September 2001

# SECTION 227-NATIONAL SHORELINE EROSION CONTROL DEVELOPMENT AND DEMONSTRATION PROGRAM

## COASTAL PROCESSES ANALYSIS
## DADE COUNTY AND 63RD STREET HOT SPOT

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# Report Documentation Page

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# 1.0 - INTRODUCTION

## 1.1 Authorization

On August 29, 2001, the U.S. Army Corps of Engineers (USACE), Jacksonville District authorized Coastal Systems International (Coastal Systems) to perform Phase I investigations for the 227 Demonstration Project at the 63rd Street Erosional Hot Spot, City of Miami Beach, Miami-Dade County. The Phase I investigations consisted of an analysis of beach erosion and sand transport, both cross-shore and longshore, for most of Miami-Dade County and in the vicinity of the 63rd Street Hot Spot. Based on these investigations, basic design parameters for a demonstration project were determined. This work will also provide calibration data for Phase II sediment transport modeling, and the investigations will be the basis for detailed shore protection design parameters for the demonstration project.

## 1.2 Purpose and Scope

The 63rd Street erosional hot spot demonstration project site along the City of Miami Beach shoreline provides an excellent opportunity to address "erosional hot spot" issues which are being experienced in many Federal shore protection projects. Beach fill hot spots are problematic in that they may trigger early project renourishments thereby increasing project costs. To address these issues, Section 227 of the Water Resource and Development Act of 1996 (WRDA '96) authorized the National Shoreline Erosion Control Development and Demonstration Program (NSECDDP). The Program is aimed at advancing the state-of-the-art and innovative shore protection solutions on the open coast in coastal shoreline protection. The Section 227 legislation provides a vehicle by which shore protection devices, designs, and methods can be constructed, monitored and evaluated. This report examines the coastal processes of the region and the 63rd Street Hot Spot in order to determine basic design parameters for a demonstration project, and to provide the basis for future shoreline and project performance modeling.

This report consists of an update to the findings in the February 1997 "Coastal Engineering Report – Dade County Regional Sediment Budget" prepared by Coastal Systems for the

Miami-Dade County Department of Environmental Resources Management (DERM), and the investigation of coastal processes in the vicinity of the 63rd Street Hot Spot. The updated study determined recent regional shoreline, volumetric, and sediment budget changes for Miami-Dade County's shoreline using the previous 1996 study data and recent LIDAR survey data performed in June 2000. Most of the Miami-Dade County shoreline is part of the Federally authorized Dade County Beach Erosion and Hurricane Protection Project (BEC&HP). LIDAR hydrographic survey data was provided by the USACE Jacksonville District, as well as a draft Design Memorandum report prepared by the USACE Jacksonville District, were reviewed and interpreted to provide historical shoreline and volumetric changes within the region.

The 1997 regional sediment budget that identified the sand movement, or net longshore sediment transport, within the active littoral system has been updated utilizing the volumetric changes within each specific segment. The sand movement over the 4 year period from 1996 to 2000 was analyzed and combined with the previous data (1980 through 1996) to create a 20 year average of littoral transport, or sand movement. This regional sediment budget takes into consideration any "sinks" and "sources" of sediment as well as any longshore sediment barriers that may interrupt the sand flow along the shoreline of Miami-Dade County. Based on the above findings, a localized sediment budget and basic design parameters for the 63rd Street Hot Spot were developed.

### 1.3 Background

Miami-Dade County, which is located at the southeast terminus of the Florida Peninsula, is bordered to the north by Broward County, to the south and west by Monroe and Collier Counties, and to the east by the Atlantic Ocean (see Figure 1.1). Miami-Dade County's sandy shoreline is located on the Atlantic Ocean side of several coastal barrier islands that are separated from the mainland by Biscayne Bay. The 14.3-mile long barrier island between the Dade/Broward County line and Government Cut is low with elevations ranging from 5 to 10 feet above mean low water (MLW). The highest elevations are

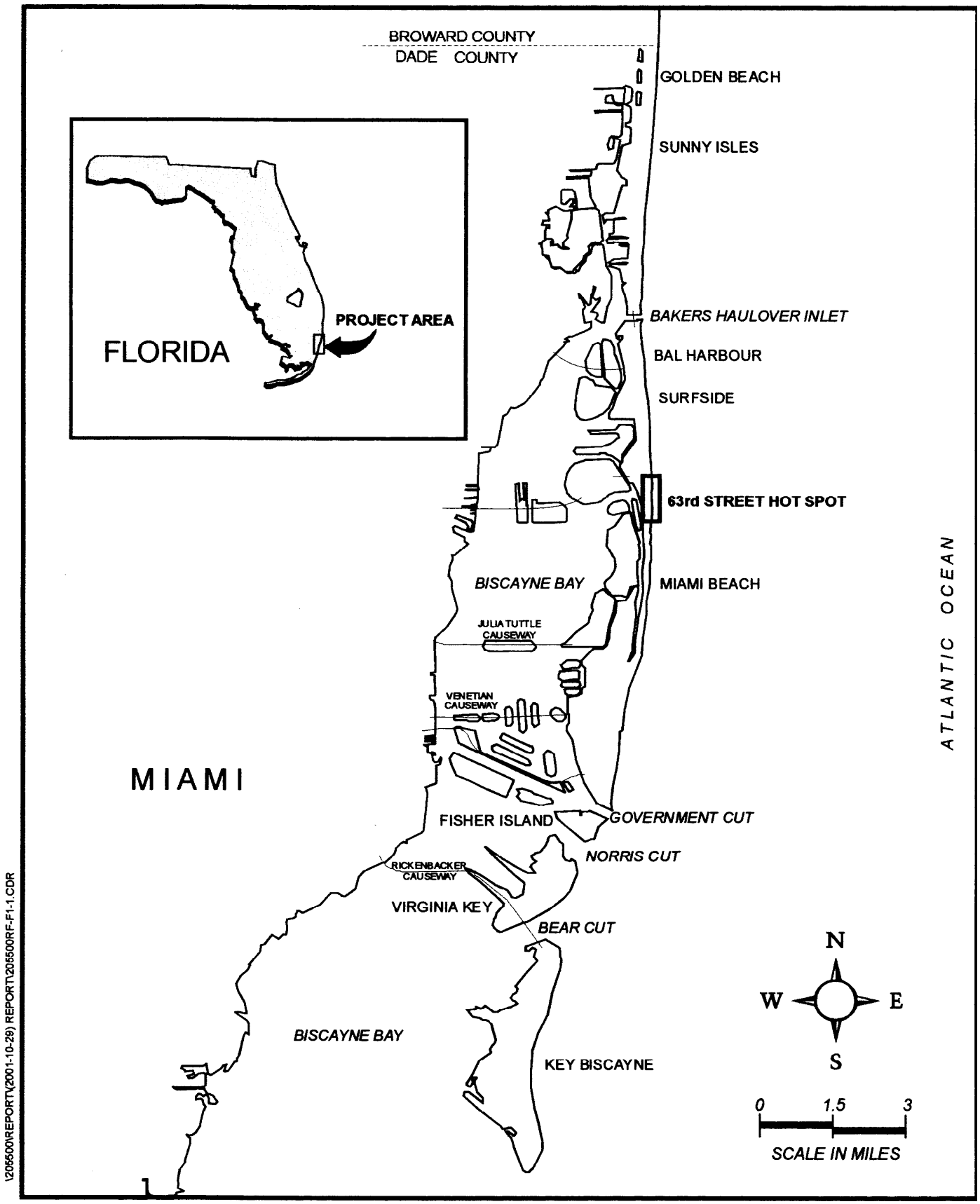
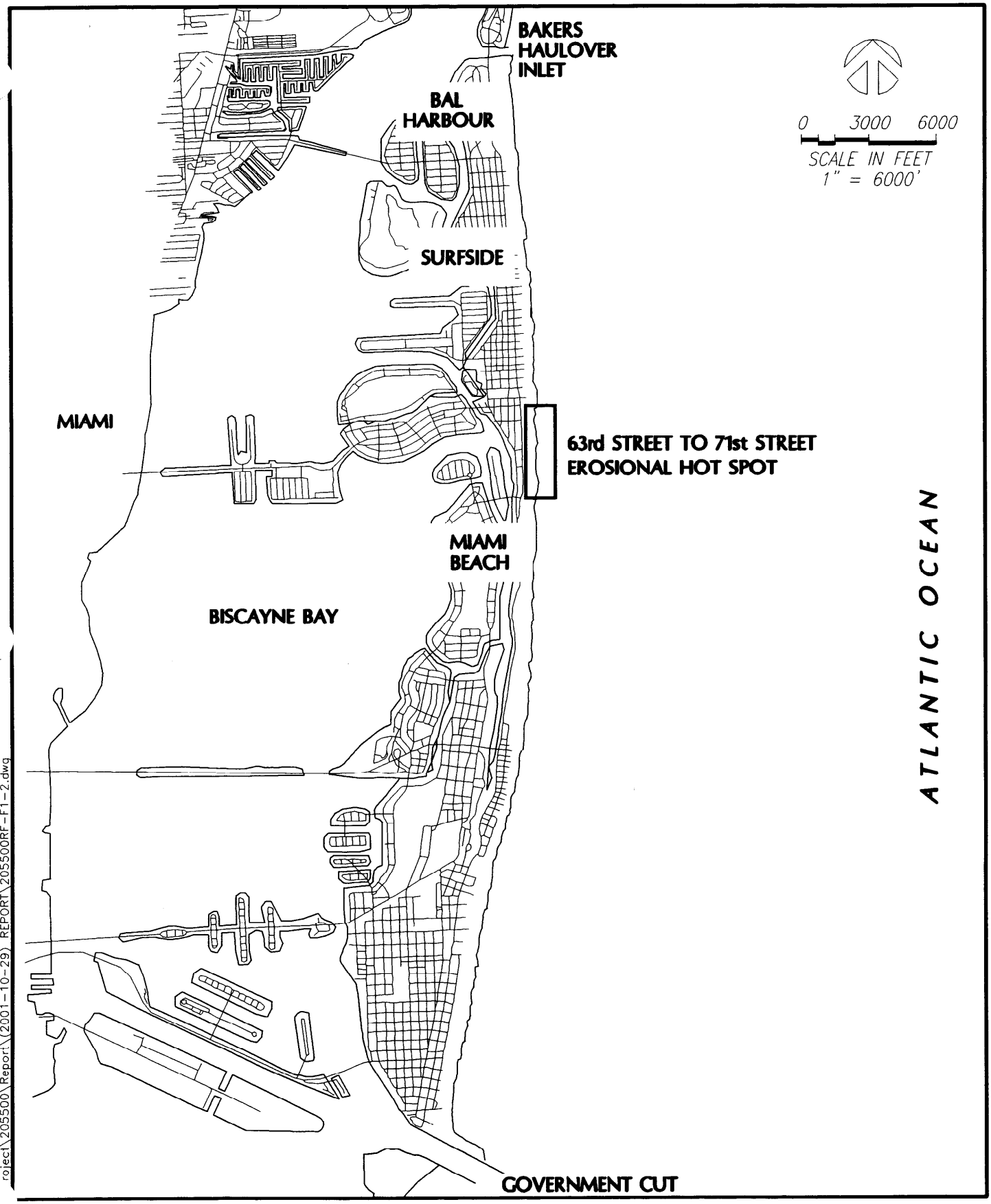



**FIGURE 1.1**
LOCATION MAP




# FIGURE 1.2

LOCATION MAP

63rd STREET EROSIONAL HOT SPOT

located along the beach ridge parallel to the Atlantic Ocean. These elevations transition down to Biscayne Bay and the Intracoastal Waterway to the west. Generally, the width of the barrier islands varies from 0.2 to 0.5 miles south of Bakers Haulover Inlet and from 0.2 to 1.5 miles north of the Inlet. The 63rd Street Hot Spot is located between monuments R-42 and R-47, as shown in Figure 1.2.

Upland development along Miami Beach has occurred relatively recently with major growth occurring in the 1930's. According to the U.S. Army Corps of Engineers (1974), seawalls almost continually lined the shoreline with abutting groins between Bakers Haulover Inlet and Government Cut measuring approximately 48,985 linear feet. Of these seawalls, approximately 27,460 feet of seawall had little or no beach in front of them. After World War II, many hotel owners on Miami Beach obtained permits to construct new bulkheads 75 feet seaward of the existing one, which, in most instances, were seaward of the existing Mean High Water Line (Wiegel, 1992).

Given the poor shoreline conditions and the demand for beach area, a decision was made to nourish the beach and provide for hurricane protection. The USACE initiated a beach erosion study of the Dade County shoreline (USACE, 1965). The Miami-Dade County BEC&HP project was authorized according to the 1968 Flood Control Act. Modifications to the BEC&HP project made in 1974 provided for beach erosion control and hurricane protection along the shorelines of Miami Beach, Surfside and Bal Harbour as well as for a recreational beach along Haulover Beach Park. The project was later extended to include erosion control and recreational beach along Sunny Isles.

A total volume of 1,320,000 cubic yards of fill were placed along the Sunny Isles beaches in 1988. In 1990, an estimated 60,000 cubic yards were dredged from Bakers Haulover Inlet and were placed on Sunny Isles (DEP monuments R-7 to R-20) (CPE, 1995).

The Intracoastal Waterway, immediately adjacent to Bakers Haulover Inlet, has been dredged periodically, with the dredge spoil being placed on the beaches to the north of the inlet. Records show that between 1979 and 1993, 78,163 cubic yards of sand were

dredged form the inlet and placed onto the Haulover Beach Park beach (DEP monuments R-20 to R-26). An additional 240,000 cubic yards were dredged from an offshore borrow area and placed in Haulover Beach Park in 1987.

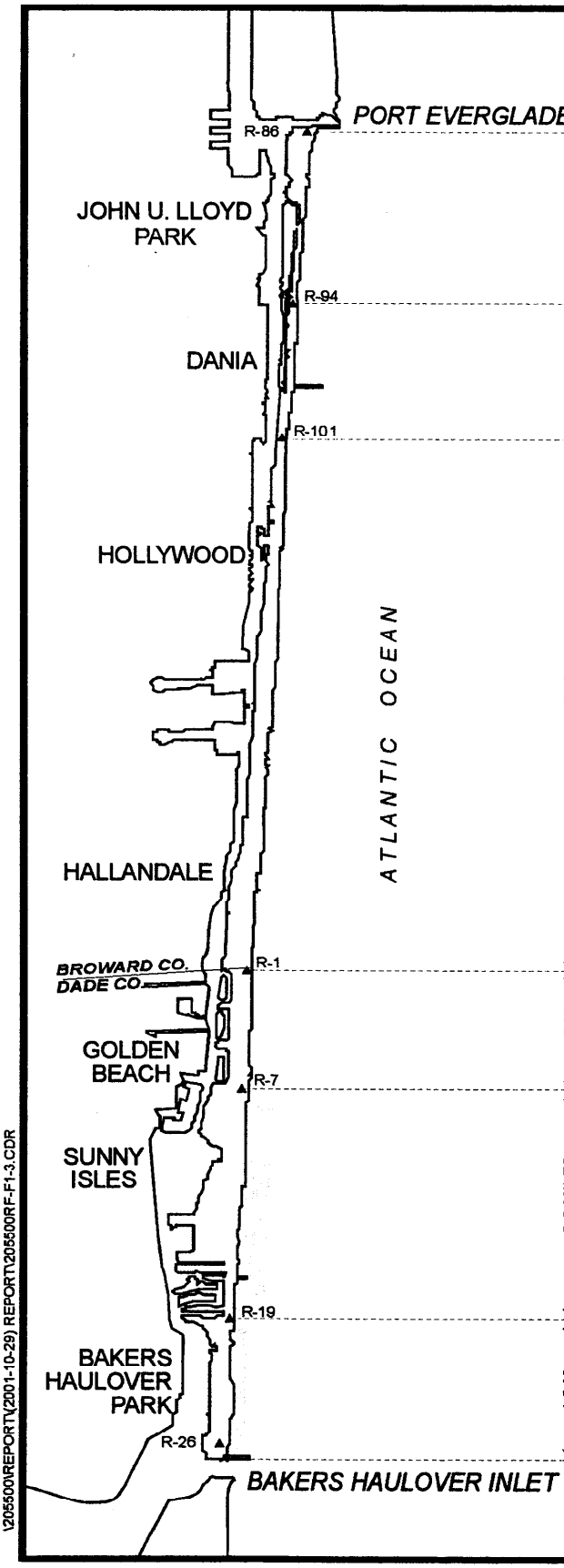
In May 1977, construction began along the first authorized BEC&HP project segment, located between R-31 and R-38 (96th and 80th streets, respectively) at Surfside. An estimated volume of 2,940,000 cubic yards of sand was placed at this location, as shown in Figure 1.3. The project segment was completed in September 1978. In August 1978, construction began along the authorized segment between R-38 and R-46 (80th and 63rd streets, respectively), as shown in Figure 1.4. The fill volume along this segment was 1,530,000 cubic yards. In 1979-1980, the authorized segment between 63rd street and 36th street was constructed with 3,177,100 cubic yards of sand. In 1980-81, the fourth authorized segment, located between 37th street and 16th street, was constructed. The total fill volume was 2,200,000 cubic yards in this 2.3 mile segment. In 1981-1982, the fifth authorized segment was restored when 2,400,000 cubic yards of sand were placed between R-66 and R-74 (16th street and Government Cut) (COE, 1984).

In 1985, two reaches within the authorized Miami Beach project were renourished. Between R-41 and R-46 (71st and 63rd streets), 110,000 cubic yards of sand were placed, and between R-57 and R-60 (38th and 27th streets), 50,000 cubic yards were placed. In 1990, the Bal Harbour authorized project was renourished with 225,000 cubic yards of sand. In 1994, a 432,000 cubic yards project was initiated to renourish the authorized beach project between R-53 and R-58; however, only 120,000 cubic yards were placed between R-55 and R-56 before the project was shut down (Flynn, 1996).

## 1.4 History of Recent Beach Nourishment Projects (1996-2000)

*1997 Sunny Isles Renourishment (truck-haul)*: In January and February 1997, 9,000 cubic yards of sand were placed along Sunny Isles, primarily to replace material lost from continuing end losses at the northern end of the Project. This interim renourishment was performed in order to avoid damage to upland properties due to winter storm wave attack prior to construction of the large-scale renourishments of Sunny Isles and Miami Beach

scheduled for the summer of 1997 (see below). Fill was trucked to the site from an upland sand source and placed by earthmoving equipment at eroded portions of Sunny Isles beach. Approximately 5,000 cubic yards of fill were placed between R-7 and R-8 to replace material lost through end losses from the north end of the project; 2000 cubic yards were placed near R-10 and 2000 cubic yards were placed near R-16, to replace material lost through localized erosion at each of these areas.




| PROJECT | YEAR | VOLUME (CU.YD.) |
|---|---|---|
| **JOHN U. LLOYD PARK** | 1977 | 1,090,000 |
| | 1989 | 603,000 |
| **HOLLYWOOD/ HALLANDALE** | 1971 | 350,000 |
| | 1979 | 1,980,000 |
| | 1991 | 1,108,000 |
| **SUNNY ISLES** | | |
| R-7 to R-20 | 1988 | 1,320,000 |
| R-7 to R-20 | 1990 | 60,000 |
| R-7 to R-8 | 1997 | 5,000 |
| R-10 | 1997 | 2,000 |
| R-16 | 1997 | 2,000 |
| R-7 to R-10 | 1997 | 80,130 |
| **HAULOVER BEACH** (SAND FROM BHI) | 1955-84 | 976,377 |
| **HAULOVER BEACH** (OTHER SOURCES) | 1960 | 180,000 |
| | 1978 | 300,000 |
| | 1987 | 240,000 |

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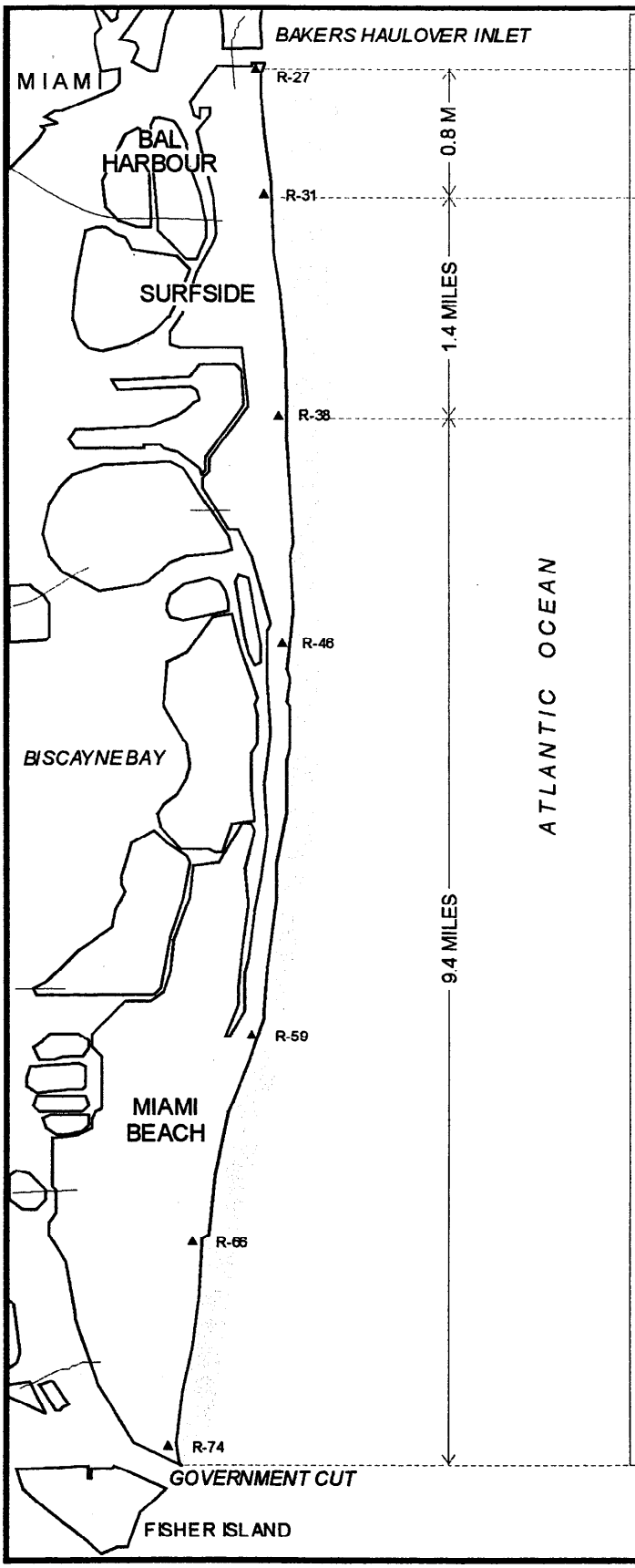
# FIGURE 1.3

HISTORIC BEACH NOURISHMENT PROJECTS
(Port Everglades to Bakers Haulover Inlet)




| PROJECT | YEAR | VOLUME (CU.YD.) |
|---|---|---|
| **BAL HARBOR** | | |
| R27 - R31 | 1960-69 | 305,000 |
| R27 - R31 | 1975 | 1,625,000 |
| R27 - R31 | 1990 | 225,000 |
| R28 - R31 | 1998 | 282,852 |
| **SURFSIDE** | | |
| PHASE I | 1978 | 2,940,000 |
| R32 - R36 | 1999 | 590,000 |
| **MIAMI BEACH** | | |
| PHASE II R38 - R46 | 1979 | 1,530,000 |
| PHASE III R46 - R59 | 1980 | 3,177,100 |
| PHASE IV R59 - R66 | 1980-81 | 2,200,000 |
| PHASE V R66 - GC | 1982 | 2,400,000 |
| R41 - R46 | 1985 | 110,000 |
| R57 - R60 | 1985 | 50,000 |
| R55 - R56 (ESTIMATED) | 1994 | 120,000 |
| R57 - R59 | 1997 | 50,000 |
| R54 - R56 | 1997 | 35,000 |
| R53 - R58 | 1997 | 478,938 |
| R44 - R45 | 1998 | 18,000 |
| R73 - G.C. | 1999 | 132,000 |

# FIGURE 1.4

HISTORIC BEACH NOURISHMENT PROJECTS
( Bakers Haulover Inlet to Government Cut)

*1997 Miami Beach Renourishments (truck-haul:* In 1997 two relatively small, rapidly eroding areas along Miami Beach were renourished using material truck-hauled from upland sources. In January 1997, placement of approximately 50,000 cubic yards of CSR Rinker lake fill material was completed along a 1,200-foot reach of shoreline between 32nd and 38th Streets (DNR monuments R-57 to R-59) in Miami Beach. In February 1997, an additional 35,000 cubic yards of material was trucked from an upland borrow site for placement along a 1,200–foot reach of shoreline between 44th and 46th Streets in Miami Beach (R-54 to R-56). Both of these truck-hauled beach fills were compacted to levels above U.S. Fish & Wildlife standards, and beach-tilling and mixing was required to loosen the fill to allow sea turtle nesting.

*1997 Sunny Isles and Miami Beach Renourishments ("Contract #1"):* Between March and July 1997, 80,130 cubic yards of fill were placed along a 3000-foot reach of northern Sunny Isles, extending from the Sunny Isles north city limit southward 3000 feet to R-10. The construction berm along the Sunny Isles segment was 70 feet wide at an elevation of +9.0 Mean Low Water (MLW), and with a front slope of 1v:10h. Under the sam e contract 478,938 cubic yards of material were placed between R-53 and R-58 on Miami Beach. The construction berm along the Miami Beach segment was 230 feet wide at an elevation of +9.0, and with a front slope of 1v:20h. This material was excavated by the hopper dredge *Dodge Island* from "Borrow Area #1", located about 2 miles offshore of Golden Beach. Material was pumped onshore for beach placem ent via offshore terminal/pipeline.

*1998 Maintenance Disposal – Bal Harbour:* A total volume of 282,852 cubic yards of material was removed from the Bakers Haulover Inlet entrance channel, the Intracoastal Waterway (IWW), and the IWW approaches to the inlet. This material was excavated using the hydraulic dredge *Jeri B,* and placed via pipeline along a 3000-foot reach of Bal Harbour, beginning 1000 feet south of the inlet (R-28 to R-31). Construction began in May 1998 and was completed in June 1998.

*1998 Miami Beach Renourishment (truck-haul)*: An additional 18,000 cubic yards of material were truck-hauled from an upland borrow area for placement between R-44 and R-45 in Miami Beach.

*1999 Renourishments of Surfside and South Miami Beach ("Contract #2).* This contract provided for the placement of 590,000 cubic yards of material along Surfside (R-32 to R-36), and 132,000 cubic yards of material along the southern end of Miami Beach (R-73 to the Government Cut northern jetty). The construction berm in Surfside was 250 feet wide, +9.0 MLW elevation, with a 1v:20h front slope. The contractor began construction on the Surfside segment in November 1998 and completed construction in June 1999. The construction berm along the southern Miami Beach segment was 180 feet wide, +9.0 MLW elevation, with a 1v:15 front slope. Construction of the southern Miami Beach segment began in June 1999 and was completed in July 1999. Both segments were constructed by the use of the hopper dredge *Dodge Island*, with material pumped ashore via pipeline from an offshore pumpout terminal. The borrow source for both fill segments was the SGC borrow area, located just south of Government cut, approximately 3 miles offshore of Virginia Key (USACE, 2001).

# 2.0 - SHORELINE AND VOLUMETRIC CHANGES

## 2.1 General

Changes in shoreline location and the associated volumetric changes were identified within the study area, which includes the region south of the Miami-Dade County border to Bakers Haulover Inlet, and from Bakers Haulover Inlet to Government Cut. The shoreline and volumetric changes were calculated based on the information provided by Morgan & Eklund, Inc., and the USACE Jacksonville District. Information reported in the inlet management plans, beach restoration reports, General Design Memorandums by the U.S. Army Corps of Engineers and others were used in order to incorporate the man-made coastal improvements within the region including beach nourishment/renourishment projects, dredging projects, inlet improvements, etc. The cross-shore distribution of volumetric changes was also extimated and described within this chapter.

## 2.2 Methodology

The cross-shore beach profiles at DEP monument locations surveyed on two different dates were used to compute the shoreline change at Mean High Water (MHW), or +1.7 feet NGVD elevation, and the volumetric change per linear foot of shoreline. The sets of data compared during this study were Miami-Dade County's 1996 survey performed by Morgan & Eklund, and the 2000 LIDAR survey provided by the USACE Jacksonville District. The 2000 LIDAR survey was referenced to MLW (-0.8 feet NGVD) and was therefore adjusted to NGVD for comparison purposes. The tidal datum elevations are based on the National Ocean Service Miami Beach Station No. 8723170.

The comparison of these beach profiles as well as their shoreline and volumetric changes are presented in Appendices A and B. Shoreline comparisons of the MHW location for each DEP profile was performed and presented on a per monument basis. These values included the effects of nourishment activities between surveys. Therefore, to determine the actual shoreline change without the effects of the beach nourishment projects, the shoreline advance from the nourishment was subtracted from the initial calculation. To determine the shoreline advance from nourishment, it was assumed that the sand quantity

of a beach fill project was uniformly distributed along the project shoreline. The shoreline advance associated with the beach project was obtained by dividing the total sand by the shoreline length shoreline and the height between the berm and the depth of closure, as described by the following:

$$\Delta y = \frac{V}{(h^* + B)l}$$

where $V$ is the volumetric change, $h^*$ is depth of closure, $B$ is the berm height (assumed to be +9.0 MLW (+8.1 feet NGVD)), $l$ is shoreline length, and $\Delta y$ is the shoreline change. This calculation is based on an assumption that a uniform offshore sand movement from the established berm to the depth of closure.

The volumetric change at each DEP monument was used to compute the volumetric changes for the beach segment between two consecutive monuments using a two-point moving average. These results included the effects of nourishment activities between surveys. Therefore, the amount of fill placed during a beach nourishment project occurring between 1996 and 2000 was subtracted from the net volume change within the two limiting DEP profile lines.

### 2.3 Shoreline Changes

In order to quantify the shoreline position changes occurring along the Miami-Dade County shoreline between June 1996 and June 2000, the change in the MHW locations were calculated for each profile. The MHW (+1.7 feet NGVD) locations provide a fixed reference for comparison and are representative of the behavior of the monitoring shoreline. The analysis results were also compared to historical changes previously calculated from 1980 to 1996. Tables 2.1 and 2.2 summarize these analyses from the Miami-Dade County/Broward County border south to Government Cut on an overall and yearly basis. Figures 2.1 through 2.3 graphically depict the shoreline changes summarized in Table 2.1, and Figures 2.4 through 2.6 represent the annual shoreline changes summarized in Table 2.2.

**Table 2.1**
**Shoreline (MHW +1.7' NGVD) Change Comparison**
**Miami-Dade County Profiles Along R-Monuments**

| | | Shoreline Changes (ft) at MHW (+1.7' NGVD) | | | | | |
|---|---|---|---|---|---|---|---|
| | Profile | With Nourishment 1980 to 1996 | Without Nourishment 1980 to 1996 | With Nourishment 1996 to 2000 | Without Nourishment 1996 to 2000 | Overall With Nourishment 1980 to 2000 | Overall Without Nourishment 1980 to 2000 |
| Golden Beach | R-1 | -26.8 | -26.8 | | | -26.8 | -26.8 |
| | R-2 | 27.2 | 27.2 | 4.0 | 4.0 | 31.2 | 31.2 |
| | R-3 | 26.9 | 26.9 | -9.0 | -9.0 | 17.8 | 17.8 |
| | R-4 | 20.8 | 20.8 | 45.8 | 45.8 | 66.6 | 66.6 |
| | R-5 | 10.8 | 10.8 | 6.5 | 6.5 | 17.2 | 17.2 |
| | R-6 | 19.6 | 19.6 | 30.2 | 30.2 | 49.8 | 49.8 |
| | R-7 | 12.7 | 12.7 | -13.7 | -13.7 | -1.0 | -1.0 |
| **Golden Beach Avg.** | | **13.0** | **13.0** | **10.6** | **10.6** | **22.1** | **22.1** |
| Sunny Isles | R-8 | 9.5 | -141.0 | 6.8 | -39.7 | 16.3 | -180.7 |
| | R-9 | 41.7 | -108.8 | 21.5 | -23.5 | 63.2 | -132.3 |
| | R-10 | 7.5 | -143.0 | 67.8 | 44.1 | 75.4 | -98.9 |
| | R-11 | 63.1 | -64.3 | 18.4 | 15.9 | 81.6 | -48.3 |
| | R-12 | 82.5 | -44.9 | 36.5 | 36.5 | 119.0 | -8.4 |
| | R-13 | 103.0 | -24.4 | -11.8 | -11.8 | 91.2 | -36.2 |
| | R-14 | 110.6 | -16.8 | 37.2 | 37.2 | 147.8 | 20.4 |
| | R-15 | 130.8 | 3.4 | -30.4 | -32.8 | 100.3 | -29.5 |
| | R-16 | 83.1 | -44.3 | 46.7 | 46.7 | 129.7 | 2.3 |
| | R-17 | 91.8 | -35.6 | -3.3 | -3.3 | 88.5 | -38.9 |
| | R-18 | 64.6 | -62.8 | 13.0 | 13.0 | 77.5 | -49.9 |
| | R-19 | 54.7 | -72.7 | 28.8 | 28.8 | 83.5 | -43.9 |
| **Sunny Isles Avg.** | | **70.2** | **-62.9** | **19.3** | **9.3** | **89.5** | **-53.7** |
| Bakers Haulover Park | R-20 | 46.1 | -3.5 | -4.9 | -4.9 | 41.3 | -8.4 |
| | R-21 | -81.9 | -131.5 | 22.4 | 22.4 | -59.5 | -109.1 |
| | R-22 | 35.6 | -14.0 | 7.9 | 7.9 | 43.6 | -6.0 |
| | R-23 | -106.7 | -156.3 | 31.8 | 31.8 | -75.0 | -124.6 |
| | R-24 | 14.9 | -34.7 | 46.6 | 46.6 | 61.5 | 11.9 |
| | R-25 | 71.4 | 21.8 | 17.6 | 17.6 | 89.0 | 39.3 |
| | R-26 | 64.5 | 14.8 | 8.2 | 8.2 | 72.7 | 23.1 |
| **B.H. Park Avg.** | | **6.3** | **-43.3** | **18.5** | **18.5** | **24.8** | **-24.8** |
| Bal Harbor | R-27 | 35.2 | 35.2 | -12.4 | -53.4 | 22.7 | -18.3 |
| | R-28 | -67.1 | -127.8 | 37.1 | -55.0 | -30.0 | -182.8 |
| | R-29 | -106.0 | -166.7 | 44.3 | -48.0 | -61.7 | -214.7 |
| | R-30 | -80.1 | -140.8 | 46.8 | -51.7 | -33.3 | -192.5 |
| **Bal Harbor Avg.** | | **-54.5** | **-100.0** | **28.9** | **-52.0** | **-25.6** | **-152.1** |
| Surfside | R-31 | -77.9 | -138.6 | 74.1 | 74.1 | -3.8 | -64.5 |
| | R-32 | -109.1 | -109.1 | 119.5 | -74.6 | 10.4 | -183.7 |
| | R-33 | -131.2 | -131.2 | 117.0 | -85.5 | -14.1 | -216.7 |
| | R-34 | -187.8 | -187.8 | 168.9 | -25.4 | -18.9 | -213.1 |
| | R-35 | -191.7 | -191.7 | 131.4 | -28.0 | -60.2 | -219.7 |
| | R-36 | -190.3 | -190.3 | 127.5 | -32.0 | -62.9 | -222.4 |
| | R-37 | -129.2 | -129.2 | 29.0 | 29.0 | -100.2 | -100.2 |
| **Surfside Avg.** | | **-145.3** | **-154.0** | **109.6** | **-20.3** | **-35.7** | **-174.3** |
| Northern Miami Beach | R-38 | -121.8 | -121.8 | -17.7 | -17.7 | -139.5 | -139.5 |
| | R-39 | -40.1 | -40.1 | -75.3 | -75.3 | -115.4 | -115.4 |
| | R-40 | -86.5 | -86.5 | -4.0 | -4.0 | -90.5 | -90.5 |
| | R-41 | -80.6 | -80.6 | -8.1 | -8.1 | -88.7 | -88.7 |
| | R-42 | -100.3 | -124.6 | -11.4 | -11.4 | -111.7 | -136.0 |
| | R-43 | -80.4 | -104.8 | -28.7 | -28.7 | -109.1 | -133.4 |
| | R-44 | -117.5 | -141.9 | 18.9 | -7.8 | -98.6 | -149.7 |
| | R-45 | -125.8 | -150.2 | -28.1 | -54.8 | -153.9 | -205.0 |
| | R-46 | -135.9 | -160.3 | -36.1 | -36.1 | -172.0 | -196.4 |
| **N. Miami Beach Avg.** | | **-98.8** | **-112.3** | **-21.2** | **-27.1** | **-119.9** | **-139.4** |
| Miami Beach | R-47 | -156.6 | -156.6 | -39.5 | -39.5 | -196.1 | -196.1 |
| | R-48 | -0.6 | -0.6 | -11.3 | -11.3 | -11.8 | -11.8 |
| | R-49 | -131.8 | -131.8 | -9.3 | -9.3 | -141.0 | -141.0 |
| | R-50 | -242.0 | -242.0 | 6.3 | 6.3 | -235.6 | -235.6 |
| | R-51 | -174.9 | -174.9 | 6.4 | 6.4 | -168.6 | -168.6 |
| | R-52 | -152.9 | -152.9 | 10.8 | 10.8 | -142.1 | -142.1 |
| | R-53 | -104.2 | -104.2 | 46.3 | -68.2 | -57.8 | -172.3 |
| | R-54 | -142.6 | -142.6 | 82.7 | -31.8 | -59.9 | -174.4 |
| | R-55 | -162.1 | -162.1 | 72.2 | -47.8 | -89.9 | -209.9 |
| | R-56 | -168.6 | -292.2 | 49.8 | -77.9 | -118.7 | -370.0 |
| | R-57 | -177.4 | -177.4 | 66.9 | -50.2 | -110.5 | -227.6 |
| | R-58 | -209.7 | -229.0 | 75.0 | -77.5 | -134.6 | -306.4 |
| | R-59 | -253.3 | -272.6 | 55.3 | 22.0 | -198.0 | -250.6 |
| **Miami Beach Avg.** | | **-159.7** | **-172.2** | **31.7** | **-28.3** | **-128.1** | **-200.5** |
| Lower Miami Beach | R-60 | -148.3 | -167.6 | -6.3 | -6.3 | -154.6 | -173.9 |
| | R-61 | -83.9 | -83.9 | 5.4 | 5.4 | -78.5 | -78.5 |
| | R-62 | -62.4 | -62.4 | -3.1 | -3.1 | -65.5 | -65.5 |
| | R-63 | 44.7 | 44.7 | -7.8 | -7.8 | 36.9 | 36.9 |
| | R-64 | 145.1 | 145.1 | 12.1 | 12.1 | 157.2 | 157.2 |
| | R-65 | 67.5 | 67.5 | 16.2 | 16.2 | 83.7 | 83.7 |
| | R-66 | 502.5 | 502.5 | 40.2 | 40.2 | 542.7 | 542.7 |
| **Lower Miami Beach Avg.** | | **66.5** | **63.7** | **8.1** | **8.1** | **74.6** | **71.8** |
| South Beach | R-67 | 537.7 | 237.9 | 57.4 | 57.4 | 595.1 | 295.3 |
| | R-68 | 488.9 | 189.1 | 19.6 | 19.6 | 508.4 | 208.6 |
| | R-69 | 443.9 | 144.1 | 22.5 | 22.5 | 466.5 | 166.7 |
| | R-70 | 302.8 | 3.0 | 10.5 | 10.5 | 313.3 | 13.5 |
| | R-71 | 248.5 | -51.3 | 34.9 | 34.9 | 283.4 | -16.4 |
| | R-72 | 215.3 | -84.5 | 59.9 | 59.9 | 275.2 | -24.6 |
| | R-73 | 231.0 | -68.8 | 110.4 | 35.9 | 341.5 | -32.8 |
| | R-74 | 246.8 | -53.0 | 145.0 | 61.5 | 391.8 | 8.5 |
| **South Beach Avg.** | | **339.4** | **39.6** | **57.5** | **37.8** | **396.9** | **77.3** |
| **Dade County Avg.** | | **-0.6** | **-66.7** | **28.0** | **-4.1** | **27.1** | **-70.7** |

**Table 2.2**
**Annual Shoreline (MHW +1.7' NGVD) Recession Rates**
**Miami-Dade County Profiles Along R-Monuments**

| | | Shoreline Changes (ft/yr) at MHW (+1.7' NGVD) | | | | | |
|---|---|---|---|---|---|---|---|
| | Profile | With Nourishment 1980 to 1996 | Without Nourishment 1980 to 1996 | With Nourishment 1996 to 2000 | Without Nourishment 1996 to 2000 | Overall With Nourishment 1980 to 2000 | Overall Without Nourishment 1980 to 2000 |
| Golden Beach | R-1 | -1.7 | -1.7 | 0.0 | 0.0 | -1.3 | -1.3 |
| | R-2 | 1.7 | 1.7 | 1.0 | 1.0 | 1.6 | 1.6 |
| | R-3 | 1.7 | 1.7 | -2.3 | -2.3 | 0.9 | 0.9 |
| | R-4 | 1.3 | 1.3 | 11.5 | 11.5 | 3.3 | 3.3 |
| | R-5 | 0.7 | 0.7 | 1.6 | 1.6 | 0.9 | 0.9 |
| | R-6 | 1.2 | 1.2 | 7.5 | 7.5 | 2.5 | 2.5 |
| | R-7 | 0.8 | 0.8 | -3.4 | -3.4 | 0.0 | 0.0 |
| **Golden Beach Avg.** | | **0.8** | **0.8** | **2.3** | **2.3** | **1.1** | **1.1** |
| Sunny Isles | R-8 | 0.6 | -8.8 | 1.7 | -9.9 | 0.8 | -9.0 |
| | R-9 | 2.6 | -6.8 | 5.4 | -5.9 | 3.2 | -6.6 |
| | R-10 | 0.5 | -8.9 | 17.0 | 11.0 | 3.8 | -4.9 |
| | R-11 | 3.9 | -4.0 | 4.6 | 4.0 | 4.1 | -2.4 |
| | R-12 | 5.2 | -2.8 | 9.1 | 9.1 | 5.9 | -0.4 |
| | R-13 | 6.4 | -1.5 | -3.0 | -3.0 | 4.6 | -1.8 |
| | R-14 | 6.9 | -1.1 | 9.3 | 9.3 | 7.4 | 1.0 |
| | R-15 | 8.2 | 0.2 | -7.6 | -8.2 | 5.0 | -1.5 |
| | R-16 | 5.2 | -2.8 | 11.7 | 11.7 | 6.5 | 0.1 |
| | R-17 | 5.7 | -2.2 | -0.8 | -0.8 | 4.4 | -1.9 |
| | R-18 | 4.0 | -3.9 | 3.2 | 3.2 | 3.9 | -2.5 |
| | R-19 | 3.4 | -4.5 | 7.2 | 7.2 | 4.2 | -2.2 |
| **Sunny Isles Avg.** | | **4.4** | **-3.9** | **4.8** | **2.3** | **4.5** | **-2.7** |
| Bakers Haulover Park | R-20 | 2.9 | -0.2 | -1.2 | -1.2 | 2.1 | -0.4 |
| | R-21 | -5.1 | -8.2 | 5.6 | 5.6 | -3.0 | -5.5 |
| | R-22 | 2.2 | -0.9 | 2.0 | 2.0 | 2.2 | -0.3 |
| | R-23 | -6.7 | -9.8 | 7.9 | 7.9 | -3.7 | -6.2 |
| | R-24 | 0.9 | -2.2 | 11.6 | 11.6 | 3.1 | 0.6 |
| | R-25 | 4.5 | 1.4 | 4.4 | 4.4 | 4.4 | 2.0 |
| | R-26 | 4.0 | 0.9 | 2.1 | 2.1 | 3.6 | 1.2 |
| **B.H. Park Avg.** | | **0.4** | **-2.7** | **4.6** | **4.6** | **1.2** | **-1.2** |
| Bal Harbor | R-27 | 2.2 | 2.2 | -3.1 | -13.4 | 1.1 | -0.9 |
| | R-28 | -4.2 | -8.0 | 9.3 | -13.8 | -1.5 | -9.1 |
| | R-29 | -6.6 | -10.4 | 11.1 | -12.0 | -3.1 | -10.7 |
| | R-30 | -5.0 | -8.8 | 11.7 | -12.9 | -1.7 | -9.6 |
| **Bal Harbor Avg.** | | **-3.4** | **-6.3** | **7.2** | **-13.0** | **-1.3** | **-7.6** |
| Surfside | R-31 | -4.9 | -8.7 | 18.5 | 18.5 | -0.2 | -3.2 |
| | R-32 | -6.8 | -6.8 | 29.9 | -18.7 | 0.5 | -9.2 |
| | R-33 | -8.2 | -8.2 | 29.3 | -21.4 | -0.7 | -10.8 |
| | R-34 | -11.7 | -11.7 | 42.2 | -6.3 | -0.9 | -10.7 |
| | R-35 | -12.0 | -12.0 | 32.9 | -7.0 | -3.0 | -11.0 |
| | R-36 | -11.9 | -11.9 | 31.9 | -8.0 | -3.1 | -11.1 |
| | R-37 | -8.1 | -8.1 | 7.3 | 7.3 | -5.0 | -5.0 |
| **Surfside Avg.** | | **-9.1** | **-9.6** | **27.4** | **-5.1** | **-1.8** | **-8.7** |
| Northern Miami Beach | R-38 | -7.6 | -7.6 | -4.4 | -4.4 | -7.0 | -7.0 |
| | R-39 | -2.5 | -2.5 | -18.8 | -18.8 | -5.8 | -5.8 |
| | R-40 | -5.4 | -5.4 | -1.0 | -1.0 | -4.5 | -4.5 |
| | R-41 | -5.0 | -5.0 | -2.0 | -2.0 | -4.4 | -4.4 |
| | R-42 | -6.3 | -7.8 | -2.9 | -2.9 | -5.6 | -6.8 |
| | R-43 | -5.0 | -6.5 | -7.2 | -7.2 | -5.5 | -6.7 |
| | R-44 | -7.3 | -8.9 | 4.7 | -2.0 | -4.9 | -7.5 |
| | R-45 | -7.9 | -9.4 | -7.0 | -13.7 | -7.7 | -10.3 |
| | R-46 | -8.5 | -10.0 | -9.0 | -9.0 | -8.6 | -9.8 |
| **N. Miami Beach Avg.** | | **-6.2** | **-7.0** | **-5.3** | **-6.8** | **-6.0** | **-7.0** |
| Miami Beach | R-47 | -9.8 | -9.8 | -9.9 | -9.9 | -9.8 | -9.8 |
| | R-48 | 0.0 | 0.0 | -2.8 | -2.8 | -0.6 | -0.6 |
| | R-49 | -8.2 | -8.2 | -2.3 | -2.3 | -7.1 | -7.1 |
| | R-50 | -15.1 | -15.1 | 1.6 | 1.6 | -11.8 | -11.8 |
| | R-51 | -10.9 | -10.9 | 1.6 | 1.6 | -8.4 | -8.4 |
| | R-52 | -9.6 | -9.6 | 2.7 | 2.7 | -7.1 | -7.1 |
| | R-53 | -6.5 | -6.5 | 11.6 | -17.0 | -2.9 | -8.6 |
| | R-54 | -8.9 | -8.9 | 20.7 | -7.9 | -3.0 | -8.7 |
| | R-55 | -10.1 | -10.1 | 18.0 | -12.0 | -4.5 | -10.5 |
| | R-56 | -10.5 | -18.3 | 12.5 | -19.5 | -5.9 | -18.5 |
| | R-57 | -11.1 | -11.1 | 16.7 | -12.6 | -5.5 | -11.4 |
| | R-58 | -13.1 | -14.3 | 18.8 | -19.4 | -6.7 | -15.3 |
| | R-59 | -15.8 | -17.0 | 13.8 | 5.5 | -9.9 | -12.5 |
| **Miami Beach Avg.** | | **-10.0** | **-10.8** | **7.9** | **-7.1** | **-6.4** | **-10.0** |
| Lower Miami Beach | R-60 | -9.3 | -10.5 | -1.6 | -1.6 | -7.7 | -8.7 |
| | R-61 | -5.2 | -5.2 | 1.3 | 1.3 | -3.9 | -3.9 |
| | R-62 | -3.9 | -3.9 | -0.8 | -0.8 | -3.3 | -3.3 |
| | R-63 | 2.8 | 2.8 | -2.0 | -2.0 | 1.8 | 1.8 |
| | R-64 | 9.1 | 9.1 | 3.0 | 3.0 | 7.9 | 7.9 |
| | R-65 | 4.2 | 4.2 | 4.0 | 4.0 | 4.2 | 4.2 |
| | R-66 | 31.4 | 31.4 | 10.1 | 10.1 | 27.1 | 27.1 |
| **Lower Miami Beach Avg.** | | **4.2** | **4.0** | **2.0** | **2.0** | **3.7** | **3.6** |
| South Beach | R-67 | 33.6 | 14.9 | 14.4 | 14.4 | 29.8 | 14.8 |
| | R-68 | 30.6 | 11.8 | 4.9 | 4.9 | 25.4 | 10.4 |
| | R-69 | 27.7 | 9.0 | 5.6 | 5.6 | 23.3 | 8.3 |
| | R-70 | 18.9 | 0.2 | 2.6 | 2.6 | 15.7 | 0.7 |
| | R-71 | 15.5 | -3.2 | 8.7 | 8.7 | 14.2 | -0.8 |
| | R-72 | 13.5 | -5.3 | 15.0 | 15.0 | 13.8 | -1.2 |
| | R-73 | 14.4 | -4.3 | 27.6 | 9.0 | 17.1 | -1.6 |
| | R-74 | 15.4 | -3.3 | 36.3 | 15.4 | 19.6 | 0.4 |
| **South Beach Avg.** | | **21.2** | **2.5** | **14.4** | **9.4** | **19.8** | **3.9** |
| **Dade County Avg.** | | **0.0** | **-4.2** | **6.9** | **-1.0** | **1.4** | **-3.5** |

MHW SHORELINE CHANGE (IN 100 FEET)

6
5
4
3
2
1
0
−1
−2
−3

RECESSION ⟵ ⟶ ADVANCE

R-1 R-2 R-3 R-4 R-5 R-6 R-7 R-8 R-9 R-10 R-11 R-12 R-13 R-14 R-15 R-16 R-17 R-18 R-19 R-20 R-21 R-22 R-23 R-24 R-25 R-26 R-27 R-28 R-29 R-30 R-31 R-32 R-33 R-34 R-35 R-36 R-37 R-38 R-39 R-40 R-41 R-42 R-43 R-44 R-45 R-46 R-47 R-48 R-49 R-50 R-51 R-52 R-53 R-54 R-55 R-56 R-57 R-58 R-59 R-60 R-61 R-62 R-63 R-64 R-65 R-66 R-67 R-68 R-69 R-70 R-71 R-72 R-73 R-74

BROWARD COUNTY
MIAMI-DADE COUNTY
GOLDEN BEACH
SUNNY ISLES
BAKERS HAULOVER PARK
BAKERS HAULOVER INLET
BAL HARBOUR
SURFSIDE
63rd STREET HOT SPOT
MIAMI BEACH
GOVERNMENT CUT

## LEGEND

0 2500 5000
SCALE IN FEET
1" = 5000'

MHW CHANGE WITH NOURISHMENT 1980 TO 1996
MHW CHANGE WITHOUT NOURISHMENT 1980 TO 1996

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# FIGURE 2.1

MHW SHORELINE CHANGE – 1980 TO 1996
63rd STREET EROSIONAL HOT SPOT STUDY

MHW SHORELINE CHANGE (IN 100 FEET)

6
5
4
3
2
1
0
-1
-2
-3

RECESSION ADVANCE

R-1 R-2 R-3 R-4 R-5 R-6 R-7 R-8 R-9 R-10 R-11 R-12 R-13 R-14 R-15 R-16 R-17 R-18 R-19 R-20 R-21 R-22 R-23 R-24 R-25 R-26 R-27 R-28 R-29 R-30 R-31 R-32 R-33 R-34 R-35 R-36 R-37 R-38 R-39 R-40 R-41 R-42 R-43 R-44 R-45 R-46 R-47 R-48 R-49 R-50 R-51 R-52 R-53 R-54 R-55 R-56 R-57 R-58 R-59 R-60 R-61 R-62 R-63 R-64 R-65 R-66 R-67 R-68 R-69 R-70 R-71 R-72 R-73 R-74

BROWARD COUNTY
MIAMI-DADE COUNTY
GOLDEN BEACH
SUNNY ISLES
BAKERS HAULOVER PARK
BAKERS HAULOVER INLET
BAL HARBOUR
SURFSIDE
63rd STREET HOT SPOT
MIAMI BEACH
GOVERNMENT CUT

## LEGEND

0 2500 5000
SCALE IN FEET
1" = 5000'

MHW CHANGE WITH NOURISHMENT 1996 TO 2000
MHW CHANGE WITHOUT NOURISHMENT 1996 TO 2000

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# FIGURE 2.2

MHW SHORELINE CHANGE – 1996 TO 2000
63rd STREET EROSIONAL HOT SPOT STUDY

MHW SHORELINE CHANGE (IN 100 FEET)

6
5
4
3
2
1
0
−1
−2
−3

RECESSION ⟵ ⟶ ADVANCE

R-1 R-2 R-3 R-4 R-5 R-6 R-7 R-8 R-9 R-10 R-11 R-12 R-13 R-14 R-15 R-16 R-17 R-18 R-19 R-20 R-21 R-22 R-23 R-24 R-25 R-26 R-27 R-28 R-29 R-30 R-31 R-32 R-33 R-34 R-35 R-36 R-37 R-38 R-39 R-40 R-41 R-42 R-43 R-44 R-45 R-46 R-47 R-48 R-49 R-50 R-51 R-52 R-53 R-54 R-55 R-56 R-57 R-58 R-59 R-60 R-61 R-62 R-63 R-64 R-65 R-66 R-67 R-68 R-69 R-70 R-71 R-72 R-73 R-74

BROWARD COUNTY
MIAMI-DADE COUNTY
GOLDEN BEACH
SUNNY ISLES
BAKERS HAULOVER PARK
BAKERS HAULOVER INLET
BAL HARBOUR
SURFSIDE
63rd STREET HOT SPOT
MIAMI BEACH
GOVERNMENT CUT

## LEGEND

MHW CHANGE WITH NOURISHMENT 1980 TO 2000

MHW CHANGE WITHOUT NOURISHMENT 1980 TO 2000

0 2500 5000
SCALE IN FEET
1" = 5000'

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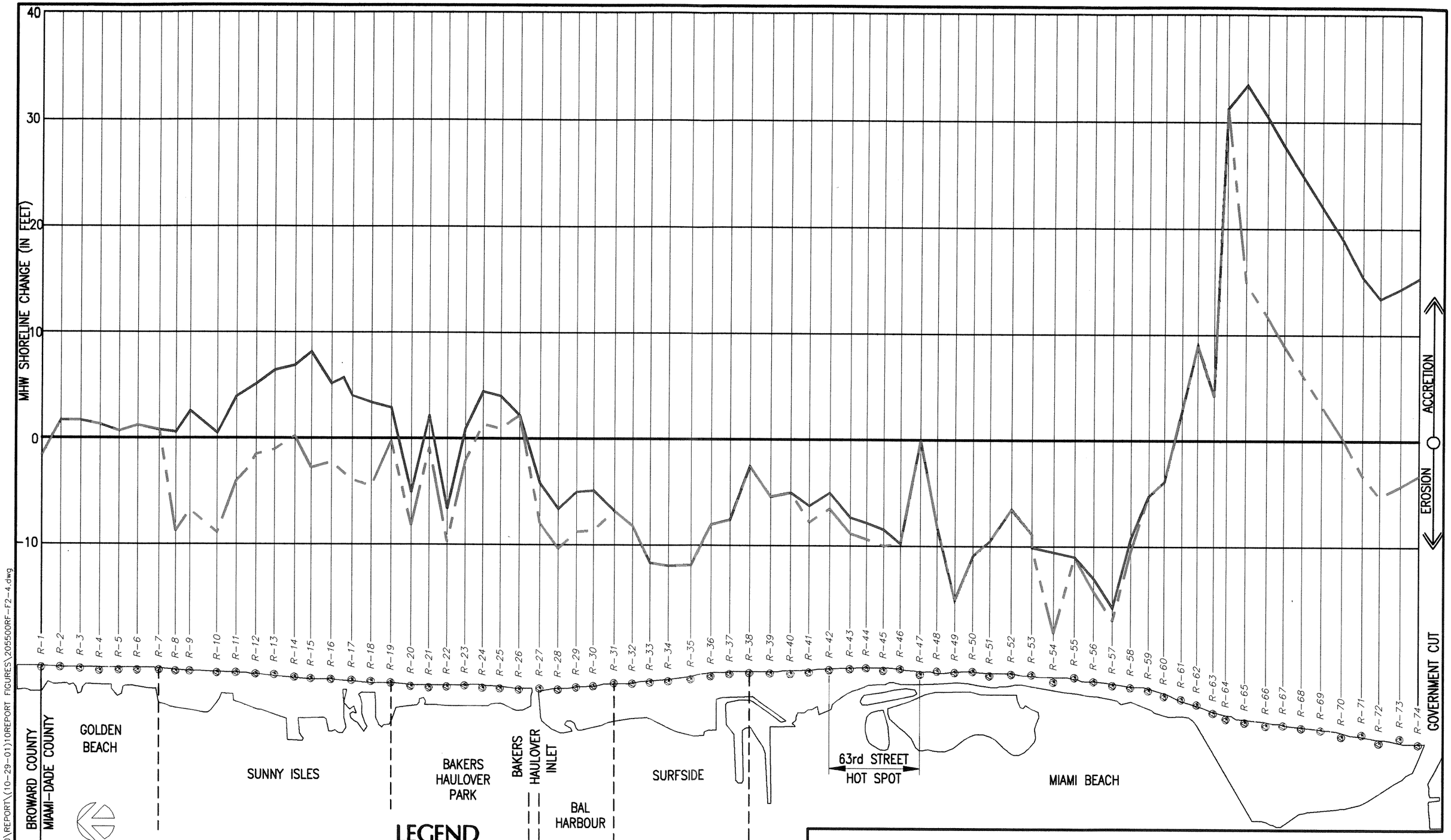
# FIGURE 2.3

MHW SHORELINE CHANGE – 1980 TO 2000
63rd STREET EROSIONAL HOT SPOT STUDY

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# FIGURE 2.4

MHW YEARLY CHANGE - 1980 TO 1996
63rd STREET EROSIONAL HOT SPOT STUDY

MHW SHORELINE CHANGE (IN FEET)

40
30
20
10
0
10

ACCRETION
EROSION

R-1 R-2 R-3 R-4 R-5 R-6 R-7 R-8 R-9 R-10 R-11 R-12 R-13 R-14 R-15 R-16 R-17 R-18 R-19 R-20 R-21 R-22 R-23 R-24 R-25 R-26 R-27 R-28 R-29 R-30 R-31 R-32 R-33 R-34 R-35 R-36 R-37 R-38 R-39 R-40 R-41 R-42 R-43 R-44 R-45 R-46 R-47 R-48 R-49 R-50 R-51 R-52 R-53 R-54 R-55 R-56 R-57 R-58 R-59 R-60 R-61 R-62 R-63 R-64 R-65 R-66 R-67 R-68 R-69 R-70 R-71 R-72 R-73 R-74

BROWARD COUNTY
MIAMI-DADE COUNTY
GOLDEN BEACH
SUNNY ISLES
BAKERS HAULOVER PARK
BAKERS HAULOVER INLET
BAL HARBOUR
SURFSIDE
63rd STREET HOT SPOT
MIAMI BEACH
GOVERNMENT CUT

0 2500 5000
SCALE IN FEET
1" = 5000'

## LEGEND

MHW SHORELINE CHANGE WITH NOURISHMENT 1996 TO 2000
MHW SHORELINE CHANGE WITHOUT NOURISHMENT 1996 TO 2000

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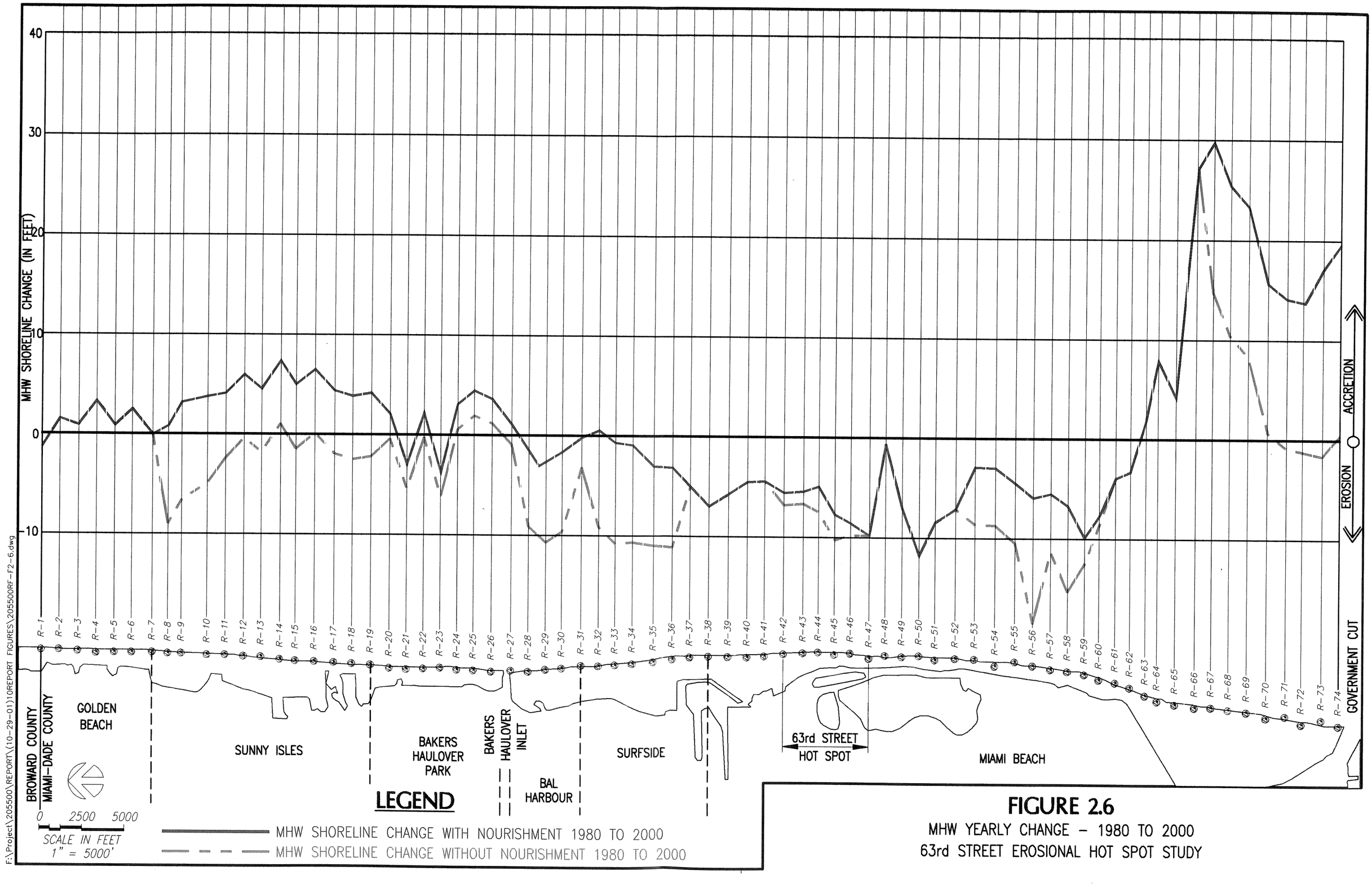
# FIGURE 2.5

MHW YEARLY CHANGE - 1996 TO 2000
63rd STREET EROSIONAL HOT SPOT STUDY

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# FIGURE 2.6

MHW YEARLY CHANGE – 1980 TO 2000
63rd STREET EROSIONAL HOT SPOT STUDY

### *2.3.1 Miami-Dade County Border to Bakers Haulover Inlet*

The Town of Golden Beach is the northernmost coastal community within Miami-Dade County, and extends from Miami-Dade County DEP monuments R-1 to R-7. The 2000 LIDAR survey did not include R-monument R-1, and is therefore not included in this analysis. The Golden Beach shoreline segment has historically been relatively stable to accretional. During the period between 1996 and 2000, the shoreline accreted +10.6 feet, or +2.3 feet/year. This increase in shoreline advance as compared to historical trends (+13.0 feet average or +0.8 feet/year from 1980 to 1996) is likely due to large beach nourishment projects constructed both north and south of Golden Beach. In 1997, the northern Sunny Isles shoreline was renourished, and Golden Beach benefited from end losses of this project. A combination of the analyses shows that over 20 years, this area experienced an average shoreline advance of +1.1 feet/year.

The Sunny Isles shoreline, which extends from the monuments R-7 to R-19, was slightly accretional during the period between 1996 and 2000. In 1997, approximately 87,000 cy were placed along the northern portion of Sunny Isles from R-7 to R-11, and resulted in an average shoreline advance of +19.3 feet, or +4.8 feet per year. However, after adjusting for the effect of the nourishment, the average change was +9.3 feet, or +2.3 feet per year. The northern portion of the nourishment experienced the significant shoreline retreat, however, the shoreline to the south likely benefited from end losses and southern transport of the sand, which created the overall shoreline advance. The Sunny Isles recent average shoreline advance differs from the nourishment included historical shoreline loss of –62.9 or –3.9 feet/year observed between 1980 and 1996. The reversal in shoreline change may be due to the movement of sand into Sunny Isles from projects to the north and into Broward County. As a result, when the 20 year average is calculated from 1980 to 2000 and the nourishments are included, the shoreline experienced an average recession of –53.7 feet or –2.7 feet per year

The advancement trend continued along the Bakers Haulover Park beach segment (R-19 to Bakers Haulover Inlet), which experienced an average shoreline change of +18.5 feet, or +4.6 feet/year. The shoreline segment, except for the northern limit (R-20) was

accretional, which is a reversal in trend as compared to the historical 1980 to 1996 period that showed erosion along most of the shoreline and accretion just north of Bakers Haulover Inlet. There was no nourishment activity in this area during the recent study period (1996-2000), however this reversal in overall shoreline performance may be due to the southerly transport of nourishment endlosses and erosion from recent projects to the north being impounded and held slightly upstream of the inlet. While no apparent data errors were evident, the amount of accretion however is larger than would typically be expected for this area over a four year period. Therefore, it is recommended that this area should be further assessed with additional studies, surveys, and a review of recent aerial photographs.

### *2.3.2 Bakers Haulover Inlet to Government Cut*

South of Bakers Haulover Inlet lies Bal Harbour, which is a small community that extends approximately 1 mile south from Bakers Haulover Inlet (R-27 through R-31). This area has historically been highly erosional and as a result, this segment was nourished in 1998 with approximately 250,000 cy of sand dredged from Bakers Haulover Inlet. Comparison of the 1996 and 2000 surveys indicated an average shoreline change for Bal Harbour or +28.9 feet or +7.2 feet/year. However, after adjusting for the 1998 beach nourishment project, the shoreline experienced significant recession with an average shoreline loss of −50.5 feet or −12.6 feet/year. These losses are similar in trend to the historical shoreline changes between 1980 and 1996 of −54.5 feet (-3.4 feet/year) and −85.6 feet (-5.4 feet/year), with and without nourishment respectively. The 20 year average shows Bal Harbour experienced average shoreline changes of −25.6 feet (-1.3 feet/year) and −136.2 feet (-6.8 feet/year), both with and without nourishments.

This erosional trend continued along the Surfside segment in North Miami Beach (R-31 through R-38) with an average shoreline erosion of −20.3 feet or −5.1 feet/year, when considering the approximately 590,000 cy placed between R-32 and R-36 in 1997. These losses follow the erosional trend observed for the period between 1980 and 1996, where an average of −9.4 feet/year were lost. The overall 20 year average of shoreline change for the Surfside shoreline was calculated as −8.5 feet/year.

The City of Miami Beach was divided into four segments, according to the historic beach nourishment projects that have taken place. The first segment along the northern portion of Miami Beach corresponds to Phase II of the Dade Erosion Control and Hurricane Protection Project, implemented in 1979. This segment runs from R-38 to R-46 (80th and 63rd streets). The second segment, which corresponds to Phase III of the aforementioned project, extends from R-46 to R-59 (63rd and 36th streets). The third segment consists of the Phase IV limits, which is located along the lower portion of Miami Beach and stretches from R-59 to R-66 (32nd and 16th streets). The fourth segment, or Phase V segment along the historical "South Beach" portion of Miami Beach, extends between R-66 and Government Cut (16th street to Government Cut).

Within the northern and middle limits of Miami Beach, the shoreline eroded at a high rate and includes the hot spot areas at 63rd street (R-42 to R-47) and 32nd street (R-59). The first segment or northern portion of Miami Beach from R-38 to R-46 experienced an average shoreline retreat of –27.1 feet, or –6.8 feet/year with nourishment activity. Shoreline recession was significant near 63rd street without nourishment of –54.8 feet (-12.7 feet/year) and –36.1 feet (-9.0 feet/year) at monuments R-45 and R-46 respectively. These shoreline change rates are consistent with historical changes of –7.0 feet per year between 1980 and 1996.

The second segment or middle portion of Miami Beach experienced an average shoreline retreat of –28.3 feet, or –7.1 feet/year when considering the approximately 564,000 cy of sand placed between R-53 and R-59 in 1997. Combining the data for the 20 year period between 1980 and 2000 brings the average shoreline changes for northern and mid Miami Beach to –7.0 and –9.8 feet/year respectively.

The shoreline south of 32nd street (R-59) begins to transition from erosional to accretional at 16th street (R-63), with an average shoreline advance of +8.1 feet (+2.0 feet/year). The shoreline at R-60 retreated –6.3 feet (-1.6 feet/year) and advanced +40.2 feet (+10.1 feet/year) at R-63. These shoreline changes follow the historical trend of erosion and

accretion noticed between 1980 and 1996, with changes of −13.8 feet/year and +17.8 feet/year at R-60 and R-66 respectively. Due to the variance in shoreline change from retreat to advance over this section of shoreline, the 20 year average change between R-60 and R-66 is +0.9 feet/year when considering nourishment activity.

The South Beach segment between 16th street and Government Cut continued to experienced a substantial shoreline advance, averaging +37.8 feet, or +9.4 feet/year when considering nourishment activities. The southern portion of South Beach, from R-73 to Government Cut was nourished with approximately 130,000 cy in 1999. Prior to the nourishment, the northern jetty at Government Cut was sand tightened, which in combination with the nourishment is likely a result of the recent change in erosional to accretional trends noticed between R-70 and R-74 as compared to the 1980 to 1996 study results. The continual accretion of this segment is shown in the 20 year average shoreline of +4.78 feet/year.

## 2.4 Volumetric Changes

Volumetric changes were calculated within the study area along the Miami-Dade County shoreline for the period between 1996 and 2000. Analyses of each profile's volumetric change were performed between two different sets of cutoff elevations in order to understand both the longshore and cross-shore movement of sand along the shoreline. These analyses also provide an indicator of the total profile performance, in contrast to the preceding shoreline analysis, which only shows the performance of one particular point (MHW) on the beach profile. The elevations to which volume changes were calculated were the profile's depth of closure (DOC), which is the depth beyond which no significant volume change in the beach profile occurs, and at −6 feet NGVD. Depth of closures along the Miami-Dade County shoreline varied between −15 feet NGVD and −18 feet NGVD. The DOC for each monument was established on a review of historical values and depth at which the profiles continuously overlapped or closed. Table 2.3 shows the volumetric changes with nourishments included for the 1996 to 2000 period. Tables 2.4 and 2.5 summarize the total and yearly changes with and without nourishment activity for

the periods 1980 to 1996, 1996 to 2000, and 1980 to 2000. Figures 2.7 through 2.12 graphically depict the results shown in Tables 2.4 and 2.5.

## Table 2.3
## Miami-Dade County Volumetric Change Summary (Average End) for 1996 to 2000

| | Segment | Volumetric Changes (cy) | | | Volumetric Changes (cy/ft) | | |
|---|---|---|---|---|---|---|---|
| | | Above -6 ft. | Below -6 ft. | Above D.O.C. | Above -6 ft. | Below -6 ft. | Above D.O.C. |
| Golden Beach | R-1 to R-2 | -381 | 4,881 | 4,500 | -0.4 | 4.7 | 4.3 |
| | R-2 to R-3 | -8,662 | 13,234 | 4,571 | -7.9 | 12.0 | 4.1 |
| | R-3 to R-4 | 1,604 | 12,092 | 13,696 | 1.5 | 11.3 | 12.8 |
| | R-4 to R-5 | 6,655 | 8,621 | 15,276 | 6.2 | 8.0 | 14.2 |
| | R-5 to R-6 | 4,454 | 5,704 | 10,158 | 4.4 | 5.6 | 10.0 |
| | R-6 to R-7 | -2,905 | 6,042 | 3,136 | -2.4 | 5.0 | 2.6 |
| **Golden Beach Total** | | **766** | **50,573** | **51,338** | | | |
| Sunny Isles | R-7 to R-8 | -11,714 | 6,505 | -5,209 | -12.9 | 7.2 | -5.7 |
| | R-8 to R-9 | -3,589 | 21,211 | 17,622 | -4.5 | 26.8 | 22.3 |
| | R-9 to R-10 | 15,699 | 38,450 | 54,149 | 10.4 | 25.6 | 36.0 |
| | R-10 to R-11 | 5,658 | 8,610 | 14,268 | 5.4 | 8.2 | 13.5 |
| | R-11 to R-12 | -5,549 | 8,061 | 2,512 | -5.1 | 7.4 | 2.3 |
| | R-12 to R-13 | -7,652 | 11,966 | 4,314 | -7.5 | 11.7 | 4.2 |
| | R-13 to R-14 | -11,604 | 25,073 | 13,469 | -10.4 | 22.4 | 12.0 |
| | R-14 to R-15 | -15,028 | 15,807 | 779 | -16.5 | 17.4 | 0.9 |
| | R-15 to R-16 | -8,589 | 14,907 | 6,319 | -7.8 | 13.5 | 5.7 |
| | R-16 to R-17 | -3,099 | 15,630 | 12,531 | -2.7 | 13.7 | 11.0 |
| | R-17 to R-18 | -14,684 | 14,298 | -386 | -14.1 | 13.7 | -0.4 |
| | R-18 to R-19 | 2,353 | 18,740 | 21,094 | 2.1 | 17.0 | 19.2 |
| **Sunny Isles Total** | | **-57,798** | **199,259** | **141,460** | | | |
| Bakers Haulover Park | R-19 to R-20 | 13,360 | 21,805 | 35,165 | 11.9 | 19.5 | 31.4 |
| | R-20 to R-21 | 14,510 | 8,457 | 22,967 | 14.5 | 8.5 | 23.0 |
| | R-21 to R-22 | 8,270 | 12,715 | 20,986 | 8.3 | 12.8 | 21.1 |
| | R-22 to R-23 | -1,772 | 30,066 | 28,294 | -1.8 | 30.3 | 28.5 |
| | R-23 to R-24 | 12,536 | 25,574 | 38,110 | 12.6 | 25.7 | 38.3 |
| | R-24 to R-25 | 20,718 | 14,446 | 35,164 | 21.2 | 14.8 | 36.0 |
| | R-25 to R-26 | 16,908 | 9,233 | 26,141 | 16.0 | 8.7 | 24.7 |
| | R-26 to BHI | 5,516 | 2,970 | 8,486 | 8.5 | 4.6 | 13.1 |
| **B.H. Park Total** | | **90,047** | **125,267** | **215,314** | | | |
| Bal Harbor | R-27 to R-28 | 8,763 | 21,009 | 29,773 | 8.6 | 20.5 | 29.1 |
| | R-28 to R-29 | 39,475 | 18,603 | 58,078 | 38.7 | 18.2 | 56.9 |
| | R-29 to R-30 | 41,232 | 18,185 | 59,417 | 43.1 | 19.0 | 62.1 |
| | R-30 to R-31 | 45,301 | 13,343 | 58,644 | 39.0 | 11.5 | 50.5 |
| **Bal Harbor Total** | | **134,772** | **71,140** | **205,913** | | | |
| Surfside | R-31 to R-32 | 55,294 | 12,386 | 67,680 | 54.6 | 12.2 | 66.8 |
| | R-32 to R-33 | 65,708 | 14,094 | 79,802 | 67.7 | 14.5 | 82.2 |
| | R-33 to R-34 | 87,408 | 11,645 | 99,053 | 86.4 | 11.5 | 97.9 |
| | R-34 to R-35 | 107,358 | 15,585 | 122,942 | 87.1 | 12.6 | 99.7 |
| | R-35 to R-36 | 92,575 | 8,653 | 101,228 | 81.0 | 7.6 | 88.6 |
| | R-36 to R-37 | 65,783 | 1,674 | 67,457 | 62.1 | 1.6 | 63.7 |
| | R-37 to R-38 | 13,227 | -4,311 | 8,917 | 12.1 | -3.9 | 8.1 |
| **Surfside Total** | | **487,354** | **59,725** | **547,079** | | | |
| Northern Miami Beach | R-38 to R-39 | -35,653 | 7,719 | -27,934 | -31.2 | 6.7 | -24.4 |
| | R-39 to R-40 | -38,807 | 15,028 | -23,780 | -35.0 | 13.6 | -21.4 |
| | R-40 to R-41 | -9,711 | 9,673 | -38 | -9.5 | 9.5 | 0.0 |
| | R-41 to R-42 | -6,769 | 10,320 | 3,550 | -6.0 | 9.1 | 3.1 |
| | R-42 to R-43 | -26,401 | 5,619 | -20,782 | -23.1 | 4.9 | -18.2 |
| | R-43 to R-44 | -13,336 | 4,931 | -8,405 | -14.9 | 5.5 | -9.4 |
| | R-44 to R-45 | -14,072 | 12,626 | -1,446 | -14.5 | 13.0 | -1.5 |
| | R-45 to R-46 | -23,929 | 11,052 | -12,878 | -25.8 | 11.9 | -13.9 |
| **N. Miami Beach Total** | | **-168,679** | **76,966** | **-91,712** | | | |
| Miami Beach | R-46 to R-47 | -33,715 | 6,572 | -27,143 | -29.5 | 5.7 | -23.7 |
| | R-47 to R-48 | -30,035 | -5,208 | -35,243 | -31.4 | -5.4 | -36.8 |
| | R-48 to R-49 | -14,291 | -10,396 | -24,687 | -14.5 | -10.5 | -25.0 |
| | R-49 to R-50 | -3,329 | -988 | -4,317 | -3.4 | -1.0 | -4.3 |
| | R-50 to R-51 | 7 | -1,009 | -1,002 | 0.0 | -1.1 | -1.0 |
| | R-51 to R-52 | -1,902 | -1,622 | -3,524 | -1.6 | -1.4 | -3.0 |
| | R-52 to R-53 | 15,399 | 10,777 | 26,176 | 13.8 | 9.7 | 23.5 |
| | R-53 to R-54 | 54,407 | 29,152 | 83,560 | 43.2 | 23.2 | 66.4 |
| | R-54 to R-55 | 57,262 | 45,692 | 102,954 | 48.4 | 38.6 | 87.0 |
| | R-55 to R-56 | 39,537 | 39,946 | 79,483 | 36.2 | 36.6 | 72.9 |
| | R-56 to R-57 | 36,849 | 21,182 | 58,030 | 34.9 | 20.1 | 55.0 |
| | R-57 to R-58 | 31,504 | -2,331 | 29,173 | 31.5 | -2.3 | 29.2 |
| | R-58 to R-59 | 31,504 | -2,331 | 29,173 | 31.5 | -2.3 | 29.2 |
| **Miami Beach Total** | | **183,198** | **129,437** | **312,635** | | | |
| Lower Miami Beach | R-59 to R-60 | 10,067 | -2,332 | 7,736 | 11.1 | -2.6 | 8.5 |
| | R-60 to R-61 | 2,964 | 9,025 | 11,990 | 3.1 | 9.3 | 12.4 |
| | R-61 to R-62 | 1,370 | 10,478 | 11,848 | 1.5 | 11.6 | 13.1 |
| | R-62 to R-63 | -7,219 | 9,070 | 1,851 | -7.2 | 9.0 | 1.8 |
| | R-63 to R-64 | 911 | 10,798 | 11,709 | 1.2 | 13.8 | 14.9 |
| | R-64 to R-65 | 6,271 | 8,011 | 14,282 | 5.9 | 7.5 | 13.4 |
| | R-65 to R-66 | 15,114 | 10,362 | 25,476 | 12.9 | 8.8 | 21.8 |
| **Lower M. B. Total** | | **29,477** | **55,414** | **84,891** | | | |
| South Beach | R-66 to R-67 | 27,989 | 27,642 | 55,632 | 28.8 | 28.5 | 57.3 |
| | R-67 to R-68 | 29,276 | 24,842 | 54,118 | 28.6 | 24.3 | 52.9 |
| | R-68 to R-69 | 23,341 | 14,085 | 37,426 | 21.7 | 13.1 | 34.8 |
| | R-69 to R-70 | 15,993 | 32,534 | 48,528 | 13.5 | 27.4 | 40.9 |
| | R-70 to R-71 | 4,703 | 35,871 | 40,573 | 4.2 | 32.2 | 36.4 |
| | R-71 to R-72 | 13,479 | 14,950 | 28,429 | 13.0 | 14.4 | 27.4 |
| | R-72 to R-73 | 49,735 | 7,766 | 57,501 | 42.1 | 6.6 | 48.7 |
| | R-73 to R-74 | 83,027 | 9,604 | 92,631 | 78.8 | 9.1 | 87.9 |
| | R-74 to G.C. | 16,858 | 1,300 | 18,158 | 48.2 | 3.7 | 51.9 |
| **South Beach Total** | | **264,401** | **168,595** | **432,996** | | | |

Note: Depths are

| | | | |
|---|---|---|---|
| **Dade County Total** | **963,637** | **936,376** | **1,899,913** |

## Table 2.4
## Miami-Dade County Volumetric Change Summary (Average End)

| | | Total Volumetric Changes (cy) Above Depth of Closure | | | | | |
|---|---|---|---|---|---|---|---|
| | Segment | With Nourishment 1980 to 1996 | Without Nourishment 1980 to 1996 | With Nourishment 1996 to 2000 | Without Nourishment 1996 to 2000 | Overall With Nourishment 1980 to 2000 | Overall Without Nourishment 1980 to 2000 |
| Golden Beach | R-1 to R-2 | 29,331 | 29,331 | 4,500 | 4,500 | 33,831 | 33,831 |
| | R-2 to R-3 | 67,140 | 67,140 | 4,571 | 4,571 | 71,712 | 71,712 |
| | R-3 to R-4 | 66,956 | 66,956 | 13,696 | 13,696 | 80,652 | 80,652 |
| | R-4 to R-5 | 63,305 | 63,305 | 15,276 | 15,276 | 78,581 | 78,581 |
| | R-5 to R-6 | 56,590 | 56,590 | 10,158 | 10,158 | 66,749 | 66,749 |
| | R-6 to R-7 | 85,467 | 85,467 | 3,136 | 3,136 | 88,603 | 88,603 |
| **Golden Beach Total** | | **368,789** | **368,789** | **51,338** | **51,338** | **420,127** | **420,127** |
| Sunny Isles | R-7 to R-8 | 62,950 | -43,640 | -5,209 | -36,919 | 57,741 | -80,559 |
| | R-8 to R-9 | 57,296 | -35,595 | 17,622 | -9,088 | 74,918 | -44,683 |
| | R-9 to R-10 | 127,477 | -48,812 | 54,149 | 27,439 | 181,626 | -21,373 |
| | R-10 to R-11 | 106,554 | -17,016 | 14,268 | 12,268 | 120,822 | -4,748 |
| | R-11 to R-12 | 129,325 | 1,173 | 2,512 | 2,512 | 131,836 | 3,684 |
| | R-12 to R-13 | 105,904 | -13,661 | 4,314 | 4,314 | 110,217 | -9,347 |
| | R-13 to R-14 | 139,283 | 8,171 | 13,469 | 13,469 | 152,752 | 21,640 |
| | R-14 to R-15 | 139,708 | 33,129 | 779 | 779 | 140,487 | 33,908 |
| | R-15 to R-16 | 159,226 | 29,431 | 6,319 | 4,319 | 165,545 | 33,750 |
| | R-16 to R-17 | 142,852 | 8,870 | 12,531 | 12,531 | 155,383 | 21,401 |
| | R-17 to R-18 | 79,564 | -42,806 | -386 | -386 | 79,179 | -43,191 |
| | R-18 to R-19 | 63,723 | -65,382 | 21,094 | 21,094 | 84,816 | -44,288 |
| **Sunny Isles Total** | | **1,313,861** | **-186,139** | **141,460** | **52,330** | **1,455,322** | **-133,808** |
| Bakers Haulover Park | R-19 to R-20 | 46,973 | 1,928 | 35,165 | 35,165 | 82,139 | 37,093 |
| | R-20 to R-21 | 5,073 | -35,099 | 22,967 | 22,967 | 28,040 | -12,132 |
| | R-21 to R-22 | -1,574 | -41,608 | 20,986 | 20,986 | 19,412 | -20,622 |
| | R-22 to R-23 | 9,475 | -30,414 | 28,294 | 28,294 | 37,768 | -2,121 |
| | R-23 to R-24 | 36,551 | -3,488 | 38,110 | 38,110 | 74,661 | 34,623 |
| | R-24 to R-25 | 81,696 | 42,431 | 35,164 | 35,164 | 116,860 | 77,595 |
| | R-25 to R-26 | 120,917 | 78,320 | 26,141 | 26,141 | 147,059 | 104,461 |
| | R-26 to BHI | 71,838 | 45,718 | 8,486 | 8,486 | 80,324 | 54,204 |
| **B.H. Park Total** | | **370,950** | **57,787** | **215,314** | **215,314** | **586,264** | **273,101** |
| Bal Harbor | R-27 to R-28 | 39,602 | -15,729 | 29,773 | -5,583 | 69,375 | -21,312 |
| | R-28 to R-29 | -40,762 | -95,915 | 58,078 | -12,635 | 17,317 | -108,550 |
| | R-29 to R-30 | -104,193 | -155,908 | 59,417 | -11,296 | -44,775 | -167,204 |
| | R-30 to R-31 | -131,838 | -194,639 | 58,644 | -12,069 | -73,194 | -206,707 |
| **Bal Harbor Total** | | **-237,191** | **-462,191** | **205,913** | **-41,582** | **-31,278** | **-503,773** |
| Surfside | R-31 to R-32 | -63,980 | -63,980 | 67,680 | -26,677 | 3,700 | -90,657 |
| | R-32 to R-33 | -43,307 | -43,307 | 79,802 | -38,198 | 36,495 | -81,505 |
| | R-33 to R-34 | -71,005 | -71,005 | 99,053 | -18,947 | 28,048 | -89,952 |
| | R-34 to R-35 | -133,878 | -133,878 | 122,942 | 4,942 | -10,935 | -128,935 |
| | R-35 to R-36 | -106,227 | -106,227 | 101,228 | -16,772 | -4,999 | -122,999 |
| | R-36 to R-37 | -78,220 | -78,220 | 67,457 | 8,457 | -10,763 | -69,763 |
| | R-37 to R-38 | -39,951 | -39,951 | 8,917 | 8,917 | -31,035 | -31,035 |
| **Surfside Total** | | **-536,567** | **-536,567** | **547,079** | **-78,278** | **10,512** | **-614,845** |
| Northern Miami Beach | R-38 to R-39 | 22,510 | 22,510 | -27,934 | -27,934 | -5,424 | -5,424 |
| | R-39 to R-40 | 52,905 | 52,905 | -23,780 | -23,780 | 29,125 | 29,125 |
| | R-40 to R-41 | 33,797 | 33,797 | -38 | -38 | 33,759 | 33,759 |
| | R-41 to R-42 | 47,727 | 23,205 | 3,550 | 3,550 | 51,278 | 26,755 |
| | R-42 to R-43 | 21,352 | -3,485 | -20,782 | -20,782 | 570 | -24,267 |
| | R-43 to R-44 | -36,841 | -56,316 | -8,405 | -8,405 | -45,246 | -64,721 |
| | R-44 to R-45 | -43,628 | -64,642 | -1,446 | -19,446 | -45,074 | -84,088 |
| | R-45 to R-46 | -35,539 | -55,690 | -12,878 | -12,878 | -48,416 | -68,568 |
| **N. Miami Beach Total** | | **62,284** | **-47,716** | **-91,712** | **-109,712** | **-29,429** | **-157,429** |
| Miami Beach | R-46 to R-47 | -54,534 | -54,534 | -27,143 | -27,143 | -81,676 | -81,676 |
| | R-47 to R-48 | 17,308 | 17,308 | -35,243 | -35,243 | -17,935 | -17,935 |
| | R-48 to R-49 | 18,490 | 18,490 | -24,687 | -24,687 | -6,197 | -6,197 |
| | R-49 to R-50 | -85,319 | -85,319 | -4,317 | -4,317 | -89,636 | -89,636 |
| | R-50 to R-51 | -72,275 | -72,275 | -1,002 | -1,002 | -73,277 | -73,277 |
| | R-51 to R-52 | -61,627 | -61,627 | -3,524 | -3,524 | -65,150 | -65,150 |
| | R-52 to R-53 | -54,273 | -54,273 | 26,176 | 26,176 | -28,097 | -28,097 |
| | R-53 to R-54 | -47,494 | -47,494 | 83,560 | -12,227 | 36,065 | -59,722 |
| | R-54 to R-55 | -64,965 | -64,965 | 102,954 | -10,333 | 37,988 | -75,299 |
| | R-55 to R-56 | -68,475 | -68,475 | 79,483 | -33,804 | 11,008 | -102,279 |
| | R-56 to R-57 | -59,477 | -59,477 | 58,030 | -37,757 | -1,447 | -97,234 |
| | R-57 to R-58 | -52,675 | -69,880 | 29,173 | -91,614 | -23,502 | -161,493 |
| | R-58 to R-59 | -71,934 | -89,101 | 29,173 | 4,173 | -42,760 | -84,928 |
| **Miami Beach Total** | | **-657,250** | **-691,622** | **312,635** | **-251,300** | **-344,616** | **-942,922** |
| Lower Miami Beach | R-59 to R-60 | -50,310 | -65,939 | 7,736 | 7,736 | -42,575 | -58,203 |
| | R-60 to R-61 | 4,286 | 4,286 | 11,990 | 11,990 | 16,276 | 16,276 |
| | R-61 to R-62 | 63,950 | 63,950 | 11,848 | 11,848 | 75,798 | 75,798 |
| | R-62 to R-63 | 119,850 | 119,850 | 1,851 | 1,851 | 121,701 | 121,701 |
| | R-63 to R-64 | 110,673 | 110,673 | 11,709 | 11,709 | 122,383 | 122,383 |
| | R-64 to R-65 | 103,449 | 103,449 | 14,282 | 14,282 | 117,731 | 117,731 |
| | R-65 to R-66 | 305,025 | 305,025 | 25,476 | 25,476 | 330,500 | 330,500 |
| **Lower M. B. Total** | | **656,922** | **641,294** | **84,891** | **84,891** | **741,813** | **726,185** |
| South Beach | R-66 to R-67 | 451,362 | 192,288 | 55,632 | 55,632 | 506,993 | 247,920 |
| | R-67 to R-68 | 468,796 | 195,560 | 54,118 | 54,118 | 522,915 | 249,679 |
| | R-68 to R-69 | 471,031 | 184,078 | 37,426 | 37,426 | 508,457 | 221,504 |
| | R-69 to R-70 | 410,348 | 93,687 | 48,528 | 48,528 | 458,876 | 142,215 |
| | R-70 to R-71 | 268,980 | -28,504 | 40,573 | 40,573 | 309,553 | 12,069 |
| | R-71 to R-72 | 216,178 | -60,655 | 28,429 | 28,429 | 244,607 | -32,227 |
| | R-72 to R-73 | 294,238 | -20,875 | 57,501 | 57,501 | 351,739 | 36,626 |
| | R-73 to R-74 | 385,469 | 104,207 | 92,631 | 26,631 | 478,101 | 130,839 |
| | R-74 to G.C. | 3,907 | 3,907 | 18,158 | -47,842 | 22,065 | -43,935 |
| **South Beach Total** | | **2,970,309** | **663,695** | **432,996** | **300,996** | **3,403,305** | **964,691** |
| **Dade County Total** | | **4,312,107** | **-192,670** | **1,899,913** | **223,996** | **6,212,021** | **31,326** |

## Table 2.5
## Miami-Dade County Volumetric Change per Year Summary (Average End)

| | | Total Volumetric Changes (cy/yr) Above Depth of Closure | | | | | |
|---|---|---|---|---|---|---|---|
| | Segment | With Nourishment 1980 to 1996 | Without Nourishment 1980 to 1996 | With Nourishment 1996 to 2000 | Without Nourishment 1996 to 2000 | Overall With Nourishment 1980 to 2000 | Overall Without Nourishment 1980 to 2000 |
| Golden Beach | R-1 to R-2 | 1,833 | 1,833 | 1,125 | 1,125 | 1,692 | 1,692 |
| | R-2 to R-3 | 4,196 | 4,196 | 1,143 | 1,143 | 3,586 | 3,586 |
| | R-3 to R-4 | 4,185 | 4,185 | 3,424 | 3,424 | 4,033 | 4,033 |
| | R-4 to R-5 | 3,957 | 3,957 | 3,819 | 3,819 | 3,929 | 3,929 |
| | R-5 to R-6 | 3,537 | 3,537 | 2,540 | 2,540 | 3,337 | 3,337 |
| | R-6 to R-7 | 5,342 | 5,342 | 784 | 784 | 4,430 | 4,430 |
| **Golden Beach Total** | | **23,049** | **23,049** | **12,835** | **12,835** | **21,006** | **21,006** |
| Sunny Isles | R-7 to R-8 | 3,934 | -2,727 | -1,302 | -9,230 | 2,887 | -4,028 |
| | R-8 to R-9 | 3,581 | -2,225 | 4,406 | -2,272 | 3,746 | -2,234 |
| | R-9 to R-10 | 7,967 | -3,051 | 13,537 | 6,860 | 9,081 | -1,069 |
| | R-10 to R-11 | 6,660 | -1,064 | 3,567 | 3,067 | 6,041 | -237 |
| | R-11 to R-12 | 8,083 | 73 | 628 | 628 | 6,592 | 184 |
| | R-12 to R-13 | 6,619 | -854 | 1,078 | 1,078 | 5,511 | -467 |
| | R-13 to R-14 | 8,705 | 511 | 3,367 | 3,367 | 7,638 | 1,082 |
| | R-14 to R-15 | 8,732 | 2,071 | 195 | 195 | 7,024 | 1,695 |
| | R-15 to R-16 | 9,952 | 1,839 | 1,580 | 1,080 | 8,277 | 1,687 |
| | R-16 to R-17 | 8,928 | 554 | 3,133 | 3,133 | 7,769 | 1,070 |
| | R-17 to R-18 | 4,973 | -2,675 | -96 | -96 | 3,959 | -2,160 |
| | R-18 to R-19 | 3,983 | -4,086 | 5,273 | 5,273 | 4,241 | -2,214 |
| **Sunny Isles Total** | | **82,116** | **-11,634** | **35,365** | **13,083** | **72,766** | **-6,690** |
| Bakers Haulover Park | R-19 to R-20 | 2,936 | 120 | 8,791 | 8,791 | 4,107 | 1,855 |
| | R-20 to R-21 | 317 | -2,194 | 5,742 | 5,742 | 1,402 | -607 |
| | R-21 to R-22 | -98 | -2,600 | 5,246 | 5,246 | 971 | -1,031 |
| | R-22 to R-23 | 592 | -1,901 | 7,073 | 7,073 | 1,888 | -106 |
| | R-23 to R-24 | 2,284 | -218 | 9,528 | 9,528 | 3,733 | 1,731 |
| | R-24 to R-25 | 5,106 | 2,652 | 8,791 | 8,791 | 5,843 | 3,880 |
| | R-25 to R-26 | 7,557 | 4,895 | 6,535 | 6,535 | 7,353 | 5,223 |
| | R-26 to BHI | 4,490 | 2,857 | 2,122 | 2,122 | 4,016 | 2,710 |
| **B.H. Park Total** | | **23,184** | **3,612** | **53,828** | **53,828** | **29,313** | **13,655** |
| Bal Harbor | R-27 to R-28 | 2,475 | -983 | 7,443 | -1,396 | 3,469 | -1,066 |
| | R-28 to R-29 | -2,548 | -5,995 | 14,520 | -3,159 | 866 | -5,428 |
| | R-29 to R-30 | -6,512 | -9,744 | 14,854 | -2,824 | -2,239 | -8,360 |
| | R-30 to R-31 | -8,240 | -12,165 | 14,661 | -3,017 | -3,660 | -10,335 |
| **Bal Harbor Total** | | **-14,824** | **-28,887** | **51,478** | **-10,396** | **-1,564** | **-25,189** |
| Surfside | R-31 to R-32 | -3,999 | -3,999 | 16,920 | -6,669 | 185 | -4,533 |
| | R-32 to R-33 | -2,707 | -2,707 | 19,951 | -9,549 | 1,825 | -4,075 |
| | R-33 to R-34 | -4,438 | -4,438 | 24,763 | -4,737 | 1,402 | -4,498 |
| | R-34 to R-35 | -8,367 | -8,367 | 30,736 | 1,236 | -547 | -6,447 |
| | R-35 to R-36 | -6,639 | -6,639 | 25,307 | -4,193 | -250 | -6,150 |
| | R-36 to R-37 | -4,889 | -4,889 | 16,864 | 2,114 | -538 | -3,488 |
| | R-37 to R-38 | -2,497 | -2,497 | 2,229 | 2,229 | -1,552 | -1,552 |
| **Surfside Total** | | **-33,535** | **-33,535** | **136,770** | **-19,570** | **526** | **-30,742** |
| Northern Miami Beach | R-38 to R-39 | 1,407 | 1,407 | -6,984 | -6,984 | -271 | -271 |
| | R-39 to R-40 | 3,307 | 3,307 | -5,945 | -5,945 | 1,456 | 1,456 |
| | R-40 to R-41 | 2,112 | 2,112 | -10 | -10 | 1,688 | 1,688 |
| | R-41 to R-42 | 2,983 | 1,450 | 888 | 888 | 2,564 | 1,338 |
| | R-42 to R-43 | 1,334 | -218 | -5,195 | -5,195 | 28 | -1,213 |
| | R-43 to R-44 | -2,303 | -3,520 | -2,101 | -2,101 | -2,262 | -3,236 |
| | R-44 to R-45 | -2,727 | -4,040 | -362 | -4,862 | -2,254 | -4,204 |
| | R-45 to R-46 | -2,221 | -3,481 | -3,219 | -3,219 | -2,421 | -3,428 |
| **N. Miami Beach Total** | | **3,893** | **-2,982** | **-22,928** | **-27,428** | **-1,471** | **-7,871** |
| Miami Beach | R-46 to R-47 | -3,408 | -3,408 | -6,786 | -6,786 | -4,084 | -4,084 |
| | R-47 to R-48 | 1,082 | 1,082 | -8,811 | -8,811 | -897 | -897 |
| | R-48 to R-49 | 1,156 | 1,156 | -6,172 | -6,172 | -310 | -310 |
| | R-49 to R-50 | -5,332 | -5,332 | -1,079 | -1,079 | -4,482 | -4,482 |
| | R-50 to R-51 | -4,517 | -4,517 | -250 | -250 | -3,664 | -3,664 |
| | R-51 to R-52 | -3,852 | -3,852 | -881 | -881 | -3,258 | -3,258 |
| | R-52 to R-53 | -3,392 | -3,392 | 6,544 | 6,544 | -1,405 | -1,405 |
| | R-53 to R-54 | -2,968 | -2,968 | 20,890 | -3,057 | 1,803 | -2,986 |
| | R-54 to R-55 | -4,060 | -4,060 | 25,738 | -2,583 | 1,899 | -3,765 |
| | R-55 to R-56 | -4,280 | -4,280 | 19,871 | -8,451 | 550 | -5,114 |
| | R-56 to R-57 | -3,717 | -3,717 | 14,508 | -9,439 | -72 | -4,862 |
| | R-57 to R-58 | -3,292 | -4,367 | 7,293 | -22,903 | -1,175 | -8,075 |
| | R-58 to R-59 | -4,496 | -5,569 | 7,293 | 1,043 | -2,138 | -4,246 |
| **Miami Beach Total** | | **-41,078** | **-43,226** | **78,159** | **-62,825** | **-17,231** | **-47,146** |
| Lower Miami Beach | R-59 to R-60 | -3,144 | -4,121 | 1,934 | 1,934 | -2,129 | -2,910 |
| | R-60 to R-61 | 268 | 268 | 2,997 | 2,997 | 814 | 814 |
| | R-61 to R-62 | 3,997 | 3,997 | 2,962 | 2,962 | 3,790 | 3,790 |
| | R-62 to R-63 | 7,491 | 7,491 | 463 | 463 | 6,085 | 6,085 |
| | R-63 to R-64 | 6,917 | 6,917 | 2,927 | 2,927 | 6,119 | 6,119 |
| | R-64 to R-65 | 6,466 | 6,466 | 3,571 | 3,571 | 5,887 | 5,887 |
| | R-65 to R-66 | 19,064 | 19,064 | 6,369 | 6,369 | 16,525 | 16,525 |
| **Lower M. B. Total** | | **41,058** | **40,081** | **21,223** | **21,223** | **37,091** | **36,309** |
| South Beach | R-66 to R-67 | 28,210 | 12,018 | 13,908 | 13,908 | 25,350 | 12,396 |
| | R-67 to R-68 | 29,300 | 12,223 | 13,530 | 13,530 | 26,146 | 12,484 |
| | R-68 to R-69 | 29,439 | 11,505 | 9,357 | 9,357 | 25,423 | 11,075 |
| | R-69 to R-70 | 25,647 | 5,855 | 12,132 | 12,132 | 22,944 | 7,111 |
| | R-70 to R-71 | 16,811 | -1,781 | 10,143 | 10,143 | 15,478 | 603 |
| | R-71 to R-72 | 13,511 | -3,791 | 7,107 | 7,107 | 12,230 | -1,611 |
| | R-72 to R-73 | 18,390 | -1,305 | 14,375 | 14,375 | 17,587 | 1,831 |
| | R-73 to R-74 | 24,092 | 6,513 | 23,158 | 6,658 | 23,905 | 6,542 |
| | R-74 to G.C. | 244 | 244 | 4,540 | -11,961 | 1,103 | -2,197 |
| **South Beach Total** | | **185,644** | **41,481** | **108,249** | **75,249** | **170,165** | **48,235** |
| **Dade County Total** | | **269,507** | **-12,042** | **474,978** | **55,999** | **310,601** | **1,566** |

VOLUMETRIC CHANGE (IN 10,000 CY)

55
50
45
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20

ACCRETION

EROSION

R-1 R-2 R-3 R-4 R-5 R-6 R-7 R-8 R-9 R-10 R-11 R-12 R-13 R-14 R-15 R-16 R-17 R-18 R-19 R-20 R-21 R-22 R-23 R-24 R-25 R-26 R-27 R-28 R-29 R-30 R-31 R-32 R-33 R-34 R-35 R-36 R-37 R-38 R-39 R-40 R-41 R-42 R-43 R-44 R-45 R-46 R-47 R-48 R-49 R-50 R-51 R-52 R-53 R-54 R-55 R-56 R-57 R-58 R-59 R-60 R-61 R-62 R-63 R-64 R-65 R-66 R-67 R-68 R-69 R-70 R-71 R-72 R-73 R-74

BROWARD COUNTY
MIAMI-DADE COUNTY
GOLDEN BEACH
SUNNY ISLES
BAKERS HAULOVER PARK
BAKERS HAULOVER INLET
BAL HARBOUR
SURFSIDE
63rd STREET HOT SPOT
MIAMI BEACH
GOVERNMENT CUT

0 2500 5000
SCALE IN FEET
1" = 5000'

LEGEND

VOLUMETRIC CHANGE WITH NOURISHMENT 1980 TO 1996 – ABOVE D.O.C.
VOLUMETRIC CHANGE WITHOUT NOURISHMENT 1980 TO 1996– ABOVE D.O.C.

