Crooks Ranch/Golden Ox, LWDD E-1 and E-2, and Loxahatchee Mitigation Bank Project Data Processing

(Purchase Order No. 4500022767)

Prepared for:

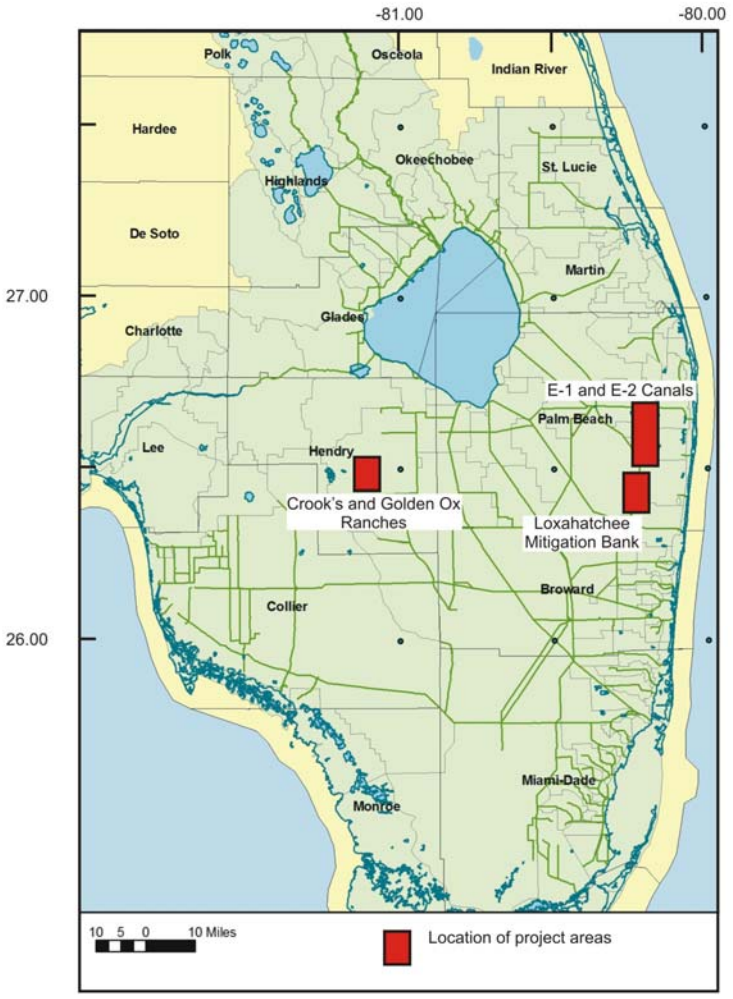

Figure 1 Location of the 37 target wells

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EXECUTIVE SUMMARY

The South Florida Water Management District (SFWMD) is responsible for the stewardship of the region's water resources. As part of the agency's mission, its personnel have conducted a number of localized projects designed to meet specific objectives. Much of the resulting groundwater, surface water, and meteorological data from these individual projects reside in hardcopy format or in electronic files on personal computers. One of the goals of SFWMD is to enter these data into the corporate database, DBHYDRO, so that the data are accessible to other SFWMD users, contractors, water managers, and the general public.

Adamski Geological Consulting, LLC, (AGC) was selected to review and revise the site information and time-series data from three projects conducted by SFWMD for eventual uploading into DBHYDRO. The three projects and their associated stations are as follows:

- **Crook's and Golden Ox Ranches**—a total of fourteen groundwater wells and five stilling wells were installed at seven sites on two ranches located in Hendry County. Groundwater level data and wetland stage data were collected from the stations from March 2005 through October 2007 as part of a hydrogeological assessment of the area. Time-series data were collected in 1-hour increments. Rainfall data were collected at 1-hour increments at four of the sites from January through October 2007. Aquifer performance tests were conducted at two monitor wells installed at the ranches.
- **LWDD E-1 and E-2**—a total of seven stilling wells were installed at six locations on the E-1 and E-2 Canals in Palm Beach County. Stage data were collected from the E-1 Canal stations from May 2005 through May 2008, whereas stage data were collected from the E-2 stations from October 2006 through May 2008. Time-series data were collected in 15-minute increments.
- **Loxahatchee Mitigation Bank**—five stilling wells and two groundwater wells were installed as part of the Loxahatchee Mitigation Bank. The period of data collection varied between the sites. The data set from one well (FPL) extends from October 2002 – March 2008, whereas data were collected from stilling well SWL3 only from March – December 2005. The collection was sporadic with large gaps in most of the time-series data. The temporal resolution of the data varied from 15-minute to 1-hour increments.

Staff at AGC performed the following tasks and data analysis as part of this project.

- Meta data (site information) and time-series data from all 37 sites were obtained from SFWMD and its contractors. Site information, which included latitude-longitude coordinates, reference and land-surface elevation, photographs, field books, and lithologic descriptions, were mostly available in

electronic files. Time-series data included the raw (breakpoint) data available in numerous electronic spreadsheet and ASCII files.

- The reference elevations, land-surface elevations, and time-series data from the Crook's and Golden Ox Ranches project were converted from North American Vertical Datum of 1988 (NAVD88) to the National Geodetic Vertical Datum of 1929 (NGVD29).
- The site information was entered into registration worksheets for each station for uploading into DBHYDRO. One registration worksheet was completed for sites with two or more stations, such as site HESDS1 which included two wells, one stilling well and one rain station.
- Construction and lithologic data, when available, were entered into the Hydrogeologic Data Loader for uploading into DBHYDRO. Information about the two aquifer performance tests also were entered into the Hydrogeologic Data Loader.
- Information from each site, including the registration worksheets, was compiled into folders for uploading into the SFWMD SIM Maintenance database.
- The breakpoint data from each station were compiled into single files, and reviewed for accuracy and completeness. A final set breakpoint data from each station were compiled into one or more comma-delimited files for uploading into DBHYDRO.
- Daily values (means for water levels and sums for rainfall) were calculated from the breakpoint data. Daily-value data were compiled into comma-delimited files for uploading into DBHYDRO.
- Daily-values data from each station were thoroughly reviewed according to SFWMD quality assurance protocols. Summary statistics, box plots, and hydrographs were generated to assess the data from each station for periods of missing values (gaps) and anomalies that could indicate erroneous data.
- A final set of preferred data were generated in comma-delimited files for each station for uploading into DBHYDRO.

In general, the site information for the stations appeared to be accurate, but the quantity of available data varied between the three projects. Location coordinates, reference and land-surface elevations, construction information, photographs, and lithologic information were readily available for the 19 wells and stilling wells at Crook's and Golden Ox Ranches. The stations on the E-1 and E-2 Canals also had accurate information on location, reference and land-surface elevations, and photographs, but construction information generally was unavailable. Well depth and lithology was not available for the two wells installed as part of the Loxahatchee Mitigation Bank, and

reference elevations for were not available for two of the stilling wells (Double72s and Double84s).

The time-series data (water-level and rainfall data) from the 37 stations generally appeared to be valid data that accurately represents hydrologic conditions at the sites. However, 27 of the 33 wells and stilling wells had periods of missing data. The gaps in original time-series data ranged in length from 1 day to 183 days. No attempt was made to estimate values for the missing data.

A total of seven sites had anomalous data that were inconsistent with nearby stations, and determined to be erroneous. Three stations (HES-11, HES-16, and HES-19) had periods of anomalous data that probably resulted from the water level declining below the instrument in these stilling wells. The anomalous data from these stations were deleted and the missing values coded as M. Correction factors were applied to portions of the time-series data from two stations (E2LWN_H and US441). Finally, the time-series data from Double72s had two periods of anomalous data that were subsequently deleted. Deletion of erroneous data resulted in a higher number of missing values for each of these stations.

Overall, the site information and time-series data from these stations have been thoroughly reviewed, and generally appear to be accurate. Anomalous or suspicious data were confirmed with similar data from nearby stations, corrected, or deleted before the preferred set of time-series data were compiled. The time-series and site information data have been compiled and are ready for uploading into DBHYDRO and associated SFWMD databases.

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1 INTRODUCTION

1.1 Objectives

The objective of this contract (P.O. no. 4500022767) is to obtain professional consulting services for processing site information (Meta data) and providing quality assurance and quality control of ground-water data. The objective of the project is to review and revise Meta data and time-series data (water levels) for 37 stations, stilling wells, and rain stations monitored by the South Florida Water Management District (SFWMD). This report contains the summary of the review and revisions of the 37 stations. SFWMD staff collected and used the data from these stations for scientific, modeling, and regulatory purposes. The data currently are stored on individual computers in SFWMD. The purpose of this project is to enter the Meta and time-series data into templates for uploading into the SFWMD corporate database, DBHYDRO, and have the data available for use by the general public, consulting firms, and other government agencies. Hence, the quality of these data is crucial to the mission of SFWMD.

SFWMD procured the services of Adamski Geological Consulting, LLC (AGC) to conduct task orders as outlined in the statement of work dated March 26, 2008. The duration of the project is from March through August 28, 2008.

1.2 Scope of Work

The overall scope of work for the project is to conduct quality assurance/quality control assessment of site information (Meta data) and time-series data for 37 stations. The work is to be conducted off-site by staff at AGC. The project was conducted in two phases as follows:

Phase 1. Compilation of existing data

- All available Meta and time-series data for the stations were obtained from SFWMD.
- The vertical datum for wells from Crook's and Golden Ox Ranches was converted from the North American Vertical Datum of 1988 (NAVD 88) to the National Geodetic Vertical Datum of 1929 (NGVD 29) using the U.S. Army Corps of Engineers Corpscon6 software.
- New station registration forms were generated for all stations for uploading of site location and elevation information into DBHYDRO. Electronic files containing photographs, survey notes, and other information were arranged in folders for storage in the SFWMD database.
- The Hydrogeologic data loader was completed for all monitoring and stilling wells for uploading of construction and geologic information into DBHYDRO.

Phase 2. Analysis of data and report activities

- Continual time-series (breakpoint) data for each station were compiled. Breakpoint data were collected at 15-minute or 1-hour increments, depending upon the station.
- Daily value (averages) data were calculated from the breakpoint data
- Daily value data were extensively reviewed for quality control; summary statistics and hydrographs were generated for daily value data from each station.
- Breakpoint and daily-value data were exported into ASCII files for uploading into DBHYDRO.
- All files were downloaded onto a DVD and submitted with this report.

The purpose of this report is to summarize work conducted by AGC on the project through August 2008. During this period, Meta and time-series data from 37 stations were reviewed and revised for quality assurance and quality control. The revised data are submitted with this report for approval and uploading into DBHYDRO.

1.3 Data Sources

The Meta and time-series data for all 37 stations were collected by SFWMD and its contractors, and will be uploaded into the DBHYDRO database (Table 1). The data were collected as part of three separate projects. The first project was the Crook's and Golden Ox Ranches, which reviewed the effects of groundwater withdrawals on wetlands located on two ranches in Hendry County. The second project consisted of monitoring water levels (stage) on the E-1 and E-2 Canals in the Lake Worth Drainage District. The third project consisted of monitoring water levels as part of the Loxahatchee Mitigation Bank.

Number	*Station name*	*Station type*	*Project*	*Reference elevation*
1	HES-1	Well	Crook's/Golden Ox	31.245
2	HES-2	Well	Crook's/Golden Ox	30.995
3	HES-3	Stilling well	Crook's/Golden Ox	30.325
4	HESDS1_R	Rain station	Crook's/Golden Ox	
5	HES-4	Well	Crook's/Golden Ox	31.469
6	HES-5	Well	Crook's/Golden Ox	31.619
7	HES-6	Stilling well	Crook's/Golden Ox	31.289
8	HES-7	Well	Crook's/Golden Ox	31.422
9	HES-8	Well	Crook's/Golden Ox	31.422
10	HESDS3_R	Rain station	Crook's/Golden Ox	
11	HES-9	Well	Crook's/Golden Ox	30.452
12	HES-10	Well	Crook's/Golden Ox	30.482
13	HES-11	Stilling well	Crook's/Golden Ox	30.592
14	HES-12	Well	Crook's/Golden Ox	30.315
15	HES-13	Well	Crook's/Golden Ox	30.325
16	HESDS5_R	Rain station	Crook's/Golden Ox	
17	HES-14	Well	Crook's/Golden Ox	28.355
18	HES-15	Well	Crook's/Golden Ox	28.475
19	HES-16	Stilling well	Crook's/Golden Ox	29.875
20	HES-17	Well	Crook's/Golden Ox	33.932
21	HES-18	Well	Crook's/Golden Ox	33.352
22	HES-19	Stilling well	Crook's/Golden Ox	33.612
23	HESDS7_R	Rain station	Crook's/Golden Ox	
24	E1BOYNTON	Stilling well	LWDD E1 and E2	20.126
25	E1LW	Stilling well	LWDD E1 and E2	21.177
26	E1PIONEER	Stilling well	LWDD E1 and E2	21.935
27	E1E2LYONS	Stilling well	LWDD E1 and E2	18.54
28	E2BENOIST	Stilling well	LWDD E1 and E2	23.16
29	E2LWN_H	Stilling well	LWDD E1 and E2	18.45
30	E2LWS_T	Stilling well	LWDD E1 and E2	18.47
31	DOUBLE72	Stilling well	Loxahatchee	

32	DOUBLE84s	Stilling well	Loxahatchee	
33	FPL	Well	Loxahatchee	19.42
34	G94A	Stilling well	Loxahatchee	16.92
35	MUDFLATS	Well	Loxahatchee	18.71
36	SWL3	Stilling well	Loxahatchee	15.55
37	US441	Stilling well	Loxahatchee	19.35

Table 1 Site information for target stations reviewed through August 2008. [WMD, South Florida Water Management District]

The site information and time-series data from most of the target stations were obtained from electronic files stored on CDs or on the SFWMD ftp server. The time-series data from the seven target stations for the Loxahatchee Mitigation Bank were obtained from the contractor, Tetra Tech, EC, Inc. The time-series data from nearby wells, stilling wells, and rain gages also were downloaded from DBHYDRO to assist in the quality assurance analysis of the time-series data. A discussion of the results in provided in the following Results and Discussion section.

2 METHODS

2.1 Data Acquisition

Meta data and time-series data for the 37 stations and rain gages were obtained from SFWMD by downloading the files from the agency's ftp site.

2.2 Procedures for Compiling Existing Information

Accurate site information and time-series data are important in maintaining the integrity of the SFWMD database. The site information and time-series data were reviewed and compiled as follows:

1. AGC staff became familiar with and knowledgeable about the target stations by reviewing photographs, survey reports, and field notes. AGC also consulted the statement of work and final report (Lukasiewicz and other, in press) to obtain additional information on the Crook's Ranch and Golden Ox Ranch project.

2. In order to obtain the most accurate information on station location, construction, and site geology, AGC spoke with numerous individuals involved in the projects. These individuals included Cindy Bevier, PG, and Simon Sunderland (SFWMD), Ed Rectenwald, PG (MWH Americas, Inc.), Scott Jones, PE (Johnson-Prewitt & Associates, Inc.), Paul Petrey (Applied Drilling Engineering, Inc.), Patrick Zuloaga and Maura Saks, PE (Tetra Tech EC, Inc.) and staff at Advanced Well Drilling (Appendix B).

3. The locations of the stations were evaluated using GIS by plotting the stations using latitude-longitude coordinates available in the survey reports. A final map was generated showing the location of target wells (fig. 1).

4. Township and range location, basin, and USGS topographic quadrangle location also were determined by using the U.S. Geological Survey National Map Viewer and by using GIS and coverages downloaded from the SFWMD web site.
5. Elevation and time-series data from the Crook's Ranch/Golden Ox Ranch project were converted from NAVD 88 to NGVD 29 using the U.S. Army Corps of Engineers Corpscon6 software.
6. The site information, including location, construction, geologic, and lithologic information, was entered into registration worksheets and hydrogeologic data loader for uploading into the DBHYDRO and WREP databases.
7. Breakpoint data, which were stored in multiple files, were compiled into single files for each station. Average values of breakpoint data for each available date were calculated in order to obtain daily value data.

2.3 Procedures for QA/QC of Water-Level Data

After information and data were compiled, quality assurance was conducted on time-series data from each well using methods derived from SFWMD standard operating procedures (Sangoyomi and others, 2005; Sangoyomi and others, 2006; Sangoyomi and Lambright, 2006). These methods are summarized as follows:

1. Daily value data from the target stations were plotted in order to identify and document anomalies, outliers, and gaps in the record. Gaps, or periods of missing data, are easily identified. Anomalies are shifts in the values that might or might not represent valid hydrologic data. Anomalies could also be periods of flat or suspiciously linear data. Outliers are extreme values that are significantly greater than or less than a specified range within which most of the data occur. Anomalies and outliers might represent valid hydrologic conditions such as a drought or excessive rainfall. However, anomalies and outliers that are inconsistent with data from nearby wells and rain gages could indicate errors in the time-series data.
2. Summary statistics (minimum, mean, median, maximum, and standard deviation) were determined for each set of time-series data prior to revision (Appendix A).
3. Box plots of time-series data for each of the target wells were generated in order to quantitatively identify outliers. Box plots consist of a box with one end (lower quartile, Q1) representing the 25^{th} percentile, and the opposite end (upper quartile, Q3) representing the 75^{th} percentile of the time-series data (fig. 2). A line is drawn near the middle of the box to represent the median of the data. The distance between the lower and upper quartiles is the inter quartile range (QR). An outlier is defined as any data point greater than the upper fence (upper quartile plus 1.5*QR), or any data point less than the lower fence (lower quartile minus 1.5*QR).
4. Time-series data from the target wells were plotted with data from nearby monitoring wells and rain gages in order to evaluate anomalies and outliers. For example, heavy rains could explain a sudden increase in water levels in the target well. Trends in

nearby wells also were used to document and verify that anomalies in the time-series data of the target wells represented valid hydrologic conditions.

5. Anomalies and outliers that did not appear to represent valid hydrologic conditions were deleted from the record. The values were coded as an "M" for missing.
6. Gaps in data were coded as an "M", which indicates the data are missing, possibly as a result of equipment failure or some other technical problem.
7. The data were revised, based on the analysis of anomalies, outliers, and gaps. Summary statistics were determined for the revised time-series data (Appendix A). Revisions, deletion of suspect data, caused the summary statistics, including the value and number of outliers, to change. Final hydrographs (Appendix A) of the revised data were reviewed to verify that the data were valid.

Revised time-series data are submitted with this report for approval and uploading into DBHYDRO.

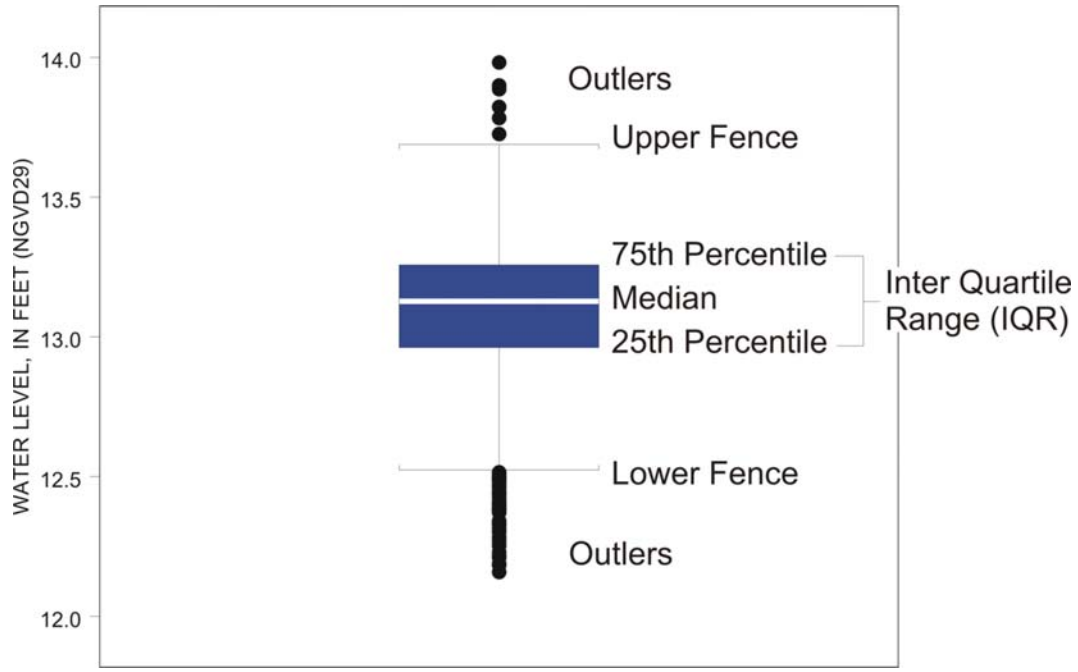


Figure 2 Sample box plot showing lower (Q1) and upper (Q3) quartiles.

Well depths (strata) are listed as feet below land surface, unless otherwise noted. Water-level data and reference and land-surface elevations are listed as feet above mean sea level (NGVD29), unless otherwise noted. Horizontal locations are based on North American Datum of 1983 (NAD83).

