# APPENDIX F

# HYDROLOGY

**ENGINEERING APPENDIX F**
**HYDROLOGY**

**Table of Contents**

**1.0 BACKGROUND**

**2.0 ANALYSIS**

**3.0 RESULTS**

**4.0 CONCLUSIONS AND RECOMMENDATIONS**

**FEMA Flood Insurance Study Cross Sections Location Map**

**Plates**

## 1.0 BACKGROUND

To increase overall fish production in the Upper Salmon River drainage, stream, and habitat improvement measures have been proposed in the vicinity of Challis, Idaho. A primary goal of the restoration project is to improve habitat for listed salmonids by reopening abandoned side channels as well as modifying levees and riprapped banks. The proposed project is within the 12-mile long Round Valley reach of the Upper Salmon River, located between Highway 93 and Bruno's Bridge. The following are five proposed project sites:

(a) Pennal Gulch, referred to as site 4
(b) Hot Springs, referred to as site 3
(c) One-Mile Island, referred to as site 2
(d) Dunfee Slough, referred to as site 1
(e) Highway 93 bridge, referred to as site 5

Refer to the Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) Cross Section Locations map in this appendix for the locations of the five restoration sites and the FIS cross sections within the study area.

The proposed project work lies within a FEMA detailed FIS that has a delineated flood plain for the "flood having a 1 percent chance of being equaled or exceeded in any year," commonly known as the "100-Year Flood," as well as a designated floodway. This study was published by FEMA on March 4, 1988; for Custer County, Idaho; and incorporated areas, for community numbers 160053 (city of Challis, Idaho) and 160211 (unincorporated areas). The numbers of the FEMA maps that provide coverage for the study area are 16037C0383 C, 16037C0384 C, 16037C0382 C, 16037C0244 C, and 16037C0242 C. Therefore, the effects of the proposed restoration work on the FIS must be evaluated in accordance with Executive Order 11988, Flood Plain Management. As stated in a paper titled, "The FEMA, Region 10, Policy on Fish Enhancement Structures in the Floodway" by Charles Steele, Carl Cook, and Mark Eberlein, "FEMA's regulations require communities to prohibit encroachments in regulated floodways unless accompanied by a no-rise analysis that demonstrates the project will cause no rise in the 100-year flood level. Their paper states that "FEMA is trying to walk the fine line of preserving floodwater conveyance while at the same time promoting actions that increase habitat, reduce erosion, and protect the flood plain values of recreation, water quality, and vegetative growth." Their paper also discusses the intricate balance between anadromous fish needs and the human environment. The paper also states that" . . . at a minimum, provide a feasibility analysis and certification that the project was designed to keep any rise in the 100-year flood levels as close to zero as practically possible and that no buildings would be negatively impacted by a potential rise. Additionally, routine maintenance of any project would be necessary to sustain conveyance over time, and the community should commit to a long-term maintenance program in their acceptance of the project. The FEMA also recommends a condition be placed

on the projects emphasizing the dynamics of a river and, if the community deems necessary, further analysis be required."  Typically, any rise caused would require some offsetting action such as channel alteration or removal of existing encroachments.  One of these alternatives would be appropriate to compensate for any rise and still preserve the integrity of the flood plain standards.

## 2.0 ANALYSIS

The data for the existing FEMA FIS was assembled and converted from its existing Hydrologic Engineering Center's (HEC) HEC-2 (Water Surface Profiles) hydraulic model format to the newer HEC-RAS (River Analysis System) hydraulic model format. In addition, this HEC-RAS model was refined to incorporate newer geometry available from recent topography and which was also utilized in a MIKE-11 hydraulic model for the study area; that model being developed by the University of Idaho. The original HEC-2 model coverage was also extended further downstream and terminated a short distance downstream of Bruno's Bridge. The new HEC-RAS model was used to develop a new base condition for the Salmon River between river miles 311 and 327. In addition, a "with restoration project" model was assembled based upon the new hydraulic model reflecting the implementation of the proposed restoration work.

## 3.0 RESULTS

Plates 1 through 30 compare the topography for the original and updated hydraulic models for each FEMA FIS cross section located along the study reach, which are designated as FEMA sections D through AG in the FEMA FIS. Table 1 summarizes the water surface elevation information at each FEMA cross section location. As shown by the “Elevation Difference” column in table 1, implementation of the proposed restoration projects at sites 1 through 5 will result in some minor rises in the one percent chance of annual exceedance flood (100-Year Flood) elevations at some FEMA cross section locations. Some will likely experience a minor decrease in elevation due to minor increases of the average flow velocities. At two cross sections located within site 1, namely FIS cross section designators W and X, the resultant water surface elevations exceed the original FEMA FIS floodway elevations. Because the proposed work lies within the detailed FIS, a “no-rise condition” must be maintained, which will require flow conveyance compensation to account for the loss of flow conveyance due to the project’s implementation. Executive Order 11988, “Flood Plain Management,” should be further consulted for guidance and information regarding the significance of “no-rise” condition.

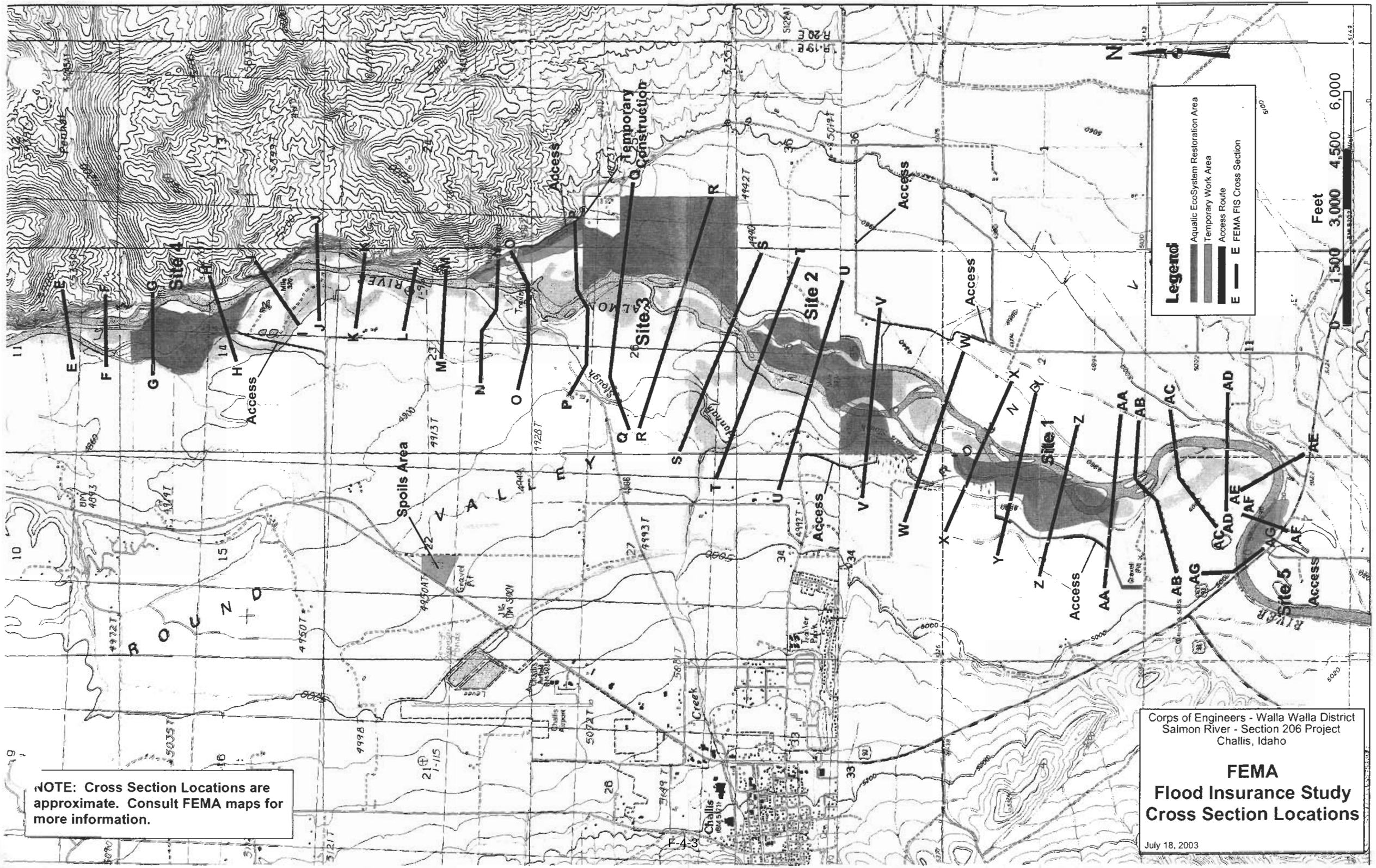
Because the vertical rises in water surface elevation induced by the restoration sites are minor, the differences in flood plain extent would also be minor and difficult to map using the scale of the FEMA FIS mapping. Therefore, the existing FEMA flood plain mapping would also be representative of “post project” conditions at the 100-Year Flood level.

## 4.0 CONCLUSIONS AND RECOMMENDATIONS

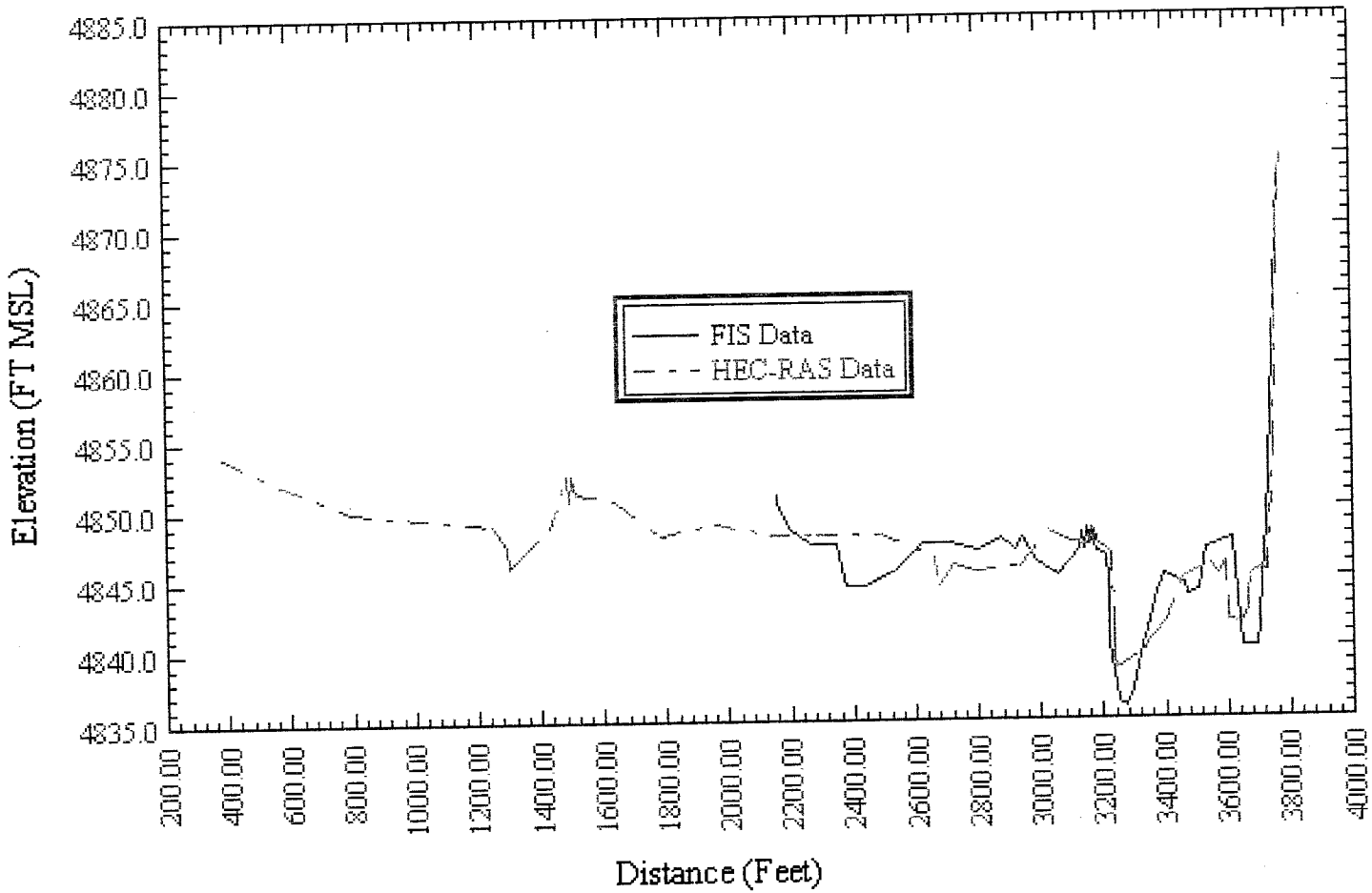
As shown by this analysis, the post project water surface elevations at two locations located within site 1 will exceed the FEMA FIS floodway elevations published in table 4, entitled “Floodway Data for Salmon River,” of the current FIS. It is recommended that appropriate compensatory measures, such as those previously mentioned in section 1.0, of this report, be incorporated into the project design to alleviate this rise in the 100-Year Flood water surface elevations.

**TABLE 1.** Upper Salmon River Aquatic Ecosystem Restoration Section 206 (Sites 1-5)
Restoration Effects on 1 Percent Exceedance (100 Year) Flood Elevations

