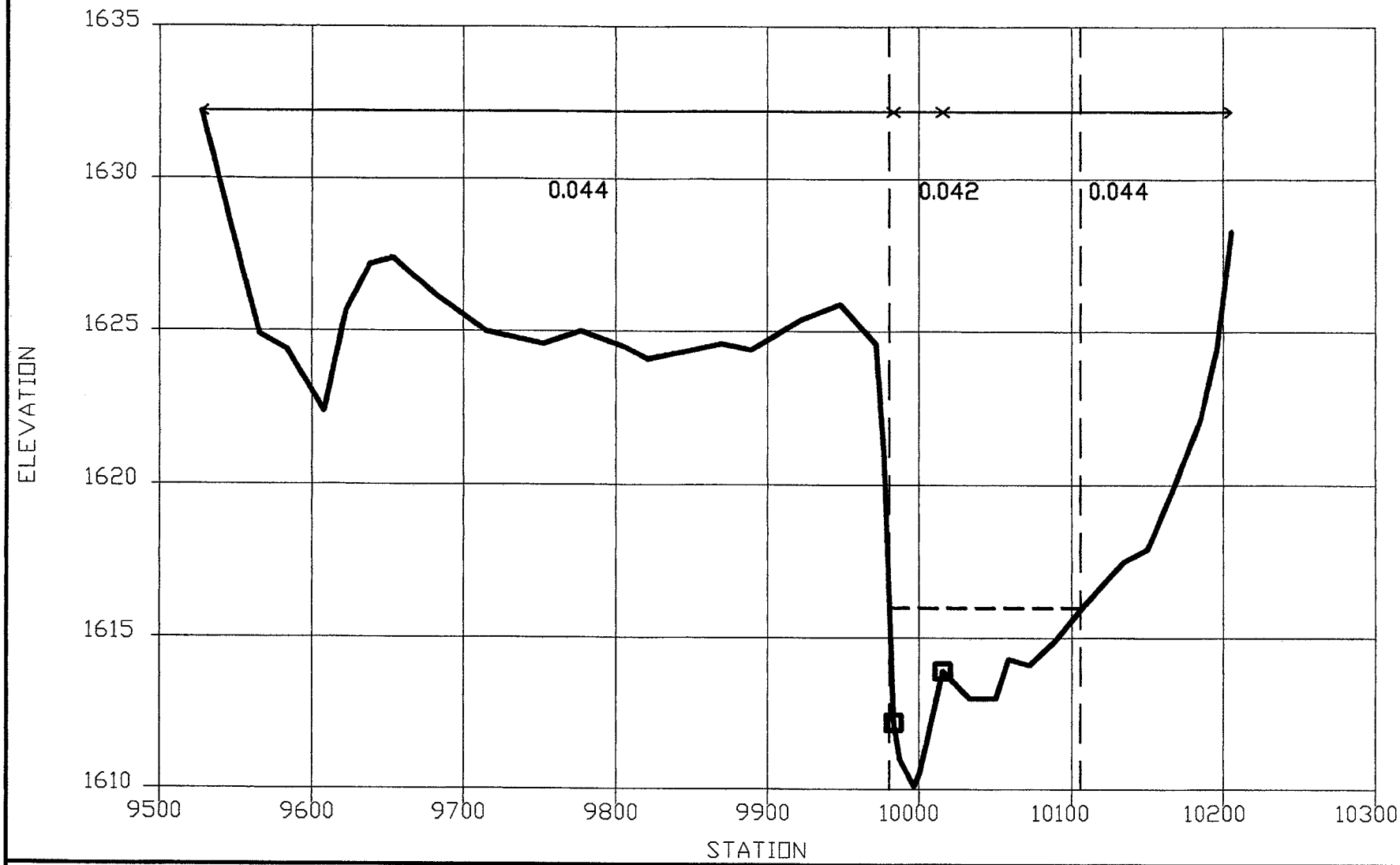


SECTION : 3.82

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

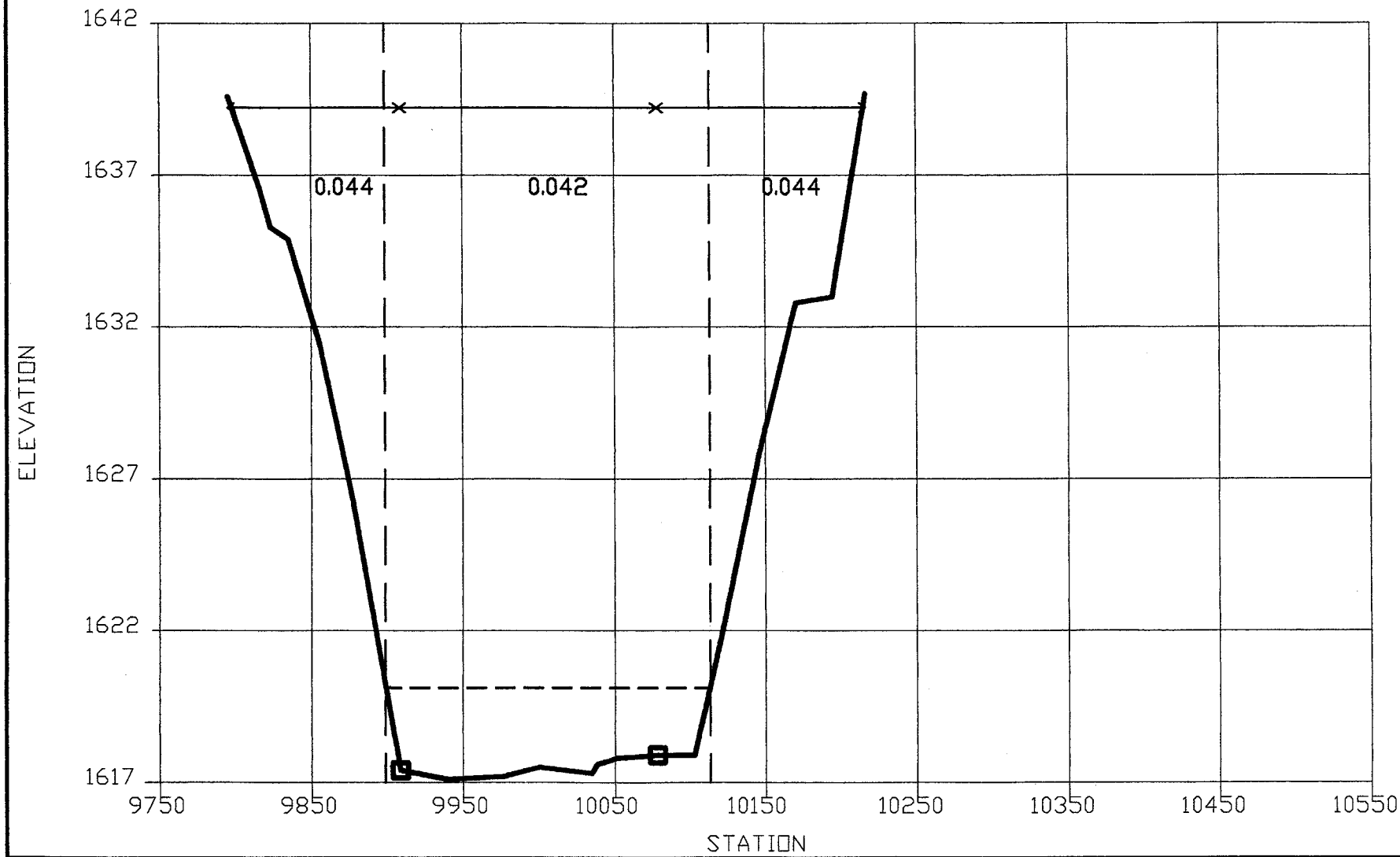


SECTION : 3.93

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

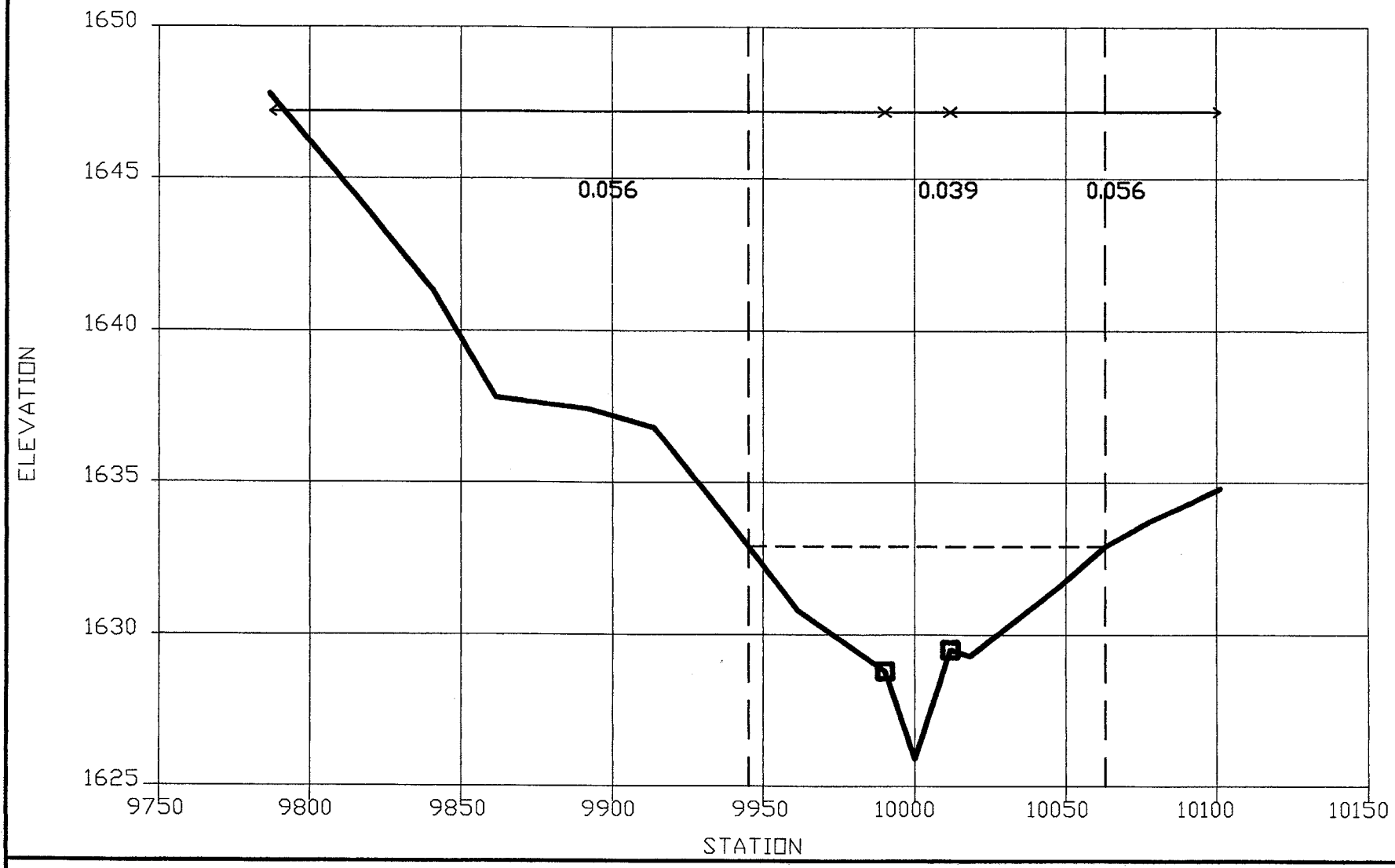


SECTION : 4.00

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

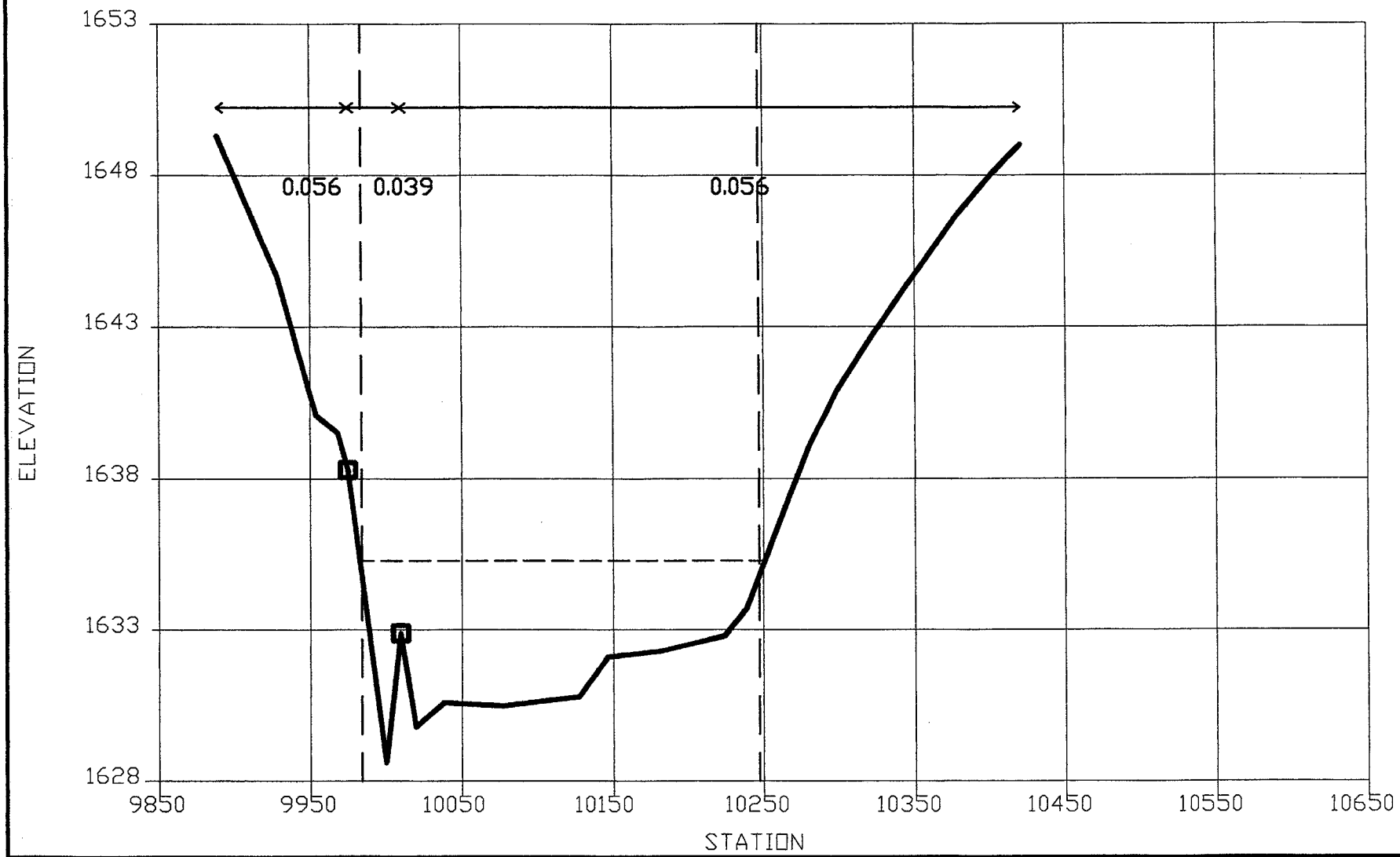


SECTION : 4.06

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

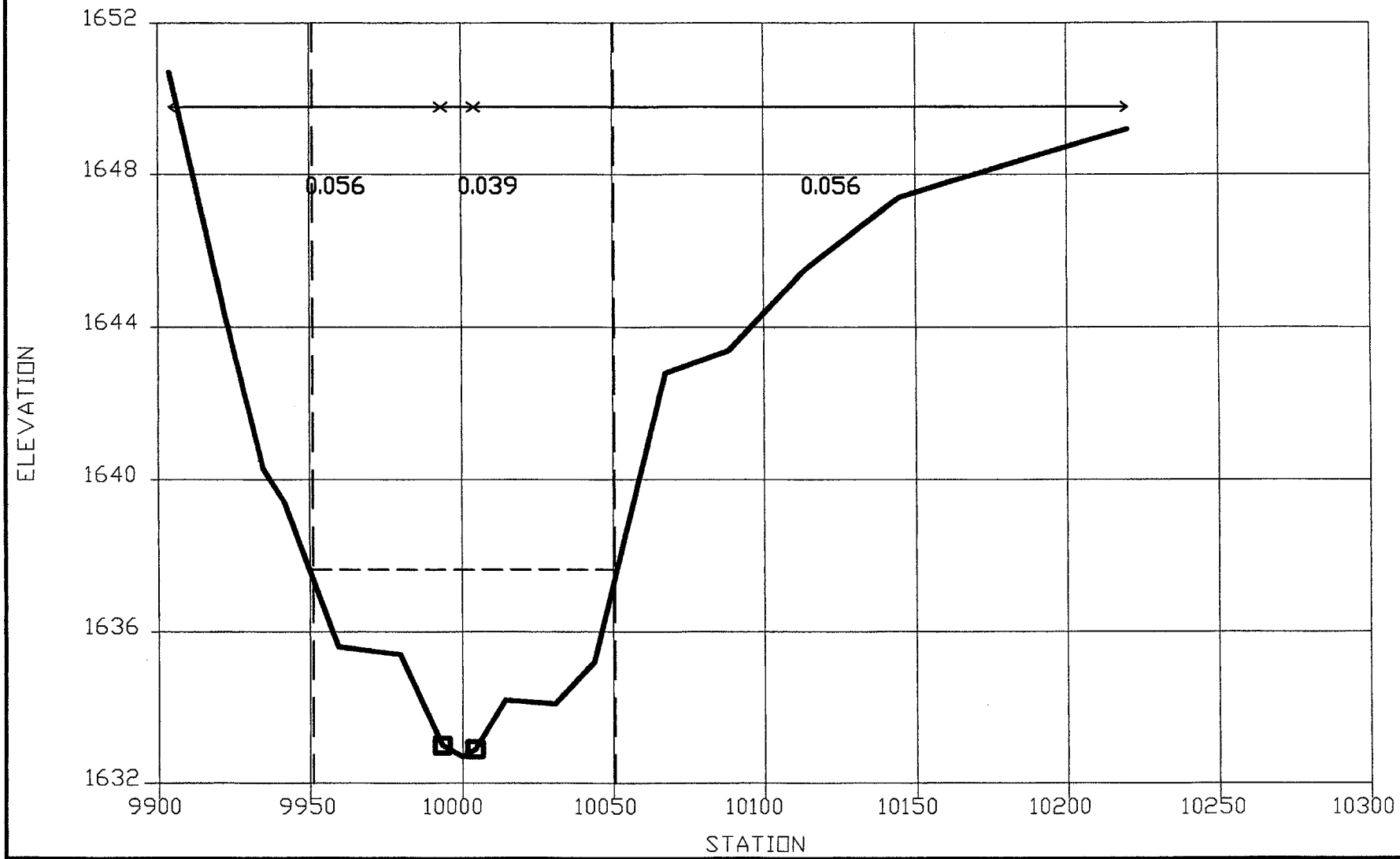


SECTION : 4.10

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

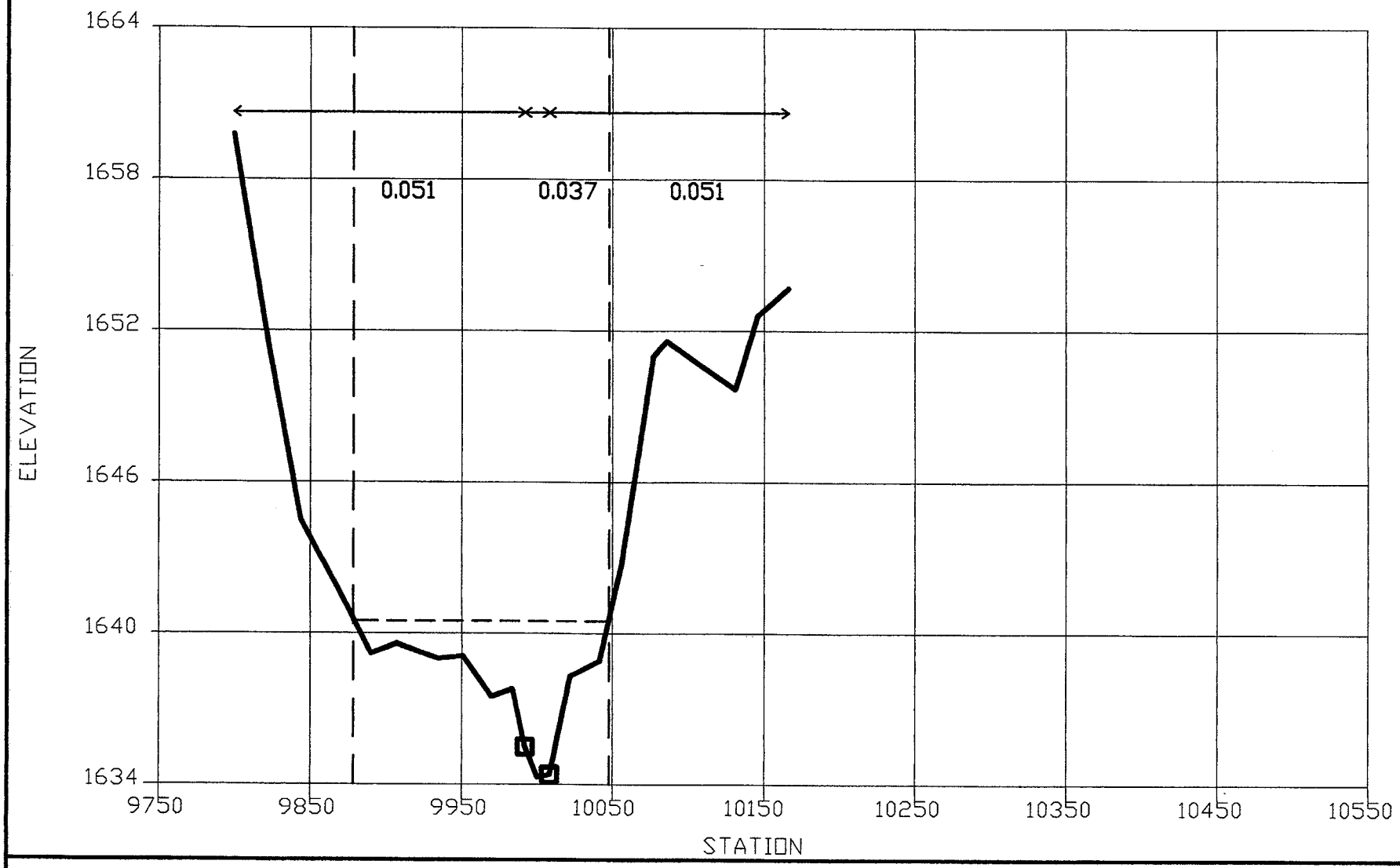


SECTION : 4.19

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

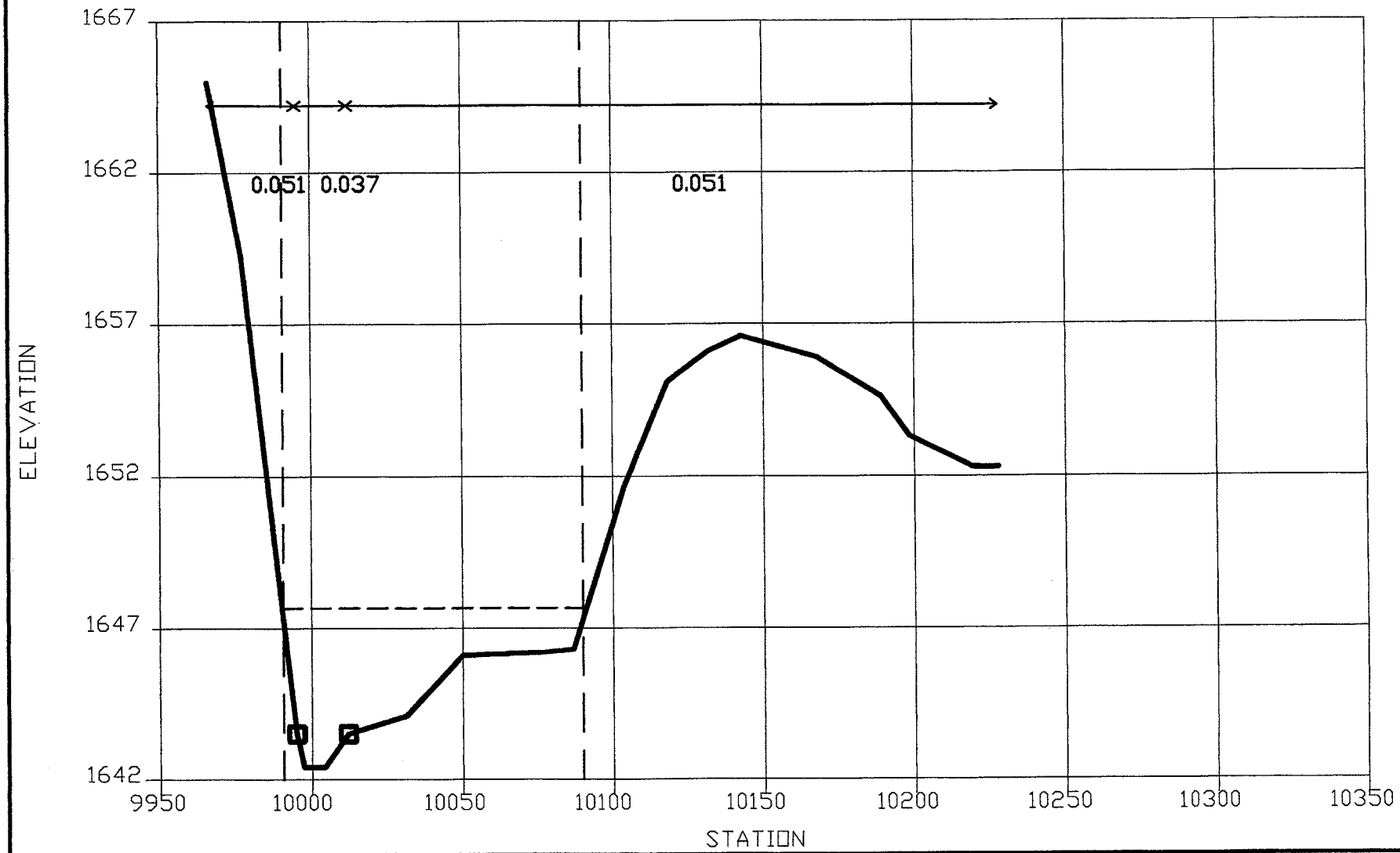


SECTION : 4.23

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

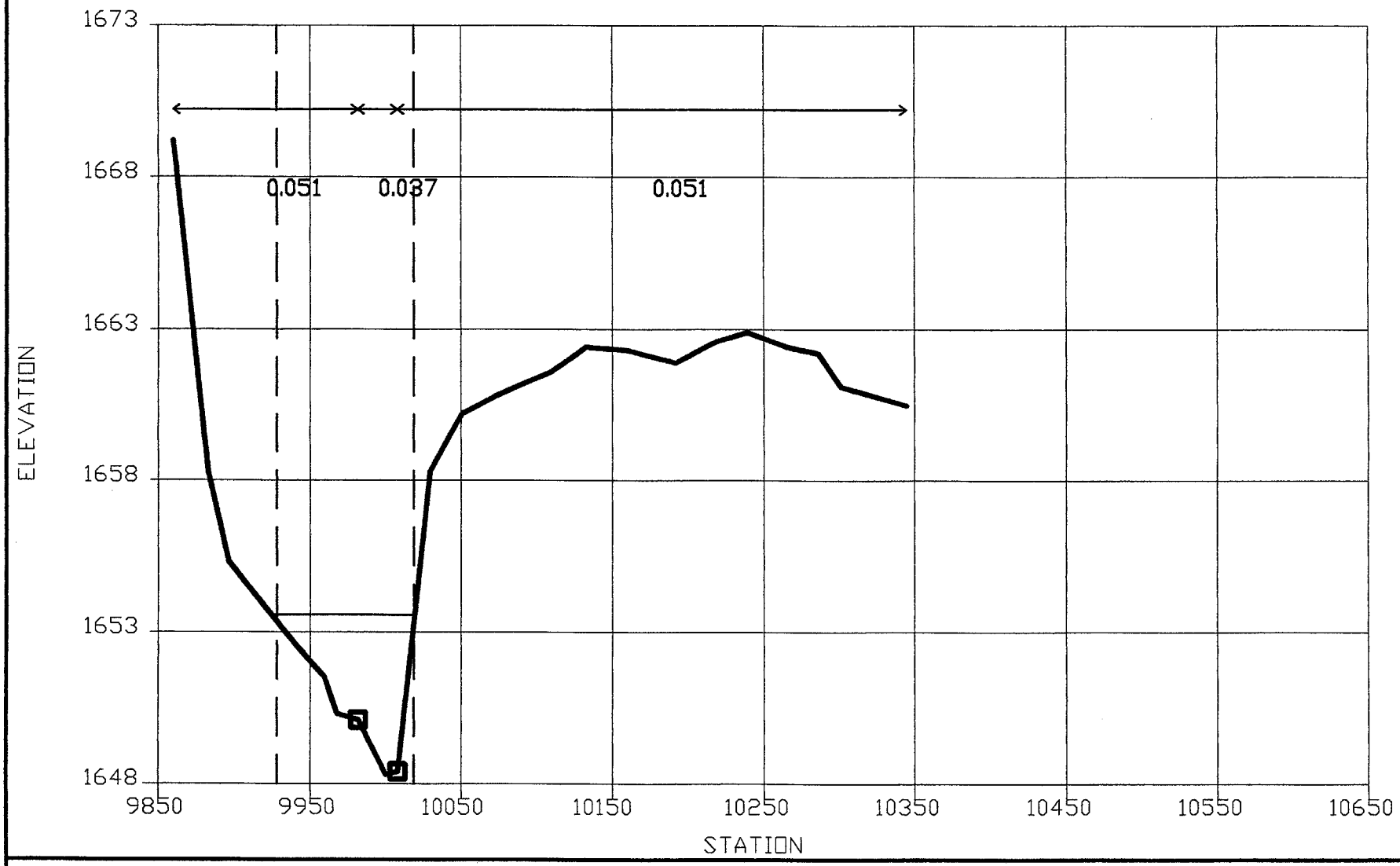


SECTION : 4.32

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

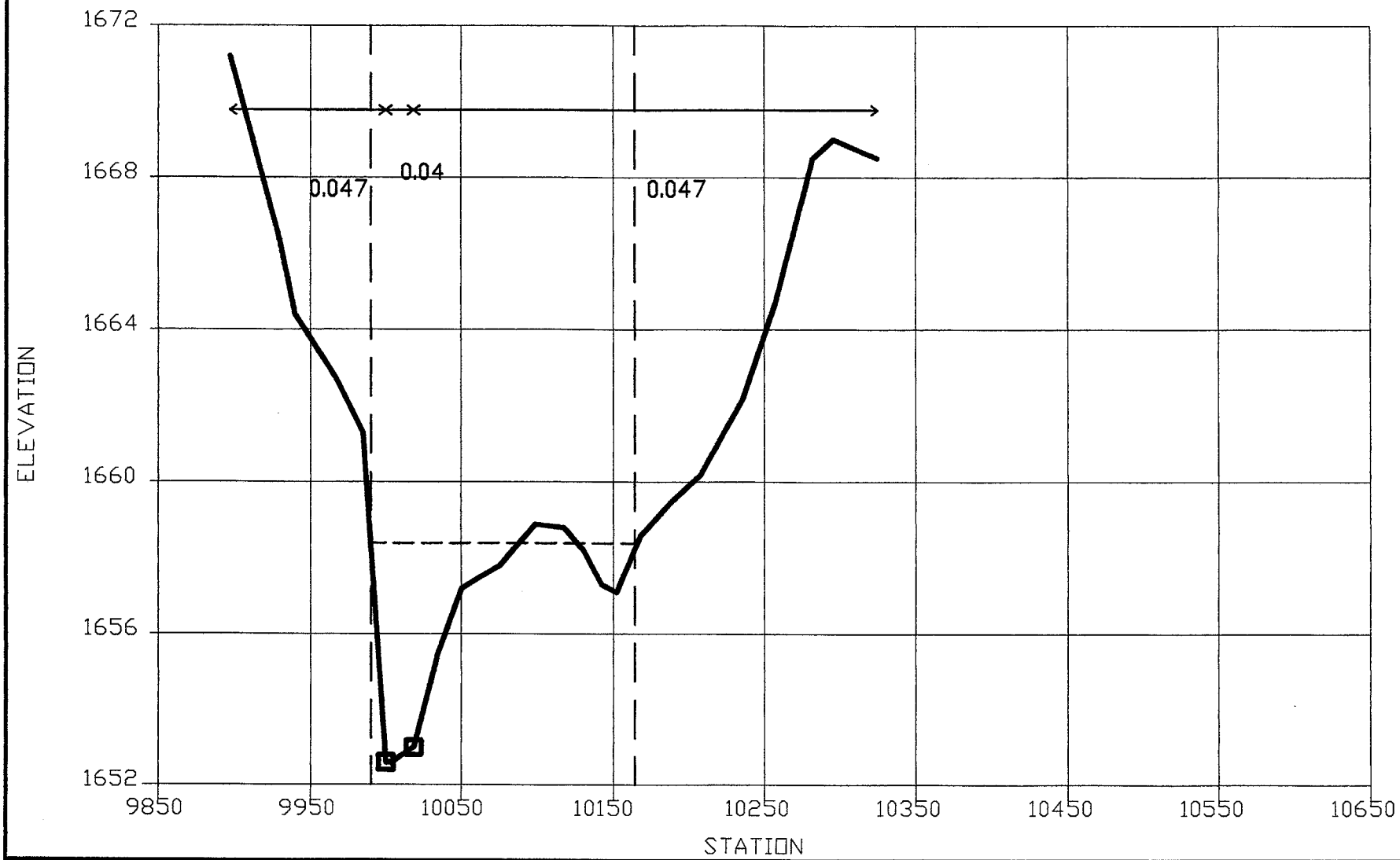


SECTION : 4.39

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

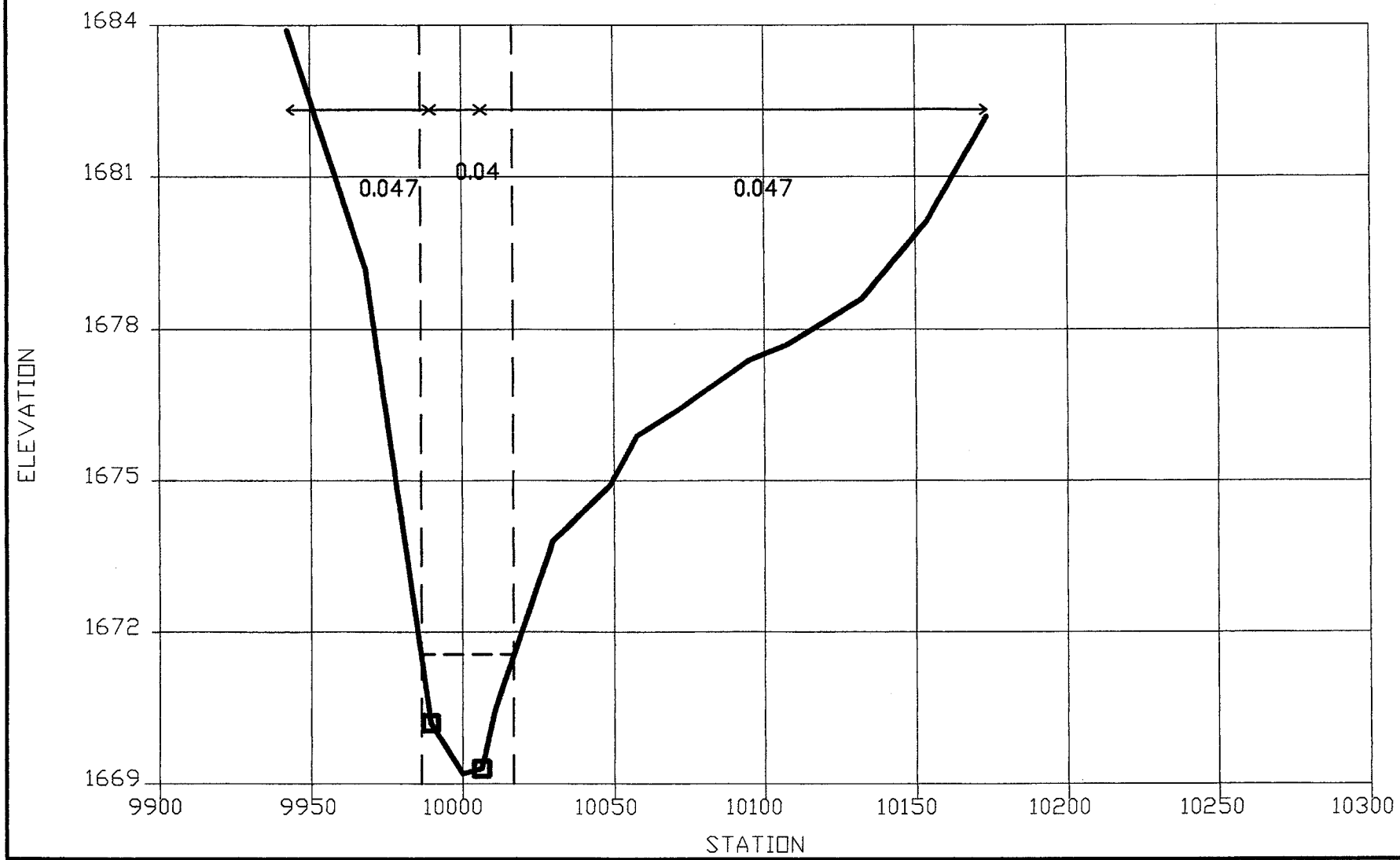


SECTION : 4.44

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

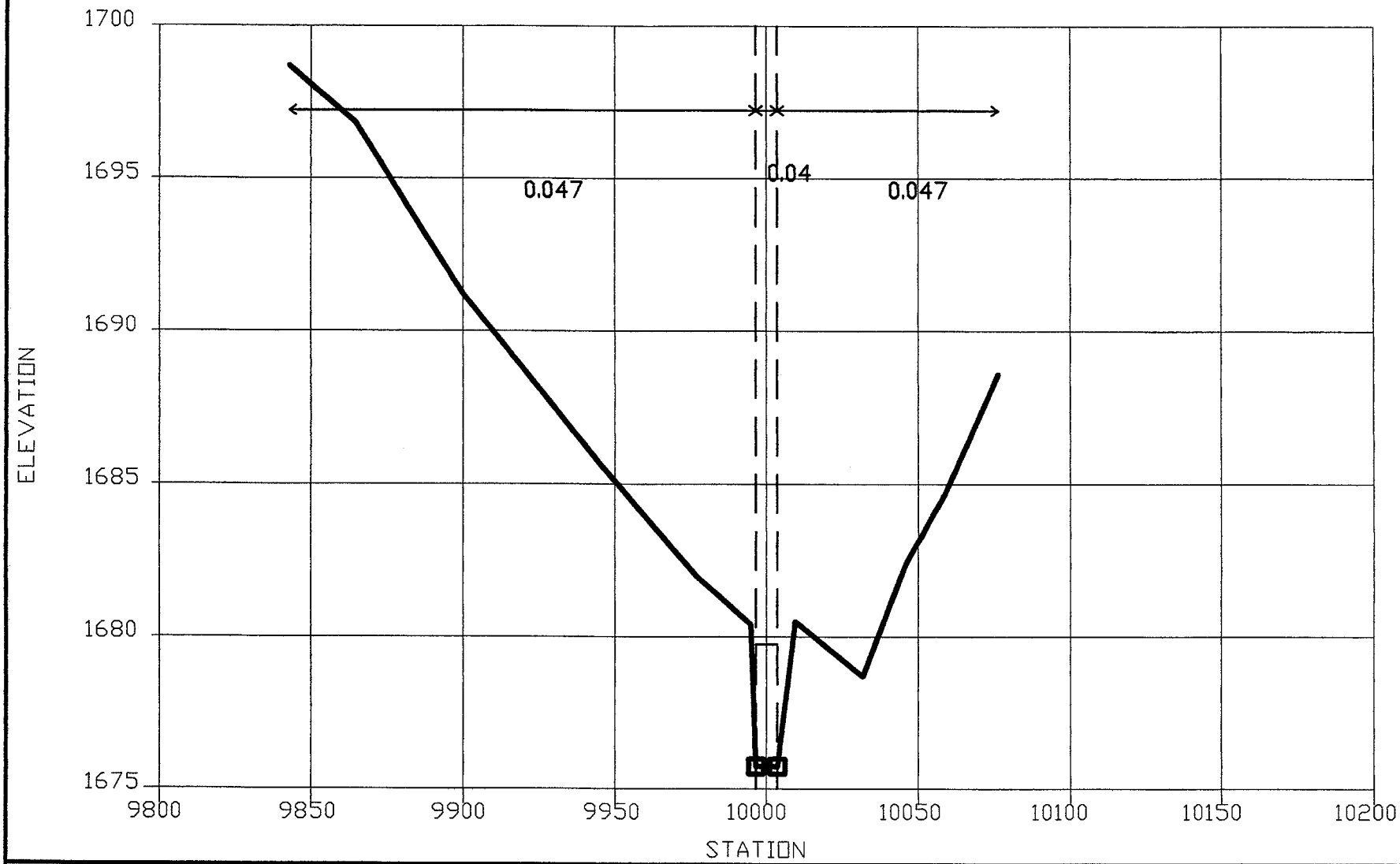


SECTION : 4.54

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

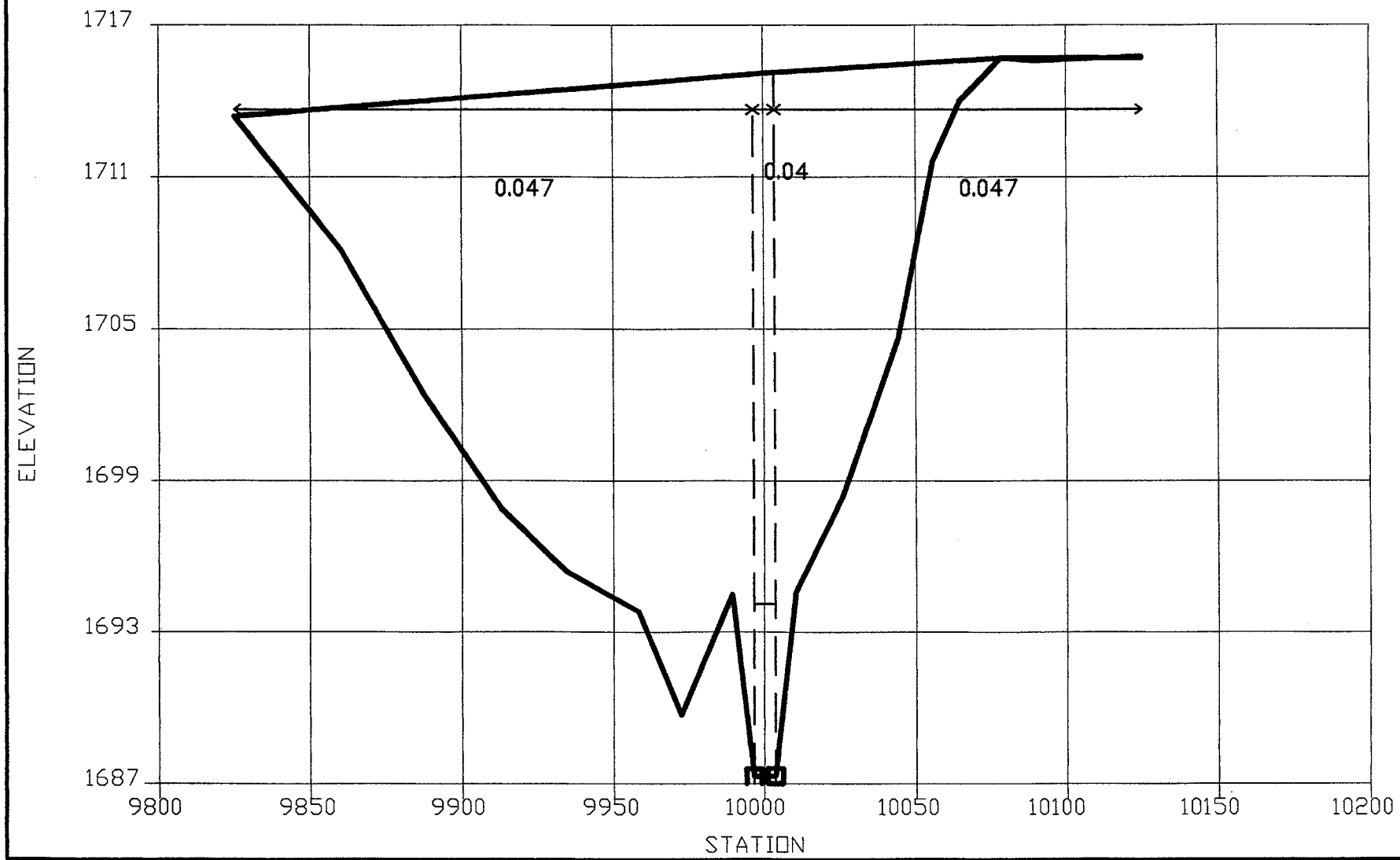


SECTION : 4.60

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

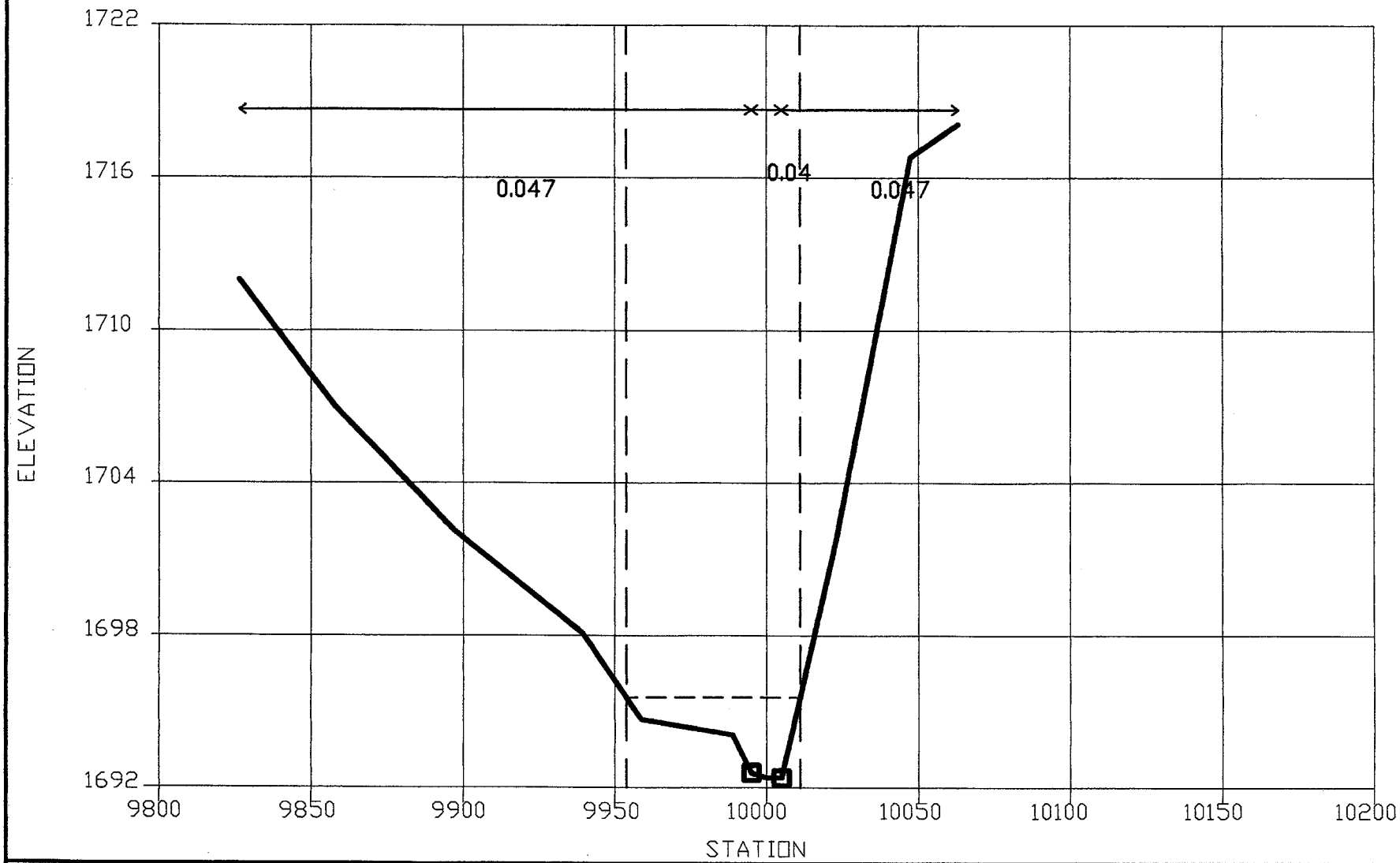


SECTION : 4.64

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

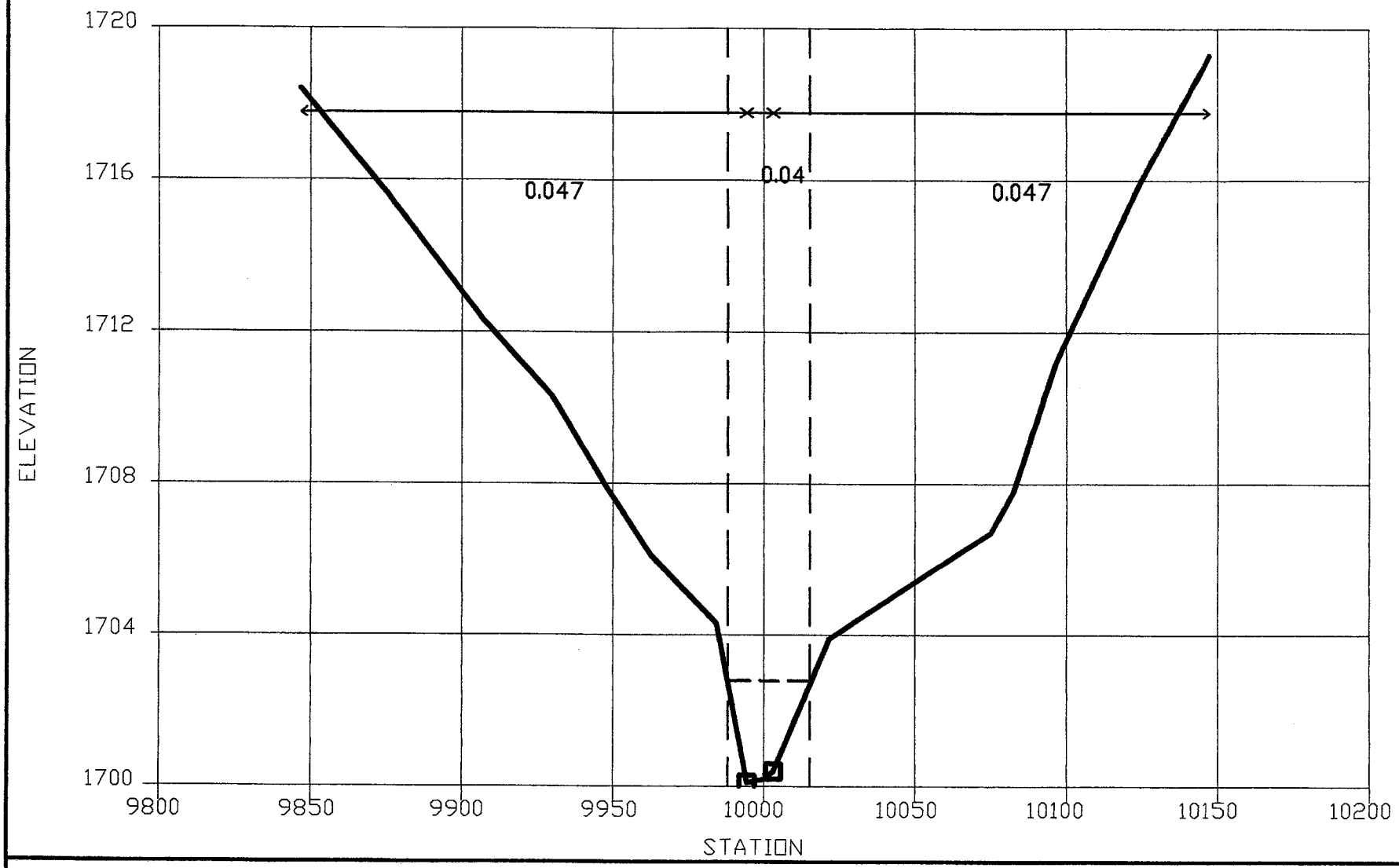


SECTION : 4.71

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

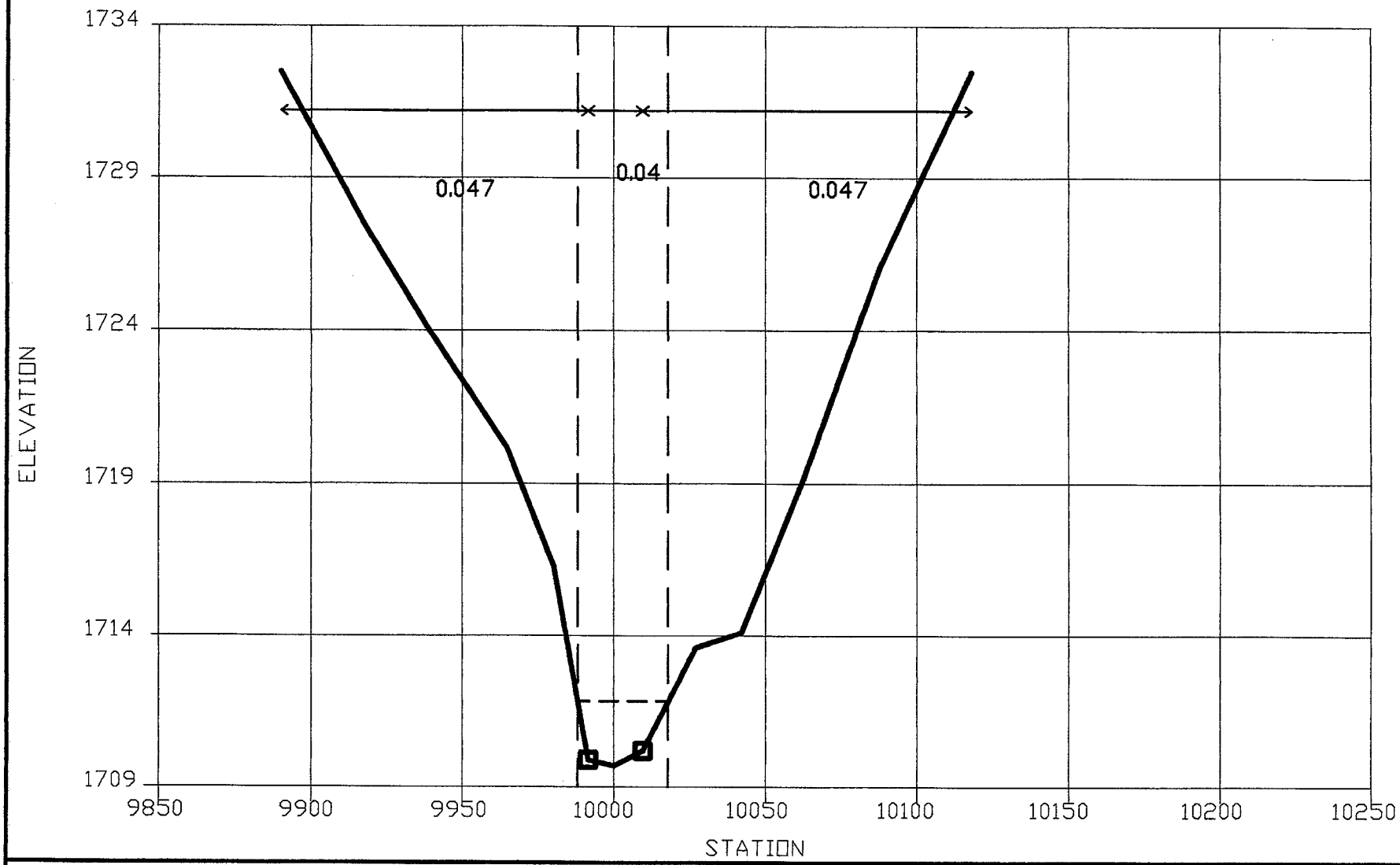


SECTION : 4.78

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

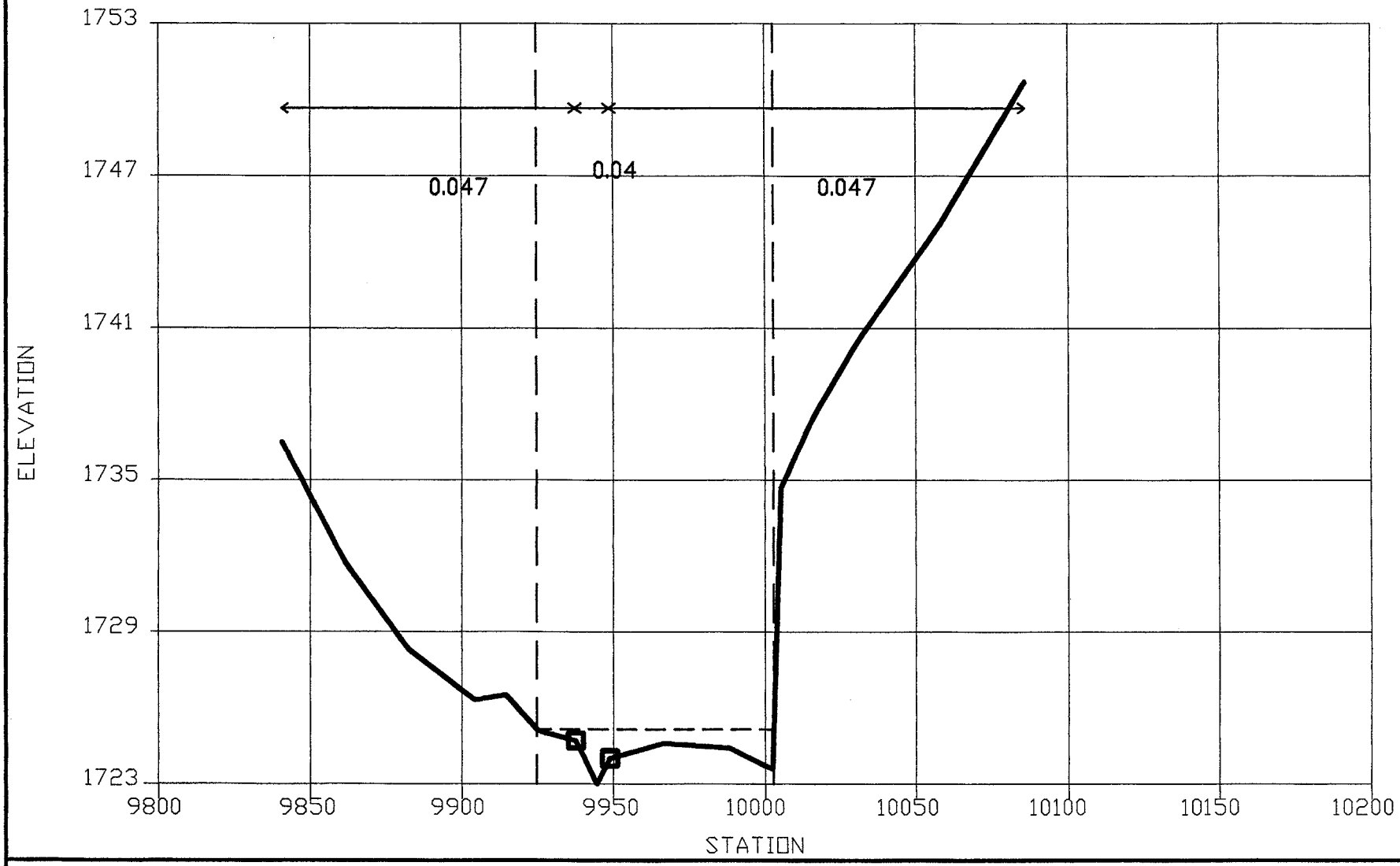


SECTION : 4.84

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

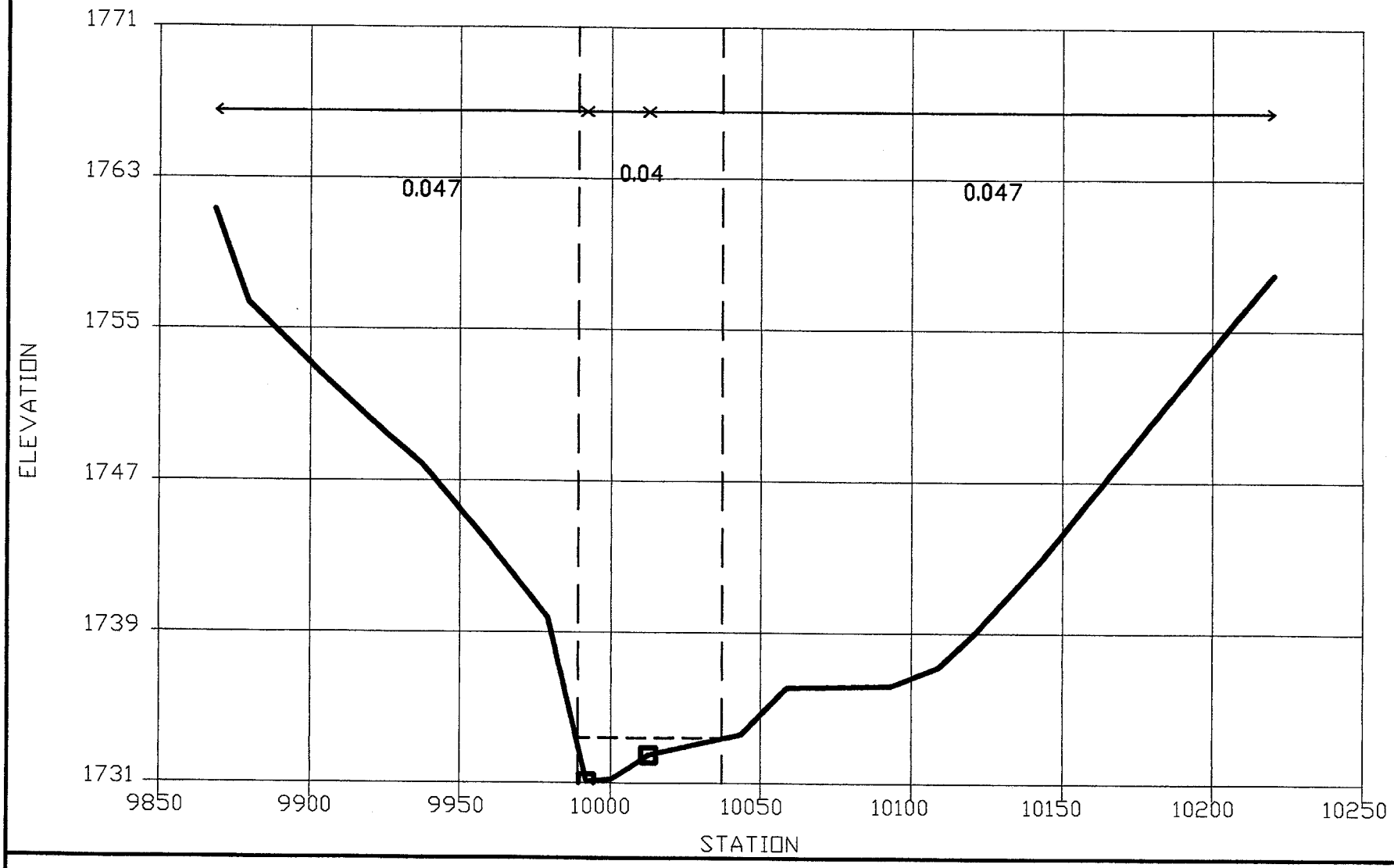


SECTION : 4.92

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

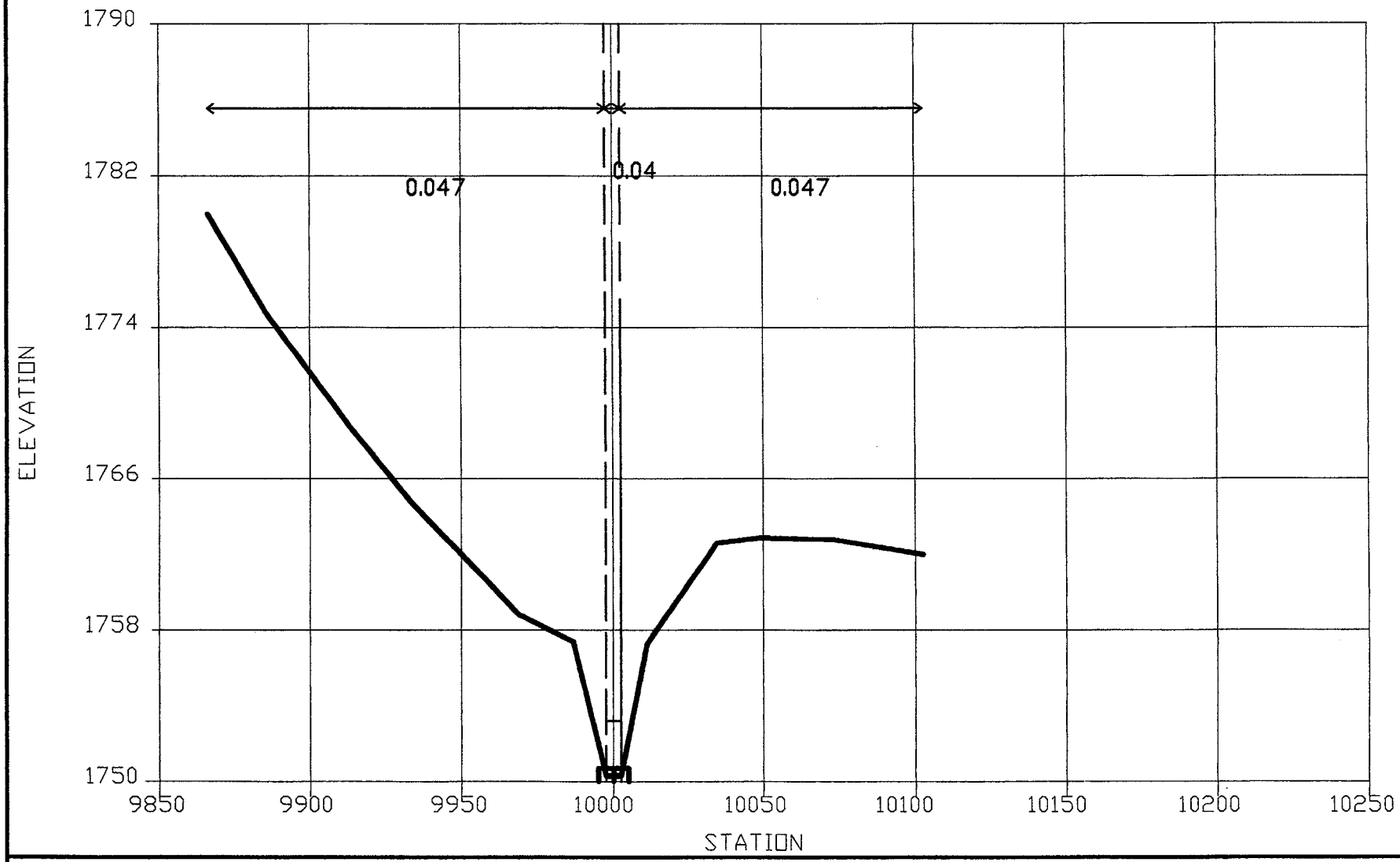


SECTION : 4.97

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

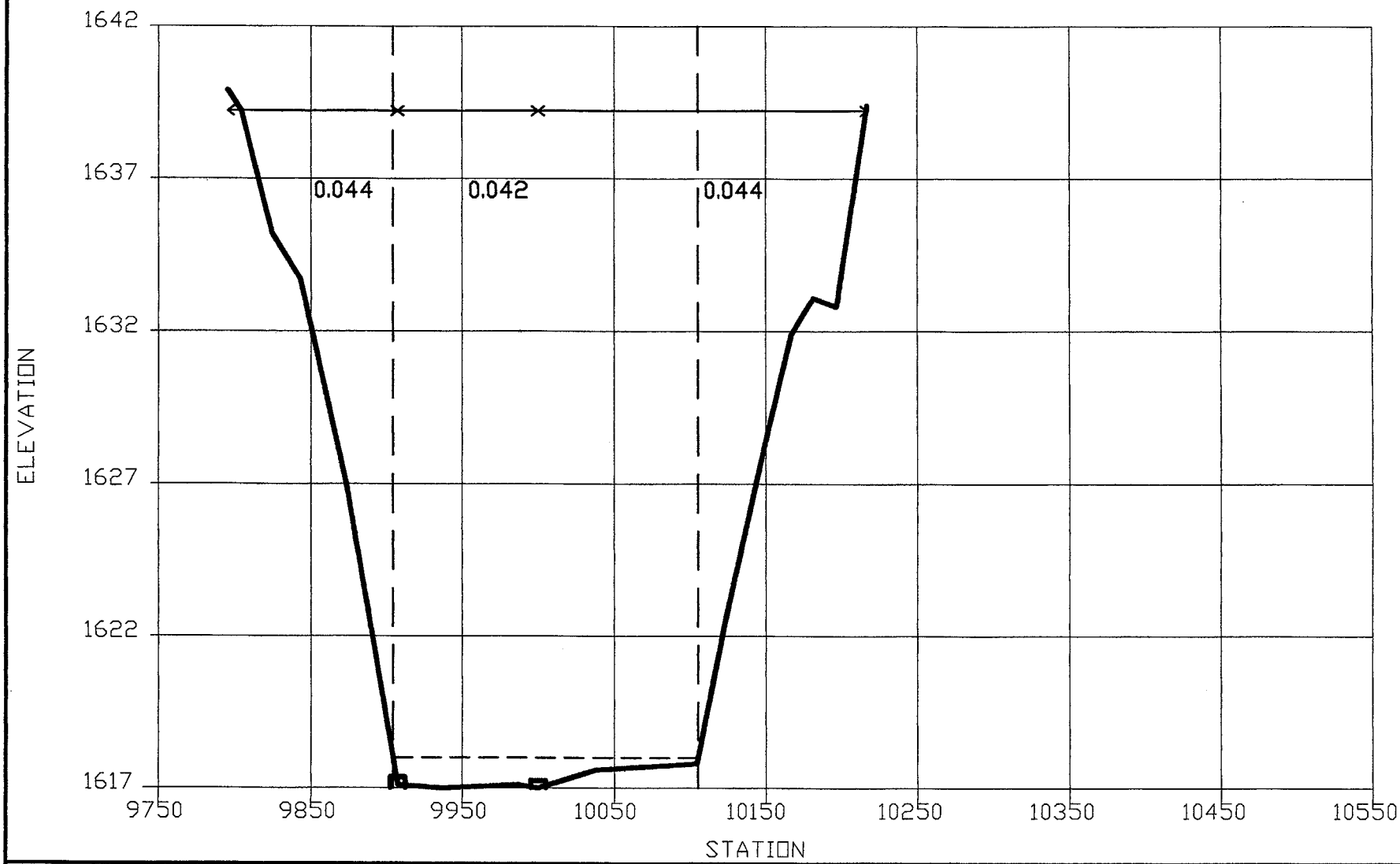


SECTION : 5.02

Fountain Hills (south) FIS

Cereus Wash

File: CER-XSEC.DWG

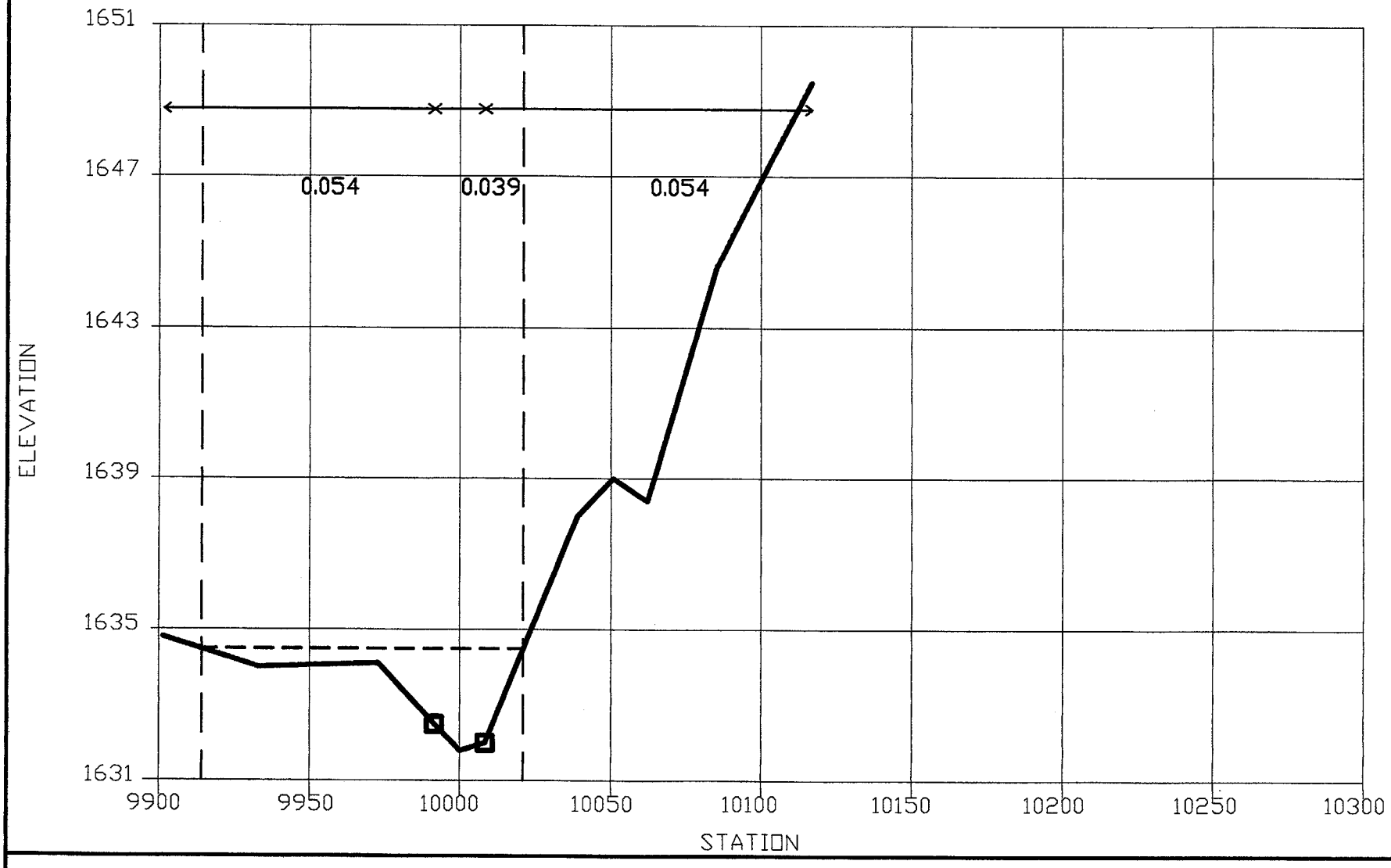


SECTION : 0.00

Fountain Hills (south) FIS

Logan Wash

File: LOG-XSEC.DWG

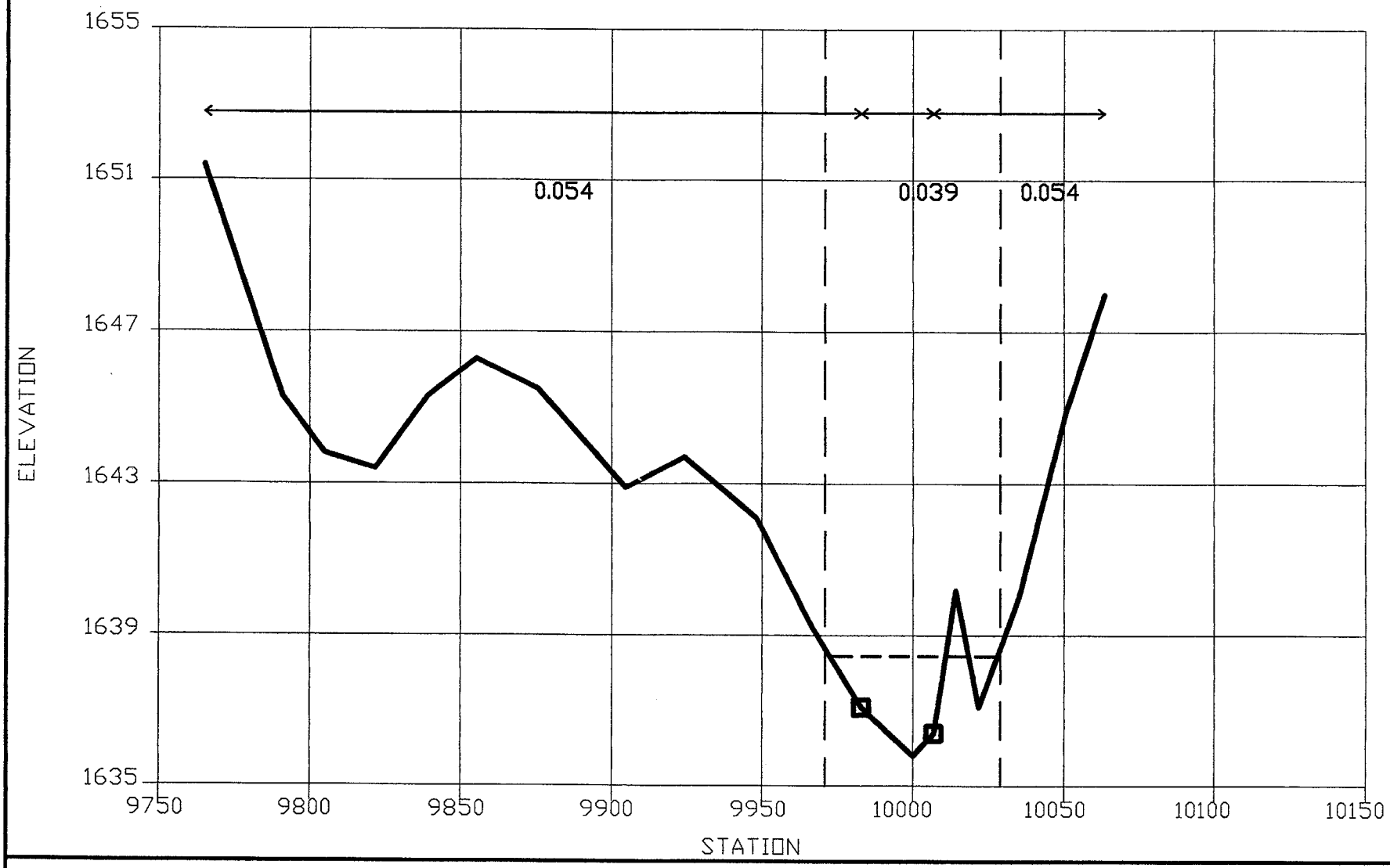


SECTION : 0.07

Fountain Hills (south) FIS

Logan Wash

File: LOG-XSEC.DWG

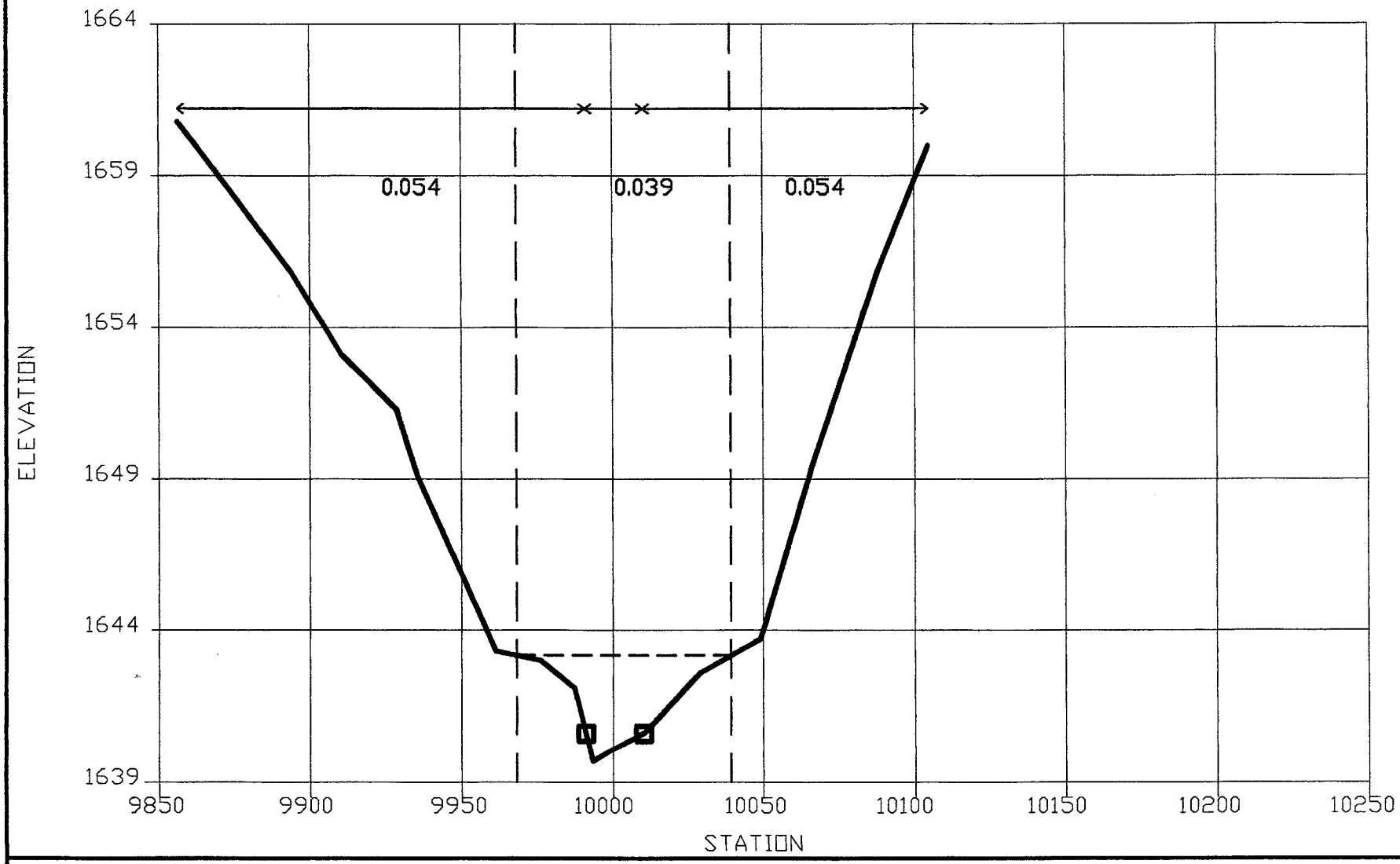


SECTION : 0.11

Fountain Hills (south) FIS

Logan Wash

File: LOG-XSEC.DWG

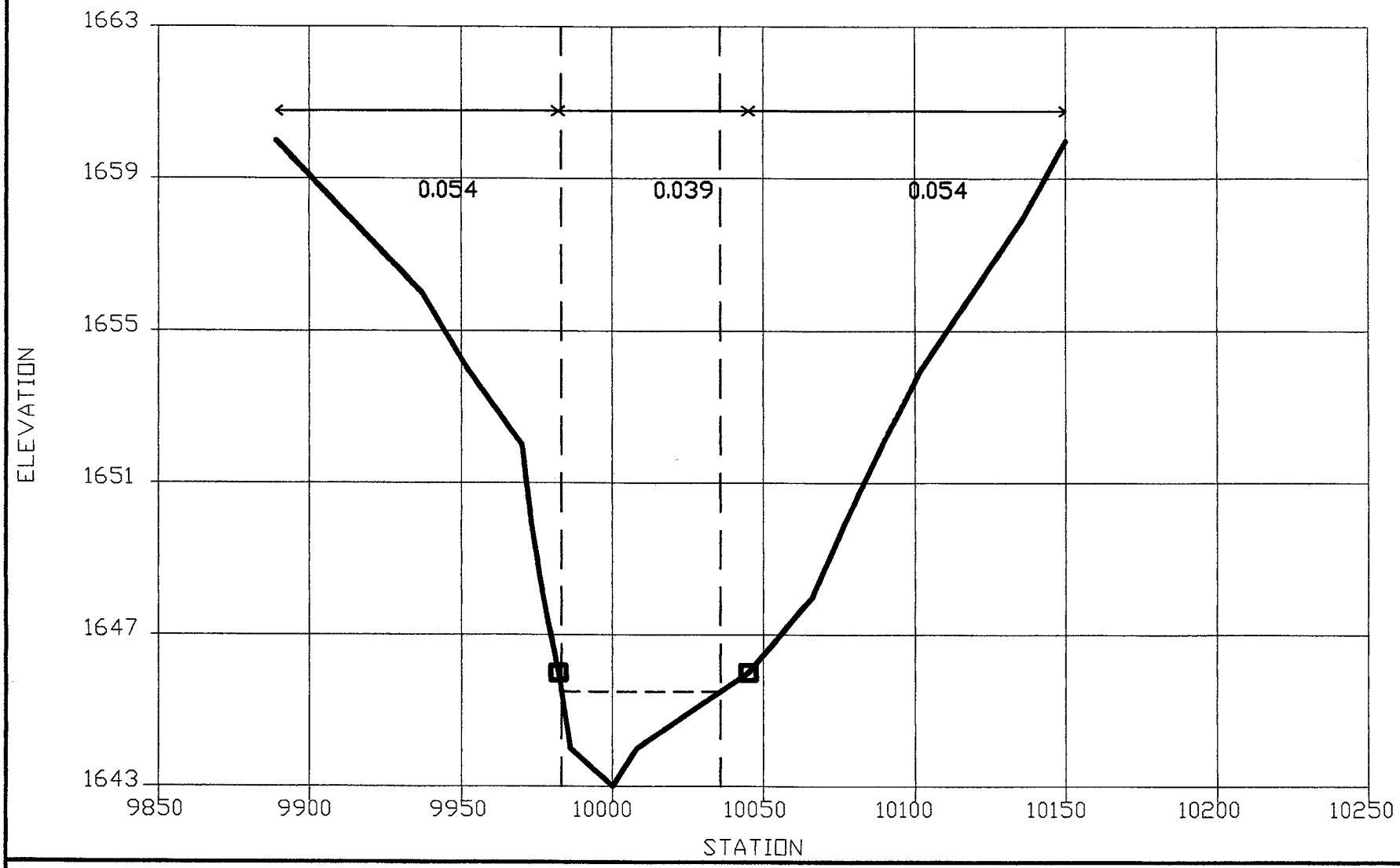


SECTION : 0.21

Fountain Hills (south) FIS

Logan Wash

File: LOG-XSEC.DWG

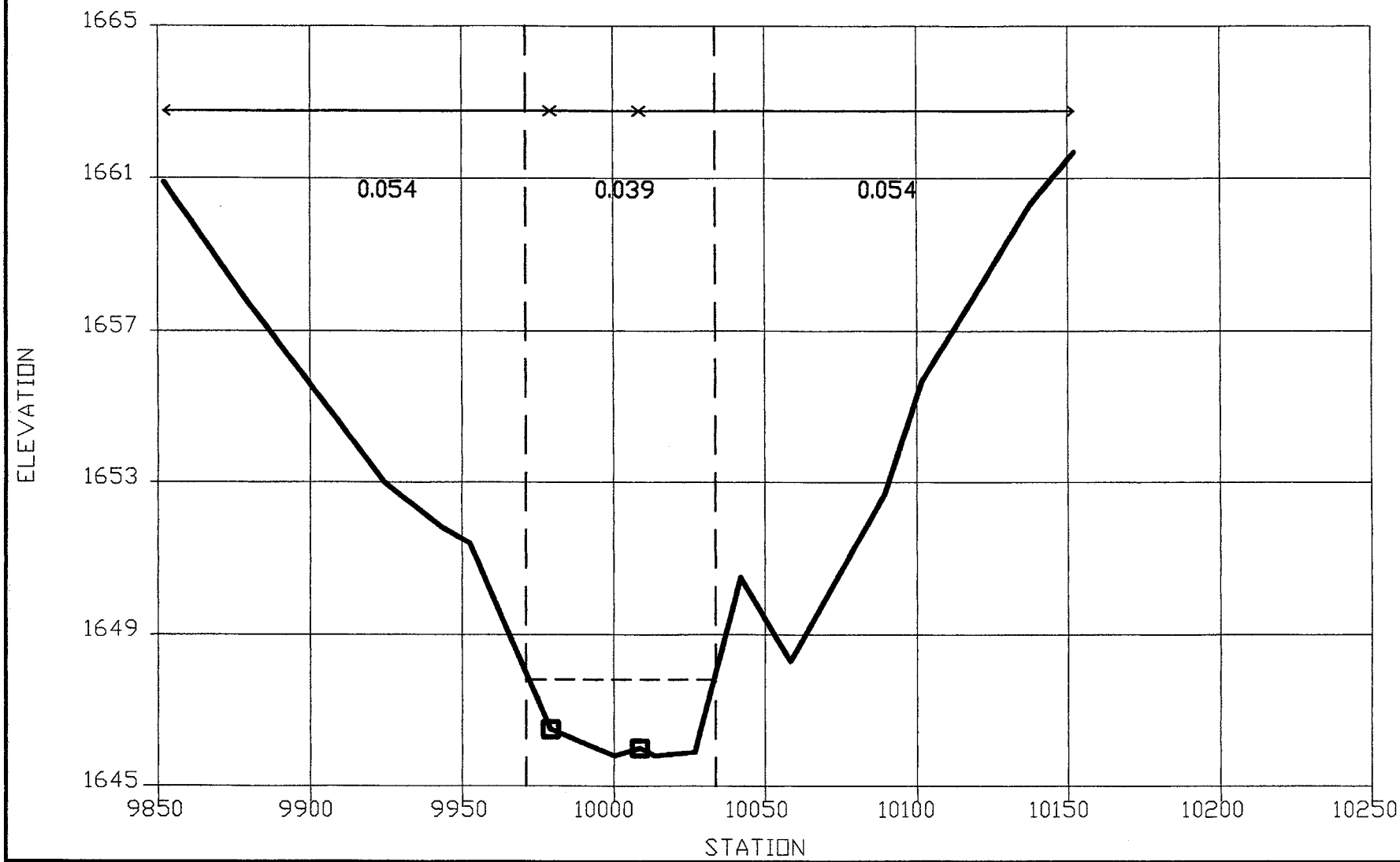


SECTION : 0.25

Fountain Hills (south) FIS

Logan Wash

File: LOG-XSEC.DWG

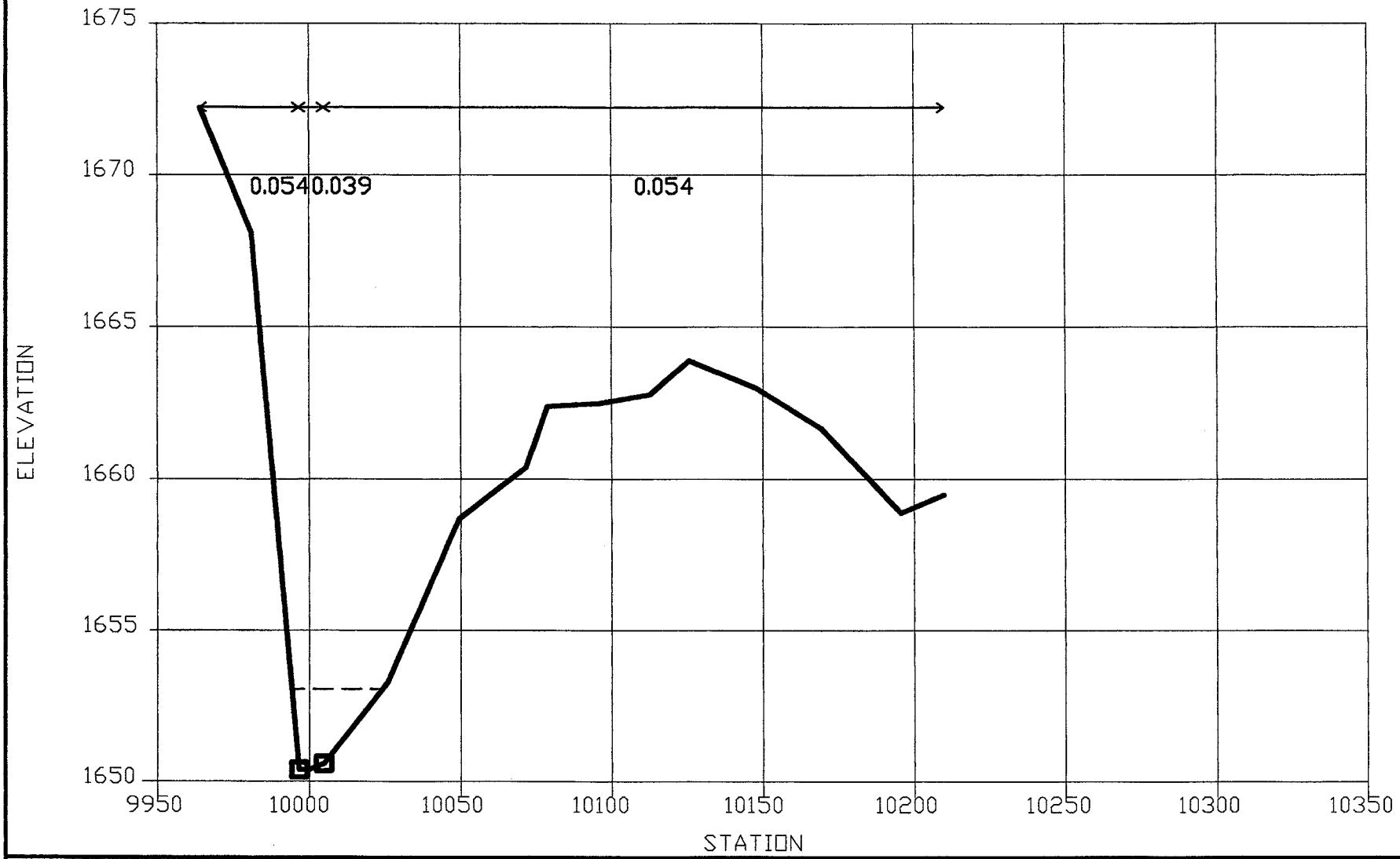


SECTION : 0.28

Fountain Hills (south) FIS

Logan Wash

File: LOG-XSEC.DWG

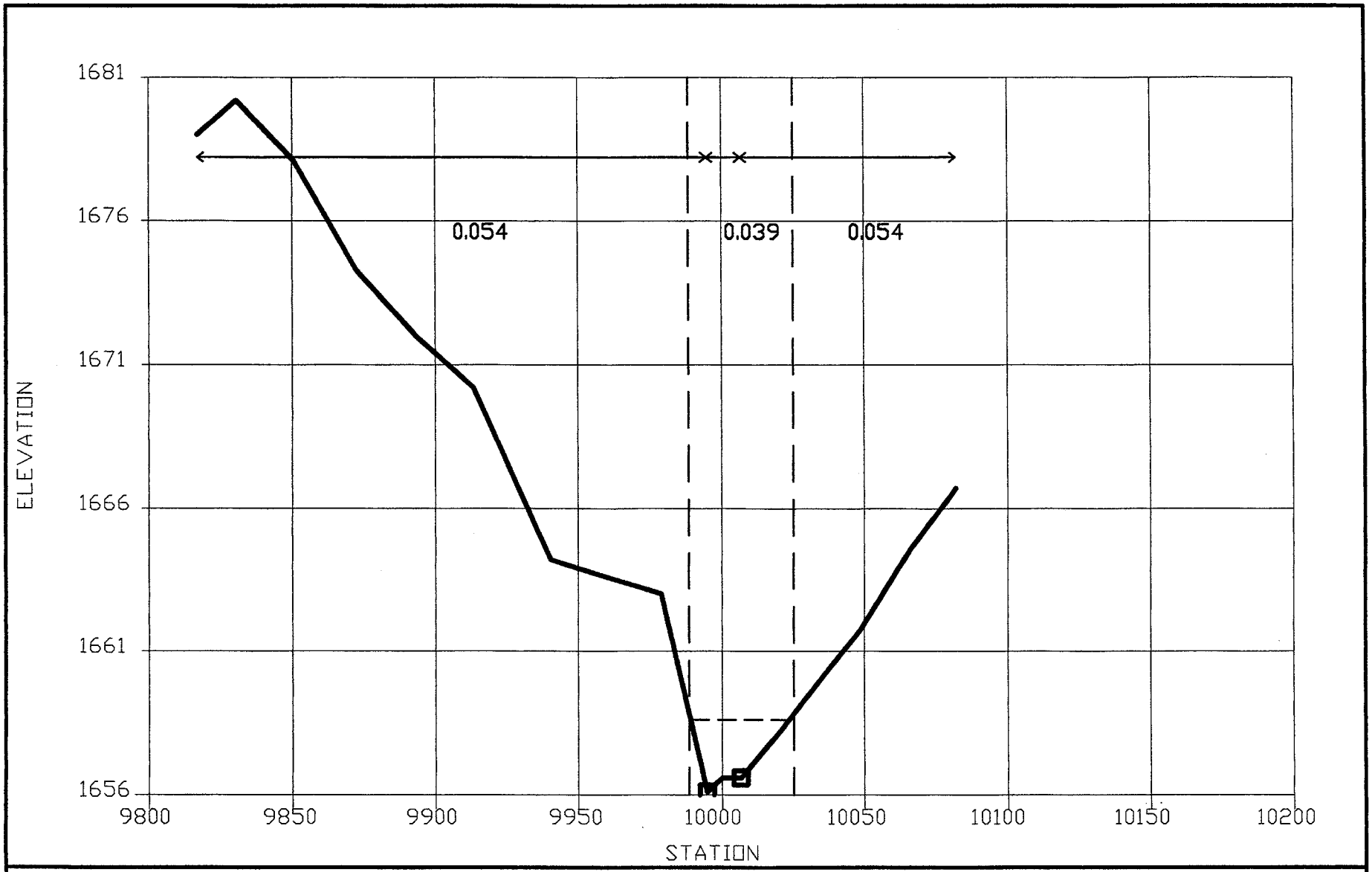


SECTION : 0.34

Fountain Hills (south) FIS

Logan Wash

File: LOG-XSEC.DWG

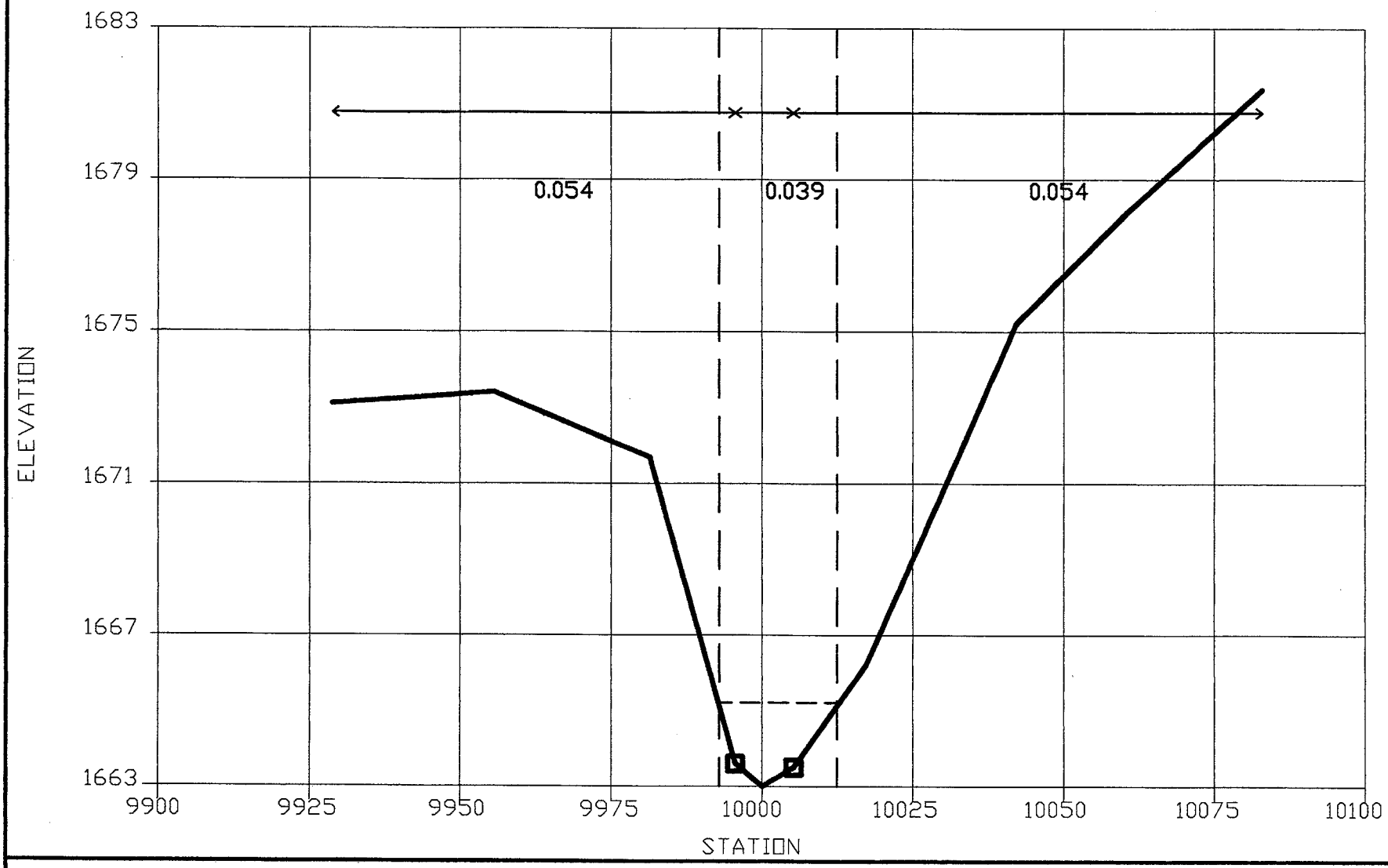


SECTION : 0.41

Fountain Hills (south) FIS

Logan Wash

File: LOG-XSEC.DWG

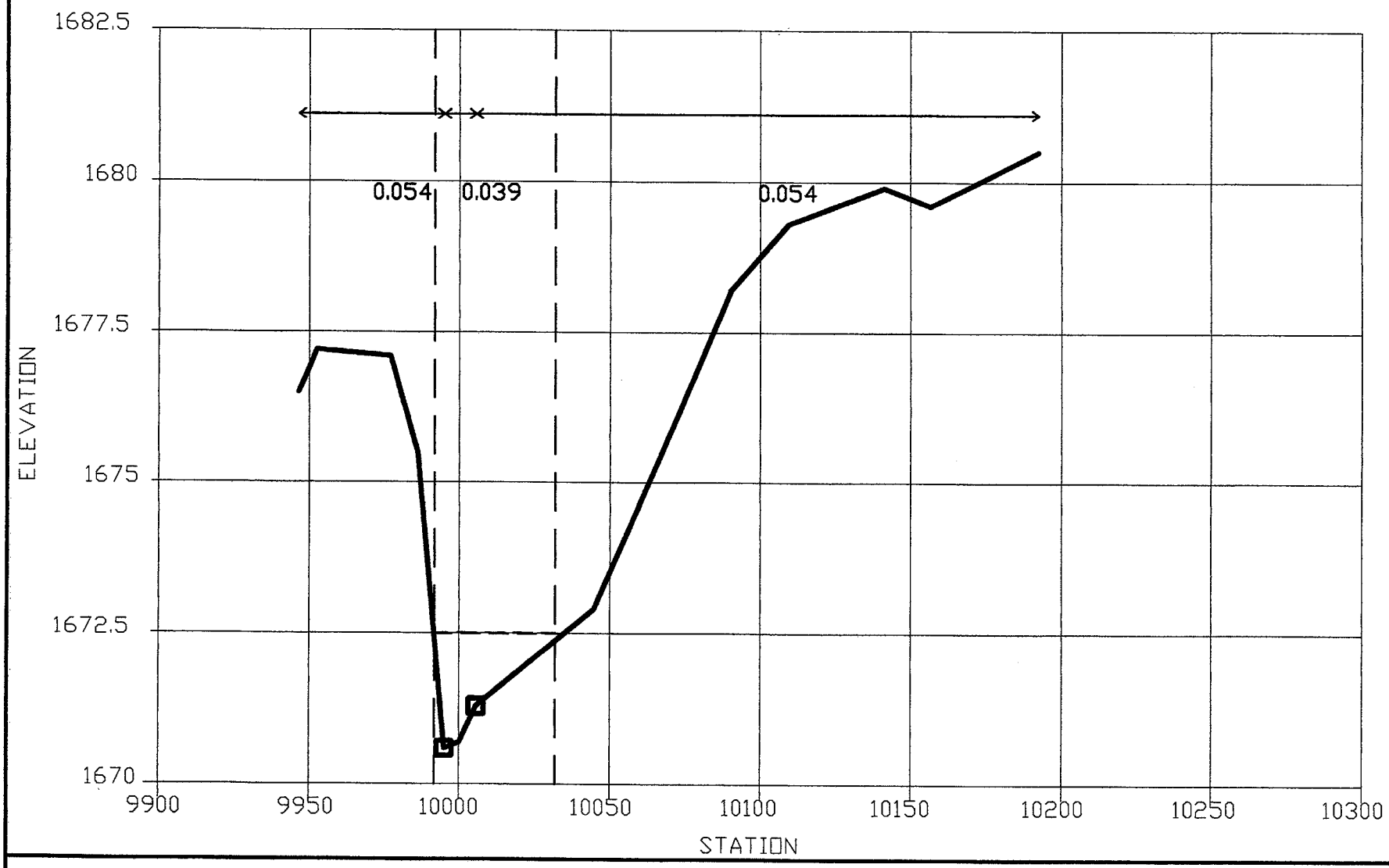


SECTION : 0.47

Fountain Hills (south) FIS

Logan Wash

File: LOG-XSEC.DWG

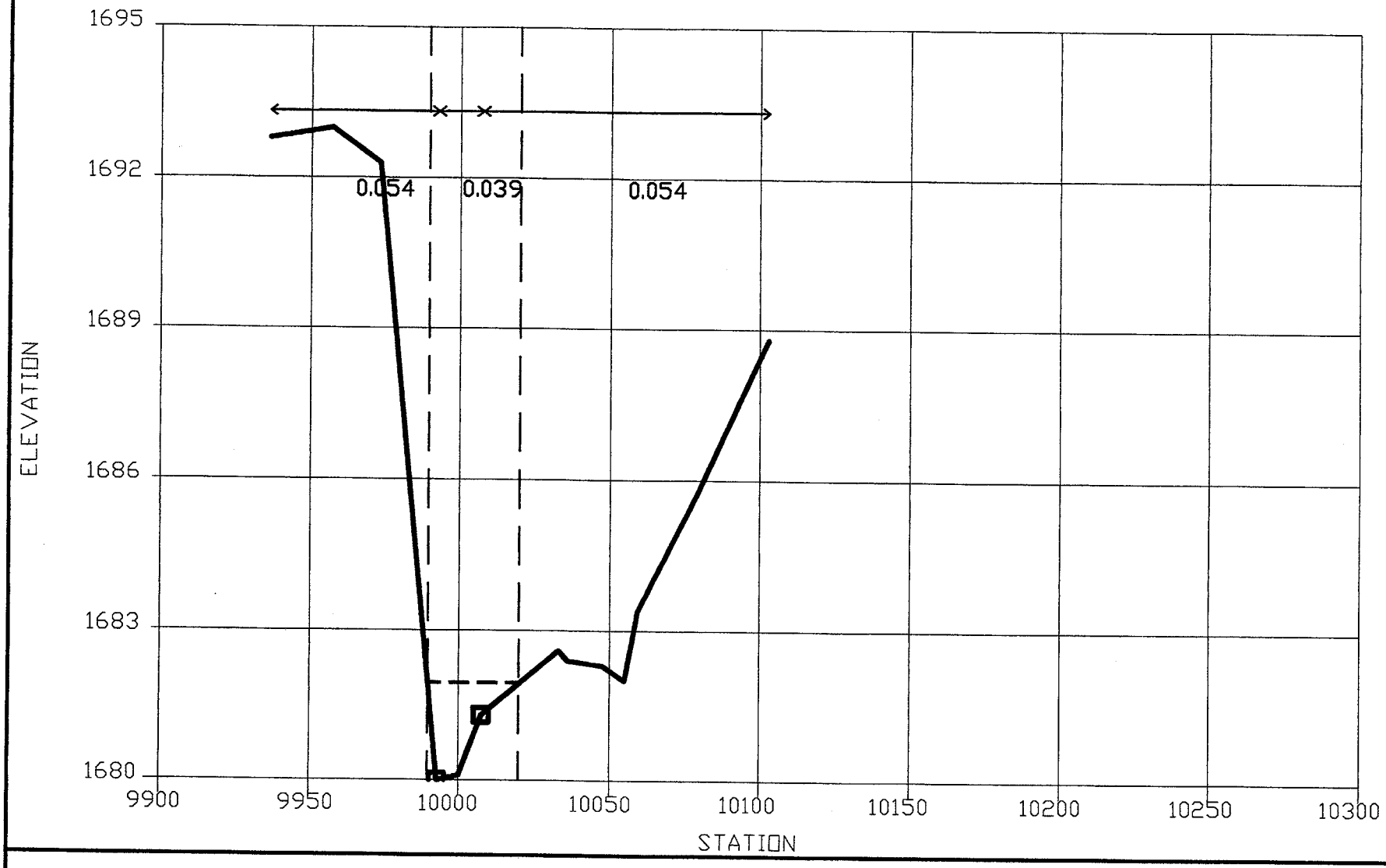


SECTION : 0.51

Fountain Hills (south) FIS

Logan Wash

File: LOG-XSEC.DWG

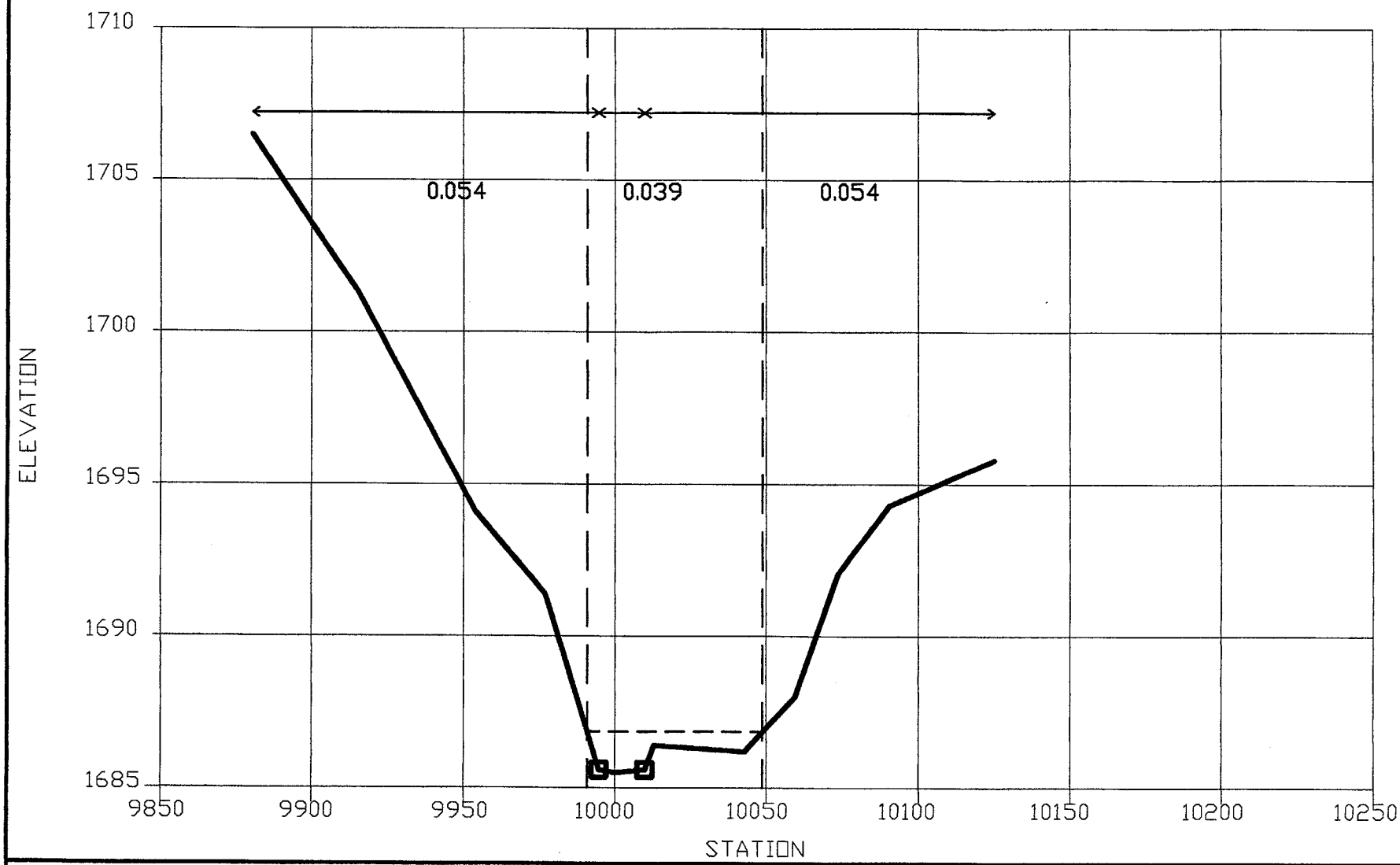


SECTION : 0.61

Fountain Hills (south) FIS

Logan Wash

File: LOG-XSEC.DWG

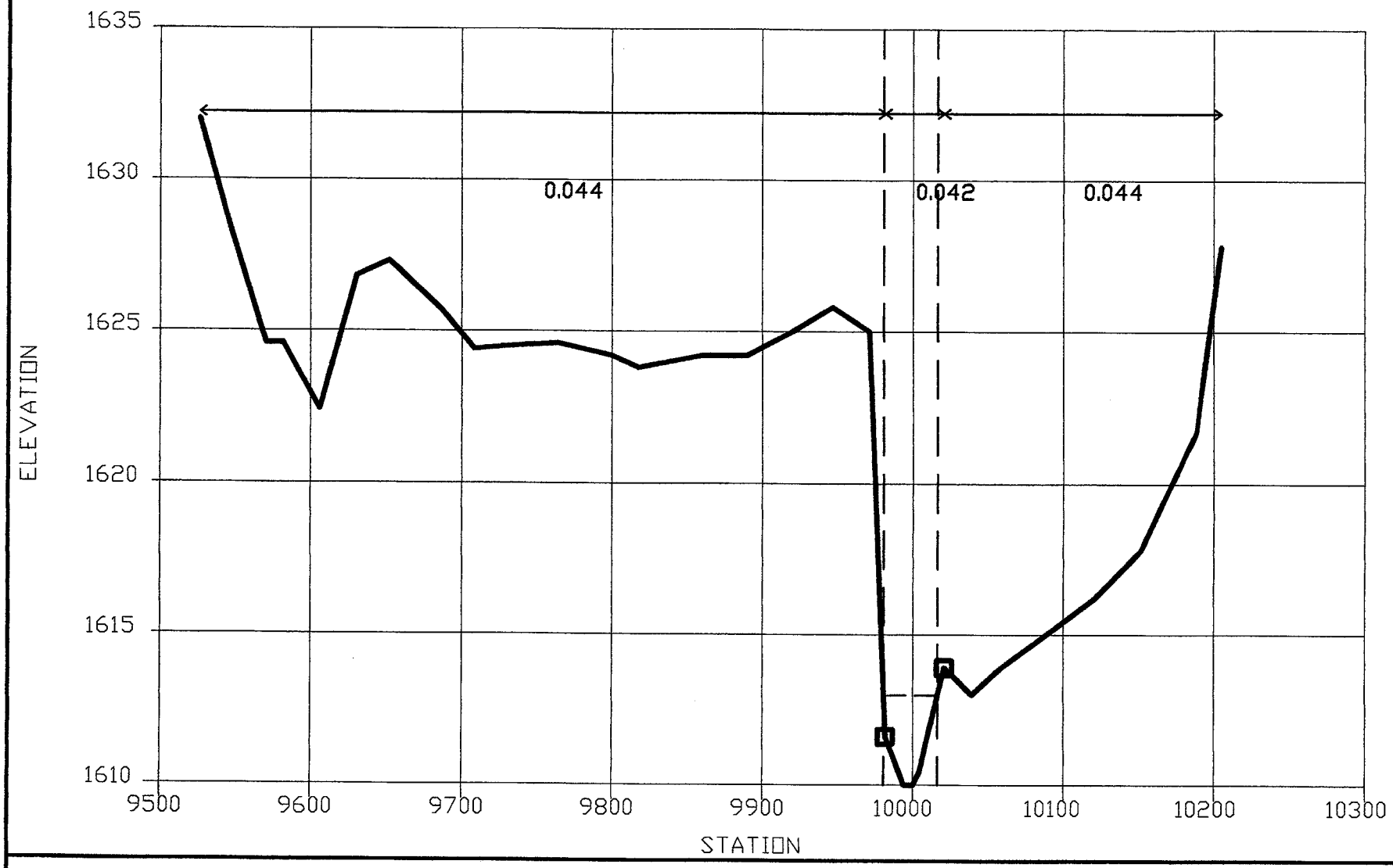


SECTION : 0.63

Fountain Hills (south) FIS

Logan Wash

File: LOG-XSEC.DWG

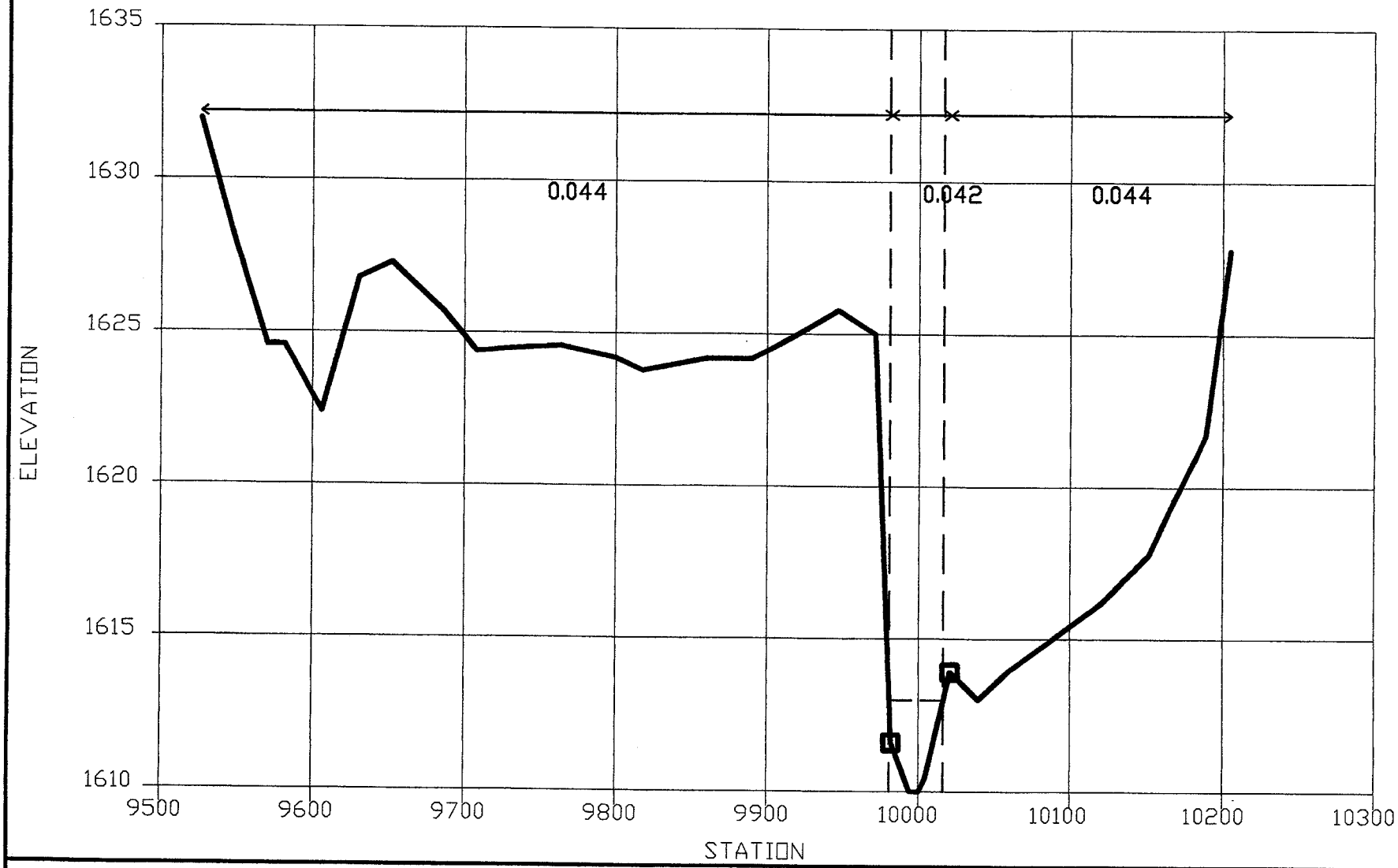


SECTION : 3.93

Fountain Hills (south) FIS

Logan Wash

File: LOG-XSEC.DWG

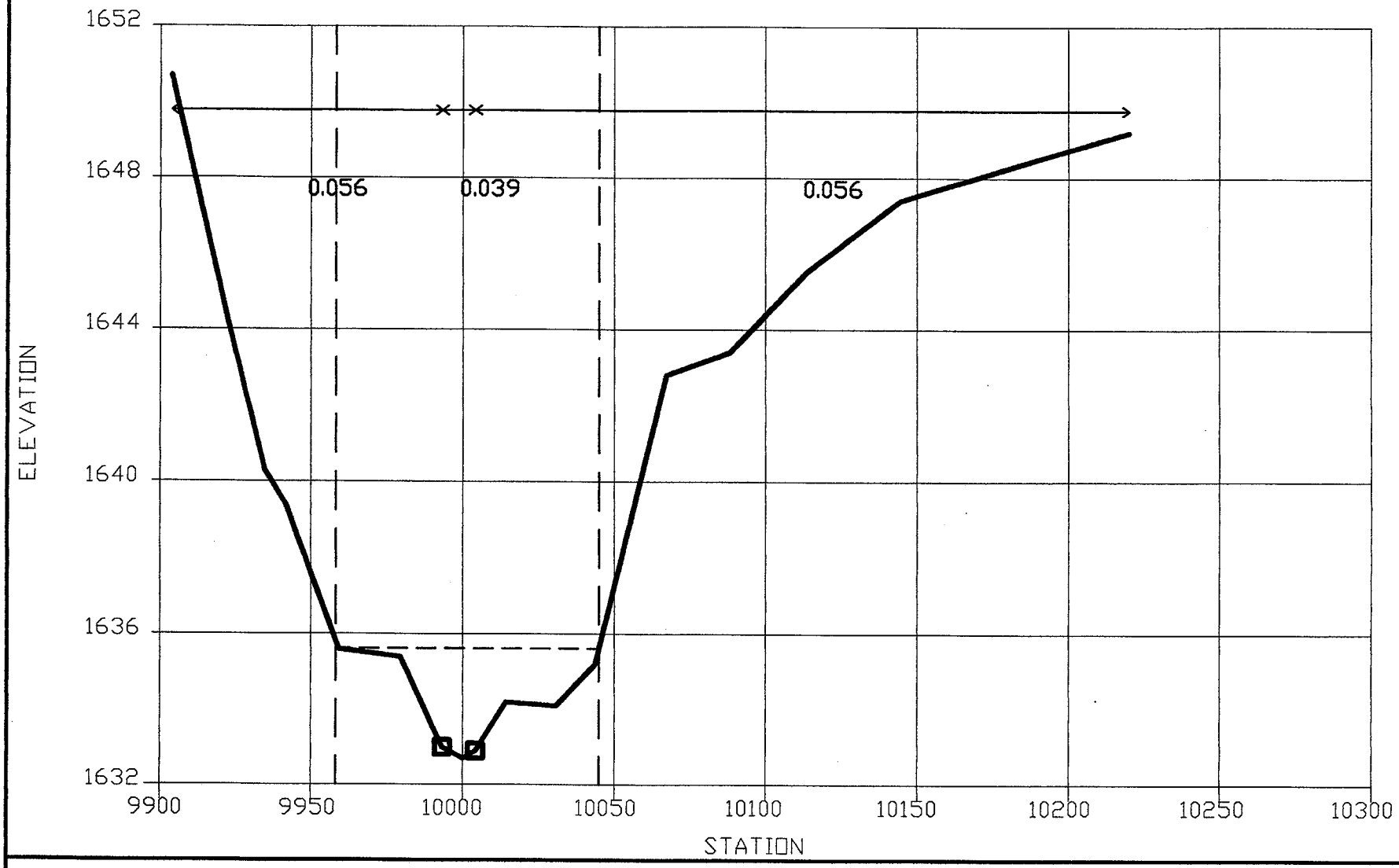


SECTION : 3.93

Fountain Hills (south) FIS

Logan Wash

File: LOG-XSEC.DWG

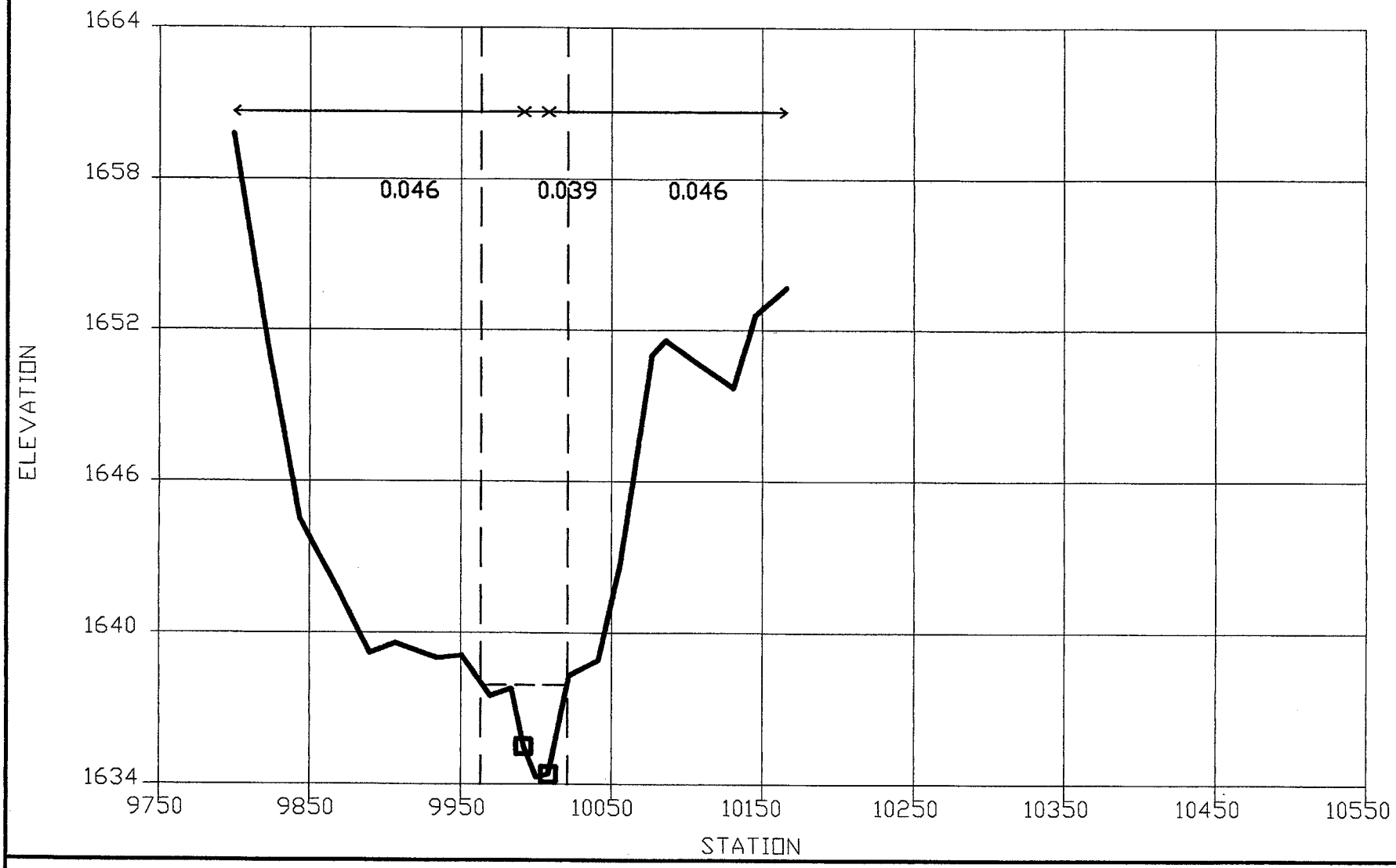


SECTION : 4.19

Fountain Hills (south) FIS

Chukar Wash

File: CHU-XSEC.DWG

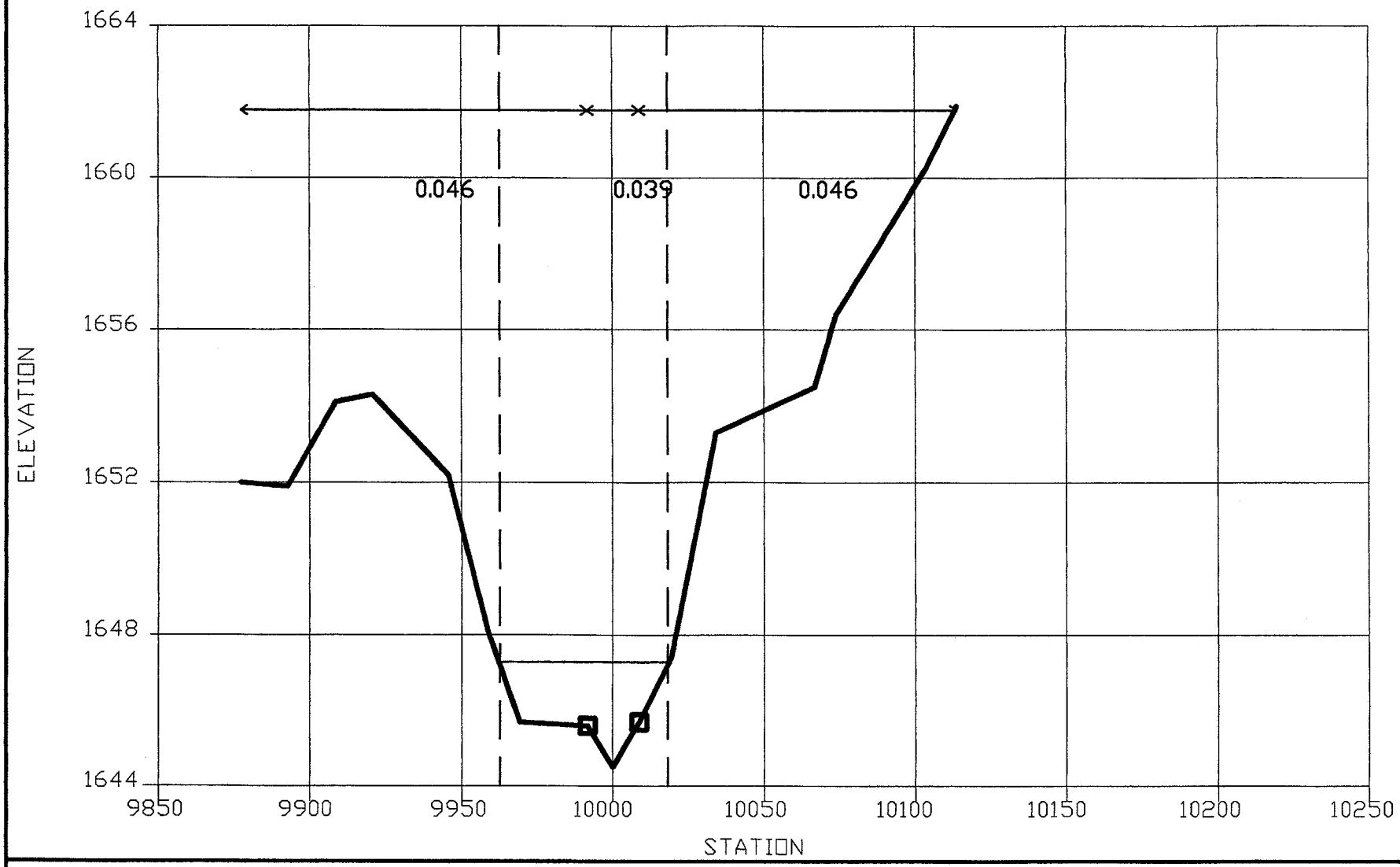


SECTION : 0.00

Fountain Hills (south) FIS

Chukar Wash

File: CHU-XSEC.DWG

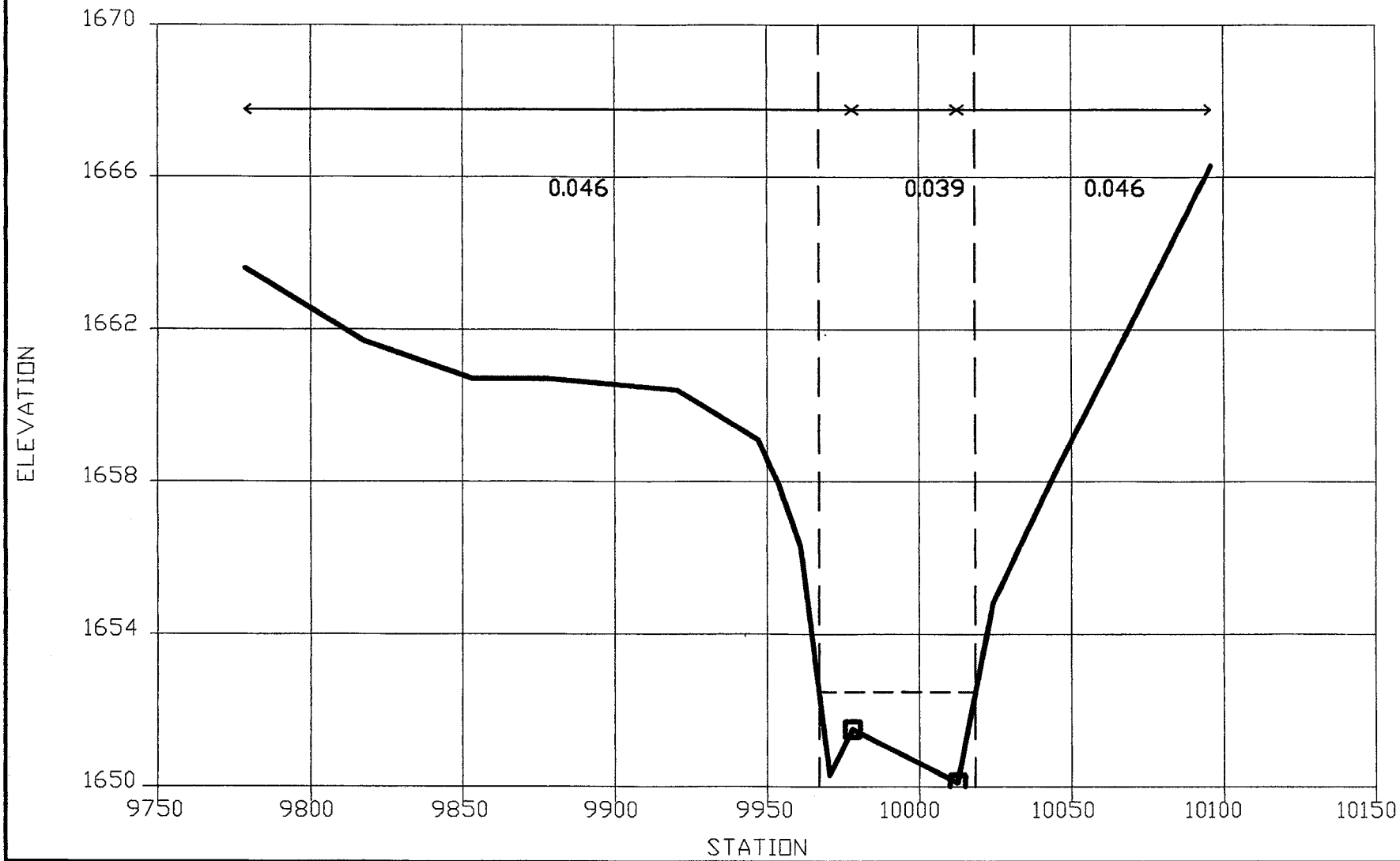


SECTION : 0.09

Fountain Hills (south) FIS

Chukar Wash

File: CHU-XSEC.DWG

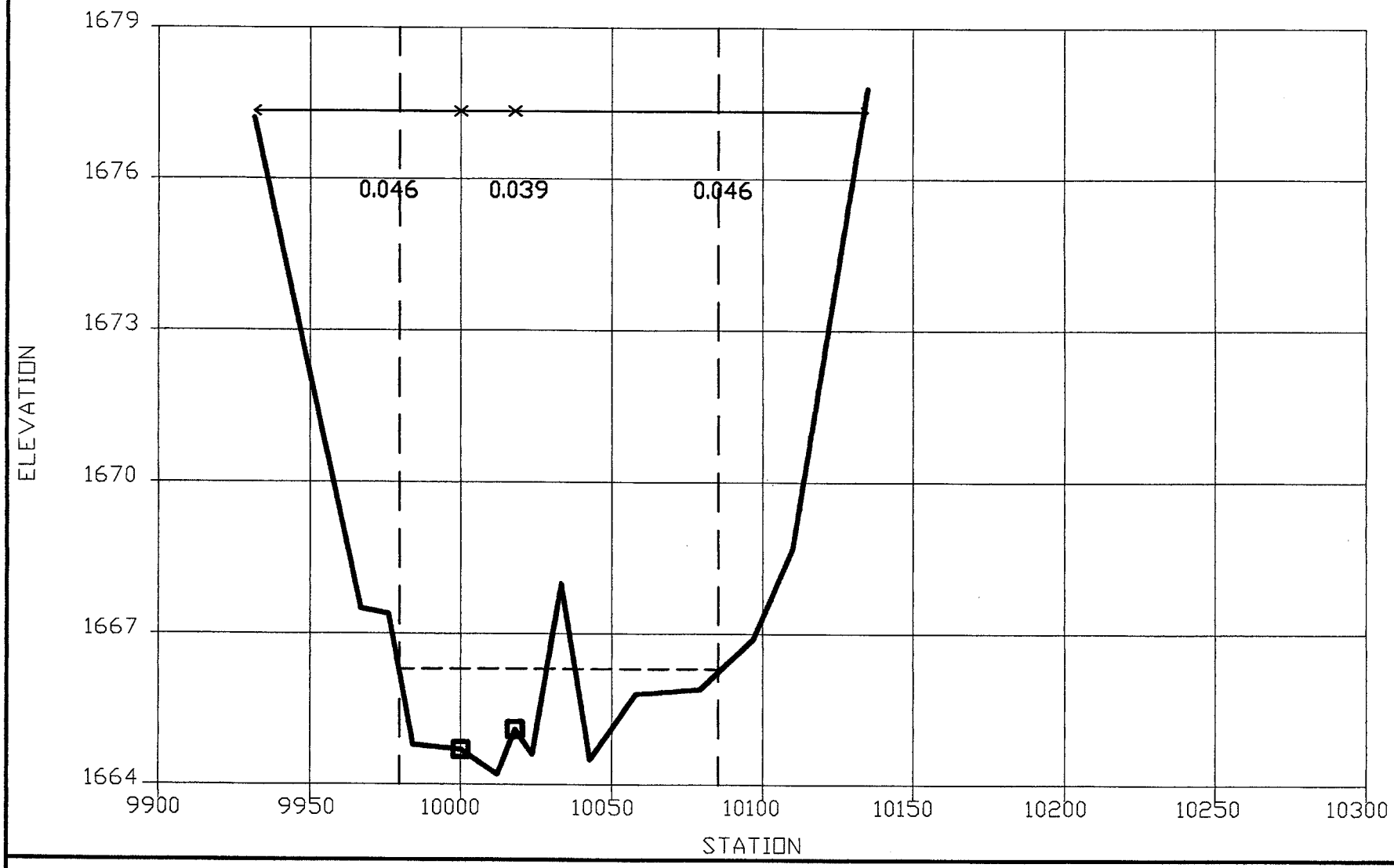


SECTION : 0.11

Fountain Hills (south) FIS

Chukar Wash

File: CHU-XSEC.DWG

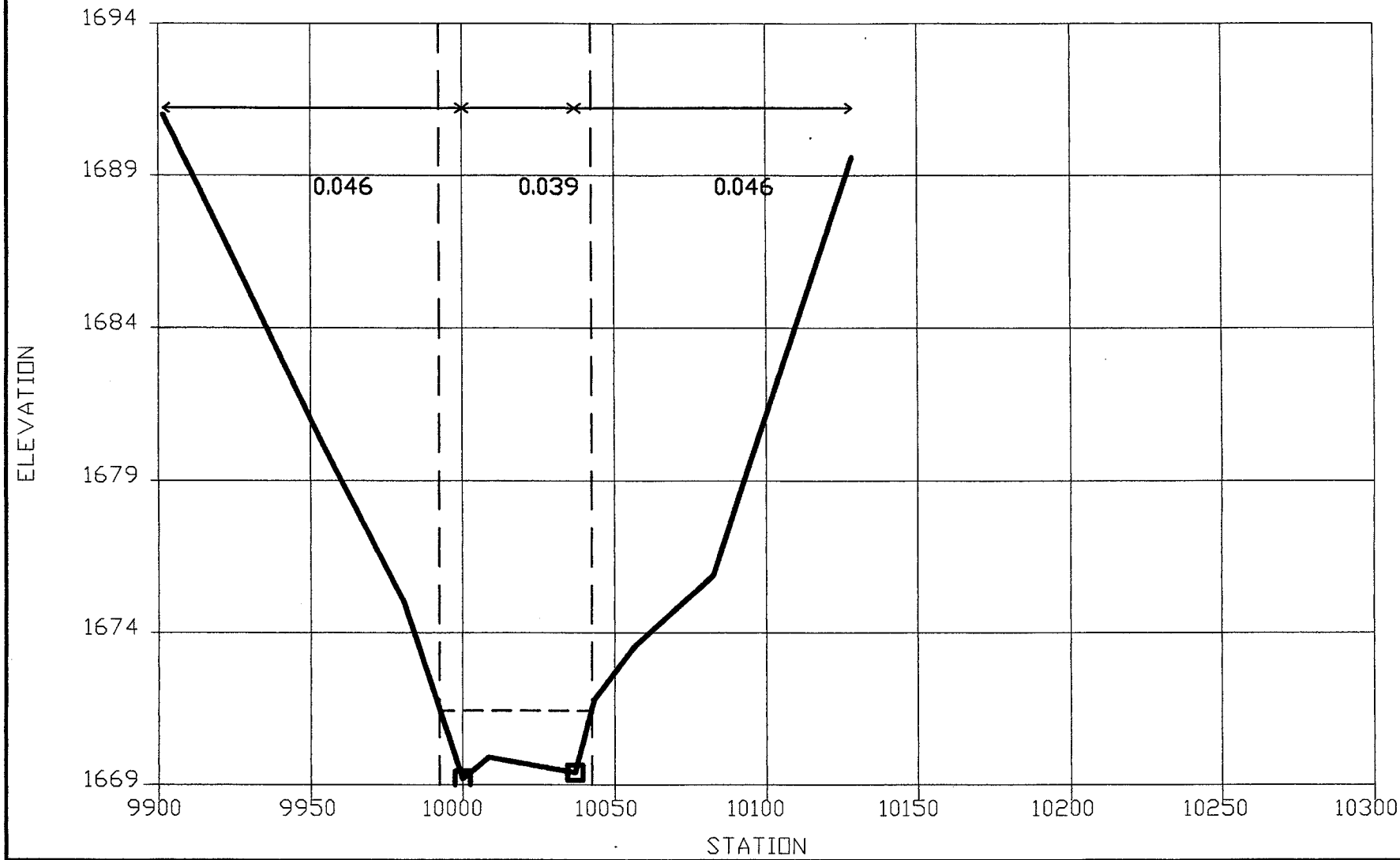


SECTION : 0.20

Fountain Hills (south) FIS

Chukar Wash

File: CHU-XSEC.DWG

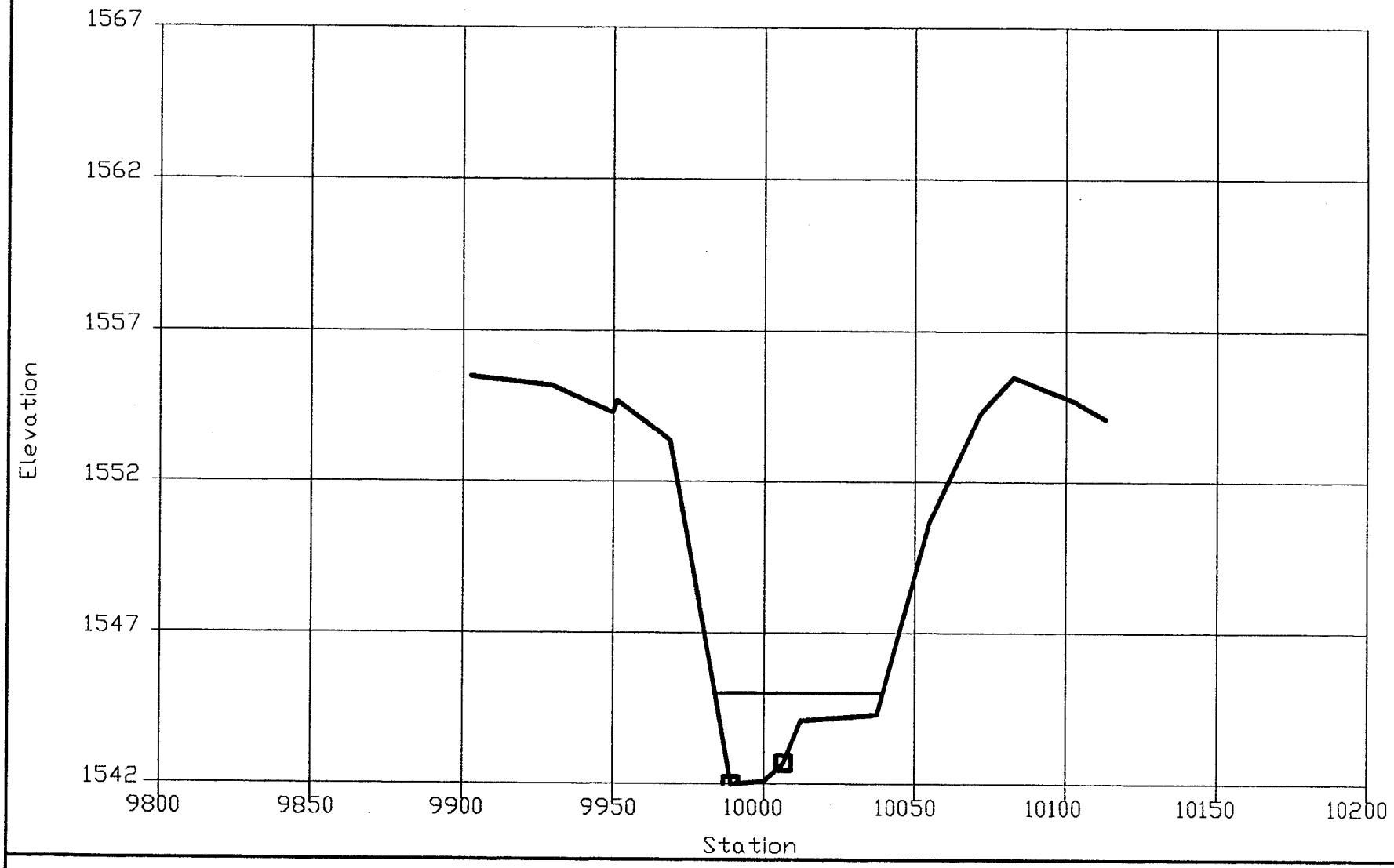


SECTION : 0.26

Fountain Hills (south) FIS

Chukar Wash

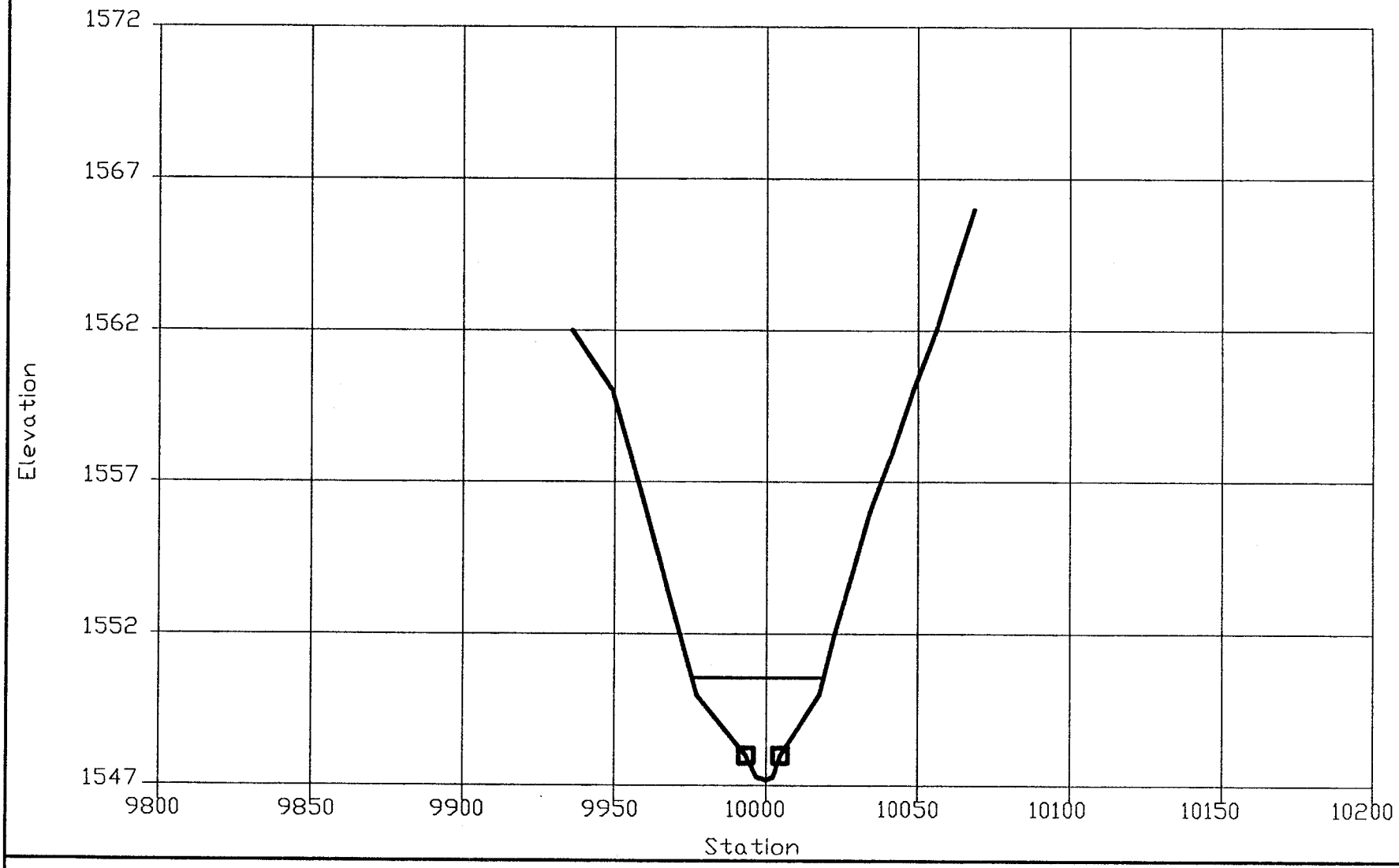
File: CHU-XSEC.DWG



SECTION : 0

Fountain Hills ADMP
Laser drain

File: LD-XSEC.DWG



SECTION : 0.064

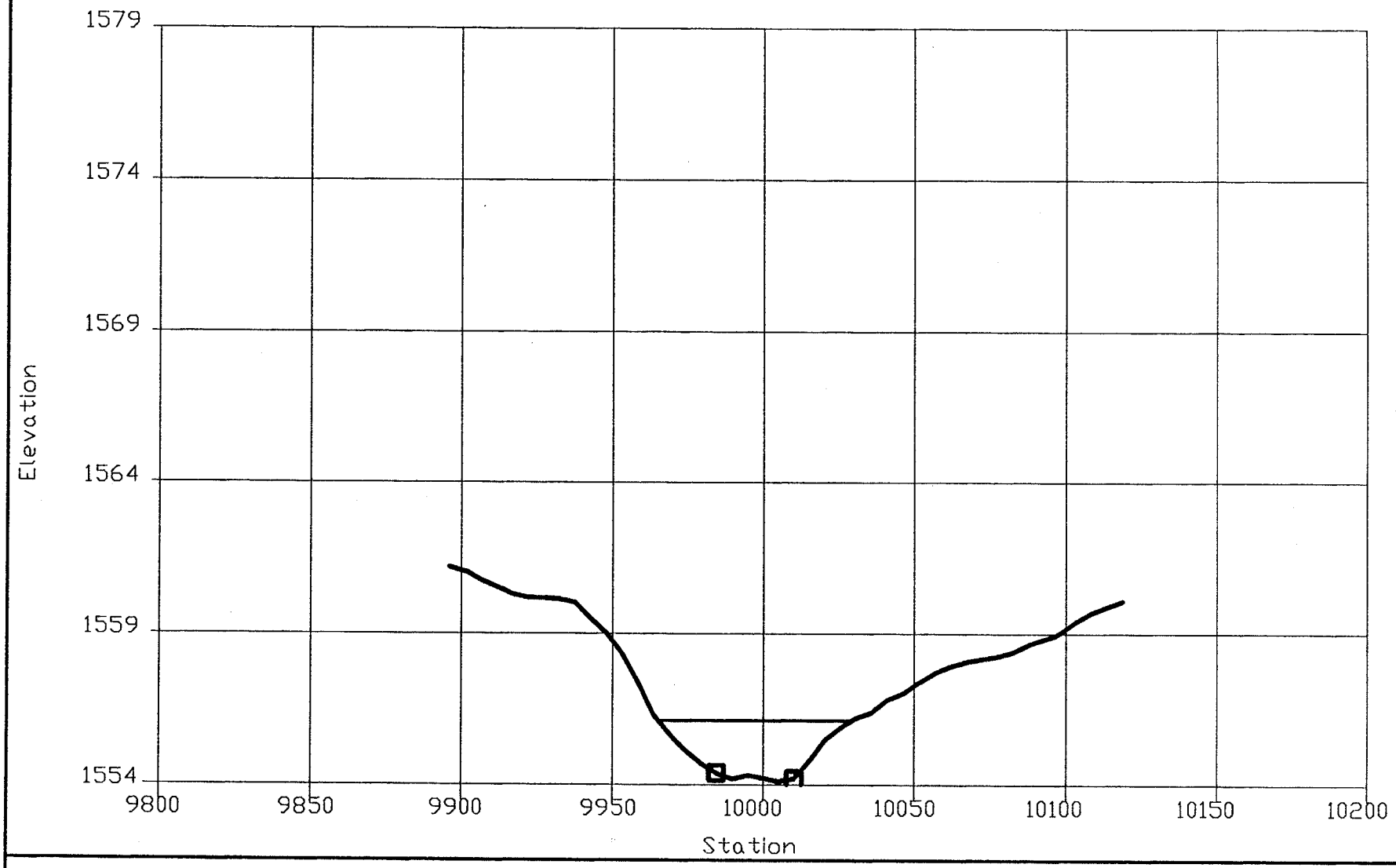
Fountain Hills ADMP
Laser drain

File: LD-XSEC.DWG

SECTION : 0.093

Fountain Hills ADMP
Laser drain

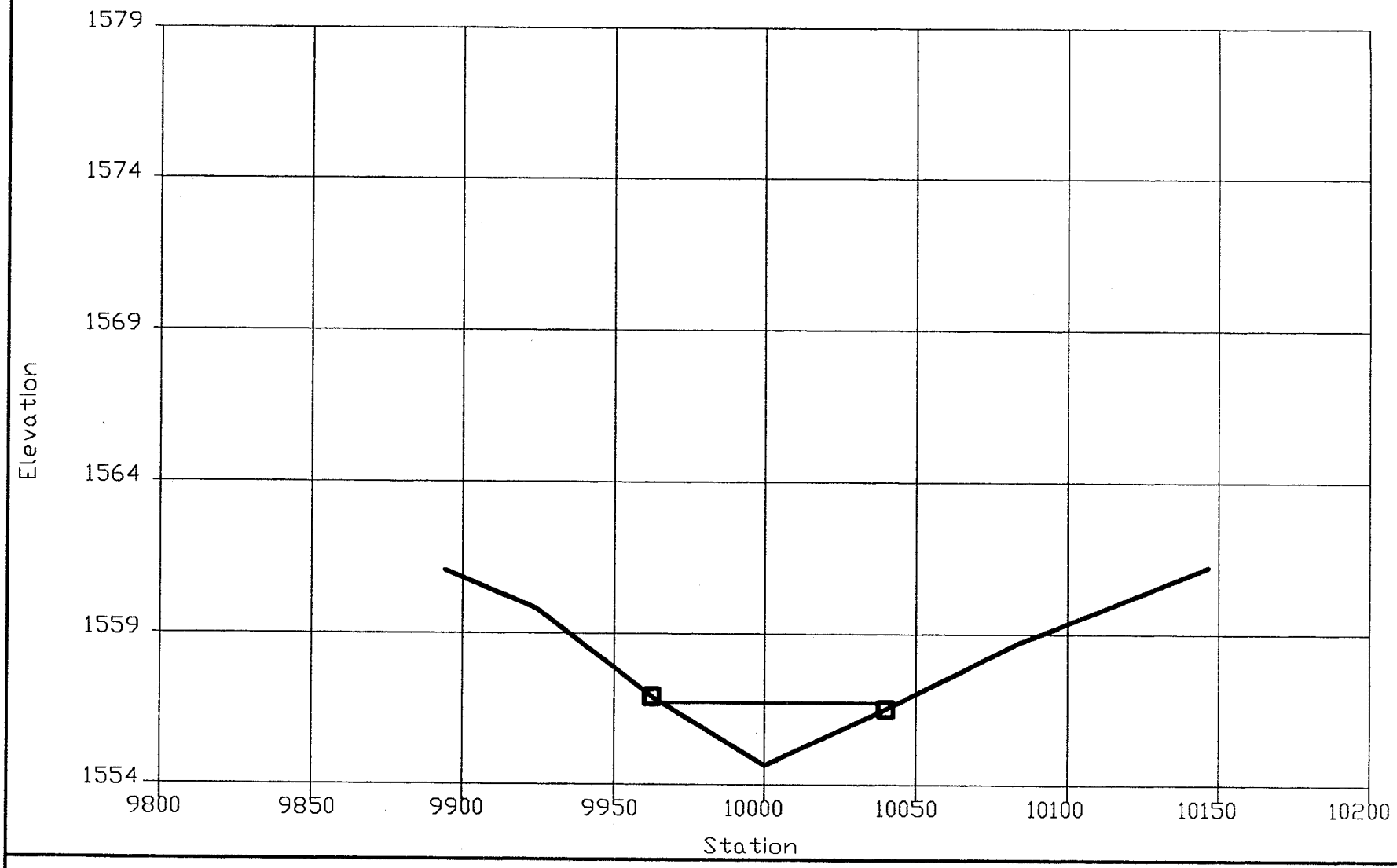
File: LD-XSEC.DWG



SECTION : 0.120

Fountain Hills ADMP
Laser drain

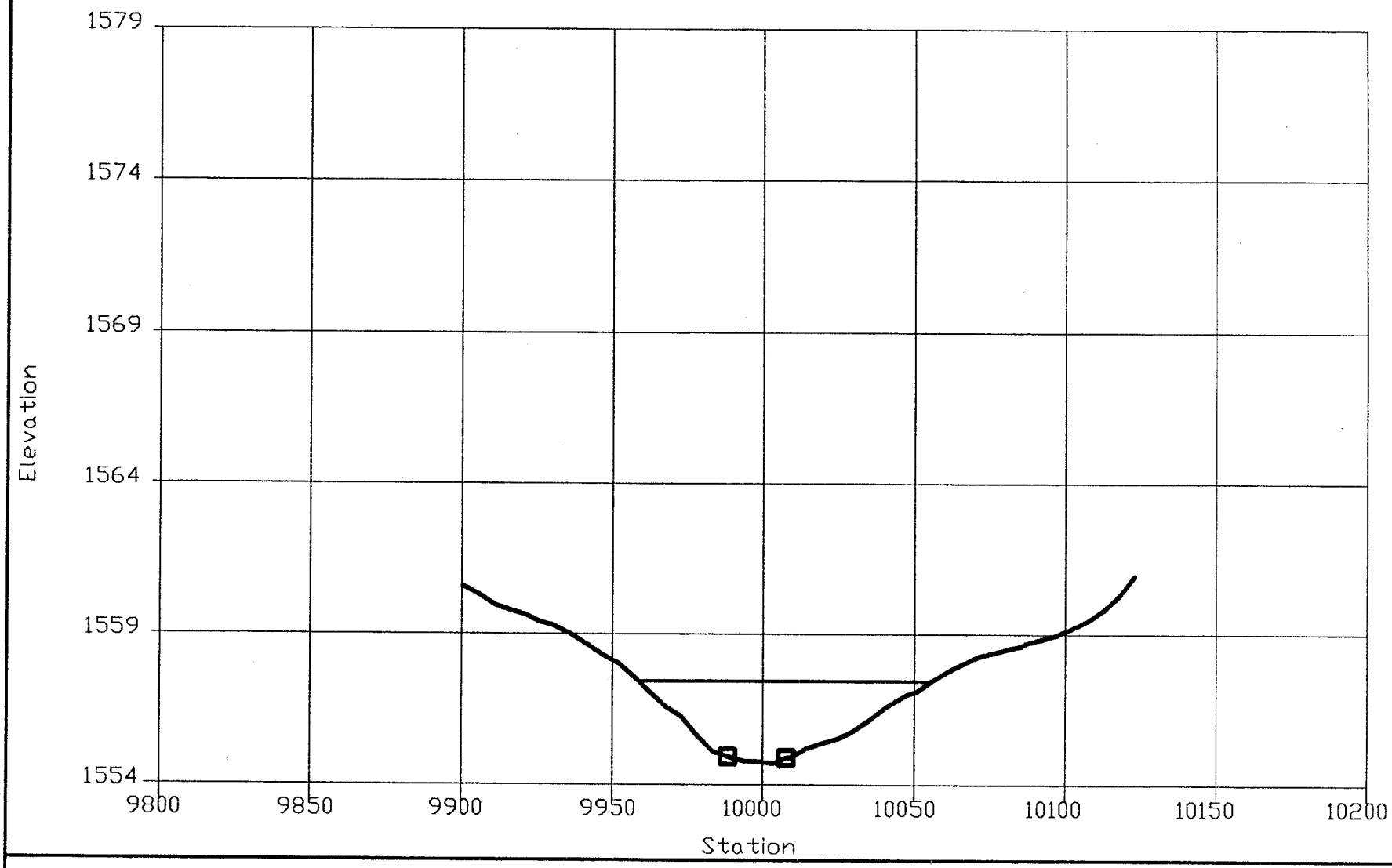
File: LD-XSEC.DWG



SECTION : 0.123

Fountain Hills ADMP
Laser drain

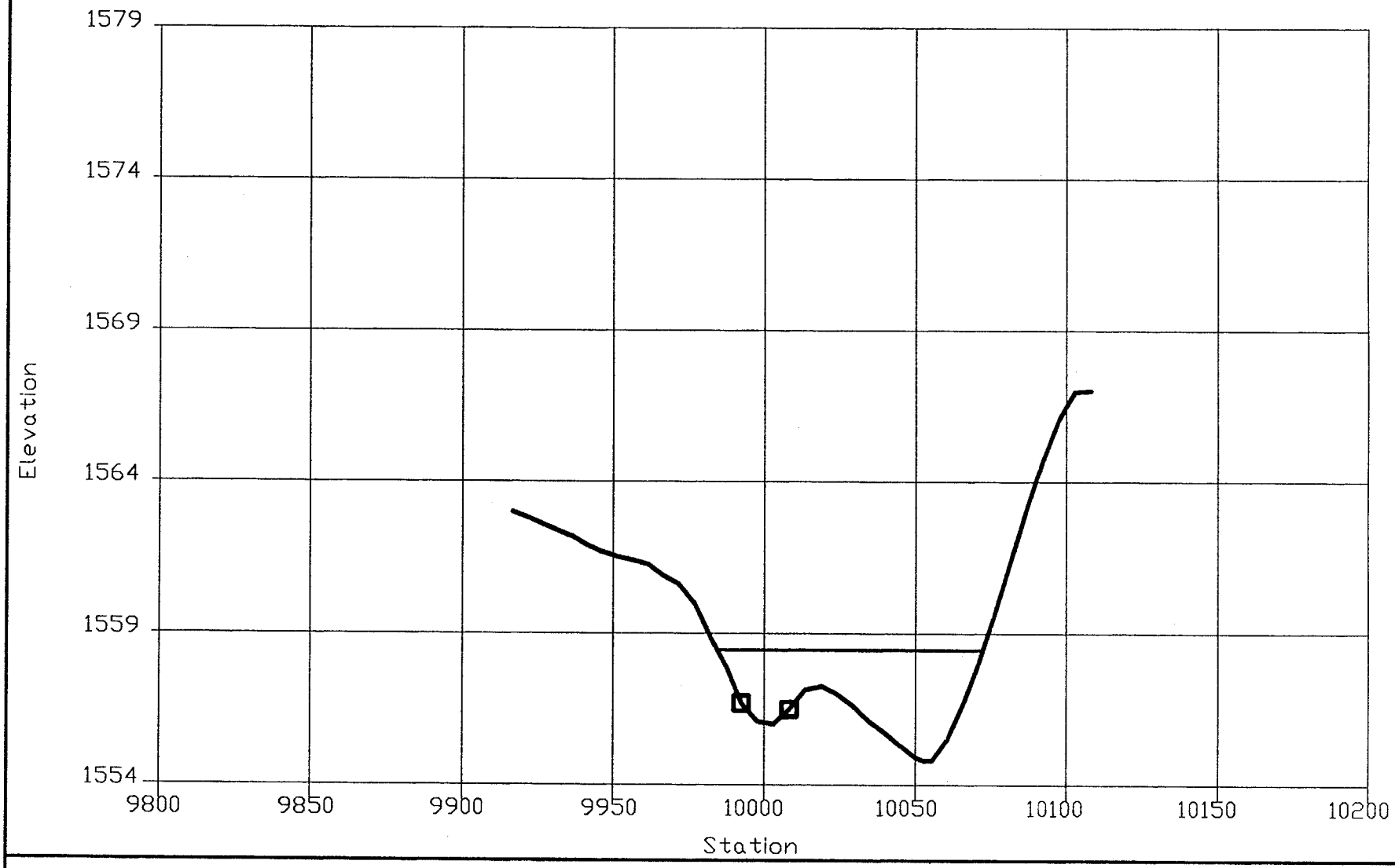
File: LD-XSEC.DWG



SECTION : 0.127

Fountain Hills ADMP
Laser drain

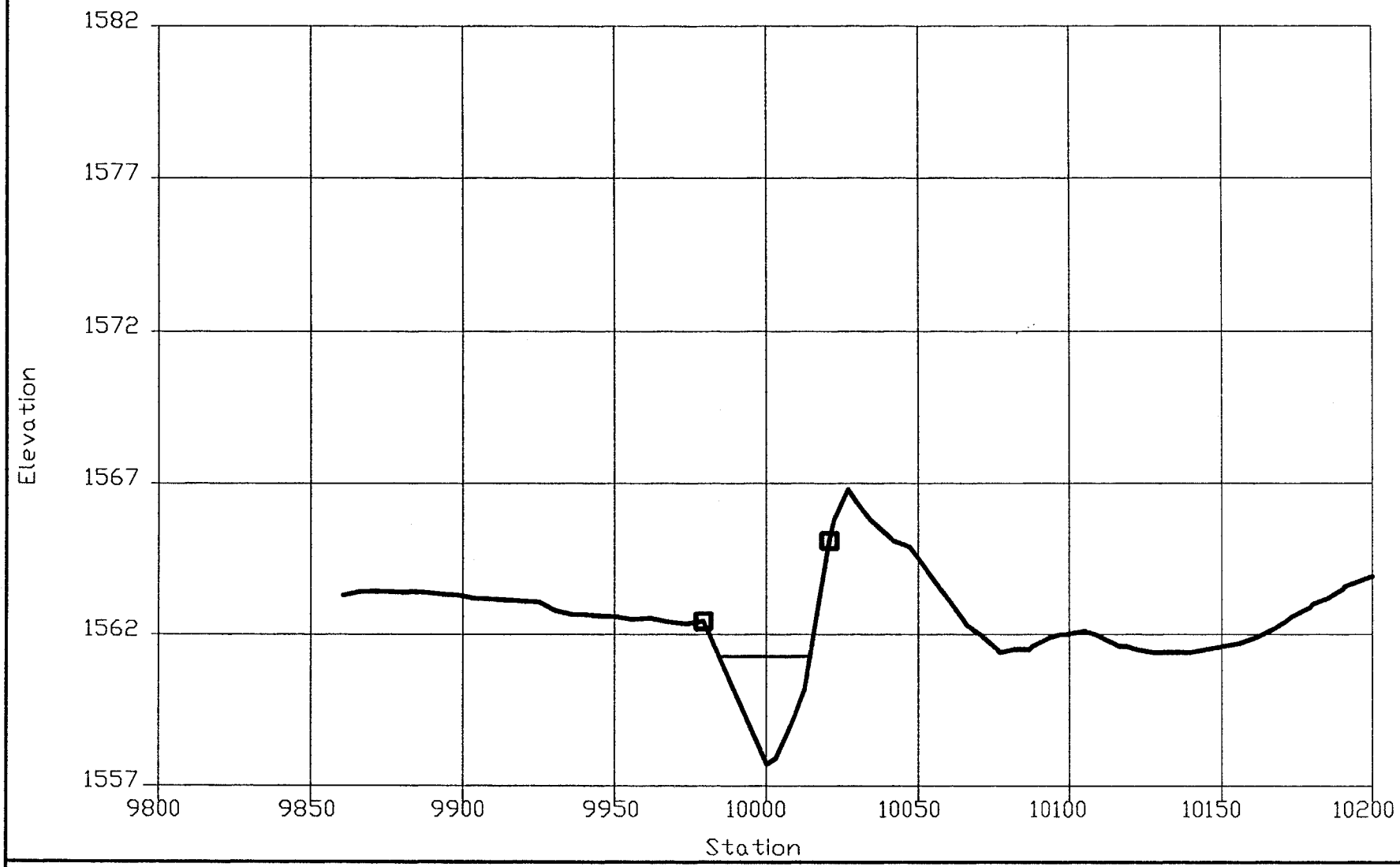
File: LD-XSEC.DWG



SECTION : 0.145

Fountain Hills ADMP
Laser drain

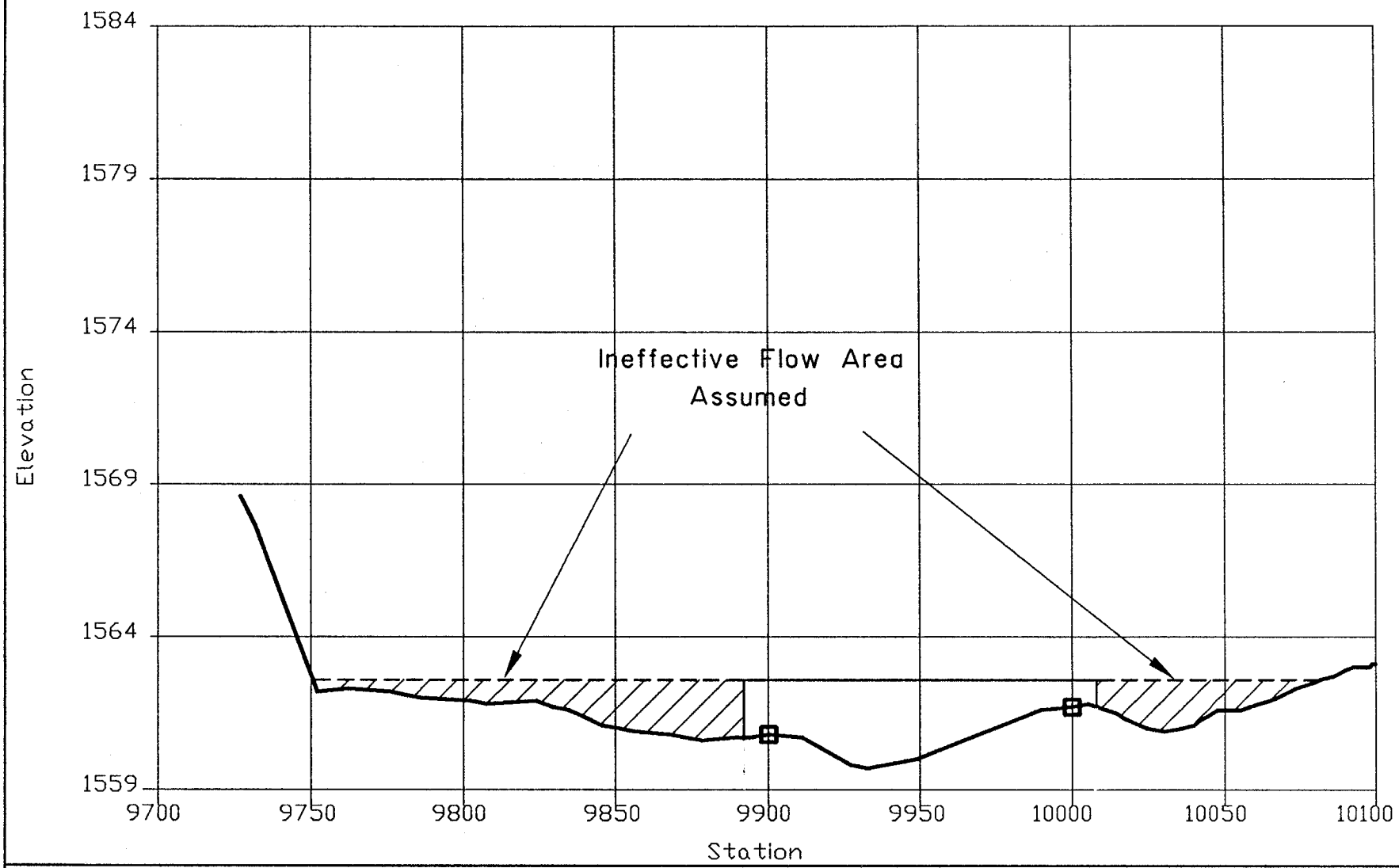
File: LD-XSEC.DWG



SECTION : 0.161

Fountain Hills ADMP
Laser drain

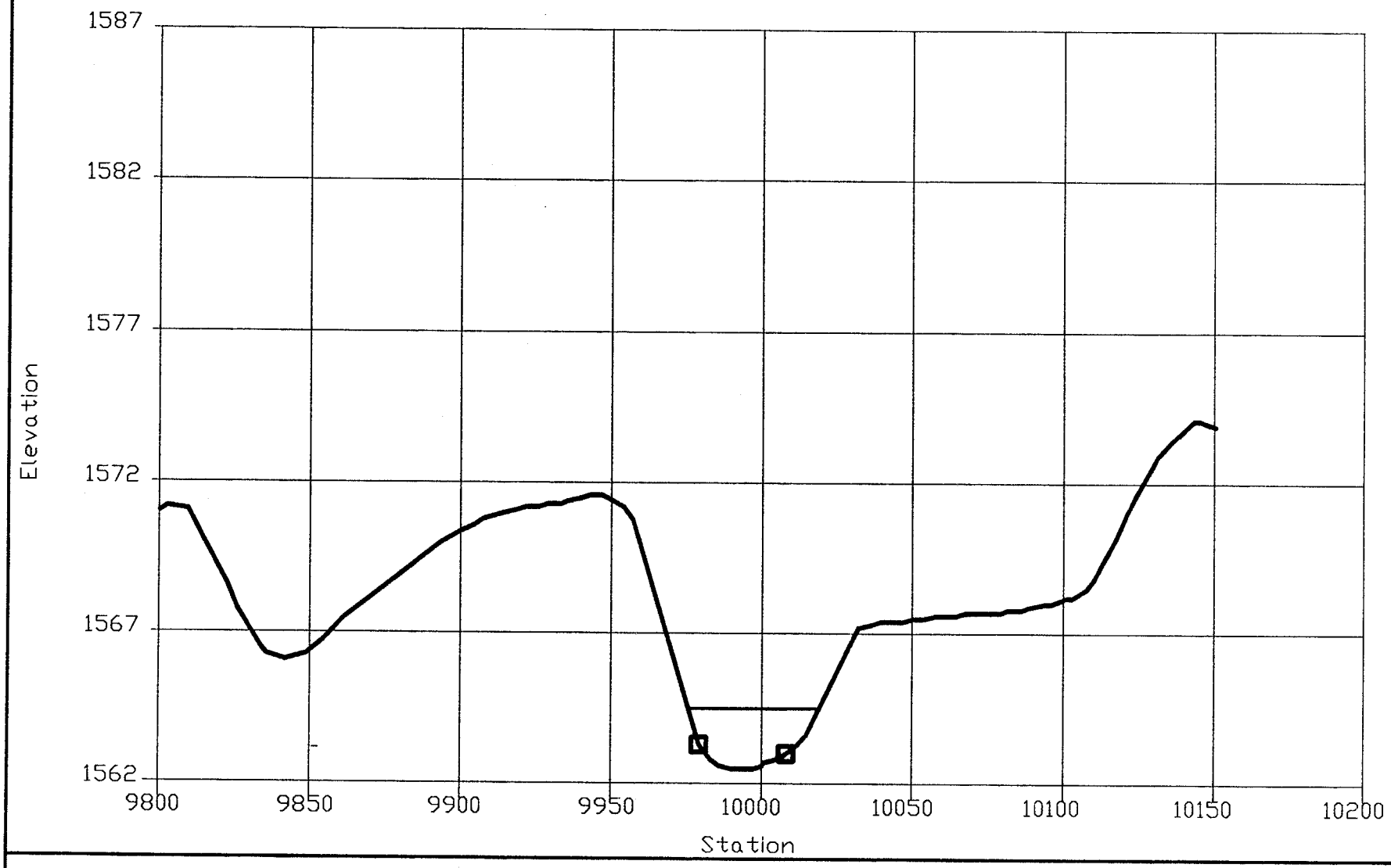
File: LD-XSEC.DWG



SECTION : 0.197

Fountain Hills ADMP
Laser drain

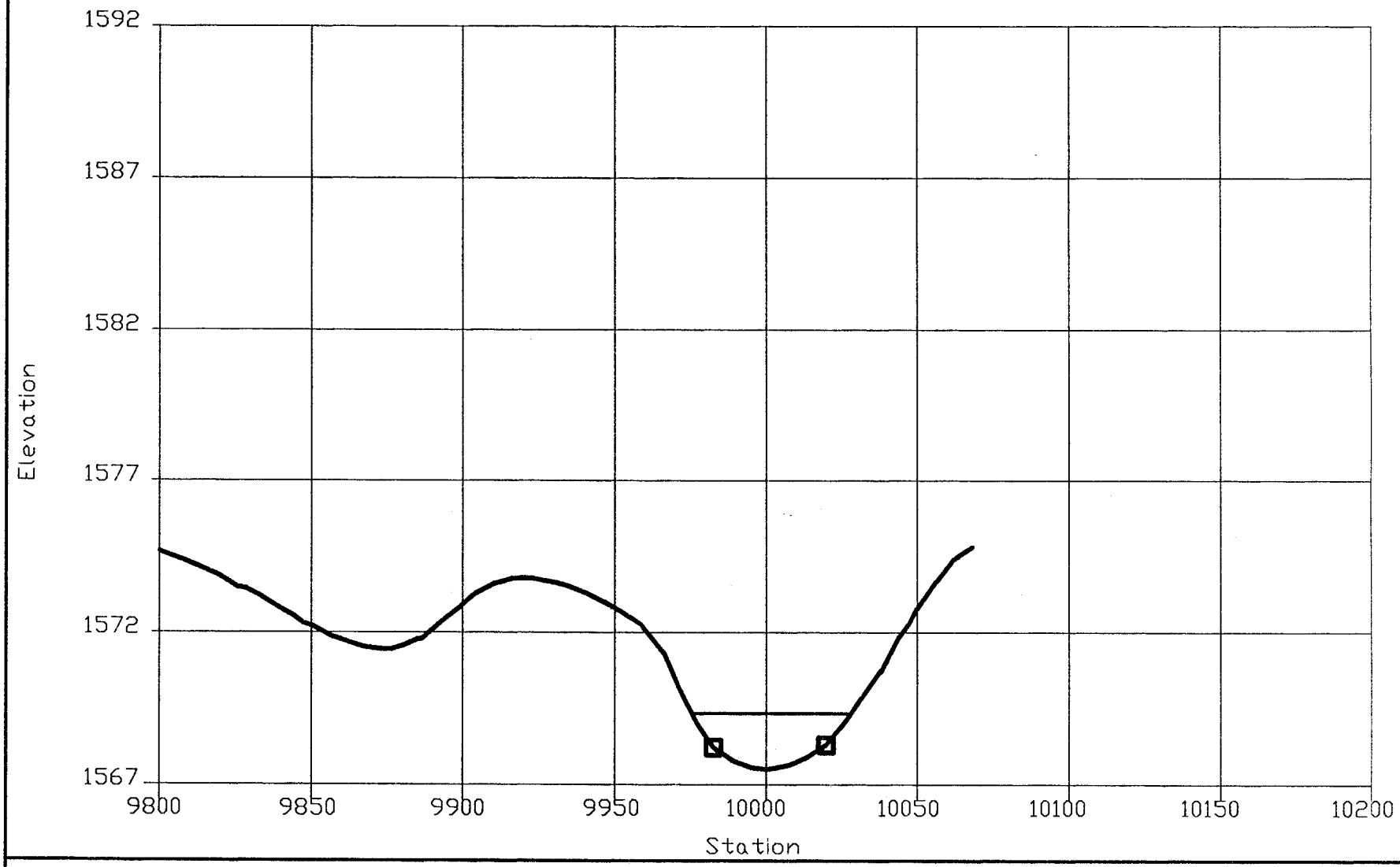