3 RESULTS AND DISCUSSION

The site information and time-series data from 37 stations were reviewed and analyzed according to SFWMD quality-assurance protocols (eg, Sangoyomi and Lambright, 2006). Site-information data were verified and (or) corrected using the methods described in the previous section. The site information and locations of the target stations for this report generally were in agreement with GIS and other information; therefore, the site information for the wells was considered accurate. The locations of the wells are shown in figures 3, 4, and 5.

The stations monitored for the Crook's Ranch and Golden Ox Ranch project consists of 19 wells and stilling wells installed at 7 locations. Each of the seven locations (drill sites HESDS1 – HESDS7) consists of a shallow well tapping the surficial aquifer system and a deep well tapping the Lower Tamiami aquifer. Five of the locations (HESDS1, HESDS2, HESDS4, HESDS6, and HESDS7) also had nearby stilling wells installed to monitored water levels in wetlands. The water levels in these 19 wells were recorded at 1-hour increments. Sites HESDS1, HESDS3, HESDS5, and HESDS7 also were equipped with tipping-bucket rain stations, which collected data every hour or every tip of the bucket. The time-series data provided by the contractor recorded the bucket tips, which were converted during this project to breakpoint and daily values (sums). One bucket tip was equivalent to 0.01 inch of rain.

The LWDD E-1 and E-2 Canals project consisted of seven stilling wells installed at six locations on the E-1 and E-2 Canals. One site, located on the E-2 Canal at the Florida Turnpike and Lake Worth Road, had two stilling wells installed (ELWN_H and ELWS_T) on the headwater and tailwater side of a gate for controlling flow.

The Loxahatchee Mitigation Bank project consisted of five stilling wells and two groundwater wells installed in Palm Beach County. Little site information was available for these sites. Most of the time-series data were obtained from the contractor (Maura Saks, Tetra Tech EC, Inc., written commun., 2008).

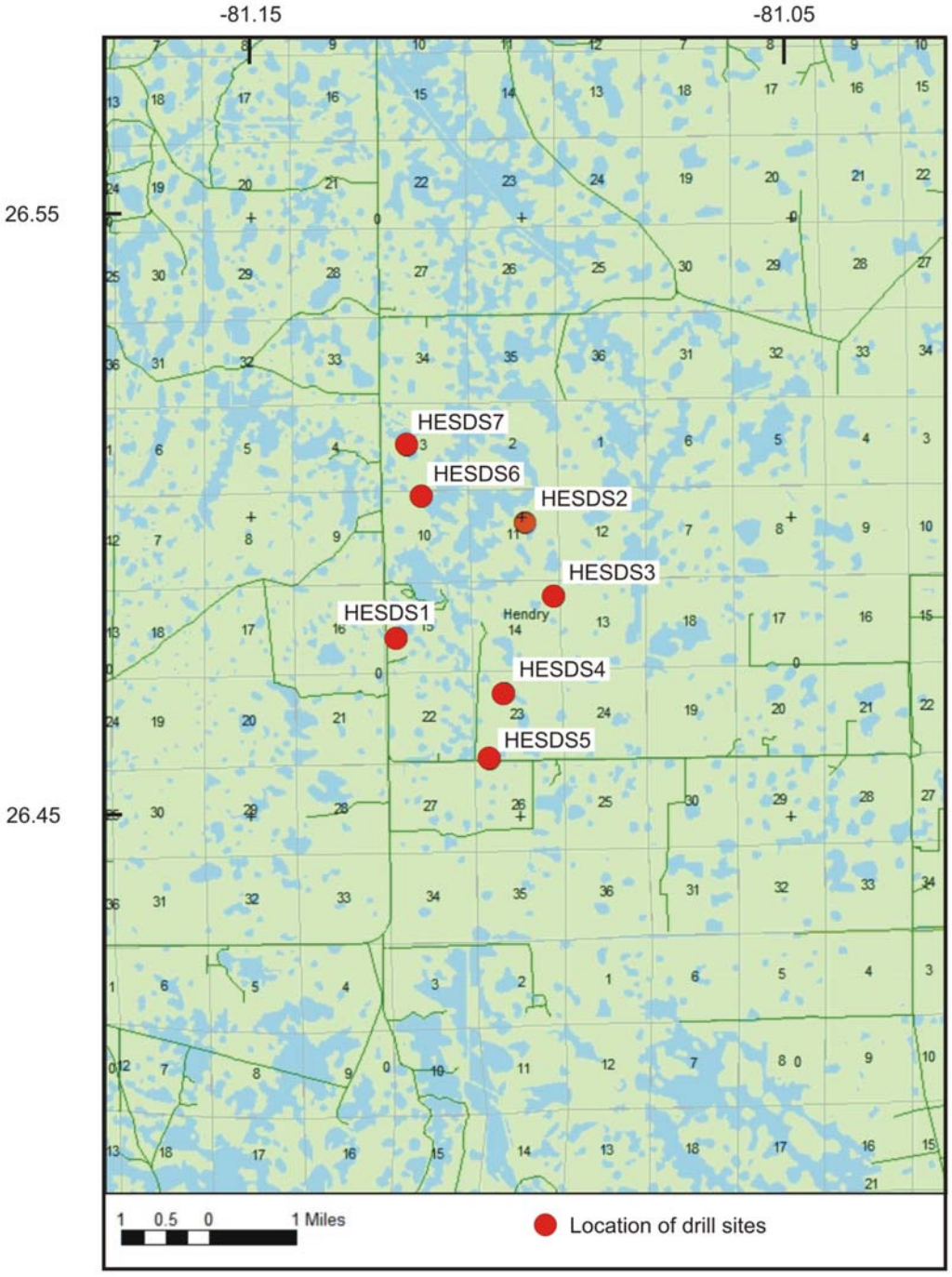


Figure 3 Location of target wells at the Crook's and Golden Ox Ranches in Hendry County, Florida.

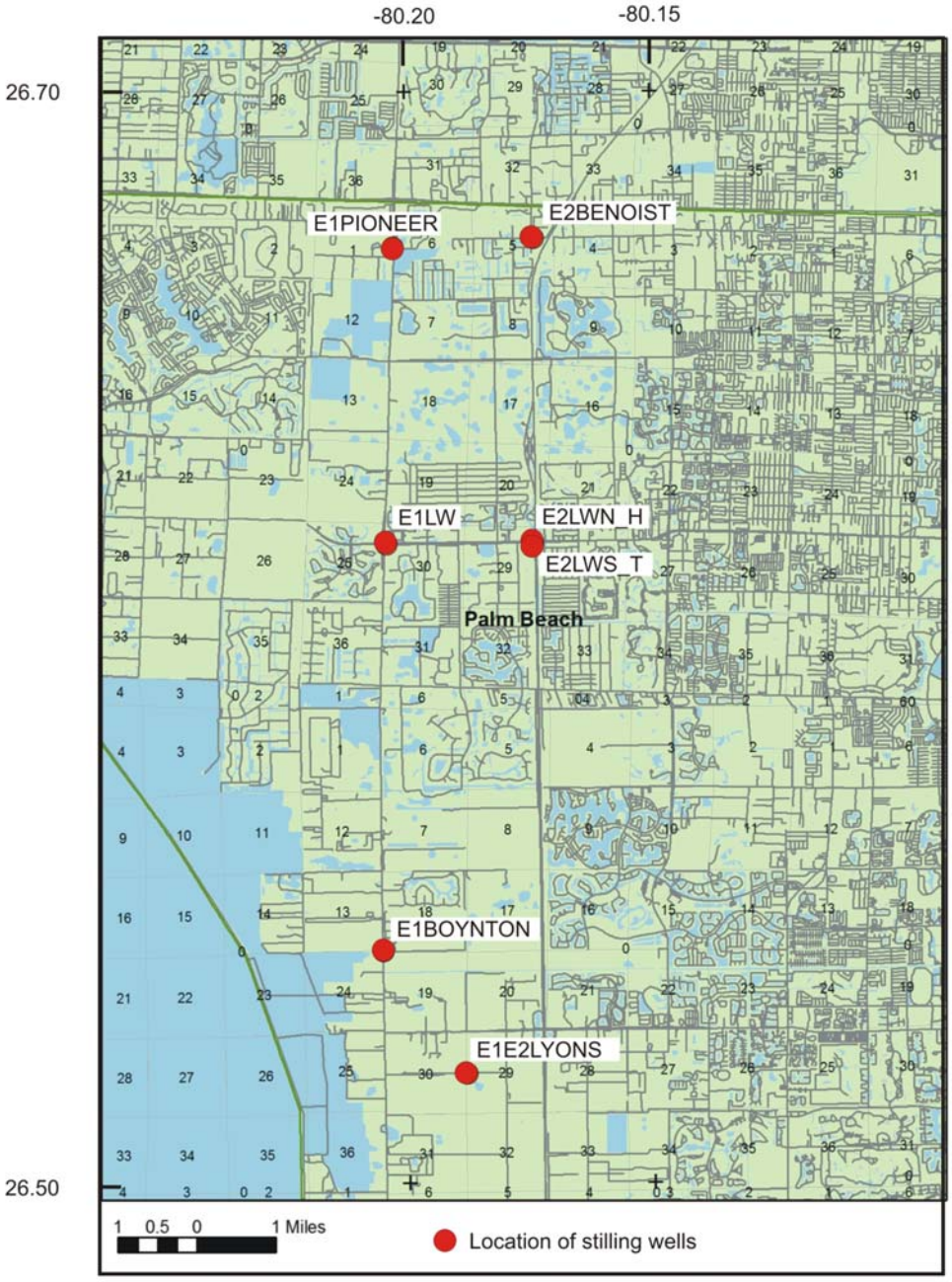


Figure 4 Location of stilling wells along E-1 and E-2 Canals, Palm Beach County, Florida.

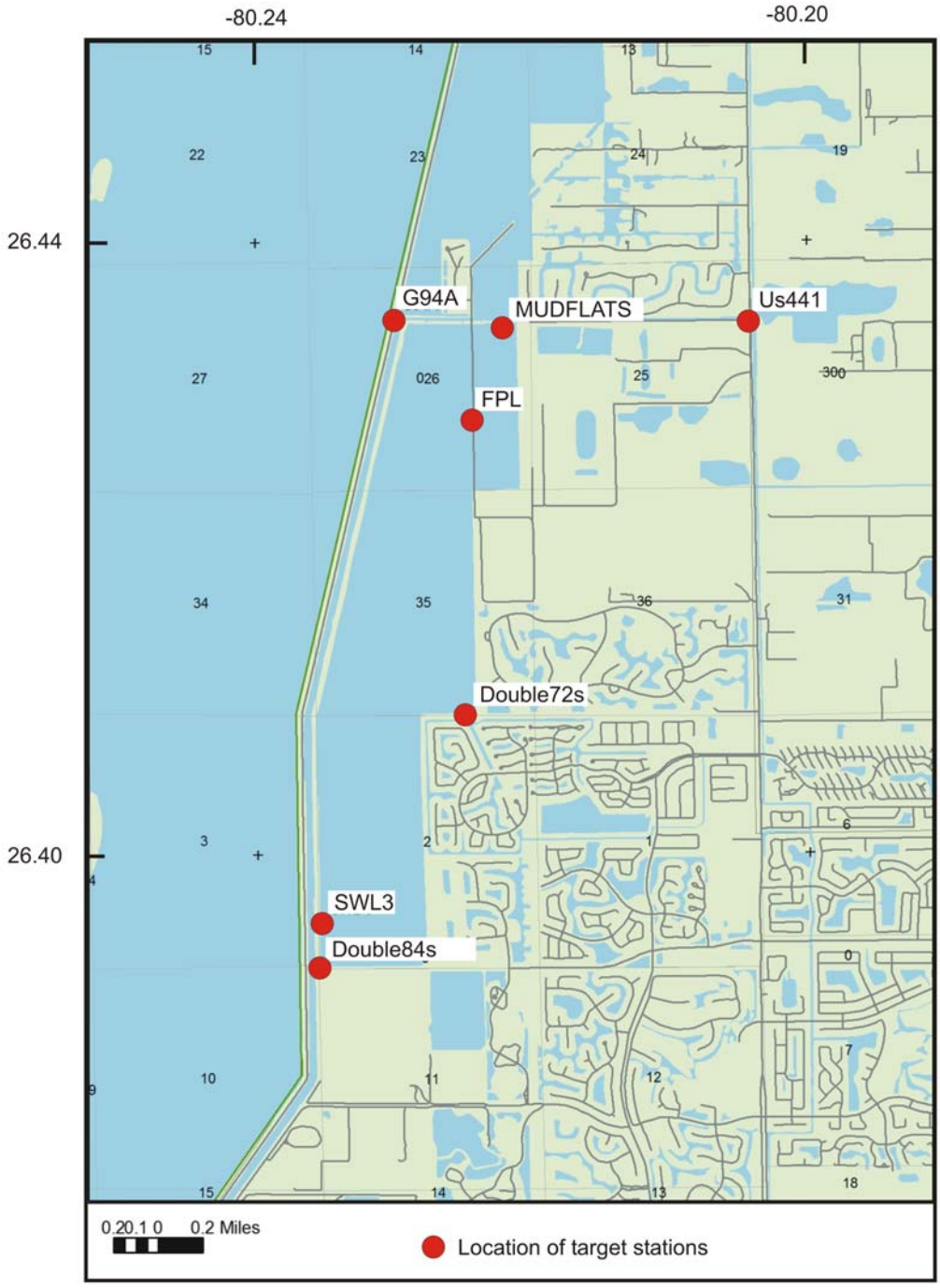


Figure 5 Location of target stations installed as part of the Loxahatchee Mitigation Bank, Palm Beach County, Florida.

3.1 Station 1: HES-1

HES-1 is a 15 ft deep well located in Hendry County (figs. 1 and 3). HES-1 is located at drill site 1 (HESDS1) on Crook's Ranch, which also includes well HES-2, and stilling well HES-3. The site was briefly instrumented with rain station HESDS1_R.

3.1.1 Site and data description

Variable	Original value	Revised value
Station	HES-1	HES-1
Source DBKEY		
MOD1 DBKEY		
Latitude	26 28 47.9	26 28 47.9
Longitude	81 07 23.1	81 07 23.1
X Coordinate	616128.16	616128.16
Y Coordinate	782640.2	782640.2
Land-surface elevation (feet) (NGVD 29)	28.478	28.478
Reference elevation (feet) (NGVD 29)	31.245	31.245
Measuring point (feet)	2.35	2.35
Well bottom elevation (feet) (NGVD 29)	13.895	13.895
Strata (feet)	15	15
Sensor elevation (feet) (NGVD 29)	18.05	18.05

Table 2 Site information was obtained for Station 1: HES-1

Analysis: HES-1 is a shallow well that taps the surficial aquifer system. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on June 29, 2005 (Scott, Jones, PE, Johnson-Prewitt and Associates, Inc., written commun.,, 2008). The land-surface elevation was not surveyed, but was calculated by subtracting the pad height (0.417 ft) from the benchmark elevation. A photograph of HES-1 and adjacent well HES-2 is shown below. No revisions were necessary, other than converting elevations from NAVD 88 to NGVD 29.

Stations HES1 and HES-2

3.1.2 Data analysis and revision

The period of record analyzed for well HES-1 extends from March 16, 2005 to September 26, 2007 (Appendix A). The time-series data from that period contain 925 observations with no outliers and 27 missing values. The summary statistics for well HES-1 are provided in table 3.

Problem: The time-series data from well HES-1 contain 27 missing values.

Analysis: The missing values occurred from October 8 to November 3, 2006, and possibly result from budgetary constraints during the start of a new fiscal year (Cindy Bevier, SFWMD, personal commun., 2008). The missing values were coded as M for uploading into DBHYDRO.

Summary: The peaks and declines in water levels in well HES-1 roughly coincide with peaks and declines in water levels in nearby wells (HES-4, HES-7, and HES-9) drilled to similar depths. The water levels in well HES-1 also increase as a result of rain storms and decrease during periods of dry weather. Therefore, the water-level data from well HES-1 appear to be valid data that accurately represent hydrologic conditions at the site. No revisions were required, other than converting data from NAVD 88 to NGVD 29.

Statistics	Original series	Revised series
Minimum (feet)	24.128	24.128
Mean (feet)	25.619	25.619
Median (feet)	25.711	25.711
Maximum (feet)	27.243	27.243
Standard deviation	0.705	0.705
Variance	0.497	0.497
Outliers	0	0
Missing values	27	27

Table 3 Summary statistics of original time-series data for Station 1: HES-1

3.2 Station 2: HES-2

HES-2 is a 78 ft deep well located in Hendry County (figs. 1 and 3). HES-2 is located at drill site 1 (HESDS1) on Crook's Ranch, which also includes well HES-1, and stilling well HES-3. The site was briefly instrumented with rain station HESDS1_R.

3.2.1 Site and data description

Variable	Original value	Revised value
Station	HES-2	HES-2
Source DBKEY		
MOD1 DBKEY		
Latitude	26 28 47.9	26 28 47.9
Longitude	81 07 23.1	81 07 23.1
X Coordinate	616130.79	616130.79
Y Coordinate	780181.2	780181.2
Land-surface elevation (feet) (NGVD 29)	28.168	28.168
Reference elevation (feet) (NGVD 29)	30.995	30.995
Measuring point (feet)	2.41	2.41
Well bottom elevation (feet) (NGVD 29)	-49.415	-49.415
Strata (feet)	78	78
Sensor elevation (feet) (NGVD 29)	10.78	10.78

Table 4 Site information obtained for Station 2: HES-2

Analysis: HES-2 is a monitoring well that taps the Lower Tamiami aquifer. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on June 29, 2005 (Scott, Jones, PE, Johnson-Prewitt and Associates, Inc., written commun.,, 2008). The land-surface

elevation was not surveyed, but was calculated by subtracting the pad height (0.417 ft) from the benchmark elevation. A photograph of HES-2 and adjacent well HES-1 is shown in the discussion of HES-1. No revisions were necessary, other than converting elevations from NAVD 88 to NGVD 29.

3.2.2 Data analysis and revision

The period of record analyzed for well HES-2 extends from March 16, 2005 to October 20 2007 (Appendix A). The time-series data from that period contain 949 observations with no outliers and 89 missing values. The summary statistics for well HES-2 are provided in table 5.

Problem: The time-series data from well HES-2 contain 89 missing values.

Analysis: Missing values occurred from October 8 to November 3, 2006, and probably result from budgetary constraints at the start of a new fiscal year (Cindy Bevier, SFWMD, personal commun., 2008). Missing values also occurred from May 6 to July 6, 2007, possibly as a result of equipment problems, as data from adjacent (HES-1) and nearby wells (HES-8, HES-10, and HES-15) were available during this period. The missing values were coded as M for uploading into DBHYDRO.

Summary: The peaks and declines in water-level data from well HES-2 closely coincide with peaks and declines in water-level data from nearby wells (HES-8, HES-10, and HES-15) drilled to a similar depth (Appendix A). In addition, water levels in the target well decline as expected during periods of low rainfall, and increase as expected during periods of excessive rainfall recorded by nearby rain gages. Some of the declines in water levels happened quickly, and possibly indicate drawdown as a result of withdrawals from nearby production wells. The sharp declines in water levels in well HES-2 coincide with similar declines in nearby wells. Therefore, the time-series data from well HES-2 probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required, other than converting data from NAVD 88 to NGVD 29.

Statistics	Original series	Revised series
Minimum (feet)	16.547	16.547
Mean (feet)	23.132	23.132
Median (feet)	23.173	23.173
Maximum (feet)	27.378	27.378
Standard deviation	2.658	2.658
Variance	7.065	7.065
Outliers	0	0
Missing values	89	89

Table 5 Summary statistics of original time-series data for Station 2: HES-2

3.3 Station 3: HES-3

HES-3 is a 4 ft deep stilling well located in Hendry County (figs. 1 and 3). HES-3 is located at drill site 1 (HESDS1) on Crook's Ranch, which also includes wells HES-1 and HES-2. The site was briefly instrumented with rain station HESDS1_R.

3.3.1 Site and data description

Variable	Original value	Revised value
Station	HES-3	HES-3
Source DBKEY		
MOD1 DBKEY		
Latitude	26 28 47.8	26 28 47.8
Longitude	81 07 23.1	81 07 23.1
X Coordinate	616005	616005
Y Coordinate	780025	780025
Land-surface elevation (feet) (NGVD 29)	26.83	26.83
Reference elevation (feet) (NGVD 29)	30.325	30.325
Well bottom elevation (feet) (NGVD 29)	22.83	22.83
Strata (feet)	4	4
Sensor elevation (feet) (NGVD 29)	23.005	23.005

Table 6 Site information obtained for Station 3: HES-3

Analysis: HES-3 is a stilling well that monitors the water level in a wetland. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on June 29, 2005 (Scott, Jones, PE, Johnson-Prewitt and Associates, Inc., written commun., 2008). The median water level in the well is less than the land-surface elevation (calculated), which indicates the site was only seasonally inundated. A photograph of HES-3 is shown below. No revisions were necessary, other than converting elevations from NAVD 88 to NGVD 29.

Station HES-3

3.3.2 Data analysis and revision

The period of record analyzed for well HES-3 extends from March 16, 2005 through October 20, 2007 (Appendix A). The time-series data from that period contain 949 observations with no outliers and 27 missing values. The summary statistics for this station are provided in table 7.

Problem: The time-series data from well HES-3 contain 27 missing values.