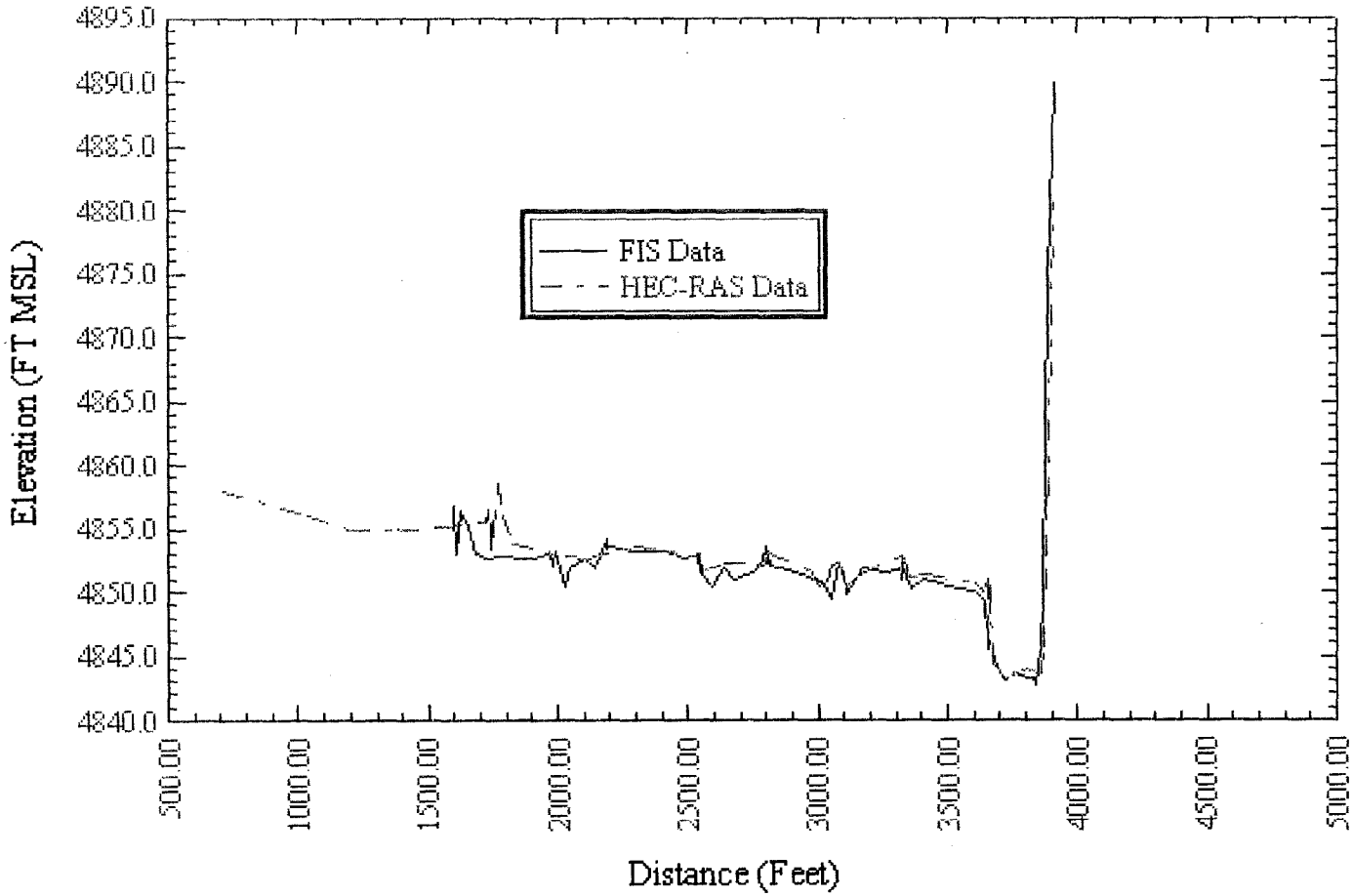
| FEMA FIS DESIGNATOR | FIS BASE FLOOD ELEVATION | NEW BASE FLOOD ELEVATIONS | WITH RESTORATION | BASE FLOOD ELEVATION DIFFERENCE | FEMA FIS FLOODWAY | FLOODWAY ELEVATION DIFFERENCE | RESTORATION SITE NAME | NEW BASE FLOOD ELEVATION DIFFERENCE |
|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5)=(4)-(2) | (6) | (7)=(6)-(4) | (8) | (9)=(3)-(4) |
| D | 4848.30 | 4848.27 | 4848.27 | -0.03 | 4849.30 | 1.03 | | 0.00 |
| E | 4852.70 | 4852.95 | 4852.98 | 0.28 | 4853.40 | 0.42 | Site 4 | -0.03 |
| F | 4857.50 | 4857.56 | 4857.82 | 0.32 | 4858.40 | 0.58 | Site 4 | -0.26 |
| G | 4863.60 | 4862.73 | 4863.20 | -0.40 | 4863.80 | 0.60 | Site 4 | -0.47 |
| H | 4870.60 | 4869.05 | 4869.44 | -1.16 | 4871.10 | 1.66 | Site 4 | -0.39 |
| I | 4875.20 | 4873.18 | 4873.45 | -1.75 | 4875.50 | 2.05 | Site 4 | -0.27 |
| J | 4879.10 | 4877.91 | 4877.85 | -1.25 | 4880.10 | 2.25 | | 0.06 |
| K | 4885.20 | 4883.17 | 4883.20 | -2.00 | 4886.20 | 3.00 | | -0.03 |
| L | 4888.30 | 4887.66 | 4887.65 | -0.65 | 4889.20 | 1.55 | Site 3 | 0.01 |
| M | 4890.40 | 4889.51 | 4889.51 | -0.89 | 4891.10 | 1.59 | Site 3 | 0.00 |
| N | 4894.50 | 4893.92 | 4893.92 | -0.58 | 4895.10 | 1.18 | Site 3 | 0.00 |
| 0 | 4899.10 | 4899.24 | 4899.29 | 0.19 | 4899.60 | 0.31 | Site 3 | -0.05 |
| P | 4904.20 | 4903.69 | 4903.76 | -0.44 | 4905.20 | 1.44 | Site 3 | -0.07 |
| Q | 4908.10 | 4908.28 | 4908.33 | 0.23 | 4909.10 | 0.77 | Site 3 | -0.05 |
| R | 4915.80 | 4915.19 | 4915.21 | -0.59 | 4916.50 | 1.29 | Site 3 | -0.02 |
| S | 4920.90 | 4917.42 | 4917.42 | -3.48 | 4921.90 | 4.48 | Site 2 | 0.00 |
| T | 4925.40 | 4922.46 | 4922.49 | -2.91 | 4926.20 | 3.71 | Site 2 | -0.03 |
| U | 4928.00 | 4928.37 | 4928.62 | 0.62 | 4928.80 | 0.18 | Site 2 | -0.25 |
| V | 4937.30 | 4935.97 | 4936.38 | -0.92 | 4938.00 | 1.62 | Site 2 | -0.41 |
| W | 4942.40 | 4942.85 | 4942.96 | 0.56 | 4942.90 | **-0.06** | Site 1 | -0.11 |
| X | 4948.30 | 4949.12 | 4949.19 | 0.89 | 4948.80 | **-0.39** | Site 1 | -0.07 |
| Y | 4954.70 | 4954.65 | 4954.92 | 0.22 | 4955.70 | 0.78 | Site 1 | -0.27 |
| Z | 4957.50 | 4957.91 | 4958.15 | 0.65 | 4958.50 | 0.35 | Site 1 | -0.24 |
| AA | 4960.20 | 4960.71 | 4960.77 | 0.57 | 4961.00 | 0.23 | Site 1 | -0.06 |
| AB | 4969.00 | 4967.59 | 4967.64 | -1.36 | 4969.90 | 2.26 | Site 1 | -0.05 |
| AC | 4972.70 | 4972.73 | 4972.70 | 0.00 | 4973.60 | 0.90 | | 0.03 |
| AD | 4978.60 | 4976.84 | 4976.86 | -1.74 | 4978.90 | 2.04 | | -0.02 |
| AE | 4983.80 | 4981.84 | 4981.83 | -1.97 | 4984.80 | 2.97 | Site 5 | 0.01 |
| AF | 4988.80 | 4988.27 | 4988.30 | -0.50 | 4988.90 | 0.60 | Site 5 | -0.03 |
| AG | 4993.50 | 4992.56 | 4992.59 | -0.91 | 4993.90 | 1.31 | Site 5 | -0.03 |


Legend
Aquatic EcoSystem Restoration Area
Temporary Work Area
Access Route
E FEMA FIS Cross Section
Feet
0 1,500 3,000 4,500 6,000
N
Site 1
Site 2
Site 3
Site 4
Site 5
Temporary Construction
Access
Spoils Area
Gravel Pit
Challis
Challis Airport
Trailer Park
Salmon River
Creek
ROCKY VALLEY
NOTE: Cross Section Locations are approximate. Consult FEMA maps for more information.
Corps of Engineers - Walla Walla District
Salmon River - Section 206 Project
Challis, Idaho
FEMA
Flood Insurance Study
Cross Section Locations
July 18, 2003

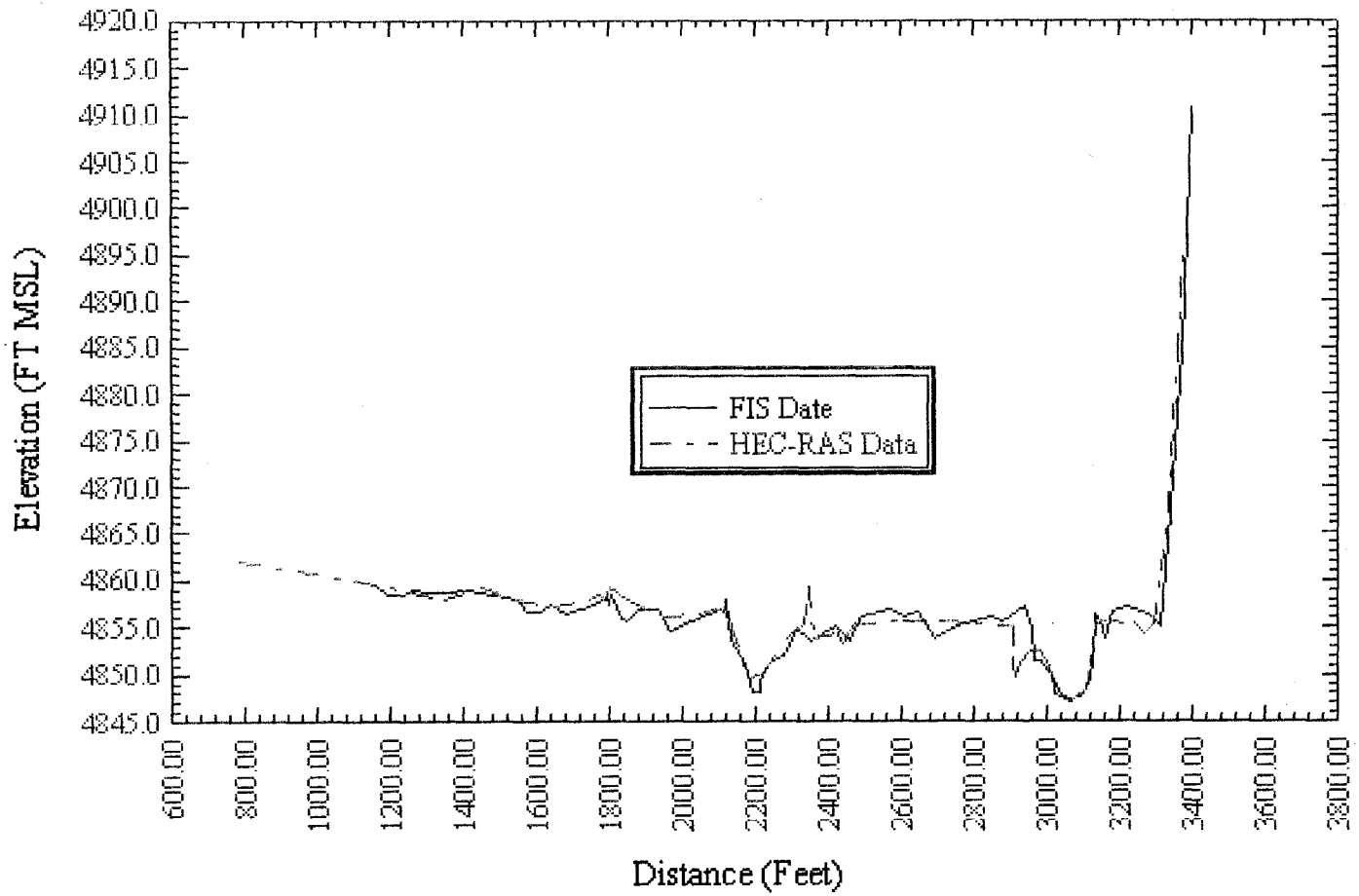
## Plate 1. FIS Section D (#33, d/s Site #4)



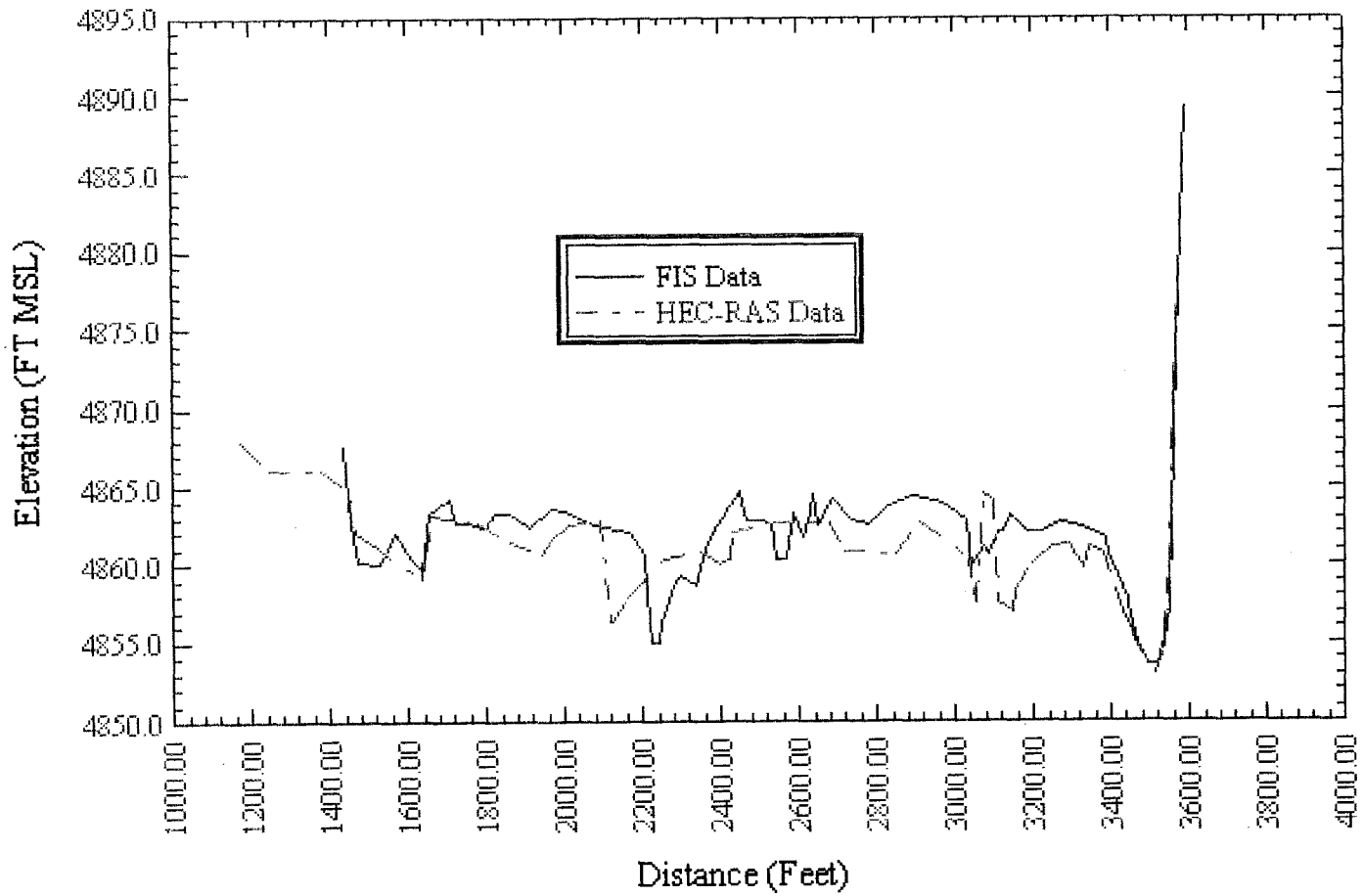
## Plate 2. FIS Section E (#34, at Site #4)



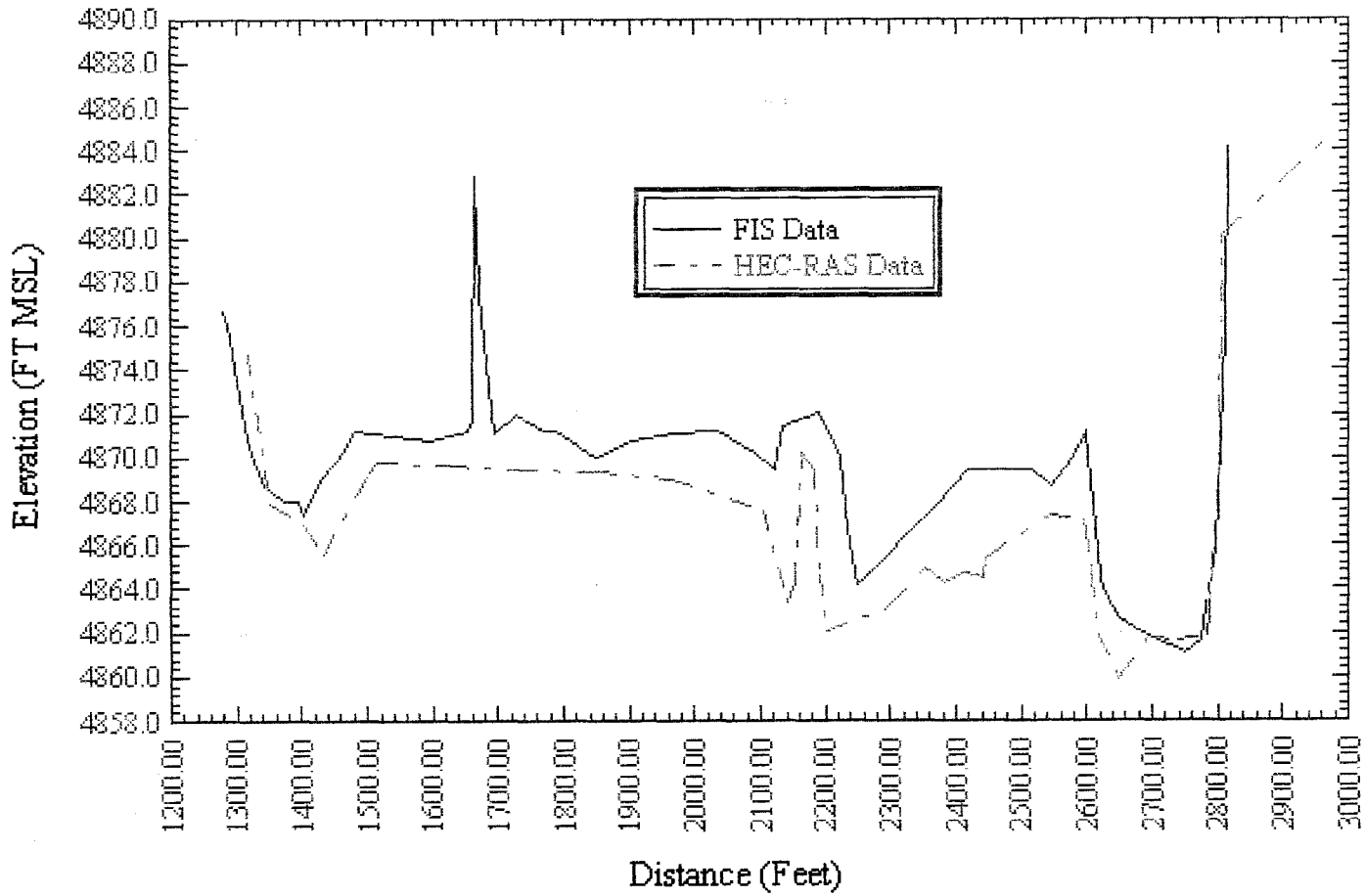
## Plate 3. FIS Section F (#35, at Site #4)