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# FIGURE 2.7

VOLUMETRIC CHANGE – 1980 TO 1996
63rd STREET EROSIONAL HOT SPOT STUDY

VOLUMETRIC CHANGE (IN 10,000 CY)

55 50 45 40 35 30 25 20 15 10 5 0 -5 -10 -15 -20

EROSION ACCRETION

R-1 R-2 R-3 R-4 R-5 R-6 R-7 R-8 R-9 R-10 R-11 R-12 R-13 R-14 R-15 R-16 R-17 R-18 R-19 R-20 R-21 R-22 R-23 R-24 R-25 R-26 R-27 R-28 R-29 R-30 R-31 R-32 R-33 R-34 R-35 R-36 R-37 R-38 R-39 R-40 R-41 R-42 R-43 R-44 R-45 R-46 R-47 R-48 R-49 R-50 R-51 R-52 R-53 R-54 R-55 R-56 R-57 R-58 R-59 R-60 R-61 R-62 R-63 R-64 R-65 R-66 R-67 R-68 R-69 R-70 R-71 R-72 R-73 R-74

BROWARD COUNTY
MIAMI-DADE COUNTY
GOLDEN BEACH
SUNNY ISLES
BAKERS HAULOVER PARK
BAKERS HAULOVER INLET
BAL HARBOUR
SURFSIDE
63rd STREET HOT SPOT
MIAMI BEACH
GOVERNMENT CUT

0 2500 5000
SCALE IN FEET
1" = 5000'

LEGEND

VOLUMETRIC CHANGE WITH NOURISHMENT 1996 TO 2000 – ABOVE D.O.C.

VOLUMETRIC CHANGE WITHOUT NOURISHMENT 1996 TO 2000 – ABOVE D.O.C.

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# FIGURE 2.8

VOLUMETRIC CHANGE – 1996 TO 2000
63rd STREET EROSIONAL HOT SPOT STUDY

VOLUMETRIC CHANGE (IN 10,000 CY)

55 50 45 40 35 30 25 20 15 10 5 0 −5 −10 −15 −20

ACCRETION

EROSION

R-1 R-2 R-3 R-4 R-5 R-6 R-7 R-8 R-9 R-10 R-11 R-12 R-13 R-14 R-15 R-16 R-17 R-18 R-19 R-20 R-21 R-22 R-23 R-24 R-25 R-26 R-27 R-28 R-29 R-30 R-31 R-32 R-33 R-34 R-35 R-36 R-37 R-38 R-39 R-40 R-41 R-42 R-43 R-44 R-45 R-46 R-47 R-48 R-49 R-50 R-51 R-52 R-53 R-54 R-55 R-56 R-57 R-58 R-59 R-60 R-61 R-62 R-63 R-64 R-65 R-66 R-67 R-68 R-69 R-70 R-71 R-72 R-73 R-74

BROWARD COUNTY

MIAMI-DADE COUNTY

GOLDEN BEACH

SUNNY ISLES

BAKERS HAULOVER PARK

BAKERS HAULOVER INLET

BAL HARBOUR

SURFSIDE

63rd STREET HOT SPOT

MIAMI BEACH

GOVERNMENT CUT

0 2500 5000

SCALE IN FEET
1" = 5000'

LEGEND

VOLUMETRIC CHANGE WITH NOURISHMENT 1980 TO 2000 – ABOVE D.O.C.

VOLUMETRIC CHANGE WITHOUT NOURISHMENT 1980 TO 2000– ABOVE D.O.C.

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# FIGURE 2.9

VOLUMETRIC CHANGE – 1980 TO 2000
63rd STREET EROSIONAL HOT SPOT STUDY

VOLUMETRIC CHANGE (IN 1,000 CY)

40
30
20
10
0
10

ACCRETION

EROSION

GOVERNMENT CUT

R-1 R-2 R-3 R-4 R-5 R-6 R-7 R-8 R-9 R-10 R-11 R-12 R-13 R-14 R-15 R-16 R-17 R-18 R-19 R-20 R-21 R-22 R-23 R-24 R-25 R-26 R-27 R-28 R-29 R-30 R-31 R-32 R-33 R-34 R-35 R-36 R-37 R-38 R-39 R-40 R-41 R-42 R-43 R-44 R-45 R-46 R-47 R-48 R-49 R-50 R-51 R-52 R-53 R-54 R-55 R-56 R-57 R-58 R-59 R-60 R-61 R-62 R-63 R-64 R-65 R-66 R-67 R-68 R-69 R-70 R-71 R-72 R-73 R-74

BROWARD COUNTY
MIAMI-DADE COUNTY
GOLDEN BEACH
SUNNY ISLES
BAKERS HAULOVER PARK
BAKERS HAULOVER INLET
BAL HARBOUR
SURFSIDE
63rd STREET HOT SPOT
MIAMI BEACH

0 2500 5000
SCALE IN FEET
1" = 5000'

LEGEND

VOLUMETRIC CHANGE WITH NOURISHMENT 1980 TO 1996 – ABOVE D.O.C.

VOLUMETRIC CHANGE WITHOUT NOURISHMENT 1980 TO 1996 – ABOVE D.O.C.

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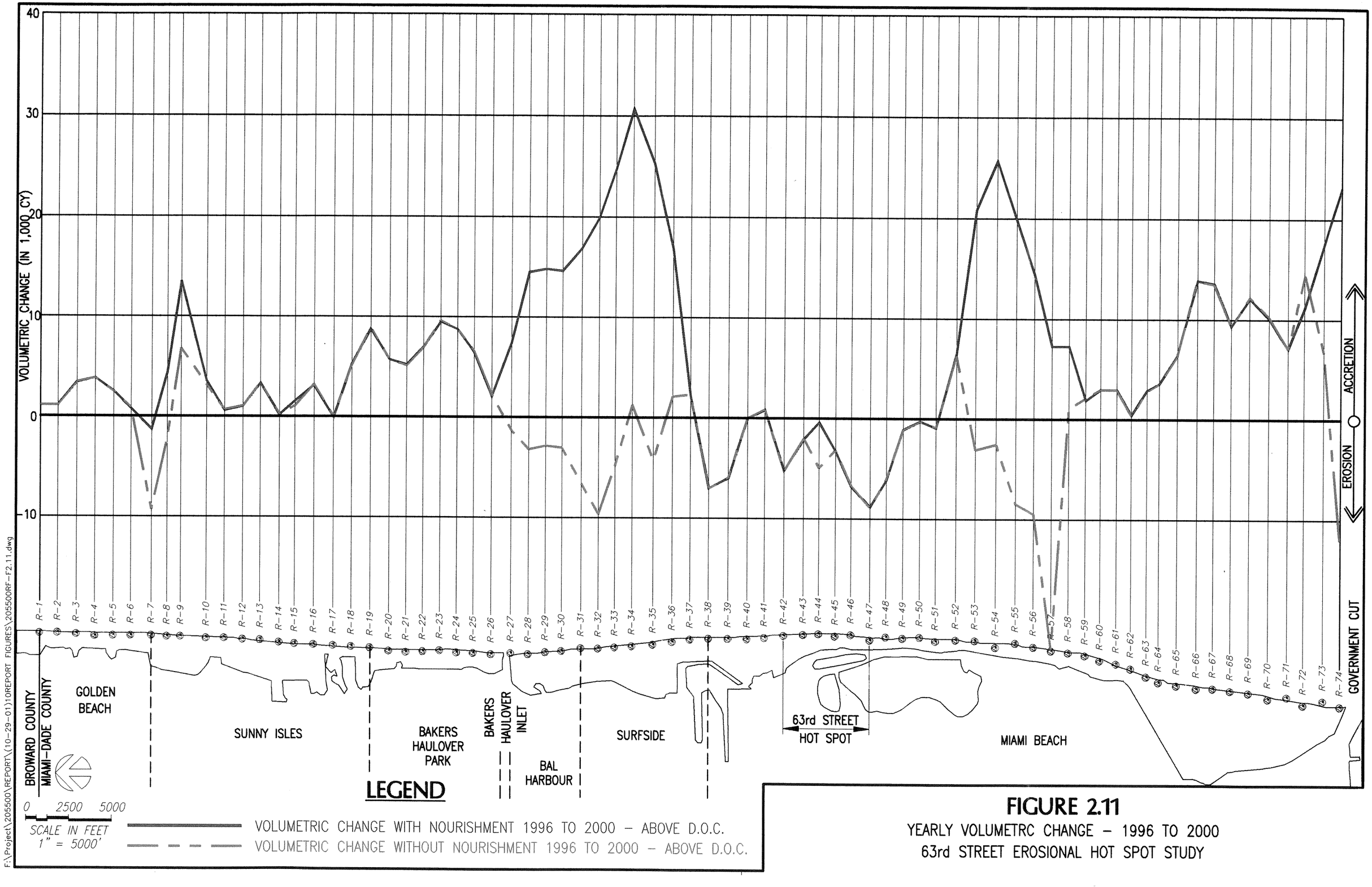
# FIGURE 2.10

YEARLY VOLUMETRIC CHANGE – 1980 TO 1996
63rd STREET EROSIONAL HOT SPOT STUDY

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# FIGURE 2.11

YEARLY VOLUMETRC CHANGE – 1996 TO 2000
63rd STREET EROSIONAL HOT SPOT STUDY

VOLUMETRIC CHANGE (IN 1,000 CY)

40
30
20
10
0
10

EROSION
ACCRETION

R-1 R-2 R-3 R-4 R-5 R-6 R-7 R-8 R-9 R-10 R-11 R-12 R-13 R-14 R-15 R-16 R-17 R-18 R-19 R-20 R-21 R-22 R-23 R-24 R-25 R-26 R-27 R-28 R-29 R-30 R-31 R-32 R-33 R-34 R-35 R-36 R-37 R-38 R-39 R-40 R-41 R-42 R-43 R-44 R-45 R-46 R-47 R-48 R-49 R-50 R-51 R-52 R-53 R-54 R-55 R-56 R-57 R-58 R-59 R-60 R-61 R-62 R-63 R-64 R-65 R-66 R-67 R-68 R-69 R-70 R-71 R-72 R-73 R-74

BROWARD COUNTY
MIAMI-DADE COUNTY
GOLDEN BEACH
SUNNY ISLES
BAKERS HAULOVER PARK
BAKERS HAULOVER INLET
BAL HARBOUR
SURFSIDE
63rd STREET HOT SPOT
MIAMI BEACH
GOVERNMENT CUT

0 2500 5000
SCALE IN FEET
1" = 5000'

LEGEND

VOLUMETRIC CHANGE WITH NOURISHMENT 1980 TO 2000 – ABOVE D.O.C.
VOLUMETRIC CHANGE WITHOUT NOURISHMENT 1980 TO 2000– ABOVE D.O.C.

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# FIGURE 2.12

YEARLY VOLUMETRIC CHANGE – 1980 TO 2000
63rd STREET EROSIONAL HOT SPOT STUDY

### *2.4.1 Miami-Dade County Border to Bakers Haulover Inlet*

Comparison of the 1996 and 2000 surveys for the Golden Beach segment has continued to benefit from adjacent beach nourishment projects both to the north in Broward County and to the south in Sunny Isles sites. Volumetric changes of approximately +51,000 cy or +13,000 cy/year were calculated for this segment. A majority of the accretion occurred below the -6 feet NGVD (+50,000 cy), while above –6 feet NGVD the northern and southern limits of Golden Beach lost sand and the central portion gained sand for a total volumetric change of +800 cy. These recent trends follow the historical changes for the period between 1980 and 1996 where approximately +1,400 cy/year and +22,000 cy/year of accretion were calculated above and below –6 feet NGVD respectively. A combination of both the recent and historical studies show and overall gain of sand of approximately +21,000 cy/year between 1980 and 2000.

The Sunny Isles beach segment was found to be accreting during the 1996 to 2000 study period at +52,300 cy or at a rate of +13,000 cy/year after adjusting for the nourishment of approximately 89,000 cubic yards placed on the beach in 1997. The accretion along this stretch of shoreline differs from the historically erosional value of –4,000 cy/year calculated for the period between 1980 and 1996. The shoreline however lost sand above –6 feet NGVD and gained a significant amount below –6 feet NGVD. The increase in sand may be due to the net southerly transport of sand and end effects or losses of nourishment activities to the north of Sunny Isles.

Bakers Haulover Park beach (R-19 to Bakers Haulover Inlet) was noticed to have gained significant amounts of sand over the 1996 to 2000 study period. There have been no nourishments of this area, and comparisons of the surveys indicate that approximately +215,000 cy or +54,000 cy/year of sand have accreted along this stretch of shoreline. Most of the increase in volume occurred below –6 feet NGVD at +125,000 cy or +31,300 cy/year. Historical studies show that this area is typically accretional (+3,600 cy/year), however not at the same rate observed for the recent study. This large order of magnitude increase in accretion may be due to the transport of sand from projects

nourished to the north over recent years. However, this area should be further studied further with additional survey data to better assess the long-term volumetric changes.

### *2.4.2 Bakers Haulover Inlet to Government Cut*

The Bal Harbour shoreline segment from south of Bakers Haulover Inlet to R-31 experienced a volumetric change of +205,913 cubic yards between 1996 and 2000. However, considering the 1998 nourishment of approximately 248,000 cy, the shoreline is actually experiencing erosion of approximately –41,600 cy, or –11,000 cy/year. From the analysis, it was observed that a significant portion of the 1998 beach project still remains within the project limits, with some cross-shore equilibration of the fill. The shoreline change trend along Bal Harbour has historically been erosional (approximately –29,000 cy/year between 1980 and 1996), when considering all nourishment activity. The analysis of the 20 year changes results in a loss of approximately –25,000 cy/year for the Bal Harbour segment.

A comparison of the 1996 and 2000 surveys results in a gain of approximately 550,000 cy along R-31 to R-38 inside the City of Surfside limits. This accretion is due to the end effects of the 1998 Bal Harbour project immediately north of the city, and the 1999 nourishment which placed approximately 590,000 cy between R-31 and R-37. Therefore, considering the nourishment activity, the Surfside shoreline actually experienced losses of approximately –78,000 cy or –19,500 cy/year. Some cross-shore equilibration of the recently placed fill was observed along this shoreline segment. The yearly losses are slightly lower, however confirm the historical shoreline erosional trend of approximately –33,500 cy/year calculated for the period between 1980 and 1996. The overall sum of yearly losses, considering nourishments over the 20 year period from 1980 to 2000, is approximately –31,000 cy/year.

The northern portion or first segment of Miami Beach, which extends from R-38 to R-46, is highly erosional and contains the 63$^{rd}$ Street Hot Spot. When accounting for the small truck-fill nourishment of 18,000 cy in 1998 between R-44 and R-45, the volumetric change for the entire segment between 1996 and 2000 was approximately –110,000 cy or

–27,500 cy/year. Analysis of the volumetric change also indicated that approximately –187,000 cy (-46,500 cy/year) were lost above –6 feet NGVD and approximately +77,000 cy (19,300 cy/year) were gained below –6 feet NGVD. This indicates both significant cross-shore and longshore transport of sand from the area. The erosion rates for this segment are considerably higher for the recent study period as compared to the period between 1980 and 1996, where approximately –3,000 cy/year were lost from this segment of the shoreline. The increased erosion may be due to the effects of the 63rd Street Hot Spot area and no significant nourishment activities in this area since 1985. The summation of the historical and recent study results and considering nourishment activities, show that the 20 year erosional rate for the northern segment of Miami Beach is approximately –8,000 cy/year.

The mid-Miami Beach, or second shoreline segment was also observed to be highly erosional, and extends from R-47 to the 32nd Street Hot Spot at R-59. After deducting the 1997 nourishment fill volume of approximately 564,000 cy, this segment experienced the erosion of approximately –250,000 cy, or -65,000 cy/year between 1996 and 2000. A significant portion of the sand loss occurred immediately south of the 63rd street Hot Spot and to the north of the 32nd street Hot Spot. The latter erosional losses also were at the end of the 1997 nourishment, and may be partly attributed to end losses. These erosion rates are similar, though slightly higher than the nourishment deducted historical rates of –43,000 cy/year observed between 1980 and 1996. The combination of the two studies show the 20 year erosion rate for the mid-Miami Beach area to be approximately –47,000 cy/year.

In the third segment or lower portion of Miami Beach, which is located south of the 32nd street Hot Spot (R-59) to 16th street (R-66), the shoreline became accretional and had no nourishment activity between 1996 and 2000. Along this segment, the beach accreted approximately +85,000 cy or at the rate of +21,300 cubic yards per year. This accretional trend is consistent, however lower than the historical data between 1980 and 1996, which showed an accretional yearly rate of +40,000 cy/year. Based on these

analyses, the volumetric change over the 20 year period between 1980 and 2000 was +36,000 cy/year.

The fourth segment in Miami Beach, or historical South Beach area, between R-66 and Government Cut (16th street to Government Cut), has also been accreting. Considering the 1999 nourishment activity that occurred just north of Government Cut that placed approximately 132,000 cy between the inlet jetty and R-73, the shoreline gained approximately 301,000 cy, or +75,000 cy/year between 1996 and 2000. Historical data shows similar accretional trends, though at a lower rate of approximately +42,000 cy/year between 1980 and 1996. The increase accretion is likely due to the sand tightening of the northern Government Cut jetty, and resulting increase in the trapping sand that previously moved around and into the cut. The 20 year volumetric change for this area is approximately +48,000 cy/year.

# 3.0 - REGIONAL SEDIMENT BUDGET

## 3.1 General

An updated sediment budget for the period of 1996 through 2000 has been developed for the study region delineated between the Broward County/Miami-Dade County border and Government Cut. The northern boundary condition at the Miami-Dade County border was established from the historical sand transport rates computed for the previous 1980 to 1996 study. The budget for the recent study period was then combined with the historical results to provide a 20 year average sediment budget. The Miami-Dade County border was utilized as a boundary value due to not having updated volumetric change calculations for the Broward County shoreline south of Port Everglades. The seaward boundary of the study region is at the depth of closure, and the individual components of the sediment budget are based on the computed volumetric changes presented in Section 2.

## 3.2 Regional Sediment Budget

The overall sand movement, sediment sources and sinks within the study region are evaluated based on the computed volumetric changes at each DEP monument. These overall changes were used toward the development of an updated regional sediment budget. The study region is divided into several segments according to different municipalities. The results are presented in Figures 3.1 through 3.3 display the changes within each of these segments for the 1980 to 1996, 1996 to 2000, and 1980 to 2000 periods respectively. The development of the regional sediment budget is described below:

### *3.2.1 Miami-Dade County Border to Bakers Haulover Inlet*

At the Broward/Miami-Dade County line, the estimated longshore sediment transport flowing into the beaches of Miami-Dade County is 85,000 cubic yards per year, based on historical data obtained from the Coastal Systems 1997 report. This value may have changed however due to the potential southerly flow of sand lost from nourishments conducted in Broward County. A study of recent volumetric changes along the Broward

UNITS : CY/YR

ATLANTIC OCEAN

85,000 | 62,000 | 66,000 | 62,000 | 21,000 | 50,000 | 84,000 | 87,000 | 117,000 | 71,000 | 26,000

+23,000 | −4,000 | +4,000 | −29,000 | −34,000 | −3,000 | −30,000 | +46,000 | +45,000

R-1 R-2 R-3 R-4 R-5 R-6 R-7 R-8 R-9 R-10 R-11 R-12 R-13 R-14 R-15 R-16 R-17 R-18 R-19 R-20 R-21 R-22 R-23 R-24 R-25 R-26 R-27 R-28 R-29 R-30 R-31 R-32 R-33 R-34 R-35 R-36 R-37 R-38 R-39 R-40 R-41 R-42 R-43 R-44 R-45 R-46 R-47 R-48 R-49 R-50 R-51 R-52 R-53 R-54 R-55 R-56 R-57 R-58 R-59 R-60 R-61 R-62 R-63 R-64 R-65 R-66 R-67 R-68 R-69 R-70 R-71 R-72 R-73 R-74

BROWARD COUNTY
MIAMI-DADE COUNTY

GOLDEN BEACH

SUNNY ISLES

BAKERS HAULOVER PARK

BAKERS HAULOVER INLET

BAL HARBOUR

SURFSIDE

63rd STREET HOT SPOT

MIAMI BEACH

GOVERNMENT CUT

0 2500 5000
SCALE IN FEET
1" = 5000'

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# FIGURE 3.1

REGIONAL SEDIMENT BUDGET
(MIAMI-DADE COUNTY BORDER TO GOVERNMENT CUT, 1980-1996)

ATLANTIC OCEAN

UNITS : CY\YR

85,000 | 72,000 | 59,000 | 54,000 | 0 | 10,000 | 30,000 | 57,000 | 120,000 | 99,000 | 24,000

+13,000 | +13,000 | +5,000 | −10,000 | −20,000 | −27,000 | −63,000 | +21,000 | +75,000

R-1 R-2 R-3 R-4 R-5 R-6 R-7 R-8 R-9 R-10 R-11 R-12 R-13 R-14 R-15 R-16 R-17 R-18 R-19 R-20 R-21 R-22 R-23 R-24 R-25 R-26 R-27 R-28 R-29 R-30 R-31 R-32 R-33 R-34 R-35 R-36 R-37 R-38 R-39 R-40 R-41 R-42 R-43 R-44 R-45 R-46 R-47 R-48 R-49 R-50 R-51 R-52 R-53 R-54 R-55 R-56 R-57 R-58 R-59 R-60 R-61 R-62 R-63 R-64 R-65 R-66 R-67 R-68 R-69 R-70 R-71 R-72 R-73 R-74

BROWARD COUNTY
MIAMI-DADE COUNTY

GOLDEN BEACH

SUNNY ISLES

BAKERS HAULOVER PARK

BAKERS HAULOVER INLET

BAL HARBOUR

SURFSIDE

63rd STREET HOT SPOT

MIAMI BEACH

GOVERNMENT CUT

0 2500 5000
SCALE IN FEET
1" = 5000'

F:\Project\205500\REPORT\(10-29-01)10REPORT FIGURES\205500RF-F3-2.dwg

# FIGURE 3.2

REGIONAL SEDIMENT BUDGET
(MIAMI-DADE COUNTY BORDER TO GOVERNMENT CUT, 1996-2000)

ATLANTIC OCEAN

UNITS : CY/YR

85,000 → 64,000 → 65,000 → 51,000 → 21,000 → 46,000 → 77,000 → 85,000 → 122,000 → 81,000 → 30,000

+21,000 | −1,000 | +14,000 | −25,000 | −31,000 | −8,000 | −37,000 | +41,000 | +51,000

R-1 R-2 R-3 R-4 R-5 R-6 R-7 R-8 R-9 R-10 R-11 R-12 R-13 R-14 R-15 R-16 R-17 R-18 R-19 R-20 R-21 R-22 R-23 R-24 R-25 R-26 R-27 R-28 R-29 R-30 R-31 R-32 R-33 R-34 R-35 R-36 R-37 R-38 R-39 R-40 R-41 R-42 R-43 R-44 R-45 R-46 R-47 R-48 R-49 R-50 R-51 R-52 R-53 R-54 R-55 R-56 R-57 R-58 R-59 R-60 R-61 R-62 R-63 R-64 R-65 R-66 R-67 R-68 R-69 R-70 R-71 R-72 R-73 R-74

BROWARD COUNTY
MIAMI-DADE COUNTY
GOLDEN BEACH
SUNNY ISLES
BAKERS HAULOVER PARK
BAKERS HAULOVER INLET
BAL HARBOUR
SURFSIDE
63rd STREET HOT SPOT
MIAMI BEACH
GOVERNMENT CUT

0 2500 5000
SCALE IN FEET
1" = 5000'

F:\Project\205500\REPORT\(10-29-01)10REPORT FIGURES\205500RF-F3-1.dwg

# FIGURE 3.3

REGIONAL SEDIMENT BUDGET
(MIAMI-DADE COUNTY BORDER TO GOVERNMENT CUT, 1980-2000)

shoreline south of Port Everglades is recommended to better understand the recent changes transport of sand along the Miami Dade County shoreline.

The first shoreline segment located in Miami-Dade County is the Golden Beach, which is non-nourished shoreline. This area has received the benefits, however, from projects to the north and to the south of the city and is the reason for the accretion observed along the site of approximately +13,000 cy/year during the study period between 1996 and 2000. Based on the Golden Beach shoreline performance, the annual volumetric change was deducted from the Miami-Dade County border boundary condition, thereby resulting in approximately 72,000 cy/year of sand moving into Sunny Isles to the south.

The next segment, Sunny Isles, is a periodically renourished community and when these nourishments are deducted, experienced volumetric changes between 1996 and 2000 of approximately +13,000 cy/ year. The recent accretional trend is opposite of the historical erosion of –4,000 cy/year calculated for this segment between 1980 and 1996. However, this reversal is likely due to an accretional wave created by the movement of sand from nourishments to the north of the city. Based on the recent results, the transport of sand moving past Sunny Isles and into Bakers Haulover Park is reduced to 59,000 cy/year.

The shoreline along Bakers Haulover Beach Park extends south from DEP profile line 19 to Bakers Haulover Inlet. During the 1996 through 2000 study time period, approximately +215,000 cy or +54,000 cy/year of accretion were calculated for this area. As discussed in Section 2, this value is greater than expected and may require additional investigation to verify the amount of volumetric change. However, based upon the calculations, the +54,000 cy/year are subtracted from the longshore sediment transport rate, so that approximately 5,000 cy/year flowed into Bakers Haulover Inlet over the four year study period.

### *3.2.2 Bakers Haulover Inlet*

The historical sand transport rates for Bakers Haulover Inlet that were calculated for the 1997 report show that approximately 21,000 cubic yards per year naturally bypasses the

inlet and reaches Bal Harbour, located immediately south of the inlet. However, due to the increased accretion measured along the Bakers Haulover Park shoreline, there is little sand (5,000 cy/year) moving into the inlet system. Therefore, considering the recent maintenance of the inlet and the dredging of the interior and ebb shoal, it is likely that the sand recently entering the system has not been bypassed to Bal Harbour. Specifically, the upper boundary condition for Bal Harbour is taken to be zero for the updated analysis.

### *3.2.3 Bakers Haulover Inlet to Government Cut*

The Bal Harbour segment located between DEP profile line R-27 (south jetty at Bakers Haulover Inlet) and profile line R-31 experienced an annual erosion rate of –10,000 cy/year between 1996 and 2000. This volume of sand is therefore incorporated into the net littoral transport moving south along the rest of Miami Beach.

During the study period, the community of Surfside, located between DEP profile line R-31 (96$^{th}$ street) and profile line R-38 (80$^{th}$ street) was also erosional after considering the 1999 nourishment project. The shoreline lost approximately -20,000 cy/year. These losses were added into the littoral drift system, so that approximately 30,000 cy/year are transported into Miami Beach.

The first segment of Miami Beach between profile line R-38 (80$^{th}$ street) and profile line R-46 (63$^{rd}$ street) was highly erosional between 1996 and 2000 at a rate of approximately –27,000 cy/year. This likely due to the effects of the 63$^{rd}$ street Hot Spot located along this stretch of shoreline. The eroded volume calculated for this segment was therefore incorporated into the net southerly littoral transport, so that 57,000 cy/year pass into the next segment of Miami Beach.

The next segment, located between R-46 and R-59 (63$^{rd}$ and 32$^{nd}$ streets respectively) also lost a considerable amount of sand at a rate of -63,000 cy/year between 1996 and 2000. It should be noted that this segment includes an accumulation of sand in the offshore bar located around –6 feet NGVD. This segment also contains the 32$^{nd}$ street Hot Spot along the southern portion of the shoreline, and is likely a contributor to the overall losses.

These losses raise the annual littoral transport of 120,000 cy/year of sand moving into the southern reaches of Miami Beach.

The third Miami Beach segment between R-59 and R-66 (36th and 16th streets, respectively), shows a shift from an erosional to accretional trend. During the period between 1996 and 2000, the shoreline experienced accretion of 21,000 cy/year. Therefore, the longshore sediment transport into the next segment is reduced to 99,000 cubic yards per year.

Further substantial accretion occurred along the South Beach segment between R-66 (16th street) and Government Cut, with approximately 75,000 cy/year being accumulated along this segment. This accretion further reduces the amount of material arriving at Government Cut, which is now only 24,000 cy/year.

This observed erosion/accretion trend combined with the resulting littoral transport rates is consistent with expected behavior of an open shoreline with a limited supply of sand from the north and a terminal structure at the south.

### *3.2.4 Government Cut*

Based on the analysis of volumetric changes between 1996 and 2000, the total amount of sand that could potentially be transported into the channel was 24,000 cy/year. This volume of sand is probably being trapped and moved offshore due to the sand tightening of the north Government Cut jetty that was performed in 1999. This value is similar to the amount calculated for the previous study, which indicated that approximately 26,000 cy/year moved into the cut.

The sediment budget values for the 1996 to 2000 study period typically follow the trends of the previous (1980-1996) study, with the exception of Sunny Isles and Bakers Haulover Park, as described above. To provide a 20 year average, the annual sediment transport rates were calculated for the period between 1980 through 2000.

## 3.3 63rd Street Hot Spot Sediment Budget

To determine the behavior of the 63rd street Hot Spot (R-42 to R-47), shoreline and volumetric changes were analyzed on a more localized scale. These results were utilized to determine longshore and cross-shore transport rates for the hot spot area and in its vicinity. For the local sediment budget northern boundary, the analysis began at R-38 which was the end of a regional sediment budget computational cell. The results of the analyses are presented in Table 3.1, and are shown graphically in Figures 3.4 through 3.6.

Along the 63rd street Hot Spot shoreline, there was an average volumetric loss of approximately –10,900 cy/year between 1996 and 2000 when taking nourishment activity into account. This rate of erosion compares very well with the historical value of approximately –11,300 cy/year measured between 1980 and 1996. Therefore an overall 20 year erosion rate is approximately –11,000 cy/year. A review of the volumetric changes when considering nourishment activity both above and below –6 feet NGVD between 1996 and 2000 shows that there was a significant loss of sand in the upper "active" beach area of –32,000 cy/year. There was, however, some cross-shore movement of sand, or gain below –6 feet NGVD of + 14,700 cy/year. The volumetric changes above and below –6 feet NGVD for the period between 1980 and 1996 did not have the effects of nourishment factored out. However, the calculations indicate a similar cross-shore trend with almost double the yearly loss in the area above –6 feet NGVD as compared to the volumetric gains below –6 feet NGVD.

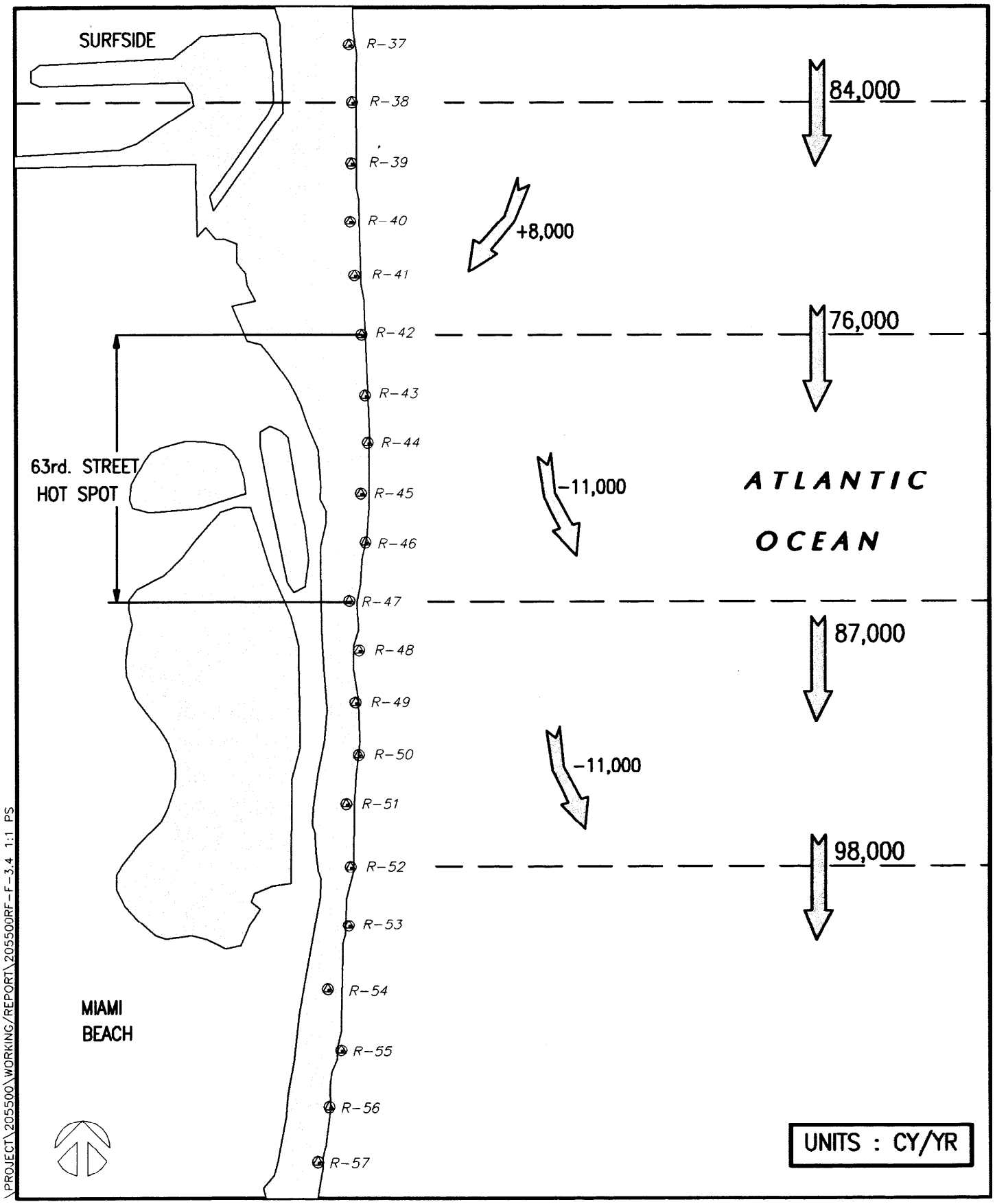
The area just north of the 63rd street Hot Spot saw a reversal in overall segment performance from accretional (+ 8,000 cy/year) to erosional (-12,000 cy/year) between the period from 1996 to 2000 as compared to the previous study results from 1980 to 1996. There was an increase in erosion above –6 feet NGVD and a reduction in accretion below –6 feet NGVD. An increase in erosion was also observed in the area immediately downdrift of the Hot Spot. The overall erosion along this shoreline segment increased from approximately –11,500 cy/year (1980-1996) to –17,000 cy/year (1996-2000). The significant change is that the area below –6 feet NGVD switched from accretional to

slightly erosional. The large accumulation of sand in the offshore bars of the hot spot and northern area may be trapping sand and starving the area to the south.

## Table 3.1
## 63rd Street Volumetric Change Summary (Average End)

| | Segment | 1980-1996 Volumetric Changes | | | | | 1996-2000 Volumetric Changes | | | | 1980-2000 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | With Nourishment | | | w/o Nour. | Sediment | Without Nourishment | | | Sediment | Volume | Sediment |
| | | Above -6 (cy/yr) | Below -6 (cy/yr) | Above DOC (cy/yr) | Above DOC (cy/yr) | Budget (cy/yr) | Above -6 (cy/yr) | Below -6 (cy/yr) | Above DOC (cy/yr) | Budget (cy/yr) | Above DOC (cy/yr) | Budget (cy/yr) |
| | | | | | | 84,000* | | | | 30,000* | | 73,000* |
| North of Hot Spot | R-38 to R-39 | -2,196 | 3,603 | 1,407 | 1,407 | | -8,913 | 1,930 | -6,984 | | -271.2 | |
| | R-39 to R-40 | -1,393 | 4,699 | 3,307 | 3,307 | | -9,702 | 3,757 | -5,945 | | 1,456.3 | |
| | R-40 to R-41 | -2,155 | 4,267 | 2,112 | 2,112 | | -2,428 | 2,418 | -10 | | 1,687.9 | |
| | R-41 to R-42 | -2,491 | 5,474 | 2,983 | 1,450 | | -1,692 | 2,580 | 888 | | 1,337.8 | |
| **North of Hot Spot Total** | | **-8,235** | **18,043** | **9,809** | **8,276** | 76,000 | **-22,735** | **10,685** | **-12,050** | 42,000 | **4,211** | 69,000 |
| 63rd St. Hot Spot | R-42 to R-43 | -2,137 | 3,471 | 1,334 | -218 | | -6,600 | 1,405 | -5,195 | | -1,213.4 | |
| | R-43 to R-44 | -2,218 | -84 | -2,303 | -3,520 | | -5,584 | 3,483 | -2,101 | | -3,236.1 | |
| | R-44 to R-45 | -3,261 | 534 | -2,727 | -4,040 | | -5,768 | 5,407 | -362 | | -3,304.4 | |
| | R-45 to R-46 | -3,913 | 1,691 | -2,221 | -3,481 | | -5,982 | 2,763 | -3,219 | | -3,428.4 | |
| | R-46 to R-47 | -5,131 | 1,722 | -3,408 | -3,408 | | -8,429 | 1,643 | -6,786 | | -4,083.8 | |
| **63rs St. Hot Spot Total** | | **-16,659** | **7,335** | **-5,916** | **-11,258** | 87,000 | **-32,363** | **14,700** | **-10,878** | 53,000 | **-11,182** | 80,000 |
| South of Hot Spot | R-47 to R-48 | -1,779 | 2,861 | 1,082 | 1,082 | | -7,509 | -1,302 | -8,811 | | -896.8 | |
| | R-48 to R-49 | -1,389 | 2,545 | 1,156 | 1,156 | | -3,573 | -2,599 | -6,172 | | -309.8 | |
| | R-49 to R-50 | -4,811 | -522 | -5,332 | -5,332 | | -832 | -247 | -1,079 | | -4,481.8 | |
| | R-50 to R-51 | -5,453 | 936 | -4,517 | -4,517 | | 2 | -252 | -250 | | -3,663.8 | |
| | R-51 to R-52 | -5,234 | 1,382 | -3,852 | -3,852 | | -475 | -405 | -881 | | -3,257.5 | |
| **South of Hot Spot Total** | | **-18,666** | **7,202** | **-11,464** | **-11,464** | 98,000 | **-12,387** | **-4,806** | **-17,193** | 70,000 | **-12,610** | 93,000 |

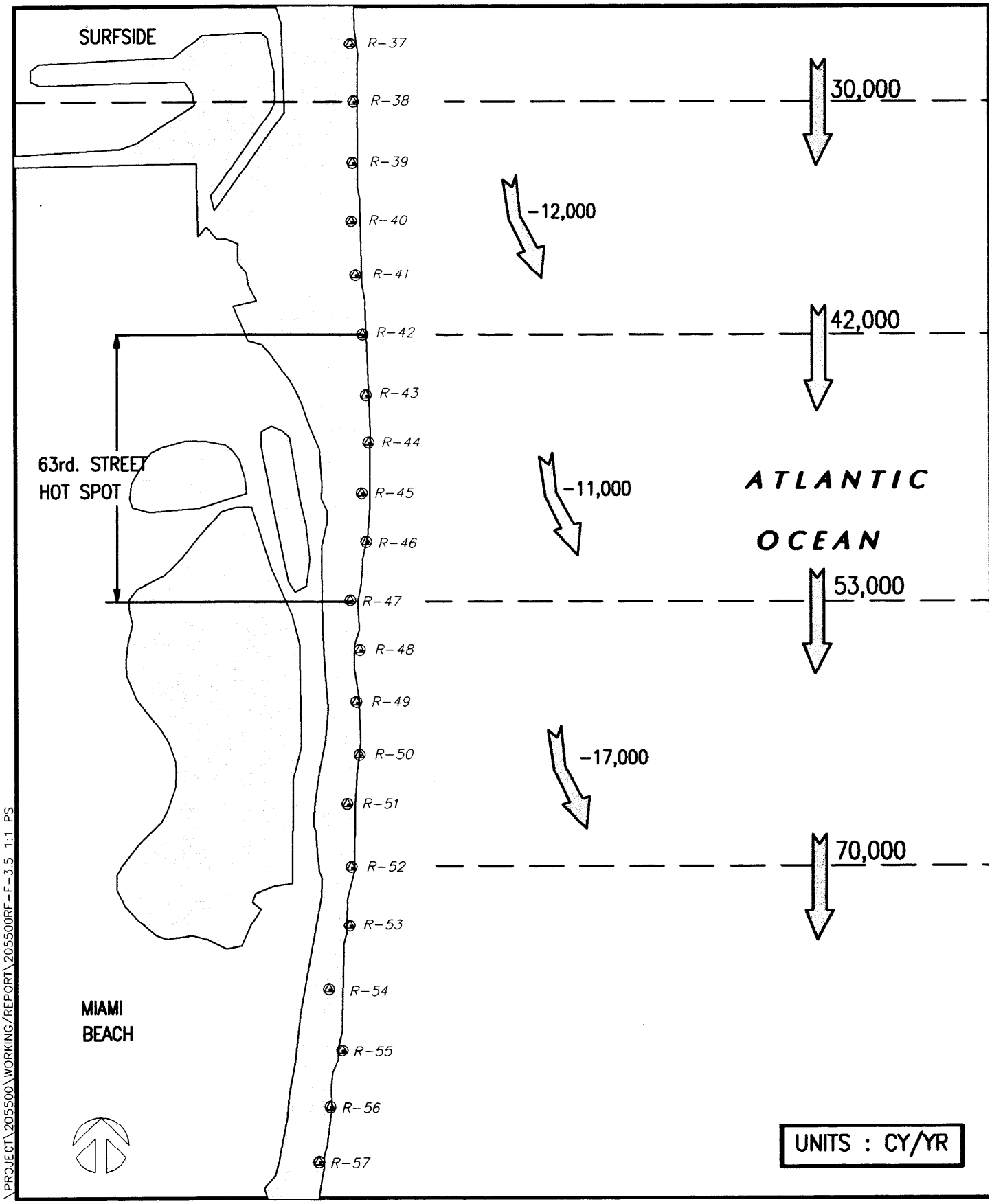
* Note: Value is the northern boundary input for the 63rd Street Sediment Budget and was obtained form the Regional Sediment Budget as described in Section 3.3




# FIGURE 3.4

63rd. STREET SEDIMENT BUDGET

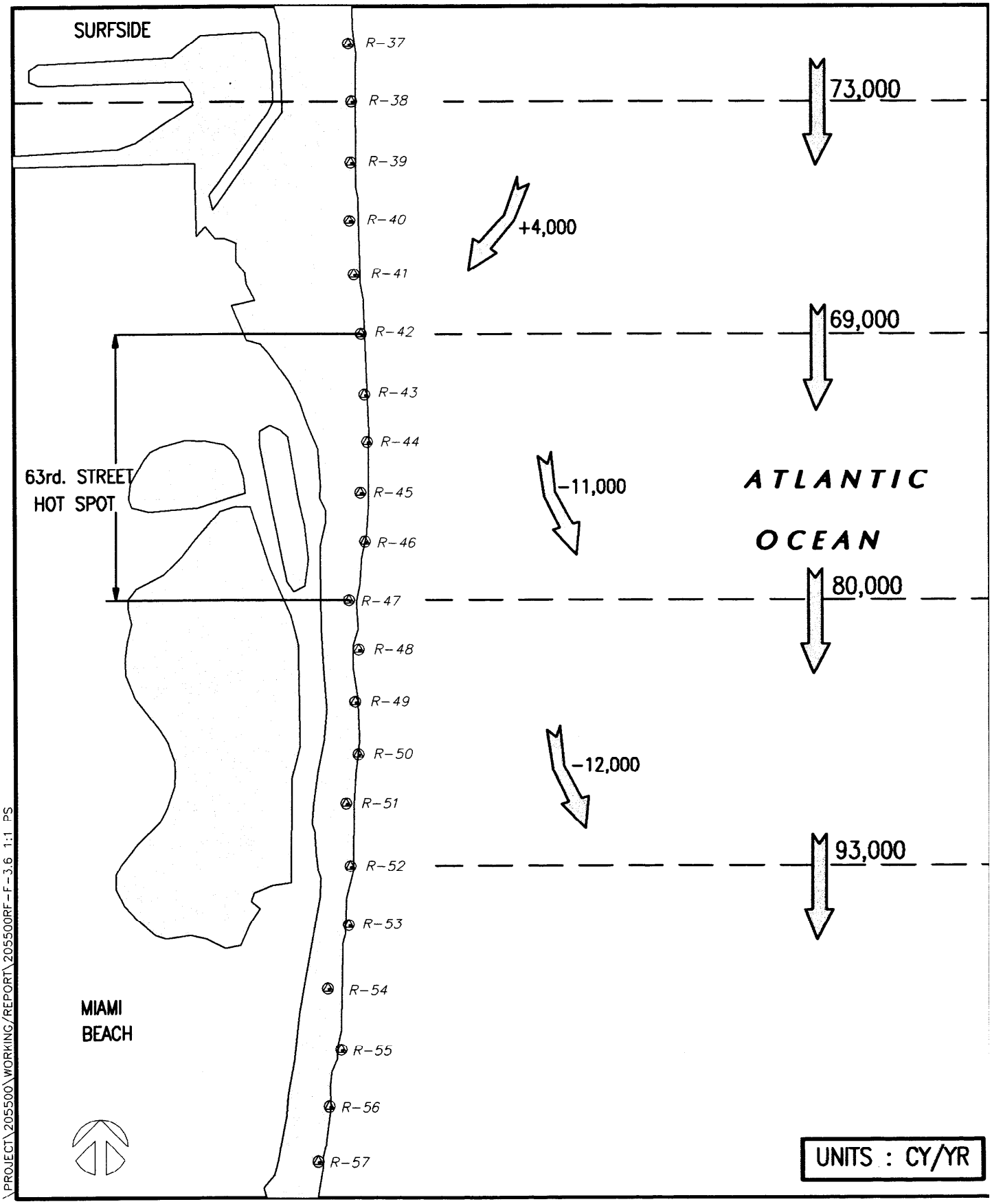
1980 - 1996




# FIGURE 3.5

63rd. STREET SEDIMENT BUDGET

1996 - 2000




# FIGURE 3.6

63rd. STREET SEDIMENT BUDGET

1980 - 2000

# 4.0 – PRELIMINARY SHORE PROTECTION DESIGN PARAMETERS for 63rd STREET HOT SPOT

## 4.1 General

Basic shore protection design parameters were developed within the 63rd street Erosion Hot Spot Demonstration Project area. These parameters consist of beach slopes, sand grain sizes, storm surge recurrence intervals, annual sediment transport rates and budgets, existing shoreline positions in the project area, and typical cross shore profile configurations.

## 4.2 Design Parameters

Table 4.1 contains a summary of the basic design parameters for the 63rd street Erosion Hot Spot Demonstration Project. The following sections describe the parameters in more detail.

**Table 4.1**
**Summary of Basic Design Parameters for the 63rd Street Erosional Hot Spot Demonstration Project**

| Parameter | Value |
|---|---|
| Typical Beach Slope | 1h:8v to 1h:12v |
| Median Grain Size | 0.25 mm |
| Storm Surge | +13.6 feet NGVD<br>(for a 100 year return period storm) |
| Sediment Transport | -11,000 c/yr above DOC<br>(-32,000 cy/yr above –6 feet NGVD)<br>(+ 15,000 cy/yr below –6 feet NGVD) |

***4.2.1 Beach Slopes:*** A review of recent and historical profiles indicates that the typical beach slope in this area ranges between 1h:8v to 1h:12v.

***4.2.2 Grain Size:*** From previous nourishments along the Miami-Dade County shoreline, the mean grain size placed was 0.25 mm (Flynn, personal communication). Pre-nourishment grain size studies showed that the median grain size along the foreshore for Miami-Dade County ranged from 0.35 to 028 mm (USACE, 1965)

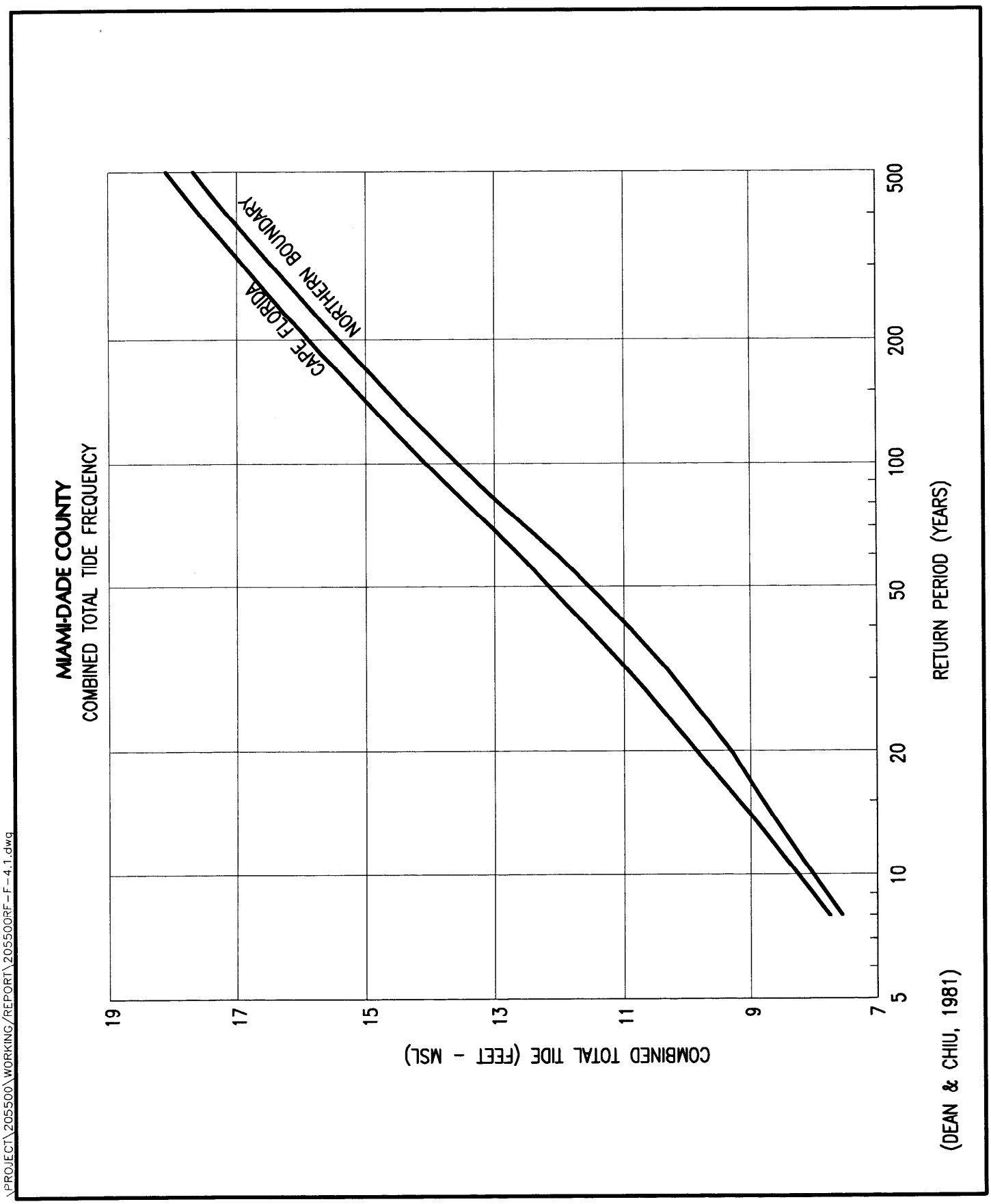
***4.2.3 Storm Surge Elevations:*** Historical records compiled over the past 124 years indicate that there have been approximately 29 hurricanes of Category 1 strength or greater (sustained winds greater than 64 mph) that have passed within a 50 nautical mile radius of Government Cut. Based on this history, we can expect a hurricane of Category 1 strength or greater to occur, on average, every 4.3 years and pass within a 50 nautical mile radius of Miami-Dade County.

The storm surge elevations have been calculated for the entire Miami-Dade County shoreline and are presented below in Table 4.2 and shown graphically in Figure 4.1. For the area in the vicinity of the 63$^{rd}$ street Hot Spot, the storm surge elevation of +13.6 feet NGVD corresponds to a recurrence interval of 100 years, or a 1% chance of occurrence each year. (Dean & Chiu, 1981)

**Table 4.2**
**Combined Total Storm Tide values for Miami Dade County**

| Return Period TR (years) | Combined Total Storm Tide Level* above MSL | | |
|---|---|---|---|
| | North (R-1 to R-30) | Middle (R-31 to R-80) | South (R-81 to R-113) |
| 500 | 17.6 | 17.7 | 18.0 |
| 200 | 15.3 | 15.4 | 15.8 |
| 100 | 13.5 | 13.6 | 14.0 |
| 50 | 11.4 | 10.8 | 12.1 |
| 20 | 9.3 | 9.5 | 9.8 |
| 10 | 8.0 | 8.1 | 8.2 |

* Includes contributions of: wind stress, barometric pressure, dynamic wind setup and astronomical tides.




# FIGURE 4.1

COMBINED TOTAL STORM TIDE FREQUENCY FOR MIAMI-DADE COUNTY

***4.2.4 Typical Profile:*** Profiles in the vicinity of the 63rd street Hot Spot are provided in Appendix C.

***4.2.5 63rd Street Sediment Budget:*** The 63rd street Hot Spot shoreline experienced an average volumetric loss of approximately –10,900 cy/year between 1996 and 2000 when taking nourishment activity into account. A review of the volumetric changes above –6 feet NGVD between shows that there was significant erosion of the active beach area in the order of –32,000 cy/year. There was some cross-shore movement of the eroded sand, resulting in a gain of + 14,700 cy/year below – 6 feet NGVD.

# 5.0 - CONCLUSIONS AND RECOMMENDATIONS

## 5.1 Conclusions

The following conclusions are presented as they relate to the various shoreline segments within Miami-Dade County:

1. All volumetric and shoreline changes presented below have the effects of nourishment deducted, or are changes that would be experienced without nourishment activities.

2. Comparison of the 1996 and 2000 beach profiles along Golden Beach indicates that this segment has remained stable to slightly accretional with an average shoreline change rate of +2.3 ft/year, and a volumetric accretion rate of +13,000 cy/year. The Town of Golden Beach has benefited from adjacent beach nourishment projects, and will remain stable with continued nourishment projects near the Town's limits.

3. The computed shoreline and volumetric changes along the Sunny Isles segment indicate a shoreline change rate of +2.3 ft/year and a volumetric change rate of +13,000 cy/year between 1980 and 1996. This area has historically been erosive and the accretional trend may be due to the southerly transport of sand from nourishment projects to the north in Broward County. However, the north end of the Sunny Isles Beach project (around DEP monument R-7) had an excessive beach erosion rate and it is considered as one of Miami-Dade County's most noticeable "Hot Spots."

4. The Sunny Isles segment was observed to have lost sand above –6 feet NGVD and gained a significant amount in the offshore bar below –6 feet NGVD. This indicates a large cross-shore inequality in the sand distribution and the build-up of the offshore bar. This area is currently being nourished and should be closely monitored to determine the performance of the project. Due to the recently

measured accretion below –6 feet NGVD, the beach profiles in the area are presently closer to an equilibrium condition, and less offshore movement of sand is expected. Therefore the new beach renourishment project should result in a more stable profile and subsequently, will reduce the rates of cross-shore loss.

5. The updated 1996 to 2000 sediment budget developed in this study indicates that approximately 72,000 cubic yards of sand are annually transported into the Sunny Isles segment. Due to the recent measured accretion of the area, approximately +13,000 cy/year are added to the beach system, resulting in 59,000 cubic yards per year flowing into Bakers Haulover Park area.

6. Bakers Haulover Park experienced a large amount of annual accretion over the 1996 to 2000 study period, with an average shoreline change rate of +4.6 feet/year, and a volumetric change rate of +54,000 cy/year. This large amount of accretion is not expected and further studies using additional surveys and aerial photography is recommended. The amount of accretion in this shoreline segment also has a significant impact on the sand transport rates into and beyond Bakers Haulover Inlet. Therefore, the gains and losses along the shorelines are true, but the overall transport values may be less than what should occur.

7. The large amount of accretion along Bakers Haulover Park greatly reduced the quantity of sand entering Bakers Haulover Inlet to 5,000 cy/year, from previously measured rates of 62,000 cy/year.

8. Due to the minimal amount of sand calculated to be moving past Bakers Haulover Inlet during the 1996 to 2000 study, it is expected that none of this sediment is transported past the inlet and south to Bal Harbour below the inlet.

9. Both Bal Harbour and Surfside have experienced erosion over the 1996 through 2000 period, with average shoreline recession rates of –13.0 and –5.1 ft/year when considering nourishment activity. These areas lost approximately –10,000 cy/year

and –20,000 cy/year respectively. The losses are likely related to the reduced amount of sediment that historically bypasses Bakers Haulover Inlet.

10. Large shoreline recession rates and volumetric losses within the Surfside segment, particularly along the northern portion, are indicative of a "Hot Spot".

11. Based on the zero transport rate past Bakers Haulover Inlet for the period between 1996 to 2000, the longshore transport rate into Surfside is the –10,000 cy/year erosion rate of the Bal Harbour beaches. Additionally, the erosion along surfside adds 20,000 cy/year to the longshore transport so that approximately 30,000 cy/year of sand move into Miami Beach.

12. Within the northern part of Miami Beach, 80$^{th}$ and 63$^{rd}$ streets, shoreline recession continued at an average rate of –6.8 ft/year when considering nourishments. The area also experienced a large amount of volumetric loss of approximately –27,000 cy/year.

13. The shoreline along the northern part of Miami Beach lost a significant amount of sand above –6 feet NGVD, and experienced some gain below –6 feet NGVD. This shoreline segment contains the 63$^{rd}$ street Hot Spot, which is likely a significant contributor to the losses observed in this area.

14. Central Miami Beach, between 63$^{rd}$ and 32$^{nd}$ streets, has experienced considerable erosion in the amount of –7.1 ft/year and -63,000 cy/year. This erosion may be due to large losses from the project constructed between R-53 and R-58 in 1997, and also the effect of the 32$^{nd}$ street Hot Spot (R-59) located at the southern end of this segment.

15. The significant erosion of sand from the mid-Miami Beach segment brings the amount of sand moving into the lower part of Miami Beach to 120,000 cy/year for the period between 1996 and 2000.

16. The southern portions of Miami Beach were accretional, which follows historical trends for this area. Specifically, the shoreline between 32nd and 16th streets accreted at a rate of +2.0 ft/year, and experienced approximately +21,000 cy/year of sand accumulation annually. Along South Beach between 16th street and Government Cut, the beach advanced an average 9.4 ft/year and received +75,000 cy/year.

17. The accretion along the southern portion of South Beach increased when compared to historical data, and is likely due to the nourishment between R-73 and Government Cut, and the sand tightening of the jetty.

18. Based on the overall volumetric changes and sediment transport calculations, approximately 24,000 cy/year of sand arrived at Government Cut every year during the 1996 to 2000 study period.

19. A localized sediment budget for the 63rd street Hot Spot (R-42 to R-47) and the areas immediately north (R-38 to R-41) and south (R-48 to R-52) of the Hot Spot was established. The study utilized volumetric changes calculated for the regional study, and used the regional sediment budget transport value passing R-38 as a boundary condition. The analysis showed that approximately 11,000 cy/year was lost from the Hot Spot, with approximately -17,000 cy/year being lost above –6 feet NGVD.

20. Analysis of the 63rd street Hot Spot profiles and cross-shore transport rates indicate that there is a large accumulation of sand in the offshore bar immediately north and within the Hot Spot area. This accumulation may indicate the bar is trapping sand and may result in a sand deficit to the shoreline south of the Hot Spot.

## 5.2 Recommendations

The following actions are recommended:

1. A regional sediment transport model as proposed for Phase II of the 227 program, should be developed in order to be able to predict shoreline changes along the Miami-Dade County project area due to normal, storm, and seasonal conditions. The results of these modeling exercises will provide increased understanding of the shoreline response to varying wave conditions, and bathymetry. This model will be the basis of potential project performance assessments.

2. Computer modeling of the Sunny Isles, 32nd Street, and proposed 63rd Street shoreline stabilization devices should be developed in order to determine the regional and local effects. In addition, planned and/or hypothetical future beach fill placements should be included in the shoreline change models during simulations to determine the effects these projects (with and without various shoreline stabilization devices in place) would have on the performance of the county's shoreline and sediment transport rates.

3. To better understand the mechanics and behavior of Hot Spots, particularly the 63rd street Hot Spot, site specific or localized wave and shoreline models should also be developed. The results of this study and the regional sediment model will serve as calibration for the localized model. The results of these modeling exercises will provide increased understanding of the shoreline response to varying wave conditions, sediment transport rates, and provide better design criteria.

4. Detailed shore protection design parameters should be developed for the 63rd Street Hot Spot in order to facilitate the rational design of a demonstration project in that location.

5. The placement of shore protection project at the 32nd street Hot Spot involving the placement shore protection structures and approximately 60,000 cy is soon to be

under construction and should alleviate the existing rapid erosion and stabilize this area. This site should provide important monitoring data and analysis for the 227 program.

6. Volumetric and shoreline changes along the southern portion of Broward County during the update study period from 1996 to 2000 should be evaluated to better understand the sediment transport into Miami-Dade County. Recent projects conducted along the southern Broward shoreline may alter the short term transport rates and will effect the performance of Miami-Dade beaches.

7. The areas of Sunny Isles and Bakers Haulover Park should be further investigated using other available survey data and aerial photography. The accretion rates of these areas are greater than expected and their impact on sand transport calculations may be significant.

8. To increase the accuracy of assessing the performance of Hot Spots along the Miami-Dade County shoreline, increased hydrographic surveys at closer intervals or LIDAR surveys should be performed. This will also be beneficial to wave and shoreline modeling, as it will provide increased detail as to the effects of offshore bathymetry on the coastal processes.

## 6.0 REFERENCES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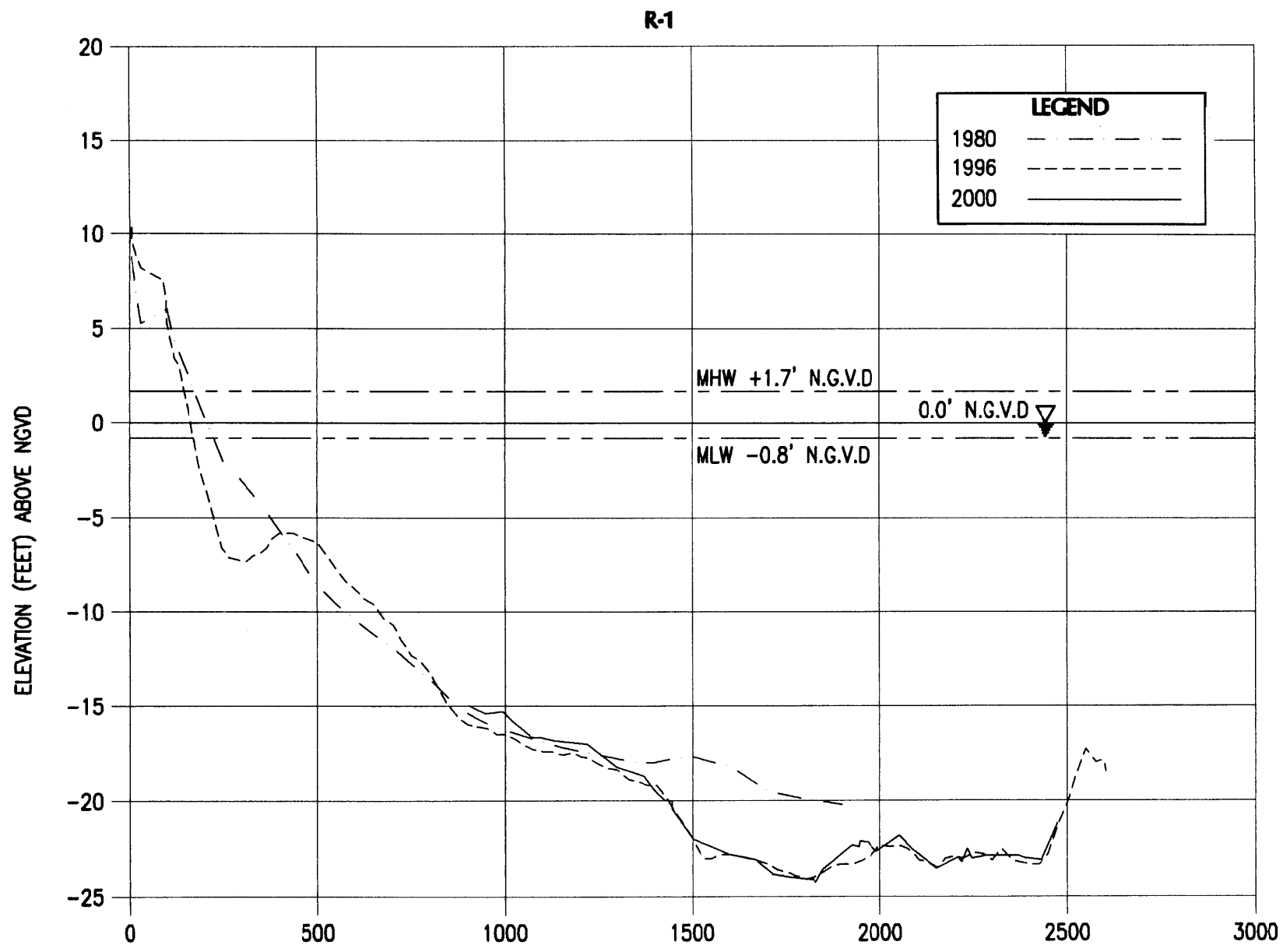
# R-1 - GOLDEN BEACH

MIAMI-DADE COUNTY, FLORIDA




**NOTE**
2000 LIDAR SURVEY DID NOT COVER ALL OF R-1

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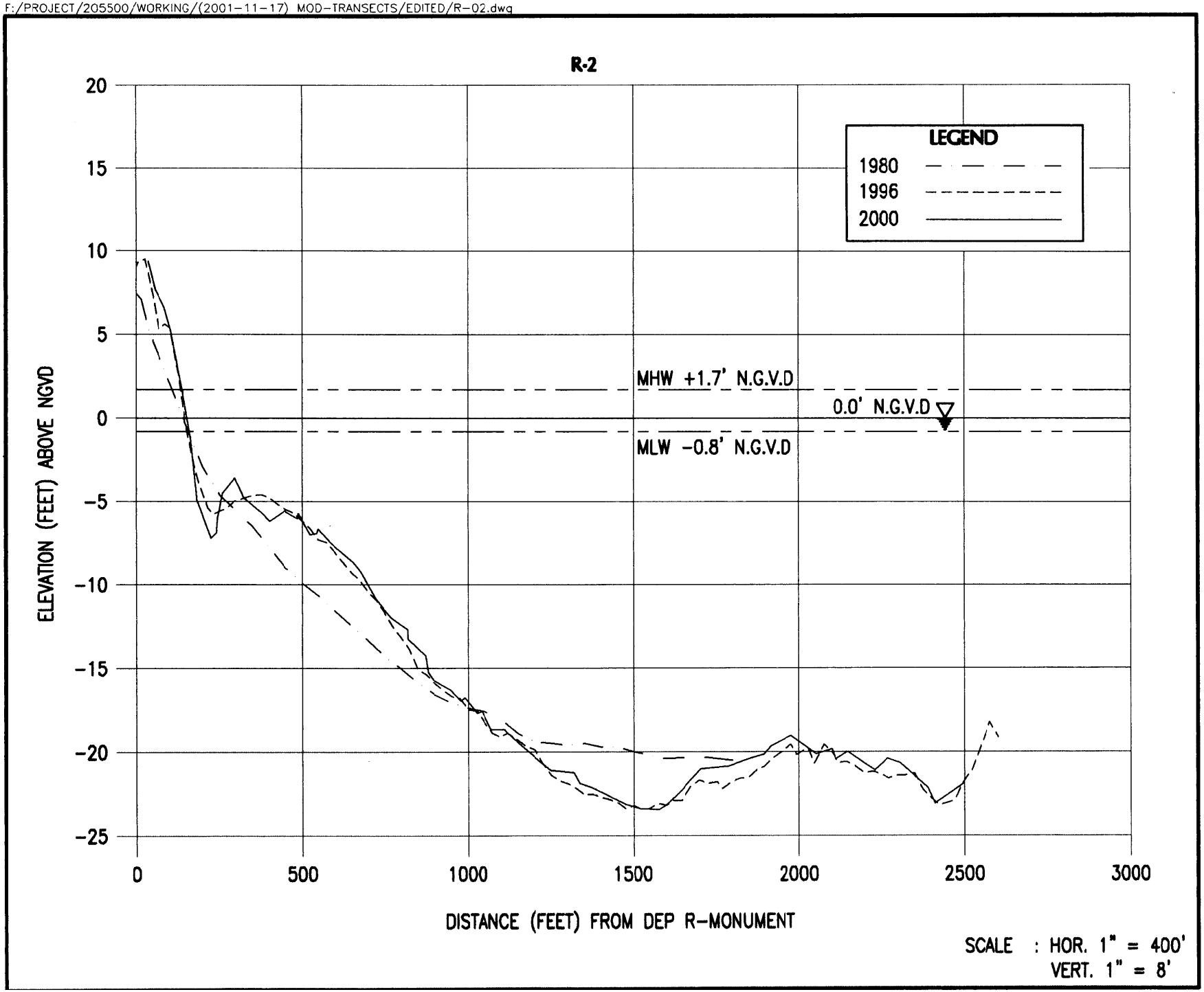
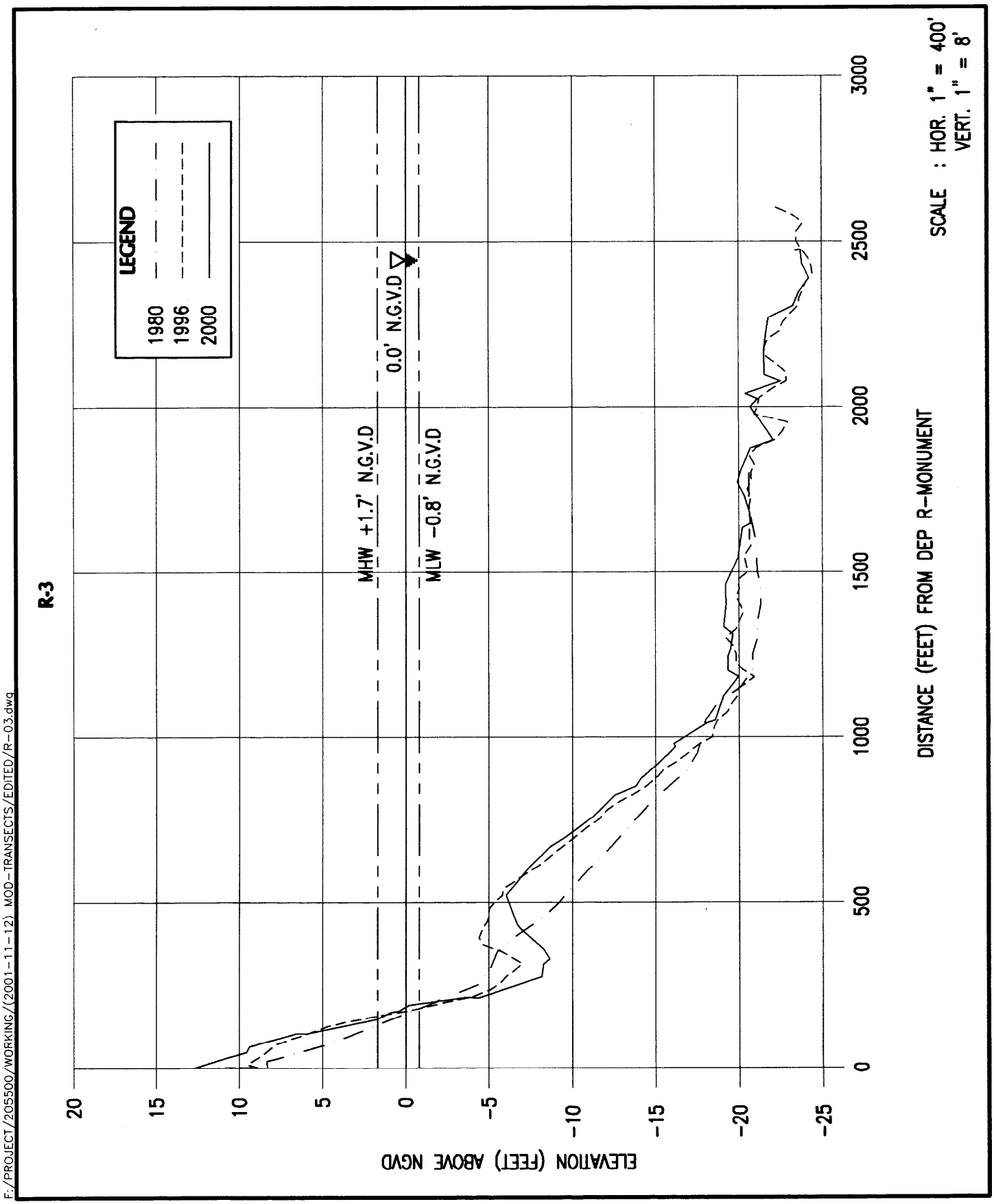



# R-2 - GOLDEN BEACH

MIAMI-DADE COUNTY, FLORIDA

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MIAMI-DADE COUNTY, FLORIDA

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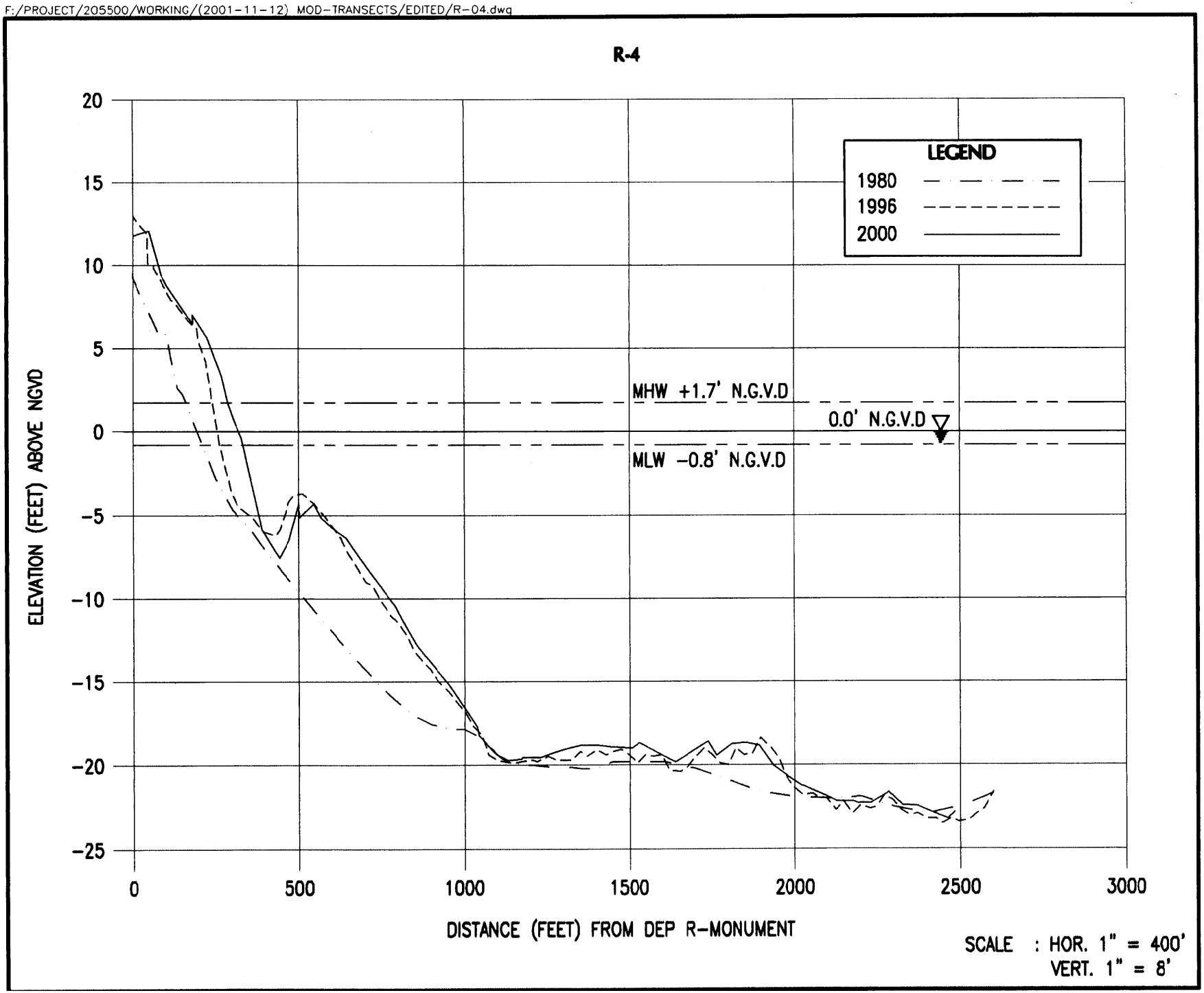
MIAMI-DADE COUNTY, FLORIDA



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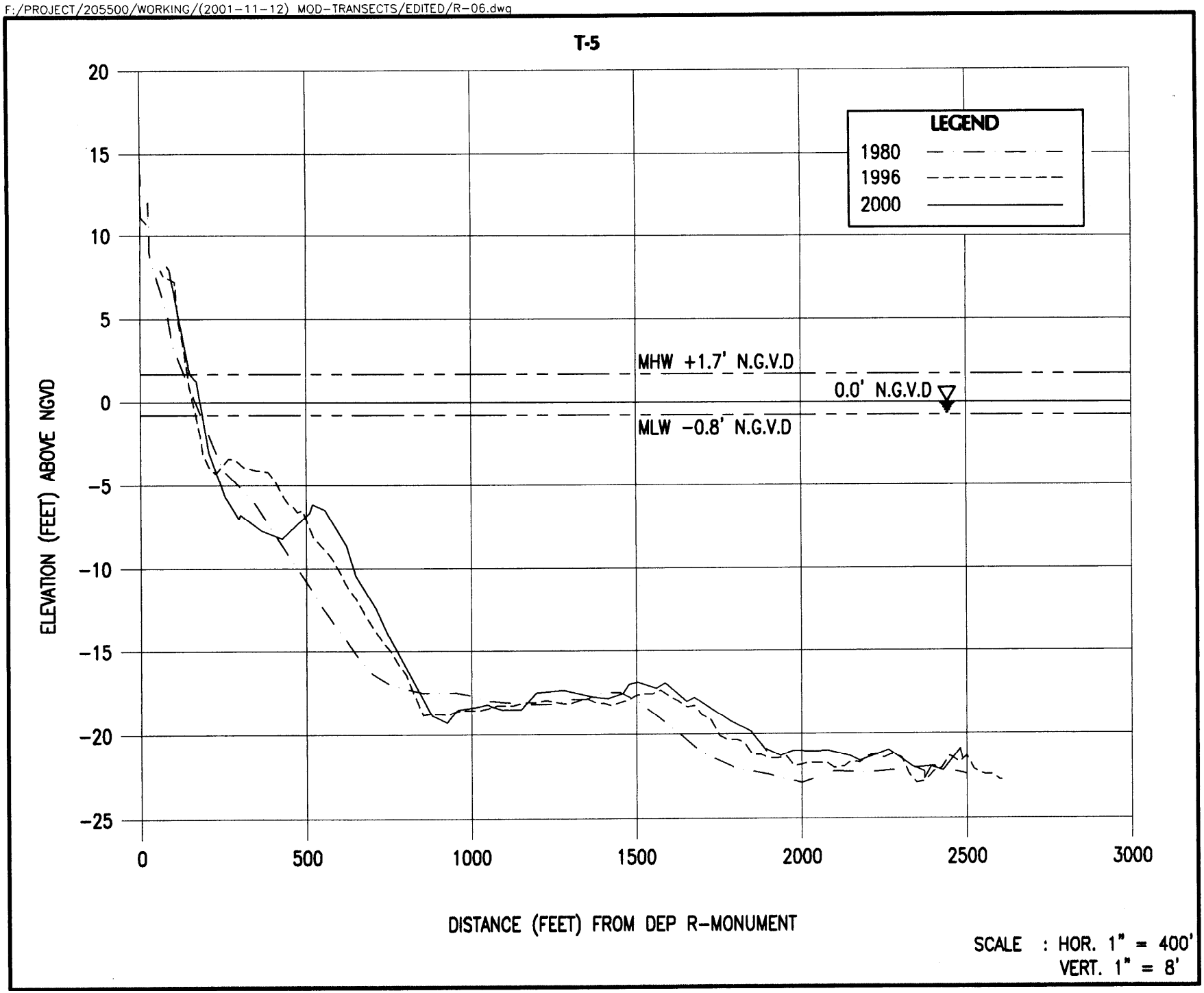
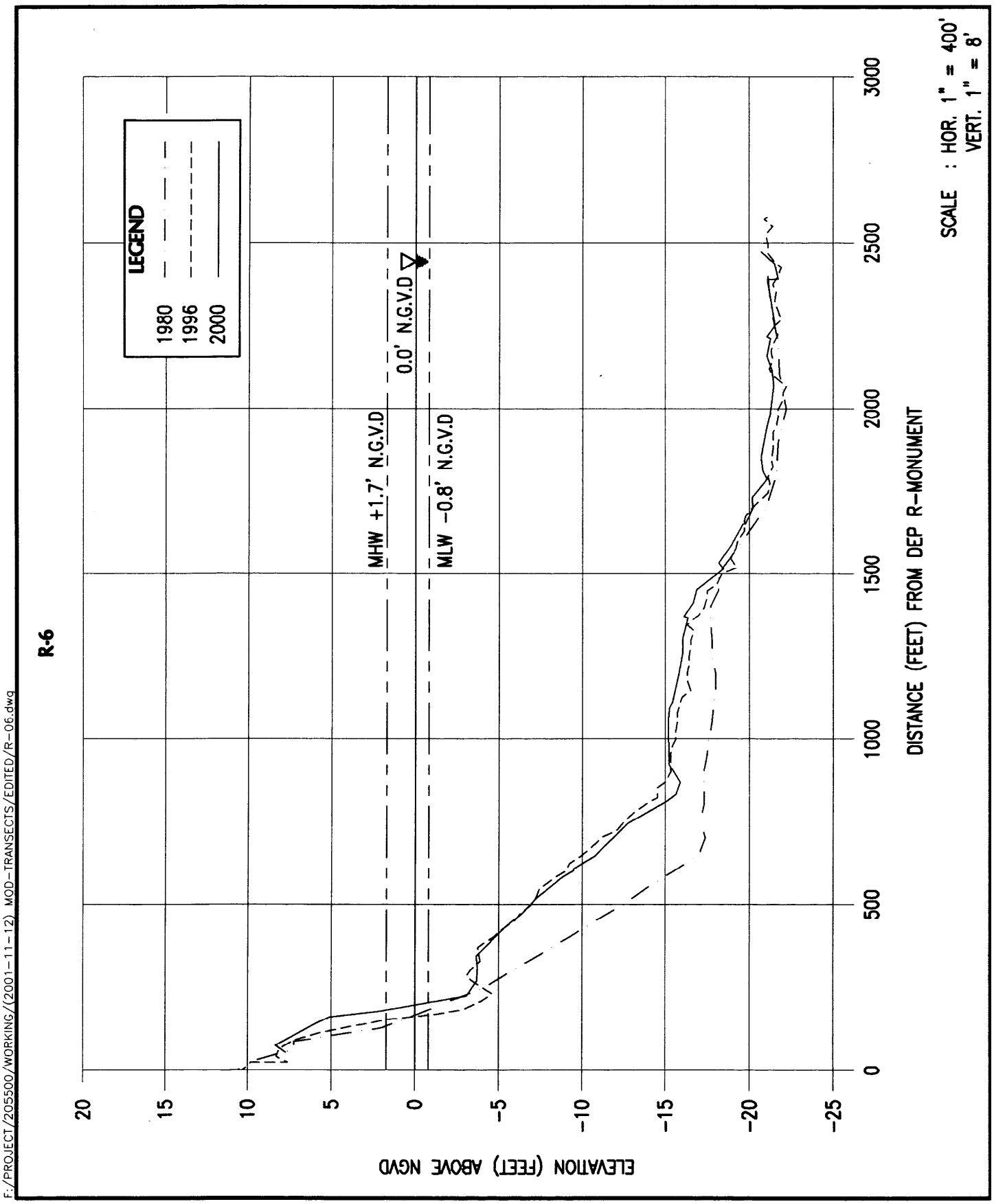
# T-5 - GOLDEN BEACH

MIAMI-DADE COUNTY, FLORIDA



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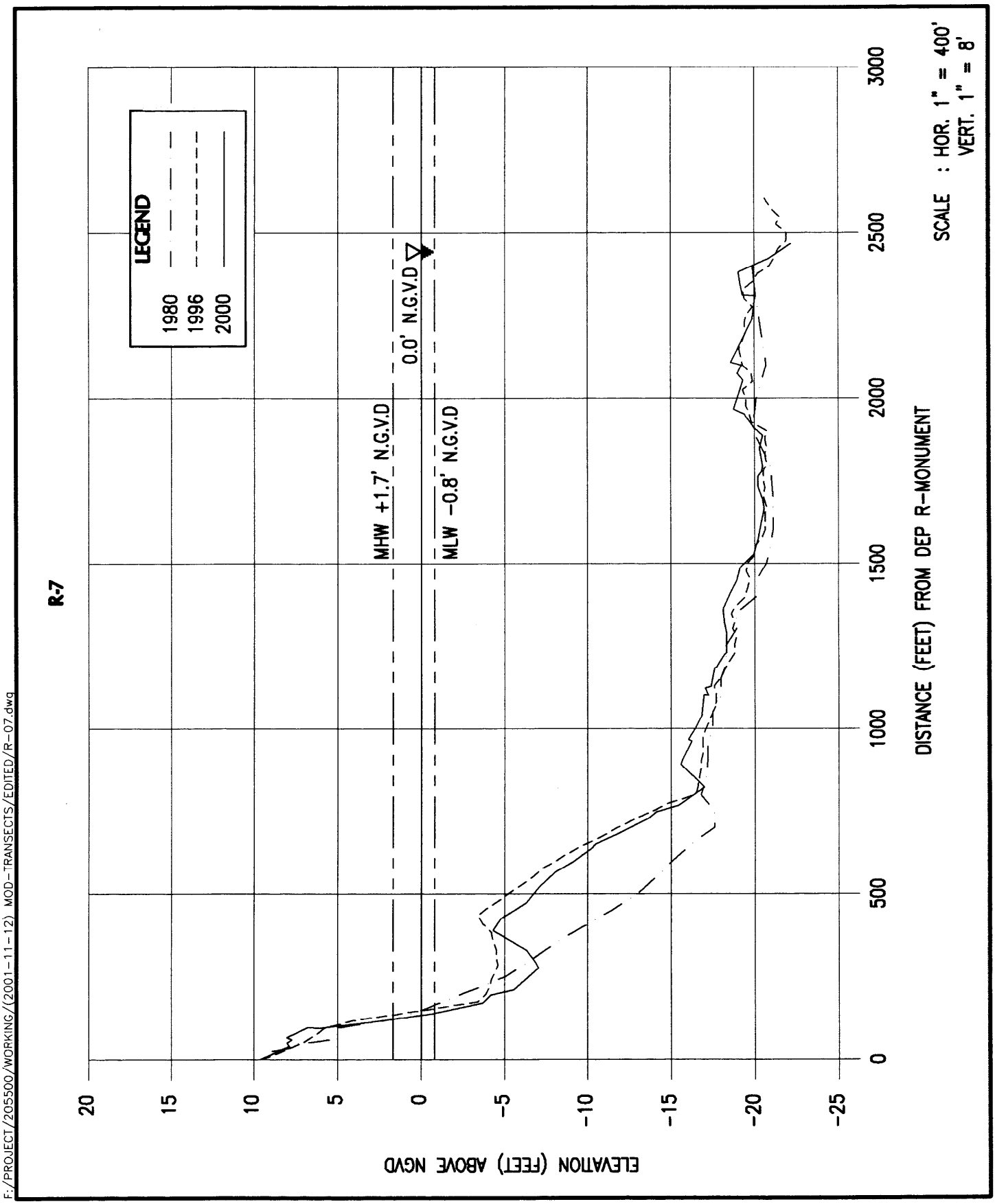


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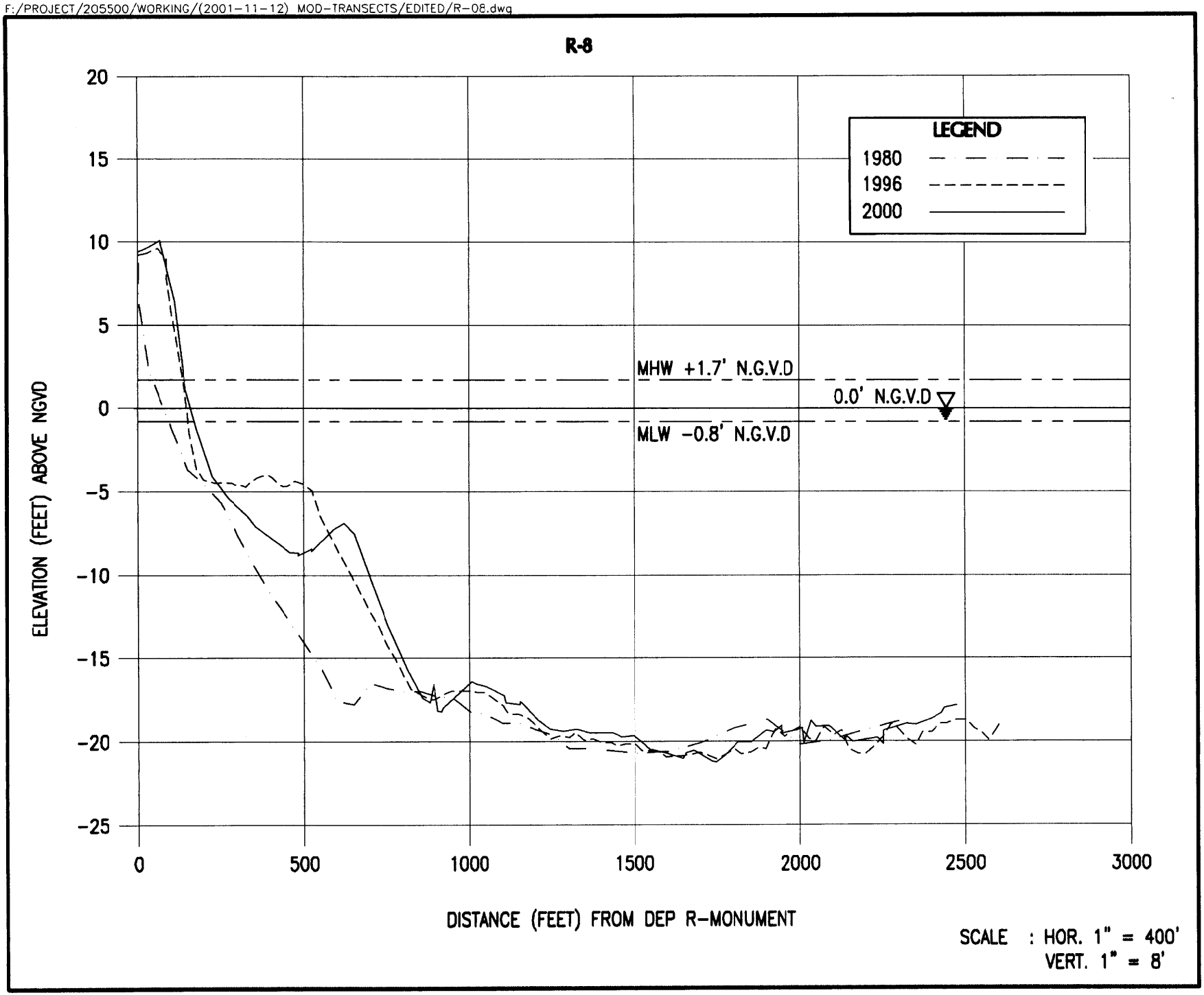