Analysis: Missing values occurred from October 8 to November 3, 2006, and probably result from budgetary constraints at the start of the new fiscal year (Cindy Bevier, SFWMD, personal commun., 2008). The missing values were coded as M for uploading into DBHYDRO.

Summary: The peaks and declines in water-level data from station HES-3 roughly coincide with peaks and declines in water-level data from nearby stilling wells (HES-6, HES-16, and HES-19) drilled to a similar depth (Appendix A). In addition, water levels in the target well decline as expected during periods of low rainfall, and increase as expected during periods of excessive rainfall recorded by nearby rain gages. Therefore, the time-series data from well HES-3 probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	24.077	24.077
Mean (feet)	25.606	25.606
Median (feet)	25.667	25.667
Maximum (feet)	27.024	27.024
Standard deviation	0.747	0.747
Variance	0.558	0.558
Outliers	0	0
Missing values	27	27

Table 7 Summary statistics of time-series data for Station 3: HES-3

3.4 Station 4: HESDS1_R

HESDS1_R is a rain station located in Hendry County (figs. 1 and 3). The station is located at drill site 1 (HESDS1) on Crook's Ranch, which also includes wells HES-1 and HES-2, and stilling well HES-3.

3.4.1 Site and data description

Variable	Original value	Revised value
Station	HESDS1_R	HESDS1_R
Source DBKEY		
MOD1 DBKEY		
Latitude	26 28 47.9	26 28 47.9
Longitude	81 07 23.1	81 07 23.1
X Coordinate	616130.79	616130.79
Y Coordinate	780181.2	780181.2

Table 8 Site information obtained for Station 4: HESDS1_R

3.4.2 Data analysis and revision

The period of record analyzed for station HESDS1_R extends from April 7 through October 26, 2007 (Appendix A). The time-series data contain 203 observations with 28 outliers and no missing values.

Problem: The time-series data contain 28 outliers, all of which are greater than the upper fence of 0.36 inches.

Analysis: The median value for the time-series data is 0, which indicates that no precipitation occurred during at least half the period of record. Therefore, days with even moderate precipitation (greater than 0.36 inch) are statistical outliers. These outliers coincide with moderate to heavy rainfalls recorded at nearby stations. Hence, the outliers are valid data that accurately represent hydrologic conditions at the site.

Summary: The precipitation recorded at HESDS1_R coincides with precipitation data from nearby wells (ALICO_R, DEVILS_R, and HESDS5_R), particularly with excessive

rainfall of 1 inch or more (Appendix A). In addition, periods of low rainfall also coincide with dry periods recorded at nearby stations. The time-series data from HESDS1_R probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	0.000	0.000
Mean (feet)	0.181	0.181
Median (feet)	0.000	0.000
Maximum (feet)	4.260	4.260
Standard deviation	0.458	0.458
Variance	0.210	0.210
Outliers	28	28
Missing values	0	0

Table 9 Summary statistics of original time-series data for Station 4: HESDS1_R

3.5 Station 5: HES-4

HES-4 is a 15-ft deep well located in Hendry County (figs. 1 and 3). HES-4 is located at drill site 2 (HESDS2) ON Crook's Ranch, which also includes well HES-5 and stilling well HES-6.

3.5.1 Site and data description

Variable	Original value	Revised value
Station	HES-4	HES-4
Source DBKEY		
MOD1 DBKEY		
Latitude	26 29 56.8	26 29 56.8
Longitude	81 05 57.3	81 05 57.3
X Coordinate	623740.75	623740.75
Y Coordinate	787127.9	787127.9
Land-surface elevation (feet) (NGVD 29)	28.642	28.642
Reference elevation (feet) (NGVD 29)	31.469	31.469
Measuring point (feet)	2.41	2.41
Well bottom elevation (feet) (NGVD 29)	14.059	14.059
Strata (feet)	15	15
Sensor elevation (feet) (NGVD 29)	18.239	18.239

Table 10 Site information obtained for Station 5: HES-4

Analysis: HES-4 is a shallow well that taps the surficial aquifer system. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on June 29, 2005 (Scott, Jones, PE, Johnson-Prewitt and Associates, Inc., written commun.,, 2008). The land-surface elevation was not surveyed, but was calculated by subtracting the pad height (0.417 ft) from the benchmark elevation. A photograph of HES-4 and adjacent well HES-5 is shown below. No revisions were necessary, other than converting elevations from NAVD 88 to NGVD 29.

Stations HES-4 and HES-5

3.5.2 Data analysis and revision

The period of record analyzed for well HES-4 extends from March 16, 2005 through September 7, 2007 (Appendix A). The time-series data from that period contain 906 observations with no outliers and 51 missing values. The summary statistics for this well are provided in table 11.

Problem: The time-series data from well HES-4 contain 51 missing values.

Analysis: Missing values occurred from January 18 through February 10, 2006, and possibly result from equipment problems as data from nearby wells are available from that period. Missing values also occurred from October 8 through November 3, 2006, and probably result from budgetary constraints at the start of a new fiscal year (Cindy Bevier, SFWMD, personal commun., 2008). The missing values were coded as M for uploading into DBHYDRO.

Summary: The peaks and declines in water-level data from well HES-4 roughly coincide with peaks and declines in water-level data from nearby wells (HES-1, HES-7, and HES-9) drilled to similar depths (Appendix A). In addition, water levels in the target well increase modestly during periods of excessive rainfall recorded by nearby rain gages, and decline during dry periods. Other factors, such as pumping from nearby productions wells, also appear to be affecting water levels in the target well. Therefore, the time-series data from well HES-4 probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	25.365	25.365
Mean (feet)	26.995	26.995
Median (feet)	27.207	27.207
Maximum (feet)	28.362	28.362
Standard deviation	0.698	0.698
Variance	0.487	0.487
Outliers	0	0
Missing values	51	51

Table 11 Summary statistics of time-series data for Station 5: HES-4

3.6 Station 6: HES-5

HES-5 is a 61-ft deep well located in Hendry County (figs. 1 and 3). HES-5 is located at drill site 2 (HESDS2) on Crook's Ranch, which also includes well HES-4 and stilling well HES-6.

3.6.1 Site and data description

Variable	Original value	Revised value
Station	HES-5	HES-5
Source DBKEY		
MOD1 DBKEY		
Latitude	26 29 56.8	26 29 56.8
Longitude	81 05 57.3	81 05 57.3
X Coordinate	623738.94	623738.94
Y Coordinate	787118.4	787118.4
Land-surface elevation (feet) (NGVD 29)	28.722	28.722
Reference elevation (feet) (NGVD 29)	31.619	31.619
Measuring point (feet)	2.48	2.48
Well bottom elevation (feet) (NGVD 29)	-31.861	-31.861
Strata (feet)	61	61
Sensor elevation (feet) (NGVD 29)	11.479	11.479

Table 12 Site information obtained for Station 6: HES-5

Analysis: HES-5 is a monitoring well that taps the Lower Tamiami aquifer. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on June 29, 2005 (Scott, Jones, PE, Johnson-Prewitt and Associates, Inc., written commun.,, 2008). The land-surface elevation was not surveyed, but was calculated by subtracting the pad height (0.417 ft) from the benchmark elevation. A photograph of HES-5 and adjacent well HES-4 is shown in the discussion of HES-4. No revisions were necessary, other than converting elevations from NAVD 88 to NGVD 29.

3.6.2 Data analysis and revision

The period of record analyzed for well HES-5 extends from March 16, 2005 through October 20, 2007 (Appendix A). The time-series data from that period contain 949 observations with no outliers and 68 missing values. The summary statistics for this well are provided in table 11.

Problem: The time-series data from well HES-5 contain 68 missing values.

Analysis: Missing values occurred from October 8 through November 3, 2006, and possibly result from budgetary constraints at the start of a new fiscal year (Cindy Bevier, SFWMD, personal commun., 2008). Missing values also occurred from July 8 through August 17, 2007, and possibly result from equipment problems as data from nearby wells are available for the same period. The missing values were coded as M for uploading into DBHYDRO.

Summary: The peaks and declines in water-level data from well HES-5 closely coincide with peaks and declines in water-level data from nearby wells (HES-2, HES-8, and HES-15) drilled to a similar depth (Appendix A). In addition, water levels in the target well show a general pattern of increase during periods of rain and decrease during the dry season. Other factors, such as withdrawals from nearby production wells, also appear to be affecting water levels in the target wells, as indicated by abrupt oscillations of the water levels, particularly during dry periods. Therefore, the time-series data from well HES-5 probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required, other than converting data from NAVD 88 to NGVD 29.

Statistic	Original series	Revised series
Minimum (feet)	17.326	17.326
Mean (feet)	24.121	24.121
Median (feet)	24.416	24.416
Maximum (feet)	28.046	28.046
Standard deviation	2.678	2.678
Variance	7.174	7.174
Outliers	0	0
Missing values	68	68

Table 13 Summary statistics of original time-series data for Station 6: HES-5

3.7 Station 7: HES-6

HES-6 is a 4-ft deep stilling well located in Hendry County (figs. 1 and 3). HES-6 is located at drill site 2 (HESDS2) on Crook's Ranch, which also includes wells HES-4 and HES-5.

3.7.1 Site and data description

Variable	Original value	Revised value
Station	HES-6	HES-6
Source DBKEY		
MOD1 DBKEY		
Latitude	26 29 56.7	26 29 56.7
Longitude	81 05 53.7	81 05 53.7
X Coordinate	624073.12	624073.12
Y Coordinate	796986.2	796986.2
Land-surface elevation (feet) (NGVD 29)	27.79	27.79
Reference elevation (feet) (NGVD 29)	31.289	31.289
Well bottom elevation (feet) (NGVD 29)	23.79	23.79
Strata (feet)	4	4
Sensor elevation (feet) (NGVD 29)	24.139	24.139

Table 14 Site information obtained for Station 7: HES-6

Analysis: HES-6 is a stilling well that monitors the water level in a wetland. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on June 29, 2005 (Scott, Jones, PE, Johnson-Prewitt and Associates, Inc., written commun.,, 2008). The median water level in the well is less than the land-surface elevation (calculated), which indicates the site was only seasonally inundated. A photograph of HES-6 is shown below. No revisions were necessary, other than converting elevations from NAVD 88 to NGVD 29.

HES-6

3.7.2 Data analysis and revision

The period of record analyzed for stilling well HES-6 extends from March 16, 2005 through October 20, 2007 (Appendix A). The time-series data from that period contain 949 observations with no outliers and 27 missing values. The summary statistics for this station are provided in table 15.

Problem: The time-series data from well HES-6 contain 27 missing values.

Analysis: Missing values from well HES-6 occurred from October 8 through November 3, 2006, probably as a result of budgetary constraints at the start of a new fiscal year (Cindy Bevier, SFWMD, personal commun., 2008). The missing values were coded as M for uploading into DBHYDRO.

Summary: The peaks and declines in water-level data from stilling well HES-6 generally coincide with peaks and declines in water-level data from nearby stilling wells (HES-3, HES-16, and HES-19) installed to a similar depth (Appendix A). In addition, water levels in the target well decline as expected during periods of low rainfall, and increase as expected during periods of excessive rainfall recorded by nearby rain gages. Therefore, the time-series data from well HES-6 probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required, other than converting the data from NAVD 88 to NGVD 29.

Statistics	Original series	Revised series
Minimum (feet)	24.778	24.778
Mean (feet)	26.828	26.828
Median (feet)	26.997	26.997
Maximum (feet)	28.500	28.500
Standard deviation	0.944	0.944
Variance	0.891	0.891
Outliers	0	0
Missing values	27	27

Table 15 Summary statistics of time-series data for Station 7: HES-6

3.8 Station 8: HES-7

HES-7 is a 16-ft deep well located in Hendry County (figs. 1 and 3). HES-7 is located at drill site 3 (HESDS3) at Crook's Ranch which also includes well HES-8. The site was briefly equipped with rain station HESDS3_R.

3.8.1 Site and data description

Variable	Original value	Revised value
Station	HES-7	HES-7
Source DBKEY		
MOD1 DBKEY		
Latitude	26 29 12.8	26 29 12.8
Longitude	81 05 37.8	81 05 37.8
X Coordinate	625473.02	625473.02
Y Coordinate	782640.2	782640.2
Land-surface elevation (feet) (NGVD 29)	28.445	28.445
Reference elevation (feet) (NGVD 29)	31.422	31.422
Measuring point (feet)	2.56	2.56
Well bottom elevation (feet) (NGVD 29)	12.862	12.862
Strata (feet)	16	16
Sensor elevation (feet) (NGVD 29)	18.162	18.162

Table 16 Site information obtained for Station 8: HES-7

Analysis: HES-7 is a shallow well that taps the surficial aquifer system. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on June 30, 2005 (Scott, Jones,

PE, Johnson-Prewitt and Associates, Inc., written commun.,, 2008). The land-surface elevation was not surveyed, but was calculated by subtracting the pad height (0.417 ft) from the benchmark elevation. A photograph of HES-7 and adjacent well HES-8 is shown below. No revisions were necessary, other than converting elevations from NAVD 88 to NGVD 29.

Stations HES-7 and HES-8

Analysis: The value in DBHYDRO was the elevation of the well bottom (ft above mean sea level) listed on the recorder registration worksheet. The Strata is defined as the depth of well in ft below land surface (Sangoyomi and Lambright, 2006). The correct Strata value is 49.6 ft below land surface, which was revised and verified in DBHYDRO during this project.

Overall, the site information is consistent, and appears to be accurate. No other revisions were required.

3.8.2 Data analysis and revision

The period of record analyzed for well HES-7 extends from March 16, 2005 through August 18, 2007 (Appendix A). The time-series data from that period contain 886 observations with 80 outliers and 27 missing values. The summary statistics for this well are provided in table 17.

Problem: The time-series data from well HES-7 contain 80 outliers, all of which exceeded the upper outlier of 26.825 ft above mean sea level.

Analysis: The outliers generally coincide with peaks in water levels in nearby wells (HES-1, HES-4, and HES-9) drilled to similar depths. In addition, the outliers occurred shortly after periods of excessive rain. For example, the water level in the target well increased from 24.874 ft above mean sea level on October 23, 2005, to 26.953 ft above mean sea level on the following day. The increase coincided with excessive rainfall of 3.44 to 81.4 inches recorded at three rain stations on October 24 (fig. 6). Hence, the outliers probably result from the water level response to meteorological events and are valid data.

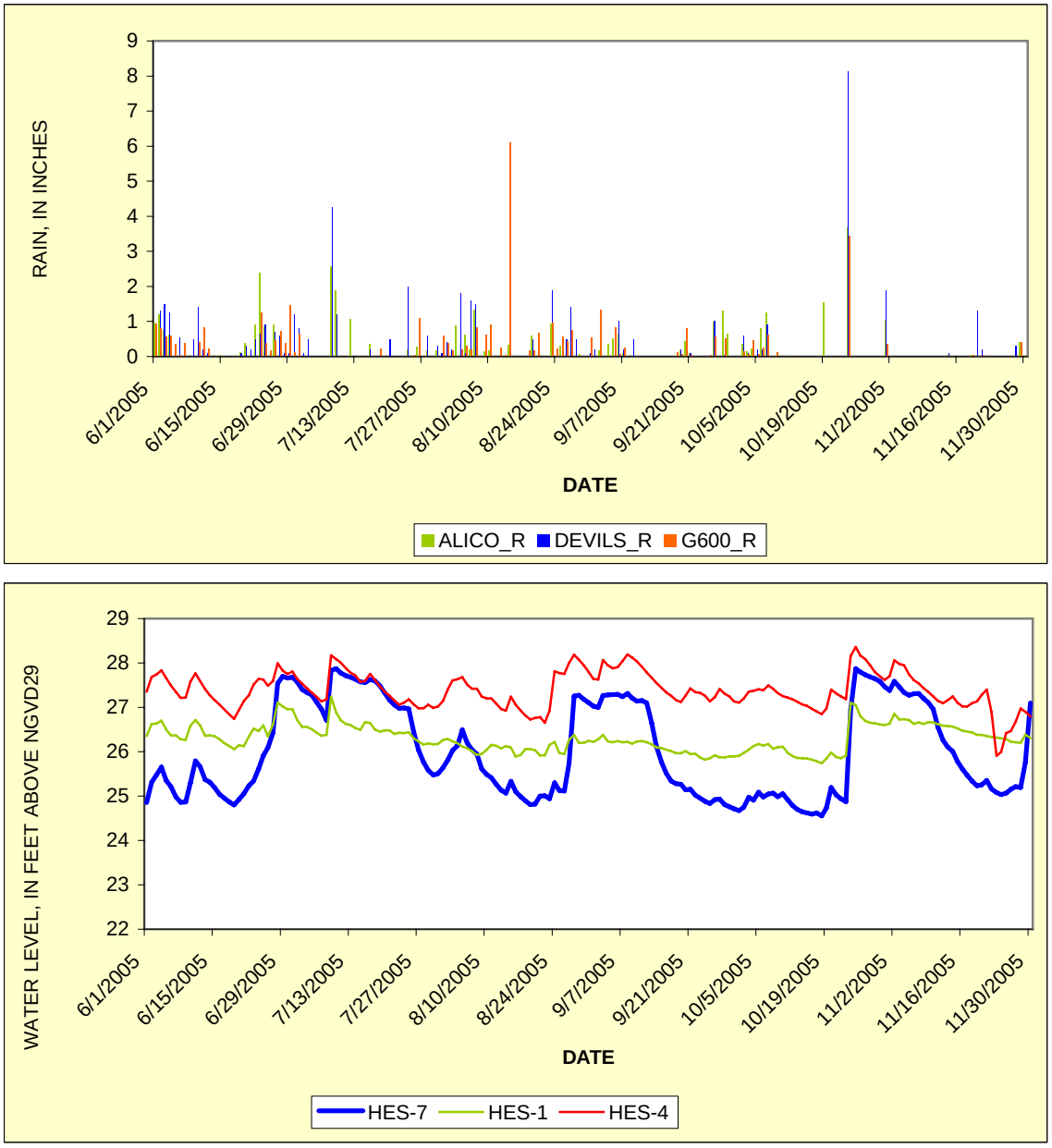


Figure 6 Rain and water level data at well HES-7 and nearby sites.

Problem: The time-series data from HES-7 contain 27 missing values.

Analysis: Missing values occurred from October 8 through November 3, 2006, and probably result from budgetary constraints at the start of a new fiscal year (Cindy Bevier, SFWMD, personal commun., 2008). The missing values were coded as M for uploading into DBHYDRO.

Summary: The peaks and declines in water-level data from well HES-7 generally coincide with peaks and declines in water-level data from nearby wells (HES-1, HES-4, and HES-9) drilled to similar depths (Appendix A). In addition, water levels in the target well decline as expected during periods of low rainfall, and increase as expected during periods of excessive rainfall recorded by nearby rain gages. Therefore, the time-series data from well HES-7 probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required, other than converting the data from NAVD 88 to NGVD 29.

Statistics	Original series	Revised series
Minimum (feet)	23.303	23.303
Mean (feet)	24.936	24.936
Median (feet)	24.756	24.756
Maximum (feet)	27.876	27.876
Standard deviation	1.002	1.002
Variance	1.004	1.004
Outliers	80	80
Missing values	27	27

Table 17 Summary statistics of original time-series data for Station 8: HES-7

3.9 Station 9: HES-8

HES-8 is an 87-ft deep well located in Hendry County (figs. 1 and 3). HES-8 is located at drill site 3 (HESDS3) on Crook's Ranch, which also includes HES-7. Rainfall at the site was briefly monitored with station HESDS3_R.

3.9.1 Site and data description

Variable	Original value	Revised value
Station	HES-8	HES-8
Source DBKEY		
MOD1 DBKEY		
Latitude	26 29 12.8	26 29 12.8
Longitude	81 05 37.8	81 05 37.8
X Coordinate	625472.53	625472.53
Y Coordinate	782650.1	782650.1
Land-surface elevation (feet) (NGVD 29)	28.525	28.525
Reference elevation (feet) (NGVD 29)	31.442	31.442
Measuring point (feet)	2.5	2.5
Well bottom elevation (feet) (NGVD 29)	-58.058	-58.058
Strata (feet)	87	87
Sensor elevation (feet) (NGVD 29)	11.272	11.272

Table 18 Site information obtained for Station 9: HES-8

Analysis: HES-8 is a monitoring well that taps the Lower Tamiami aquifer. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on June 30, 2005 (Scott, Jones, PE, Johnson-Prewitt and Associates, Inc., written commun.,, 2008). The land-surface elevation was not surveyed, but was calculated by subtracting the pad height (0.417 ft) from the benchmark elevation. A photograph of HES-8 and adjacent well HES-7 is shown in the discussion of HES-7. No revisions were necessary, other than converting elevations from NAVD 88 to NGVD 29.

3.9.2 Data analysis and revision

The period of record analyzed for well HES-8 extends from March 16, 2005 through October 20, 2007 (Appendix A). The time-series data from that period contain 949 observations with no outliers and 54 missing values. The summary statistics for this well are provided in table 19.

Problem: The time-series data from well HES-8 contain 54 missing values.