File: LD-XSEC.DWG



SECTION : 0.225

Fountain Hills ADMP
Laser drain

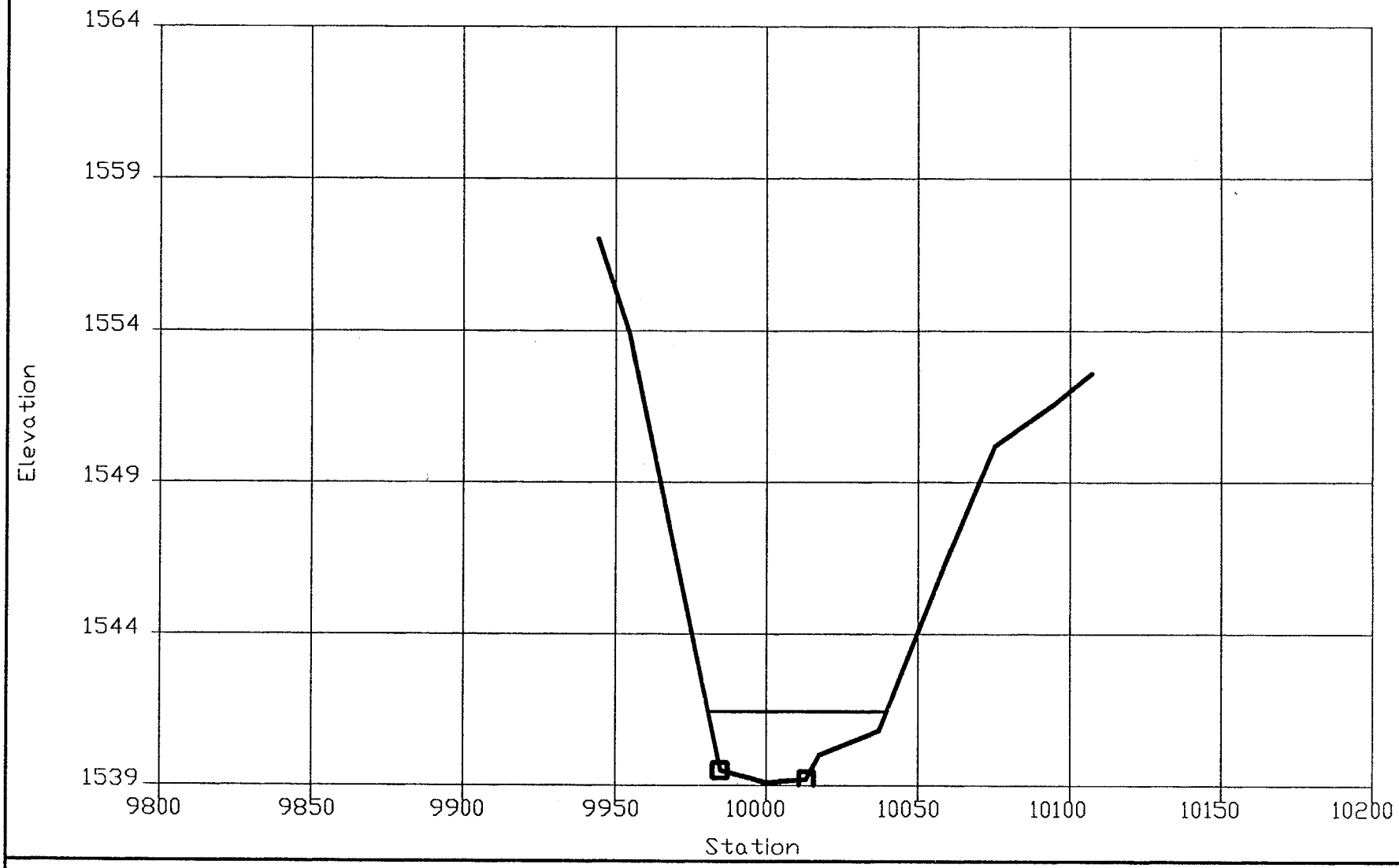
File: LD-XSEC.DWG



SECTION : 0.271

Fountain Hills ADMP
Laser drain

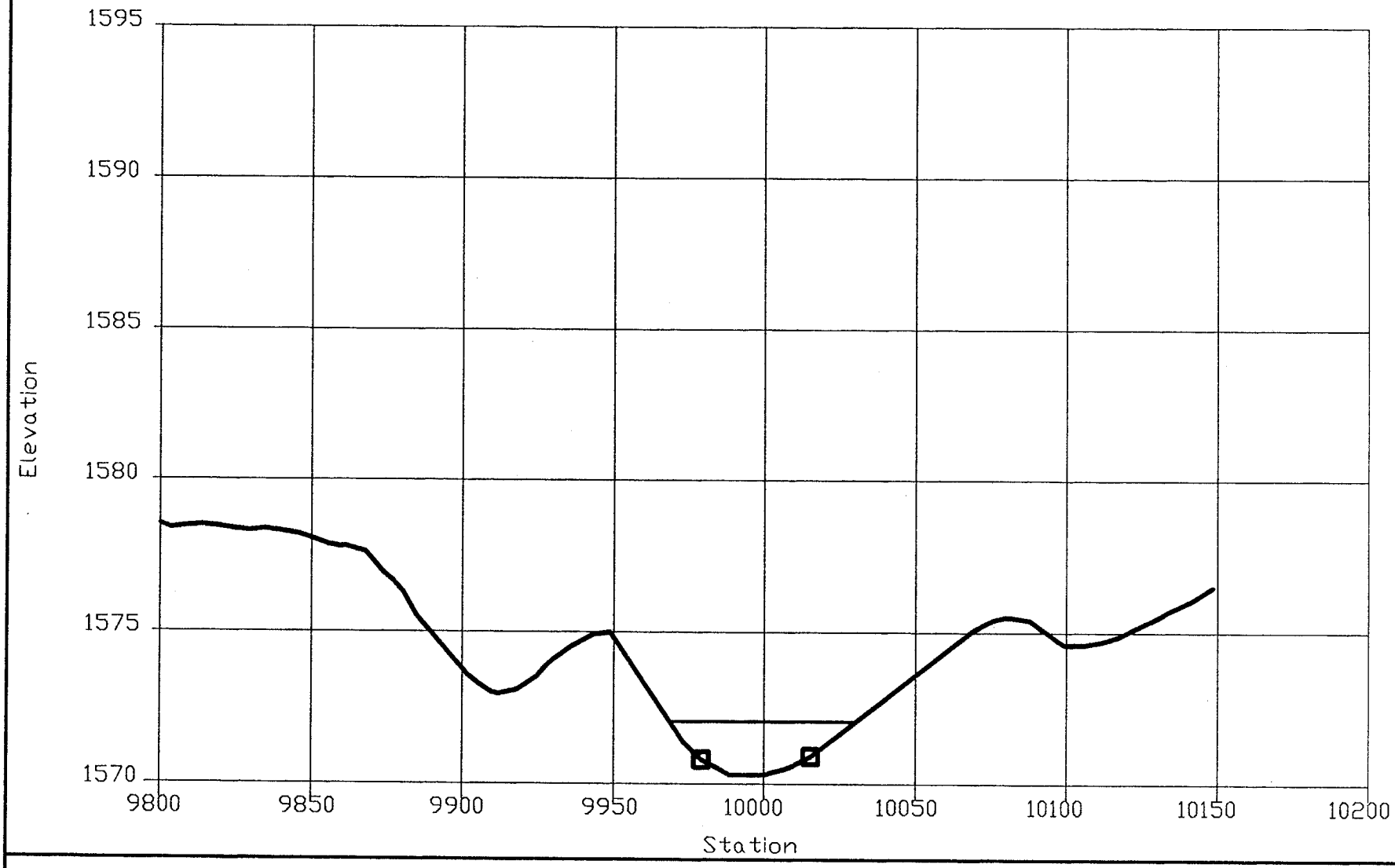
File: LD-XSEC.DWG



SECTION : 2.88

Fountain Hills ADMP
Laser drain

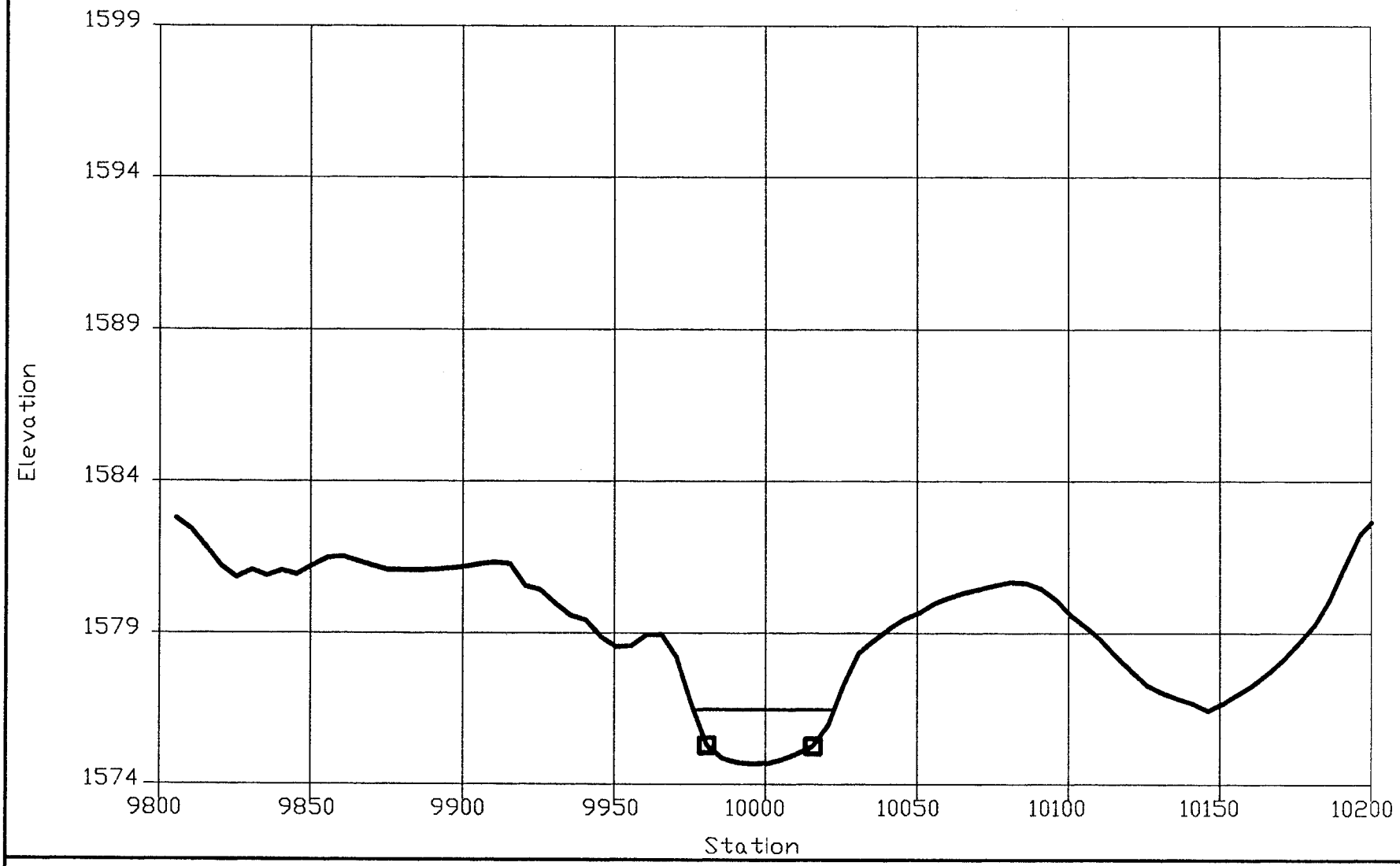
File: LD-XSEC.DWG



SECTION : 0.306

Fountain Hills ADMP
Laser drain

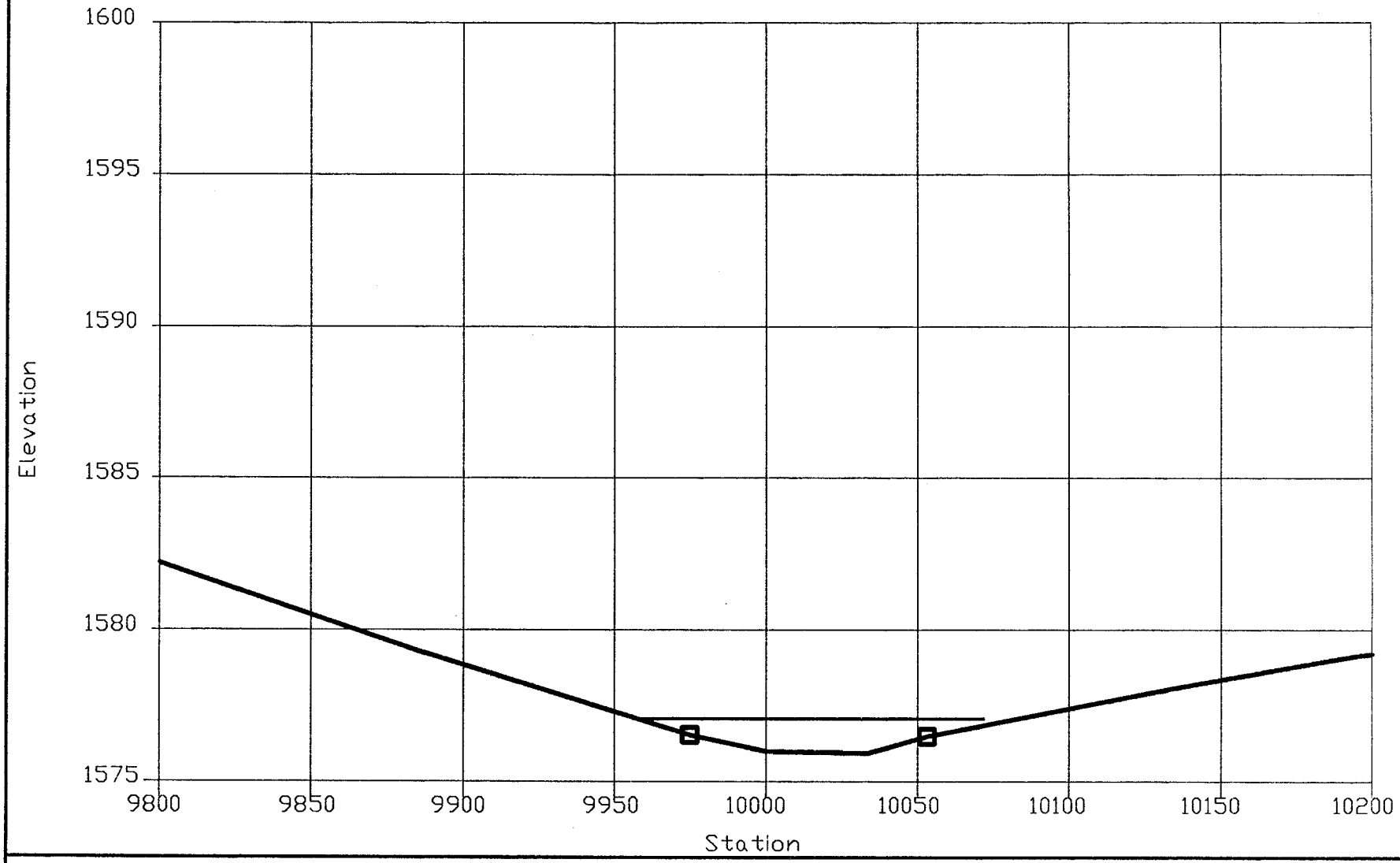
File: LD-XSEC.DWG



SECTION : 0.362

Fountain Hills ADMP
Laser drain

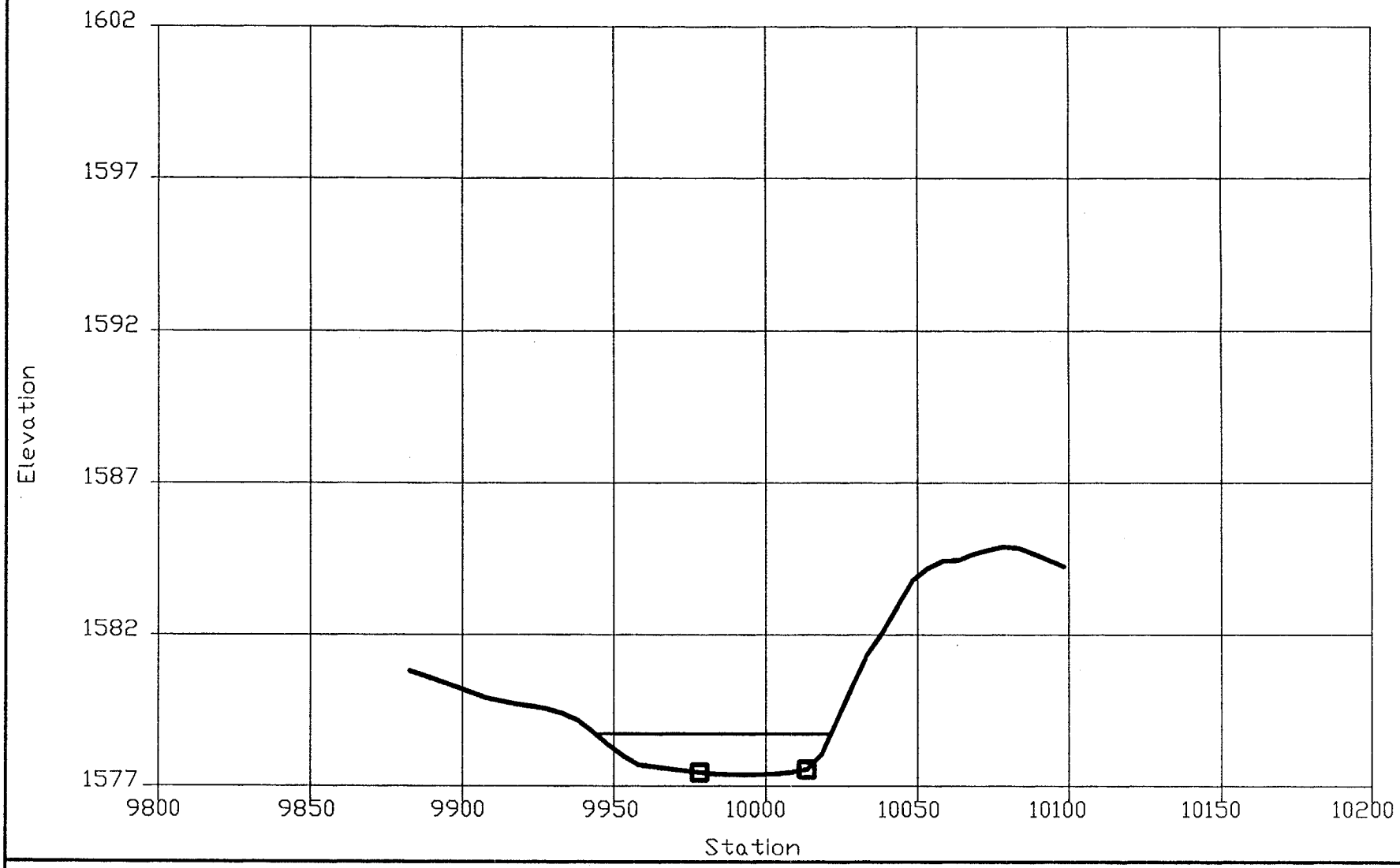
File: LD-XSEC.DWG



SECTION : 0.368

Fountain Hills ADMP
Laser drain

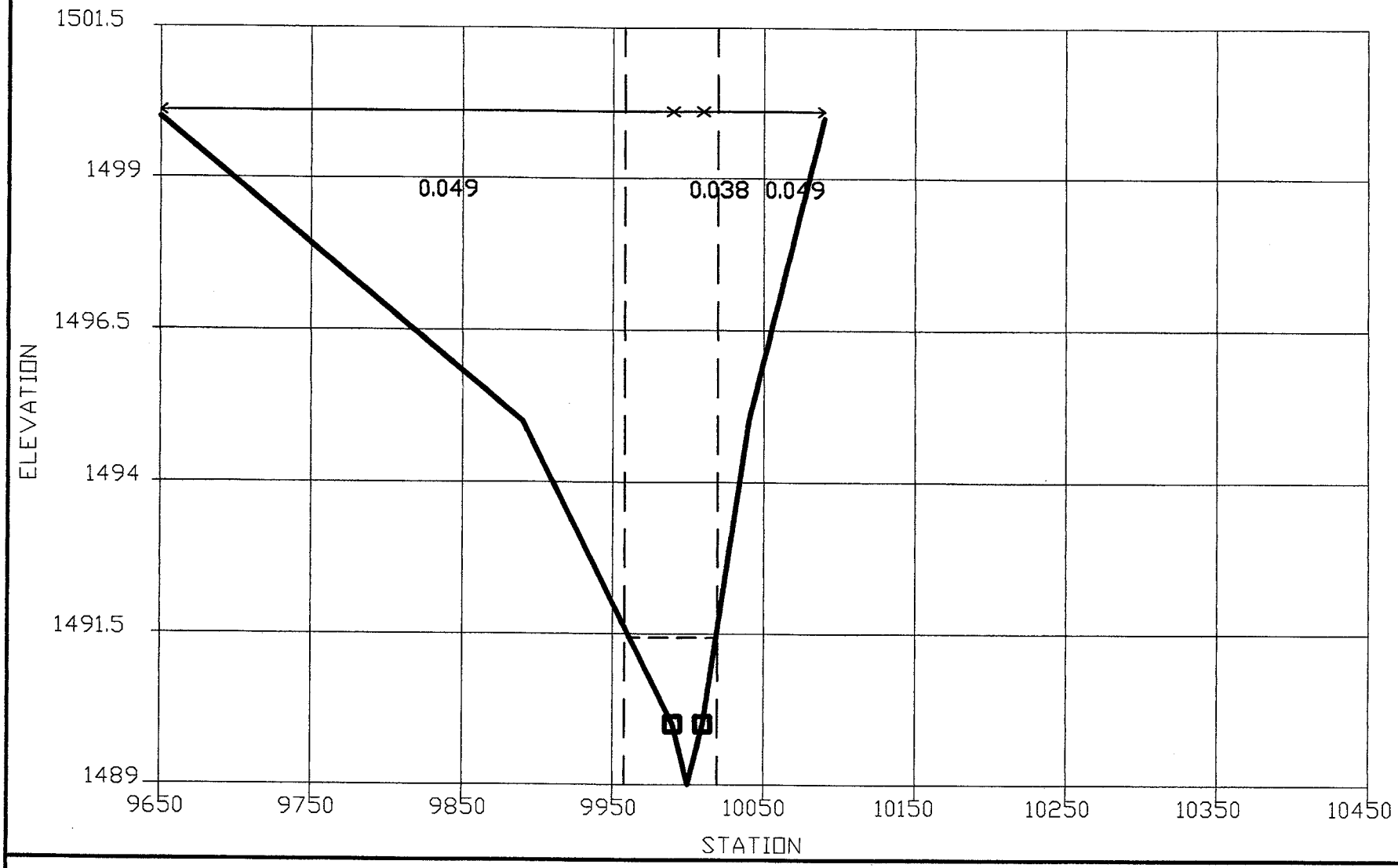
File: LD-XSEC.DWG



SECTION : 0.388

Fountain Hills ADMP
Laser drain

File: LD-XSEC.DWG

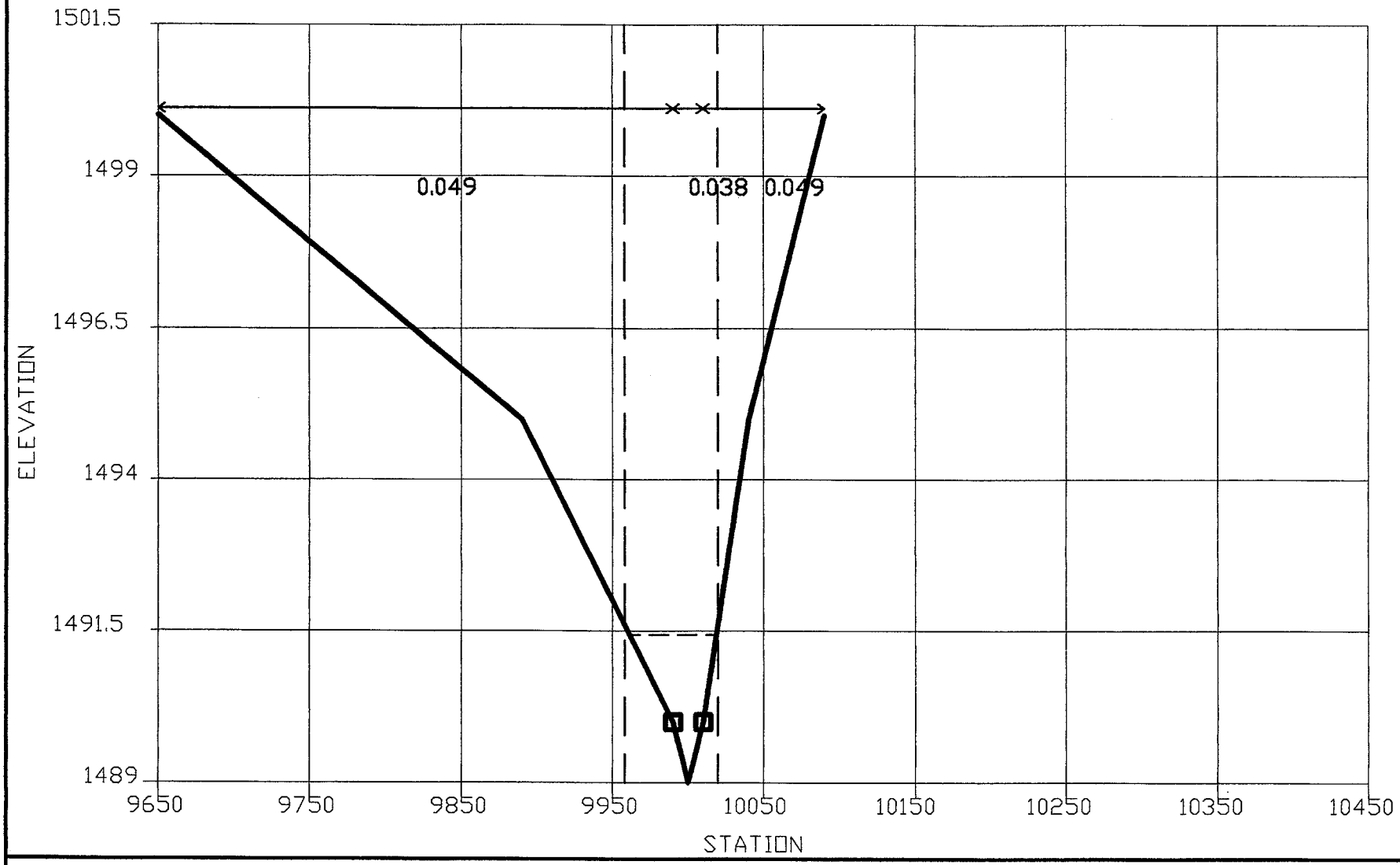


SECTION : 10000

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

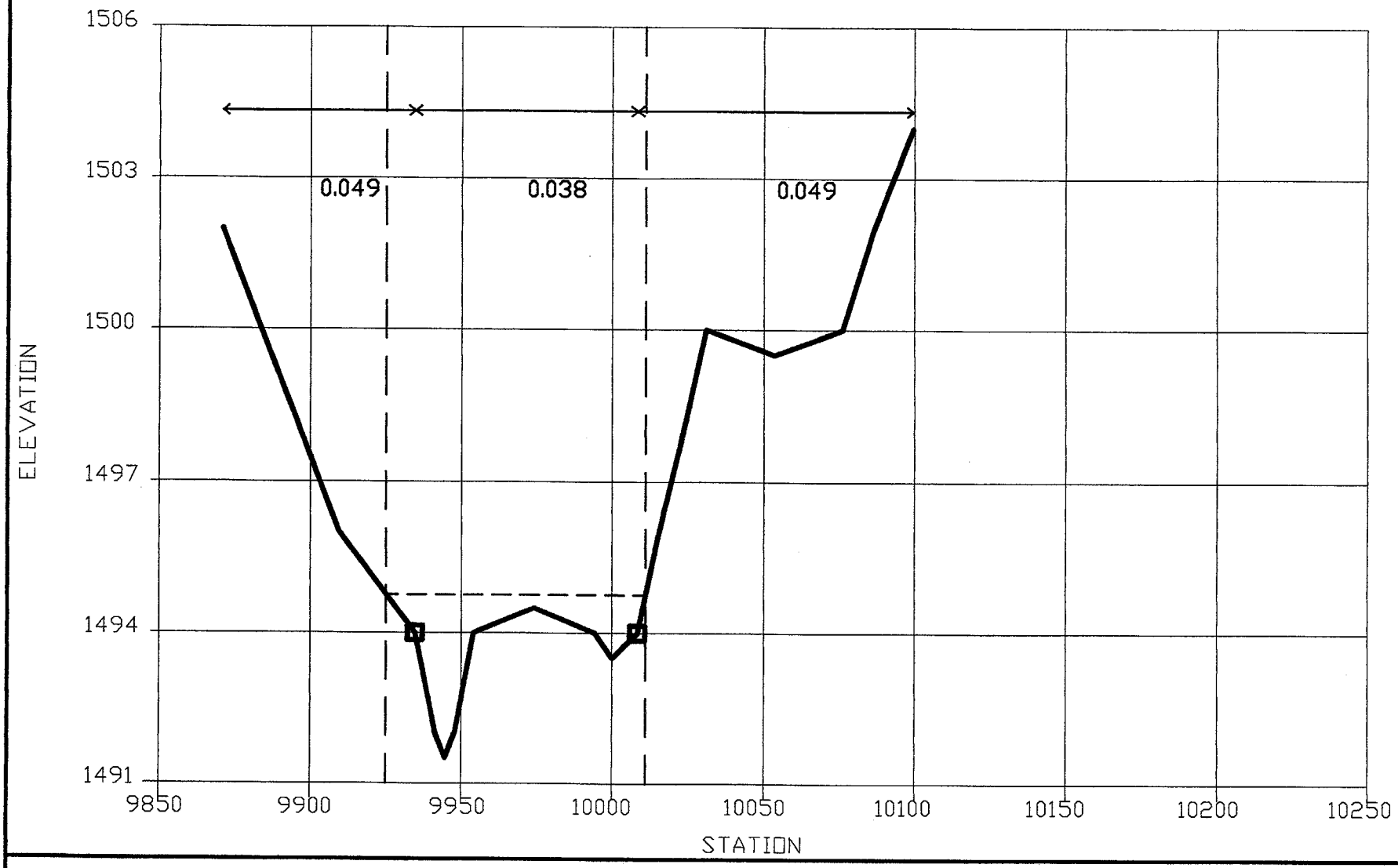


SECTION : 10000

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

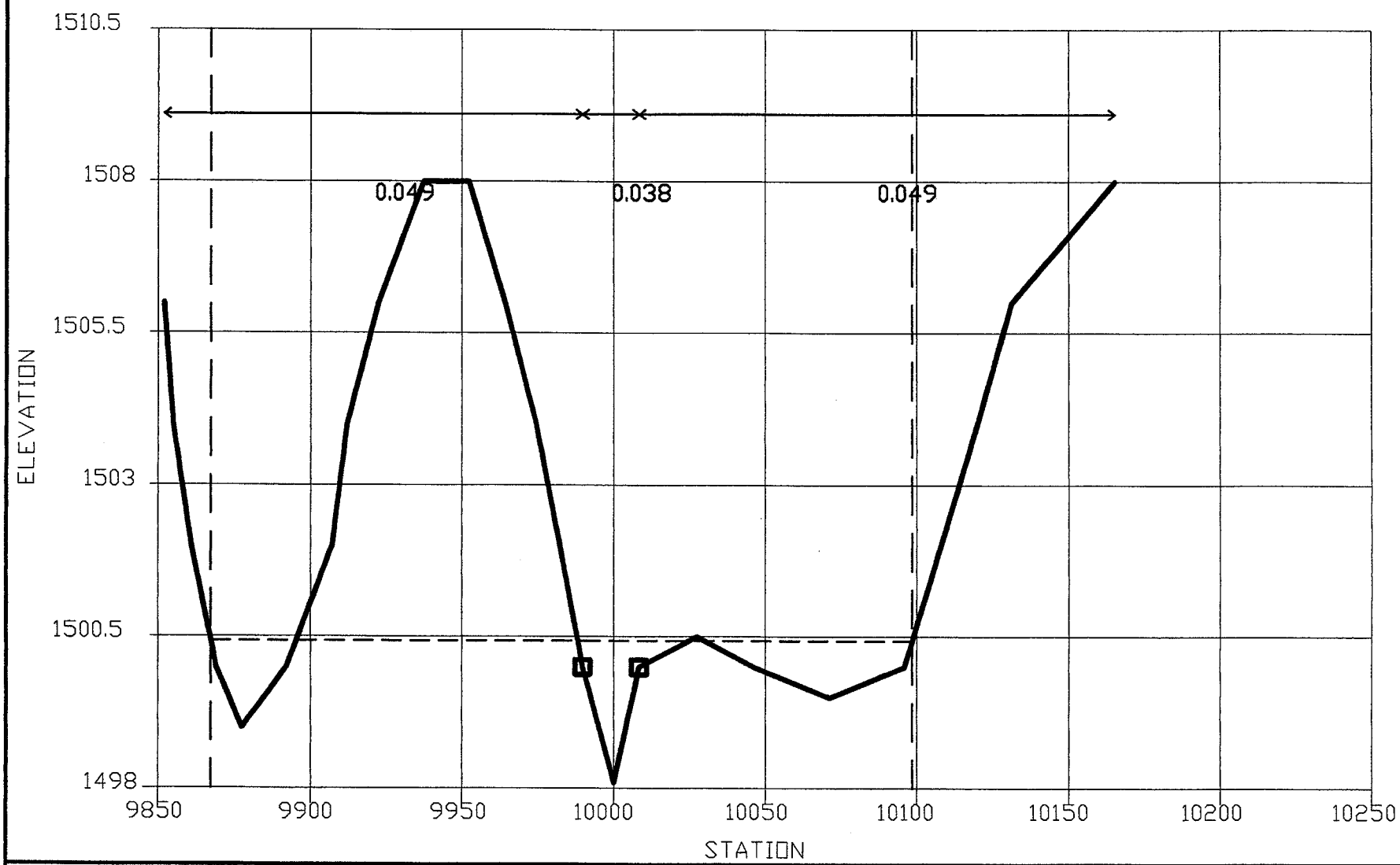


SECTION : 2.18

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

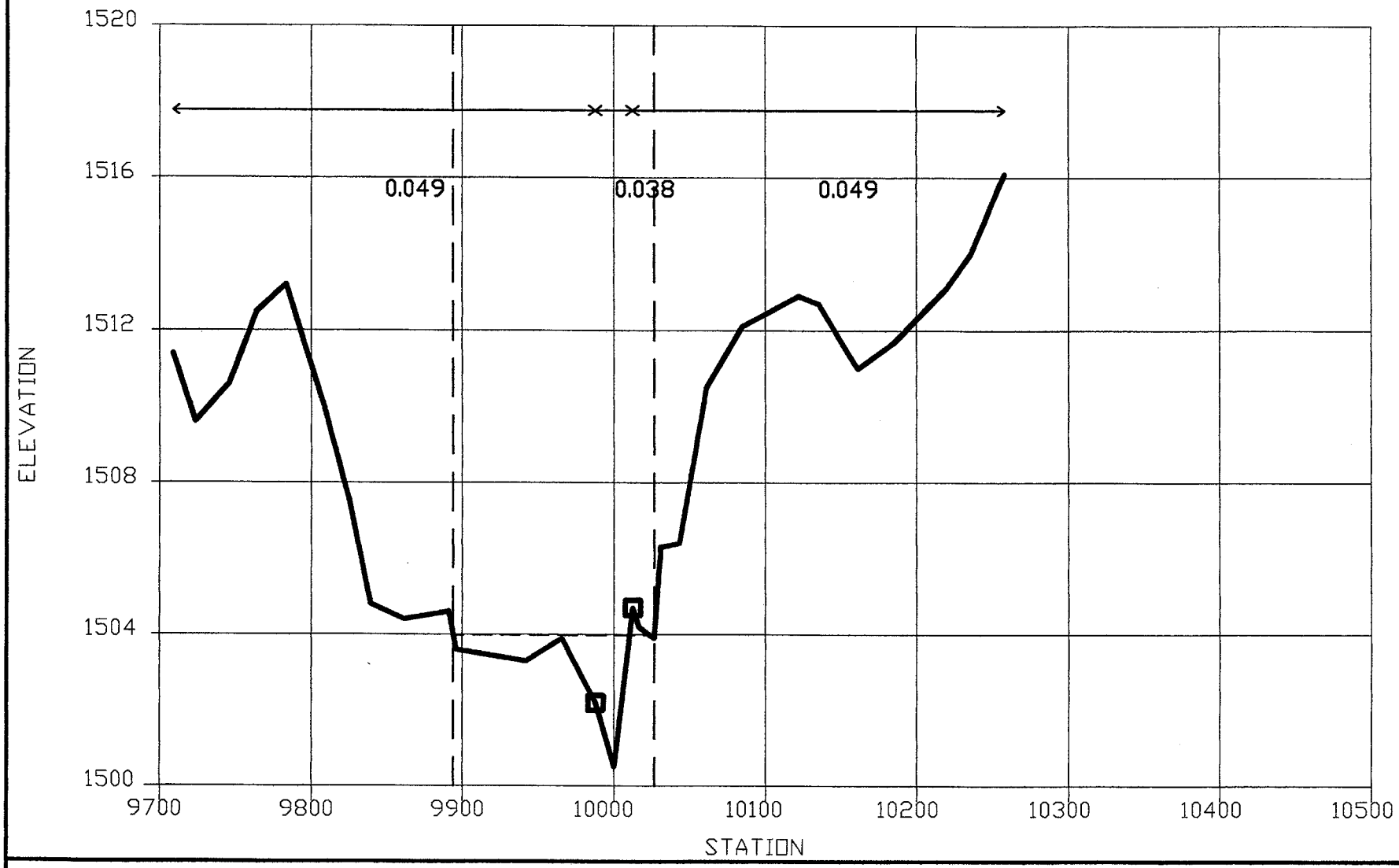


SECTION : 2.23

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

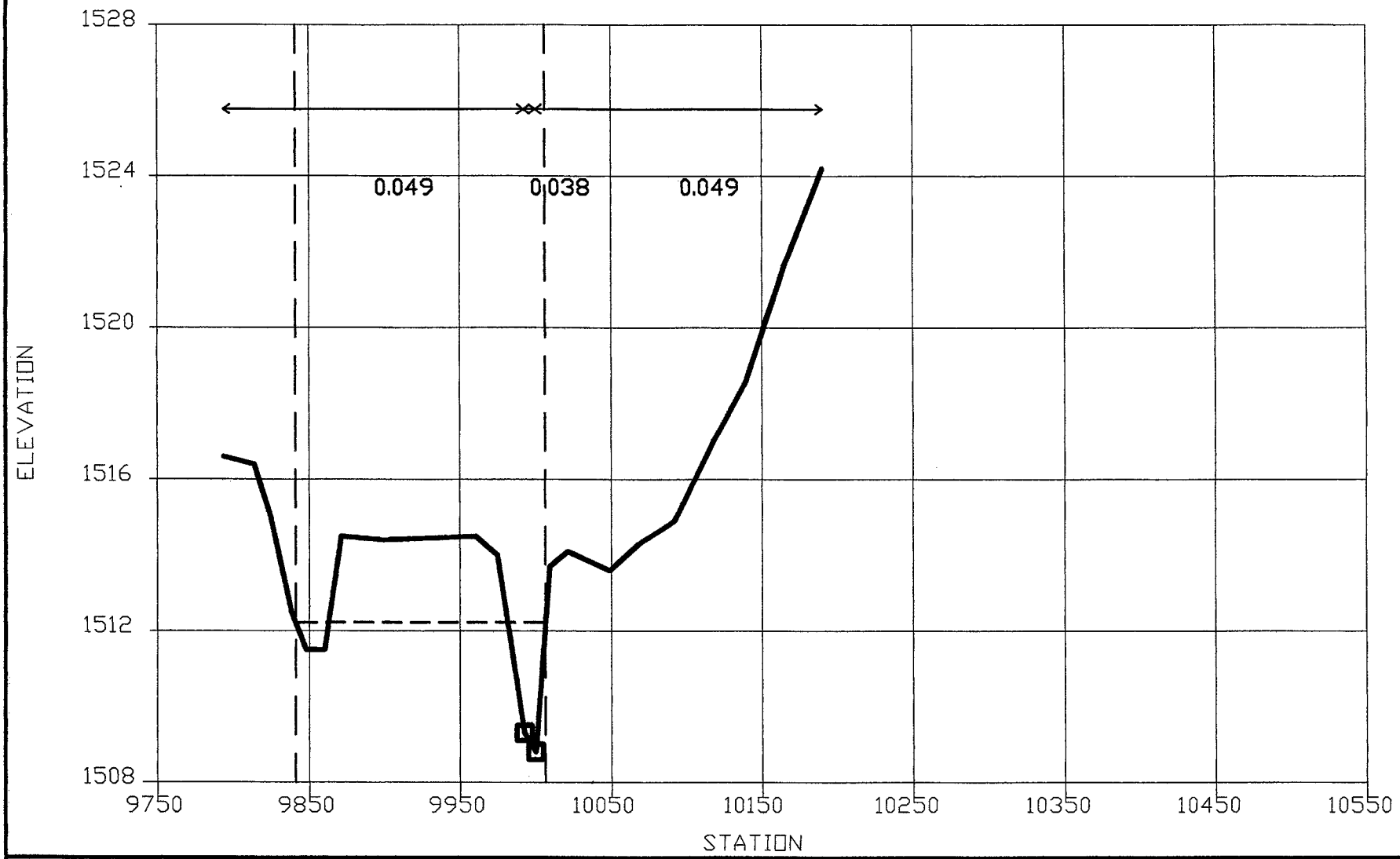


SECTION : 2.25

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

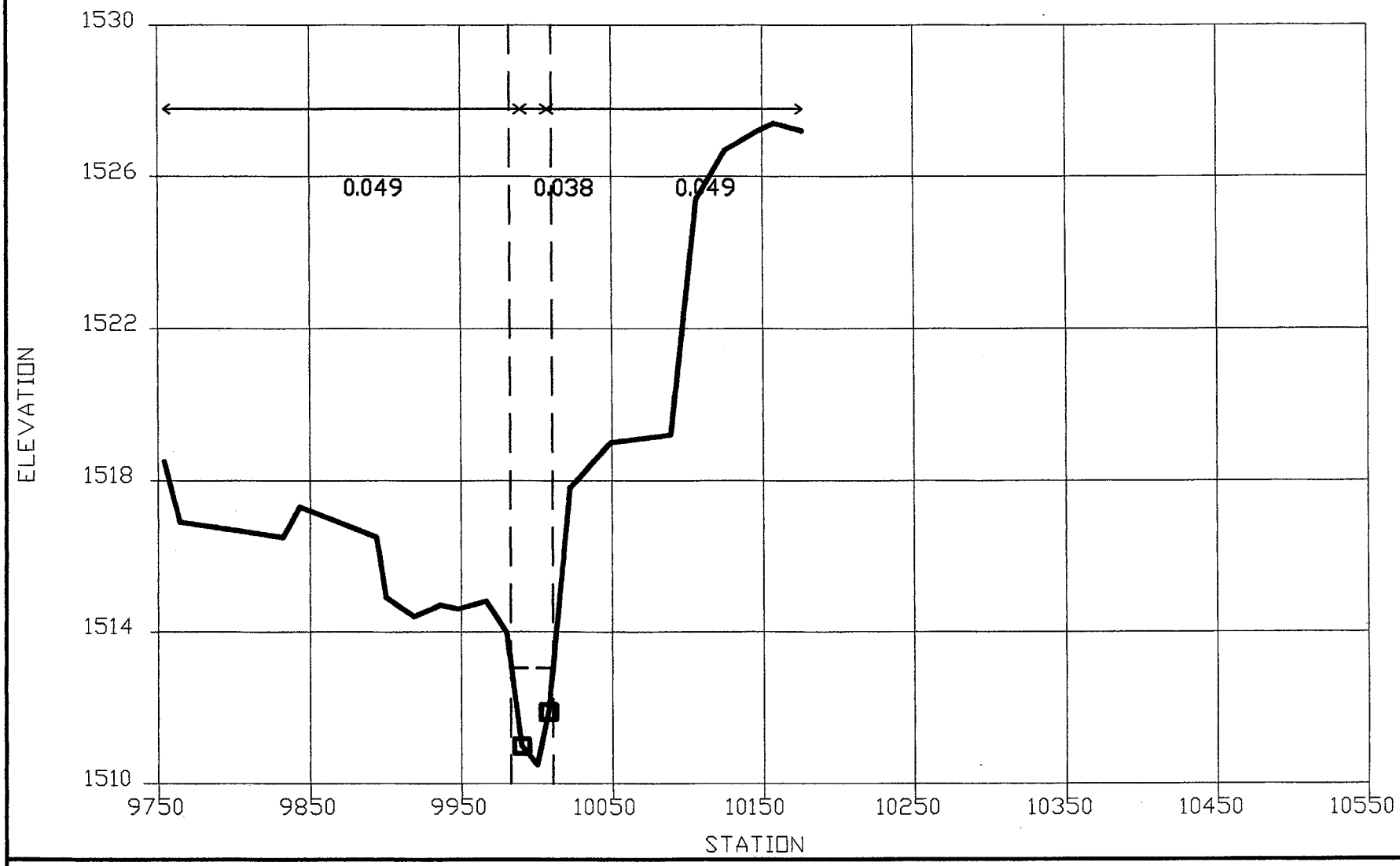


SECTION : 2.29

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

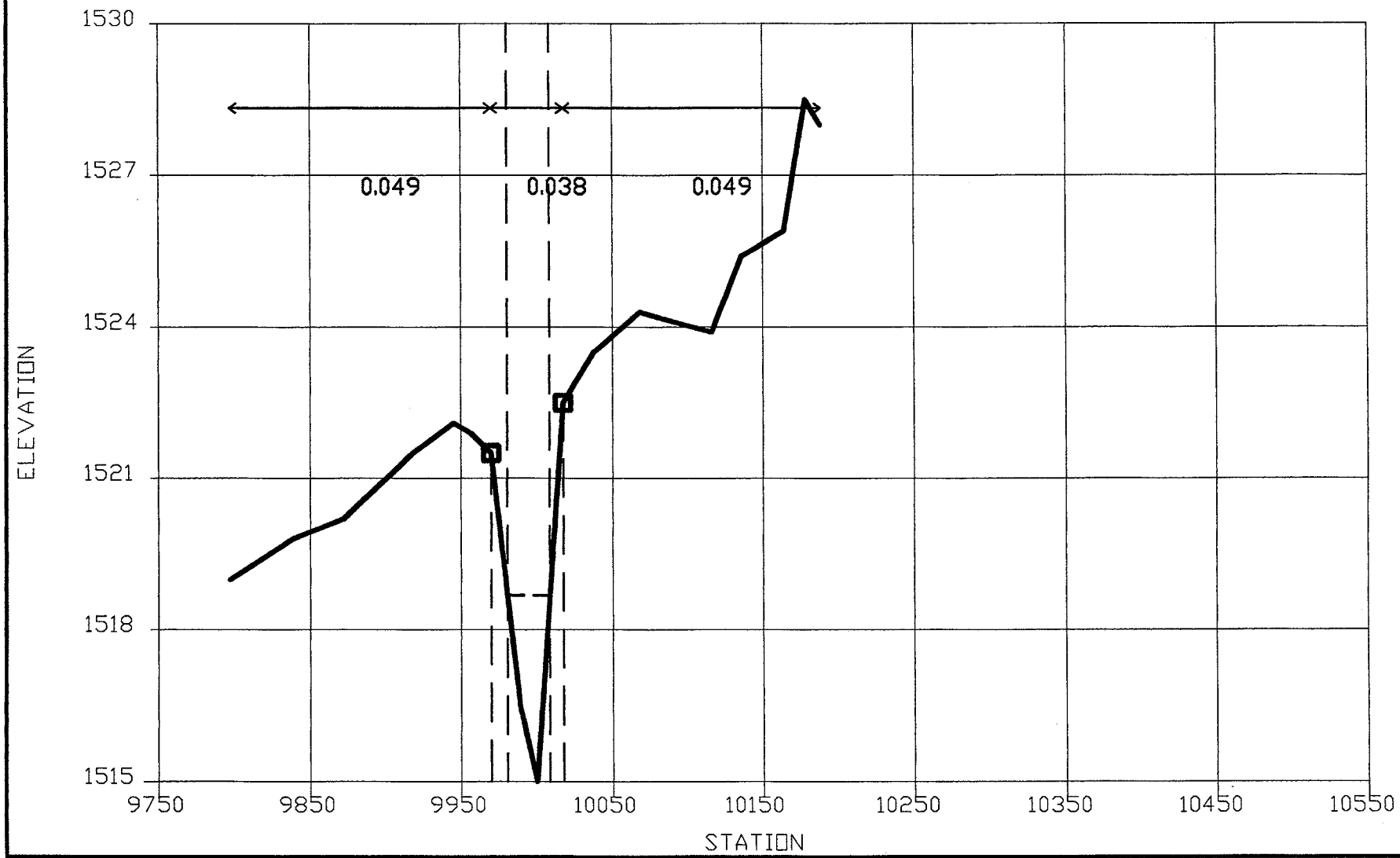


SECTION : 2.30

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

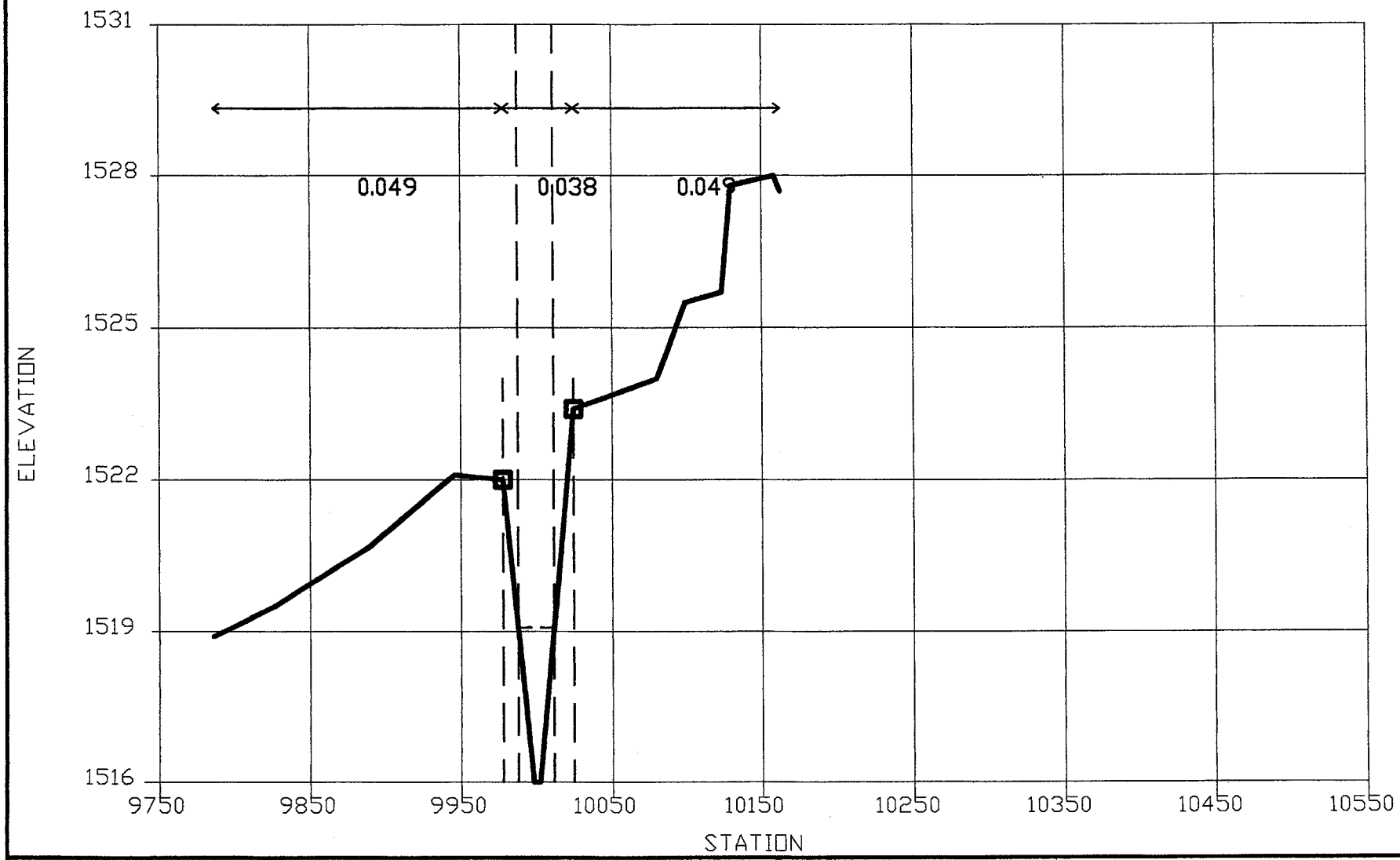


SECTION : 2.38

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

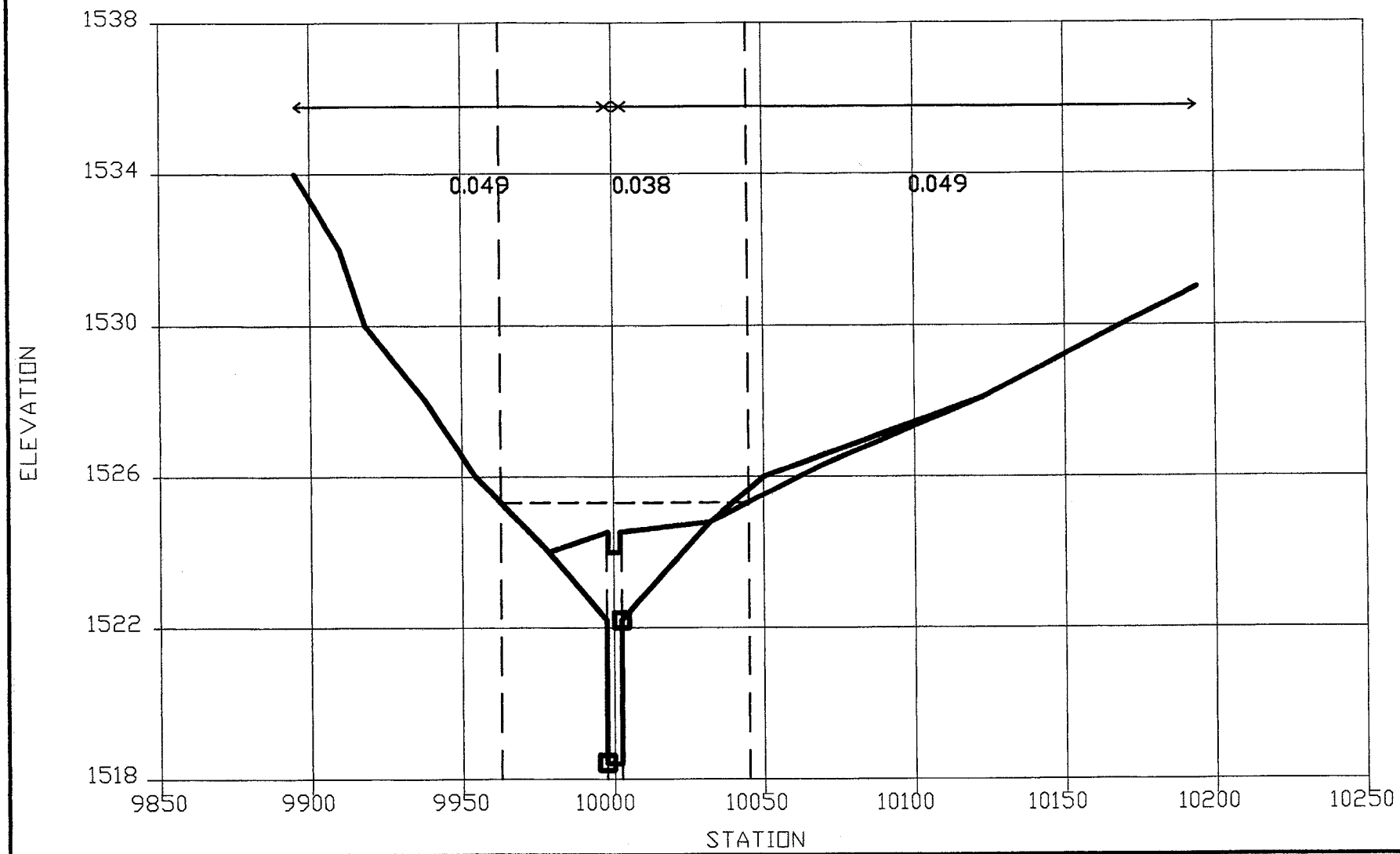


SECTION : 2.39

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

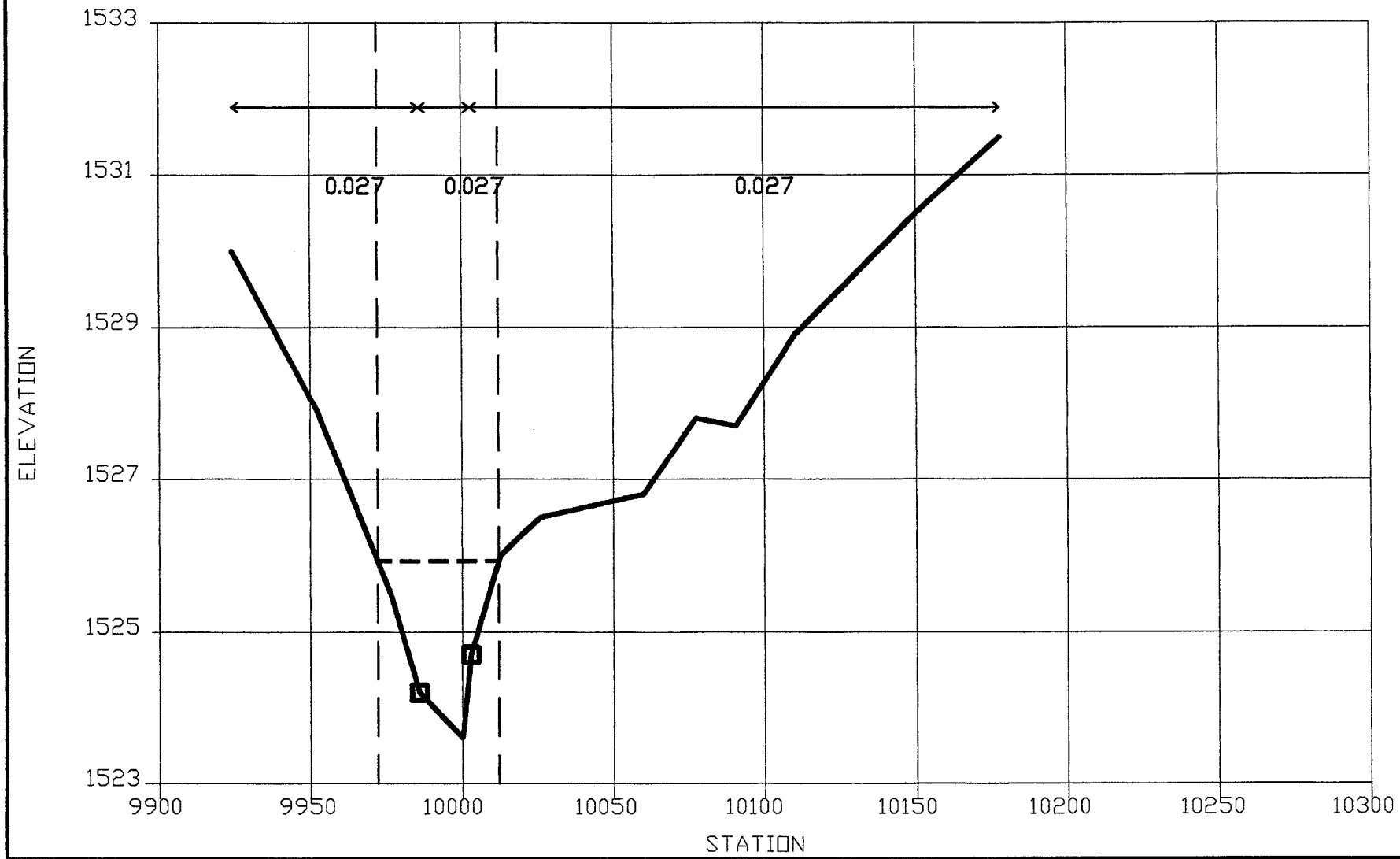


SECTION : 2.43

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

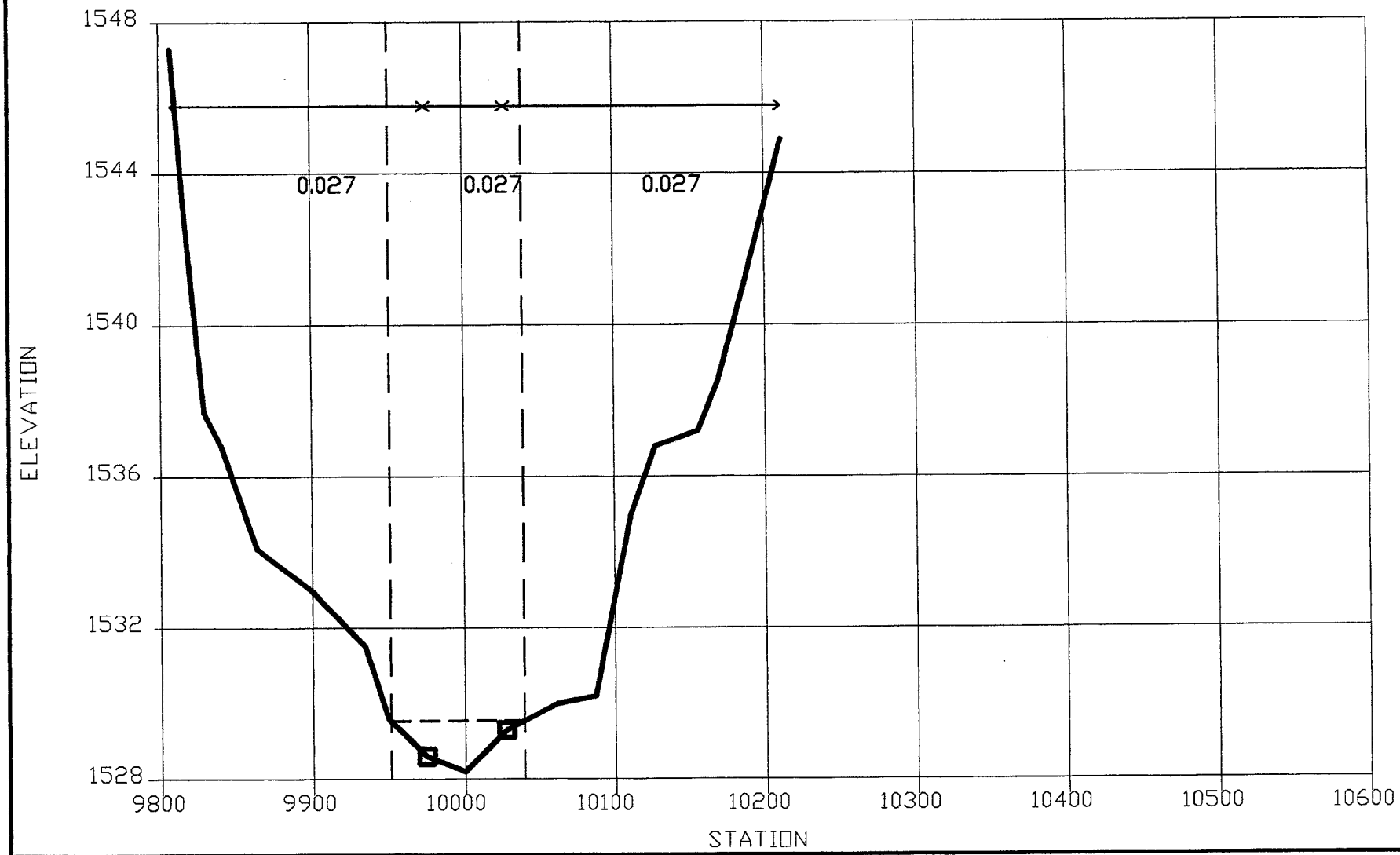


SECTION : 2.44

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

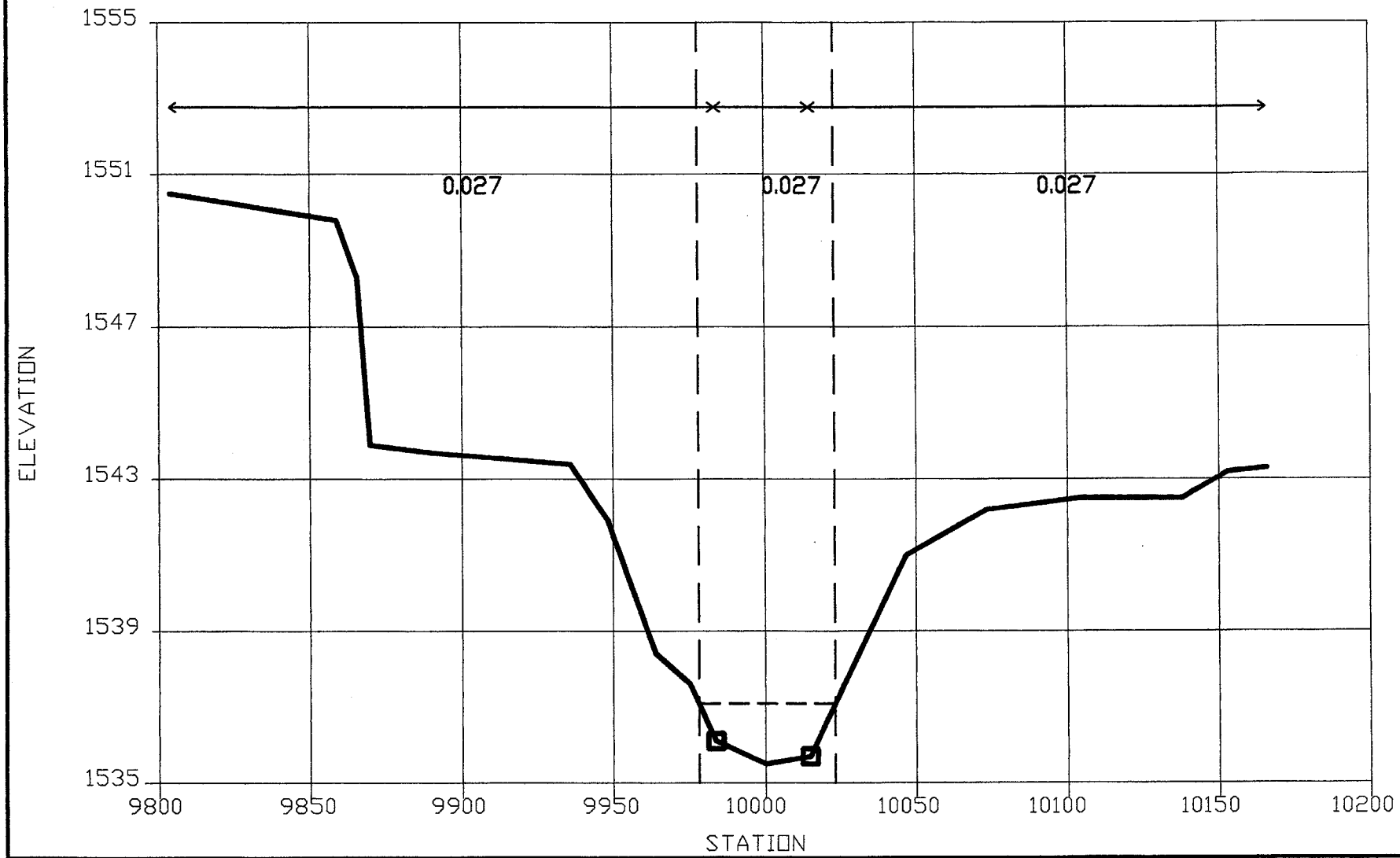


SECTION : 2.48

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

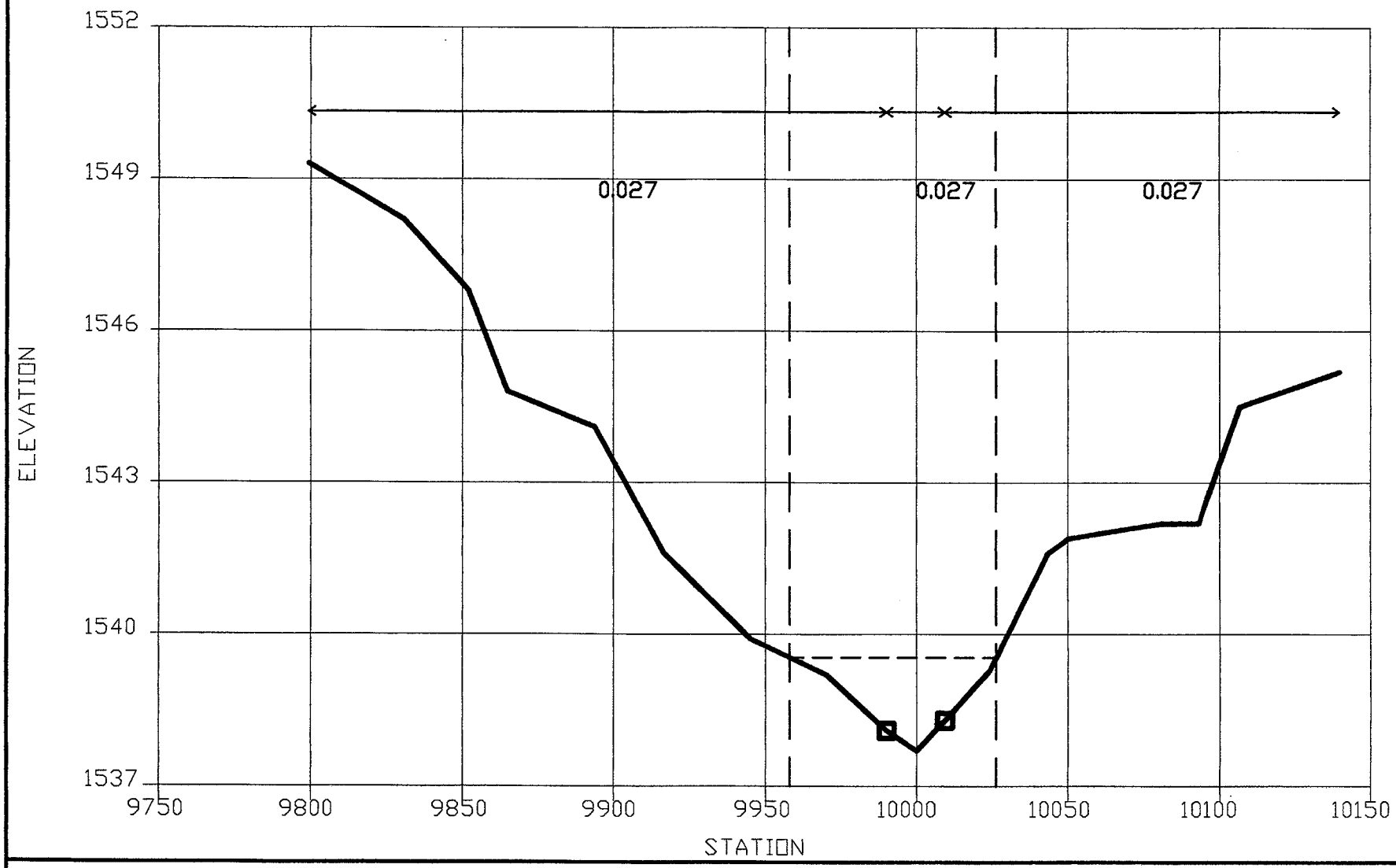


SECTION : 2.52

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

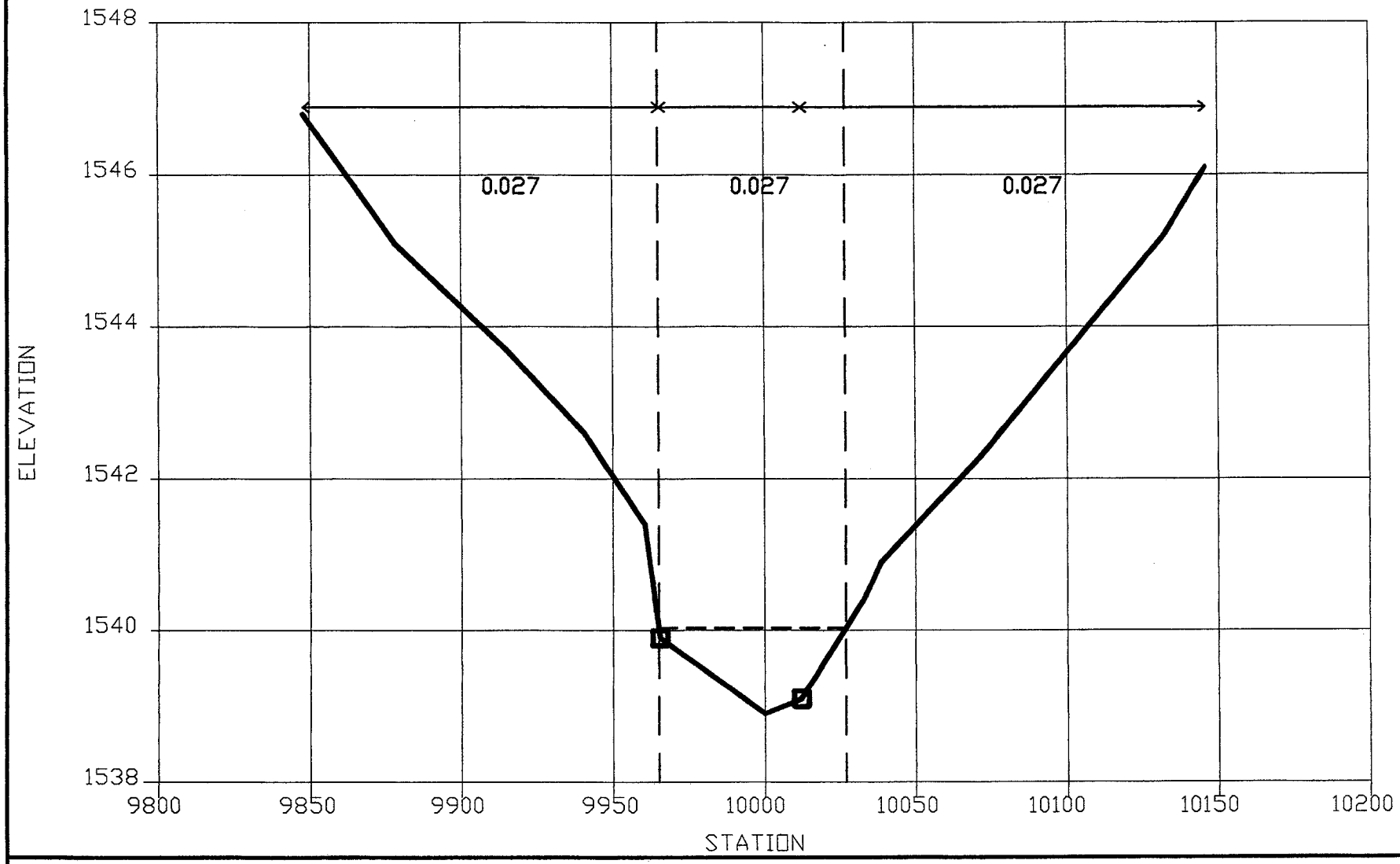


SECTION : 2.53

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

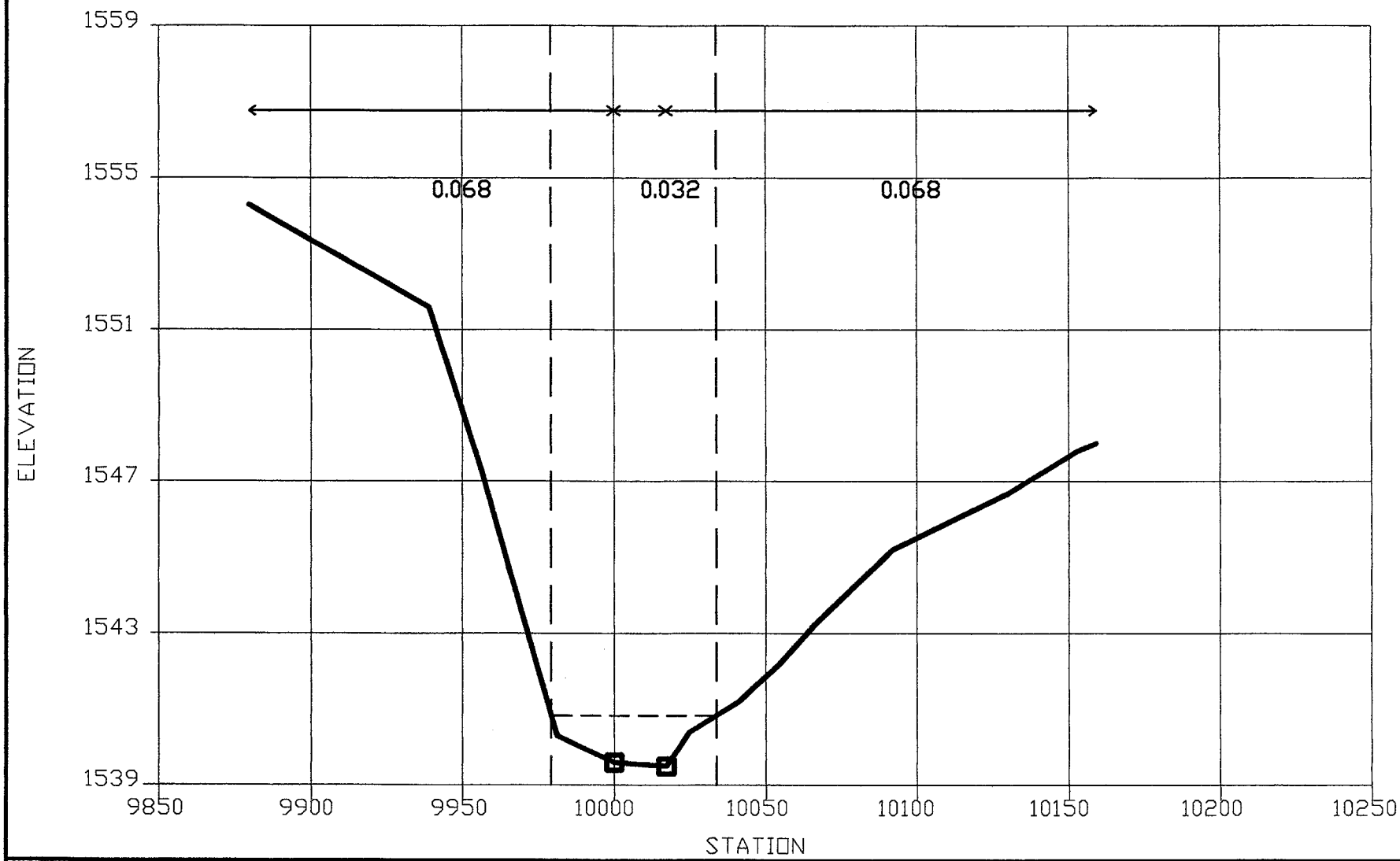


SECTION : 2.54

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

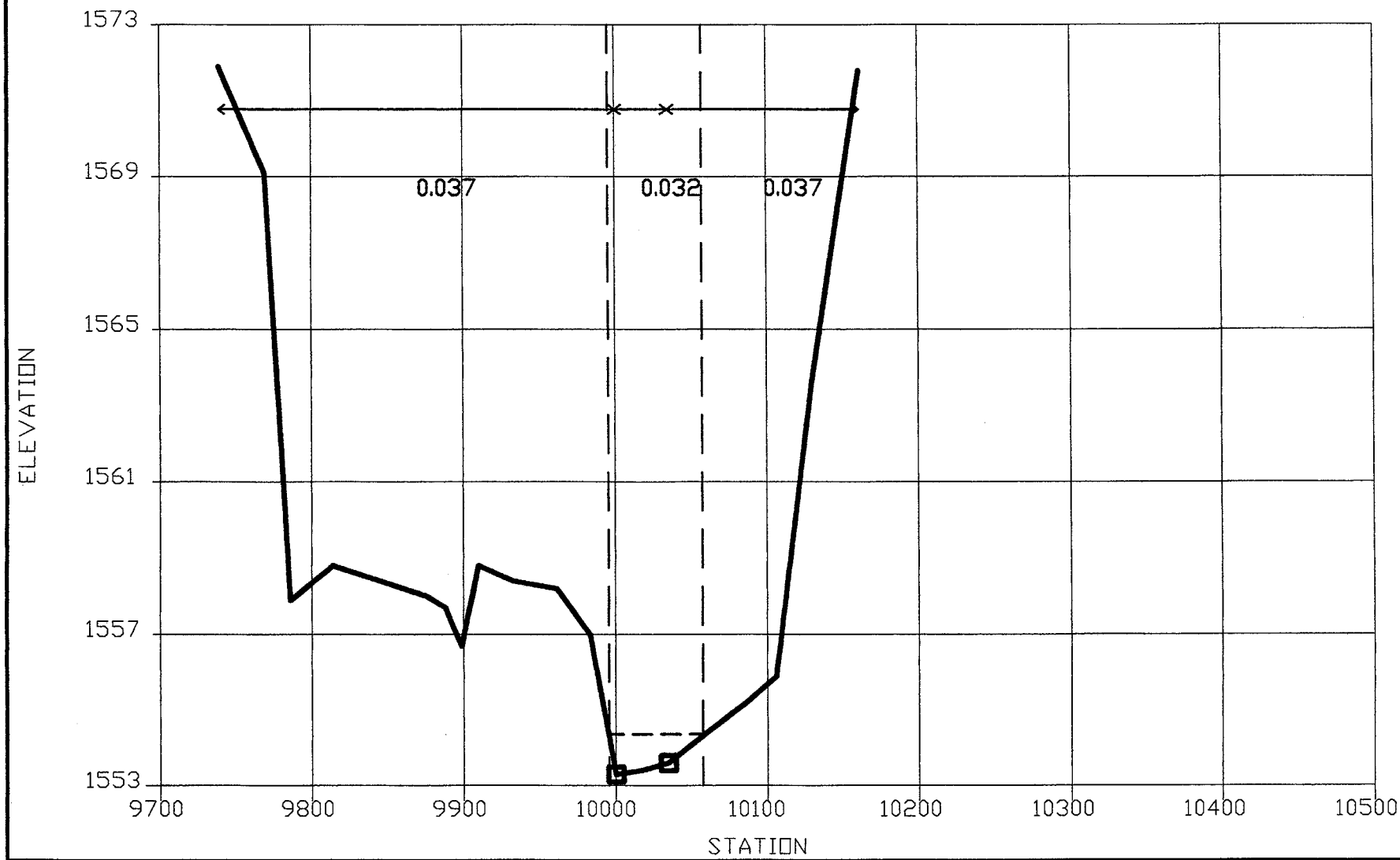


SECTION : 2.55

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

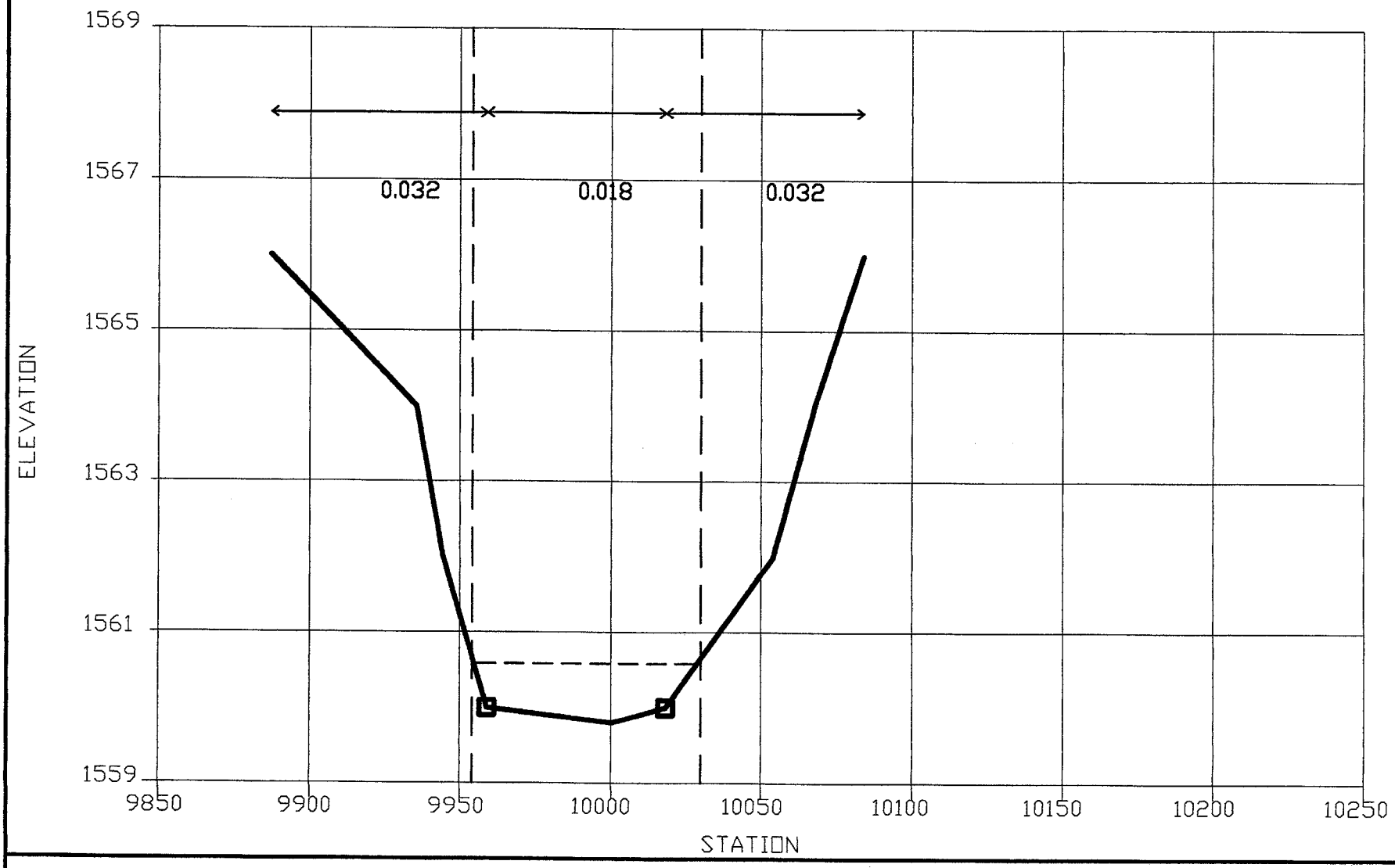


SECTION : 2.64

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

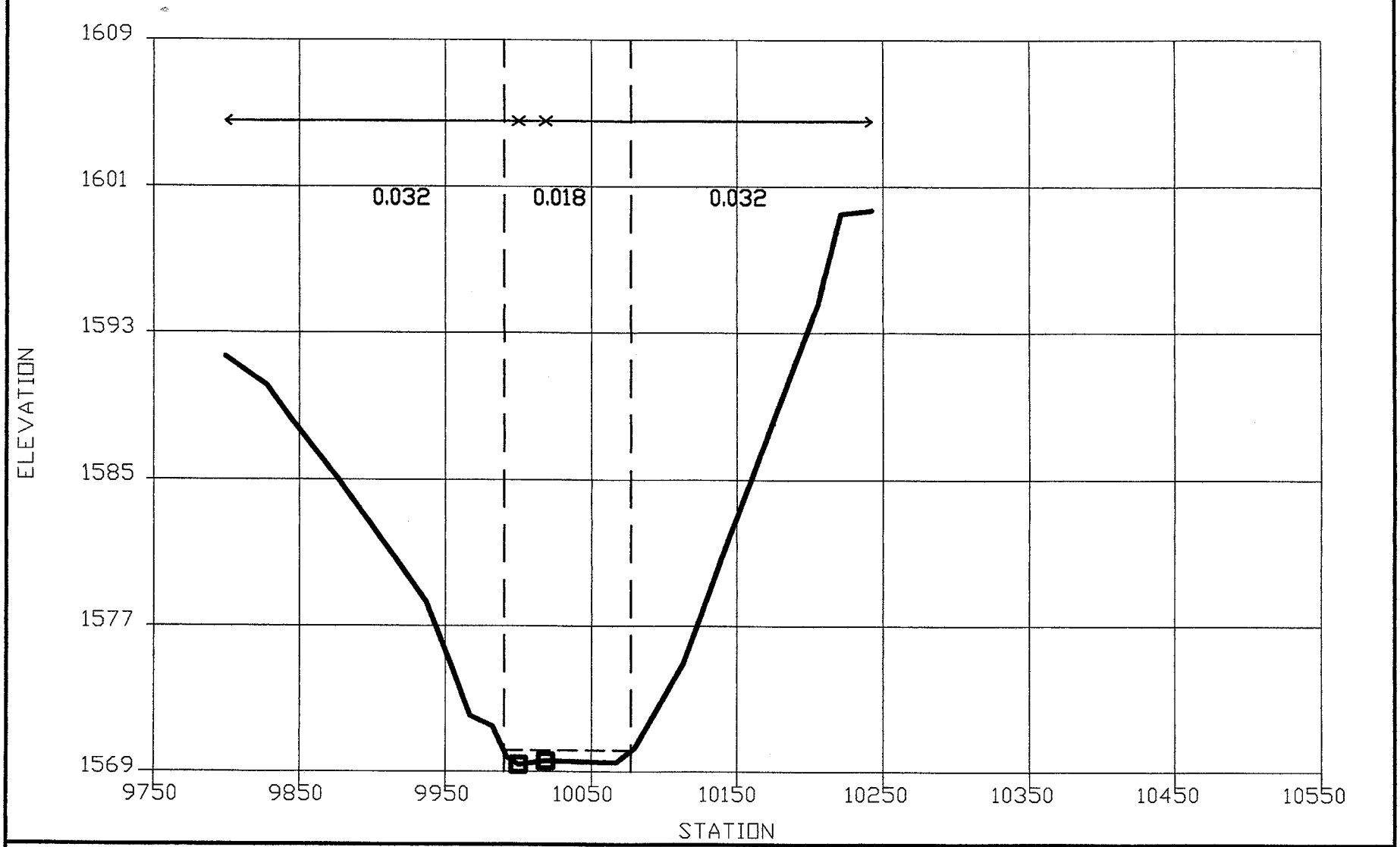


SECTION : 2.69

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

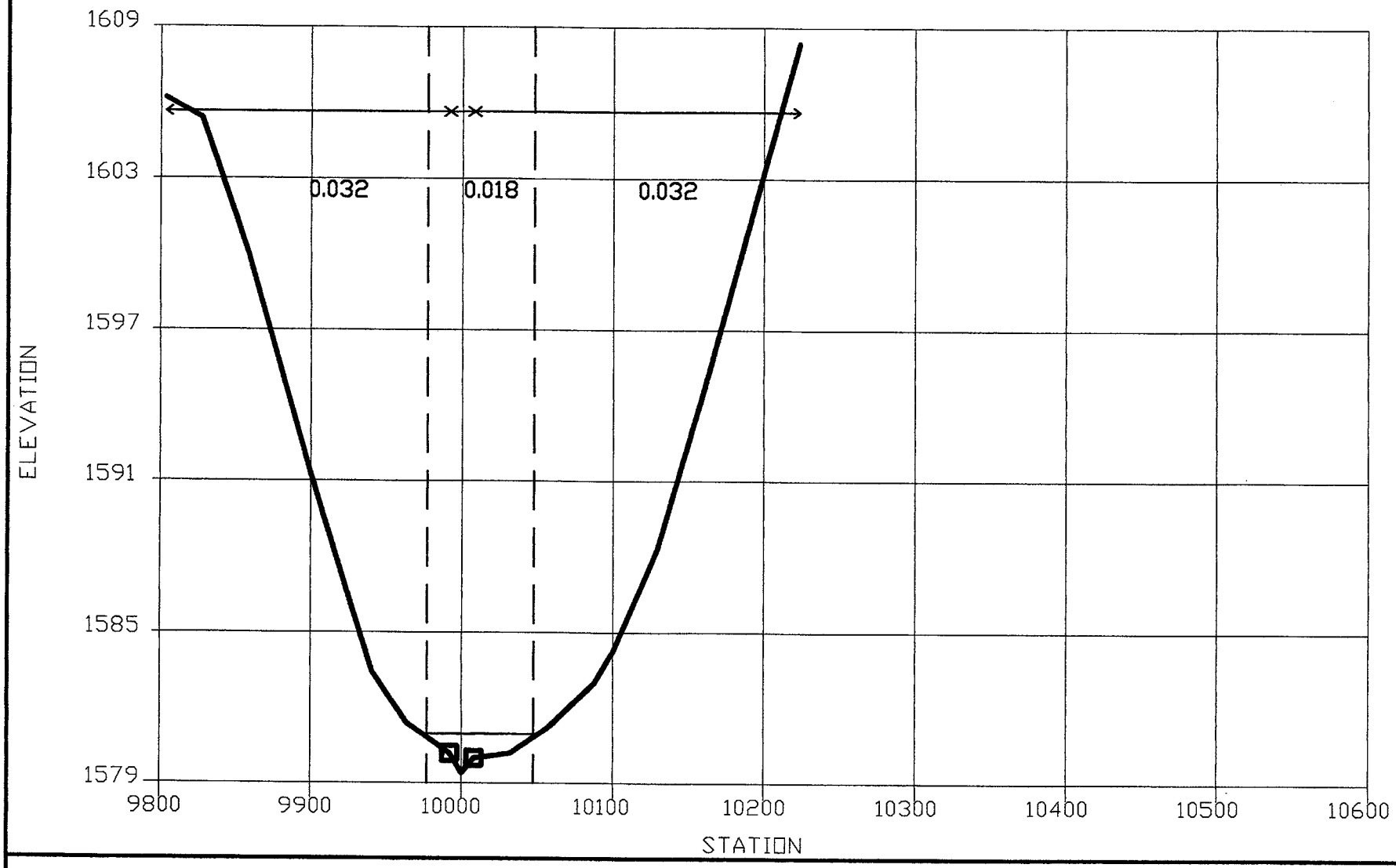


SECTION : 2.74

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

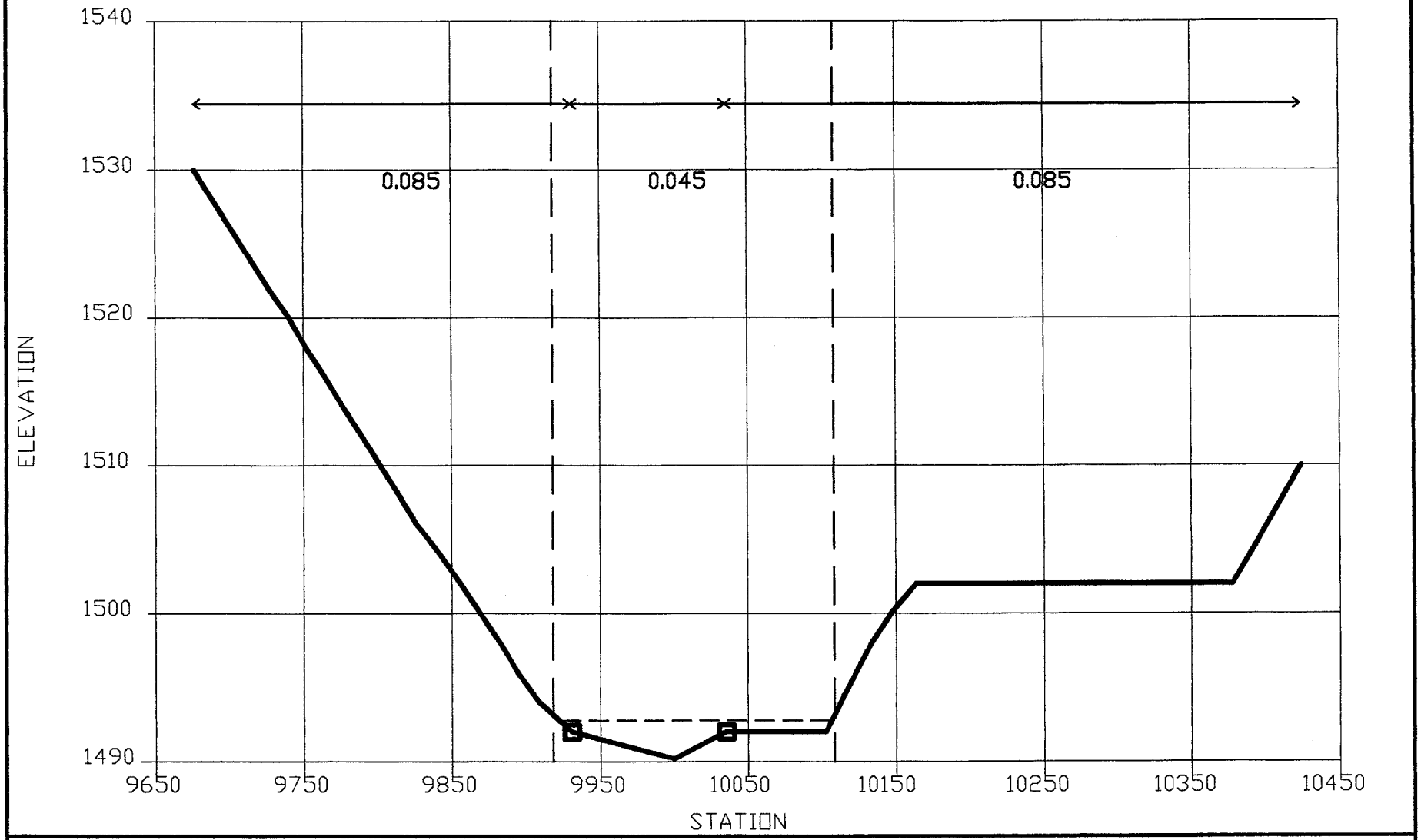


SECTION : 2.79

Fountain Hills (south) FIS

Cyprus Point Wash

File: CPW-XSEC.DWG

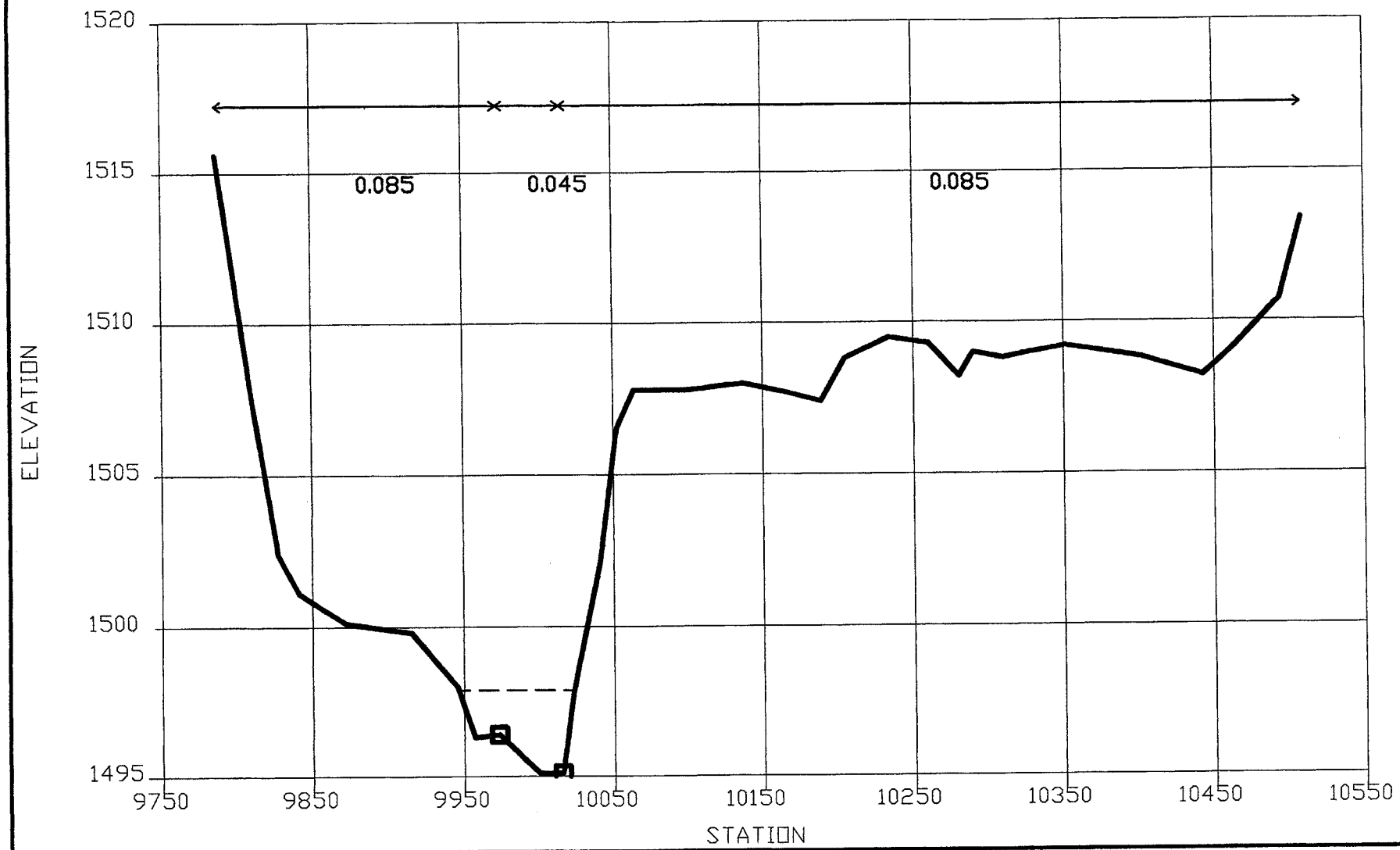


SECTION : 2.20

Fountain Hills (south) FIS

Jacklin Wash

File: JKL-XSEC.DWG

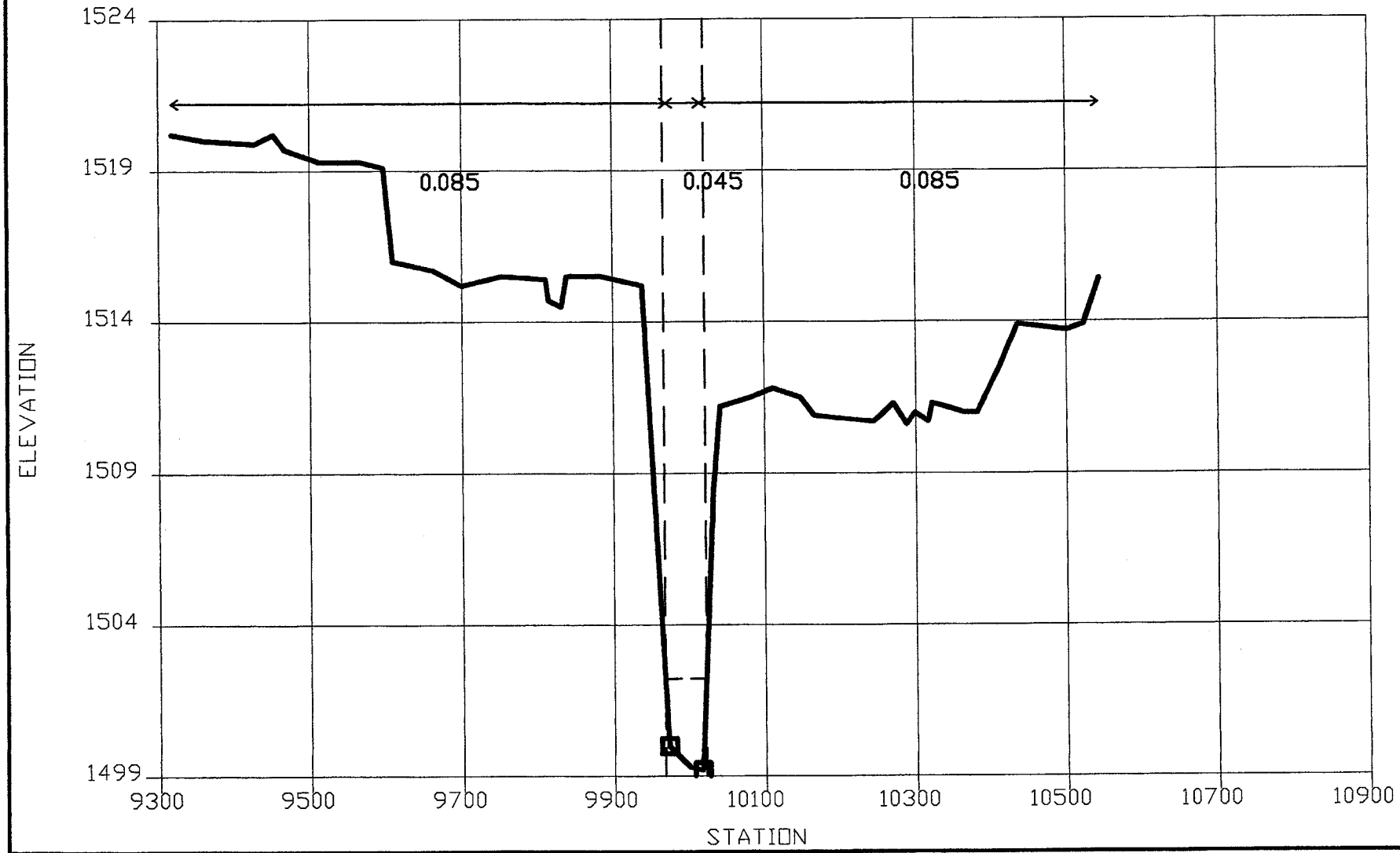


SECTION : 2.27

Fountain Hills (south) FIS

Jacklin Wash

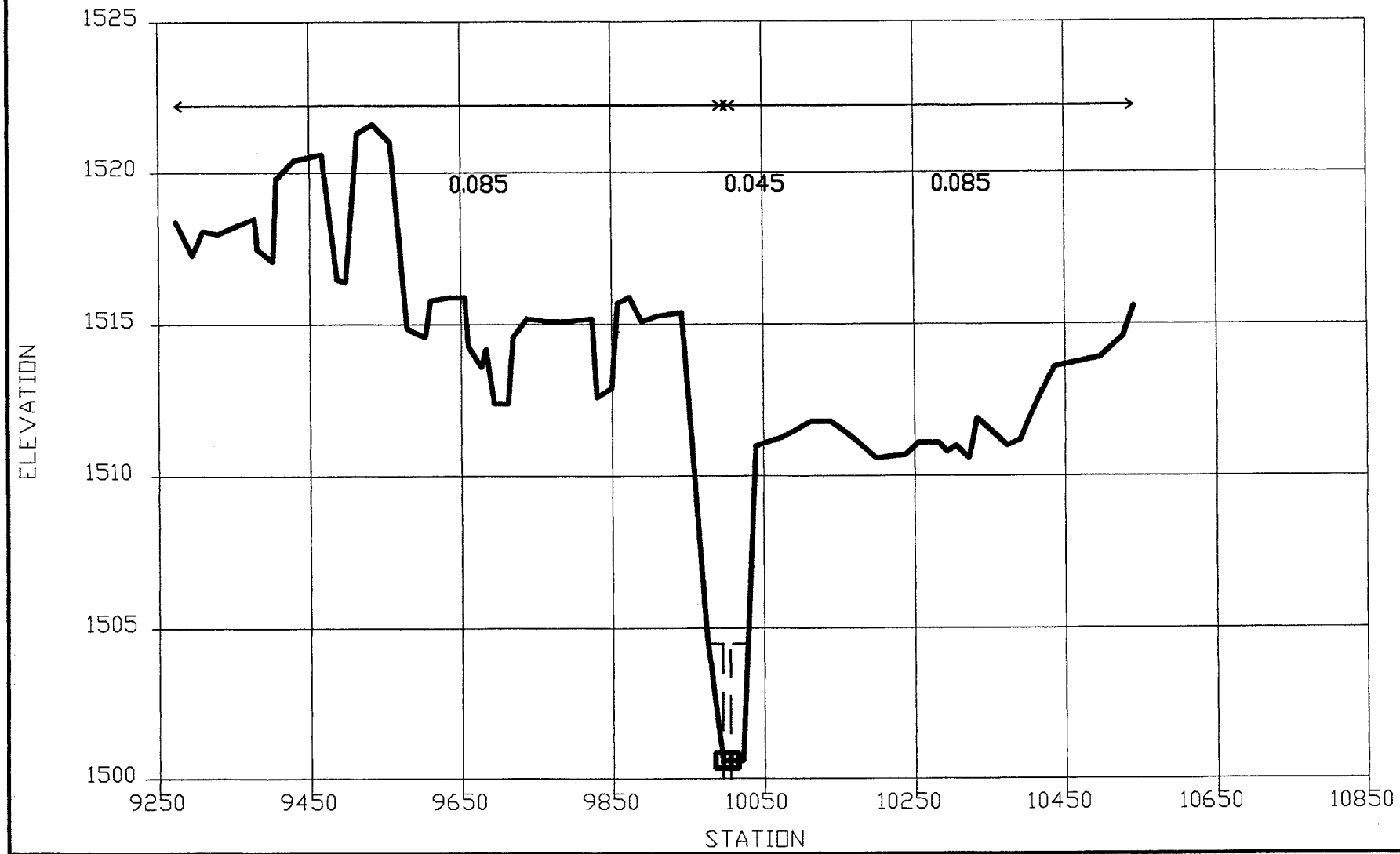
File: JKL-XSEC.DWG



SECTION : 2.32

Fountain Hills (south) FIS
Fountain Hills (south) - JACKLIN WASH
Jacklin Wash

File: JKL-XSEC.DWG

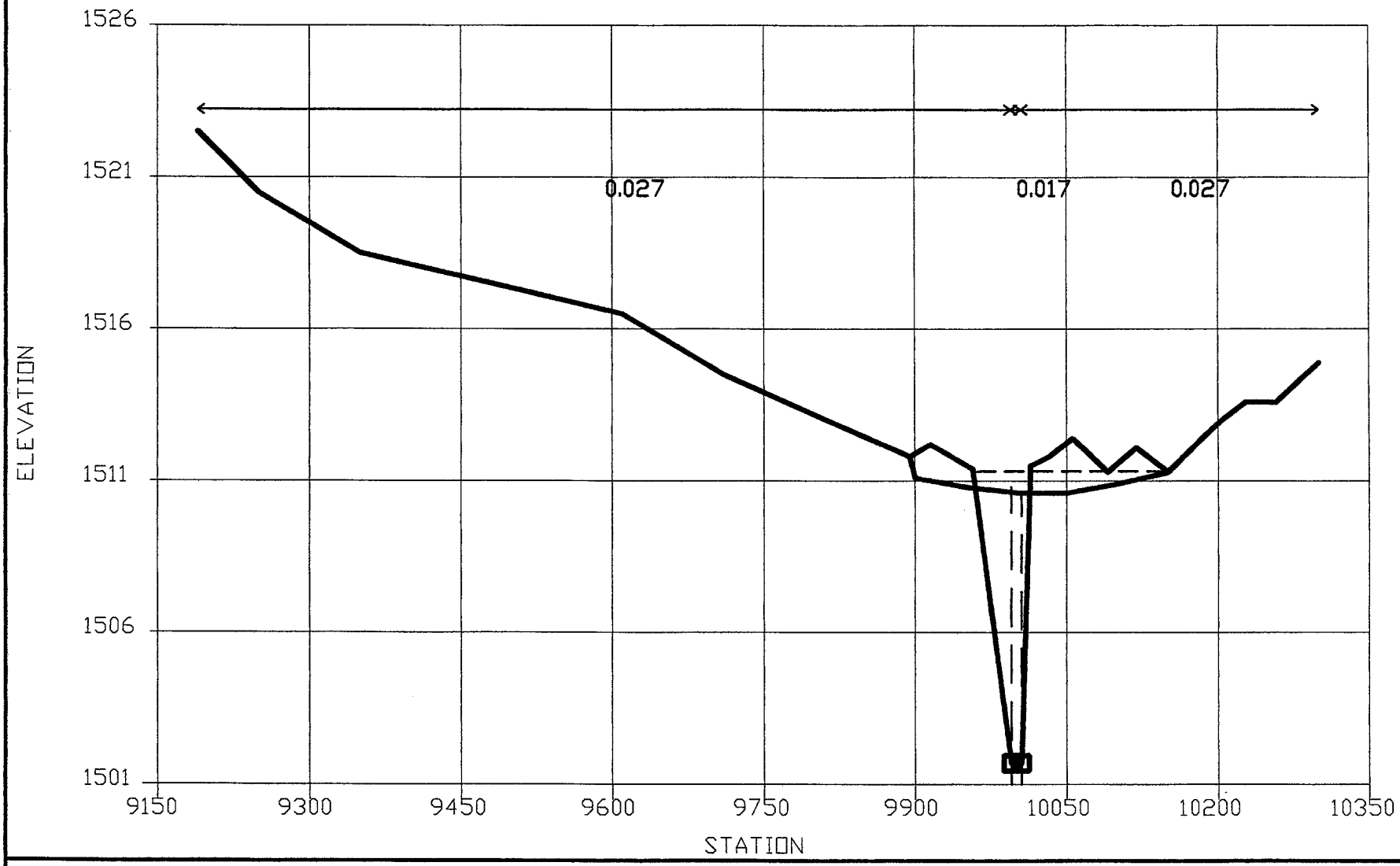


SECTION : 2.33

Fountain Hills (south) FIS

Jacklin Wash

File: JKL-XSEC.DWG

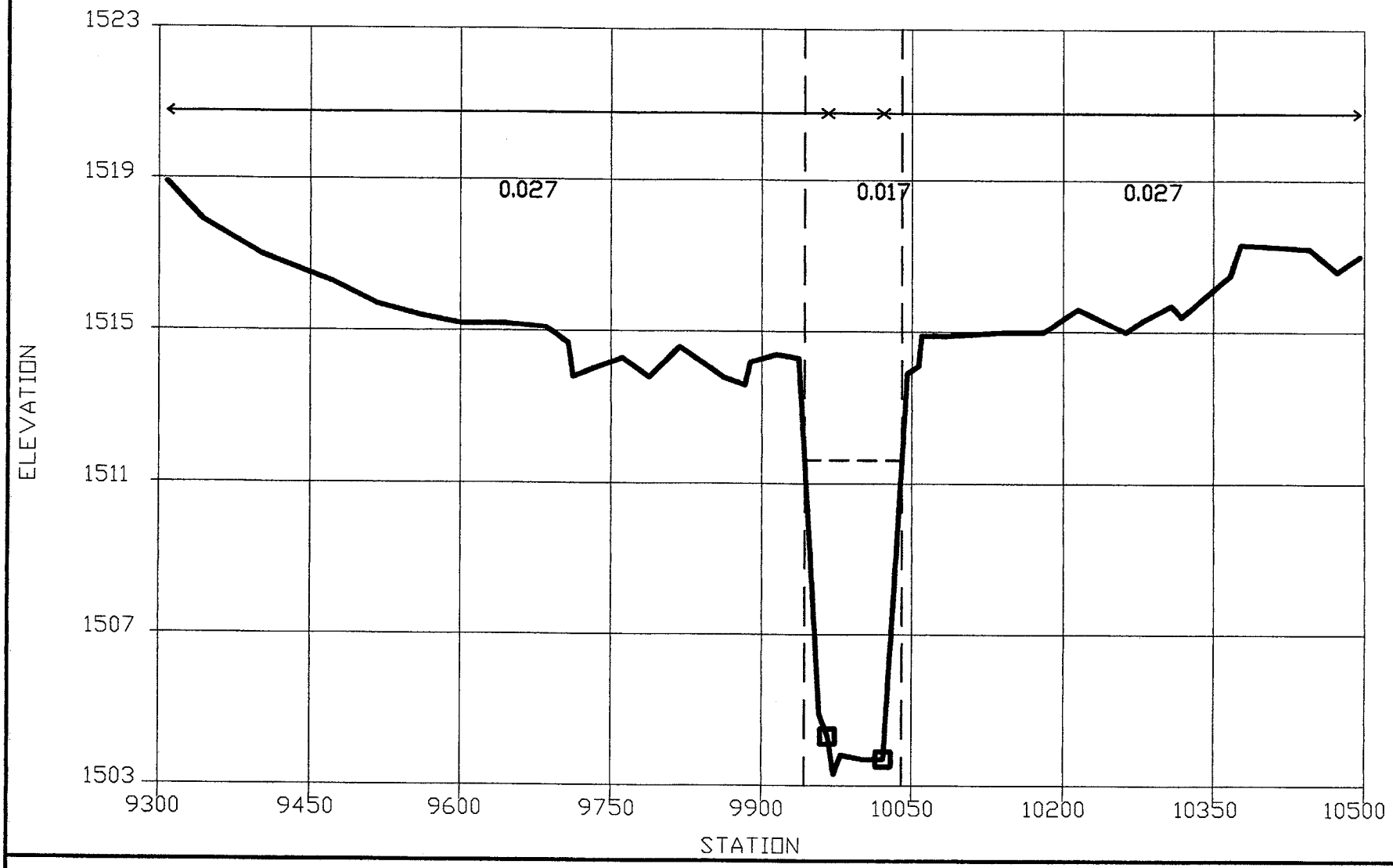


SECTION : 2.34

Fountain Hills (south) FIS

Jacklin Wash

File: JKL-XSEC.DWG

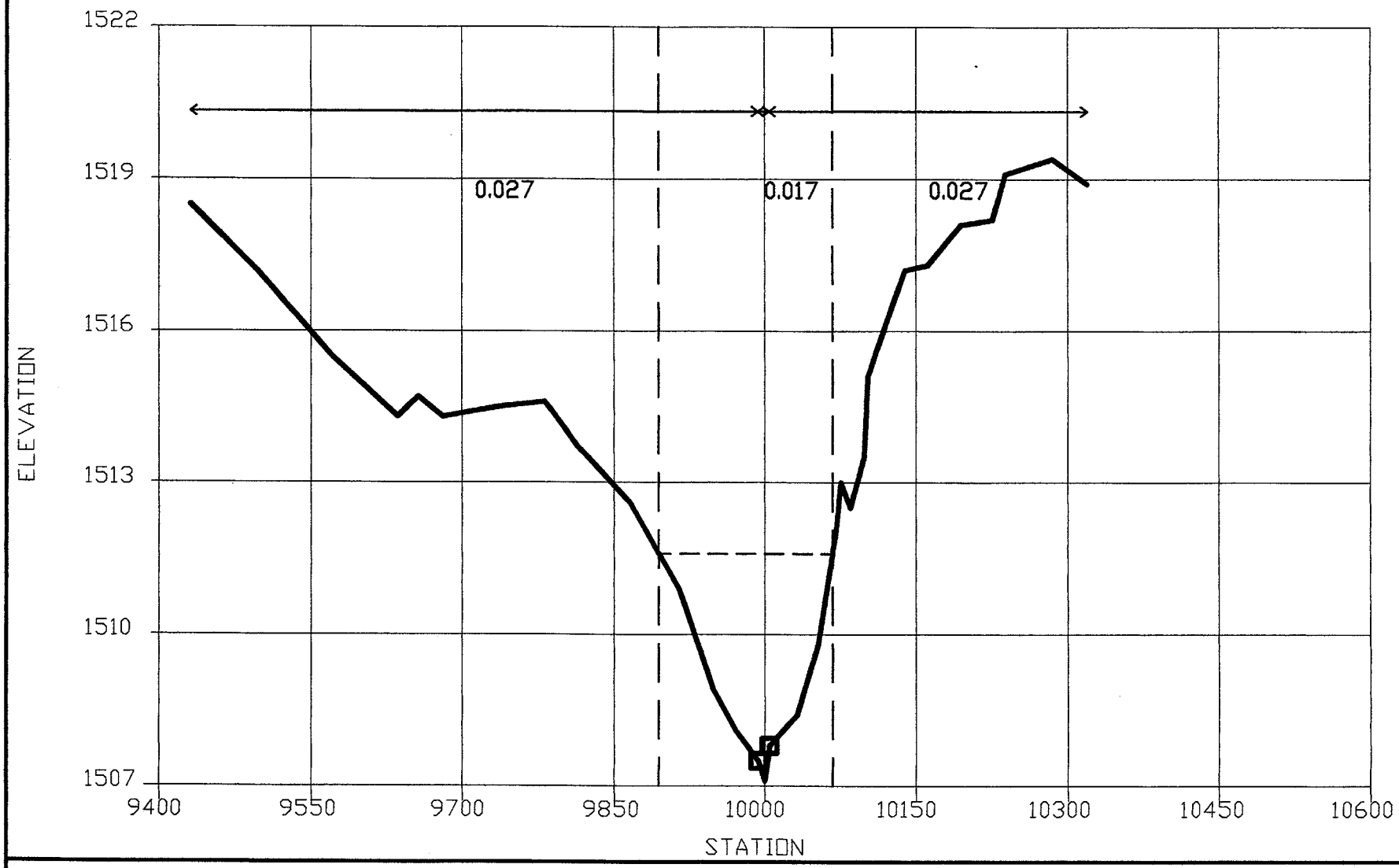


SECTION : 2.35

Fountain Hills (south) FIS

Jacklin Wash

File: JKL-XSEC.DWG

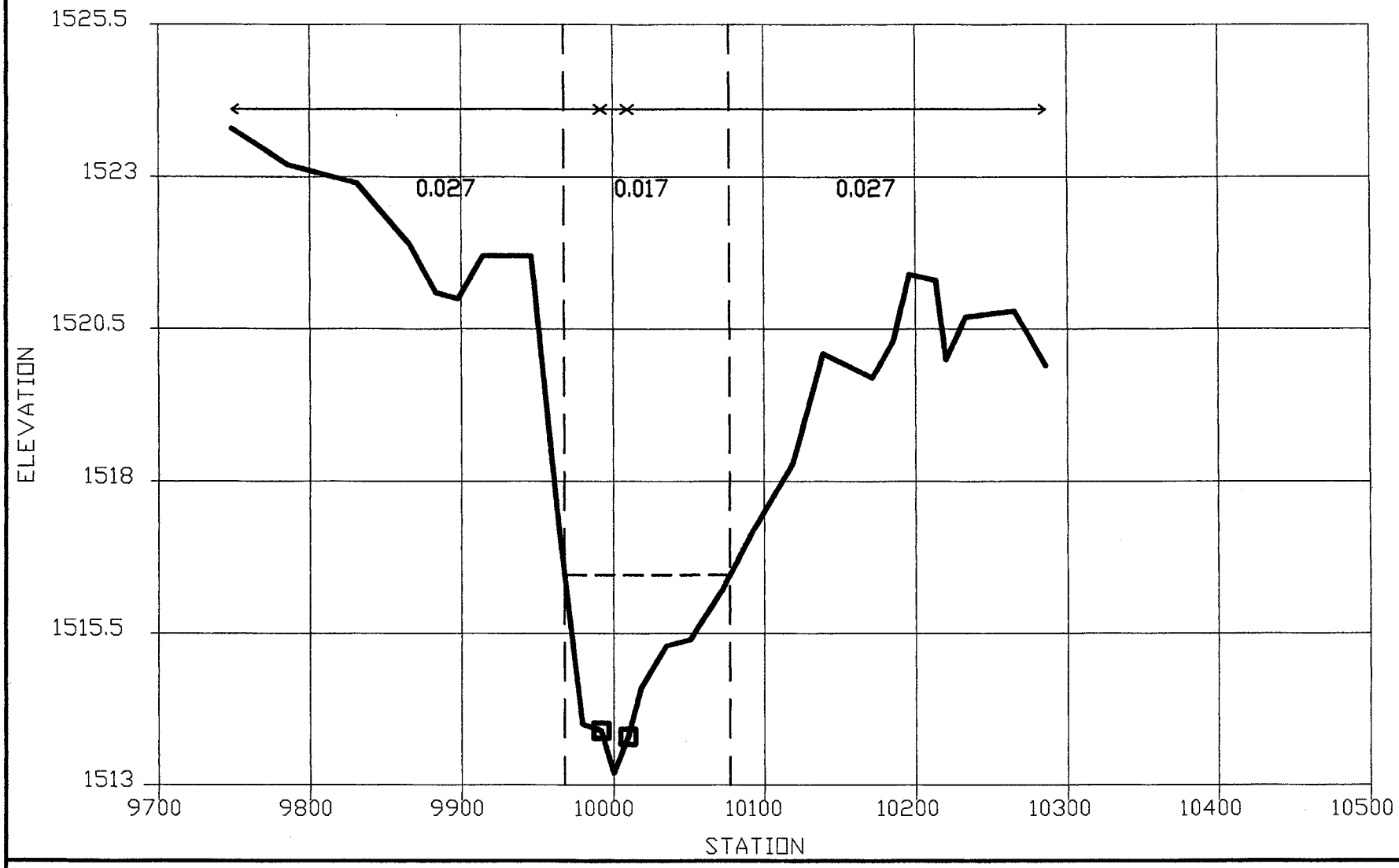


SECTION : 2.39

Fountain Hills (south) FIS

Jacklin Wash

File: JKL-XSEC.DWG

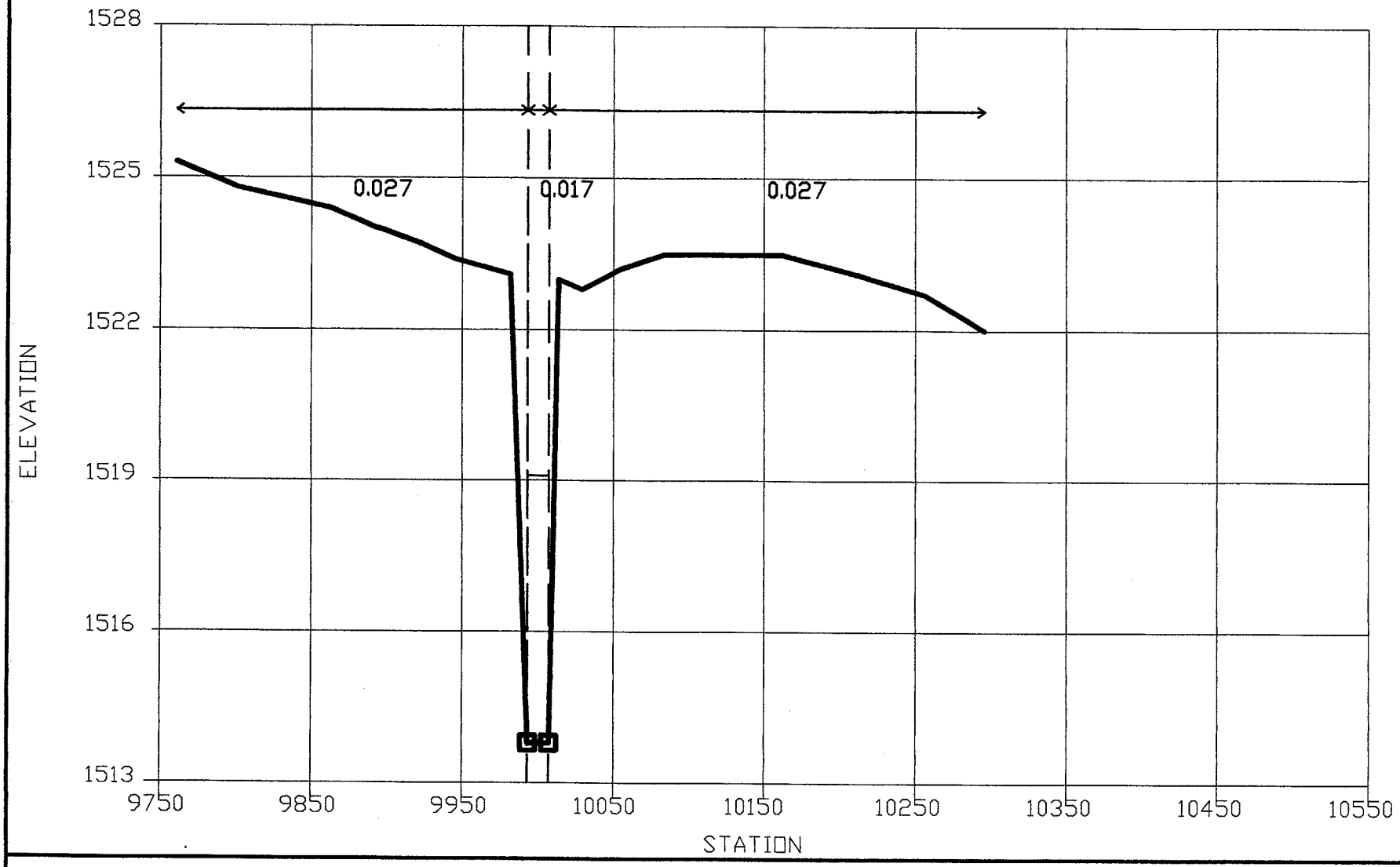


SECTION : 2.45

Fountain Hills (south) FIS

Jacklin Wash

File: JKL-XSEC.DWG

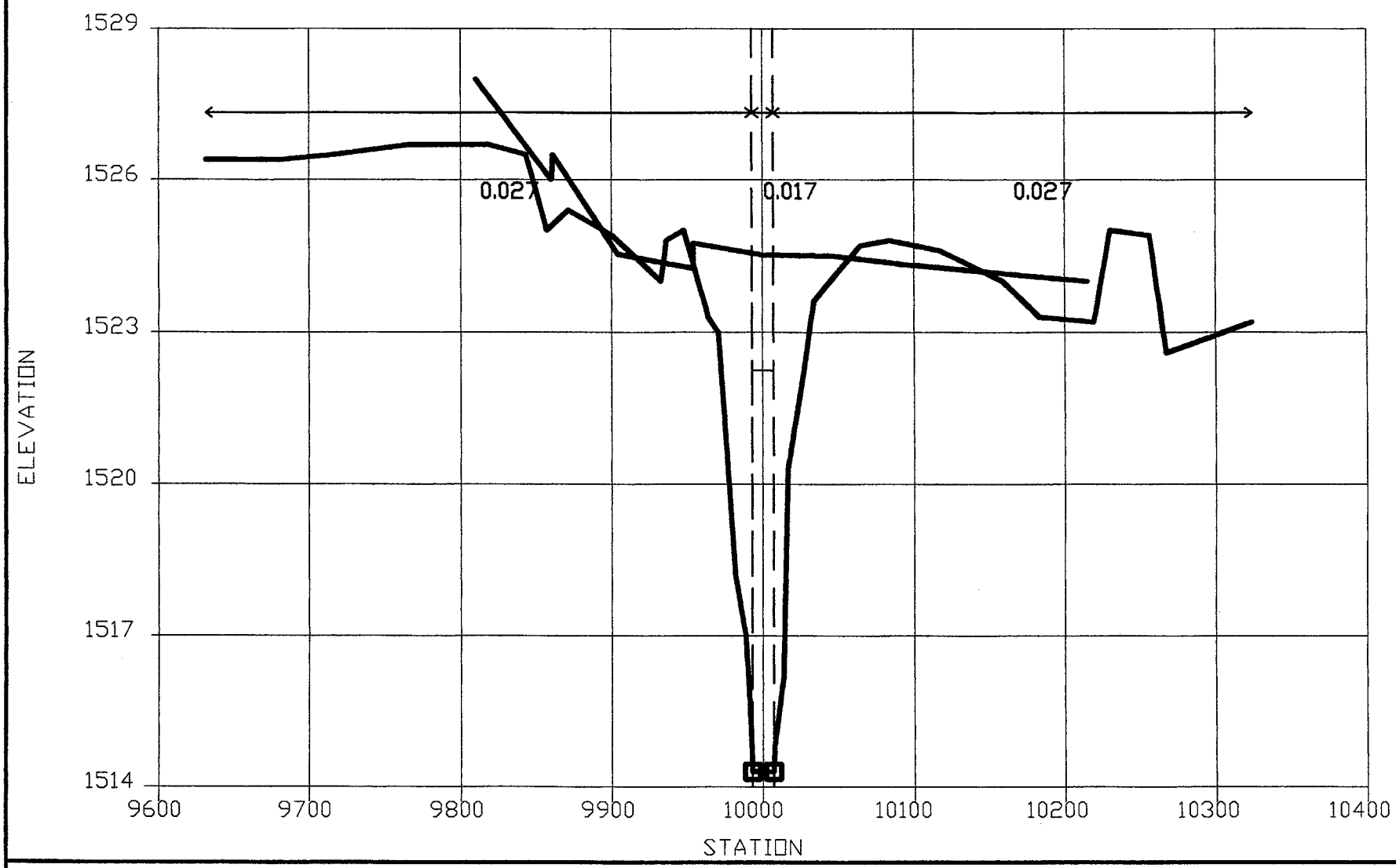


SECTION : 2.46

Fountain Hills (south) FIS

Jacklin Wash

File: JKL-XSEC.DWG

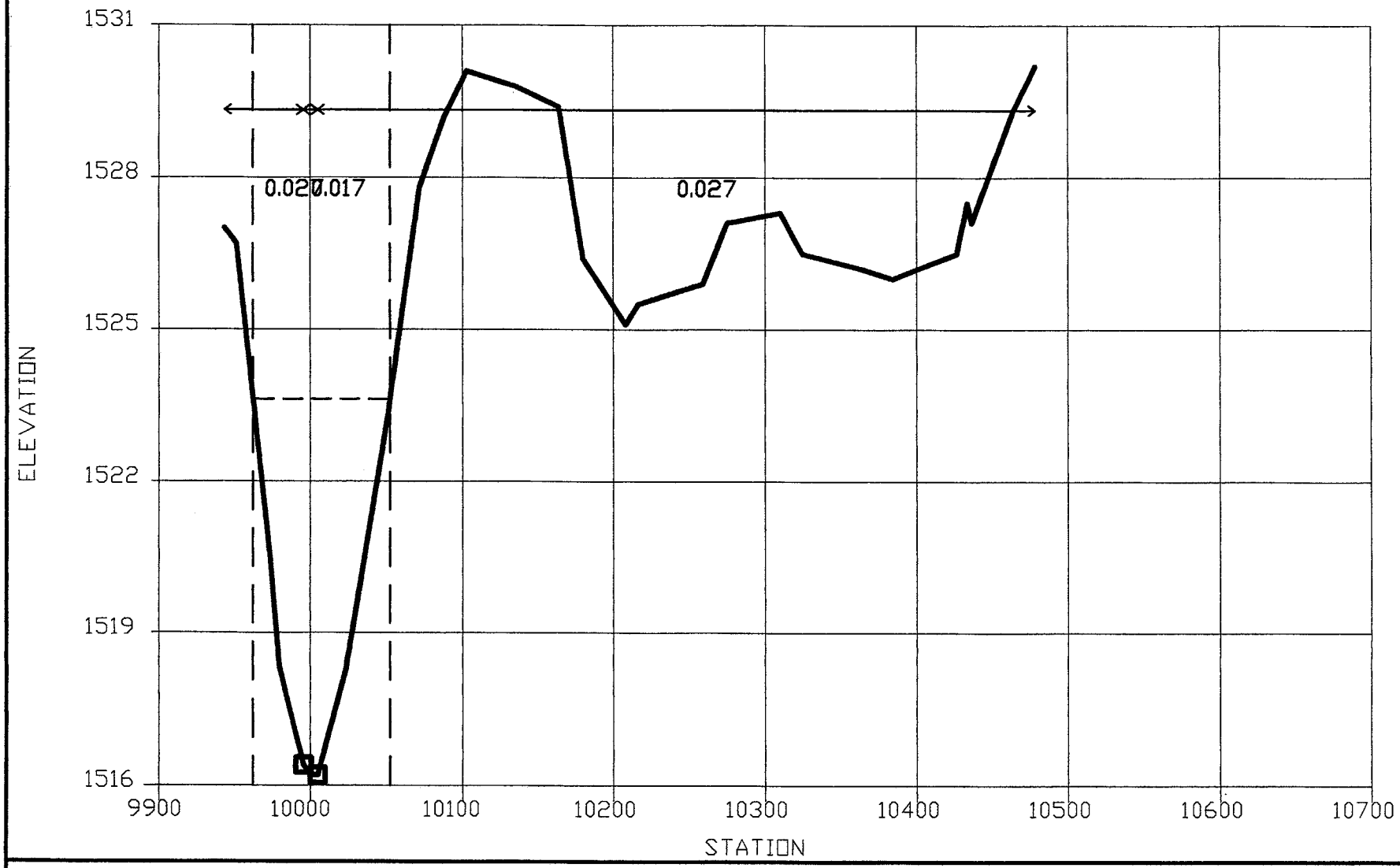


SECTION : 2.48

Fountain Hills (south) FIS

Jacklin Wash

File: JKL-XSEC.DWG

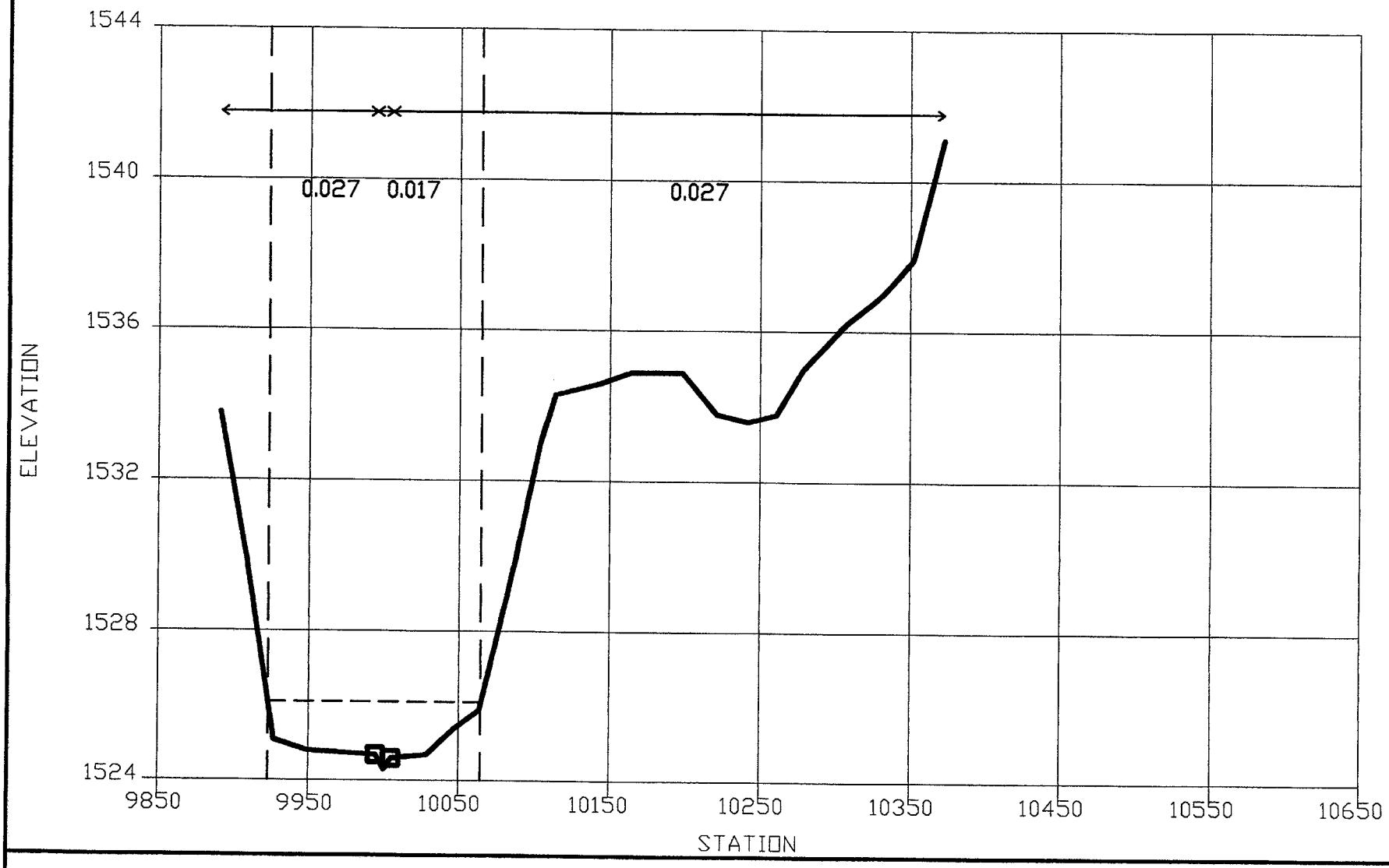


SECTION : 2.49

Fountain Hills (south) FIS

Jacklin Wash

File: JKL-XSEC.DWG

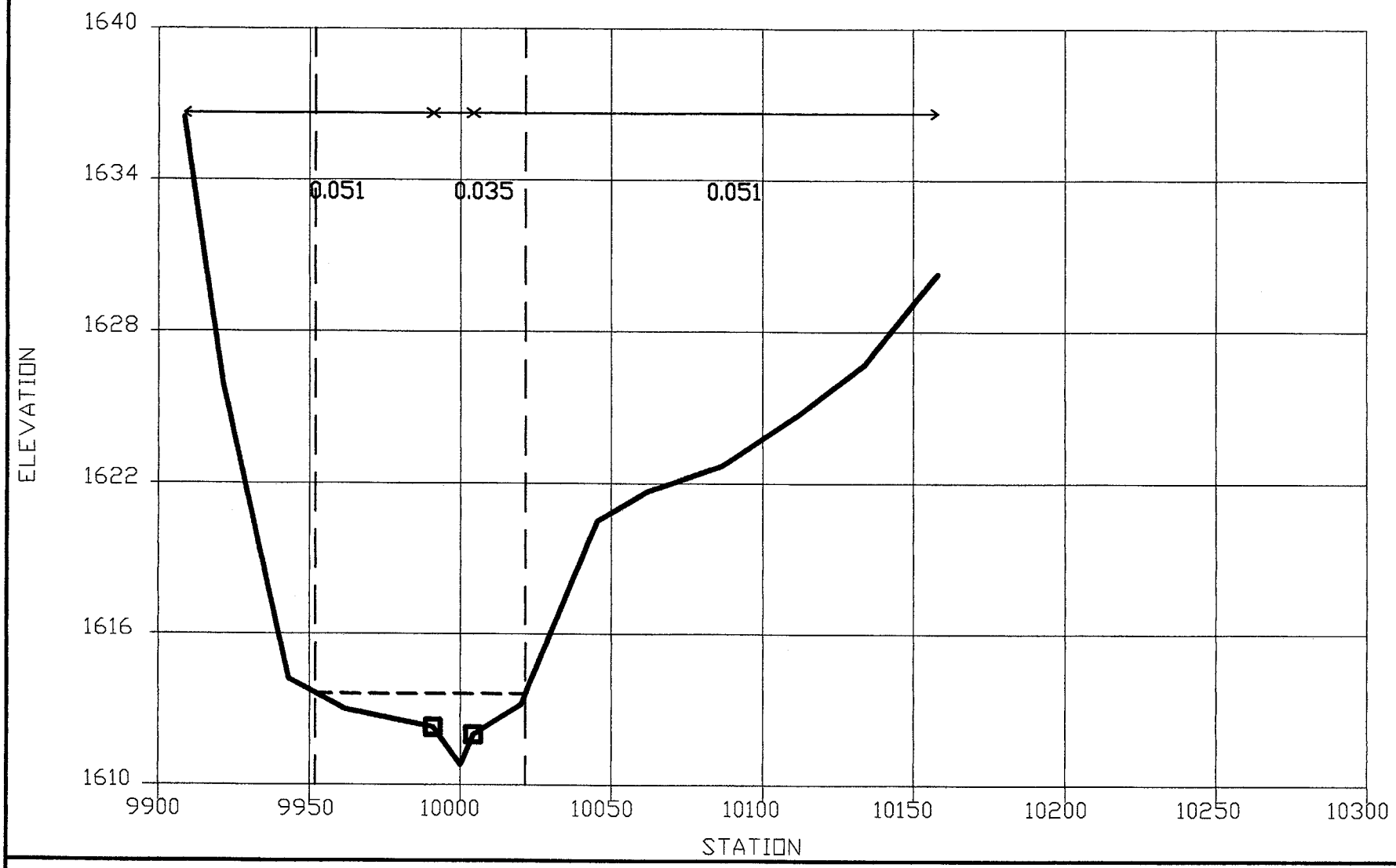


SECTION : 2.58

Fountain Hills (south) FIS

Jacklin Wash

File: JKL-XSEC.DWG

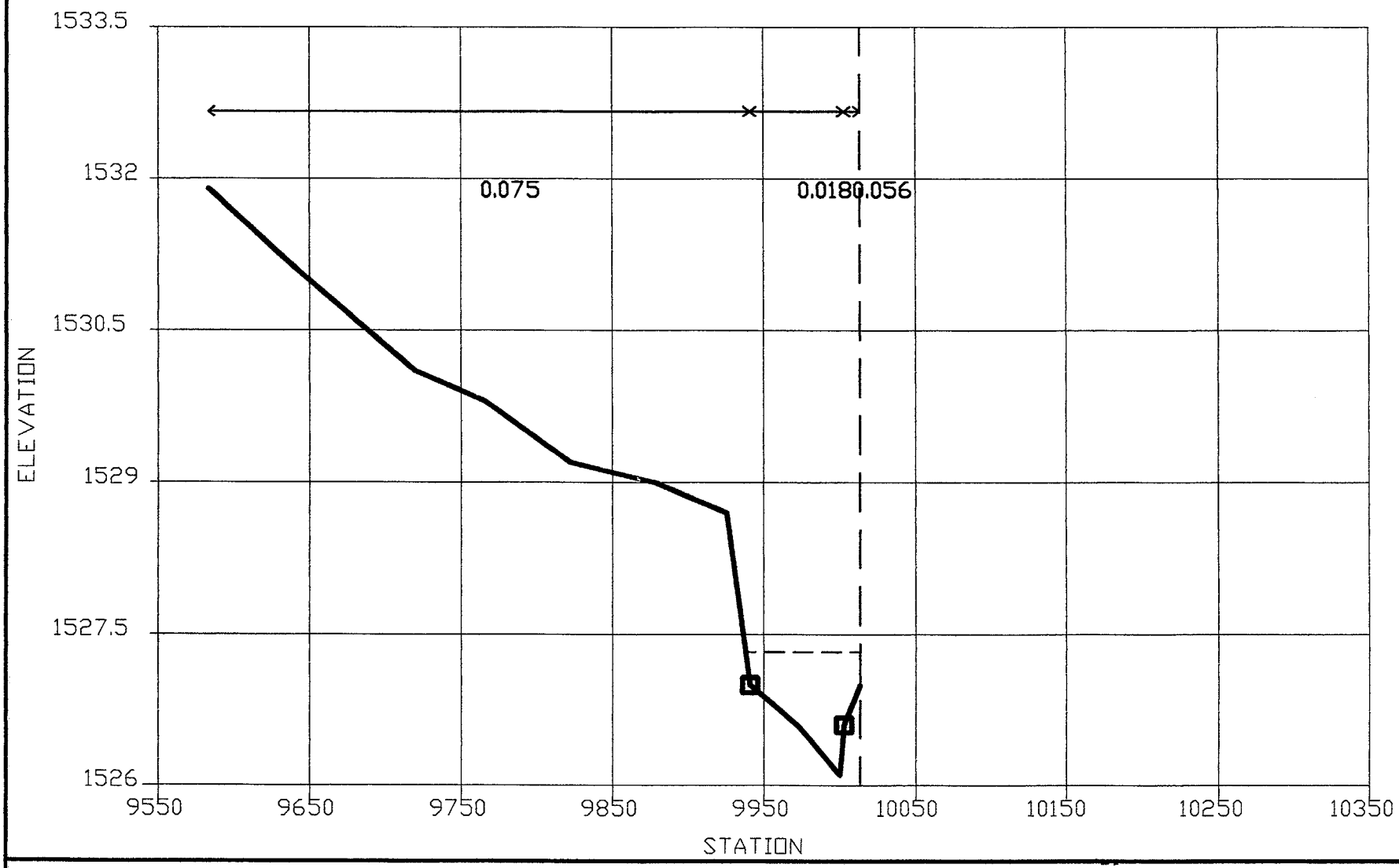


SECTION : 3.39

Fountain Hills (south) FIS

Jacklin Wash

File: JKL-XSEC.DWG



SECTION : 0.00

Fountain Hills (south) FIS

Kingstree Wash

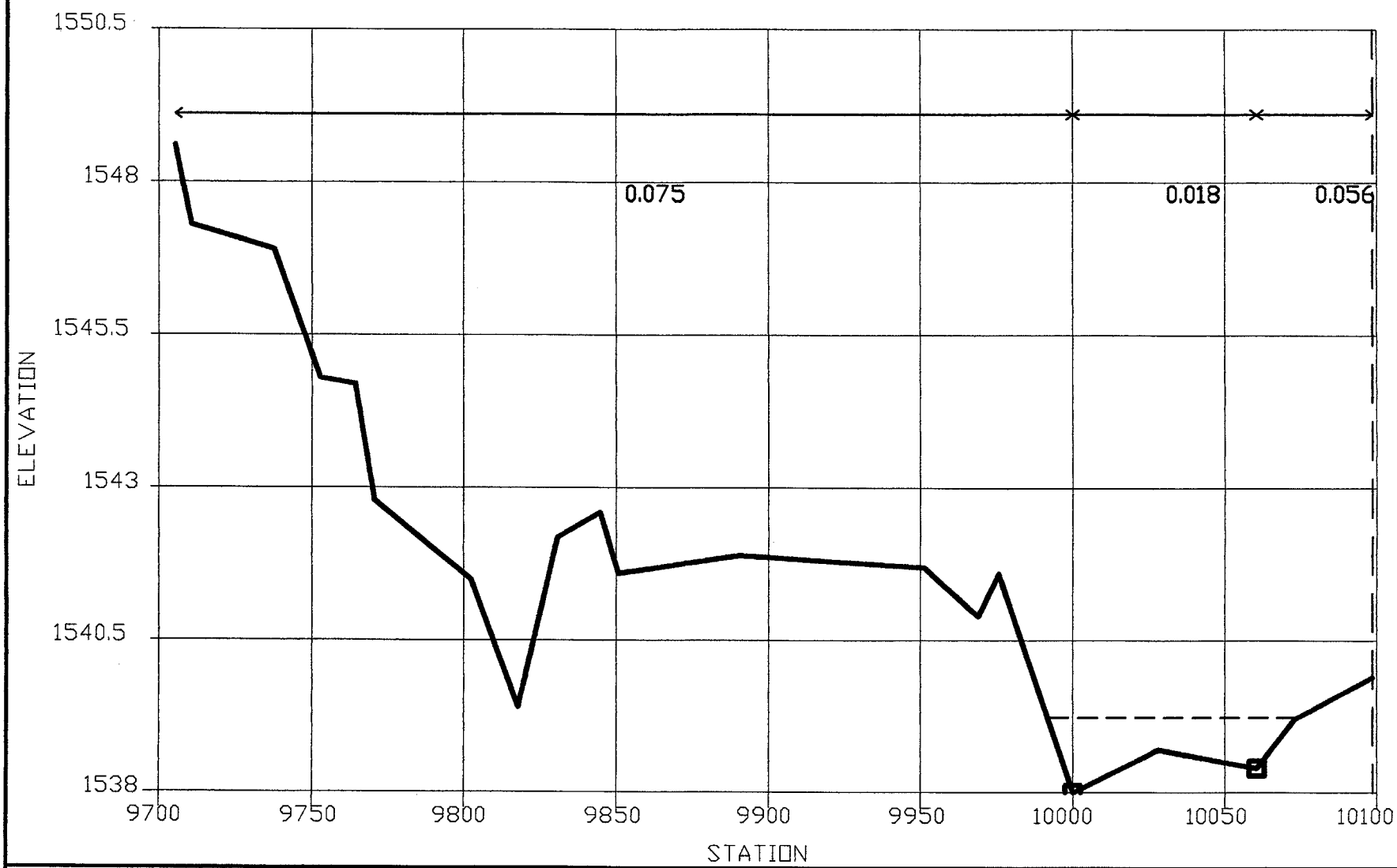
File: KGT-XSEC.DWG

SECTION : 0.09

Fountain Hills (south) FIS

Kingstree Wash

File: KGT-XSEC.DWG



SECTION : 0.16

Fountain Hills (south) FIS

Kingstree Wash

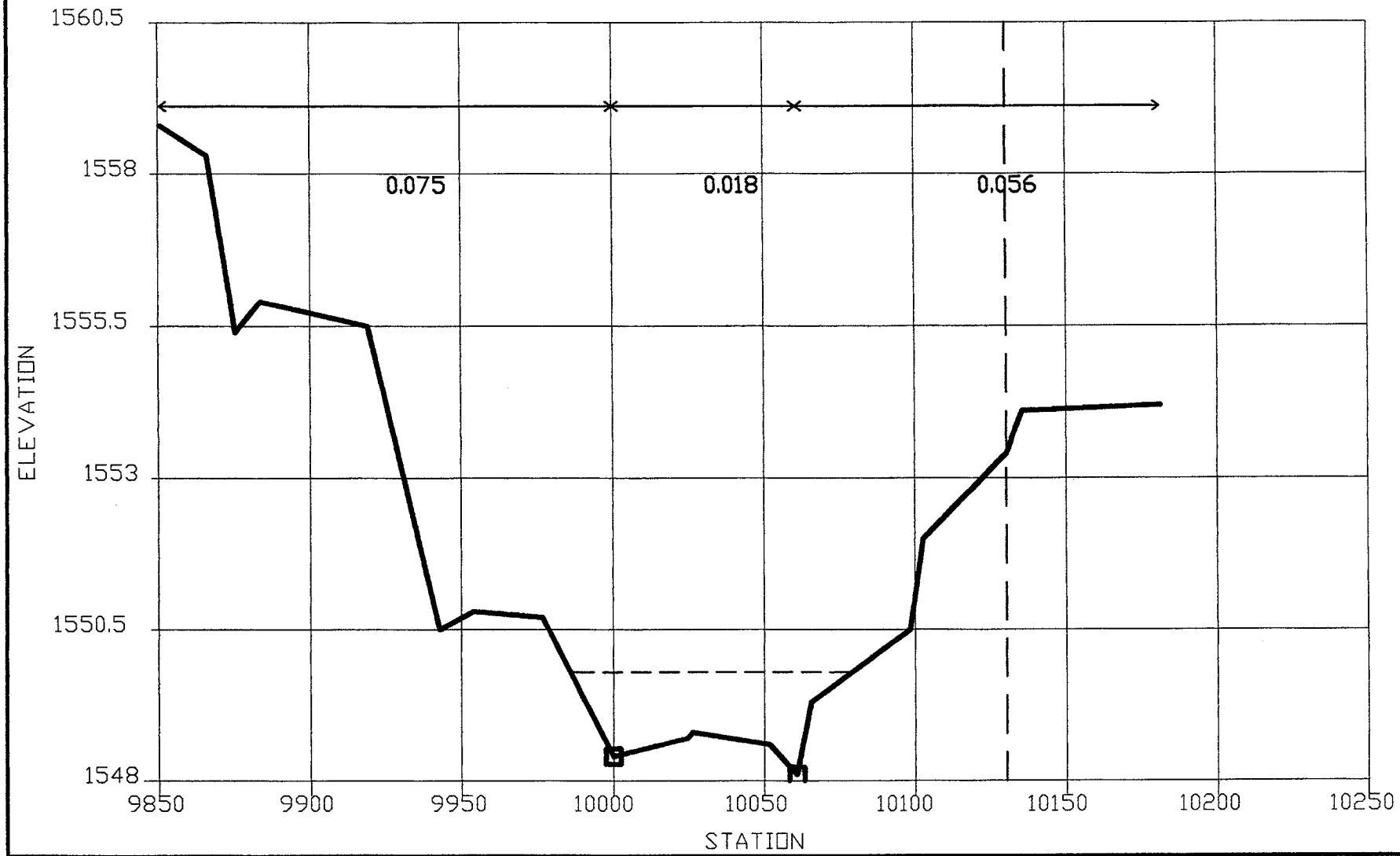
File: KGT-XSEC.DWG

SECTION : 0.20

Fountain Hills (south) FIS

Kingstree Wash

File: KGT-XSEC.DWG

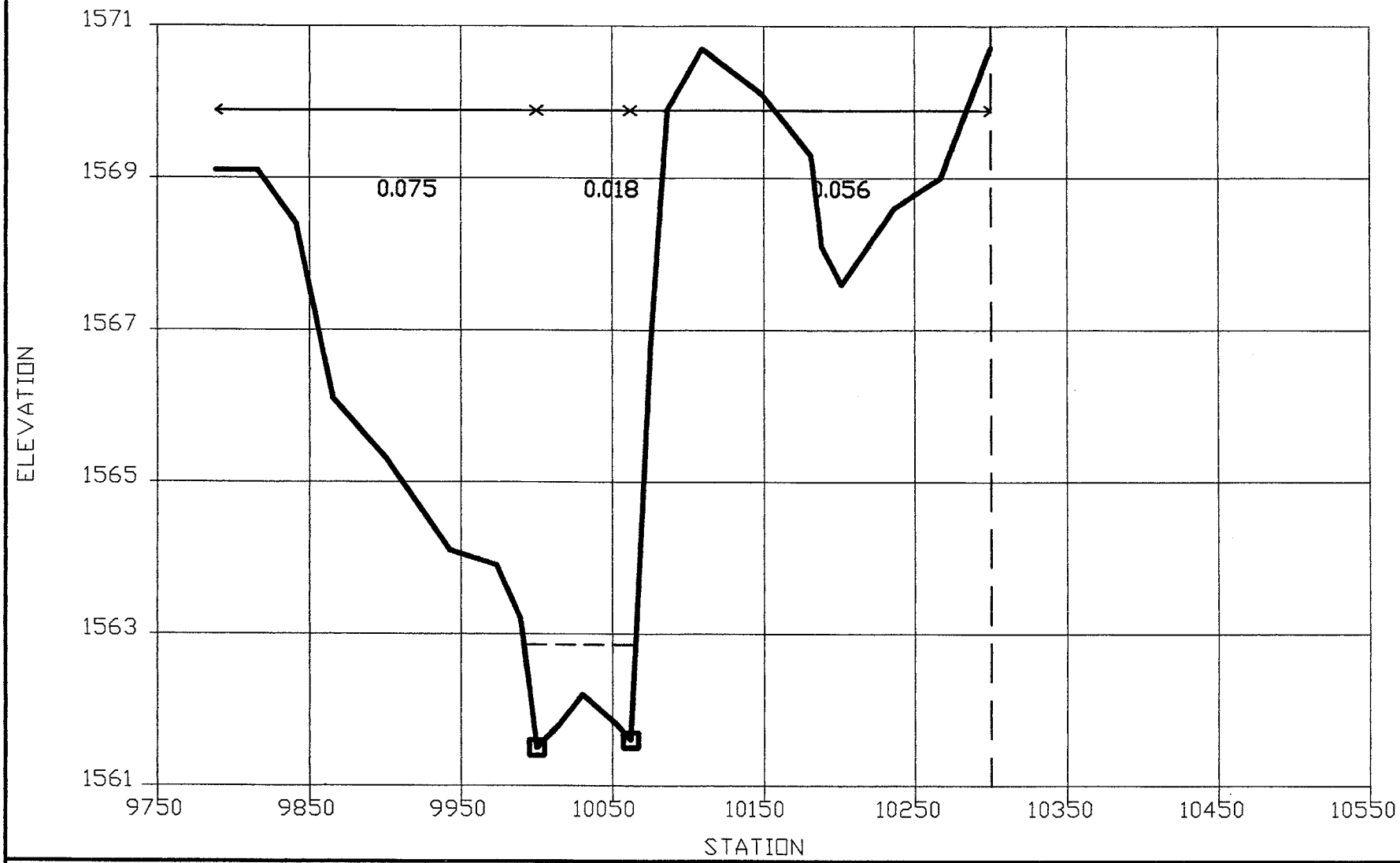


SECTION : 0.28

Fountain Hills (south) FIS

Kingstree Wash

File: KGT-XSEC.DWG

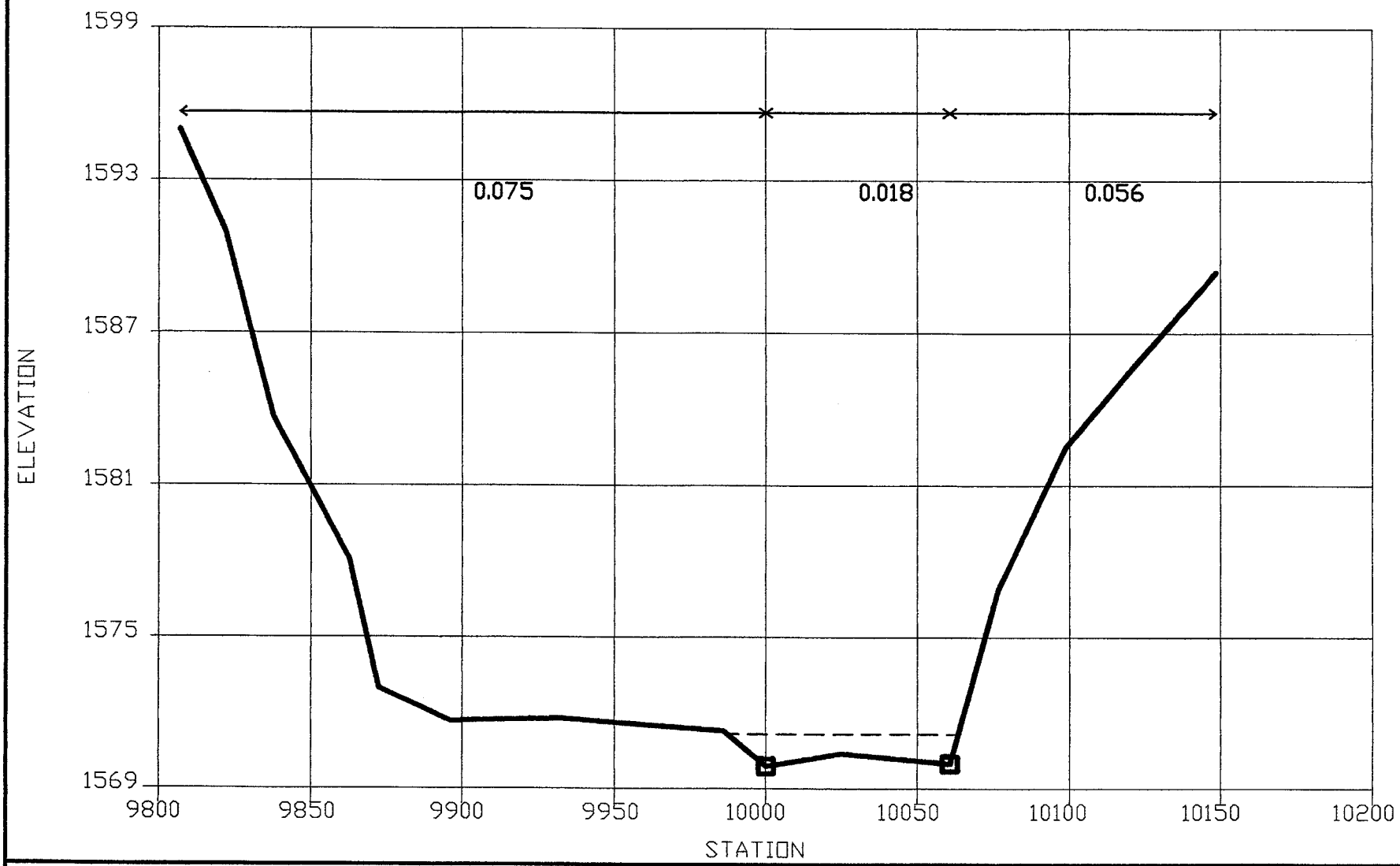


SECTION : 0.35

Fountain Hills (south) FIS

Kingstree Wash

File: KGT-XSEC.DWG

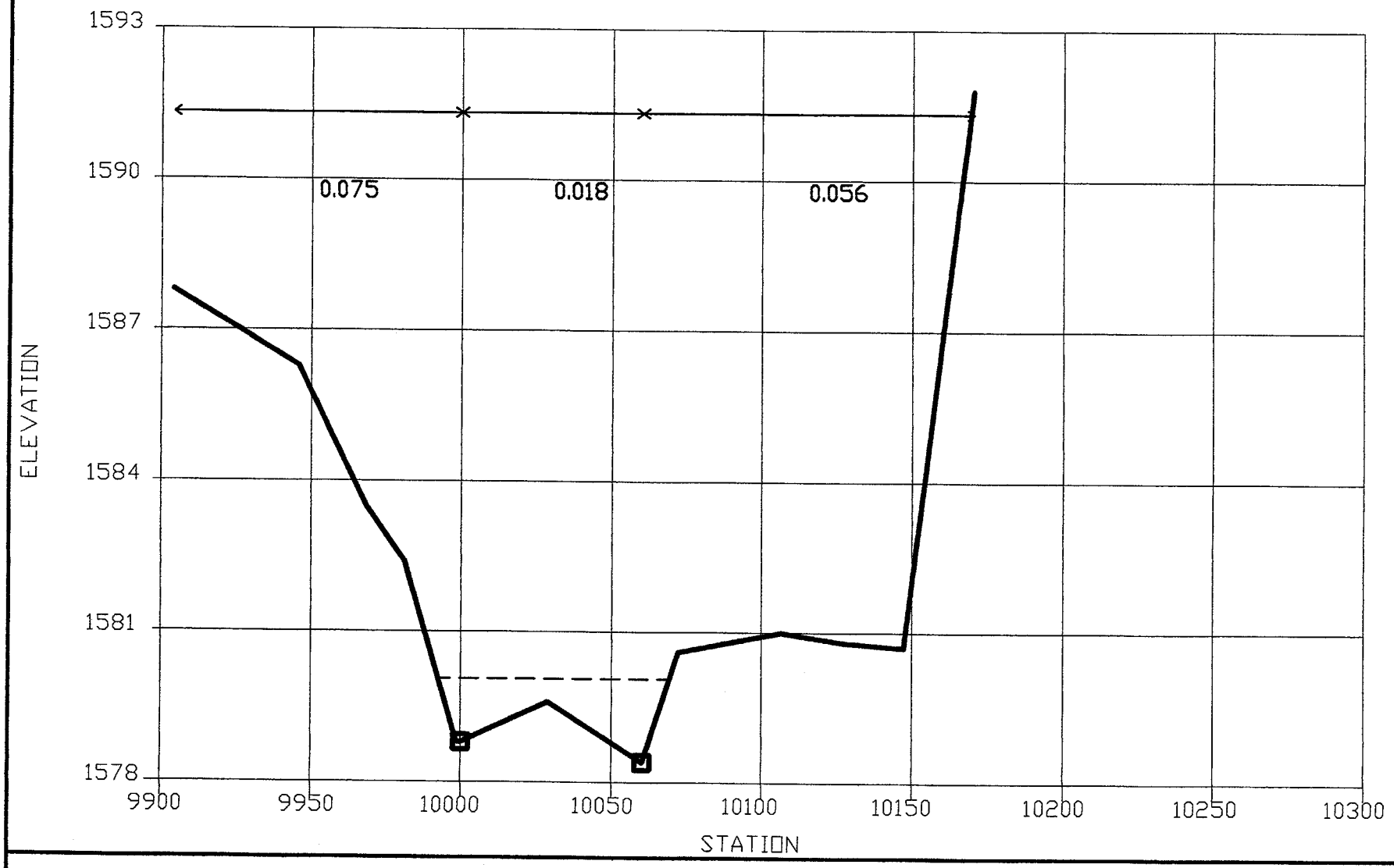


SECTION : 0.41

Fountain Hills (south) FIS

Kingstree Wash

File: KGT-XSEC.DWG

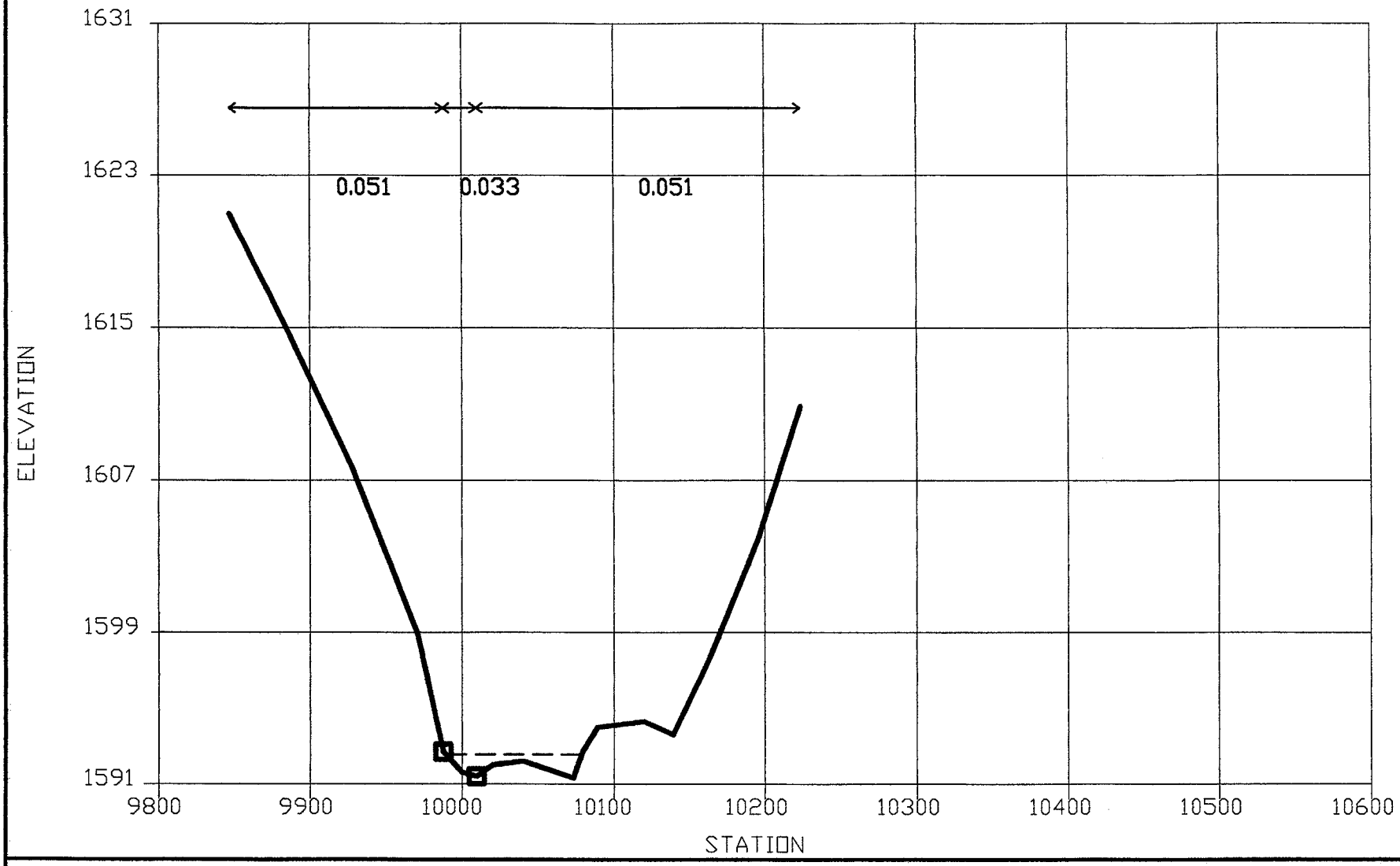


SECTION : 0.47

Fountain Hills (south) FIS

Kingstree Wash