# R-8 - SUNNY ISLES

MIAMI-DADE COUNTY, FLORIDA

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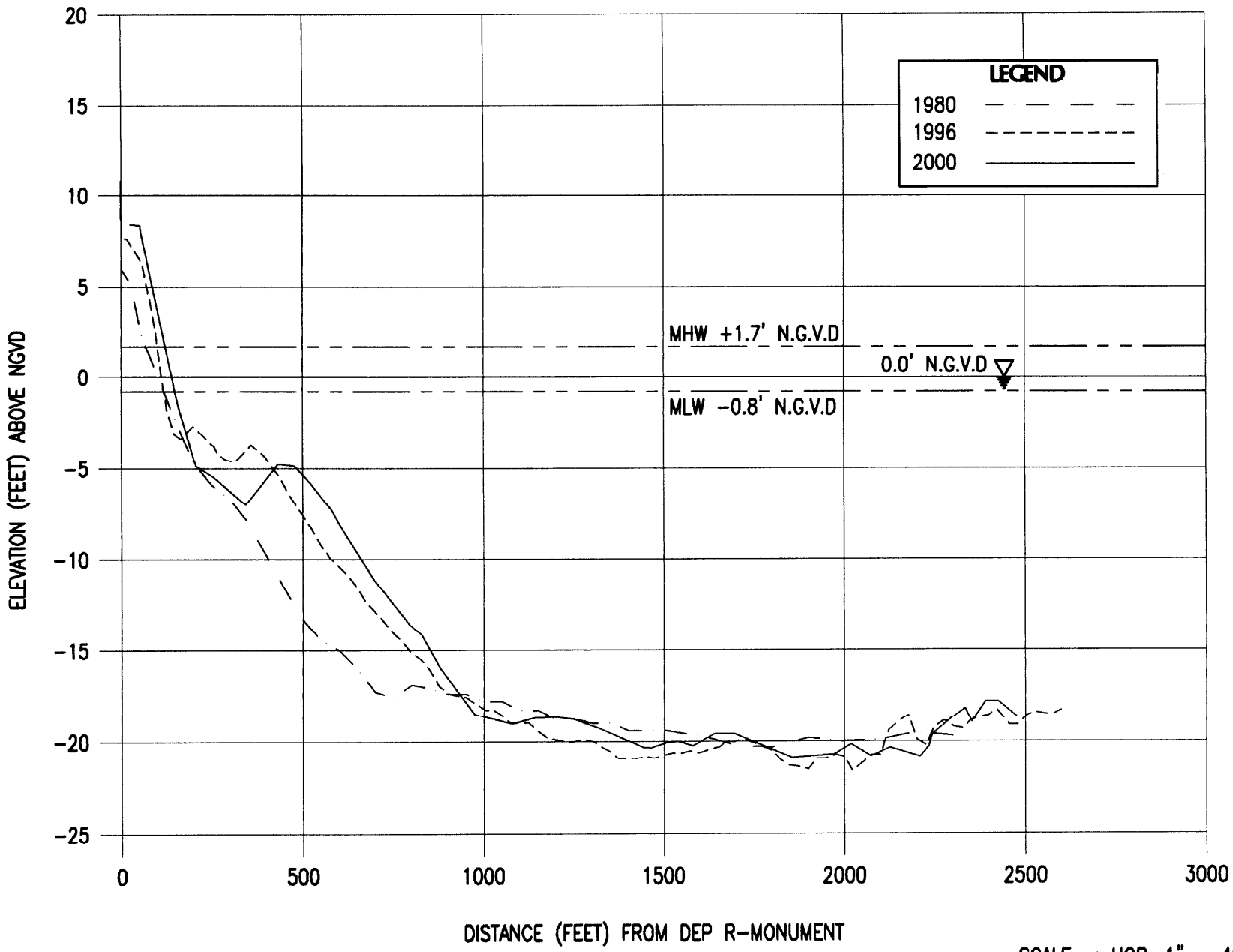
# R-9 - SUNNY ISLES

MIAMI-DADE COUNTY, FLORIDA



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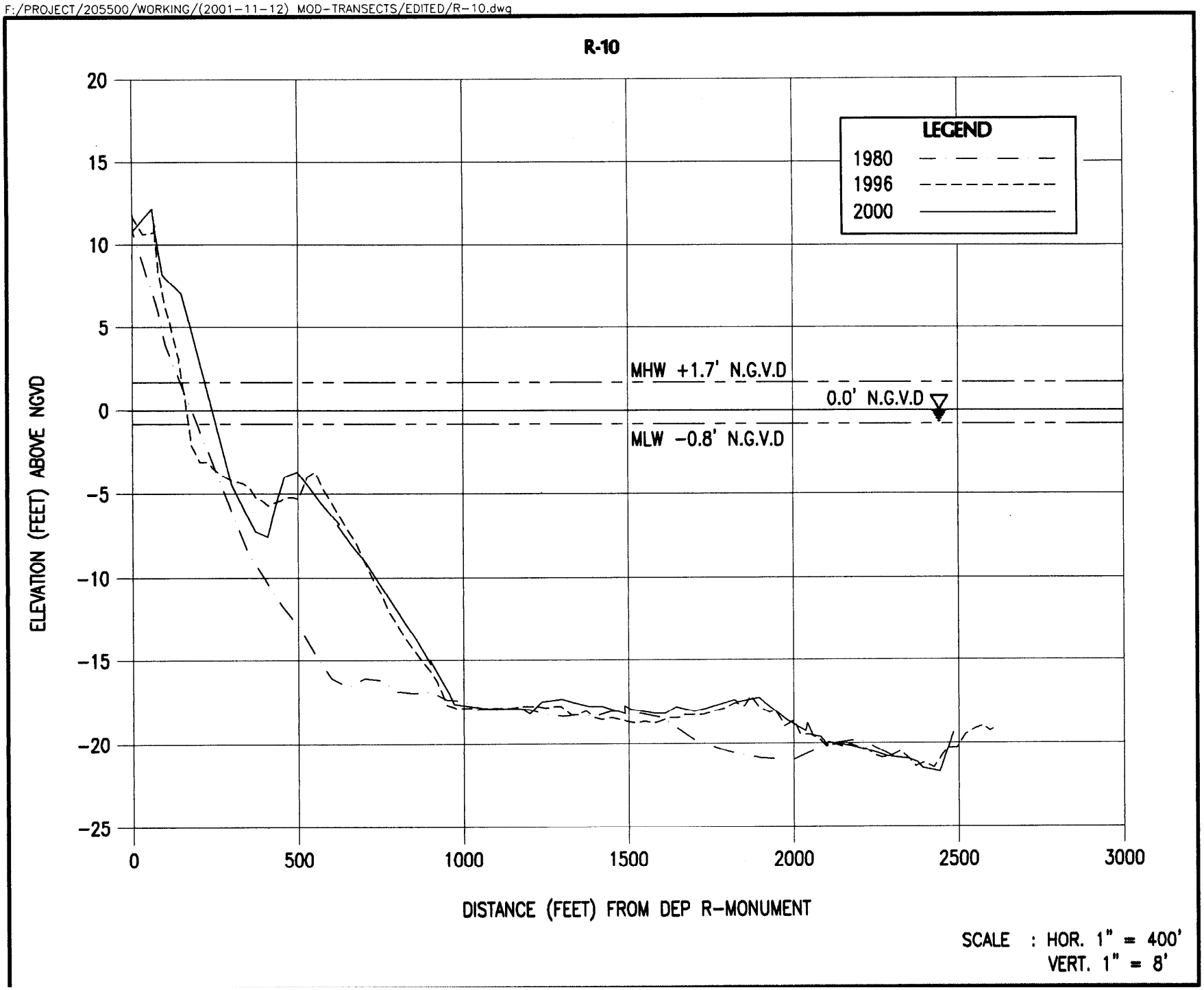
# R-10 - SUNNY ISLES

MIAMI-DADE COUNTY, FLORIDA



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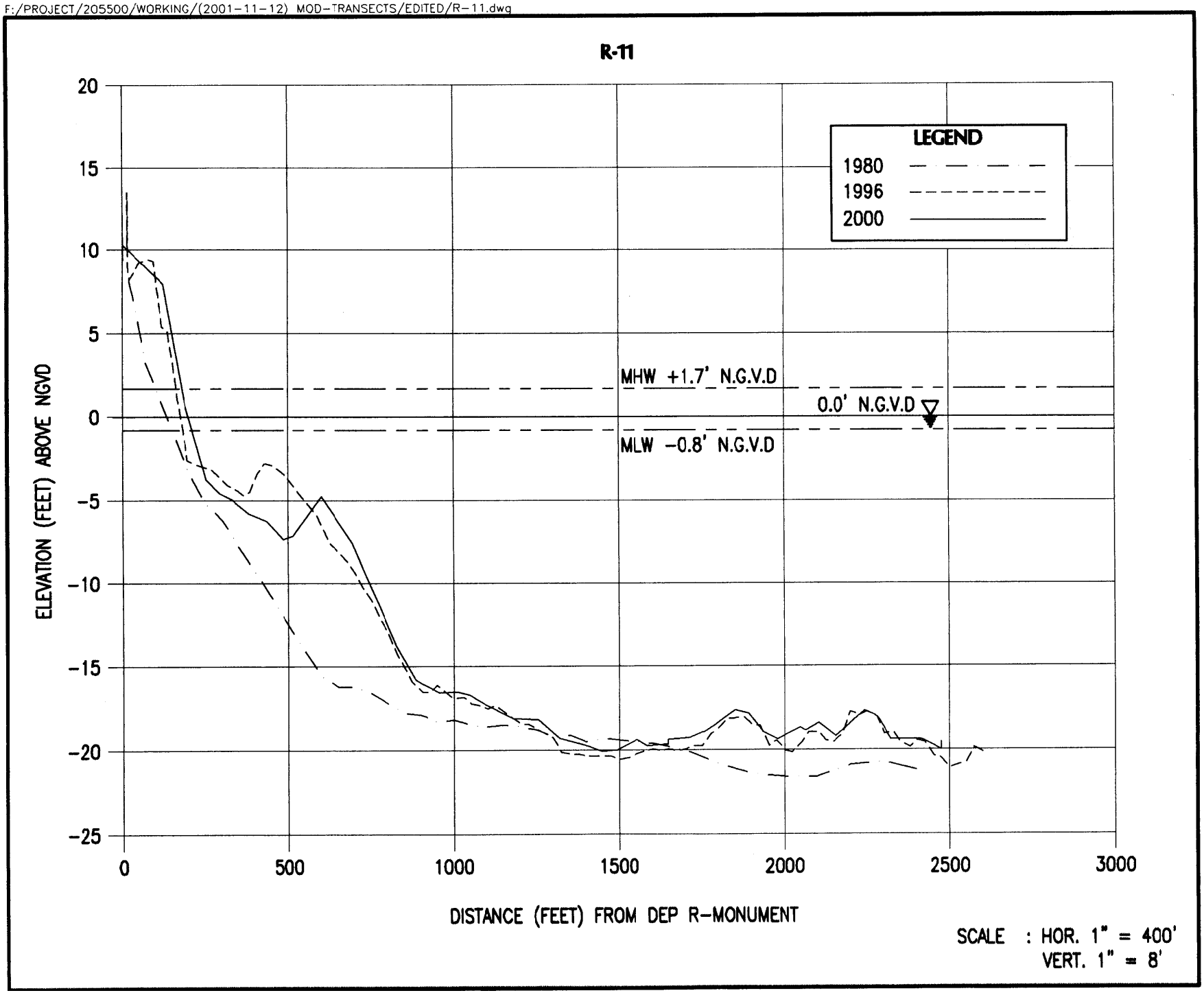


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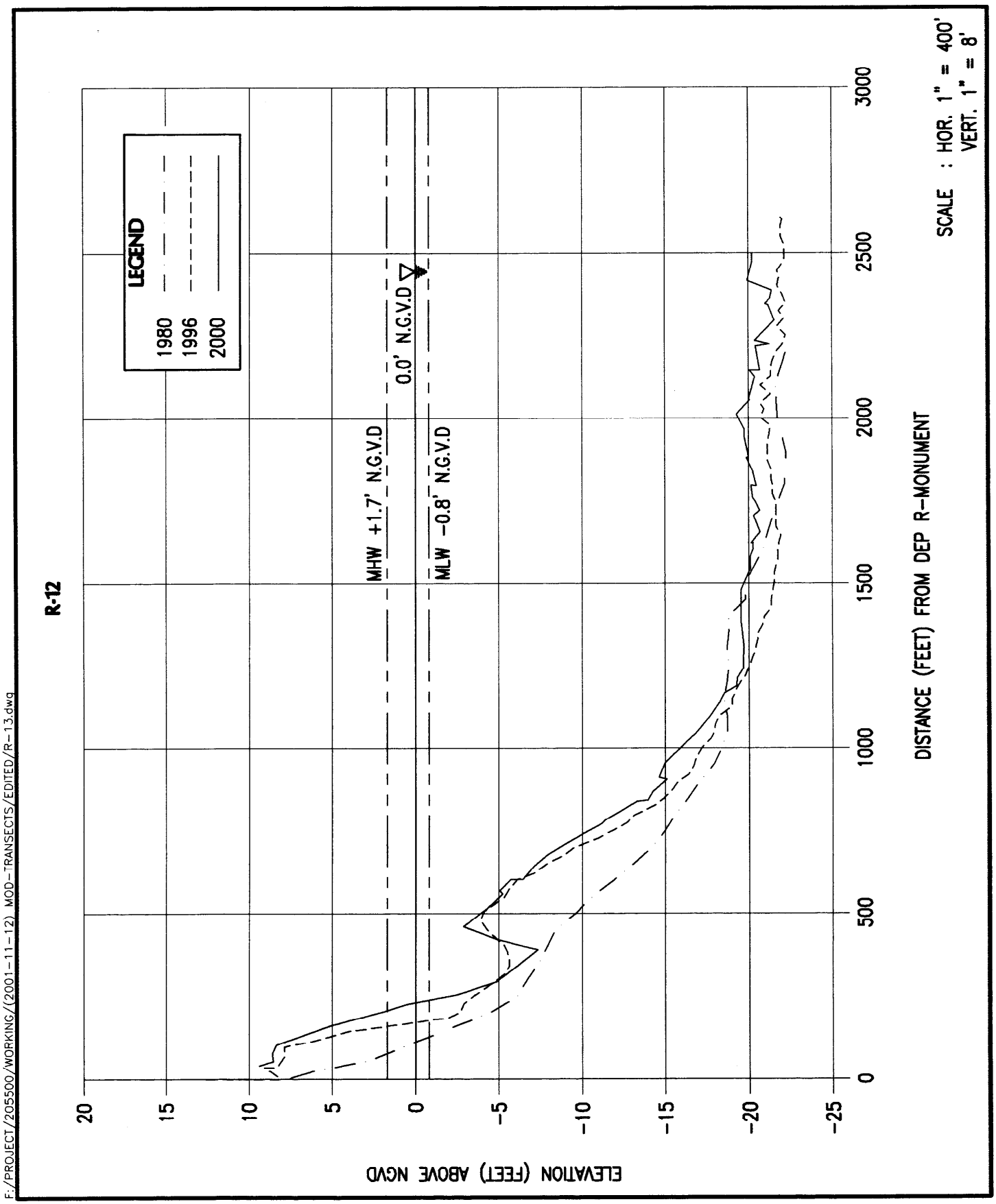


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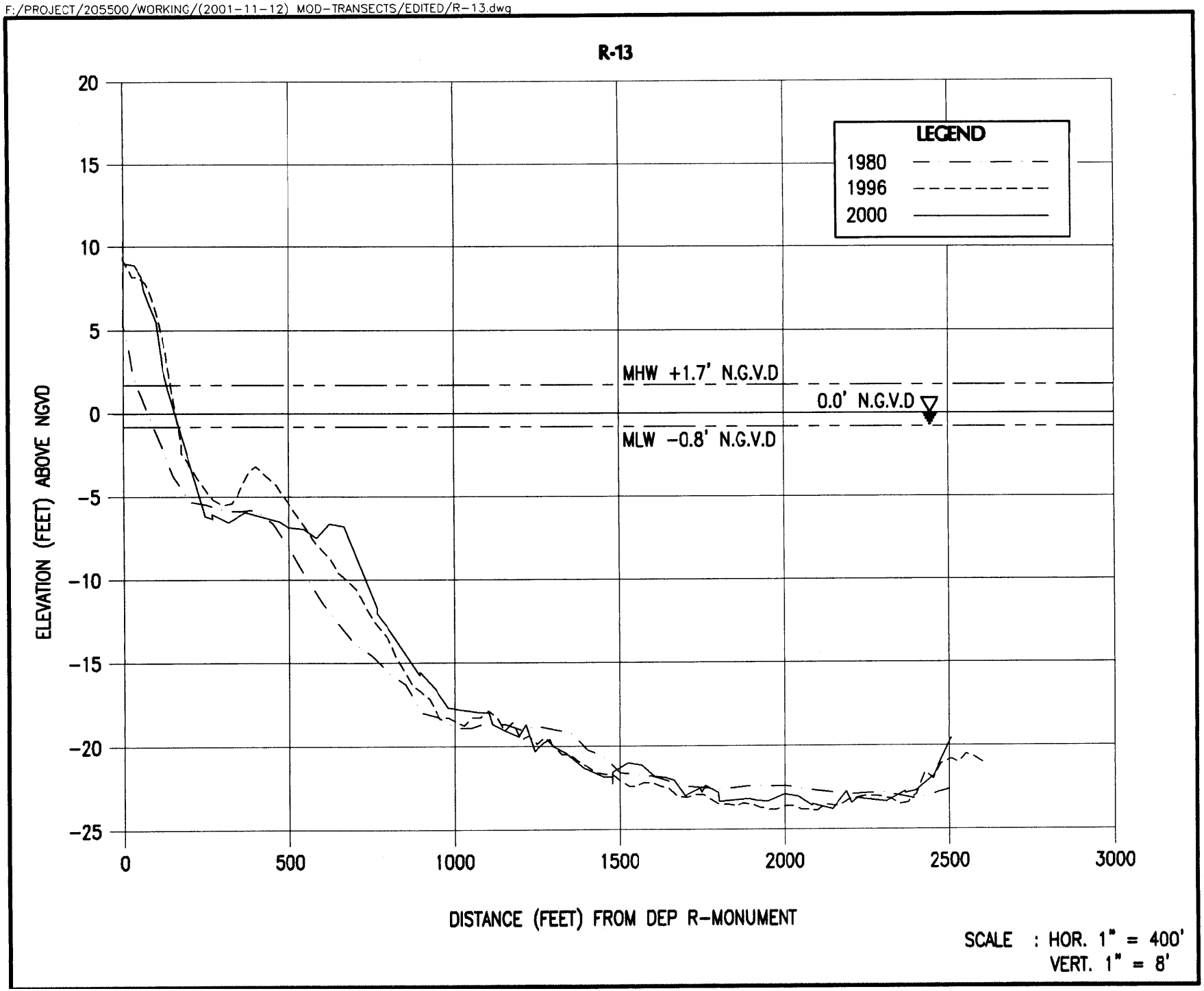


# R-13 - SUNNY ISLES

MIAMI-DADE-COUNTY, FLORIDA

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# R-14 - SUNNY ISLES

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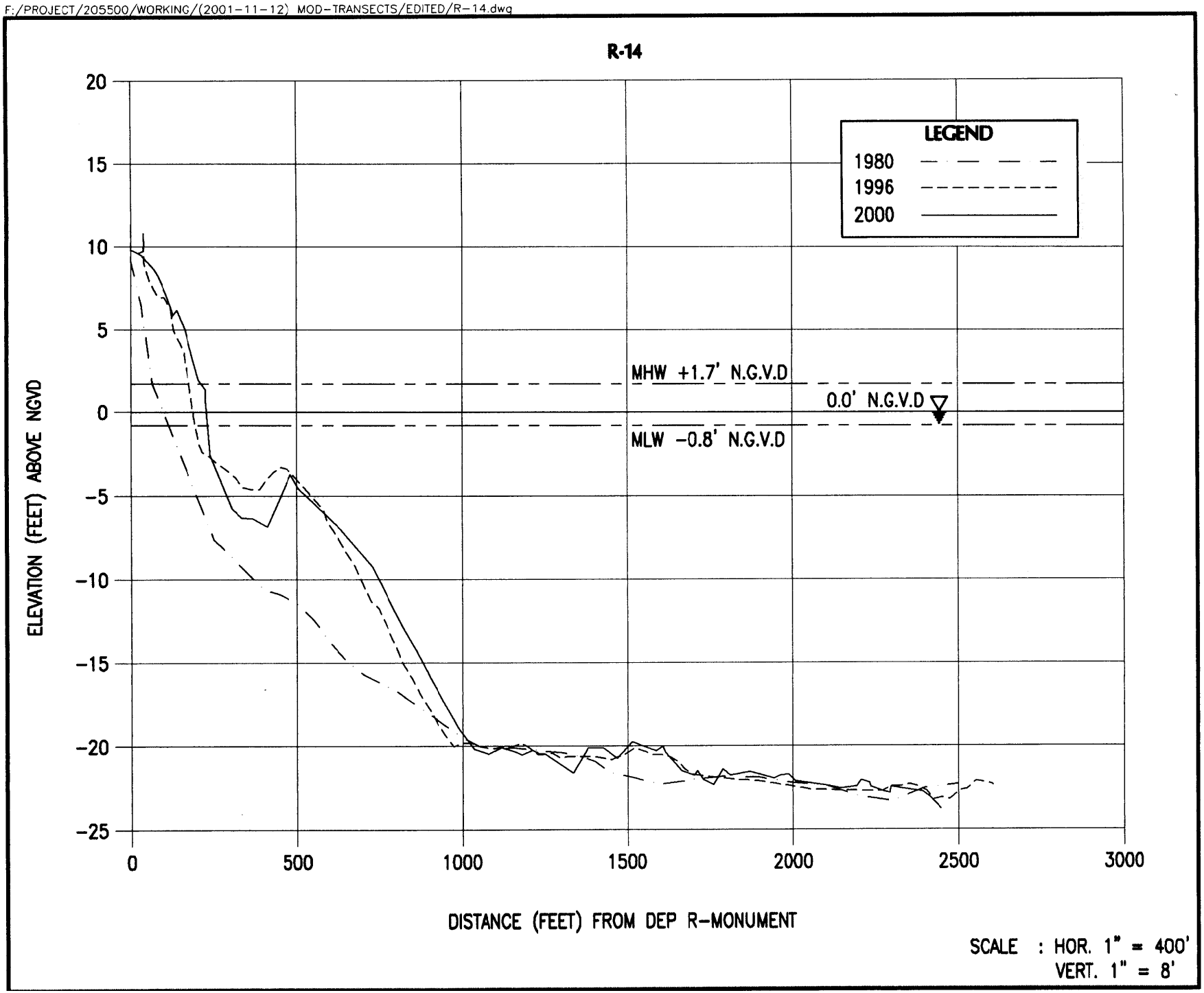

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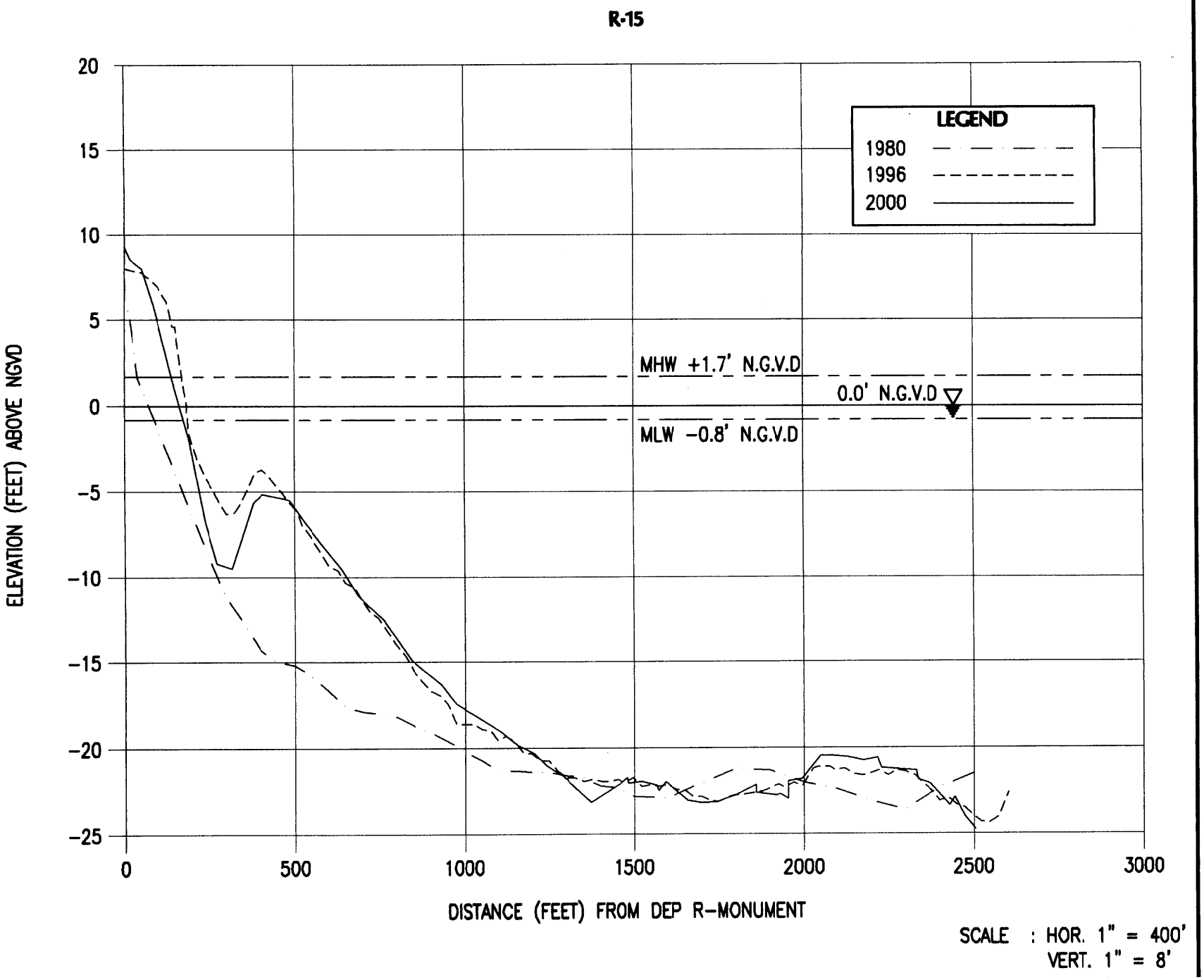

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# R-16 SUNNY ISLES

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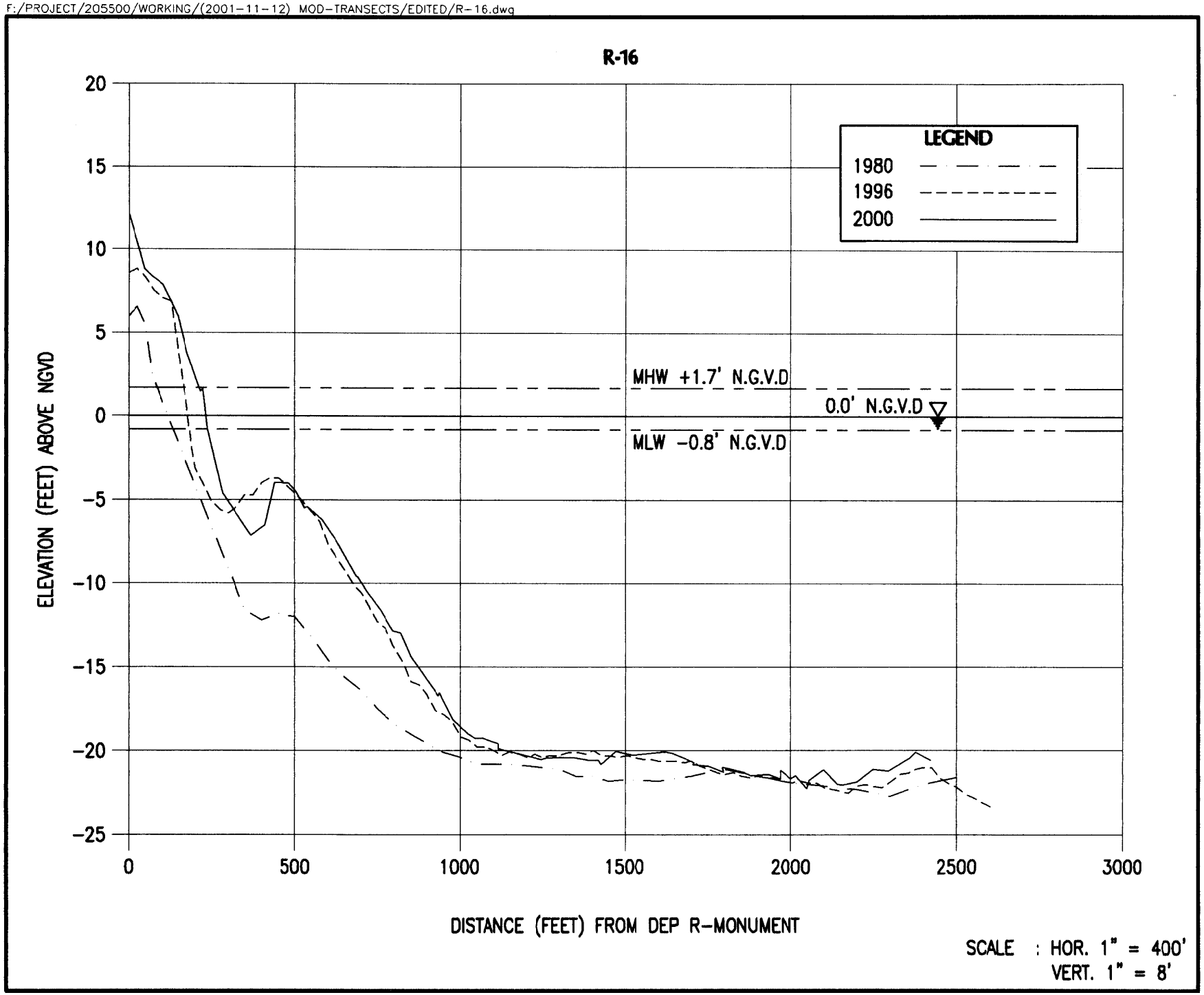

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# R-17 SUNNY ISLES

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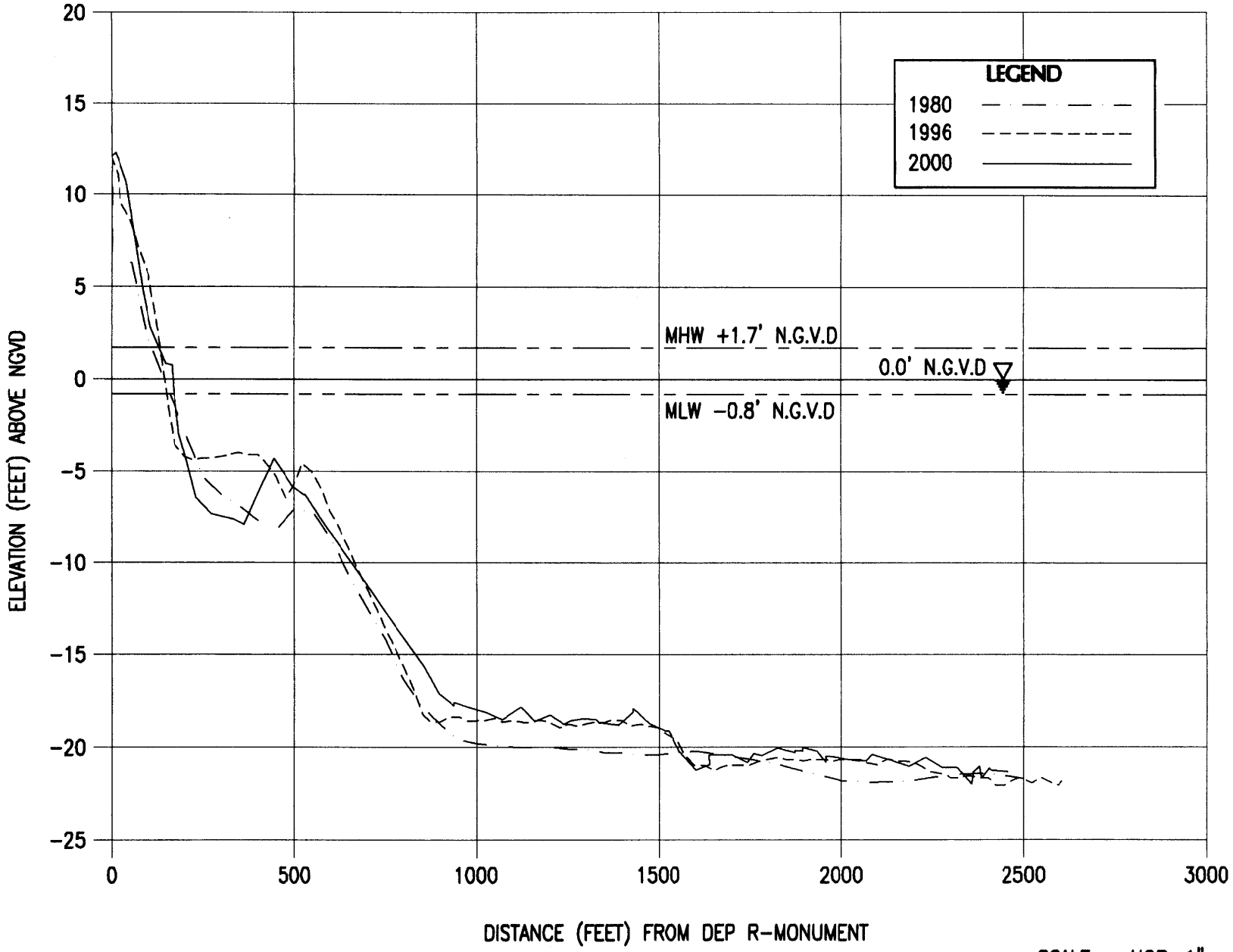


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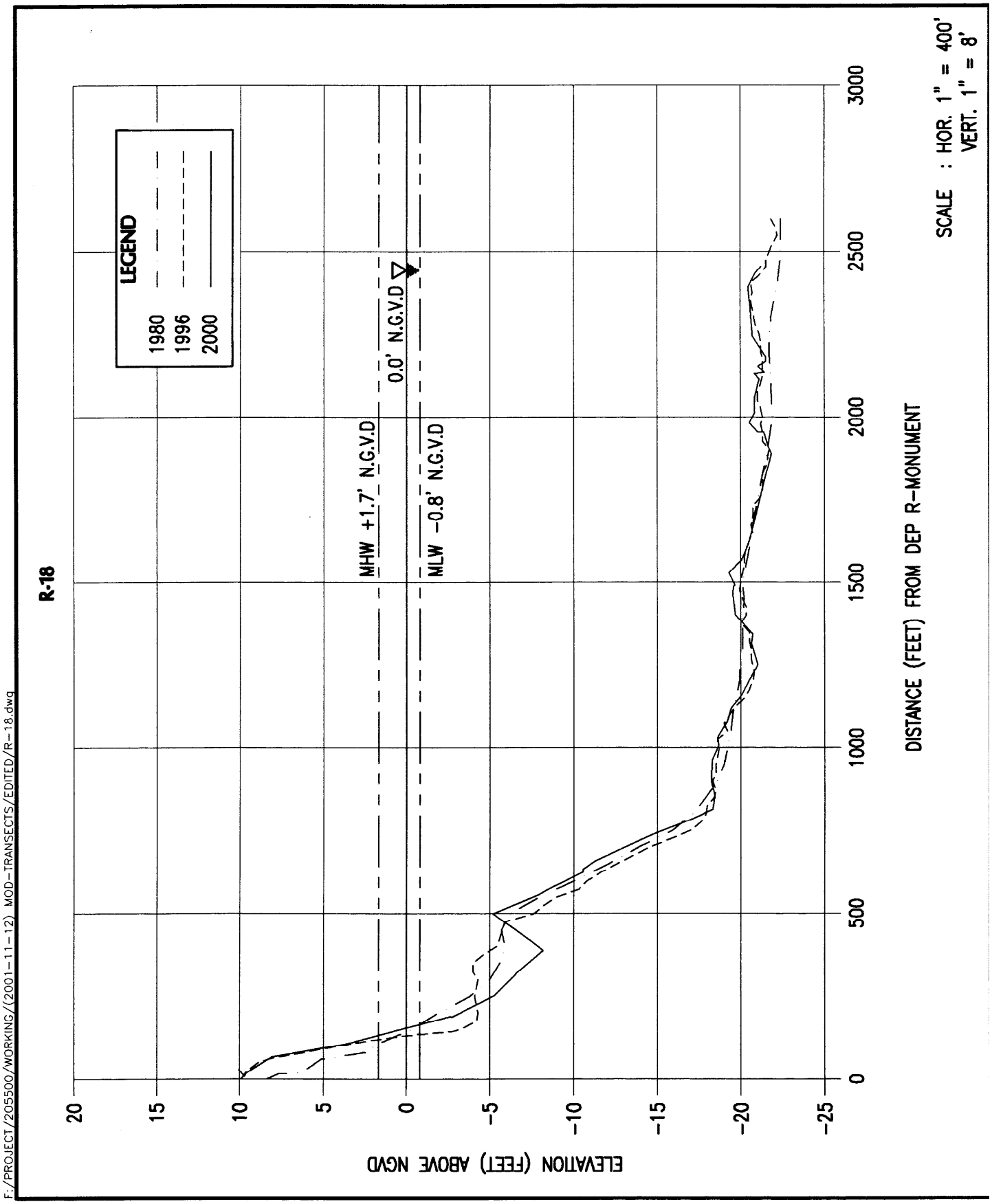


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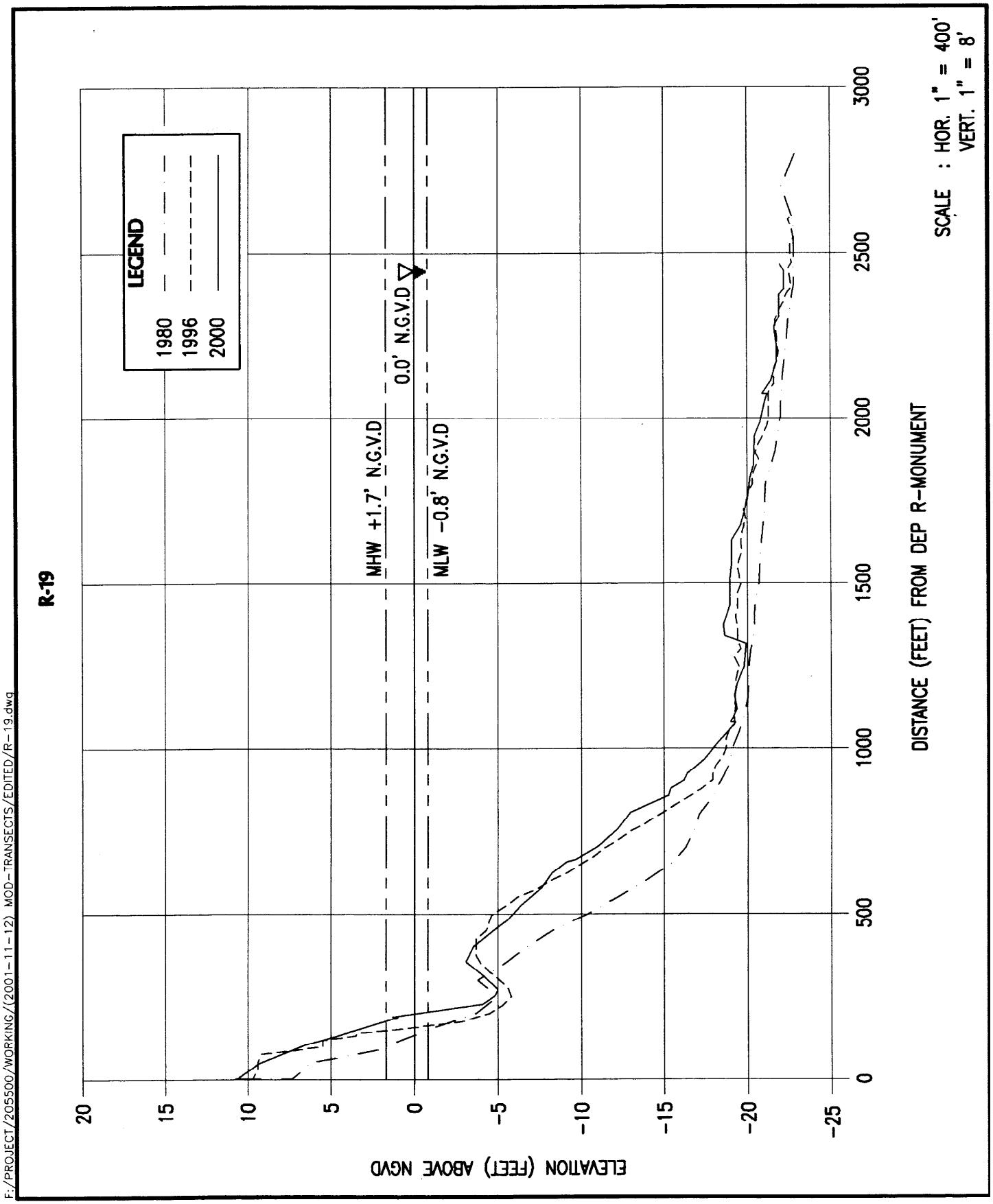


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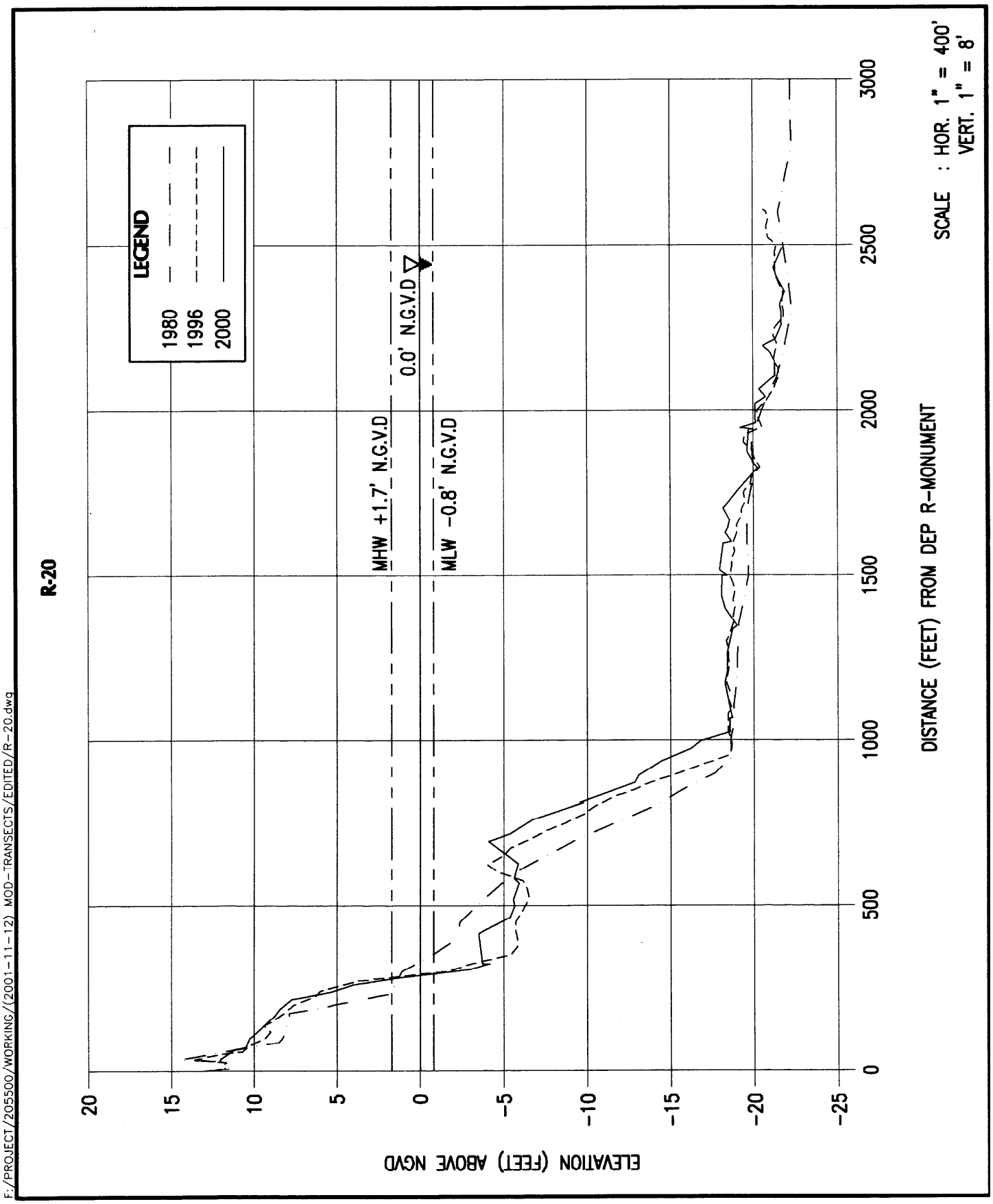


# R-20 - BAKERS HAULOVER PARK

MIAMI-DADE COUNTY, FLORIDA

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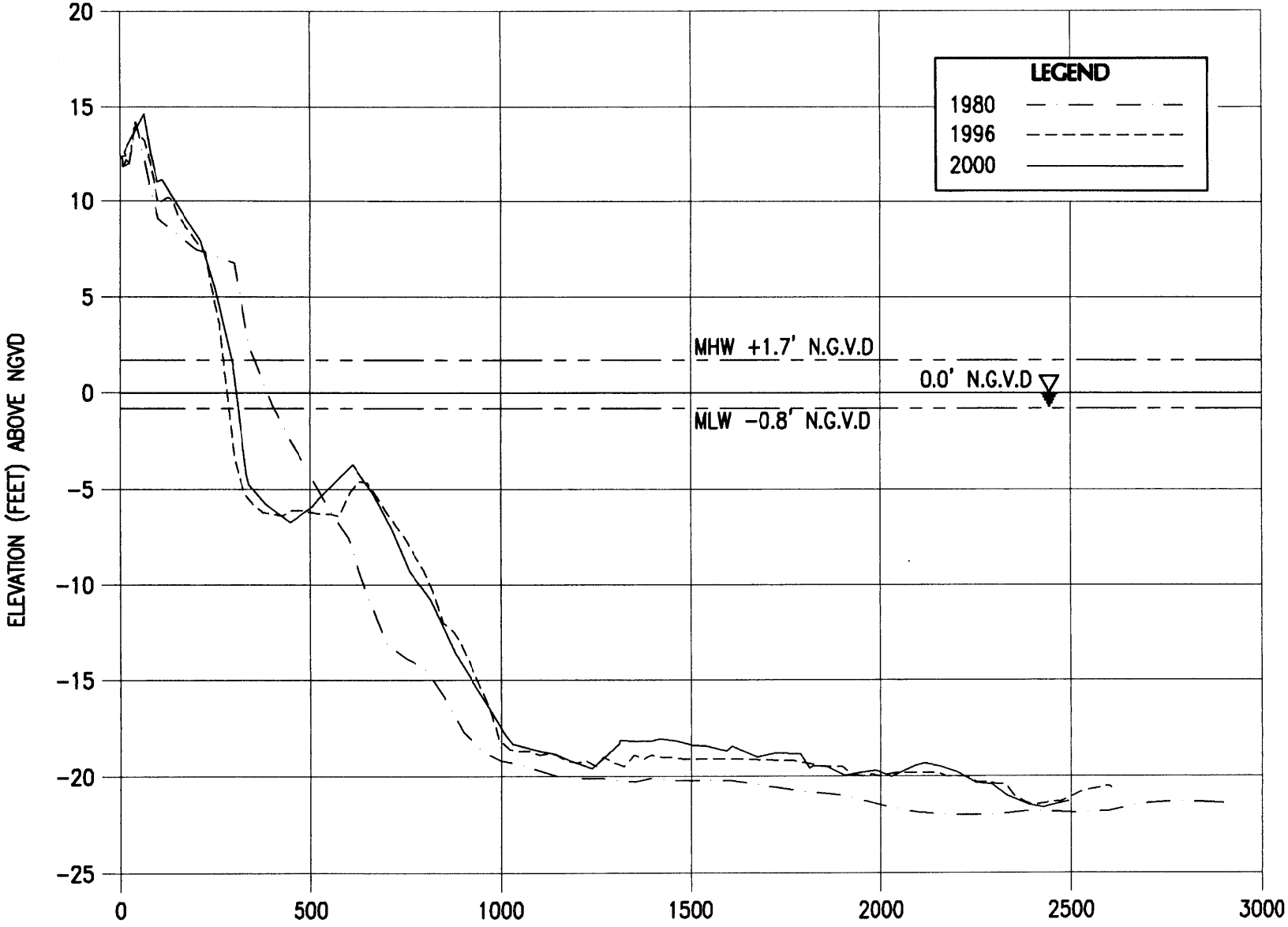
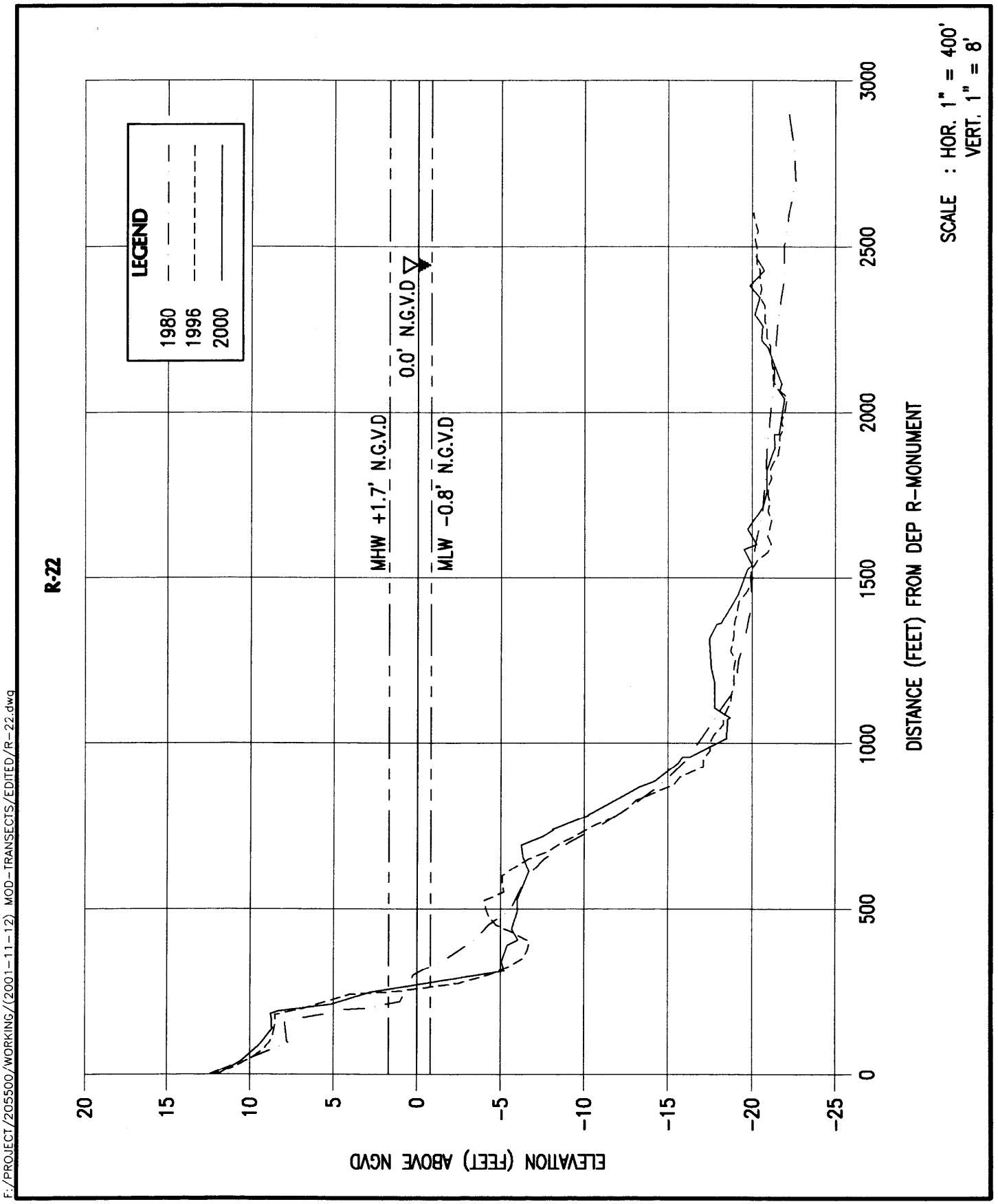
# R-21 - BAKERS HAULOVER PARK

MIAMI-DADE COUNTY, FLORIDA



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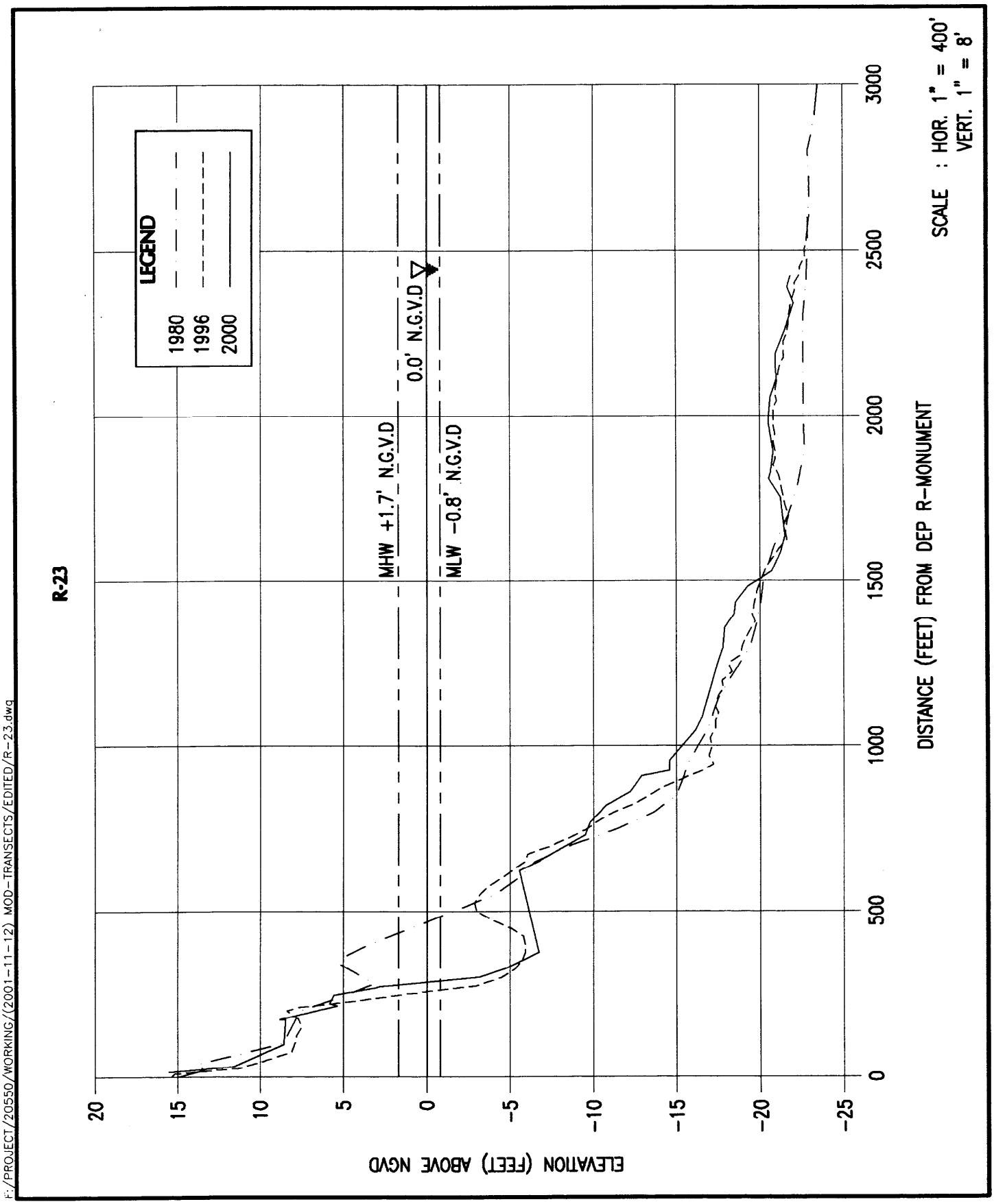


# R-23 BAKERS HAULOVER PARK

MIAMI-DADE COUNTY, FLORIDA

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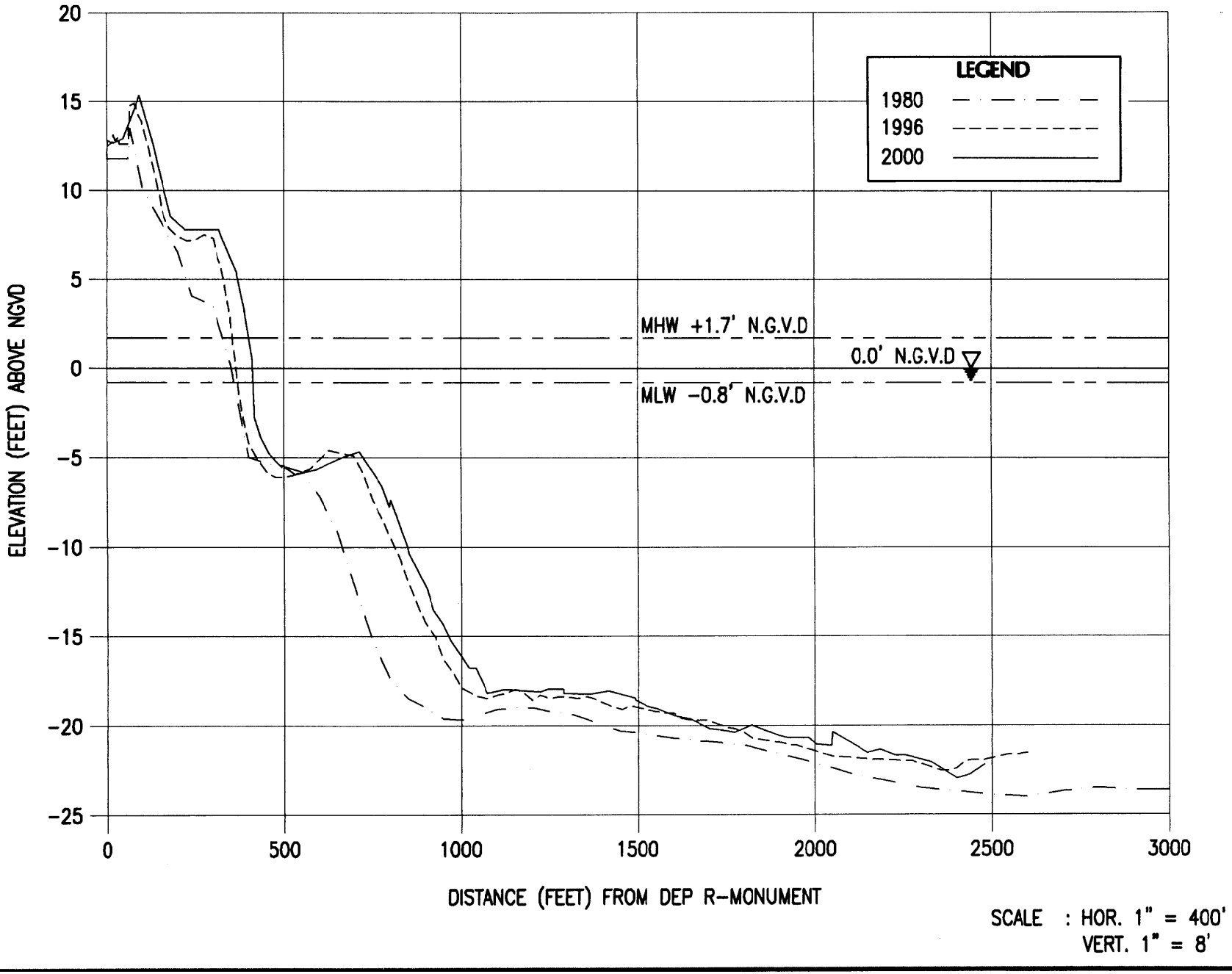
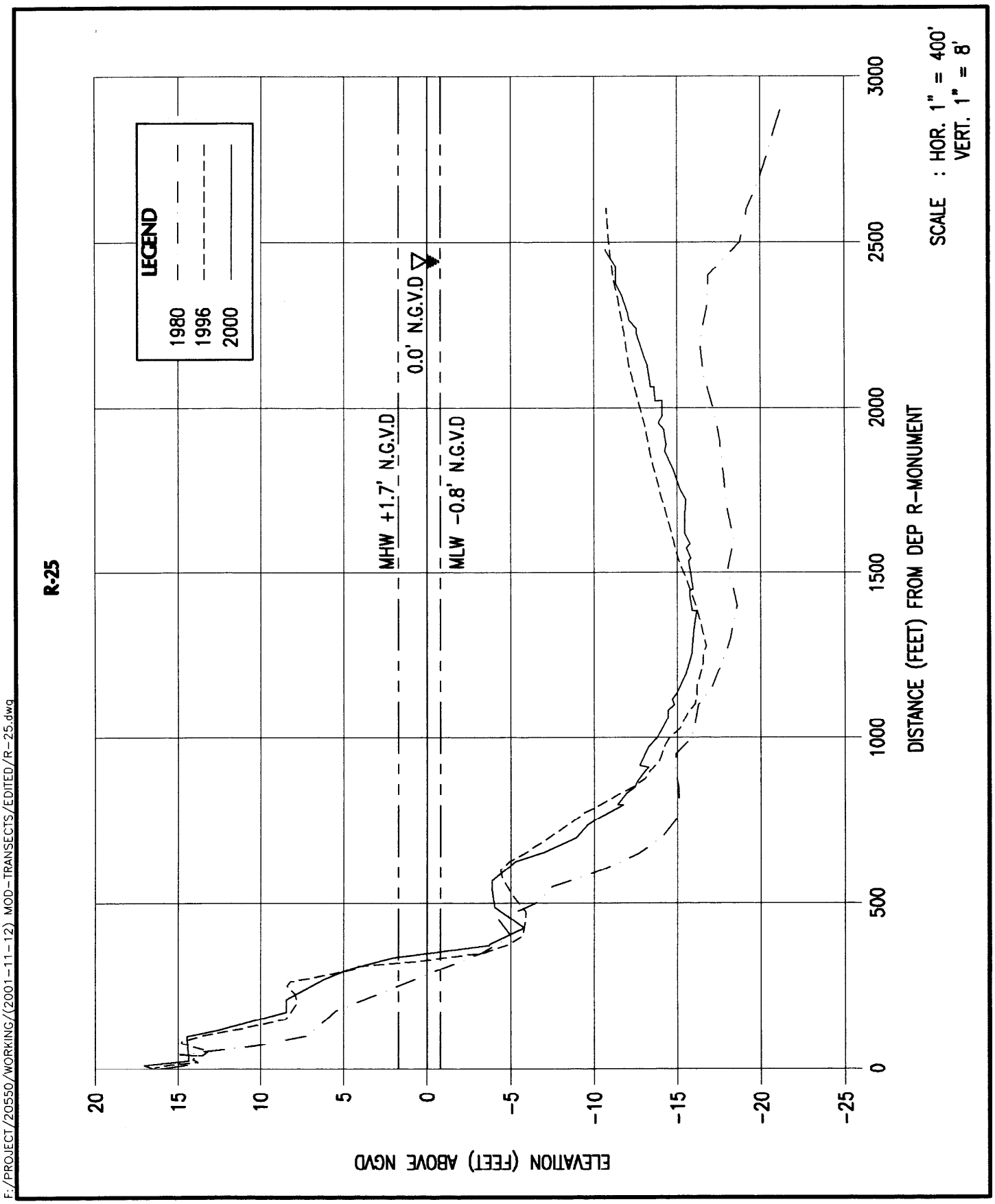
# R-24 BAKERS HAULOVER PARK

MIAMI-DADE COUNTY, FLORIDA



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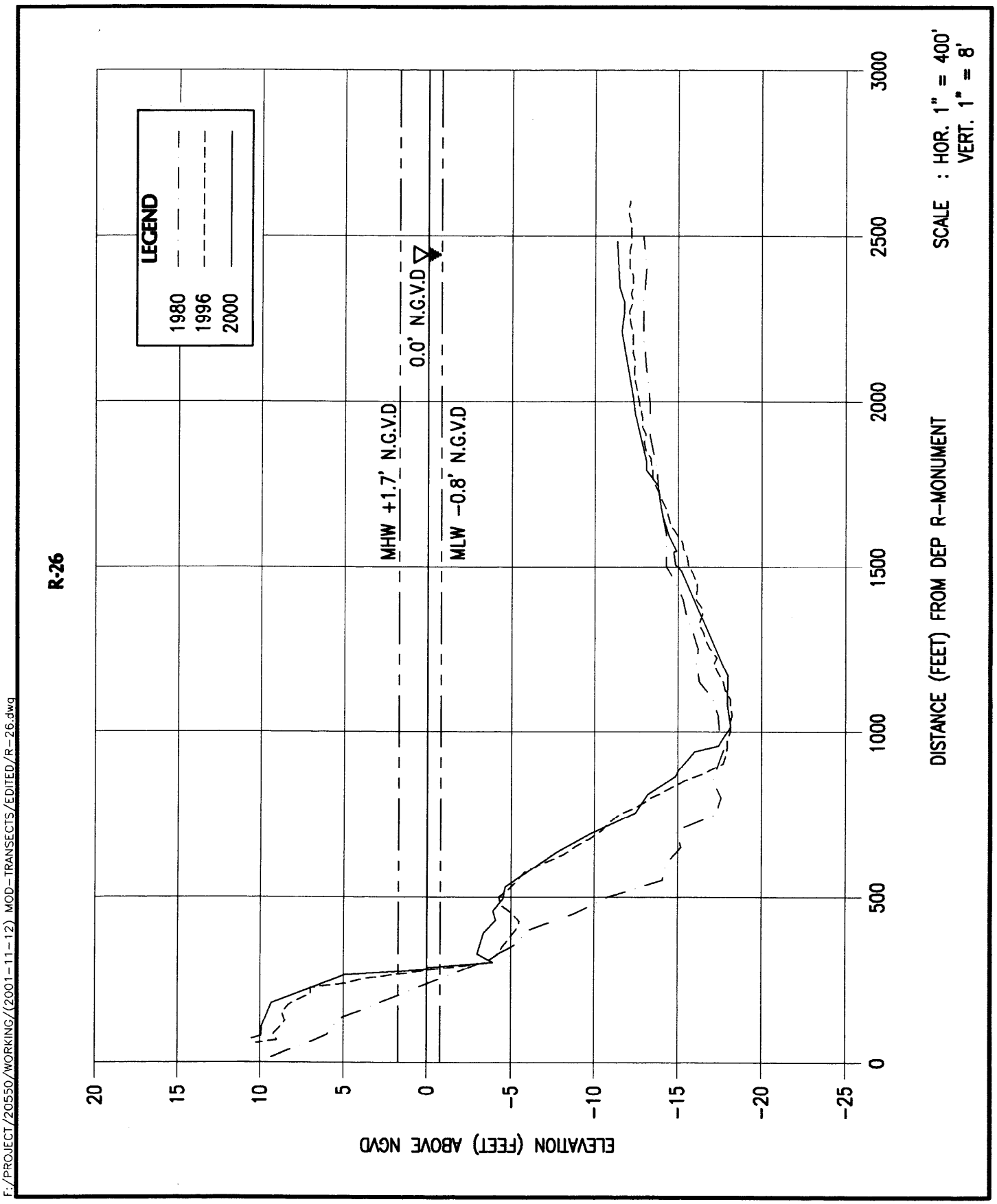


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MIAMI-DADE COUNTY, FLORIDA

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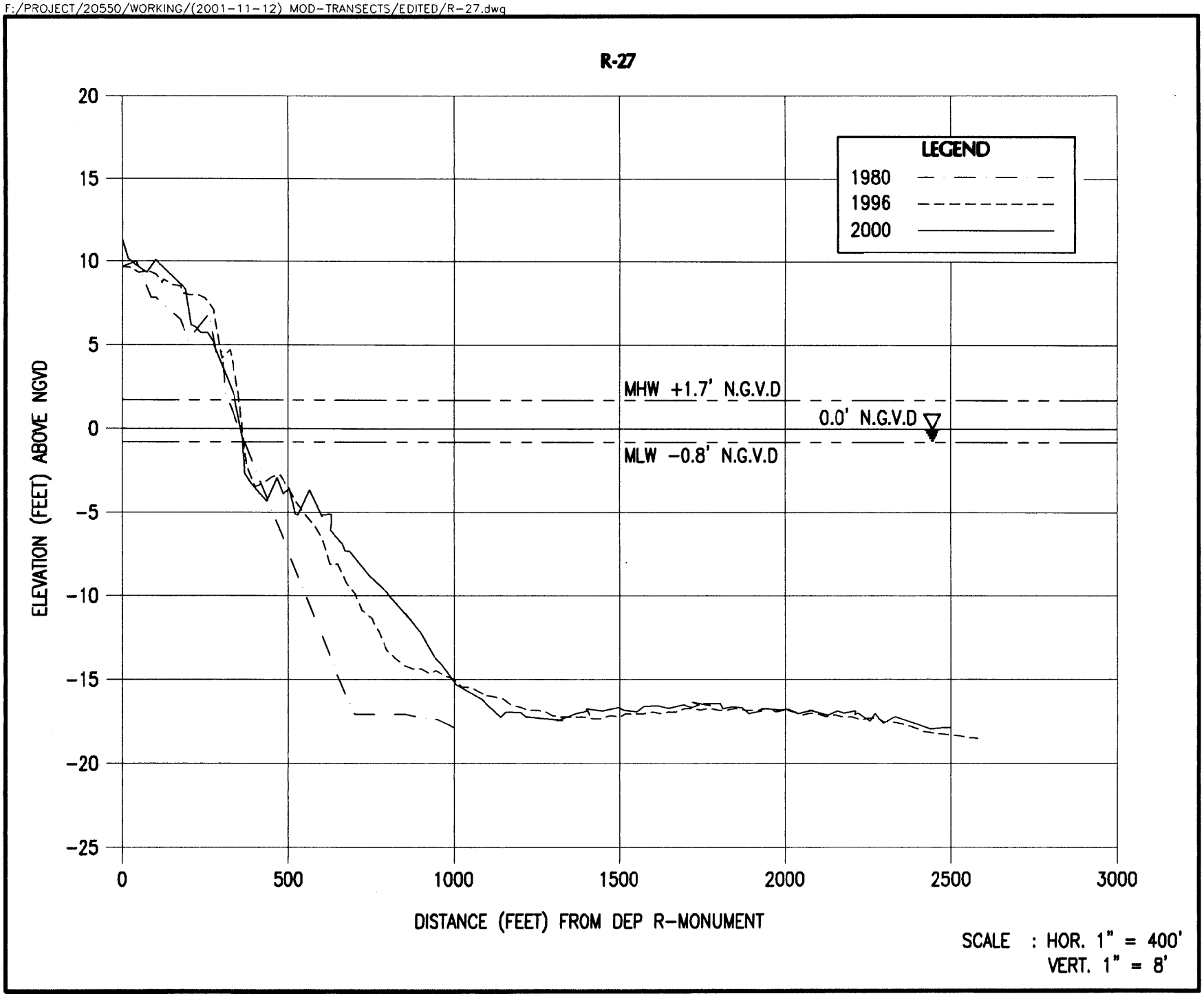
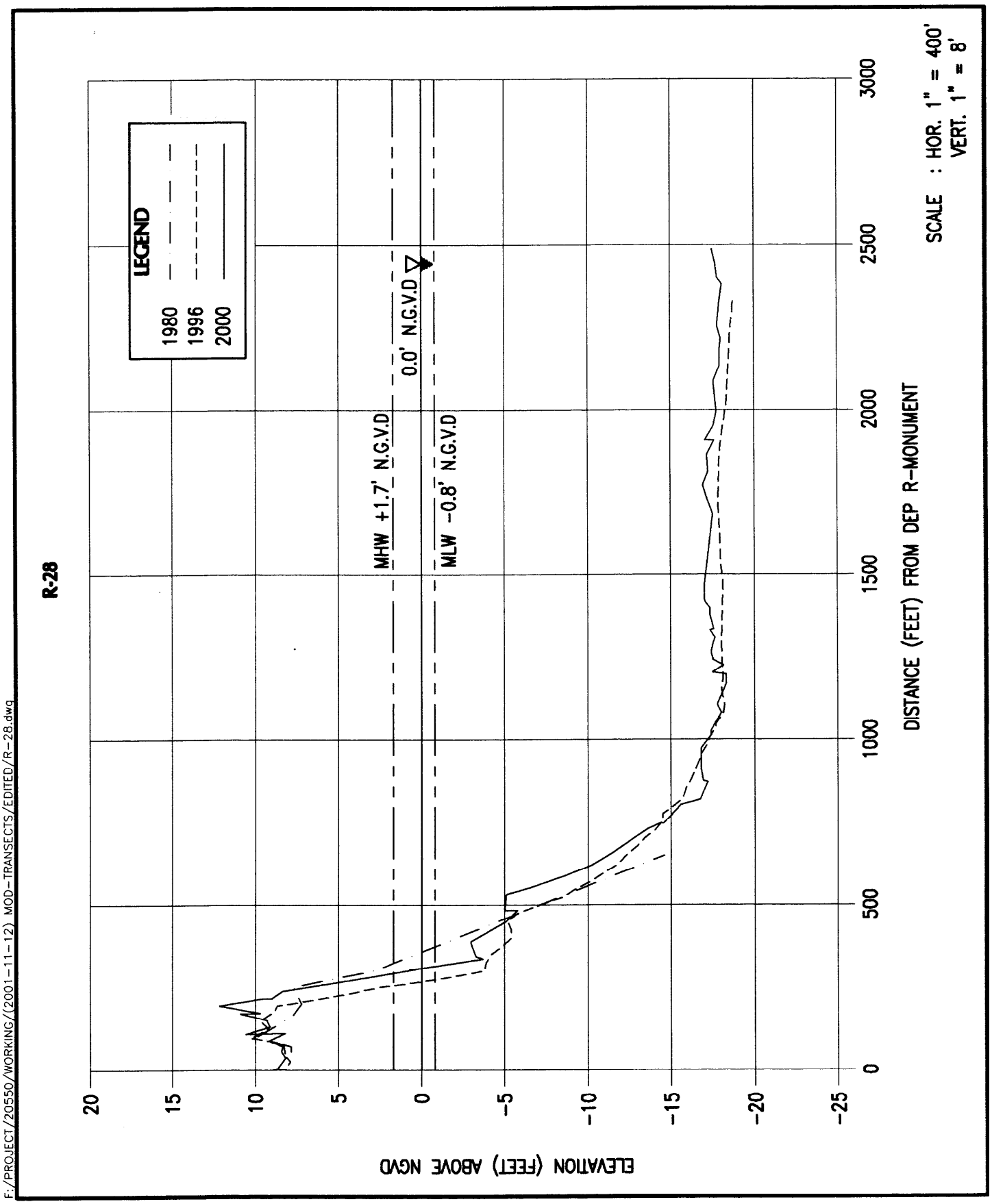


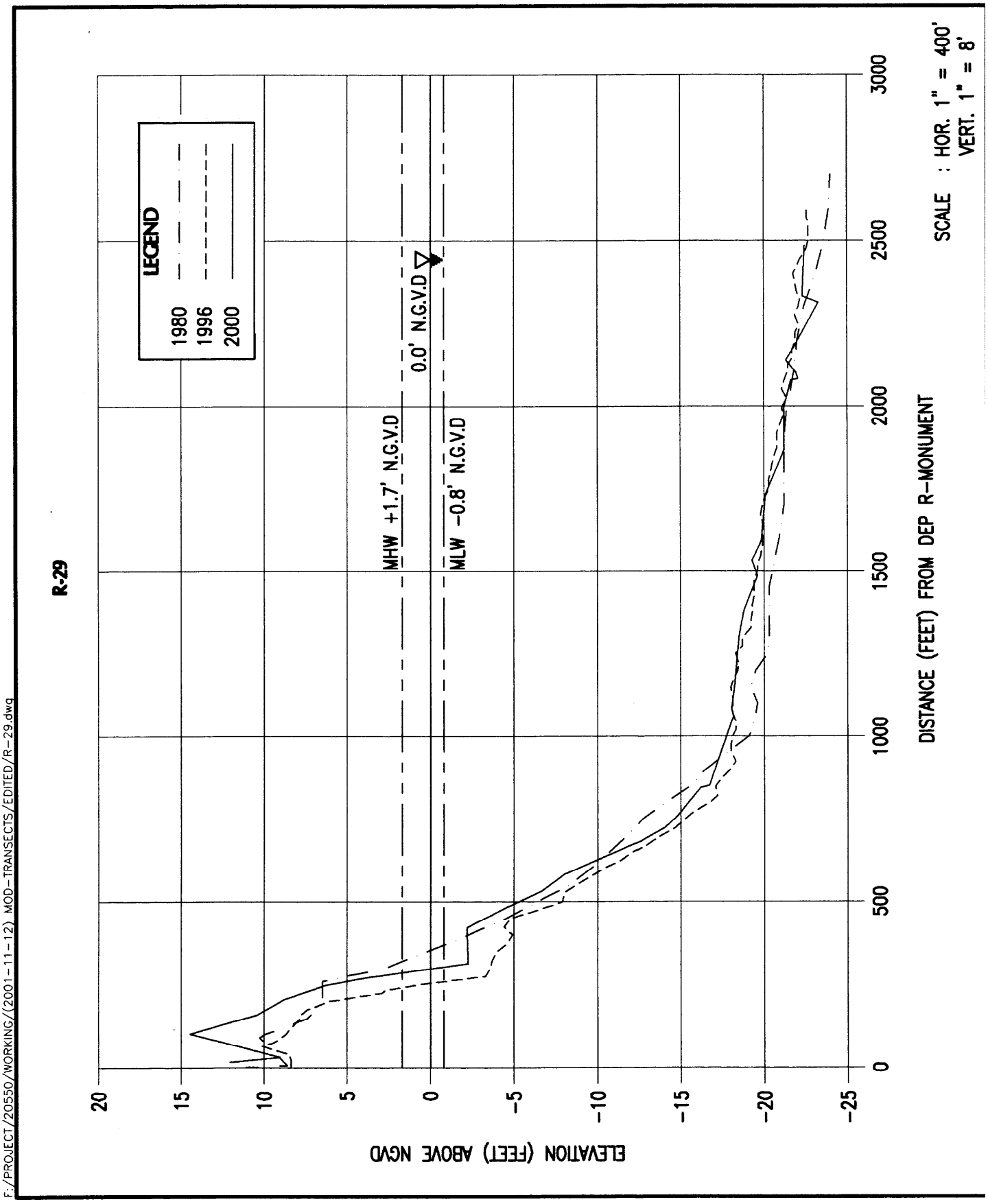

# R-27 - BAL HABOUR

MIAMI-DADE COUNTY, FLORIDA



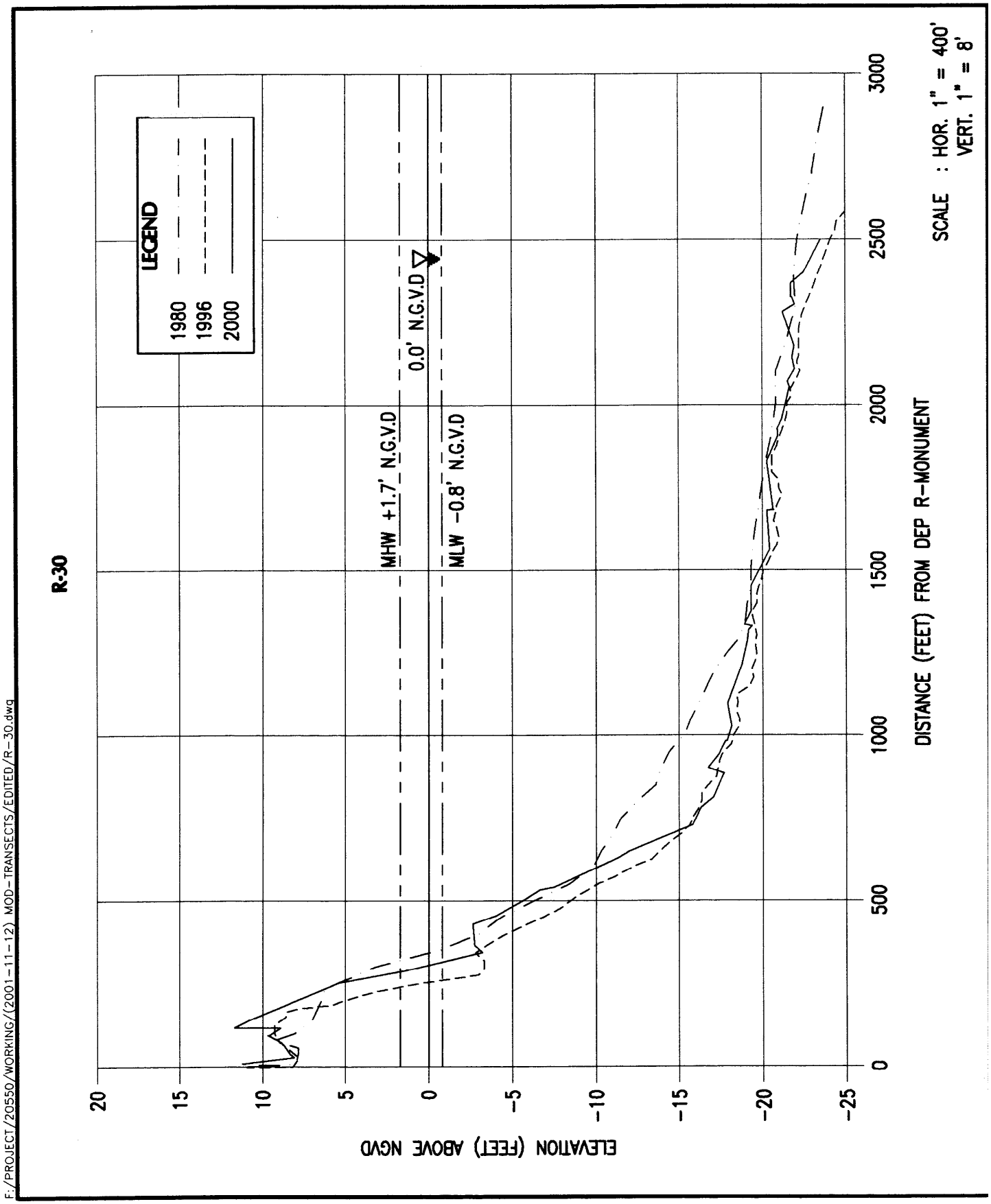

# R-28 - BAL HARBOUR

MIAMI-DADE COUNTY =, FLORIDA




# R-29 - BAL HARBOUR

MIAMI-DADE COUNTY, FLORIDA

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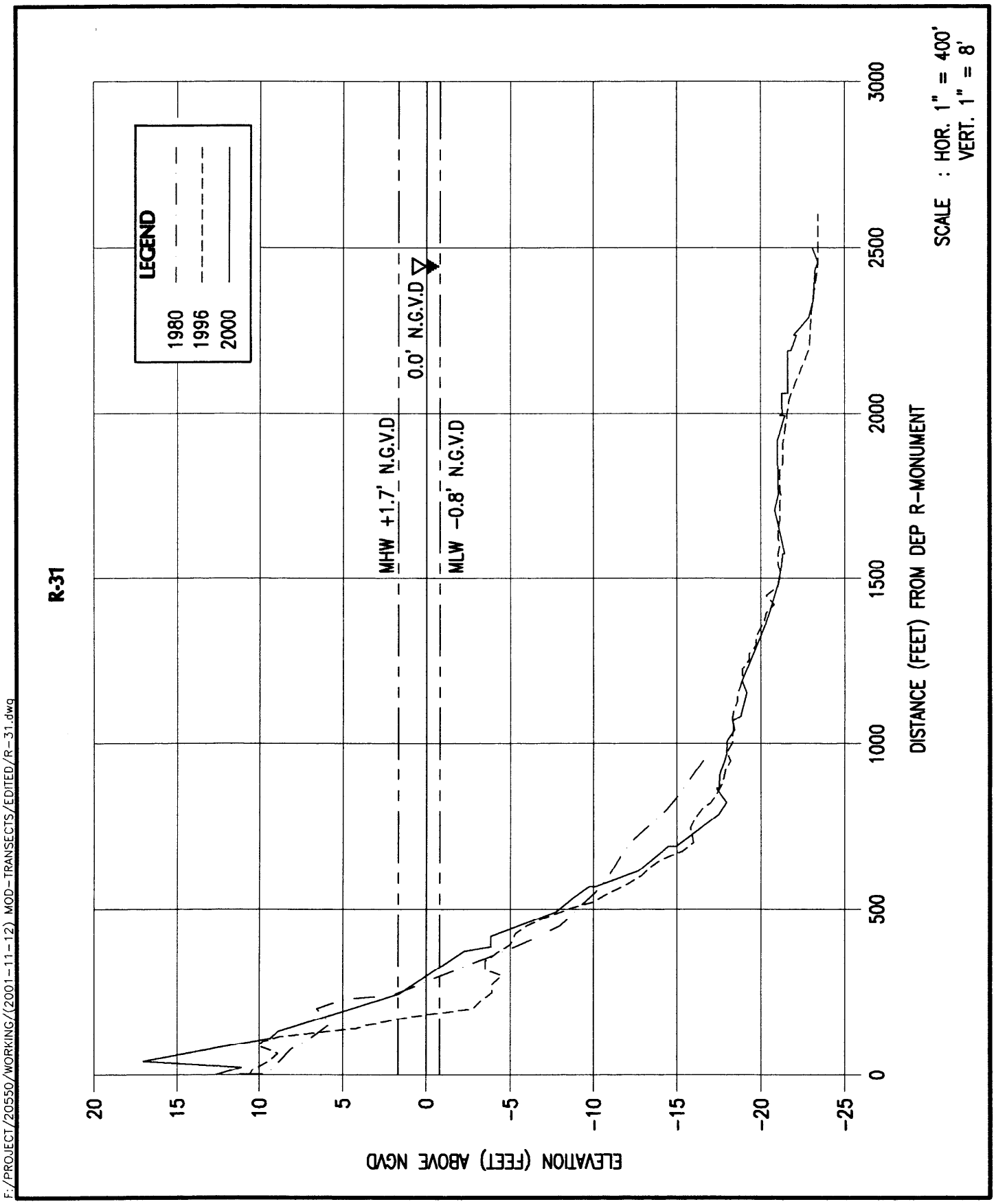
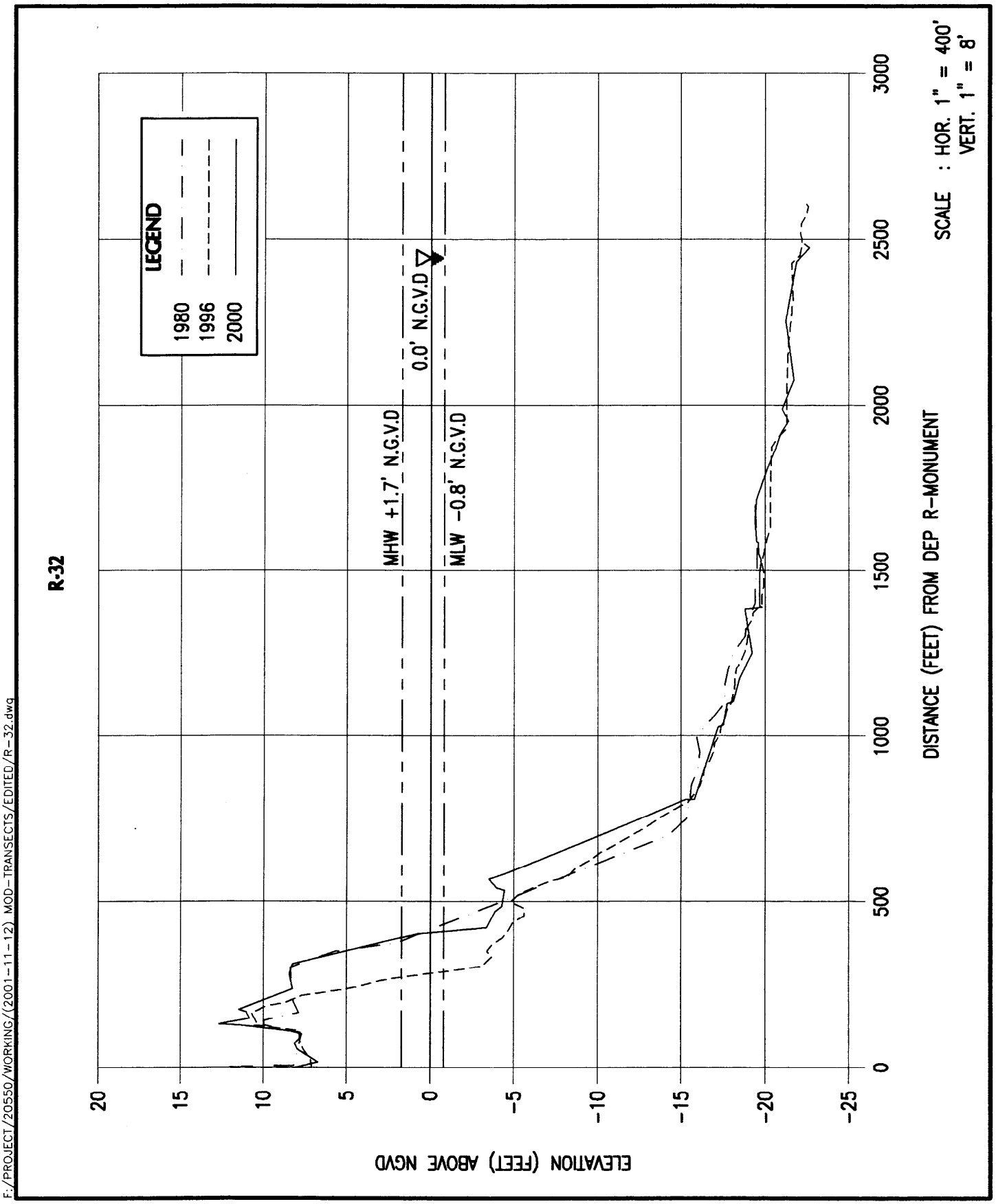
# R-30 - BAL HARBOUR

MIAMI-DADE COUNTY, FLORIDA



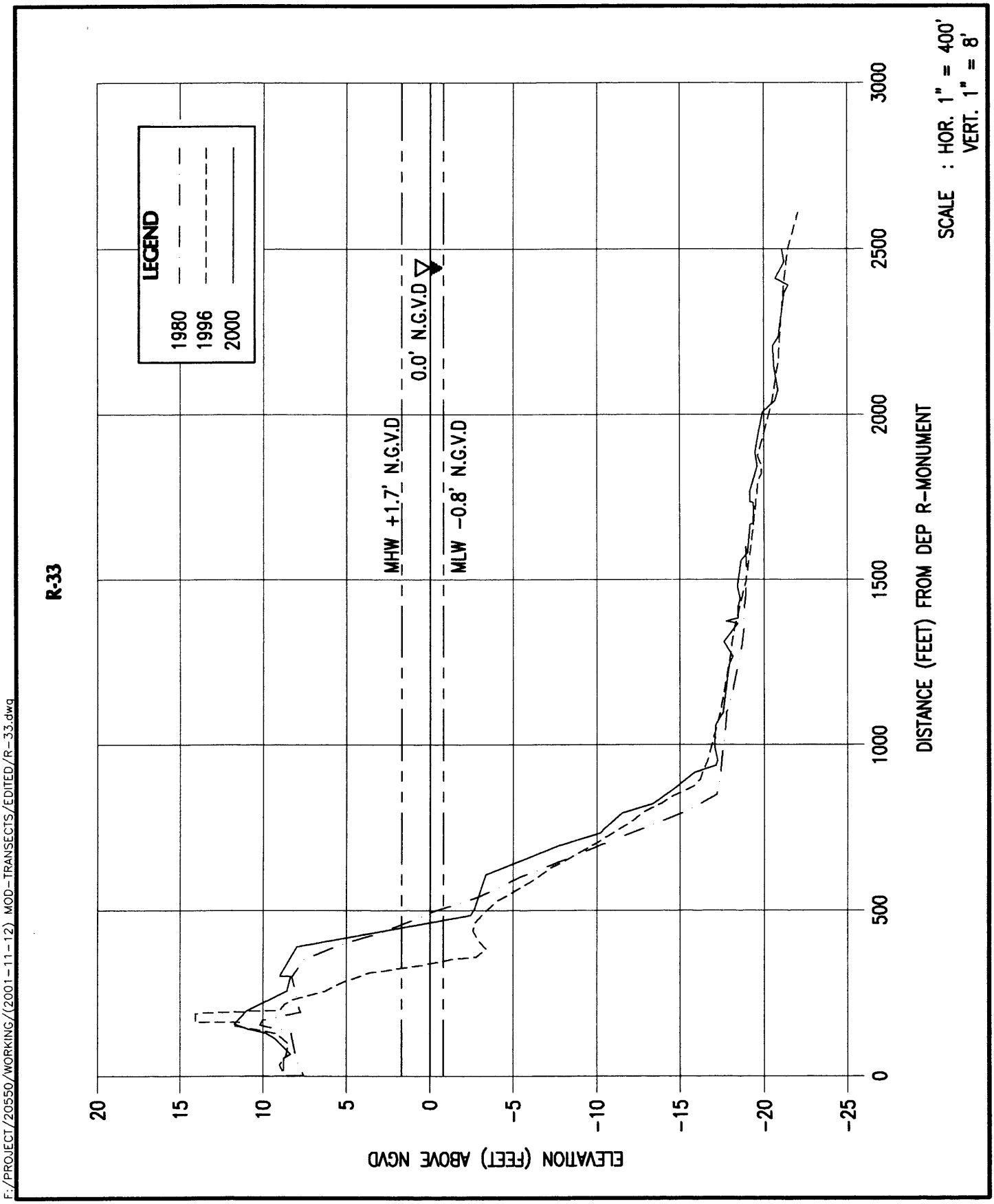

# R-31 - BAL HARBOUR

MIAMI-DADE COUNTY, FLORIDA



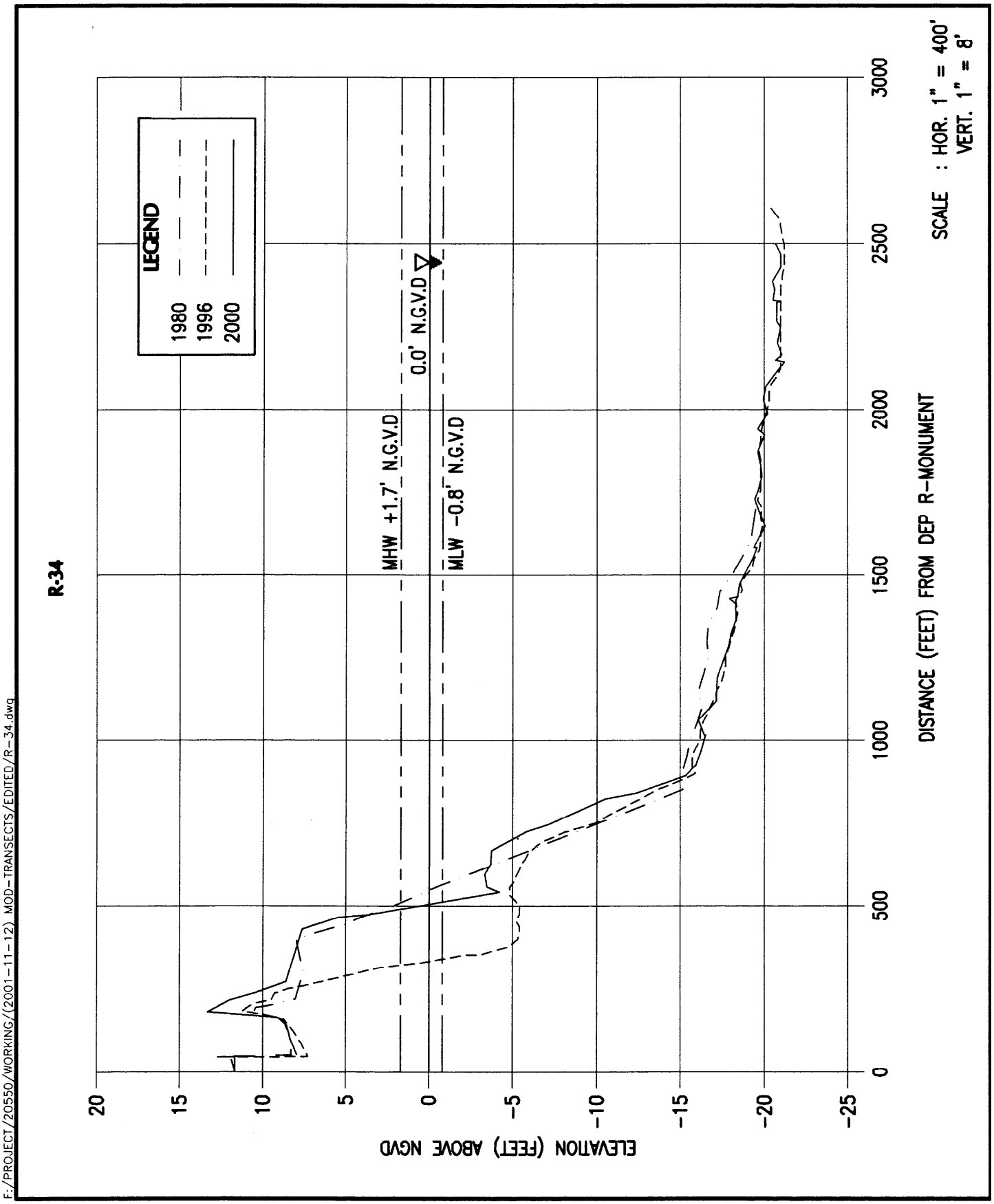

# R-32 - SURFSIDE

MIAMI-DADE COUNTY, FLORIDA




# R-33 - SURFSIDE

MIAMI-DADE COUNTY, FLORIDA




# R-34 - SURFSIDE

MIAMI-DADE COUNTY, FLORIDA

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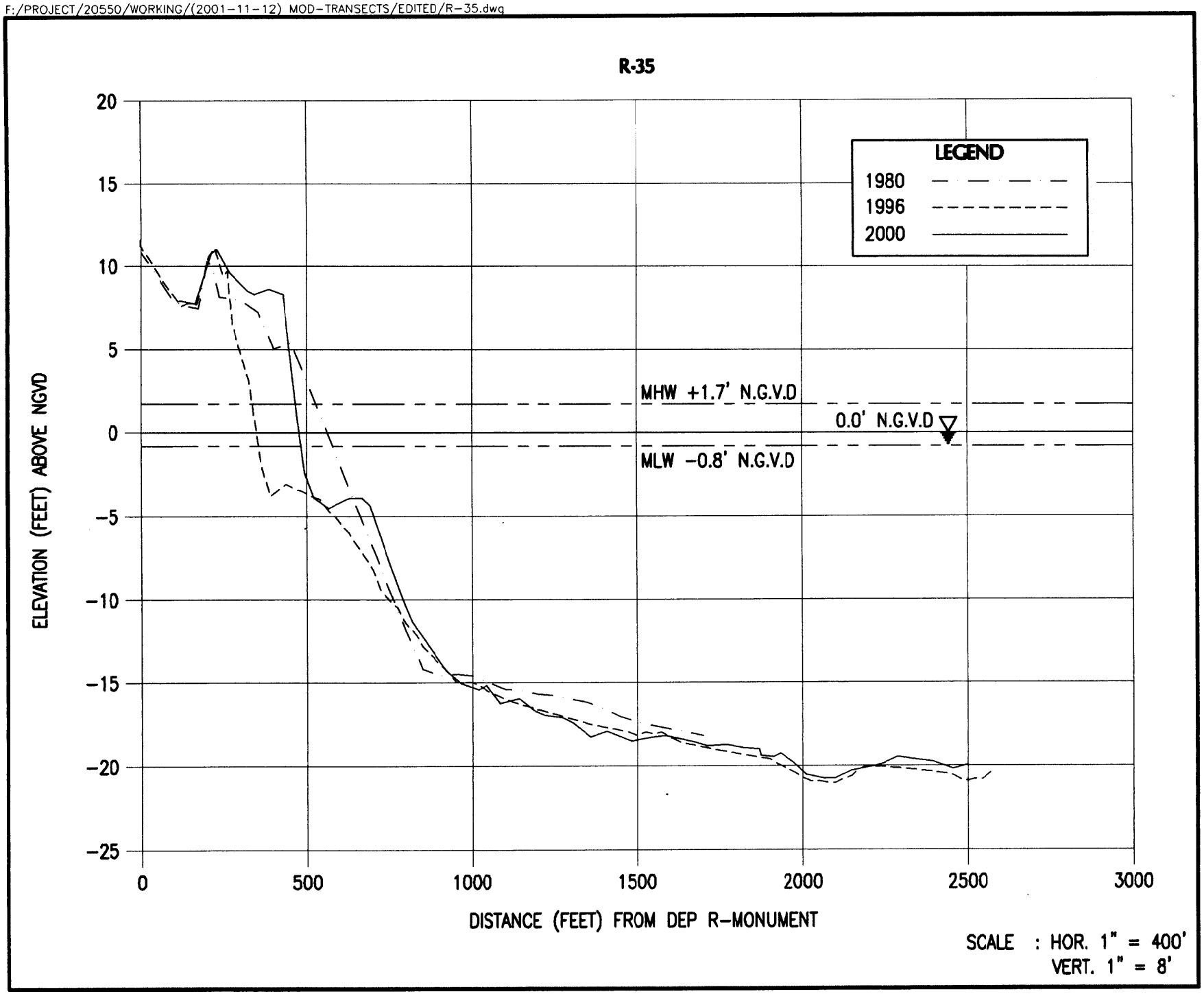
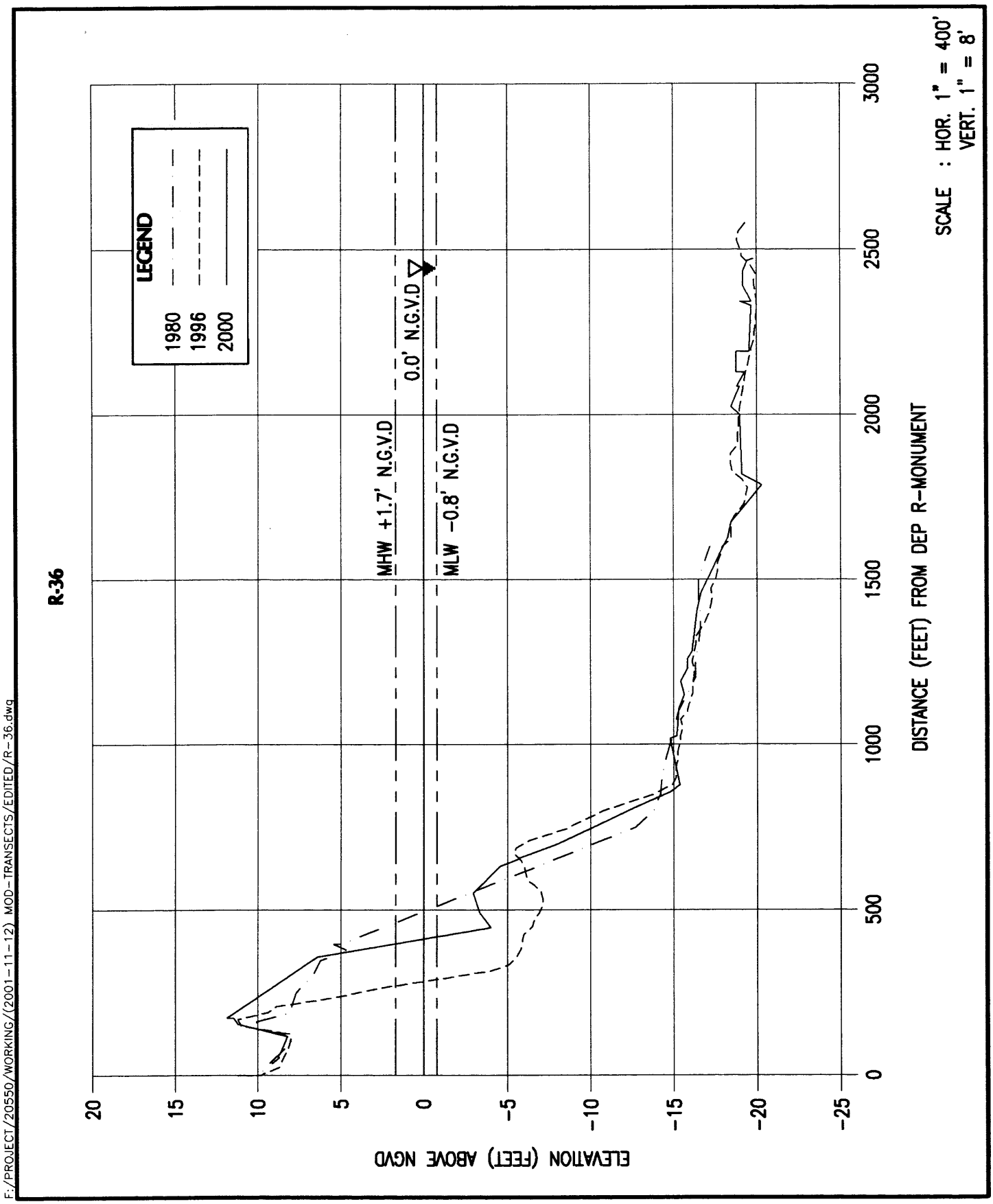
# R-35 - SURFSIDE