Analysis: Missing values occurred from October 8 through November 3, 2006, probably as a result of budgetary constraints at the start of a new fiscal year (Cindy Bevier, SFWMD, personal commun., 2008). Missing values also occurred from June 10 through July 6, 2007, possibly indicating equipment issues. However, nearby wells (HES-2, HES-5, and HES-15) are also missing values before, after, and (or) during the same period. The missing values were coded as M for uploading into DBHYDRO.

Summary: The peaks and declines in water-level data from well HES-8 closely coincide with peaks and declines in water-level data from nearby wells (HES-2, HES-5, and HES-15) drilled to similar depths (Appendix A). In addition, water levels in the target well generally decline during periods of low rainfall, and increase during periods of excessive rainfall recorded by nearby rain gages. Water levels in the target well also appear to be affected by other factors, such as the withdrawal of water from nearby production wells, as indicated by abrupt oscillations of the data, particularly during periods of low rainfall. The time-series data from well HES-8 appear to be valid data that accurately represent hydrologic conditions at the site. No revisions were required, other than converting the data from NAVD 88 to NGVD 29.

Statistics	Original series	Revised series
Minimum (feet)	17.308	17.308
Mean (feet)	23.590	23.590
Median (feet)	23.724	23.724
Maximum (feet)	27.313	27.313
Standard deviation	2.388	2.388
Variance	5.703	5.703
Outliers	0	0
Missing values	54	54

Table 19 Summary statistics of time-series data for Station 9: HES-8

3.10 **Station 10: HESDS3_R**

HESDS3_R is a rain station located in Hendry County (figs. 1 and 3). The station is located at drill site 3 (HESDS3) on Crook's Ranch, which also includes wells HES-7 and HES-8.

3.10.1 Site and data description

Variable	Original value	Revised value
Station	HESDS3_R	HESDS3_R
Source DBKEY		
MOD1 DBKEY		
Latitude	26 29 12.8	26 29 12.8
Longitude	81 05 37.8	81 05 37.8
X Coordinate	625472.53	625472.53
Y Coordinate	782650.1	782650.1

Table 20 Site information obtained for Station 10: HESDS3_R

3.10.2 Data analysis and revision

The period of record analyzed for station HESDS3_R extends from January 6 through October 26, 2007 (Appendix A). The time-series data contain 294 observations with 56 outliers and no missing values.

Problem: The time-series data from HESDS3_R contain 56 outliers, all of which exceed the upper fence of 0.273 inch.

Analysis: The median value for the time-series data is 0, which indicates that no precipitation occurred during at least half the period of record. Therefore, days with even moderate precipitation (greater than 0.27 inch) are statistical outliers. These outliers coincide with moderate to heavy rainfalls recorded at nearby stations. Hence, the outliers are valid data that accurately represent hydrologic conditions at the site.

Summary: The precipitation recorded at HESDS3_R coincides with precipitation data from nearby wells (ALICO_R, DEVILS_R, and HESDS5_R), particularly with excessive rainfall of 1 inch or more (Appendix A). In addition, periods of low rainfall also coincide with dry periods recorded at nearby stations. The time-series data from HESDS3_R probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	0.000	0.000
Mean (feet)	0.134	0.134
Median (feet)	0.000	0.000
Maximum (feet)	2.670	2.670
Standard deviation	0.371	0.371
Variance	0.138	0.138
Outliers	56	56
Missing values	0	0

Table 21 Summary statistics of time-series data for Station 10: HESDS3_R

3.11 Station 11: HES-9

HES-9 is a 14-ft deep well located in Hendry County (figs. 1 and 3). HES-9 is located at drill site 4 (HESDS4) on Crook's Ranch, which also includes well HES-10 and stilling well HES-11.

3.11.1 Site and data description

Variable	Original value	Revised value
Station	HES-9	HES-9
Source DBKEY		
MOD1 DBKEY		
Latitude	26 28 14	26 28 14
Longitude	81 06 10.9	81 06 10.9
X Coordinate	622468.79	622468.79
Y Coordinate	776542	776542
Land-surface elevation (feet) (NGVD 29)	27.545	27.545
Reference elevation (feet) (NGVD 29)	30.452	30.452
Measuring point (feet)	2.49	2.49
Well bottom elevation (feet) (NGVD 29)	13.962	13.962
Strata (feet)	14	14
Sensor elevation (feet) (NGVD 29)	17.232	17.232

Table 22 Site information obtained for Station 11: HES-9

Analysis: HES-9 is a shallow well that taps the surficial aquifer system. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on June 30, 2005 (Scott, Jones, PE, Johnson-Prewitt and Associates, Inc., written commun.,, 2008). The land-surface elevation was not surveyed, but was calculated by subtracting the pad height (0.417 ft) from the benchmark elevation. The maximum water level in the well is slightly higher than the land-surface elevation, indicating the site is periodically inundated. A photograph of HES-9 and adjacent well HES-10 (below) shows the site with standing water. No revisions were necessary, other than converting elevations from NAVD 88 to NGVD 29.

Stations HES-9 and HES-10

3.11.2 Data analysis and revision

The period of record analyzed for well HES-9 extends from March 16, 2005 through October 20, 2007 (Appendix A). The time-series data from that period contain 949 observations with no outliers and 27 missing values. The summary statistics for this well are provided in table 23.

Problem: The time-series data from well HES-9 contain 27 missing values.

Analysis: Missing values occurred from October 8 through November 3, 2006, probably as a result of budgetary constraints at the start of a new fiscal year (Cindy Bevier, SFWMD, personal commun., 2008). The missing values were coded as M for uploading into DBHYDRO.

Summary: The peaks and declines in water-level data from well HES-9 coincide with peaks and declines in water-level data from nearby wells (HES-1, HES-4, and HES-7) drilled to similar depths (Appendix A). In addition, water levels in the target well generally decline during periods of low rainfall, and increase during periods of excessive rainfall recorded by nearby rain gages. The time-series data from well HES-9 probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required, other than converting the data from NAVD 88 to NGVD 29.

Statistics	Original series	Revised series
Minimum (feet)	22.719	22.719
Mean (feet)	25.687	25.687
Median (feet)	26.005	26.005
Maximum (feet)	27.829	27.829
Standard deviation	1.390	1.390
Variance	1.932	1.932
Outliers	0	0
Missing values	27	27

Table 23 Summary statistics of time-series data for Station 11: HES-9

3.12 Station 12: HES-10

HES-10 is a 91-ft deep well located in Hendry County (figs. 1 and 3). HES-10 is located at drill site 4 (HESDS4) on Crook's Ranch, which also includes well HES-9 and stilling well HES-11.

3.12.1 Site and data description

Variable	Original value	Revised value
Station	HES-10	HES-10
Source DBKEY		
MOD1 DBKEY		
Latitude	26 28 14	26 28 14
Longitude	81 06 10.9	81 06 10.9
X Coordinate	622478.96	622478.96
Y Coordinate	776540.9	776540.9
Land-surface elevation (feet) (NGVD 29)	27.585	27.585
Reference elevation (feet) (NGVD 29)	30.482	30.482
Measuring point (feet)	2.48	2.48
Well bottom elevation (feet) (NGVD 29)	-62.998	-62.998
Strata (feet)	91	91
Sensor elevation (feet) (NGVD 29)	10.262	10.262

Table 24 Site information obtained for Station 12: HES-10

Analysis: HES-10 is a monitoring well that taps the Lower Tamiami aquifer. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on June 30, 2005 (Scott, Jones, PE, Johnson-Prewitt and Associates, Inc., written commun.,, 2008). The land-surface elevation was not surveyed, but was calculated by subtracting the pad height (0.417 ft)

from the benchmark elevation. A photograph of HES-10 and adjacent well HES-9 is shown in the discussion of HES-9. No revisions were necessary, other than converting elevations from NAVD 88 to NGVD 29.

3.12.2 Data analysis and revision

The period of record analyzed for well HES-10 extends from March 16, 2005 through October 20, 2007 (Appendix A). The time-series data from that period contain 949 observations with no outliers and 27 missing values. The summary statistics for this well are provided in table 25.

Problem: The time-series data from well HES-10 contain 27 missing values.

Analysis: Missing values occurred from October 8 through November 3, 2006, probably as a result of budgetary constraints at the start of a new fiscal year (Cindy Bevier, SFWMD, personal commun., 2008). The missing values were coded as M for uploading into DBHYDRO.

Summary: The peaks and declines in water-level data from well HES-10 closely coincide with peaks and declines in water-level data from nearby wells (HES-2, HES-8, and HES-13) drilled to similar depths (Appendix A). In addition, water levels in the target well generally decline during periods of low rainfall, and increase during periods of excessive rainfall recorded by nearby rain gages. Other factors, such as withdrawals from nearby productions wells, appears to be affecting water levels in the target well, as indicated by abrupt oscillations in the data, particularly during dry periods. Oscillations are present in water levels in nearby wells, so equipment malfunctions are not likely the cause. Therefore, the time-series data from well HES-10 probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required, other than converting the data from NAVD 88 to NGVD 29.

Statistics	Original series	Revised series
Minimum (feet)	16.435	16.435
Mean (feet)	22.731	22.731
Median (feet)	23.025	23.025
Maximum (feet)	26.938	26.938
Standard deviation	2.634	2.634
Variance	6.938	6.938
Outliers	0	0
Missing values	27	27

Table 25 Summary statistics of time-series data for Station 12: HES-10

3.13 Station 13: HES-11

HES-11 is a 5-ft deep stilling well located in Hendry County (figs. 1 and 3). HES-11 is located at drill site 4 (HESDS4) on Crook's Ranch. The drill site also includes wells HES-9 and HES-10.

3.13.1 Site and data description

Variable	Original value	Revised value
Station	HES-11	HES-11
Source DBKEY		
MOD1 DBKEY		
Latitude	26 28 13.8	26 28 13.8
Longitude	81 06 11.5	81 06 11.5
X Coordinate	622370	622370
Y Coordinate	775720	775720
Land-surface elevation (feet) (NGVD 29)	27.09	27.09
Reference elevation (feet) (NGVD 29)	30.592	30.592
Well bottom elevation (feet) (NGVD 29)	22.09	22.09
Strata (feet)	5	5
Sensor elevation (feet) (NGVD 29)	23.442	23.442

Table 26 Site information obtained for Station 13: HES-11

Analysis: HES-11 is a stilling well that monitors the water level in a wetland. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on June 30, 2005 (Scott, Jones, PE, Johnson-Prewitt and Associates, Inc., written commun.,, 2008). The median water level in the well is less than the land-surface elevation (calculated), which indicates the site was only seasonally inundated. A photograph of HES-11 is shown below. No revisions were necessary, other than converting elevations from NAVD 88 to NGVD 29.

Station HES-11

3.13.2 Data analysis and revision

The period of record analyzed for well HES-11 extends from March 16, 2005 through October 20, 2006 (Appendix A). The time-series data from that period contain 949 observations with no outliers and 27 missing values. The summary statistics for this well are provided in table 27.

Problem: The time-series data from well HES-11 contain 27 missing values.

Analysis: Missing values occurred from October 8 through November 3, 2006, probably as a result of budgetary constraints at the start of a new fiscal year (Cindy Bevier, SFWMD, personal commun., 2008). The missing values were coded as M for uploading into DBHYDRO.

Problem: The water-level data in the target well appear anomalously flat from March 20 through May 7, 2007.

Analysis: The water level in the target well appears to have declined below the level of the pressure transducer in the well, which would result in a flat, steady period of data. The pressure transducer is set at an elevation of 23.442 ft above mean sea level. The water level in the target well recorded during this period ranges from 23.18 to 23.26 ft above mean sea level. The daily values were coded with a less than sign (<) for uploading into DBHYDRO. For the preferred data set (MOD1), the suspect data were deleted and coded as M for uploading into DBHYDRO (figure 7).

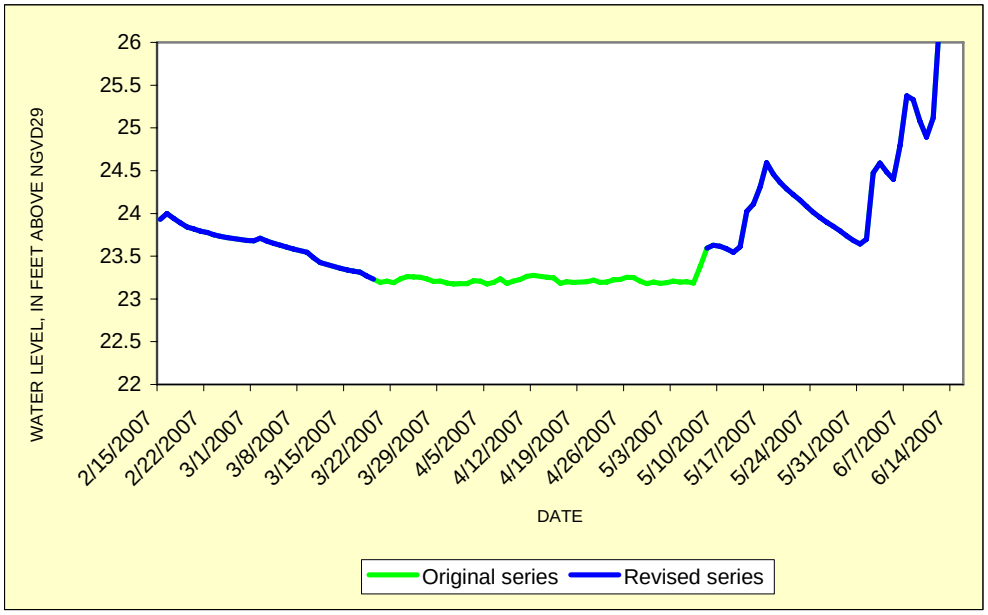


Figure 7 Water-level data from stilling well HES-11 (blue). The water levels from March 20 – May 7 (green) were below the sensor, so the data were deleted in the revised series.

Summary: The peaks and declines in water-level data from stilling well HES-11 generally coincide with peaks and declines in water-level data from nearby wells (HES-3, HES-6, and HES-16) drilled to similar depths (Appendix A). In addition, water levels in the target well decline as expected during periods of low rainfall, and increase as expected during periods of excessive rainfall recorded by nearby rain gages. Therefore, the time-series data from stilling well HES-11 probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required, other than deleting the suspect data that resulted from the water level declining below the elevation of the pressure transducer. The data also were converted from NAVD88 to NGVD29.

Statistics	Original series	Revised series
Minimum (feet)	23.176	23.223
Mean (feet)	25.799	25.944
Median (feet)	26.433	26.548
Maximum (feet)	27.900	27.900
Standard deviation	1.448	1.349
Variance	2.098	1.820
Outliers	0	0
Missing values	27	76

Table 27 Summary statistics of time-series data for Station 13: HES-11

3.14 Station 14: HES-12

HES-12 is a 31-ft deep well located in Hendry County (figs. 1 and 3). The well is located at drill site 5 (HSDS5) on Crook's Ranch. A second well, HES-13, and rain station HESDS5_R are also located at the same drill site.

3.14.1 Site and data description

Variable	Original value	Revised value
Station	HES-12	HES-12
Source DBKEY		
MOD1 DBKEY		
Latitude	26 27 34.3	26 27 34.3
Longitude	81 06 20.4	81 06 20.4
X Coordinate	621596.4	621596.4
Y Coordinate	772738.8	772738.8
Land-surface elevation (feet) (NGVD 29)	27.198	27.198
Reference elevation (feet) (NGVD 29)	30.315	30.315
Measuring point (feet)	2.7	2.7
Well bottom elevation (feet) (NGVD 29)	-3.385	-3.385
Strata (feet)	31	31
Sensor elevation (feet) (NGVD 29)	17.215	17.215

Table 28 Site information obtained for Station 14: HES-12

Analysis: HES-12 is a shallow well that taps the surficial aquifer system. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on June 30, 2005 (Scott, Jones, PE, Johnson-Prewitt and Associates, Inc., written commun.,, 2008). The land-surface elevation was not surveyed, but was calculated by subtracting the pad height (0.417 ft) from the benchmark elevation. The maximum water level in the well is slightly higher than the land-surface elevation, indicating the site is periodically inundated. A photograph of HES-12 and adjacent well HES-13 is shown below. No revisions were necessary, other than converting elevations from NAVD 88 to NGVD 29.

Stations HES-12 and HES-13

3.14.2 Data analysis and revision

The period of record analyzed for well HES-12 extends from March 16, 2005 through October 20, 2007 (Appendix A). The time-series data from that period contain 949 observations with no outliers and 45 missing values. The summary statistics for this well are provided in table 29.

Problem: The time-series data from well HES-12 contain 45 missing values.

Analysis: Missing values occurred from October 8 through November 3, 2006, probably as a result of budgetary constraints at the start of a new fiscal year (Cindy Bevier, SFWMD, personal commun., 2008). Missing values also occurred from July 31 through August 17, 2007. Data are available from nearby wells (HES-1, HES-7, and HES-9) during the same period, so the missing data from the target well possibly resulted from equipment malfunctions specific to that well. Missing values were coded as M for uploading into DBHYDRO.

Summary: The peaks and declines in water-level data from well HES-12 coincide with peaks and declines in water-level data from nearby wells (HES-1, HES-7, and HES-9) drilled to similar depths (Appendix A). In addition, water levels in the target well decline as expected during periods of low rainfall, and increase as expected during periods of excessive rainfall recorded by nearby rain gages. Therefore, the time-series data from well HES-12 probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	22.312	22.312
Mean (feet)	24.139	24.139
Median (feet)	23.870	23.870
Maximum (feet)	27.409	27.409
Standard deviation	1.168	1.168
Variance	1.365	1.365
Outliers	0	0
Missing values	45	45

Table 29 Summary statistics of time-series data for Station 14: HES-12

3.15 Station 15: HES-13

HES-13 is an 88-ft deep well located in Hendry County (figs. 1 and 3). HES-13 is located at Crook's Ranch drill site 5 (HESDS5), along with adjacent well HES-12 and rain station HESDS5_R.

3.15.1 Site and data description

Variable	Original value	Revised value
Station	HES-13	HES-13
Source DBKEY		
MOD1 DBKEY		
Latitude	26 27 34.3	26 27 34.3
Longitude	81 06 20.4	81 06 20.4
X Coordinate	621585	621585
Y Coordinate	772740	772740
Land-surface elevation (feet) (NGVD 29)	27.318	27.318
Reference elevation (feet) (NGVD 29)	30.325	30.325
Measuring point (feet)	2.59	2.59
Well bottom elevation (feet) (NGVD 29)	-60.265	-60.265
Strata (feet)	88	88
Sensor elevation (feet) (NGVD 29)	10.005	10.005

Table 30 Site information obtained for Station 15: HES-13

Analysis: HES-13 is a monitoring well that taps the Lower Tamiami aquifer. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on June 30, 2005 (Scott, Jones, PE, Johnson-Prewitt and Associates, Inc., written commun.,, 2008). The land-surface elevation was not surveyed, but was calculated by subtracting the pad height (0.417 ft)

from the benchmark elevation. A photograph of HES-13 and adjacent well HES-12 is shown in the discussion of HES-12. No revisions were necessary, other than converting elevations from NAVD 88 to NGVD 29.

3.15.2 Data analysis and revision

The period of record analyzed for well HES-13 extends from March 16, 2005 through September 8, 2007 (Appendix A). The time-series data from that period contain 907 observations with no outliers and 38 missing values. The summary statistics for this well are provided in table 31.

Problem: The time-series data from well HES-13 contain 38 missing values.

Analysis: Missing values occurred from October 8 through November 3, 2006, probably as a result of budgetary constraints at the start of a new fiscal year. Missing values also occurred from August 7 – 17, 2007. Data were available from nearby wells (HES-2, HES-8, and HES-10) during the same period, so the missing data from the target well probably resulted from equipment malfunction at that specific well. Missing values were coded as M for uploading into DBHYDRO.

Summary: The peaks and declines in water-level data from well HES-13 closely coincide with peaks and declines in water-level data from nearby wells (HES-2, HES-8, and HES-10) drilled to similar depths (Appendix A). In addition, water levels in the target well decline during periods of low rainfall, and increase during periods of excessive rainfall recorded by nearby rain gages. Other factors, such as withdrawals from nearby production wells, also appear to be affecting water levels in the target well, as indicated by oscillations in the data, particularly during dry periods. Therefore, the time-series data from well HES-13 probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required, other than converting the data from NAVD88 to NGVD29.

Statistics	Original series	Revised series
Minimum (feet)	15.444	15.444
Mean (feet)	21.890	21.890
Median (feet)	22.231	22.231
Maximum (feet)	25.828	25.828
Standard deviation	2.445	2.445
Variance	5.980	5.980
Outliers	0	0
Missing values	38	38

Table 31 Summary statistics of time-series data for Station 15: HES-13

3.16 Station 16: HESDS5_R

HESDS5_R is a rain station located in Hendry County (figs. 1 and 3). HESDS5_R is located at Crook's Ranch drill site 5 (HESDS5), along with adjacent wells HES-12 and HES-13.

3.16.1 Site and data description

Variable	Original value	Revised value
Station	HESDS5_R	HESDS5_R
Source DBKEY		
MOD1 DBKEY		
Latitude	26 27 34.3	26 27 34.3
Longitude	81 06 20.4	81 06 20.4
X Coordinate	621585	621585
Y Coordinate	772740	772740

Table 32 Site information obtained for Station 16: HESDS5_R

3.16.2 Data analysis and revision

The period of record analyzed for well HESDS5_R extends from January 6 through October 26, 2007 (Appendix A). The time-series data contain 294 observations with 55 outliers and no missing values.