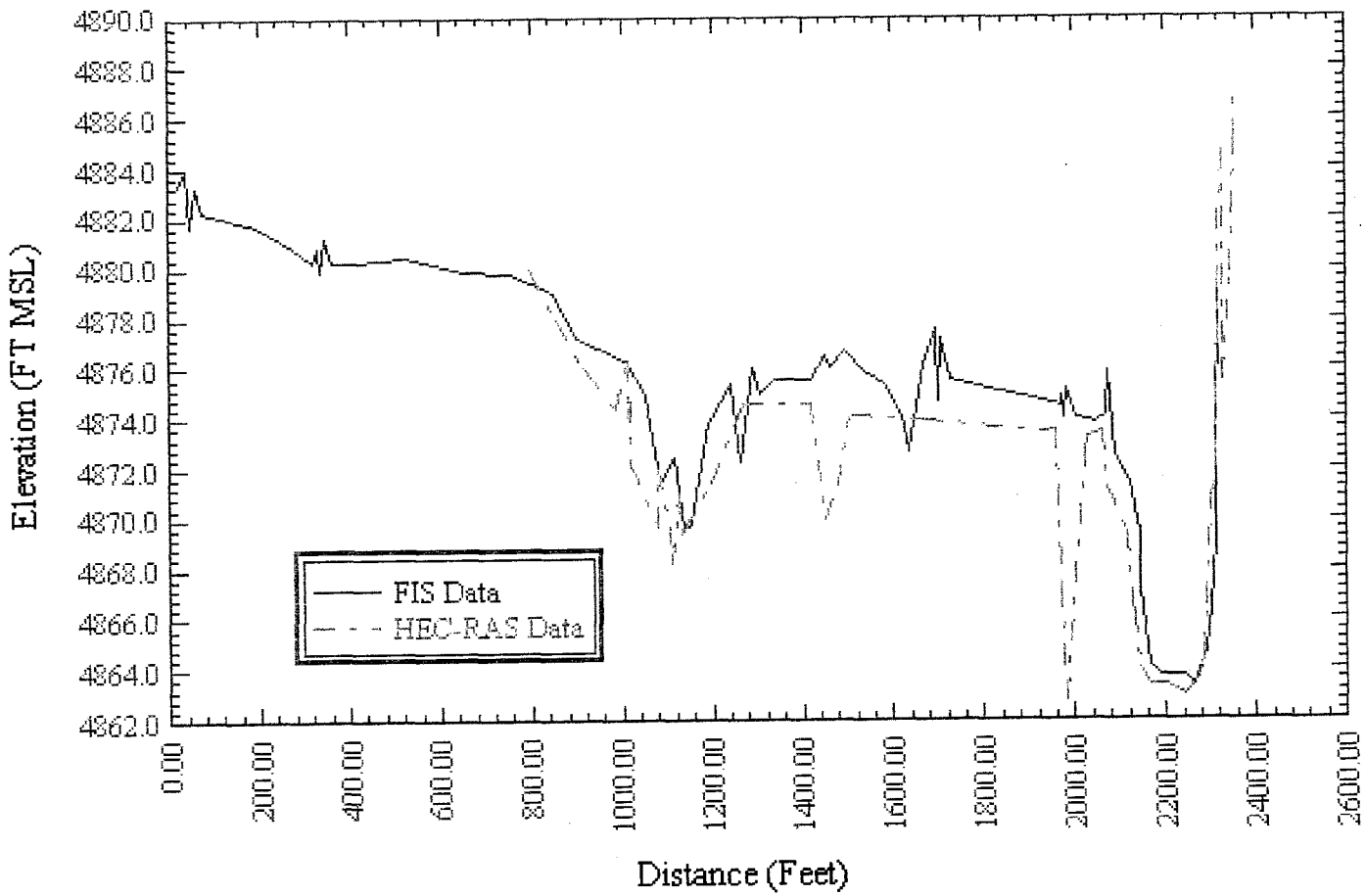
## Plate 4. FIS Section G (#36, at Site #4)



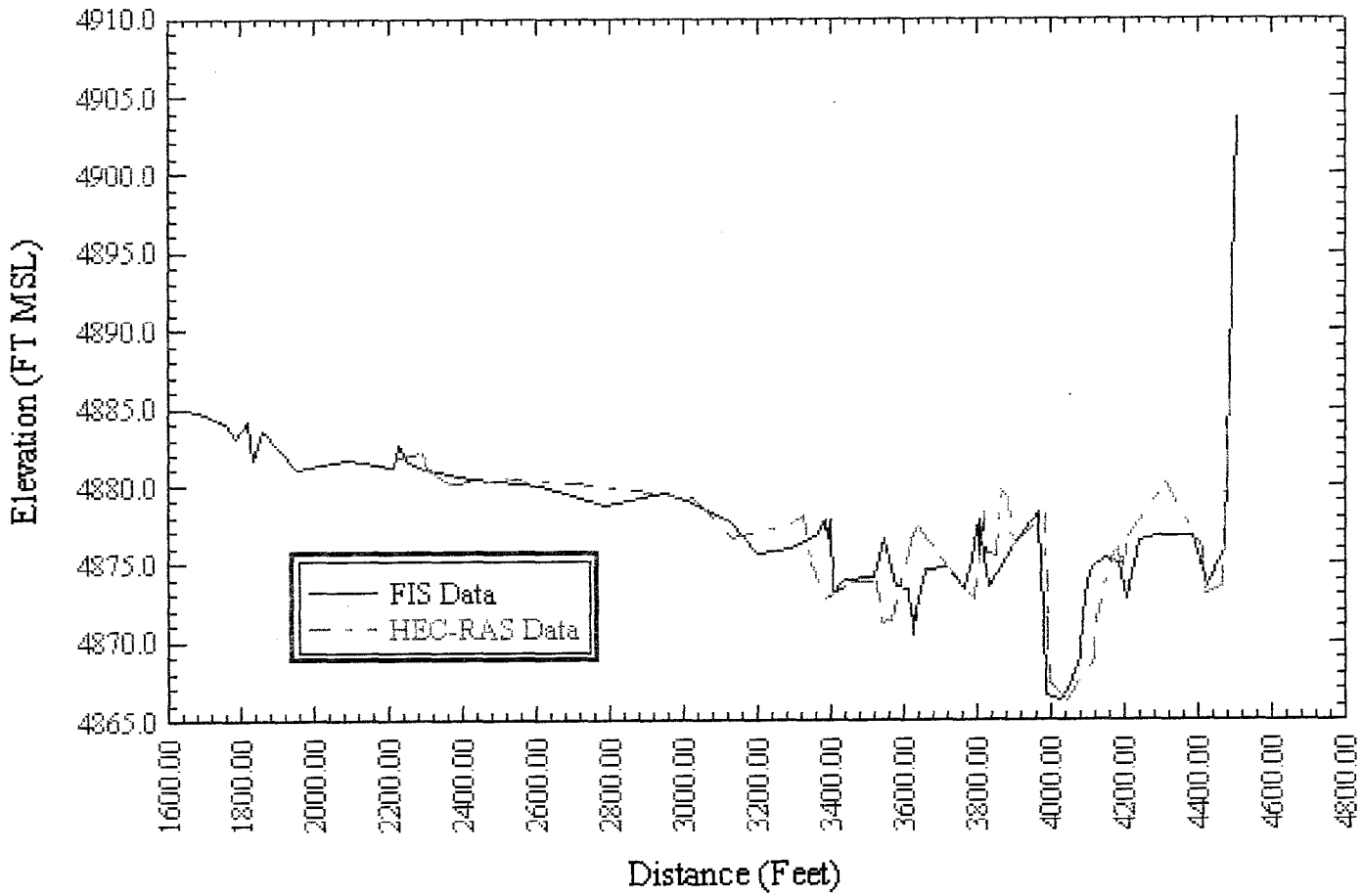
## Plate 5. FIS Section H (#37, at Site #4)



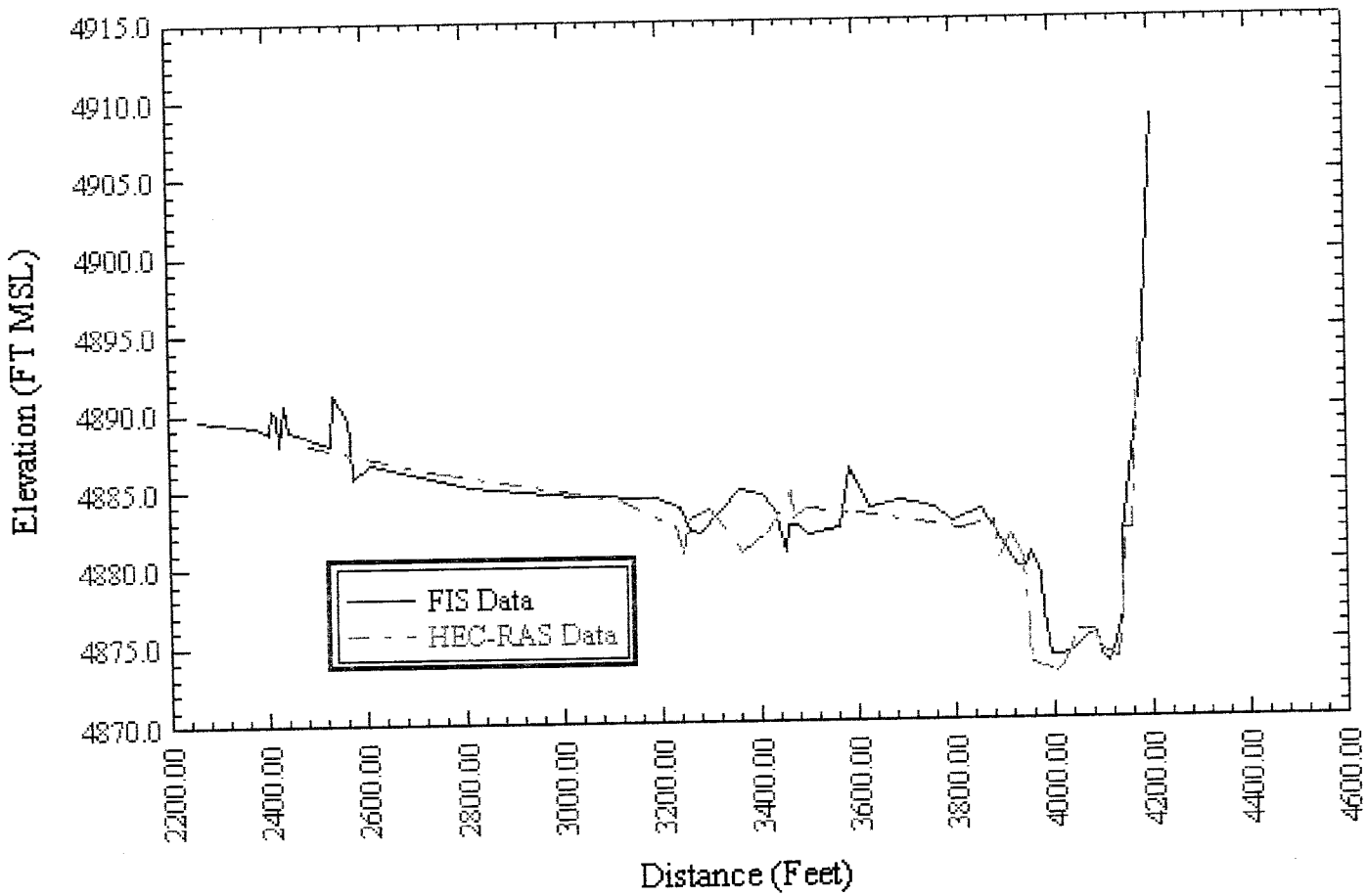
## Plate 6. FIS Section I (#38, at Site #4)



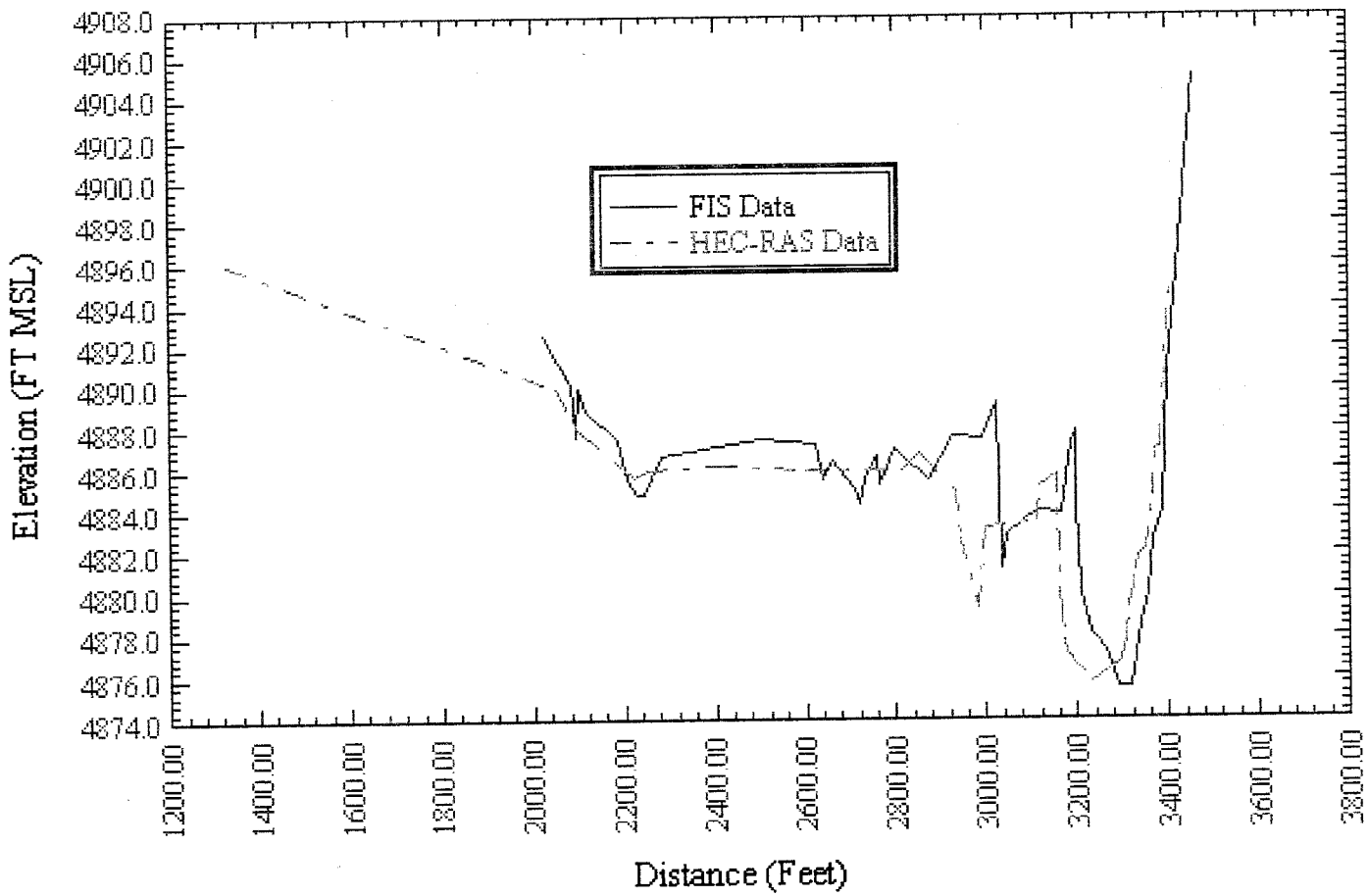
## Plate 7. FIS Section J (#39, D/S Site #3)