MIAMI-DADE COUNTY, FLORIDA



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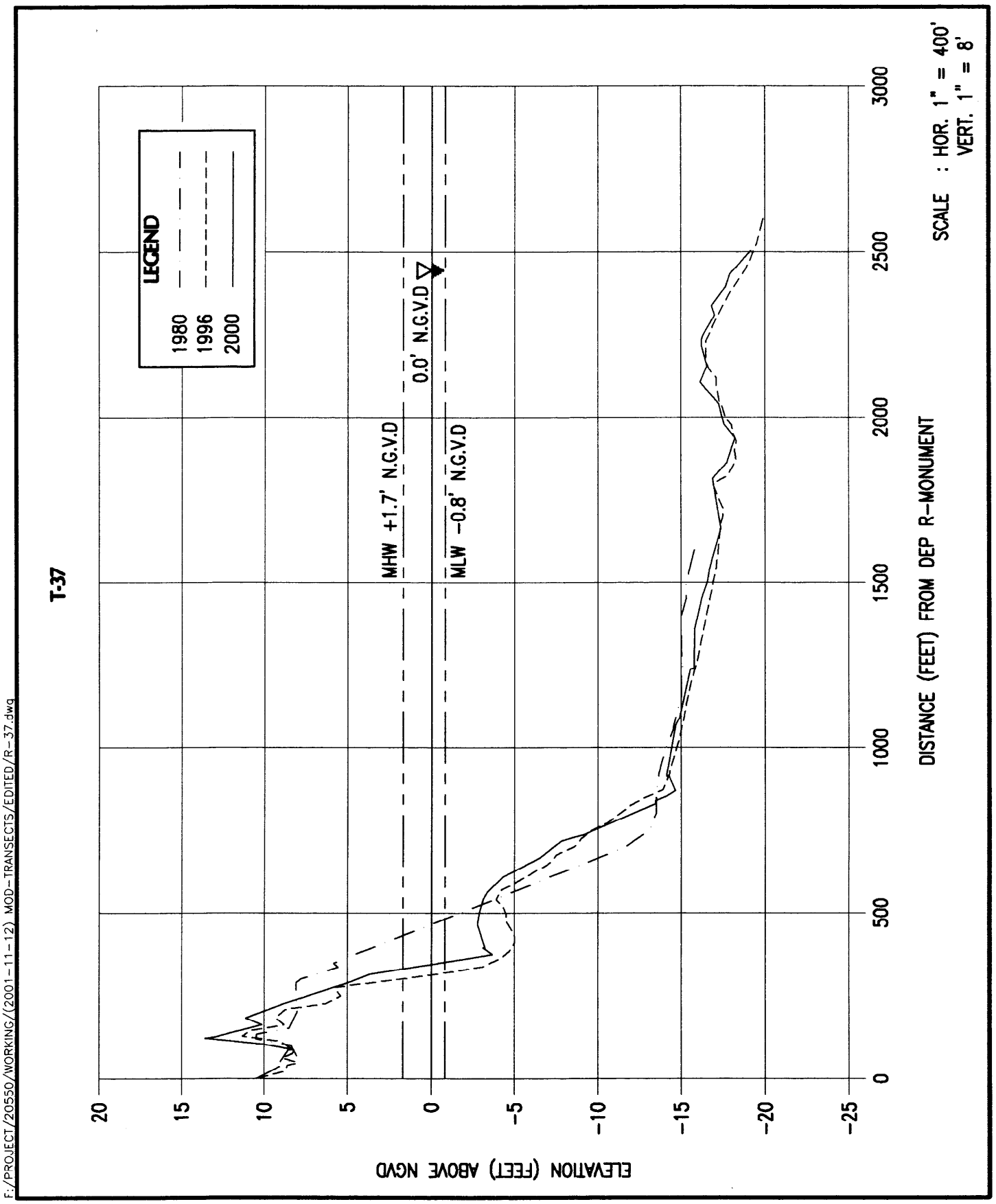
# R-36 - SURFSIDE

MIAMI-DADE COUNTY, FLORIDA

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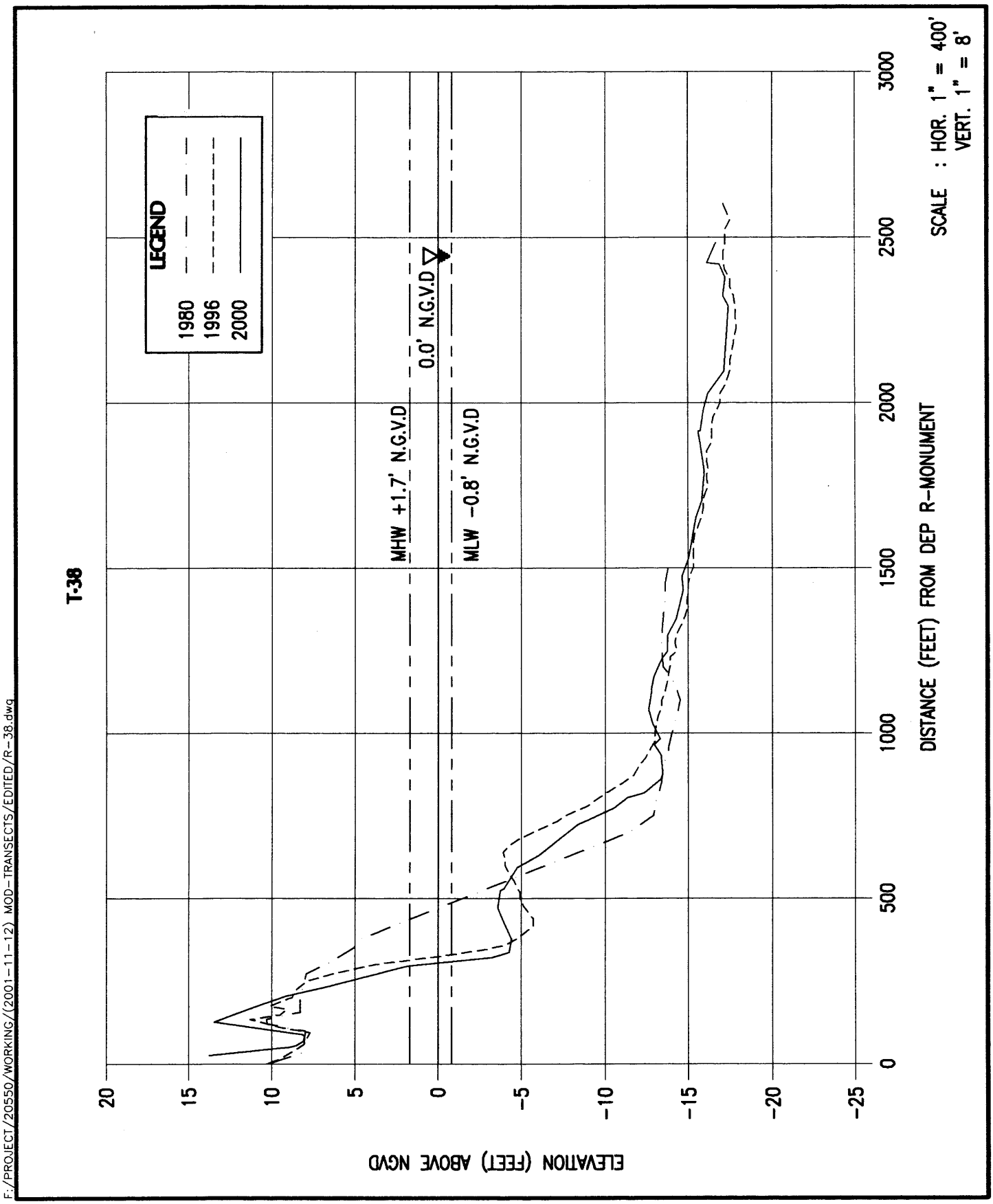
# T-37 SURFSIDE

MIAMI DADE COUNTY, FLORIDA



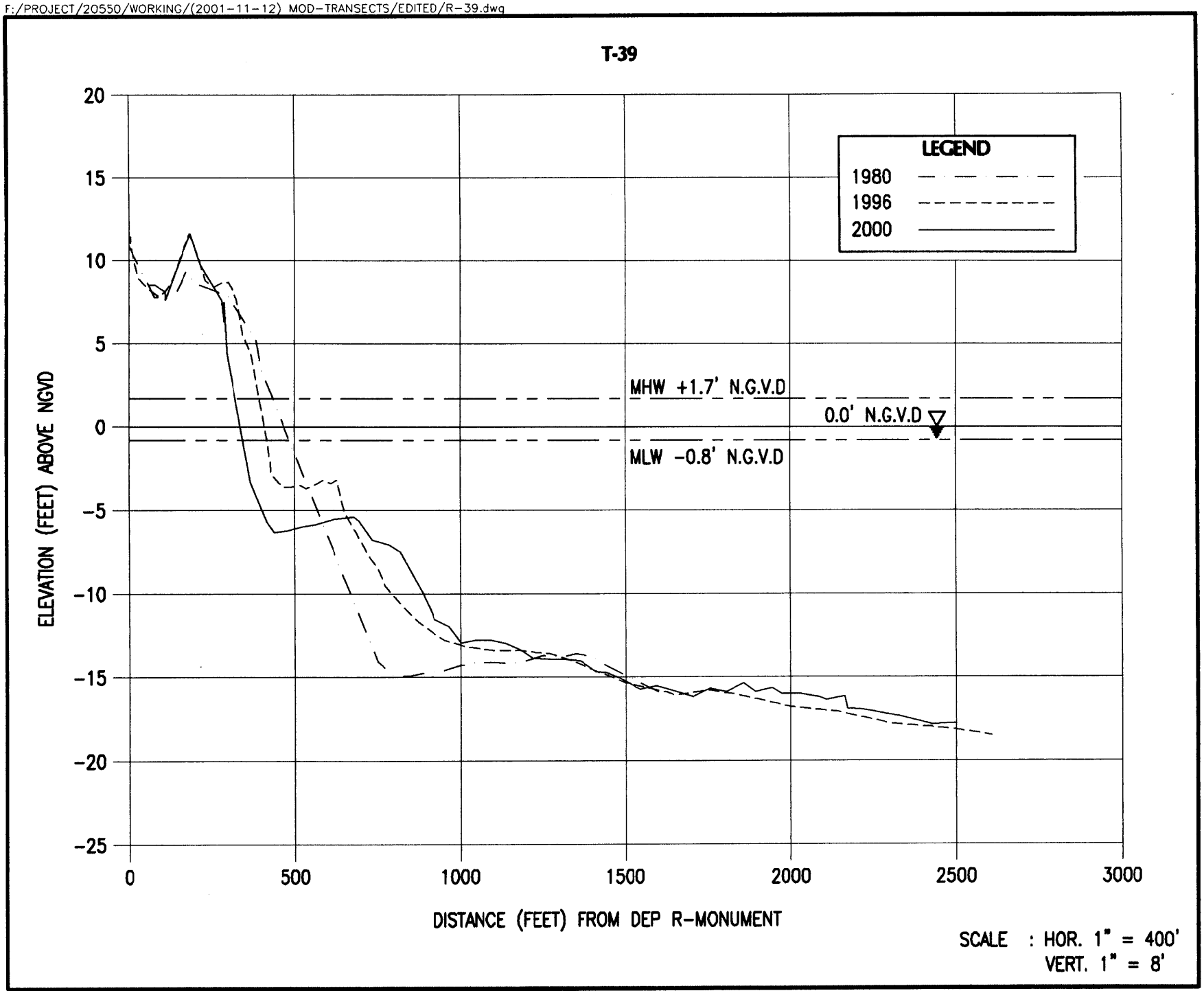

# T-38 - SURFSIDE

MIAMI-DADE COUNTY, FLORIDA

F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/EDITED/R-39.dwg

# T-39 - MIAMI BEACH

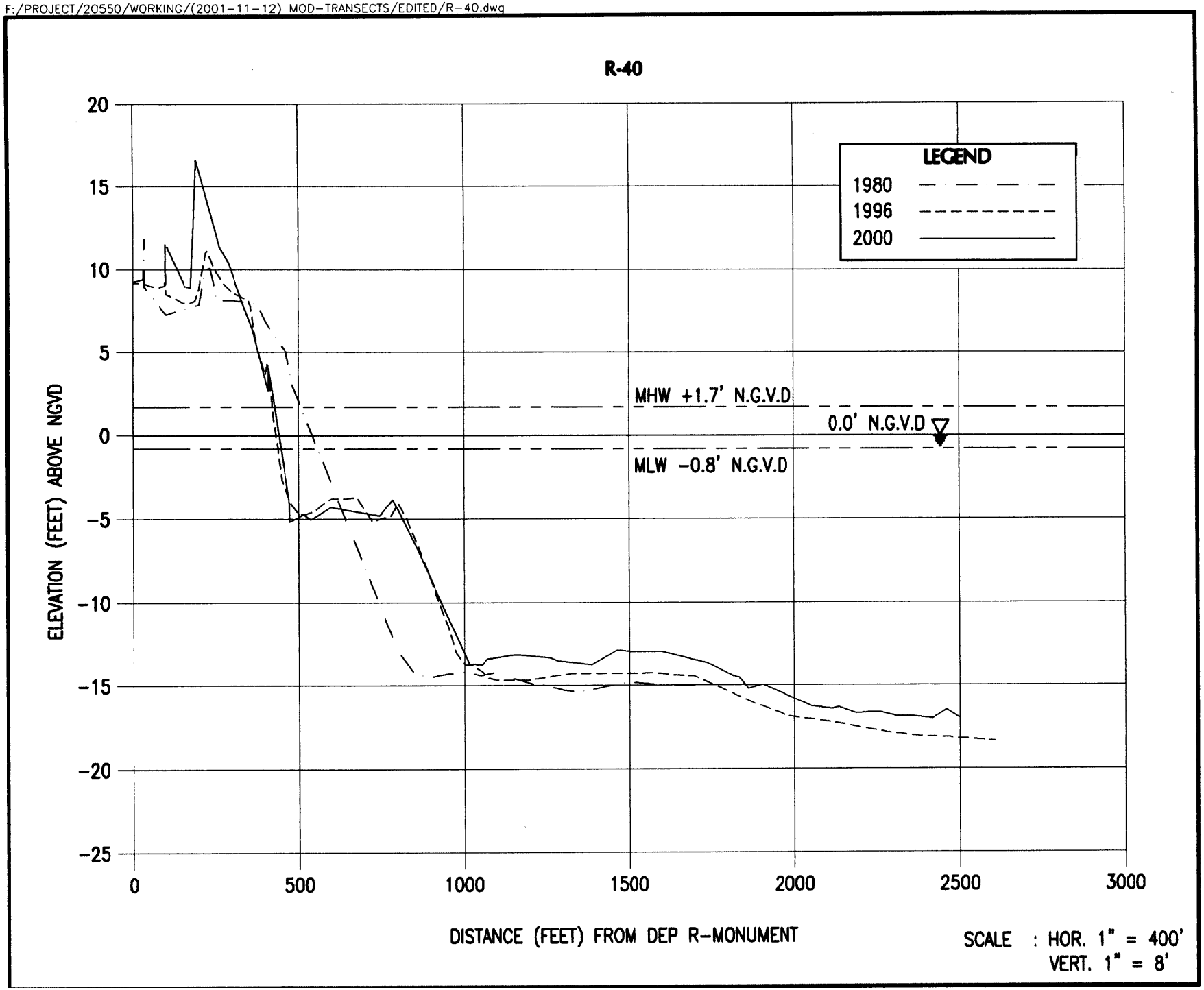
MIAMI-DADE COUNTY, FLORIDA



F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/EDITED/R-40.dwg

# R-40 MIAMI BEACH

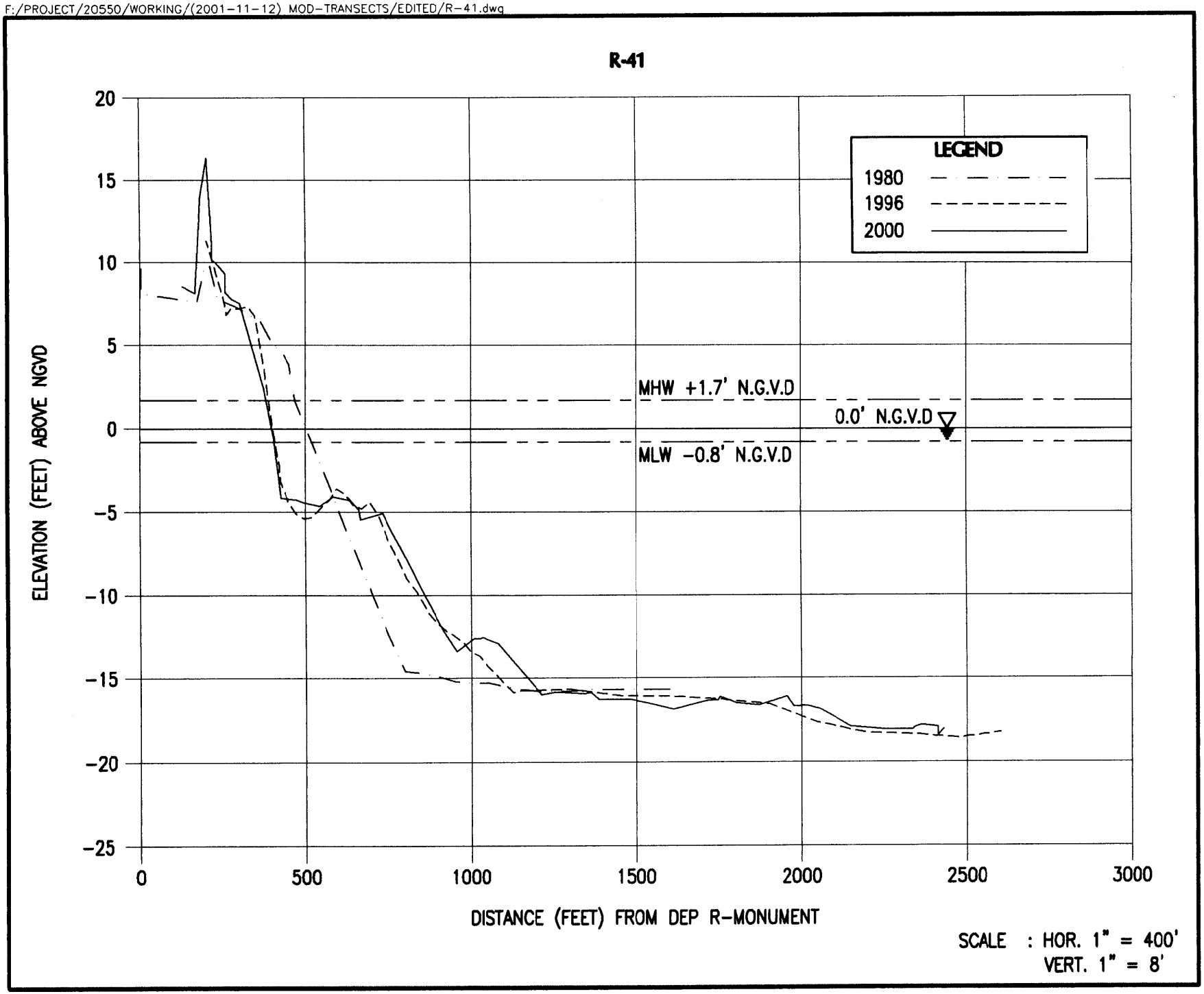
MIAMI-DADE COUNTY, FLORIDA

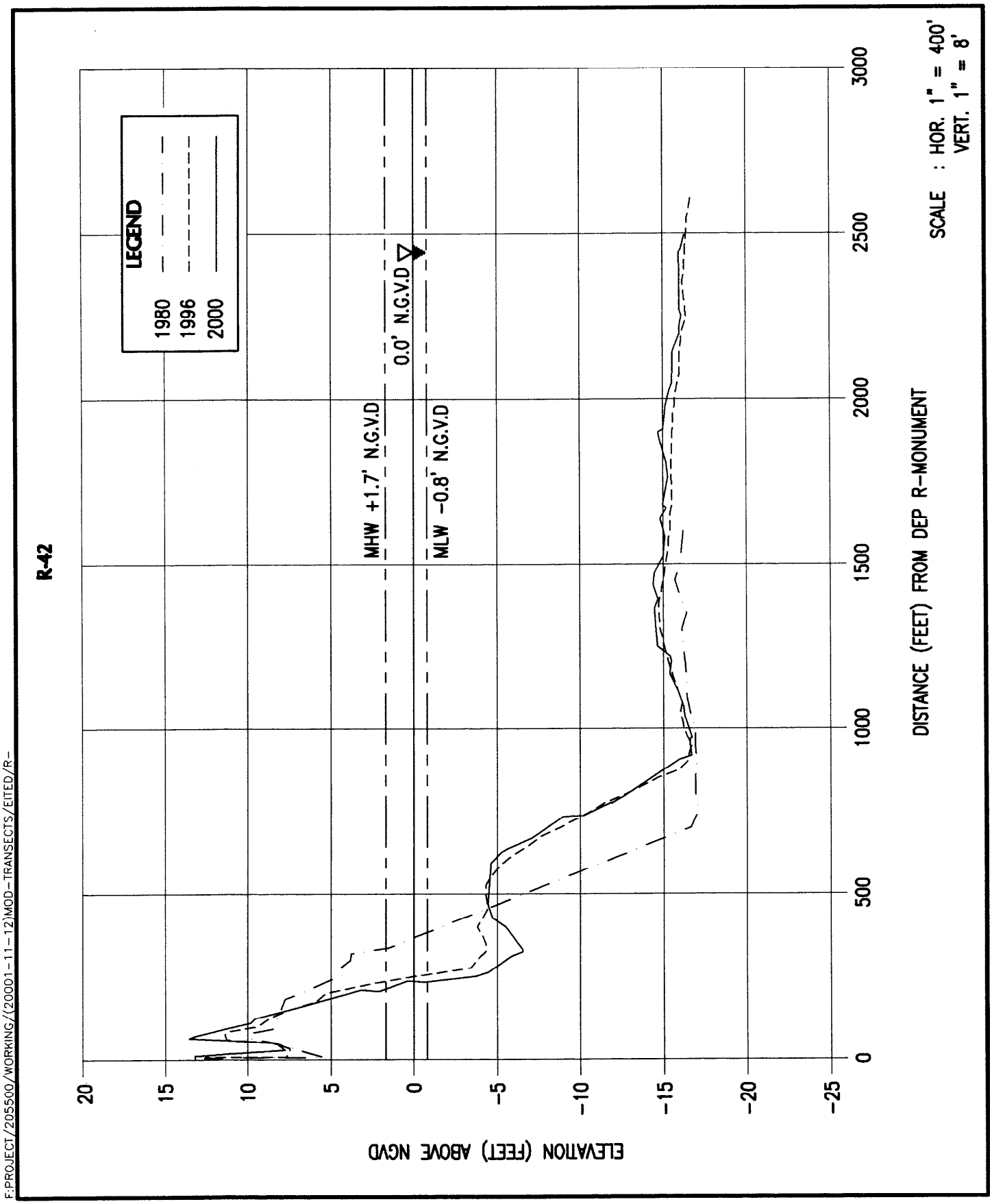


F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/EDITED/R-41.dwg

# R-41 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

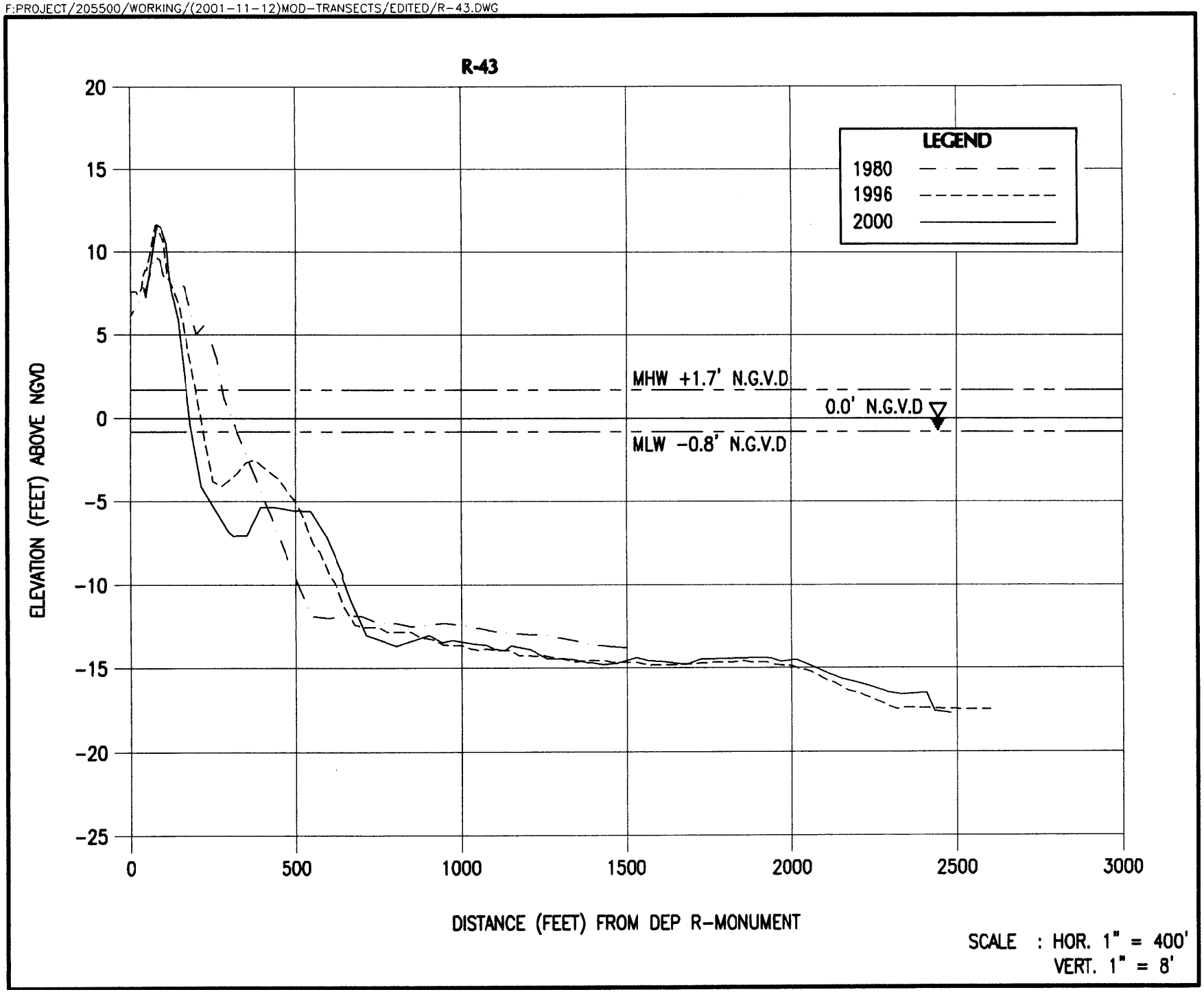





# R-42 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

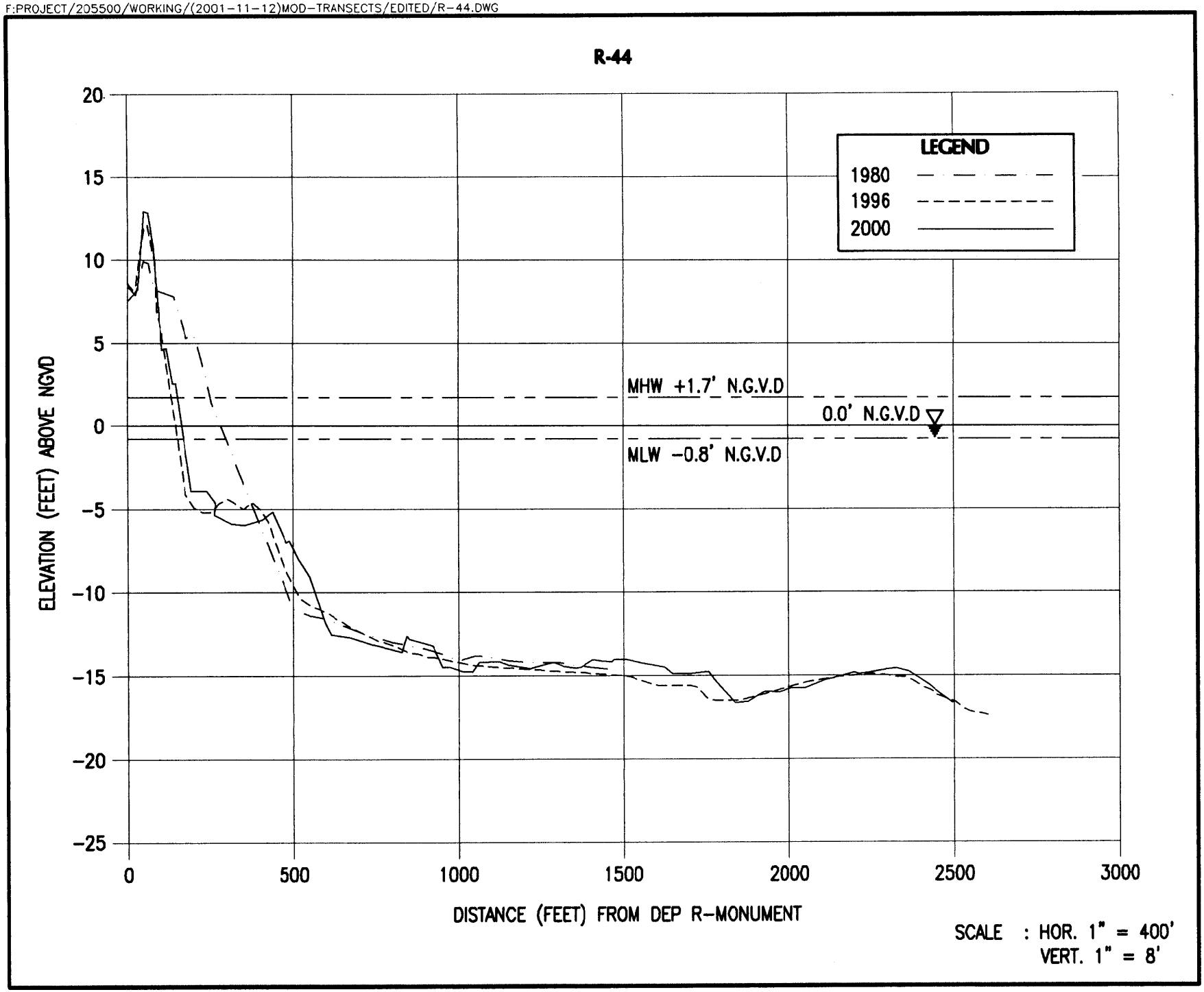
F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/EDITED/R-43.DWG




# R-43 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

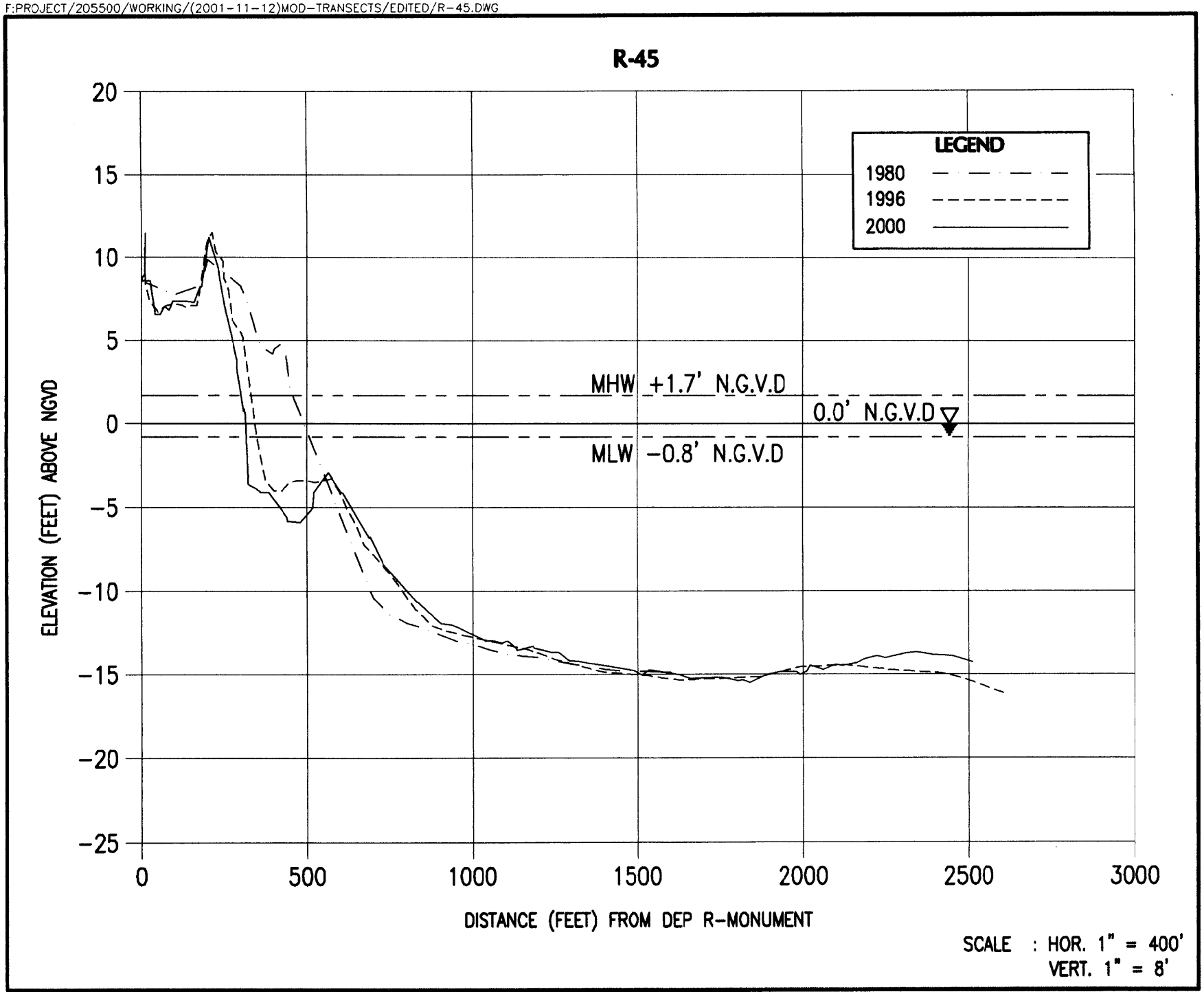
F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/EDITED/R-44.DWG