Problem: The time-series data from HESDS5_R contain 55 outliers, all of which exceed the upper fence of 0.283 inch.

Analysis: The median value for the time-series data is 0, which indicates that no precipitation occurred during at least half the period of record. Therefore, days with even moderate precipitation (greater than 0.28 inch) are statistical outliers. These outliers coincide with moderate to heavy rainfalls recorded at nearby stations. Hence, the outliers are valid data that accurately represent hydrologic conditions at the site.

Summary: The precipitation recorded at HESDS5_R coincides with precipitation data from nearby wells (ALICO_R, DEVILS_R, and HESDS3_R), particularly with excessive rainfall of 1 inch or more (Appendix A). In addition, periods of low rainfall also coincide with dry periods recorded at nearby stations. The time-series data from HESDS5_R probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	0.000	0.000
Mean (feet)	0.135	0.135
Median (feet)	0.000	0.000
Maximum (feet)	2.530	2.530
Standard deviation	0.343	0.343
Variance	0.117	0.117
Outliers	55	55
Missing values	0	0

Table 33 Summary statistics of time-series data for Station 16: HESDS5_R

3.17 Station 17: HES-14

HES-14 is a 20-ft deep well located in Hendry County (figs. 1 and 3). HES-14 is located Golden Ox Ranch drill site 6 (HESDS6), along with adjacent well HES-15, and stilling well HES-16.

3.17.1 Site and data description

Variable	Original value	Revised value
Station	HES-14	HES-14
Source DBKEY		
MOD1 DBKEY		
Latitude	26 30 12.5	26 30 12.5
Longitude	81 07 06.4	81 07 06.4
X Coordinate	617286.36	617286.36
Y Coordinate	788221.2	788221.2
Land-surface elevation (feet) (NGVD 29)	25.388	25.388
Reference elevation (feet) (NGVD 29)	28.355	28.355
Measuring point (feet)	2.55	2.55
Well bottom elevation (feet) (NGVD 29)	5.805	5.805
Strata (feet)	20	20
Sensor elevation (feet) (NGVD 29)	15.23	15.23

Table 34 Site information obtained for Station 17: HES-14

Analysis: HES-14 is a shallow well that taps the surficial aquifer system. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on June 30, 2005 (Scott, Jones, PE, Johnson-Prewitt and Associates, Inc., written commun.,, 2008). The land-surface elevation was not surveyed, but was calculated by subtracting the pad height (0.417 ft) from the benchmark elevation. The maximum water level in the well is higher than the land-surface elevation, indicating the site is periodically inundated. A photograph of HES-14 and adjacent well HES-15 (below) shows the site inundated with water. No revisions were necessary, other than converting elevations from NAVD 88 to NGVD 29.

Stations HES-14 and HES-15

3.17.2 Data analysis and revision

The period of record analyzed for well HES-14 extends from March 16, 2005 through October 20, 2007 (Appendix A). The time-series data from that period contain 949 observations with no outliers and 27 missing values. The summary statistics for this well are provided in table 35.

Problem: The time-series data from well HES-14 contain 27 missing values.

Analysis: Missing values occurred from October 8 through November 3, 2006, probably as a result of budgetary constraints at the start of a new fiscal year (Cindy Bevier, SFWMD, personal commun., 2008). Missing values were coded as M for uploading into DBHYDRO.

Summary: The peaks and declines in water-level data from well HES-14 roughly coincide with peaks and declines in water-level data from nearby wells (HES-1, HES-4, and HES-17) drilled to similar depths (Appendix A). In addition, water levels in the target well generally decline during periods of low rainfall, and increase during periods of excessive rainfall recorded by nearby rain gages. Short-term oscillations in the water levels from the target well could indicate effects of withdrawals from nearby production wells. The time-series data from well HES-14 probably are valid data that accurately represent hydrologic conditions at the site. No other revisions were required, other than converting the time-series data from NAVD88 to NGVD29.

Statistics	Original series	Revised series
Minimum (feet)	19.720	19.720
Mean (feet)	23.131	23.131
Median (feet)	23.170	23.170
Maximum (feet)	26.184	26.184
Standard deviation	1.834	1.834
Variance	3.365	3.365
Outliers	0	0
Missing values	27	27

Table 35 Summary statistics of time-series data for Station 17: HES-14

3.18 Station 18: HES-15

HES-15 is a 71-ft deep well located in Hendry County (figs. 1 and 3). HES-15 is located at the Golden Ox Ranch drill site 6 (HESDS6), which also includes well HES-14 and stilling well HES-16.

3.18.1 Site and data description

Variable	Original value	Revised value
Station	HES-15	HES-15
Source DBKEY		
MOD1 DBKEY		
Latitude	26 30 12.5	26 30 12.5
Longitude	81 07 06.4	81 07 06.4
X Coordinate	617288.17	617288.17
Y Coordinate	788231.5	788231.5
Land-surface elevation (feet) (NGVD 29)	25.428	25.428
Reference elevation (feet) (NGVD 29)	28.475	28.475
Measuring point (feet)	2.63	2.63
Well bottom elevation (feet) (NGVD 29)	-45.155	-45.155
Strata (feet)	71	71
Sensor elevation (feet) (NGVD 29)	8.15	8.15

Table 36 Site information obtained for Station 18: HES-15

Analysis: HES-15 is a monitoring well that taps the Lower Tamiami aquifer. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on June 30, 2005 (Scott, Jones, PE, Johnson-Prewitt and Associates, Inc., written commun.,, 2008). The land-surface elevation was not surveyed, but was calculated by subtracting the pad height (0.417 ft)

from the benchmark elevation. A photograph of HES-15 and adjacent well HES-14 is shown in the discussion of HES-14. No revisions were necessary, other than converting elevations from NAVD 88 to NGVD 29.

3.18.2 Data analysis and revision

The period of record analyzed for well HES-15 extends from March 16, 2005 through October 20, 2007 (Appendix A). The time-series data from that period contain 949 observations with no outliers and 70 missing values. The summary statistics for this well are provided in table 37.

Problem: The time-series data from well HES-15 contain 70 missing values.

Analysis: Missing values occurred from October 8 through November 3, 2006, probably as a result of budgetary constraints at the start of a new fiscal year (Cindy Bevier, SFWMD, personal commun., 2008). Missing values also occurred from March 11 through April 6, 2007, and from May 24 through June 8, 2007. These gaps probably result from equipment malfunctions. Well HES-2 also was missing data from the latter period, but the overlapping gaps could be a coincidence. Missing values were coded as M for uploading into DBHYDRO.

Summary: The peaks and declines in water-level data from well HES-15 coincide with peaks and declines in water-level data from nearby wells (HES-2, HES-5, and HES-15) drilled to similar depths (Appendix A). In addition, water levels in the target well decline during periods of low rainfall, and increase during periods of excessive rainfall recorded by nearby rain gages. Short-term oscillations indicate that the water level in the target well could be affected by other factors, such as withdrawals from nearby production wells. The time-series data from well HES-15 probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required, other than converting the time-series data from NAVD88 to NGVD29.

Statistics	Original series	Revised series
Minimum (feet)	18.888	18.888
Mean (feet)	23.101	23.101
Median (feet)	23.152	23.152
Maximum (feet)	26.125	26.125
Standard deviation	1.818	1.818
Variance	3.305	3.305
Outliers	0	0
Missing values	70	70

Table 37 Summary statistics of time-series data for Station 18: HES-15

3.19 Station 19: HES-16

HES-16 is a 5-ft deep stilling well located in Hendry County (figs. 1 and 3). HES-16 is located at the Golden Ox Ranch drill site 6 (HESDS6), which also includes well HES-14 and HES-15.

3.19.1 Site and data description

Variable	Original value	Revised value
Station	HES-16	HES-16
Source DBKEY		
MOD1 DBKEY		
Latitude	26 30 14.4	26 30 14.4
Longitude	81 07 03.2	81 07 03.2
X Coordinate	617450	617450
Y Coordinate	788485	788485
Land-surface elevation (feet) (NGVD 29)	26.38	26.38
Reference elevation (feet) (NGVD 29)	29.875	29.875
Well bottom elevation (feet) (NGVD 29)	21.38	21.38
Strata (feet)	5	5
Sensor elevation (feet) (NGVD 29)	22.745	22.745

Table 38 Site information obtained for Station 19: HES-16

Analysis: HES-16 is a stilling well that monitors the water level in a wetland. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on July 1, 2005 (Scott, Jones, PE, Johnson-Prewitt and Associates, Inc., written commun.,, 2008). The median water level in the well is less than the land-surface elevation (calculated), which indicates the site was only seasonally inundated. A photograph of HES-16 is shown below. No revisions were necessary, other than converting elevations from NAVD 88 to NGVD 29.

Station HES-16

3.19.2 Data analysis and revision

The period of record analyzed for well HES-16 extends from March 16, 2005 through October 20, 2007 (Appendix A). The time-series data from that period contain 949 observations with no outliers and 27 missing values. The summary statistics for this well are provided in table 39.

Problem: The time-series data from well HES-16 contain 27 missing values.

Analysis: Missing values occurred from October 8 through November 3, 2006, probably as a result of budgetary constraints at the start of a new fiscal year (Cindy Bevier, SFWMD, personal commun., 2008). The missing values were coded as M for uploading into DBHYDRO.

Problem: The time-series data from well HES-16 contain two periods of anomalously flat data.

Analysis: The anomalous data occurred from May 4 through July 20, 2006, and from February 28 through June 10, 2007, during periods of low rain fall. The water level in the stilling well appears to have declined below the elevation of the pressure transducer. The water level during these two periods averaged about 21.6 ft above mean sea level (fig. 8), which is less than the listed elevation of 22.745 ft for the pressure transducer. The suspect data were coded with less than signs (<) for the standard data set, and deleted from the preferred data set (MOD1). The missing values were coded as M for uploading into DBHYDRO.

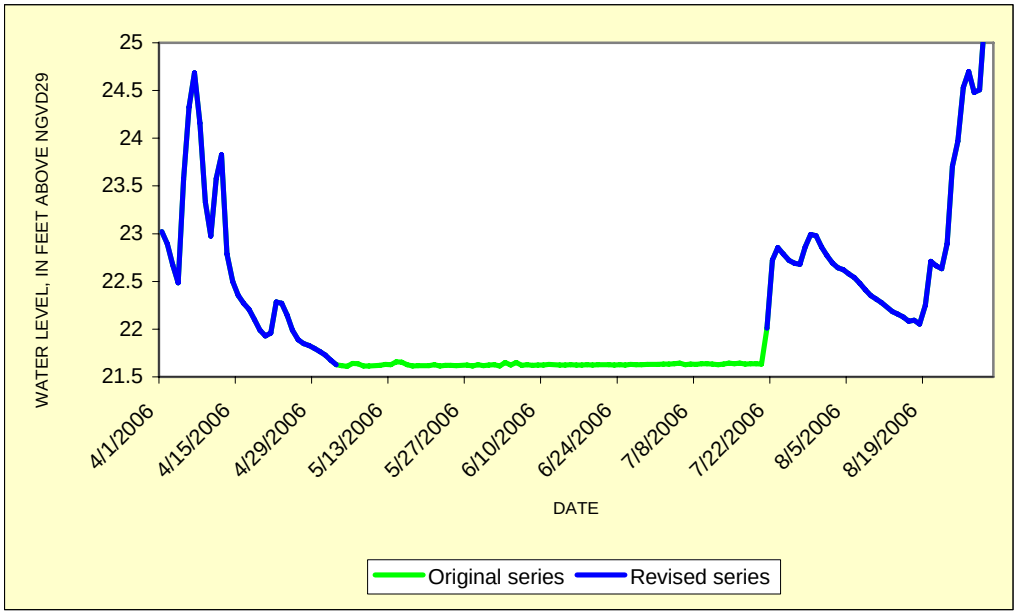


Figure 8 Water-level data from target well (blue) contained anomalously flat periods, which resulted from the water level declining below the pressure transducer. The suspect data (green) were deleted for the preferred data set.

Summary: The peaks and declines in water-level data from stilling well HES-16 roughly coincide with peaks and declines in water-level data from nearby wells (HES-3, HES-6, and HES-19) drilled to similar depths (Appendix A). In addition, water levels in the target well generally decline during periods of low rainfall, and increase during periods of excessive rainfall recorded by nearby rain gages. The time-series data from stilling well HES-16 probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required, other than deleting the suspect data resulting from declining water levels. The time-series data also were converted from NAVD88 to NGVD29.

Statistics	Original series	Revised series
Minimum (feet)	21.608	21.624
Mean (feet)	23.822	24.355
Median (feet)	23.795	24.719
Maximum (feet)	26.401	26.401
Standard deviation	1.652	1.396
Variance	2.729	1.949
Outliers	0	0
Missing values	27	208

Table 39 Summary statistics of time-series data for Station 19: HES-16

3.20 Station 20: HES-17

HES-17 is a 10-ft deep well located in Hendry County (figs. 1 and 3). The well is located at the Golden Ox Ranch drill site 7 (HESDS7), which also includes well HES-18, stilling well HES-19, and rain station HESDS7_R.

3.20.1 Site and data description

Variable	Original value	Revised value
Station	HES-17	HES-17
Source DBKEY		
MOD1 DBKEY		
Latitude	26 30 43.6	26 30 43.6
Longitude	81 07 15.6	81 07 15.6
X Coordinate	616570	616570
Y Coordinate	791845	791845
Land-surface elevation (feet) (NGVD 29)	30.935	30.935
Reference elevation (feet) (NGVD 29)	33.932	33.932
Measuring point (feet)	2.58	2.58
Well bottom elevation (feet) (NGVD 29)	21.352	21.352
Strata (feet)	10	10
Sensor elevation (feet) (NGVD 29)	22.732	22.732

Table 40 Site information obtained for Station 20: HES-17

Analysis: HES-17 is a shallow well that taps the surficial aquifer system. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on June 30, 2005 (Scott, Jones, PE, Johnson-Prewitt and Associates, Inc., written commun.,, 2008). The land-surface elevation was not surveyed, but was calculated by subtracting the pad height (0.417 ft) from the benchmark elevation. A photograph of HES-17 and adjacent well HES-18 is shown below. No revisions were necessary, other than converting elevations from NAVD 88 to NGVD 29.

Stations HES-17 and HES-18

3.20.2 Data analysis and revision

The period of record analyzed for well HES-17 extends from March 16, 2005 to June 9, 2007 (Appendix A). The time-series data for that period contain 816 observations with 89 outliers and 50 missing values. The summary statistics for well HES-17 are provided in table 41.

Problem: The time-series data from well HES-17 contain 50 missing values.

Analysis: Missing values occurred from August 17 through September 8, 2006, and from October 8 through November 3, 2006. The first gap probably resulted from equipment malfunction, as data were available from nearby wells (HES-1, HES-4, and HES-14). The latter gap probably resulted from budgetary constraints at the start of a new fiscal year (Cindy Bevier, SFWMD, personal commun., 2008). Missing values were coded as M for uploading into DBHYDRO.

Problem: The time-series data from well HES-17 contain 89 outliers, most of which were less than the lower fence.

Analysis: Outliers less than the lower fence of 26.351 ft above mean sea level occurred from May 10 through July 21, 2006 (fig. 9) and from May 1 – 7, 2007. These declines in water levels in the target well coincide dry periods and with similar declines in nearby wells, particularly HES-14, and therefore probably are valid data.

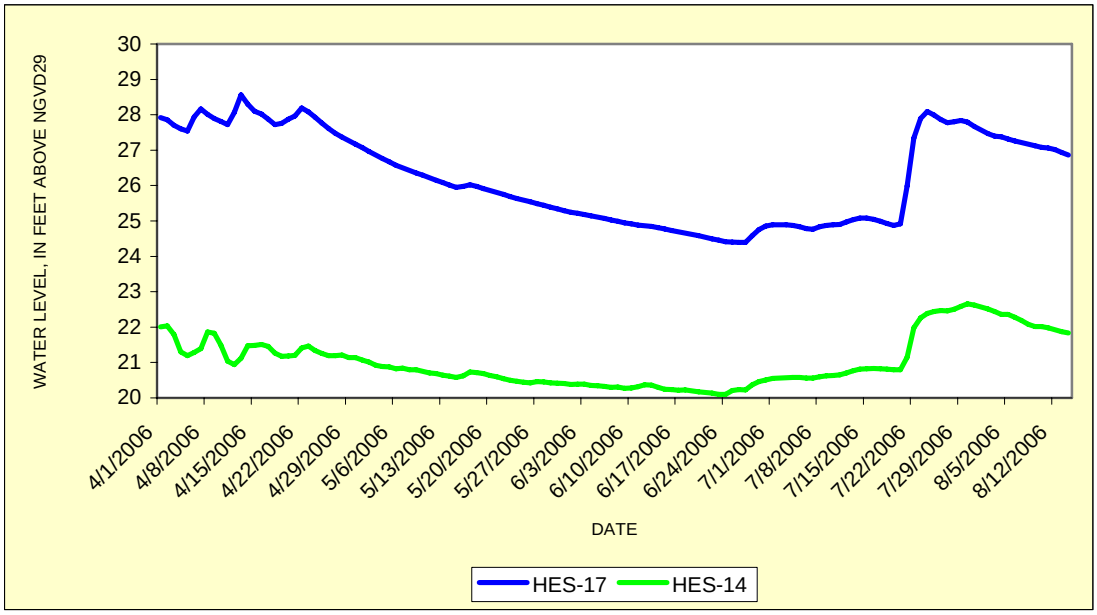


Figure 9 Water level data from target well (blue) contained lower outliers from May 10 through July 31 that coincide with water-level declines in a nearby well HES-14 (green).

Outliers that exceeded the upper fence of 29.995 ft above mean sea level occurred from July 9 – 15, 2005, after excessive (greater than 1 inch) rainfalls on July 8, 9 and 12 resulted in a rapid increase in water level in the target well. This peak in the water level in the target well coincided with similar peaks in nearby wells (HES-1 and HES-4). The outliers probably are valid data that accurately represent hydrologic conditions at the site.

Summary: The peaks and declines in water-level data from well HES-17 roughly coincide with peaks and declines in water-level data from nearby wells (HES-1, HES-4, and HES-14) drilled to similar depths (Appendix A). In addition, water levels in the target well decline during periods of low rainfall, and increase during periods of excessive rainfall recorded by nearby rain gages. The time-series data from well HES-17 probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required, other than converting the data from NAVD 88 to NGVD 29.

Statistics	Original series	Revised series
Minimum (feet)	24.393	24.393
Mean (feet)	27.967	27.967
Median (feet)	28.281	28.281
Maximum (feet)	30.331	30.331
Standard deviation	1.163	1.163
Variance	1.353	1.353
Outliers	89	89
Missing values	50	50

Table 41 Summary statistics of time-series data for Station 17: HES-17

3.21 Station 21: HES-18

HES-18 is a 56-ft deep well located in Hendry County (figs. 1 and 3). HES-18 is located at Golden Ox Ranch drill site 7 (HESDS7), which also includes well HES-17, stilling well HES-19, and rain station HESDS7_R.

3.21.1 Site and data description

Variable	Original value	Revised value
Station	HES-18	HES-18
Source DBKEY		
MOD1 DBKEY		
Latitude	26 3043.6	26 3043.6
Longitude	81 07 15.6	81 07 15.6
X Coordinate	616570	616570
Y Coordinate	791855	791855
Land-surface elevation (feet) (NGVD 29)	30.205	30.205
Reference elevation (feet) (NGVD 29)	33.352	33.352
Measuring point (feet)	2.73	2.73
Well bottom elevation (feet) (NGVD 29)	-25.378	-25.378
Strata (feet)	56	56
Sensor elevation (feet) (NGVD 29)	13.012	13.012

Table 42 Site information obtained for Station 21: HES-18

Analysis: HES-18 is a monitoring well that taps the Lower Tamiami aquifer. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on June 30, 2005 (Scott, Jones, PE, Johnson-Prewitt and Associates, Inc., written commun.,, 2008). The land-surface elevation was not surveyed, but was calculated by subtracting the pad height (0.417 ft) from the benchmark elevation. A photograph of HES-18 and adjacent well HES-17 is shown in the discussion of HES-17. No revisions were necessary, other than converting elevations from NAVD 88 to NGVD 29.

3.21.2 Data analysis and revision

The period of record analyzed for well HES-18 extends from March 16, 2005 through October 20, 2007 (Appendix A). The time-series data for that period contain 949 observations with no outliers and 27 missing values. The summary statistics for well HES-18 are provided in table 43.

Problem: The time-series data from well HES-18 contain 27 missing values.

Analysis: Missing values occurred from October 8 through November 3, 2006, and probably result from budgetary constraints at the start of a new fiscal year. Missing values were coded as M for uploading into DBHYDRO.

Summary: The peaks and declines in water-level data from well HES-18 coincide with peaks and declines in water-level data from nearby wells (HES-2, HES-5, and HES-15) drilled to similar depths (Appendix A). Water levels in the target well generally decline during periods of low rainfall, and increase during periods of excessive rainfall recorded by nearby rain gages. Other factors, such as withdrawals from nearby production wells, probably also affect water levels in the target well, as indicated by the short-term fluctuations in data, particularly during dry periods. The time-series data from well HES-18 probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required, other than converting the data from NAVD 88 to NGVD 29.