File: KGT-XSEC.DWG

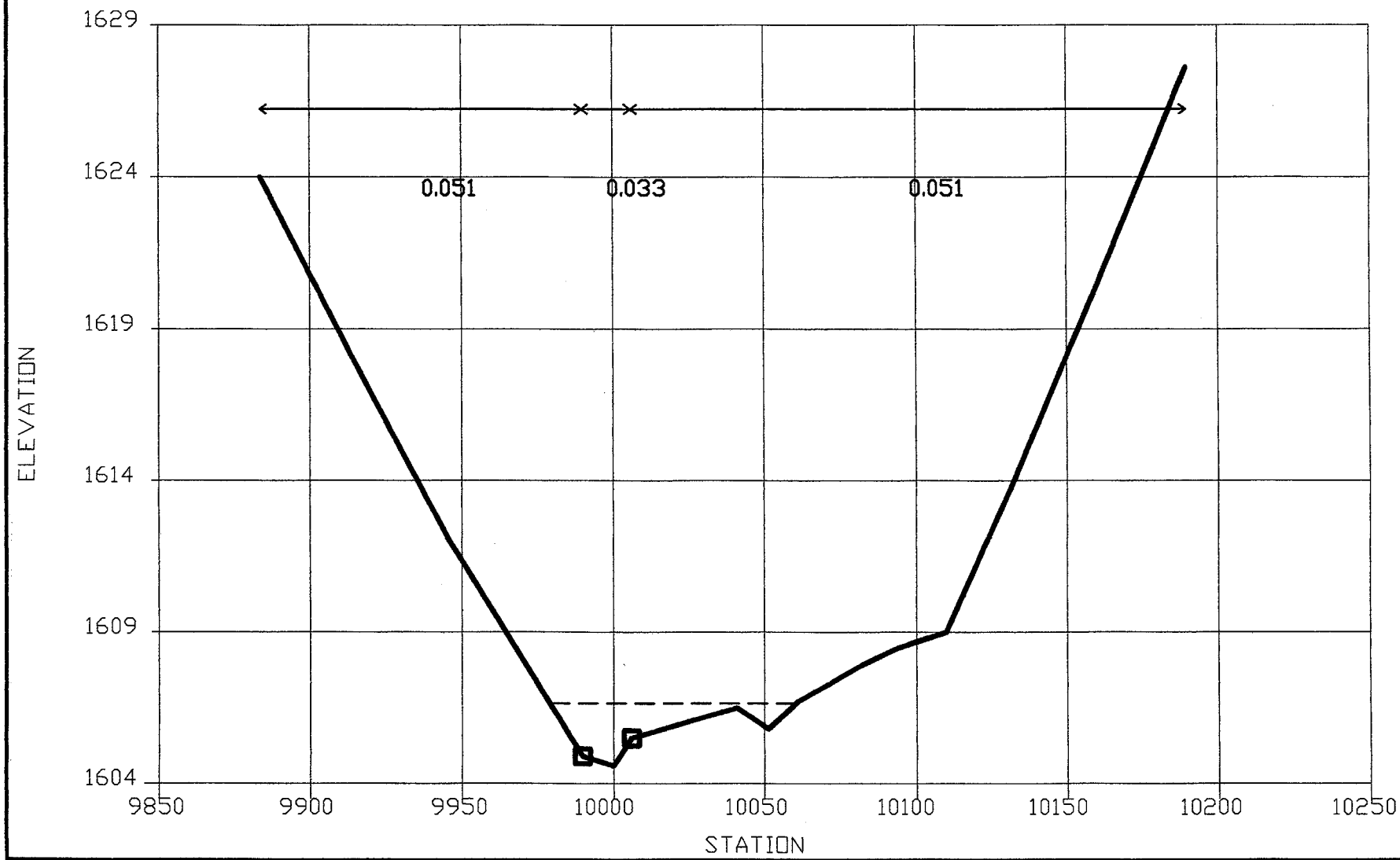


SECTION : 0.53

Fountain Hills (south) FIS

Kingstree Wash

File: KGT-XSEC.DWG

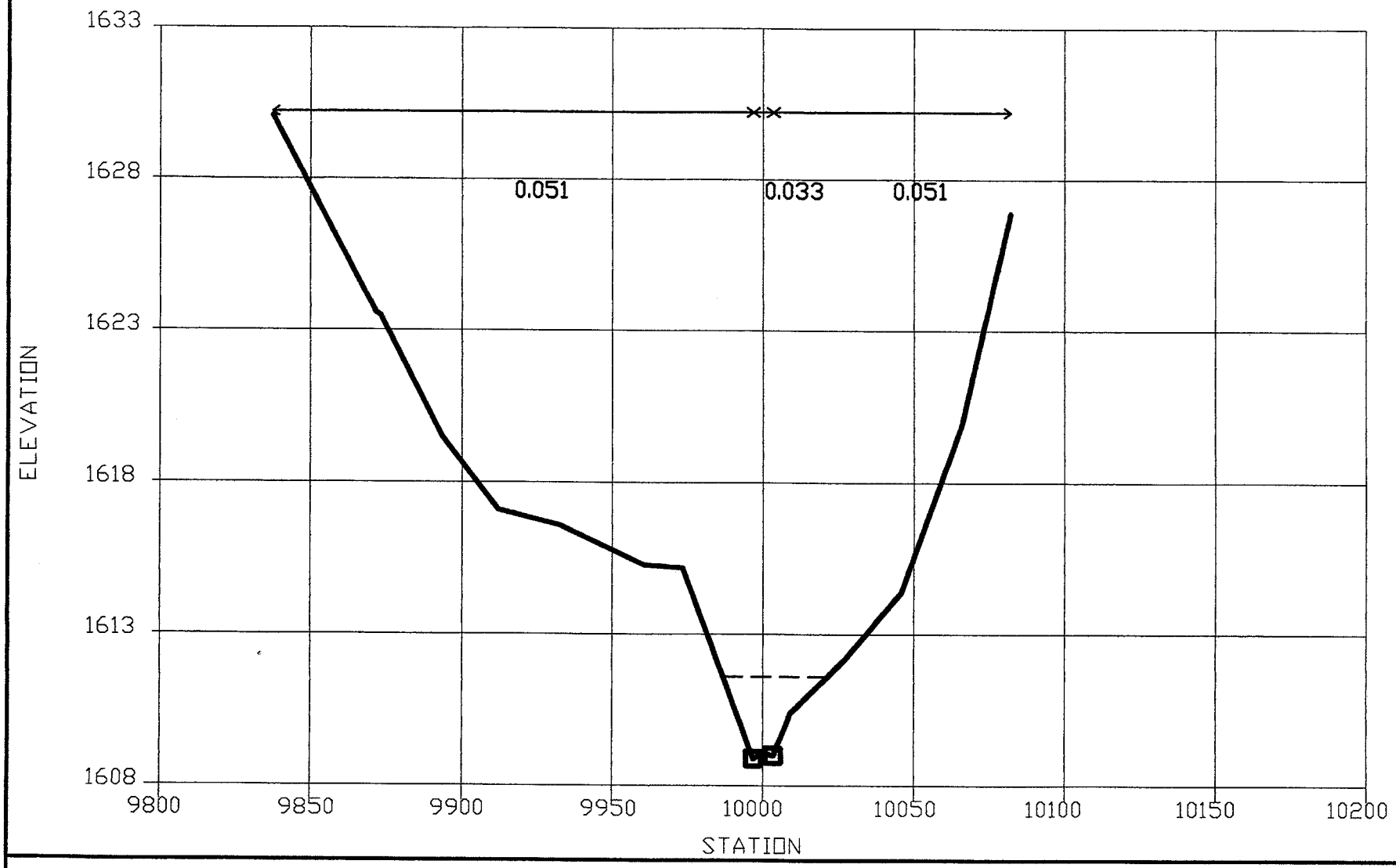


SECTION : 0.62

Fountain Hills (south) FIS

Kingstree Wash

File: KGT-XSEC.DWG

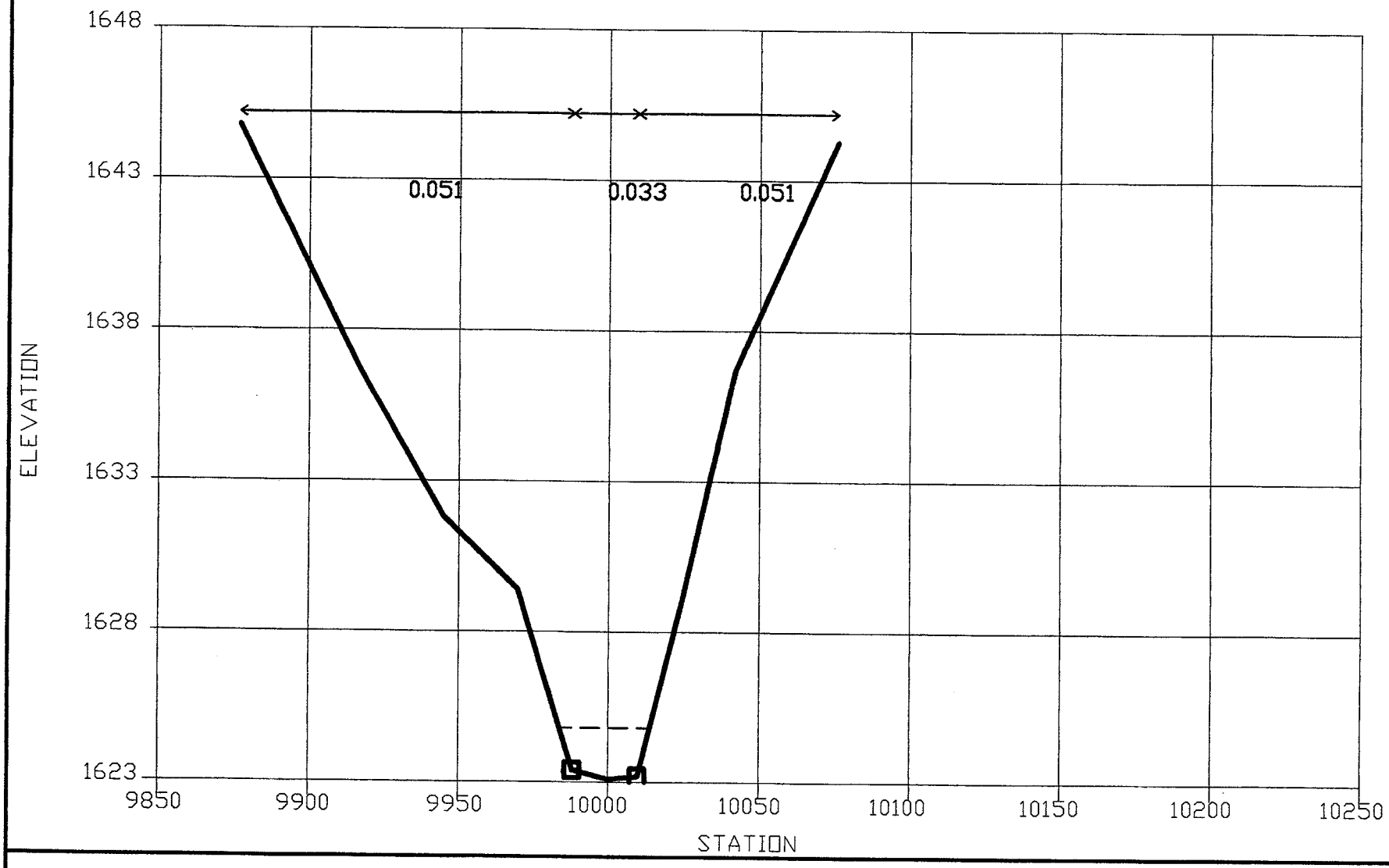


SECTION : 0.71

Fountain Hills (south) FIS

Kingstree Wash

File: KGT-XSEC.DWG

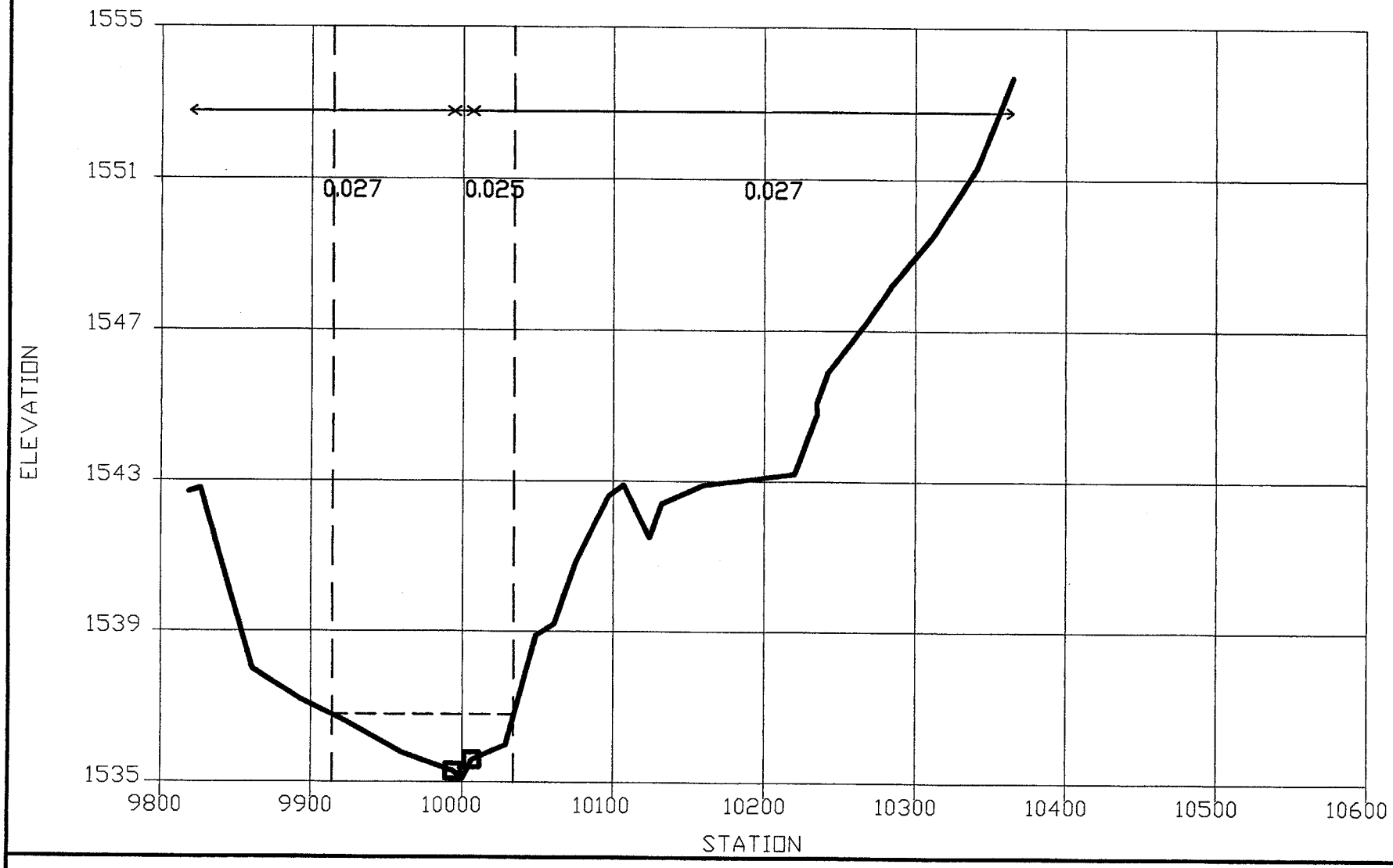


SECTION : 0.81

Fountain Hills (south) FIS

Kingstree Wash

File: KGT-XSEC.DWG

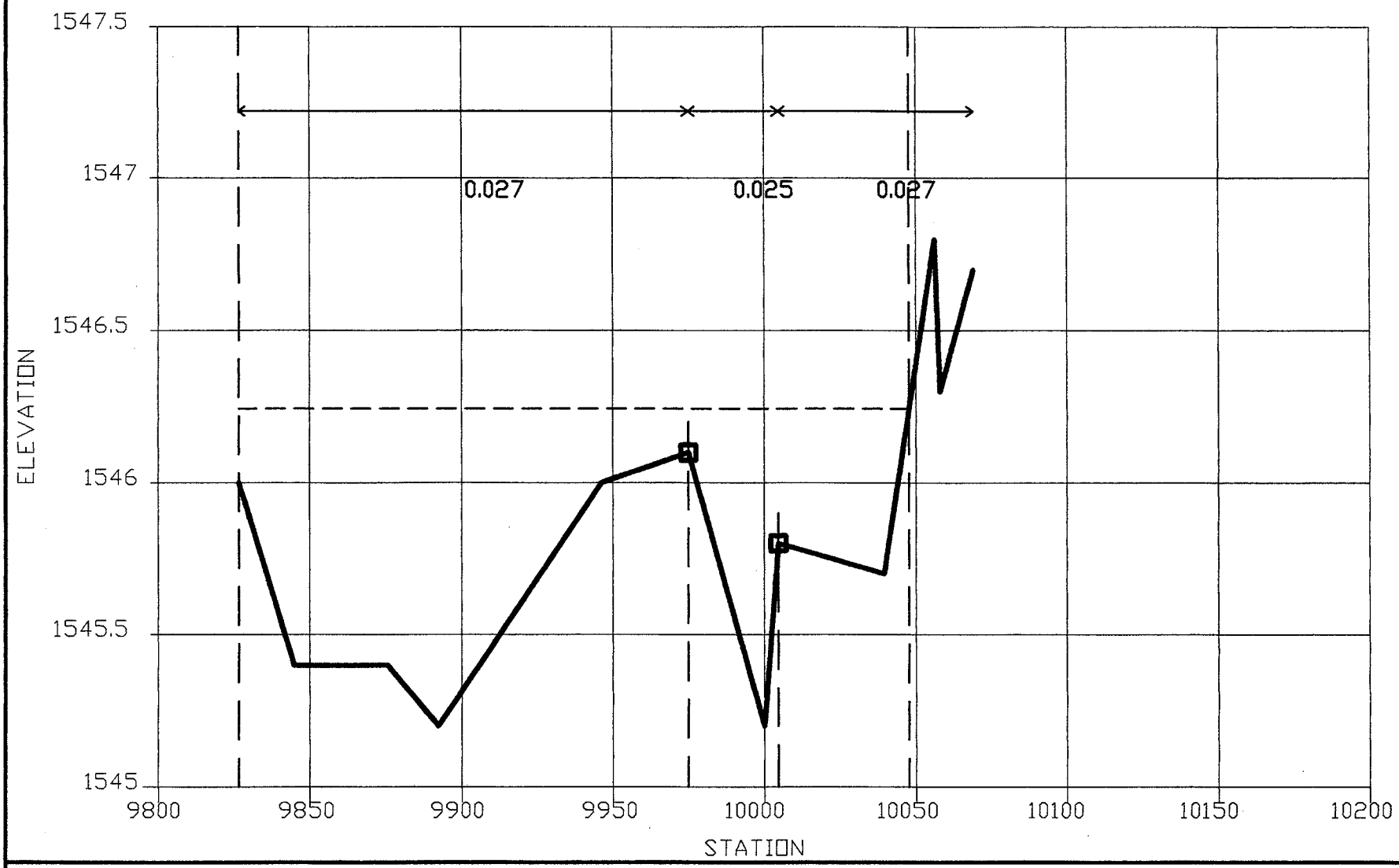


SECTION : 0.00

Fountain Hills (south) FIS

Mangrum Wash

File: MAN-XSEC.DWG

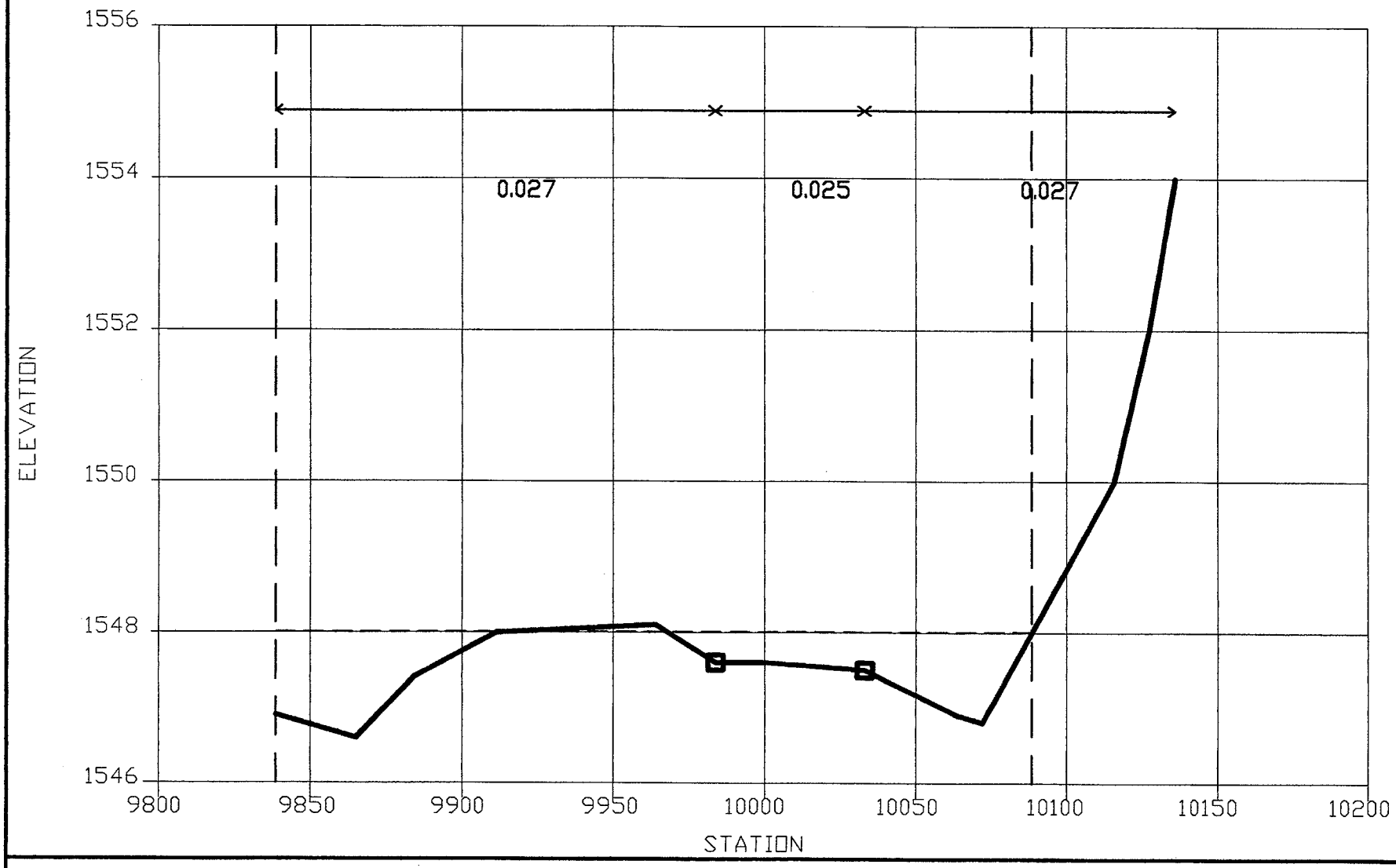


SECTION : 0.06

Fountain Hills (south) FIS

Mangrum Wash

File: MAN-XSEC.DWG

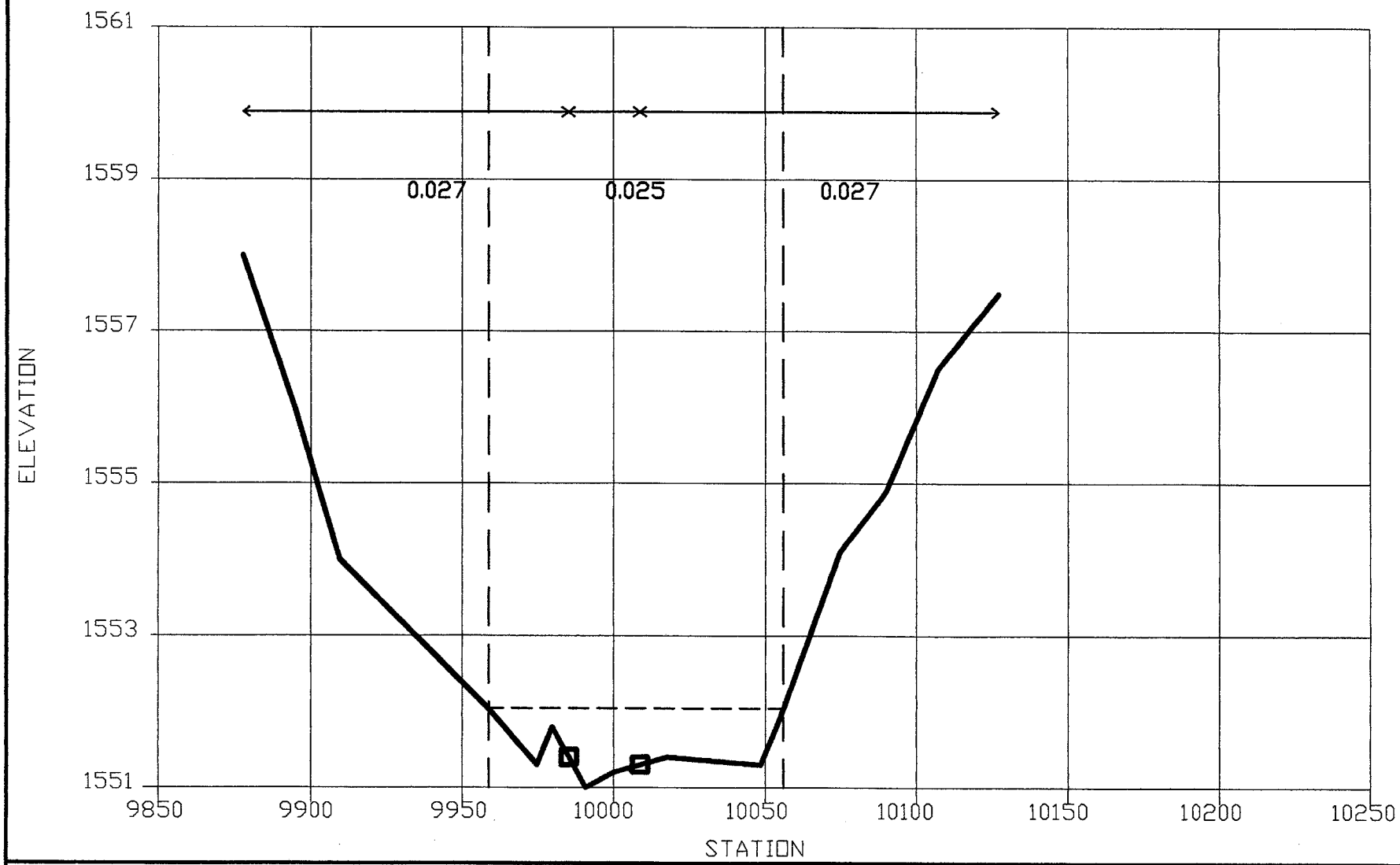


SECTION : 0.07

Fountain Hills (south) FIS

Mangrum Wash

File: MAN-XSEC.DWG

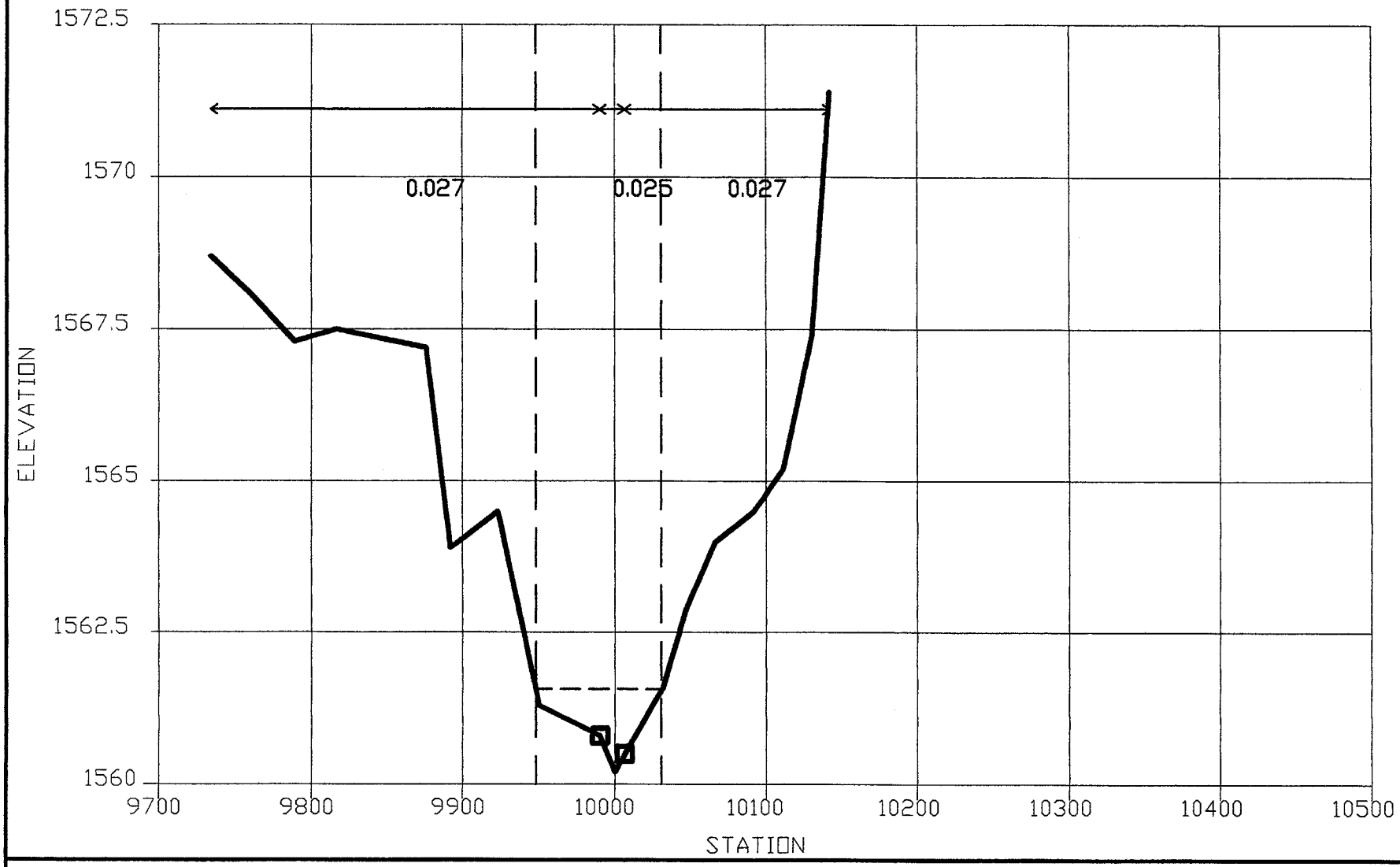


SECTION : 0.10

Fountain Hills (south) FIS

Mangrum Wash

File: MAN-XSEC.DWG

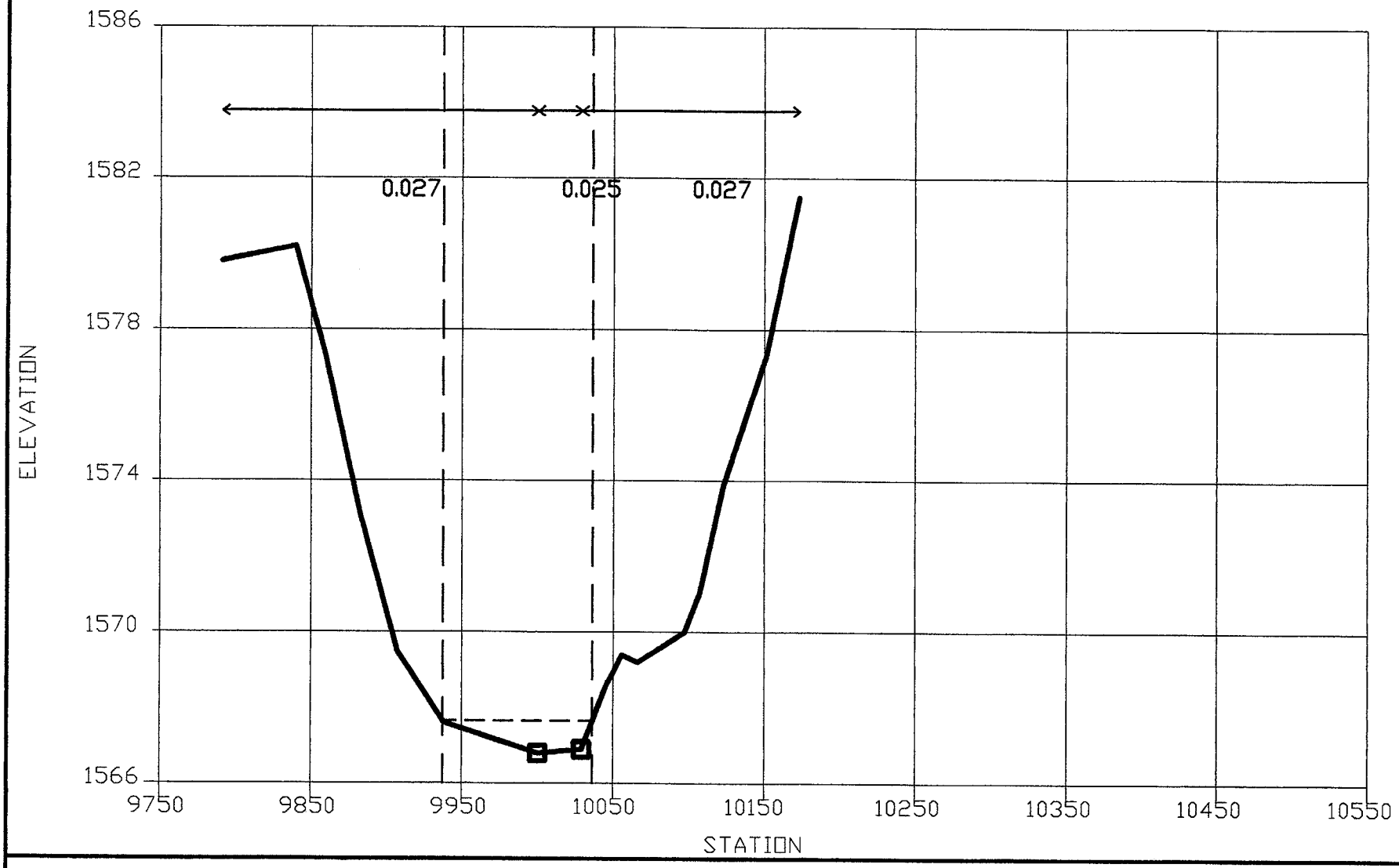


SECTION : 0.17

Fountain Hills (south) FIS

Mangrum Wash

File: MAN-XSEC.DWG

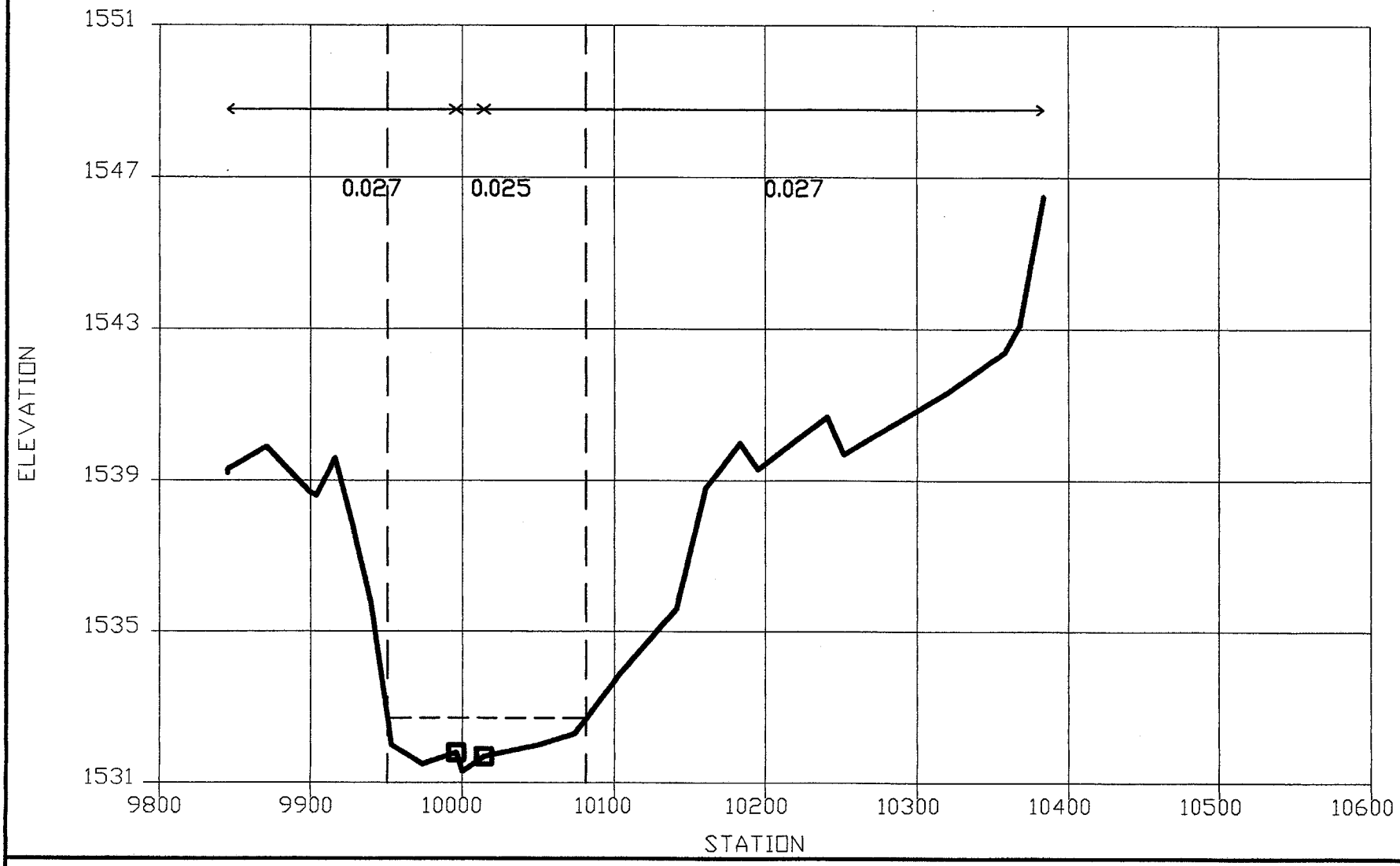


SECTION : 0.21

Fountain Hills (south) FIS

Mangrum Wash

File: MAN-XSEC.DWG

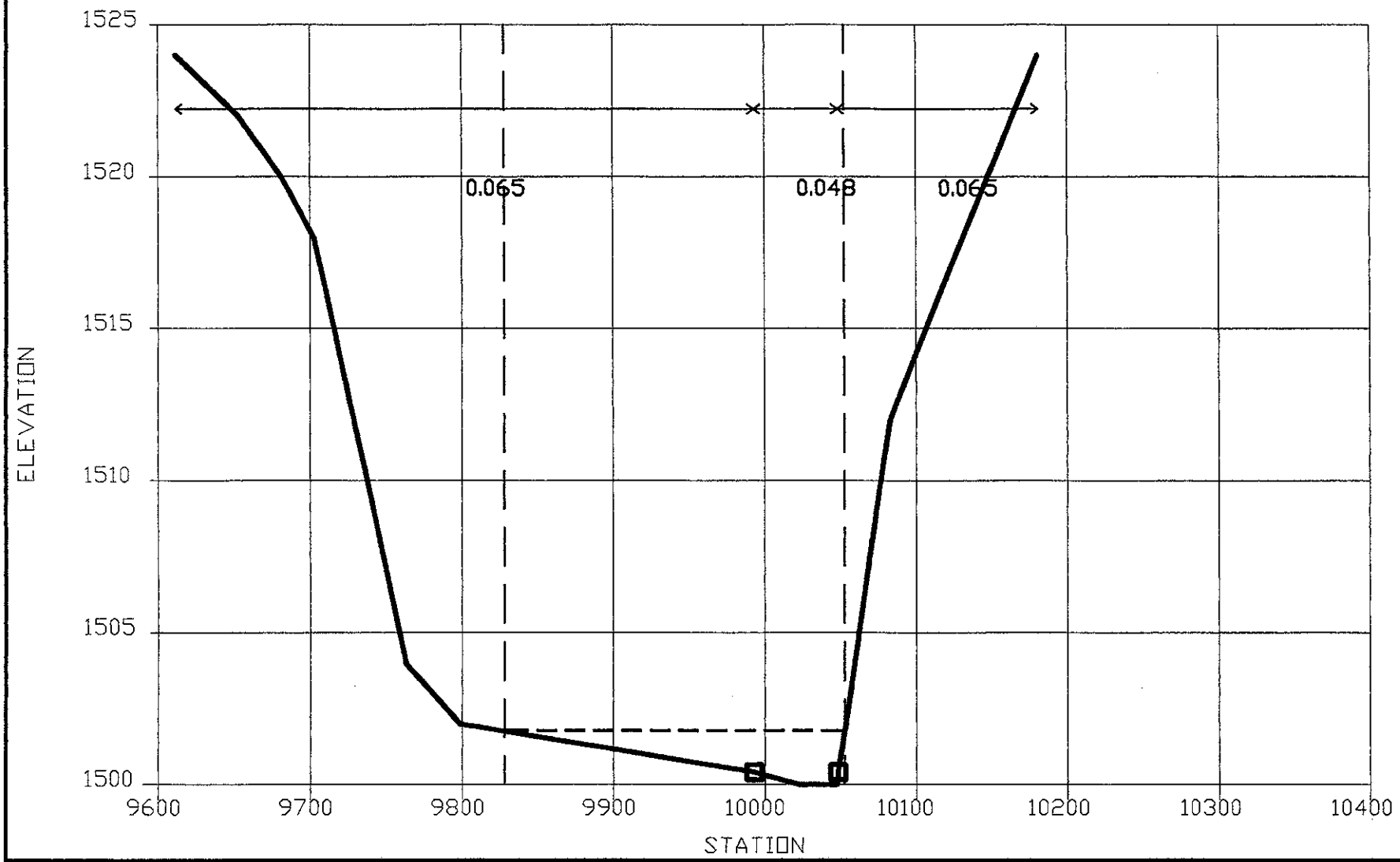


SECTION : 2.65

Fountain Hills (south) FIS

Mangrum Wash

File: MAN-XSEC.DWG

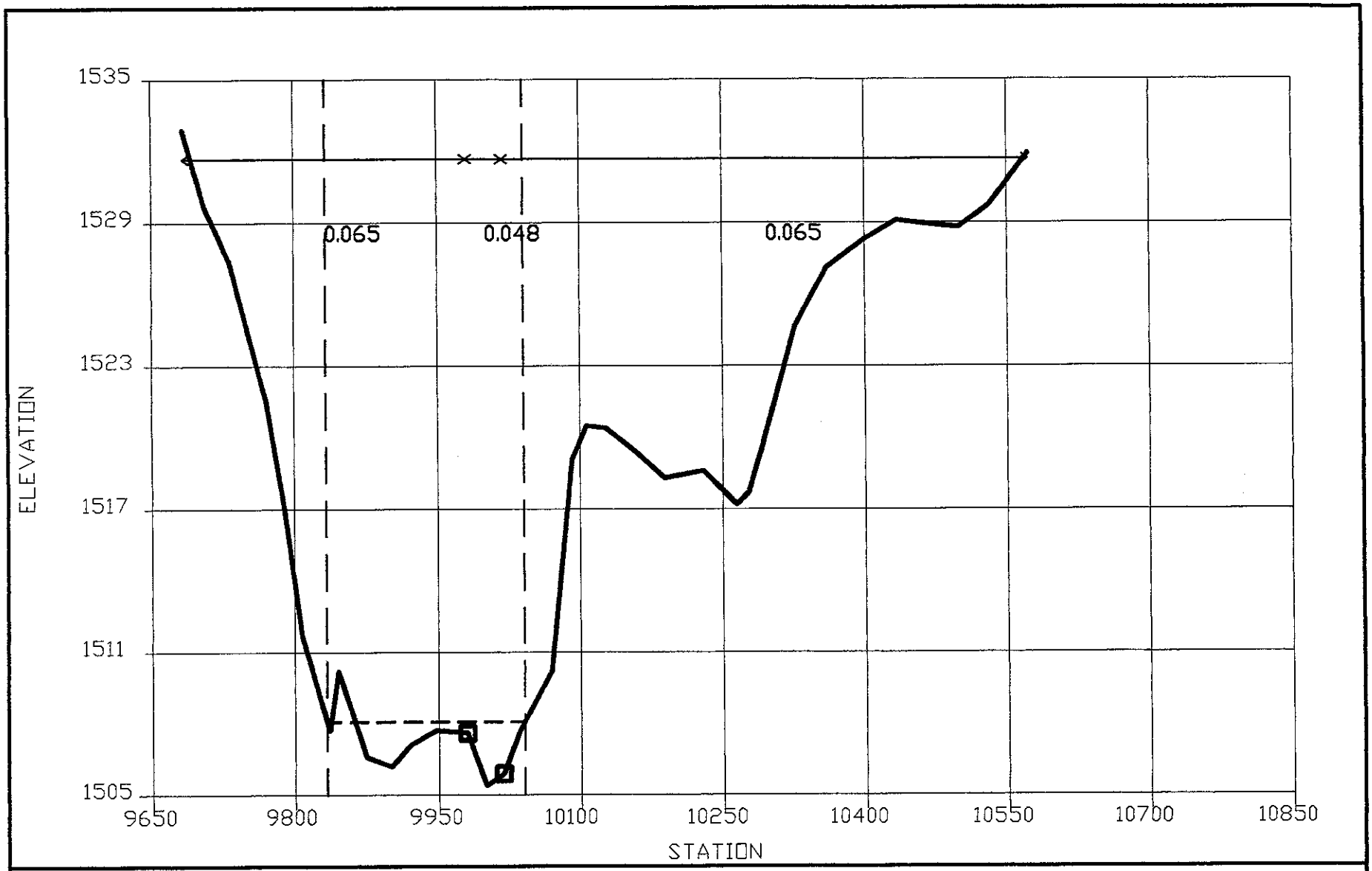


SECTION : 2.10

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

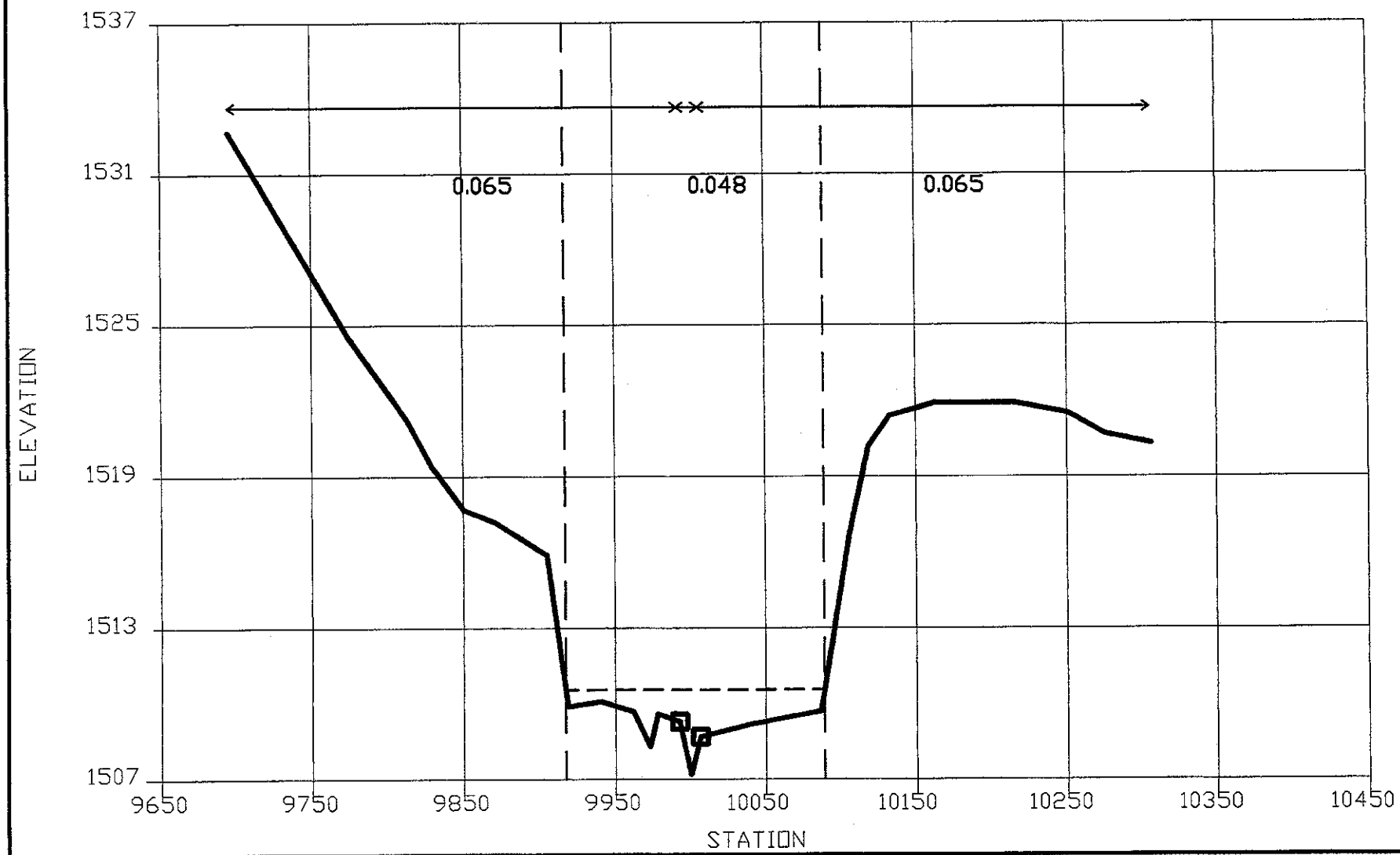


SECTION : 2.28

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

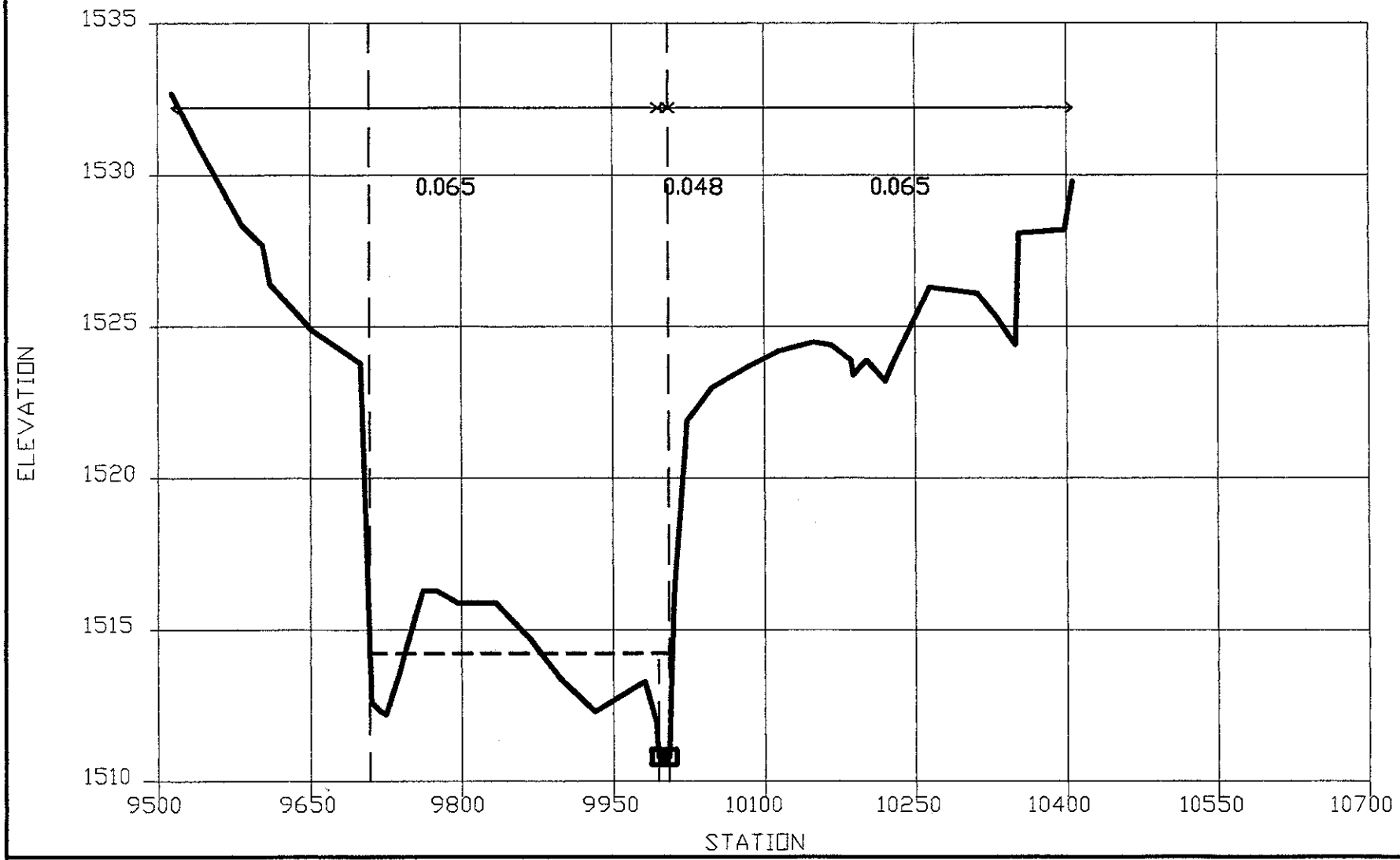


SECTION : 2.30

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

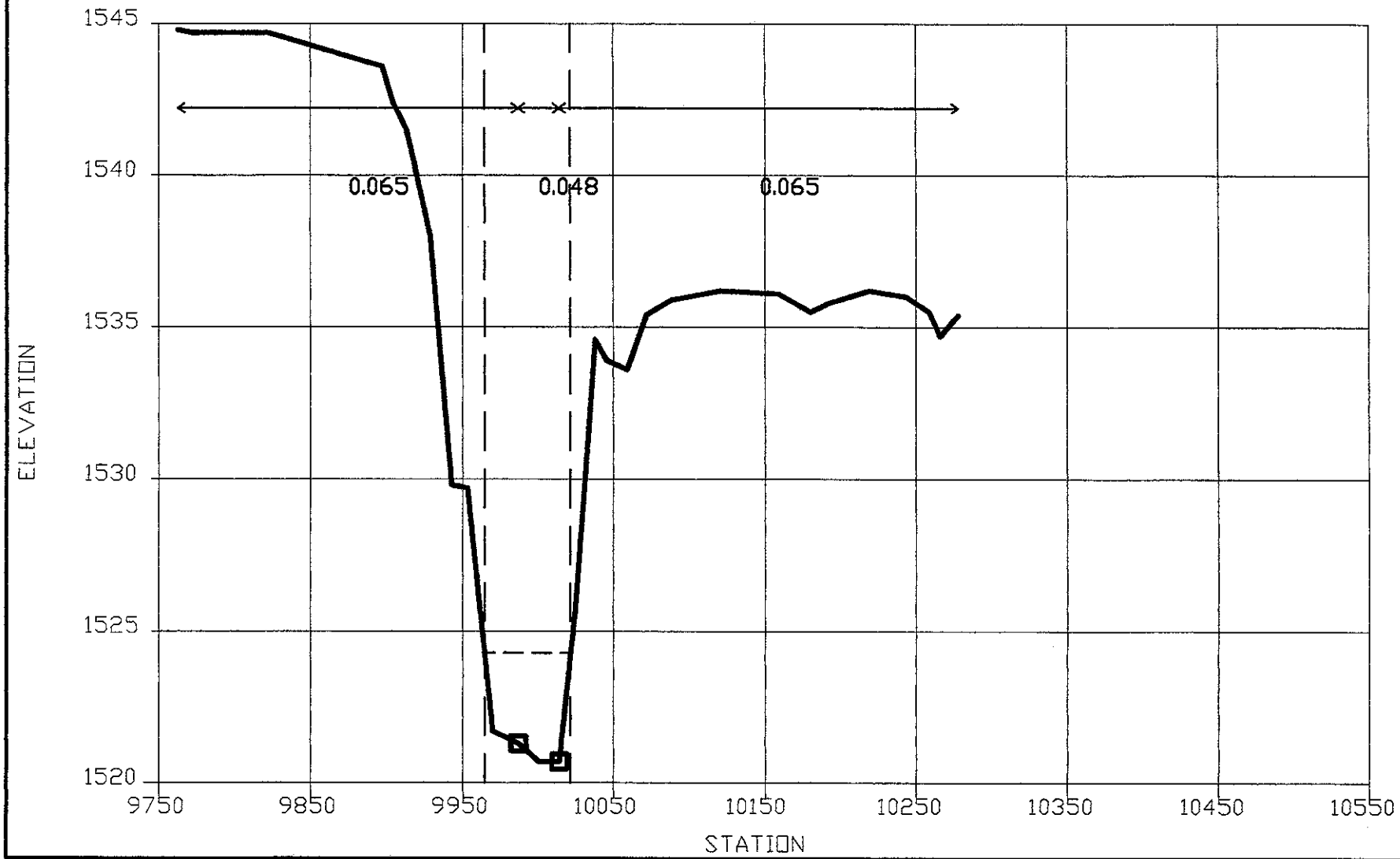


SECTION : 2.35

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

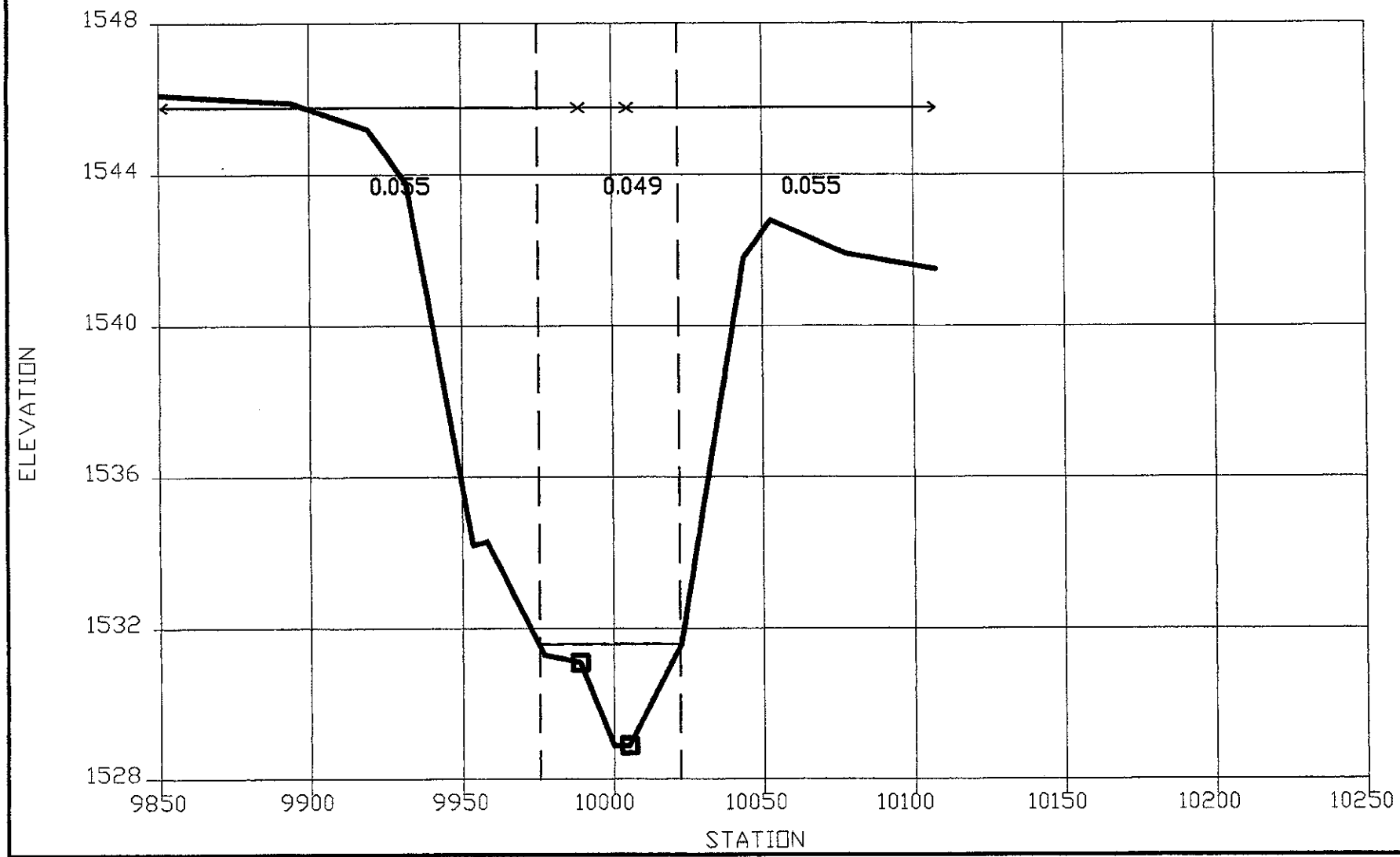


SECTION : 2.45

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

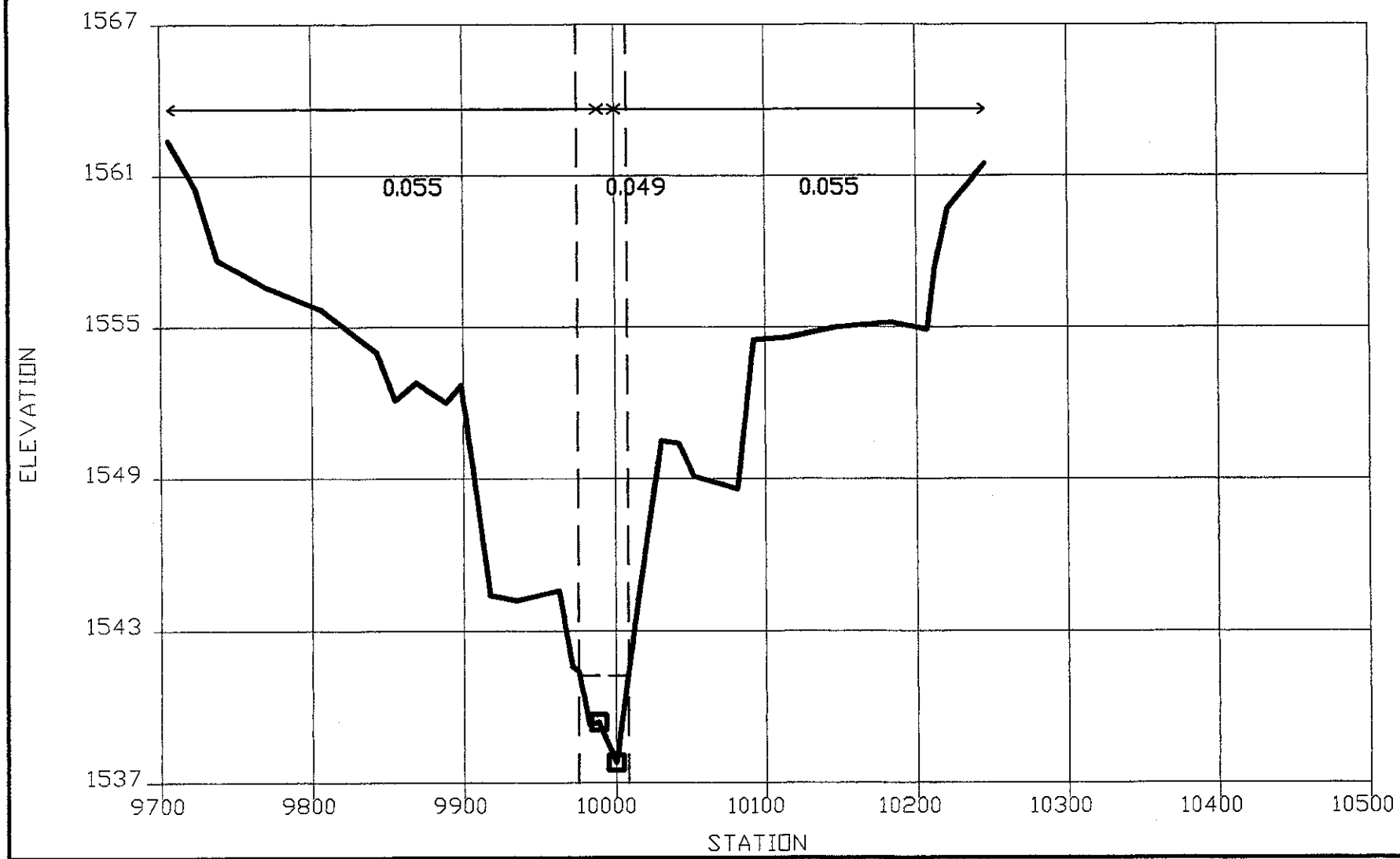


SECTION : 2.54

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

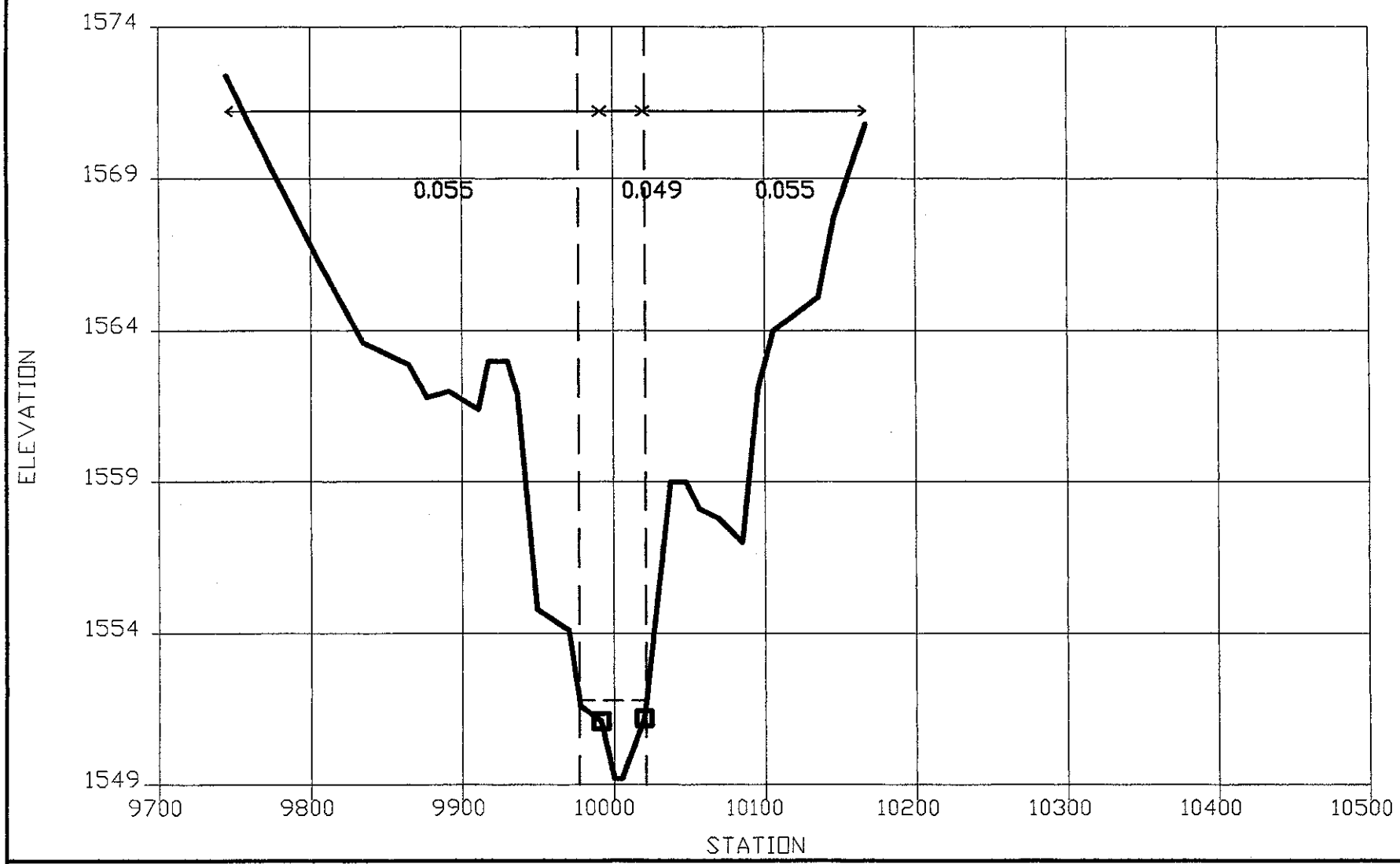


SECTION : 2.64

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

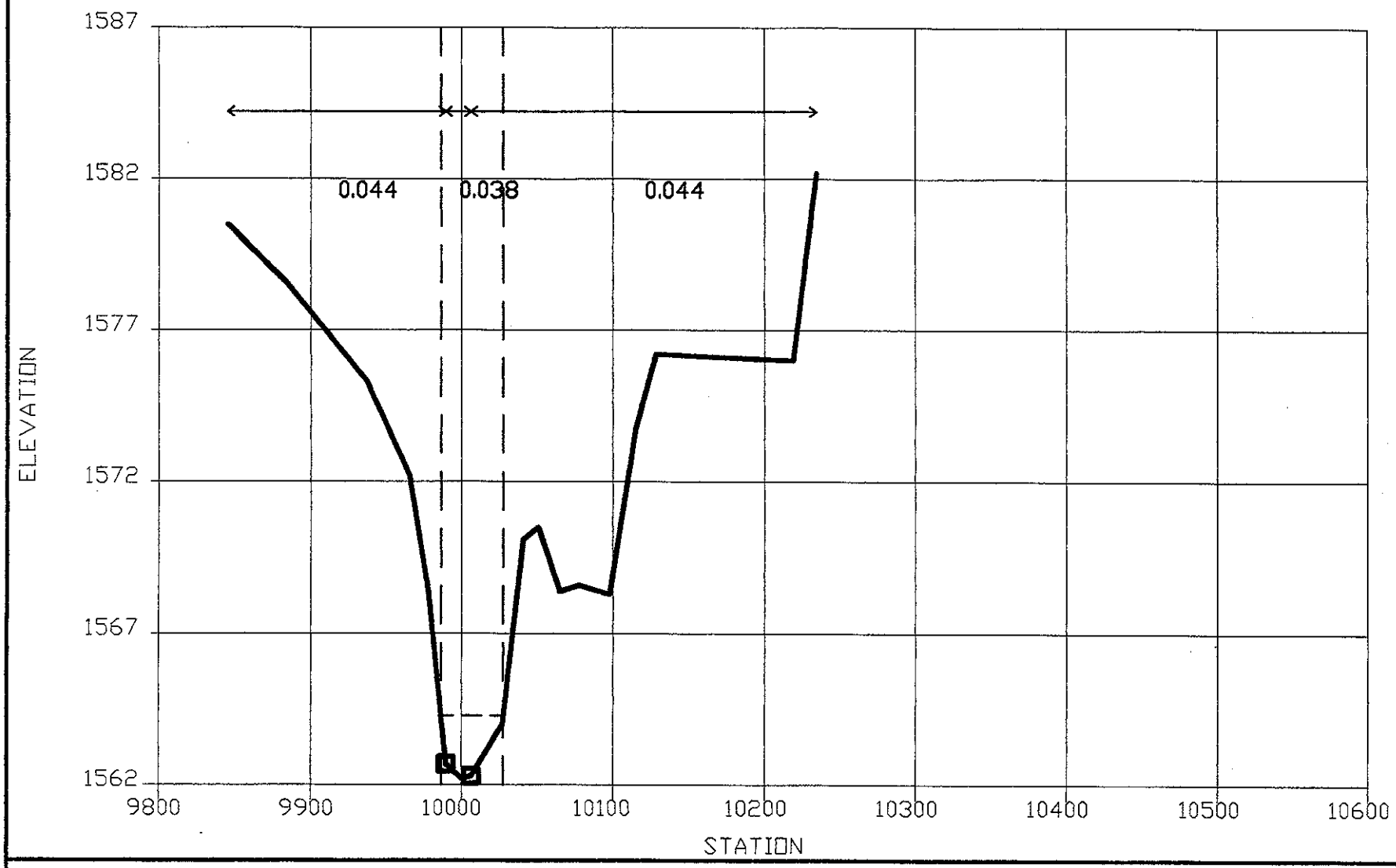


SECTION : 2.73

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

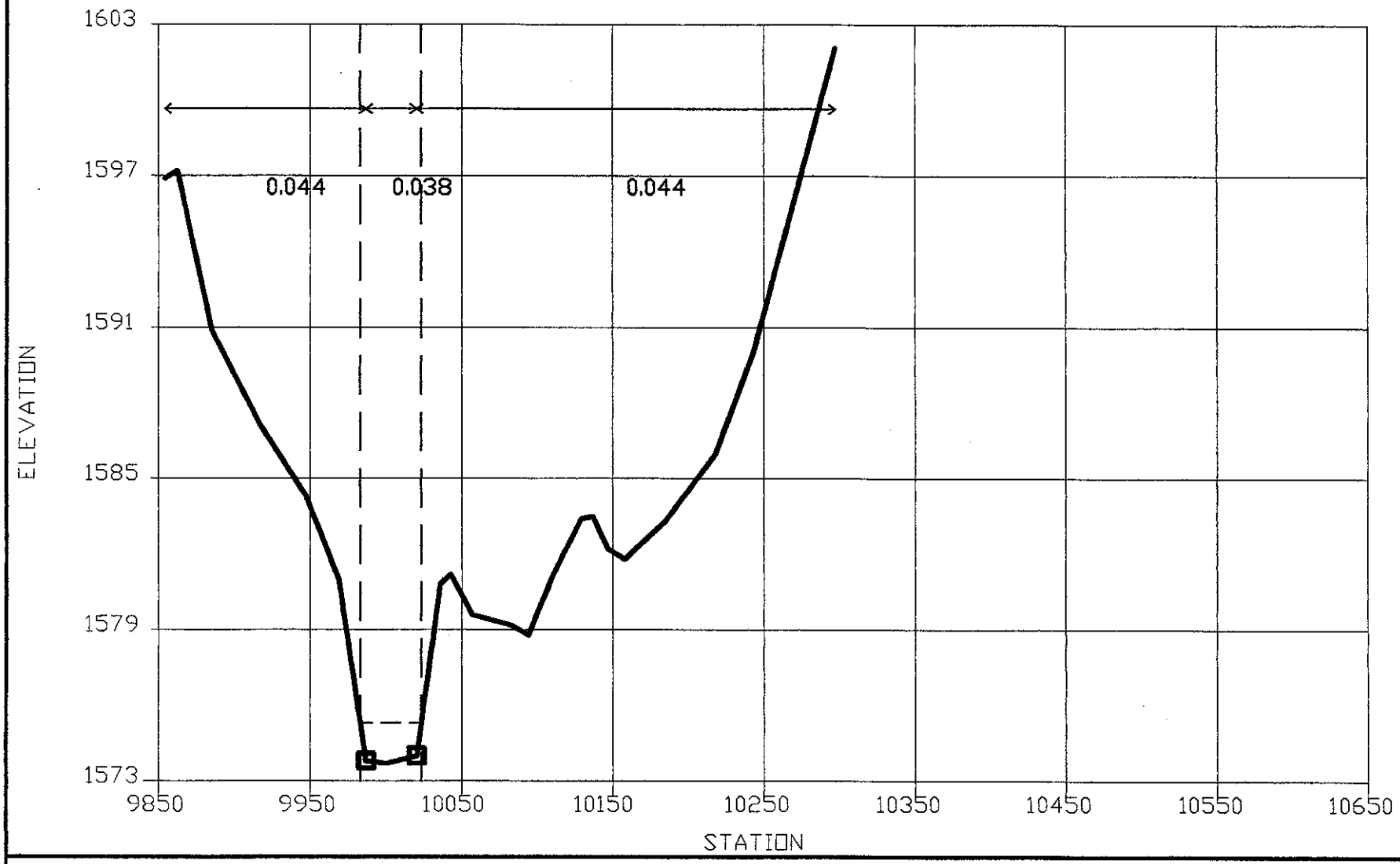


SECTION : 2.82

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

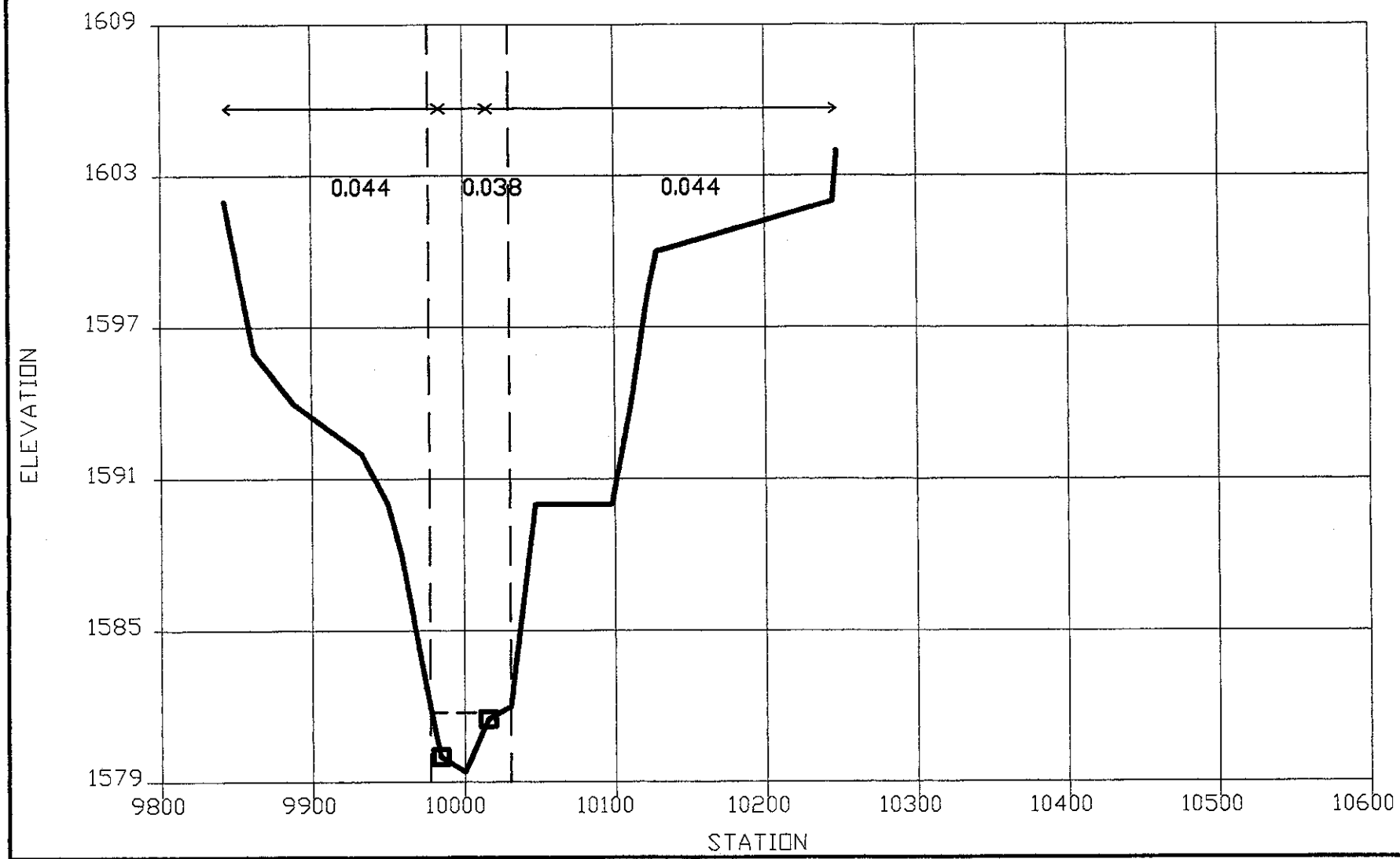


SECTION : 2.92

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

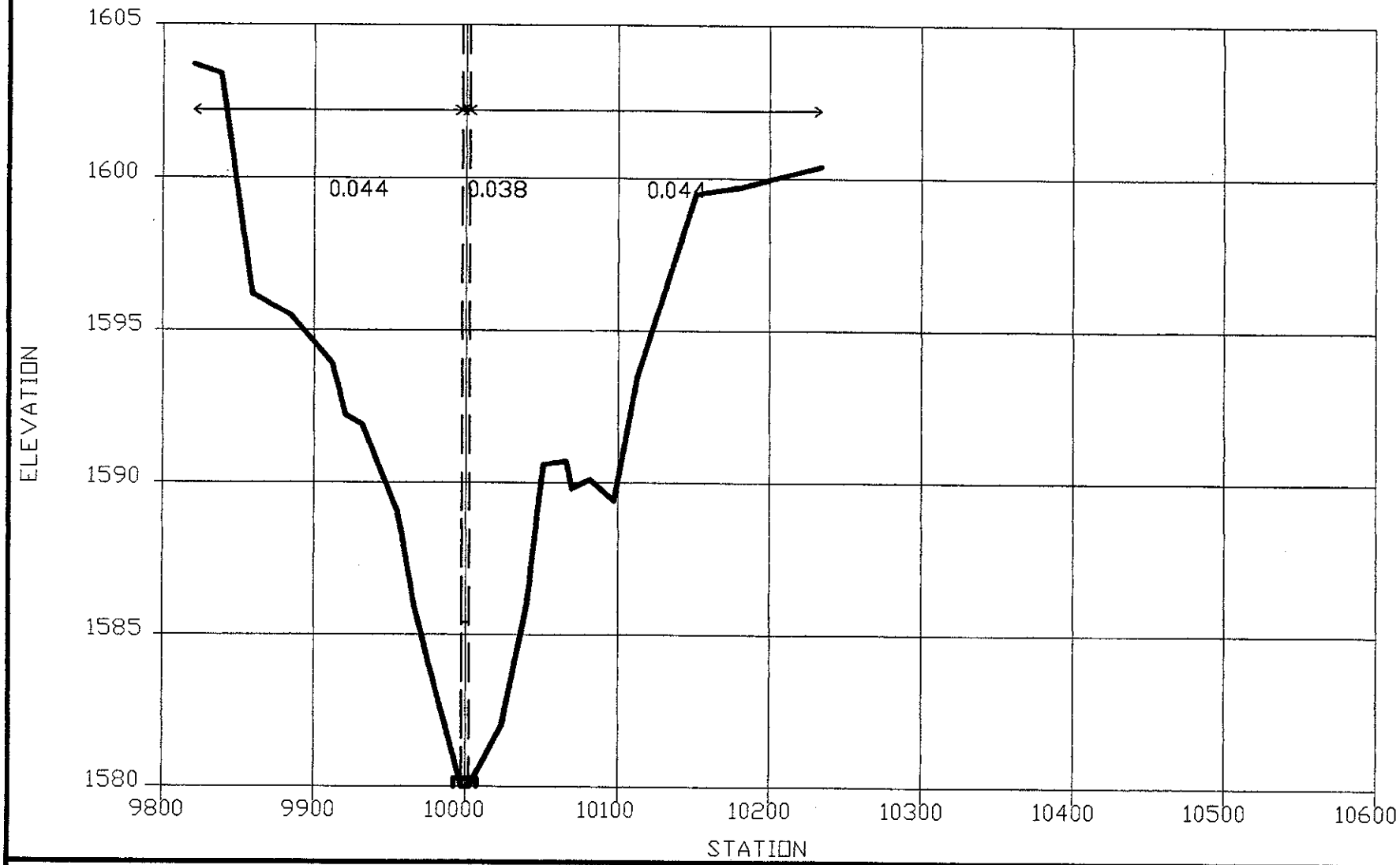


SECTION : 2.99

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

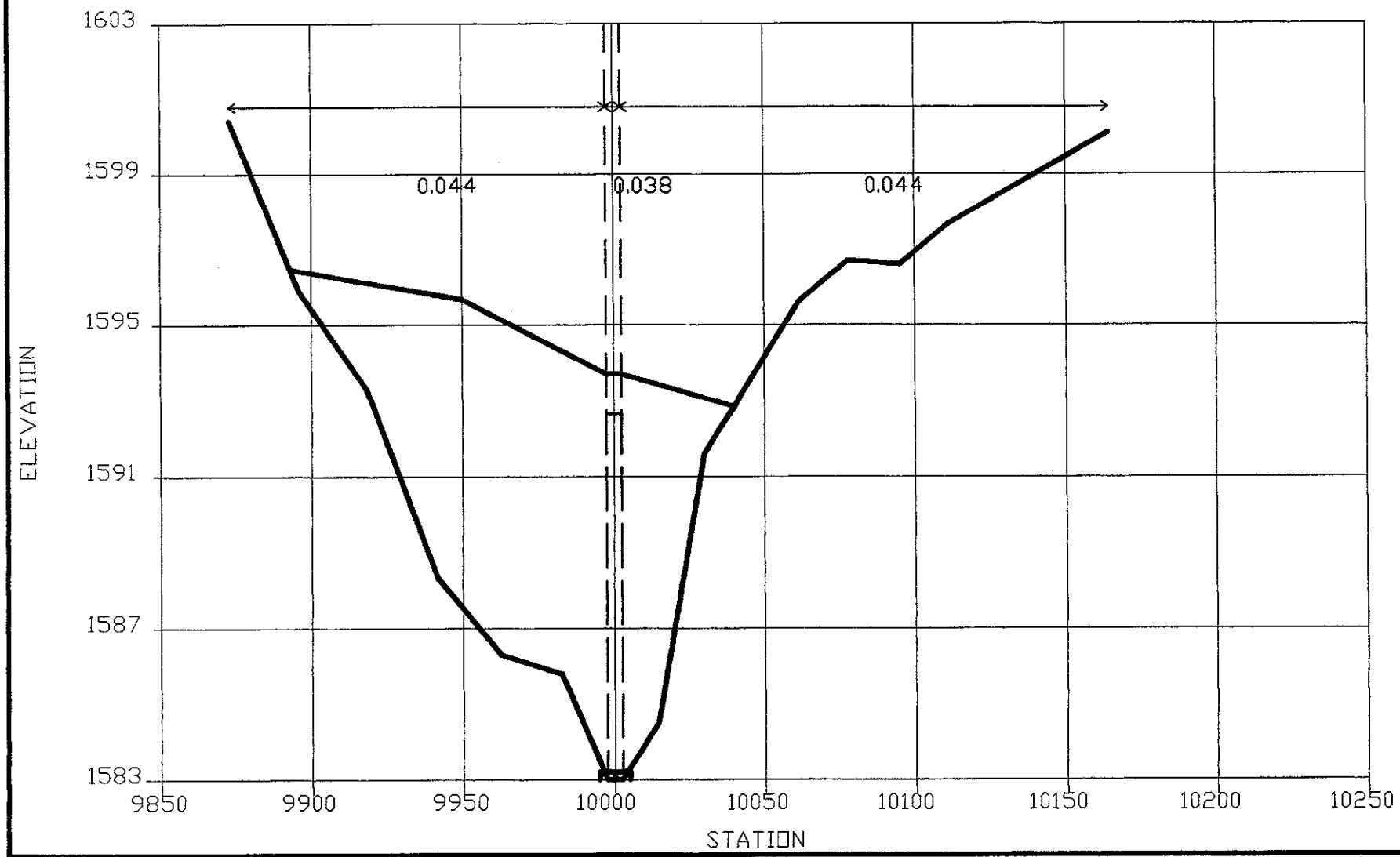


SECTION : 3.00

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

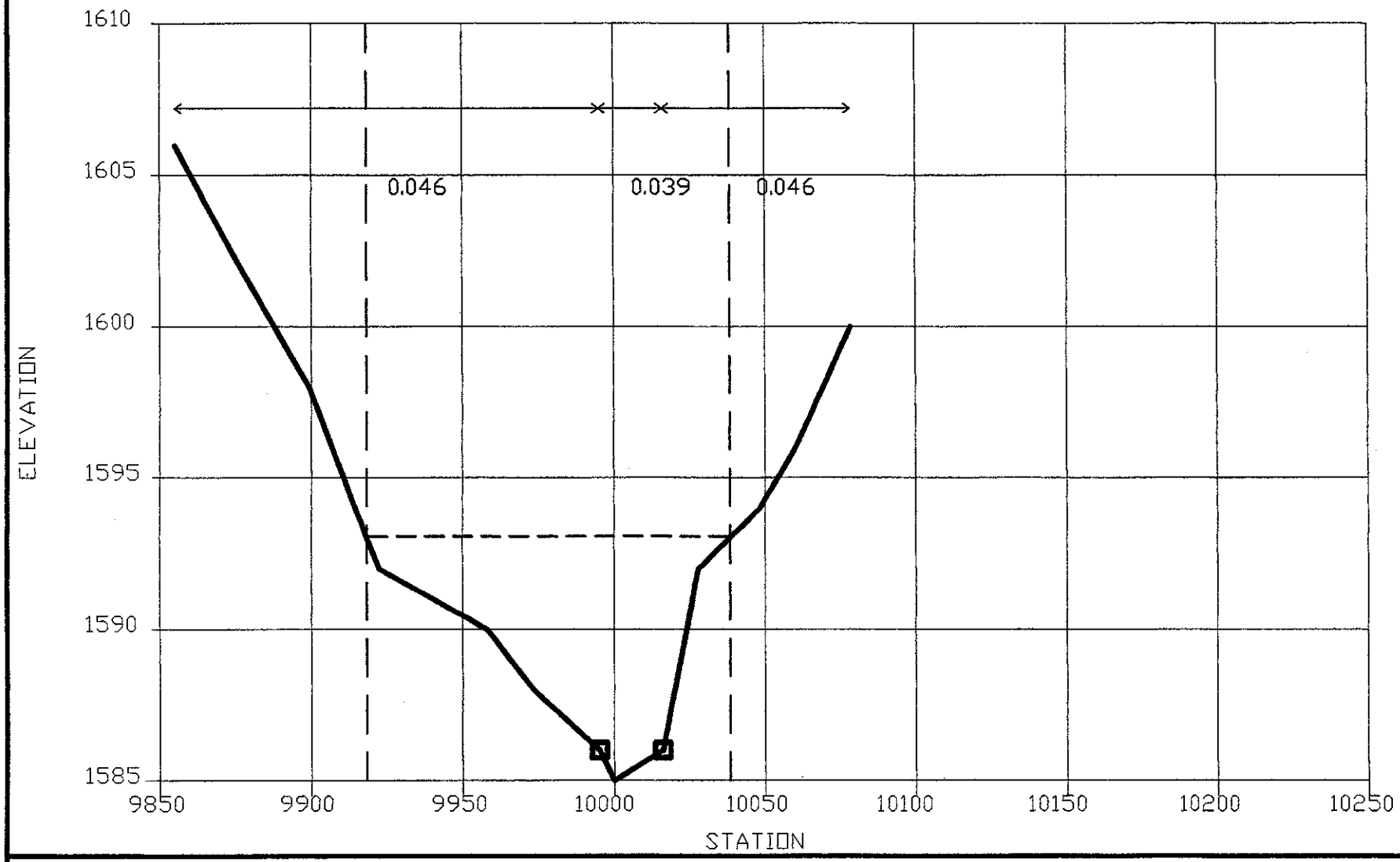


SECTION : 3.03

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

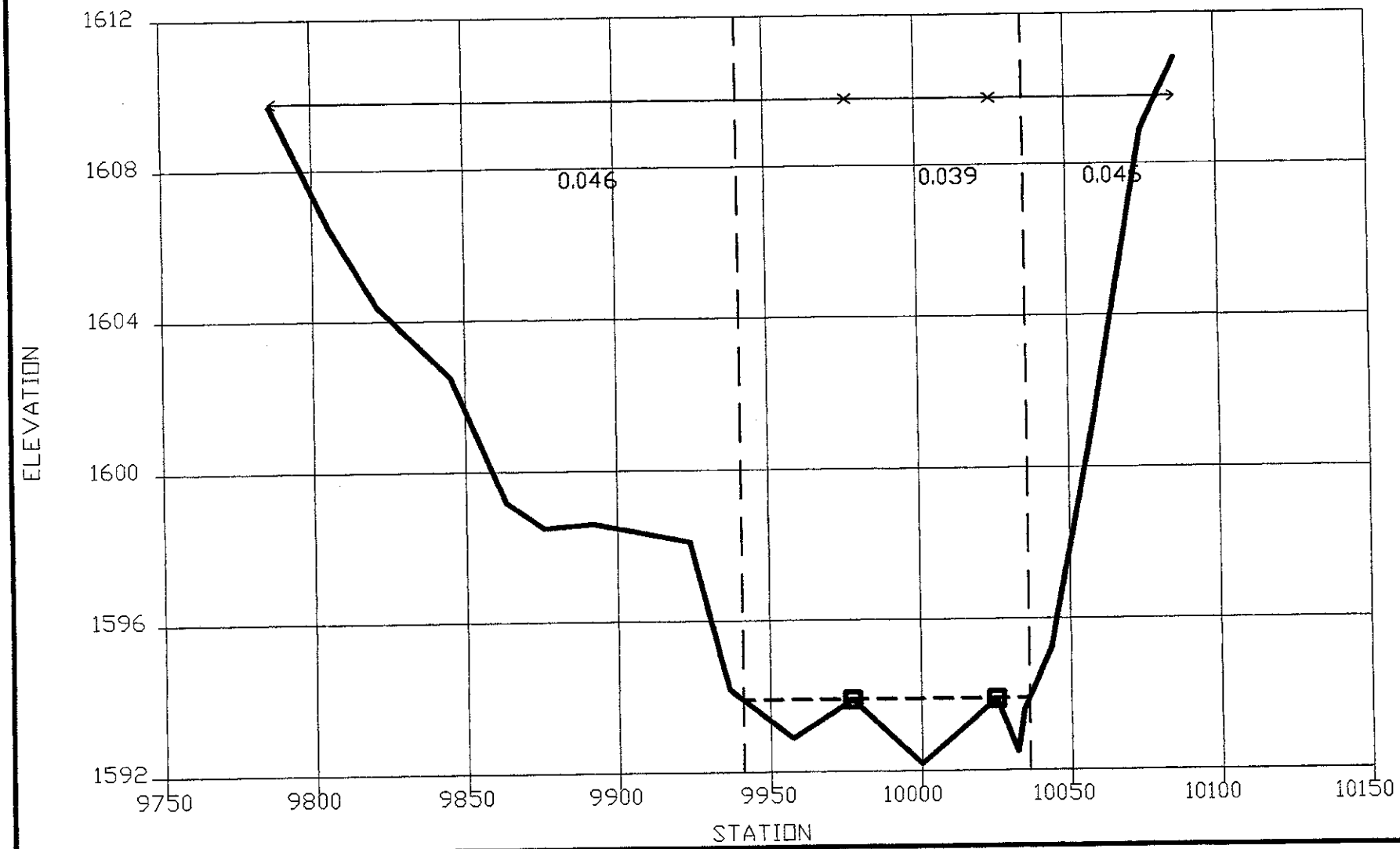


SECTION : 3.04

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

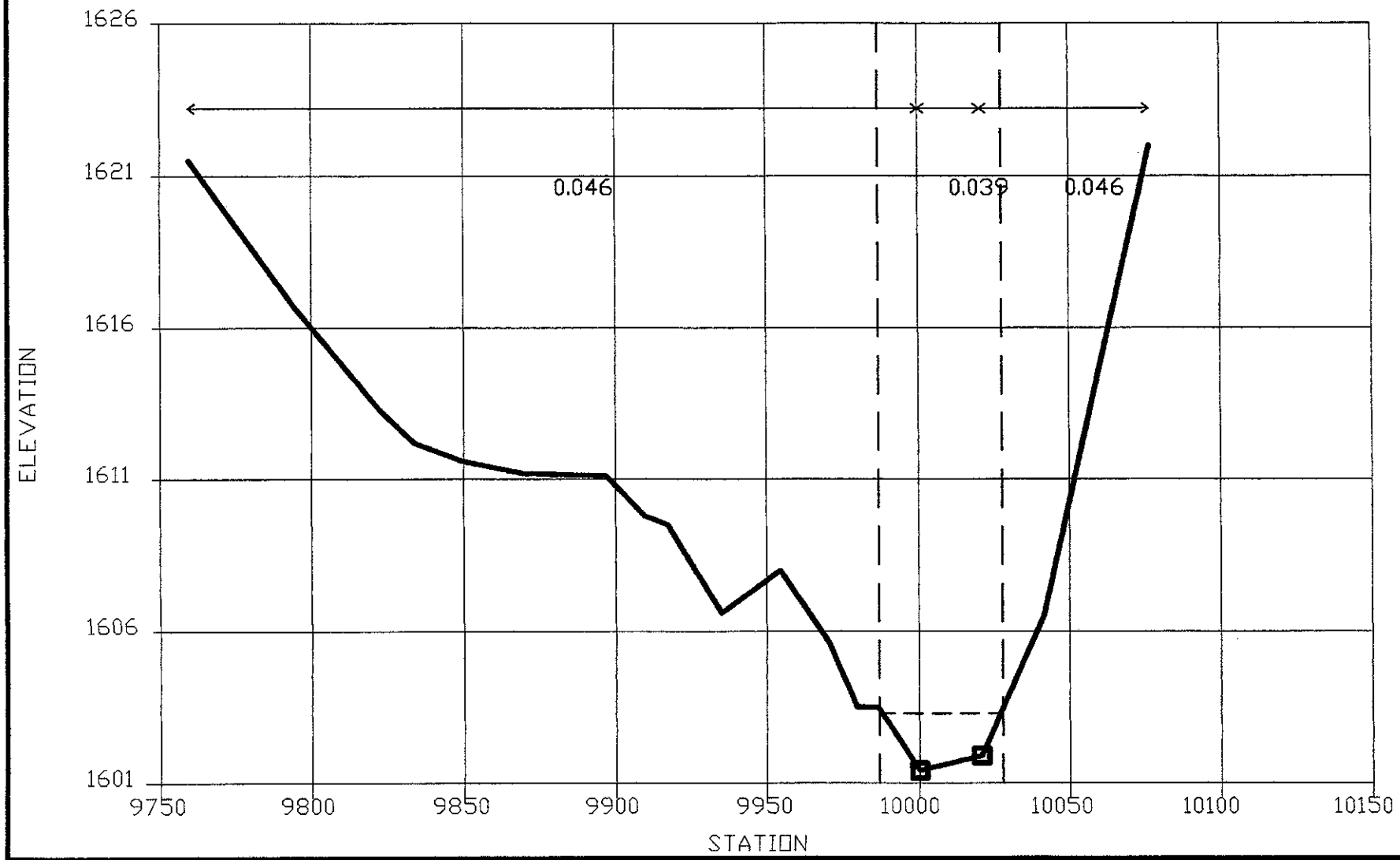


SECTION : 3.11

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

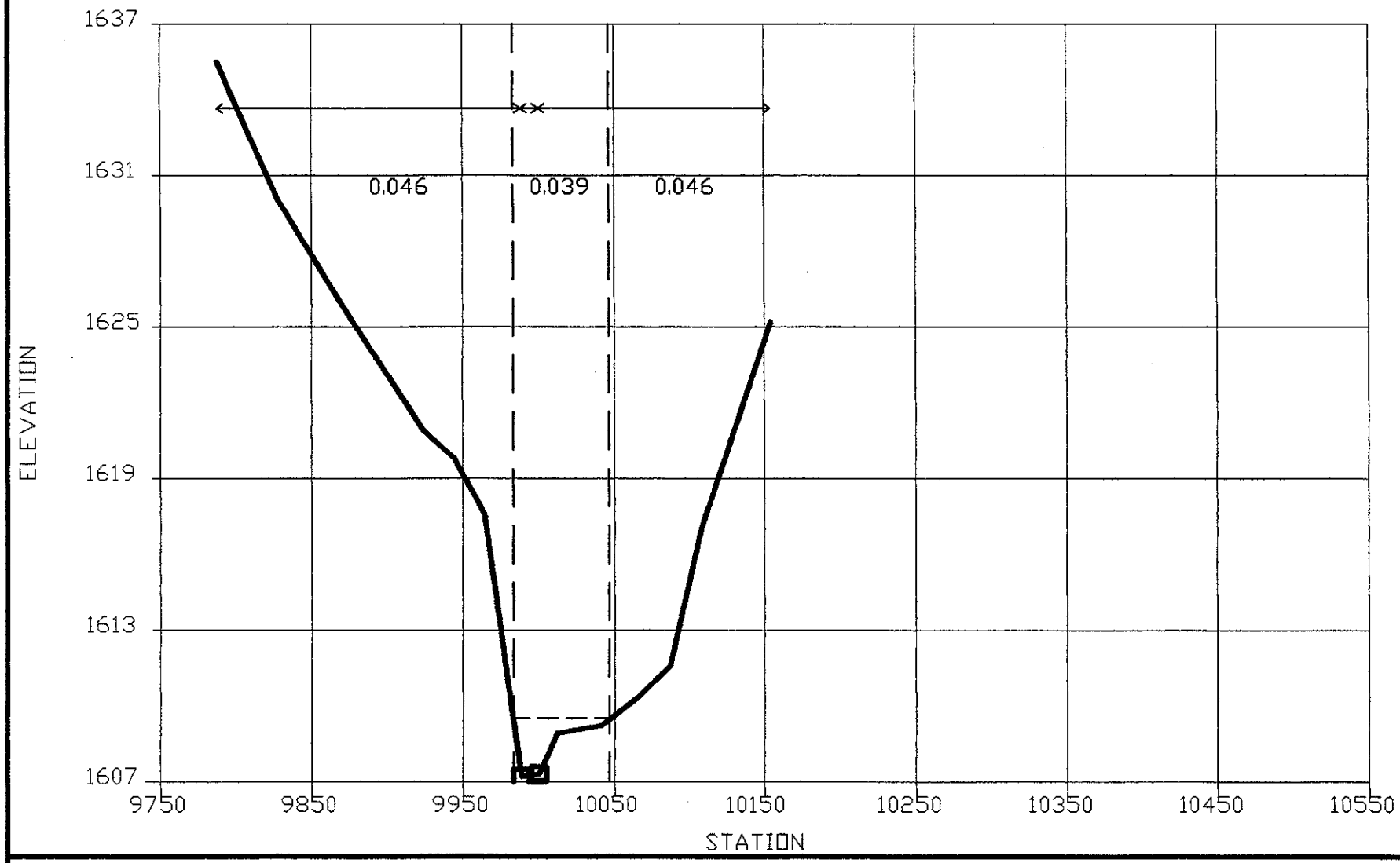


SECTION : 3.19

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

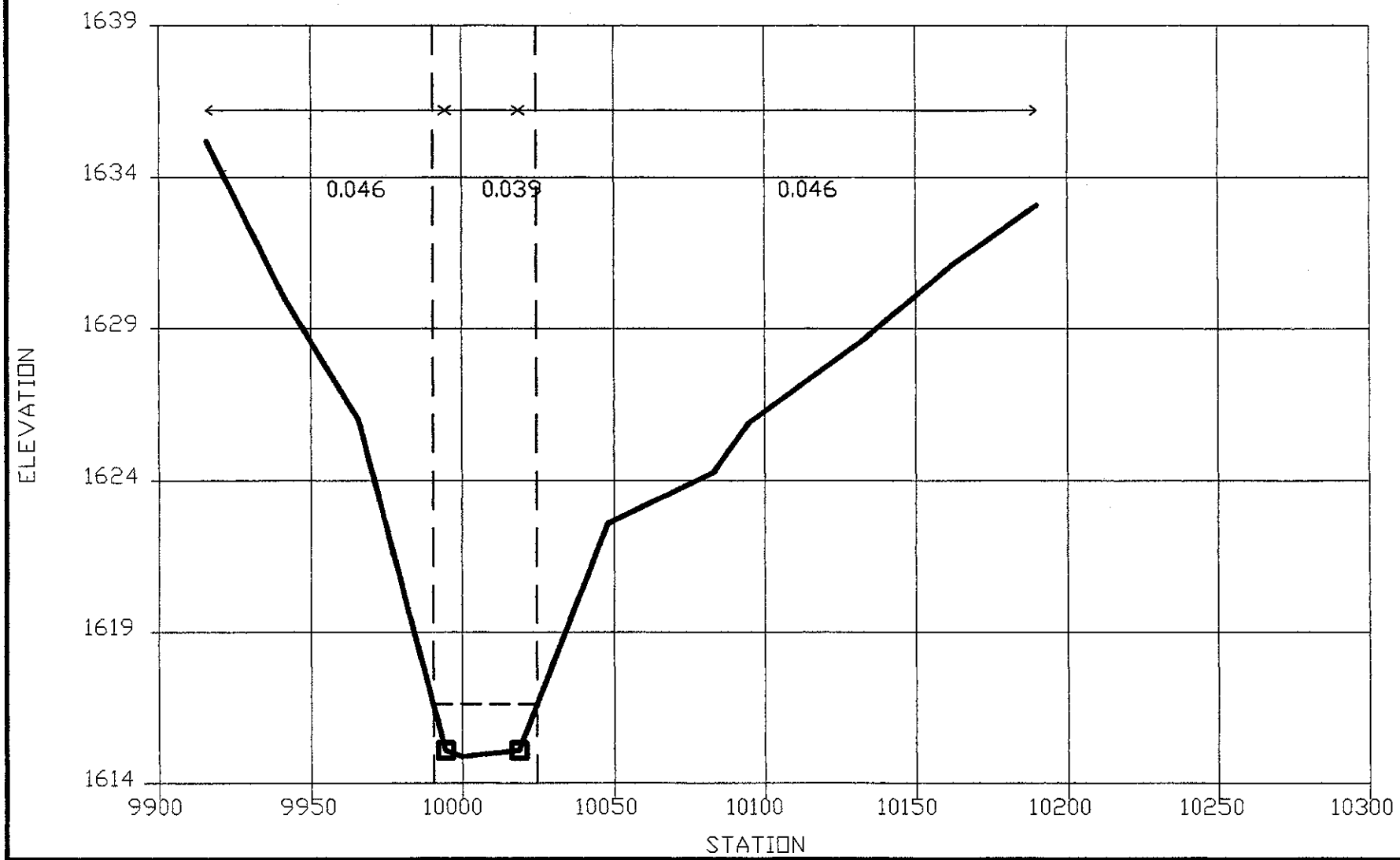


SECTION : 3.25

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

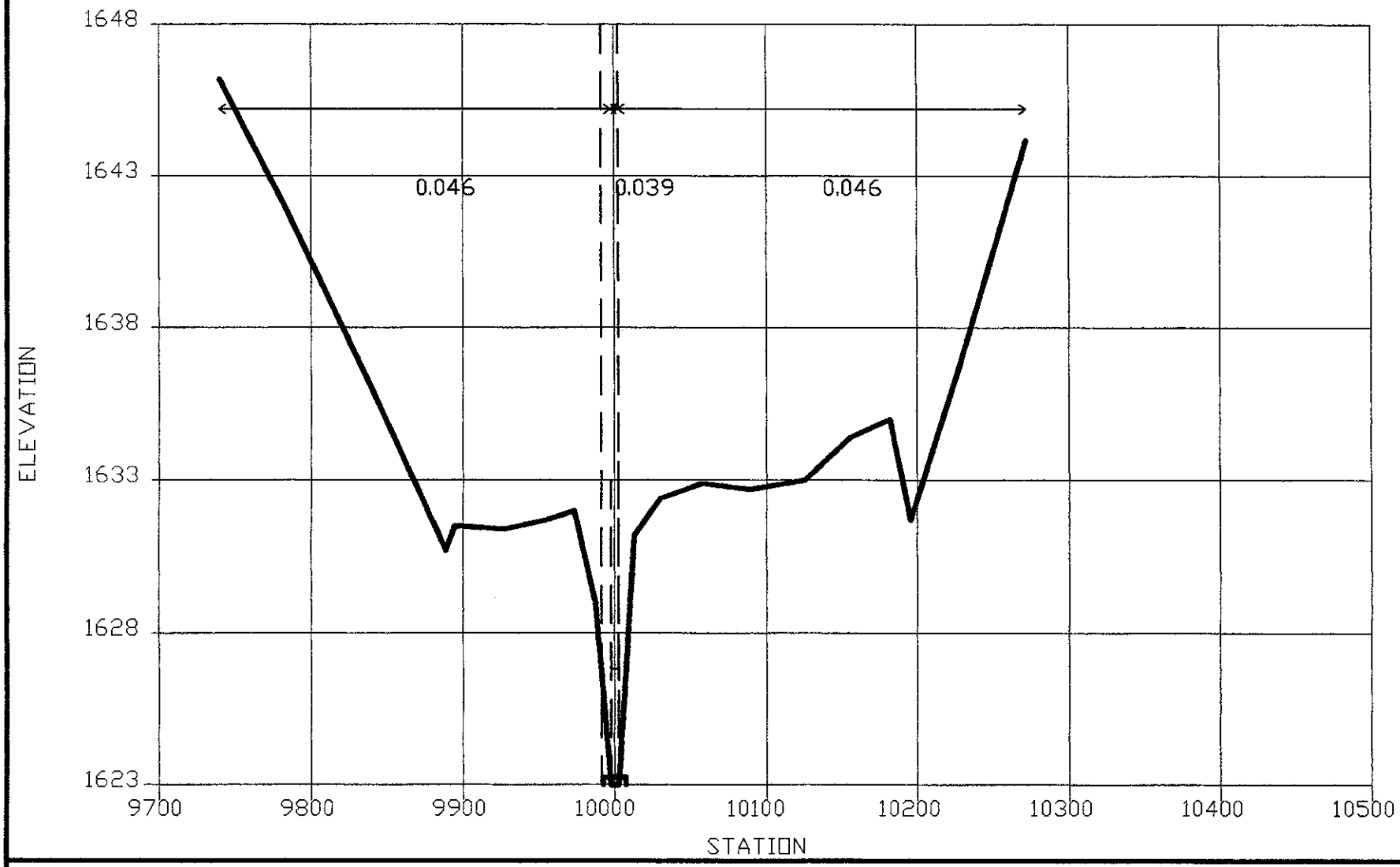


SECTION : 3.30

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

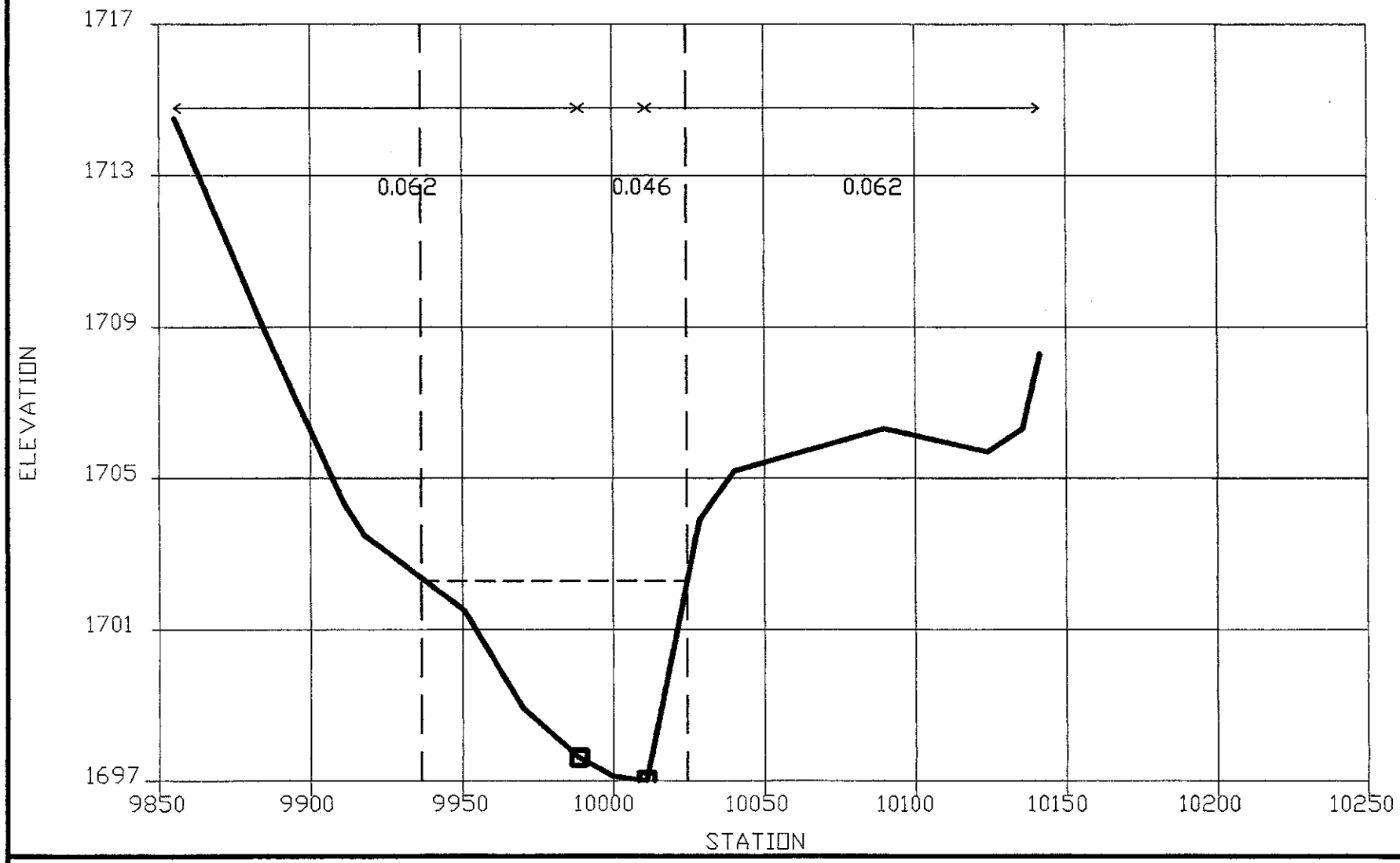


SECTION : 3.33

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

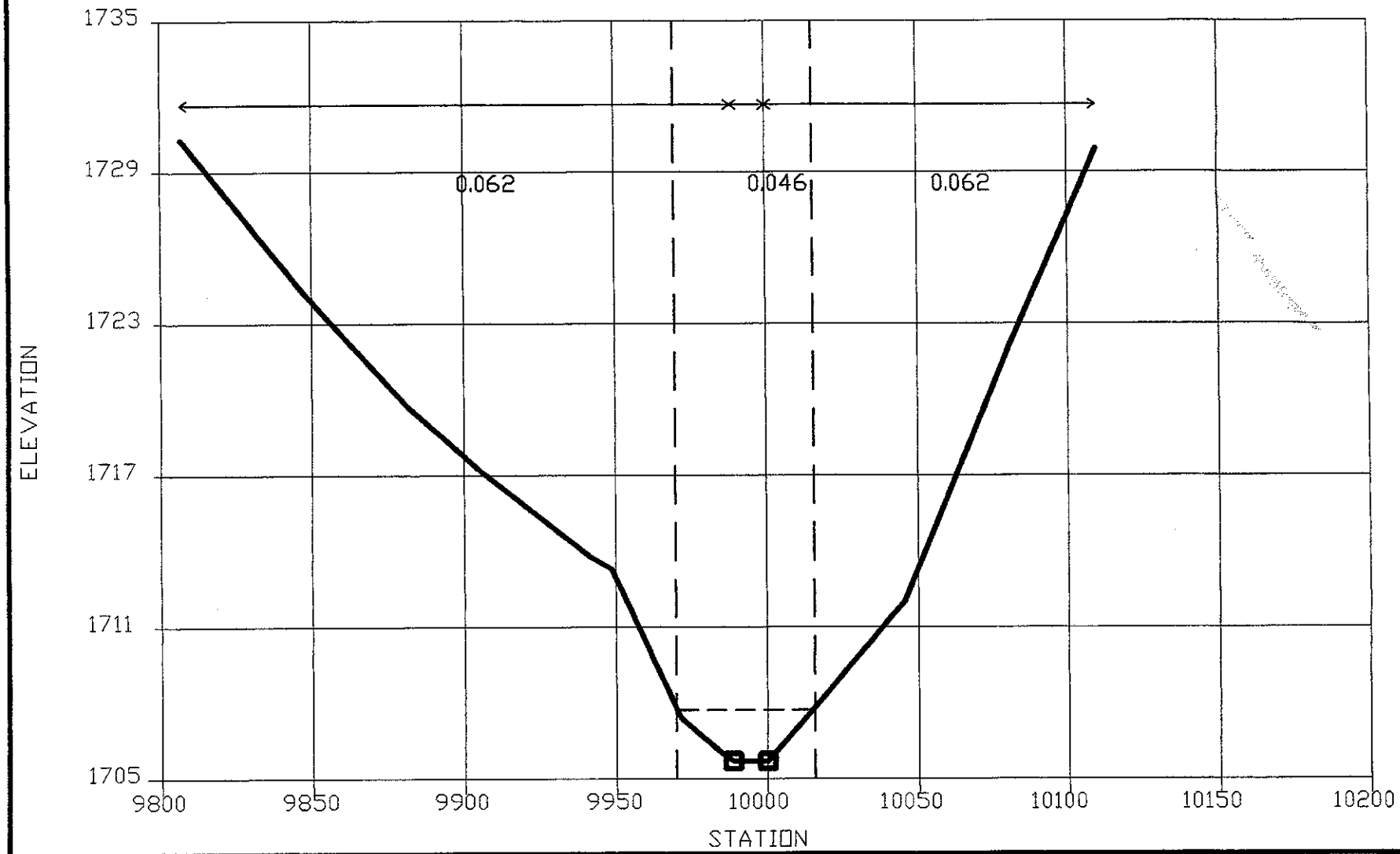


SECTION : 4.01

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

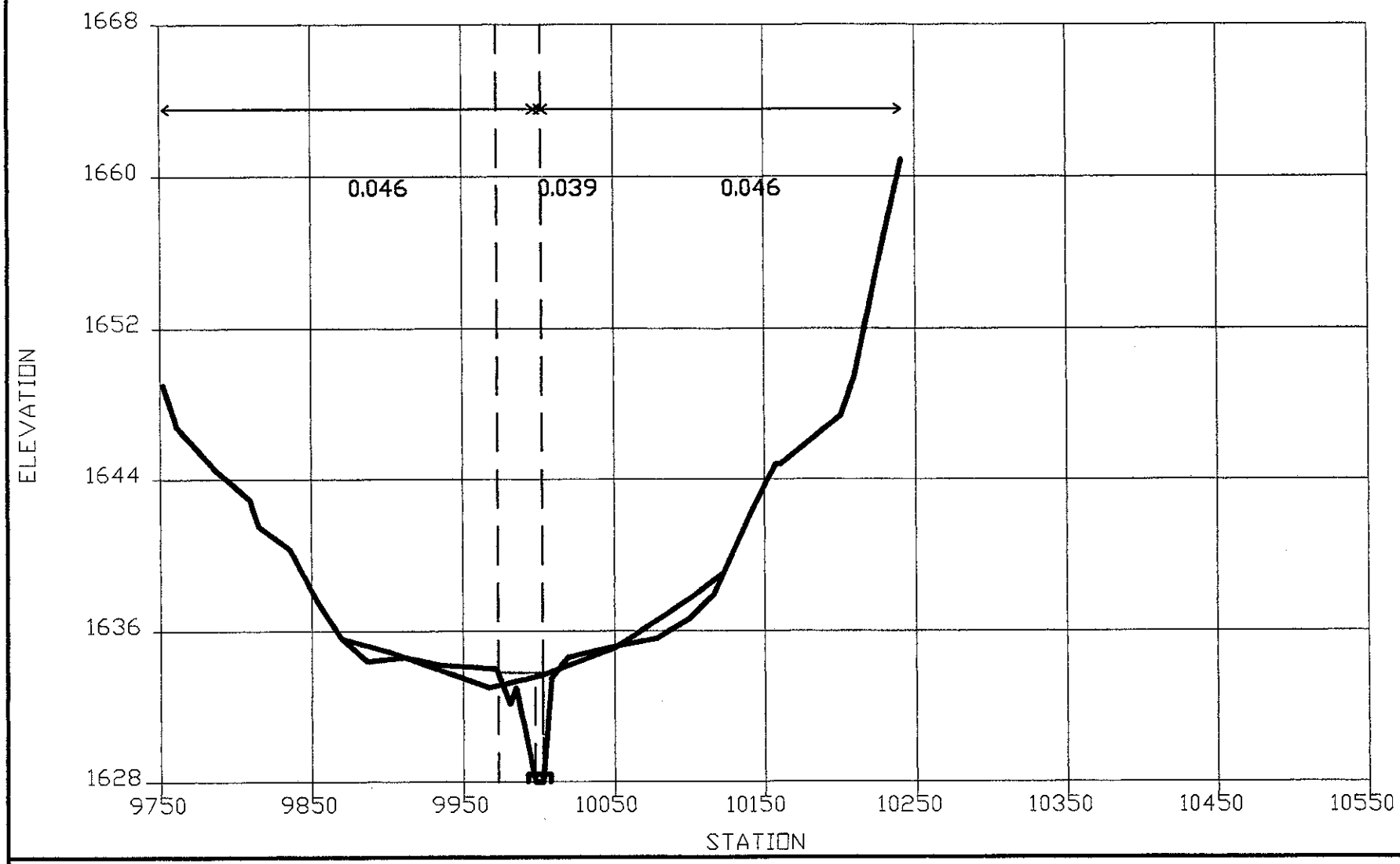


SECTION : 4.07

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

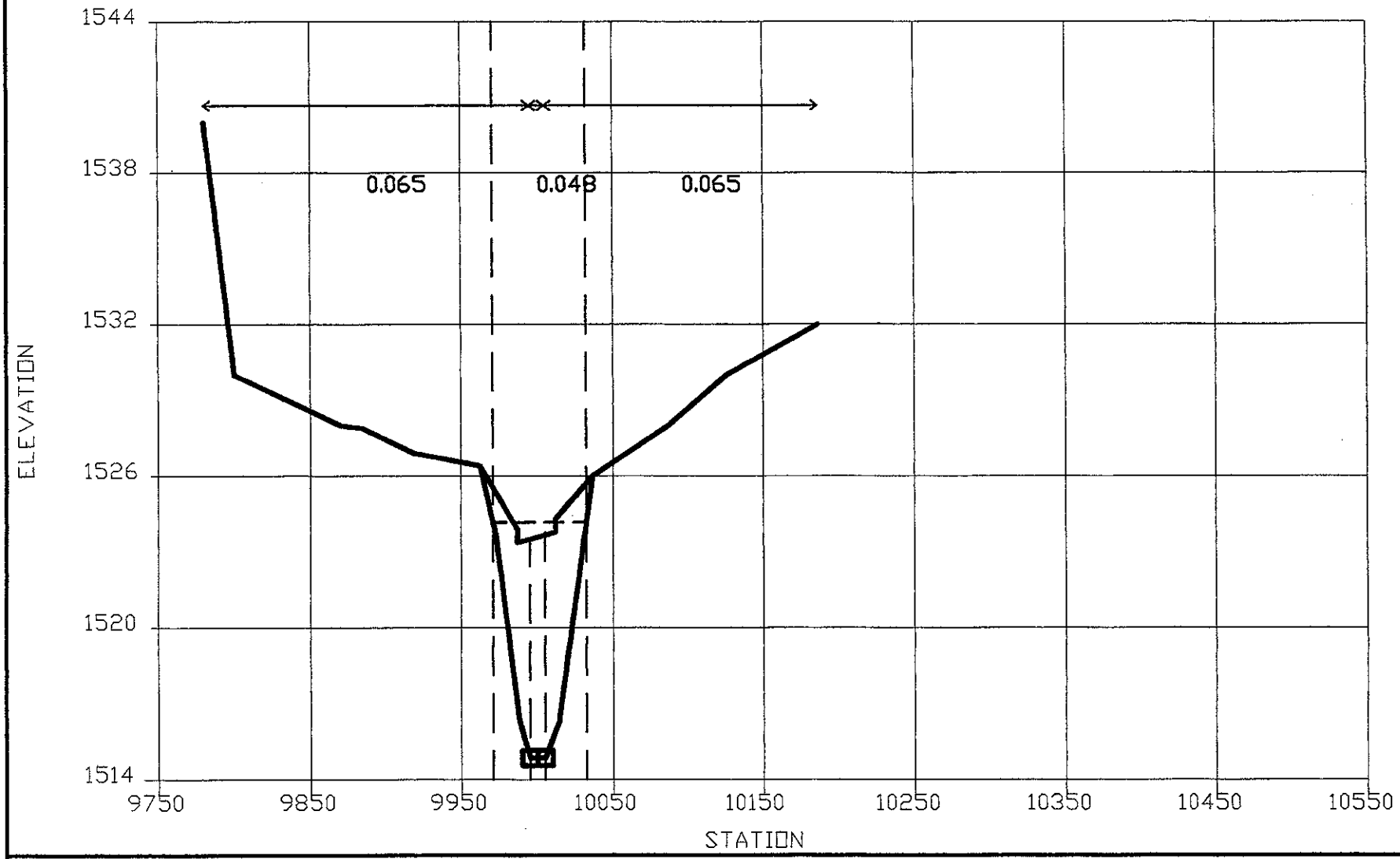


SECTION : 3.36

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

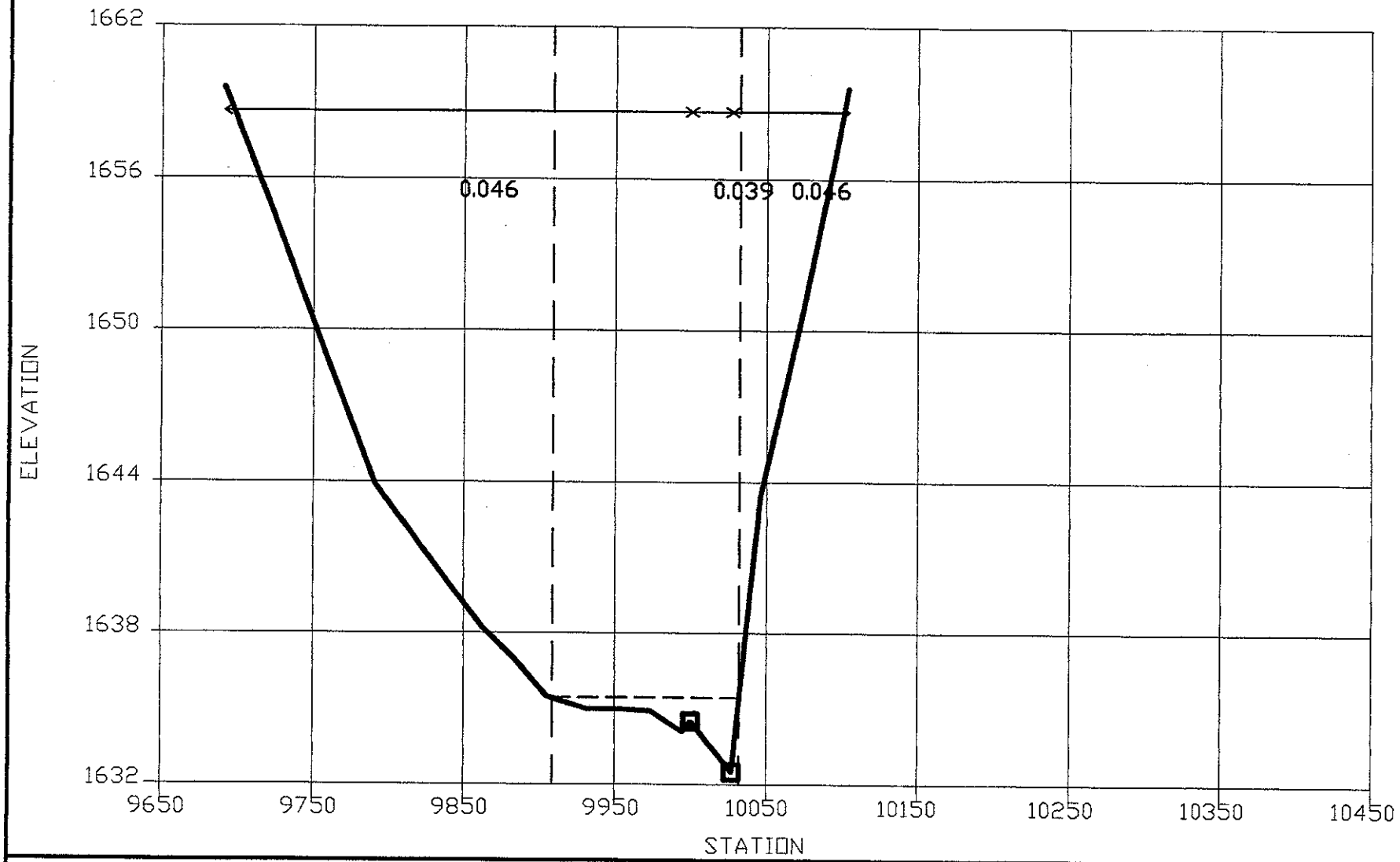


SECTION : 2.39

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

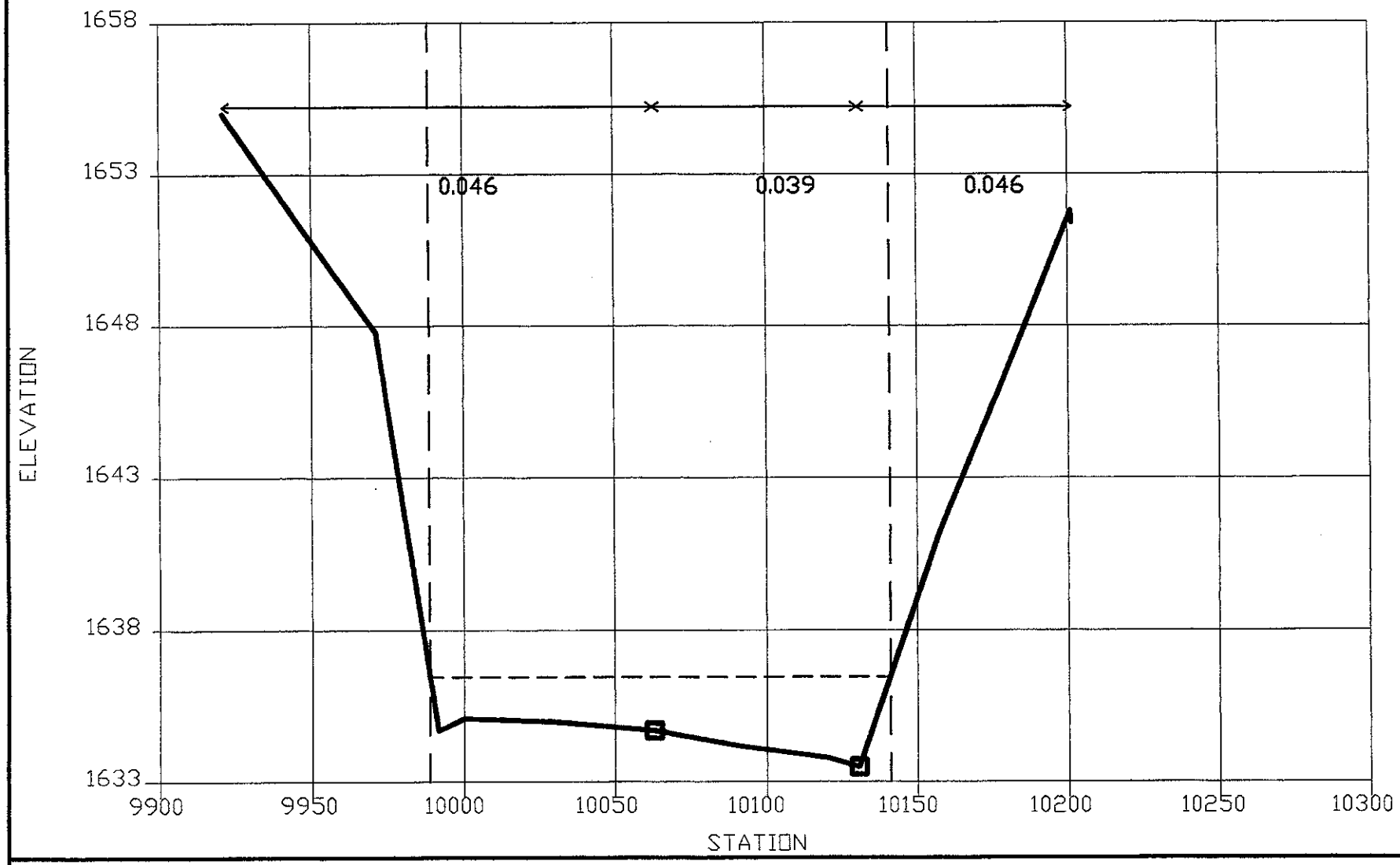


SECTION : 3.42

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

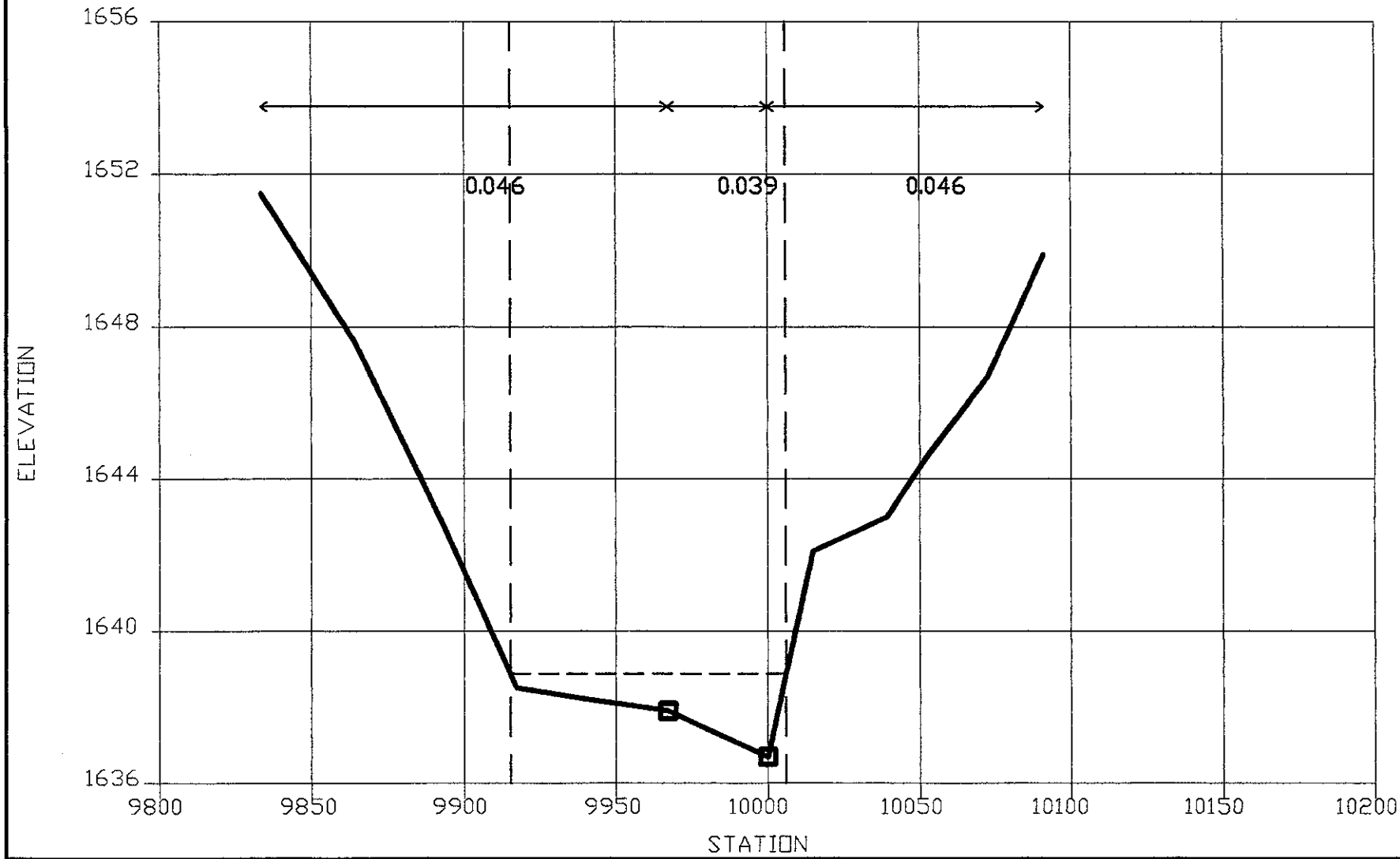


SECTION : 3.47

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

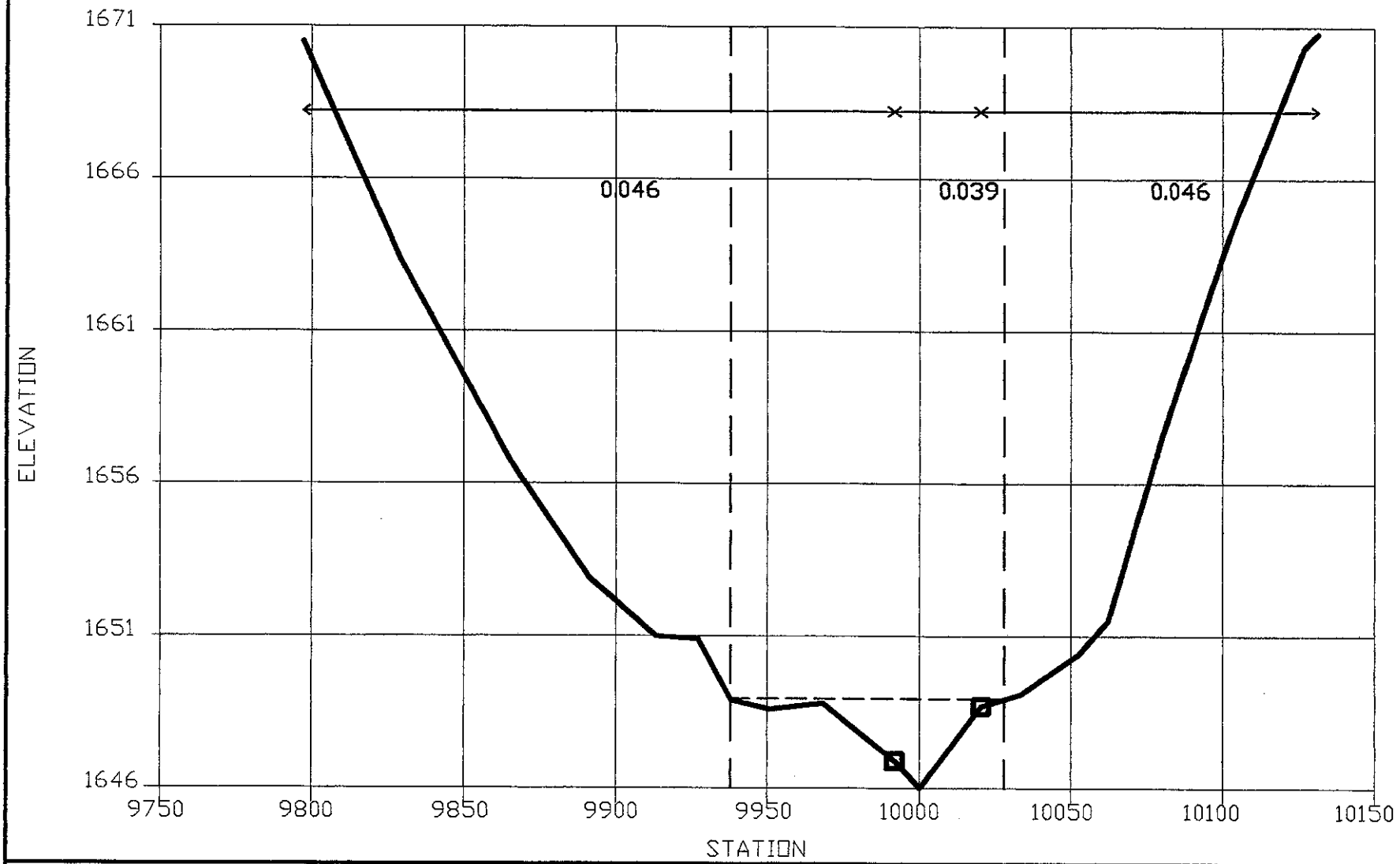


SECTION : 3.51

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

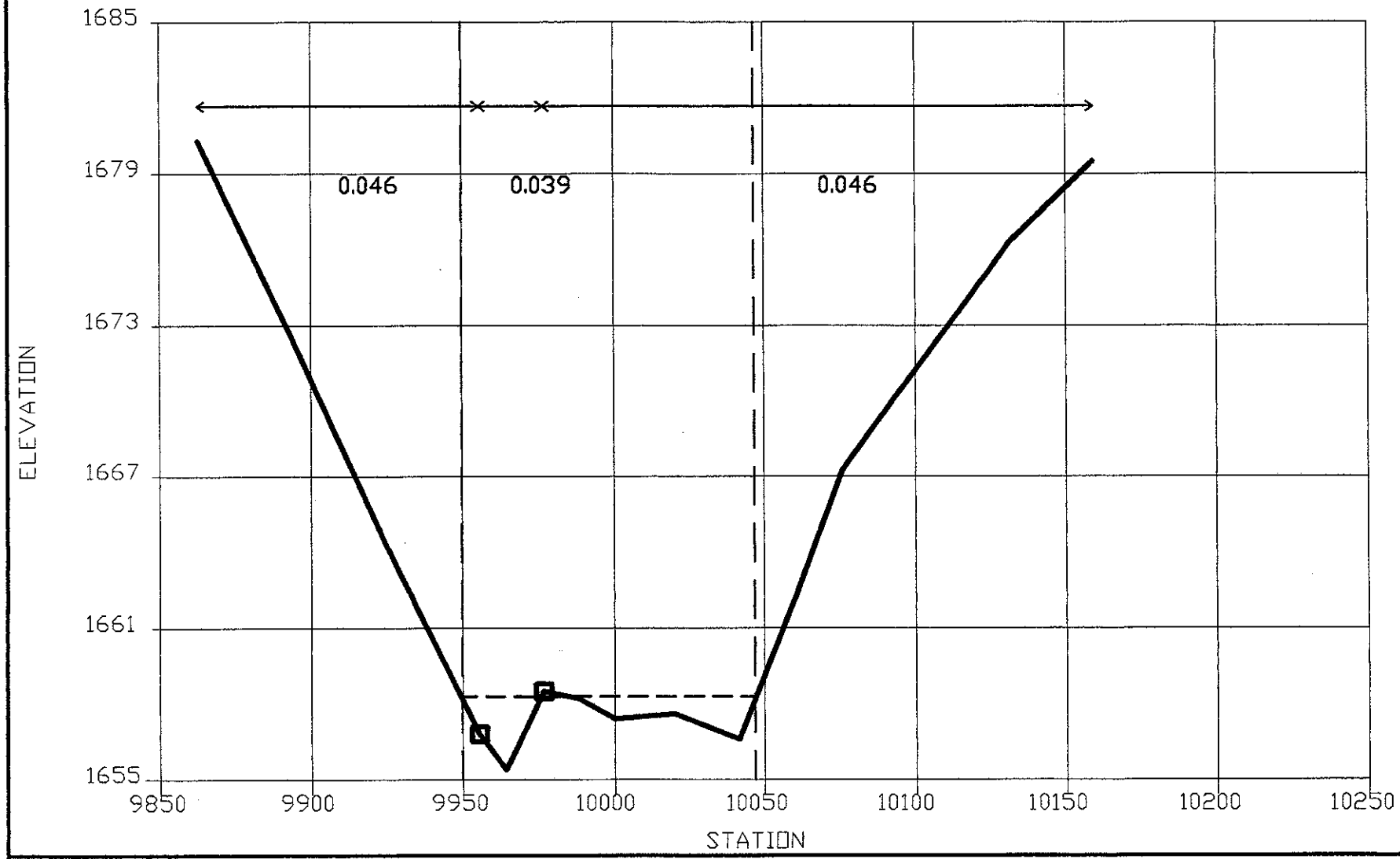


SECTION : 3.61

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

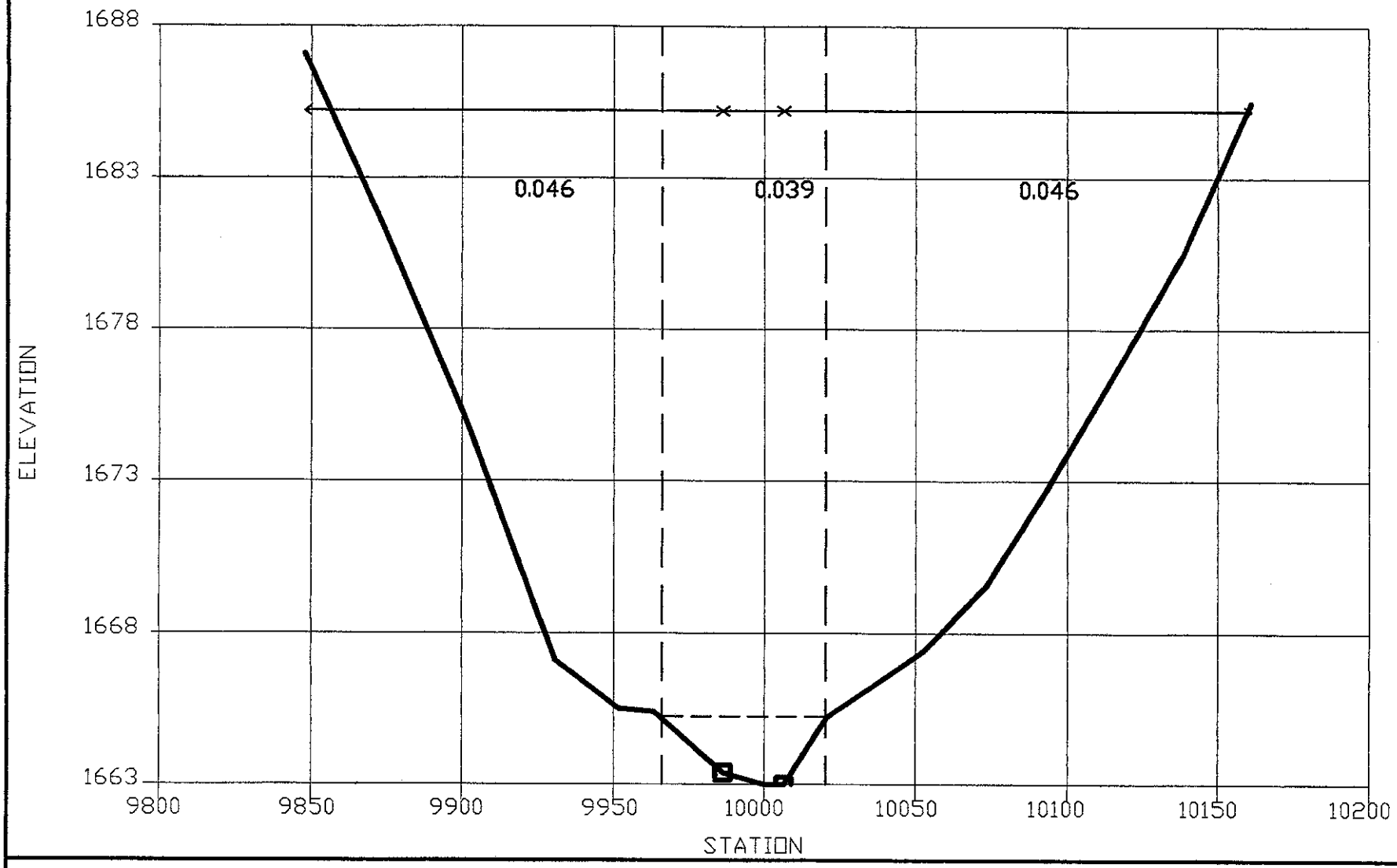


SECTION : 3.69

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

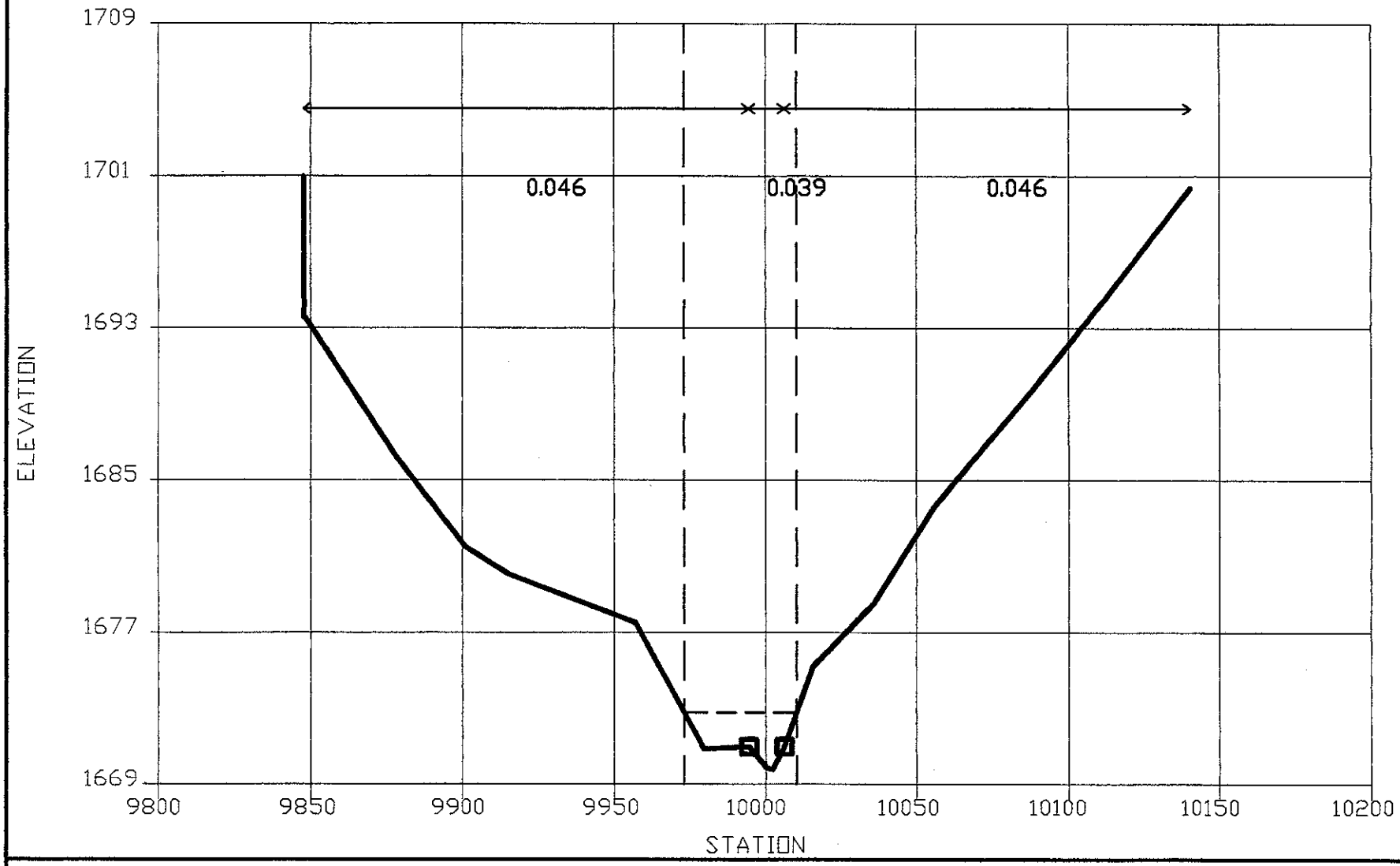


SECTION : 3.75

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

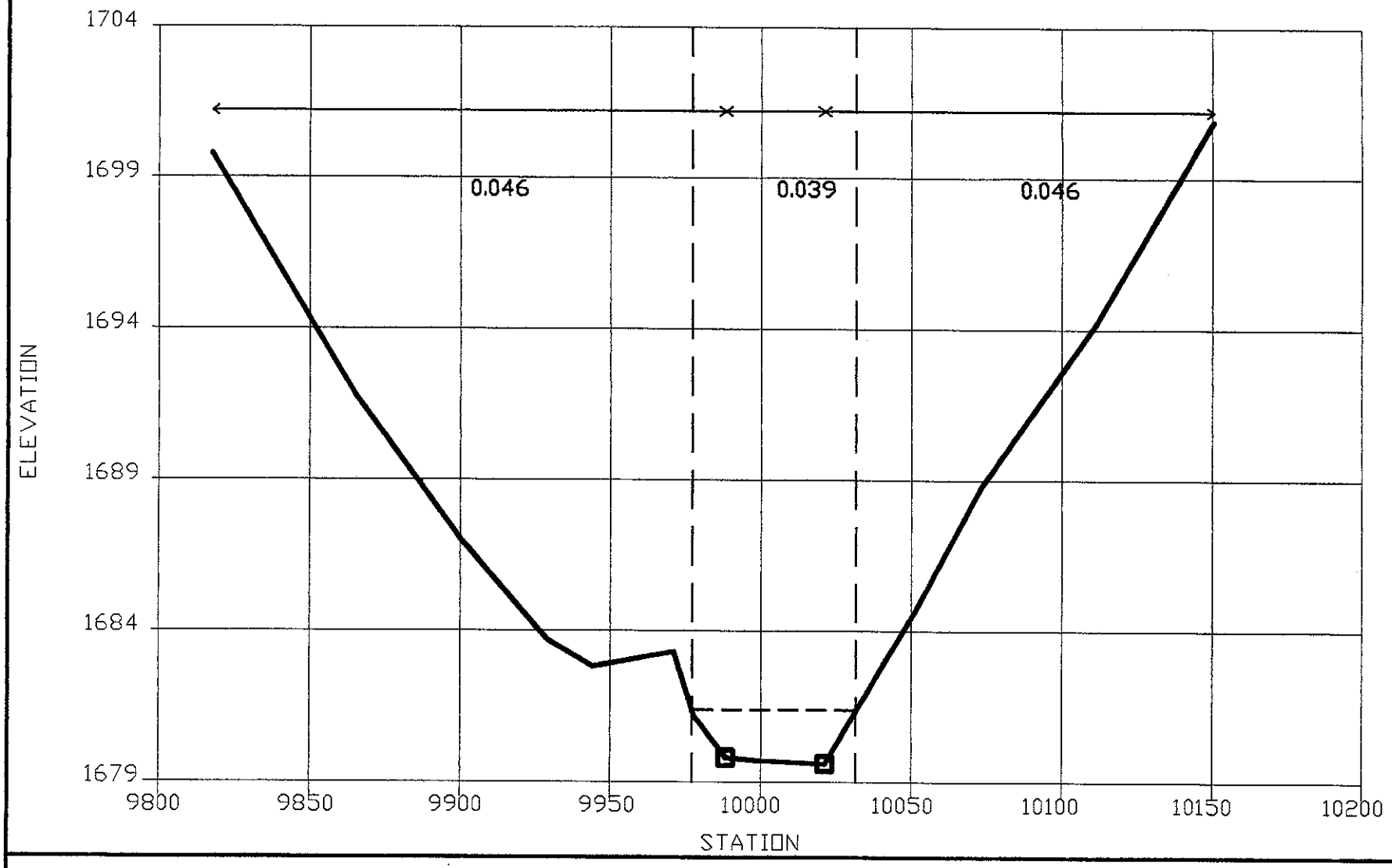


SECTION : 3.82

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

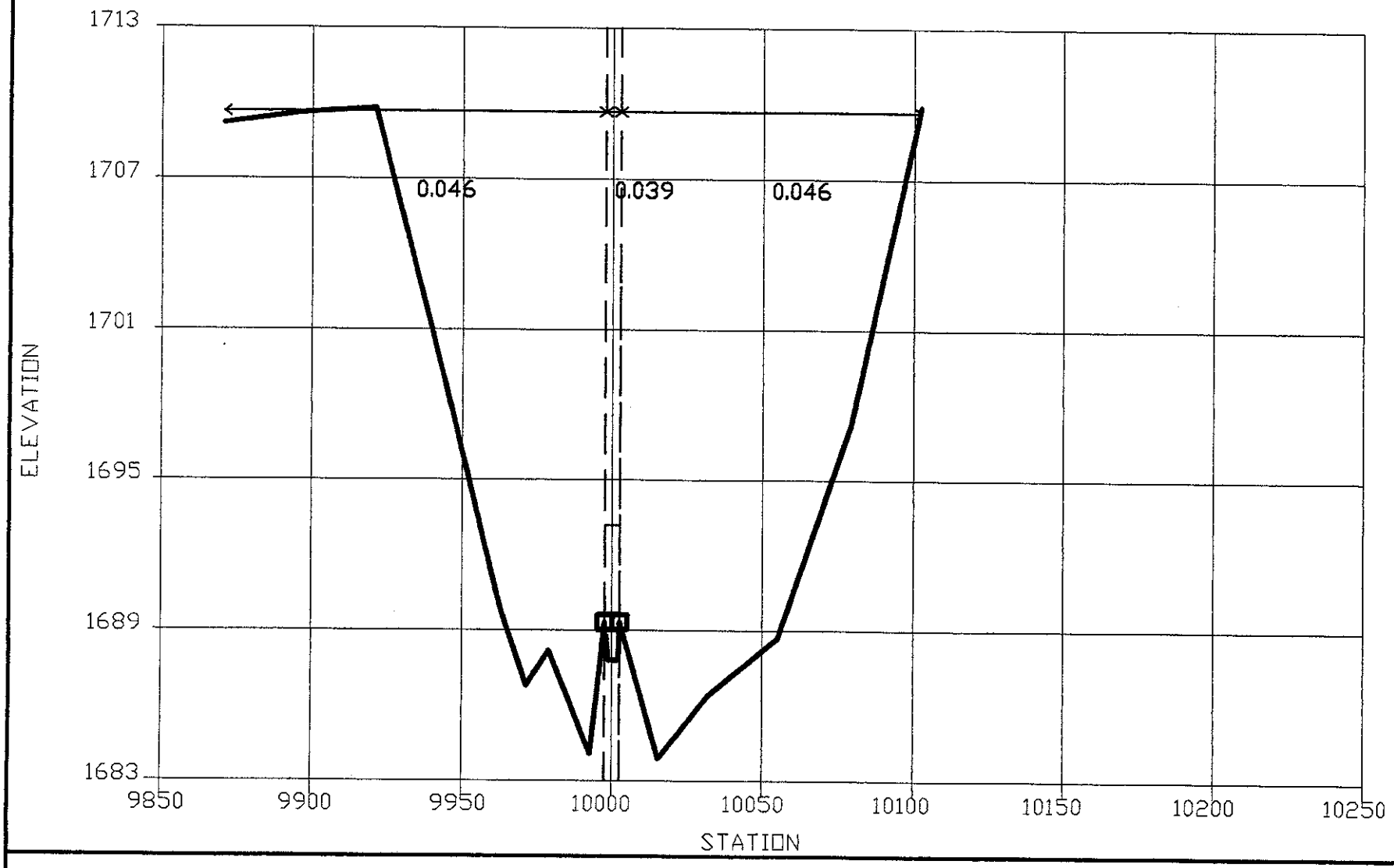


SECTION : 3.88

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

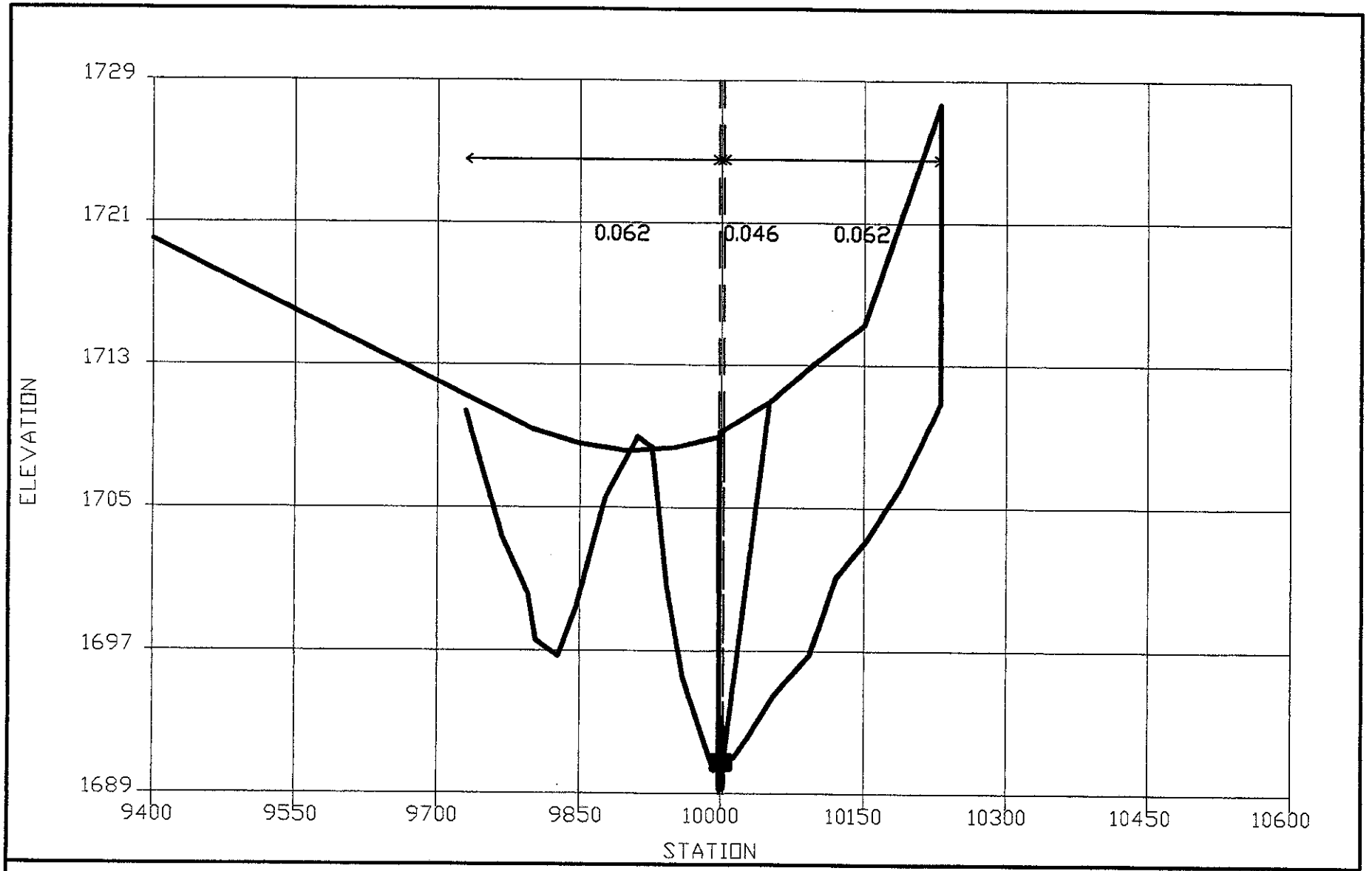


SECTION : 3.90

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

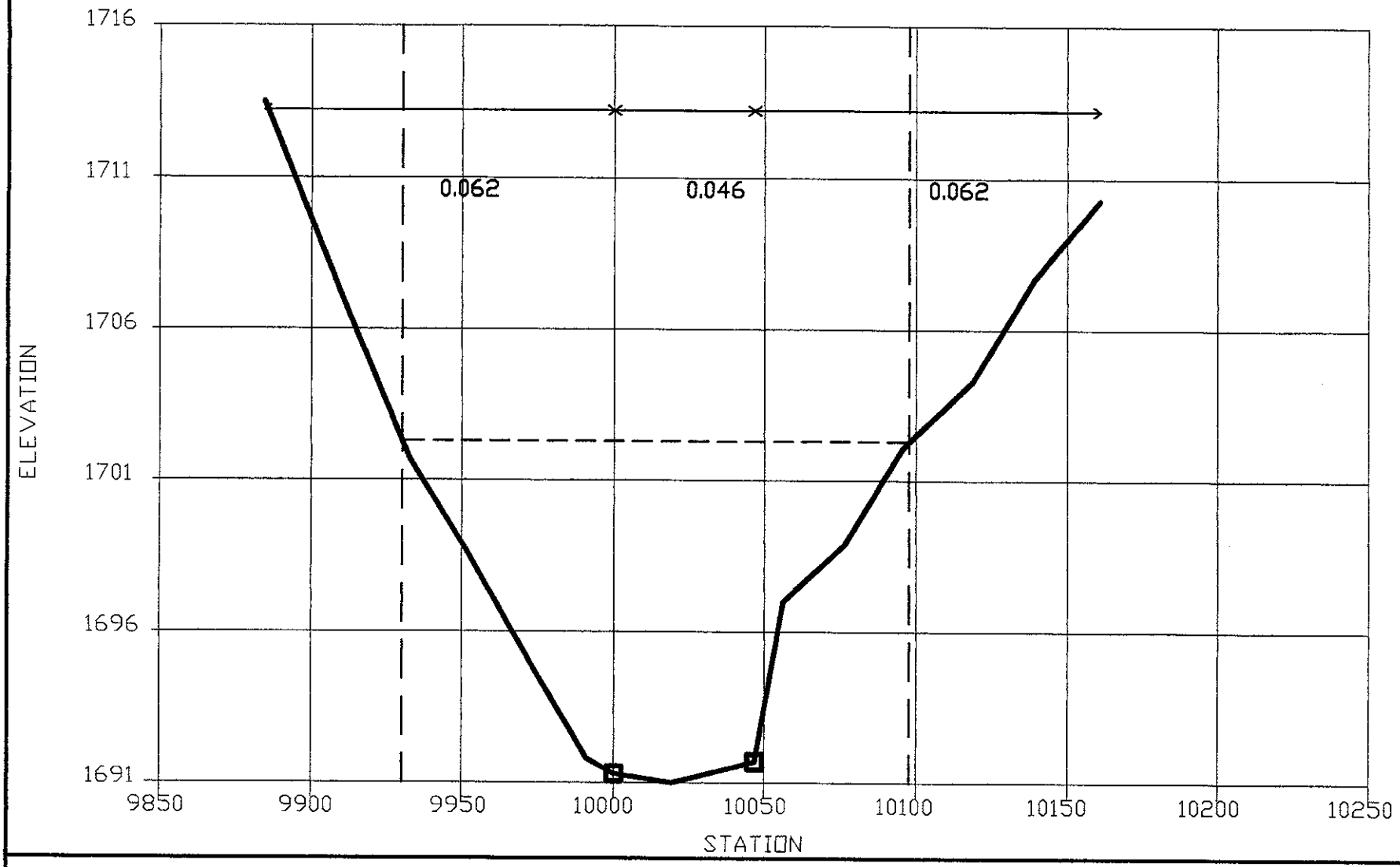


SECTION : 3.94

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

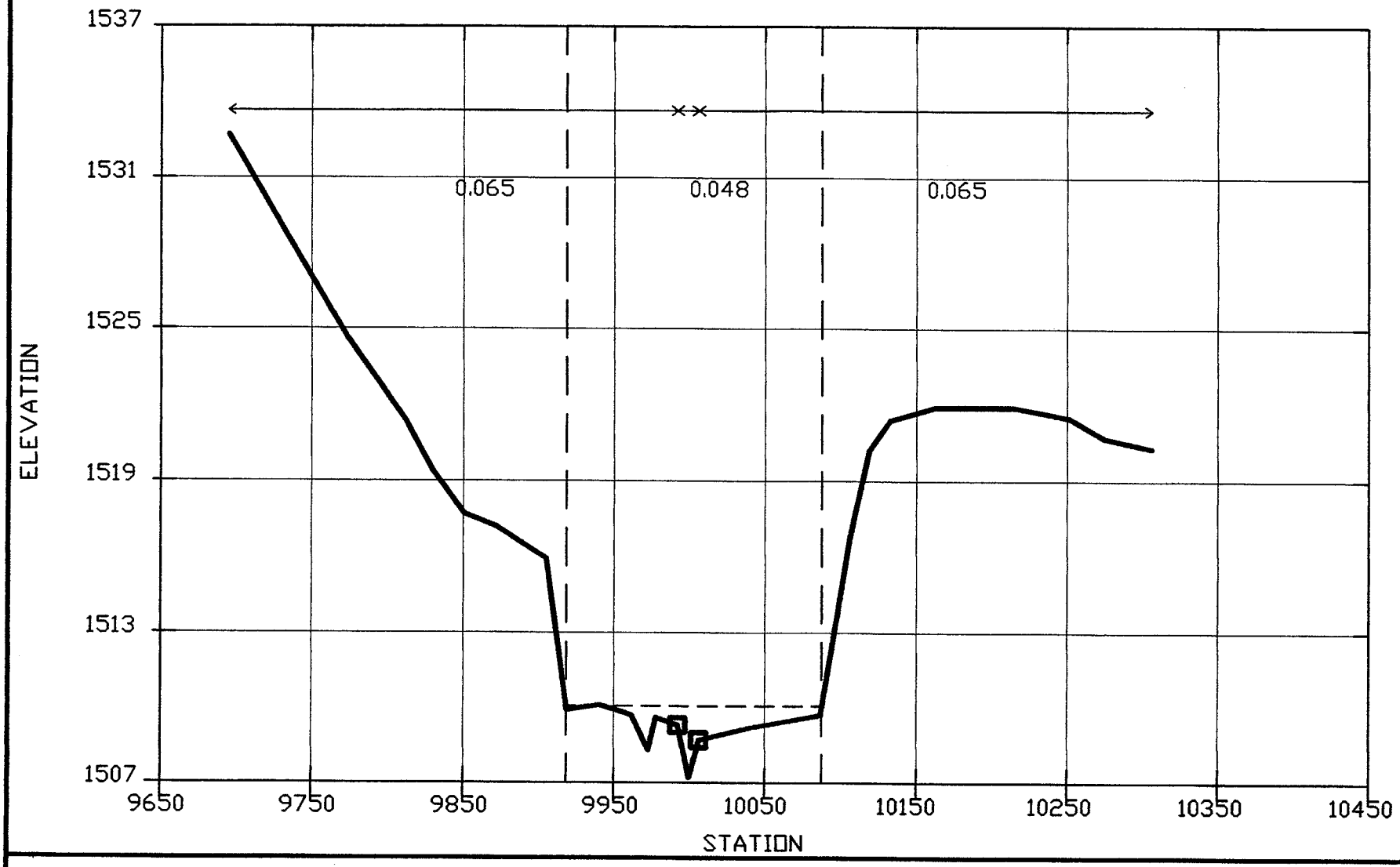


SECTION : 3.95

Fountain Hills (south) FIS

Emerald Wash

File: EMR-XSEC.DWG

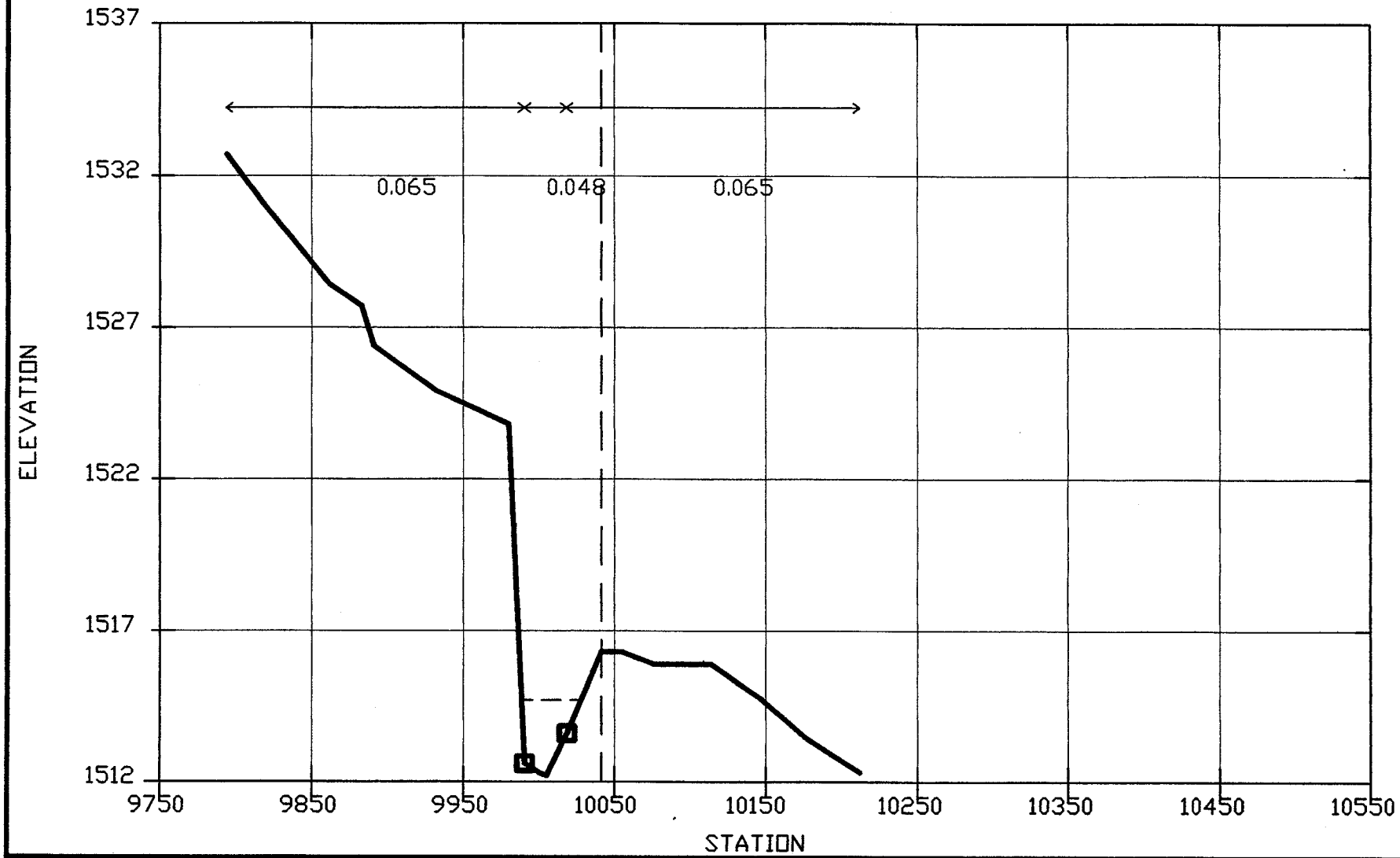


SECTION : 0.00

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

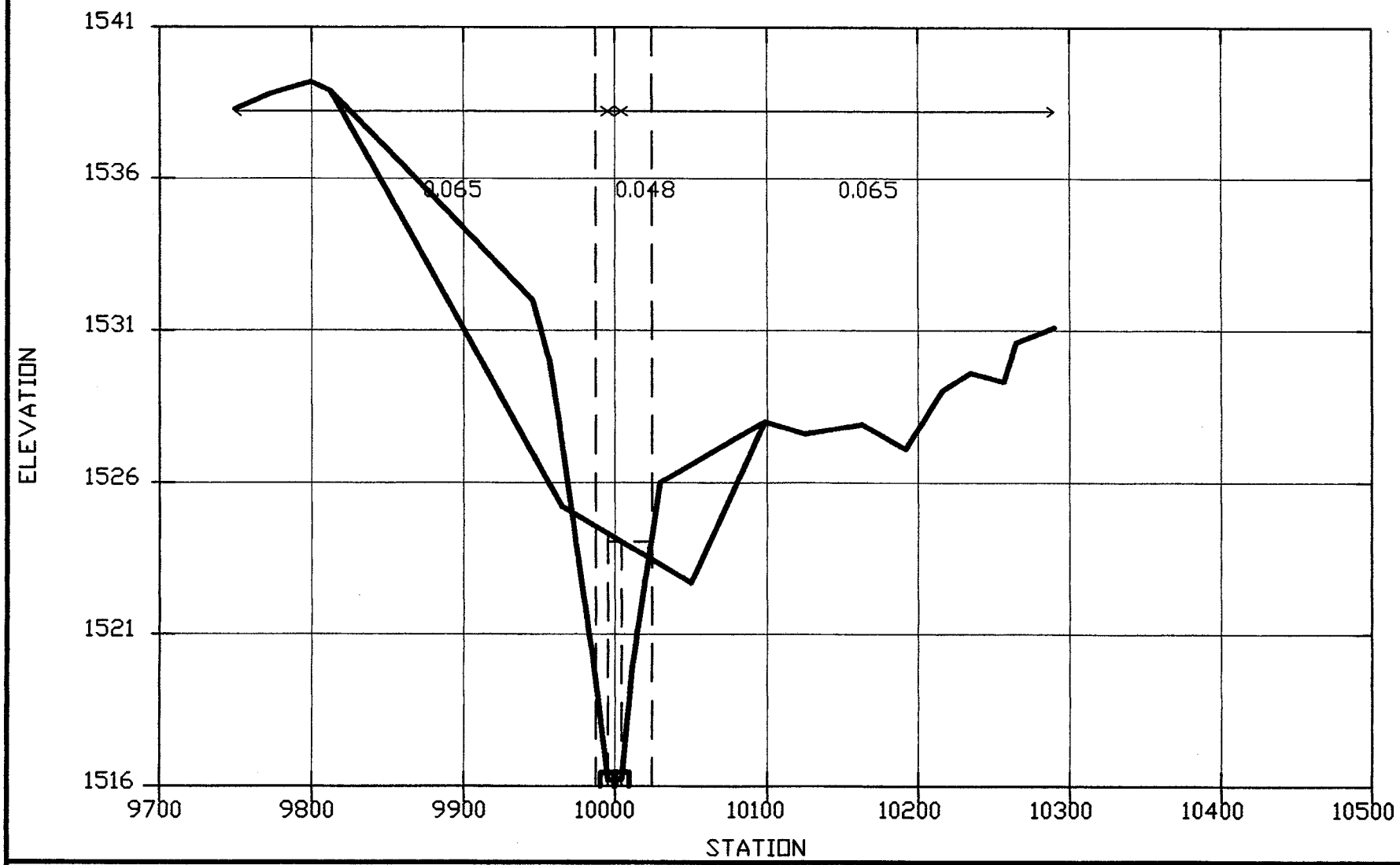


SECTION : 0.03

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

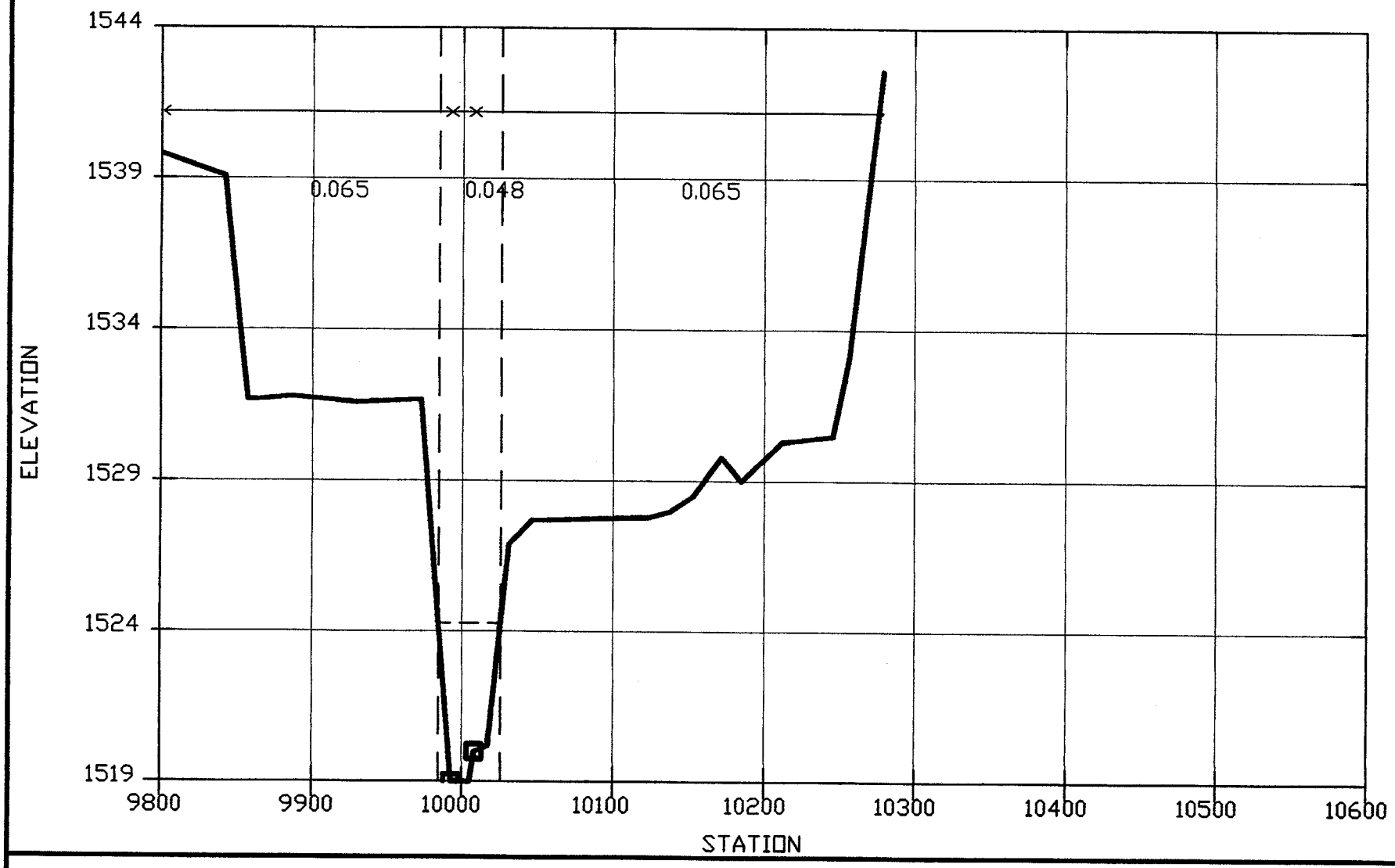


SECTION : 0.06

