



Vertical Datum at USGS Gaging Stations & WCA 1 Stations

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U.S. Department of the Interior
U.S. Geological Survey

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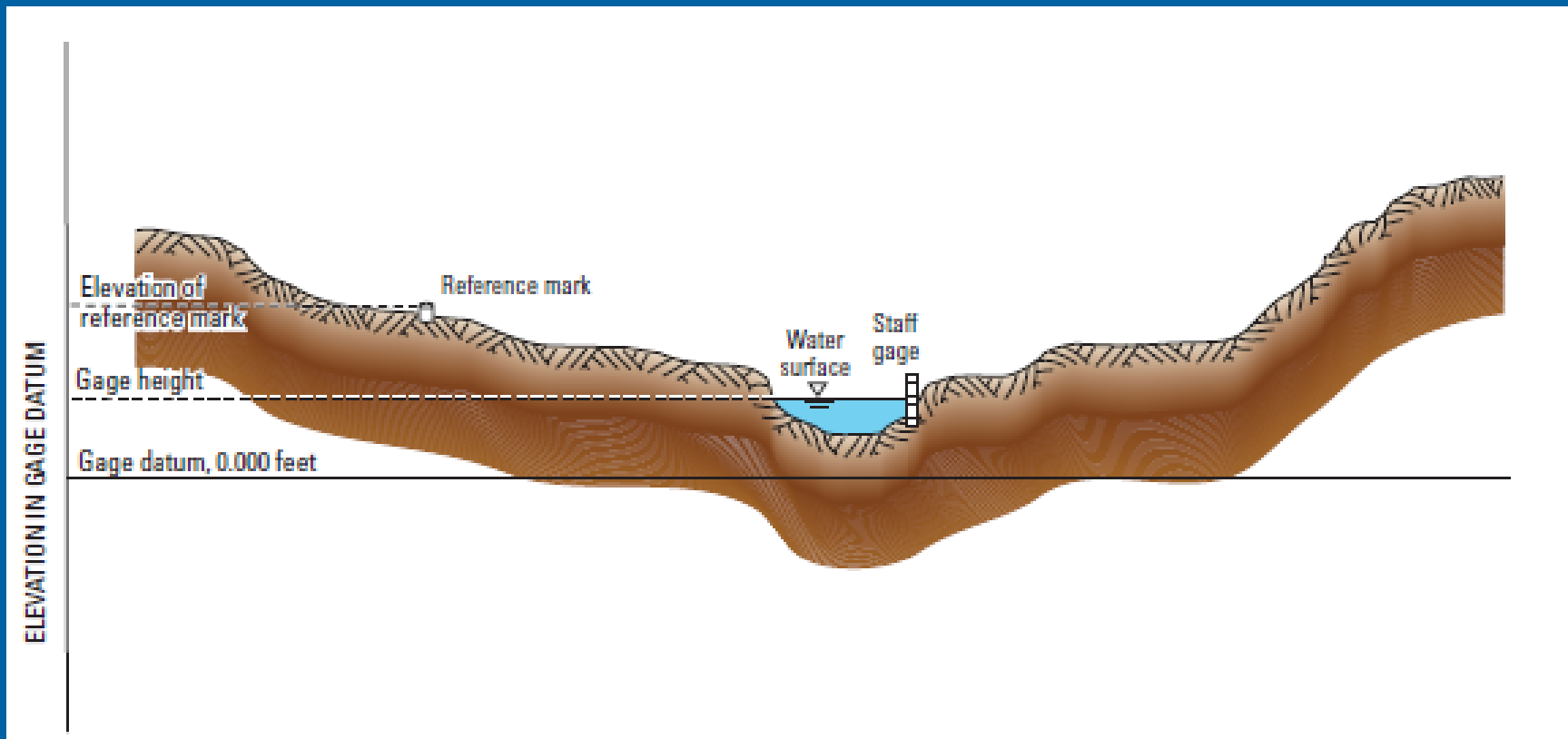
Terms used interchangeably:

Gage = Site = Station = Monitoring or Gaging Station

Data = Record = Gage Height = Stage = Water Levels

Gage Datum

- A horizontal surface or plane used as a zero point for measurement of stage or gage height
- Slightly below the lowest point of the stream



USGS Perspective

- Discharge usually the product
- Gages located over a large range of elevations and/or far from a published vertical benchmark
- Practical considerations:
 - Stage-discharge rating uses log space (no zero!)
 - Recorders limited by memory storage
 - Ranges of staff gages, steel tapes, or charts
- Long, continuous period of record
- Just need stable vertical gage datum!