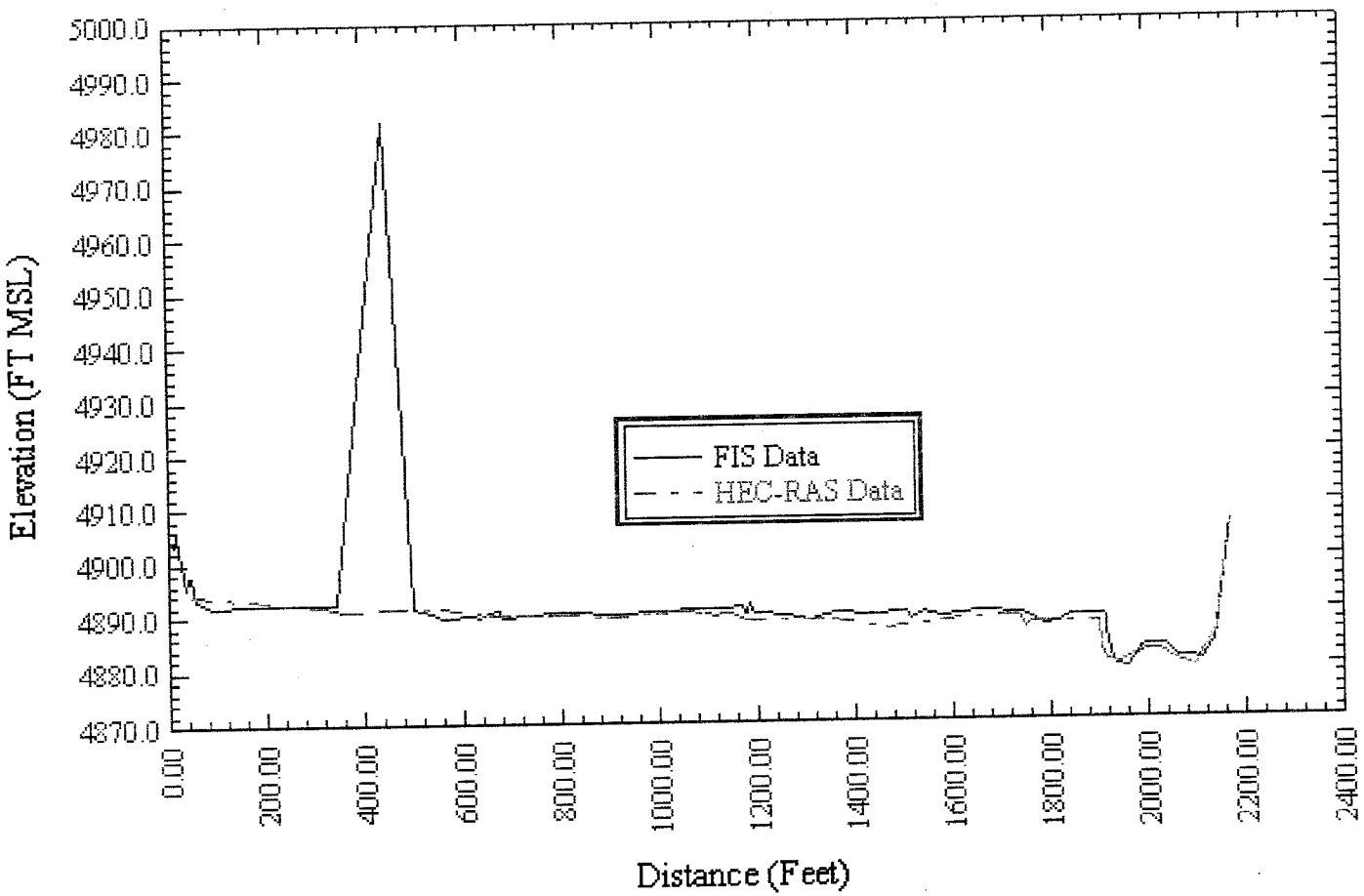
## Plate 8. FIS Section K (#40, D/S Site #3)



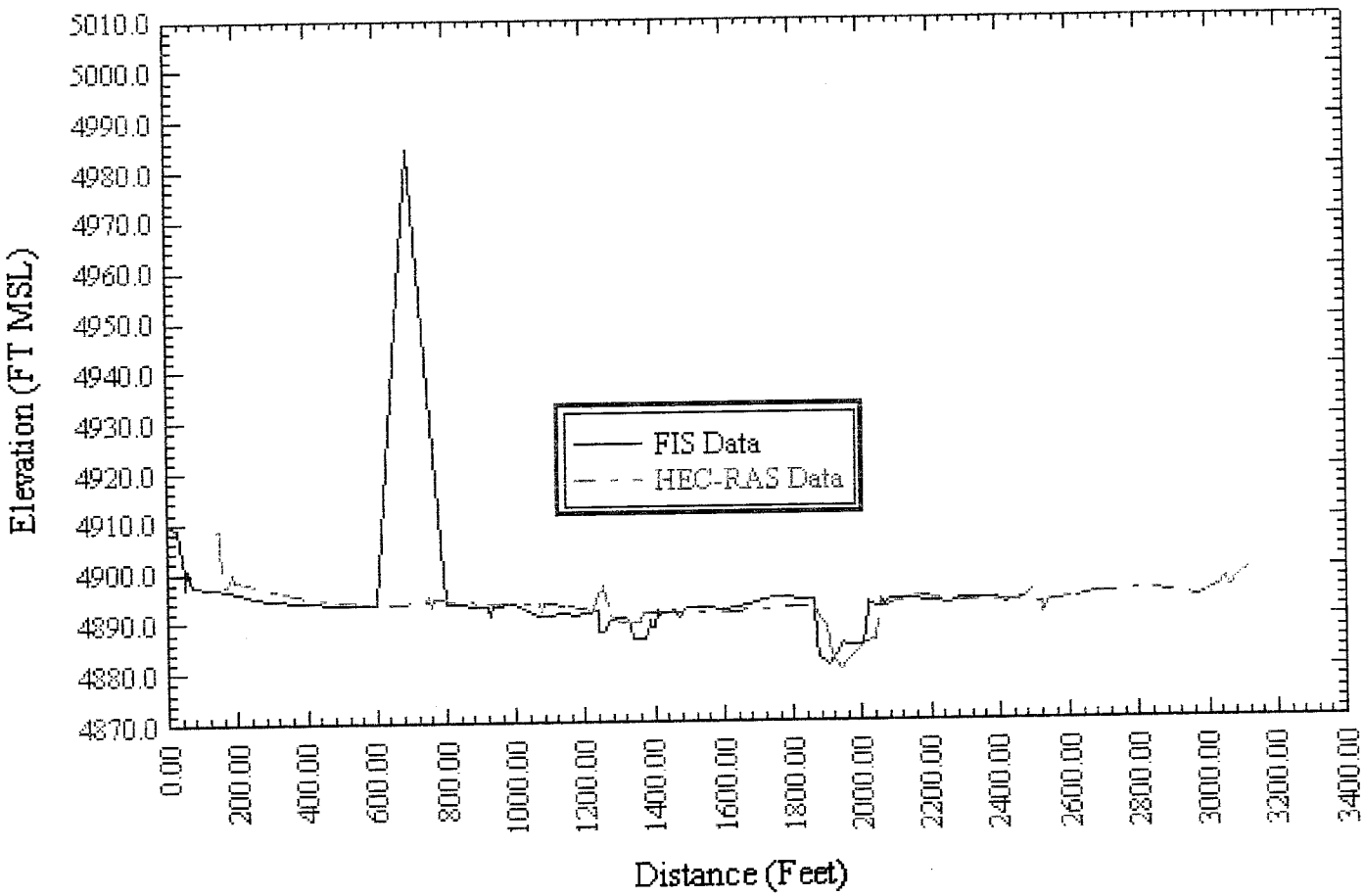
## Plate 9. FIS Section L (#41, at Site #3)



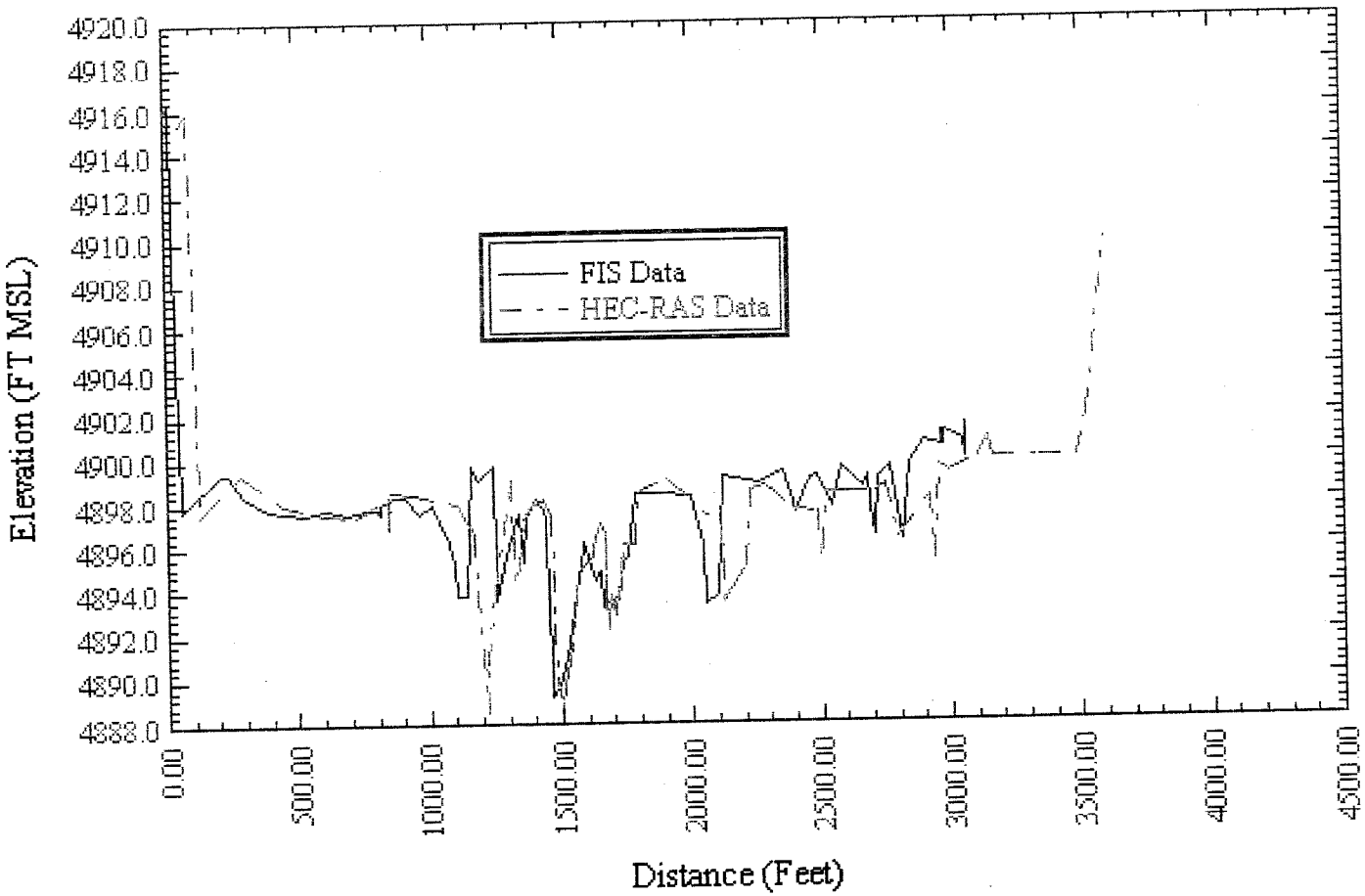
## Plate 10. FIS Section M (#42, at Site #3)



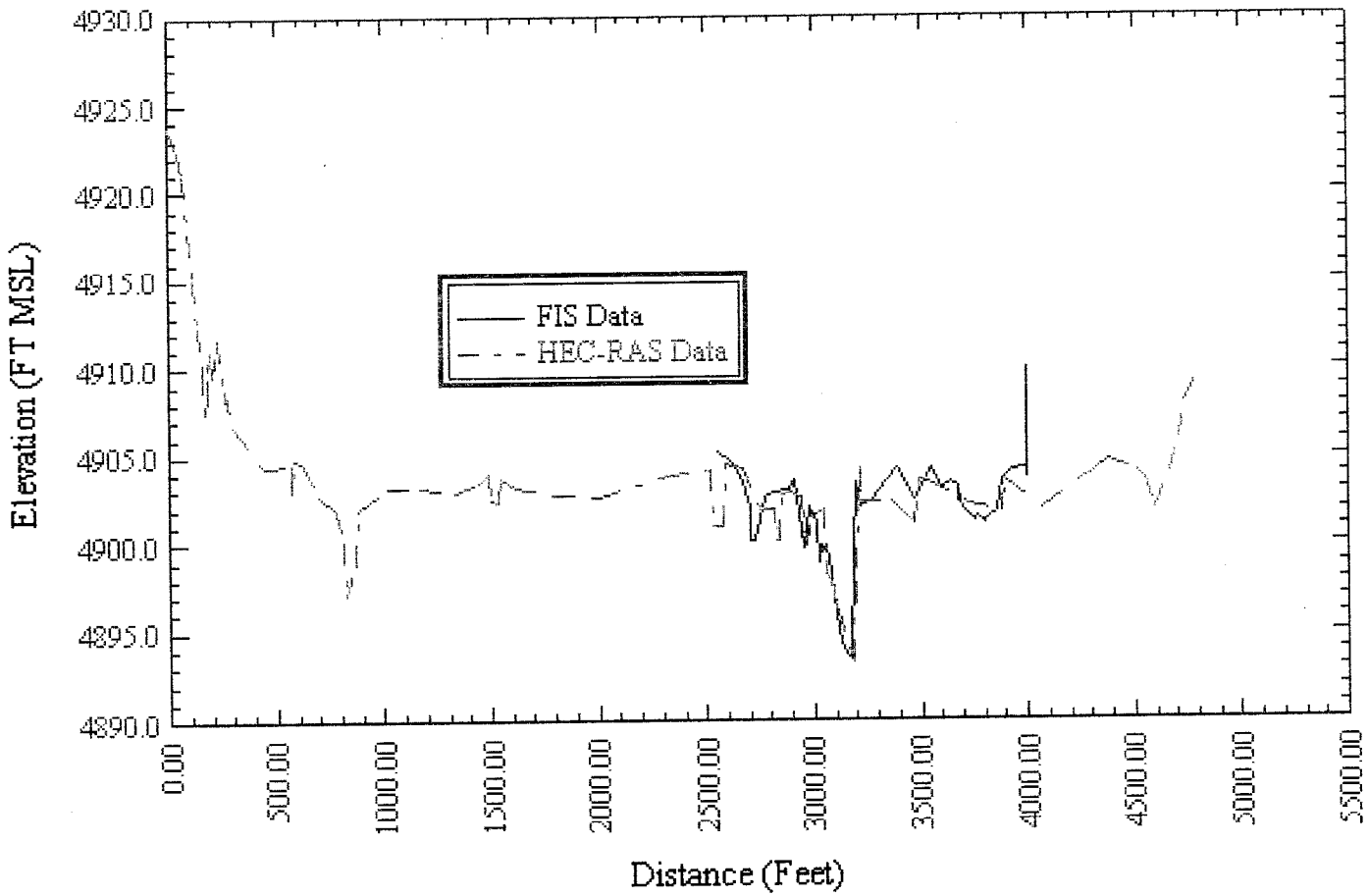
## Plate 11. FIS Section N (#43, at Site #3)