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

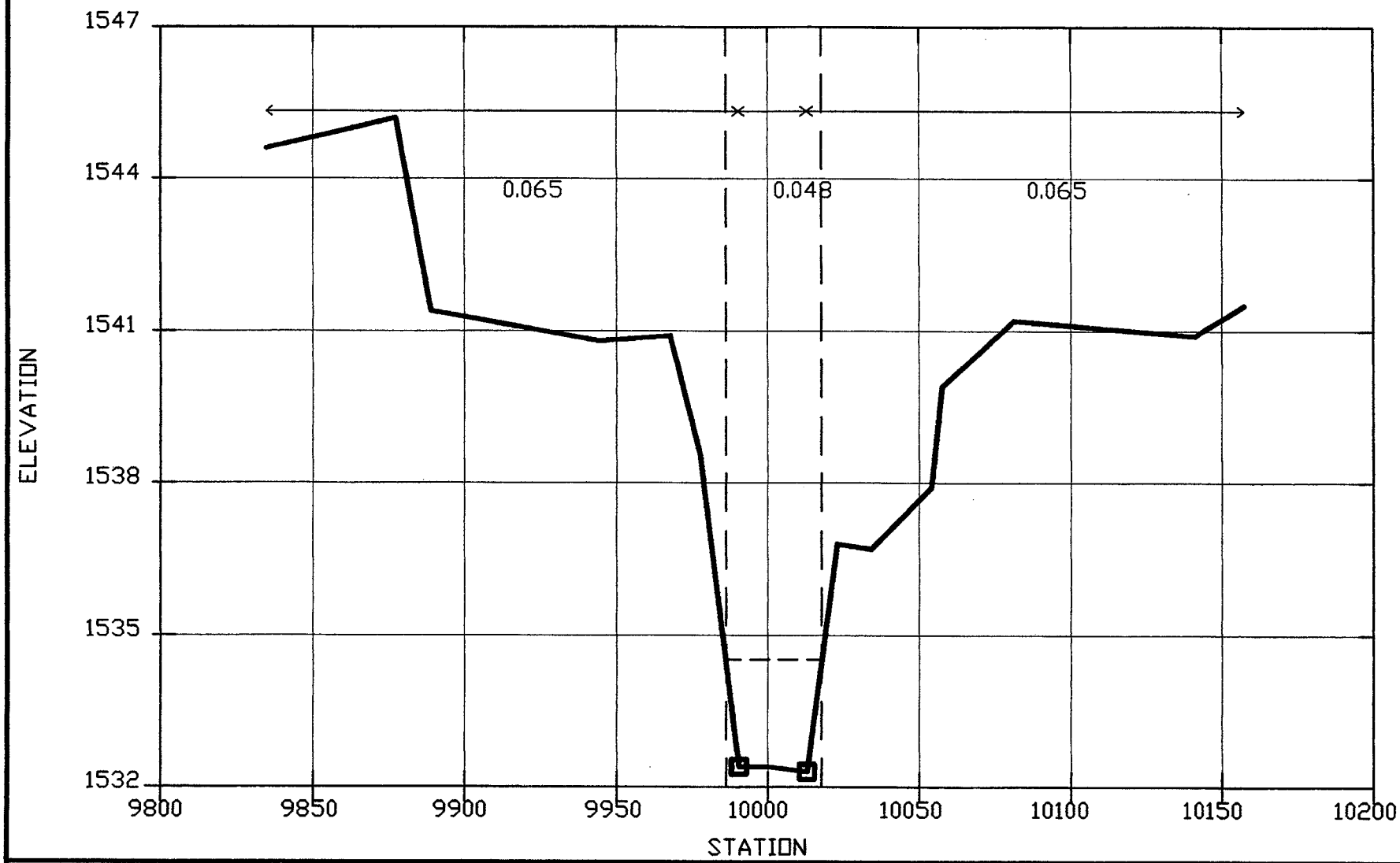


SECTION : 0.07

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

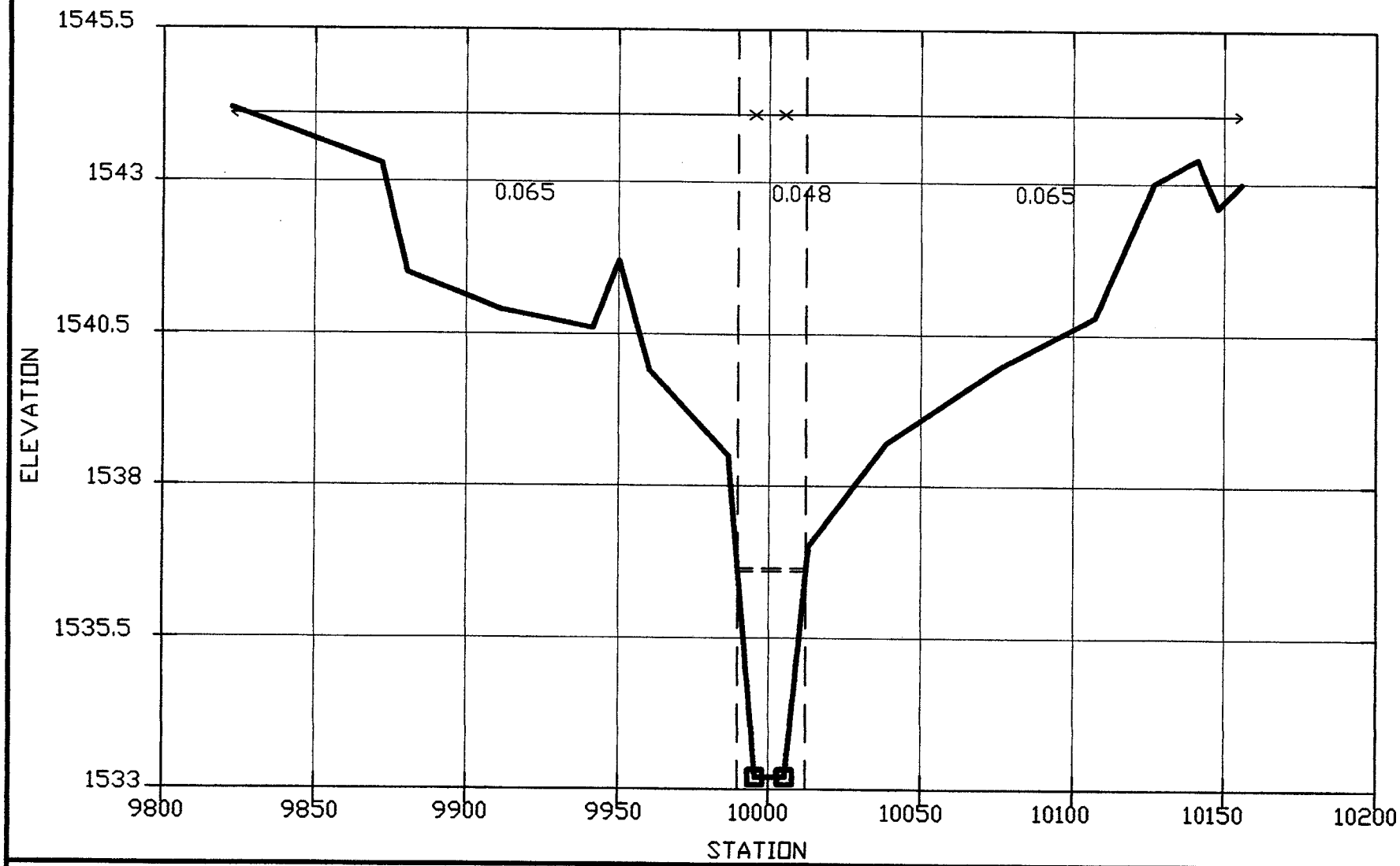


SECTION : 0.16

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

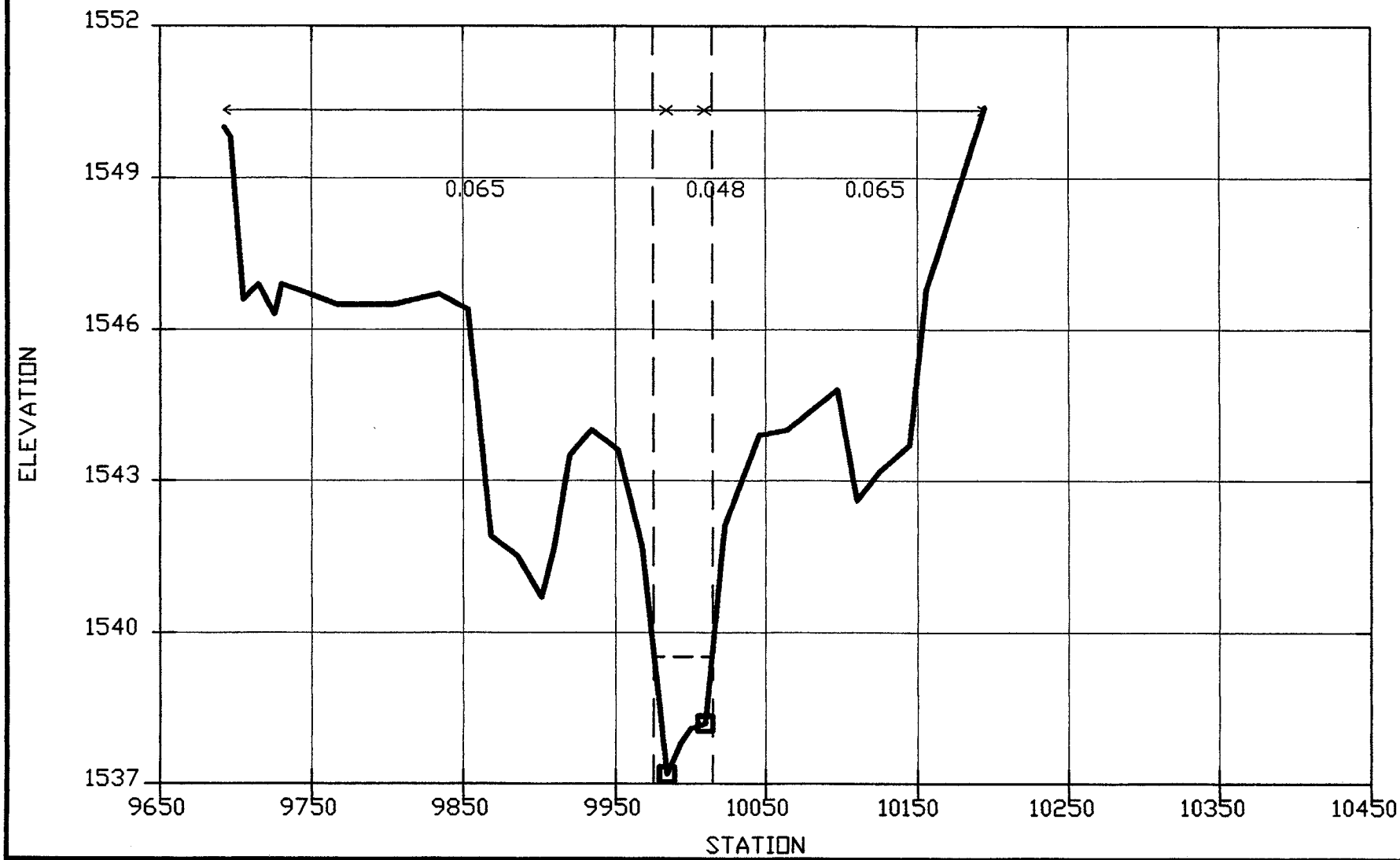


SECTION : 0.17

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

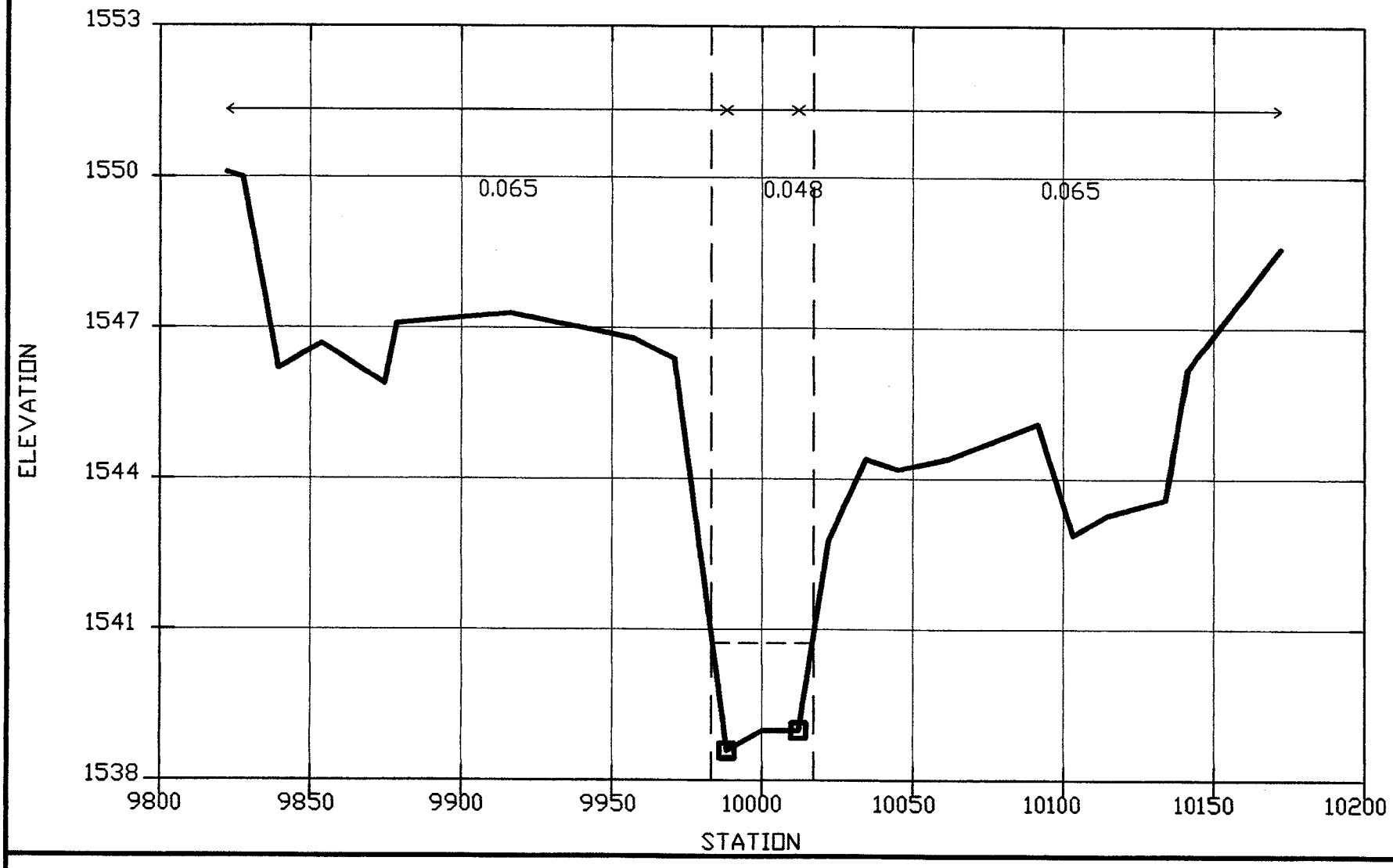


SECTION : 0.18

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

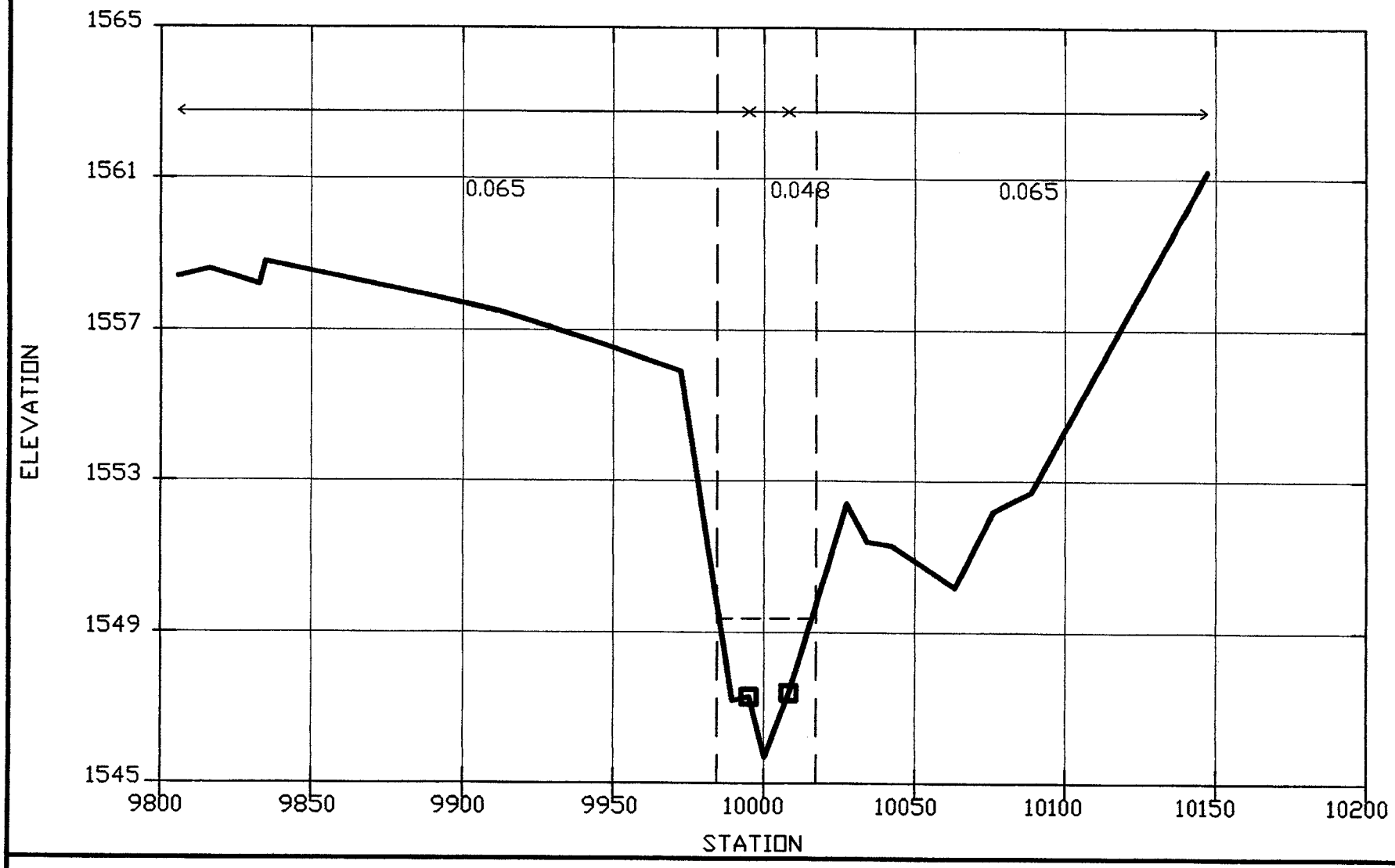


SECTION : 0.19

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

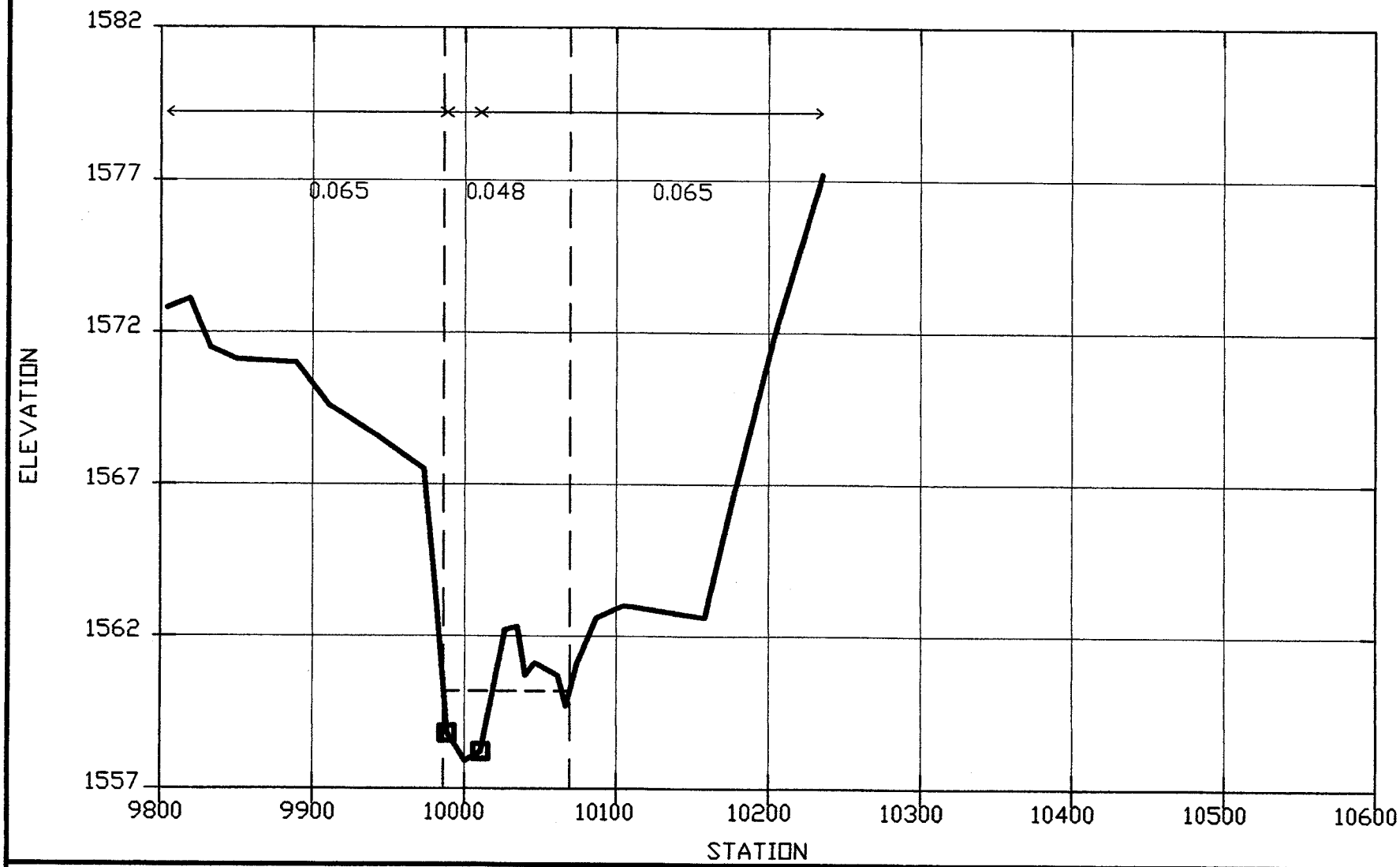


SECTION : 0.27

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

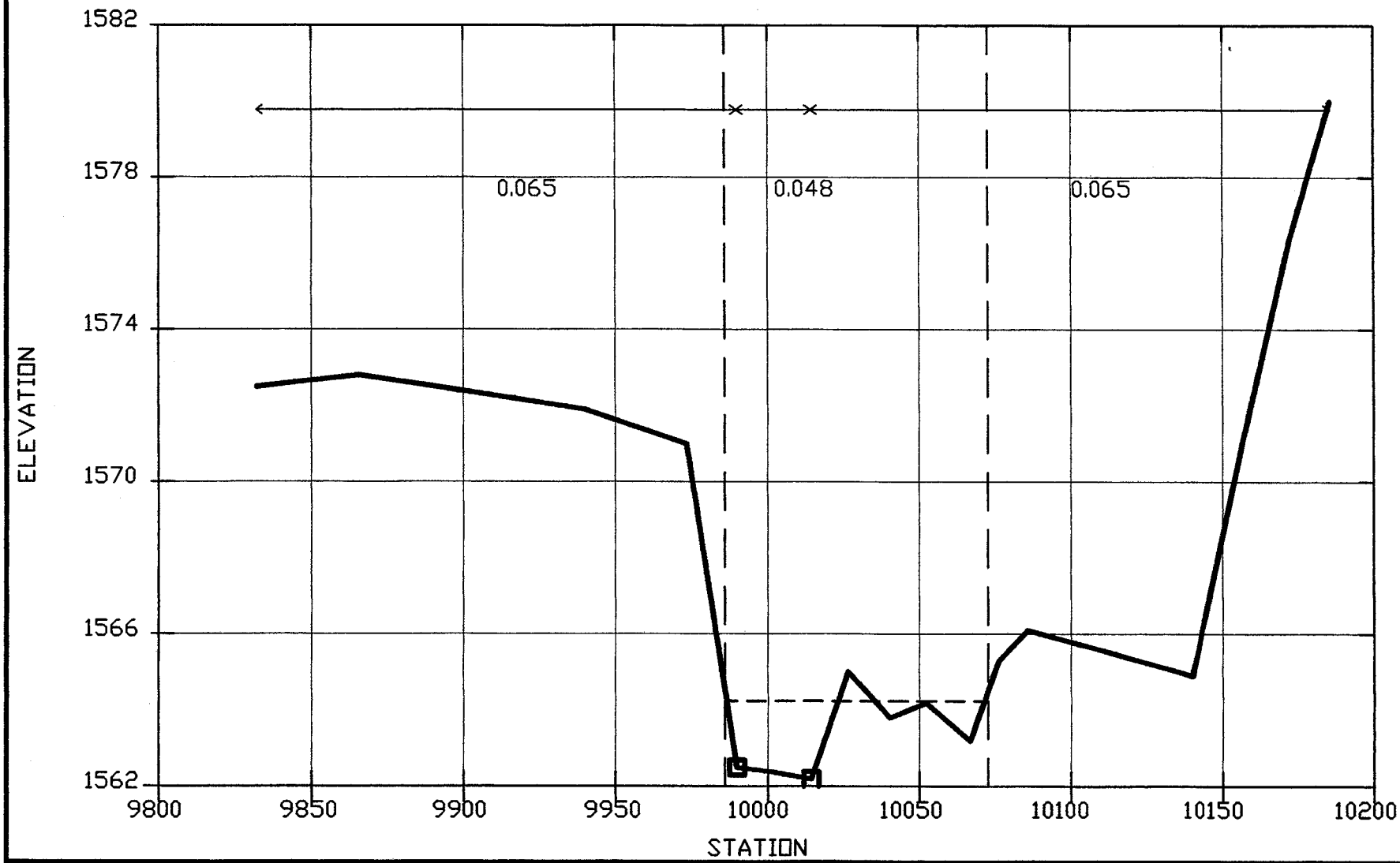


SECTION : 0.36

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

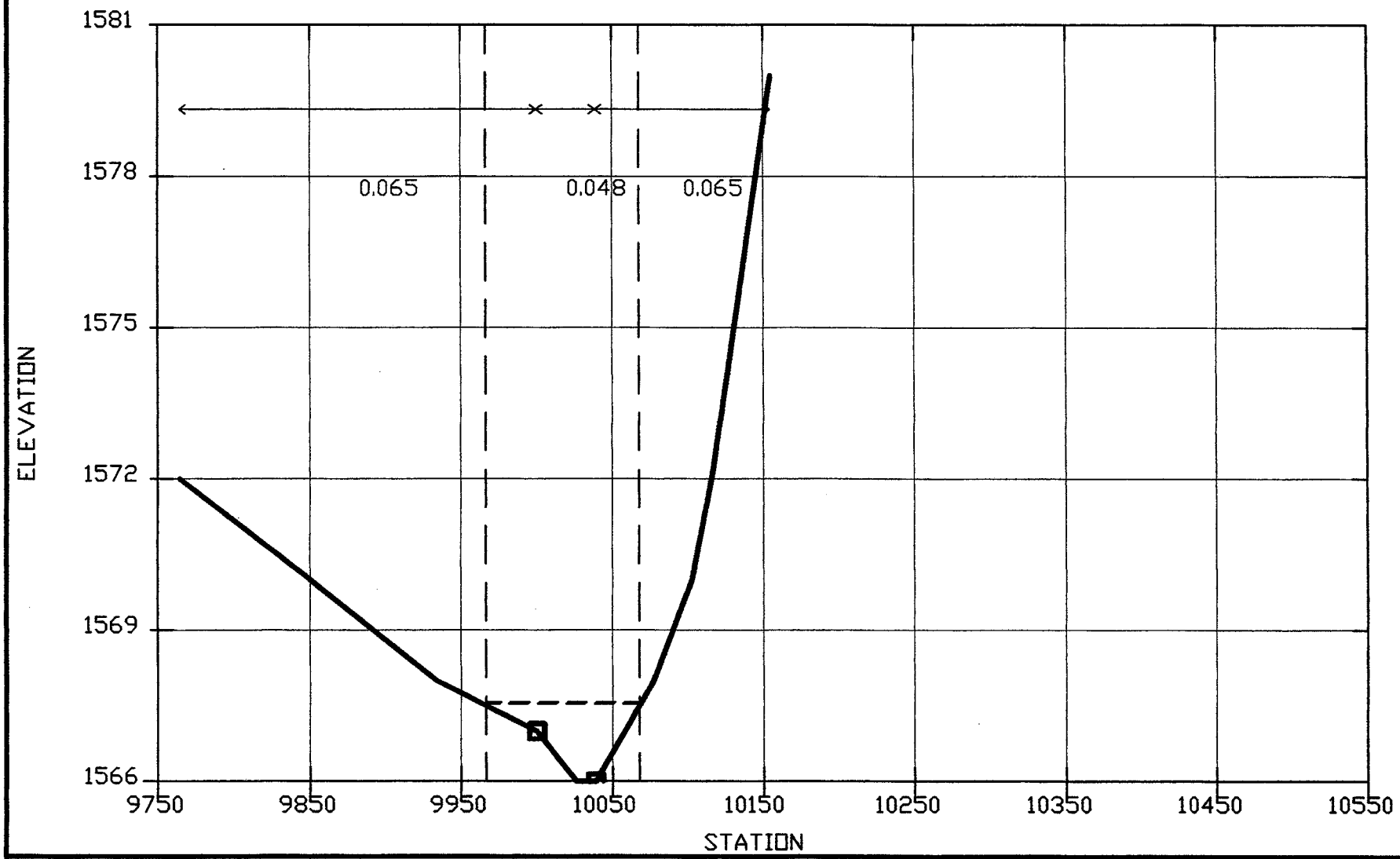


SECTION : 0.40

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

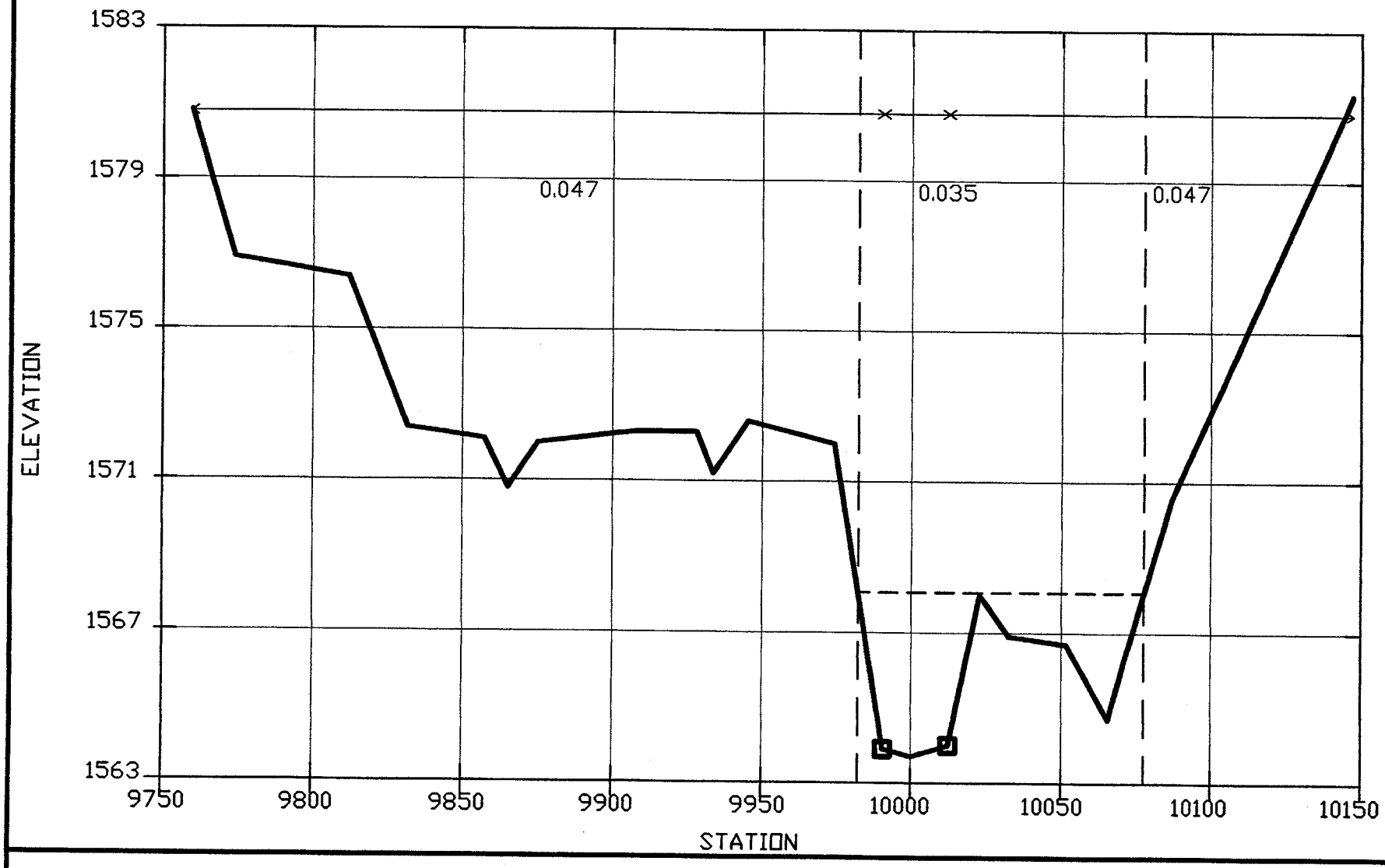


SECTION : 0.41

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

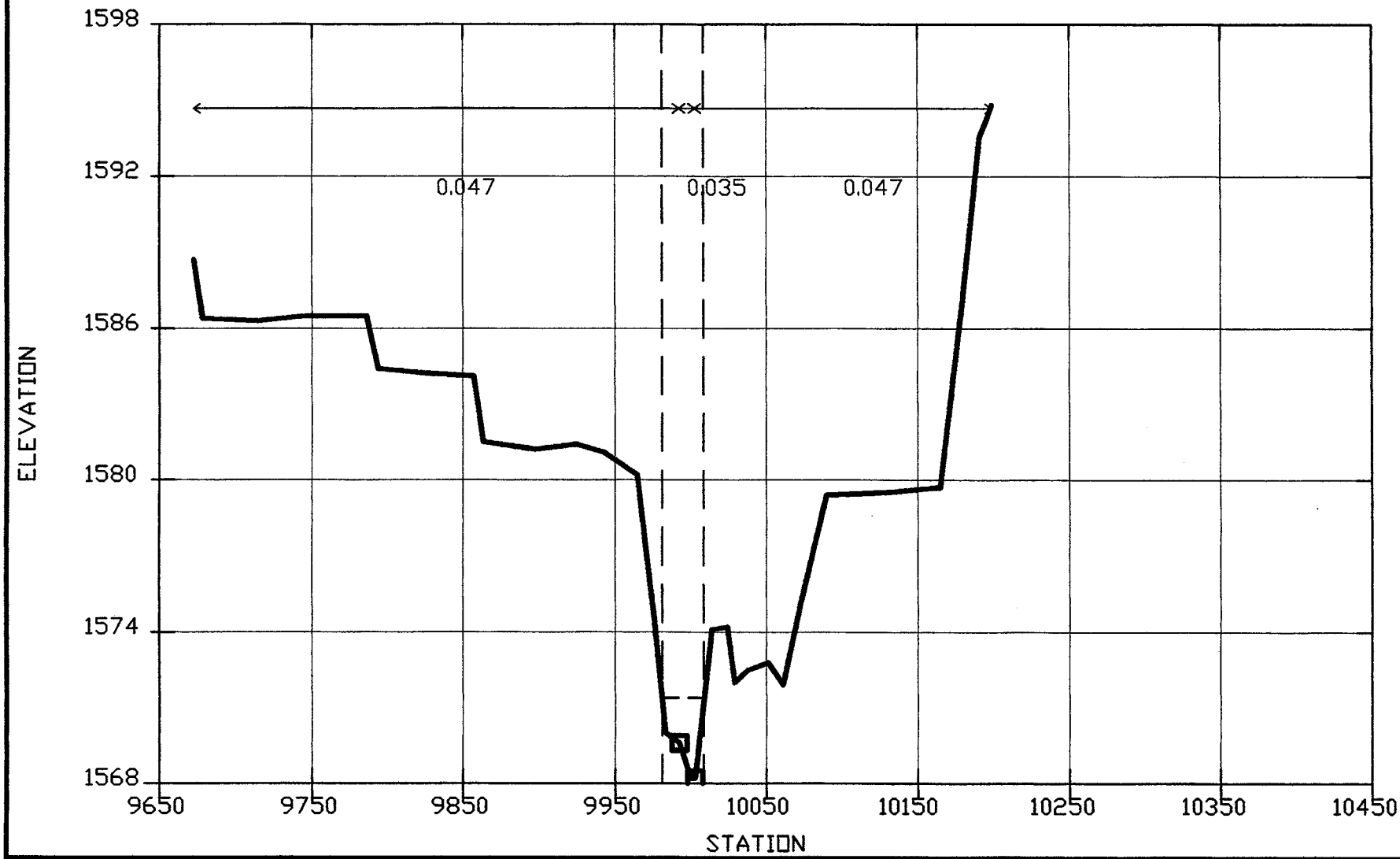


SECTION : 0.42

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

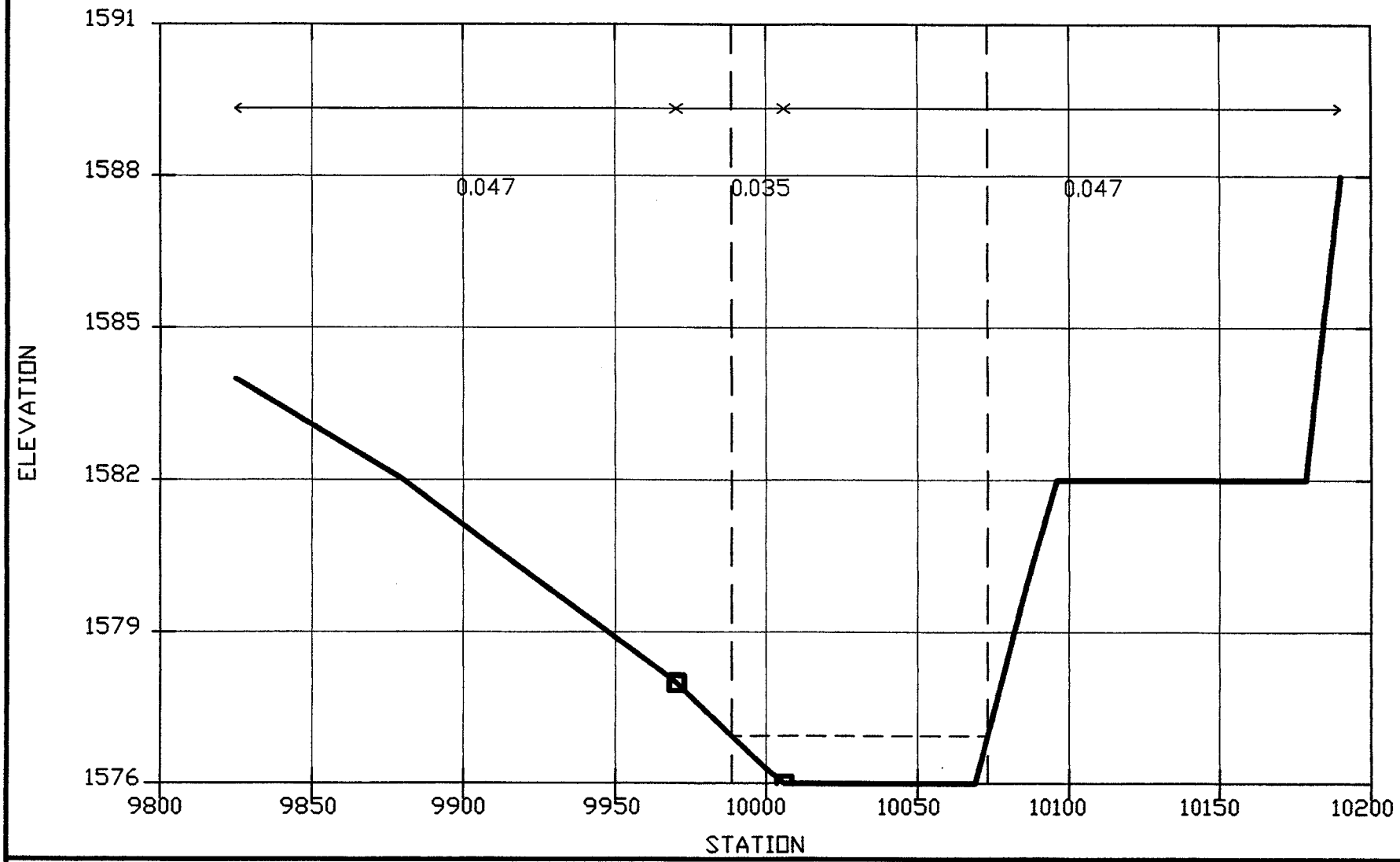


SECTION : 0.46

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

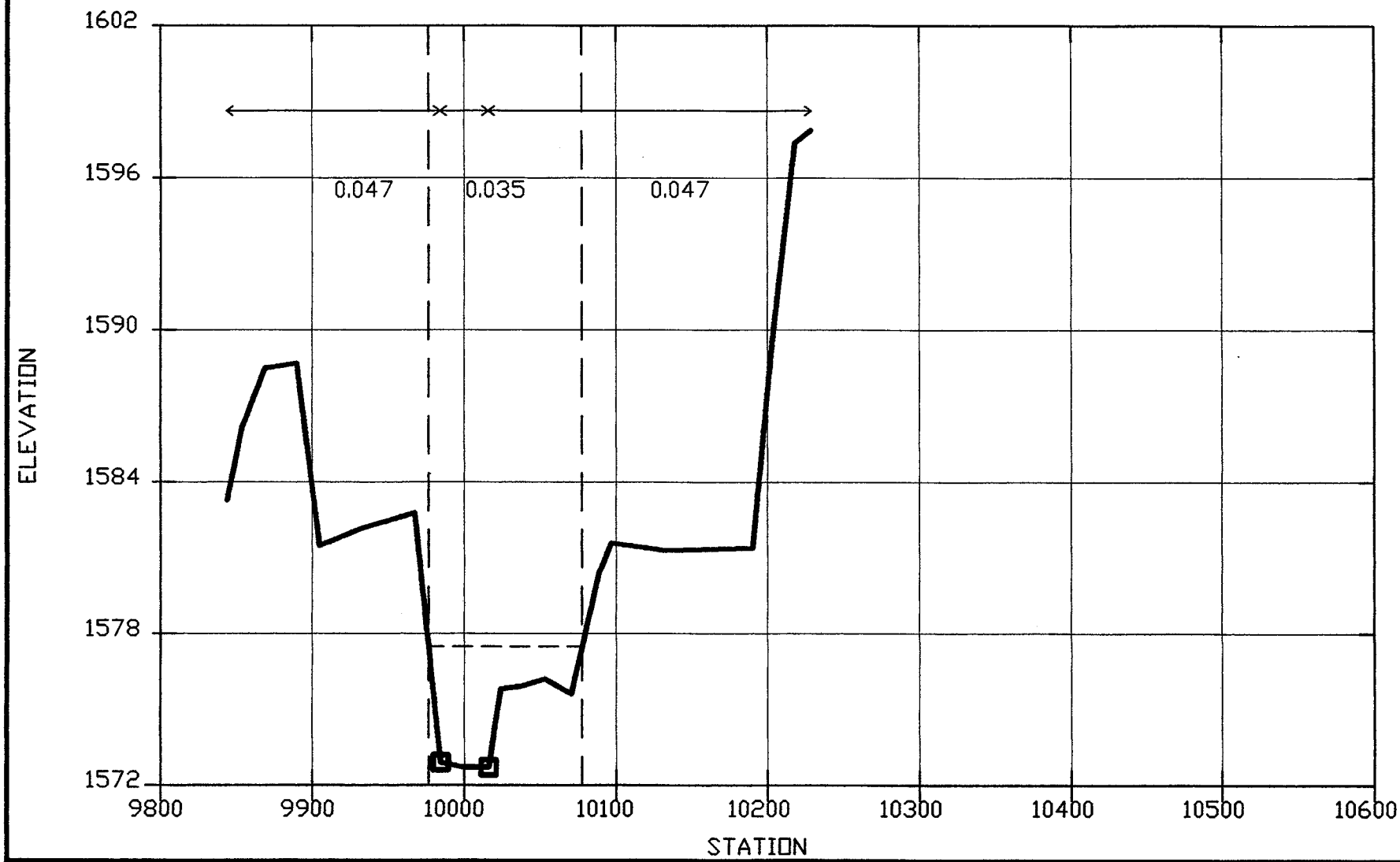


SECTION : 0.47

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

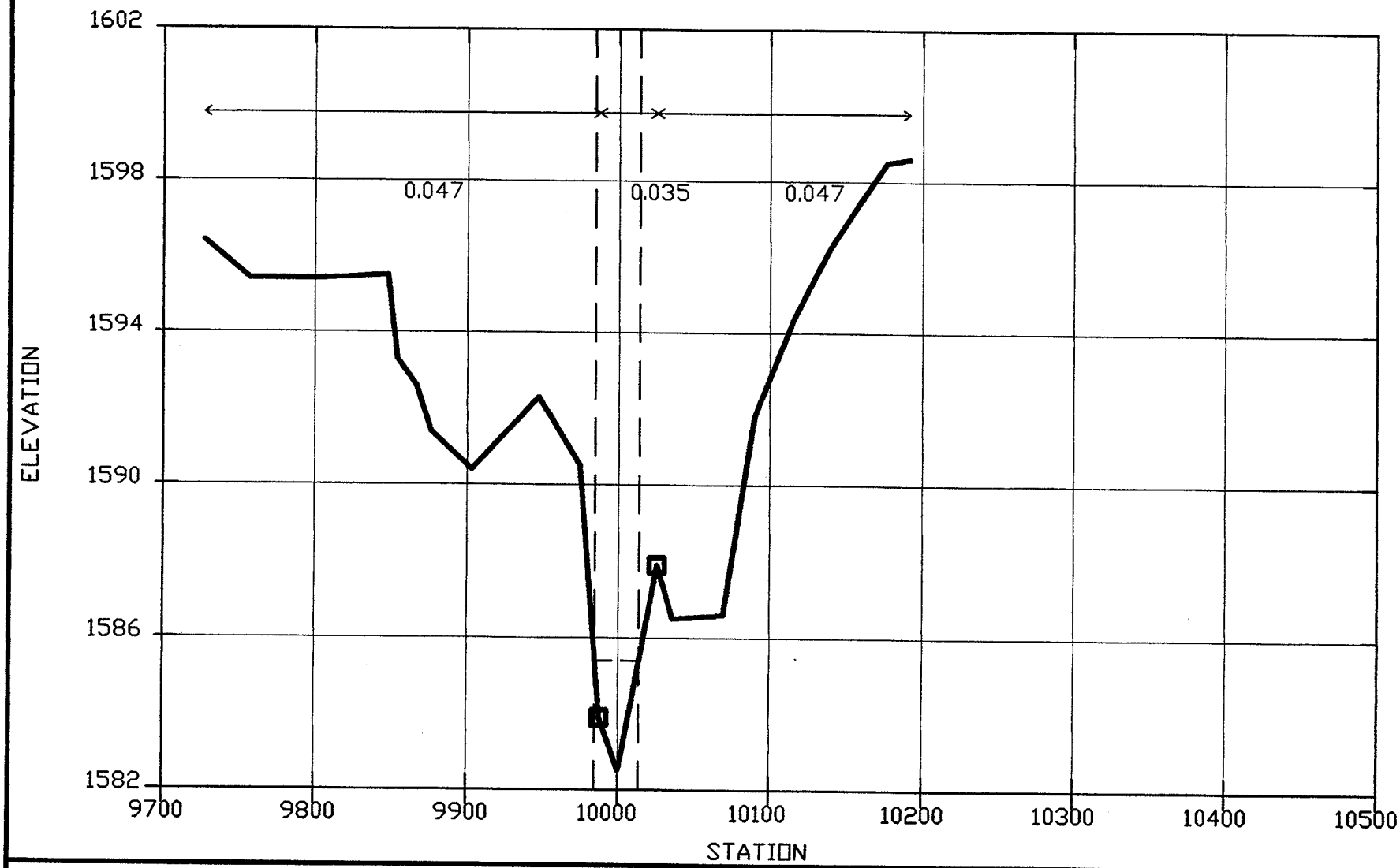


SECTION : 0.48

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

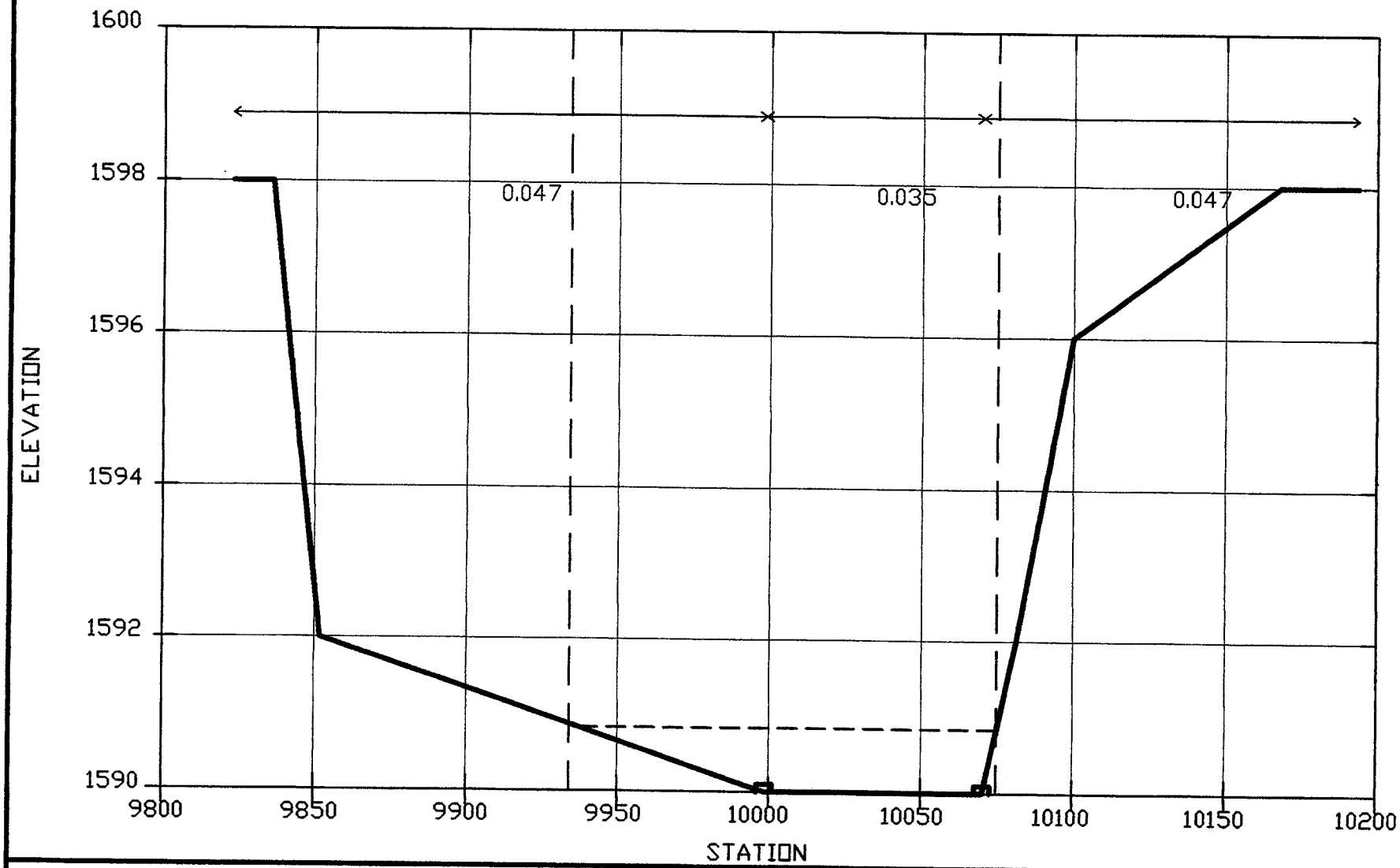


SECTION : 0.55

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

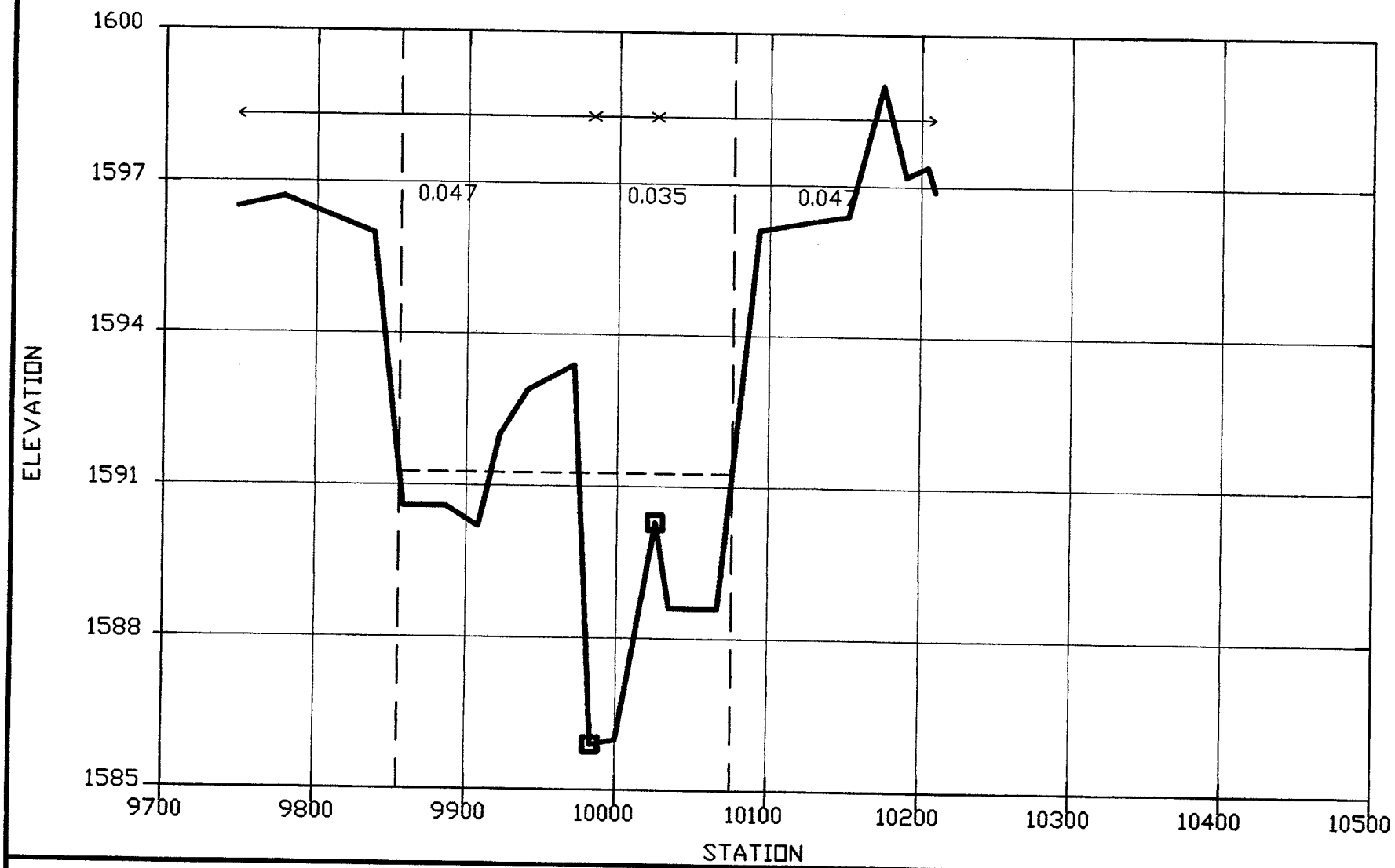


SECTION : 0.56

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

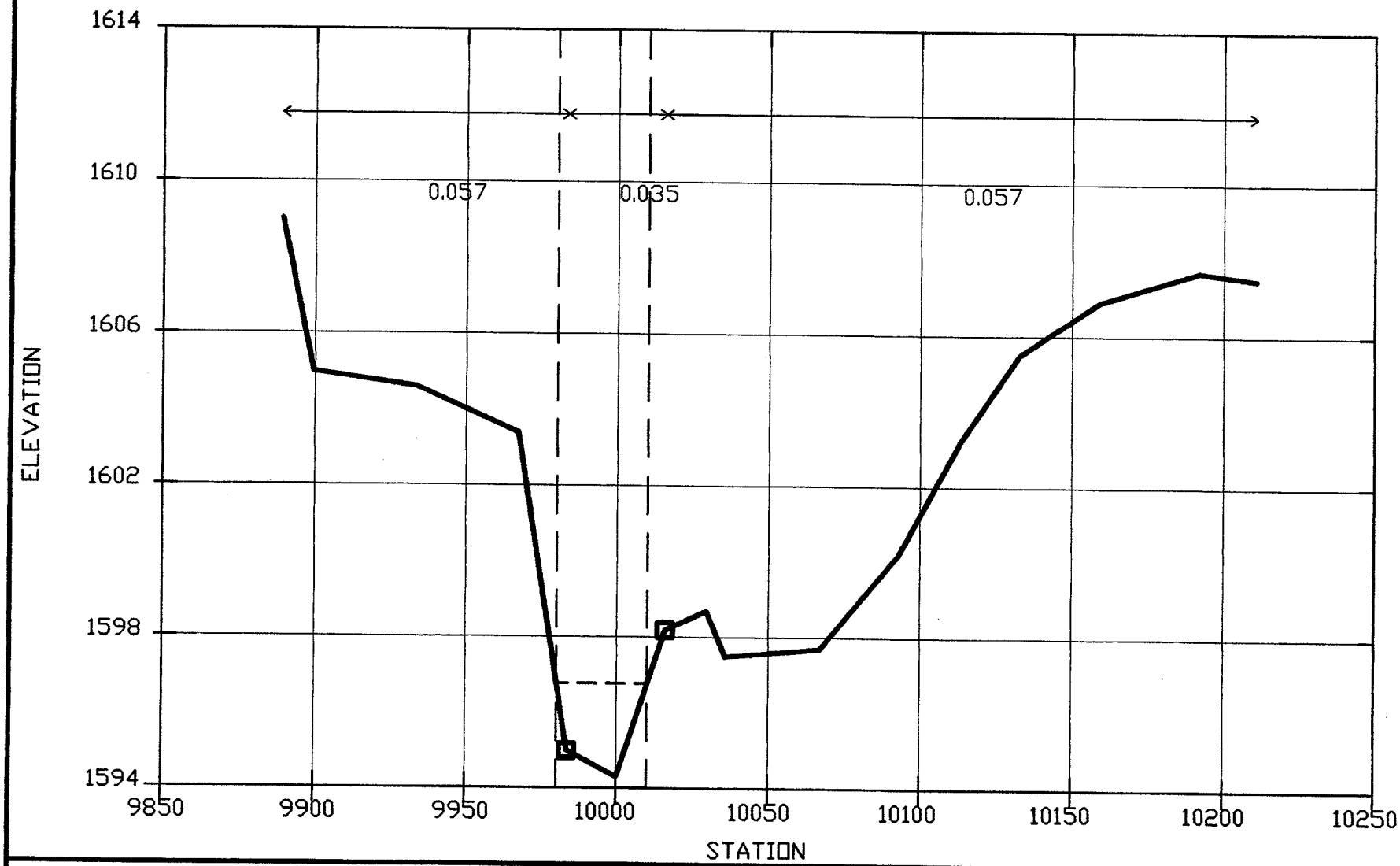


SECTION : 0.57

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

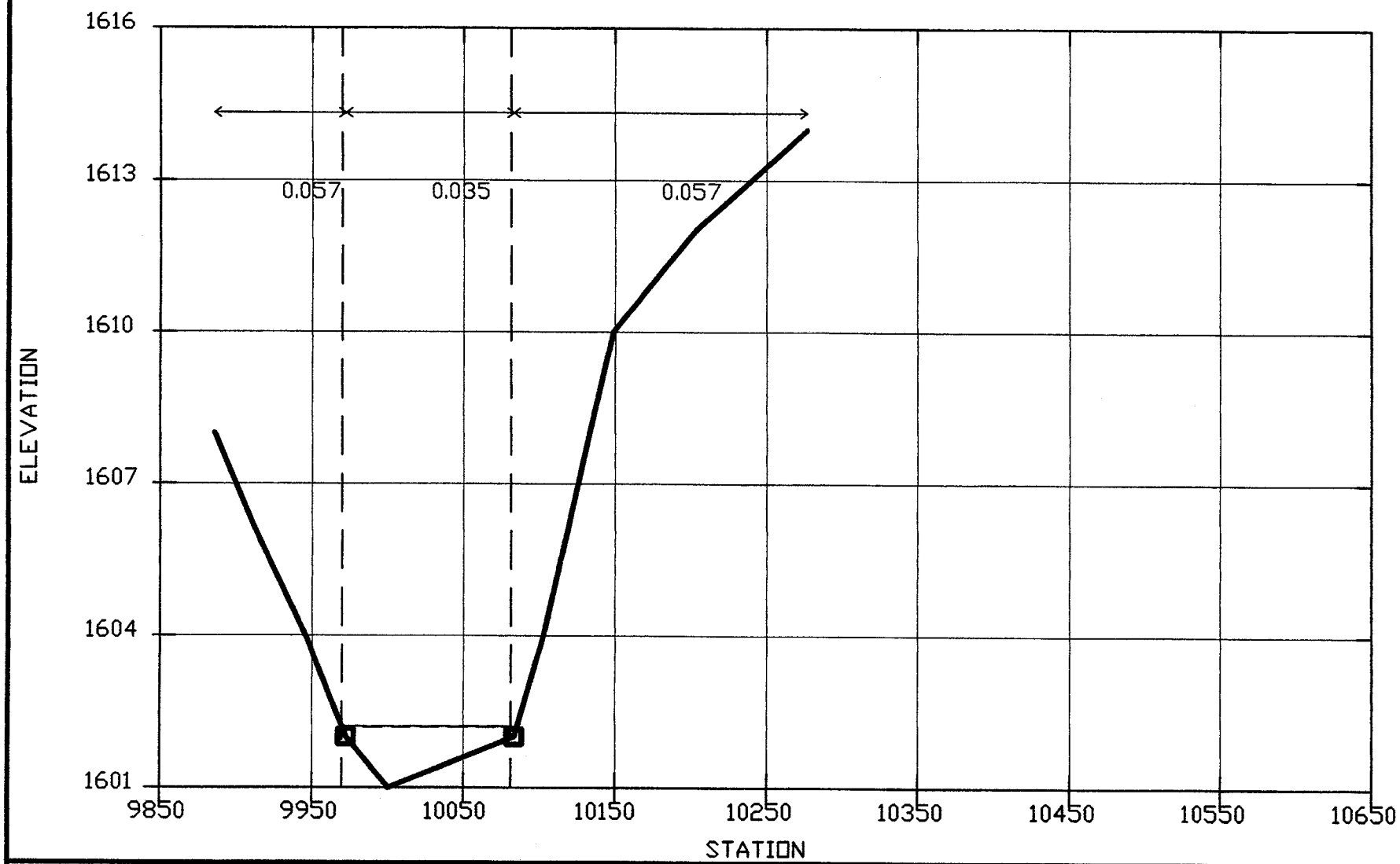


SECTION : 0.64

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

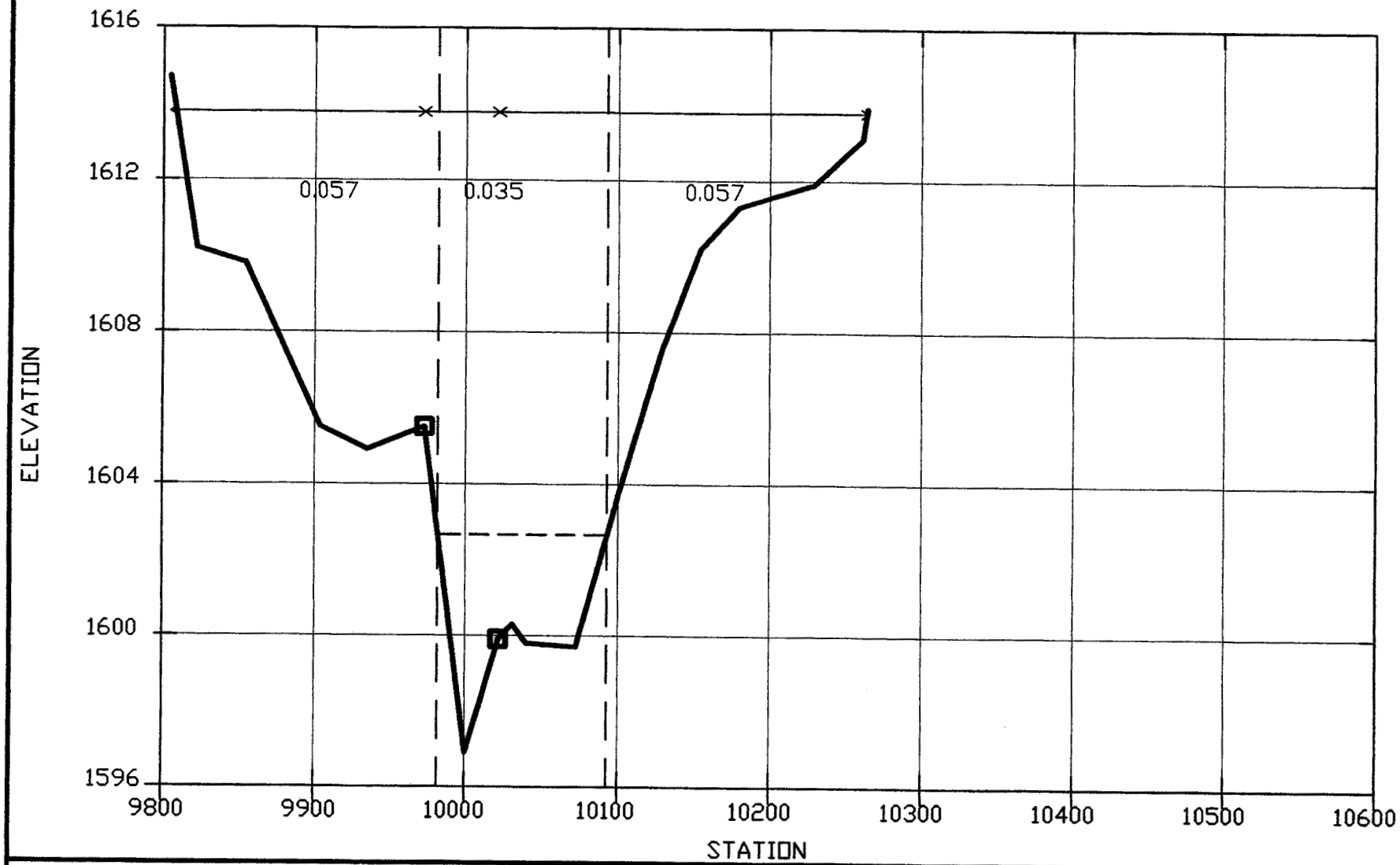


SECTION : 0.65

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

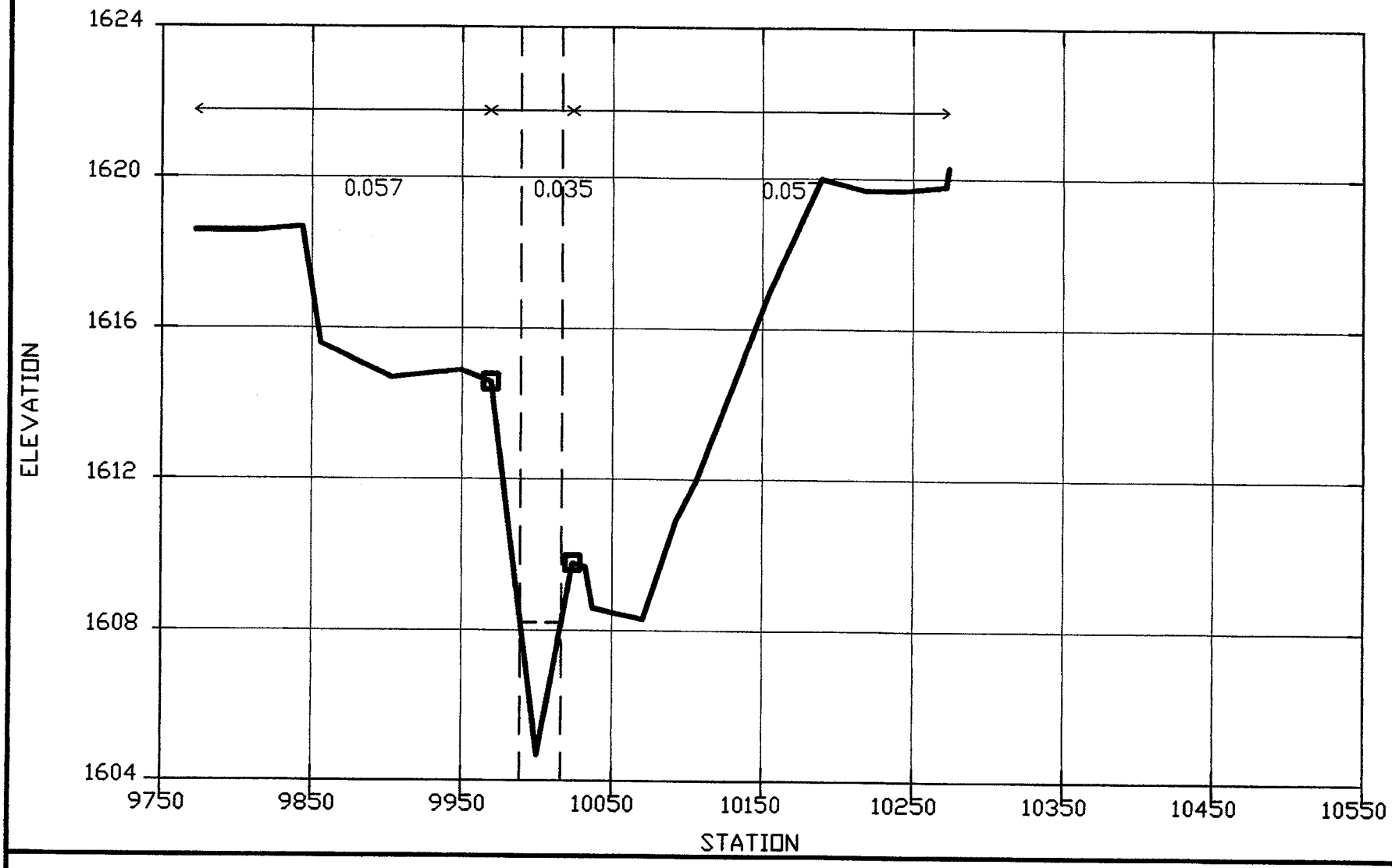


SECTION : 0.66

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

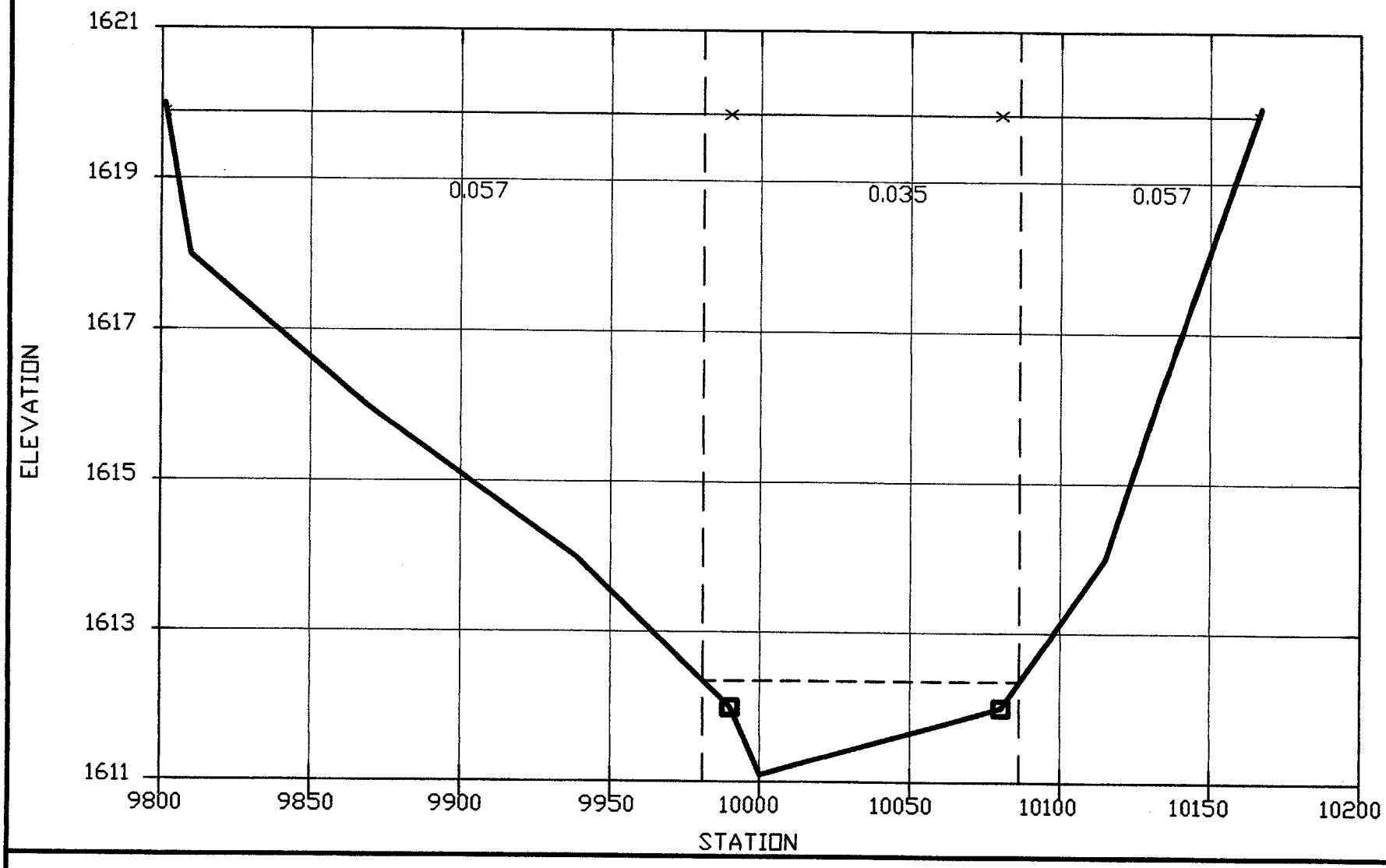


SECTION : 0.71

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

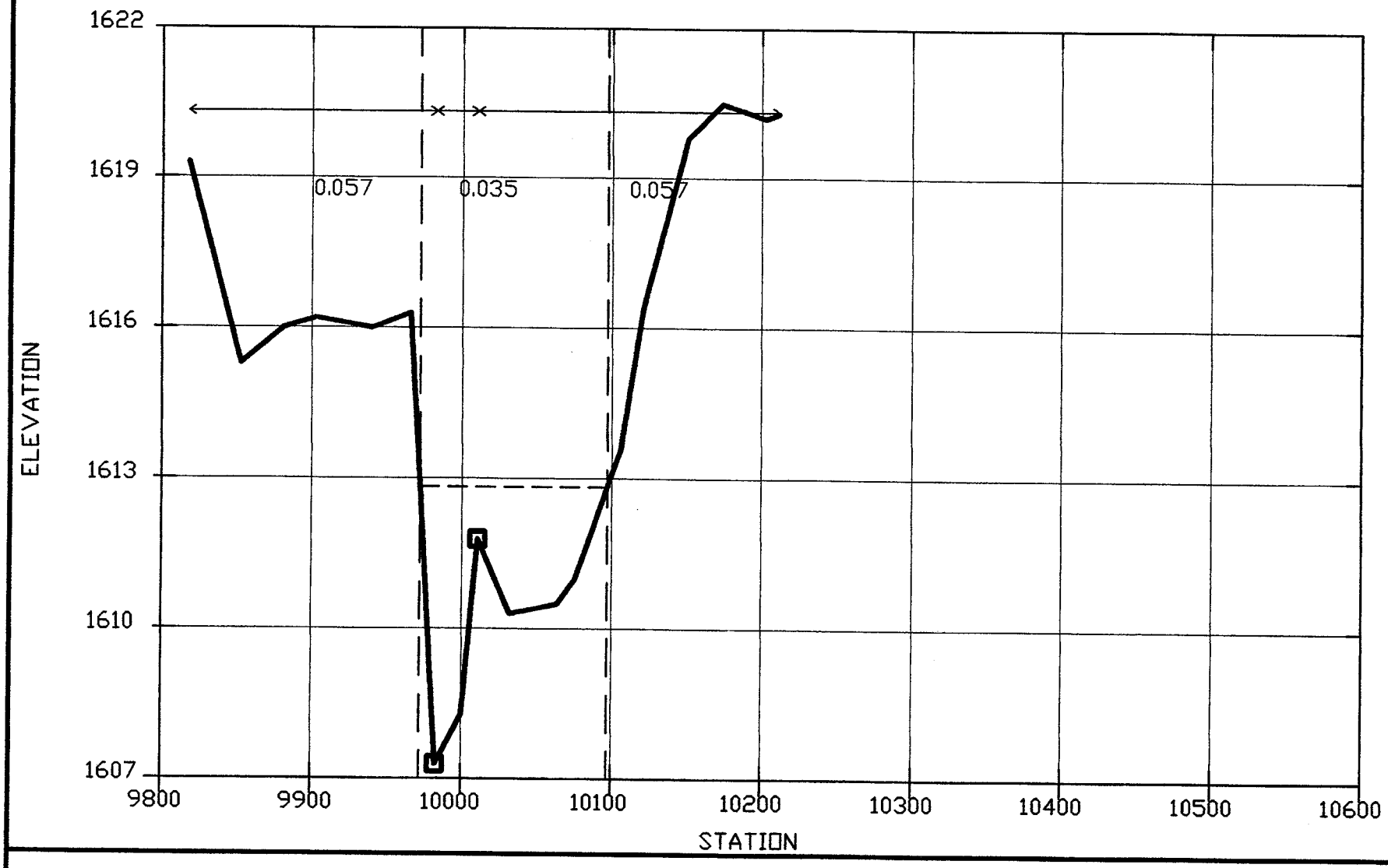


SECTION : 0.72

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

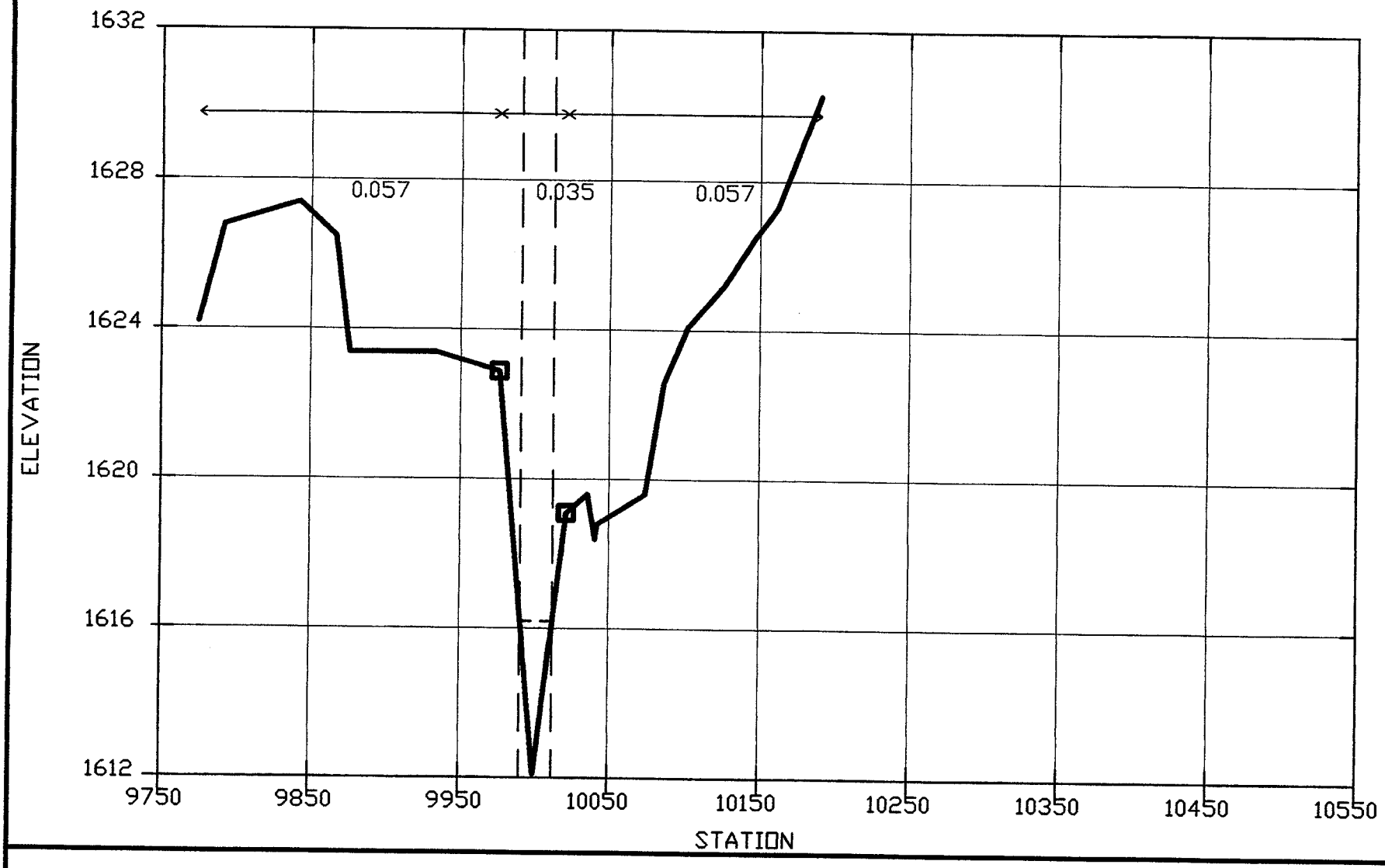


SECTION : 0.73

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

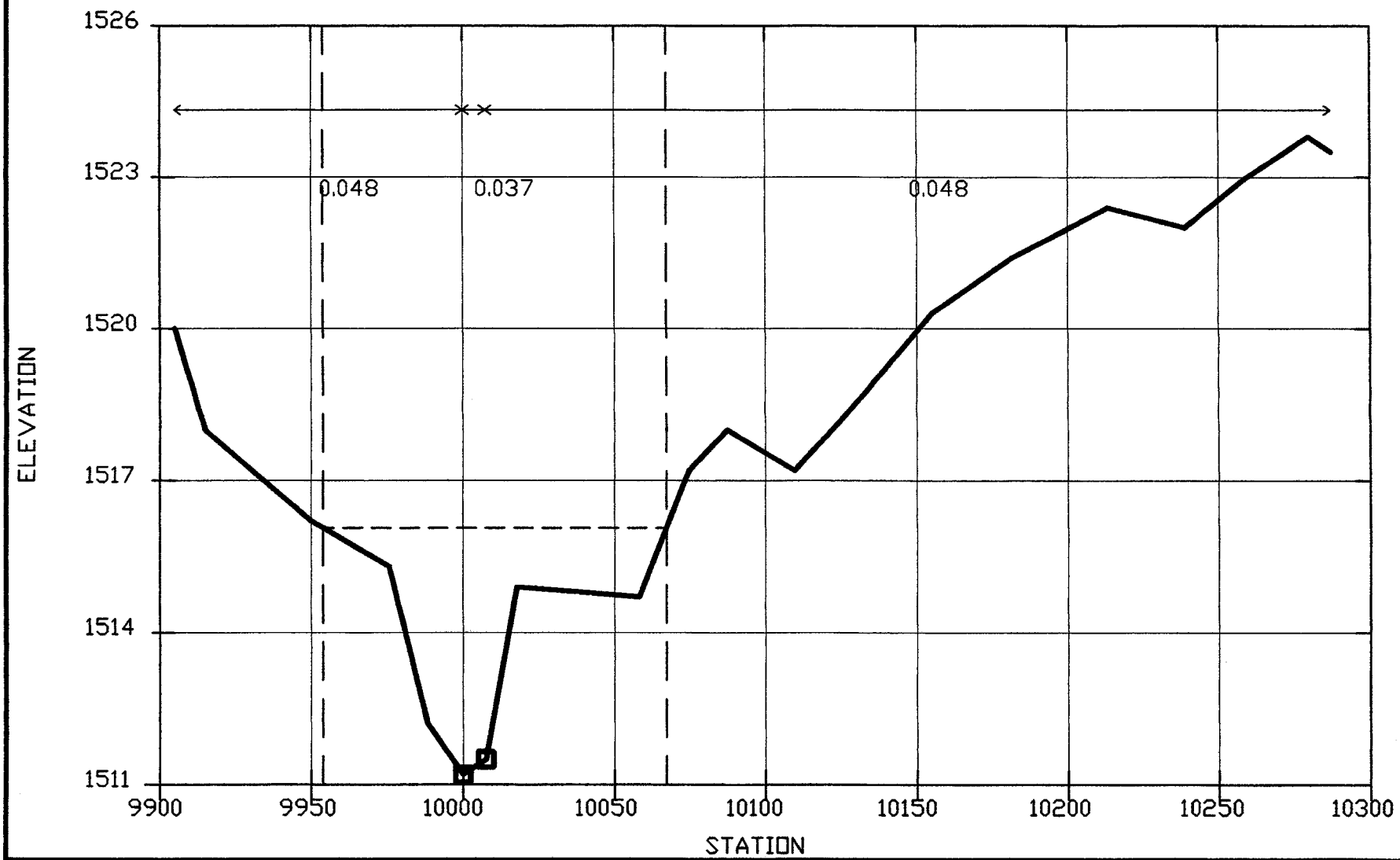


SECTION : 0.78

Fountain Hills (south) FIS

Malta Drain

File: MAL-XSEC.DWG

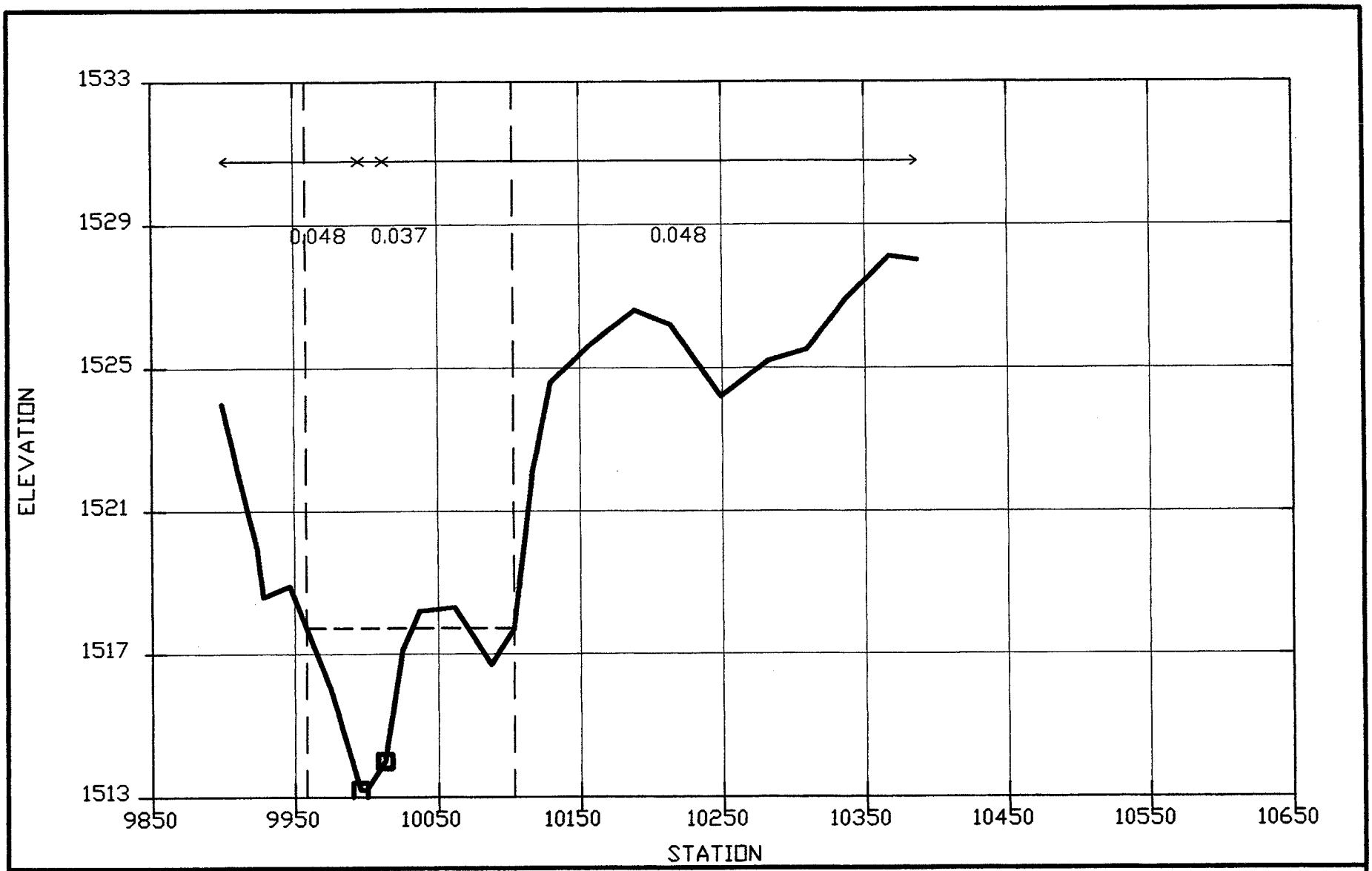


SECTION : 2.52

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG



SECTION : 2.54

Fountain Hills (south) FIS

Colony Wash

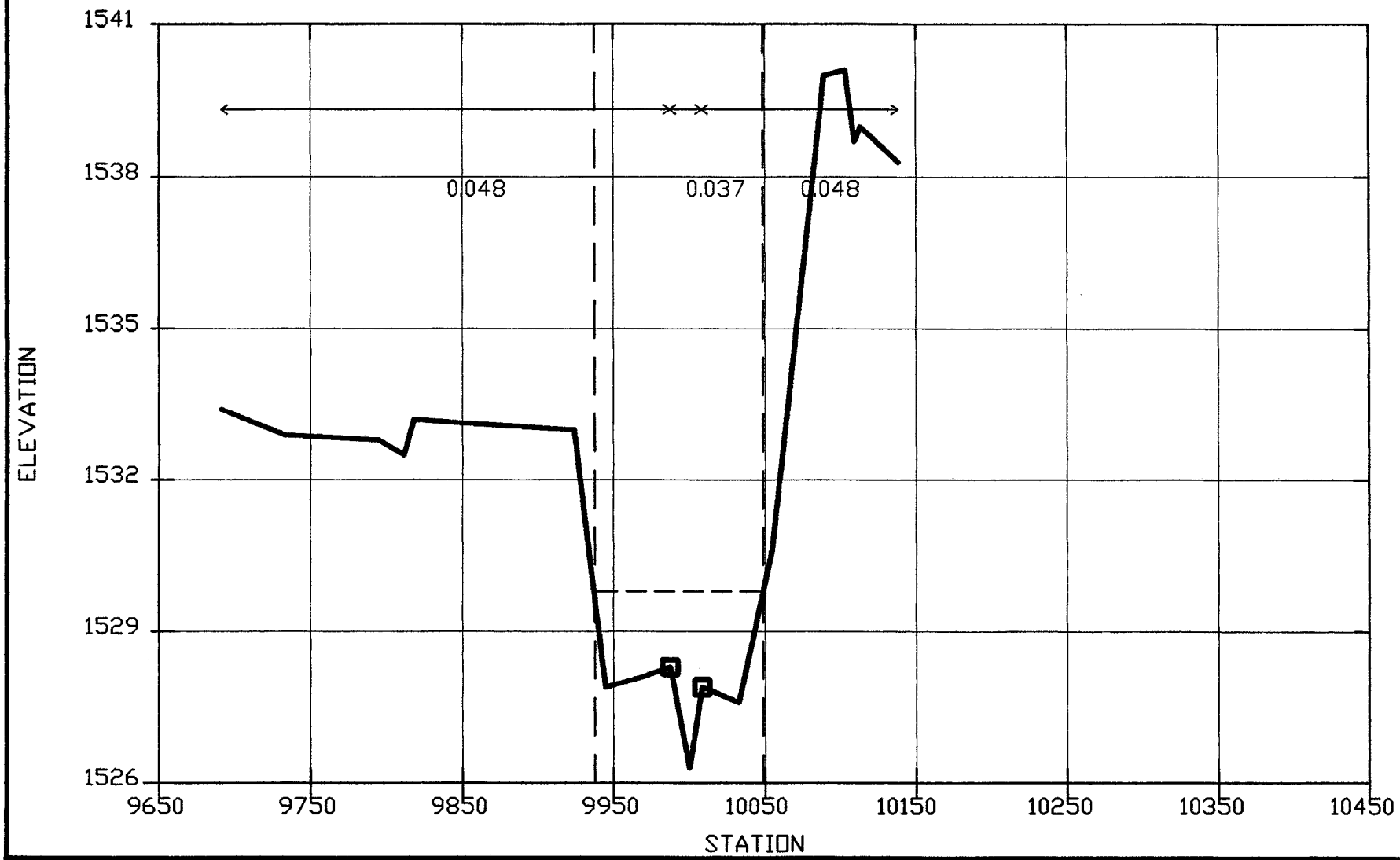
File: COL-XSEC.DWG

SECTION : 2.59

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

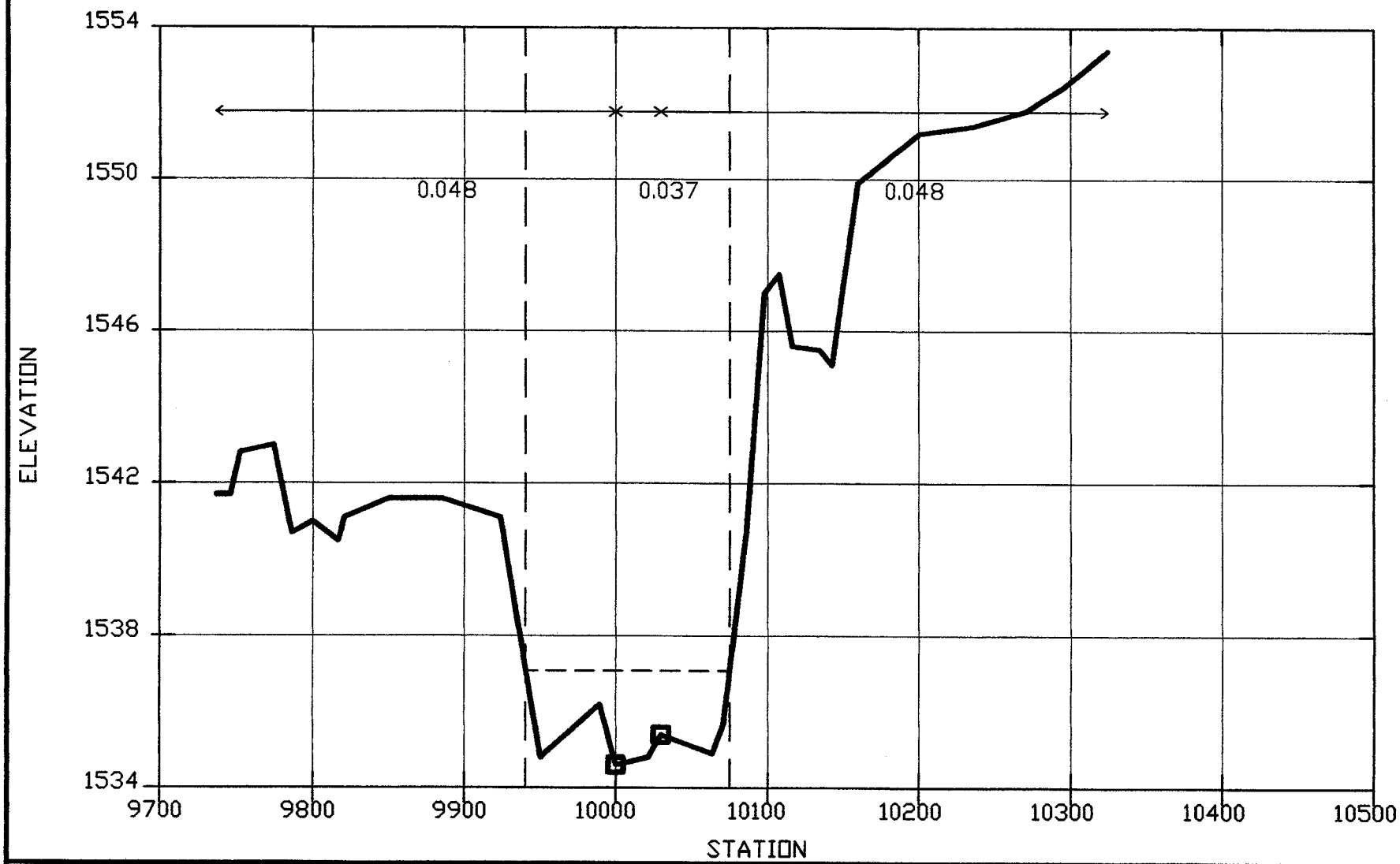


SECTION : 2.68

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

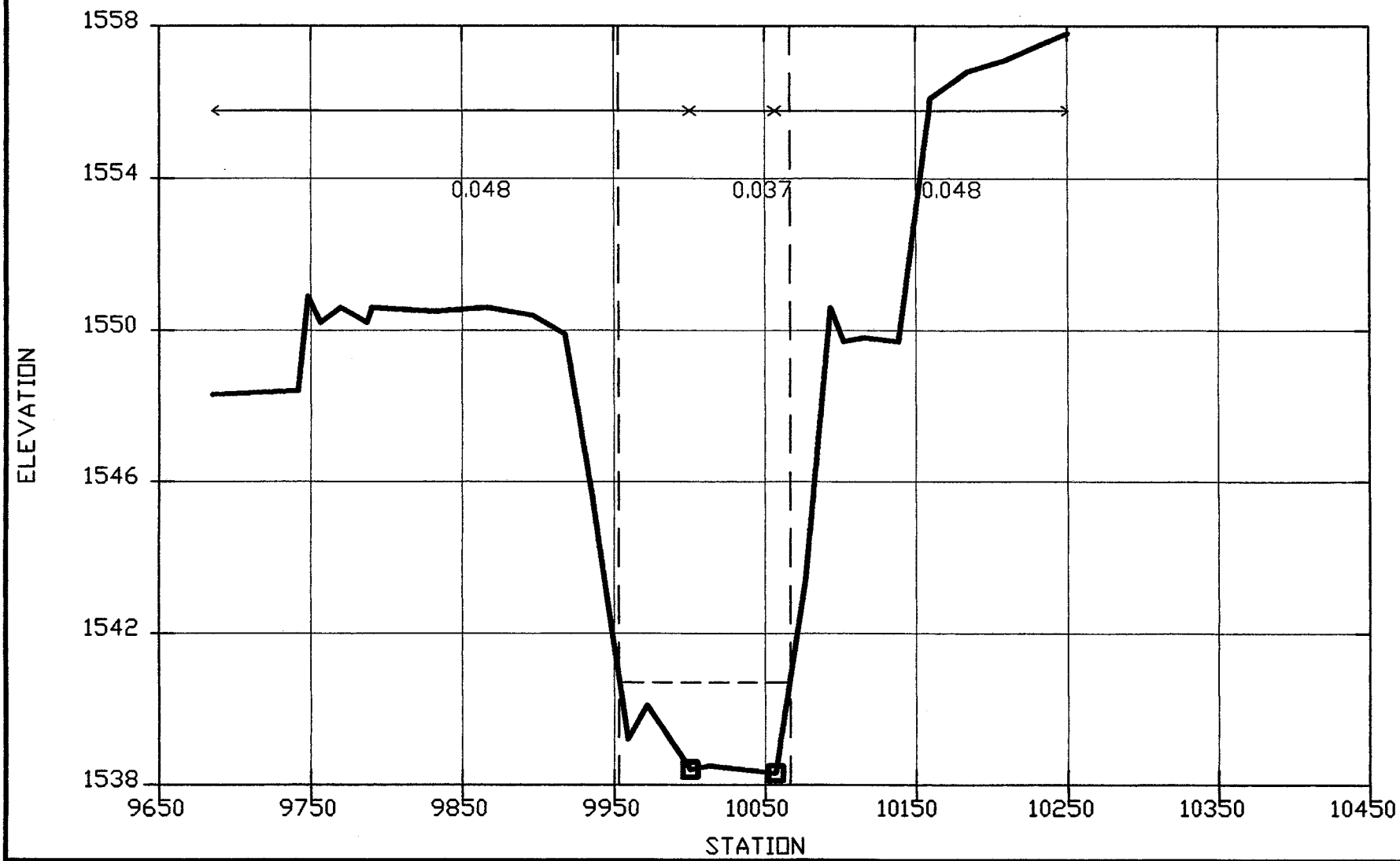


SECTION : 2.78

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

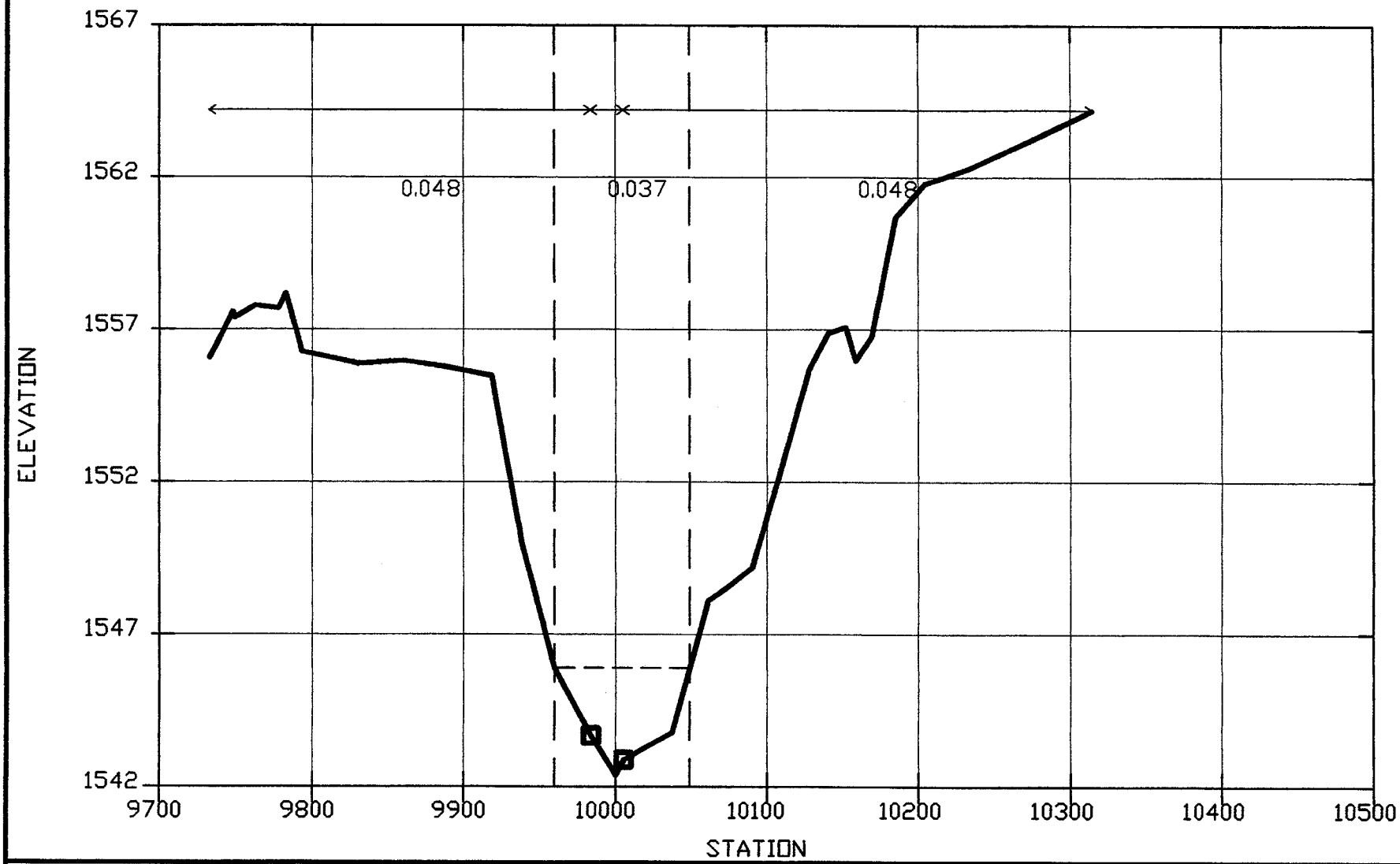


SECTION : 2.84

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

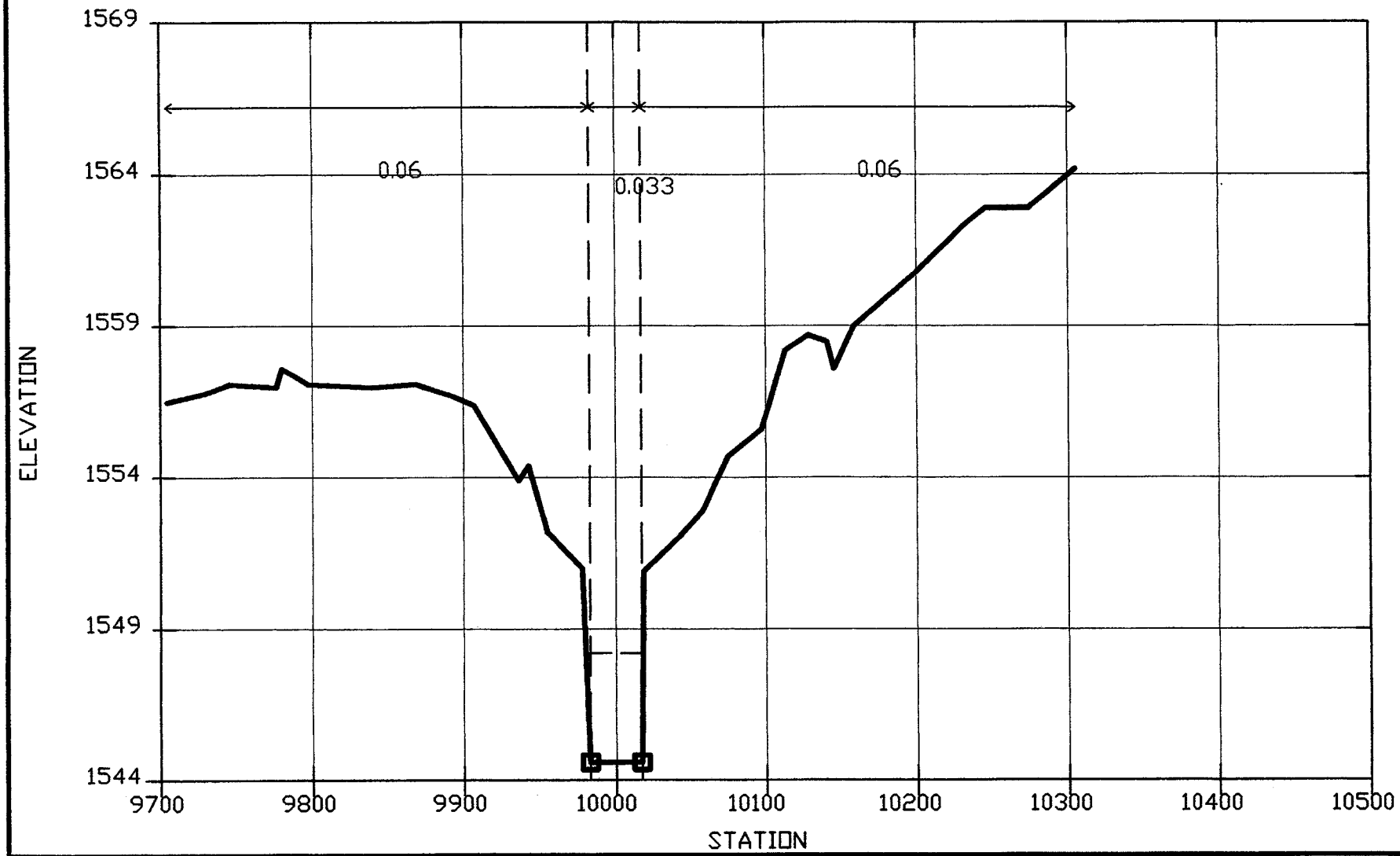


SECTION : 2.87

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

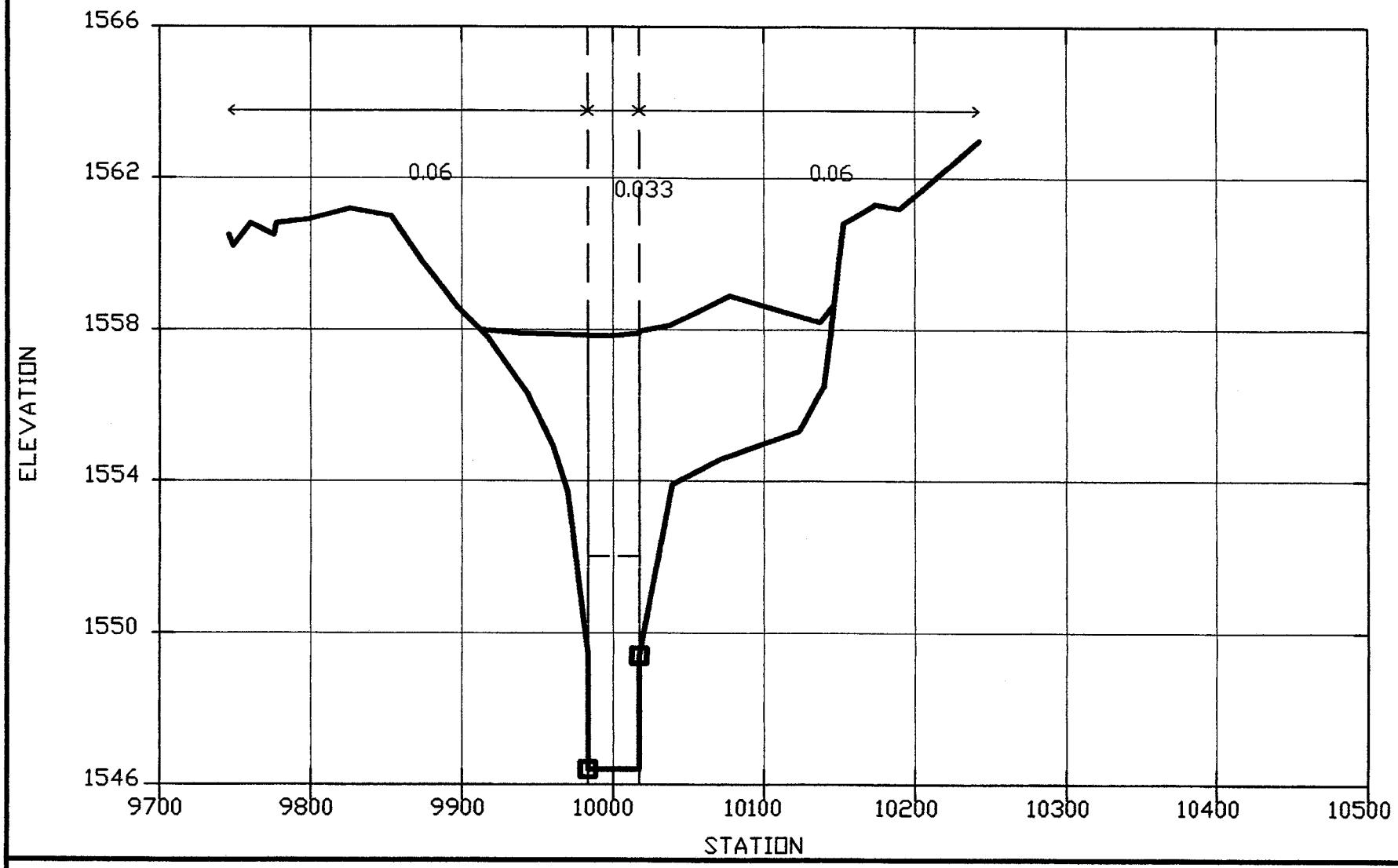


SECTION : 2.88

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

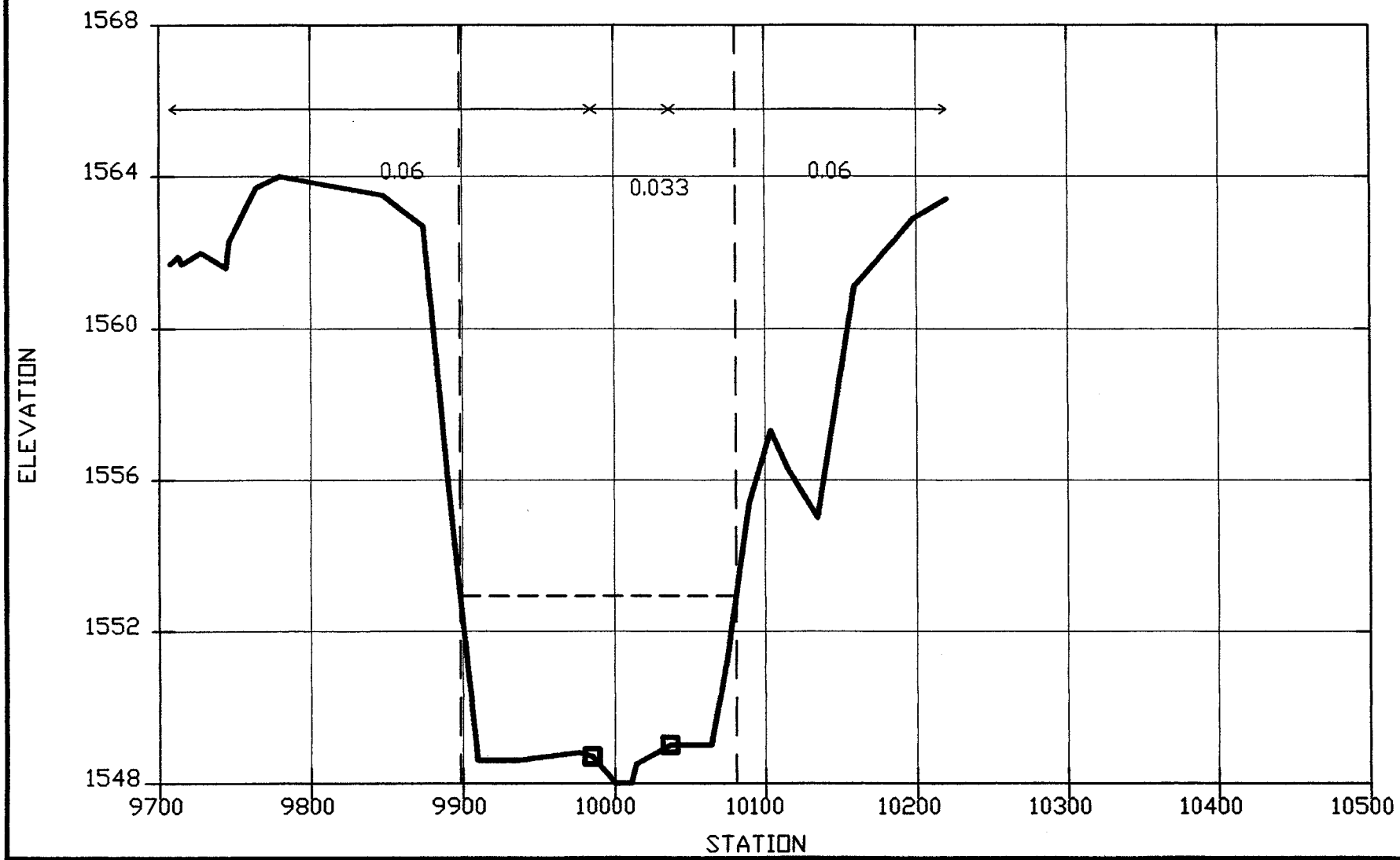


SECTION : 2.91

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

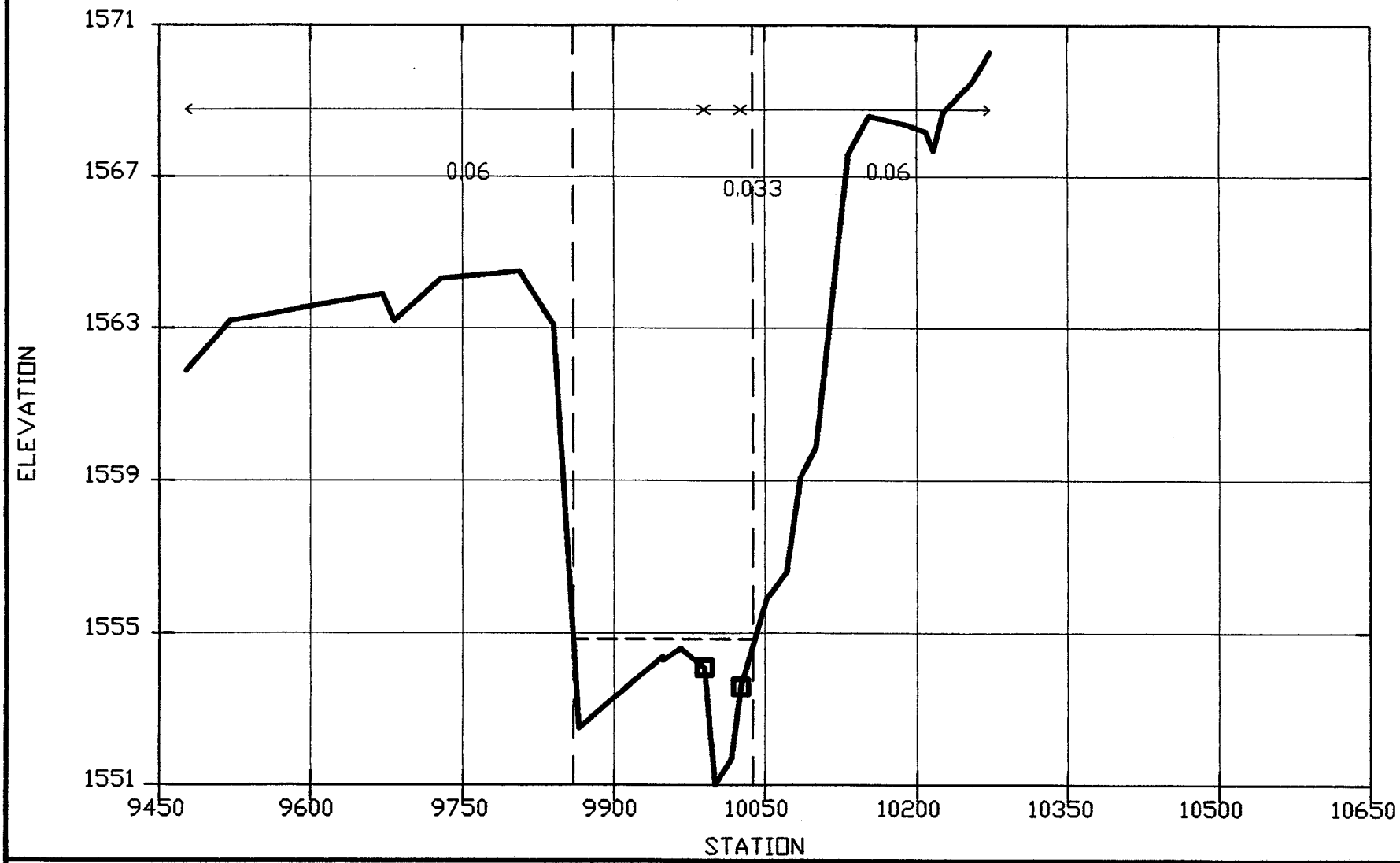


SECTION : 2.92

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

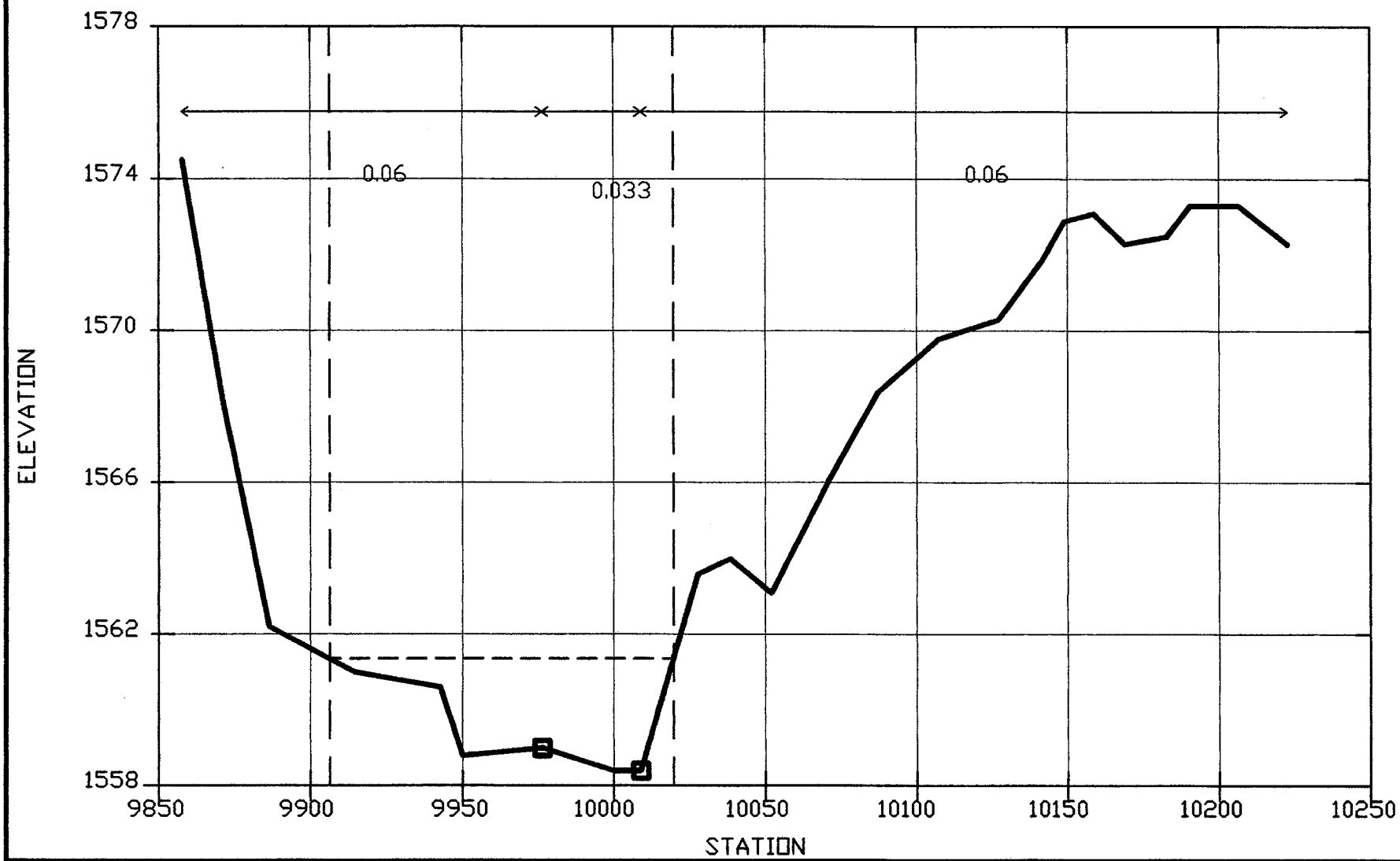


SECTION : 2.97

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

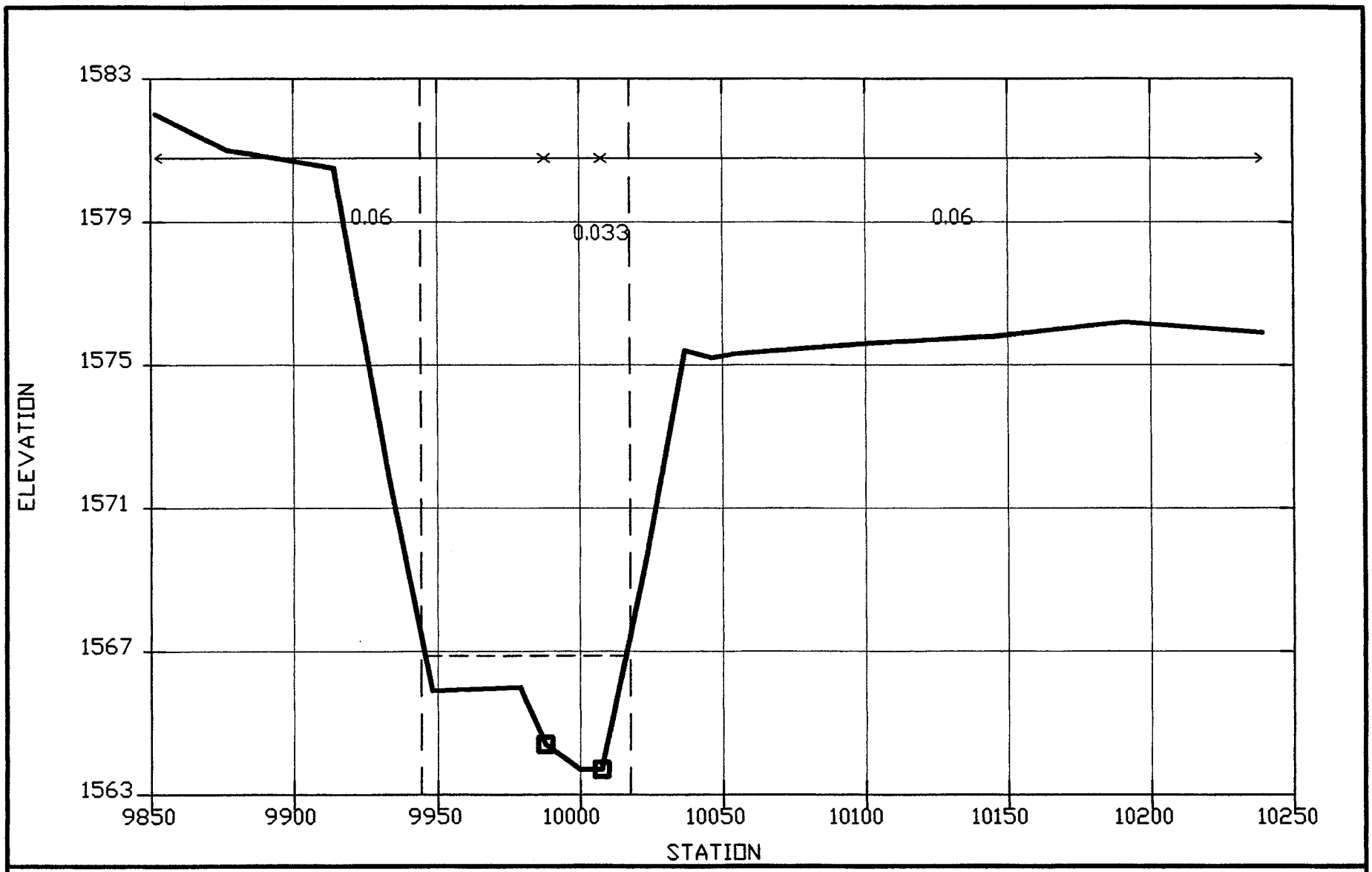


SECTION : 3.02

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

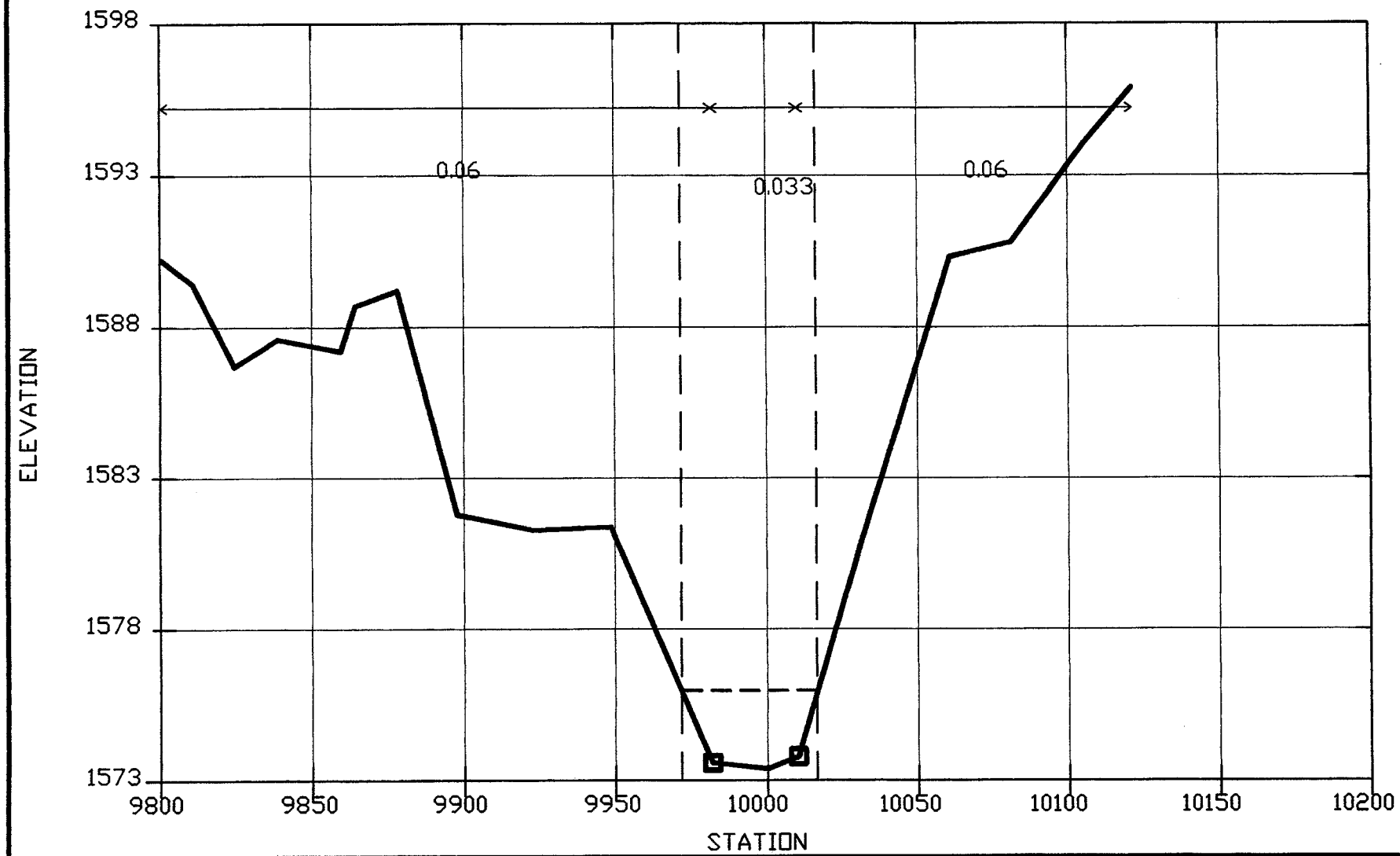


SECTION : 3.12

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

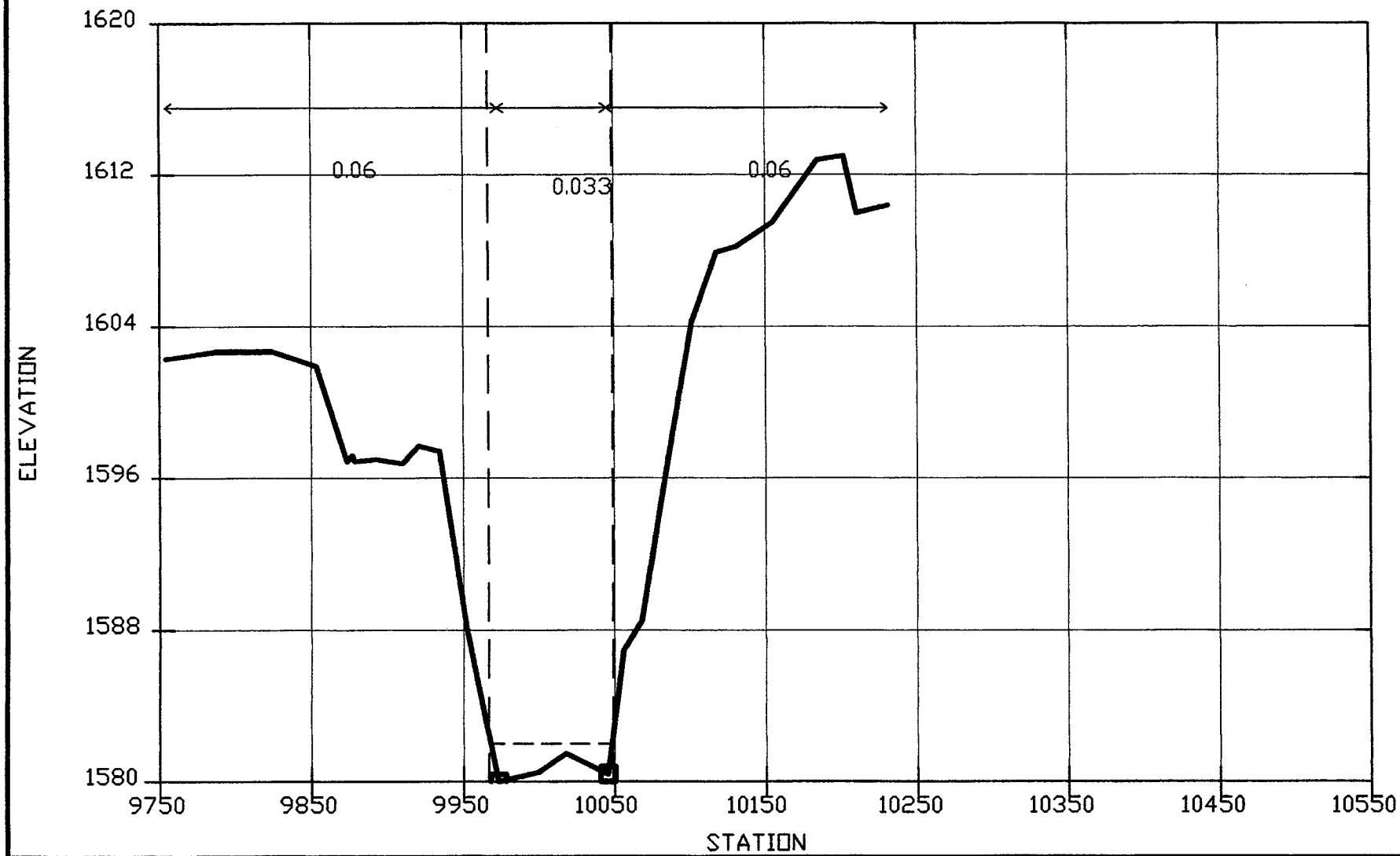


SECTION : 3.22

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

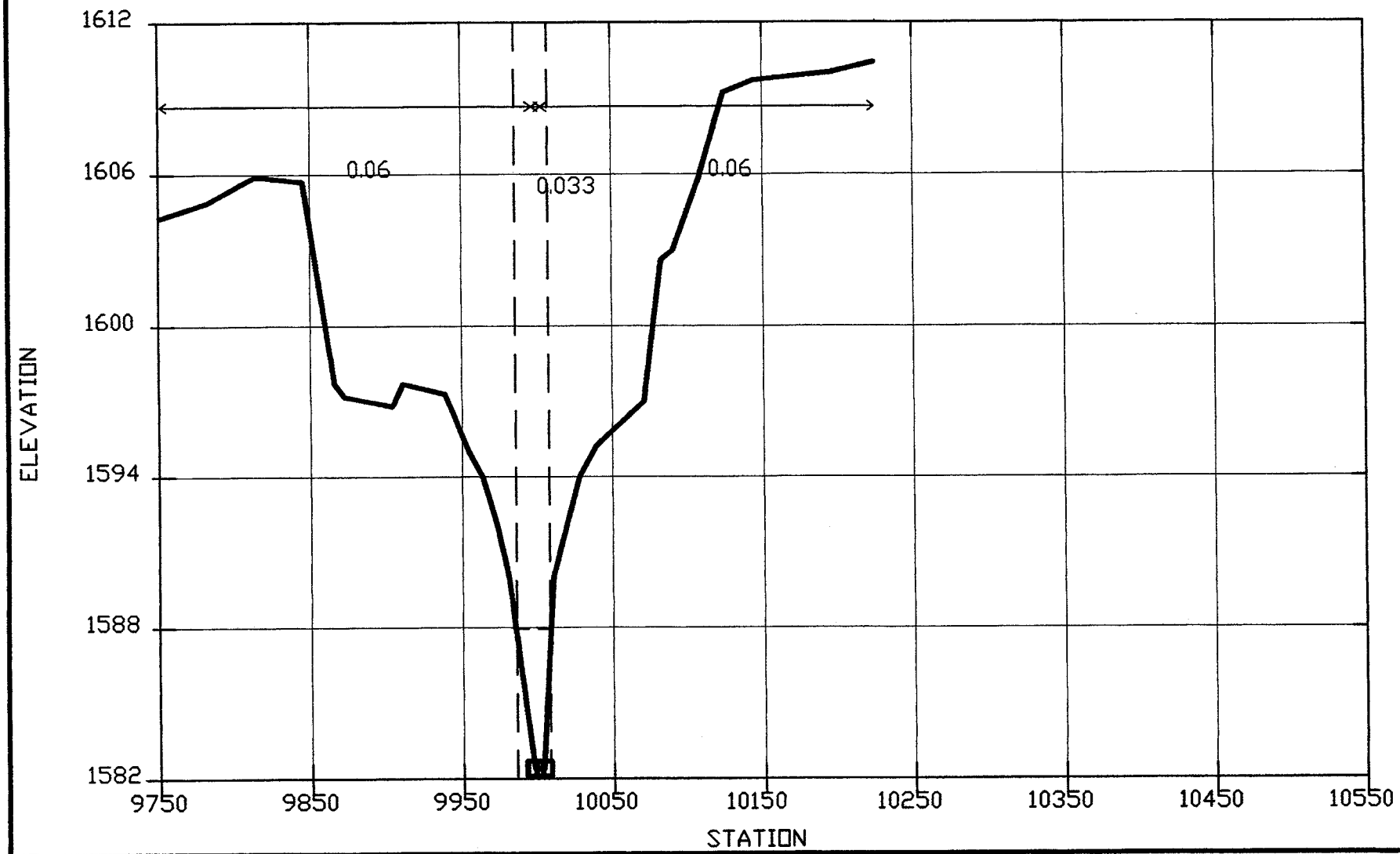


SECTION : 3.27

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

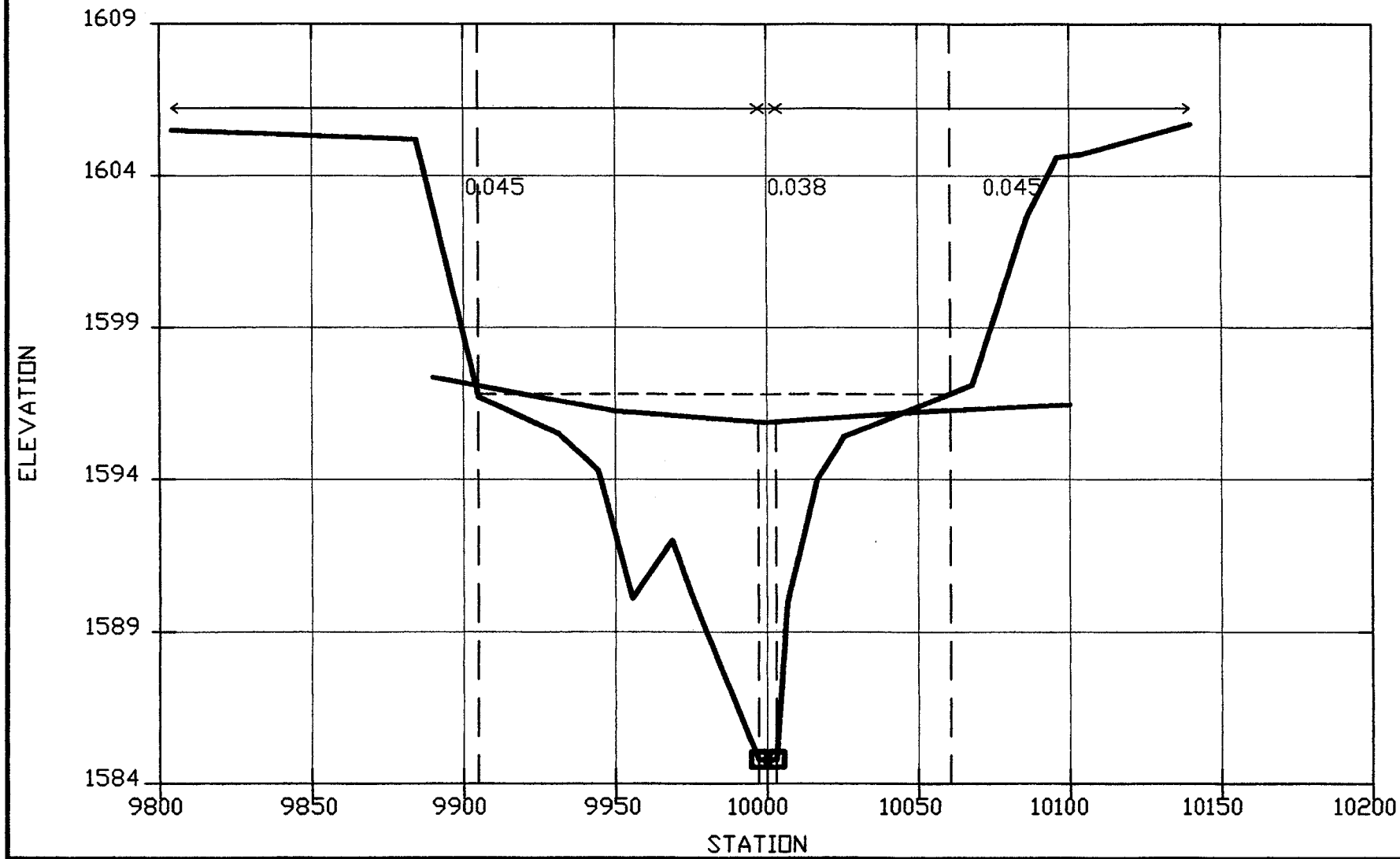


SECTION : 3.28

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

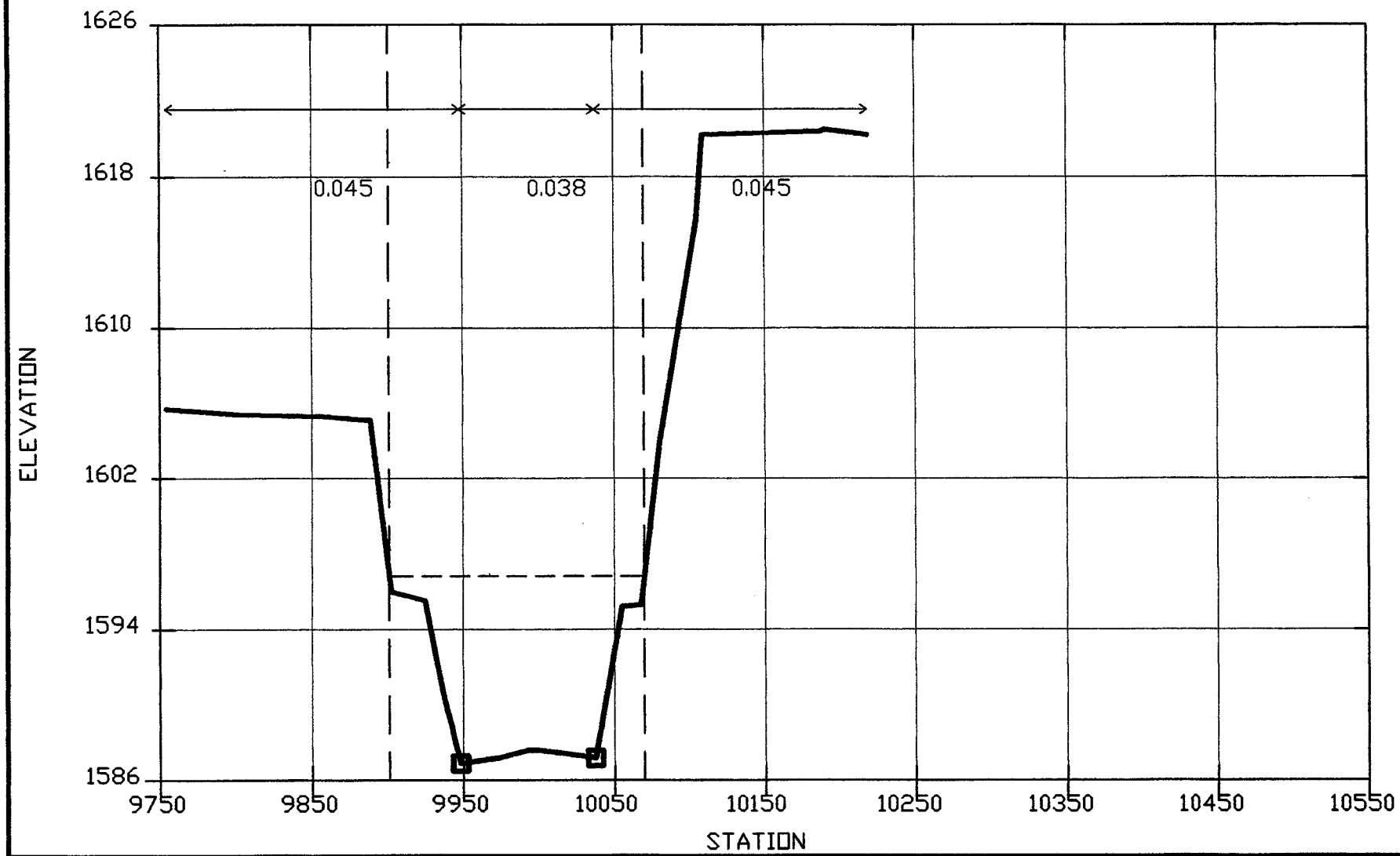


SECTION : 3.32

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

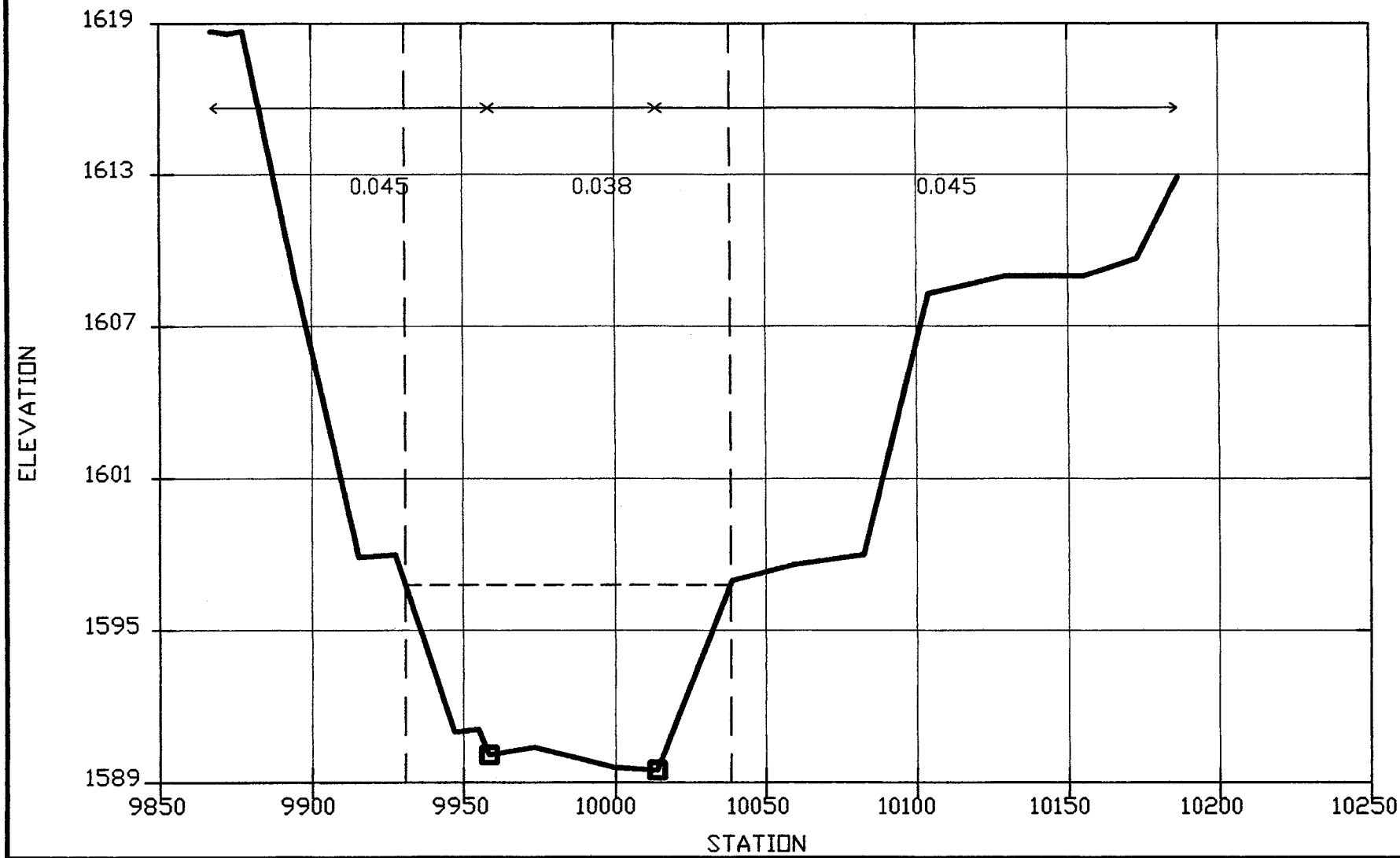


SECTION : 3.33

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

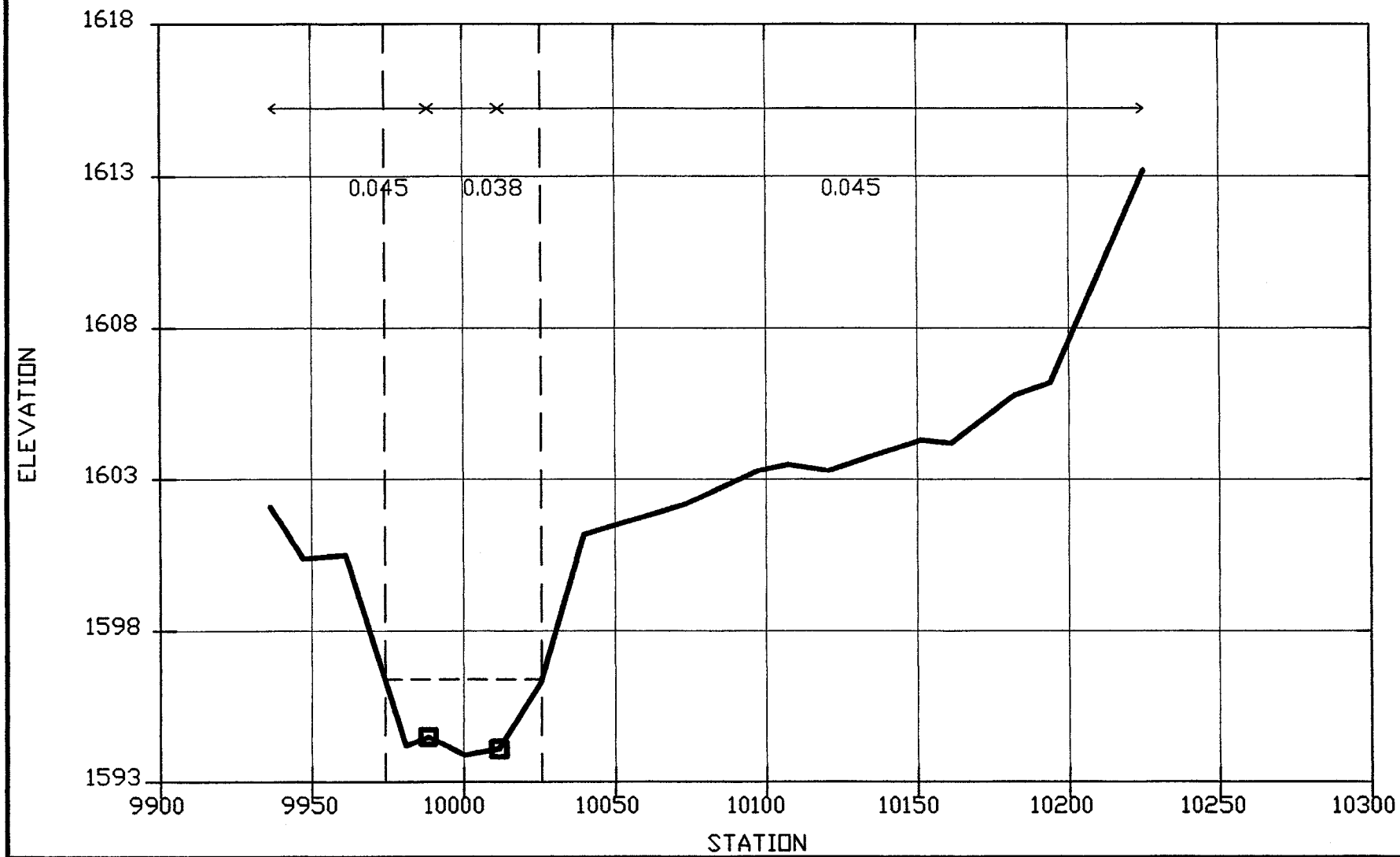


SECTION : 3.41

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

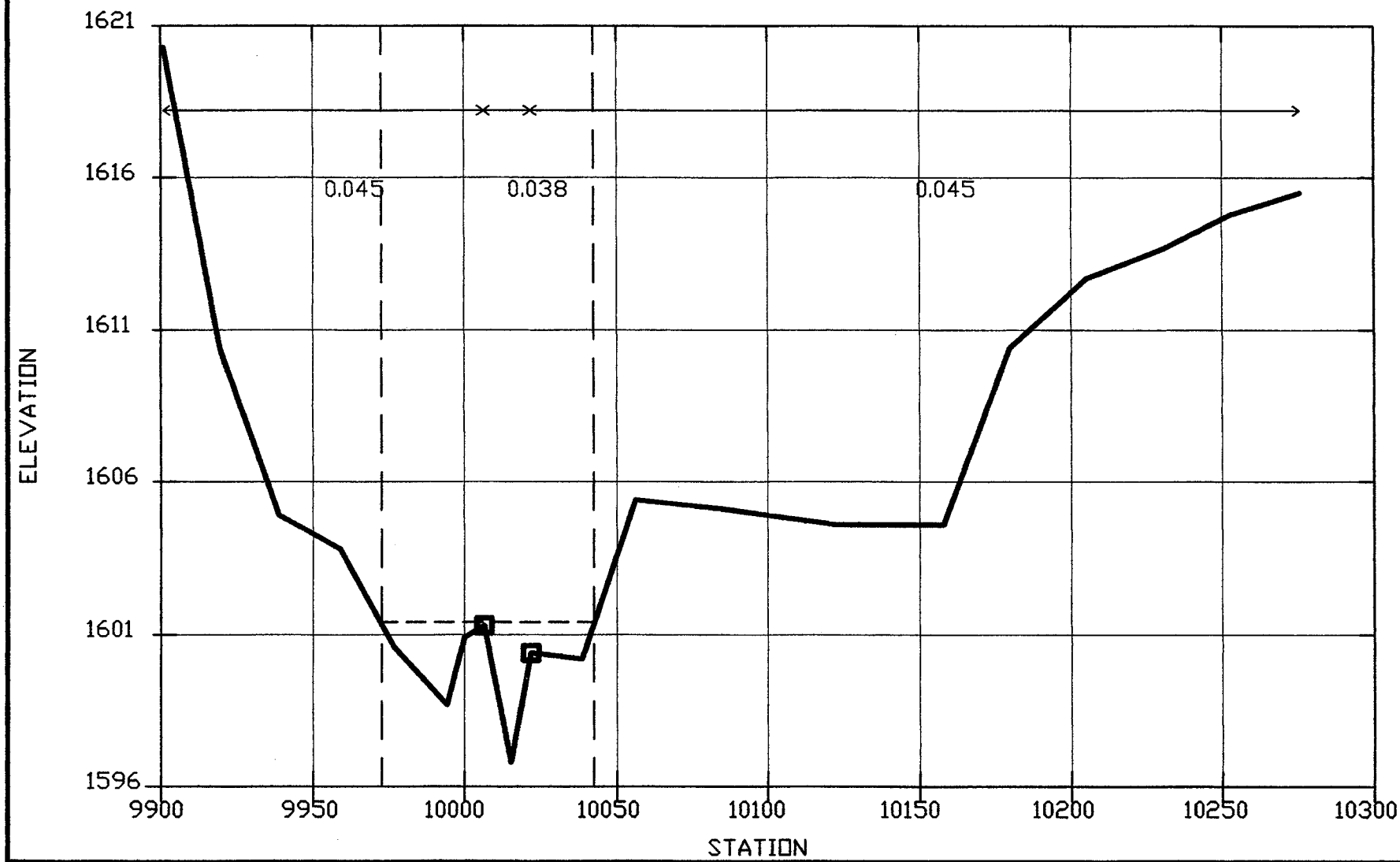


SECTION : 3.47

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

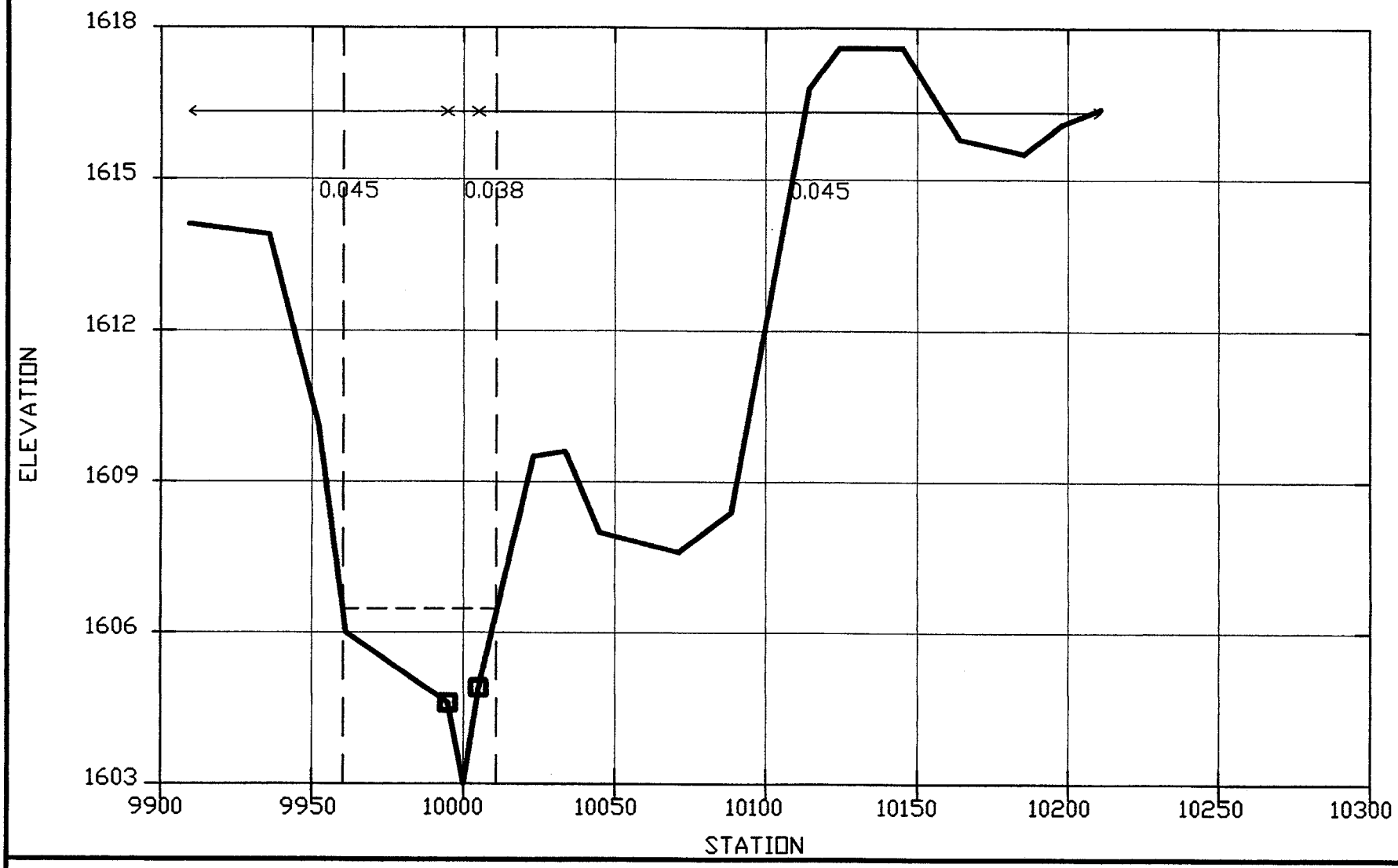


SECTION : 3.52

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

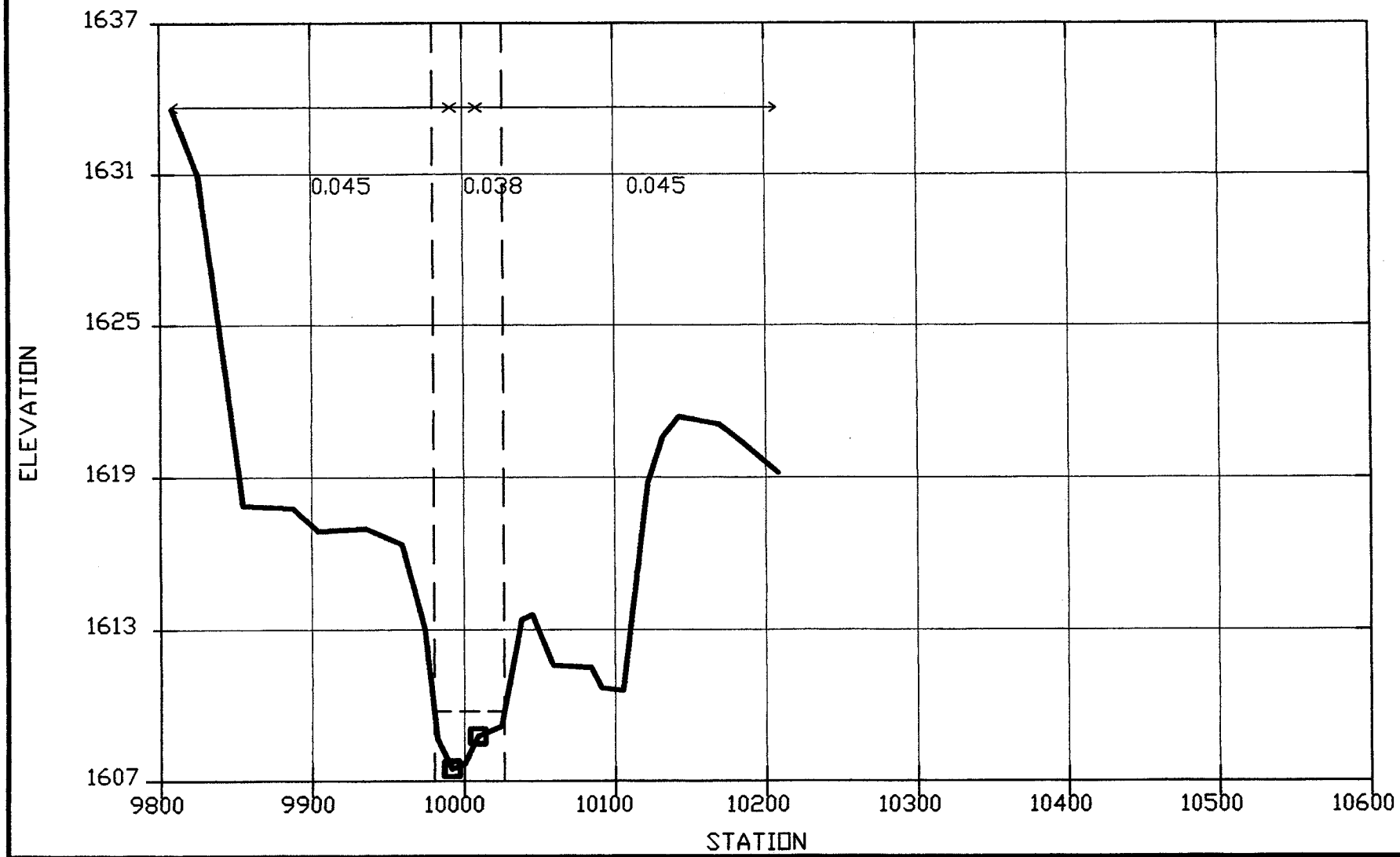


SECTION : 3.56

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

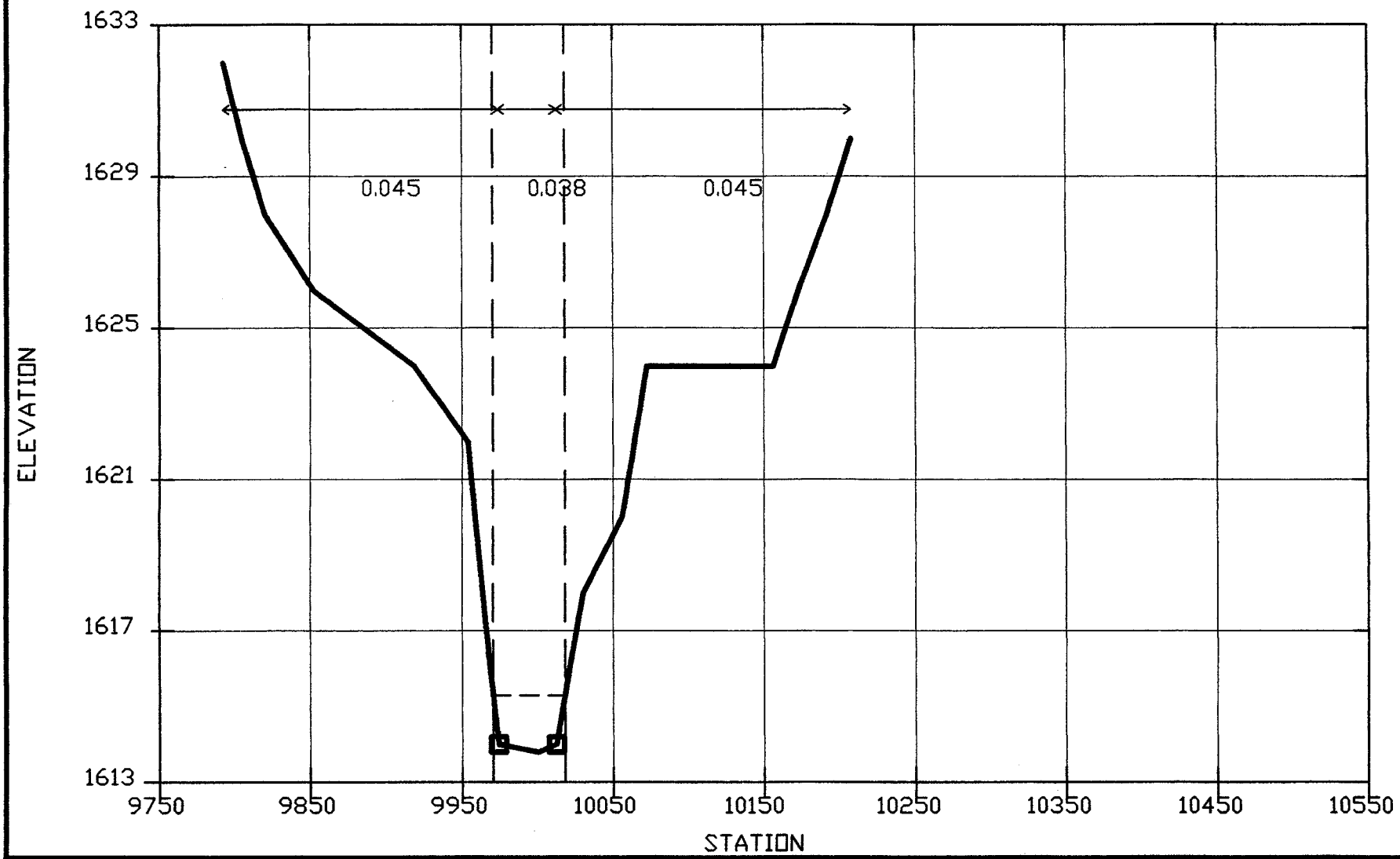


SECTION : 3.59

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

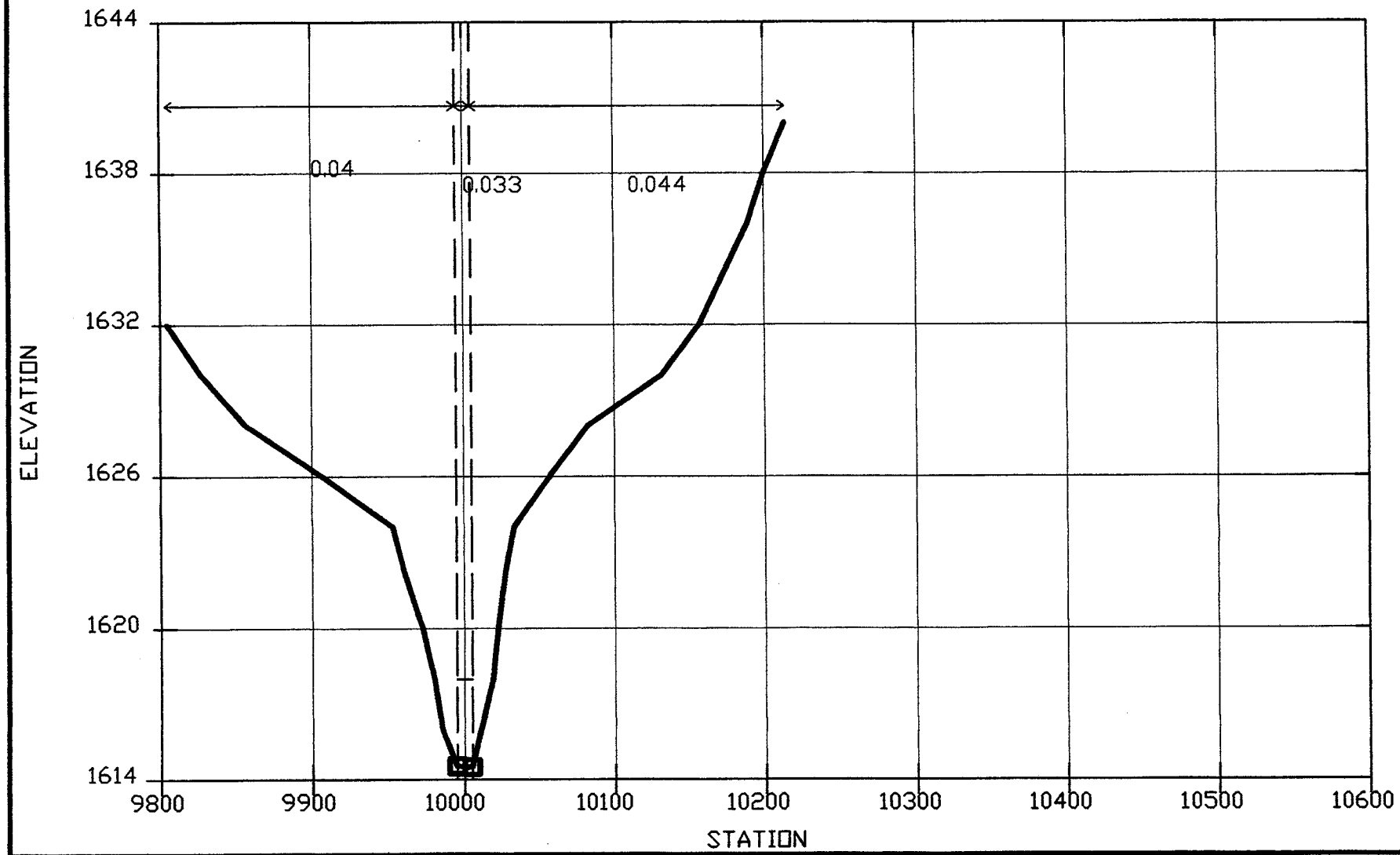


SECTION : 3.64

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

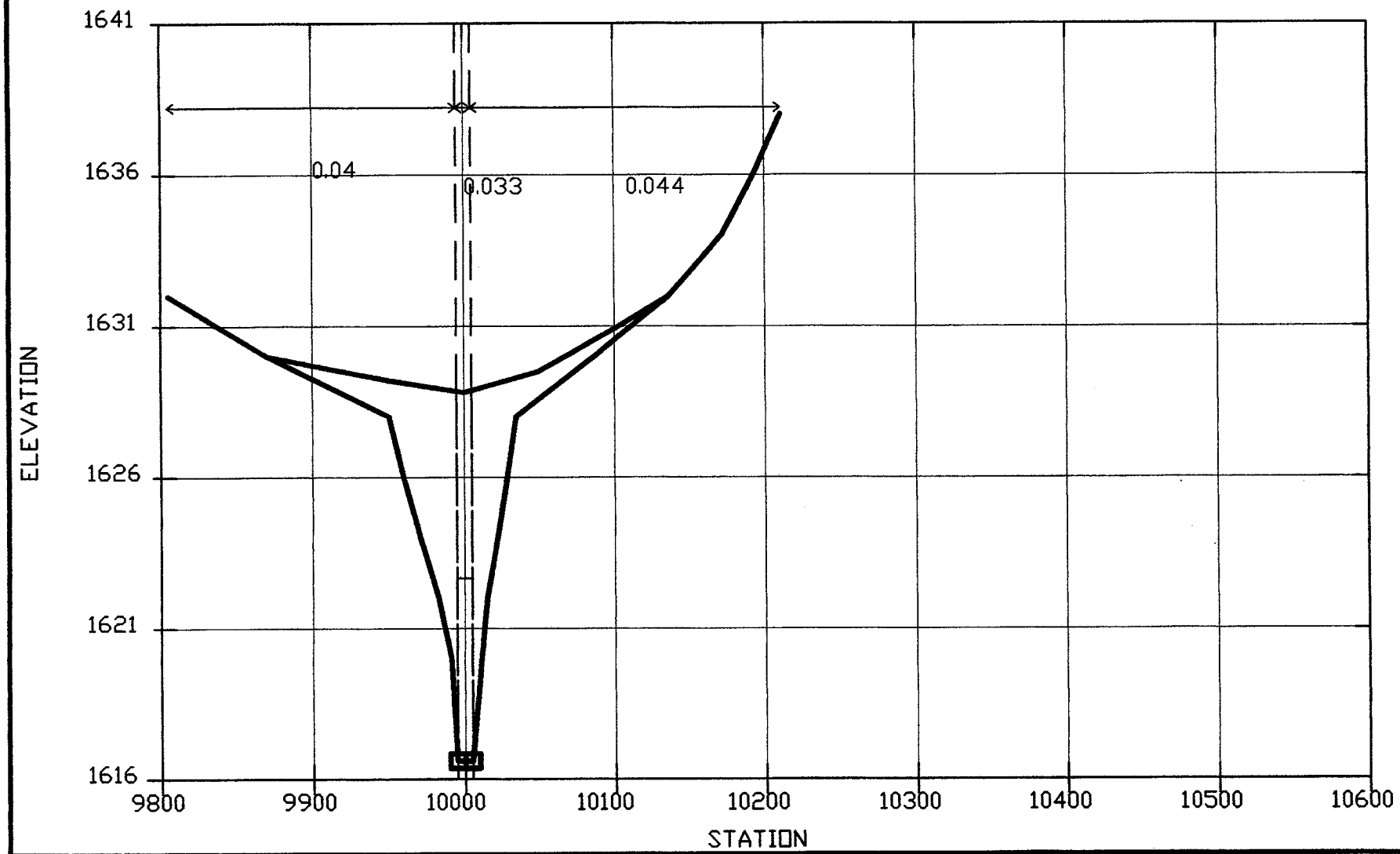


SECTION : 3.65

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

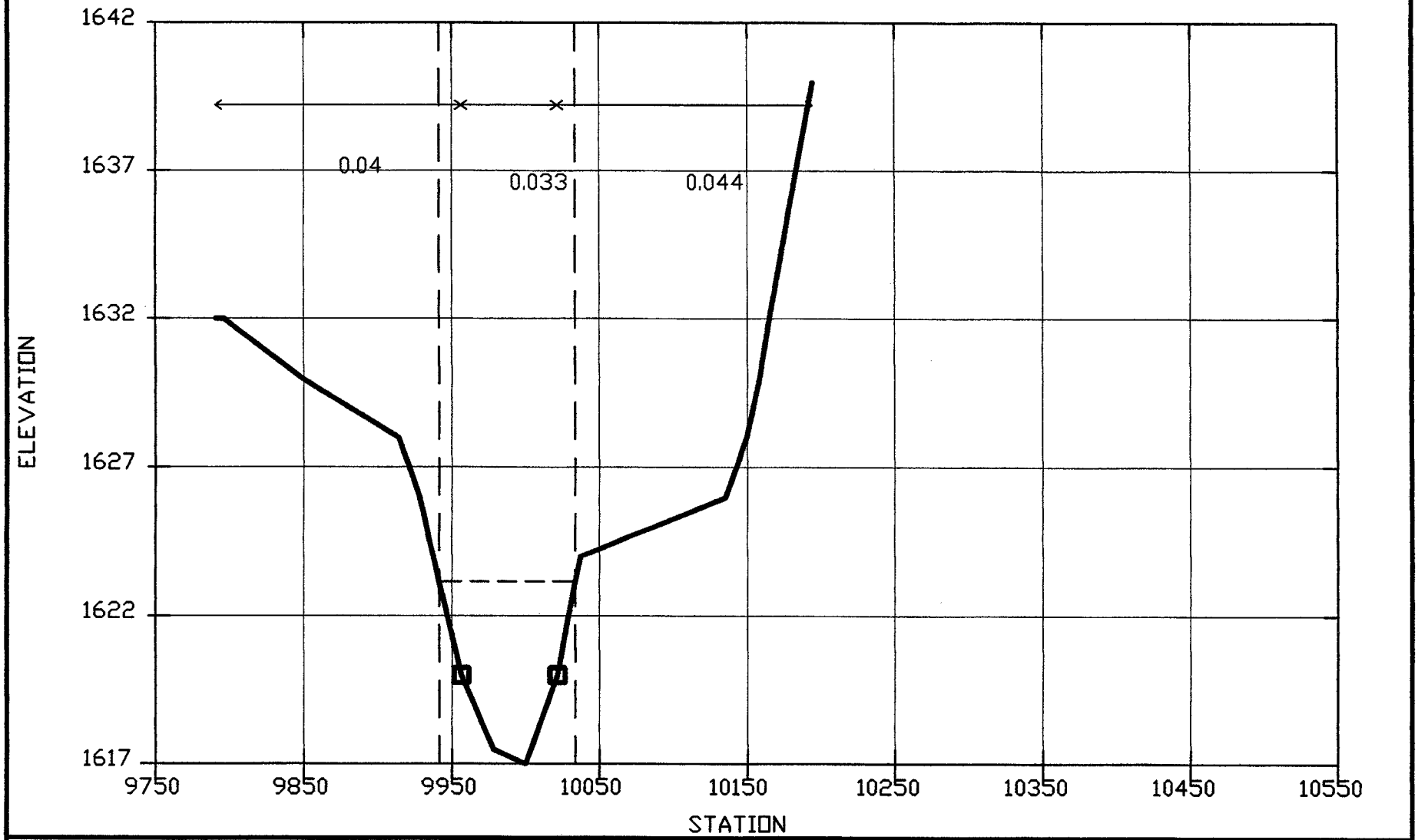