USGS Perspective (cont)

- Establish a local gage datum – saves time, money!
- Acknowledge other uses for water level data
 - Many gages in FL set to NGVD29
 - Goal is to reference gage datum to NAVD88

USGS Perspective (cont)

85,000 USGS Surface-water stations (2013)

- Datums determined from:
 - 62,000 from maps (DEM, topo)
 - 7,700 from levels
 - 8,000 unknown
 - 1,300 from GPS

- 4,800 at NAVD88

USGS Policy Guidance

USGS Office of Water Information Technical Memorandum 2002.01:

- NAVD88 is the recommended datum established in the Federal Geographic Data framework.

2010 USGS T&Ms for stage measurements and station levels:

- Maintain a permanent gage datum so that only one datum for the gage-height record is used for the life of the gaging station
- Reference to NAVD88



Reference gage to another datum

- Sources?
 - Transfer from nearby BM
 - Survey-grade GPS
 - Vertcon
- How?
 - List conversion in Water Year Summary
 - Report data in NAVD88 in addition to gage datum
 - Continue field operations at gage datum
 - Many newer gages established at NAVD88
 - Projects to transfer in NAVD88 or convert data

Identifying Gage Datum

- Manuscript or Water Year Summary (NWISWeb)
 - Identifies gage datum
 - May include reference to NAVD88 and/or NGVD29
- Questions? Contact USGS office

262100080190001 HILLSBORO CANAL AT S-10-A, NEAR DEERFIELD BEACH, FL

LOCATION - Lat 26°21'36.0", long 80°18'45.0" referenced to North American Datum of 1983, in NE 1/4 sec.24, T.47 S., R.40 E., Palm Beach County, FL, Hydrologic Unit 03090202, on Hillsboro Canal on the north bank of the spillway 575 ft ENE of S-10-A, a four-gated control structure, 6.9 mi west of State Road 7 (U.S. Highway 441) on Hillsboro Boulevard. The auxiliary stage recorder is located approximately 20 yards downstream of S-10-A on the south bank of the spillway.

DRAINAGE AREA - Indeterminate.

SURFACE-WATER RECORDS

PERIOD OF RECORD - June 1991 to current year.

GAGE - Satellite data collection platform with water-stage shaft encoders upstream and downstream of structure S-10-A. Datum of gage is National Geodetic Vertical Datum of 1929 and 1.49 ft below the North American Vertical Datum of 1988 (NAVD 88).

COOPERATION - U.S. Army Corps of Engineers.

REMARKS - Station is one of several located on L-39 which regulates flow for Conservation Areas 1 and 2A. Gage records are primarily used to determine stages. Water levels below land-surface datum can be recorded. Revised figures of downstream stage for water year 2000 are available in the files of the U.S. Geological Survey. These supersede those published in the water year 2000 report. Revisions were necessary due to new levels run on February 7, 2002.

Why not adjust all water level record to a particular datum?