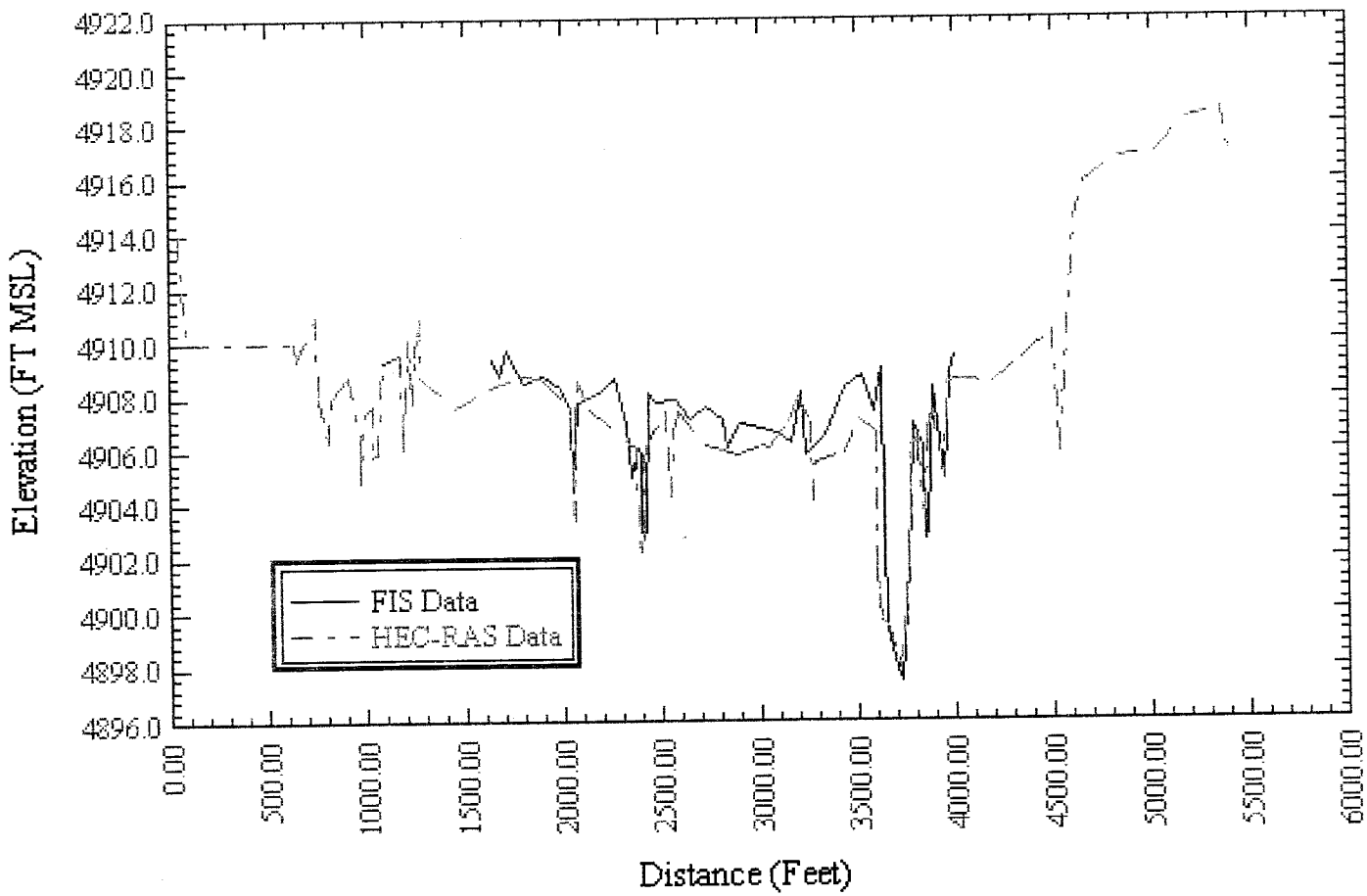
## Plate 12. FIS Section O (#44, at Site #3)



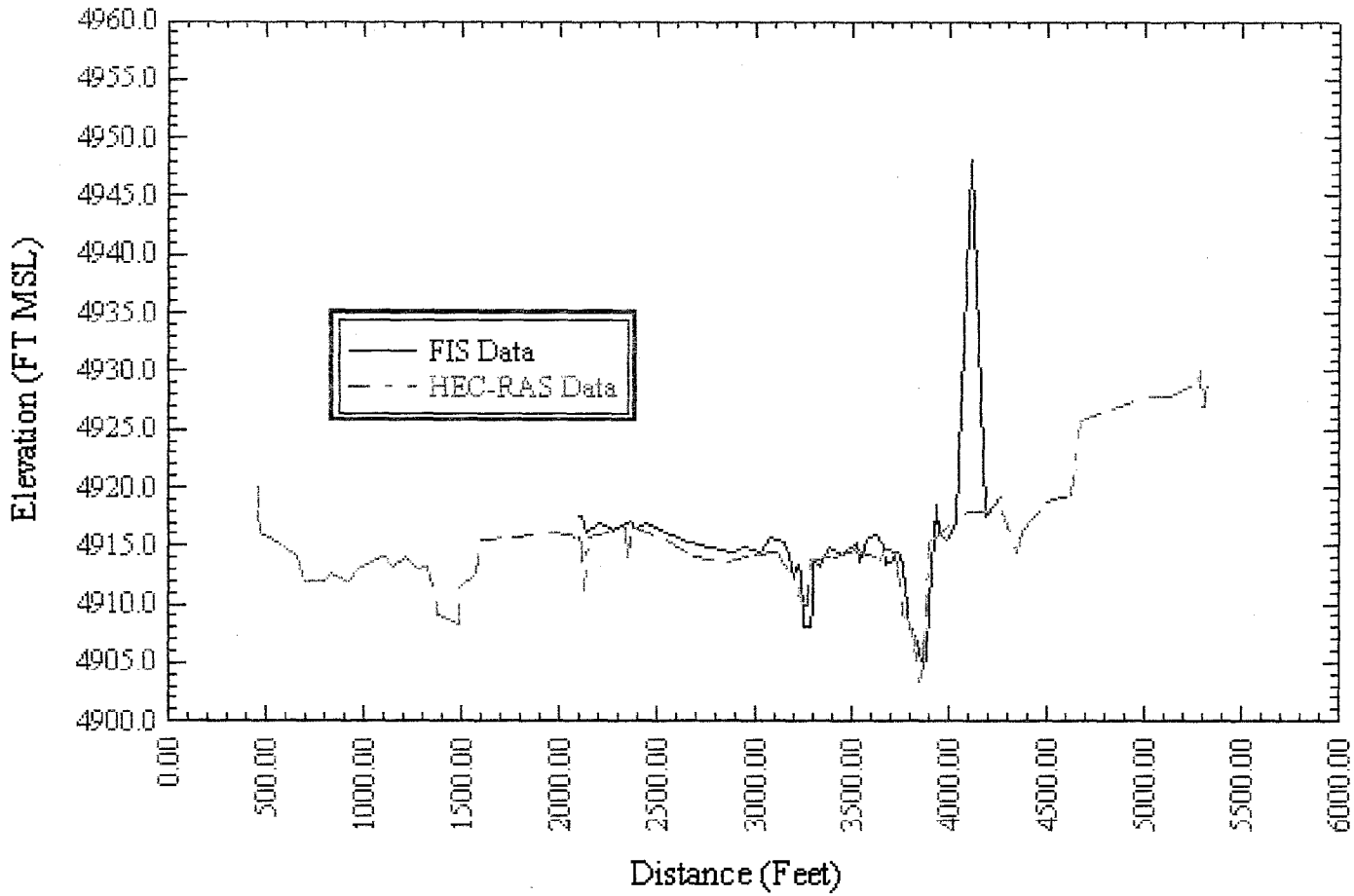
## Plate 13. FIS Section P (#45, at Site #3)



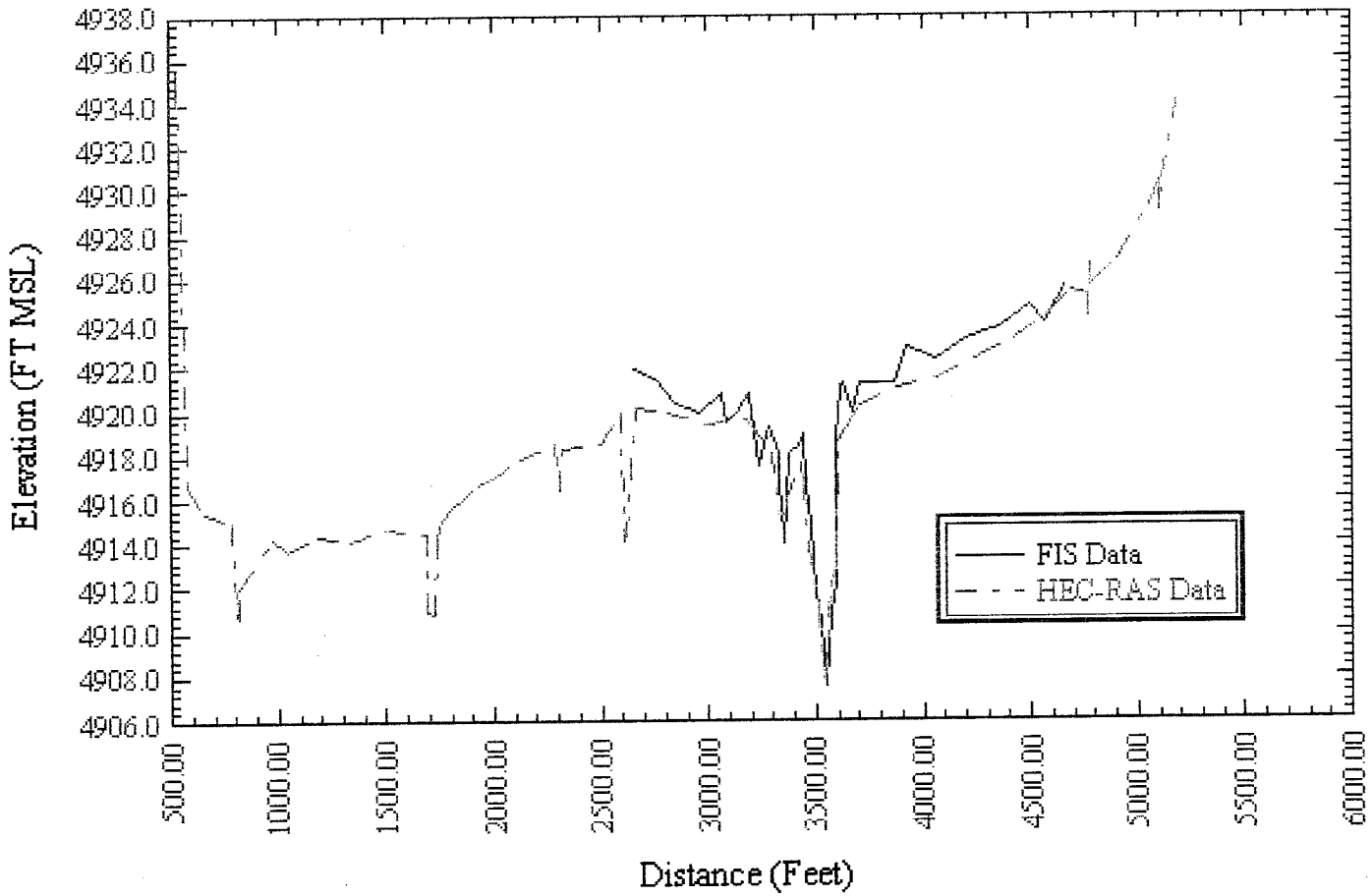
## Plate 14. FIS Section Q (#46, at Site #3)



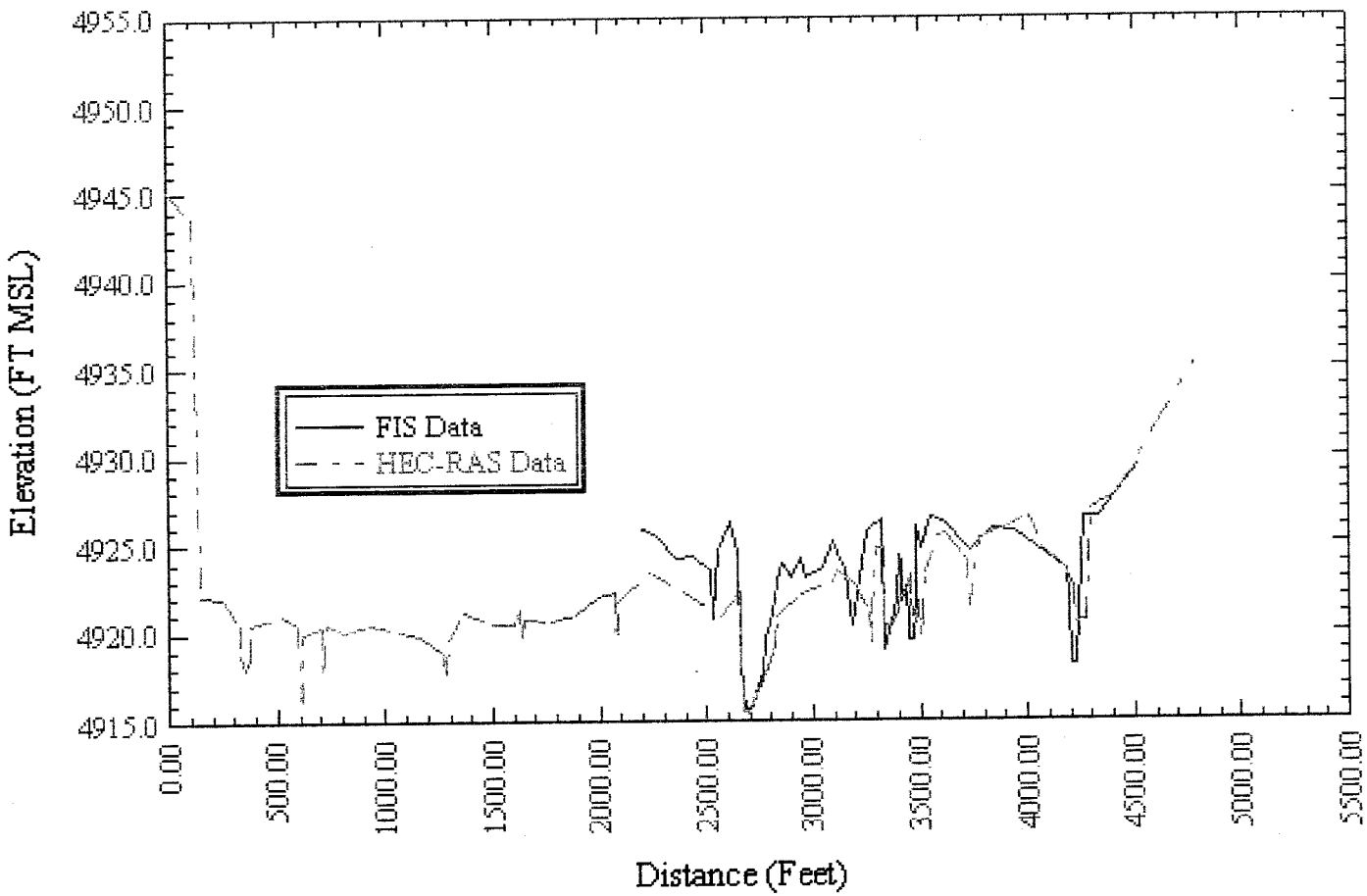
## Plate 15. FIS Section R (#47, at Site #3)