SECTION : 3.67

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

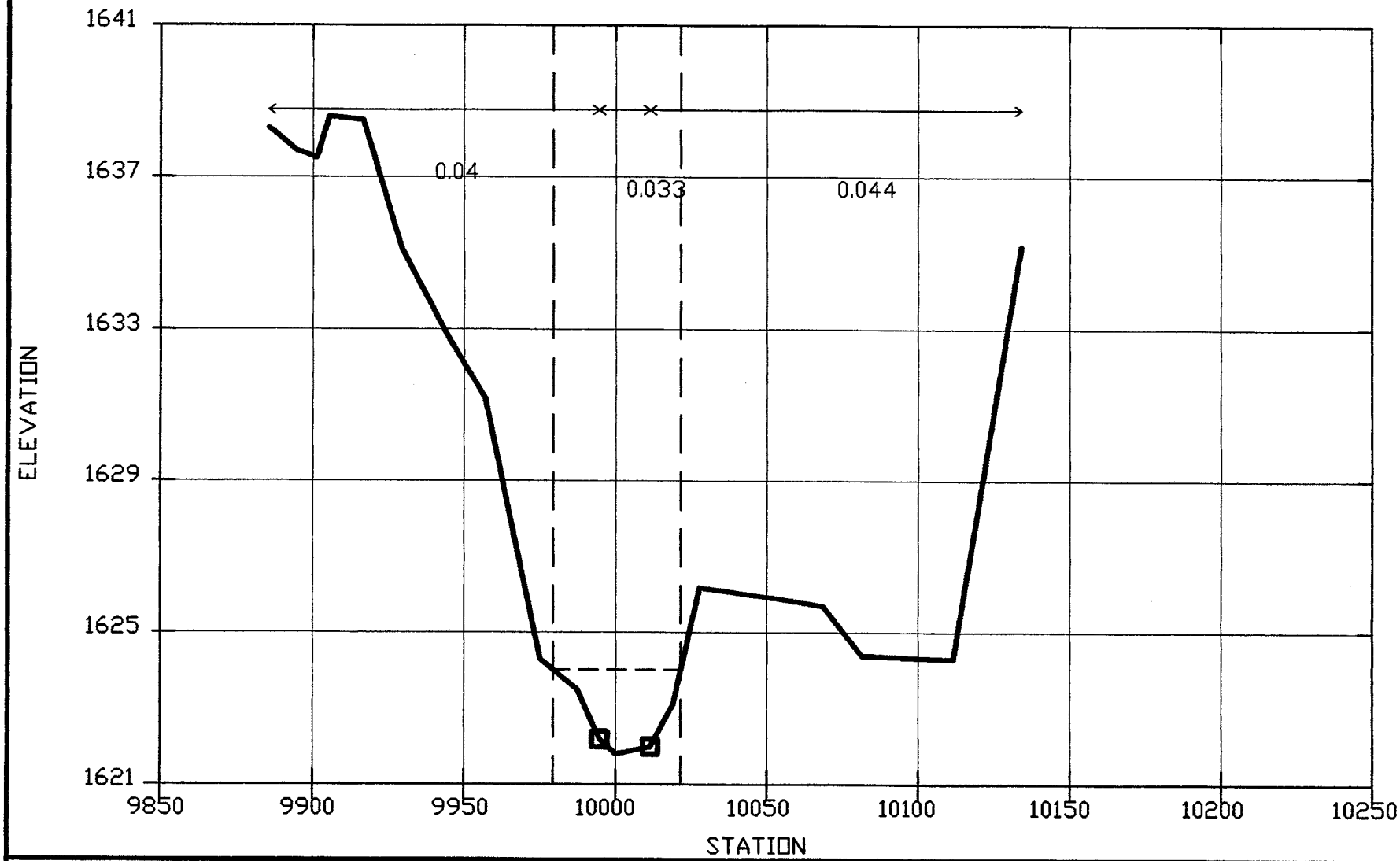


SECTION : 3.68

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

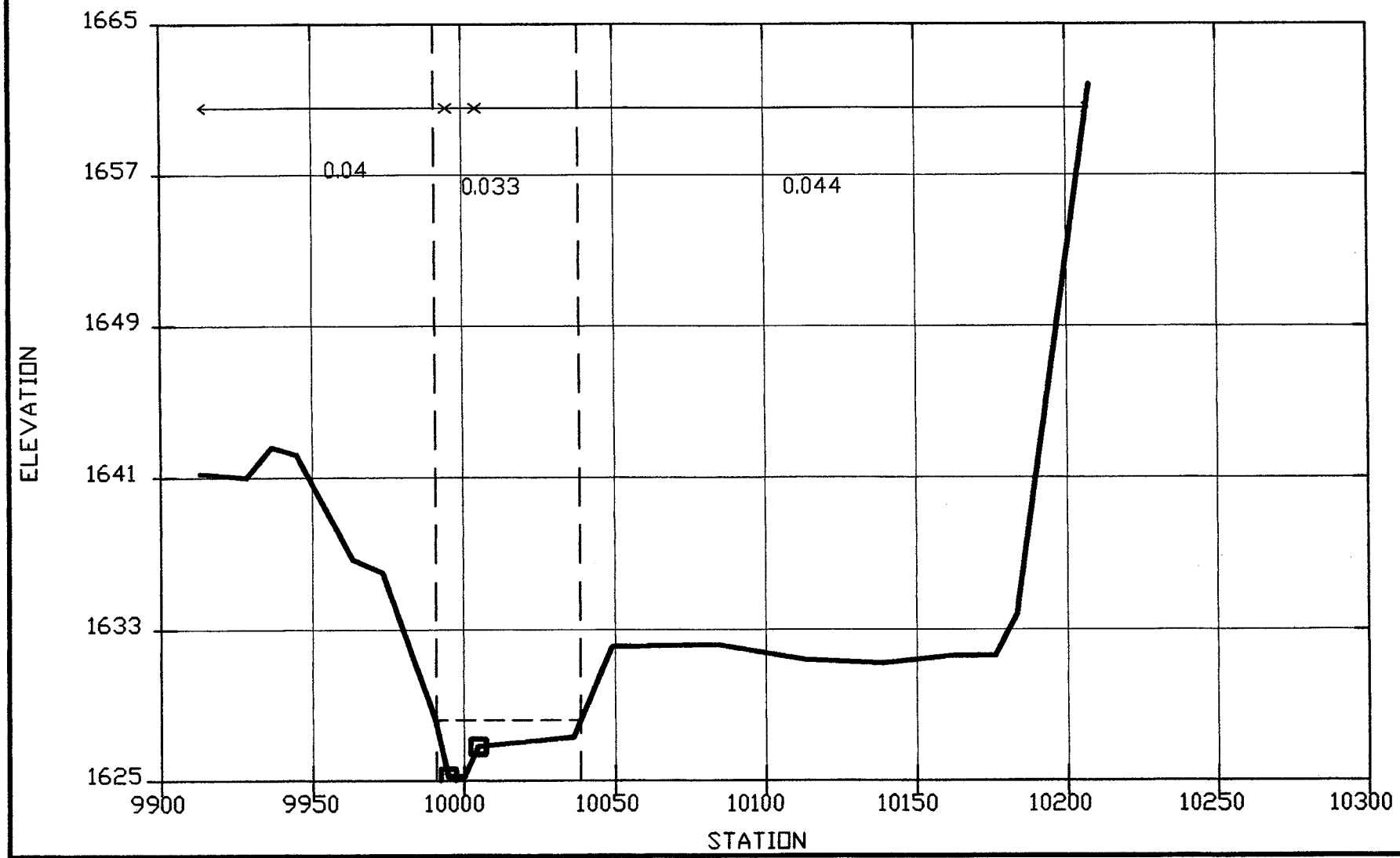


SECTION : 3.77

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

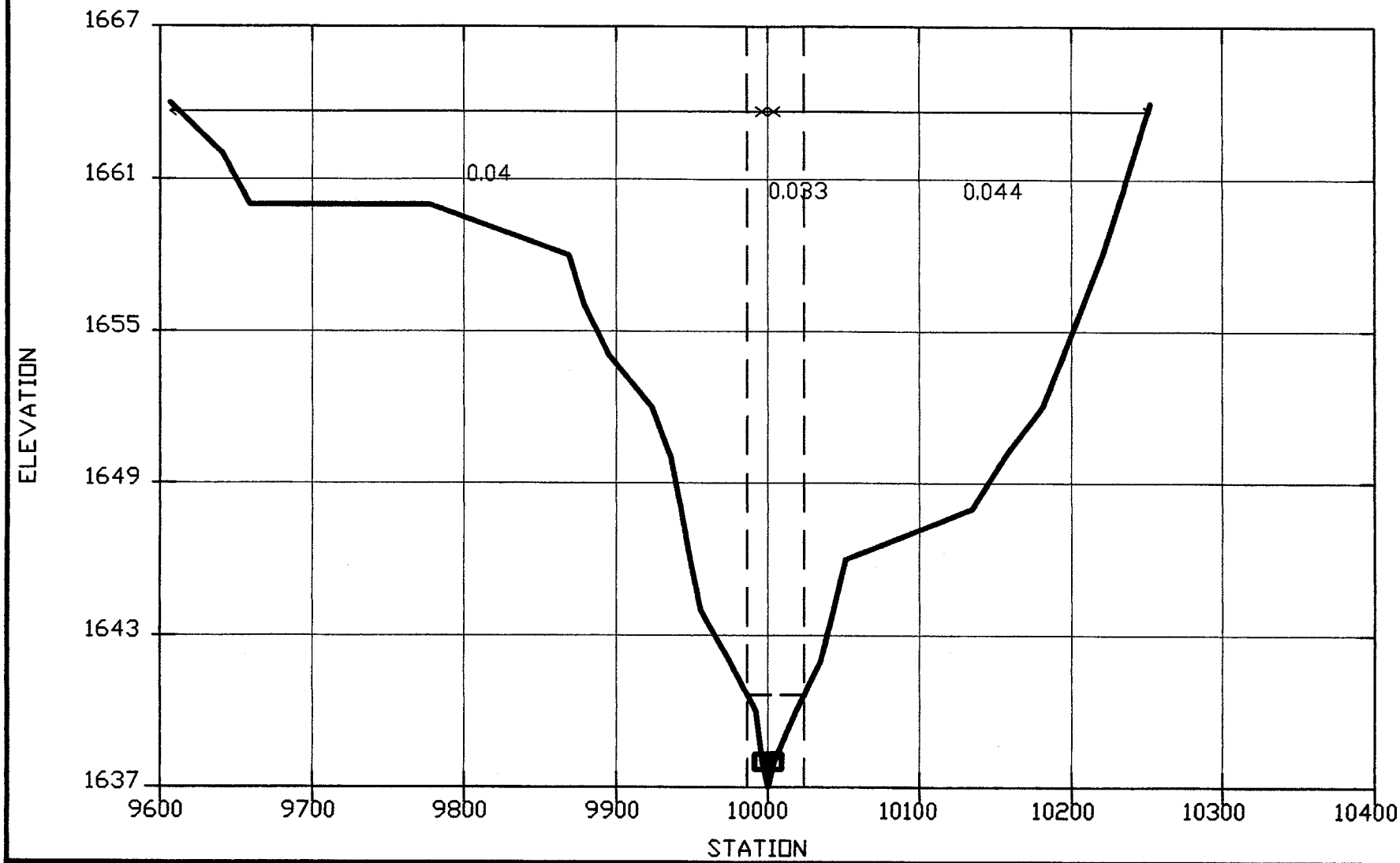


SECTION : 3.83

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

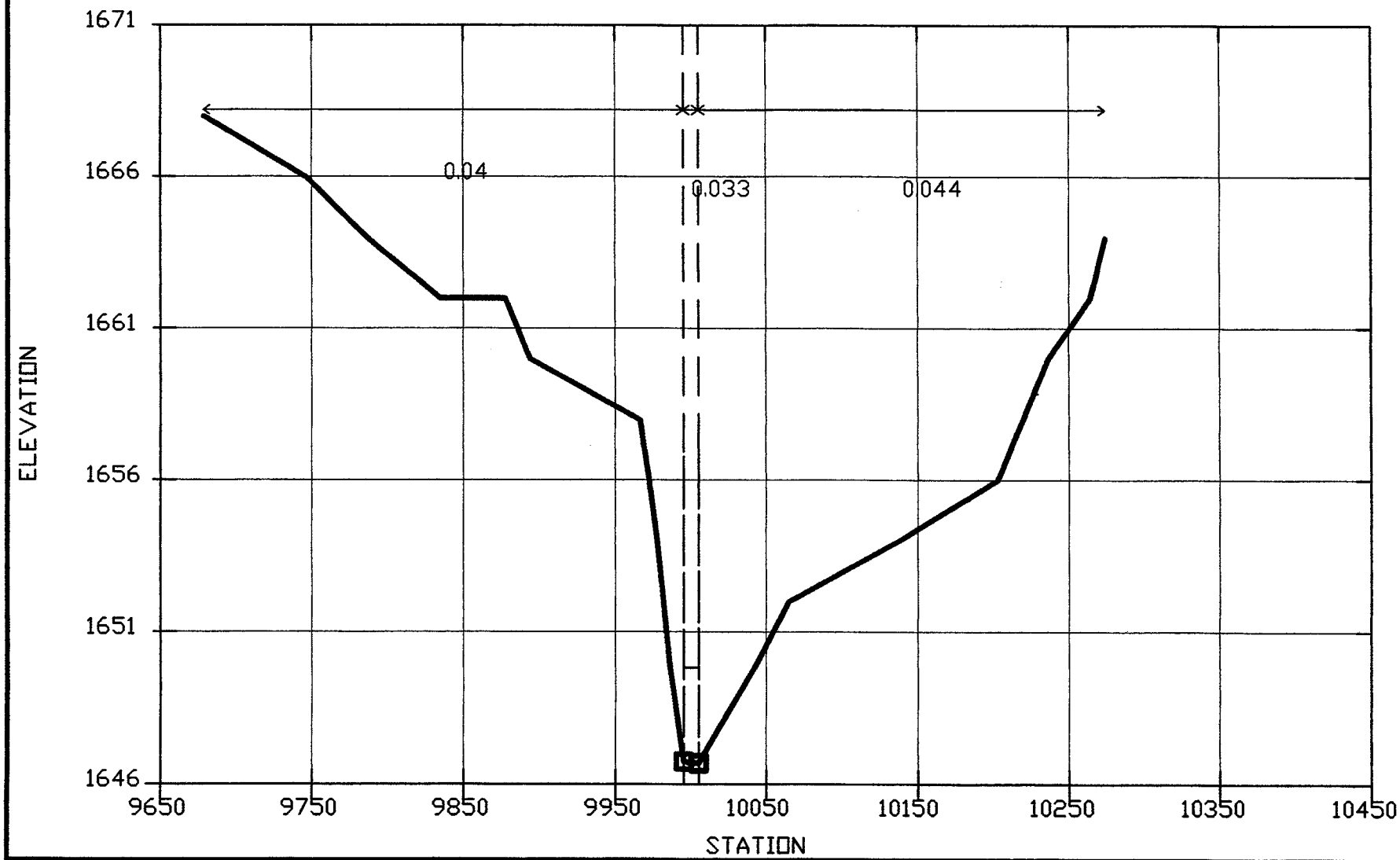


SECTION : 3.90

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

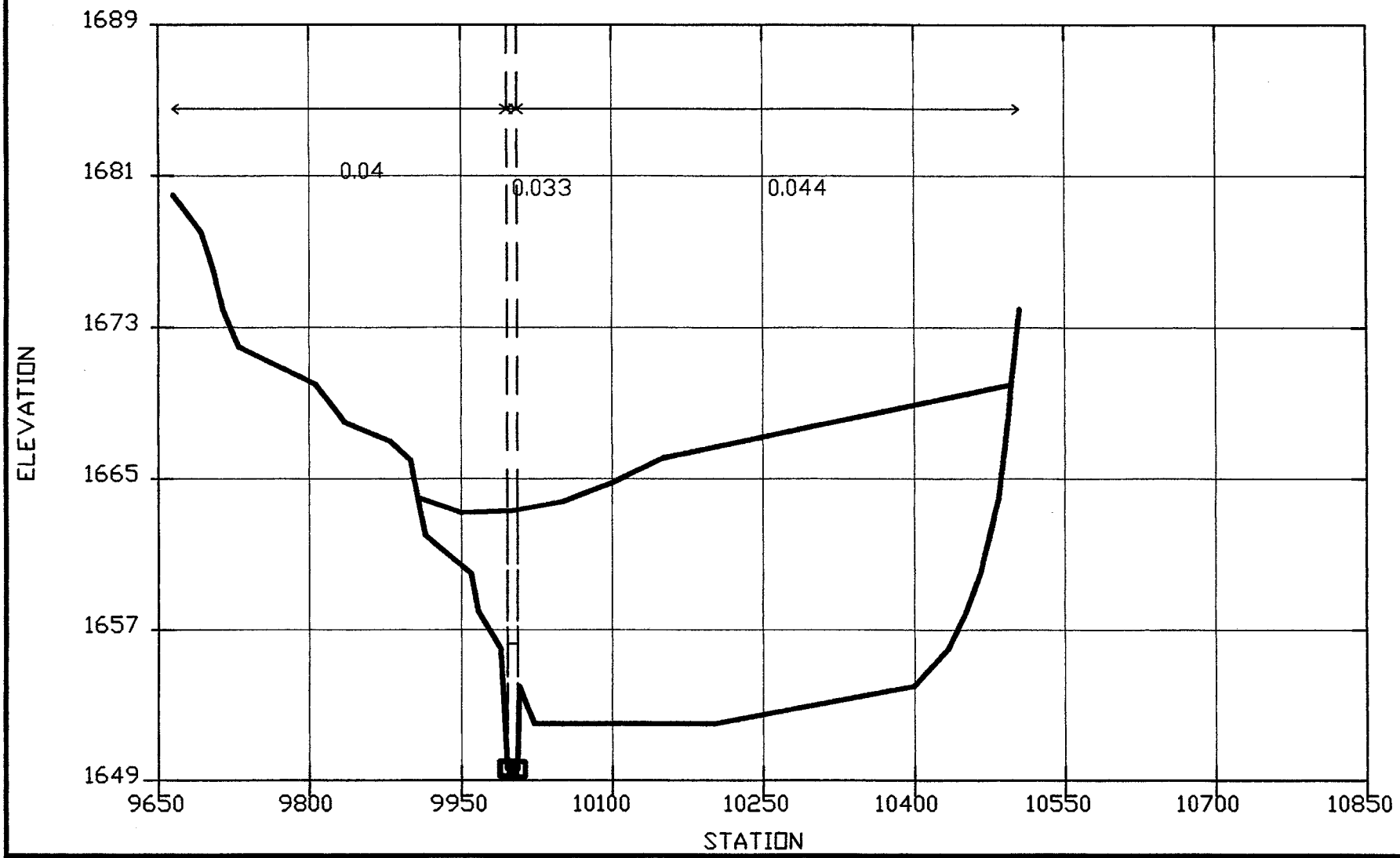


SECTION : 3.92

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

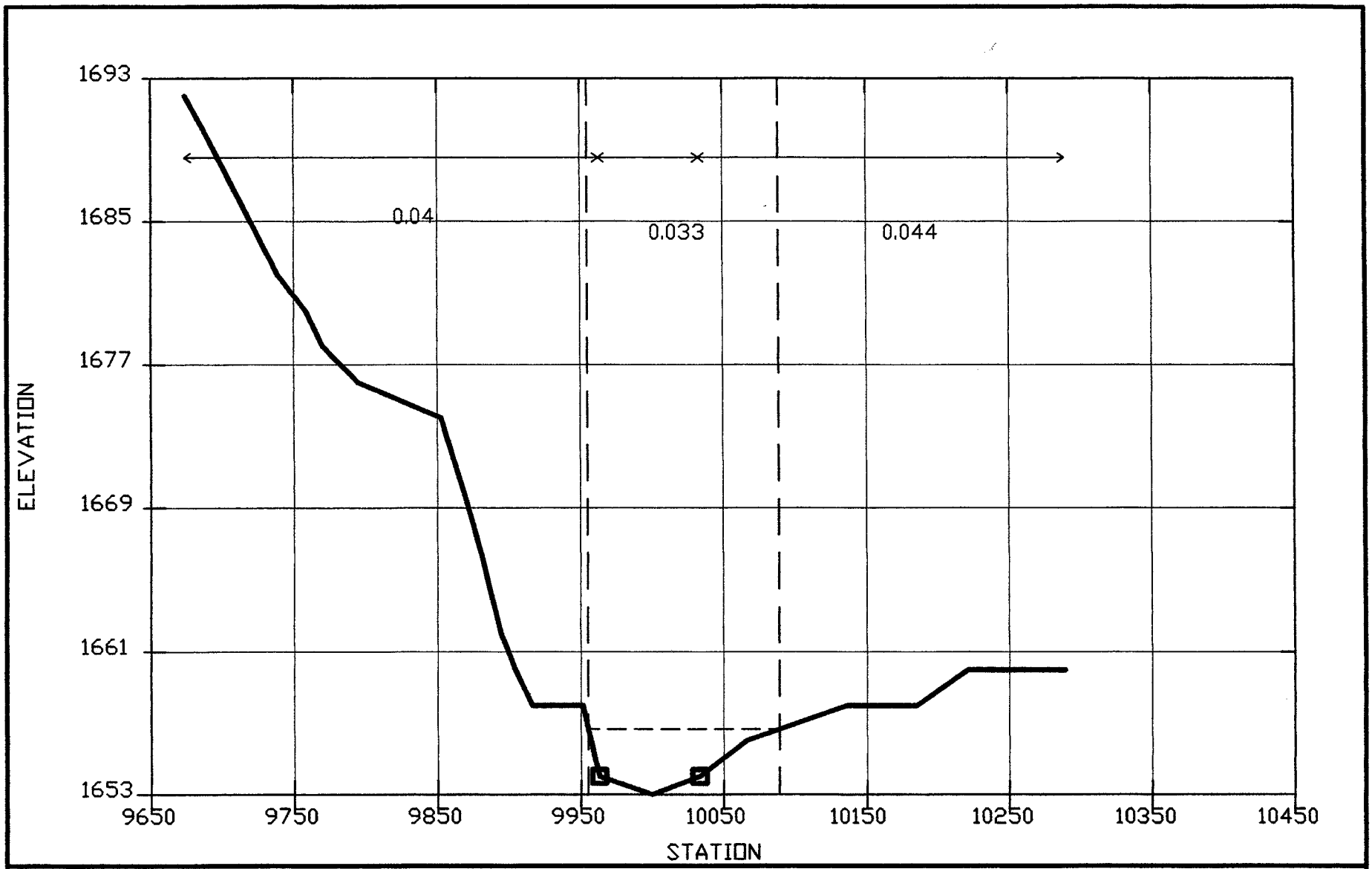


SECTION : 3.95

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

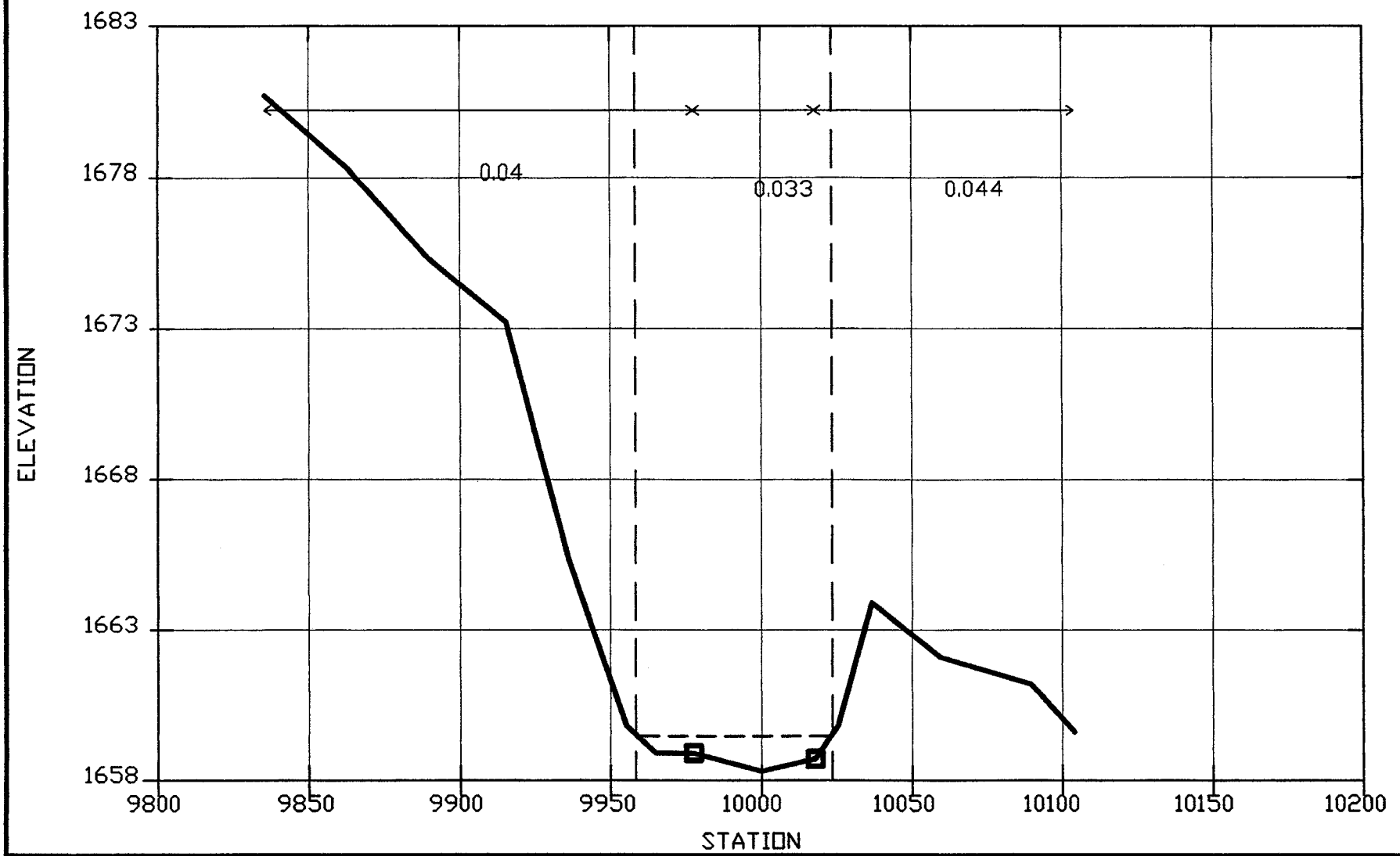


SECTION : 3.98

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

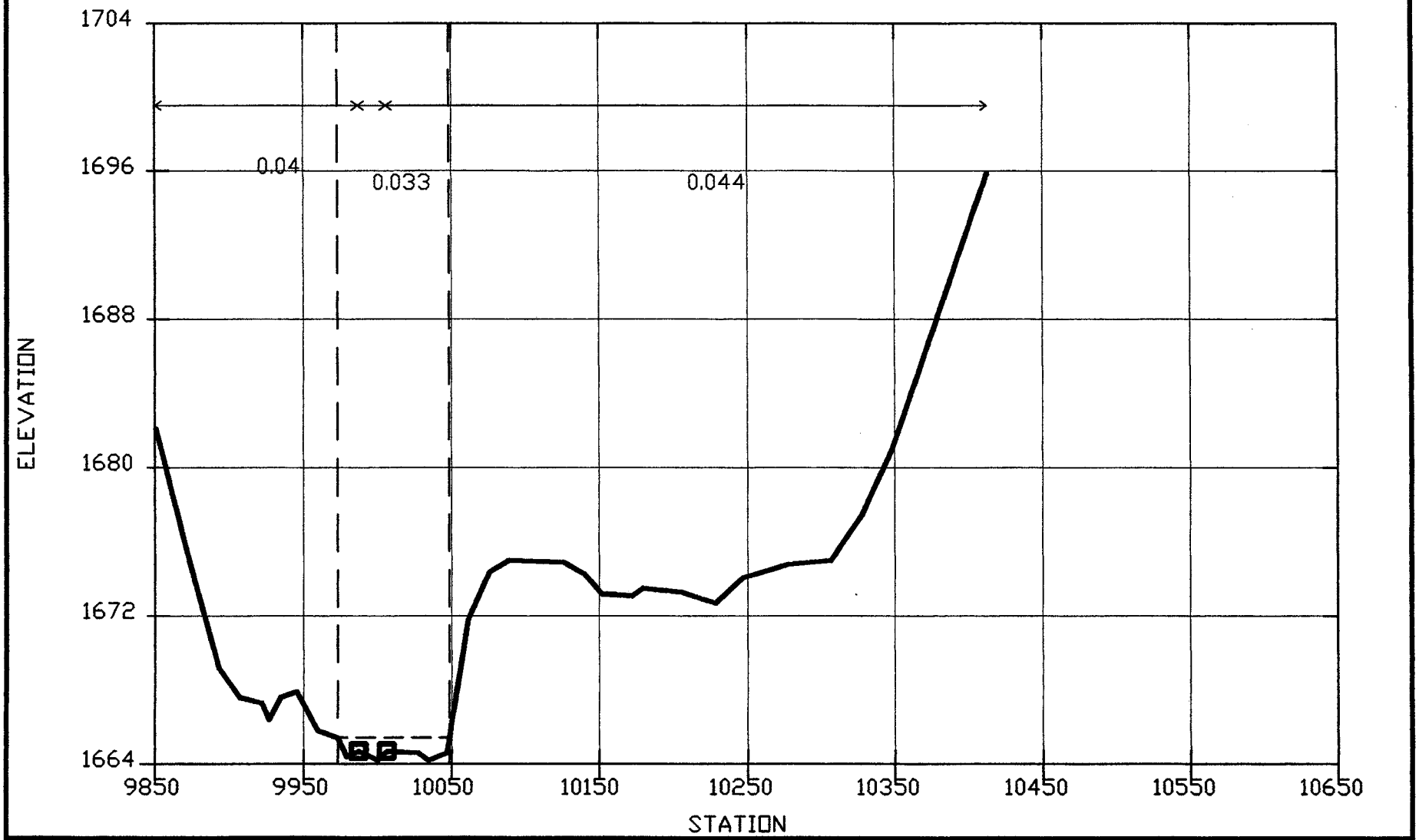


SECTION : 4.05

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

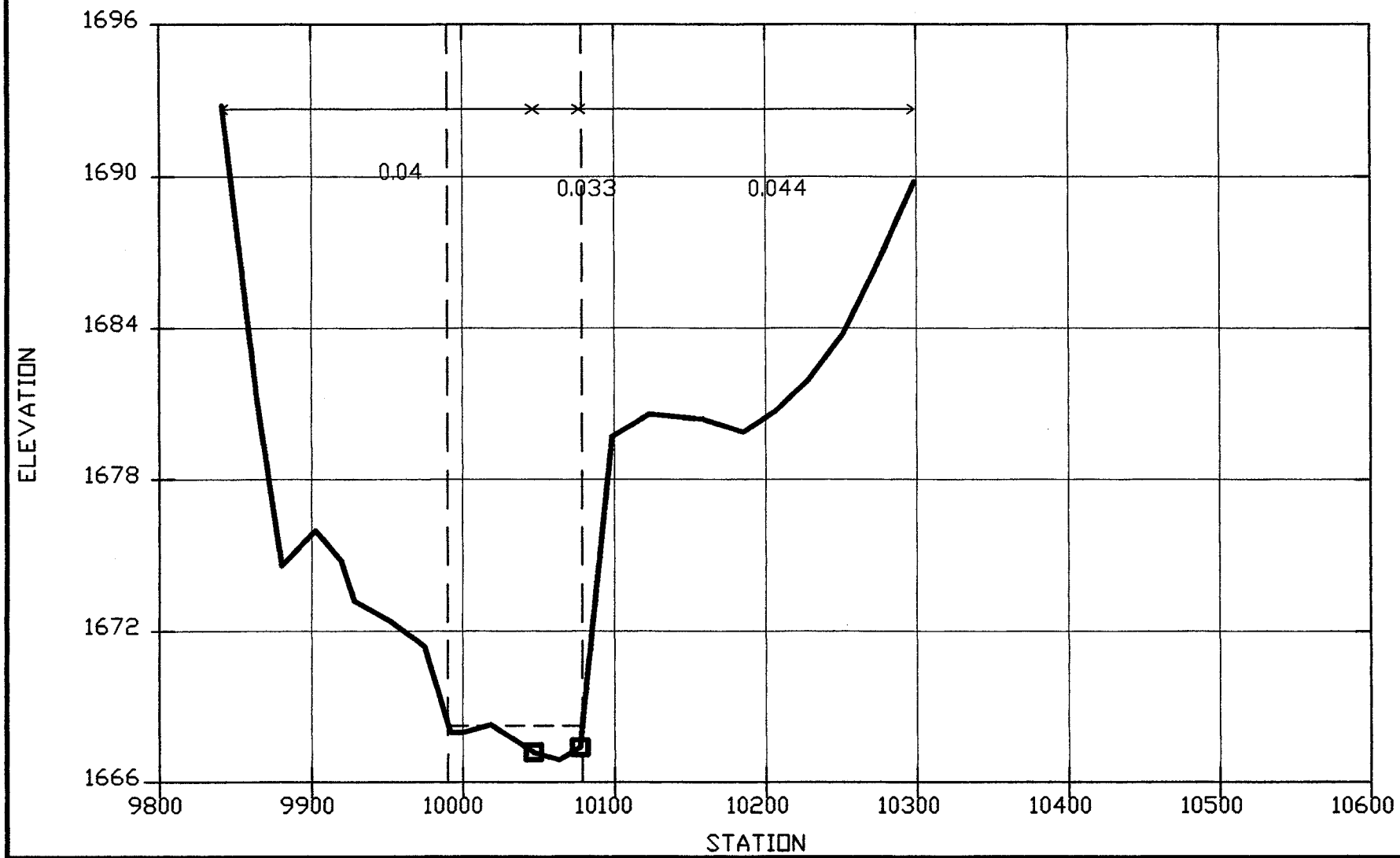


SECTION : 4.15

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

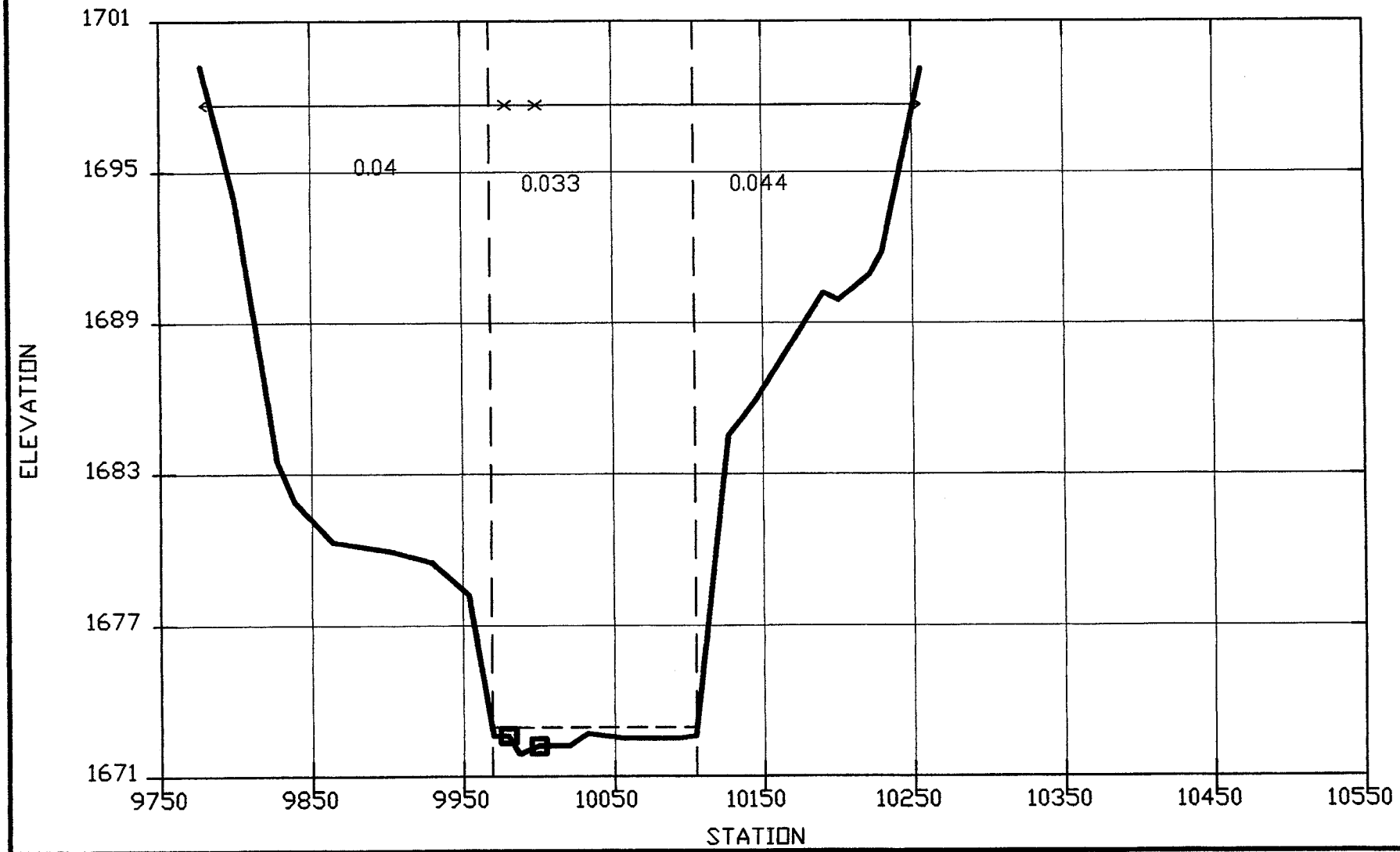


SECTION : 4.20

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

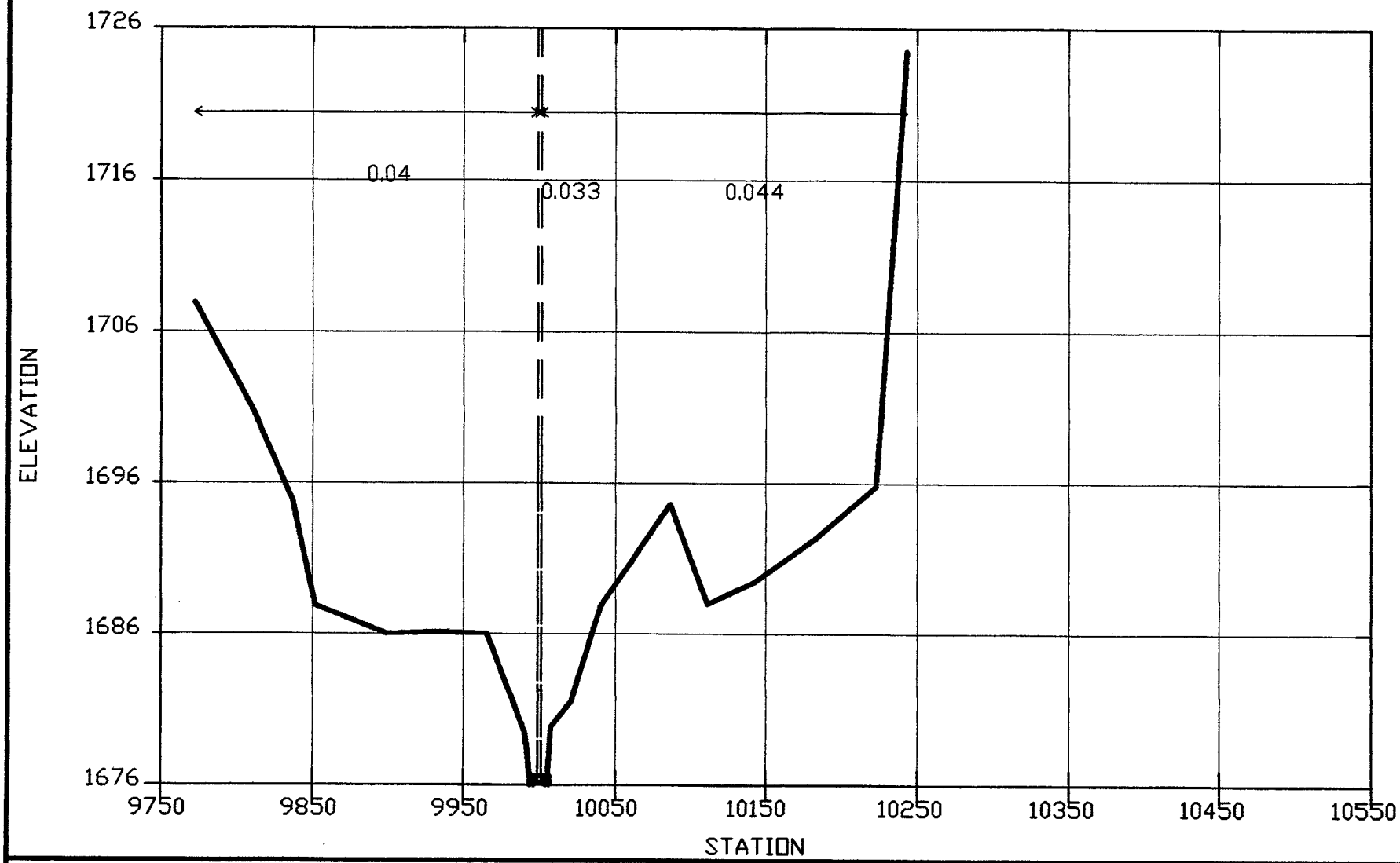


SECTION : 4.24

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

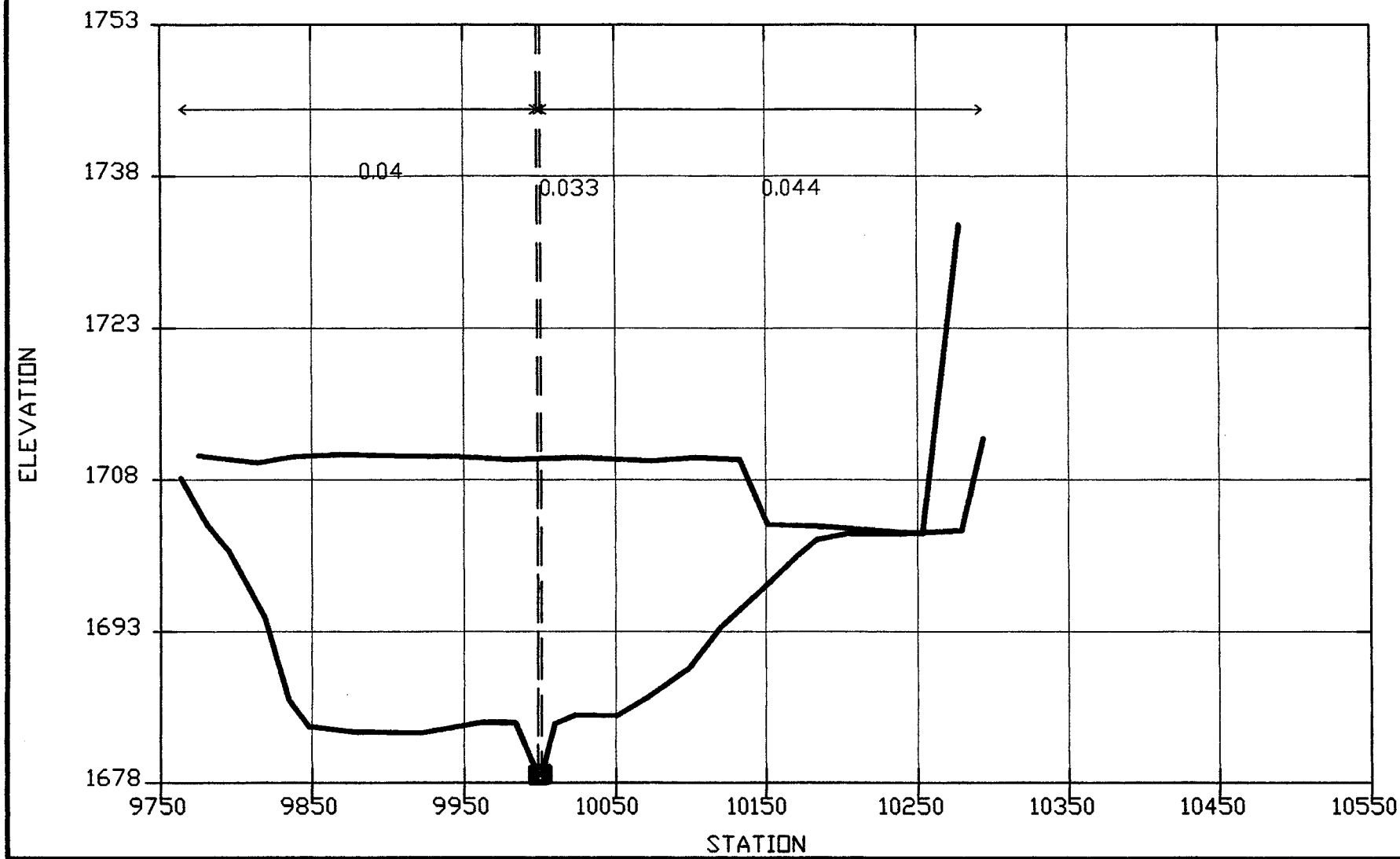


SECTION : 4.29

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

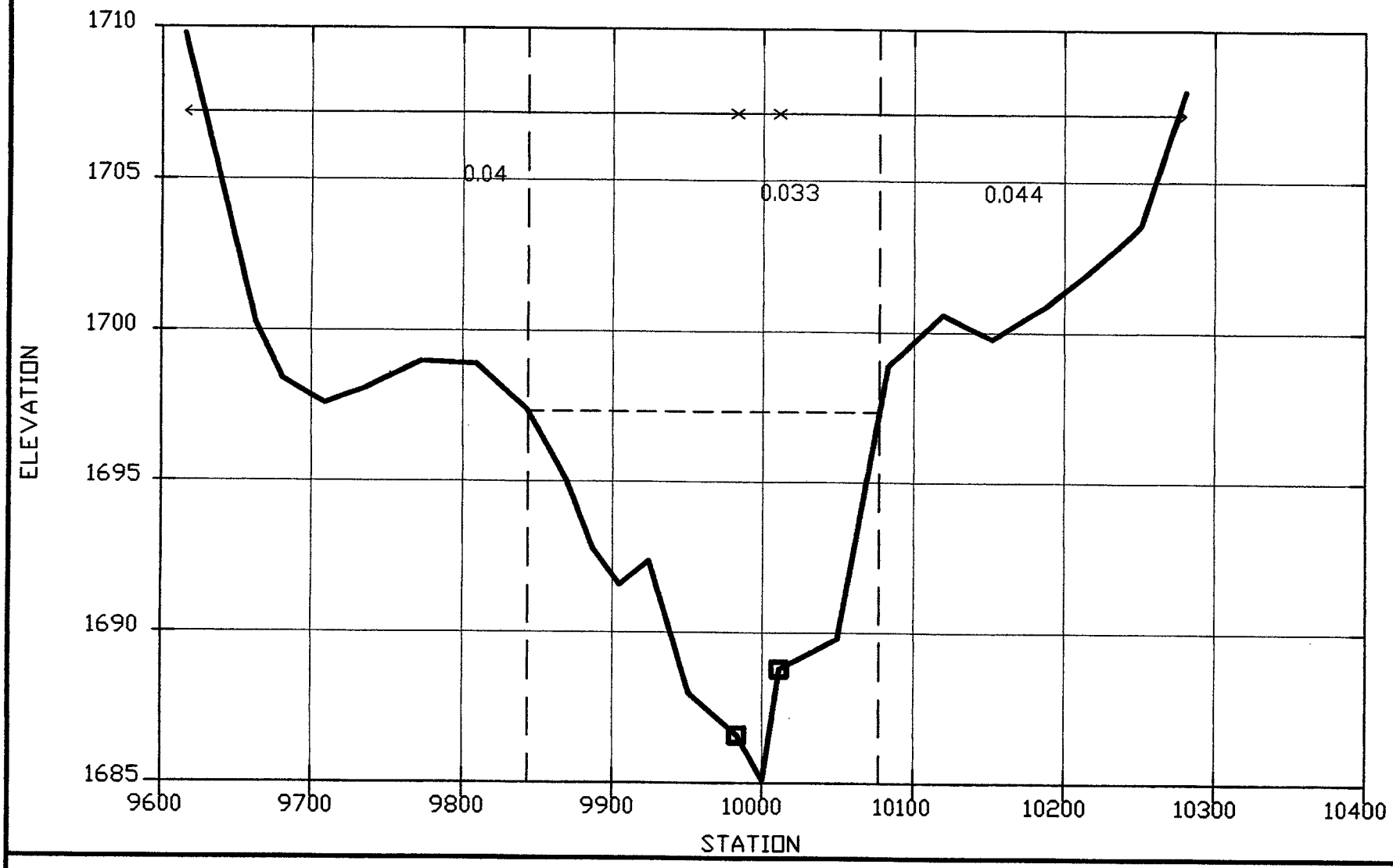


SECTION : 4.32

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

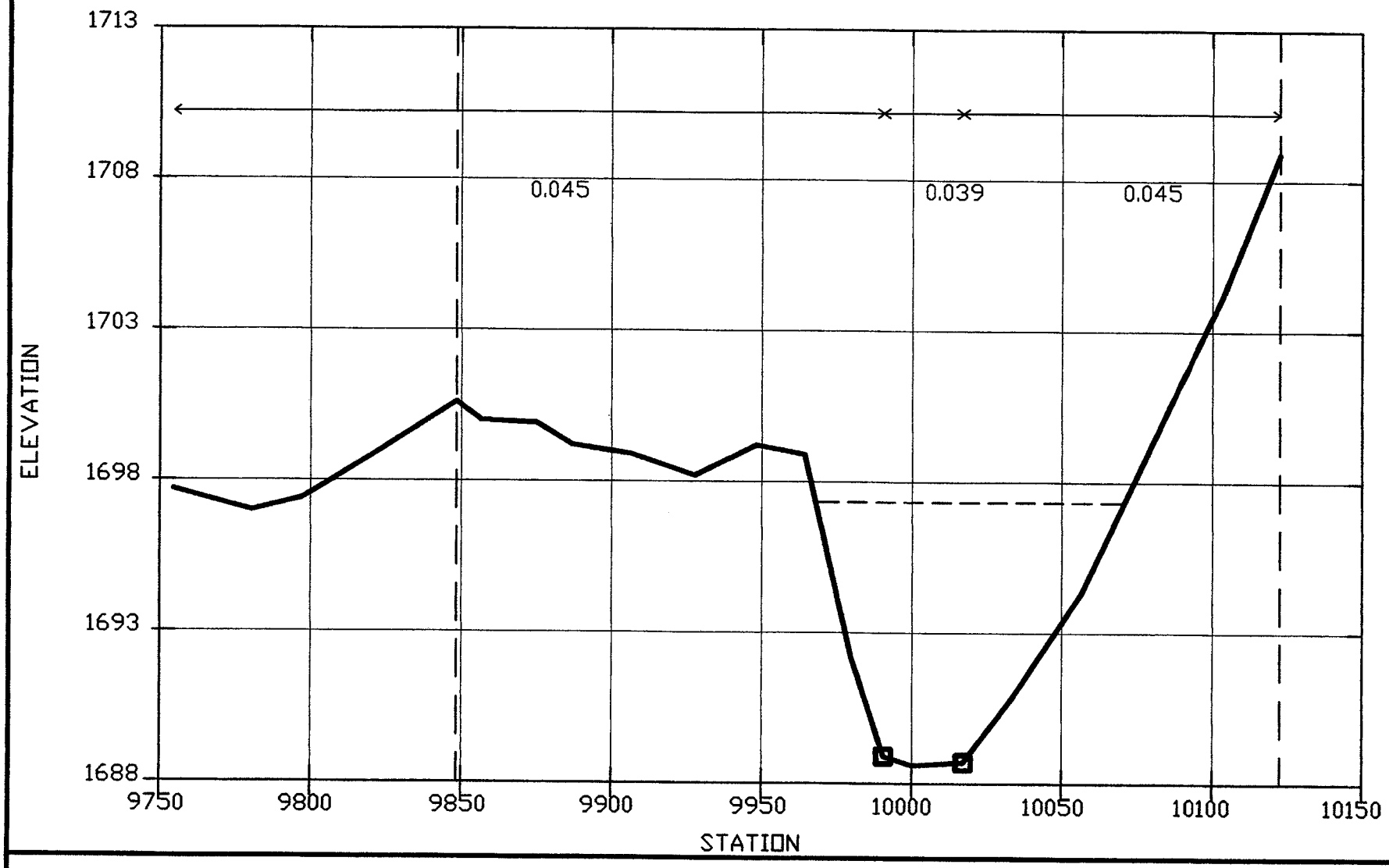


SECTION : 4.37

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

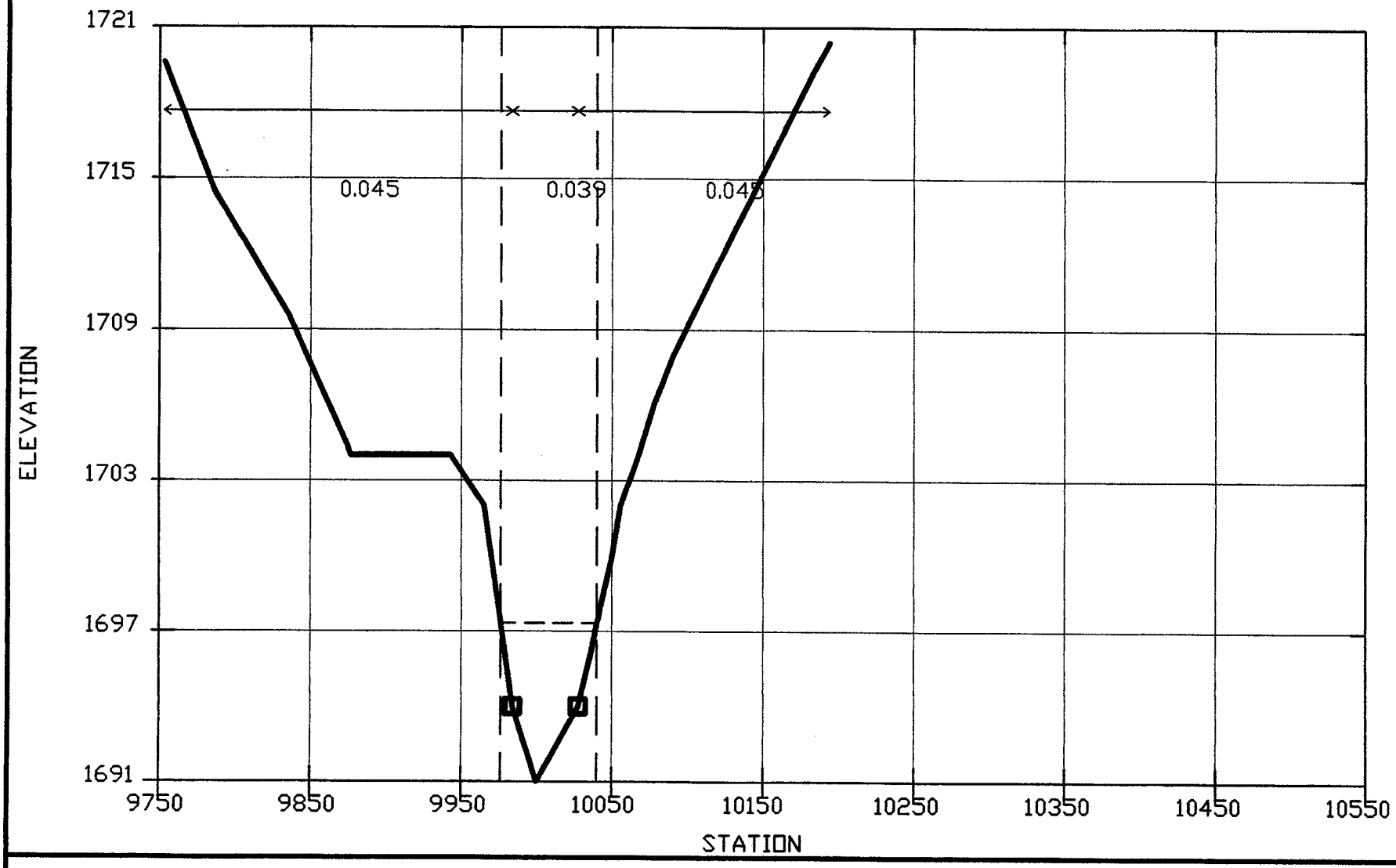


SECTION : 4.41

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

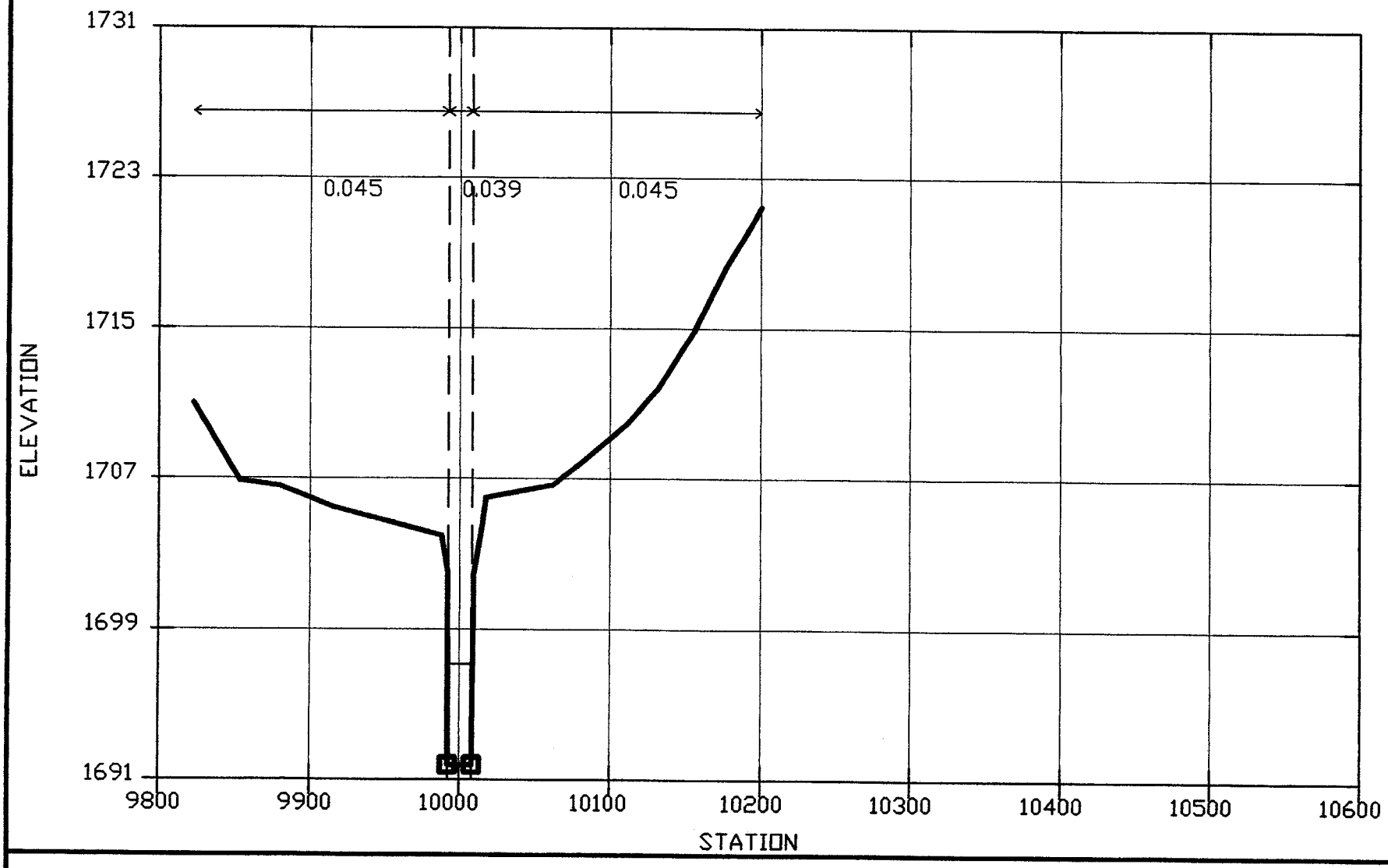


SECTION : 4.44

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

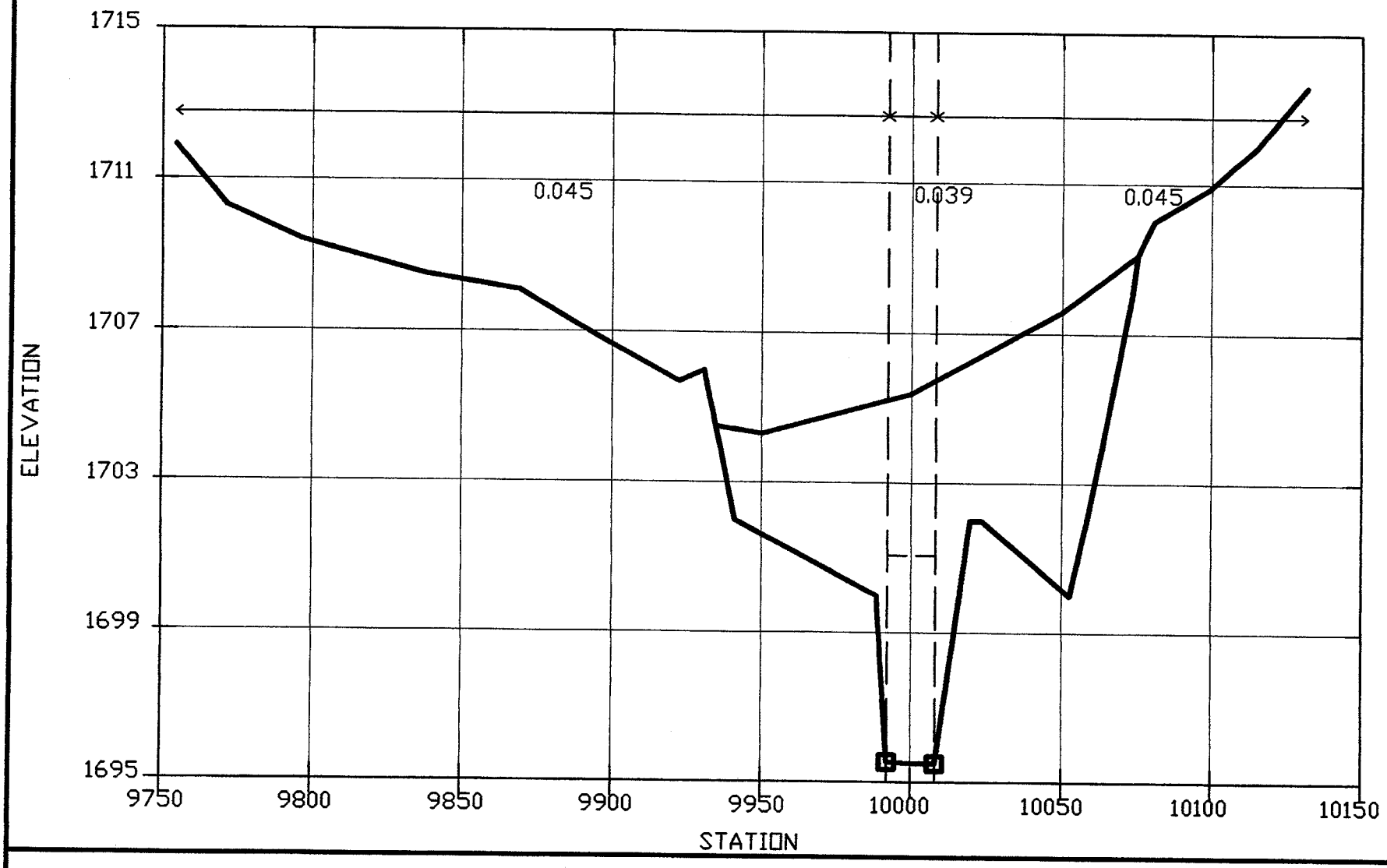


SECTION : 4.45

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

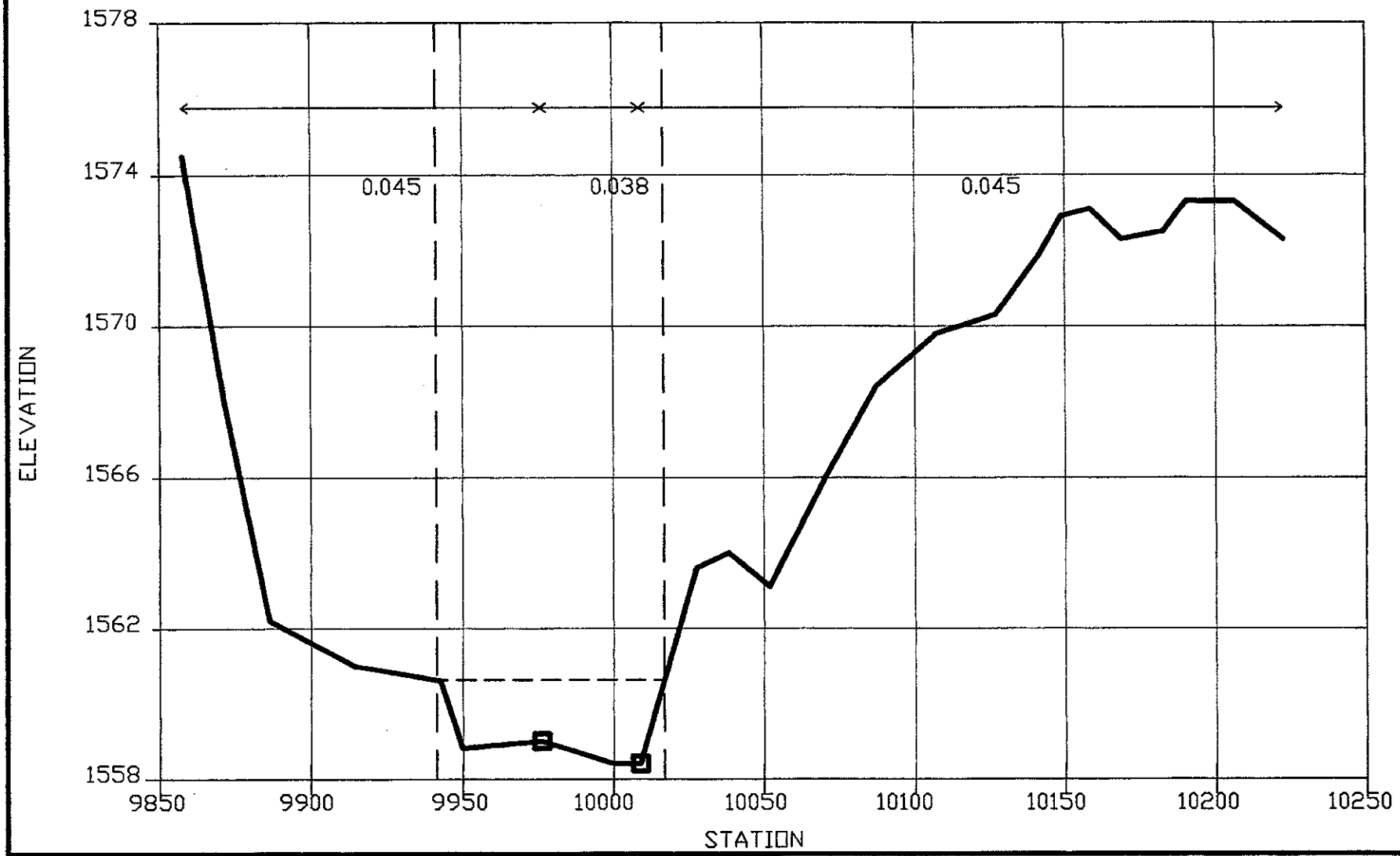


SECTION : 4.47

Fountain Hills (south) FIS

Colony Wash

File: COL-XSEC.DWG

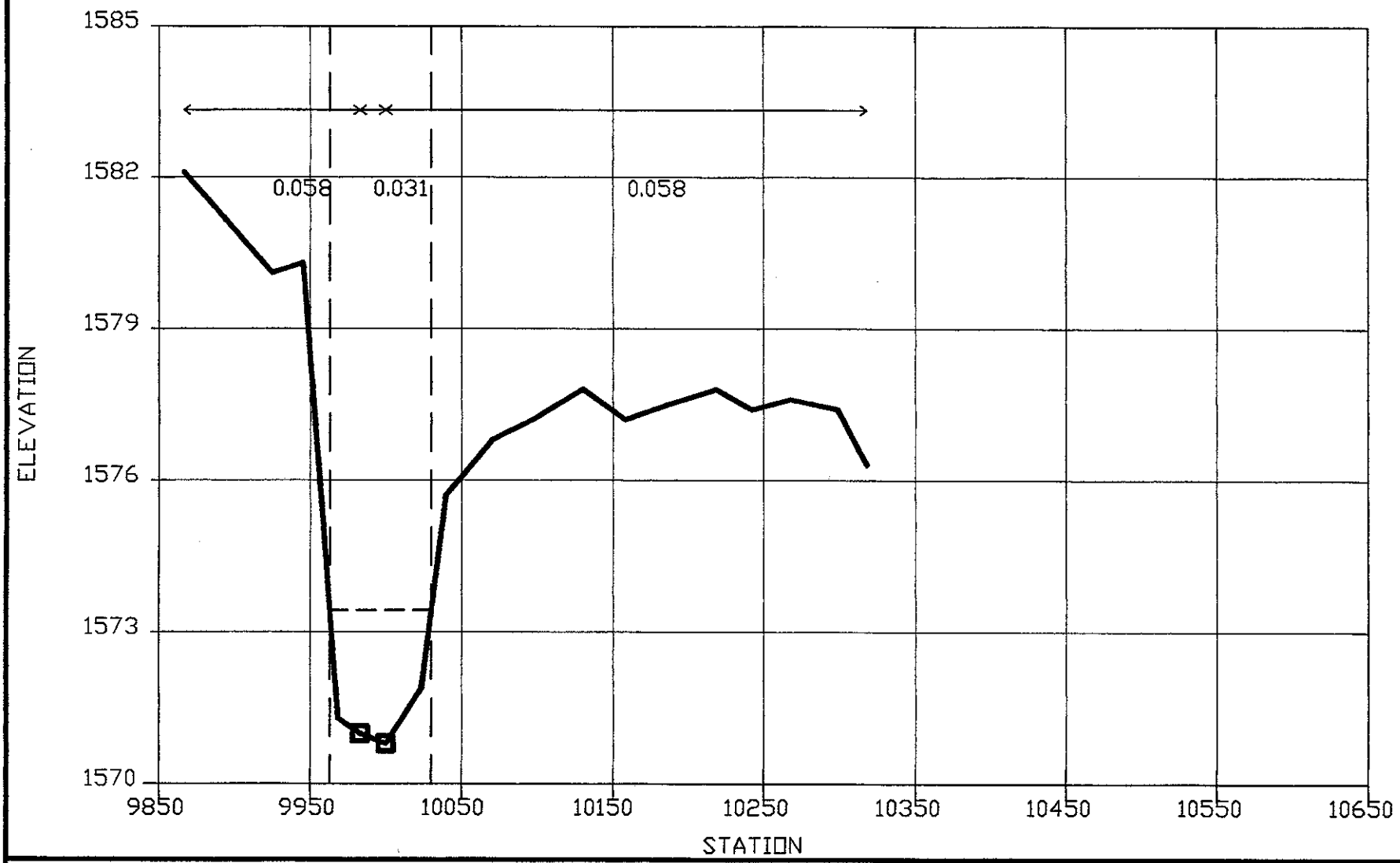


SECTION : 0.00

Fountain Hills (south) FIS

Fountain Channel

File: FOC-XSEC.DWG

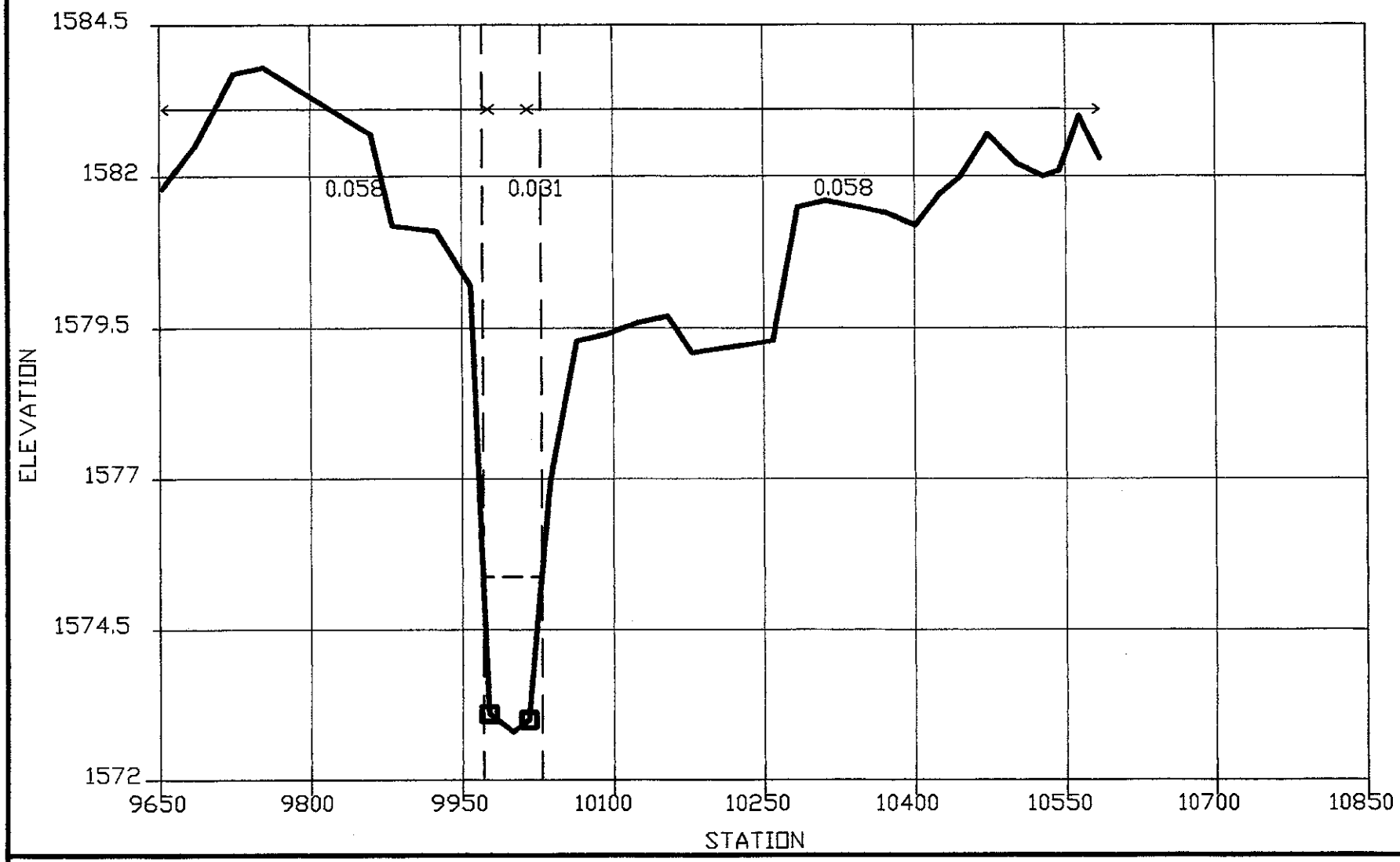


SECTION : 0.08

Fountain Hills (south) FIS

Fountain Channel

File: FOC-XSEC.DWG

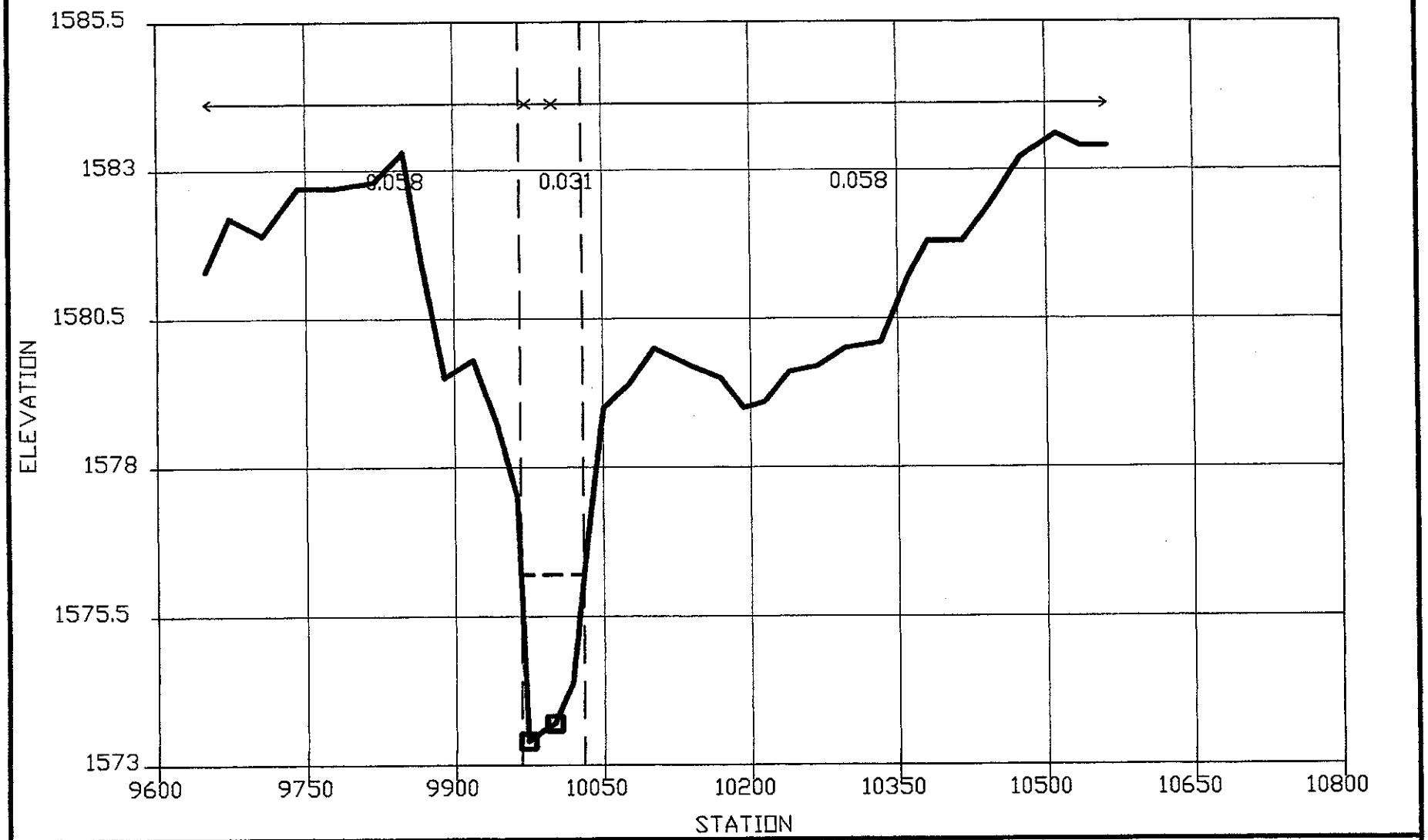


SECTION : 0.11

Fountain Hills (south) FIS

Fountain Channel

File: FOC-XSEC.DWG

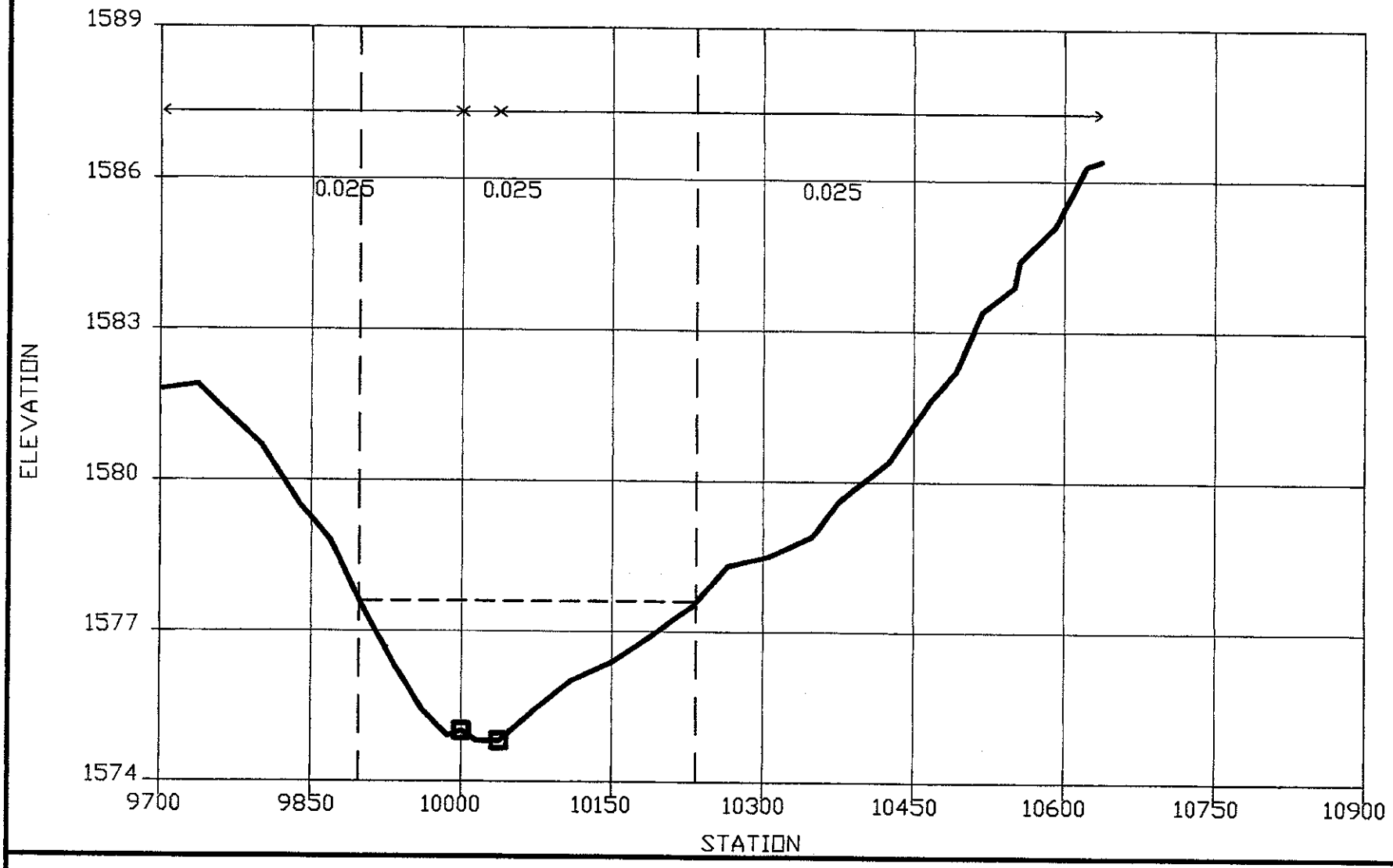


SECTION : 0.12

Fountain Hills (south) FIS

Fountain Channel

File: FOC-XSEC.DWG

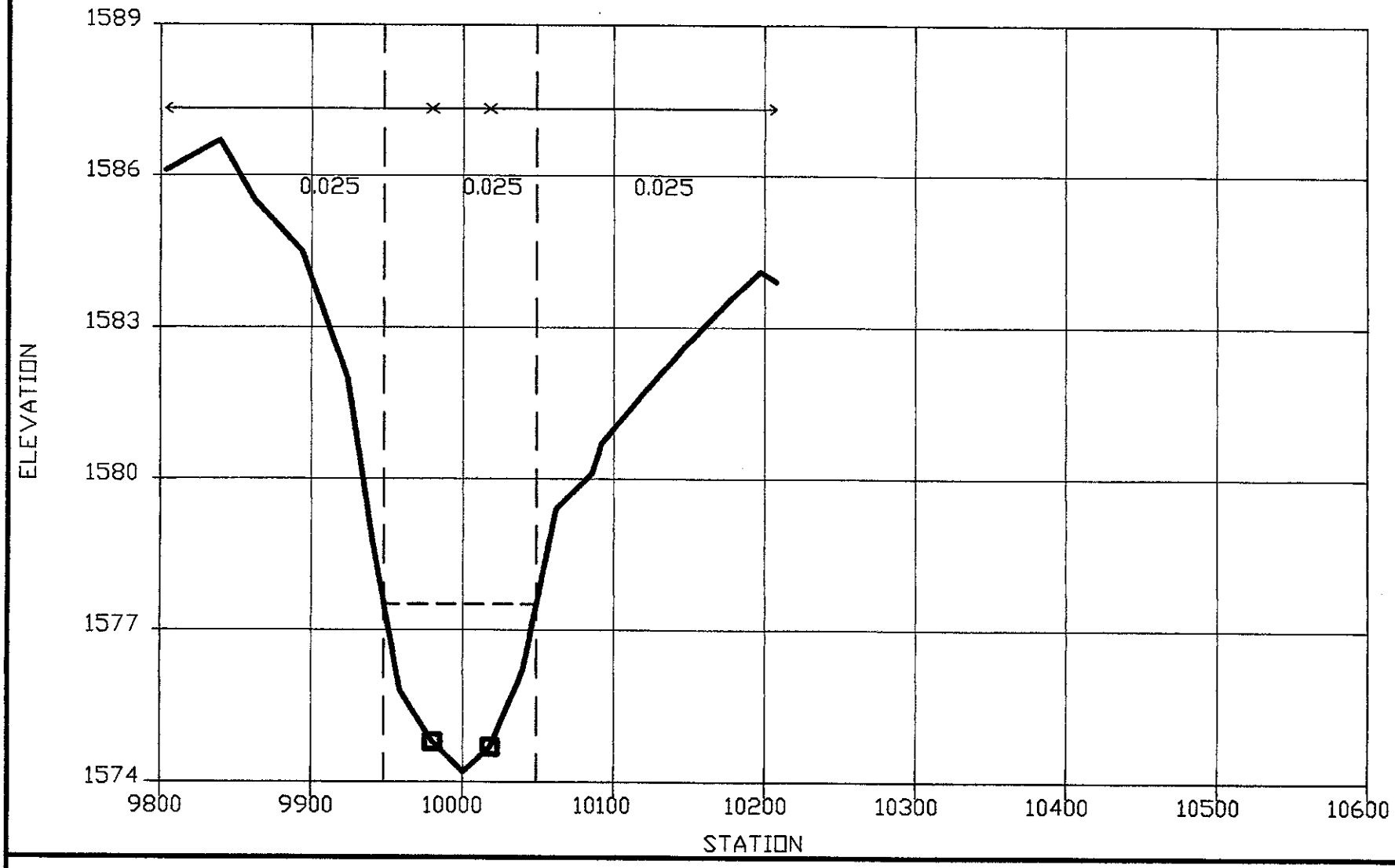


SECTION : 0.13

Fountain Hills (south) FIS

Fountain Channel

File: FOC-XSEC.DWG

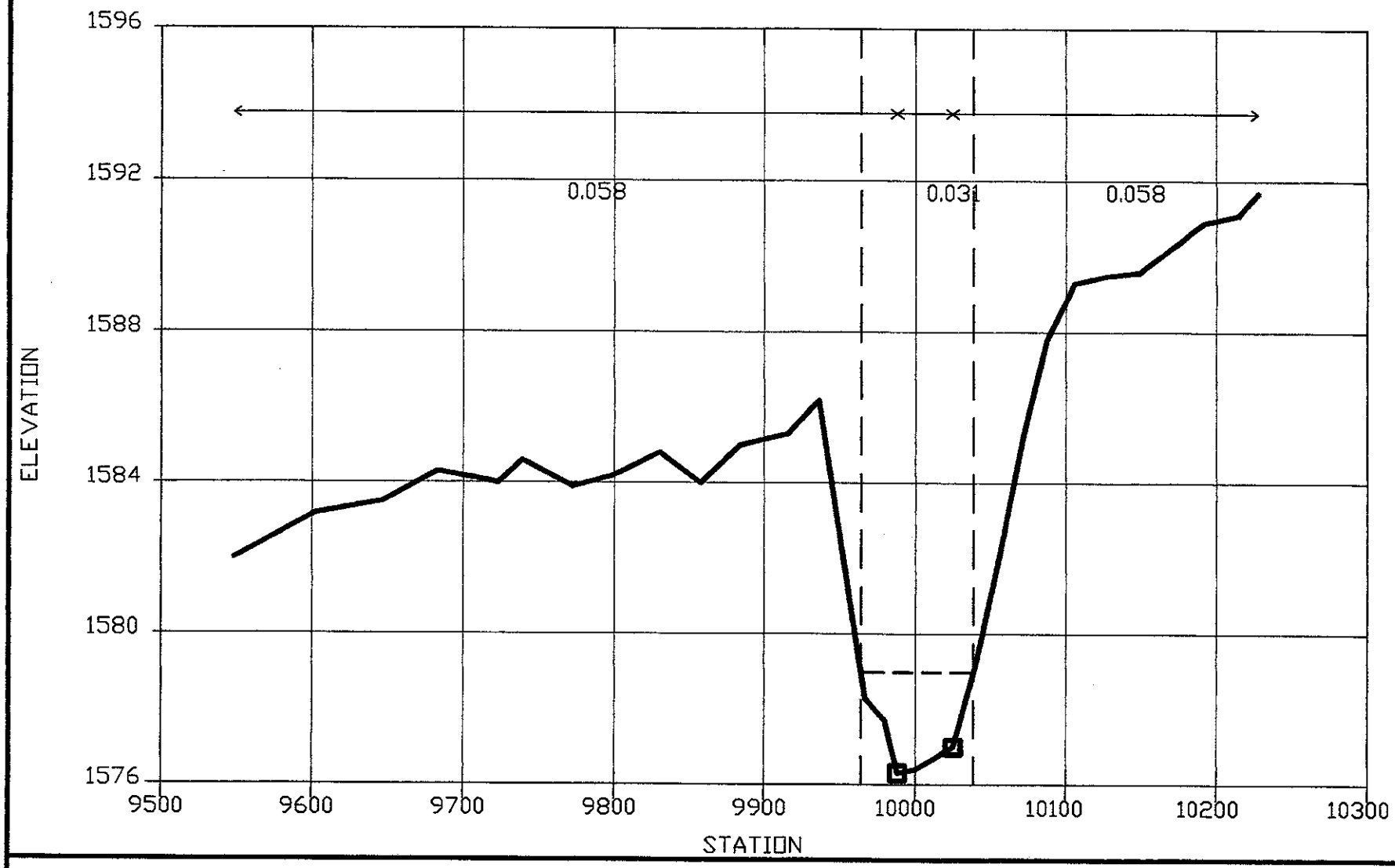


SECTION : 0.14

Fountain Hills (south) FIS

Fountain Channel

File: FOC-XSEC.DWG

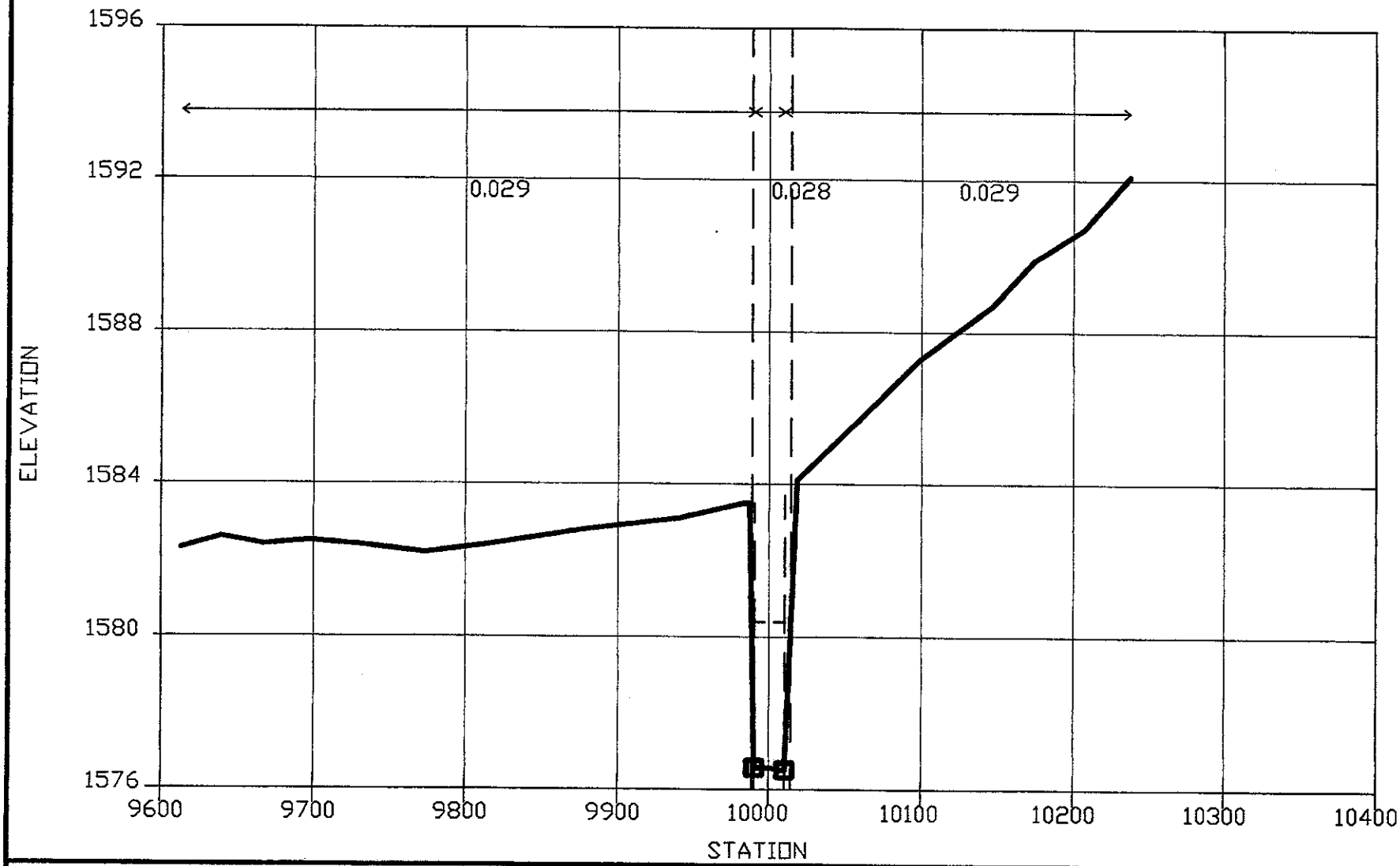


SECTION : 0.20

Fountain Hills (south) FIS

Fountain Channel

File: FOC-XSEC.DWG

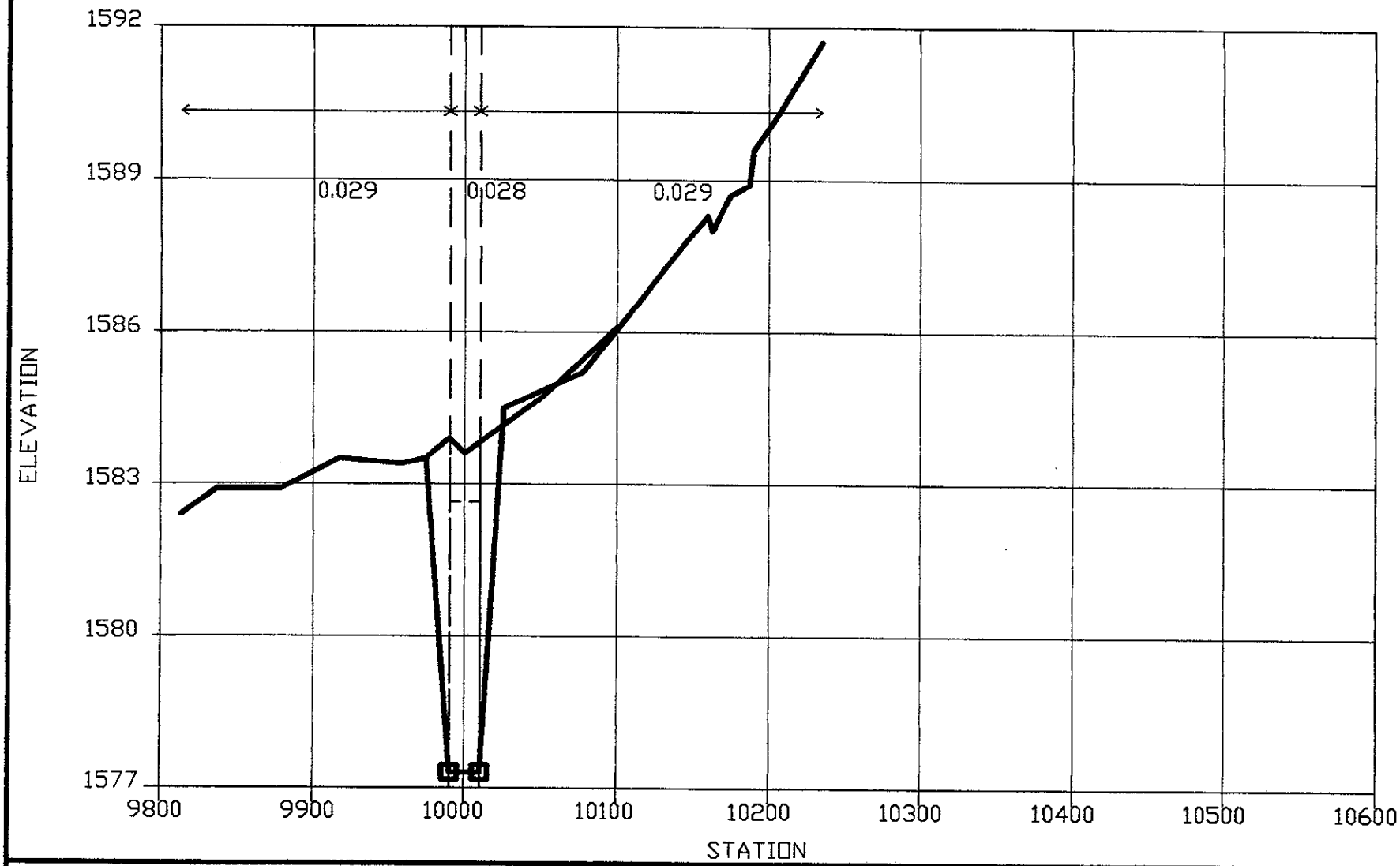


SECTION : 0.21

Fountain Hills (south) FIS

Fountain Channel

File: FOC-XSEC.DWG

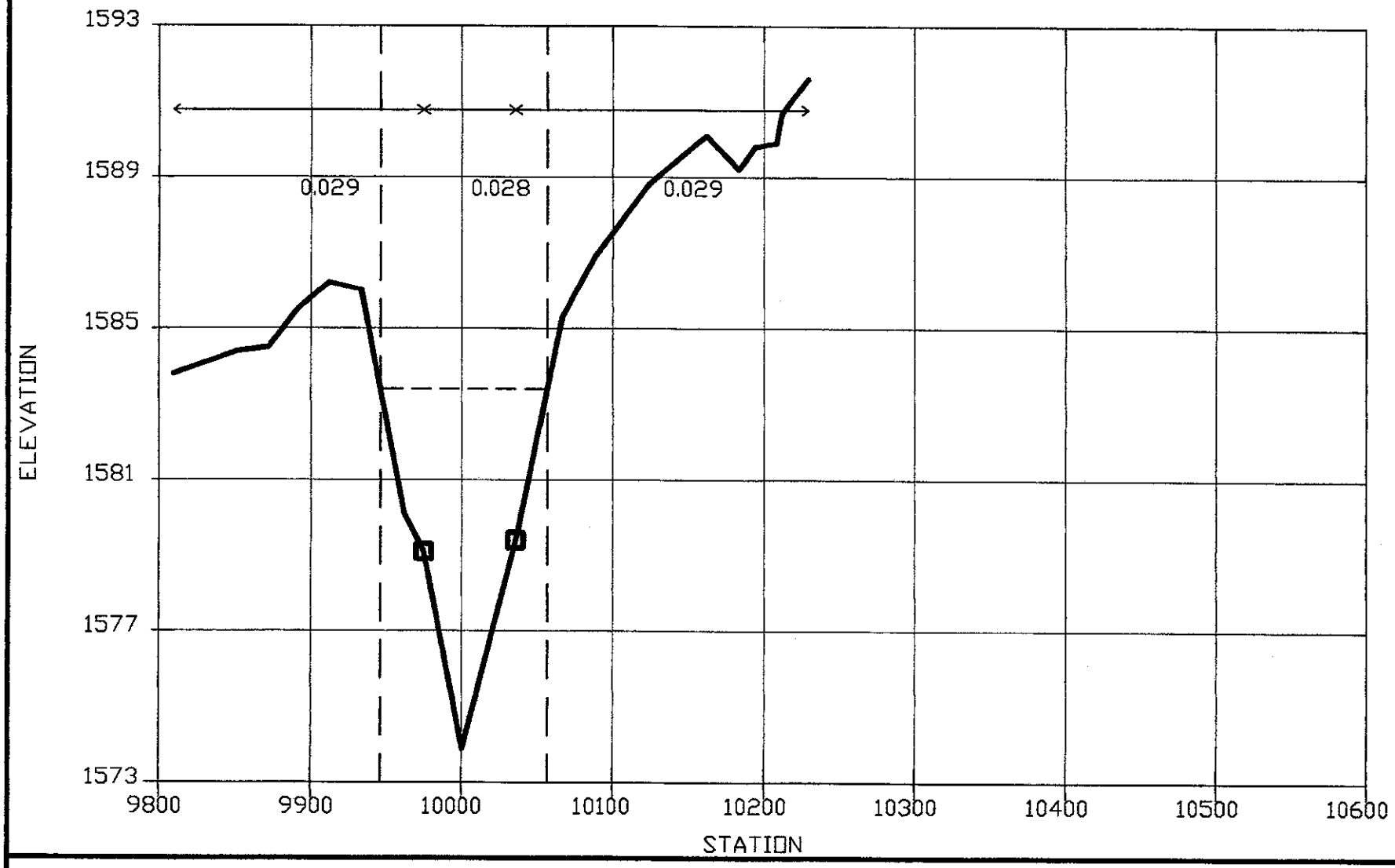


SECTION : 0.23

Fountain Hills (south) FIS

Fountain Channel

File: FOC-XSEC.DWG

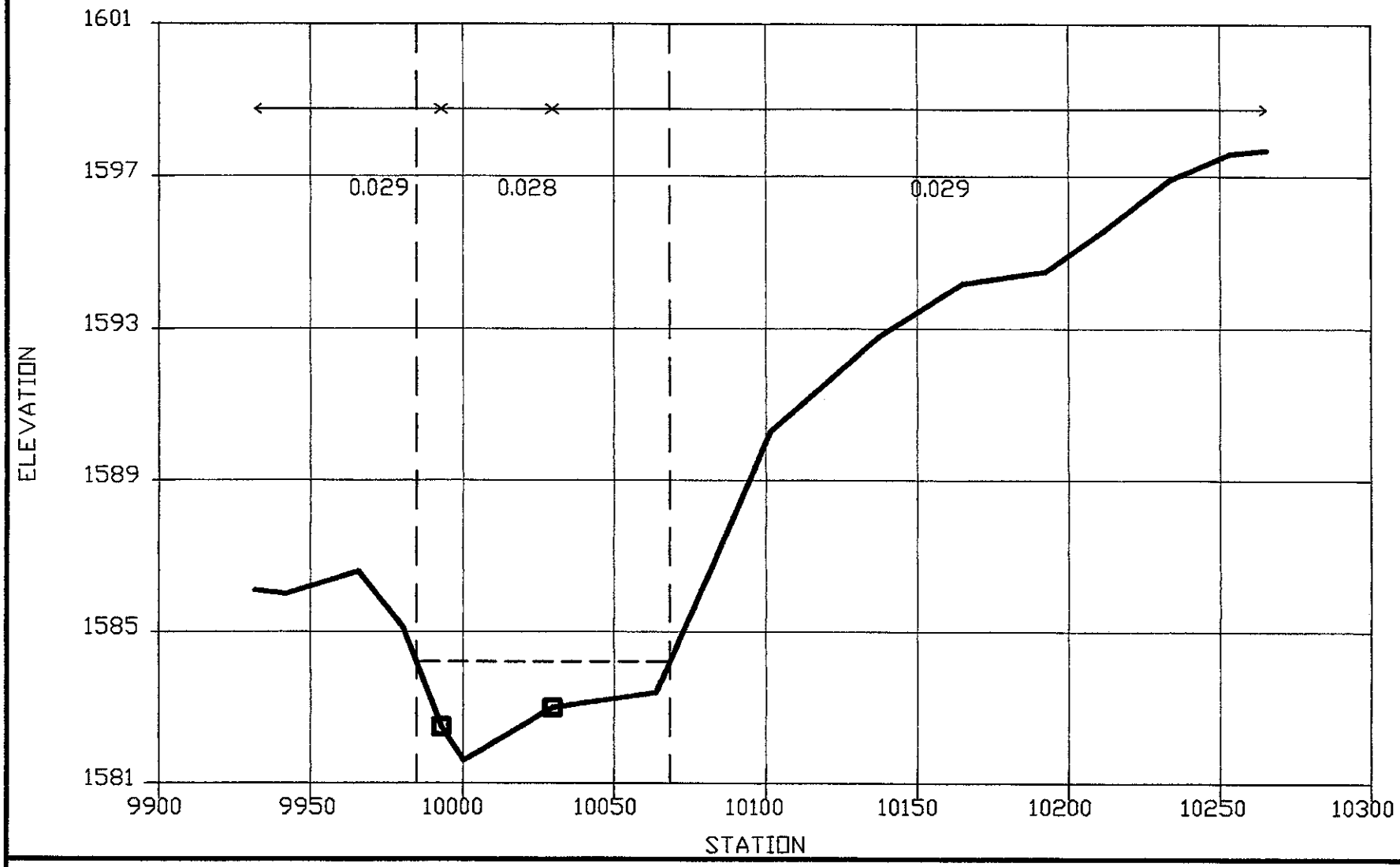


SECTION : 0.24

Fountain Hills (south) FIS

Fountain Channel

File: FOC-XSEC.DWG

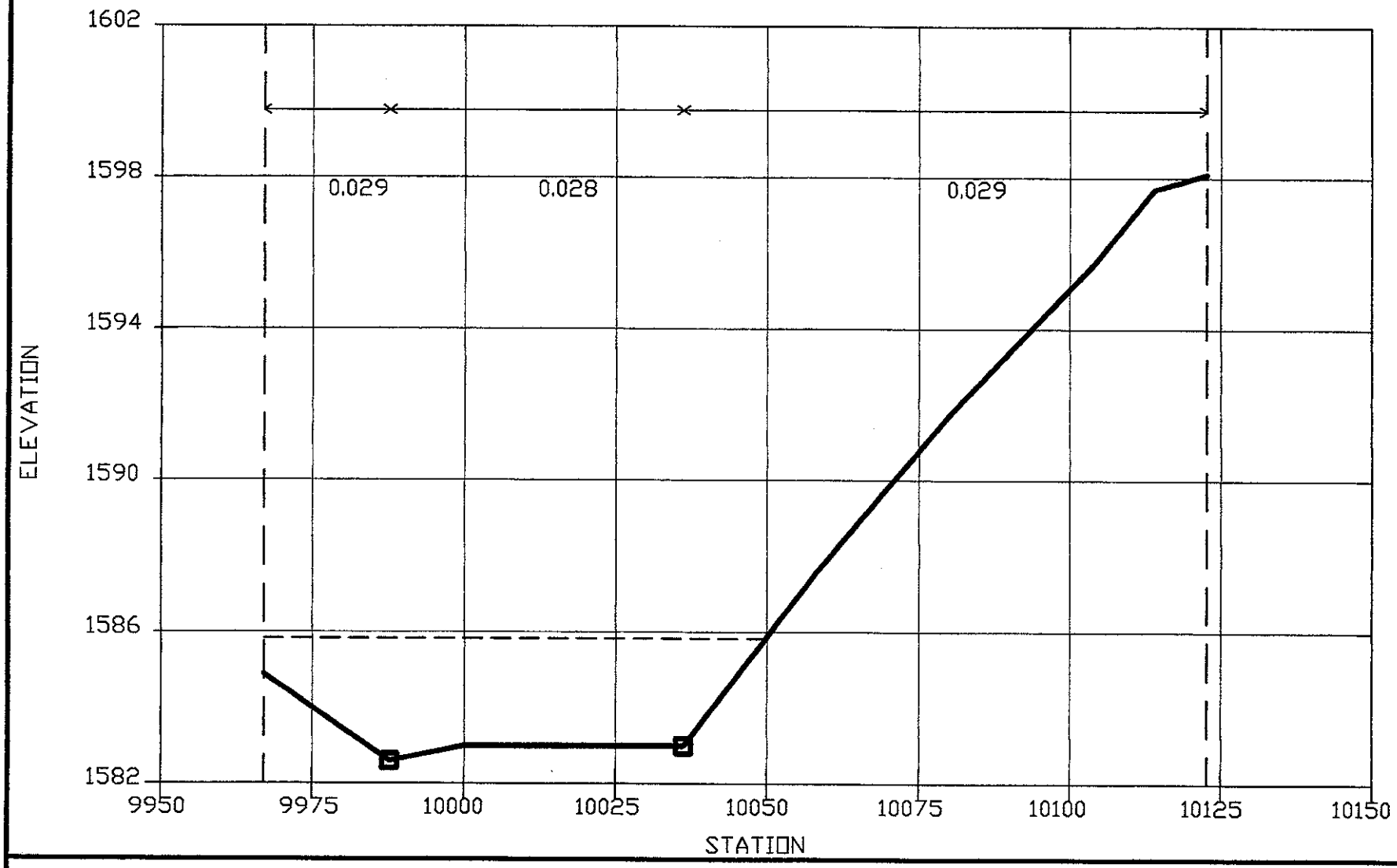


SECTION : 0.32

Fountain Hills (south) FIS

Fountain Channel

File: FOC-XSEC.DWG

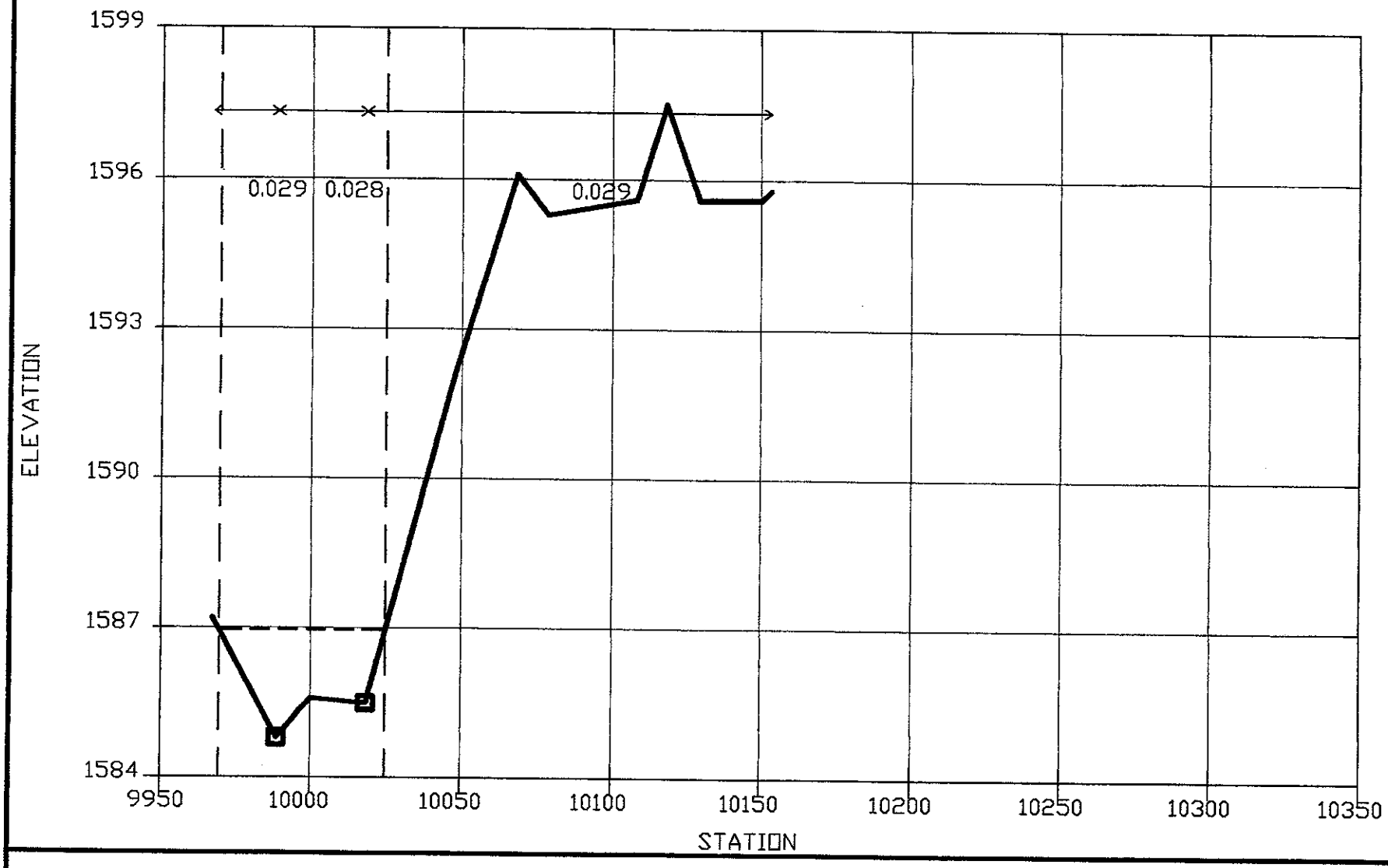


SECTION : 0.41

Fountain Hills (south) FIS

Fountain Channel

File: FOC-XSEC.DWG

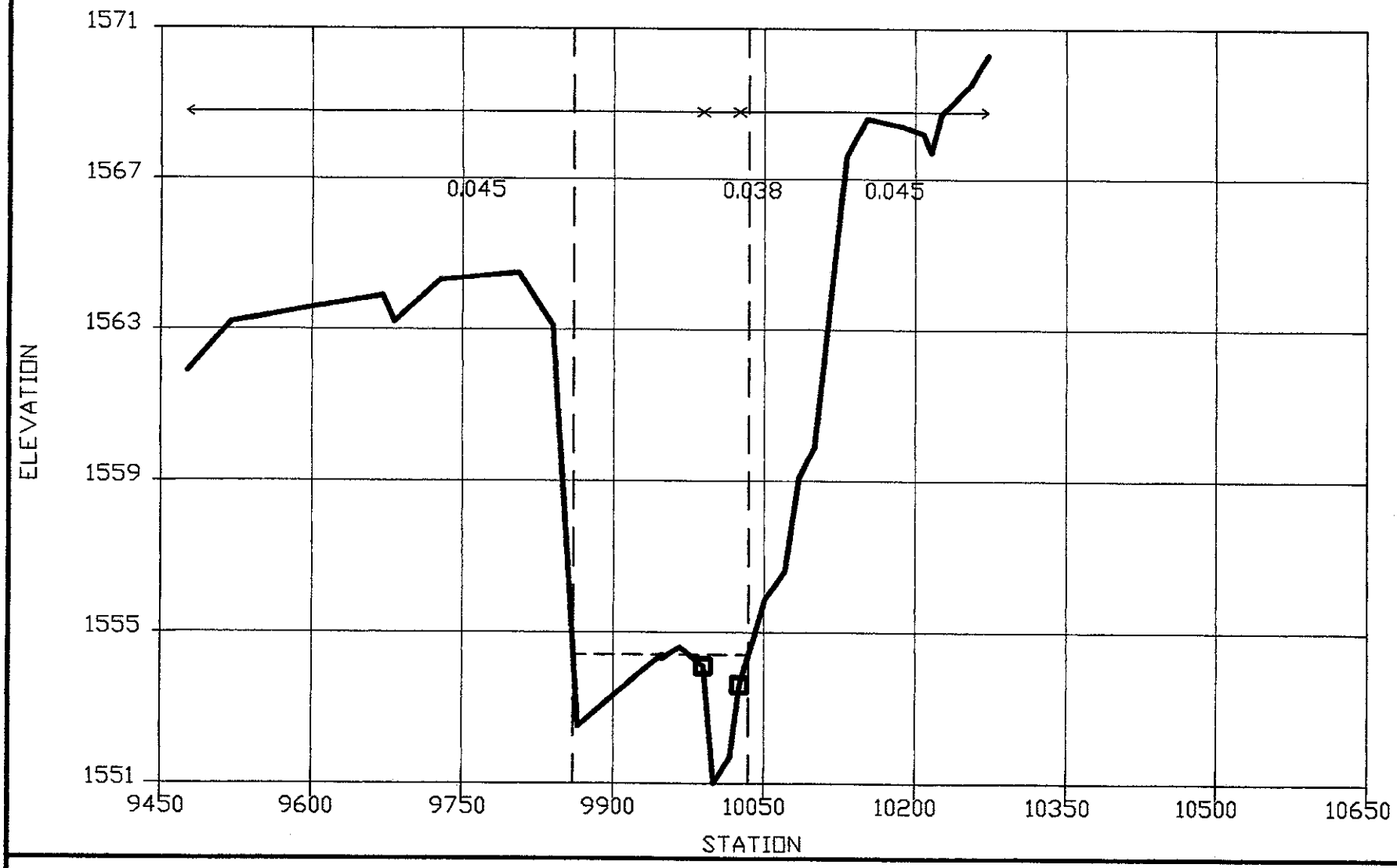


SECTION : 0.50

Fountain Hills (south) FIS

Fountain Channel

File: FOC-XSEC.DWG

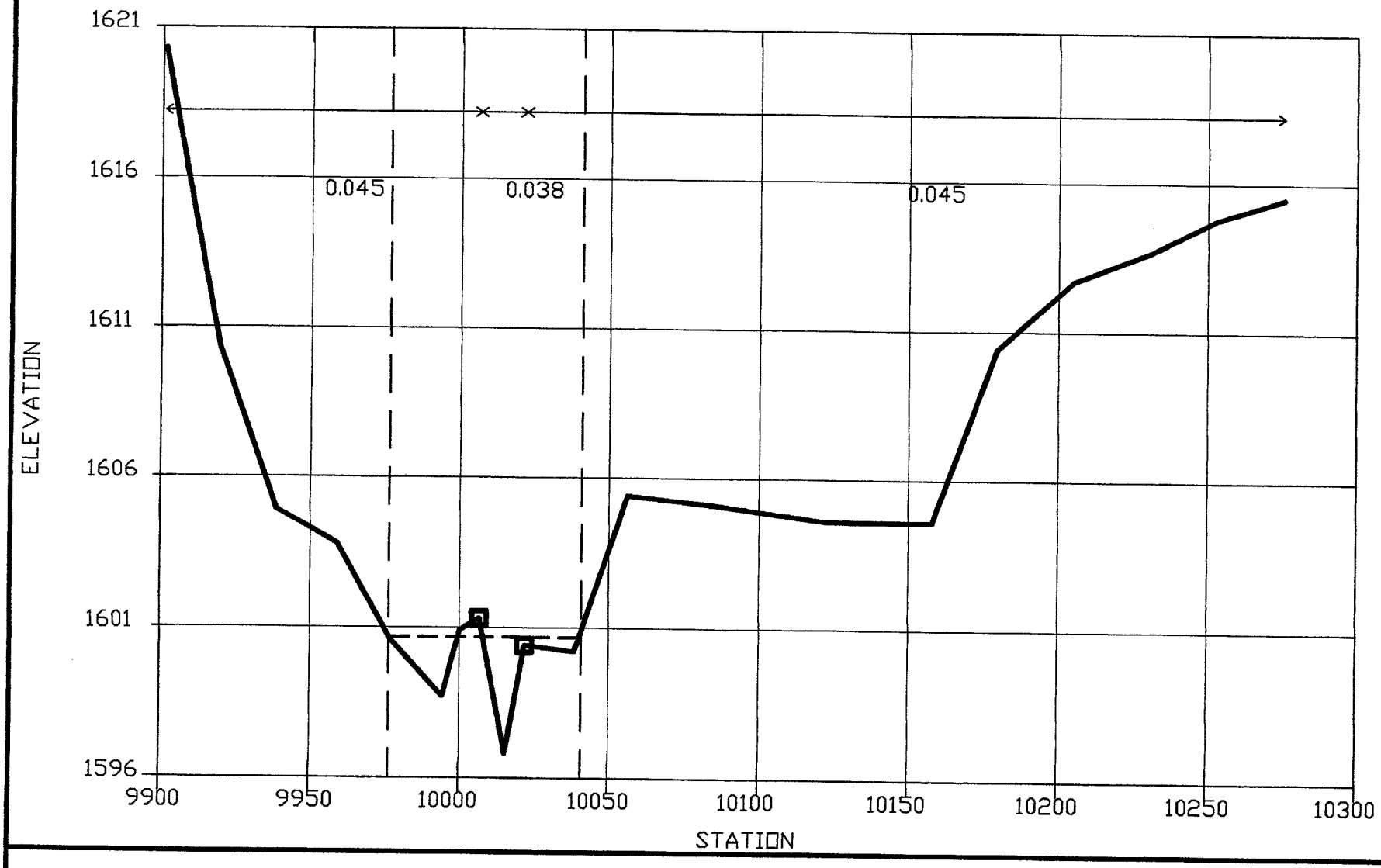


SECTION : 2.99

Fountain Hills (south) FIS

Fountain Channel

File: FOC-XSEC.DWG

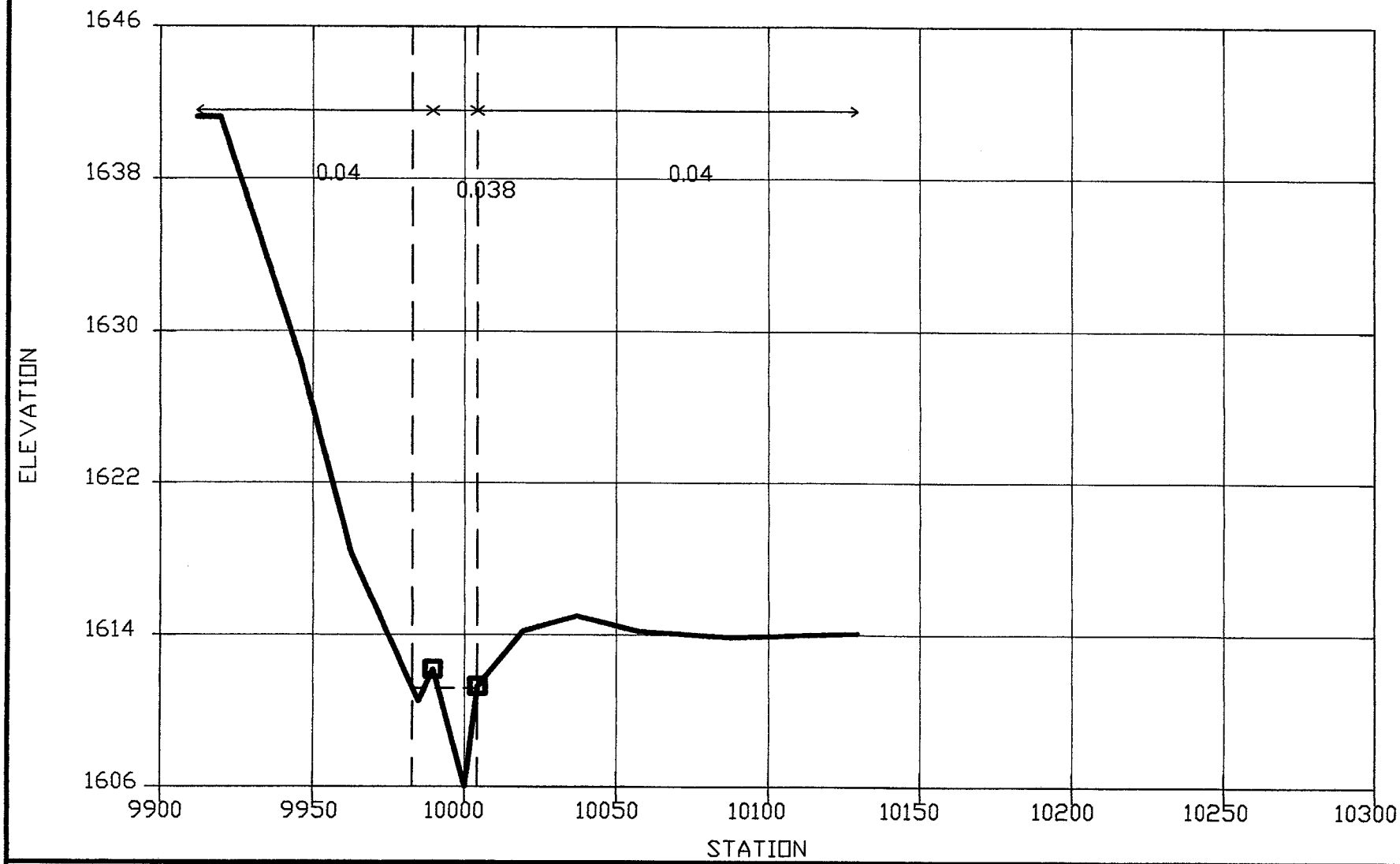


SECTION : 0.00

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

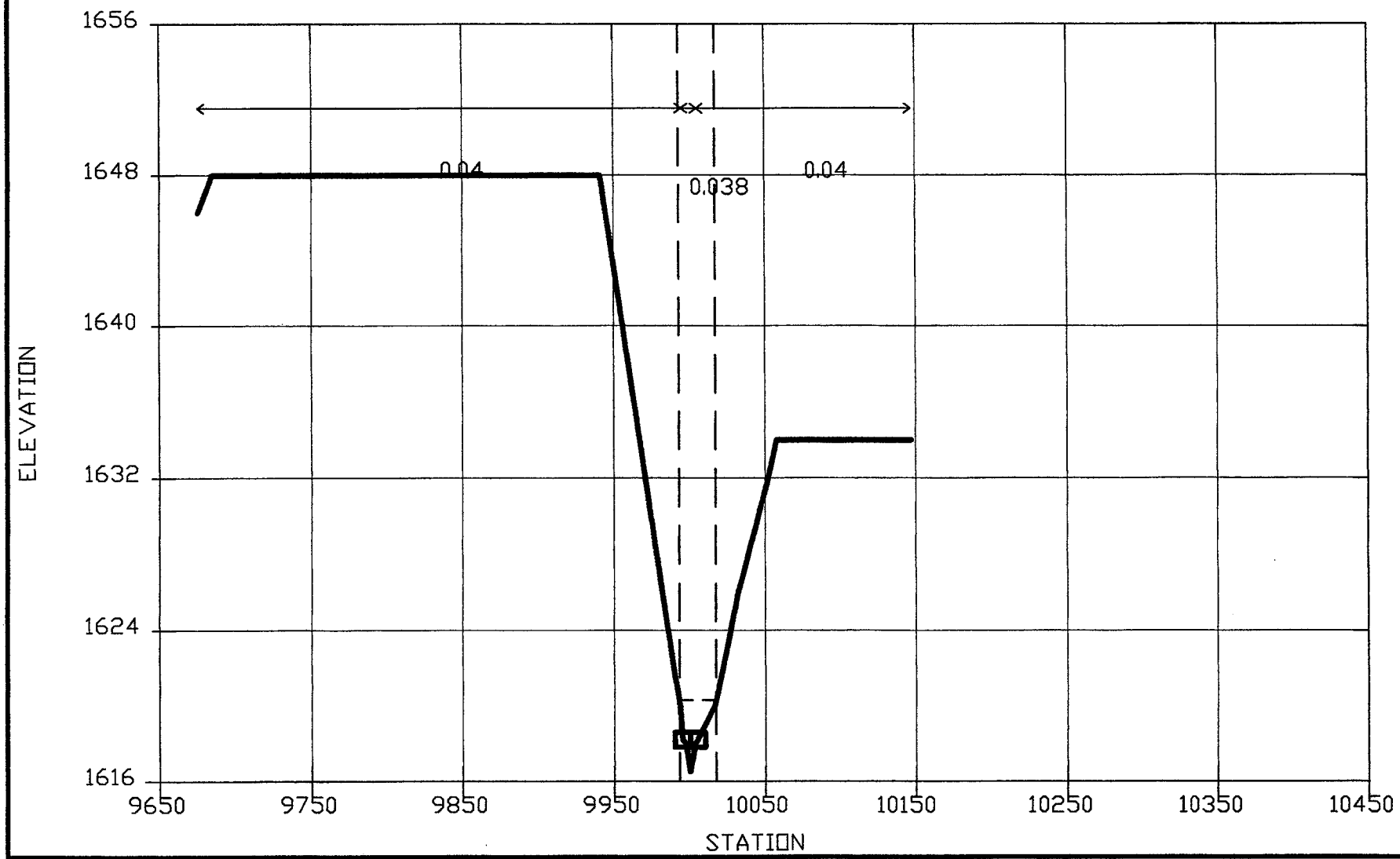


SECTION : 0.04

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

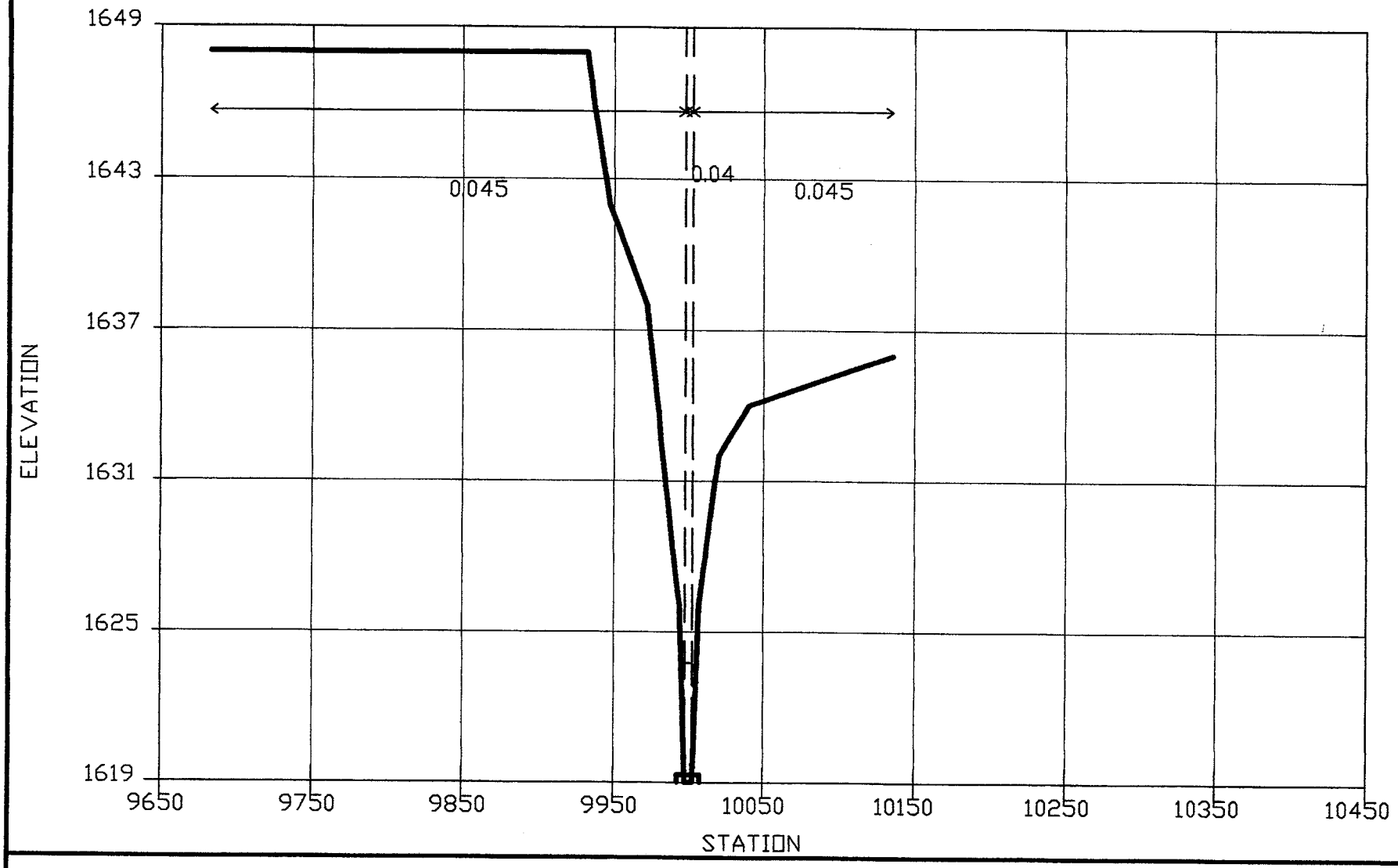


SECTION : 0.07

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

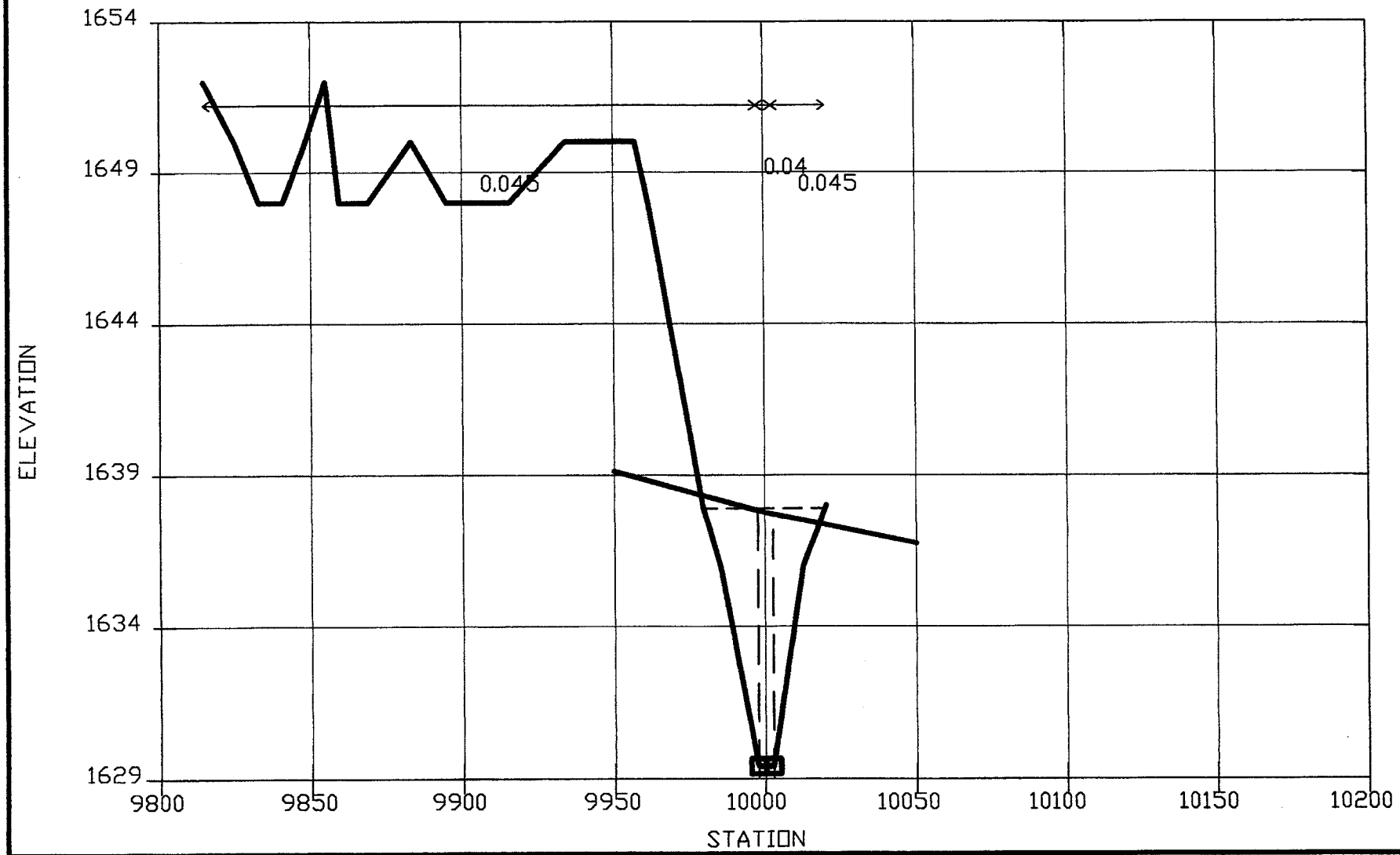


SECTION : 0.08

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

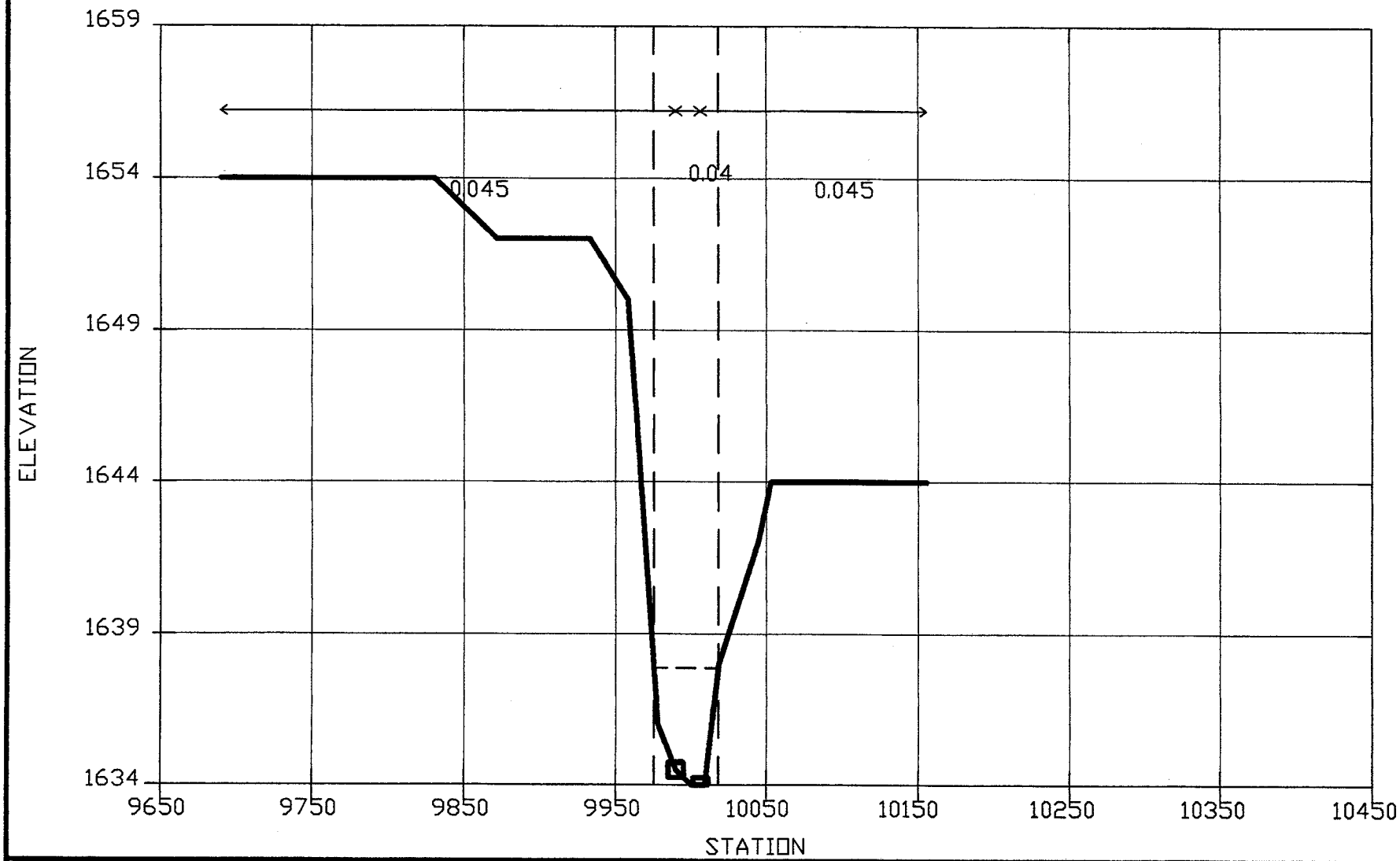


SECTION : 0.10

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

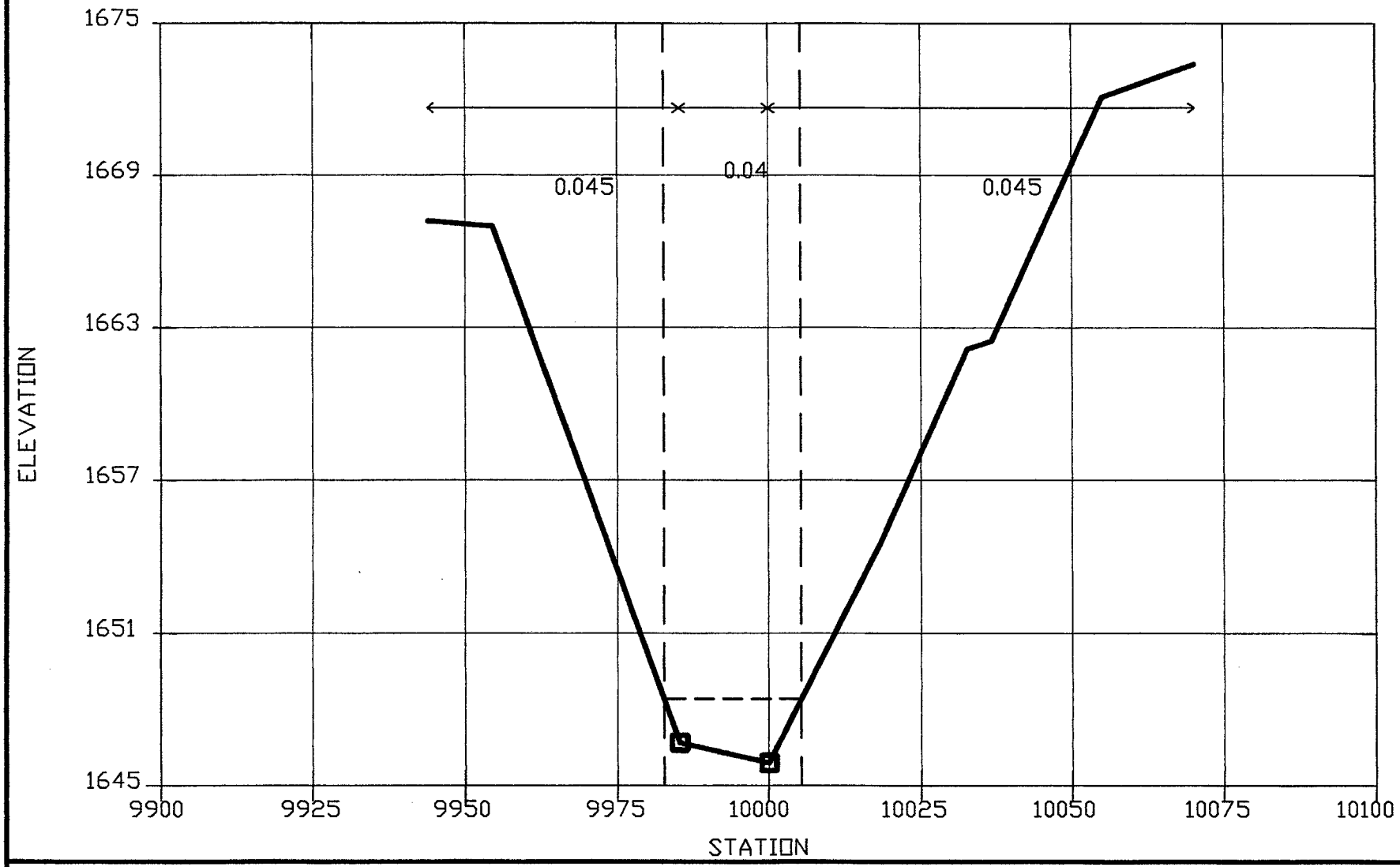


SECTION : 0.11

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

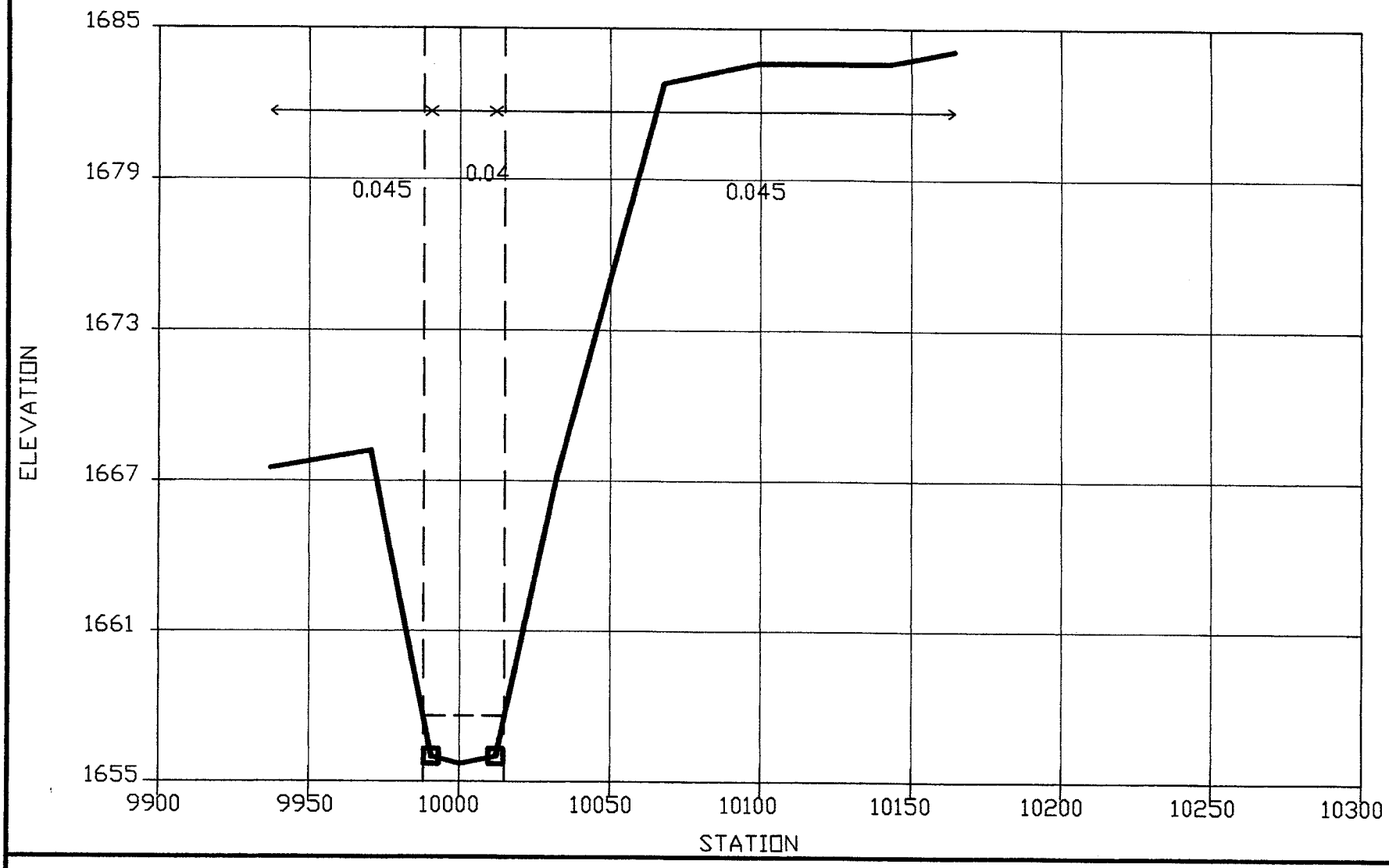


SECTION : 0.18

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

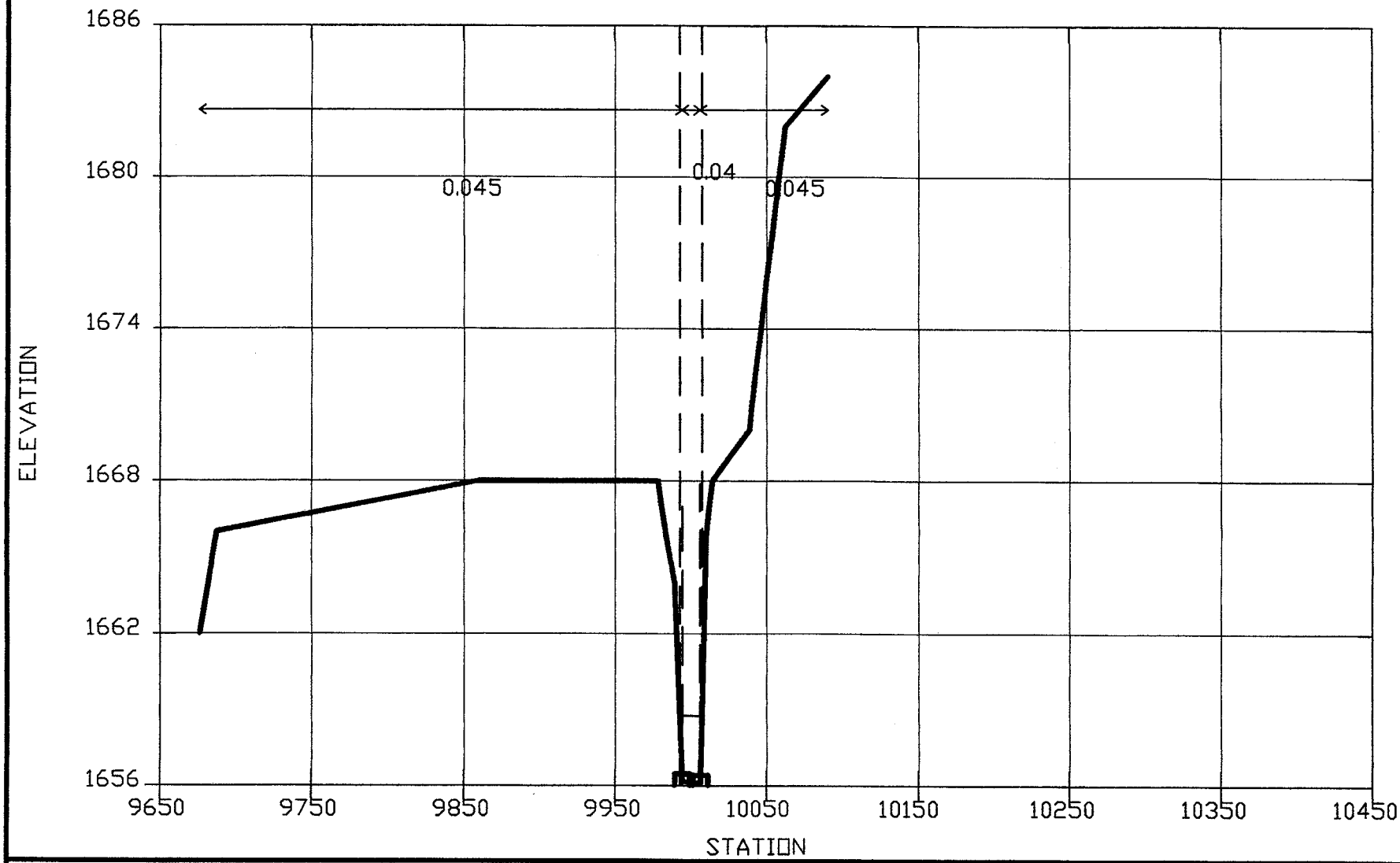


SECTION : 0.25

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

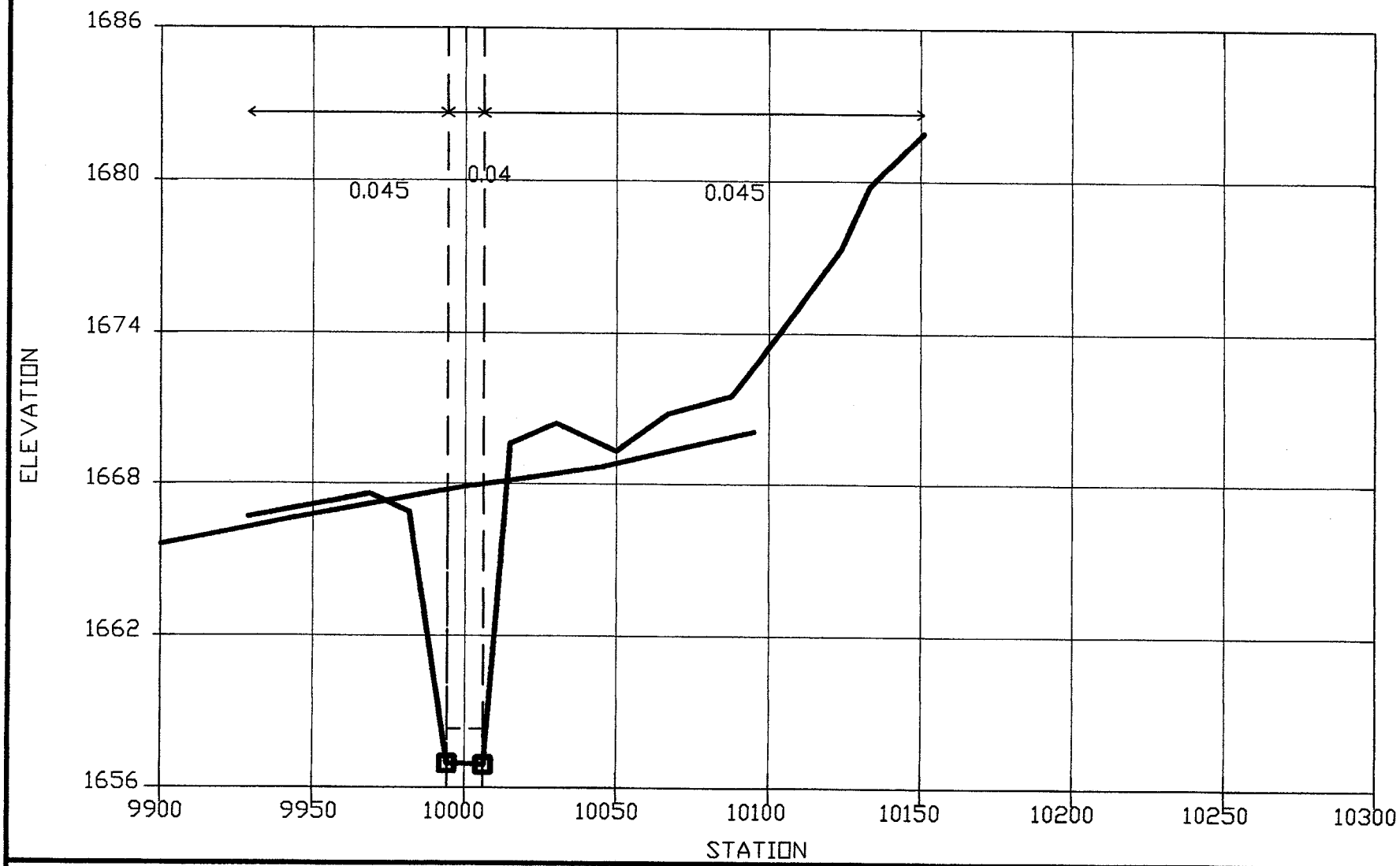


SECTION : 0.26

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

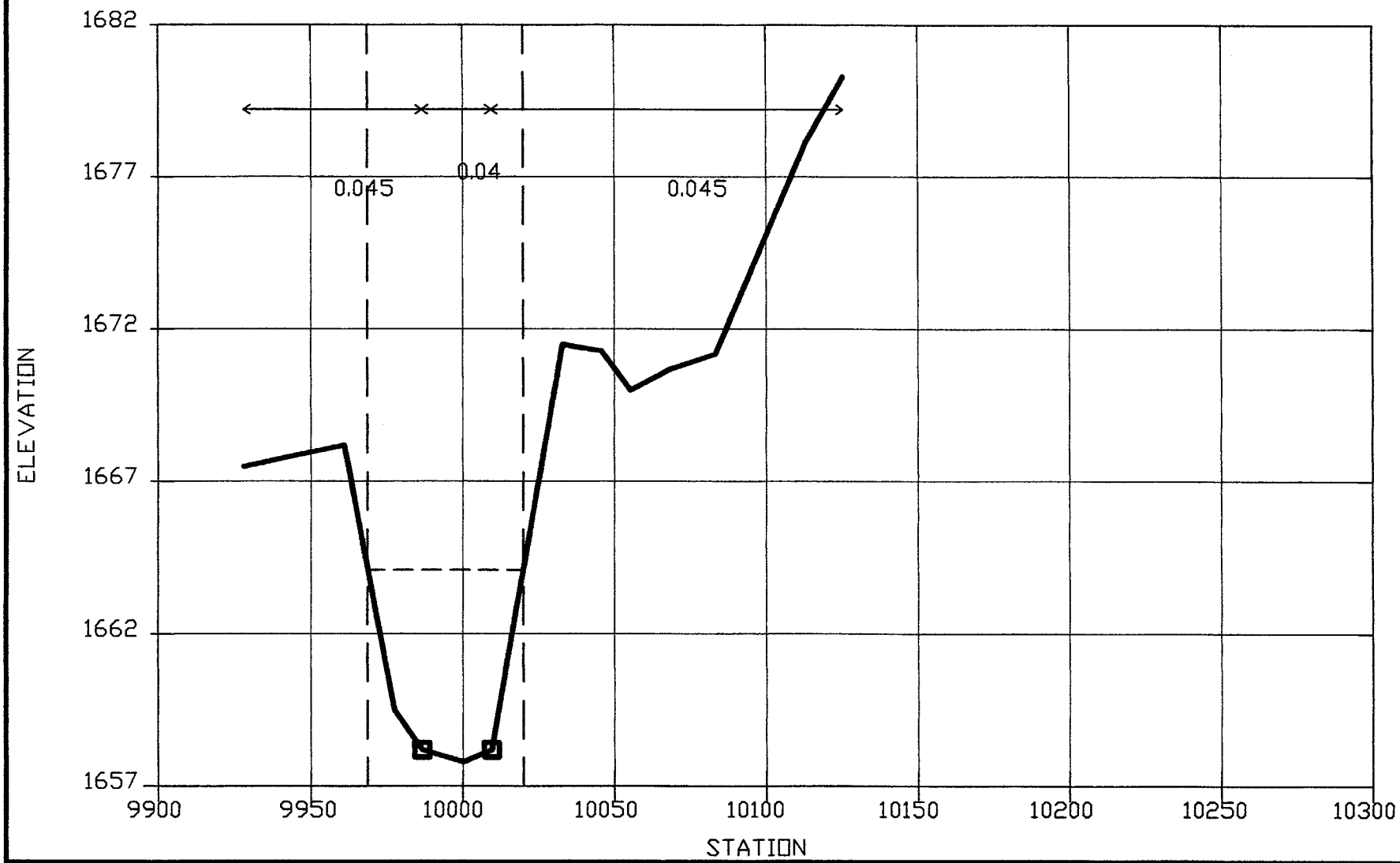


SECTION : 0.27

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

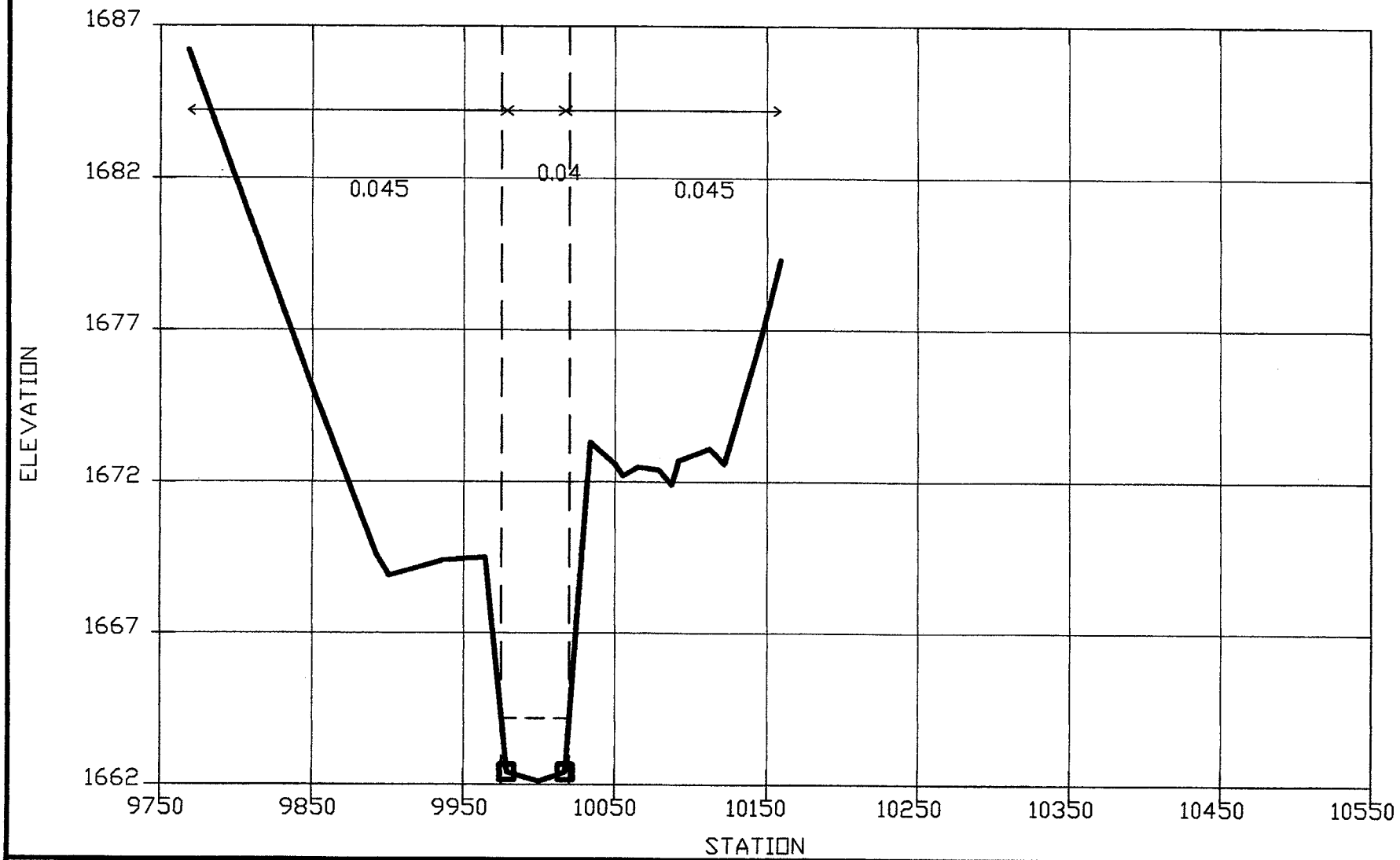


SECTION : 0.28

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG



SECTION : 0.37

Fountain Hills (south) FIS

North Colony Wash

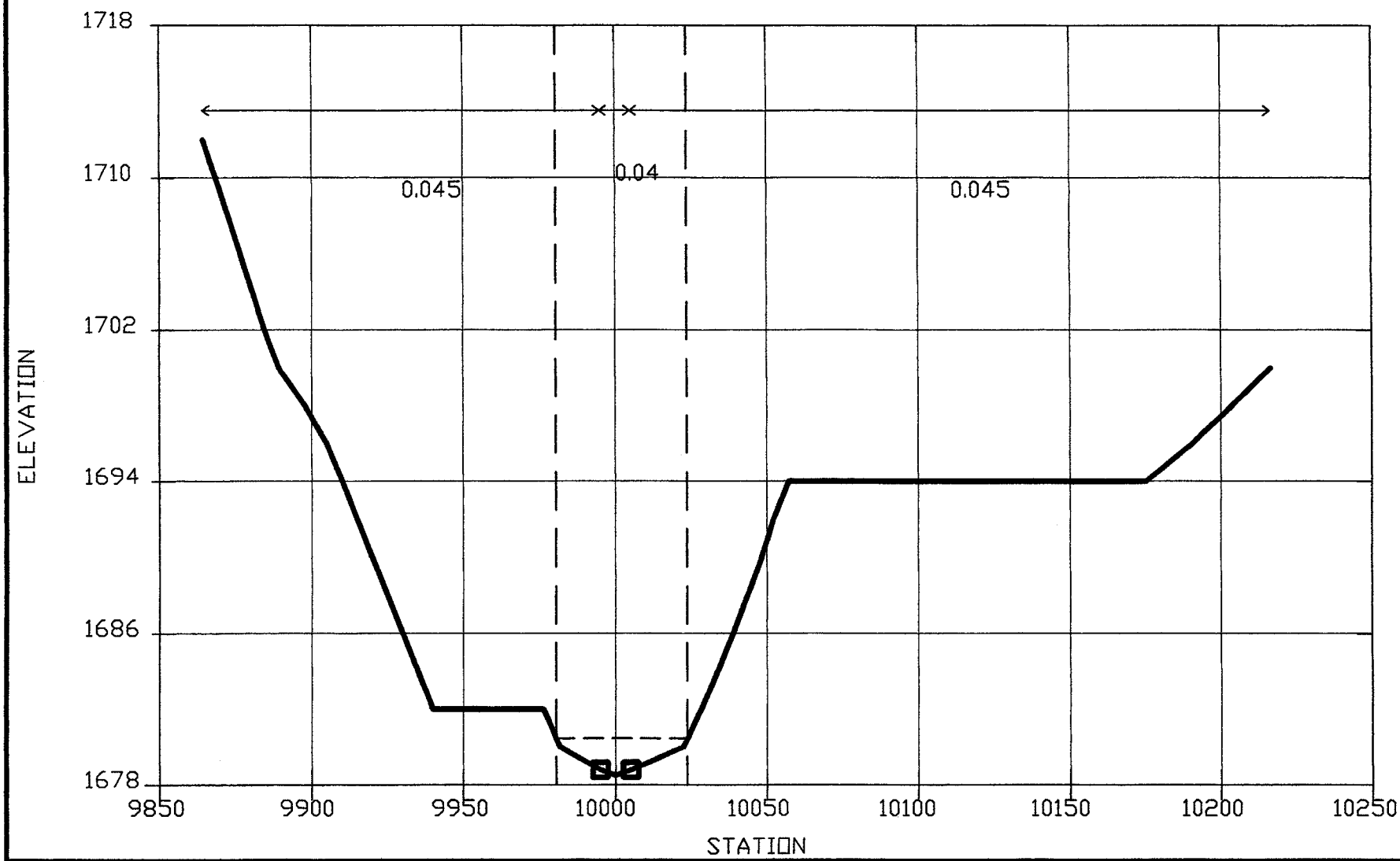
File: NCW-XSEC.DWG

SECTION : 0.46

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

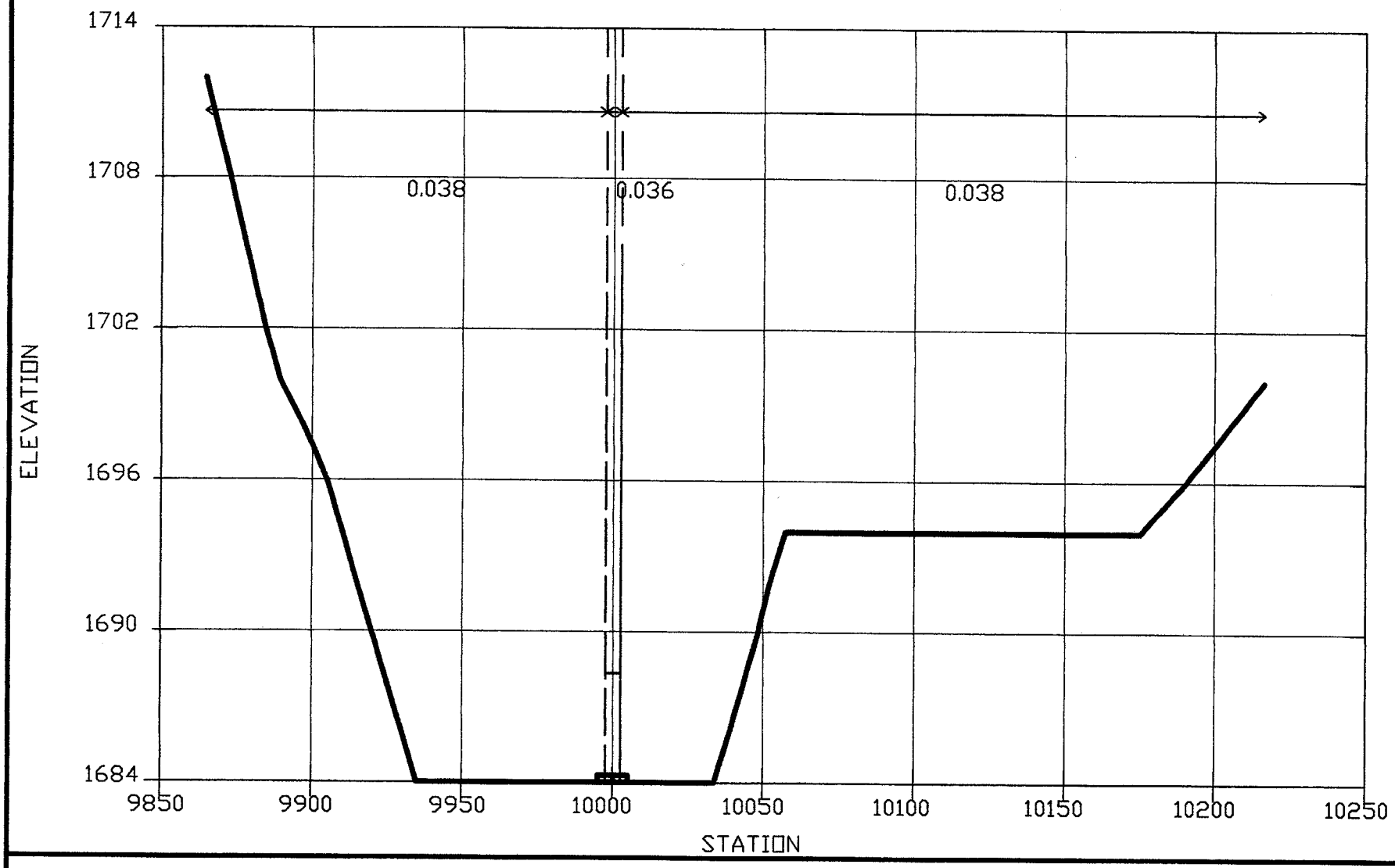


SECTION : 0.51

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

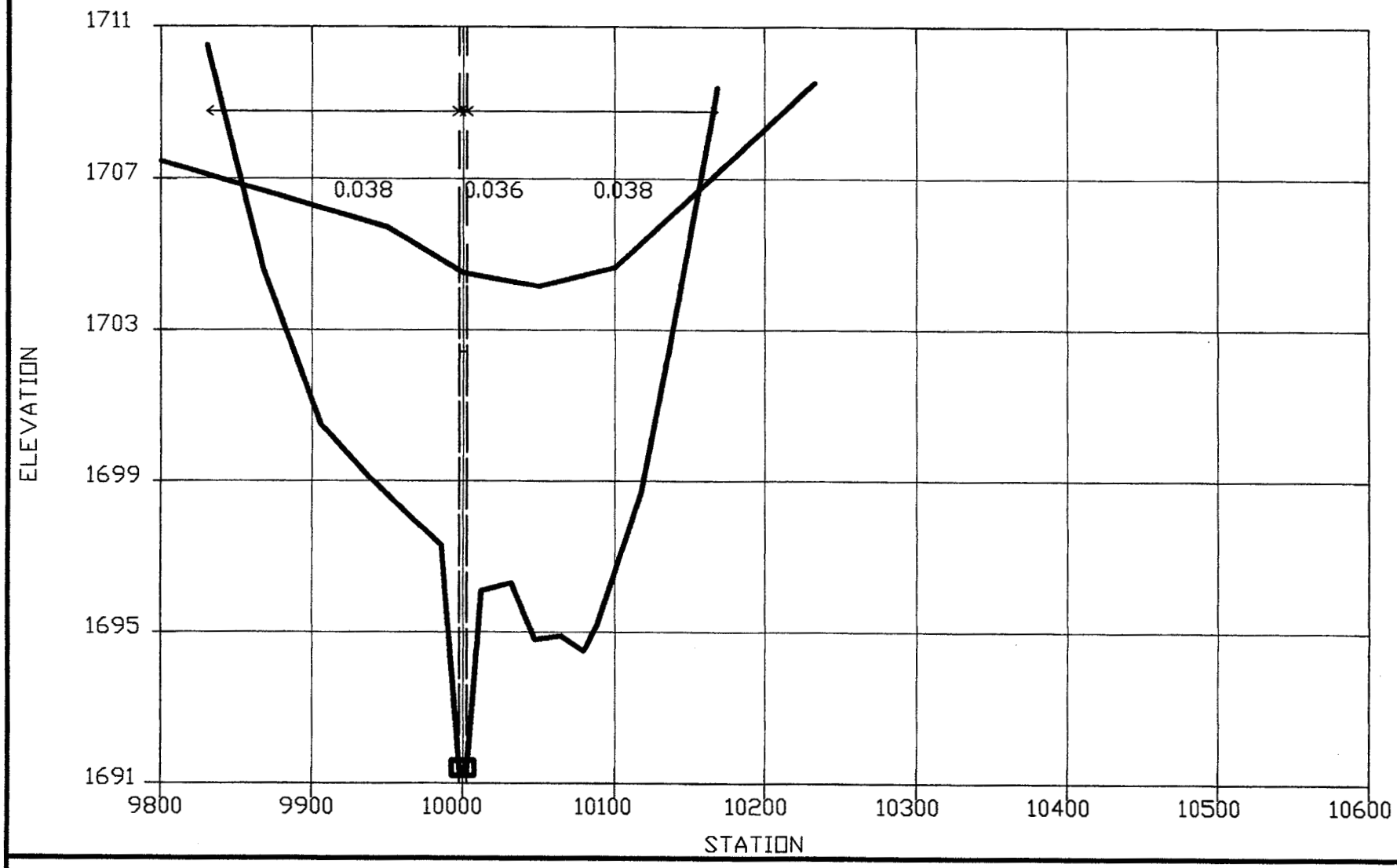


SECTION : 0.55

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