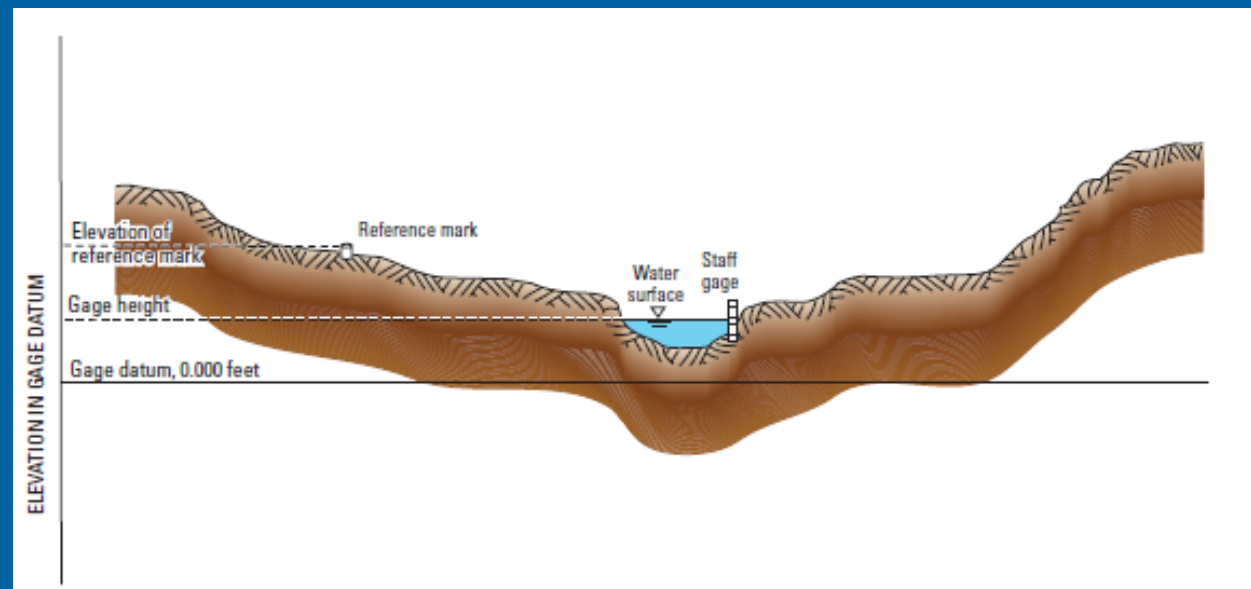
- Database challenges – time and expense
- Continuity of record
- Ratings
- Data used in reports and models
- What happens for the next new datum?
 - NGVD29 vs CERP adjustment to NGVD29
 - NAVD88
 - GRAV-D
 - ???

USGS Operations at Gaging Stations

- Establish gage datum
- Maintain gage datum
- Data Corrections

Establish gage datum

- Establish gage datum at a “*base RM*”
 - Provided elevation of a BM, RM, or MP
 - Nearby BM with published elevation
 - Arbitrary datum
 - DEM or topo
 - GPS



Establish gage datum (cont)

- Transfer gage datum from “*base RM*”
 - Two additional RMs as back up
 - All reference gages
 - Set sensor
 - Document



Maintain gage datum

- Routine sensor checks
 - Compare sensor to reference gage
 - Reset sensor and correct record if needed
 - Affects current year data (provisional)
- Periodic reference gage checks – 1 to 3 years
 - Rerun levels to check and correct for settling
 - Start at “*base RM*” and run to all RMs, RPs, gages
 - Reset sensor and correct record as needed
 - May affect approved data (revised record)

Data Corrections

- Corrections to current year data – no problem!
- Corrections to approved data – uh-oh!
 - Issue – data retrieval from NWISWeb does not include metadata about adjustments
 - Usual approach:
 - Avoid corrections to approved gage height record
 - If necessary, correct to previous levels run (1 to 3 year cycle)
 - Notification in Water Year Summary
 - First year: Revision statement in Water Year Summary
 - Subsequent years: Revised Records statement in WYS

Data Corrections (cont)

Notification of changes to previously approved data

02290766 LEVEE 31 NORTH EXTENSION AT 4 MILE NEAR WEST MIAMI, FL

LOCATION - Lat 25°42'07.8", long 80°29'45.5" referenced to North American Datum of 1983, in NE 1/4 NE 1/4 NE 1/4 sec.35, T.54 S., R.38 E., Miami-Dade County, FL, Hydrologic Unit 03090202, 1.0 mi west of the junction of U.S. Highway 41 and Krome Avenue and 4.1 mi south of U.S. Highway 41 on west side of Levee 31 North, near West Miami.

DRAINAGE AREA - Indeterminate.

SURFACE-WATER RECORDS

PERIOD OF RECORD - June 1984 to current year.

REVISED RECORDS - WDR-US-2007: site 02290766, 2006.

GAGE - Satellite data collection platform with acoustic Doppler velocity meter with acoustic stage sensor. Prior to January 10, 2007, satellite data collection platform with water-stage shaft encoder and acoustic velocity meter. Datum of gage is National Geodetic Vertical Datum of 1929 (FCE bench mark).