# R-44 - MIAMI BEACH

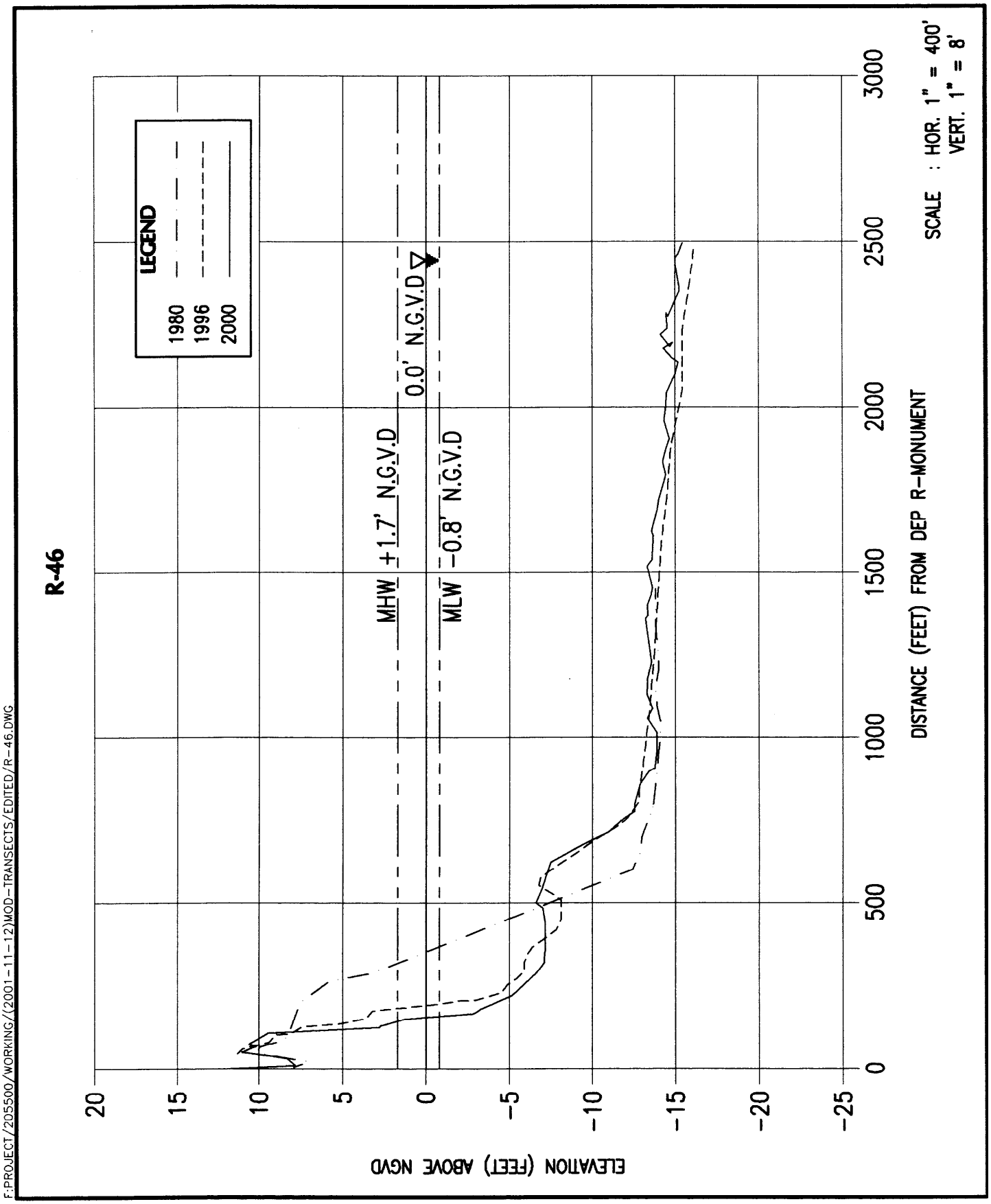
MIAMI-DADE COUNTY, FLORIDA

F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/EDITED/R-45.DWG




# R-45 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA



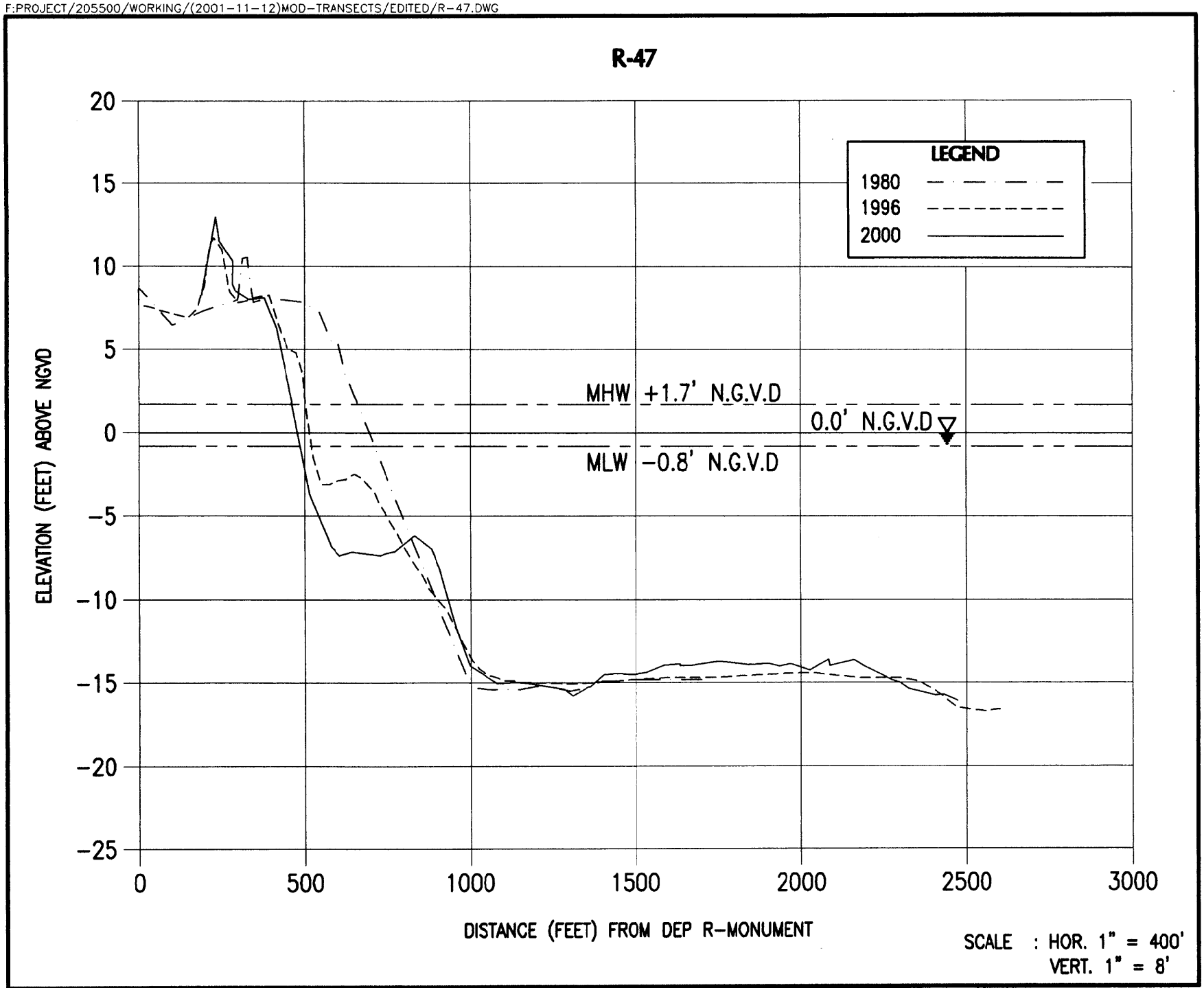

# R-46 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/EDITED/R-47.DWG

# R-47 - MIAMI BEACH

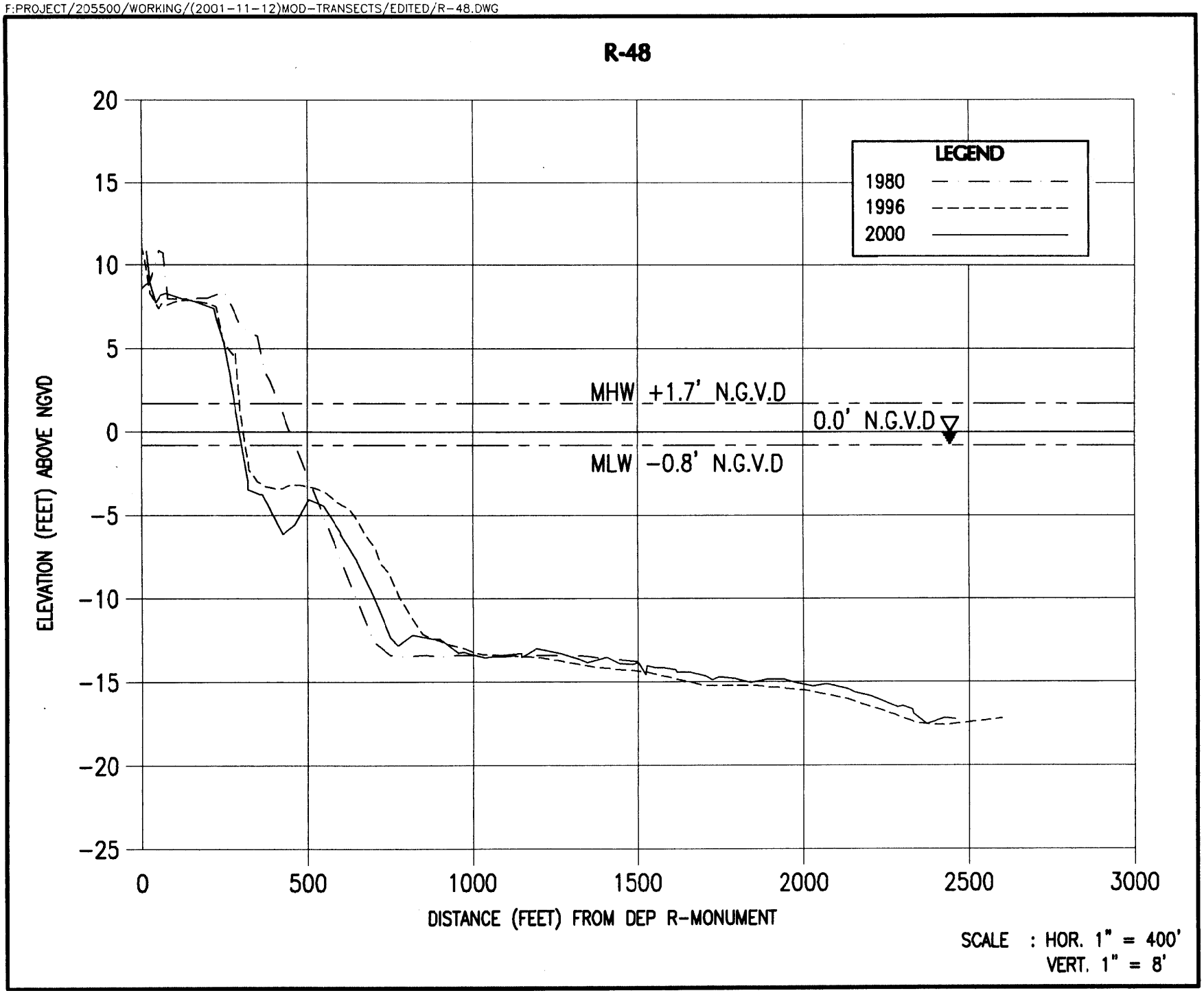
MIAMI-DADE COUNTY, FLORIDA



F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/EDITED/R-48.DWG

# R-48 - MIAMI BEACH

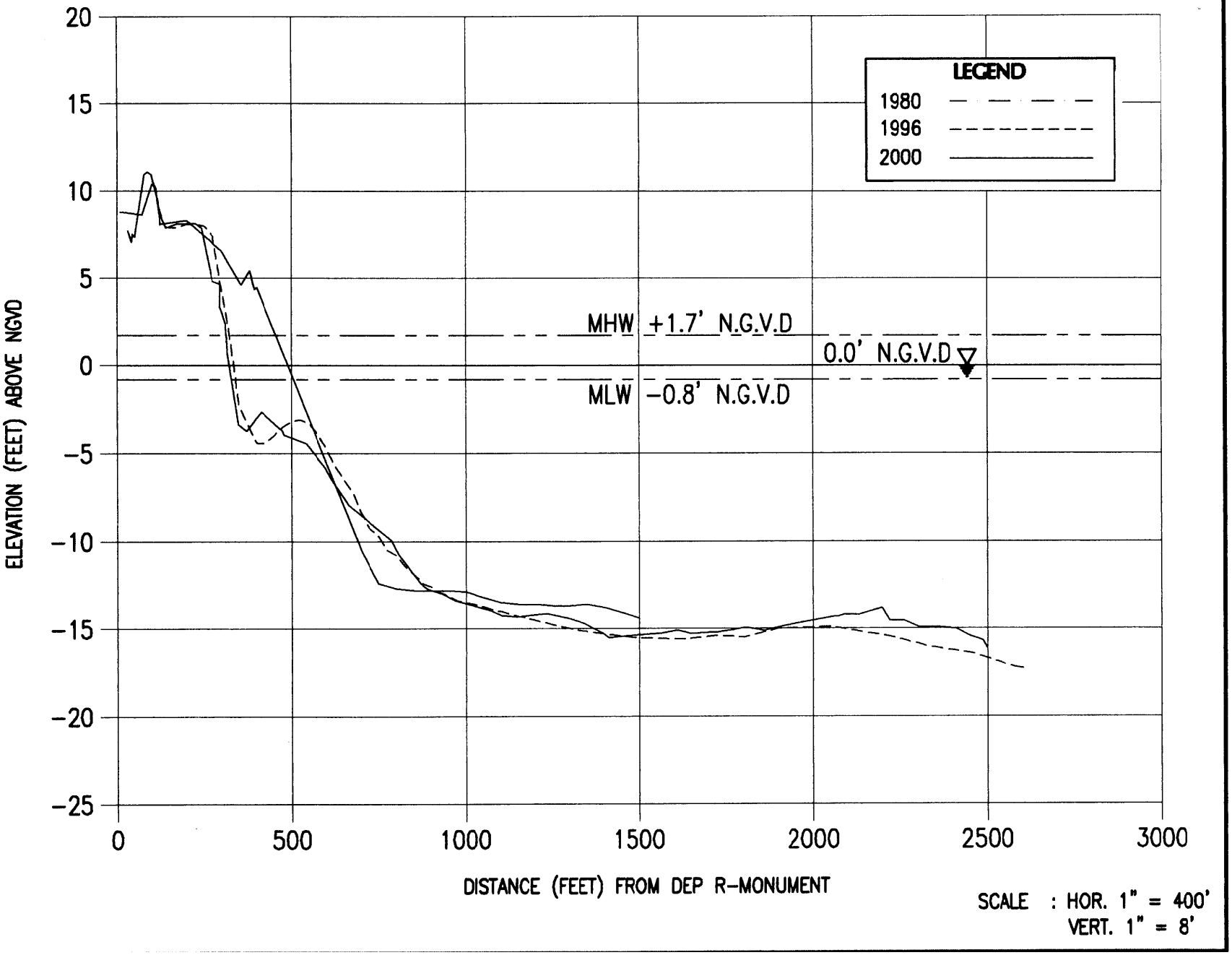
MIAMI-DADE COUNTY, FLORIDA

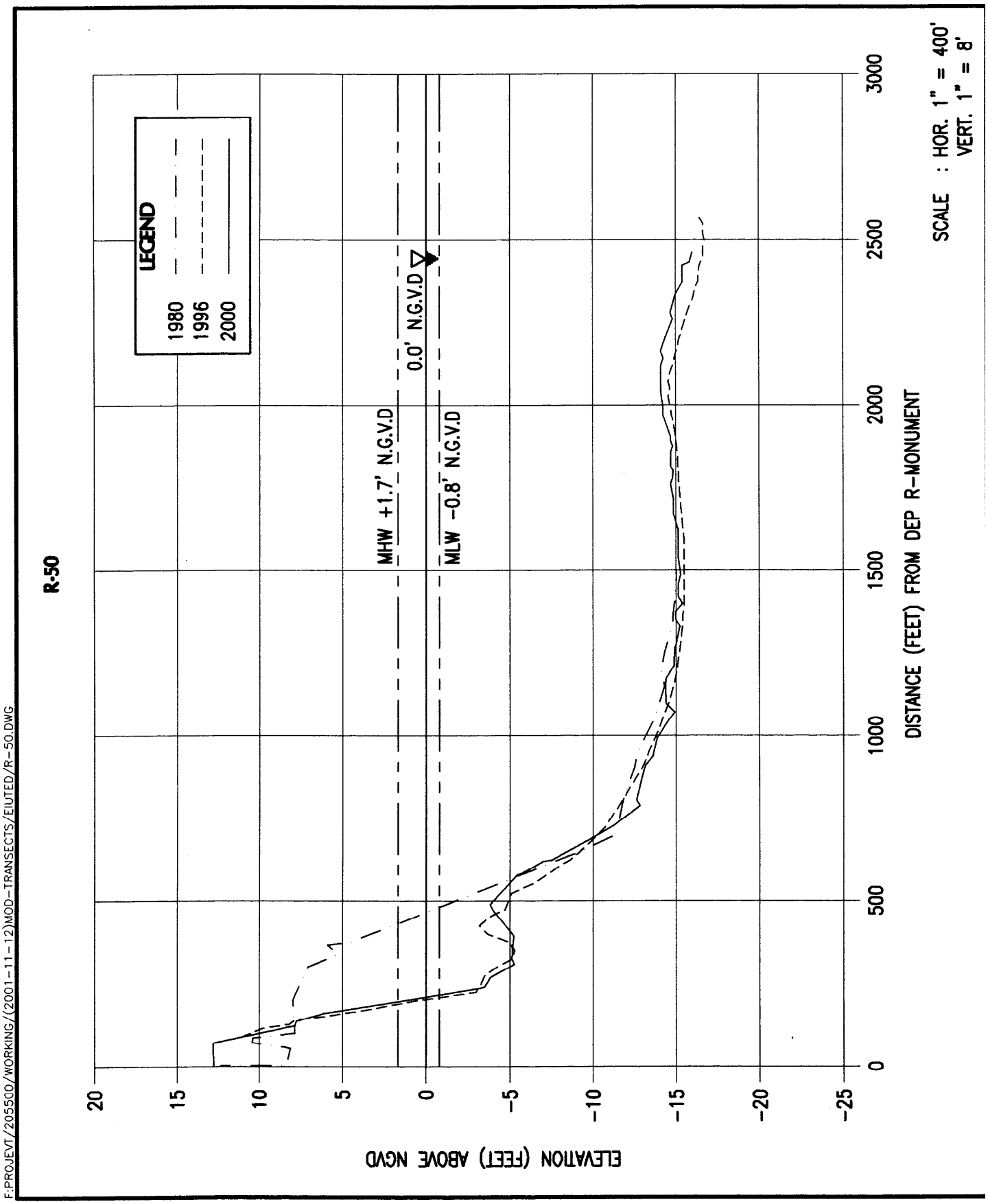


F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/EDITED/R-49.DWG

# R-49 - MIAMI BEACH

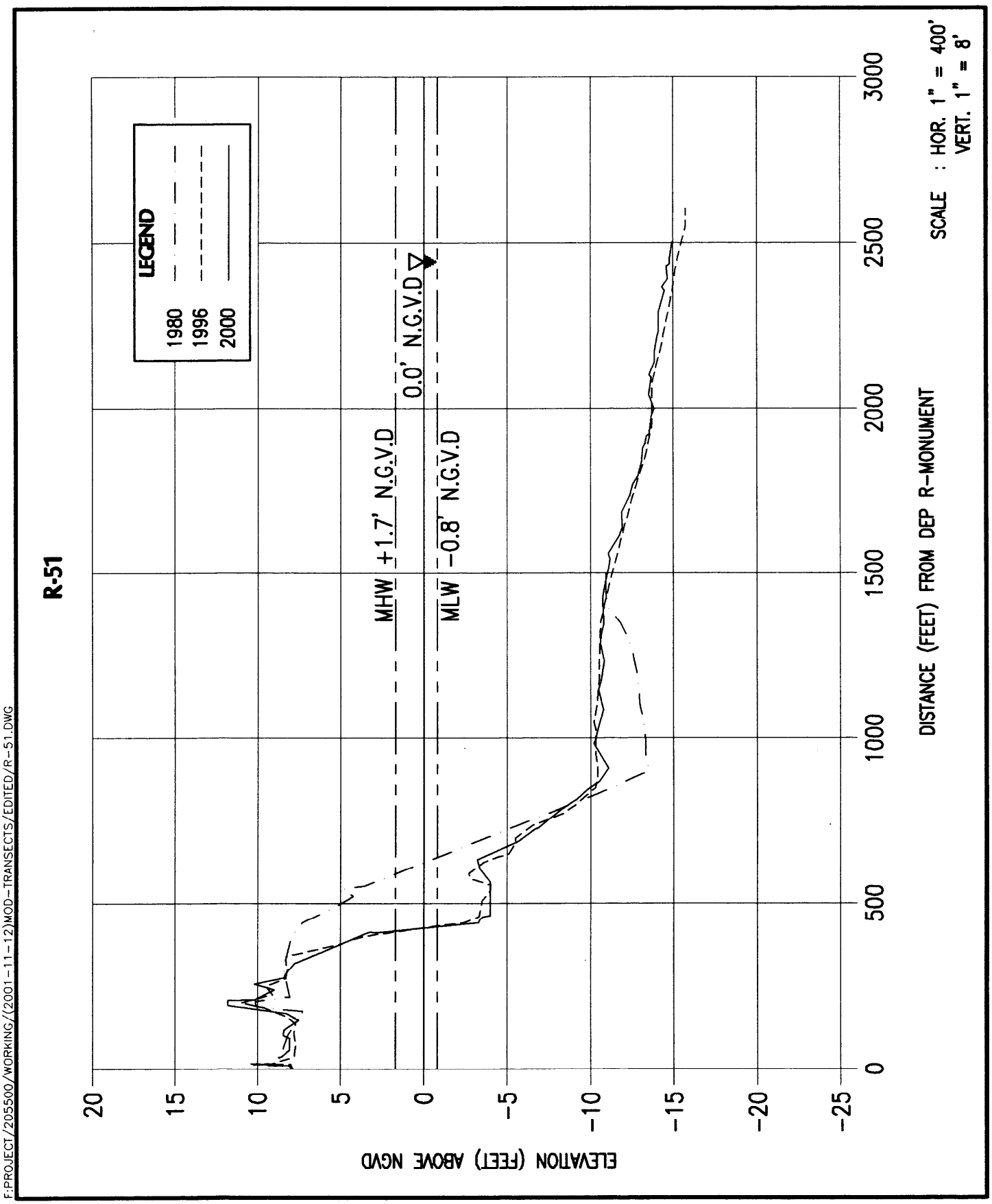
MIAMI-DADE COUNTY, FLORIDA






# R-50 - MIAMI BEACH

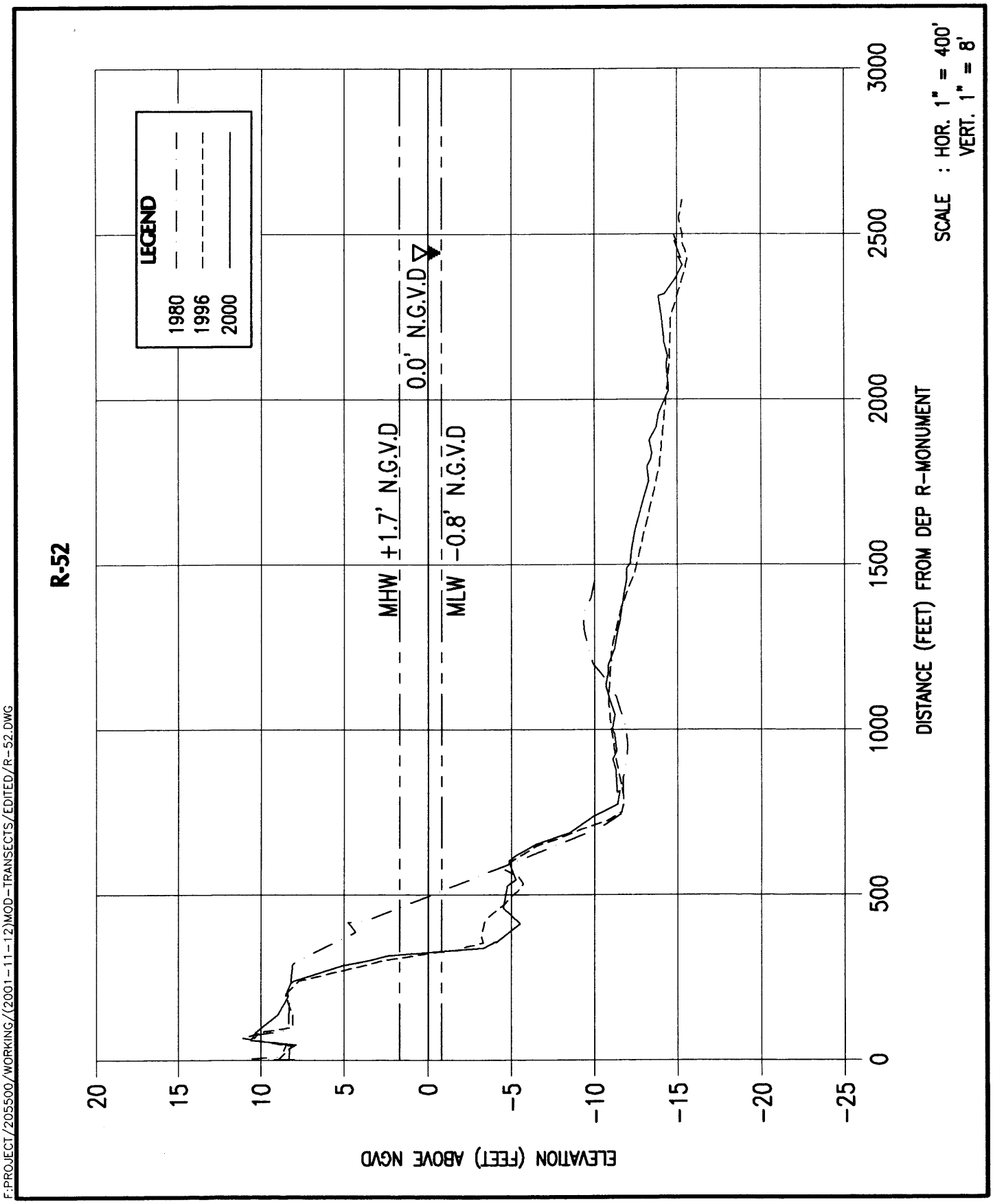
MIAMI-DADE COUNTY, FLORIDA




F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/EDITED/R-51.DWG

# R-51 - MIAMI BEACH

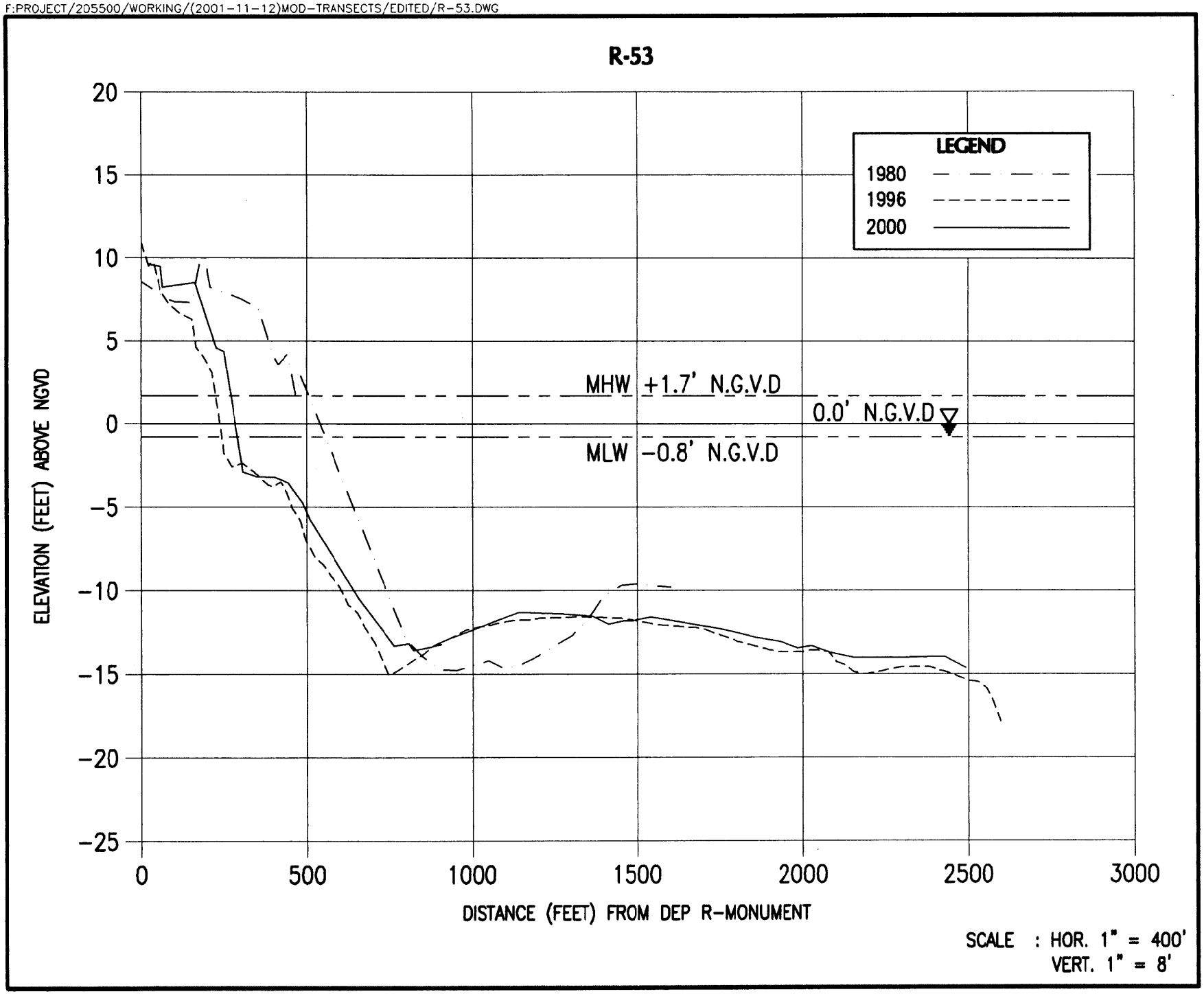
MIAMI-DADE COUNTY, FLORIDA




# R-52 - MIAMI BEACH

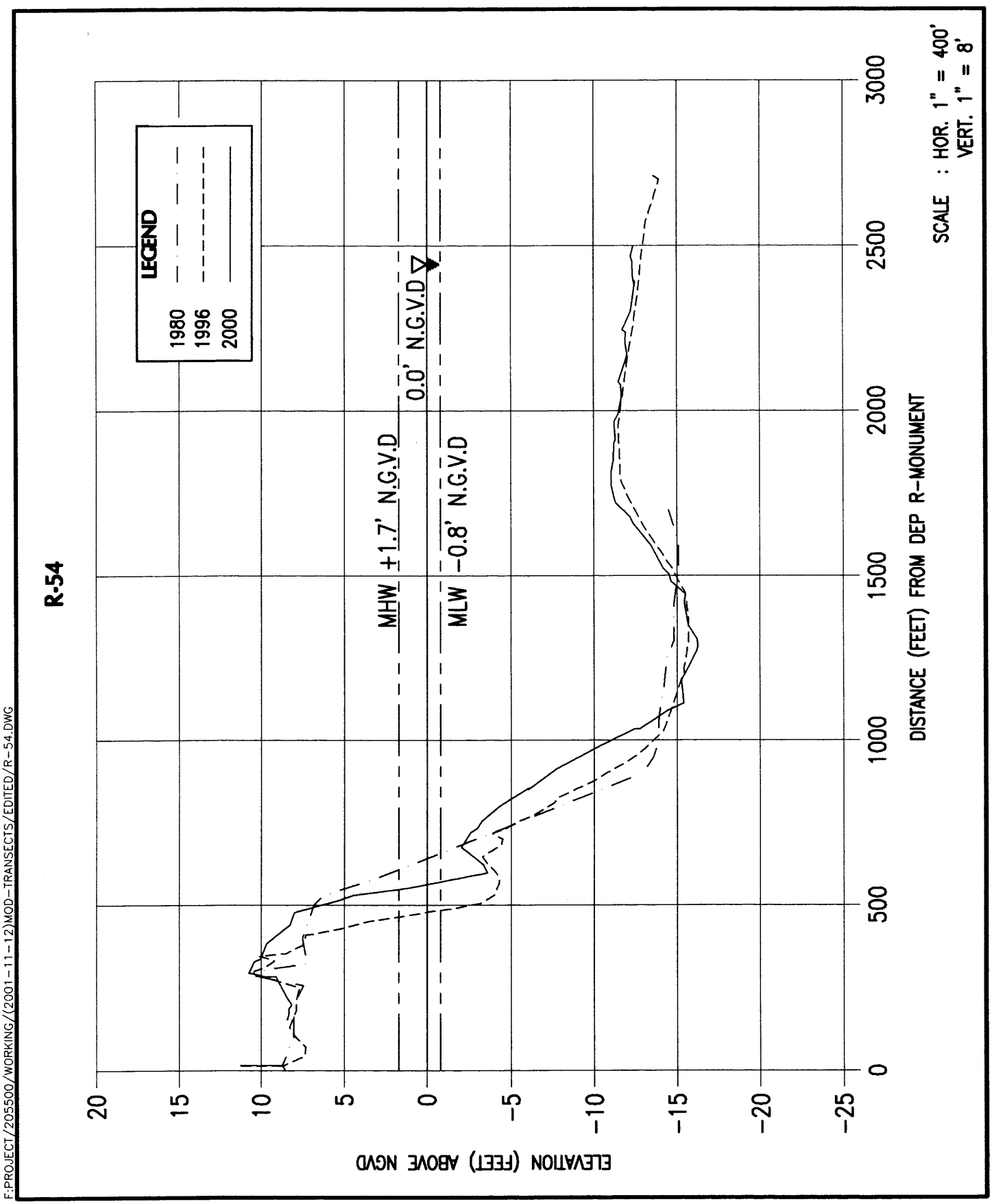
MIAMI-DADE COUNTY, FLORIDA

F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/EDITED/R-53.DWG




# R-53 - MIAMI BEACH

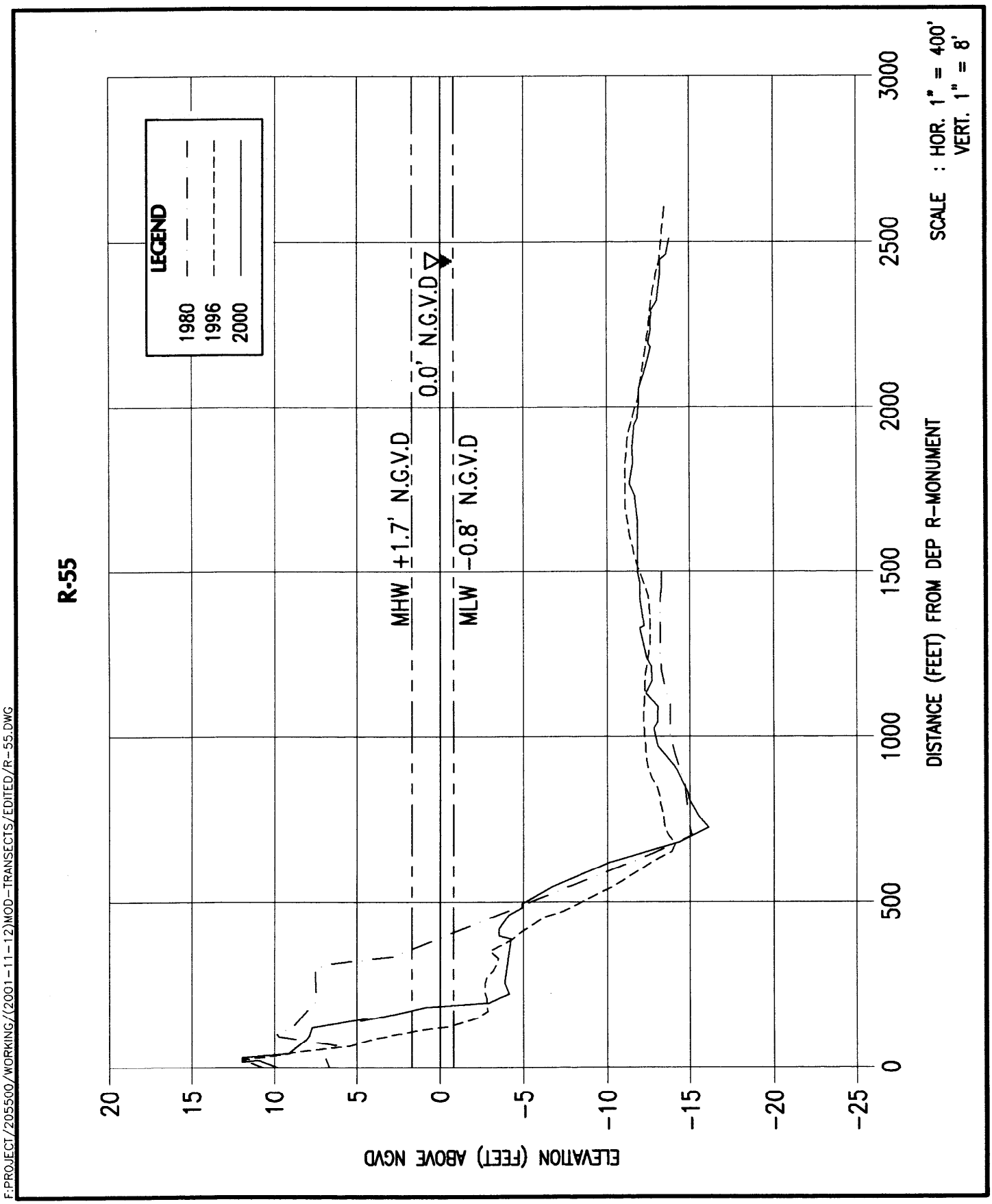
MIAMI-DADE COUNTY, FLORIDA




F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/EDITED/R-54.DWG

# R-54 - MIAMI BEACH

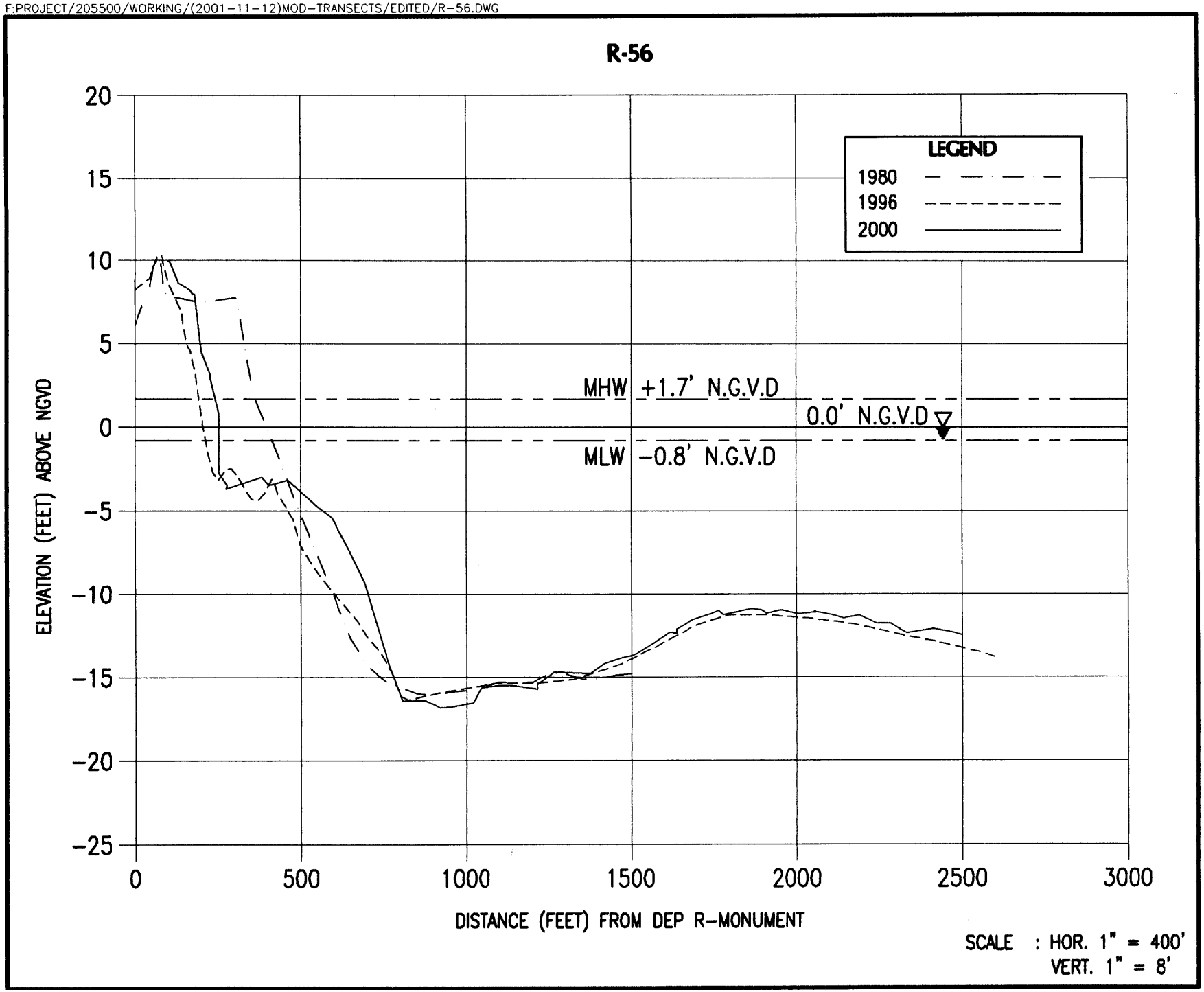
MIAMI-DADE COUNTY, FLORIDA




# R-55 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/EDITED/R-56.DWG



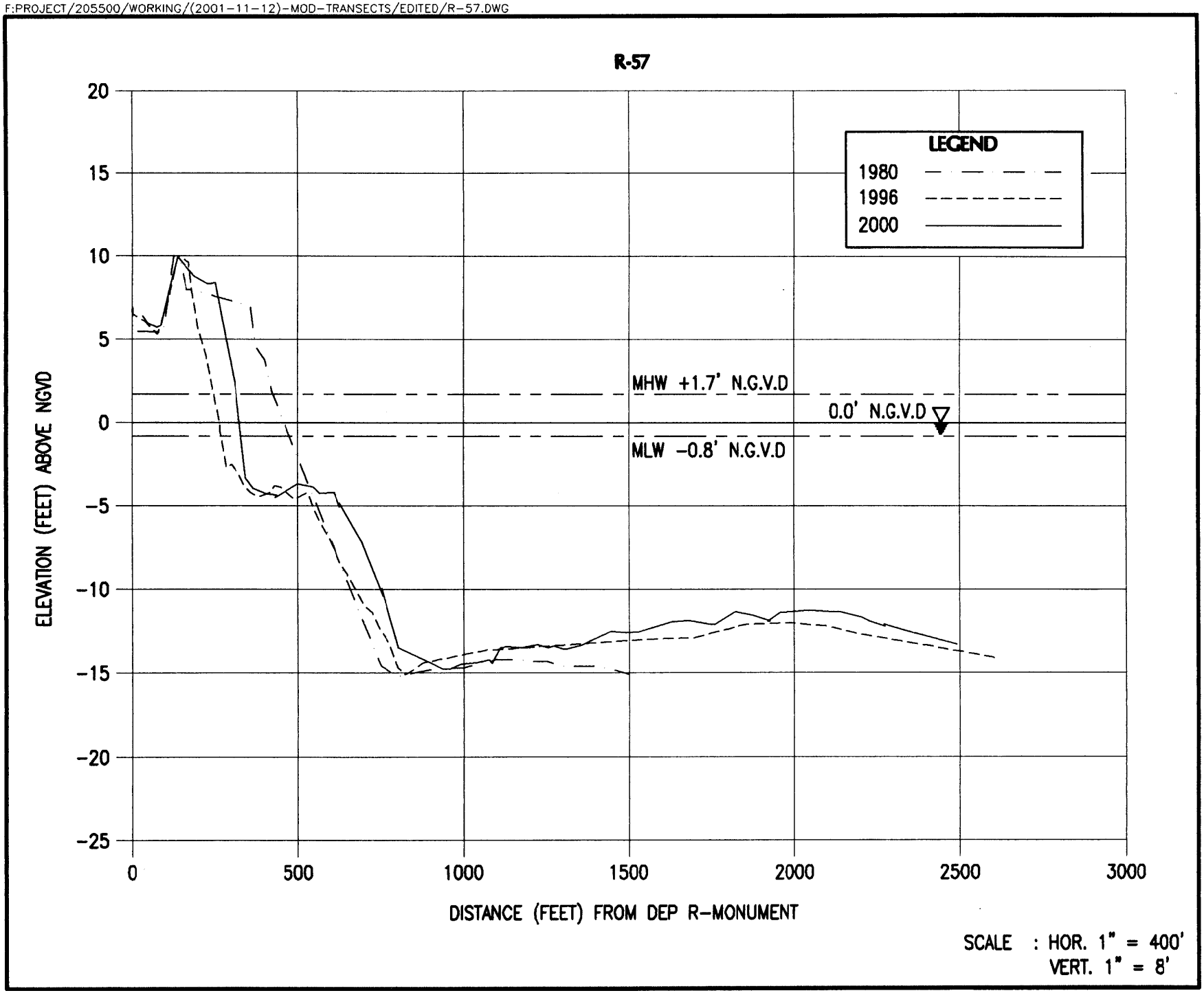

# R-56 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

F:PROJECT/205500/WORKING/(2001-11-12)-MOD-TRANSECTS/EDITED/R-57.DWG

# R-57 -MIAMI BEACH

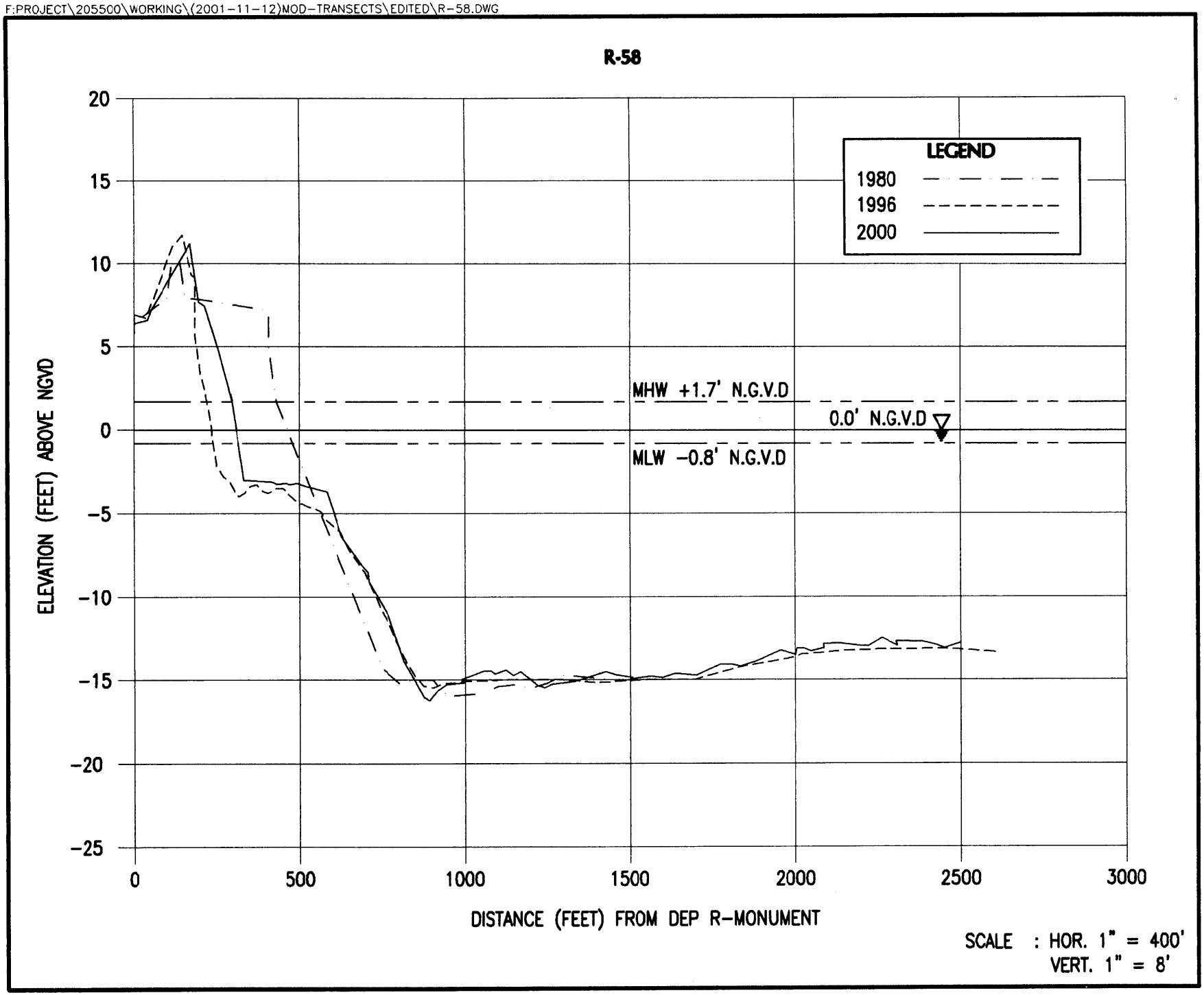
MIAMI-DADE COUNTY, FLORIDA

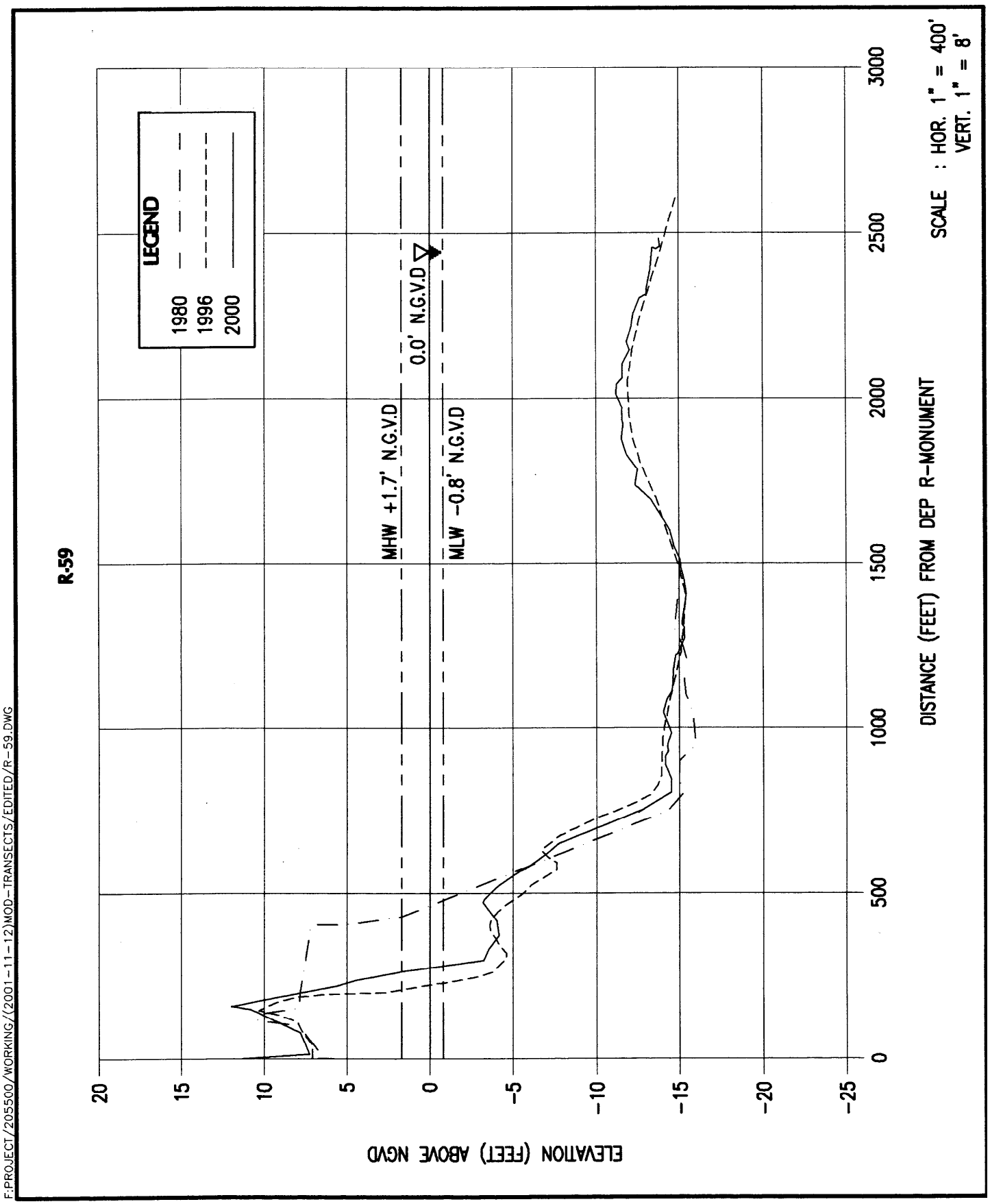


F:PROJECT\205500\WORKING\(2001-11-12)MOD-TRANSECTS\EDITED\R-58.DWG

# R-58 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

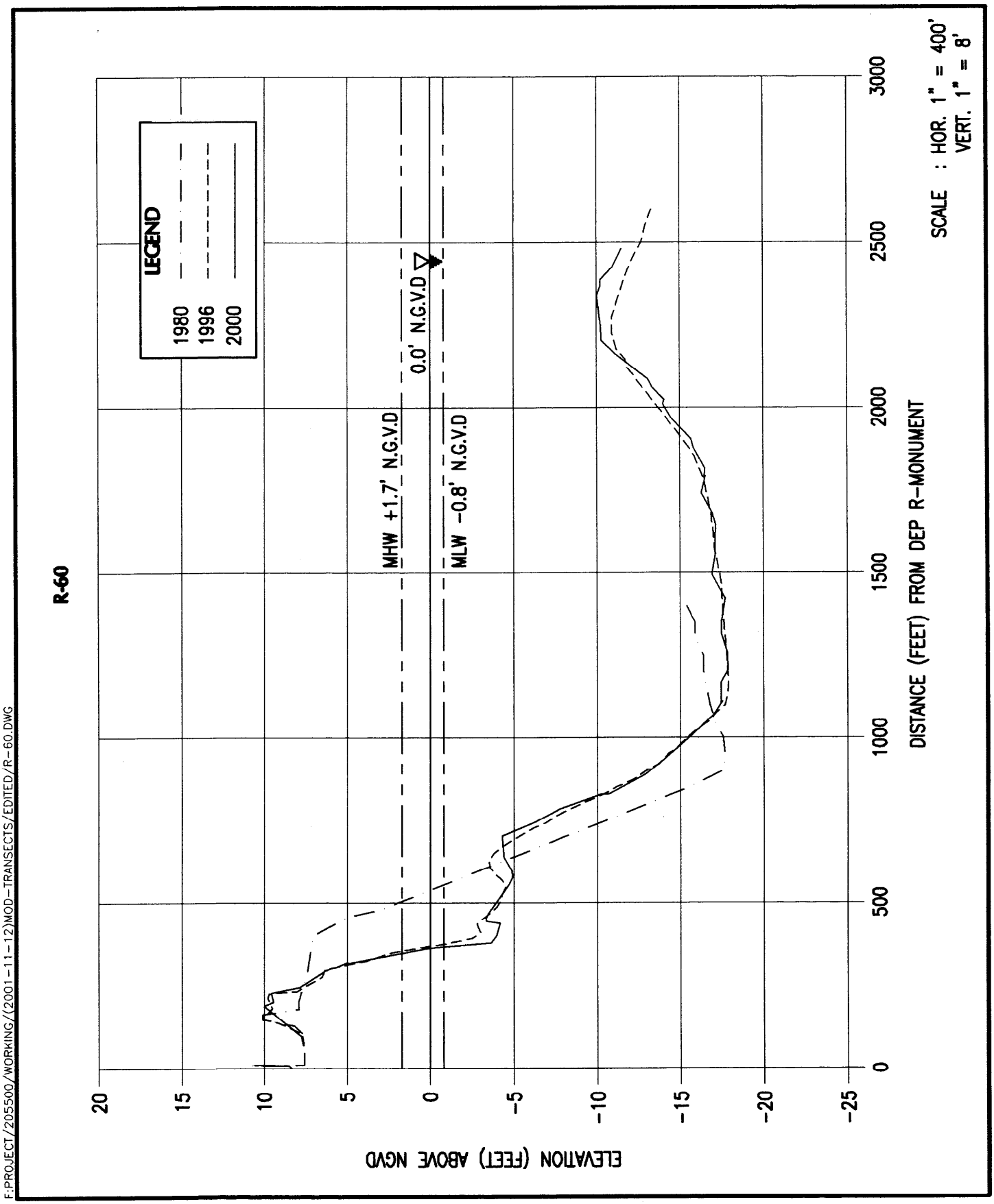





F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/EDITED/R-59.DWG

# R-59 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA



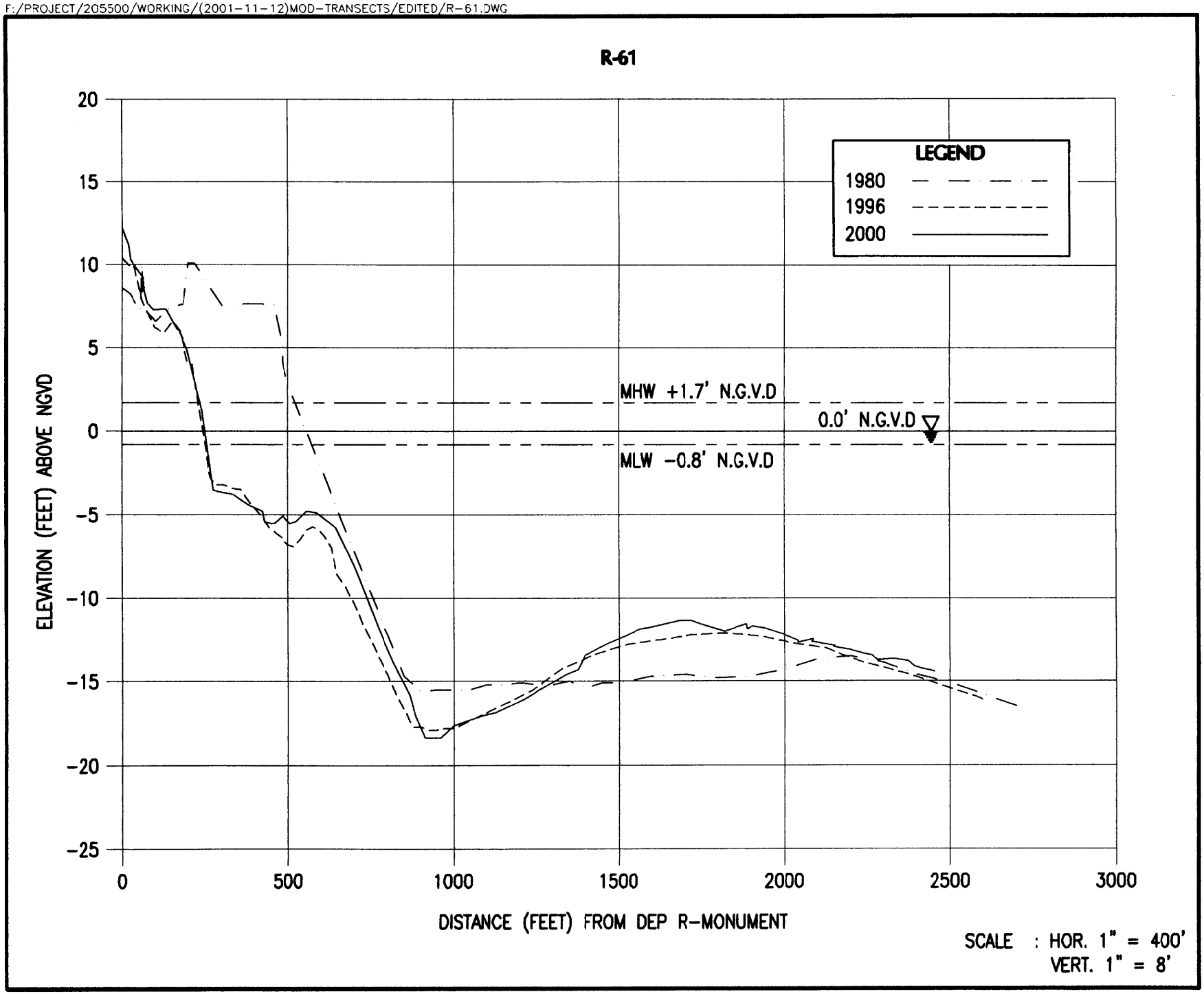

# R-60 - MIAMI BEACH

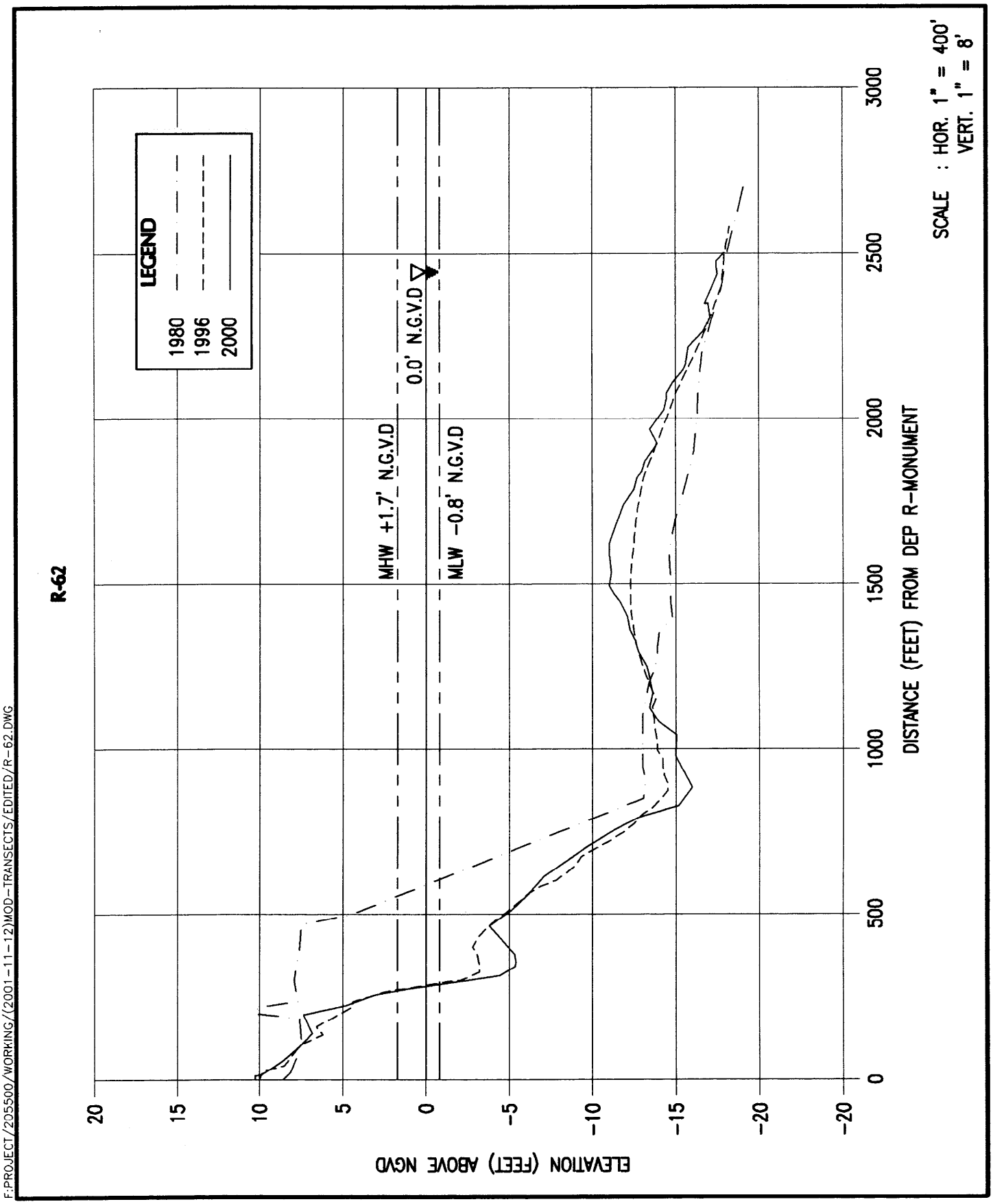
MIAMI-DADE COUNTY, FLORIDA

F:/PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/EDITED/R-61.DWG

# R-61 - MIAMI BEACH

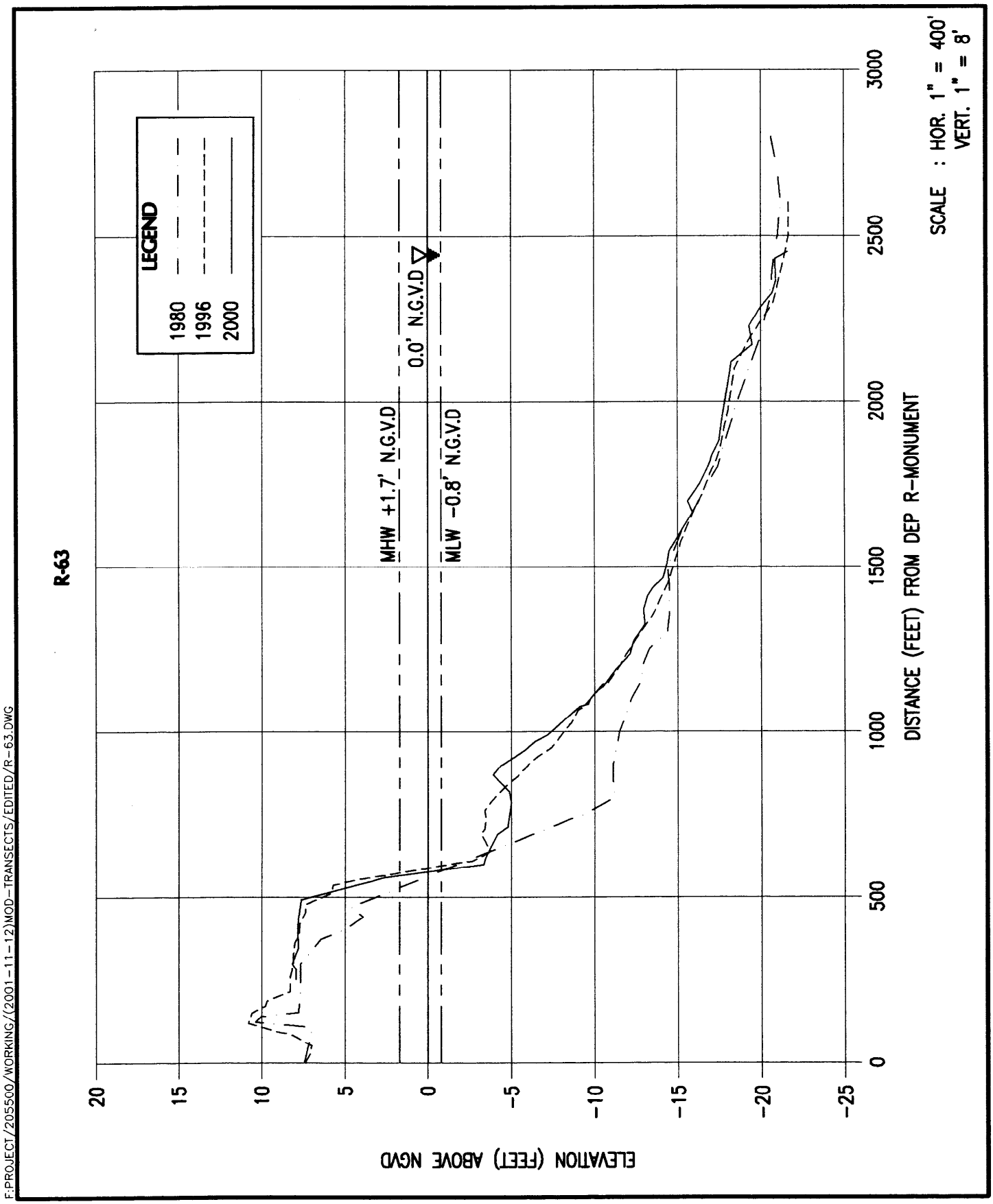
MIAMI-DADE COUNTY, FLORIDA





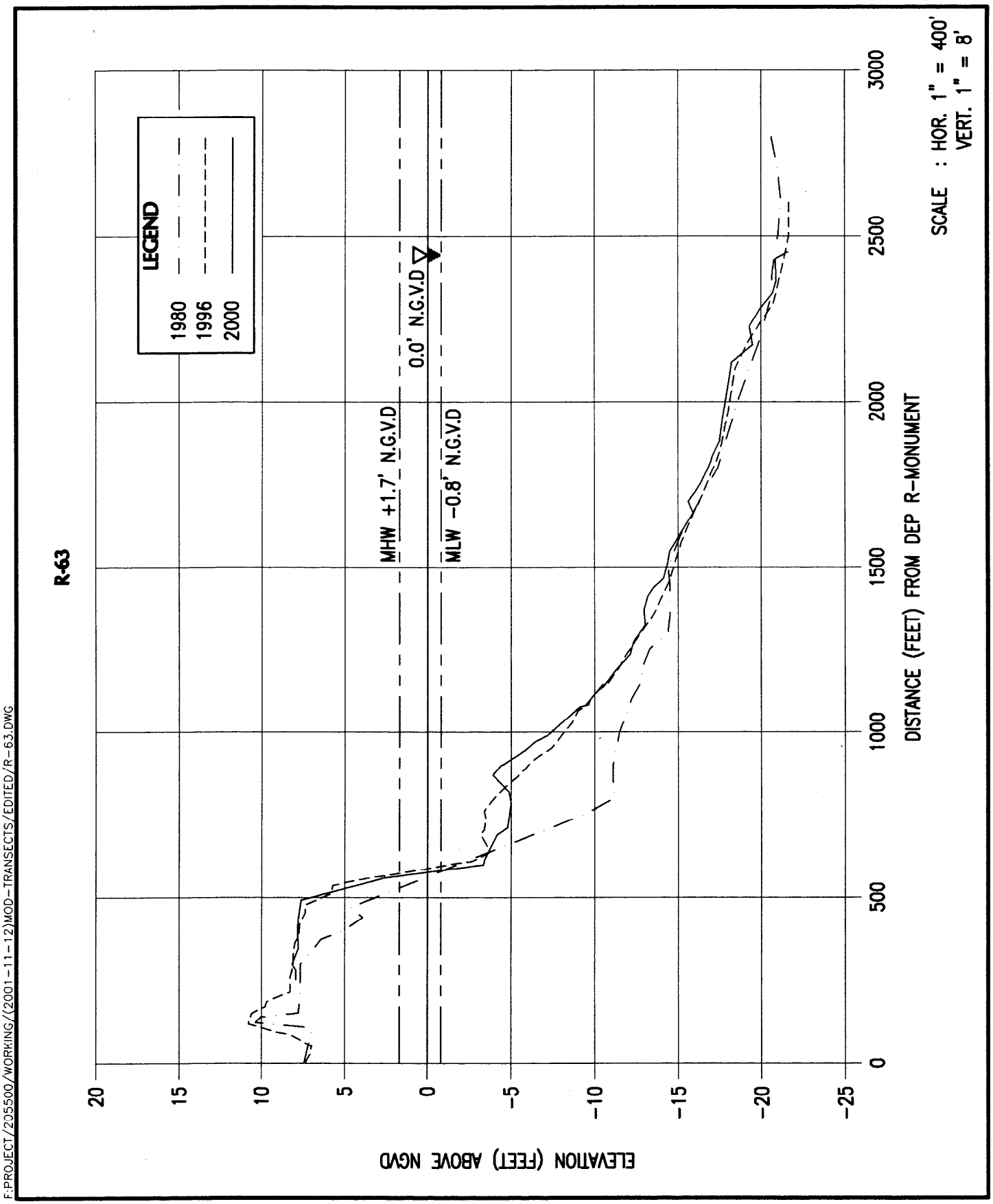

# R-62 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA




# R-63 - MIAMI BEACH

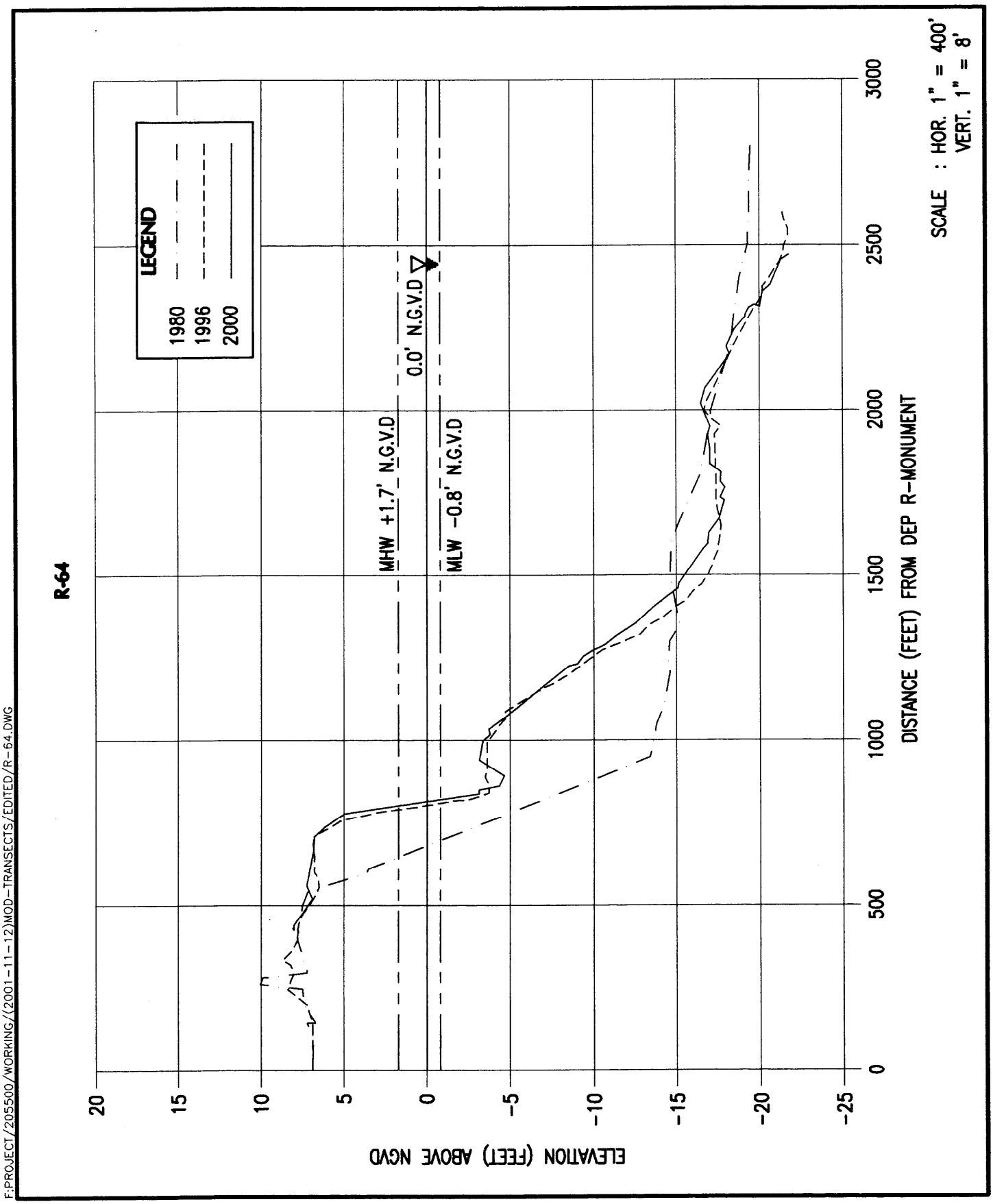
MIAMI-DADE COUNTY, FLORIDA




F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/EDITED/R-63.DWG

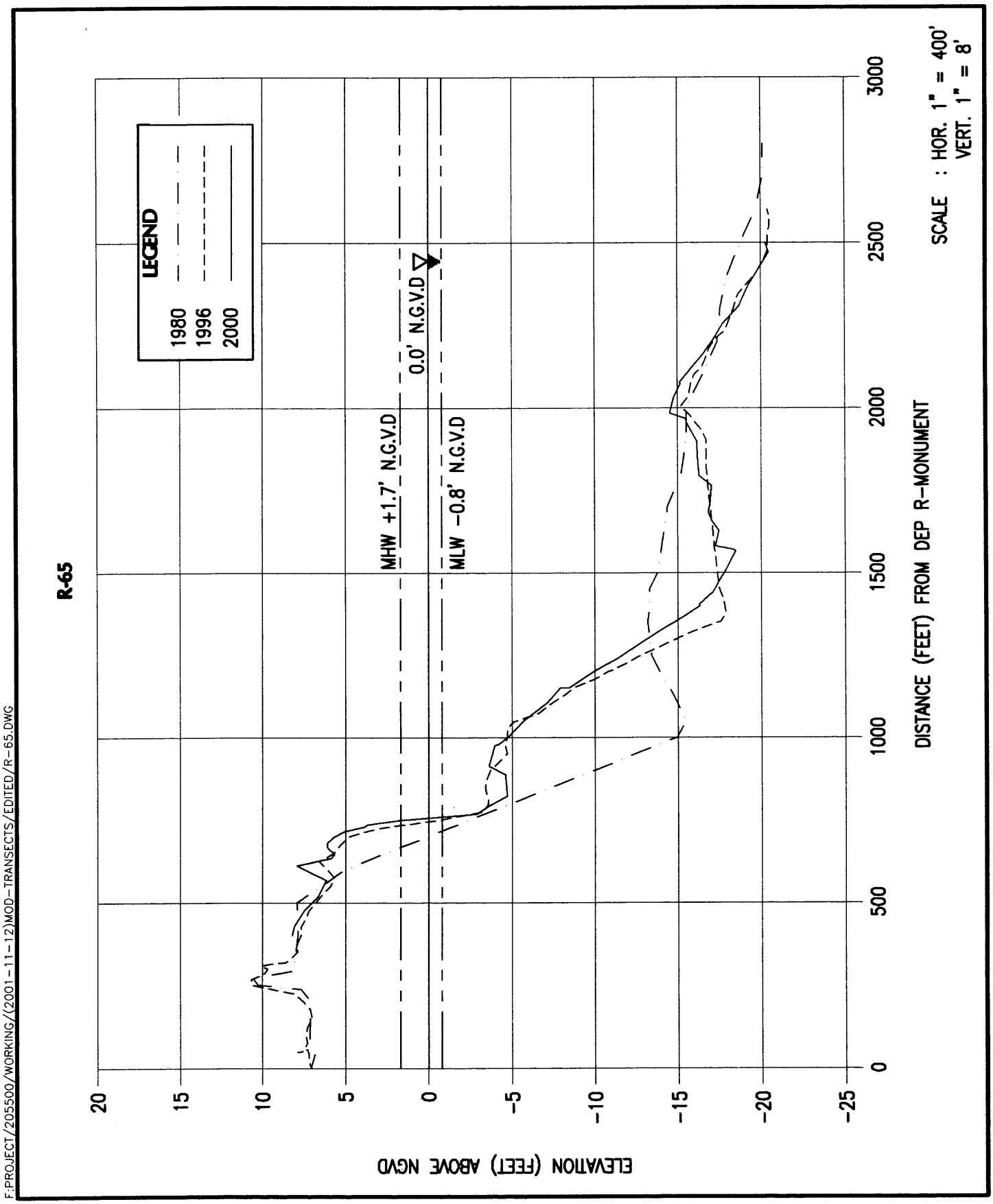
# R-63 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA




# R-64 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

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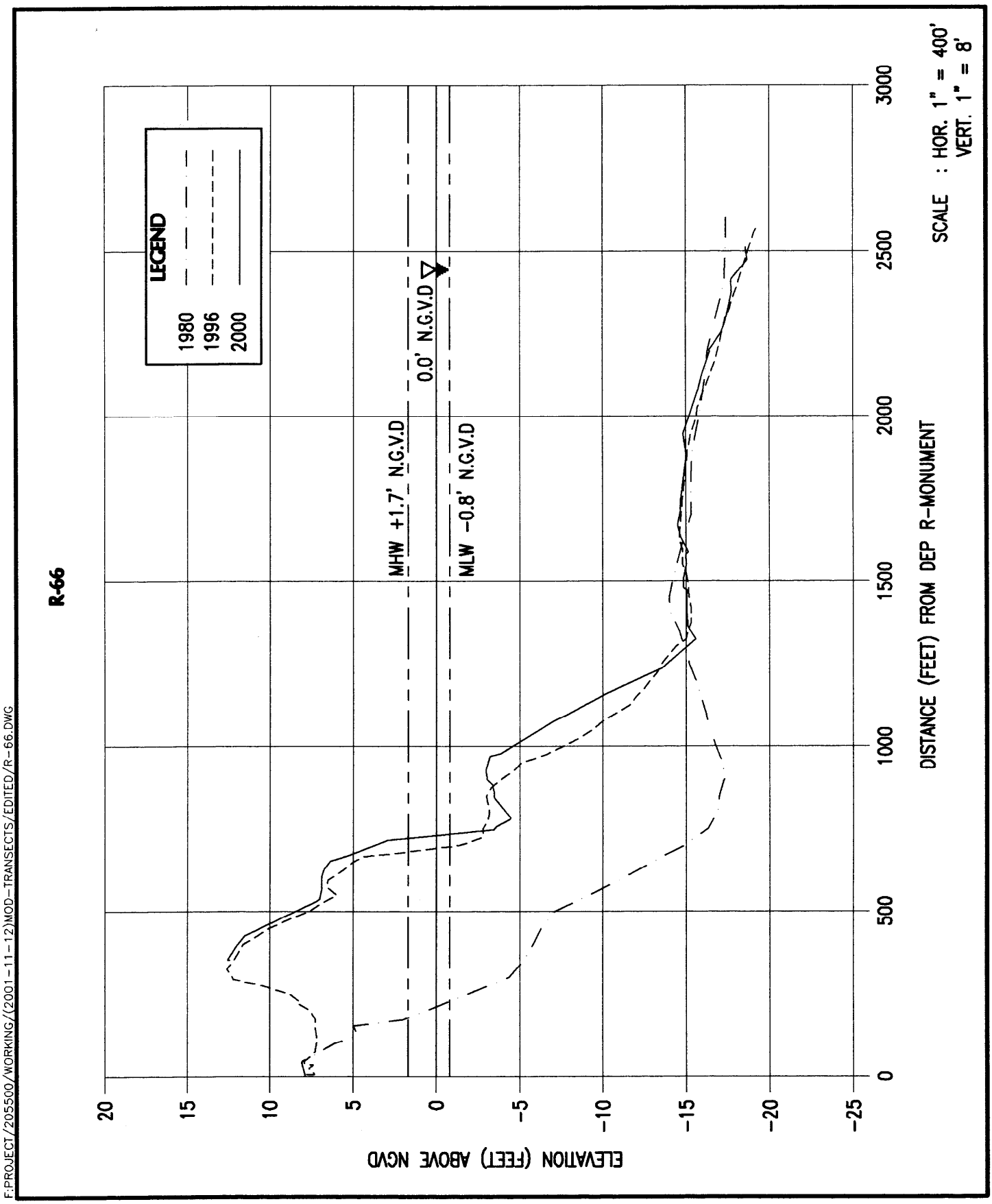
# R-65 - MIAMI BEACH

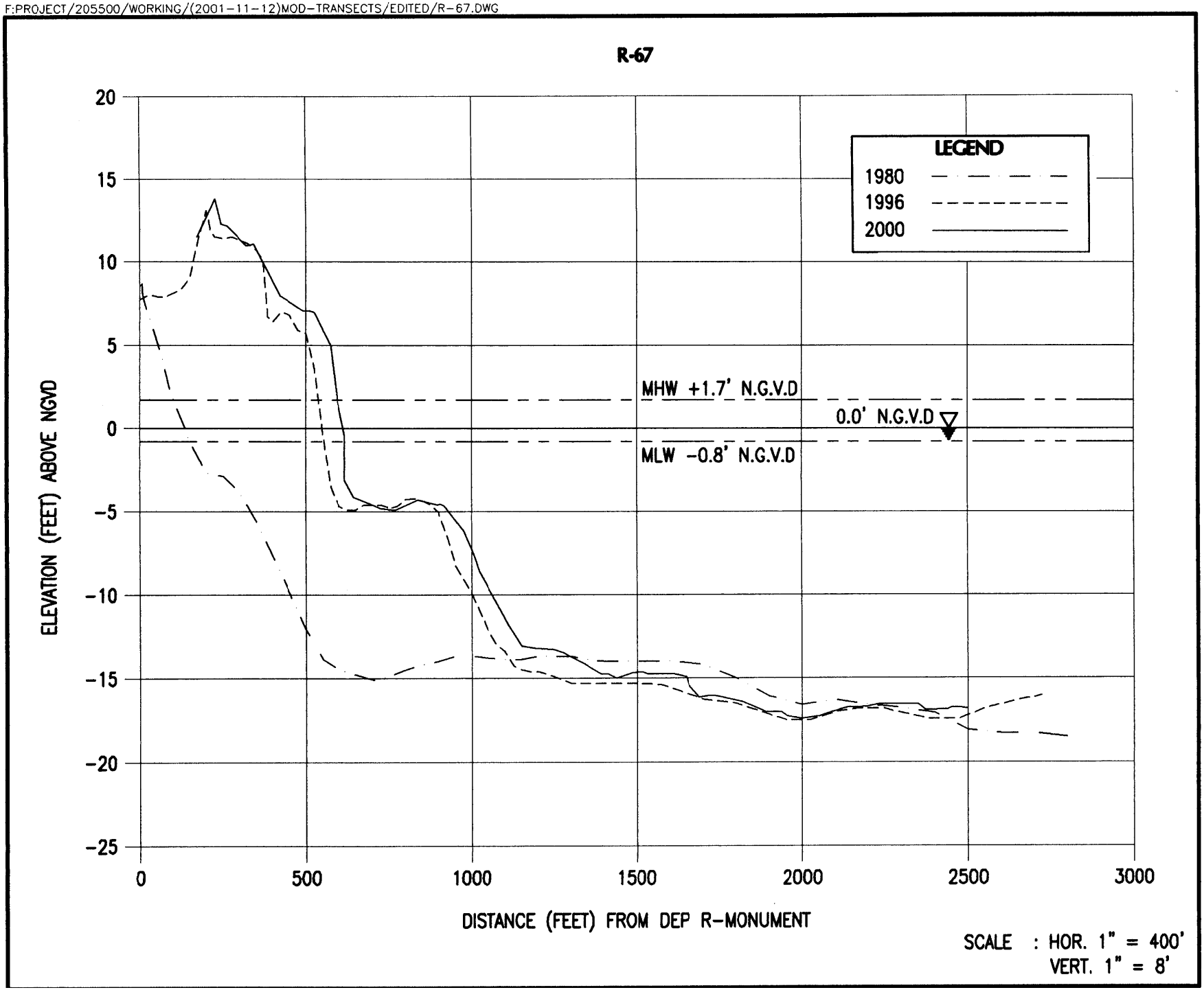
MIAMI-DADE COUNTY, FLORIDA




# R-66 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

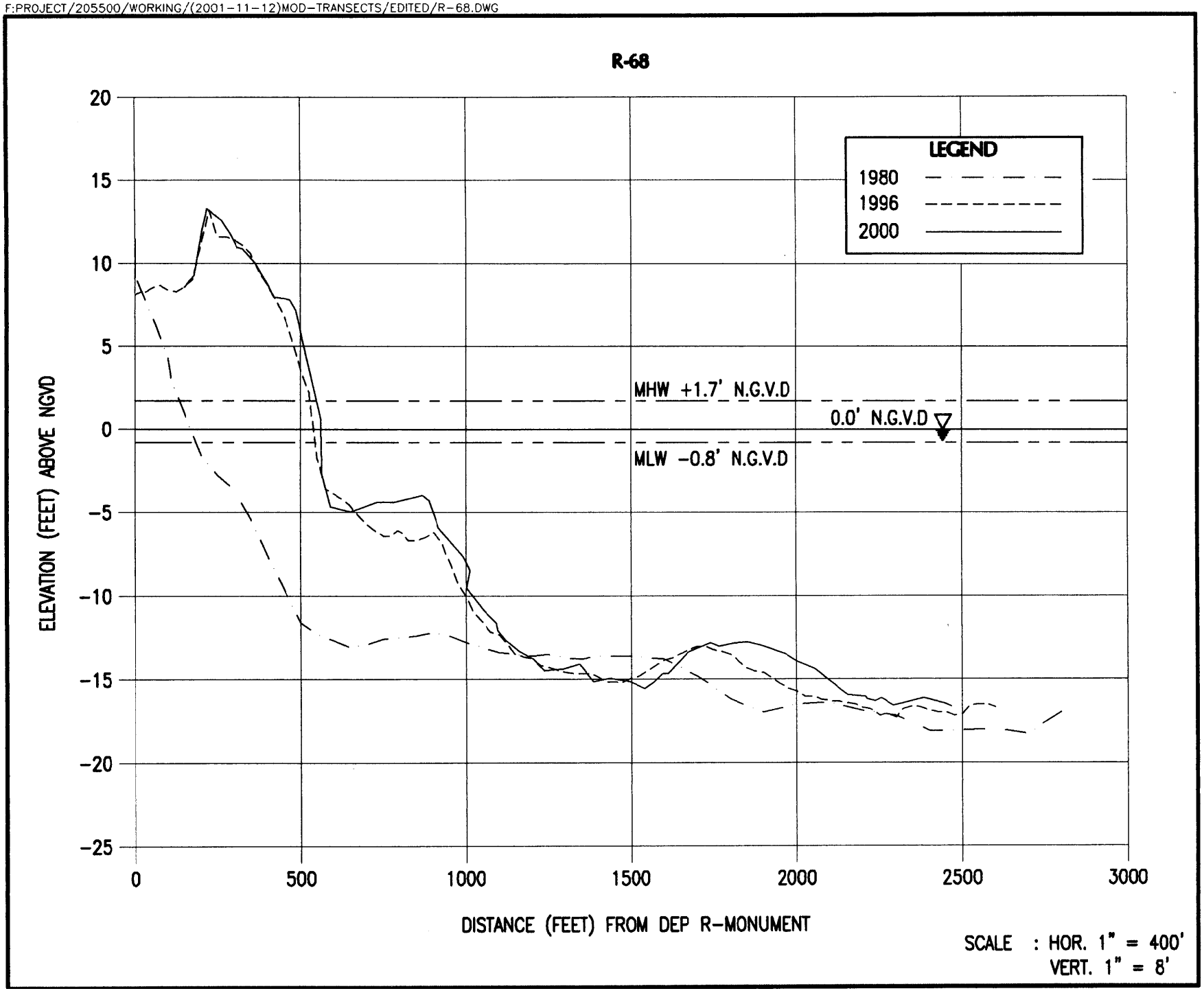
F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/EDITED/R-67.DWG




# R-67 - MIAMI BEACH

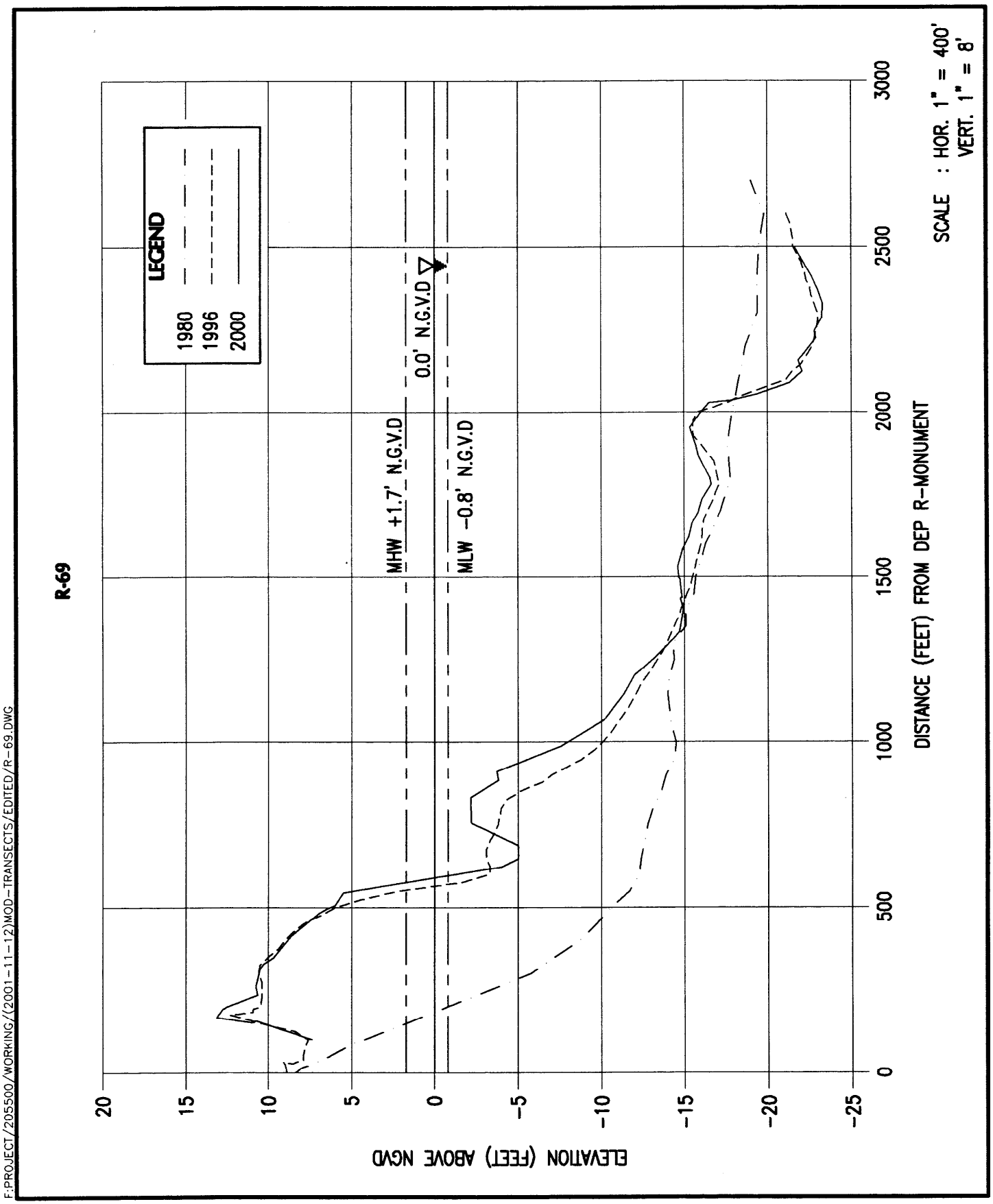
MIAMI-DADE COUNTY, FLORIDA

F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/EDITED/R-68.DWG




# R-68 -MIAMI BEACH

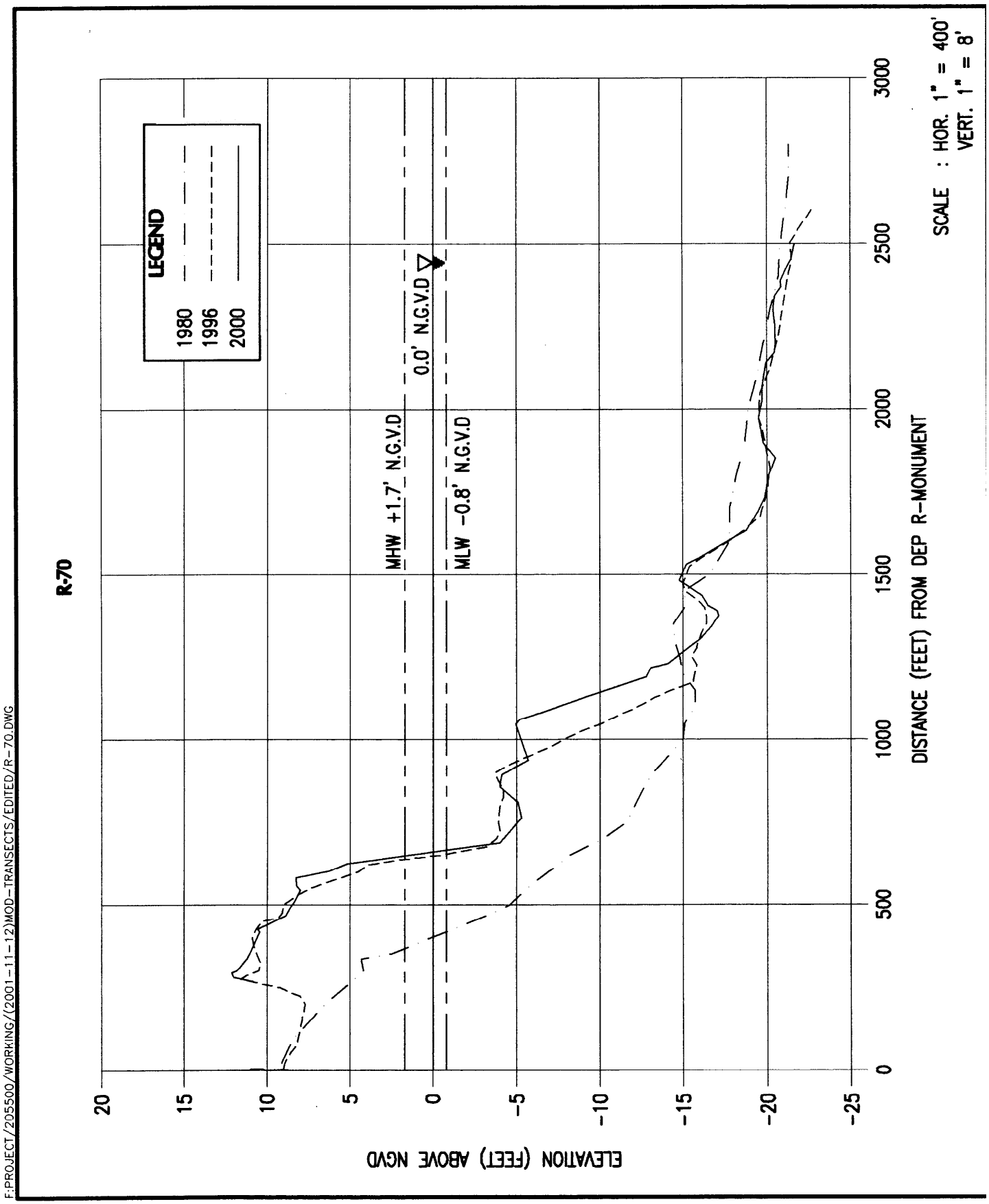
MIAMI-DADE COUNTY, FLORIDA




F:\PROJECT\205500\WORKING\(2001-11-12)MOD-TRANSECTS\EDITED\R-69.DWG

# R-69 - MIAMI BEACH

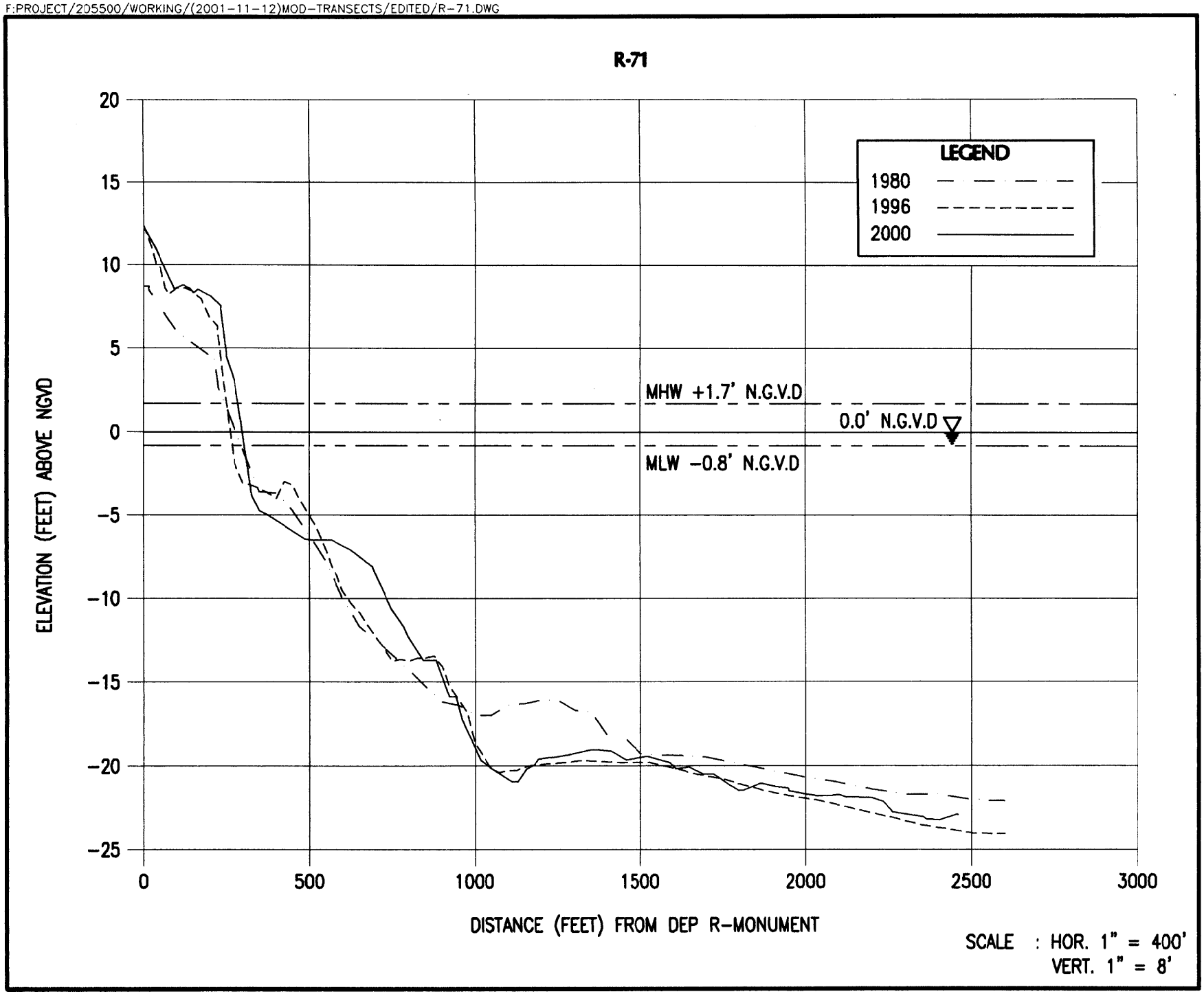
MIAMI-DADE COUNTY, FLORIDA




# R-70 - MIAMI BEACH

MIAMII-DADE COUNTY, FLORIDA

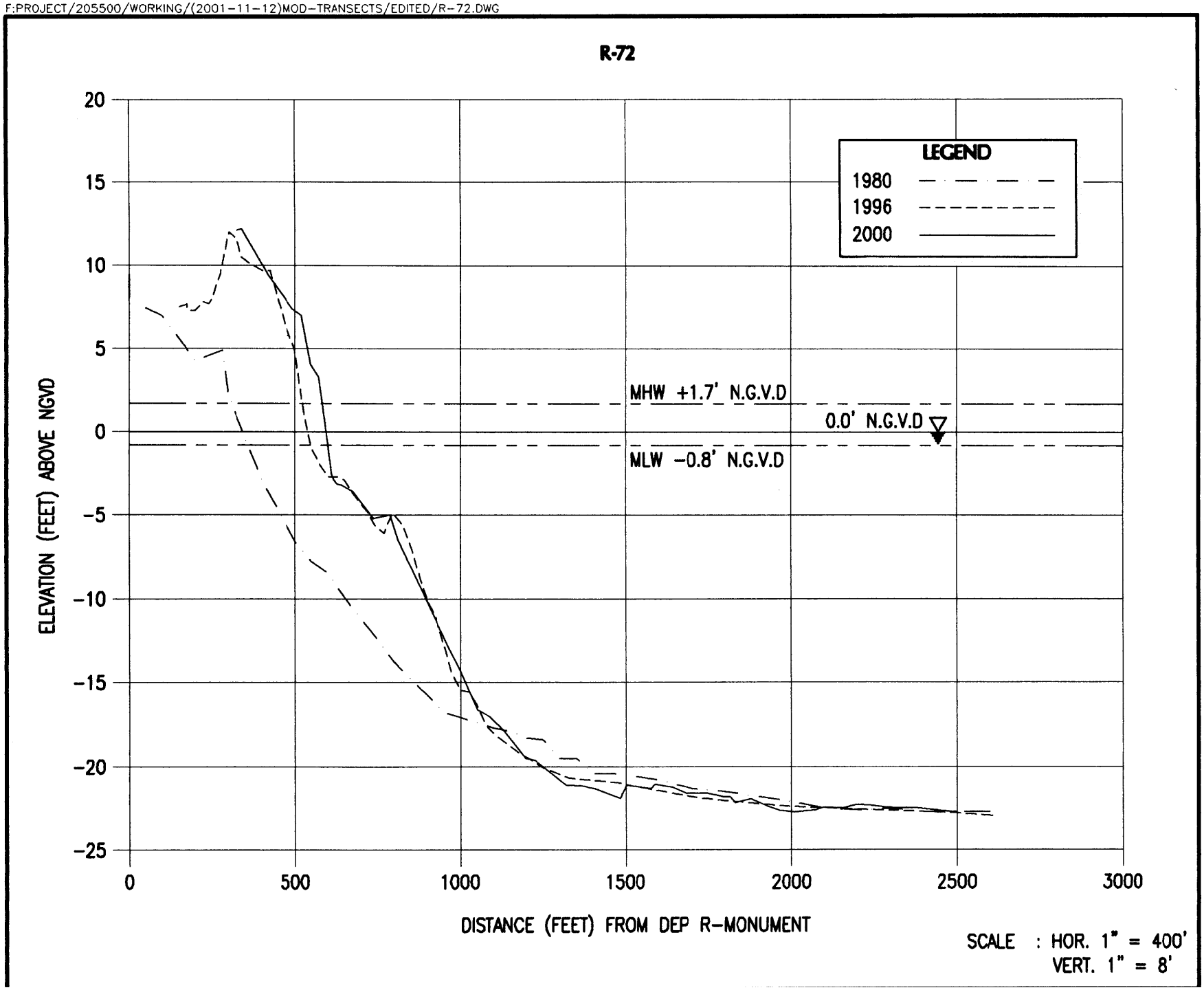
F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/EDITED/R-71.DWG




# R-71 - MIAMI BEACH

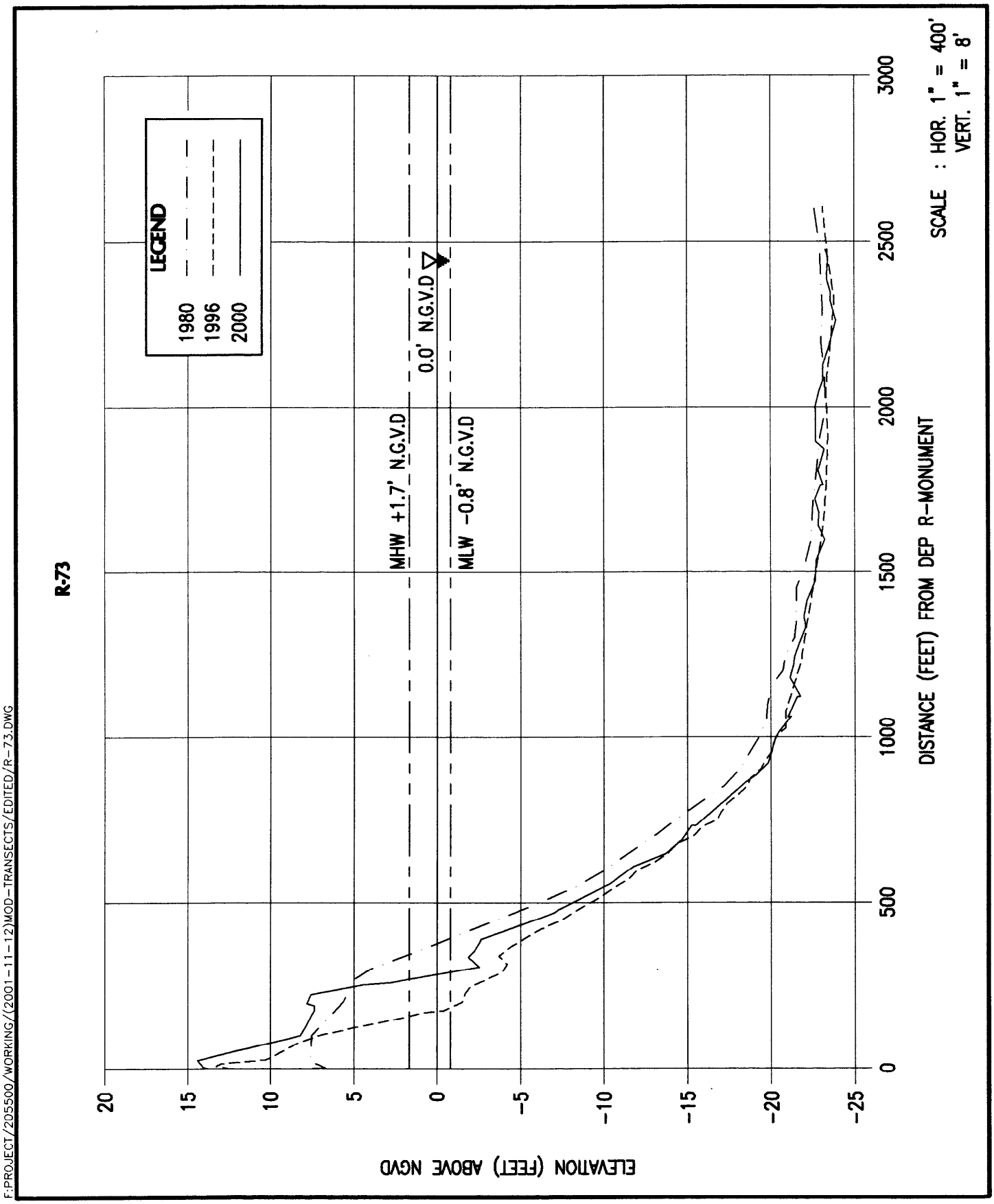
MIAMI-DADE COUNTY, FLORIDA

F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/EDITED/R-72.DWG



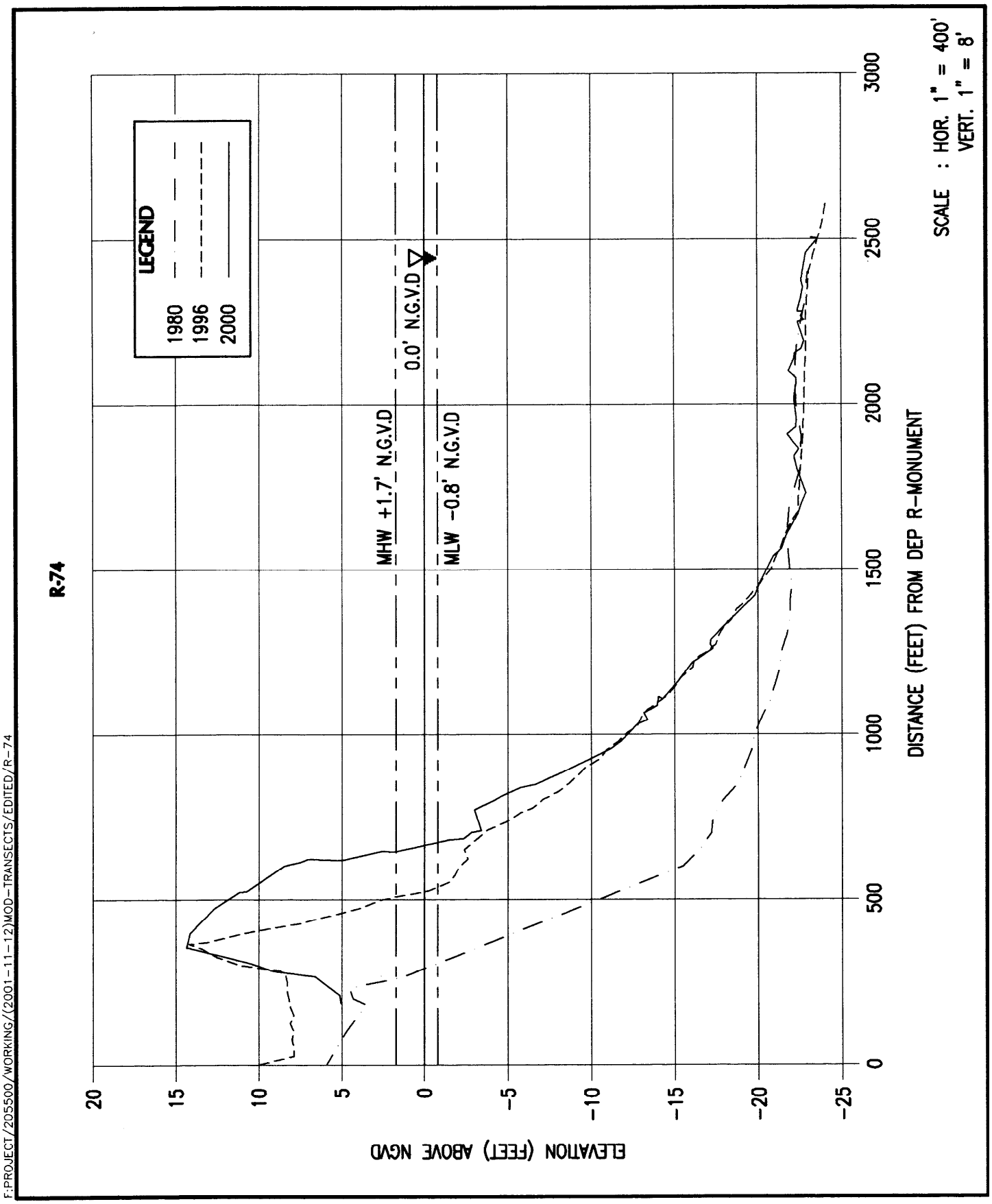

# R-72 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA




# R-73 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA



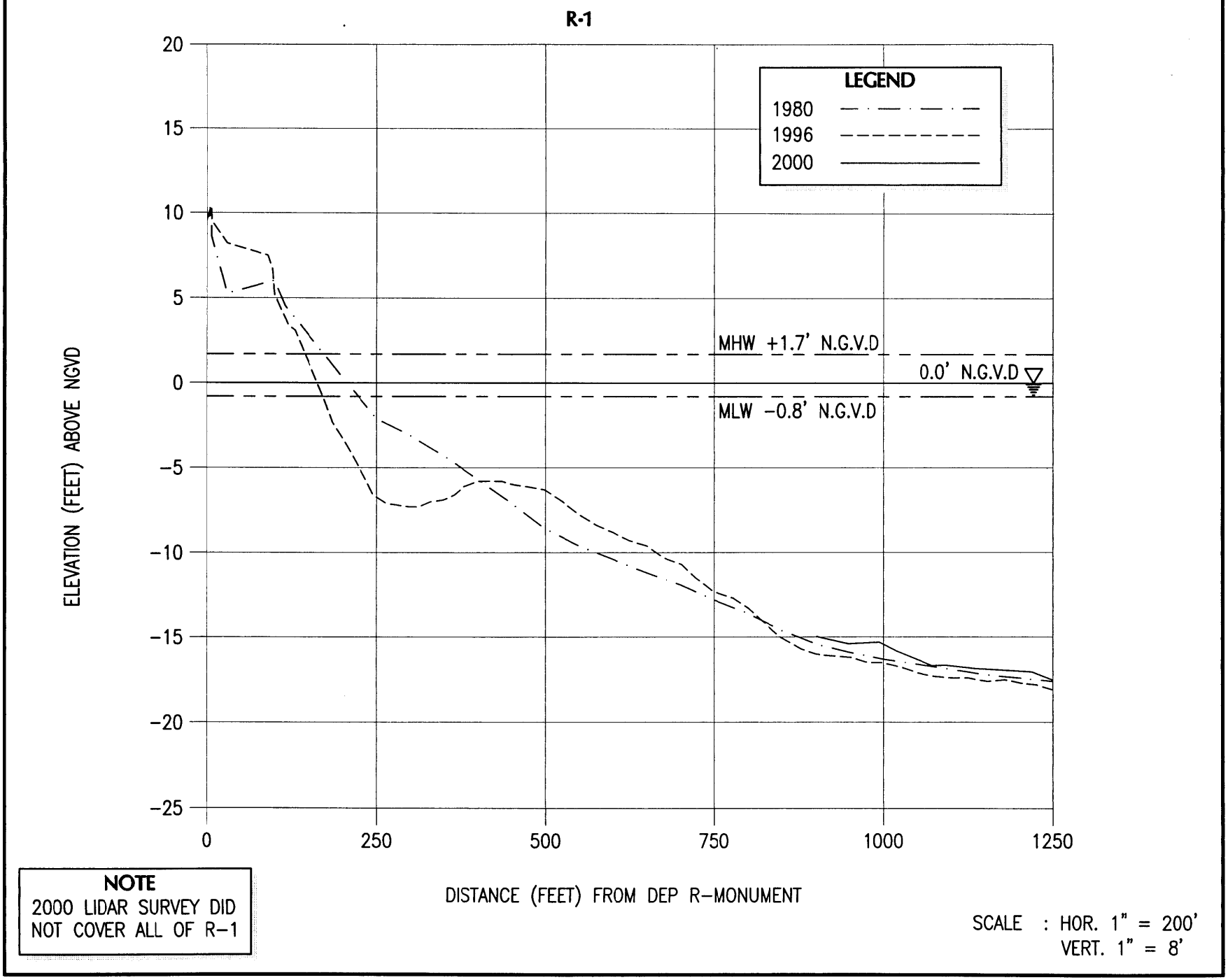

# R-74 - MIAMI BEACH

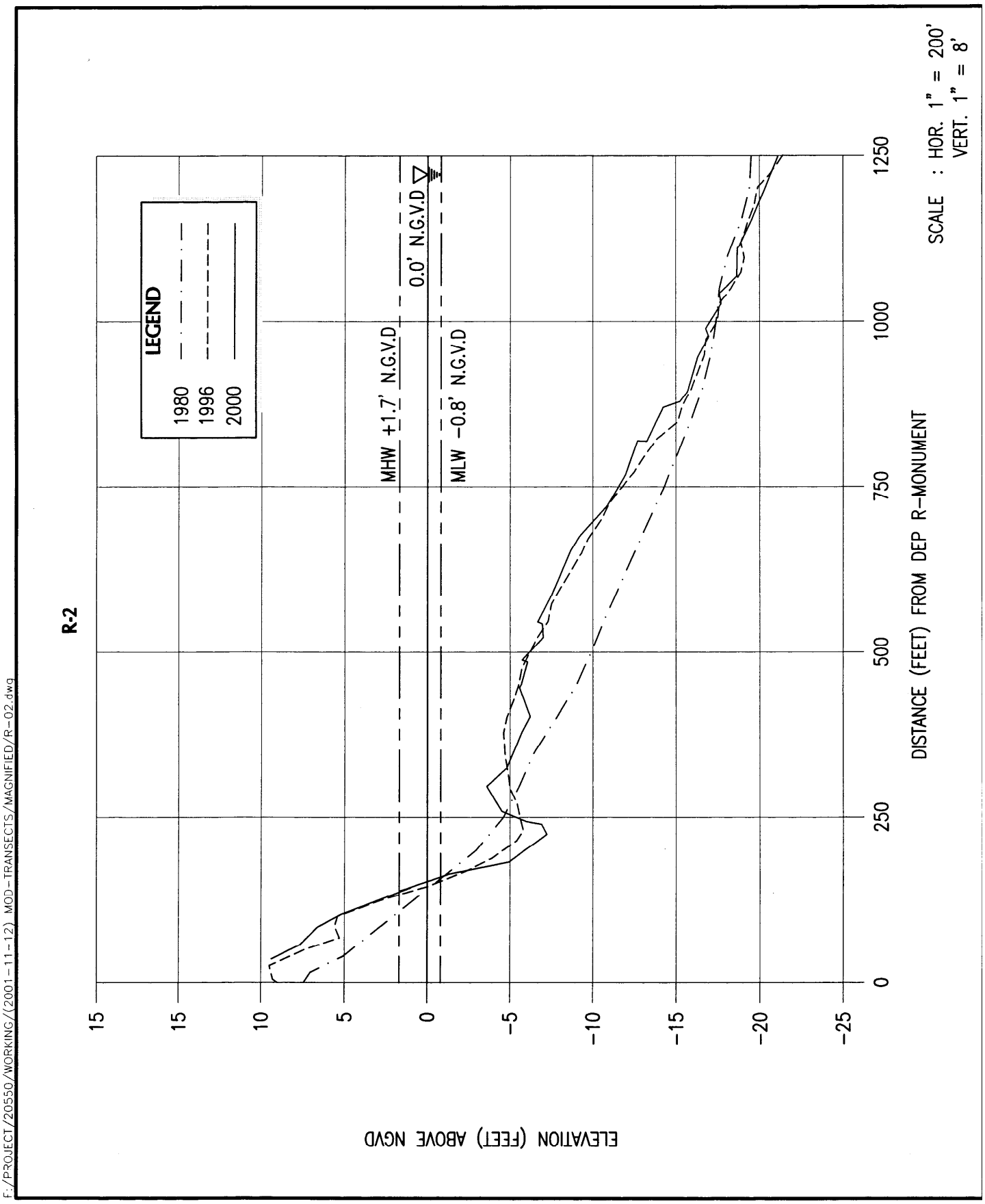
MIAMI-DADE COUNTY, FLORIDA

F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-01.dwg

# R-1 - GOLDEN BEACH

MIAMI-DADE COUNTY, FLORIDA






F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-02.dwg

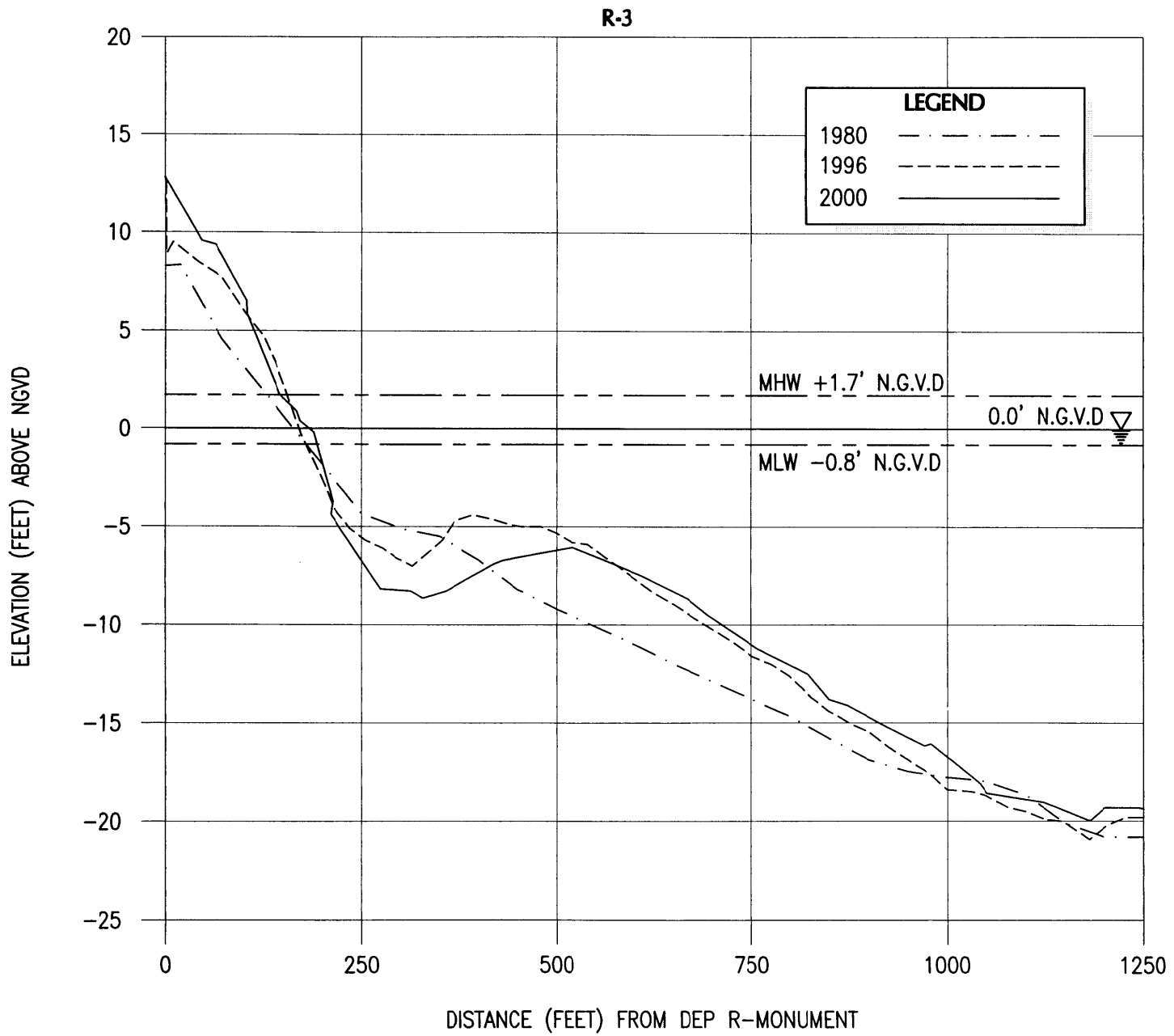
# R-2 - GOLDEN BEACH

MIAMI-DADE COUNTY, FLORIDA

F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-03.dw

# R-3 - GOLDEN BEACH

MIAMI-DADE COUNTY, FLORIDA

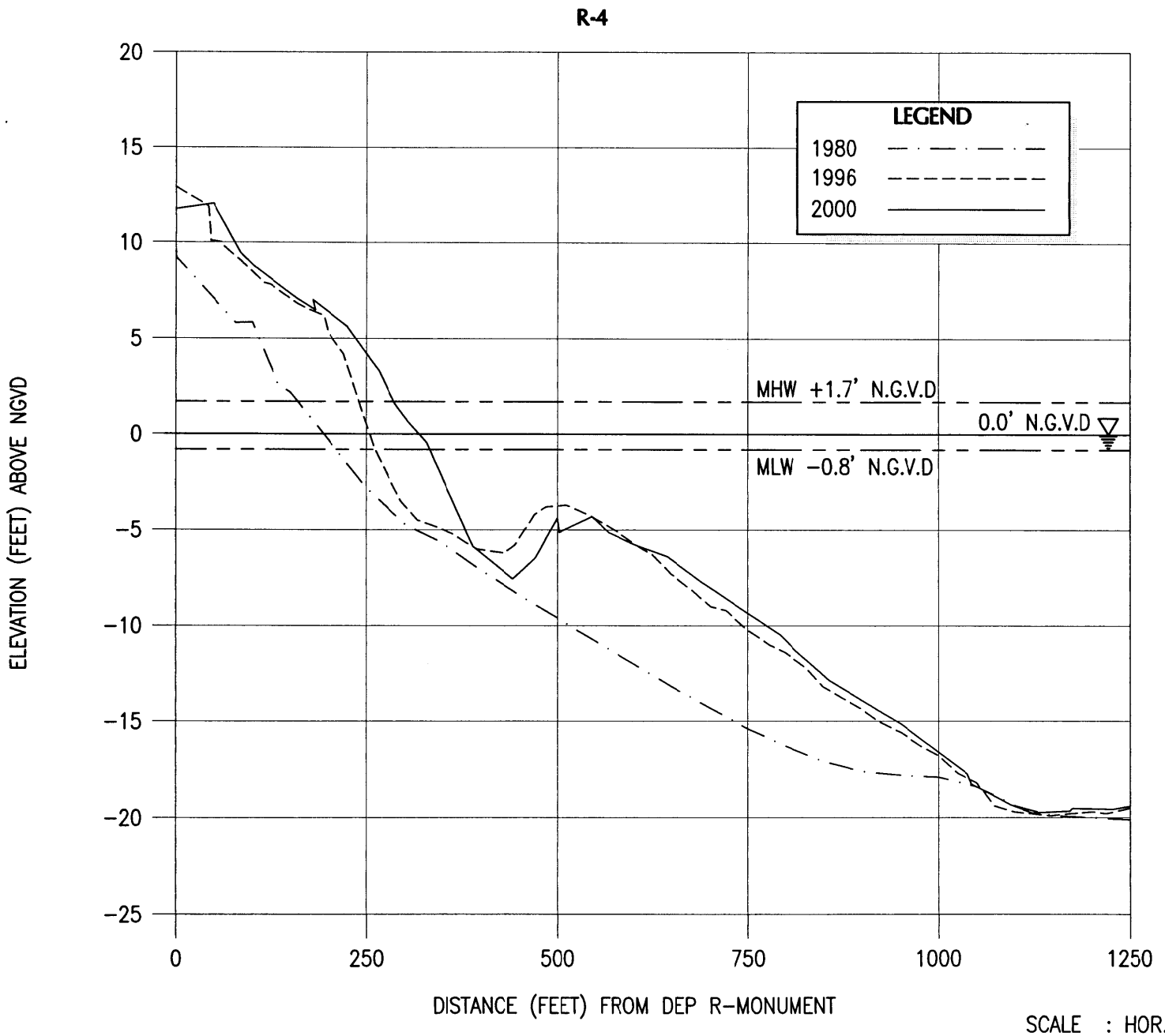



SCALE : HOR. 1" = 200'
VERT. 1" = 8'

F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-04.dw

# R-4 - GOLDEN BEACH

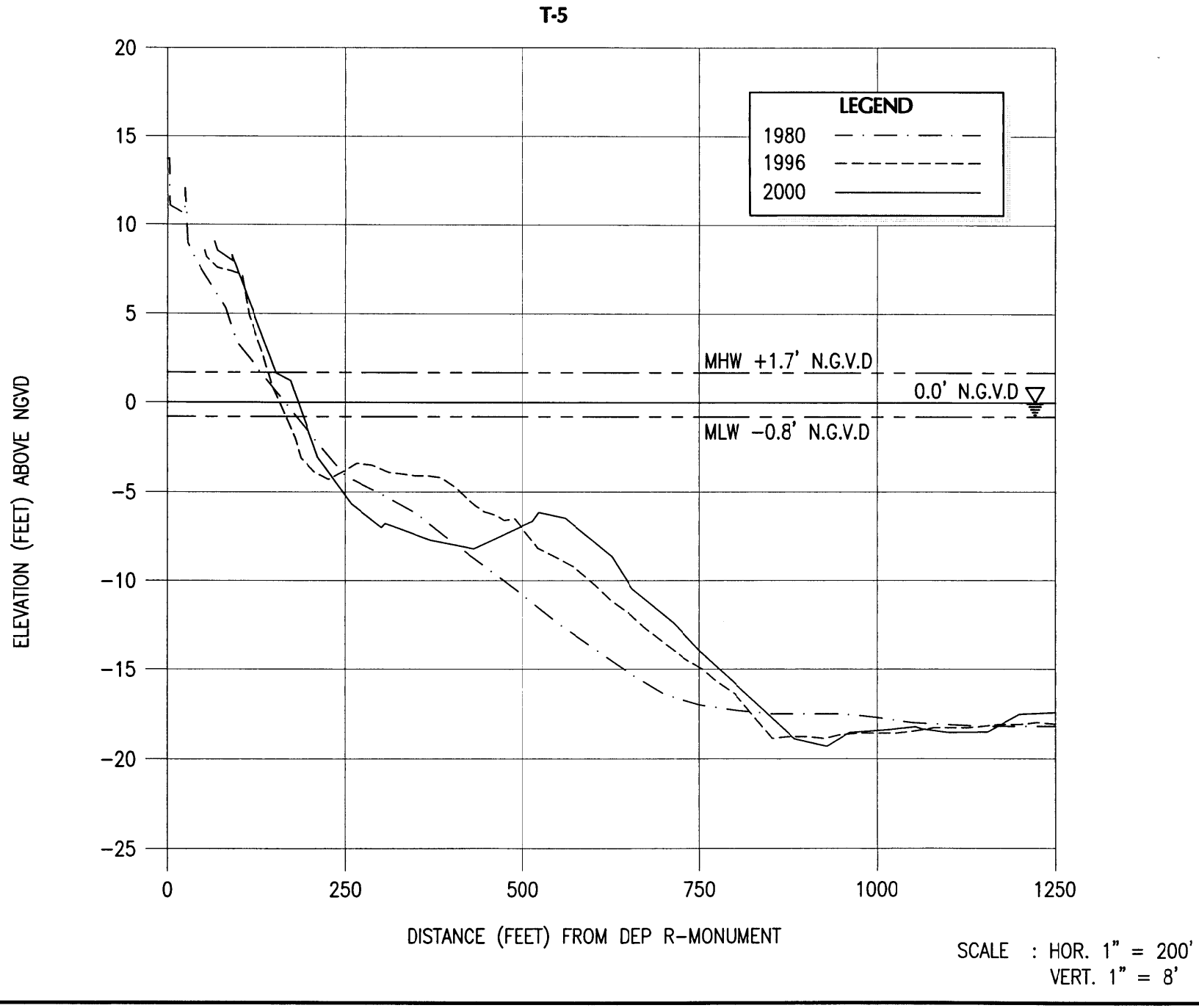
MIAMI-DADE COUNTY, FLORIDA



F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-05.dwg

# T-5 - GOLDEN BEACH

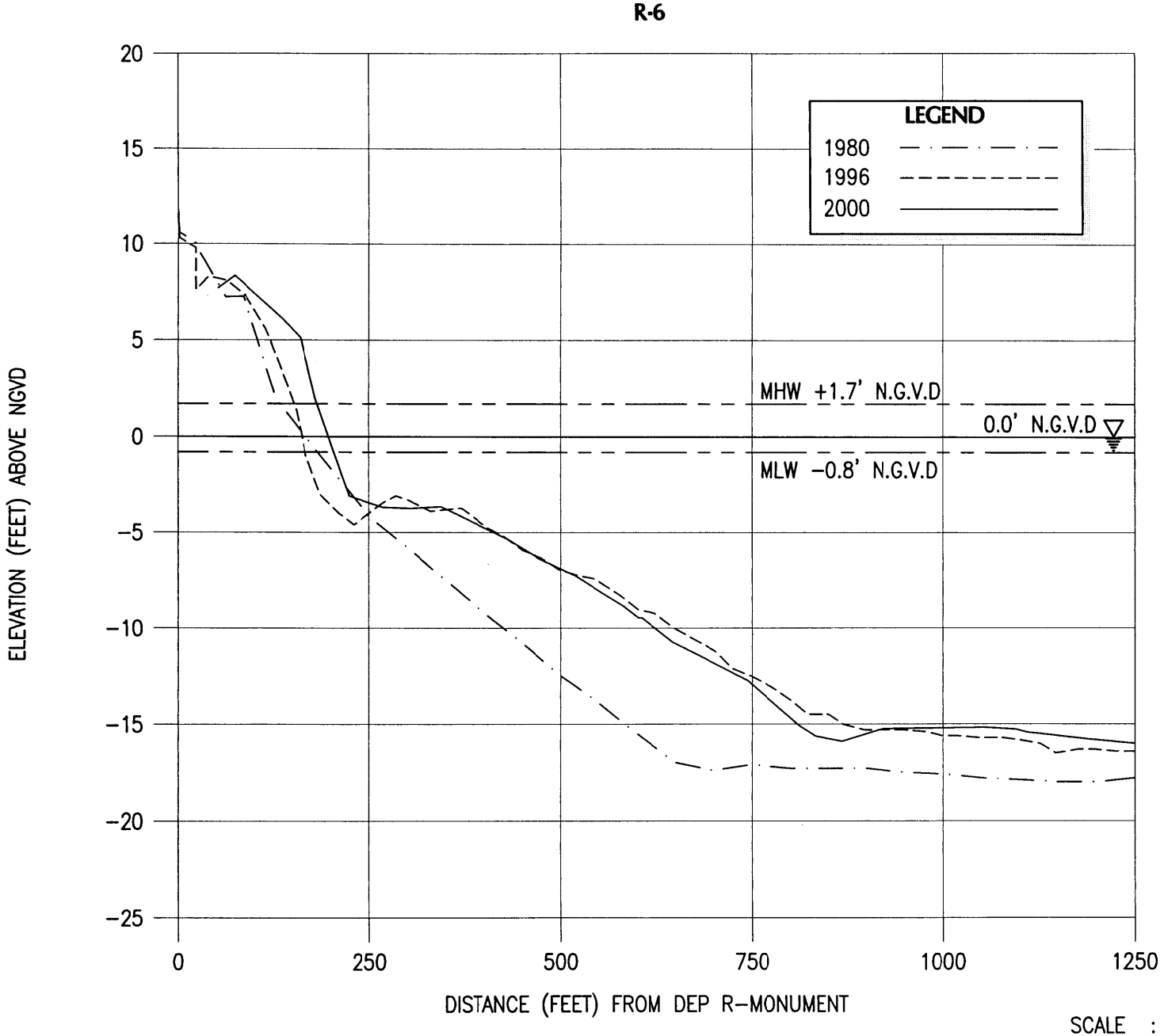
MIAMI-DADE COUNTY, FLORIDA



F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-06.dwg

# R-6 - GOLDEN BEACH

MIAMI-DADE COUNTY, FLORIDA

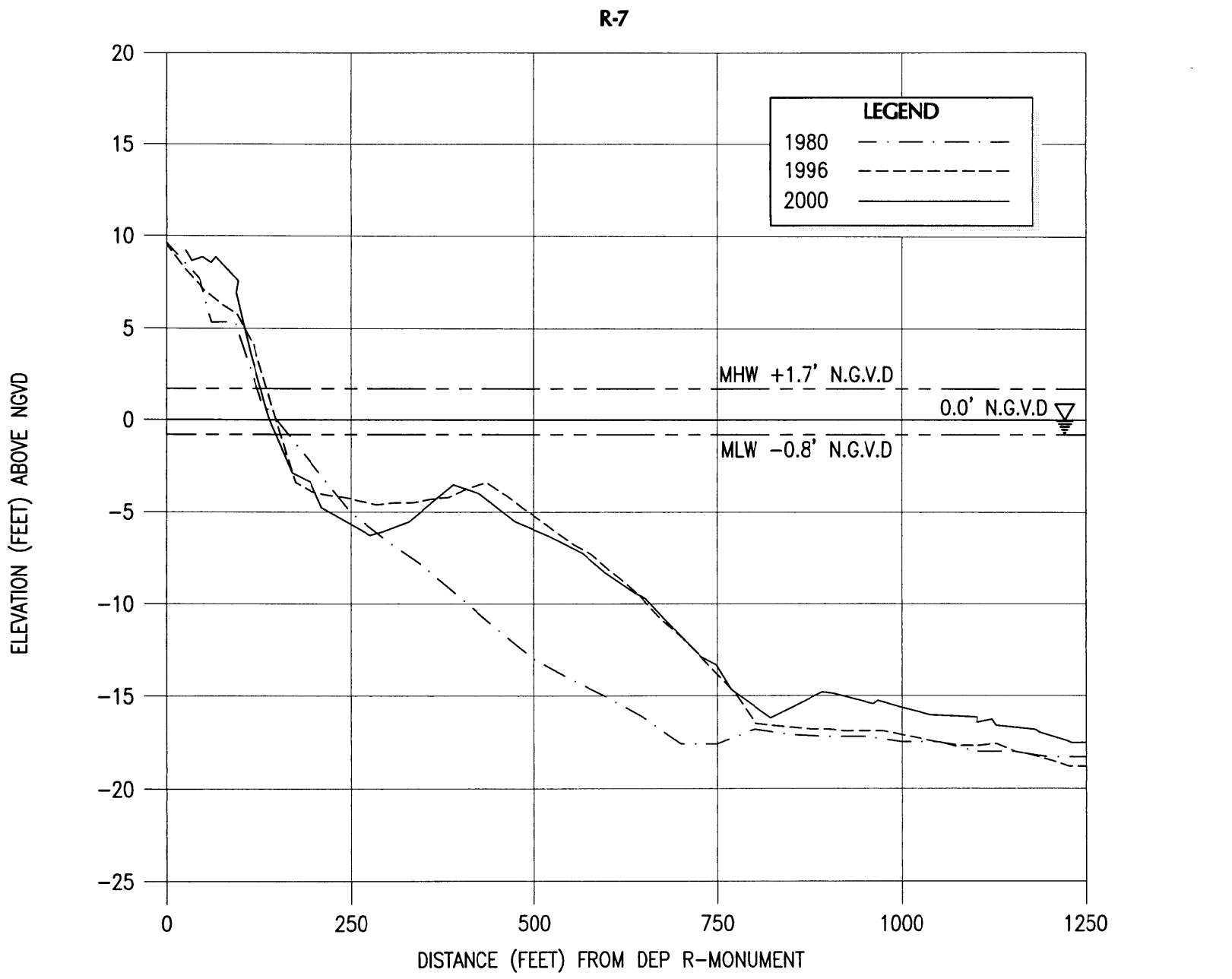



SCALE : HOR. 1" = 200'
VERT. 1" = 8'

F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-07.dwg

# R-7 - GOLDEN BEACH

MIAMI-DADE COUNTY, FLORIDA

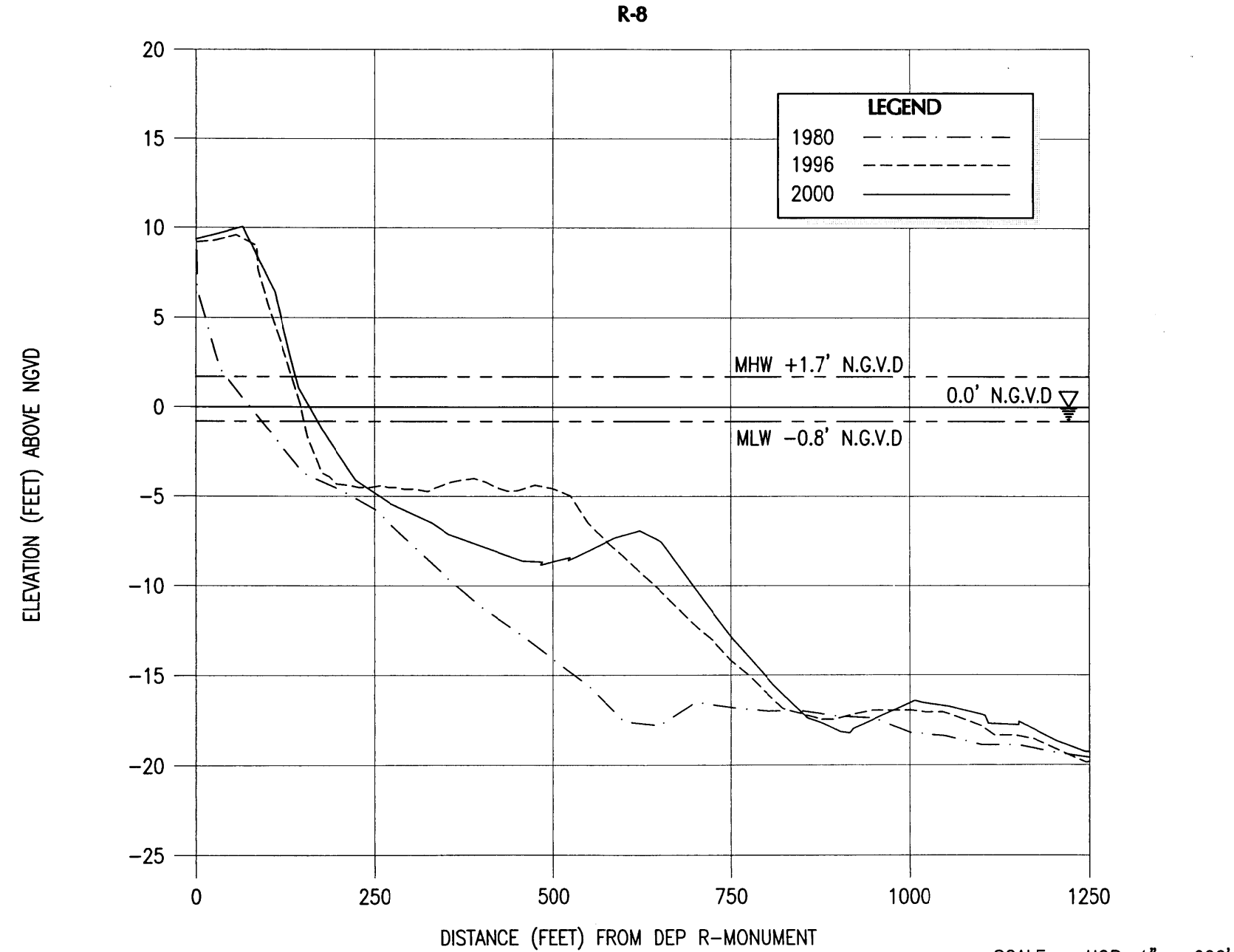



SCALE : HOR. 1" = 200'
VERT. 1" = 8'