Statistics	Original series	Revised series
Minimum (feet)	21.293	21.293
Mean (feet)	26.557	26.557
Median (feet)	26.612	26.612
Maximum (feet)	29.905	29.905
Standard deviation	1.865	1.865
Variance	3.476	3.476
Outliers	0	0
Missing values	27	27

Table 43 Summary statistics of time-series data for Station 21: HES-18

3.22 Station 22: HES-19

HES-19 is a 5-ft deep well located in Hendry County (figs. 1 and 3). HES-19 is located at Golden Ox Ranch drill site 7 (HESDS7), which also includes wells HES-17 and HES-18, and rain station HESDS7_R.

3.22.1 Site and data description

Variable	Original value	Revised value
Station	HES-19	HES-19
Source DBKEY		
MOD1 DBKEY		
Latitude	26 30 43.6	26 30 43.6
Longitude	81 07 15.6	81 07 15.6
X Coordinate	616530	616530
Y Coordinate	792000	792000
Land-surface elevation (feet) (NGVD 29)	30.11	30.11
Reference elevation (feet) (NGVD 29)	33.612	33.612
Well bottom elevation (feet) (NGVD 29)	25.11	25.11
Strata (feet)	5	5
Sensor elevation (feet) (NGVD 29)	26.472	26.472

Table 44 Site information obtained for Station 22: HES-19

Analysis: HES-19 is a stilling well that monitors the water level in a wetland. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on June 30, 2005 (Scott, Jones, PE, Johnson-Prewitt and Associates, Inc., written commun.,, 2008). The median water level in the well is less than the land-surface elevation (calculated), which indicates the site was only seasonally inundated. A photograph of HES-19 is shown below. No revisions were necessary, other than converting elevations from NAVD 88 to NGVD 29.

Station HES-19

3.22.2 Data analysis and revision

The period of record analyzed for well HES-19 extends from March 16, 2005 through October 20, 2007 (Appendix A). The time-series data for that period contain 949 observations with 1 outlier and 27 missing values. The summary statistics for well HES-19 are provided in table 45.

Problem: The time-series data from HES-19 contain 1 outlier.

Analysis: The single outlier occurred near the end of the wet season on September 25, 2007, and exceeded the upper fence of 31.67 ft above mean sea level. The outlier also coincided with similar peaks in nearby stilling wells (HES-3, HES-6, and HES-16). Hence, the outlier probably is a valid data point that accurately represents hydrologic conditions at the site.

Problem: The time-series data for well HES-19 contain 27 missing values.

Analysis: Missing values occurred from October 8 through November 3, 2006, and probably results from budgetary constraints at the start of a new fiscal year (Cindy Bevier, SFWMD, personal commun., 2008). Missing values were coded as M for uploading into DBHYDRO.

Problem: The time-series data from well HES-19 contain four periods of anomalously flat data.

Analysis: The anomalous data occurred from May 9 through July 22, 2006, August 9 – 19, 2006 (fig. 10), April 21 through May 14, 2007, and from May 24 through June 10, 2007, during periods of low rain fall. The water level in the stilling well appears to have declined below the elevation of the pressure transducer. The water level during these periods averaged less than 26.4 ft above mean sea level, which is less than the listed elevation of 26.472 ft for the pressure transducer. The suspect data were coded with less than signs (<) for the standard data set, and deleted from the preferred data set (MOD1). The missing values were coded as M for uploading into DBHYDRO.

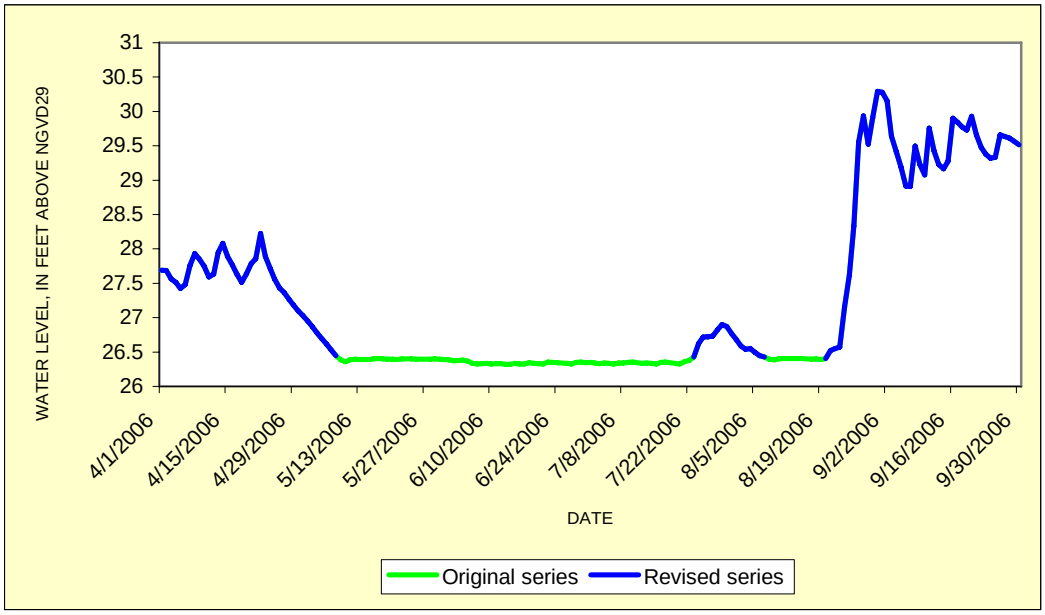


Figure 10 Water-level data from target well (blue) contained anomalously flat periods, which resulted from the water level declining below the pressure transducer. The suspect data (green) were deleted for the preferred data set.

Summary: The peaks and declines in water-level data from stilling well HES-19 roughly coincide with peaks and declines in water-level data from nearby wells (HES-3, HES-6, and HES-16) drilled to similar depths (Appendix A). In addition, water levels in the target well generally decline during periods of low rainfall, and increase during periods of excessive rainfall recorded by nearby rain gages. The time-series data from stilling well HES-19 probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required, other than deleting anomalous data from dry periods. The time-series data also were converted from NAVD88 to NGVD29.

Statistics	Original series	Revised series
Minimum (feet)	26.305	26.318
Mean (feet)	28.212	28.515
Median (feet)	28.185	28.385
Maximum (feet)	31.690	31.690
Standard deviation	1.245	1.072
Variance	1.551	1.149
Outliers	1	8
Missing values	27	156

Table 45 Summary statistics of time-series data for Station 22: HES-19

3.23 Station 23: HESDS7_R

HESDS7_R is a rain station located in Hendry County (figs. 1 and 3). HESDS7_R is located at Golden Ox Ranch drill site 7 (HESDS7), which also includes wells HES-17 and HES-18, and stilling well HES-19.

3.23.1 Site and data description

Variable	Original value	Revised value
Station	HESDS7_R	HES-18
Source DBKEY		
MOD1 DBKEY		
Latitude	26 3043.6	26 3043.6
Longitude	81 07 15.6	81 07 15.6
X Coordinate	616570	616570
Y Coordinate	791855	791855

Table 46 Site information obtained for Station 23: HESDS7_R

3.23.2 Data analysis and revision

The period of record analyzed for station HESDS7_R extends from January 6 through August 18, 2007 (Appendix A). The time-series data contain 225 observations with 44 outliers and no missing values.

Problem: The time-series data from HESDS7_R contain 44 outliers, all of which exceeded the upper fence of 0.253 inch.

Analysis: The median value for the time-series data is 0, which indicates that no precipitation occurred during at least half the period of record. Therefore, days with even moderate precipitation (greater than 0.25 inch) are statistical outliers. These outliers coincide with moderate to heavy rainfalls recorded at nearby stations. Hence, the outliers are valid data that accurately represent hydrologic conditions at the site.

Summary: The precipitation recorded at HESDS7_R coincides with precipitation data from nearby wells (ALICO_R, DEVILS_R, and HESDS3_R), particularly with excessive rainfall of 1 inch or more (Appendix A). In addition, periods of low rainfall also coincide with dry periods recorded at nearby stations. The time-series data from HESDS7_R probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	0.000	0.000
Mean (feet)	0.106	0.106
Median (feet)	0.000	0.000
Maximum (feet)	1.770	1.770
Standard deviation	0.290	0.290
Variance	0.084	0.084
Outliers	44	44
Missing values	0	0

Table 47 Summary statistics of time-series data for Station 23: HESDS7_R

3.24 Station 24: E1BOYNTON

E1BOYNTON is a stilling well located on the E1 Canal at Boynton Beach Blvd in Palm Beach County (figs. 1 and 4).

3.24.1 Site and data description

Variable	Original value	Revised value
Station	E1BOYNTON	E1BOYNTON
DBKEY		
MOD1 DBKEY		
Latitude	26 32 33	26 32 33
Longitude	80 12 19	80 12 19
X Coordinate	919060.76	919060.76
Y Coordinate	803869.1	803869.1
Land-surface elevation (feet) (NGVD 29)	19	19
Benchmark elevation (feet) (NGVD 29)	20.933	20.933
Reference elevation (feet) (NGVD 29)	20.126	20.126

Table 48 Site information obtained for Station 24: E1BOYNTON

Analysis: E1BOYNTON is a stilling well that monitors the stage on the E-1 Canal. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on or before June 29, 2005 (survey notes from Mark Hummel, PSM). A photograph of the station is shown below. No revisions were necessary.

Station 20: E1BOYNTON

3.24.2 Data analysis and revision

The period of record analyzed for well E1BOYNTON extends from May 12, 2005 through October 10, 2006 (Appendix A). The time-series data for that period contain 517 observations with 33 outliers and no missing values. The summary statistics for well E1BOYNTON are provided in table 49.

Problem: The time-series data for well E1BOYNTON contain 33 outliers.

Analysis: A total of 21 values exceed the upper fence of 16.512 ft above mean sea level. These outliers, which occurred from May 27 through July 4, 2005, coincide with the start of the wet season, and a period of heavy rainfall. The outliers also coincide with peaks recorded at nearby stilling wells (E1LW and E1PIONEER) also located on the E1 Canal (Appendix A). The remaining 12 outliers, which are less than the lower fence of 14.816 ft above mean sea level, occurred on July 9 and 10, August 25 and 26, October 20 - 25, 2006, and August 29 and 30, 2006. These lower outliers, which represent sudden declines in the stage of the canal, coincide closely with stage data from nearby stations E1LW and E1PIONEER. Hence, all of the outliers appear to be valid data that accurately represent stage conditions on the E1 canal during these periods.

Summary: The stage data from stilling well E1BOYNTON closely coincide with stage data from nearby stilling wells (E1LW and E1PIONEER) that also monitor the E1 Canal (Appendix A). Stage data from E1BOYNTON respond moderately to rainfall, but also appear to be affected by other factors such as the control of structures on the canal. The time-series data from well E1BOYNTON probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	13.515	13.515
Mean (feet)	15.667	15.667
Median (feet)	15.556	15.556
Maximum (feet)	17.456	17.456
Standard deviation	0.464	0.464
Variance	0.215	0.215
Outliers	33	33
Missing values	0	0

Table 49 Summary statistics of time-series data for Station 24: E1BOYNTON

3.25 Station 25: E1LW

E1LW is a stilling well located on the E1 Canal at Lake Worth Road and U.S. 441 in Palm Beach County (figs. 1 and 4).

3.25.1 Site and data description

Variable	Original value	Revised value
Station	E1LW	E1LW
DBKEY		
MOD1 DBKEY		
Latitude	26 37 01	26 37 01
Longitude	80 12 15	80 12 15
X Coordinate	916227.88	916227.88
Y Coordinate	830941.7	830941.7
Land-surface elevation (feet) (NGVD 29)	20.5	20.5
Benchmark elevation (feet) (NGVD 29)	21.58	21.58
Reference elevation (feet) (NGVD 29)	21.177	21.177

Table 50 Site information obtained for Station 25: E1LW

Analysis: E1LW is a stilling well that monitors the stage on the E-1 Canal. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on or before June 29, 2005 (survey notes from Mark Hummel, PSM). A photograph of the station (see below) shows the stilling well on a concrete wall alongside a bridge. No revisions were necessary.

Station 21: E1LW

3.25.2 Data analysis and revision

The period of record analyzed for stilling well E1LW extends from May 12, 2005 through May 11, 2008 (Appendix A). The time-series data for that period contain 1,096 observations with 59 outliers and no missing values. The summary statistics for stilling well E1LW are provided in table 51.

Problem: The time-series data from station E1LW contain 59 outliers, all of which were less than the lower fence of 14.935 ft above mean sea level.

Analysis: The outliers occurred sporadically throughout the period of record including July, August, and October 2005, and May 2007. These outliers coincide with declines in stage recorded at nearby stations (E1BOYNTON, E1PIONEER, and E1E2LYONS) on the E1 Canal. Because the declines are recorded simultaneously at several stations, the declines probably result from operation of structures or some similar management activity. Hence, the outliers probably are valid data that accurately represent hydrologic conditions at the site.

Summary: The stage data from stilling well E1LW closely coincide with stage data from nearby stilling wells (E1BOYNTON, E1PIONEER, and E1E2LYONS) that also monitor the E1 Canal (Appendix A). Stage data from E1LW respond moderately to rainfall, but also appear to be affected by other factors such as the control of structures on the canal. The time-series data from well E1LW probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	13.711	13.711
Mean (feet)	15.707	15.707
Median (feet)	15.759	15.759
Maximum (feet)	16.550	16.550
Standard deviation	0.425	0.425
Variance	0.180	0.180
Outliers	59	59
Missing values	0	0

Table 51 Summary statistics of time-series data for Station 25: E1LW

3.26 Station 26: E1PIONEER

E1PIONEER is a stilling well located on the E1 Canal at Pioneer Road in Palm Beach County (figs. 1 and 4).

3.26.1 Site and data description

Variable	Original value	Revised value
Station	E1PIONEER	E1PIONEER
DBKEY		
MOD1 DBKEY		
Latitude	26 40 17	26 40 17
Longitude	80 12 09	80 12 09
X Coordinate	916562.11	916562.11
Y Coordinate	850577.7	850577.7
Land-surface elevation (feet) (NGVD 29)	20.5	20.5
Benchmark elevation (feet) (NGVD 29)	22.94	22.94
Reference elevation (feet) (NGVD 29)	21.935	21.935

Table 52 Site information obtained for Station 26: E1PIONEER

Analysis: E1PIONEER is a stilling well that monitors the stage on the E-1 Canal. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on or before June 29, 2005 (survey notes from Mark Hummel, PSM). A photograph (see below) shows the stilling well on the concrete wall of a bridge. No revisions were necessary.

Station 26: E1PIONEER

3.26.2 Data analysis and revision

The period of record analyzed for stilling well E1PIONEER extends from May 12, 2005 through May 11, 2008 (Appendix A). The time-series data for that period contain 1,096 observations with 54 outliers and 74 missing values. The summary statistics for well E1PIONEER are provided in table 53.

Problem: The time-series data from station E1PIONEER contain 54 outliers, all of which were less than the lower fence of 14.881 ft above mean sea level.

Analysis: These lower outliers occurred sporadically throughout the period of record including August, September, and October 2005, August, September, and December 2006, and May, June, and October 2007. These outliers result from short-term (1 to 3 days) declines in stage in the canal, and coincide with similar declines in stage recorded by nearby stations (E1LW, and E1E2LYONS). The outliers probably represent valid data that accurately represent hydrologic conditions at the site.

Problem: The time-series data from station E1PIONEER contain 74 missing values.

Analysis: Missing values occurred from July 6 – 17, 2005, November 9 through December 21, 2005, and April 15 through May 3, 2007. These gaps do not coincide with gaps in nearby stations monitoring the E1 Canal. According to the field notes from July 15, 2005, the water level in the canal was below the pressure transducer. The site was visited again on July 18, and the problem was resolved.

According to field notes from December 22, 2005, missing data in November and December 2005 resulted from a full memory on the transducer. The pressure transducer was replaced with a new unit during the visit. Finally, the gap in April and May 2007 resulted from equipment failure. Field notes from May 4, 2007, state the data logger was

replaced with a new unit after personnel were unable to communicate with old unit on April 20. Missing values were coded with M for uploading into DBHYDRO.

Summary: The stage data from stilling well E1PIONEER closely coincide with stage data from nearby stilling wells (E1BOYNTON, E1LW, and E1E2LYONS) that also monitor the E1 Canal (Appendix A). Stage data from E1PIONEER respond moderately to rainfall, but also appear to be affected by other factors such as the control of structures on the canal. The time-series data from well E1PIONEER probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	13.444	13.444
Mean (feet)	15.833	15.833
Median (feet)	15.895	15.895
Maximum (feet)	16.826	16.826
Standard deviation	0.506	0.506
Variance	0.256	0.256
Outliers	54	54
Missing values	74	74

Table 53 Summary statistics of time-series data for Station 26: E1PIONEER

3.27 Station 27: E1E2LYONS

E1E2LYONS is a stilling well located on a small canal that connects the E1 and E2 Canals (figs. 1 and 4). The station is located on Lyons Road, just south of Boynton Beach Blvd. in Palm Beach County.

3.27.1 Site and data description

Variable	Original value	Revised value
Station	E1E2LYONS	E1E2LYONS
DBKEY		
MOD1 DBKEY		
Latitude	26 31 12	26 31 12
Longitude	80 11 18	80 11 18
X Coordinate	921611	921611
Y Coordinate	795571	795571
Land-surface elevation (feet) (NGVD 29)	18.81	18.81
Benchmark elevation (feet) (NGVD 29)	18.81	18.81
Reference elevation (feet) (NGVD 29)	18.54	18.54

Table 54 Site information obtained for Station 27: E1E2LYONS

Analysis: E1E2LYONS is a stilling well that monitors the stage on a small canal that connects the E1 and E2 Canals. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on or before November 2, 2006 (survey report from Keith and Schnars, P.A.). Two photographs of the station are shown below. No revisions were necessary.

Station E1E2LYONS

3.27.2 Data analysis and revision

The period of record analyzed for stilling well E1E2LYONS extends from October 16, 2006 through May 11, 2008 (Appendix A). The time-series data for that period contain 574 observations with 51 outliers and no missing values. The summary statistics for stilling well E1E2LYONS are provided in table 55.

Problem: The time-series data from stilling well E1E2LYONS contain 51 outliers, all of which are less than the lower fence of 14.794 ft above mean sea level.

Analysis: The outliers occurred primarily from late March to early June 2007, after a period of low rainfall. The declines in stage at the target station coincide with similar declines in stage at nearby stations on the E2 Canal, particularly stilling well E2LWS_T. The outliers from the target station probably are valid data that accurately represent hydrologic conditions at the site.

Summary: The stage data from stilling well E1E2LYONS coincide with stage data from nearby stilling wells such as E2LWN_H, E2BENOIST, and particularly E2LWS_T, which also monitor the E2 Canal (Appendix A). Stage data from E1E2LYONS respond moderately to rainfall, but also appear to be affected by other factors such as the control of structures on the canal. The time-series data from well E1E2LYONS probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	13.442	13.442
Mean (feet)	15.672	15.672
Median (feet)	15.780	15.780
Maximum (feet)	16.658	16.658
Standard deviation	0.573	0.573
Variance	0.328	0.328
Outliers	51	51
Missing values	0	0

Table 55 Summary statistics of time-series data for Station 27: E1E2LYONS

3.28 Station 28: E2BENOIST

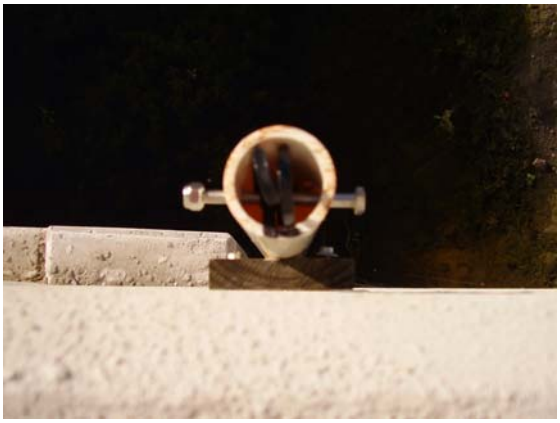
E2BENOIST is a stilling well located on the E2 Canal (figs. 1 and 4). The station is located on Benoist Farm, off Pioneer Road in Palm Beach County.

3.28.1 Site and data description

Variable	Original value	Revised value
Station	E2BENOIST	E2BENOIST
DBKEY		
MOD1 DBKEY		
Latitude	26 40 23	26 40 23
Longitude	80 10 26	80 10 26
X Coordinate	925896	925896
Y Coordinate	851252	851252
Land-surface elevation (feet) (NGVD 29)	20	20
Benchmark elevation (feet) (NGVD 29)	20.06	20.06
Reference elevation (feet) (NGVD 29)	23.16	23.16

Table 56 Site information obtained for Station 28: E2BENOIST

Analysis: E2BENOIST is a stilling well that monitors the stage on the E2 Canal. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on or before October 25, 2006 (survey report from Keith and Schnars, P.A.). Two photographs of the station are shown below. No revisions were necessary.