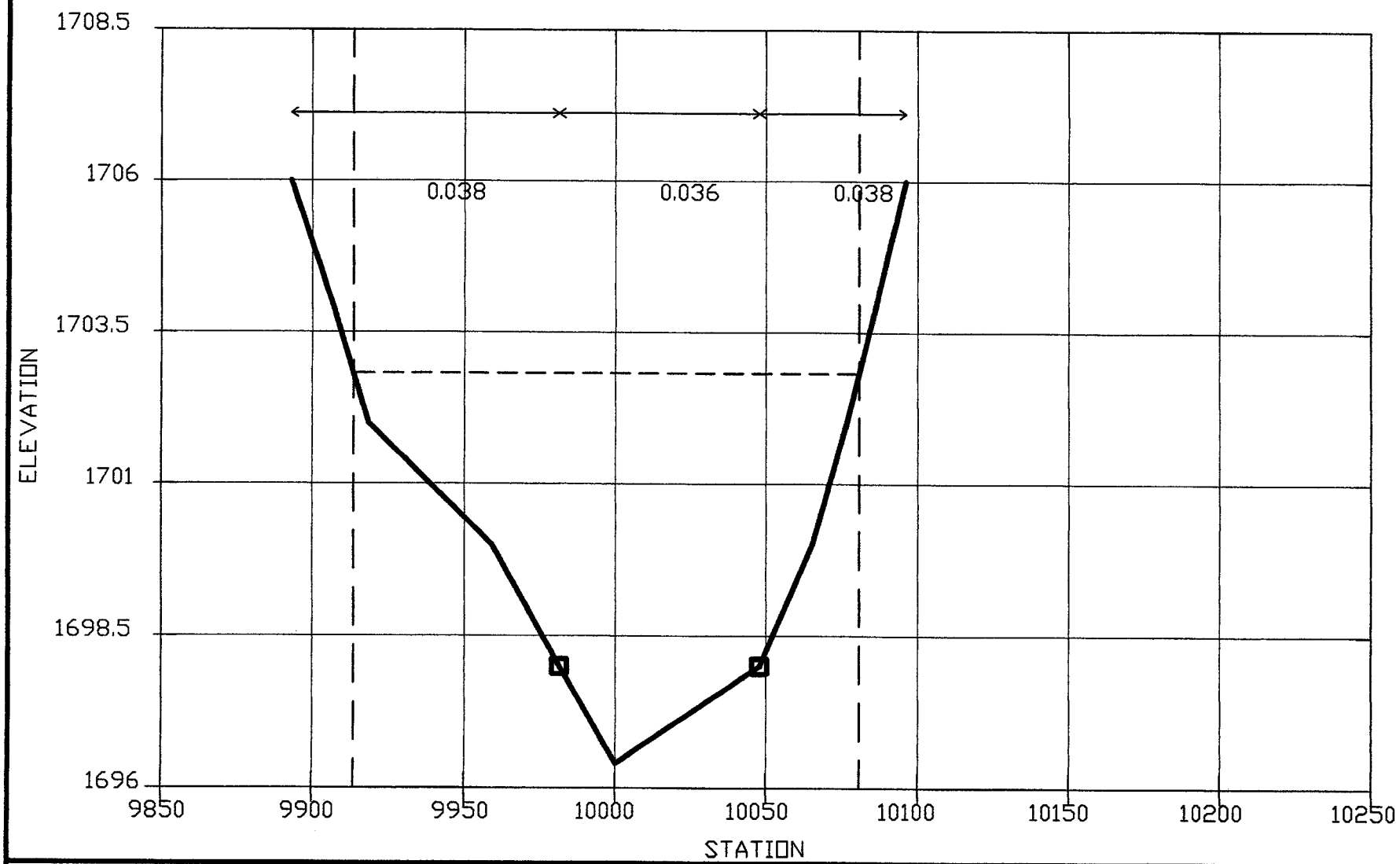


SECTION : 0.59

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

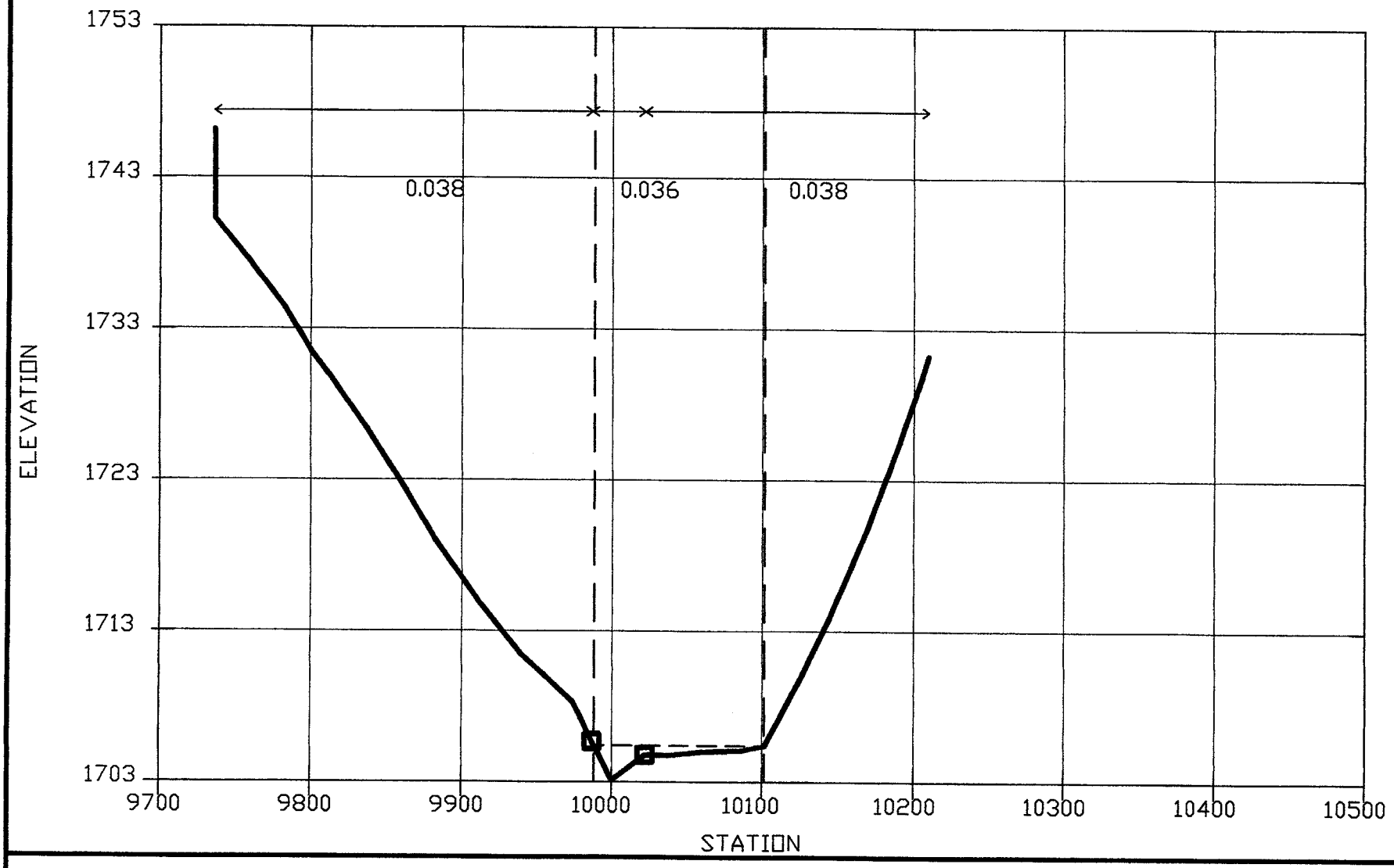


SECTION : 0.61

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

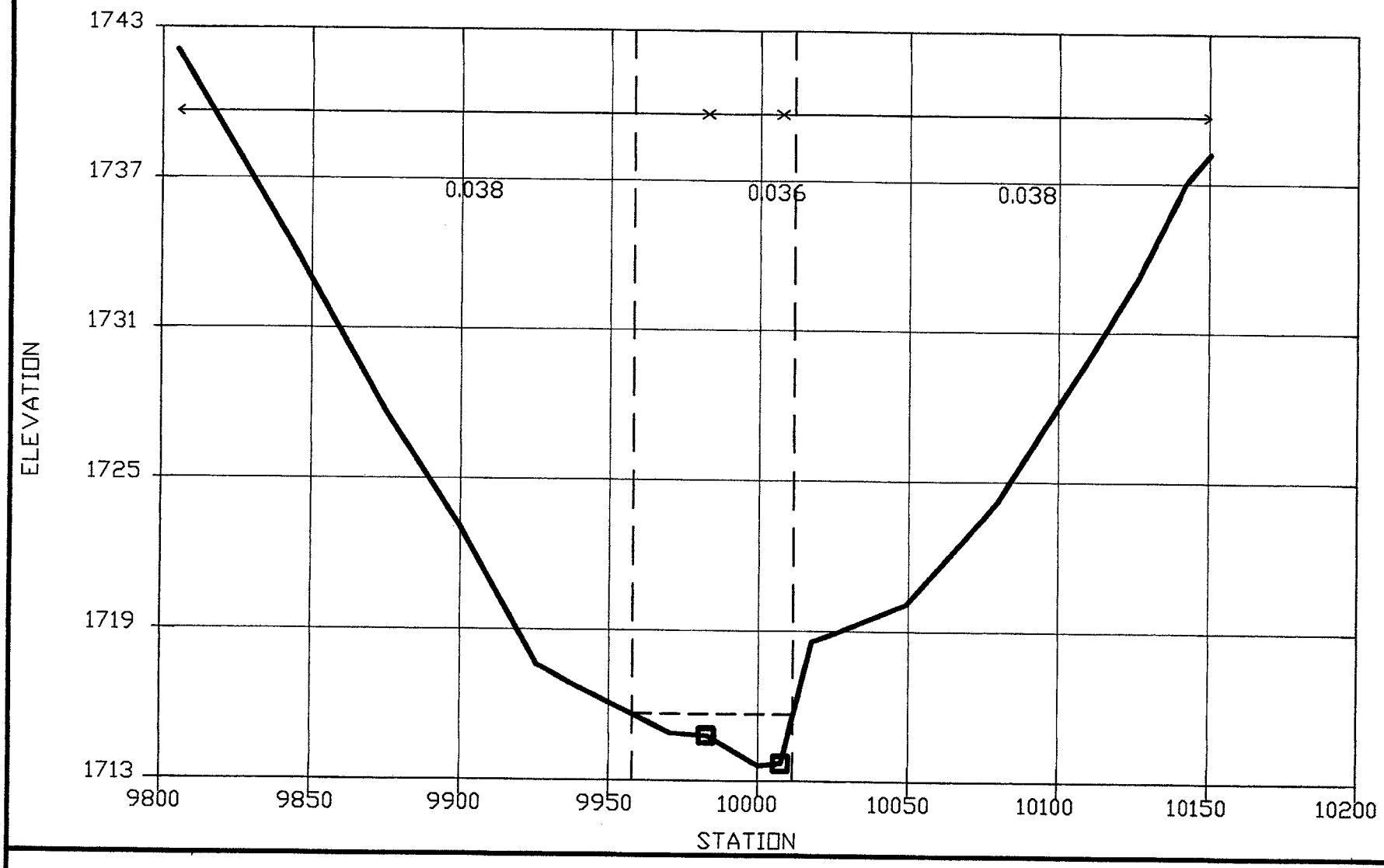


SECTION : 0.68

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

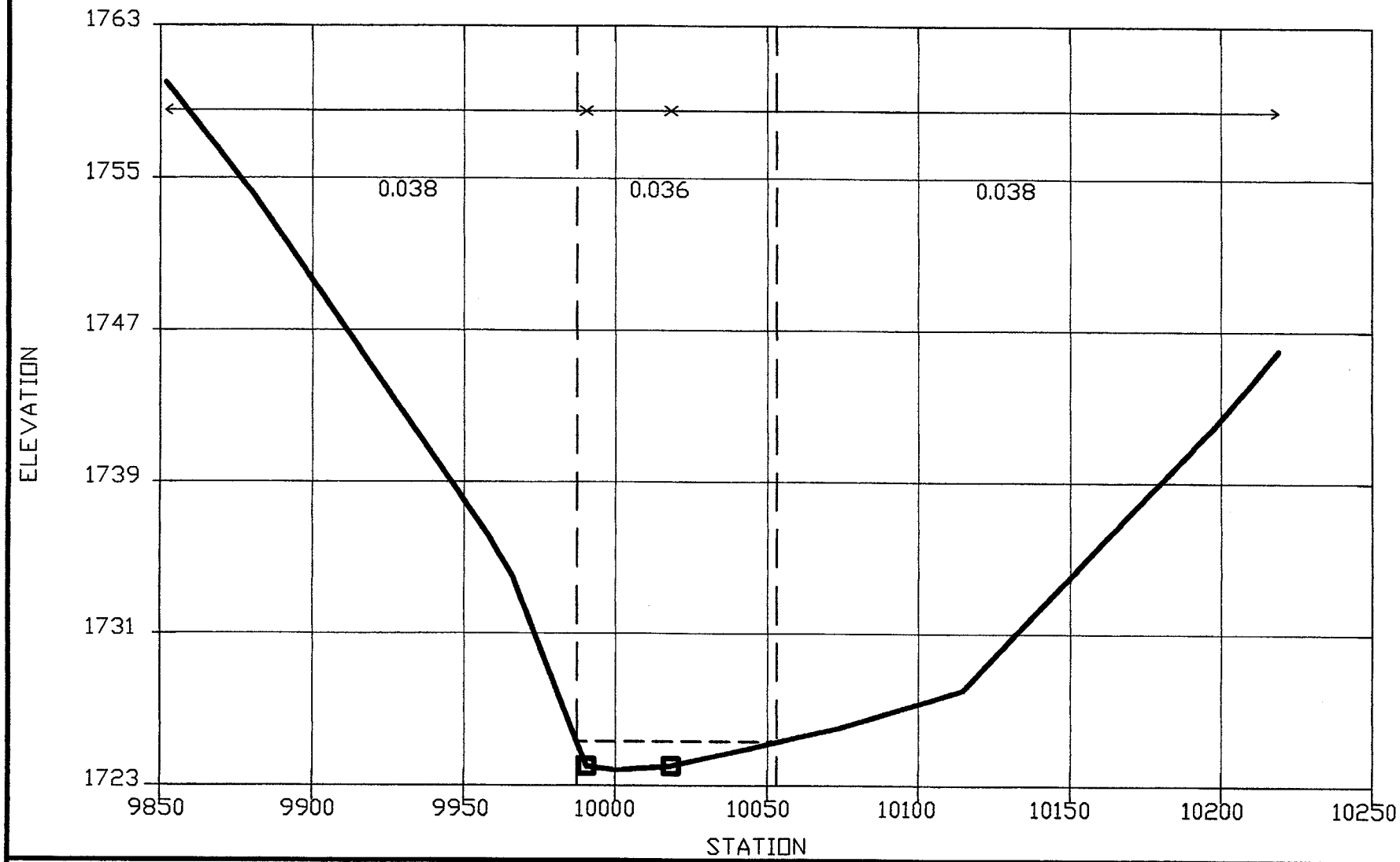


SECTION : 0.75

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

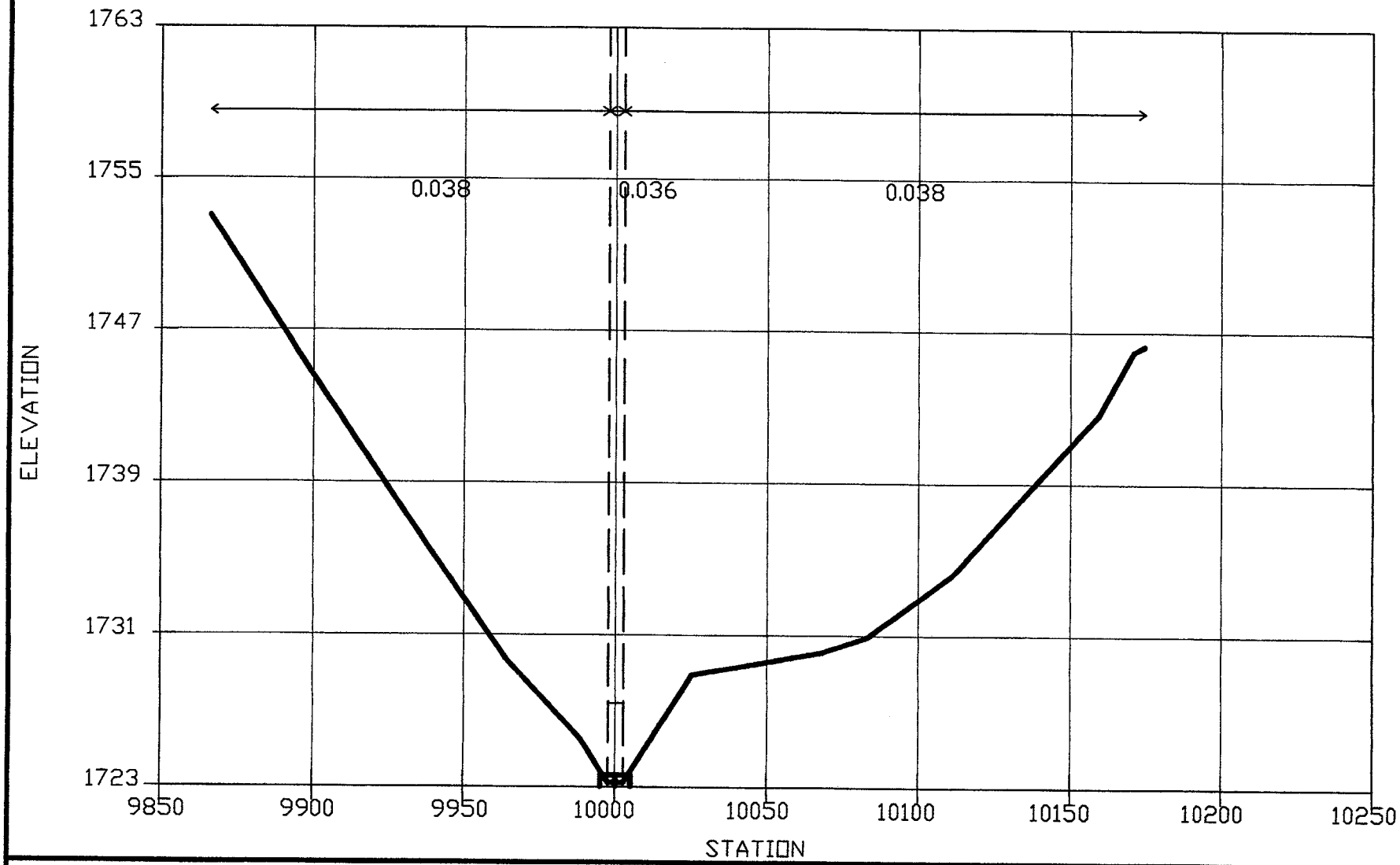


SECTION : 0.81

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

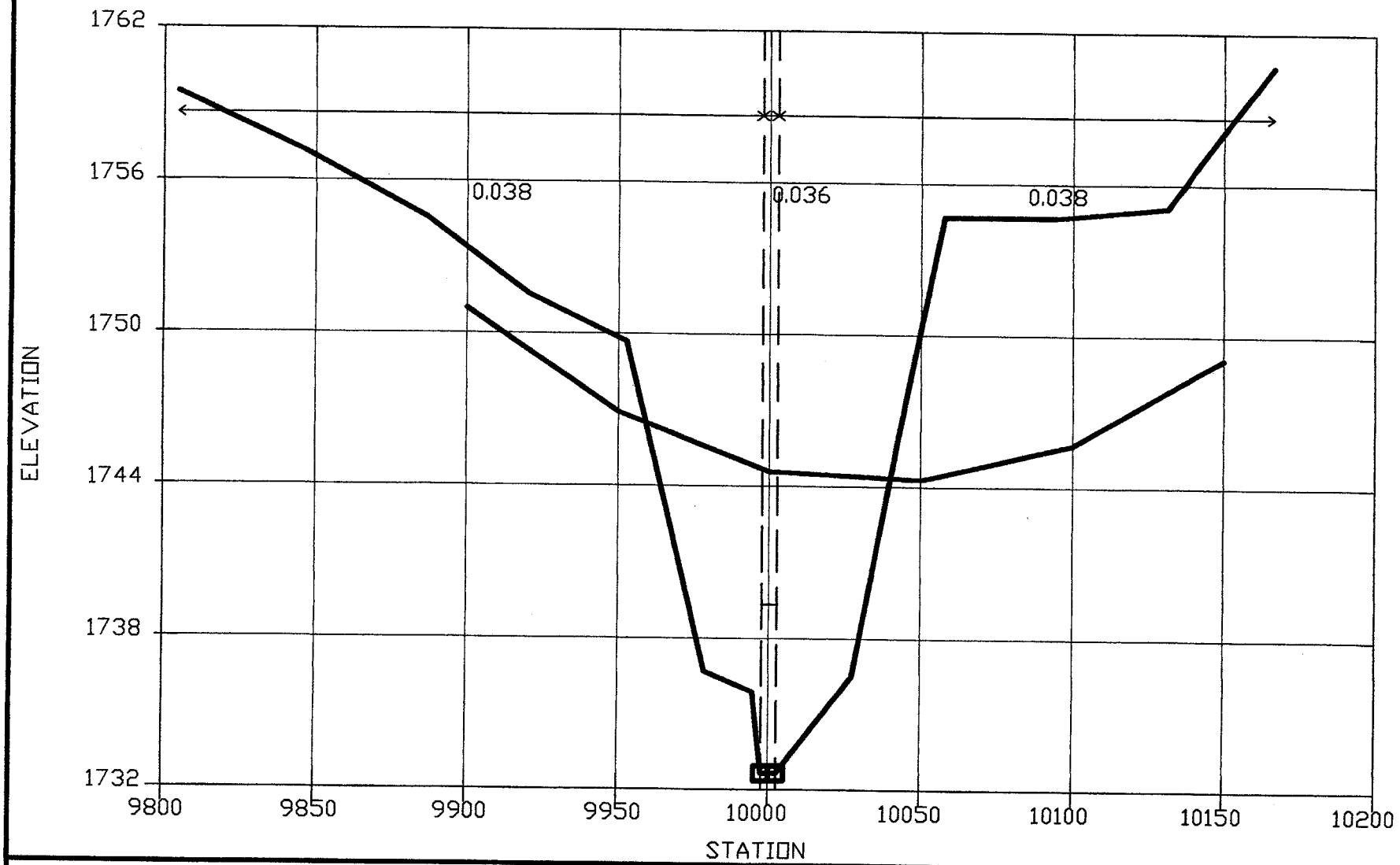


SECTION : 0.83

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

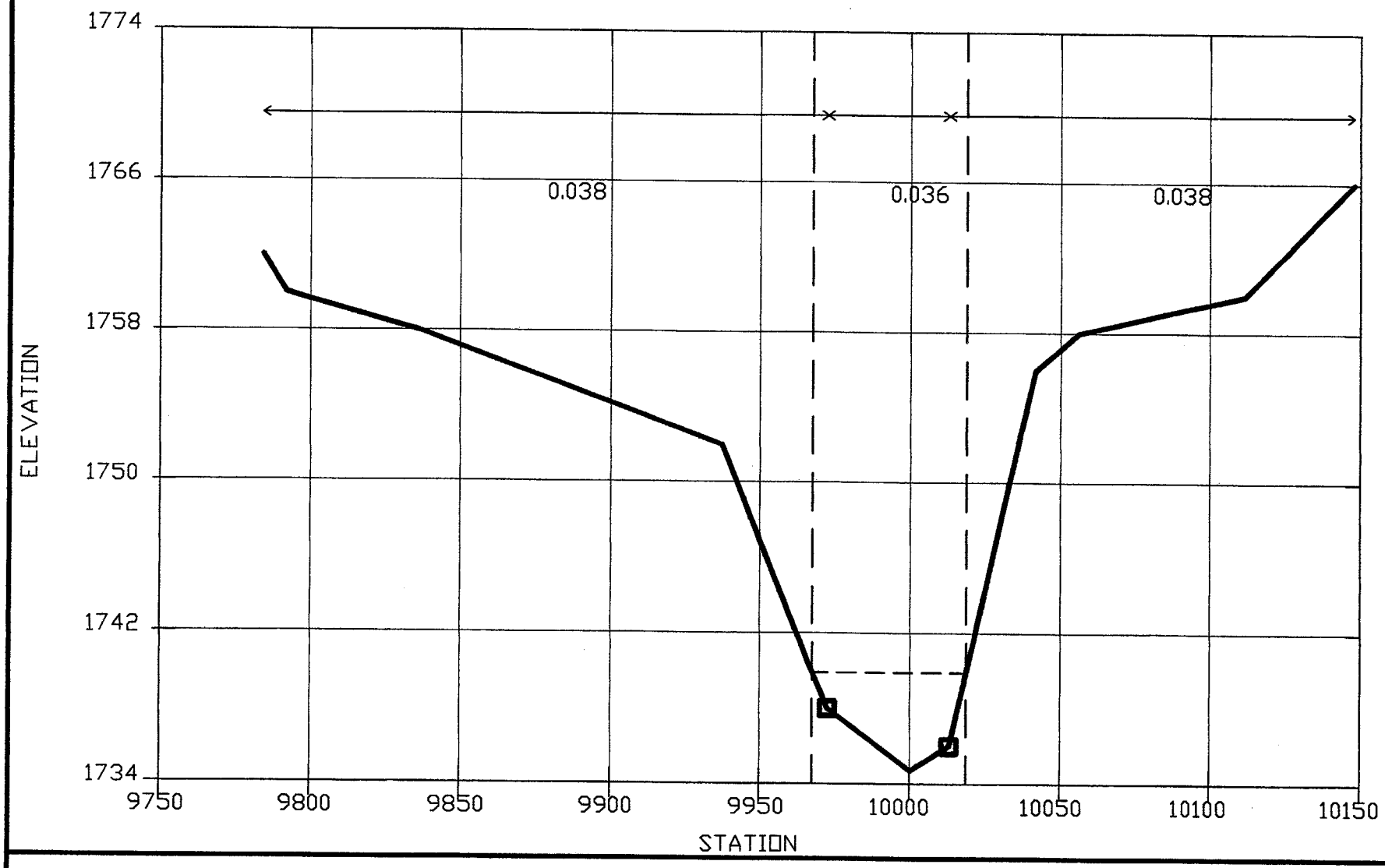


SECTION : 0.86

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

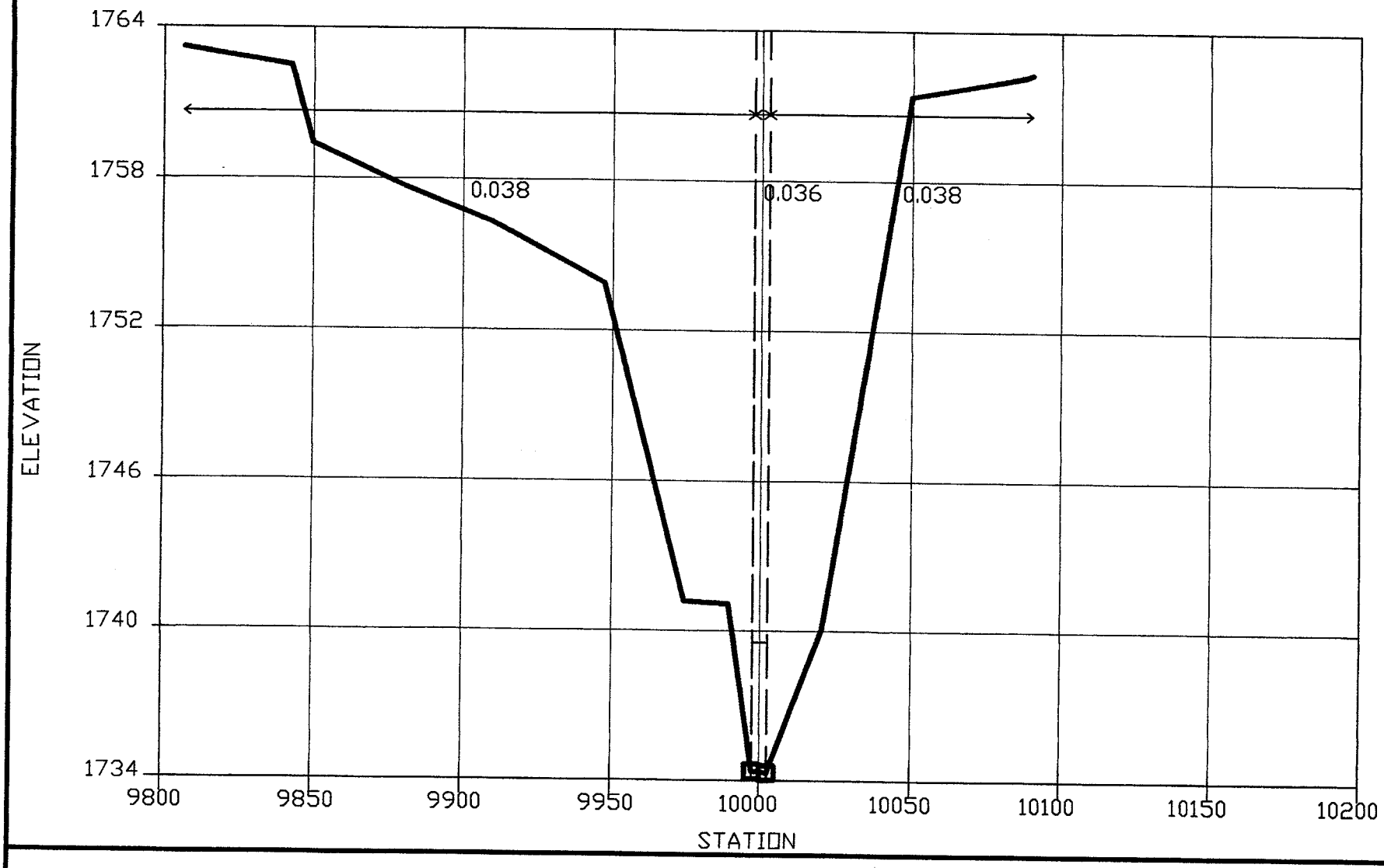


SECTION : 0.87

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

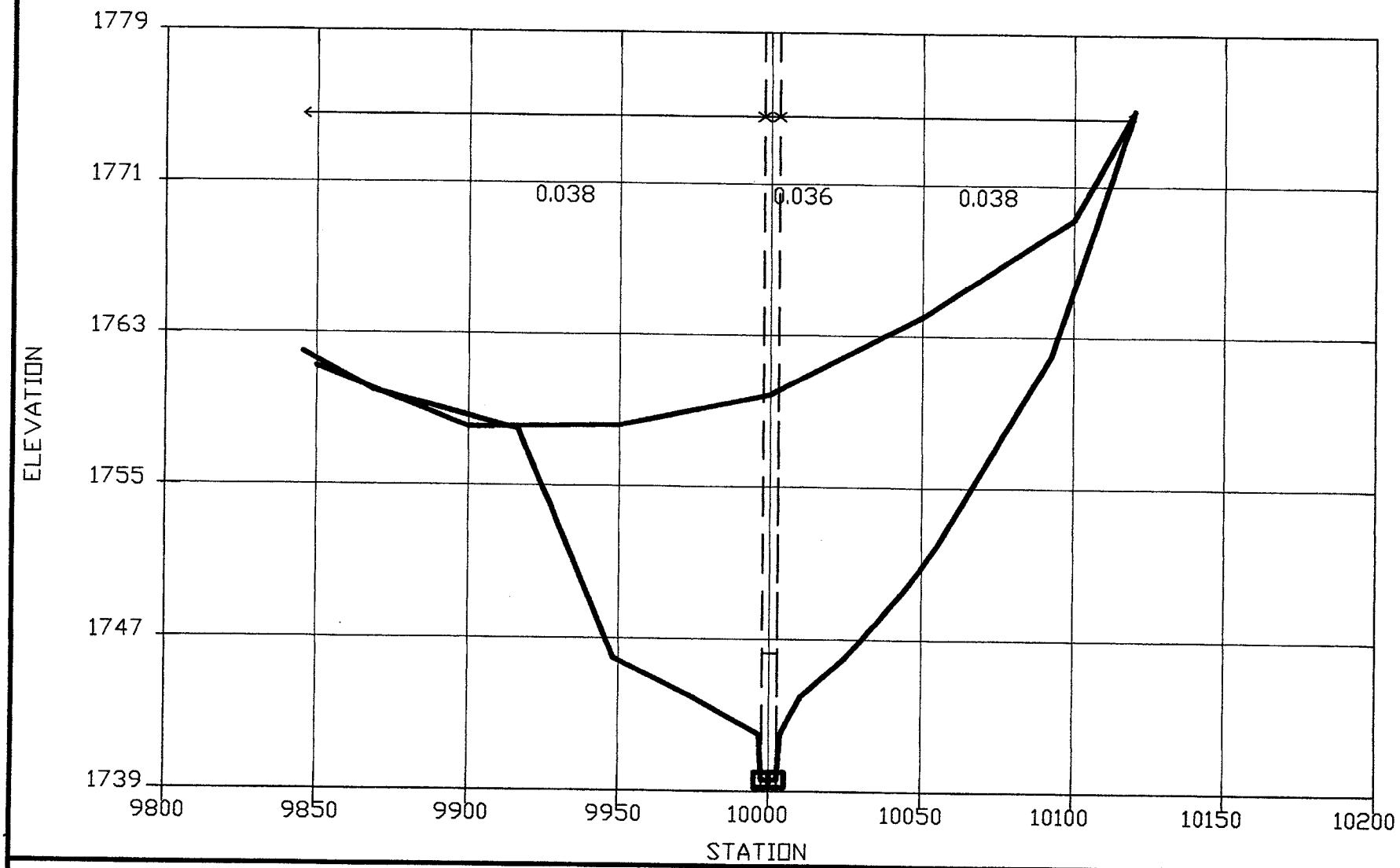


SECTION : 0.89

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

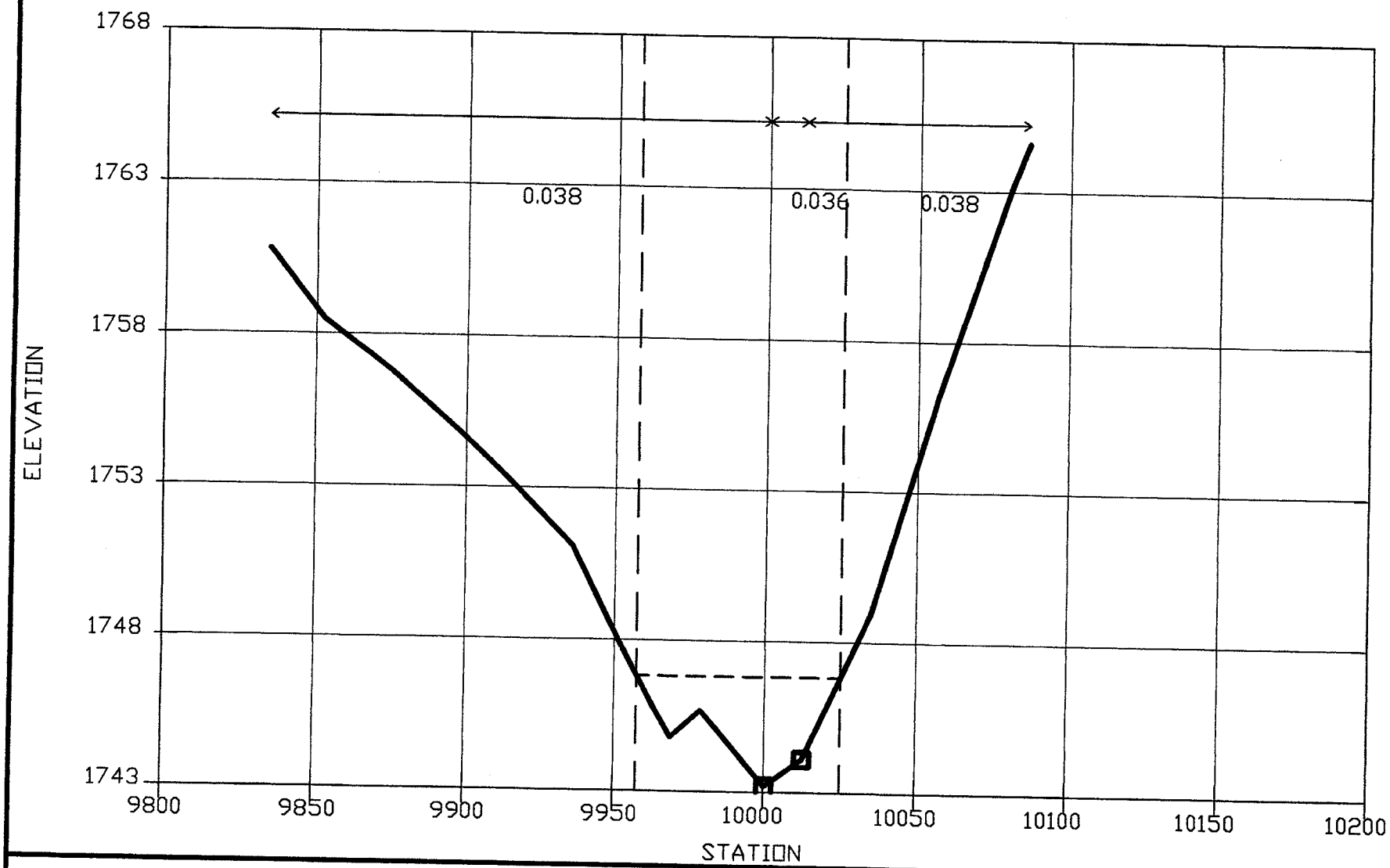


SECTION : 0.92

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

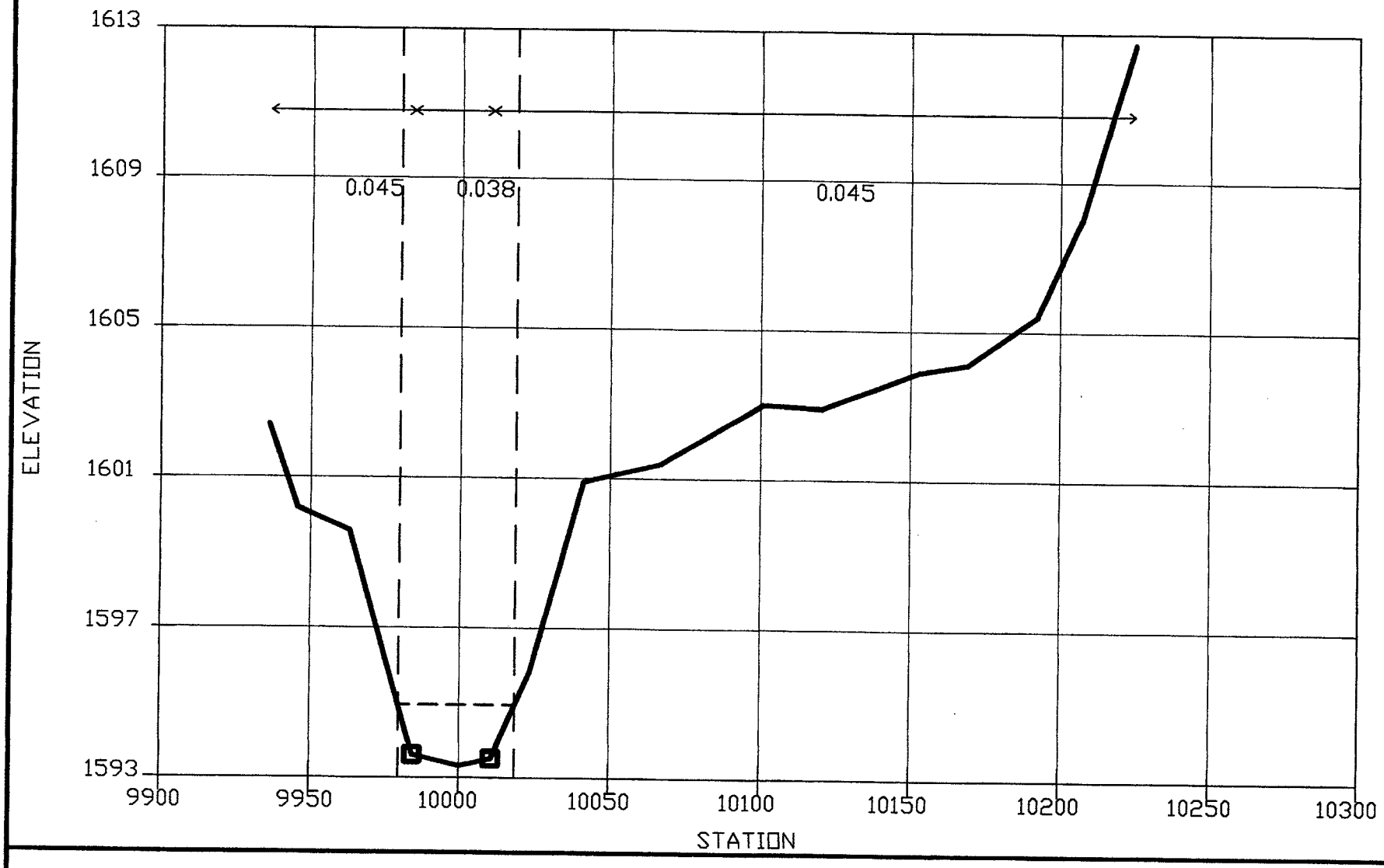


SECTION : 0.94

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

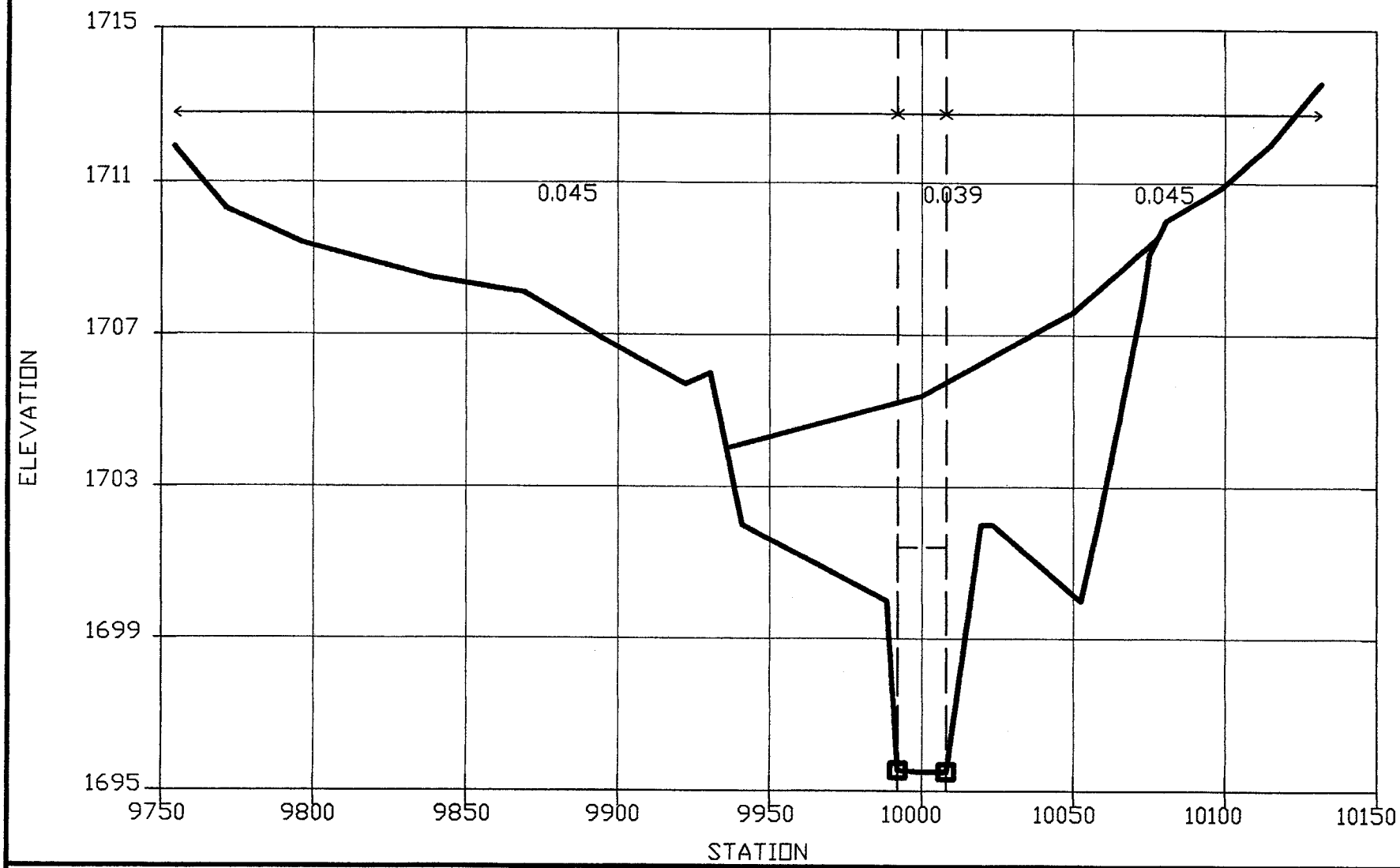


SECTION : 3.47

Fountain Hills (south) FIS

North Colony Wash

File: NCW-XSEC.DWG

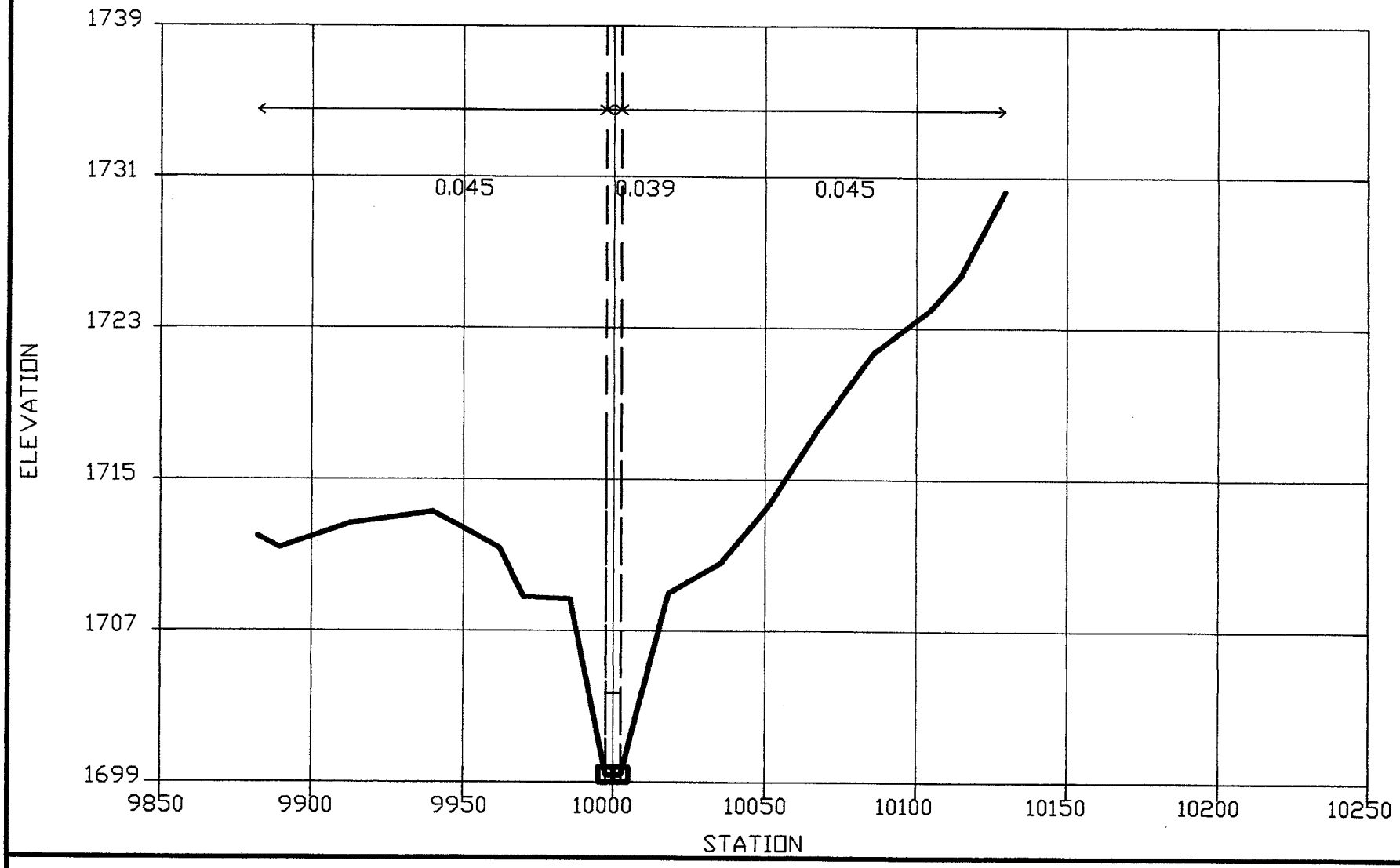


SECTION : 0.00

Fountain Hills (south) FIS

Sycamore Wash

File: SYC-XSEC.DWG

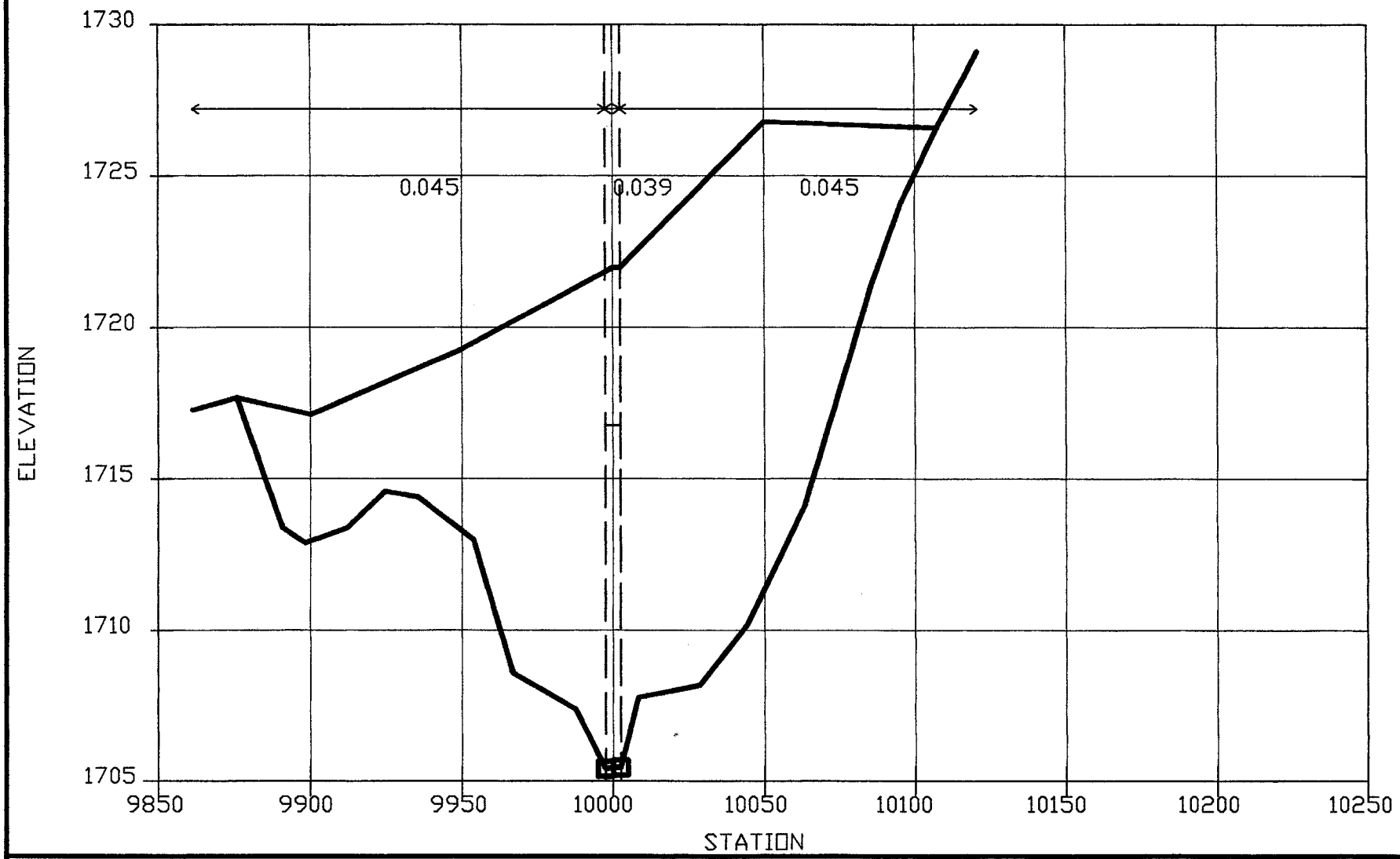


SECTION : 0.05

Fountain Hills (south) FIS

Sycamore Wash

File: SYC-XSEC.DWG

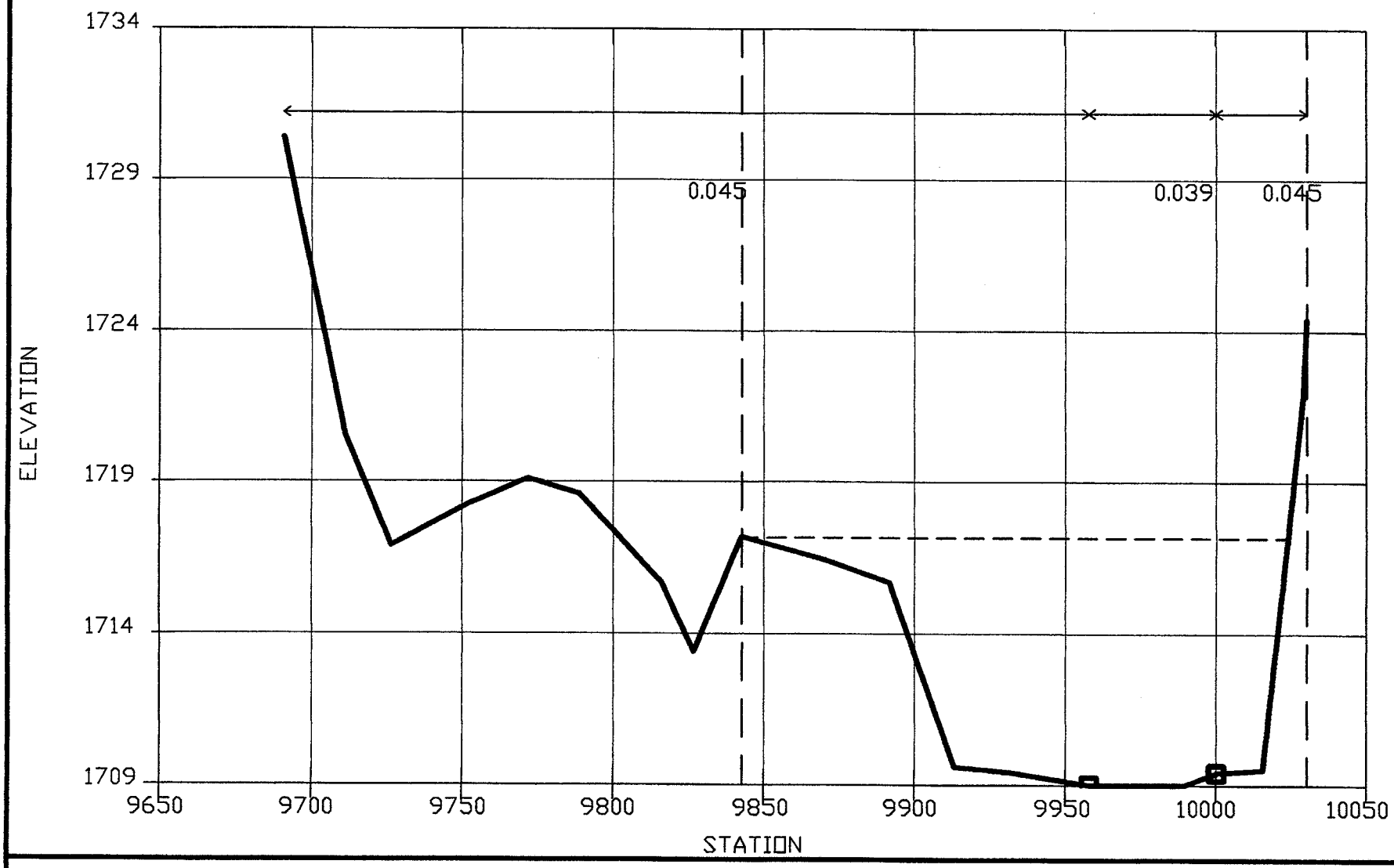


SECTION : 0.06

Fountain Hills (south) FIS

Sycamore Wash

File: SYC-XSEC.DWG

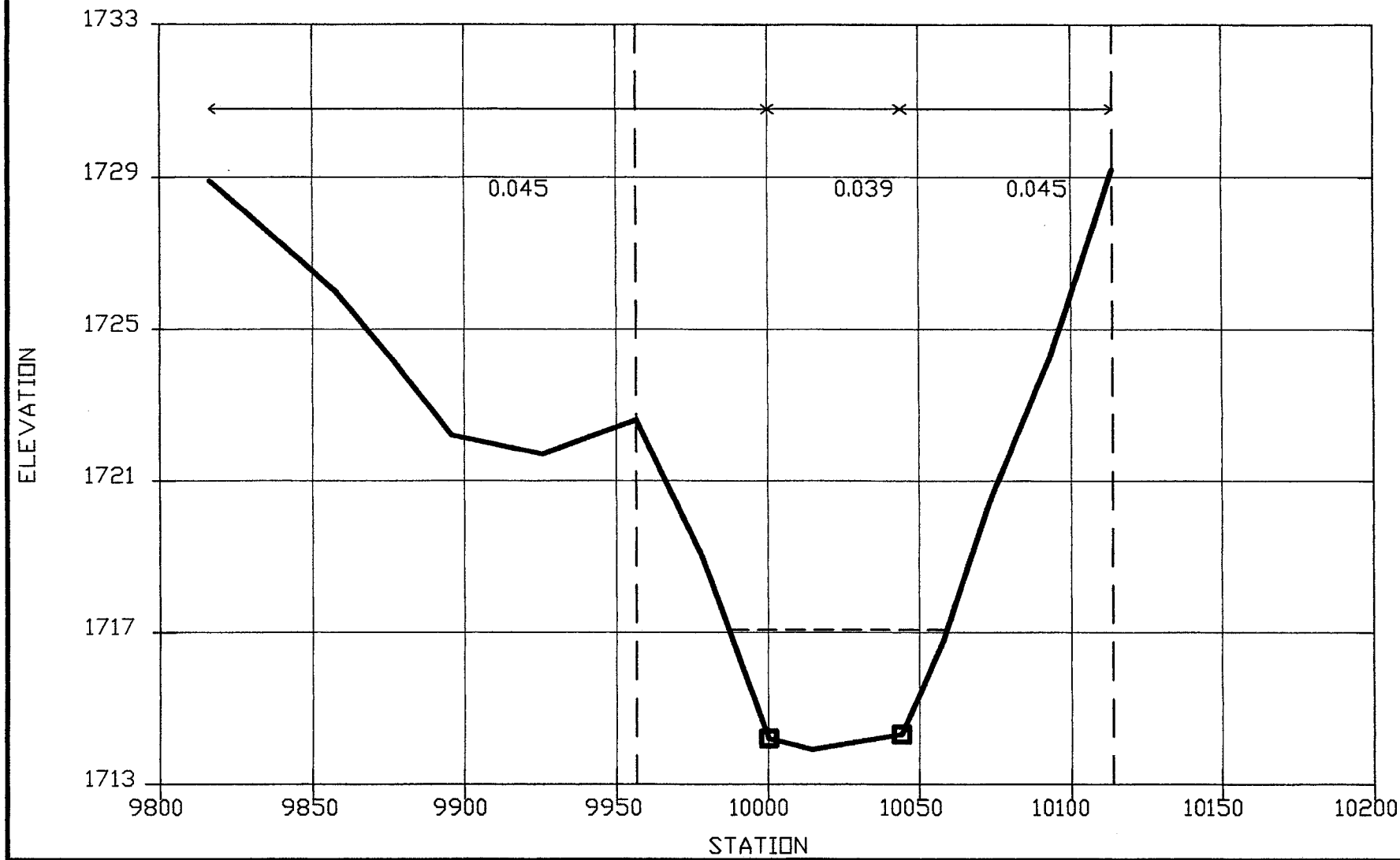


SECTION : 0.09

Fountain Hills (south) FIS

Sycamore Wash

File: SYC-XSEC.DWG

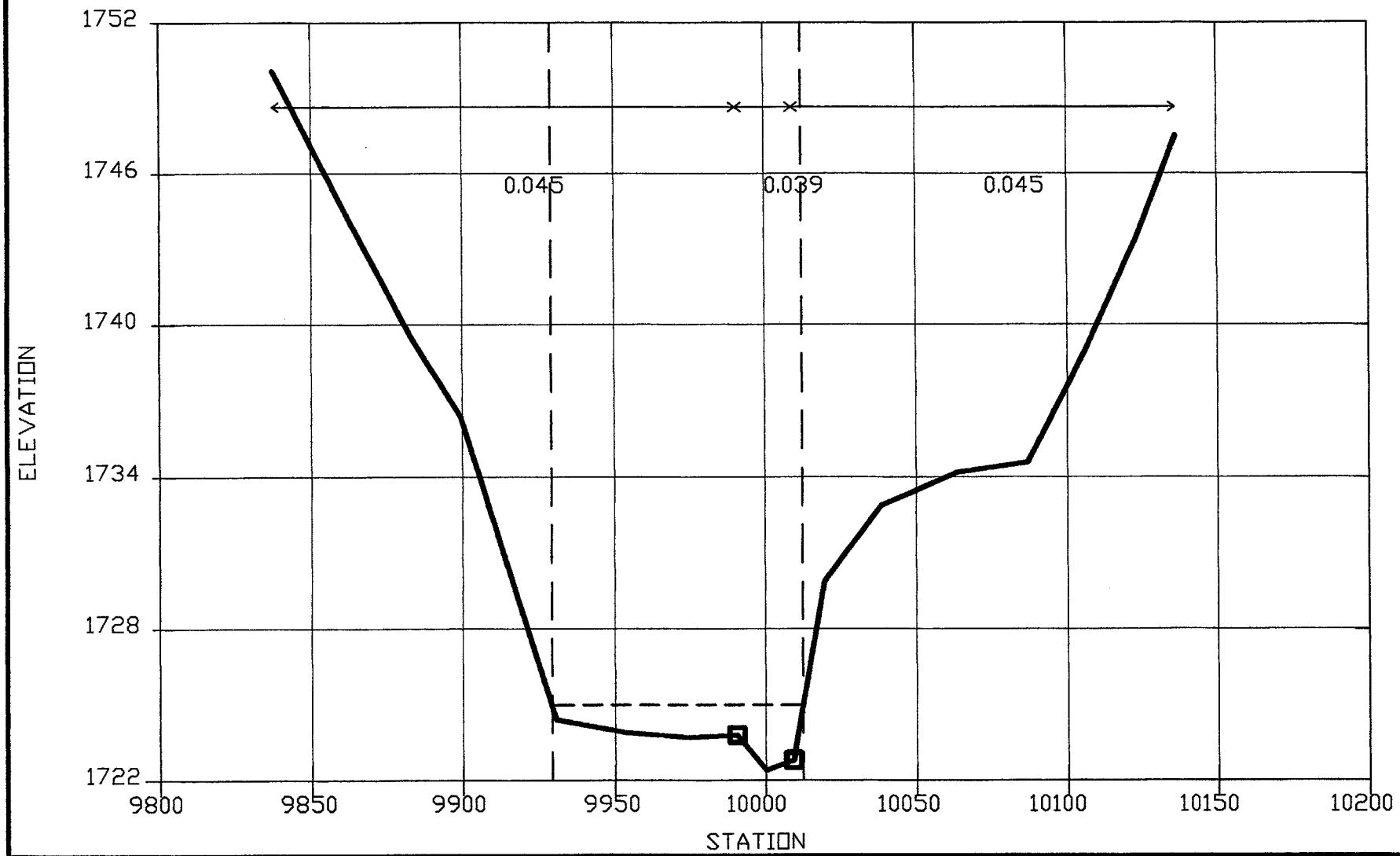


SECTION : 0.15

Fountain Hills (south) FIS

Sycamore Wash

File: SYC-XSEC.DWG

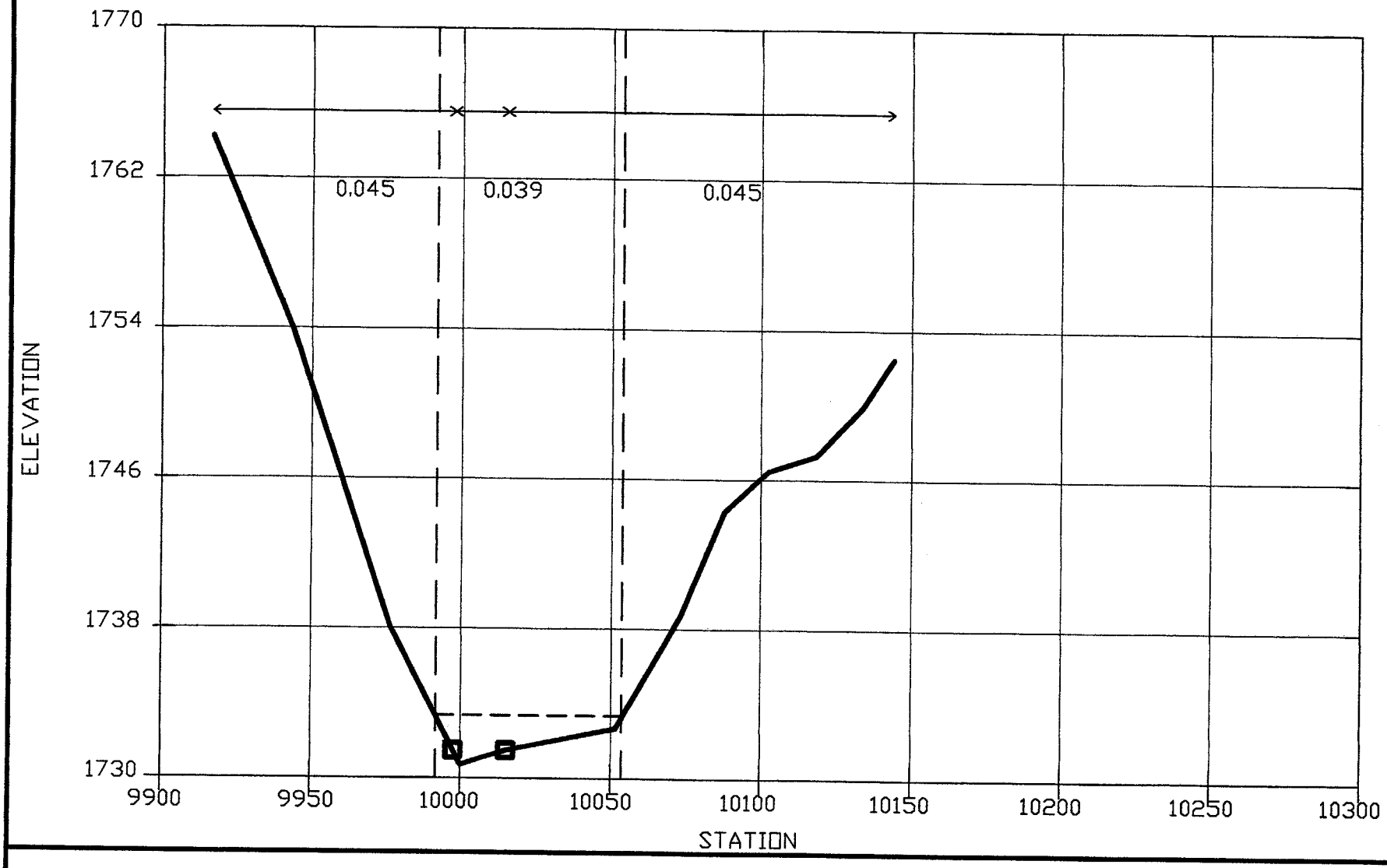


SECTION : 0.22

Fountain Hills (south) FIS

Sycamore Wash

File: SYC-XSEC.DWG

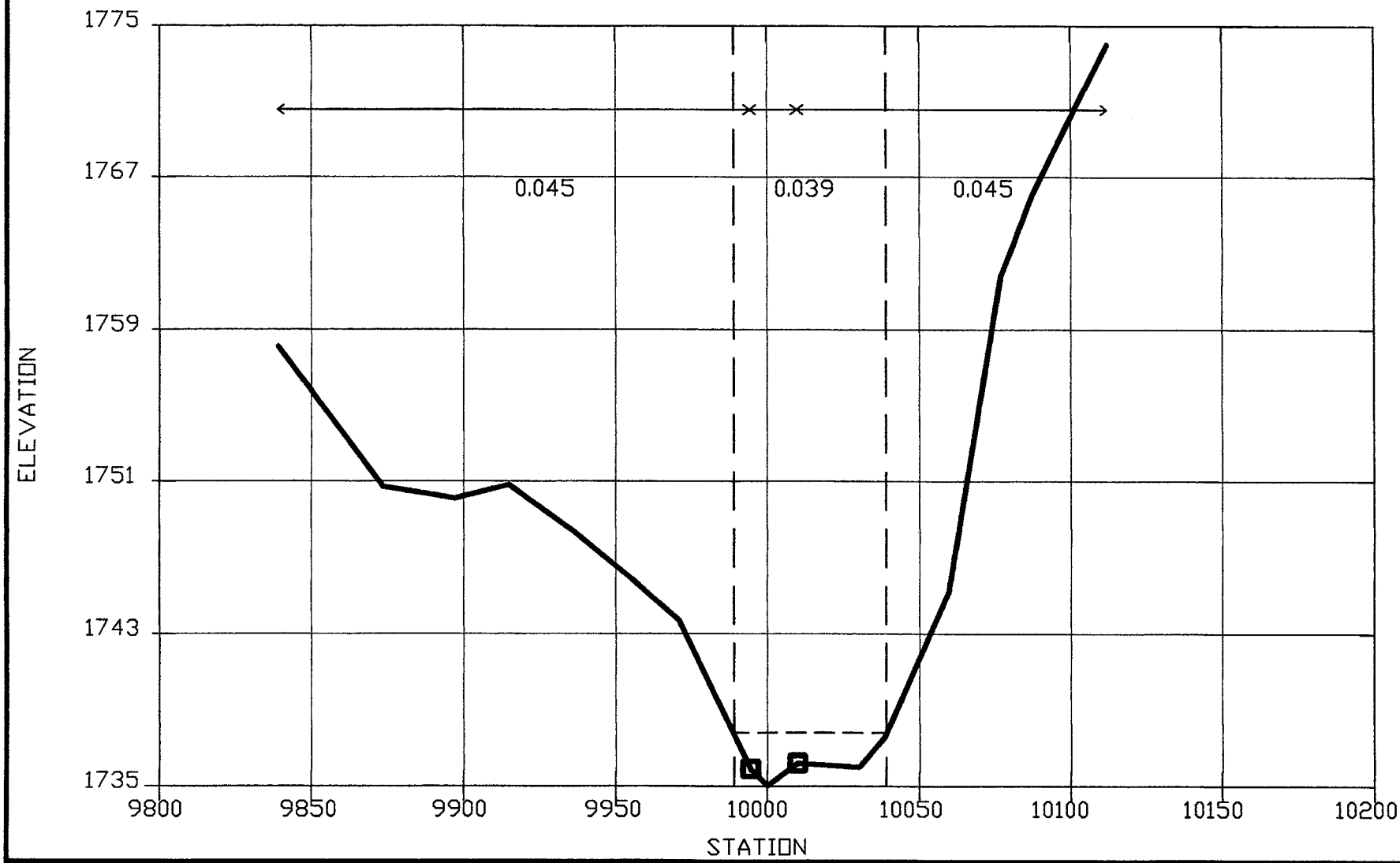


SECTION : 0.31

Fountain Hills (south) FIS

Sycamore Wash

File: SYC-XSEC.DWG

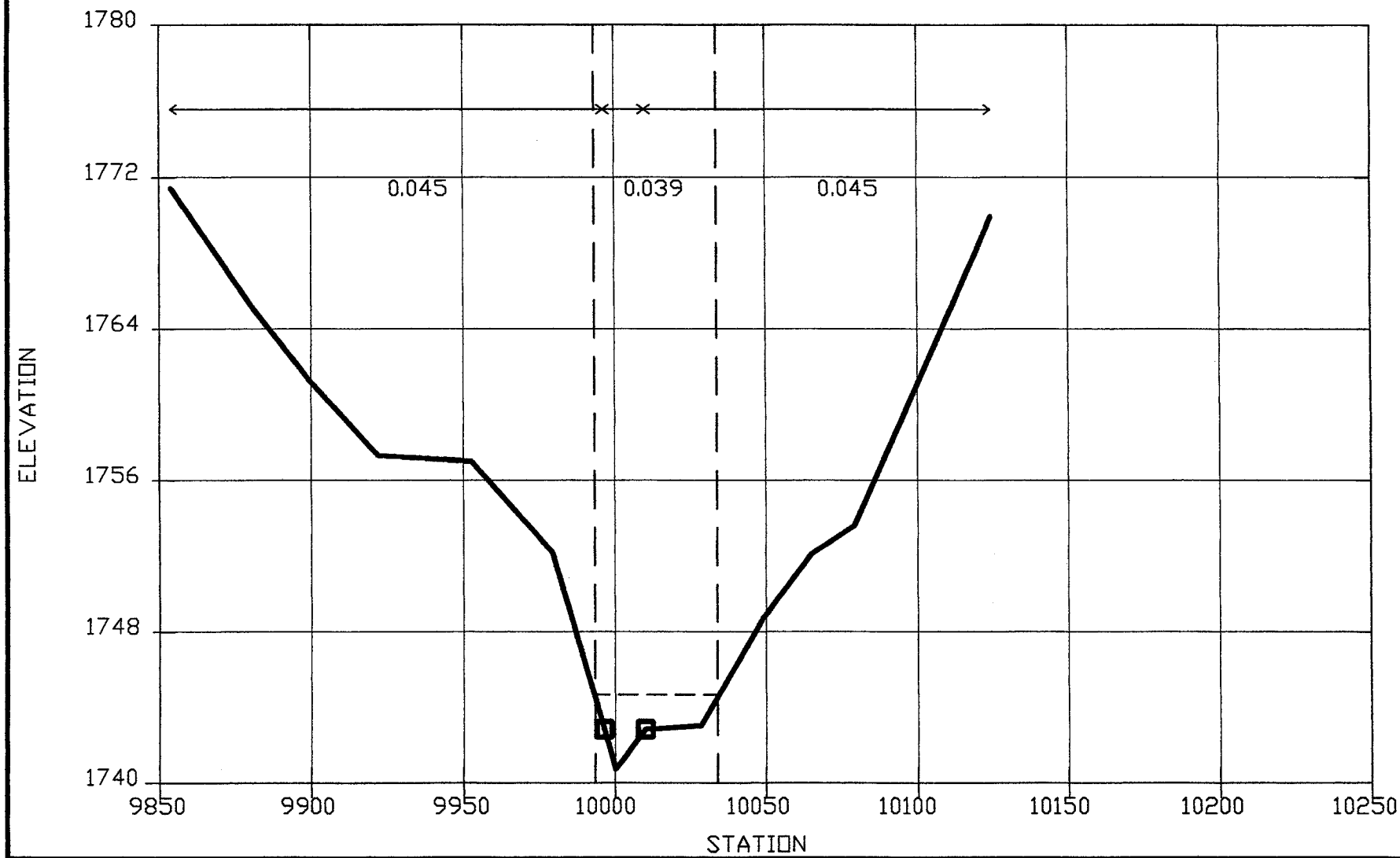


SECTION : 0.36

Fountain Hills (south) FIS

Sycamore Wash

File: SYC-XSEC.DWG

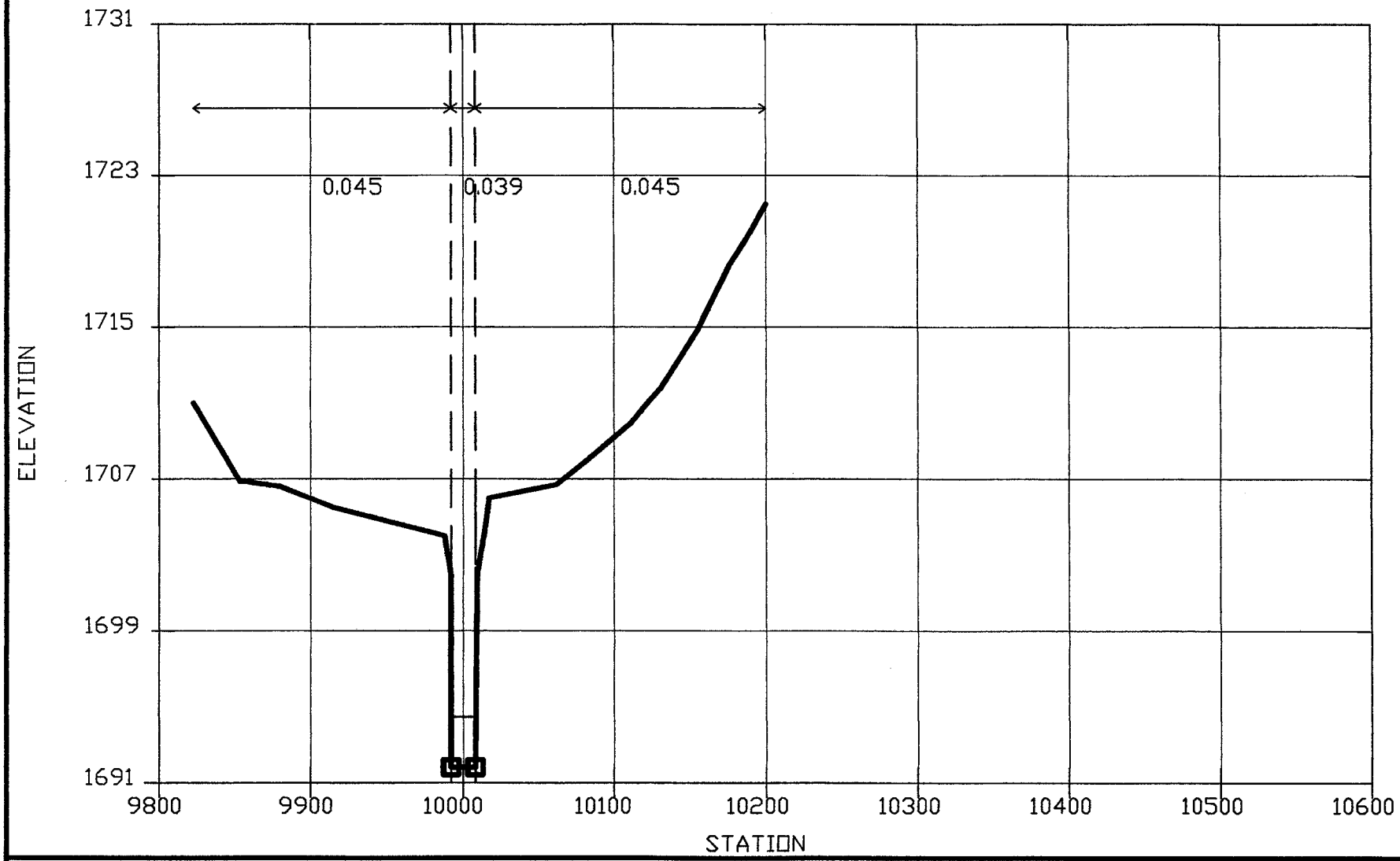


SECTION : 0.40

Fountain Hills (south) FIS

Sycamore Wash

File: SYC-XSEC.DWG

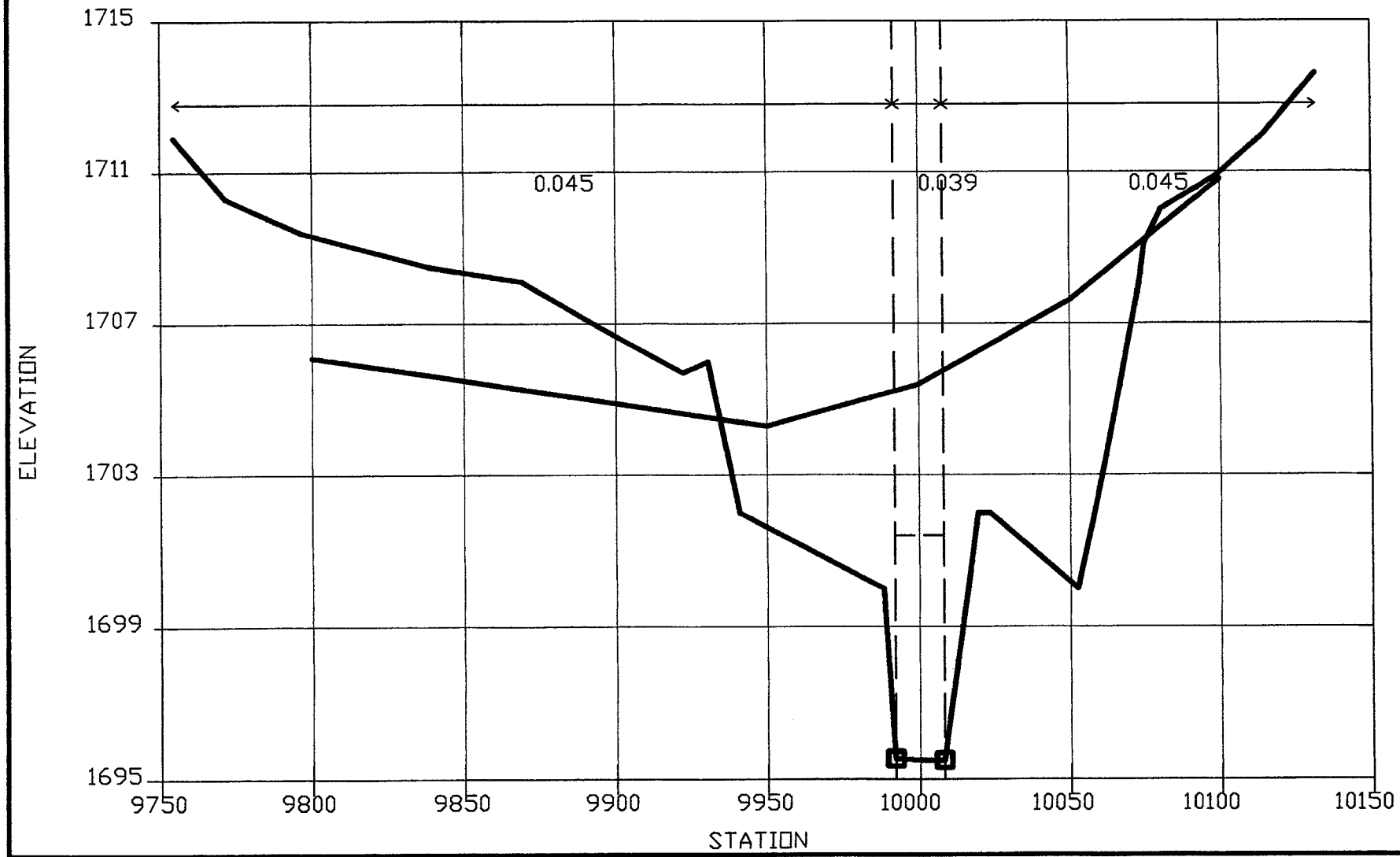


SECTION : 4.45

Fountain Hills (south) FIS

Sycamore Wash

File: SYC-XSEC.DWG

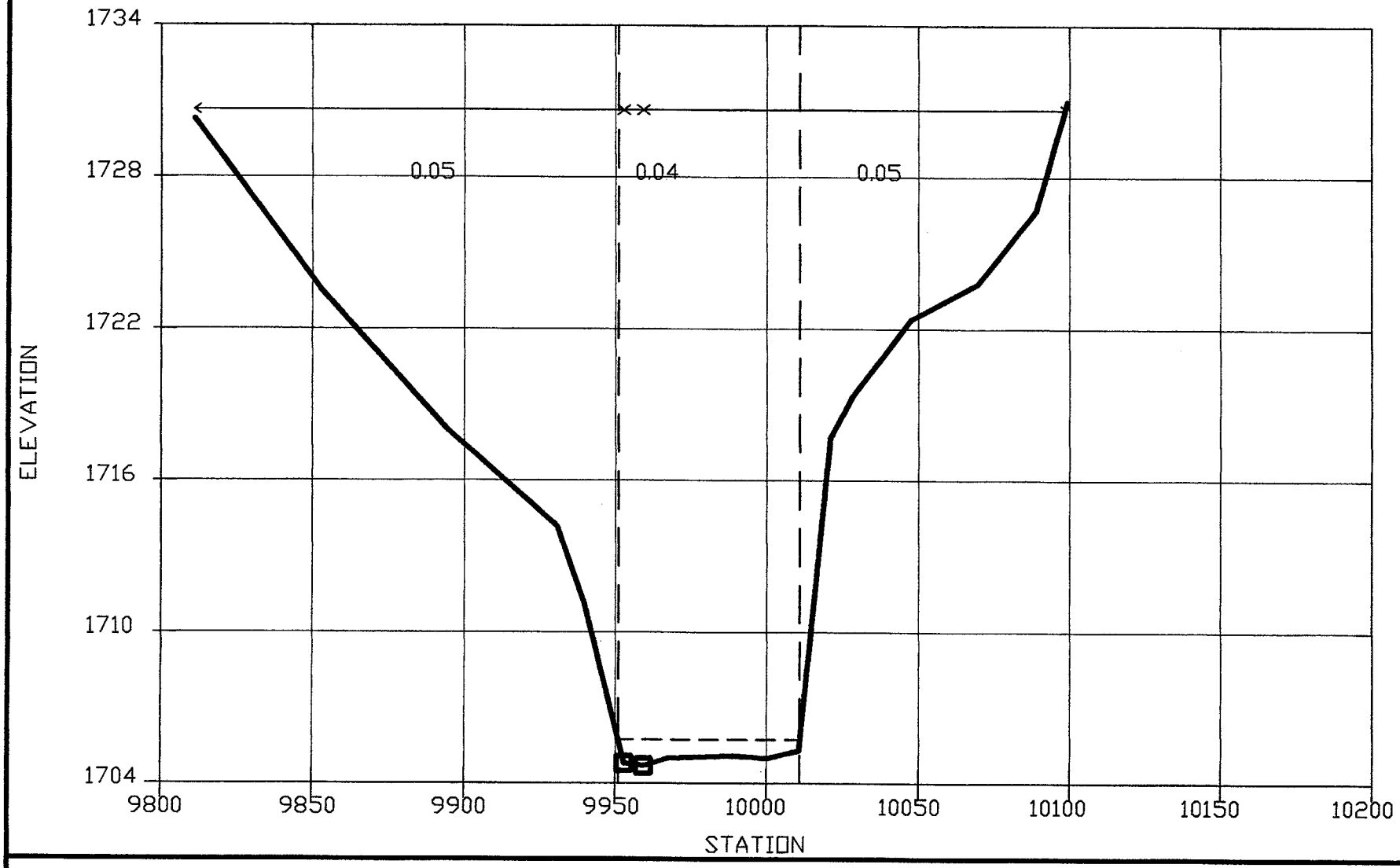


SECTION : 0.00

Fountain Hills (south) FIS

Greystone Wash

File: GRE-XSEC.DWG

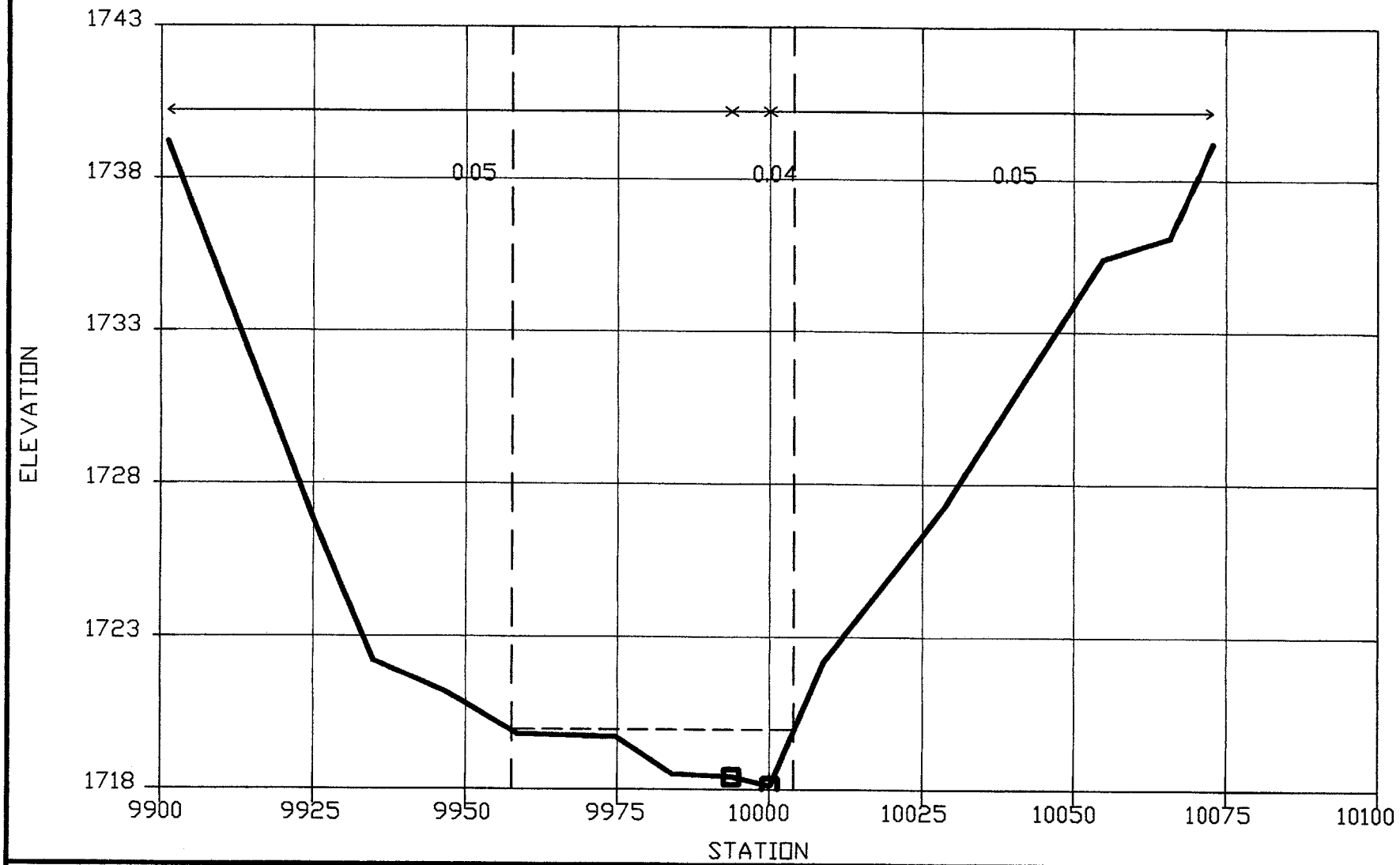


SECTION : 0.05

Fountain Hills (south) FIS

Greystone Wash

File: GRE-XSEC.DWG

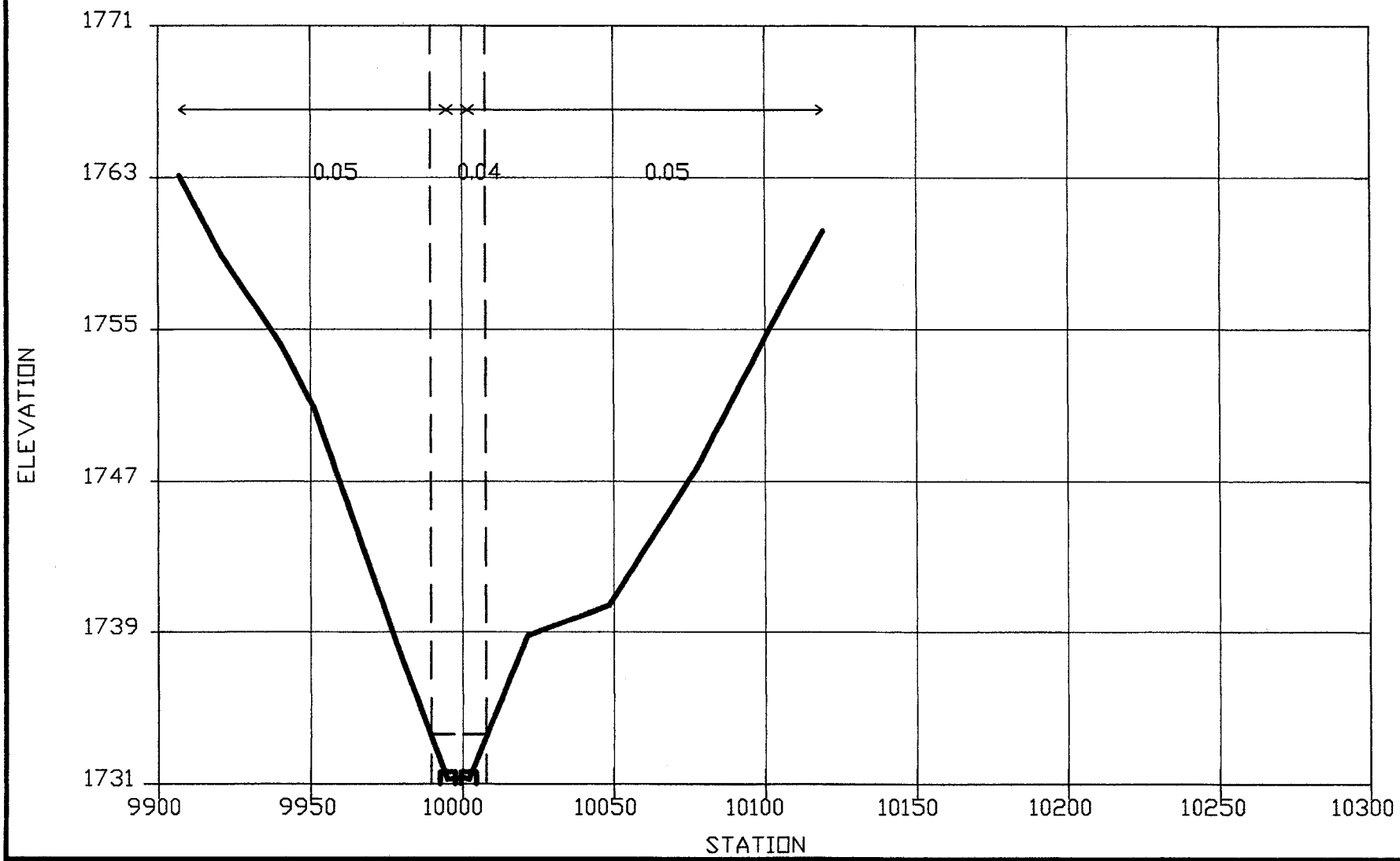


SECTION : 0.11

Fountain Hills (south) FIS

Greystone Wash

File: GRE-XSEC.DWG

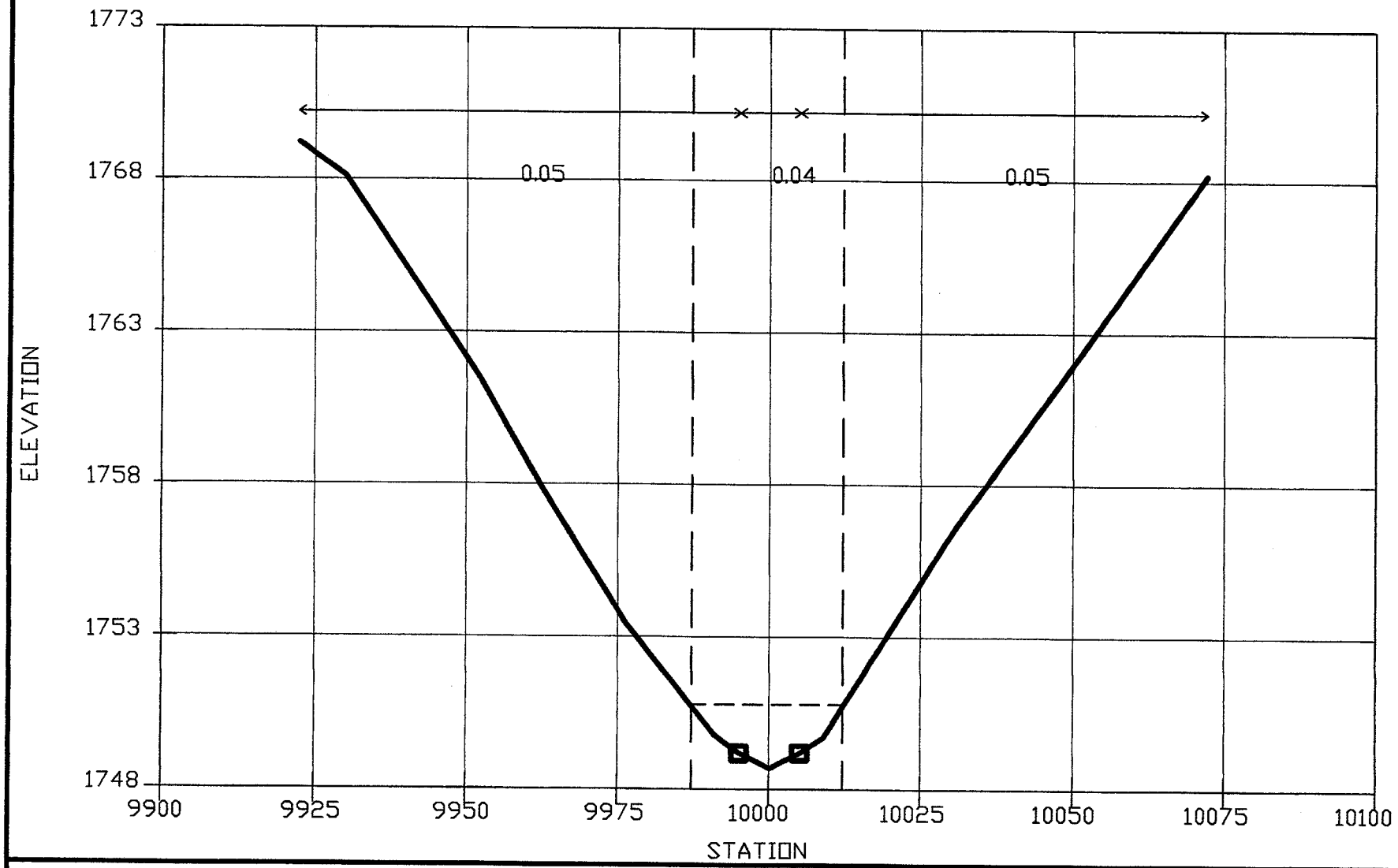


SECTION : 0.18

Fountain Hills (south) FIS

Greystone Wash

File: GRE-XSEC.DWG

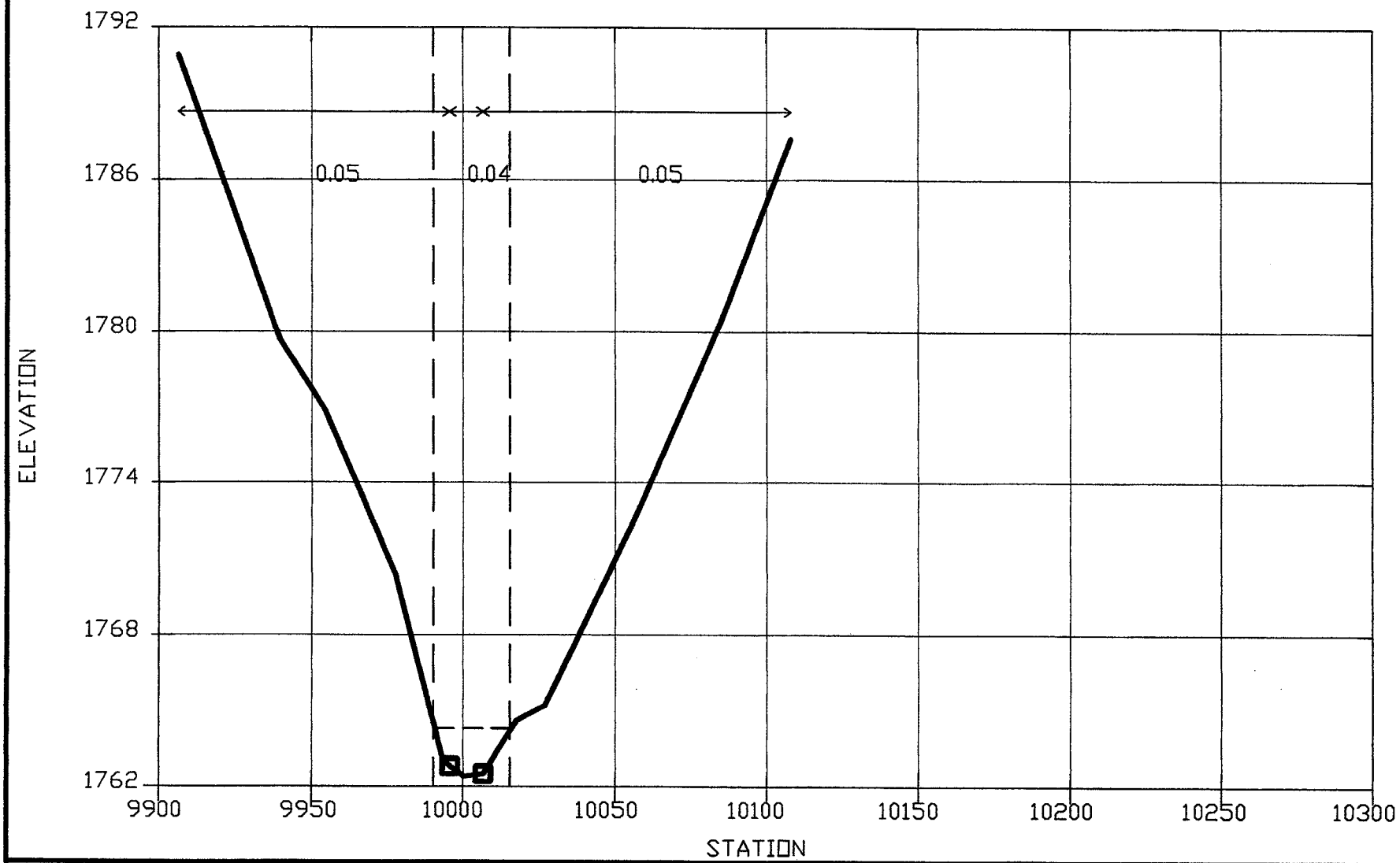


SECTION : 0.26

Fountain Hills (south) FIS

Greystone Wash

File: GRE-XSEC.DWG

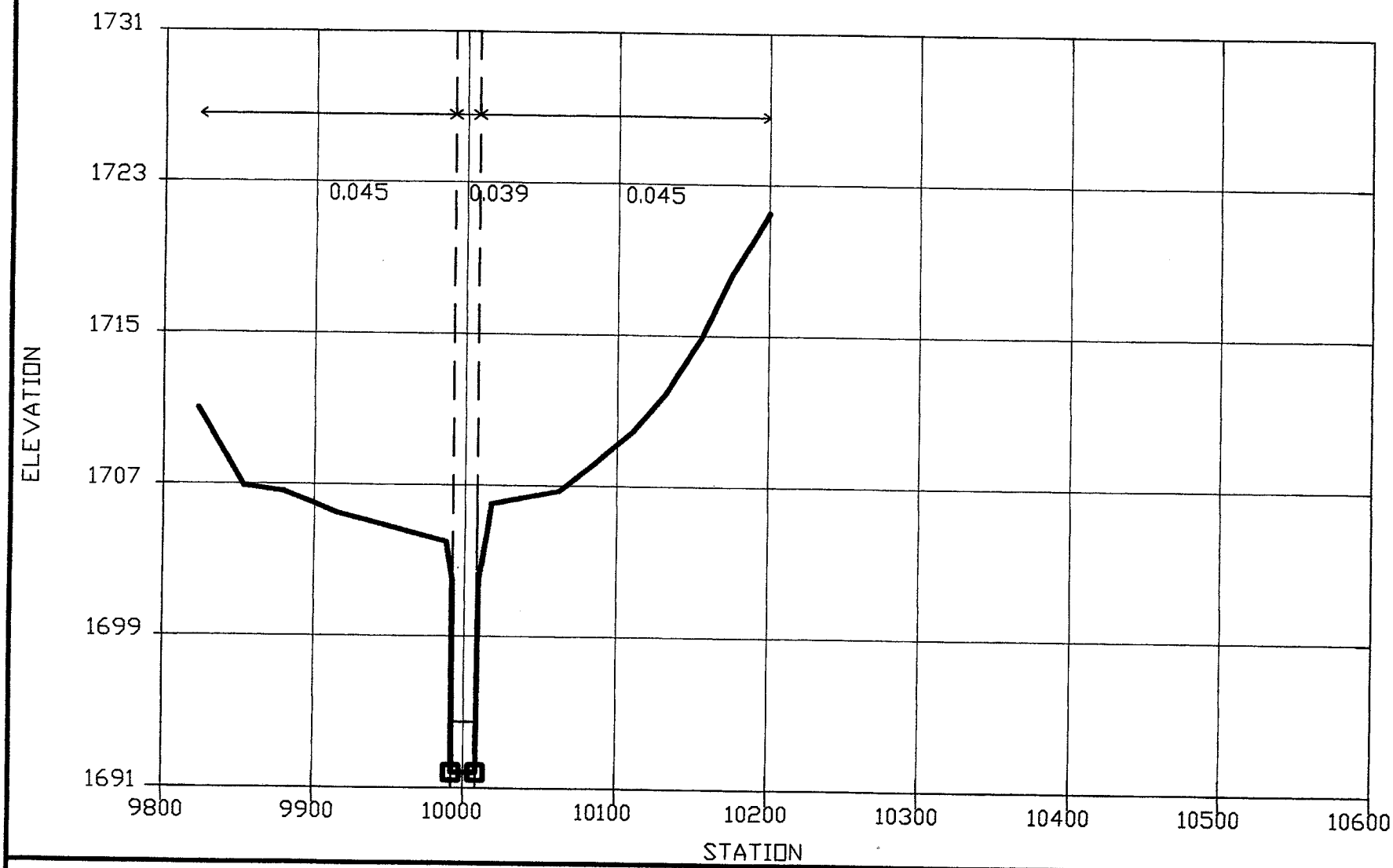


SECTION : 0.31

Fountain Hills (south) FIS

Greystone Wash

File: GRE-XSEC.DWG

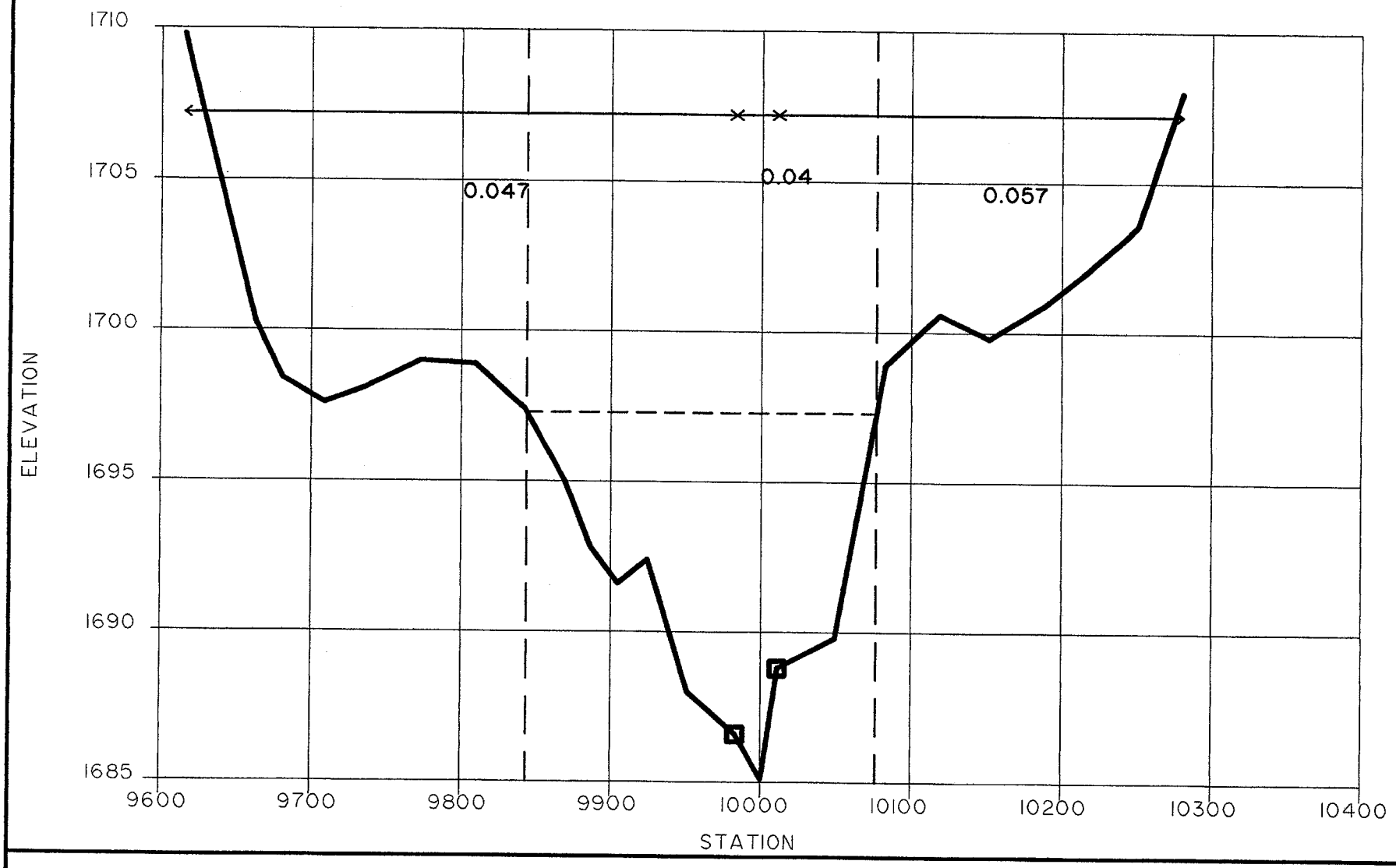


SECTION : 4.45

Fountain Hills (south) FIS

Greystone Wash

File: GRE-XSEC.DWG

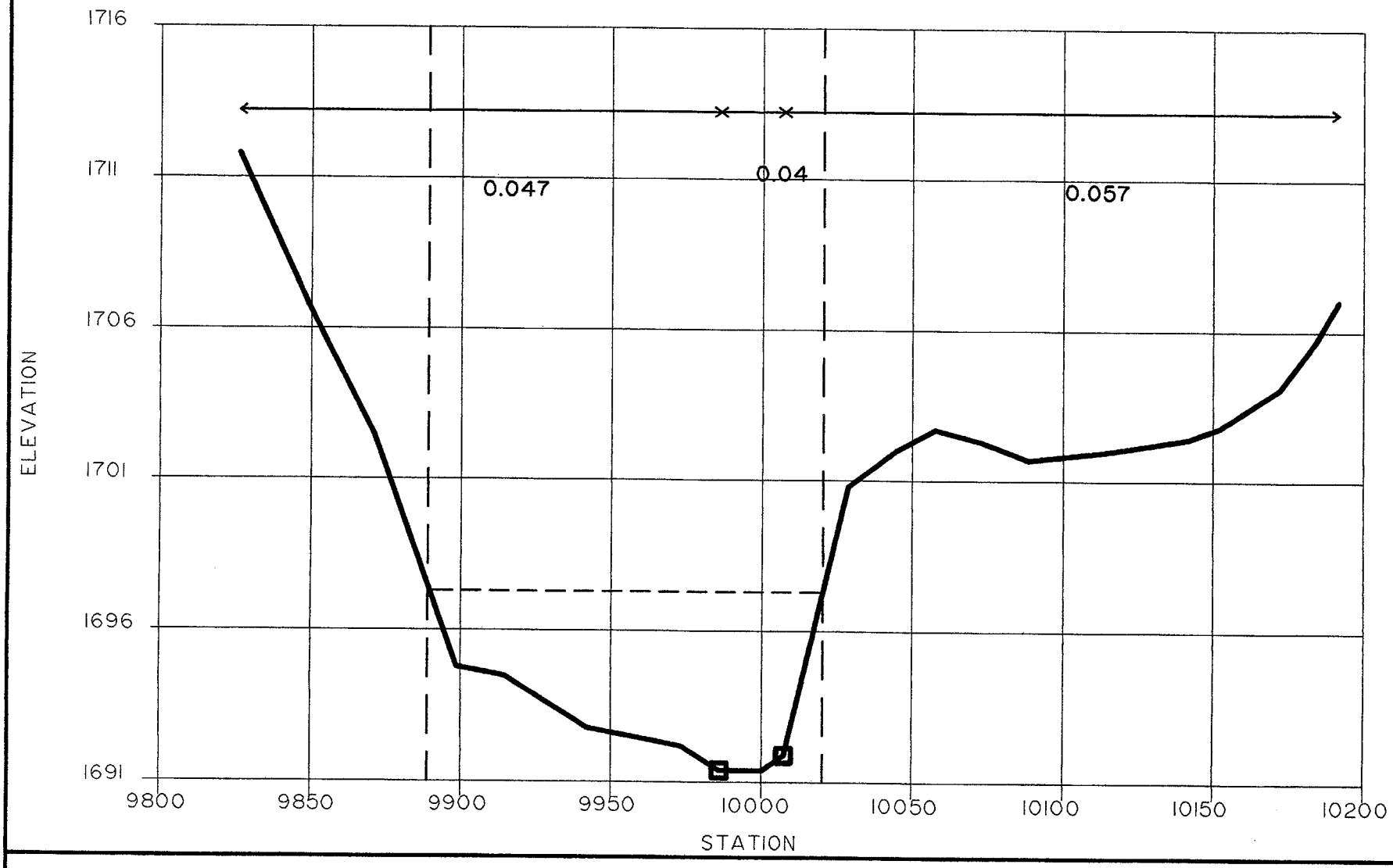


SECTION : 0.00

Fountain Hills (south) FIS

Sunburst Wash

File: SUN-XSEC.DWG

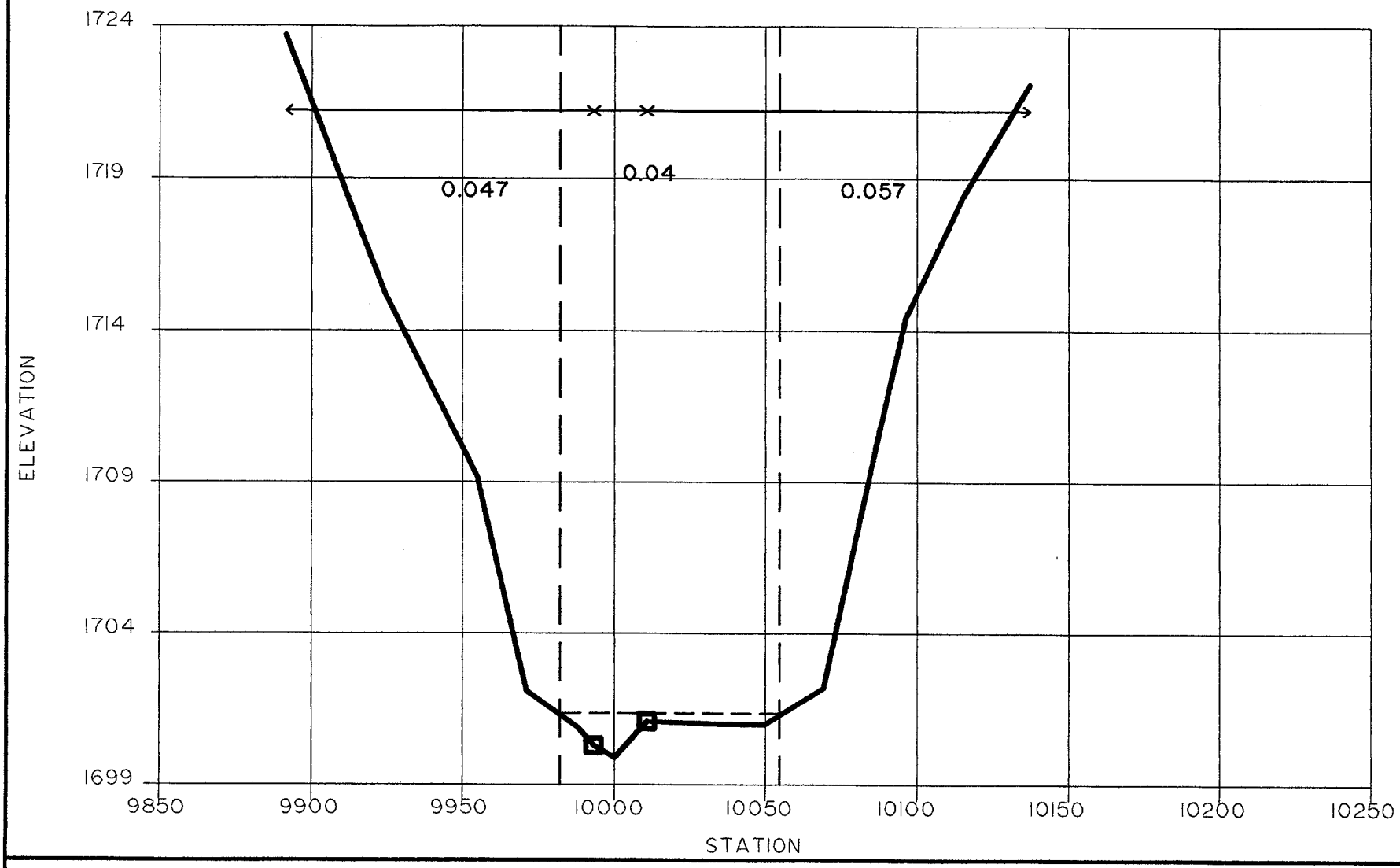


SECTION : 0.04

Fountain Hills (south) FIS

Sunburst Wash

File: SUN-XSEC.DWG

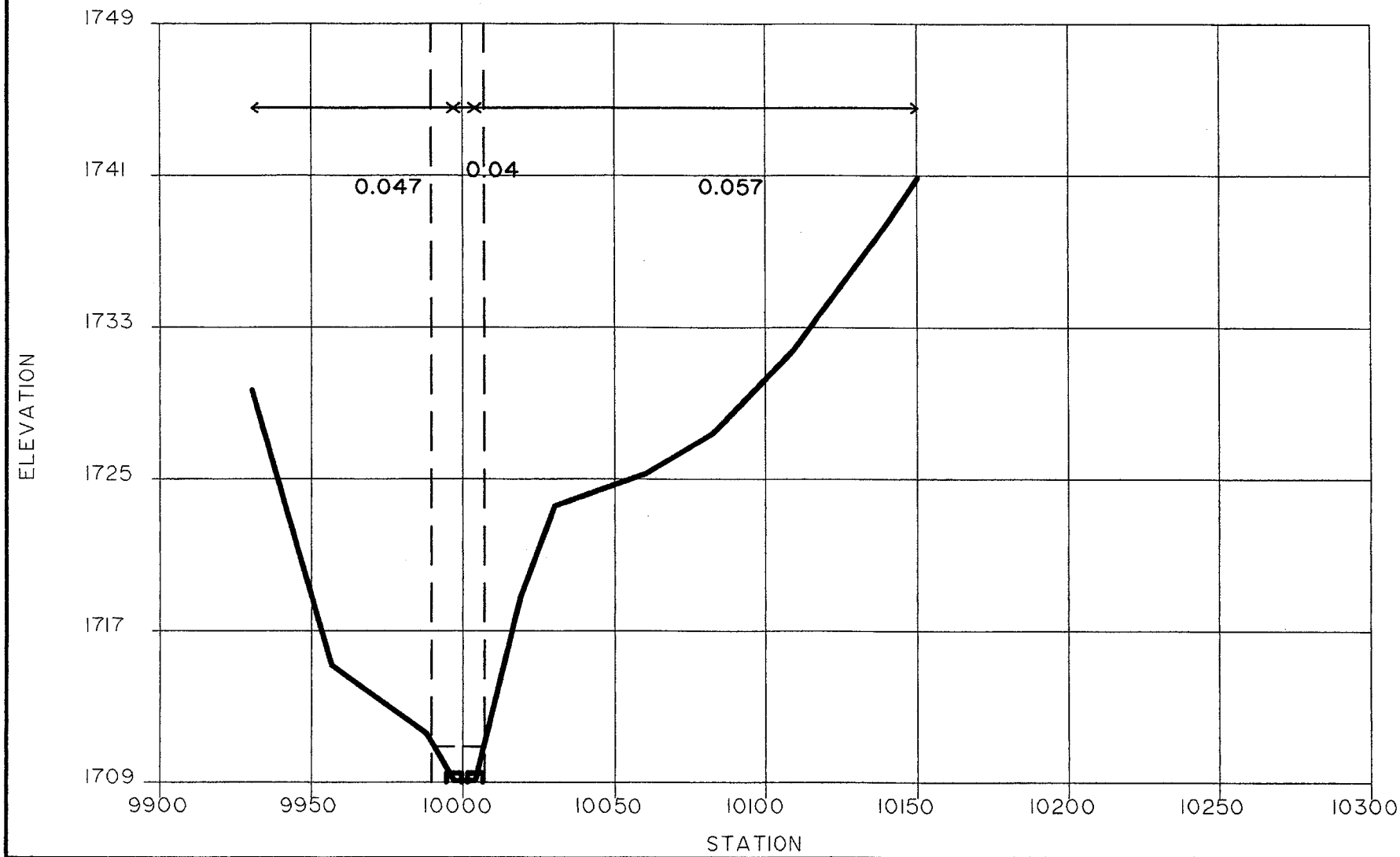


SECTION : 0.10

Fountain Hills (south) FIS

Sunburst Wash

File: SUN-XSEC.DWG

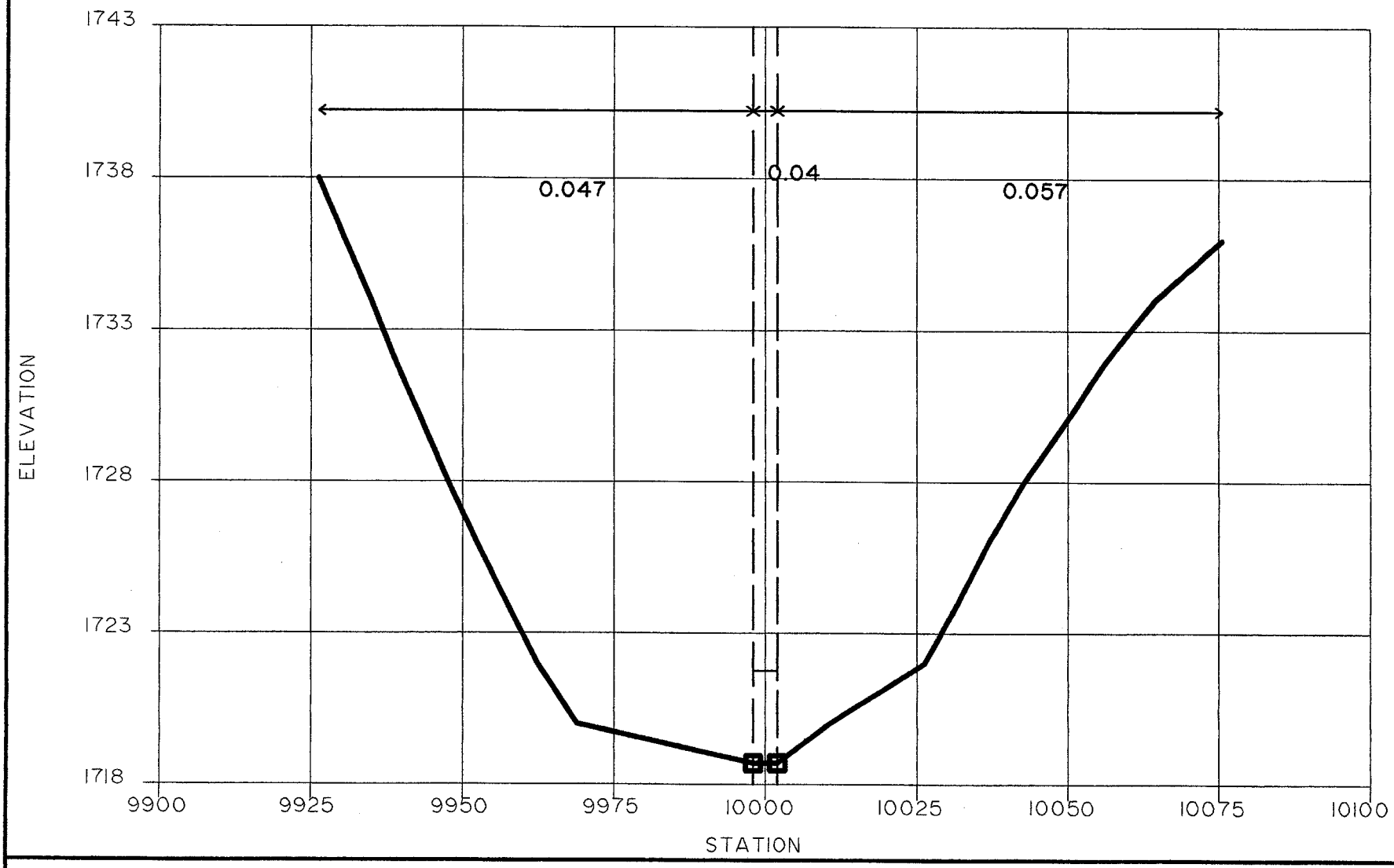


SECTION : 0.19

Fountain Hills (south) FIS

Sunburst Wash

File: SUN-XSEC.DWG

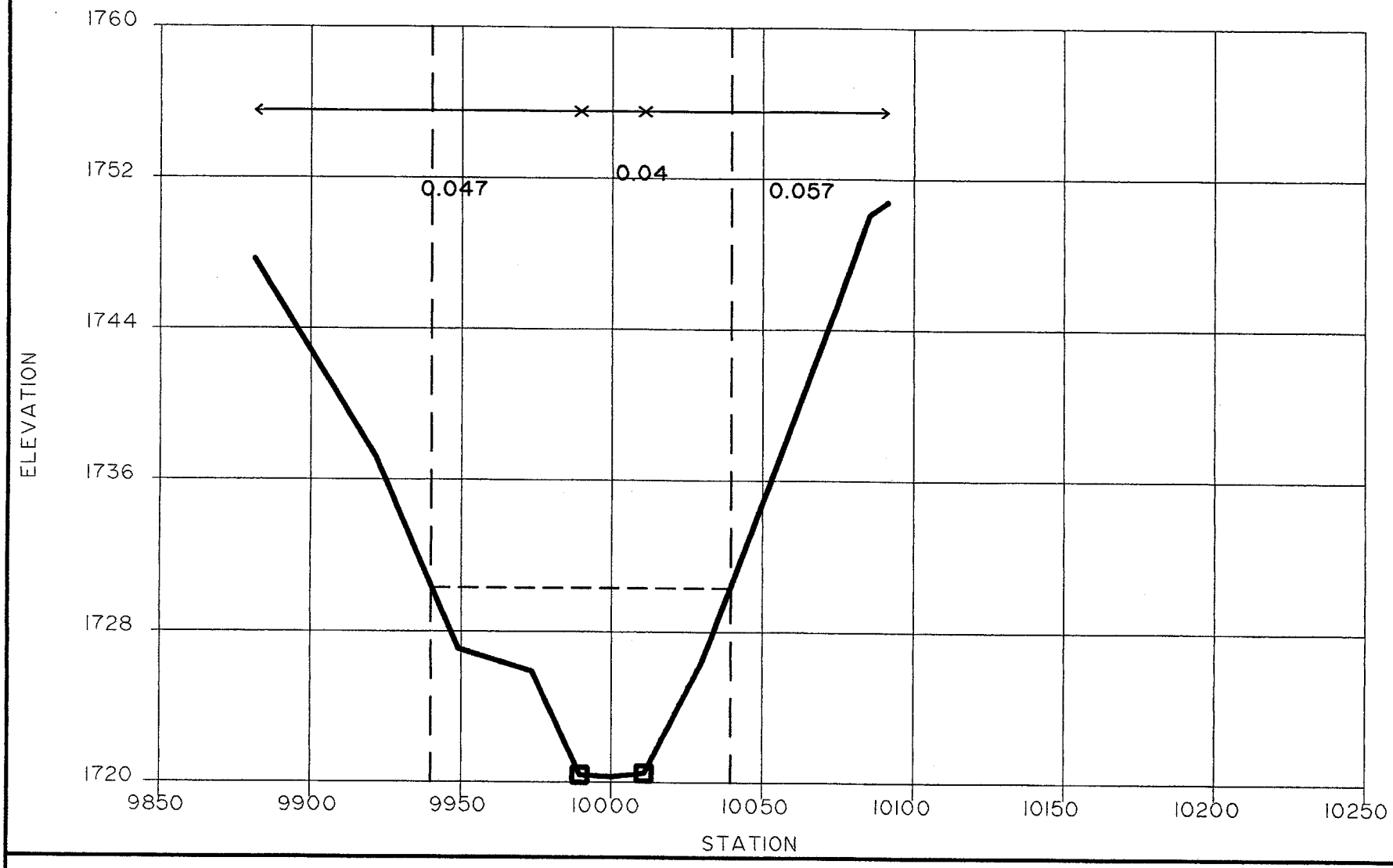


SECTION : 0.21

Fountain Hills (south) FIS

Sunburst Wash

File: SUN-XSEC.DWG

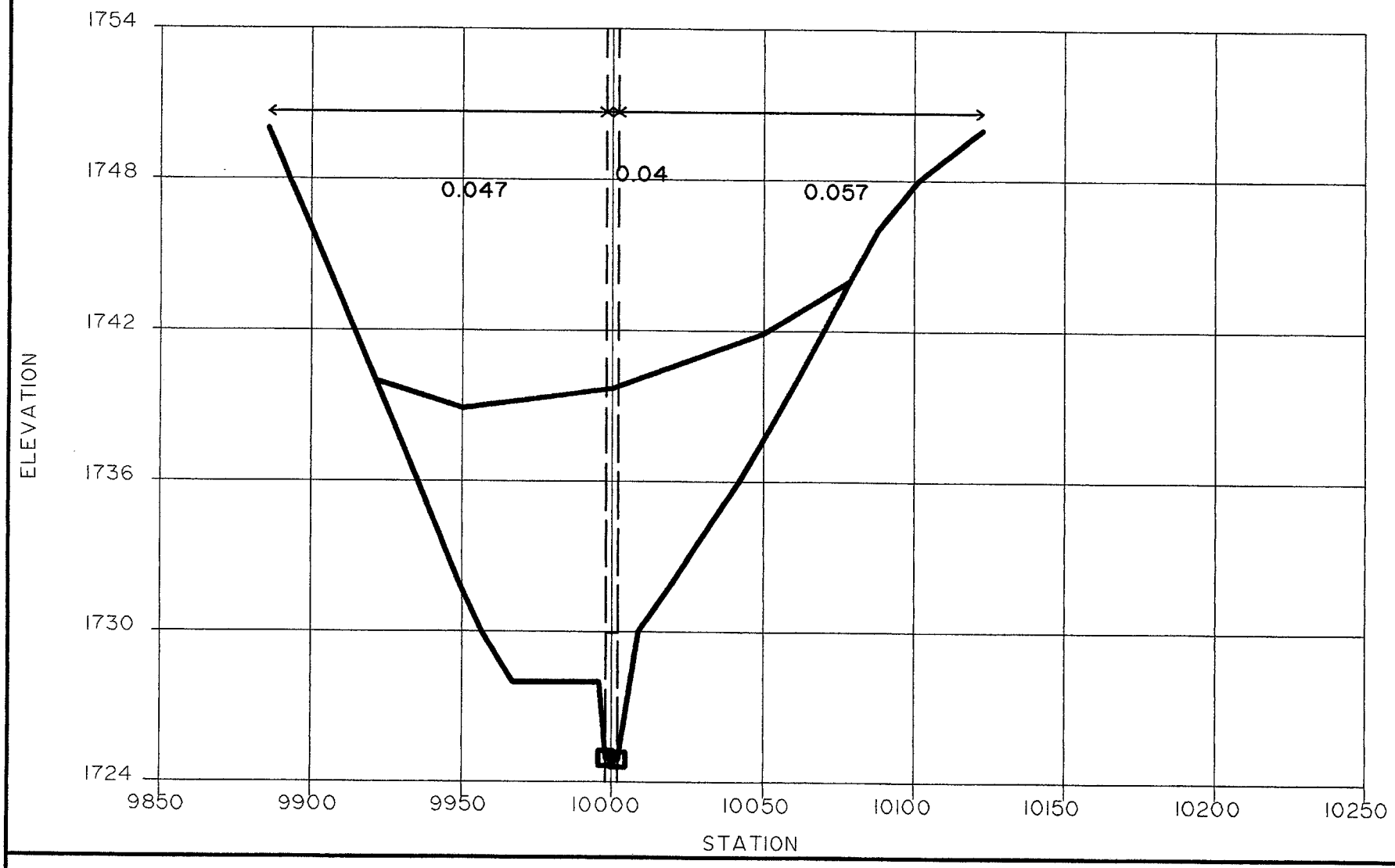


SECTION : 0.26

Fountain Hills (south) FIS

Sunburst Wash

File: SUN-XSEC.DWG

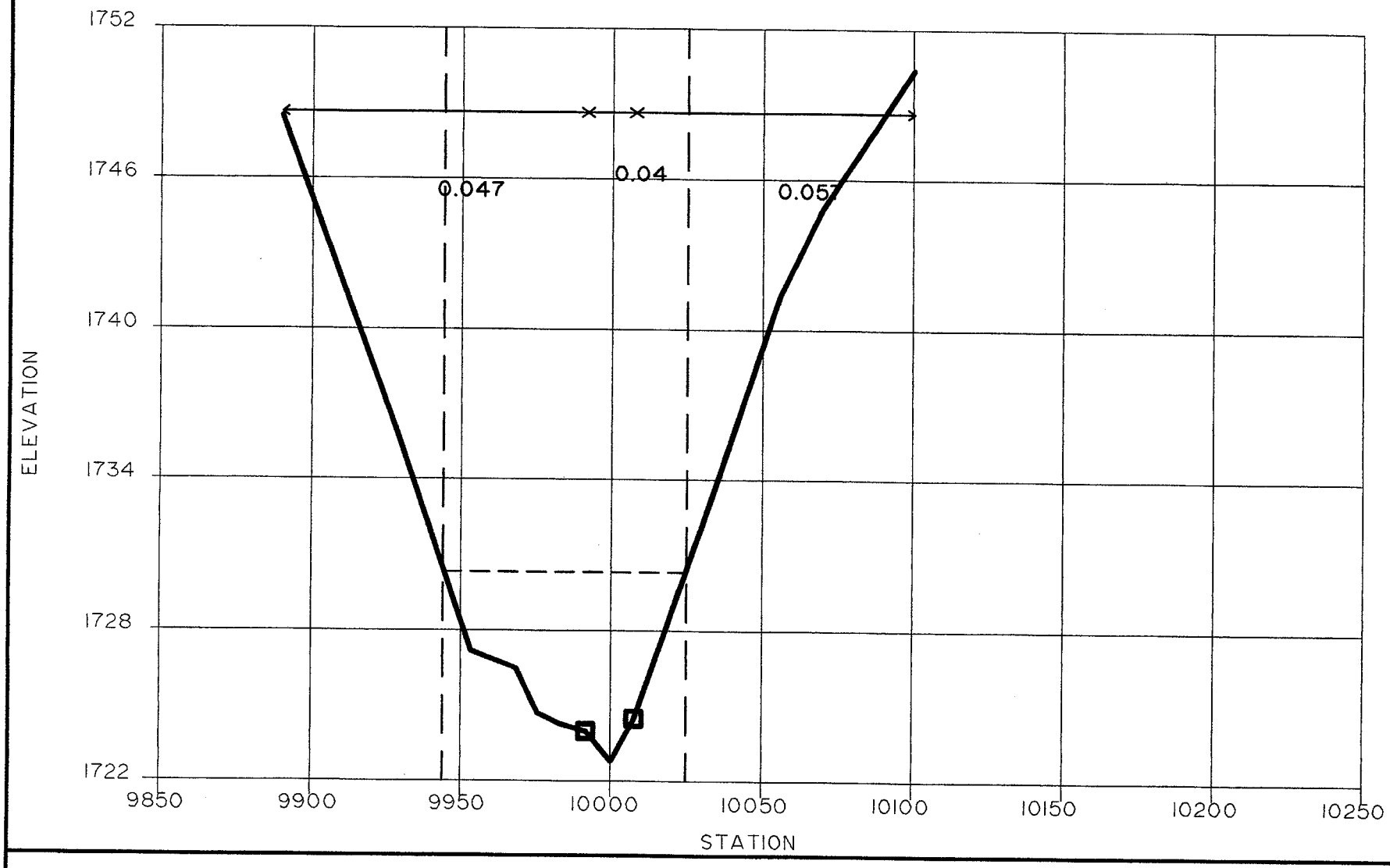


SECTION : 0.24

Fountain Hills (south) FIS

Sunburst Wash

File: SUN-XSEC.DWG

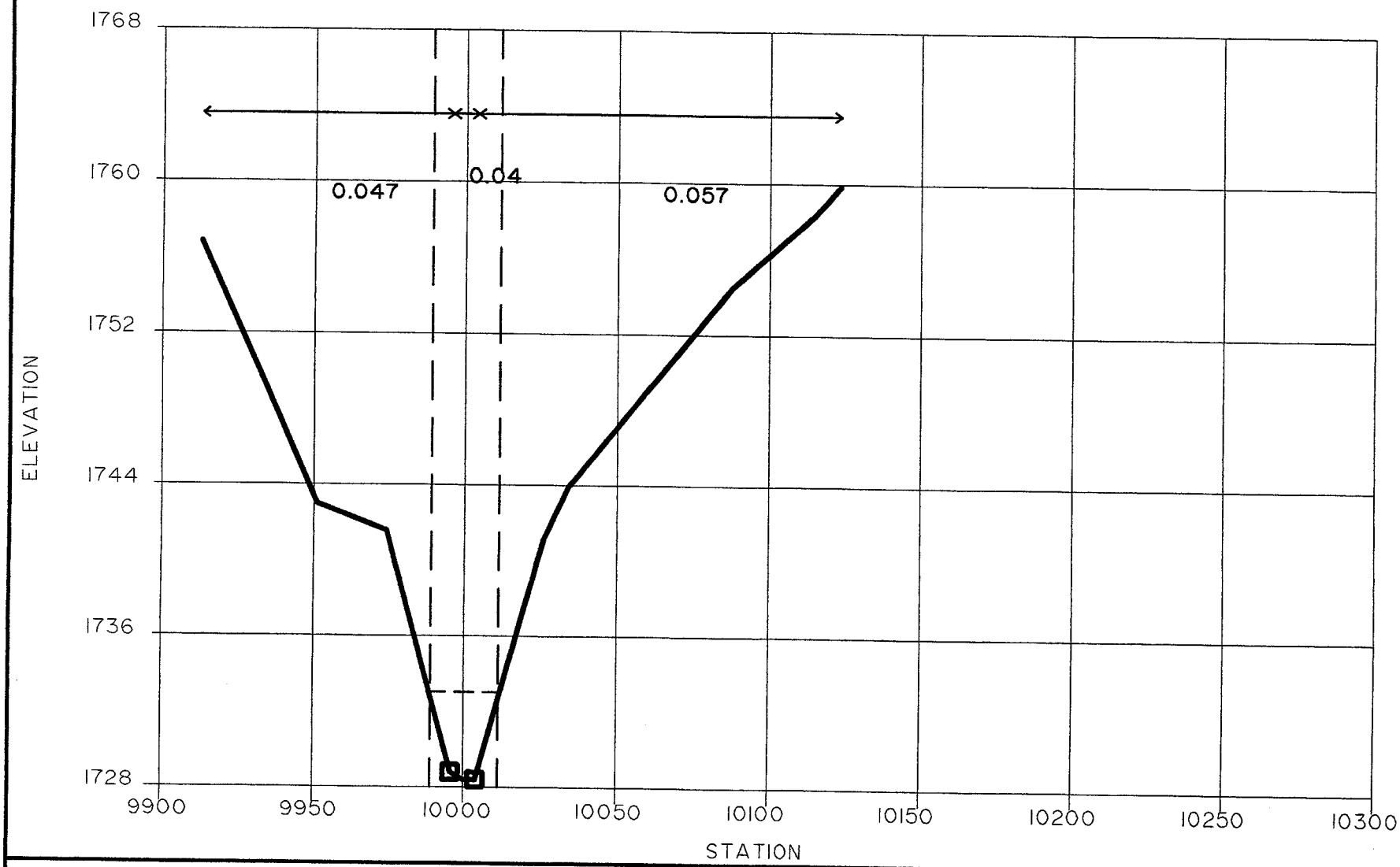


SECTION : 0.30

Fountain Hills (south) FIS

Sunburst Wash

File: SUN-XSEC.DWG



SECTION : 0.36

Fountain Hills (south) FIS

Sunburst Wash

File: SUN-XSEC.DWG

Intelligent Engineering
Environmental *Solutions*

March 30, 1999

FLOOD CONTROL DISTRICT
RECEIVED
MAR 31 1999
CHENG | P & PM
PIO | REG
ADMIN | PW MGT
FINANCE | CONTRACT
O & M | FILE
ENGR | TMM
REMARKS

Mr. Tim Murphy
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix, AZ 85009

Reference: Fountain Hills South Floodplain Delineation Study
FCD 92-05

Dear Mr. Murphy:

Entellus

A couple of months ago while working on another project in the Fountain Hills area, we discovered that the elevation for Elevation Reference Mark (ERM) No. 5, as shown in Appendix A of the *Technical Data Notebook, Hydraulics*, was incorrectly referenced by Valco Surveying Corporation, our subconsultant for the above referenced project.

After reviewing their notes and revisiting the site, Velco Surveying noticed that at the time of the original survey performed around 1994, there were two intersections of Laser Drive and Saguaro Blvd. The intersection where ERM No. 5 was referred to has been renamed and is now known as Tombstone Avenue and Saguaro Blvd.