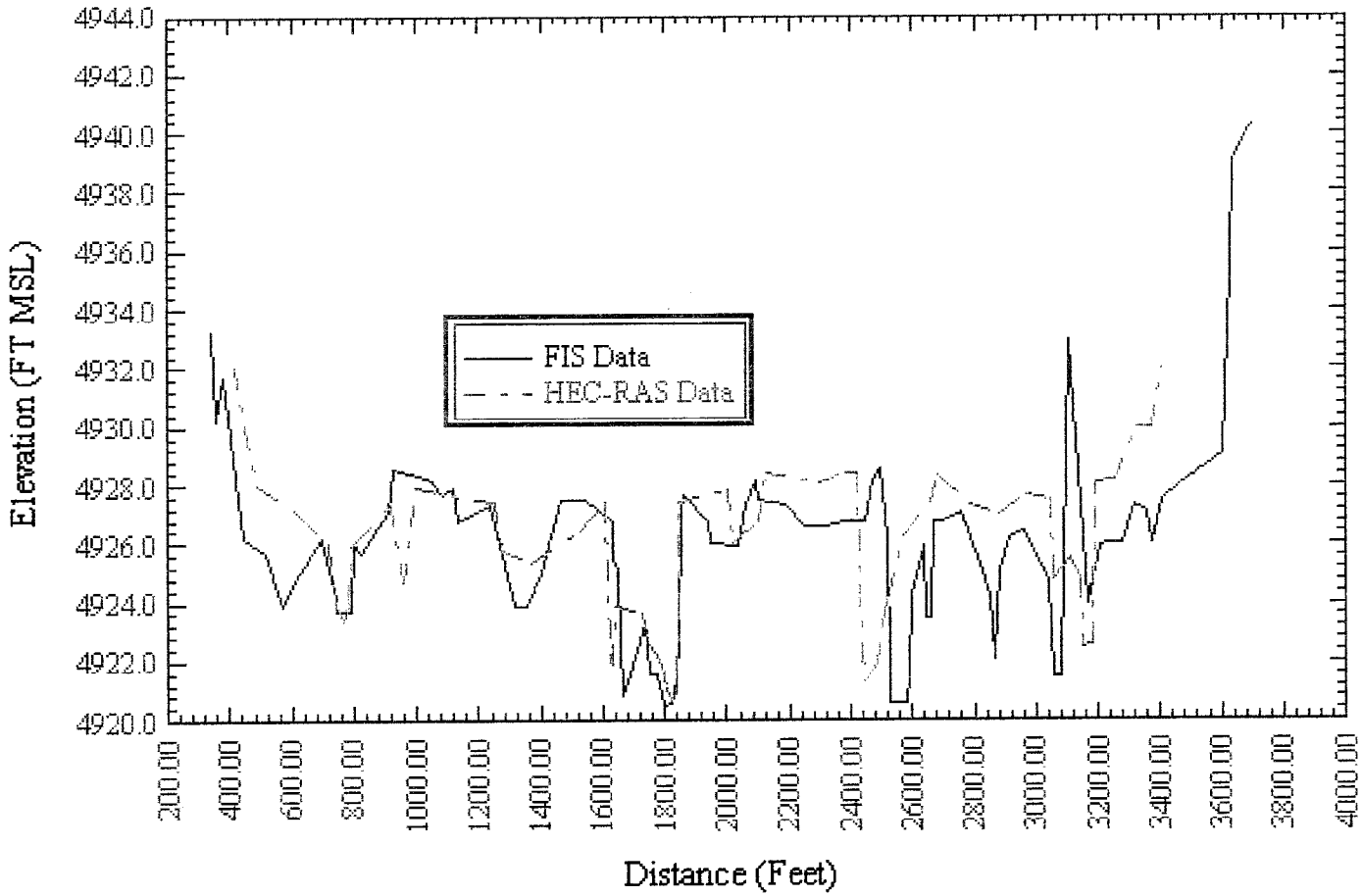
## Plate 16. FIS Section S (#48, at Sites #3 and #2)



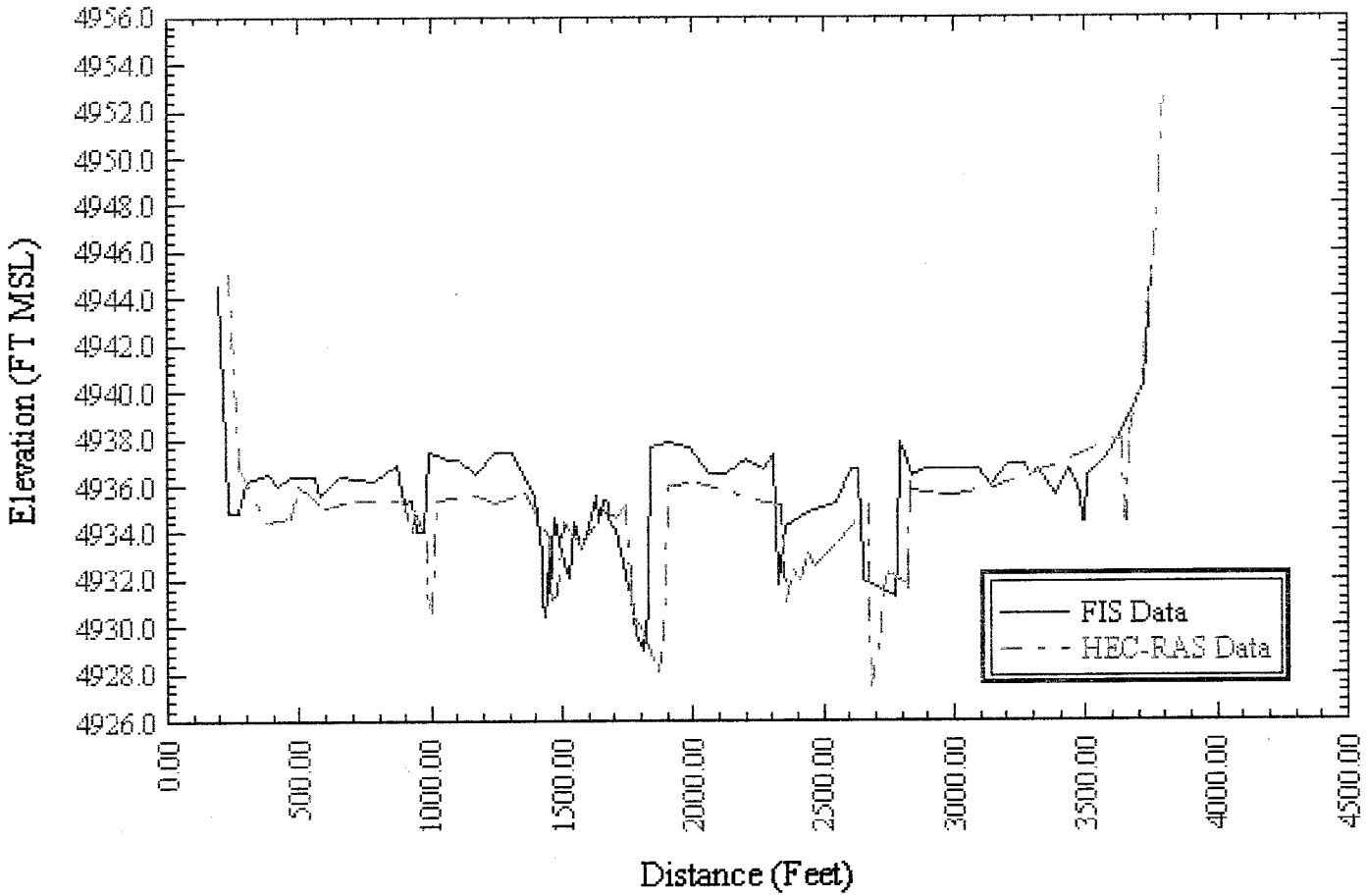
## Plate 17. FIS Section T (#49, at Site #2)



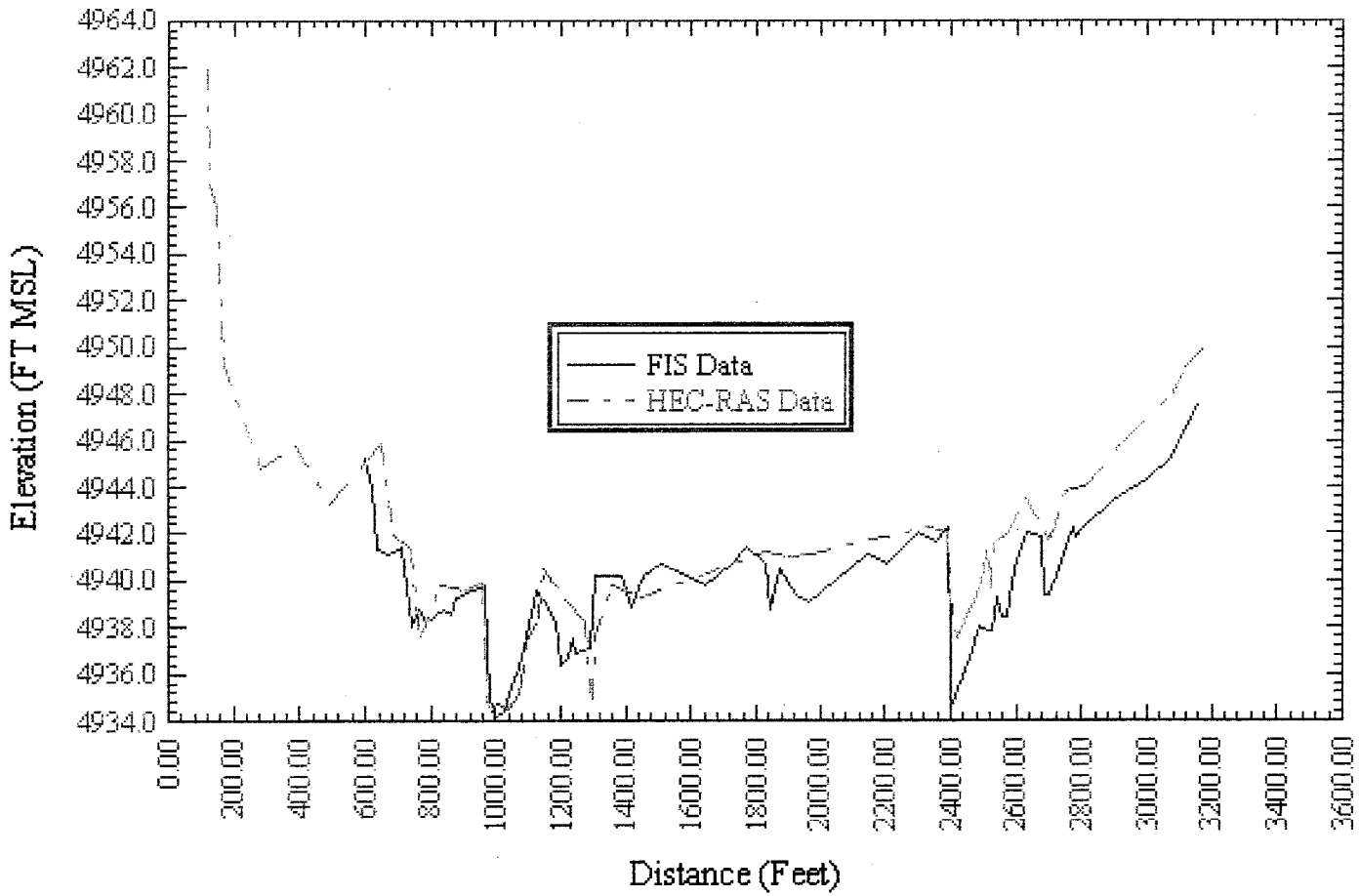
## Plate 18. FIS Section U (#50, at Site #2)



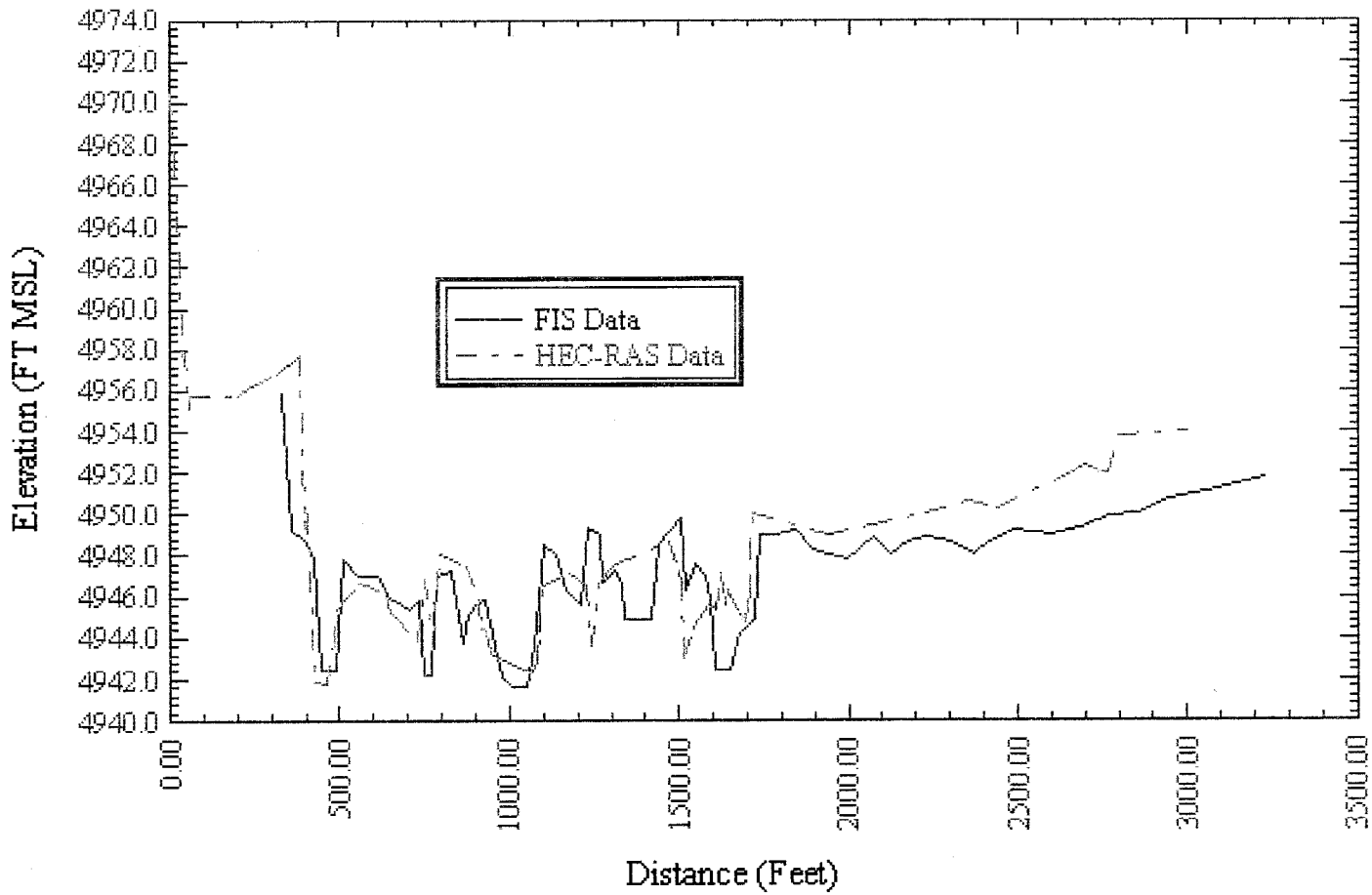
## Plate 19. FIS Section V (#51, at Site #2)



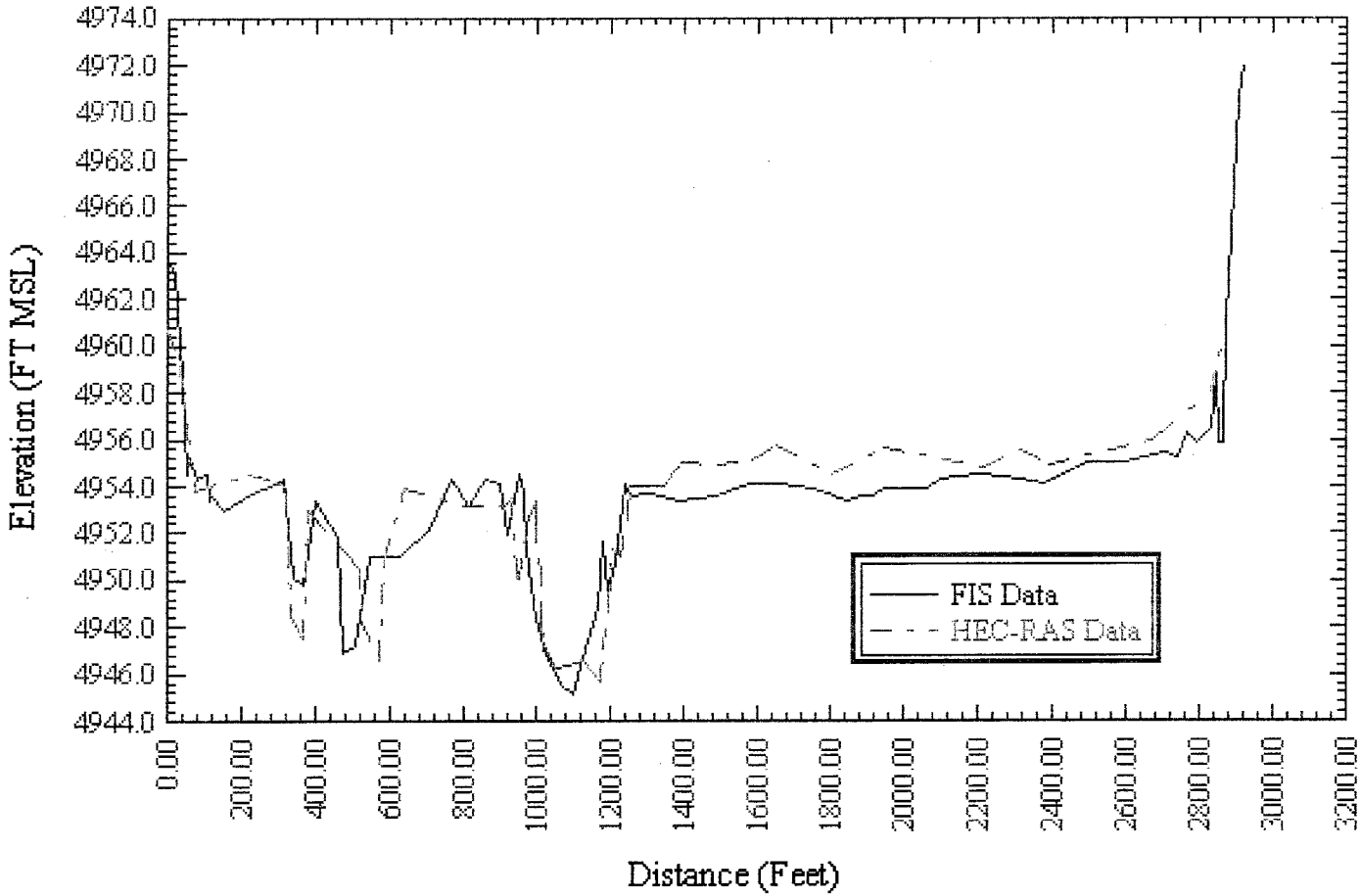
## Plate 20. FIS Section W (#52, at Site #1)