F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-08.dwg

# R-8 - SUNNY ISLES

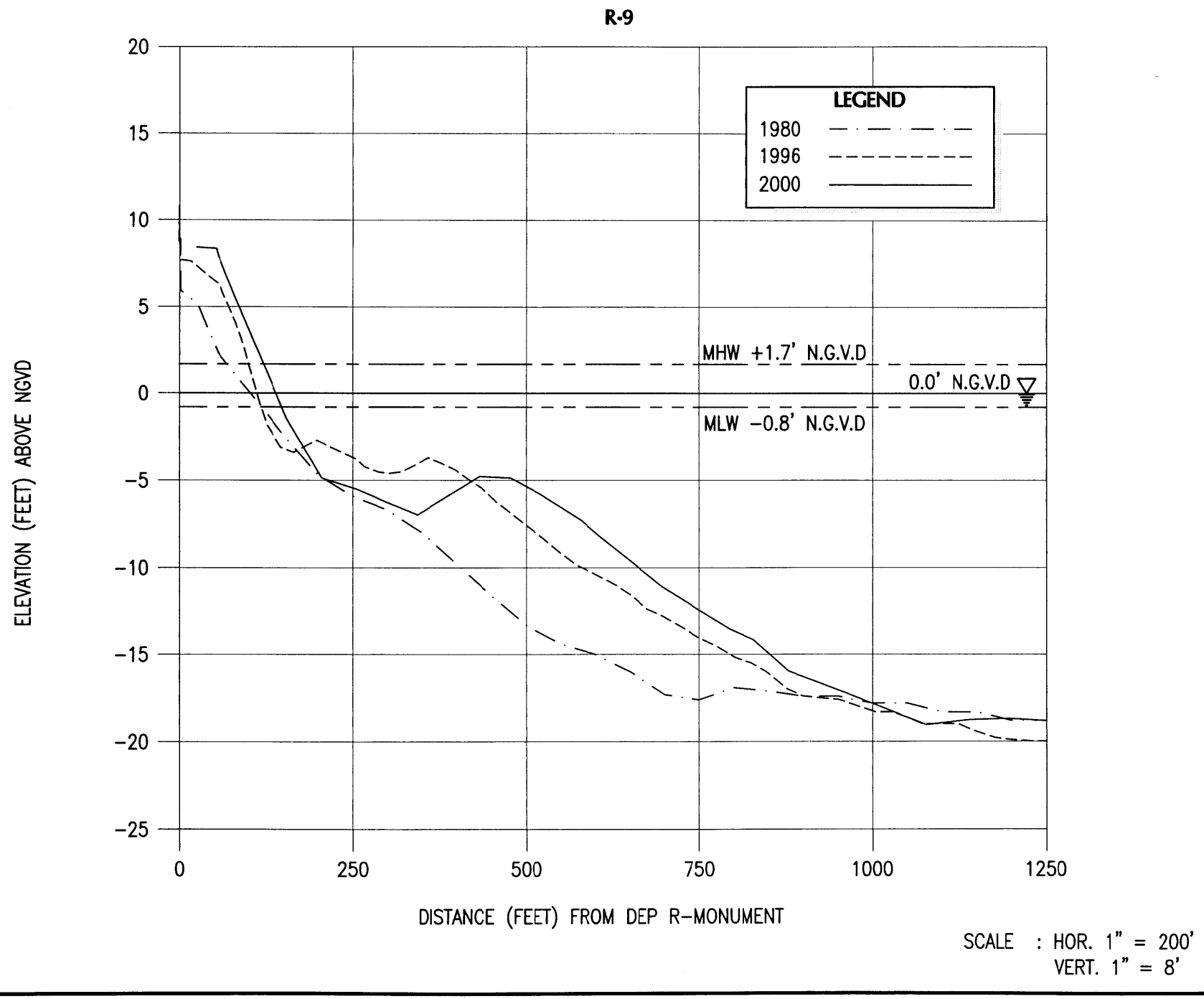
MIAMI-DADE COUNTY, FLORIDA

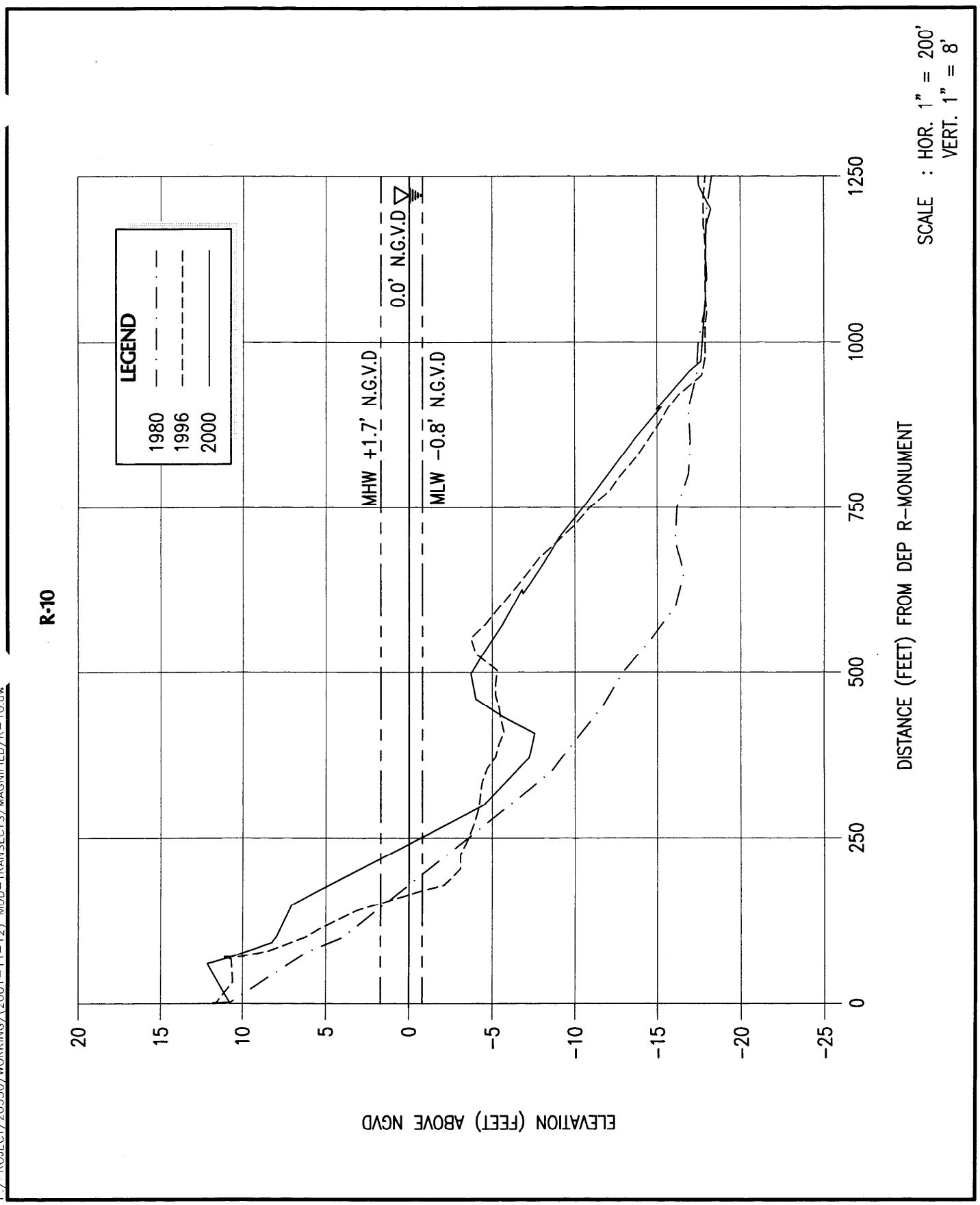


F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-09.dg

# R-9 - SUNNY ISLES

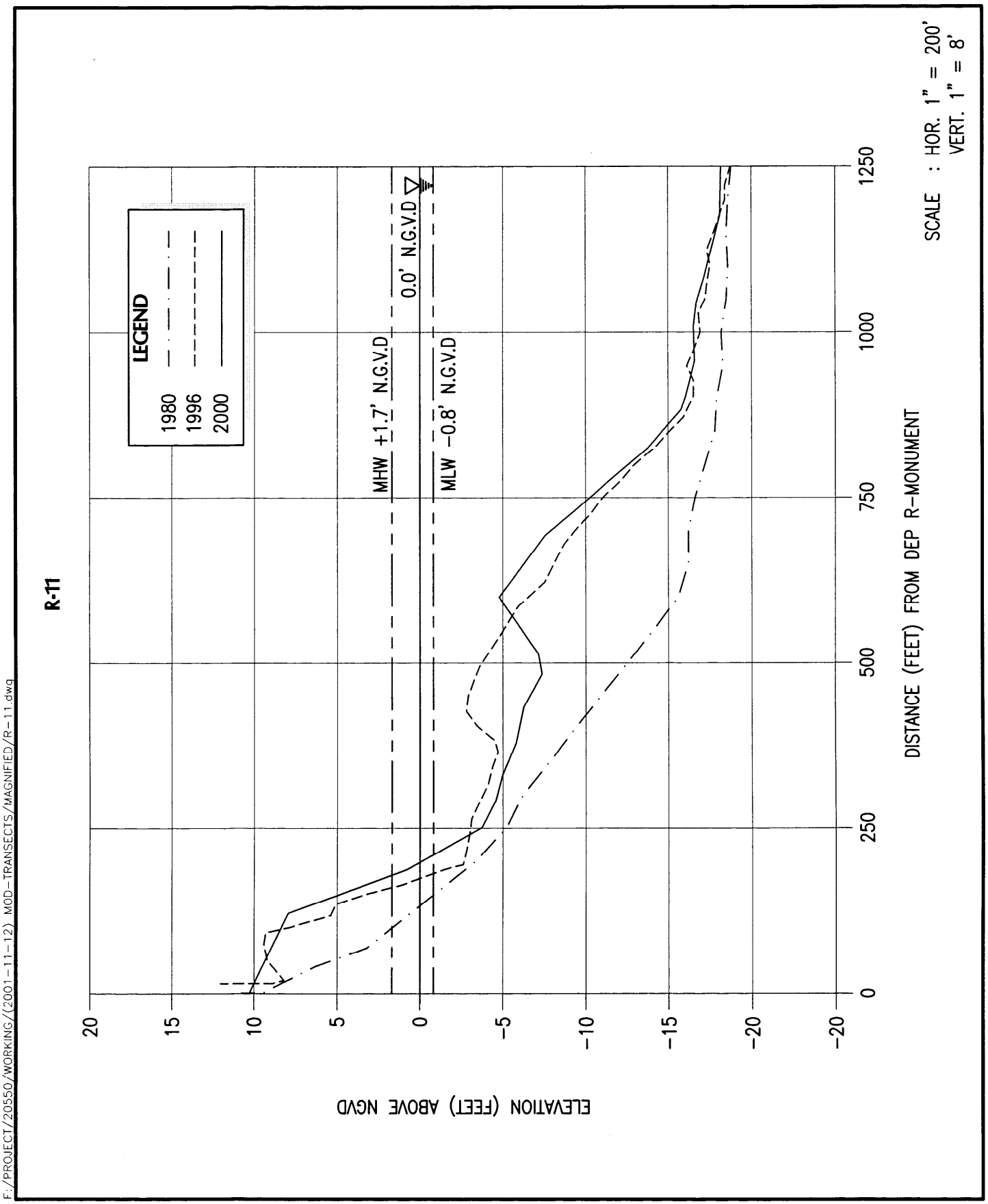
MIAMI-DADE COUNTY, FLORIDA






# R-10 - SUNNY ISLES

MIAMI-DADE COUNTY, FLORIDA



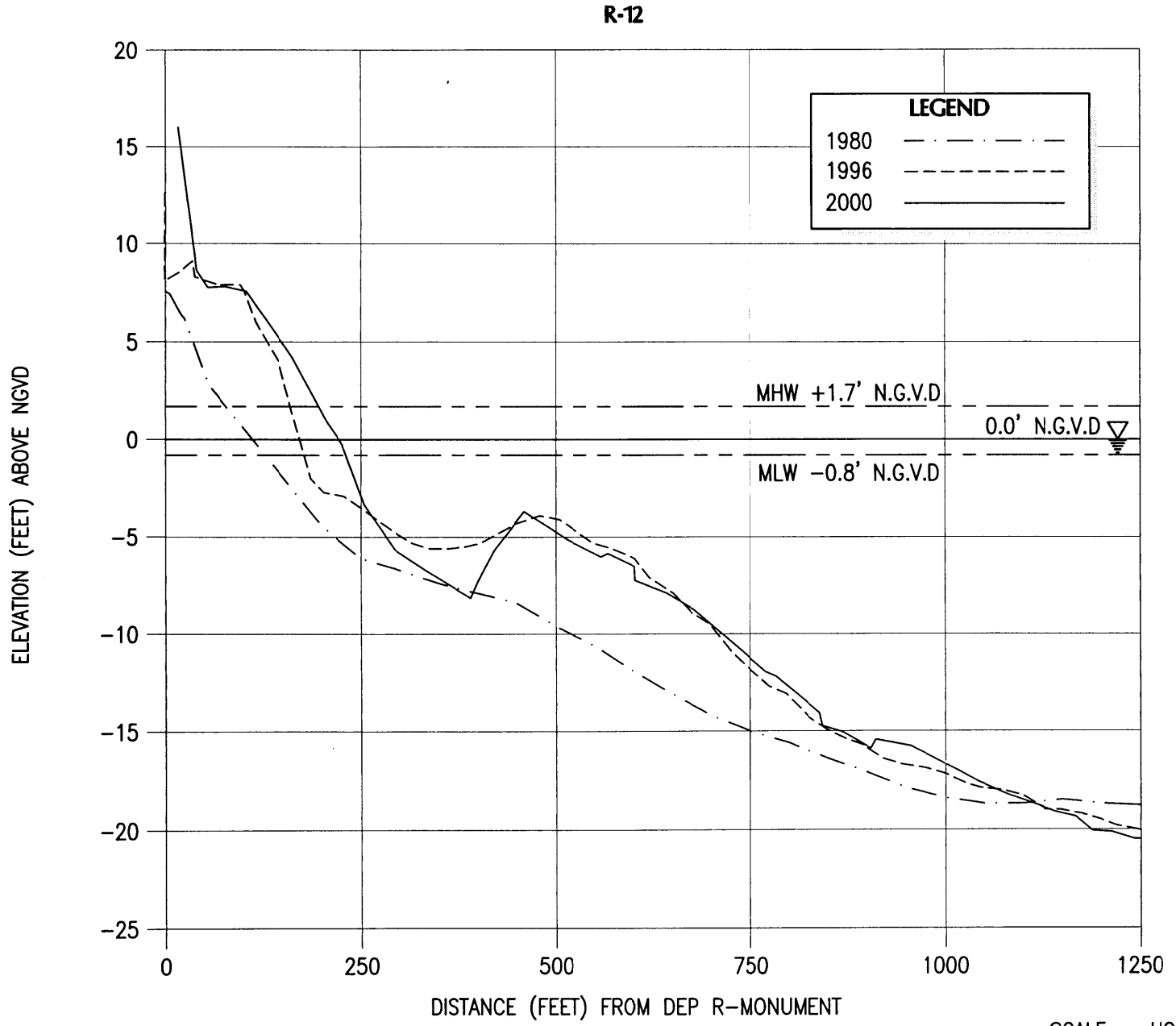

# R-11 - SUNNY ISLES

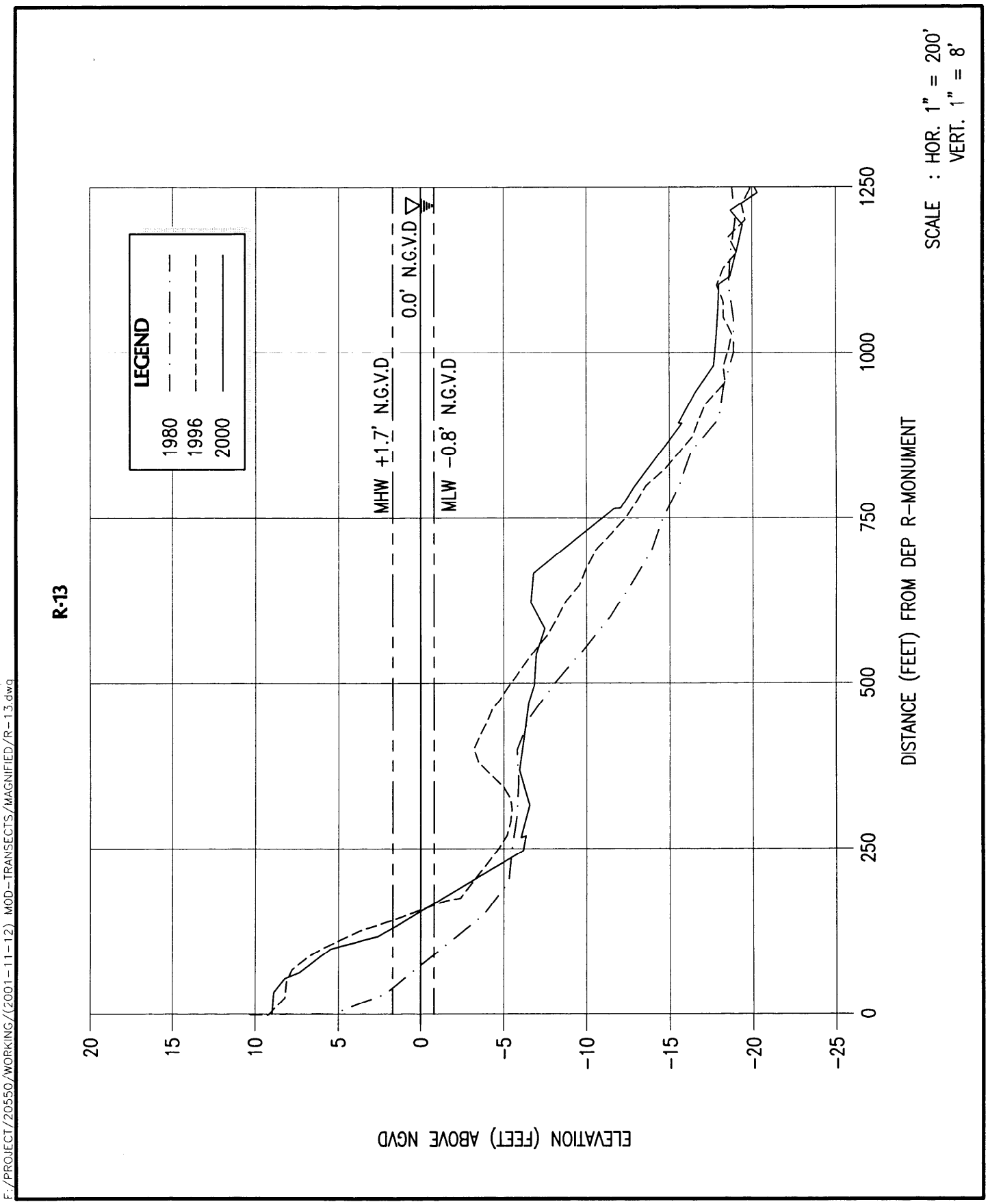
MIAMI-DADE COUNTY, FLORIDA

F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-12.dv

# R-12 - SUNNY ISLES

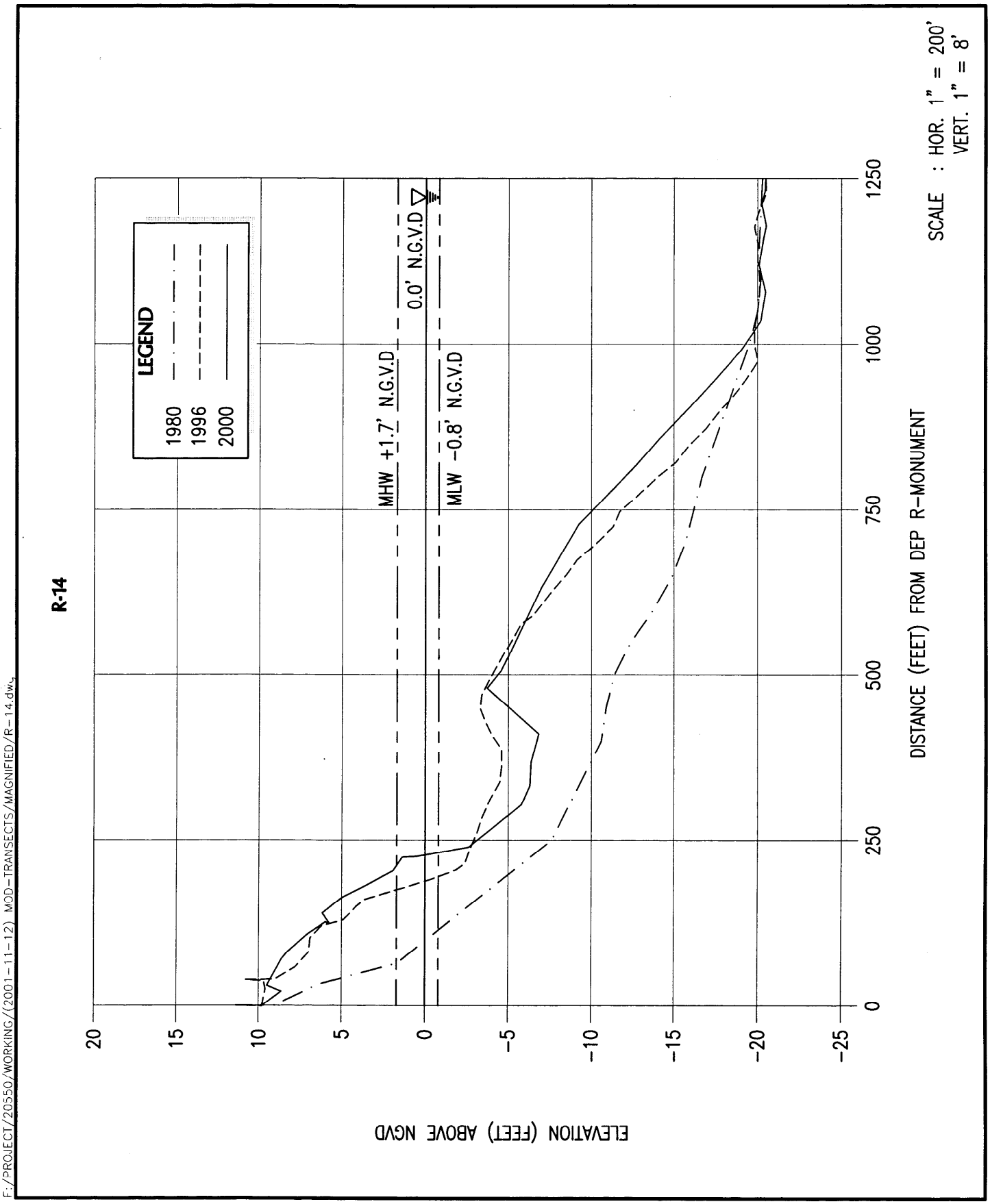
MIAMI-DADE COUNTY, FLORIDA






# R-13 - SUNNY ISLES

MIAMI-DADE COUNTY, FLORIDA



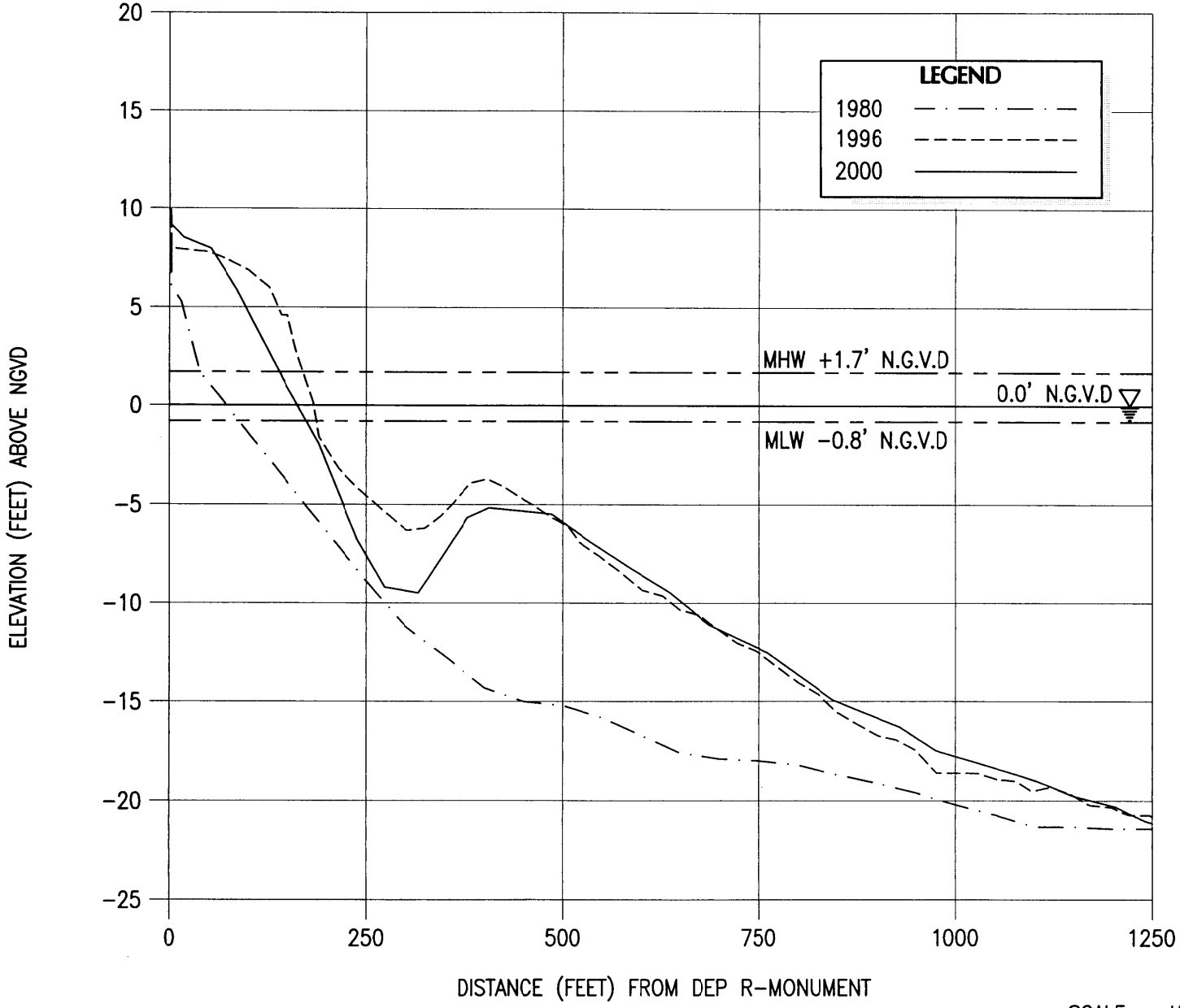

# R-14 - SUNNY ISLES

MIAMI-DADE COUNTY, FLORIDA

F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-15.dwg

# R-15 - SUNNY ISLES

MIAMI-DADE COUNTY, FLORIDA

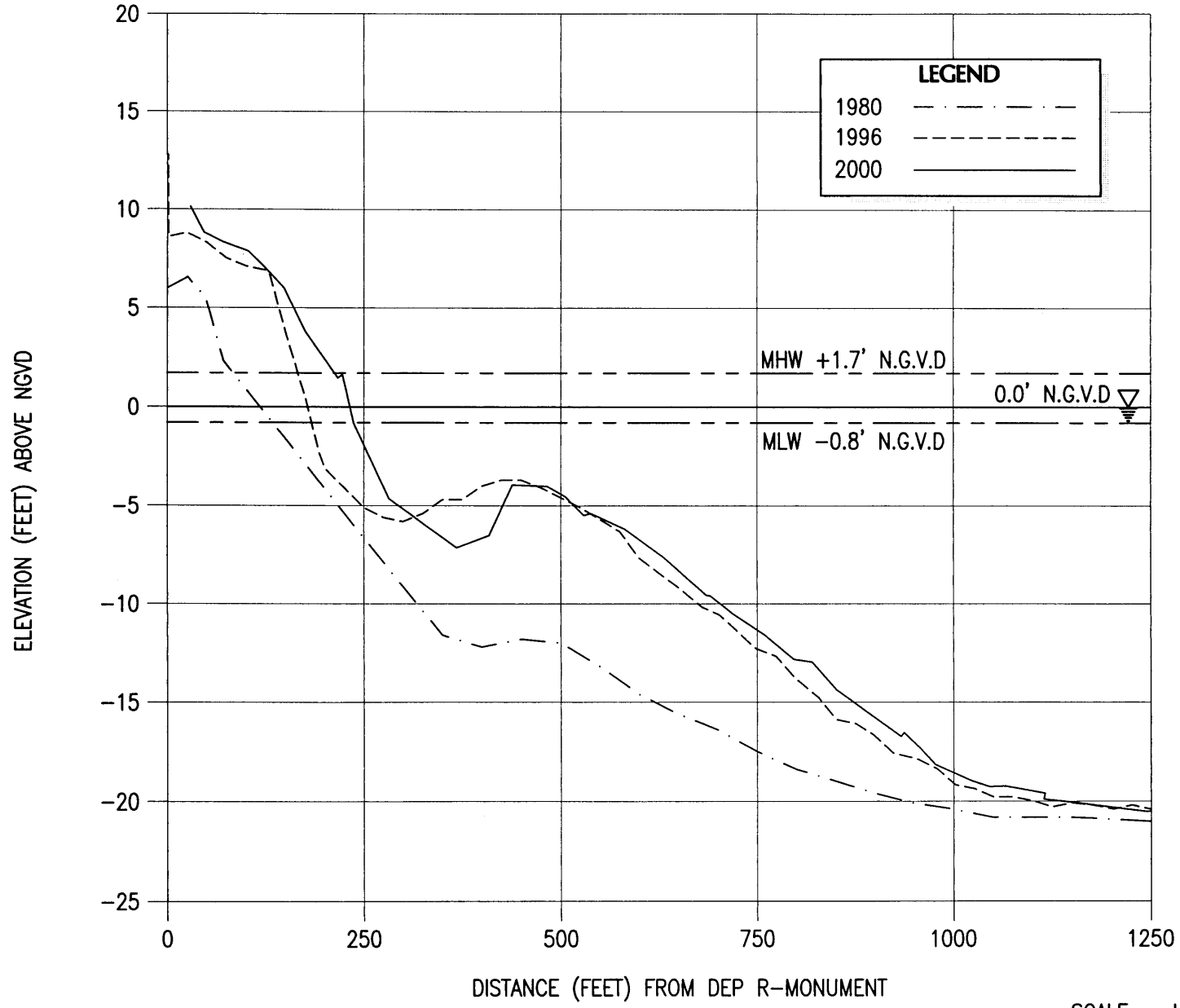



SCALE : HOR. 1" = 200'
VERT. 1" = 8'

F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-16.dwg

# R-16 SUNNY ISLES

MIAMI-DADE COUNTY, FLORIDA

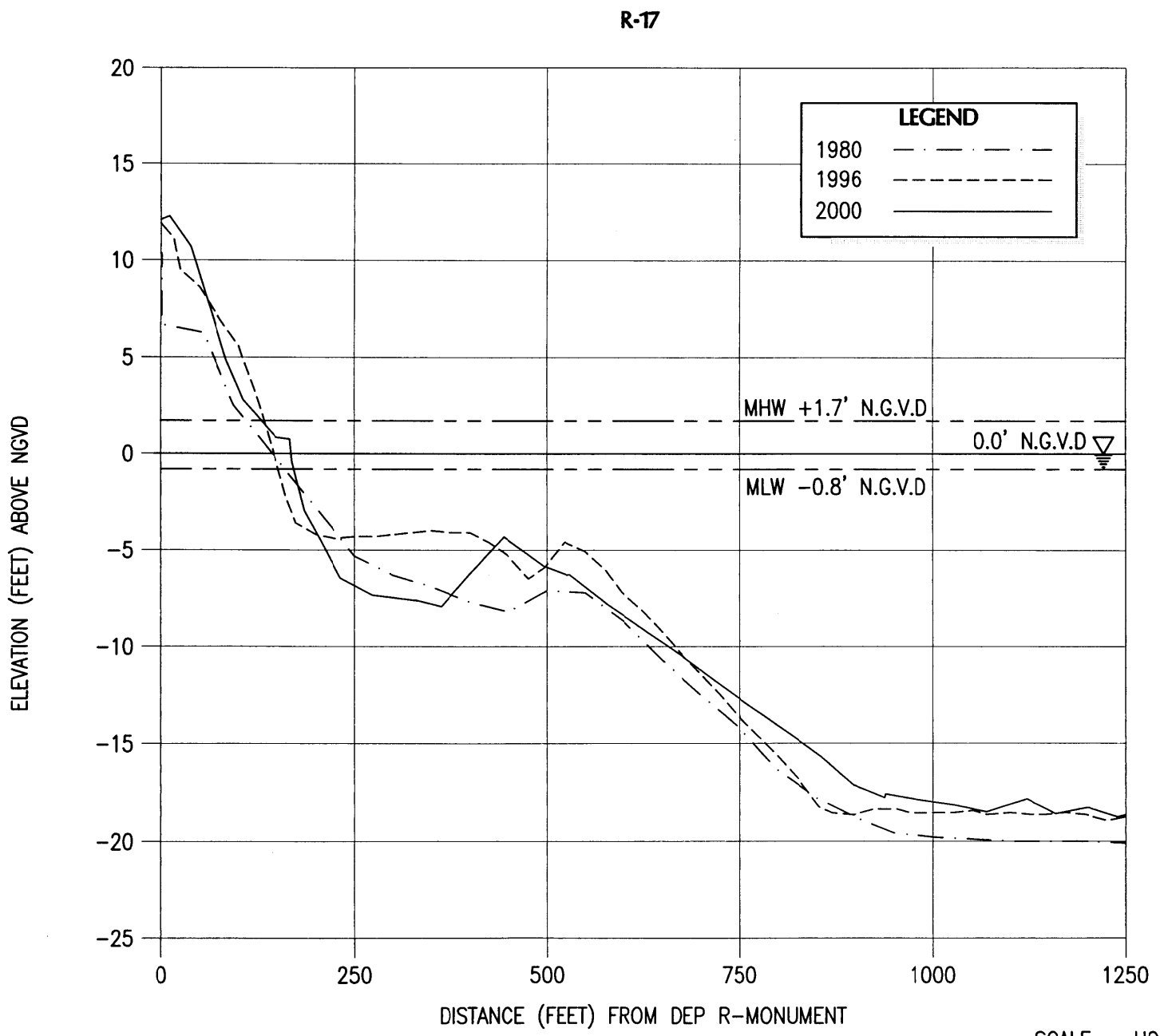



SCALE : HOR. 1" = 200'
VERT. 1" = 8'

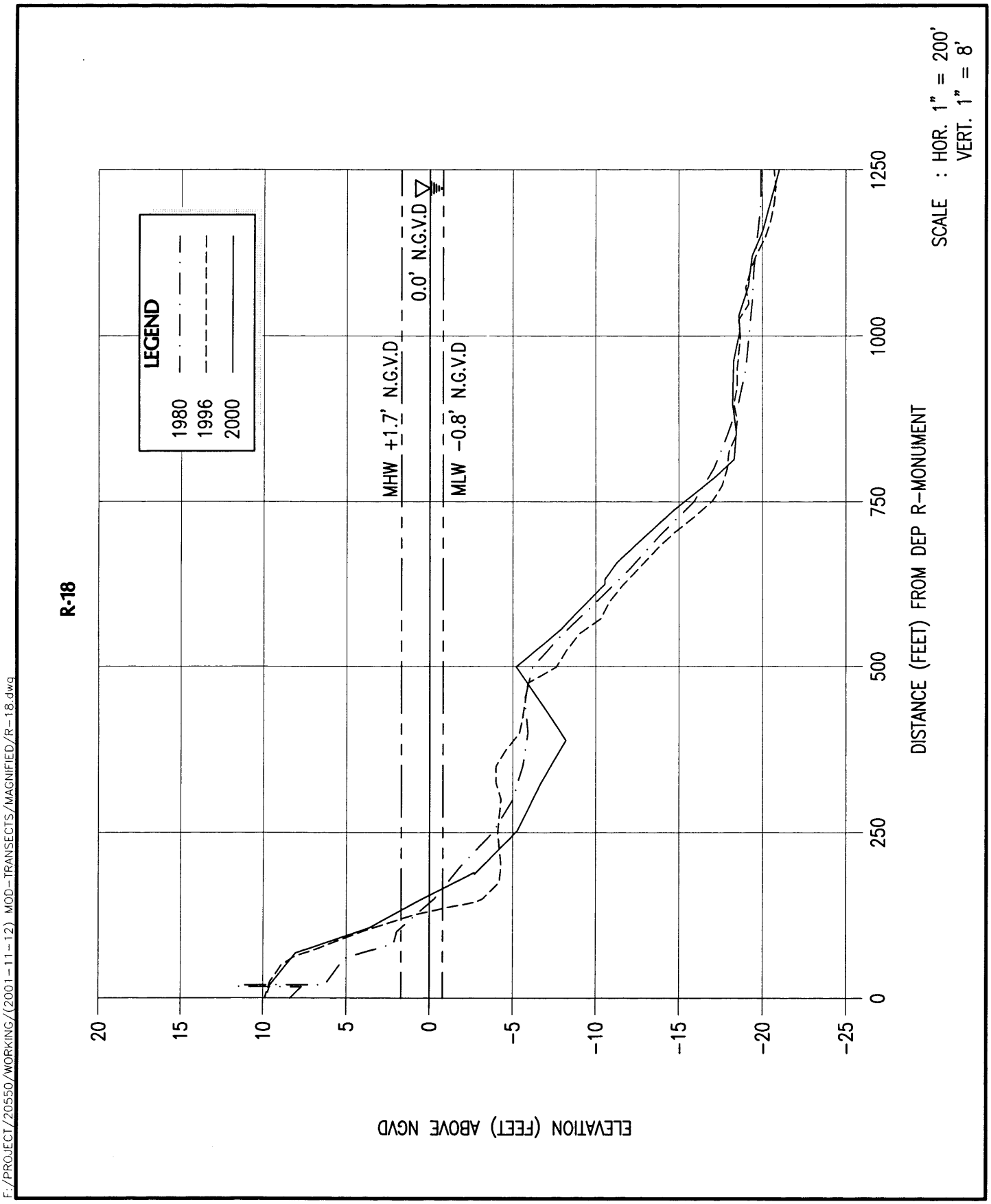
F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-17.dwg

# R-17 - SUNNY ISLES

MIAMI-DADE COUNTY, FLORIDA




SCALE : HOR. 1" = 200'
VERT. 1" = 8'

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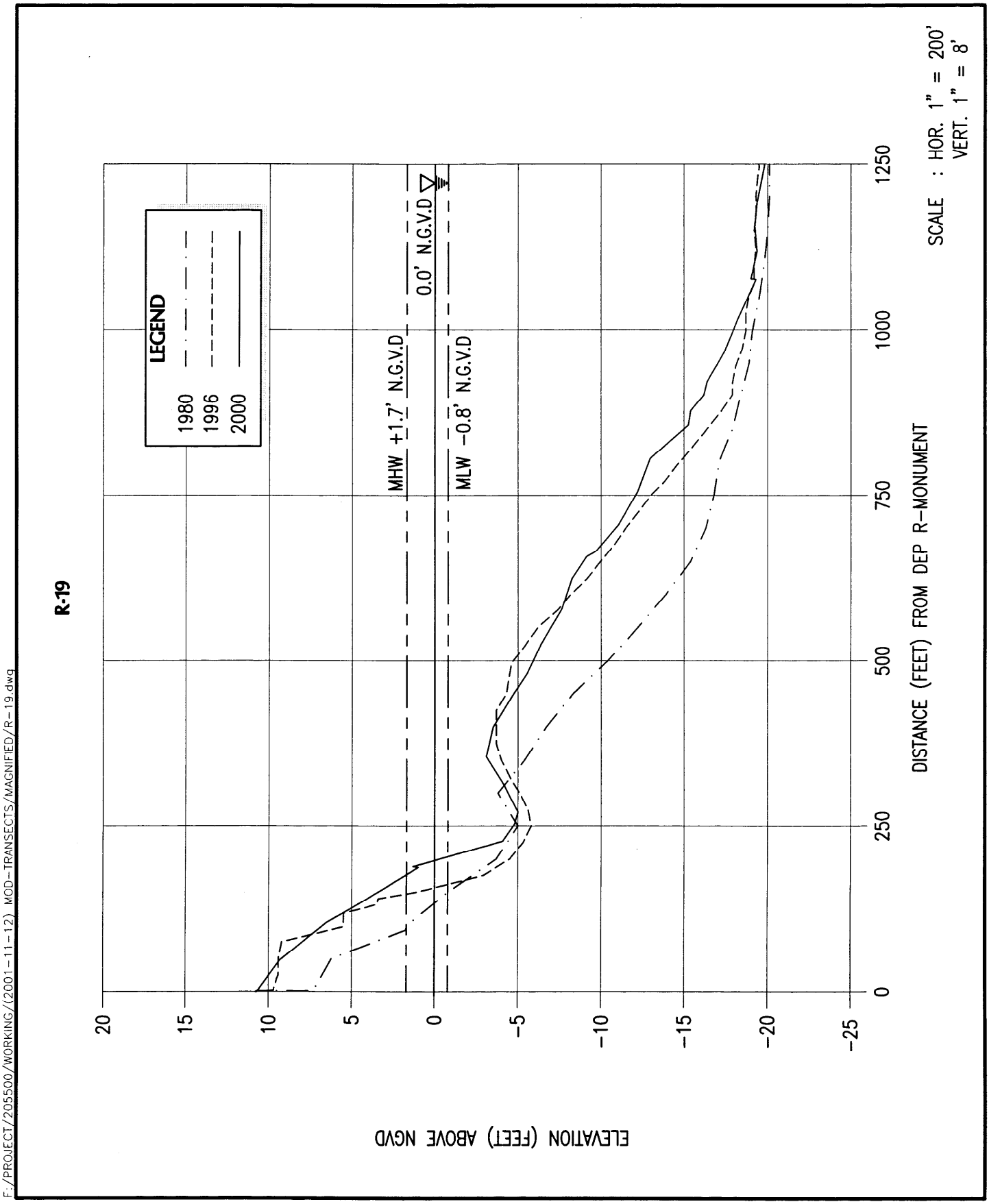
# R-18 SUNNY ISLES

MIAMI-DADE COUNTY, FLORIDA

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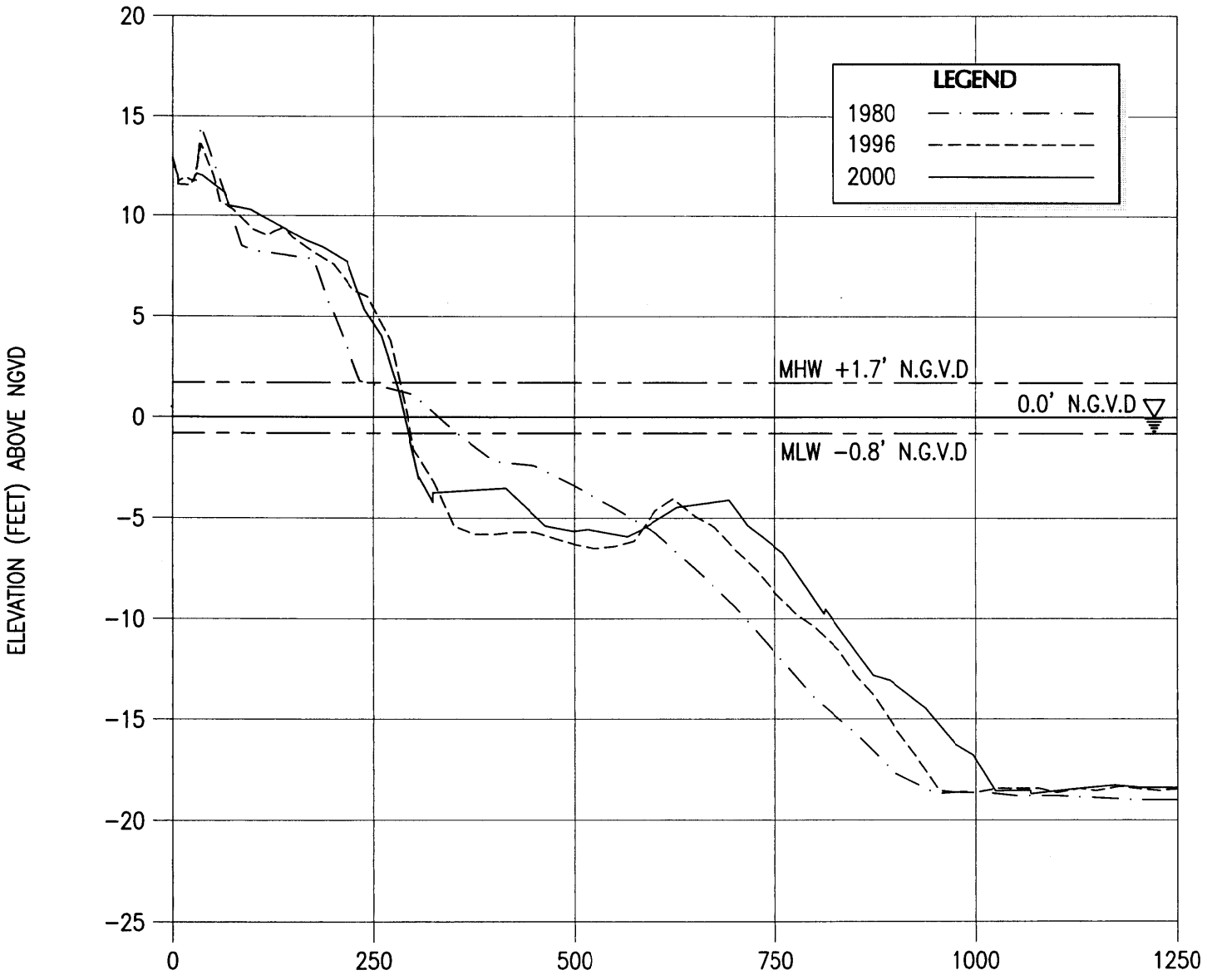
# R-19 - BAKERS HAULOVER INLET

MIAMI-DADE COUNTY, FLORIDA

F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-20.dwg

# R-20 - BAKERS HAULOVER PARK

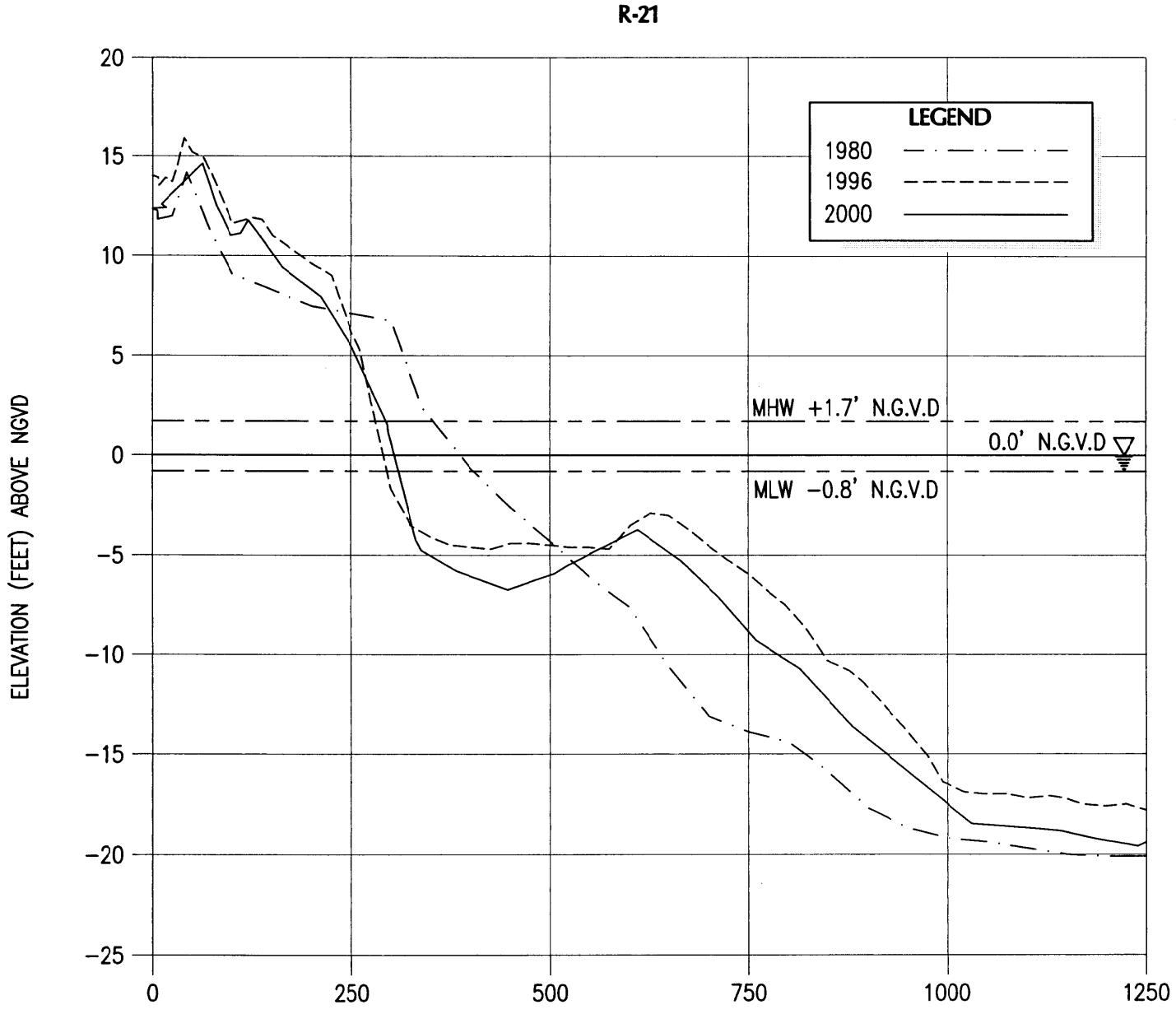
MIAMI-DADE COUNTY, FLORIDA

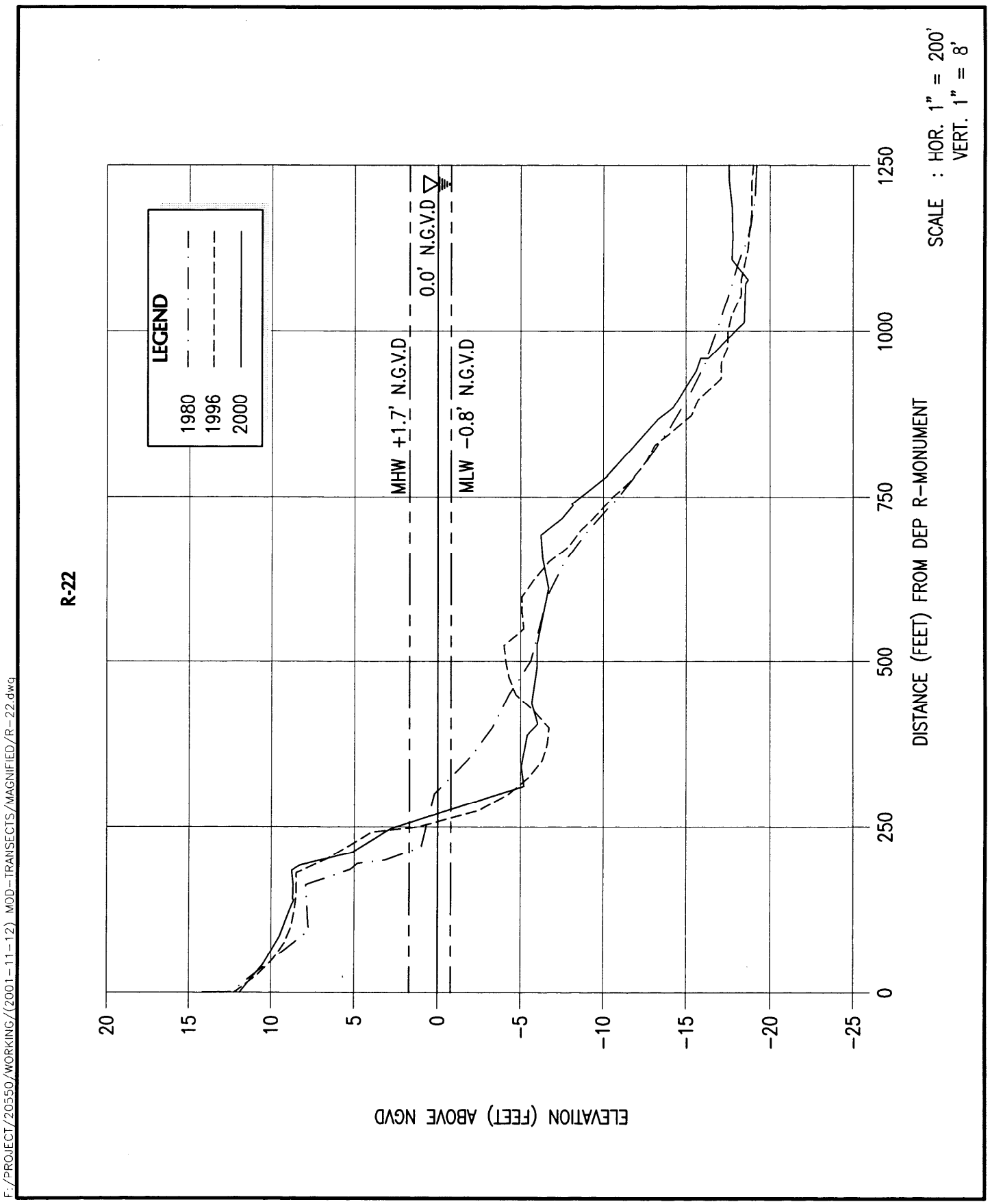


F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-21.dwg

# R-21 - BAKERS HAULOVER PARK

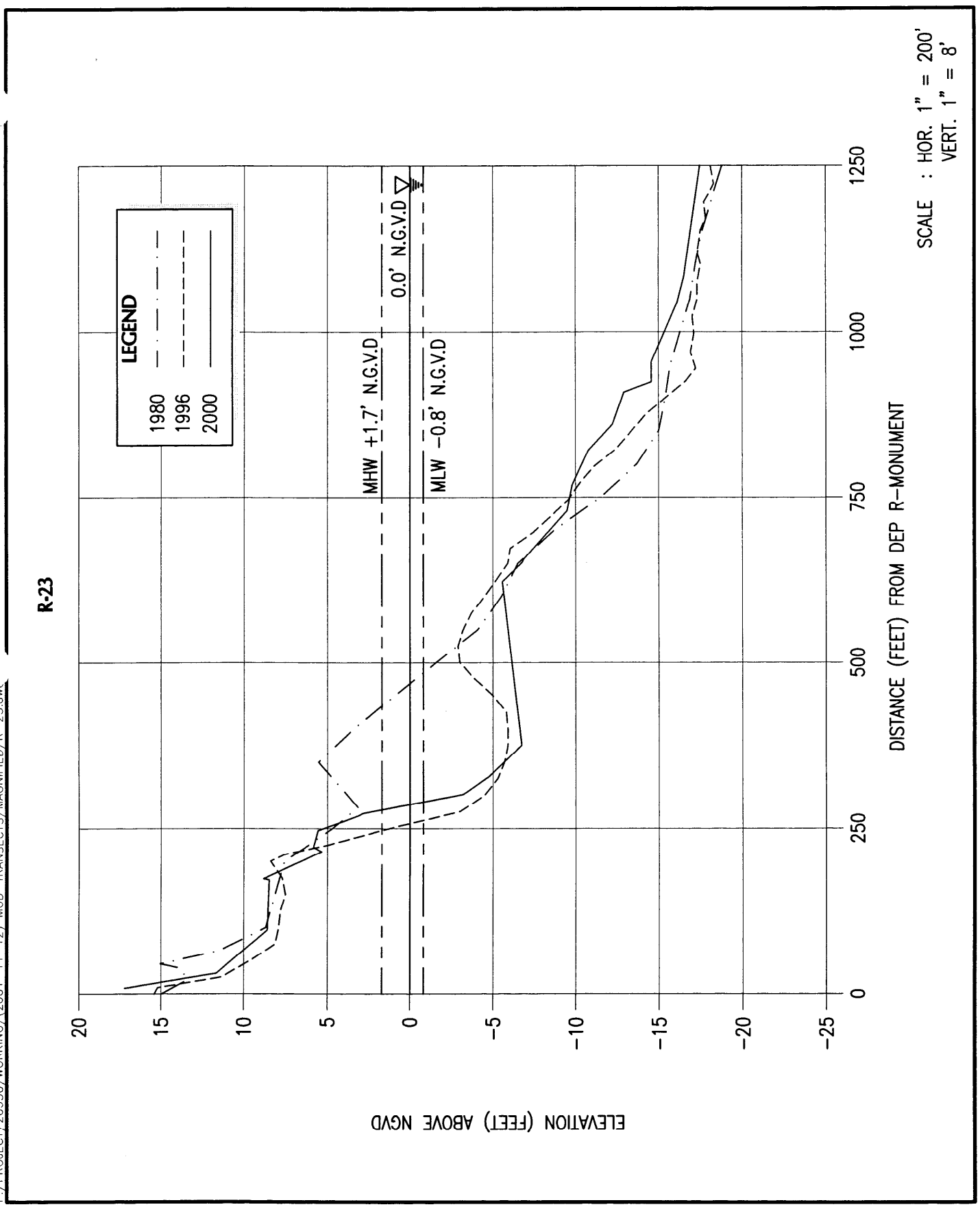
MIAMI-DADE COUNTY, FLORIDA






# R-22 - BAKERS HAULOVER PARK

MIAMI-DADE COUNTY, FLORIDA



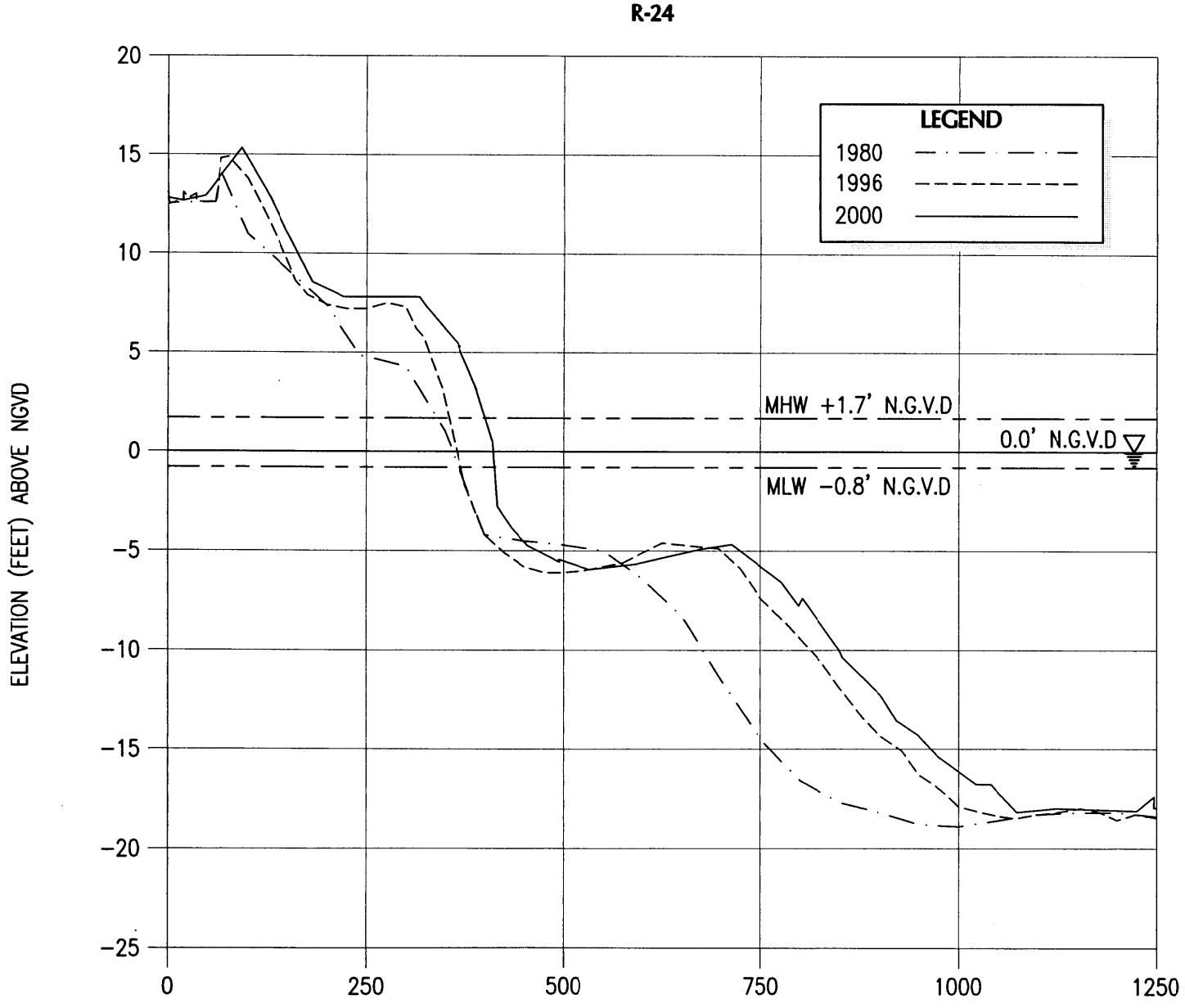

# R-23 - BAKERS HAULOVER PARK

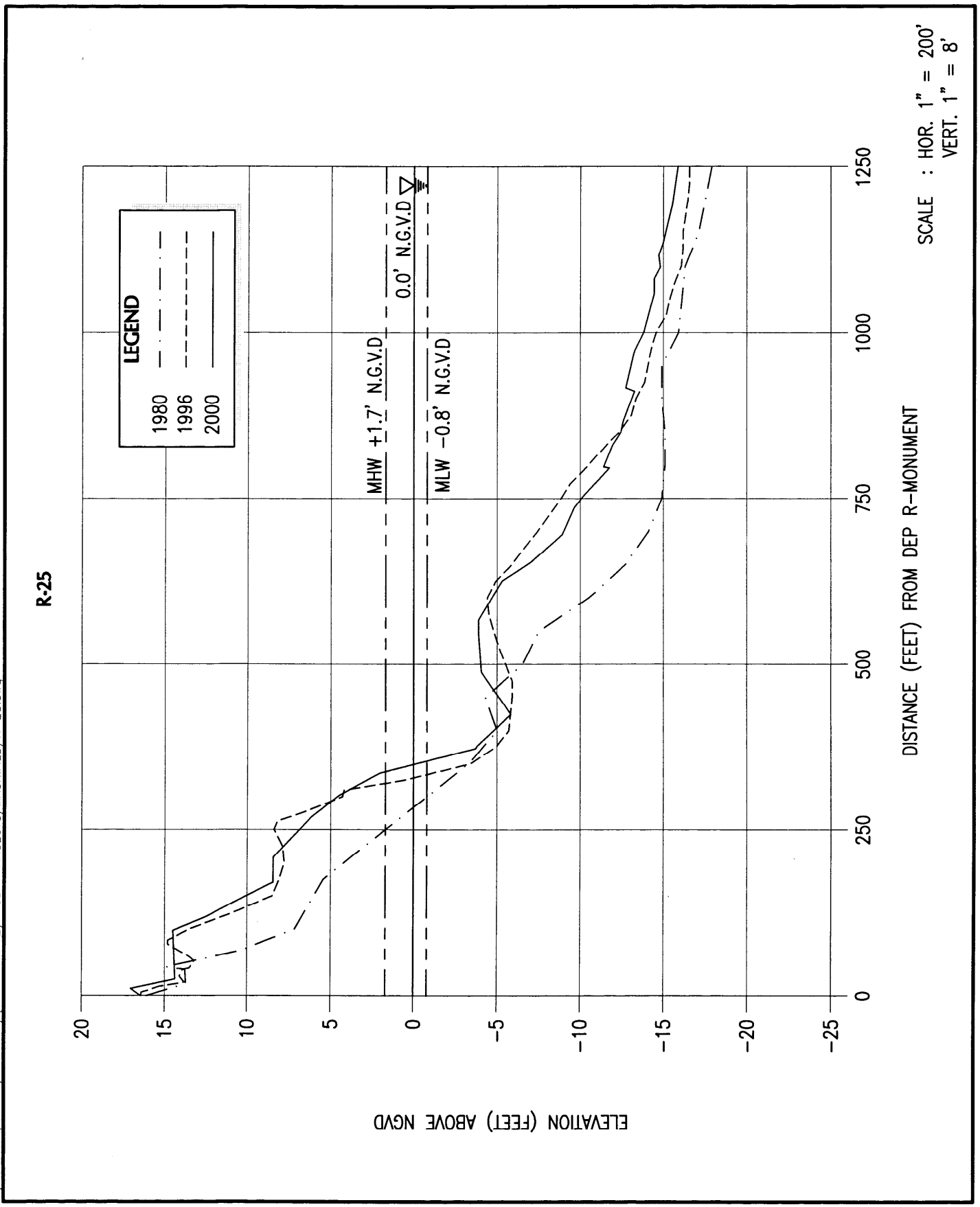
MIAMI-DADE COUNTY, FLORIDA

F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-24.dw

# R-24 - BAKERS HAULOVER PARK

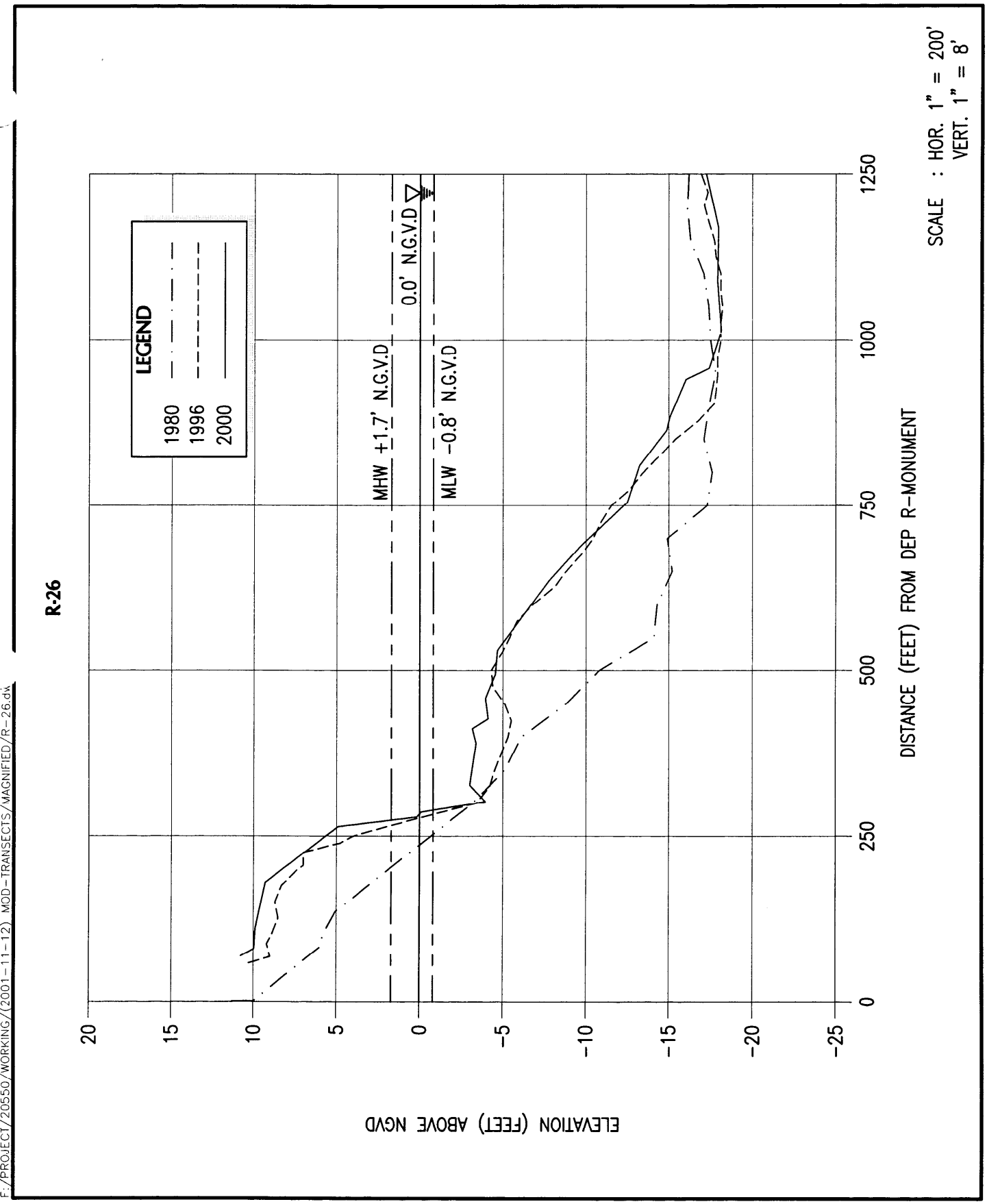
MIAMI-DADE COUNTY, FLORIDA






# R-25 - BAKERS HAULOVER PARK

MIAMI-DADE COUNTY, FLORIDA



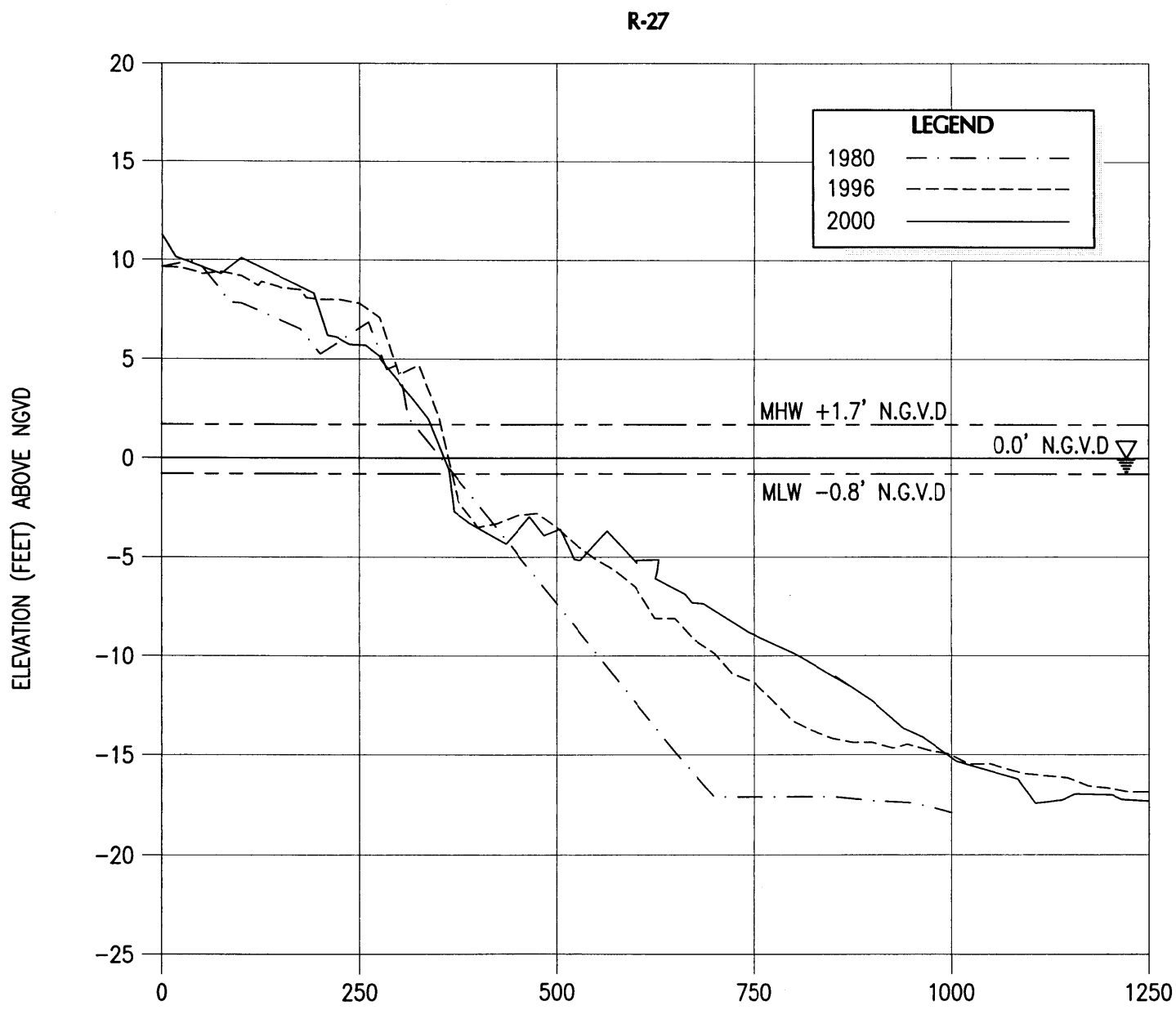

# R-26 - BAKERS HAULOVER PARK

MIAMI-DADE CONTY, FLORIDA

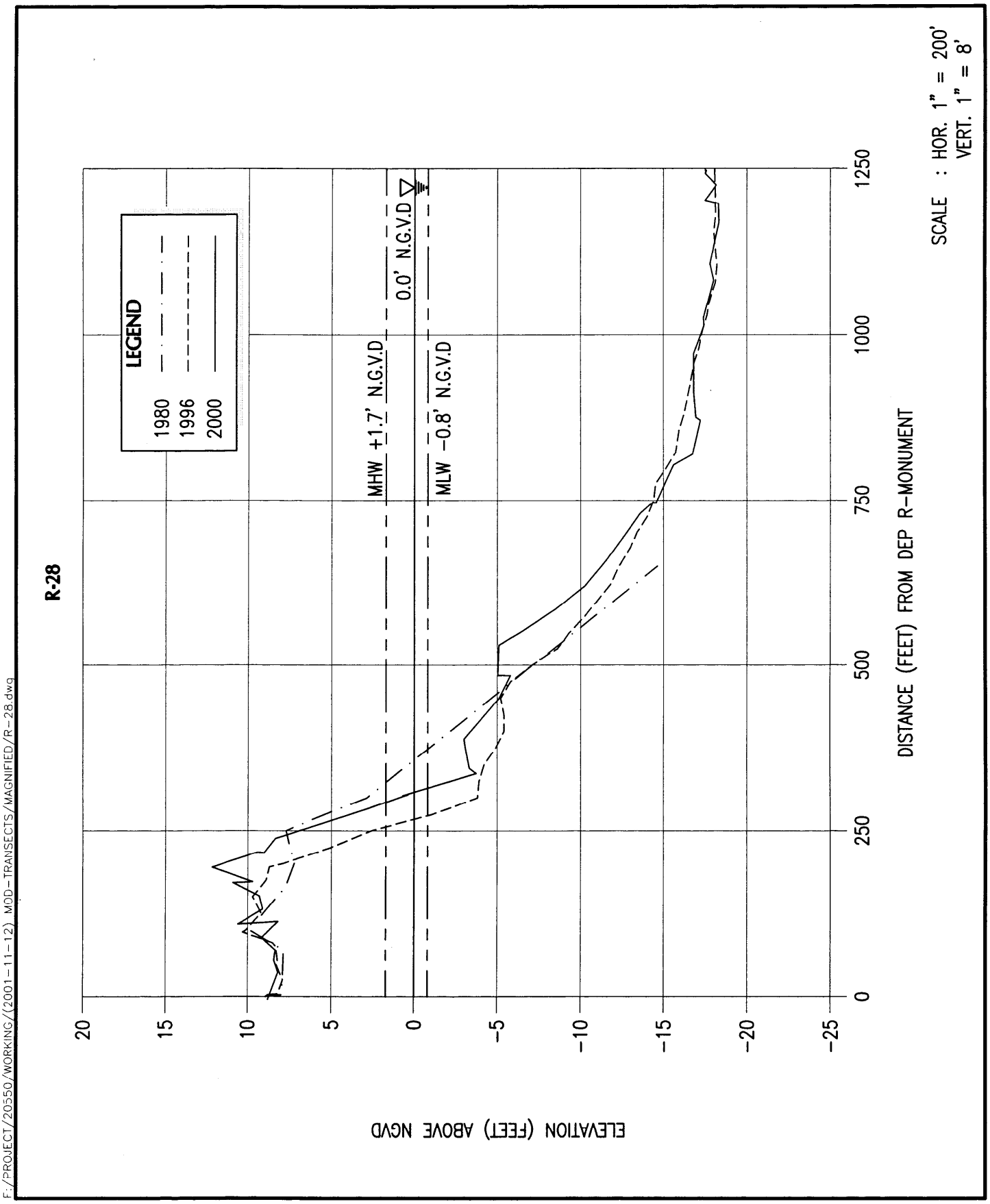
F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-27.dw

# R-27 - BAL HARBOUR

MIAMI-DADE COUNTY, FLORIDA

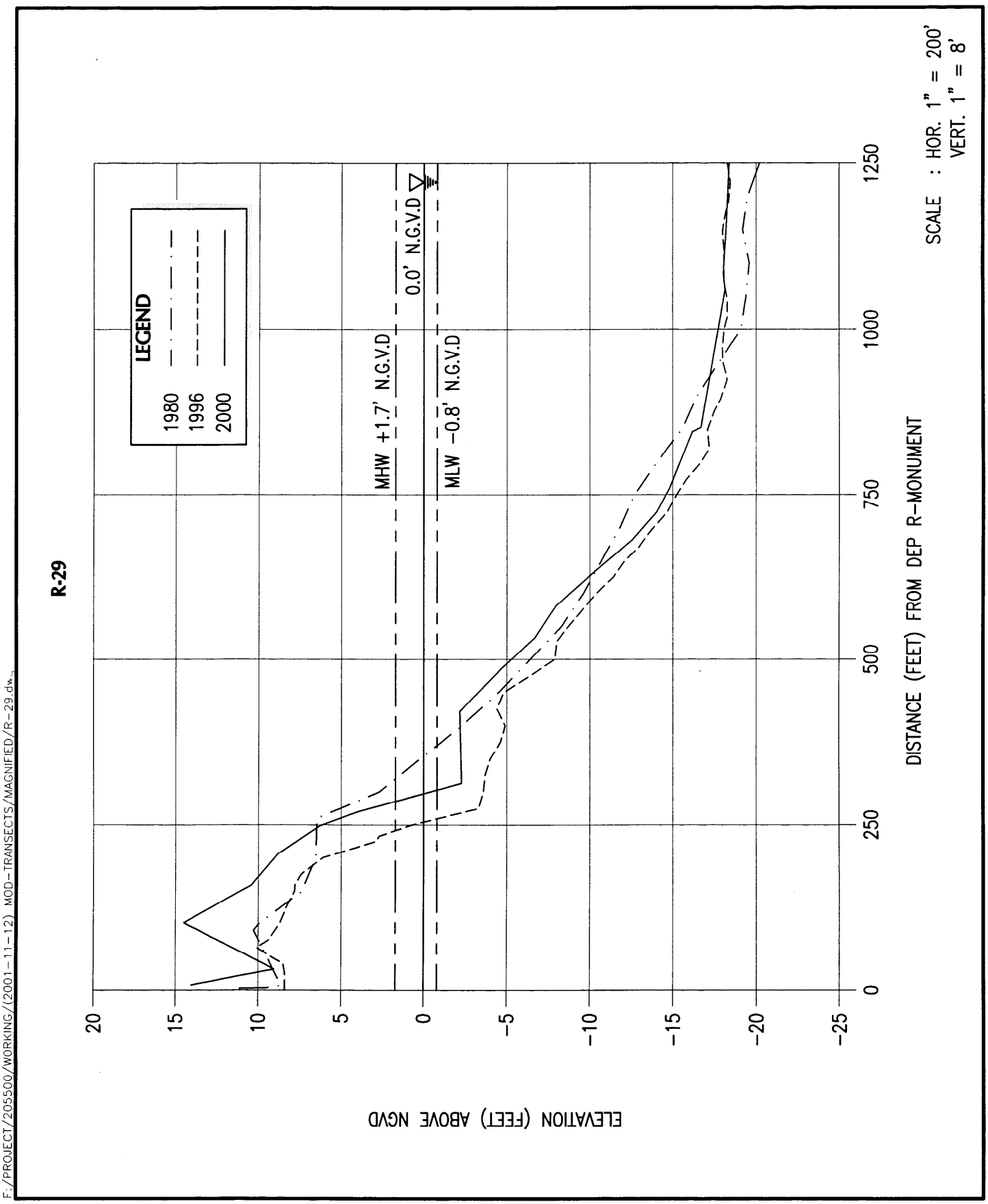



SCALE : HOR. 1" = 200'
VERT. 1" = 8'



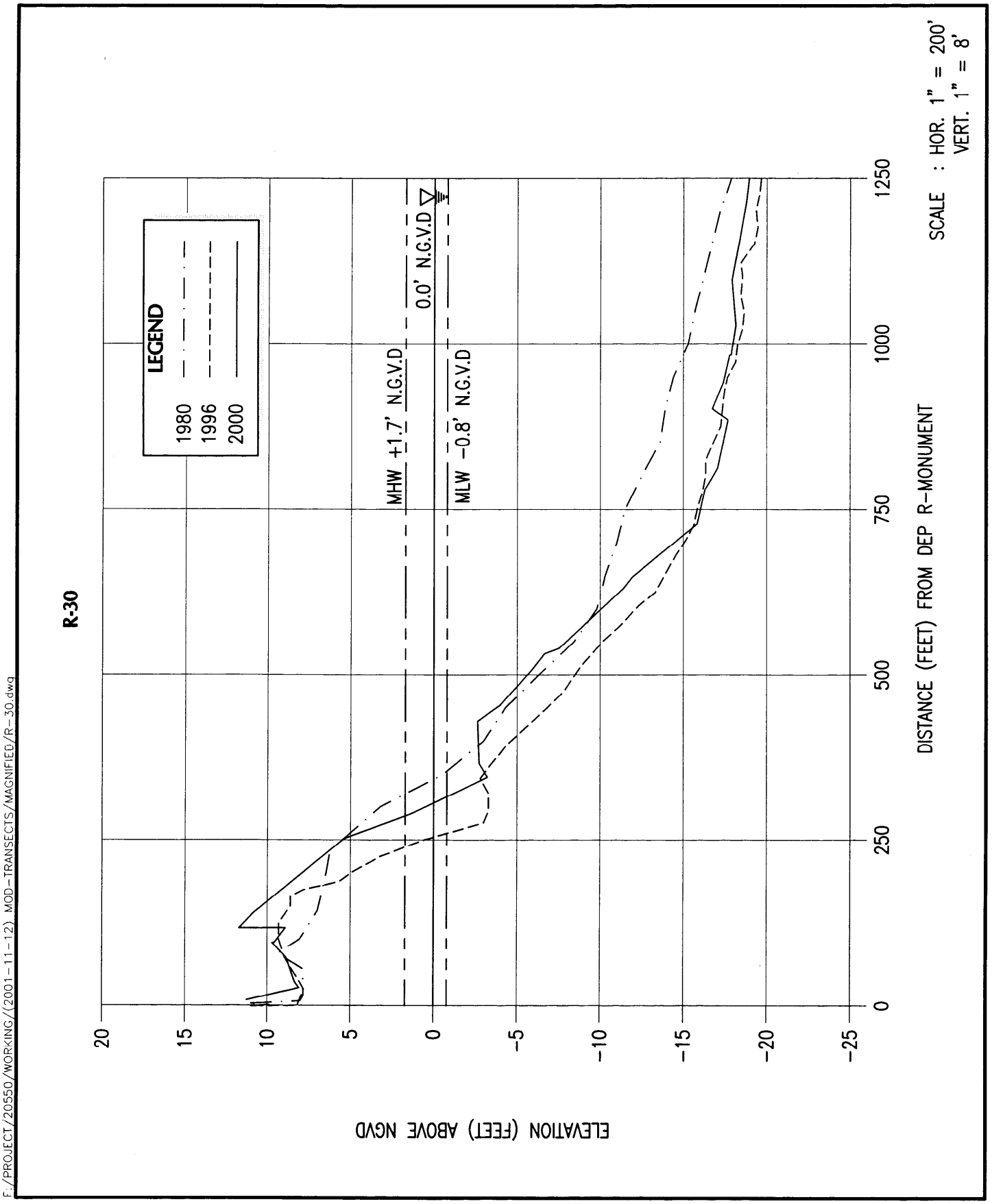

# R-28 - BAL HARBOUR

MIAMI-DADE COUNTY, FLORIDA



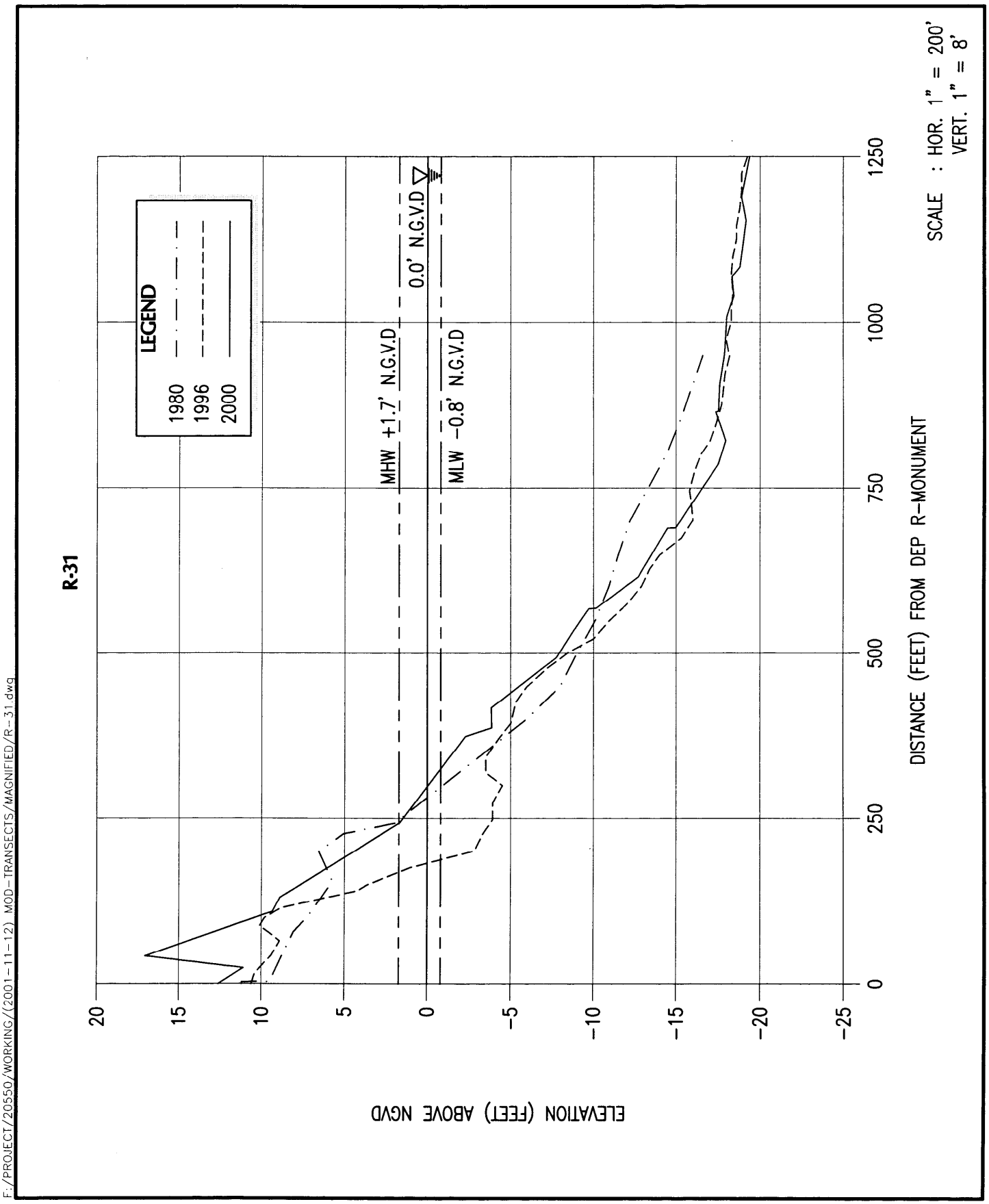

# R-29 - BAL HARBOUR

MIAMI-DADE COUNTY, FLORIDA




# R-30 - BAL HARBOUR

MIAMI-DADE COUNTY, FLORIDA




F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-31.dwg

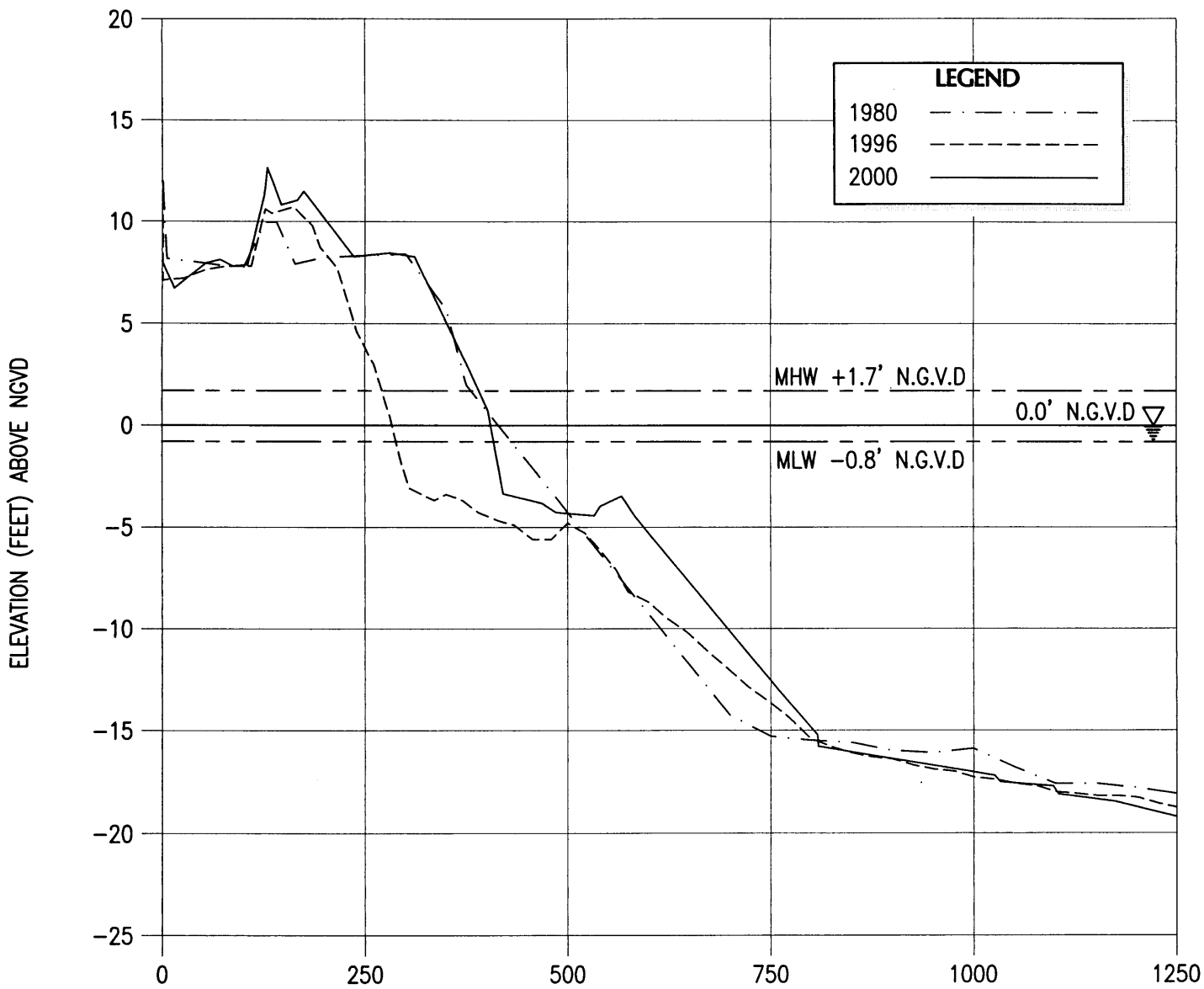
# R-31 - BAL HARBOUR

MIAMI-DADE COUNTY, FLORIDA

F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-33.dwg

# R-32 - SURFSIDE

MIAMI-DADE COUNTY, FLORIDA

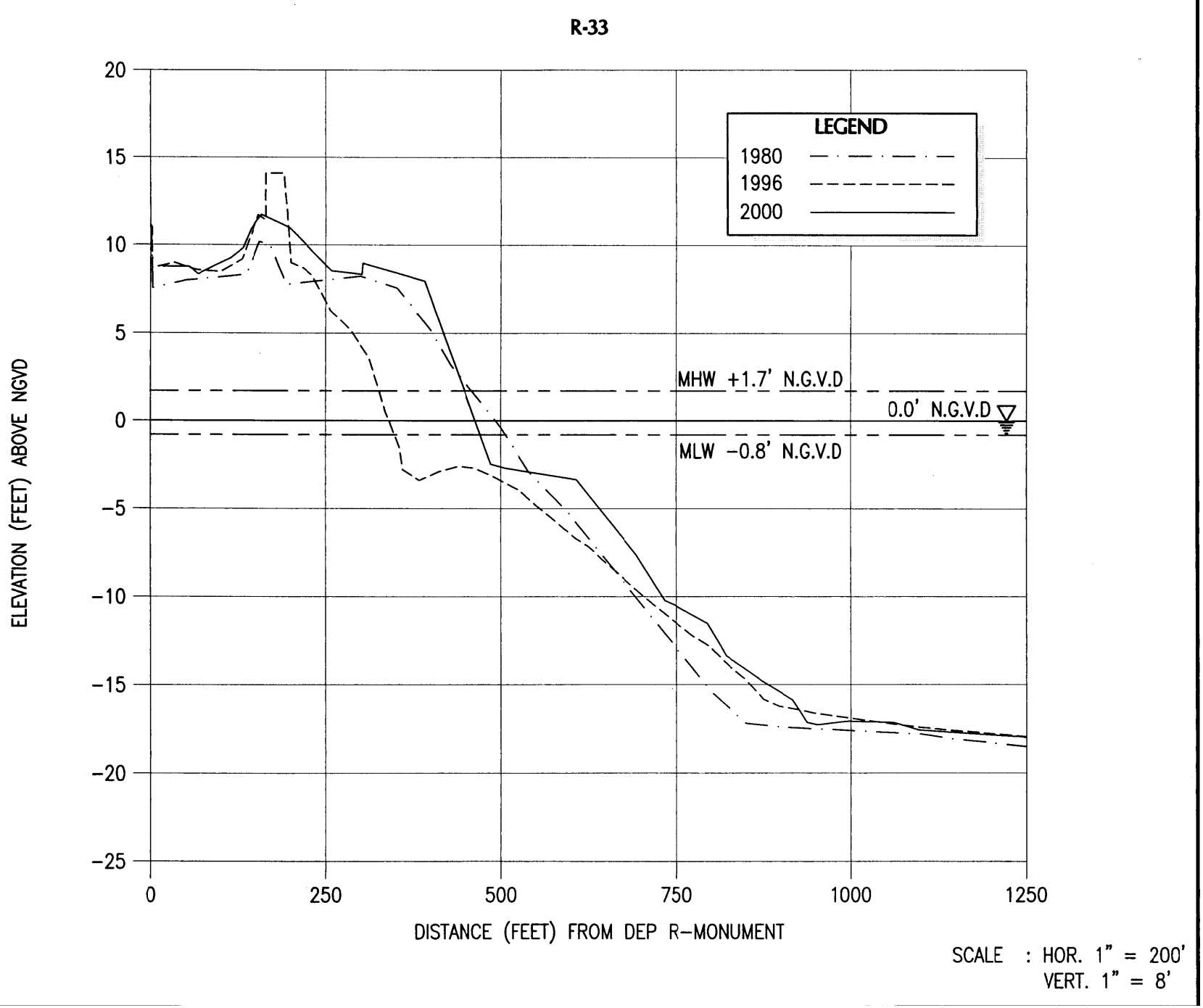


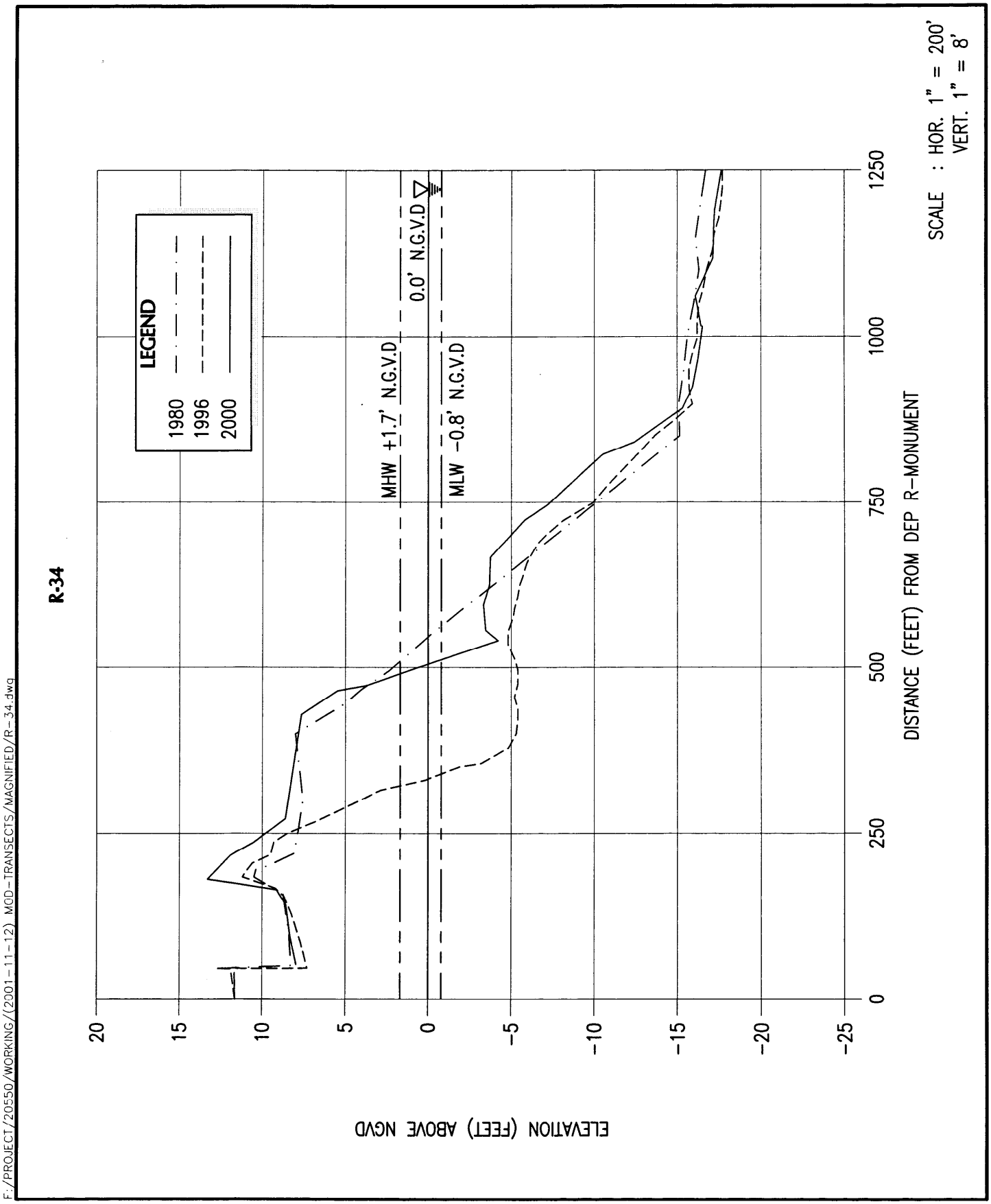

SCALE : HOR. 1" = 200'
VERT. 1" = 8'

F:/PROJECT/20550/WORKING/(2001-11-12) MCD-TRANSECTS/MAGNIFIED/R-33.dwg

# R-33 - SURFSIDE

MIAMI-DADE COUNTY, FLORIDA





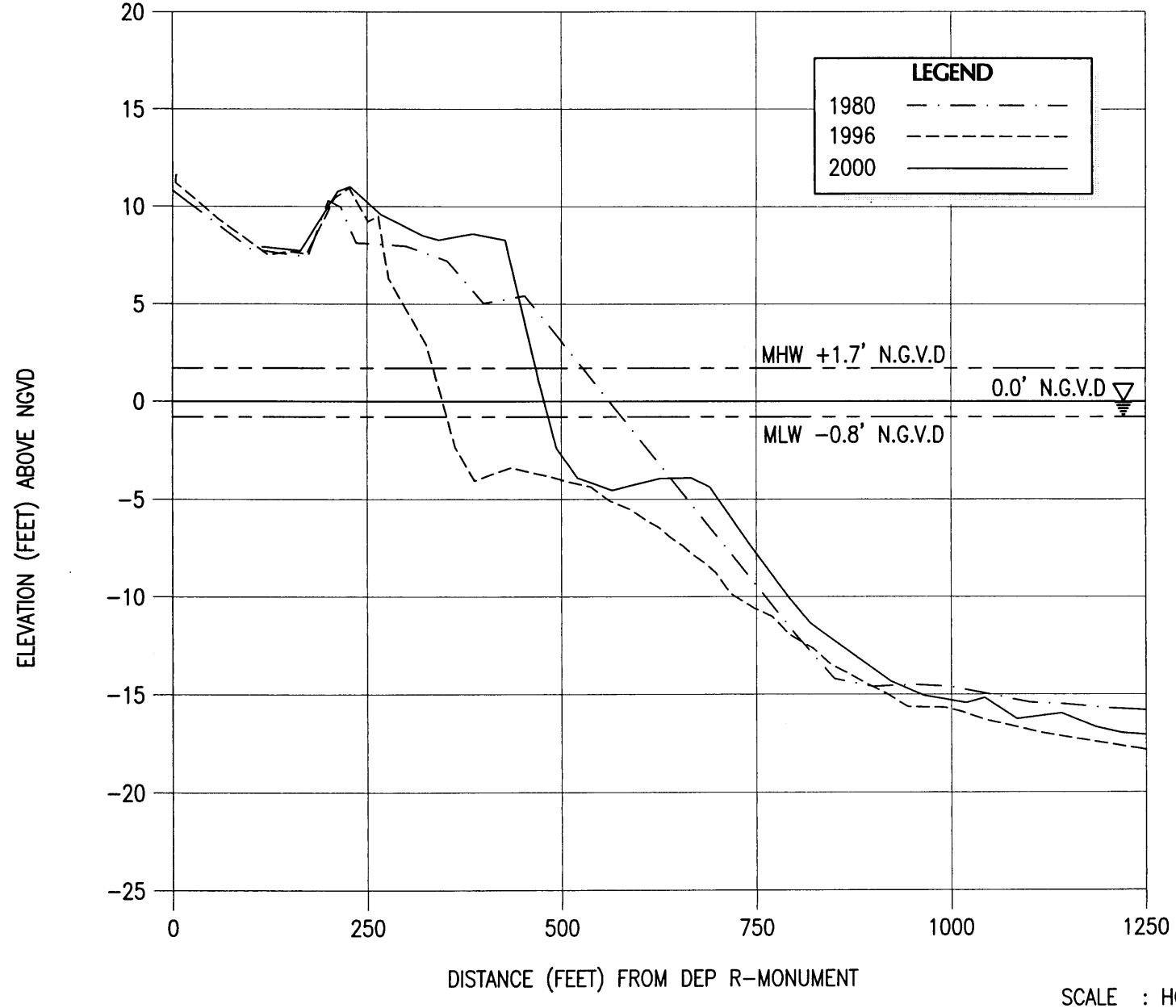

# R-34 - SURFSIDE

MIAMI-DADE COUNTY, FLORIDA

F:/PROJECT/20550/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-35.dwg

# R-35 - SURFSIDE

MIAMI-DADE COUNTY, FLORIDA

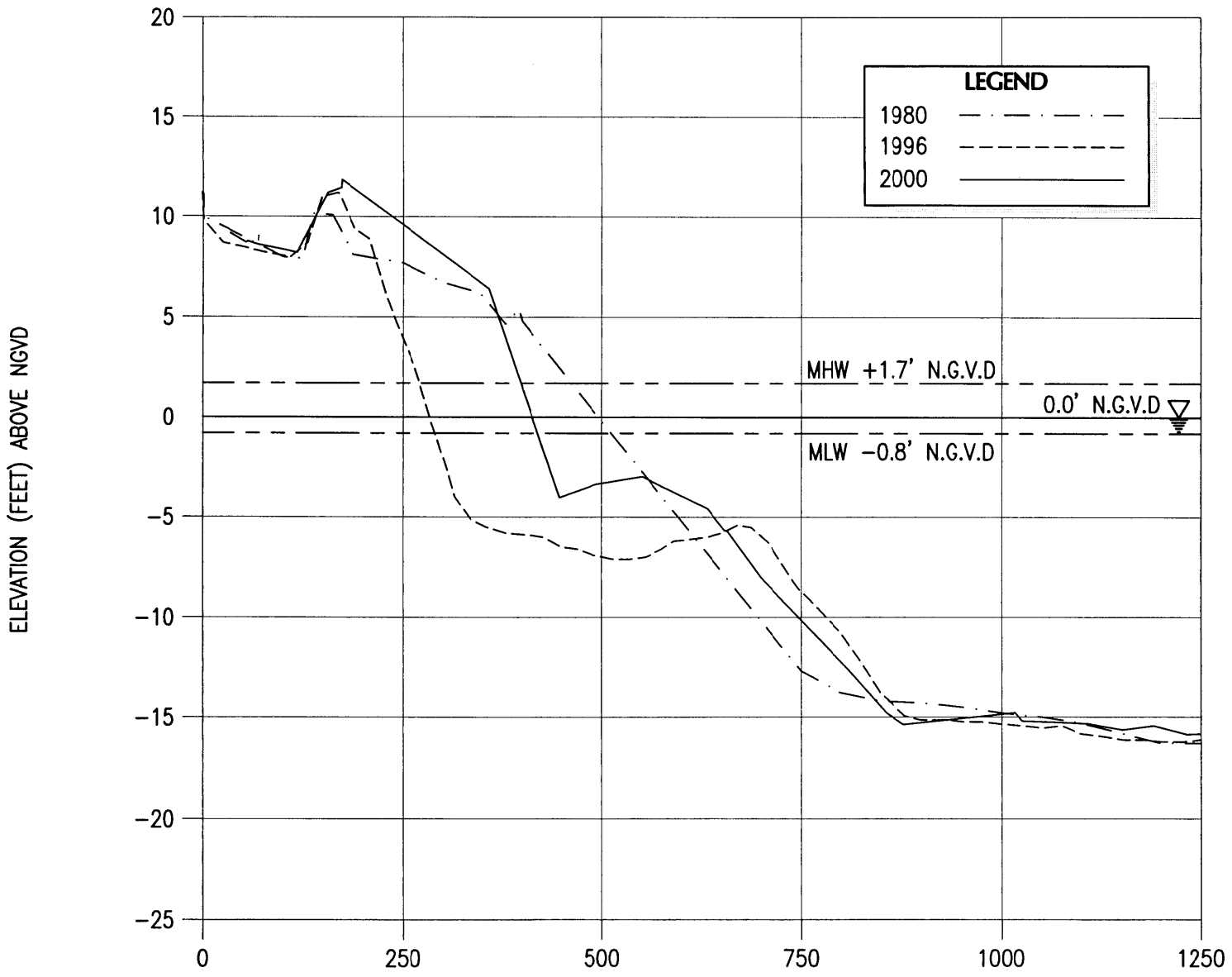



SCALE : HOR. 1" = 200'
VERT. 1" = 8'