Enclosed are copies of the original and the revised Elevation Reference Marks (ERM) lists. Velco Surveying has listed both of these intersections and their appropriate elevations on their revised ERM list and identified them as ERM No. 5 and No. 5A.

We hope that this information would clarify the inconsistency of the elevation references. We apologize for any inconvenience caused by this inadvertent oversight. If you should have any questions or need further clarifications on this matter, please do not hesitate to contact us.

Sincerely,

ENTELLUS, INC.

Samuel E. Kao, Ph.D., P.E.
Vice President

cc: Mr. Randy Harrel, P.E., Town of Fountain Hills

2255 N. 44th Street
Suite 330
Phoenix, Arizona
85008.3279

Tel 602.244.2566
Fax 602.244.8947

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY

FOUNTAIN HILLS SOUTH FLOODPLAIN DELINEATION STUDY

FCD 92-05

REVISED ELEVATION REFERENCE MARKS (ERM'S)

REVISED JANUARY 1999

PREPARED BY

Valco Surveying Corporation
6426 East Virginia Avenue
Scottsdale, AZ 85257
(602) 990-2412

ELEVATION REFERENCE MARKS (ERM)
FOUNTAIN HILLS SOUTH FLOODPLAIN DELINEATION STUDY
REVISED JANUARY 1999

ID Number	Elevation (ft)	Description
1	1591.21	Top of Brass Cap, at intersection of Last Trail Drive and Saguaro Boulevard, being i nthe Southeast 1/4 of Section 27, Township 3 North, Range 6 East.
2	1619.95	Top of Brass Cap, at intersection of Leo Drive and Saguaro Blvd, being in the Southwest 1/4 of Section 27, Township 3 North, Range 6 East.
3	1659.58	Top of Brass Cap at a point of curvature of center line of Powderhorn Drive, 180 feet east of centerline of Powder Wash and 600 feet southeast of Tombstone Drive, being in the Southwest 1/4 of Section 27, Township 3 North, Range 6 East.
4	1550.10	Top of Brass Cap, at intersection of Firebrick Drive and Last Trail Drive, being in the Southwest 1/4 of Section 26, Township 3 North, Range 6 East.
5	1656.11	Top of Brass Cap, at intersection of Tombstone Avenue and Saguaro Blvd, being in the Southwest 1/4 of Section 27, Township 3 North, Range 6 East.
5A	1561.53	Top of Brass Cap, at intersection of Laser Drive and Saguaro Blvd, being in the Southwest 1/4 of Section 26, Township 3 North, Range 6 East.
6	1730.16	Top of Boat Spike at intersection of Nicklaus Drive and Keota Drive, at North 1/4 section corner of Section 27, Township 3 North, Range 6 East.
7	1782.62	Top of Brass Cap at intersection of Kingstree Boulevard and Keota Drive, being in the Southwest 1/4 of Section 22, Township 3 North, Range 6 East.
8	1772.76	Top of Boat Spike at intersection of Pinto Drive and Fountain Hills Boulevard, being in the Southeast 1/4 of Section 21, Township 3 North, Range 6 East.

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY

FOUNTAIN HILLS SOUTH FLOODPLAIN DELINEATION STUDY

FCD 92-05

ELEVATION REFERENCE MARKS (ERM)

JANUARY 1996

REGISTERED LAND SURVEYOR
CERTIFICATE NO.
18552
Valentine M.
Padilla
Date Signed 1-15-96
ARIZONA, U.S.A.

Prepared by

Valco Surveying Corporation
6426 East Virginia Avenue
Scottsdale, Arizona 85257
(602) 990-2412

ELEVATION REFERENCE MARKS (EMR)
FOUNTAIN HILLS SOUTH PLOODPLAIN DELINEATION STUDY

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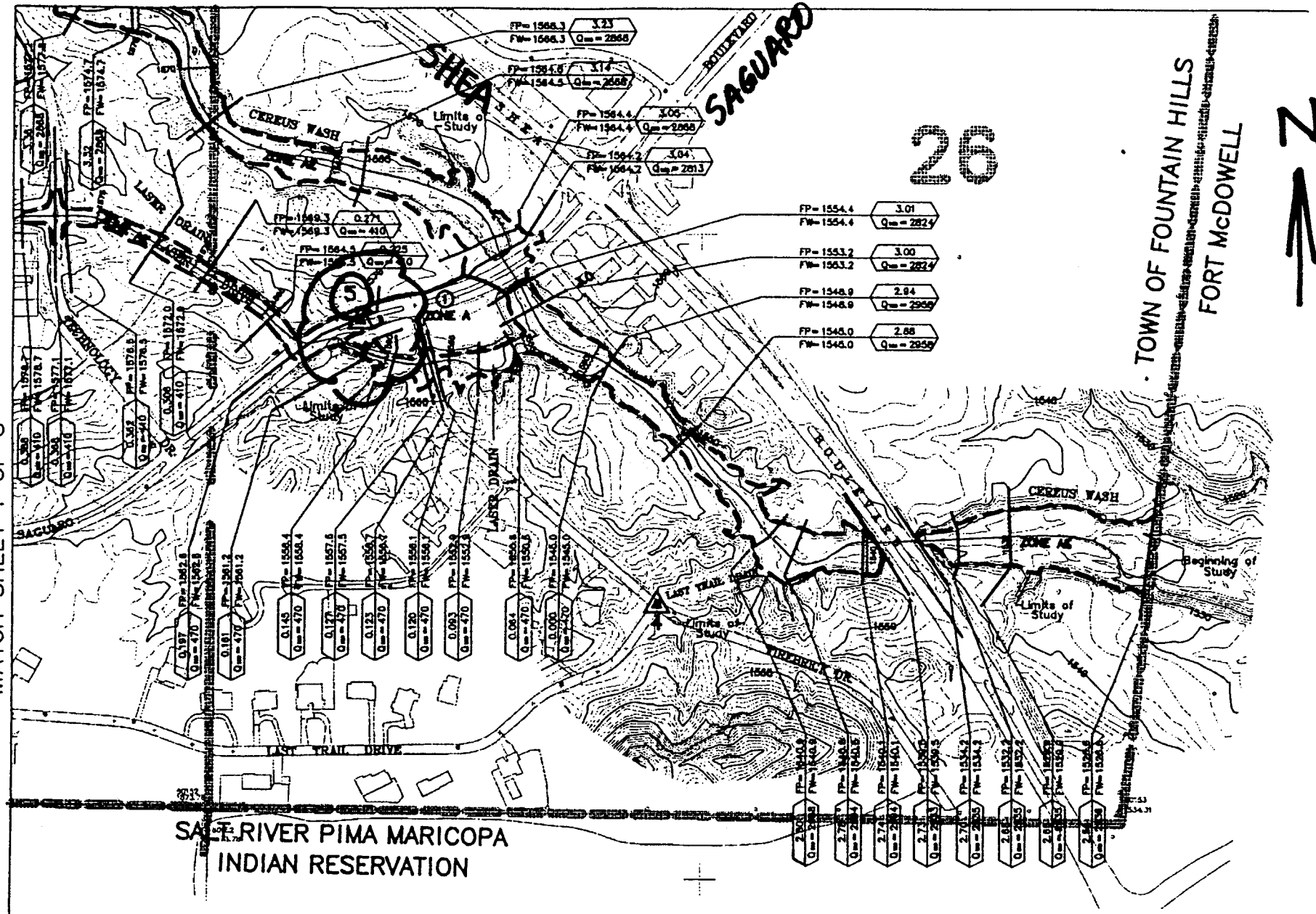
8	1772.76	Top of Boat Spike at intersection of Pinto Drive and Fountain Hills Boulevard, being in the Southeast 1/4 of Section 21, Township 3 North, Range 6 East.

MATCH SHEET 4 OF 8



MATCH SHEET 1 OF 8

Federal Emergency Management Agency

Washington, D.C. 20472

FLOOD CONTROL DISTRICT
RECEIVED
OCT 23 1997
CH ENG | P & PM
DEP
ADM
FINA
1 RGN

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

IN REPLY REFER TO:
Case No.: 97-09-534P

The Honorable Don Stapley
Chairperson, Maricopa County Board
of Supervisors
301 West Jefferson Street
Phoenix, Arizona 85003

Community: Maricopa County, Arizona
Community No.: 040037
Panels Affected: 04013C1270 D, 1300 E, and 1750 E
Effective Date of This Revision: OCT 21 1997

102-I-C

Dear Mr. Stapley:

This responds to a request that the Federal Emergency Management Agency (FEMA) revise the effective Flood Insurance Rate Map (FIRM) for Maricopa County, Arizona and Incorporated Areas (the effective FIRM for your community), in accordance with Part 65 of the National Flood Insurance Program (NFIP) regulations. In a letter dated February 10, 1997, Mr. Ron Nevitt, Program Manager, NFIP, Flood Control District of Maricopa County, requested that FEMA revise the FIRM to show the effects of detailed studies along the following flooding sources: Arrow Wash, Ashbrook Wash, Balboa Wash, Caliente Wash, Cereus Wash, Chukar Wash, Colony Wash, Cyprus Point Wash, Emerald Wash, Escalante Wash, Fountain Channel, Greystone Wash, Hesperus Wash, Jacklin Wash, Kingstree Wash, Laser Drain, Legend Wash, Logan Wash, Malta Drain, Mangrum Drain, North Colony Wash, Oxford Wash, Powder Wash, Sunburst Wash, Sycamore Wash, and Tulip Wash.

All data required to complete our review of this request were submitted with letters from Mr. Nevitt. Because this Letter of Map Revision (LOMR) is based on a detailed hydrologic or hydraulic study conducted by a Federal, State, or local agency to replace an approximate study conducted by FEMA, fees were not assessed for the review.