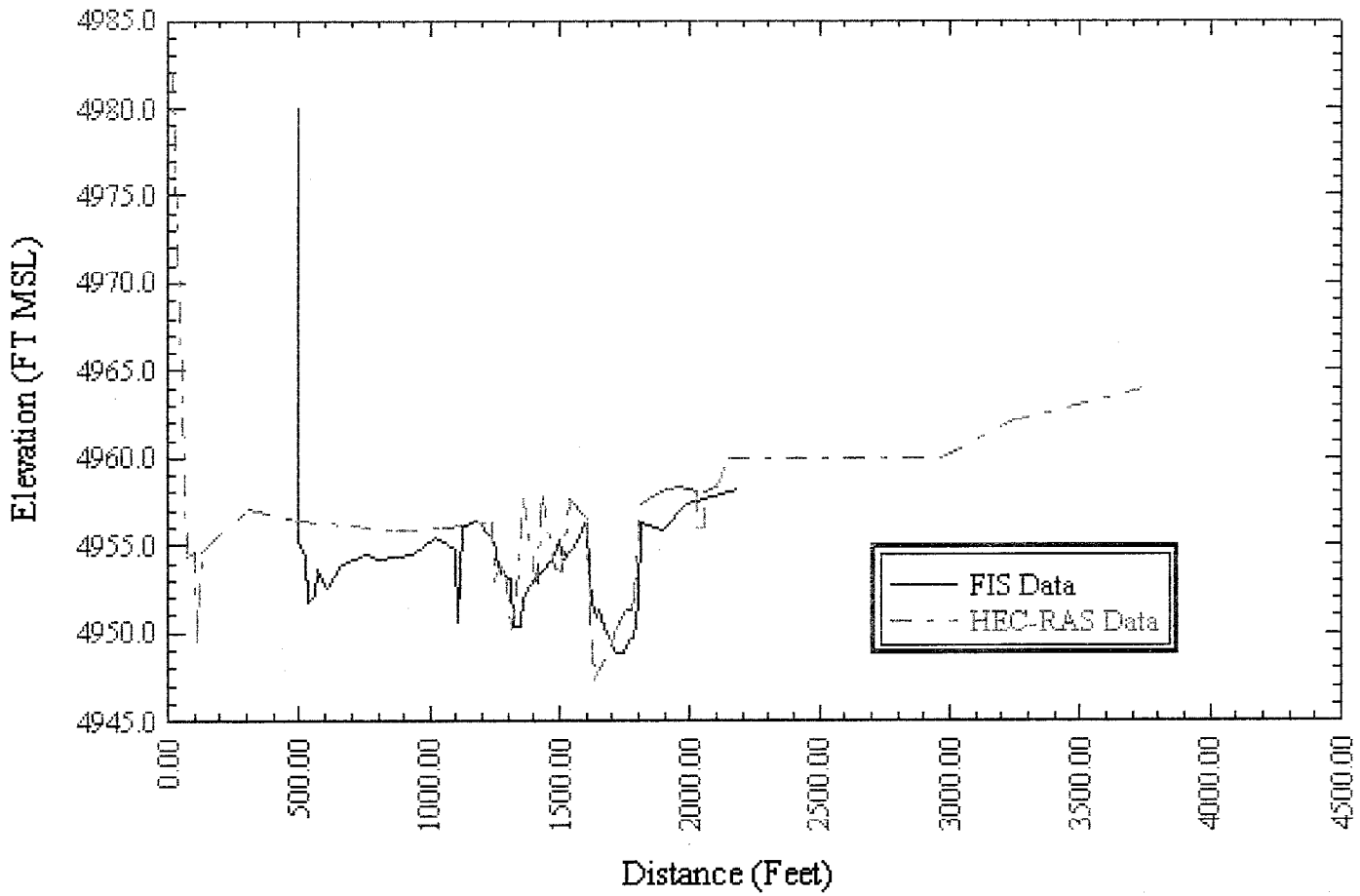
## Plate 21. FIS Section X (#53, at Site #1)



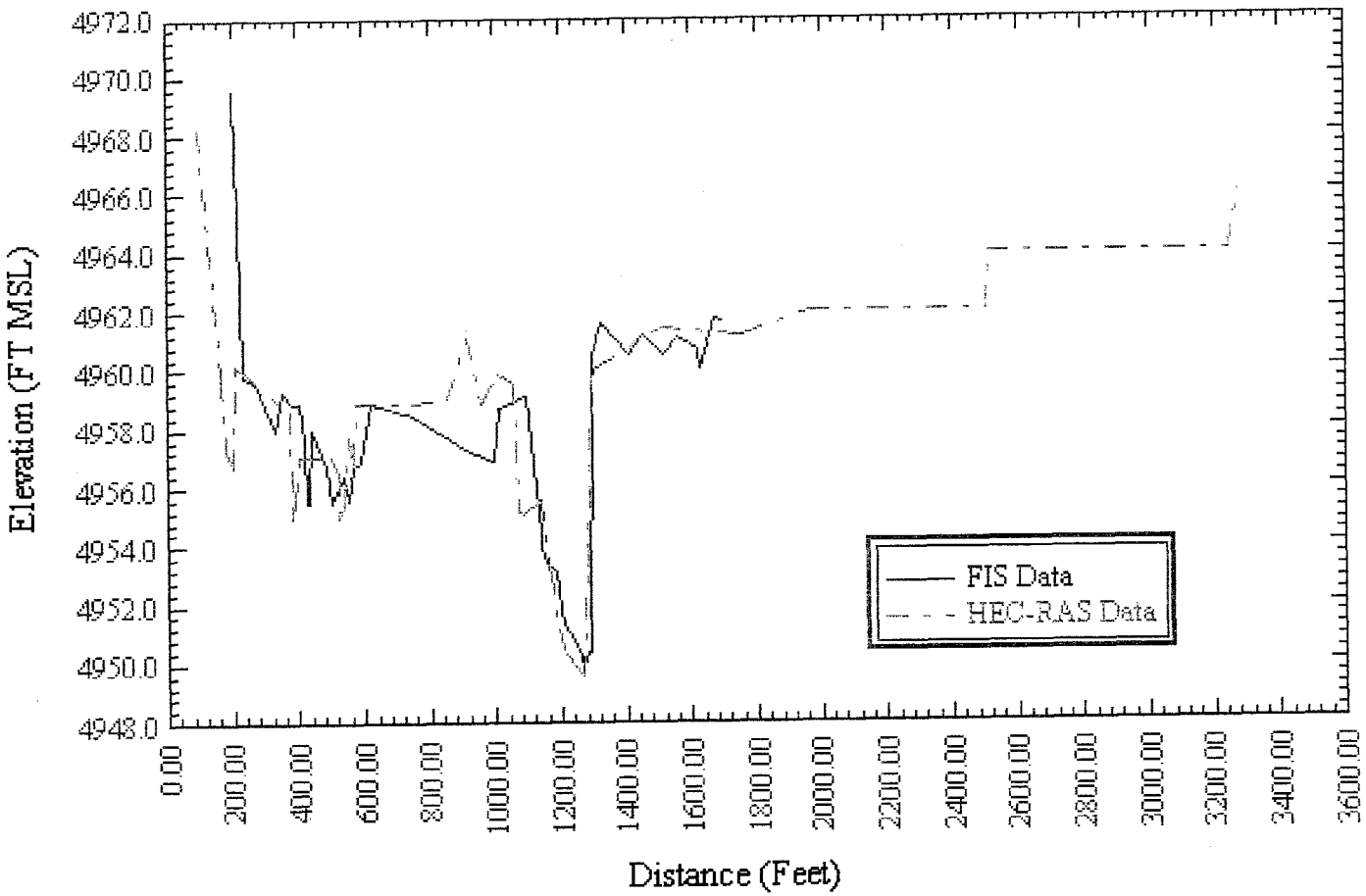
## Plate 22. FIS Section Y (#54, at Site #1)



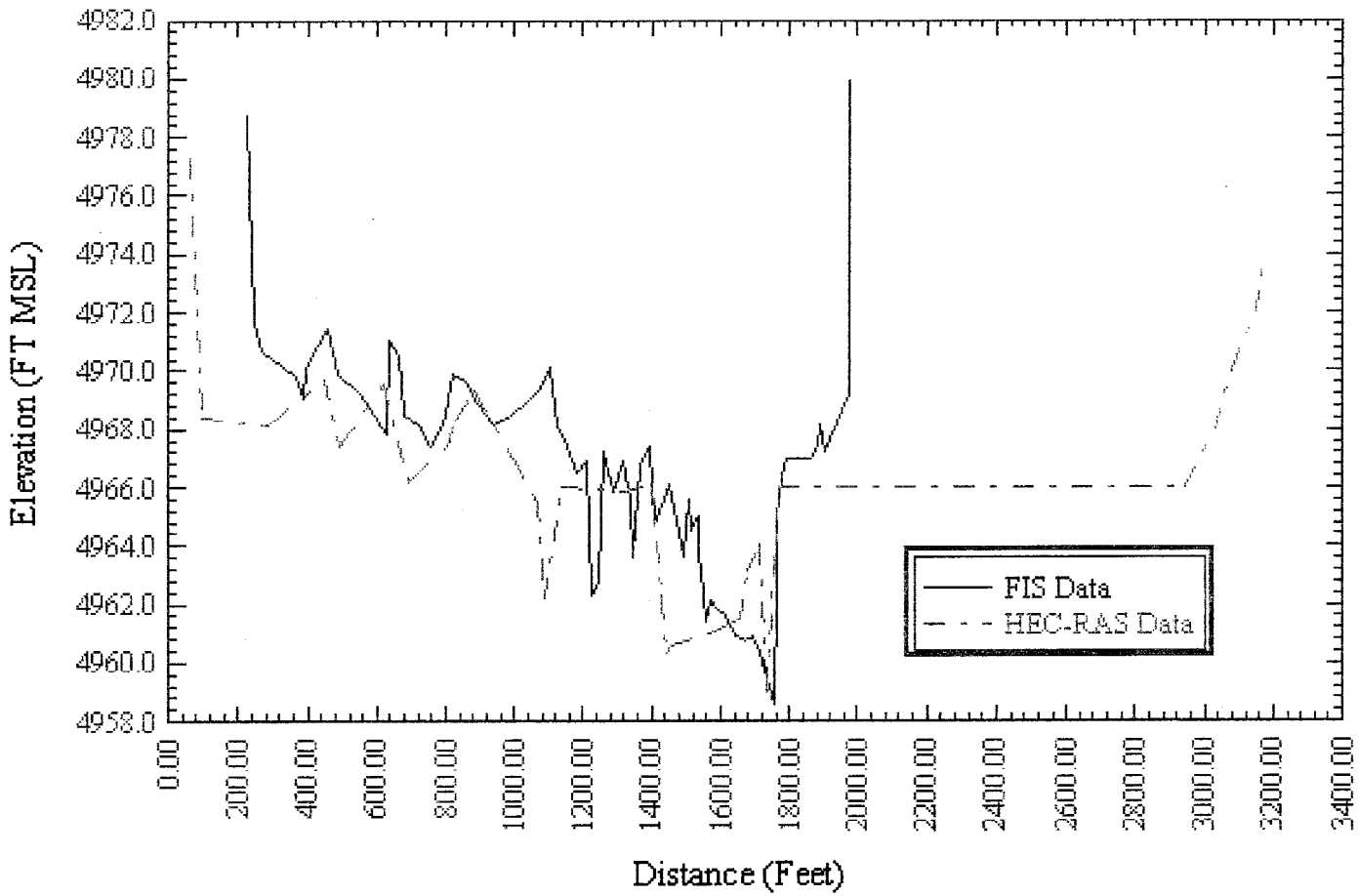
## Plate 23. FIS Section Z (#55, at Site #1)



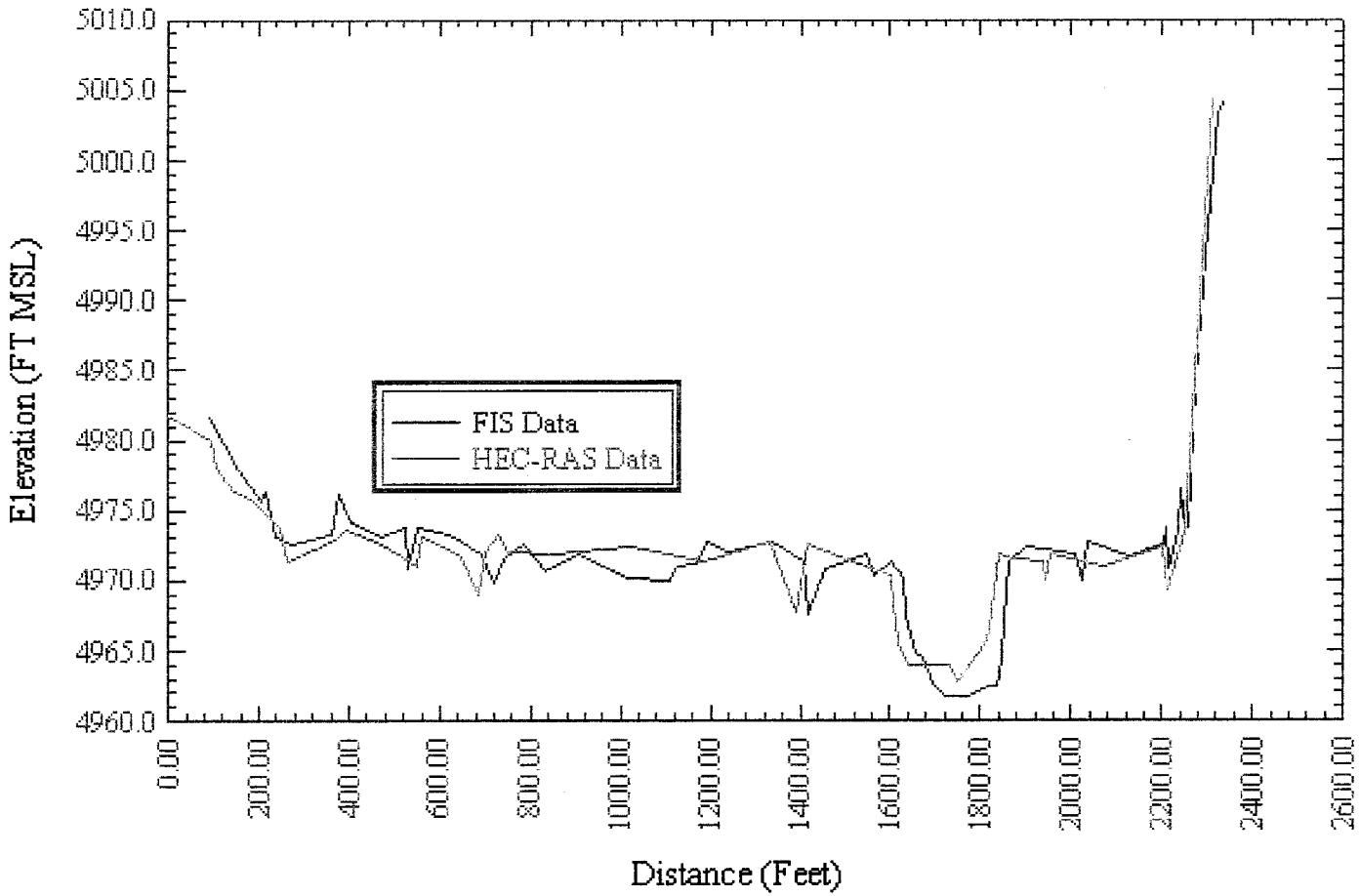
## Plate 24. FIS Section AA (#56, at Site #1)