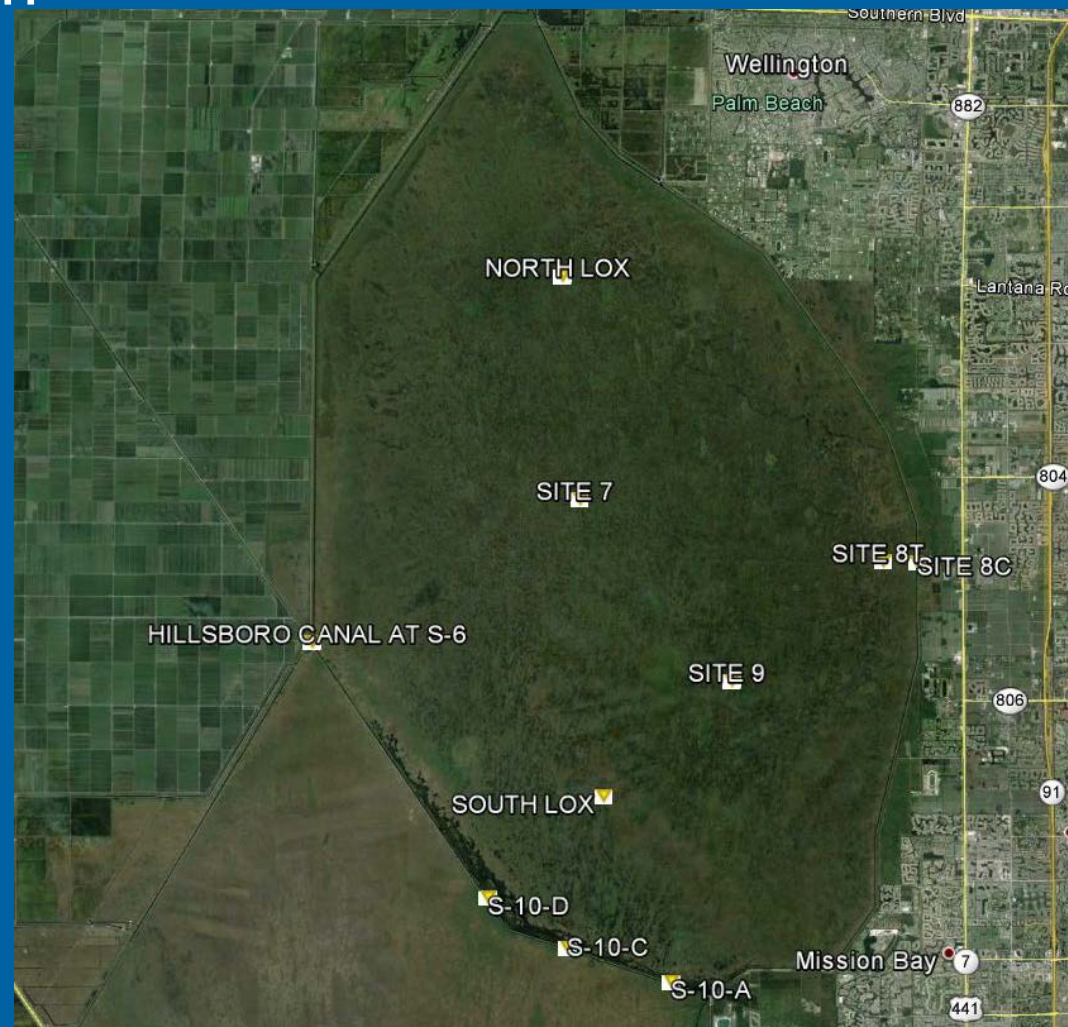
COOPERATION - Miami-Dade County.

REMARKS - Flow primarily regulated by control structures S-335 upstream and G-211 downstream; occasionally S-334, S-336 and G-119 upstream and S-338 downstream also affect L-31 canal flows. The control structure S-24 located near the Tamiami Trail bridge is not used for regulation. The manual operation gated culvert S-24A, that is located 1 mi upstream, is inoperable.