Station E2BENOIST

3.28.2 Data analysis and revision

The period of record analyzed for stilling well E2BENOIST extends from October 10, 2006 through May 11, 2008 (Appendix A). The time-series data for that period contain 580 observations with 82 outliers and no missing values. The summary statistics for stilling well E2BENOIST are provided in table 57.

Problem: The time-series data from station E2BENOIST contain 82 outliers.

Analysis: A total of 21 outliers exceeded the upper fence of 13.758 ft above mean sea level. These upper outliers occurred sporadically from October 2007 to March 2008, and coincide with similar peaks in water levels at nearby stations, such as E2LWN_H. The remaining outliers were less than the lower fence of 12.87 ft above mean sea level. These lower outliers generally occurred during the dry season from late March to early June 2007, and coincide with declines in water levels at nearby stations, such as E2LWN_H. In addition, water levels at the target station declined abruptly on December 14 – 15, 2006. These outliers coincide with a similar drop in water level at station E2LWN_H. All of the outliers appear to be valid data that accurately represent hydrologic conditions at the site.

Problem: The water-level data from E2BENOIST is anomalously flat during two short periods.

Analysis: The water-level data are anomalously flat (as indicated by the hydrograph) from April 3 – 9, 2007, when the water level varied only from 12.653 to 12.669 ft above mean sea level, and from May 19 through June 1, 2007, when the data varied only from 12.663 to 12.664 ft above mean sea level. In addition, these flat water levels are inconsistent with water-level data from nearby stations, such as E2LWN_H, which have declining water levels during the same two periods (fig. 11).

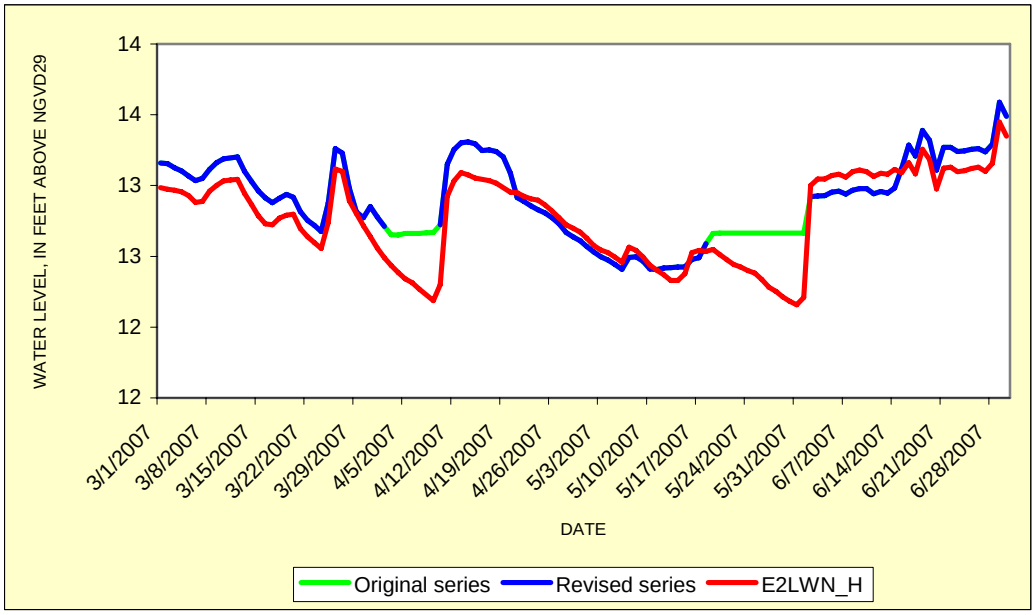


Figure 11 Water levels from the target station (blue) contained anomalously flat data (green) which were inconsistent with data from nearby stations (red). The anomalous data were deleted from the preferred data set.

The elevation of the pressure transducer is unknown, but water levels as low as 12.14 ft above mean sea level were accurately recorded. Hence, the problem does not appear to result from water levels declining below the transducer. The transducer could have been fouled or debris could have clogged the stilling well, but the problem appears to have resolved itself, as no information is made in the field notes. These anomalous data were deleted and coded as M in the preferred data set.

Summary: The stage data from stilling well E2BENOIST coincide with stage data from nearby stilling wells such as E2LWS_T, E1E2LYONS, and particularly E2LWN_H, which also monitor the E2 Canal (Appendix A). Stage data from E2BENOIST respond moderately to rainfall, but also appear to be affected by other factors such as the control of structures on the canal. The time-series data from well E2BENOIST probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	12.144	12.144
Mean (feet)	13.266	13.288
Median (feet)	13.276	13.282
Maximum (feet)	14.132	14.132
Standard deviation	0.290	0.270
Variance	0.084	0.073
Outliers	82	65
Missing values	0	21

Table 57 Summary statistics of time-series data for Station 28: E2BNOIST

3.29 Station 29: E2LWN_H

E2LWN_H is a stilling well located on the E2 Canal (figs. 1 and 4). The station is located on north (headwater) side of a gate on the canal at the Florida Turnpike and Lake Worth Road in Palm Beach County. A second stilling well, E2LWS_T, is located on the south (tailwater) side of the gate.

3.29.1 Site and data description

Variable	Original value	Revised value
Station	E2LWN_H	E2LWN_H
DBKEY		
MOD1 DBKEY		
Latitude	26 37 02	26 37 02
Longitude	80 10 27	80 10 27
X Coordinate	925974	925974
Y Coordinate	830900	830900
Land-surface elevation (feet) (NGVD 29)	19.682	19.682
Benchmark elevation (feet) (NGVD 29)	19.682	19.682
Reference elevation (feet) (NGVD 29)	18.45	18.45

Table 58 Site information obtained for Station 29: E2LWN_H

Analysis: E2LWN_H is a stilling well that monitors the stage on the E2 Canal. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on or before November 2, 2006 (survey report from Keith and Schnars, P.A.). Two photographs of the station are shown below. No revisions were necessary.


Station E2LWN_H

3.29.2 Data analysis and revision

The period of record analyzed for stilling well E2LWN_H extends from October 16, 2006 through May 11, 2008 (Appendix A). The time-series data for that period contain 574 observations with 69 outliers and 1 missing value. The summary statistics for stilling well E2LWN_H are provided in table 59.

Problem: The time-series data from station E2LWN_H contain 69 outliers.

Analysis: Nine outliers exceeded the upper fence of 13.68 ft above mean sea level. These outliers primarily in October 2007 and March 2008, and coincide with peaks in water levels at nearby stations, particularly E2BENOIST. The remaining outliers were less than the lower fence of 12.55 ft above mean sea level. These outliers primarily occurred as a series of declines in water levels in April, May, and early June 2007, at the end of the dry season. The outliers closely coincide with declines in water levels recorded at nearby stations (E1E2LYONS, E2BENOIST, and E2LWS_T). The hydrograph (Appendix A) also shows two abrupt declines in water level occurring on December 15, 2006 and October 31, 2007, which are probably related to operations of structures on the canals. All of the outliers appear to be valid data that accurately represent hydrologic conditions at the site.

Problem: The time-series data from station E2LWN_H contain one missing value.

Analysis: The missing value occurred on November 29, 2006. Field notes indicated the site was visited on November 28 and again on November 30, 2006, but no explanation is provided for the two visits or for the missing value. The missing value probably results from a problem with the equipment, which was resolved on November 30. The missing value was coded as M for uploading in DBHYDRO.

The hydrograph indicates a significant increase in water level from 12.439 ft above mean sea level on November 28 and to 13.14 ft November 30 (Appendix A). The problem apparently resulted from calibration of the sonde on the day of installation (Simon Sunderland, SFWMD, written commun., 2008), and was corrected on November 30. The suspect data were corrected by determining the difference between the recorded

and measured water levels on October 16, 2006, and adding that correction (0.399 ft) to the suspect data (fig. 12).

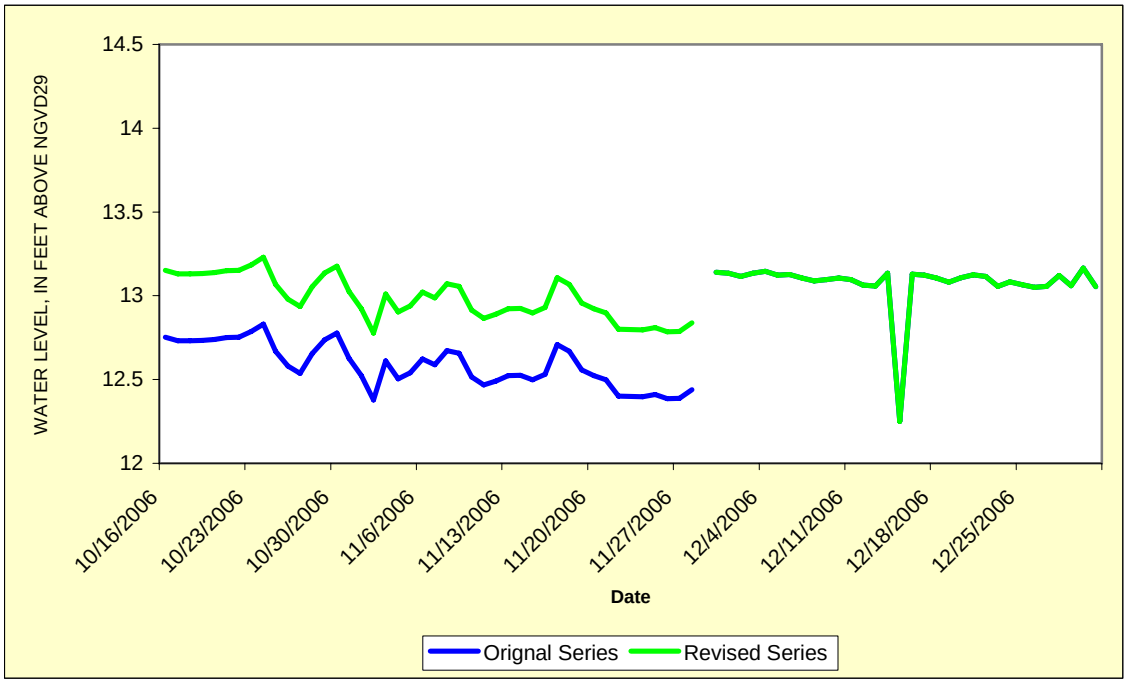


Figure 12 Water level data from E2LWN_H (blue) collected from October 16 – November 28, 2006 were revised (green) by adding a correction factor of 0.399 ft.

Summary: The stage data from stilling well E2LWN_H coincide with stage data from nearby stilling wells such as E2LWS_T, E1E2LYONS, and particularly E2BENOIST, which also monitor the E2 Canal (Appendix A). E1LWN_H and E2BENOIST are both located on the headwater side of the gate at the Florida Turnpike and Lake Worth Rd, with no apparent structure in between the two stations, so strong correlation between the sites is expected. Stage data from E2LWN_H respond moderately to rainfall, but also appear to be affected by other factors such as the operation of structures on the canal. The time-series data from well E2LWN_H probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	12.158	12.158
Mean (feet)	13.074	13.105
Median (feet)	13.123	13.130
Maximum (feet)	13.982	13.982
Standard deviation	0.319	0.289
Variance	0.102	0.083
Outliers	69	60
Missing values	1	1

Table 59 Summary statistics of time-series data for Station 29: E2LWN_H

3.30 Station 30: E2LWS_T

E2LWS_T is a stilling well located on the E2 Canal (figs. 1 and 4). The station is located on south (tailwater) side of a gate at the Florida Turnpike and Lake Worth Road in Palm Beach County. A second stilling well, E2LWN_H, is located on the north (headwater) side of the gate.

3.30.1 Site and data description

Variable	Original value	Revised value
Station	E2LWS_T	E2LWS_T
DBKEY		
MOD1 DBKEY		
Latitude	26 37 02	26 37 02
Longitude	80 10 27	80 10 27
X Coordinate	925974	925974
Y Coordinate	830900	830900
Land-surface elevation (feet) (NGVD 29)	19.682	19.682
Benchmark elevation (feet) (NGVD 29)	19.682	19.682
Reference elevation (feet) (NGVD 29)	18.47	18.47

Table 60 Site information obtained for Station 30: E2LWS_T

Analysis: E2LWS_T is a stilling well that monitors the stage on the E2 Canal. The benchmark and reference elevations are consistent with water-level data collected at the site, and appear to be accurate. The well was surveyed on or before November 2, 2006 (survey report from Keith and Schnars, P.A.). Two photographs of the station are shown below. No revisions were necessary.


Station E2LWS_T

3.30.2 Data analysis and revision

The period of record analyzed for stilling well E2LWS_T extends from October 16, 2006 through May 11, 2008 (Appendix A). The time-series data for that period contain 574 observations with 41 outliers and 1 missing value. The summary statistics for stilling well E2LWS_T are provided in table 61.

Problem: The time-series data from stilling well E2LWS_T contain 41 outliers, all of which are less than the lower fence of 14.767 ft above mean sea level.

Analysis: The outliers primarily occurred as a series of declines in water levels in April, May, and early June 2007, at the end of the dry season. The outliers closely coincide with declines in water levels recorded at nearby stations (E1E2LYONS, E2BENOIST, and E2LWS_T). The outliers probably are valid data that accurately represent hydrologic conditions at the site.

Problem: The time-series data from stilling well E2LWS_T contain 1 missing value.

Analysis: The missing value occurred on November 29, 2006. Field notes indicated the site was visited on November 28 and again on November 30, 2006, but no explanation is provided for the two visits or for the missing value. The missing value probably results from a problem with the equipment, which was resolved on November 30. The missing value was coded as M for uploading in DBHYDRO.

Summary: The stage data from stilling well E2LWS_T coincide with stage data from nearby stilling wells such as E2LWS_T, E2BENOIST, and particularly E1E2LYONS, which also monitor the E2 Canal (Appendix A). E1LWS_T and E1E2LYONS are both located on the tailwater side of the gate at the Florida Turnpike and Lake Worth Rd, with no apparent structure in between the two stations, so strong correlation between the sites is expected. Stage data from E2LWS_T respond moderately to rainfall, but also appear to be affected by other factors such as the operation of structures on the canal. The time-series data from well E2LWS_T probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	13.711	13.711
Mean (feet)	15.669	15.669
Median (feet)	15.759	15.759
Maximum (feet)	16.550	16.550
Standard deviation	0.512	0.512
Variance	0.262	0.262
Outliers	41	41
Missing values	1	1

Table 61 Summary statistics of time-series data for Station 30: E2LWS_T

3.31 Station 31: Double72s

Double72s is a stilling well located in Palm Beach County (figs. 1 and 5). The station was installed on a 72-in culvert as part of the Loxahatchee Mitigation Bank.

3.31.1 Site and data description

Variable	Original value	Revised value
Station	Double72s	Double72s
Source DBKEY		
MOD1 DBKEY		
Latitude	262433.02	262433.02
Longitude	801328.76	801328.76
X Coordinate	909985.97	909985.97
Y Coordinate	755264.74	755264.74
Land-surface elevation (feet) (USGS NMV)	14	14
Reference elevation (feet)		
Recorder	CR10	CR10

Table 62 Site information obtained for Station 31: Double72s

Analysis: No reference elevation is available for this station. The water-level data were tied to a staff gage on the culvert. The land-surface elevation was estimated using the USGS National Map Viewer (NMV). A photograph (below) shows the site. No other information was available.

Station 31: Double72s

3.31.2 Data analysis and revision

The period of record analyzed for station Double72s extends from March 15, 2005 through February 14, 2008 (Appendix A). The time-series data for that period contain 1,067 observations with 24 outliers and 183 missing values. The summary statistics for station Double72s are provided in table 63.

Problem: The time-series data for the stations contained 24 outliers.

Analysis: Eleven outliers exceeded the upper fence of 13.75 ft above mean sea level. These outliers generally are consistent with peaks in water levels in nearby stations, and also coincide with excessive rainfall. For example, upper outliers occurred on September 4, 5, 7 and 20, and December 14 and 15, 2006. Rainfalls exceeding 1 inch occurred on or before those dates.

Thirteen outliers were less than the lower fence of 12.26 ft above mean sea level. Two of the outliers, which occurred on August 25, 2005, and October 22, 2007, coincide with declines in water levels in nearby stations. The remaining outliers appear to result from an abrupt and anomalous decline in water level from May 26 – June 5, 2007 (fig. 13). In addition, the time-series data from these dates show the water level at the site to be unusually flat. This decline and flat response of water levels in the target station were not consistent with fluctuations in water levels in nearby stations, and the data determined to be erroneous. These lower outliers were subsequently deleted from the data set.

The time-series data from the target station also were anomalous from June 14 – August 2, 2005, when the water level was continuously 12.97 ft above mean sea level

(fig. 13). This flat response in water level was inconsistent with data from nearby stations, and determined to be erroneous. The erroneous data were deleted.

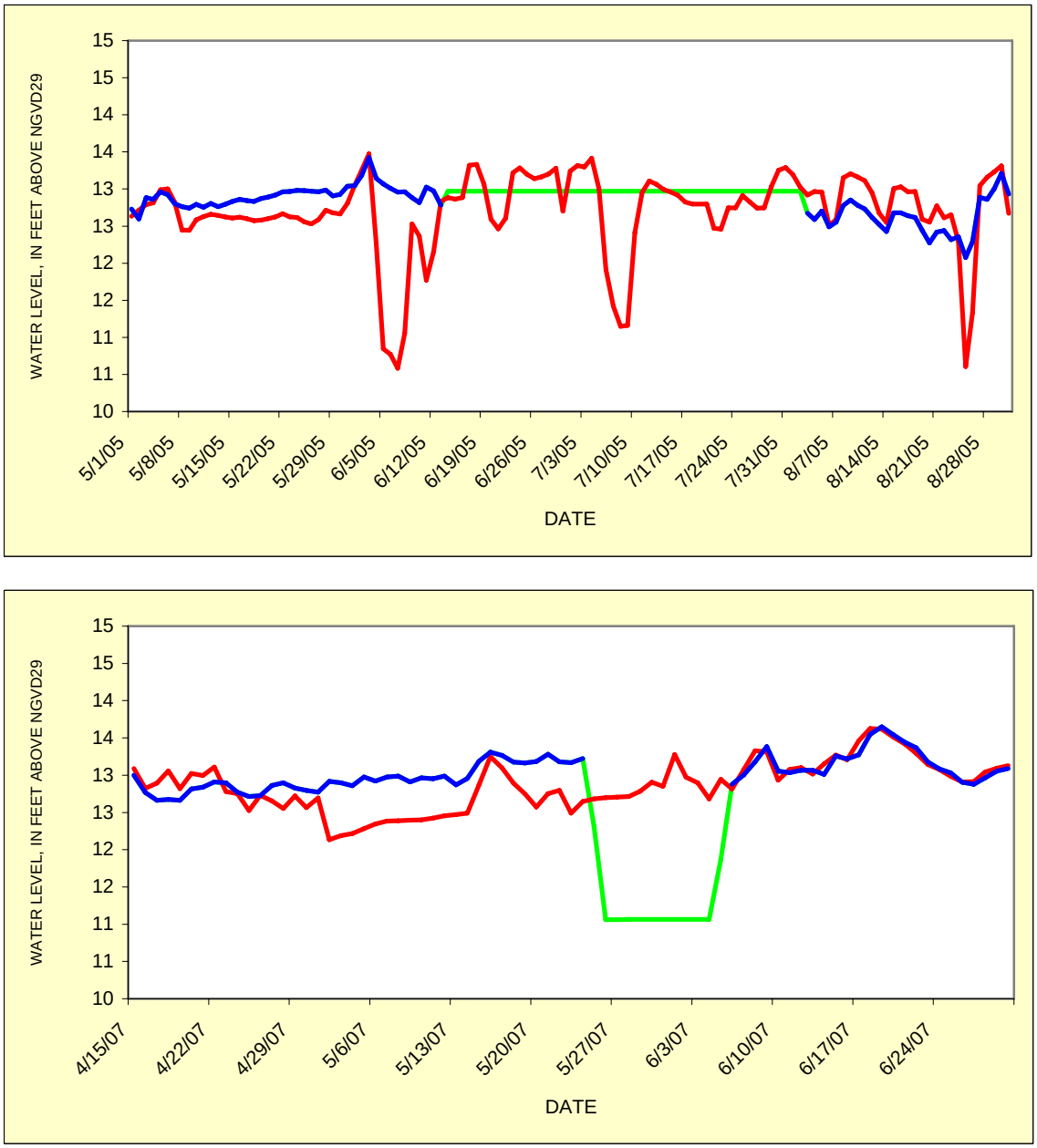


Figure 13 Water-level data from the target well (blue) had two periods of anomalous values (green) that were inconsistent with nearby stations, such as Double84s (red). The suspect data were deleted from the preferred data set.

Problem: The time-series data from the target station originally contained 183 missing values. With the deletion of the erroneous data, the total number of missing values was 245.

Analysis: Missing values from the original set of data occurred from September 27, 2005 – March 29, 2006. The missing values were not estimated as part of this project.

Summary: The peaks and declines in water-level data from station Double72s generally coincide with peaks and declines in water-level data from nearby stations (Double84s, G94A, and S39_T) (Appendix A). In general, water levels in the stilling well decline as expected during periods of low rainfall, and increase as expected during periods of excessive rainfall recorded by nearby rain gages. However, two periods of anomalous data were detected. No revisions were required, other than deleting the anomalous data.