F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-36.dwg

# R-36 - SURFSIDE

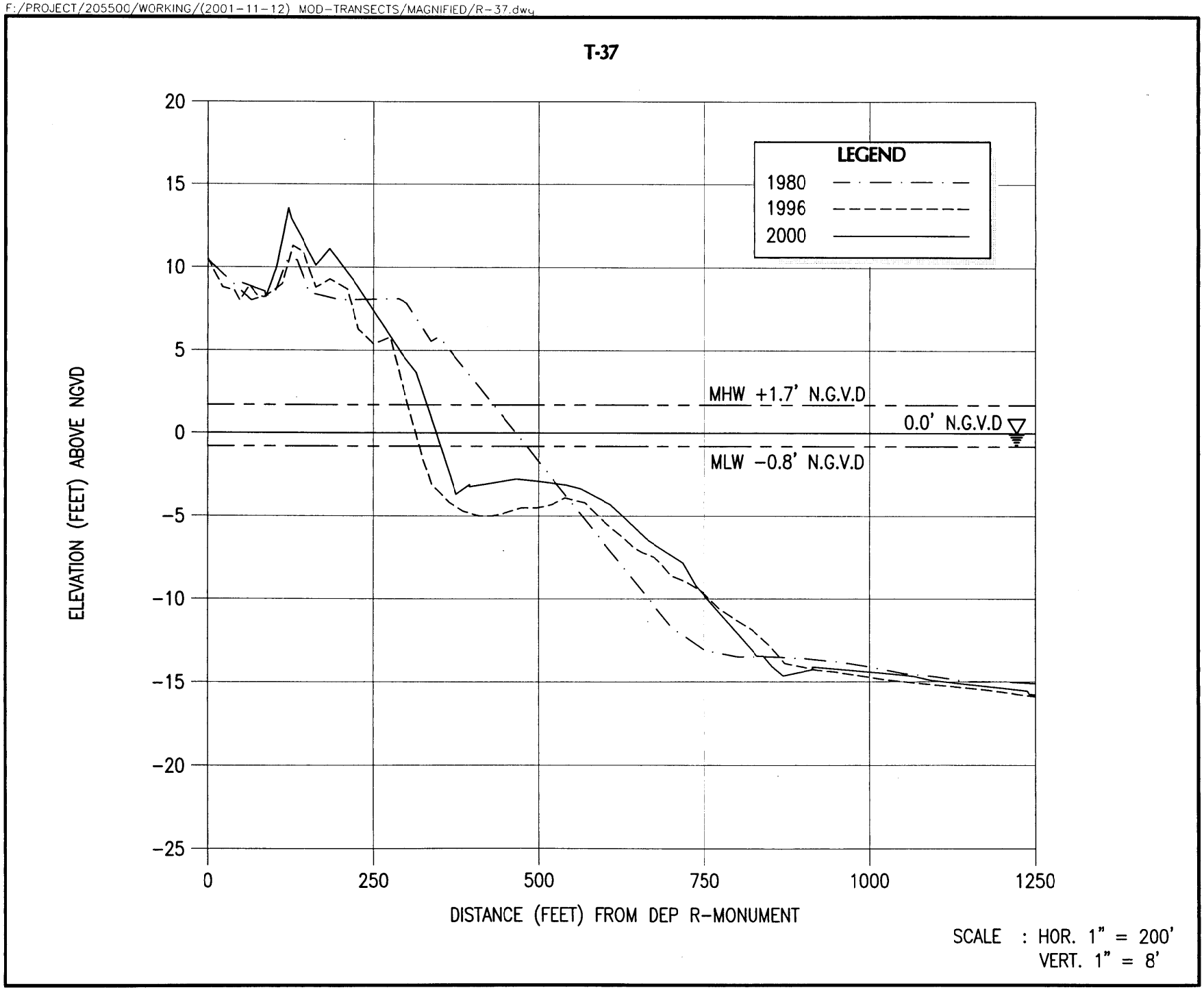
MIAMI-DADE COUNTY, FLORIDA



F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-37.dwg

# T-37 - SURFSIDE

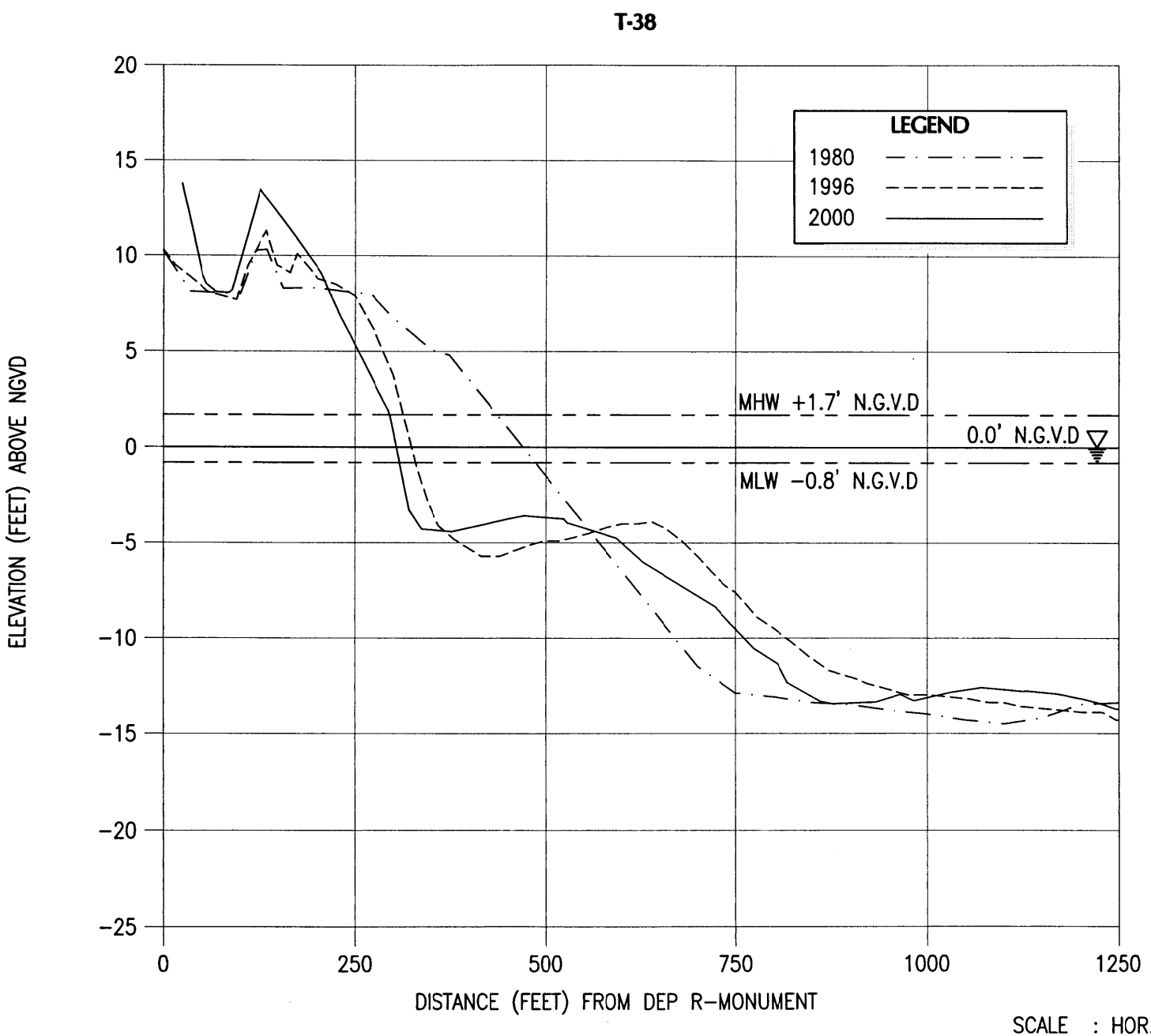
MIAMI-DADE COUNTY, FLORIDA

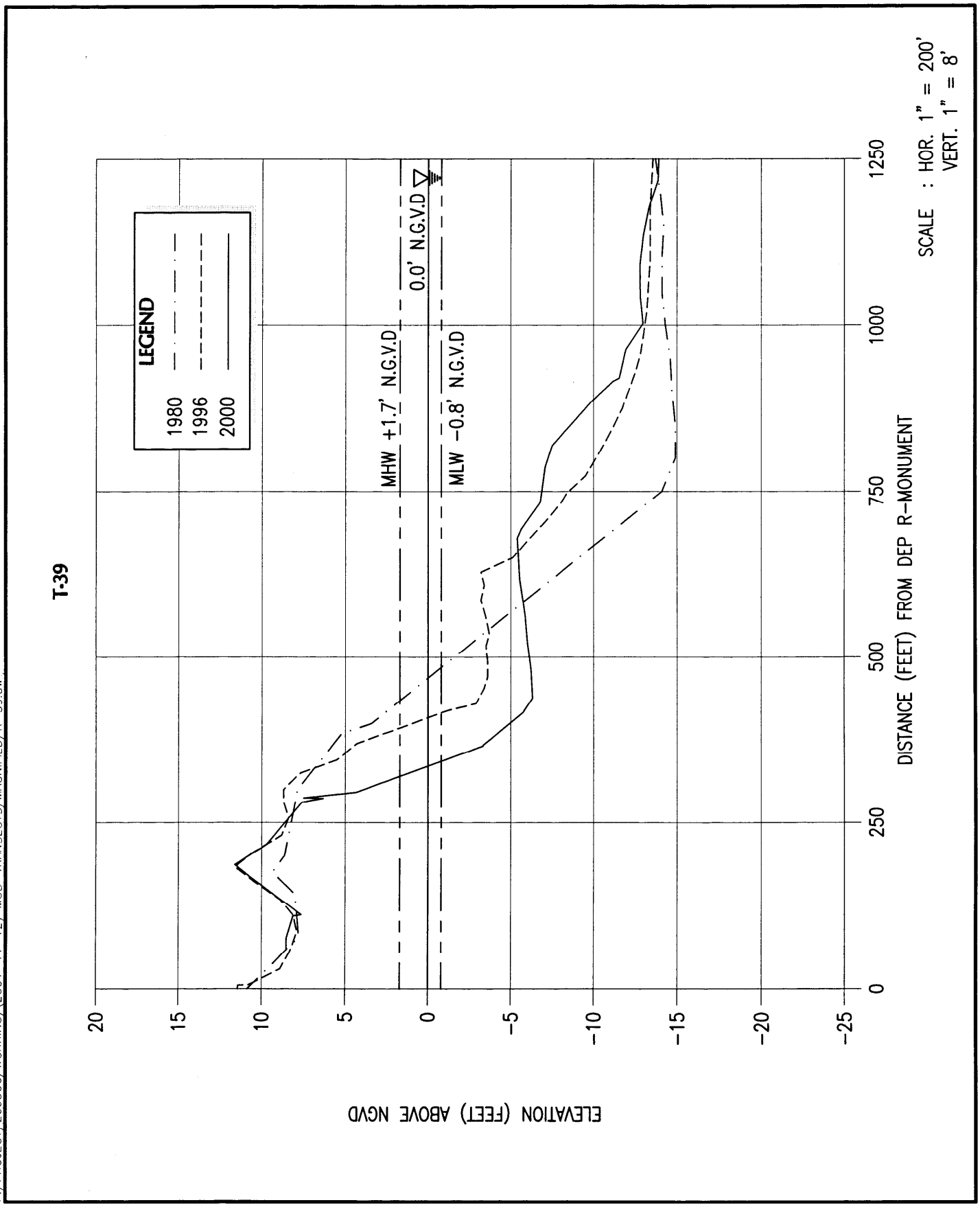


F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-38.dwg

# T-38 - SURFSIDE

MIAMI-DADE COUNTY, FLORIDA






F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-39.dwg

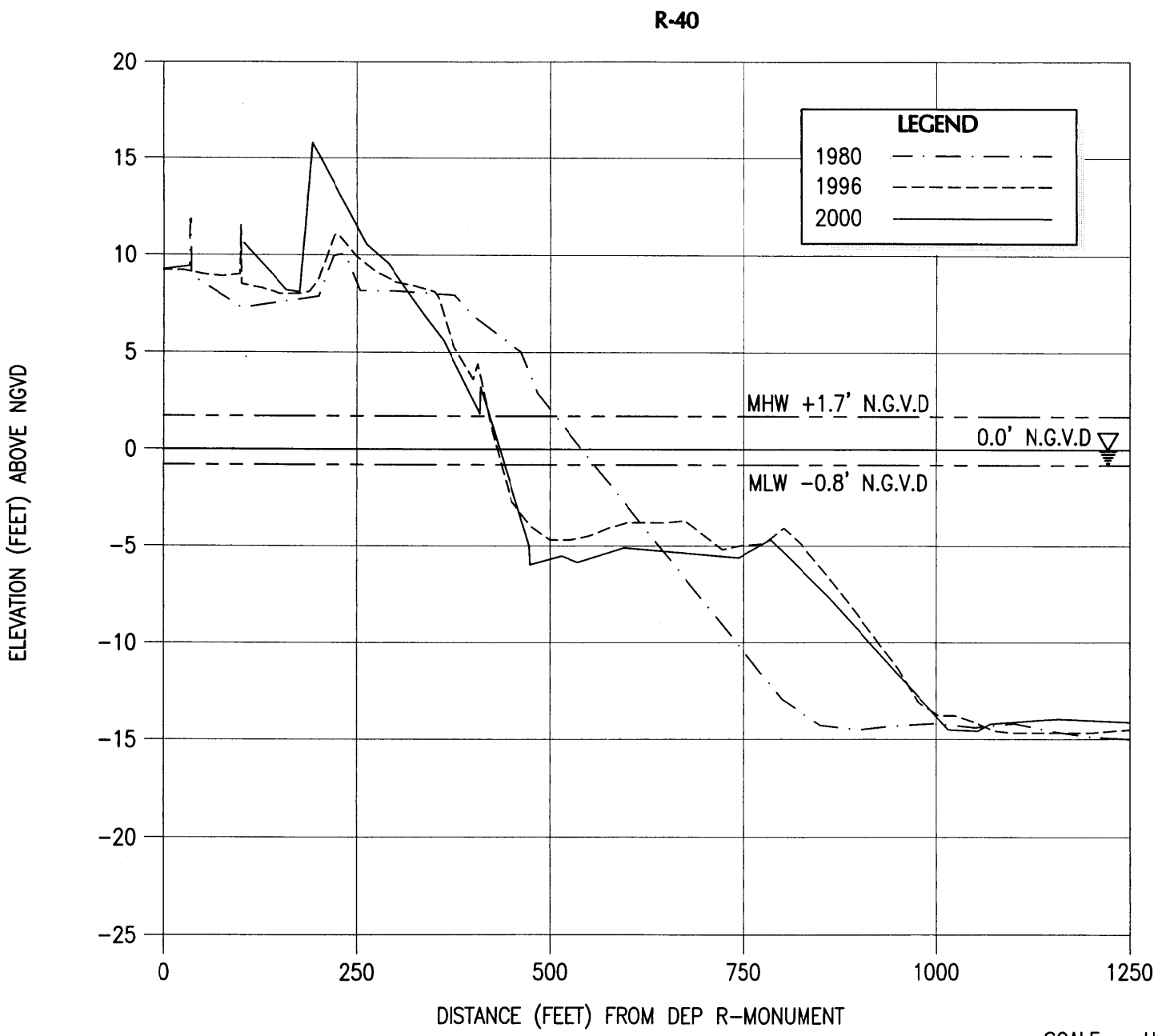
# T-39 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

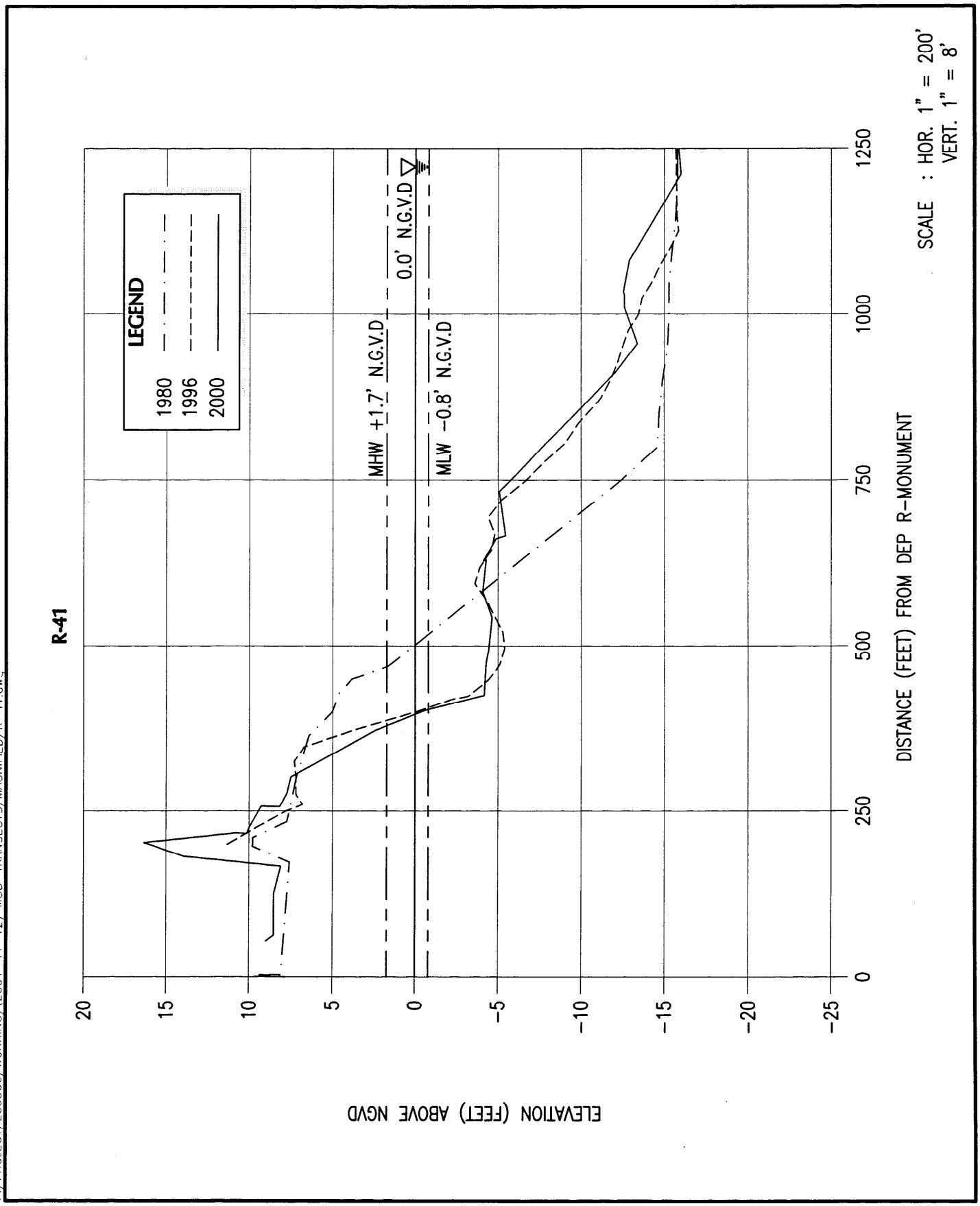
F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-40.dwg

# R-40 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

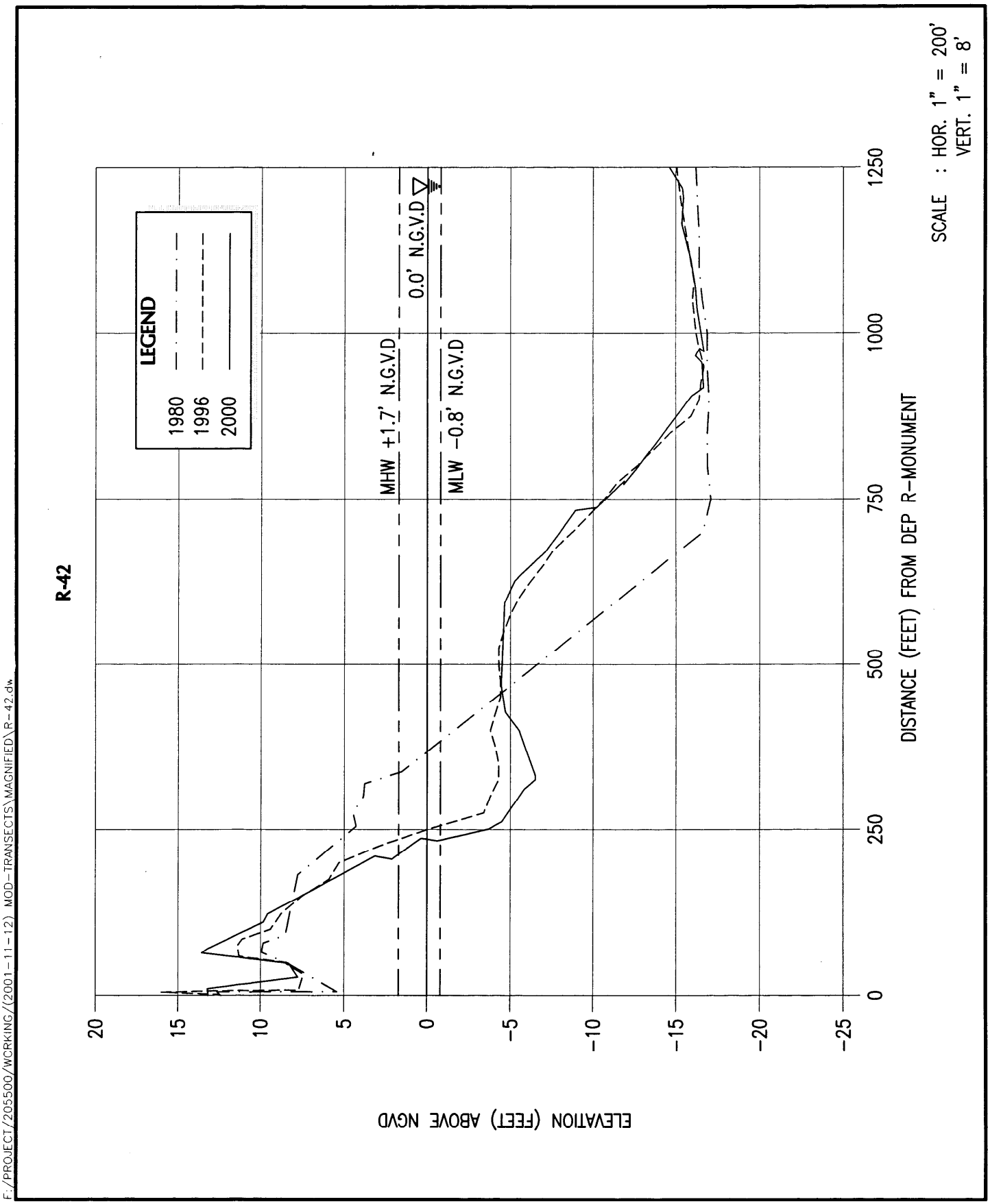



SCALE : HOR. 1" = 200'
VERT. 1" = 8'



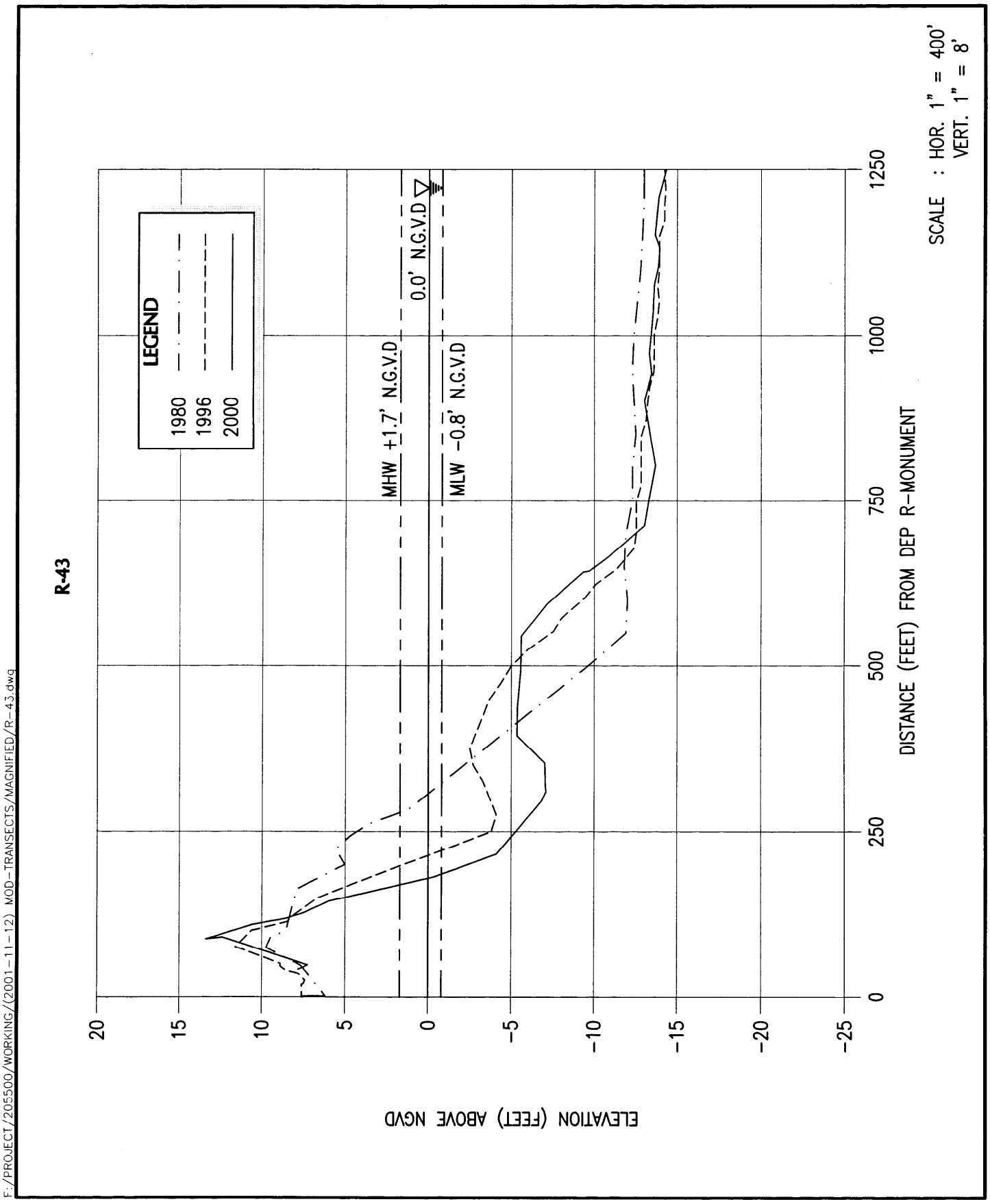

# R-41 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA




# R-42 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA




F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-43.dwg

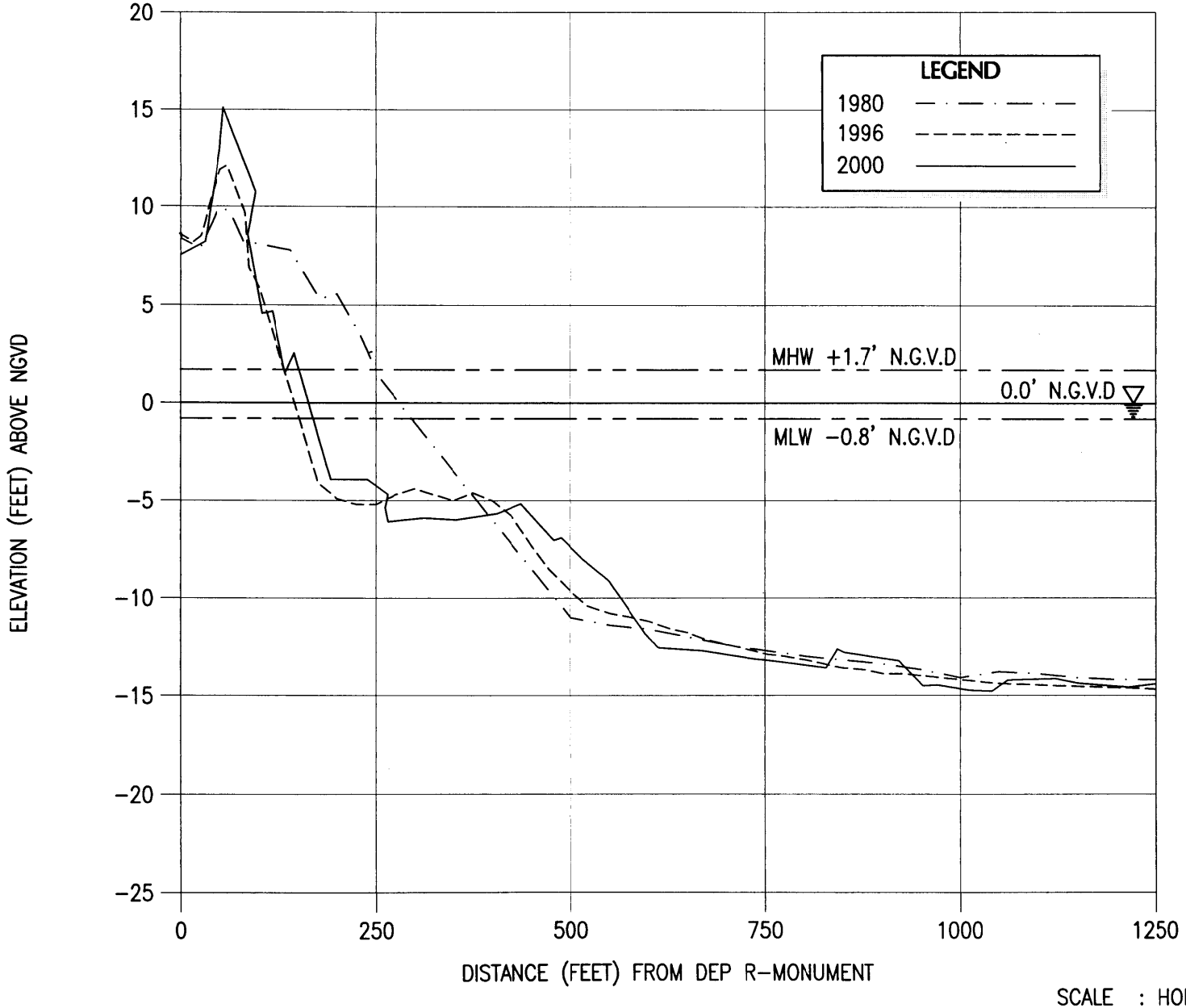
# R-43 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

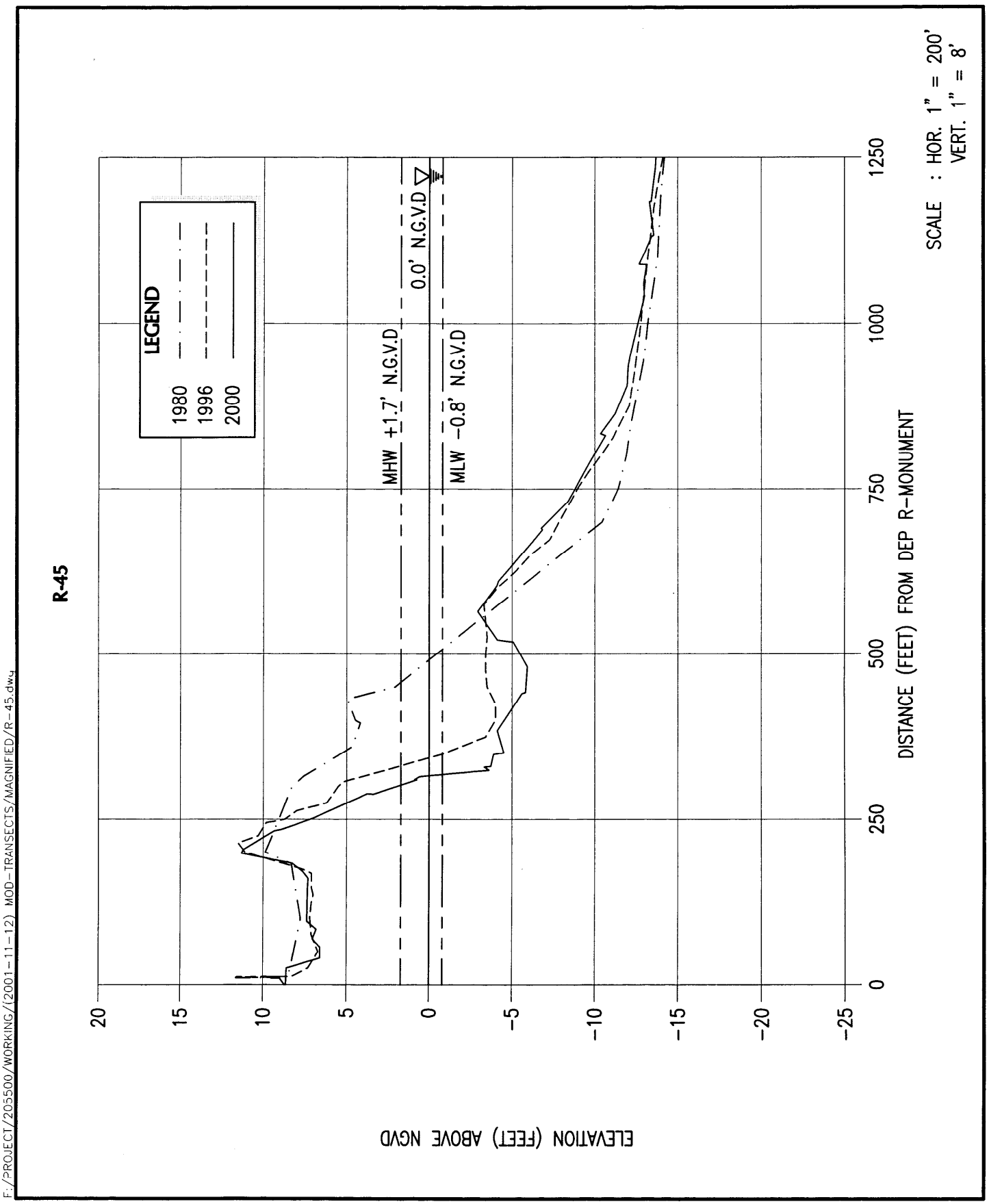
F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-44.dwg

# R-44 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

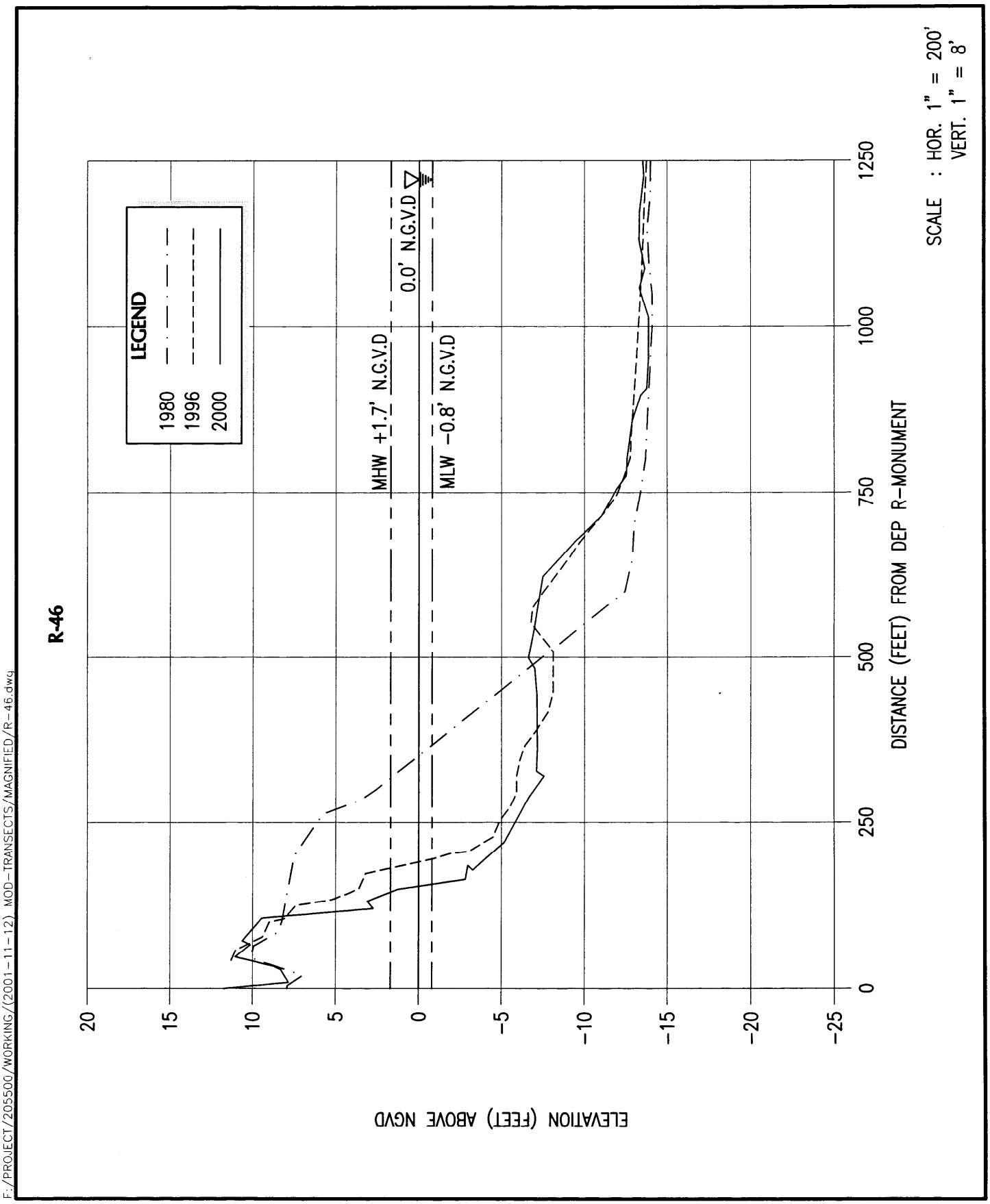



SCALE : HOR. 1" = 200'
VERT. 1" = 8'




# R-45 - MIAMI BEACH

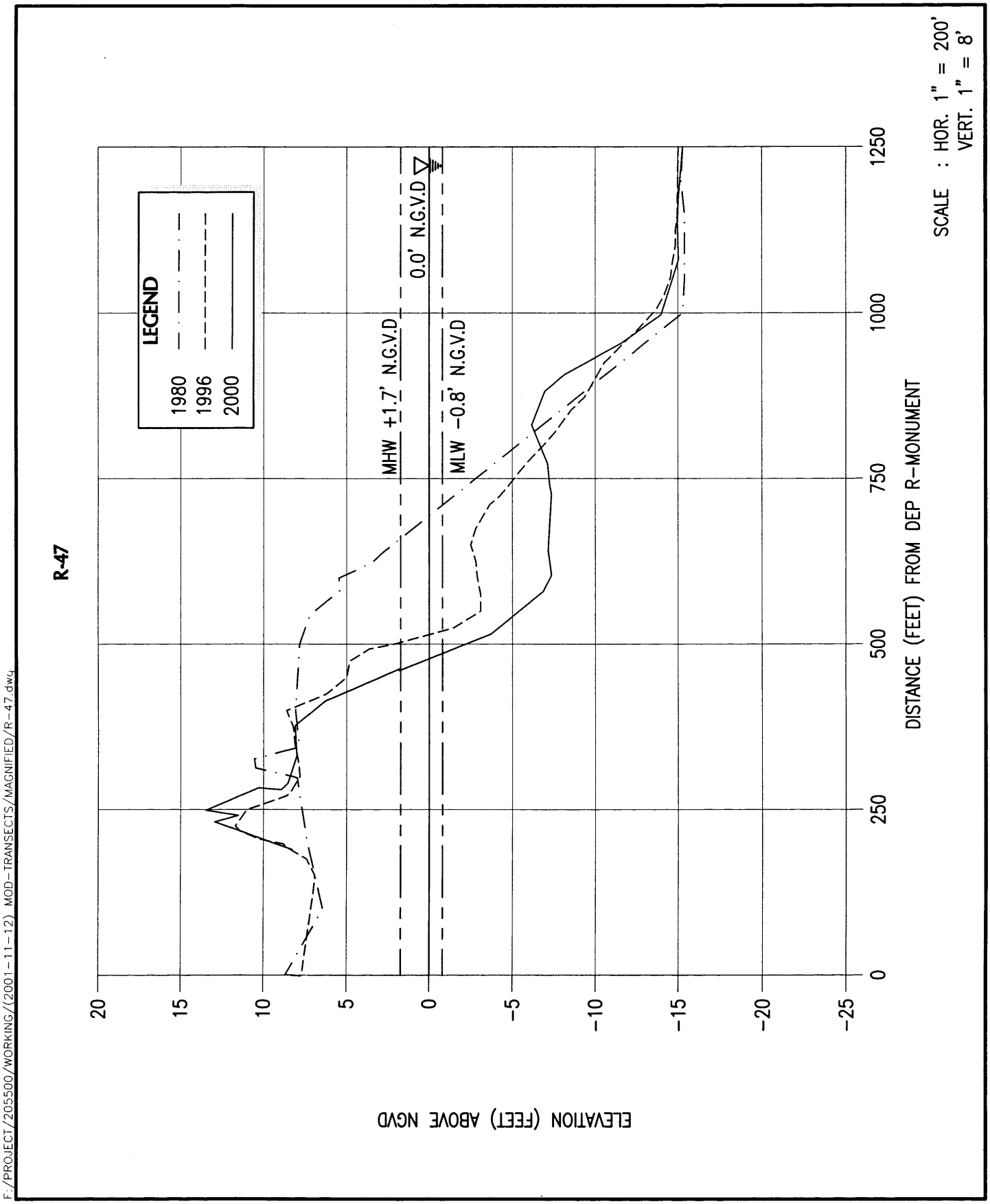
MIAMI-DADE COUNTY, FLORIDA




F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-46.dwg

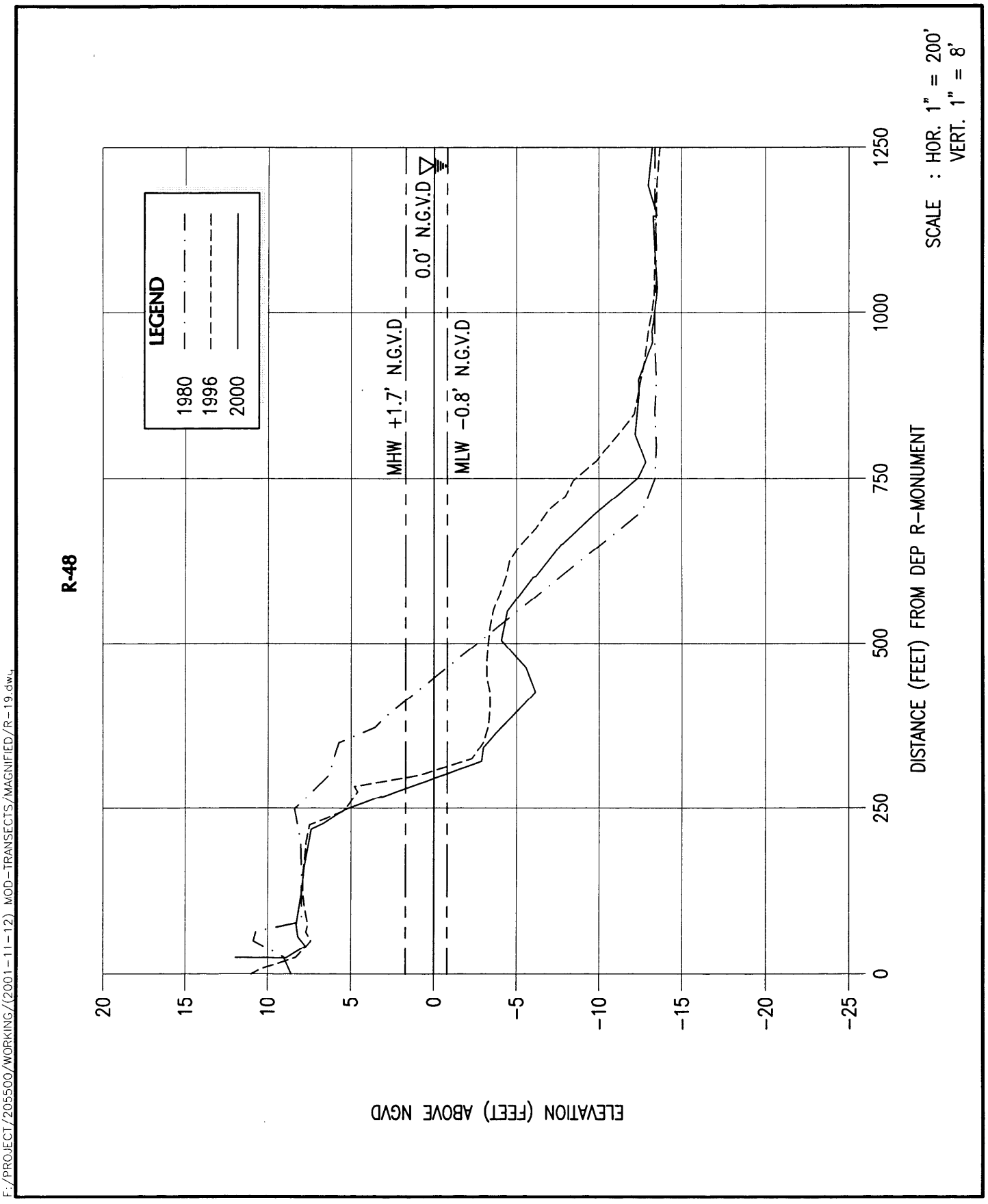
# R-46 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA




# R-47 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA




F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-19.dwg

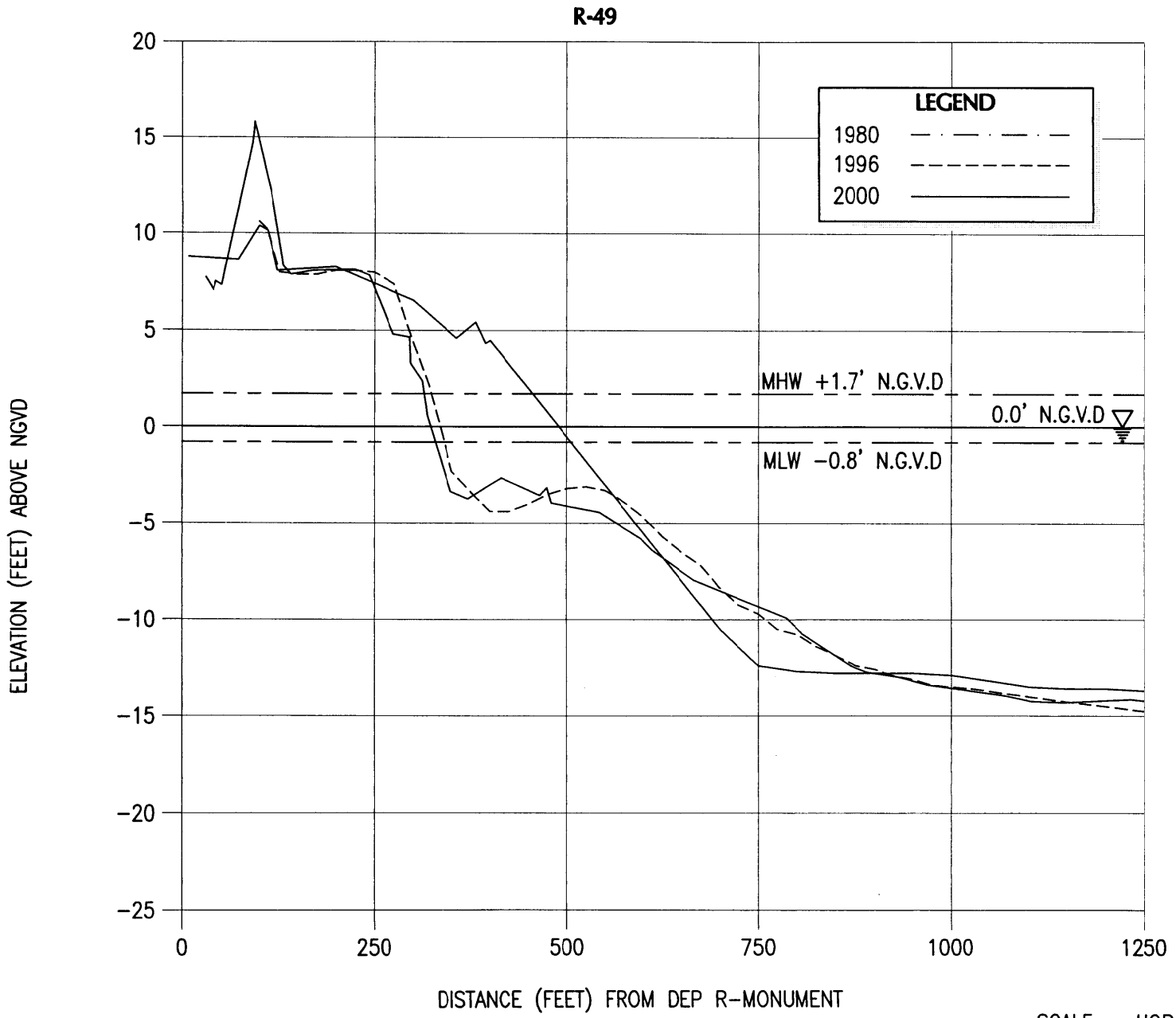
# R-48 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

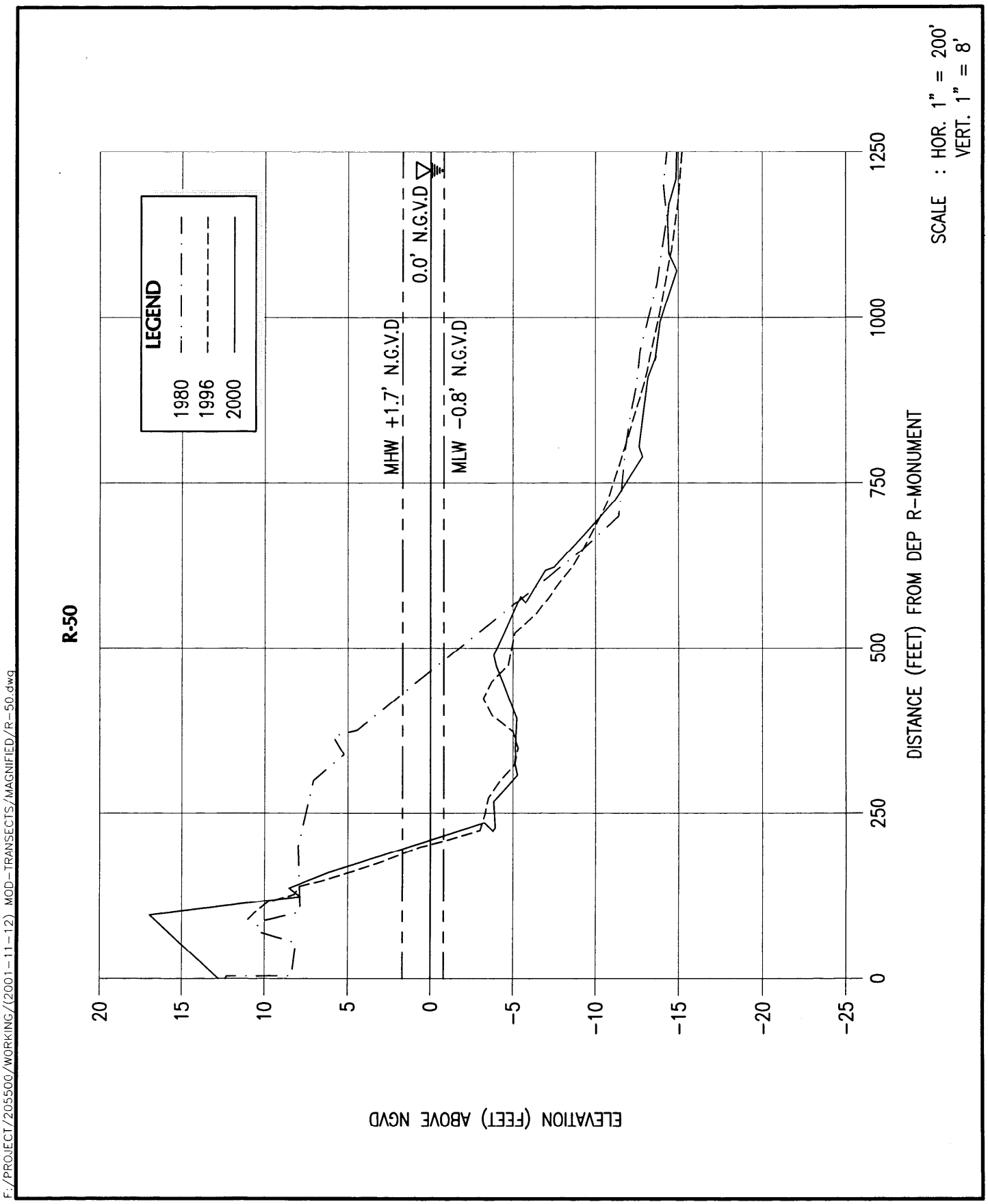
F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-19.dwg

# R-49 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA




SCALE : HOR. 1" = 200'
VERT. 1" = 8'




F:/PROJECT/20550Q/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-50.dwg

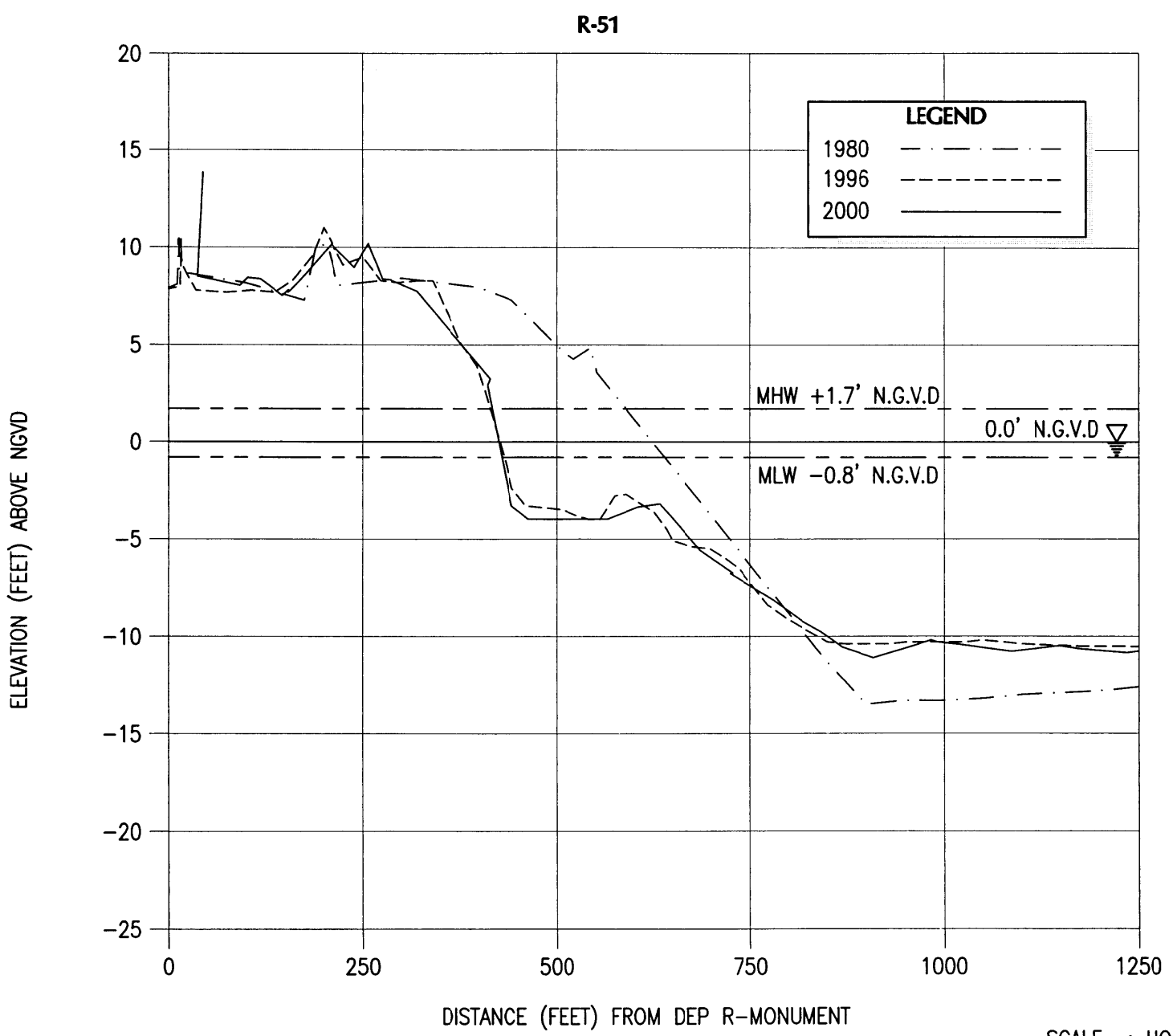
# R-50 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-19.dwg

# R-51 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

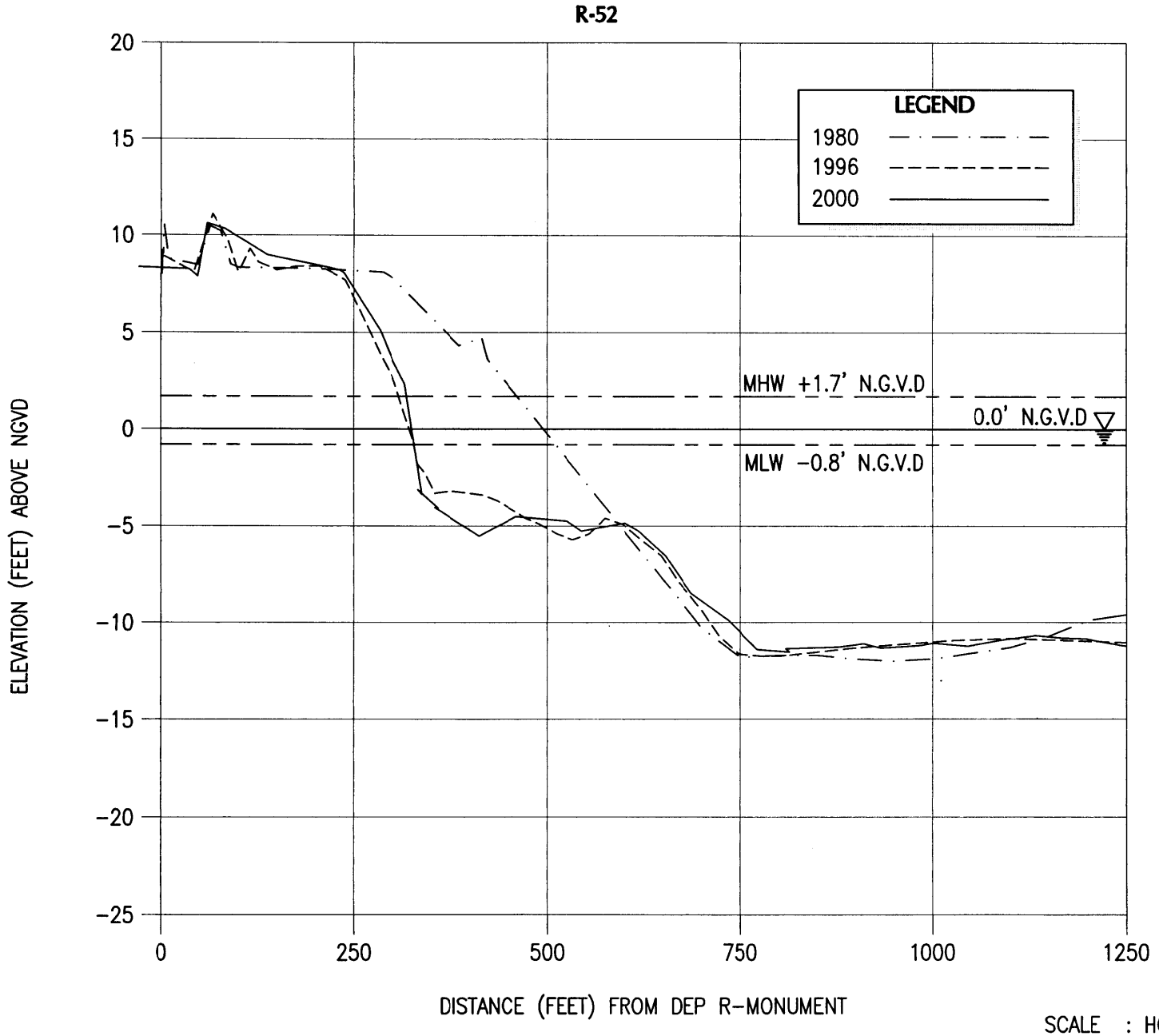



SCALE : HOR. 1" = 200'
VERT. 1" = 8'

F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-52.dwg

# R-52 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

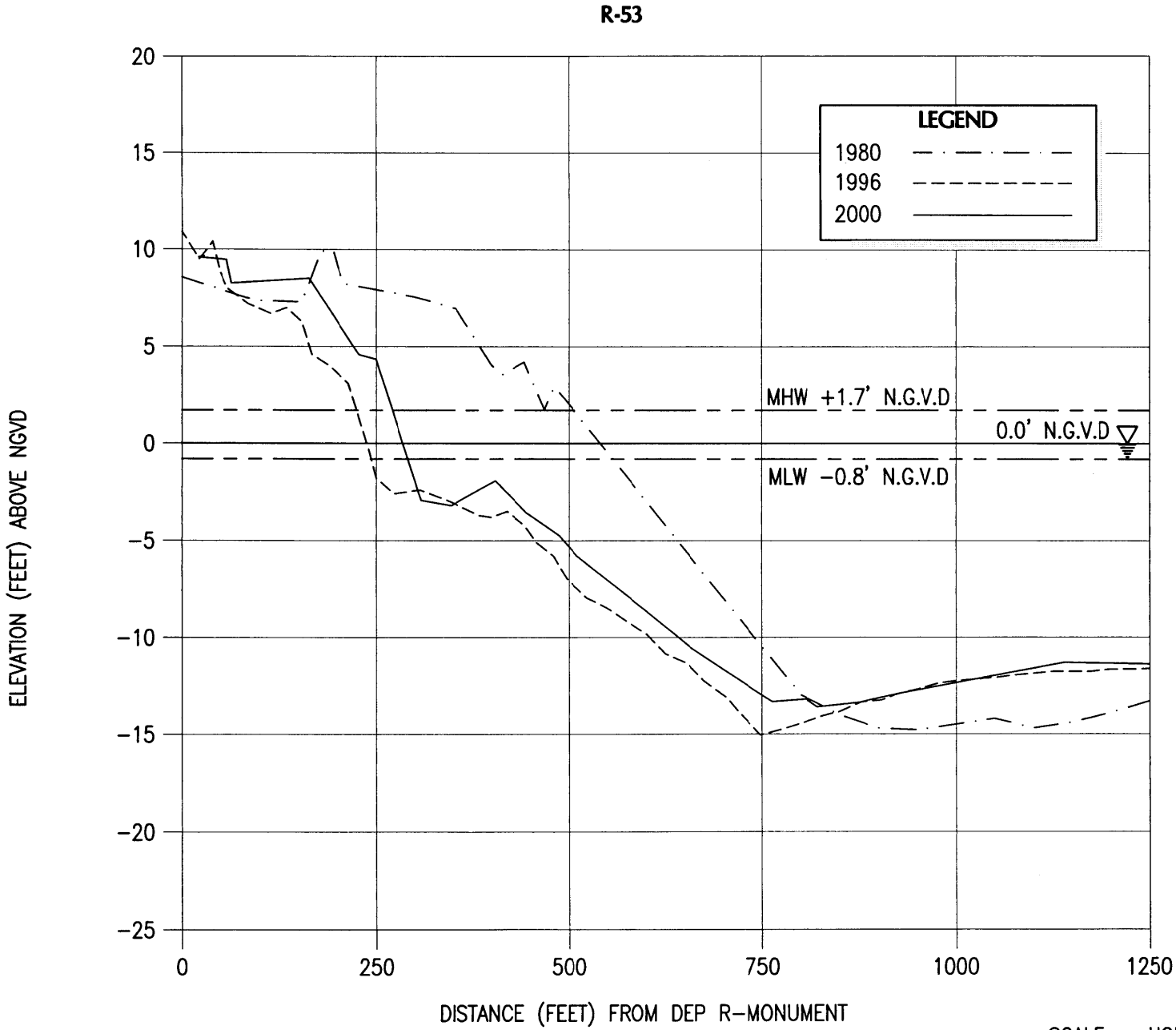



SCALE : HOR. 1" = 200'
VERT. 1" = 8'

F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-53.dwg

# R-53 - MIAMI BEACH

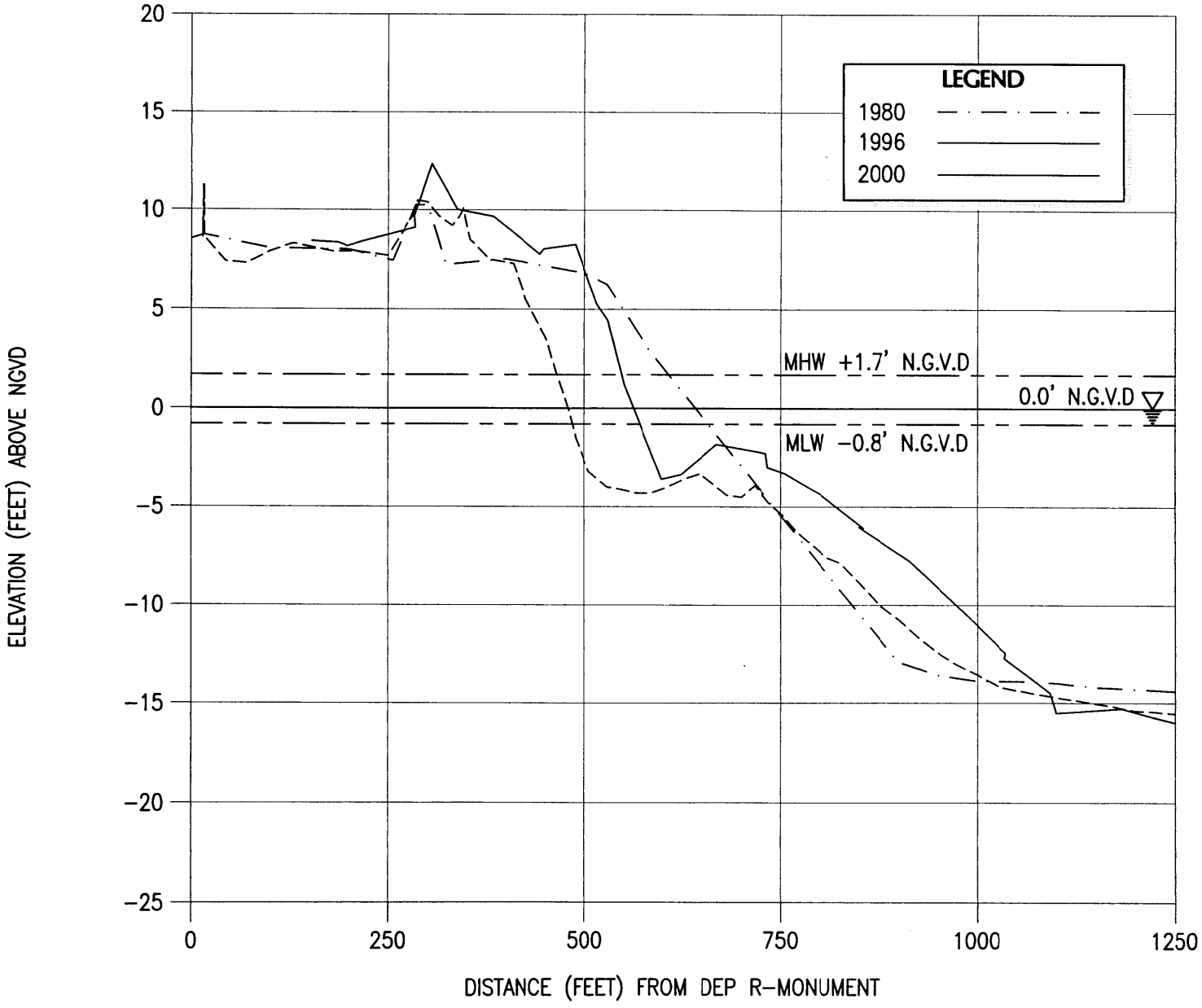
MIAMI-DADE COUNTY, FLORIDA



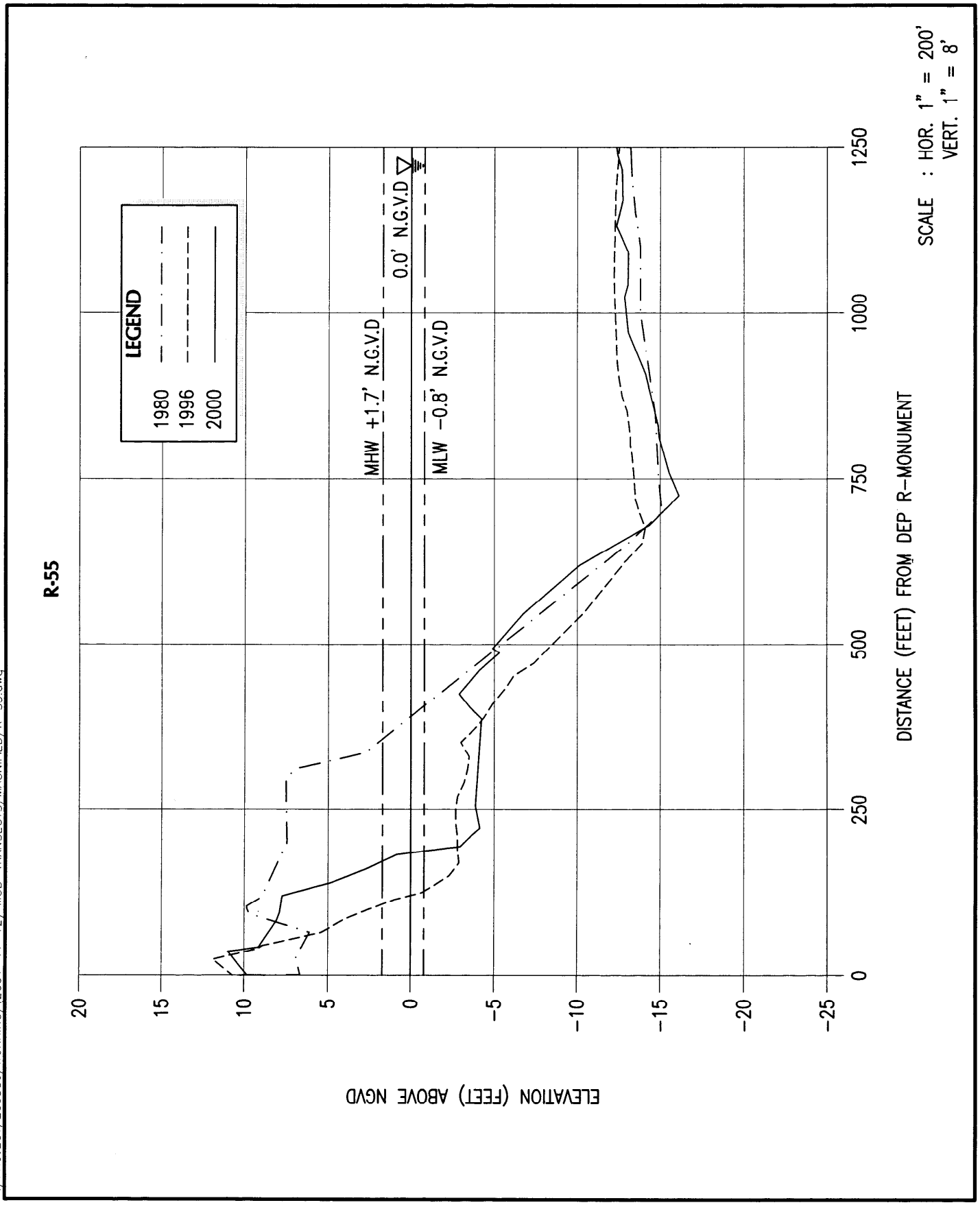
F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-54.dwg

# R-54 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA




SCALE : HOR. 1" = 200'
VERT. 1" = 8'



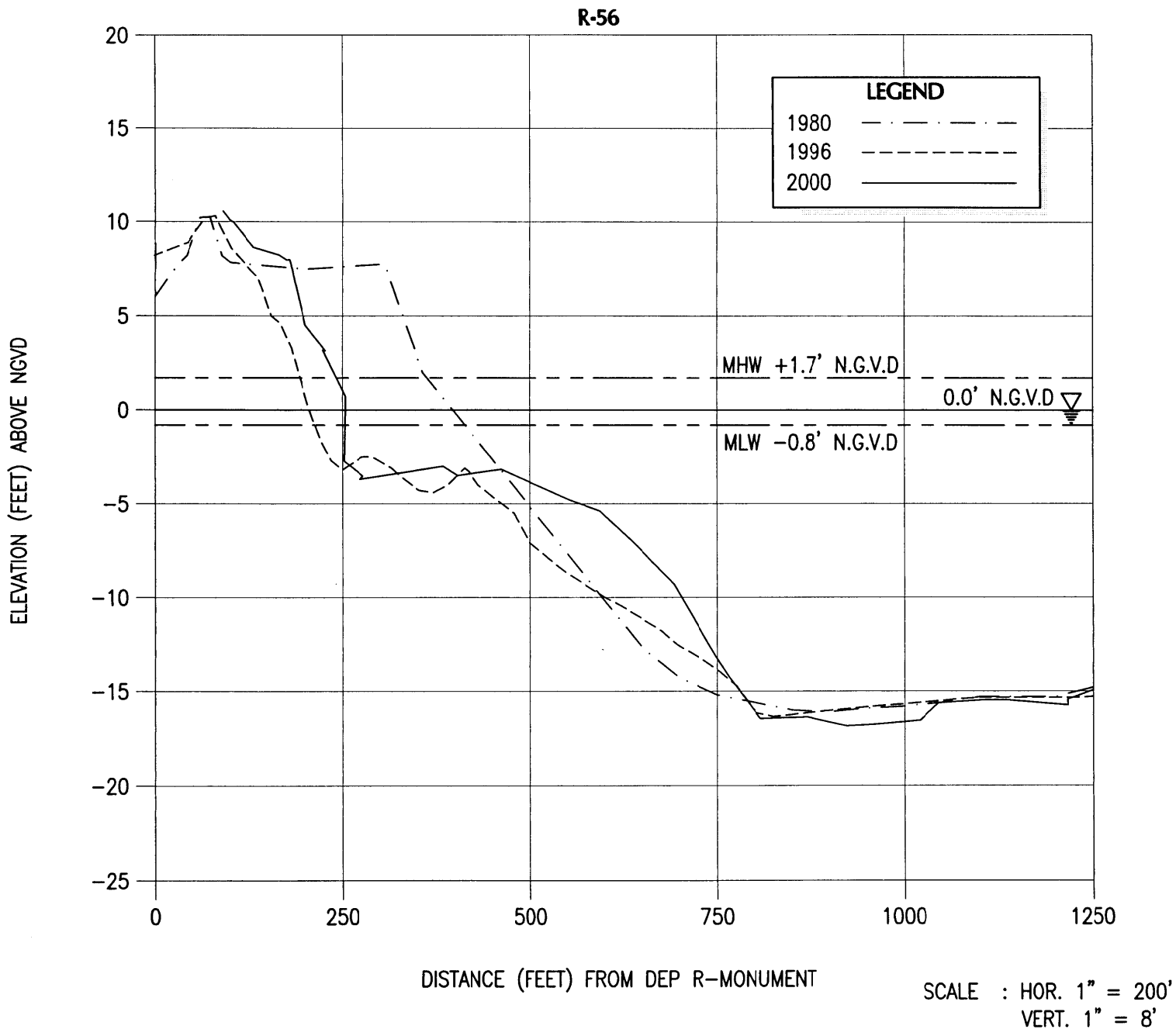

# R-55 - MIAMI BEACH

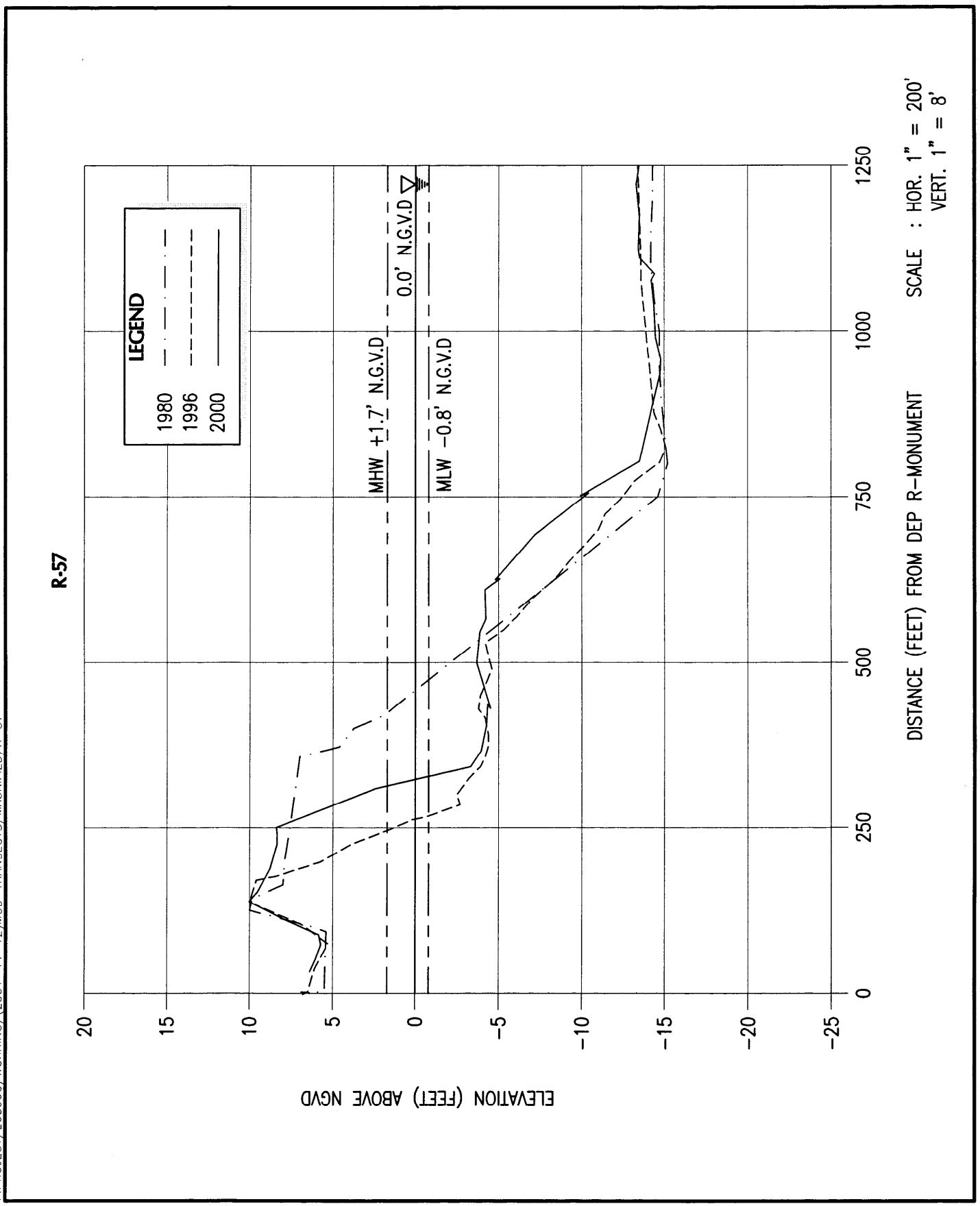
MIAMI-DADE COUNTY, FLORIDA

F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/MAGNIFIED/R-56.DWG

# R-56 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

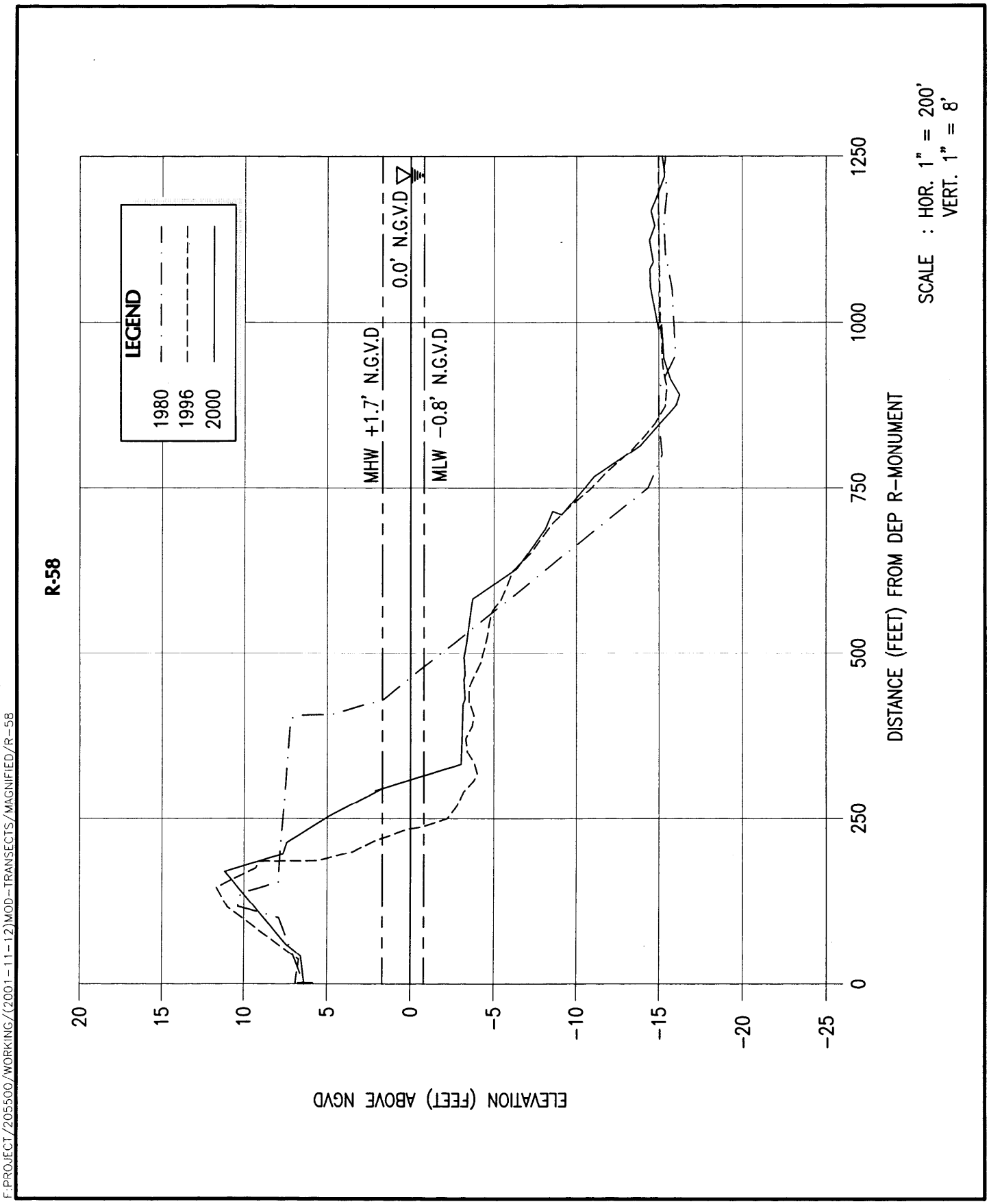





F:\PROJECT\205500\WORKING\(2001-11-12)MOD-TRANSECTS\MAGNIFIED\R-57

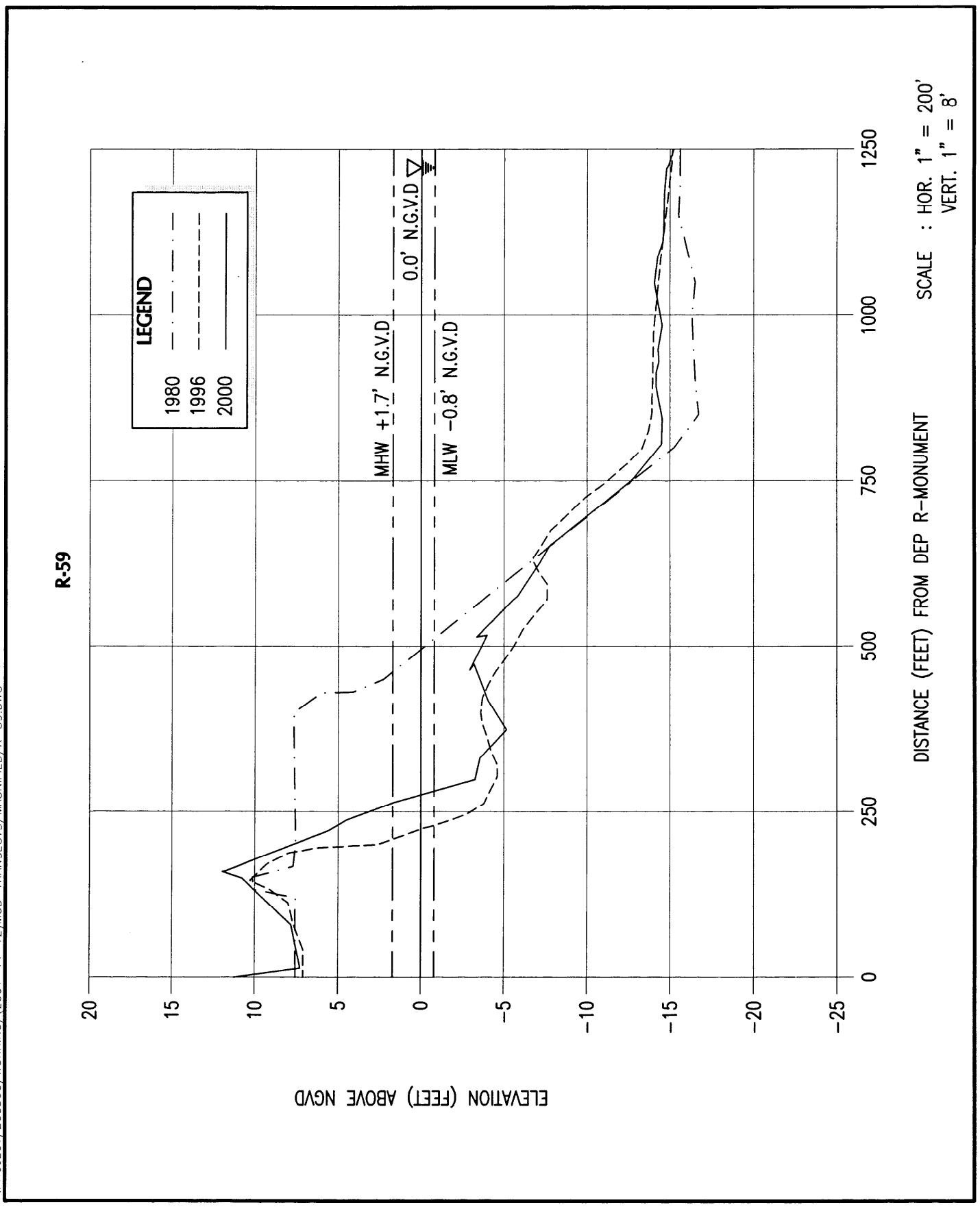
# R-57 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA




# R-58 - MIAMI BEACH

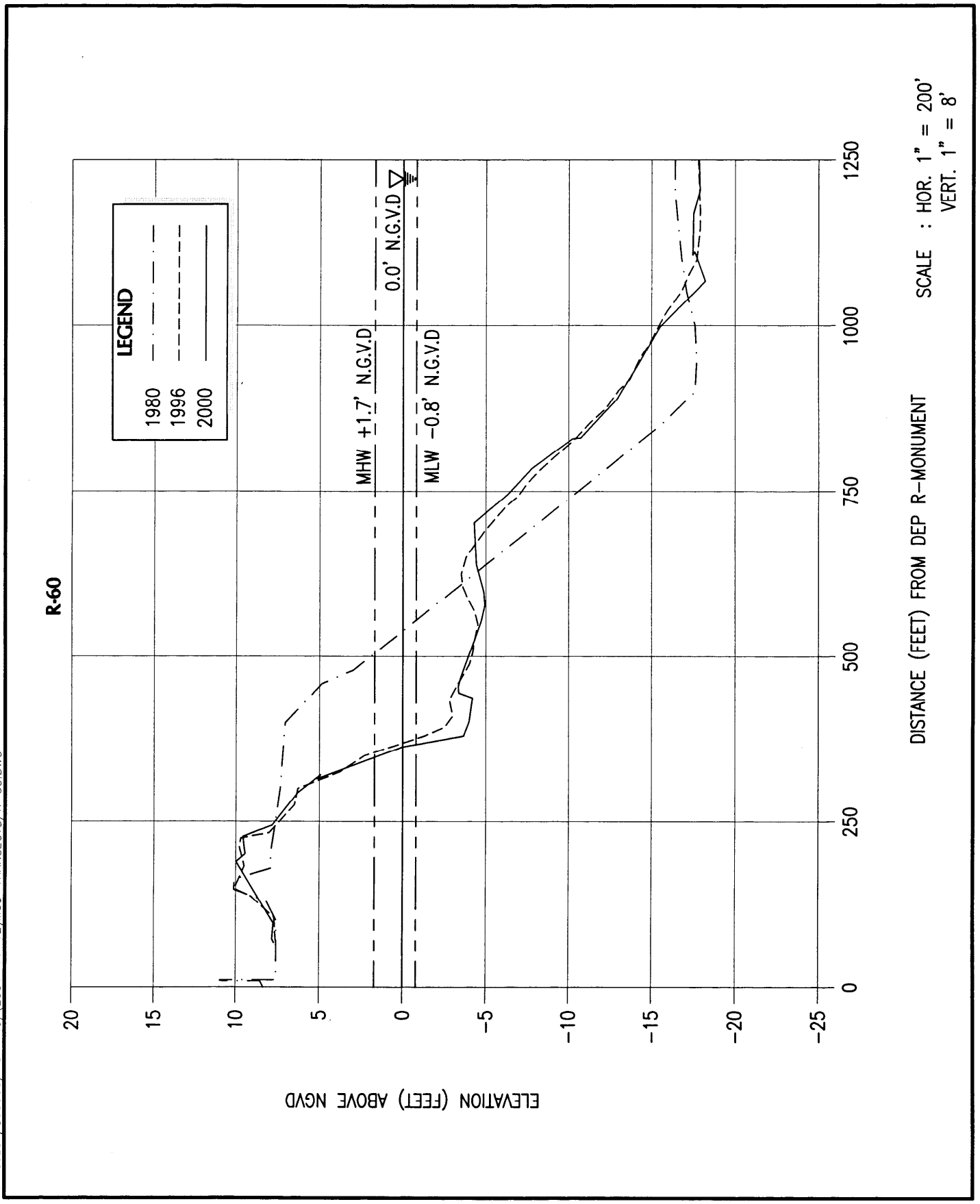
MIAMI-DADE COUNTY, FLORIDA




F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/MAGNIFIED/R-59.DWG

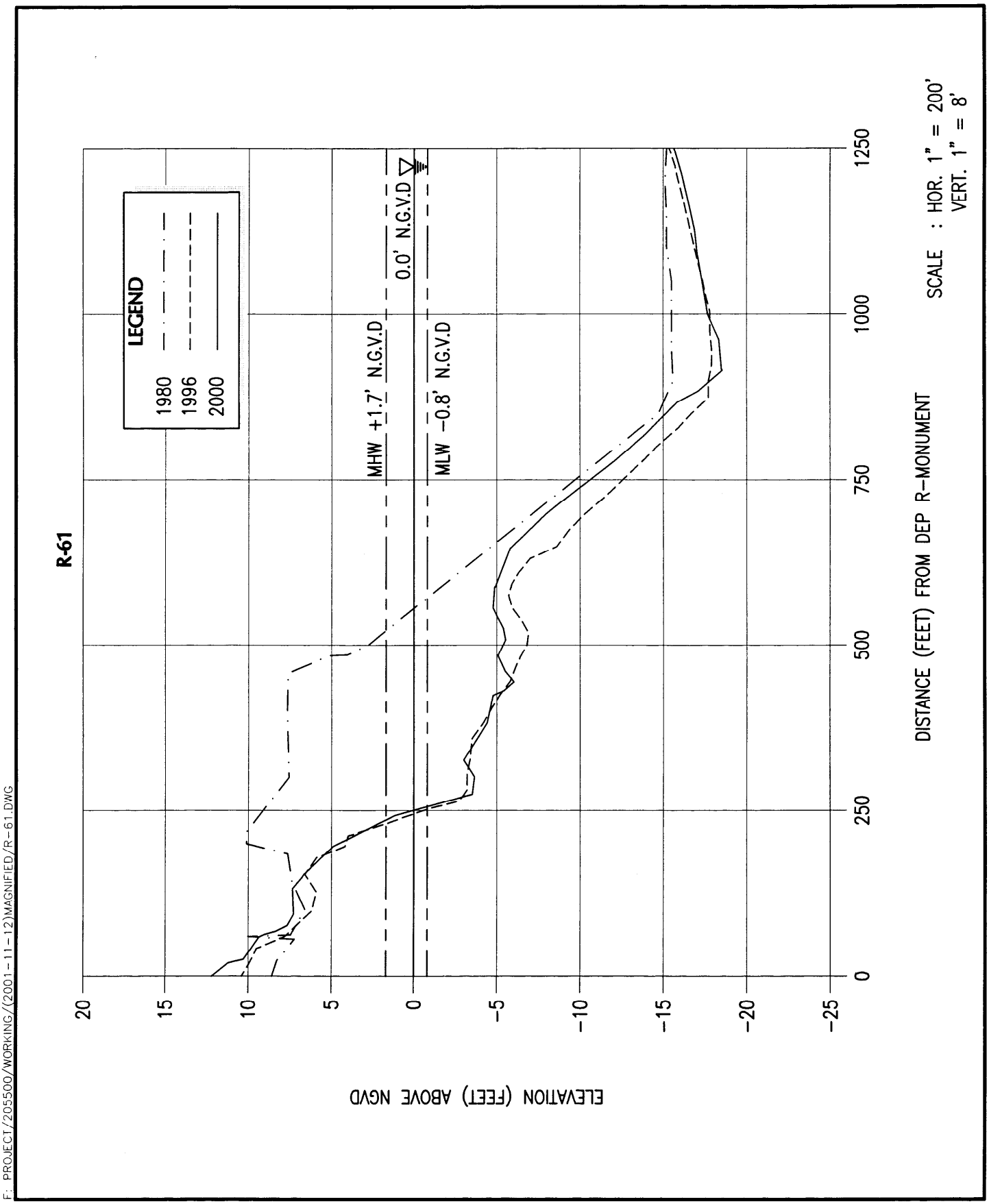
# R-59 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA




# R-60 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

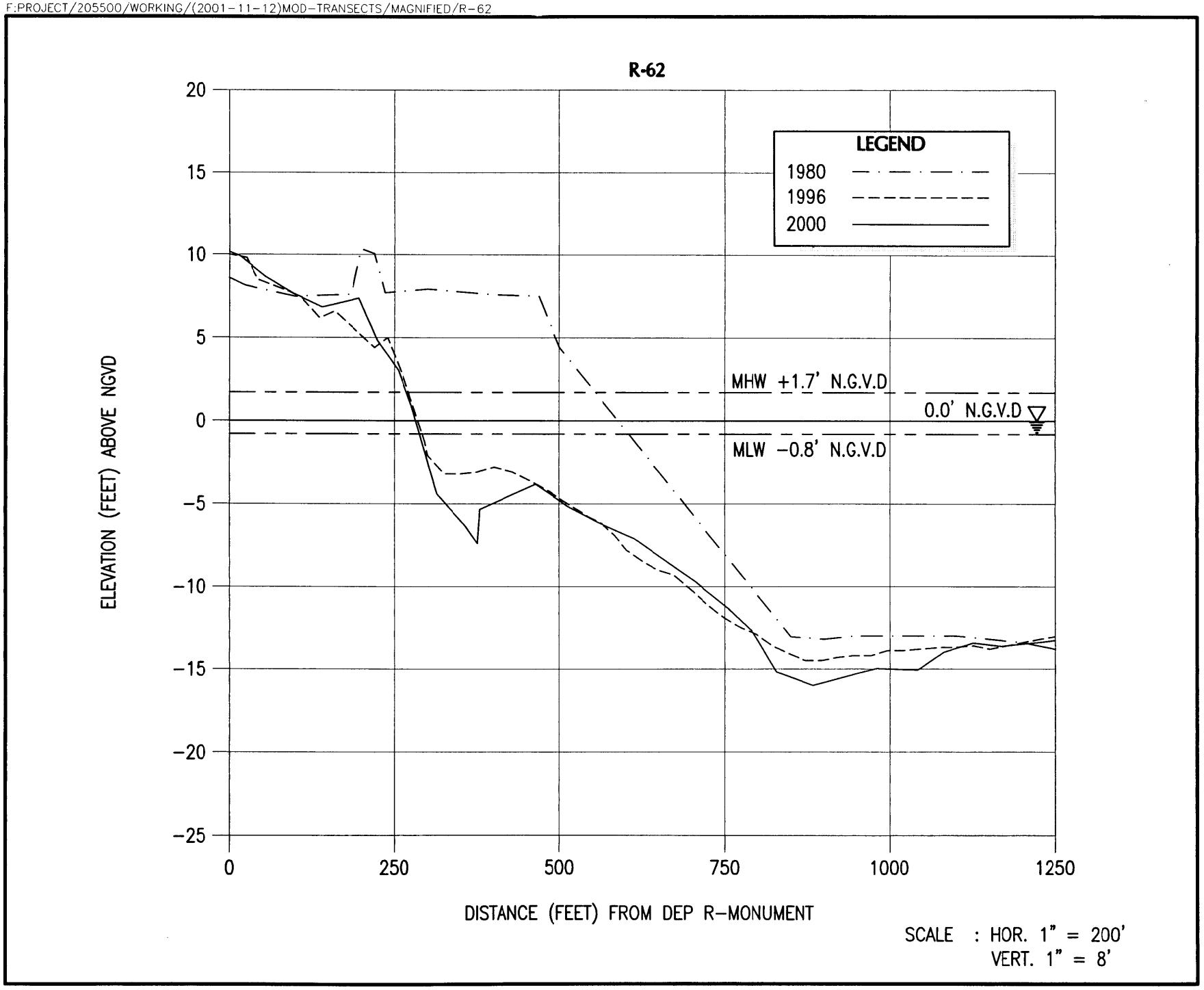



F:\ PROJECT/205500/WORKING/(2001-11-12)MAGNIFIED/R-61.DWG

# R-61 - MIAMI BEACH

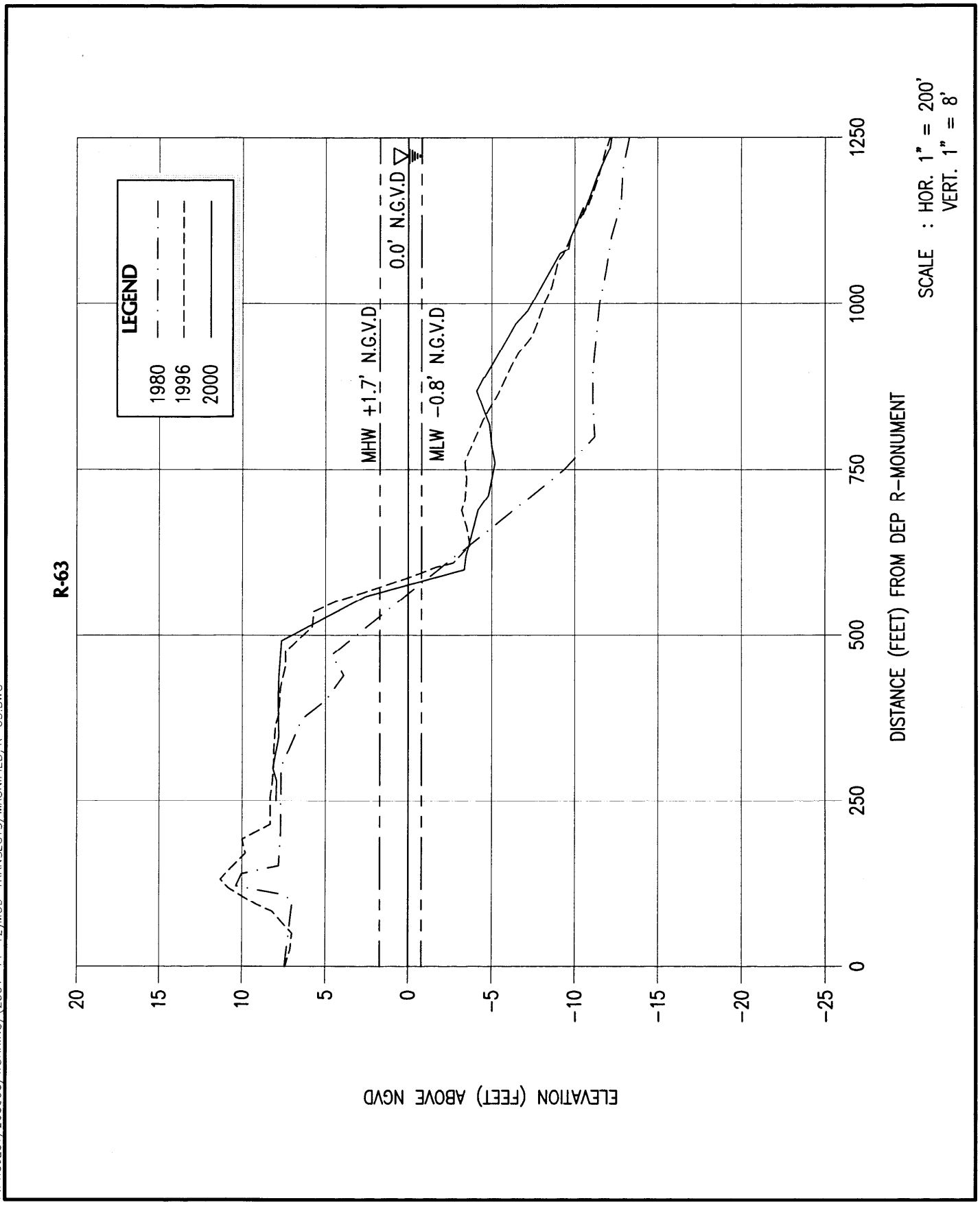
MIAMI-DADE COUNTY, FLORIDA

F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/MAGNIFIED/R-62




# R-62 - MIAMI BEACH

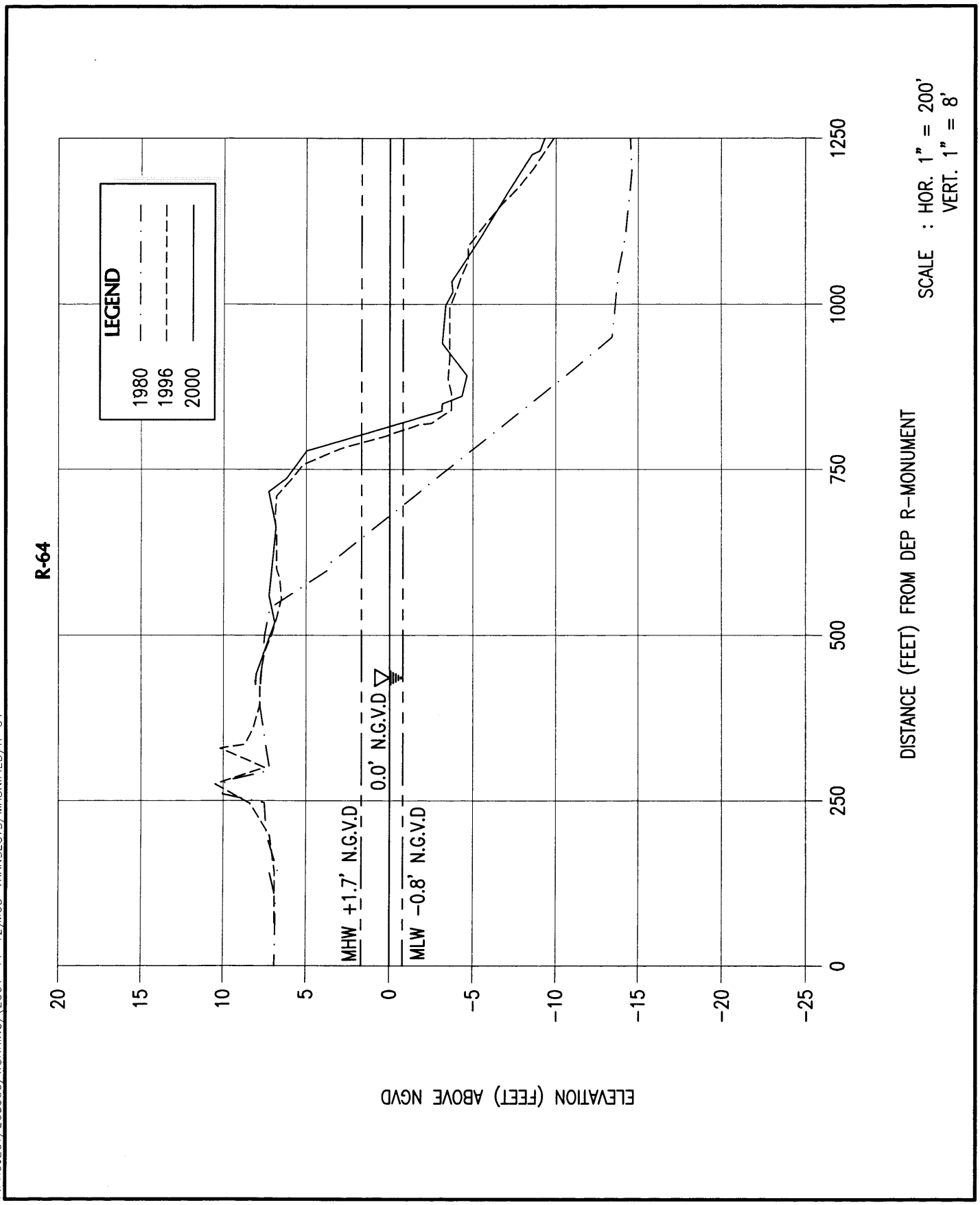
MIAMI-DADE COUNTY, FLORIDA




F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/MAGNIFIED/R-63.DWG

# R-63 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA




F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/MAGNIFIED/R-64

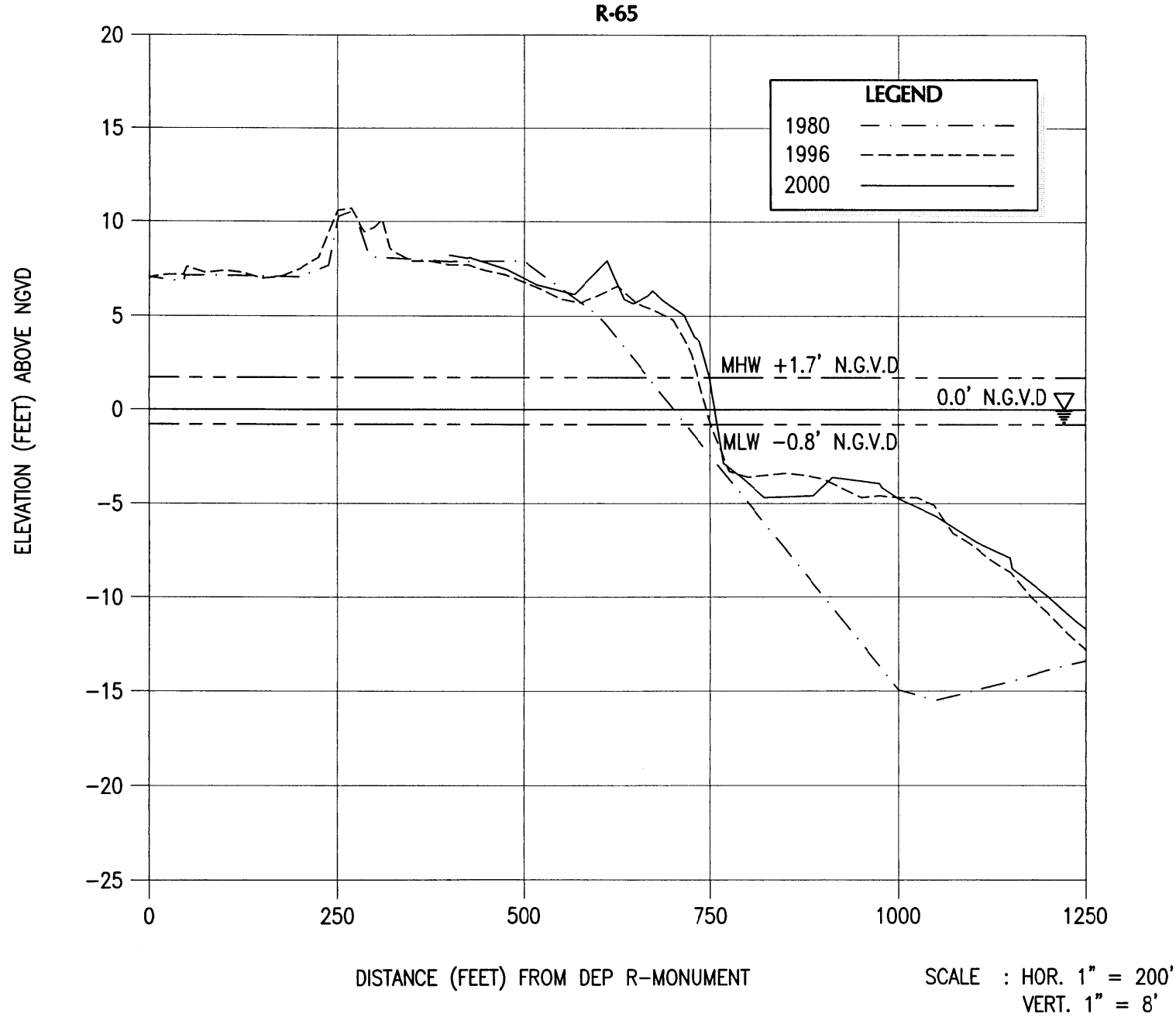
# R-64 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/MAGNIFIED/R-65