Datum at WCA 1 Stations

In 1991, USGS began gage operations for USACE Streamgaging program

- Site 7 (1-7)
- Site 9 (1-9)
- Site 8T (1-8T)
- Site 8C (1-8C)



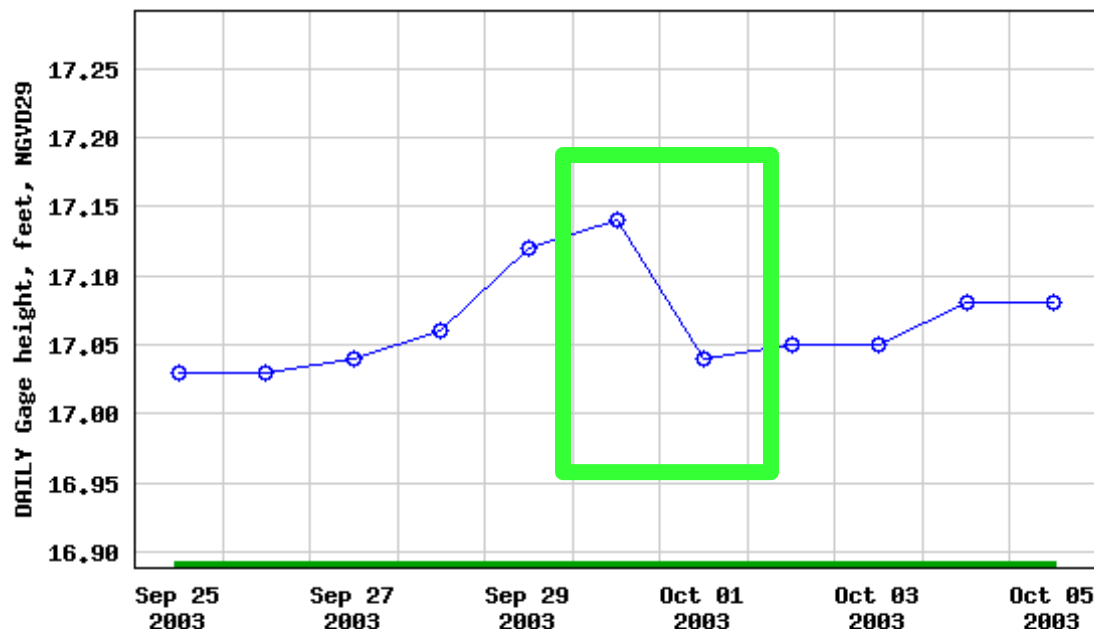
WCA 1 Gages

- Purpose is for USACE water operations
- Other users:
 - USACE EDEN project
 - Add North and South Loxahatchee gages
 - Loxahatchee NWR Preserve
 - SFWMD
 - Others?

Site 7 gage datum

- 1991: established from BM USCE-141 (NGVD29)
 - Included FCE-1017 and FCE-1018 as station RMs
- 2002: FL DEP installed BM “WCA1 Site 7”
 - Elevation determined by GPS (NAVD88)
 - reported to tenths of a foot
 - converted to NGVD29 using Vertcon
 - Included in Oct 2003 levels – difference of -0.102 ft
 - Gage reset to “WCA1 Site 7” starting Oct 1, 2003
 - Prior record unadjusted
 - Conversion from gage datum to NAVD88: -1.47 ft

USGS 263180080205001 SITE 7 IN CONS AREA NO. 1 NR SHAWANO, FL



263180080205001 SITE 7 IN CONSERVATION AREA NO. 1 NEAR SHAWANO, FL

LOCATION - Lat 26°31'21.56", long 80°20'11.36" referenced to North American Datum of 1983, in T.45 S., R.40 E., Palm Beach County, FL, Hydrologic Unit 03090202, in Loxahatchee Wildlife Refuge (Arthur R. Marshall Park). Township and range approximated from topographic map for which most section lines are not delineated, unable to determine section.

DRAINAGE AREA - Indeterminate.

SURFACE-WATER RECORDS

PERIOD OF RECORD - July 1991 to current year.

GAGE - Satellite data collection platform with water-stage shaft encoder. Prior to October 1, 2003, a tipping bucket rain gage. Datum of gage is National Geodetic Vertical Datum (NGVD) of 1929 converted through VERTCON using the NAVD 88 survey levels from a benchmark provided by Florida Department of Environmental Protection (FDEP). The datum of the gage is 1.47 feet below North American Vertical Datum of 1988 (NAVD 88). The current datum of gage that started October 1, 2003, is at a datum 0.102 ft lower than previously published historic NGVD 1929 datum. Prior to October 1, 2003, datum of gage was historic NGVD 1929 (benchmark provided by U.S. Army Corps of Engineers (USACE)).