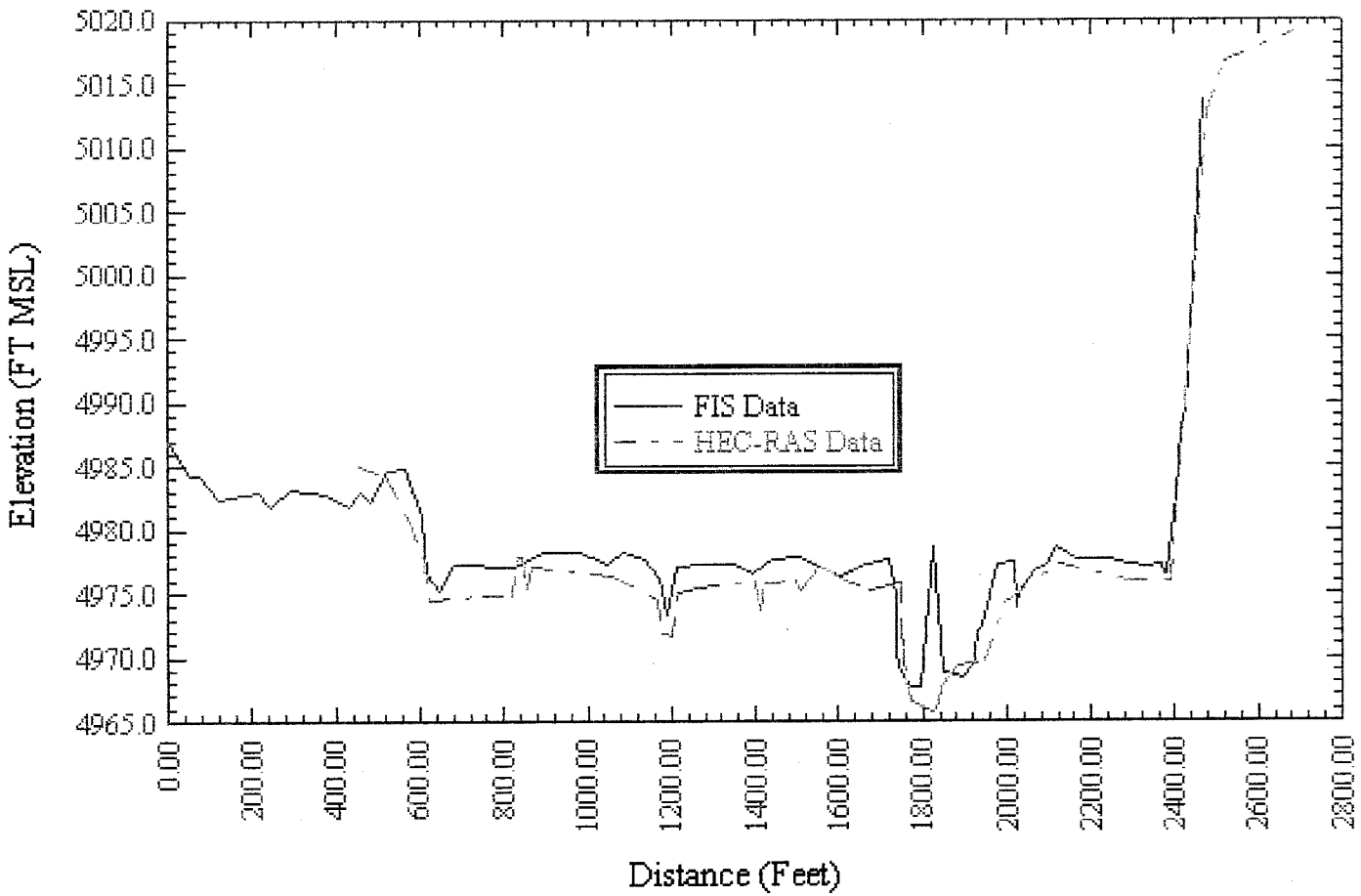
## Plate 25. FIS Section AB (#57, at Site #1)



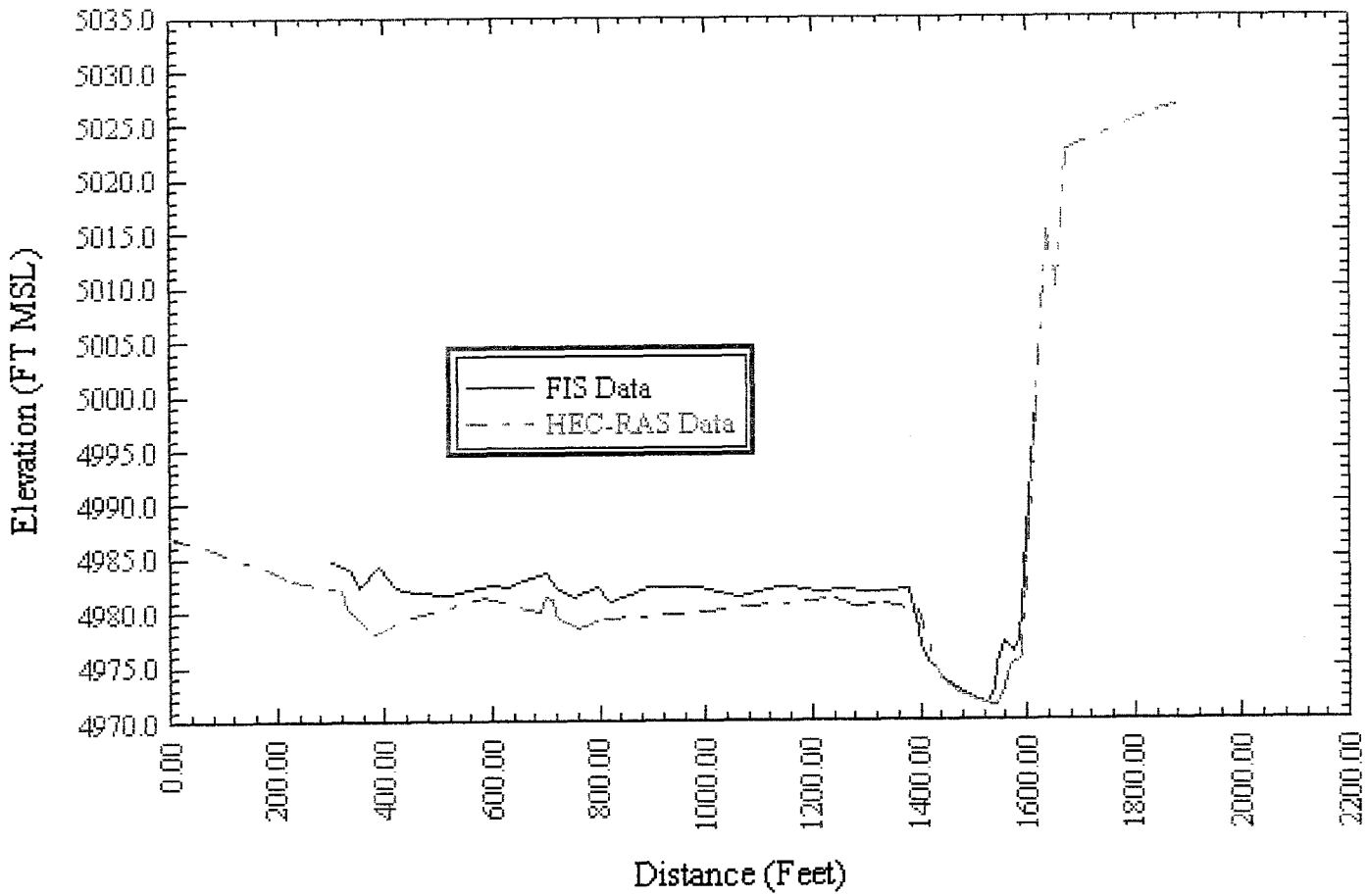
## Plate 26. FIS Section AC (#58, D/S Site #5)



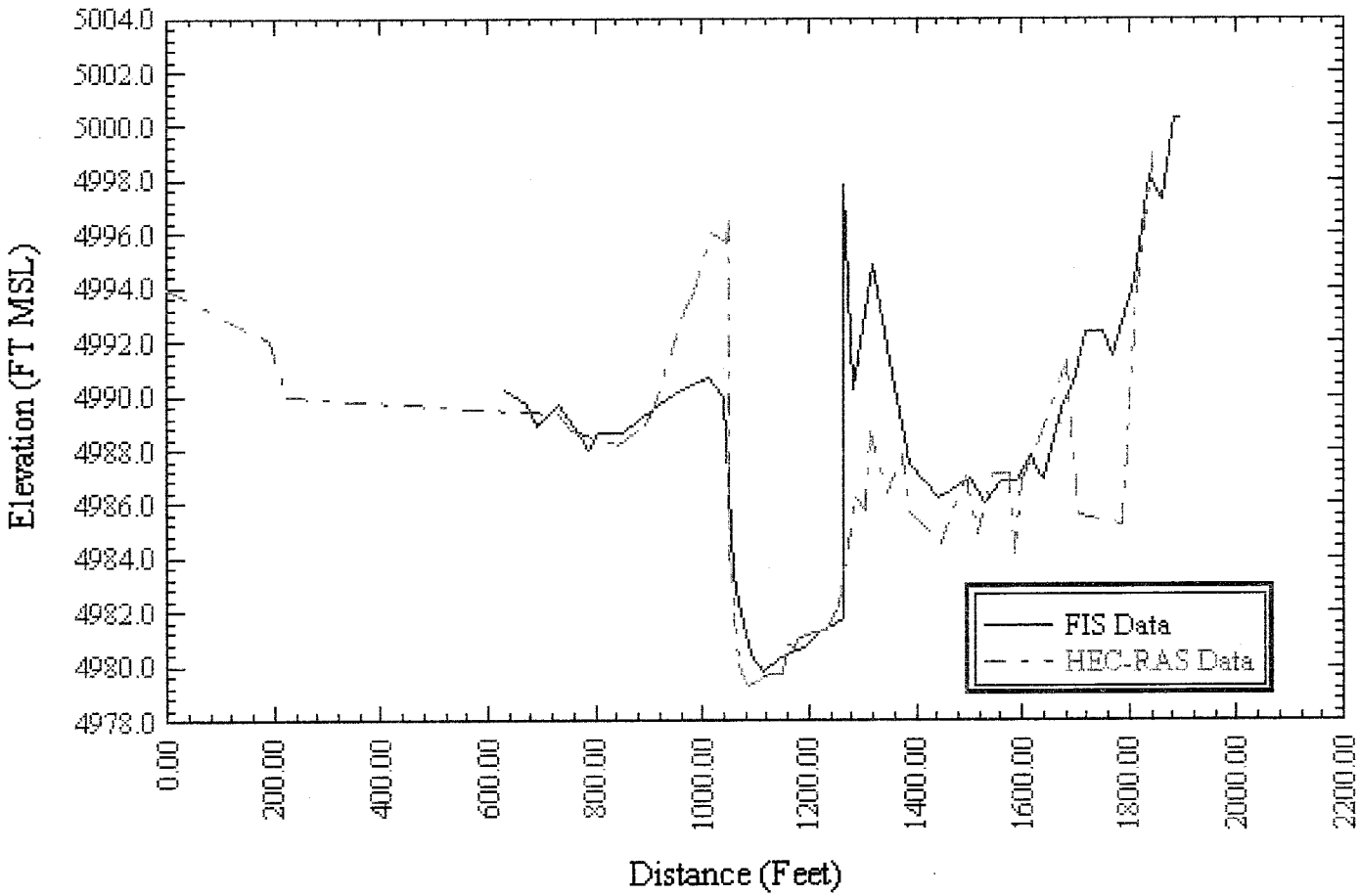
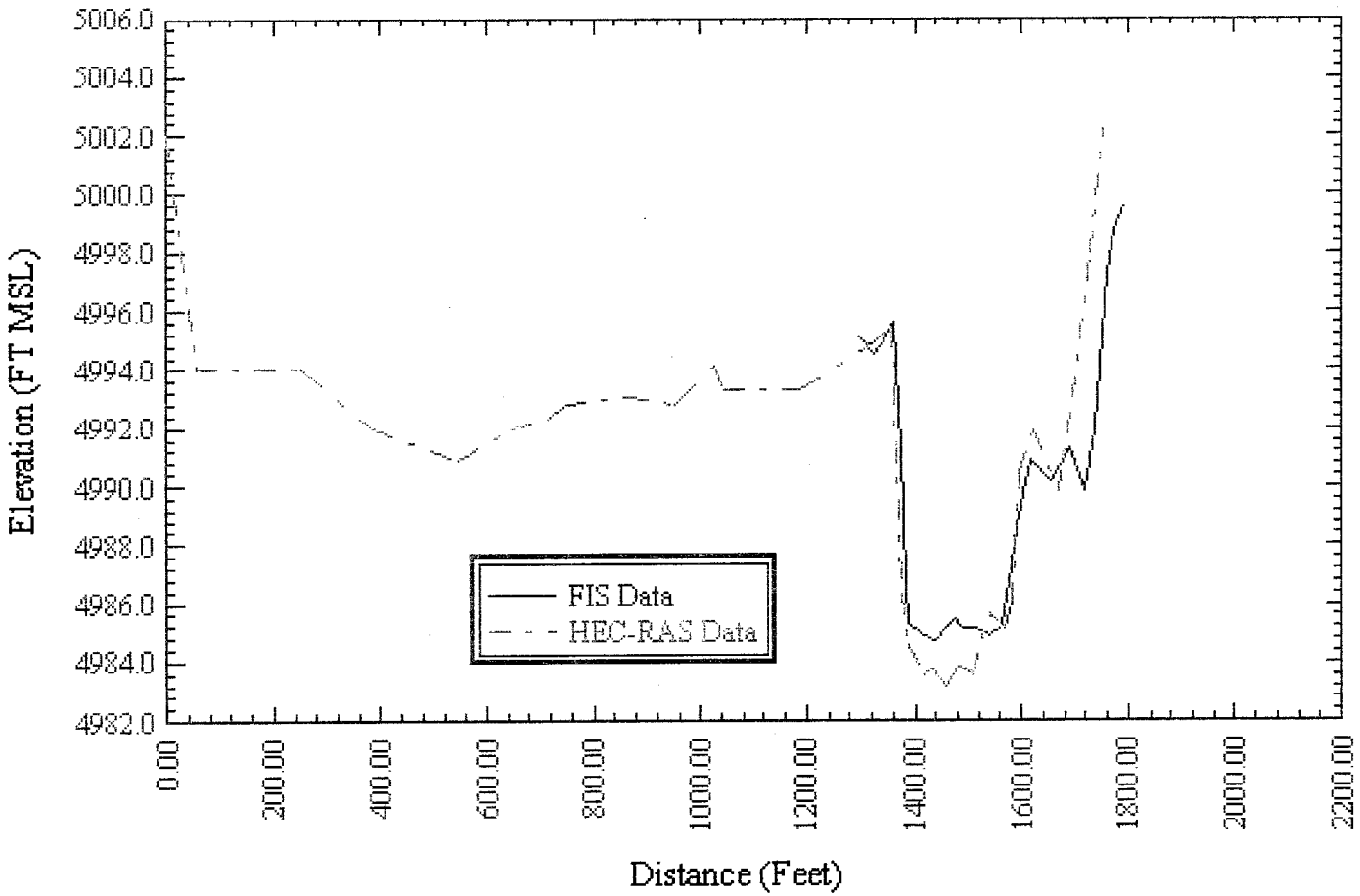
## Plate 27. FIS Section AD (#59, D/S Site #5)



## Plate 28. FIS Section AE (#60, Site #5)



## Plate 29. FIS Section AF (#61, at Site #5)



## Plate 30. FIS Section AG (#62, at Site #5)