# R-65 -MIAMI BEACH

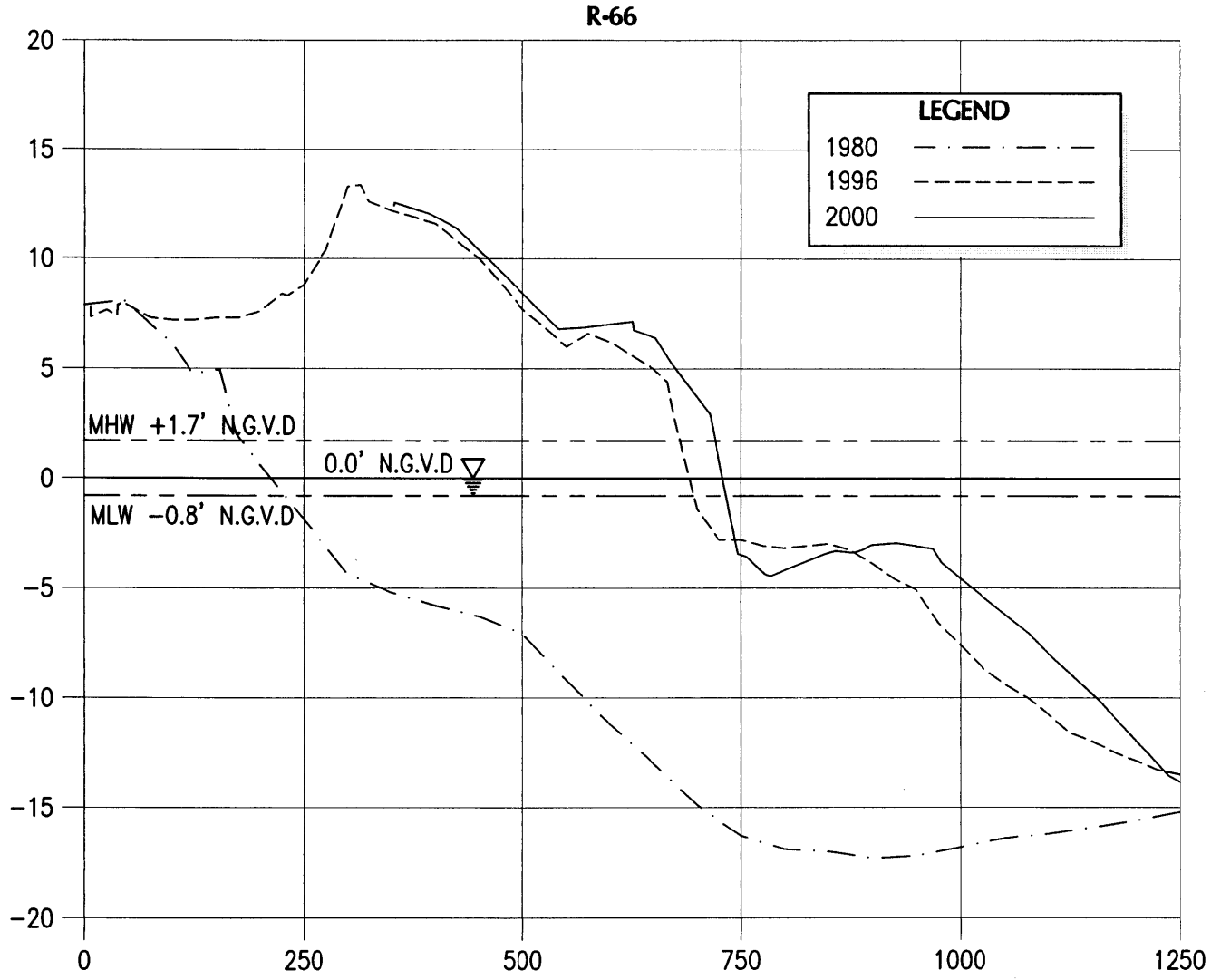
MIAMI-DADE COUNTY, FLORIDA



F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/R-66.DWG

# R-66 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

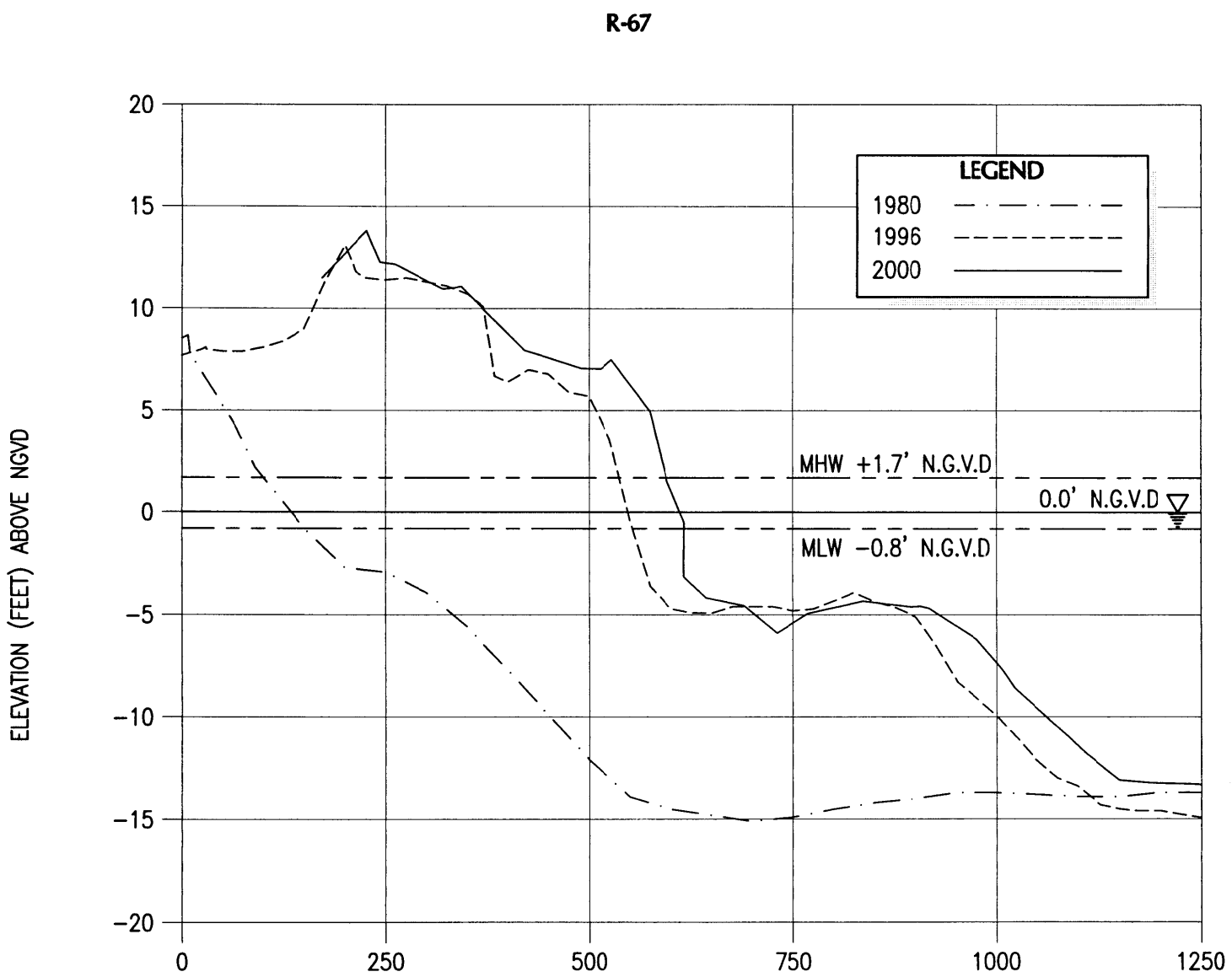



SCALE : HOR. 1" = 200'
VERT. 1" = 8'

F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/MAGNIFIED/R-67

# R-67 -MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

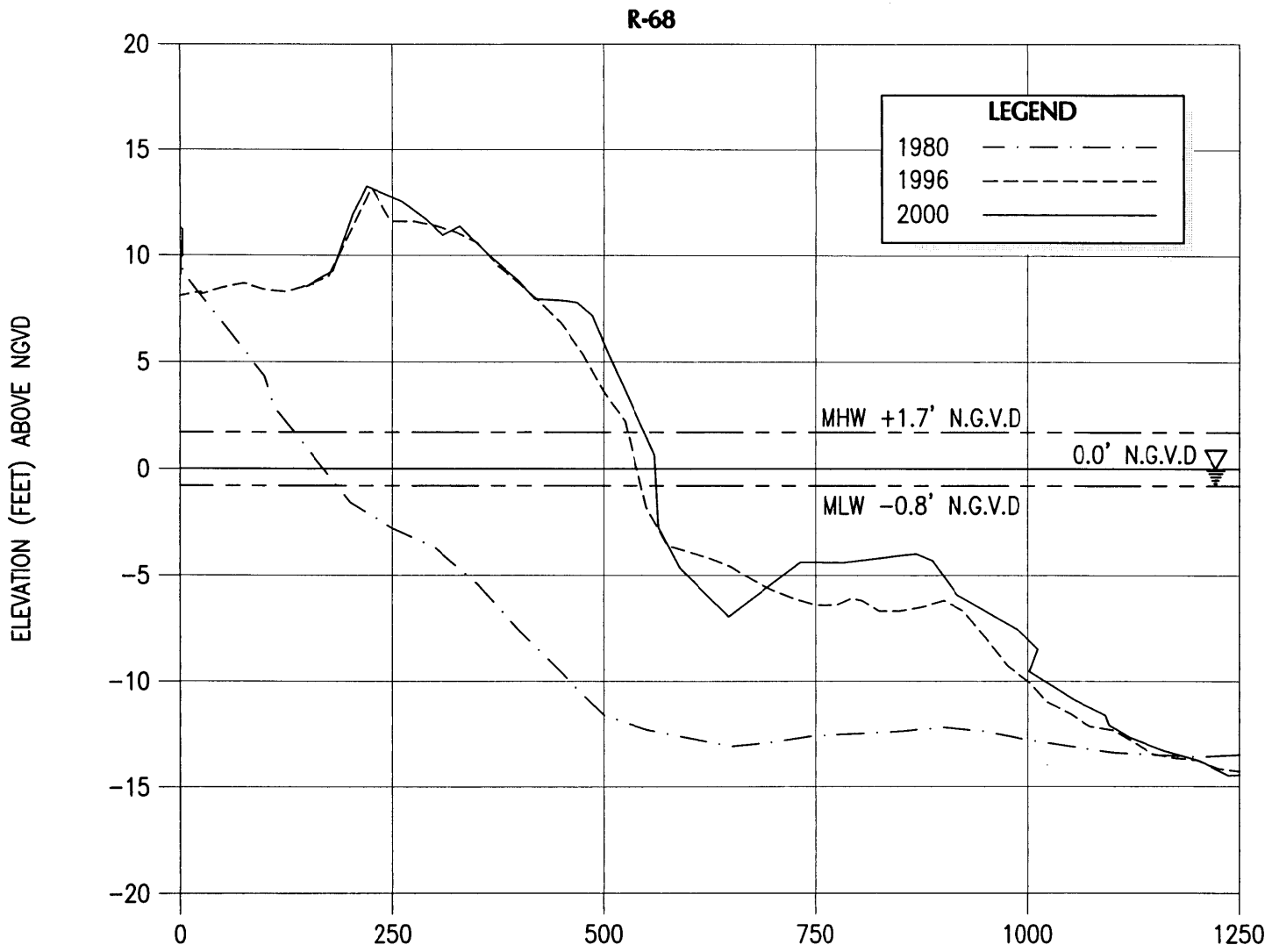



SCALE : HOR. 1" = 200'
VERT. 1" = 8'

F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRNASECTS/MAGNIFIED/R-68

# R-68 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

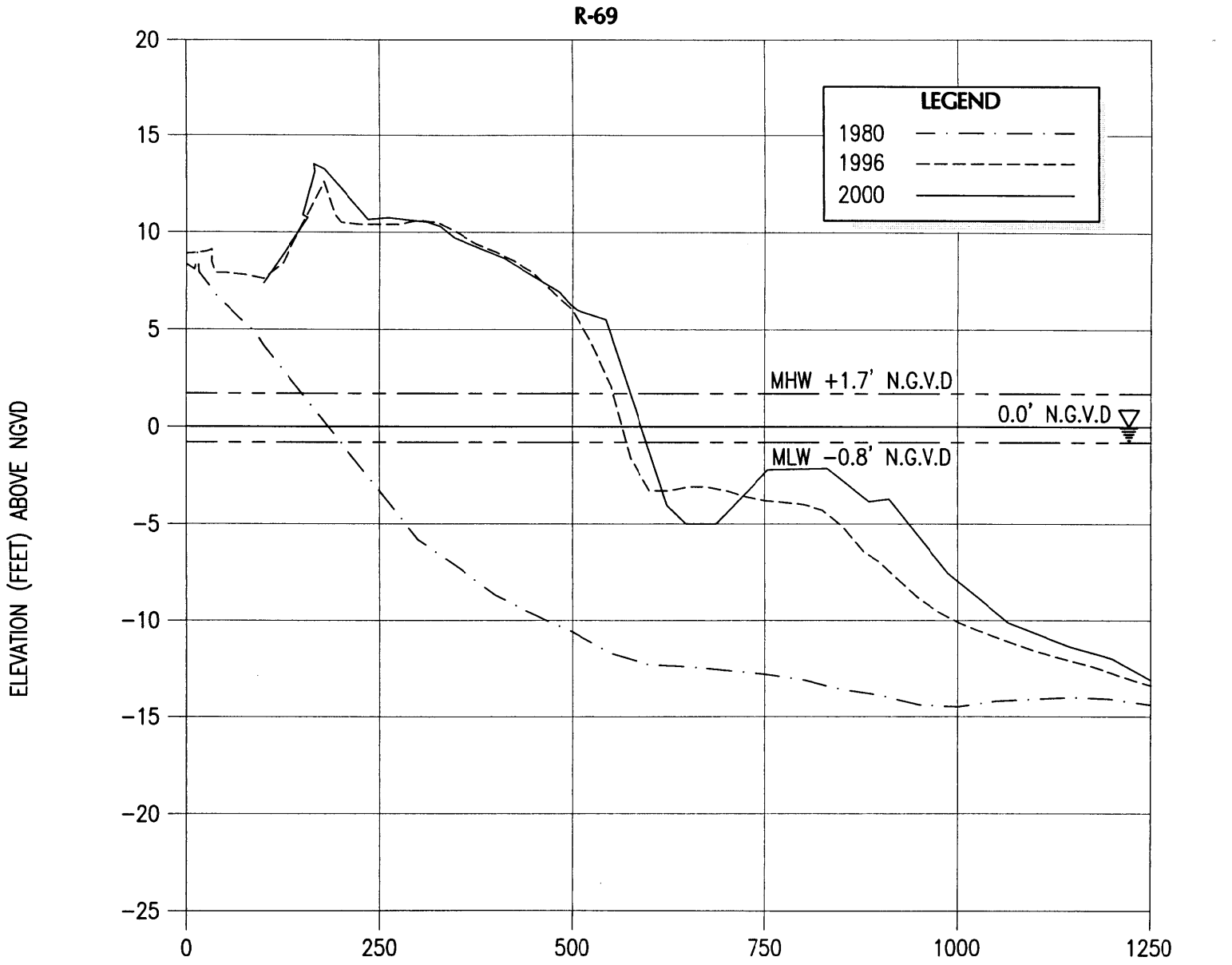


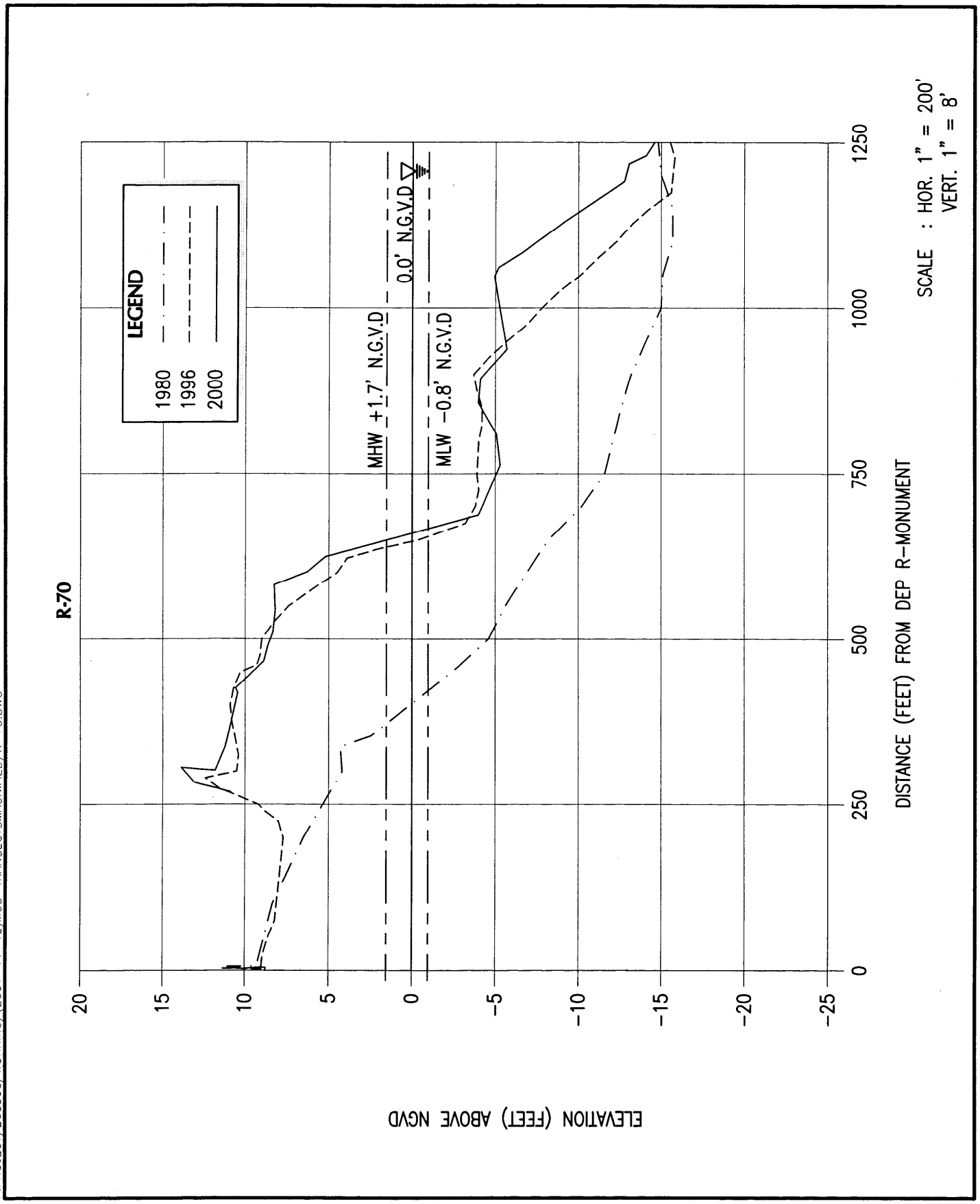

SCALE : HOR. 1" = 200'
VERT. 1" = 8'

F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/MAGNIFIED/R-69

# R-69 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

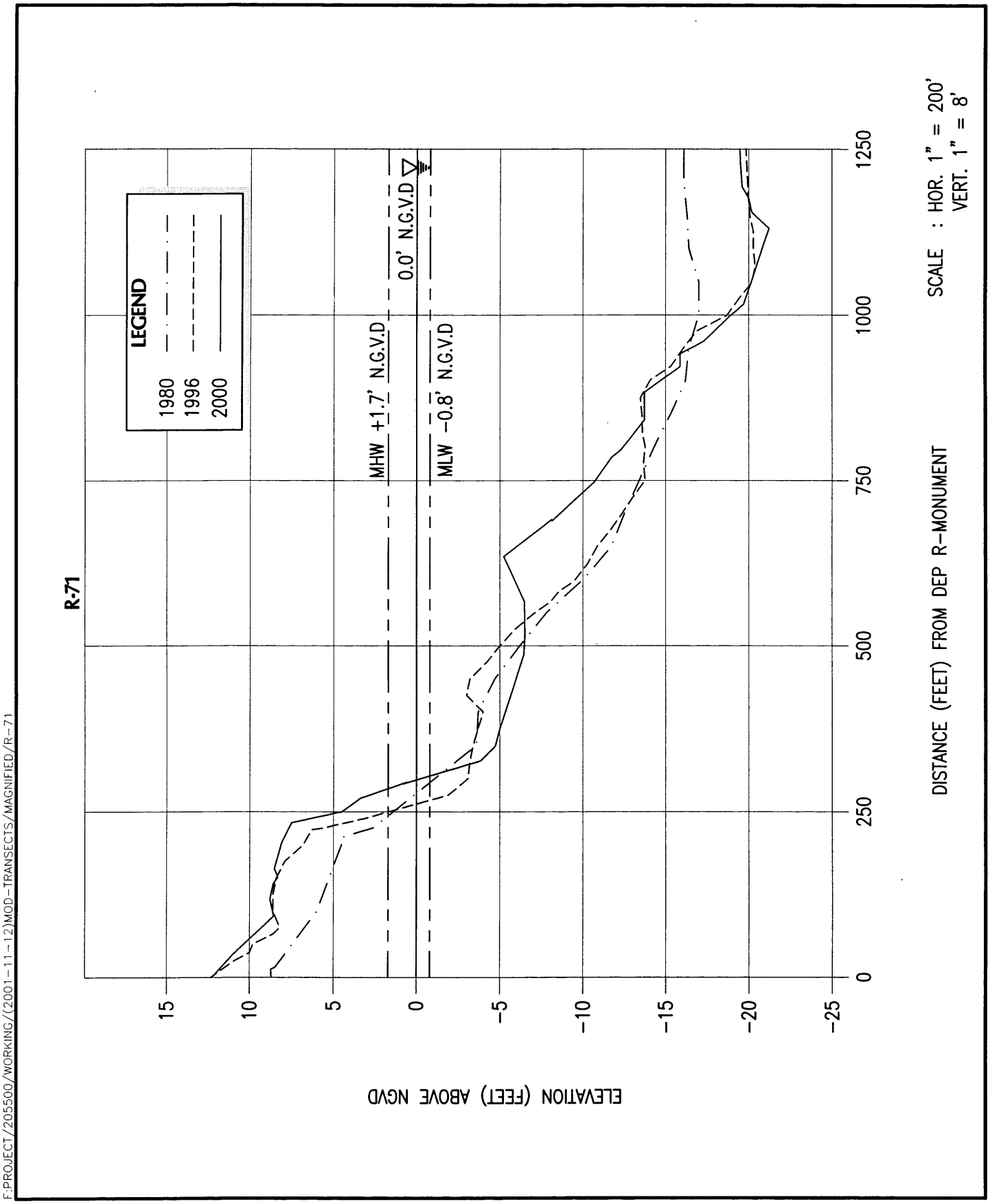





F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTSMAGNIFIED/R-70.DWG

# R-70 - MIAMI BEACH

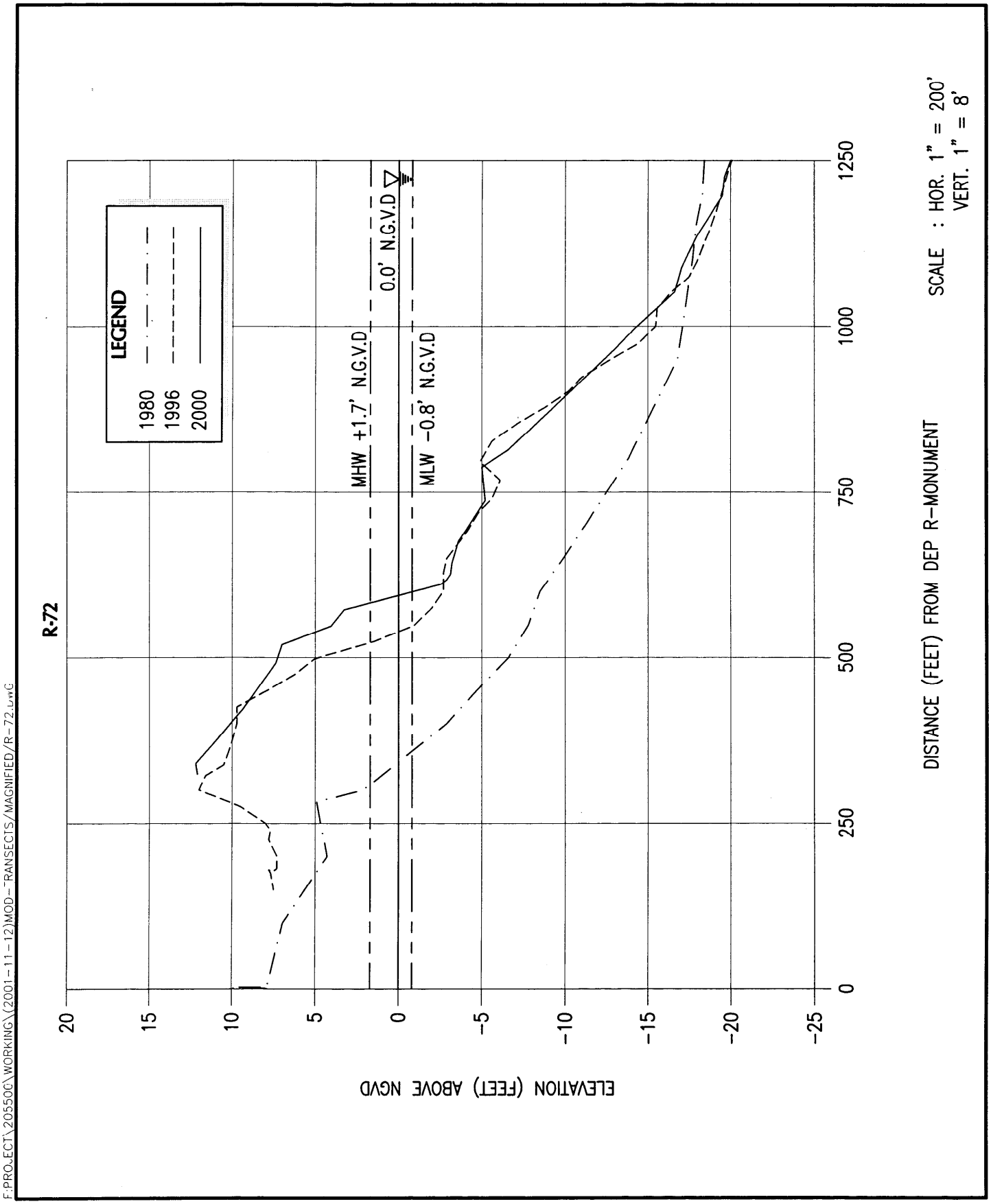
MIAMI-DADE COUNTY, FLORIDA




F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/MAGNIFIED/R-71

# R-71 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA




F:\PROJECT\20550C\WORKING\(2001-11-12)MOD-TRANSECTS/MAGNIFIED/R-72.DWG

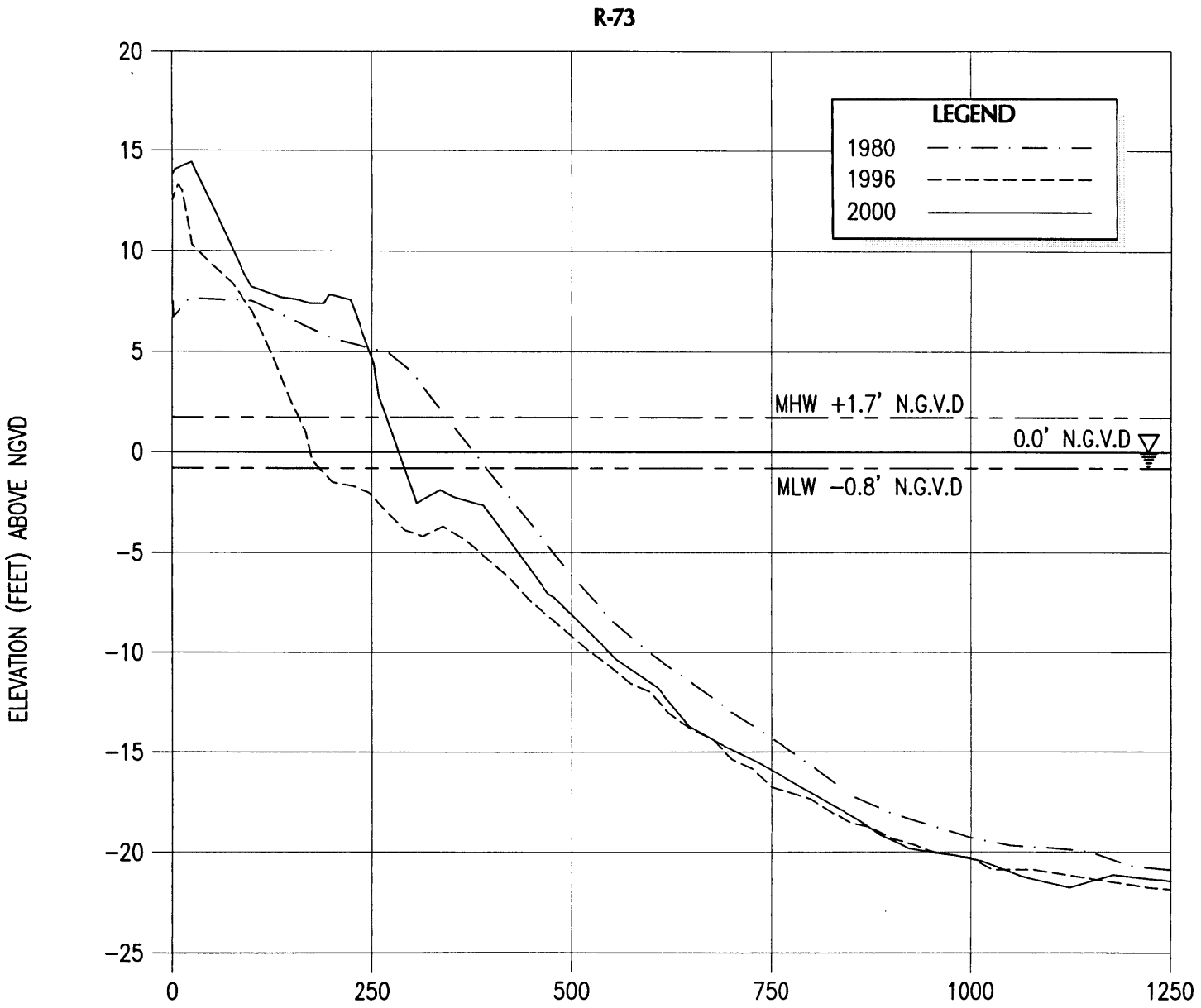
# R-72 - MIAMI BEACH

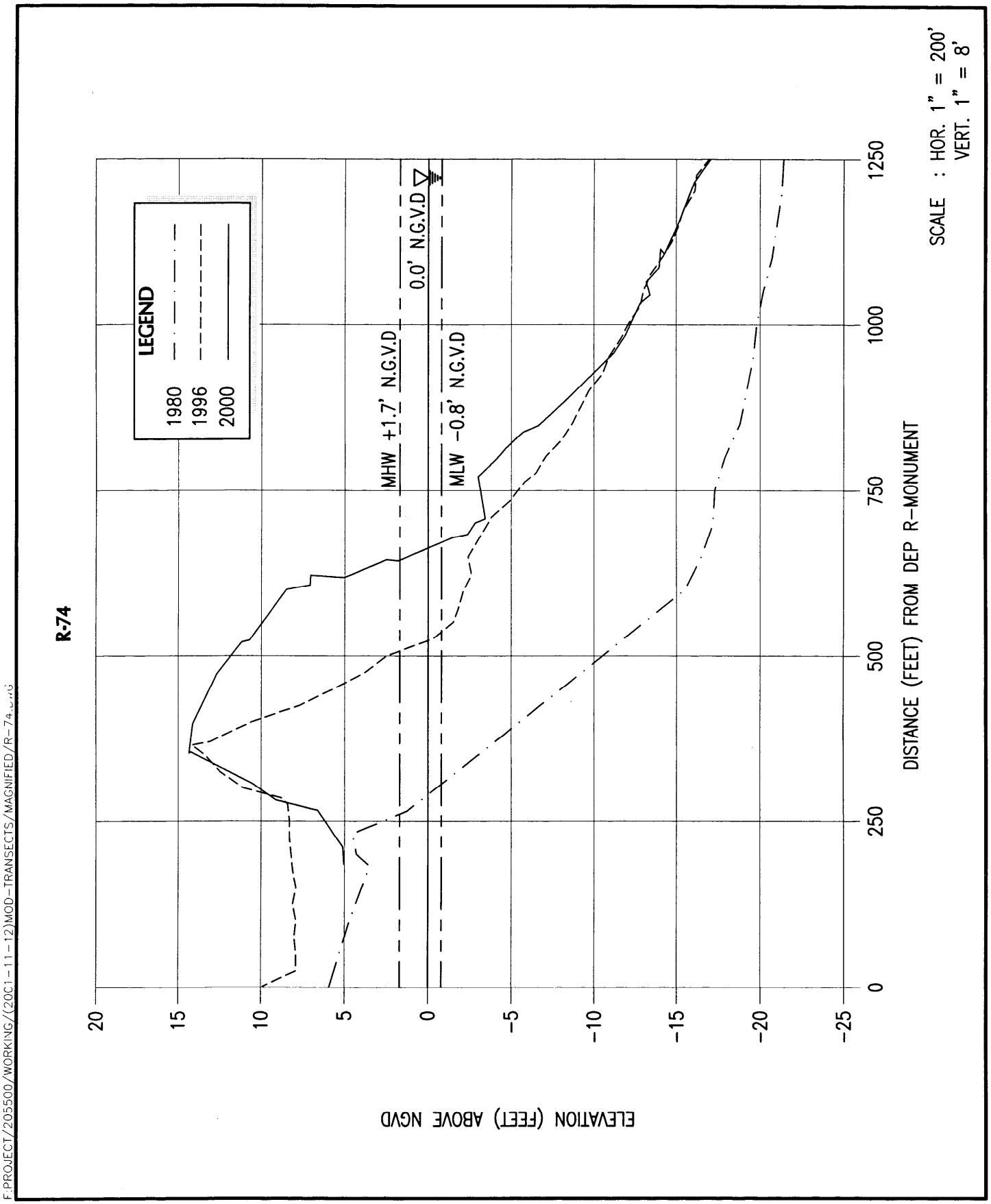
MIAMI-DADE COUNTY, FLORIDA

F:PROJECT/205500/WORKING/(2001-11-12)MOD-TRANSECTS/MAGNIFIED/R-73.DWG

# R-73 MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA






F:PROJECT/205500/WORKING/(20C1-11-12)MOD-TRANSECTS/MAGNIFIED/R-74.DWG

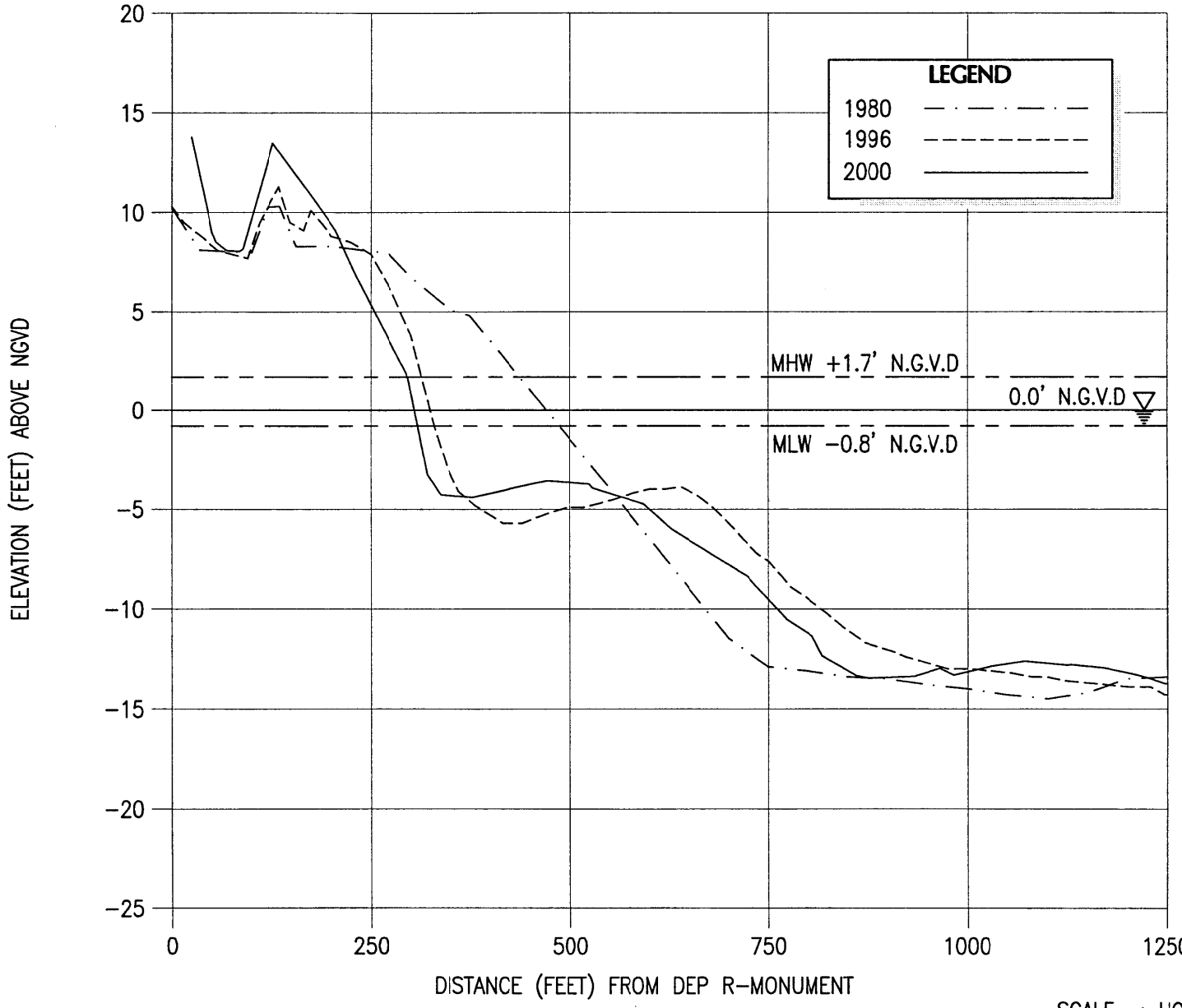
# R-74 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-38.dwg

# T-38 - SURFSIDE

MIAMI-DADE COUNTY, FLORIDA

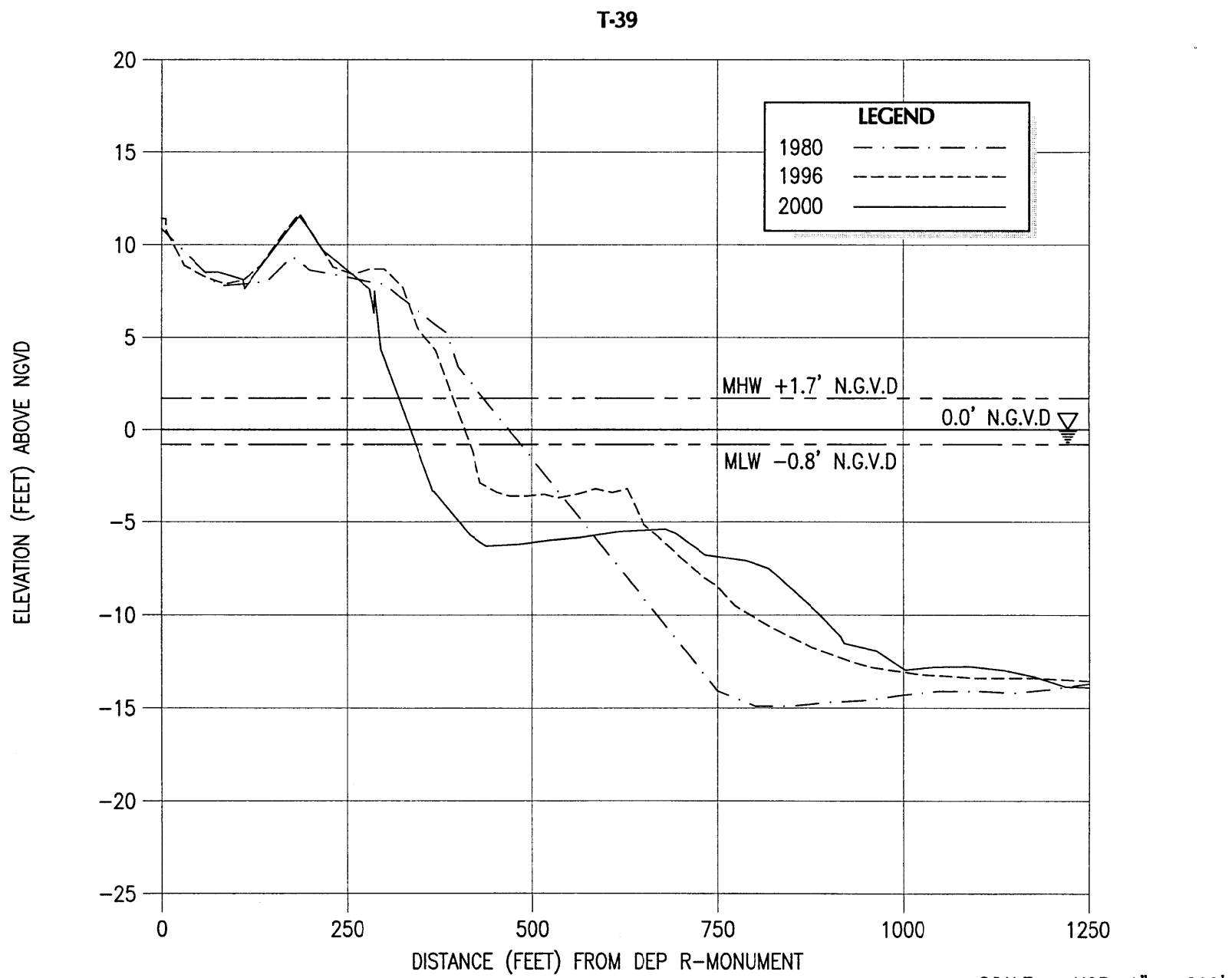



SCALE : HOR. 1" = 200'
VERT. 1" = 8'

F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-39.dw

# T-39 - MIAMI BEACH

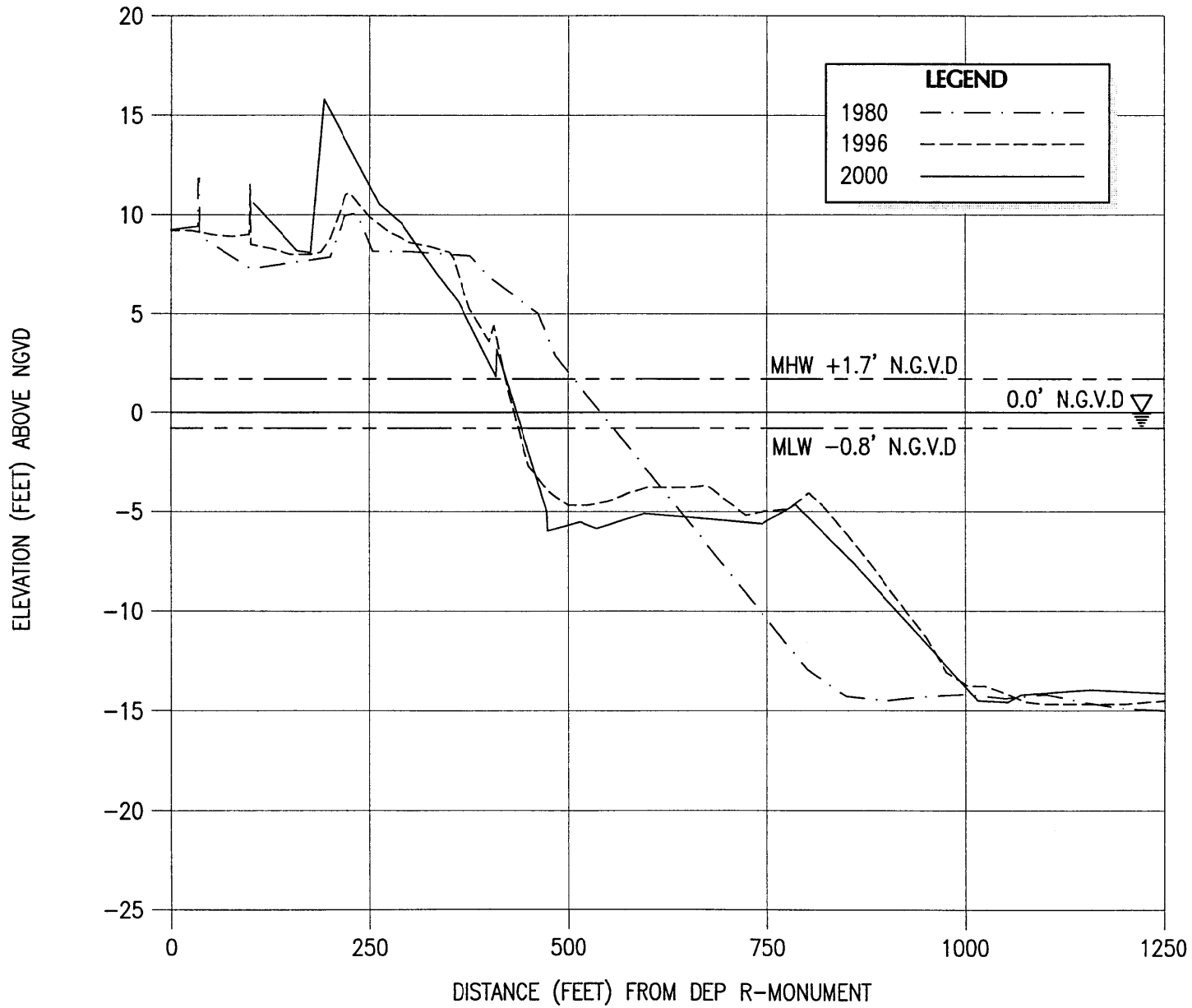
MIAMI-DADE COUNTY, FLORIDA



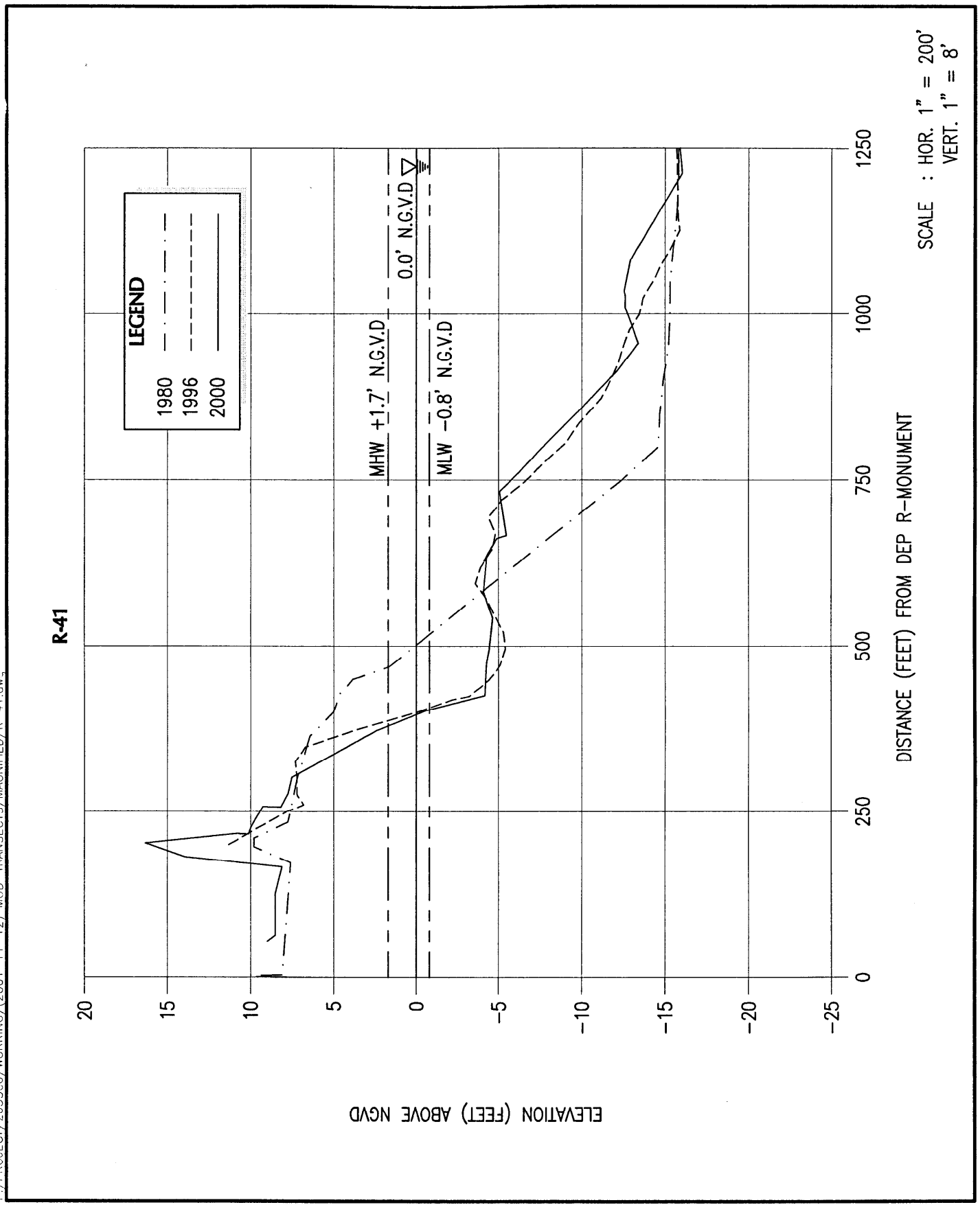
F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-40.dw

# R-40 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA




SCALE : HOR. 1" = 200'
VERT. 1" = 8'



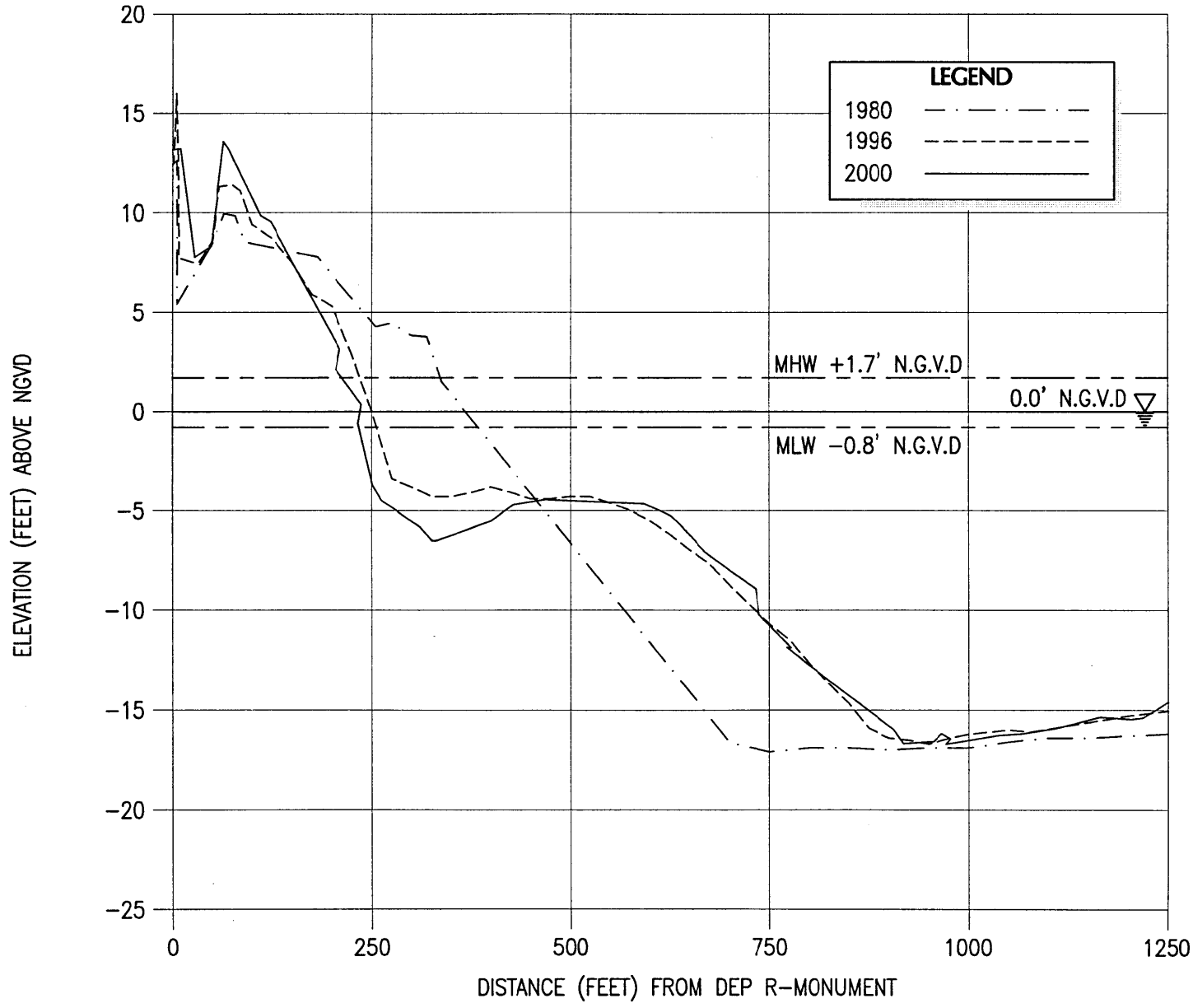

# R-41 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS\MAGNIFIED\R-42.dw

# R-42 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

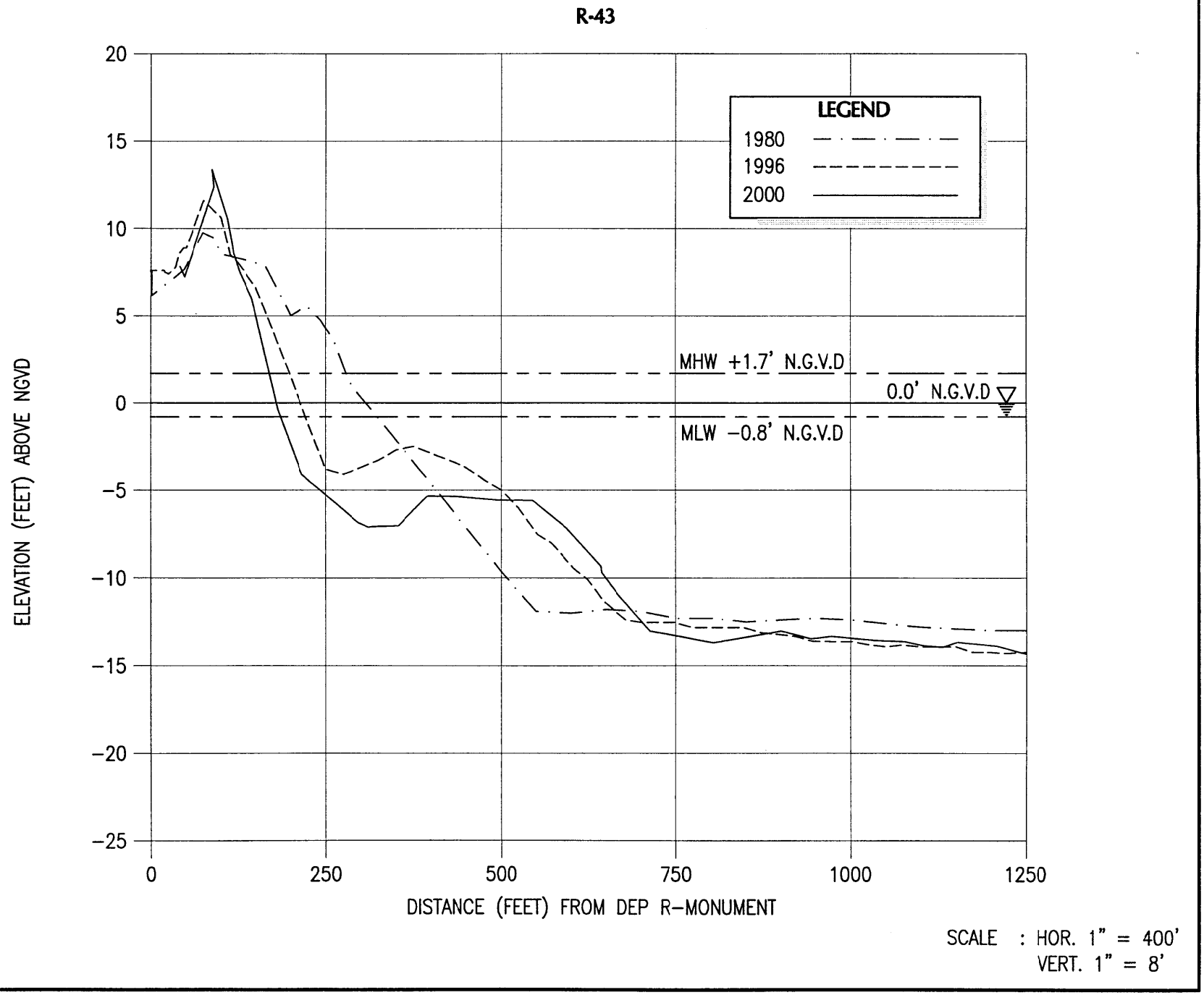



SCALE : HOR. 1" = 200'
VERT. 1" = 8'

F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-43.dv

# R-43 - MIAMI BEACH

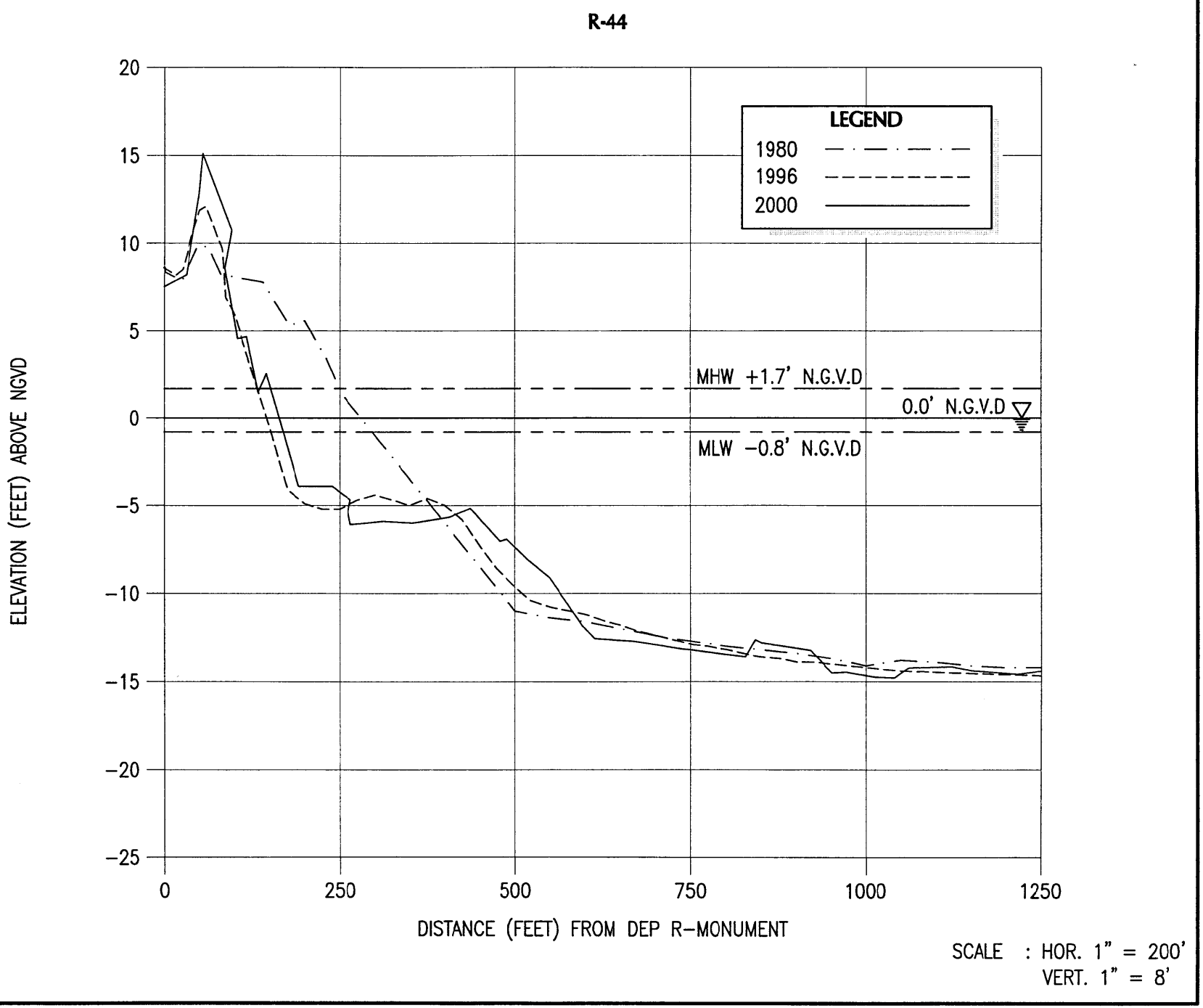
MIAMI-DADE COUNTY, FLORIDA



F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-44.d

# R-44 - MIAMI BEACH

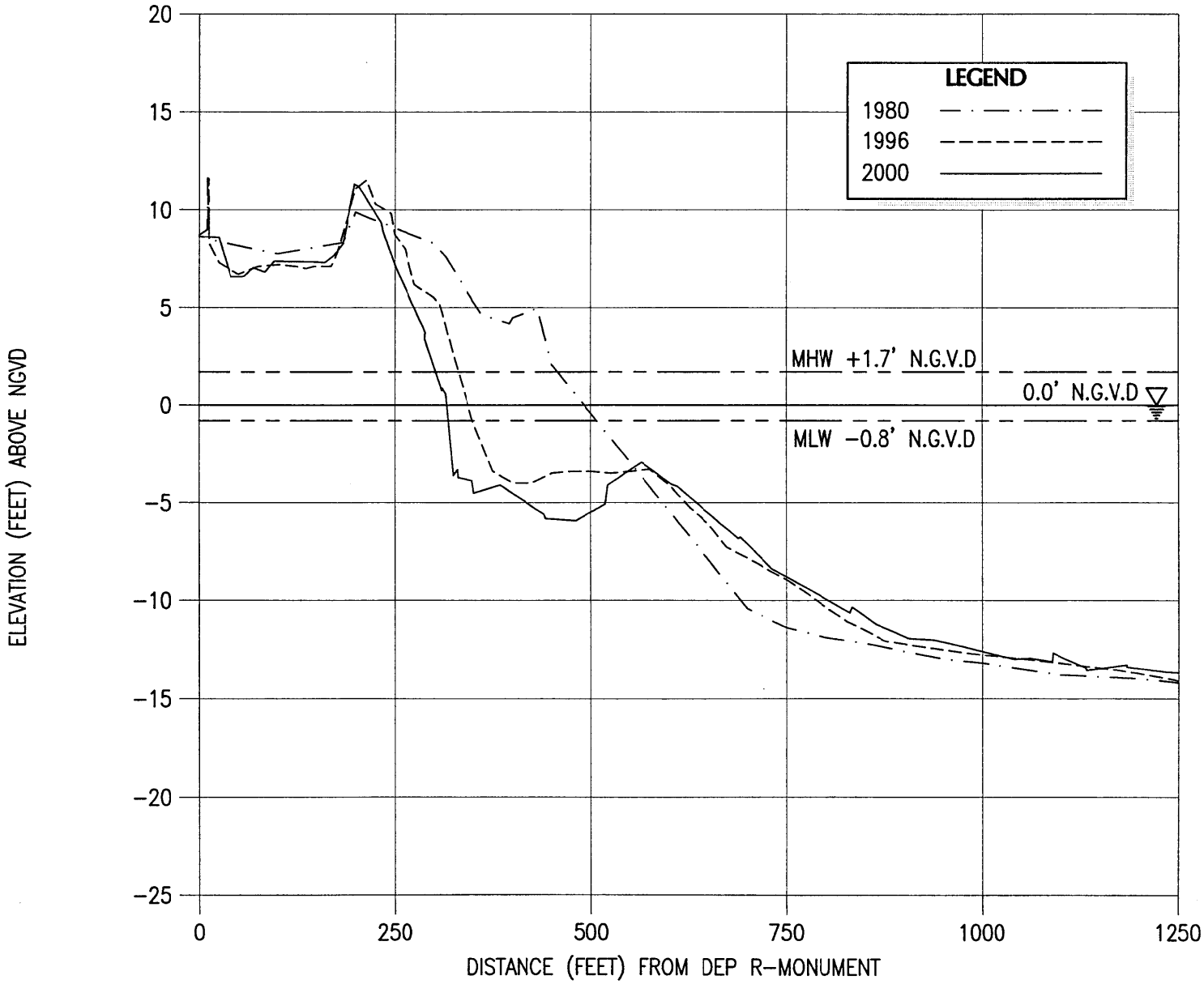
MIAMI-DADE COUNTY, FLORIDA



F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-45.dw

# R-45 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

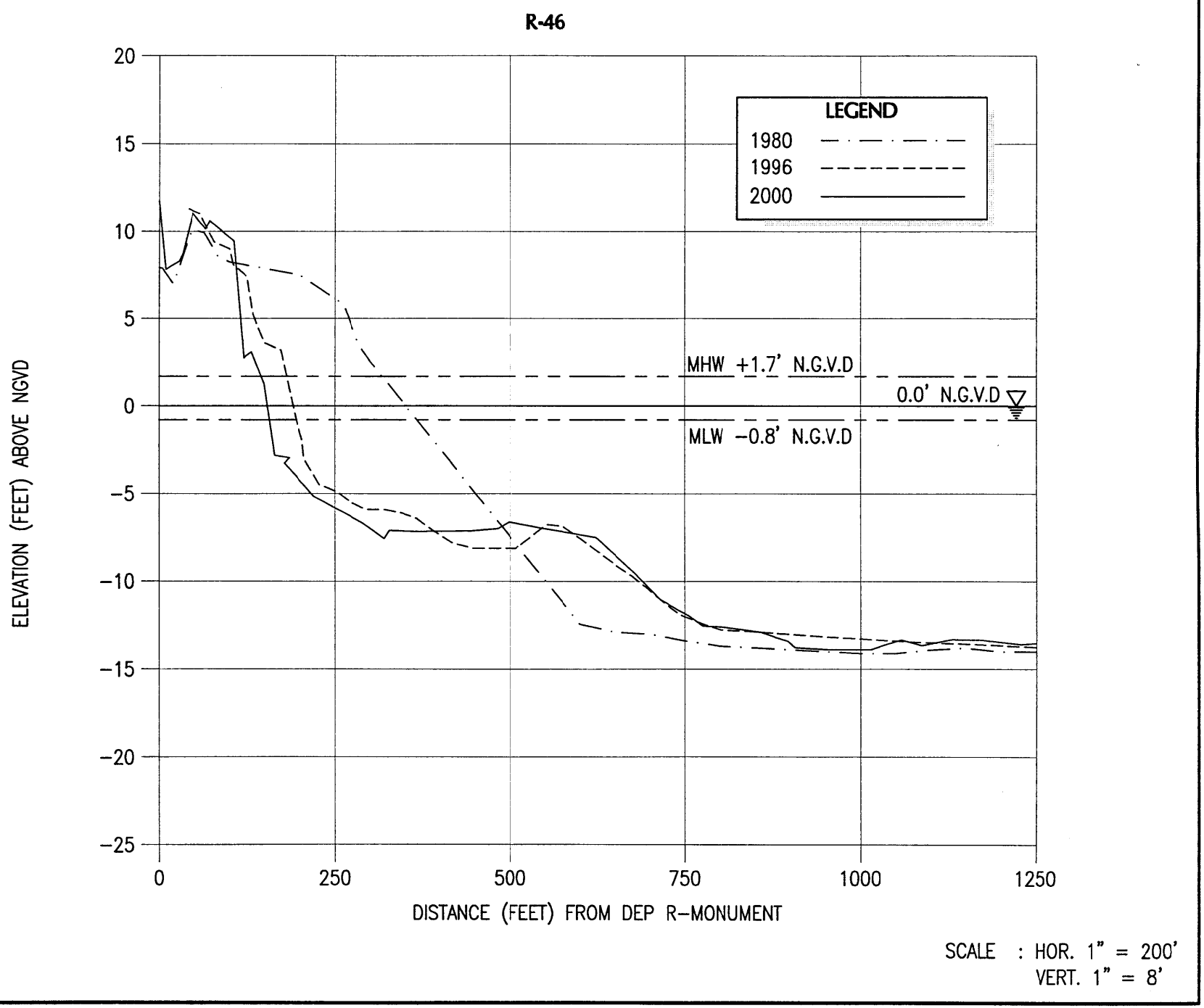



SCALE : HOR. 1" = 200'
VERT. 1" = 8'

F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-46.dwg

# R-46 - MIAMI BEACH

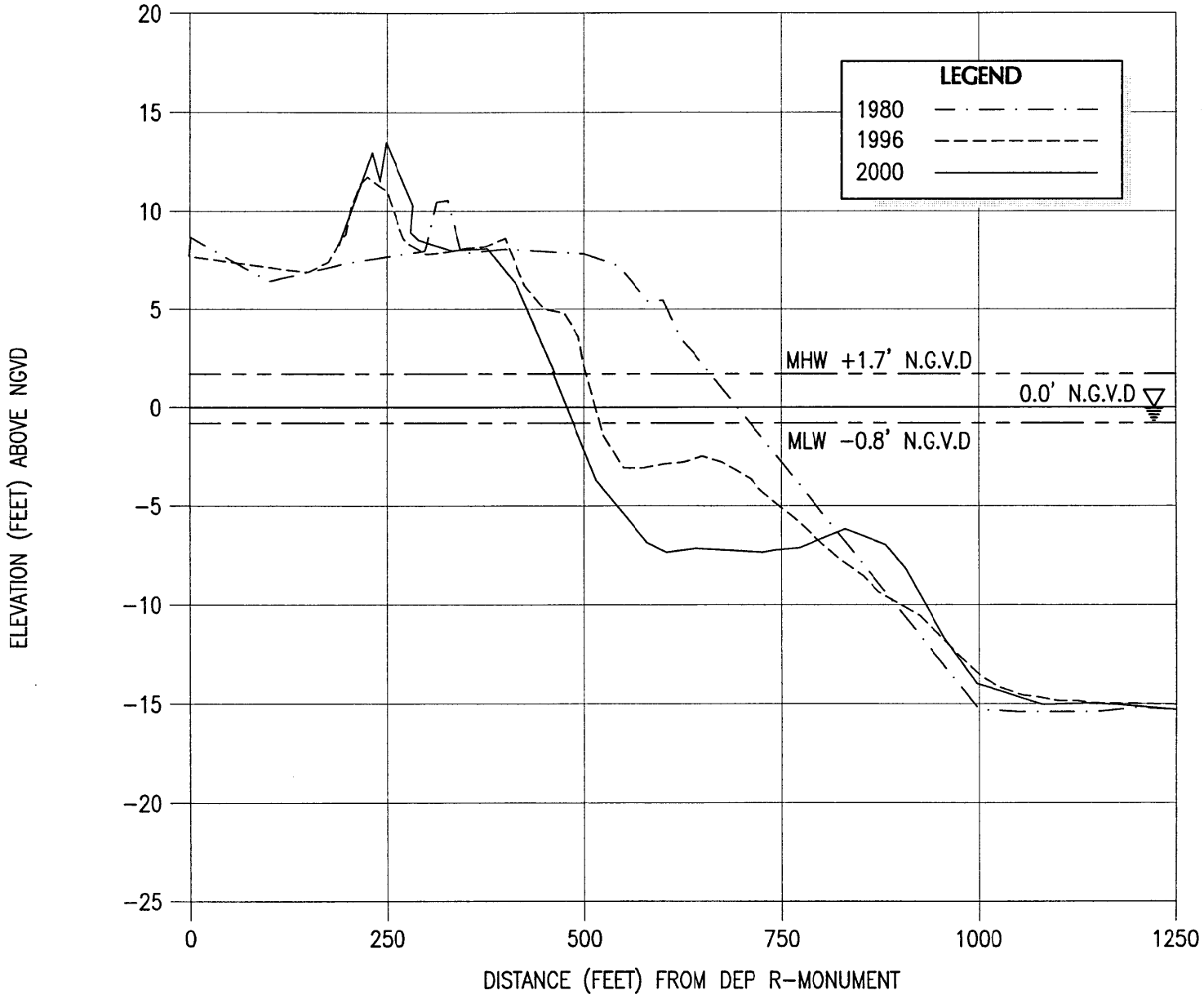
MIAMI-DADE COUNTY, FLORIDA



F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-47.dwg

# R-47 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

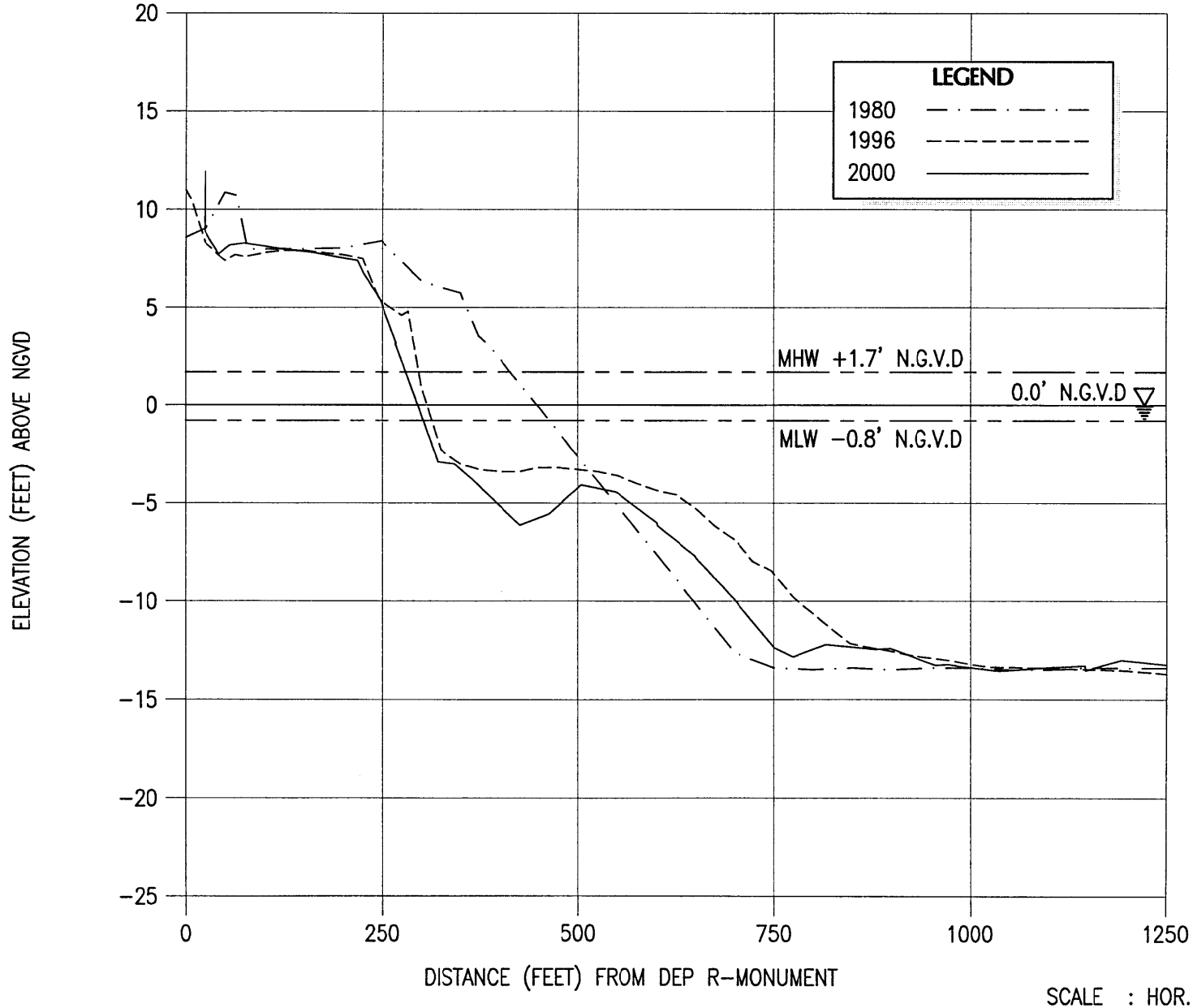



SCALE : HOR. 1" = 200'
VERT. 1" = 8'

F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-19.dw

# R-48 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

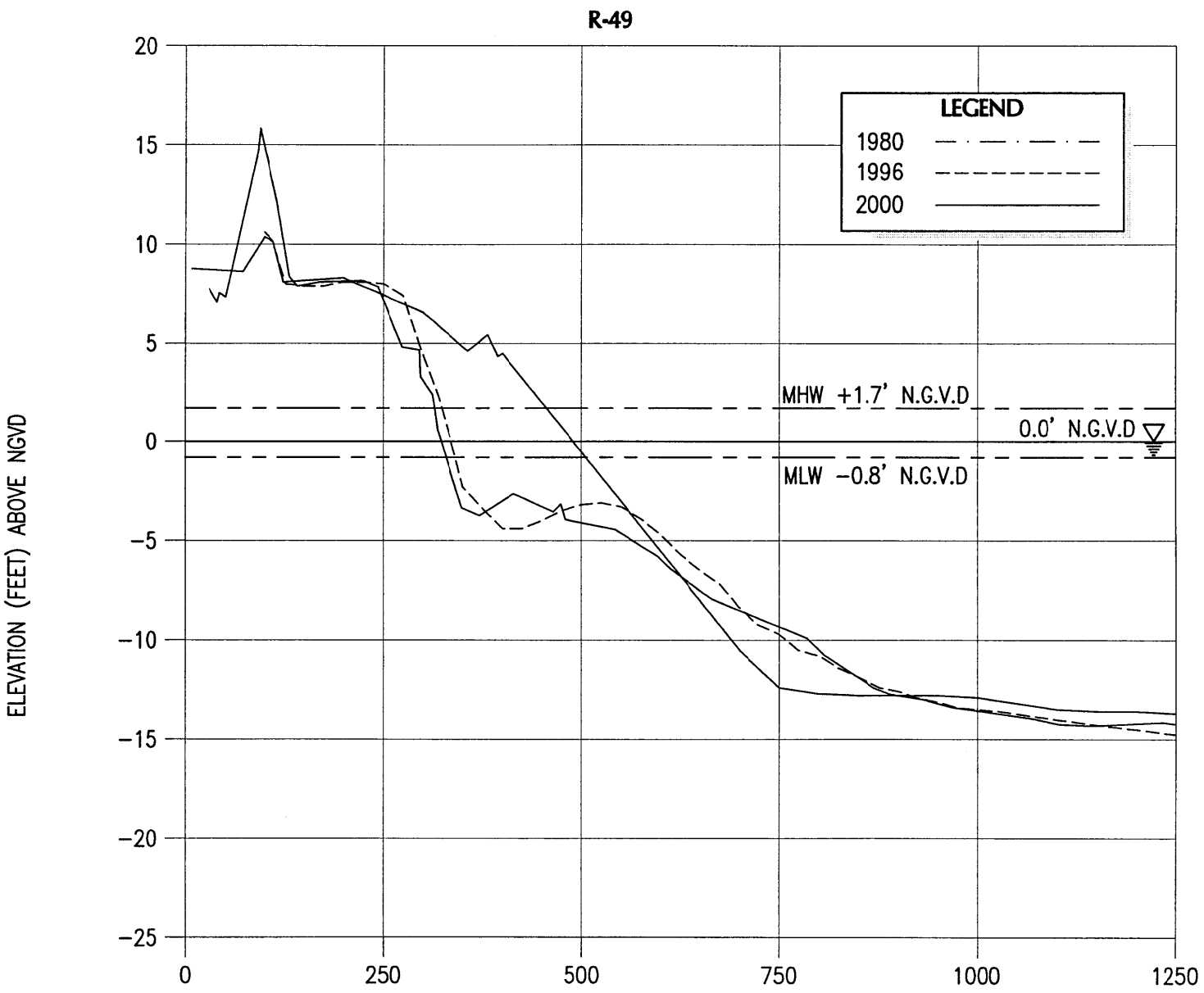



SCALE : HOR. 1" = 200'
VERT. 1" = 8'

F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-19.a

# R-49 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

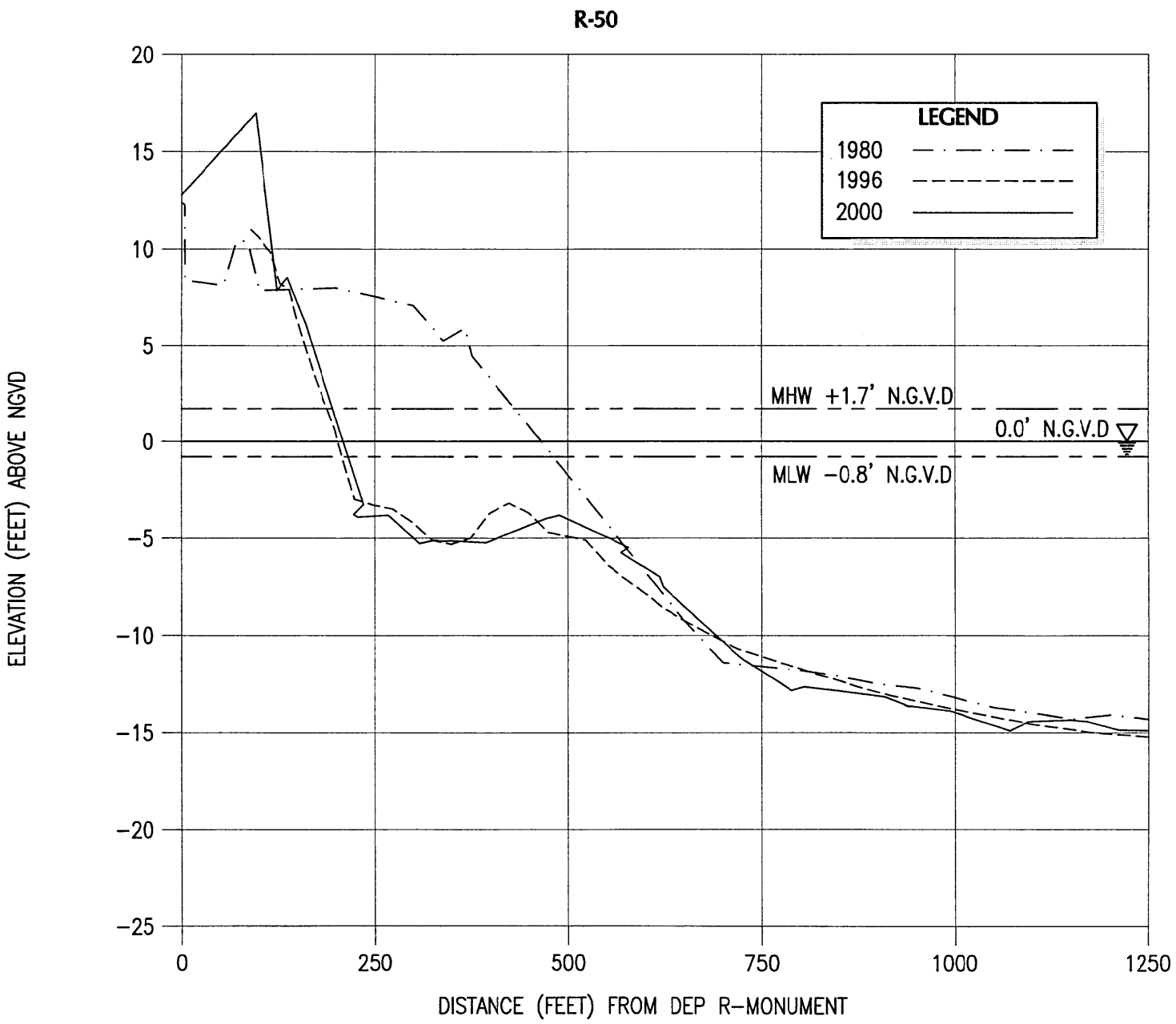



SCALE : HOR. 1" = 200'
VERT. 1" = 8'

F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-50.d

# R-50 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA

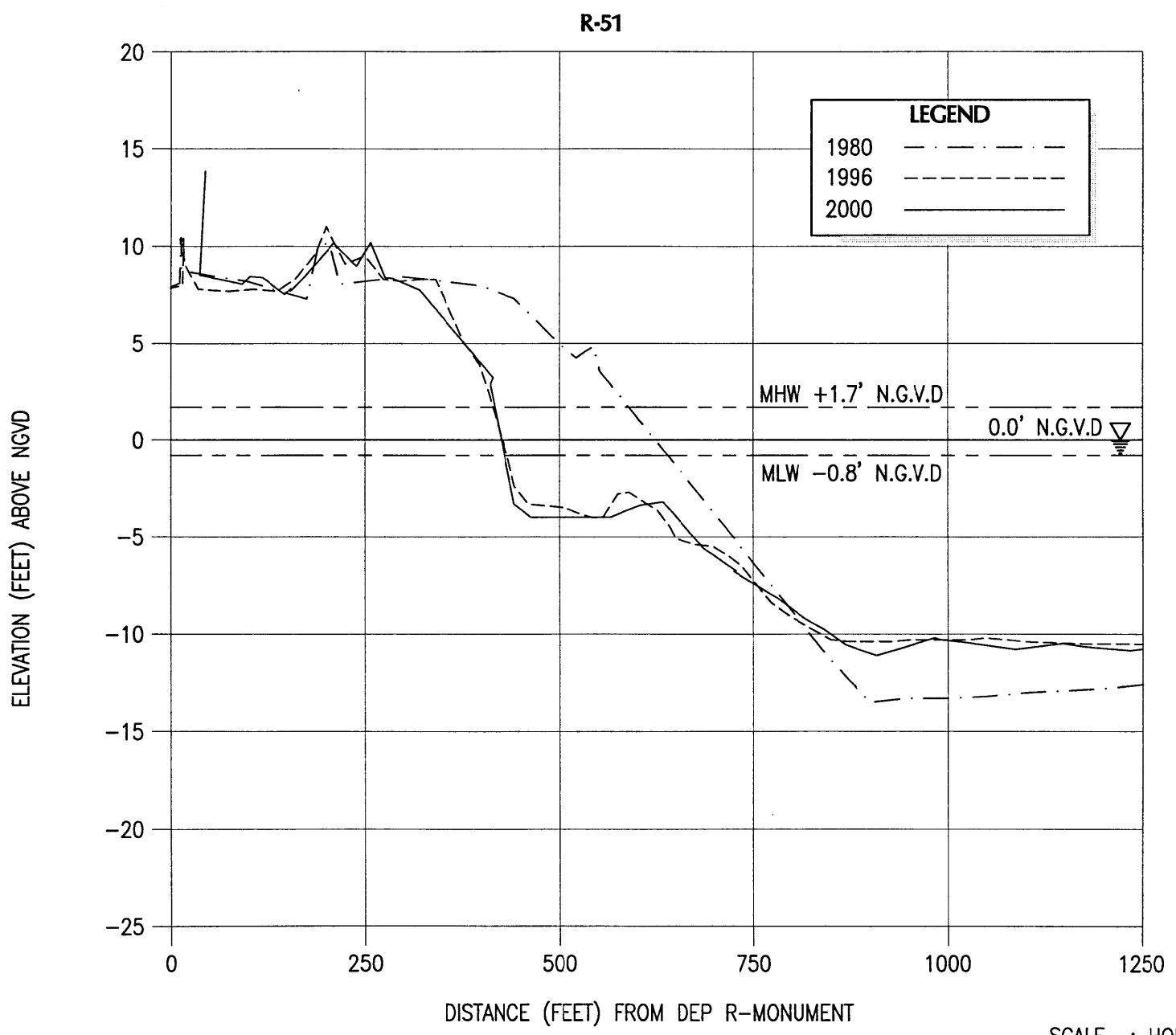



SCALE : HOR. 1" = 200'
VERT. 1" = 8'

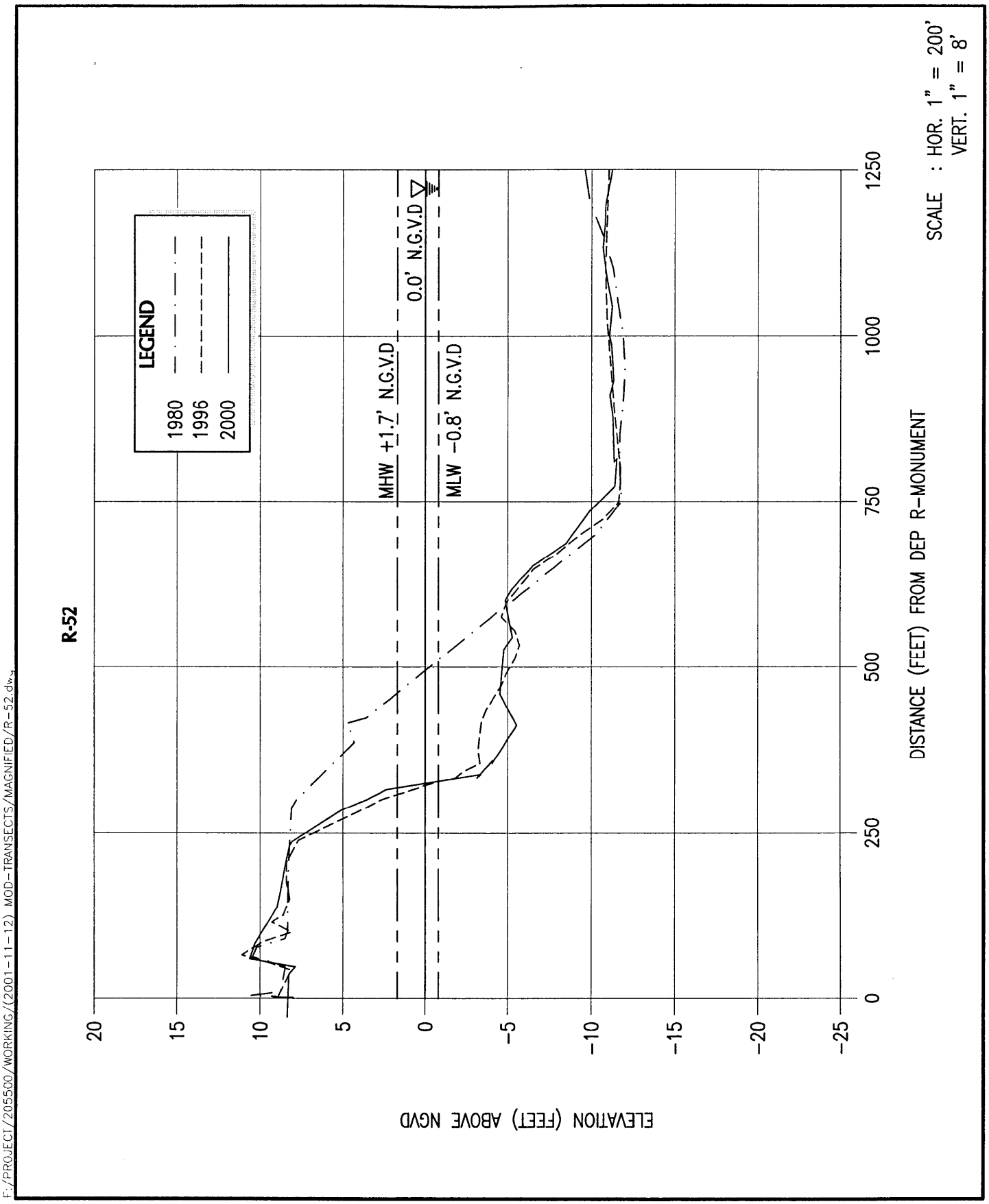
F:/PROJECT/205500/WORKING/(2001-11-12) MOD-TRANSECTS/MAGNIFIED/R-'9.dw

# R-51 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA




SCALE : HOR. 1" = 200'
VERT. 1" = 8'




# R-52 - MIAMI BEACH

MIAMI-DADE COUNTY, FLORIDA