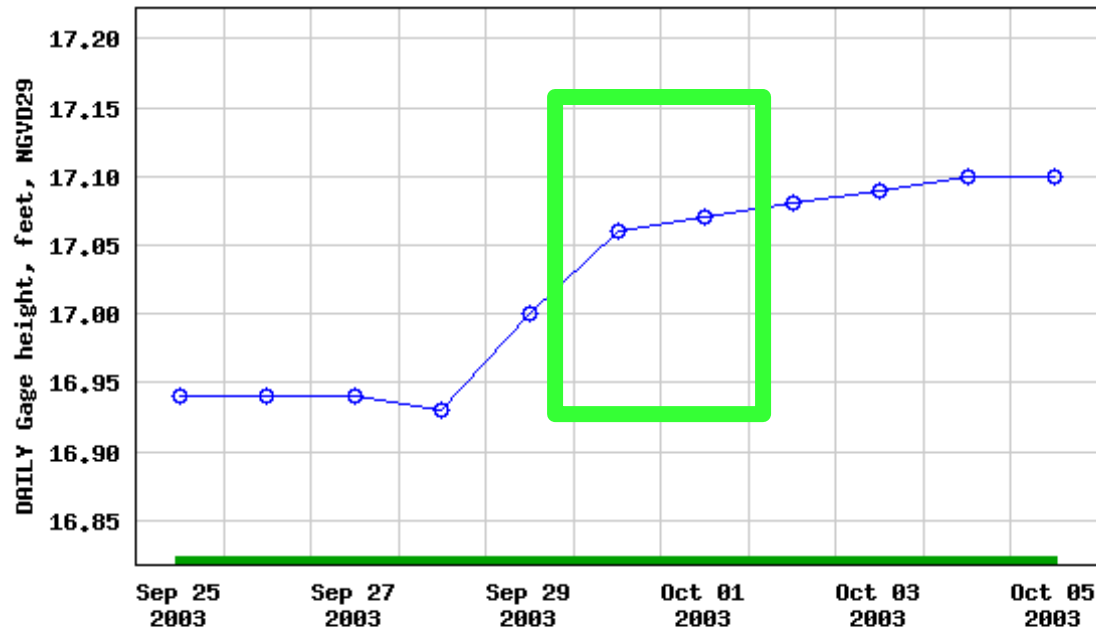
COOPERATION - U.S. Army Corps of Engineers.

REMARKS - Land surface is approximately 15 ft above National Geodetic Vertical datum of 1929 (Benchmark provided by FDEP converted from NAVD 88 survey levels through VERTCON to NGVD 1929). Station is one of several located in Conservation Area No. 1. Gage is capable of recording water levels below land-surface datum. Precipitation is not published, but is available in files of the U.S. Geological Survey. The precipitation record was discontinued September 30, 2003.

Site 9 gage datum

- 1991: established from BM USCE-142 (NGVD29)
 - Included FCE-1014 and FCE-1016 as station RMs
- 2002: FL DEP installed BM “WCA1 Site 9”
 - Elevation determined by GPS (NAVD88)
 - reported to tenths of a foot
 - converted to NGVD29 using Vertcon
 - Included in Oct 2003 levels – difference of -0.015 ft
 - Gage reset to “WCA1 Site 9” starting Oct 1, 2003
 - Prior record unadjusted
 - Conversion from gage datum to NAVD88: -1.48 ft

USGS 262750080175001 SITE 9 IN CONSERVATION AREA NO.1 IN BOYNTON BCH FL



262750080175001 SITE 9 IN CONSERVATION AREA NO. 1, NEAR BOYNTON BEACH, FL

LOCATION - Lat 26°27'35.3", long 80°17'25.9" referenced to North American Datum of 1983, in T.50 S., R.40 E., Palm Beach County, FL, Hydrologic Unit 03090202, in Loxahatchee wildlife Refuge (Arthur R. Marshall Park). Township and range approximated from topographic map for which most section lines are not delineated, unable to determine section.

DRAINAGE AREA - Indeterminate.

SURFACE-WATER RECORDS

PERIOD OF RECORD - July 1991 to current year.

REVISED RECORDS - WDR FL-97-2A, 1997.