Statistics	Original series	Revised series
Minimum (feet)	11.060	12.079
Mean (feet)	12.994	13.021
Median (feet)	13.004	13.041
Maximum (feet)	14.191	14.191
Standard deviation	0.350	0.289
Variance	0.122	0.083
Outliers	24	10
Missing values	183	245

Table 63 Summary statistics of time-series data for Station 31: Double72s

3.32 Station 32: Double84s

Double84s is a stilling well located in Palm Beach County (figs. 1 and 5). The station was installed on an 84-in culvert as part of the Loxahatchee Mitigation Bank.

3.32.1 Site and data description

Variable	Original value	Revised value
Station	Double84s	Double84s
Source DBKEY		
MOD1 DBKEY		
Latitude	262333.9	262333.9
Longitude	801408.11	801408.11
X Coordinate	906427.13	906427.13
Y Coordinate	749399.12	749399.12
Land-surface elevation (feet) (USGS NMV)	14	14
Reference elevation (feet)		
Recorder	CR10	CR10

Table 64 Site information obtained for Station 32: Double84s

Analysis: As with Double72s, little site information is available for Double84s. No reference elevation was available. The water-level data were tied to a staff gage on the culvert. The land-surface elevation was estimated using the USGS National Map Viewer (NMV). A photograph (below) shows the site. No other information was available.

Station 32: Double84s

3.32.2 Data analysis and revision

The period of record analyzed for station Double84s extends from March 15, 2005 through March 18, 2008 (Appendix A). The time-series data for that period contain 1,100 observations with 22 outliers and 157 missing values. The summary statistics for Double84s are provided in table 65.

Problem: The time-series data from Double84s contain 22 outliers, all of which were less than the lower fence of 11.47 ft above mean sea level.

Analysis: Outliers occurred primarily in March – October 2005, but also occurred in May and June 2006 and October 2007. The outliers, which are relatively sharp declines in water levels at the station, closely coincide with similar declines in water levels in nearby stations, such as G94A. The outliers probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Problem: The time-series data contain 157 missing values, which occurred from July 28 – December 31, 2006.

Analysis: This large gap in data probably results from a cessation of data-collection activities. The missing values were not estimated as part of this project.

Summary: The peaks and declines in water-level data from station Double84s closely coincide with peaks and declines in water-level data from nearby stations (G94A, and S39_T), and generally coincide with water levels from station Double72s (Appendix A). In general, water levels in the stilling well decline as expected during periods of low rainfall, and increase as expected during periods of excessive rainfall recorded by nearby rain gages. However, several periods of sharp declines in water level were detected, particularly in 2005. These declines, which coincide with similar declines in water levels in nearby stations, probably result from operations and management of nearby control structures. No revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	10.583	10.583
Mean (feet)	12.658	12.658
Median (feet)	12.704	12.704
Maximum (feet)	13.877	13.877
Standard deviation	0.522	0.522
Variance	0.272	0.272
Outliers	22	22
Missing values	157	157

Table 65 Summary statistics of time-series data for Station 32: Double84s

3.33 Station 33: FPL

FPL is a shallow monitor well located in Palm Beach County (figs. 1 and 5). The well was installed as part of the Loxahatchee Mitigation Bank.

3.33.1 Site and data description

Variable	Original value	Revised value
Station	FPL	FPL
Source DBKEY		
MOD1 DBKEY		
Latitude	262542.04	262542.04
Longitude	801327.04	801327.04
X Coordinate	910097	910097
Y Coordinate	762219.19	762219.19
Land-surface elevation (feet)	15.08	15.08
Reference elevation (feet)	19.42	19.42
Recorder	CR10	CR10

Table 66 Site information obtained for Station 33: FPL

Analysis: The reference elevation listed in the field book is identical to the reference elevation provided by the contractor in charge of collecting time-series data from this station (Maura Saks, Tetra Tech EC, Inc., written commun., 2008). The contractor also provided the land-surface elevation for the site. The maximum water level is higher than the land-surface elevation, indicating that the site is periodically inundated with water. No information was available on the well depth or screen interval.

3.33.2 Data analysis and revision

The period of record analyzed for well FPL extends from October 4, 2002 through March 4, 2008 (Appendix A). The time-series data contain 1,979 observations with 10 outliers and 166 missing values. The summary statistics for well FPL are provided in table 67.

Problem: The time-series data contain 10 outliers, all of which are less than the lower fence of 11.09 ft above mean sea level.

Analysis: The outliers occurred in May 2006 and May 2007 after a period of low rainfall at the end of the dry season. The outliers also coincide with similar declines in water levels in nearby wells drilled to similar depths. The outliers probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Problem: The time-series data contain 166 missing values.

Analysis: Missing values occurred from October 13 – November 9, 2003, July 17 – 28, 2005, February 17 – March 28, 2006, and from November 20, 2007 – February 13, 2008. The missing values were not estimated as part of this project.

Summary: The peaks and declines in water-level data from well FPL generally coincide with peaks and declines in water-level data from two nearby wells (PB-1108 and PB-1661) and closely coincide with data from well MUDFLATS (Appendix A). In addition, water levels in the target well decline as expected during periods of low rainfall, and increase as expected during periods of excessive rainfall recorded by nearby rain

gages. The time-series data from well FPL probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	10.961	10.961
Mean (feet)	13.730	13.730
Median (feet)	13.725	13.725
Maximum (feet)	16.161	16.161
Standard deviation	1.125	1.125
Variance	1.265	1.265
Outliers	10	10
Missing values	166	166

Table 67 Summary statistics of time-series data for Station 33: FPL

3.34 Station 34: G94A

G94A is a stilling well located at a gated culvert in Palm Springs County (figs. 1 and 5). The station was installed as part of the Loxahatchee Mitigation Bank.

3.34.1 Site and data description

Variable	Original value	Revised value
Station	G94A	G94A
Source DBKEY		
MOD1 DBKEY		
Latitude	262605.9	262605.9
Longitude	801347.2	801347.2
X Coordinate	908188.67	908188.67
Y Coordinate	764567.9	764567.9
Land-surface elevation (feet)	6.19	6.19
Reference elevation (feet) (DCVP)	16.92	16.92
Recorder	CR10	CR10

Table 68 Site information obtained for Station 34: G94A

Analysis: The reference and land-surface elevations obtained from SFWMD are identical to the values obtained from the contractor (Maura Saks, Tetra Tech EC, Inc., written commun., 2008). The location of the station appears to be accurate. The minimum water level is higher than the land-surface elevation, indicating the site is continuously inundated with water. The land-surface elevation might represent the elevation of the channel bottom. No revisions are required.

3.34.2 Data analysis and revision

The period of record analyzed for station G94A extends from March 15, 2005 through July 27, 2006 (Appendix A). The time-series data for that period contain 500 observations with 8 outliers and 82 missing values. The summary statistics for G94A are

provided in table 69. In addition to these time-series data, SFWMD has collected continuous stage data from the headwater and tailwater sides of the culvert from September 4, 2007 to present. Daily water readings and periodic flow measurements dating back to January 18, 2000 also are available for the site.

Problem: The time-series data from G94A contain 8 outliers, all of which were less than the lower fence of 10.98 feet above mean sea level.

Analysis: Outliers occurred in April, June, and October 2005, and closely coincide with sharp declines in water levels at nearby station Double84s, which is located down gradient on the same canal. The outliers probably result from the operation of the culvert, and appear to be valid data. No revisions were required.

Problem: The time-series data from station G94A contain 82 missing values.

Analysis: The missing values occurred from July 6 – September 25, 2005. The missing values were not estimated as part of this project.

Summary: The peaks and declines in water-level data from station G94A closely coincide with peaks and declines in water-level data from nearby well Double84s, and roughly coincide with water-level data from stations Double72s and S39_T (Appendix A). In addition, water levels in the target station decline as expected during periods of low rainfall, and increase as expected during periods of excessive rainfall recorded by nearby rain gages. The time-series data from station G94A probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	10.317	10.317
Mean (feet)	12.330	12.330
Median (feet)	12.435	12.435
Maximum (feet)	13.486	13.486
Standard deviation	0.504	0.504
Variance	0.254	0.254
Outliers	8	8
Missing values	82	82

Table 69 Summary statistics of time-series data for Station 34: G94A

3.35 Station 35: MUDFLATS

MUDFLATS is a shallow monitor well located in Palm Beach County (figs. 1 and 5). The well was installed as part of the Loxahatchee Mitigation Bank.

3.35.1 Site and data description

Variable	Original value	Revised value
Station	MUDFLATS	MUDFLATS
Source DBKEY		
MOD1 DBKEY		
Latitude	262605.3	262605.3
Longitude	801317.9	801317.9
X Coordinate	910782.04	910782.04
Y Coordinate	764470.04	764470.04
Land-surface elevation (feet)	13.6	13.6
Reference elevation (feet) (Steve Krupa, SFWMD)	18.65	18.65
Reference elevation (feet) (Maura Saks, TetraTech EC)	18.71	18.71
Recorder	CR10	CR10

Table 70 Site information obtained for Station 35: MUDFLATS

Analysis: The reference elevation obtained from the contractor (Maura Saks, Tetra Tech EC, Inc., written commun., 2008) is slightly higher than the reference elevation on file with SFWMD. The SFWMD is assumed to be correct, and was entered into the data base. The difference between the reference and land-surface elevations indicates the casing extends about 5 ft above land surface. A photograph of the site (below) confirms the casing height. The maximum water level is higher than the land-surface elevation, which indicates that the site is occasionally inundated with water. The casing height could be to allow periodic inundation. The location of the site appears to be accurate. No revisions are required.

Station 35: MUDFLATS

3.35.2 Data analysis and revision

The period of record analyzed for well MUDFLATS extends from March 15, 2005 through March 24, 2008 (Appendix A). The time-series data for that period contain 1,106 observations with 3 outliers and 109 missing values. The summary statistics for well MUDFLATS are provided in table 71.

Problem: The time-series data from MUDFLATS contain 3 outliers, all of which are less than the lower fence.

Analysis: The outliers occurred from April 11 – 13, 2007, after a period of low rainfall at the end of the dry season. The outliers generally coincide with a decline in water level in nearby well FPL. The outliers probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Problem: The time-series data from well MUDFLATS contain 109 missing values.

Analysis: The missing values occurred from September 14 – December 31, 2005, and possibly result from a cessation of data-collection activities. The missing values were not estimated as part of this project.

Summary: The peaks and declines in water-level data from well MUDFLATS generally coincide with peaks and declines in water-level data from nearby wells (FPL, PB-1108, and PB-1661) drilled to similar depths (Appendix A). In addition, water levels in the target well decline as expected during periods of low rainfall, and increase as expected during periods of excessive rainfall recorded by nearby rain gages. The time-series data from well MUDFLATS probably are valid data that accurately represent hydrologic conditions at the site. No other revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	9.813	9.813
Mean (feet)	13.321	13.321
Median (feet)	13.315	13.315
Maximum (feet)	15.438	15.438
Standard deviation	0.983	0.983
Variance	0.966	0.966
Outliers	3	3
Missing values	109	109

Table 71 Summary statistics of time-series data for Station 35: MUDFLATS

3.36 Station 36: SWL3

SWL3 is a stilling well located in Palm County (figs. 1 and 5). The station was installed as part of the Loxahatchee Mitigation Bank.

3.36.1 Site and data description

Variable	Original value	Revised value
Station	SWL3	SWL3
Source DBKEY		
MOD1 DBKEY		
Latitude	262343.8	262343.8
Longitude	801407.0	801407.0
X Coordinate	906478.16	906478.16
Y Coordinate	750180.36	750180.36
Land-surface elevation (feet)	13.5	13.5
Reference elevation (feet) (DVCP)	15.55	15.55
Recorder	CR10	CR10

Table 72 Site information obtained for Station 36: SWL3

Analysis: The reference elevation from the contractor (Maura Saks, Tetra Tech EC, Inc., written commun., 2008) is identical to the reference elevation obtained from SFWMD. The difference between the reference and land-surface elevation indicates the casing extends about 2 ft above ground. The median water level is slightly higher than the land-surface elevation, indicating the site is inundated more than half of the time. Inundation of the site is expected, as this station was installed to monitor surface-water stage. The site information and location appear accurate. No revisions were required.

3.36.2 Data analysis and revision

The period of record analyzed for station SWL3 extends from March 15 – December 13, 2005 (Appendix A). The time-series data from that period contain 183 observations with no outliers and no missing values. The summary statistics for SWL3 are provided in table 73.

Summary: The peaks and declines in water-level data from station SWL3 roughly coincide with peaks and declines in water-level data from nearby stations (Double72s, Double84s, and S39_T) (Appendix A). In addition, water levels in the target station decline as expected during periods of low rainfall, and increase as expected during periods of excessive rainfall recorded by nearby rain gages. The time-series data from station SWL3 probably are valid data that accurately represent hydrologic conditions at the site. No revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	12.369	12.369
Mean (feet)	13.347	13.347
Median (feet)	13.363	13.363
Maximum (feet)	14.194	14.194
Standard deviation	0.482	0.482
Variance	0.232	0.232
Outliers	0	0
Missing values	0	0

Table 73 Summary statistics of time-series data for Station 36: SWL3

3.37 Station 37: US441

US441 is s stilling well located in Palm Beach County (figs. 1 and 5). US441 was installed as part of the Loxahatchee Mitigation Bank.

3.37.1 Site and data description

Variable	Original value	Revised value
Station	US441	US441
Source DBKEY		
MOD1 DBKEY		
Latitude	262605.7	262605.7
Longitude	801215.1	801215.1
X Coordinate	916568.21	916568.21
Y Coordinate	764593.49	764593.49
Land-surface elevation (feet)	8.1	8.1
Reference elevation (feet)	19.35	19.35
Recorder	CR10	CR10

Table 74 Site information obtained for Station 37: US441

Analysis: The reference elevation obtained from the contractor (Maura Saks, Tetra Tech EC, Inc., written commun., 2008) is identical to the reference elevation obtained from SFWMD, and probably is correct. The difference between the reference and land-surface elevations indicates the casing extends 11.25 ft above ground. No photographs of the site were available to verify the casing height. However, the station is a stilling well that is probably installed on a bridge or culvert, so an 11-ft high casing is not unexpected. The minimum water level is higher than land-surface elevation, indicating the site is continuously inundated with water. The land-surface elevation probably represents the channel bottom. The site information appears accurate. No revisions are required.

3.37.2 Data analysis and revision

The period of record analyzed for US441 extends from March 15, 2005 through September 20, 2006. The time-series data contain 555 observations with 77 outliers and 110 missing values. The summary statistics for station US441 are provided in table 75.

Problem: The time-series data from station US441 contain 77 outliers.

Analysis: Seventy-five outliers exceed the upper fence of 16.70 ft above mean sea level. All 75 upper outliers occurred after July 6, 2006, when the water level at the station increased 3.15 ft in 15 minutes as indicated by the breakpoint data. This sharp increase is inconsistent with water levels in nearby stations, and does not correspond to a specific rain storm. Hence, the increase in water levels at the target station probably is related to equipment issues, and the data were determined to be erroneous. A correction factor of -3.15 ft was applied to the preferred set of time-series data to resolve the problem (fig. 14)

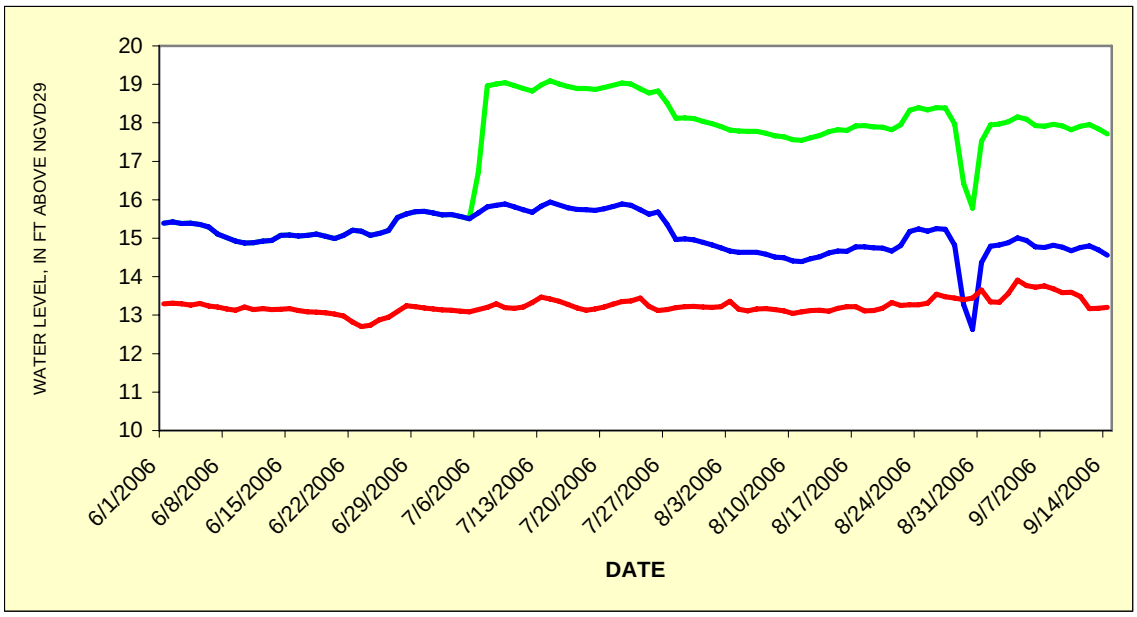


Figure 14 Water levels at the target station (blue) contained an anomalously sharp increase (green) inconsistent with data from nearby stations such as Double72s (red). A correction factor was applied to the suspect data in the preferred data set.

Problem: The time-series data from station US441 contain 110 missing values.

Analysis: Missing values occurred from September 13 – December 31, 2005. The missing values were not estimated as part of this project.

Summary: The peaks and declines in water-level data from station US441 roughly coincide with peaks and declines in water-level data from nearby stations (Double72s, Double84s, and S39_T) (Appendix A). In addition, water levels in the target well generally decline during periods of low rainfall, and increase during periods of excessive rainfall recorded by nearby rain gages. However, the time-series data from the target

station increased 3.15 ft on July 6, 2006. The increase, which was inconsistent with water level data and rainfall data from nearby stations, was determined to be erroneous. A correction factor of -3.15 ft was applied to the anomalous data. Overall, the time-series data from station US441 probably are valid data that accurately represent hydrologic conditions at the site. No other revisions were required.

Statistics	Original series	Revised series
Minimum (feet)	14.049	12.631
Mean (feet)	15.821	15.281
Median (feet)	15.357	15.222
Maximum (feet)	19.090	16.282
Standard deviation	1.119	0.389
Variance	1.252	0.151
Outliers	77	9
Missing values	110	110

Table 75 Summary statistics of time-series data for Station 37: US441

4 SUMMARY

The site and time-series data from 37 target stations were reviewed as part of this project. The stations, which included 4 rain gages, 17 stilling wells, and 16 groundwater monitor wells, were installed for projects conducted by South Florida Water Management District at Crook's and Golden Ox Ranches, the E-1 and E-2 Canals, and for the Loxahatchee Mitigation Bank. Site information and time-series data were obtained from electronic files stored at South Florida Water Management District (SFWMD) and from various contractors that worked on the projects. In general, the site information for the stations appeared to be accurate, but the quantity of available data varied between the three projects. Location coordinates, reference and land-surface elevations, well depth, and lithologic information were readily available for the 19 wells and stilling wells at Crook's and Golden Ox Ranches. No information on well depth or lithology was available for the two wells installed as part of the Loxahatchee Mitigation Bank. Recorder registration worksheets were produced for each station or set of stations for uploading of site information into the SFWMD databases. Lithologic and geologic data, when available, were placed in the Hydrogeologic Data Loader for uploading into SFWMD database.

Continuous water-level and (or) rainfall data were collected at the stations in 15-min or 1-hr increments. During this project, the data were reviewed, daily values (means for water levels; sums for rainfall) were calculated, and summary statistics were generated. The time-series data were reviewed for quality assurance according to SFWMD protocols.

The time-series data (water-level and rainfall data) from the 37 stations generally appeared to be valid data that accurately represents hydrologic conditions at the sites. However, 27 of the 33 wells and stilling wells had periods of missing data. The gaps in

original time-series data ranged in length from 1 day to 183 days. No attempt was made to estimate values for the missing data.

A total of seven sites had anomalous data that were inconsistent with nearby stations, and determined to be erroneous. Three stations (HES-11, HES-16, and HES-19) had periods of anomalous data that probably resulted from the water level declining below the instrument in these stilling wells. The anomalous data from these stations were deleted and the missing values coded as M. Correction factors were applied to portions of the time-series data from two stations (E2LWN_H and US441). Finally, the time-series data from Double72s had two periods of anomalous data that were subsequently deleted. Deletion of erroneous data resulted in a higher number of missing values for each of these stations.

A series of comma-delimited files were produced for uploading time-series data into DBHYDRO. One or more files were generating for each station for uploading the extensive sets of breakpoint (raw incremental) data. Two more files for each station contain the initial daily values and the daily values revised after the in-depth quality-assurance analysis.

5 REFERENCES

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