We have completed our review of the submitted data. We have revised the FIRM to add floodplain boundary delineations and zone designations of the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood) along Arrow Wash, Ashbrook Wash, Balboa Wash, Caliente Wash, Cereus Wash, Chukar Wash, Colony Wash, Cyprus Point Wash, Emerald Wash, Escalante Wash, Fountain Channel, Greystone Wash, Hesperus Wash, Jacklin Wash, Kingstree Wash, Laser Drain, Legend Wash, Logan Wash, Malta Drain, Mangrum Drain, North Colony Wash, Oxford Wash, Powder Wash, Sunburst Wash, Sycamore Wash, and Tulip Wash. The modifications are shown on the enclosed annotated copies of FIRM Panel(s) 04013C1270 D, dated April 15, 1988, and 04013C1300 E and 04013C1750 E, both dated September 4, 1991. This LOMR hereby revises the above-referenced panel(s) of the effective FIRM.

Because this revision request also affects the Town of Fountain Hills, a separate LOMR for that community was issued on the same date as this LOMR.

The modifications are effective as of the date shown above. The map panel(s) as listed above and as modified by this letter will be used for all flood insurance policies and renewals issued for your community.

A review of the determination made by this LOMR and any requests to alter this determination should be made within 30 days. Any request to alter the determination must be based on scientific or technical data.

We are preparing a revised FIRM and Flood Insurance Study (FIS) report for Maricopa County, Arizona and Incorporated Areas; therefore, we will not physically revise and republish the FIRM and FIS report for your community to incorporate the modifications made by this LOMR at this time. Preliminary copies of the FIRM and FIS report will be distributed for review in fall 1997. For informational purposes, detailed flood hazard data for the above-mentioned flooding sources have been shown on the enclosed annotated copies of the Summary of Discharges Table, Floodway Data Table, and Flood Profile Panel(s). Please note that corporate limits for the Town of Fountain Hills are not shown on the effective FIRM. We will incorporate the modifications made by this LOMR, the detailed flood hazard data, and the corporate limits for the Town of Fountain Hills into the preliminary FIRM and FIS report before they are distributed, and the modifications will be included when the FIRM and FIS report become effective.

This revision affects effective FIRM Panels 04013C1270 D, 04013C1300 E, and 04013C1750 E. Effective FIRM Panels 04013C1300 E and 04013C1750 E are currently shown at a scale of 2,000 feet per inch. When the preliminary copies of the FIRM are distributed, portions of FIRM Panel 04013C1300 E will be replaced by FIRM Panels 04013C1288 F and 04013C1289 F, and portions of FIRM Panel 04013C1750 E will be replaced by FIRM Panels 04013C1726 F, 04013C1727 F, 04013C1728 F, and 04013C1729 F. The new FIRM panels will be shown at a scale of 500 feet per inch.

This LOMR is based on minimum floodplain management criteria established under the NFIP. Your community is responsible for approving all floodplain development, and for ensuring all necessary permits required by Federal or State law have been received. State, county, and community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction in the Special Flood Hazard Area. If the State, county, or community has adopted more restrictive or comprehensive floodplain management criteria, these criteria take precedence over the minimum NFIP criteria.

Because this LOMR will not be printed and distributed to primary users, such as local insurance agents and mortgage lenders, your community will serve as a repository for these new data. We encourage you to disseminate the information reflected by this LOMR throughout the community, so that interested persons, such as property owners, local insurance agents, and mortgage lenders, may benefit from the information. We also encourage you to prepare a related article for publication in your community's local newspaper. This article should describe the assistance that officials of your community will give to interested persons by providing these data and interpreting the NFIP maps.

This determination has been made pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (Public Law 93-234) and is in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, Public Law 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed minimum NFIP criteria. These criteria are the minimum and do not supersede any State or local requirements of a more stringent nature. This includes adoption of the effective FIRM to which the regulations apply and the modifications described in this LOMR. Our records show that your community has met this requirement.

A Consultation Coordination Officer (CCO) has been designated to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Dorothy M. Lacey
Director, Mitigation Division
Federal Emergency Management Agency, Region IX
The Presidio of San Francisco, Building 105
San Francisco, California 94129-1250
(415) 923-7177

If you have any questions regarding floodplain management regulations for your community or the NFIP in general, please contact the CCO for your community at the telephone number cited above. If you have any technical questions regarding this LOMR, please contact Mr. John Magnotti of our staff in Washington, DC, either by telephone at (202) 646-3932 or by facsimile at (202) 646-4596.

Sincerely,

Frederick H. Sharrocks, Jr., Chief
Hazard Identification Branch
Mitigation Directorate

Enclosure(s)

cc: The Honorable Jerry Miles
Mayor, Town of Fountain Hills

Mr. Randy L. Harrel
Town Engineer
Town of Fountain Hills

Mr. Ron Nevitt
Program Manager
NFIP
Flood Control District of Maricopa County