GAGE - Satellite data collection platform with water-stage shaft encoder. Prior to October 1, 2003 tipping bucket precipitation gage. Datum of gage is National Geodetic Vertical Datum (NGVD) 1929 converted through VERTCON using NAVD 88 survey levels from a benchmark provided by Florida Department of Environmental Protection (FDEP). Datum of gage is 1.48 ft below North American Vertical Datum of 1988 (NAVD 88). The current datum of gage that started October 1, 2003, is at a datum 0.015 ft lower than previously published historic NGVD 1929 datum. Prior to October 1, 2003, datum of gage was historic NGVD 1929 (benchmark provided by U.S. Army Corps of Engineers (USACE)).

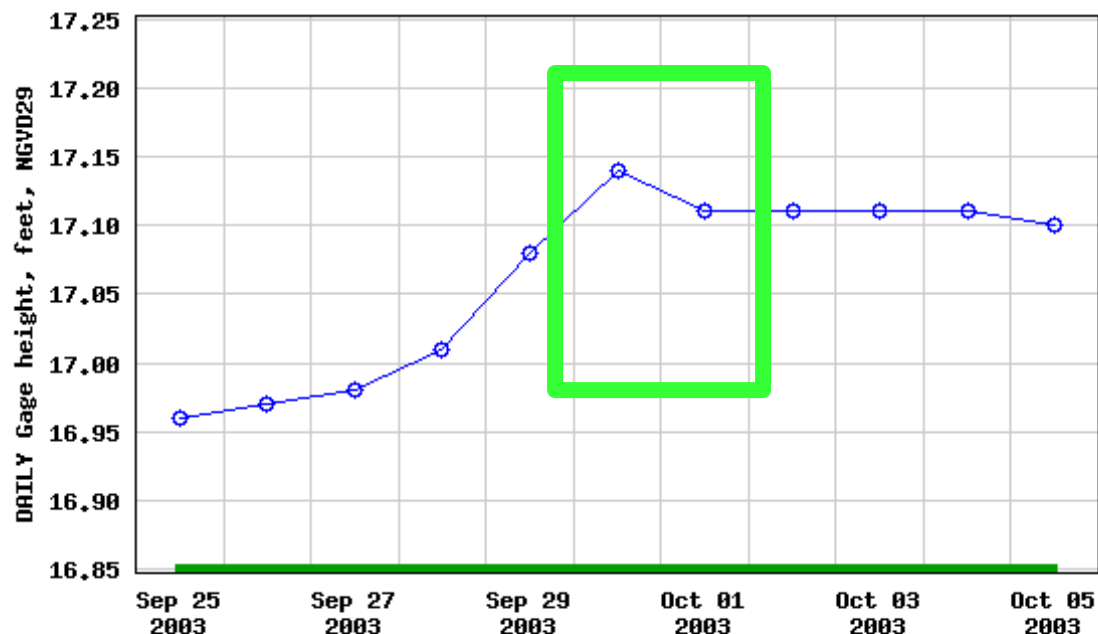
COOPERATION - U.S. Army Corps of Engineers.

REMARKS - Land surface is approximately 15 ft above National Geodetic Vertical Datum of 1929 (benchmark provided by FDEP converted from NAVD 88 survey levels through VERTCON to NGVD 1929). Station is one of several located in Conservation Area No. 1. Gage is capable of recording water levels below land-surface datum. Rainfall data is not published, but available in files of the U.S. Geological Survey. The rainfall record was discontinued September 30, 2003.

Site 8T gage datum

- 1991: established from USACE BM ? (NGVD29)
 - Included USCE-128T as station RM
- 2002: FL DEP installed BM “WCA1 Site 1 8T”
 - Elevation determined by GPS (NAVD88)
 - reported to tenths of a foot
 - converted to NGVD29 using Vertcon
 - Included in Oct 2003 levels – difference of -0.038 ft
 - Gage reset to “WCA1 Site 1 8T” starting Oct 1, 2003
 - Prior record unadjusted
 - Conversion from gage datum to NAVD88: -1.47 ft

USGS 263050080145001 SITE 8T IN CONS AREA NO.1 NR BOYNTON BCH, FL



263050080145001 SITE 8T IN CONSERVATION AREA NO. 1 NEAR BOYNTON BEACH, FL

LOCATION - Lat 26°29'58.5", long 80°14'04.9" referenced to North American Datum of 1983, in T.41 S., R.41 E., Palm Beach County, FL, Hydrologic Unit 03090202, in Loxahatchee Wildlife Refuge (Arthur R. Marshall Park). Township and range approximated from topographic map for which most section lines are not delineated, unable to determine section.

DRAINAGE AREA - Indeterminate.

SURFACE-WATER RECORDS

PERIOD OF RECORD - July 1991 to current year.

GAGE - Satellite data collection platform with water-stage shaft encoder. Prior to October 1, 2003, tipping bucket precipitation gage. Datum of gage is National Geodetic Vertical Datum (NGVD) 1929 converted through VERTCON using the NAVD 88 survey levels from a benchmark provided by Florida Department of Environmental Protection (FDEP). Datum of gage is 1.47 ft below North American Vertical Datum of 1988 (NAVD 88). The current datum of gage that started October 1, 2003, is at a datum 0.04 ft lower than previously published historic NGVD 1929 datum. Prior to October 1, 2003, datum of gage was historic NGVD 1929 (benchmark provided by U.S. Army Corps of Engineers (USACE)).

COOPERATION - U.S. Army Corps of Engineers.

REMARKS - Records fair. Land surface is approximately 15 ft above National Geodetic Vertical datum of 1929 (benchmark provided by FDEP converted from NAVD 88 survey levels through VERTCON to NGVD 1929). Station is one of several located in Conservation Area No. 1. Gage is capable of recording water levels below land-surface datum. Rainfall record is not published, but available in files of the U.S. Geological Survey. The rainfall record was discontinued September 30, 2003.

Site 8C gage datum

- 1991: established from BM PB-44 (NGVD29)
 - Datasheet of Nov 1982
- Jan 14, 2005: SFWMD levels from T536
 - CERP adjusted NGVD29
 - Tied in PB-44 and ROOS
 - Elevations 0.217 ft lower
- March 2005: USACE requests use of ROOS
 - Datasheet updated Aug 1989
 - Elevations 0.096 ft higher than SFWMD levels
 - Elevations 0.121 ft higher than historical gage datum
 - Gage reset to ROOS Dec 1, 2004
 - Prior record unadjusted
 - Conversion from gage datum to NAVD88: -1.60 ft



**263000080120001 SITE 8C NEAR L-40 IN CONSERVATION AREA 1 NEAR BOYNTON BEACH,
FL**

LOCATION - Lat 26°29'57.4", long 80°13'19.6" referenced to North American Datum of 1983, in T.46 S., R.41 E., Palm Beach County, FL, Hydrologic Unit 03090202, 20 ft west of L-40 near Loxahatchee Wildlife Refuge (Arthur R. Marshall Park). Township and range approximated from topographic map for which most section lines are not delineated, unable to determine section.

DRAINAGE AREA - Indeterminate.

SURFACE-WATER RECORDS

PERIOD OF RECORD - April 1991 to current year

GAGE - Satellite data collection platform with water-stage shaft encoder. Prior to Oct. 1, 2003, tipping bucket precipitation gage. Datum of gage is National Geodetic Vertical Datum of 1929 and 1.60 ft below North American Vertical Datum of 1988 (NAVD 88). Prior to Oct. 31, 1995, datum of gage is 0.10 ft higher, from Nov. 1, 1995 to Sept. 14, 1997, datum of gage is 0.11 ft higher, from Sept. 15, 1997 to July 14, 1999, datum of gage is 0.12 ft higher, from July 15, 1999 to May 31, 2001, datum of gage is 0.13 ft higher, from June 1, 2001 to Mar. 31, 2003, datum of gage is 0.14 ft higher, from Apr. 1, 2003 to July 30, 2003, datum of gage is 0.15 ft higher, and from July 31, 2003 to Sept. 5, 2004, 0.13 ft higher than present datum. The change in datum is based upon an adjustment to PB-44 benchmark elevation surveyed by South Florida Water Management District and revised by the U.S. Army Corps of Engineers (USACE). See REMARKS.

COOPERATION - U.S. Army Corps of Engineers.

REMARKS - Record is good. Station is one of several located in Conservation Area No. 1. Rainfall data not published but available in files of the U.S. Geological Survey. The precipitation record was discontinued Sept. 30, 2003. Maximum gage height may have been exceeded. Station was destroyed during Hurricane Frances on Sept. 5, 2004 and reconstructed Dec. 1, 2004.

Thank you!

Questions?